RADIO TEST REPORT

Report No.:STS2107056W01

Issued for

Wuxi Wisen Innovation Co., Ltd.

Office D501, 530 Mansion, Taihu International Hi-tech Zone,
Xinwu District, Wuxi, China

Product Name:	Mini Smart Gateway
Brand Name:	WiSenMeshWAN®
Model Name:	6003
Series Model:	600X
FCC ID:	2AUZW-600X
Test Standard:	FCC Part 15.247

Shenzhen STS Test Services Co., Ltd.
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TEST RESULT CERTIFICATION

Applicant's Name..... :	Wuxi Wisen Innovation Co., Ltd.
Address ..... :	Office D501, 530 Mansion, Taihu International Hi-tech Zone, Xinwu District, Wuxi, China
Manufacturer's Name ..... :	Wuxi Wisen Innovation Co., Ltd.
Address ..... :	Office D501, 530 Mansion, Taihu International Hi-tech Zone, Xinwu District, Wuxi, China

Product Description

Product Name ..... :	Mini Smart Gateway
Brand Name ..... :	WiSenMeshWAN®
Model Name ..... :	6003
Series Model ..... :	600X
Test Standards..... :	FCC Part15.247
Test Procedure ..... :	ANSI C63.10-2013

This device described above has been tested by STS, the test results show that the equipment under test (EUT) is in compliance with the FCC requirements. And it is applicable only to the tested sample identified in the report.
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Date of Test..... :	
Date of receipt of test item ..... :	08 July 2021
Date (s) of performance of tests..... :	08 July 2021 ~ 23 July 2021
Date of Issue..... :	23 July 2021
Test Result..... :	**Pass**

Testing Engineer : Chris Chen

(Chris Chen)

Technical Manager : Sean She

(Sean she)

Authorized Signatory : Vita Li

(Vita Li)

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Revision History

Rev.	Issue Date	Report NO.	Effect Page	Contents
00	23 July 2021	STS2107056W01	ALL	Initial Issue

1. SUMMARY OF TEST RESULTS

Test procedures according to the technical standards:
KDB 558074 D01 15.247 Meas Guidance v05r02.

FCC Part 15.247,Subpart C			
Standard Section	Test Item	Judgment	Remark
15.207	Conducted Emission	PASS	--
15.247 (a)(2)	6dB Bandwidth	PASS	--
15.247 (b)(3)	Output Power	PASS	--
15.209	Radiated Spurious Emission	PASS	--
15.247 (d)	Conducted Spurious & Band Edge Emission	PASS	--
15.247 (e)	Power Spectral Density	PASS	--
15.205	Restricted bands of operation	PASS	--
Part 15.247(d)/ Part 15.209(a)	Band Edge Emission	PASS	--
15.203	Antenna Requirement	PASS	--

NOTE:

(1) 'N/A' denotes test is not applicable in this Test Report.

(2) All tests are according to ANSI C63.10-2013.

1.1 TEST FACTORY

SHENZHEN STS TEST SERVICES CO., LTD
Add. : A 1/F, Building B, Zhuoke Science Park, No.190 Chongqing Road, HepingShequ, Fuyong Sub-District, Bao'an District, Shenzhen, Guang Dong, China
FCC test Firm Registration Number: 625569
IC test Firm Registration Number: 12108A
A2LA Certificate No.: 4338.01

1.2 MEASUREMENT UNCERTAINTY

The reported uncertainty of measurement **y** ± **U**, where expended uncertainty **U** is based on a standard uncertainty multiplied by a coverage factor of **k=2**, providing a level of confidence of approximately **95** %.

No.	Item	Uncertainty
1	RF output power, conducted	±0.68dB
2	Unwanted Emissions, conducted	±2.988dB
3	All emissions, radiated 9K-30MHz	±2.84dB
4	All emissions, radiated 30M-1GHz	±4.39dB
5	All emissions, radiated 1G-6GHz	±5.10dB
6	All emissions, radiated>6G	±5.48dB
7	Conducted Emission (9KHz-150KHz)	±2.79dB
8	Conducted Emission (150KHz-30MHz)	±2.80dB

2. GENERAL INFORMATION

2.1 GENERAL DESCRIPTION OF THE EUT

Product Name	Mini Smart Gateway
Trade Name	WiSenMeshWAN®
Model Name	6003
Series Model	600X
Model Difference	600X, Where X can be 0-F (Hexadecimal).
Product Description	The EUT is a Mini Smart Gateway Operation Frequency: 902MHz-928MHz Modulation Type: FSK/LoRa Number Of Channel: Please refer to the Note 2. Antenna Designation: Please refer to the Note 3. Antenna Gain (dBi) 5dBi
Channel List	Please refer to the Note 2.
Rating	Input: DC 5V/0.3A
Hardware version number	V1.1
Software version number	V1332
Connecting I/O Port(s)	Please refer to the Note 1.

Note:

1. For a more detailed features description, please refer to the manufacturer's specifications or the User Manual.
2.

Channel List			
Channel	Frequency (MHz)	Channel	Frequency (MHz)
01	905	04	920
02	910	05	925
03	915	--	--

3. Table for Filed Antenna

Ant.	Brand	Model Name	Antenna Type	Connector	Gain (dBi)	NOTE
1	WiSenMesh WAN®	6003	External	N/A	5dBi	ANT

Note: The antenna information refer the manufacturer provide report, applicable only to the tested sample identified in the report.

2.2 DESCRIPTION OF THE TEST MODES

For conducted test items and radiated spurious emissions
Each of these EUT operation mode(s) or test configuration mode(s) mentioned below was evaluated respectively.

Worst Mode	Description	Data/Modulation
Mode 1	TX CH01(905MHz)	FSK/LoRa
Mode 2	TX CH03(915MHz)	FSK/LoRa
Mode 3	TX CH05(925MHz)	FSK/LoRa

For AC Conducted Emission

Test Case	
AC Conducted Emission	Mode 4 : Keeping TX

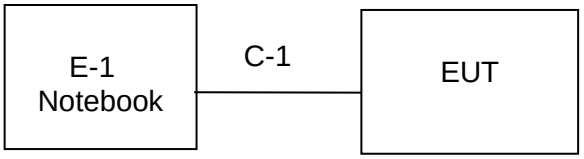
2.3 TEST SOFTWARE AND POWER LEVEL

During testing channel & power controlling software provided by the customer was used to control the operating channel as well as the output power level.

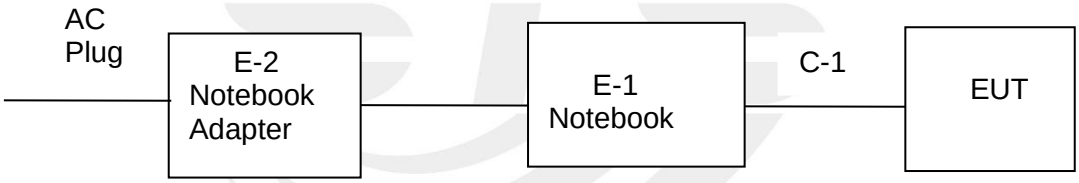
RF Function	Type	Mode Or Modulation type	ANT Gain(dBi)	Power Class	Software For Testing
Other SRD	902-928MHz	FSK/LoRa	0	Default	The EUT has signal transmission when it is powered on

2.4 BLOCK DIAGRAM SHOWING THE CONFIGURATION OF SYSTEM TESTED

Radiated Spurious Emission Test



Conducted Emission Test



2.5 DESCRIPTION OF NECESSARY ACCESSORIES AND 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.

Necessary accessories

Item	Equipment	Mfr/Brand	Model/Type No.	Length	Note
N/A	N/A	N/A	N/A	N/A	N/A

Support units

Item	Equipment	Mfr/Brand	Model/Type No.	Length	Note
E-1	Notebook	LENOVO	ThinkPad E470	N/A	N/A
E-2	Notebook Adapter	LENOVO	ADLX45DLC3A	N/A	N/A
C-1	USB Cable	N/A	N/A	80cm	N/A

Note:

(1) For detachable type I/O cable should be specified the length in cm in『Length』column.
(2) “YES” is means “with core”; “NO” is means “without core”.

2.6 EQUIPMENTS LIST

Radiation Test equipment

Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until
Test Receiver	R&S	ESCI	101427	2020.10.12	2021.10.11
Signal Analyzer	R&S	FSV 40-N	101823	2020.10.10	2021.10.09
Active loop Antenna	ZHINAN	ZN30900C	16035	2021.04.11	2022.04.10
Bilog Antenna	TESEQ	CBL6111D	34678	2020.10.12	2022.10.11
Horn Antenna	SCHWARZBECK	BBHA 9120D	02014	2019.10.15	2021.10.14
SHF-EHF Horn Antenna (18G-40GHz)	A-INFO	LB-180400-KF	J211020657	2020.10.12	2022.10.11
Pre-Amplifier (0.1M-3GHz)	EM	EM330	060665	2020.10.12	2021.10.11
Pre-Amplifier (1G-18GHz)	SKET	LNPA-01018G-45	SK2018080901	2020.10.12	2021.10.11
Pre-Amplifier (18G-40GHz)	SKET	LNPA-1840-50	SK2018101801	2020.10.10	2021.10.09
Temperature & Humidity	HH660	Mieo	N/A	2020.10.13	2021.10.12
Turn table	EM	SC100_1	60531	N/A	N/A
Antenna mast	EM	SC100	N/A	N/A	N/A
Test SW	FARAD	EZ-EMC(Ver.STSLAB-03A1 RE)			

Conduction Test equipment

Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until
Test Receiver	R&S	ESCI	101427	2020.10.12	2021.10.11
LISN	R&S	ENV216	101242	2020.10.12	2021.10.11
LISN	EMCO	3810/2NM	23625	2020.10.12	2021.10.11
Temperature & Humidity	HH660	Mieo	N/A	2020.10.13	2021.10.12
Test SW	FARAD	EZ-EMC(Ver.STSLAB-03A1 CE)			

RF Connected Test

Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until
Power Sensor	Keysight	U2021XA	MY55520005	2020.10.10	2021.10.09
			MY55520006	2020.10.10	2021.10.09
			MY56120038	2020.10.10	2021.10.09
			MY56280002	2020.10.10	2021.10.09
Signal Analyzer	Agilent	N9020A	MY51110105	2021.03.04	2022.03.03
Temperature & Humidity	HH660	Mieo	N/A	2020.10.13	2021.10.12
MIMO Power measurement test Set	Keysight	U2021XA	MY55520005	2020.10.10	2021.10.09
Test SW	FARAD	EZ-EMC(Ver.STSLAB-03A1 RE)			

3. EMC EMISSION TEST

3.1 CONDUCTED EMISSION MEASUREMENT

3.1.1 POWER LINE CONDUCTED EMISSION LIMITS

The radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table.

FREQUENCY (MHz)	Conducted Emission limit (dBuV)	
	Quasi-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

Note:

(1) The tighter limit applies at the band edges.

(2) The limit of " * " marked band means the limitation decreases linearly with the logarithm of the frequency in the range.

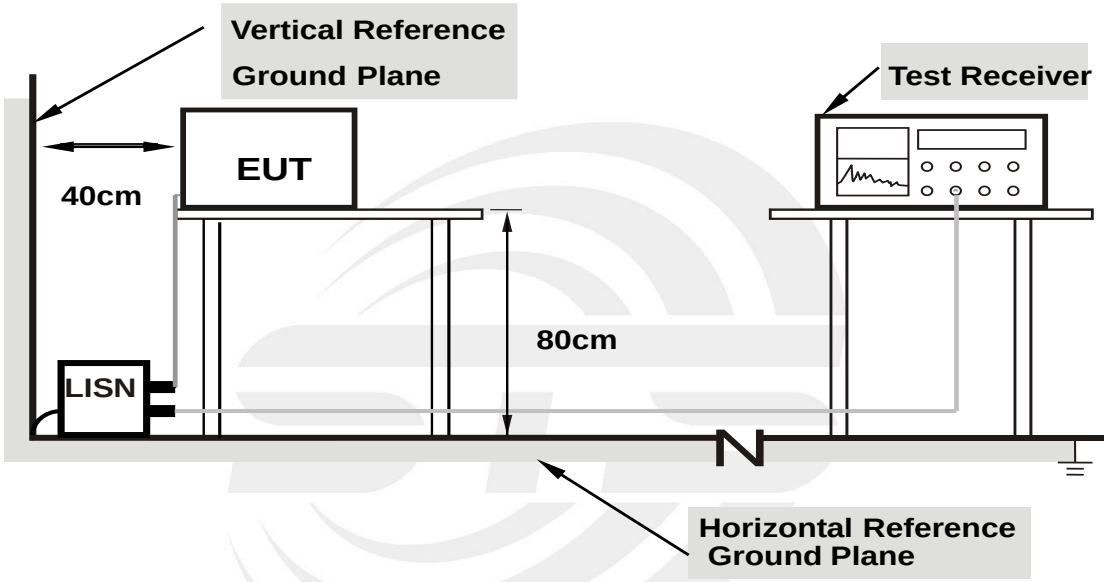
The following table is the setting of the receiver

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

3.2 TEST PROCEDURE

a. The EUT is 0.8 m from the horizontal ground plane and 0.4 m from the vertical ground plane with EUT being connected to the power mains through a line impedance stabilization network (LISN). All other support equipments are powered from additional LISN(s). The LISN provides 50 Ohm/ 50uH of coupling impedance for the measuring instrument.
b. Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.
c. I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.
d. LISN is at least 80 cm from the nearest part of EUT chassis.
e. For the actual test configuration, please refer to the related Item –EUT Test Photos.

3.3 TEST SETUP



Note: 1. Support units were connected to second LISN.

2. Both of LISNs (AMN) are 80 cm from EUT and at least 80 cm from other units and other metal planes support units.

3.4 EUT OPERATING CONDITIONS

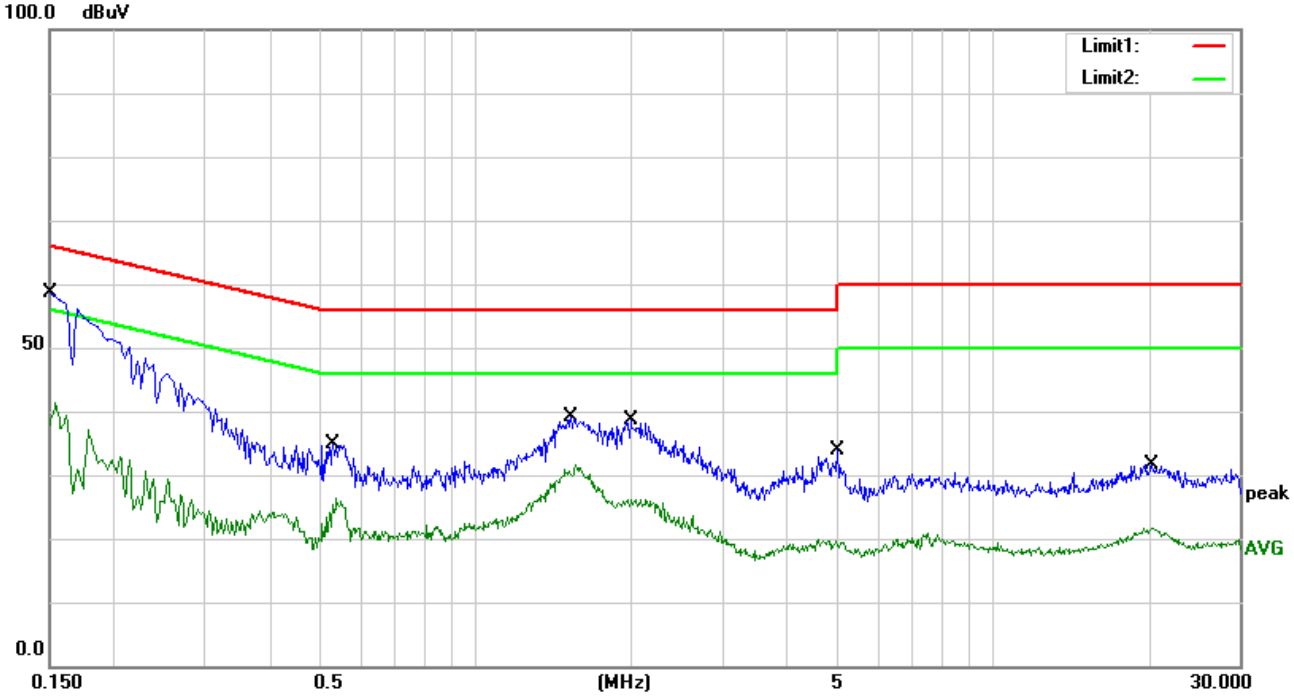
The EUT was configured for testing in a typical fashion (as a customer would normally use it). The EUT has been programmed to continuously transmit during test. This operating condition was tested and used to collect the included data.

3.5 TEST RESULTS

Temperature:	26.3(C)	Relative Humidity:	62%RH
Test Voltage:	DC 5V from PC (AC 120V/60Hz)	Phase:	L
Test Mode:	Mode 4		

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Remark
1	0.1500	38.33	20.29	58.62	66.00	-7.38	QP
2	0.1500	21.01	20.29	41.30	56.00	-14.70	AVG
3	0.5300	14.31	20.47	34.78	56.00	-21.22	QP
4	0.5300	5.82	20.47	26.29	46.00	-19.71	AVG
5	1.5340	18.85	20.35	39.20	56.00	-16.80	QP
6	1.5340	11.34	20.35	31.69	46.00	-14.31	AVG
7	1.9940	18.14	20.39	38.53	56.00	-17.47	QP
8	1.9940	5.86	20.39	26.25	46.00	-19.75	AVG
9	5.0180	13.25	20.53	33.78	60.00	-26.22	QP
10	5.0180	-0.43	20.53	20.10	50.00	-29.90	AVG
11	20.3740	8.84	22.89	31.73	60.00	-28.27	QP
12	20.3740	-1.26	22.89	21.63	50.00	-28.37	AVG

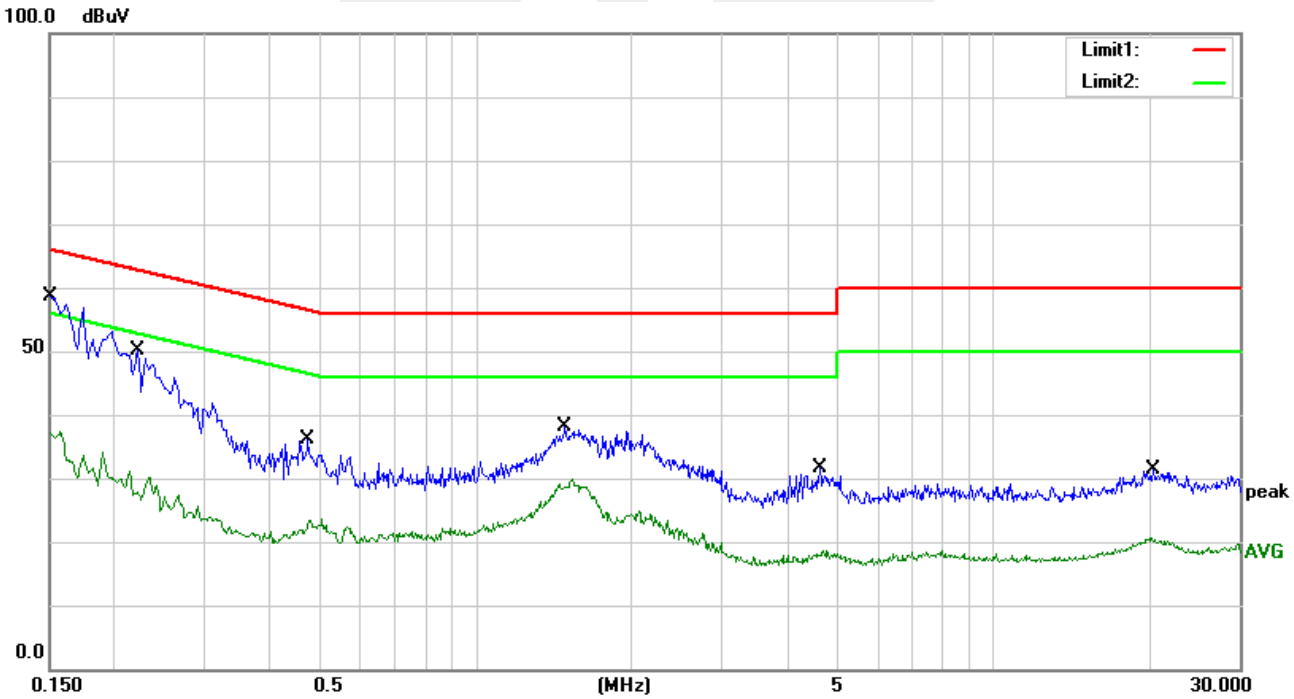
Remark:
1. All readings are Quasi-Peak and Average values.
2. Margin = Result (Result =Reading + Factor)–Limit.
3. Factor=LISN factor+Cable loss+Limiter (10dB).



Temperature:	26.3(C)	Relative Humidity:	62%RH
Test Voltage:	DC 5V from PC (AC 120V/60Hz)	Phase:	N
Test Mode:	Mode 4		

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Remark
1	0.1500	38.43	20.29	58.72	66.00	-7.28	QP
2	0.1500	17.07	20.29	37.36	56.00	-18.64	AVG
3	0.2220	29.72	20.49	50.21	62.74	-12.53	QP
4	0.2220	13.61	20.49	34.10	52.74	-18.64	AVG
5	0.4740	15.64	20.51	36.15	56.44	-20.29	QP
6	0.4740	3.10	20.51	23.61	46.44	-22.83	AVG
7	1.4900	17.67	20.34	38.01	56.00	-17.99	QP
8	1.4900	9.42	20.34	29.76	46.00	-16.24	AVG
9	4.6380	11.06	20.52	31.58	56.00	-24.42	QP
10	4.6380	-1.93	20.52	18.59	46.00	-27.41	AVG
11	20.4260	8.54	22.89	31.43	60.00	-28.57	QP
12	20.4260	-2.38	22.89	20.51	50.00	-29.49	AVG

Remark:
1. All readings are Quasi-Peak and Average values.
2. Margin = Result (Result =Reading + Factor)–Limit.
3. Factor=LISN factor+Cable loss+Limiter (10dB).



4. RADIATED EMISSION MEASUREMENT

4.1 RADIATED EMISSION LIMITS

In any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the Restricted band specified on Part15.205(a)&209(a) limit in the table and according to ANSI C63.10-2013 below has to be followed.

LIMITS OF RADIATED EMISSION MEASUREMENT (Frequency Range 9kHz-1000MHz)

Frequencies (MHz)	Field Strength (micorvolts/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

LIMITS OF RADIATED EMISSION MEASUREMENT (Above 1000MHz)

FREQUENCY (MHz)	(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).

LIMITS OF RESTRICTED FREQUENCY BANDS

FREQUENCY (MHz)	FREQUENCY (MHz)	FREQUENCY (MHz)	FREQUENCY (GHz)
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
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	Above 38.6
13.36-13.41			

For Radiated Emission

Spectrum Parameter	Setting
Attenuation	Auto
Detector	Peak/QP/AV
Start Frequency	9 KHz/150KHz(Peak/QP/AV)
Stop Frequency	150KHz/30MHz(Peak/QP/AV)
RB / VB (emission in restricted band)	200Hz (From 9kHz to 0.15MHz)/ 9KHz (From 0.15MHz to 30MHz); 200Hz (From 9kHz to 0.15MHz)/ 9KHz (From 0.15MHz to 30MHz)

Spectrum Parameter	Setting
Attenuation	Auto
Detector	Peak/QP
Start Frequency	30 MHz(Peak/QP)
Stop Frequency	1000 MHz (Peak/QP)
RB / VB (emission in restricted band)	120 KHz / 300 KHz

Spectrum Parameter	Setting
Attenuation	Auto
Detector	Peak/AV
Start Frequency	1000 MHz(Peak/AV)
Stop Frequency	10th carrier hamonic(Peak/AV)
RB / VB (emission in restricted band)	1 MHz / 3 MHz(Peak) 1 MHz/1/T MHz(AVG)

For Restricted band

Spectrum Parameter	Setting
Detector	Peak/AV
Start/Stop Frequency	Lower Band Edge: 890 to 910 MHz Upper Band Edge: 920 to 940 MHz
RB / VB	1 MHz / 3 MHz(Peak) 1 MHz/1/T MHz(AVG)

Receiver Parameter	Setting
Start ~ Stop Frequency	9kHz~90kHz / RB 200Hz for PK & AV
Start ~ Stop Frequency	90kHz~110kHz / RB 200Hz for QP
Start ~ Stop Frequency	110kHz~490kHz / RB 200Hz for PK & AV
Start ~ Stop Frequency	490kHz~30MHz / RB 9kHz for QP
Start ~ Stop Frequency	30MHz~1000MHz / RB 120kHz for QP

4.2 TEST PROCEDURE

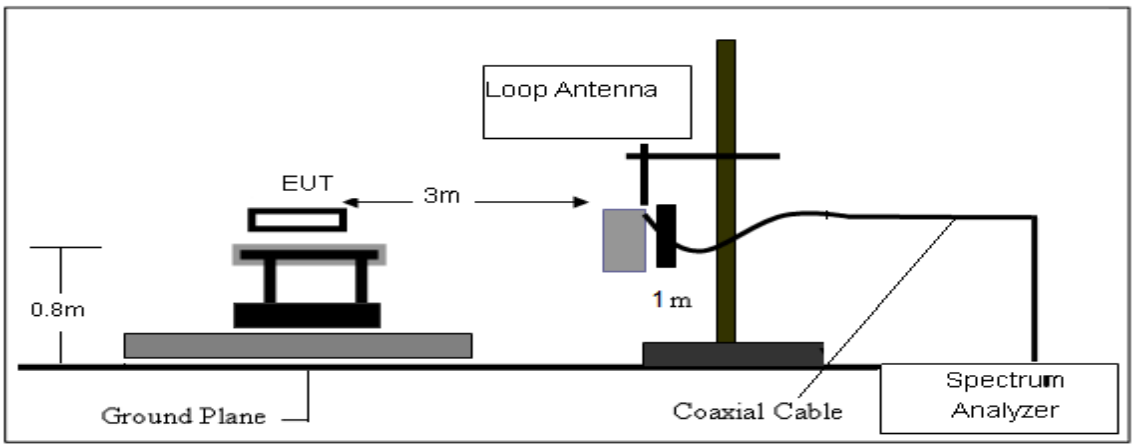
a. The measuring distance at 3 m shall be used for measurements at frequency 0.009MHz up to 1GHz, and above 1GHz.
b. The EUT was placed on the top of a rotating table 0.8 m (above 1GHz is 1.5 m) above the ground at a 3 m anechoic chamber test site. The table was rotated 360 degree to determine the position of the highest radiation.
c. The height of the equipment shall be 0.8 m (above 1GHz is 1.5 m); the height of the test antenna shall vary between 1 m to 4 m. Horizontal and vertical polarization of the antenna are set to make the measurement.
d. The initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and QuasiPeak detector mode will be re-measured.
e. If the Peak Mode measured value is compliance with and lower than Quasi Peak Mode Limit, the EUT shall be deemed to meet QP Limits and no additional QP Mode measurement was performed.
f. For the actual test configuration, please refer to the related Item –EUT Test Photos.

Note:

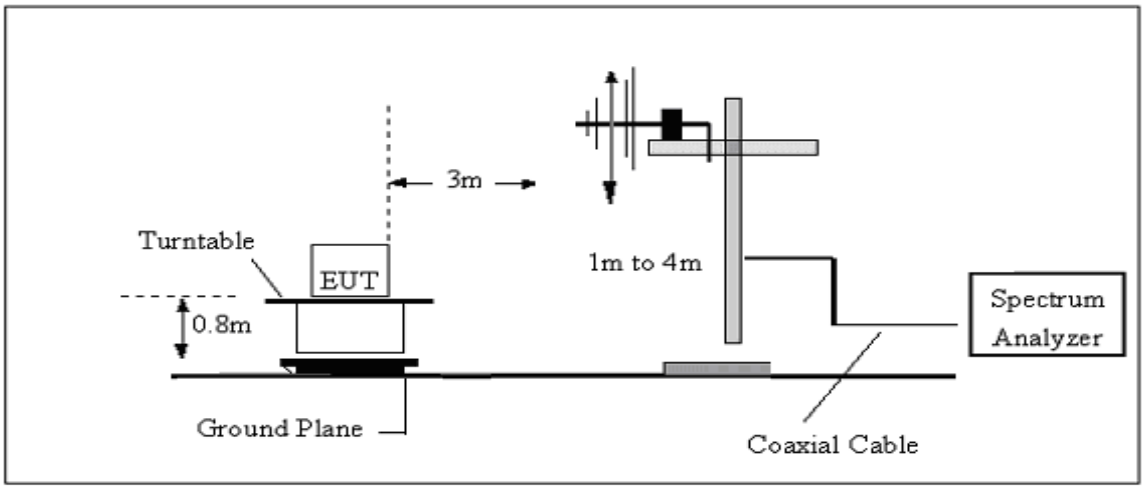
Both horizontal and vertical antenna polarities were tested and performed pretest to three orthogonal axis. The worst case emissions were reported.

4.3 TEST SETUP

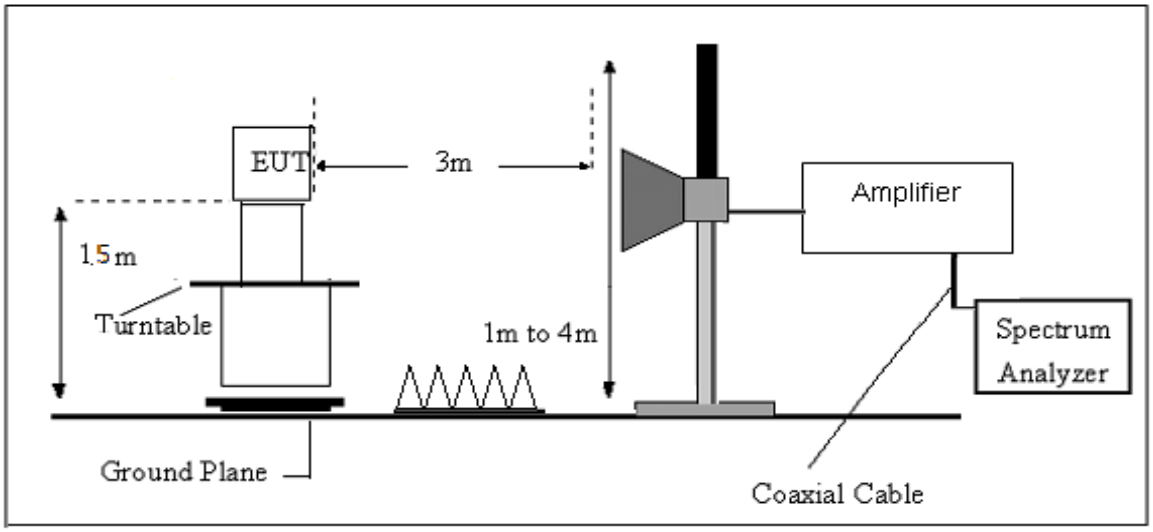
(A) Radiated Emission Test-Up Frequency Below 30MHz



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



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



4.4 EUT OPERATING CONDITIONS

Please refer to section 3.4 of this report.

4.5 FIELD STRENGTH CALCULATION

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CL - AG

Where

FS = Field Strength

CL = Cable Attenuation Factor (Cable Loss)

RA = Reading Amplitude

AG = Amplifier Gain

AF = Antenna Factor

For example

Frequency	FS	RA	AF	CL	AG	Factor
(MHz)	(dBμV/m)	(dBμV/m)	(dB)	(dB)	(dB)	(dB)
300	40	58.1	12.2	1.6	31.9	-18.1

Factor=AF+CL-AG

4.6 TEST RESULTS

(Between 9KHz – 30 MHz)

Temperature:	23.1(C)	Relative Humidtity:	60%RH
Test Voltage:	DC 5V	Polarization:	--
Test Mode:	TX Mode		

Freq.	Reading	Limit	Margin	State
(MHz)	(dBuV/m)	(dBuV/m)	(dB)	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);

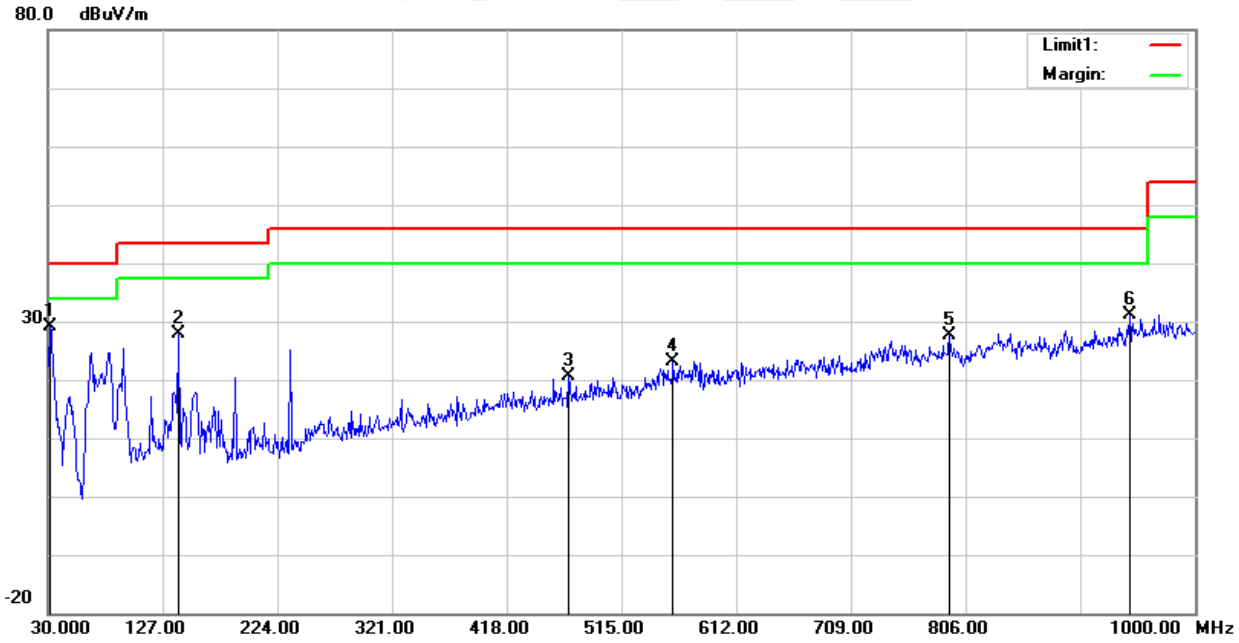
Limit line = specific limits(dBuv) + distance extrapolation factor.

(30MHz -1000MHz)

Temperature:	23.1(C)	Relative Humidity:	60%RH
Test Voltage:	DC 5V	Phase:	Horizontal
Test Mode:	Mode 1/2/3 (Mode 1 worst mode)		

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	31.9400	42.97	-13.86	29.11	40.00	-10.89	QP
2	140.5800	45.90	-18.05	27.85	43.50	-15.65	QP
3	470.3800	29.55	-8.99	20.56	46.00	-25.44	QP
4	558.6500	28.69	-5.52	23.17	46.00	-22.83	QP
5	792.4200	29.74	-1.99	27.75	46.00	-18.25	QP
6	944.7100	29.71	1.48	31.19	46.00	-14.81	QP

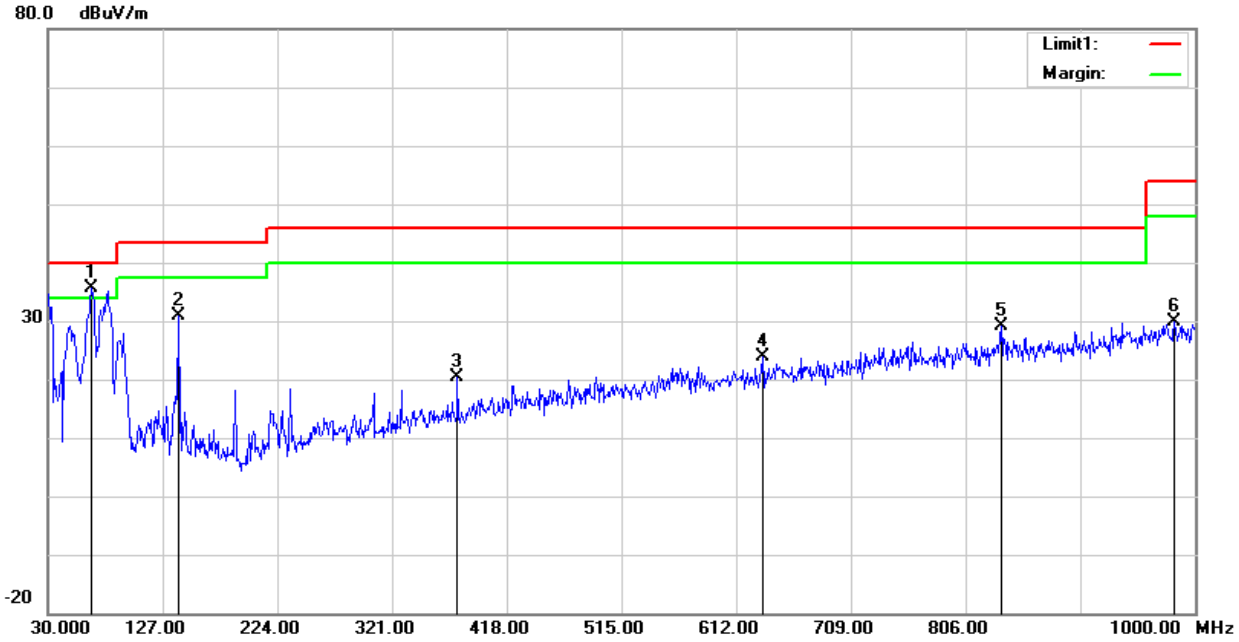
Remark:
1. Margin = Result (Result =Reading + Factor)–Limit
2. Factor= Antenna factor+Cable attenuation factor(cable loss)-Amplifier gain



Temperature:	23.1(C)	Relative Humidity:	60%RH
Test Voltage:	DC 5V	Phase:	Vertical
Test Mode:	Mode 1/2/3 (Mode 1 worst mode)		

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	66.8600	60.98	-25.44	35.54	40.00	-4.46	QP
2	140.5800	48.83	-18.05	30.78	43.50	-12.72	QP
3	376.2900	32.66	-12.35	20.31	46.00	-25.69	QP
4	634.3100	28.77	-4.95	23.82	46.00	-22.18	QP
5	836.0700	29.59	-0.50	29.09	46.00	-16.91	QP
6	982.5400	27.44	2.52	29.96	54.00	-24.04	QP

Remark:
1. Margin = Result (Result =Reading + Factor)–Limit
2. Factor= Antenna factor+Cable attenuation factor(cable loss)-Amplifier gain



(1GHz-25GHz) Spurious emission Requirements

FSK/LoRa

Frequency	Meter Reading	Amplifier	Loss	Antenna Factor	Corrected Factor	Emission Level	Limits	Margin	Detector	Comment
(MHz)	(dBμV)	(dB)	(dB)	(dB/m)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	Type	
Low Channel (FSK/LoRa /905 MHz)										
1230.06	60.92	44.70	6.70	28.20	-9.80	51.12	74.00	-22.88	PK	Vertical
1230.06	49.99	44.70	6.70	28.20	-9.80	40.19	54.00	-13.81	AV	Vertical
1230.08	60.80	44.70	6.70	28.20	-9.80	51.00	74.00	-23.00	PK	Horizontal
1230.08	51.10	44.70	6.70	28.20	-9.80	41.30	54.00	-12.70	AV	Horizontal
1810.14	59.24	44.20	9.04	31.60	-3.56	55.68	74.00	-18.32	PK	Vertical
1810.14	49.36	44.20	9.04	31.60	-3.56	45.80	54.00	-8.20	AV	Vertical
1810.23	58.83	44.20	9.04	31.60	-3.56	55.27	74.00	-18.73	PK	Horizontal
1810.23	49.61	44.20	9.04	31.60	-3.56	46.05	54.00	-7.95	AV	Horizontal
2019.40	48.02	44.20	9.86	32.00	-2.34	45.68	74.00	-28.32	PK	Vertical
2019.40	39.30	44.20	9.86	32.00	-2.34	36.96	54.00	-17.04	AV	Vertical
2019.39	48.00	44.20	9.86	32.00	-2.34	45.66	74.00	-28.34	PK	Horizontal
2019.39	38.74	44.20	9.86	32.00	-2.34	36.40	54.00	-17.60	AV	Horizontal
2714.99	54.12	43.50	11.40	35.50	3.40	57.52	74.00	-16.48	PK	Vertical
2714.99	43.66	43.50	11.40	35.50	3.40	47.06	54.00	-6.94	AV	Vertical
2714.91	54.03	43.50	11.40	35.50	3.40	57.43	74.00	-16.57	PK	Horizontal
2714.91	43.69	43.50	11.40	35.50	3.40	47.09	54.00	-6.91	AV	Horizontal
Middle Channel (FSK/LoRa /915 MHz)										
1243.06	61.32	44.70	6.70	28.20	-9.80	51.52	74.00	-22.48	PK	Vertical
1243.06	50.86	44.70	6.70	28.20	-9.80	41.06	54.00	-12.94	AV	Vertical
1242.98	62.27	44.70	6.70	28.20	-9.80	52.47	74.00	-21.53	PK	Horizontal
1242.98	49.87	44.70	6.70	28.20	-9.80	40.07	54.00	-13.93	AV	Horizontal
1830.13	58.65	44.20	9.04	31.60	-3.56	55.09	74.00	-18.91	PK	Vertical
1830.77	50.30	44.20	9.04	31.60	-3.56	46.74	54.00	-7.26	AV	Vertical
1830.27	58.57	44.20	9.04	31.60	-3.56	55.01	74.00	-18.99	PK	Horizontal
1830.35	49.54	44.20	9.04	31.60	-3.56	45.98	54.00	-8.02	AV	Horizontal
2040.69	48.41	44.20	9.86	32.00	-2.34	46.07	74.00	-27.93	PK	Vertical
2040.69	39.20	44.20	9.86	32.00	-2.34	36.86	54.00	-17.14	AV	Vertical
2040.80	48.55	44.20	9.86	32.00	-2.34	46.21	74.00	-27.79	PK	Horizontal
2040.70	38.64	44.20	9.86	32.00	-2.34	36.30	54.00	-17.70	AV	Horizontal
2745.04	54.94	43.50	11.40	35.50	3.40	58.34	74.00	-15.66	PK	Vertical
2745.68	44.33	43.50	11.40	35.50	3.40	47.73	54.00	-6.27	AV	Vertical
2745.64	53.65	43.50	11.40	35.50	3.40	57.05	74.00	-16.95	PK	Horizontal
2745.26	44.61	43.50	11.40	35.50	3.40	48.01	54.00	-5.99	AV	Horizontal

High Channel (FSK/LoRa /925 MHz)										
1257.19	61.91	44.70	6.70	28.20	-9.80	52.11	74.00	-21.89	PK	Vertical
1257.19	50.60	44.70	6.70	28.20	-9.80	40.80	54.00	-13.20	AV	Vertical
1257.20	62.02	44.70	6.70	28.20	-9.80	52.22	74.00	-21.78	PK	Horizontal
1257.20	50.49	44.70	6.70	28.20	-9.80	40.69	54.00	-13.31	AV	Horizontal
1850.03	58.64	44.20	9.04	31.60	-3.56	55.08	74.00	-18.92	PK	Vertical
1850.49	49.25	44.20	9.04	31.60	-3.56	45.69	54.00	-8.31	AV	Vertical
1850.28	58.84	44.20	9.04	31.60	-3.56	55.28	74.00	-18.72	PK	Horizontal
1850.49	49.97	44.20	9.04	31.60	-3.56	46.41	54.00	-7.59	AV	Horizontal
2064.00	48.28	44.20	9.86	32.00	-2.34	45.94	74.00	-28.06	PK	Vertical
2064.00	40.38	44.20	9.86	32.00	-2.34	38.04	54.00	-15.96	AV	Vertical
2064.05	47.96	44.20	9.86	32.00	-2.34	45.62	74.00	-28.38	PK	Horizontal
2064.05	38.71	44.20	9.86	32.00	-2.34	36.37	54.00	-17.63	AV	Horizontal
2775.00	54.42	43.50	11.40	35.50	3.40	57.82	74.00	-16.18	PK	Vertical
2775.66	44.44	43.50	11.40	35.50	3.40	47.84	54.00	-6.16	AV	Vertical
2775.44	54.42	43.50	11.40	35.50	3.40	57.82	74.00	-16.18	PK	Horizontal
2775.31	44.12	43.50	11.40	35.50	3.40	47.52	54.00	-6.48	AV	Horizontal

Note:

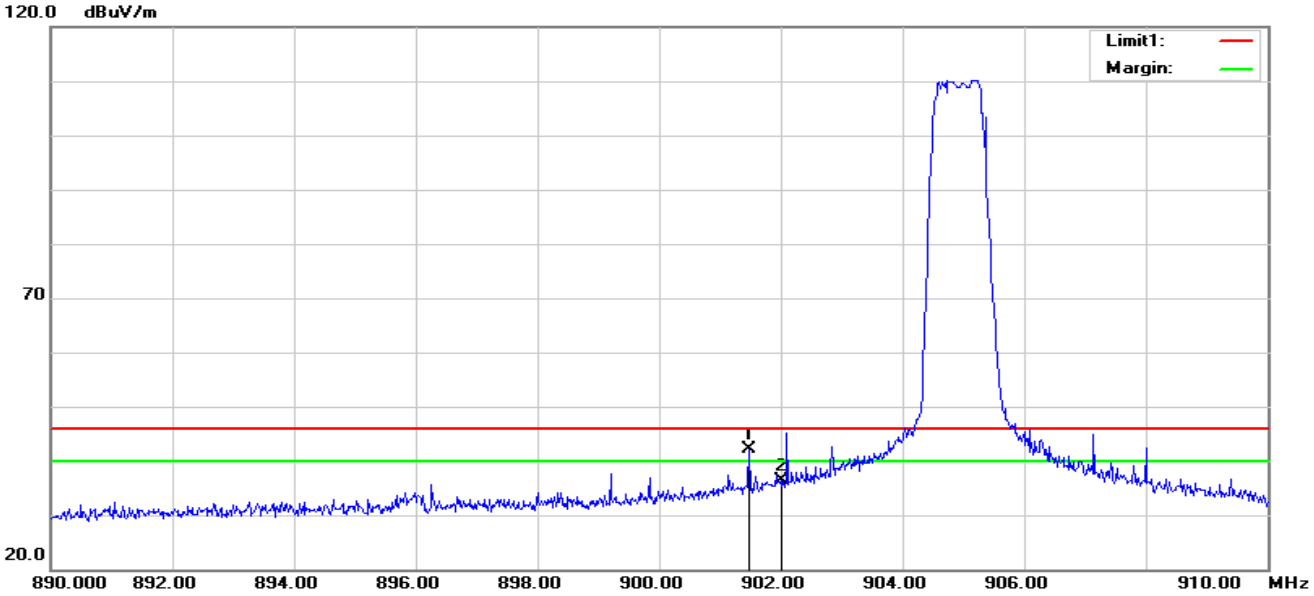
1) Factor = Antenna Factor + Cable Loss – Pre-amplifier.
   Emission Level = Reading + Factor

2) The frequency emission of peak points that did not show above the forms are at least 20dB below the limit, the frequency emission is mainly from the environment noise.

4.6 TEST RESULTS (Restricted Bands Requirements)

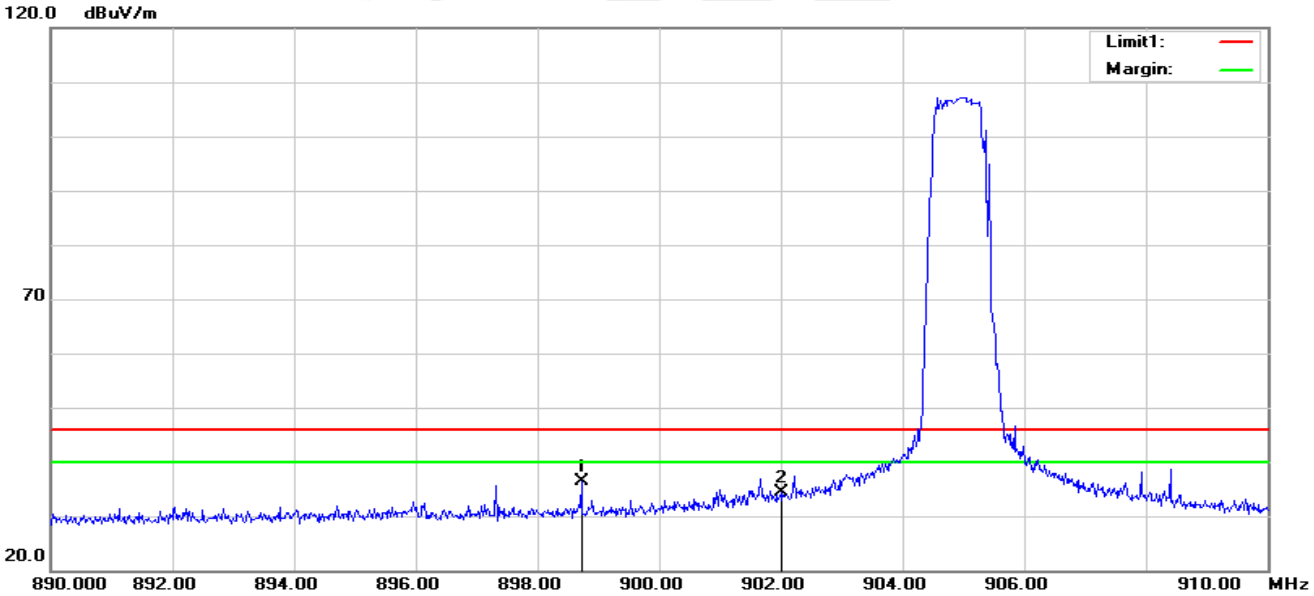
Low

Horizontal



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	901.4800	42.58	-0.41	42.17	46.00	-3.83	peak
2	902.0000	36.72	-0.40	36.32	46.00	-9.68	peak

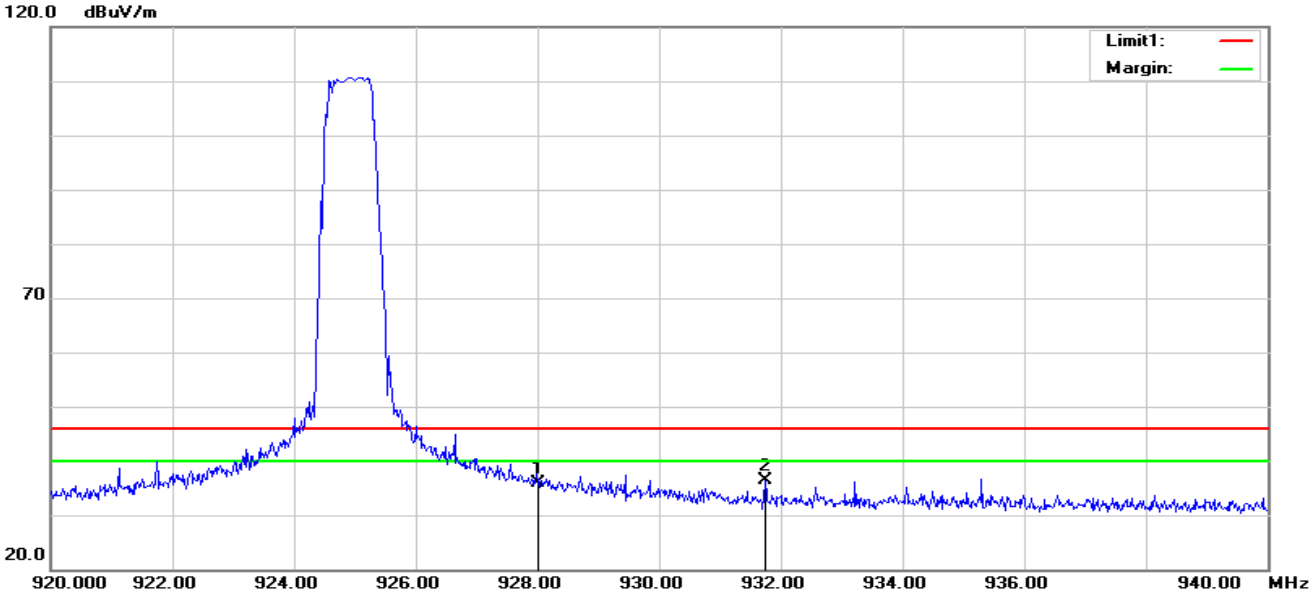
Vertical



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	898.7200	36.78	-0.48	36.30	46.00	-9.70	peak
2	902.0000	34.76	-0.40	34.36	46.00	-11.64	peak

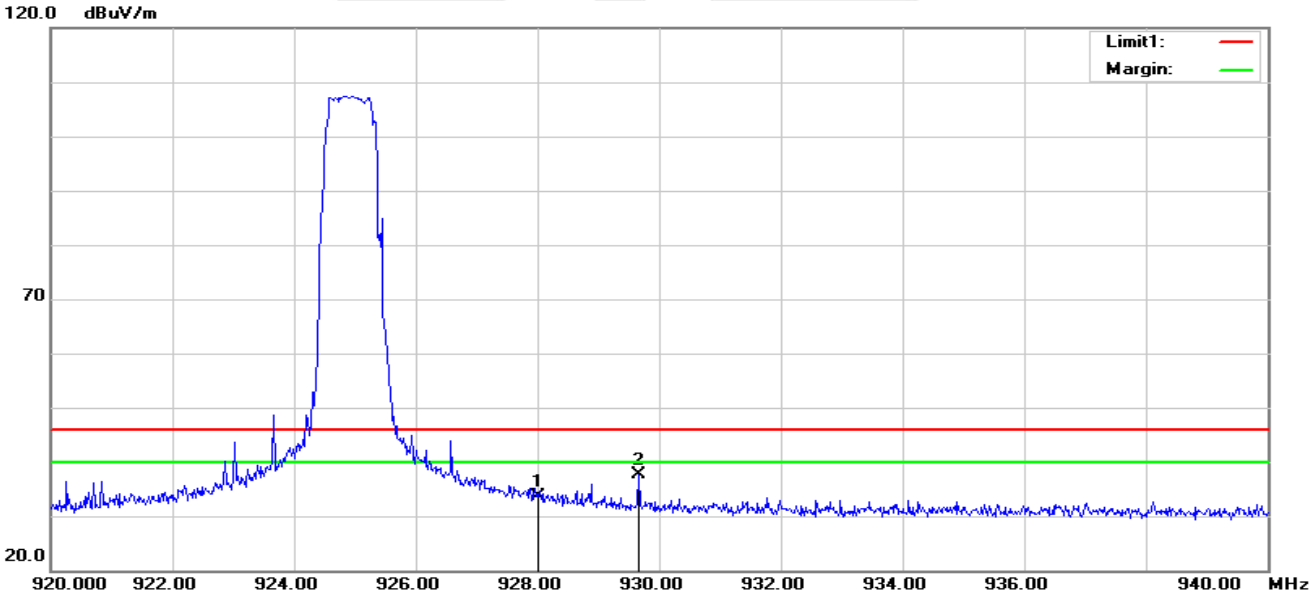
High

Horizontal



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	928.0000	35.55	0.43	35.98	46.00	-10.02	peak
2	931.7400	35.68	0.69	36.37	46.00	-9.63	peak

Vertical



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	928.0000	33.31	0.43	33.74	46.00	-12.26	peak
2	929.6600	37.17	0.52	37.69	46.00	-8.31	peak

5. CONDUCTED SPURIOUS & BAND EDGE EMISSION

5.1 LIMIT

According to FCC section 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)).

5.2 TEST PROCEDURE

Spectrum Parameter	Setting
Detector	Peak
Start/Stop Frequency	30 MHz to 10th carrier harmonic
RB / VB (emission in restricted band)	100 KHz/300 KHz
Trace-Mode:	Max hold

For Band edge

Spectrum Parameter	Setting
Detector	Peak
Start/Stop Frequency	Lower Band Edge: 850-910 MHz Upper Band Edge: 920-1000 MHz
RB / VB (emission in restricted band)	100 KHz/300 KHz
Trace-Mode:	Max hold

5.3 TEST SETUP

The EUT which is powered by the DC Power, is connected to the Spectrum Analyzer; the RF load attached to the EUT antenna terminal is 50 Ohm; the path loss as the factor is calibrated to correct the reading. Make the measurement with the spectrum analyzer's resolution bandwidth(RBW) = 100 kHz. In order to make an accurate measurement, set the span greater than RBW.

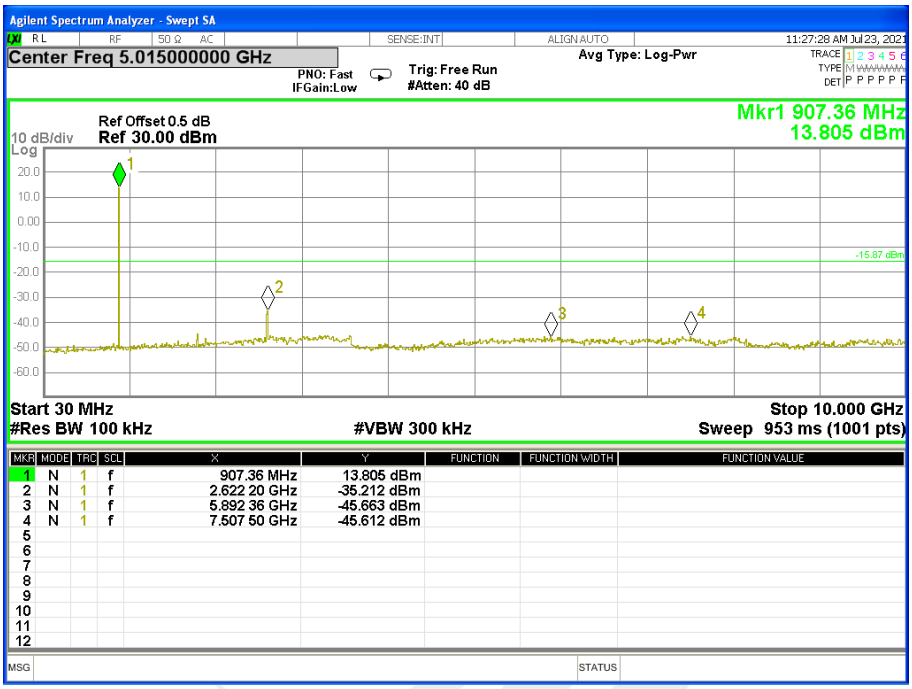
5.4 EUT OPERATION CONDITIONS

Please refer to section 3.4 of this report.

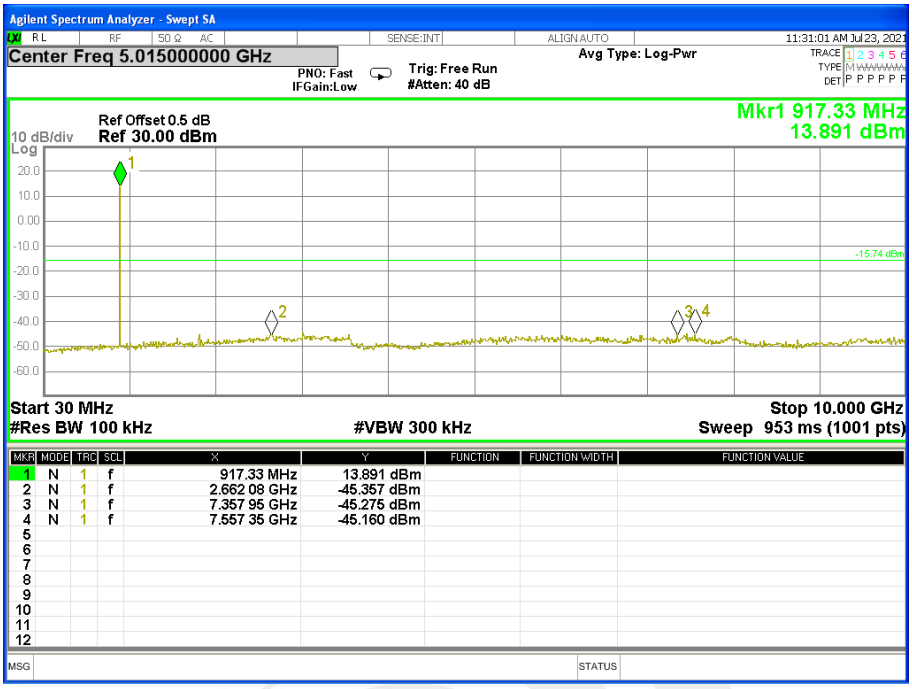
5.5 TEST RESULTS

Temperature:	25 ℃	Relative Humidity:	50%
Test Voltage:	DC 5V	Test Mode:	TX Mode /CH01, CH03, CH05

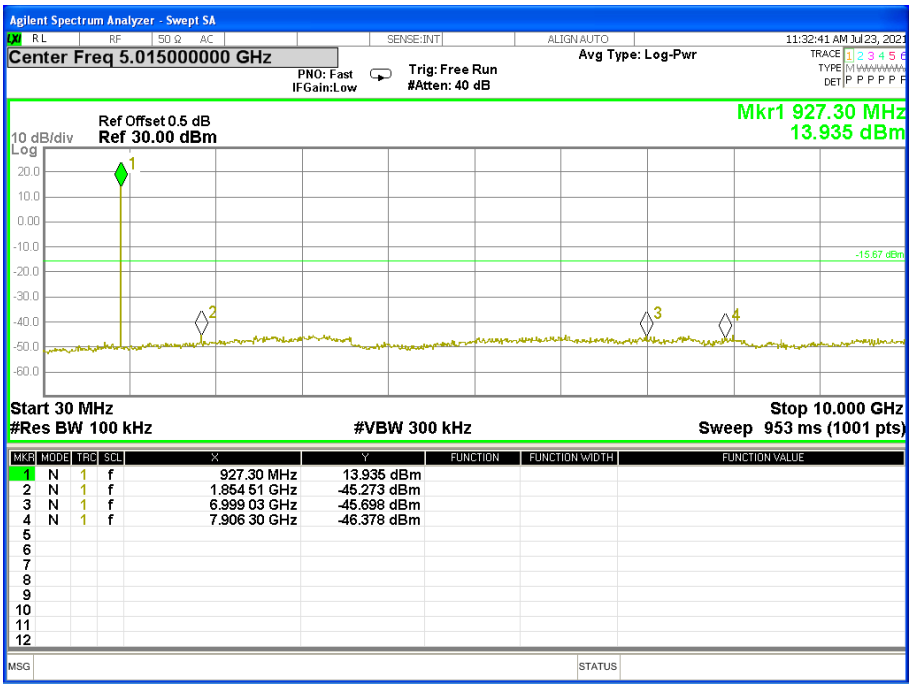
TX CH01



TX CH03

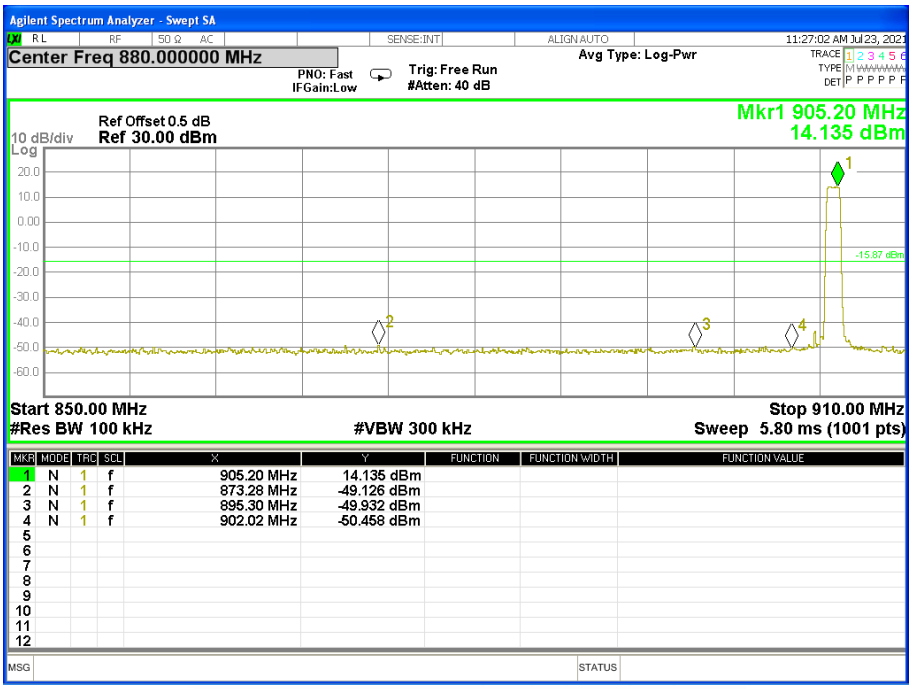


TX CH05

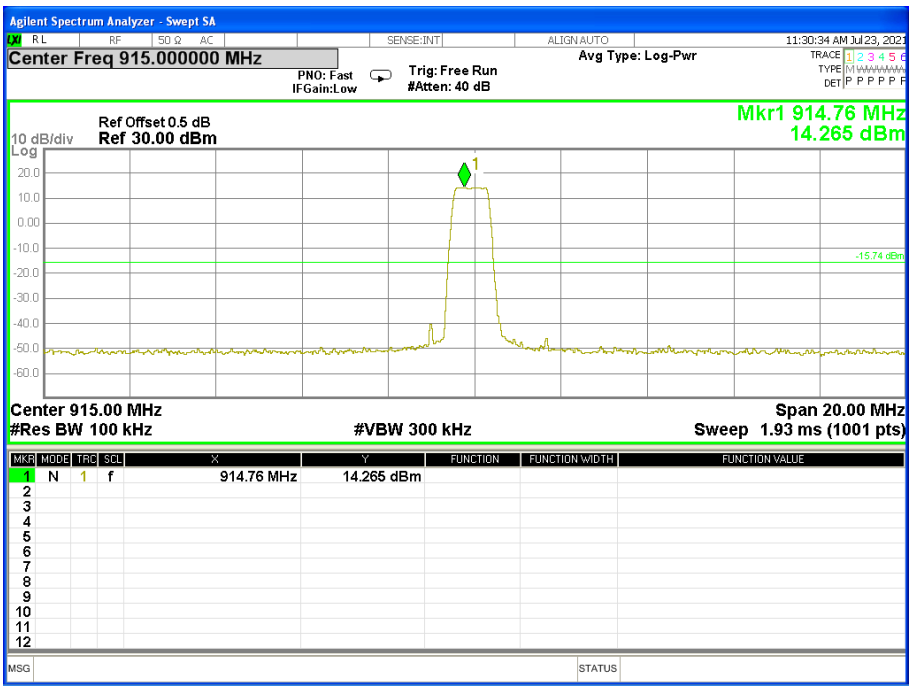


For Band edge(it's also the reference level for conducted spurious emission)

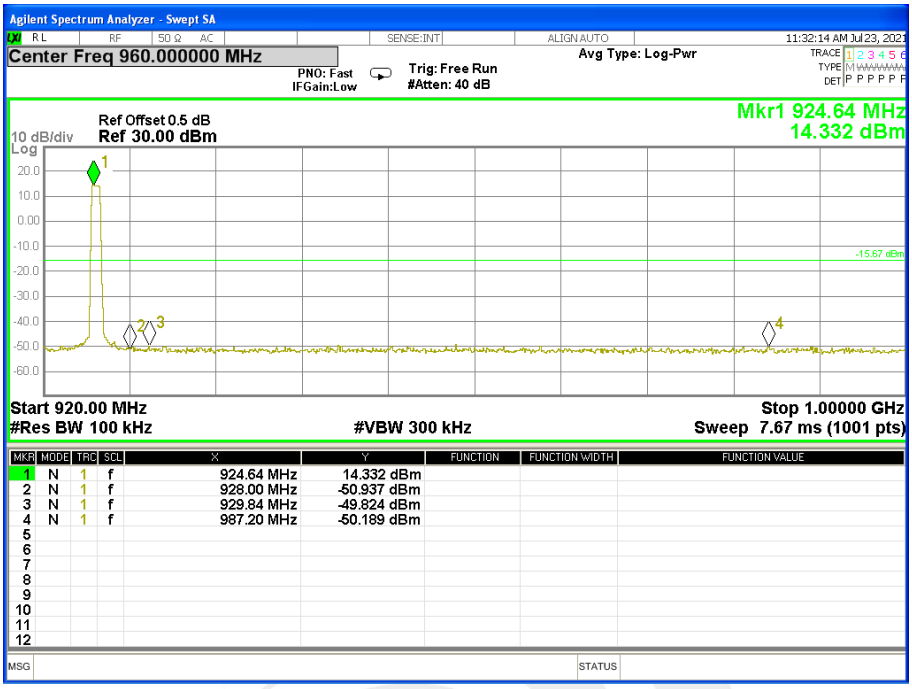
TX CH01



TX CH03



TX CH05


Agilent Spectrum Analyzer - Swept SA
Center Freq 960.000000 MHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 40 dB
Avg Type: Log-Pwr
11:32:14 AM Jul 23, 2021
Ref Offset 0.5 dB
10 dB/div
Ref 30.00 dBm
Log
Mkr1 924.64 MHz
14.332 dBm
-15.67 dBm
Start 920.00 MHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 1.00000 GHz
Sweep 7.67 ms (1001 pts)
1 N 1 f 924.64 MHz 14.332 dBm
2 N 1 f 928.00 MHz -50.937 dBm
3 N 1 f 929.84 MHz -49.824 dBm
4 N 1 f 987.20 MHz -50.189 dBm

6. POWER SPECTRAL DENSITY TEST

6.1 LIMIT

FCC Part 15.247,Subpart C				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247(e)	Power Spectral Density	≤8 dBm (RBW≥3KHz)	902-928	PASS

6.2 TEST PROCEDURE

1. Set analyzer center frequency to DTS channel center frequency.
2. Set the span to 1.5 times the DTS channel bandwidth.
3. Set the RBW to: 100 kHz ≥ RBW ≥ 3 kHz.
4. Set the VBW ≥ 3 x RBW.
5. Detector = power averaging (rms) or sample detector (when rms not available).
6. Sweep time = auto couple.
7. Trace mode = Employ trace averaging (rms) mode over a minimum of 100 traces.
8. Use the peak marker function to determine the maximum amplitude level.
9. If the measured value exceeds requirement, then reduce RBW (but no less than 3 kHz) and repeat (note that this may require zooming in on the emission of interest and reducing the span to meet the minimum measurement point requirement as the RBW is reduced).

6.3 TEST SETUP

6.4 EUT OPERATION CONDITIONS

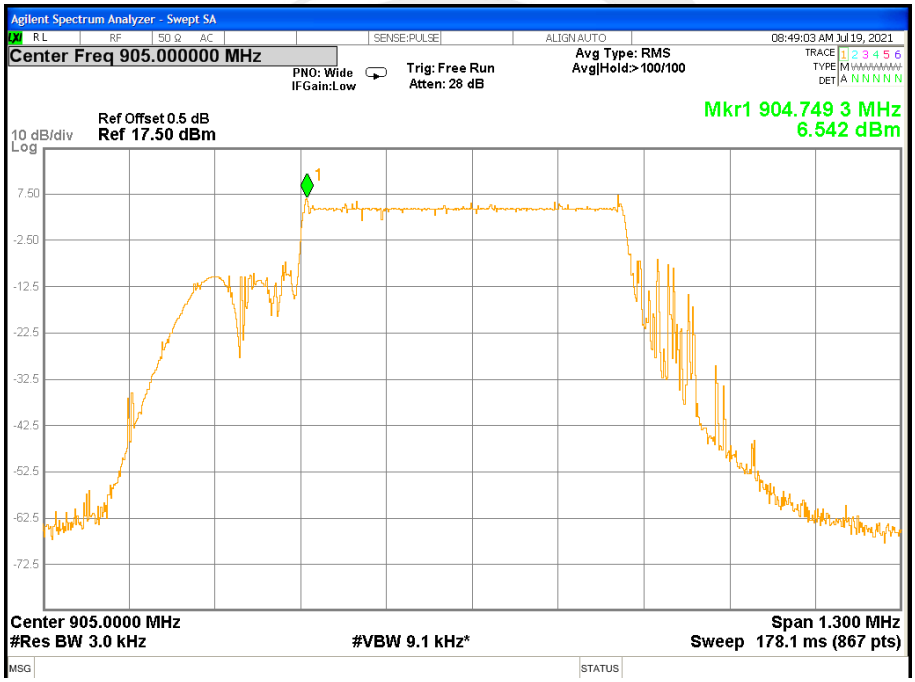
Please refer to section 3.4 of this report.

6.5 TEST RESULTS

Temperature:	25 ℃	Relative Humidity:	60%
Test Voltage:	DC 5V	Test Mode:	TX Mode /CH01, CH03, CH05

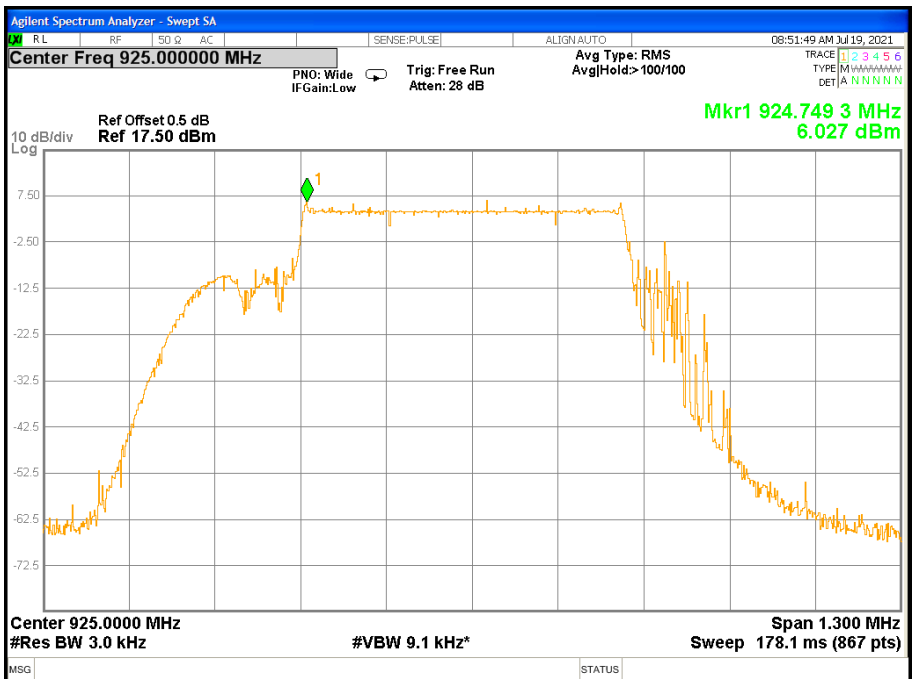
Frequency	Power Density (dBm/3kHz)	Limit (dBm/3KHz)	Result
905 MHz	6.542	≤8	PASS
915 MHz	7.550	≤8	PASS
925 MHz	6.027	≤8	PASS

TX CH01



TX CH03

TX CH05



7. BANDWIDTH TEST

7.1 LIMIT

FCC Part 15.247,Subpart C				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247(a)(2)	Bandwidth	>= 500KHz (6dB bandwidth)	902-928	PASS

7.2 TEST PROCEDURE

The automatic bandwidth measurement capability of an instrument may be employed using the X dB bandwidth mode with X set to 6 dB, if the functionality described above (i.e., RBW = 100 kHz, VBW≥3RBW, peak detector with maximum hold) is implemented by the instrumentation function. When using this capability, care shall be taken so that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be≥6 dB.

7.3 TEST SETUP

7.4 EUT OPERATION CONDITIONS

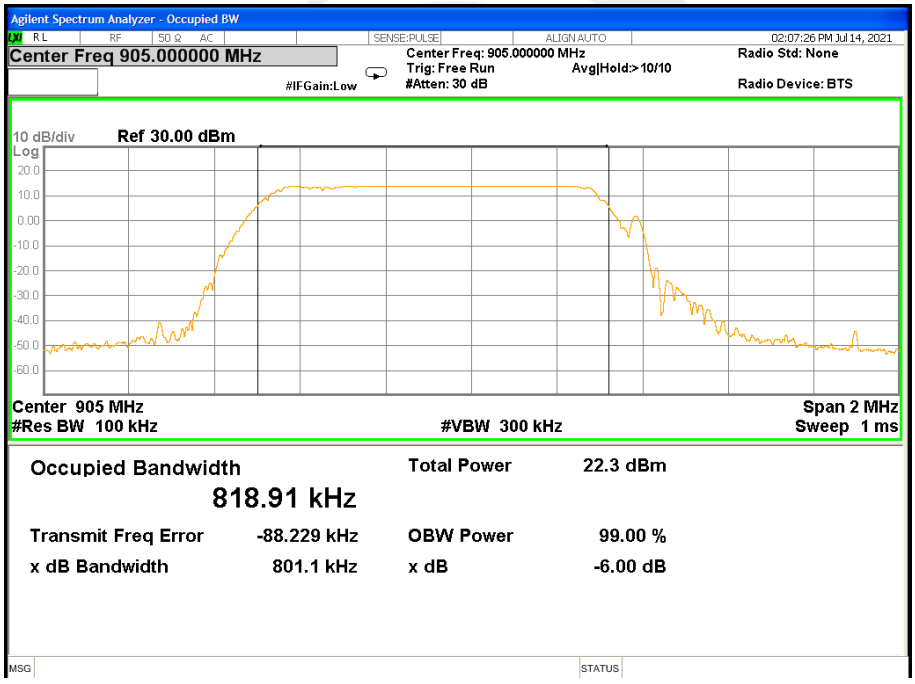
Please refer to section 3.4 of this report.

7.5 TEST RESULTS

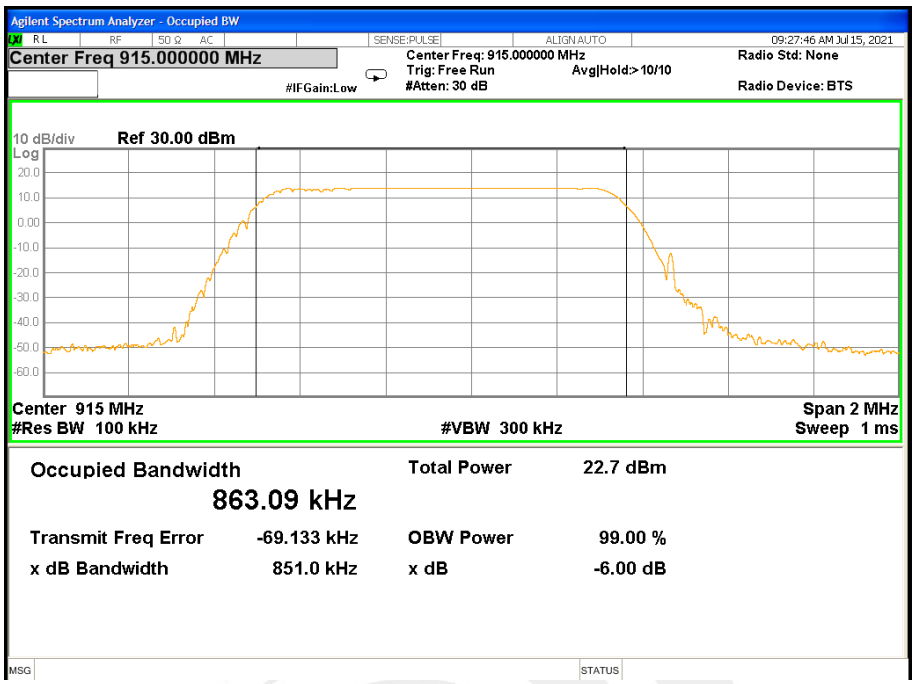
Temperature:	25 ℃	Relative Humidity:	60%
Test Voltage:	DC 5V	Test Mode:	TX Mode /CH01, CH03, CH05

Frequency	6dB Bandwidth (KHz)	Limit (KHz)	Result
905 MHz	801.100	≥500KHz	PASS
915 MHz	851.000	≥500KHz	PASS
925 MHz	836.800	≥500KHz	PASS

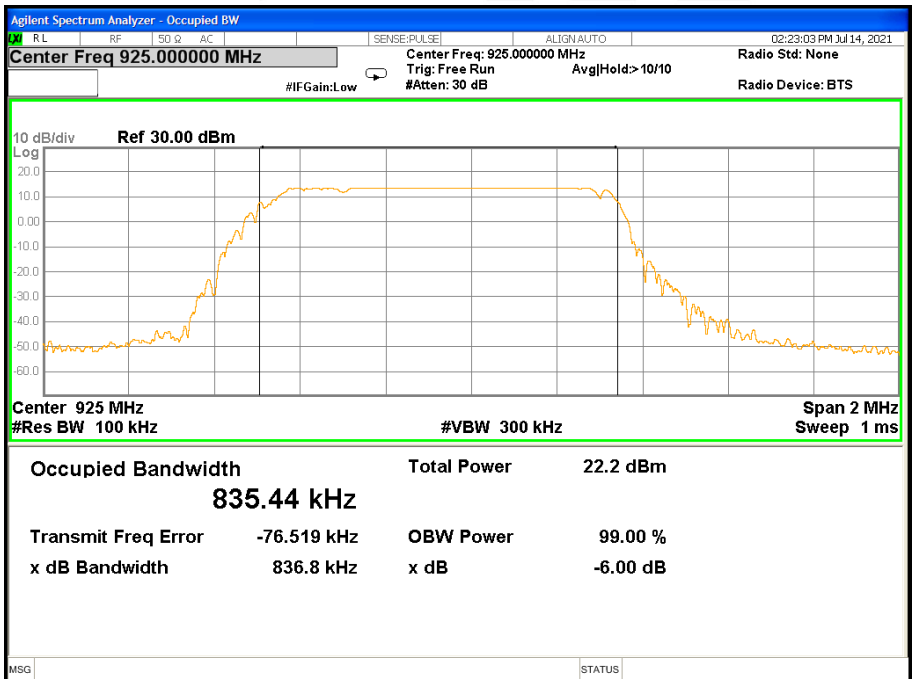
TX CH01



TX CH03



TX CH05



8. OUTPUT POWER TEST

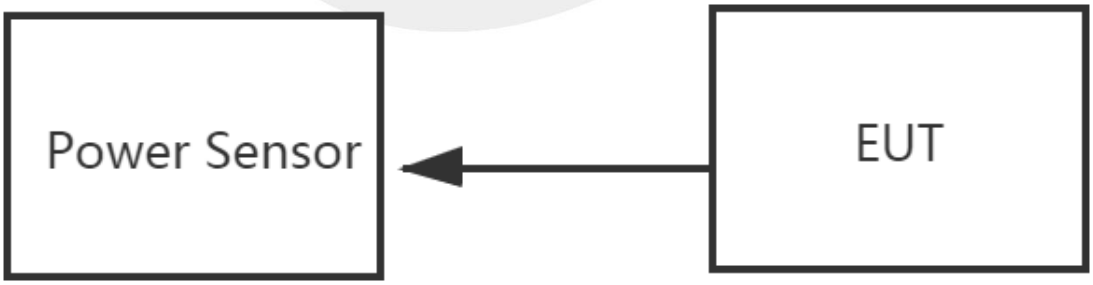
8.1 LIMIT

FCC Part 15.247,Subpart C				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247(b)(3)	Output Power	1 watt or 30dBm	902-928	PASS

8.2 TEST PROCEDURE

Method AVGSA-1 uses trace averaging with the EUT transmitting at full power throughout each sweep. The procedure for this method is as follows:
a) Set span to at least 1.5 times the OBW.
b) Set RBW = 1% to 5% of the OBW, not to exceed 1 MHz.
c) Set VBW ≥ [3 x RBW].
d) Number of points in sweep ≥ [2 x span / RBW]. (This gives bin-to-bin spacing ≤ RBW / 2, so that narrowband signals are not lost between frequency bins.)
e) Sweep time = auto.
f) Detector = RMS (i.e., power averaging), if available. Otherwise, use sample detector mode.
g) If transmit duty cycle < 98%, use a sweep trigger with the level set to enable triggering only on full power pulses. The transmitter shall operate at the maximum power control level for the entire duration of every sweep. If the EUT transmits continuously (i.e., with no OFF intervals) or at duty cycle ≥ 98%, and if each transmission is entirely at the maximum power control level, then the trigger shall be set to “free run.”
h) Trace average at least 100 traces in power averaging (rms) mode.
i) Compute power by integrating the spectrum across the OBW of the signal using the instrument’s band power measurement function, with band limits set equal to the OBW band edges. If the instrument does not have a band power function, sum the spectrum levels (in power units) at intervals equal to the RBW extending across the entire OBW of the spectrum.

8.3 TEST SETUP



8.4 EUT OPERATION CONDITIONS

Please refer to section 3.4 of this report.

8.5 TEST RESULTS

Temperature:	25 ℃	Relative Humidity:	60%
Test Voltage:	DC 5V	Test Mode:	TX Mode /CH01, CH03, CH05

Test Channe	Frequency	Average Conducted Output Power	LIMIT
	(MHz)	(dBm)	dBm
CH1	905	14.25	30
CH3	915	14.16	30
CH5	925	14.17	30

Note: Our power sensor test AVG power has no duty cycle display. The power sensor measures AVG power is Burst power. The software has considered the factor of the duty cycle factor, so it is unnecessary to add it again.

Duty cycle

Ton	Tp	Duty cycle(%)	Duty factor(dB)
1.432	1.440	99.44%	0.02

9. ANTENNA REQUIREMENT

9.1 STANDARD REQUIREMENT

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.

9.2 EUT ANTENNA

The EUT antenna is External Antenna. It comply with the standard requirement.

10. EUT TEST PHOTO

Note: See test photos in setup photo document for the actual connections between Product and support equipment.

※※※※※END OF THE REPORT※※※※※