TEST REPORT

Report No.:	BCTC2308942666E
Applicant:	Shenzhen Enruipu Technology Co., Ltd
Product Name:	UHF RFID Module
Model/Type reference:	NRP-ML200F01
Tested Date:	2023-08-11 to 2023-09-12
Issued Date:	2023-09-12

Shenzhen BCTC Testing Co., Ltd.

FCC ID: 2BCZ3-ML200F01

Product Name:	UHF RFID Module
Trademark:	NRP
Model/Type Reference:	NRP-ML200F01 NRP-ML200E01, NRP-MN200F, NRP-MN200E, NRP-R915N01, NRP-R915N02, NRP-R915N03, NRP-R915Q01, NRP-R915Q02, NRP-R915Q03
Prepared For:	Shenzhen Enruipu Technology Co., Ltd
Address:	Room 412, Building 1, Nanyou Fourth Industrial Zone, Nanshan Avenue, Nanshan District, Shenzhen, China
Manufacturer:	Shenzhen Enruipu Technology Co., Ltd
Address:	Room 412, Building 1, Nanyou Fourth Industrial Zone, Nanshan Avenue, Nanshan District, Shenzhen, China
Prepared By:	Shenzhen BCTC Testing Co., Ltd.
Address:	1-2/F., Building B, Pengzhou Industrial Park, No.158, Fuyuan 1st Road, Zhancheng, Fuhai Subdistrict, Bao'an District, Shenzhen, Guangdong, China
Sample Received Date:	2023-08-11
Sample tested Date:	2023-08-11 to 2023-09-12
Issue Date:	2023-09-12
Report No.:	BCTC2308942666E
Test Standards	FCC CFR Title 47 Part 15 Subpart C Section 15.247 FCC KDB 558074 D01 15.247 Meas Guidance v05r02 ANSI C63.10:2013
Test Results	PASS

Tested by:

Lei Chen

Lei Chen/Project Handler

Approved by:

Zero Zhou/Reviewer

The test report is effective only with both signature and specialized stamp. This result(s) shown in this report refer only to the sample(s) tested. Without written approval of Shenzhen BCTC Testing Co., Ltd, this report can't be reproduced except in full. The tested sample(s) and the sample information are provided by the client.

Table Of Content

Test Report Declaration Page
1. Version 5
2. Test Summary 6
3. Measurement Uncertainty 7
4. Product Information And Test Setup 8
4.1 Product Information 8
4.2 Test Setup Configuration 8
4.3 Support Equipment 9
4.4 Channel List 9
4.5 Test Mode 10
4.6 Table Of Parameters Of Text Software Setting 10
5. Test Facility And Test Instrument Used 11
5.1 Test Facility 11
5.2 Test Instrument Used 11
6. Conducted Emissions 13
6.1 Block Diagram Of Test Setup 13
6.2 Limit 13
6.3 Test procedure 13
6.4 EUT operating Conditions 13
6.5 Test Result 14
7. Radiated Emissions 16
7.1 Block Diagram Of Test Setup 16
7.2 Limit 17
7.3 Test procedure 18
7.4 EUT operating Conditions 19
7.5 Test Result 19
8. Radiated Band Emission Measurement And Restricted Bands Of Operation 23
8.1 Block Diagram Of Test Setup 23
8.2 Limit 23
8.3 Test procedure 24
8.4 EUT operating Conditions 24
8.5 Test Result 25
9. Conducted Spurious Emission Measurement 26
9.1 Block Diagram Of Test Setup 26
9.2 Limit 26
9.3 Test procedure 26
9.4 Test Result 27
10. Occupy Bandwidth 30
10.1 Block Diagram Of Test Setup 30
10.2 Limit 30
10.3 Test procedure 30
10.4 Test Result 30
11. Conducted Output Power 33
11.1 Block Diagram Of Test Setup 33
11.2 Limit 33

11.3 Test procedure 33
11.4 Test Result 33
12. Hopping Channel Separation 36
12.1 Block Diagram Of Test Setup 36
12.2 Limit 36
12.3 Test procedure 36
12.4 Test Result 36
13. Number Of Hopping Frequency 39
13.1 Block Diagram Of Test Setup 39
13.2 Limit 39
13.3 Test procedure 39
13.4 Test Result 39
14. Dwell Time 41
14.1 Block Diagram Of Test Setup 41
14.2 Limit 41
14.3 Test procedure 41
14.4 Test Result 42
15. Antenna Requirement 43
15.1 Limit 43
15.2 Test Result 43
16. EUT Photographs 44
17. EUT Test Setup Photographs 45

(Note: N/A Means Not Applicable)

1. Version

Report No.	Issue Date	Description	Approved
BCTC2308942666E	2023-09-12	Original	Valid

2. Test Summary

The Product has been tested according to the following specifications:

No.	Test Parameter	Clause No.	Results
1	Conducted Emission AC Power Port	§15.207	PASS
2	Conducted Peak Output Power	§15.247(b)	PASS
3	Occupied Bandwidth	§15.247(a)	PASS
4	Carrier Frequencies Separation	§15.247 (a)	PASS
5	Hopping Channel Number	§15.247 (a)(1)	PASS
6	Dwell Time	§15.247 (f)	PASS
7	Radiated Emission	§15.205/§15.209	PASS
8	Band Edge	§15.247(d)	PASS

3. Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the Product as specified in CISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

No.	Item	Uncertainty
1	3m Chamber Radiated spurious Emission(30MHz-1GHz)	U=4.3dB
2	3m Chamber Radiated Spurious Emission(9KHz-30MHz)	U=3.7dB
3	3m Chamber Radiated Spurious Emission(1GHz-18GHz)	U=4.5dB
4	3m Chamber Radiated Spurious Emission(18GHz-40GHz)	U=3.34dB
5	Conducted Emission (150kHz-30MHz)	U=3.20dB
6	Conducted Adjacent Channel Power	U=1.38dB
7	Conducted Output Power Uncertainty Above 1G	U=1.576dB
8	Conducted Output Power Uncertainty Below 1G	U=1.28dB
9	Humidity Uncertainty	U=5.3%
10	Temperature Uncertainty	U=0.59℃

4. Product Information And Test Setup

4.1 Product Information

Model/Type reference:	NRP-ML200F01 NRP-ML200E01, NRP-MN200F, NRP-MN200E, NRP-R915N01, NRP-R915N02, NRP-R915N03, NRP-R915Q01, NRP-R915Q02, NRP-R915Q03
Model differences:	All the model are the same circuit and RF module, except model names.
Hardware Version:	N/A
Software Version:	N/A
Operation Frequency:	902.25MHz -927.75MHz
Type of Modulation:	ASK
Number Of Channel	52 CH
Antenna installation:	External antenna
Antenna Gain:	8.06 dBi
Ratings:	DC 3.6-5V

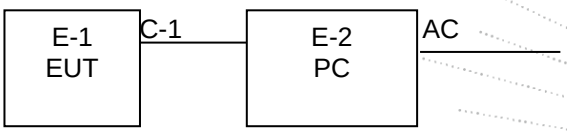
Cable of Product

No.	Cable Type	Quantity	Provider	Length (m)	Shielded	Note
1	--	--	Applicant	---	Yes/No	With a ferrite ring in mid Detachable
2	--	--	BCTC	--	Yes/No	--

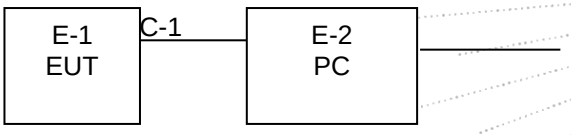
4.2 Test Setup Configuration

See test photographs attached in *EUT TEST SETUP PHOTOGRAPHS* for the actual connections between Product and support equipment.

Conducted Emission:



Radiated Spurious Emission



4.3 Support Equipment

No.	Device Type	Brand	Model	Series No.	Note
E-1	UHF RFID Module	N/A	NRP-ML200F01	N/A	EUT
E-2	PC	Lenovo	Thinkpad S2	N/A	Auxiliary

Item	Shielded Type	Ferrite Core	Length	Note
C-1	N/A	N/A	0.5M	DC cable unshielded

Notes:
1. All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.
2. Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.

4.4 Channel List

CH	Frequency (MHz)	CH	Frequency (MHz)	CH	Frequency (MHz)
1	902.25	25	914.25	49	926.25
2	902.75	26	914.75	50	926.75
3	903.25	27	915.25	51	927.25
4	903.75	28	916.25	52	927.75
5	904.25	29	916.75		
6	904.75	30	917.25		
7	905.25	31	917.75		
8	905.75	32	918.25		
9	906.25	33	918.75		
10	906.75	34	919.25		
11	907.25	35	919.75		
12	907.75	36	920.25		
13	908.25	37	920.75		
14	908.75	38	921.25		
15	909.25	39	921.75		
16	909.75	40	922.25		
17	910.25	41	922.75		
18	910.75	42	923.25		
19	911.25	43	923.75		
20	911.75	44	924.25		
21	912.25	45	924.75		
22	912.75	46	925.25		
23	913.25	47	925.75		
24	913.75	48	926.25		

4.5 Test Mode

To investigate the maximum EMI emission characteristics generates from EUT, the test system was pre-scanning tested base on the consideration of following EUT operation mode or test configuration mode which possible have effect on EMI emission level. Each of these EUT operation mode(s) or test configuration mode(s) mentioned above was evaluated respectively.

Test Mode	Low channel	Middle channel	High channel
1	902.25MHz	914.75MHz	927.75MHz
2	Hopping Mode		
3	Transmitting (Conducted emission & Radiated emission)		

Note:
(1) The measurements are performed at the highest, middle, lowest available channels.

4.6 Table Of Parameters Of Text Software Setting

During testing channel & power controlling software provided by the customer was used to control the operating channel as well as the output power level. The RF output power selection is for the setting of RF output power expected by the customer and is going to be fixed on the firmware of the final end product power parameters

Test software Version	UHF-RFID		
Frequency	902.25MHz	914.75MHz	927.75MHz
Parameters	DEF	DEF	DEF

5. Test Facility And Test Instrument Used

5.1 Test Facility

All measurement facilities used to collect the measurement data are located at Shenzhen BCTC Testing Co., Ltd. Address: 1-2/F., Building B, Pengzhou Industrial Park, No.158, Fuyuan 1st Road, Zhancheng, Fuhai Subdistrict, Bao'an District, Shenzhen, Guangdong, China. The site and apparatus are constructed in conformance with the requirements of ANSI C63.4 and CISPR 16-1-1 other equivalent standards.
FCC Test Firm Registration Number: 712850
A2LA certificate registration number is: CN1212
ISED Registered No.: 23583
ISED CAB identifier: CN0017

5.2 Test Instrument Used

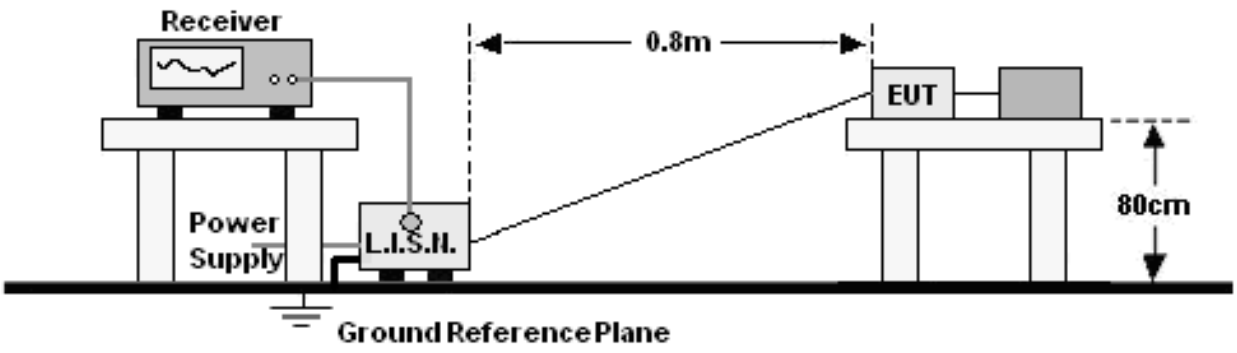
Conducted Emissions Test					
Equipment	**Manufacturer**	**Model#**	**Serial#**	**Last Cal.**	**Next Cal.**
Receiver	R&S	ESR3	102075	May 15, 2023	May 14, 2024
LISN	R&S	ENV216	101375	May 15, 2023	May 14, 2024
Software	Frad	EZ-EMC	EMC-CON 3A1	\	\
Attenuator	\	10dB DC-6GHz	1650	May 15, 2023	May 14, 2024

RF Conducted Test					
Equipment	**Manufacturer**	**Model#**	**Serial#**	**Last Cal.**	**Next Cal.**
Power Meter	Keysight	E4419	\	May 15, 2023	May 14, 2024
Power Sensor (AV)	Keysight	E9300A	\	May 15, 2023	May 14, 2024
Signal Analyzer20kHz-26.5GHz	Keysight	N9020A	MY49100060	May 15, 2023	May 14, 2024
Spectrum Analyzer9kHz-40GHz	R&S	FSP40	100363	May 15, 2023	May 14, 2024

Radiated Emissions Test (966 Chamber01)					
Equipment	**Manufacturer**	**Model#**	**Serial#**	**Last Cal.**	**Next Cal.**
966 chamber	ChengYu	966 Room	966	May 15, 2023	May 14, 2026
Receiver	R&S	ESR3	102075	May 15, 2023	May 14, 2024
Receiver	R&S	ESRP	101154	May 15, 2023	May 14, 2024
Amplifier	Schwarzbeck	BBV9744	9744-0037	May 15, 2023	May 14, 2024
TRILOG Broadband Antenna	Schwarzbeck	VULB9163	942	May 29, 2023	May 28, 2024
Loop Antenna(9KHz -30MHz)	Schwarzbeck	FMZB1519B	00014	May 31, 2023	May 30, 2024
Amplifier	SKET	LAPA_01G18 G-45dB	\	May 15, 2023	May 14, 2024
Horn Antenna	Schwarzbeck	BBHA9120D	1541	May 31, 2023	May 30, 2024
Amplifier(18G Hz-40GHz)	MITEQ	TTA1840-35-HG	2034381	May 15, 2023	May 14, 2024
Horn Antenna(18G Hz-40GHz)	Schwarzbeck	BBHA9170	00822	May 31, 2023	May 30, 2024
Spectrum Analyzer9kHz-40GHz	R&S	FSP40	100363	May 15, 2023	May 14, 2024
Software	Frad	EZ-EMC	FA-03A2 RE	\	\

6. Conducted Emissions

6.1 Block Diagram Of Test Setup



6.2 Limit

Frequency (MHz)	Limit (dBuV)	
	Quas-peak	Average
0.15 -0.5	66 - 56 *	56 - 46 *
0.50 -5.0	56.00	46.00
5.0 -30.0	60.00	50.00

Notes:
1. *Decreasing linearly with logarithm of frequency.
2. The lower limit shall apply at the transition frequencies.

6.3 Test procedure

Receiver Parameters	Setting
Attenuation	10 dB
Start Frequency	0.15 MHz
Stop Frequency	30 MHz
IF Bandwidth	9 kHz

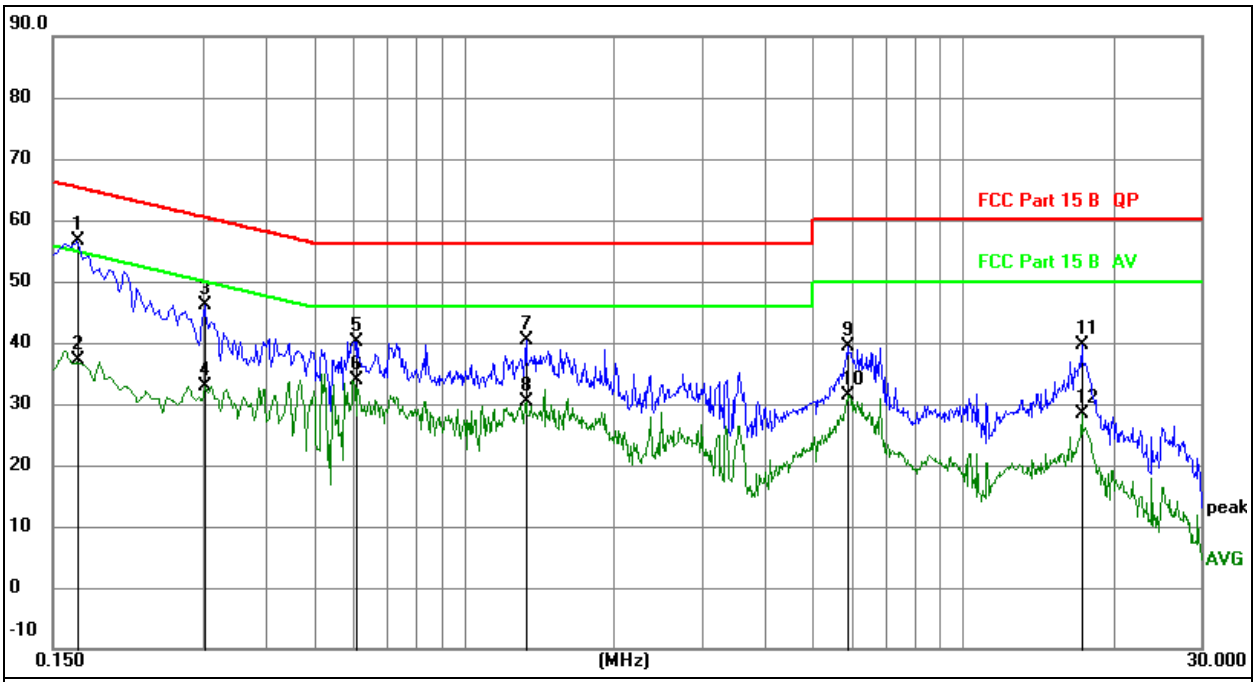
a. The Product was placed on a nonconductive table 0.8 m above the horizontal ground reference plane, and 0.4 m from the vertical ground reference plane, and connected to the main through Line Impedance Stability Network (L.I.S.N).
b. The RBW of the receiver was set at 9 kHz in 150 kHz ~ 30MHz with Peak and AVG detector in Max Hold mode. Run the receiver's pre-scan to record the maximum disturbance generated from Product in all power lines in the full band.
c. For each frequency whose maximum record was higher or close to limit, measure its QP and AVG values and record.

6.4 EUT operating Conditions

The EUT was configured for testing in a typical fashion (as a customer would normally use it). The EUT has been programmed to continuously transmit during test. This operating condition was tested and used to collect the included data.

6.5 Test Result

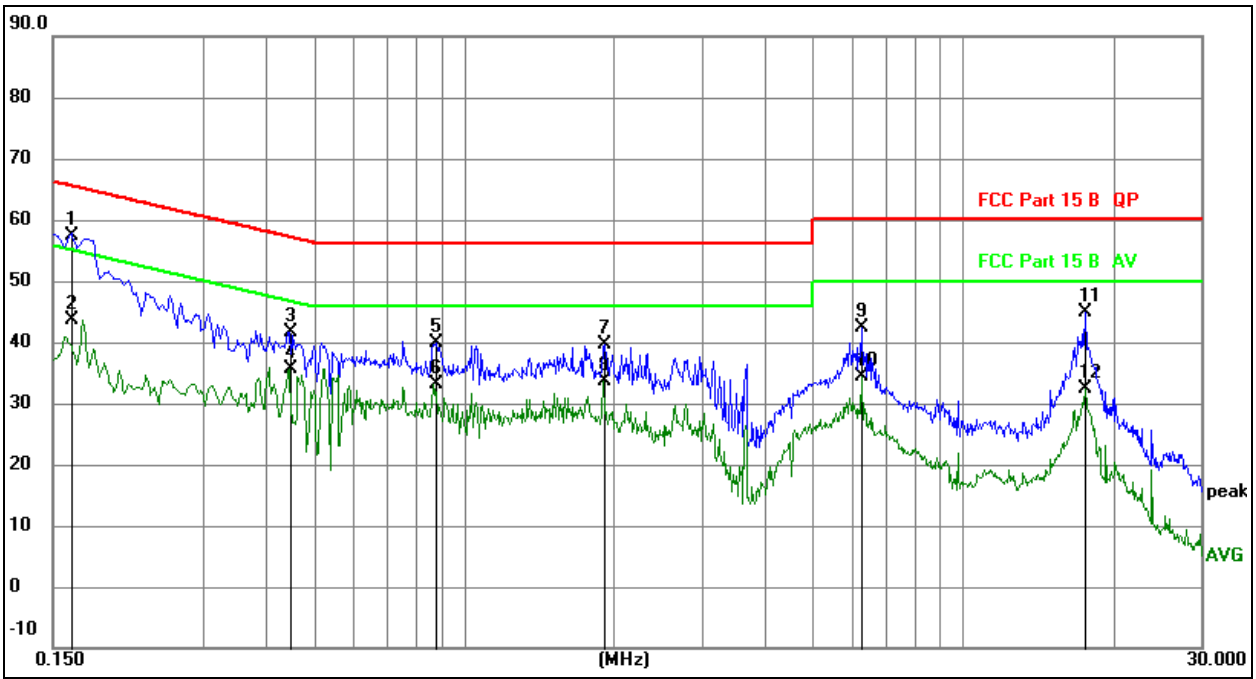
Temperature:	26 ℃	Relative Humidity:	54%
Pressure:	101KPa	Phase :	L
Test Mode:	Mode 3	Test Voltage :	AC 120V/60Hz



Remark:
1. All readings are Quasi-Peak and Average values.
2. Factor = Insertion Loss + Cable Loss.
3. Measurement = Reading Level + Correct Factor
4. Over = Measurement - Limit

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz		dB	dBuV	dBuV	dB	Detector
1	*	0.1680	47.14	9.55	56.69	65.06	-8.37	QP
2		0.1680	27.50	9.55	37.05	55.06	-18.01	AVG
3		0.3030	36.62	9.61	46.23	60.16	-13.93	QP
4		0.3030	23.17	9.61	32.78	50.16	-17.38	AVG
5		0.6045	30.54	9.62	40.16	56.00	-15.84	QP
6		0.6045	24.23	9.62	33.85	46.00	-12.15	AVG
7		1.3335	30.61	9.73	40.34	56.00	-15.66	QP
8		1.3335	20.55	9.73	30.28	46.00	-15.72	AVG
9		5.8875	29.68	9.78	39.46	60.00	-20.54	QP
10		5.8875	21.60	9.78	31.38	50.00	-18.62	AVG
11		17.3310	29.79	9.72	39.51	60.00	-20.49	QP
12		17.3310	18.61	9.72	28.33	50.00	-21.67	AVG

Temperature:	26 ℃	Relative Humidity:	54%
Pressure:	101KPa	Phase :	N
Test Mode:	Mode 3	Test Voltage :	AC 120V/60Hz



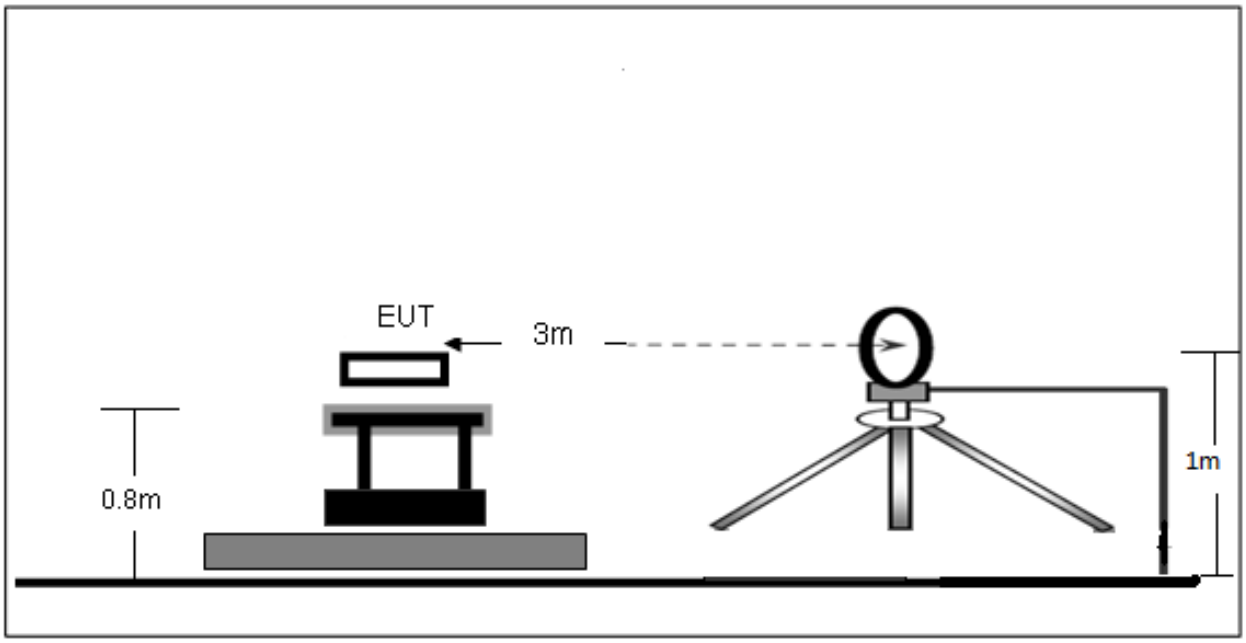
Remark:
1. All readings are Quasi-Peak and Average values.
2. Factor = Insertion Loss + Cable Loss.
3. Measurement = Reading Level + Correct Factor
4. Over = Measurement - Limit

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz		dB	dBuV	dBuV	dB	Detector
1	*	0.1641	47.95	9.54	57.49	65.25	-7.76	QP
2		0.1641	34.16	9.54	43.70	55.25	-11.55	AVG
3		0.4468	31.95	9.62	41.57	56.93	-15.36	QP
4		0.4468	25.90	9.62	35.52	46.93	-11.41	AVG
5		0.8803	30.26	9.69	39.95	56.00	-16.05	QP
6		0.8803	23.34	9.69	33.03	46.00	-12.97	AVG
7		1.9080	30.02	9.73	39.75	56.00	-16.25	QP
8		1.9080	23.95	9.73	33.68	46.00	-12.32	AVG
9		6.2520	32.64	9.76	42.40	60.00	-17.60	QP
10		6.2520	24.59	9.76	34.35	50.00	-15.65	AVG
11		17.5677	35.05	9.72	44.77	60.00	-15.23	QP
12		17.5677	22.73	9.72	32.45	50.00	-17.55	AVG

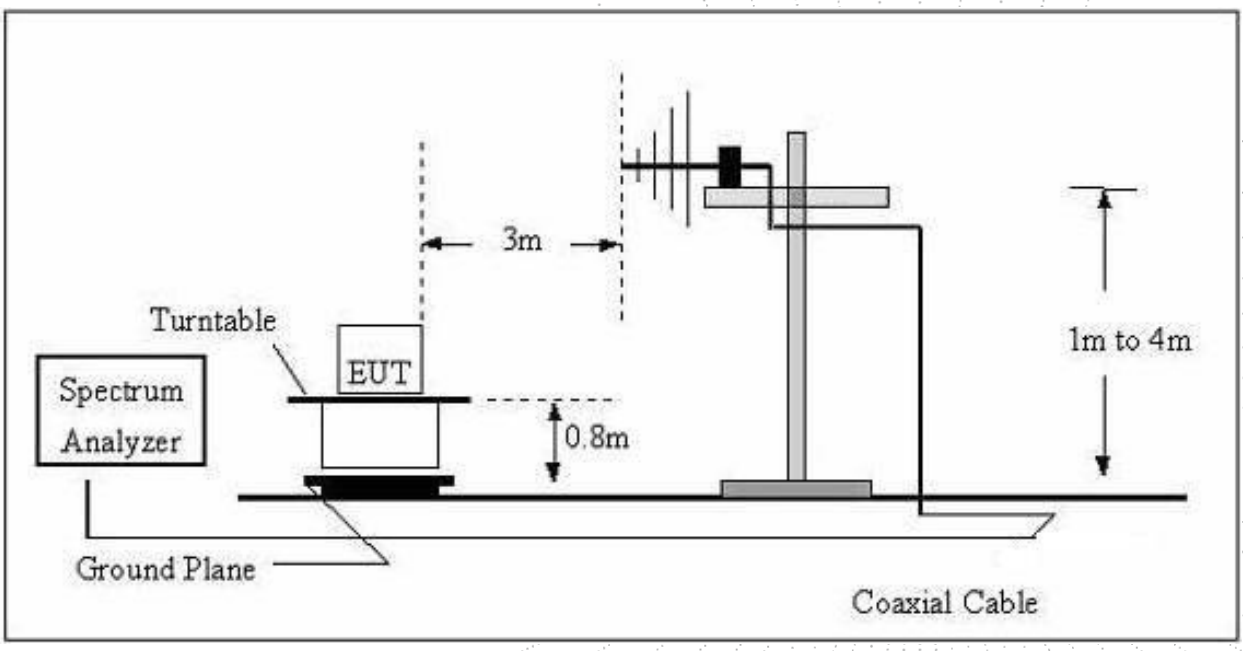
7. Radiated Emissions

7.1 Block Diagram Of Test Setup

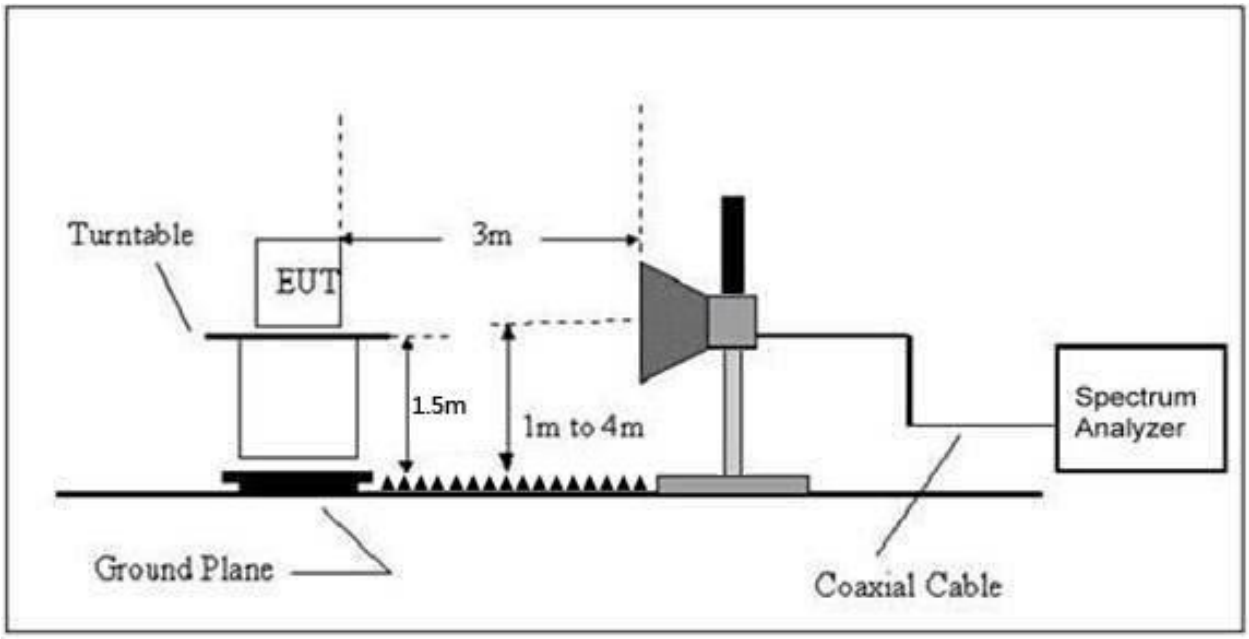
（A）Radiated Emission Test-Up Frequency Below 30MHz



（B）Radiated Emission Test-Up Frequency 30MHz~1GHz



（C）Radiated Emission Test-Up Frequency Above 1GHz



7.2 Limit

20dBc in any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the restricted band specified on 15.205(a), then the 15.209(a) limit in the table below has to be followed.

Frequency	Field Strength	Distance	Field Strength Limit at 3m Distance	
(MHz)	uV/m	(m)	uV/m	dBuV/m
0.009 ~ 0.490	2400/F(kHz)	300	10000 * 2400/F(kHz)	$20\log^{(2400/F(kHz))} + 80$
0.490 ~ 1.705	24000/F(kHz)	30	100 * 24000/F(kHz)	$20\log^{(24000/F(kHz))} + 40$
1.705 ~ 30	30	30	100 * 30	$20\log^{(30)} + 40$
30 ~ 88	100	3	100	$20\log^{(100)}$
88 ~ 216	150	3	150	$20\log^{(150)}$
216 ~ 960	200	3	200	$20\log^{(200)}$
Above 960	500	3	500	$20\log^{(500)}$

Limits Of Radiated Emission Measurement (Above 1000MHz)

Frequency (MHz)	Limit (dBuV/m) (at 3M)	
	Peak	Average
Above 1000	74	54

Notes:
(1)The limit for radiated test was performed according to FCC PART 15C.
(2)The tighter limit applies at the band edges.
(3) Emission level (dBuV/m)=20log Emission level (uV/m).

Frequency Range Of Radiated Measurement
(a) For an intentional radiator the spectrum shall be investigated from the lowest radio frequency signal generated in the device, without going below 9 kHz, up to at least the frequency shown in this paragraph:
(1) If the intentional radiator operates below 10 GHz: to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.
(2) If the intentional radiator 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.
(3) If the intentional radiator 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 elsewhere in the rules.
(4) If the intentional radiator operates at or above 95 GHz: To the third harmonic of the highest fundamental frequency or to 750 GHz, whichever is lower, unless specified otherwise elsewhere in the rules.
(5) If the intentional radiator contains a digital device, regardless of whether this digital device controls the functions of the intentional radiator or the digital device is used for additional control or function purposes other than to enable the operation of the intentional radiator, the frequency range shall be investigated up to the range specified in paragraphs (a) (1)through (4) of this section or the range applicable to the digital device, as shown in paragraph (b)(1) of this section, whichever is the higher frequency range of investigation.

7.3 Test procedure

Receiver Parameter	Setting
Attenuation	Auto
9kHz~150kHz	RBW 200Hz for QP
150kHz~30MHz	RBW 9kHz for QP
30MHz~1000MHz	RBW 120kHz for QP

Spectrum Parameter	Setting
1-25GHz	RBW 1 MHz /VBW 1 MHz for Peak, RBW 1 MHz / VBW 10Hz for Average

Below 1GHz test procedure as below:
a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi-anechoic camber. 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. The antenna 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 (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) 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. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.
Above 1GHz test procedure as below:
a. The EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter camber. 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.The antenna 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 rota 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. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.
g. Test the EUT in the lowest channel, the middlest channel, the Highest channel.
Note:
Both horizontal and vertical antenna polarities were tested and performed pretest to three orthogonal axis. The worst case emissions were reported.

7.4 EUT operating Conditions

The EUT was configured for testing in a typical fashion (as a customer would normally use it). The EUT has been programmed to continuously transmit during test. This operating condition was tested and used to collect the included data.

7.5 Test Result

Below 30MHz

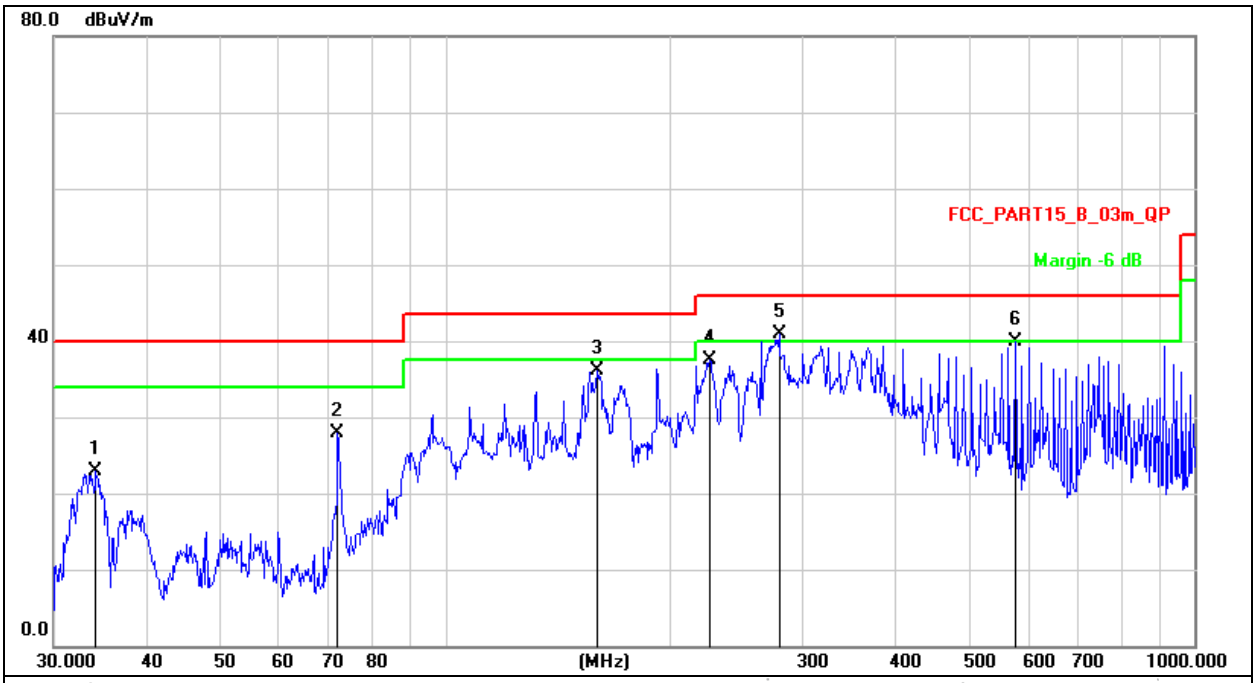
Temperature:	26 ℃	Relative Humidity:	54%
Pressure:	101KPa	Test Voltage :	DC 5V from PC
Test Mode:	Mode 3		

Freq. (MHz)	Reading (dBuV/m)	Limit (dBuV/m)	Margin (dB)	State P/F
--	--	--	--	PASS
--	--	--	--	PASS

Note:
The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.
Distance extrapolation factor =40 log (specific distance/test distance)(dB);
Limit line = specific limits(dBuv) + distance extrapolation factor.

Between 30MHz – 1GHz

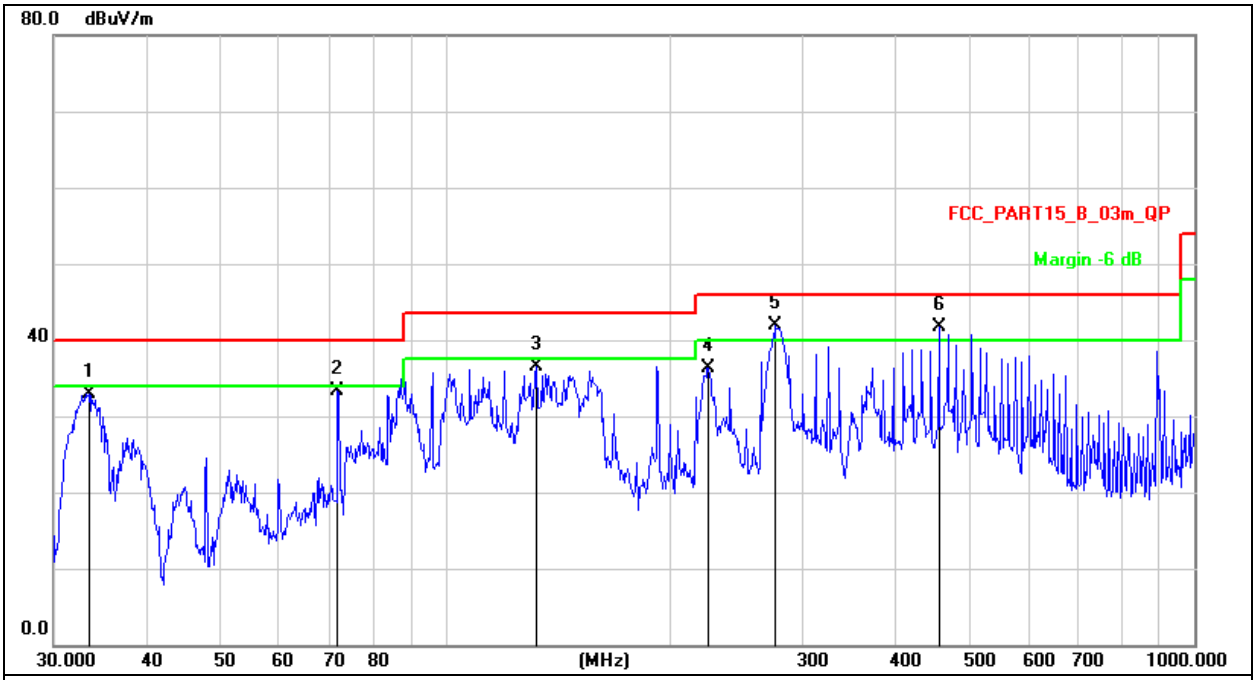
Temperature:	26 ℃	Relative Humidity:	54%
Pressure:	101KPa	Phase :	Horizontal
Test Mode:	Mode 3	Test Voltage:	DC 5V from PC



Remark:
1. Factor = Antenna Factor + Cable Loss – Pre-amplifier.
2. Measurement = Reading Level + Correct Factor
3. Over = Measurement - Limit

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dB/m	dB	Detector
1		34.1561	40.69	-17.69	23.00	40.00	-17.00	QP
2		71.8320	48.16	-20.24	27.92	40.00	-12.08	QP
3		159.7844	56.41	-20.33	36.08	43.50	-7.42	QP
4		225.3080	54.11	-16.59	37.52	46.00	-8.48	QP
5	*	279.0436	56.02	-15.10	40.92	46.00	-5.08	QP
6		576.6443	48.88	-8.92	39.96	46.00	-6.04	QP

Temperature:	26 ℃	Relative Humidity:	54%
Pressure:	101KPa	Phase :	Vertical
Test Mode:	Mode 3	Test Voltage:	DC 5V from PC



Remark:
1. Factor = Antenna Factor + Cable Loss – Pre-amplifier.
2. Measurement = Reading Level + Correct Factor
3. Over = Measurement - Limit

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dB/m	dB	Detector
1		33.4448	50.74	-17.81	32.93	40.00	-7.07	QP
2		71.8319	53.48	-20.24	33.24	40.00	-6.76	QP
3		132.2205	56.40	-19.88	36.52	43.50	-6.98	QP
4		224.5192	52.92	-16.61	36.31	46.00	-9.69	QP
5	*	276.1235	57.15	-15.18	41.97	46.00	-4.03	QP
6	!	455.9057	53.08	-11.34	41.74	46.00	-4.26	QP

Between 1GHz – 25GHz

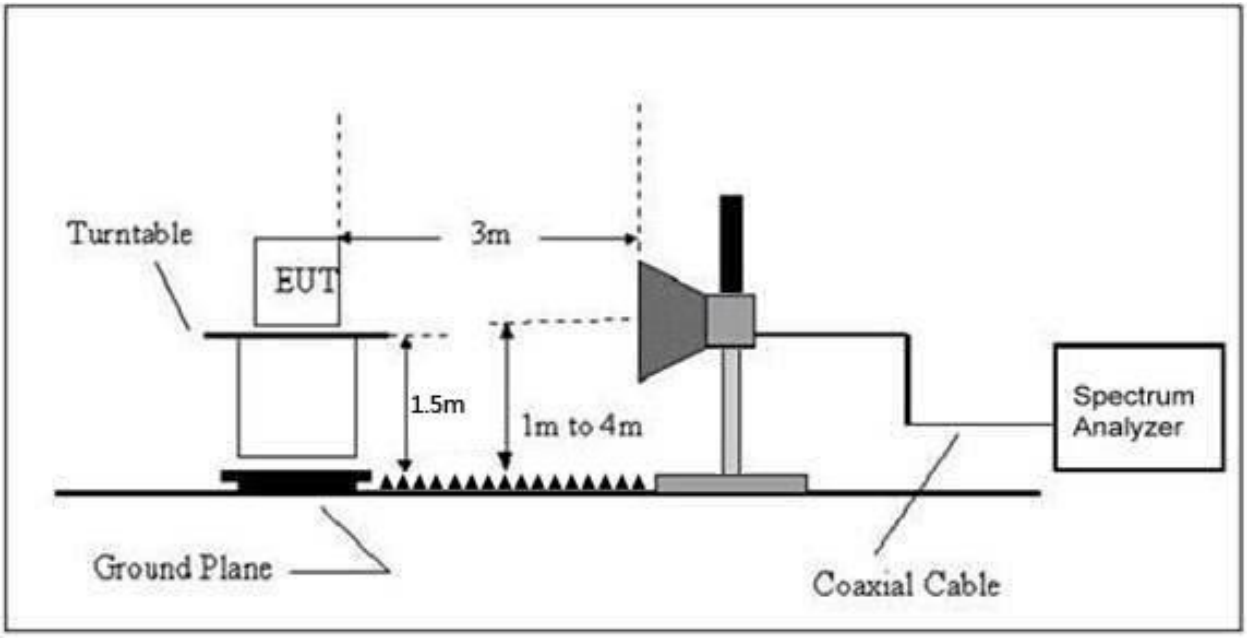
Polar (H/V)	Frequency (MHz)	Reading Level (dBuV/m)	Correct Factor (dB)	Measure-ment (dBuV/m)	Limits (dBuV/m)	Over (dB)	Detector Type
ASK Low channel							
V	1805.50	83.33	-27.03	56.30	74.00	-17.70	PK
V	1805.50	68.49	-27.03	41.46	54.00	-12.54	AV
V	2708.25	68.70	-24.48	44.22	74.00	-29.78	PK
V	2708.25	57.90	-24.48	33.42	54.00	-20.58	AV
H	1805.50	80.07	-27.03	53.04	74.00	-20.96	PK
H	1805.50	67.12	-27.03	40.09	54.00	-13.91	AV
H	2708.25	66.79	-24.48	42.31	74.00	-31.69	PK
H	2708.25	59.11	-24.48	34.63	54.00	-19.37	AV
ASK Middle channel							
V	1829.50	78.06	-26.98	51.08	74.00	-22.92	PK
V	1829.50	71.73	-26.98	44.75	54.00	-9.25	AV
V	2744.25	67.18	-24.37	42.81	74.00	-31.19	PK
V	2744.25	58.39	-24.37	34.02	54.00	-19.98	AV
H	1829.50	76.37	-26.98	49.39	74.00	-24.61	PK
H	1829.50	67.18	-26.98	40.20	54.00	-13.80	AV
H	2744.25	66.15	-24.37	41.78	74.00	-32.22	PK
H	2744.25	58.96	-24.37	34.59	54.00	-19.41	AV
ASK High channel							
V	1854.50	80.29	-26.92	53.37	74.00	-20.63	PK
V	1854.50	70.95	-26.92	44.03	54.00	-9.97	AV
V	2781.75	72.26	-24.25	48.01	74.00	-25.99	PK
V	2781.75	62.03	-24.25	37.78	54.00	-16.22	AV
H	1854.50	78.74	-26.92	51.82	74.00	-22.18	PK
H	1854.50	68.56	-26.92	41.64	54.00	-12.36	AV
H	2781.75	70.71	-24.25	46.46	74.00	-27.54	PK
H	2781.75	62.72	-24.25	38.47	54.00	-15.53	AV

Remark:
1.Emission Level = Meter Reading + Factor, Factor = Antenna Factor + Cable Loss – Pre-amplifier. Over= Emission Level - Limit
2.If peak below the average limit, the average emission was no test.
3. In restricted bands of operation, The spurious emissions below the permissible value more than 20dB
4. The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

8. Radiated Band Emission Measurement And Restricted Bands Of Operation

8.1 Block Diagram Of Test Setup

Radiated Emission Test-Up Frequency Above 1GHz



8.2 Limit

FCC Part15 C Section 15.209 and 15.205

(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
[1]0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	([2])
13.36-13.41			

Limits Of Radiated Emission Measurement (Above 1000MHz)

Frequency (MHz)	Limit (dBuV/m) (at 3M)	
	Peak	Average
Above 1000	74	54

Notes:
(1)The limit for radiated test was performed according to FCC PART 15C.
(2)The tighter limit applies at the band edges.
(3)Emission level (dBuV/m)=20log Emission level (uV/m).

8.3 Test procedure

Receiver Parameter	Setting
Attenuation	Auto
Start Frequency	2300MHz
Stop Frequency	2520
RB / VB (Emission In Restricted Band)	1 MHz / 1 MHz for Peak, 1 MHz / 10Hz for Average

Above 1GHz test procedure as below:
a.The EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter camber. 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.The antenna 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 rota 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. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.
g. Test the EUT in the lowest channel, the Highest channel.

Note:
Both horizontal and vertical antenna polarities were tested and performed pretest to three orthogonal axis. The worst case emissions were reported.

8.4 EUT operating Conditions

The EUT was configured for testing in a typical fashion (as a customer would normally use it). The EUT has been programmed to continuously transmit during test. This operating condition was tested and used to collect the included data.

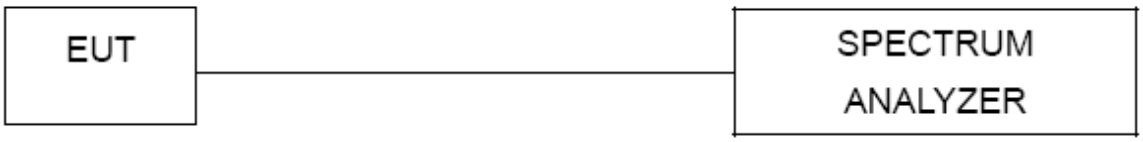
8.5 Test Result

Test mode	Polar (H/V)	Frequency (MHz)	Reading Level (dBuV/m)	Correct Factor (dB)	Measure-ment (dBuV/m) PK	Limits (dBuV/m)	Result
ASK	**Low Channel 902.25MHz**						
	H	900	38.24	-5.60	32.64	46.00	PASS
	H	902	41.49	-5.54	35.95	46.00	PASS
	V	900	36.13	-5.60	30.53	46.00	PASS
	V	902	38.33	-5.54	32.79	46.00	PASS
	High Channel 927.75MHz						
	H	928	41.09	-4.76	36.33	46.00	PASS
	H	930	39.21	-4.70	34.51	46.00	PASS
	V	928	38.74	-4.76	33.98	46.00	PASS
	V	930	36.57	-4.70	31.87	46.00	PASS

Remark:
1. Emission Level = Meter Reading + Factor, Factor = Antenna Factor + Cable Loss – Pre-amplifier. Over= Emission Level – Limit
2. If the PK measured levels comply with average limit, then the average level were deemed to comply with average limit.
3 In restricted bands of operation, The spurious emissions below the permissible value more than 20dB
4. The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

9. Conducted Spurious Emission Measurement

9.1 Block Diagram Of Test Setup



9.2 Limit

Regulation 15.247 (d),In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c))

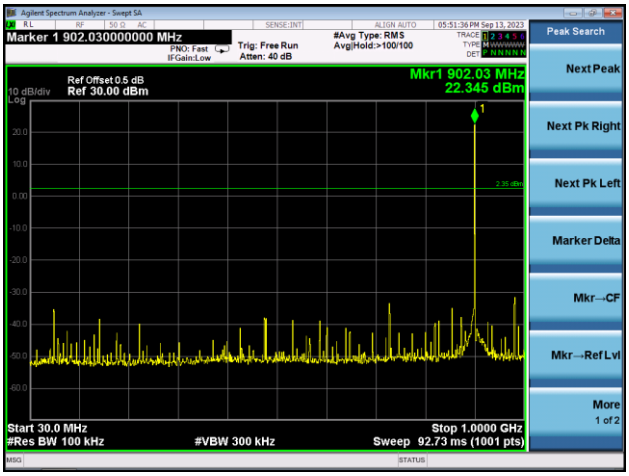
9.3 Test procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer:
RBW = 100kHz, VBW = 300kHz, Sweep = auto
Detector function = peak, Trace = max hold

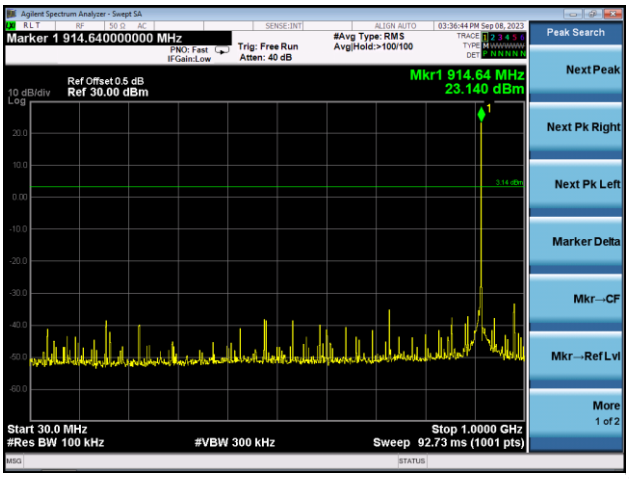
9.4 Test Result

30MHz – 25GHz

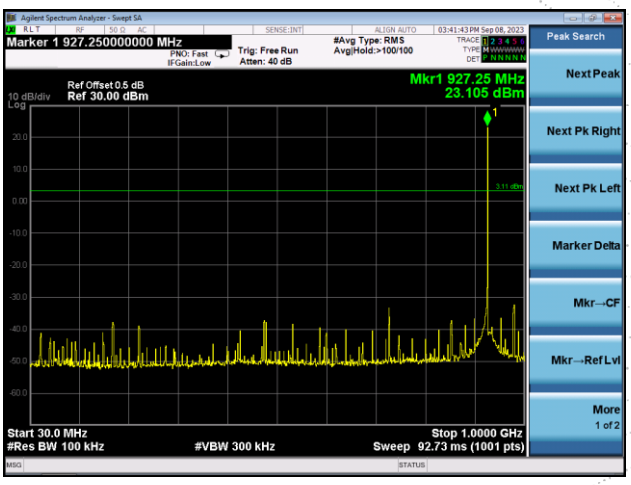
L



M

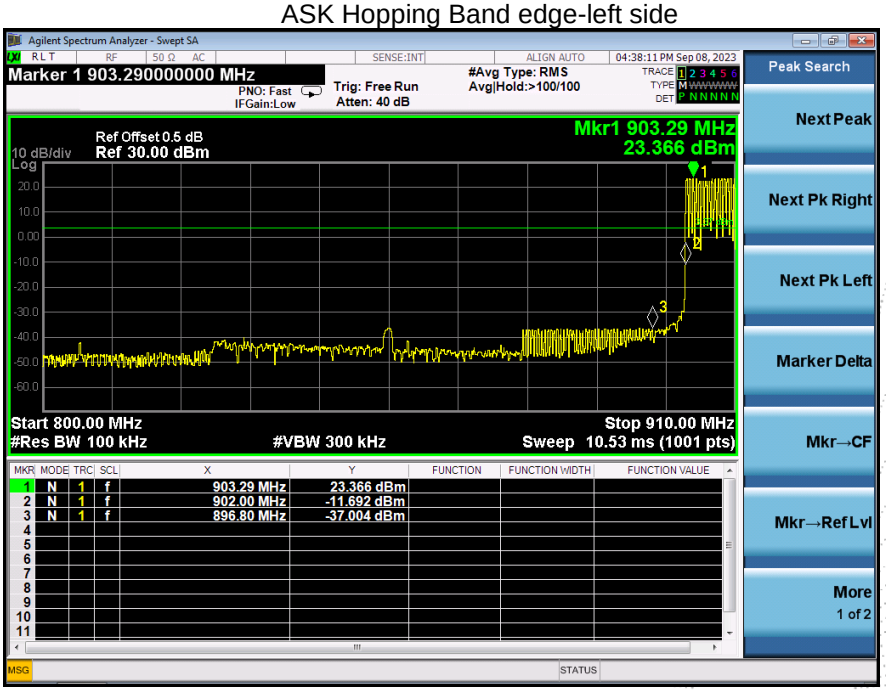


H

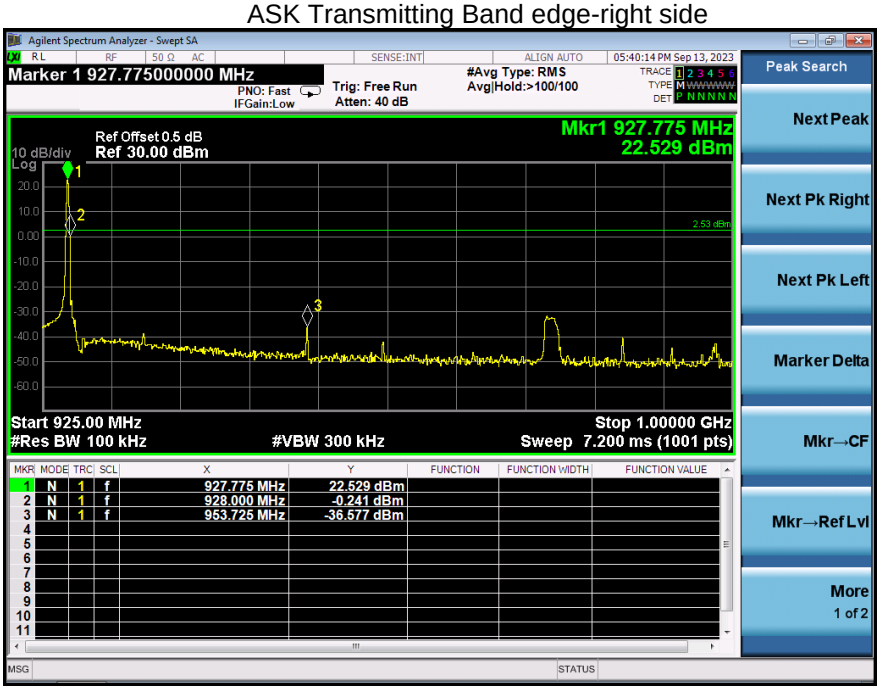


ASK Transmitting Band edge-left side

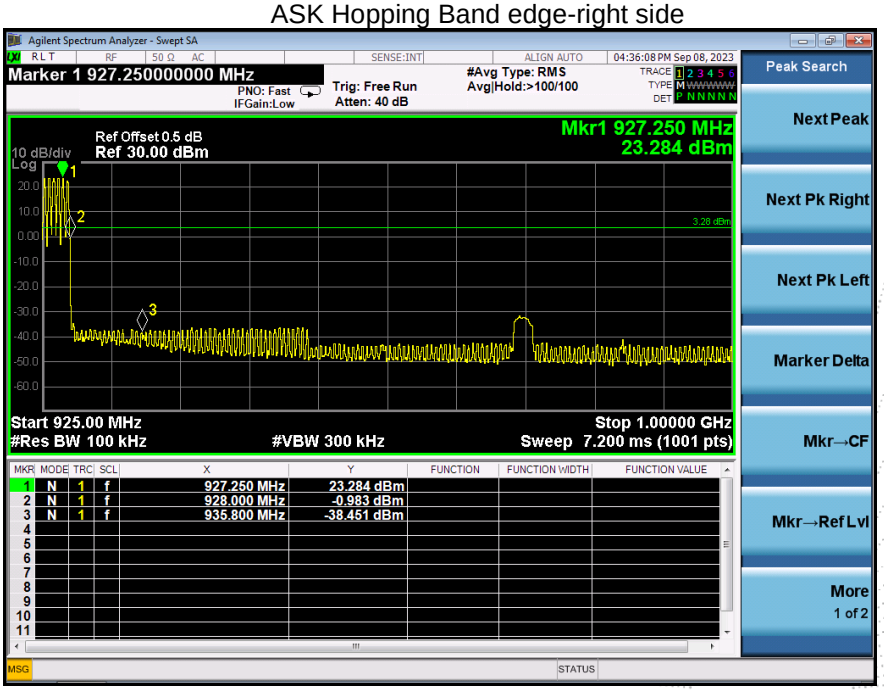
ASK Hopping Band edge-left side



ASK Transmitting Band edge-right side



ASK Hopping Band edge-right side



10. Occupy Bandwidth

10.1 Block Diagram Of Test Setup

10.2 Limit

For frequency hopping systems operating in the 902-928 MHz band: The maximum allowed 20 dB bandwidth of the hopping channel is 250 kHz

10.3 Test procedure

1. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
2. Set to the maximum power setting and enable the EUT transmit continuously.
3. Use the following spectrum analyzer settings for 20dB Bandwidth measurement.
Span = approximately 2 to 5 times the 20 dB bandwidth, centered on a hopping channel; 1%≤RBW≤5% of the 20 dB bandwidth; VBW≥3RBW;
Sweep = auto; Detector function = peak; Trace = max hold.
4. Measure and record the results in the test report.

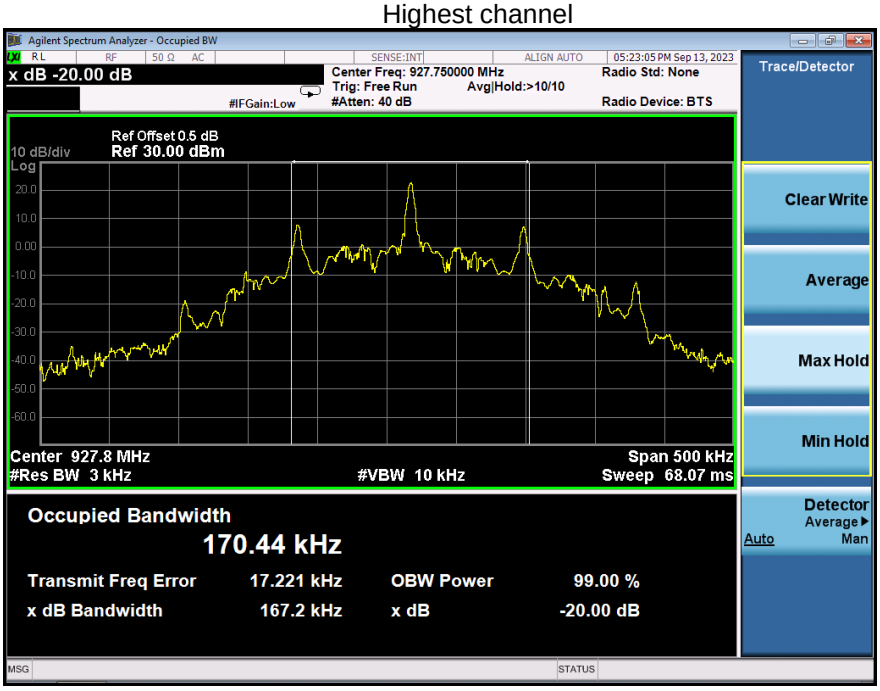
10.4 Test Result

Test channel		ASK		
		20dB(kHz)	Limit(kHz)	Conclusion
Lowest	Antenna1	166.7	≤250	PASS
Middlest		167.4	≤250	PASS
Highest		167.2	≤250	PASS

Lowest channel

Middlest channel

Highest channel



11. Conducted Output Power

11.1 Block Diagram Of Test Setup

11.2 Limit

For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.

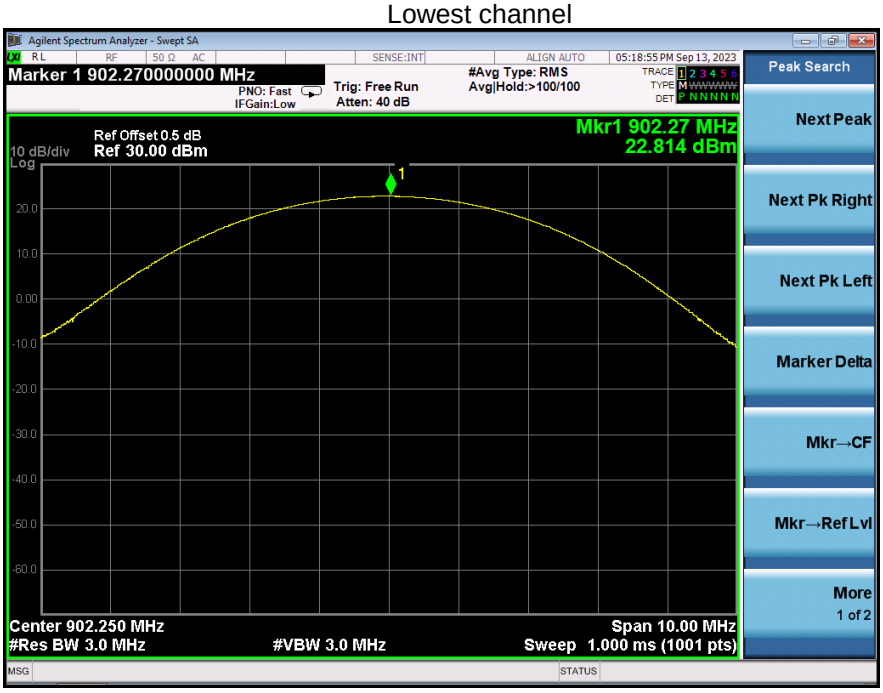
11.3 Test procedure

Use the following spectrum analyzer settings:
Span = approximately 5 times the 20 dB bandwidth,
centered on a hopping channel
RBW > the 20 dB bandwidth of the emission being measured VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold
Allow the trace to stabilize.
Use the marker-to-peak function to set the marker to the peak of the emission.

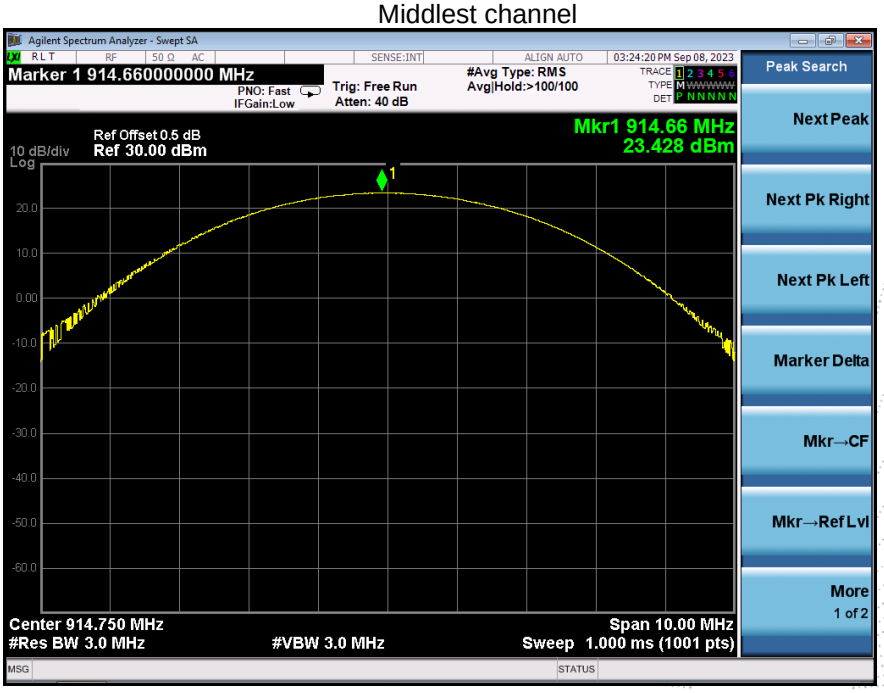
11.4 Test Result

ASK				
Test channel		**Peak Output Power (dBm)**	**Limit (dBm)**	**Result**
Lowest	Antenna1	22.814	30.00	PASS
Middlest		23.428	30.00	PASS
Highest		23.235	30.00	PASS

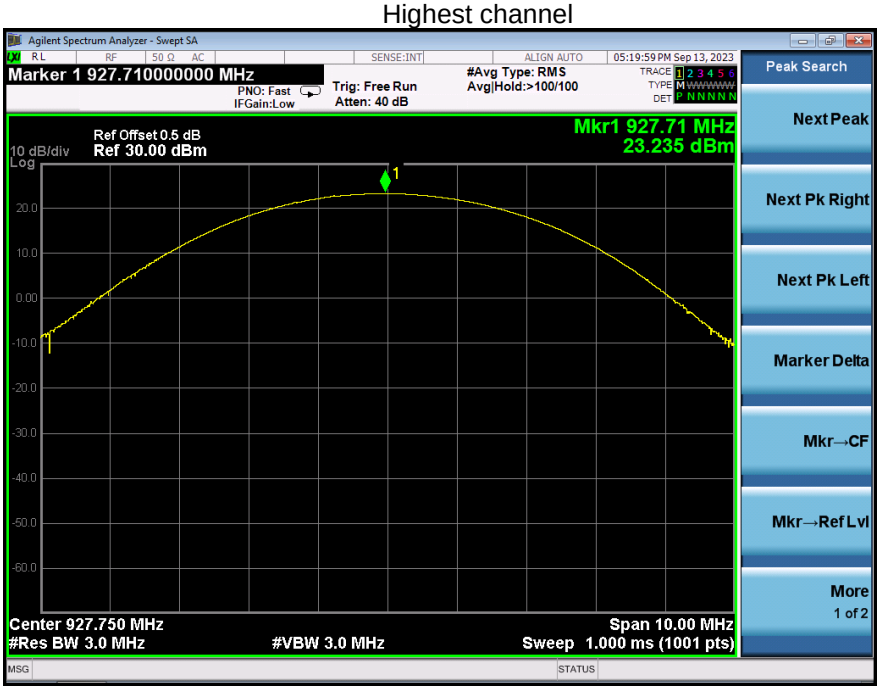
Lowest channel



Middlest channel

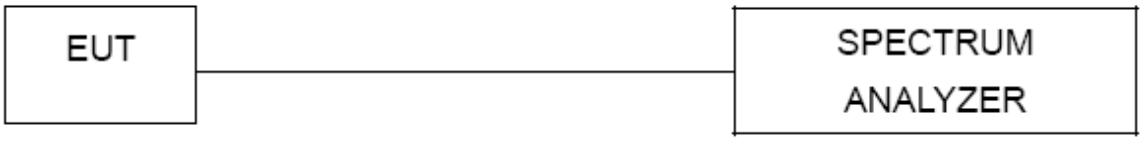


Highest channel



12. Hopping Channel Separation

12.1 Block Diagram Of Test Setup



12.2 Limit

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

12.3 Test procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 30kHz. VBW = 100kHz, Span = 1.0MHz. Sweep = auto; Detector Function = Peak. Trace = Max hold.
3. Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The limit is specified in one of the subparagraphs of this Section Submit this plot.

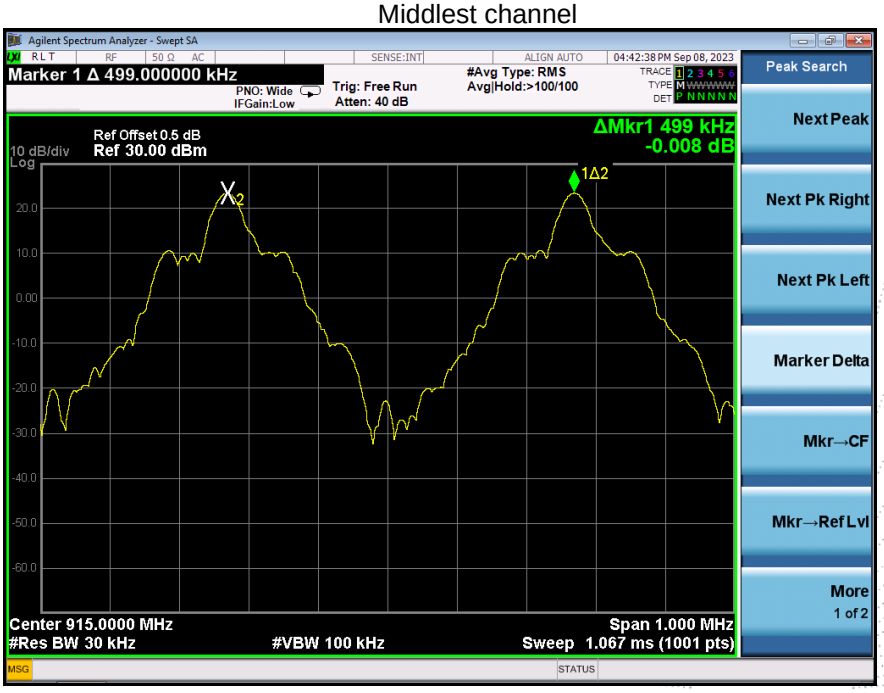
12.4 Test Result

For FHSS:

ASK				
Test channel		**Carrier Frequencies Separation (kHz)**	**Limit (kHz)**	**Result**
Lowest	Antenna1	500	166.7	PASS
Middlest		499	167.4	PASS
Highest		500	167.2	PASS

Lowest channel

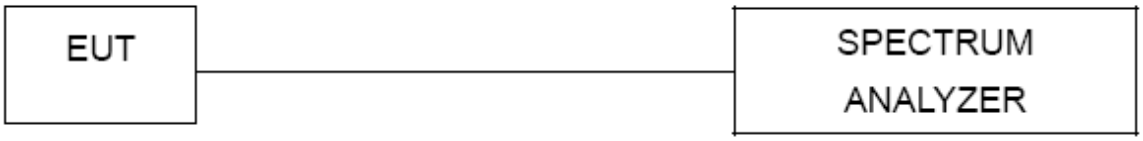
Middlest channel



Highest channel

13. Number Of Hopping Frequency

13.1 Block Diagram Of Test Setup



13.2 Limit

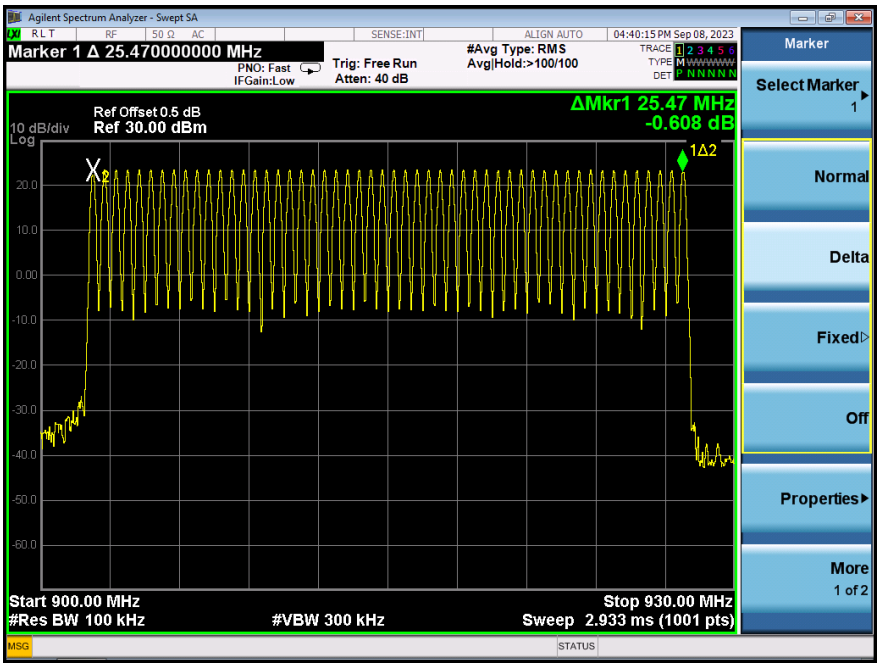
For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies.

13.3 Test procedure

1. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
2. Set to the maximum power setting and enable the EUT transmit continuously.
3. Enable the EUT hopping function.
4. Use the following spectrum analyzer settings: Span = the frequency band of operation; set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller; VBW≥RBW; Sweep = auto; Detector function = peak; Trace = max hold
5. The number of hopping frequency used is defined as the number of total channel.
6. Record the measurement data in report.

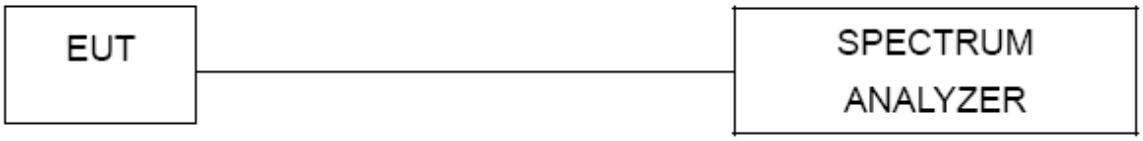
13.4 Test Result

Antenna	Hopping channel numbers	Limit	Result
Antenna1	52	50	PASS


Agilent Spectrum Analyzer - Swept SA
Marker 1 Δ 25.470000000 MHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 40 dB
#Avg Type: RMS
Avg|Hold:>100/100
04:40:15 PM Sep 08, 2023
Ref Offset 0.5 dB
10 dB/div
Ref 30.00 dBm
Log
ΔMkr1 25.47 MHz
-0.608 dB
1Δ2
Start 900.00 MHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 930.00 MHz
Sweep 2.933 ms (1001 pts)
Marker
Select Marker
1
Normal
Delta
Fixed
Off
Properties
More
1 of 2

14. Dwell Time

14.1 Block Diagram Of Test Setup



14.2 Limit

For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

14.3 Test procedure

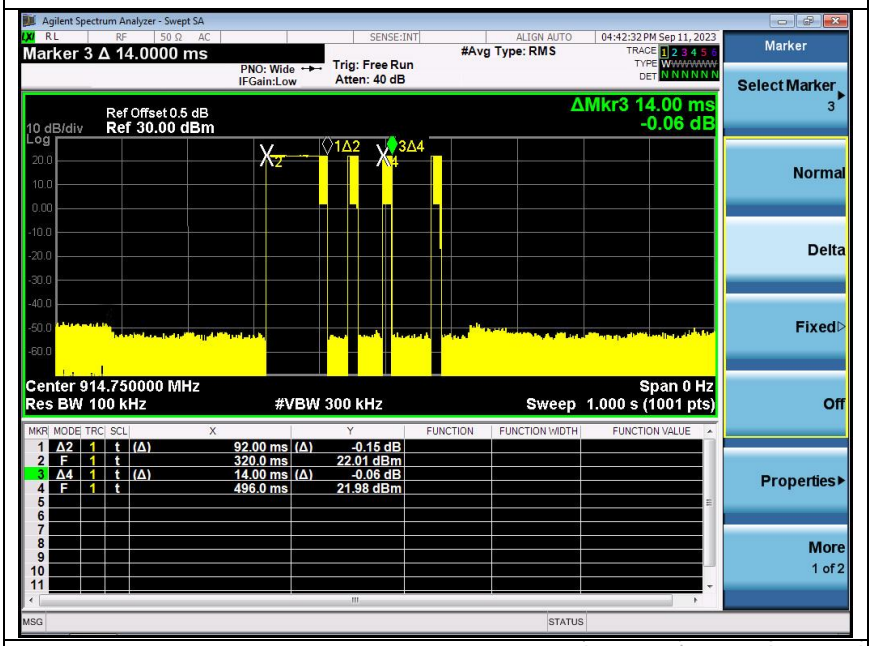
1. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
2. Set to the maximum power setting and enable the EUT transmit continuously.
3. Enable the EUT hopping function.
4. The spectrum analyzer is set to:
Center frequency = 914.75MHz, Span = zero
RBW = 100 kHz (RBW shall be ≤ channel spacing and where possible RBW should be set >> 1 / T, where T is the expected dwell time per channel),
VBW ≥ RBW Detector function = peak,
Trace = max hold
5. Measure and record the results in the test report.

14.4 Test Result

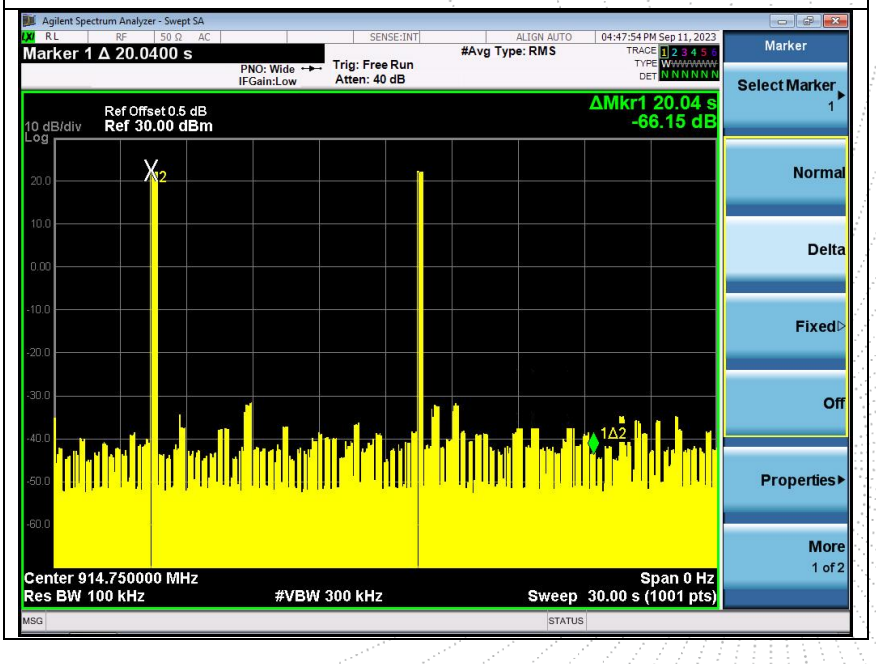
Length (ms)	Number	Dwell time (ms)	Limit (ms)	Result
134	2	268	400	PASS

Note: Length=92ms*1+14ms*3=134ms
Dwell time= Length* Number

Length (Hopping Mode)



Period (Hopping Mode)



15. Antenna Requirement

15.1 Limit

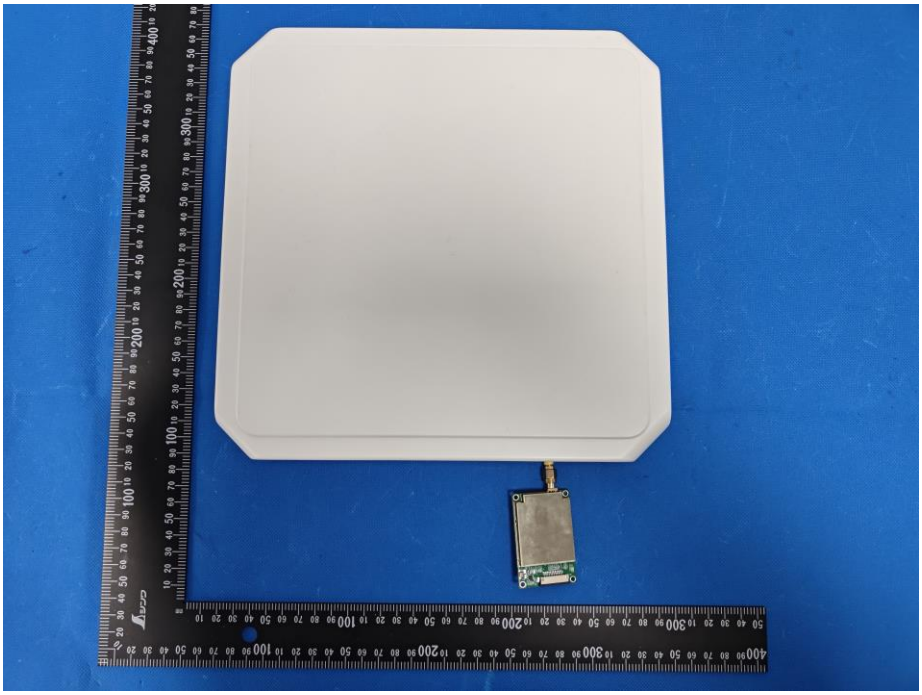
15.203 requirement: For intentional device, according to 15.203: an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

15.2 Test Result

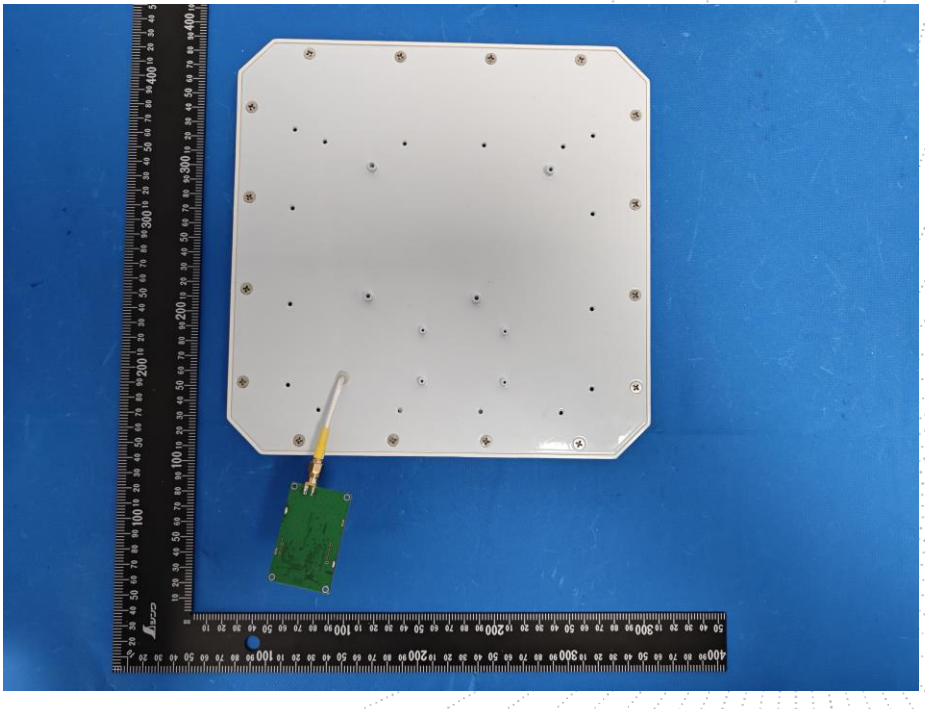
The EUT antenna is External antenna, antenna gain is 8.06 dBi, antenna connector type is RP-SMA, fulfill the requirement of this section.

16. EUT Photographs

EUT Photo 1



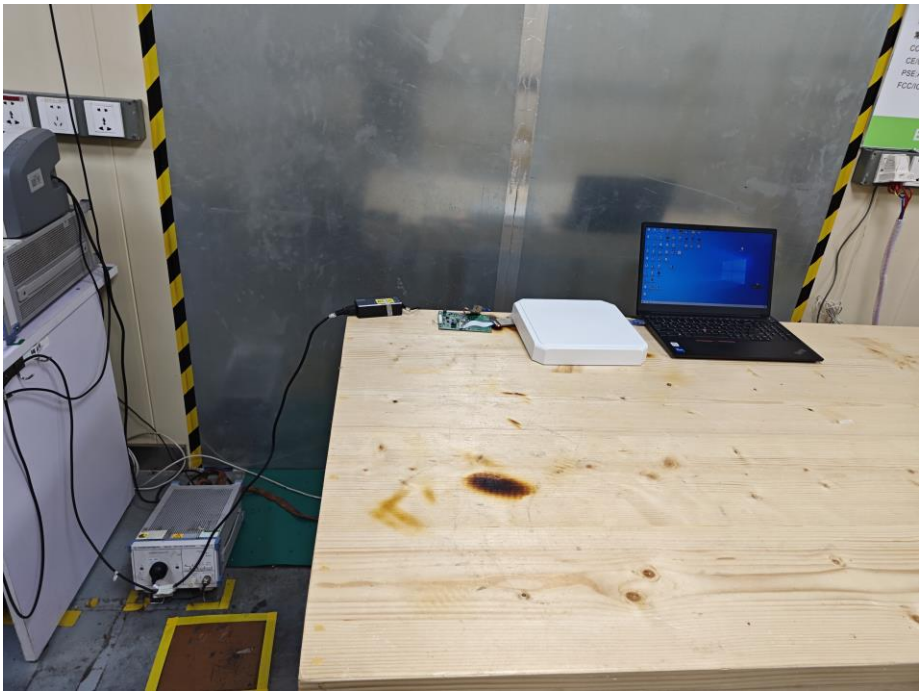
EUT Photo 2

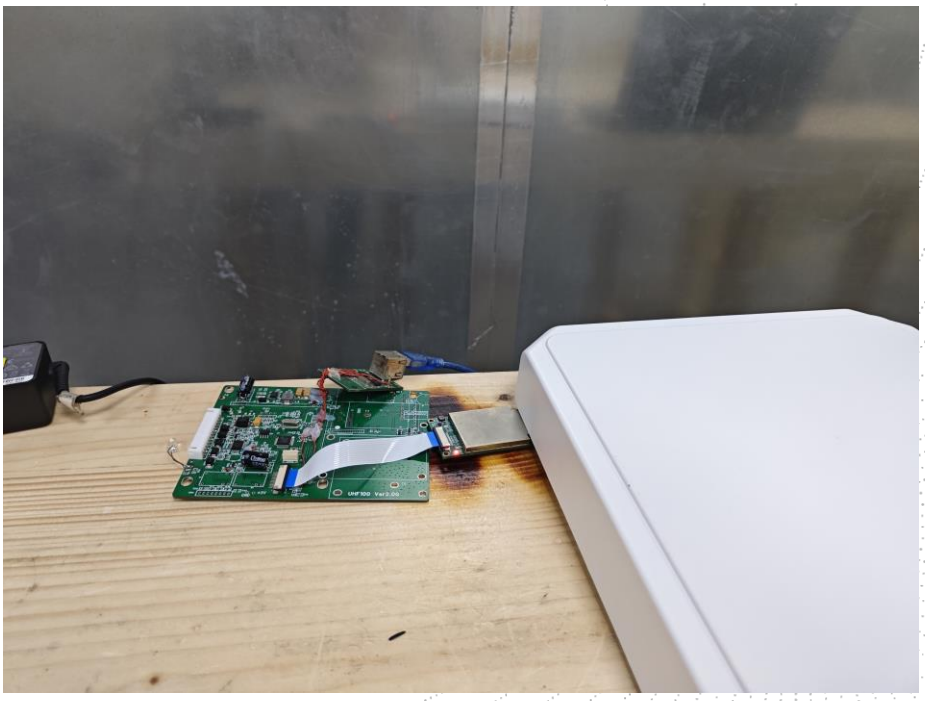


NOTE: Appendix-Photographs Of EUT Constructional Details

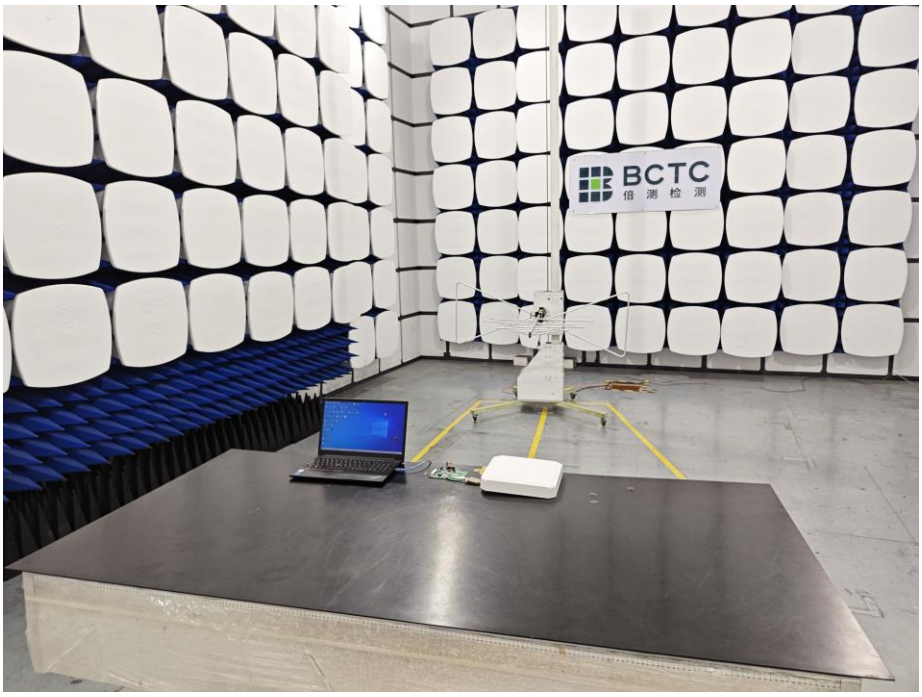
17. EUT Test Setup Photographs

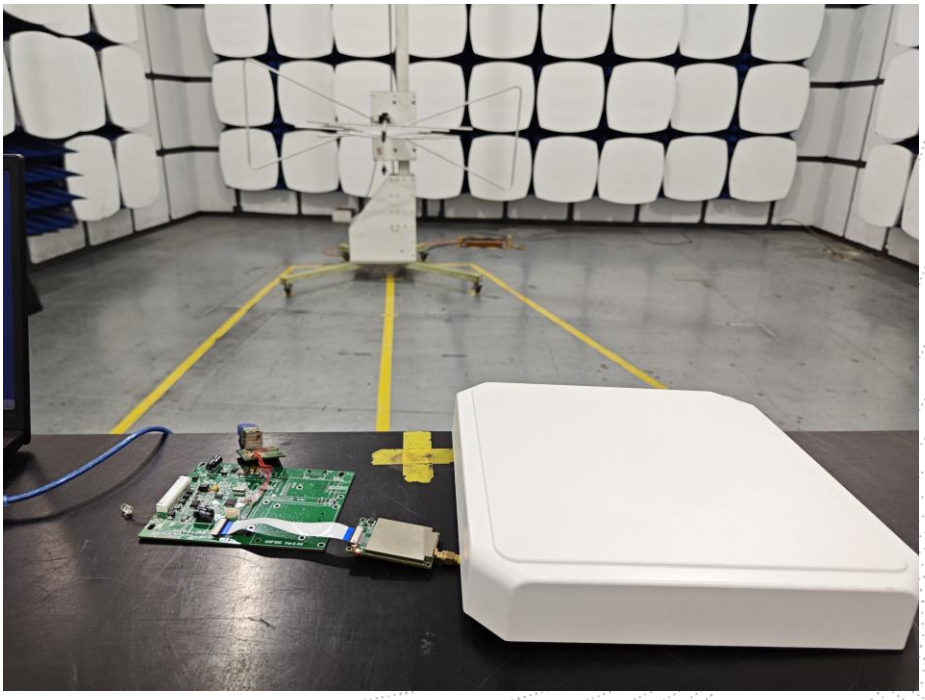
Conducted emissions

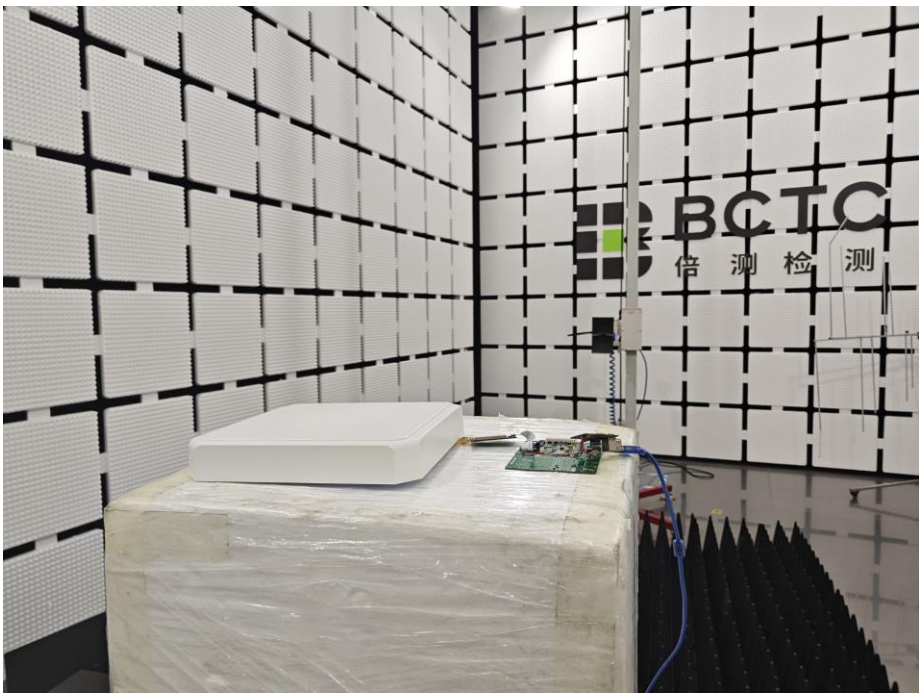




Radiated Measurement Photos






BCTC
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STATEMENT

1. The equipment lists are traceable to the national reference standards.

2. The test report can not be partially copied unless prior written approval is issued from our lab.

3. The test report is invalid without the "special seal for inspection and testing".

4. The test report is invalid without the signature of the approver.

5. The test process and test result is only related to the Unit Under Test.

6. Sample information is provided by the client and the laboratory is not responsible for its authenticity.

7. The quality system of our laboratory is in accordance with ISO/IEC17025.

8. If there is any objection to this test report, the client should inform issuing laboratory within 15 days from the date of receiving test report.

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