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

Test Report No.	**: OT-194-RWD-058**
AGR No.	**: A193A-186**
Applicant	**: BROS & COMPANY INC.**
Address	**: A-402, InnoValley, 253, Pangyo-ro, Bundang-gu, Seongnam-si, Gyeonggi-do, Korea**
Manufacturer	**: SHENZHEN ARBITER TECHNOLOGY CO., LTD**
Address	**: Bldg A, Meisheng Industrial Park, Chongqing Rd., Fuyong, Bao'an District, Shenzhen, China**
Type of Equipment	**: Receiver**
FCC ID.	**: 2AQISPOUT-01402**
Model Name	**: POUT-01402**
Multiple Model Name:	**N/A**
Serial number	**: N/A**
Total page of Report	**: 36 pages (including this page)**
Date of Incoming	**: March 18, 2019**
Date of issue	**: April 23, 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:

Ha-Ram, Lee / Assistant Manager
ONETECH Corp.

Approved by:

Jae-Ho Lee / Chief Engineer
ONETECH Corp.

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Revision History

Issued Report No.	Issued Date	Revisions	Effect Section
OT-194-RWD-058	April 23, 2019	Initial Issue	All

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1. VERIFICATION OF COMPLIANCE

APPLICANT	: BROS & COMPANY INC.
ADDRESS	: A-402, InnoValley, 253, Pangyo-ro, Bundang-gu, Seongnam-si, Gyeonggi-do, Korea
CONTACT PERSON	: KIYEOL PARK / CEO
TELEPHONE NO	: +82-31-286-8646
FCC ID	: 2AQISPOUT-01402
MODEL NAME	: POUT-01402
SERIAL NUMBER	: N/A
DATE	: April 23, 2019

EQUIPMENT CLASS	***DSS – PART 15 SPREAD SPECTRUM TRANSMITTER***
KIND OF EQUIPMENT	Receiver
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) (1)	Carrier Frequency Separation	Met the Limit / PASS
15.247 (a) (1) (iii)	Minimum Number of Hopping Channels	Met the Limit / PASS
15.247 (a) (1) (iii)	Average Time of Occupancy	Met the Limit / PASS
15.247 (b) (1)	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
15.209	Radiated Emission Limits, General Requirement	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.

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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

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3. GENERAL INFORMATION

3.1 Product Description

The BROS & COMPANY INC., Model POUT-01402 (referred to as the EUT in this report) is a Receiver. The product specification described herein was obtained from product data sheet or user's manual.

Device Type	Receiver
Operating Frequency	2 402.75 MHz ~ 2 480.75 MHz
RF Output Power	-14.84 dBm
Number of Channel	16 Channels
Modulation Type	GFSK
Antenna Type	PCB Antenna
Antenna Gain	-0.84 dBi
List of each Osc. or crystal Freq.(Freq. >= 1 MHz)	16 MHz
Rated Supply Voltage	DC 5.0 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

- None

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5.3 Mode of operation during the test

For the testing, software used to control the EUT for staying in continuous transmitting and receiving mode is programmed. The EUT was set at Low Channel (2 402.75 MHz), Middle Channel (2 441.75MHz), and High Channel (2 480.75 MHz). To get a maximum radiated 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 test report.

5.4 Configuration of Test System

Line Conducted Test: The EUT was tested in a Charging & Transmitting mode. The EUT was connected to USB and the power of USB was connected to Notebook PC. All supporting equipment were connected to another LISN. Preliminary Power line Conducted Emission test was performed by using the procedure in ANSI C63.10: 2013 to determine the worse operating conditions.

Radiated Emission Test: The EUT was tested in a Charging & Transmitting mode. Preliminary radiated emissions test was conducted using the procedure in ANSI C63.10: 2013 to determine the worse operating conditions. Final radiated emission tests were conducted at 3 m 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 transmitter antenna of the EUT is a PCB Antenna, so no consideration of replacement by the user.

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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)
Charging & Transmitting mode.	X

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7. MINIMUM 20 dB BANDWIDTH

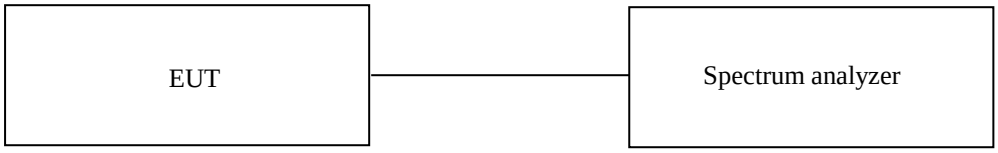
7.1 Operating environment

Temperature : 23 ℃

Relative humidity : 49 % 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 10 kHz, and peak detection was used. The 20 dB bandwidth is defined as the total spectrum over which the power is higher than the peak power minus 20 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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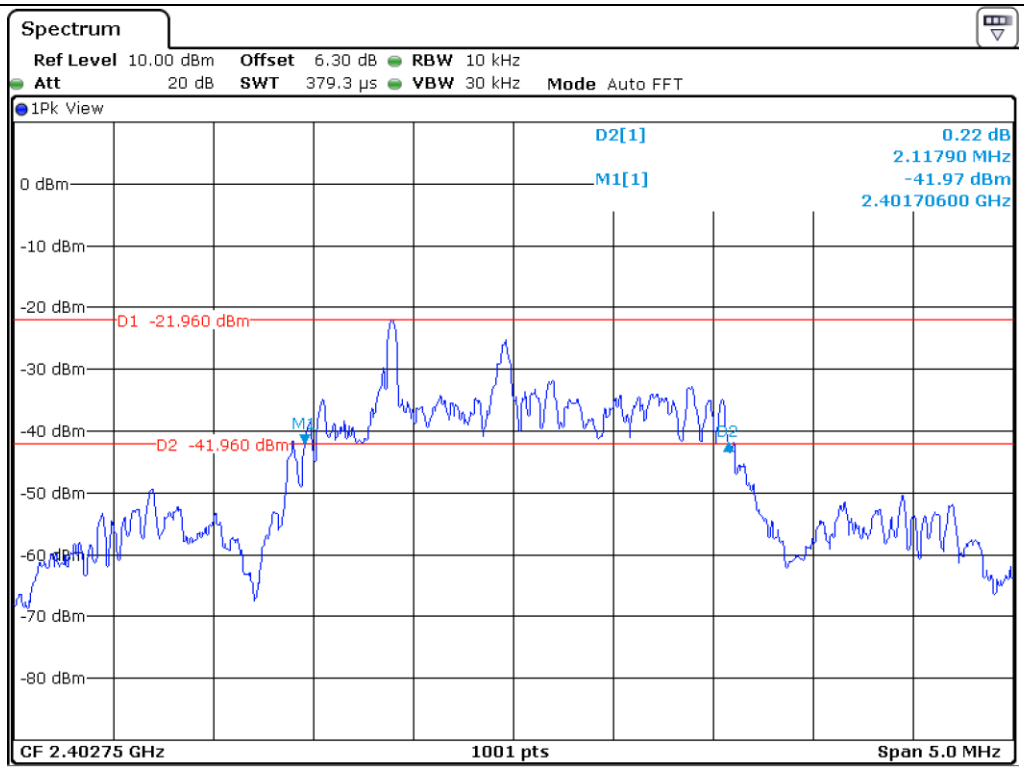
7.4 Test data

-. Test Date : March 18, 2019

CHANNEL	FREQUENCY (MHz)	20 dB Bandwidth (kHz)
Low	2 402.75	2 117.90
Middle	2 441.75	2 127.90
High	2 480.75	2 117.90

Tested by: Sieon Lee / Assistant Manager



Low Channel

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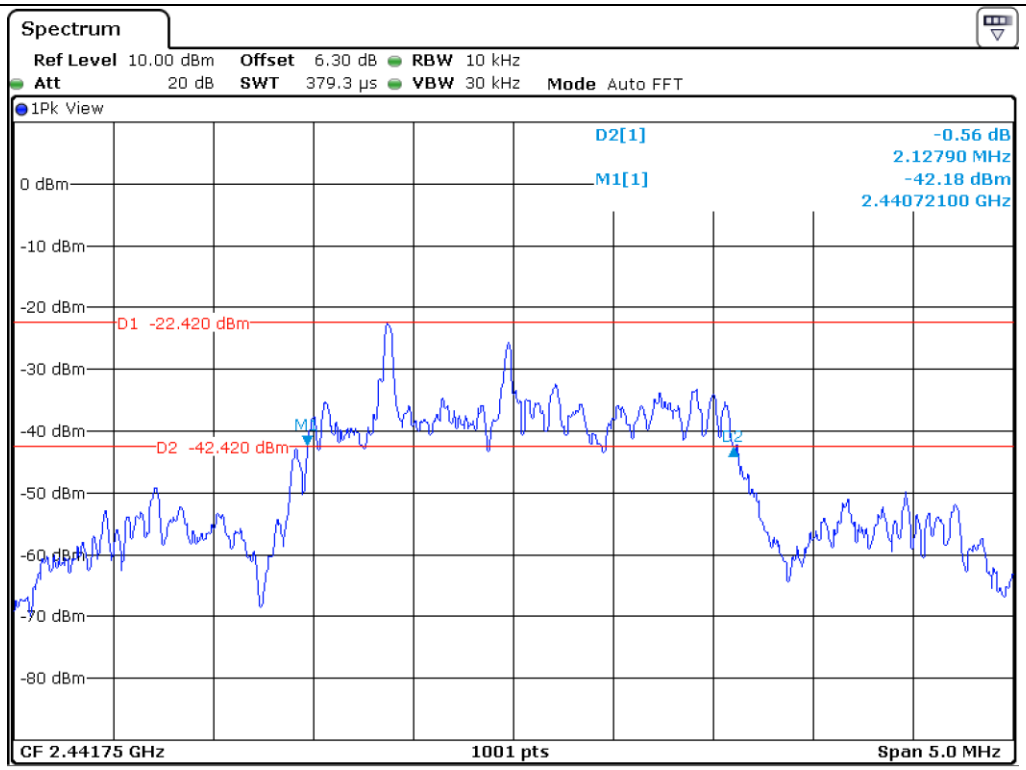
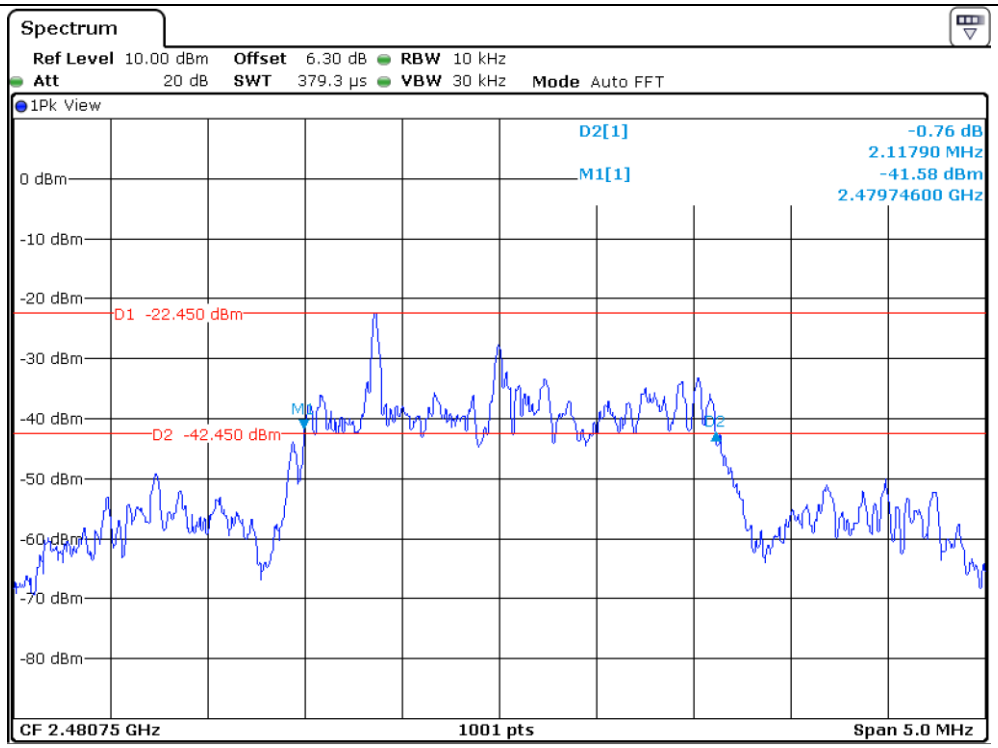


Middle Channel



High Channel

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8. HOPPING FREQUENCY SEPARATION

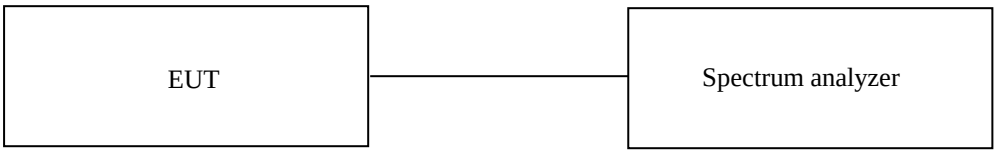
8.1 Operating environment

Temperature : 23 ℃

Relative humidity : 49 % R.H.

8.2 Test set-up

The antenna output of the EUT was connected to the spectrum analyzer. The frequency span is set to 5 MHz. The analyzer is set to peak hold then a pseudo-random hopping sequence of the transmitter is captured. The mark delta function was used to measure the frequency separation between two adjacent hopping channels.



8.3 Test equipment used

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

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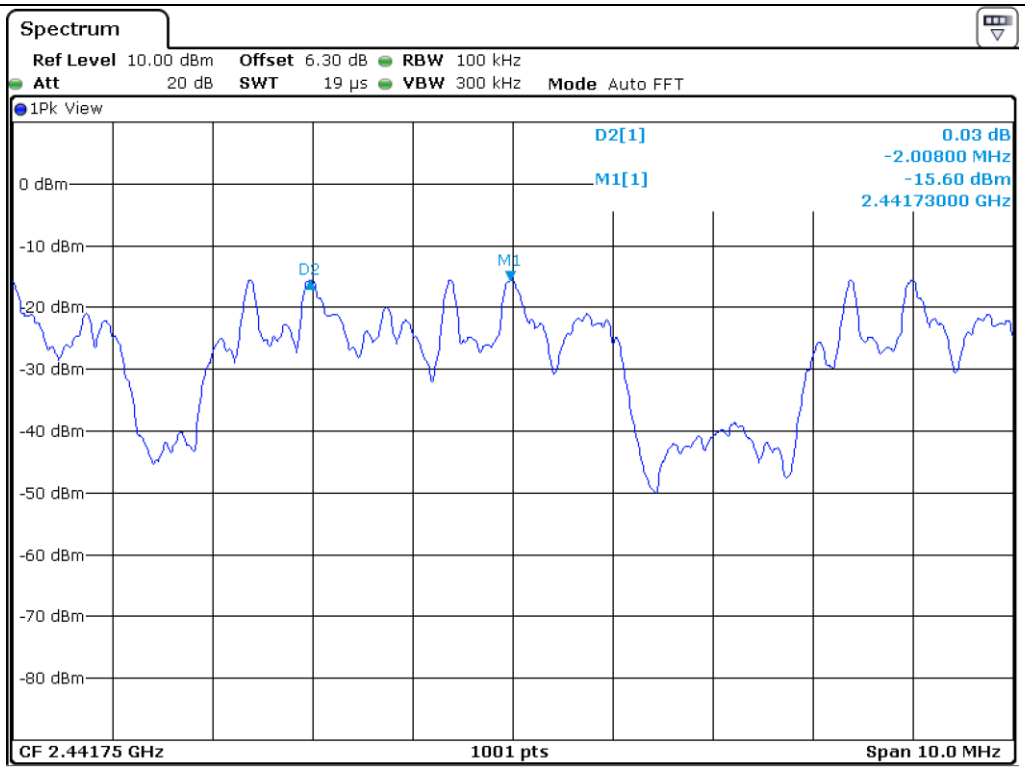
8.4 Test data

-. Test Date : March 18, 2019

-. Test Result : Pass

MEASURED VLAUE (kHz)	Two-third of 20 dB Bandwidth (kHz)	LIMIT
2 008.00	1 418.60	Separated by a minimum of 25 kHz

Tested by: Sieon Lee / Assistant Manager



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9. NUMBER OF HOPPING CHANNELS

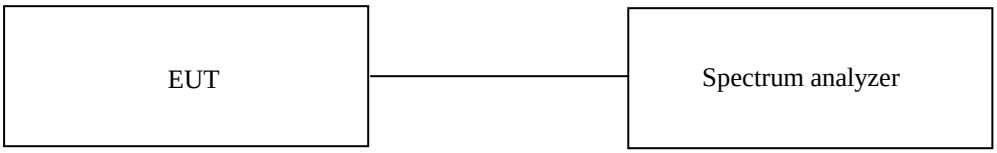
9.1 Operating environment

Temperature : 23 ℃

Relative humidity : 49 % R.H.

9.2 Test set-up

The antenna output of the EUT was connected to the spectrum analyzer. The frequency span is set to frequency band of operation and the resolution bandwidth is set to 100 kHz. The analyzer is set to peak hold and then complete pseudo-random hopping sequence of the transmitter is captured.



9.3 Test equipment used

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

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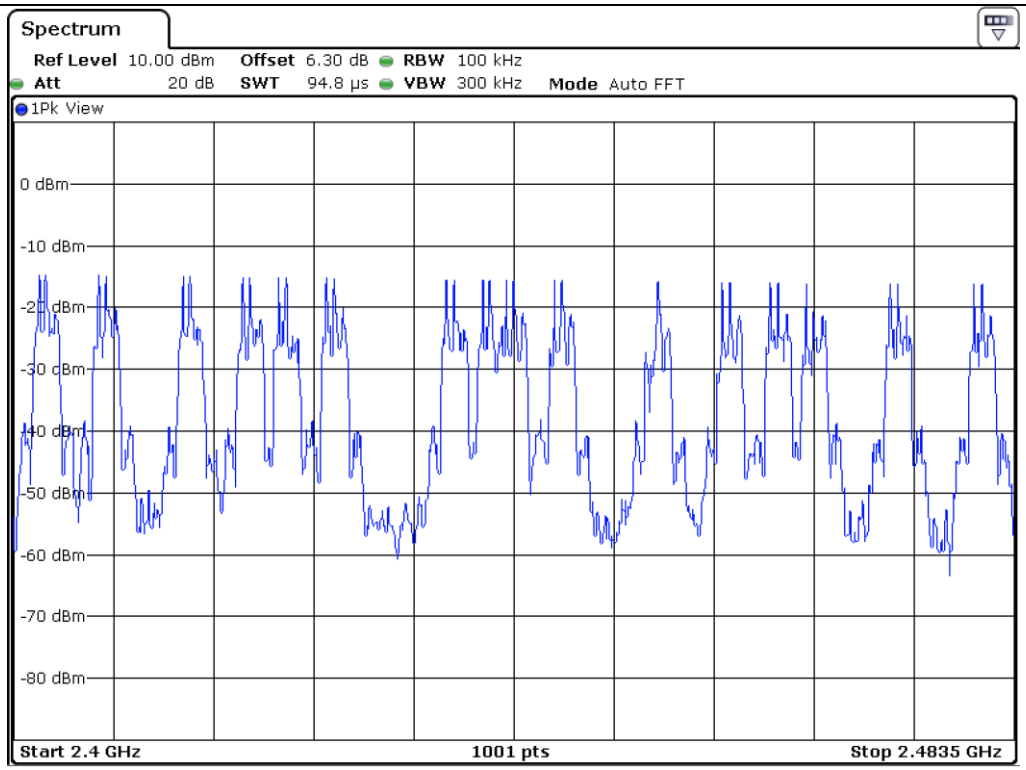
9.4 Test data

-. Test Date : March 18, 2019

-. Test Result : Pass

Measured value (Number)	Limit (Number)	Margin (Number)
16	Minimum of 15	1

Tested by: Sieon Lee / Assistant Manager



Total number of hopping channel: 6+6+4 = 16

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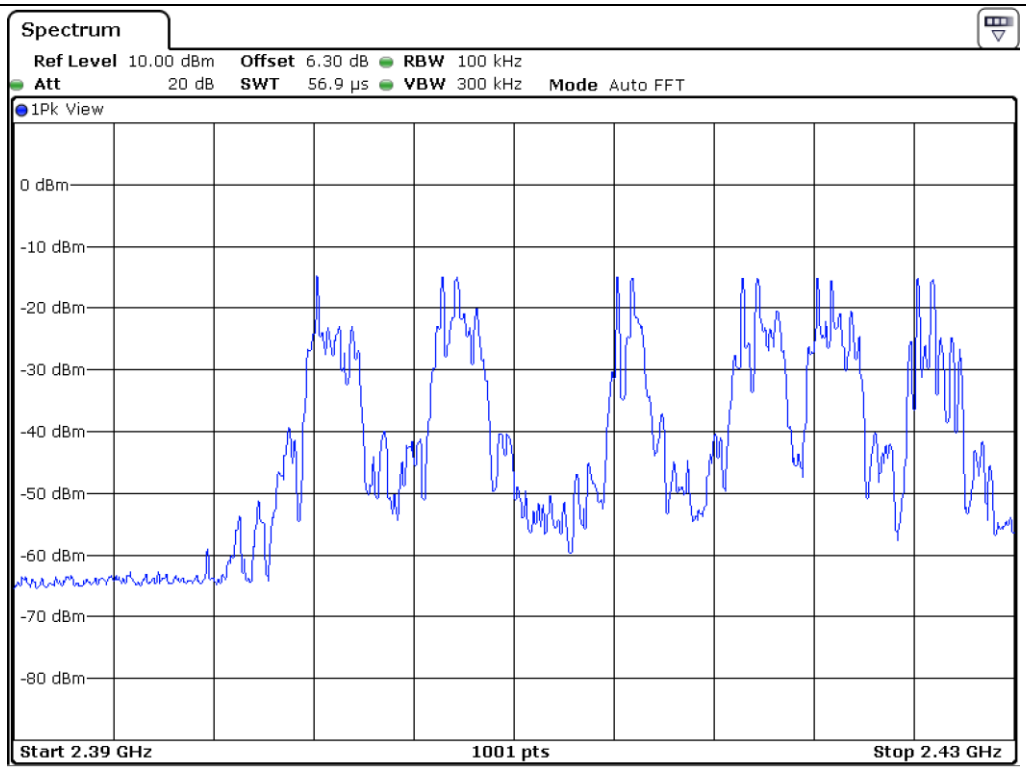
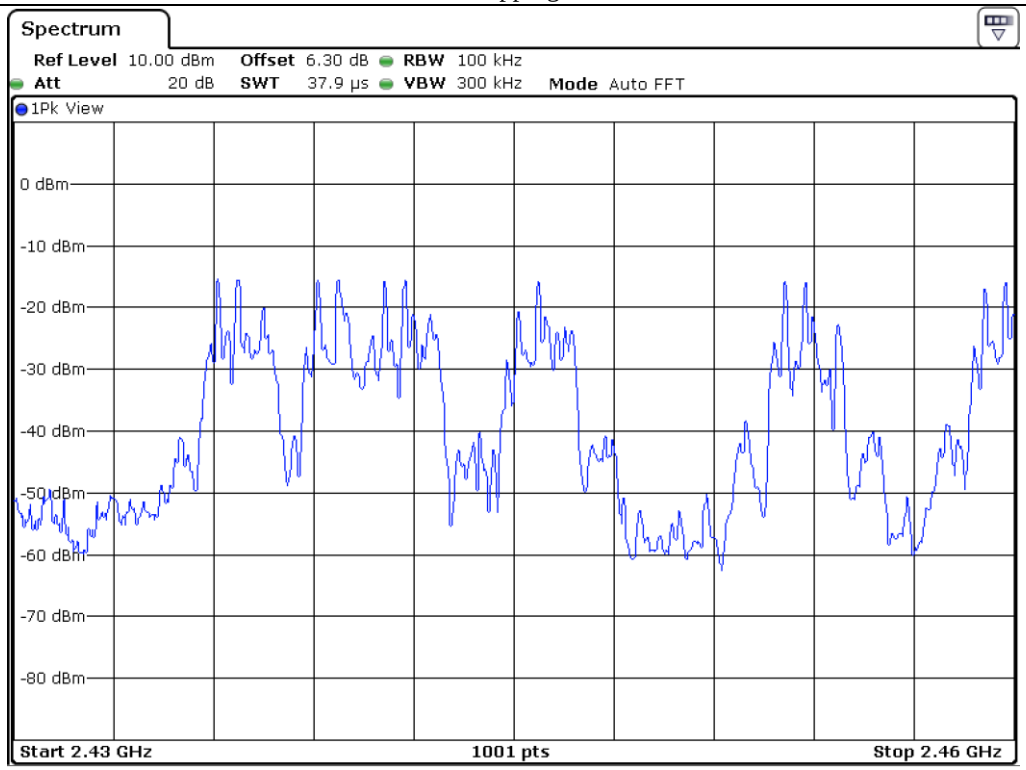


Number of hopping channel: 6



Number of hopping channel: 6

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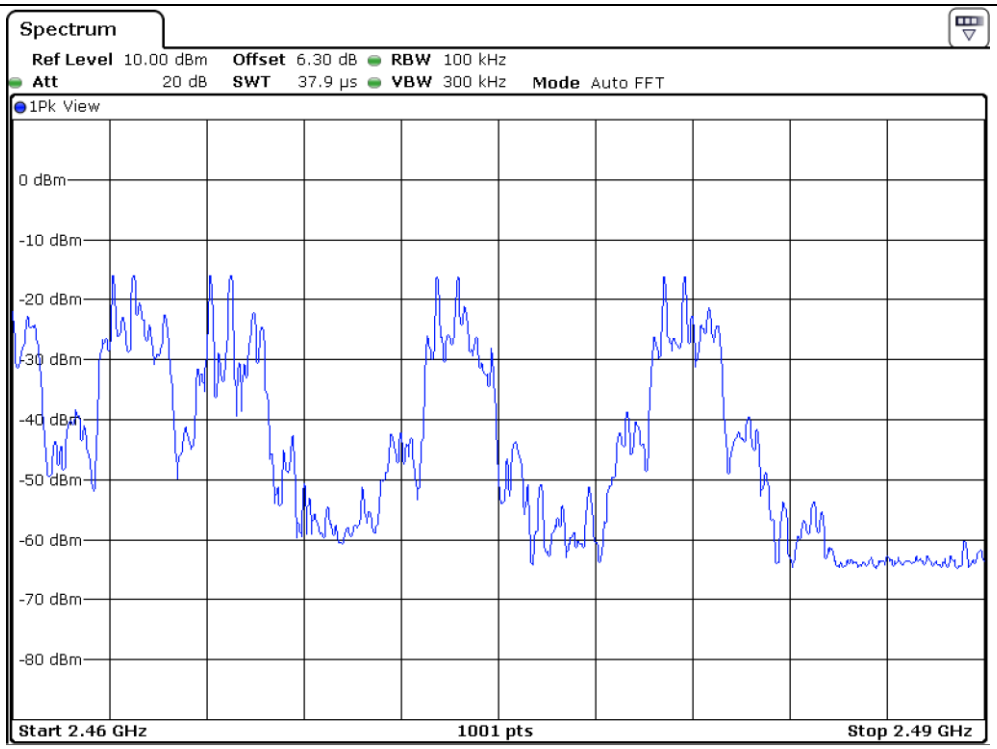

Number of hopping channel: 4

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10. TIME OF OCCUPANCY

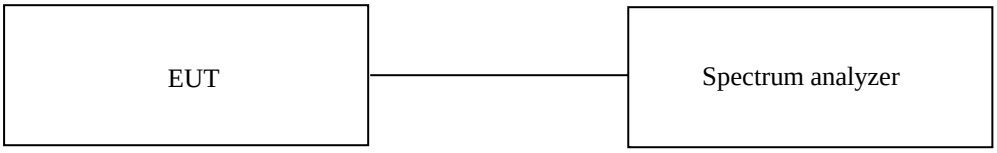
10.1 Operating environment

Temperature : 23 ℃

Relative humidity : 49 % R.H.

10.2 Test set-up

The antenna output of the EUT was connected to the spectrum analyzer. The transmitter is set to operate in its normal frequency hopping mode. The center frequency of the spectrum analyzer is set to one of hopping channels near the center of the operating band and span is set to zero Hz. The sweep time is set to display one complete pulse. The mark delta function is used to measure the duration of the pulses.



10.3 Test equipment used

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

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10.4 Test data

-. Test Date : March 18, 2019

Frequency (MHz)	Pulse Time (ms)	Hops per second with channels	Period Time (s)	Total Dwell Time (ms)	Limit (ms)	Test Result
2 441	0.120	8.13	6.4	6.24	400	PASS

Total dwell time is calculated as following.

Period Time = 0.4 * 16 [channel]

Total Dwell Time = Pulse time * Hops per second with channels * period time

Remark: See next page for an overview sweep performed with peak detector.

Tested by: Sieon Lee / Assistant Manager

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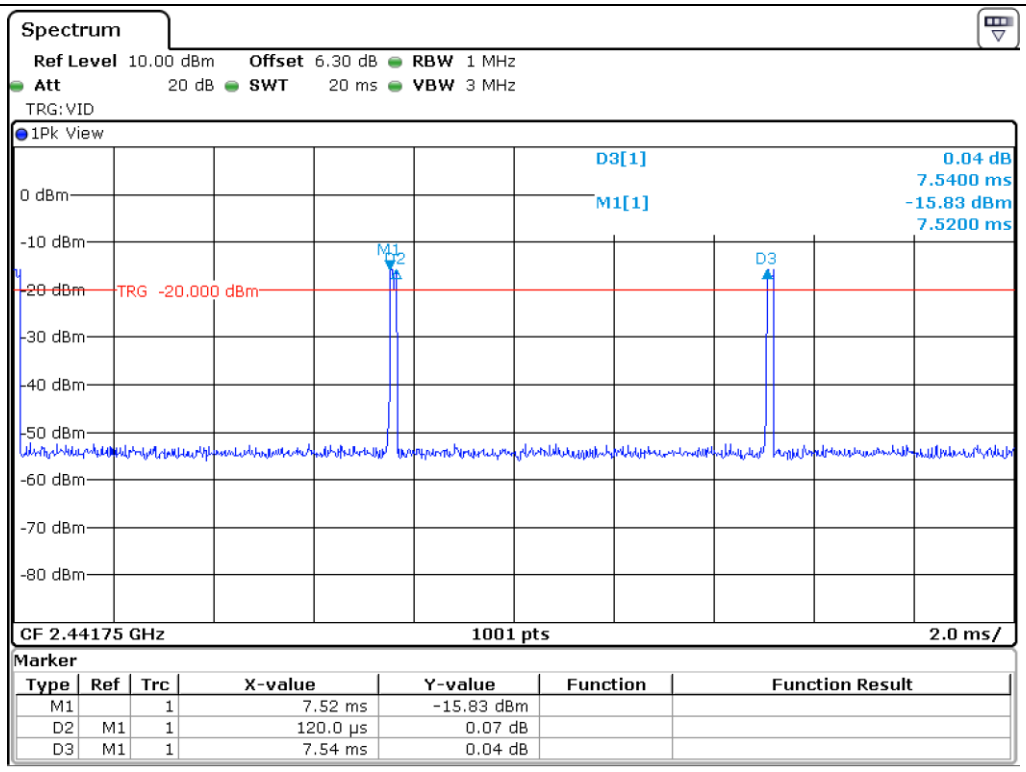

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	7.52 ms	-15.83 dBm		
D2	M1	1	120.0 µs	0.07 dB		
D3	M1	1	7.54 ms	0.04 dB		

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11. MAXIMUM PEAK OUTPUT POWER

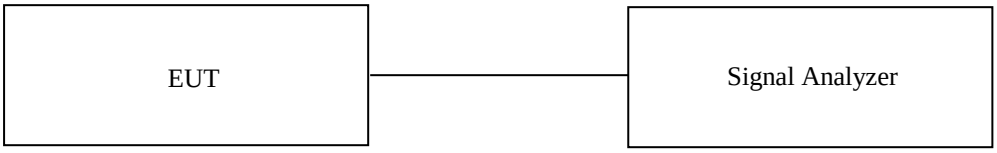
11.1 Operating environment

Temperature : 23 ℃

Relative humidity : 49 % R.H

11.2 Test set-up

The maximum peak output power was measured with the spectrum analyzer connected to the antenna output of the EUT. The EUT was operating in transmit mode at the appropriate center frequency.



11.3 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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11.4 Test data

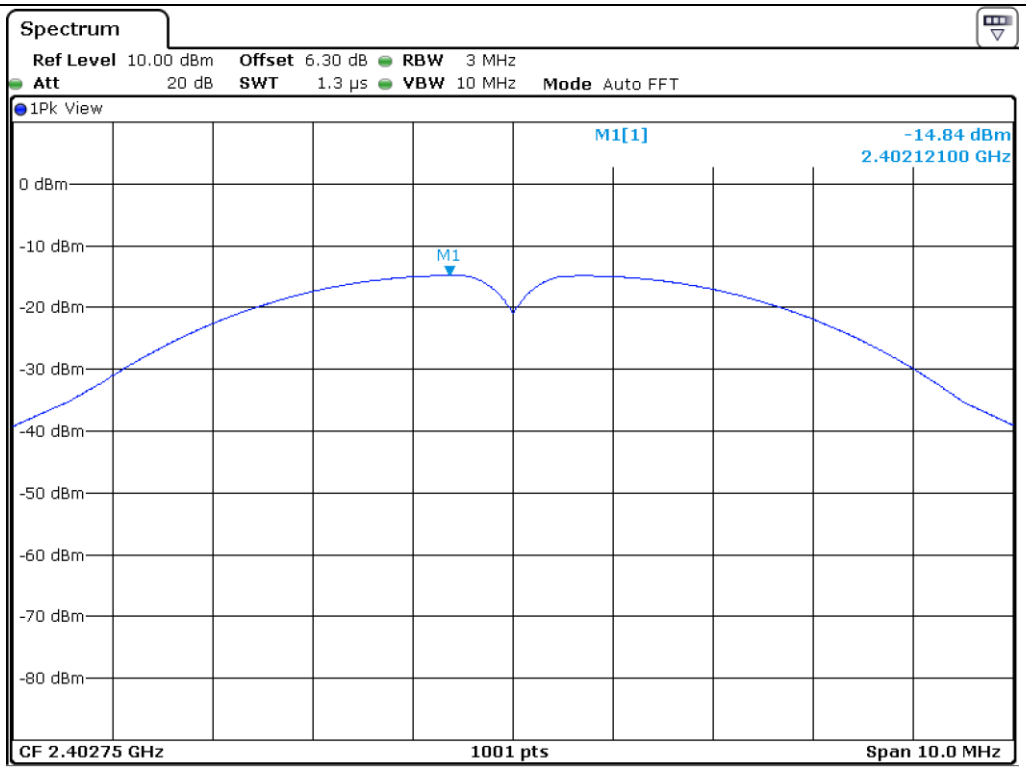
-. Test Date : March 18, 2019

-. Test Result : Pass

CHANNEL	FREQUENCY (MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 402.75	-14.84	21.00	35.84
MIDDLE	2 441.75	-15.60	21.00	36.60
HIGH	2 480.75	-16.26	21.00	37.26

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

Tested by: Sieon Lee / Assistant Manager



Low Channel

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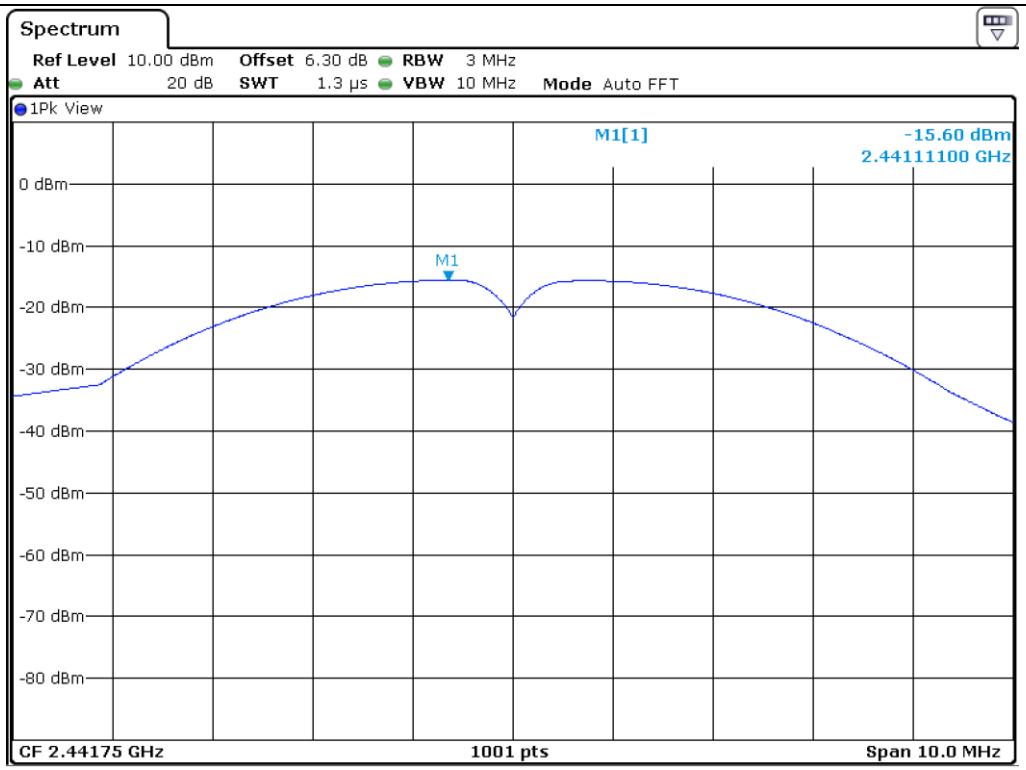
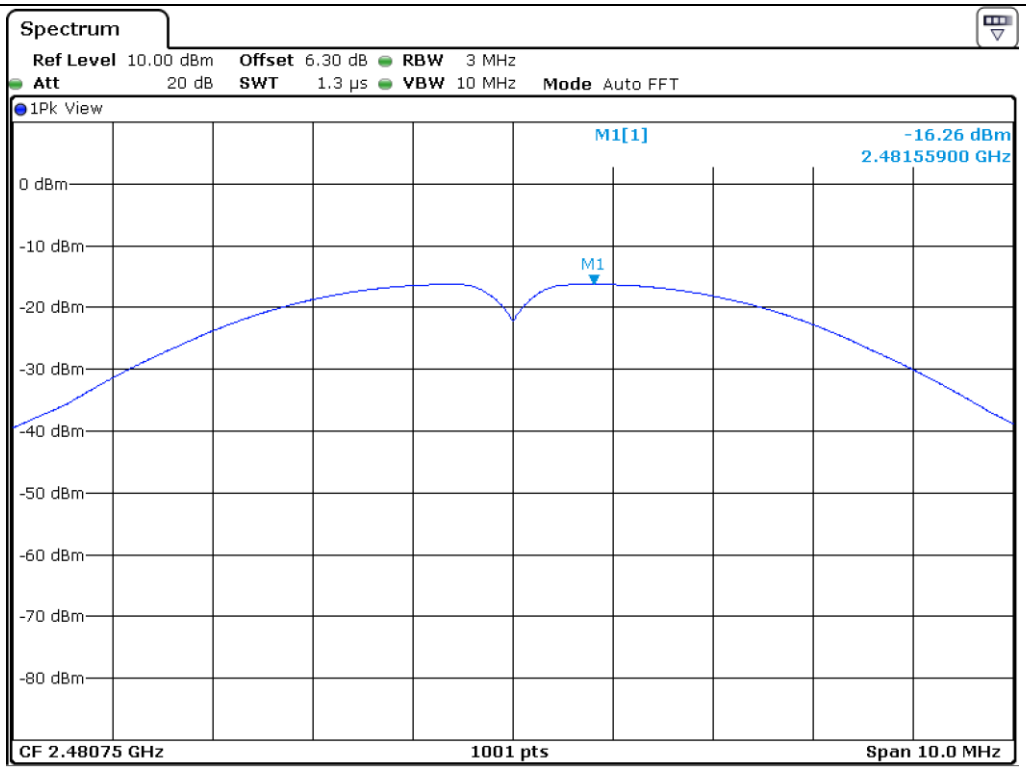


Middle Channel



High Channel

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12. 100 kHz BANDWIDTH OUTSIDE THE FREQUENCY BAND

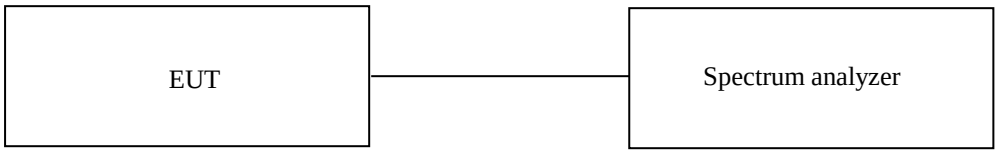
12.1 Operating environment

Temperature : 22 ℃

Relative humidity : 51 % R.H

12.2 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.



12.3 Test set-up for radiated measurement

The radiated emissions measurements were performed on the 3 m, open-field test site. The EUT was placed on a non-conductive turntable approximately 0.8 m above the ground plane.

The frequency spectrum from 30 kHz 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 ms in order to determine the maximum emission levels. This procedure was performed for horizontal and vertical polarization of the receiving antenna.

12.4 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. 18, 2019 (1Y)
■ -	FSV30	Rohde & Schwarz	Signal Analyzer	101200	Aug. 23, 2018 (1Y)
■ -	SCU18	Rohde & Schwarz	Pre-Amplifier	102266	Aug. 24, 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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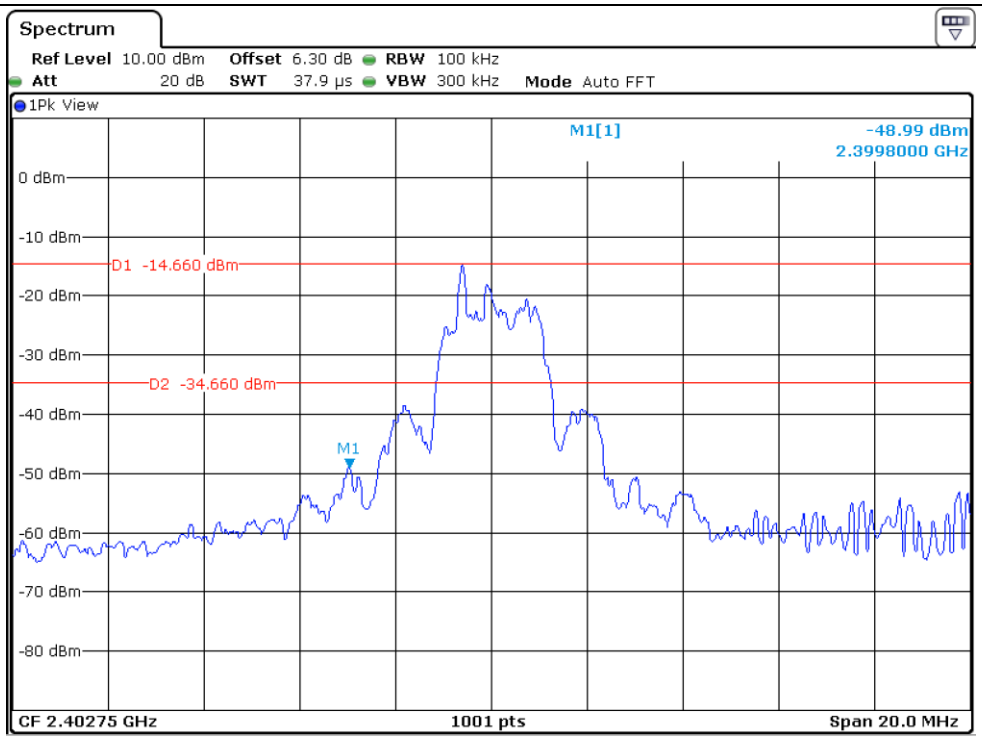
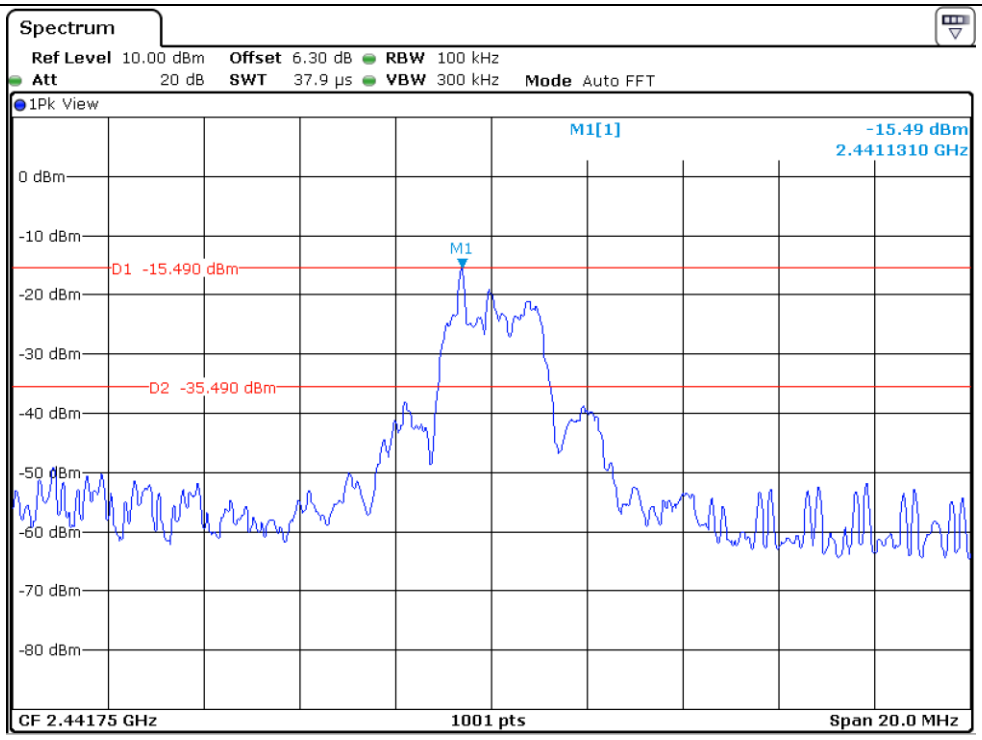
12.5 Test data for conducted emission



Low Channel



Middle Channel

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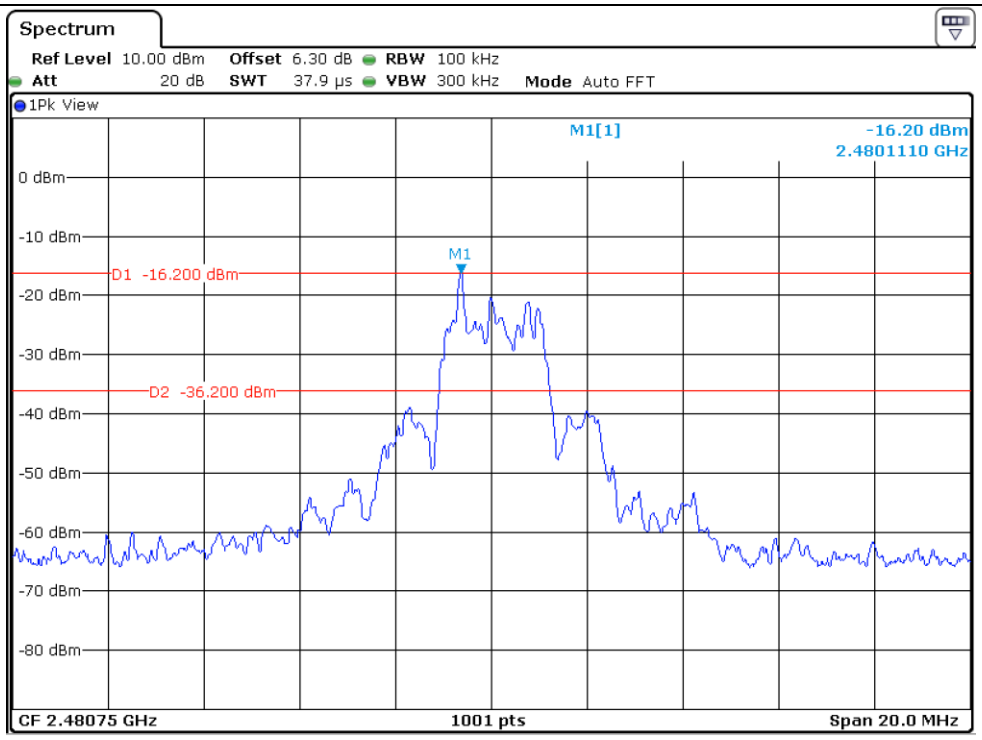
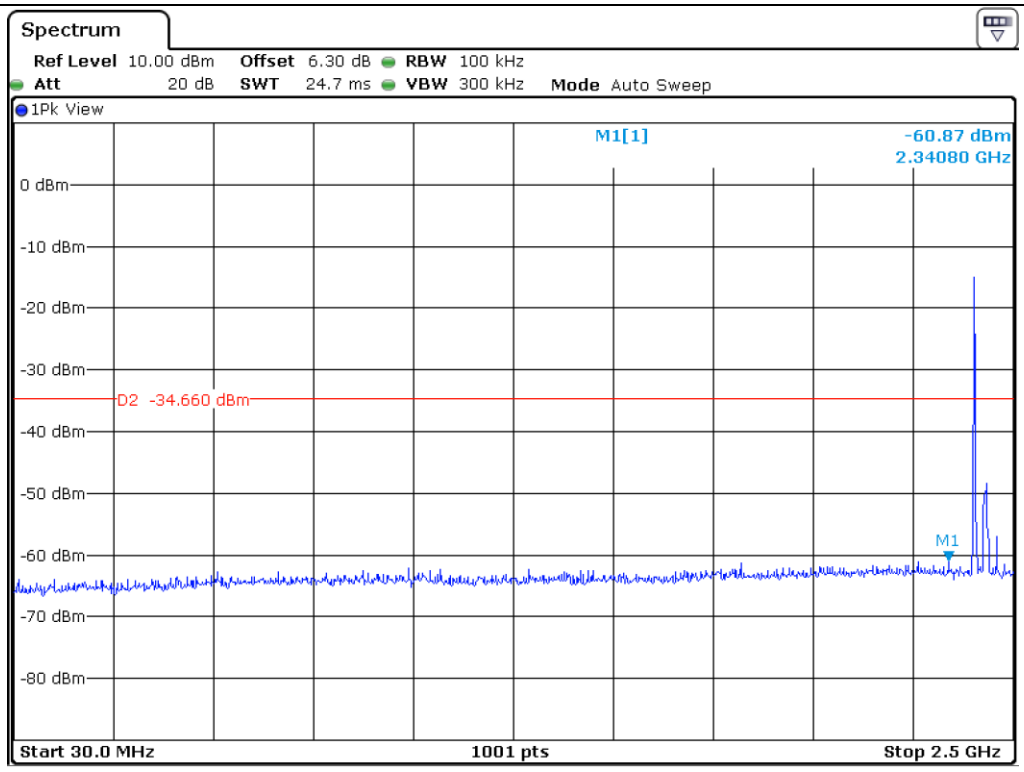
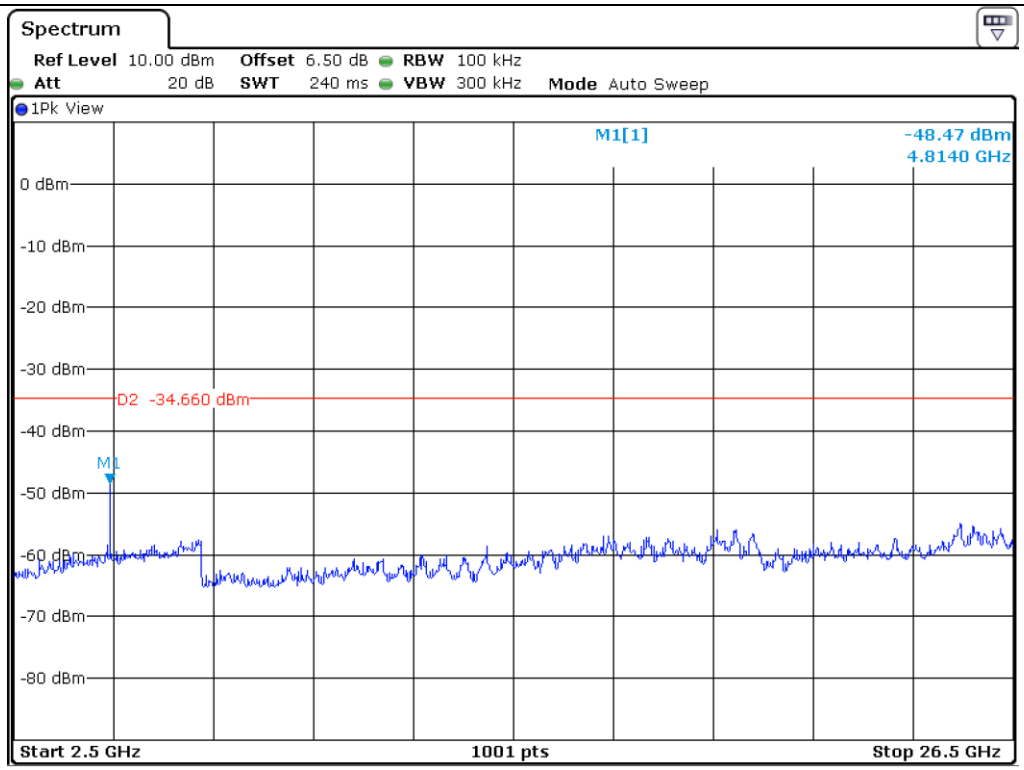


High Channel

ONETECH Corp.: 43-14, Jinsaegol-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea (TEL: 82-31-799-9500, FAX: 82-31-799-9599)



Low Channel



Low Channel

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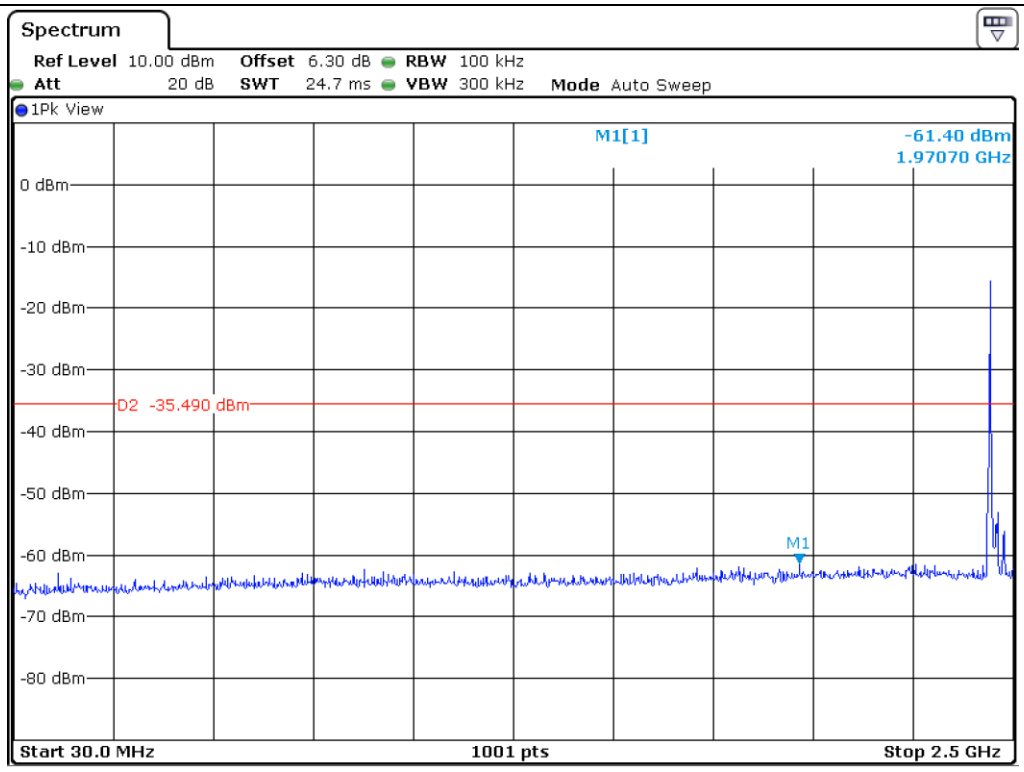
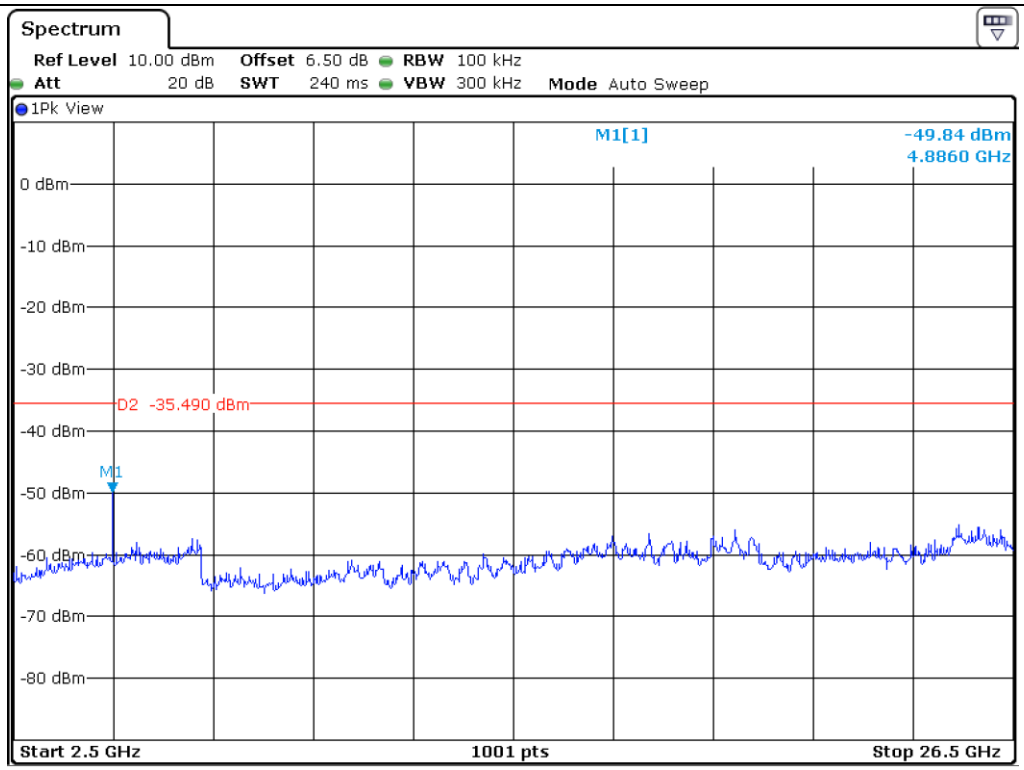
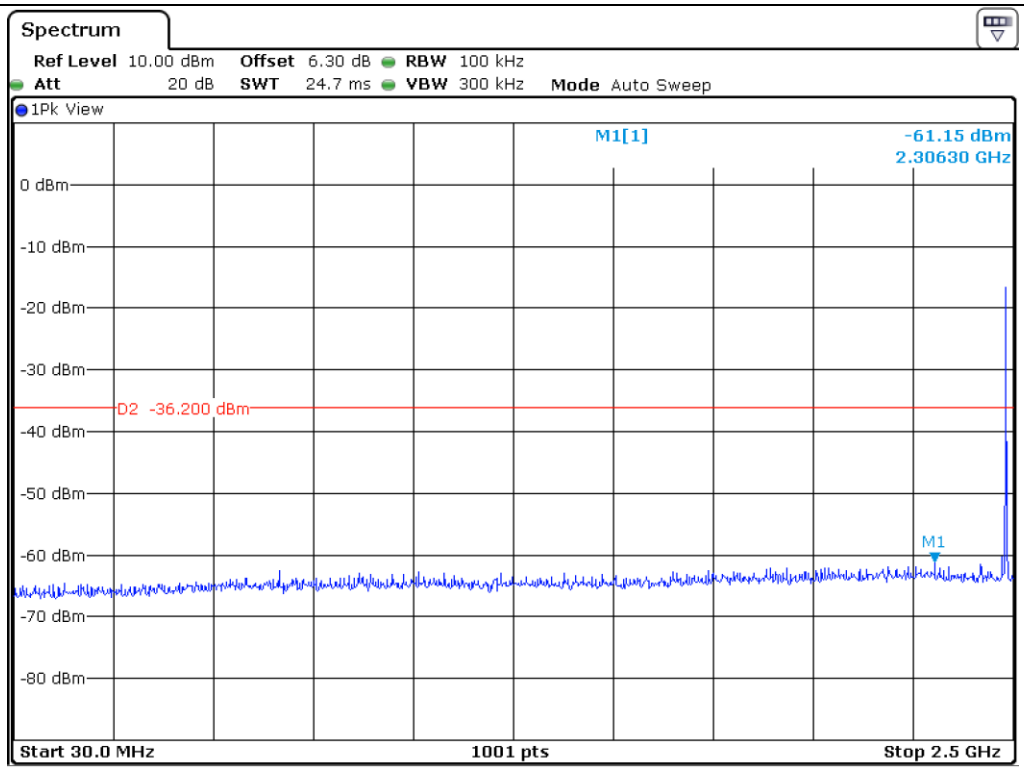


Middle Channel

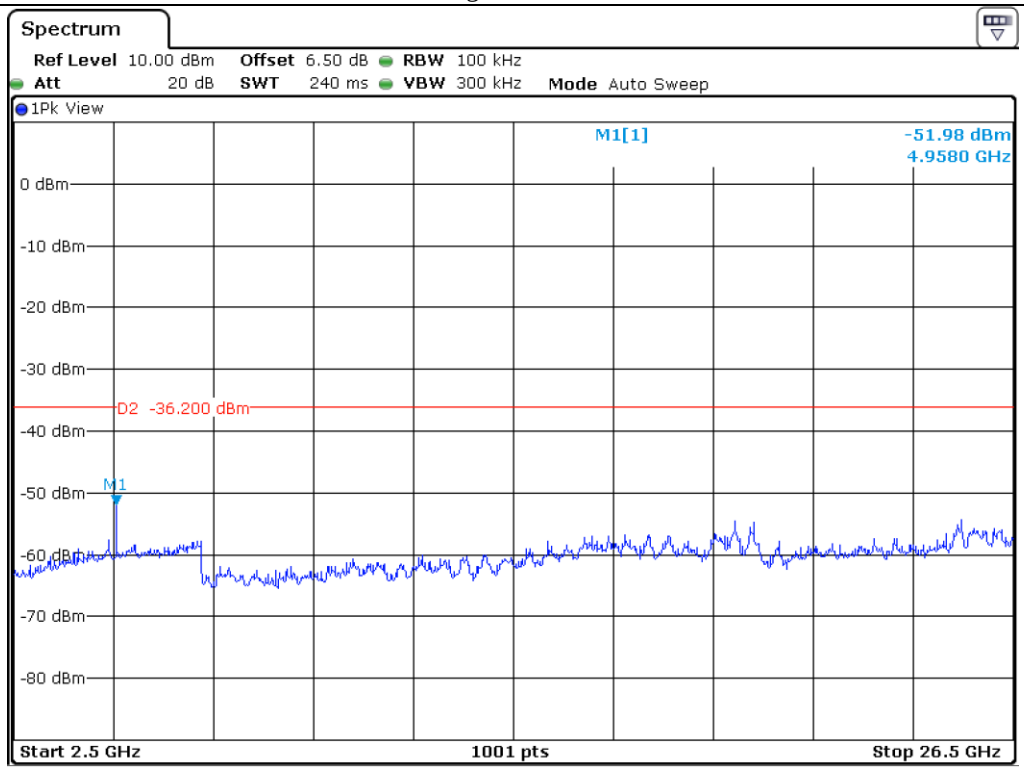


Middle Channel

ONETECH Corp.: 43-14, Jinsaegol-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea (TEL: 82-31-799-9500, FAX: 82-31-799-9599)



High Channel



High Channel

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12.6 Test data for Transmitting Mode radiated emission

12.6.1 Radiated Emission which fall in the Restricted Band

12.6.1.1 Test data

-. Test Date : March 29, 2019

-. 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

-. Operating Condition : Highest Output Power Transmitting Mode (Low Channel and High Channel)

-. 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									
2 367.58	43.36	Peak	H	27.60	11.40	34.29	48.07	74.00	25.93
2 343.17	30.61	Average	H				35.32	54.00	18.68
2 325.07	41.94	Peak	V				46.65	74.00	27.35
2 342.01	30.99	Average	V				35.70	54.00	18.30
Test Data for High Channel									
2 483.51	56.25	Peak	H	27.80	11.40	34.46	60.99	74.00	13.01
2 483.51	31.03	Average	H				35.77	54.00	18.23
2 483.51	54.49	Peak	V				59.23	74.00	14.77
2 484.11	30.45	Average	V				35.19	54.00	18.81

Tabulated test data for Restricted Band

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

Tested by: Sieon Lee / Assistant Manager

12.6.2 Spurious & Harmonic Radiated Emission above 1 GHz

12.6.2.1 Test data

-. Test Date : March 29, 2019

-. 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

-. Operating Condition : Highest Output Power Transmitting Mode

-. 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									
4 805.50	45.61	Peak	H	31.00	16.10	35.23	57.48	74.00	16.52
	31.18	Average	H				43.05	54.00	10.95
	45.03	Peak	V				56.90	74.00	17.10
	30.97	Average	V				42.84	54.00	11.16
Test Data for Middle Channel									
4 883.50	50.41	Peak	H	31.10	16.10	35.27	62.34	74.00	11.66
	31.64	Average	H				43.57	54.00	10.43
	48.75	Peak	V				60.68	74.00	13.32
	31.24	Average	V				43.17	54.00	10.83
Test Data for High Channel									
4 961.50	45.54	Peak	H	31.20	16.10	35.28	57.56	74.00	16.44
	31.66	Average	H				43.68	54.00	10.32
	44.09	Peak	V				56.11	74.00	17.89
	31.28	Average	V				43.30	54.00	10.70

Tabulated test data for Restricted Band

Remark: “H”: Horizontal, “V”: Vertical, “*” Frequency fall in restricted band

Tested by: Sieon Lee / Assistant Manager

12.6.3 Spurious Radiated Emission

12.6.3.1 Test Data for 30 MHz ~ 1 GHz (Transmitting Mode)

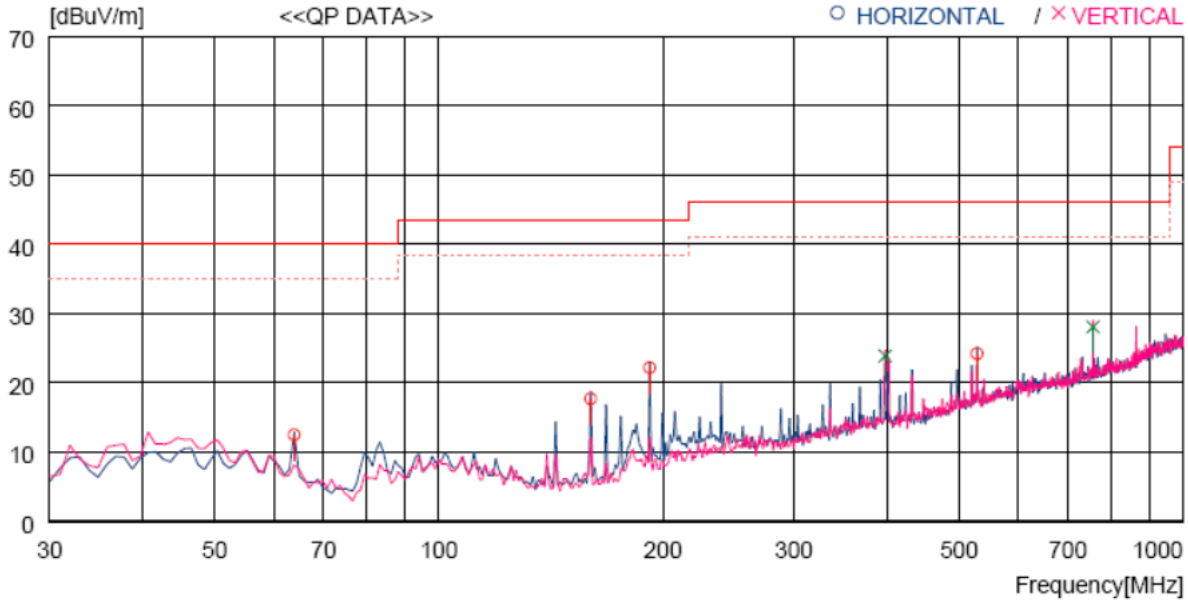
Humidity Level : 51 % R.H. Temperature: 22 ℃

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

Result : PASSED

EUT : Receiver Date: March 29, 2019

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	63.950	32.0	11.7	1.9	33.1	12.5	40.0	27.5	400	195
2	159.980	39.0	8.7	3.0	33.0	17.7	43.5	25.8	200	0
3	191.990	41.1	10.9	3.2	33.0	22.2	43.5	21.3	200	0
4	528.580	34.1	18.1	5.3	33.3	24.2	46.0	21.8	200	50
----- Vertical ------										
5	397.630	36.6	15.8	4.6	33.1	23.9	46.0	22.1	200	359
6	756.523	34.2	20.7	6.4	33.2	28.1	46.0	17.9	100	322

Tested by: Sieon Lee / Assistant Manager

12.6.3.2 Test Data for Below 30 MHz

-. Test Date : March 29, 2019

-. 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 Condition : Highest Output Power Transmitting Mode

-. Result : PASSED

Frequency (MHz)	Reading (dBµV)	Ant. Pol. (H/V)	Ant. Factor (dB/m)	Cable Loss	Amp Gain	Emission Level(dBµV/m)	Limits (dBµV/m)	Margin (dB)
Emissions observed were 20dB below the limit and thus not reported								

12.6.3.3 Test Data for above 1 GHz

-. Test Date : March 29, 2019

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

-. Frequency range : 1 GHz ~ 26.5 GHz

-. Measurement distance : 3 m

-. Operating Condition : Highest Output Power Transmitting Mode

-. Result : PASSED

Frequency (MHz)	Reading (dBµV)	Ant. Pol. (H/V)	Ant. Factor (dB/m)	Cable Loss	Amp Gain	Emission Level(dBµV/m)	Limits (dBµV/m)	Margin (dB)
Emissions observed were 20dB below the limit and thus not reported								

Tested by: Sieon Lee / Assistant Manager