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TEST REPORT

FCC/ISED 60 GHz Test for LGSRFR1
Certification

APPLICANT
LG Electronics, Inc.

REPORT NO.
HCT-RF-2303-FI007

DATE OF ISSUE
April 17, 2023

Tested by
Kyung Soo Kang

Technical Manager
Jong Seok Lee

Accredited by KOLAS, Republic of KOREA

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TEST REPORT
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Additional Model
-

Applicant	**LG Electronics Inc.** 222, LG-ro, Jinwi-myeon, Pyeongtaek-si, Gyeonggi-do, 451-713, South Korea
Product Name Model Name	RF module LGSRFR1
Contains FCC ID Contains IC	BEJLGSRFR1 2703H-LGSRFR1
Date of Test	February 15, 2023 ~ March 31, 2023
Test Standard Used	FCC Part 2, Part 15.255 RSS-GEN issue 5, RSS-210 issue 10
Frequency Range	57 GHz ~ 66 GHz
FCC Classification	DXX (Part 15 Low Power Communication Device Transmitter)
Max. RF Output Power	C0-Left_Ant 0 Peak: 35.52 dBm Aver: 34.92 dBm

The result shown in this test report refer only to the sample(s) tested unless otherwise stated.
This test results were applied only to the test methods required by the standard.

REVISION HISTORY

The revision history for this test report is shown in table.

Revision No.	Date of Issue	Description
0	April 17, 2023	Initial Release

Engineering Statement:
The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of the FCC / ISED Rules under normal use and maintenance.

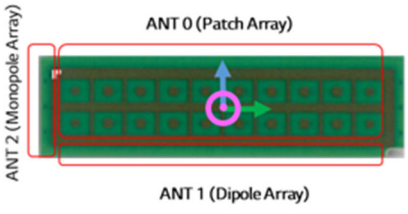
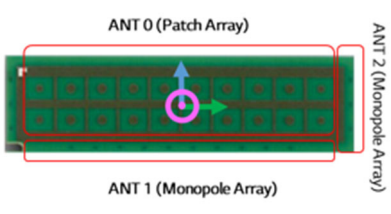
KOLAS Statement:
The above Test Report is the accredited test result by (KS Q) ISO/IEC 17025 and KOLAS(Korea Laboratory Accreditation Scheme), which signed the ILAC-MRA. (KOLAS Accreditation No. KT197)

If this report is required to confirmation of authenticity, please contact to www.hct.co.kr

CONTENTS

1. EUT DESCRIPTION

Model	LGSRFR1			
Additional Model	-			
EUT Type	RF module			
EUT Serial Number	LGSRFR1-01			
Power Supply	12.0 V			
Frequency Range	57 GHz ~ 66 GHz			
EIRP	Peak	35.52 dBm		
	Average	34.92 dBm		
Modulation Type	MCS1 ~ MCS6	BPSK	MCS7 ~ MCS11	QPSK
	MCS12 ~ MCS16	16QAM	MCS17~MCS21	64QAM
Antenna Specification	C0-Left_Ant 0	Antenna Type	Patch Array Antenna	
		Peak Gain(dBi)	19.5	
	C0-Left_Ant 1	Antenna Type	Dipole Array Antenna	
		Peak Gain(dBi)	13.7	
	C0-Left_Ant 2	Antenna Type	Monopole Array Antenna	
		Peak Gain(dBi)	7.7	
	C0-Right_Ant 0	Antenna Type	Patch Array Antenna	
		Peak Gain(dBi)	19.5	
	C0-Right_Ant 1	Antenna Type	Monopole Array Antenna	
		Peak Gain(dBi)	12.5	
	C0-Right_Ant 2	Antenna Type	Monopole Array Antenna	
		Peak Gain(dBi)	7.7	

C0-Left	C0-Right
	

Date(s) of Tests	February 15, 2023 ~ March 31, 2023
PMN (Product Marketing Number)	RF module
HVIN (Hardware Version Identification Number)	LGSRFR1
FVIN (Firmware Version Identification Number)	W22_RF1.0
HMN (Host Marketing Name)	N/A
Factory	**LG Electronics Inc.** 168, Suchul-daero, Gumi-si, Gyeongsangbuk-do, Republic of Korea

2. TEST METHODOLOGY

The measurement procedure described in the American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices (ANSI C63.10-2013) Operating Under § 15.255" were used in the measurement.

2.1 EUT CONFIGURATION

The EUT configuration for testing is installed on EIRP measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

2.2 EUT EXERCISE

The EUT was operated in the engineering mode to fix the Tx Frequency that was for the purpose of the measurements.

2.3 GENERAL TEST PROCEDURES

Radiated Emissions

The EUT is placed on a turn table, which is 0.8 m above the ground plane below 1 GHz and 1.5 m above 1 GHz with absorbers between the EUT and receiving antenna. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set far-field distance away from the receiving antenna, which varied from 1 m to 4 m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this hand-held transmitter (EUT) was rotated through three orthogonal axes according to the requirements in Section 8 of ANSI C63.10. (Version: 2013)

2.4 DESCRIPTION OF TEST MODES

The EUT has been tested under operating condition. Test program used to control the EUT for staying in continuous transmitting and receiving mode is programmed.

3. INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipment's, which is traceable to recognized national standards.
Especially, all antennas(Up to 40 GHz) for measurement are calibrated in accordance with the requirements of C63.5 (Version : 2006).

4. FACILITIES AND ACCREDITATIONS

4.1 FACILITIES

The SAC(Semi-Anechoic Chamber) and conducted measurement facility used to collect the radiated data are located at the 74, Seoicheon-ro 578beon-gil,
Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA.
The site is constructed in conformance with the requirements of ANSI C63.4. (Version :2014) and CISPR Publication 22.
Detailed description of test facility was submitted to the Commission and accepted dated April 02, 2018 (Registration Number: KR0032).
For ISED, test facility was accepted dated February 14, 2019 (CAB identifier: KR0032).

4.2 EQUIPMENT

Radiated emissions are measured with one or more of the following types of Linearly polarized antennas: tuned dipole, bi-conical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and quasi-peak detectors are used to perform radiated measurements. Conducted emissions are measured with Line Impedance Stabilization Networks and EMI Test Receivers. Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.
All receiving equipment conforms to CISPR Publication 16-1, "Radio Interference Measuring Apparatus and Measurement Methods."

5. ANTENNA REQUIREMENTS

According to FCC 47 CFR § 15.203:

"An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section."

- The antennas of this E.U.T are permanently attached.
- The E.U.T Complies with the requirement of § 15.203 / RSS-Gen

6. MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.4:2014.

All measurement uncertainty values are shown with a coverage factor of $k = 2$ to indicate a 95 % level of confidence.

Parameter	Expanded Uncertainty (± dB)
Radiated Disturbance (9 kHz ~ 30 MHz)	4.14 (Confidence level about 95 %, k=2)
Radiated Disturbance (30 MHz ~ 1 GHz)	5.82 (Confidence level about 95 %, k=2)
Radiated Disturbance (1 GHz ~ 18 GHz)	5.74 (Confidence level about 95 %, k=2)
Radiated Disturbance (18 GHz ~ 40 GHz)	5.76 (Confidence level about 95 %, k=2)
Radiated Disturbance (Above 40 GHz)	5.52 (Confidence level about 95 %, k=2)

7. SUMMARY TEST OF RESULTS

Test Description	FCC Part Section(s)	ISED	Test Limit	Test Condition	Test Result
Occupied Bandwidth	§ 2.1049	RSS-GEN, Section 6.7 RSS-210, Annex J.4(c)	FCC: 57-71 GHz ISED: 57-71 GHz	RADIATED	PASS
RF Output Power	§ 15.255(c) § 15.255(e)	RSS-210, Annex J.2	< EIRP 40 dBm (Average) < EIRP 43 dBm (Peak) < 500 mW (Peak Conducted)		PASS
Unwanted emissions	§ 15.255(d)	RSS-GEN, Section 6.13, Section 8.9 RSS-210, Annex J.3	0.009 – 0.490 MHz: 2400/F[kHz] 0.490 – 1.705 MHz: 24000/F[kHz] 1.705 – 30.0 MHz: 29.5 dBµV/m 30 – 88 MHz: 40.0 dBµV/m 88 – 216 MHz: 43.5 dBµV/m 216 – 960 MHz: 46.0 dBµV/m 960 – 40 000 MHz: 54.0 dBµV/m 40 – 200 GHz: -< EIRP -9.96 dBm		PASS
Receiver Spurious Emission	-	RSS-GEN, Section 7.3	30 – 88 MHz: 100 µV/m at 3 m 88 – 216 MHz: 150 µV/m at 3m 216 – 960 MHz: 200 µV/m at 3m above 960 MHz: 500 µV/m at 3m		PASS
Fundamental Emissions (Frequency stability)	§ 15.255(f)	RSS-GEN, Section 6.11, Section 8.11 RSS-210, Annex J.6	57–71 GHz		PASS

Worst data rate

Frequency	Data rate (Mbps)	Reading [mV]	Total [dBm]	Limit [dBm]	Measurement Type
59.40	**MCS 1**	89	**35.52**	**43**	**PK**
59.40	**MCS 1**	81	**34.92**	**40**	**AV**
59.40	MCS 2	86	35.34	43	PK
59.40	MCS 2	79	34.53	40	AV
59.40	MCS 3	84	35.32	43	PK
59.40	MCS 3	78	34.42	40	AV
59.40	MCS 4	82	35.23	43	PK
59.40	MCS 4	76	34.27	40	AV
59.40	MCS 5	81	34.94	43	PK
59.40	MCS 5	75	34.21	40	AV
59.40	MCS 6	81	35.14	43	PK
59.40	MCS 6	75	34.19	40	AV
59.40	MCS 7	84	34.96	43	PK
59.40	MCS 7	77	34.36	40	AV
59.40	MCS 8	83	35.09	43	PK
59.40	MCS 8	77	34.31	40	AV
59.40	MCS 9	46	32.65	43	PK
59.40	MCS 9	42	30.96	40	AV
59.40	MCS 10	47	32.41	43	PK
59.40	MCS 10	42	31.01	40	AV
59.40	MCS 11	45	32.57	43	PK
59.40	MCS 11	42	30.90	40	AV
59.40	MCS 12	49	32.49	43	PK
59.40	MCS 12	44	31.24	40	AV
59.40	MCS 13	47	32.45	43	PK
59.40	MCS 13	42	31.13	40	AV
59.40	MCS 14	46	32.62	43	PK

59.40	MCS 14	42	30.91	40	AV
59.40	MCS 15	47	32.54	43	PK
59.40	MCS 15	42	31.01	40	AV
59.40	MCS 16	46	32.39	43	PK
59.40	MCS 16	42	30.94	40	AV
59.40	MCS 17	48	32.65	43	PK
59.40	MCS 17	43	31.25	40	AV
59.40	MCS 18	49	32.31	43	PK
59.40	MCS 18	43	32.81	40	AV
59.40	MCS 19	49	32.21	43	PK
59.40	MCS 19	43	31.21	40	AV
59.40	MCS 20	48	32.59	43	PK
59.40	MCS 20	43	31.12	40	AV
59.40	MCS 21	48	32.75	43	PK
59.40	MCS 21	43	31.16	40	AV

Note: After MCS-E.I.R.P. spot checking, we found that MCS 1 is the worst data rate. Thus, we have only included MCS 1 test results except for Radiated Power.

- All tests is performed by radiated measurement and applied below conditions.

: Measurement distance of fundamental tests is as follow.

Wavelength[m] = Speed of light[m/s] / Measurement frequency[Hz] = (3 x 10^{8}) / (66 x 10^{9}) = 0.0045

(2 X (EUT Antenna dimension)^{2}) / Wavelength = (2 X (0.04148)^{2})/ 0.0045 = 0.76 ***m***

(2 X (measurement Antenna dimension)^{2}) / Wavelength = (2 X (0.04179)^{2})/ 0.0045 = 0.77 ***m***

For fundamental and out-of-band emissions the largest far-field distance of either the EUT antenna or measurement antenna shall be used. **So, measurement distance is 1.0 m.**

: Spurious emissions measurement distance is shown in table below. (Far field)

Frequency Rage (GHz)	Wavelength (cm)	Far Field Distance (m)	Measured Distance (m)
40 ~ 60	0.50	1.354	1.5
60 ~ 90	0.33	0.856	1.0
90 ~ 140	0.21	0.572	1.0
140 ~ 200	0.15	0.365	1.0

8. TEST RESULT

8.1 OCCUPIED BANDWIDTH MEASUREMENT

FCC Rules

Test Requirements and limit, § 2.1049

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured.

ISED Rules

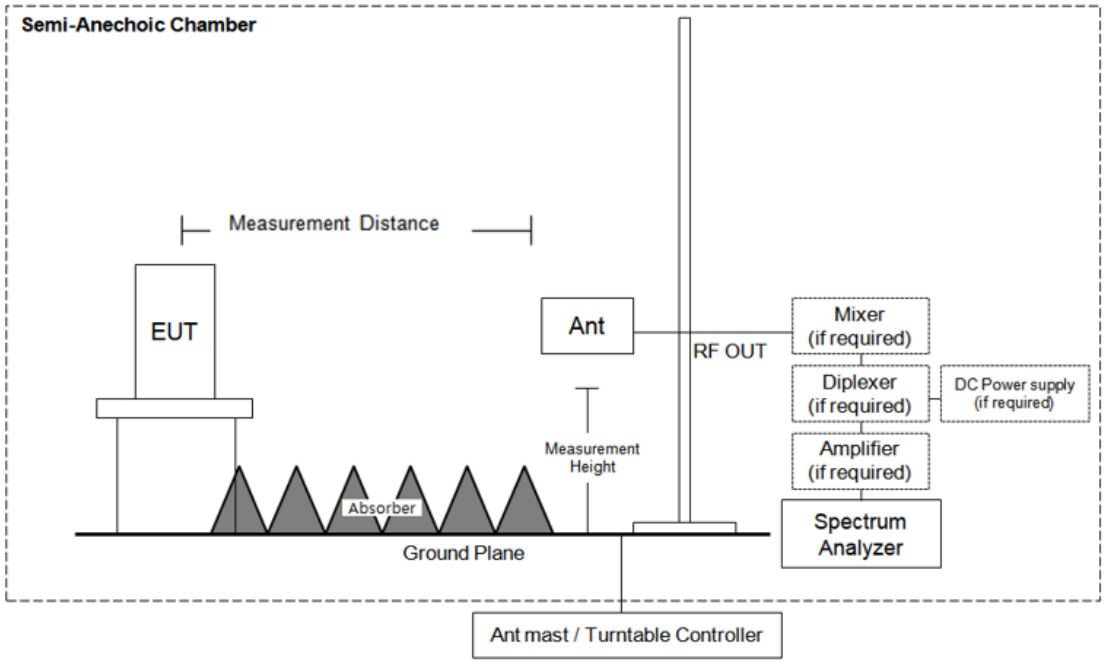
RSS-GEN, Section 6.7 Occupied bandwidth (or 99 % emission bandwidth) and x dB bandwidth

The occupied bandwidth or the “99 % emission bandwidth” is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99 % of the total transmitted power of the fundamental transmitted emission is contained. The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs

RSS-210, Annex J.4(c)

For the purpose of this standard, emission bandwidth is defined as the instantaneous frequency range occupied by a steady radiated signal with modulation, outside which the radiated power spectral density shall be 6 dB below the maximum radiated power spectral density in the band, as measured with a 100 kHz resolution bandwidth. The centre frequency must be stationary during the measurement interval, even if not stationary during normal operation.

▣ TEST CONFIGURATION



▣ TEST PROCEDURE

The transmitter output is connected to the Spectrum Analyzer.

RBW = 8 MHz

VBW ≥ 3 x RBW

Detector = Peak

Trace mode = max hold

Sweep = auto couple

Allow the trace to stabilize

Note:

1. It was measured as the maximum RBW value of the equipment we used.
2. We tested all antennas of the EUT, but we only included the worst result in this test report.

▣ TEST RESULTS

C0-Left_Ant0, CH 9 [Center frequency: 59.4 GHz]

TEST CONDITIONS:		Occupied Channel Bandwidth (GHz)
T nom	V nom	3.9585

C0-Left_Ant0, CH 10 [Center frequency: 61.56 GHz)

TEST CONDITIONS:		Occupied Channel Bandwidth (GHz)
T nom	V nom	3.9708

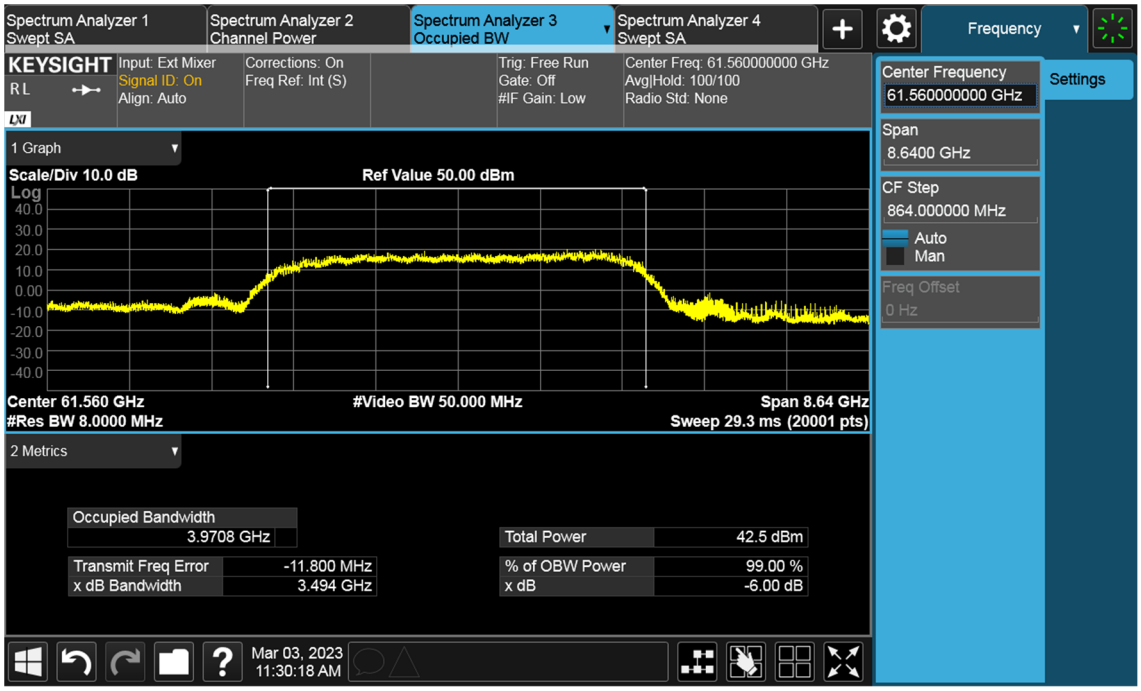
C0-Left_Ant0, CH 11 [Center frequency: 63.72 GHz]

TEST CONDITIONS:		Occupied Channel Bandwidth (GHz)
T nom	V nom	3.9028

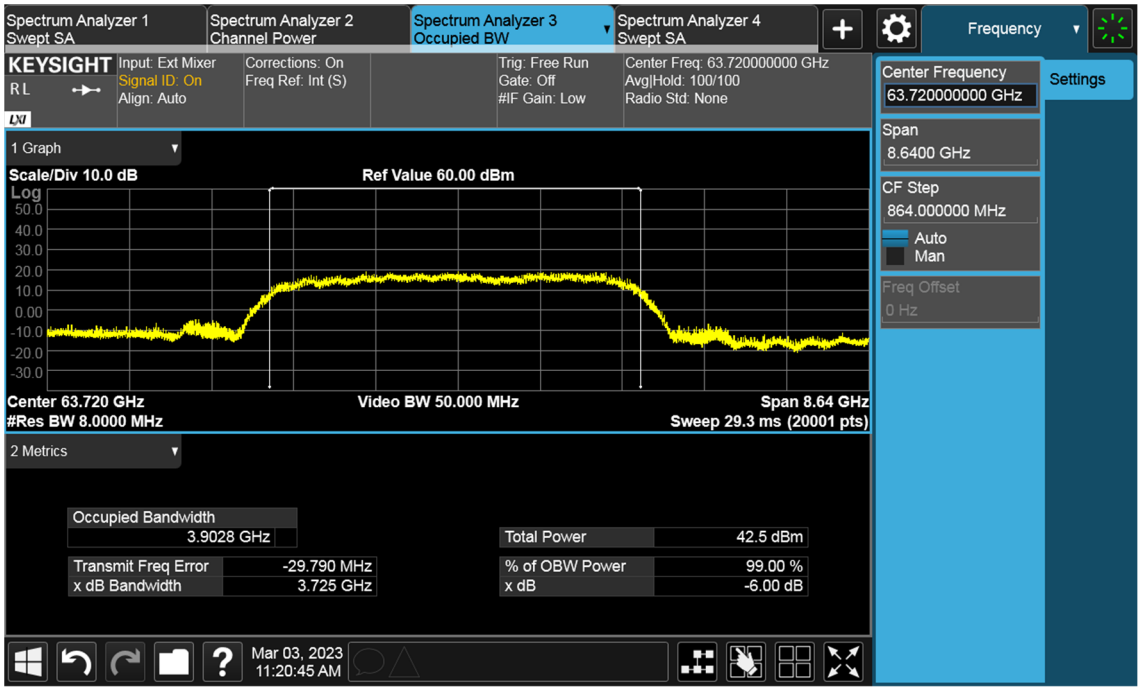
▣ RESULT PLOTS

CH 9 Occupied Channel Bandwidth plot

CH 10 Occupied Channel Bandwidth plot



CH 11 Occupied Channel Bandwidth plot



8.2 RF OUTPUT POWER

FCC Rules

Test Requirements and limit, § 15.255(c)

Within the 57-71 GHz band, emission levels shall not exceed the following equivalent isotropically radiated power (EIRP):

(1) Products other than fixed field disturbance sensors and short-range devices for interactive motion sensing shall comply with one of the following emission limits, as measured during the transmit interval:

(i) The average power of any emission shall not exceed 40 dBm and the peak power of any emission shall not exceed 43 dBm; or

§ 15.255

(e) Except as specified paragraph (e)(1) of this section, the peak transmitter conducted output power shall not exceed 500 mW. Depending on the gain of the antenna, it may be necessary to operate the intentional radiator using a lower peak transmitter output power in order to comply with the EIRP limits specified in paragraph (b) of this section.

(1) Transmitters with an emission bandwidth of less than 100 MHz must limit their peak transmitter conducted output power to the product of 500 mW times their emission bandwidth divided by 100 MHz. For the purposes of this paragraph, emission bandwidth is defined as the instantaneous frequency range occupied by a steady state radiated signal with modulation, outside which the radiated power spectral density never exceeds 6 dB below the maximum radiated power spectral density in the band, as measured with a 100 kHz resolution bandwidth spectrum analyzer. The center frequency must be stationary during the measurement interval, even if not stationary during normal operation (e.g., for frequency hopping devices).

§ ANSI 63.10 9.11 Measurement of the fundamental emission using an RF detector

The following procedure shall be used for measuring the fundamental emission using an RF detector:

a) Set up the test as follows:

1) The measurement instrument shall be either a mm-wave RF detector that has an RF bandwidth encompassing the entire authorized frequency band or a mm-wave downconverter connected to a microwave RF detector, such that the RF input of the downconverter encompasses the entire authorized frequency band and both the IF output of the downconverter and the RF input of the detector encompass the entire downconverted authorized frequency band. The input VSWR of the mm-wave detector or mm-wave downconverter shall be less than 3:1. If the detector or downconverter as a stand-alone device

does not meet this requirement, then a mm-wave isolator shall be connected to the input RF port, and the input VSWR of the combination of isolator plus detector, or isolator plus downconverter, shall be less than 3:1.

2) For conducted measurements of transmitter output power, connect the mm-wave RF detector or the downconverter, with appropriate attenuation as needed to prevent damage or overload to the measurement instrumentation, to the output port of the EUT.

3) For radiated emissions measurements, connect the test antenna for the fundamental frequency band to the mm-wave RF detector or the downconverter. Place the test horn in the main beam of the EUT at a distance that will provide a signal within the operating range of the RF detector or downconverter.

b) Connect the video output of the detector to the 50 Ω input of a DSO. The video bandwidth of the combination of the detector and DSO must be greater than 10 MHz. When connected to the 50 Ω input of the DSO, the video bandwidth will typically be greater than 10 MHz, in which case a low-pass filter (LPF) with a cutoff frequency of at least 10 MHz may be inserted between the output of the detector and the input of the DSO. Due to the input capacitance of the DSO, the video bandwidth will normally be less than 10 MHz when the output of the detector is connected to the high impedance (e.g., 1 MΩ) input of the DSO.

c) Set the sampling rate of the DSO to at least twice the cutoff frequency of any LPF used or to at least twice the signal bandwidth without a LPF. Adjust the memory depth, the triggering, and the sweep speed to obtain a display that is representative of the signal considering the type of modulation. If the signal is noncontinuous, then identify the segment of the signal that has the highest amplitude, and then adjust the triggering and the sweep speed to capture that segment. If the emission consists of RF bursts, then identify the highest level burst and adjust the triggering and sweep rate of the DSO to display the entire burst without blanking intervals.

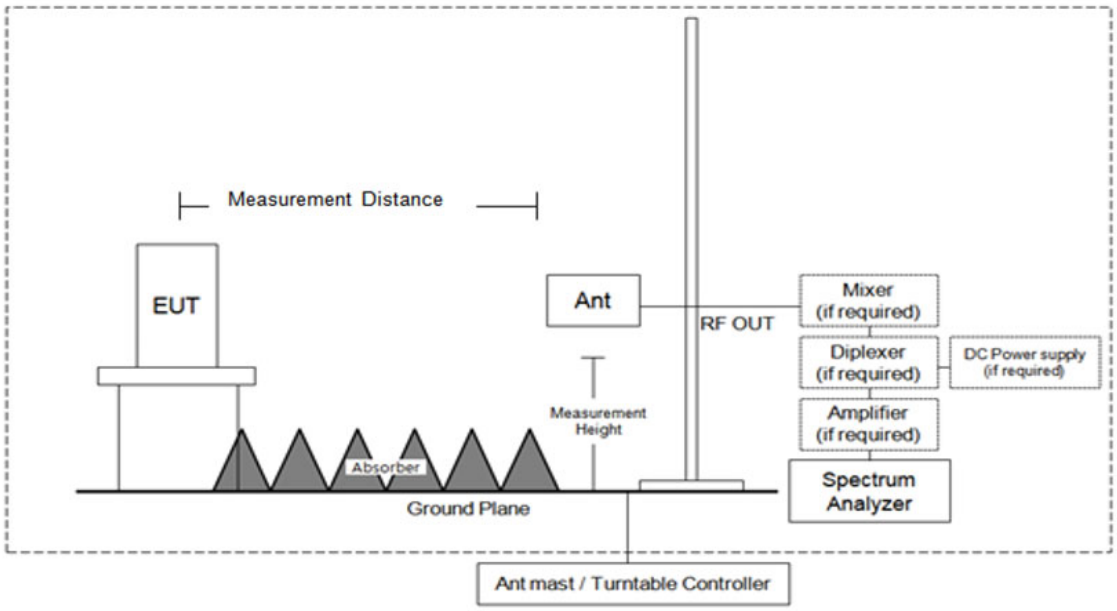
ISED Rules

RSS-210, Annex J.2.2(b)

(b) For other devices, the average and peak e.i.r.p. of any emission shall not exceed 40 dBm and 43 dBm, respectively.

▣ Test Configuration

40 GHz – 200 GHz



▣ TEST PROCEDURE

1) Record the average and peak voltages from the DSO.
2) Disconnect the test antenna or EUT (as applicable for radiated or conducted tests) from the RF input port of the instrumentation system.
3) Connect a mm-wave source to the RF input port of the instrumentation system via a waveguide variable attenuator.
4) The mm-wave source shall be unmodulated.
5) Adjust the frequency of the mm-wave source to the center of the frequency range occupied by the transmitter.
6) Adjust the amplitude of the mm-wave source and/or the variable attenuator such that the DSO indicates a voltage equal to the peak voltage recorded in step e1).
7) Disconnect the waveguide variable attenuator from the RF input port of the instrumentation system.
8) Without changing any settings, connect the waveguide variable attenuator to a wideband mm-wave power meter with a thermocouple detector or equivalent.
9) Measure and note the power.

▣ TEST RESULTS

C0-Left_Ant0 Channel 9

Frequency [GHz]	Reading [mV]	Ant. Pol. [H/V]	Total [dBm]	Limit [dBm]	Margin [dB]	Measurement Type
59.4	89	H	35.52	43	7.48	PK
59.4	81	H	34.92	40	5.08	AV

Note :

1. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
2. E.I.R.P. [dBm] = Source Module Power [dBm] + Ant. Gain [dBi]

Peak Conducted Output Power

Frequency [GHz]	Peak EIRP [dBm]	Antenna Gain [dBi]	Peak Conducted Output Power [mW]	Limit [mW]	Measurement Type
59.40	35.52	19.5	39.99	500	PK

Note : Peak Conducted Output Power [dBm] = Peak E.I.R.P. [dBm] – EUT Ant. Gain [dBi]

C0-Left_Ant0 Channel 10

Frequency [GHz]	Reading [mV]	Ant. Pol. [H/V]	Total [dBm]	Limit [dBm]	Margin [dB]	Measurement Type
61.56	77	H	34.31	43	8.69	PK
61.56	69	H	33.71	40	6.29	AV

Note :

1. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
2. E.I.R.P. [dBm] = Source Module Power [dBm] + Ant. Gain [dBi]

Peak Conducted Output Power

Frequency [GHz]	Peak EIRP [dBm]	Antenna Gain [dBi]	Peak Conducted Output Power [mW]	Limit [mW]	Measurement Type
61.56	34.31	19.5	30.27	500	PK

Note : Peak Conducted Output Power [dBm] = Peak E.I.R.P. [dBm] – EUT Ant. Gain [dBi]

C0-Left_Ant0 Channel 11

Frequency [GHz]	Reading [mV]	Ant. Pol. [H/V]	Total [dBm]	Limit [dBm]	Margin [dB]	Measurement Type
63.72	76	H	34.26	43	8.74	PK
63.72	69	H	33.66	40	6.34	AV

Note :

1. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
2. E.I.R.P. [dBm] = Source Module Power [dBm] + Ant. Gain [dBi]

Peak Conducted Output Power

Frequency [GHz]	Peak EIRP [dBm]	Antenna Gain [dBi]	Peak Conducted Output Power [mW]	Limit [mW]	Measurement Type
63.72	34.26	19.5	29.92	500	PK

Note : Peak Conducted Output Power [dBm] = Peak E.I.R.P. [dBm] – EUT Ant. Gain [dBi]

C0-Right_Ant0 Channel 9

Frequency [GHz]	Reading [mV]	Ant. Pol. [H/V]	Total [dBm]	Limit [dBm]	Margin [dB]	Measurement Type
59.40	86	H	35.36	43	7.64	PK
59.40	78	H	34.70	40	5.30	AV

Note :

1. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
2. E.I.R.P. [dBm] = Source Module Power [dBm] + Ant. Gain [dBi]

Peak Conducted Output Power

Frequency [GHz]	Peak EIRP [dBm]	Antenna Gain [dBi]	Peak Conducted Output Power [mW]	Limit [mW]	Measurement Type
59.40	35.36	19.5	38.55	500	PK

Note : Peak Conducted Output Power [dBm] = Peak E.I.R.P. [dBm] – EUT Ant. Gain [dBi]

C0-Right_Ant0 Channel 10

Frequency [GHz]	Reading [mV]	Ant. Pol. [H/V]	Total [dBm]	Limit [dBm]	Margin [dB]	Measurement Type
61.56	72	H	34.11	43	8.89	PK
61.56	64	H	33.50	40	6.50	AV

Note :

1. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
2. E.I.R.P. [dBm] = Source Module Power [dBm] + Ant. Gain [dBi]

Peak Conducted Output Power

Frequency [GHz]	Peak EIRP [dBm]	Antenna Gain [dBi]	Peak Conducted Output Power [mW]	Limit [mW]	Measurement Type
61.56	34.11	19.5	28.91	500	PK

Note : Peak Conducted Output Power [dBm] = Peak E.I.R.P. [dBm] – EUT Ant. Gain [dBi]

C0-Right_Ant0 Channel 11

Frequency [GHz]	Reading [mV]	Ant. Pol. [H/V]	Total [dBm]	Limit [dBm]	Margin [dB]	Measurement Type
63.72	72	H	34.12	43	8.88	PK
63.72	64	H	33.52	40	6.48	AV

Note :

1. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
2. E.I.R.P. [dBm] = Source Module Power [dBm] + Ant. Gain [dBi]

Peak Conducted Output Power

Frequency [GHz]	Peak EIRP [dBm]	Antenna Gain [dBi]	Peak Conducted Output Power [mW]	Limit [mW]	Measurement Type
63.72	34.12	19.5	28.97	500	PK

Note : Peak Conducted Output Power [dBm] = Peak E.I.R.P. [dBm] – EUT Ant. Gain [dBi]

C0-Left_Ant1

Frequency [GHz]	Reading [mV]	Ant. Pol. [H/V]	Total [dBm]	Limit [dBm]	Margin [dB]	Measurement Type
59.40	8.5	H	22.50	43	20.5	PK
59.40	8.2	H	21.90	40	18.10	AV
61.56	8.4	H	22.46	43	20.54	PK
61.56	8.1	H	21.86	40	18.14	AV
63.72	7.8	H	21.45	43	21.55	PK
63.72	7.5	H	20.85	40	19.15	AV

Note :

1. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
2. E.I.R.P. [dBm] = Source Module Power [dBm] + Ant. Gain [dBi]

C0-Left_Ant1 Peak Conducted Output Power

Frequency [GHz]	Peak EIRP [dBm]	Antenna Gain [dBi]	Peak Conducted Output Power [mW]	Limit [mW]	Measurement Type
59.40	22.50	13.7	7.59	500	PK
61.56	22.46	13.7	7.52	500	PK
63.72	21.45	13.7	5.96	500	PK

Note : Peak Conducted Output Power [dBm] = Peak E.I.R.P. [dBm] – EUT Ant. Gain [dBi]

C0-Left_Ant2

Frequency [GHz]	Reading [mV]	Ant. Pol. [H/V]	Total [dBm]	Limit [dBm]	Margin [dB]	Measurement Type
59.40	2.8	H	15.55	43	27.45	PK
59.40	2.6	H	14.95	40	25.05	AV
61.56	3.4	H	17.01	43	25.99	PK
61.56	3.2	H	16.41	40	23.59	AV
63.72	3.3	H	16.73	43	26.27	PK
63.72	3.1	H	16.13	40	23.87	AV

Note :

1. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
2. E.I.R.P. [dBm] = Source Module Power [dBm] + Ant. Gain [dBi]

C0-Left_Ant2 Peak Conducted Output Power

Frequency [GHz]	Peak EIRP [dBm]	Antenna Gain [dBi]	Peak Conducted Output Power [mW]	Limit [mW]	Measurement Type
59.40	15.55	7.7	6.10	500	PK
61.56	17.01	7.7	8.53	500	PK
63.72	16.73	7.7	8.00	500	PK

Note : Peak Conducted Output Power [dBm] = Peak E.I.R.P. [dBm] – EUT Ant. Gain [dBi]

C0-Right_Ant1

Frequency [GHz]	Reading [mV]	Ant. Pol. [H/V]	Total [dBm]	Limit [dBm]	Margin [dB]	Measurement Type
59.4	5.4	H	19.46	43	23.54	PK
59.4	5.2	H	18.91	40	22.94	AV
61.56	5.4	H	19.52	43	25.84	PK
61.56	5.2	H	18.91	40	23.44	AV
63.72	7.8	H	21.47	43	25.54	PK
63.72	7.6	H	20.86	40	23.14	AV

Note :

1. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
2. E.I.R.P. [dBm] = Source Module Power [dBm] + Ant. Gain [dBi]

C0-Right_Ant1 Peak Conducted Output Power

Frequency [GHz]	Peak EIRP [dBm]	Antenna Gain [dBi]	Peak Conducted Output Power [mW]	Limit [mW]	Measurement Type
59.40	19.46	12.5	4.97	500	PK
61.56	19.52	12.5	5.04	500	PK
63.72	21.47	12.5	7.89	500	PK

Note : Peak Conducted Output Power [dBm] = Peak E.I.R.P. [dBm] – EUT Ant. Gain [dBi]

C0-Right_Ant2 Right

Frequency [GHz]	Reading [mV]	Ant. Pol. [H/V]	Total [dBm]	Limit [dBm]	Margin [dB]	Measurement Type
59.40	3.6	H	17.66	43	25.34	PK
59.40	3.4	H	17.06	40	22.94	AV
61.56	3.4	H	17.16	43	25.84	PK
61.56	3.2	H	16.56	40	23.44	AV
63.72	3.5	H	17.46	43	25.54	PK
63.72	3.3	H	16.86	40	23.14	AV

Note :

1. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
2. E.I.R.P. [dBm] = Source Module Power [dBm] + Ant. Gain [dBi]

C0-Right_Ant2 Peak Conducted Output Power

Frequency [GHz]	Peak EIRP [dBm]	Antenna Gain [dBi]	Peak Conducted Output Power [mW]	Limit [mW]	Measurement Type
59.40	17.66	7.7	9.91	500	PK
61.56	17.16	7.7	8.83	500	PK
63.72	17.46	7.7	9.46	500	PK

Note : Peak Conducted Output Power [dBm] = Peak E.I.R.P. [dBm] – EUT Ant. Gain [dBi]

8.3 UNWANTED EMISSIONS

FCC Rules

Test Requirements and limit, § 15.255(d)

(1) The power density of any emissions outside the 57-71 GHz band shall consist solely of spurious emissions.

(2) Radiated emissions below 40 GHz shall not exceed the general limits in § 15.209.

(3) Between 40 GHz and 200 GHz, the level of these emissions shall not exceed 90 pW/cm2 at a distance of 3 meters.

(4) The levels of the spurious emissions shall not exceed the level of the fundamental emission.

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meter)
0.009 ~ 0.490	2400/F(kHz)	300
0.490 ~ 1.705	24000/F(kHz)	30
1.705 ~ 30.0	30	30
30 ~ 88	100	3
88 ~ 216	150	3
216 ~ 960	200	3
Above 960	500	3

ISED Rules

RSS-210, Annex J.3 Spurious emissions

The power of any emissions outside the band 57-71 GHz shall consist solely of spurious emissions and shall not exceed:

a. the fundamental emission levels
b. the general field strength limits specified in RSS-Gen for emissions below 40 GHz
c. 90 pW/cm2 at a distance of 3 m for emissions between 40 GHz and 200 GHz

RSS GEN, 6.13 Transmitter unwanted emissions

6.13.1 Detector

When the unwanted emissions limits are defined in relative terms, the same parameter, peak power or average power, shall be used as the reference for both the transmitter's output power and the unwanted emissions measurements.

When the unwanted emissions limits are expressed in absolute terms, unless otherwise stated in the applicable RSS, the following conditions shall apply:

Below 1 GHz, compliance with the limits shall be demonstrated using a CISPR quasi-peak detector and the related measurement bandwidth (see section 6.10).

Above 1 GHz, compliance with the limits shall be demonstrated using a linear average detector (see section 6.10) with a minimum resolution bandwidth of 1 MHz.

6.13.2 Frequency range for measuring unwanted emission

In measuring unwanted emissions, the spectrum shall be investigated from 30 MHz or the lowest radio frequency signal generated or used in the equipment, whichever is lower, without going below 9 kHz, up to at least the applicable frequency given below:

a. If the equipment operates below 10 GHz: to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.
b. If the equipment operates at or above 10 GHz and below 30 GHz: to the fifth harmonic of the highest fundamental frequency or to 100 GHz, whichever is lower.
c. If the equipment operates at or above 30 GHz: to the fifth harmonic of the highest fundamental frequency or to 200 GHz, whichever is lower, unless specified otherwise in the applicable RSS.
d. If the equipment contains a digital device that is exclusively used for enabling the operation of the radio apparatus: the spectrum shall be investigated according to the conditions specified in paragraphs (a) through (c) of this section or the range applicable to the digital device, as shown in table 2, whichever is the higher frequency range of investigation.

RSS GEN, 8.9 Transmitter emission limits

Except where otherwise indicated in the applicable RSS, radiated emissions shall comply with the field strength limits shown in table 5 and table 6. Additionally, the level of any transmitter unwanted emission shall not exceed the level of the transmitter's fundamental emission.

Frequency (MHz)	Magnetic field strength (microamperes/meter)	Measurement distance (meter)
0.009 ~ 0.490	6.37/F(kHz)	300
0.490 ~ 1.705	63.7/F(kHz)	30
1.705 ~ 30.0	0.08	30
Frequency (MHz)	**Field strength (microvolts/meter)**	**Measurement distance (m)**
30 ~ 88	100	3
88 ~ 216	150	3
216 ~ 960	200	3
Above 960	500	3

▣ Test Procedure

For below 40 GHz

1. The EUT is placed on a turntable, which is 1.5 m above ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
4. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
5. Repeat above procedures until the measurements for all frequencies are complete.

For Above 40 GHz

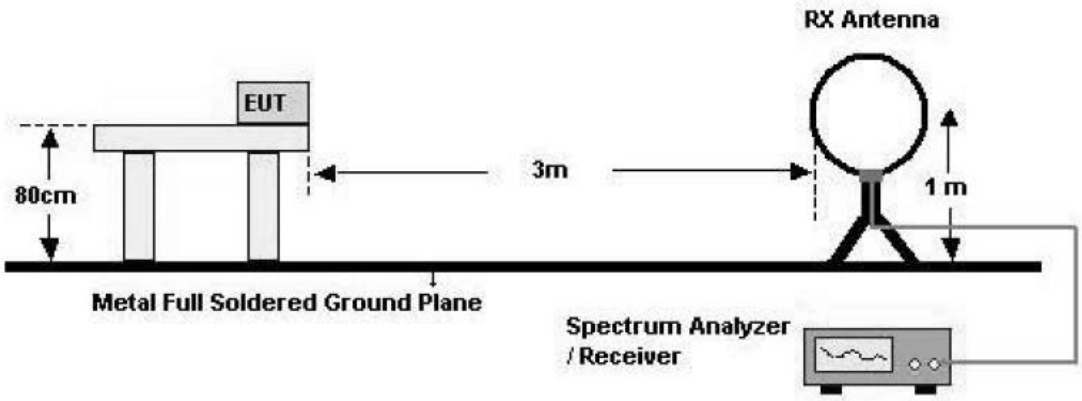
1. Connect the test antenna covering the appropriate frequency range toa spectrum analyzer via anexternal mixer to the spectrum analyzer.
2. Set spectrum analyzer RBW = 1 MHz, VBW =3MHz,averagedetector.
3. Calculate the distance to the far field boundaryand determine the maximum measurement distance.
4. Perform an exploratory search for emissions and determine the approximate direction at whicheach observed emission emanates from the EUT.
5. Exploratory measurements be made at a closer distance than the validated maximum measurement distance.
6. Perform a final measurement; begin with the test antenna at the approximate position where the maximum leveloccurred during the exploratory scan.
7. Slowly scan the test antenna around this position, slowly vary the test antennapolarization by rotating through at least 0° to 180°, and slowly vary the orientation ofthe test antenna to find thefinal position, polarization, and orientation at which the maximum level of theemission is observed.

h. Record the measured reading with the test antenna fixed at this maximized position, polarization, andorientation. Record the measurement distance.

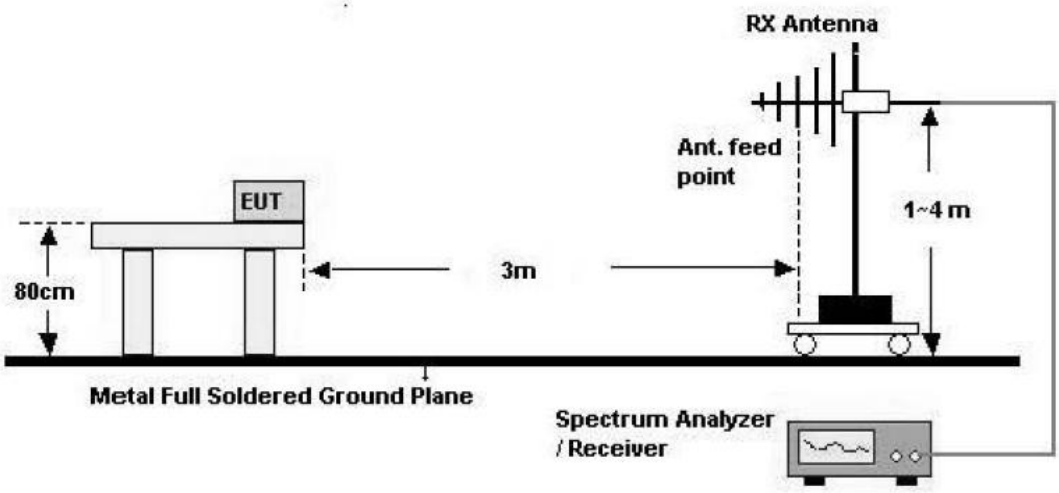
8. Calculate the maximum field strength of the emission at the measurement distance and the adjusted/corrected power at the output of the test antenna.
9. Calculate the EIRP from the measured field strength andthen convert to the linear.
10. Calculate the power density at the distance specified by the limit from thefield strength at the distance specified by the limit.
11. Repeat the preceding sequence for every emission observed in the frequency band underinvestigation.

Test Configuration

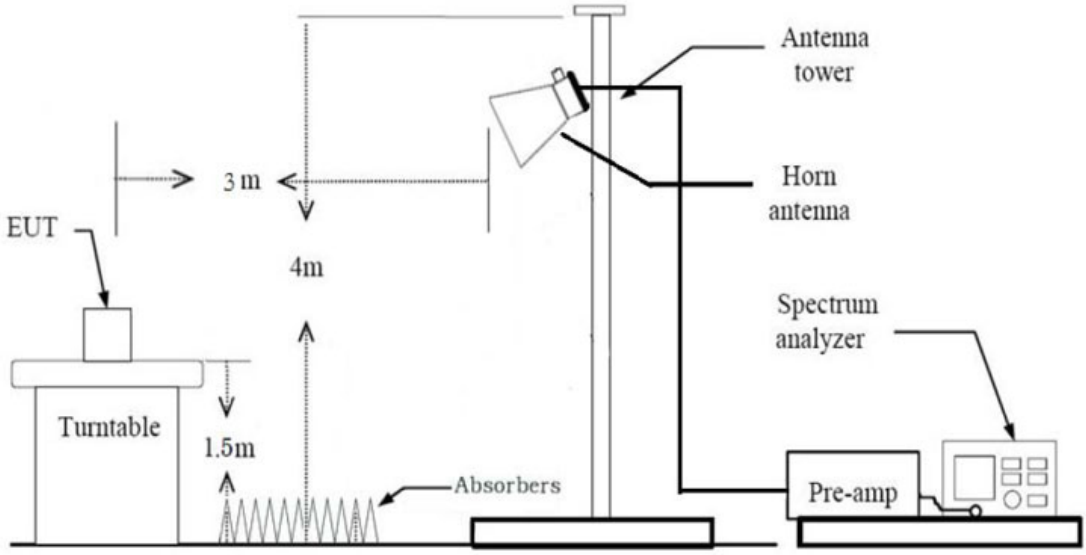
Below 30 MHz



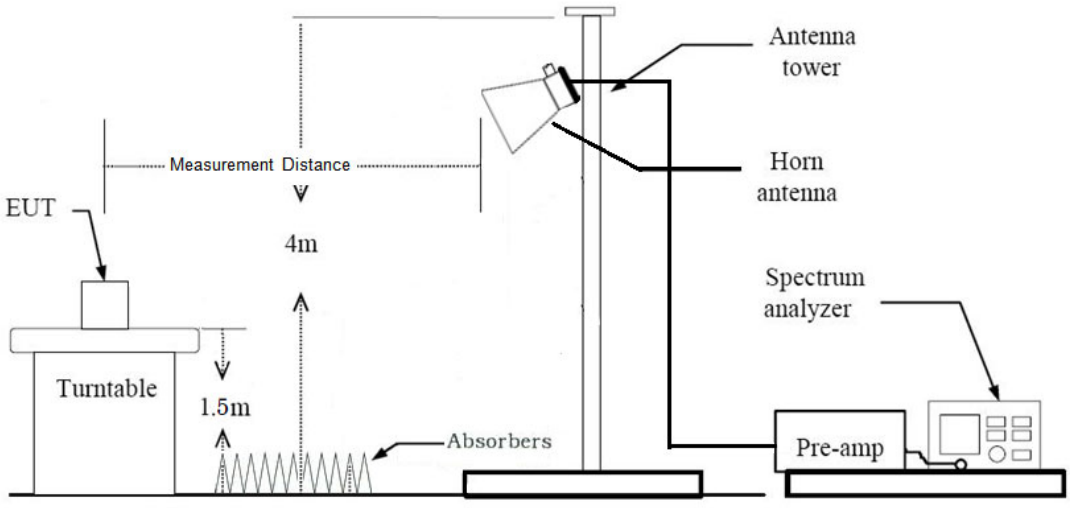
30 MHz - 1 GHz



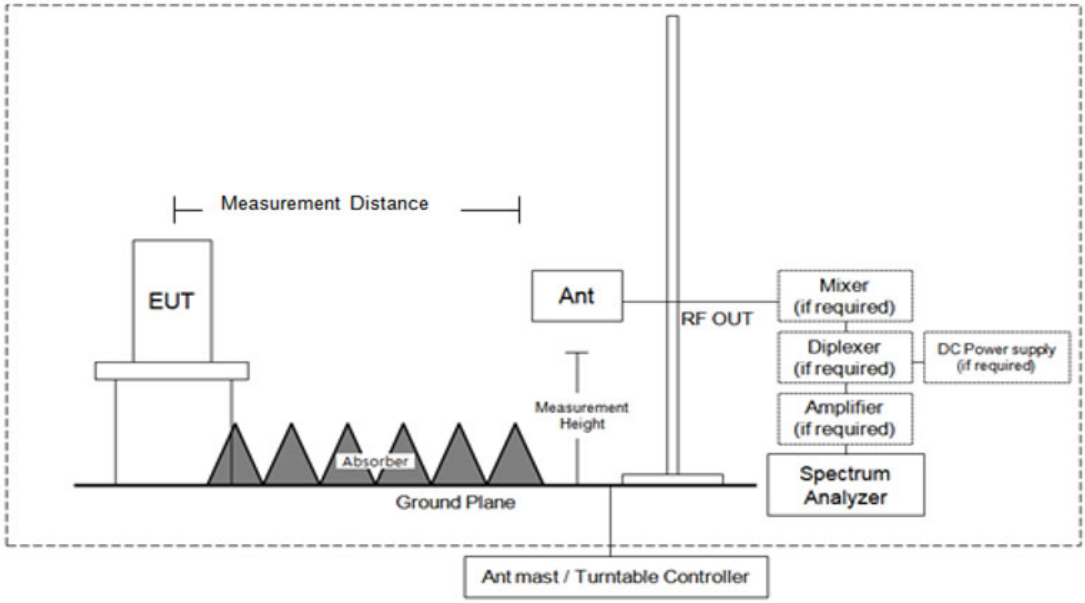
1 GHz – 18 GHz



18 GHz – 40 GHz



40 GHz – 200 GHz



Note: We tested all antennas of the EUT, but we only included the worst result in this test report.

▣ TEST RESULTS

C0-Left_Ant0, CH 9

9 kHz – 30MHz

Operation Mode: Continuous TX Mode

Frequency	Reading	Ant. factor	Cable loss	Ant. POL	Total	Limit	Margin
MHz	dBµV	dB/m	dB	(H/V)	dBµV/m	dBµV/m	dB
No Critical peaks found							

Notes:

1. Measuring frequencies from 9 kHz to the 30MHz.
2. The reading of emissions are attenuated more than 20 dB below the permissible limits or the field strength is too small to be measured.
3. Distance extrapolation factor = 40 log (specific distance / test distance) (dB)
4. Limit line = specific Limits (dBuV) + Distance extrapolation factor
5. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
6. The test results for below 30 MHz is correlated to an open site.
   The result on OFTS is about 2 dB higher than semi-anechoic chamber(10 m chamber)

Below 1 GHz

Operation Mode: Continuous TX Mode

Frequency	Reading	Ant. factor	Cable loss	Ant. POL	Total	Limit	Margin
MHz	dBµV	dB/m	dB	(H/V)	dBµV/m	dBµV/m	dB
No Critical peaks found							

Notes:

1. Measuring frequencies from 30 MHz to the 1 GHz.
2. Radiated emissions measured in frequency range from 30 MHz to 1000 MHz were made with an instrument using Quasi peak detector mode.
3. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.

1 GHz – 18 GHz

Operation Frequency: Continuous TX Mode

Frequency	Reading	A.F.+C.L.-AMP G +D.F.	ANT. POL	Total	Limit	Margin
[GHz]	[dBμV]	[dB/m]	[H/V]	[dBμV/m]	[dBμV/m]	[dB]
No Critical peaks found						

※ A·F: ANTENNA FACTOR
C·L: CABLE LOSS
AMP G: AMPLIFIER GAIN

Notes:

1. Measuring frequencies from 1 GHz to the 5th harmonic of highest fundamental frequency.
2. Measurements above show only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.
3. Radiated emissions measured in frequency above 1000MHz were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column.
4. Total = Reading Value + Antenna Factor + Cable Loss – Amplifier Gain + Distance Factor
5. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.

18 GHz – 40 GHz

Operation Frequency: Continuous TX Mode

Frequency	Reading	A.F.+C.L.-AMP G +D.F.	ANT. POL	Total	Limit	Margin
[GHz]	[dBμV]	[dB/m]	[H/V]	[dBμV/m]	[dBμV/m]	[dB]
No Critical peaks found						

※ A·F: ANTENNA FACTOR
C·L: CABLE LOSS
AMP G: AMPLIFIER GAIN

Note :

1. Total = Reading Value + Antenna Factor + Cable Loss + Distance Factor – Amp Gain
2. Distance extrapolation factor = 20 log (test distance / specific distance) (dB)
3. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna. Worst case is y plane and vertical polarization.

40 GHz – 200 GHz

Operation Frequency: Continuous TX Mode

Frequency	Reading	A.F.+C.L.-AMP G +D.F.	ANT. POL	Total	Limit	Margin
[GHz]	[dBμV]	[dB/m]	[H/V]	[dBμV/m]	[dBμV/m]	[dB]
No Critical peaks found						

Note :

1. Total(dBμV/m) = Reading Value(dBm) + AFCL(dB)
2. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna. Worst case is y plane and horizontal polarization.
3. In this test, AFCL factor consists of antenna factor, cable loss, mixer loss, amplifier gain
4. AV: Average

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9 kHz – 30MHz

Operation Mode: Continuous TX Mode

Frequency	Reading	Ant. factor	Cable loss	Ant. POL	Total	Limit	Margin
MHz	dBµV	dB/m	dB	(H/V)	dBµV/m	dBµV/m	dB
No Critical peaks found							

Notes:

1. Measuring frequencies from 9 kHz to the 30MHz.
2. The reading of emissions are attenuated more than 20 dB below the permissible limits or the field strength is too small to be measured.
3. Distance extrapolation factor = 40 log (specific distance / test distance) (dB)
4. Limit line = specific Limits (dBuV) + Distance extrapolation factor
5. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
6. The test results for below 30 MHz is correlated to an open site.
   The result on OFTS is about 2 dB higher than semi-anechoic chamber(10 m chamber)

Below 1 GHz

Operation Mode: Continuous TX Mode

Frequency	Reading	Ant. factor	Cable loss	Ant. POL	Total	Limit	Margin
MHz	dBµV	dB/m	dB	(H/V)	dBµV/m	dBµV/m	dB
No Critical peaks found							

Notes:

1. Measuring frequencies from 30 MHz to the 1 GHz.
2. Radiated emissions measured in frequency range from 30 MHz to 1000 MHz were made with an instrument using Quasi peak detector mode.
3. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.

1 GHz – 18 GHz

Operation Frequency: Continuous TX Mode

Frequency	Reading	A.F.+C.L.-AMP G +D.F.	ANT. POL	Total	Limit	Margin
[GHz]	[dBμV]	[dB/m]	[H/V]	[dBμV/m]	[dBμV/m]	[dB]
No Critical peaks found						

※ A·F: ANTENNA FACTOR
C·L: CABLE LOSS
AMP G: AMPLIFIER GAIN

Notes:

1. Measuring frequencies from 1 GHz to the 5th harmonic of highest fundamental frequency.
2. Measurements above show only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.
3. Radiated emissions measured in frequency above 1000MHz were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column.
4. Total = Reading Value + Antenna Factor + Cable Loss – Amplifier Gain + Distance Factor
5. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.

18 GHz – 40 GHz

Operation Frequency: Continuous TX Mode

Frequency	Reading	A.F.+C.L.-AMP G +D.F.	ANT. POL	Total	Limit	Margin
[GHz]	[dBμV]	[dB/m]	[H/V]	[dBμV/m]	[dBμV/m]	[dB]
No Critical peaks found						

※ A·F: ANTENNA FACTOR
C·L: CABLE LOSS
AMP G: AMPLIFIER GAIN

Note :

1. Total = Reading Value + Antenna Factor + Cable Loss + Distance Factor – Amp Gain
2. Distance extrapolation factor = 20 log (test distance / specific distance) (dB)
3. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna. Worst case is y plane and vertical polarization.

40 GHz – 200 GHz

Operation Frequency: Continuous TX Mode

Frequency	Reading	A.F.+C.L.-AMP G +D.F.	ANT. POL	Total	Limit	Margin
[GHz]	[dBμV]	[dB/m]	[H/V]	[dBμV/m]	[dBμV/m]	[dB]
No Critical peaks found						

Note :

1. Total(dBμV/m) = Reading Value(dBm) + AFCL(dB)
2. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna. Worst case is y plane and horizontal polarization.
3. In this test, AFCL factor consists of antenna factor, cable loss, mixer loss, amplifier gain
4. AV: Average

C0-Left_Ant0, CH 11

9 kHz – 30MHz

Operation Mode: Continuous TX Mode

Frequency	Reading	Ant. factor	Cable loss	Ant. POL	Total	Limit	Margin
MHz	dBµV	dB/m	dB	(H/V)	dBµV/m	dBµV/m	dB
No Critical peaks found							

Notes:

1. Measuring frequencies from 9 kHz to the 30MHz.
2. The reading of emissions are attenuated more than 20 dB below the permissible limits or the field strength is too small to be measured.
3. Distance extrapolation factor = 40 log (specific distance / test distance) (dB)
4. Limit line = specific Limits (dBuV) + Distance extrapolation factor
5. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
6. The test results for below 30 MHz is correlated to an open site.
   The result on OFTS is about 2 dB higher than semi-anechoic chamber(10 m chamber)

Below 1 GHz

Operation Mode: Continuous TX Mode

Frequency	Reading	Ant. factor	Cable loss	Ant. POL	Total	Limit	Margin
MHz	dBµV	dB/m	dB	(H/V)	dBµV/m	dBµV/m	dB
No Critical peaks found							

Notes:

1. Measuring frequencies from 30 MHz to the 1 GHz.
2. Radiated emissions measured in frequency range from 30 MHz to 1000 MHz were made with an instrument using Quasi peak detector mode.
3. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.

1 GHz – 18 GHz

Operation Frequency: Continuous TX Mode

Frequency	Reading	A.F.+C.L.-AMP G +D.F.	ANT. POL	Total	Limit	Margin
[GHz]	[dBμV]	[dB/m]	[H/V]	[dBμV/m]	[dBμV/m]	[dB]
No Critical peaks found						

※ A·F: ANTENNA FACTOR
C·L: CABLE LOSS
AMP G: AMPLIFIER GAIN

Notes:

1. Measuring frequencies from 1 GHz to the 5th harmonic of highest fundamental frequency.
2. Measurements above show only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.
3. Radiated emissions measured in frequency above 1000MHz were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column.
4. Total = Reading Value + Antenna Factor + Cable Loss – Amplifier Gain + Distance Factor
5. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.

18 GHz – 40 GHz

Operation Frequency: Continuous TX Mode

Frequency	Reading	A.F.+C.L.-AMP G +D.F.	ANT. POL	Total	Limit	Margin
[GHz]	[dBμV]	[dB/m]	[H/V]	[dBμV/m]	[dBμV/m]	[dB]
No Critical peaks found						

※ A·F: ANTENNA FACTOR
C·L: CABLE LOSS
AMP G: AMPLIFIER GAIN

Note :

1. Total = Reading Value + Antenna Factor + Cable Loss + Distance Factor – Amp Gain
2. Distance extrapolation factor = 20 log (test distance / specific distance) (dB)
3. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna. Worst case is y plane and vertical polarization.

40 GHz – 200 GHz

Operation Frequency: Continuous TX Mode

Frequency	Reading	A.F.+C.L.-AMP G +D.F.	ANT. POL	Total	Limit	Margin
[GHz]	[dBμV]	[dB/m]	[H/V]	[dBμV/m]	[dBμV/m]	[dB]
No Critical peaks found						

Note :

1. Total(dBμV/m) = Reading Value(dBm) + AFCL(dB)
2. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna. Worst case is y plane and horizontal polarization.
3. In this test, AFCL factor consists of antenna factor, cable loss, mixer loss, amplifier gain
4. AV: Average

8.4 RECEIVER UNWANTED EMISSION

RSS GEN, 7.3 Receiver radiated emissions limits

Radiated emission measurements shall be performed with the receiver antenna connected to the receiver antenna ports. The search for spurious emissions shall be from the lowest frequency internally generated or used in the receiver (e.g. local oscillator, intermediate or carrier frequency), or 30 MHz, whichever is higher; to at least five times the highest tunable or local oscillator frequency, whichever is higher, without exceeding 40 GHz.

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (m)
30 ~ 88	100	3
88 ~ 216	150	3
216 ~ 960	200	3
Above 960	500	3

Note: We tested all antennas of the EUT, but we only included the worst result in this test report.

C0-Left_Ant0, CH 9

30 MHz ~ 1 GHz

Frequency (GHz)	Polarization (H/V)	Measured Value (dBµV)	Ant. Factor (dB/m)	A.G. + C.L. (dB)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Type
No Critical peaks found								

1 GHz ~ 18 GHz

Frequency (GHz)	Polarization (H/V)	Measured Value (dBµV)	Ant. Factor (dB/m)	A.G. + C.L. (dB)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Type
No Critical peaks found								

18 GHz ~ 40 GHz

Frequency (GHz)	Polarization (H/V)	Measured Value (dBµV)	Ant. Factor (dB/m)	A.G. + C.L. (dB)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Type
21.12	H	51.38	37.7	47.68	41.40	54	12.60	AV
21.12	H	57.52	37.7	47.68	47.54	74	26.46	PK

***Note:** Result (dBµV/m) = Measured Value (dBµV) + Ant. Factor (dB/m) – A.G. + C.L. (dB)

C0-Left_Ant0, CH 10

30 MHz ~ 1 GHz

Frequency (GHz)	Polarization (H/V)	Measured Value (dBµV)	Ant. Factor (dB/m)	A.G. + C.L. (dB)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Type
No Critical peaks found								

1 GHz ~ 18 GHz

Frequency (GHz)	Polarization (H/V)	Measured Value (dBµV)	Ant. Factor (dB/m)	A.G. + C.L. (dB)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Type
No Critical peaks found								

18 GHz ~ 40 GHz

Frequency (GHz)	Polarization (H/V)	Measured Value (dBµV)	Ant. Factor (dB/m)	A.G. + C.L. (dB)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Type
21.12	H	51.65	37.7	47.68	41.67	54	12.33	AV
21.12	H	55.68	37.7	47.68	45.70	74	28.30	PK

***Note:** Result (dBµV/m) = Measured Value (dBµV) + Ant. Factor (dB/m) – A.G. + C.L. (dB)

C0-Left_Ant0, CH 11

30 MHz ~ 1 GHz

Frequency (GHz)	Polarization (H/V)	Measured Value (dBµV)	Ant. Factor (dB/m)	A.G. + C.L. (dB)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Type
No Critical peaks found								

1 GHz ~ 18 GHz

Frequency (GHz)	Polarization (H/V)	Measured Value (dBµV)	Ant. Factor (dB/m)	A.G. + C.L. (dB)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Type
No Critical peaks found								

18 GHz ~ 40 GHz

Frequency (GHz)	Polarization (H/V)	Measured Value (dBµV)	Ant. Factor (dB/m)	A.G. + C.L. (dB)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Type
21.12	H	51.36	37.7	47.68	41.38	54	12.62	AV
21.12	H	56.97	37.7	47.68	46.99	74	27.01	PK

***Note:** Result (dBµV/m) = Measured Value (dBµV) + Ant. Factor (dB/m) – A.G. + C.L. (dB)

8.5 FUNDAMENTAL EMISSIONS (FREQUENCY STABILITY)

FCC Rules

§ 15.255(f) Frequency stability.

Fundamental emissions must be contained within the frequency bands specified in this section during all conditions of operation. Equipment is presumed to operate over the temperature range − 20 to + 50 degrees Celsius with an input voltage variation of 85% to 115% of rated input voltage, unless justification is presented to demonstrate otherwise.

ISED Rules

RSS-210, Annex J.6 Transmitter frequency stability

Fundamental emissions shall be contained within the 57-71 GHz frequency band during all conditions of operation when tested at the temperature and voltage variations specified for the frequency stability measurement in RSS-Gen.

RSS-GEN, 6.11 Transmitter frequency stability

For licence-exempt devices, the following conditions apply:

a. at the temperatures of -20°C (-4°F), +20°C (+68°F) and +50°C (+122°F), and at the manufacturer's rated supply voltage
b. at the temperature of +20°C (+68°F) and at ±15% of the manufacturer's rated supply voltage

RSS-GEN, 8.11 Frequency stability

If the frequency stability of the licence-exempt radio apparatus is not specified in the applicable RSS, the fundamental emissions of the radio apparatus should be kept within at least the central 80% of its permitted operating frequency band in order to minimize the possibility of out-of-band operation. In addition, its occupied bandwidth shall be entirely outside the restricted bands and the prohibited TV bands of 54-72 MHz, 76-88 MHz, 174-216 MHz, and 470-602 MHz, unless otherwise indicated.

▣ TEST PROCEDURE

The transmitter output is connected to the Spectrum Analyzer.

RBW = 8 MHz.

VBW = 50 MHz

Detector = Peak

Trace mode = max hold

Sweep = auto couple

Allow the trace to stabilize

The frequency drift was investigated for every 10 °C increment until the unit is stabilized then recorded the reading in tabular format with the temperature range of -10 to 50 °C, declared by the manufacturer.

Voltage supplied to EUT is 12.0 V and reference temperature was done at 20°C.

The voltage was varied in 10.8 V to 13.2 V which manufacturers declare.

Note: We tested all antennas of the EUT, but we only included the worst result in this test report.

▣ TEST RESULTS

Reference: 12 V at 20°c

Voltage	Temp.	Low Frequency	High Frequency	Limit	Result
(V)	(°C)	(GHz)	(GHz)	(GHz)	
12.0	+20(Ref)	57.4499	65.6821	57 ~ 66	Pass
	-10	57.4901	65.6588		Pass
	0	57.5784	65.6899		Pass
	10	57.5741	65.6847		Pass
	30	57.5779	65.6875		Pass
	40	57.5741	65.6867		Pass
	50	57.4136	65.6670		Pass
10.8	20	57.4525	65.6752		Pass
13.2	20	57.4477	65.6825		Pass

Note: C0-Left_Ant0

9. LIST OF TEST EQUIPMENT

Equipment	Model	Manufacturer	Serial No.	Due to Calibration	Calibration Interval
Horn Antenna	BBHA 9170	Schwarzbeck	BBHA9170541	11/16/2023	Biennial
Controller (Antenna mast)	CO3000	Innco system	CO3000-4p	N/A	N/A
Antenna Position Tower	MA4640/800-XP-EP	Innco system	N/A	N/A	N/A
Temperature & Humidity Chamber	PL-4KP	ESPEC	14021890	10/04/2023	Annual
Spectrum Analyzer	FSV40-N	ROHDE & SCHWARZ	101068-SZ	09/07/2023	Annual
Spectrum Analyzer	N9030B	Keysight	MY60070602	10/19/2023	Annual
Spectrum Analyzer	FSW85	Rohde & Schwarz	101256	10/31/2023	Annual
Spectrum Analyzer	FSP40	Rohde & Schwarz	100843	11/08/2023	Annual
Controller	2090	Emco	060520	N/A	N/A
Turn Table	Turn Table	Ets	N/A	N/A	N/A
Loop Antenna	FMZB 1513	Rohde & Schwarz	1513-175	06/04/2023	Biennial
Hybrid Antenna	VULB 9168	Schwarzbeck	9168-0895	08/16/2024	Biennial
Horn Antenna	BBHA 9120D	Schwarzbeck	1298	05/18/2024	Biennial
Horn Antenna	WR-19 Horn Antenna	OML INC.	M19RH-180423-1	03/14/2024	Biennial
Horn Antenna	WR-12 Horn Antenna	OML INC.	M12RH-180423-1	03/14/2024	Biennial
Horn Antenna	WR-08 Horn Antenna	OML INC.	M08RH-180501-1	03/15/2024	Biennial
Horn Antenna	WR-05 Horn Antenna	OML INC.	M05RH-180501-1	03/15/2024	Biennial
Horn Antenna	SAR-2309-15-S2	ERAVANT	08394-01	12/23/2024	Biennial
Harmonic Mixer	WR-19	VDI	SAX 771	03/14/2024	Annual
Harmonic Mixer	WR-12	VDI	SAX 773	03/22/2024	Annual
Harmonic Mixer	WR-15	VDI	SAX 936	07/19/2023	Annual
Harmonic Mixer	WR-08	VDI	SAX 779	03/14/2024	Annual
Harmonic Mixer	WR-05	VDI	SAX 774	03/14/2024	Annual
Source Module	WR-19	OML INC.	S19MS-A-160516-1	07/19/2023	Annual
Source Module	WR-12	OML INC.	S12MS-A-160419-1	07/19/2023	Annual
Source Module	WR-08	OML INC.	S08MS-A-160419-1	09/05/2023	Annual
Source Module	WR-05	OML INC.	S05MS-A-160419-1	07/19/2023	Annual
Signal Generator	SMB100A	Rohde & Schwarz	177633	07/05/2023	Annual
Oscilloscope	RTO2024	Rohde & Schwarz	300090	06/15/2023	Annual
Waveguide Detector	SFD-503753-15SF-P1	ERAVANT	08395-01	01/09/2024	Annual
Low Noise Amplifier	TK-PA1840H	TESTEK	170011-L	10/24/2023	Annual
LNA(0.1 ~ 18 GHz)	FBSR-04C	TNM system	N/A	08/23/2023	Annual
Low Noise Amplifier	LLAU1183540Q	LTC Microwave	100	08/23/2023	Annual
POWER AMP (9 kHz ~ 1 GHz)	310N	SONOMA Instrument	186169	02/15/2024	Annual

Note:

1. Equipment listed above that calibrated during the testing period was set for test after the calibration.
2. Equipment listed above that has a calibration due date during the testing period, the testing is completed before equipment expiration date, or will be tested after the calibration is completed.

10. ANNEX A_ TEST SETUP PHOTO

Please refer to test setup photo file no. as follows;

No.	Description
1	HCT-RF-2303-FI007-P