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

Test Report No.	**: W159R-D017**
AGR No.	**: A157A-337**
Applicant	**: Smart Power Solutions Inc.**
Address	**: 1FL, Venture Town Janyoungsilkwan 1688-5, Sinil-do, Daeduck-gu, Daejeon, 306-203, South Korea**
Manufacturer	**: Smart Power Solutions Inc.**
Address	**: 1FL, Venture Town Janyoungsilkwan 1688-5, Sinil-do, Daeduck-gu, Daejeon, 306-203, South Korea**
Type of Equipment	**: UHF RFID Reader Dongle**
FCC ID.	**: UQBASR-03XD**
Model Name	**: ASR-030D**
Serial number	**: N/A**
Total page of Report	**: 44 pages (including this page)**
Date of Incoming	**: August 20, 2015**
Date of issue	**: September 11, 2015**

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: Ki-Hong, Nam / Asst, Chief Engineer
ONETECH Corp.

Approved by: Sung-Ik, Han/ Managing Director
ONETECH Corp.

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EMC Testing Div : 307-51 Daessangnyeong-ri, Chowol-eup, Gwangju-si, Gyeonggi-do 464-862 Korea (TEL: 82-31-765-8289, FAX: 82-31-766-2904)

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Revision History

Issued Report No.	Issued Date	Revisions	Effect Section
W159R-D017	September 11, 2015	Initial Issue	All

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1. VERIFICATION OF COMPLIANCE

APPLICANT : Smart Power Solutions Inc.
ADDRESS : 1FL, Venture Town Janyoungsilkwan 1688-5, Sinil-do, Daeduck-gu, Daejeon, 306-203, South Korea
CONTACT PERSON : Sang-Min, Kim / Manager
TELEPHONE NO : +82-42-936-4905
FCC ID : UQBASR-03XD
MODEL NAME : ASR-030D
BRAND NAME : -
SERIAL NUMBER : N/A
DATE : September 11, 2015

EQUIPMENT CLASS	**DSS – PART 15 SPREAD SPECTRUM TRANSMITTER**
KIND OF EQUIPMENT	UHF RFID Reader Dongle
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) (i)	Minimum Number of Hopping Channels	Met the Limit / PASS
15.247 (a) (1) (i)	Average Time of Occupancy	Met the Limit / PASS
15.247 (b) (2)	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	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.

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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 301-14, Daessangnyeong-ri, Chowol-eup, Gwangju-si, Gyeonggi-do, 464-862 Korea.

-. Site Filing:

VCCI (Voluntary Control Council for Interference) – Registration No. R-4112/ C-4617/ G-666/ T-1842 IC (Industry Canada) – Registration No. Site# 3736-3

-. Site Accreditation:

KOLAS (Korea Laboratory Accreditation Scheme) - Accreditation No. 85

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 Smart Power Solutions Inc., Model ASR-030D (referred to as the EUT in this report) is a UHF RFID Reader Dongle. The product specification described herein was obtained from product data sheet or user's manual.

DEVICE TYPE	RFID Reader
OPERATING FREQUENCY	917.1 MHz ~ 926.9 MHz
RF OUTPUT POWER	25.12 dBm (0.325 W)
NUMBER OF CHANNEL	50 Channels
MODULATION TYPE	ASK
ANTENNA TYPE	Patch Antenna
ANTENNA GAIN	1.10 dBi
LIST OF EACH OSC. OR CRYSTAL. FREQ.(FREQ.>=1 MHz)	19.20 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	Smart Power Solutions Inc.	AD52-RR1LT1N-P1-A201	N/A
BATTERY	N/A	N/A	N/A
Antenna Board	SANGSHIN ELECOM CO., LTD	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
ASR-030D	Smart Power Solutions Inc.	UHF RFID Reader Dongle (EUT)	Notebook PC
LGR501	LG	Notebook PC	EUT
N/A	Smart Power Solutions Inc.	JIG	EUT
A1421	Apple	IPOD	EUT

5.3 Mode of operation during the test

-. EUT does not transmitting mode during charging

-. Charg mode : The magccon connector on the EUT was connected to the Jig and then the EUT was operated with charging continuously during the testing.

-. For the testing, software used to control the EUT for staying in continuous transmitting mode is programmed.
For final testing, RFID Reader Dongle was set at Low Channel (917.1 MHz), Middle Channel (921.9 MHz), and High Channel (926.9 MHz).

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5.4 Configuration of Test System

Line Conducted Test: The EUT was tested in a charging mode. The EUT was connected to Jig and the power of Jig USB was connected to Notebook PC. All supporting equipments 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: 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 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

According to the rule, FCC Part 15C Section 15.203 the transmitter antenna shall be integral with the device, or the antenna coupling be so designed that no antenna other than that furnished by the party responsible for compliance shall be used.

Antenna Construction:

The transmitter antenna port of the EUT is a Patch Antenna connector type has counter clock wise type.

6. PRELIMINARY TEST

6.1 AC Power line Conducted Emissions Tests

During Preliminary Tests, the following operating mode was investigated

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

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 Mode	-
Transmitting Mode	X

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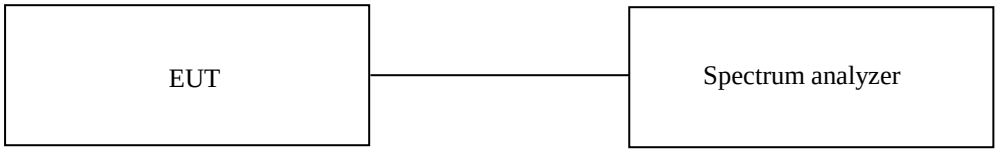
7. MINIMUM 20 dB BANDWIDTH

7.1 Operating environment

Temperature	:	22.9 ℃
Relative humidity	:	50.1 % 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.
■ -	FSV40	Rohde & Schwarz	Signal Analyzer	101009	Jul. 22, 2015 (1Y)

All test equipment used is calibrated on a regular basis.

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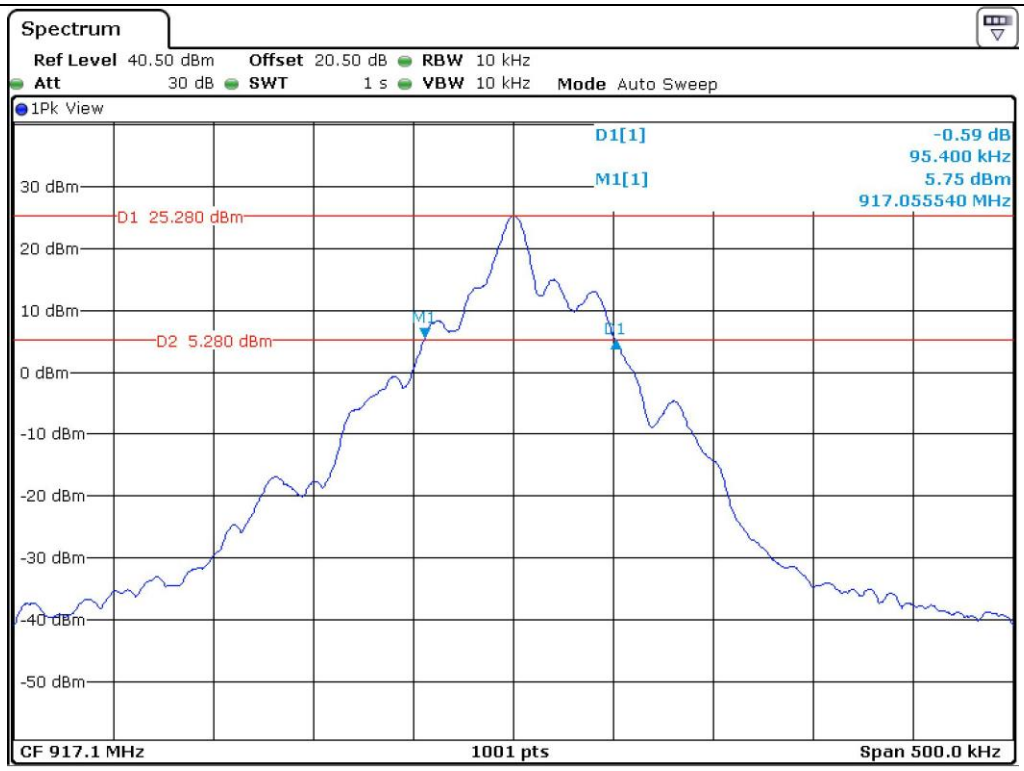
7.4 Test data

-. Test Date : August 27, 2015

CHANNEL	FREQUENCY (MHz)	20 dB Bandwidth (kHz)	Limits(kHz)
Low	917.10	95.40	250
Middle	921.90	95.40	
High	926.90	101.40	

Tested by: Tae-Ho, Kim / Project Engineer



Low Channel

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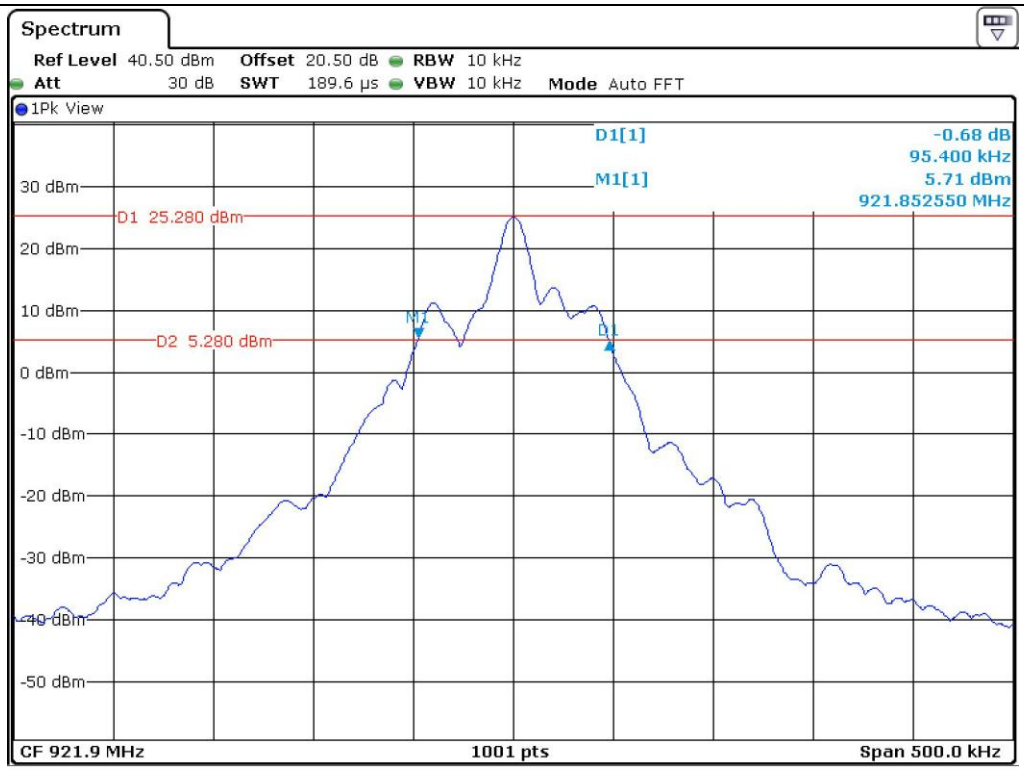
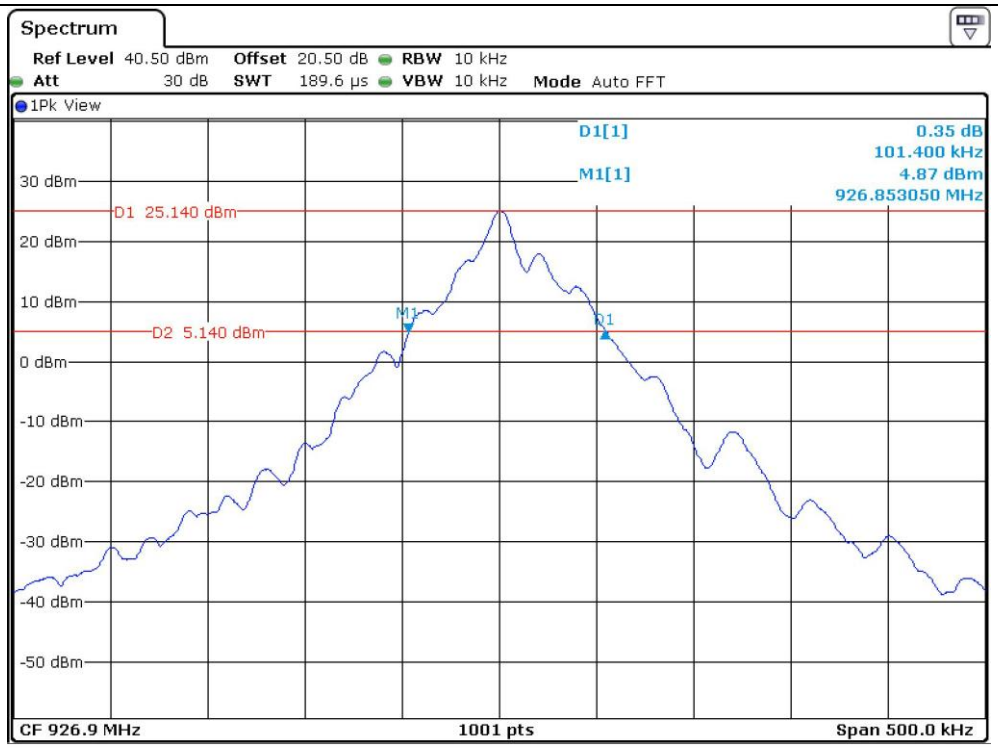


Middle Channel



High Channel

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8. HOPPING FREQUENCY SEPARATION

8.1 Operating environment

Temperature : 22.9 ℃

Relative humidity : 50.1 % 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 10 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.
■ -	FSV40	Rohde & Schwarz	Signal Analyzer	101009	Jul. 22, 2015 (1Y)

All test equipment used is calibrated on a regular basis.

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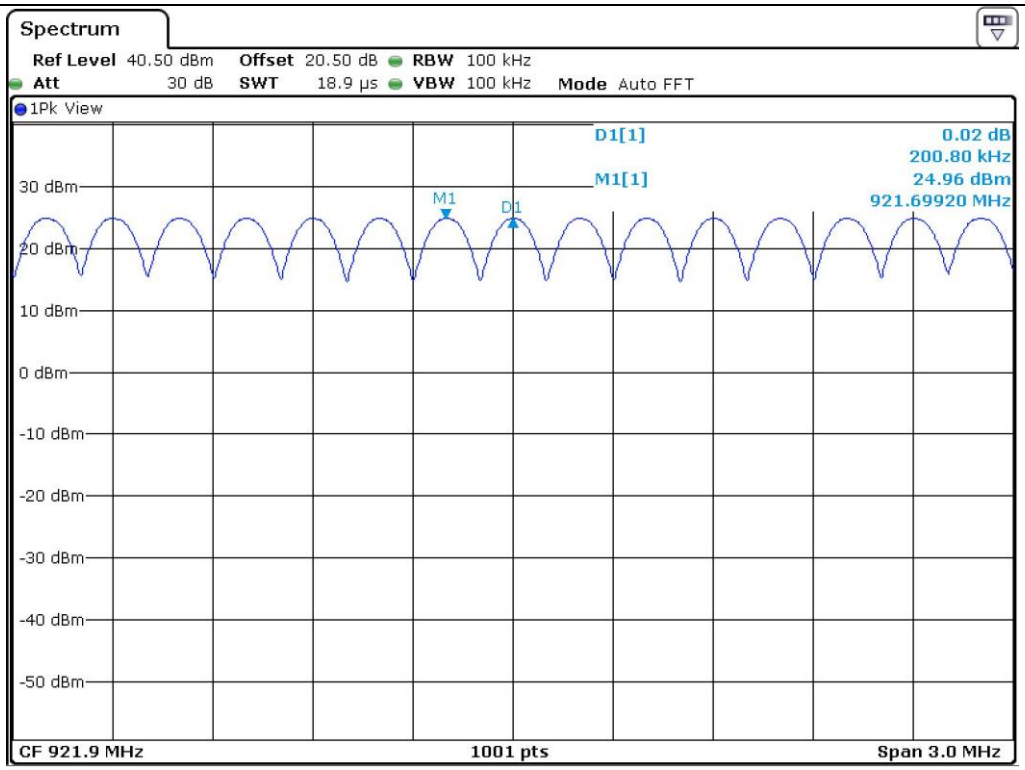
8.4 Test data

-. Test Date : August 27, 2015

-. Test Result : Pass

Frequency (MHz)	Measured Value (kHz)	LIMIT
921.90	200.8	Minimum of 25 kHz or the 20 dB Bandwidth

Tested by: Tae-Ho, Kim / Project Engineer



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9. NUMBER OF HOPPING CHANNELS

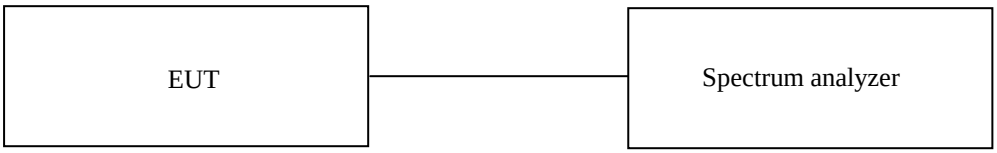
9.1 Operating environment

Temperature : 22.9 ℃

Relative humidity : 50.1 % R.H.

9.2 Test set-up

The antenna output of the EUT was connected to the spectrum analyzer. 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.
■ -	FSV40	Rohde & Schwarz	Signal Analyzer	101009	Jul. 22, 2015 (1Y)

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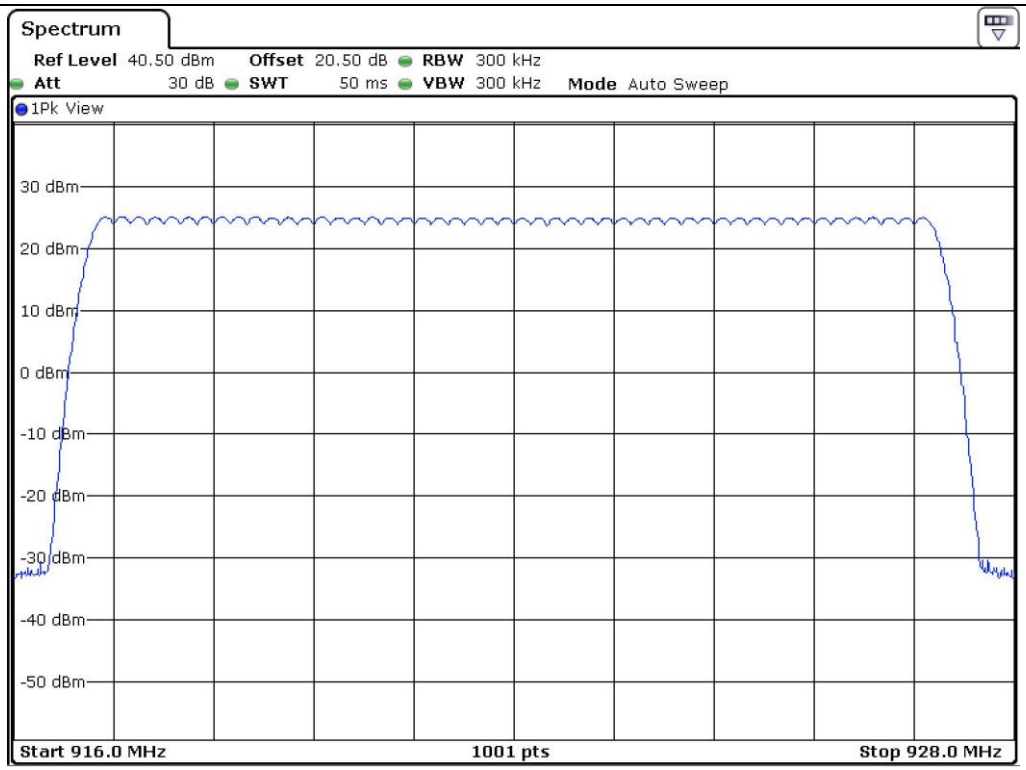
9.4 Test data

-. Test Date : August 27, 2015

-. Test Result : Pass

Frequency Range (MHz)	Measured value (Number)	20 dB Bandwidth (kHz)	Limit
917.1 ~ 926.9	50	< 250	≥ 50

Tested by: Tae-Ho, Kim / Project Engineer



Total number of hopping channel: 50

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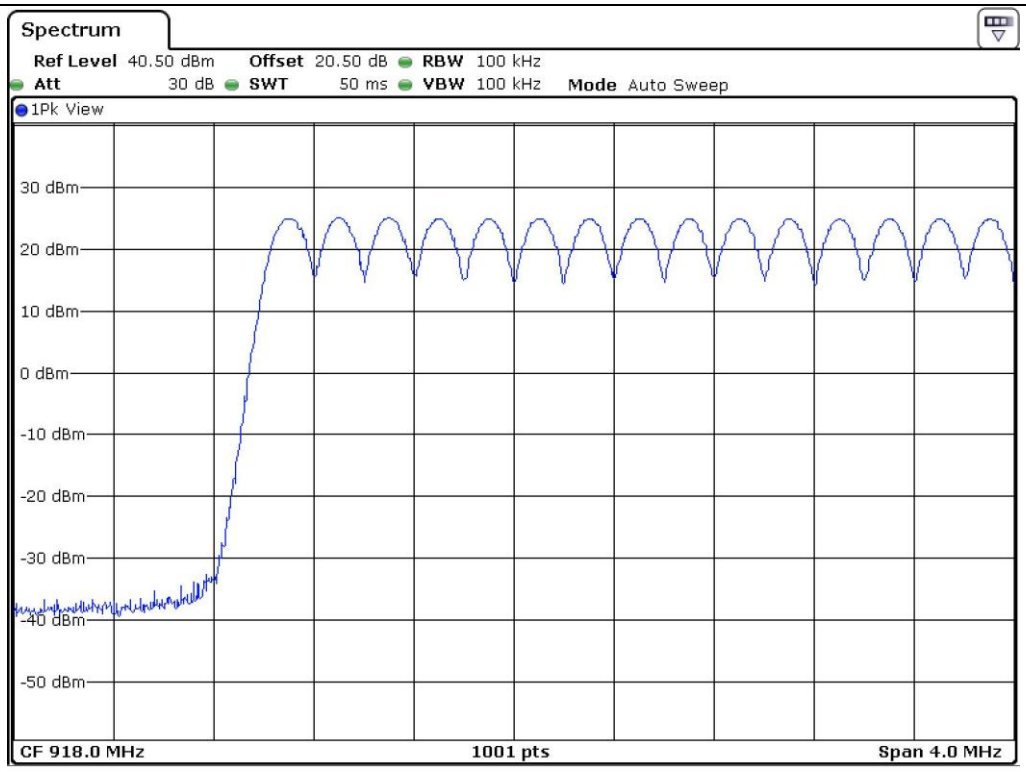
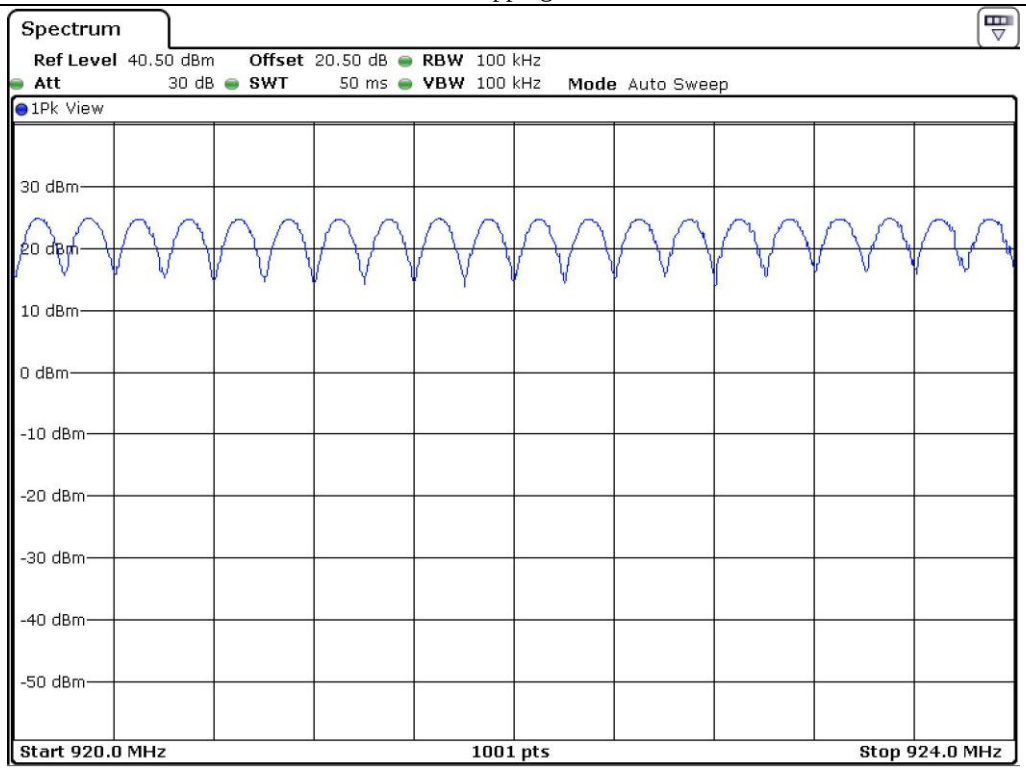


Number of hopping channel: 15



Number of hopping channel: 20

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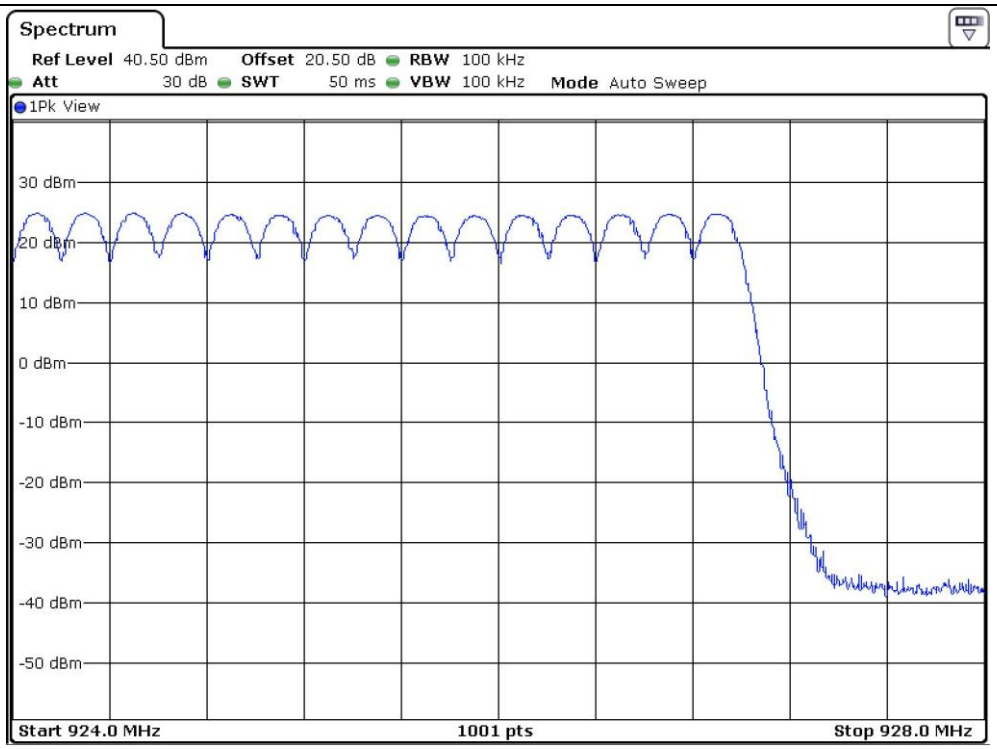

Number of hopping channel: 15

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10. TIME OF OCCUPANCY

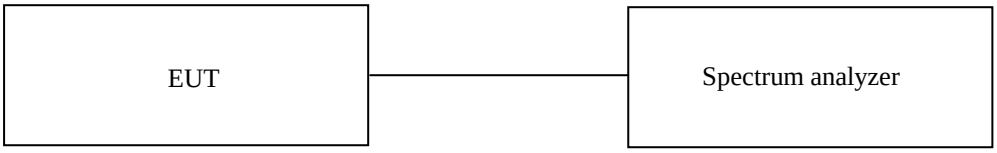
10.1 Operating environment

Temperature : 22.9 ℃

Relative humidity : 50.1 % 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.
■ -	FSV40	Rohde & Schwarz	Signal Analyzer	101009	Jul. 22, 2015 (1Y)

All test equipment used is calibrated on a regular basis.

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10.4 Test data

-. Test Date : August 27, 2015

Frequency Range (MHz)	20 dB Bandwidth (kHz)	Pulse Time (ms)	Number of Transmission (20 s period)	Dwell Time (ms)	Limit (ms)
917.1 ~ 926.9	< 250	112.800	3.0	338.40	< 400

Note: Dwell Time (s) = Pulse Time * Number of Transmissions during a 20 second period.

Tested by: Tae-Ho, Kim / Project Engineer

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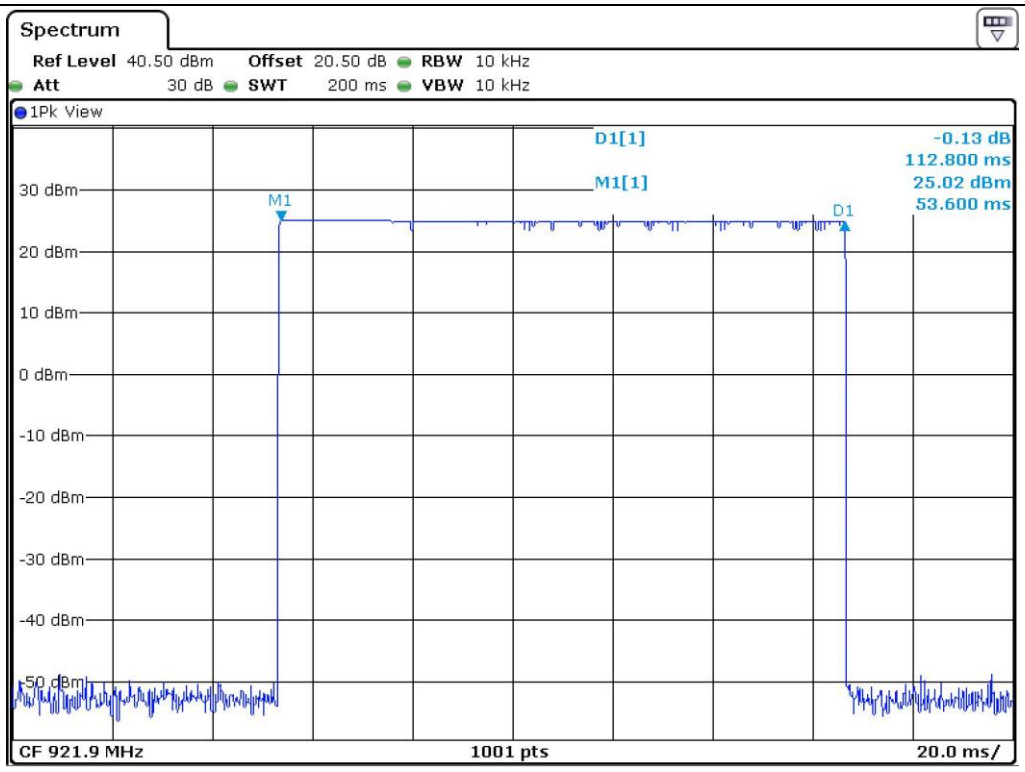
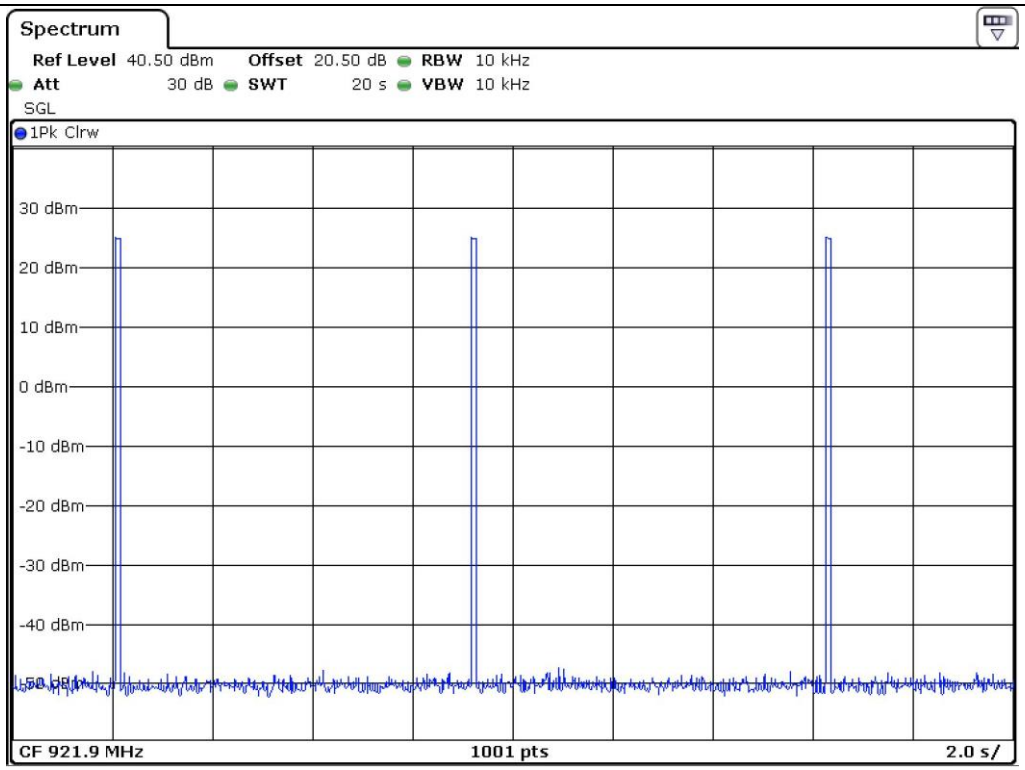


Pulse Time



Number of Transmissions during a 20 second period

HEAD OFFICE : 301-14 Daessangnyeong-ri, Chowol-eup, Gwangju-si, Gyeonggi-do 464-862 Korea (TEL: 82-31-799-9500, FAX: 82-31-799-9599)
EMC Testing Div : 307-51 Daessangnyeong-ri, Chowol-eup, Gwangju-si, Gyeonggi-do 464-862 Korea (TEL: 82-31-765-8289, FAX: 82-31-766-2904)

11. MAXIMUM PEAK OUTPUT POWER

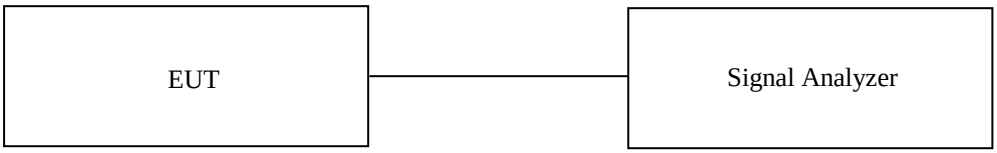
11.1 Operating environment

Temperature : 22.9 ℃

Relative humidity : 50.1 % 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.
■ -	FSV40	Rohde & Schwarz	Signal Analyzer	101009	Jul. 22, 2015 (1Y)

All test equipment used is calibrated on a regular basis.

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EMC Testing Div : 307-51 Daessangnyeong-ri, Chowol-eup, Gwangju-si, Gyeonggi-do 464-862 Korea (TEL: 82-31-765-8289, FAX: 82-31-766-2904)

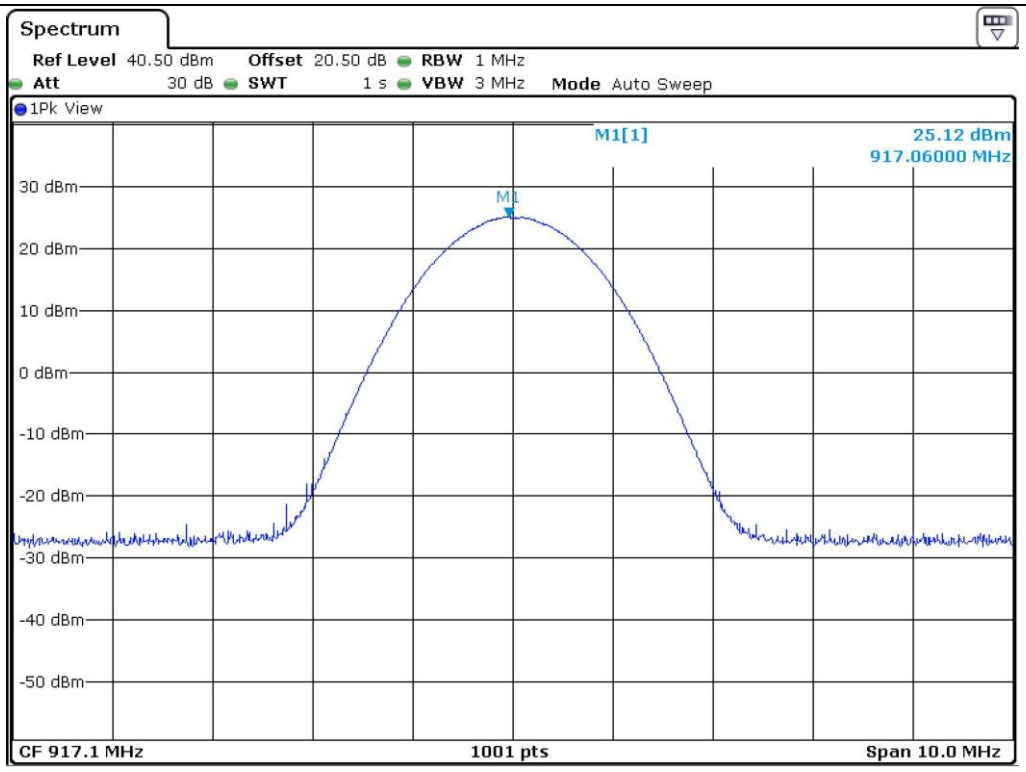
11.4 Test data

-. Test Date : August 27, 2015

-. Test Result : Pass

CHANNEL	FREQUENCY (MHz)	MEASURED VLAUE (dBm)	MEASURED VLAUE (W)	LIMITS (dBm)	LIMITS (W)
Low	917.1	25.12	0.325	30.00	1.0
Middle	921.9	24.96	0.313	30.00	1.0
High	926.9	24.89	0.308	30.00	1.0

Tested by: Tae-Ho, Kim / Project Engineer



Low Channel

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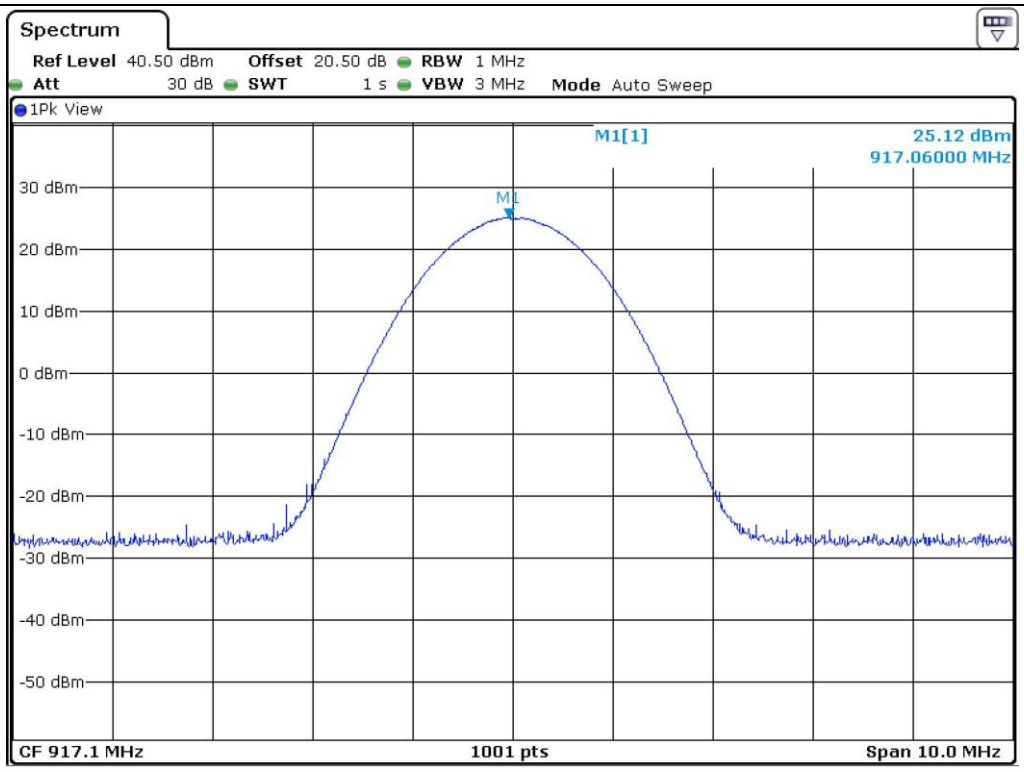
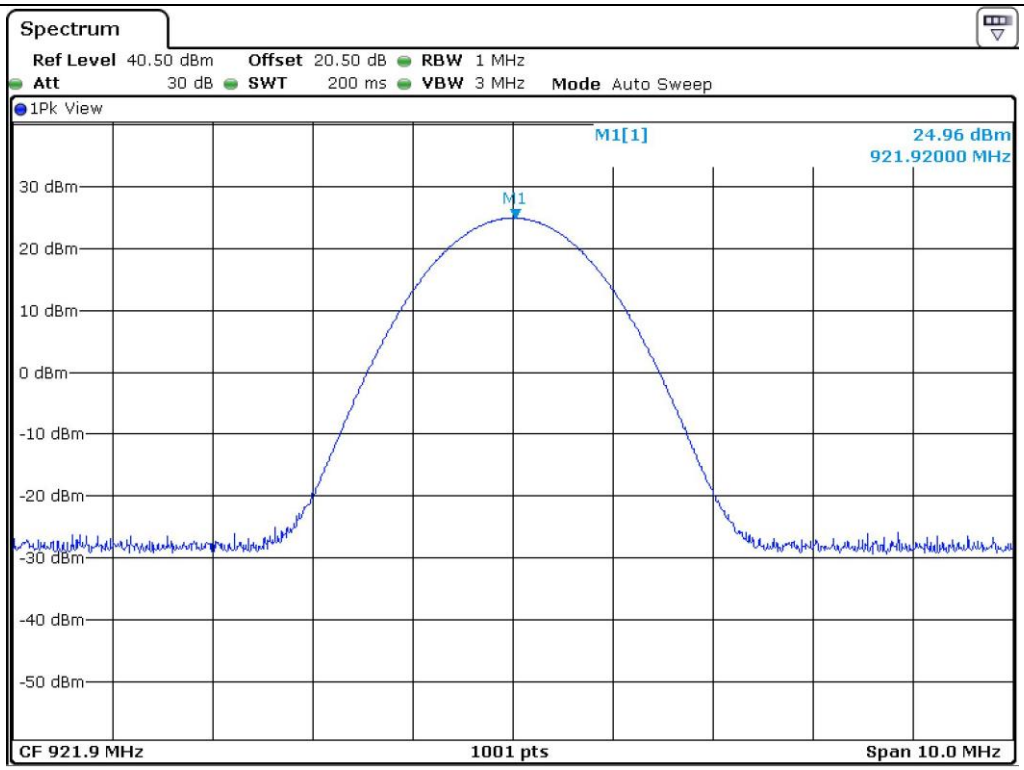


Middle Channel



High Channel

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12. 100 kHz BANDWIDTH OUTSIDE THE FREQUENCY BAND

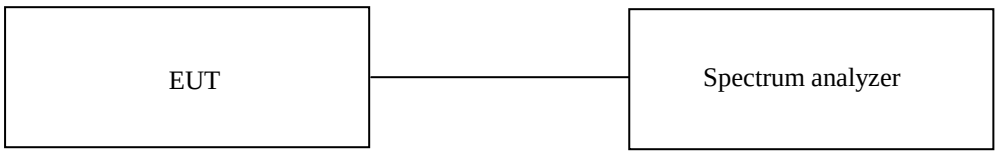
12.1 Operating environment

Temperature : 22.2 ℃

Relative humidity : 50.3 % 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 semi anechoic chamber.3 m, The EUT was placed on a non-conductive turntable approximately 0.8 m above the ground plane.

The frequency spectrum from 30 MHz to 10 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)
■ -	FSV40	Rohde & Schwarz	Signal Analyzer	101009	Jul. 22, 2015 (1Y)
■ -	ESU	Rohde & Schwarz	EMI Test Receiver	100261	Apr. 29, 2015 (1Y)
■ -	310N	Sonoma Instrument	Pre-Amplifier	312544	Apr. 29, 2015 (1Y)
■ -	SCU-18	Rohde & Schwarz	Pre-Amplifier	10041	Nov. 25, 2014 (1Y)
■ -	DT3000	Innco System	Turn Table	930611	N/A
■ -	MA4000-EP	Innco System	Antenna Master	3320611	N/A
■ -	VULB9163	Schwarzbeck	TRILOG Broadband Antenna	9163-421	Jul. 10, 2014 (2Y)
■ -	BBHA9120D	Schwarzbeck	Horn Antenna	BBHA9120D295	Aug. 31, 2015 (2Y)
■ -	BBHA9170	Schwarzbeck	Horn Antenna	BBHA9170178	Apr. 30, 2015 (2Y)

All test equipment used is calibrated on a regular basis.

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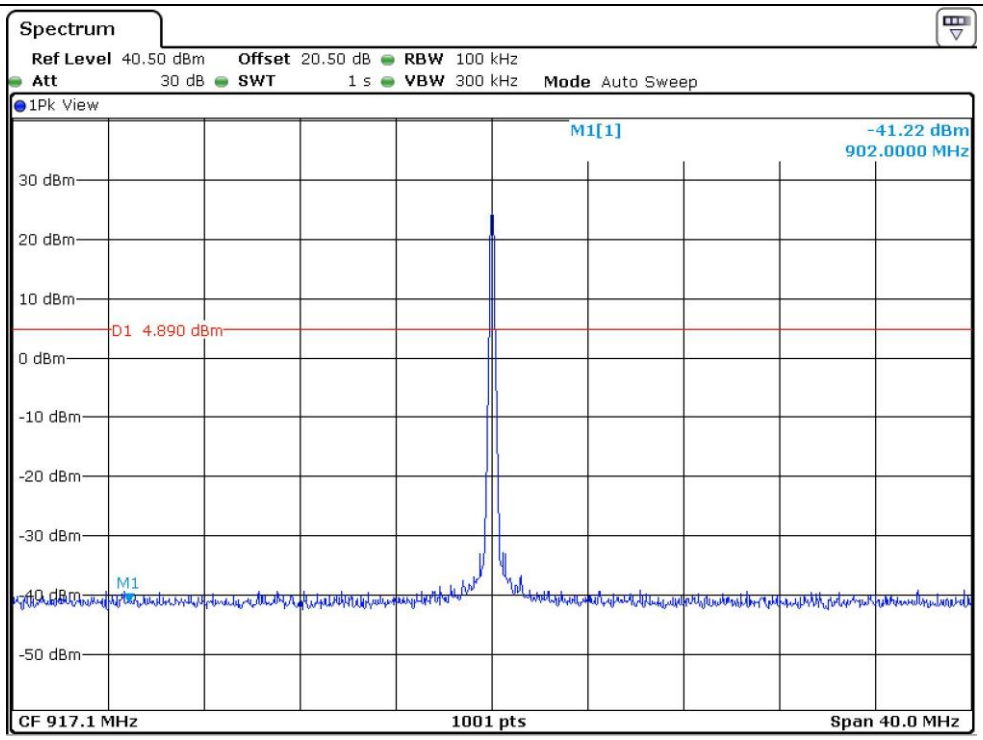
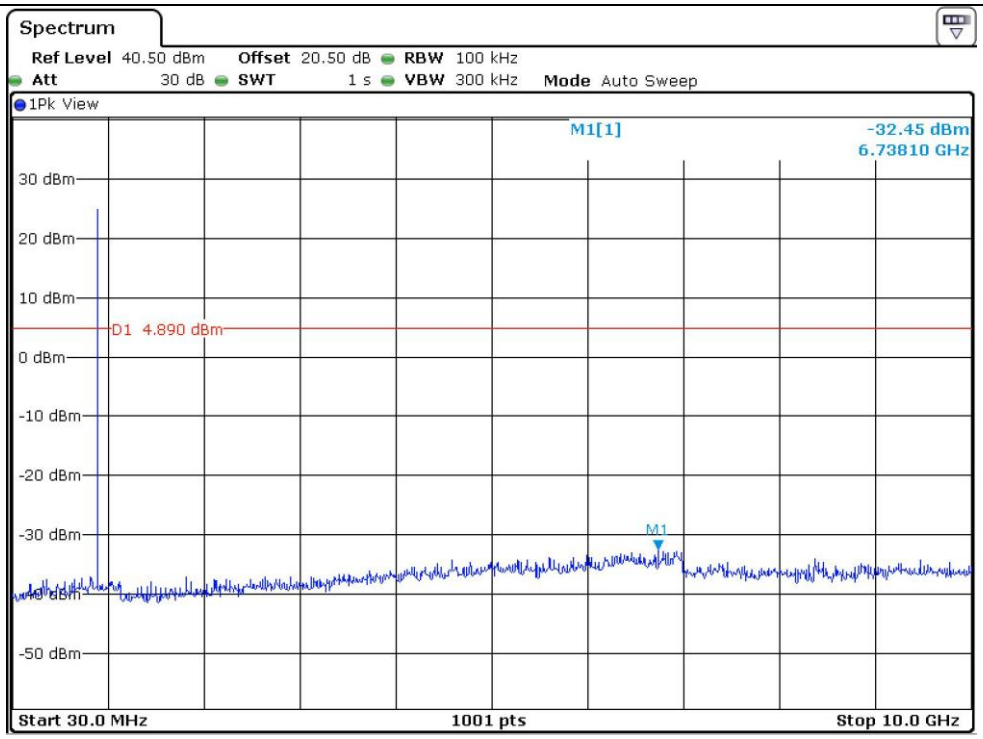
12.5 Test data for conducted emission



Low Channel



Low Channel

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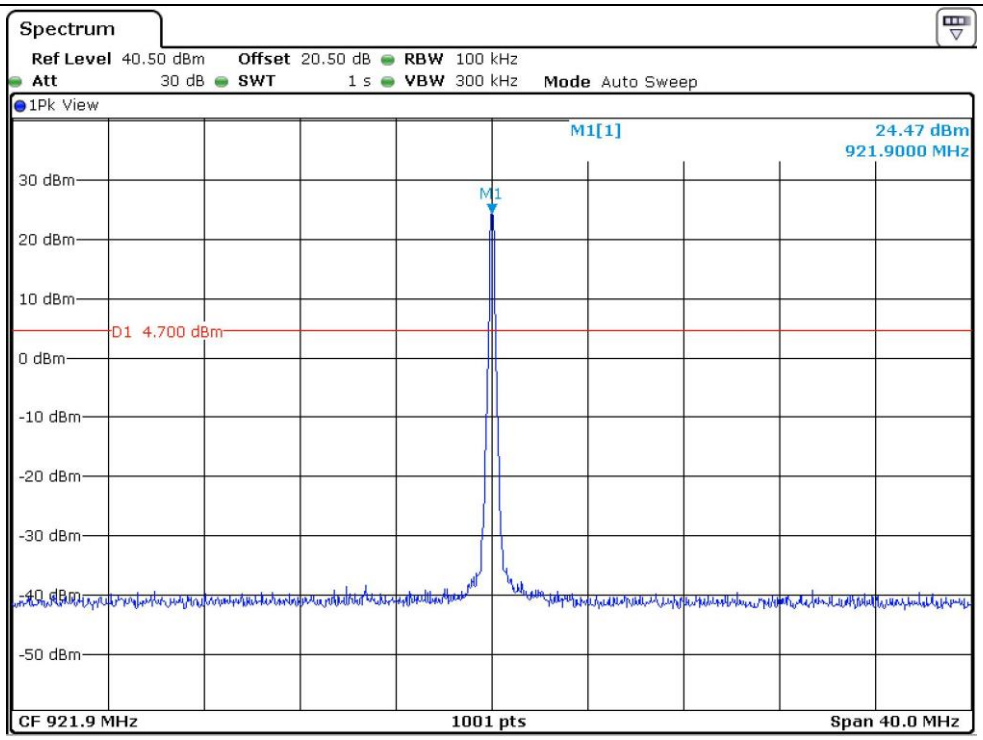
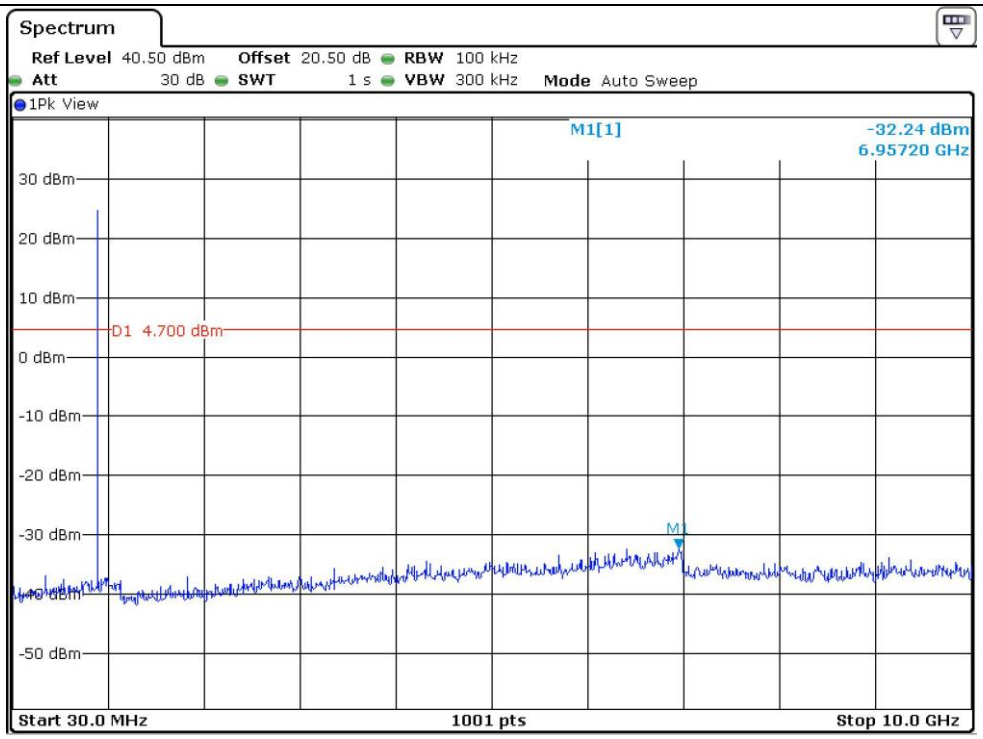


Middle Channel



Middle Channel

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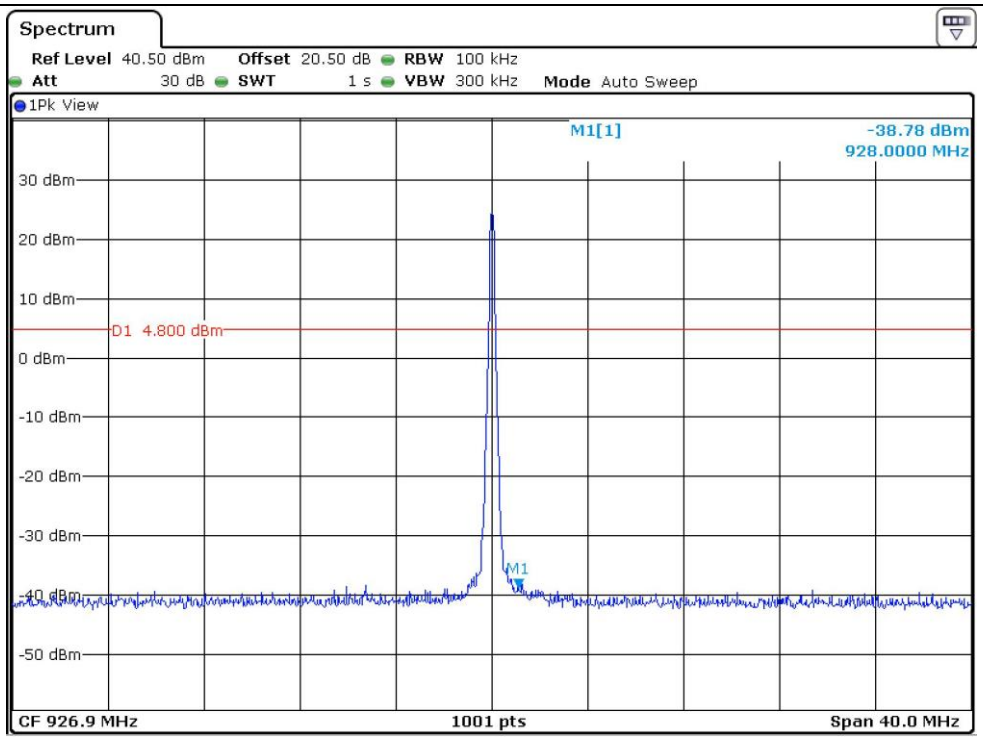
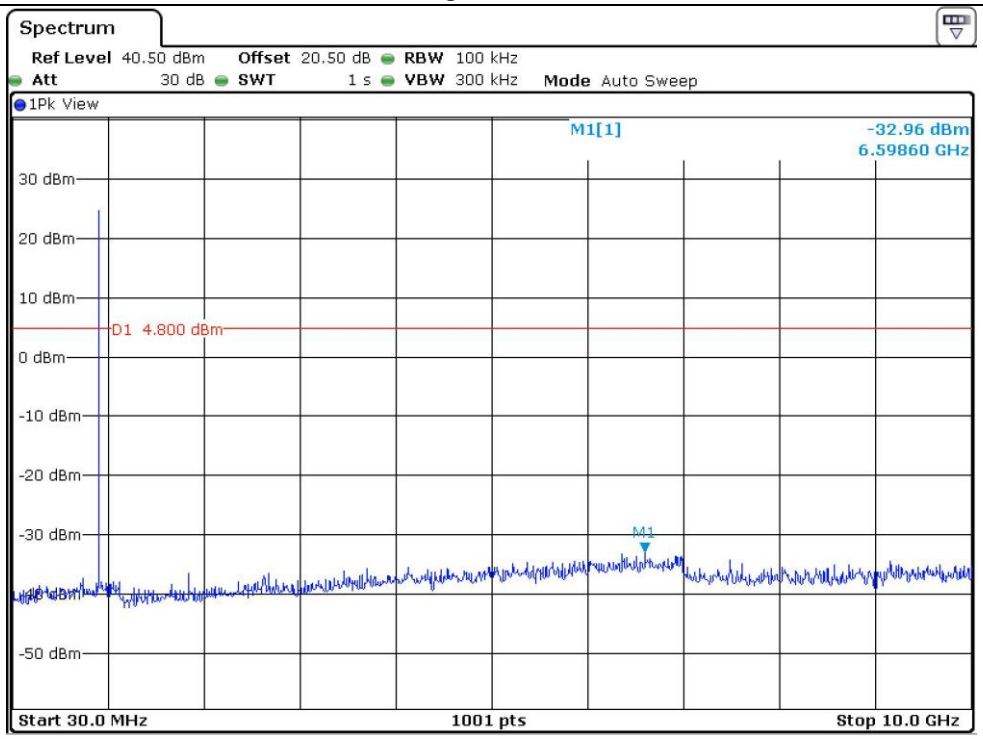
EMC Testing Div : 307-51 Daessangnyeong-ri, Chowol-eup, Gwangju-si, Gyeonggi-do 464-862 Korea (TEL: 82-31-765-8289, FAX: 82-31-766-2904)



High Channel



High Channel

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12.6 Test data for radiated emission at Transmitting Mode

12.6.1 Radiated Emission which fall in the Band Edge

-. Test Date : September 03, 2015

-. Resolution bandwidth : 100 kHz

-. Video bandwidth : 300 kHz

-. Measurement distance : 3 m

-. Operating Condition : Highest Output Power Transmitting Mode

-. 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)
901.99	41.45	Peak	H	21.90	12.30	32.30	43.35	53.98	10.63
928.45	42.34	Peak	V				44.24	53.98	9.74

Tabulated test data for Restricted Band

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

Tested by: Tae-Ho, Kim / Project Engineer

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12.6.2 Spurious & Harmonic Radiated Emission above 1 GHz

-. Test Date : September 03, 2015

-. 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 ~ 10 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									
917.10	113.20	Peak	H	21.90	12.30	32.30	115.10	-	115.10
	114.50	Peak	V				116.40	-	116.40
1 834.20	45.84	Peak	H	25.30	11.10	42.50	39.74	74.00	34.26
	36.28	Average	H				30.18	54.00	23.82
	49.25	Peak	V				43.15	74.00	30.85
	38.64	Average	V				32.54	54.00	21.46
Test Data for Middle Channel									
921.90	113.00	Peak	H	21.90	12.30	32.30	114.90	-	114.90
	114.20	Peak	V				116.10	-	116.10
1 843.80	45.29	Peak	H	25.30	11.20	42.50	39.29	74.00	34.71
	35.54	Average	H				29.54	54.00	24.46
	47.33	Peak	V				41.33	74.00	32.67
	37.50	Average	V				31.50	54.00	22.50

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EMC Testing Div : 307-51 Daessangnyeong-ri, Chowol-eup, Gwangju-si, Gyeonggi-do 464-862 Korea (TEL: 82-31-765-8289, FAX: 82-31-766-2904)

Test Data for High Channel									
926.90	112.80	Peak	H	21.90	12.30	32.30	114.70	-	114.70
	113.90	Peak	V				115.80	-	115.80
1 853.80	44.98	Peak	H	25.30	11.30	42.50	39.08	74.00	34.92
	35.39	Average	H				29.49	54.00	24.51
	46.84	Peak	V				40.94	74.00	33.06
	37.29	Average	V				31.39	54.00	22.61

Tabulated test data for Restricted Band

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

Tested by: Tae-Ho, Kim / Project Engineer

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12.6.3 Spurious Radiated Emission

12.6.3.1 Test Data for 30 MHz ~ 1 000 MHz

Humidity Level : 50.3 % R.H. Temperature: 22.2 ℃

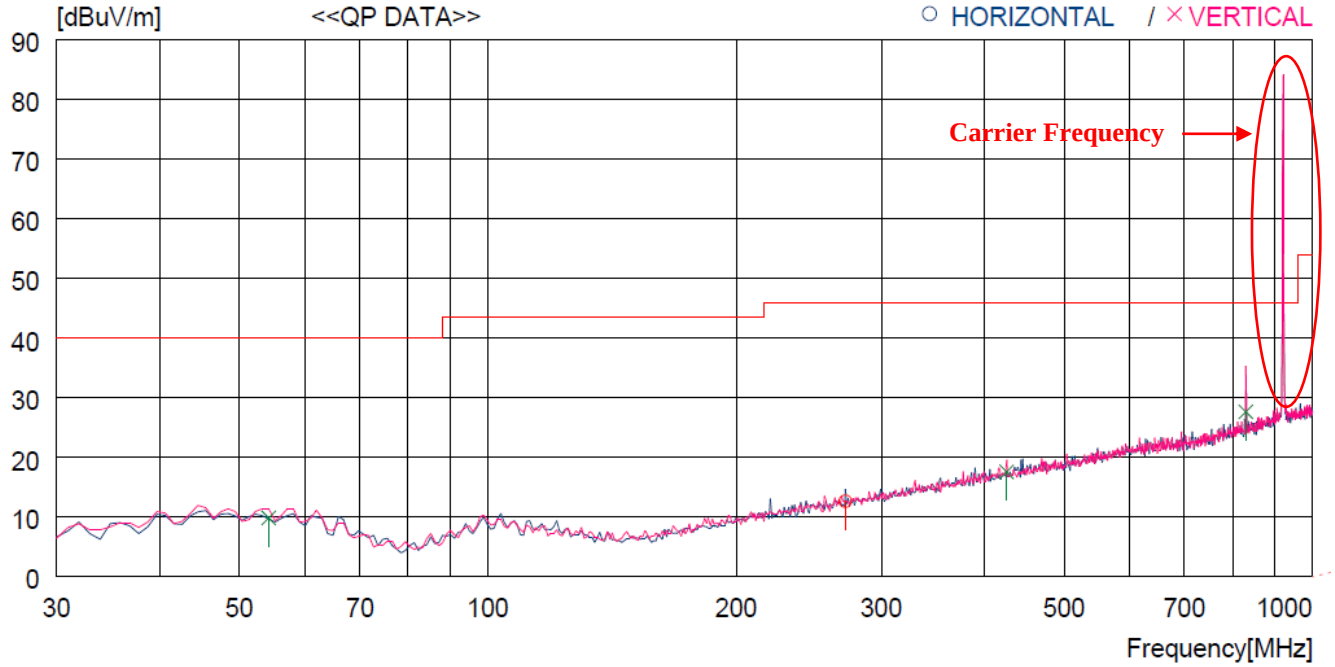
Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.247

Result : PASSED

EUT : UHF RFID Reader Dongle Date: September 03, 2015

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

Operating condition : Low Channel



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	271.530	27.9	12.9	4.8	32.9	12.7	46.0	33.3	400	321
----- Vertical ------										
2	54.250	27.3	13.5	2.1	33.0	9.9	40.0	30.1	300	359
3	425.761	28.3	16.3	6.1	33.1	17.6	46.0	28.4	300	357
4	830.241	30.4	21.3	8.8	32.8	27.7	46.0	18.3	100	359

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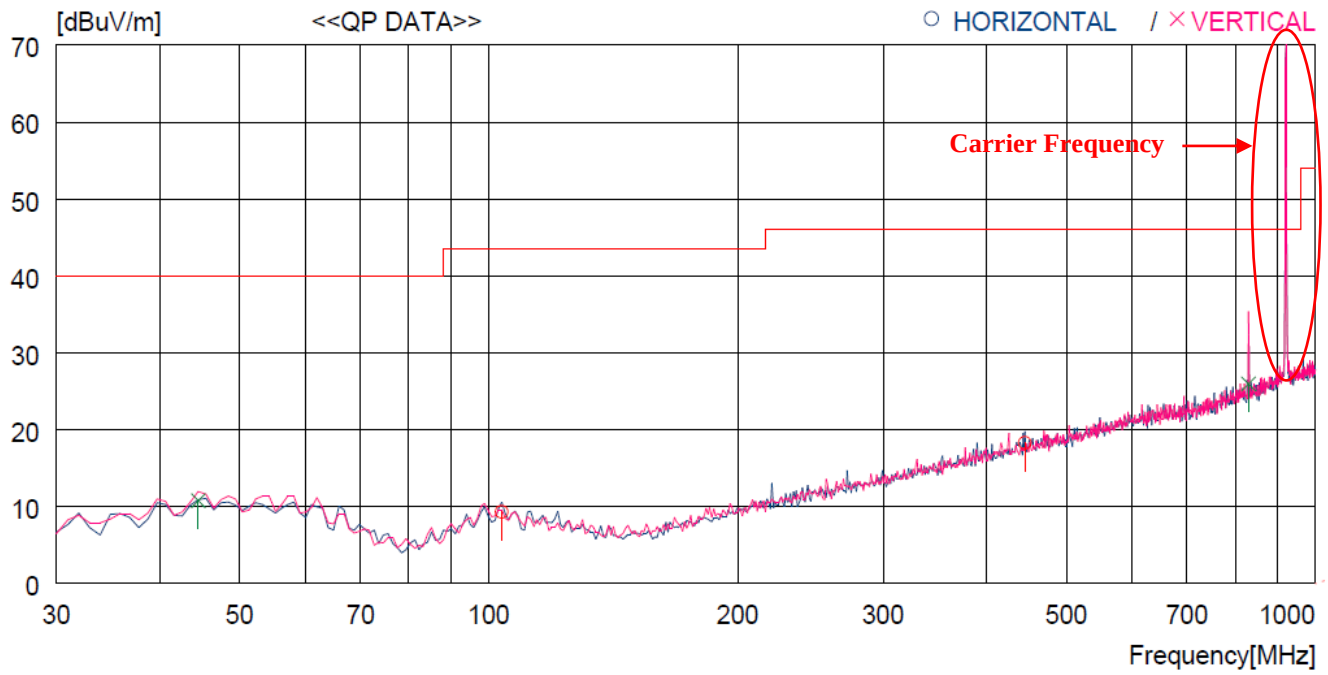
EMC Testing Div : 307-51 Daessangnyeong-ri, Chowol-eup, Gwangju-si, Gyeonggi-do 464-862 Korea (TEL: 82-31-765-8289, FAX: 82-31-766-2904)

Operating condition : Middle Channel



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	103.720	28.1	11.6	2.9	33.3	9.3	43.5	34.2	100	0
2	445.161	28.4	16.5	6.2	32.8	18.3	46.0	27.7	100	0
----- Vertical ------										
3	44.550	27.9	13.9	1.9	32.9	10.8	40.0	29.2	300	359
4	830.241	29.3	21.3	8.8	33.4	26.0	46.0	20.0	100	359

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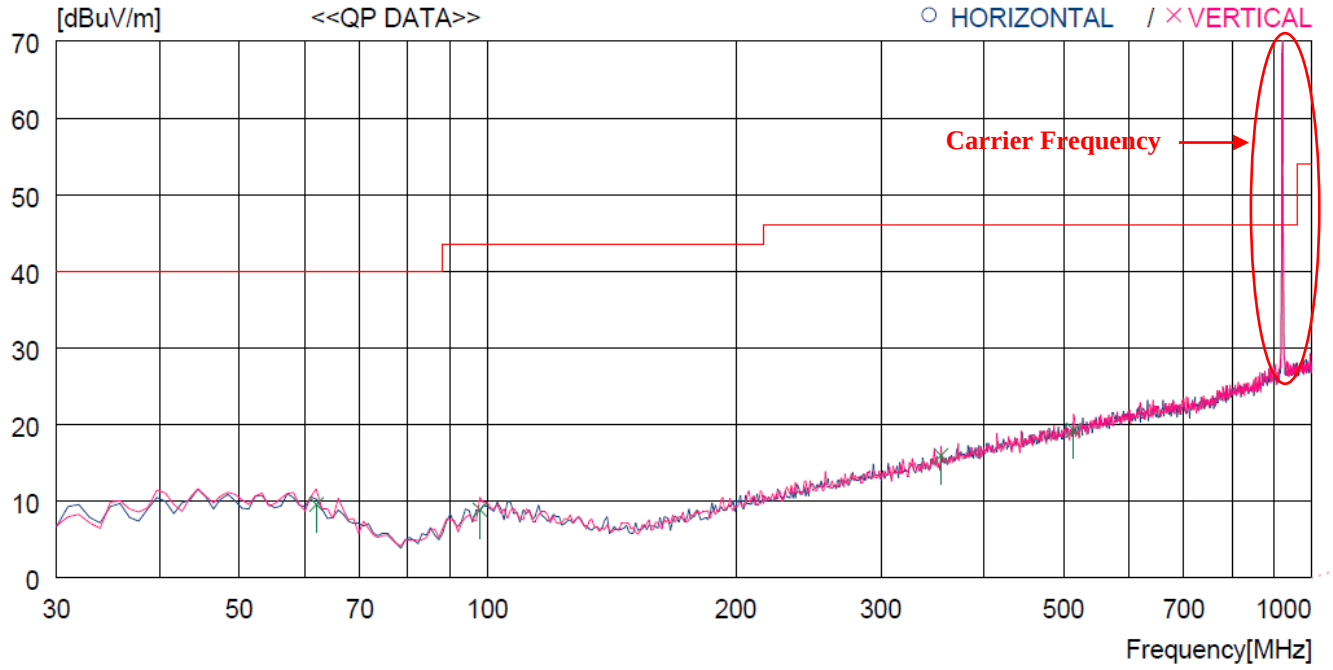
Operating condition : High Channel



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	62.010	27.8	12.6	2.3	33.1	9.6	40.0	30.4	400	0
2	97.900	27.8	11.6	2.8	33.3	8.9	43.5	34.6	100	229
3	354.950	28.2	14.9	5.5	32.6	16.0	46.0	30.0	200	81
4	514.031	27.9	17.6	6.7	32.9	19.3	46.0	26.7	100	2

Tested by: Tae-Ho, Kim / Project Engineer

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12.6.3.2 Test Data for Below 30 MHz

-. Test Date : September 03, 2015

-. 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)
It was not observed any emissions from the EUT.								

12.6.3.3 Test data for above 1 GHz

-. Test Date : September 03, 2015

-. 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 ~ 10 GHz

-. Measurement distance : 3 m

-. Operating Condition : Highest Output Power Transmitting Mode

-. Result : PASSED

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)
It was not observed any emissions from the EUT.									

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13. RADIATED EMISSION TEST

13.1 Operating environment

Temperature : 22.2 ℃

Relative humidity : 50.3 % R.H

13.2 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 1 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.

13.3 Measurement uncertainty

Radiated emission electric field intensity, 0.15 MHz ~ 30 MHz : ± 2.61 dB

Radiated emission electric field intensity, 30 MHz ~ 300 MHz : ± 4.43 dB

Radiated emission electric field intensity, 300 MHz ~ 1 000 MHz : ± 3.80 dB

Radiated emission electric field intensity, 1 000 MHz ~ 3 000 MHz: ± 4.40 dB

Measurement uncertainty is calculated in accordance with CISPR 16-4-2. The measurement uncertainty is given with a confidence of 95 % with the coverage factor, k = 2.

13.4 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal.(Interval)
■ -	FSV40	Rohde & Schwarz	Signal Analyzer	101009	Jul. 22, 2015 (1Y)
■ -	ESU	Rohde & Schwarz	EMI Test Receiver	100261	Apr. 29, 2015 (1Y)
■ -	310N	Sonoma Instrument	Pre-Amplifier	312544	Apr. 29, 2015 (1Y)
■ -	SCU-18	Rohde & Schwarz	Pre-Amplifier	10041	Nov. 25, 2014 (1Y)
■ -	DT3000	Innco System	Turn Table	930611	N/A
■ -	MA4000-EP	Innco System	Antenna Master	3320611	N/A
■ -	VULB9163	Schwarzbeck	TRILOG Broadband Antenna	9163-421	Jul. 10, 2014 (2Y)
■ -	HFH2-Z2	Rohde & Schwarz	Loop Antenna	879 285/26	Dec. 09, 2014(2Y)
■ -	BBHA9120D	Schwarzbeck	Horn Antenna	BBHA9120D295	Aug. 31, 2015 (2Y)
■ -	BBHA9170	Schwarzbeck	Horn Antenna	BBHA9170178	Apr. 30, 2015 (2Y)

All test equipment used is calibrated on a regular basis.

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13.5 Test data for Charging Mode

13.5.1 Test data for 30 MHz ~ 1 000 MHz

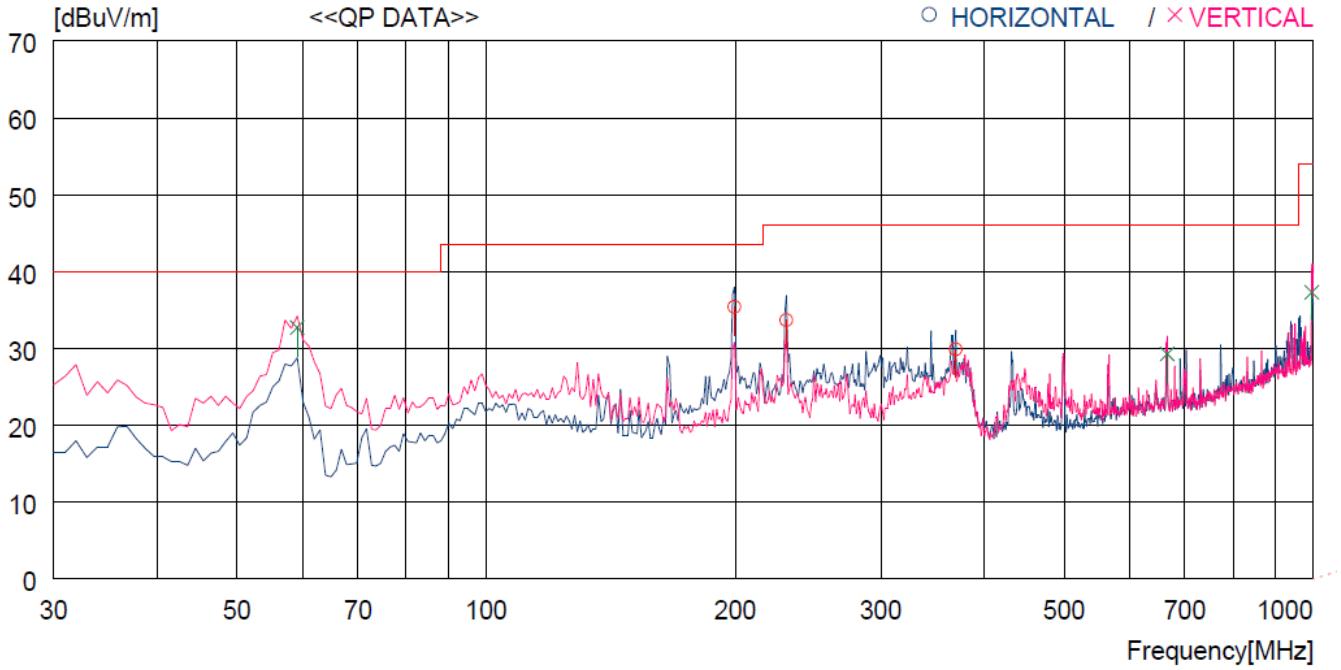
Humidity Level : 50.3 % R.H. Temperature: 22.2 ℃

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

Result : PASSED

EUT : UHF RFID Reader Dongle Date: September 03, 2015

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	199.750	53.4	10.7	4.1	32.8	35.4	43.5	8.1	100	359
2	230.790	50.3	11.8	4.4	32.8	33.7	46.0	12.3	100	82
3	369.500	41.7	15.2	5.6	32.6	29.9	46.0	16.1	100	264
----- Vertical ------										
4	59.100	50.2	13.3	2.2	33.0	32.7	40.0	7.3	100	264
5	666.316	35.5	19.5	7.8	33.5	29.3	46.0	16.7	100	0
6	996.106	36.7	22.6	9.7	31.7	37.3	54.0	16.7	100	180

Tested by: Tae-Ho, Kim / Project Engineer

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13.5.2 Test data for Below 30 MHz

-. Test Date : September 03, 2015

-. 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 : Charging 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)
It was not observed any emissions from the EUT.								

13.5.3 Test data for above 1 GHz

-. Test Date : September 03, 2015

-. 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 Condition : Charging Mode

-. Result : PASSED

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)
It was not observed any emissions from the EUT.									

Tested by: Tae-Ho, Kim / Project Engineer

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14. CONDUCTED EMISSION TEST

14.1 Operating environment

Temperature	:	22.2 ℃
Relative humidity	:	50.3 % R.H

14.2 Test set-up

The EUT was placed on a wooden table, 0.8 m height above the floor. Power was fed to the EUT through a 50 Ω / 50 μH + 5 Ω Artificial Mains Network (AMN). The ground plane was electrically bonded to the reference ground system and all power lines were filtered from ambient.

14.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
■ -	ESPI	Rohde & Schwarz	Test Receiver	101012	Nov. 03, 2014 (1Y)
□ -	ESHS10	Rohde & Schwarz	Test Receiver	834467/007	Apr. 29, 2015 (1Y)
□ -	NSLK8128	Schwarzbeck	AMN	8128-216	Apr. 06, 2015 (1Y)
■ -	NSLK8126	Schwarzbeck	AMN	8126-404	Apr. 29, 2015 (1Y)
□ -	3825/2	EMCO	AMN	9109-1869	Apr. 29, 2015 (1Y)
■ -	3825/2	EMCO	AMN	9109-1867	Apr. 29, 2015 (1Y)

All test equipment used is calibrated on a regular basis.

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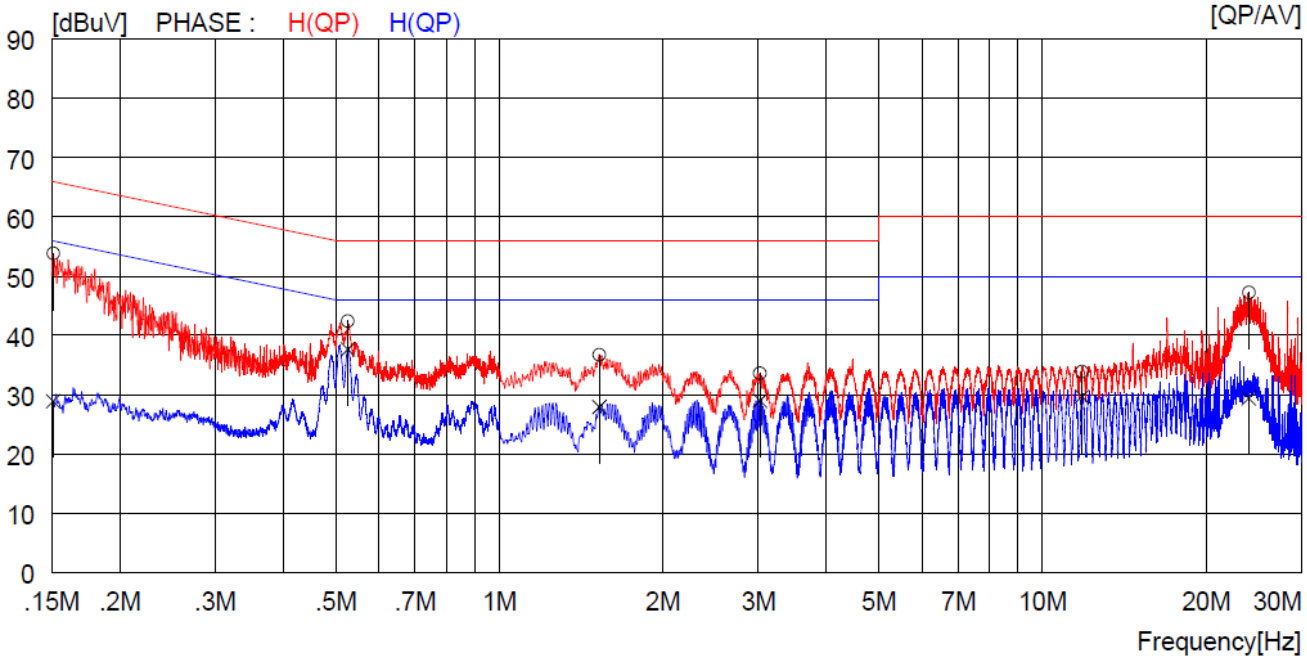
14.4 Test data for Charging Mode

-. Test Date : September 03, 2015

-. Resolution bandwidth : 9 kHz

-. Frequency range : 0.15 MHz ~ 30 MHz

-. Tested Line : HOT LINE



NO	FREQ [MHz]	READING QP [dBuV]	READING AV [dBuV]	C.FACTOR QP [dB]	C.FACTOR AV [dBuV]	RESULT QP [dBuV]	RESULT AV [dBuV]	LIMIT QP [dBuV]	LIMIT AV [dBuV]	MARGIN QP [dBuV]	MARGIN AV [dBuV]	PHASE
1	0.15100	33.6	----	20.2		53.8	----	65.9	----	12.1	----	H(QP)
2	0.52600	22.2	----	20.2		42.4	----	56.0	----	13.6	----	H(QP)
3	1.52800	16.5	----	20.2		36.7	----	56.0	----	19.3	----	H(QP)
4	3.02000	13.3	----	20.3		33.6	----	56.0	----	22.4	----	H(QP)
5	11.83000	13.6	----	20.3		33.9	----	60.0	----	26.1	----	H(QP)
6	23.99000	26.8	----	20.4		47.2	----	60.0	----	12.8	----	H(QP)
7	0.15100	----	8.7	20.2		----	28.9	----	55.9	----	27.0	H(CAV)
8	0.52600	----	17.4	20.2		----	37.6	----	46.0	----	8.4	H(CAV)
9	1.52800	----	7.7	20.2		----	27.9	----	46.0	----	18.1	H(CAV)
10	3.02000	----	8.7	20.3		----	29.0	----	46.0	----	17.0	H(CAV)
11	11.83000	----	9.4	20.3		----	29.7	----	50.0	----	20.3	H(CAV)
12	23.99000	----	9.0	20.4		----	29.4	----	50.0	----	20.6	H(CAV)

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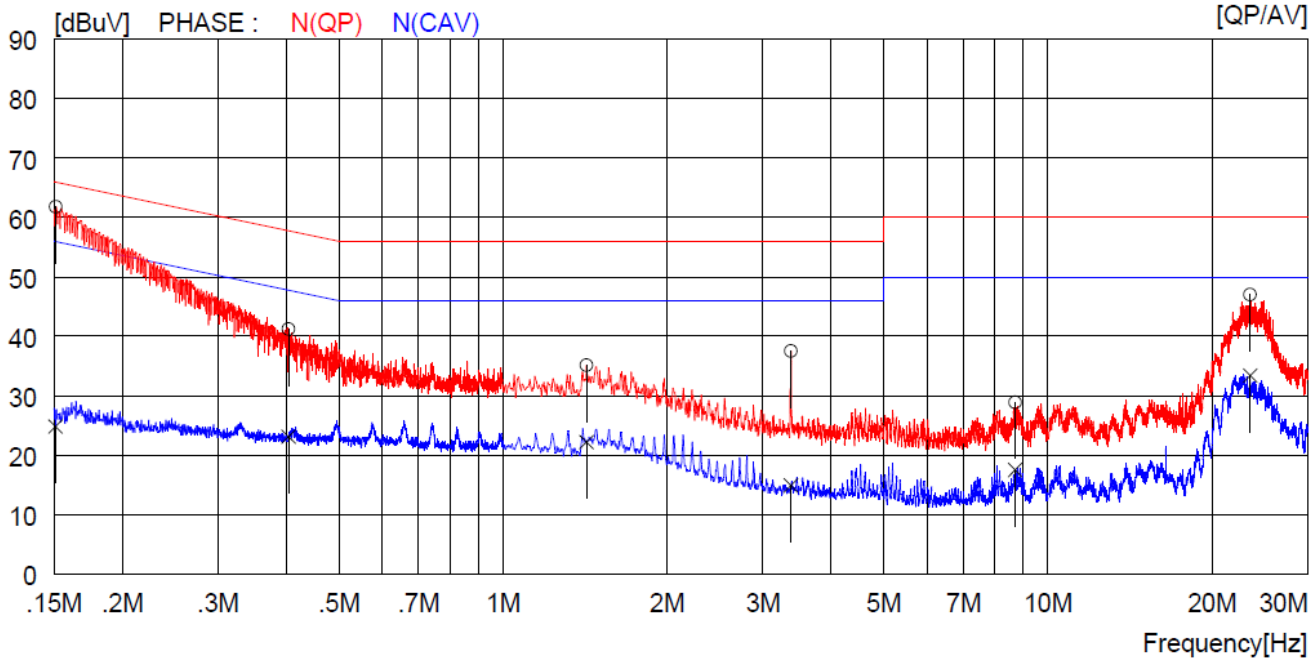
-. Tested Line : NEUTRAL LINE



NO	FREQ [MHz]	READING QP [dBuV]	READING AV [dBuV]	C.FACTOR QP [dB]	C.FACTOR AV [dBuV]	RESULT QP [dBuV]	RESULT AV [dBuV]	LIMIT QP [dBuV]	LIMIT AV [dBuV]	MARGIN QP [dBuV]	MARGIN AV [dBuV]	PHASE
1	0.15100	41.6	----	20.2		61.8	----	65.9	----	4.1	----	N(QP)
2	0.40400	21.0	----	20.2		41.2	----	57.8	----	16.6	----	N(QP)
3	1.42400	14.9	----	20.2		35.1	----	56.0	----	20.9	----	N(QP)
4	3.37600	17.2	----	20.3		37.5	----	56.0	----	18.5	----	N(QP)
5	8.71000	8.6	----	20.3		28.9	----	60.0	----	31.1	----	N(QP)
6	23.51000	26.6	----	20.4		47.0	----	60.0	----	13.0	----	N(QP)
7	0.15100	----	4.6	20.2		----	24.8	----	55.9	----	31.1	N(CAV)
8	0.40400	----	2.9	20.2		----	23.1	----	47.8	----	24.7	N(CAV)
9	1.42400	----	2.0	20.2		----	22.2	----	46.0	----	23.8	N(CAV)
10	3.37600	----	-5.4	20.3		----	14.9	----	46.0	----	31.1	N(CAV)
11	8.71000	----	-2.8	20.3		----	17.5	----	50.0	----	32.5	N(CAV)
12	23.51000	----	13.0	20.4		----	33.4	----	50.0	----	16.6	N(CAV)

Remark: Margin (dB) = Limit – Level (Result)

The emission level in above table is included the transducer factor that means insertion loss (LISN), cable loss and attenuator.

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