Test Report No.:
GJWSZ2024-0005-RF

RF Test Report

FCC ID	:	**2BEE6-SUP-WSR550**
EUT	:	**Radar level transmitter**
MODEL	:	**WSR550**
BRAND NAME	:	**N/A**
APPLICANT	:	**Hangzhou Supmea Automation Co.,Ltd.**
Classification of Test	:	**N/A**

CVC Testing Technology (Shenzhen) Co., Ltd.

Applicant	**Name : Hangzhou Supmea Automation Co.,Ltd.** **Address :Room No.526, 5th floor, Building 4, Singapore-Hangzhou Science &Technology Park, Hangzhou, China**
Manufacturer	**Name : Hangzhou Supmea Automation Co.,Ltd.** **Address :Room No.526, 5th floor, Building 4, Singapore-Hangzhou Science &Technology Park, Hangzhou, China**
Factory	**Name : Hangzhou Supmea Automation Co., Ltd.** **Address :No.369, Kechuang Road,Gaoqiao Street(Development Zone) ,TongxiangCity,Jiaxing City, Zhejiang Province**
Equipment Under Test	**Name :Radar level transmitter** **Model/Type:SUP-WSR550** **Trade mark : N/A** **Serial NO.:N/A** **Sampe NO.:2-1**

Date of Receipt.	**2024.01.04**	Date of Testing	**2024.01.04～2024.01.23**

Test Specification	**Test Result**
FCC Part 15, Subpart C (15.256)	PASS

Evaluation of Test Result	The equipment under test was found to comply with the requirements of the standards applied. Seal of CVC **Issue Date: 2024.01.24**

Tested by:	Tested by:	Approved by:
Liang Jiatong	Huang Meng	Dong Sanbi
Name Signature	Name Signature	Name Signature

Other Aspects: NONE.

Abbreviations:OK, Pass= passed Fail = failed N/A= not applicable EUT= equipment, sample(s) under tested

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RELEASE CONTROL RECORD

ISSUE NO.	REASON FOR CHANGE	DATE ISSUED
GJWSZ2024-0005-RF	Original release	2024.01.24

1 SUMMARY OF TEST RESULTS

The EUT has been tested according to the following specifications:

APPLIED STANDARD: FCC Part 15.256			
STANDARD SECTION	**TEST TYPE AND LIMIT**	**RESULT**	**REMARK**
15.207	AC Power Conducted Emission	N/A	DC power supply
15.256(h)	Unwanted emissions	PASS	See section 3.2
15.256(f)	Fundamental bandwidth	PASS	See section 3.3
---	Occupied Bandwidth Measurement	Report only	See section 3.3
15.256(g)	Fundamental emissions limits	PASS	See section 3.4
15.215(c)	Frequency stability	PASS	See section 3.5
15.256(i)	Antenna beamwidth	PASS	See section 3.6
15.256(j)	Antenna side lobe gain	PASS	See section 3.6

1.1 LIST OF TEST AND MEASUREMENT INSTRUMENTS

Equipment	Manufacturer	Model No.	Serial Number	Cal. interval	Cal. Due
Radiation Spurious(1GHz-40GHz)					/
Signal&Spectrum Analyzer	Rohde&Schwarz	FSV 40	101898	1 year	2024.5.21
EMI Test Receiver	Rohde&Schwarz	ESR3	102693	1 year	2024.5.25
Antenna(30MHz~1001MHz)	SCHWARZBECK	VULB 9168	1133	1 year	2024.2.21
Horn antenna(1GHz-18GHz)	ETS	3117	227611	1 year	2024.3.25
Horn antenna(18GHz-40GHz)	QMS	QMS-00880	22051	1 year	2024.3.25
3m anechoic chamber	MORI	966	CS0300011	3 year	2026.5.18
Filter group(RSE-BT/WiFi)	Rohde&Schwarz	WiFi /BT Variant 1	100820	1 year	2024.5.21
Filter group(RSE-Cellular)	Rohde&Schwarz	Cellular Variant 1	100768	1 year	2024.5.21
Preamplifier(10kHz-1GHz)	Rohde&Schwarz	SCU-01F	100299	1 year	2024.5.21
Preamplifier(1GHz-18GHz)	Rohde&Schwarz	SCU-18F	100799	1 year	2024.5.21
Preamplifier(1GHz-18GHz)	Rohde&Schwarz	SCU-18F	100801	1 year	2024.5.21
Preamplifier(18Gz-40GHz)	Rohde&Schwarz	SCU-40A	101209	1 year	2024.5.21
#2 control room	MORI	433	CS0300028	3 year	2024.5.21
Temperature and humidity meter	/	C193561517	C193561517	1 year	2024.5.21
Radiation Spurious(Below 1GHz)					/
EMI Test Receiver	Rohde&Schwarz	ESR 26	101718	1 year	2024.5.25
Loop antenna（8.3k~30MHz）	Rohde&Schwarz	HFH2-Z2E	100951	1 year	2024.5.26
Antenna(30MHz~1000MHz)	SCHWARZBECK	VULB 9168	1132	1 year	2024.2.14
3m anechoic chamber	MORI	966	CS0200019	3 year	2026.5.18
Attenuator	/	SJ-5dB	607684	1 year	2024.2.21
#1 control room	MORI	433	CS0300028	3 year	2026.5.16
Temperature and humidity meter	/	C193561473	CS0200071	1 year	2024.5.21
Conducted emission					/
EMI Test Receiver	Rohde&Schwarz	ESR3	102694	1 year	2024.5.25
limiter（10 dB）	Rohde&Schwarz	ESH3-Z2	102824	1 year	2024.5.16
Voltage probe	Rohde&Schwarz	CVP9222C	28	1 year	2024.5.16
Current probe	Rohde&Schwarz	EZ-17	101442	1 year	2024.5.21
ISN network	Rohde&Schwarz	ENV 81	100401	1 year	2024.5.16
ISN network	Rohde&Schwarz	ENV 81 Cat6	101896	1 year	2024.5.16
LISN（single-phase ）	Rohde&Schwarz	ENV216	102569	1 year	2024.4.11
#1Shielding room	MORI	854	N/A	3 year	2026.5.16
Radiation Spurious(Above 40GHz)					/
Equipment	**Manufacturer**	**Model No.**	**Serial Number**	**Cal. interval**	**Cal. Due**
3m anechoic chamber	MORI	966	CS0300011	3 year	2026.5.18
#2 control room	MORI	433	CS0300028	3 year	2024.5.21
Temperature and humidity meter	/	C193561517	C193561517	1 year	2024.5.21
Signal&Spectrum Analyzer	keysight	N9040B	CS0300074	1 year	2024.9.24
SA Expansion Module(40-60GHz)	VDI	N9029AV19	CS0300075	3 year	2025.9.14
SA Expansion Module(60-90GHz)	VDI	N9029AV12	CS0300076	3 year	2025.9.14
SA Expansion Module(90-140GHz)	VDI	N9029AV08	CS0300077	3 year	2025.9.14
SA Expansion Module(140-220GHz)	VDI	N9029AV05	CS0300078	3 year	2025.9.14
SA Expansion Module(220-330GHz)	VDI	N9029AV03	CS0300079	3 year	2025.9.14
Horn antenna(40-60GHz)	CMI	HO19R	CS0300086	3 year	2025.9.14
Horn antenna(60-90GHz)	CMI	HO12R	CS0300088	3 year	2025.9.14
Horn antenna(90-140GHz)	CMI	HO08R	CS0300090	3 year	2025.9.14
Horn antenna(140-220GHz)	CMI	HO05R	CS0300092	3 year	2025.9.14
Horn antenna(220-330GHz)	CMI	HO03R	CS0300094	3 year	2025.9.14

1.2 MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

Measurement Uncertainty		
No.	**Item**	**Measurement Uncertainty**
1	Occupied Channel Bandwidth	±1.86%
	Radiated Emission (9kHz-30MHz)	+/-5.6 dB
2	Radiated Emissions(30MHz-1GHz)	±5.0dB
3	Radiated Emissions(1GHz-18GHz)	±4.8dB
4	Radiated Emissions(18GHz-40GHz)	±5.1dB
5	Radiated Emissions(40GHz-60GHz)	±4.8dB
6	Radiated Emissions(60GHz-90GHz)	±4.8dB
7	Radiated Emissions(90GHz-140GHz)	±5.0dB
8	Radiated Emissions(140GHz-220GHz)	±5.1dB
9	Radiated Emissions(220GHz-300GHz)	±4.8dB
10	Temperature	±0.73°C
11	Supply voltages	±0.37 %
12	Humidity	±3.9 %
Remark: 95% Confidence Levels, k=2.		

1.3 TEST LOCATION

The tests and measurements refer to this report were performed by EMC testing Lab. of CVC Testing Technology (Shenzhen) Co., Ltd.

Lab Address: No. 1301, Guanguang Road, Xinlan Community, Guanlan Street, Longhua District, Shenzhen City, Guangdong Province 518110 P.R.China
Post Code：518110 Tel：0755-23763060-8805
Fax：0755-23763060 E-mail：sz-kf@cvc.org.cn
FCC(Test firm designation number：CN1363)
IC(Test firm CAB identifier number：CN0137)
CNAS(Test firm designation number：L16091)

2 GENERAL INFORMATION

2.1 GENERAL PRODUCT INFORMATION

PRODUCT	Radar level transmitter
BRAND	N/A
TEST MODEL	SUP-WSR550
ADDITIONAL MODEL	N/A
POWER SUPPLY	DC 24V
MODULATIONTECHNOLOGY	FMCW
FREQUENCY RANGE	76GHz-79.3GHz
PEAK OUTPUT POWER	23.83dBm (Maximum)
ANTENNA TYPE(Note 3)	PCB Antenna with gain 27.5dBi
I/O PORTS	Refer to user's manual
CABLE SUPPLIED	N/A

Note:

1. For more detailed features description, please refer to the manufacturer's specifications or the User's Manual.
2. For the test results, the EUT had been tested with all conditions. But only the worst case was shown in test report.
3. Since the above data and/or information is provided by the client, CVC is not responsible for the authenticity, integrity and results of the data and information and/or the validity of the conclusion.

2.2 GENERAL DESCRIPTION OF APPLIED STANDARDS

The EUT is a RF product, according to the specifications of the manufacturers. It must comply with the requirements of the following standards:

FCC PART 15, Subpart C. Section 15.256
ANSI C63.10-2020
TCBC Workshop(2023.10.25) Part 15.255 Rules Amendment
Keysight Application Note 5952-1039

All test items have been performed and recorded as per the above standards.

2.3 DESCRIPTION OF SUPPORT UNITS

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

Support Equipment					
NO	**Description**	**Brand**	**Model No.**	**Serial Number**	**Supplied by**
1	Laptop	Lenovo	K4e-ARE120	MP20kshe	Lab

Support Cable							
NO	**Description**	**Quantity (Number)**	**Length (cm)**	**Detachable (Yes/ No)**	**Shielded (Yes/ No)**	**Cores (Number)**	**Supplied by**

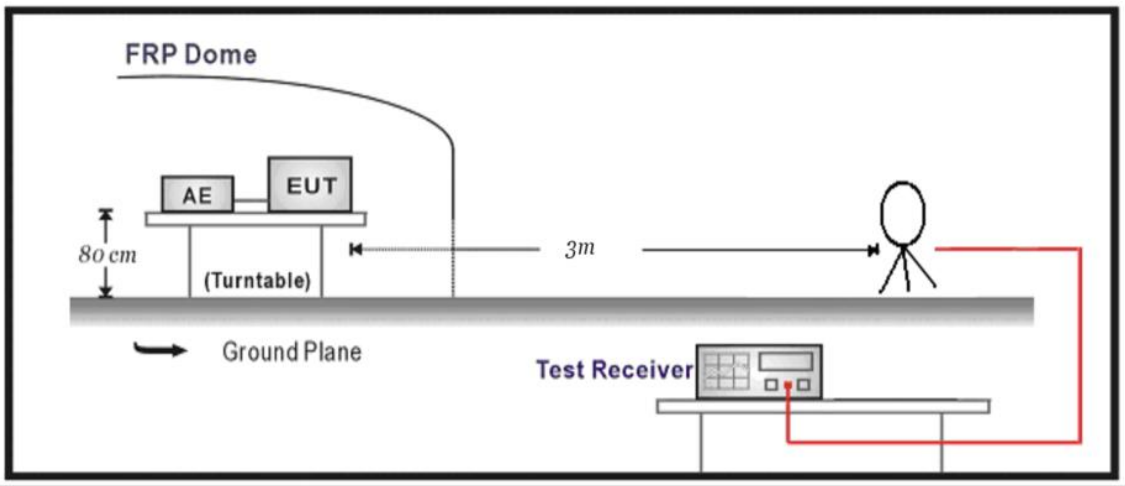
2.4 FAR FIELD CONDITION FOR FREQUENCY ABOVE 18GHZ

The equipment under test was transmitting while connected to its integral antenna and is placed on a turn table.The measurement antenna is in the far field of the EUT per formula $2D^2/\lambda$ where D is the larger between the dimension of the measurement antenna and the transmitting antenna of the EUT. In this case, "D" is the largest dimension of the measurement antenna. The EUT is manipulated through all orthogonal planes representative of its typical use to achieve the highest reading on the receive spectrum analyzer.

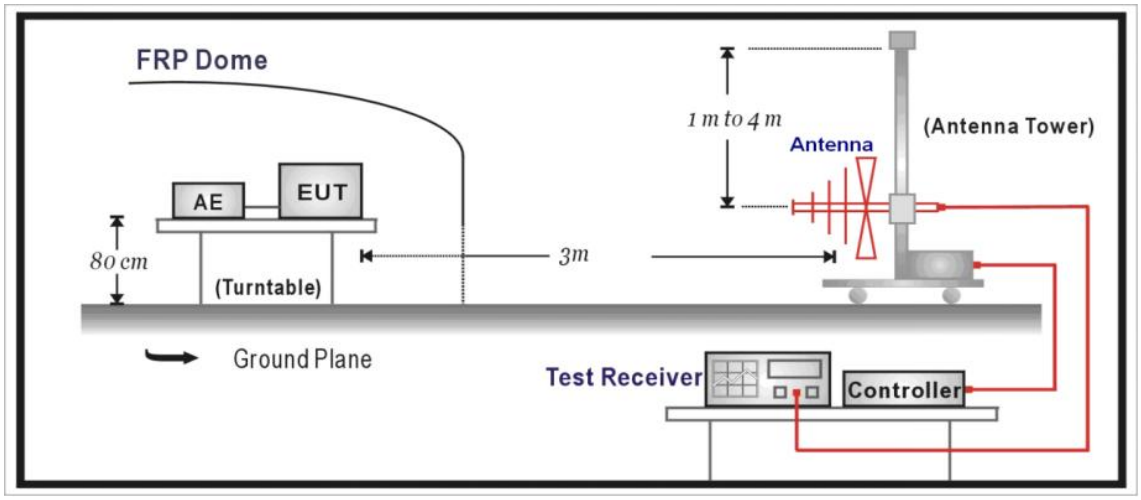
HornAntenna	Frequency (GHz)	Antenna Dimension A(mm)	Wavelength (λ)(m)	Far field R(m)>=$2D^2/\lambda$	Measurement Distance(D)(m)
QMS-00880	18	0.08	0.0167	0.77	3
	40	0.08	0.0075	1.71	
HO19R	40	0.046	0.0075	0.56	1
	60	0.046	0.005	0.85	
HO12R	60	0.03	0.005	0.36	1
	90	0.03	0.0033	0.55	
HO8R	90	0.019	0.0033	0.22	1
	140	0.019	0.0021	0.34	
HO5R	140	0.012	0.0021	0.14	1
	220	0.012	0.0014	0.21	
HO3R	220	0.008	0.0014	0.09	1
	330	0.008	0.0009	0.14	

2.5 RADIATED TEST SETUP

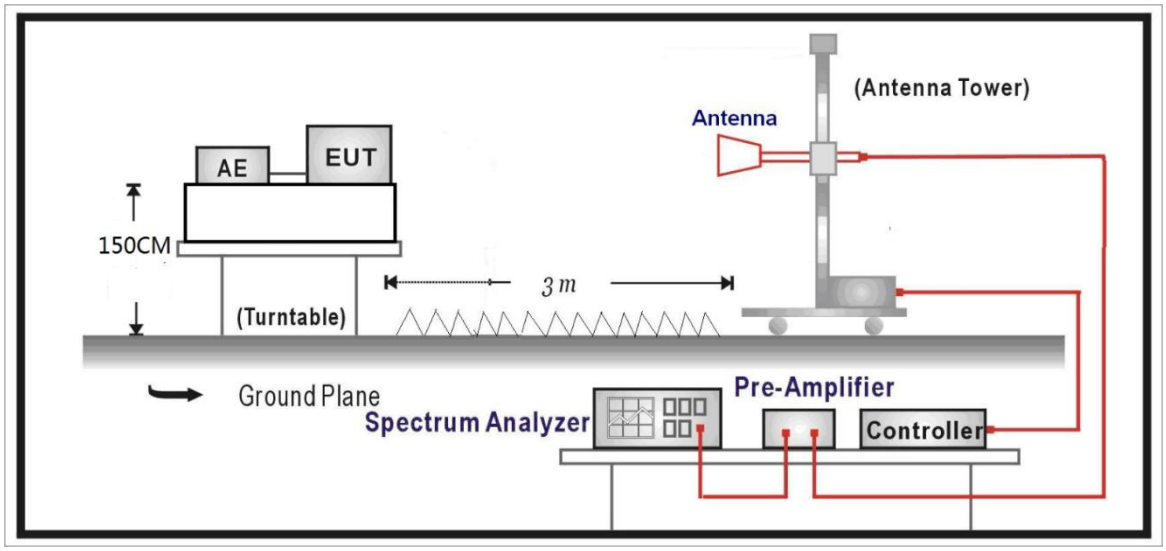
Below 30MHz Test Setup:



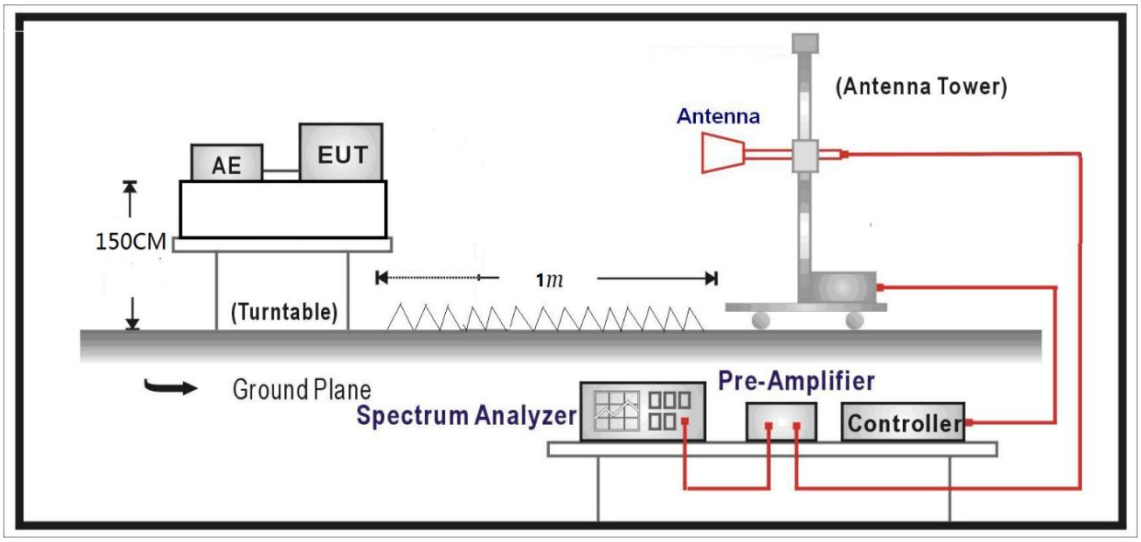
30MHz-1GHz Test Setup:



1GHz -40GHz Test Setup:



Above 40GHz Test Setup:



3 TEST TYPES AND RESULTS

3.1 CONDUCTED EMISSION MEASUREMENT

3.1.1 Limit

Frequency (MHz)	Conducted Limits(dBμV)	
	Quasi-peak	Average
0.15 - 0.5	66 to 56 *	56 to 46*
0.5 - 5	56	46
5 - 30	60	50
NOTE: 1. The lower limit shall apply at the transition frequencies. NOTE: 2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.		

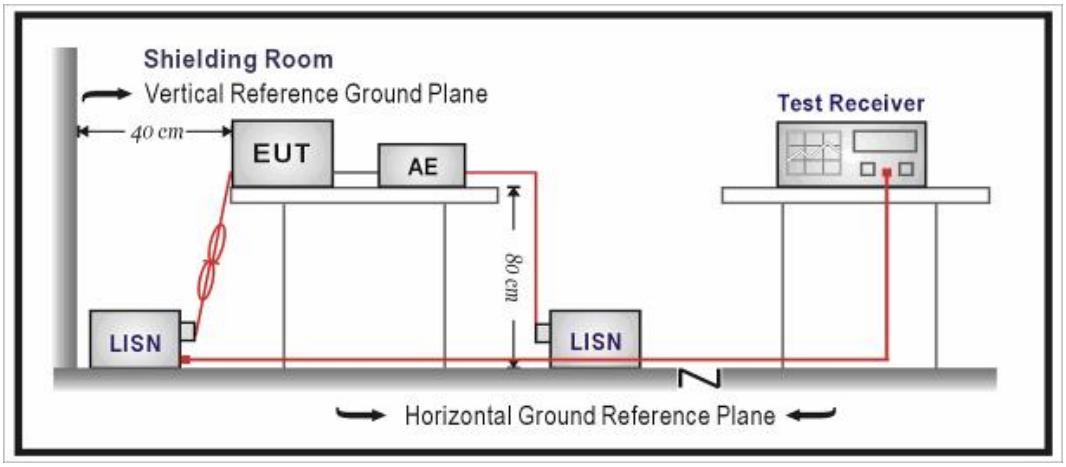
3.1.2 Measurement procedure

a. The EUT was placed on a platform of nominal size, 1 m by 1.5 m, raised 80 cm above the conducting ground plane. The vertical conducting plane was located 40 cm to the rear of the EUT. All other surfaces of EUT were at least 80 cm from any other grounded conducting surface. The EUT and simulators are connected to the main power through a line impedance stabilization network (LISN). The LISN provides a 50 ohm /50uH coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN. (Please refer to the Test photographs) Each current-carrying conductor of the EUT power cord, except the ground (safety) conductor, was individually connected through a LISN to the input power source.The equipment under test shall be placed on a support of non-metallic material, the height of which shall be1.5m above the ground,

b. The excess length of the power cord between the EUT and the LISN receptacle were folded back and forth at the center of the lead to form a bundle not exceeding 40 cm in length.

c. Conducted emissions were investigated over the frequency range from 0.15MHz to 30MHz using a receiver bandwidth of 9 kHz.

3.1.3 Test setup



3.1.4 Test results

N/A, DC power supply

3.2 TRANSMITTER SPURIOUS EMISSIONS MEASUREMENT

3.2.1 Limit

Radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a).

FREQUENCIES (MHz)	FIELD STRENGTH (Microvolts/Meter)	MEASUREMENT DISTANCE (Meters)
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

NOTE: 1. The lower limit shall apply at the transition frequencies.
NOTE: 2. Emission level (dBuV/m) = 20 log Emission level (uV/m).
NOTE: 3. As shown in 15.35(b), for frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20dB under any condition of modulation.

3.2.2 Measurement procedure

Measurement of harmonic and spurious emissions below 40 GHz

a. The EUT was placed on the top of a rotating table 1.5 meters(above 1GHz) and 0.8 meters(below 1GHz) above the ground at a 3 meters semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
c. For below 1GHz was used bilog antenna, and above 1GHz was used horn antenna, and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
f. For below 30MHz, a loop antenna with its vertical plane is place 3m from the EUT and rotated about its vertical axis for maximum response at each azimuth about the EUT. And the centre of the loop shall be 1m above the ground.
g. During the test, each emission was maximized by: having the EUT continuously working, investigated all operating modes, rotated about all 3 axis (X, Y & Z) and considered typical configuration to obtain worst position, manipulating interconnecting cables, For battery operated equipment, the equipment tests shall be perform using fresh batteries. The turntable was rotated to maximize the emission level.

NOTE:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and video bandwidth is 3MHz for Peak detection at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is ⩾ 1/T (Duty cycle < 98%) or 10Hz(Duty cycle > 98%) for Average detection (AV) at frequency above 1GHz.
4. All modes of operation were investigated and the worst-case emissions are reported.
5. The testing of the EUT was performed on all 3 orthogonal axes; the worst-case test configuration was reported on the file test setup photo.

Measurement of harmonic and spurious emissions above 40 GHz

a. Connect the test antenna covering the appropriate frequency range to a spectrum analyzer via an external mixer.
b. Set spectrum analyzer RBW = 1MHz, VBW = 3MHz, peak/average detector.
c. Maximize all observed emissions. Note the maximum power indicated on the spectrum analyzer. Adjust this reading, if necessary, by the conversion loss of the external mixer used at the frequency under investigation and the external mixer IF cable loss.
d. Calculate the maximum field strength of the emission at the measurement distance
e. Calculate the power density at the distance specified by the limit from the field strength at the distance specified by the limit
f. Repeat the preceding sequence for every emission observed in the frequency band under investigation.

3.2.3 Test setup

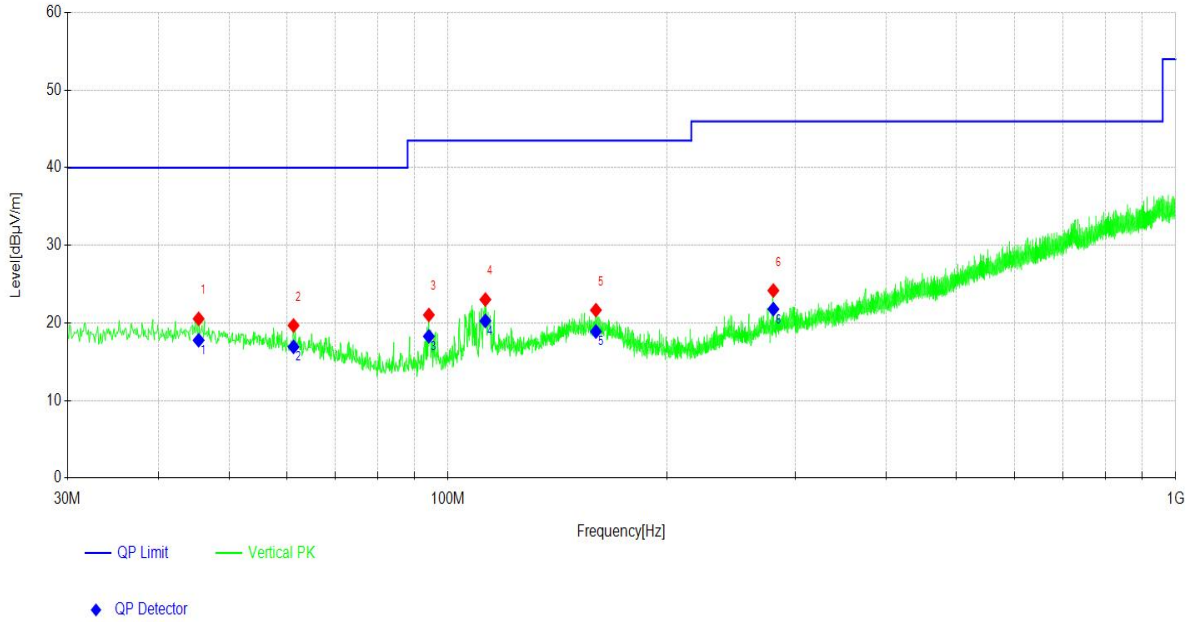
See section 2.5 of this report.

3.2.4 Test results(9kHz-30MHz)

The amplitude of spurious emissions attenuated more than 20 dB below the permissible value is not required to be report.

3.2.5 Test results(30MHz-1GHz)-SHOWING THE HIGHEST VALUE, "WORST CASE"

Center Frequency	77.5GHz	Frequency Range	30MHz-1000MHz



Suspected Data List									
NO.	Freq. [MHz]	Reading [dBµV]	Factor [dB/m]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	45.425	1.62	18.91	20.53	40.00	19.47	200	336	Vertical
2	61.334	2.15	17.52	19.67	40.00	20.33	100	257	Vertical
3	94.123	6.34	14.69	21.03	43.50	22.47	300	73	Vertical
4	112.555	6.94	16.08	23.02	43.50	20.48	200	147	Vertical
5	159.702	2.52	19.13	21.65	43.50	21.85	300	2	Vertical
6	279.994	6.16	18.02	24.18	46.00	21.82	100	104	Vertical

Remark: 1. Level (dBuV/m) = Reading (dBuV) + Factor (dB/m).
2. Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB).
3. Margin(dB) = Limit[dBµV/m] - Level [dBµV/m]

3.2.6 Test results(1GHz-40GHz)- SHOWING THE HIGHEST VALUE, "WORST CASE"

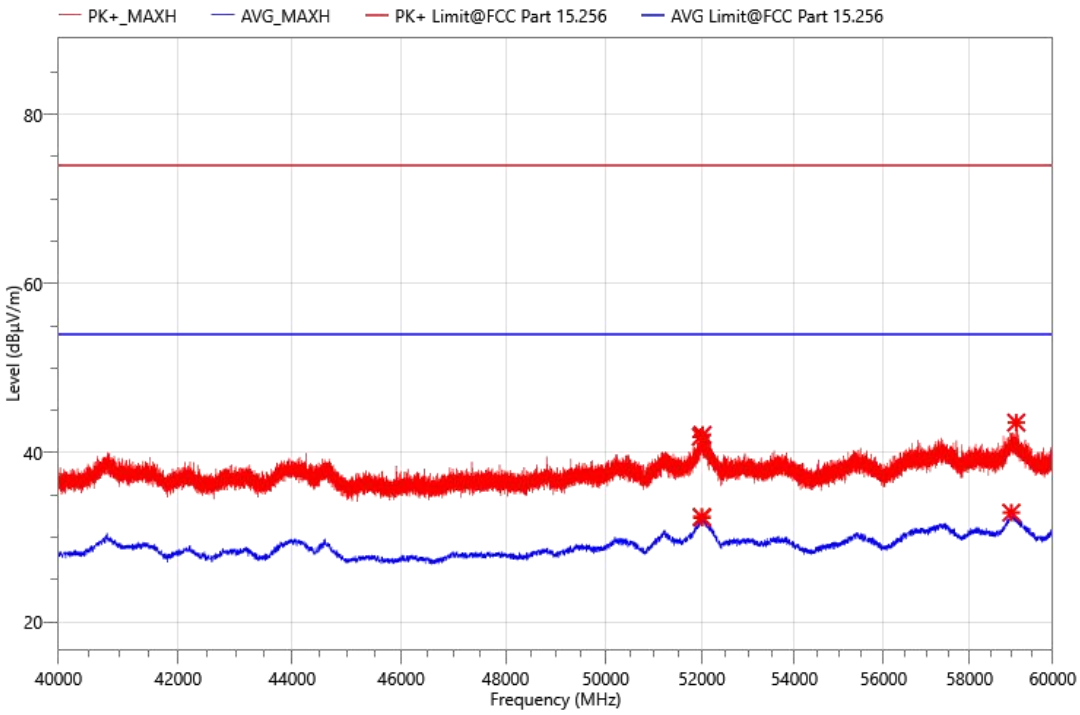
Center Frequency	77.5GHz	Frequency Range	1-40GHz

Data List								
NO.	Freq. [MHz]	Reading [dBμV]	Factor [dB/m]	Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Detector	Polarity
1	5381.52	35.55	13.37	48.92	54.00	5.08	AV	Vertical
2	5407.59	44.41	13.65	58.06	74.00	15.94	PK	Vertical
3	6204.62	44.78	14.53	59.31	74.00	14.69	PK	Vertical
4	6288.12	35.05	15.48	50.53	54.00	3.47	AV	Vertical
5	16943.38	13.97	25.59	39.56	54.00	14.44	AV	Vertical
6	16964.45	23.12	25.92	49.04	74.00	24.96	PK	Vertical
7	35531.35	57.61	-1.20	56.41	68.20	11.79	PK	Vertical
8	36314.63	48.82	-0.25	48.57	54.00	5.43	AV	Vertical
9	37025.30	47.84	1.12	48.96	54.00	5.04	AV	Vertical
10	37058.31	55.85	1.03	56.88	68.20	11.32	PK	Vertical
11	39788.78	55.31	2.41	57.72	68.20	10.48	PK	Vertical
12	39821.78	46.85	2.45	49.30	54.00	4.70	AV	Vertical

Remark: 1. The emission levels of other frequencies were greater than 20dB margin.
2. Level (dBuV/m) = Reading (dBuV) + Factor (dB/m).
3. Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB).
4. Margin(dB) = Limit(dBuV/m) - Level (dBuV/m)

3.2.7 Test results(40GHz-200GHz)-SHOWING THE HIGHEST VALUE, "WORST CASE"

Center Frequency	77.5GHz	Frequency Range	40-60GHz

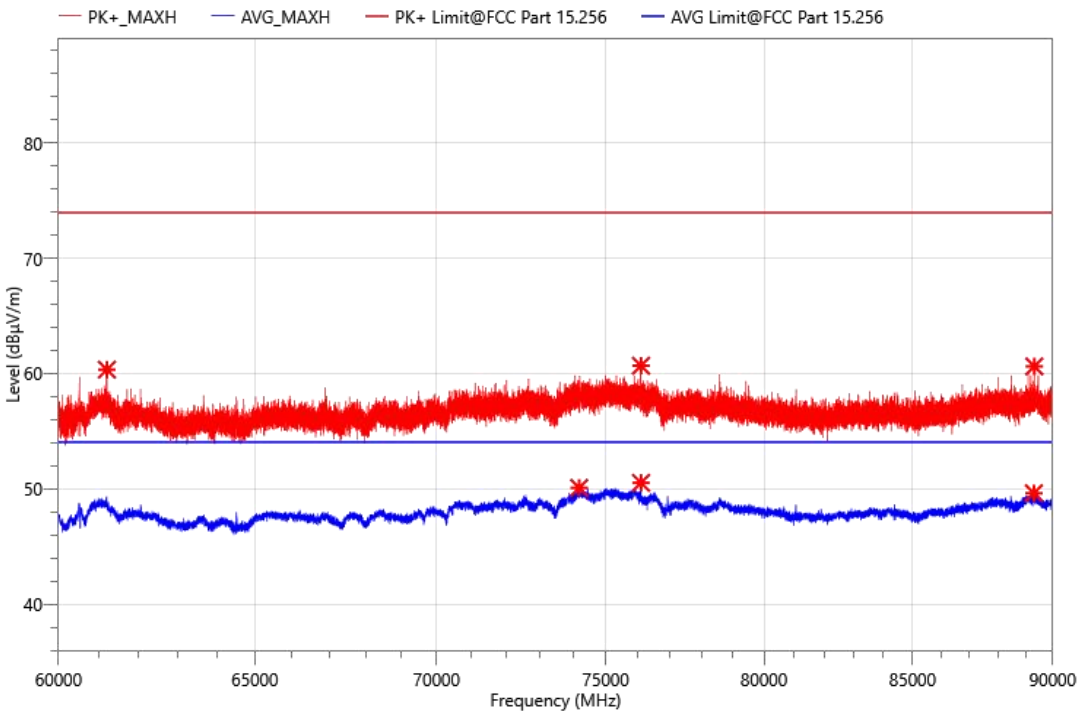


Freq. (MHz)	Reading (dBµV)	Meas. (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Det.	Pol.	Corr. (dB/m)
61194	11.8	41.88	74.00	32.12	PK+	V	30.08
74192.25	2.17	32.42	54.00	21.58	AVG	V	30.25
76086	2.09	32.33	54.00	21.67	AVG	V	30.24
76087.5	11.93	42.12	74.00	31.88	PK+	V	30.19
89310.75	2.17	32.92	54.00	21.08	AVG	V	30.75
89327.25	13.33	43.57	74.00	30.43	PK+	V	30.24

Note:

1. Meas.(dBµV/m) = Reading@1m(dBµV) + Corr.(dB/m)
2. Corr.(dB/m) = Cable Loss (dB) + Antenna Factor (dB/m) + Mixer Conversion Loss (dB) + Distance extrapolation factor(dB)
3. Distance extrapolation factor(dB) = 20*log(specific distance/test distance)
4. Margin(dB) = Limit(dBµV/m) - Meas.(dBµV/m)

Center Frequency	**77.5GHz**	**Frequency Range**	60-90GHz

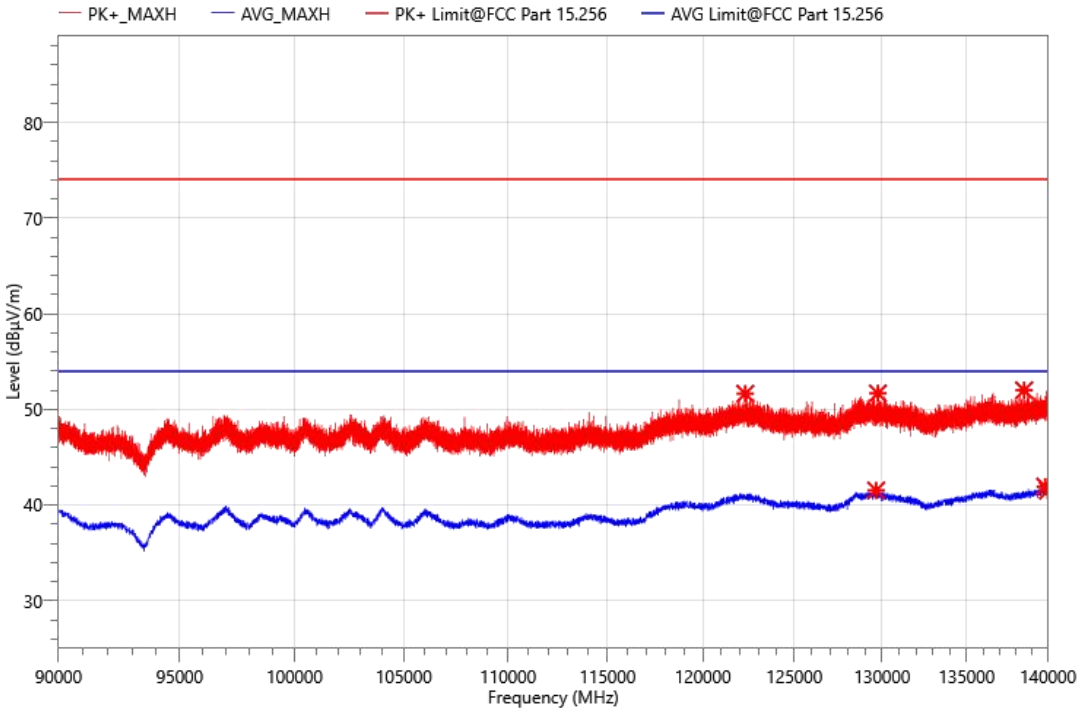


Freq. (MHz)	Reading (dBµV)	Meas. (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Det.	Pol.	Corr. (dB/m)
61194	27.21	60.34	74.00	13.66	PK+	V	33.13
74192.25	16.37	50.08	54.00	3.92	AVG	V	33.71
76086	26.74	60.68	74.00	13.32	PK+	V	33.94
76087.5	16.58	50.52	54.00	3.48	AVG	V	33.94
89310.75	14.52	49.62	54.00	4.38	AVG	V	35.1
89327.25	25.51	60.62	74.00	13.38	PK+	V	35.11

Note:

1. Meas.(dBµV/m) = Reading@1m(dBµV) + Corr.(dB/m)
2. Corr.(dB/m) = Cable Loss (dB) + Antenna Factor (dB/m) + Mixer Conversion Loss (dB) + Distance extrapolation factor(dB)
3. Distance extrapolation factor(dB) = 20*log(specific distance/test distance)
4. Margin(dB) = Limit(dBµV/m) - Meas.(dBµV/m)

Center Frequency	**77.5GHz**	**Frequency Range**	90-140GHz

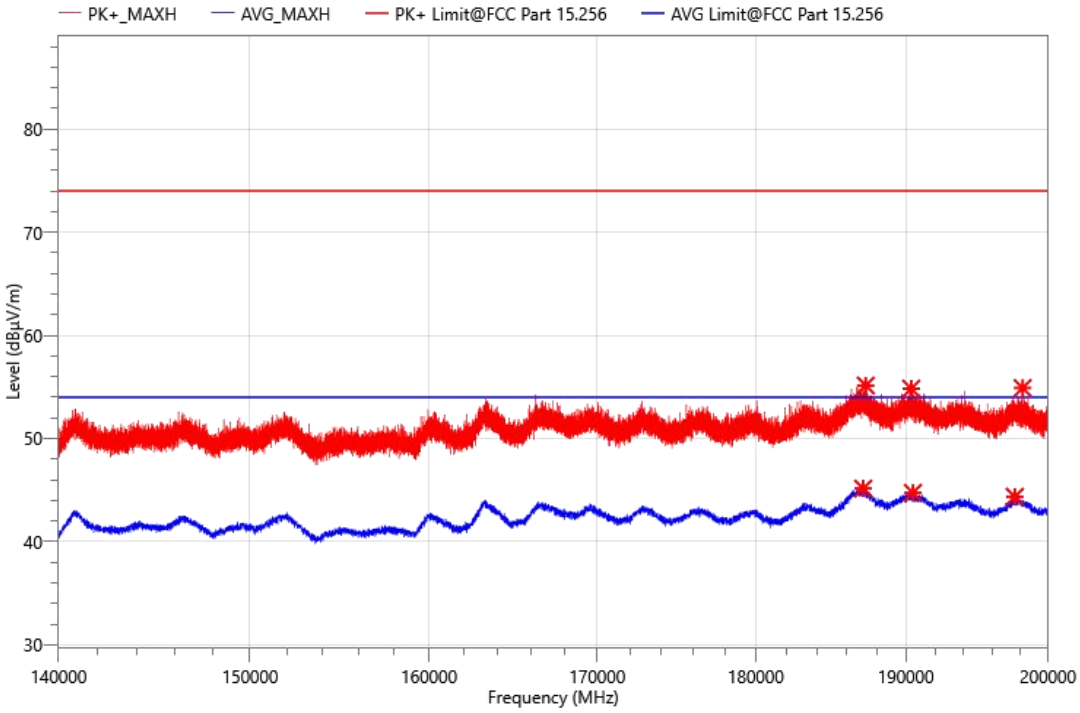


Freq. (MHz)	Reading (dBµV)	Meas. (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Det.	Pol.	Corr. (dB/m)
122298.7	12.76	51.63	74.00	22.37	PK+	V	38.87
129658.7	2.46	41.52	54.00	12.48	AVG	V	39.06
129757.5	12.64	51.67	74.00	22.33	PK+	V	39.03
138517.5	12.87	51.99	74.00	22.01	PK+	V	39.12
139826.2	2.43	41.92	54.00	12.08	AVG	V	39.49
140000	1.94	41.5	54.00	12.5	AVG	V	39.56

Note:

1. Meas.(dBµV/m) = Reading@1m(dBµV) + Corr.(dB/m)
2. Corr.(dB/m) = Cable Loss (dB) + Antenna Factor (dB/m) + Mixer Conversion Loss (dB) + Distance extrapolation factor(dB)
3. Distance extrapolation factor(dB) = 20*log(specific distance/test distance)
4. Margin(dB) = Limit(dBµV/m) - Meas.(dBµV/m)

Center Frequency	**77.5GHz**	**Frequency Range**	140-200GHz



Freq. (MHz)	Reading (dBµV)	Meas. (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Det.	Pol.	Corr. (dB/m)
187112	2.32	45.15	54.00	8.85	AVG	V	42.83
187283	12.4	55.14	74.00	18.86	PK+	V	42.74
190382	12.49	54.84	74.00	19.16	PK+	V	42.35
190493	2.41	44.74	54.00	9.26	AVG	V	42.33
197621	2.42	44.36	54.00	9.64	AVG	V	41.94
198177.5	13.16	54.9	74.00	19.1	PK+	V	41.74

Note:

1. Meas.(dBµV/m) = Reading@1m(dBµV) + Corr.(dB/m)
2. Corr.(dB/m) = Cable Loss (dB) + Antenna Factor (dB/m) + Mixer Conversion Loss (dB) + Distance extrapolation factor(dB)
3. Distance extrapolation factor(dB) = 20*log(specific distance/test distance)
4. Margin(dB) = Limit(dBµV/m) - Meas.(dBµV/m)

3.3 BANDWIDTH MEASUREMENT

3.3.1 Limits

According to §15.256 (f)

The fundamental bandwidth of an LPR emission is defined as the width of the signal between two points, one below and one above the center frequency, outside of which all emissions are attenuated by at least 10 dB relative to the maximum transmitter output power when measured in an equivalent resolution bandwidth.

3.3.2 Measurement procedure

10DB BANDWIDTH MEASUREMENT PARAMETER	
Detector:	Peak
Resolution bandwidth:	1 MHz
Video bandwidth:	3 MHz
Trace-Mode:	Max Hold
Sweep	Auto couple.

99% OCCUPIED BANDWIDTH MEASUREMENT PARAMETER	
Detector:	Peak
Resolution bandwidth:	8 MHz (The analyzer limits maximum RBW at 8 MHz.)
Video bandwidth:	50 MHz
Trace-Mode:	Max Hold
Sweep	Auto couple.

Measurement procedures:Bandwidth: ANSI C63.10-2013 6.9 / 9.3

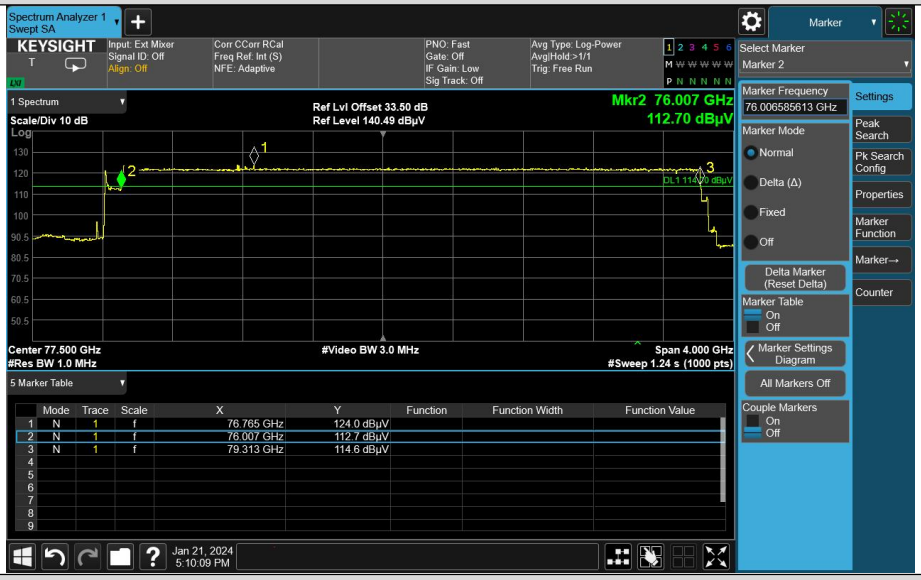
Measure the maximum width of the emission that is constrained by the frequencies associated with the two amplitude points (upper and lower)

3.3.3 Test setup See section 2.5 of this report.

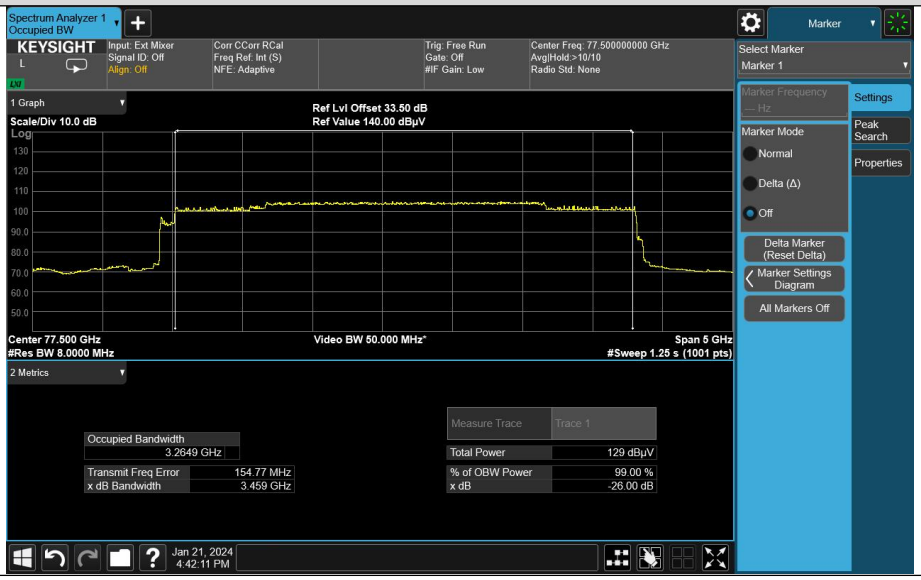
3.3.4 Test results

Center Frequency (GHz)	99% Occupied Bandwidth (GHz)	10dB Bandwidth (GHz)	10dB Bandwidth Minimum limit(MHz)
77.5	3.2649	3.306	50
10dB Bandwidth Lower(GHz)	**10dB Bandwidth Upper(GHz)**	**Lower limit (GHz)**	**Upper limit (GHz)**
76.007	79.313	75	85
Verdict	**Pass**		

10dB Bandwidth



99% Occupied Bandwidth



3.4 EIRP POWER MEASUREMENT

3.4.1 Limits

According to §15.256 (g)

(1) All emission limits provided in this section are expressed in terms of Equivalent Isotropic Radiated Power (EIRP).
(2) The EIRP level is to be determined from the maximum measured power within a specified bandwidth.
(i) The EIRP in 1 MHz is computed from the maximum power level measured within any 1 MHz bandwidth using a power averaging detector;
(ii) The EIRP in 50 MHz is computed from the maximum power level measured with a peak detector in a 50- MHz bandwidth centered on the frequency at which the maximum average power level is realized and this 50 MHz bandwidth must be contained within the authorized operating bandwidth. For a RBW less than 50 MHz, the peak EIRP limit (in dBm) is reduced by 20 log(RBW/50) dB where RBW is the resolution bandwidth in megahertz. The RBW shall not be lower than 1 MHz or greater than 50 MHz. The video bandwidth of the measurement instrument shall not be less than the RBW. If the RBW is greater than 3 MHz, the application for certification filed shall contain a detailed description of the test procedure, calibration of the test setup, and the instrumentation employed in the testing.
(3) The EIRP limits for LPR operations in the bands authorized by this rule section are provided in Table below. The emission limits in Table below are based on boresight measurements (i.e., measurements performed within the main beam of an LPR antenna).

Frequency band of Operation	Average emission limit (EIRP in dBm measured in 1 MHz)	Peak emission limit (EIRP in dBm measured in 50 MHz)
5.925 to 7.250GHz	-33dBm	+7dBm
24.05 to 29.00GHz	-14dBm	+26dBm
75.00 to 85.00GHz	-3dBm	+34dBm

3.4.2 Measurement procedure

Test Settings
1. Radiated power measurements are performed using the signal analyzer's swept mode measurement capability for signals with continuous operation.
2. RBW = 1MHz
3. VBW ≥ 3 x RBW
4. Span as required, enough to observe the fundamental spike around 77.5 GHz
5. No. of sweep points ≥ 2 x span / RBW
6. Detector and Trace mode = Suitable for peak and average measurements respectively over 100 sweeps
7. The trace was allowed to stabilize

Method of measurement:
Refer as TCBC Workshop(2023.10.25) Part 15.255 Rules Amendment

FMCW desensitization factor:
Desensitization factor and sweep time considerations for measurements of FMCW signals in ANSI C63.10-2020 Annex L
The derivation of the FMCW desensitization factor is given in Keysight Application Note 5952-1039 Appendix B.

3.4.3 Test setup

See section 2.5 of this report.

3.4.4 Test results

According to the manufacturer’s declaration, the parameter of the FMCW modulation as below:

Sweep time (T_s) (us)	Sweep width(F_s) (MHz)	3 dB IF bandwidth (MHz)	Cycle time (us)
612.3	3306	1	1241000

PK POWER

Center Frequency (GHz)	Level@ 1m (dBuV/m)	Power (dBm)	Desensitization factor(dB)	Peak EIRP (dBm)	Peak EIRP Limit(dBm)	Marin (dB)	Verdict
77.5	124.48	19.71	4.12	23.83	34	10.71	PASS

Remark:

1. Peak EIRP = Power +desensitization factor
2. Level[dBuV/m] = Power[dBm] - 20*log(d[meters]) + 104.77,

where

d = distance at which field strength limit is specified in the rules(1m)

3. FMCW desensitization factor =-20 * Log(α) = -20 * log(0.622) = 4.12dB

where

$$\alpha = \frac{1}{\sqrt[4]{1+\left(\frac{2\ln(2)}{\pi}\right)^2\left(\frac{F_s}{T_s B^2}\right)^2}}$$

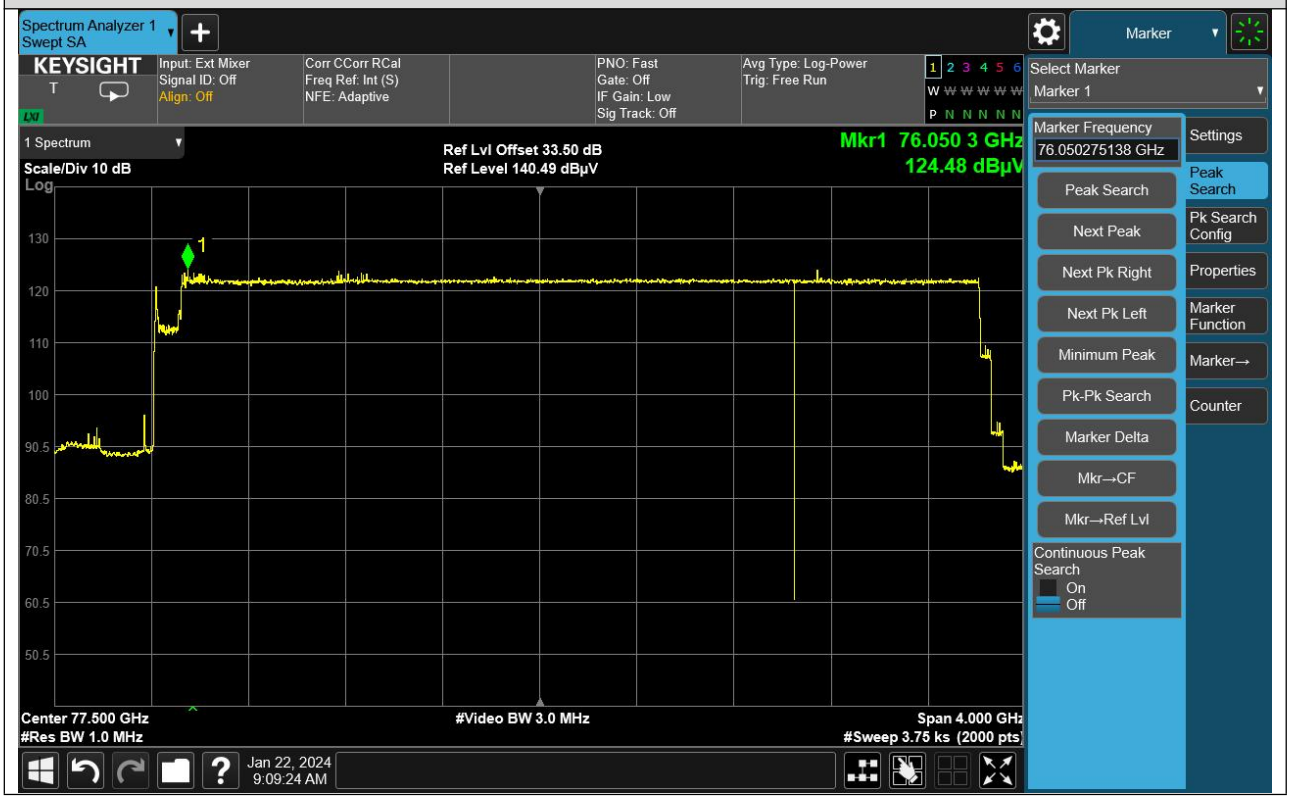
AV POWER

Center Frequency (GHz)	AV factor (dB)	Peak EIRP (dBm)	AV EIRP (dBm)	AV EIRP Limit(dBm)	Marin (dB)	Verdict
77.5	-68.26	23.83	-44.43	-3	41.43	PASS

Remark:

1. $T_D = T_S/F_S$
2. Average factor = 10*log[(T_D) / cycle time]

Peak EIRP


Spectrum Analyzer 1
Swept SA
KEYSIGHT
Input: Ext Mixer
Signal ID: Off
Align: Off
Corr CCorr RCal
Freq Ref: Int (S)
NFE: Adaptive
PNO: Fast
Gate: Off
IF Gain: Low
Sig Track: Off
Avg Type: Log-Power
Trig: Free Run
Marker
Select Marker
Marker 1
1 Spectrum
Scale/Div 10 dB
Log
Ref Lvl Offset 33.50 dB
Ref Level 140.49 dBµV
Mkr1 76.050 3 GHz
124.48 dBµV
130
120
110
100
90.5
80.5
70.5
60.5
50.5
Center 77.500 GHz
#Res BW 1.0 MHz
#Video BW 3.0 MHz
Span 4.000 GHz
#Sweep 3.75 ks (2000 pts)
Jan 22, 2024
9:09:24 AM
Marker Frequency
76.050275138 GHz
Settings
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Minimum Peak
Pk-Pk Search
Marker Delta
Mkr→CF
Mkr→Ref Lvl
Pk Search Config
Properties
Marker Function
Marker→
Counter
Continuous Peak Search
On
Off

3.5 FREQUENCY STABILITY

3.5.1 Description of Frequency Stability Measurement

According to §15.256 (g)

As specified in Section 15.215(c), the bandwidth of the fundamental emission must be contained within the frequency band over the temperature range -20 to +50 degrees Celsius with an input voltage variation of 85% to 115% of rated input voltage. Frequency stability is to be measured according to Section 2.1055 at the highest and lowest frequency of operation and with the modulation that produces the widest emission bandwidth.

3.5.2 Measurement Procedure

Method of measurement: Refer as ANSI C63.10-2020 clause 9.5

3.5.3 Test setup

See section 2.5 of this report.

3.5.4 Test results

FREQUENCY STABILITY					
Temperature (°C)	Voltage (Volt)	FL (GHz)	FH (GHz)	Limit (GHz)	Result
50	Normal Voltage	75.9135	79.3112	75-85GHz	PASS
40		75.9137	79.3128		
30		75.9130	79.3126		
20		75.9120	79.3117		
10		75.9131	79.3125		
0		75.9151	79.3111		
-10		75.9135	79.3123		
-20		75.9132	79.3100		
-30		75.9123	79.3106		
20	115%	75.9123	79.3124		
20	85%	75.9151	79.3098		

3.6 ANTENNA REQUIREMENT

3.6.1 LIMITS OFFREQUENCY STABILITY

According to §15.256 (i)-Antenna beamwidth

(A) LPR devices operating under the provisions of this section within the 5.925–7.250 GHz and 24.05–29.00 GHz bands must use an antenna with a −3 dB beamwidth no greater than 12 degrees.

(B) LPR devices operating under the provisions of this section within the 75–85 GHz band must use an antenna with a −3 dB beamwidth no greater than 8 degrees.

According to §15.256 (j)-Antenna side lobe gain

Antenna side lobe gain. LPR devices operating under the provisions of this section must limit the side lobe antenna gain relative to the main beam gain for off-axis angles from the main beam of greater than 60 degrees to the levels provided in Table 2.

Frequency band of Operation	Antenna beamwidth in degree (°)	Antenna side lobe gain limit relative to main beam gain (dB)
5.925 to 7.250GHz	12	-22
24.05 to 29.00GHz	12	-27
75.00 to 85.00GHz	8	-38

3.6.2 ANTENNA DATA

Frequency band	Antenna Gian (dBi)	Maximum 3 dB beam width(°)	Maximum side lobe level > 60° (dB)
75.00 to 85.00GHz	27.5	6.5	-38.5
Limit	/	8	-38

The antenna characteristics (gain vs angle) were taken from the provided data sheet by the manufacturer.

4 PHOTOGRAPHS OF TEST SETUP

Please refer to the attached file (Test Setup Photo).

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5 PHOTOGRAPHS OF THE EUT

Please refer to the attached file (External Photos report and Internal Photos).

------ End of the Report ------

Important

(1) The test report is valid without the official stamp of CVC;

(2) Any part photocopies of the test report are forbidden without the written permission from CVC;

(3) The test report is invalid without the signatures of Approval and Reviewer;

(4) The test report is invalid if altered;

(5) Objections to the test report must be submitted to CVC within 15 days.

(6) Generally, commission test is responsible for the tested samples only.

(7) As for the test result “-” or “N” means “not applicable”, “/” means “not test”, “P” means “pass” and “F” means “fail”

The test data and test results given in this test report should only be used for purposes of scientific research, teaching and internal quality control when the CMA symbol is not presented.

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