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

Test Report No.	**: OT-188-RWD-025**
AGR No.	**: A187A-016**
Applicant	**: ELRETRON INC.**
Address	**: 1206, 16, Digital-ro 32gil, Guro-gu, Seoul, Republic of Korea**
Manufacturer	**: NATURELINK INC.**
Address	**: 602ho, 38, Digital-ro 29-gil, Guro-gu, Seoul, Republic of Korea**
Type of Equipment	**: RF Module (BLE)**
FCC ID.	**: 2AQWK-ELBM52832**
Model Name	**: ELBM52832**
Multiple Model Name	**: N/A**
Serial number	**: N/A**
Total page of Report	**: 29 pages (including this page)**
Date of Incoming	**: July 25, 2018**
Date of issue	**: August 17, 2018**

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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Revision History

Rev. No.	Issue Report No.	Issued Date	Revisions	Section Affected
0	OT-188-RWD-025	August 17, 2018	Initial Issue	All

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1. VERIFICATION OF COMPLIANCE

Applicant : ELRETRON INC.
Address : 1206, 16, Digital-ro 32gil, Guro-gu, Seoul, Republic of Korea
Contact Person : Da Geun Lee / CTO
Telephone No. : +82-10-4716-1720
FCC ID : 2AQWK-ELBM52832
Model Name : ELBM52832
Serial Number : N/A
Date : August 17, 2018

EQUIPMENT CLASS	DTS – DIGITAL TRNSMISSION SYSTEM
KIND OF EQUIPMENT	RF Module (BLE)
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.

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	Met the Limit / PASS
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 ELRETRON INC., Model ELBM52832 (referred to as the EUT in this report) is an RF Module (BLE). The product specification described herein was obtained from product data sheet or user's manual.

Device Type	RF Module (BLE)
Operating Frequency	2 402 MHz ~ 2 480 MHz
RF Output Power	-0.93 dBm
Number of Channel	40 Channels
Modulation Type	GFSK(Bluetooth LE)
Antenna Type	Chip Antenna
Antenna Gain	0.5 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

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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	-

5.2 Peripheral equipment

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

Model	Manufacturer	Description	Connected to
HP Pavilion g series	HP	Notebook PC	EUT
Series PPP009L-E	LIE-ON-TECHNOLOGY(CHANGZHOU)CO.,LTD	AC adapter	Notebook PC
DC Power Supply	Protek	PWS-3003D	EUT

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 2 402 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 Chip Antenna on the main board in the EUT, so no consideration of replacement by the user.

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

7. MIMIMUM 6 dB BANDWIDTH

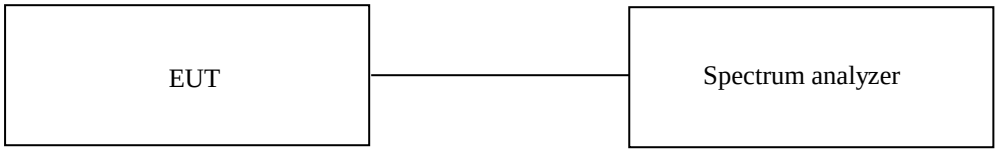
7.1 Operating environment

Temperature : 25 ℃

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	Oct.26, 2017 (1Y)

All test equipment used is calibrated on a regular basis.

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7.4 Test data

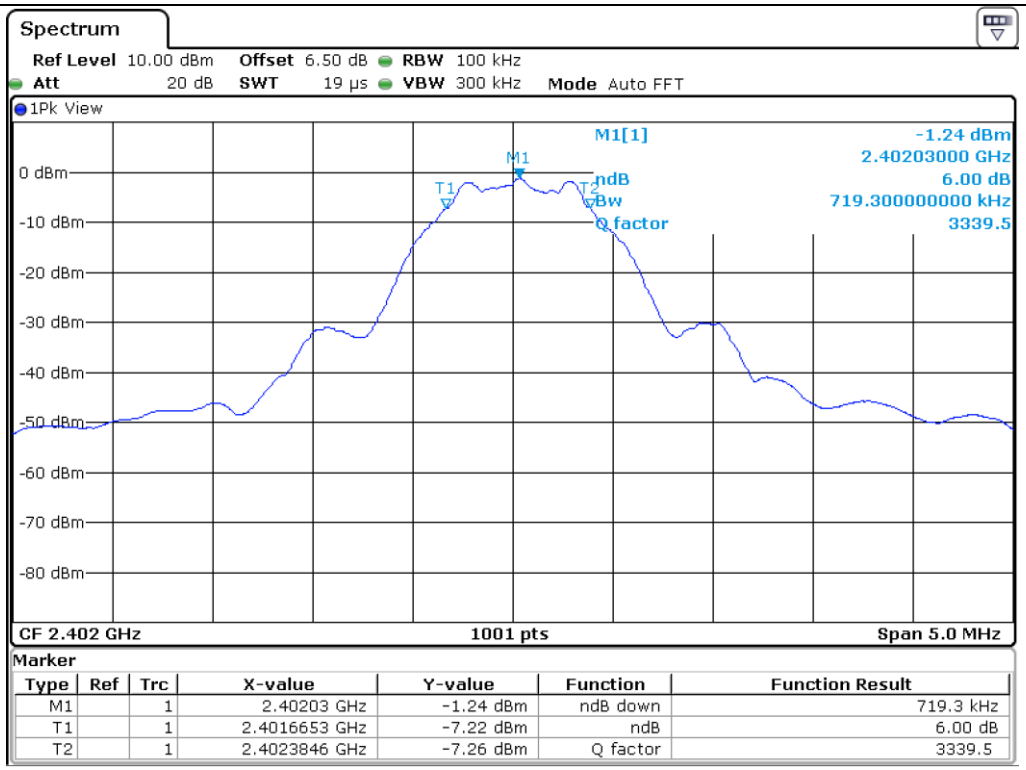
-. Test Date : July 25, 2018

-. Test Result : Pass

CHANNEL	FREQUENCY(MHz)	MEASURED VALUE (kHz)	LIMIT (kHz)	MARGIN (kHz)
Low	2 402.00	719.30	500	219.30
Middle	2 440.00	724.30	500	224.30
High	2 480.00	724.30	500	224.30

Remark. Margin = Measured Value - Limit

Tested by: Ju Yun Park / Assistant Manager



Low Channel

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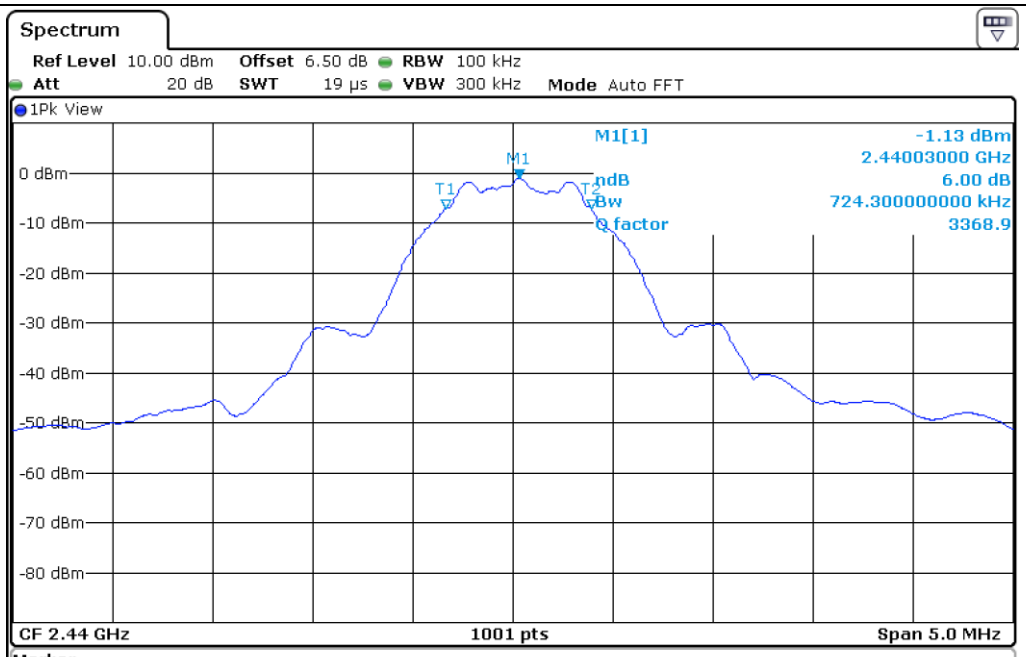
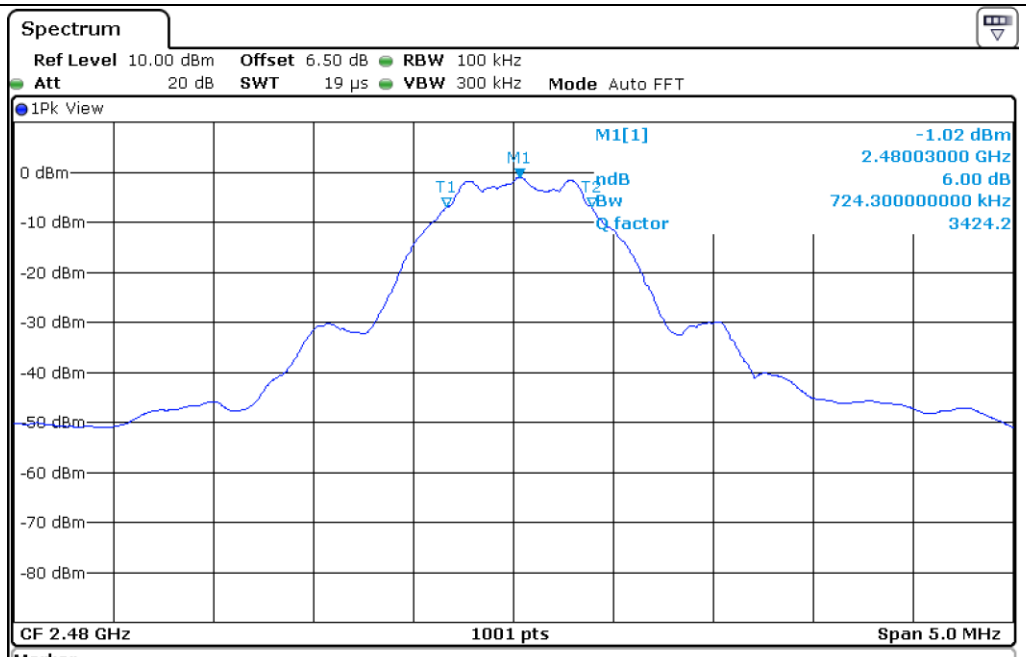


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.44003 GHz	-1.13 dBm	ndB down	724.3 kHz
T1		1	2.4396653 GHz	-7.11 dBm	ndB	6.00 dB
T2		1	2.4403896 GHz	-7.14 dBm	Q factor	3368.9

Middle Channel



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.48003 GHz	-1.02 dBm	ndB down	724.3 kHz
T1		1	2.4796653 GHz	-7.04 dBm	ndB	6.00 dB
T2		1	2.4803896 GHz	-7.01 dBm	Q factor	3424.2

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8. MAXIMUM PEAK OUTPUT POWER

8.1 Operating environment

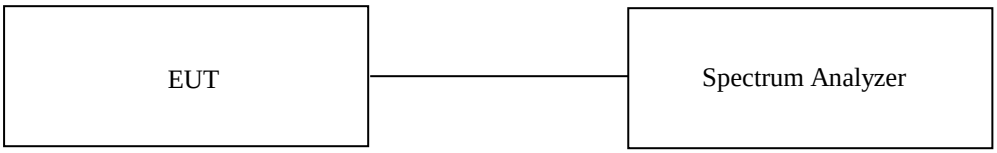
Temperature : 25 ℃

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	Oct.26, 2017 (1Y)

All test equipment used is calibrated on a regular basis.

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8.4 Test data

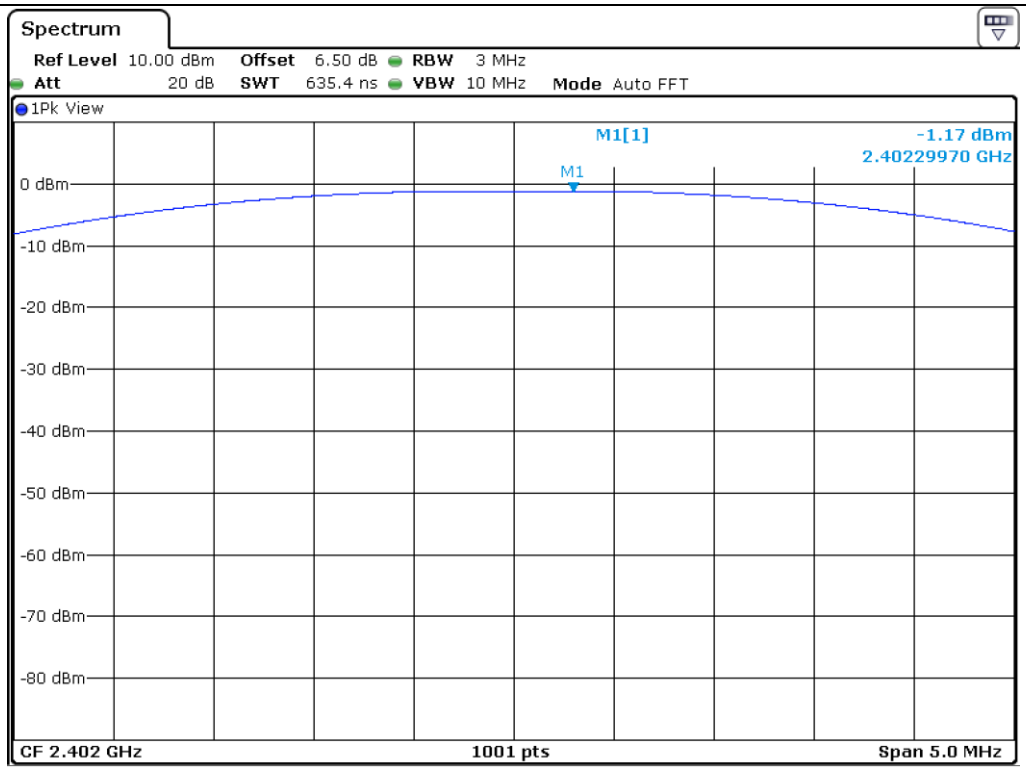
-. Test Date : July 25, 2018

-. Test Result : Pass

CHANNEL	FREQUENCY (MHz)	MEASURED VALUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 402.00	-1.17	30.00	31.17
MIDDLE	2 440.00	-1.06	30.00	31.06
HIGH	2 480.00	-0.93	30.00	30.93

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

Tested by: Ju Yun Park / Assistant Manager



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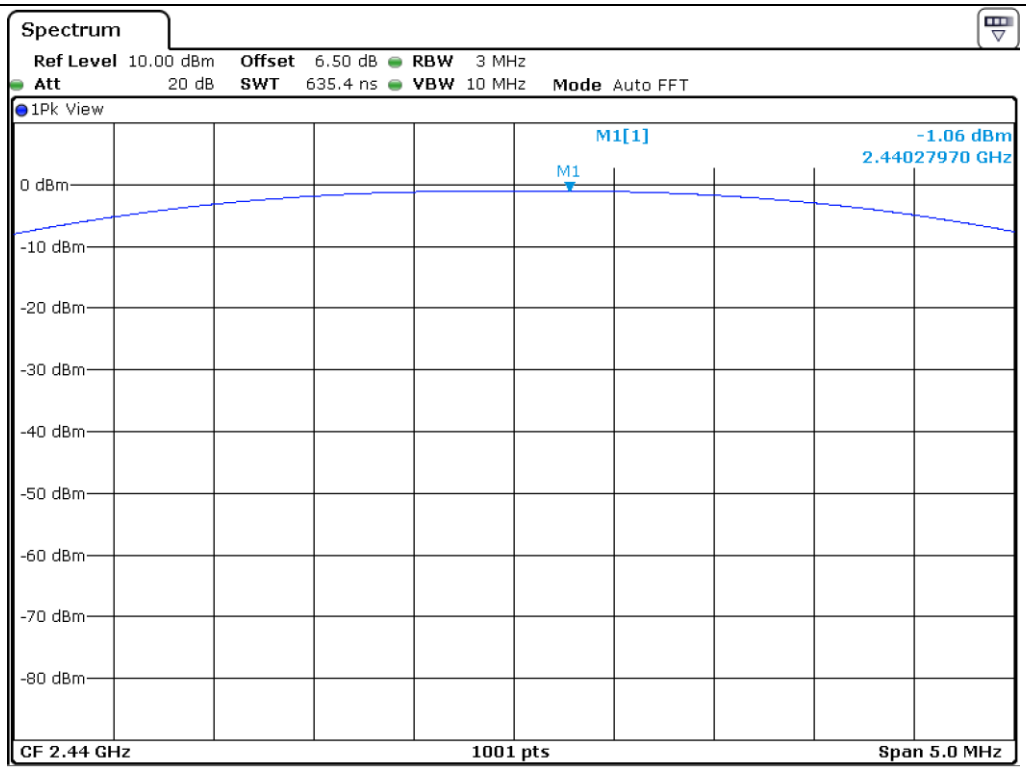
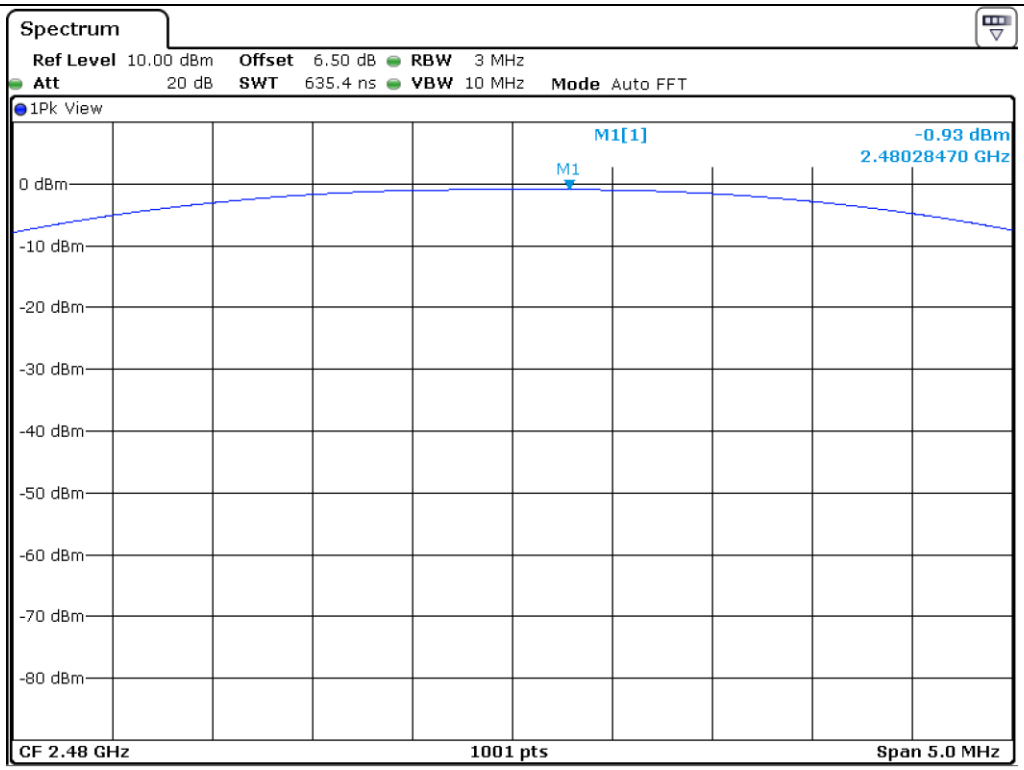


Middle Channel



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9. 100 kHz BANDWIDTH OUTSIDE THE FREQUENCY BAND

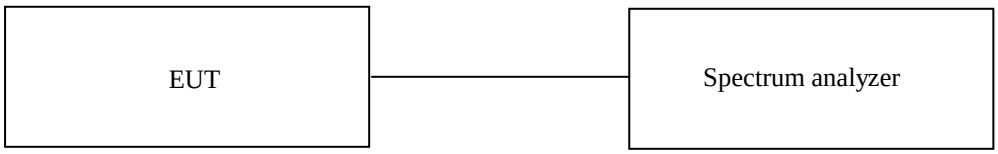
9.1 Operating environment

Temperature : 24 ℃

Relative humidity : 44 % 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)
■ -	ESR	Rohde & Schwarz	EMI Test Receiver	101470	Oct. 27, 2017 (1Y)
■ -	310N	Sonoma Instrument	AMPLIFIER	312544	Mar. 28, 2018 (1Y)
■ -	FSV30	Rohde & Schwarz	Signal Analyzer	101200	Oct. 26, 2017 (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	9163-202	Nov. 15, 2016 (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	Sep. 01, 2017 (1Y)

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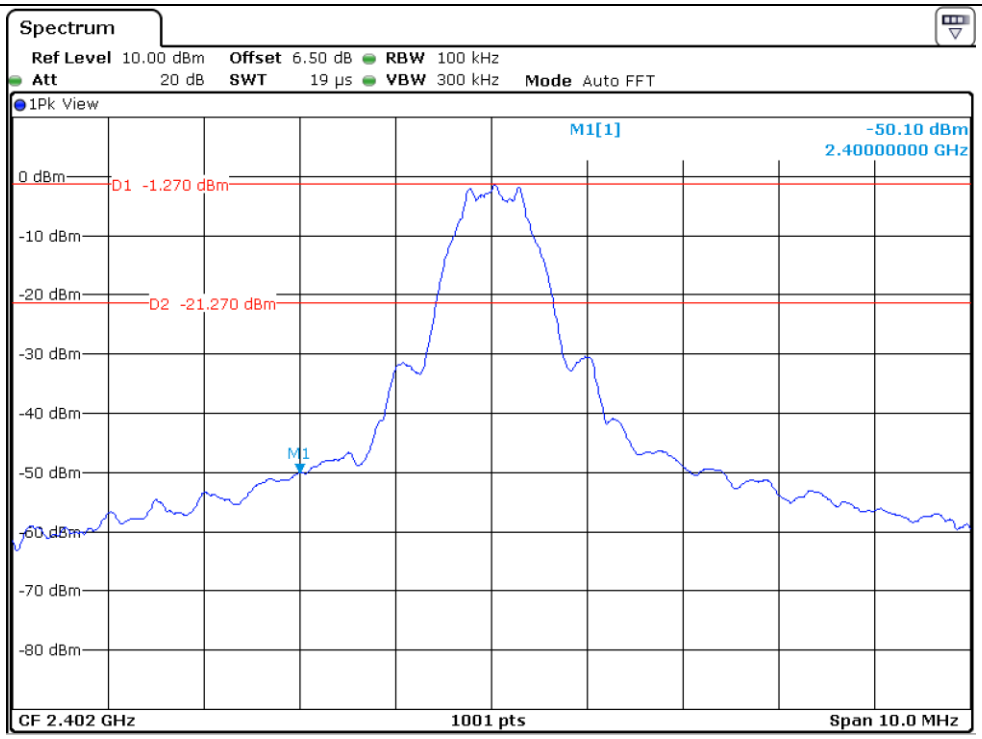
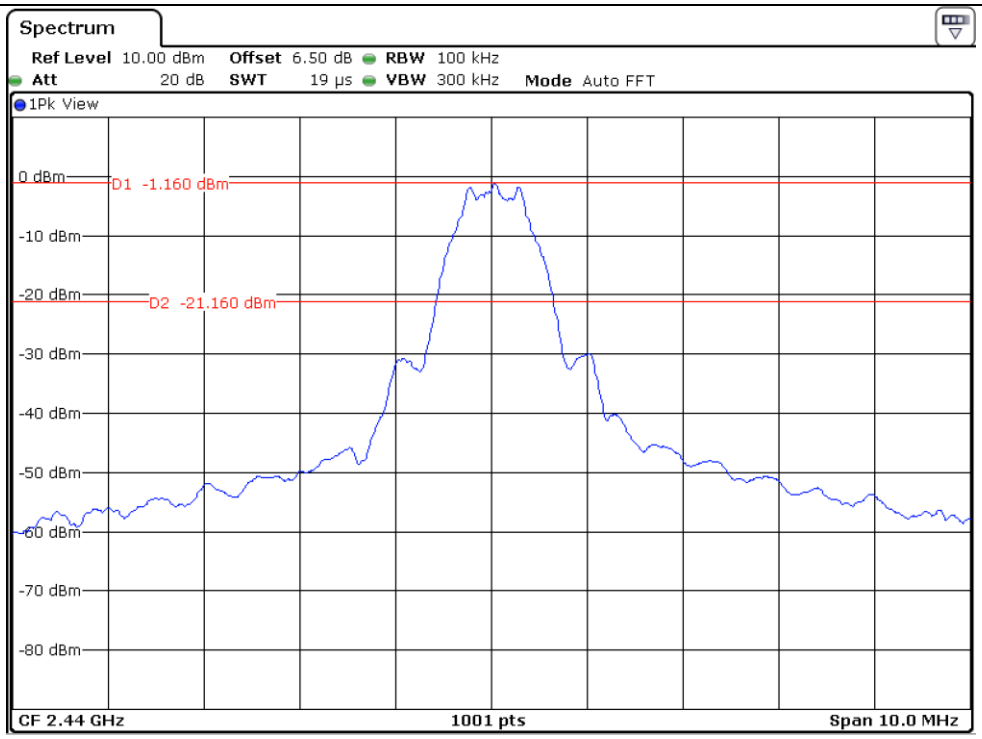
9.5 Test data for conducted emission



Low Channel



Middle Channel

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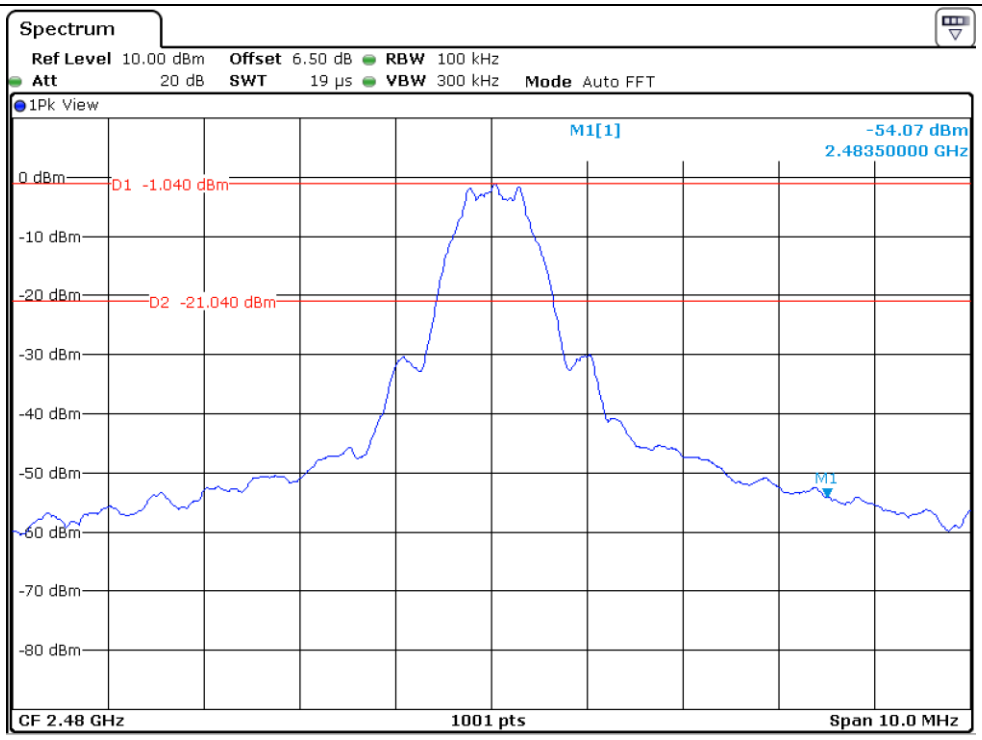

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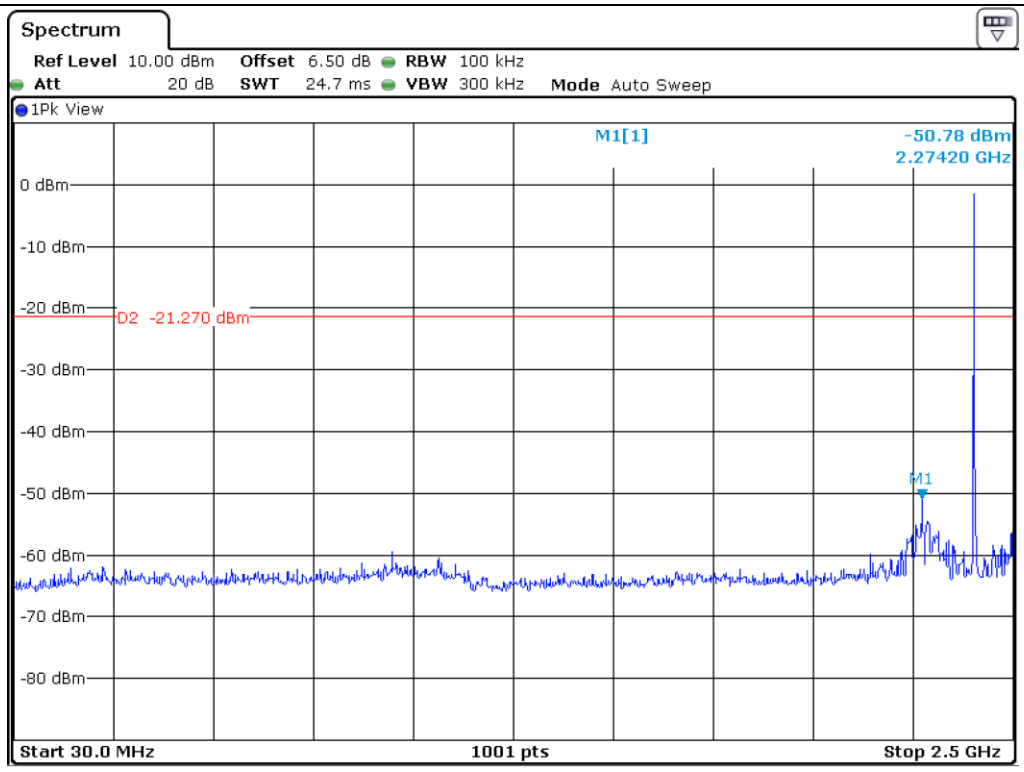

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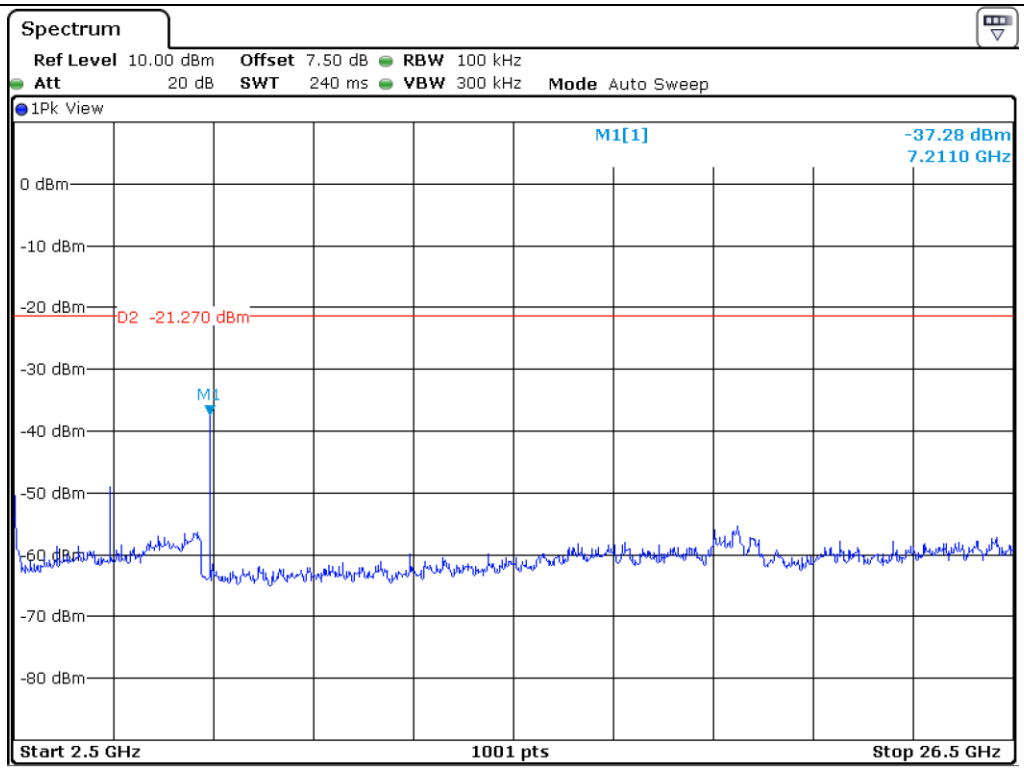

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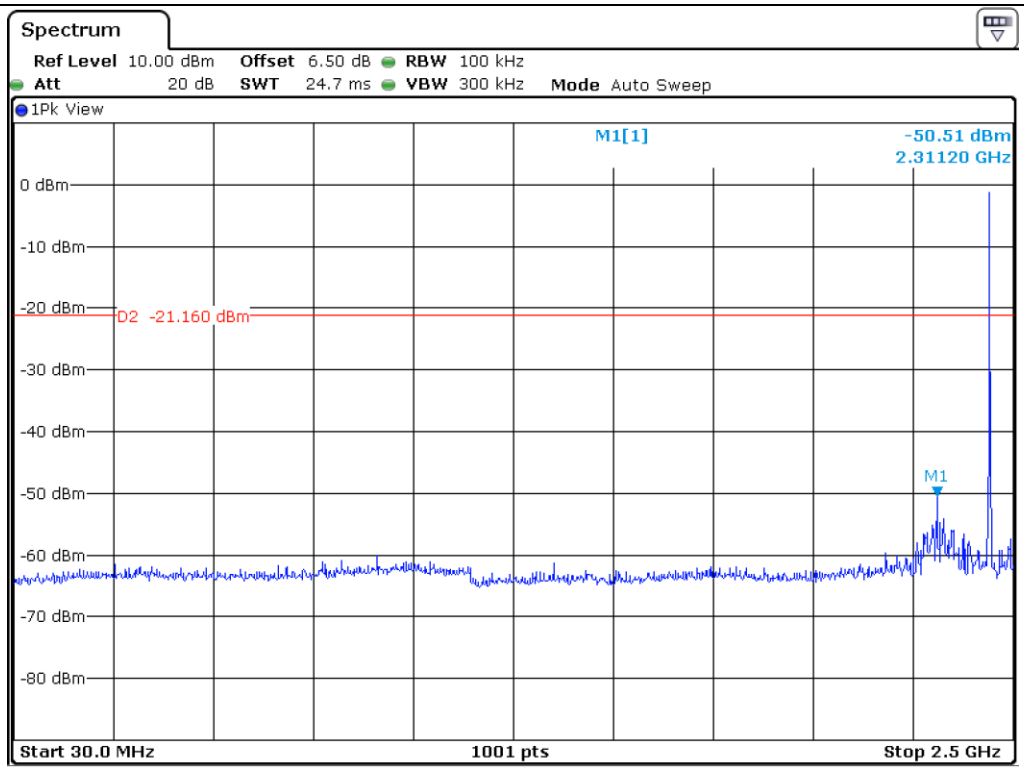
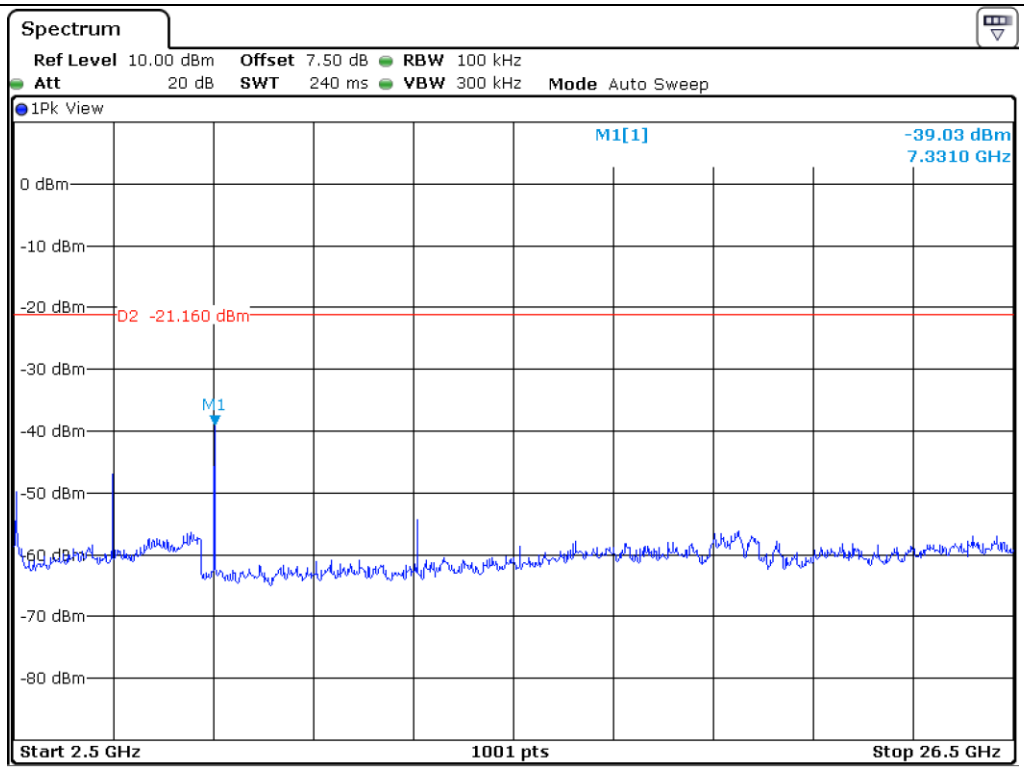


Middle Channel



Middle Channel

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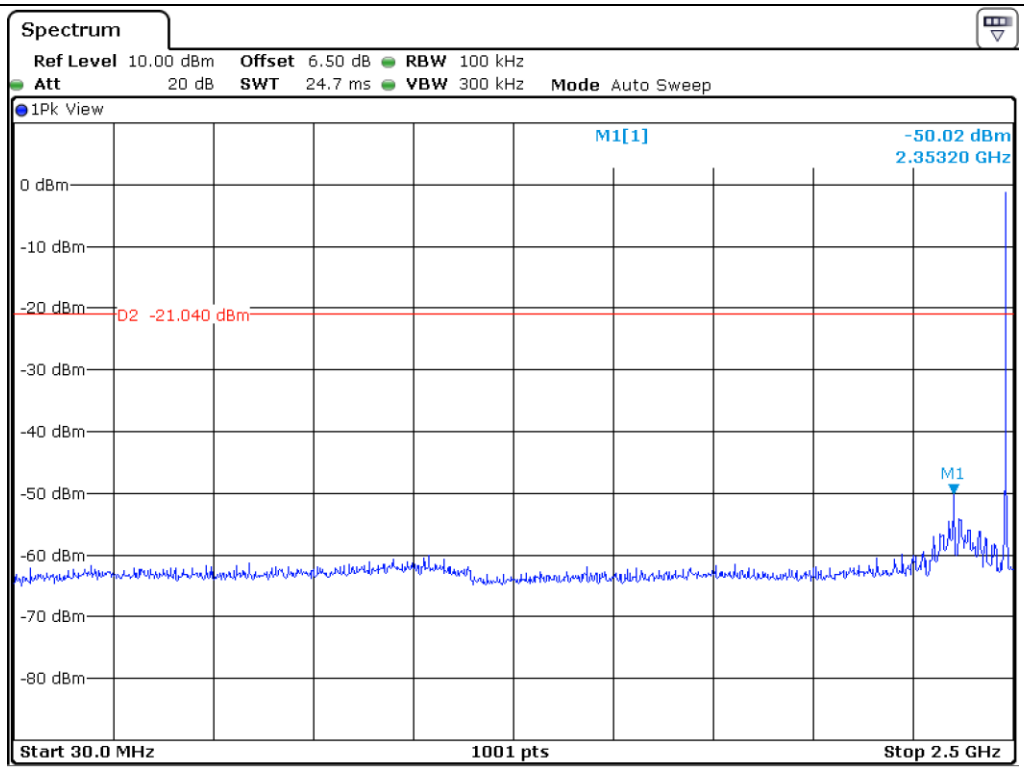
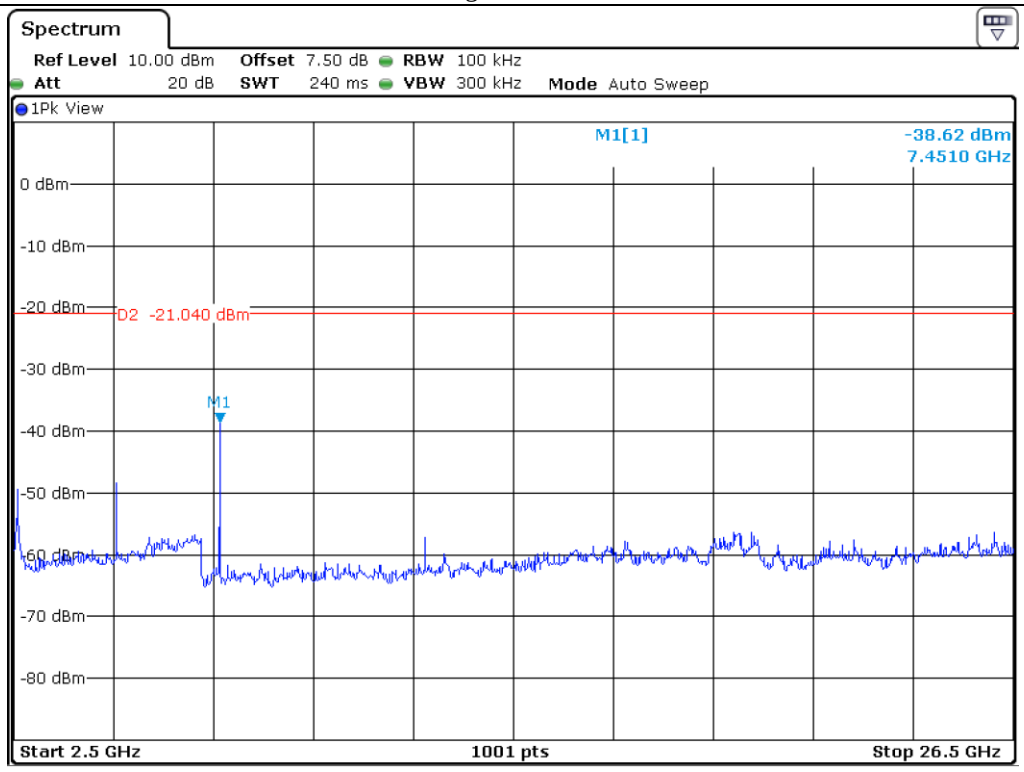


High Channel



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 : August 01, 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									
2362.22	33.20	Peak	H	27.60	11.40	33.52	38.68	74.00	35.32
2347.84	21.11	Average	H				26.59	54.00	27.41
2377.41	32.59	Peak	V				38.07	74.00	35.93
2359.51	21.10	Average	V				26.58	54.00	27.42
Test Data for High Channel									
2491.00	34.78	Peak	H	27.80	11.40	33.63	40.35	74.00	33.65
2494.51	20.85	Average	H				26.42	54.00	27.58
2496.11	33.67	Peak	V				39.24	74.00	34.76
2488.23	21.25	Average	V				26.82	54.00	27.18

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: Ju Yun Park / Assistant Manager

9.6.2 Spurious & Harmonic Radiated Emission

-. Test Date : August 01, 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									
4 804.00	32.09	Peak	H	31.00	16.10	32.90	46.29	74.00	27.71
	19.20	Average	H				33.40	54.00	20.60
	30.62	Peak	V				44.82	74.00	29.18
	19.37	Average	V				33.57	54.00	20.43
Test Data for Middle Channel									
4 880.00	35.77	Peak	H	31.10	16.10	33.00	49.97	74.00	24.03
	24.61	Average	H				38.81	54.00	15.19
	35.54	Peak	V				49.74	74.00	24.26
	24.75	Average	V				38.95	54.00	15.05
Test Data for High Channel									
4 960.00	31.41	Peak	H	31.20	16.10	33.10	45.61	74.00	28.39
	19.23	Average	H				33.43	54.00	20.57
	30.31	Peak	V				44.51	74.00	29.49
	20.04	Average	V				34.24	54.00	19.76

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

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10. PEAK POWER SPECTRAL DENSITY

10.1 Operating environment

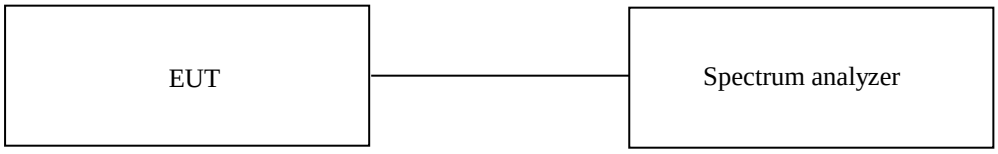
Temperature : 25 ℃

Relative humidity : 45 % 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	Oct.26, 2017 (1Y)

All test equipment used is calibrated on a regular basis.

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10.4 Test data

-. Test Date : July 25, 2018

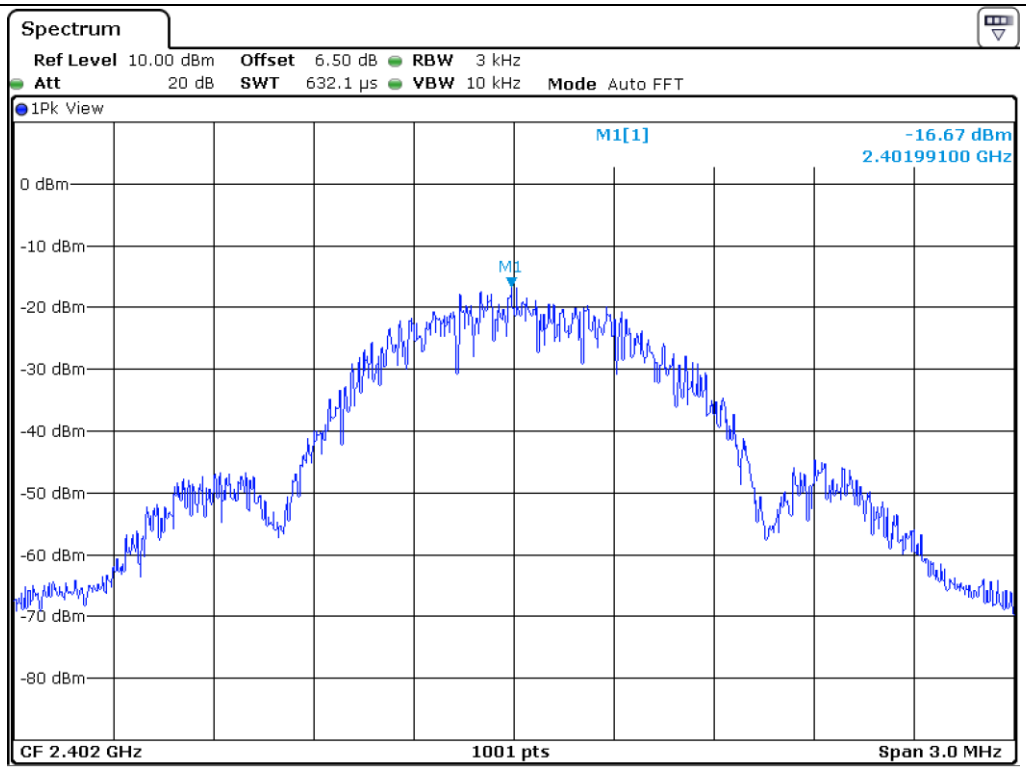
-. Test Result : Pass

-. Operating Condition : Continuous transmitting mode

CHANNEL	FREQUENCY(MHz)	MEASURED VALUE (dBm)	LIMIT (dBm)	MARGIN (dB)
Low	2 402.00	-16.67	8.00	24.67
Middle	2 440.00	-16.58	8.00	24.58
High	2 480.00	-16.49	8.00	24.49

Remark. Margin = Limit – Measured value

Tested by: Ju Yun Park / Assistant Manager



Low Channel

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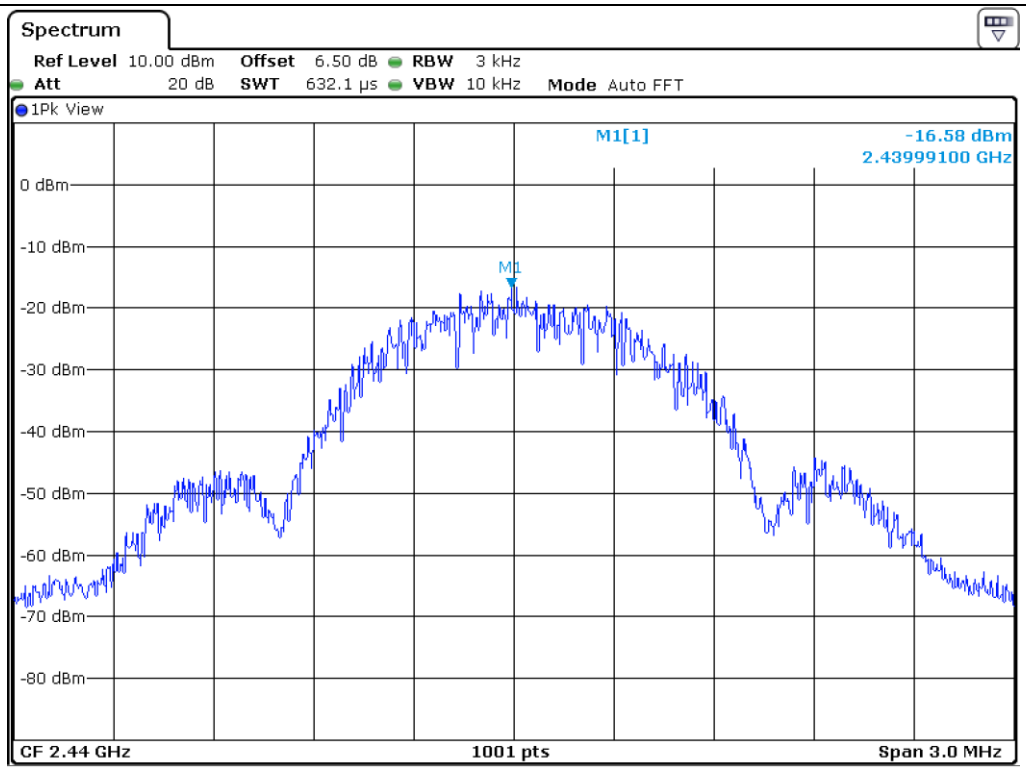
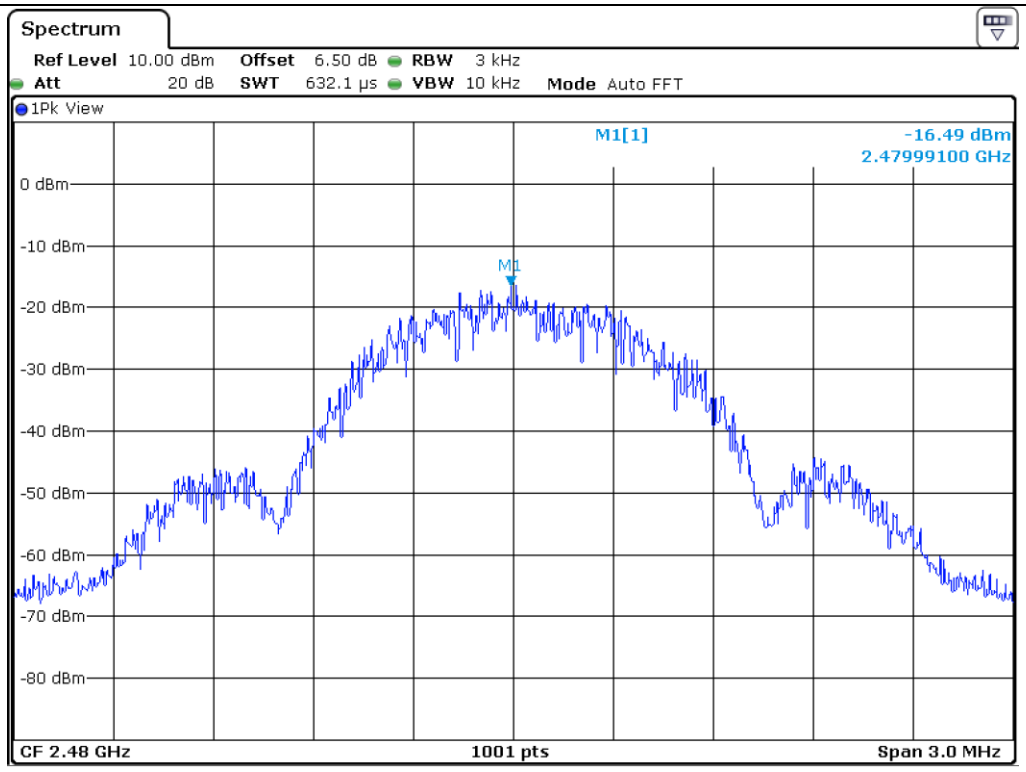


Middle Channel



High Channel

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11. RADIATED EMISSION TEST

11.1 Operating environment

Temperature : 24 ℃

Relative humidity : 44 % 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)
■ -	ESR	Rohde & Schwarz	EMI Test Receiver	101470	Oct. 27, 2017 (1Y)
■ -	310N	Sonoma Instrument	AMPLIFIER	312544	Mar. 28, 2018 (1Y)
■ -	FSV30	Rohde & Schwarz	Signal Analyzer	101200	Oct. 26, 2017 (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	9163-202	Nov. 15, 2016 (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	Sep. 01, 2017 (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

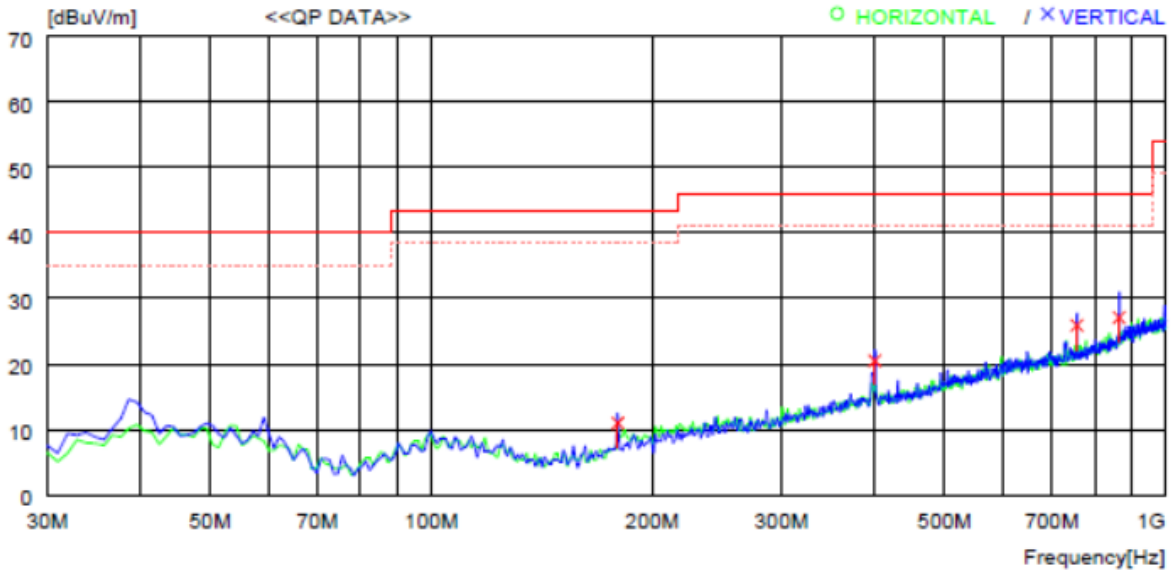
Humidity Level : 44 % R.H. Temperature: 24 ℃

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

Result : PASSED

EUT : RF Module (BLE) Date: August 01, 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]
----- Vertical ------										
1	179.380	31.2	9.7	3.1	33.0	11.0	43.5	32.5	100	2
2	401.510	33.1	15.9	4.6	33.1	20.5	46.0	25.5	400	75
3	756.523	32.0	20.7	6.4	33.2	25.9	46.0	20.1	100	0
4	864.190	31.0	21.9	6.9	32.7	27.1	46.0	18.9	200	359

Tested by: Ju Yun Park / Assistant Manager

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11.4.2 Test data for Below 30 MHz

-. Test Date : August 01, 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 : August 01, 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: Ju Yun Park / Assistant Manager

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