

### Measurement Conditions

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

|                                    |                     |          |
|------------------------------------|---------------------|----------|
| DASY Version                       | DASY5               | V52.10.1 |
| Phantom                            | HAC Test Arch       |          |
| Distance Dipole Top - Probe Center | 15 mm               |          |
| Scan resolution                    | dx, dy = 5 mm       |          |
| Frequency                          | 835 MHz $\pm$ 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 | 108.7 V/m = 40.72 dBV/m                        |
| Maximum measured above low end     | 100 mW input power | 108.6 V/m = 40.72 dBV/m                        |
| Averaged maximum above arm         | 100 mW input power | <b>108.7 V/m <math>\pm</math> 12.8 % (k=2)</b> |

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

#### Antenna Parameters

| Frequency | Return Loss | Impedance                       |
|-----------|-------------|---------------------------------|
| 800 MHz   | 16.4 dB     | 40.0 $\Omega$ - 9.2 j $\Omega$  |
| 835 MHz   | 25.5 dB     | 53.7 $\Omega$ + 4.0 j $\Omega$  |
| 880 MHz   | 17.8 dB     | 60.3 $\Omega$ - 9.8 j $\Omega$  |
| 900 MHz   | 16.5 dB     | 51.6 $\Omega$ - 15.3 j $\Omega$ |
| 945 MHz   | 21.7 dB     | 43.9 $\Omega$ + 4.8 j $\Omega$  |

#### 3.2 Antenna Design and Handling

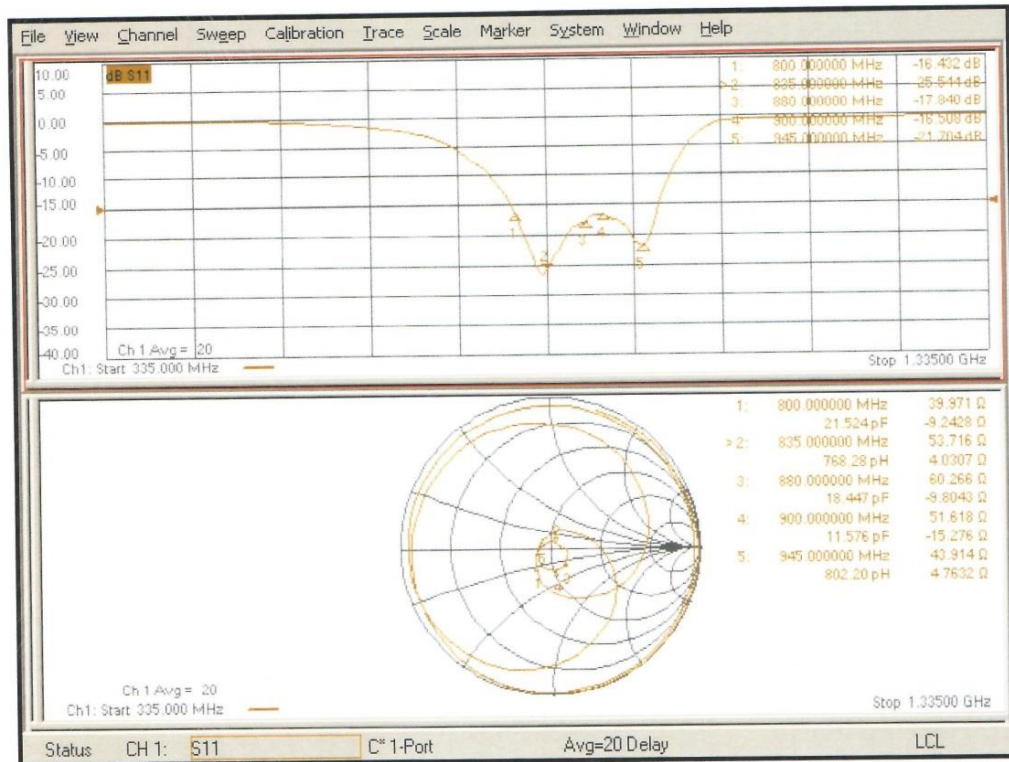
The calibration dipole has a symmetric geometry with a built-in two stub matching network, which leads to the enhanced bandwidth.

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.

## Impedance Measurement Plot



## DASY5 E-field Result

Date: 19.07.2018

Test Laboratory: SPEAG Lab2

**DUT: HAC-Dipole 835 MHz; Type: CD835V3; Serial: CD835V3 - SN: 1165**

Communication System: UID 0 - CW ; Frequency: 835 MHz

Medium parameters used:  $\sigma = 0$  S/m,  $\epsilon_r = 1$ ;  $\rho = 0$  kg/m<sup>3</sup>

Phantom section: RF Section

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

DASY52 Configuration:

- Probe: EF3DV3 - SN4013; ConvF(1, 1, 1) @ 835 MHz; Calibrated: 05.03.2018
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn781; Calibrated: 17.01.2018
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA; Serial: 1070
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

**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 = 130.9 V/m; Power Drift = 0.02 dB

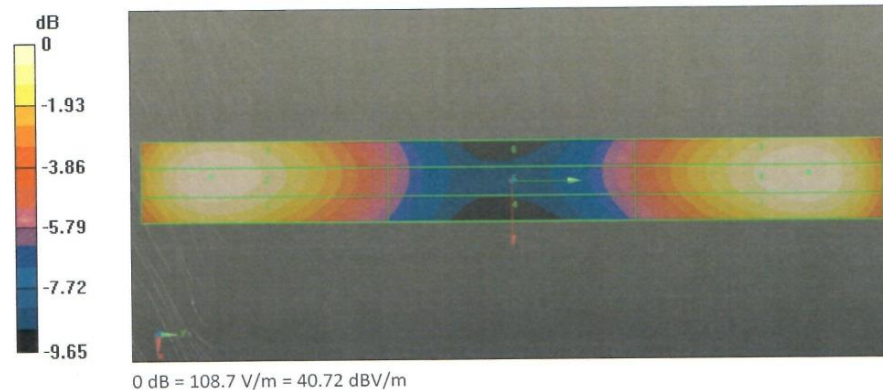
Applied MIF = 0.00 dB

RF audio interference level = 40.73 dBV/m

**Emission category: M3**

MIF scaled E-field

|             |             |             |
|-------------|-------------|-------------|
| Grid 1 M3   | Grid 2 M3   | Grid 3 M3   |
| 40.28 dBV/m | 40.72 dBV/m | 40.67 dBV/m |
| Grid 4 M4   | Grid 5 M4   | Grid 6 M4   |
| 35.61 dBV/m | 35.96 dBV/m | 35.94 dBV/m |
| Grid 7 M3   | Grid 8 M3   | Grid 9 M3   |
| 40.41 dBV/m | 40.73 dBV/m | 40.67 dBV/m |





Dipole 1880 MHz



No. I20N00775-HAC RF

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



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

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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 **CTTL (Auden)**

Certificate No: **CD1880V3-1149\_Jul18**

## CALIBRATION CERTIFICATE

Object **CD1880V3 - SN: 1149**

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

Calibration date: **July 19, 2018**

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 ( $22 \pm 3$ )°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-18 (No. 217-02672/02673)   | Apr-19                 |
| Power sensor NRP-Z91            | SN: 103244         | 04-Apr-18 (No. 217-02672)         | Apr-19                 |
| Power sensor NRP-Z91            | SN: 103245         | 04-Apr-18 (No. 217-02673)         | Apr-19                 |
| Reference 20 dB Attenuator      | SN: 5058 (20k)     | 04-Apr-18 (No. 217-02682)         | Apr-19                 |
| Type-N mismatch combination     | SN: 5047.2 / 06327 | 04-Apr-18 (No. 217-02683)         | Apr-19                 |
| Probe EF3DV3                    | SN: 4013           | 05-Mar-18 (No. EF3-4013_Mar18)    | Mar-19                 |
| Probe H3DV6                     | SN: 6065           | 30-Dec-17 (No. H3-6065_Dec17)     | Dec-18                 |
| DAE4                            | SN: 781            | 17-Jan-18 (No. DAE4-781_Jan18)    | Jan-19                 |
| Secondary Standards             | ID #               | Check Date (in house)             | Scheduled Check        |
| Power meter Agilent 4419B       | SN: GB42420191     | 09-Oct-09 (in house check Oct-17) | In house check: Oct-20 |
| Power sensor HP E4412A          | SN: US38485102     | 05-Jan-10 (in house check Oct-17) | In house check: Oct-20 |
| Power sensor HP 8482A           | SN: US37295597     | 09-Oct-09 (in house check Oct-17) | In house check: Oct-20 |
| RF generator R&S SMT-06         | SN: 832283/011     | 27-Aug-12 (in house check Oct-17) | In house check: Oct-20 |
| Network Analyzer Agilent E8358A | SN: US41080477     | 31-Mar-14 (in house check Oct-17) | In house check: Oct-18 |

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

Issued: July 19, 2018

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



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**S** Servizio svizzero di taratura  
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Multilateral Agreement for the recognition of calibration certificates

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%.

### Measurement Conditions

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

|                                    |                      |          |
|------------------------------------|----------------------|----------|
| DASY Version                       | DASY5                | V52.10.1 |
| Phantom                            | HAC Test Arch        |          |
| Distance Dipole Top - Probe Center | 15 mm                |          |
| Scan resolution                    | dx, dy = 5 mm        |          |
| Frequency                          | 1880 MHz $\pm$ 1 MHz |          |
| Input power drift                  | < 0.05 dB            |          |

### 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 | 89.8 V/m = 39.06 dBV/m                        |
| Maximum measured above low end     | 100 mW input power | 89.3 V/m = 39.02 dBV/m                        |
| Averaged maximum above arm         | 100 mW input power | <b>89.5 V/m <math>\pm</math> 12.8 % (k=2)</b> |

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

#### Antenna Parameters

| Frequency | Return Loss | Impedance                      |
|-----------|-------------|--------------------------------|
| 1730 MHz  | 23.9 dB     | 53.9 $\Omega$ + 5.4 j $\Omega$ |
| 1880 MHz  | 22.5 dB     | 54.7 $\Omega$ + 6.3 j $\Omega$ |
| 1900 MHz  | 23.4 dB     | 55.6 $\Omega$ + 4.5 j $\Omega$ |
| 1950 MHz  | 30.3 dB     | 52.9 $\Omega$ - 1.3 j $\Omega$ |
| 2000 MHz  | 21.3 dB     | 44.2 $\Omega$ + 5.7 j $\Omega$ |

#### 3.2 Antenna Design and Handling

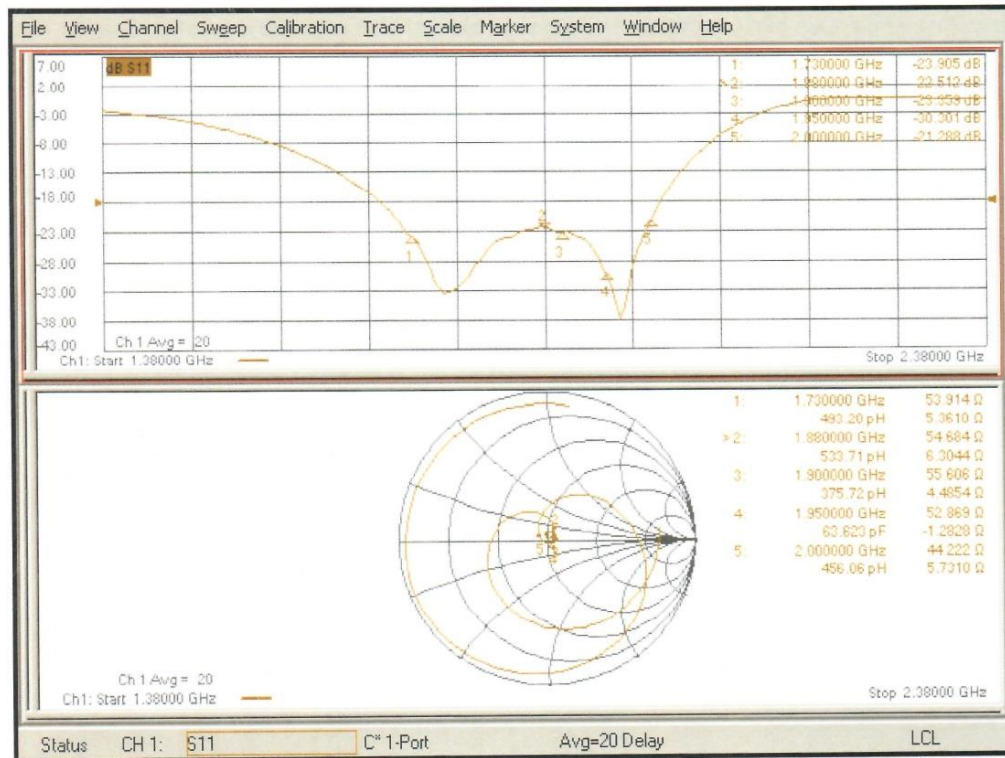
The calibration dipole has a symmetric geometry with a built-in two stub matching network, which leads to the enhanced bandwidth.

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.

## Impedance Measurement Plot





## DASY5 E-field Result

Date: 19.07.2018

Test Laboratory: SPEAG Lab2

**DUT: HAC Dipole 1880 MHz; Type: CD1880V3; Serial: CD1880V3 - SN: 1149**

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

DASY52 Configuration:

- Probe: EF3DV3 - SN4013; ConvF(1, 1, 1) @ 1880 MHz; Calibrated: 05.03.2018
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn781; Calibrated: 17.01.2018
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA; Serial: 1070
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

### 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 = 160.1 V/m; Power Drift = -0.04 dB

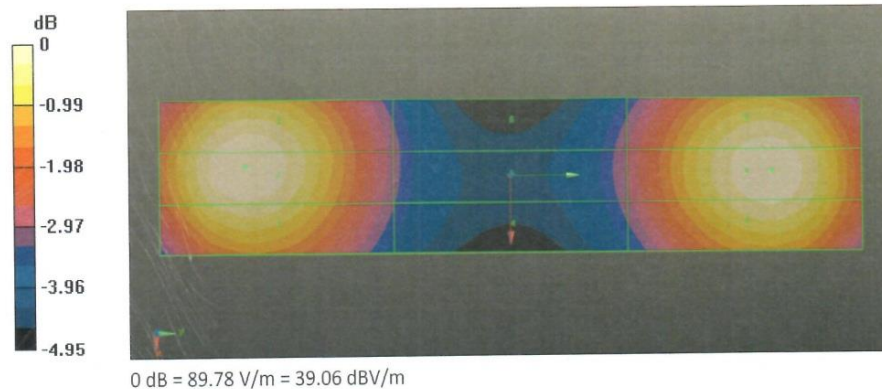
Applied MIF = 0.00 dB

RF audio interference level = 39.06 dBV/m

**Emission category: M2**

MIF scaled E-field

|             |             |             |
|-------------|-------------|-------------|
| Grid 1 M2   | Grid 2 M2   | Grid 3 M2   |
| 38.67 dBV/m | 39.06 dBV/m | 39.01 dBV/m |
| Grid 4 M2   | Grid 5 M2   | Grid 6 M2   |
| 36 dBV/m    | 36.15 dBV/m | 36.1 dBV/m  |
| Grid 7 M2   | Grid 8 M2   | Grid 9 M2   |
| 38.79 dBV/m | 39.02 dBV/m | 38.91 dBV/m |





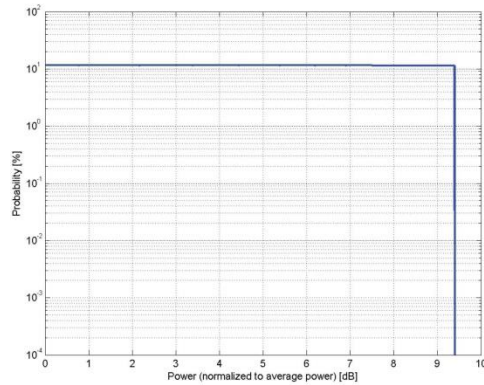
## ANNEX E: UID Specification

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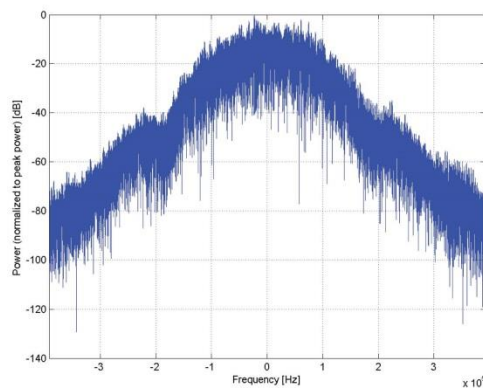
|                         |  |
|-------------------------|--|
| Name:                   | GSM-FDD (TDMA, GMSK)   |
| Group:                  | GSM  |
| UID:                    | 10021-DAC  |
| PAR: <sup>1</sup>       | 9.39 dB  |
| MIF: <sup>2</sup>       | 3.63 dB  |
| Standard Reference:     | ETSI TS 100 909 V8.9.0 (2005-01)<br>FCC OET KDB 941225, D03 and D04  |
| Category:               | Periodic pulsed modulation   |
| Modulation:             | GMSK   |
| Frequency Band:         | GSM 450 (450.4 - 457.6 MHz)<br>GSM 480 (478.8 - 486.0 MHz)<br>GSM 710 (698.0 - 716.0 MHz)<br>GSM 750 (747.0 - 763.0 MHz)<br>GSM 850 (824.0 - 849.0 MHz)<br>P-GSM 900 (890.0 - 915.0 MHz)<br>E-GSM 900 (880.0 - 915.0 MHz)<br>R-GSM 900 (876.0 - 915.0 MHz)<br>DCS 1800 (1710.0 - 1785.0 MHz)<br>PCS 1900 (1850.0 - 1910.0 MHz)<br>ER-GSM 900 (873.0 - 915.0 MHz)<br>Validation band (0.0 - 6000.0 MHz) |
| Detailed Specification: | Active Slot: TN0<br>Data: PN9 continuous<br>Frame: composed out of 8 Slots<br>Multiframe: 26th (IDLE) Frame set blank<br>Slottype & -timing: Normal burst for GMSK   |
| Bandwidth:              | 0.2 MHz  |
| Integration Time:       | 120.0 ms   |

<sup>1</sup> PAR (0.1%) in accordance with FCC KDB 971168, Section 6.0 "Measurement of the Peak-to-Average Power Ratio (PAPR)"  
<sup>2</sup> Modulation Interference Factor (MIF) value valid only in conjunction with advanced probe response linearization calibration for the same communication system (same UID and version).

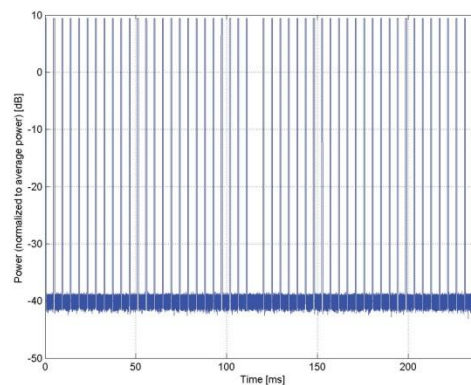
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**Complementary Cumulative Distribution Function (CCDF)**



**Frequency Domain**



**Time Domain**

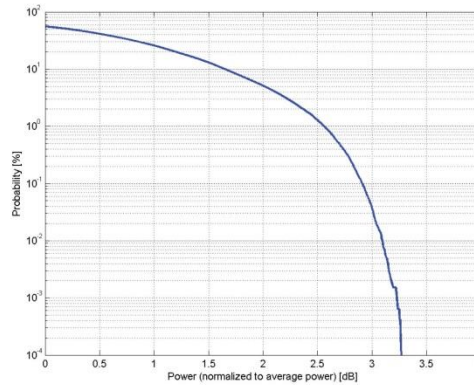
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|                         |  |
|-------------------------|--|
| Name:                   | UMTS-FDD (WCDMA)                                   |
| Group:                  | WCDMA  |
| UID:                    | 10011-CAB  |
| PAR: <sup>1</sup>       | 2.91 dB  |
| MIF: <sup>2</sup>       | -27.23 dB  |
| Standard Reference:     | 3GPP TS 25.141 Annex A                             |
| Category:               | FCC OET KDB 941225 D01 SAR test for 3G devices v02 |
| Modulation:             | Random amplitude modulation                        |
| Frequency Band:         | QPSK   |
|                         | Band 1, UTRA/FDD (1920.0-1980.0 MHz, 20000)        |
|                         | Band 2, UTRA/FDD (1850.0-1910.0 MHz, 20001)        |
|                         | Band 3, UTRA/FDD (1710.0-1785.0 MHz, 20002)        |
|                         | Band 4, UTRA/FDD (1710.0-1755.0 MHz, 20003)        |
|                         | Band 5, UTRA/FDD (824.0-849.0 MHz, 20004)          |
|                         | Band 6, UTRA/FDD (830.0-840.0 MHz, 20005)          |
|                         | Band 7, UTRA/FDD (2500.0-2570.0 MHz, 20006)        |
|                         | Band 8, UTRA/FDD (880.0-915.0 MHz, 20007)          |
|                         | Band 9, UTRA/FDD (1749.9-1784.9 MHz, 20008)        |
|                         | Band 10, UTRA/FDD (1710.0-1770.0 MHz, 20009)       |
|                         | Band 11, UTRA/FDD (1427.9-1452.9 MHz, 20010)       |
|                         | Band 12, UTRA/FDD (698.0-716.0 MHz, 20011)         |
|                         | Band 13, UTRA/FDD (777.0-787.0 MHz, 20012)         |
|                         | Band 14, UTRA/FDD (788.0-798.0 MHz, 20013)         |
|                         | Band 19, UTRA/FDD (830.0-845.0 MHz, 20130)         |
|                         | Band 20, UTRA/FDD (832.0-862.0 MHz, 20131)         |
|                         | Band 21, UTRA/FDD (1447.9-1462.9 MHz, 20132)       |
|                         | Band 22, UTRA/FDD (3410.0-3490.0 MHz, 20217)       |
|                         | Band 25, UTRA/FDD (1850.0-1915.0 MHz, 20218)       |
|                         | Band 26, UTRA/FDD (814.0-849.0 MHz, 20219)         |
| Detailed Specification: | Dedicated Channel Type: RMC                        |
|                         | Bitrate: 12.2 kbps                                 |
|                         | DPDCH: 60 kbps                                     |
|                         | DPCCH: 15 kbps                                     |
|                         | DPCCH/DPDCH power ratio: -5.46 dB                  |
| Bandwidth:              | 5.0 MHz  |
| Integration Time:       | 100.0 ms   |

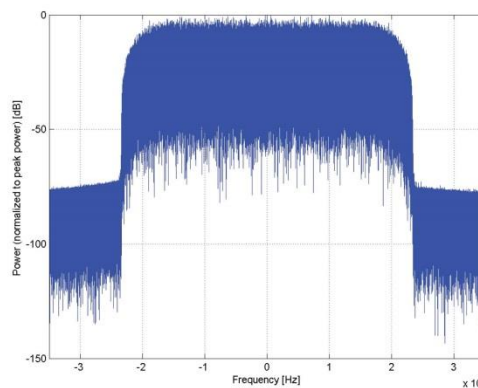
<sup>1</sup> PAR (0.1%) in accordance with FCC KDB 971168, Section 6.0 "Measurement of the Peak-to-Average Power Ratio (PAPR)"  
<sup>2</sup> Modulation Interference Factor (MIF) value valid only in conjunction with advanced probe response linearization calibration for the same communication system (same UID and version).



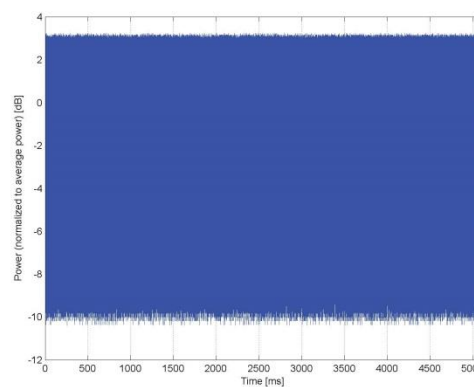
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 Zeughausstrasse 43, 8004 Zurich, Switzerland



Complementary Cumulative Distribution Function (CCDF)



Frequency Domain



Time Domain

**ANNEX F: Accreditation Certificate**



**Accredited Laboratory**

A2LA has accredited

**SHENZHEN ACADEMY OF INFORMATION AND COMMUNICATIONS TECHNOLOGY**

*Shenzhen, People's Republic of China*

for technical competence in the field of

**Electrical Testing**

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 General requirements for the competence of testing and calibration laboratories. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).



Presented this 30<sup>th</sup> day of October 2019.



Vice President, Accreditation Services  
For the Accreditation Council  
Certificate Number 4353.01  
Valid to November 30, 2021

*For the tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.*

**\*\*\*END OF REPORT\*\*\***