HAC RF EMISSION TEST REPORT

Report No.: 20241217G26473X-W1

Product: Smart Phone

Model No.: A55

FCC ID: 2AQRMA55

Brand Name: FOXX

Applicant: FOXX Development Inc.

Address: 3480 Preston Ridge Road, Suite500, Alpharetta, GA 30005, USA

Test Date: 12/13/2024~12/13/2024

Issued Date: 12/23/2024

Issued by: CCIC Southern Testing Co., Ltd.

Lab Location: Electronic Testing Building, No.43, Shahe Road, Xili Street, Nanshan District, Shenzhen, Guangdong, China

Tel: 86-755-26627338 **E-Mail:** manager@ccic-set.com

Test Report

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Applicant……………………...: FOXX Development Inc.

Applicant Address…………..: 3480 Preston Ridge Road, Suite500, Alpharetta, GA 30005, USA

Test Standards……………….: ANSI C63.19-2019 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

Test Result……………………: Pass

Tested by ……………………..:

Carl Wei, Test Engineer

Reviewed by…………………..:

Sun Jiaohui, Senior Engineer

Approved by…………………..:

Chris You, RF 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 June 30, 2025.
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, 2025.
Test Environment Condition:	Temperature (℃): 20℃ ~25℃ Relative Humidity (%): 35%~75% RH Atmospheric Pressure (kPa): 86KPa-106KPa

2. EQUIPMENT UNDER TEST(EUT)

Identification of the Equipment under Test

Sample Name:	Smart Phone	
Model Name:	A55	
Brand Name:	FOXX	
General description:	Support Band	GSM850/1900, WCDMA B2/4/5 LTE B2/4/5/12/17/25/26/41/66/71 2.4G WIFI, Bluetooth,
	Test Band	GSM 850/1900
	Development Stage	Identical Prototype
	Accessories	Power Supply
	Antenna type	PIFA Antenna
	Operation mode	GSM Voice WCDMA Voice LTE Voice
	Modulation mode	GSM: GMSK, 8PSK WCDMA: QPSK LTE: QPSK, 16QAM 2.4GHz WIFI: DSSS, OFDM BT: GFSK/π/4-DQPSK/8-DPSK

Note: these models 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 C63.19:2019	American National Standard Methods of Measurement of Compatibility between Wireless Communications Devices and Hearing Aids
3	KDB 285076 D01 HAC Guidance v06Rr01	EQUIPMENT AUTHORIZATION GUIDANCE FOR HEARING AID COMPATIBILITY
4	KDB 285076 D02 v04	Guidance for performing T-Coil tests for air interfaces supporting voice over IP (e.g., LTE and WiFi) to support CMRS based telephone services", Feb. 23, 2022
5	KDB 285076 D03 v01r06	Hearing aid compatibility frequently asked questions

3.2 Summary Of HAC Result

Band	Result
GSM850	Pass
GSM1900	Pass

4. HEARING AID COMPATIBILITY

4.1 Introduction

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

b) T-coil mode, magnetic signal strength in the audio band

c) T-coil mode, magnetic signal and noise articulation index

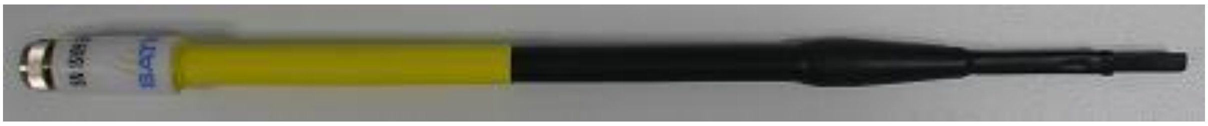
d) T-coil mode, magnetic signal frequency response through the audio band Corresponding to the WD measurements, the hearing aid is measured for:

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	Type	C63.19 RFAIL Tested	Simultaneous Transmitter	Name of Service	Power Reduction
GSM	850	VO	Yes	WLAN & BT	CMRS Voice	No
	1900	VO	Yes	WLAN & BT	CMRS Voice	No
	GPRS/EGPRS	DT	Yes	N/A	N/A	No
WCDMA	Band II	VO	No	WLAN & BT	CMRS Voice	No
	Band IV	VO	No	WLAN & BT	CMRS Voice	No
	Band V	VO	No	WLAN & BT	CMRS Voice	No
	HSPA	DT	No	N/A	N/A	No
LTE	Band 2	VD	No	WLAN & BT	VoLTE	No
	Band 4	VD	No	WLAN & BT	VoLTE	No
	Band 5	VD	No	WLAN & BT	VoLTE	No
	Band 12	VD	No	WLAN & BT	VoLTE	No
	Band 17	VD	No	WLAN & BT	VoLTE	No
	Band 25	VD	No	WLAN & BT	VoLTE	No
	Band 26 part 90	VD	No	WLAN & BT	VoLTE	No
	Band 26 part 22	VD	No	WLAN & BT	VoLTE	No
	Band 41	VD	No	WLAN & BT	VoLTE	No
	Band 66	VD	No	WLAN & BT	VoLTE	No
	Band 71	VD	No	WLAN & BT	VoLTE	No
WLAN	2.4G	DT	No	WWAN	N/A	No
BT	2450	DT	No	WWAN	N/A	No

NA: Not Applicable

VO: Voice Only

VD: CMRS and IP Voice Service over Digital Transport

DT: Digital Transport Only

Note1:The air interface max power plus MIF is complies with ANSI63.19-2019 Table 4.1 RFAIPL

Note2: According to ANSI C63.19 2019-version, for the air interface technology of a device is exempt from testing whose peak antenna input power, averaged over intervals ≤50 μs, is ≤23 dBm.

Note3:The hearing aid compatibility mode of the prototype was turned on during testing, and all tests were performed in HAC mode.

5.2 Power Reduction Description

Each qualified transmitter is tested individually using the method of ANSI C63.19-2019 Clause 4. Other WD transmitters shall be temporarily disabled or reduced in power level such that their average antenna input power is at least 6 dB lower than the average antenna input power of the transmitter under test. The transmitter under test is set to the fixed and repeatable combination of power and modulation characteristic that is representative of the worst case (highest interference potential) likely to be encountered while the WD is experiencing normal voice mode operation.

The limiting measurement for device qualification is the highest RF audio interference potential measured for any of the WD transmitters. If the highest interference measurement is from a transmitter that is not required for normal voice mode operation, a secondary rating may be given that applies when that transmitter is disabled.

Note:The device does not support power reduction for HAC mode, so we do not need to consider the case of power reduction.

5.2 HAC Measurement System

For HAC RF emission testing, the EUT was linked and controlled by wireless communication test set. Communication between the EUT and the wireless communication test set was established by air link. The distance between the EUT and the communicating antenna of the test set is larger than 50 cm and the output power radiated from the wireless communication test set antenna is at least 30 dB smaller than the output power of EUT. The EUT was set from the wireless communication test set to radiate maximum output power during HAC test.

WD reference and plane for RF emission measurements

5.4 Equipment and results of validation testing

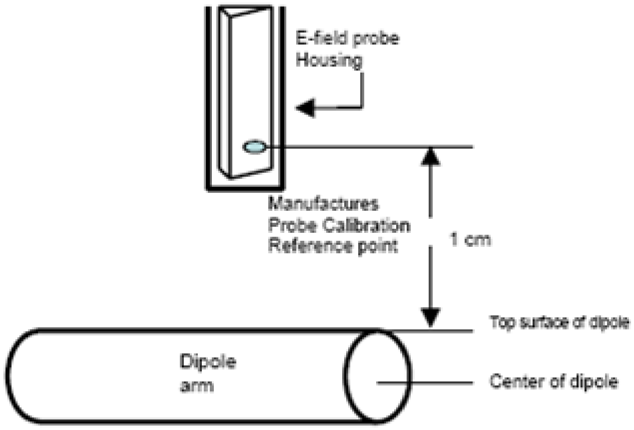
5.4.1 System Check Parameters

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

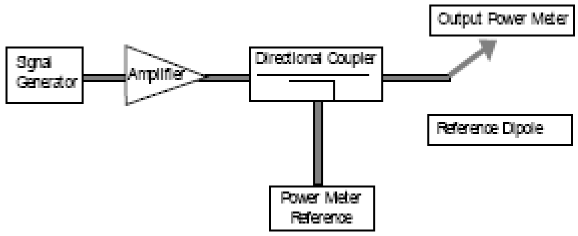
A dipole antenna meeting the requirements given in PC63.19 was placed in the position normally occupied by the WD.

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

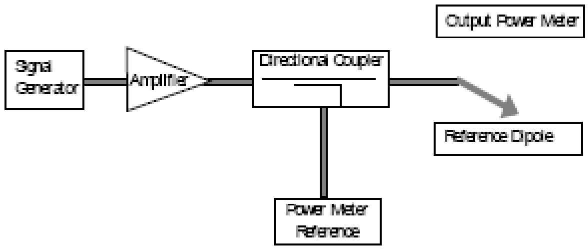
Using the near-field measurement system, scan the antenna over the radiating dipole and record the greatest field reading observed. Due to the nature of E-fields about free-space dipoles, the two

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.

E-Field Scan						
Mode	Frequency (MHz)	Input Power (mW)	Measured Value (dBV/m)	Target Value (dBV/m)	Deviation (%)	Limit (%)
CW	835	100	214.26	209.89	2.08%	±12.8
CW	1900	100	147.18	145.34	1.27%	±12.8

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

5.5 WD emission requirements

The WD's conducted power must be at or below either the stated RFAIPL (Table1.1) or the stated peak power level (Table 1.2), or the average near-field emissions over the measurement area must be at or below the stated RFAII. (Table 1.3), or the stated peak field strength (Table 1.4). The WD may demonstrate compliance by meeting any of these four requirements, but it must do so in each of its operating bands at its established worst-case normal speech- mode operating condition.

Table 1.1—Wireless device RF audio interference power level

Frequency range (MHz)	RFAIPL (dBm)
◎60	29
960-2000	26
>2000	25

Table 1.2—Wireless device RF peak power level

Frequency range (MHz)	RFpcak Po^cr (dBm)
<960	35
960-2000	32
>2000	31

Table 1.3——Wireless device RF audio interference level

Frequency range (MHz)	RFAIL |dB(V/m)j
<960	39
960-2000	36
>2000	35

Table 1.4-Wireless device RF peak near-field level

Frequency range (MHz)	RFpck |dB(V/m)|
<960	45
96CH2000	42
>2000	41

5.6 Modulation Interference Factor (MIF)

The HAC Standard ANSI C63.19-2019 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 devel oped that relates its interference potential to its steady-state rms signal level or average power level. This factor is a f
unction only of the audio-frequency amplitude modulation characteristics of the signal and is the same for field-strengt h 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.

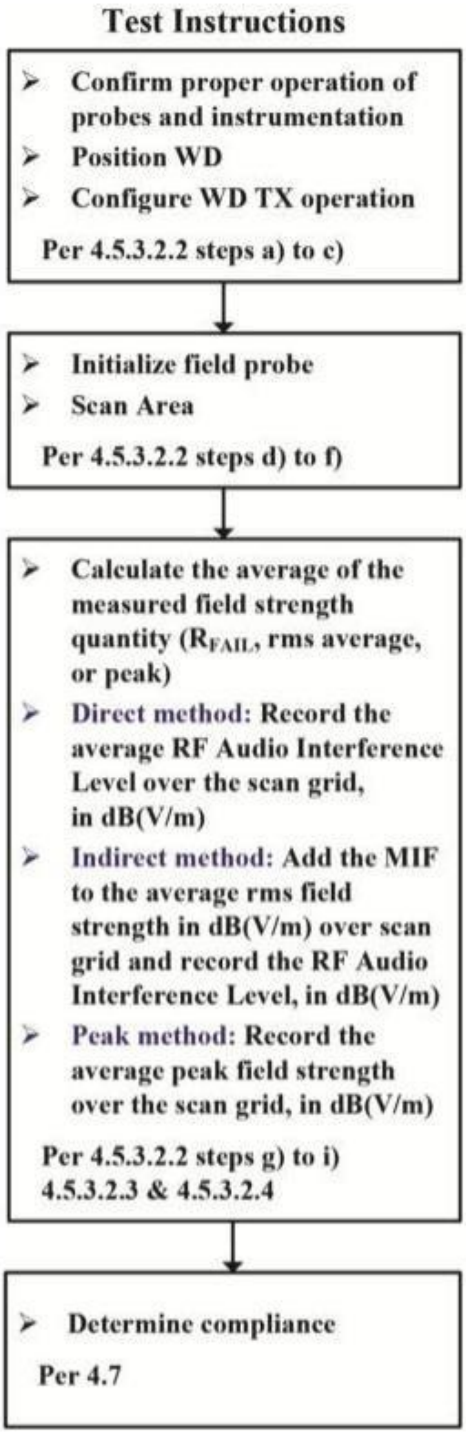
The MIF may be determined using a radiated RF field, a conducted RF signal, or in a preliminary stage, a mathematical analysis of a modeled RF signal:
a)Verify the slope accuracy and dynamic range capability over the desired operating frequency band of a fast probe or sensor, square-law detector, as specified in D.3, and weighting system as specified in D.4 and D.5. For the probe and instrumentation included in the measurement of MIF, additional calibration and application of calibration factors are not required.
b)Using RF illumination or conducted coupling, apply the specific modulated signal in question to the measurement system at a level within its confirmed operating dynamic range.
c)Measure the steady-state rms level at the output of the fast probe or sensor.
d)Measure the steady-state average level at the weighting output.
e)Without changing the square-law detector or weighting system, and using RF illumination or conducted coupling, substitute for the specific modulated signal a 1kHz, 80% amplitude-modulated carrier at the same frequency and adjust its strength until the level at the weighting output equals the step d) measurement.
f)Without changing the carrier level from step e), remove the 1 kHz modulation and again measure the steady-state rms level indicated at the output of the fast probe or sensor.
g)The MIF for the specific modulation characteristic is provided by the ratio of the step f) measurement to the step c) measurement, expressed in dB (20 × log(step f))/step c)).

In practice, step e) and step f) need not be repeated for each MIF determination if the relationship between the two measurements has been preestablished for the measurement system over the operating frequency and dynamic ranges.

Modulation group	Modulation characteristics	MIF
GSM	TDMA	3.63
WCDMA	UMTS-FDD	-25.43
LTE	LTE-FDD / RB=1 / BW=20 MHz / QPSK	-9.76
	LTE-TDD / RB=1 / BW=20 MHz / QPSK	-1.44
2.4G WiFi	IEEE 802.11b WiFi 2.4 GHz (DSSS, 11 Mbps)	-2.02
	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 54 Mbps)	0.12
Bluetooth	IEEE 802.15.1 Bluetooth (GFSK, DH1)	1.02

6. HAC Immunity Measurement Procedures

6.1 HAC Measurement Process Diagram



6.2 RF Emission Measurement Procedures: indirect measurement-preferred

a.The measurement procedure using a probe and instrumentation chain with a response of <10 kHz (see ANSI63.19-2019 section4.5.1) is identical to the direct measurement method of ANSl63.19-2019 section4.5.3.2.2: however, because of the bandwidth limitations, it cannot include the direct use of the spectral and temporal weighting functions, The output of such measurement systems must be readings of steady state rms field strength in dB(V/m).

b.The RF audio interference level in dB(Vim) is obtained by adding the Modulation Interference Factor (in decibels) to the average steady state rms field strength reading over the measurement area, in dB(V/m), from Step c). Use this result to determine the WD's compliance per ANSl 63.19-2019 section4.7.

c.The measurement area shall be centered on the acoustic output or the T-Coil mode measurement reference point, as appropriate. Locate the field probe at the initial test position in the 50 mm by 50 mm measurement area, which is contained i n the measurement plane.described in ANSl 63.19-2019 section 4.5.2 and illustrated in Figure A.1. If the field alignment method is used, align the probe for maximum field reception.

d.Record the reading at the output of the measurement system.

e.Scan the entire 50 mm by 50 mm measurement area in equally spaced step sizes and record the reading at each measurement point. The step size shall meet the specification for step size in ANSl 63.19-2019 section 4.5.3.

f.Calculate the average ofthe measurements taken in Step f.

g.Convert the average value found in Step g) to RF audio interference level, in volts per meter, by taking the square root of the reading and then dividing it by the measurement system transfer function, as established in ANSl 63.19-2019 section 4.5.3.2.1 pre-test procedure. Convert the result to dB(V/m) by taking the base-10 logarithm and multiplying it by 20.Expressed as a formula:

$$\text{RF audio interference level in db(V/M)} = 20\text{x} \log(R_{ave}^{1/2} / \text{TF})$$

where

R_{ave} is the average reading

h.Compare this RF audio interference level to the limits in 6 and record the result.

6. Max Conducted RF Output Power

2G

Mode: GSM850	Maximum Tune-up(dBm)	Burst Average Power (dBm)		
		CH128	CH190	CH251
		824.2MHz	836.6MHz	848.8MHz
GSM	33.00	32.65	32.67	32.86
Mode: GSM1900	Maximum Tune-up(dBm)	Burst Average Power (dBm)		
		CH512	CH661	CH810
		1850.2MHz	1880.0MHz	1909.8MHz
GSM	30.00	29.71	29.66	29.26

3G

Mode	Maximum Tune-up(dBm)	WCDMA Band II		
		Conducted Power (dBm)		
		CH9262	CH9400	CH9538
		1852.4	1880.0	1907.6
RMC 12.2K	23.00	22.69	22.60	22.44
Mode	Maximum Tune-up(dBm)	WCDMA Band IV		
		Conducted Power (dBm)		
		CH1312	CH1413	CH1513
		1712.4	1732.6	1752.6
RMC 12.2K	22.50	22.20	22.48	22.41
Mode	Maximum Tune-up(dBm)	WCDMA Band V		
		Conducted Power (dBm)		
		CH4132	CH4183	CH4233
		826.4	836.6	846.6
RMC 12.2K	23.00	22.50	22.50	22.56

4G

Band 2

Bandwidth	Modulation	RB allocation	RB offset	Maximum Tune-up(dBm)	18700	18900	19100
					1860.0MHz	1880.0MHz	1900.0MHz
20MHz	QPSK	1	0	24.00	23.81	23.78	23.74
			49	24.00	23.72	23.77	23.77
			99	24.00	23.73	23.79	23.80
		50	0	23.00	22.71	22.56	22.51
			24	23.00	22.83	22.71	22.54
			49	23.00	22.77	22.51	22.67
		100	0	23.00	22.72	22.62	22.65
	16QAM	1	0	23.00	22.53	22.31	22.60
			49	23.00	22.49	22.43	22.63
			99	23.00	22.44	22.34	22.60
		50	0	22.00	21.93	21.78	21.70
			24	22.00	21.97	21.67	21.71
			49	22.00	21.94	21.74	21.71
		100	0	22.00	21.94	21.75	21.70

Band 4

Bandwidth	Modulation	RB allocation	RB offset	Maximum Tune-up(dBm)	20050	20175	20300
					1720.0MHz	1732.5MHz	1745.0MHz
20MHz	QPSK	1	0	24.00	23.39	23.64	23.66
			49	24.00	23.37	23.84	23.63
			99	24.00	23.61	23.81	23.85
		50	0	23.00	22.29	22.60	22.49
			24	23.00	22.33	22.55	22.47
			49	23.00	22.46	22.65	22.59
		100	0	23.00	22.44	22.61	22.60
	16QAM	1	0	23.00	22.04	22.71	22.78
			49	23.00	22.13	22.80	22.79
			99	23.00	22.36	22.73	22.95
		50	0	22.00	21.58	21.58	21.56
			24	22.00	21.67	21.77	21.56
			49	22.00	21.70	21.63	21.77
		100	0	22.00	21.58	21.66	21.61

Band 5

Bandwidth	Modulation	RB allocation	RB offset	Maximum Tune-up(dBm)	20450	20525	20600
					829.0MHz	836.5MHz	844.0MHz
10MHz	QPSK	1	0	24.00	23.37	23.45	23.50
			24	24.00	23.35	23.57	23.62
			49	24.00	23.37	23.69	23.70
		25	0	22.50	22.43	22.48	22.45
			12	23.00	22.37	22.43	22.68
			24	23.00	22.48	22.46	22.57
		50	0	23.00	22.41	22.47	22.56
	16QAM	1	0	24.00	23.56	22.41	22.38
			24	23.50	23.45	22.41	22.50
			49	24.00	23.56	22.53	22.68
		25	0	22.00	21.56	21.43	21.90
			12	22.00	21.81	21.53	21.54
			24	22.00	21.53	21.55	21.72
		50	0	22.00	21.96	21.59	21.52

Band 12

Bandwidth	Modulation	RB allocation	RB offset	Maximum Tune-up(dBm)	23060	23095	23130
					704.0MHz	707.5MHz	711.0MHz
10MHz	QPSK	1	0	23.00	22.55	22.68	22.62
			24	23.00	22.54	22.62	22.72
			49	23.00	22.63	22.76	22.98
		25	0	22.00	21.66	21.59	21.65
			12	22.00	21.73	21.67	21.58
			24	22.00	21.54	21.62	21.87
		50	0	22.00	21.69	21.74	21.62
	16QAM	1	0	23.00	22.71	21.68	21.62
			24	23.00	22.77	21.61	21.63
			49	23.00	22.76	21.73	21.72
		25	0	21.50	21.02	21.02	20.61
			12	21.50	20.98	20.52	21.09
			24	21.50	20.96	21.14	21.27
		50	0	21.50	21.07	20.61	21.02

Band 17

Band width	Modulation	RB allocation	RB offset	Maximum Tune-up(dBm)	23780	23790	23800
					709MHz	710MHz	711MHz
10MHz	QPSK	1	0	23.00	22.55	22.63	22.70
			24	23.00	22.55	22.71	22.73
			49	23.00	22.69	22.76	22.93
		25	0	22.00	21.57	21.63	21.63
			12	22.00	21.60	21.61	21.68
			24	22.00	21.70	21.59	21.87
		50	0	22.00	21.55	21.60	21.60
	16QAM	1	0	23.00	22.67	21.57	21.6
			24	23.00	22.63	21.66	21.69
			49	23.00	22.92	21.83	21.75
		25	0	21.00	20.83	20.52	20.6
			12	21.50	20.39	21.09	21.12
			24	21.50	20.99	21.15	21.26
		50	0	21.50	20.52	21.10	21.04

Band 25

Band width	Modulation	RB allocation	RB offset	Maximum Tune-up(dBm)	26140	26365	26590
					1860.0MHz	1882.5MHz	1905.0MHz
20MHz	QPSK	1	0	24.00	23.65	23.69	23.64
			49	24.00	23.70	23.69	23.69
			99	24.00	23.64	23.70	23.71
		50	0	23.00	22.73	22.74	22.60
			24	23.00	22.70	22.64	22.52
			49	23.00	22.74	22.65	22.64
		100	0	23.00	22.84	22.63	22.52
	16QAM	1	0	23.00	22.50	22.37	22.63
			49	23.00	22.50	22.34	22.53
			99	23.00	22.48	22.34	22.64
		50	0	22.00	21.95	21.73	21.62
			24	22.00	21.94	21.70	21.70
			49	22.00	21.91	21.77	21.61
		100	0	22.00	21.93	21.73	21.72

Band 26 Part90

Band width	Modulation	RB allocation	RB offset	Maximum Tune-up(dBm)	26740
					819.0MHz
10MHz	QPSK	1	0	24.00	23.58
			24	24.00	23.50
			49	24.00	23.56
		25	0	23.00	22.53
			12	22.50	22.49
			24	23.00	22.50
		50	0	23.00	22.59
	16QAM	1	0	24.00	23.69
			24	24.00	23.66
			49	24.00	23.64
		25	0	22.00	21.50
			12	22.00	21.50
			24	22.00	21.52
		50	0	22.00	21.57

Band 26 Part 22

Band width	Modulation	RB allocation	RB offset	Maximum Tune-up(dBm)	26865	26915	26965
					831.5MHz	836.5MHz	841.5MHz
15MHz	QPSK	1	0	24.00	23.39	23.53	23.44
			37	24.00	23.42	23.67	23.58
			74	24.00	23.51	23.82	23.69
		36	0	23.00	22.56	22.45	22.41
			18	23.00	22.50	22.50	22.66
			39	23.00	22.48	22.64	22.81
		75	0	23.00	22.60	22.55	22.69
	16QAM	1	0	24.00	23.60	22.50	23.00
			38	24.00	23.52	22.54	23.22
			75	24.00	23.65	22.76	23.35
		36	0	22.50	21.58	22.07	21.64
			18	22.00	21.56	21.71	21.54
			39	22.50	21.64	21.72	22.12
		75	0	22.00	21.45	21.55	21.73

Band 41

Band width	Modulation	RB allocation	RB offset	Maximum Tune-up(dBm)	39750	40620	41490
					2506.0 MHz	2593.0 MHz	2680.0 MHz
20MHz	QPSK	1	0	23.50	23.03	22.82	23.02
			49	23.50	22.89	22.77	23.19
			99	23.50	22.85	22.83	23.39
		50	0	22.00	21.91	21.64	21.84
			24	22.00	21.96	21.68	21.97
			49	22.50	21.99	21.76	22.19
		100	0	22.00	21.91	21.69	21.97
	16QAM	1	0	22.00	21.70	21.56	21.82
			49	22.00	21.57	21.66	21.14
			99	22.50	21.58	21.60	22.09
		50	0	21.50	21.24	20.87	21.14
			24	21.50	21.16	20.82	21.37
			49	21.50	21.10	20.84	21.39
		100	0	21.50	21.06	20.93	21.14

Band 66

Band width	Modulation	RB allocation	RB offset	Maximum Tune-up(dBm)	132072	132322	132572
					1720.0 MHz	1745.0 MHz	1770.0 MHz
20MHz	QPSK	1	0	23.50	22.77	23.15	23.06
			49	23.50	22.85	23.06	23.08
			99	23.50	22.97	23.23	22.92
		50	0	22.50	21.86	22.00	21.97
			24	22.50	21.82	22.01	21.84
			49	22.50	21.86	22.02	21.91
		100	0	22.00	21.90	21.89	21.98
	16QAM	1	0	22.50	21.49	22.13	21.92
			49	22.50	21.59	22.13	21.99
			99	22.50	21.76	22.17	21.78
		50	0	21.50	20.97	21.07	21.04
			24	21.50	21.03	20.95	20.97
			49	21.50	21.10	21.06	20.92
		100	0	21.00	20.92	20.94	20.99

Band 71

Band width	Modulation	RB allocation	RB offset	Maximum Tune-up(dBm)	133222	133322	133372
					673.0 MHz	683.0 MHz	688.0 MHz
20MHz	QPSK	1	0	24.00	23.33	23.51	23.46
			49	24.00	23.38	23.52	23.39
			99	24.00	23.43	23.61	23.33
		50	0	23.00	22.28	22.53	22.35
			24	22.50	22.38	22.45	22.30
			49	23.00	22.60	22.44	22.29
		100	0	22.50	22.37	22.39	22.34
	16QAM	1	0	22.50	22.08	22.35	22.40
			49	22.50	22.10	22.48	22.31
			99	22.50	22.24	22.46	22.22
		50	0	22.00	21.96	21.42	21.73
			24	22.00	21.56	21.90	21.71
			49	22.50	22.01	21.86	21.25
		100	0	22.00	21.47	21.74	21.76

2.4G

Band (GHz)	Mode	Channel	Freq. (MHz)	Average Power (dBm)	Maximum Tune-up(dBm)
2.4G WIFI (2.4~2.4835)	802.11b	1	2412	15.59	16.00
		6	2437	9.76	10.00
		11	2462	11.92	12.00
	802.11g	1	2412	15.09	15.50
		6	2437	9.98	10.00
		11	2462	11.60	12.00
	802.11n(HT20)	1	2412	12.94	13.00
		6	2437	6.65	7.00
		11	2462	9.46	9.50

Bluetooth

EDR	Mode	Maximum Tune-up(dBm)	Average Conducted Output Power (dBm)		
			0	39	78
			2402MHz	2441MHz	2480MHz
	GFSK	5.50	5.30	2.72	1.12
	π/4QPSK	5.50	5.28	3.41	1.88
	8DPSK	6.00	5.59	3.79	2.26
BLE	Mode	Maximum Tune-up(dBm)	Average Conducted Output Power (dBm)		
			0	20	39
			2402MHz	2440MHz	2480MHz
	1Mbps	-1.50	-1.68	-3.86	-4.32

7. Low-Power Exemption

7.1 Tune-up Power

Mode	Tune-up Power (dBm)
GSM 850	33.00
GSM 1900	30.00
WCDMA II	23.00
WCDMA IV	22.50
WCDMA V	23.00
LTE Band 2	24.00
LTE Band 4	24.00
LTE Band 5	24.00
LTE Band 12	23.00
LTE Band 17	23.00
LTE Band 25	24.00
LTE Band 26 part 90	24.00
LTE Band 26 part 22	24.00
LTE Band 41	23.50
LTE Band 66	23.50
LTE Band 71	24.00
2.4G WIFI	16.00
Bluetooth	6.00

7.2 RF Emissions Lower Power Exemption

Mode	Tune-up Power(dBm)	MIF	Power + MIF(dB)	C63.19 Lowest RFAIPL(dBm)	C63.19 Test Required?
GSM 850	33.00	3.63	36.63	29.00	Yes
GSM 1900	30.00	3.63	33.63	26.00	Yes
WCDMA 850	23.00	-25.43	-2.43	26.00	No
WCDMA 1700	22.50	-25.43	-2.93	29.00	No
WCDMA 1900	23.00	-25.43	-2.43	29.00	No
LTE Band 2	24.00	-9.76	14.24	26.00	No
LTE Band 4	24.00	-9.76	14.24	26.00	No
LTE Band 5	24.00	-9.76	14.24	29.00	No
LTE Band 12	23.00	-9.76	13.24	29.00	No
LTE Band 17	23.00	-9.76	13.24	29.00	No
LTE Band 25	24.00	-9.76	14.24	26.00	No
LTE Band 26 part 90	24.00	-9.76	14.24	29.00	No
LTE Band 26 part 22	24.00	-9.76	14.24	29.00	No
LTE Band 41	23.50	-1.44	22.06	25.00	No
LTE Band 66	23.50	-9.76	13.74	26.00	No
LTE Band 71	24.00	-9.76	14.24	29.00	No
2.4G WIFI	16.00	-2.02	13.98	25.00	No
Bluetooth	6.00	1.02	7.02	25.00	No

Note:

1. Use maximum power plus worst case MIF to determine whether it complies wih RFAIPL
2. If maximum power plus worst case MIF does not complies with RFAIPL, then further evaluation RFAIPL include in section 11.2.
3. EDGE data modes is not necessary due the GSM Voice mode is the worst case.
4. According to ANSI C63.19 2019, if maximum power plus worst case MIF is complies with RFAIPL, means compliance with WD emission requirements.

8. TEST RESULTS

Band	Channel	Frequency (MHz)	RF audio interference level [dB(V/m)]	Device compliant	Plot
GSM850	Low (128)	824.2MHz	34.34	Yes	1#
	Middle(190)	836.6MHz	34.28	Yes	/
	High(251)	848.8MHz	33.39	Yes	/
GSM1900	Low (512)	1850.2MHz	25.36	Yes	/
	Middle(661)	1880.0MHz	26.26	Yes	/
	High(810)	1909.8MHz	27.57	Yes	2#

9. MEASUREMENT UNCERTAINTY

UNCERTAINTY EVALUATION FOR RF HAC MEASUREMENT					
Uncertainty Component	Tol (+- %)	Prob. Dist.	Div.	Uncertainty (dB)	Uncertainty (%)
Measurement System					
RF reflections	0.1	R	√3	0.06	
Field probe conv. Factor	0.4	R	√3	0.23	
Field probe anisotropy	0.25	R	√3	0.14	
Positioning accuracy	0.2	R	√3	0.12	
Probe cable placement	0.1	R	√3	0.06	
System repeatability	0.2	R	√3	0.12	
EUT repeatability	0.4	N	1	0.40	
Combined Standard Uncertainty		N	1	0.52	
Expanded Uncertainty (95% CONFIDENCE INTERVAL)		N	K=2	1.03	12.65
REPORTED Expanded uncertainty (confidence level of 95%, k = 2)		N	K=2	1.00	13.00

10. MAIN TEST INSTRUMENTS

No.	EQUIPMENT	TYPE	Series No.	Due Date
1	E-Field Probe	SATIMO/SCE	SN 02/12 EPH34	2025/05/14
2	Dipole	SATIMO/SIDB835	SN 18/12 DHA37	2026/05/23
3	Dipole	SATIMO/SIDB1900	SN 18/12 DHB42	2026/05/23
4	Amplifier	Nucletudes	143060	2025/01/17
5	Multi-meter	Keithley - 2000	4014020	2025/01/17
6	Wireless Communication Tester	CMU200	113189	2025/04/10
7	Wireless Communication Tester	CMW500	148888	2025/03/26
8	Signal Generator	SMU100A	177649	2025/05/09
9	Power Meter	NRP2	103434	2025/03/27
10	Directional Coupler	DC6180A	305827	2025/06/01

11. ANNEX A TEST SETUP

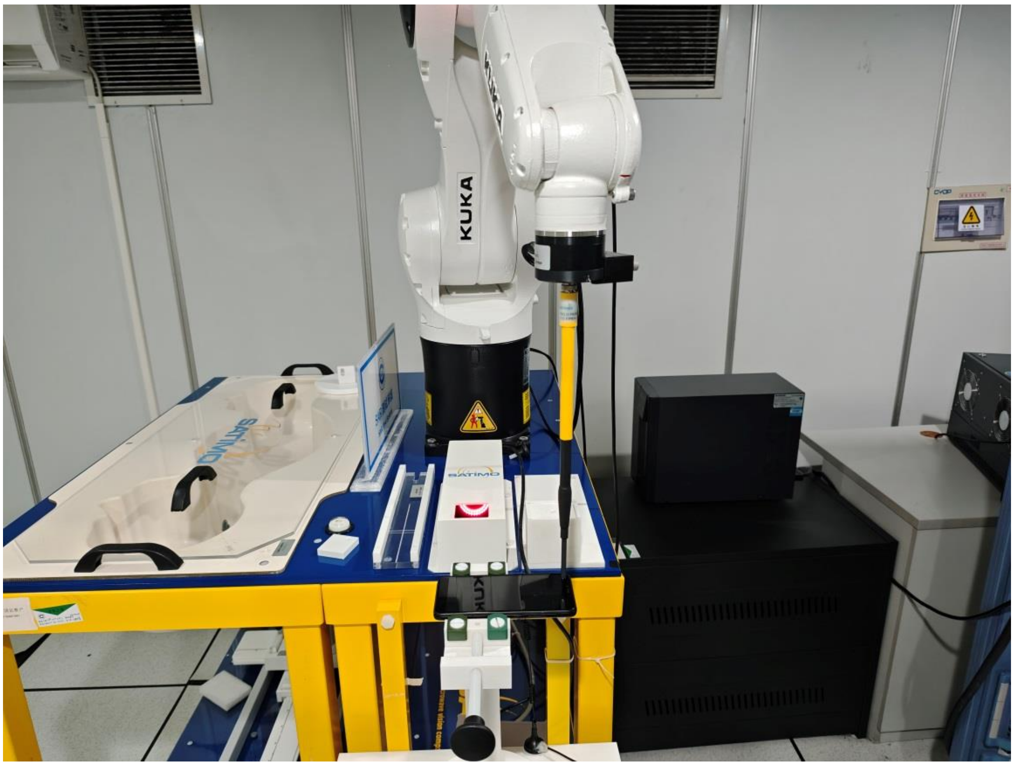
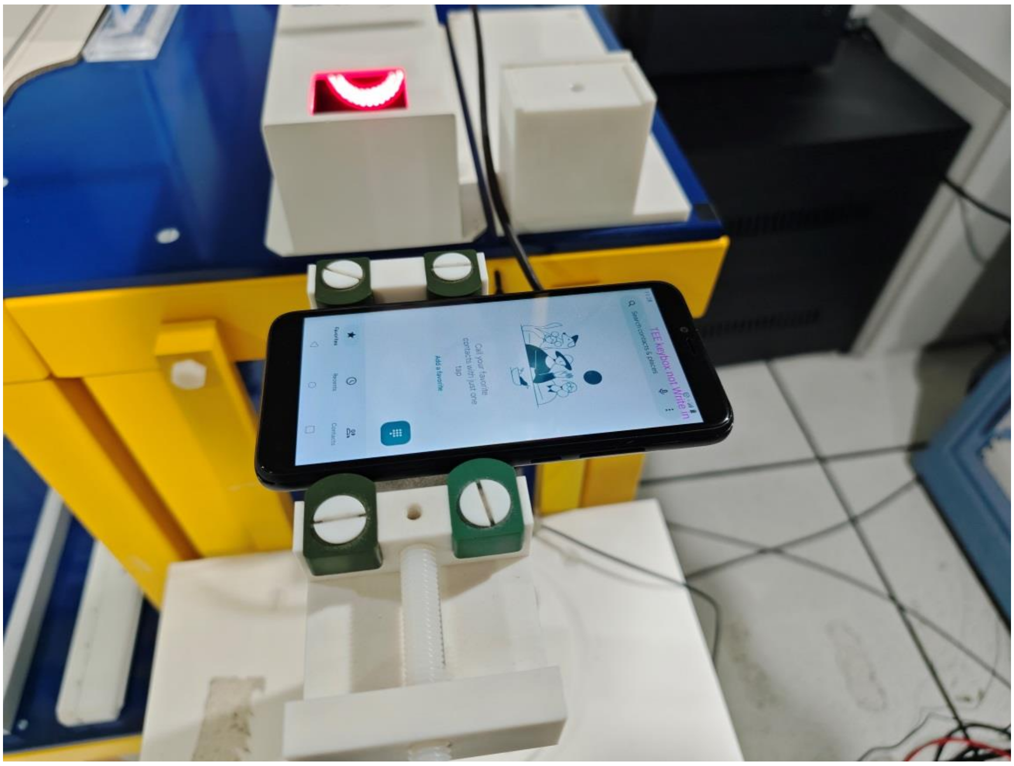
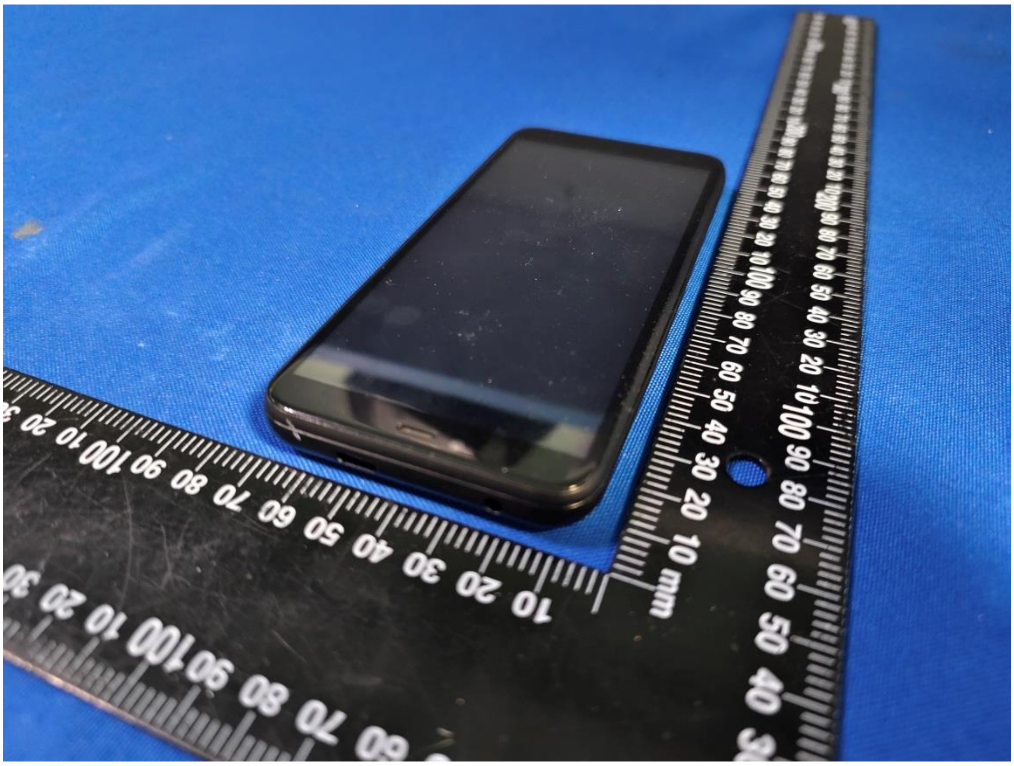
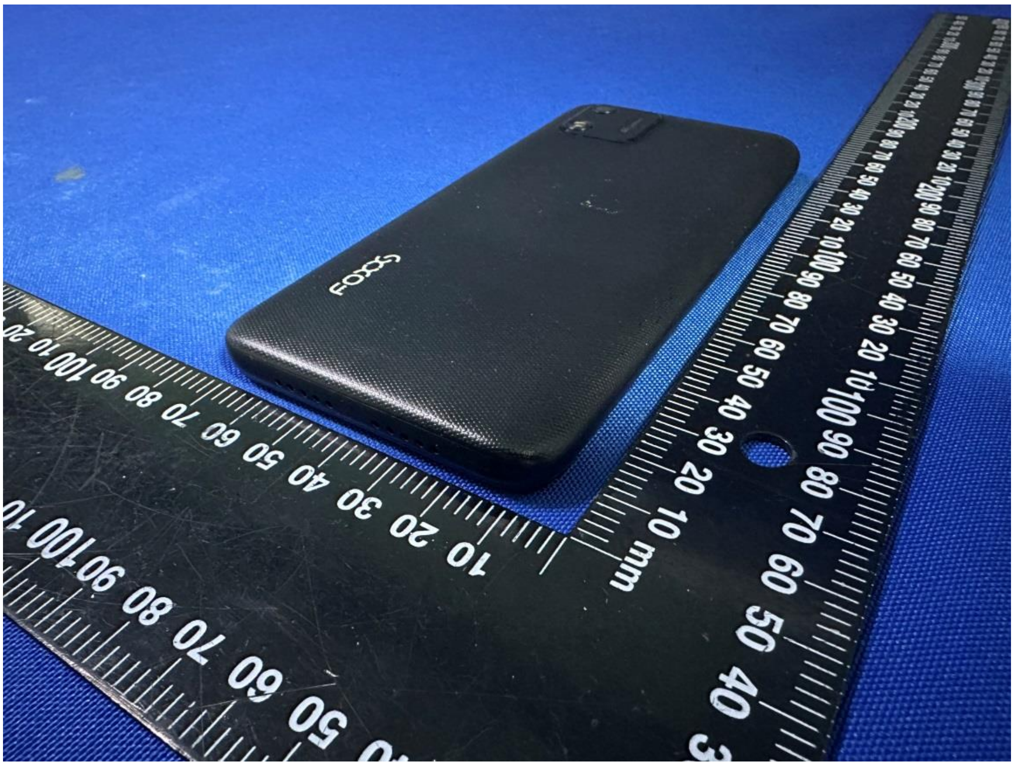


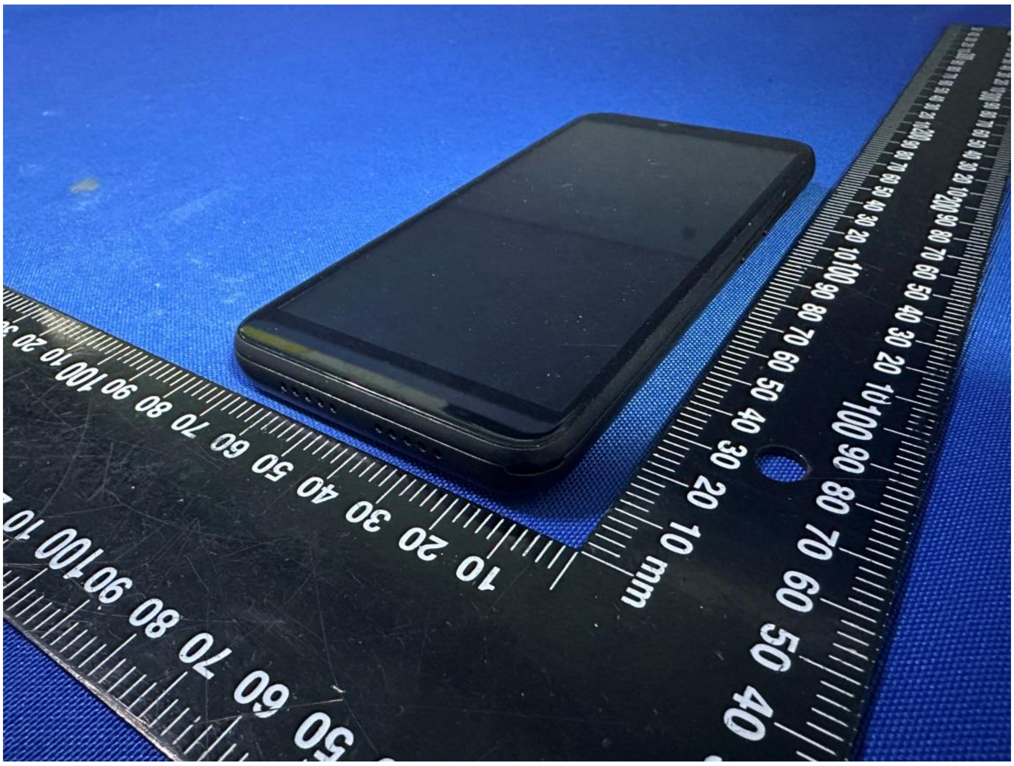
Fig.1 Testing Photo



12. ANNEX B TEST SETUP







13. ANNEX C SYSTEM CHECK

System check at 835.00 MHz

Date of measurement: 13/12/2024

Experimental Conditions

Probe	SN 02/12 EPH34
Signal	CW
Band	CW835
Channels	middle
Frequency (MHz)	835.00

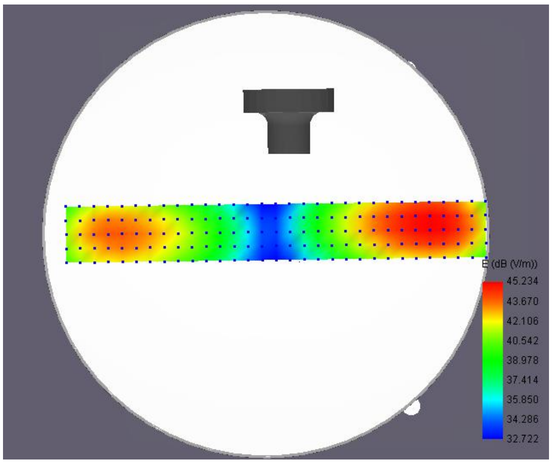
Results

E-field average [dB(V/m)]	214.26
Right E-field maximum [dB(V/m)]	213.32
Left E-field maximum [dB(V/m)]	215.20

Scan parameter

Scan area: length (mm), width (mm)	20.00, 150.00
Measurement point spacing (mm)	5
distance to reference plane (mm)	10.00
X and Y offset with the reference point (mm)	0.00, 0.00
Number of measurement points	155

RF audio interference near field



System check at 1900.00 MHz

Date of measurement: 13/12/2024

Experimental Conditions

Probe	SN 02/12 EPH34
Signal	CW
Band	CW1900
Channels	middle
Frequency (MHz)	1900.00

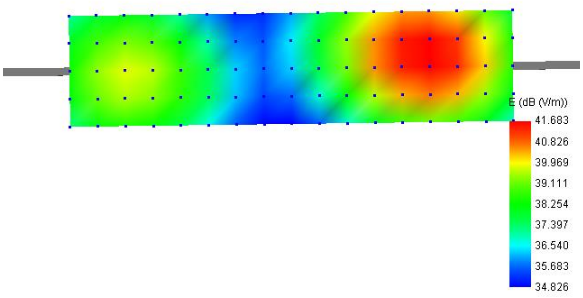
Results

E-field average [dB(V/m)]	147.18
Right E-field maximum [dB(V/m)]	145.03
Left E-field maximum [dB(V/m)]	149.33

Scan parameter

Scan area: length (mm), width (mm)	20.00, 80.00
Measurement point spacing (mm)	5
distance to reference plane (mm)	10.00
X and Y offset with the reference point (mm)	0.00, 0.00
Number of measurement points	85

RF audio interference near field



14. ANNEX D TEST PLOTS

Measurement at GSM850

Date of measurement: 13/12/2024

Experimental Conditions

Probe	SN 02/12 EPH34
Signal	GSM
Band	GSM850
Channels	low
Channels Number	128
Frequency (MHz)	824.20
MIF	3.30

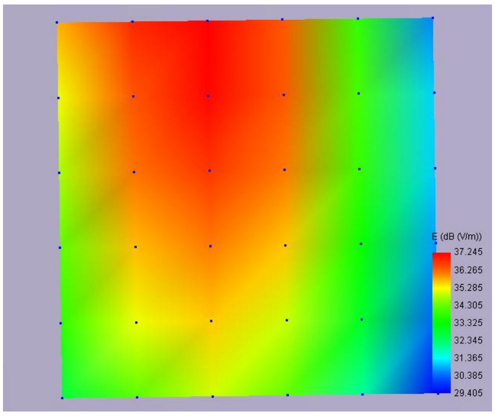
Results

RF audio interference level [dB(V/m)]	34.34
Device compliant	Yes
Measurement status	Complete

Scan parameter

Scan area: length (mm), width (mm)	50.00, 50.00
Measurement point spacing (mm)	10
distance to reference plane (mm)	15.00
X and Y offset with the reference point (mm)	0.00, 0.00
Number of measurement points	36

RF audio interference near field



Measurement at GSM1900

Date of measurement: 13/12/2024

Experimental Conditions

Probe	SN 02/12 EPH34
Signal	GSM
Band	GSM1900
Channels	high
Channels Number	810
Frequency (MHz)	1909.80
MIF	3.30

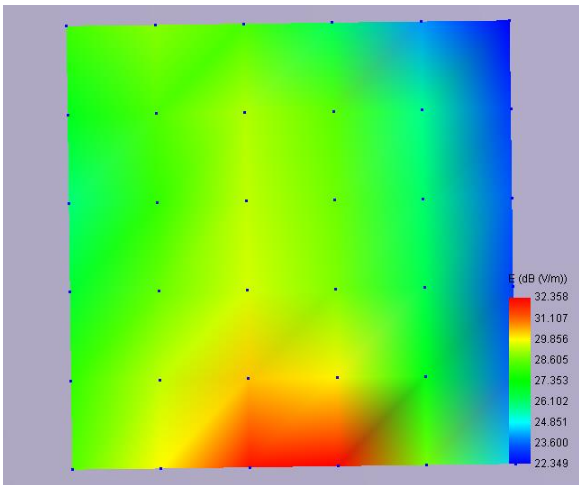
Results

RF audio interference level [dB(V/m)]	27.57
Device compliant	Yes
Measurement status	Complete

Scan parameter

Scan area: length (mm), width (mm)	50.00, 50.00
Measurement point spacing (mm)	10
distance to reference plane (mm)	15.00
X and Y offset with the reference point (mm)	0.00, 0.00
Number of measurement points	36

RF audio interference near field



15. ANNEX E CALIBRATION REPORTS

COMOHAC E-Field Probe Calibration Report

Ref : ACR.145.28.24.BES.A

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: 05/15/2024

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).

COMOHAC E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.145.28.24.BES.A

	Name	Function	Date	Signature
Prepared by :	Cyrille ONNEE	Measurement Responsible	5/15/2024	
Checked & approved by:	Jérôme Luc	Technical Manager	5/15/2024	
Authorized by:	Yann Toutain	Laboratory Director	5/16/2024	

Yann Toutain ID
Signature numérique de Yann Toutain ID
Date : 2024.05.16 09:56:14 +02'00'

	Customer Name
Distribution :	

Issue	Name	Date	Modifications
A	Cyrille ONNEE	5/15/2024	Initial release
B	Cyrille ONNEE	5/16/2024	

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-3.0GHz
Resistance of Three Dipoles at Connector	Dipole 1: R1=1.212 MΩ Dipole 2: R2=1.195 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 SENSITIVITY

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

3.2 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).

3.3 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.

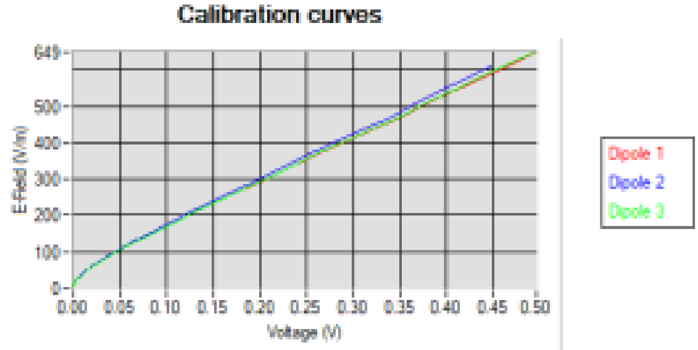
The estimated expanded uncertainty (k=2) in calibration for E-Field (V/m) is +/-9.6% with respect to measurement conditions.

5 CALIBRATION RESULTS

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

5.1 CALIBRATION IN AIR

The following curve represents the measurement in waveguide of the voltage picked up by the probe toward the E-field generated inside the waveguide.



From this curve, the sensitivity in air is calculated using the below formula.

$$E^2 = \sum_{i=1}^{3} \frac{V_i\,(1 + V_i/DCP_i)}{Norm_i}$$

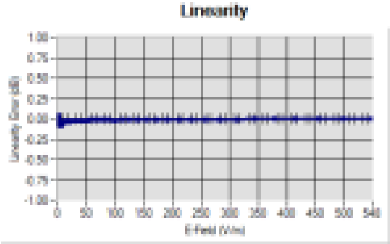
Vi=voltage readings on the 3 channels of the probe
DCPi=diode compression point given below for the 3 channels of the probe
Normi=dipole sensitivity given below for the 3 channels of the probe

Normx dipole 1 ($\mu V/(V/m)^2$)	Normy dipole 2 ($\mu V/(V/m)^2$)	Normz dipole 3 ($\mu V/(V/m)^2$)
6.68	6.48	6.78

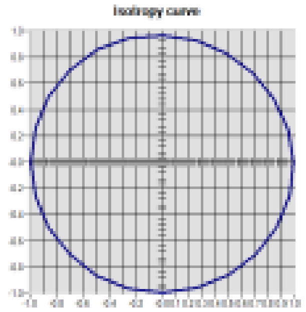
DCP dipole 1 (mV)	DCP dipole 2 (mV)	DCP dipole 3 (mV)
109	105	104

6 VERIFICATION RESULTS

The figures below represent the measured linearity and axial isotropy for this probe. The probe specification is +/-0.2 dB for linearity and +/-0.15 dB for axial isotropy.



Linearity:+/-1.90% (+/-0.08dB)



Isotropy:+/-2.15% (+/-0.08dB)

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	08/2021	08/2024
Network Analyzer	Agilent 8753ES	MY40003210	10/2023	10/2026
Network Analyzer – Calibration kit	Rohde & Schwarz ZV-Z235	101223	07/2022	07/2025
Network Analyzer – Calibration kit	HP 85033D	3423A08186	06/2021	06/2027
Multimeter	Keithley 2000	4013982	02/2023	02/2026
Signal Generator	Rohde & Schwarz SMB	106589	03/2022	03/2025
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	06/2021	06/2024
Power Meter	Keysight U2000A	SN: MY62340002	10/2022	10/2025
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.145.30.23.BES.B

Cancel and replace the report ACR.145.30.23.BES.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: 05/24/2023

Accreditations #2-6789
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).

HAC REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.145.30.23.BES.B

	Name	*Function*	*Date*	*Signature*
Prepared by :	Cyrille ONNEE	Measurement Responsible	5/25/2023	
Checked & approved by:	Jérôme Luc	Technical Manager	5/25/2023	
Authorized by:	Yann Toutain	Laboratory Director	6/16/2023	

Yann Toutain ID Signature numérique de Yann Toutain ID Date : 2023.06.16 09:37:10 +02'00'

	Customer Name
Distribution :	CCIC SOUTHERN TESTING CO., LTD

Issue	*Name*	*Date*	*Modifications*
A	Cyrille ONNEE	5/25/2023	Initial release
B	Cyrille ONNEE	6/16/2023	Typo in calibration date

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

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.
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 S11 PARAMETER 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.

4.2 E-FIELD REQUIREMENTS

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

5.1 S11 PARAMETER

The estimated expanded uncertainty (k=2) in calibration for the S11 parameter in linear is +/-0.08 with respect to measurement conditions.

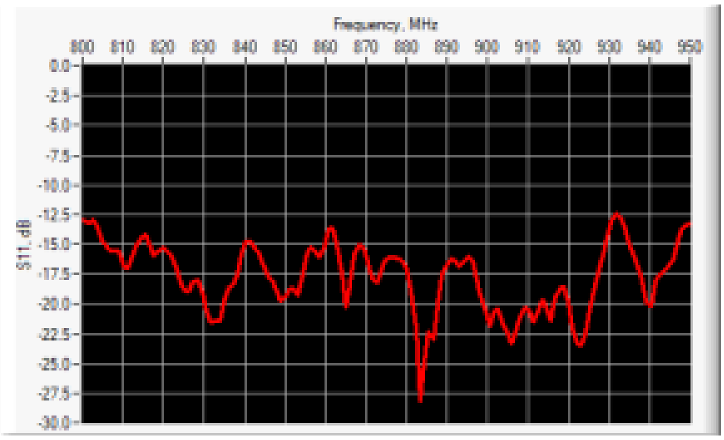
5.2 E-FIELD

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

The estimated expanded uncertainty (k=2) in calibration for the E-Field measurement in V/m is +/-14% with respect to measurement conditions.

6 CALIBRATION RESULTS

6.1 S11 PARAMETER



Frequency (MHz)	Worst Case S11 parameter (dB)	Requirement (dB)
800-950 MHz	-12.40	-10

6.2 E-FIELD

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.

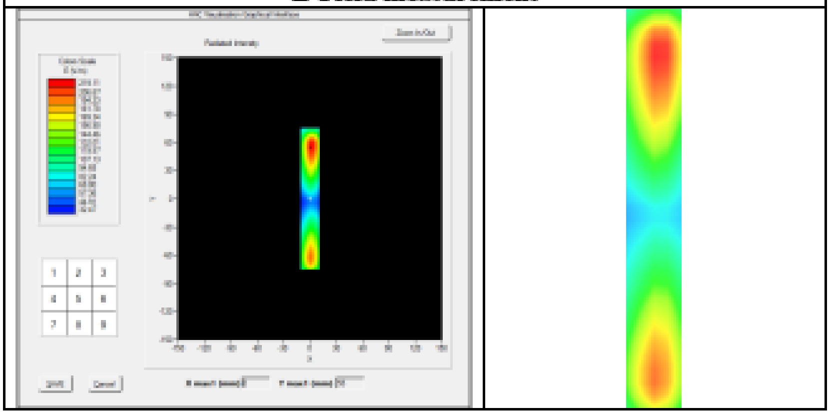
Measurement Condition

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
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)	209.89	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	08/2021	08/2024
Network Analyzer	Agilent 8753ES	MY40003210	10/2019	10/2023
Network Analyzer – Calibration kit	Rohde & Schwarz ZV-Z235	101223	07/2022	07/2025
Network Analyzer – Calibration kit	HP 85033D	3423A08186	06/2021	06/2027
Reference Probe	MVG	EPH32 SN 26/11	02/2023	02/2024
Multimeter	Keithley 2000	4013982	02/2023	02/2026
Signal Generator	Rohde & Schwarz SMB	106589	03/2022	03/2025
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	06/2021	06/2024
Power Meter	Keysight U2000A	SN: MY62340002	10/2022	10/2025
Directional Coupler	Krytar 158020	131467	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Temperature and Humidity Sensor	Testo 184 H1	44225320	06/2021	06/2024

HAC Reference Dipole Calibration Report

Ref : ACR.145.31.23.BES.B

Cancel and replace the report ACR.145.31.23.BES.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: 05/24/2023

Accreditations #2-6789
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 :	Cyrille ONNEE	Measurement Responsible	5/25/2023	
Checked & approved by:	Jérôme Luc	Technical Manager	5/25/2023	
Authorized by:	Yann Toutain	Laboratory Director	6/16/2023	Yann TOUTAIN

Yann Toutain ID
Signature numérique de Yann Toutain
Date : 2023.06
09:37:38 +02'

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1 INTRODUCTION

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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

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.

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4.2 E-FIELD REQUIREMENTS

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

5.1 S11 PARAMETER

The estimated expanded uncertainty (k=2) in calibration for the S11 parameter in linear is +/-0.08 with respect to measurement conditions.

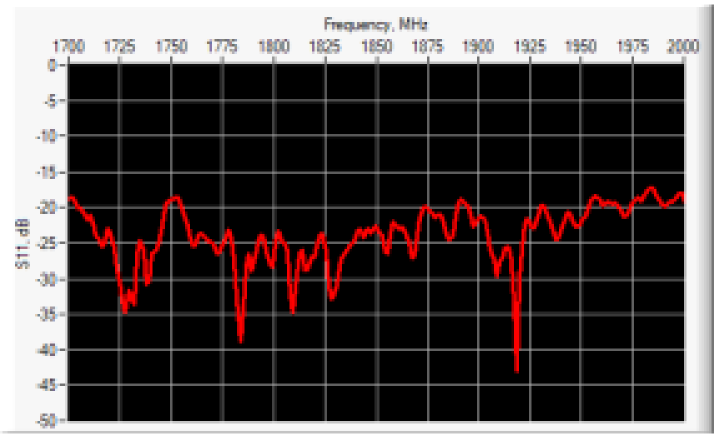
5.2 E-FIELD

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

The estimated expanded uncertainty (k=2) in calibration for the E-Field measurement in V/m is +/-14% with respect to measurement conditions.

6 CALIBRATION RESULTS

6.1 S11 PARAMETER



Frequency (MHz)	Worst Case S11 parameter (dB)	Requirement (dB)
1700-2000 MHz	-17.30	-10

6.2 E-FIELD

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.

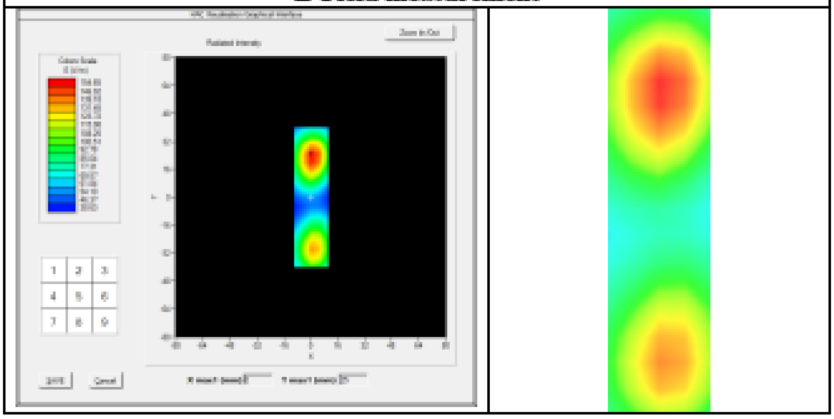
Measurement Condition

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=80mm/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)	145.34	146.1

E-Field measurement



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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	06/2021	06/2024
Power Meter	Keysight U2000A	SN: MY62340002	10/2022	10/2025
Directional Coupler	Krytar 158020	131467	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Temperature and Humidity Sensor	Testo 184 H1	44225320	06/2021	06/2024

———End of the Report———