

FCC Part 15 Subpart B&C §15.247

Test Report

Equipment Under Test	Wireless communication device
Model Name	ACRO-M
Applicant	INSOPACK. CO., LTD.
FCC ID	RGN-ACRO-M
Manufacturer	INSOPACK. CO., LTD.
Date of Test(s)	2015. 08. 03 ~ 2015. 08. 28
Date of Issue	2015. 09. 17

In the configuration tested, the EUT complied with the standards specified above.

Issue to	Issue by
INSOPACK. CO., LTD. 101/508, Digital Empire Building, Sin-dong, Yeongtong-gu, Suwon, Kyeonggi-do, Korea. Tel.: +82-31-695-8400 Fax: +82-31-695-8406	MOVON Corporation 498-2, Geumeo-ro, Pogok-eup, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea, 449-812 Tel.: +82-31-338-8837 Fax: +82-31-338-8847

Revision history

Revision	Date of issue	Description	Revised by
--	Sep. 17, 2015	Initial	--

Table of contents

1. ATTESTATION OF TEST RESULTS	4
2. EUT DESCRIPTION	6
3. FREQUENCY HOPPING SYSTEM REQUIREMENTS	7
4. TRANSMITTER RADIATED SPURIOUS EMISSIONS AND CONDUCTED SPURIOUS EMISSIONS	9
5. CONDUCTED POWER LINE TEST	32
6. 20 dB BANDWIDTH MEASUREMENT	35
7. MAXIMUM PEAK OUTPUT POWER MEASUREMENT	40
8. HOPPING CHANNEL SEPARATION	45
9. NUMBER OF HOPPING FREQUENCY	47
10. TIME OF OCCUPANCY (DWEELL TIME)	49
11. ANTENNA REQUIREMENT	54
12. RF EXPOSURE EVALUATION	55

1. Attestation of test results

1.1. Details of applicant & manufacturer

Applicant	: INSOPACK. CO., LTD.
Address	: 101/508, Digital Empire Building, Sin-dong, Yeongtong-gu, Suwon, Kyeonggi-do, Korea.
Contact Person	: Jeong Hyun, Cho
Telephone	: +82-31-695-8400
Fax	: +82-31-695-8406

1.2. Summary of test results

The EUT has been tested according to the following specifications;

Section in FCC part 15	Description	Result
§15.205(a) §15.209 §15.247(d)	Transmitter radiated spurious emissions, Conducted spurious emission	C
§15.109(a)	Receiver radiated spurious emission	C
§15.247(a)(1)	20 dB bandwidth	C
§15.247(b)(1)	Maximum peak output power	C
§15.247(a)(1)	Frequency separation	C
§15.247(a)(1)(iii)	Number of hopping frequency	C
§15.247(a)(1)(iii)	Time of occupancy(Dwell time)	C
§15.247(i) §1.1307(b)(1)	RF exposure evaluation	C

The sample was tested according to the following specification:

FCC Parts 15.247; ANSI C-63.4-2009

FCC Public Notice DA 00-705

TEST SITE REGISTRATION NUMBER: FCC(670686), FCC(287786)

※ Abbreviation

C Complied
N/A Not applicable
F Fail

Approval Signatories

Test and Report Completed by :	Report Approval by :
	
Jungmoo Her Test Engineer MOVON CORPORATION	Issac Jin Technical Manager MOVON CORPORATION

2. EUT Description

Kind of product	Wireless communication device
Model Name	ACRO-M
FCC ID	RGN-ACRO-M
Serial Number	N/A
Power supply	DC 3.8V
Frequency range	2 402 MHz ~ 2 480 MHz
Modulation technique	GFSK, Pi/4DQPSK, 8DPSK
Number of channels	79
Antenna gain	-2.17 dBi (Max.)
TEST SITE REGISTRATION NUMBER	FCC(670686), FCC(287786)

2.1. Declarations by the manufacturer : None

2.2. Details of modification : None

2.3. MEASUREMENT EQUIPMENT

Equipment	Manufacturer	Model	Serial number	Calibration Interval	Calibration due.
EMI Receiver	R&S	ESVN30	832854/010	1 year	2016-01-12
Signal Generator	R&S	SMBV100	257379	1 year	2015-09-29
Spectrum Analyzer	R&S	FSV-40	100832	1 year	2016-03-06
Test Receiver	R&S	ESPI	100012	1 year	2016.01.12
Horn Antenna	SCHWARZBECK MESS-ELECTRONIK	BBHA 9120 D	BBHA 9120 D 517	2 year	2016-10-16
Bi-Log Antenna	SCHWARZBECK	VULB 9160	9160-3122	2 year	2016-04-02
Biconical Antenna	SCHWARZBECK	VHA9103	2502	2 year	2017-08-31
EMC Analyzer	H.P	E7403A	US39150108	1 year	2016.01.12
RF Amplifier	COM-POWER	PAM-118A	551019	1 year	2016-07-21
High Pass Filter	Wainwright	WHK3.0/18G-10SS	508	1 year	2015-09-29
Tunable Controller	AUDIX	ACT	N/A	N/A	N/A
Antenna Master	AUDIX	N/A	N/A	N/A	N/A
Loop Antenna	R&S	HEH2-Z2	881056/6	2 year	2017-01-06

※ Remark : Support equipment

Description	Manufacturer	Model	Serial number
-	-	-	-

3. Frequency Hopping System Requirements

3.1. Standard Applicable

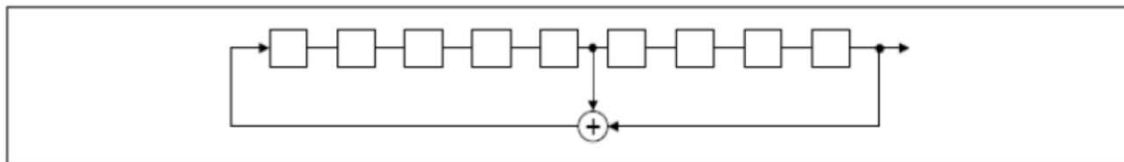
According to FCC Part 15.247(a)(1), The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

(g) Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this section should the transmitter be presented with a continuous data (or information) stream. In addition, a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its transmissions over the minimum number of hopping channels specified in this section.

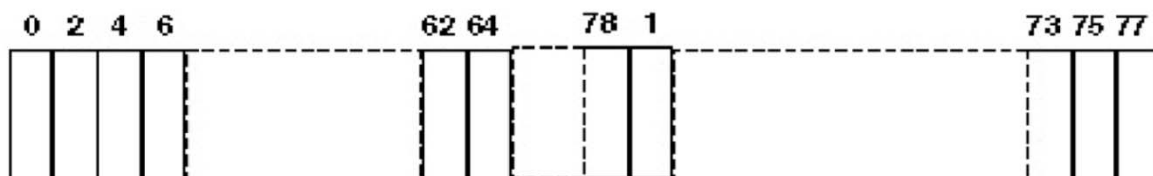
(h) The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hopsets to avoid hopping on occupied channels is permitted. The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

3.2. EUT Pseudorandom Frequency Hopping Sequence

The pseudorandom sequence may be generated in a nine-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage, and the result is fed back to the input of the first stage. The sequence begins with the first ONE of 9 consecutive ONES; i.e. the shift register is initialized with nine ones. Number of shift register stages: 9 Length of pseudo-random sequence: $2^9 - 1 = 511$ bits Longest sequence of zeros: 8 (non-inverted signal)



Linear Feedback Shift Register for Generation of the PRBS sequence



Each frequency used equally on the average by each transmitter. The system receiver have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shift frequencies in synchronization with the transmitted signals.

3.3. Frequency Hopping System

This transmitter device is frequency hopping device, and complies with FCC part 15.247 rule. This device uses Bluetooth radio which operates in 2400-2483.5 MHz band. Bluetooth uses a radio technology called frequency-hopping spread spectrum, which chops up the data being sent and transmits chunks of it on up to 79 bands (1 MHz each; centred from 2402 to 2480 MHz) in the range 2,400-2,483.5 MHz. The transmitter switches hop frequencies 1,600 times per second to assure a high degree of data security. All Bluetooth devices participating in a given piconet are synchronized to the frequency-hopping channel for the piconet. The frequency hopping sequence is determined by the master's device address and the phase of the hopping sequence (the frequency to hop at a specific time) is determined by the master's internal clock. Therefore, all slaves in a piconet must know the master's device address and must synchronize their clocks with the master's clock.

Adaptive Frequency Hopping (AFH) was introduced in the Bluetooth specification to provide an effective way for a Bluetooth radio to counteract normal interference. AFH identifies "bad" channels, where either other wireless devices are interfering with the Bluetooth signal or the Bluetooth signal is interfering with another device. The AFH-enabled Bluetooth device will then communicate with other devices within its piconet to share details of any identified bad channels. The devices will then switch to alternative available "good" channels, away from the areas of interference, thus having no impact on the bandwidth used.

*Example for a Bluetooth device using channel numbers would be :

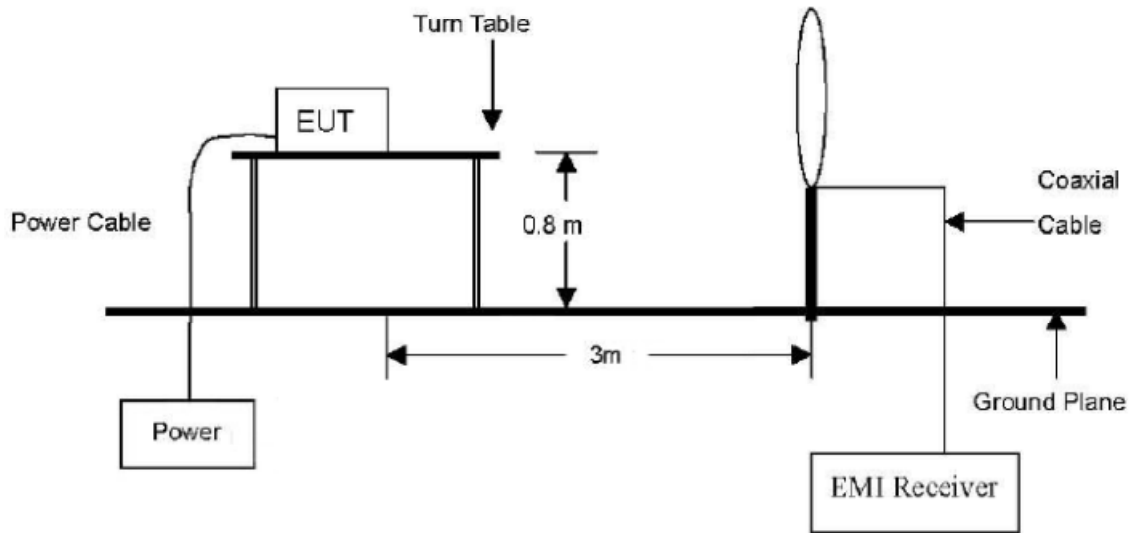
Ch 44, 35, 78, 03, 15, 21, 76, 40, 56, 13, 02, 19, 67, 39, 78, 20, 21, 64, 75 etc.

4. Transmitter radiated spurious emissions and conducted spurious emissions

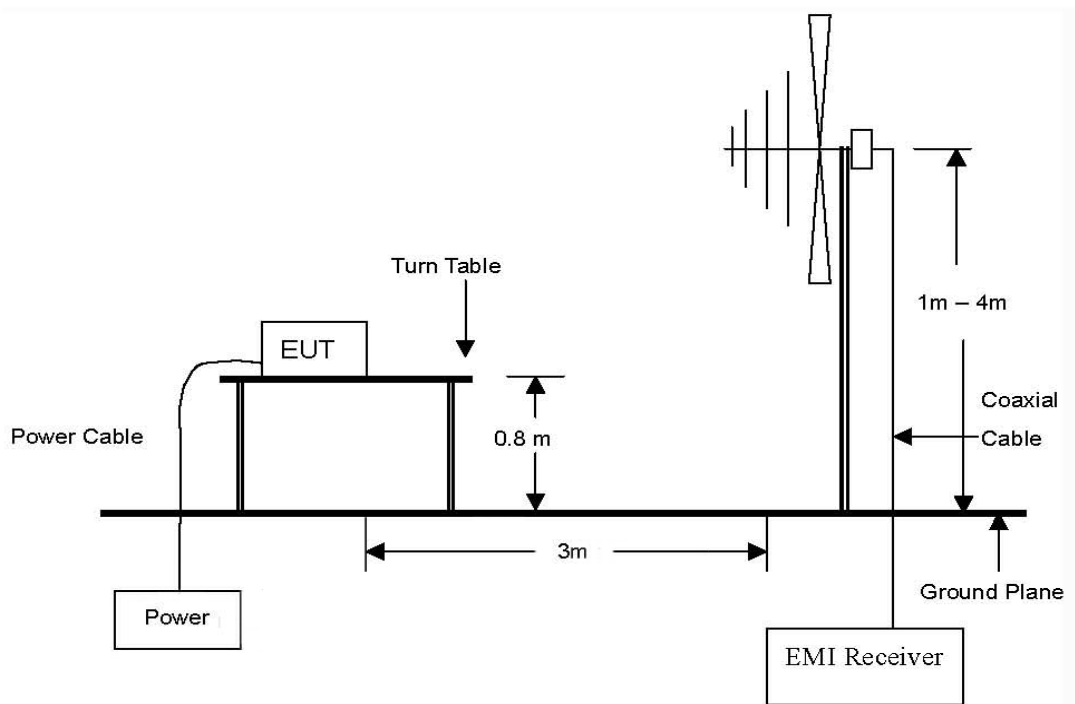
4.1. Test setup

4.1.1. Transmitter radiated spurious emissions

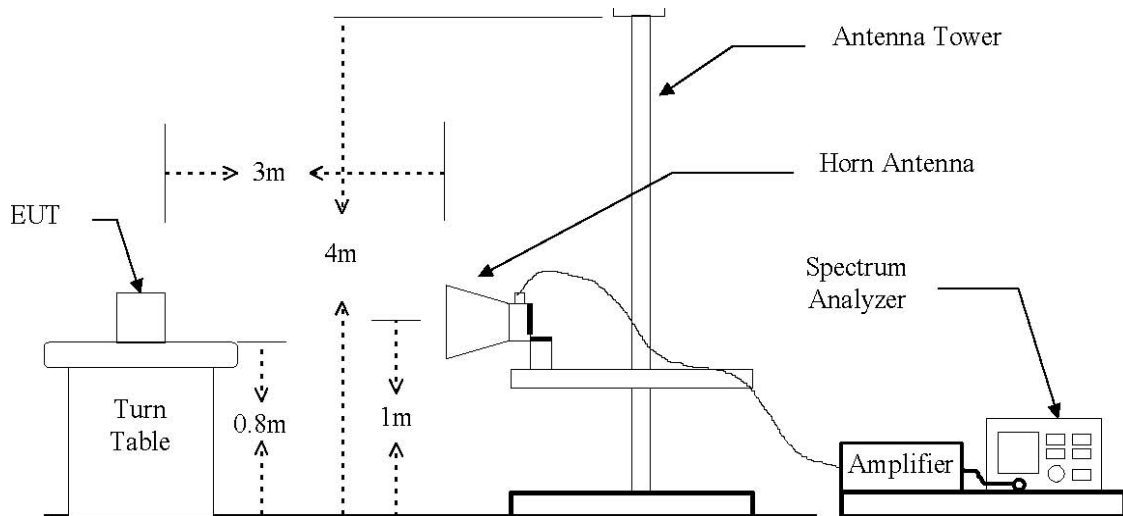
The diagram below shows the test setup that is utilized to make the measurements for emission from 9kHz to 30MHz Emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission from 30 MHz to 1 GHz emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission from 1 GHz to 26.5 GHz emissions.



4.2. Limit

According to §15.247(d), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph(b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in section §15.209(a) is not required. In addition, radiated emission which in the restricted band, as define in section §15.205(a), must also comply the radiated emission limits specified in section §15.209(a) (see section §15.205(c))

According to § 15.109(a), for an intentional radiator devices, the general required of field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values :

Frequency (MHz)	Distance (Meters)	Radiated at 3M (dB μ V/m)	Radiated (μ V/m)
0.009–0.490	300	See the remark	2400/F(kHz)
0.490–1.705	30		24000/F(kHz)
1.705–30.0	30		30
30 - 88	3	40.0	100
88 – 216	3	43.5	150
216 – 960	3	46.0	200
Above 960	3	54.0	500

*Remark

- Emission level in dB μ V/m = 20 log (μ V/m)
- Measurement was performed at an antenna to the closed point of EUT distance of meters.
- Distance extrapolation factor = 40log(Specific distance/ test distance) (dB)
Limit line=Specific limits(dB μ V) + distance extrapolation factor.

4.3. Test procedures

Radiated emissions from the EUT were measured according to the dictates of ANSI C63.4:2009. In case of the air temperature of the test site is out of the range is 10 to 40°C before the testing proceeds the warm-up time of EUT maintain adequately.

4.3.1. Test procedures for radiated spurious emissions

1. The EUT is placed on a turntable, which is 0.8 m above ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3 m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Repeat above procedures until the measurements for all frequencies are complete.

※ **Remark;**

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 10 kHz for Peak detection (PK) at frequency below 30 MHz.
2. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Peak detection (PK) or Quasi-peak detection (QP) at frequency below 1 GHz.
3. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1 MHz for Peak detection and frequency above 1 GHz.
4. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 10 Hz for Average detection (AV) at frequency above 1 GHz.

4.3.2. Test procedures for conducted spurious emissions

1. The transmitter output was connected to the spectrum analyzer through an attenuator.
2. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using RBW = 100 kHz, VBW = 100 kHz.

4.4. Test result

Ambient temperature: 23°C

Relative humidity: 45 % R.H.

4.4.1. Spurious radiated emission

The frequency spectrum from 9kHz to 30 MHz was investigated. Emission levels are not reported much lower than the limits by over 20 dB. All reading values are peak values.

To get a maximum emission levels from the EUT, the EUT was moved throughout the XY, XZ, and YZ planes.

Operation mode

A. Low channel (2 402 MHz)

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dBμV)	Detector mode	Pol.	Ant. factor (dB/m)	CL (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
No other emissions were detected at a level greater than 20dB below limit.								

B. Middle channel (2 441 MHz)

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dBμV)	Detector mode	Pol.	Ant. factor (dB/m)	CL (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
No other emissions were detected at a level greater than 20dB below limit.								

C. High channel (2 480 MHz)

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dBμV)	Detector mode	Pol.	Ant. factor (dB/m)	CL (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
No other emissions were detected at a level greater than 20dB below limit.								

※ Remark

1. Actual = Reading + Ant. factor + CL (Cable loss)
2. Distance extrapolation factor = 40 log (specific distance / test distance) (dB)
3. Limit line = specific Limits (dBuV) + Distance extrapolation factor
4. 15.31 Measurement standards.

The amplitude of spurious emissions from intentional radiators and emissions from unintentional radiators which are attenuated more than 20 dB below the permissible value need not be reported unless specifically required elsewhere in this part.

4.4.2. Spurious radiated emission

The frequency spectrum from 30 MHz to 1 000 MHz was investigated. Emission levels are not reported much lower than the limits by over 20 dB. All reading values are peak values.

To get a maximum emission levels from the EUT, the EUT was moved throughout the XY, XZ, and YZ planes.

Operation mode: Basic mode

A. Low channel (2 402 MHz)

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detector mode	Pol.	Ant. factor (dB/m)	CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
159.23	15.91	Peak	H	13.74	1.30	30.95	43.52	12.57
236.64	21.96	Peak	V	11.57	1.58	35.11	46.02	10.91
298.27	20.33	Peak	H	13.74	1.79	35.86	46.02	10.16
422.06	25.59	Peak	V	15.70	2.11	43.40	46.02	2.62
427.36	26.15	Peak	H	15.83	2.12	44.10	46.02	1.92
578.67	22.18	Peak	V	18.53	2.41	43.12	46.02	2.90
Above 600.00	Not Detected	-	-	-	-	-	-	-

※ **Remark**

1. Actual = Reading + Ant. factor + CL (Cable loss)
2. 15.31 Measurement standards.

The amplitude of spurious emissions from intentional radiators and emissions from unintentional radiators which are attenuated more than 20 dB below the permissible value need not be reported unless specifically required elsewhere in this part.

B. Middle channel (2 441 MHz)

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detector mode	Pol.	Ant. factor (dB/m)	CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
159.21	15.85	Peak	H	13.74	1.30	30.89	43.52	12.63
236.62	21.93	Peak	V	11.56	1.58	35.07	46.02	10.95
298.22	20.26	Peak	H	13.74	1.79	35.79	46.02	10.23
422.01	25.56	Peak	V	15.70	2.11	43.37	46.02	2.65
427.40	26.11	Peak	H	15.84	2.12	44.07	46.02	1.95
578.71	22.14	Peak	V	18.53	2.41	43.08	46.02	2.94
Above 600.00	Not Detected	-	-	-	-	-	-	-

C. High channel (2 480 MHz)

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detector mode	Pol.	Ant. factor (dB/m)	CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
159.22	15.89	Peak	H	13.74	1.30	30.93	43.52	12.59
236.63	21.92	Peak	V	11.57	1.58	35.07	46.02	10.95
298.25	20.31	Peak	H	13.74	1.79	35.84	46.02	10.18
422.04	25.53	Peak	V	15.70	2.11	43.34	46.02	2.68
427.34	26.17	Peak	H	15.83	2.12	44.12	46.02	1.90
578.64	22.21	Peak	V	18.53	2.41	43.15	46.02	2.87
Above 600.00	Not Detected	-	-	-	-	-	-	-

※ Remark

1. Actual = Reading + Ant. factor + CL (Cable loss)
2. 15.31 Measurement standards.

The amplitude of spurious emissions from intentional radiators and emissions from unintentional radiators which are attenuated more than 20 dB below the permissible value need not be reported unless specifically required elsewhere in this part.

Operation mode: EDR

A. Low channel (2 402 MHz)

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detector mode	Pol.	Ant. factor (dB/m)	CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
159.21	15.95	Peak	H	13.74	1.30	30.99	43.52	12.53
236.66	22.00	Peak	V	11.57	1.58	35.15	46.02	10.87
298.25	20.37	Peak	H	13.74	1.79	35.90	46.02	10.12
422.04	25.65	Peak	V	15.70	2.11	43.46	46.02	2.56
427.37	26.20	Peak	H	15.83	2.12	44.15	46.02	1.87
578.66	22.23	Peak	V	18.53	2.41	43.17	46.02	2.85
Above 600.00	Not Detected	-	-	-	-	-	-	-

B. Middle channel (2 441 MHz)

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detector mode	Pol.	Ant. factor (dB/m)	CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
159.33	16.01	Peak	H	13.74	1.30	31.05	43.52	12.47
236.70	22.02	Peak	V	11.57	1.58	35.17	46.02	10.85
298.35	20.35	Peak	H	13.74	1.79	35.88	46.02	10.14
422.16	25.41	Peak	V	15.70	2.11	43.22	46.02	2.80
427.45	26.03	Peak	H	15.84	2.12	43.99	46.02	2.03
578.66	22.13	Peak	V	18.53	2.41	43.07	46.02	2.95
Above 600.00	Not Detected	-	-	-	-	-	-	-

※ **Remark**

1. Actual = Reading + Ant. factor + CL (Cable loss)
2. 15.31 Measurement standards.

The amplitude of spurious emissions from intentional radiators and emissions from unintentional radiators which are attenuated more than 20 dB below the permissible value need not be reported unless specifically required elsewhere in this part.

C. High channel (2 480 MHz)

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dBμV)	Detector mode	Pol.	Ant. factor (dB/m)	CL (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
159.21	15.93	Peak	H	13.74	1.30	30.97	43.52	12.55
236.66	21.89	Peak	V	11.57	1.58	35.04	46.02	10.98
298.25	20.28	Peak	H	13.74	1.79	35.81	46.02	10.21
422.03	25.48	Peak	V	15.70	2.11	43.29	46.02	2.73
427.34	25.99	Peak	H	15.83	2.12	43.94	46.02	2.08
578.65	22.05	Peak	V	18.53	2.41	42.99	46.02	3.03
Above 600.00	Not Detected	-	-	-	-	-	-	-

※ Remark

1. Actual = Reading + Ant. factor + CL(Cable loss)

2. 15.31 Measurement standards.

The amplitude of spurious emissions from intentional radiators and emissions from unintentional radiators which are attenuated more than 20 dB below the permissible value need not be reported unless specifically required elsewhere in this part.

4.4.3. Spurious radiated emission

The frequency spectrum above 1 000 MHz was investigated. Emission levels are not reported much lower than the limits by over 20 dB.

To get a maximum emission levels from the EUT, the EUT was moved throughout the XY, XZ, and YZ planes.

Operation mode: Basic mode

A. Low channel (2 402 MHz)

Radiated emissions			Ant.	Correction factors			Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detector mode	Pol.	Ant. factor (dB/m)	Cable Loss (dB)	Amp Gain (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
1 049.57	52.04	Peak	H	25.39	3.13	40.09	40.47	74.00	33.53
1 049.57	54.27	Peak	V	25.46	3.13	40.09	42.77	74.00	31.23
4 096.43	47.72	Peak	V	29.31	6.15	41.63	41.55	74.00	32.45
4 618.93	48.20	Peak	H	30.39	6.50	41.53	43.56	74.00	30.44
Above 5 000.00	Not Detected	-	-	-			-	-	-

B. Middle channel (2 441 MHz)

Radiated emissions			Ant.	Correction factors			Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detector mode	Pol.	Ant. factor (dB/m)	Cable Loss (dB)	Amp Gain (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
1 049.57	51.91	Peak	H	25.39	3.13	40.09	40.34	74.00	33.66
1 049.57	54.13	Peak	V	25.39	3.13	40.09	42.56	74.00	31.44
1 198.38	48.27	Peak	V	25.46	3.32	40.10	36.95	74.00	37.05
4 882.74	47.69	Peak	H	30.86	6.76	41.25	44.06	74.00	29.94
Above 5 000.00	Not Detected	-	-	-			-	-	-

※ Remark

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental Frequency.
2. Radiated emissions measured in frequency above 1 000 MHz were made with an instrument using peak/average detector mode.
3. Average test would be performed if the peak result were greater than the average limit.
4. Actual = Reading + Ant. factor - Amp + CL (Cable loss)
5. 15.31 Measurement standards.

THE AMPLITUDE OF SPURIOUS EMISSIONS FROM INTENTIONAL RADIATORS AND EMISSIONS FROM UNINTENTIONAL RADIATORS WHICH ARE ATTENUATED MORE THAN 20 DB BELOW THE PERMISSIBLE VALUE NEED NOT BE REPORTED UNLESS SPECIFICALLY REQUIRED ELSEWHERE IN THIS PART.

C. High channel (2 480 MHz)

Radiated emissions			Ant.	Correction factors			Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detector mode	Pol.	Ant. factor (dB/m)	Cable Loss (dB)	Amp Gain (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
1 049.57	54.54	Peak	V	25.39	3.13	40.09	42.97	74.00	31.03
1 078.16	49.54	Peak	H	25.41	3.17	40.09	38.03	74.00	35.97
4 643.82	48.48	Peak	V	30.44	6.52	41.50	43.94	74.00	30.06
4 962.12	50.67	Peak	H	31.00	6.83	41.15	47.35	74.00	26.65
Above 5 000.00	Not Detected	-	-	-			-	-	-

※ **Remark**

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental Frequency.
2. Radiated emissions measured in frequency above 1 000 MHz were made with an instrument using peak/average detector mode.
3. Average test would be performed if the peak result were greater than the average limit.
4. Actual = Reading + Ant. factor - Amp + CL (Cable loss)
5. 15.31 Measurement standards.

THE AMPLITUDE OF SPURIOUS EMISSIONS FROM INTENTIONAL RADIATORS AND EMISSIONS FROM UNINTENTIONAL RADIATORS WHICH ARE ATTENUATED MORE THAN 20 DB BELOW THE PERMISSIBLE VALUE NEED NOT BE REPORTED UNLESS SPECIFICALLY REQUIRED ELSEWHERE IN THIS PART.

Operation mode: EDR

A. Low channel (2 402 MHz)

Radiated emissions			Ant.	Correction factors			Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detector mode	Pol.	Ant. factor (dB/m)	Cable Loss (dB)	Amp Gain (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
1 049.57	54.09	Peak	V	25.39	3.13	40.09	42.52	74.00	31.48
1 164.51	48.63	Peak	H	25.45	3.27	40.10	37.25	74.00	36.75
4 804.64	47.09	Peak	H	30.72	6.68	41.33	43.16	74.00	30.84
-	-	-	-	-	-	-	-	-	-
Above 5 000.00	Not Detected	-	-	-	-	-	-	-	-

B. Middle channel (2 441 MHz)

Radiated emissions			Ant.	Correction factors			Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detector mode	Pol.	Ant. factor (dB/m)	Cable Loss (dB)	Amp Gain (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
1 049.57	51.66	Peak	H	25.39	3.13	40.09	40.09	74.00	33.91
1 049.57	54.29	Peak	V	25.39	3.13	42.72	40.09	74.00	33.91
4 140.70	48.04	Peak	V	29.41	6.18	41.63	42.00	74.00	32.00
4 891.50	51.49	Peak	H	30.87	6.76	41.24	47.88	74.00	26.12
Above 5 000.00	Not Detected	-	-	-	-	-	-	-	-

※ Remark

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental Frequency.
2. Radiated emissions measured in frequency above 1 000 MHz were made with an instrument using peak/average detector mode.
3. Average test would be performed if the peak result were greater than the average limit.
4. Actual = Reading + Ant. factor - Amp + CL (Cable loss)
5. 15.31 Measurement standards.

The amplitude of spurious emissions from intentional radiators and emissions from unintentional radiators which are attenuated more than 20 dB below the permissible value need not be reported unless specifically required elsewhere in this part.

C. High channel (2 480 MHz)

Radiated emissions			Ant.	Correction factors			Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detector mode	Pol.	Ant. factor (dB/m)	Cable Loss (dB)	Amp Gain (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
1 049.57	53.55	Peak	V	25.39	3.13	40.09	41.98	74.00	32.02
1 049.57	51.34	Peak	H	25.39	3.13	40.09	39.77	74.00	34.23
3 498.87	47.73	Peak	V	28.49	5.67	41.48	40.41	74.00	33.59
4 512.58	47.53	Peak	V	30.19	6.39	41.65	42.46	74.00	31.54
Above 5 000.00	Not Detected	-	-	-			-	-	-

※ Remark

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental Frequency.
2. Radiated emissions measured in frequency above 1 000 MHz were made with an instrument using peak/average detector mode.
3. Average test would be performed if the peak result were greater than the average limit.
4. Actual = Reading + Ant. factor - Amp + CL (Cable loss)
5. 15.31 Measurement standards.

THE AMPLITUDE OF SPURIOUS EMISSIONS FROM INTENTIONAL RADIATORS AND EMISSIONS FROM UNINTENTIONAL RADIATORS WHICH ARE ATTENUATED MORE THAN 20 DB BELOW THE PERMISSIBLE VALUE NEED NOT BE REPORTED UNLESS SPECIFICALLY REQUIRED ELSEWHERE IN THIS PART.

4.4.4. Band Edge

Operation mode: Basic mode

A. 2 310 - 2 390 MHz measurement

Radiated emissions			Ant.	Correction factors			Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detector mode	Pol.	Ant. factor (dB/m)	Cable Loss (dB)	Amp Gain (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
2 389.64	47.78	Peak	H	26.74	4.61	41.03	38.10	74.00	35.90
2 336.78	47.80	Peak	V	26.67	4.58	40.96	38.09	74.00	35.91
2 389.16	36.55	Average	H	26.74	4.61	41.03	26.87	54.00	27.13
2 389.06	34.88	Average	V	26.74	4.61	41.03	25.20	54.00	28.80

B. 2 483.5 – 2 500 MHz measurement

Radiated emissions			Ant.	Correction factors			Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detector mode	Pol.	Ant. factor (dB/m)	Cable Loss (dB)	Amp Gain (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
2 483.50	60.47	Peak	H	26.86	4.66	41.20	50.79	74.00	23.21
2 483.50	52.46	Peak	V	26.86	4.66	41.20	42.78	74.00	31.22
2 483.50	55.59	Average	H	26.86	4.66	41.20	45.91	54.00	8.09
2 483.50	48.38	Average	V	26.86	4.66	41.20	38.70	54.00	15.30

Operation mode: EDR

A. 2 310 - 2 390 MHz measurement

Radiated emissions			Ant.	Correction factors			Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detector mode	Pol.	Ant. factor (dB/m)	Cable Loss (dB)	Amp Gain (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
2 389.35	48.05	Peak	H	26.74	4.61	41.03	38.37	74.00	35.63
2 388.00	47.74	Peak	V	26.74	4.61	41.03	38.06	74.00	35.94
2 389.35	37.85	Average	H	26.74	4.61	41.03	28.17	54.00	25.83
2 389.45	35.14	Average	V	26.74	4.61	41.03	25.46	54.00	28.54

B. 2 483.5 – 2 500 MHz measurement

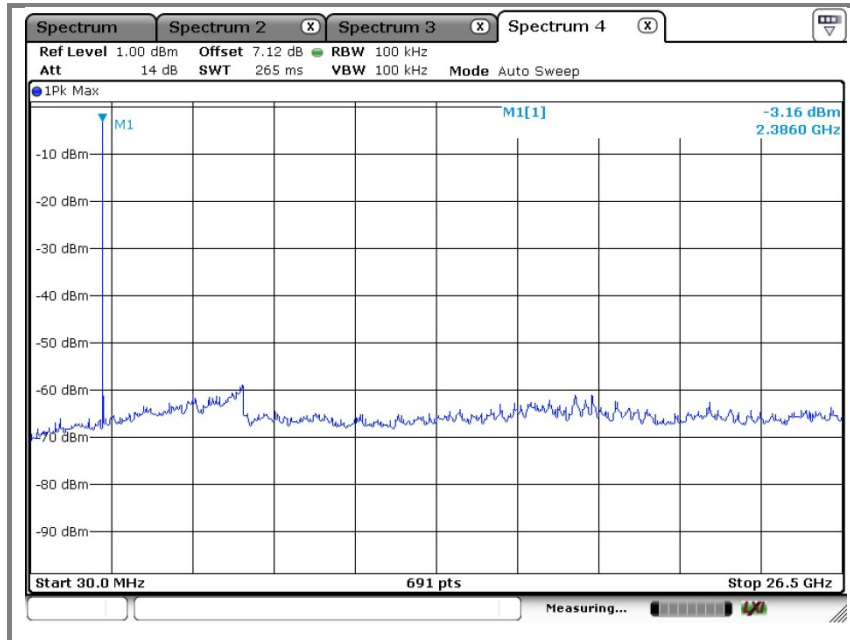
Radiated emissions			Ant.	Correction factors			Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detector mode	Pol.	Ant. factor (dB/m)	Cable Loss (dB)	Amp Gain (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
2 483.50	59.48	Peak	H	26.86	4.66	41.20	49.80	74.00	24.20
2 483.50	51.78	Peak	V	26.86	4.66	41.20	42.10	74.00	31.90
2 483.50	53.58	Average	H	26.86	4.66	41.20	43.90	54.00	10.10
2 483.50	46.02	Average	V	26.86	4.66	41.20	36.34	54.00	17.66

4.4.5. Spurious RF conducted emissions: Plot of spurious RF conducted emission

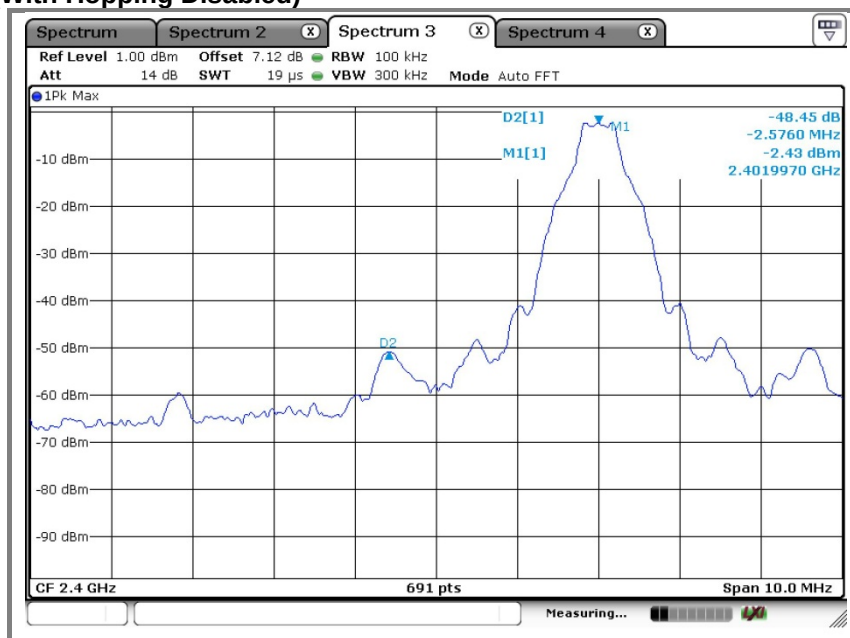
Operation mode: Basic mode

A. Low channel (2 402 MHz)

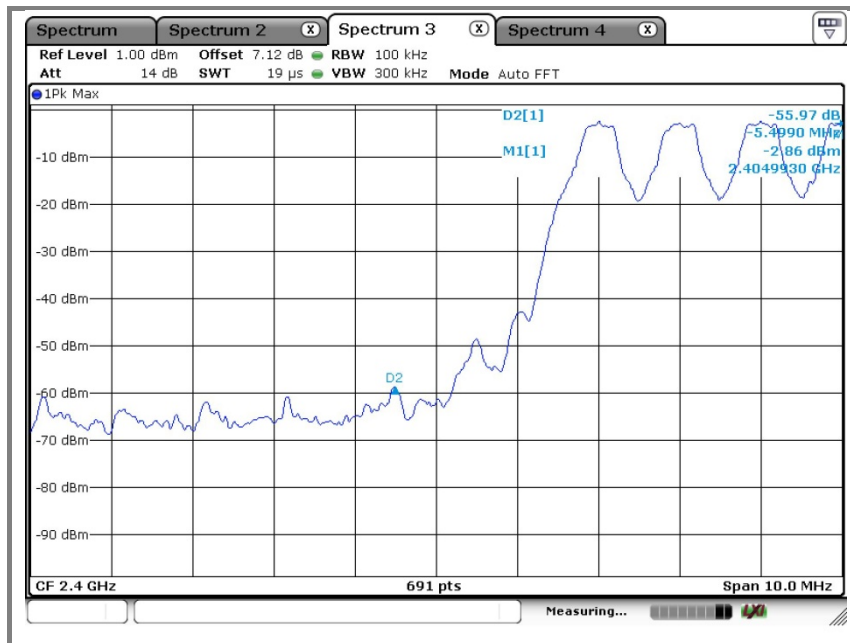
Unwanted Emission data



Band-edge data (With Hopping Disabled)

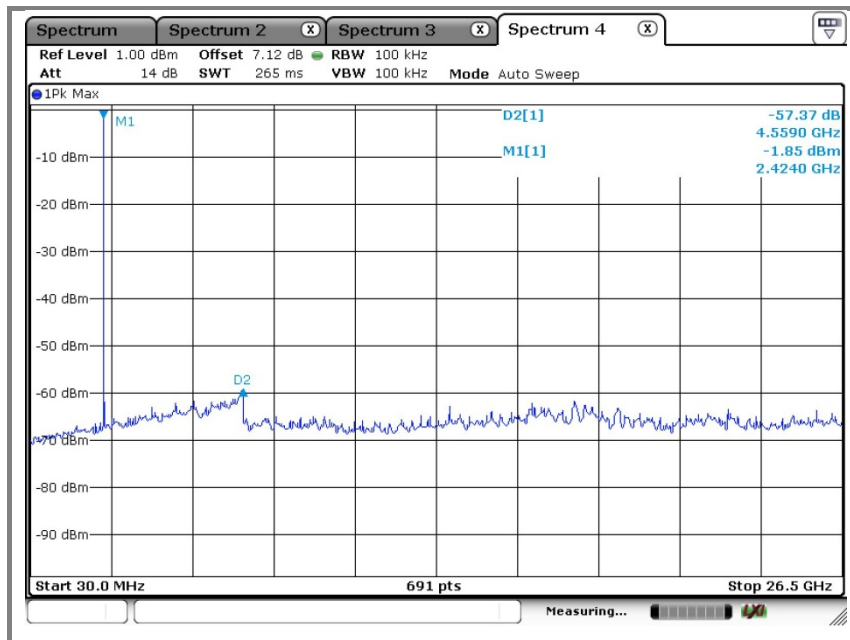


Band-edge data (With Hopping Enabled)



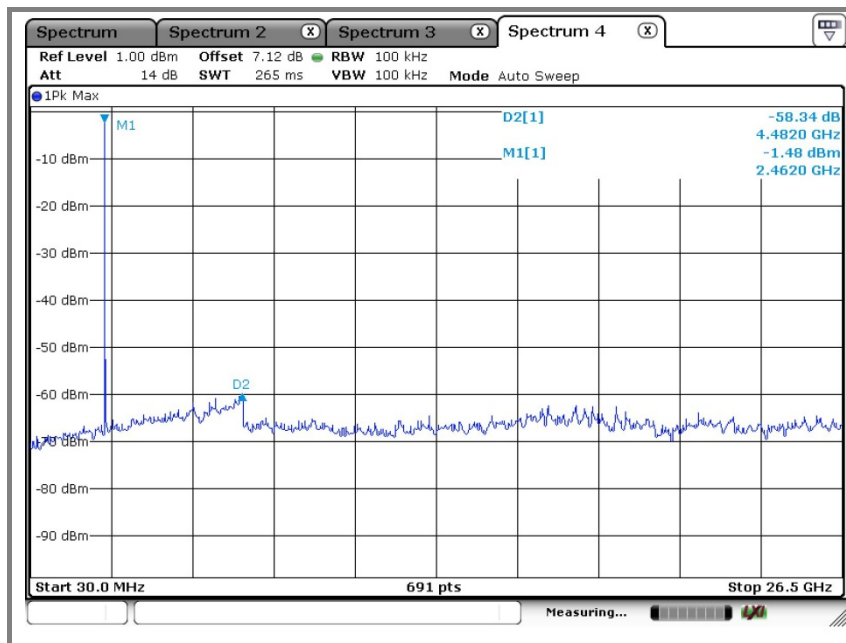
B. Middle channel (2 441 MHz)

Unwanted Emission data

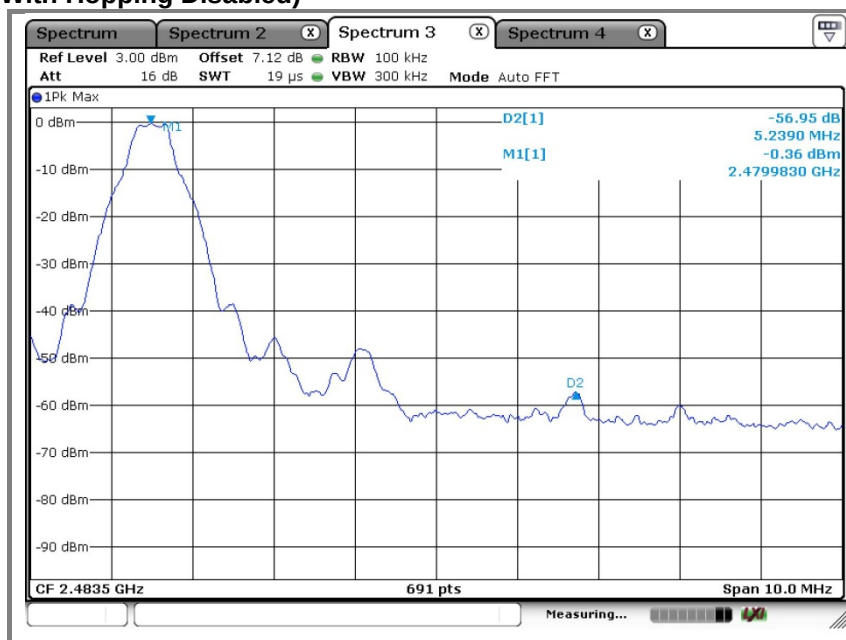


C. High channel (2 480 MHz)

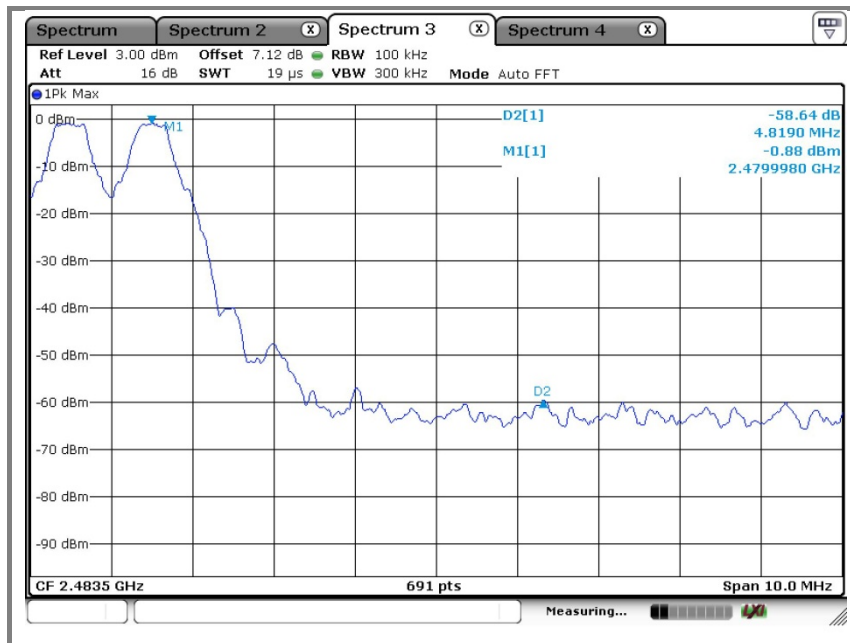
Unwanted Emission data



Band-edge data (With Hopping Disabled)

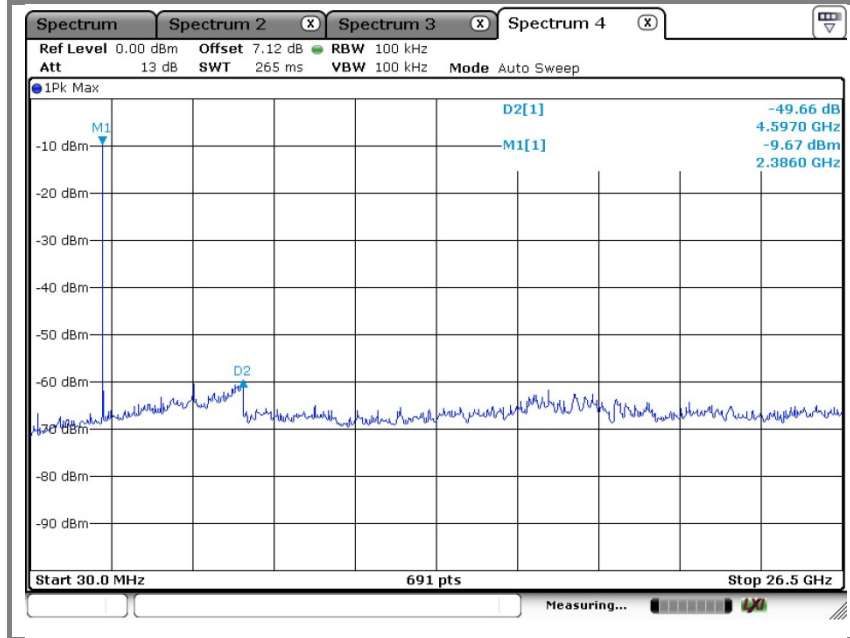


Unwanted Emission data (With Hopping Enabled)

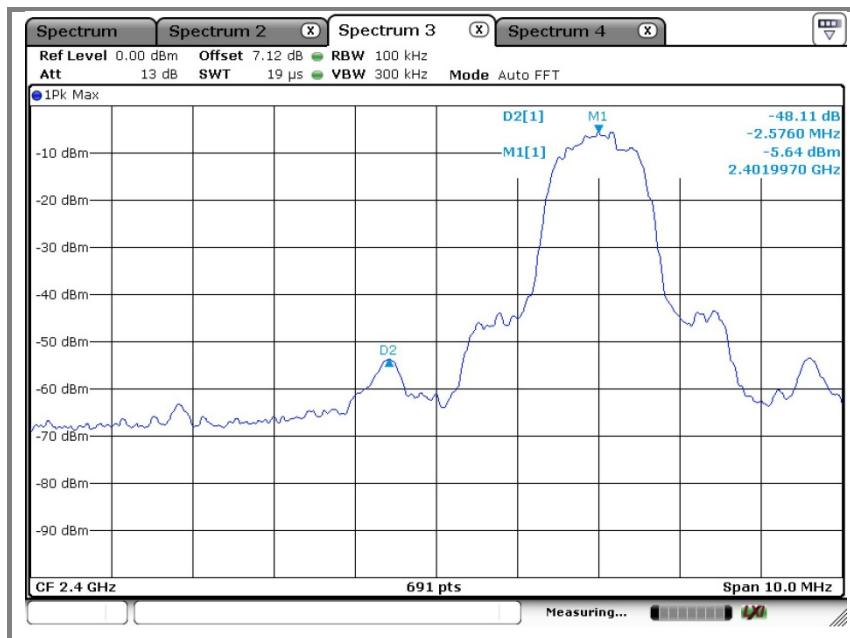


Operation mode:EDR

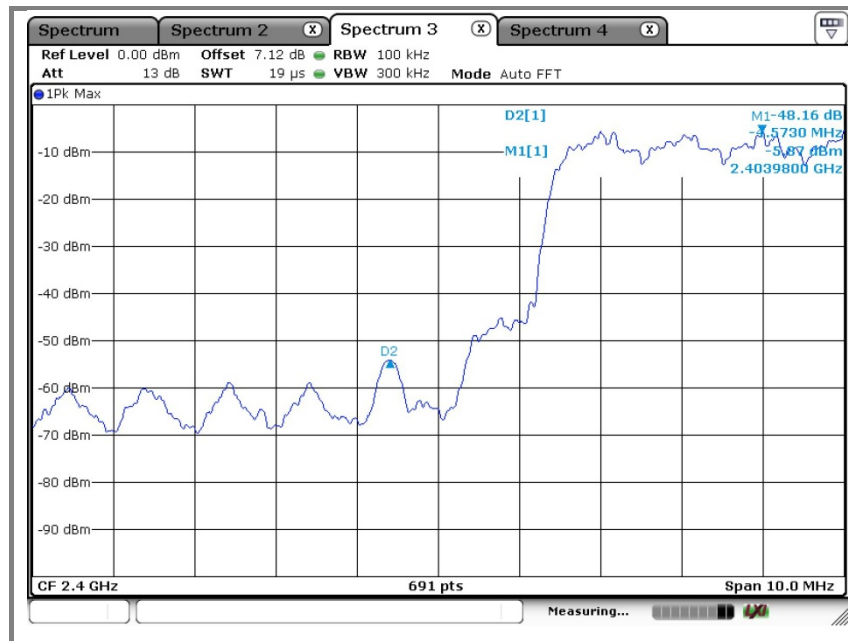
A. Low channel (2 402 MHz) Unwanted Emission data



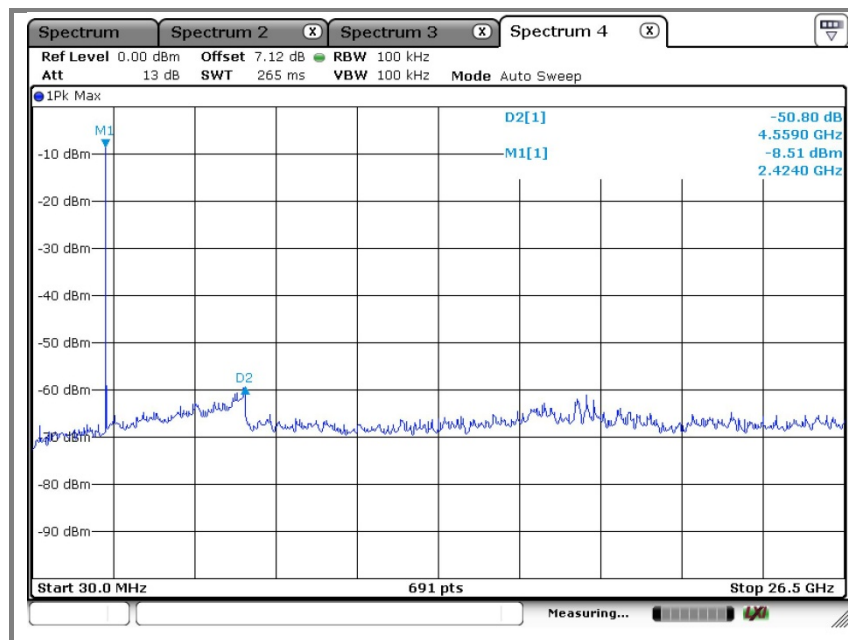
Band-edge data (With Hopping Disabled)



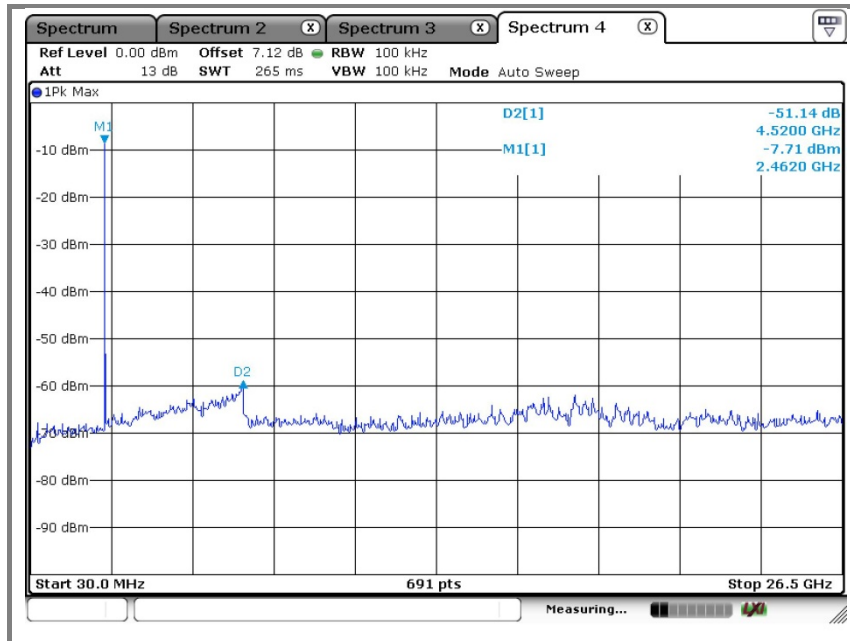
Band-edge data (With Hopping Enabled)



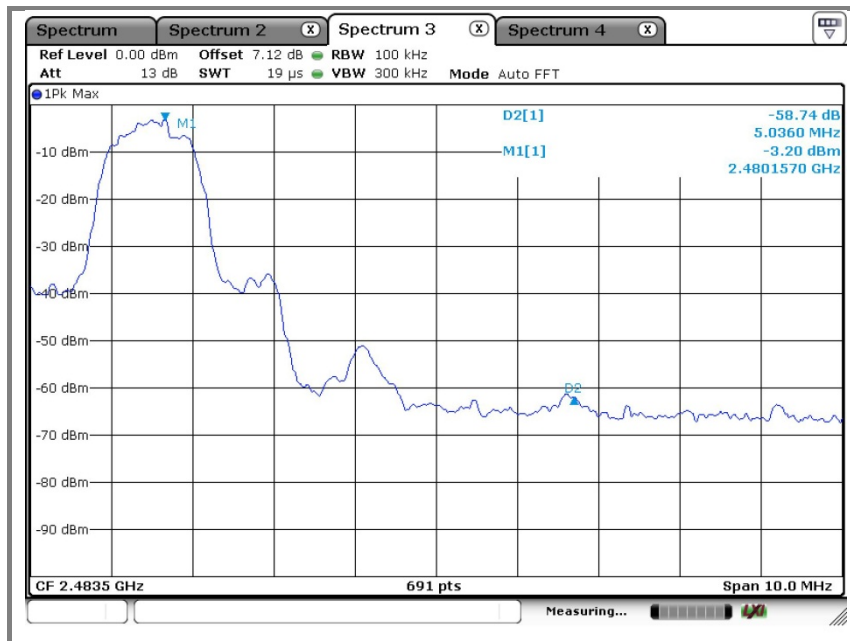
B. Middle channel (2 441 MHz) Unwanted Emission data



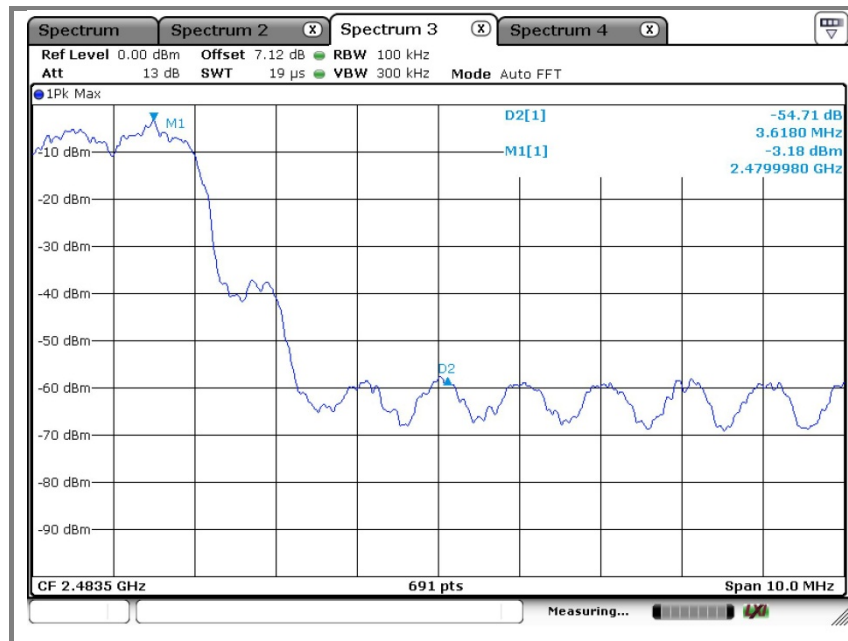
C. High channel (2 480 MHz) Unwanted Emission data



Band-edge data (With Hopping Disabled)

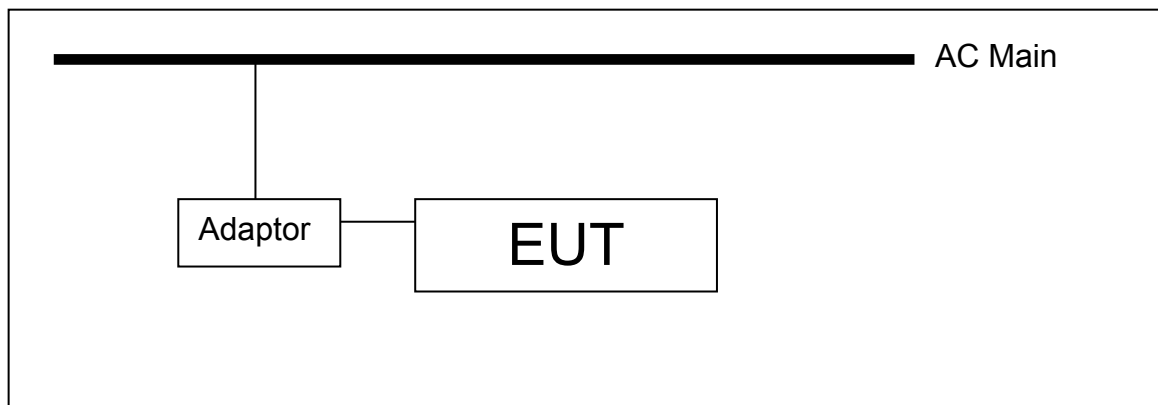


Unwanted Emission data (With Hopping Enabled)



5. Conducted power line test

5.1. Test setup



5.2. Limit

According to §15.107(a) for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 uH/ 50 ohm line impedance stabilization network (LISN). Compliance with the provision of this paragraph shall on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower applies at the boundary between the frequencies ranges.

Frequency of Emission (MHz)	Conducted limit (dBμV/m)	
	Quasi-peak	Average
0.15 – 0.50	66 - 56*	56 - 46*
0.50 – 5.00	56	46
5.00 – 30.0	60	50

※ Remark

Decreases with the logarithm of the frequency.

5.3. Test procedures

The test procedure is performed in a 6.5 m × 3.6 m × 3.6 m (L × W × H) shielded room. The EUT along with its peripherals were placed on a 1.0 m(W) × 1.5 m(L) and 0.8 m in height wooden table and the EUT was adjusted to maintain a 0.4 meter space from a vertical reference plane.

The EUT was connected to power mains through a line impedance stabilization network (LISN) which provides 50 ohm coupling impedance for measuring instrument and the chassis ground was bounded to the horizontal ground plane of shielded room. All peripherals were connected to the second LISN and the chassis ground also bounded to the horizontal ground plane of shielded room. The excess power cable between the EUT and the LISN was bundled. The power cables of peripherals were unbundled. All connecting cables of EUT and peripherals were moved to find the maximum emission.

5.4. Test results

Ambient temperature: 23 °C

Relative humidity: 45 % R.H.

Frequency range: 0.15 MHz ~ 30 MHz

Measured bandwidth: 9 kHz

Freq. (MHz)	Line	Q-Peak		
		Level(dB μ V/m)	Limit(dB μ V/m)	Margin(dB)
0.198	H	35.35	79.00	43.65
6.288	H	32.90	73.00	40.10
7.292	H	33.62	73.00	39.38
7.696	H	54.70	73.00	18.30
16.308	H	37.47	73.00	35.53
23.332	H	27.38	73.00	45.62

Freq. (MHz)	Line	Q-Peak		
		Level(dB μ V/m)	Limit(dB μ V/m)	Margin(dB)
0.166	N	35.00	79.00	44.00
4.622	N	23.32	73.00	49.68
80.56	N	25.05	73.00	47.95
16.620	N	32.30	73.00	40.70
18.812	N	19.58	73.00	53.42
27.540	N	18.38	73.00	54.62

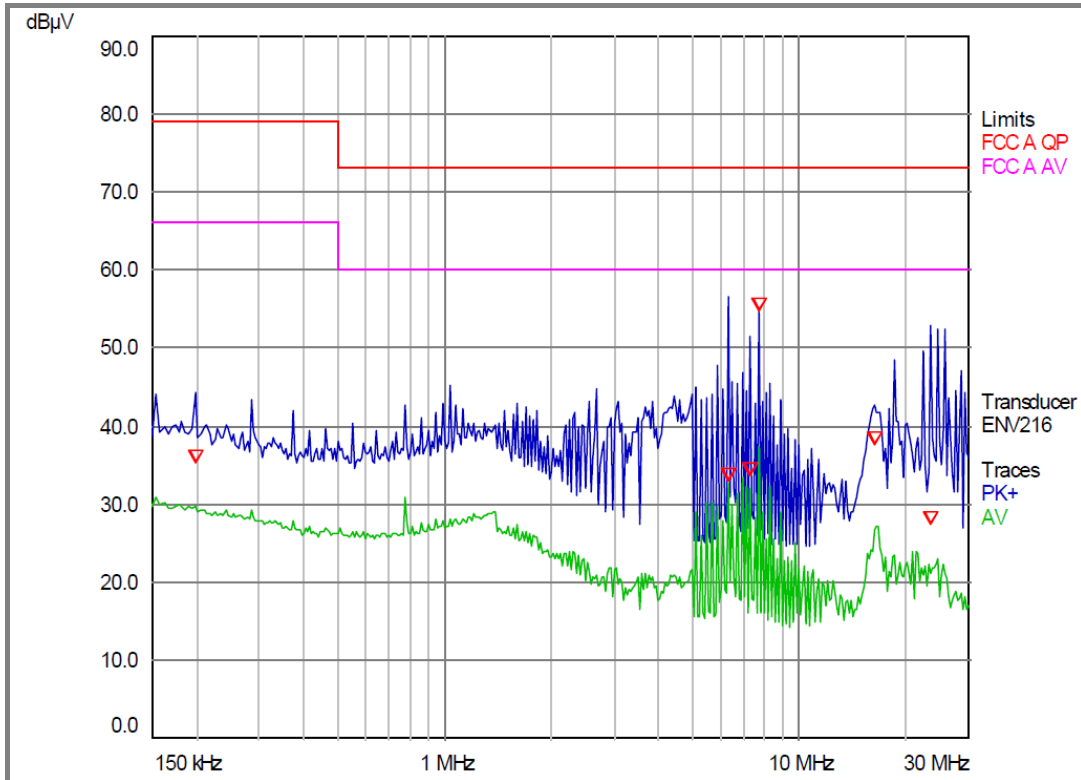
※ Remark

Line(H): Hot

Line(N): Neutral

Plot of conducted power line

Test mode: Hot



Test mode: Neutral

