HAC RF EMISSION TEST REPORT

Report No.:	SET2022-11483
Product:	5G Smart Phone
Model No.:	N6501L
Serial Model:	B20
FCC ID:	2ADINN6501L
Brand Name:	NUU
Applicant:	Sun Cupid Technology (HK) Ltd.
Address:	16/F, CEO Tower, 77 Wing Hong Street, Cheung Sha Wan, Kowloon, Hongkong
Test Date:	08/17/2022
Issued Date:	08/18/2022
Issued by:	CCIC Southern Testing Co., Ltd.
Lab Location:	Electronic Testing Building, No. 43 Shahe Road, Xili Street, Nanshan District, Shenzhen, Guangdong, China.
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Test Report

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Applicant Address…………..:	16/F, CEO Tower, 77 Wing Hong Street, Cheung Sha Wan, Kowloon, Hongkong
Test Standards……………….:	ANSI C63.19-2011 American National Standard Methods of Measurement of Compatibility between Wireless Communications Devices and Hearing Aids FCC 47 CFR § 20.19 American National Standard Methods of Measurement of Compatibility between Wireless Communications Devices and Hearing Aids
RF Emission Rating………:	M4
Test Result……………………:	Pass
Tested by ……………………..:	Xinyuan Fang Xinyuan Fang, Test Engineer
Reviewed by………………….:	Chris You Chris You, Senior Engineer
Approved by………………….:	Shuangwen Zhang Shuangwen Zhang, Manager

Contents

1. Administrative Data

1.1 Testing Laboratory

Test Site:	CCIC Southern Testing Co., Ltd.
Address:	Electronic Testing Building, No. 43 Shahe Road, Xili Street, Nanshan District, Shenzhen, Guangdong, China.
A2LA Lab Code:	CCIC-SET is a third party testing organization accredited by A2LA according to ISO/IEC 17025. The accreditation certificate number is 5721.01.
FCC Registration:	CCIC-SET Laboratory has been registered and fully described in a report filed with the FCC (Federal Communications Commission). The acceptance letter from the FCC is maintained in our files. Designation Number: CN1283, valid time is until April 19, 2023.
ISED Registration:	CCIC-SET Laboratory has been registered by Certification and Engineering Bureau of Industry Canada for the performance of radiated measurements with Registration No. 11185A, CAB Identifier: CN0064, valid time is until June 30, 2023
Test Environment Condition:	Temperature (℃): 21℃ Relative Humidity (%): 60% Atmospheric Pressure (kPa): 86KPa-106KPa

2. EQUIPMENT UNDER TEST(EUT)

Identification of the Equipment under Test

Sample Name:	**5G Smart Phone**	
Model Name:	**N6501L, B20**	
Brand Name:	**NUU**	
General description:	Support Band	GSM850/1900, WCDMA B2/4/5 LTE B2/4/5/7/12/13/17/25/26/41/66/71 NR n2/ n5/ n25/ n41/ n66/ n71 2.4G WIFI, BT, 5G WIFI(B1,B4)
	Test Band	GSM850MHz/1900MHz WCDMA Band 2/4/5
	Development Stage	Identical Prototype
	Accessories	Power Supply
	Antenna type	PIFA Antenna
	Operation mode	GSM Voice WCDMA Voice
	Modulation mode	GSM: GMSK, 8PSK WCDMA: QPSK LTE/NR: QPSK, 16QAM,64QAM,256QAM 2.4GHz WIFI: DSSS, OFDM 5G WIFI: OFDM BT: GFSK/π/4-DQPSK/8-DPSK

Note: these two model only the model name is difference for market purpose

3. SUMMARY OF TEST RESUSLTS

3.1 Test Standards

No.	Identity	Document Title
1	FCC 47 CFR Part 20.19	Hearing aid-compatible mobile handsets.
2	ANCI C63.19:2011	American National Standard Methods of Measurement of Compatibility between Wireless Communications Devices and Hearing Aids
3	KDB 285076 D01 HAC Guidance v06r01	EQUIPMENT AUTHORIZATION GUIDANCE FOR HEARING AID COMPATIBILITY

3.2 Summary Of HAC Rating

Summary of Max. M-Rating

Band	E-field dB(V/m)	M-Rating
GSM850	28.40	M4
GSM1900	25.01	M4
WCDMA850	28.22	M4
WCDMA1900	26.28	M4
WCDMA1700	26.01	M4

4. HEARING AID COMPATIBILITY

4.1 Introduction

The purpose of the Hearing Aid Compatibility extension is to enable measurements of the near electric and magnetic fields generated by wireless communication devices in the region controlled for use by a hearing aid in accordance with ANSI-C63.19-2011 FCC has granted a request for waiver of the HAC rules in section 20.19 for dual band GSM handsets. The waiver has specific conditions, as stated in the order (FCC 05-166) and expires 1 August 2007.

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 and magnetic fields emitted by a WD to categorize these emissions for correlation with the RF immunity of a hearing aid.
b) Magnetic field measurements of a WD emitted via the audio transducer associated with the T-coil mode of the hearing aid, for assessment of hearing aid performance.
c) Measurements with the hearing aid and a simulation of the categorized WD T-coil emissions to assess the hearing aid RF immunity in the T-coil mode.

The WD radio frequency (RF) and audio band emissions are measured.

Hence, the following are measurements made for the WD:

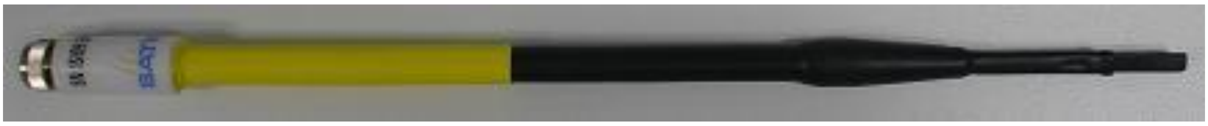
a) RF E-Field emissions
c) T-coil mode, magnetic signal strength in the audio band
d) T-coil mode, magnetic signal and noise articulation index
e) T-coil mode, magnetic signal frequency response through the audio band

Corresponding to the WD measurements, the hearing aid is measured for:

a) RF immunity in microphone mode
b) RF immunity in T-coil mode

4.2 Description of Test System

4.2.1 COMOHAC E-FIELD PROBE



Serial Number:	SN 02/12 EPH34
Frequency:	0.7GHz – 2.5GHz
Probe length:	330mm
Length of one dipole:	3.3mm
Maximum external diameter:	8mm
Probe extremity diameter:	5mm
Distance between dipoles/probe extremity:	3mm
Resistance of the three dipole (at the connector):	Dipole 1:R1=1.201 MΩ Dipole 2:R1=1.193 MΩ Dipole 3:R3=0.994 MΩ

4.2.2 System Hardware

The HAC positioning ruler is used to position the phone properly with the regard to the position of the probe during a measurement. The positioning system is made of a dedicated frame that can be fixed on the table. The tip of the probe is positioned on a reference point located on the top of the positioning ruler. The distance between this reference point and the cross located on the ruler being known, the speaker of the phone is positioned on this cross in order to make sure both probe and phone are positioned properly.

During the measurement, the HAC ruler has to be removed so that it does not interfere with the measurement.

Position device

5. OPERATIONAL CONDITIONS DURING TEST

5.1 Schematic Test Configuration

The EUT should use its internal transmitter. The antenna(s), battery and accessories shall be those specified by the manufacturer. The EUT battery must be fully charged and checked periodically during the test to ascertain uniform power output. If a wireless link was used, the antenna connected to the output of the base station simulator shall be placed at least 50 cm away from the handset.

Air-interface	Band (MHz)	Type	C63.19-2011 Tested	Simultaneous Transmissions Scenarios invoice (Not to be tested)	Reduced power	VOIP
GSM	850	Voice	Yes	Yes: WIFI or BT	N/A	N/A
	1900	Voice	Yes	Yes: WIFI or BT	N/A	N/A
	GPRS	Data	N/A	N/A	N/A	N/A
WCDMA	850	Voice	Yes	Yes: WIFI or BT	N/A	N/A
	1700	Voice	Yes	Yes: WIFI or BT	N/A	N/A
	1900	Voice	Yes	Yes: WIFI or BT	N/A	N/A
	HSPA	Data	N/A	N/A	N/A	N/A
LTE	Band 2	Data	N/A	Yes: WIFI or BT	N/A	N/A
	Band 4	Data	N/A	Yes: WIFI or BT	N/A	N/A
	Band 5	Data	N/A	Yes: WIFI or BT	N/A	N/A
	Band 7	Data	N/A	Yes: WIFI or BT	N/A	N/A
	Band 12	Data	N/A	Yes: WIFI or BT	N/A	N/A
	Band 13	Data	N/A	Yes: WIFI or BT	N/A	N/A
	Band 25	Data	N/A	Yes: WIFI or BT	N/A	N/A
	Band 26	Data	N/A	Yes: WIFI or BT	N/A	N/A
	Band 41	Data	N/A	Yes: WIFI or BT	N/A	N/A
	Band 66	Data	N/A	Yes: WIFI or BT	N/A	N/A
	Band 71	Data	N/A	Yes: WIFI or BT	N/A	N/A
NR	N2	Data	N/A	Yes: WIFI or BT	N/A	N/A
	N5	Data	N/A	Yes: WIFI or BT	N/A	N/A
	N41	Data	N/A	Yes: WIFI or BT	N/A	N/A
	N66	Data	N/A	Yes: WIFI or BT	N/A	N/A
	N71	Data	N/A	Yes: WIFI or BT	N/A	N/A
WIFI	2.4/5GHz	Data	N/A	Yes GSM or WCDMA	N/A	N/A
BT	2.4GHz	Data	N/A	Yes GSM or WCDMA	N/A	N/A
Note: N/A=Not support						

The volume is at the maximum value, and the backlight of the phone is turned off. The Manufacturer design HAC mode software on the EUT

5.2 HAC Measurement System

The HAC measurement system being used is the COMO HAC system, the system is controlled remotely from a PC, which contains the software to control the robot and data acquisition equipment. The software also displays the data obtained from test scans.

In operation, the system first does an 2D scan at a fixed depth within a 50mm*50mm area. When the maximum HAC point has been found, the system will then carry out a 3D scan centred at that point to determine volume averaged HAC level.

WD reference and plane for RF emission measurements

5.3 Magnetic measurement locations for the WD

T-Coil measurement points and reference planeThe following figure illustrates the three standard probeorientations. Position 1 is the axial orientation of the probe coil;orientation 2 and orientation 3 are radial orientations. The space between themeasurement positions is not fixed. It is recommende d that a scan of the EUT bedone for each probe coil orientation and that the maximum level recorde d beused as the reading for that orientation of the probe coil.

1) The reference plane is the planar area that contains thehighest point in the area of the phone th at normally rests against the user’sear. It is parallel to the centerline of the receiver area of the phon e and isdefined by the points of the receiver-end of the EUT handset, which, in normal handsetuse, r est against the ear.

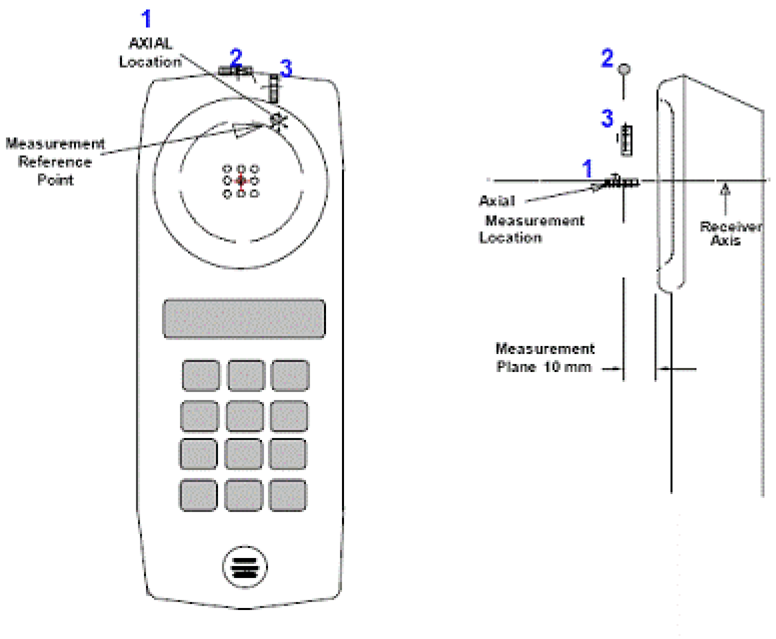
2) The measurement plane is parallel to, and10 mmin front of, the reference plane.

3) The reference axis is normal to the reference plane andpasses through the center of the receiver speaker section (or the center of thehole array); or may be centered on a secondary inductive source . The actuallocation of the measurement point shall be noted in the test report as the measurement reference point.

4) The measurement points may be located where the axialand radial field intensity measurement s are optimum with regard to therequirements. However, the measurement points should be near the acousticoutput of the EUT and shall be located in the same half of the phone as the EUTreceiver. In a EUT handset with a centered receiver and a circularly symmetricalmagnetic field, the measureme nt axis and the reference axis would coincide.

5) The relative spacing of each measurement orientation isnot fixed. The axial and two radial orie ntations should be chosen to select the optimal position.

6) The measurement point for the axial position is located10 mmfrom the reference plane on the measurement axis. The actual location of the measurementpoint shall be noted in test reports and de signated as the measurement reference point.



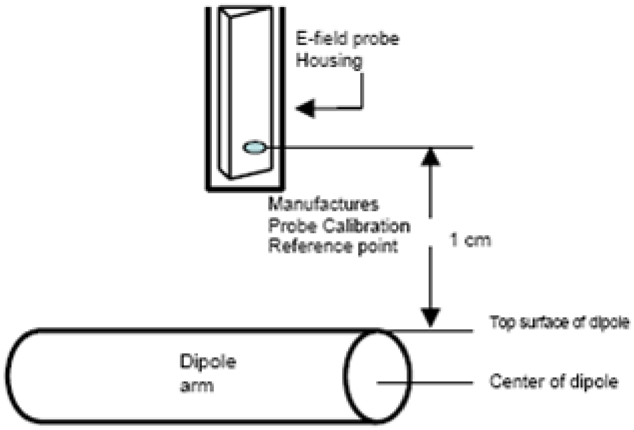
Axis and planes for EUT audio frequency magnetic field measurements

5.4 Equipment and results of validation testing

5.4.1 System Check Parameters

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

- Average Input Power P = 100mW RMS (20dBm RMS) after adjustment for return loss
- The test fixture must meet the 2 wavelength separation criterion
- The proper measurement of the 1 cm probe to dipole separation, which is measured from top surface of the dipole to the calibration reference point of the sensor, defined by the probe manufacturer is shown in the following diagram:



Separation Distance from Dipole to Field Probe

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

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

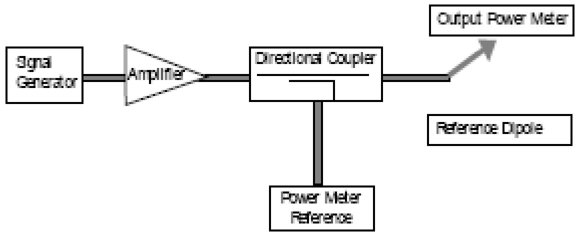
5.4.2 Validation Procedure

A dipole antenna meeting the requirements given in PC63.19 was placed in the position normally occupied by the WD.

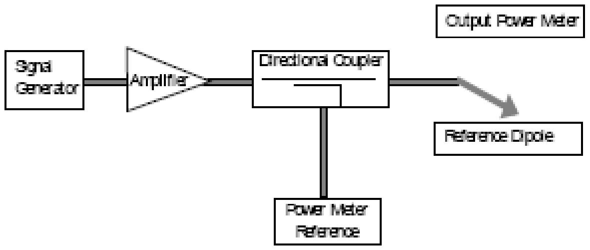
The length of the dipole was scanned with both E-field and H-field probes and the maximum values for each were recorded.

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

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



Setup for Desired Output Power to Dipole



Setup to Dipole

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

5.4.3 Test System Validation

Validation Results (20dBm forward input power), System checks the specific test data please see Annex C.

Frequency	Input Power (dBm)	E-field Result (V/m)	Target Field (V/m)	Deviation (%)
835 MHz	20.0	219.78	221.37	-0.7
1900MHz	20.0	148.40	150.02	-1.07
1700MHz	20.0	152.74	150.02	1.81
Note: The tolerance deviation limit of System validation is ±25%				

Note: Target value was referring to the Measured value in the calibration certificate of reference dipole.

5.4.4. Modulation Interference Factor (MIF)

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

The Modulation Interference factor (MIF, in dB) is added to the measured average E-field (in dBV/m) and converts it to the RF Audio Interference level (in dBV/m). This level considers the audible amplitude modulation components in the RF E-field. CW fields without amplitude modulation are assumed to not interfere with the hearing aid electronics. Modulations without time slots and low fluctuations at low frequencies have low MIF values, TDMA modulations with narrow transmission and repetition rates of few 100 Hz have high MIF values and give similar classifications as ANSI C63-2007.

Definitions, E-field probes have a bandwidth <10 kHz and can therefore not evaluate the RF envelope in the full audio band. OPENHAC is therefore using the “indirect" measurement method according to ANSI C63.19-2011 which is the primary method. These near field probes read the averaged E-field measurement. Especially for the new high peak-to-average (PAR) signal types, the probes shall be linearized by probe modulation response (PMR) calibration in order to not overestimate the field reading.The evaluation method or the MIF is defined in ANSI C63.19-2011 section D.7. An RMS demodulated RF signal is fed to a spectral filter (similar to an A weighting filter) and forwarded to a temporal filter acting as a quasi-peak detector. The averaged output of these filtering is called to a 1 kHz 80% AM signal as reference. MIF measurement requires additional instrumentation and is not well suited for evaluation by the end user with reasonable uncertainty It may alternatively be determined through analysis and simulation, because it is constraint and characteristic for a communication signal. OPENHAC uses well defined signals for PMR calibration. The MIF of these signals has been determined by simulation and is automatically applied.

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

Transmission protocol	Modulation interference factor
GSM; full-rate version 2; speech codec/handset low	+3.5dB
WCDMA; speech; speech codec low; AMR 12.2 kb/s	-20.0dB
CDMA; speech; SO3; RC3; full frame rate: 8kEVRC	-19.0dB
CDMA; speech; SO3; RC1;1/8th frame rate; 8kEVRC	+3.3dB

A PMR calibrated probe is linearized for the selected waveform over the full dynamic range within the uncertainty

specified in its calibration certificate. E-field probes have a bandwidth <10 kHz and can therefore not evaluate the RF envelope in the full audio band. OPENHAC is therefore using the \indirect" measurement method according to ANSI C63.19-2011 which is the primary method. These near field probes read the averaged E-field measurement. Especially for the new high peak-to-average (PAR) signal types, the probes shall be linearized by PMR calibration in order to not overestimate the field reading. The 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 alternatively be determined through analysis and simulation, because it is constant and characteristic for a communication signal. OPENHAC uses well-defined signals for PMR calibration. The MIF of these signals has been determined by simulation and is automatically applied. The MIF measurement uncertainty is estimated as follows, for modulation frequencies from slotted waveforms with fundamental frequency and at least 2 harmonics within 10

kHz:

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

1 dB for MIF > -20

6. CHARACTERISTICS OF THE TEST

6.1 Applicable Limit Regulations

Telephone near-field categories in linear units (<960MHz)

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

6.2 Applicable Measurement Standards

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

FCC 47CFR§20.19 American National Standard Methods of Measurement of Compatibility between Wireless Communications Devices and Hearing Aids

It specifies the measurement method for demonstration of compliance with the HAC limits for such equipment.

7. TEST RESULTS

7.1 Summary of conducted Power Measurement Results

The power level results were listed in the following two tables:

Conducted RF Power of GSM850

Band	GSM 850			GSM 1900		
Channel	128	190	251	512	661	810
Frequency	824.2	836.4	848.8	1850.2	1880.0	1909.8
GSM	32.84	33.08	33.10	29.84	29.53	29.26

Conducted RF Power of WCDMA

Band	WCDMA 850			WCDMA1900		
TX Channel	4132	4182	4233	9262	9400	9538
Frequency	826.4	835	846.6	1852.4	1880.0	1907.6
ARM	22.93	23.03	23.14	21.70	21.74	21.70

Conducted RF Power of WCDMA

Band	WCDMA 1700		
TX Channel	1312	1412	1513
Frequency	1712.4	1732.4	1752.6
ARM	22.63	22.61	22.65

7.2 Summary of Measurement Results

RF Emission Values of the EUT

Temperature: 23.0~23.5 ℃, humidity: 62~64%.				
Band	Channel	Frequency (MHz)	Test Results	Category
			E-field dB(V/m)	
GSM850	Low	824.2	27.66	M4
GSM850	Mid	836.4	**28.40**	M4
GSM850	High	848.8	28.33	M4
GSM1900	Low	1850.2	25.01	M4
GSM1900	Mid	1880.0	24.18	M4
GSM1900	High	1909.8	24.39	M4
WCDMA850	Low	826.4	28.22	M4
WCDMA850	Mid	836.4	28.11	M4
WCDMA850	High	846.6	27.09	M4
WCDMA1900	Low	1852.4	26.11	M4
WCDMA1900	Mid	1880.0	26.28	M4
WCDMA1900	High	1907.6	25.98	M4
WCDMA1700	Low	1712.4	26.01	M4
WCDMA1700	Mid	1732.4	25.50	M4
WCDMA1700	High	1752.6	25.46	M4

8. MEASUREMENT UNCERTAINTY

Table 9: Measurement Uncertainty of RF Emission Test

Uncertainty Component	Uncertainty value	Probe Dist.	Div	(Ci) E	(Ci) H	Std. Unc.(+-%)	
						E	H
Measurement System							
Probe calibration	6.00	N	1.000	1	1	6.00	6.00
Axial Isotropy	2.02	R	1.732	1	1	1.17	1.17
Sensor Displacemant	14.30	R	1.732	1	0.217	8.26	1.79
Boundary effect	2.50	R	1.732	1	1	0.87	0.87
Phantom Boundary effect	6.89	R	1.732	1	0	3.52	0.00
Linearity	2.58	R	1.732	1	1	1.49	1.49
Scaling to PMR Calibration	9.02	N	1.000	1	1	9.02	9.02
System Detection Limit	1.30	R	1.732	1	1	0.75	0.75
Readout Electronics	0.25	R	1.732	1	1	0.14	0.14
Reponse Time	1.23	R	1.732	1	1	0.71	0.71
Integration Time	2.15	R	1.732	1	1	1.24	1.24
RF Ambient Conditions	2.03	R	1.732	1	1	1.17	1.17
RF Reflections	9.09	R	1.732	1	1	5.25	5.25
Probe positioner	0.63	N	1.000	1	0.71	0.63	0.45
Probe positioning	3.12	N	1.000	1	0.71	3.12	2.22
Extrapolation and Interpolation	1.18	R	1.732	1	1	0.68	0.68
Uncertainties of the EUT							
Test sample positioning Vertical	2.73	R	1.732	1	0.71	1.58	1.12
Test sample positioning Lateral	1.19	R	1.732	1	1	0.69	0.69
Device Holder and Phantom	2.20	N	1.000	1	1	2.20	2.20
Power Drift	4.08	R	1.732	1	1	2.36	2.36
Phantom and Setup Related							
Phantom Thickness	2.00	N	1.000	1	0.6	2.00	1.20
Conbined Std. Uncertainty(k=1)						16.18	13.25
Expanded Uncertainty on Power						32.35	26.50
Expanded Uncertainty on Field						16.18	13.25

Note:

N-Nomal

R-Rectangular

Div.- Divisor used to obataion standard uncertanty

Table 10: Measurement Uncertainty of T-Coil Test

No.	Uncertainty Component	Type	Uncertainty Value (%)	Probability Distribution	k	ci	Standard Uncertainty (%) ui(%)	Degree of freedom Veff or vi
	Measurement System							
1	—Probe Calibration	B	6	N	3	1	3.5	∞
2	—Axial isotropy	B	4.7	R	1.732	0.5	4.3	∞
3	—Hemispherical Isotropy	B	9.4	R	1.732	0.5	4.3	∞
4	—Boundary Effect	B	11.0	R	1.732	1	6.4	∞
5	—Linearity	B	4.7	R	1.732	1	2.7	∞
6	—System Detection Limits	B	1.0	R	1.732	1	0.6	∞
7	—Probe Coil Sensitivity	B	0.49	R	1.732	1	0.28	∞
8	—Response Time	B	0.00	R	1.732	1	0.00	∞
9	—Integration Time	B	0.00	R	1.732	1	0.00	∞
10	—RF Ambient Conditions	B	3.0	R	1.732	1	1.73	∞
11	—Probe Position Mechanical tolerance	B	0.4	R	1.732	1	0.2	∞
12	—Probe Position with respect to Phantom Shell	B	2.9	R	1.732	1	1.7	∞
	Uncertainties of the DUT							
13	—Position of the DUT	A	4.8	N	3	1	4.8	5
14	—Holder of the DUT	A	7.1	N	3	1	7.1	5
15	—Repeatability of the WD	B	5.0	R	1.732	1	2.9	∞
	Acoustic noise							
16	—Acoustic noise	B	1.0	R	1.732	1	0.6	∞
21	—Cable loss	B	0.46	N	1.732	1	0.46	∞
Combined Standard Uncertainty				RSS			17.26	42.33
Expanded uncertainty (Confidence interval of 95 %)				K=2			34.52	

9. MAIN TEST INSTRUMENTS

No.	EQUIPMENT	TYPE	Series No.	Due Date
1	E-Field Probe	SATIMO/SCE	SN 02/12 EPH34	2023/01/23
2	Dipole	SATIMO/SIDB835	SN 18/12 DHA37	2023/06/23
3	Dipole	SATIMO/SIDB1900	SN 18/12 DHB42	2023/06/23
4	Amplifier	Nucletudes	143060	2023/04/04
5	Multi-meter	Keithley - 2000	4014020	2023/04/04
6	Wireless Communication Test Set	CMU200	A0304212	2023/04/10
7	Signal Generator	SMU200A	A140801889	2023/05/09
8	Power Meter	NRP2	A140401673	2023/03/27
9	Directional Coupler	DC6180A	305827	2023/03/27

10. ANNEX A TEST SETUP

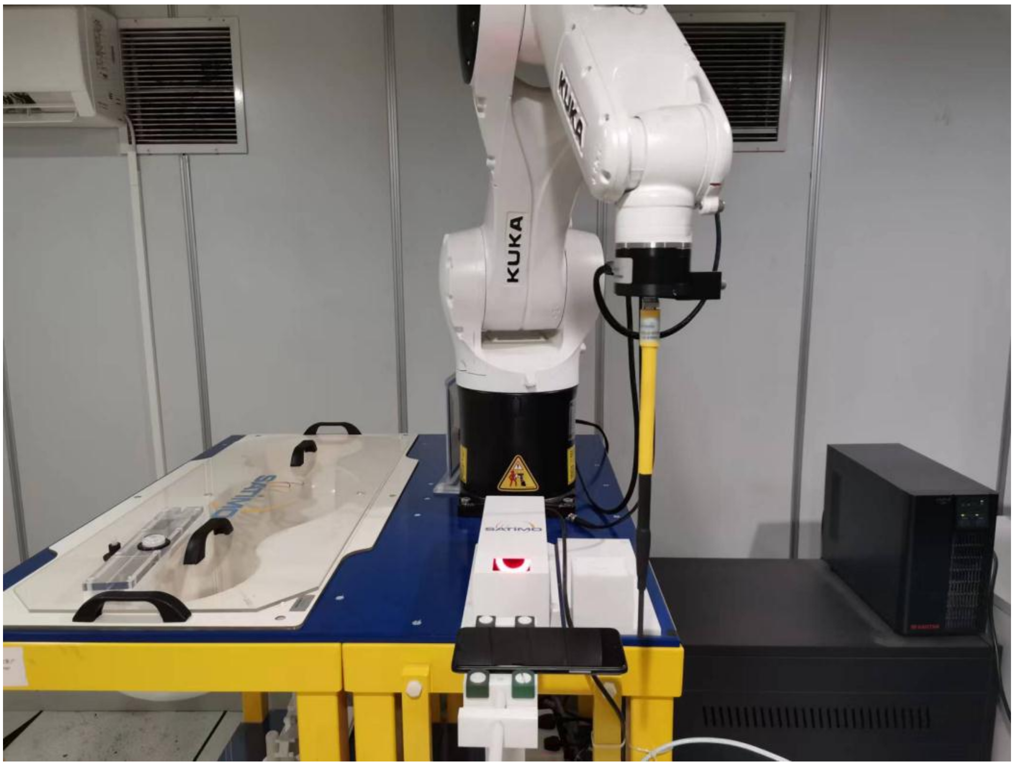


Fig.1 Testing Photo

11. ANNEX B SYSTEM CHECK

System Performance Check (E, 835MHz)

Date of measurement: 08/17/2022

Mobile Phone IMEI number: --

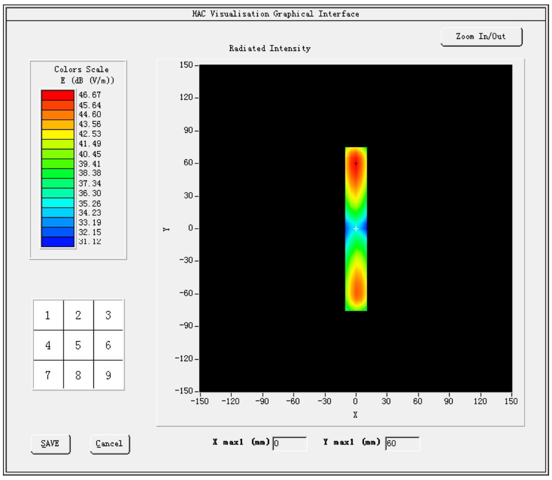
A. Experimental conditions.

Band	CUSTOM (CW835)
Channel	MID
Signal	Duty Cycle: 1
Input power	20dBm

B. HAC Measurement Results

Frequency (MHz): 835.000000

SURFACE HAC



Probe Modulation Factor= 1.00

Maximum value of total field = 219.78 V/m

E in V/m

System Performance Check (E, 1900MHz)

Date of measurement: 08/17/2022

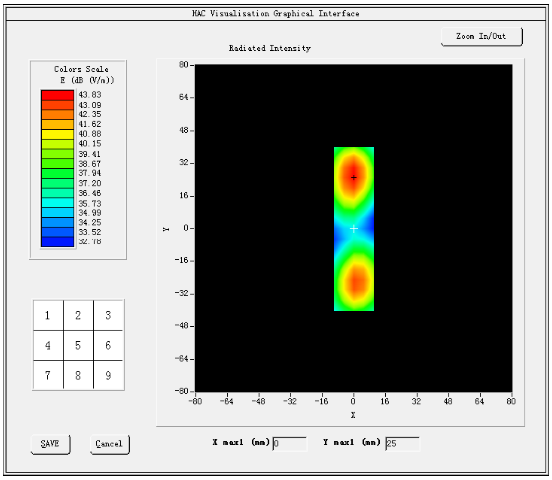
Mobile Phone IMEI number: --

A. Experimental conditions.

Band	CUSTOM (CW1900)
Channel	Middle
Signal	Duty Cycle: 1
Input Power	20dBm

B. HAC Measurement Results

Frequency (MHz): 1900.000000

SURFACE HAC


Probe Modulation Factor= 1.00

Maximum value of total field = 148.40V/m;

E in V/m

System Performance Check (E, 1700MHz)

Date of measurement: 08/17/2022

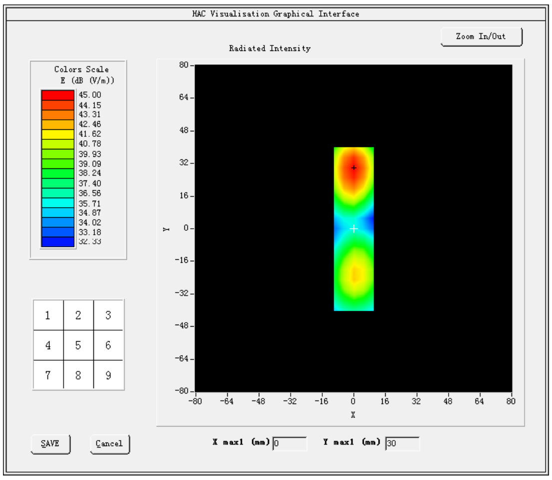
Mobile Phone IMEI number: --

A. Experimental conditions.

Band	CUSTOM (CW1700)
Channel	Middle
Signal	Duty Cycle: 1
Input Power	20dBm

B. HAC Measurement Results

Frequency (MHz): 1700.000000

SURFACE HAC


Probe Modulation Factor= 1.00

Maximum value of total field = 152.74V/m;

E in V/m

12. ANNEX C TEST PLOTS

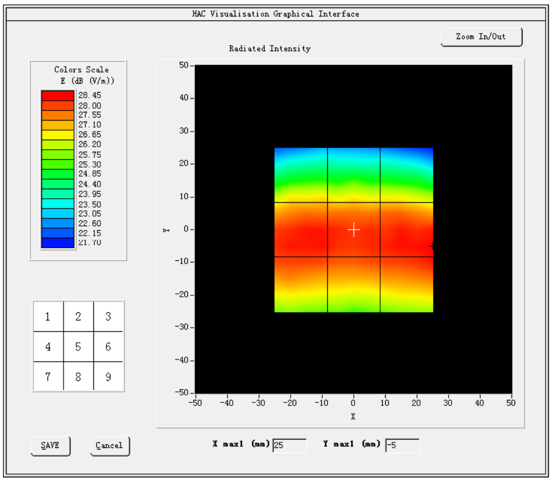
Worst-Case Test Plot (GSM850, E, Mid Channel)

Date of measurement: 06/10/2022

Mobile Phone IMEI number: --

A. Experimental conditions.

Grid size (mm x mm)	50.0, 50.0
Step (mm)	5
Band	GSM850
Channel	Mid
Signal	GSM
SURFACE HAC	



Maximum value of total field = 28.40 V/m

Hearing Aid Near-Field Category: M4 (AWF -5 dB)

Grid 1: 26.77	Grid 2: 26.69	Grid 3: 26.63
Grid 4: 28.40	Grid 5: 28.28	Grid 6: 28.45
Grid 7: 28.15	Grid 8: 28.10	Grid 9: 28.43

13. ANNEX D CALIBRATION REPORTS

COMOHAC E-Field Probe Calibration Report

Ref : ACR.24.5.22.BES.A

CCIC SOUTHERN TESTING CO., LTD
ELECTRONIC TESTING BUILDING, NO. 43 SHAHE ROAD, XILI STREET, NANSHAN DISTRICT
SHENZHEN, GUANGDONG, CHINA
MVG COMOHAC E-FIELD PROBE
SERIAL NO.: SN 02/12 EPH34

Calibrated at MVG
Z.I. de la pointe du diable
Technopôle Brest Iroise – 295 avenue Alexis de Rochon
29280 PLOUZANE - FRANCE

Calibration date: 01/24/2022

Accreditations #2-6789
Scope available on www.cofrac.fr

Summary:

This document presents the method and results from an accredited COMOHAC E-Field Probe calibration performed at MVG, using the CALIPROBE test bench, for use with a MVG COMOHAC system only. The test results covered by accreditation are traceable to the International System of Units (SI).

Page: 1/7

	Name	*Function*	*Date*	*Signature*
Prepared by :	Jérôme Luc	Technical Manager	1/24/2022	
Checked by :	Jérôme Luc	Technical Manager	1/24/2022	
Approved by :	Yann Toutain	Laboratory Director	1/25/2022	Yann TOUTAIN

2022.01.25
11:53:23 +01'00'

	Customer Name
Distribution :	CCIC SOUTHERN TESTING CO., LTD

Issue	*Name*	*Date*	*Modifications*
A	Jérôme Luc	1/24/2022	Initial release

TABLE OF CONTENTS

1 DEVICE UNDER TEST

Device Under Test

Device Type	COMOHAC E FIELD PROBE
Manufacturer	MVG
Model	SCE
Serial Number	SN 02/12 EPH34
Product Condition (new / used)	Used
Frequency Range of Probe	0.7GHz-2.5GHz
Resistance of Three Dipoles at Connector	Dipole 1: R1=1.202 MΩ Dipole 2: R2=1.194 MΩ Dipole 3: R3=0.994 MΩ

2 PRODUCT DESCRIPTION

2.1 GENERAL INFORMATION

MVG's COMOHAC E field Probes are built in accordance to the ANSI C63.19 and IEEE 1309 standards.

Figure 1 – *MVG COMOHAC E field Probe*

Probe Length	330 mm
Length of Individual Dipoles	3.3 mm
Maximum external diameter	8 mm
Probe Tip External Diameter	5 mm
Distance between dipoles / probe extremity	3 mm

3 MEASUREMENT METHOD

All methods used to perform the measurements and calibrations comply with the ANSI C63.19 and IEEE 1309 standards.

3.1 LINEARITY

The linearity was determined using a standard dipole with the probe positioned 10 mm above the dipole. The input power of the dipole was adjusted from -15 to 36 dBm using a 1dB step (to cover the range 2V/m to 1000A/m).

3.2 SENSITIVITY

The sensitivity factors of the three dipoles were determined using the waveguide method outlined in the fore mentioned standards.

3.3 ISOTROPY

The axial isotropy was evaluated by exposing the probe to a reference wave from a standard dipole. The probe was rotated along its main axis from 0 - 360 degrees in 15 degree steps.

4 MEASUREMENT UNCERTAINTY

The guidelines outlined in the ANSI C63.19 and IEEE 1309 standards were followed to generate the measurement uncertainty associated with an E-field probe calibration using the waveguide technique. All uncertainties listed below represent an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2, traceable to the Internationally Accepted Guides to Measurement Uncertainty.

Uncertainty analysis of the probe calibration in waveguide					
ERROR SOURCES	**Uncertainty value (%)**	**Probability Distribution**	**Divisor**	**ci**	**Standard Uncertainty (%)**
Expanded uncertainty 95 % confidence level k = 2					9.6 %

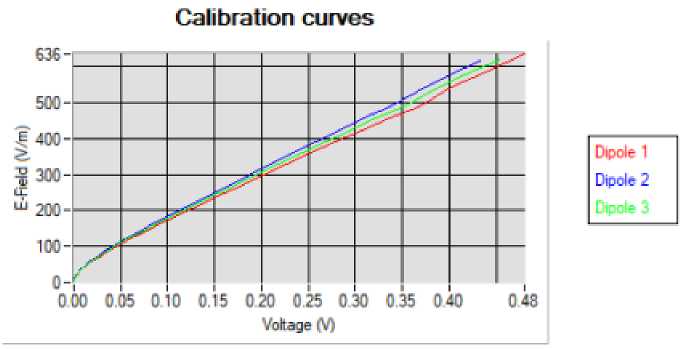
5 CALIBRATION MEASUREMENT RESULTS

Calibration Parameters	
Lab Temperature	20 +/-1 °C
Lab Humidity	30-70 %

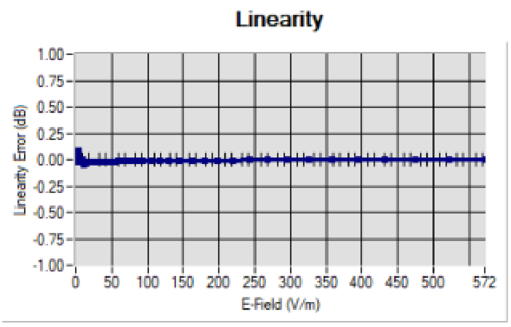
5.1 SENSITIVITY IN AIR

Normx dipole 1 ($\mu V/(V/m)^2$)	Normy dipole 2 ($\mu V/(V/m)^2$)	Normz dipole 3 ($\mu V/(V/m)^2$)
6.52	5.77	6.09

DCP dipole 1 (mV)	DCP dipole 2 (mV)	DCP dipole 3 (mV)
107	106	108

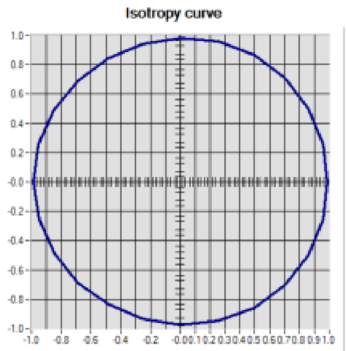


5.2 LINEARITY



Linearity:+/-1.94% (+/-0.08dB)

5.3 ISOTROPY



Isotropy:+/-1.66% (+/-0.07dB)

6 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Description	**Manufacturer / Model**	**Identification No.**	**Current Calibration Date**	**Next Calibration Date**
HAC positioning ruler	MVG	TABH12 SN 42/09	Validated. No cal required.	Validated. No cal required.
COMOHAC Test Bench	Version 2	NA	Validated. No cal required.	Validated. No cal required.
Network Analyzer	Rohde & Schwarz ZVM	100203	05/2019	05/2022
Network Analyzer	Agilent 8753ES	MY40003210	10/2019	10/2022
Network Analyzer – Calibration kit	Rohde & Schwarz ZV-Z235	101223	05/2019	05/2022
Network Analyzer – Calibration kit	HP 85033D	3423A08186	06/2021	06/2027
Multimeter	Keithley 2000	1160271	02/2020	02/2023
Signal Generator	Rohde & Schwarz SMB	106589	04/2019	04/2022
Amplifier	MVG	MODU-023-C-0002	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	NI-USB 5680	170100013	05/2019	05/2022
Power Meter	Rohde & Schwarz NRVD	832839-056	11/2019	11/2022
Directional Coupler	Krytar 158020	131467	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Waveguide	MVG	SN 32/16 WG8_1	Validated. No cal required.	Validated. No cal required.
Temperature / Humidity Sensor	Testo 184 H1	44225320	06/2021	06/2024

HAC Reference Dipole Calibration Report

Ref : ACR.181.5.20.MVGB.A

CCIC SOUTHERN TESTING CO., LTD
ELECTRONIC TESTING BUILDING, NO. 43 SHAHE ROAD,
XILI STREET, NANSHAN DISTRICT
SHENZHEN, GUANGDONG, CHINA
MVG COMOHAC REFERENCE DIPOLE
FREQUENCY: 800-950MHZ
SERIAL NO.: SN 18/12 DHA37

Calibrated at MVG
Z.I. de la pointe du diable
Technopôle Brest Iroise – 295 avenue Alexis de Rochon
29280 PLOUZANE - FRANCE

Calibration date: 06/24/2020

Accreditations #2-6789 and #2-6814
Scope available on www.cofrac.fr

Summary:

This document presents the method and results from an accredited HAC reference dipole calibration performed at MVG, using the COMOHAC test bench. The test results covered by accreditation are traceable to the International System of Units (SI).

	Name	*Function*	*Date*	*Signature*
Prepared by :	Jérôme LUC	Technical Manager	6/29/2020	
Checked by :	Jérôme LUC	Technical Manager	6/29/2020	
Approved by :	Yann Toutain	Laboratory Director	6/29/2020	

	Customer Name
Distribution :	CCIC SOUTHERN TESTING CO., LTD

Issue	*Name*	*Date*	*Modifications*
A	Jérôme LUC	6/29/2020	Initial release

TABLE OF CONTENTS

1 INTRODUCTION

This document contains a summary of the requirements set forth by the ANSI C63.19 standard for reference dipoles used for HAC measurement system validations and the measurements that were performed to verify that the product complies with the fore mentioned standards.

2 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOHAC 800-950 MHz REFERENCE DIPOLE
Manufacturer	MVG
Model	SIDB835
Serial Number	SN 18/12 DHA37
Product Condition (new / used)	Used

A yearly calibration interval is recommended.

3 PRODUCT DESCRIPTION

3.1 GENERAL INFORMATION

MVG's COMOHAC Validation Dipoles are built in accordance to the ANSI C63.19 standard. The product is designed for use with the COMOHAC system only.

Figure 1 – *MVG COMOHAC Validation Dipole*

4 MEASUREMENT METHOD

The ANSI C63.19 standard outlines the requirements for reference dipoles to be used for system validation measurements. The following measurements were performed to verify that the product complies with the fore mentioned standard.

4.1 RETURN LOSS REQUIREMENTS

The dipole used for HAC system validation measurements and checks must have a return loss of -10 dB or better. The return loss measurement shall be performed in free space. A direct method is used with a network analyser and its calibration kit, both with a valid ISO17025 calibration.

4.1 REFERENCE DIPOLE CALIBRATION

The IEEE ANSI C63-19 standard states that the dipole used for validation measurements and checks must be scanned with the E field probe, with the dipole 10 mm below the probe. The E field strength plots are compared to the simulation results obtained by MVG.

5 MEASUREMENT UNCERTAINTY

All uncertainties listed below represent an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2, traceable to the Internationally Accepted Guides to Measurement Uncertainty.

5.1 RETURN LOSS

The following uncertainties apply to the return loss measurement:

Frequency band	Expanded Uncertainty on Gain
400-6000MHz	0.08 LIN

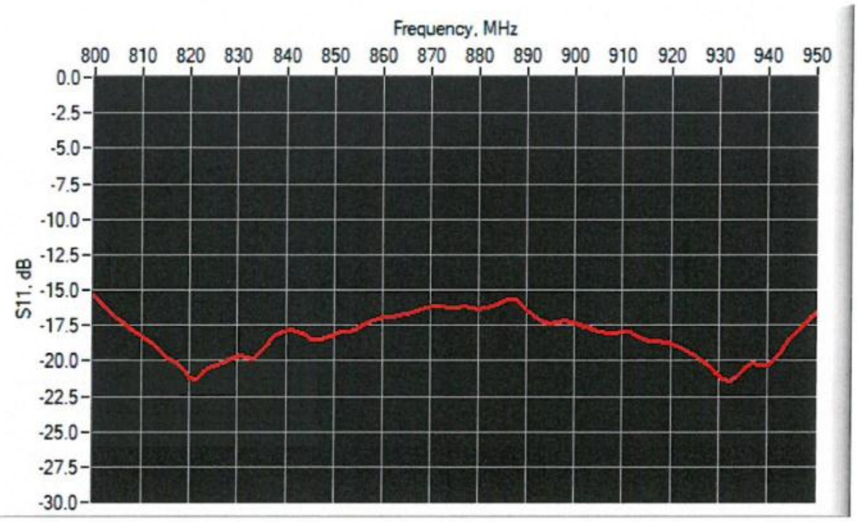
5.2 VALIDATION MEASUREMENT

The guideline outlined in the IEEE ANSI C63.19 standard was followed to generate the measurement uncertainty for validation measurements.

6 CALIBRATION MEASUREMENT RESULTS

Uncertainty analysis of the probe calibration in waveguide					
ERROR SOURCES	**Uncertainty value (%)**	**Probability Distribution**	**Divisor**	**Uncertainty (dB)**	**Standard Uncertainty (%)**
Expanded uncertainty 95 % confidence level k = 2				1.1	14

6.1 RETURN LOSS



Frequency (MHz)	Worst Case Return Loss (dB)	Requirement (dB)
800-950 MHz	-15.53	-10

6.2 VALIDATION MEASUREMENT

The IEEE ANSI C63.19 standard states that the system validation measurements must be performed using a reference dipole meeting the fore mentioned return loss requirements. The system validations measurement results are then compared to MVG's simulated results.

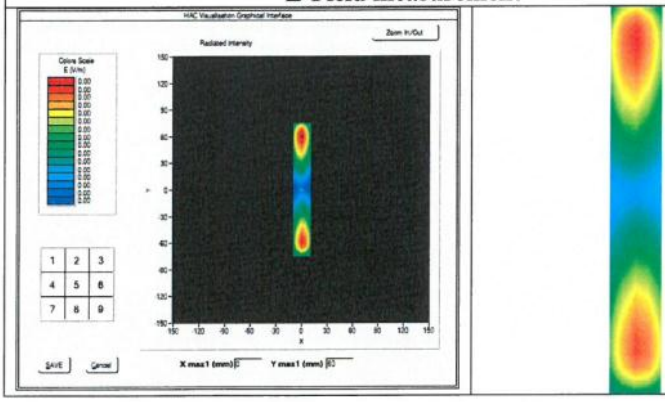
Measurement Condition

Software Version	OpenHAC V2
HAC positioning ruler	SN 42/09 TABH12
E-Field probe	SN 26/11 EPH32
Distance between dipole and sensor center	10 mm
E-field scan size	X=150mm/Y=20mm
H-field scan size	X=40mm/Y=20mm
Scan resolution	dx=5mm/dy=5mm
Frequency	835 MHz
Input power	20 dBm
Lab Temperature	20 +/- 1°C
Lab Humidity	30-70%

Measurement Result

	Measured	Internal Requirement
E field (V/m)	200.29	210.0

E-Field measurement



7 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Description	**Manufacturer / Model**	**Identification No.**	**Current Calibration Date**	**Next Calibration Date**
HAC positioning ruler	MVG	TABH12 SN 42/09	Validated. No cal required.	Validated. No cal required.
COMOHAC Test Bench	Version 2	NA	Validated. No cal required.	Validated. No cal required.
Network Analyzer	Rohde & Schwarz ZVM	100203	05/2019	05/2022
Network Analyzer – Calibration kit	Rohde & Schwarz ZV-Z235	101223	05/2019	05/2022
Reference Probe	Satimo/MVG	EPH32 SN 26/11	05/2020	05/2021
Multimeter	Keithley 2000	1160271	02/2020	02/2023
Signal Generator	Rohde & Schwarz SMB	106589	04/2019	04/2022
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	NI-USB 5680	170100013	05/2019	05/2022
Directional Coupler	Narda 4216-20	01386	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Temperature and Humidity Sensor	Control Company	150798832	11/2017	11/2020

HAC Reference Dipole Calibration Report

Ref : ACR.181.6.20.MVGB.A

CCIC SOUTHERN TESTING CO., LTD
ELECTRONIC TESTING BUILDING, NO. 43 SHAHE ROAD, XILI STREET, NANSHAN DISTRICT
SHENZHEN, GUANGDONG, CHINA
MVG COMOHAC REFERENCE DIPOLE
FREQUENCY: 1700-2000MHZ
SERIAL NO.: SN 18/12 DHB42

Calibrated at MVG
Z.I. de la pointe du diable
Technopôle Brest Iroise – 295 avenue Alexis de Rochon
29280 PLOUZANE - FRANCE

Calibration date: 06/24/2020

Accreditations #2-6789 and #2-6814
Scope available on www.cofrac.fr

Summary:

This document presents the method and results from an accredited HAC reference dipole calibration performed at MVG, using the COMOHAC test bench. The test results covered by accreditation are traceable to the International System of Units (SI).

	Name	Function	Date	Signature
Prepared by :	Jérôme LUC	Technical Manager	6/29/2020	
Checked by :	Jérôme LUC	Technical Manager	6/29/2020	
Approved by :	Yann Toutain	Laboratory Director	6/29/2020	

	Customer Name
Distribution :	CCIC SOUTHERN TESTING CO., LTD

Issue	Name	Date	Modifications
A	Jérôme LUC	6/29/2020	Initial release

TABLE OF CONTENTS

1 INTRODUCTION

This document contains a summary of the requirements set forth by the ANSI C63.19 standard for reference dipoles used for HAC measurement system validations and the measurements that were performed to verify that the product complies with the fore mentioned standards.

2 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOHAC 1700-2000 MHz REFERENCE DIPOLE
Manufacturer	MVG
Model	SIDB1900
Serial Number	SN 18/12 DHB42
Product Condition (new / used)	Used

A yearly calibration interval is recommended.

3 PRODUCT DESCRIPTION

3.1 GENERAL INFORMATION

MVG's COMOHAC Validation Dipoles are built in accordance to the ANSI C63.19 standard. The product is designed for use with the COMOHAC system only.

Figure 1 – *MVG COMOHAC Validation Dipole*

4 MEASUREMENT METHOD

The ANSI C63.19 standard outlines the requirements for reference dipoles to be used for system validation measurements. The following measurements were performed to verify that the product complies with the fore mentioned standard.

4.1 RETURN LOSS REQUIREMENTS

The dipole used for HAC system validation measurements and checks must have a return loss of -10 dB or better. The return loss measurement shall be performed in free space. A direct method is used with a network analyser and its calibration kit, both with a valid ISO17025 calibration.

4.1 REFERENCE DIPOLE CALIBRATION

The IEEE ANSI C63-19 standard states that the dipole used for validation measurements and checks must be scanned with the E field probe, with the dipole 10 mm below the probe. The E field strength plots are compared to the simulation results obtained by MVG.

5 MEASUREMENT UNCERTAINTY

All uncertainties listed below represent an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2, traceable to the Internationally Accepted Guides to Measurement Uncertainty.

5.1 RETURN LOSS

The following uncertainties apply to the return loss measurement:

Frequency band	Expanded Uncertainty on Gain
400-6000MHz	0.08 LIN

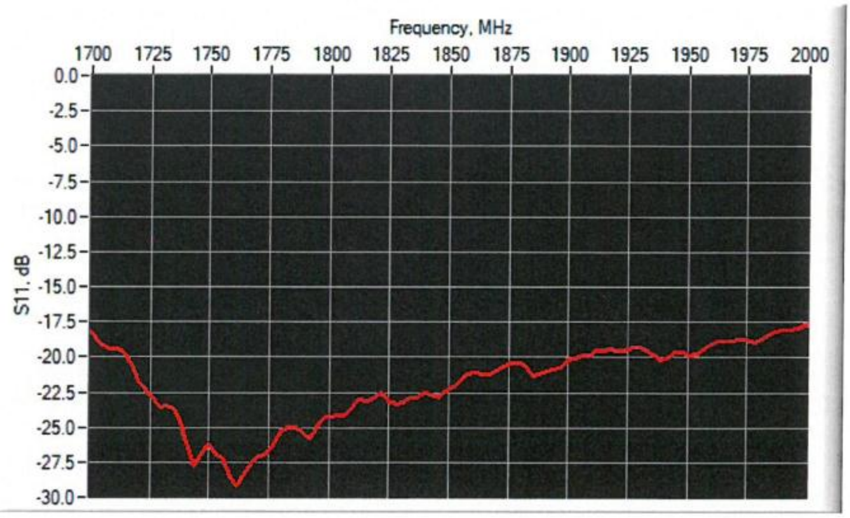
5.2 VALIDATION MEASUREMENT

The guideline outlined in the IEEE ANSI C63.19 standard was followed to generate the measurement uncertainty for validation measurements.

6 CALIBRATION MEASUREMENT RESULTS

Uncertainty analysis of the probe calibration in waveguide					
ERROR SOURCES	**Uncertainty value (%)**	**Probability Distribution**	**Divisor**	**Uncertainty (dB)**	**Standard Uncertainty (%)**
Expanded uncertainty 95 % confidence level k = 2				1.1	14

6.1 RETURN LOSS



Frequency (MHz)	Worst Case Return Loss (dB)	Requirement (dB)
1700-2000 MHz	-17.93	-10

6.2 VALIDATION MEASUREMENT

The IEEE ANSI C63.19 standard states that the system validation measurements must be performed using a reference dipole meeting the fore mentioned return loss requirements. The system validations measurement results are then compared to MVG's simulated results.

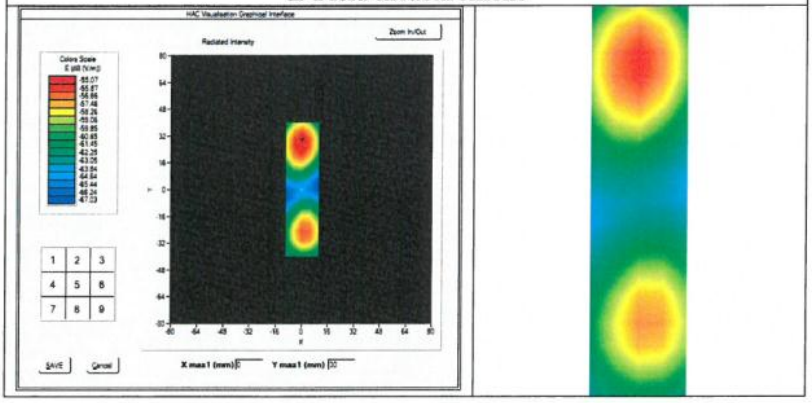
Measurement Condition

Software Version	OpenHAC V2
HAC positioning ruler	SN 42/09 TABH12
E-Field probe	SN 26/11 EPH32
Distance between dipole and sensor center	10 mm
E-field scan size	X=150mm/Y=20mm
H-field scan size	X=40mm/Y=20mm
Scan resolution	dx=5mm/dy=5mm
Frequency	1900 MHz
Input power	20 dBm
Lab Temperature	20 +/- 1°C
Lab Humidity	30-70%

Measurement Result

	Measured	Internal Requirement
E field (V/m)	146.11	146.1

E-Field measurement



7 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Description	**Manufacturer / Model**	**Identification No.**	**Current Calibration Date**	**Next Calibration Date**
HAC positioning ruler	MVG	TABH12 SN 42/09	Validated. No cal required.	Validated. No cal required.
COMOHAC Test Bench	Version 2	NA	Validated. No cal required.	Validated. No cal required.
Network Analyzer	Rohde & Schwarz ZVM	100203	05/2019	05/2022
Network Analyzer – Calibration kit	Rohde & Schwarz ZV-Z235	101223	05/2019	05/2022
Reference Probe	Satimo/MVG	EPH32 SN 26/11	05/2020	05/2021
Multimeter	Keithley 2000	1160271	02/2020	02/2023
Signal Generator	Rohde & Schwarz SMB	106589	04/2019	04/2022
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	NI-USB 5680	170100013	05/2019	05/2022
Directional Coupler	Narda 4216-20	01386	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Temperature and Humidity Sensor	Control Company	150798832	11/2017	11/2020

———End of the Report———