RF-Emission Test Report

Report No:	ZR/2020/80027
Applicant:	TCL Communication Ltd.
Manufacturer:	TCL Communication Ltd.
Product Name:	LTE/UMTS/GSM mobile phone
Model No.(EUT):	5029F
Trade Mark:	alcatel
FCC ID:	2ACCJH119
Standards:	ANSI C63.19-2011 CFR 47 FCC Part 20
Date of Receipt:	2020-08-21
Date of Test:	2020-08-24 to 2020-08-24
Date of Issue:	2020-08-25
Test conclusion:	**PASS ***

* In the configuration tested, the EUT detailed in this report complied with the standards specified above.

Authorized Signature:

Derek Yang

Wireless Laboratory Manager

The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report.

If the product in this report is used in any configuration other than that detailed in the report, the manufacturer must ensure the new system complies with all relevant standards. Any mention of SGS International Electrical Approvals or testing done by SGS International Electrical Approvals in connection with, distribution or use of the product described in this report must be approved by SGS International Electrical Approvals in writing.

REVISION HISTORY

Revision Record				
Version	Chapter	Date	Modifier	Remark
01		2020-08-25		Original

TEST SUMMARY

Frequency Band	HAC RF Emission Test result*		M-rating
GSM850	E-Field dB(V/m)	42.49	M3
GSM1900	E-Field dB(V/m)	29.90	M4
WCDMA Band II	E-Field dB(V/m)	/	M4
WCDMA Band IV	E-Field dB(V/m)	/	M4
WCDMA Band V	E-Field dB(V/m)	/	M4
LTE Band 2	E-Field dB(V/m)	/	M4
LTE Band 4	E-Field dB(V/m)	/	M4
LTE Band 5	E-Field dB(V/m)	/	M4
LTE Band 7	E-Field dB(V/m)	/	M4
LTE Band 13	E-Field dB(V/m)	/	M4
LTE Band 17	E-Field dB(V/m)	/	M4
LTE Band 66	E-Field dB(V/m)	/	M4
WiFi 2.4G	E-Field dB(V/m)	/	M4
HAC Rate Category: M3			

Note:
1) This portable wireless equipment has been shown to be hearing-aid compatible under the above rated category, specified in ANSI/IEEE Std.C63.19-2011 and had been tested in accordance with the specified measurement procedures, Hear-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 and are for North American Bands only.
2) *- HAC RF Emission Test for low power exemption according to ANSI C63.19-2011 and HAC RF Emission rating is M4 (Refer to Section 9.3 for details).

Approved & Released by

Simon Ling

SAR Manager

Tested by

Gavin Gao

SAR Engineer

CONTENTS

1 General Information

1.1 Introduction

The purpose of the Hearing Aid Compatibility is to enable measurements of the near electric fields generated by wireless communication devices in the region controlled for use by a hearing aid in accordance with ANSI-C63.19-2011

The purpose of this standard is to establish categories for hearing aids and for WD (wireless communications devices) that can indicate to health care practitioners and hearing aid users which hearing aids are compatible with which WD, and to provide tests that can be used to assess the electromagnetic characteristics of hearing aids and WD and assign them to these categories. The various parameters required, in order to demonstrate compatibility and accessibility are measured. The design of the standard is such that when a hearing aid and WD achieve one of the categories specified, as measured by the methodology of this standard, the indicated performance is realized.

In order to provide for the usability of a hearing aid with a WD, several factors must be coordinated:
a) Radio frequency (RF) measurements of the near-field electric fields emitted by a WD to categorize these emissions for correlation with the RF immunity of a hearing aid.

Hence, the following are measurements made for the WD:
RF E-Field emissions

The measurement plane is parallel to, and 1.5cm in front of, the reference plane.

Applications for certification of equipment operation under part 20, that a manufacturer is seeking to certify as hearing aid compatible, as set forth in §20.19 of that part, shall include a statement indication compliance with the test requirements of §20.19 and indicating the appropriate U-rating for the equipment. The manufacturer of the equipment shall be responsible for maintaining the test results.

1.2 Details of Client

Applicant:	TCL Communication Ltd.
Address:	5/F, Building 22E, 22 Science Park East Avenue, Hong Kong Science Park, Shatin, NT, Hong Kong
Manufacturer:	TCL Communication Ltd.
Address:	5/F, Building 22E, 22 Science Park East Avenue, Hong Kong Science Park, Shatin, NT, Hong Kong

1.3 Test Location

Company:	SGS-CSTC Standards Technical Services Co., Ltd. Xi'an Branch
Address:	Single floor D, building 1, Kanghong orange square science and technology park, No.137 keyuan 3rd road, fengdong new town, Xi 'an city, shaanxi China
Post code:	710086
Telephone:	+86 (0) 29 6282 7885
Fax:	+86 (0) 29 6282 7885
E-mail:	ee.xian@sgs.com

1.4 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

• **A2LA (Certificate No. 4854.01)**

SGS-CSTC Standards Technical Services Co., Ltd., Xi'an Branch is accredited by the American Association for Laboratory Accreditation(A2LA). Certificate No. 4854.01.

• **FCC –Designation Number: CN1271**

SGS-CSTC Standards Technical Services Co., Ltd., Xi'an Branch has been recognized as an accredited testing laboratory.

Designation Number: CN1271. Test Firm Registration Number: 637380.

• **Innovation, Science and Economic Development Canada**

SGS-CSTC Standards Technical Services Co., Ltd., Xi'an Branch has been recognized by ISED as an accredited testing laboratory.

CAB identifier: CN0095

ISED#: 25613.

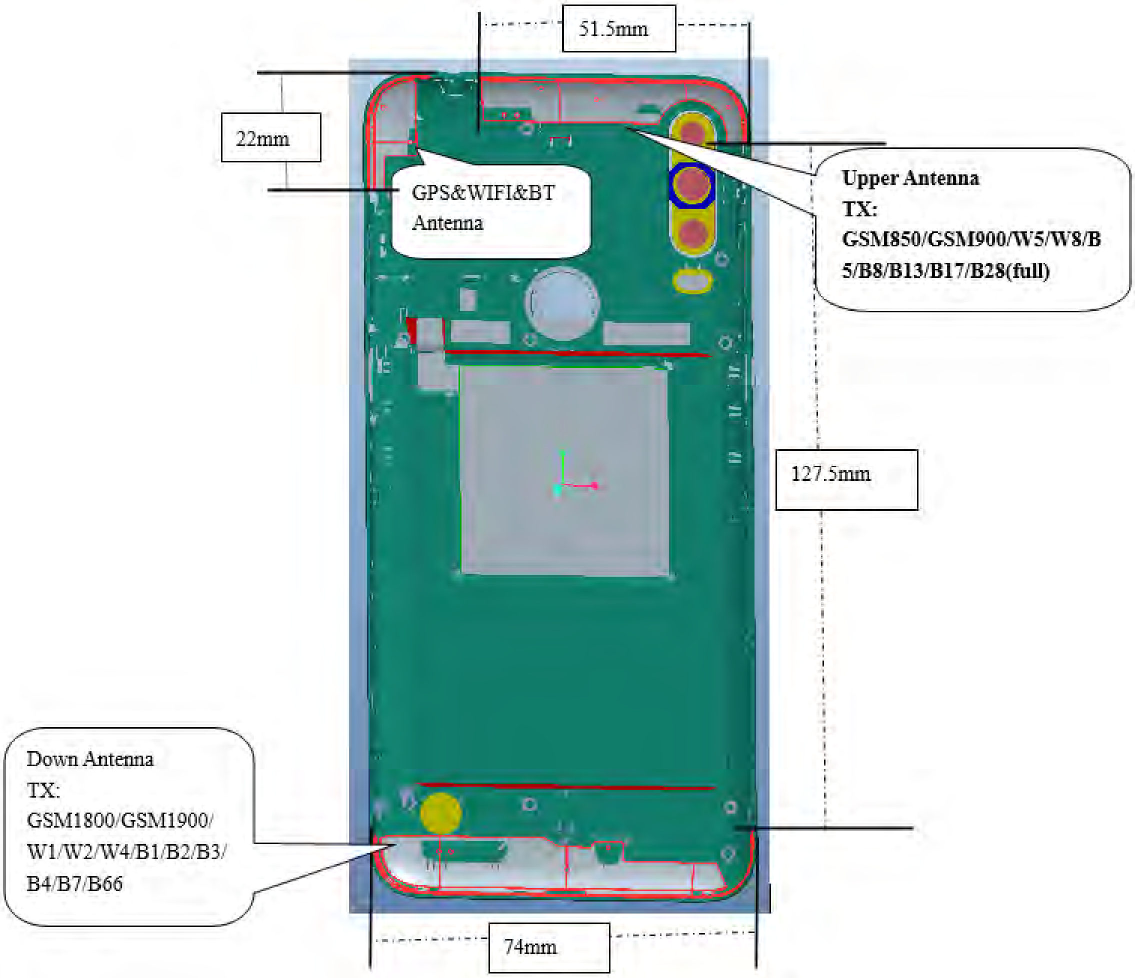
1.5 General Description of EUT

<table>
<tr><td>Device Type :</td><td colspan="3">portable device</td></tr>
<tr><td>Exposure Category:</td><td colspan="3">uncontrolled environment / general population</td></tr>
<tr><td>Product Name:</td><td colspan="3">LTE/UMTS/GSM mobile phone</td></tr>
<tr><td>Model No.(EUT):</td><td colspan="3">5029F</td></tr>
<tr><td>Trade Mark:</td><td colspan="3">alcatel</td></tr>
<tr><td>Product Phase:</td><td colspan="3">production unit</td></tr>
<tr><td>FCC ID:</td><td colspan="3">2ACCJH119</td></tr>
<tr><td>SN:</td><td colspan="3">9X4PQ8YHO7Y5J7SW/MVLB49HARSHYJFKR</td></tr>
<tr><td>Hardware Version:</td><td colspan="3">PIO</td></tr>
<tr><td>Software Version:</td><td colspan="3">V4F5P</td></tr>
<tr><td>Antenna Type:</td><td colspan="3">Inner Antenna</td></tr>
<tr><td colspan="4">Device Operating Configurations :</td></tr>
<tr><td>Modulation Mode:</td><td colspan="3">GSM: GMSK, 8PSK; WCDMA: QPSK, 16QAM(HSPA+); LTE: QPSK,16QAM
WIFI: DSSS, OFDM BT: GFSK, π/4DQPSK,8DPSK</td></tr>
<tr><td>Device Class:</td><td colspan="3">B</td></tr>
<tr><td>GPRS Multi-slots Class:</td><td>12</td><td>EGPRS Multi-slots Class:</td><td>12</td></tr>
<tr><td>HSDPA UE Category:</td><td>14</td><td>HSUPA UE Category</td><td>7</td></tr>
<tr><td>DC-HSDPA UE Category:</td><td colspan="3">24</td></tr>
<tr><td rowspan="4">Power Class</td><td colspan="3">4,tested with power level 5(GSM850)</td></tr>
<tr><td colspan="3">1,tested with power level 0(GSM1900)</td></tr>
<tr><td colspan="3">3, tested with power control "all 1"(WCDMA Band II/IV/V)</td></tr>
<tr><td colspan="3">3, tested with power control Max Power(LTE Band 2/4/5/7/13/17/66)</td></tr>
<tr><td rowspan="15">Frequency Bands:</td><td>Band</td><td>Tx (MHz)</td><td>Rx (MHz)</td></tr>
<tr><td>GSM850</td><td>824~849</td><td>869~894</td></tr>
<tr><td>GSM1900</td><td>1850~1910</td><td>1930~1990</td></tr>
<tr><td>WCDMA Band II</td><td>1850~1910</td><td>1930~1990</td></tr>
<tr><td>WCDMA Band IV</td><td>1710~1755</td><td>2110~2155</td></tr>
<tr><td>WCDMA Band V</td><td>824~849</td><td>869~894</td></tr>
<tr><td>LTE Band 2</td><td>1850~1910</td><td>1930~1990</td></tr>
<tr><td>LTE Band 4</td><td>1710~1755</td><td>2110~2155</td></tr>
<tr><td>LTE Band 5</td><td>824~849</td><td>869~894</td></tr>
<tr><td>LTE Band 7</td><td>2500~2570</td><td>2620~2690</td></tr>
<tr><td>LTE Band 13</td><td>777~787</td><td>746~756</td></tr>
<tr><td>LTE Band 17</td><td>704~716</td><td>734~746</td></tr>
<tr><td>LTE Band 66</td><td>1710~1780</td><td>2110~2180</td></tr>
<tr><td>WIFI 2.4G</td><td>2412~2462</td><td>2412~2462</td></tr>
<tr><td>BT</td><td>2402~2480</td><td>2402~2480</td></tr>
<tr><td rowspan="4">Battery Information 1#:</td><td>Model:</td><td colspan="2">CAC3860024C1</td></tr>
<tr><td>Normal Voltage:</td><td colspan="2">3.85V</td></tr>
<tr><td>Rated capacity:</td><td colspan="2">3860mAh</td></tr>
<tr><td>Manufacturer:</td><td colspan="2">Shenzhen BYD Lithium Battery Company Limited</td></tr>
<tr><td rowspan="4">Battery Information 2#:</td><td>Model:</td><td colspan="2">CAC3860025C7</td></tr>
<tr><td>Normal Voltage:</td><td colspan="2">3.85V</td></tr>
<tr><td>Rated capacity:</td><td colspan="2">3860mAh</td></tr>
<tr><td>Manufacturer:</td><td colspan="2">Ningbo Veken Battery Company Limited</td></tr>
<tr><td rowspan="2">Headset Information1#:</td><td>Model:</td><td colspan="2">CCB0046A10C1</td></tr>
<tr><td>Manufacturer:</td><td colspan="2">JUWEI</td></tr>
<tr><td rowspan="2">Headset Information2#:</td><td>Model:</td><td colspan="2">CCB0049A10C1</td></tr>
<tr><td>Manufacturer:</td><td colspan="2">JUWEI</td></tr>
</table>

Headset Information3#:	Model:	CCB0046A10C4
	Manufacturer:	MEIHAO
Headset Information4#:	Model:	CCB0049A10C4
	Manufacturer:	MEIHAO
Headset Information5#:	Model:	CCB0046A15C1（CCB0046A15C1 Same with CCB0046A10C1, only remove alcatel logo）
	Manufacturer:	JUWEI
Headset Information6#:	Model:	CCB0046A15C4（CCB0046A15C4 Same with CCB0046A10C4, only remove alcatel logo）
	Manufacturer:	MEIHAO
Headset Information7#:	Model:	CCB0049A12C1（CCB0049A12C1 Same with CCB0049A10C1， only remove alcatel logo）
	Manufacturer:	JUWEI
Headset Information8#:	Model:	CCB0049A12C4（CCB0049A12C4 Same with CCB0049A10C4， only remove alcatel logo ）
	Manufacturer:	MEIHAO

Remark:
Declaration of changes from 5029E to 5029F, only memory layout changed, detail change is as below,
1. Memory chip is changed, from DDR4 to DDR3;
2. Delete little matching component of DDR4 memory;
3. Memory PMU position is changed;
4. Because the memory is different, the software version need update (V4F5P)
Acrroding to above differences, in this report only tested for the worst case on the original report ZR/2019/C003505.

1.5.1 DUT Antenna Locations



1.5.2 List of air interfaces/frequency bands

Air- Interface	Band (MHZ)	Type	ANSI C63.19 Tested	Simultaneous Transmitter	Name of Voice Service	Power Reduction
GSM	850	VO	Yes	BT or Wi-Fi	NA	NA
	1900					
	GPRS/EGPRS	VD	Yes	BT or Wi-Fi	No	
WCDMA	Band II	VO	No (1)	BT or Wi-Fi	NA	NA
	Band IV					
	Band V					
	HSPA	VD	No (1)	BT or Wi-Fi	No	
LTE FDD	2	VD	No (1)	BT or Wi-Fi	NA	NA
	4					
	5					
	7					
	13					
	17					
	66					
Wi-Fi	2450	VD	No (1)	WWAN	NA	NA
BT	2450	DT	No	WWAN	NA	NA

VO: Legacy Cellular Voice Service from Table 7.1 in 7.4.2.1 of ANSI C63.19-2011
DT: Digital Transport (no voice)
VD: IP Voice Service over Digital Transport
Remark:
1. The air interface is exempted from testing by low power exemption that its average antenna input power plus its MIF is ≤17 dBm and is rated as M4.

1.6 Test Specification

Identity	Document Title
CFR 47 FCC Part 20	§20.19 Hearing aid-compatible mobile handsets.
ANSI C63.19-2011	American National Standard for Methods of Measurement of Compatibility between Wireless Communication Devices
KDB 285076 D01	HAC Guidance v05r01
KDB 285076 D03	HAC FAQ v01r02

1.7 ANSI C63.19-2011 limits

Emission Categories	E-field emissions dB(V/m)	
	< 960 MHz	> 960 MHz
Category M1	50-55	40-45
Category M2	45-50	35-40
Category M3	40-45	30-45
Category M4	<40	<30

Table 1： Telephone near-field categories in linear units

2 Calibration certificate

Temperature	Min. = 18°C, Max. = 25 °C
Relative humidity	Min. = 30%, Max. = 70%

Table 2： The Ambient Conditions

3 HAC (T Coil) Measurement System

3.1 Measurement System Diagram for SPEAG Robotic

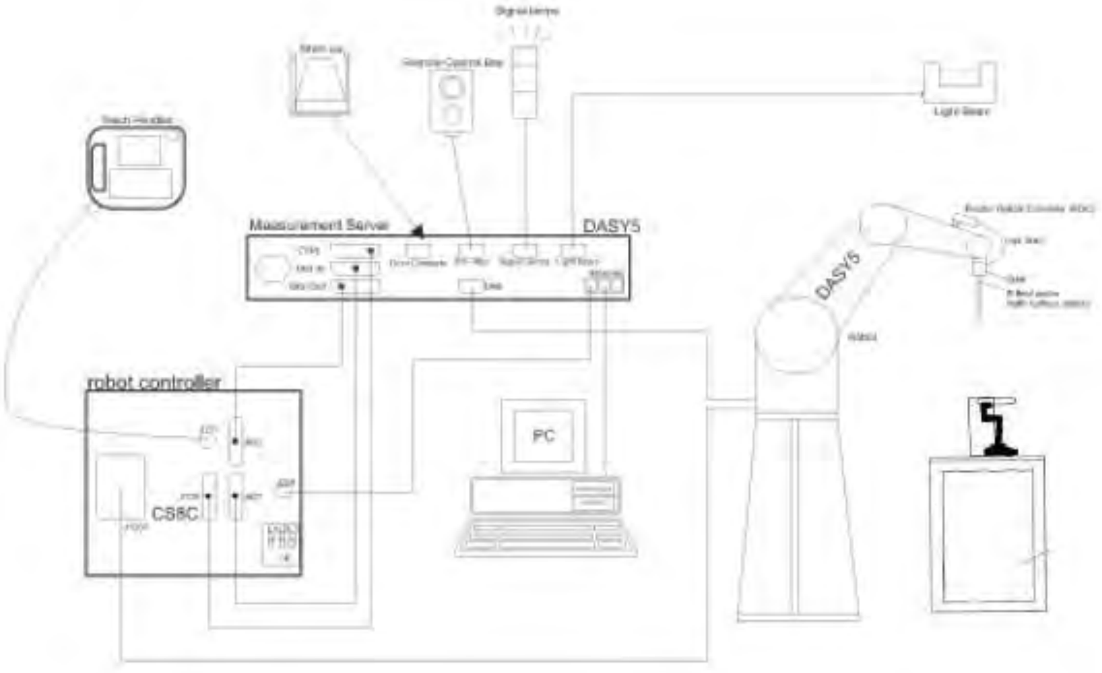


Fig. 1. The SPEAG Robotic Diagram

The DASY5 system for performing compliance tests consists of the following items:

- A standard high precision 6-axis robot (Stabile RX family) with controller, teach pendant and software. An arm extension is for accommodating the data acquisition electronics (DAE).
- An Audio Magnetic probe.
- A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- The Electro-optical converter (EOC) performs the conversion between optical and electrical of the signals for the digital communication to the DAE and for the analog signal from the optical surface detection. The EOC is connected to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- A probe alignment unit which improves the (absolute) accuracy of the probe positioning.
- A computer operating Windows 7.
- DASY5 software.
- Remote control with teach pendant and additional circuitry for robot safety such as warning lamps, etc.
- The Test Arch SAM phantom
- The device holder for handheld mobile phones.
- Validation dipole kits allowing to validate the proper functioning of the system.

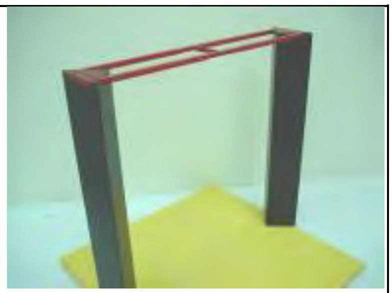
3.2 E-Field Probe

Construction	One dipole parallel, two dipoles normal to probe axis Built-in shielding against static charges PEEK enclosure material
Calibration	In air from 100 MHz to 6.0 GHz (absolute accuracy ±6.0%, k=2)
Frequency	(extended to 20 MHz for MRI), Linearity: ± 0.2 dB (100 MHz to 6 GHz)
Directivity	± 0.2 dB in air (rotation around probe axis) ± 0.4 dB in air (rotation normal to probe axis)
Dynamic Range	2 V/m to > 1000 V/m; Linearity: ± 0.2 dB
Dimensions	Tip diameter: 8 mm Distance from probe tip to dipole centers: 2.5 mm


EF3DV3 E-Field Probe

3.3 Test Arch

Description	Enables easy and well defined positioning of the phone and validation dipoles as well as simple teaching of the robot.
Dimensions	length: 370 mm width: 370 mm height: 370 mm


Test Arch

3.4 Phone Holder

Description	Supports accurate and reliable positioning of any phone Effect on near field <+/- 0.5 dB


Phone Holder

4 Measurement uncertainty evaluation

Uncertainty Component	Uncertainty Value (%)	Probability Distribution	Divisor	ci (E)	Standard Uncertainty (E) (%)
Measurement system					
Probe calibration	±5.1	N	1	1	±5.1
Axial isotropy	±4.7	R	$\sqrt{3}$	1	±2.7
Sensor position	±16.5	R	$\sqrt{3}$	1	±9.5
Boundary effect	±2.4	R	$\sqrt{3}$	1	±1.4
Phantom Boundary Effect	±7.2	R	$\sqrt{3}$	1	±4.1
Linearity	±4.7	R	$\sqrt{3}$	1	±2.7
Scaling with PMR calibration	±10.0	R	$\sqrt{3}$	1	±5.8
System Detection limit	±1.0	R	$\sqrt{3}$	1	±0.6
Readout Electronics	±0.3	N	1	1	±0.3
Response time	±0.8	R	$\sqrt{3}$	1	±0.5
Integration time	±2.6	R	$\sqrt{3}$	1	±1.5
RF ambient conditions	±3.0	R	$\sqrt{3}$	1	±1.7
RF reflection	±12.0	R	$\sqrt{3}$	1	±6.9
Probe positioner	±1.2	R	$\sqrt{3}$	1	±0.7
Probe positioning	±4.7	R	$\sqrt{3}$	1	±2.7
Extrapolation and interpolation	±1.0	R	$\sqrt{3}$	1	±0.6
Related to test samples					
Device Positioning Vertical	±4.7	R	$\sqrt{3}$	1	±2.7
Device Positioning Lateral	±1.0	R	$\sqrt{3}$	1	±0.6
Device Holder and Phantom	±2.4	R	$\sqrt{3}$	1	±1.4
Power drift	±5.0	R	$\sqrt{3}$	1	±2.9
Phantom and Setup Related					
Phantom Thickness	±2.4	R	$\sqrt{3}$	1	±1.4
Combined Std. Uncertainty	$u_c^{'} = \sqrt{\sum_{i=1}^{21} c_i^2 u_i^2}$				**±16.3**
Expanded Std. Uncertainty on Power (K=2)					**±32.6**
Expanded Std. Uncertainty on Field (K=2)					**±16.3**

Table 3： Measurement uncertainties for RF

5 RF Emission Measurements Reference and Plane

Fig.3 illustrate the references and reference plane that shall be used in a typical EUT emissions measurement. The principle of this section is applied to EUT with similar geometry. Please refer to Appendix C for the setup photographs.

- The area is 5 cm by 5 cm.
- The area is centered on the audio frequency output transducer of the EUT.
- The area is in a reference plane, which is defined as the planar area that contains the highest point in the area of the phone that normally rests against the user's ear. It is parallel to the centerline of the receiver area of the phone and is defined by the points of the receiver-end of the EUT handset, which, in normal handset use, rest against the ear.
- The measurement plane is parallel to, and 10 mm in front of, the reference plane.

Fig.3 WD reference and plane for RF emission measurements

6 System Verification Procedure

6.1 System Check

Place a dipole antenna meeting the requirements given in ANSI C63.19-2011 in the position normally occupied by the WD. The dipole antenna serves as a known source for an electrical and magnetic output. Position the E-field probe so that the following occurs:

• The probes and their cables are parallel to the coaxial feed of the dipole antenna
• The probe cables and the coaxial feed of the dipole antenna approach the measurement area from opposite directions
• The center point of the probe element(s) are 15 mm from the closest surface of the dipole elements.

Scan the length of the dipole with the E-field probe and record the two maximum values found near the dipole ends. Average the two readings and compare the reading to the expected value in the calibration certificate or the expected value in this standard.

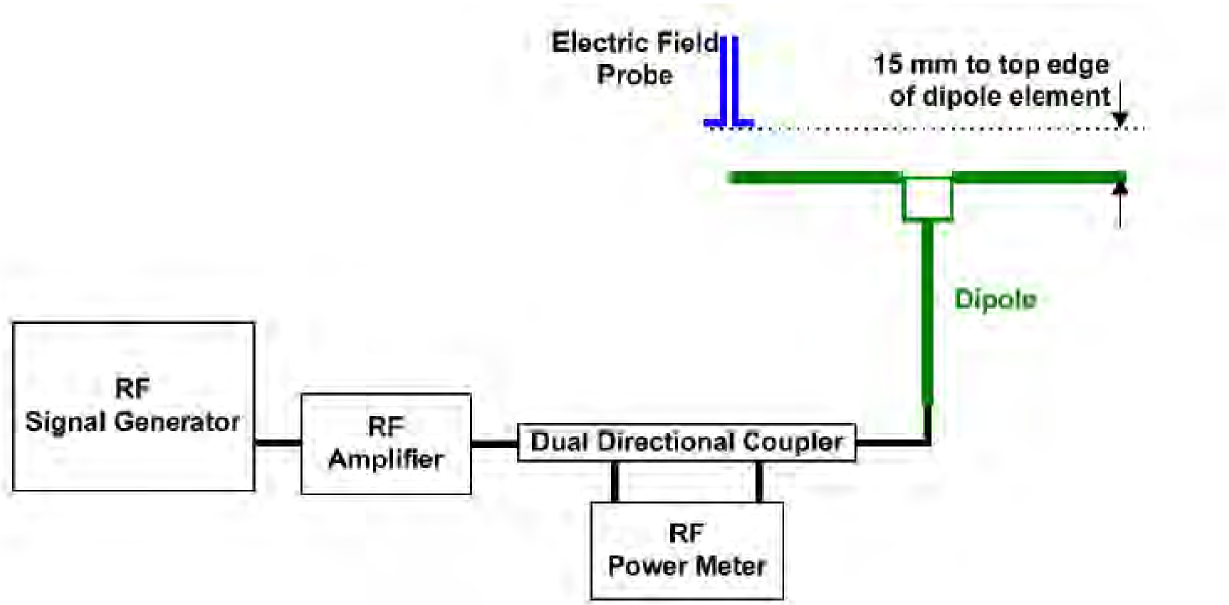


Fig.4 System verification

6.2 System Check Result

Frequency (MHz)	Input Power (mW)	E-Field Value 1 (V/m)	E-Field Value 2 (V/m)	Averaged Measured* Value(V/m)	Target** Value (V/m)	Deviation*** (%)	Limit**** (%)	Test Date
835	100	106.60	117.00	111.80	106.8	4.68	±18%	2020/08/24
1880	100	88.71	92.55	90.63	86.9	4.29	±18%	2020/08/24

Note:
* Please refer to the appendix A for detailed measurement data and plot.
** Target value is provided by SPEAD in the calibration certificate of specific dipoles.
*** Deviation (%) = 100 * (Measured value minus Target value) divided by Target value.
**** ANSI C63.19 requires values within ± 18% are acceptable.

7 Modulation Interference Factor

The HAC Standard ANSI C63.19-2011 defines a new scaling using the Modulation Interference Factor (MIF). For any specific fixed and repeatable modulated signal, a modulation interference factor (MIF, expressed in dB) may be developed 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. It is important to emphasize that 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 Modulation Interference factor (MIF, in dB) is added to the measured average E-field (in dBV/m) and converts it to the RF Audio Interference level (in dBV/m). This level considers the audible amplitude modulation components in the RF E-field. CW fields without amplitude modulation are assumed to not interfere with the hearing aid electronics.

Modulations without time slots and low fluctuations at low frequencies have low MIF values, TDMA modulations with narrow transmission and repetition rates of few 100 Hz have high MIF values and give similar classifications as ANSI C63.19-2011.

ER3D, EF3D and EU2D E-field probes have a bandwidth <10 kHz and can therefore not evaluate the RF envelope in the full audio band. DASY52 is therefore using the indirect measurement method according to ANSI C63.19-2011 which is the primary method. These near field probes read the averaged E-field measurement. Especially for the new high peak-to-average (PAR) signal types, the probes shall be linearized by PMR calibration in order to not overestimate the field reading. Probe Modulation Response (PMR) calibration linearizes the probe response over its dynamic range for specific modulations which are characterized by their UID and result in an uncertainty specified in the probe calibration certificate. The MIF is characteristic for a given waveform envelope and can be used as a constant conversion factor if the probe has been PMR calibrated.

The evaluation method for the MIF is defined in ANSI C63.19-2011 section D.7. An RMS demodulated RF signal is fed to a spectral filter (similar to an A weighting filter) and forwarded to a temporal filter acting as a quasi-peak detector. The averaged output of these filtering is scaled to a 1 kHz 80% AM signal as reference. MIF measurement requires additional instrumentation and is not well suited for evaluation by the end user with reasonable uncertainty.

It may alliteratively be determined through analysis and simulation, because it is constant and characteristic for a communication signal. DASY52 uses well-defined signals for PMR calibration. The MIF of these signals has been determined by simulation and it is automatically applied.

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

1. 0.2 dB for MIF: -7 to +5 dB
2. 0.5 dB for MIF: -13 to +11 dB
3. 1 dB for MIF: > -20 dB

MIF values applied in this test report were provided by the HAC equipment provider of SPEAG, and the worst values for all air interface are listed below to be determine the Low-power Exemption.

SPEAG UID	UID version	Communication system	MIF(dB)
10021	DAC	GSM-FDD (TDMA,GMSK)	3.63
10025	DAC	EDGE-FDD (TDMA, 8PSK, TN 0)	3.75
10460	AAA	UMTS-FDD (WCDMA, AMR)	-25.43
10225	AAA	UMTS-FDD (HSPA+)	-20.39
10169	CAE	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	-15.63
10170	CAE	LTE-FDD (SC-FDMA,1RB, 20 MHz,16-QAM)	-9.76
10061	CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 11 Mbps)	-2.02
10077	CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 54 Mbps)	0.12
10427	AAB	IEEE 802.11n (HT Green eld, 150 Mbps, 64-QAM)	-13.44

8 HAC Measurement Procedure

The evaluation was performed with the following procedure:
a) Confirm the proper operation of the field probe, probe measurement system, and other instrumentation and the positioning system.
b) Position the WD in its intended test position.
c) Set the WD to transmit a fixed and repeatable combination of signal power and modulation characteristic that is representative of the worst case (highest interference potential) encountered in normal use. Transiently occurring start-up, changeover, or termination conditions, or other operations likely to occur less than 1% of the time during normal operation, may be excluded from consideration.
d) The center subgrid shall be centered on the T-Coil mode perpendicular measurement point or the acoustic output, as appropriate. Locate the field probe at the initial test position in the 50 mm by 50 mm grid, which is contained in the measurement plane, refer to illustrated in Figure 3. If the field alignment method is used, align the probe for maximum field reception.
e) Record the reading at the output of the measurement system.
f) Scan the entire 50 mm by 50 mm region in equally spaced increments and record the reading at each measurement point. The distance between measurement points shall be sufficient to assure the identification of the maximum reading.
g) Identify the five contiguous subgrids around the center subgrid whose maximum reading is the lowest of all available choices. This eliminates the three subgrids with the maximum readings. Thus, the six areas to be used to determine the WD's highest emissions are identified.
h) Identify the maximum reading within the nonexcluded subgrids identified in step g).
i) Convert the maximum reading identified in step h) to RF audio interference level, in, V/m, by taking the square root of the reading and then dividing it by the measurement system transfer function, established in 5.5.1.1. Convert the result to dB(V/m) by taking the base-10 logarithmand multiplying it by 20.
Indirect measurement method
Replacing step i) of 5.5.1.2, the RF audio interference level in dB(V/m) is obtained by adding the MIF (in dB) to the maximum steady-state rms field-strength reading, in dB(V/m), from step h). Use this result to determine the category rating.
j) Compare this RF audio interference level with the categories in Clause 8 and record the resulting WD category rating.
k) For the T-Coil mode M-rating assessment, determine whether the chosen perpendicular measurement point is contained in an included subgrid of the first scan. If so, then a second scan is not necessary. The first scan and resultant category rating may be used for the T-Coil mode M rating.
Otherwise, repeat step a) through step i), with the grid shifted so that it is centered on the perpendicular measurement point. Record the WD category rating.

9 HAC RF Measurement Results

9.1 Max Tune-up

Frequency Band		Average Power (dBm)
GSM	GSM850	31.80
	EDGE850	28.00
	GSM1900	30.80
	EDGE1900	28.00
WCDMA	Band V	22.50
	Band IV	23.50
	Band II	23.00
	HSPA	22.50
FDD LTE	Band 2	23.00
	Band 4	22.50
	Band 5	22.50
	Band 7	23.50
	Band 13	22.50
	Band 17	23.50
	Band 66	22.50
2.4GHz WLAN	802.11b	18.00
	802.11g	16.00
	802.11n-HT20	14.00
	802.11n-HT40	13.00

9.2 Conducted RF Output Power

GSM 850				
Burst Output Power(dBm)				Tune up
Channel	128	190	251	
GSM (GMSK, 1 Tx slot)	**31.59**	**31.55**	31.31	31.80
GSM 1900				
Burst Output Power(dBm)				Tune up
Channel	512	661	810	
GSM (GMSK, 1 Tx slot)	29.96	29.91	30.05	30.80

9.3 Low-power Exemption

According to ANSI C63.19-2011, a RF air interface technology of a device is exempt from testing when its average antenna input power plus its MIF is ≤17 dBm for any of its operation modes.

Air Interface	Max Average Antenna Input Power (dBm)	Worst Case MIF (dB)	Power + MIF(dB)	C63.19 test required
GSM850	31.80	3.63	35.43	Yes
EDGE850	28.00	3.75	31.75	No
GSM1900	30.80	3.63	34.43	Yes
EDGE1900	28.00	3.75	31.75	No
WCDMA	23.50	-25.43	-1.93	No
WCDMA - HSPA	22.50	-20.39	2.11	No
LTE - FDD	23.50	-9.76	13.74	No
802.11b	18.00	-2.02	15.98	No
802.11g	16.00	0.12	16.12	No
802.11n-HT20	14.00	-13.44	0.56	No
802.11n-HT40	13.00	-13.44	-0.44	No

General Note:

1. EDGE data modes and 16QAM is not necessary due the GSM Voice mode and QPSK is the worst case.
2. According to ANSI C63.19 2011-version, for the air interface technology of a device is exempt from testing when its average antenna input power plus its MIF is ≤17 dBm for any of its operating modes.
3. HAC RF rating is M4 for the air interface which meets the low power exemption.

9.4 HAC RF Emission Test Results

Band	Test Mode	Channel	Frequency (MHz)	MIF (dB)	Audio Interference Level (dBV/m)	Power Drift (dB)	Category	Accessory Information
GSM850	GSM Voice	128	824.2	3.63	40.91	0.02	M3	Battery 1#
GSM850	GSM Voice	190	836.6	3.63	41.83	0.04	M3	Battery 1#
GSM850	GSM Voice	251	848.8	3.63	42.49	-0.01	M3	Battery 1#
GSM850	GSM Voice	251	848.8	3.63	42.20	-0.13	M3	Battery 2#
GSM1900	GSM Voice	512	1850.2	3.63	27.47	-0.04	M4	Battery 1#
GSM1900	GSM Voice	661	1880	3.63	27.08	-0.06	M4	Battery 1#
GSM1900	GSM Voice	810	1909.8	3.63	27.21	-0.19	M4	Battery 1#
GSM1900	GSM Voice	512	1850.2	3.63	28.98	-0.17	M4	Battery 2#

Table 4： RF Emission results(original report ZR/2019/C003505)

Band	Test Mode	Channel	Frequency (MHz)	MIF (dB)	Audio Interference Level (dBV/m)	Power Drift (dB)	Category	Accessory Information
GSM850	GSM Voice	251	848.8	3.63	41.87	-0.03	M3	Battery 1#
GSM1900	GSM Voice	512	1850.2	3.63	29.90	-0.10	M4	Battery 2#

Table 5： RF Emission results(Variant)

Remark:

1. The detail RF Emission results please refer to appendix B.

10 Equipment list

	Equipment	Manufacturer	Model	Serial Number	Calibration Date	Due date of calibration
☒	Software	SPEAG	DASY52 52.8.8	NA	NCR	NCR
☒	DAE	SPEAG	DAE4	896	2020-06-11	2021-06-10
☒	E-Field Probe	SPEAG	EF3DV3	4051	2020-05-29	2021-05-28
☒	Validation Kits	SPEAG	CD835V3	1052	2020-05-25	2021-05-24
☒	Validation Kits	SPEAG	CD1880V3	1044	2020-05-25	2021-05-24
☒	Test Arch SD HAC	SPEAG	NA	NA	NCR	NCR
☒	Universal Radio Communication Tester	R&S	CMU200	123090	2020-06-11	2021-06-10
☒	Universal Radio Communication Tester	R&S	CMW500	111637	2020-04-16	2021-04-15
☒	Signal Generator	Agilent	N5171B	MY53050736	2020-04-15	2021-04-14
☒	Preamplifier	Mini-Circuits	ZHL-42W	15542	NCR	NCR
☒	Power Meter	Agilent	E4416A	GB41292095	2020-04-15	2021-04-14
☒	Power Sensor	Agilent	8481H	MY41091234	2020-04-15	2021-04-14
☒	Power Sensor	R&S	NRP-Z92	100025	2020-04-16	2021-04-15
☒	Attenuator	SHX	TS2-3dB	30704	NCR	NCR
☒	Coaxial low pass filter	Mini-Circuits	VLF-2500(+)	NA	NCR	NCR
☒	Coaxial low pass filter	Microlab Fxr	LA-F13	NA	NCR	NCR
☒	DC POWER SUPPLY	SAKO	SK1730SL5A	NA	NCR	NCR
☒	Humidity and Temperature Indicator	KIMTOKA	KIMTOKA	NA	2020-04-21	2021-04-20

Note:
1. All the equipments are within the valid period when the tests are performed.
2. NCR: "No-Calibration Required".

11 Calibration certificate

Please see the Appendix B

12 Photographs

Please see the Appendix C

Appendix A: Detailed System Check Results

Appendix B: Detailed Test Results

Appendix C: Calibration certificate

Appendix D: Photographs

---END---

Appendix A

Detailed System Check Results

1. System Check Results
System Performance Check 835 MHz
System Performance Check 1880 MHz

Date: 2020-08-24

Test Laboratory: SGS-SAR Lab

HAC-E-Dipole CD835V3

DUT: CD835V3; Type: CD835V3; Serial: 1052

Communication System: UID 0, CW; Frequency: 835 MHz;Duty Cycle: 1:1

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

DASY 5 Configuration:

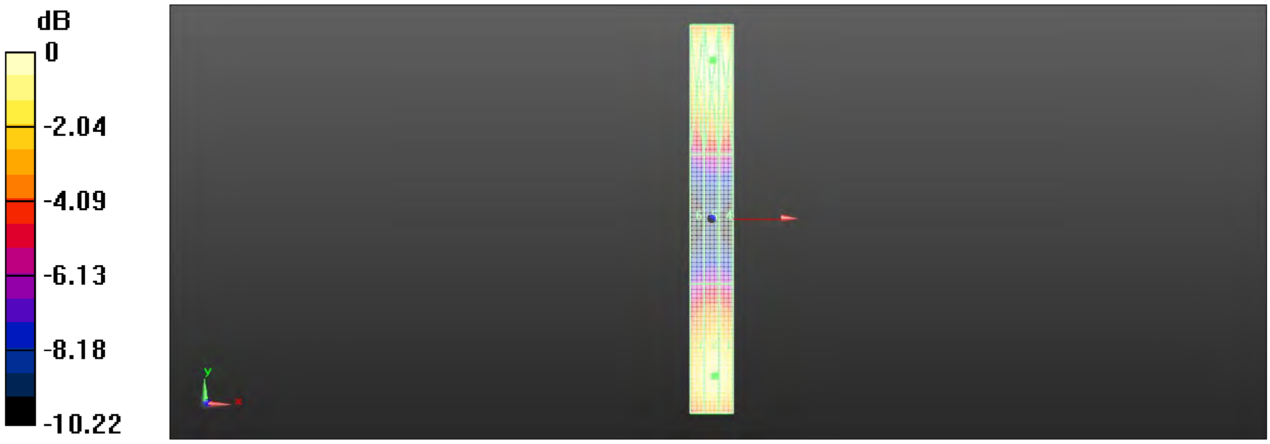
- Probe: EF3DV3 - SN4051; ConvF(1, 1, 1); Calibrated: 2020-05-29;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn896; Calibrated: 2020-06-11
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Dipole E-Field measurement/E Scan - measurement distance from the probe sensor center to CD835 = 15mm/Hearing Aid Compatibility Test at 15mm distance (41x361x1): Interpolated grid: dx=0.5000 mm, dy=0.5000 mm
Device Reference Point: 0, 0, -6.3 mm
Reference Value = 181.0 V/m; Power Drift = -0.01 dB
PMR not calibrated. PMF = 1.000 is applied.
E-field emissions = 106.6 V/m
Near-field category: M4 (AWF 0 dB)

PMF scaled E-field

Grid 1 **M4** **106.0 V/m**	Grid 2 **M4** **106.6 V/m**	Grid 3 **M4** **103.1 V/m**
Grid 4 **M4** **63.25 V/m**	Grid 5 **M4** **63.39 V/m**	Grid 6 **M4** **61.16 V/m**
Grid 7 **M4** **115.0 V/m**	Grid 8 **M4** **117.0 V/m**	Grid 9 **M4** **113.3 V/m**

Cursor:
Total = 117.0 V/m
E Category: M4
Location: 0.5, 73.5, 8.7 mm



0 dB = 117.0 V/m = 41.36 dBV/m

Date: 2020-08-24

Test Laboratory: SGS-SAR Lab

HAC-E-Dipole CD1880V3

DUT: CD1880V3; Type: CD1880V3; Serial: 1044

Communication System: UID 0, CW; Frequency: 1880 MHz;Duty Cycle: 1:1

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

DASY 5 Configuration:

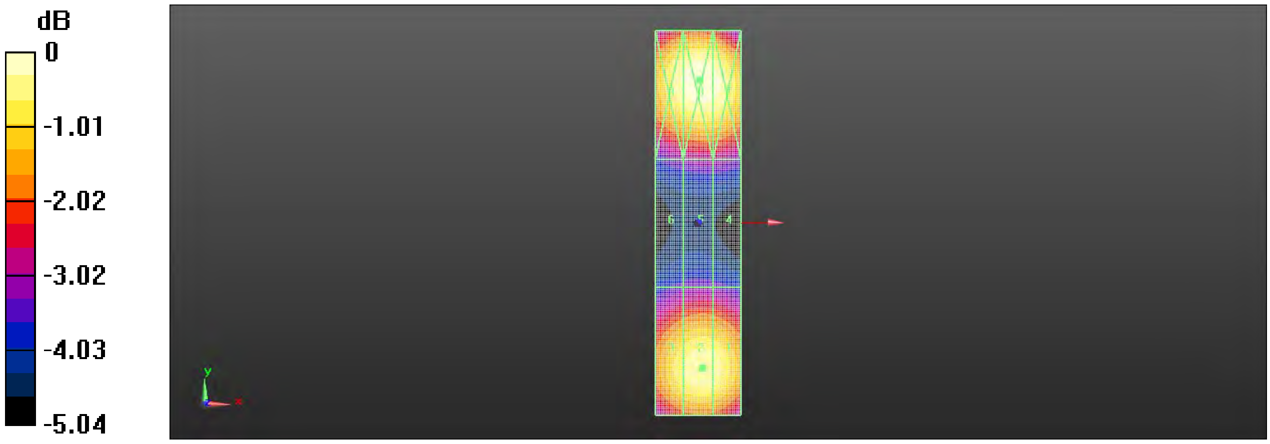
- Probe: EF3DV3 - SN4051; ConvF(1, 1, 1); Calibrated: 2020-05-29;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn896; Calibrated: 2020-06-11
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Dipole E-Field measurement/E Scan - measurement distance from the probe sensor center to CD1880 = 15mm/Hearing Aid Compatibility Test at 15mm distance (41x181x1): Interpolated grid: dx=0.5000 mm, dy=0.5000 mm
Device Reference Point: 0, 0, -6.3 mm
Reference Value = 156.3 V/m; Power Drift = -0.08 dB
PMR not calibrated. PMF = 1.000 is applied.
E-field emissions = 88.71 V/m
Near-field category: M3 (AWF 0 dB)

PMF scaled E-field

Grid 1 **M3** **87.93 V/m**	Grid 2 **M3** **88.71 V/m**	Grid 3 **M3** **85.90 V/m**
Grid 4 **M3** **65.75 V/m**	Grid 5 **M3** **65.78 V/m**	Grid 6 **M3** **64.36 V/m**
Grid 7 **M3** **91.22 V/m**	Grid 8 **M3** **92.55 V/m**	Grid 9 **M3** **89.70 V/m**

Cursor:
Total = 92.55 V/m
E Category: M3
Location: 0.5, 33.5, 8.7 mm



0 dB = 92.55 V/m = 39.33 dBV/m

Appendix B

Detailed Test Results

1. GSM
GSM850 for E-Field Emission
GSM1900 for E-Field Emission

Date: 2020-08-24

Test Laboratory: SGS-SAR Lab

5029F HAC-RF-GSM850 GSM Voice 251CH

DUT: 5029F; Type: LTE/WCDMA/GSM mobile phone; Serial: 9X4PQ8YHO7Y5J7SW

Communication System: UID 10021 - DAC, GSM-FDD (TDMA, GMSK); Frequency: 848.8 MHz;Duty Cycle: 1:8.6896

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

DASY 5 Configuration:

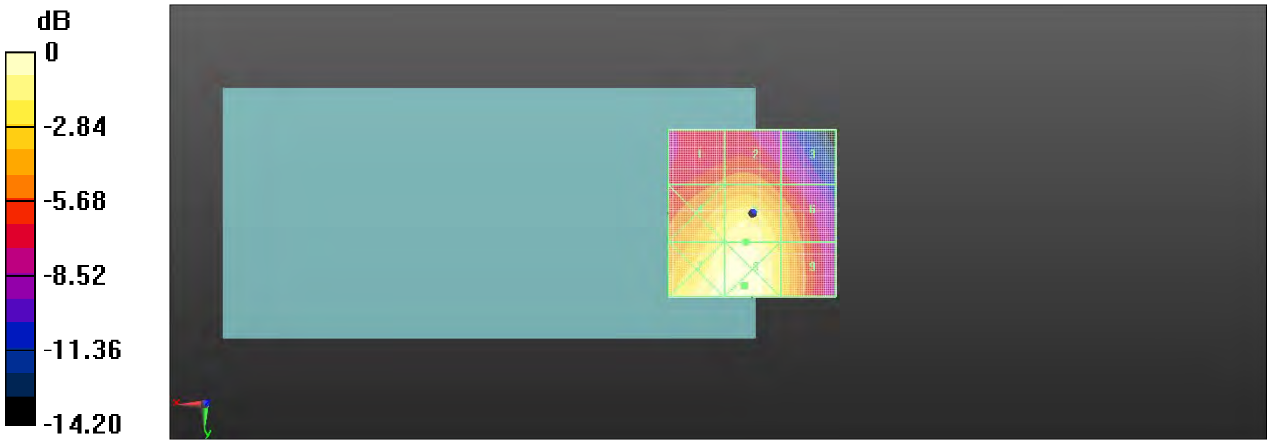
- Probe: EF3DV3 - SN4051; ConvF(1, 1, 1); Calibrated: 2020-05-29;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn896; Calibrated: 2020-06-11
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Device E-Field measurement/E Scan - ER3D: 15 mm from Probe Center to the Device/Hearing Aid Compatibility Test (101x101x1): Interpolated grid: dx=0.5000 mm, dy=0.5000 mm
Device Reference Point: 0, 0, -6.3 mm
Reference Value = 118.8 V/m; Power Drift = -0.03 dB
Applied MIF = 3.63 dB
RF audio interference level = 41.87 dBV/m
Emission category: M3

MIF scaled E-field

Grid 1 **M4** **37.58 dBV/m**	Grid 2 **M4** **38.09 dBV/m**	Grid 3 **M4** **36.36 dBV/m**
Grid 4 **M3** **41.04 dBV/m**	Grid 5 **M3** **41.87 dBV/m**	Grid 6 **M4** **39.43 dBV/m**
Grid 7 **M3** **42.34 dBV/m**	Grid 8 **M3** **42.77 dBV/m**	Grid 9 **M4** **39.99 dBV/m**

Cursor:
Total = 42.77 dBV/m
E Category: M3
Location: 2.5, 21.5, 7.7 mm



0 dB = 137.6 V/m = 42.77 dBV/m

Date: 2020-08-24

Test Laboratory: SGS-SAR Lab

5029F HAC-RF-GSM1900 GSM Voice 512CH

DUT: 5029F; Type: LTE/WCDMA/GSM mobile phone; Serial: MVLB49HARSHYJFKR

Communication System: UID 10021 - DAC, GSM-FDD (TDMA, GMSK); Frequency: 1850.2 MHz;Duty Cycle: 1:8.6896

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

DASY 5 Configuration:

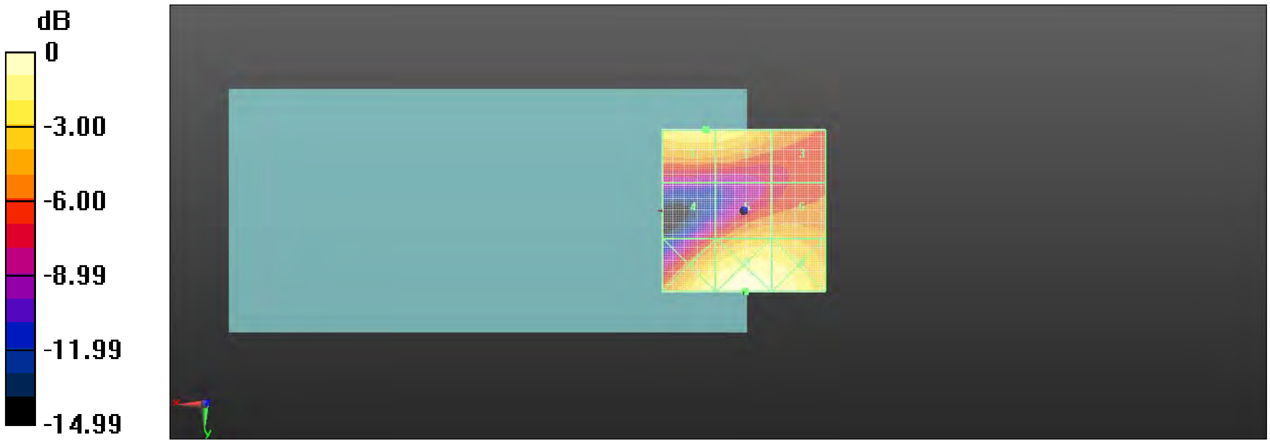
- Probe: EF3DV3 - SN4051; ConvF(1, 1, 1); Calibrated: 2020-05-29;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn896; Calibrated: 2020-06-11
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Device E-Field measurement/E Scan - ER3D: 15 mm from Probe Center to the Device/Hearing Aid Compatibility Test (101x101x1): Interpolated grid: dx=0.5000 mm, dy=0.5000 mm
Device Reference Point: 0, 0, -6.3 mm
Reference Value = 12.20 V/m; Power Drift = -0.10 dB
Applied MIF = 3.63 dB
RF audio interference level = 29.90 dBV/m
Emission category: M4

MIF scaled E-field

Grid 1 **M4** **29.9 dBV/m**	Grid 2 **M4** **29.81 dBV/m**	Grid 3 **M4** **27.13 dBV/m**
Grid 4 **M4** **25.14 dBV/m**	Grid 5 **M4** **27.86 dBV/m**	Grid 6 **M4** **27.86 dBV/m**
Grid 7 **M3** **30.68 dBV/m**	Grid 8 **M3** **31.52 dBV/m**	Grid 9 **M3** **30.93 dBV/m**

Cursor:
Total = 31.52 dBV/m
E Category: M3
Location: -0.5, 25, 7.7 mm



0 dB = 37.69 V/m = 31.52 dBV/m

Appendix C

Calibration certificate

1. Dipole
CD835V3-SN 1052(2020-05-25)
CD1880V3-SN 1044(2020-05-25)
2. DAE
DAE4-SN 896(2020-06-11)
3. Probe
EF3DV3-SN 4051(2020-05-29)

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

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

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

Accreditation No.: SCS 0108

Client SGS-CN (Auden)

Certificate No: CD835V3-1052_May20

CALIBRATION CERTIFICATE

Object	CD835V3 - SN: 1052
Calibration procedure(s)	QA CAL-20.v7 Calibration Procedure for Validation Sources in air
Calibration date:	May 25, 2020

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	01-Apr-20 (No. 217-03100/03101)	Apr-21
Power sensor NRP-Z91	SN: 103244	01-Apr-20 (No. 217-03100)	Apr-21
Power sensor NRP-Z91	SN: 103245	01-Apr-20 (No. 217-03101)	Apr-21
Reference 20 dB Attenuator	SN: BH9394 (20k)	31-Mar-20 (No. 217-03106)	Apr-21
Type-N mismatch combination	SN: 310982 / 06327	31-Mar-20 (No. 217-03104)	Apr-21
Probe EF3DV3	SN: 4013	31-Dec-19 (No. EF3-4013_Dec19)	Dec-20
Probe H3DV6	SN: 6065	31-Dec-19 (No. H3-6065_Dec19)	Dec-20
DAE4	SN: 781	27-Dec-19 (No. DAE4-781_Dec19)	Dec-20

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: 837633/005	10-Jan-19 (in house check Jan-19)	In house check: Oct-20
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-19)	In house check: Oct-20

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

Issued: May 26, 2020

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

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

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

Accreditation No.: SCS 0108

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 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 E-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	V52.10.4
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	108.1 V/m = 40.68 dBV/m
Maximum measured above low end	100 mW input power	105.5 V/m = 40.47 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

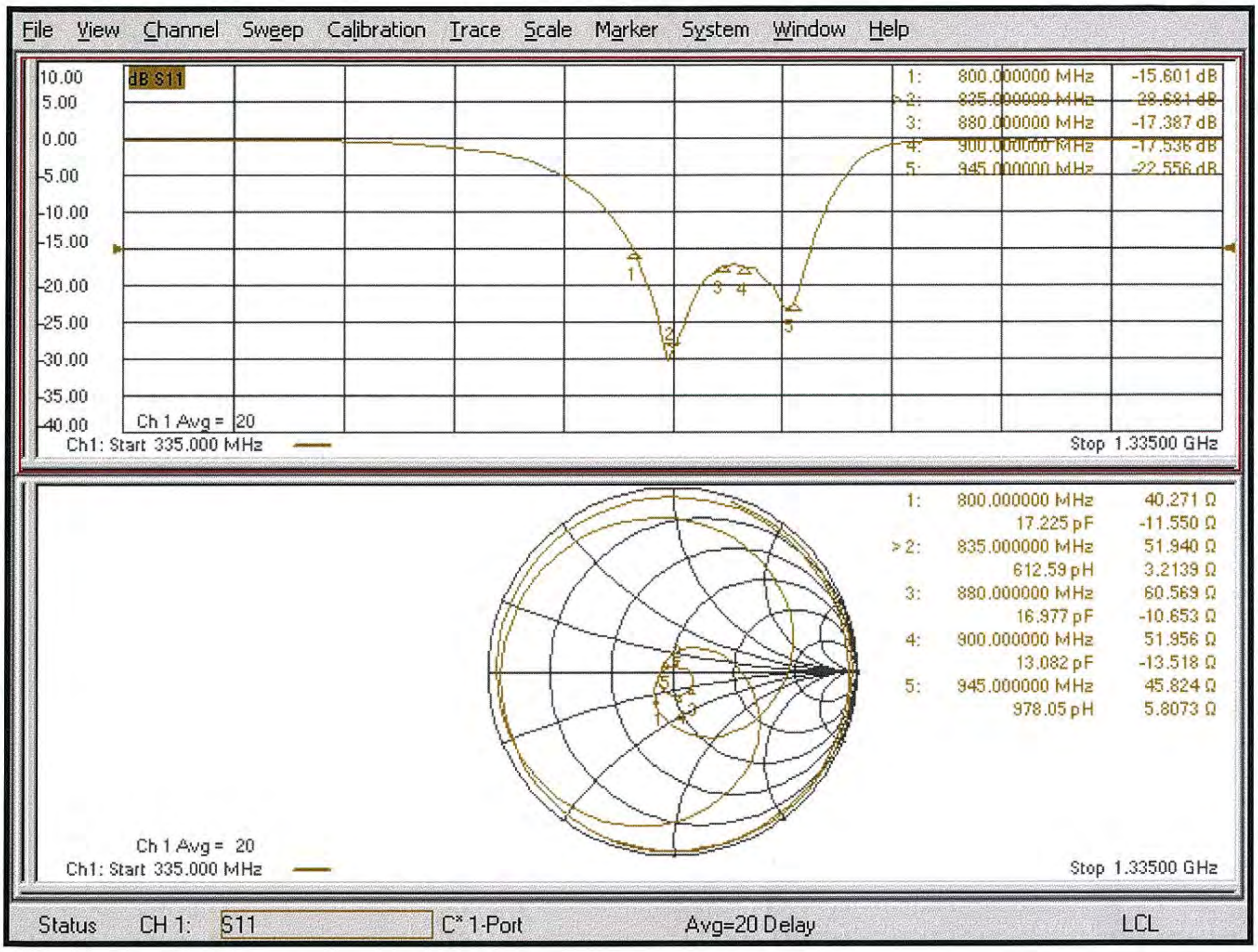
Frequency	**Return Loss**	**Impedance**
800 MHz	15.6 dB	40.3 Ω - 11.6 jΩ
835 MHz	28.7 dB	51.9 Ω + 3.2 jΩ
880 MHz	17.4 dB	60.6 Ω - 10.7 jΩ
900 MHz	17.5 dB	52.0 Ω - 13.5 jΩ
945 MHz	22.6 dB	45.8 Ω + 5.8 jΩ

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.

Impedance Measurement Plot



DASY5 E-field Result

Date: 25.05.2020

Test Laboratory: SPEAG Lab2

DUT: HAC-Dipole 835 MHz; Type: CD835V3; Serial: CD835V3 - SN: 1052

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

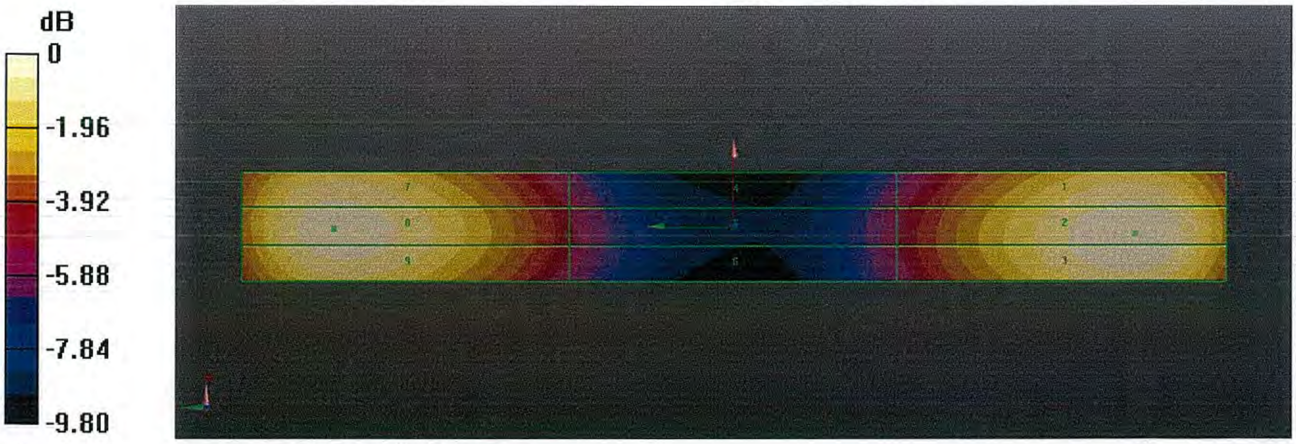
DASY52 Configuration:

- Probe: EF3DV3 - SN4013; ConvF(1, 1, 1) @ 835 MHz; Calibrated: 31.12.2019
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn781; Calibrated: 27.12.2019
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA; Serial: 1070
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

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 = 126.7 V/m; Power Drift = -0.02 dB
Applied MIF = 0.00 dB
RF audio interference level = 40.68 dBV/m
Emission category: M3

MIF scaled E-field

Grid 1 **M3** **40.24 dBV/m**	Grid 2 **M3** **40.68 dBV/m**	Grid 3 **M3** **40.64 dBV/m**
Grid 4 **M4** **35.36 dBV/m**	Grid 5 **M4** **35.62 dBV/m**	Grid 6 **M4** **35.55 dBV/m**
Grid 7 **M3** **40.21 dBV/m**	Grid 8 **M3** **40.47 dBV/m**	Grid 9 **M3** **40.36 dBV/m**



0 dB = 108.1 V/m = 40.68 dBV/m

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

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

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

Accreditation No.: **SCS 0108**

Client **SGS-CN (Auden)**

Certificate No: **CD1880V3-1044_May20**

CALIBRATION CERTIFICATE

Object	CD1880V3 - SN: 1044
Calibration procedure(s)	QA CAL-20.v7 Calibration Procedure for Validation Sources in air
Calibration date:	May 25, 2020

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	01-Apr-20 (No. 217-03100/03101)	Apr-21
Power sensor NRP-Z91	SN: 103244	01-Apr-20 (No. 217-03100)	Apr-21
Power sensor NRP-Z91	SN: 103245	01-Apr-20 (No. 217-03101)	Apr-21
Reference 20 dB Attenuator	SN: BH9394 (20k)	31-Mar-20 (No. 217-03106)	Apr-21
Type-N mismatch combination	SN: 310982 / 06327	31-Mar-20 (No. 217-03104)	Apr-21
Probe EF3DV3	SN: 4013	31-Dec-19 (No. EF3-4013_Dec19)	Dec-20
Probe H3DV6	SN: 6065	31-Dec-19 (No. H3-6065_Dec19)	Dec-20
DAE4	SN: 781	27-Dec-19 (No. DAE4-781_Dec19)	Dec-20

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: 837633/005	10-Jan-19 (in house check Jan-19)	In house check: Oct-20
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-19)	In house check: Oct-20

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

Issued: May 26, 2020

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 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 E-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	V52.10.4
Phantom	HAC Test Arch	
Distance Dipole Top - Probe Center	15 mm	
Scan resolution	dx, dy = 5 mm	
Frequency	1880 MHz ± 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	87.8 V/m = 38.87 dBV/m
Maximum measured above low end	100 mW input power	86.0 V/m = 38.69 dBV/m
Averaged maximum above arm	100 mW input power	**86.9 V/m ± 12.8 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters

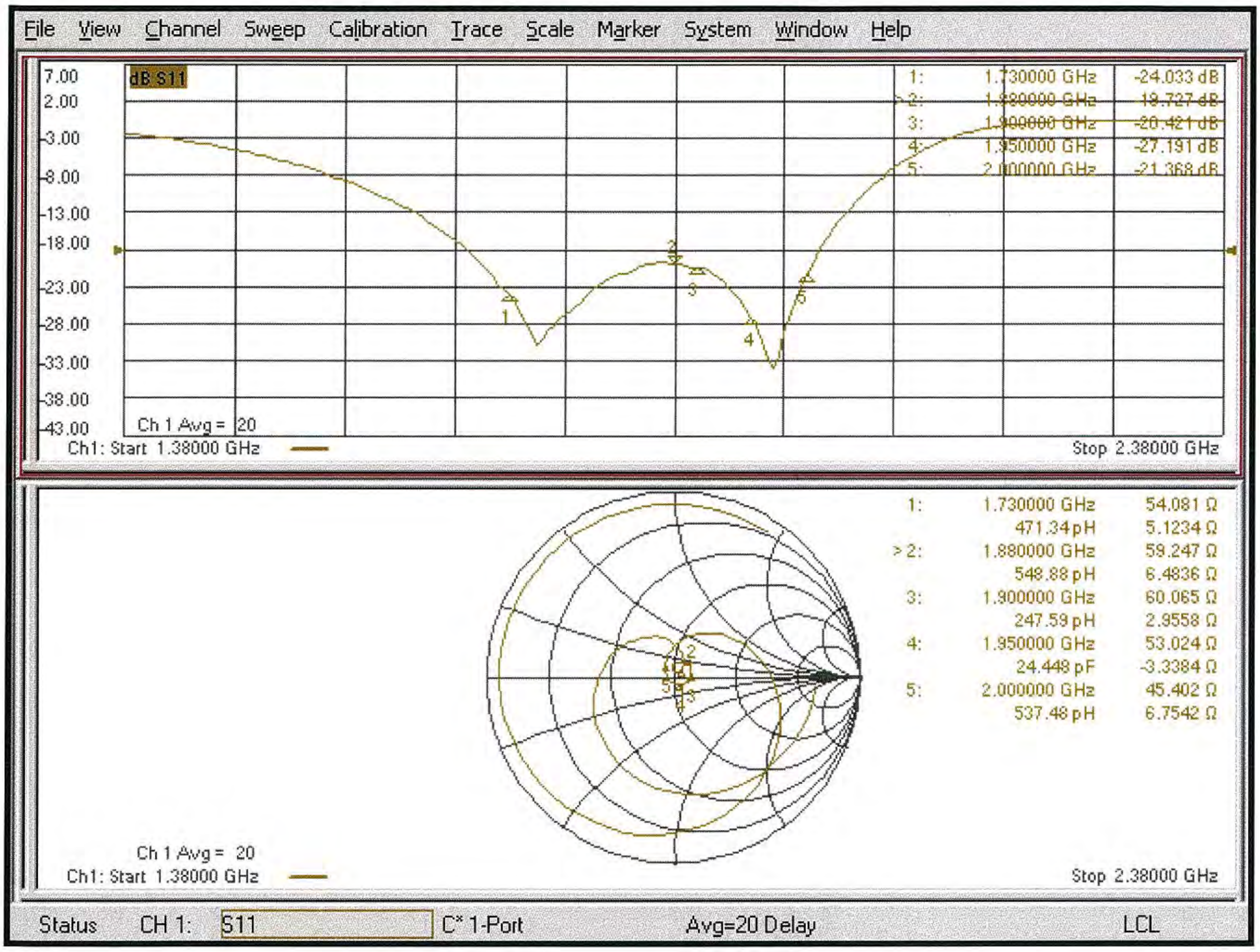
Frequency	**Return Loss**	**Impedance**
1730 MHz	24.0 dB	54.1 Ω + 5.1 jΩ
1880 MHz	19.7 dB	59.2 Ω + 6.5 jΩ
1900 MHz	20.4 dB	60.1 Ω + 3.0 jΩ
1950 MHz	27.2 dB	53.0 Ω - 3.3 jΩ
2000 MHz	21.4 dB	45.4 Ω + 6.8 jΩ

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.

Impedance Measurement Plot



DASY5 E-field Result

Date: 25.05.2020

Test Laboratory: SPEAG Lab2

DUT: HAC Dipole 1880 MHz; Type: CD1880V3; Serial: CD1880V3 - SN: 1044

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

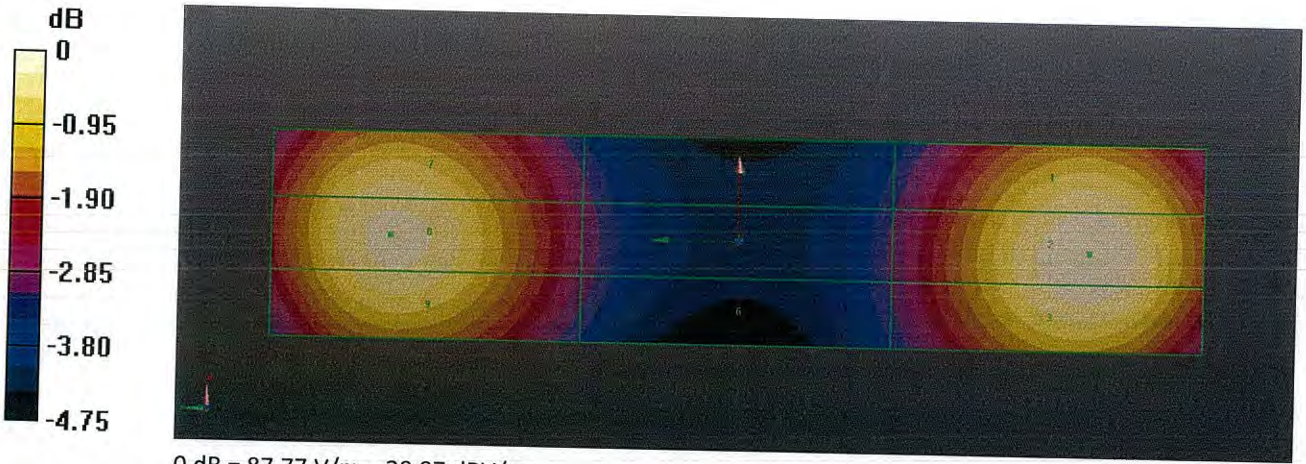
DASY52 Configuration:

- Probe: EF3DV3 - SN4013; ConvF(1, 1, 1) @ 1880 MHz; Calibrated: 31.12.2019
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn781; Calibrated: 27.12.2019
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA; Serial: 1070
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

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 = 151.5 V/m; Power Drift = -0.02 dB
Applied MIF = 0.00 dB
RF audio interference level = 38.87 dBV/m
Emission category: M2

MIF scaled E-field

Grid 1 **M2** **38.59 dBV/m**	Grid 2 **M2** **38.87 dBV/m**	Grid 3 **M2** **38.77 dBV/m**
Grid 4 **M2** **35.89 dBV/m**	Grid 5 **M2** **36.02 dBV/m**	Grid 6 **M2** **35.96 dBV/m**
Grid 7 **M2** **38.46 dBV/m**	Grid 8 **M2** **38.69 dBV/m**	Grid 9 **M2** **38.53 dBV/m**



0 dB = 87.77 V/m = 38.87 dBV/m

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

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

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

Accreditation No.: SCS 0108

Client **SGS - CN (Auden)**

Certificate No: DAE4-896_Sep19

CALIBRATION CERTIFICATE

Object	DAE4 - SD 000 D04 BJ - SN: 896
Calibration procedure(s)	QA CAL-06.v29 Calibration procedure for the data acquisition electronics (DAE)
Calibration date:	September 18, 2019

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
Keithley Multimeter Type 2001	SN: 0810278	03-Sep-19 (No:25949)	Sep-20
Secondary Standards	**ID #**	**Check Date (in house)**	**Scheduled Check**
Auto DAE Calibration Unit	SE UWS 053 AA 1001	07-Jan-19 (in house check)	In house check: Jan-20
Calibrator Box V2.1	SE UMS 006 AA 1002	07-Jan-19 (in house check)	In house check: Jan-20

	Name	Function	Signature
Calibrated by:	Dominique Steffen	Laboratory Technician	
Approved by:	Sven Kühn	Deputy Manager	i.V.

Issued: September 18, 2019

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

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

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

Accreditation No.: **SCS 0108**

Glossary

DAE	data acquisition electronics
Connector angle	information used in DASY system to align probe sensor X to the robot coordinate system.

Methods Applied and Interpretation of Parameters

- *DC Voltage Measurement:* Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.
- *Connector angle*: The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.
- The following parameters as documented in the Appendix contain technical information as a result from the performance test and require no uncertainty.
  - *DC Voltage Measurement Linearity:* Verification of the Linearity at +10% and -10% of the nominal calibration voltage. Influence of offset voltage is included in this measurement.
  - *Common mode sensitivity:* Influence of a positive or negative common mode voltage on the differential measurement.
  - *Channel separation:* Influence of a voltage on the neighbor channels not subject to an input voltage.
  - *AD Converter Values with inputs shorted:* Values on the internal AD converter corresponding to zero input voltage
  - *Input Offset Measurement*: Output voltage and statistical results over a large number of zero voltage measurements.
  - *Input Offset Current:* Typical value for information; Maximum channel input offset current, not considering the input resistance.
  - *Input resistance:* Typical value for information: DAE input resistance at the connector, during internal auto-zeroing and during measurement.
  - *Low Battery Alarm Voltage:* Typical value for information. Below this voltage, a battery alarm signal is generated.
  - *Power consumption:* Typical value for information. Supply currents in various operating modes.

DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1μV , full range = -100...+300 mV

Low Range: 1LSB = 61nV , full range = -1.......+3mV

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Calibration Factors	X	Y	Z
High Range	404.022 ± 0.02% (k=2)	404.257 ± 0.02% (k=2)	404.191 ± 0.02% (k=2)
Low Range	3.98013 ± 1.50% (k=2)	3.99657 ± 1.50% (k=2)	3.97235 ± 1.50% (k=2)

Connector Angle

Connector Angle to be used in DASY system	37.5 ° ± 1 °

Appendix (Additional assessments outside the scope of SCS0108)

1. DC Voltage Linearity

High Range		Reading (µV)	Difference (µV)	Error (%)
Channel X	+ Input	200040.89	5.76	0.00
Channel X	+ Input	20006.10	0.48	0.00
Channel X	- Input	-20002.92	2.55	-0.01
Channel Y	+ Input	200032.08	-3.21	-0.00
Channel Y	+ Input	20004.20	-1.29	-0.01
Channel Y	- Input	-20004.09	1.52	-0.01
Channel Z	+ Input	200033.60	-1.56	-0.00
Channel Z	+ Input	20003.49	-2.00	-0.01
Channel Z	- Input	-20004.81	0.85	-0.00

Low Range		Reading (µV)	Difference (µV)	Error (%)
Channel X	+ Input	2000.63	-0.76	-0.04
Channel X	+ Input	201.08	-0.29	-0.15
Channel X	- Input	-199.07	-0.39	0.20
Channel Y	+ Input	2001.55	0.25	0.01
Channel Y	+ Input	199.66	-1.59	-0.79
Channel Y	- Input	-199.65	-0.88	0.45
Channel Z	+ Input	2001.32	0.14	0.01
Channel Z	+ Input	200.72	-0.51	-0.25
Channel Z	- Input	-200.26	-1.43	0.72

2. Common mode sensitivity

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Common mode Input Voltage (mV)	High Range Average Reading (µV)	Low Range Average Reading (µV)
Channel X	200	11.76	10.55
	- 200	-10.27	-11.69
Channel Y	200	15.87	16.13
	- 200	-17.91	-18.33
Channel Z	200	5.47	5.16
	- 200	-7.23	-6.76

3. Channel separation

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Input Voltage (mV)	Channel X (µV)	Channel Y (µV)	Channel Z (µV)
Channel X	200	-	-0.54	-4.17
Channel Y	200	7.56	-	0.46
Channel Z	200	9.61	5.52	-

4. AD-Converter Values with inputs shorted

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	High Range (LSB)	Low Range (LSB)
Channel X	15562	17474
Channel Y	15992	17482
Channel Z	15642	14726

5. Input Offset Measurement

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec
Input 10MΩ

	Average (μV)	min. Offset (μV)	max. Offset (μV)	Std. Deviation (μV)
Channel X	0.71	-0.23	2.09	0.45
Channel Y	-0.40	-1.78	0.63	0.55
Channel Z	-0.76	-1.83	0.29	0.47

6. Input Offset Current

Nominal Input circuitry offset current on all channels: <25fA

7. Input Resistance (Typical values for information)

	Zeroing (kOhm)	Measuring (MOhm)
Channel X	200	200
Channel Y	200	200
Channel Z	200	200

8. Low Battery Alarm Voltage (Typical values for information)

Typical values	Alarm Level (VDC)
Supply (+ Vcc)	+7.9
Supply (- Vcc)	-7.6

9. Power Consumption (Typical values for information)

Typical values	Switched off (mA)	Stand by (mA)	Transmitting (mA)
Supply (+ Vcc)	+0.01	+6	+14
Supply (- Vcc)	−0.01	-8	-9

Schmid & Partner Engineering AG

s p e a g

Zeughausstrasse 43, 8004 Zurich, Switzerland
Phone +41 44 245 9700, Fax +41 44 245 9779
www.speag.swiss, info@speag.swiss

IMPORTANT NOTICE

USAGE OF THE DAE4

The DAE unit is a delicate, high precision instrument and requires careful treatment by the user. There are no serviceable parts inside the DAE. Special attention shall be given to the following points:

Battery Exchange: The battery cover of the DAE4 unit is fixed using a screw, over tightening the screw may cause the threads inside the DAE to wear out.

Shipping of the DAE: Before shipping the DAE to SPEAG for calibration, remove the batteries and pack the DAE in an antistatic bag. This antistatic bag shall then be packed into a larger box or container which protects the DAE from impacts during transportation. The package shall be marked to indicate that a fragile instrument is inside.

E-Stop Failures: Touch detection may be malfunctioning due to broken magnets in the E-stop. Rough handling of the E-stop may lead to damage of these magnets. Touch and collision errors are often caused by dust and dirt accumulated in the E-stop. To prevent E-stop failure, the customer shall always mount the probe to the DAE carefully and keep the DAE unit in a non-dusty environment if not used for measurements.

Repair: Minor repairs are performed at no extra cost during the annual calibration. However, SPEAG reserves the right to charge for any repair especially if rough unprofessional handling caused the defect.

DASY Configuration Files: Since the exact values of the DAE input resistances, as measured during the calibration procedure of a DAE unit, are not used by the DASY software, a nominal value of 200 MOhm is given in the corresponding configuration file.

Important Note:
Warranty and calibration is void if the DAE unit is disassembled partly or fully by the Customer.

Important Note:
Never attempt to grease or oil the E-stop assembly. Cleaning and readjusting of the E-stop assembly is allowed by certified SPEAG personnel only and is part of the annual calibration procedure.

Important Note:
To prevent damage of the DAE probe connector pins, use great care when installing the probe to the DAE. Carefully connect the probe with the connector notch oriented in the mating position. Avoid any rotational movement of the probe body versus the DAE while turning the locking nut of the connector. The same care shall be used when disconnecting the probe from the DAE.

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

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

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

Accreditation No.: SCS 0108

Client **SGS-CN (Auden)**

Certificate No: EF3-4051_May20

CALIBRATION CERTIFICATE

Object	EF3DV3- SN:4051
Calibration procedure(s)	QA CAL-02.v9, QA CAL-25.v7 Calibration procedure for E-field probes optimized for close near field evaluations in air
Calibration date:	May 29, 2020

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	01-Apr-20 (No. 217-03100/03101)	Apr-21
Power sensor NRP-Z91	SN: 103244	01-Apr-20 (No. 217-03100)	Apr-21
Power sensor NRP-Z91	SN: 103245	01-Apr-20 (No. 217-03101)	Apr-21
Reference 20 dB Attenuator	SN: CC2552 (20x)	31-Mar-20 (No. 217-03106)	Apr-21
DAE4	SN: 789	27-Dec-19 (No. DAE4-789_Dec19)	Dec-20
Reference Probe ER3DV6	SN: 2328	05-Oct-19 (No. ER3-2328_Oct19)	Oct-20
Secondary Standards	ID	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (in house check Jun-18)	In house check: Jun-20
Power sensor E4412A	SN: MY41498087	06-Apr-16 (in house check Jun-18)	In house check: Jun-20
Power sensor E4412A	SN: 000110210	06-Apr-16 (in house check Jun-18)	In house check: Jun-20
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Jun-18)	In house check: Jun-20
Network Analyzer E8358A	SN: US41080477	31-Mar-14 (in house check Oct-19)	In house check: Oct-20

	Name	Function	Signature
Calibrated by:	Michael Weber	Laboratory Technician	M.Weber
Approved by:	Katja Pokovic	Technical Manager	

Issued: June 1, 2020

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

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

DASY/EASY - Parameters of Probe: EF3DV3 - SN:4051

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm (µV/(V/m)^2)	0.63	0.49	1.31	± 10.1 %
DCP (mV)[B]	100.9	97.5	97.9	

Calibration results for Frequency Response (30 MHz – 6 GHz)

Frequency MHz	Target E-Field V/m	Measured E-field (En) V/m	Deviation E-normal in %	Measured E-field (Ep) V/m	Deviation E-normal in %	Unc (k=2) %
30	77.2	77.4	0.2%	77.5	0.3%	± 5.1 %
100	77.3	78.1	1.0%	77.8	0.6%	± 5.1 %
450	77.1	78.0	1.1%	77.9	1.0%	± 5.1 %
600	77.2	77.6	0.6%	77.5	0.5%	± 5.1 %
750	77.3	77.4	0.2%	77.2	0.0%	± 5.1 %
1800	140.3	139.4	-2.6%	139.2	-2.8%	± 5.1 %
2000	133.0	131.5	-2.6%	131.3	-2.8%	± 5.1 %
2200	125.1	123.5	-3.2%	124.3	-2.5%	± 5.1 %
2500	123.7	122.5	-2.4%	123.3	-1.7%	± 5.1 %
3000	78.9	75.8	-4.4%	76.8	-3.2%	± 5.1 %
3500	250.5	249.2	-3.0%	245.7	-4.3%	± 5.1 %
3700	244.2	240.4	-3.6%	238.9	-4.2%	± 5.1 %
5200	50.8	51.3	1.1%	51.8	2.0%	± 5.1 %
5500	49.7	49.4	-0.6%	48.3	-2.8%	± 5.1 %
5800	48.9	48.5	-0.6%	49.8	1.9%	± 5.1 %

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

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

DASY/EASY - Parameters of Probe: EF3DV3 - SN:4051

Calibration Results for Modulation Response

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Max dev.	Max Unc[E] (k=2)
0	CW	X	0.00	0.00	1.00	0.00	152.5	± 3.0 %	± 4.7 %
		Y	0.00	0.00	1.00		128.9		
		Z	0.00	0.00	1.00		133.2		
10352-AAA	Pulse Waveform (200Hz, 10%)	X	3.23	67.04	11.13	10.00	60.0	± 2.0 %	± 9.6 %
		Y	3.68	68.14	11.60		60.0		
		Z	7.90	78.64	17.21		60.0		
10353-AAA	Pulse Waveform (200Hz, 20%)	X	1.96	65.47	9.44	6.99	80.0	± 1.0 %	± 9.6 %
		Y	1.78	64.57	9.02		80.0		
		Z	20.00	90.21	19.52		80.0		
10354-AAA	Pulse Waveform (200Hz, 40%)	X	1.54	67.18	9.24	3.98	95.0	± 1.0 %	± 9.6 %
		Y	1.25	65.60	8.43		95.0		
		Z	20.00	92.13	18.95		95.0		
10355-AAA	Pulse Waveform (200Hz, 60%)	X	20.00	88.28	14.96	2.22	120.0	± 1.0 %	± 9.6 %
		Y	6.46	79.23	12.18		120.0		
		Z	20.00	98.21	20.59		120.0		
10387-AAA	QPSK Waveform, 1 MHz	X	1.97	69.65	16.93	1.00	150.0	± 1.9 %	± 9.6 %
		Y	2.16	73.51	18.30		150.0		
		Z	2.23	69.86	17.89		150.0		
10388-AAA	QPSK Waveform, 10 MHz	X	2.51	70.43	17.23	0.00	150.0	± 1.1 %	± 9.6 %
		Y	2.45	71.25	17.77		150.0		
		Z	3.15	73.53	18.73		150.0		
10396-AAA	64-QAM Waveform, 100 kHz	X	3.09	73.49	20.35	3.01	150.0	± 0.7 %	± 9.6 %
		Y	2.61	71.58	19.60		150.0		
		Z	5.67	82.23	23.88		150.0		
10399-AAA	64-QAM Waveform, 40 MHz	X	3.57	67.65	16.25	0.00	150.0	± 0.9 %	± 9.6 %
		Y	3.50	67.89	16.46		150.0		
		Z	3.89	68.81	16.99		150.0		
10414-AAA	WLAN CCDF, 64-QAM, 40MHz	X	4.82	65.80	15.74	0.00	150.0	± 1.3 %	± 9.6 %
		Y	4.65	65.95	15.88		150.0		
		Z	5.17	66.20	16.10		150.0		

Note: For details on UID parameters see Appendix

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

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

DASY/EASY - Parameters of Probe: EF3DV3 - SN:4051

Sensor Frequency Model Parameters

	Sensor X	Sensor Y	Sensor Z
Frequency Corr. (LF)	0.02	-0.01	5.74
Frequency Corr. (HF)	2.82	2.82	2.82

Sensor Model Parameters

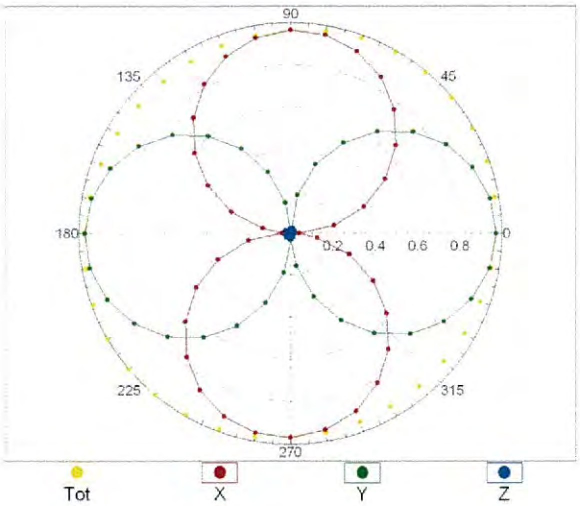
	C1 fF	C2 fF	α V^{-1}	T1 $ms.V^{-2}$	T2 $ms.V^{-1}$	T3 ms	T4 V^{-2}	T5 V^{-1}	T6
X	46.2	295.59	34.91	7.40	0.49	4.93	1.37	0.04	1.00
Y	34.4	219.69	34.92	6.17	0.61	4.92	1.20	0.00	1.00
Z	72.9	477.88	36.58	13.78	0.88	4.99	1.70	0.27	1.01

Other Probe Parameters

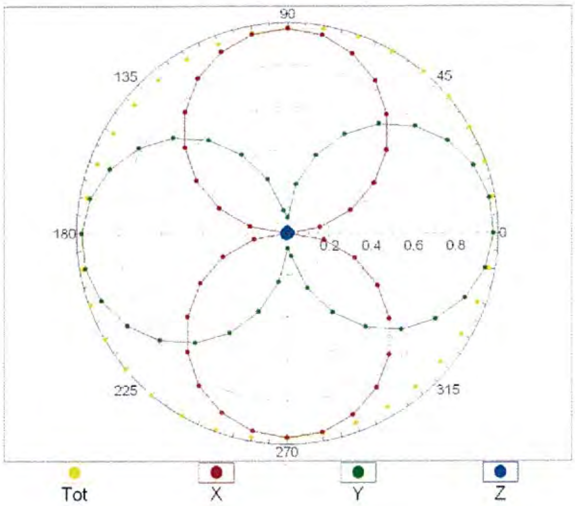
Sensor Arrangement	Rectangular
Connector Angle (°)	130
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	12 mm
Tip Length	25 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	1.5 mm
Probe Tip to Sensor Y Calibration Point	1.5 mm
Probe Tip to Sensor Z Calibration Point	1.5 mm

Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM,0°

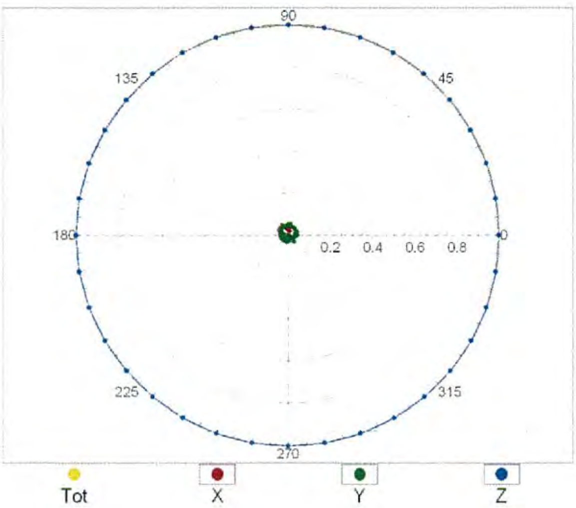


f=1800 MHz,R22,0°

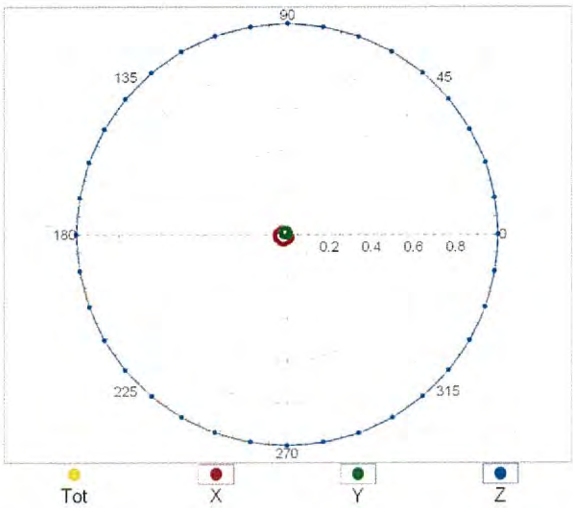


Receiving Pattern (ϕ), ϑ = 90°

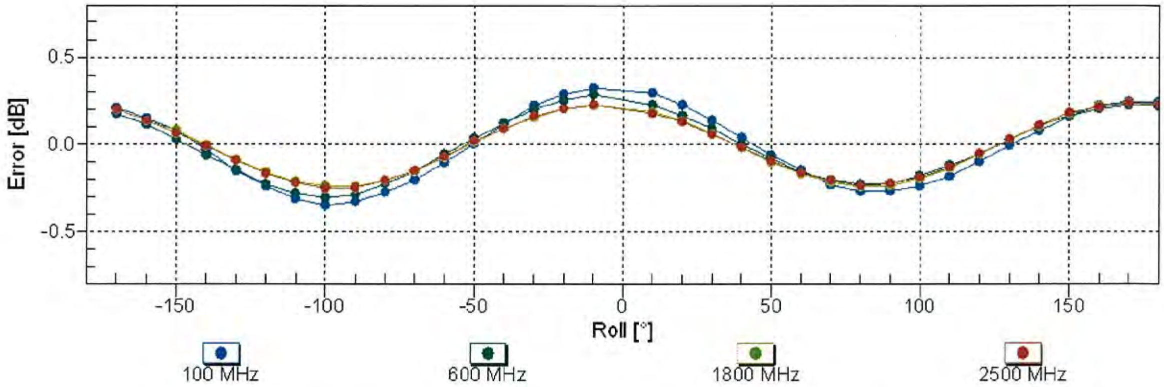
f=600 MHz,TEM,90°



f=1800 MHz,R22,90°

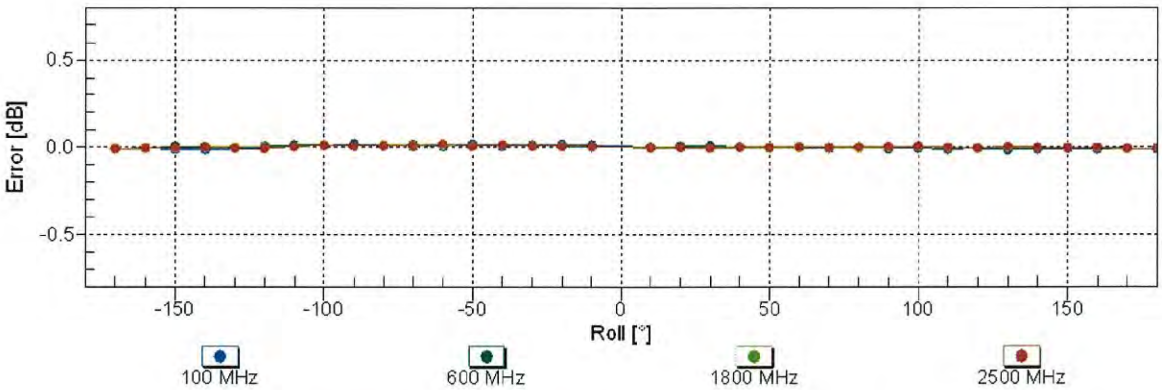


Receiving Pattern (ϕ), ϑ = 0°



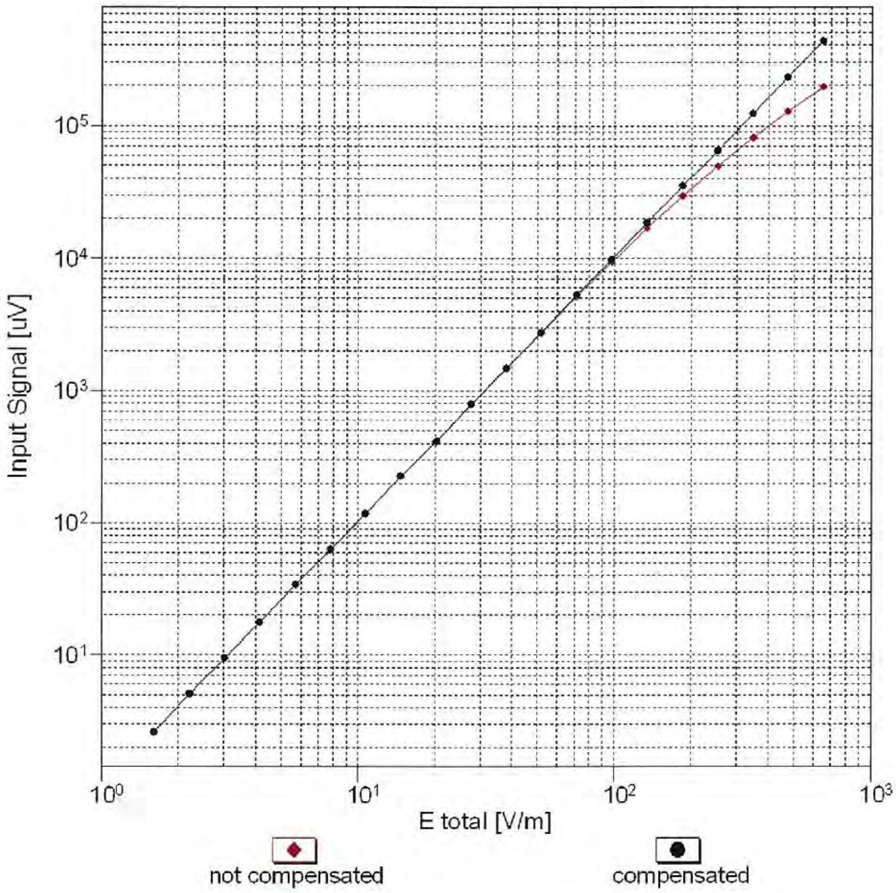
Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

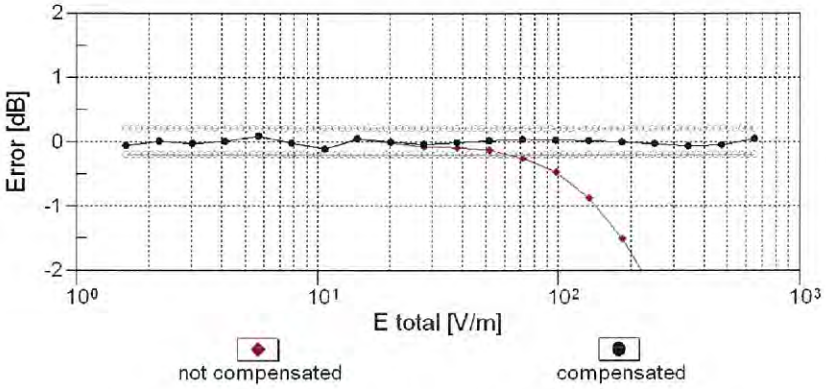
Receiving Pattern (ϕ), ϑ = 90°



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

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

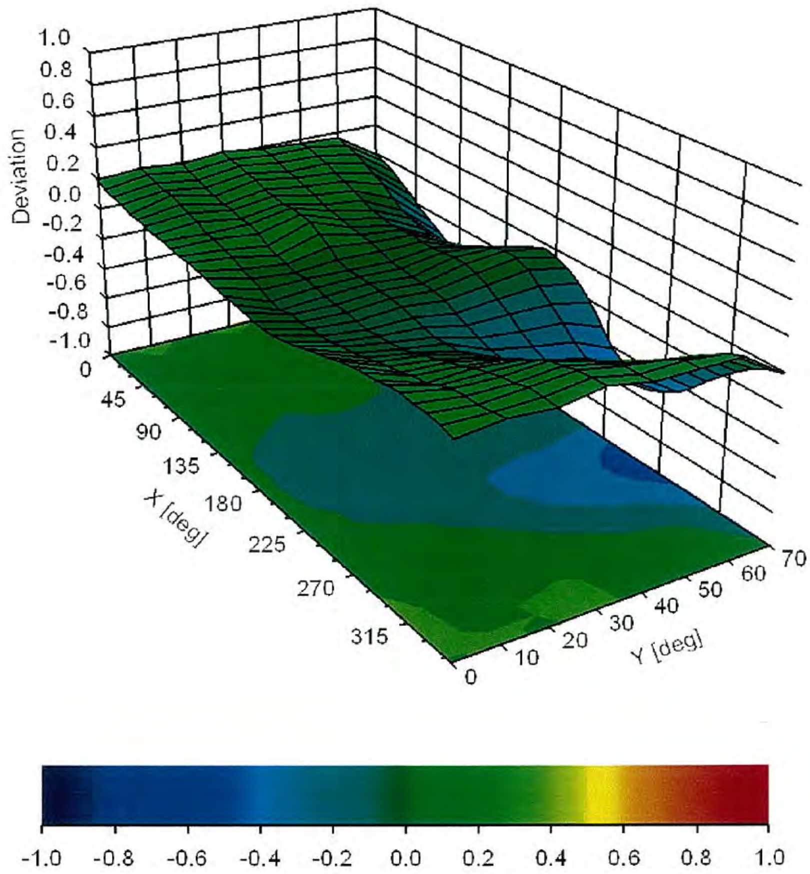




Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Deviation from Isotropy in Air

Error (ϕ, ϑ), f = 900 MHz



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

Appendix: Modulation Calibration Parameters

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

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