ELECTROMAGNETIC EMISSION COMPLIANCE REPORT FOR LOW-POWER, NON-LICENSED TRANSMITTER

Test Report No.	**: OT-192-RWD-010**
AGR No.	**: A18NA-185**
Applicant	**: OSSTEM IMPLANT Co., Ltd.**
Address	**: 1st floor, B-dong, 135, Gasan digital 2-ro, Geumcheon-gu, Seoul, Korea**
Manufacturer	**: OSSTEM IMPLANT Co., Ltd.**
Address	**: 1st floor, B-dong, 135, Gasan digital 2-ro, Geumcheon-gu, Seoul, Korea**
Type of Equipment	**: Osstem Zigbee Module**
FCC ID.	**: 2ASB7K-WLM-01**
Model Name	**: K-WLM-01**
Multiple Model Name	**: N/A**
Serial number	**: N/A**
Total page of Report	**: 30 pages (including this page)**
Date of Incoming	**: October 15, 2018**
Date of issue	**: January 25, 2019**

SUMMARY

The equipment complies with the regulation; ***FCC PART 15 SUBPART C Section 15.247***

This test report only contains the result of a single test of the sample supplied for the examination.

It is not a generally valid assessment of the features of the respective products of the mass-production.

Reviewed by: Jae-Ho Lee / Chief Engineer
ONETECH Corp.

Approved by: Keun-Young, Choi / Vice President
ONETECH Corp.

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CONTENTS

PAGE

1. VERIFICATION OF COMPLIANCE **5**

2. TEST SUMMARY **6**

2.1 TEST ITEMS AND RESULTS 6

2.2 ADDITIONS, DEVIATIONS, EXCLUSIONS FROM STANDARDS 6

2.3 RELATED SUBMITTAL(S) / GRANT(S) 6

2.4 PURPOSE OF THE TEST 6

2.5 TEST METHODOLOGY 6

2.6 TEST FACILITY 6

3. GENERAL INFORMATION **7**

3.1 PRODUCT DESCRIPTION 7

3.2 ALTERNATIVE TYPE(S)/MODEL(S); ALSO COVERED BY THIS TEST REPORT. 7

4. EUT MODIFICATIONS **7**

5. SYSTEM TEST CONFIGURATION **8**

5.1 JUSTIFICATION 8

5.2 PERIPHERAL EQUIPMENT 8

5.3 MODE OF OPERATION DURING THE TEST 8

5.4 CONFIGURATION OF TEST SYSTEM 9

5.5 ANTENNA REQUIREMENT 9

6. PRELIMINARY TEST **10**

6.1 AC POWER LINE CONDUCTED EMISSIONS TESTS 10

6.2 GENERAL RADIATED EMISSIONS TESTS 10

7. MIMIMUM 6 DB BANDWIDTH **11**

7.1 OPERATING ENVIRONMENT 11

7.2 TEST SET-UP 11

7.3 TEST EQUIPMENT USED 11

7.4 TEST DATA 12

8. MAXIMUM PEAK OUTPUT POWER **14**

8.1 OPERATING ENVIRONMENT 14

8.2 TEST SET-UP 14

8.3 TEST EQUIPMENT USED 14

8.4 TEST DATA 15

9. 100 KHZ BANDWIDTH OUTSIDE THE FREQUENCY BAND **17**

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9.1 OPERATING ENVIRONMENT 17
9.2 TEST SET-UP FOR CONDUCTED MEASUREMENT 17
9.3 TEST SET-UP FOR RADIATED MEASUREMENT 17
9.4 TEST EQUIPMENT USED 17
9.5 TEST DATA FOR CONDUCTED EMISSION 18
9.6 TEST DATA FOR RADIATED EMISSION 23
9.6.1 Radiated Emission which fall in the Restricted Band *23*
9.6.2 Spurious & Harmonic Radiated Emission *24*
10. PEAK POWER SPECTRAL DENSITY **25**
10.1 OPERATING ENVIRONMENT 25
10.2 TEST SET-UP 25
10.3 TEST EQUIPMENT USED 25
10.4 TEST DATA 26
11. RADIATED EMISSION TEST **28**
11.1 OPERATING ENVIRONMENT 28
11.2 TEST SET-UP 28
11.3 TEST EQUIPMENT USED 28
11.4 TEST DATA FOR TRANSMITTING MODE 29
11.4.1 Test data for 30 MHz ~ 1 GHz *29*
11.4.2 Test data for Below 30 MHz *30*
11.4.3 Test data for above 1 GHz *30*

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Revision History

Rev. No.	Issue Report No.	Issued Date	Revisions	Section Affected
0	OT-192-RWD-010	January 25, 2019	Initial Issue	All

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1. VERIFICATION OF COMPLIANCE

Applicant : OSSTEM IMPLANT Co., Ltd.
Address : 1st floor, B-dong, 135, Gasan digital 2-ro, Geumcheon-gu, Seoul, Korea
Contact Person : Hyeri Han / Associate
Telephone No. : +82-70-4626-0881
FCC ID : 2ASB7K-WLM-01
Model Name : K-WLM-01
Serial Number : N/A
Date : January 25, 2019

EQUIPMENT CLASS	DTS – DIGITAL TRNSMISSION SYSTEM
KIND OF EQUIPMENT	Osstem Zigbee Module
THIS REPORT CONCERNS	Original Grant
MEASUREMENT PROCEDURES	ANSI C63.10: 2013
TYPE OF EQUIPMENT TESTED	Pre-Production
KIND OF EQUIPMENT AUTHORIZATION REQUESTED	Certification
EQUIPMENT WILL BE OPERATED UNDER FCC RULES PART(S)	FCC PART 15 SUBPART C Section 15.247
MODIFICATIONS ON THE EQUIPMENT TO ACHIEVE COMPLIANCE	None
FINAL TEST WAS CONDUCTED ON	3 m, Semi Anechoic Chamber

-. The above equipment was tested by ONETECH Corp. for compliance with the requirement set forth in the FCC Rules and Regulations. This said equipment in the configuration described in this report, shows the maximum emission levels emanating from equipment are within the compliance requirements.

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2. TEST SUMMARY

2.1 Test items and results

SECTION	TEST ITEMS	RESULTS
15.247 (a) (2)	Minimum 6 dB Bandwidth	Met the Limit / PASS
15.247 (b) (3)	Maximum Peak Conducted Output Power	Met the Limit / PASS
15.247 (d)	100 kHz Bandwidth Outside the Frequency Band	Met the Limit / PASS
15.247 (d)	Radiated Emission which fall in the Restricted Band	Met the Limit / PASS
15.247 (e)	Peak Power Spectral Density	Met the Limit / PASS
15.209	Radiated Emission Limits	Met the Limit / PASS
15.207	Conducted Limits	N/A
15.203	Antenna Requirement	Met requirement / PASS

2.2 Additions, deviations, exclusions from standards

No additions, deviations or exclusions have been made from standard.

2.3 Related Submittal(s) / Grant(s)

Original submittal only

2.4 Purpose of the test

To determine whether the equipment under test fulfills the requirements of the regulation stated in FCC PART 15 SUBPART C Section 15.247.

2.5 Test Methodology

Both conducted and radiated testing was performed according to the procedures in ANSI C63.10: 2013. Radiated testing was performed at a distance of 3 m from EUT to the antenna.

2.6 Test Facility

The Onetech Corp. has been designated to perform equipment testing in compliance with ISO/IEC 17025.

The Electromagnetic compatibility measurement facilities are located at 43-14, Jinsaegol-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea

-. Site Filing:

VCCI (Voluntary Control Council for Interference) – Registration No. R-4112/ C-14617/ G-10666 / T-1842

IC (Industry Canada) – Registration No. Site# 3736A-3

-. Site Accreditation:

KOLAS (Korea Laboratory Accreditation Scheme) - Accreditation NO. KT085

FCC (Federal Communications Commission) - Accreditation No. KR0013

RRA (Radio Research Agency) – Designation No. KR0013

3. GENERAL INFORMATION

3.1 Product Description

The OSSTEM IMPLANT Co., Ltd., Model K-WLM-01 (referred to as the EUT in this report) is Osstem Zigbee Module. The product specification described herein was obtained from product data sheet or user's manual.

Device Type	Osstem Zigbee Module			
Operating Frequency	2 405 MHz ~ 2 480 MHz			
RF Output Power	4.24 dBm			
Modulation Type	O-QPSK			
Antenna Type / Antenna Gain	Monopole Antenna	Antenna 1 (Basic)	GW26.0152	1.8 dBi
		Antenna 2 (Additional)	SAT-G01R	1.5 dBi
		Antenna 3 (Additional)	RN-SMA-S-RP	1.7 dBi
		Antenna 4 (Additional)	GW26.0151	1.8 dBi
List of each Osc. or crystal Freq.(Freq. >= 1 MHz)	32 MHz			
Rated Supply Voltage	DC 3.3 V			

3.2 Alternative type(s)/model(s); also covered by this test report.

-. None

4. EUT MODIFICATIONS

-. None

5. SYSTEM TEST CONFIGURATION

5.1 Justification

This device was configured for testing in a typical way as a normal customer is supposed to be used. During the test, the following components were installed inside of the EUT.

DEVICE TYPE	MANUFACTURER	MODEL/PART NUMBER	FCC ID
Main Board	N/A	N/A	-
Front Board	N/A	N/A	-

5.2 Peripheral equipment

Defined as equipment needed for correct operation of the EUT, but not considered as tested:

Model	Manufacturer	Description	Connected to
ZIG Board	N/A	ZIG Board	EUT
G6-1121TV	HP	Notebook PC	EUT, AC/DC Adapter
PPP009C	HP	AC/DC Adapter	Notebook PC

5.3 Mode of operation during the test

For the testing, software used to control the EUT for staying in continuous transmitting is programmed.

For final testing, the EUT was set at 2 405 MHz, 2 440 MHz, and 2 480 MHz to get a maximum emission levels from the EUT. The EUT was moved throughout the XY, XZ, and YZ planes and the worst case is “XY” axis, but the worst data was recorded in this report.

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5.4 Configuration of Test System

Radiated Emission Test: Preliminary radiated emissions test were conducted using the procedure in ANSI C63.10: 2013 to determine the worse operating conditions. Final radiated emission tests were conducted at 3 meter Semi Anechoic Chamber.

The turntable was rotated through 360 degrees and the EUT was tested by positioned three orthogonal planes to obtain the highest reading on the field strength meter. Once maximum reading was determined, the search antenna was raised and lowered in both vertical and horizontal polarization.

5.5 Antenna Requirement

For intentional device, according to section 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.

Antenna Construction:

The antenna of the EUT is a Monopole Antenna on the main board in the EUT.

Antenna connectors for each antenna are as below.

Antenna	Model name	Connector
Antenna 1 (Basic)	GW26.0152	RP-SMA(M)
Antenna 2 (Additional)	SAT-G01R	SMA Male Reverse
Antenna 3 (Additional)	RN-SMA-S-RP	SMA-Male-RP
Antenna 4 (Additional)	GW26.0151	RP-SMA(M) Connector

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6. PRELIMINARY TEST

6.1 AC Power line Conducted Emissions Tests

As this product is only using DC power, AC conducted emission test has not been performed.

6.2 General Radiated Emissions Tests

During Preliminary Tests, the following operating modes were investigated

Operation Mode	The Worse operating condition (Please check one only)
Transmitting Mode	X

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7. MIMIMUM 6 dB BANDWIDTH

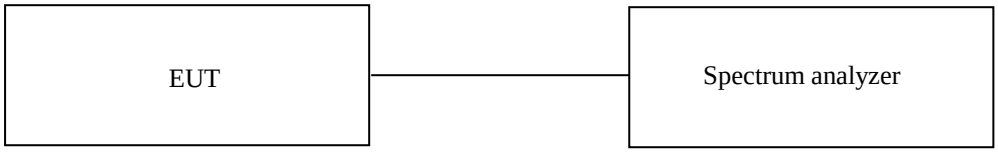
7.1 Operating environment

Temperature : 24 ℃

Relative humidity : 45 % R.H.

7.2 Test set-up

The antenna output of the EUT was connected to the spectrum analyzer. The resolution bandwidth is set to 100 kHz, and peak detection was used. The 6 dB bandwidth is defined as the total spectrum over which the power is higher than the peak power minus 6 dB.



7.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ -	FSV30	Rohde & Schwarz	Signal Analyzer	101200	Aug.23, 2018 (1Y)

All test equipment used is calibrated on a regular basis.

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7.4 Test data

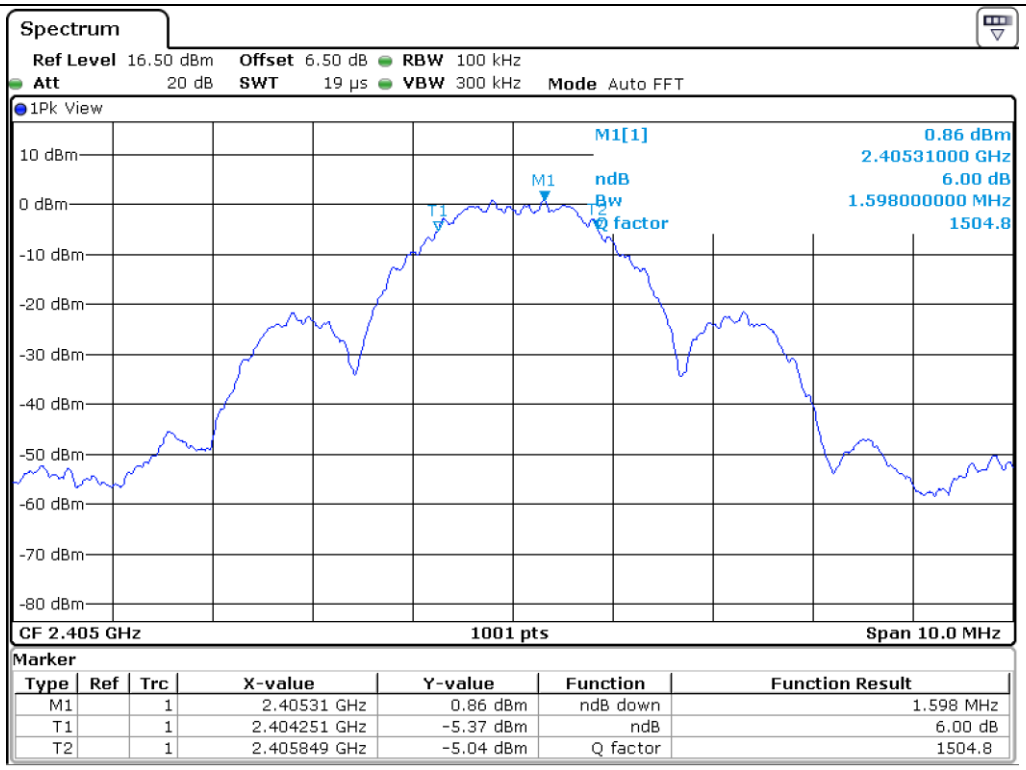
-. Test Date : October 30, 2018

-. Test Result : Pass

CHANNEL	FREQUENCY(MHz)	MEASURED VALUE (kHz)	LIMIT (kHz)	MARGIN (kHz)
Low	2 405.00	1598.00	500	1098.00
Middle	2 440.00	1598.00	500	1098.00
High	2 480.00	1598.00	500	1098.00

Remark. Margin = Measured Value - Limit

Tested by: Min-Gu Ji / Assistant Manager



Low Channel

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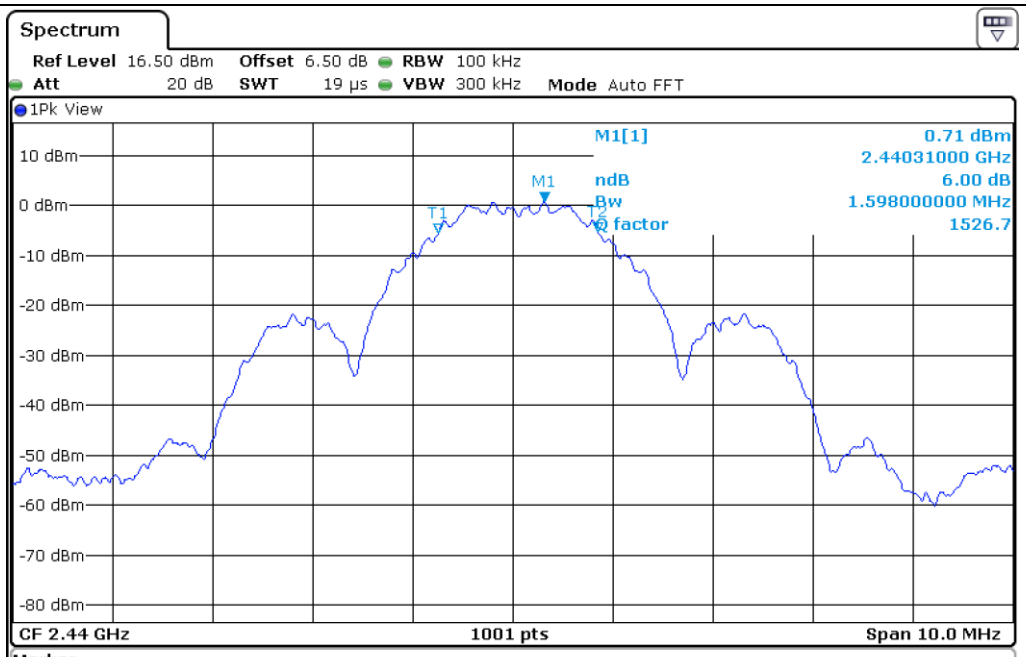
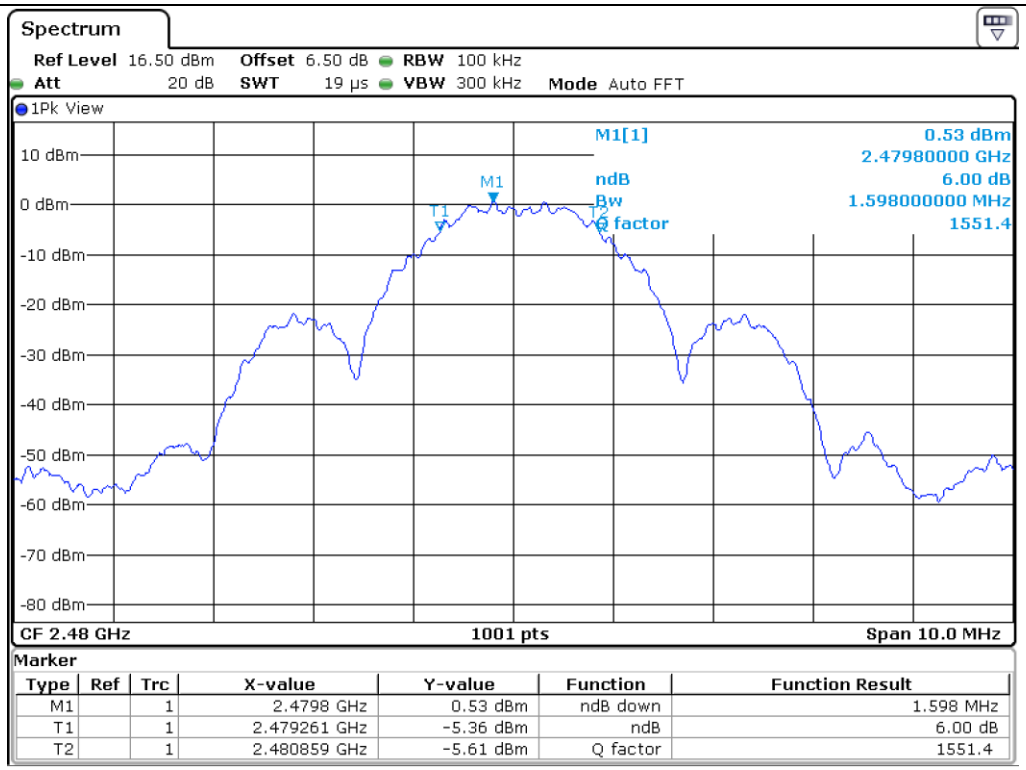


Middle Channel



High Channel

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8. MAXIMUM PEAK OUTPUT POWER

8.1 Operating environment

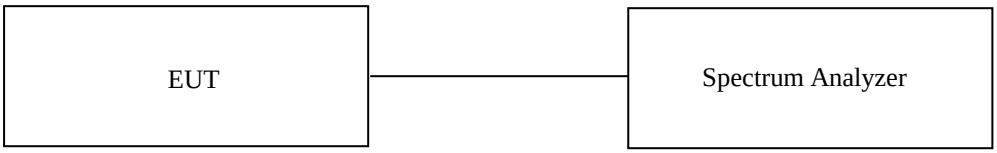
Temperature : 24 ℃

Relative humidity : 45 % R.H.

8.2 Test set-up

The antenna output of the EUT was connected to the spectrum analyzer.

The resolution bandwidth is set to ≥DTS Bandwidth, the video bandwidth is set to 3 times the resolution bandwidth.



8.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ -	FSV30	Rohde & Schwarz	Signal Analyzer	101200	Aug.23, 2018 (1Y)

All test equipment used is calibrated on a regular basis.

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8.4 Test data

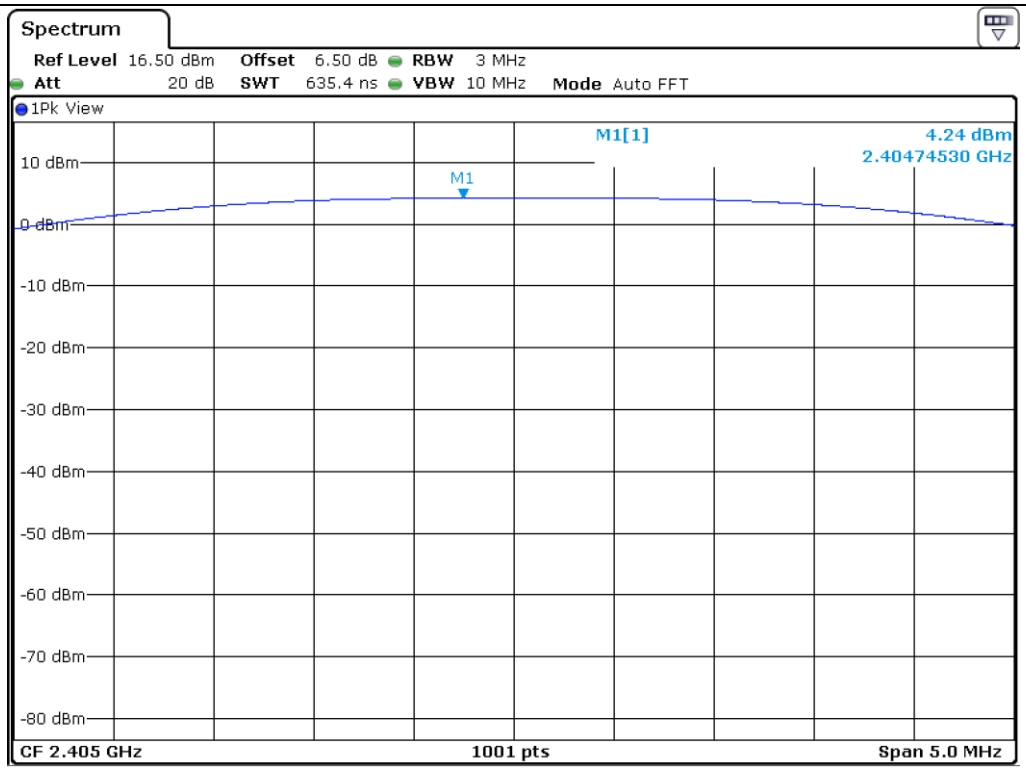
-. Test Date : October 30, 2018

-. Test Result : Pass

CHANNEL	FREQUENCY (MHz)	MEASURED VALUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 405.00	4.24	30.00	25.76
MIDDLE	2 440.00	4.08	30.00	25.92
HIGH	2 480.00	3.92	30.00	26.08

Remark. Margin = Limit – Measured Value (=Receiver Reading + Cable Loss)

Tested by: Min-Gu Ji / Assistant Manager



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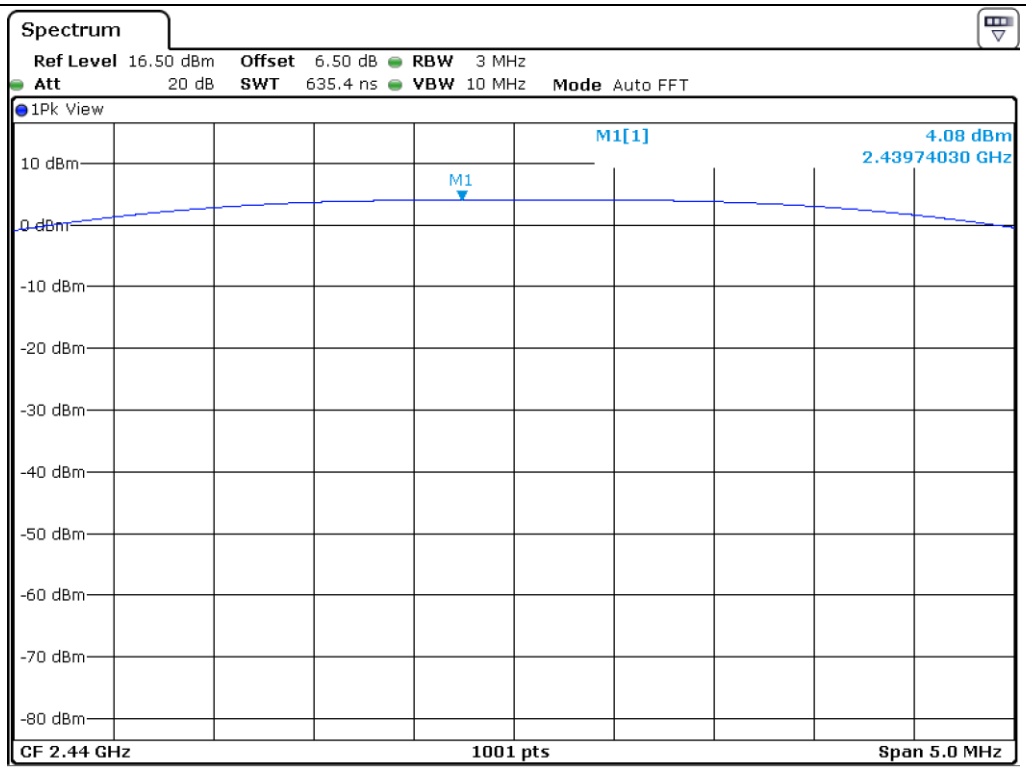
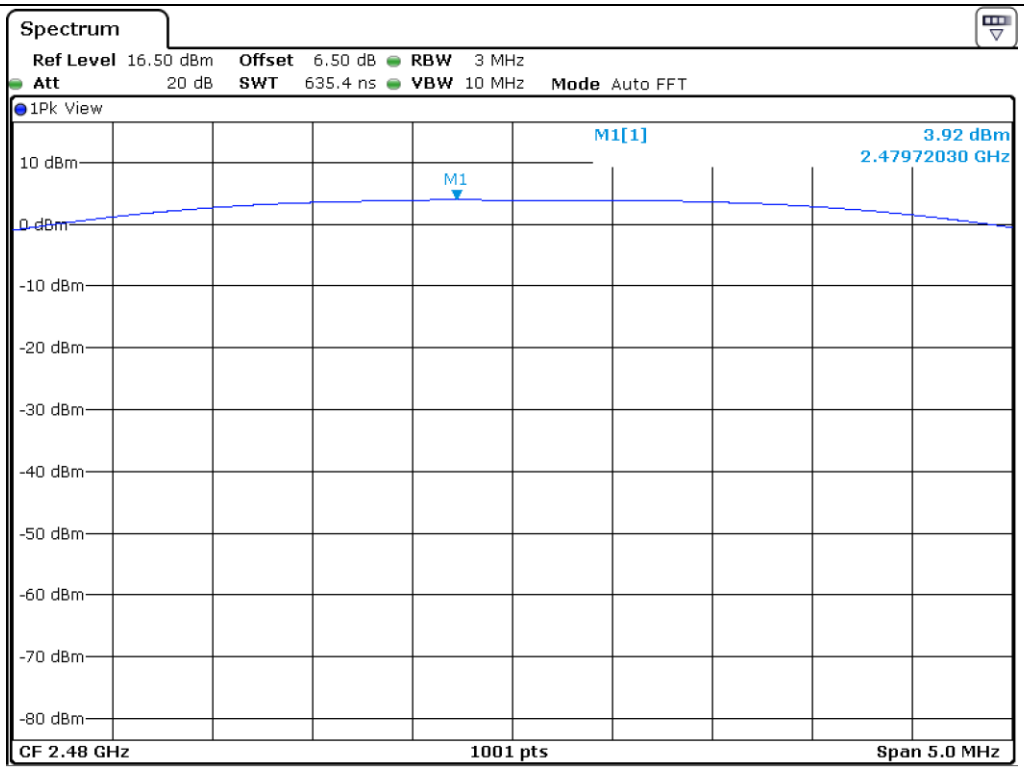


Middle Channel



High Channel

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9. 100 kHz BANDWIDTH OUTSIDE THE FREQUENCY BAND

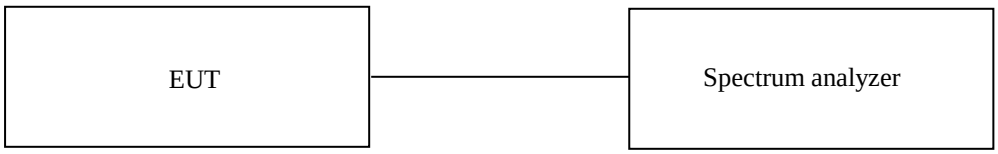
9.1 Operating environment

Temperature : 24 ℃

Relative humidity : 51 % R.H.

9.2 Test set-up for conducted measurement

The antenna output of the EUT was connected to the spectrum analyzer. The resolution and video bandwidth is set to 100 kHz, and peak detection was used.



9.3 Test set-up for radiated measurement

The radiated emissions measurements were performed on the 3 m semi anechoic chamber. The EUT was placed on turntable approximately 1.5 m above the ground plane.

The frequency spectrum from 30 MHz to 26.5 GHz was scanned and maximum emission levels at each frequency recorded. The system was rotated 360°, and the antenna was varied in the height between 1.0 m and 4.0 m in order to determine the maximum emission levels. This procedure was performed for horizontal and vertical polarization of the receiving antenna.

9.4 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
☐ -	ESCI	Rohde & Schwarz	EMI Test Receiver	101012	Oct. 22, 2018 (1Y)
■ -	ESR	Rohde & Schwarz	EMI Test Receiver	101470	Oct. 22, 2018 (1Y)
☐ -	FSP	Rohde & Schwarz	Spectrum Analyzer	100017	Aug. 23, 2018 (1Y)
■ -	310N	Sonoma Instrument	AMPLIFIER	312544	Mar. 28, 2018 (1Y)
■ -	FSV30	Rohde & Schwarz	Signal Analyzer	101200	Aug. 23, 2018 (1Y)
☐ -	SCU18	Rohde & Schwarz	Pre-Amplifier	102266	Aug. 24, 2018 (1Y)
■ -	BBV 9718 B	Schwarzbeck	Broadband Preamplifier	009	Mar. 16, 2018 (1Y)
■ -	MA-4000XPET	Innco Systems GmbH	Antenna Master	MA4000/509	N/A
☐ -	HD100	HD GmbH	Position Controller	N/A	N/A
■ -	DT3000-3t	Innco Systems GmbH	Turn Table	N/A	N/A
☐ -	FMZB 1513	Schwarzbeck	LOOP ANTENNA	1513-235	May. 13, 2018 (2Y)
■ -	VULB9163	Schwarzbeck	TRILOG Broadband Antenna	9163-255	Jun 05, 2018 (2Y)
■ -	BBHA9120D	Schwarzbeck	Horn Antenna	BBHA9120D295	Aug. 16, 2017 (2Y)
■ -	BBHA9170	Schwarzbeck	Horn Antenna	BBHA91700179	Jul. 28, 2017 (2Y)
■ -	SCU40A	Rohde & Schwarz	Pre-Amplifier	100436	May. 15, 2018 (1Y)

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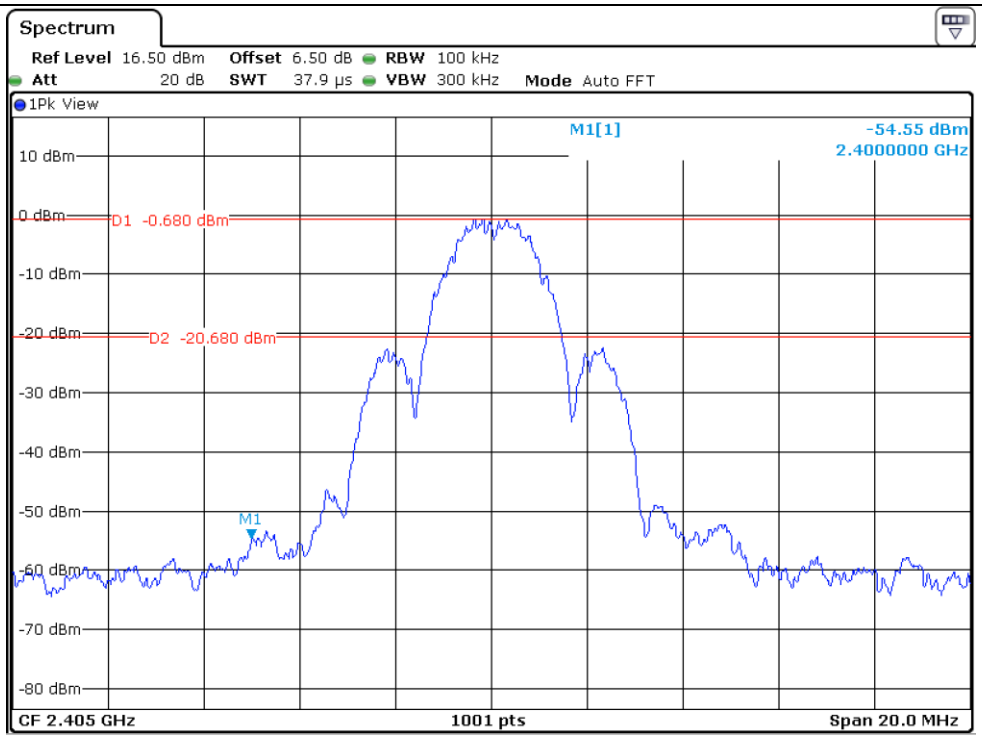
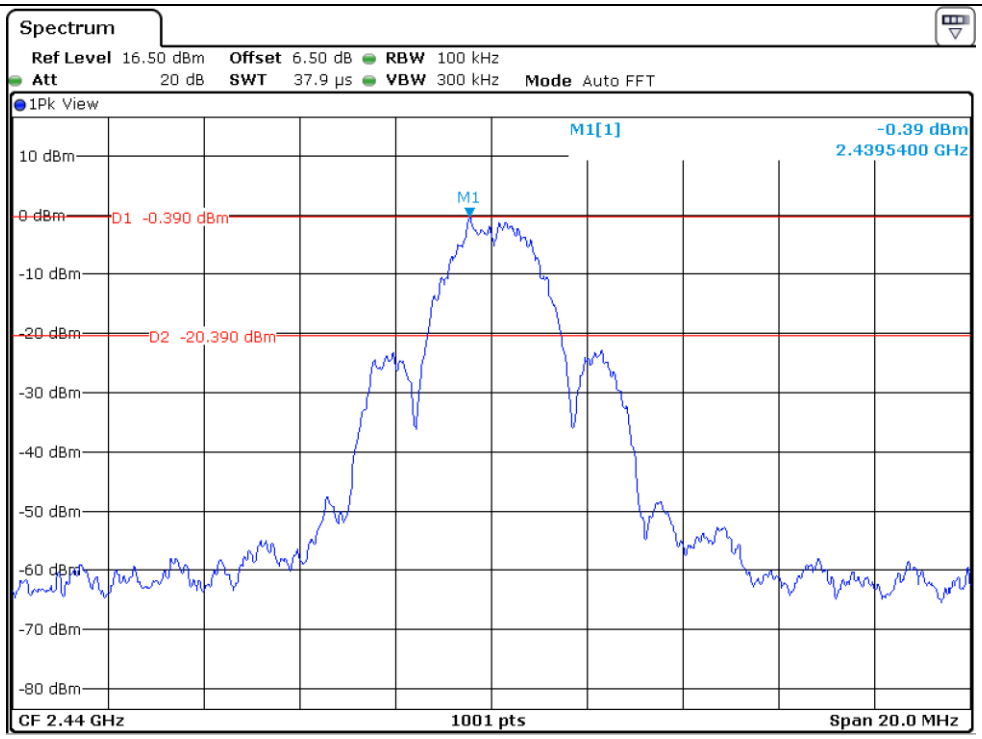
9.5 Test data for conducted emission



Low Channel



Middle Channel

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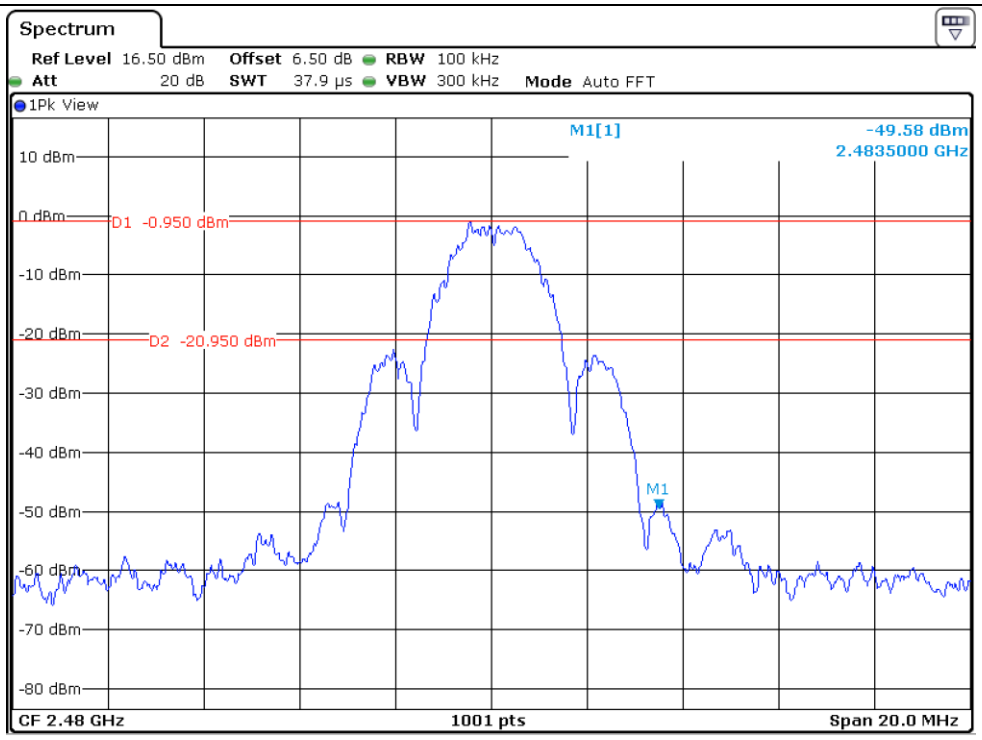

High Channel

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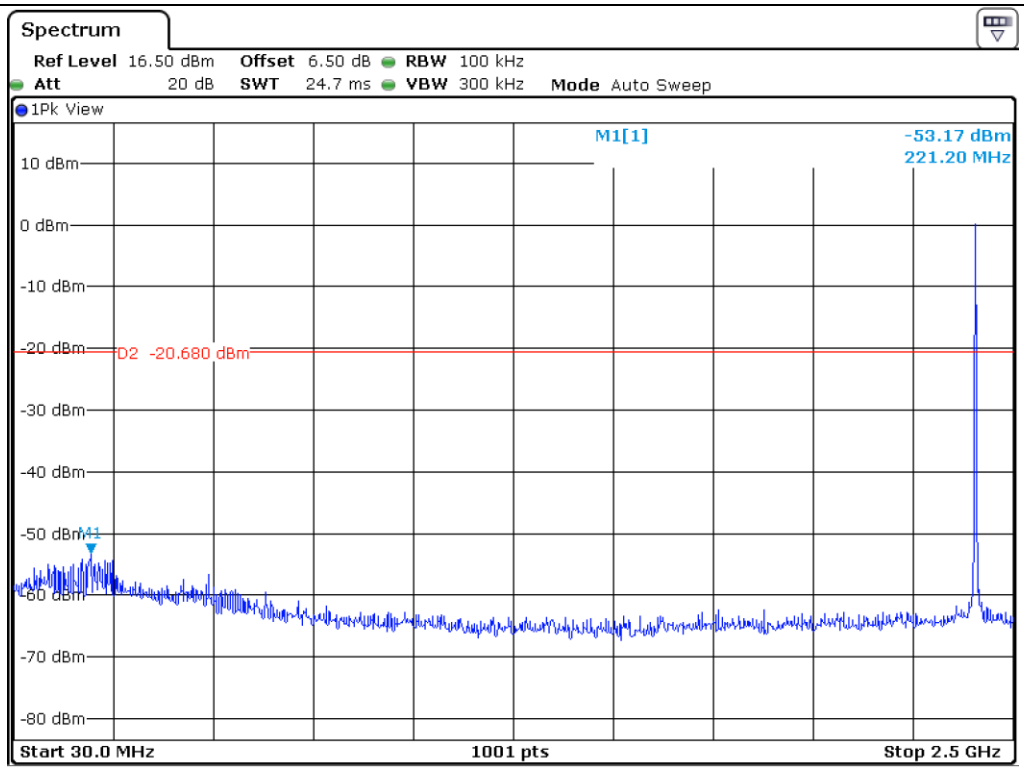
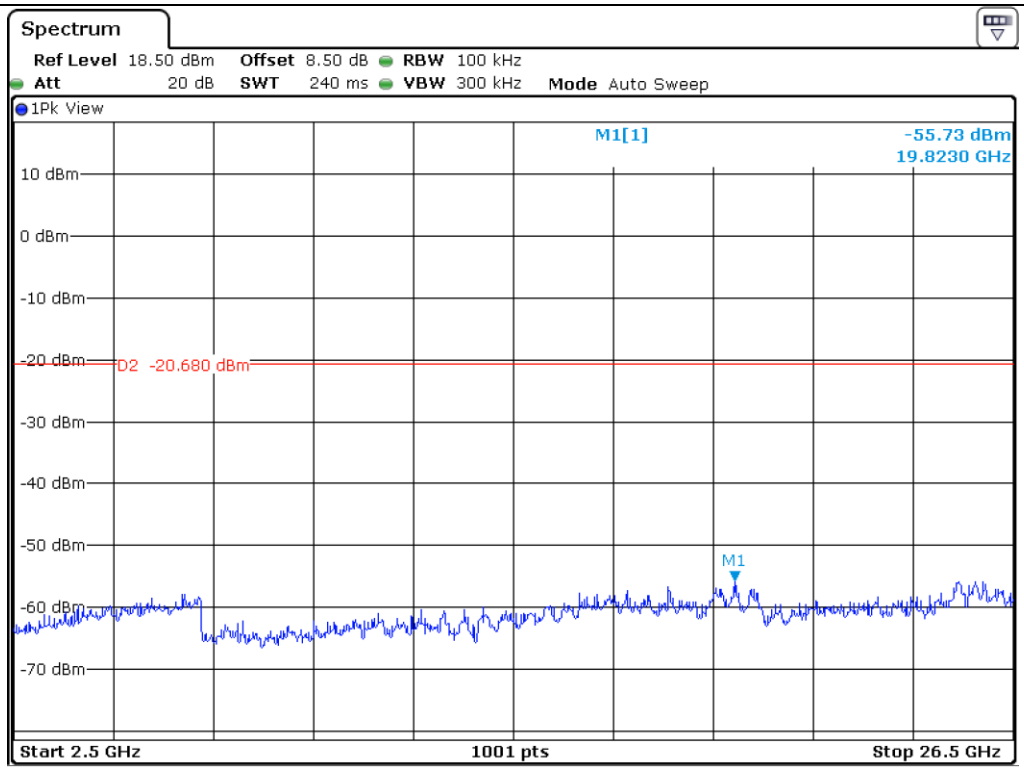


Low Channel



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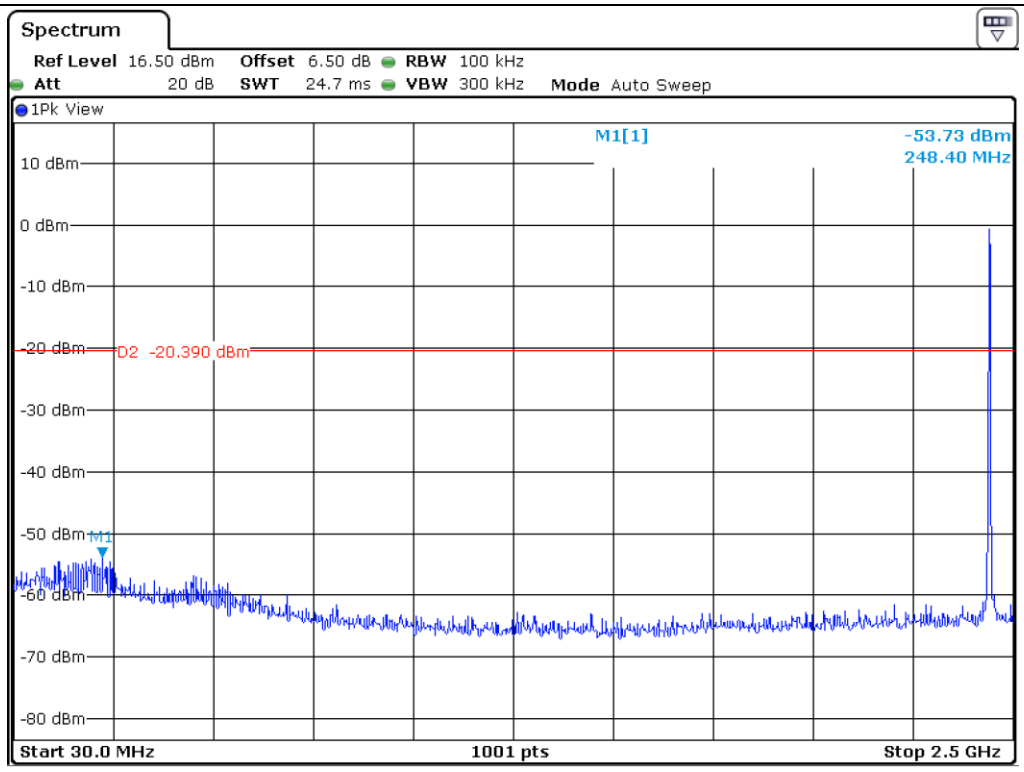
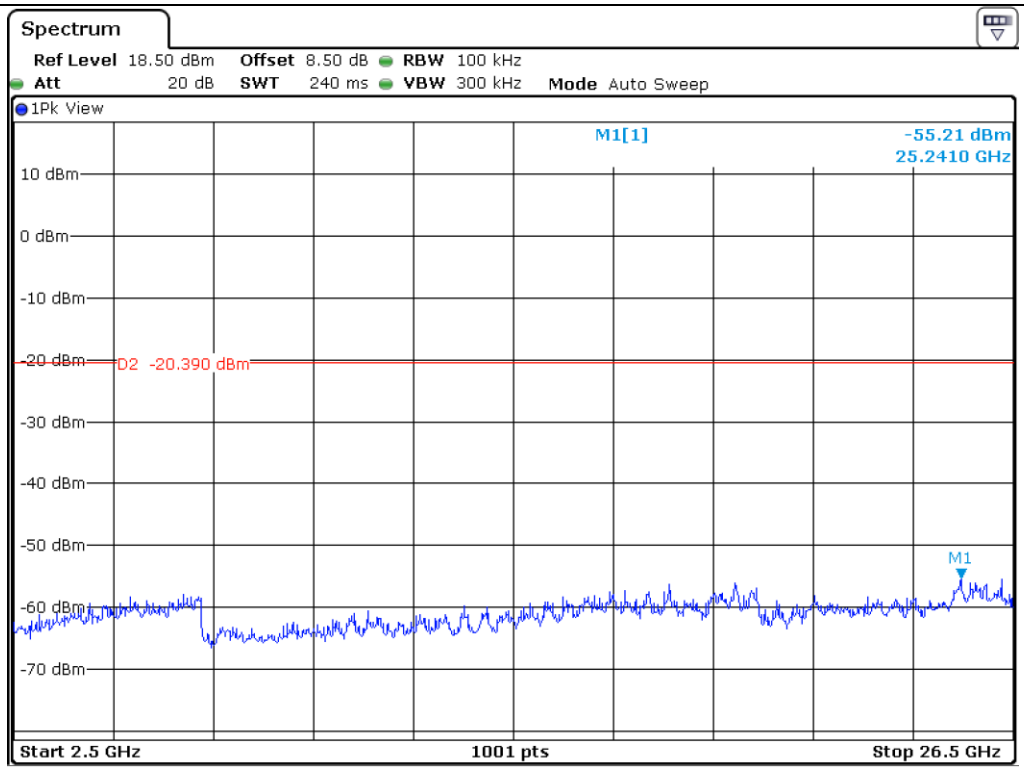


Middle Channel



Middle Channel

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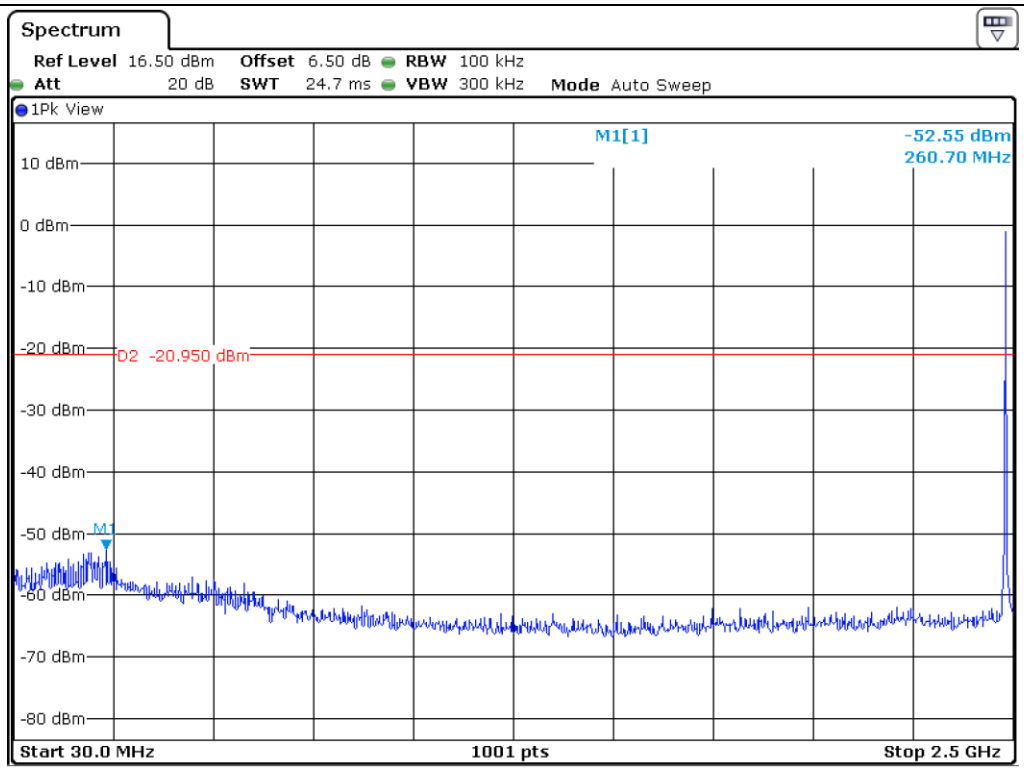
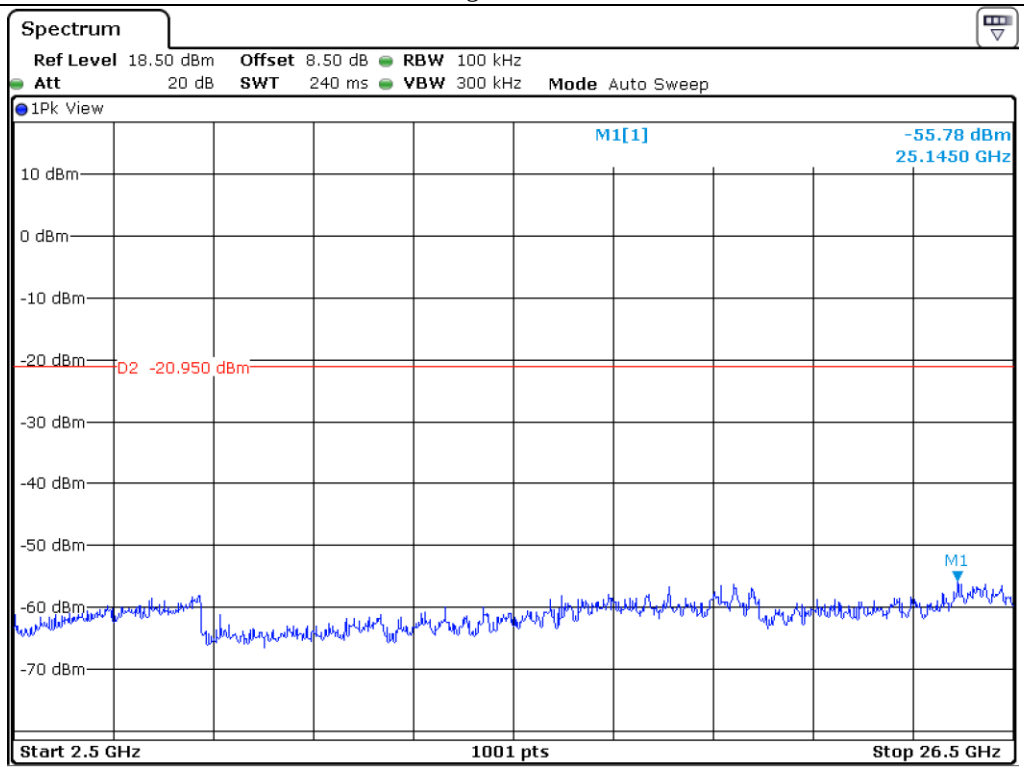


High Channel



High Channel

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9.6 Test data for radiated emission

9.6.1 Radiated Emission which fall in the Restricted Band

-. Test Date : October 31, 2018

-. Resolution bandwidth : 1 MHz for Peak and Average Mode

-. Video bandwidth : 3 MHz for Peak and Average Mode

-. Detector : Peak Mode(Peak), Average Mode(RMS)

-. Measurement distance : 3 m

-. Result : PASSED

Frequency (MHz)	Reading (dBµV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBµV/m)	Limits (dBµV/m)	Margin (dB)
Test Data for Low Channel									
2377.25	32.83	Peak	H	27.60	11.40	34.30	37.53	74.00	36.47
2389.96	20.21	Average	H				24.91	54.00	29.09
2389.88	36.10	Peak	V				40.80	74.00	33.20
2368.54	19.06	Average	V				23.76	54.00	30.24
Test Data for High Channel									
2483.50	49.92	Peak	H	27.80	11.40	34.40	54.72	74.00	19.28
2483.50	36.86	Average	H				41.66	54.00	12.34
2483.50	52.77	Peak	V				57.57	74.00	16.43
2483.50	44.12	Average	V				48.92	54.00	5.08

Tabulated test data for Restricted Band

Remark: “H”: Horizontal, “V”: Vertical

Margin (dB) = Limits (dBµV/m) - Total Level (dBµV/m)

Total Level = Reading + Antenna Factor + Cable Loss – Pre-Amplifier Gain

Tested by: Min-Gu Ji / Assistant Manager

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9.6.2 Spurious & Harmonic Radiated Emission

-. Test Date : October 31, 2018

-. Resolution bandwidth : 1 MHz for Peak and Average Mode

-. Video bandwidth : 3 MHz for Peak and Average Mode

-. Detector : Peak Mode(Peak), Average Mode(RMS)

-. Frequency range : 1 GHz ~ 26.5 GHz

-. Measurement distance : 3 m

-. Result : PASSED

Frequency (GHz)	Reading (dBµV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBµV/m)	Limits (dBµV/m)	Margin (dB)
Test Data for Low Channel									
4 810.00	40.26	Peak	H	31.00	16.10	35.23	52.13	74.00	21.87
	33.23	Average	H				45.10	54.00	8.90
	47.82	Peak	V				59.69	74.00	14.31
	30.82	Average	V				42.69	54.00	11.31
Test Data for Middle Channel									
4 880.00	41.77	Peak	H	31.10	16.10	35.27	53.70	74.00	20.30
	35.00	Average	H				46.93	54.00	7.07
	48.01	Peak	V				59.94	74.00	14.06
	39.50	Average	V				51.43	54.00	2.57
Test Data for High Channel									
4 960.00	42.73	Peak	H	31.20	16.10	35.29	54.74	74.00	19.26
	36.77	Average	H				48.78	54.00	5.22
	48.76	Peak	V				60.77	74.00	13.23
	40.70	Average	V				52.71	54.00	1.29

Tabulated test data for Restricted Band

Remark: “H”: Horizontal, “V”: Vertical

Margin (dB) = Limits (dBµV/m) - Total Level (dBµV/m)

Total Level = Reading + Antenna Factor + Cable Loss – Pre-Amplifier Gain

Tested by: Min-Gu Ji / Assistant Manager

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10. PEAK POWER SPECTRAL DENSITY

10.1 Operating environment

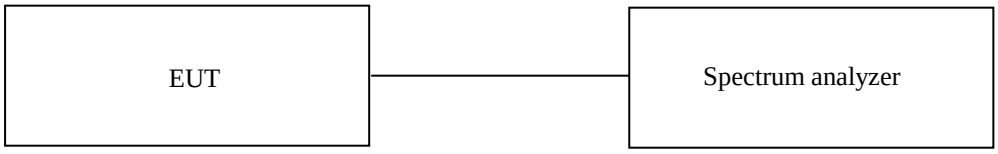
Temperature : 24 ℃

Relative humidity : 44 % R.H.

10.2 Test set-up

The antenna output of the EUT was connected to the spectrum analyzer.

The resolution bandwidth is set to 3 kHz ≤ RBW ≤100 kHz , the video bandwidth is set to 3 times the resolution bandwidth.



10.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ -	FSV30	Rohde & Schwarz	Signal Analyzer	101200	Aug.23, 2018 (1Y)

All test equipment used is calibrated on a regular basis.

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10.4 Test data

-. Test Date : October 30, 2018

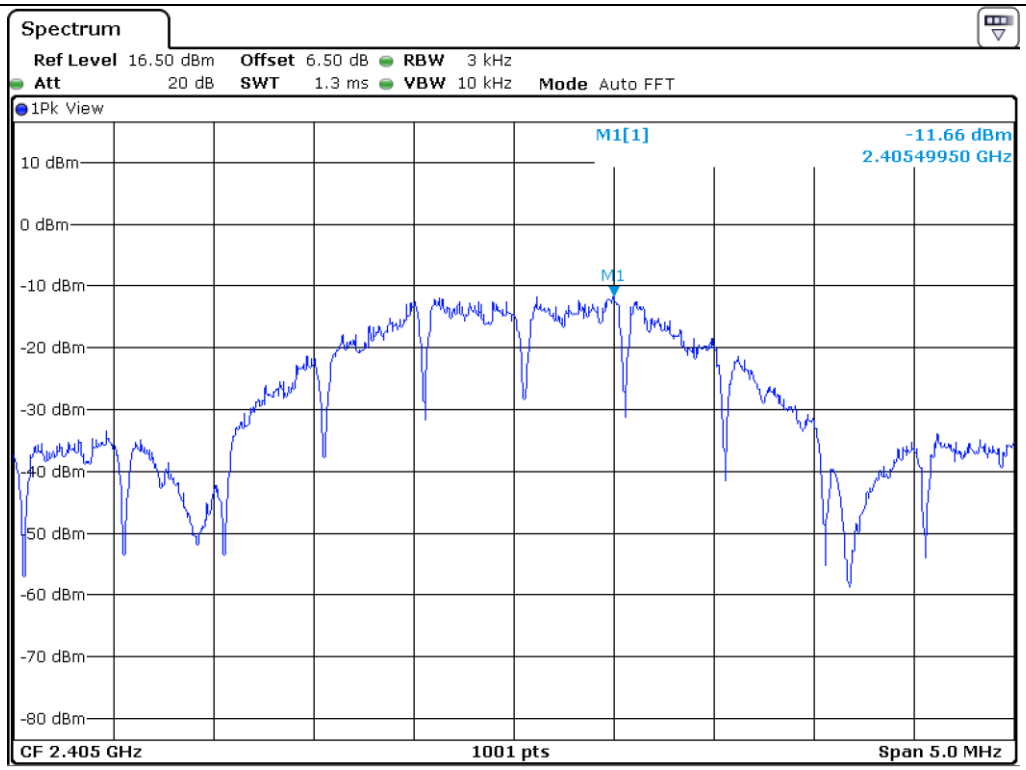
-. Test Result : Pass

-. Operating Condition : Continuous transmitting mode

CHANNEL	FREQUENCY(MHz)	MEASURED VALUE (dBm)	LIMIT (dBm)	MARGIN (dB)
Low	2 405.00	-11.66	8.00	19.66
Middle	2 440.00	-11.09	8.00	19.09
High	2 480.00	-10.81	8.00	18.81

Remark. Margin = Limit – Measured value

Tested by: Min-Gu Ji / Assistant Manager



Low Channel

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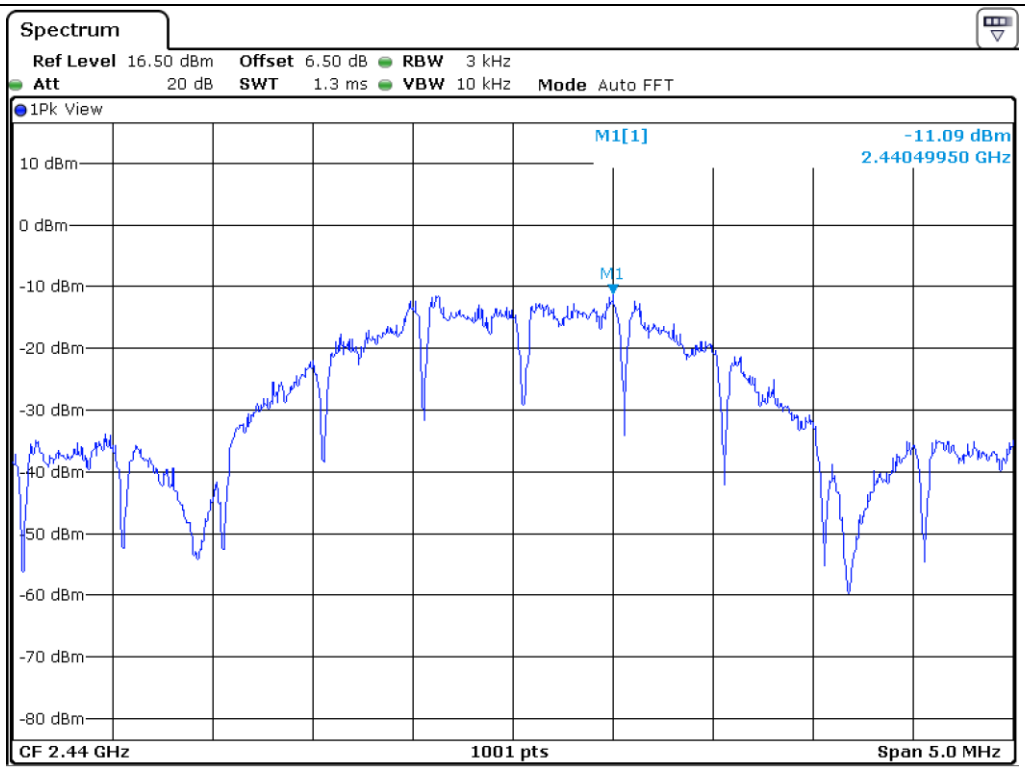
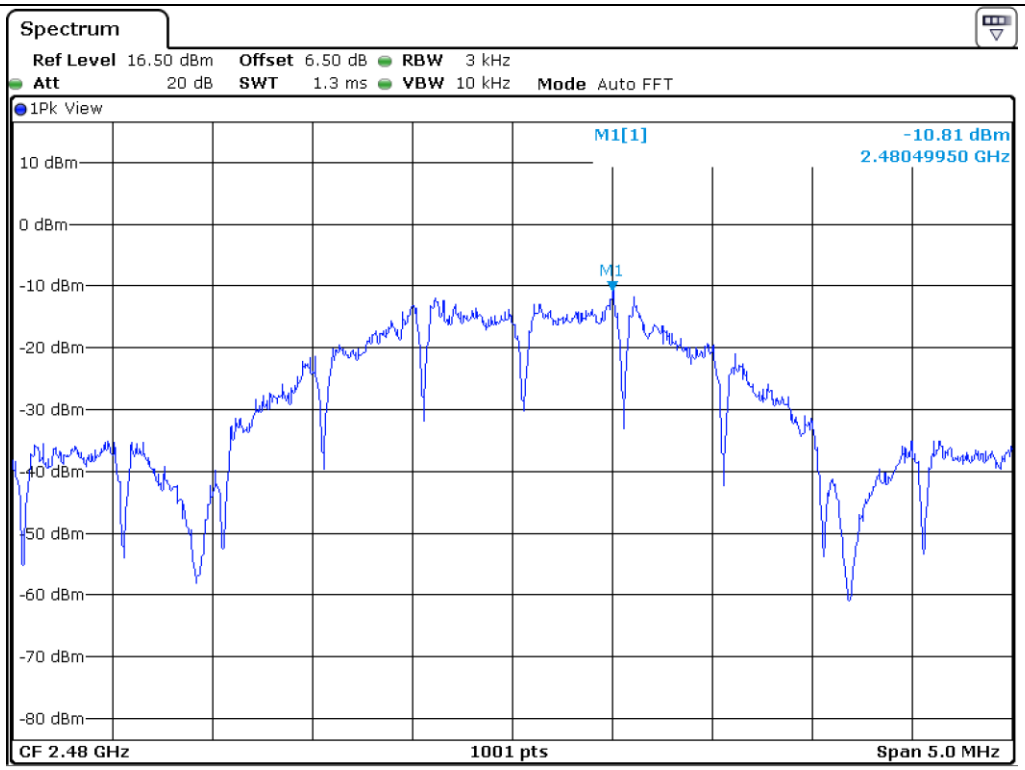


Middle Channel



High Channel

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11. RADIATED EMISSION TEST

11.1 Operating environment

Temperature : 24 ℃

Relative humidity : 51 % R.H.

11.2 Test set-up

The radiated emissions measurements were on the 3 m semi anechoic chamber. The EUT and other support equipment were placed on a non-conductive turntable above the ground plane. The interconnecting cables from outside test site were inserted into ferrite clamps at the point where the cables reach the turntable.

The frequency spectrum from 30 MHz to 26.5 GHz was scanned and emission levels maximized at each frequency recorded. The system was rotated 360°, and the antenna was varied in height between 1.0 m and 4.0 m in order to determine the maximum emission levels. This procedure was performed for both horizontal and vertical polarization of the receiving antenna.

11.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
☐ -	ESCI	Rohde & Schwarz	EMI Test Receiver	101012	Oct. 22, 2018 (1Y)
■ -	ESR	Rohde & Schwarz	EMI Test Receiver	101470	Oct. 22, 2018 (1Y)
☐ -	FSP	Rohde & Schwarz	Spectrum Analyzer	100017	Aug. 23, 2018 (1Y)
■ -	310N	Sonoma Instrument	AMPLIFIER	312544	Mar. 28, 2018 (1Y)
■ -	FSV30	Rohde & Schwarz	Signal Analyzer	101200	Aug. 23, 2018 (1Y)
☐ -	SCU18	Rohde & Schwarz	Pre-Amplifier	102266	Aug. 24, 2018 (1Y)
■ -	BBV 9718 B	Schwarzbeck	Broadband Preamplifier	009	Mar. 16, 2018 (1Y)
■ -	MA-4000XPET	Innco Systems GmbH	Antenna Master	MA4000/509	N/A
☐ -	HD100	HD GmbH	Position Controller	N/A	N/A
■ -	DT3000-3t	Innco Systems GmbH	Turn Table	N/A	N/A
☐ -	FMZB 1513	Schwarzbeck	LOOP ANTENNA	1513-235	May. 13, 2018 (2Y)
■ -	VULB9163	Schwarzbeck	TRILOG Broadband Antenna	9163-255	Jun 05, 2018 (2Y)
■ -	BBHA9120D	Schwarzbeck	Horn Antenna	BBHA9120D295	Aug. 16, 2017 (2Y)
■ -	BBHA9170	Schwarzbeck	Horn Antenna	BBHA91700179	Jul. 28, 2017 (2Y)
■ -	SCU40A	Rohde & Schwarz	Pre-Amplifier	100436	May. 15, 2018 (1Y)

All test equipment used is calibrated on a regular basis.

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11.4 Test data for Transmitting Mode

11.4.1 Test data for 30 MHz ~ 1 GHz

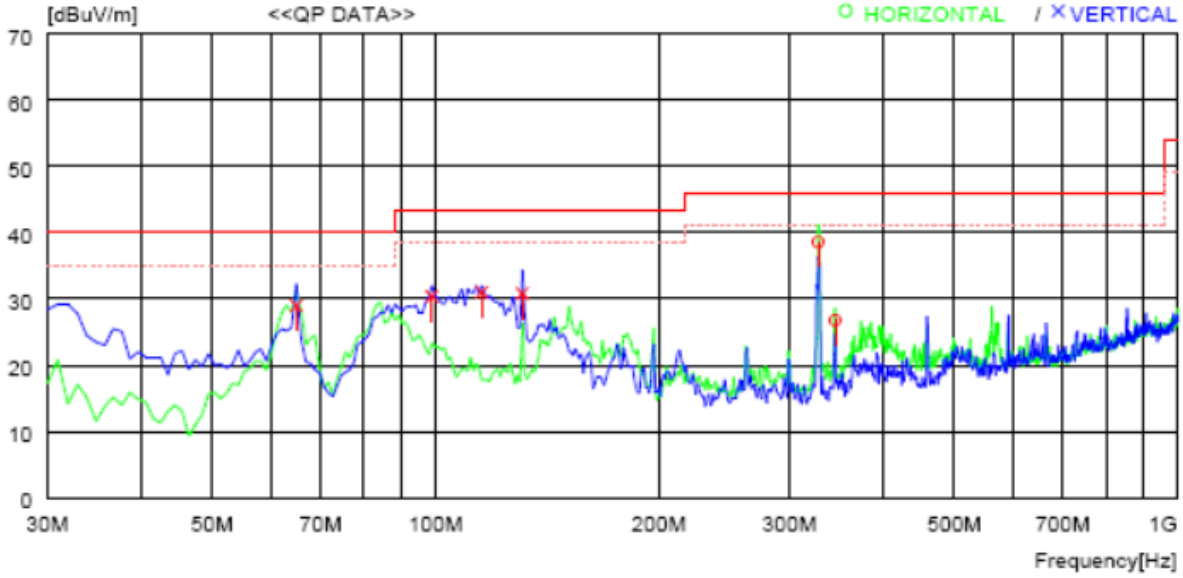
Humidity Level : 51 % R.H. Temperature: 24 ℃

Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.247

Result : PASSED

EUT : Osstem Zigbee Module Date: October 31, 2018

Detector : CISPR Quasi-Peak (6 dB Bandwidth: 120 kHz)



No.	FREQ [MHz]	READING QP [dBuV]	ANT FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Horizontal ------										
1	327.790	53.2	14.2	4.2	33.0	38.6	46.0	7.4	100	0
2	345.250	40.6	14.9	4.3	33.0	26.8	46.0	19.2	100	0
----- Vertical ------										
3	64.920	48.8	11.4	1.9	33.1	29.0	40.0	11.0	100	359
4	98.870	49.2	11.9	2.3	33.0	30.4	43.5	13.1	100	359
5	115.360	50.2	11.3	2.5	33.0	31.0	43.5	12.5	100	359
6	130.880	52.1	9.1	2.6	33.0	30.8	43.5	12.7	100	156

Tested by: Min-Gu Ji / Assistant Manager

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11.4.2 Test data for Below 30 MHz

-. Test Date : October 31, 2018

-. Resolution bandwidth : 200 Hz (from 9 kHz to 0.15 MHz), 9 kHz (from 0.15 MHz to 30 MHz)

-. Frequency range : 9 kHz ~ 30 MHz

-. Measurement distance : 3 m

-.Operating mode : Transmitting mode

Frequency (MHz)	Reading (dBµV)	Ant. Pol. (H/V)	Ant. Height (m)	Angle (°)	Ant. Factor (dB/m)	Cable Loss	Emission Level(dBµV/m)	Limits (dBµV/m)	Margin (dB)
Any emissions less than 20 dB below the limit were not observed.									

11.4.3 Test data for above 1 GHz

-. Test Date : October 31, 2018

-. Resolution bandwidth : 1 MHz for Peak and Average Mode

-. Video bandwidth : 1 MHz for Peak Mode, 10 Hz for Average Mode

-. Frequency range : 1 GHz ~ 26.5 GHz

-. Measurement distance : 3 m

-.Operating mode : Transmitting mode

Frequency (MHz)	Reading (dBµV)	Ant. Pol. (H/V)	Ant. Height (m)	Angle (°)	Ant. Factor (dB/m)	Cable Loss	Emission Level(dBµV/m)	Limits (dBµV/m)	Margin (dB)
Any emissions less than 20 dB below the limit were not observed.									

Tested by: Min-Gu Ji / Assistant Manager

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