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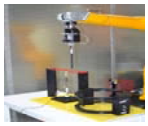

# HEARING AID COMPATIBILITY

**Applicant Name:**
LG Electronics MobileComm U.S.A. Inc.
1000 Sylvan Avenue
Englewood Cliffs, NJ 07632
United States

**Date of Testing:**
04/16/2018 - 04/19/2018
**Test Site/Location:**
PCTEST Lab, Columbia, MD, USA
**Test Report Serial No.:**
1M1804030062-11-R1.ZNF

| | |
|---|---|
| **FCC ID:** | **ZNFG710VM** |
| **APPLICANT:** | **LG ELECTRONICS MOBILECOMM U.S.A. INC.** |

| | |
|---|---|
| **Scope of Test:** | RF Emissions Testing |
| **Application Type:** | Class II Permissive Change |
| **FCC Rule Part(s):** | CFR §20.19(b) |
| **HAC Standard:** | ANSI C63.19-2011<br>285076 D01 HAC Guidance v05<br>285076 D02 T-Coil testing for CMRS IP v03 |
| **DUT Type:** | Portable Handset |
| **Model:** | LM-G710VM |
| **Additional Model(s):** | LMG710VM, G710VM, LG-G710PM, LGG710PM, G710PM, LG-G710ULM, LGG710ULM, G710ULM, LM-G710VMP, LMG710VMP, G710VMP |
| **Test Device Serial No.:** | *Pre-Production Sample* [S/N: 12330] |
| **Class II Permissive Change(s):** | See FCC Change Document |

| | |
|---|---|
| **C63.19-2011 HAC Category:** | **M4 (RF EMISSIONS CATEGORY)** |

Note: This revised Test Report (S/N: 1M1804030062-11-R1.ZNF) supersedes and replaces the previously issued test report on the same subject device for the same type of testing as indicated. Please discard or destroy the previously issued test report(s) and dispose of it accordingly.

This wireless portable device has been shown to be hearing-aid compatible under the above rated category, specified in ANSI/IEEE Std. C63.19-2011 and has been tested in accordance with the specified measurement procedures. Hearing-Aid Compatibility is based on the assumption that all production units will be designed electrically identical to the device tested in this report. Test results reported herein relate only to the item(s) tested. North America bands only.

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

Randy Ortanez
President



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# 1. INTRODUCTION

On July 10, 2003, the Federal Communications Commission (FCC) adopted new rules requiring wireless manufacturers and service providers to provide digital wireless phones that are compatible with hearing aids. The FCC has modified the exemption for wireless phones under the Hearing Aid Compatibility Act of 1998 (HAC Act) in WT Docket 01-309 RM-8658[1] to extend the benefits of wireless telecommunications to individuals with hearing disabilities. These benefits encompass business, social and emergency communications, which increase the value of the wireless network for everyone. An estimated more than 10% of the population in the United States show signs of hearing impairment and of that fraction, almost 80% use hearing aids. Approximately 500 million people worldwide suffer from hearing loss.

**Compatibility Tests Involved:**

The standard calls for wireless communications devices to be measured for:

- RF Electric-field emissions
- T-coil mode, magnetic-signal strength in the audio band
- T-coil mode, magnetic-signal frequency response through the audio band
- T-coil mode, magnetic-signal and noise articulation index

The hearing aid must be measured for:

- RF immunity in microphone mode
- RF immunity in T-coil mode

In the following tests and results, this report includes the evaluation for a wireless communications device.

**Figure 1-1 Hearing Aid *in-situ***

[1] FCC Rule & Order, WT Docket 01-309 RM-8658



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# 2. DUT DESCRIPTION

| | |
|---|---|
| FCC ID: | ZNFG710VM |
| Manufacturer: | LG Electronics MobileComm U.S.A. Inc.<br>1000 Sylvan Avenue<br>Englewood Cliffs, NJ 07632<br>United States |
| Model: | LM-G710VM |
| Additional Model(s): | LMG710VM, G710VM, LG-G710PM, LGG710PM, G710PM, LG-G710ULM, LGG710ULM, G710ULM, LM-G710VMP, LMG710VMP, G710VMP |
| Serial Number: | 12330 |
| Antenna Configurations: | Internal Antenna |
| DUT Type: | Portable Handset |

## I. Power Reduction for WIFI

This device uses an independent fixed level power reduction mechanism for 2.4GHz WIFI modes as well as 2.4GHz and 5GHz simultaneous operations during voice or VoIP held to ear scenarios. Reduced powers were used to evaluate for low-power exemption in Section 9.II for WIFI. Detailed descriptions of the power reduction mechanism are included in the operational description.

## II. LTE Band Selection

This device supports the following pair of LTE bands with similar frequencies: LTE B12 & B17, B2 & B25, B4 & B66. These pairs of LTE bands have the same target power and share the same transmission path. Since the supported frequency span for the smaller LTE bands are completely covered by the larger LTE bands, only the larger LTE bands (LTE B66, B25, and B12) were evaluated for hearing-aid compliance.




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## Table 2-1
## ZNFG710VM HAC Air Interfaces

| Air-Interface | Band (MHz) | Type Transport | HAC Tested | Simultaneous But Not Tested | Name of Voice Service |
|---|---|---|---|---|---|
| CDMA | 835 | VO | Yes | Yes: WIFI or BT | CMRS Voice |
| | 1900 | | | | |
| | EvDO | VD | No[1] | Yes: WIFI or BT | Google Duo |
| GSM | 850 | VO | Yes | Yes: WIFI or BT | CMRS Voice |
| | 1900 | | | | |
| | GPRS/EDGE | VD | No[1] | Yes: WIFI or BT | Google Duo |
| UMTS | 850 | VD | No[1] | Yes: WIFI or BT | CMRS Voice |
| | 1700 | | | | |
| | 1900 | | | | |
| | HSPA | VD | No[1] | Yes: WIFI or BT | Google Duo |
| LTE (FDD) | 700 (B12) | VD | No[1] | Yes: WIFI or BT | VoLTE, Google Duo |
| | 700 (B17) | | | | |
| | 780 (B13) | | | | |
| | 850 (B5) | | | | |
| | 850 (B26) | | | | |
| | 1700 (B4) | | | | |
| | 1700 (B66) | | | | |
| | 1900 (B2) | | | | |
| | 1900 (B25) | | | | |
| LTE (TDD) | 2600 (B41) | VD | Yes | Yes: WIFI or BT | VoLTE, Google Duo |
| WIFI | 2450 | VD | No[1] | Yes: CDMA, GSM, UMTS, or LTE | VoWIFI, Google Duo |
| | 5200 (U-NII 1) | | | | |
| | 5300 (U-NII 2A) | | | | |
| | 5500 (U-NII 2C) | | | | |
| | 5800 (U-NII 3) | | | | |
| BT | 2450 | DT | No | Yes: CDMA, GSM, UMTS, or LTE | N/A |

Type Transport
VO = Voice Only
DT = Digital Data - Not intended for CMRS Service
VD = CMRS and IP Voice over Data Transport

Notes:
1. Evaluated for MIF and low-power exemption.



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# 3. ANSI/IEEE C63.19 PERFORMANCE CATEGORIES

## I. RF EMISSIONS

The ANSI Standard presents performance requirements for acceptable interoperability of hearing aids with wireless communications devices. When these parameters are met, a hearing aid operates acceptably in close proximity to a wireless communications device.

| Category | Telephone RF Parameters |
|---|---|
| **Near field Category** | **E-field emissions CW dB(V/m)** |
| **f < 960 MHz** | |
| **M1** | 50 to 55 |
| **M2** | 45 to 50 |
| **M3** | 40 to 45 |
| **M4** | < 40 |
| **f > 960 MHz** | |
| **M1** | 40 to 45 |
| **M2** | 35 to 40 |
| **M3** | 30 to 35 |
| **M4** | < 30 |

**Table 3-1**
**WD near-field categories as defined in ANSI C63.19-2011**



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# 4. SYSTEM SPECIFICATIONS

### ER3DV6 E-Field Probe Description

| | |
|---|---|
| Construction: | One dipole parallel, two dipoles normal to probe axis<br>Built-in shielding against static charges |
| Calibration: | In air from 100 MHz to 3.0 GHz<br>(absolute accuracy ±6.0%, k=2) |
| Frequency: | 100 MHz to > 6 GHz;<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<br>(M3 or better device readings fall well below diode compression point) |
| 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 |

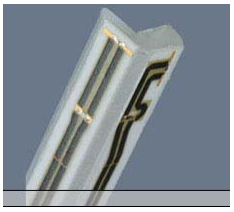
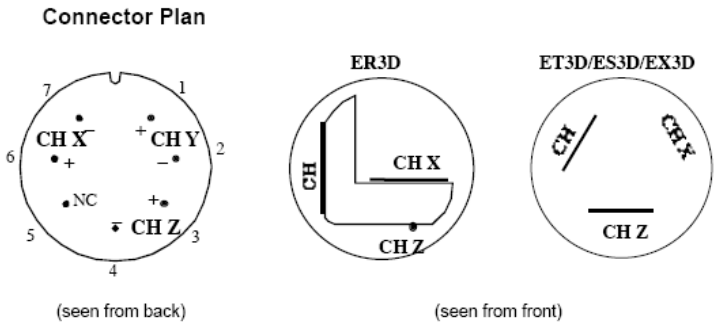


**Figure 4-1**
E-field Free-space Probe

### Probe Tip Description

HAC field measurements take place in the close near field with high gradients. Increasing the measuring distance from the source will generally decrease the measured field values (in case of the validation dipole approx. 10% per mm).

The electric field probes have an irregular internal geometry because it is physically not possible to have the 3 orthogonal sensors situated with the same center. The effect of the different sensor centers is accounted for in the HAC uncertainty budget ("sensor displacement"). Their geometric center is at 2.5mm from the tip, and the element ends are 1.1mm closer to the tip.




The antistatic shielding inside the probe is connected to the probe connector case.

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## Instrumentation Chain

**Equation 1**

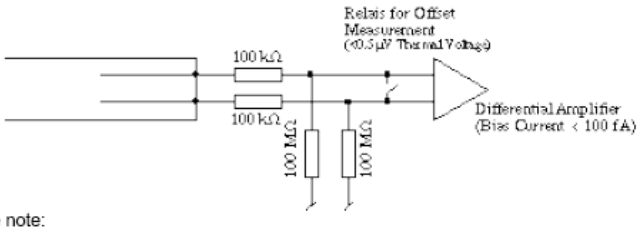
**Conversion of Connector Voltage $u_i$ to E-Field $E_i$**

$$E_i = \sqrt{\frac{u_i + (u_i^2 \cdot CF)/(DCP)}{Norm_i \cdot ConvF}}$$

whereby

| | |
|---|---|
| $E_i$: | electric field in V/m |
| $u_i$: | voltage of channel i at the connector in µV |
| $Norm_i$: | sensitivity of channel i in µV/(V/m)$^2$ |
| $ConvF$: | enhancement factor in liquid (ConvF=1 for Air) |
| $DCP$: | diode compression point in µV |
| $CF$: | signal crest factor (peak power/average power) |

**Conditions of Calibration**




Please note:
- a lower input impedance of the amplifier will result in different sensitivity factors $Norm_i$ and $DCP$
- larger bias currents will cause higher offset

## Probe Response to Frequency

The E-field sensors have inherently a very flat frequency response. They are calibrated with a number of frequencies resulting in a common calibration factor, with the frequency behavior documented in the calibration certificate (See also below).

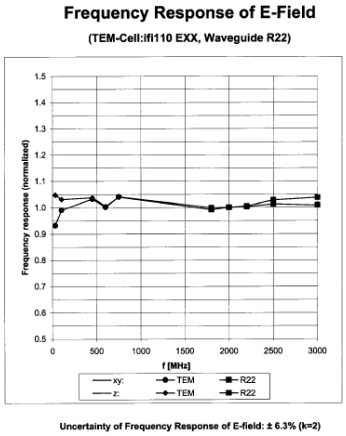



**Figure 4-2** E-Field Probe Frequency Response

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## SPEAG Robotic System

E-field measurements are performed using the DASY5 automated dosimetric assessment system. The DASY5 is made by Schmid & Partner Engineering AG (SPEAG) in Zurich, Switzerland and consists of high precision robotics system (Staubli), robot controller, Intel CORE i7 computer, near-field probe, probe alignment sensor, and the HAC phantom. The robot is a six-axis industrial robot performing precise movements to position the probe to the location (points) of maximum electromagnetic field (EMF).

**Figure 4-3**
SPEAG Robotic System

## System Hardware

A cell controller system contains the power supply, robot controller, teach pendant (Joystick), and a remote control used to drive the robot motors. The PC consists of the computer with operating system and RF Measurement Software DASY5 v52.8 (with HAC Extension), A/D interface card, monitor, mouse, and keyboard. The Staubli Robot is connected to the cell controller to allow software manipulation of the robot. A data acquisition electronic (DAE) circuit that 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.



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## System Electronics

The DAE 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.

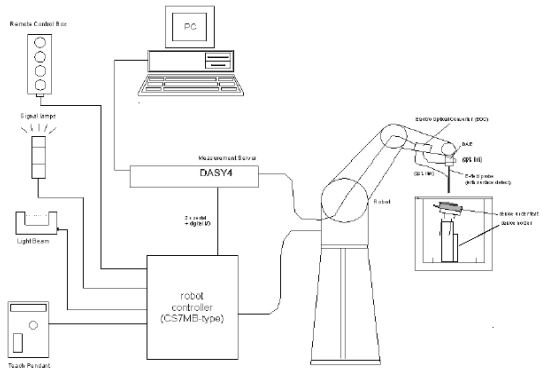


**Figure 4-4**
SPEAG Robotic System Diagram

## DASY5 Instrumentation Chain

The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC-transmission factor from the diode to the evaluation electronics. If the exciting field is pulsed, the crest factor of the signal must be known to correctly compensate for peak power. The formula for each channel can be given as:

$$V_i = U_i + U_i^2 \cdot \frac{cf}{dcp_i}$$

| | | | |
|---|---|---|---|
| with | $V_i$ | = compensated signal of channel i | (i = x, y, z) |
| | $U_i$ | = input signal of channel i | (i = x, y, z) |
| | $cf$ | = crest factor of exciting field | (DASY parameter) |
| | $dcp_i$ | = diode compression point | (DASY parameter) |



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From the compensated input signals the primary field data for each channel can be evaluated:

$$\text{E} - \text{fieldprobes}: \qquad E_i = \sqrt{\frac{V_i}{Norm_i \cdot ConvF}}$$

with $V_i$ = compensated signal of channel i (i = x, y, z)
$Norm_i$ = sensor sensitivity of channel i (i = x, y, z)
$\mu\text{V}/(\text{V/m})^2$ for E-field Probes
$ConvF$ = sensitivity enhancement in solution
$E_i$ = electric field strength of channel i in V/m

The RSS value of the field components gives the total field strength (Hermitian magnitude):

$$E_{tot} = \sqrt{E_x^2 + E_y^2 + E_z^2}$$

The primary field data are used to calculate the derived field units.

The measurement/integration time per point, as specified by the system manufacturer is >500ms.

The signal response time is evaluated as the time required by the system to reach 90% of the expected final value after an on/off switch of the power source with an integration time of 500ms and a probe response time of <5 ms. In the current implementation, DASY5 waits longer than 100ms after having reached the grid point before starting a measurement, i.e., the response time uncertainty is negligible.

If the device under test does not emit a CW signal, the integration time applied to measure the electric field at a specific point may introduce additional uncertainties due to the discretization. The tolerances for the different systems had the worst-case of 2.6%.


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# 5. TEST PROCEDURE

## I. RF EMISSIONS

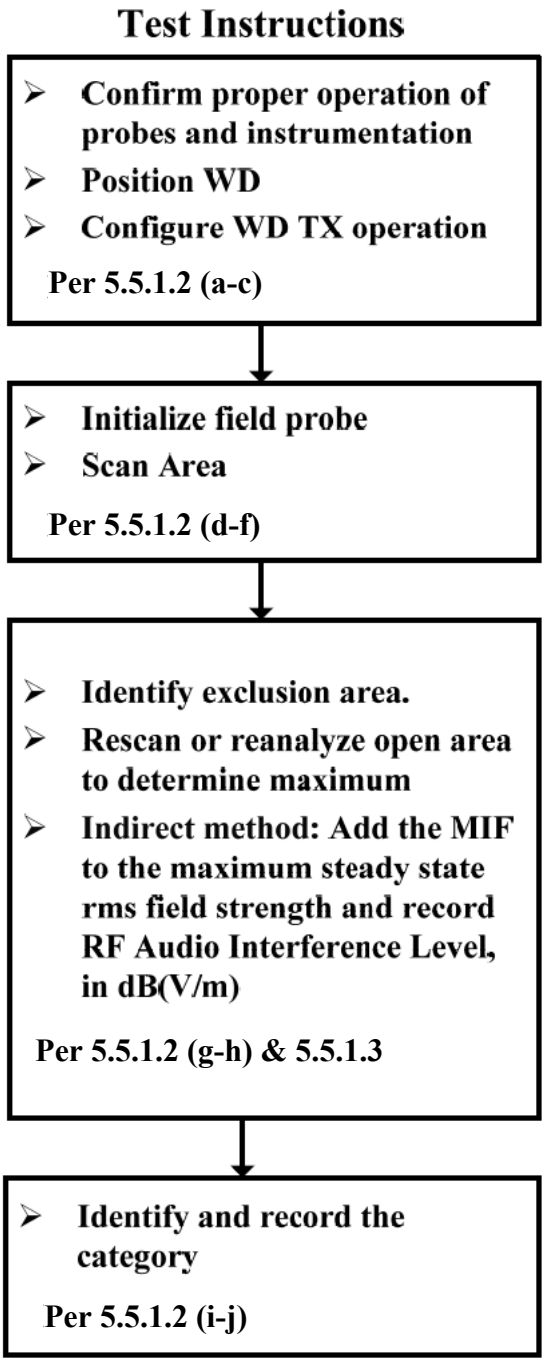


**Figure 5-1 RF Emissions Flow Chart**




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## Test Setup

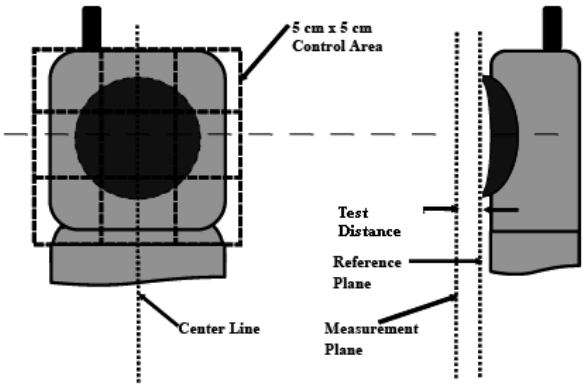


**Figure 5-2**
E-Field Emissions Test Setup Diagram (See Test Photographs for actual WD scan grid overlay)

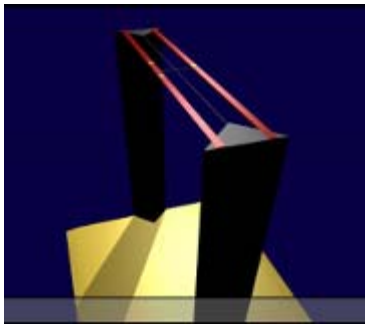

**Figure 5-3**
HAC Phantom

## RF Emissions Test Procedure:

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

1. Proper operation of the field probe, probe measurement system, other instrumentation, and the positioning system was confirmed.

2. WD is positioned in its intended test position, acoustic output point of the device perpendicular to the field probe.

3. The WD operation for maximum rated RF output power was configured and confirmed with the base station simulator, at the test channel and other normal operating parameters as intended for the test. The battery was ensured to be fully charged before each test.

4. The center sub-grid was centered over the center of the acoustic output (also audio band magnetic output, if applicable). The WD audio output was positioned tangent (as physically possible) to the measurement plane.

5. A surface calibration was performed before each setup change to ensure repeatable spacing and proper maintenance of the measurement plane using the HAC Phantom.

6. The measurement system measured the field strength at the reference location.

7. Measurements at 2mm or 5mm increments in the 5 x 5 cm region were performed at a distance 15 mm from the center point of the probe measurement element to the WD. A 360° rotation about the azimuth axis at the maximum interpolated position was measured. For the worst-case condition, the peak reading from this rotation was used in re-evaluating the HAC category.

8. The system performed a drift evaluation by measuring the field at the reference location. If the power drift deviated by more than 5%, the HAC test and drift measurements were repeated.



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# 6. SYSTEM CHECK

## I. System Check Parameters

The input signal was an un-modulated continuous wave. The following points were taken into consideration in performing this check:

- Average Input Power P = 100mW RMS (20dBm RMS) after adjustment for return loss
- The test fixture must meet the 2 wavelength separation criterion
- The proper measurement of the 15 mm probe to dipole separation, which is measured from top surface of the dipole to the calibration reference point of the sensor, defined by the probe manufacturer is shown in the following diagram:

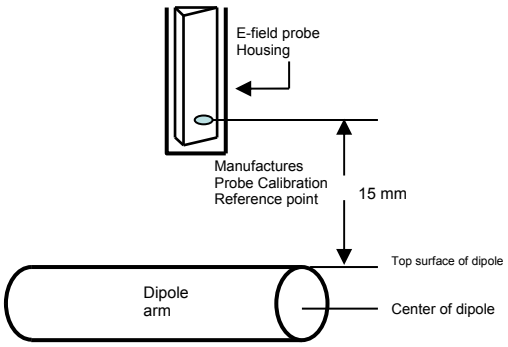


**Figure 6-1**
Separation Distance from Dipole to Field Probe

RF power was recorded using both an average reading meter and a peak reading meter. Readings of the probe are provided by the measurement system.

To assure proper operation of the near-field measurement probe the input power to the dipole shall be commensurate with the full rated output power of the wireless device [e.g. - for a cellular phone wireless device the average peak antenna input power will be on the order of 100mW (20dBm) RMS] after adjustment for any mismatch.

## II. Validation Procedure

A dipole antenna meeting the requirements given in C63.19 was placed in the position normally occupied by the WD.

The length of the dipole was scanned, and the average peak value was recorded.

**Measurement of CW**

Using the near-field measurement system, scan the antenna over the radiating dipole and record the greatest field reading observed. Due to the nature of E-fields about free-space dipoles, the two E-field peaks measured over the dipole are averaged to compensate for non-parallelity of the setup (see manufacturer method on dipole calibration certificates, page 2). Field strength measurements shall be made only when the probe is stationary.




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RF power was recorded using both an average and a peak power reading meter.

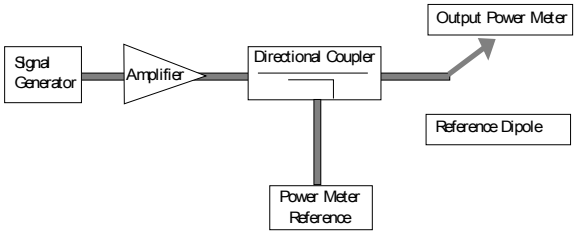


**Figure 6-2**
Setup for Desired Output Power to Dipole

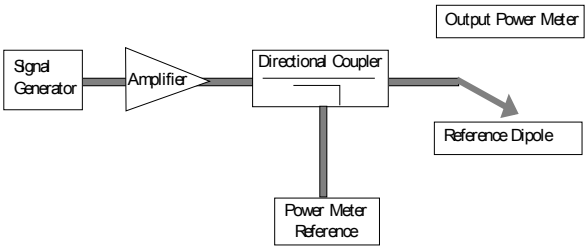


**Figure 6-3**
Setup to Dipole

Using this setup configuration, the signal generator was adjusted for the desired output power (100mW) at a specified frequency. The reference power from the coupled port of the directional coupler is recorded. Next, the output cable is connected to the reference dipole, as shown in Figure 6-3.

The input signal level was adjusted until the reference power from the coupled port of the directional coupler was the same as previously recorded, to compensate for the impedance mismatch between the output cable and the reference dipole. To assure proper operation of the near-field measurement probe the input power to the reference dipole was verified to the full rated output power of the wireless device. The dipole was secured in a holder in a manner to meet the 20 dB reflection. The near-field measurement probe was positioned over the dipole. The antenna was scanned over the appropriate sized area to cover the dipole from end to end. SPEAG uses 2D interpolation algorithms between the measured points. Please see below two dimensional plots showing that the interpolated values interpolate smoothly between 5mm steps for a free-space RF dipole:

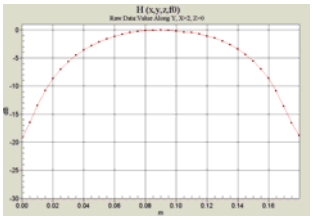

**Figure 6-4**
2-D Raw Data from scan along dipole axis

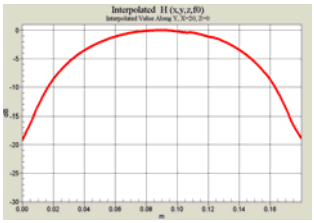

**Figure 6-5**
2-D Interpolated points from scan along dipole axis

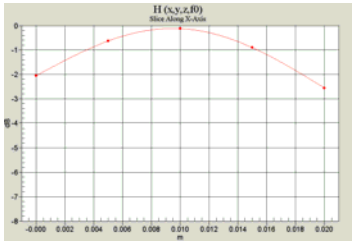

**Figure 6-6**
2-D Raw Data from scan along transverse axis

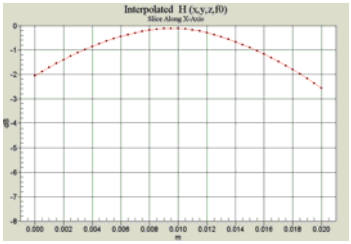

**Figure 6-7**
2-D Interpolated points from scan along transverse axis



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# III. System Check Results

## Validation Results

| Date | Frequency (MHz) | Probe S/N | DAE S/N | Dipole S/N | Input Power (dBm) | E-field Result (V/m) | Target Field (V/m) | % Deviation |
|---|---|---|---|---|---|---|---|---|
| 4/16/2018 | 835 | 2335 | 859 | 1082 | 20.0 | 108.7 | **106.8** | **1.8%** |
| 4/16/2018 | 1880 | | | 1064 | 20.0 | 90.6 | **89.6** | **1.1%** |
| 4/16/2018 | 2600 | | | 1013 | 20.0 | 88.8 | **84.5** | **5.1%** |

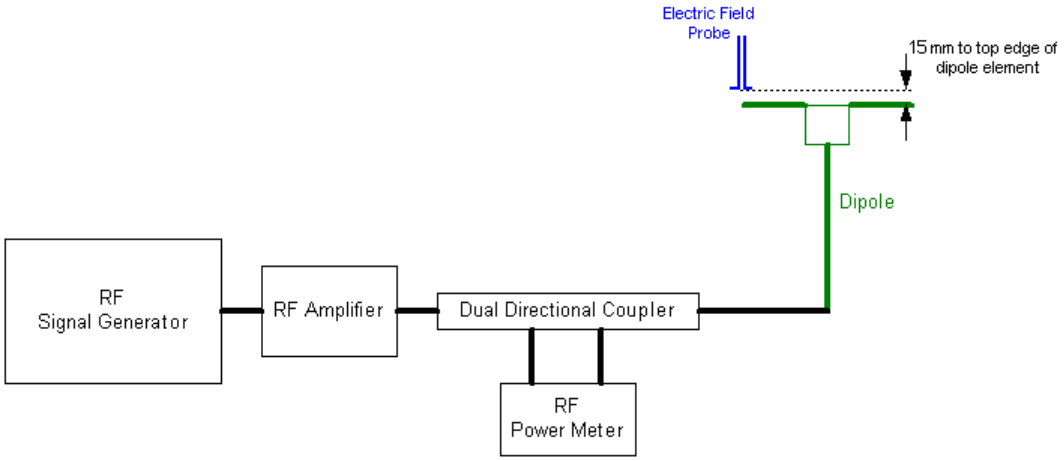


**Figure 6-8**
System Check Setup




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# 7. MODULATION INTERFERENCE FACTOR

## I. Measuring Modulation Interference Factors

For any specific fixed and repeatable modulated signal, a modulation interference factor (MIF, expressed in dB) may be determined that relates its interference potential to its steady-state RMS signal level or average power level. This factor is a function only of the audio-frequency amplitude modulation characteristics of the signal and is the same for field-strength and conducted power measurements. The MIF is valid only for a specific repeatable audio-frequency amplitude modulation characteristic; any change in modulation characteristic requires determination and application of a new MIF.

The MIF may be determined using a radiated RF field or a conducted RF signal:

a. Using RF illumination or conducted coupling, apply the specific modulated signal in question to the measurement system at a level within its confirmed operating dynamic range.
b. Measure the steady-state RMS level at the output of the fast probe or sensor.
c. Measure the steady-state average level at the weighting output.
d. Without changing the square-law detector or weighting system, and using RF illumination or conducted coupling, substitute for the specific modulated signal a 1 kHz, 80% amplitude modulated carrier at the same frequency and adjust its strength until the level at the weighting output equals the step c) measurement.
e. Without changing the carrier level from step d), remove the 1 kHz modulation and again measure the steady-state RMS level indicated at the output of the fast probe or sensor.
f. The MIF for the specific modulation characteristic is provided by the ratio of the step e) measurement to the step b) measurement, expressed in dB (20 × log[(step e)/(step b)]).

The following procedure was used to measure the MIF using the SPEAG Audio Interference Analyzer (AIA), Type No: SE UMS 170 CB, Serial No.: 1010:

1. The device was placed into a simulated call using a base station simulator or set to transmit using test software for a given mode.
2. The device was then set to continuously transmit at maximum power.
3. Using a coupler if needed, the device output signal was connected to the RF In port of the AIA, which was connected to a desktop computer. Alternatively, a radiated RF signal may be used with the AIA's built-in antenna.
4. The MIF measurement procedure in the DASY software was run, and the resulting MIF value was recorded.
5. Steps 1-4 were repeated for all CMRS air interfaces, frequency bands, and modulations.

The modulation interference factors obtained were applied to readings taken of the actual wireless device in order to obtain an accurate audio interference level reading using the formula:

**Audio Interference Level [dB(V/m)] = 20 * log[Raw Field Value (V/m)] + MIF (dB)**

Because the MIF value is output power independent, MIF values for a given mode should be constant across all devices; however, per C63.19-2011 §D.7, MIF values should be measured for each device being evaluated. The voice modes for this device have been investigated in this section of the report.



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## II. MIF Measurement Block Diagrams

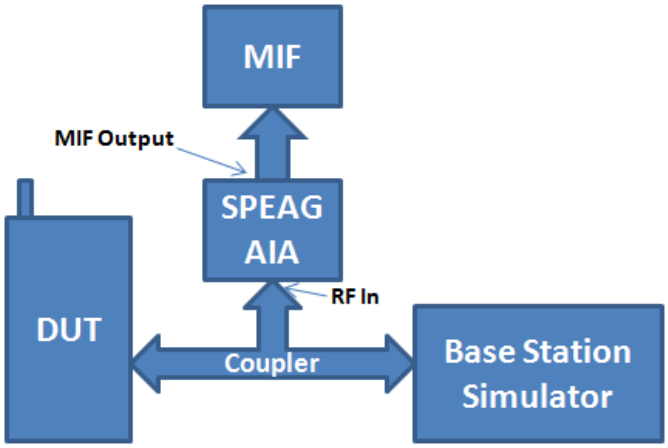


**Figure 7-1**
MIF Measurement Setup
for licensed modes

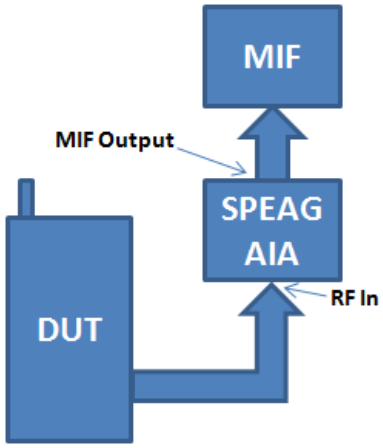


**Figure 7-2**
MIF Measurement Setup
for unlicensed modes

## III. Measured Modulation Interference Factors:

**Table 7-1**
CDMA Modulation Interference Factors[1]

| Mode | | Cell | | | | PCS | | |
|---|---|---|---|---|---|---|---|---|
| | | 90S | 22H | 22H | 22H | 24E | 24E | 24E |
| | | 564 | 1013 | 384 | 777 | 25 | 600 | 1175 |
| CDMA | RC1/SO3 | 3.02 | 3.02 | 3.01 | 3.02 | 3.00 | 2.97 | 3.01 |
| | RC3/SO3 | -19.80 | -19.43 | -19.73 | -19.63 | -19.55 | -19.63 | -19.53 |
| | EvDO | -18.97 | -18.82 | -19.01 | -18.81 | -18.22 | -18.60 | -18.32 |

**Table 7-2**
GSM Modulation Interference Factors[1]

| Mode | | GSM850 | | | GSM1900 | | |
|---|---|---|---|---|---|---|---|
| | | 128 | 190 | 251 | 512 | 661 | 810 |
| GSM | Voice | 3.54 | 3.54 | 3.54 | 3.54 | 3.54 | 3.54 |
| | EDGE | 3.75 | 3.73 | 3.76 | 3.68 | 3.68 | 3.67 |

**Table 7-3**
UMTS Modulation Interference Factors[1]

| Mode | | UMTS V | | | UMTS IV | | | UMTS II | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 4132 | 4183 | 4233 | 1312 | 1412 | 1513 | 9262 | 9400 | 9538 |
| UMTS | 12.2 kbps RMC | -24.92 | -25.46 | -25.37 | -24.82 | -24.14 | -24.30 | -23.38 | -23.93 | -23.86 |
| | 12.2 kbps AMR | -25.06 | -24.57 | -24.23 | -24.18 | -24.41 | -24.71 | -23.64 | -23.84 | -23.58 |
| | HSUPA Subtest1 | -19.51 | -19.45 | -19.51 | -19.10 | -18.88 | -18.90 | -19.02 | -19.16 | -19.15 |

[1] Note: Measured MIF values may be lower than sample MIF values provided in ANSI C63.19-2011 Annex D.7 Table D.5 due to manufacturing variations for each device, however per Annex D.7, the sample MIF values of Table D.5 are not intended to substitute for measurements of actual devices under test and their respective operating modes.




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**Table 7-4**
LTE FDD Modulation Interference Factors[1,2]

| LTE Band | Frequency [MHz] | Channel | Bandwidth [MHz] | Modulation | RB Size | RB Offset | MIF [dB] |
|---|---|---|---|---|---|---|---|
| 5 | 836.5 | 20525 | 10 | 16QAM | 1 | 0 | -9.81 |
| 12 | 707.2 | 23095 | 10 | 16QAM | 1 | 0 | -9.83 |
| 13 | 782.0 | 23230 | 10 | 16QAM | 1 | 0 | -10.63 |
| 26 | 831.5 | 26865 | 15 | 16QAM | 1 | 0 | -9.80 |
| 66 | 1745.0 | 132322 | 20 | 16QAM | 1 | 0 | -10.24 |
| 25 | 1882.5 | 26365 | 20 | 16QAM | 1 | 0 | -9.96 |
| 26 | 831.5 | 26865 | 15 | 64QAM | 1 | 0 | -10.31 |
| 26 | 831.5 | 26865 | 15 | QPSK | 1 | 0 | -14.74 |
| 26 | 831.5 | 26865 | 15 | 16QAM | 1 | 36 | -10.41 |
| 26 | 831.5 | 26865 | 15 | 16QAM | 1 | 74 | -10.40 |
| 26 | 831.5 | 26865 | 15 | 16QAM | 36 | 0 | -17.29 |
| 26 | 831.5 | 26865 | 15 | 16QAM | 75 | 0 | -19.35 |
| 26 | 831.5 | 26865 | 10 | 16QAM | 1 | 0 | -9.81 |
| 26 | 831.5 | 26865 | 5 | 16QAM | 1 | 0 | -9.60 |
| 26 | 831.5 | 26865 | 3 | 16QAM | 1 | 0 | -9.74 |
| 26 | 831.5 | 26865 | 1.4 | 16QAM | 1 | 0 | -10.58 |
| 26 | 816.5 | 26715 | 5 | 16QAM | 1 | 0 | -9.77 |
| 26 | 846.5 | 27015 | 5 | 16QAM | 1 | 0 | -10.86 |

**Table 7-5**
LTE TDD Power Class 3 Modulation Interference Factors[1,3]

| LTE Band | Frequency [MHz] | Channel | Bandwidth [MHz] | Modulation | RB Size | RB Offset | MIF [dB] |
|---|---|---|---|---|---|---|---|
| 41 | 2593.0 | 40620 | 20 | 16QAM | 1 | 0 | 3.63 |
| 41 | 2593.0 | 40620 | 20 | QPSK | 1 | 0 | 3.61 |
| 41 | 2593.0 | 40620 | 20 | 64QAM | 1 | 0 | 3.56 |
| 41 | 2593.0 | 40620 | 20 | 16QAM | 1 | 50 | 3.62 |
| 41 | 2593.0 | 40620 | 20 | 16QAM | 1 | 99 | 3.62 |
| 41 | 2593.0 | 40620 | 20 | 16QAM | 50 | 0 | 3.56 |
| 41 | 2593.0 | 40620 | 20 | 16QAM | 100 | 0 | 3.55 |
| 41 | 2593.0 | 40620 | 15 | 16QAM | 1 | 0 | 3.62 |
| 41 | 2593.0 | 40620 | 10 | 16QAM | 1 | 0 | 3.61 |
| 41 | 2593.0 | 40620 | 5 | 16QAM | 1 | 0 | 3.61 |
| 41 | 2506.0 | 39750 | 20 | 16QAM | 1 | 0 | 3.65 |
| 41 | 2549.5 | 40185 | 20 | 16QAM | 1 | 0 | 3.65 |
| 41 | 2636.5 | 41055 | 20 | 16QAM | 1 | 0 | 3.63 |
| 41 | 2680.0 | 41490 | 20 | 16QAM | 1 | 0 | 3.65 |

[1] Note: Measured MIF values may be lower than sample MIF values provided in ANSI C63.19-2011 Annex D.7 Table D.5 due to manufacturing variations for each device, however per Annex D.7, the sample MIF values of Table D.5 are not intended to substitute for measurements of actual devices under test and their respective operating modes.

[2] Note: All FDD LTE bands were found to have substantially similar MIF values given similar RB, BW, and modulation configurations.

[3] Note: LTE TDD MIFs were taken using UL-DL Configuration 5 for Power Class 3. More information about the chosen UL-DL Configuration can be found in Section 10.




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**Table 7-6**
LTE TDD Power Class 2 Modulation Interference Factors[1,2]

| LTE Band | Frequency [MHz] | Channel | Bandwidth [MHz] | Modulation | RB Size | RB Offset | MIF [dB] |
|---|---|---|---|---|---|---|---|
| 41 | 2593.0 | 40620 | 20 | 16QAM | 1 | 0 | 3.79 |
| 41 | 2593.0 | 40620 | 20 | QPSK | 1 | 0 | 3.61 |
| 41 | 2593.0 | 40620 | 20 | 64QAM | 1 | 0 | 3.63 |
| 41 | 2593.0 | 40620 | 20 | 16QAM | 1 | 50 | 3.68 |
| 41 | 2593.0 | 40620 | 20 | 16QAM | 1 | 99 | 3.67 |
| 41 | 2593.0 | 40620 | 20 | 16QAM | 50 | 0 | 3.57 |
| 41 | 2593.0 | 40620 | 20 | 16QAM | 100 | 0 | 3.58 |
| 41 | 2593.0 | 40620 | 15 | 16QAM | 1 | 0 | 3.84 |
| 41 | 2593.0 | 40620 | 10 | 16QAM | 1 | 0 | 3.83 |
| 41 | 2593.0 | 40620 | 5 | 16QAM | 1 | 0 | 3.69 |
| 41 | 2506.0 | 39750 | 15 | 16QAM | 1 | 0 | 3.74 |
| 41 | 2549.5 | 40185 | 15 | 16QAM | 1 | 0 | 3.61 |
| 41 | 2636.5 | 41055 | 15 | 16QAM | 1 | 0 | 3.84 |
| 41 | 2680.0 | 41490 | 15 | 16QAM | 1 | 0 | 3.72 |

**Table 7-7**
LTE FDD Uplink Carrier Aggregation Modulation Interference Factor[1,3]

| Combination | PCC | | | | | | | SCC | | | | | | | MIF (dB) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PCC Band | PCC Bandwidth [MHz] | PCC (UL/DL) Channel | PCC (UL/DL) Frequency [MHz] | Modulation | PCC UL# RB | PCC UL RB Offset | SCC Band | SCC Bandwidth [MHz] | SCC (UL/DL) Channel | SCC (UL/DL) Frequency [MHz] | Modulation | SCC UL# RB | SCC UL RB Offset | |
| CA_5B | LTE B5 | 10 | 20525 | 836.5 | 16QAM | 1 | 0 | LTE B5 | 5MHz | 20453 | 874.3 | 16QAM | 1 | 24 | -11.83 |

**Table 7-8**
LTE TDD Uplink Carrier Aggregation Modulation Interference Factor[1,4]

| Combination | PCC | | | | | | | SCC | | | | | | | MIF (dB) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PCC Band | PCC Bandwidth [MHz] | PCC (UL/DL) Channel | PCC (UL/DL) Frequency [MHz] | Modulation | PCC UL# RB | PCC UL RB Offset | SCC Band | SCC Bandwidth [MHz] | SCC (UL/DL) Channel | SCC (UL/DL) Frequency [MHz] | Modulation | SCC UL# RB | SCC UL RB Offset | |
| CA_41C | LTE B41 | 20 | 40185 | 2549.5 | 16QAM | 1 | 0 | 41 | 20 | 39987 | 2529.7 | 16QAM | 1 | 99 | -1.60 |

[1] Note: Measured MIF values may be lower than sample MIF values provided in ANSI C63.19-2011 Annex D.7 Table D.5 due to manufacturing variations for each device, however per Annex D.7, the sample MIF values of Table D.5 are not intended to substitute for measurements of actual devices under test and their respective operating modes.

[2] Note: LTE TDD MIFs were taken using UL-DL Configuration 5 for Power Class 2. More information about the chosen UL-DL Configuration can be found in Section 10.

[3] Note: The configuration for LTE FDD ULCA was determined from the worst-case configuration from Table 7-4. The worst-case channel 20525 was evaluated to ensure worst-case modulation was evaluated for PCC due to the CA combination constraint of CA_5B.

[4] Note: The configuration for LTE TDD ULCA was determined from the worst-case configuration from Table 7-5. The worst-case channel 40185 was evaluated to ensure worst-case modulation was evaluated for PCC due to the CA combination constraint of CA_41C.



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**Table 7-9**
802.11b (2.4GHz, SISO) Modulation Interference Factors[1,2]

| Mode | 802.11b MIF Measurements [dB] | | | |
|---|---|---|---|---|
| | Data Rate [Mbps] | | | |
| | 1 | 2 | 5.5 | 11 |
| 802.11b | -9.70 | -14.08 | -11.42 | -10.87 |

**Table 7-10**
802.11b (2.4GHz, MIMO) Modulation Interference Factors[1,2]

| Mode | 802.11b MIF Measurements [dB] | | | |
|---|---|---|---|---|
| | Data Rate [Mbps] | | | |
| | 1 | 4 | 11 | 22 |
| 802.11b | -9.54 | -14.08 | -12.61 | -10.41 |

**Table 7-11**
802.11g (2.4GHz, SISO) Modulation Interference Factors[1,2]

| Mode | 802.11g MIF Measurements [dB] | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Data Rate [Mbps] | | | | | | | |
| | 6 | 9 | 12 | 18 | 24 | 36 | 48 | 54 |
| 802.11g | -12.24 | -11.51 | -11.10 | -10.18 | -9.76 | -9.48 | -9.49 | -9.52 |

**Table 7-12**
802.11g (2.4GHz, MIMO) Modulation Interference Factors[1,2]

| Mode | 802.11g MIF Measurements [dB] | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Data Rate [Mbps] | | | | | | | |
| | 12 | 18 | 24 | 36 | 48 | 72 | 92 | 108 |
| 802.11g | -12.29 | -11.43 | -11.07 | -10.05 | -9.68 | -9.28 | -9.30 | -9.45 |

**Table 7-13**
802.11n (2.4GHz, SISO) Modulation Interference Factors[1,2]

| Mode | 802.11n (2.4GHz) MIF Measurements [dB] | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Data Rate [Mbps] | | | | | | | |
| | 6.5 | 13 | 19.5 | 26 | 39 | 52 | 58.5 | 65 |
| 802.11n | -12.49 | -11.15 | -10.24 | -9.94 | -9.54 | -9.69 | -9.74 | -9.89 |

**Table 7-14**
802.11n (2.4GHz, MIMO) Modulation Interference Factors[1,2]

| Mode | 802.11n (2.4GHz) MIF Measurements [dB] | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Data Rate [Mbps] | | | | | | | |
| | 13 | 26 | 39 | 52 | 78 | 104 | 117 | 130 |
| 802.11n | -11.72 | -12.07 | -9.57 | -9.20 | -9.78 | -9.87 | -9.06 | -10.10 |

[1] Note: Measured MIF values may be lower than sample MIF values provided in ANSI C63.19-2011 Annex D.7 Table D.5 due to manufacturing variations for each device, however per Annex D.7, the sample MIF values of Table D.5 are not intended to substitute for measurements of actual devices under test and their respective operating modes.

[2] Note: WIFI MIF values were found to be independent of the transmit channel.



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**Table 7-15**
802.11ac (2.4GHz, SISO) Modulation Interference Factors[1,2]

| Mode | 802.11ac (2.4GHz) MIF Measurements [dB] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Data Rate [Mbps] | | | | | | | | |
| | 6.5 | 13 | 19.5 | 26 | 39 | 52 | 58.5 | 65 | 78 |
| 802.11ac | -12.48 | -11.10 | -10.20 | -9.69 | -9.47 | -9.60 | -9.70 | -9.89 | -10.18 |

**Table 7-16**
802.11ac (2.4GHz, MIMO) Modulation Interference Factors[1,2]

| 802.11ac (2.4GHz) MIF Measurements [dB] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Data Rate [Mbps] | | | | | | | | |
| 13 | 26 | 39 | 52 | 78 | 104 | 117 | 130 | 156 |
| -11.70 | -10.46 | -9.65 | -9.10 | -8.98 | -9.06 | -9.15 | -10.08 | -10.29 |

**Table 7-17**
802.11a (5GHz, 20MHz BW, SISO) Modulation Interference Factors[1,2]

| Mode | 802.11a MIF Measurements [dB] | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Data Rate [Mbps] | | | | | | | |
| | 6 | 9 | 12 | 18 | 24 | 36 | 48 | 54 |
| 802.11a | -12.30 | -11.56 | -11.15 | -10.25 | -9.81 | -9.51 | -9.52 | -9.59 |

**Table 7-18**
802.11a (5GHz, 20MHz BW, MIMO) Modulation Interference Factors[1,2]

| Mode | 802.11a MIF Measurements [dB] | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Data Rate [Mbps] | | | | | | | |
| | 12 | 18 | 24 | 36 | 48 | 72 | 92 | 108 |
| 802.11a | -12.18 | -11.34 | -11.00 | -10.04 | -9.58 | -9.21 | -9.18 | -9.26 |

**Table 7-19**
802.11n (5GHz, 20MHz BW, SISO) Modulation Interference Factors[1,2]

| Mode | 20MHz BW 802.11n (5GHz) MIF Measurements [dB] | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Data Rate [Mbps] | | | | | | | |
| | 6.5 | 13 | 19.5 | 26 | 39 | 52 | 58.5 | 65 |
| 802.11n | -12.52 | -11.17 | -10.30 | -9.98 | -9.60 | -9.68 | -9.73 | -9.95 |

**Table 7-20**
802.11n (5GHz, 20MHz BW, MIMO) Modulation Interference Factors[1,2]

| Mode | 20MHz BW 802.11n (5GHz) MIF Measurements [dB] | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Data Rate [Mbps] | | | | | | | |
| | 13 | 26 | 39 | 52 | 78 | 104 | 117 | 130 |
| 802.11n | -11.77 | -10.54 | -9.80 | -9.43 | -9.18 | -9.23 | -9.33 | -9.56 |

[1] Note: Measured MIF values may be lower than sample MIF values provided in ANSI C63.19-2011 Annex D.7 Table D.5 due to manufacturing variations for each device, however per Annex D.7, the sample MIF values of Table D.5 are not intended to substitute for measurements of actual devices under test and their respective operating modes.

[2] Note: WIFI MIF values were found to be independent of the transmit channel.




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**Table 7-21**
802.11ac (5GHz, 20MHz BW, SISO) Modulation Interference Factors[1,2]

| Mode | 20MHz BW 802.11ac (5GHz) MIF Measurements [dB] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Data Rate [Mbps] | | | | | | | | |
| | 6.5 | 13 | 19.5 | 26 | 39 | 52 | 58.5 | 65 | 78 |
| 802.11ac | -12.53 | -11.19 | -10.45 | -9.85 | -9.61 | -9.65 | -9.69 | -9.95 | -10.23 |

**Table 7-22**
802.11ac (5GHz, 20MHz BW, MIMO) Modulation Interference Factors[1,2]

| Mode | 20MHz BW 802.11ac (5GHz) MIF Measurements [dB] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Data Rate [Mbps] | | | | | | | | |
| | 13 | 26 | 39 | 52 | 78 | 104 | 117 | 130 | 156 |
| 802.11ac | -11.78 | -10.53 | -9.83 | -9.33 | -9.18 | -9.21 | -9.32 | -9.54 | -9.83 |

**Table 7-23**
802.11n (5GHz, 40MHz BW, SISO) Modulation Interference Factors[1,2]

| Mode | 40MHz BW 802.11n (5GHz) MIF Measurements [dB] | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Data Rate [Mbps] | | | | | | | |
| | 13.5 | 27 | 40.5 | 54 | 81 | 108 | 121.5 | 135 |
| 802.11n | -10.85 | -9.68 | -9.28 | -8.99 | -9.31 | -9.81 | -10.26 | -10.58 |

**Table 7-24**
802.11n (5GHz, 40MHz BW, MIMO) Modulation Interference Factors[1,2]

| Mode | 40MHz BW 802.11n (5GHz) MIF Measurements [dB] | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Data Rate [Mbps] | | | | | | | |
| | 27 | 54 | 81 | 108 | 162 | 216 | 243 | 270 |
| 802.11n | -10.53 | -9.52 | -9.05 | -8.72 | -9.03 | -9.45 | -9.95 | -10.21 |

**Table 7-25**
802.11ac (5GHz, 40MHz BW, SISO) Modulation Interference Factors[1,2]

| Mode | 40MHz BW 802.11ac (5GHz) MIF Measurements [dB] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Data Rate [Mbps] | | | | | | | | |
| | 13.5 | 27 | 40.5 | 54 | 81 | 108 | 121.5 | 135 | 180 |
| 802.11ac | -10.88 | -9.72 | -9.23 | -9.00 | -9.27 | -9.88 | -10.14 | -10.47 | -10.63 |

**Table 7-26**
802.11ac (5GHz, 40MHz BW, MIMO) Modulation Interference Factors[1,2]

| Mode | 40MHz BW 802.11ac (5GHz) MIF Measurements [dB] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Data Rate [Mbps] | | | | | | | | |
| | 27 | 54 | 81 | 108 | 162 | 216 | 243 | 270 | 360 |
| 802.11ac | -10.64 | -9.44 | -8.90 | -8.63 | -8.93 | -9.51 | -9.79 | -10.10 | -10.82 |

[1] Note: Measured MIF values may be lower than sample MIF values provided in ANSI C63.19-2011 Annex D.7 Table D.5 due to manufacturing variations for each device, however per Annex D.7, the sample MIF values of Table D.5 are not intended to substitute for measurements of actual devices under test and their respective operating modes.

[2] Note: WIFI MIF values were found to be independent of the transmit channel.




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**Table 7-27**
802.11ac (5GHz, 80MHz BW, SISO) Modulation Interference Factors[1,2]

| Mode | 80MHz BW 802.11ac (5GHz) MIF Measurements [dB] | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Data Rate [Mbps] | | | | | | | | | |
| | 29.3 | 58.5 | 87.8 | 117 | 175.5 | 234 | 263.3 | 292.5 | 351 | 390 |
| 802.11ac | -11.15 | -10.00 | -9.43 | -9.26 | -9.54 | -10.05 | -10.59 | -10.80 | -11.28 | -10.66 |

**Table 7-28**
802.11ac (5GHz, 80MHz BW, MIMO) Modulation Interference Factors[1,2]

| Mode | 80MHz BW 802.11ac (5GHz) MIF Measurements [dB] | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Data Rate [Mbps] | | | | | | | | | |
| | 58.5 | 117 | 175.5 | 234 | 351 | 468 | 526.5 | 585 | 702 | 780 |
| 802.11ac | -10.80 | -9.69 | -9.04 | -8.92 | -9.21 | -9.86 | -10.17 | -10.44 | -10.90 | -11.27 |

**Table 7-29**
Simultaneous 2.4GHz and 5GHz WIFI Modulation Interference Factors[1,2,3]

| # Tx | 5 GHz WIFI [dBm] | | 2.4 GHz WIFI [dBm] | | Measured MIF (dB) |
|---|---|---|---|---|---|
| | Ant1 | Ant2 | Ant1 | Ant2 | |
| 2 | - | x | x | - | -10.79 |

[1] Note: Measured MIF values may be lower than sample MIF values provided in ANSI C63.19-2011 Annex D.7 Table D.5 due to manufacturing variations for each device, however per Annex D.7, the sample MIF values of Table D.5 are not intended to substitute for measurements of actual devices under test and their respective operating modes.

[2] Note: WLAN MIF values were found to be independent of the transmit channel.

[3] Note: The configuration for each scenario (e.g. bandwidth, data rate, etc.) was determined using the worst-case configuration from SISO MIF measurements.



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# 8. RF CONDUCTED POWER MEASUREMENTS

## I. Procedures Used to Establish RF Signal for HAC Testing

The handset was placed into a simulated call using a base station simulator in a shielded chamber. Such test signals offer a consistent means for testing HAC and are recommended for evaluating HAC. Measurements were taken with a fully charged battery. In order to verify that the device was tested and maintained at full power, this was configured with the base station simulator.

## II. HAC Measurement Conditions

### Output Power Verification

Maximum output power is verified on the High, Middle and Low channels for all applicable air interfaces. See Table 8-1 for air interface specific settings of transmit power parameters.

**Table 8-1**
**Power Control Parameters and Settings by Air Interface**

| Air Interface: | Parameter Name: | Parameter Set To: |
|---|---|---|
| CDMA | Power Control Bits | "All Up" |
| GSM | PCL | GSM850: "5"; GSM1900: "0" |
| UMTS | TPC | "All 1's" |
| LTE | TPC | "Max Power" |
| WIFI | Mfr Configured | Mfr Specified |

## III. Setup Used to Measure RF Conducted Powers

Power measurements for licensed modes were performed using a base station simulator under digital average power. Power measurements for unlicensed modes were performed using a power meter and power sensor.

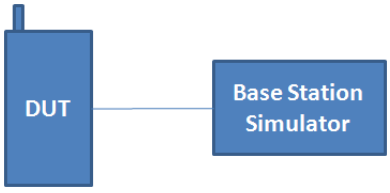


Figure 8-1
Power Measurement Setup for licensed modes

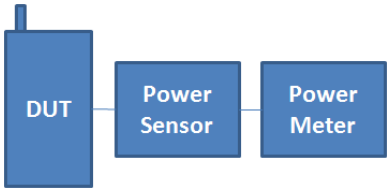


Figure 8-2
Power Measurement Setup for unlicensed modes

## IV. CDMA Conducted Powers

| Band | Channel | Rule Part | Frequency | SO2 [dBm] | SO2 [dBm] | SO2 [dBm] | SO55 [dBm] | SO55 [dBm] | SO75 [dBm] | SO9 [dBm] | SO9 [dBm] | SO3 [dBm] | SO3 [dBm] | SO3 [dBm] | 1x EvDO Rev. A [dBm] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | F-RC | | MHz | RC1 | RC3 | RC4 | RC1 | RC3 | RC11 | RC2 | RC5 | RC1 | RC3 | RC4 | (RETAP) |
| Cellular | 564 | 90S | 820.1 | 25.22 | 25.24 | 25.08 | 25.22 | 25.22 | 25.34 | 25.32 | 25.12 | 25.34 | 25.38 | 25.13 | 25.20 |
| Cellular | 1013 | 22H | 824.7 | 25.26 | 25.33 | 25.33 | 25.31 | 25.26 | 25.20 | 25.36 | 25.32 | 25.24 | 25.24 | 25.42 | 25.24 |
| | 384 | 22H | 836.52 | 25.29 | 25.28 | 25.06 | 25.16 | 25.25 | 25.33 | 25.22 | 25.18 | 25.30 | 25.26 | 25.18 | 25.20 |
| | 777 | 22H | 848.31 | 25.30 | 25.27 | 25.25 | 25.20 | 25.23 | 25.13 | 25.29 | 25.31 | 25.19 | 25.13 | 25.20 | 25.22 |
| PCS | 25 | 24E | 1851.25 | 24.97 | 25.15 | 25.06 | 25.10 | 25.06 | 25.11 | 25.14 | 25.05 | 24.99 | 25.13 | 25.06 | 25.09 |
| | 600 | 24E | 1880 | 25.11 | 25.16 | 25.11 | 25.13 | 25.20 | 25.15 | 25.19 | 25.13 | 25.14 | 25.18 | 25.08 | 25.11 |
| | 1175 | 24E | 1908.75 | 25.11 | 25.03 | 25.15 | 25.10 | 25.09 | 25.07 | 25.10 | 25.15 | 25.06 | 25.12 | 25.17 | 25.14 |




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## V. GSM Conducted Powers

| Band | Channel | GSM [dBm] CS (1 Slot) | EDGE [dBm] 1 Tx Slot |
|---|---|---|---|
| GSM 850 | 128 | 31.54 | 27.33 |
| | 190 | 31.50 | 27.32 |
| | 251 | 31.51 | 27.25 |
| GSM 1900 | 512 | 30.59 | 26.44 |
| | 661 | 30.61 | 26.41 |
| | 810 | 30.51 | 26.31 |

## VI. UMTS Conducted Powers

| Mode | 3GPP 34.121 Subtest | Cellular Band [dBm] | | | AWS Band [dBm] | | | PCS Band [dBm] | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 4132 | 4183 | 4233 | 1312 | 1412 | 1513 | 9262 | 9400 | 9538 |
| WCDMA | 12.2 kbps RMC | 25.35 | 25.31 | 25.29 | 24.99 | 24.96 | 25.03 | 25.19 | 25.21 | 25.25 |
| | 12.2 kbps AMR | 25.25 | 25.30 | 25.34 | 25.00 | 24.65 | 24.99 | 25.13 | 25.20 | 25.29 |
| HSUPA | Subtest 1 | 25.14 | 25.12 | 25.15 | 24.90 | 24.87 | 24.90 | 25.04 | 24.96 | 25.05 |

## VII. LTE Conducted Powers

### a. LTE Band 12

**Table 8-2**
**LTE Band 12 (707.5MHz) Conducted Powers – 10MHz Bandwidth**

| LTE Band 12 10 MHz Bandwidth | | | | | |
|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Mid Channel 23095 (707.5 MHz) Conducted Power [dBm] | MPR Allowed per 3GPP [dB] | MPR [dB] |
| QPSK | 1 | 0 | 25.10 | 0 | 0 |
| | 1 | 25 | 25.03 | | 0 |
| | 1 | 49 | 24.96 | | 0 |
| | 25 | 0 | 23.94 | 0-1 | 1 |
| | 25 | 12 | 23.97 | | 1 |
| | 25 | 25 | 24.07 | | 1 |
| | 50 | 0 | 23.96 | | 1 |
| 16QAM | 1 | 0 | 24.00 | 0-1 | 1 |
| | 1 | 25 | 23.89 | | 1 |
| | 1 | 49 | 23.93 | | 1 |
| | 25 | 0 | 23.04 | 0-2 | 2 |
| | 25 | 12 | 23.02 | | 2 |
| | 25 | 25 | 23.09 | | 2 |
| | 50 | 0 | 23.05 | | 2 |
| 64QAM | 1 | 0 | 23.00 | 0-2 | 2 |
| | 1 | 25 | 23.01 | | 2 |
| | 1 | 49 | 23.13 | | 2 |
| | 25 | 0 | 22.02 | 0-3 | 3 |
| | 25 | 12 | 22.07 | | 3 |
| | 25 | 25 | 21.97 | | 3 |
| | 50 | 0 | 21.92 | | 3 |

Note: Since LTE Band 12 at 10MHz bandwidth does not support 3 non-overlapping channels, conducted power measurements were made only on the middle channel.



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## Table 8-3
## LTE Band 12 (707.5MHz) Conducted Powers – 5MHz Bandwidth

| LTE Band 12<br>5 MHz Bandwidth | | | | | | | |
|---|---|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Low Channel<br>23035<br>(701.5 MHz) | Mid Channel<br>23095<br>(707.5 MHz) | High Channel<br>23155<br>(713.5 MHz) | MPR Allowed per 3GPP [dB] | MPR [dB] |
| | | | Conducted Power [dBm] | | | | |
| QPSK | 1 | 0 | 24.85 | 24.96 | 25.03 | 0 | 0 |
| | 1 | 12 | 24.88 | 24.92 | 25.03 | | 0 |
| | 1 | 24 | 25.09 | 24.97 | 24.96 | | 0 |
| | 12 | 0 | 23.92 | 23.87 | 24.06 | 0-1 | 1 |
| | 12 | 6 | 23.98 | 23.97 | 23.99 | | 1 |
| | 12 | 13 | 24.04 | 23.95 | 24.04 | | 1 |
| | 25 | 0 | 23.97 | 23.91 | 24.09 | | 1 |
| 16QAM | 1 | 0 | 24.24 | 24.20 | 24.25 | 0-1 | 1 |
| | 1 | 12 | 24.30 | 24.30 | 24.36 | | 1 |
| | 1 | 24 | 24.28 | 24.20 | 24.34 | | 1 |
| | 12 | 0 | 23.04 | 22.95 | 23.03 | 0-2 | 2 |
| | 12 | 6 | 23.10 | 23.05 | 23.07 | | 2 |
| | 12 | 13 | 23.09 | 23.00 | 23.09 | | 2 |
| | 25 | 0 | 23.03 | 22.96 | 23.15 | | 2 |
| 64QAM | 1 | 0 | 23.22 | 23.13 | 23.13 | 0-2 | 2 |
| | 1 | 12 | 23.22 | 23.27 | 23.22 | | 2 |
| | 1 | 24 | 23.25 | 23.08 | 23.24 | | 2 |
| | 12 | 0 | 21.96 | 21.84 | 21.99 | 0-3 | 3 |
| | 12 | 6 | 22.01 | 22.02 | 22.06 | | 3 |
| | 12 | 13 | 21.95 | 21.91 | 22.04 | | 3 |
| | 25 | 0 | 21.99 | 21.94 | 22.11 | | 3 |

## Table 8-4
## LTE Band 12 (707.5MHz) Conducted Powers – 3MHz Bandwidth

| LTE Band 12<br>3 MHz Bandwidth | | | | | | | |
|---|---|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Low Channel<br>23025<br>(700.5 MHz) | Mid Channel<br>23095<br>(707.5 MHz) | High Channel<br>23165<br>(714.5 MHz) | MPR Allowed per 3GPP [dB] | MPR [dB] |
| | | | Conducted Power [dBm] | | | | |
| QPSK | 1 | 0 | 24.66 | 25.01 | 24.94 | 0 | 0 |
| | 1 | 7 | 24.88 | 25.01 | 24.94 | | 0 |
| | 1 | 14 | 24.77 | 24.89 | 25.02 | | 0 |
| | 8 | 0 | 23.82 | 23.89 | 24.06 | 0-1 | 1 |
| | 8 | 4 | 23.87 | 23.97 | 24.01 | | 1 |
| | 8 | 7 | 23.92 | 23.93 | 23.99 | | 1 |
| | 15 | 0 | 23.83 | 23.93 | 24.01 | | 1 |
| 16QAM | 1 | 0 | 24.11 | 24.20 | 24.29 | 0-1 | 1 |
| | 1 | 7 | 24.23 | 24.29 | 24.44 | | 1 |
| | 1 | 14 | 24.20 | 24.17 | 24.47 | | 1 |
| | 8 | 0 | 22.90 | 22.86 | 23.08 | 0-2 | 2 |
| | 8 | 4 | 23.01 | 22.96 | 23.03 | | 2 |
| | 8 | 7 | 22.99 | 22.90 | 22.98 | | 2 |
| | 15 | 0 | 22.92 | 22.93 | 23.03 | | 2 |
| 64QAM | 1 | 0 | 23.05 | 23.07 | 23.24 | 0-2 | 2 |
| | 1 | 7 | 23.18 | 23.22 | 23.34 | | 2 |
| | 1 | 14 | 23.12 | 23.10 | 23.41 | | 2 |
| | 8 | 0 | 21.77 | 21.78 | 22.05 | 0-3 | 3 |
| | 8 | 4 | 21.88 | 21.90 | 21.98 | | 3 |
| | 8 | 7 | 21.94 | 21.78 | 21.94 | | 3 |
| | 15 | 0 | 21.81 | 21.83 | 22.00 | | 3 |




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## Table 8-5
## LTE Band 12 (707.5MHz) Conducted Powers – 1.4MHz Bandwidth

| LTE Band 12<br>1.4 MHz Bandwidth | | | | | | | |
|---|---|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Low Channel<br>23017<br>(699.7 MHz) | Mid Channel<br>23095<br>(707.5 MHz) | High Channel<br>23173<br>(715.3 MHz) | MPR Allowed per 3GPP [dB] | MPR [dB] |
| | | | Conducted Power [dBm] | | | | |
| QPSK | 1 | 0 | 25.05 | 25.20 | 25.30 | 0 | 0 |
| | 1 | 2 | 25.12 | 25.29 | 25.34 | | 0 |
| | 1 | 5 | 25.05 | 25.27 | 25.32 | | 0 |
| | 3 | 0 | 25.15 | 25.30 | 25.40 | | 0 |
| | 3 | 2 | 25.12 | 25.38 | 25.40 | | 0 |
| | 3 | 3 | 25.18 | 25.40 | 25.37 | | 0 |
| | 6 | 0 | 24.15 | 24.29 | 24.34 | 0-1 | 1 |
| 16QAM | 1 | 0 | 24.45 | 24.28 | 24.31 | 0-1 | 1 |
| | 1 | 2 | 24.46 | 24.29 | 24.18 | | 1 |
| | 1 | 5 | 24.45 | 24.32 | 24.23 | | 1 |
| | 3 | 0 | 24.39 | 24.38 | 24.18 | | 1 |
| | 3 | 2 | 24.36 | 24.44 | 24.10 | | 1 |
| | 3 | 3 | 24.34 | 24.45 | 24.11 | | 1 |
| | 6 | 0 | 23.14 | 23.25 | 23.25 | 0-2 | 2 |
| 64QAM | 1 | 0 | 23.36 | 23.27 | 23.24 | 0-2 | 2 |
| | 1 | 2 | 23.42 | 23.26 | 23.12 | | 2 |
| | 1 | 5 | 23.45 | 23.32 | 23.12 | | 2 |
| | 3 | 0 | 23.26 | 23.25 | 23.10 | | 2 |
| | 3 | 2 | 23.27 | 23.42 | 23.09 | | 2 |
| | 3 | 3 | 23.25 | 23.41 | 22.99 | | 2 |
| | 6 | 0 | 22.03 | 22.17 | 22.19 | 0-3 | 3 |

## b. LTE Band 13

## Table 8-6
## LTE Band 13 (780.0MHz) Conducted Powers – 10MHz Bandwidth

| LTE Band 13<br>10 MHz Bandwidth | | | | | |
|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Mid Channel<br>23230<br>(782.0 MHz)<br>Conducted Power [dBm] | MPR Allowed per 3GPP [dB] | MPR [dB] |
| QPSK | 1 | 0 | 25.06 | 0 | 0 |
| | 1 | 25 | 25.07 | | 0 |
| | 1 | 49 | 25.04 | | 0 |
| | 25 | 0 | 23.94 | 0-1 | 1 |
| | 25 | 12 | 24.01 | | 1 |
| | 25 | 25 | 23.97 | | 1 |
| | 50 | 0 | 23.92 | | 1 |
| 16QAM | 1 | 0 | 23.96 | 0-1 | 1 |
| | 1 | 25 | 24.10 | | 1 |
| | 1 | 49 | 24.05 | | 1 |
| | 25 | 0 | 22.99 | 0-2 | 2 |
| | 25 | 12 | 23.04 | | 2 |
| | 25 | 25 | 23.02 | | 2 |
| | 50 | 0 | 22.91 | | 2 |
| 64QAM | 1 | 0 | 23.00 | 0-2 | 2 |
| | 1 | 25 | 23.01 | | 2 |
| | 1 | 49 | 23.13 | | 2 |
| | 25 | 0 | 22.06 | 0-3 | 3 |
| | 25 | 12 | 22.07 | | 3 |
| | 25 | 25 | 21.98 | | 3 |
| | 50 | 0 | 22.09 | | 3 |




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**Table 8-7**
**LTE Band 13 (780.0MHz) Conducted Powers – 5MHz Bandwidth**

| LTE Band 13 5 MHz Bandwidth | | | | | |
|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Mid Channel 23230 (782.0 MHz) Conducted Power [dBm] | MPR Allowed per 3GPP [dB] | MPR [dB] |
| QPSK | 1 | 0 | 25.29 | 0 | 0 |
| | 1 | 12 | 25.39 | | 0 |
| | 1 | 24 | 24.99 | | 0 |
| | 12 | 0 | 24.24 | 0-1 | 1 |
| | 12 | 6 | 24.46 | | 1 |
| | 12 | 13 | 24.32 | | 1 |
| | 25 | 0 | 24.30 | | 1 |
| 16QAM | 1 | 0 | 24.39 | 0-1 | 1 |
| | 1 | 12 | 24.31 | | 1 |
| | 1 | 24 | 24.30 | | 1 |
| | 12 | 0 | 23.25 | 0-2 | 2 |
| | 12 | 6 | 23.33 | | 2 |
| | 12 | 13 | 23.37 | | 2 |
| | 25 | 0 | 23.36 | | 2 |
| 64QAM | 1 | 0 | 23.22 | 0-2 | 2 |
| | 1 | 12 | 23.06 | | 2 |
| | 1 | 24 | 23.15 | | 2 |
| | 12 | 0 | 22.13 | 0-3 | 3 |
| | 12 | 6 | 22.06 | | 3 |
| | 12 | 13 | 22.22 | | 3 |
| | 25 | 0 | 22.21 | | 3 |

Note: Since LTE Band 13 at 5MHz bandwidth does not support 3 non-overlapping channels, conducted power measurements were made only on the middle channel.

## c. LTE Band 5

**Table 8-8**
**LTE Band 5 (836.5MHz) Conducted Powers – 10MHz Bandwidth**

| LTE Band 5 (Cell) 10 MHz Bandwidth | | | | | |
|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Mid Channel 20525 (836.5 MHz) Conducted Power [dBm] | MPR Allowed per 3GPP [dB] | MPR [dB] |
| QPSK | 1 | 0 | 25.34 | 0 | 0 |
| | 1 | 25 | 24.93 | | 0 |
| | 1 | 49 | 25.19 | | 0 |
| | 25 | 0 | 24.28 | 0-1 | 1 |
| | 25 | 12 | 24.17 | | 1 |
| | 25 | 25 | 24.15 | | 1 |
| | 50 | 0 | 24.26 | | 1 |
| 16QAM | 1 | 0 | 24.11 | 0-1 | 1 |
| | 1 | 25 | 24.33 | | 1 |
| | 1 | 49 | 24.20 | | 1 |
| | 25 | 0 | 23.27 | 0-2 | 2 |
| | 25 | 12 | 23.11 | | 2 |
| | 25 | 25 | 23.18 | | 2 |
| | 50 | 0 | 23.19 | | 2 |
| 64QAM | 1 | 0 | 23.03 | 0-2 | 2 |
| | 1 | 25 | 23.23 | | 2 |
| | 1 | 49 | 23.10 | | 2 |
| | 25 | 0 | 22.25 | 0-3 | 3 |
| | 25 | 12 | 22.09 | | 3 |
| | 25 | 25 | 22.06 | | 3 |
| | 50 | 0 | 22.16 | | 3 |

Note: Since LTE Band 5 at 10MHz bandwidth does not support 3 non-overlapping channels, conducted power measurements were made only on the middle channel.




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## Table 8-9
## LTE Band 5 (836.5MHz) Conducted Powers – 5MHz Bandwidth

| LTE Band 5 (Cell) 5 MHz Bandwidth | | | | | | | |
|---|---|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Low Channel 20425 (826.5 MHz) | Mid Channel 20525 (836.5 MHz) | High Channel 20625 (846.5 MHz) | MPR Allowed per 3GPP [dB] | MPR [dB] |
| | | | Conducted Power [dBm] | | | | |
| QPSK | 1 | 0 | 25.24 | 25.27 | 25.09 | 0 | 0 |
| | 1 | 12 | 25.18 | 25.09 | 24.97 | | 0 |
| | 1 | 24 | 25.21 | 25.14 | 25.10 | | 0 |
| | 12 | 0 | 24.25 | 24.16 | 24.10 | 0-1 | 1 |
| | 12 | 6 | 24.28 | 24.13 | 24.21 | | 1 |
| | 12 | 13 | 24.18 | 24.12 | 24.25 | | 1 |
| | 25 | 0 | 24.25 | 24.08 | 24.17 | | 1 |
| 16QAM | 1 | 0 | 24.15 | 24.21 | 24.15 | 0-1 | 1 |
| | 1 | 12 | 24.09 | 24.37 | 23.89 | | 1 |
| | 1 | 24 | 24.15 | 24.22 | 24.05 | | 1 |
| | 12 | 0 | 23.31 | 23.20 | 23.30 | 0-2 | 2 |
| | 12 | 6 | 23.34 | 23.15 | 23.24 | | 2 |
| | 12 | 13 | 23.27 | 23.16 | 23.35 | | 2 |
| | 25 | 0 | 23.22 | 23.12 | 23.20 | | 2 |
| 64QAM | 1 | 0 | 23.03 | 23.07 | 23.03 | 0-2 | 2 |
| | 1 | 12 | 23.09 | 23.26 | 22.87 | | 2 |
| | 1 | 24 | 23.02 | 23.11 | 22.96 | | 2 |
| | 12 | 0 | 22.17 | 22.10 | 22.29 | 0-3 | 3 |
| | 12 | 6 | 22.32 | 22.02 | 22.12 | | 3 |
| | 12 | 13 | 22.19 | 22.11 | 22.35 | | 3 |
| | 25 | 0 | 22.16 | 22.11 | 22.12 | | 3 |

## Table 8-10
## LTE Band 5 (836.5MHz) Conducted Powers – 3MHz Bandwidth

| LTE Band 5 (Cell) 3 MHz Bandwidth | | | | | | | |
|---|---|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Low Channel 20415 (825.5 MHz) | Mid Channel 20525 (836.5 MHz) | High Channel 20635 (847.5 MHz) | MPR Allowed per 3GPP [dB] | MPR [dB] |
| | | | Conducted Power [dBm] | | | | |
| QPSK | 1 | 0 | 25.01 | 25.12 | 25.15 | 0 | 0 |
| | 1 | 7 | 25.07 | 25.13 | 25.10 | | 0 |
| | 1 | 14 | 25.01 | 25.07 | 25.10 | | 0 |
| | 8 | 0 | 24.16 | 24.13 | 24.06 | 0-1 | 1 |
| | 8 | 4 | 24.22 | 24.13 | 24.22 | | 1 |
| | 8 | 7 | 24.09 | 24.07 | 24.16 | | 1 |
| | 15 | 0 | 24.22 | 24.15 | 24.20 | | 1 |
| 16QAM | 1 | 0 | 24.05 | 24.05 | 24.25 | 0-1 | 1 |
| | 1 | 7 | 24.29 | 24.19 | 24.19 | | 1 |
| | 1 | 14 | 23.85 | 23.75 | 24.15 | | 1 |
| | 8 | 0 | 23.27 | 23.19 | 23.09 | 0-2 | 2 |
| | 8 | 4 | 23.26 | 23.09 | 23.21 | | 2 |
| | 8 | 7 | 23.21 | 23.10 | 23.20 | | 2 |
| | 15 | 0 | 23.19 | 23.07 | 23.09 | | 2 |
| 64QAM | 1 | 0 | 23.05 | 23.03 | 23.21 | 0-2 | 2 |
| | 1 | 7 | 23.18 | 23.08 | 23.10 | | 2 |
| | 1 | 14 | 22.81 | 22.64 | 23.11 | | 2 |
| | 8 | 0 | 22.23 | 22.16 | 21.95 | 0-3 | 3 |
| | 8 | 4 | 22.15 | 22.03 | 22.11 | | 3 |
| | 8 | 7 | 22.09 | 22.02 | 22.11 | | 3 |
| | 15 | 0 | 22.14 | 22.00 | 22.02 | | 3 |




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## Table 8-11
## LTE Band 5 (836.5MHz) Conducted Powers – 1.4MHz Bandwidth

| LTE Band 5 (Cell) 1.4 MHz Bandwidth | | | | | | | |
|---|---|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Low Channel 20407 (824.7 MHz) | Mid Channel 20525 (836.5 MHz) | High Channel 20643 (848.3 MHz) | MPR Allowed per 3GPP [dB] | MPR [dB] |
| | | | Conducted Power [dBm] | | | | |
| QPSK | 1 | 0 | 25.01 | 24.98 | 25.04 | 0 | 0 |
| | 1 | 2 | 25.06 | 25.02 | 25.06 | | 0 |
| | 1 | 5 | 25.00 | 25.05 | 25.05 | | 0 |
| | 3 | 0 | 25.21 | 24.98 | 25.10 | | 0 |
| | 3 | 2 | 25.22 | 25.06 | 25.25 | | 0 |
| | 3 | 3 | 25.10 | 24.97 | 25.16 | | 0 |
| | 6 | 0 | 24.17 | 24.06 | 24.09 | 0-1 | 1 |
| 16QAM | 1 | 0 | 24.28 | 24.30 | 24.15 | 0-1 | 1 |
| | 1 | 2 | 24.21 | 24.09 | 24.19 | | 1 |
| | 1 | 5 | 24.27 | 24.31 | 24.25 | | 1 |
| | 3 | 0 | 24.38 | 24.15 | 24.19 | | 1 |
| | 3 | 2 | 24.30 | 24.16 | 24.17 | | 1 |
| | 3 | 3 | 24.26 | 24.13 | 24.15 | | 1 |
| | 6 | 0 | 23.10 | 23.18 | 23.01 | 0-2 | 2 |
| 64QAM | 1 | 0 | 23.23 | 23.18 | 23.09 | 0-2 | 2 |
| | 1 | 2 | 23.19 | 23.05 | 23.14 | | 2 |
| | 1 | 5 | 23.24 | 23.19 | 23.23 | | 2 |
| | 3 | 0 | 23.29 | 23.15 | 23.11 | | 2 |
| | 3 | 2 | 23.27 | 23.08 | 23.07 | | 2 |
| | 3 | 3 | 23.13 | 23.01 | 23.13 | | 2 |
| | 6 | 0 | 22.08 | 22.07 | 21.97 | 0-3 | 3 |

## d. LTE Band 26

## Table 8-12
## LTE Band 26 (836.5MHz) Conducted Powers – 15MHz Bandwidth

| LTE Band 26 (Cell) 15 MHz Bandwidth | | | | | |
|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Mid Channel 26865 (831.5 MHz) Conducted Power [dBm] | MPR Allowed per 3GPP [dB] | MPR [dB] |
| QPSK | 1 | 0 | 24.99 | 0 | 0 |
| | 1 | 36 | 25.06 | | 0 |
| | 1 | 74 | 24.99 | | 0 |
| | 36 | 0 | 23.99 | 0-1 | 1 |
| | 36 | 18 | 24.02 | | 1 |
| | 36 | 37 | 24.12 | | 1 |
| | 75 | 0 | 24.11 | | 1 |
| 16QAM | 1 | 0 | 24.00 | 0-1 | 1 |
| | 1 | 36 | 24.01 | | 1 |
| | 1 | 74 | 24.02 | | 1 |
| | 36 | 0 | 22.99 | 0-2 | 2 |
| | 36 | 18 | 22.92 | | 2 |
| | 36 | 37 | 22.88 | | 2 |
| | 75 | 0 | 23.01 | | 2 |
| 64QAM | 1 | 0 | 23.00 | 0-2 | 2 |
| | 1 | 36 | 22.96 | | 2 |
| | 1 | 74 | 23.12 | | 2 |
| | 36 | 0 | 21.98 | 0-3 | 3 |
| | 36 | 18 | 22.06 | | 3 |
| | 36 | 37 | 21.98 | | 3 |
| | 75 | 0 | 22.03 | | 3 |

Note: Since LTE Band 26 at 15MHz bandwidth does not support 3 non-overlapping channels, conducted power measurements were made only on the middle channel.



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## Table 8-13
## LTE Band 26 (831.5MHz) Conducted Powers – 10MHz Bandwidth

| LTE Band 26 (Cell) 10 MHz Bandwidth | | | | | | | |
|---|---|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Low Channel 26740 (819.0 MHz) | Mid Channel 26865 (831.5 MHz) | High Channel 26990 (844.0 MHz) | MPR Allowed per 3GPP [dB] | MPR [dB] |
| | | | Conducted Power [dBm] | | | | |
| QPSK | 1 | 0 | 24.97 | 25.17 | 25.06 | 0 | 0 |
| | 1 | 25 | 24.93 | 25.22 | 25.16 | | 0 |
| | 1 | 49 | 24.85 | 24.87 | 24.80 | | 0 |
| | 25 | 0 | 24.16 | 24.26 | 24.33 | 0-1 | 1 |
| | 25 | 12 | 23.99 | 24.09 | 24.26 | | 1 |
| | 25 | 25 | 24.08 | 24.08 | 24.27 | | 1 |
| | 50 | 0 | 23.95 | 24.17 | 24.19 | | 1 |
| 16QAM | 1 | 0 | 24.42 | 24.46 | 24.46 | 0-1 | 1 |
| | 1 | 25 | 24.21 | 24.36 | 24.44 | | 1 |
| | 1 | 49 | 24.27 | 24.43 | 24.00 | | 1 |
| | 25 | 0 | 23.10 | 23.22 | 23.28 | 0-2 | 2 |
| | 25 | 12 | 23.13 | 23.29 | 23.35 | | 2 |
| | 25 | 25 | 23.02 | 23.16 | 23.27 | | 2 |
| | 50 | 0 | 23.13 | 23.28 | 23.26 | | 2 |
| 64QAM | 1 | 0 | 23.36 | 23.40 | 23.42 | 0-2 | 2 |
| | 1 | 25 | 23.19 | 23.32 | 23.31 | | 2 |
| | 1 | 49 | 23.14 | 23.32 | 22.86 | | 2 |
| | 25 | 0 | 22.07 | 22.22 | 22.16 | 0-3 | 3 |
| | 25 | 12 | 22.05 | 22.16 | 22.22 | | 3 |
| | 25 | 25 | 21.90 | 22.13 | 22.23 | | 3 |
| | 50 | 0 | 22.01 | 22.22 | 22.17 | | 3 |

## Table 8-14
## LTE Band 26 (831.5MHz) Conducted Powers – 5MHz Bandwidth

| LTE Band 26 (Cell) 5 MHz Bandwidth | | | | | | | |
|---|---|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Low Channel 26715 (816.5 MHz) | Mid Channel 26865 (831.5 MHz) | High Channel 27015 (846.5 MHz) | MPR Allowed per 3GPP [dB] | MPR [dB] |
| | | | Conducted Power [dBm] | | | | |
| QPSK | 1 | 0 | 25.10 | 25.17 | 25.01 | 0 | 0 |
| | 1 | 12 | 25.21 | 25.22 | 25.00 | | 0 |
| | 1 | 24 | 25.00 | 25.06 | 24.76 | | 0 |
| | 12 | 0 | 24.30 | 24.29 | 24.25 | 0-1 | 1 |
| | 12 | 6 | 24.25 | 24.23 | 24.20 | | 1 |
| | 12 | 13 | 24.21 | 24.17 | 23.97 | | 1 |
| | 25 | 0 | 24.07 | 24.13 | 24.13 | | 1 |
| 16QAM | 1 | 0 | 24.45 | 24.43 | 24.44 | 0-1 | 1 |
| | 1 | 12 | 24.36 | 24.43 | 24.35 | | 1 |
| | 1 | 24 | 24.46 | 24.36 | 23.89 | | 1 |
| | 12 | 0 | 23.29 | 23.24 | 23.31 | 0-2 | 2 |
| | 12 | 6 | 23.32 | 23.27 | 23.38 | | 2 |
| | 12 | 13 | 23.16 | 23.08 | 23.09 | | 2 |
| | 25 | 0 | 23.28 | 23.23 | 23.27 | | 2 |
| 64QAM | 1 | 0 | 23.41 | 23.42 | 23.34 | 0-2 | 2 |
| | 1 | 12 | 23.31 | 23.29 | 23.34 | | 2 |
| | 1 | 24 | 23.38 | 23.22 | 22.76 | | 2 |
| | 12 | 0 | 22.17 | 22.20 | 22.30 | 0-3 | 3 |
| | 12 | 6 | 22.27 | 22.13 | 22.32 | | 3 |
| | 12 | 13 | 22.05 | 22.01 | 21.96 | | 3 |
| | 25 | 0 | 22.15 | 22.09 | 22.18 | | 3 |



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## Table 8-15
## LTE Band 26 (831.5MHz) Conducted Powers – 3MHz Bandwidth

| LTE Band 26 (Cell) 3 MHz Bandwidth | | | | | | | |
|---|---|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Low Channel 26705 (815.5 MHz) | Mid Channel 26865 (831.5 MHz) | High Channel 27025 (847.5 MHz) | MPR Allowed per 3GPP [dB] | MPR [dB] |
| | | | Conducted Power [dBm] | | | | |
| QPSK | 1 | 0 | 24.99 | 25.17 | 25.03 | 0 | 0 |
| | 1 | 7 | 25.16 | 25.29 | 24.91 | | 0 |
| | 1 | 14 | 24.99 | 25.01 | 24.82 | | 0 |
| | 8 | 0 | 24.26 | 24.29 | 24.10 | 0-1 | 1 |
| | 8 | 4 | 24.22 | 24.20 | 23.93 | | 1 |
| | 8 | 7 | 24.21 | 24.15 | 23.85 | | 1 |
| | 15 | 0 | 24.17 | 24.19 | 23.99 | | 1 |
| 16QAM | 1 | 0 | 24.41 | 24.33 | 24.50 | 0-1 | 1 |
| | 1 | 7 | 24.47 | 24.39 | 24.32 | | 1 |
| | 1 | 14 | 24.35 | 24.34 | 23.92 | | 1 |
| | 8 | 0 | 23.28 | 23.15 | 23.05 | 0-2 | 2 |
| | 8 | 4 | 23.33 | 23.27 | 23.03 | | 2 |
| | 8 | 7 | 23.22 | 23.08 | 22.84 | | 2 |
| | 15 | 0 | 23.26 | 23.26 | 23.04 | | 2 |
| 64QAM | 1 | 0 | 23.40 | 23.29 | 23.36 | 0-2 | 2 |
| | 1 | 7 | 23.44 | 23.32 | 23.23 | | 2 |
| | 1 | 14 | 23.33 | 23.22 | 22.80 | | 2 |
| | 8 | 0 | 22.24 | 22.03 | 21.98 | 0-3 | 3 |
| | 8 | 4 | 22.25 | 22.15 | 21.95 | | 3 |
| | 8 | 7 | 22.14 | 22.08 | 21.84 | | 3 |
| | 15 | 0 | 22.14 | 22.15 | 21.94 | | 3 |

## Table 8-16
## LTE Band 26 (831.5MHz) Conducted Powers – 1.4MHz Bandwidth

| LTE Band 26 (Cell) 1.4 MHz Bandwidth | | | | | | | |
|---|---|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Low Channel 26697 (814.7 MHz) | Mid Channel 26865 (831.5 MHz) | High Channel 27033 (848.3 MHz) | MPR Allowed per 3GPP [dB] | MPR [dB] |
| | | | Conducted Power [dBm] | | | | |
| QPSK | 1 | 0 | 24.98 | 25.03 | 24.87 | 0 | 0 |
| | 1 | 2 | 25.09 | 25.16 | 24.85 | | 0 |
| | 1 | 5 | 24.97 | 24.91 | 24.53 | | 0 |
| | 3 | 0 | 25.07 | 25.16 | 24.85 | | 0 |
| | 3 | 2 | 25.06 | 25.13 | 24.70 | | 0 |
| | 3 | 3 | 25.05 | 25.16 | 24.69 | | 0 |
| | 6 | 0 | 23.98 | 24.08 | 23.86 | 0-1 | 1 |
| 16QAM | 1 | 0 | 24.24 | 24.43 | 24.37 | 0-1 | 1 |
| | 1 | 2 | 24.29 | 24.40 | 24.27 | | 1 |
| | 1 | 5 | 24.25 | 24.38 | 24.05 | | 1 |
| | 3 | 0 | 24.22 | 24.12 | 23.91 | | 1 |
| | 3 | 2 | 24.30 | 24.26 | 23.92 | | 1 |
| | 3 | 3 | 24.16 | 24.13 | 23.75 | | 1 |
| | 6 | 0 | 23.05 | 23.15 | 22.96 | 0-2 | 2 |
| 64QAM | 1 | 0 | 23.15 | 23.42 | 23.28 | 0-2 | 2 |
| | 1 | 2 | 23.20 | 23.28 | 23.22 | | 2 |
| | 1 | 5 | 23.20 | 23.37 | 23.05 | | 2 |
| | 3 | 0 | 23.11 | 22.98 | 22.84 | | 2 |
| | 3 | 2 | 23.20 | 23.12 | 22.82 | | 2 |
| | 3 | 3 | 23.12 | 23.04 | 22.73 | | 2 |
| | 6 | 0 | 22.02 | 22.13 | 21.93 | 0-3 | 3 |



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## e. LTE Band 66

**Table 8-17**
**LTE Band 66 (1745.0MHz) Conducted Powers – 20MHz Bandwidth**

| LTE Band 66 (AWS) 20 MHz Bandwidth | | | | | | | |
|---|---|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Low Channel 132072 (1720.0 MHz) | Mid Channel 132322 (1745.0 MHz) | High Channel 132572 (1770.0 MHz) | MPR Allowed per 3GPP [dB] | MPR [dB] |
| | | | Conducted Power [dBm] | | | | |
| QPSK | 1 | 0 | 25.07 | 25.11 | 24.96 | 0 | 0 |
| | 1 | 50 | 25.15 | 25.09 | 25.06 | | 0 |
| | 1 | 99 | 25.20 | 25.19 | 25.09 | | 0 |
| | 50 | 0 | 23.98 | 23.97 | 24.03 | 0-1 | 1 |
| | 50 | 25 | 24.04 | 23.97 | 23.96 | | 1 |
| | 50 | 50 | 24.10 | 24.07 | 23.89 | | 1 |
| | 100 | 0 | 24.00 | 24.03 | 23.90 | | 1 |
| 16QAM | 1 | 0 | 24.03 | 23.93 | 24.04 | 0-1 | 1 |
| | 1 | 50 | 24.04 | 23.95 | 23.96 | | 1 |
| | 1 | 99 | 23.96 | 23.93 | 23.95 | | 1 |
| | 50 | 0 | 23.01 | 23.13 | 22.96 | 0-2 | 2 |
| | 50 | 25 | 22.95 | 23.00 | 23.00 | | 2 |
| | 50 | 50 | 23.20 | 22.90 | 23.10 | | 2 |
| | 100 | 0 | 23.16 | 22.95 | 22.98 | | 2 |
| 64QAM | 1 | 0 | 22.93 | 22.91 | 23.07 | 0-2 | 2 |
| | 1 | 50 | 23.13 | 22.96 | 23.07 | | 2 |
| | 1 | 99 | 23.19 | 23.02 | 23.18 | | 2 |
| | 50 | 0 | 22.05 | 22.17 | 22.07 | 0-3 | 3 |
| | 50 | 25 | 22.05 | 22.01 | 21.97 | | 3 |
| | 50 | 50 | 22.19 | 21.93 | 21.88 | | 3 |
| | 100 | 0 | 22.03 | 22.03 | 22.09 | | 3 |

**Table 8-18**
**LTE Band 66 (1745.0MHz) Conducted Powers – 15MHz Bandwidth**

| LTE Band 66 (AWS) 15 MHz Bandwidth | | | | | | | |
|---|---|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Low Channel 132047 (1717.5 MHz) | Mid Channel 132322 (1745.0 MHz) | High Channel 132597 (1772.5 MHz) | MPR Allowed per 3GPP [dB] | MPR [dB] |
| | | | Conducted Power [dBm] | | | | |
| QPSK | 1 | 0 | 25.11 | 24.76 | 24.94 | 0 | 0 |
| | 1 | 36 | 24.80 | 24.52 | 24.57 | | 0 |
| | 1 | 74 | 25.01 | 24.92 | 24.88 | | 0 |
| | 36 | 0 | 23.85 | 23.73 | 23.96 | 0-1 | 1 |
| | 36 | 18 | 23.50 | 23.71 | 23.86 | | 1 |
| | 36 | 37 | 24.09 | 23.95 | 23.98 | | 1 |
| | 75 | 0 | 23.88 | 23.95 | 23.91 | | 1 |
| 16QAM | 1 | 0 | 24.00 | 23.57 | 23.76 | 0-1 | 1 |
| | 1 | 36 | 23.66 | 23.32 | 23.66 | | 1 |
| | 1 | 74 | 23.76 | 23.69 | 23.84 | | 1 |
| | 36 | 0 | 22.25 | 22.75 | 22.83 | 0-2 | 2 |
| | 36 | 18 | 22.51 | 22.74 | 22.93 | | 2 |
| | 36 | 37 | 23.11 | 22.95 | 22.87 | | 2 |
| | 75 | 0 | 22.72 | 22.95 | 22.96 | | 2 |
| 64QAM | 1 | 0 | 22.94 | 22.52 | 22.70 | 0-2 | 2 |
| | 1 | 36 | 22.58 | 22.22 | 22.61 | | 2 |
| | 1 | 74 | 22.63 | 22.64 | 22.76 | | 2 |
| | 36 | 0 | 21.19 | 21.67 | 21.72 | 0-3 | 3 |
| | 36 | 18 | 21.45 | 21.66 | 21.87 | | 3 |
| | 36 | 37 | 22.00 | 21.85 | 21.81 | | 3 |
| | 75 | 0 | 21.66 | 21.84 | 21.93 | | 3 |



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## Table 8-19
## LTE Band 66 (1745.0MHz) Conducted Powers – 10MHz Bandwidth

| LTE Band 66 (AWS) 10 MHz Bandwidth | | | | | | | |
|---|---|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Low Channel 132022 (1715.0 MHz) | Mid Channel 132322 (1745.0 MHz) | High Channel 132622 (1775.0 MHz) | MPR Allowed per 3GPP [dB] | MPR [dB] |
| | | | Conducted Power [dBm] | | | | |
| QPSK | 1 | 0 | 24.99 | 24.80 | 24.88 | 0 | 0 |
| | 1 | 25 | 25.01 | 24.90 | 25.18 | | 0 |
| | 1 | 49 | 25.00 | 25.17 | 25.18 | | 0 |
| | 25 | 0 | 23.42 | 23.87 | 24.10 | 0-1 | 1 |
| | 25 | 12 | 23.68 | 23.98 | 24.15 | | 1 |
| | 25 | 25 | 23.76 | 24.17 | 24.10 | | 1 |
| | 50 | 0 | 23.60 | 23.97 | 24.10 | | 1 |
| 16QAM | 1 | 0 | 23.48 | 23.61 | 24.10 | 0-1 | 1 |
| | 1 | 25 | 23.50 | 23.79 | 23.95 | | 1 |
| | 1 | 49 | 23.70 | 23.91 | 24.07 | | 1 |
| | 25 | 0 | 22.33 | 23.03 | 23.12 | 0-2 | 2 |
| | 25 | 12 | 22.47 | 23.12 | 23.14 | | 2 |
| | 25 | 25 | 22.87 | 23.10 | 23.15 | | 2 |
| | 50 | 0 | 22.87 | 23.07 | 22.98 | | 2 |
| 64QAM | 1 | 0 | 22.39 | 22.58 | 23.07 | 0-2 | 2 |
| | 1 | 25 | 22.45 | 22.76 | 22.85 | | 2 |
| | 1 | 49 | 22.56 | 22.82 | 23.00 | | 2 |
| | 25 | 0 | 21.21 | 22.00 | 22.00 | 0-3 | 3 |
| | 25 | 12 | 21.45 | 22.01 | 22.01 | | 3 |
| | 25 | 25 | 21.73 | 22.03 | 22.03 | | 3 |
| | 50 | 0 | 21.83 | 22.06 | 21.84 | | 3 |

## Table 8-20
## LTE Band 66 (1745.0MHz) Conducted Powers – 5MHz Bandwidth

| LTE Band 66 (AWS) 5 MHz Bandwidth | | | | | | | |
|---|---|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Low Channel 131997 (1712.5 MHz) | Mid Channel 132322 (1745.0 MHz) | High Channel 132647 (1777.5 MHz) | MPR Allowed per 3GPP [dB] | MPR [dB] |
| | | | Conducted Power [dBm] | | | | |
| QPSK | 1 | 0 | 24.80 | 24.83 | 25.09 | 0 | 0 |
| | 1 | 12 | 25.03 | 24.71 | 24.99 | | 0 |
| | 1 | 24 | 24.80 | 24.84 | 25.17 | | 0 |
| | 12 | 0 | 23.59 | 24.02 | 24.11 | 0-1 | 1 |
| | 12 | 6 | 23.69 | 23.90 | 24.12 | | 1 |
| | 12 | 13 | 23.81 | 23.97 | 24.10 | | 1 |
| | 25 | 0 | 23.62 | 24.00 | 23.99 | | 1 |
| 16QAM | 1 | 0 | 23.58 | 24.19 | 23.98 | 0-1 | 1 |
| | 1 | 12 | 23.73 | 24.09 | 24.10 | | 1 |
| | 1 | 24 | 23.75 | 24.02 | 23.93 | | 1 |
| | 12 | 0 | 22.70 | 23.06 | 23.11 | 0-2 | 2 |
| | 12 | 6 | 22.80 | 23.10 | 23.09 | | 2 |
| | 12 | 13 | 22.73 | 23.17 | 23.10 | | 2 |
| | 25 | 0 | 22.72 | 22.90 | 23.10 | | 2 |
| 64QAM | 1 | 0 | 22.44 | 23.14 | 22.88 | 0-2 | 2 |
| | 1 | 12 | 22.73 | 23.03 | 23.00 | | 2 |
| | 1 | 24 | 22.73 | 22.89 | 22.89 | | 2 |
| | 12 | 0 | 21.69 | 21.98 | 22.01 | 0-3 | 3 |
| | 12 | 6 | 21.76 | 21.97 | 22.03 | | 3 |
| | 12 | 13 | 21.69 | 22.04 | 21.98 | | 3 |
| | 25 | 0 | 21.63 | 21.79 | 22.03 | | 3 |




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## Table 8-21
## LTE Band 66 (1745.0MHz) Conducted Powers – 3MHz Bandwidth

| LTE Band 66 (AWS) 3 MHz Bandwidth | | | | | | | |
|---|---|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Low Channel 131987 (1711.5 MHz) | Mid Channel 132322 (1745.0 MHz) | High Channel 132657 (1778.5 MHz) | MPR Allowed per 3GPP [dB] | MPR [dB] |
| | | | Conducted Power [dBm] | | | | |
| QPSK | 1 | 0 | 24.81 | 24.88 | 24.79 | 0 | 0 |
| | 1 | 7 | 24.82 | 24.99 | 24.91 | | 0 |
| | 1 | 14 | 24.74 | 24.71 | 24.90 | | 0 |
| | 8 | 0 | 24.06 | 23.94 | 23.78 | 0-1 | 1 |
| | 8 | 4 | 23.80 | 23.97 | 23.85 | | 1 |
| | 8 | 7 | 23.82 | 23.79 | 24.00 | | 1 |
| | 15 | 0 | 23.90 | 23.85 | 23.92 | | 1 |
| 16QAM | 1 | 0 | 24.10 | 24.13 | 24.07 | 0-1 | 1 |
| | 1 | 7 | 24.18 | 24.10 | 23.91 | | 1 |
| | 1 | 14 | 24.09 | 24.04 | 24.04 | | 1 |
| | 8 | 0 | 22.90 | 22.89 | 22.97 | 0-2 | 2 |
| | 8 | 4 | 22.98 | 22.72 | 23.02 | | 2 |
| | 8 | 7 | 23.01 | 22.88 | 22.86 | | 2 |
| | 15 | 0 | 22.79 | 22.92 | 22.85 | | 2 |
| 64QAM | 1 | 0 | 23.06 | 23.00 | 23.02 | 0-2 | 2 |
| | 1 | 7 | 23.07 | 23.08 | 22.90 | | 2 |
| | 1 | 14 | 23.07 | 23.03 | 22.98 | | 2 |
| | 8 | 0 | 21.76 | 21.84 | 21.88 | 0-3 | 3 |
| | 8 | 4 | 21.96 | 21.67 | 21.93 | | 3 |
| | 8 | 7 | 21.97 | 21.83 | 21.77 | | 3 |
| | 15 | 0 | 21.77 | 21.91 | 21.78 | | 3 |

## Table 8-22
## LTE Band 66 (1745.0MHz) Conducted Powers – 1.4MHz Bandwidth

| LTE Band 66 (AWS) 1.4 MHz Bandwidth | | | | | | | |
|---|---|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Low Channel 131979 (1710.7 MHz) | Mid Channel 132322 (1745.0 MHz) | High Channel 132665 (1779.3 MHz) | MPR Allowed per 3GPP [dB] | MPR [dB] |
| | | | Conducted Power [dBm] | | | | |
| QPSK | 1 | 0 | 24.75 | 24.73 | 24.85 | 0 | 0 |
| | 1 | 2 | 24.87 | 24.77 | 24.78 | | 0 |
| | 1 | 5 | 24.90 | 24.81 | 24.91 | | 0 |
| | 3 | 0 | 24.79 | 24.68 | 24.87 | | 0 |
| | 3 | 2 | 24.81 | 24.73 | 24.80 | | 0 |
| | 3 | 3 | 24.68 | 24.85 | 24.75 | | 0 |
| | 6 | 0 | 23.86 | 23.66 | 23.89 | 0-1 | 1 |
| 16QAM | 1 | 0 | 24.09 | 24.13 | 23.84 | 0-1 | 1 |
| | 1 | 2 | 24.03 | 24.09 | 24.11 | | 1 |
| | 1 | 5 | 23.96 | 23.90 | 24.01 | | 1 |
| | 3 | 0 | 23.91 | 23.74 | 23.88 | | 1 |
| | 3 | 2 | 23.83 | 23.92 | 23.98 | | 1 |
| | 3 | 3 | 23.85 | 23.68 | 23.97 | | 1 |
| | 6 | 0 | 22.80 | 22.78 | 22.68 | 0-2 | 2 |
| 64QAM | 1 | 0 | 22.97 | 23.07 | 22.81 | 0-2 | 2 |
| | 1 | 2 | 22.97 | 23.07 | 23.05 | | 2 |
| | 1 | 5 | 22.88 | 22.88 | 22.88 | | 2 |
| | 3 | 0 | 22.84 | 22.67 | 22.79 | | 2 |
| | 3 | 2 | 22.78 | 22.88 | 22.87 | | 2 |
| | 3 | 3 | 22.80 | 22.55 | 22.89 | | 2 |
| | 6 | 0 | 21.72 | 21.74 | 21.67 | 0-3 | 3 |



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## f. LTE Band 25

**Table 8-23**
**LTE Band 25 (1882.5MHz) Conducted Powers – 20MHz Bandwidth**

| LTE Band 25 (PCS) 20 MHz Bandwidth | | | | | | | |
|---|---|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Low Channel 26140 (1860.0 MHz) | Mid Channel 26365 (1882.5 MHz) | High Channel 26590 (1905.0 MHz) | MPR Allowed per 3GPP [dB] | MPR [dB] |
| | | | Conducted Power [dBm] | | | | |
| QPSK | 1 | 0 | 25.00 | 25.12 | 25.14 | 0 | 0 |
| | 1 | 50 | 25.11 | 25.13 | 25.24 | | 0 |
| | 1 | 99 | 25.33 | 25.18 | 25.08 | | 0 |
| | 50 | 0 | 24.26 | 24.25 | 23.95 | 0-1 | 1 |
| | 50 | 25 | 24.00 | 24.19 | 24.22 | | 1 |
| | 50 | 50 | 24.04 | 24.13 | 24.13 | | 1 |
| | 100 | 0 | 24.06 | 24.16 | 24.22 | | 1 |
| 16QAM | 1 | 0 | 24.15 | 24.05 | 24.13 | 0-1 | 1 |
| | 1 | 50 | 24.16 | 24.27 | 24.16 | | 1 |
| | 1 | 99 | 23.92 | 24.31 | 24.14 | | 1 |
| | 50 | 0 | 23.18 | 23.06 | 23.24 | 0-2 | 2 |
| | 50 | 25 | 23.15 | 23.28 | 23.20 | | 2 |
| | 50 | 50 | 23.14 | 23.10 | 23.18 | | 2 |
| | 100 | 0 | 23.01 | 23.07 | 23.11 | | 2 |
| 64QAM | 1 | 0 | 23.30 | 23.16 | 23.17 | 0-2 | 2 |
| | 1 | 50 | 23.02 | 23.12 | 23.22 | | 2 |
| | 1 | 99 | 23.30 | 23.15 | 23.13 | | 2 |
| | 50 | 0 | 22.32 | 22.24 | 21.89 | 0-3 | 3 |
| | 50 | 25 | 22.06 | 22.33 | 22.10 | | 3 |
| | 50 | 50 | 22.21 | 22.23 | 22.29 | | 3 |
| | 100 | 0 | 22.02 | 22.22 | 22.24 | | 3 |

**Table 8-24**
**LTE Band 25 (1882.5MHz) Conducted Powers – 15MHz Bandwidth**

| LTE Band 25 (PCS) 15 MHz Bandwidth | | | | | | | |
|---|---|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Low Channel 26115 (1857.5 MHz) | Mid Channel 26365 (1882.5 MHz) | High Channel 26615 (1907.5 MHz) | MPR Allowed per 3GPP [dB] | MPR [dB] |
| | | | Conducted Power [dBm] | | | | |
| QPSK | 1 | 0 | 25.17 | 25.32 | 24.98 | 0 | 0 |
| | 1 | 36 | 24.84 | 24.93 | 24.68 | | 0 |
| | 1 | 74 | 25.03 | 24.96 | 24.91 | | 0 |
| | 36 | 0 | 23.94 | 24.27 | 23.74 | 0-1 | 1 |
| | 36 | 18 | 23.81 | 24.10 | 24.01 | | 1 |
| | 36 | 37 | 23.85 | 24.13 | 24.09 | | 1 |
| | 75 | 0 | 23.80 | 24.14 | 23.86 | | 1 |
| 16QAM | 1 | 0 | 24.33 | 24.31 | 24.24 | 0-1 | 1 |
| | 1 | 36 | 23.97 | 24.25 | 23.84 | | 1 |
| | 1 | 74 | 24.26 | 24.41 | 23.88 | | 1 |
| | 36 | 0 | 23.05 | 23.29 | 22.78 | 0-2 | 2 |
| | 36 | 18 | 22.94 | 23.23 | 23.10 | | 2 |
| | 36 | 37 | 22.84 | 23.13 | 23.30 | | 2 |
| | 75 | 0 | 22.96 | 23.27 | 22.99 | | 2 |
| 64QAM | 1 | 0 | 23.19 | 23.28 | 23.17 | 0-2 | 2 |
| | 1 | 36 | 22.93 | 23.14 | 22.78 | | 2 |
| | 1 | 74 | 23.18 | 23.31 | 22.79 | | 2 |
| | 36 | 0 | 21.94 | 22.18 | 21.65 | 0-3 | 3 |
| | 36 | 18 | 21.87 | 22.17 | 22.08 | | 3 |
| | 36 | 37 | 21.71 | 22.09 | 22.18 | | 3 |
| | 75 | 0 | 21.87 | 22.15 | 21.92 | | 3 |



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## Table 8-25
## LTE Band 25 (1882.5MHz) Conducted Powers – 10MHz Bandwidth

| LTE Band 25 (PCS) 10 MHz Bandwidth | | | | | | | |
|---|---|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Low Channel 26090 (1855.0 MHz) | Mid Channel 26365 (1882.5 MHz) | High Channel 26640 (1910.0 MHz) | MPR Allowed per 3GPP [dB] | MPR [dB] |
| | | | Conducted Power [dBm] | | | | |
| QPSK | 1 | 0 | 25.39 | 25.34 | 24.81 | 0 | 0 |
| | 1 | 25 | 25.15 | 25.16 | 25.22 | | 0 |
| | 1 | 49 | 24.95 | 25.06 | 24.99 | | 0 |
| | 25 | 0 | 24.34 | 24.31 | 24.04 | 0-1 | 1 |
| | 25 | 12 | 24.07 | 24.15 | 24.35 | | 1 |
| | 25 | 25 | 24.00 | 24.17 | 24.16 | | 1 |
| | 50 | 0 | 23.94 | 24.10 | 23.95 | | 1 |
| 16QAM | 1 | 0 | 24.31 | 24.50 | 23.78 | 0-1 | 1 |
| | 1 | 25 | 24.08 | 24.23 | 24.22 | | 1 |
| | 1 | 49 | 23.91 | 24.26 | 23.80 | | 1 |
| | 25 | 0 | 23.26 | 23.30 | 23.01 | 0-2 | 2 |
| | 25 | 12 | 23.14 | 23.31 | 23.41 | | 2 |
| | 25 | 25 | 22.97 | 23.19 | 23.28 | | 2 |
| | 50 | 0 | 23.11 | 23.26 | 23.14 | | 2 |
| 64QAM | 1 | 0 | 23.28 | 23.47 | 22.65 | 0-2 | 2 |
| | 1 | 25 | 23.05 | 23.17 | 23.20 | | 2 |
| | 1 | 49 | 22.87 | 23.13 | 22.74 | | 2 |
| | 25 | 0 | 22.20 | 22.23 | 21.95 | 0-3 | 3 |
| | 25 | 12 | 22.01 | 22.26 | 22.35 | | 3 |
| | 25 | 25 | 21.84 | 22.18 | 22.26 | | 3 |
| | 50 | 0 | 21.99 | 22.16 | 22.08 | | 3 |

## Table 8-26
## LTE Band 25 (1882.5MHz) Conducted Powers – 5MHz Bandwidth

| LTE Band 25 (PCS) 5 MHz Bandwidth | | | | | | | |
|---|---|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Low Channel 26065 (1852.5 MHz) | Mid Channel 26365 (1882.5 MHz) | High Channel 26665 (1912.5 MHz) | MPR Allowed per 3GPP [dB] | MPR [dB] |
| | | | Conducted Power [dBm] | | | | |
| QPSK | 1 | 0 | 25.32 | 25.23 | 25.44 | 0 | 0 |
| | 1 | 12 | 25.33 | 25.40 | 25.16 | | 0 |
| | 1 | 24 | 25.39 | 25.31 | 24.87 | | 0 |
| | 12 | 0 | 24.48 | 24.42 | 24.44 | 0-1 | 1 |
| | 12 | 6 | 24.47 | 24.42 | 24.11 | | 1 |
| | 12 | 13 | 24.32 | 24.33 | 23.87 | | 1 |
| | 25 | 0 | 24.36 | 24.35 | 24.39 | | 1 |
| 16QAM | 1 | 0 | 24.31 | 24.35 | 24.12 | 0-1 | 1 |
| | 1 | 12 | 24.35 | 24.31 | 24.11 | | 1 |
| | 1 | 24 | 24.35 | 24.45 | 23.90 | | 1 |
| | 12 | 0 | 23.38 | 23.50 | 23.22 | 0-2 | 2 |
| | 12 | 6 | 23.31 | 23.44 | 23.21 | | 2 |
| | 12 | 13 | 23.39 | 23.35 | 23.19 | | 2 |
| | 25 | 0 | 23.39 | 23.49 | 23.22 | | 2 |
| 64QAM | 1 | 0 | 23.26 | 23.32 | 23.05 | 0-2 | 2 |
| | 1 | 12 | 23.28 | 23.29 | 23.01 | | 2 |
| | 1 | 24 | 23.22 | 23.38 | 22.90 | | 2 |
| | 12 | 0 | 22.31 | 22.39 | 22.20 | 0-3 | 3 |
| | 12 | 6 | 22.27 | 22.31 | 22.10 | | 3 |
| | 12 | 13 | 22.35 | 22.23 | 22.14 | | 3 |
| | 25 | 0 | 22.30 | 22.35 | 22.18 | | 3 |



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## Table 8-27
## LTE Band 25 (1882.5MHz) Conducted Powers – 3MHz Bandwidth

| LTE Band 25 (PCS) 3 MHz Bandwidth | | | | | | | |
|---|---|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Low Channel 26055 (1851.5 MHz) | Mid Channel 26365 (1882.5 MHz) | High Channel 26675 (1913.5 MHz) | MPR Allowed per 3GPP [dB] | MPR [dB] |
| | | | Conducted Power [dBm] | | | | |
| QPSK | 1 | 0 | 25.18 | 25.20 | 25.19 | 0 | 0 |
| | 1 | 7 | 25.22 | 25.21 | 24.61 | | 0 |
| | 1 | 14 | 25.07 | 25.00 | 24.85 | | 0 |
| | 8 | 0 | 24.28 | 24.23 | 24.18 | 0-1 | 1 |
| | 8 | 4 | 24.26 | 24.10 | 23.76 | | 1 |
| | 8 | 7 | 24.23 | 24.11 | 23.52 | | 1 |
| | 15 | 0 | 24.22 | 24.32 | 23.82 | | 1 |
| 16QAM | 1 | 0 | 24.34 | 24.34 | 24.22 | 0-1 | 1 |
| | 1 | 7 | 24.49 | 24.32 | 24.02 | | 1 |
| | 1 | 14 | 24.32 | 24.45 | 23.80 | | 1 |
| | 8 | 0 | 23.30 | 23.17 | 23.19 | 0-2 | 2 |
| | 8 | 4 | 23.45 | 23.21 | 22.98 | | 2 |
| | 8 | 7 | 23.25 | 23.20 | 22.64 | | 2 |
| | 15 | 0 | 23.33 | 23.29 | 23.06 | | 2 |
| 64QAM | 1 | 0 | 23.30 | 23.24 | 23.16 | 0-2 | 2 |
| | 1 | 7 | 23.43 | 23.29 | 22.90 | | 2 |
| | 1 | 14 | 23.21 | 23.33 | 22.77 | | 2 |
| | 8 | 0 | 22.20 | 22.13 | 22.13 | 0-3 | 3 |
| | 8 | 4 | 22.33 | 22.12 | 21.91 | | 3 |
| | 8 | 7 | 22.18 | 22.18 | 21.60 | | 3 |
| | 15 | 0 | 22.20 | 22.29 | 21.94 | | 3 |

## Table 8-28
## LTE Band 25 (1882.5MHz) Conducted Powers – 1.4MHz Bandwidth

| LTE Band 25 (PCS) 1.4 MHz Bandwidth | | | | | | | |
|---|---|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Low Channel 26047 (1850.7 MHz) | Mid Channel 26365 (1882.5 MHz) | High Channel 26683 (1914.3 MHz) | MPR Allowed per 3GPP [dB] | MPR [dB] |
| | | | Conducted Power [dBm] | | | | |
| QPSK | 1 | 0 | 25.12 | 25.07 | 25.40 | 0 | 0 |
| | 1 | 2 | 25.21 | 25.15 | 25.34 | | 0 |
| | 1 | 5 | 25.04 | 25.04 | 24.88 | | 0 |
| | 3 | 0 | 25.32 | 25.15 | 25.38 | | 0 |
| | 3 | 2 | 25.22 | 25.10 | 25.06 | | 0 |
| | 3 | 3 | 25.27 | 25.09 | 25.13 | | 0 |
| | 6 | 0 | 24.21 | 24.08 | 24.28 | 0-1 | 1 |
| 16QAM | 1 | 0 | 24.44 | 24.31 | 24.31 | 0-1 | 1 |
| | 1 | 2 | 24.43 | 24.30 | 24.40 | | 1 |
| | 1 | 5 | 24.36 | 24.26 | 24.29 | | 1 |
| | 3 | 0 | 24.41 | 24.08 | 24.41 | | 1 |
| | 3 | 2 | 24.46 | 24.18 | 24.45 | | 1 |
| | 3 | 3 | 24.34 | 24.06 | 24.16 | | 1 |
| | 6 | 0 | 23.21 | 23.36 | 23.34 | 0-2 | 2 |
| 64QAM | 1 | 0 | 23.31 | 23.23 | 23.18 | 0-2 | 2 |
| | 1 | 2 | 23.40 | 23.25 | 23.26 | | 2 |
| | 1 | 5 | 23.25 | 23.12 | 23.24 | | 2 |
| | 3 | 0 | 23.28 | 22.97 | 23.33 | | 2 |
| | 3 | 2 | 23.36 | 23.05 | 23.39 | | 2 |
| | 3 | 3 | 23.27 | 23.05 | 23.05 | | 2 |
| | 6 | 0 | 22.14 | 22.27 | 22.20 | 0-3 | 3 |




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## g. LTE FDD Uplink Carrier Aggregation

**Table 8-29**
**LTE FDD Uplink Two Component Carrier Aggregation Conducted Powers**

| Combination | PCC | | | | | | | SCC | | | | | | | Power |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PCC Band | PCC Bandwidth [MHz] | PCC (UL/DL) Channel | PCC (UL/DL) Frequency [MHz] | Modulation | PCC UL# RB | PCC UL RB Offset | SCC Band | SCC Bandwidth [MHz] | SCC (UL/DL) Channel | SCC (UL/DL) Frequency [MHz] | Modulation | SCC UL# RB | SCC UL RB Offset | LTE Tx.Power with UL CA Enabled |
| CA_5B | LTE B5 | 10 | 20525 | 836.5 | 16QAM | 1 | 0 | LTE B5 | 5MHz | 20453 | 874.3 | 16QAM | 1 | 24 | 24.52 |

## h. LTE Band 41 – Power Class 3

**Table 8-30**
**LTE Band 41 (2593.0MHz) Conducted Powers – 20MHz Bandwidth**

| LTE Band 41 20 MHz Bandwidth | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Low Channel 39750 (2506.0 MHz) | Low-Mid Channel 40185 (2549.5 MHz) | Mid Channel 40620 (2593.0 MHz) | Mid-High Channel 41055 (2636.5 MHz) | High Channel 41490 (2680.0 MHz) | MPR Allowed per 3GPP [dB] | MPR [dB] |
| | | | Conducted Power [dBm] | | | | | | |
| QPSK | 1 | 0 | 24.97 | 24.87 | 24.90 | 25.09 | 25.03 | 0 | 0 |
| | 1 | 50 | 24.87 | 25.00 | 25.08 | 25.08 | 24.98 | | 0 |
| | 1 | 99 | 25.08 | 24.87 | 25.01 | 24.95 | 24.95 | | 0 |
| | 50 | 0 | 23.90 | 23.86 | 23.96 | 23.96 | 24.00 | 0-1 | 1 |
| | 50 | 25 | 24.06 | 23.93 | 23.92 | 23.92 | 23.93 | | 1 |
| | 50 | 50 | 24.00 | 23.91 | 24.07 | 24.09 | 24.00 | | 1 |
| | 100 | 0 | 24.06 | 23.88 | 23.97 | 23.95 | 24.08 | | 1 |
| 16QAM | 1 | 0 | 23.99 | 23.95 | 23.92 | 23.92 | 23.90 | 0-1 | 1 |
| | 1 | 50 | 24.04 | 24.08 | 24.09 | 23.90 | 24.03 | | 1 |
| | 1 | 99 | 24.02 | 24.01 | 23.95 | 23.86 | 23.96 | | 1 |
| | 50 | 0 | 23.03 | 23.06 | 23.04 | 22.97 | 22.95 | 0-2 | 2 |
| | 50 | 25 | 22.86 | 22.91 | 22.91 | 22.89 | 22.87 | | 2 |
| | 50 | 50 | 23.03 | 22.92 | 23.03 | 23.08 | 22.90 | | 2 |
| | 100 | 0 | 22.98 | 22.89 | 22.88 | 23.08 | 23.07 | | 2 |
| 64QAM | 1 | 0 | 23.01 | 22.99 | 23.06 | 22.87 | 22.99 | 0-2 | 2 |
| | 1 | 50 | 23.10 | 22.93 | 23.05 | 22.94 | 23.07 | | 2 |
| | 1 | 99 | 23.05 | 23.08 | 22.97 | 23.09 | 22.97 | | 2 |
| | 50 | 0 | 22.00 | 22.01 | 21.92 | 21.97 | 21.90 | 0-3 | 3 |
| | 50 | 25 | 21.92 | 21.97 | 22.00 | 21.99 | 22.08 | | 3 |
| | 50 | 50 | 22.09 | 22.07 | 21.91 | 21.88 | 22.01 | | 3 |
| | 100 | 0 | 21.91 | 22.00 | 21.99 | 21.90 | 21.86 | | 3 |

**Table 8-31**
**LTE Band 41 (2593.0MHz) Conducted Powers – 15MHz Bandwidth**

| LTE Band 41 15 MHz Bandwidth | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Low Channel 39750 (2506.0 MHz) | Low-Mid Channel 40185 (2549.5 MHz) | Mid Channel 40620 (2593.0 MHz) | Mid-High Channel 41055 (2636.5 MHz) | High Channel 41490 (2680.0 MHz) | MPR Allowed per 3GPP [dB] | MPR [dB] |
| | | | Conducted Power [dBm] | | | | | | |
| QPSK | 1 | 0 | 25.13 | 25.10 | 25.11 | 25.08 | 24.98 | 0 | 0 |
| | 1 | 36 | 25.04 | 24.92 | 25.07 | 25.04 | 24.84 | | 0 |
| | 1 | 74 | 24.96 | 24.99 | 24.98 | 24.94 | 24.83 | | 0 |
| | 36 | 0 | 24.09 | 24.09 | 24.09 | 24.03 | 23.93 | 0-1 | 1 |
| | 36 | 18 | 24.06 | 24.00 | 24.03 | 24.08 | 23.83 | | 1 |
| | 36 | 37 | 24.05 | 24.06 | 23.97 | 24.00 | 23.95 | | 1 |
| | 75 | 0 | 24.03 | 24.01 | 24.03 | 23.99 | 23.87 | | 1 |
| 16QAM | 1 | 0 | 24.10 | 24.11 | 24.18 | 24.06 | 23.96 | 0-1 | 1 |
| | 1 | 36 | 23.91 | 24.02 | 24.09 | 24.00 | 23.88 | | 1 |
| | 1 | 74 | 23.85 | 23.93 | 24.10 | 23.88 | 23.85 | | 1 |
| | 36 | 0 | 23.12 | 23.01 | 23.03 | 23.07 | 22.92 | 0-2 | 2 |
| | 36 | 18 | 23.02 | 23.04 | 23.00 | 23.05 | 22.92 | | 2 |
| | 36 | 37 | 22.95 | 22.98 | 23.02 | 22.93 | 22.84 | | 2 |
| | 75 | 0 | 23.10 | 22.98 | 23.05 | 23.05 | 22.84 | | 2 |
| 64QAM | 1 | 0 | 22.97 | 23.07 | 23.11 | 22.95 | 22.84 | 0-2 | 2 |
| | 1 | 36 | 22.80 | 22.95 | 23.04 | 22.93 | 22.86 | | 2 |
| | 1 | 74 | 22.82 | 22.89 | 23.05 | 22.75 | 22.75 | | 2 |
| | 36 | 0 | 21.99 | 21.97 | 22.03 | 21.99 | 21.80 | 0-3 | 3 |
| | 36 | 18 | 21.98 | 21.95 | 21.86 | 22.02 | 21.87 | | 3 |
| | 36 | 37 | 21.89 | 21.91 | 21.96 | 21.84 | 21.76 | | 3 |
| | 75 | 0 | 22.02 | 21.89 | 21.98 | 22.01 | 21.77 | | 3 |



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## Table 8-32
## LTE Band 41 (2593.0MHz) Conducted Powers – 10MHz Bandwidth

| LTE Band 41 10 MHz Bandwidth | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Low Channel | Low-Mid Channel | Mid Channel | Mid-High Channel | High Channel | MPR Allowed per 3GPP [dB] | MPR [dB] |
| | | | 39750 (2506.0 MHz) | 40185 (2549.5 MHz) | 40620 (2593.0 MHz) | 41055 (2636.5 MHz) | 41490 (2680.0 MHz) | | |
| | | | Conducted Power [dBm] | | | | | | |
| QPSK | 1 | 0 | 25.10 | 24.97 | 25.12 | 25.13 | 25.09 | 0 | 0 |
| | 1 | 25 | 24.93 | 24.98 | 25.04 | 24.99 | 24.88 | | 0 |
| | 1 | 49 | 24.94 | 24.94 | 25.04 | 24.95 | 24.85 | | 0 |
| | 25 | 0 | 24.06 | 24.00 | 23.99 | 24.09 | 23.98 | 0-1 | 1 |
| | 25 | 12 | 24.09 | 24.08 | 23.97 | 24.03 | 23.94 | | 1 |
| | 25 | 25 | 23.98 | 23.99 | 24.03 | 23.98 | 24.02 | | 1 |
| | 50 | 0 | 24.08 | 23.97 | 24.03 | 24.07 | 23.99 | | 1 |
| 16QAM | 1 | 0 | 24.04 | 24.10 | 24.09 | 24.02 | 24.09 | 0-1 | 1 |
| | 1 | 25 | 23.91 | 24.02 | 24.15 | 23.92 | 23.84 | | 1 |
| | 1 | 49 | 23.96 | 23.93 | 24.12 | 23.90 | 23.87 | | 1 |
| | 25 | 0 | 23.07 | 23.04 | 23.01 | 23.06 | 23.05 | 0-2 | 2 |
| | 25 | 12 | 23.03 | 22.98 | 23.01 | 23.00 | 22.87 | | 2 |
| | 25 | 25 | 23.03 | 22.97 | 22.99 | 23.01 | 22.95 | | 2 |
| | 50 | 0 | 23.04 | 23.03 | 23.00 | 23.02 | 23.06 | | 2 |
| 64QAM | 1 | 0 | 22.92 | 23.04 | 22.99 | 22.99 | 23.04 | 0-2 | 2 |
| | 1 | 25 | 22.87 | 22.92 | 23.03 | 22.79 | 22.83 | | 2 |
| | 1 | 49 | 22.87 | 22.85 | 23.00 | 22.88 | 22.75 | | 2 |
| | 25 | 0 | 22.00 | 21.94 | 22.00 | 21.95 | 21.95 | 0-3 | 3 |
| | 25 | 12 | 21.90 | 21.91 | 21.87 | 21.96 | 21.87 | | 3 |
| | 25 | 25 | 22.00 | 21.90 | 21.92 | 21.87 | 21.85 | | 3 |
| | 50 | 0 | 21.97 | 21.98 | 21.99 | 22.00 | 21.96 | | 3 |

## Table 8-33
## LTE Band 41 (2593.0MHz) Conducted Powers – 5MHz Bandwidth

| LTE Band 41 5 MHz Bandwidth | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Low Channel | Low-Mid Channel | Mid Channel | Mid-High Channel | High Channel | MPR Allowed per 3GPP [dB] | MPR [dB] |
| | | | 39750 (2506.0 MHz) | 40185 (2549.5 MHz) | 40620 (2593.0 MHz) | 41055 (2636.5 MHz) | 41490 (2680.0 MHz) | | |
| | | | Conducted Power [dBm] | | | | | | |
| QPSK | 1 | 0 | 24.99 | 25.02 | 24.81 | 25.05 | 24.87 | 0 | 0 |
| | 1 | 12 | 24.91 | 24.94 | 24.85 | 25.06 | 24.84 | | 0 |
| | 1 | 24 | 24.95 | 24.89 | 24.81 | 25.02 | 24.80 | | 0 |
| | 12 | 0 | 24.03 | 24.00 | 23.98 | 24.07 | 23.89 | 0-1 | 1 |
| | 12 | 6 | 24.04 | 24.08 | 24.07 | 24.01 | 23.88 | | 1 |
| | 12 | 13 | 24.08 | 23.96 | 23.98 | 24.03 | 23.81 | | 1 |
| | 25 | 0 | 24.00 | 24.05 | 23.99 | 24.04 | 23.85 | | 1 |
| 16QAM | 1 | 0 | 23.90 | 23.92 | 24.11 | 23.96 | 23.81 | 0-1 | 1 |
| | 1 | 12 | 23.95 | 23.85 | 24.16 | 24.01 | 23.73 | | 1 |
| | 1 | 24 | 23.85 | 23.94 | 24.10 | 23.93 | 23.78 | | 1 |
| | 12 | 0 | 22.99 | 23.02 | 23.11 | 23.01 | 22.81 | 0-2 | 2 |
| | 12 | 6 | 23.10 | 22.99 | 23.09 | 23.05 | 22.80 | | 2 |
| | 12 | 13 | 23.02 | 22.97 | 22.98 | 22.98 | 22.82 | | 2 |
| | 25 | 0 | 22.97 | 22.98 | 23.01 | 22.97 | 22.85 | | 2 |
| 64QAM | 1 | 0 | 22.88 | 22.80 | 22.99 | 22.93 | 22.80 | 0-2 | 2 |
| | 1 | 12 | 22.90 | 22.78 | 23.07 | 22.98 | 22.67 | | 2 |
| | 1 | 24 | 22.80 | 22.85 | 23.06 | 22.83 | 22.75 | | 2 |
| | 12 | 0 | 21.94 | 21.94 | 22.02 | 21.98 | 21.77 | 0-3 | 3 |
| | 12 | 6 | 22.03 | 21.97 | 21.98 | 22.04 | 21.72 | | 3 |
| | 12 | 13 | 21.91 | 21.95 | 21.86 | 21.93 | 21.79 | | 3 |
| | 25 | 0 | 21.91 | 21.86 | 22.00 | 21.89 | 21.75 | | 3 |




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## i. LTE Band 41 – Power Class 2

### Table 8-34
### LTE Band 41 (2593.0MHz) Conducted Powers – 20MHz Bandwidth

| LTE Band 41 20 MHz Bandwidth | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Low Channel | Low-Mid Channel | Mid Channel | Mid-High Channel | High Channel | MPR Allowed per 3GPP [dB] | MPR [dB] |
| | | | 39750 (2506.0 MHz) | 40185 (2549.5 MHz) | 40620 (2593.0 MHz) | 41055 (2636.5 MHz) | 41490 (2680.0 MHz) | | |
| | | | Conducted Power [dBm] | | | | | | |
| QPSK | 1 | 0 | 27.37 | 27.47 | 27.49 | 27.46 | 27.25 | 0 | 0 |
| | 1 | 50 | 27.23 | 27.48 | 27.40 | 27.60 | 27.32 | | 0 |
| | 1 | 99 | 27.51 | 27.59 | 27.44 | 27.32 | 27.36 | | 0 |
| | 50 | 0 | 26.41 | 26.23 | 26.43 | 26.50 | 26.49 | 0-1 | 1 |
| | 50 | 25 | 26.35 | 26.49 | 26.51 | 26.52 | 26.46 | | 1 |
| | 50 | 50 | 26.44 | 26.32 | 26.27 | 26.34 | 26.19 | | 1 |
| | 100 | 0 | 26.44 | 26.47 | 26.46 | 26.38 | 26.30 | | 1 |
| 16QAM | 1 | 0 | 26.35 | 26.53 | 26.47 | 26.31 | 26.32 | 0-1 | 1 |
| | 1 | 50 | 26.37 | 26.51 | 26.39 | 26.56 | 26.54 | | 1 |
| | 1 | 99 | 26.39 | 26.34 | 26.45 | 26.45 | 26.30 | | 1 |
| | 50 | 0 | 25.32 | 25.54 | 25.46 | 25.41 | 25.39 | 0-2 | 2 |
| | 50 | 25 | 25.46 | 25.34 | 25.25 | 25.24 | 25.46 | | 2 |
| | 50 | 50 | 25.56 | 25.49 | 25.25 | 25.20 | 25.49 | | 2 |
| | 100 | 0 | 25.46 | 25.23 | 25.18 | 25.29 | 25.28 | | 2 |
| 64QAM | 1 | 0 | 25.28 | 25.24 | 25.46 | 25.48 | 25.49 | 0-2 | 2 |
| | 1 | 50 | 25.25 | 25.60 | 25.31 | 25.55 | 25.45 | | 2 |
| | 1 | 99 | 25.38 | 25.23 | 25.29 | 25.43 | 25.50 | | 2 |
| | 50 | 0 | 24.33 | 24.33 | 24.29 | 24.21 | 24.57 | 0-3 | 3 |
| | 50 | 25 | 24.37 | 24.45 | 24.33 | 24.31 | 24.31 | | 3 |
| | 50 | 50 | 24.48 | 24.33 | 24.33 | 24.37 | 24.60 | | 3 |
| | 100 | 0 | 24.51 | 24.41 | 24.33 | 24.48 | 24.48 | | 3 |

### Table 8-35
### LTE Band 41 (2593.0MHz) Conducted Powers – 15MHz Bandwidth

| LTE Band 41 15 MHz Bandwidth | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Low Channel | Low-Mid Channel | Mid Channel | Mid-High Channel | High Channel | MPR Allowed per 3GPP [dB] | MPR [dB] |
| | | | 39750 (2506.0 MHz) | 40185 (2549.5 MHz) | 40620 (2593.0 MHz) | 41055 (2636.5 MHz) | 41490 (2680.0 MHz) | | |
| | | | Conducted Power [dBm] | | | | | | |
| QPSK | 1 | 0 | 27.31 | 27.25 | 27.12 | 27.29 | 27.24 | 0 | 0 |
| | 1 | 36 | 27.14 | 27.31 | 27.36 | 27.08 | 27.17 | | 0 |
| | 1 | 74 | 27.11 | 27.19 | 27.25 | 26.95 | 27.06 | | 0 |
| | 36 | 0 | 26.33 | 26.30 | 26.29 | 26.34 | 26.20 | 0-1 | 1 |
| | 36 | 18 | 26.29 | 26.30 | 26.34 | 26.28 | 26.14 | | 1 |
| | 36 | 37 | 26.29 | 26.17 | 26.27 | 26.24 | 26.08 | | 1 |
| | 75 | 0 | 26.26 | 26.28 | 26.20 | 26.23 | 26.12 | | 1 |
| 16QAM | 1 | 0 | 26.30 | 26.21 | 26.27 | 26.52 | 26.28 | 0-1 | 1 |
| | 1 | 36 | 26.28 | 26.31 | 26.20 | 26.43 | 26.16 | | 1 |
| | 1 | 74 | 26.38 | 26.11 | 26.22 | 26.24 | 26.24 | | 1 |
| | 36 | 0 | 25.29 | 25.35 | 25.38 | 25.35 | 25.18 | 0-2 | 2 |
| | 36 | 18 | 25.32 | 25.24 | 25.34 | 25.40 | 25.14 | | 2 |
| | 36 | 37 | 25.23 | 25.24 | 25.22 | 25.27 | 25.14 | | 2 |
| | 75 | 0 | 25.25 | 25.28 | 25.30 | 25.26 | 25.14 | | 2 |
| 64QAM | 1 | 0 | 25.28 | 25.08 | 25.26 | 25.48 | 25.23 | 0-2 | 2 |
| | 1 | 36 | 25.17 | 25.20 | 25.19 | 25.34 | 25.10 | | 2 |
| | 1 | 74 | 25.25 | 25.01 | 25.12 | 25.13 | 25.13 | | 2 |
| | 36 | 0 | 24.28 | 24.31 | 24.34 | 24.33 | 24.13 | 0-3 | 3 |
| | 36 | 18 | 24.19 | 24.22 | 24.23 | 24.30 | 24.02 | | 3 |
| | 36 | 37 | 24.22 | 24.20 | 24.12 | 24.21 | 24.05 | | 3 |
| | 75 | 0 | 24.19 | 24.25 | 24.21 | 24.18 | 24.10 | | 3 |




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## Table 8-36
## LTE Band 41 (2593.0MHz) Conducted Powers – 10MHz Bandwidth

| LTE Band 41<br>10 MHz Bandwidth | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Low Channel | Low-Mid Channel | Mid Channel | Mid-High Channel | High Channel | MPR Allowed per 3GPP [dB] | MPR [dB] |
| | | | 39750 (2506.0 MHz) | 40185 (2549.5 MHz) | 40620 (2593.0 MHz) | 41055 (2636.5 MHz) | 41490 (2680.0 MHz) | | |
| | | | Conducted Power [dBm] | | | | | | |
| QPSK | 1 | 0 | 27.22 | 27.23 | 27.37 | 27.02 | 26.99 | 0 | 0 |
| | 1 | 25 | 27.19 | 27.31 | 27.33 | 27.02 | 27.15 | | 0 |
| | 1 | 49 | 27.15 | 27.34 | 27.17 | 26.91 | 27.24 | | 0 |
| | 25 | 0 | 26.27 | 26.29 | 26.31 | 26.17 | 26.32 | 0-1 | 1 |
| | 25 | 12 | 26.34 | 26.27 | 26.26 | 26.26 | 26.16 | | 1 |
| | 25 | 25 | 26.29 | 26.24 | 26.21 | 26.15 | 26.32 | | 1 |
| | 50 | 0 | 26.26 | 26.29 | 26.28 | 26.12 | 26.34 | | 1 |
| 16QAM | 1 | 0 | 26.38 | 26.08 | 26.21 | 26.35 | 26.18 | 0-1 | 1 |
| | 1 | 25 | 26.24 | 26.08 | 26.32 | 26.30 | 26.18 | | 1 |
| | 1 | 49 | 26.13 | 26.01 | 26.16 | 26.17 | 26.24 | | 1 |
| | 25 | 0 | 25.37 | 25.26 | 25.36 | 25.26 | 25.32 | 0-2 | 2 |
| | 25 | 12 | 25.31 | 25.30 | 25.32 | 25.27 | 25.20 | | 2 |
| | 25 | 25 | 25.24 | 25.24 | 25.31 | 25.15 | 25.28 | | 2 |
| | 50 | 0 | 25.32 | 25.26 | 25.29 | 25.24 | 25.29 | | 2 |
| 64QAM | 1 | 0 | 25.29 | 25.06 | 25.10 | 25.33 | 25.08 | 0-2 | 2 |
| | 1 | 25 | 25.22 | 24.97 | 25.30 | 25.20 | 25.15 | | 2 |
| | 1 | 49 | 25.09 | 24.89 | 25.14 | 25.06 | 25.20 | | 2 |
| | 25 | 0 | 24.34 | 24.17 | 24.28 | 24.15 | 24.18 | 0-3 | 3 |
| | 25 | 12 | 24.22 | 24.20 | 24.19 | 24.17 | 24.12 | | 3 |
| | 25 | 25 | 24.15 | 24.22 | 24.20 | 24.10 | 24.16 | | 3 |
| | 50 | 0 | 24.21 | 24.24 | 24.22 | 24.18 | 24.19 | | 3 |

## Table 8-37
## LTE Band 41 (2593.0MHz) Conducted Powers – 5MHz Bandwidth

| LTE Band 41<br>5 MHz Bandwidth | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Low Channel | Low-Mid Channel | Mid Channel | Mid-High Channel | High Channel | MPR Allowed per 3GPP [dB] | MPR [dB] |
| | | | 39750 (2506.0 MHz) | 40185 (2549.5 MHz) | 40620 (2593.0 MHz) | 41055 (2636.5 MHz) | 41490 (2680.0 MHz) | | |
| | | | Conducted Power [dBm] | | | | | | |
| QPSK | 1 | 0 | 27.35 | 27.31 | 27.09 | 27.19 | 27.14 | 0 | 0 |
| | 1 | 12 | 27.38 | 27.35 | 27.22 | 27.12 | 27.22 | | 0 |
| | 1 | 24 | 27.13 | 27.27 | 27.24 | 27.01 | 27.12 | | 0 |
| | 12 | 0 | 26.36 | 26.29 | 26.30 | 26.32 | 26.16 | 0-1 | 1 |
| | 12 | 6 | 26.38 | 26.39 | 26.30 | 26.33 | 26.19 | | 1 |
| | 12 | 13 | 26.26 | 26.30 | 26.31 | 26.25 | 26.12 | | 1 |
| | 25 | 0 | 26.36 | 26.27 | 26.29 | 26.29 | 26.14 | | 1 |
| 16QAM | 1 | 0 | 26.16 | 26.27 | 26.21 | 26.44 | 26.26 | 0-1 | 1 |
| | 1 | 12 | 26.23 | 26.21 | 26.27 | 26.36 | 26.29 | | 1 |
| | 1 | 24 | 26.16 | 26.15 | 26.24 | 26.36 | 26.16 | | 1 |
| | 12 | 0 | 25.22 | 25.35 | 25.20 | 25.37 | 25.18 | 0-2 | 2 |
| | 12 | 6 | 25.34 | 25.36 | 25.21 | 25.36 | 25.18 | | 2 |
| | 12 | 13 | 25.40 | 25.26 | 25.20 | 25.38 | 25.13 | | 2 |
| | 25 | 0 | 25.33 | 25.39 | 25.27 | 25.32 | 25.23 | | 2 |
| 64QAM | 1 | 0 | 25.03 | 25.21 | 25.18 | 25.31 | 25.18 | 0-2 | 2 |
| | 1 | 12 | 25.15 | 25.21 | 25.17 | 25.29 | 25.15 | | 2 |
| | 1 | 24 | 25.16 | 25.05 | 25.19 | 25.30 | 25.07 | | 2 |
| | 12 | 0 | 24.08 | 24.33 | 24.06 | 24.36 | 24.04 | 0-3 | 3 |
| | 12 | 6 | 24.20 | 24.24 | 24.10 | 24.33 | 24.10 | | 3 |
| | 12 | 13 | 24.37 | 24.22 | 24.16 | 24.30 | 24.03 | | 3 |
| | 25 | 0 | 24.20 | 24.30 | 24.25 | 24.31 | 24.15 | | 3 |

# j. LTE TDD Uplink Carrier Aggregation

## Table 8-38
## LTE TDD Uplink Two Component Carrier Aggregation Conducted Powers

| Combination | PCC | | | | | | | SCC | | | | | | | Power |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PCC Band | PCC Bandwidth [MHz] | PCC (UL/DL) Channel | PCC (UL/DL) Frequency [MHz] | Modulation | PCC UL# RB | PCC UL RB Offset | SCC Band | SCC Bandwidth [MHz] | SCC (UL/DL) Channel | SCC (UL/DL) Frequency [MHz] | Modulation | SCC UL# RB | SCC UL RB Offset | LTE Tx.Power with UL CA Enabled |
| CA_41C | LTE B41 | 20 | 40185 | 2549.5 | 16QAM | 1 | 0 | 41 | 20 | 39987 | 2529.7 | 16QAM | 1 | 99 | 22.75 |



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## VIII. WIFI Conducted Powers (SISO/MIMO)

**Table 8-39**
**IEEE 802.11b/g/n/ac (2.4GHz, SISO) Reduced Average RF Power[1]**

| 2.4GHz Conducted Power [dBm] | | | | | |
|---|---|---|---|---|---|
| Freq [MHz] | Channel | IEEE Transmission Mode | | | |
| | | 802.11b | 802.11g | 802.11n | 802.11ac |
| 2412 | 1 | 17.48 | 17.15 | 17.15 | 17.27 |
| 2417 | 2 | 17.42 | 17.04 | 17.11 | 17.12 |
| 2437 | 6 | 17.26 | 17.03 | 17.09 | 17.07 |
| 2457 | 10 | 17.46 | 17.19 | 17.24 | 17.32 |
| 2462 | 11 | 17.31 | 17.01 | 17.29 | 17.12 |

**Table 8-40**
**IEEE 802.11b/g/n/ac (2.4GHz, MIMO) Reduced Average RF Power[1]**

| 2.4GHz Conducted Power [dBm] | | | | | |
|---|---|---|---|---|---|
| Freq [MHz] | Channel | IEEE Transmission Mode | | | |
| | | 802.11b | 802.11g | 802.11n | 802.11ac |
| 2412 | 1 | 20.54 | 20.21 | 20.10 | 20.19 |
| 2417 | 2 | 20.49 | 20.10 | 20.12 | 20.12 |
| 2437 | 6 | 20.35 | 20.04 | 20.16 | 20.12 |
| 2457 | 10 | 20.46 | 20.15 | 20.25 | 20.26 |
| 2462 | 11 | 20.30 | 20.02 | 20.20 | 20.09 |

**Table 8-41**
**IEEE 802.11a/n/ac (5GHz, 20MHz BW, SISO) Average RF Power**

| 5GHz (20MHz) Conducted Power [dBm] | | | | |
|---|---|---|---|---|
| Freq [MHz] | Channel | IEEE Transmission Mode | | |
| | | 802.11a | 802.11n | 802.11ac |
| 5180 | 36 | 16.64 | 16.42 | 16.56 |
| 5200 | 40 | 17.52 | 17.40 | 17.38 |
| 5220 | 44 | 16.44 | 16.17 | 16.23 |
| 5240 | 48 | 16.55 | 16.38 | 16.47 |
| 5260 | 52 | 16.52 | 16.31 | 16.36 |
| 5280 | 56 | 17.56 | 17.34 | 17.35 |
| 5300 | 60 | 16.71 | 16.46 | 16.53 |
| 5320 | 64 | 16.71 | 16.57 | 16.66 |
| 5500 | 100 | 16.32 | 16.11 | 16.05 |
| 5600 | 120 | 16.56 | 16.46 | 16.43 |
| 5620 | 124 | 16.40 | 16.30 | 16.34 |
| 5720 | 144 | 16.45 | 16.33 | 16.33 |
| 5745 | 149 | 16.45 | 16.43 | 16.36 |
| 5785 | 157 | 17.46 | 17.38 | 17.38 |
| 5825 | 165 | 16.77 | 16.68 | 16.59 |

[1] Note: This device utilizes independent power reduction mechanisms for the WIFI transmitter in all 2.4GHz WIFI modes for held-to-ear scenarios.



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**Table 8-42**
**IEEE 802.11a/n/ac (5GHz, 20MHz BW, MIMO) Average RF Power**

| 5GHz (20MHz) Conducted Power [dBm] | | | | |
|---|---|---|---|---|
| Freq [MHz] | Channel | IEEE Transmission Mode | | |
| | | 802.11a | 802.11n | 802.11ac |
| 5180 | 36 | 19.49 | 19.43 | 19.49 |
| 5200 | 40 | 20.41 | 20.34 | 20.35 |
| 5220 | 44 | 19.47 | 19.34 | 19.35 |
| 5240 | 48 | 19.54 | 19.45 | 19.50 |
| 5260 | 52 | 19.53 | 19.45 | 19.48 |
| 5280 | 56 | 20.54 | 20.44 | 20.42 |
| 5300 | 60 | 19.57 | 19.44 | 19.48 |
| 5320 | 64 | 19.57 | 19.46 | 19.53 |
| 5500 | 100 | 19.50 | 19.19 | 19.20 |
| 5600 | 120 | 19.63 | 19.34 | 19.34 |
| 5620 | 124 | 19.55 | 19.42 | 19.36 |
| 5720 | 144 | 19.55 | 19.31 | 19.35 |
| 5745 | 149 | 19.45 | 19.30 | 19.36 |
| 5785 | 157 | 20.49 | 20.34 | 20.36 |
| 5825 | 165 | 19.67 | 19.48 | 19.47 |

**Table 8-43**
**IEEE 802.11n/ac (5GHz, 40MHz BW, SISO) Average RF Power**

| 5GHz (40MHz) Conducted Power [dBm] | | | |
|---|---|---|---|
| Freq [MHz] | Channel | IEEE Transmission Mode | |
| | | 802.11n | 802.11ac |
| 5190 | 38 | 12.61 | 12.54 |
| 5230 | 46 | 15.53 | 15.56 |
| 5270 | 54 | 15.63 | 15.58 |
| 5310 | 62 | 12.09 | 12.11 |
| 5510 | 102 | 11.80 | 11.84 |
| 5590 | 118 | 15.67 | 15.68 |
| 5630 | 126 | 15.48 | 15.50 |
| 5710 | 142 | 15.66 | 15.70 |
| 5755 | 151 | 15.46 | 15.45 |
| 5795 | 159 | 15.61 | 15.65 |



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**Table 8-44**
**IEEE 802.11n/ac (5GHz, 40MHz BW, MIMO) Average RF Power**

| 5GHz (40MHz) Conducted Power [dBm] | | | |
|---|---|---|---|
| Freq [MHz] | Channel | IEEE Transmission Mode | |
| | | 802.11n | 802.11ac |
| 5190 | 38 | 15.58 | 15.58 |
| 5230 | 46 | 18.62 | 18.66 |
| 5270 | 54 | 18.71 | 18.71 |
| 5310 | 62 | 15.09 | 15.11 |
| 5510 | 102 | 14.93 | 14.97 |
| 5590 | 118 | 18.63 | 18.63 |
| 5630 | 126 | 18.50 | 18.52 |
| 5710 | 142 | 18.75 | 18.79 |
| 5755 | 151 | 18.61 | 18.61 |
| 5795 | 159 | 18.64 | 18.66 |

**Table 8-45**
**IEEE 802.11ac (5GHz, 80MHz BW, SISO) Average RF Power**

| 5GHz (80MHz) Conducted Power [dBm] | | |
|---|---|---|
| Freq [MHz] | Channel | IEEE Transmission Mode |
| | | 802.11ac |
| 5210 | 42 | 12.61 |
| 5290 | 58 | 9.56 |
| 5530 | 106 | 12.55 |
| 5610 | 122 | 12.51 |
| 5775 | 155 | 12.25 |

**Table 8-46**
**IEEE 802.11ac (5GHz, 80MHz BW, MIMO) Average RF Power**

| 5GHz (80MHz) Conducted Power [dBm] | | |
|---|---|---|
| Freq [MHz] | Channel | IEEE Transmission Mode |
| | | 802.11ac |
| 5210 | 42 | 15.57 |
| 5290 | 58 | 12.41 |
| 5530 | 106 | 15.44 |
| 5610 | 122 | 15.39 |
| 5775 | 155 | 15.24 |



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## IX. WIFI Conducted Powers for Operations with Simultaneous 2.4GHz and 5GHz

**Table 8-47**
**IEEE 802.11b/g/n/ac (2.4GHz, Ant1) Reduced Average RF Power[1]**

| 2.4GHz Conducted Power [dBm] | | | | | |
|---|---|---|---|---|---|
| Freq [MHz] | Channel | IEEE Transmission Mode | | | |
| | | 802.11b | 802.11g | 802.11n | 802.11ac |
| 2412 | 1 | 17.58 | 17.24 | 17.02 | 17.09 |
| 2417 | 2 | 17.54 | 17.14 | 17.11 | 17.10 |
| 2437 | 6 | 17.42 | 17.02 | 17.21 | 17.14 |
| 2457 | 10 | 17.44 | 17.09 | 17.24 | 17.17 |
| 2462 | 11 | 17.27 | 17.01 | 17.09 | 17.03 |

**Table 8-48**
**IEEE 802.11a/n/ac (5GHz, 20MHz BW, Ant2) Reduced Average RF Power[1]**

| 5GHz (20MHz) Conducted Power [dBm] | | | | |
|---|---|---|---|---|
| Freq [MHz] | Channel | IEEE Transmission Mode | | |
| | | 802.11a | 802.11n | 802.11ac |
| 5180 | 36 | 14.17 | 14.01 | 14.06 |
| 5200 | 40 | 14.30 | 14.11 | 14.16 |
| 5220 | 44 | 14.37 | 14.24 | 14.31 |
| 5240 | 48 | 14.37 | 14.16 | 14.32 |
| 5260 | 52 | 14.35 | 14.29 | 14.24 |
| 5280 | 56 | 14.38 | 14.28 | 14.26 |
| 5300 | 60 | 14.29 | 14.12 | 14.15 |
| 5320 | 64 | 14.18 | 14.14 | 14.04 |
| 5500 | 100 | 14.35 | 14.28 | 14.24 |
| 5580 | 116 | 14.12 | 14.05 | 14.02 |
| 5660 | 132 | 14.20 | 14.17 | 14.14 |
| 5720 | 144 | 14.20 | 14.20 | 14.17 |
| 5745 | 149 | 14.31 | 14.23 | 14.30 |
| 5785 | 157 | 14.22 | 14.17 | 14.19 |
| 5825 | 165 | 14.27 | 14.21 | 14.25 |

[1] Note: This device utilizes independent power reduction mechanisms for the WIFI transmitter in all WIFI modes during simultaneous 2.4GHz and 5GHz operations for held-to-ear scenarios.



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**Table 8-49**
**IEEE 802.11n/ac (5GHz, 40MHz BW, Ant2) Reduced Average RF Power[1]**

| 5GHz (40MHz) Conducted Power [dBm] | | | |
|---|---|---|---|
| Freq [MHz] | Channel | IEEE Transmission Mode | |
| | | 802.11n | 802.11ac |
| 5190 | 38 | 12.37 | 12.34 |
| 5230 | 46 | 14.50 | 14.49 |
| 5270 | 54 | 14.48 | 14.51 |
| 5310 | 62 | 11.86 | 11.86 |
| 5510 | 102 | 12.11 | 11.93 |
| 5550 | 110 | 14.40 | 14.26 |
| 5670 | 134 | 14.53 | 14.46 |
| 5710 | 142 | 14.51 | 14.47 |
| 5755 | 151 | 14.51 | 14.44 |
| 5795 | 159 | 14.48 | 14.53 |

**Table 8-50**
**IEEE 802.11ac (5GHz, 80MHz BW, Ant2) Reduced Average RF Power[1]**

| 5GHz (80MHz) Conducted Power [dBm] | | |
|---|---|---|
| Freq [MHz] | Channel | IEEE Transmission Mode |
| | | 802.11ac |
| 5210 | 42 | 12.53 |
| 5290 | 58 | 9.59 |
| 5530 | 106 | 12.55 |
| 5690 | 138 | 12.54 |
| 5775 | 155 | 12.53 |

[1] Note: This device utilizes independent power reduction mechanisms for the WIFI transmitter in all WIFI modes during simultaneous 2.4GHz and 5GHz operations for held-to-ear scenarios.



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# 9. JUSTIFICATION OF HELD TO EAR MODES TESTED

## I. Analysis of RF Air Interface Technologies

An analysis was performed, following the guidance of §4.3 and §4.4 of the ANSI standard, of the RF air interface technologies being evaluated. The factors that will affect the RF interference potential were evaluated, and the worst-case operating modes were identified and used in the evaluation. A WD's interference potential is a function both of the WD's average near-field field strength and of the signal's audio-frequency amplitude modulation characteristics. Per §4.4, RF air interface technologies that have low power have been found to produce sufficiently low RF interference potential, so it is possible to exempt them from the product testing specified in Clause 5 of the ANSI standard. An RF air interface technology of a device is exempt from testing when its average antenna input power plus its MIF is ≤17dBm for all of its operating modes. RF air interface technologies exempted from testing in this manner are automatically assigned an M4 rating to be used in determining the overall rating for the WD.

The worst-case MIF plus the worst-case average antenna input power for all modes are investigated below to determine the testing requirements for this device.

## II. Individual Mode Evaluations

**Table 9-1**
Max Power + MIF calculations for Low Power Exemptions

| Air Interface | Maximum Average Power (dBm) | Worst Case MIF (dB) | Total (Power + MIF, dB) | C63.19 Testing Required |
|---|---|---|---|---|
| CDMA - Full Frame Rate | 25.38 | -19.43 | 5.95 | No |
| CDMA - 1/8th Frame Rate | 16.31* | 3.02 | 19.33 | Yes |
| CDMA - EvDO | 25.24 | -18.22 | 7.02 | No |
| GSM850 | 22.51* | 3.54 | 26.05 | Yes |
| GSM1900 | 21.58* | 3.54 | 25.12 | Yes |
| EDGE850 | 18.30* | 3.76 | 22.06 | Yes*** |
| EDGE1900 | 17.41* | 3.68 | 21.09 | Yes*** |
| UMTS - RMC | 25.35 | -23.38 | 1.97 | No |
| UMTS - AMR | 25.34 | -23.58 | 1.76 | No |
| HSPA | 25.15 | -18.88 | 6.27 | No |
| LTE - FDD | 25.44 | -9.60 | 15.84 | No |
| LTE FDD - Uplink Carrier Aggregation | 24.52 | -11.83 | 12.69 | No |
| LTE - TDD (PC3) | 15.42* | 3.65 | 19.07 | Yes |
| LTE - TDD (PC2) | 17.89* | 3.84 | 21.73 | Yes |
| LTE TDD - Uplink Carrier Aggregation | 18.91* | -1.60 | 17.31 | Yes**** |
| 2.4GHz WIFI | 20.54 | -8.98 | 11.56 | No |
| 5GHz WIFI | 20.54 | -8.63 | 11.91 | No |
| Simultaneous 2.4GHz and 5GHz WIFI Operations | 19.33** | -10.79 | 8.54 | No |



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* Note: ANSI C63.19-2011 Sec. 4.4 Footnote 20 indicates the use of a long averaging time for measuring the antenna input power when using this method of exclusion. Therefore, the frame averaged power was calculated for these modes in this investigation.

** Note: This value is calculated as the linear sum of the worst-case power for each band and antenna combination while in simultaneous 2.4GHz and 5GHz operation. This calculation is conservative and for use in this investigation only.

*** Note: EDGE data modes were considered but not tested as GSM voice modes were found to be the worst-case modes for the GSM air interface.

**** Note: LTE TDD Uplink Carrier Aggregation was considered but not tested as LTE TDD standalone data modes were found to be the worst-case modes for the LTE TDD air interface.

## III. Low-Power Exemption Conclusions

Per ANSI C63.19-2011, RF Emissions testing for this device is required only for GSM and CDMA 1/8$^{th}$ Frame Rate voice modes as well as LTE TDD (Power Class 3 and Power Class 2) data modes. All other air interfaces are exempt.




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# 10. LTE TDD UPLINK-DOWNLINK CONFIGURATION

## I. Uplink-Downlink Configuration Additional Testing

Additional testing was performed on each supported power class for LTE TDD to determine the worst-case Uplink-Downlink configuration for RFE testing.

Per 3GPP TS 36.211, the total frame length for each TDD radio frame of length $T_f = 307200 \cdot T_s = 10$ ms, where $T_s$ is a number of time units equal to 1/(15000 x 2048) seconds. Additionally, each radio frame consists of 10 subframes, each of length $30720 \cdot T_s = 1$ ms, and subframes can be designated as uplink (U), downlink (D), or special subframe (S), depending on the Uplink-Downlink configuration as indicated in Table 4.2-2 of 3GPP TS 36.211. In the transmission duty factor calculation, the special subframe configuration with the shortest UpPTS duration within the special subframe is used and will be applied for measurement. From 3GPP TS 36.211 Table 4.2-1, the shortest UpPTS is 2192 · Ts which occurs in the normal cyclic prefix and special subframe configuration 4.

See table below outlining the calculated transmission duty cycles for each Uplink-Downlink configuration:

**Table 10-1**
Uplink-Downlink Configurations for Type 2 Frame Structures

| Uplink-downlink configuration | Downlink-to-Uplink Switch-point periodicity | Subframe number | | | | | | | | | | Calculated Transmission Duty Cycle (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | |
| 0 | 5 ms | D | S | U | U | U | D | S | U | U | U | 61.4% |
| 1 | 5 ms | D | S | U | U | D | D | S | U | U | D | 41.4% |
| 2 | 5 ms | D | S | U | D | D | D | S | U | D | D | 21.4% |
| 3 | 10 ms | D | S | U | U | U | D | D | D | D | D | 30.7% |
| 4 | 10 ms | D | S | U | U | D | D | D | D | D | D | 20.7% |
| 5 | 10 ms | D | S | U | D | D | D | D | D | D | D | 10.7% |
| 6 | 5 ms | D | S | U | U | U | D | S | U | U | D | 51.4% |

## II. Power Class 3 Uplink-Downlink Configuration Additional Testing

LTE TDD was evaluated with the following radio configuration: channel 40620, 20MHz BW, 16QAM, 1RB, 0RB Offset. For Power Class 3, all configurations (0-6) are supported. The configuration which resulted in the worst-case emission was used for full testing. See Table 10-2 below for. The configuration determined in the results below was used to measure the MIF values in Table 7-5.

**Table 10-2**
LTE TDD Power Class 3 UL-DL Configuration Results

| Mode / Band | Bandwidth | Channel | UL-DL Config. | Mod. | RB Size | RB Offset | Scan Center | Time Avg. Field (V/m) | Time Avg. Field [dB(V/m)] | MIF (dB) | Audio Interference Level [dB(V/m)] | FCC Limit (dBV/m) | FCC Margin (dB) | Result | Excl Blocks per 5.5 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| E-Field Emissions | | | | | | | | | | | | | | | |
| LTE TDD / Band 41 | 20 | 40620 | 0 | 16QAM | 1 | 0 | Acoustic | 15.73 | 23.93 | -3.19 | 20.74 | 35.00 | -14.26 | M4 | none |
| | 20 | 40620 | 1 | 16QAM | 1 | 0 | Acoustic | 16.12 | 24.15 | -1.57 | 22.58 | 35.00 | -12.42 | M4 | none |
| | 20 | 40620 | 2 | 16QAM | 1 | 0 | Acoustic | 16.09 | 24.13 | 1.56 | 25.69 | 35.00 | -9.31 | M4 | none |
| | 20 | 40620 | 3 | 16QAM | 1 | 0 | Acoustic | 15.63 | 23.88 | -1.33 | 22.55 | 35.00 | -12.45 | M4 | none |
| | 20 | 40620 | 4 | 16QAM | 1 | 0 | Acoustic | 15.27 | 23.68 | 0.67 | 24.35 | 35.00 | -10.65 | M4 | none |
| | 20 | 40620 | 5 | 16QAM | 1 | 0 | Acoustic | 15.33 | 23.71 | 3.63 | 27.34 | 35.00 | -7.66 | M4 | none |
| | 20 | 40620 | 6 | 16QAM | 1 | 0 | Acoustic | 16.14 | 24.16 | -2.46 | 21.70 | 35.00 | -13.30 | M4 | none |




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## III. Power Class 2 Uplink-Downlink Configuration Additional Testing

LTE TDD was evaluated with the following radio configuration: channel 40620, 20MHz BW, 16QAM, 1RB, 0RB Offset. For Power Class 2, only configurations 1-5 are supported. The configuration which resulted in the worst-case emission was used for full testing. See Table 10-3 below for results. The configuration determined in the results below was used to measure the MIF values in Table 7-6.

**Table 10-3**
LTE TDD Power Class 2 UL-DL Configuration Results

| Mode / Band | Bandwidth | Channel | UL-DL Config. | Mod. | RB Size | RB Offset | Scan Center | Time Avg. Field (V/m) | Time Avg. Field [dB(V/m)] | MIF (dB) | Audio Interference Level [dB(V/m)] | FCC Limit (dBV/m) | FCC Margin (dB) | Result | Excl Blocks per 5.5 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **E-Field Emissions** | | | | | | | | | | | | | | | |
| LTE TDD / Band 41 | 20 | 40620 | 1 | 16QAM | 1 | 0 | Acoustic | 16.59 | 24.40 | -1.61 | 22.79 | **35.00** | -12.21 | **M4** | none |
| | 20 | 40620 | 2 | 16QAM | 1 | 0 | Acoustic | 16.14 | 24.16 | 1.54 | 25.70 | **35.00** | -9.30 | **M4** | none |
| | 20 | 40620 | 3 | 16QAM | 1 | 0 | Acoustic | 15.88 | 24.02 | -1.47 | 22.55 | **35.00** | -12.45 | **M4** | none |
| | 20 | 40620 | 4 | 16QAM | 1 | 0 | Acoustic | 15.26 | 23.67 | 0.73 | 24.40 | **35.00** | -10.60 | **M4** | none |
| | 20 | 40620 | 5 | 16QAM | 1 | 0 | Acoustic | 15.28 | 23.68 | 3.80 | 27.48 | **35.00** | -7.52 | **M4** | none |

## IV. Conclusion

Per the results above, UL-DL Configuration 5 was used for both LTE TDD Power Class 3 and LTE TDD Power Class 2 testing.




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# 11. OVERALL MEASUREMENT SUMMARY

| FCC ID: | ZNFG710VM |
|---|---|
| S/N: | 12330 |

## I. E-FIELD EMISSIONS:

**Table 11-1**
**HAC Data Summary for E-field - CDMA**

| Mode | Channel | RC/SO | Scan Center | Conducted Power at BS (dBm) | Time Avg. Field (V/m) | Time Avg. Field [dB(V/m)] | MIF (dB) | Audio Interference Level [dB(V/m)] | FCC Limit (dBV/m) | FCC Margin (dB) | Result | Excl Blocks per 5.5 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| E-Field Emissions | | | | | | | | | | | | |
| Cellular CDMA | 564* | RC1/SO3 | Acoustic | 25.34 | 13.52 | 22.62 | 3.02 | 25.64 | 45.00 | -19.36 | M4 | none |
| | 1013 | RC1/SO3 | Acoustic | 25.24 | 13.16 | 22.39 | 3.02 | 25.41 | 45.00 | -19.59 | M4 | none |
| | 384 | RC1/SO3 | Acoustic | 25.30 | 14.01 | 22.93 | 3.01 | 25.94 | 45.00 | -19.06 | M4 | none |
| | 777 | RC1/SO3 | Acoustic | 25.19 | 12.33 | 21.82 | 3.02 | 24.84 | 45.00 | -20.16 | M4 | none |
| | | | | | | | | | | | | |
| PCS CDMA | 25 | RC1/SO3 | Acoustic | 24.99 | 6.01 | 15.58 | 3.00 | 18.58 | 35.00 | -16.42 | M4 | none |
| | 600 | RC1/SO3 | Acoustic | 25.14 | 5.60 | 14.96 | 2.97 | 17.93 | 35.00 | -17.07 | M4 | none |
| | 1175 | RC1/SO3 | Acoustic | 25.06 | 5.68 | 15.09 | 3.01 | 18.10 | 35.00 | -16.90 | M4 | none |

*Note: Cell. CDMA Ch. 564 is the Part 90S test channel.

**Table 11-2**
**HAC Data Summary for E-field – GSM**

| Mode | Channel | Scan Center | Conducted Power at BS (dBm) | Time Avg. Field (V/m) | Time Avg. Field [dB(V/m)] | MIF (dB) | Audio Interference Level [dB(V/m)] | FCC Limit (dBV/m) | FCC Margin (dB) | Result | Excl Blocks per 5.5 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| E-Field Emissions | | | | | | | | | | | |
| GSM850 | 128 | Acoustic | 31.54 | 24.97 | 27.95 | 3.54 | 31.49 | 45.00 | -13.51 | M4 | none |
| | 190 | Acoustic | 31.50 | 24.95 | 27.94 | 3.54 | 31.48 | 45.00 | -13.52 | M4 | none |
| | 251 | Acoustic | 31.51 | 21.08 | 26.48 | 3.54 | 30.02 | 45.00 | -14.98 | M4 | none |
| | | | | | | | | | | | |
| GSM1900 | 512 | Acoustic | 30.59 | 12.83 | 22.16 | 3.54 | 25.70 | 35.00 | -9.30 | M4 | none |
| | 661 | Acoustic | 30.61 | 11.40 | 21.14 | 3.54 | 24.68 | 35.00 | -10.32 | M4 | none |
| | 810 | Acoustic | 30.51 | 10.44 | 20.37 | 3.54 | 23.91 | 35.00 | -11.09 | M4 | none |

**Table 11-3**
**HAC Data Summary for E-field – LTE TDD Power Class 3**

| Mode / Band | Bandwidth | Channel | UL-DL Config. | Mod. | RB Size | RB Offset | Scan Center | Conducted Power at BS (dBm) | Time Avg. Field (V/m) | Time Avg. Field [dB(V/m)] | MIF (dB) | Audio Interference Level [dB(V/m)] | FCC Limit (dBV/m) | FCC Margin (dB) | Result | Excl Blocks per 5.5 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| E-Field Emissions | | | | | | | | | | | | | | | | |
| LTE TDD / Band 41 | 20 | 39750 | 5 | 16QAM | 1 | 0 | Acoustic | 23.99 | 15.58 | 23.85 | 3.65 | 27.50 | 35.00 | -7.50 | M4 | none |
| | 20 | 40185 | 5 | 16QAM | 1 | 0 | Acoustic | 23.95 | 15.74 | 23.94 | 3.65 | 27.59 | 35.00 | -7.41 | M4 | none |
| | 20 | 40620 | 5 | 16QAM | 1 | 0 | Acoustic | 23.92 | 14.93 | 23.48 | 3.63 | 27.11 | 35.00 | -7.89 | M4 | none |
| | 20 | 41055 | 5 | 16QAM | 1 | 0 | Acoustic | 23.92 | 15.07 | 23.56 | 3.63 | 27.19 | 35.00 | -7.81 | M4 | none |
| | 20 | 41490 | 5 | 16QAM | 1 | 0 | Acoustic | 23.90 | 15.22 | 23.65 | 3.65 | 27.30 | 35.00 | -7.70 | M4 | none |

**Table 11-4**
**HAC Data Summary for E-field – LTE TDD Power Class 2**

| Mode / Band | Bandwidth | Channel | UL-DL Config. | Mod. | RB Size | RB Offset | Scan Center | Conducted Power at BS (dBm) | Time Avg. Field (V/m) | Time Avg. Field [dB(V/m)] | MIF (dB) | Audio Interference Level [dB(V/m)] | FCC Limit (dBV/m) | FCC Margin (dB) | Result | Excl Blocks per 5.5 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| E-Field Emissions | | | | | | | | | | | | | | | | |
| LTE TDD / Band 41 | 15 | 39750 | 5 | 16QAM | 1 | 0 | Acoustic | 26.30 | 15.14 | 23.60 | 3.74 | 27.34 | 35.00 | -7.66 | M4 | none |
| | 15 | 40185 | 5 | 16QAM | 1 | 0 | Acoustic | 26.21 | 15.84 | 24.00 | 3.61 | 27.61 | 35.00 | -7.39 | M4 | none |
| | 15 | 40620 | 5 | 16QAM | 1 | 0 | Acoustic | 26.27 | 15.97 | 24.06 | 3.84 | 27.90 | 35.00 | -7.10 | M4 | none |
| | 15 | 41055 | 5 | 16QAM | 1 | 0 | Acoustic | 26.52 | 15.49 | 23.80 | 3.84 | 27.64 | 35.00 | -7.36 | M4 | none |
| | 15 | 41490 | 5 | 16QAM | 1 | 0 | Acoustic | 26.28 | 15.20 | 23.64 | 3.72 | 27.36 | 35.00 | -7.64 | M4 | none |
| | 15 | 40620 | 5 | 16QAM | 1 | 0 | T-Coil | 26.27 | 15.97 | 24.06 | 3.84 | 27.90 | 35.00 | -7.10 | M4 | none |



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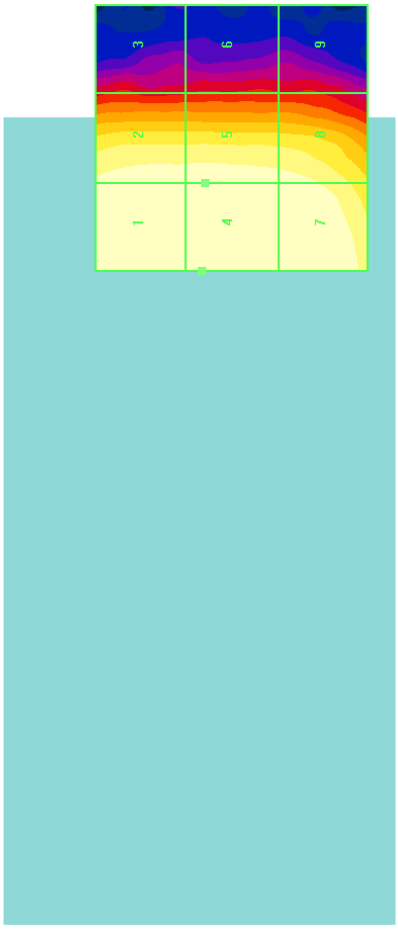


**Figure 11-1**
Sample E-field Scan Overlay
(See Test Setup Photographs for actual WD overlay)



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## II. Worst-case Configuration Evaluation

**Table 11-5**
**Peak Reading 360° Probe Rotation at Azimuth axis**

| Mode | Bandwidth | Channel | UL-DL Config. | Mod. | RB Size | RB Offset | Scan Center | Time Avg. Field (V/m) | Time Avg. Field [dB(V/m)] | MIF (dB) | Audio Interference Level [dB(V/m)] | FCC Limit (dBV/m) | FCC Margin (dB) | Result | Excl Blocks per 5.5 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Probe Rotation at Worst-Case | | | | | | | | | | | | | | | |
| LTE TDD / Band 41 | 15 | 40620 | 5 | 16QAM | 1 | 0 | Acoustic | 15.61 | 23.87 | 3.84 | 27.71 | **35.00** | -7.29 | **M4** | none |

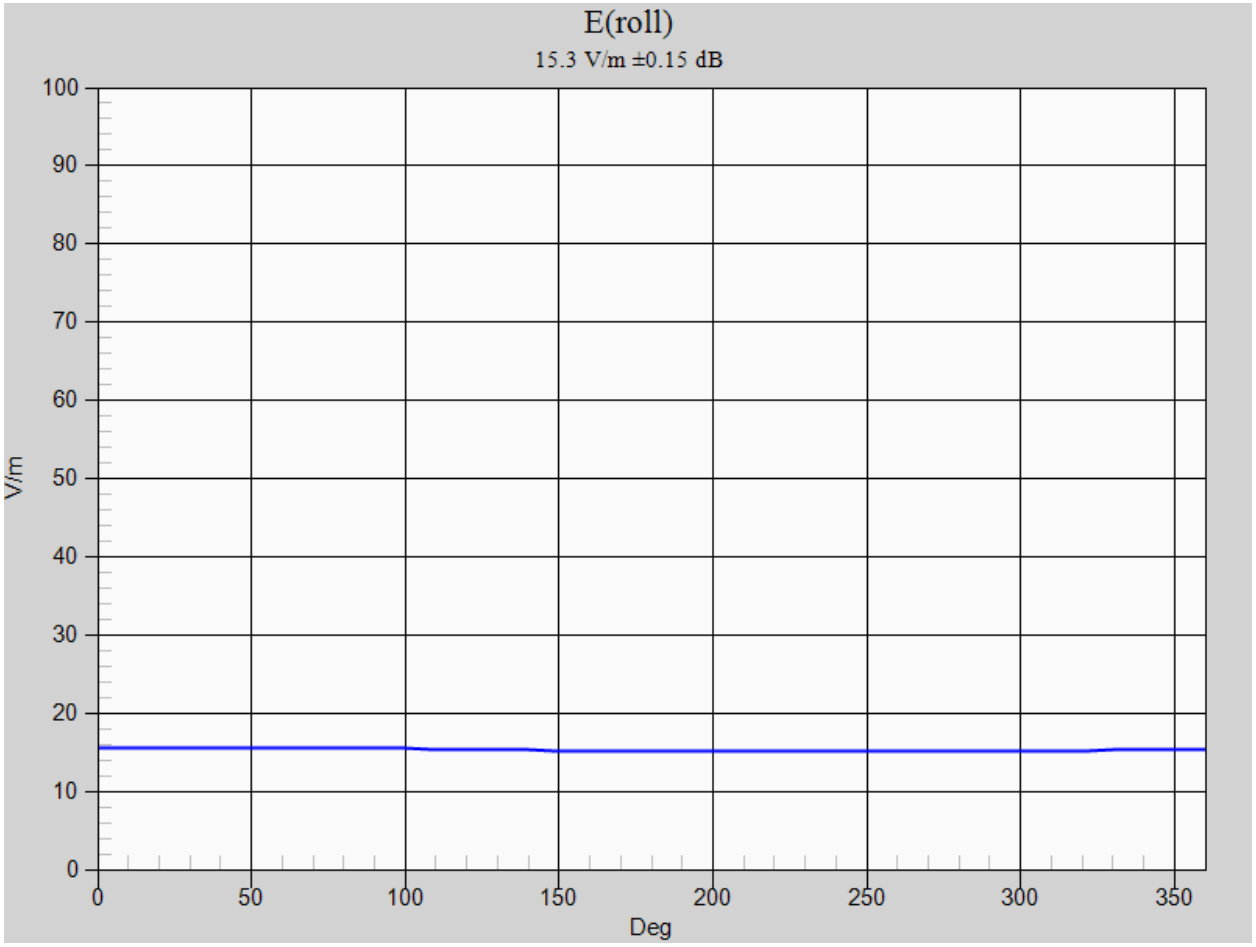


**Figure 11-2**
**Worst-Case Probe Rotation about Azimuth axis**

* Note: Locations of probe rotation (with and without exclusions) are shown in Figure 11-1 denoted by the green square markers.




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# 12. EQUIPMENT LIST

**Table 12-1**
Equipment List

| Manufacturer | Model | Description | Cal Date | Cal Interval | Cal Due | Serial Number |
|---|---|---|---|---|---|---|
| Agilent | E4438C | ESG Vector Signal Generator | 3/24/2017 | Biennial | 3/24/2019 | MY42082385 |
| Agilent | N5182A | MXG Vector Signal Generator | 1/24/2018 | Annual | 1/24/2019 | MY47420651 |
| Agilent | E5515C | Wireless Communications Test Set | 5/31/2017 | Annual | 5/31/2018 | GB43304278 |
| Amplifier Research | 15S1G6 | Amplifier | N/A | CBT* | N/A | 433978 |
| Anritsu | ML2496A | Power Meter | 4/20/2017 | Annual | 4/20/2018 | 1306009 |
| Anritsu | MA2411B | Pulse Power Sensor | 10/22/2017 | Annual | 10/22/2018 | 846215 |
| Anritsu | MA2411B | Pulse Power Sensor | 11/28/2017 | Annual | 11/28/2018 | 1027293 |
| Anritsu | MA24106A | USB Power Sensor | 6/7/2017 | Annual | 6/7/2018 | 1244512 |
| Anritsu | MA24106A | USB Power Sensor | 6/7/2017 | Annual | 6/7/2018 | 1248508 |
| Mini-Circuits | NLP-1200+ | Low Pass Filter DC to 1000 MHz | N/A | CBT* | N/A | N/A |
| Mini-Circuits | NLP-2950+ | Low Pass Filter DC to 2700 MHz | N/A | CBT* | N/A | N/A |
| Mini-Circuits | BW-N20W5 | Power Attenuator | N/A | CBT* | N/A | 1226 |
| Pasternack | PE2237-20 | Bidirectional Coupler | N/A | CBT* | N/A | N/A |
| Rohde & Schwarz | CMW500 | Radio Communication Tester | 11/3/2017 | Annual | 11/3/2018 | 100976 |
| Rohde & Schwarz | CMW500 | Wideband Radio Communication Tester | 7/14/2017 | Annual | 7/14/2018 | 140144 |
| Seekonk | NC-100 | Torque Wrench (8" lb) | 9/1/2016 | Biennial | 9/1/2018 | 21053 |
| SPEAG | AIA | Audio Interference Analzyer | N/A | CBT* | N/A | 1010 |
| SPEAG | DAE4 | Dasy Data Acquisition Electronics | 5/17/2017 | Annual | 5/17/2018 | 859 |
| SPEAG | CD1880V3 | Freespace 1880 MHz Dipole | 5/12/2016 | Biennial | 5/12/2018 | 1064 |
| SPEAG | CD835V3 | Freespace 835 MHz Dipole | 5/10/2016 | Biennial | 5/10/2018 | 1082 |
| SPEAG | CD2600V3 | Freespace 2600 MHz Dipole | 6/14/2017 | Biennial | 6/14/2019 | 1013 |
| SPEAG | ER3DV6 | Freespace E-field Probe | 8/11/2017 | Annual | 8/11/2018 | 2335 |

Calibration traceable to the National Institute of Standards and Technology (NIST).

***Note: CBT (Calibrated Before Testing).** Prior to testing, the measurement paths containing a cable, attenuator, coupler or filter were connected to a calibrated source (i.e. a signal generator) to determine the losses of the measurement path. The power meter offset was then adjusted to compensate for the measurement system losses. This level offset is stored within the power meter before measurements are made. This calibration verification procedure applies to the system verification and output power measurements. The calibrated reading is then taken directly from the power meter after compensation of the losses for all final power measurements.



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# 13. MEASUREMENT UNCERTAINTY

**Table 13-1**
Uncertainty Estimation Table

| Wireless Communications Device Near-Field Measurement Uncertainty Estimation | | | | | | | |
|---|---|---|---|---|---|---|---|
| Uncertainty Component | Data (dB) | Data Type | Prob. Dist. | Divisor | Ci (E) | Unc. (dB) | Notes/Comments |
| **Measurement System** | | | | | | | |
| RF System Reflections | 0.50 | Tolerance | N | 1.00 | 1 | 0.50 | * Refl. < -20 dB |
| Field Probe Calibration | 0.21 | Tolerance | N | 1.00 | 1 | 0.21 | |
| Field Probe Isotropy | 0.01 | Tolerance | N | 1.00 | 1 | 0.01 | |
| Field Probe Frequency Response | 0.135 | Tolerance | N | 1.00 | 1 | 0.14 | |
| Field Probe Linearity | 0.013 | Tolerance | N | 1.00 | 1 | 0.01 | |
| Modulation Interference Factor | 0.20 | Tolerance | R | 1.73 | 1 | 0.12 | Applicable for M-rating testing |
| Boundary Effects | 0.105 | Accuracy | R | 1.73 | 1 | 0.06 | * |
| Probe Positioning Accuracy | 0.20 | Accuracy | R | 1.73 | 1 | 0.12 | * |
| Probe Positioner | 0.050 | Accuracy | R | 1.73 | 1 | 0.03 | * |
| Extrapolation/Interpolation | 0.045 | Tolerance | R | 1.73 | 1 | 0.03 | * |
| Resolution to 2mm error | 0.21 | Tolerance | N | 1.00 | 1 | 0.21 | |
| System Detection Limit | 0.05 | Tolerance | R | 1.73 | 1 | 0.03 | * |
| Readout Electronics | 0.015 | Tolerance | N | 1.00 | 1 | 0.02 | * |
| Integration Time | 0.11 | Tolerance | R | 1.73 | 1 | 0.06 | * |
| Response Time | 0.033 | Tolerance | R | 1.73 | 1 | 0.02 | * |
| Phantom Thickness | 0.10 | Tolerance | R | 1.73 | 1 | 0.06 | * |
| System Repeatability (Field x 2=power) | 0.17 | Tolerance | N | 1.00 | 1 | 0.17 | * |
| **Test Sample Related** | | | | | | | |
| Device Positioning Vertical | 0.2 | Tolerance | R | 1.73 | 1 | 0.12 | * |
| Device Positioning Lateral | 0.045 | Tolerance | R | 1.73 | 1 | 0.03 | * |
| Device Holder and Phantom | 0.1 | Tolerance | R | 1.73 | 1 | 0.06 | * |
| Power Drift | 0.21 | Tolerance | R | 1.73 | 1 | 0.12 | |
| *Combined Standard Uncertainty (k=1)* | | | | | | 0.66 | 16.3% |
| ***Expanded Uncertainty [95% confidence]*** | | | | | | 1.31 | 32.6% |
| ***Expanded Uncertainty [95% confidence] on Field*** | | | | | | 0.66 | 16.3% |

Notes:
1. Test equipments are calibrated according to techniques outlined in NIS81, NIS3003 and NIST Tech Note 1297. All equipments have traceability according to NIST. Measurement Uncertainties are defined in further detail in NIS 81 and NIST Tech Note 1297 and UKAS M3003.
2. * Uncertainty specifications from Schmidt & Partner Engineering AG (not site specific)

Measurement uncertainty reflects the quality and accuracy of a measured result as compared to the true value. Such statements are generally required when stating results of measurements so that it is clear to the intended audience that the results may differ when reproduced by different facilities. Measurement results vary due to the measurement uncertainty of the instrumentation, measurement technique, and test engineer. Most uncertainties are calculated using the tolerances of the instrumentation used in the measurement, the measurement setup variability, and the technique used in performing the test. While not generally included, the variability of the equipment under test also figures into the overall measurement uncertainty. Another component of the overall uncertainty is based on the variability of repeated measurements (so-called Type A uncertainty). This may mean that the Hearing Aid immunity tests may have to be repeated by taking down the test setup and resetting it up so that there are a statistically significant number of repeat measurements to identify the measurement uncertainty. By combining the repeat measurement results with that of the instrumentation chain using the technique contained in NIS 81 and NIS 3003, the overall measurement uncertainty was estimated.



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# 14. TEST DATA

See following Attached Pages for Test Data.




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Date: 4/16/2018

PCTEST Hearing-Aid Compatibility Facility

# DUT: CD835V3 - SN1082

Type: CD835V3
Serial: 1082

**Communication System: CW; Frequency: 835 MHz;**

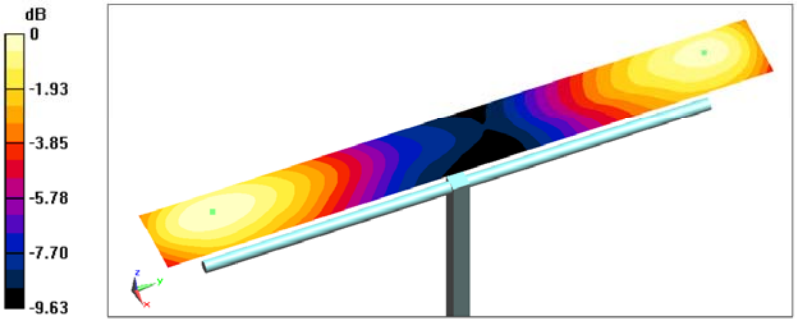
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY5 Configuration:

- Probe: ER3DV6 - SN2335; Calibrated: 8/11/2017;
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn859; Calibrated: 5/17/2017
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.10 (0);

## 835 MHz / 100mW HAC Dipole Validation at 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 = 110.9 V/m; Power Drift = 0.07 dB
Applied MIF = 0.00 dB
Average value of Peak (interpolated) = 108.7 V/m




0 dB = 110.4 V/m = 40.86 dBV/m



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Date: 4/16/2018

PCTEST Hearing-Aid Compatibility Facility

# DUT: CD1880V3 - SN1064

Type: CD1880V3
Serial: 1064

**Communication System: CW; Frequency: 1880 MHz;**

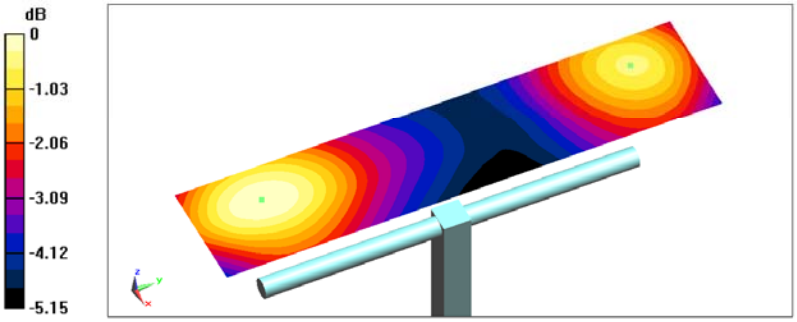
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY5 Configuration:

- Probe: ER3DV6 - SN2335; Calibrated: 8/11/2017;
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn859; Calibrated: 5/17/2017
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.10 (0);

## 1880 MHz / 100mW HAC Dipole Validation at 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 = 146.8 V/m; Power Drift = -0.13 dB
Applied MIF = 0.00 dB
Average value of Peak (interpolated) = 90.6 V/m




0 dB = 93.67 V/m = 39.43 dBV/m



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Date: 4/16/2018

PCTEST Hearing-Aid Compatibility Facility

# DUT: CD2600V3 - SN1013

Type: CD2600V3
Serial: 1013

**Communication System: CW; Frequency: 2600 MHz;**

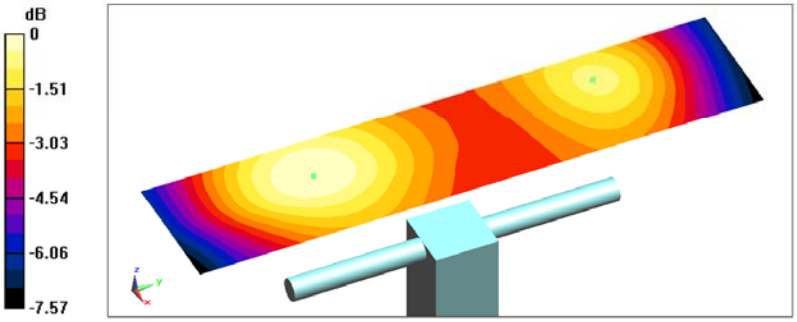
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY5 Configuration:

- Probe: ER3DV6 - SN2335; Calibrated: 8/11/2017;
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn859; Calibrated: 5/17/2017
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.10 (0);

## 2600 MHz / 100mW HAC Dipole Validation at 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 = 66.78 V/m; Power Drift = 0.05 dB
Applied MIF = 0.00 dB
Average value of Peak (interpolated) = 88.8 V/m




0 dB = 93.02 V/m = 39.37 dBV/m



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Date: 4/16/2018

PCTEST Hearing-Aid Compatibility Facility

# DUT: ZNFG710VM

Type: Portable Handset
Serial: 12330
*Backlight off*
*Duty Cycle: 1:8*

**Communication System: CDMA; Frequency: 836.52 MHz;**

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY5 Configuration:

- Probe: ER3DV6 - SN2335; Calibrated: 8/11/2017;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn859; Calibrated: 5/17/2017
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.10 (0);

## Cell. CDMA 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 = 16.52 V/m; Power Drift = 0.13 dB
Applied MIF = 3.01 dB
RF audio interference level = 25.94 dBV/m
**Emission category: M4**

MIF scaled E-field

| | | |
|---|---|---|
| Grid 1 **M4** **24.8 dBV/m** | Grid 2 **M4** **25.25 dBV/m** | Grid 3 **M4** **24.85 dBV/m** |
| Grid 4 **M4** **25.11 dBV/m** | Grid 5 **M4** **25.57 dBV/m** | Grid 6 **M4** **25.19 dBV/m** |
| Grid 7 **M4** **25.69 dBV/m** | Grid 8 **M4** **25.94 dBV/m** | Grid 9 **M4** **25.4 dBV/m** |

0 dB = 20.24 V/m = 26.12 dBV/m



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Date: 4/19/2018

PCTEST Hearing-Aid Compatibility Facility

# DUT: ZNFG710VM

Type: Portable Handset
Serial: 12330
*Backlight off*
*Duty Cycle: 1:8*

**Communication System: CDMA; Frequency: 1851.25 MHz;**

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY5 Configuration:

- Probe: ER3DV6 - SN2335; Calibrated: 8/11/2017;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn859; Calibrated: 5/17/2017
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.10 (0);

## PCS CDMA Low 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 = 6.691 V/m; Power Drift = -0.13 dB
Applied MIF = 3.00 dB
RF audio interference level = 18.58 dBV/m
**Emission category: M4**

MIF scaled E-field

| | | |
|---|---|---|
| Grid 1 **M4** **17.42 dBV/m** | Grid 2 **M4** **18.55 dBV/m** | Grid 3 **M4** **18.58 dBV/m** |
| Grid 4 **M4** **17.65 dBV/m** | Grid 5 **M4** **17.88 dBV/m** | Grid 6 **M4** **17.39 dBV/m** |
| Grid 7 **M4** **17.24 dBV/m** | Grid 8 **M4** **18.22 dBV/m** | Grid 9 **M4** **18.25 dBV/m** |

0 dB = 8.691 V/m = 18.78 dBV/m



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PCTEST Hearing-Aid Compatibility Facility

# DUT: ZNFG710VM

Type: Portable Handset
Serial: 12330
*Backlight off*
*Duty Cycle: 1:8.3*

**Communication System: GSM; Frequency: 824.2 MHz;**

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY5 Configuration:

- Probe: ER3DV6 - SN2335; Calibrated: 8/11/2017;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn859; Calibrated: 5/17/2017
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.10 (0);

## GSM850 Low 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 = 26.34 V/m; Power Drift = 0.18 dB
Applied MIF = 3.54 dB
RF audio interference level = 31.49 dBV/m
**Emission category: M4**

MIF scaled E-field

| | | |
|---|---|---|
| Grid 1 **M4** **29.42 dBV/m** | Grid 2 **M4** **31.26 dBV/m** | Grid 3 **M4** **30.72 dBV/m** |
| Grid 4 **M4** **29.8 dBV/m** | Grid 5 **M4** **31.45 dBV/m** | Grid 6 **M4** **31 dBV/m** |
| Grid 7 **M4** **30.59 dBV/m** | Grid 8 **M4** **31.49 dBV/m** | Grid 9 **M4** **31.12 dBV/m** |

0 dB = 37.35 V/m = 31.45 dBV/m



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Date: 4/16/2018

PCTEST Hearing-Aid Compatibility Facility

# DUT: ZNFG710VM

Type: Portable Handset
Serial: 12330
*Backlight off*
*Duty Cycle: 1:8.3*

**Communication System: GSM; Frequency: 1850.2 MHz;**

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY5 Configuration:

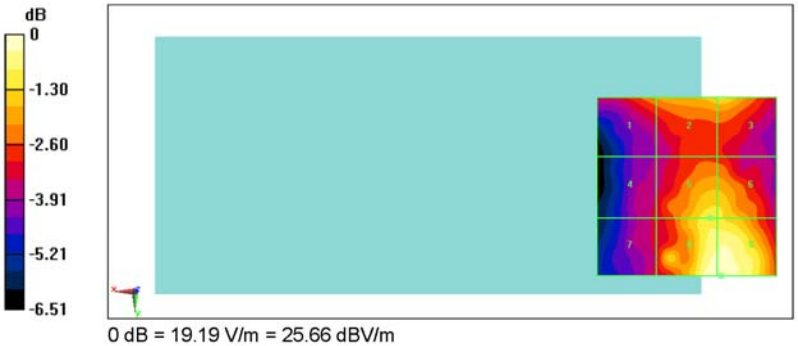
- Probe: ER3DV6 - SN2335; Calibrated: 8/11/2017;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn859; Calibrated: 5/17/2017
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.10 (0);

## GSM1900 Low 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 = 12.69 V/m; Power Drift = -0.03 dB
Applied MIF = 3.54 dB
RF audio interference level = 25.70 dBV/m
**Emission category: M4**

MIF scaled E-field

| | | |
|---|---|---|
| Grid 1 **M4** **23.57 dBV/m** | Grid 2 **M4** **24.52 dBV/m** | Grid 3 **M4** **24.57 dBV/m** |
| Grid 4 **M4** **22.39 dBV/m** | Grid 5 **M4** **24.61 dBV/m** | Grid 6 **M4** **24.5 dBV/m** |
| Grid 7 **M4** **22.43 dBV/m** | Grid 8 **M4** **25.69 dBV/m** | Grid 9 **M4** **25.7 dBV/m** |




0 dB = 19.19 V/m = 25.66 dBV/m



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Date: 4/16/2018

PCTEST Hearing-Aid Compatibility Facility

# DUT: ZNFG710VM

Type: Portable Handset
Serial: 12330
*Backlight off*
*Duty Cycle: 1:9.35*

**Communication System: LTE TDD41; Frequency: 2549.5 MHz;**

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY5 Configuration:

- Probe: ER3DV6 - SN2335; Calibrated: 8/11/2017;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn859; Calibrated: 5/17/2017
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.10 (0);

## Power Class 3 TDD LTE Band 41 Low Mid Channel, 20MHz BW, 16QAM, 1RB, 0RB Offset 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 = 10.99 V/m; Power Drift = 0.02 dB
Applied MIF = 3.65 dB
RF audio interference level = 27.59 dBV/m
**Emission category: M4**

MIF scaled E-field

| | | |
|---|---|---|
| Grid 1 **M4** **27.58 dBV/m** | Grid 2 **M4** **25.81 dBV/m** | Grid 3 **M4** **17.79 dBV/m** |
| Grid 4 **M4** **27.59 dBV/m** | Grid 5 **M4** **25.87 dBV/m** | Grid 6 **M4** **18.83 dBV/m** |
| Grid 7 **M4** **27.12 dBV/m** | Grid 8 **M4** **25.37 dBV/m** | Grid 9 **M4** **19.25 dBV/m** |

0 dB = 19.82 V/m = 25.94 dBV/m



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Date: 4/17/2018

PCTEST Hearing-Aid Compatibility Facility

# DUT: ZNFG710VM

Type: Portable Handset
Serial: 12330
*Backlight off*
*Duty Cycle: 1:9:35*

**Communication System: LTE TDD41; Frequency: 2593 MHz;**

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY5 Configuration:

- Probe: ER3DV6 - SN2335; Calibrated: 8/11/2017;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn859; Calibrated: 5/17/2017
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.10 (0);

## Power Class 2 TDD LTE Band 41 Mid Channel, 15MHz BW, 16QAM, 1RB, 0RB Offset 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 = 10.88 V/m; Power Drift = -0.15 dB
Applied MIF = 3.84 dB
RF audio interference level = 27.90 dBV/m
**Emission category: M4**

MIF scaled E-field

| | | |
|---|---|---|
| Grid 1 **M4** **27.88 dBV/m** | Grid 2 **M4** **25.93 dBV/m** | Grid 3 **M4** **16.67 dBV/m** |
| Grid 4 **M4** **27.9 dBV/m** | Grid 5 **M4** **25.98 dBV/m** | Grid 6 **M4** **16.7 dBV/m** |
| Grid 7 **M4** **27.29 dBV/m** | Grid 8 **M4** **25.45 dBV/m** | Grid 9 **M4** **16.57 dBV/m** |

0 dB = 20.10 V/m = 26.06 dBV/m



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# 15. CALIBRATION CERTIFICATES

The following pages include the probe calibration used to evaluate HAC for the DUT.




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**Zeughausstrasse 43, 8004 Zurich, Switzerland**

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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** PC Test

**Certificate No: ER3-2335_Aug17**

# CALIBRATION CERTIFICATE

Object: ER3DV6 - SN:2335

Calibration procedure(s): QA CAL-02.v8, QA CAL-25.v6
Calibration procedure for E-field probes optimized for close near field evaluations in air

Calibration date: August 11, 2017

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%. 08/30/2017

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards | ID | Cal Date (Certificate No.) | Scheduled Calibration |
|---|---|---|---|
| Power meter NRP | SN: 104778 | 04-Apr-17 (No. 217-02521/02522) | Apr-18 |
| Power sensor NRP-Z91 | SN: 103244 | 04-Apr-17 (No. 217-02521) | Apr-18 |
| Power sensor NRP-Z91 | SN: 103245 | 04-Apr-17 (No. 217-02525) | Apr-18 |
| Reference 20 dB Attenuator | SN: S5277 (20x) | 07-Apr-17 (No. 217-02528) | Apr-18 |
| Reference Probe ER3DV6 | SN: 2328 | 14-Oct-16 (No. ER3-2328_Oct16) | Oct-17 |
| DAE4 | SN: 789 | 2-Aug-17 (No. DAE4-789_Aug17) | Aug-18 |
| | | | |
| Secondary Standards | ID | Check Date (in house) | Scheduled Check |
| Power meter E4419B | SN: GB41293874 | 06-Apr-16 (in house check Jun-16) | In house check: Jun-18 |
| Power sensor E4412A | SN: MY41498087 | 06-Apr-16 (in house check Jun-16) | In house check: Jun-18 |
| Power sensor E4412A | SN: 000110210 | 06-Apr-16 (in house check Jun-16) | In house check: Jun-18 |
| RF generator HP 8648C | SN: US3642U01700 | 04-Aug-99 (in house check Jun-16) | In house check: Jun-18 |
| Network Analyzer HP 8753E | SN: US37390585 | 18-Oct-01 (in house check Oct-16) | In house check: Oct-17 |

| | Name | Function | Signature |
|---|---|---|---|
| Calibrated by: | Leif Klysner | Laboratory Technician | |
| Approved by: | Katja Pokovic | Technical Manager | |

Issued: August 12, 2017

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**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 |
| 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 3.0, November 2013

## 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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# Probe ER3DV6

# SN:2335

Manufactured: September 9, 2003
Calibrated: August 11, 2017

Calibrated for DASY/EASY Systems
(Note: non-compatible with DASY2 system!)





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# DASY/EASY - Parameters of Probe: ER3DV6 - SN:2335

## Basic Calibration Parameters

| | Sensor X | Sensor Y | Sensor Z | Unc (k=2) |
|---|---|---|---|---|
| Norm ($\mu V/(V/m)^2$) | 1.61 | 1.64 | 1.83 | ± 10.1 % |
| DCP (mV)[B] | 99.3 | 98.5 | 100.0 | |

## Modulation Calibration Parameters

| UID | Communication System Name | | A dB | B dB√μV | C | D dB | VR mV | Unc[E] (k=2) |
|---|---|---|---|---|---|---|---|---|
| 0 | CW | X | 0.0 | 0.0 | 1.0 | 0.00 | 194.5 | ±3.8 % |
| | | Y | 0.0 | 0.0 | 1.0 | | 207.3 | |
| | | Z | 0.0 | 0.0 | 1.0 | | 191.6 | |

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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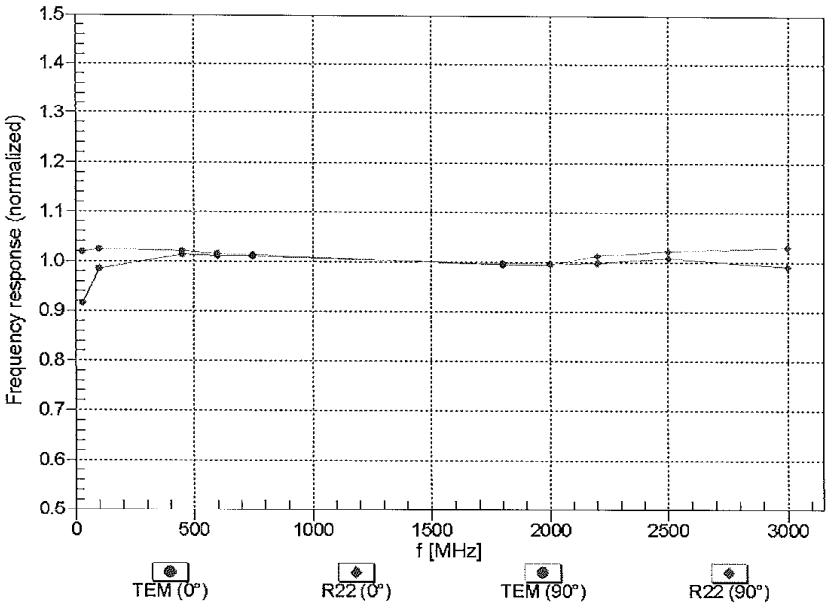
# Frequency Response of E-Field
**(TEM-Cell:ifi110 EXX, Waveguide: R22)**




**Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)**





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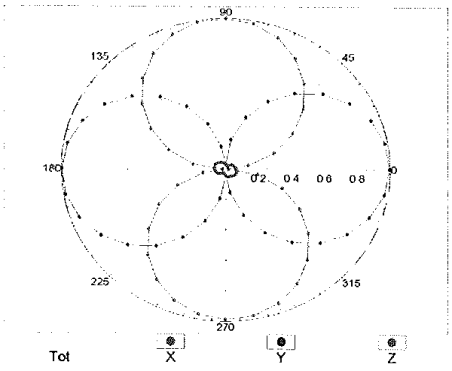
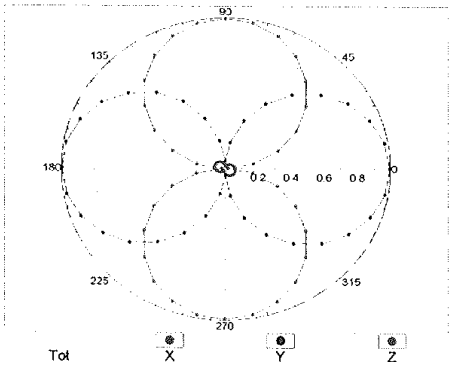
## Receiving Pattern ($\phi$), $\vartheta$ = 0°

f=600 MHz,TEM,0°

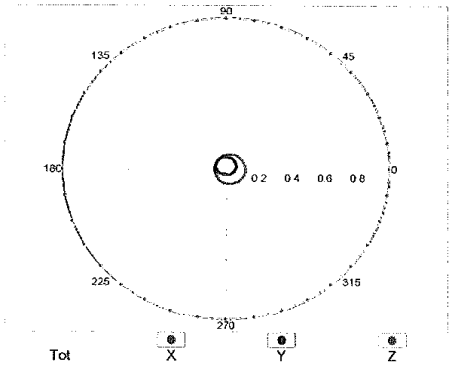



f=2500 MHz,R22,0°

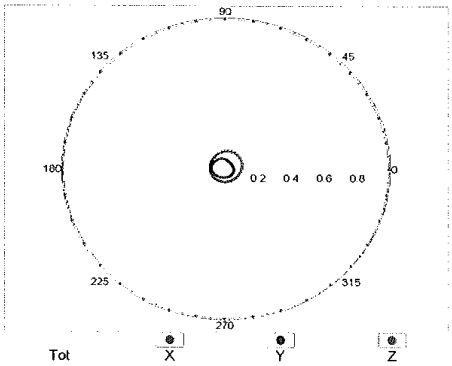



## Receiving Pattern ($\phi$), $\vartheta$ = 90°

f=600 MHz,TEM,90°




f=2500 MHz,R22,90°





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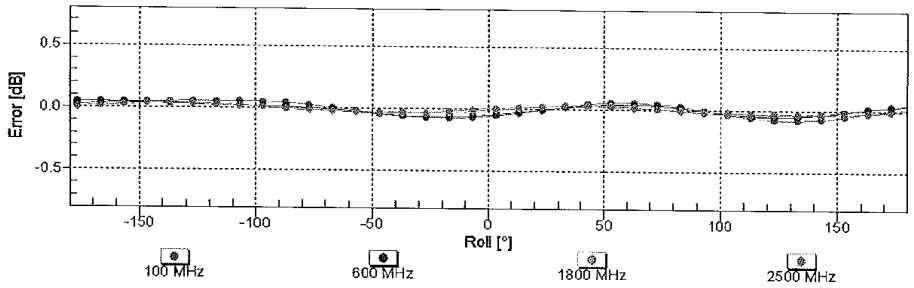
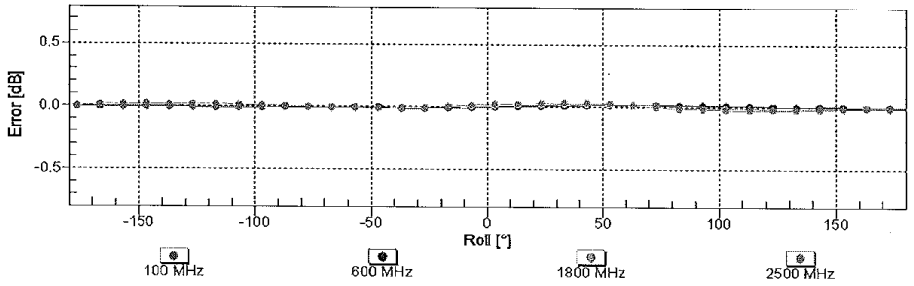
# Receiving Pattern (ϕ), ϑ = 0°




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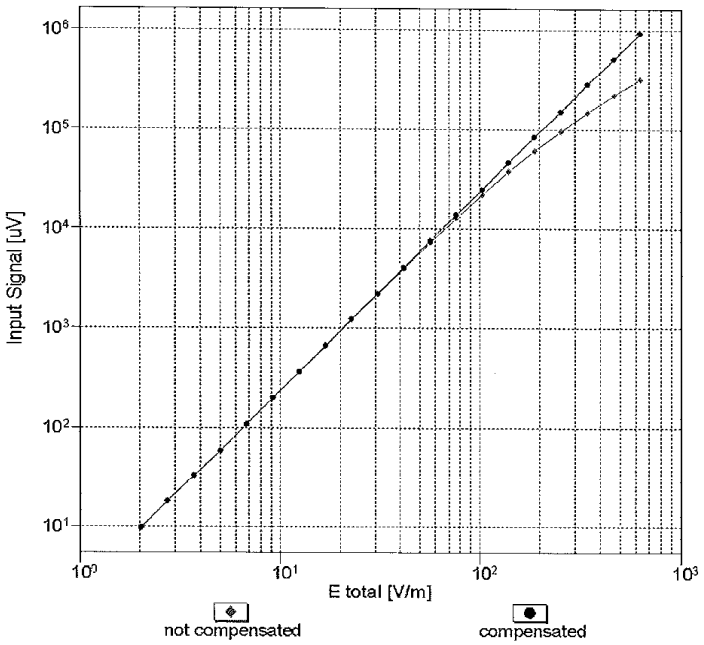
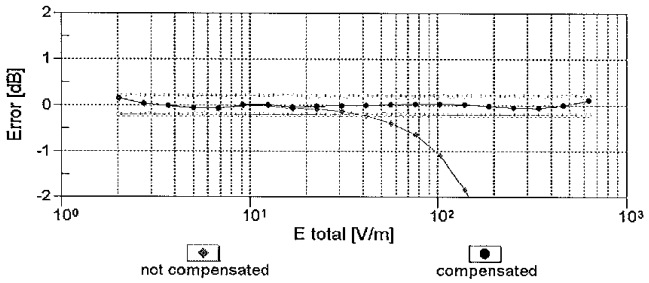
# Dynamic Range f(E-field)
(TEM cell , f = 900 MHz)




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





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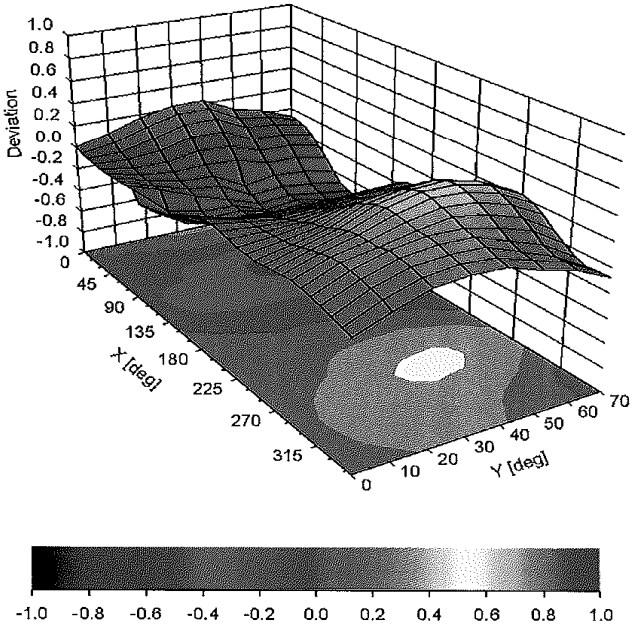
# Deviation from Isotropy in Air

**Error (ϕ, ϑ), f = 900 MHz**




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





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# DASY/EASY - Parameters of Probe: ER3DV6 - SN:2335

## Other Probe Parameters

| | |
|---|---|
| Sensor Arrangement | Rectangular |
| Connector Angle (°) | 83.1 |
| 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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Accreditation No.: SCS 0108

Client **PC Test**

Certificate No: **CD835V3-1082_May16**

# CALIBRATION CERTIFICATE

Object: CD835V3 - SN: 1082

Calibration procedure(s): QA CAL-20.v6
Calibration procedure for dipoles in air

05/25/2016

Calibration date: May 10, 2016

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 | 06-Apr-16 (No. 217-02288/02289) | Apr-17 |
| Power sensor NRP-Z91 | SN: 103244 | 06-Apr-16 (No. 217-02288) | Apr-17 |
| Power sensor NRP-Z91 | SN: 103245 | 06-Apr-16 (No. 217-02289) | Apr-17 |
| Reference 20 dB Attenuator | SN: 5058 (20k) | 05-Apr-16 (No. 217-02292) | Apr-17 |
| Type-N mismatch combination | SN: 5047.2 / 06327 | 05-Apr-16 (No. 217-02295) | Apr-17 |
| Probe ER3DV6 | SN: 2336 | 31-Dec-15 (No. ER3-2336_Dec15) | Dec-16 |
| Probe H3DV6 | SN: 6065 | 31-Dec-15 (No. H3-6065_Dec15) | Dec-16 |
| DAE4 | SN: 781 | 04-Sep-15 (No. DAE4-781_Sep15) | Sep-16 |

| Secondary Standards | ID # | Check Date (in house) | Scheduled Check |
|---|---|---|---|
| Power meter Agilent 4419B | SN: GB42420191 | 09-Oct-09 (in house check Sep-14) | In house check: Oct-17 |
| Power sensor HP E4412A | SN: US38485102 | 05-Jan-10 (in house check Sep-14) | In house check: Oct-17 |
| Power sensor HP 8482A | SN: US37295597 | 09-Oct-09 (in house check Sep-14) | In house check: Oct-17 |
| RF generator R&S SMT-06 | SN: 832283/011 | 27-Aug-12 (in house check Oct-15) | In house check: Oct-17 |
| Network Analyzer HP 8753E | SN: US37390585 | 18-Oct-01 (in house check Oct-15) | In house check: Oct-16 |

| | Name | Function | Signature |
|---|---|---|---|
| Calibrated by: | Jeton Kastrati | Laboratory Technician | |
| Approved by: | Katja Pokovic | Technical Manager | |

Issued: May 12, 2016

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Accreditation No.: SCS 0108

**References**

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

**Methods Applied and Interpretation of Parameters:**

- *Coordinate System:* y-axis is in the direction of the dipole arms. z-axis is from the basis of the antenna (mounted on the table) towards its feed point between the two dipole arms. x-axis is normal to the other axes. In coincidence with the standards [1], the measurement planes (probe sensor center) are selected to be at a distance of 15 mm above the top metal edge of the dipole arms.
- *Measurement Conditions:* Further details are available from the hardcopies at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated. The forward power to the dipole connector is set with a calibrated power meter connected and monitored with an auxiliary power meter connected to a directional coupler. While the dipole under test is connected, the forward power is adjusted to the same level.
- *Antenna Positioning:* The dipole is mounted on a HAC Test Arch phantom using the matching dipole positioner with the arms horizontal and the feeding cable coming from the floor. The measurements are performed in a shielded room with absorbers around the setup to reduce the reflections.
  It is verified before the mounting of the dipole under the Test Arch phantom, that its arms are perfectly in a line. It is installed on the HAC dipole positioner with its arms parallel below the dielectric reference wire and able to move elastically in vertical direction without changing its relative position to the top center of the Test Arch phantom. The vertical distance to the probe is adjusted after dipole mounting with a DASY5 Surface Check job. Before the measurement, the distance between phantom surface and probe tip is verified. The proper measurement distance is selected by choosing the matching section of the HAC Test Arch phantom with the proper device reference point (upper surface of the dipole) and the matching grid reference point (tip of the probe) considering the probe sensor offset. The vertical distance to the probe is essential for the accuracy.
- *Feed Point Impedance and Return Loss:* These parameters are measured using a HP 8753E Vector Network Analyzer. The impedance is specified at the SMA connector of the dipole. The influence of reflections was eliminating by applying the averaging function while moving the dipole in the air, at least 70cm away from any obstacles.
- *E-field distribution:* E field is measured in the x-y-plane with an isotropic ER3D-field probe with 100 mW forward power to the antenna feed point. In accordance with [1], the scan area is 20mm wide, its length exceeds the dipole arm length (180 or 90mm). The sensor center is 15 mm (in z) above the metal top of the dipole arms. Two 3D maxima are available near the end of the dipole arms. Assuming the dipole arms are perfectly in one line, the average of these two maxima (in subgrid 2 and subgrid 8) is determined to compensate for any non-parallelity to the measurement plane as well as the sensor displacement. The E-field value stated as calibration value represents the maximum of the interpolated 3D-E-field, in the plane above the dipole surface.

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%.





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## Measurement Conditions

DASY system configuration, as far as not given on page 1.

| DASY Version | DASY5 | V52.8.8 |
|---|---|---|
| Phantom | HAC Test Arch | |
| Distance Dipole Top - Probe Center | 15 mm | |
| Scan resolution | dx, dy = 5 mm | |
| Frequency | 835 MHz ± 1 MHz | |
| Input power drift | < 0.05 dB | |

## Maximum Field values at 835 MHz

| E-field 15 mm above dipole surface | condition | Interpolated maximum |
|---|---|---|
| Maximum measured above high end | 100 mW input power | 107.5 V/m = 40.63 dBV/m |
| Maximum measured above low end | 100 mW input power | 106.1 V/m = 40.51 dBV/m |
| Averaged maximum above arm | 100 mW input power | **106.8 V/m ± 12.8 % (k=2)** |

## Appendix (Additional assessments outside the scope of SCS 0108)

## Antenna Parameters

| Frequency | Return Loss | Impedance |
|---|---|---|
| 800 MHz | 16.4 dB | 44.5 Ω - 13.4 jΩ |
| 835 MHz | 26.3 dB | 50.0 Ω + 4.9 jΩ |
| 900 MHz | 16.4 dB | 57.4 Ω - 14.7 jΩ |
| 950 MHz | 21.9 dB | 43.6 Ω + 4.0 jΩ |
| 960 MHz | 17.2 dB | 47.9 Ω + 13.5 jΩ |

### 3.2 Antenna Design and Handling

The calibration dipole has a symmetric geometry with a built-in two stub matching network, which leads to the enhanced bandwidth.
The dipole is built of standard semirigid coaxial cable. The internal matching line is open ended. The antenna is therefore open for DC signals.
Do not apply force to dipole arms, as they are liable to bend. The soldered connections near the feedpoint may be damaged. After excessive mechanical stress or overheating, check the impedance characteristics to ensure that the internal matching network is not affected.

After long term use with 40W radiated power, only a slight warming of the dipole near the feedpoint can be measured.





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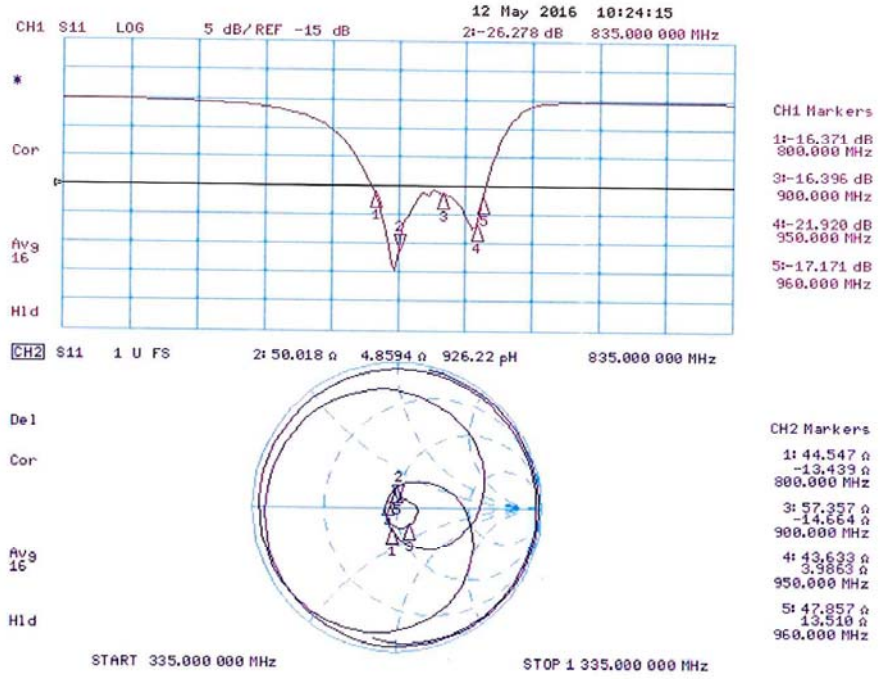
## Impedance Measurement Plot





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## DASY5 E-field Result

Date: 10.05.2016

Test Laboratory: SPEAG Lab2

**DUT: HAC-Dipole 835 MHz; Type: CD835V3; Serial: CD835V3 - SN: 1082**

Communication System: UID 0 - CW ; Frequency: 835 MHz
Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 1000$ kg/m$^3$
Phantom section: RF Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

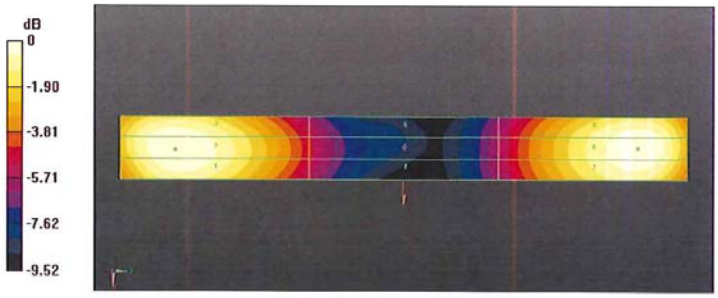
DASY52 Configuration:

- Probe: ER3DV6 - SN2336; ConvF(1, 1, 1); Calibrated: 31.12.2015;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn781; Calibrated: 04.09.2015
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA; Serial: 1070
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

**Dipole E-Field measurement @ 835MHz/E-Scan - 835MHz d=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 = 109.8 V/m; Power Drift = 0.02 dB
Applied MIF = 0.00 dB
RF audio interference level = 40.63 dBV/m
**Emission category: M3**

MIF scaled E-field

| | | |
|---|---|---|
| Grid 1 **M3** **40.52 dBV/m** | Grid 2 **M3** **40.63 dBV/m** | Grid 3 **M3** **40.46 dBV/m** |
| Grid 4 **M4** **35.69 dBV/m** | Grid 5 **M4** **35.78 dBV/m** | Grid 6 **M4** **35.62 dBV/m** |
| Grid 7 **M3** **40.38 dBV/m** | Grid 8 **M3** **40.51 dBV/m** | Grid 9 **M3** **40.37 dBV/m** |




0 dB = 107.5 V/m = 40.63 dBV/m





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**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** PC Test

Certificate No: **CD1880V3-1064_May16**

# CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | CD1880V3 - SN: 1064 |
| Calibration procedure(s) | QA CAL-20.v6<br>Calibration procedure for dipoles in air |
| Calibration date: | May 12, 2016 |

05/25/2016

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 | 06-Apr-16 (No. 217-02288/02289) | Apr-17 |
| Power sensor NRP-Z91 | SN: 103244 | 06-Apr-16 (No. 217-02288) | Apr-17 |
| Power sensor NRP-Z91 | SN: 103245 | 06-Apr-16 (No. 217-02289) | Apr-17 |
| Reference 20 dB Attenuator | SN: 5058 (20k) | 05-Apr-16 (No. 217-02292) | Apr-17 |
| Type-N mismatch combination | SN: 5047.2 / 06327 | 05-Apr-16 (No. 217-02295) | Apr-17 |
| Probe ER3DV6 | SN: 2336 | 31-Dec-15 (No. ER3-2336_Dec15) | Dec-16 |
| Probe H3DV6 | SN: 6065 | 31-Dec-15 (No. H3-6065_Dec15) | Dec-16 |
| DAE4 | SN: 781 | 04-Sep-15 (No. DAE4-781_Sep15) | Sep-16 |

| Secondary Standards | ID # | Check Date (in house) | Scheduled Check |
|---|---|---|---|
| Power meter Agilent 4419B | SN: GB42420191 | 09-Oct-09 (in house check Sep-14) | In house check: Oct-17 |
| Power sensor HP E4412A | SN: US38485102 | 05-Jan-10 (in house check Sep-14) | In house check: Oct-17 |
| Power sensor HP 8482A | SN: US37295597 | 09-Oct-09 (in house check Sep-14) | In house check: Oct-17 |
| RF generator R&S SMT-06 | SN: 832283/011 | 27-Aug-12 (in house check Oct-15) | In house check: Oct-17 |
| Network Analyzer HP 8753E | SN: US37390585 | 18-Oct-01 (in house check Oct-15) | In house check: Oct-16 |

| | Name | Function | Signature |
|---|---|---|---|
| Calibrated by: | Jeton Kastrati | Laboratory Technician | |
| Approved by: | Katja Pokovic | Technical Manager | |

Issued: May 12, 2016

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**References**

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

**Methods Applied and Interpretation of Parameters:**

- *Coordinate System:* y-axis is in the direction of the dipole arms. z-axis is from the basis of the antenna (mounted on the table) towards its feed point between the two dipole arms. x-axis is normal to the other axes. In coincidence with the standards [1], the measurement planes (probe sensor center) are selected to be at a distance of 15 mm above the top metal edge of the dipole arms.
- *Measurement Conditions:* Further details are available from the hardcopies at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated. The forward power to the dipole connector is set with a calibrated power meter connected and monitored with an auxiliary power meter connected to a directional coupler. While the dipole under test is connected, the forward power is adjusted to the same level.
- *Antenna Positioning:* The dipole is mounted on a HAC Test Arch phantom using the matching dipole positioner with the arms horizontal and the feeding cable coming from the floor. The measurements are performed in a shielded room with absorbers around the setup to reduce the reflections.
  It is verified before the mounting of the dipole under the Test Arch phantom, that its arms are perfectly in a line. It is installed on the HAC dipole positioner with its arms parallel below the dielectric reference wire and able to move elastically in vertical direction without changing its relative position to the top center of the Test Arch phantom. The vertical distance to the probe is adjusted after dipole mounting with a DASY5 Surface Check job. Before the measurement, the distance between phantom surface and probe tip is verified. The proper measurement distance is selected by choosing the matching section of the HAC Test Arch phantom with the proper device reference point (upper surface of the dipole) and the matching grid reference point (tip of the probe) considering the probe sensor offset. The vertical distance to the probe is essential for the accuracy.
- *Feed Point Impedance and Return Loss:* These parameters are measured using a HP 8753E Vector Network Analyzer. The impedance is specified at the SMA connector of the dipole. The influence of reflections was eliminating by applying the averaging function while moving the dipole in the air, at least 70cm away from any obstacles.
- *E-field distribution:* E field is measured in the x-y-plane with an isotropic ER3D-field probe with 100 mW forward power to the antenna feed point. In accordance with [1], the scan area is 20mm wide, its length exceeds the dipole arm length (180 or 90mm). The sensor center is 15 mm (in z) above the metal top of the dipole arms. Two 3D maxima are available near the end of the dipole arms. Assuming the dipole arms are perfectly in one line, the average of these two maxima (in subgrid 2 and subgrid 8) is determined to compensate for any non-parallelity to the measurement plane as well as the sensor displacement. The E-field value stated as calibration value represents the maximum of the interpolated 3D-E-field, in the plane above the dipole surface.

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%.





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## Measurement Conditions

DASY system configuration, as far as not given on page 1.

| DASY Version | DASY5 | V52.8.8 |
|---|---|---|
| Phantom | HAC Test Arch | |
| Distance Dipole Top - Probe Center | 15 mm | |
| Scan resolution | dx, dy = 5 mm | |
| Frequency | 1730 MHz ± 1 MHz<br>1880 MHz ± 1 MHz | |
| Input power drift | < 0.05 dB | |

## Maximum Field values at 1730 MHz

| E-field 15 mm above dipole surface | condition | Interpolated maximum |
|---|---|---|
| Maximum measured above high end | 100 mW input power | 96.1 V/m = 39.66 dBV/m |
| Maximum measured above low end | 100 mW input power | 95.3 V/m = 39.58 dBV/m |
| Averaged maximum above arm | 100 mW input power | **95.7 V/m ± 12.8 % (k=2)** |

## Maximum Field values at 1880 MHz

| E-field 15 mm above dipole surface | condition | Interpolated maximum |
|---|---|---|
| Maximum measured above high end | 100 mW input power | 91.2 V/m = 39.20 dBV/m |
| Maximum measured above low end | 100 mW input power | 88.0 V/m = 38.89 dBV/m |
| Averaged maximum above arm | 100 mW input power | **89.6 V/m ± 12.8 % (k=2)** |





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## Appendix (Additional assessments outside the scope of SCS 0108)

## Antenna Parameters

### Nominal Frequencies

| Frequency | Return Loss | Impedance |
|---|---|---|
| 1730 MHz | 24.0 dB | 49.6 Ω + 6.3 jΩ |
| 1880 MHz | 19.8 dB | 49.5 Ω + 10.2 jΩ |
| 1900 MHz | 20.4 dB | 52.9 Ω + 9.4 jΩ |
| 1950 MHz | 26.8 dB | 54.4 Ω + 1.8 jΩ |
| 2000 MHz | 22.7 dB | 43.2 Ω + 0.8 jΩ |

### 3.2 Antenna Design and Handling

The calibration dipole has a symmetric geometry with a built-in two stub matching network, which leads to the enhanced bandwidth.
The dipole is built of standard semirigid coaxial cable. The internal matching line is open ended. The antenna is therefore open for DC signals.
Do not apply force to dipole arms, as they are liable to bend. The soldered connections near the feedpoint may be damaged. After excessive mechanical stress or overheating, check the impedance characteristics to ensure that the internal matching network is not affected.

After long term use with 40W radiated power, only a slight warming of the dipole near the feedpoint can be measured.





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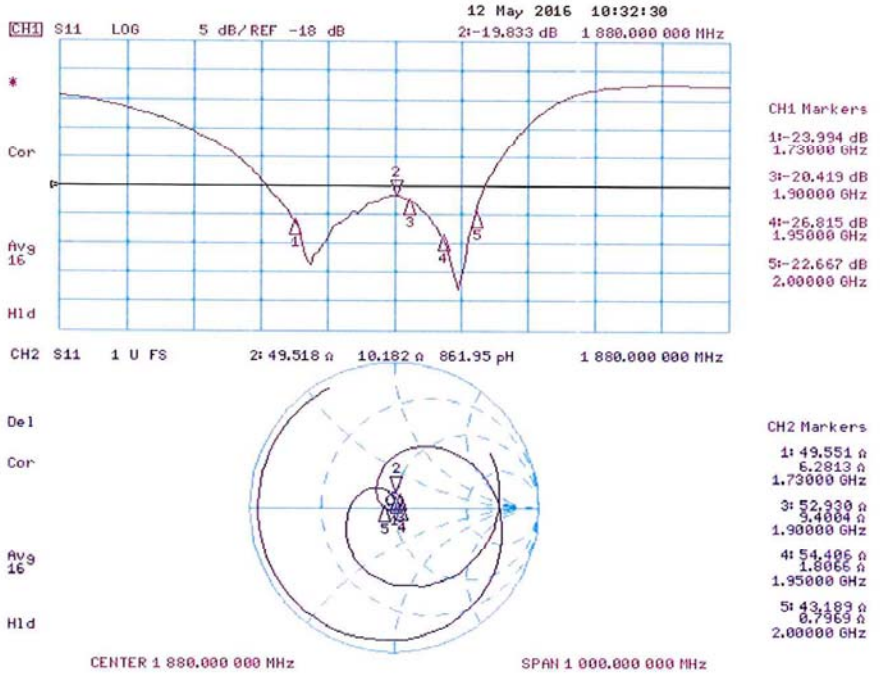
## Impedance Measurement Plot





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## DASY5 E-field Result

Date: 10.05.2016

Test Laboratory: SPEAG Lab2

**DUT: HAC Dipole 1880 MHz; Type: CD1880V3; Serial: CD1880V3 - SN: 1064**

Communication System: UID 0 - CW ; Frequency: 1880 MHz, Frequency: 1730 MHz
Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 1000$ kg/m$^3$
Phantom section: RF Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ER3DV6 - SN2336; ConvF(1, 1, 1); Calibrated: 31.12.2015;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn781; Calibrated: 04.09.2015
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA; Serial: 1070
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

**Dipole E-Field measurement @ 1880MHz/E-Scan - 1880MHz d=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 = 151.7 V/m; Power Drift = -0.01 dB
Applied MIF = 0.00 dB
RF audio interference level = 39.20 dBV/m
**Emission category: M2**

MIF scaled E-field

| | | |
|---|---|---|
| Grid 1 **M2** **39.04 dBV/m** | Grid 2 **M2** **39.2 dBV/m** | Grid 3 **M2** **39.08 dBV/m** |
| Grid 4 **M2** **36.76 dBV/m** | Grid 5 **M2** **36.86 dBV/m** | Grid 6 **M2** **36.75 dBV/m** |
| Grid 7 **M2** **38.68 dBV/m** | Grid 8 **M2** **38.89 dBV/m** | Grid 9 **M2** **38.8 dBV/m** |





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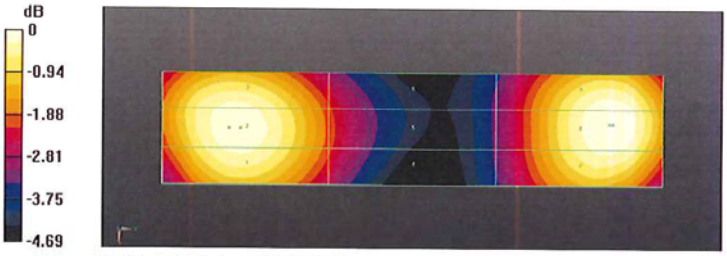
**Dipole E-Field measurement @ 1880MHz/E-Scan - 1730MHz d=15mm/Hearing Aid Compatibility Test (41x181x1):**
Interpolated grid: dx=0.5000 mm, dy=0.5000 mm
Device Reference Point: 0, 0, -6.3 mm
Reference Value = 168.3 V/m; Power Drift = 0.00 dB
Applied MIF = 0.00 dB
RF audio interference level = 39.66 dBV/m
**Emission category: M2**

MIF scaled E-field

| | | |
|---|---|---|
| Grid 1 M2<br>**39.43 dBV/m** | Grid 2 M2<br>**39.58 dBV/m** | Grid 3 M2<br>**39.44 dBV/m** |
| Grid 4 M2<br>**37.46 dBV/m** | Grid 5 M2<br>**37.56 dBV/m** | Grid 6 M2<br>**37.42 dBV/m** |
| Grid 7 M2<br>**39.44 dBV/m** | Grid 8 M2<br>**39.66 dBV/m** | Grid 9 M2<br>**39.57 dBV/m** |




0 dB = 91.23 V/m = 39.20 dBV/m





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**Accreditation No.: SCS 0108**

**Client** **PC Test**

**Certificate No: CD2600V3-1013_Jun17/2**

# CALIBRATION CERTIFICATE (Replacement of No:CD2600V3-1013_Jun17)

| | |
|---|---|
| Object | CD2600V3 - SN: 1013 |
| Calibration procedure(s) | QA CAL-20.v6<br>Calibration procedure for dipoles in air |
| Calibration date: | June 14, 2017 |

03/02/2017

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 | 04-Apr-17 (No. 217-02521/02522) | Apr-18 |
| Power sensor NRP-Z91 | SN: 103244 | 04-Apr-17 (No. 217-02521) | Apr-18 |
| Power sensor NRP-Z91 | SN: 103245 | 04-Apr-17 (No. 217-02522) | Apr-18 |
| Reference 20 dB Attenuator | SN: 5058 (20k) | 07-Apr-17 (No. 217-02528) | Apr-18 |
| Type-N mismatch combination | SN: 5047.2 / 06327 | 07-Apr-17 (No. 217-02529) | Apr-18 |
| Probe EF3DV6 | SN: 4013 | 21-Jun-16 (No. EF3-4013_Jun16) | Jun-17 |
| DAE4 | SN: 781 | 02-Sep-16 (No. DAE4-781_Sep16) | Sep-17 |

| Secondary Standards | ID # | Check Date (in house) | Scheduled Check |
|---|---|---|---|
| Power meter Agilent 4419B | SN: GB42420191 | 09-Oct-09 (in house check Sep-14) | In house check: Oct-17 |
| Power sensor HP E4412A | SN: US38485102 | 05-Jan-10 (in house check Sep-14) | In house check: Oct-17 |
| Power sensor HP 8482A | SN: US37295597 | 09-Oct-09 (in house check Sep-14) | In house check: Oct-17 |
| RF generator R&S SMT-06 | SN: 832283/011 | 27-Aug-12 (in house check Oct-15) | In house check: Oct-17 |
| Network Analyzer HP 8753E | SN: US37390585 | 18-Oct-01 (in house check Oct-16) | In house check: Oct-17 |

| | Name | Function | Signature |
|---|---|---|---|
| Calibrated by: | Johannes Kurikka | Laboratory Technician | |
| Approved by: | Katja Pokovic | Technical Manager | |

Issued: July 20, 2017

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**References**

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

**Methods Applied and Interpretation of Parameters:**

- *Coordinate System:* y-axis is in the direction of the dipole arms. z-axis is from the basis of the antenna (mounted on the table) towards its feed point between the two dipole arms. x-axis is normal to the other axes. In coincidence with the standards [1], the measurement planes (probe sensor center) are selected to be at a distance of 15 mm above the top metal edge of the dipole arms.
- *Measurement Conditions:* Further details are available from the hardcopies at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated. The forward power to the dipole connector is set with a calibrated power meter connected and monitored with an auxiliary power meter connected to a directional coupler. While the dipole under test is connected, the forward power is adjusted to the same level.
- *Antenna Positioning:* The dipole is mounted on a HAC Test Arch phantom using the matching dipole positioner with the arms horizontal and the feeding cable coming from the floor. The measurements are performed in a shielded room with absorbers around the setup to reduce the reflections.
  It is verified before the mounting of the dipole under the Test Arch phantom, that its arms are perfectly in a line. It is installed on the HAC dipole positioner with its arms parallel below the dielectric reference wire and able to move elastically in vertical direction without changing its relative position to the top center of the Test Arch phantom. The vertical distance to the probe is adjusted after dipole mounting with a DASY5 Surface Check job. Before the measurement, the distance between phantom surface and probe tip is verified. The proper measurement distance is selected by choosing the matching section of the HAC Test Arch phantom with the proper device reference point (upper surface of the dipole) and the matching grid reference point (tip of the probe) considering the probe sensor offset. The vertical distance to the probe is essential for the accuracy.
- *Feed Point Impedance and Return Loss:* These parameters are measured using a HP 8753E Vector Network Analyzer. The impedance is specified at the SMA connector of the dipole. The influence of reflections was eliminating by applying the averaging function while moving the dipole in the air, at least 70cm away from any obstacles.
- *E-field distribution:* E field is measured in the x-y-plane with an isotropic ER3D-field probe with 100 mW forward power to the antenna feed point. In accordance with [1], the scan area is 20mm wide, its length exceeds the dipole arm length (180 or 90mm). The sensor center is 15 mm (in z) above the metal top of the dipole arms. Two 3D maxima are available near the end of the dipole arms. Assuming the dipole arms are perfectly in one line, the average of these two maxima (in subgrid 2 and subgrid 8) is determined to compensate for any non-parallelity to the measurement plane as well as the sensor displacement. The E-field value stated as calibration value represents the maximum of the interpolated 3D-E-field, in the plane above the dipole surface.

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%.





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## Measurement Conditions

DASY system configuration, as far as not given on page 1.

| | | |
|---|---|---|
| **DASY Version** | DASY5 | V52.10.0 |
| **Phantom** | HAC Test Arch | |
| **Distance Dipole Top - Probe Center** | 15 mm | |
| **Scan resolution** | dx, dy = 5 mm | |
| **Frequency** | 2600 MHz ± 1 MHz | |
| **Input power drift** | < 0.05 dB | |

## Maximum Field values at 2600 MHz

| **E-field 15 mm above dipole surface** | condition | **Interpolated maximum** |
|---|---|---|
| Maximum measured above high end | 100 mW input power | 84.9 V/m = 38.58 dBV/m |
| Maximum measured above low end | 100 mW input power | 84.0 V/m = 38.48 dBV/m |
| Averaged maximum above arm | 100 mW input power | **84.5 V/m ± 12.8 % (k=2)** |

## Appendix (Additional assessments outside the scope of SCS 0108)

## Antenna Parameters

| **Frequency** | **Return Loss** | **Impedance** |
|---|---|---|
| 2450 MHz | 23.3 dB | 44.8 Ω - 3.8 jΩ |
| 2550 MHz | 32.2 dB | 51.0 Ω + 2.3 jΩ |
| 2600 MHz | 29.5 dB | 53.4 Ω - 0.3 jΩ |
| 2650 MHz | 27.0 dB | 53.2 Ω - 3.3 jΩ |
| 2750 MHz | 19.7 dB | 45.7 Ω - 8.9 jΩ |

### 3.2 Antenna Design and Handling

The calibration dipole has a symmetric geometry with a built-in two stub matching network, which leads to the enhanced bandwidth.
The dipole is built of standard semirigid coaxial cable. The internal matching line is open ended. The antenna is therefore open for DC signals.
Do not apply force to dipole arms, as they are liable to bend. The soldered connections near the feedpoint may be damaged. After excessive mechanical stress or overheating, check the impedance characteristics to ensure that the internal matching network is not affected.

After long term use with 40W radiated power, only a slight warming of the dipole near the feedpoint can be measured.





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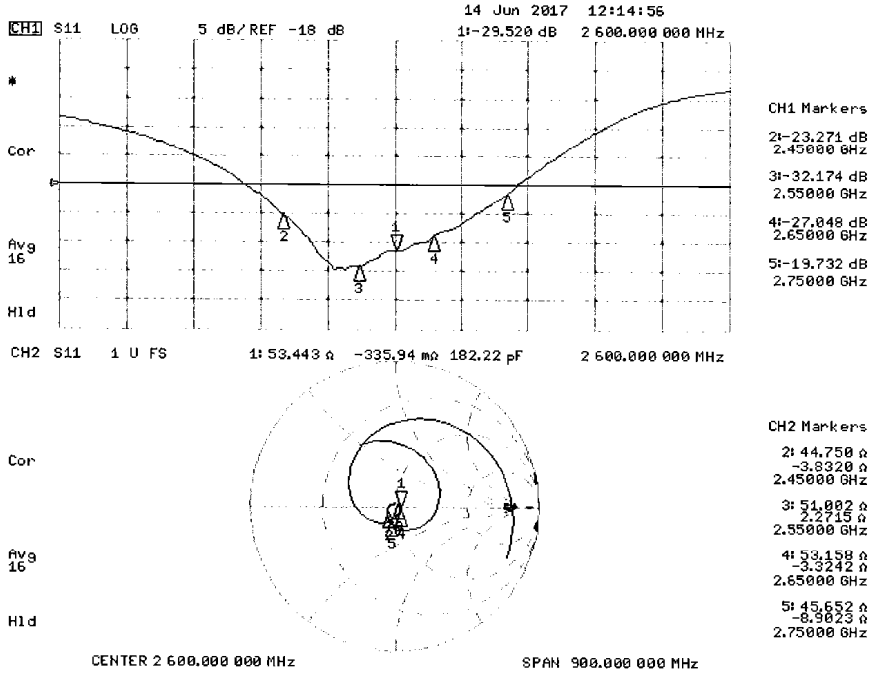
## Impedance Measurement Plot





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**DASY5 E-field Result**

Date: 14.06.2017

Test Laboratory: SPEAG Lab2

**DUT: HAC Dipole 2600 MHz; Type: CD2600V3; Serial: CD2600V3 - SN: 1013**

Communication System: UID 0 - CW ; Frequency: 2600 MHz
Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 1000$ kg/m$^3$
Phantom section: RF Section

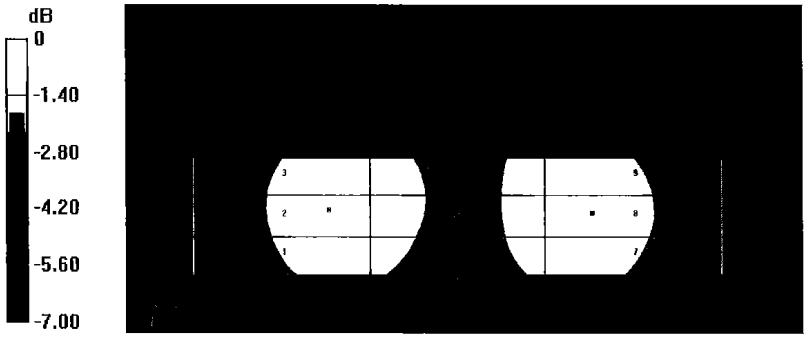
DASY52 Configuration:

- Probe: EF3DV3 - SN4013; ConvF(1, 1, 1); Calibrated:21.06.2016 ;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn781; Calibrated: 02.09.2016
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA; Serial: 1070
- DASY52 52.10.0(1444); SEMCAD X 14.6.10(7416)

**Dipole E-Field measurement @ 2600MHz - with EF_4013/E-Scan - 2600MHz d=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 = 68.41 V/m; Power Drift = -0.01 dB
PMR not calibrated. PMF = 1.000 is applied.
E-field emissions = 84.92 V/m
**Near-field category: M3 (AWF 0 dB)**

PMF scaled E-field

| | | |
|---|---|---|
| Grid 1 **M3** **81.71 V/m** | Grid 2 **M3** **83.99 V/m** | Grid 3 **M3** **83.23 V/m** |
| Grid 4 **M3** **77.39 V/m** | Grid 5 **M3** **79.18 V/m** | Grid 6 **M3** **78.75 V/m** |
| Grid 7 **M3** **82.82 V/m** | Grid 8 **M3** **84.92 V/m** | Grid 9 **M3** **83.82 V/m** |




0 dB = 84.92 V/m = 38.58 dBV/m





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# 16. CONCLUSION

The measurements indicate that the wireless communications device complies with the HAC limits specified in accordance with the ANSI C63.19 Standard and FCC WT Docket No. 01-309 RM-8658. Precise laboratory measures were taken to assure repeatability of the tests. The tested device complies with the requirements in respect to all parameters specific to the test. The test results and statements relate only to the item(s) tested.

Please note that the M-rating for this equipment only represents the field interference possible against a hypothetical and typical hearing aid. The measurement system and techniques presented in this evaluation are proposed in the ANSI standard as a means of best approximating wireless device compatibility with a hearing-aid. The literature is under continual re-construction.




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