RADIO TEST REPORT

Report No: STS2007017W01

Issued for

Orbit Irrigation Products, LLC

845 Overland Road, North Salt Lake, Utah 84058 USA

Product Name:	Sub-G Module
Brand Name:	Murata
Model Name:	CMWX1ZZABZ
Series Model:	N/A
FCC ID:	ML6CMABZ
IC:	3330A-CMABZ
Test Standard:	FCC Part 15.247 RSS-247 Issue 2, February 2017 RSS-Gen Issue 5, March 2019

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TEST RESULT CERTIFICATION

Applicant's Name .....:	Orbit Irrigation Products, LLC
Address.....:	845 Overland Road, North Salt Lake, Utah 84058 USA
Manufacturer's Name .....:	Murata Manufacturing Co., Ltd.
Address.....:	10-1, Higashikotari 1-chome, Nagaokakyo-shi, Kyoto 617-8555 Japan

Product Description

Product Name .....:	Sub-G Module
Brand Name .....:	Murata
Model Name.....:	CMWX1ZZABZ
Series Model .....:	N/A
Test Standards .....:	FCC Part15.247 RSS-247 Issue 2, February 2017 RSS-Gen Issue 5, March 2019
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/IC 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 .....:	06 July 2020
Date (s) of performance of tests :	06 July 2020 ~ 26 Aug. 2020
Date of Issue .....:	26 Aug. 2020
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	26 Aug. 2020	STS2007017W01	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 RSS-247 Issue 2			
Standard Section	Test Item	Judgment	Remark
15.207 RSS-Gen (8.8)	Conducted Emission	PASS	--
15.247(a)(1) RSS-247 (5.1)	Hopping Channel Separation	PASS	--
15.247(b)(2) RSS-247 (5.1)	Output Power	PASS	--
15.209 RSS-247 (5.5)	Radiated Spurious Emission	PASS	--
15.247(d) RSS-247 (5.5)	Conducted Spurious & Band Edge Emission	PASS	--
15.247(a)(1)(i) RSS-247 (5.1)	Number of Hopping Frequency	PASS	--
15.247(f) RSS-247 (5.1)	Dwell Time	PASS	--
15.247(a)(1) RSS-247 (5.1) RSS-Gen (6.7)	20dB Bandwidth 99% Bandwidth	PASS	--
15.205 RSS-Gen (8.9&8.10)	Restricted bands of operation	PASS	--
Part 15.247(d)/part 15.209(a) RSS-247 (5.5)	Band Edge Emission	PASS	--
15.203 RSS-Gen (6.8)	Antenna Requirement	PASS	--
RSS-Gen (6.11&8.11)	Frequency Stability	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 30-1GHz	±6.7dB
4	All emissions, radiated 1G-6GHz	±5.5dB
5	All emissions, radiated>6G	±5.8dB
6	Conducted Emission (9KHz-150KHz)	±4.43dB
7	Conducted Emission (150KHz-30MHz)	±5dB

2. GENERAL INFORMATION

2.1 GENERAL DESCRIPTION OF THE EUT

Product Name	Sub-G Module
Trade Name	Murata
Model Name	CMWX1ZZABZ
Series Model	N/A
Model Difference	N/A
Channel List	Please refer to the Note 2.
Frequency	902.3-914.7 MHz(125KHz)
Modulation Type	LoRa
Power Rating	DC 3.3V
Hardware version number	1.0
Software version number	1.3.1
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)	Channel	Frequency (MHz)
1	902.3	23	906.7	45	911.1
2	902.5	24	906.9	46	911.3
3	902.7	25	907.1	47	911.5
4	902.9	26	907.3	48	911.7
5	903.1	27	907.5	49	911.9
6	903.3	28	907.7	50	912.1
7	903.5	29	907.9	51	912.3
8	903.7	30	908.1	52	912.5
9	903.9	31	908.3	53	912.7
10	904.1	32	908.5	54	912.9
11	904.3	33	908.7	55	913.1
12	904.5	34	908.9	56	913.3
13	904.7	35	909.1	57	913.5
14	904.9	36	909.3	58	913.7
15	905.1	37	909.5	59	913.9
16	905.3	38	909.7	60	914.1
17	905.5	39	909.9	61	914.3
18	905.7	40	910.1	62	914.5
19	905.9	41	910.3	63	914.7
20	906.1	42	910.5		
21	906.3	43	910.7		
22	906.5	44	910.9		

3. Table for Filed Antenna

Ant.	Brand	Model Name	Antenna Type	Connector	Gain (dBi)	NOTE
1	Murata	CMWX1ZZABZ	Dipole	N/A	1.2	Antenna

2.2 DESCRIPTION OF THE TEST MODES

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.

Worst Mode	Description	Modulation
Mode 1	TX CH01	LoRa
Mode 2	TX CH31	LoRa
Mode 3	TX CH63	LoRa

Note:

(1) The measurements are performed at all Bit Rate of Transmitter, the worst data was reported.

(2) We have be tested for all avaiable U.S. voltage and frequencies(For 120V,50/60Hz and 240V, 50/60Hz) for which the device is capable of operation, and the worst case of 120V/ 60Hz is shown in the report.

For AC Conducted Emission

Test Case	
AC Conducted Emission	Mode 4 : Keeping EUT TX

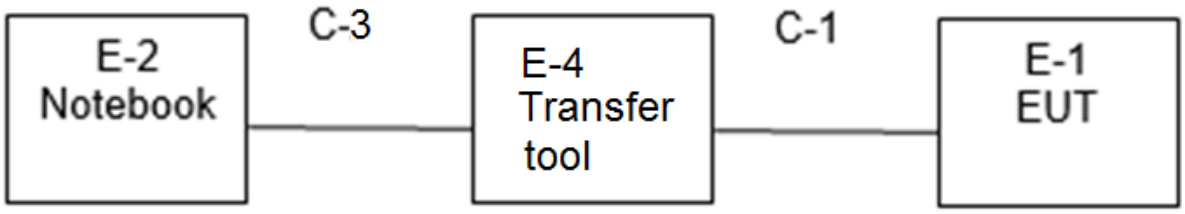
2.3 TEST SOFTWARE AND POWER LEVEL

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

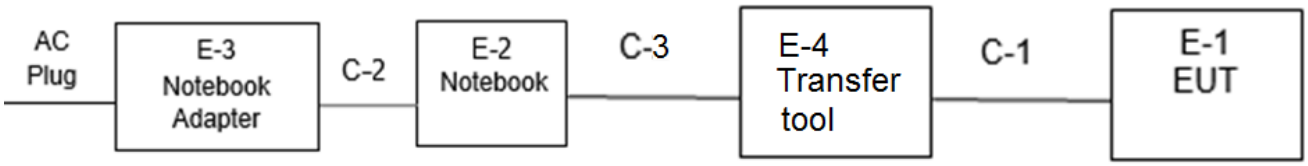
RF Function	Type	Mode Or Modulation type	Ant Gain(dBi)	Power Class	Software For Testing
LORA	125KHz	902MHz-928MHz	1.2	14	MurataLoRaModuleTestTool(v0.0.01)

2.4 BLOCK DIGRAM 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-2	Notebook	Lenovo	ThinkPad E470	N/A	N/A
E-3	Notebook Adapter	HP	HSTNN-CA15	N/A	N/A
E-4	Transfer tool	N/A	TTL-232R-3V3	N/A	N/A
C-1	USB Cable	N/A	N/A	120cm	N/A
C-2	DC Cable	N/A	N/A	150cm	N/A
C-3	Flat Cable	N/A	N/A	50cm	N/A

Note:

(1) For detachable type I/O cable should be specified the length in cm in『Length』column.

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	2019.10.09	2020.10.08
Signal Analyzer	Agilent	N9020A	MY51110105	2020.03.05	2021.03.04
Active loop Antenna	ZHINAN	ZN30900C	16035	2018.03.11	2021.03.10
Bilog Antenna	TESEQ	CBL6111D	34678	2017.11.02	2020.11.01
Horn Antenna	SCHWARZBECK	BBHA 9120D(1201)	9120D-1343	2018.10.19	2021.10.18
SHF-EHF Horn Antenna (18G-40GHz)	A-INFO	LB-180400-KF	J211020657	2018.03.11	2021.03.10
Pre-Amplifier(0.1M-3GHz)	EM	EM330	060665	2019.10.09	2020.10.08
Pre-Amplifier (1G-18GHz)	SKET	LNPA-01018G-45	SK2018080901	2019.10.12	2020.10.11
Pre-Amplifier (18G-40GHz)	SKET	LNPA-1840-50	SK2018101801	2019.10.12	2020.10.11
Temperature & Humidity	HH660	Mieo	N/A	2019.10.17	2020.10.16
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	2019.10.09	2020.10.08
LISN	R&S	ENV216	101242	2019.10.09	2020.10.08
LISN	EMCO	3810/2NM	23625	2019.10.09	2020.10.08
Temperature & Humidity	HH660	Mieo	N/A	2019.10.17	2020.10.16
Test SW	FARAD	EZ-EMC(Ver.STSLAB-03A1 CE)			

RF Connected Test

Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until
USB RF power sensor	DARE	RPR3006W	15I00041SNO03	2019.10.09	2020.10.08
Signal Analyzer	Agilent	N9020A	MY49100060	2019.10.09	2020.10.08
Temperature & Humidity	HH660	Mieo	N/A	2019.10.17	2020.10.16
Test SW	FARAD	LZ-RF /LzRf-3A3			

3. EMC EMISSION TEST

3.1 CONDUCTED EMISSION MEASUREMENT

3.1.1 POWER LINE CONDUCTED EMISSION LIMITS

Operating frequency band. In case the emission fall within the restricted band specified on art 207(a)&RSS-Gen limit in the table below has to be followed.

FREQUENCY (MHz)	Conducted Emissionlimit (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.

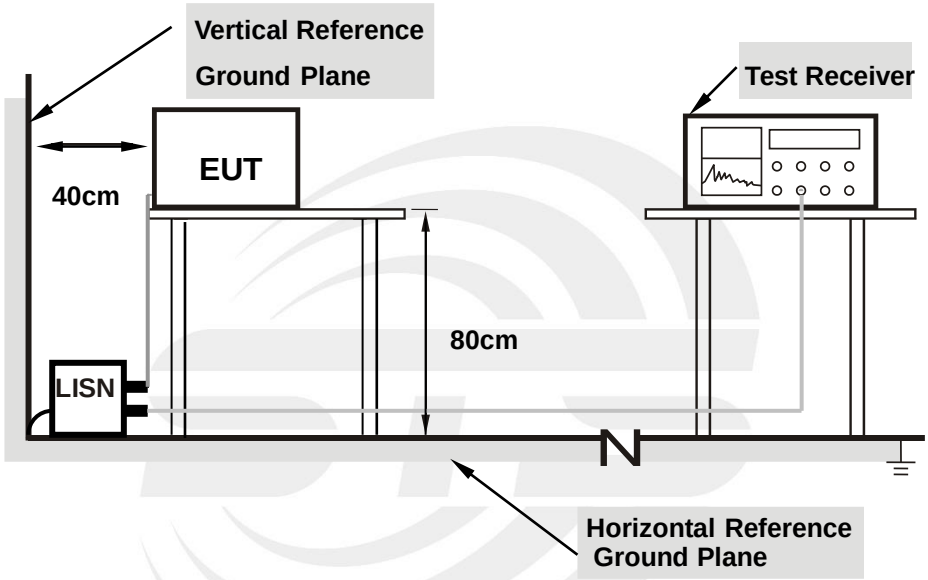
The following table is the setting of the receiver

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

3.1.2 TEST PROCEDURE

a. The EUT was 0.8 meters from the horizontal ground plane and 0.4 meters from the vertical ground plane with EUT being connected to the power mains through a line impedance stabilization network (LISN). All other support equipments powered from additional LISN(s). The LISN provide 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 at least 80 cm from nearest part of EUT chassis.
e. For the actual test configuration, please refer to the related Item –EUT Test Photos.

3.1.3 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

3.1.4 EUT OPERATING CONDITIONS

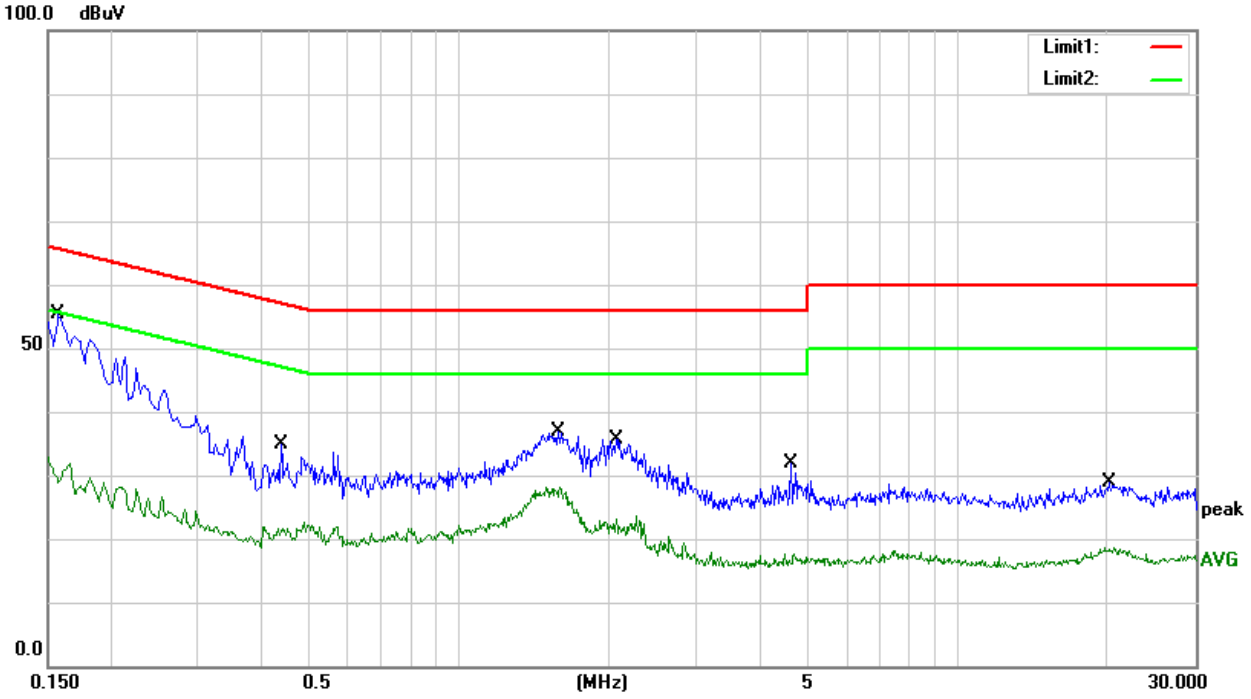
The EUT was configured for testing in a typical fashion (as a customer would normally use it). The EUT has been programmed to continuously transmit during test. This operating condition was tested and used to collect the included data.

3.1.5 TEST RESULT

Temperature:	27(C)	Relative Humidity:	67%RH
Test Voltage:	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	0.1580	35.21	20.21	55.42	65.57	-10.15	QP
2	0.1580	11.12	20.21	31.33	55.57	-24.24	AVG
3	0.4420	14.44	20.49	34.93	57.02	-22.09	QP
4	0.4420	1.22	20.49	21.71	47.02	-25.31	AVG
5	1.5780	16.67	20.15	36.82	56.00	-19.18	QP
6	1.5780	8.10	20.15	28.25	46.00	-17.75	AVG
7	2.0660	15.59	20.14	35.73	56.00	-20.27	QP
8	2.0660	2.22	20.14	22.36	46.00	-23.64	AVG
9	4.6380	11.84	20.03	31.87	56.00	-24.13	QP
10	4.6380	-2.41	20.03	17.62	46.00	-28.38	AVG
11	20.0700	8.26	20.65	28.91	60.00	-31.09	QP
12	20.0700	-2.13	20.65	18.52	50.00	-31.48	AVG

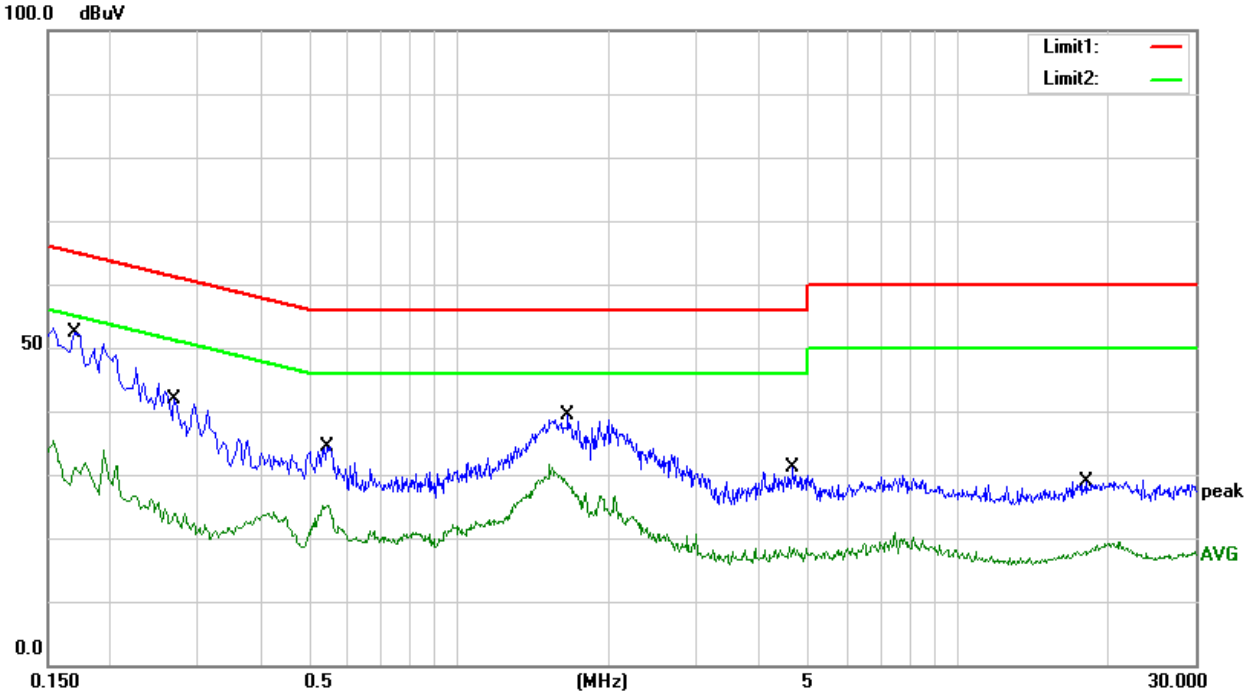
Remark:
1. All readings are Quasi-Peak and Average values.
2. Margin = Result (Result =Reading + Factor)–Limit
3. Factor=LISN factor+Cable loss+Limiter（10dB）



Temperature:	27(C)	Relative Humidity:	67%RH
Test Voltage:	AC 120V/60Hz	Phase:	N
Test Mode:	Mode 4		

No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB)	(dBuV)	(dBuV)	(dB)	
1	0.1700	32.19	20.24	52.43	64.96	-12.53	QP
2	0.1700	11.16	20.24	31.40	54.96	-23.56	AVG
3	0.2700	21.29	20.63	41.92	61.12	-19.20	QP
4	0.2700	3.20	20.63	23.83	51.12	-27.29	AVG
5	0.5460	14.07	20.39	34.46	56.00	-21.54	QP
6	0.5460	4.71	20.39	25.10	46.00	-20.90	AVG
7	1.6620	19.25	20.16	39.41	56.00	-16.59	QP
8	1.6620	9.37	20.16	29.53	46.00	-16.47	AVG
9	4.6940	11.04	20.03	31.07	56.00	-24.93	QP
10	4.6940	-1.60	20.03	18.43	46.00	-27.57	AVG
11	18.1260	8.51	20.44	28.95	60.00	-31.05	QP
12	18.1260	-1.65	20.44	18.79	50.00	-31.21	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）



3.2 RADIATED EMISSION MEASUREMENT

3.2.1 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), RSS-Gen Issue 5 and RSS-247 Issue 2, February 2017 (5.5) limit in the table and according to ANSI C63.10-2013 below has to be followed.

LIMITS OF RADIATED EMISSION MEASUREMENT (0.009MHz - 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 (1GHz-25 GHz)

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

FCC:

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			

IC:

FREQUENCY (MHz)	FREQUENCY (MHz)	FREQUENCY (GHz)
0.090 - 0.110	149.9 - 150.05	9.0 - 9.2
0.495 - 0.505	156.52475 - 156.52525	9.3 - 9.5
2.1735 - 2.1905	156.7 - 156.9	10.6 - 12.7
3.020 - 3.026	162.0125 - 167.17	13.25 - 13.4
4.125 - 4.128	167.72 - 173.2	14.47 - 14.5
4.17725 - 4.17775	240 – 285	15.35 - 16.2
4.20725 - 4.20775	322 - 335.4	17.7 - 21.4
5.677 - 5.683	399.9 - 410	22.01 - 23.12
6.215 - 6.218	608 - 614	23.6 - 24.0
6.26775 - 6.26825	960 - 1427	31.2 - 31.8
6.31175 - 6.31225	1435 - 1626.5	36.43 - 36.5
8.291 - 8.294	1645.5 - 1646.5	Above 38.6
8.362 - 8.366	1660 - 1710	
8.37625 - 8.38675	1718.8 - 1722.2	
8.41425 - 8.41475	2200 - 2300	
12.29 - 12.293	2310 - 2390	
12.51975 - 12.52025	2483.5 - 2500	
12.57675 - 12.57725	2655 - 2900	
13.36 - 13.41	3260 – 3267	
16.42 - 16.423	3332 - 3339	
16.69475 - 16.69525	3345.8 - 3358	
16.80425 - 16.80475	3500 - 4400	
25.5 - 25.67	4500 - 5150	
37.5 - 38.25	5350 - 5460	
73 - 74.6	7250 - 7750	
74.8 - 75.2	8025 – 8500	
108 – 138		

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/ 3 MHz(AVG)

For Band Edge

Spectrum Parameter	Setting
Detector	Peak
Start/Stop Frequency	Lower Band Edge: 890 to 905 MHz Upper Band Edge: 913 to 930 MHz
RB / VB	100 KHz / 300 KHz

Receiver Parameter	Setting
Attenuation	Auto
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

3.2.2 TEST PROCEDURE

a. The measuring distance of 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 meters (above 1GHz is 1.5 m) above the ground at a 3 meter anechoic chamber test site. The table was rotated 360 degrees 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 polarizations 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 then QuasiPeak detector mode re-measured.
e. If the Peak Mode measured value compliance with and lower than Quasi Peak Mode Limit, the EUT shall be deemed to meet QP Limits and then no additional QP Mode measurement performed.
f. For the actual test configuration, please refer to the related Item –EUT Test Photos.

Note:

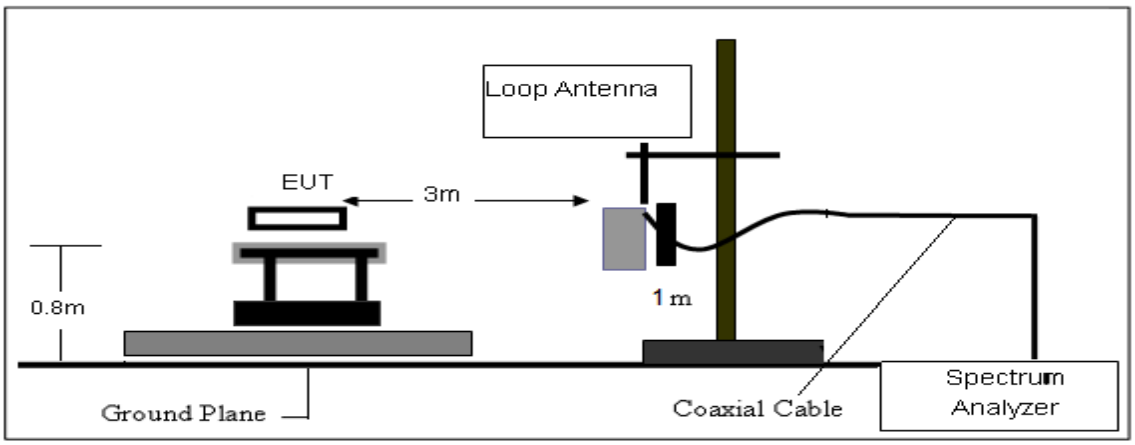
Both horizontal and vertical antenna polarities were tested and performed pretest to three orthogonal axis. The worst case emissions were reported.

3.2.3 DEVIATION FROM TEST STANDARD

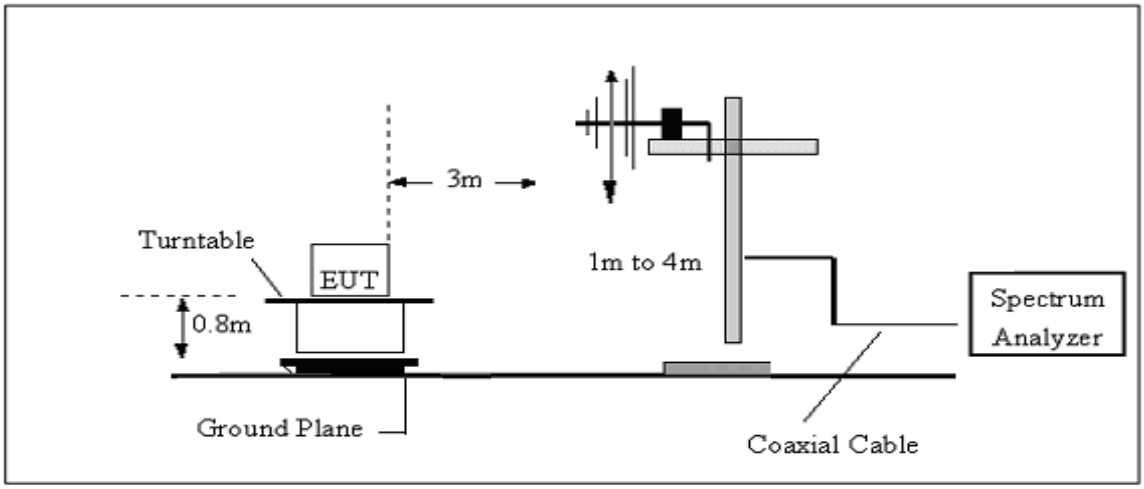
No deviation.

3.2.4 TESTSETUP

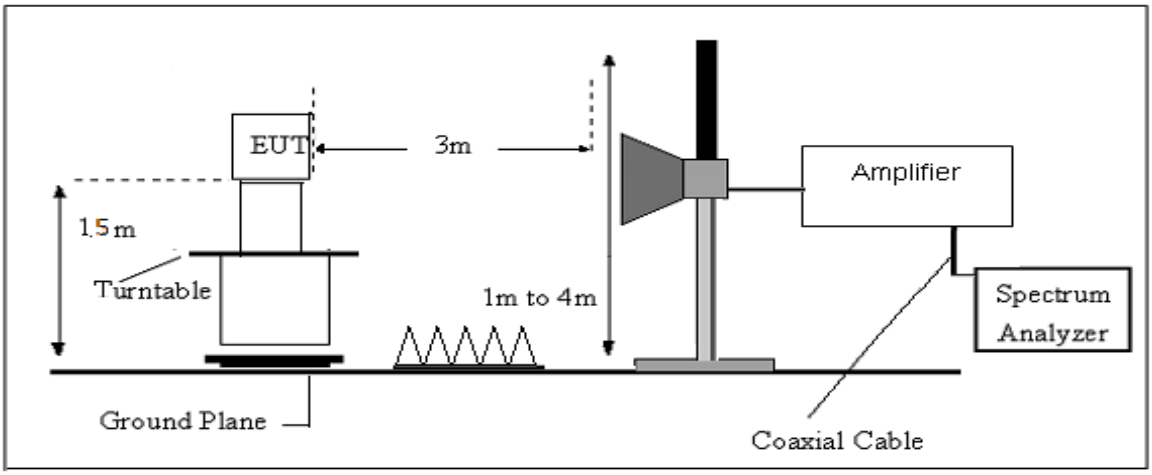
(A) Radiated Emission Test-Up Frequency Below 30MHz



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



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



3.2.5 EUT OPERATING CONDITIONS

The EUT tested system was configured as the statements of 2.4 Unless otherwise a special operating condition is specified in the follows during the testing.

3.2.6 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

3.2.7 TEST RESULTS

(9KHz-30MHz)

Temperature:	23.3(C)	Relative Humidity:	60%RH
Test Voltage:	DC 3.3V	Test Mode:	TX Mode

Freq.	Reading	Limit	Margin	State	Test Result
(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);

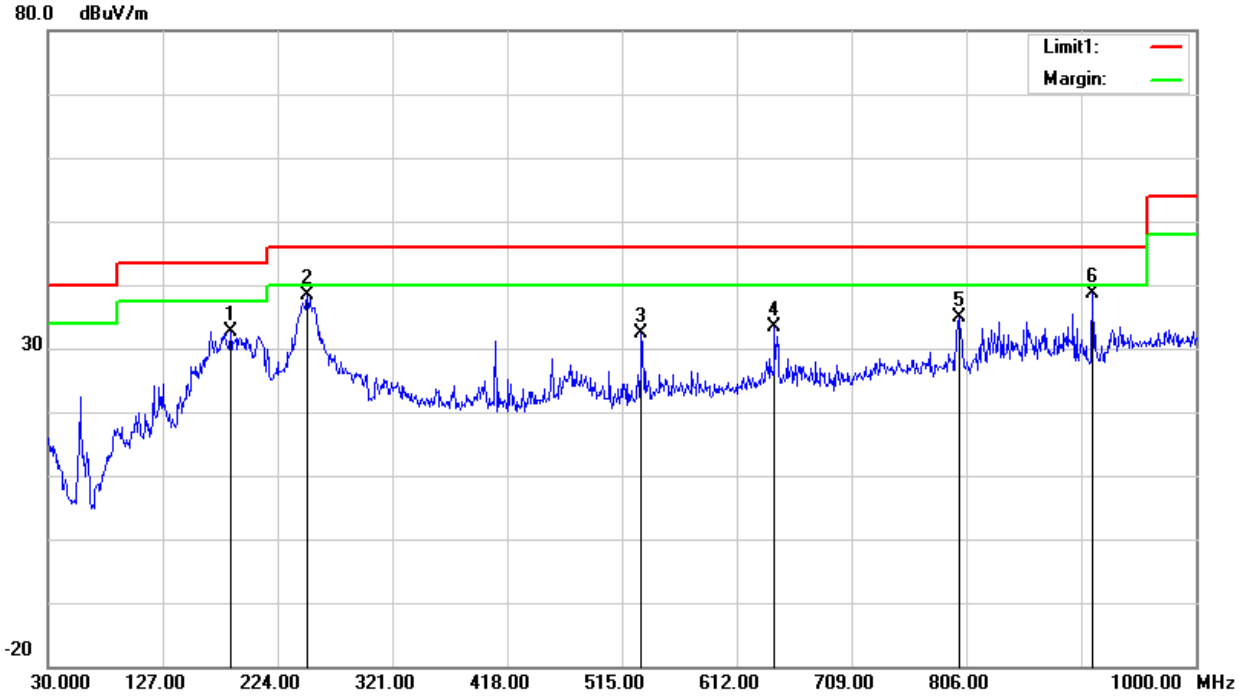
Limit line = specific limits (dBuv) + distance extrapolation factor.

(30MHz-1000MHz)

Temperature:	23.3(C)	Relative Humidity:	60%RH
Test Voltage:	DC 3.3V	Phase:	Horizontal
Test Mode:	Mode 1/2/3(Mode 2 worst case)		

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	184.2300	52.97	-20.34	32.63	43.50	-10.87	QP
2	249.2200	54.54	-16.27	38.27	46.00	-7.73	QP
3	531.4900	39.84	-7.37	32.47	46.00	-13.53	QP
4	644.0100	38.15	-4.87	33.28	46.00	-12.72	QP
5	800.1800	36.86	-2.05	34.81	46.00	-11.19	QP
6	912.7000	38.86	-0.14	38.72	46.00	-7.28	QP

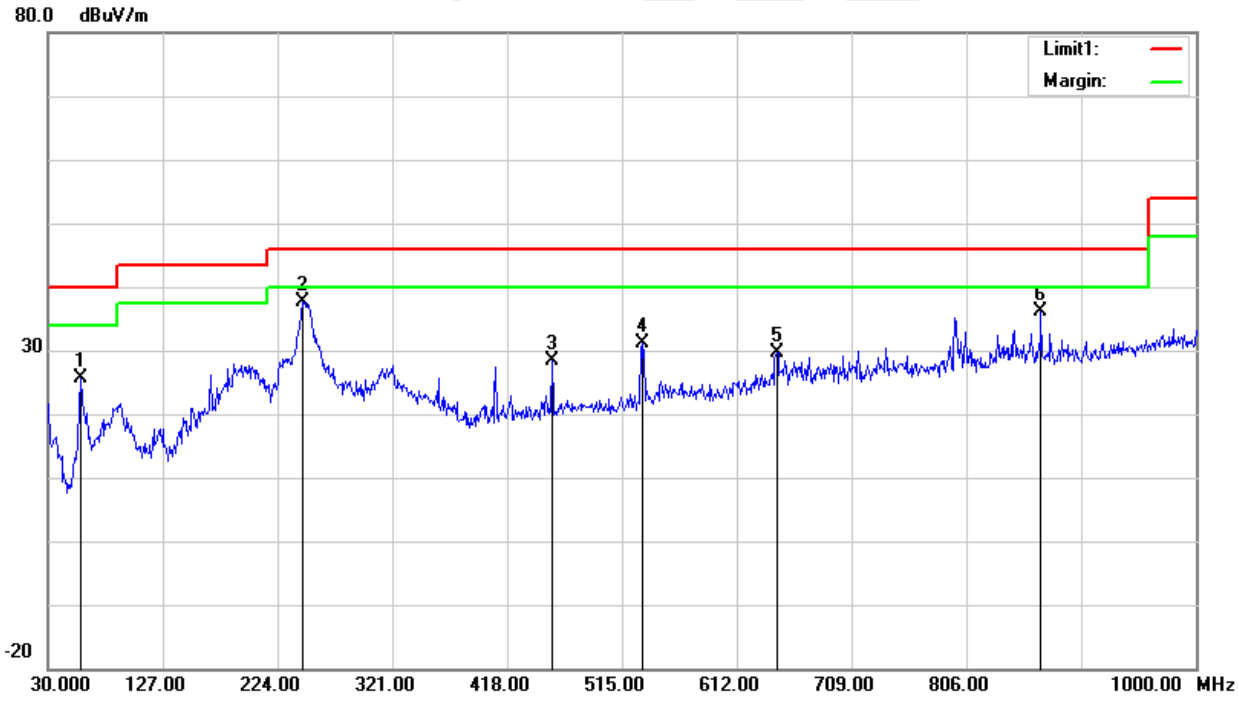
Remark:
1. Margin = Result (Result =Reading + Factor)–Limit
2. Factor= Antenna factor+Cable attenuation factor(cable loss)-Amplifier gain



Temperature:	23.3(C)	Relative Humidity:	60%RH
Test Voltage:	DC 3.3V	Phase:	Vertical
Test Mode:	Mode 1/2/3(Mode 2 worst case)		

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	57.1600	51.08	-25.45	25.63	40.00	-14.37	QP
2	245.3400	54.55	-16.92	37.63	46.00	-8.37	QP
3	455.8300	37.96	-9.55	28.41	46.00	-17.59	QP
4	532.4600	38.56	-7.31	31.25	46.00	-14.75	QP
5	645.9500	34.48	-4.87	29.61	46.00	-16.39	QP
6	869.0500	36.56	-0.52	36.04	46.00	-9.96	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

Frequency	Meter Reading	Amplifier	Loss	Antenna Factor	Orrected Factor	Emission Level	Limits	Margin	Detector	Comment
(MHz)	(dBμV)	（dB）	（dB）	（dB/m）	（dB）	(dBμV/m)	(dBμV/m)	(dB)	Type	
Low Channel (902.3 MHz)										
1226.44	61.72	44.70	6.70	28.20	-9.80	51.92	74.00	-22.08	PK	Vertical
1226.44	50.59	44.70	6.70	28.20	-9.80	40.79	54.00	-13.21	AV	Vertical
1226.33	61.66	44.70	6.70	28.20	-9.80	51.86	74.00	-22.14	PK	Horizontal
1226.33	50.31	44.70	6.70	28.20	-9.80	40.51	54.00	-13.49	AV	Horizontal
1804.72	58.59	44.20	9.04	31.60	-3.56	55.03	74.00	-18.97	PK	Vertical
1804.72	49.49	44.20	9.04	31.60	-3.56	45.93	54.00	-8.07	AV	Vertical
1804.78	58.73	44.20	9.04	31.60	-3.56	55.17	74.00	-18.83	PK	Horizontal
1804.78	50.36	44.20	9.04	31.60	-3.56	46.80	54.00	-7.20	AV	Horizontal
2013.41	48.39	44.20	9.86	32.00	-2.34	46.05	74.00	-27.95	PK	Vertical
2013.41	39.91	44.20	9.86	32.00	-2.34	37.57	54.00	-16.43	AV	Vertical
2013.35	47.23	44.20	9.86	32.00	-2.34	44.89	74.00	-29.11	PK	Horizontal
2013.35	39.36	44.20	9.86	32.00	-2.34	37.02	54.00	-16.98	AV	Horizontal
2706.79	53.92	43.50	11.40	35.50	3.40	57.32	74.00	-16.68	PK	Vertical
2706.79	44.78	43.50	11.40	35.50	3.40	48.18	54.00	-5.82	AV	Vertical
2706.80	54.96	43.50	11.40	35.50	3.40	58.36	74.00	-15.64	PK	Horizontal
2706.80	44.52	43.50	11.40	35.50	3.40	47.92	54.00	-6.08	AV	Horizontal
Middle Channel (908.3 MHz)										
1214.84	61.79	44.70	6.70	28.20	-9.80	51.99	74.00	-22.01	PK	Vertical
1214.84	51.35	44.70	6.70	28.20	-9.80	41.55	54.00	-12.45	AV	Vertical
1214.82	62.06	44.70	6.70	28.20	-9.80	52.26	74.00	-21.74	PK	Horizontal
1214.82	50.76	44.70	6.70	28.20	-9.80	40.96	54.00	-13.04	AV	Horizontal
1816.81	58.13	44.20	9.04	31.60	-3.56	54.57	74.00	-19.43	PK	Vertical
1816.81	50.15	44.20	9.04	31.60	-3.56	46.59	54.00	-7.41	AV	Vertical
1816.77	58.31	44.20	9.04	31.60	-3.56	54.75	74.00	-19.25	PK	Horizontal
1816.77	50.20	44.20	9.04	31.60	-3.56	46.64	54.00	-7.36	AV	Horizontal
1994.32	48.96	44.20	9.86	32.00	-2.34	46.62	74.00	-27.38	PK	Vertical
1994.32	39.33	44.20	9.86	32.00	-2.34	36.99	54.00	-17.01	AV	Vertical
1994.39	47.66	44.20	9.86	32.00	-2.34	45.32	74.00	-28.68	PK	Horizontal
1994.39	39.26	44.20	9.86	32.00	-2.34	36.92	54.00	-17.08	AV	Horizontal
2725.26	54.70	43.50	11.40	35.50	3.40	58.10	74.00	-15.90	PK	Vertical
2725.26	44.56	43.50	11.40	35.50	3.40	47.96	54.00	-6.04	AV	Vertical
2725.25	54.47	43.50	11.40	35.50	3.40	57.87	74.00	-16.13	PK	Horizontal
2725.25	44.88	43.50	11.40	35.50	3.40	48.28	54.00	-5.72	AV	Horizontal

High Channel (914.7 MHz)										
1204.11	61.69	44.70	6.70	28.20	-9.80	51.89	74.00	-22.11	PK	Vertical
1204.11	50.89	44.70	6.70	28.20	-9.80	41.09	54.00	-12.91	AV	Vertical
1204.11	62.24	44.70	6.70	28.20	-9.80	52.44	74.00	-21.56	PK	Horizontal
1204.11	51.02	44.70	6.70	28.20	-9.80	41.22	54.00	-12.78	AV	Horizontal
1829.51	58.90	44.20	9.04	31.60	-3.56	55.34	74.00	-18.66	PK	Vertical
1829.51	50.08	44.20	9.04	31.60	-3.56	46.52	54.00	-7.48	AV	Vertical
1829.56	59.49	44.20	9.04	31.60	-3.56	55.93	74.00	-18.07	PK	Horizontal
1829.56	49.32	44.20	9.04	31.60	-3.56	45.76	54.00	-8.24	AV	Horizontal
1976.85	48.71	44.20	9.86	32.00	-2.34	46.37	74.00	-27.63	PK	Vertical
1976.85	39.10	44.20	9.86	32.00	-2.34	36.76	54.00	-17.24	AV	Vertical
1976.84	47.17	44.20	9.86	32.00	-2.34	44.83	74.00	-29.17	PK	Horizontal
1976.84	38.97	44.20	9.86	32.00	-2.34	36.63	54.00	-17.37	AV	Horizontal
2744.03	54.79	43.50	11.40	35.50	3.40	58.19	74.00	-15.81	PK	Vertical
2744.03	43.73	43.50	11.40	35.50	3.40	47.13	54.00	-6.87	AV	Vertical
2744.07	53.55	43.50	11.40	35.50	3.40	56.95	74.00	-17.05	PK	Horizontal
2744.07	43.95	43.50	11.40	35.50	3.40	47.35	54.00	-6.65	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. CONDUCTED SPURIOUS & BAND EDGE EMISSION

4.1 LIMIT

According to FCC section 15.247(d)&RSS-247 Issue 2, February 2017 (5.5), in any 100kHz 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 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

4.2 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: 901.8– 902.8 MHz Upper Band Edge: 899.7 – 929.7 MHz
RB / VB (emission in restricted band)	100 KHz/300 KHz
Trace-Mode:	Max hold

For Hopping Band edge

Spectrum Parameter	Setting
Detector	Peak
Start/Stop Frequency	Lower Band Edge: 890– 903 MHz Upper Band Edge: 914 – 930 MHz
RB / VB (emission in restricted band)	100 KHz/300 KHz
Trace-Mode:	Max hold

4.3 TEST SETUP

The EUT is connected to the Spectrum Analyzer; the RF load attached to the EUT antenna terminal is 50Ohm; 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.

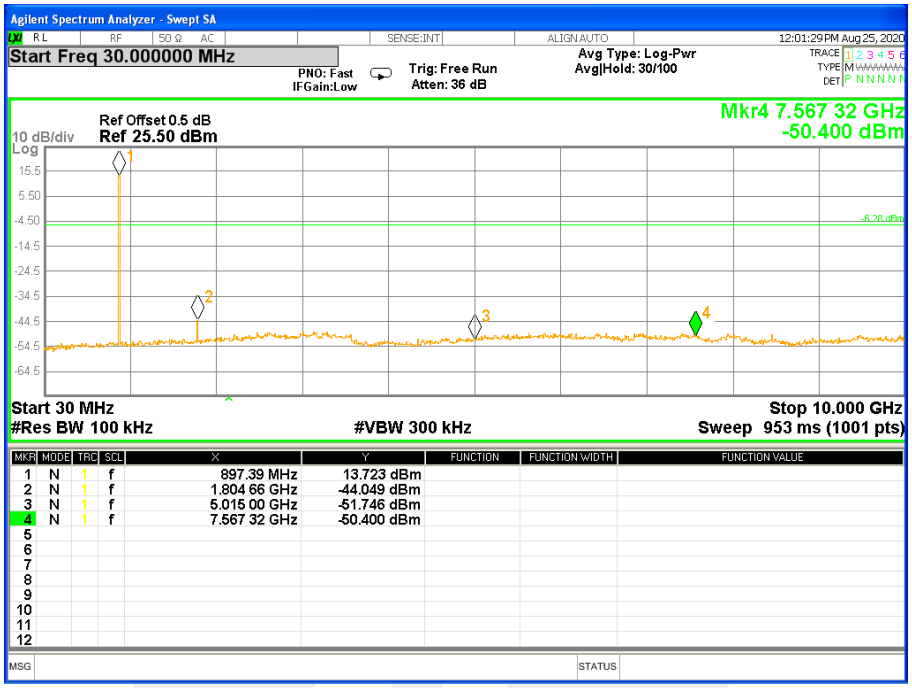
4.4 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of 2.3 Unless otherwise a special operating condition is specified in the follows during the testing.

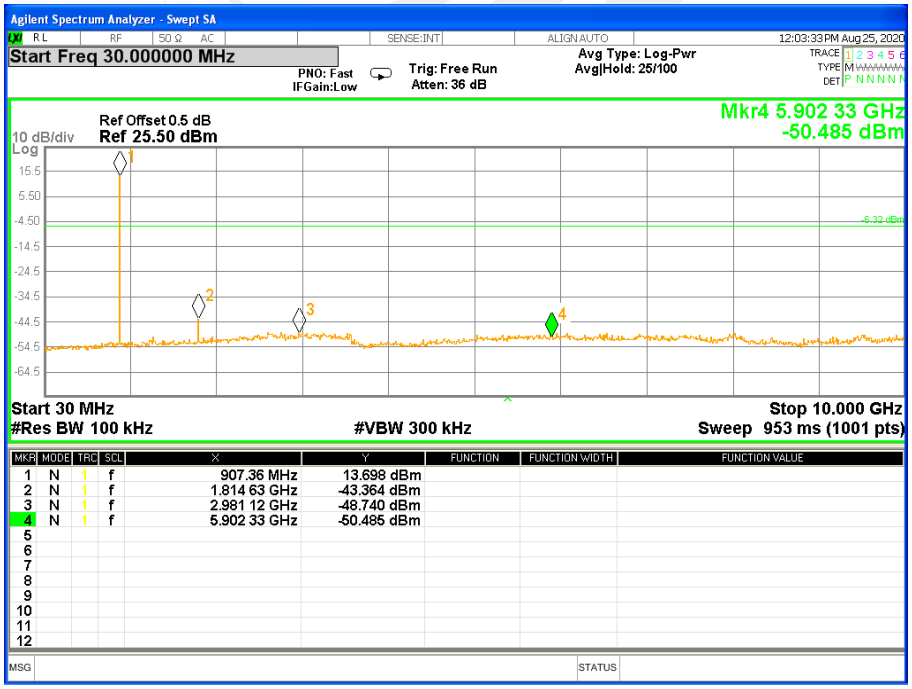
4.5 TEST RESULTS

Temperature:	25℃	Relative Humidity:	50%
Test Mode:	LoRa-01/31/63 CH	Test Voltage:	DC 3.3V

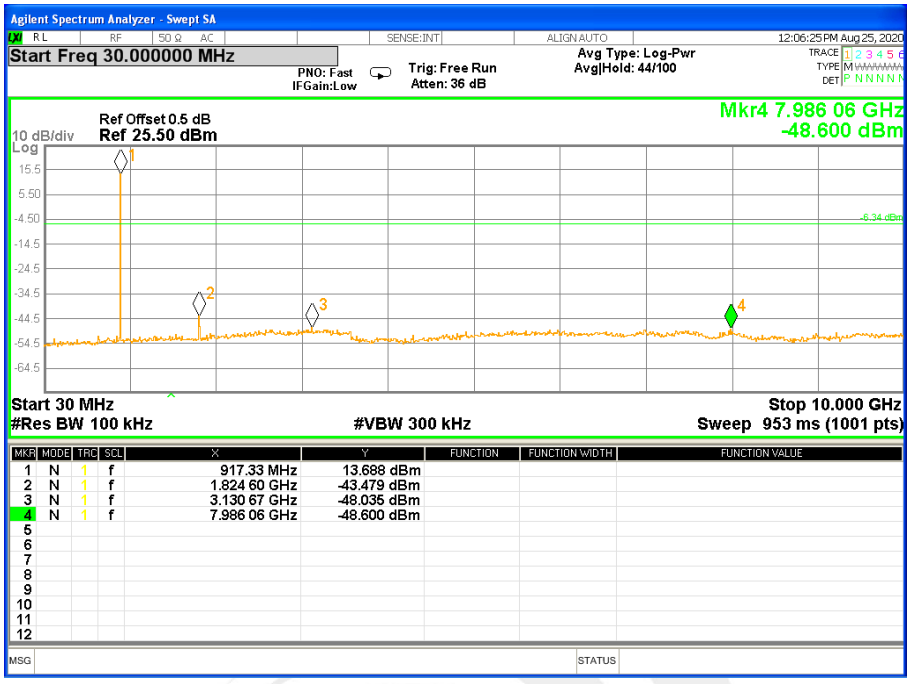
01 CH



31 CH

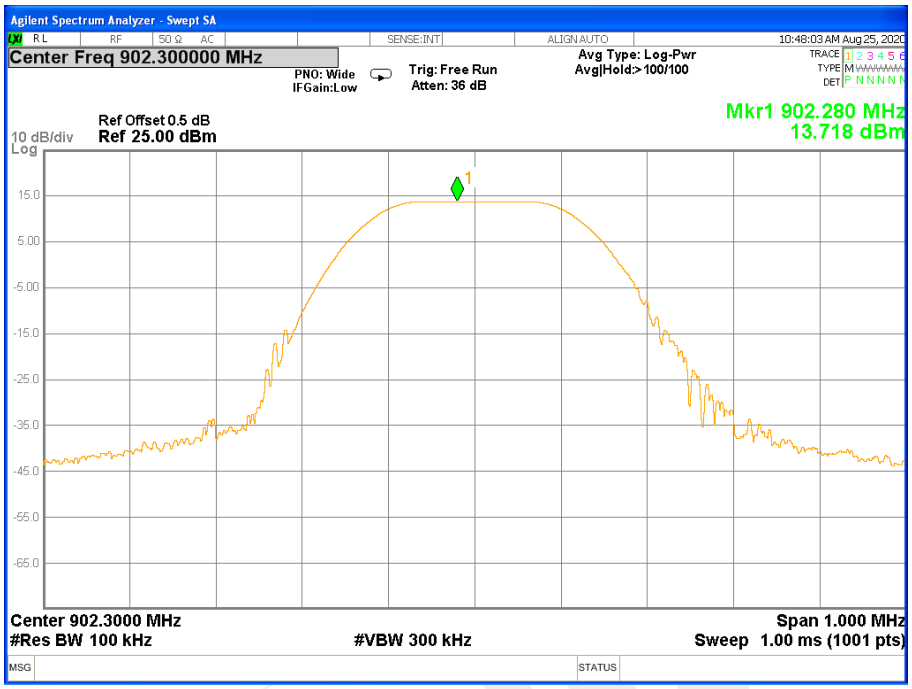


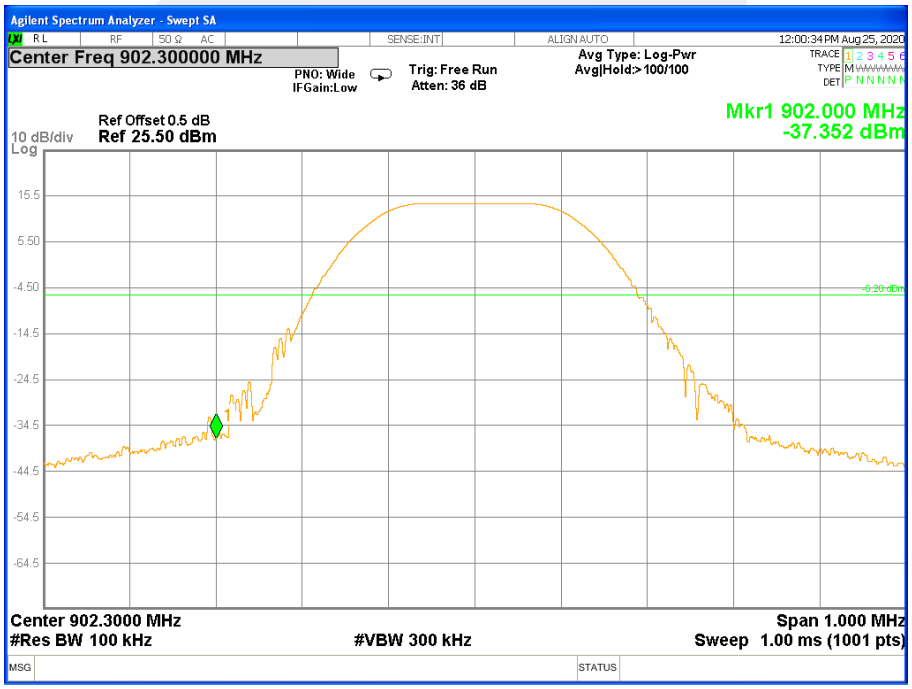
63 CH


Agilent Spectrum Analyzer - Swept SA
RL
RF
50 Ω AC
SENSE:INT
ALIGN AUTO
12:06:25 PM Aug 25, 2020
Start Freq 30.000000 MHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 36 dB
Avg Type: Log-Pwr
Avg|Hold: 44/100
TRACE 1 2 3 4 5 6
TYPE M
DET P N N N N N
Ref Offset 0.5 dB
10 dB/div
Log
Ref 25.50 dBm
Mkr4 7.986 06 GHz
-48.600 dBm
15.5
5.50
-4.50
-14.5
-24.5
-34.5
-44.5
-54.5
-64.5
-6.34 dBm
Start 30 MHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 10.000 GHz
Sweep 953 ms (1001 pts)
MKR MODE TRC SCL X Y FUNCTION FUNCTION WIDTH FUNCTION VALUE
1 N 1 f 917.33 MHz 13.688 dBm
2 N 1 f 1.824 60 GHz -43.479 dBm
3 N 1 f 3.130 67 GHz -48.035 dBm
4 N 1 f 7.986 06 GHz -48.600 dBm
5
6
7
8
9
10
11
12
MSG
STATUS

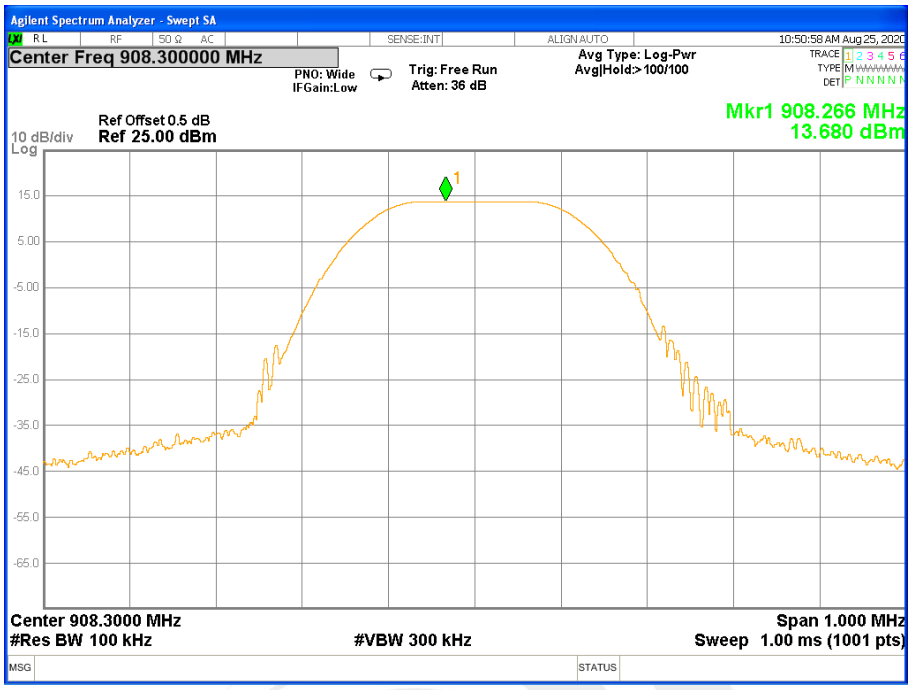
For Band edge(it's also the reference level for conducted spurious emission)

01 CH

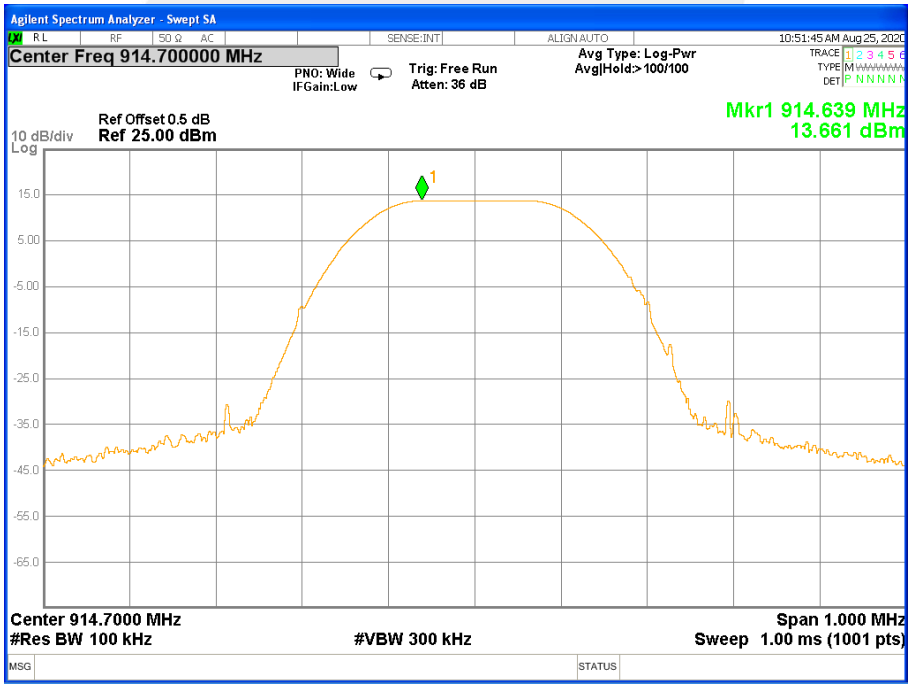


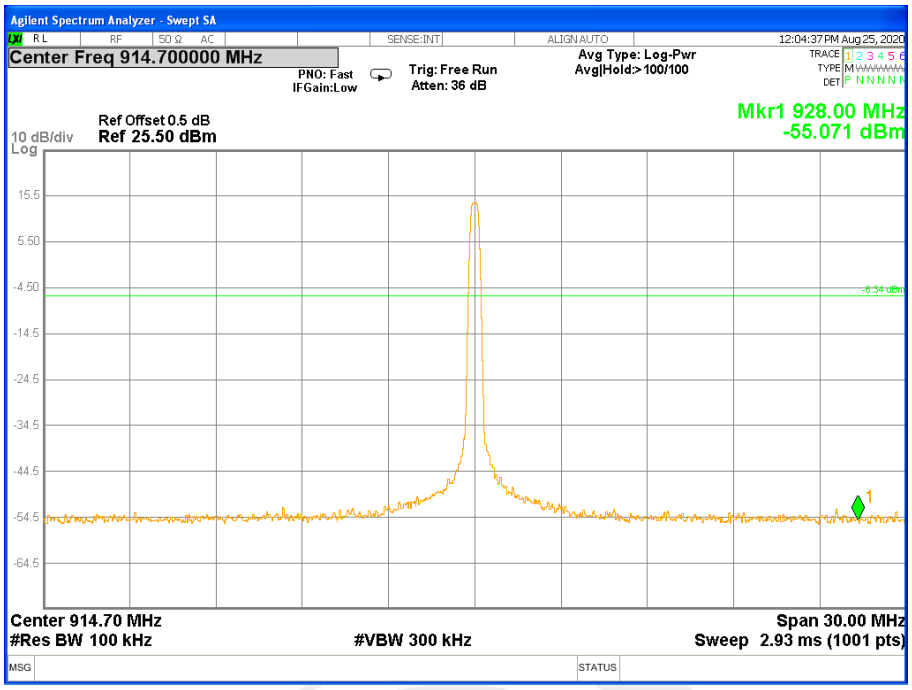


31 CH


Agilent Spectrum Analyzer - Swept SA
Center Freq 908.300000 MHz
PNO: Wide
IFGain:Low
Trig: Free Run
Atten: 36 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
10:50:58 AM Aug 25, 2020
Ref Offset 0.5 dB
10 dB/div
Ref 25.00 dBm
Log
Mkr1 908.266 MHz
13.680 dBm
15.0
5.00
-5.00
-15.0
-25.0
-35.0
-45.0
-55.0
-65.0
Center 908.3000 MHz
#Res BW 100 kHz
#VBW 300 kHz
Span 1.000 MHz
Sweep 1.00 ms (1001 pts)
MSG
STATUS

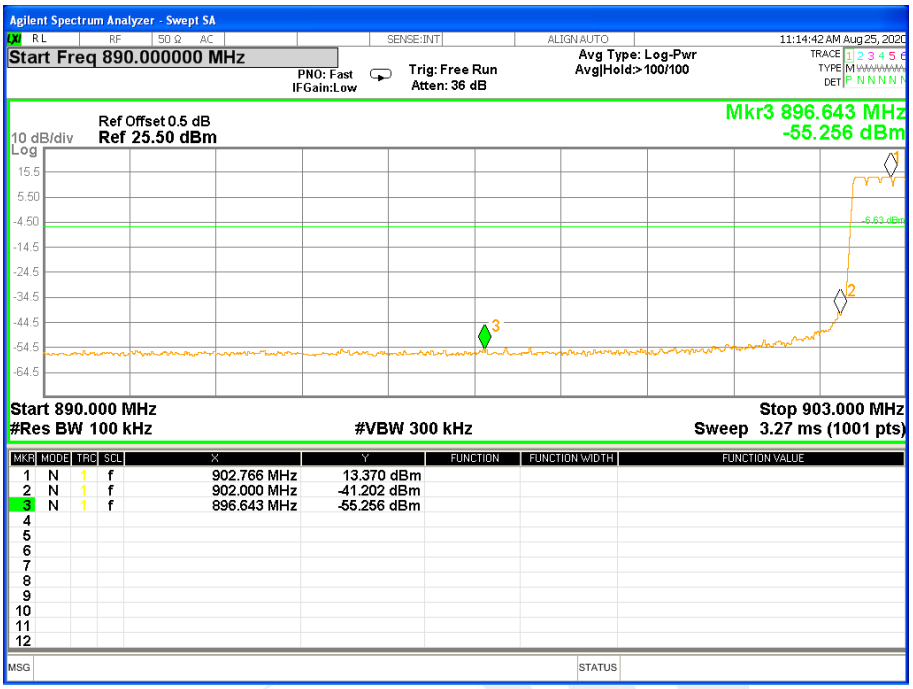
63 CH

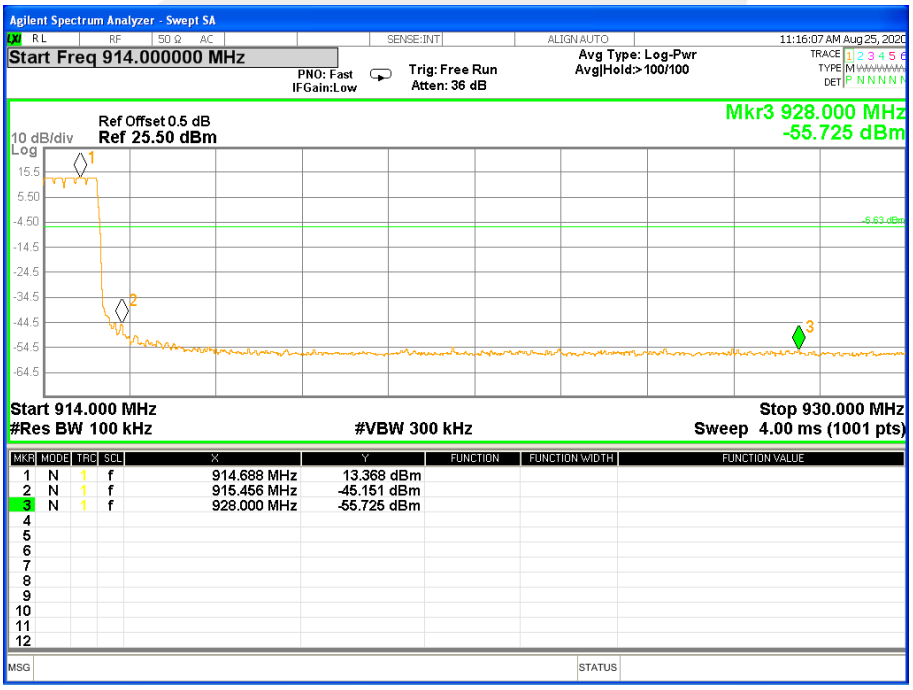

Agilent Spectrum Analyzer - Swept SA
Center Freq 914.700000 MHz
PNO: Wide
IFGain:Low
Trig: Free Run
Atten: 36 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
10:51:45 AM Aug 25, 2020
Ref Offset 0.5 dB
10 dB/div
Ref 25.00 dBm
Log
Mkr1 914.639 MHz
13.661 dBm
15.0
5.00
-5.00
-15.0
-25.0
-35.0
-45.0
-55.0
-65.0
Center 914.7000 MHz
#Res BW 100 kHz
#VBW 300 kHz
Span 1.000 MHz
Sweep 1.00 ms (1001 pts)
MSG
STATUS


Agilent Spectrum Analyzer - Swept SA
RL
RF
50 Ω AC
SENSE:INT
ALIGN AUTO
12:04:37 PM Aug 25, 2020
Center Freq 914.700000 MHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 36 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
TRACE 1 2 3 4 5 6
TYPE M
DET P N N N N N
Mkr1 928.00 MHz
-55.071 dBm
Ref Offset 0.5 dB
10 dB/div
Log
Ref 25.50 dBm
15.5
5.50
-4.50
-14.5
-24.5
-34.5
-44.5
-54.5
-64.5
-6.34 dBm
1
Center 914.70 MHz
#Res BW 100 kHz
#VBW 300 kHz
Span 30.00 MHz
Sweep 2.93 ms (1001 pts)
MSG
STATUS

For Hopping Band edge

LoRa





5. NUMBER OF HOPPING CHANNEL

5.1 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.

EUT 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50.

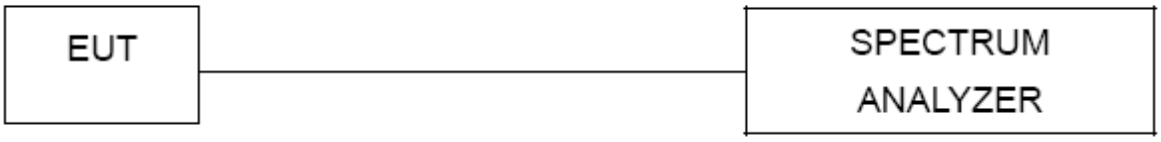
Spectrum Parameters	Setting
Attenuation	Auto
Span Frequency	> Operating FrequencyRange
RB	62KHz
VB	180KHz
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

5.2 TEST PROCEDURE

a. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.

b. Spectrum Setting: RBW= 62KHz, VBW=180KHz, Sweep time = Auto.

5.3 TEST SETUP



5.4 EUT OPERATION CONDITIONS

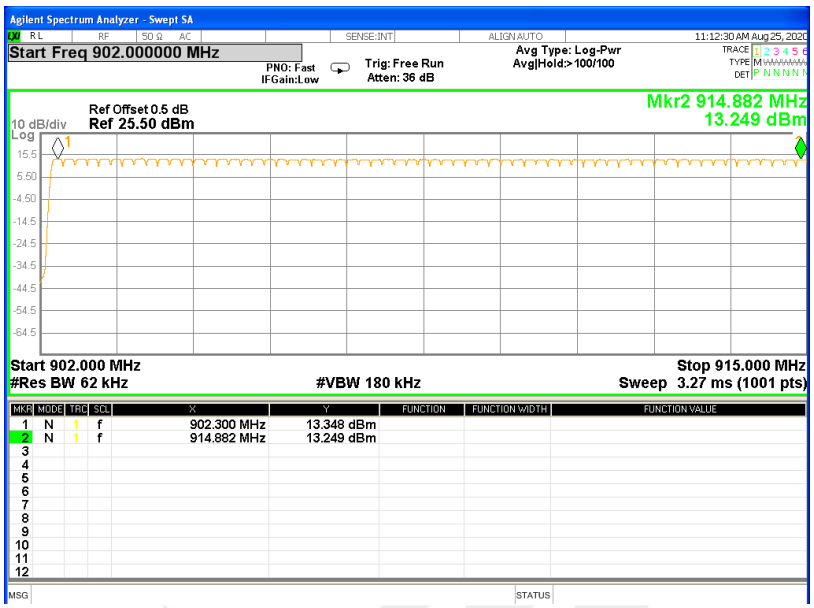
The EUT tested system was configured as the statements of 2.4 Unless otherwise a special operating condition is specified in the follows during the testing.

5.5 TEST RESULTS

Temperature:	25℃	Relative Humidity:	60%
Test Mode:	Hopping Mode -LoRa Mode	Test Voltage:	DC 3.3V

Number of Hopping Channel: 63

Hopping channel



6. AVERAGE TIME OF OCCUPANCY

6.1 LIMIT

FCC Part 15.247,Subpart C RSS-247 Issue 2				
Section	Test Item	Limit	FrequencyRange (MHz)	Result
15.247 (f) RSS-247	Average Time of Occupancy	< 0.4sec	902-928	PASS

6.2 TEST PROCEDURE

a. The transmitter output (antenna port) was connected to the spectrum analyzer.
b. Set RBW =100KHz/VBW =300KHz.
c. Use a video trigger with the trigger level set to enable triggering only on full pulses.
d. Sweep Time is 0.4* channel number.
e. Set the center frequency on any frequency would be measure and set the frequency span to zero span.
f. Measure the maximum time duration of one single pulse.

6.3 TEST SETUP

6.4 EUT OPERATION CONDITIONS

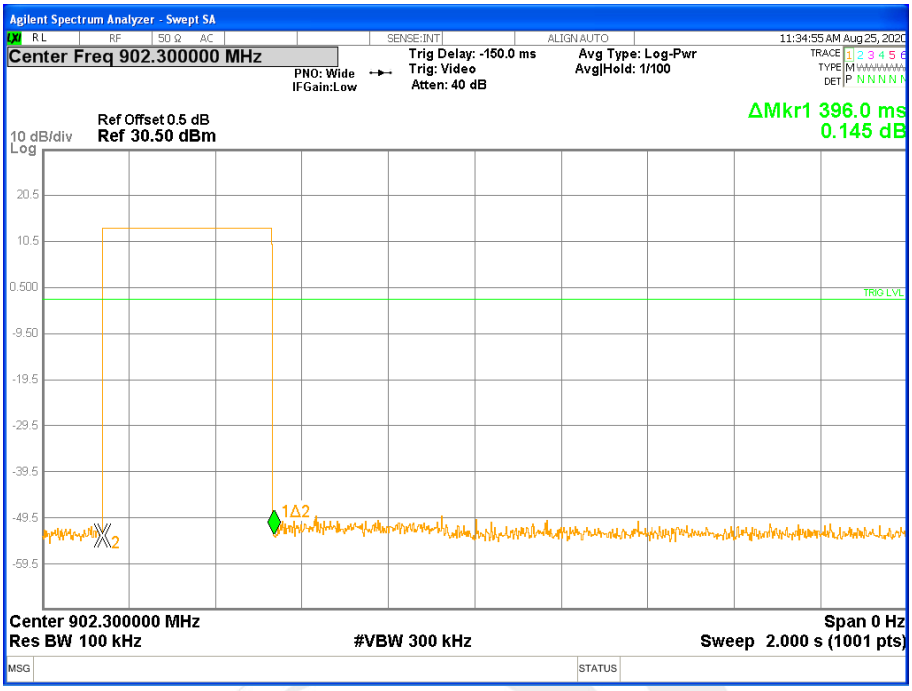
The EUT tested system was configured as the statements of 2.4 Unless otherwise a special operating condition is specified in the follows during the testing.

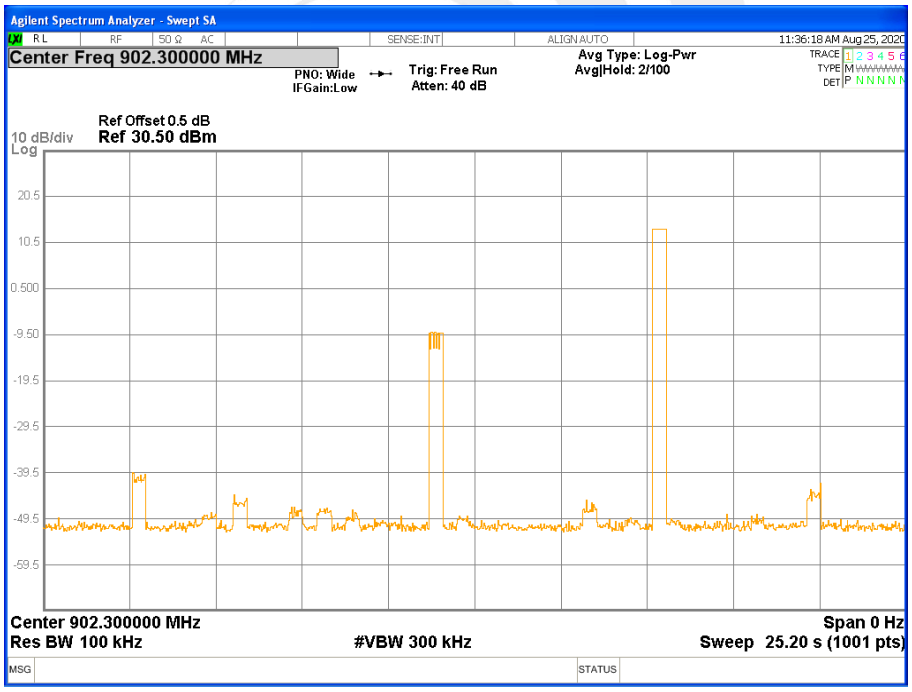
6.5 TEST RESULTS

Temperature:	25℃	Relative Humidity:	50%
Test Mode:	LoRa	Test Voltage:	DC 3.3V

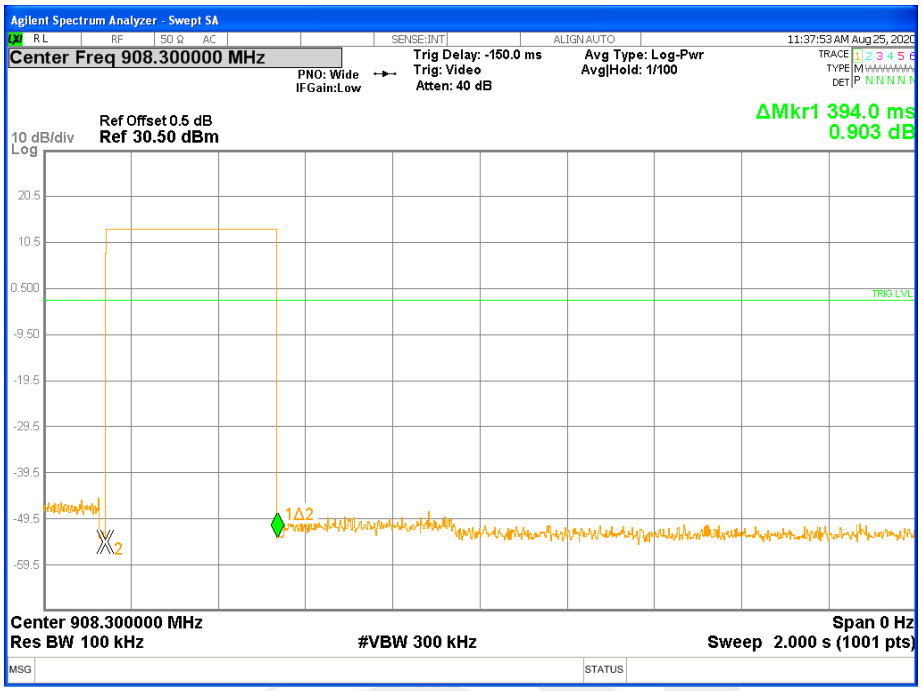
Channel	Pulse time(ms)	Number of pulses	Dwell Time(s)	Limits(s)
Low	396.000	1	0.396	0.4
Middle	394.000	1	0.394	0.4
High	396.000	1	0.396	0.4

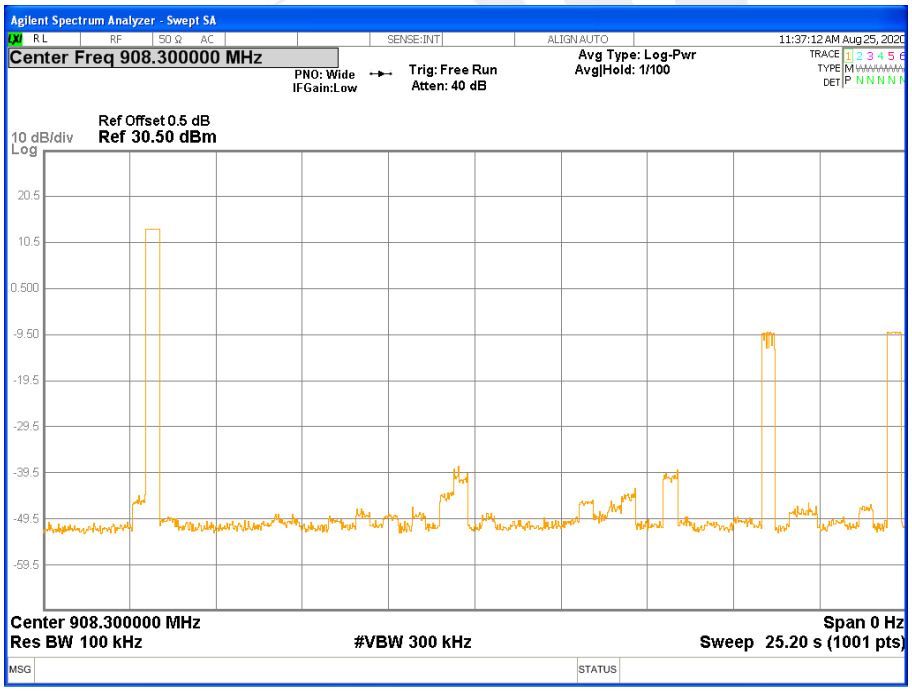
CH01


Agilent Spectrum Analyzer - Swept SA
Center Freq 902.300000 MHz
PNO: Wide
IFGain:Low
Trig Delay: -150.0 ms
Trig: Video
Atten: 40 dB
Avg Type: Log-Pwr
Avg|Hold: 1/100
11:34:55 AM Aug 25, 2020
ΔMkr1 396.0 ms
0.145 dB
Ref Offset 0.5 dB
10 dB/div
Ref 30.50 dBm
Log
20.5
10.5
0.500
-9.50
-19.5
-29.5
-39.5
-49.5
-59.5
TRIG LVL
Center 902.300000 MHz
Res BW 100 kHz
#VBW 300 kHz
Span 0 Hz
Sweep 2.000 s (1001 pts)
MSG
STATUS

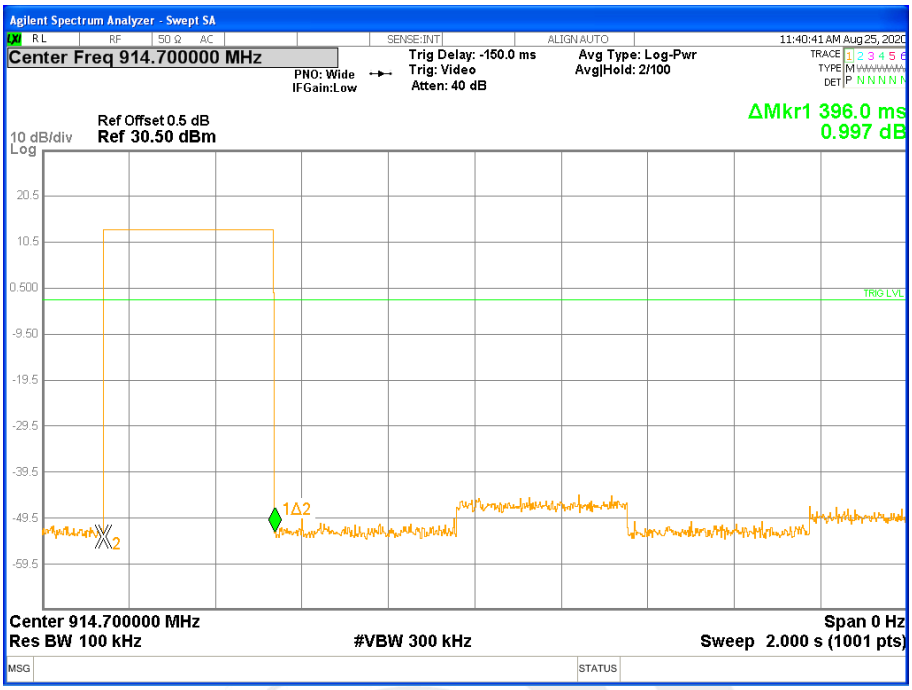

Agilent Spectrum Analyzer - Swept SA
Center Freq 902.300000 MHz
PNO: Wide
IFGain:Low
Trig: Free Run
Atten: 40 dB
Avg Type: Log-Pwr
Avg|Hold: 2/100
11:36:18 AM Aug 25, 2020
Ref Offset 0.5 dB
10 dB/div
Ref 30.50 dBm
Log
20.5
10.5
0.500
-9.50
-19.5
-29.5
-39.5
-49.5
-59.5
Center 902.300000 MHz
Res BW 100 kHz
#VBW 300 kHz
Span 0 Hz
Sweep 25.20 s (1001 pts)
MSG
STATUS

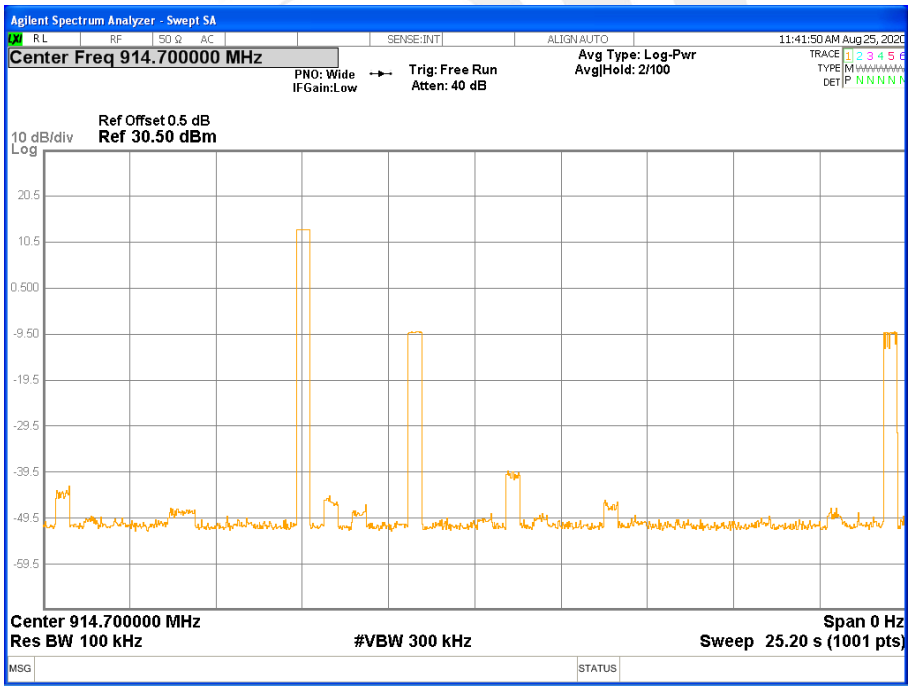
CH31


Agilent Spectrum Analyzer - Swept SA
Center Freq 908.300000 MHz
PNO: Wide
IFGain:Low
Trig Delay: -150.0 ms
Trig: Video
Atten: 40 dB
Avg Type: Log-Pwr
Avg|Hold: 1/100
11:37:53 AM Aug 25, 2020
ΔMkr1 394.0 ms
0.903 dB
Ref Offset 0.5 dB
10 dB/div
Ref 30.50 dBm
Log
20.5
10.5
0.500
-9.50
-19.5
-29.5
-39.5
-49.5
-59.5
TRIG LVL
Center 908.300000 MHz
Res BW 100 kHz
#VBW 300 kHz
Span 0 Hz
Sweep 2.000 s (1001 pts)
MSG
STATUS


Agilent Spectrum Analyzer - Swept SA
Center Freq 908.300000 MHz
PNO: Wide
IFGain:Low
Trig: Free Run
Atten: 40 dB
Avg Type: Log-Pwr
Avg|Hold: 1/100
11:37:12 AM Aug 25, 2020
Ref Offset 0.5 dB
10 dB/div
Ref 30.50 dBm
Log
20.5
10.5
0.500
-9.50
-19.5
-29.5
-39.5
-49.5
-59.5
Center 908.300000 MHz
Res BW 100 kHz
#VBW 300 kHz
Span 0 Hz
Sweep 25.20 s (1001 pts)
MSG
STATUS

CH63


Agilent Spectrum Analyzer - Swept SA
Center Freq 914.700000 MHz
PNO: Wide
IFGain:Low
Trig Delay: -150.0 ms
Trig: Video
Atten: 40 dB
Avg Type: Log-Pwr
Avg|Hold: 2/100
11:40:41 AM Aug 25, 2020
ΔMkr1 396.0 ms
0.997 dB
Ref Offset 0.5 dB
10 dB/div
Ref 30.50 dBm
Log
TRIG LVL
Center 914.700000 MHz
Res BW 100 kHz
#VBW 300 kHz
Span 0 Hz
Sweep 2.000 s (1001 pts)


Agilent Spectrum Analyzer - Swept SA
Center Freq 914.700000 MHz
PNO: Wide
IFGain:Low
Trig: Free Run
Atten: 40 dB
Avg Type: Log-Pwr
Avg|Hold: 2/100
11:41:50 AM Aug 25, 2020
Ref Offset 0.5 dB
10 dB/div
Ref 30.50 dBm
Log
Center 914.700000 MHz
Res BW 100 kHz
#VBW 300 kHz
Span 0 Hz
Sweep 25.20 s (1001 pts)

7. HOPPING CHANNEL SEPARATION MEASUREMEN

7.1 LIMIT

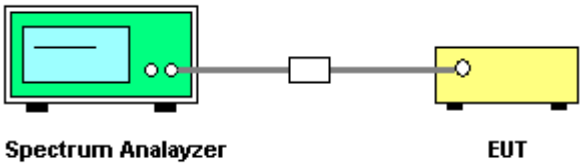
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

Spectrum Parameter	Setting
Attenuation	Auto
Span	500KHz
RB	62KHz
VB	180 kHz
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

7.2 TEST PROCEDURE

a. The transmitter output (antenna port) was connected to the spectrum analyser in peak hold mode.
b. Spectrum Setting: RBW= 62KHz, VBW= 180KHz, Sweep time = Auto.

7.3 TEST SETUP



7.4 EUT OPERATION CONDITIONS

The EUT was programmed to be in continuously transmitting mode.

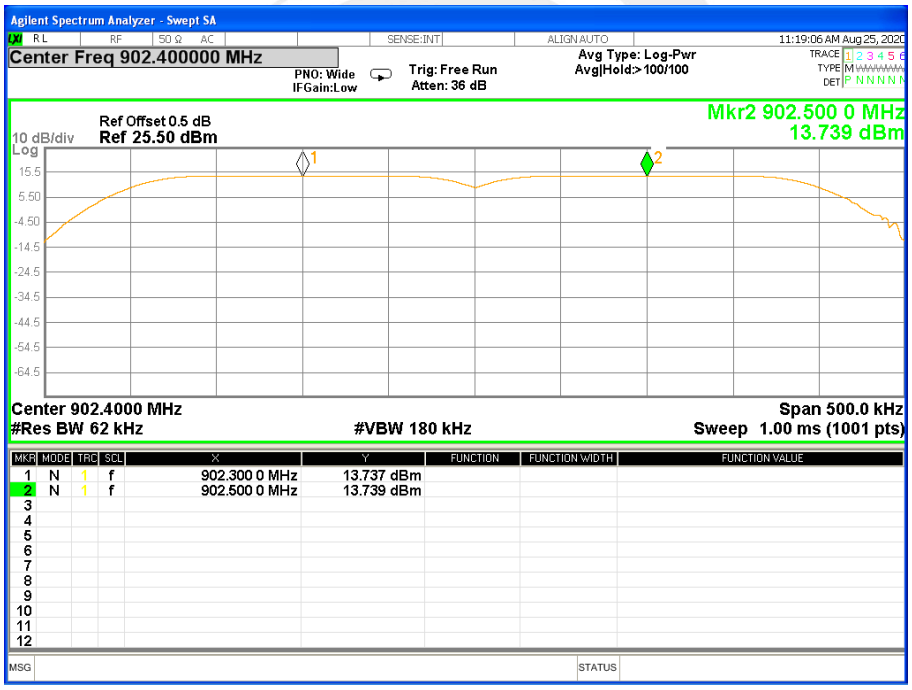
7.5 TEST RESULTS

Temperature:	25℃	Relative Humidity:	50%
Test Mode:	CH01 / CH31 / CH63	Test Voltage:	DC 3.3V

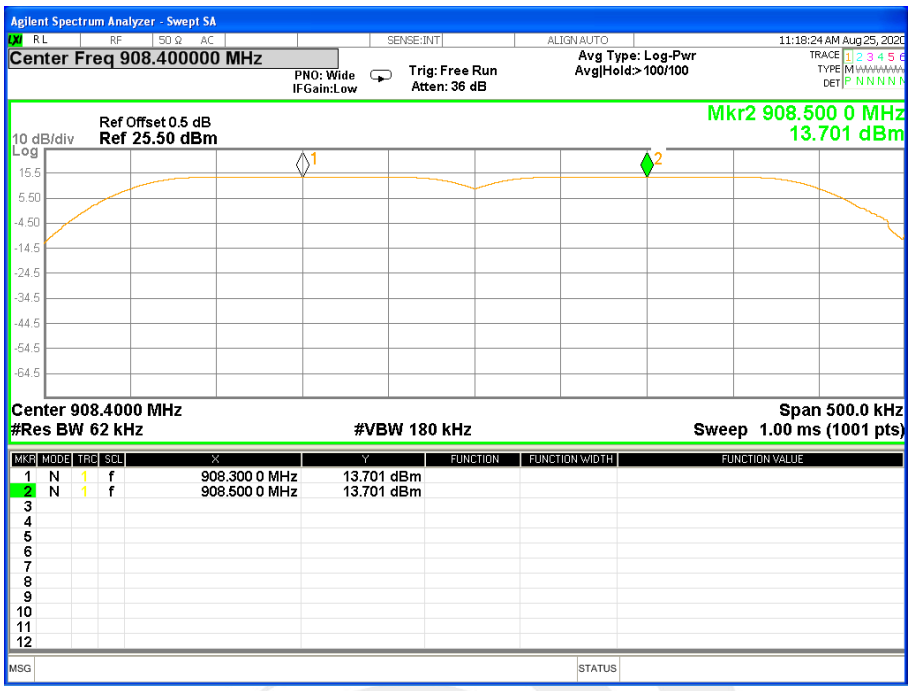
Frequency (MHz)	Mark1 Frequency （MHz）	Mark2 Frequency （MHz）	Ch. Separation (MHz)	Limit (MHz)	Result
902.3	902.300	902.500	0.200	0.138	Complies
908.3	908.300	908.500	0.200	0.136	Complies
914.7	914.500	914.700	0.200	0.136	Complies

For LoRa: Ch. Separation Limits: > 20dB bandwidth

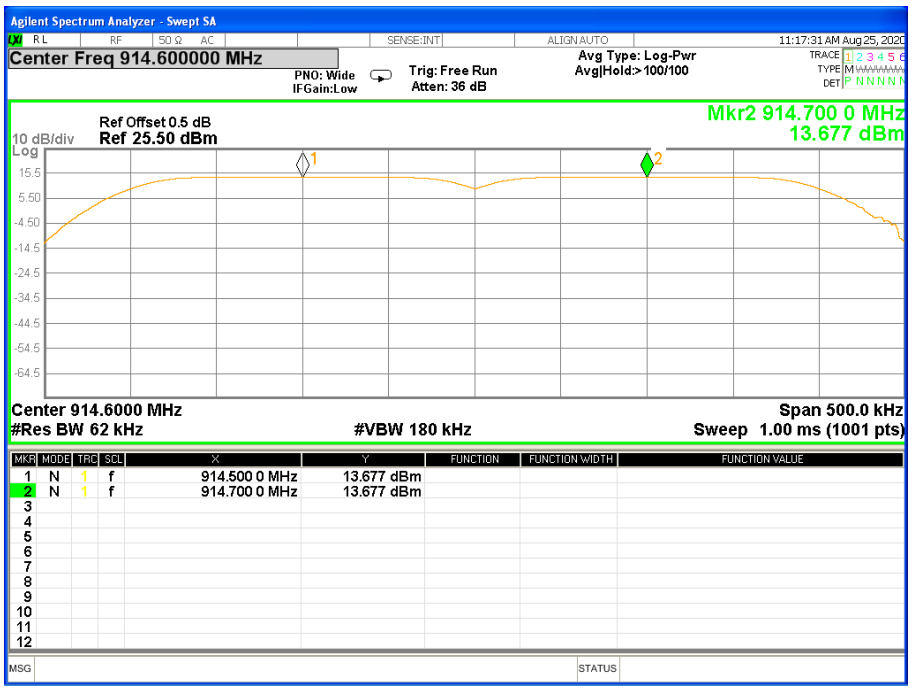
CH01



CH31


Agilent Spectrum Analyzer - Swept SA
Center Freq 908.400000 MHz
PNO: Wide
IFGain:Low
Trig: Free Run
Atten: 36 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
11:18:24 AM Aug 25, 2020
Ref Offset 0.5 dB
10 dB/div
Ref 25.50 dBm
Log
Mkr2 908.500 0 MHz
13.701 dBm
Center 908.4000 MHz
#Res BW 62 kHz
#VBW 180 kHz
Span 500.0 kHz
Sweep 1.00 ms (1001 pts)
1 N 1 f 908.300 0 MHz 13.701 dBm
2 N 1 f 908.500 0 MHz 13.701 dBm

CH63


Agilent Spectrum Analyzer - Swept SA
Center Freq 914.600000 MHz
PNO: Wide
IFGain:Low
Trig: Free Run
Atten: 36 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
11:17:31 AM Aug 25, 2020
Ref Offset 0.5 dB
10 dB/div
Ref 25.50 dBm
Log
Mkr2 914.700 0 MHz
13.677 dBm
Center 914.6000 MHz
#Res BW 62 kHz
#VBW 180 kHz
Span 500.0 kHz
Sweep 1.00 ms (1001 pts)
1 N 1 f 914.500 0 MHz 13.677 dBm
2 N 1 f 914.700 0 MHz 13.677 dBm

8. BANDWIDTH TEST

8.1 LIMIT

FCC Part15 15.247,Subpart C RSS-247 Issue 2				
Section	Test Item	Limit	FrequencyRange (MHz)	Result
15.247 (a)(1) RSS-247	Bandwidth	< 250kHz	902-928	PASS

Spectrum Parameter	Setting
Attenuation	Auto
Span	1MHz
RB	3 kHz
VB	10 kHz
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

8.2 TEST PROCEDURE

a. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
b. Spectrum Setting: RBW= 3KHz, VBW=10KHz, Sweep time = Auto.

8.3 TEST SETUP

8.4 EUT OPERATION CONDITIONS

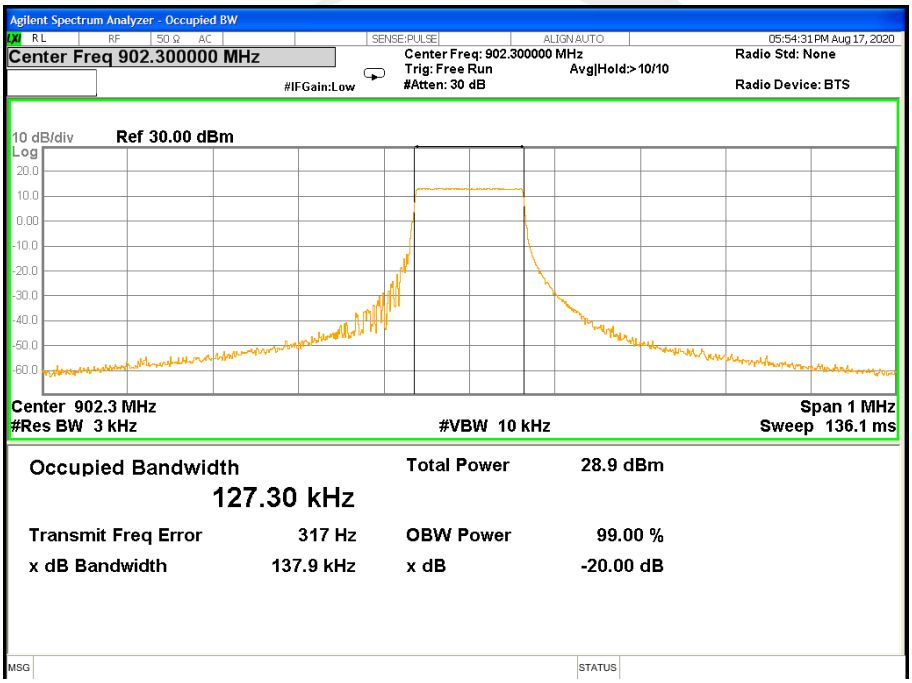
The EUT tested system was configured as the statements of 2.4 Unless otherwise a special operating condition is specified in the follows during the testing.

8.5 TEST RESULTS

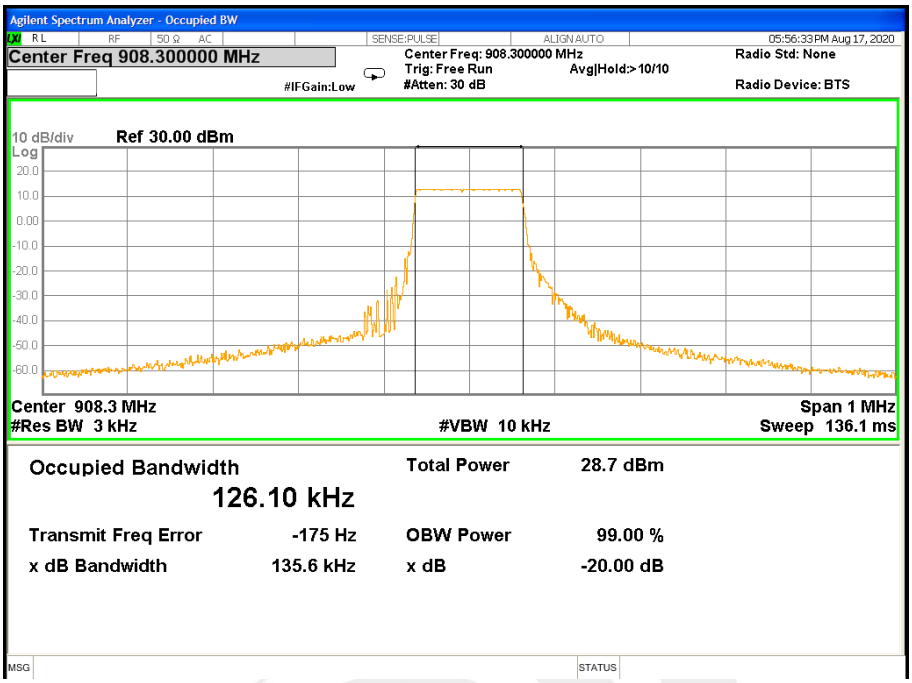
Temperature:	25℃	Relative Humidity:	50%
Test Mode:	CH01 / CH31 / CH63	Test Voltage:	DC 3.3V

Frequency	20dB Bandwidth (MHz)	99% Bandwidth (MHz)	Result
902.3 MHz	0.1379	0.1273	PASS
908.3 MHz	0.1356	0.1261	PASS
914.7 MHz	0.1361	0.1270	PASS

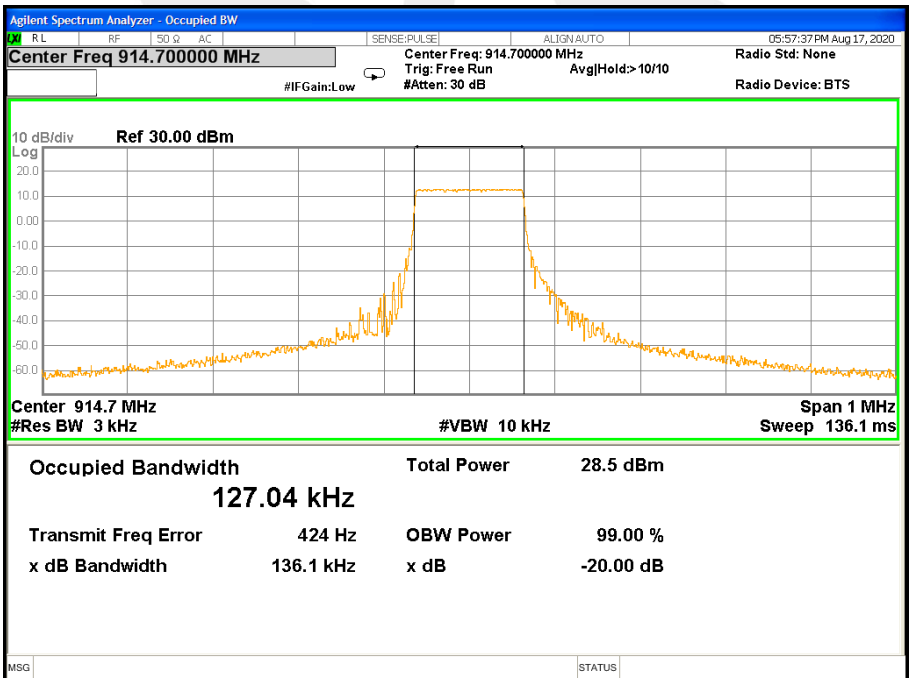
CH01



CH32


Agilent Spectrum Analyzer - Occupied BW
RL RF 50 Ω AC SENSE:PULSE ALIGN AUTO 05:56:33 PM Aug 17, 2020
Center Freq 908.300000 MHz
Center Freq: 908.300000 MHz
Trig: Free Run Avg|Hold:>10/10
#IFGain:Low #Atten: 30 dB
Radio Std: None
Radio Device: BTS
10 dB/div Ref 30.00 dBm
Log
20.0
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
Center 908.3 MHz
#Res BW 3 kHz
#VBW 10 kHz
Span 1 MHz
Sweep 136.1 ms
Occupied Bandwidth
126.10 kHz
Total Power 28.7 dBm
Transmit Freq Error -175 Hz
OBW Power 99.00 %
x dB Bandwidth 135.6 kHz
x dB -20.00 dB
MSG
STATUS

CH63


Agilent Spectrum Analyzer - Occupied BW
RL RF 50 Ω AC SENSE:PULSE ALIGN AUTO 05:57:37 PM Aug 17, 2020
Center Freq 914.700000 MHz
Center Freq: 914.700000 MHz
Trig: Free Run Avg|Hold:>10/10
#IFGain:Low #Atten: 30 dB
Radio Std: None
Radio Device: BTS
10 dB/div Ref 30.00 dBm
Log
20.0
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
Center 914.7 MHz
#Res BW 3 kHz
#VBW 10 kHz
Span 1 MHz
Sweep 136.1 ms
Occupied Bandwidth
127.04 kHz
Total Power 28.5 dBm
Transmit Freq Error 424 Hz
OBW Power 99.00 %
x dB Bandwidth 136.1 kHz
x dB -20.00 dB
MSG
STATUS

9. OUTPUT POWER TEST

9.1 LIMIT

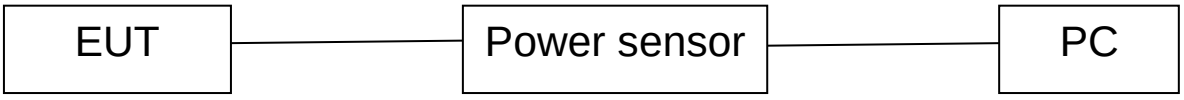
FCC Part 15.247,Subpart C RSS-247 Issue 2				
Section	Test Item	Limit	FrequencyRange (MHz)	Result
15.247(b)(2) RSS-247	Output Power	1 W	902-928	PASS
RSS-247	EIRP	4W	902-928	PASS

9.2 TEST PROCEDURE

This is an RF-conducted test to evaluate maximum peak output power. Use a direct connection between the antenna port of the unlicensed wireless device and the spectrum analyzer, through suitable attenuation. The hopping shall be disabled for this test:

a) Use the following spectrum analyzer settings:
1) Span: Approximately five times the 20 dB bandwidth, centered on a hopping channel.
2) RBW > 20 dB bandwidth of the emission being measured.
3) VBW ≥ RBW.
4) Sweep: Auto.
5) Detector function: Peak.
6) Trace: Max hold.
b) Allow trace to stabilize.
c) Use the marker-to-peak function to set the marker to the peak of the emission.
d) The indicated level is the peak output power, after any corrections for external attenuators and cables.
e) A plot of the test results and setup description shall be included in the test report.
NOTE—A peak responding power meter may be used, where the power meter and sensor system video bandwidth is greater than the occupied bandwidth of the unlicensed wireless device, rather than a spectrum analyzer.
PKPM1 Peak power meter method:
The maximum peak conducted output power may be measured using a broadband peak RF power meter. The power meter shall have a video bandwidth that is greater than or equal to the DSS bandwidth and shall use a fast-responding diode detector.

9.3 TEST SETUP



9.4 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of 2.4 Unless otherwise a special operating condition is specified in the follows during the testing.

9.5 TEST RESULTS

Temperature:	25℃	Relative Humidity:	60%
Test Voltage:	DC 3.3V		

Channel Number	Frequency (MHz)	Peak Power (dBm)	Limit (dBm)
1	902.3	24.19	30.00
31	908.3	24.58	30.00
63	914.7	23.88	30.00

EIRP Power

Frequency (MHz)	Peak Power (dBm)	Antenna Gain (dBi)	EIRP Power (dBm)	Limit (dBm)
902.3	24.19	1.20	25.39	36.02
908.3	24.58	1.20	25.78	36.02
914.7	23.88	1.20	25.08	36.02

10. ANTENNA REQUIREMENT

10.1 STANDARD REQUIREMENT

15.203&RSS-Gen lssue 5 requirement: For intentional device, according to 15.203&RSS-Gen lssue 5: 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.

10.2 EUT ANTENNA

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

11. FREQUENCY STABILITY

11.1 LIMITS OF FREQUENCY STABILITY MEASUREMENT

The frequency tolerance of the carrier signal shall be maintained within +/-0.02% of the operating frequency over a temperature variation of -30 degrees to 50 degrees C at normal supply voltage,and for a variation in primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees.

11.2 TEST PROCEDURE

1. The EUT was placed inside the environmental test chamber and powered by nominal DC voltage.
2. Turn the EUT on and couple its output to spectrum analyzer.
3. Turn the EUT off and set the chamber to the highest temperature specified.
4. Allow sufficient time (approximately 30 min) for the temperature of the chamber to stabilize,turn the EUT on and measure the operating frequency after 2,5,and 10 minutes.
5. Repeat step 2 and 3 with the temperature chamber set to the lowest temperature.
6. The test chamber was allowed to stabilize at +20 degree C for a minimum of 30 minutes.The supply voltage was then adjusted on the EUT from 85% to 115% and the frequency record.

11.3 TEST RESULT

Channel 31 (908.3MHz)

Voltage vs. Frequency Stability

Voltage(V)	Measurement Frequency(MHz)
3.795	908.3012
3.3	908.3005
2.805	908.3006
Max.Deviation(MHz)	0.0012
Max.Deviation(ppm)	1.32

Rated working voltage: DC 3.3V

Temperature vs. Frequency Stability

Temperature(℃)	Measurement Frequency(MHz)
-30	908.3010
-20	908.3007
-10	908.3005
0	908.3010
10	908.3008
20	908.3002
30	908.3009
40	908.3002
50	908.3001
Max.Deviation(MHz)	0.0010
Max.Deviation(ppm)	1.10

APPENDIX-PHOTOS OF TEST SETUP

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

※※※※※END OF THE REPORT※※※※※