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

Test Report No.	**: E14NR-003**
AGR No.	**: A149A-004**
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	**: RFID Reader**
FCC ID.	**: UQBASX-30XX**
Model Name	**: ASX-301R**
Multiple Model Name	**: ASX-31RT**
Serial number	**: N/A**
Total page of Report	**: 43 pages (including this page)**
Date of Incoming	**: October 30, 2014**
Date of issue	**: November 10, 2014**

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.

Prepared by: Ki-Hong, Nam / Senior Engineer, ONETECH Corp.

Approved by: Gea-Won, Lee / 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
E14NR-003	November 03, 2014	Initial Issue	All
	November 10, 2014	Retesting due to output value changes.	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	: UQBASX-30XX
MODEL NAME	: ASX-301R
BRAND NAME	: AsReader / AsReader / Asterisk
SERIAL NUMBER	: N/A
DATE	: November 10, 2014

EQUIPMENT CLASS	**DSS – PART 15 SPREAD SPECTRUM TRANSMITTER**
KIND OF EQUIPMENT	RFID Reader
THIS REPORT CONCERNS	Original Grant
MEASUREMENT PROCEDURES	ANSI C63.10: 2009
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: 2009. 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 ASX-301R (referred to as the EUT in this report) is a RFID Reader. 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	20.14 dBm (0.103 W)
NUMBER OF CHANNEL	50 Channels
MODULATION TYPE	ASK
ANTENNA TYPE	Patch Antenna
ANTENNA GAIN	0.45 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.

-. The following lists consist of the added model and their differences.

Model Name	Differences	Tested
ASX-301R	Basic Model	☑
ASX-31RT	The models are identical to basic model but the exterior case design is different.	☐

Note: 1. Applicant consigns only basic model to test. Therefore this test report just guarantees the units, which have been tested.

2. The Applicant/manufacturer is responsible for the compliance of all variants.

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.	ASX-30XX-XM102	N/A
SW Board A	N/A	N/A	N/A
SW Board B	N/A	N/A	N/A
Sub Board	N/A	N/A	N/A
Antenna Board	SANGSHIN ELECOM CO., LTD.	KSA-SP921MS25T3B	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
ASX-301R	Smart Power Solutions Inc.	RFID Reader (EUT)	Notebook PC
LGR501	LG	Notebook PC	EUT

5.3 Mode of operation during the test

-. The USB port on the EUT was connected to the notebook PC 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 USB and the power of 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: 2009 7.3.3 to determine the worse operating conditions.

Radiated Emission Test: Preliminary radiated emissions test were conducted using the procedure in ANSI C63.10: 2009 8.3.1.1 and 13.4.1 to determine the worse operating conditions. Final radiated emission tests were conducted at 3 m open area test site.
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 unique 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)
Transmitting Mode	X

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7. MINIMUM 20 dB BANDWIDTH

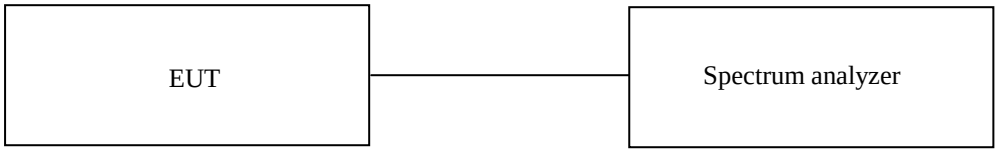
7.1 Operating environment

Temperature : 21.4 ℃

Relative humidity : 43.0 % 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. (Interval)
■ -	FSV30	Rohde & Schwarz	Signal Analyzer	101372	Apr. 28, 2014(1Y)

All test equipment used is calibrated on a regular basis.

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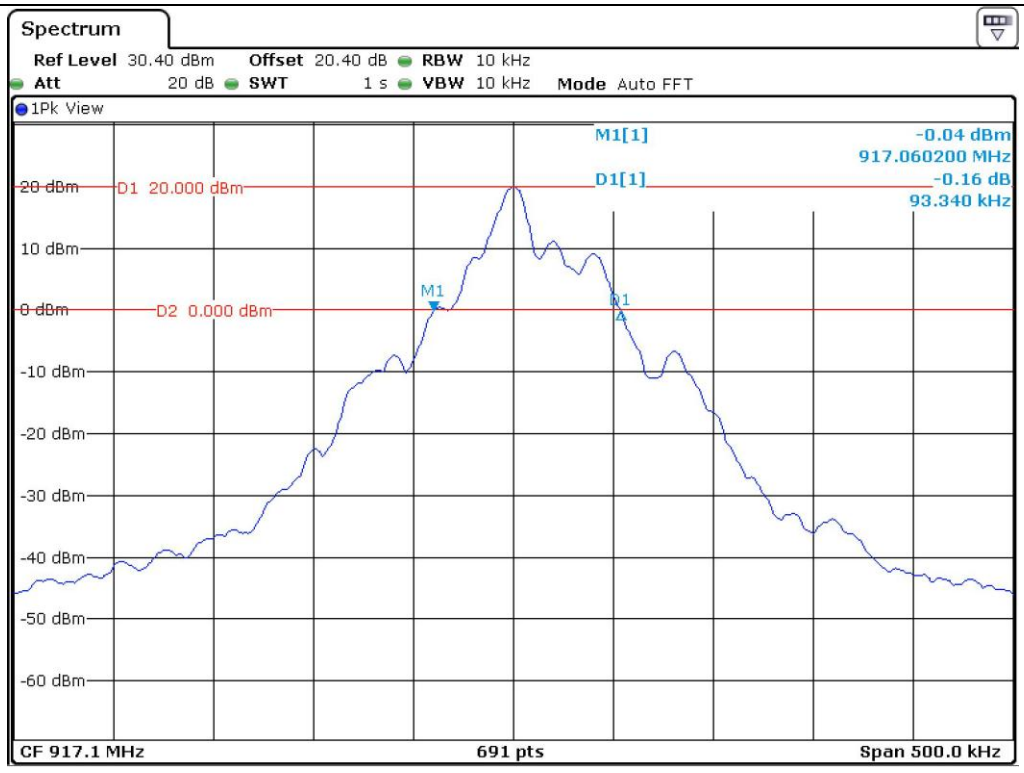
7.4 Test data

-. Test Date : November 09, 2014

CHANNEL	FREQUENCY (MHz)	20 dB Bandwidth (kHz)	Limits(kHz)
Low	917.10	93.00	250
Middle	921.90	95.00	
High	926.90	95.00	

Tested by: Tae-Ho, Kim / Project Engineer



Low Channel

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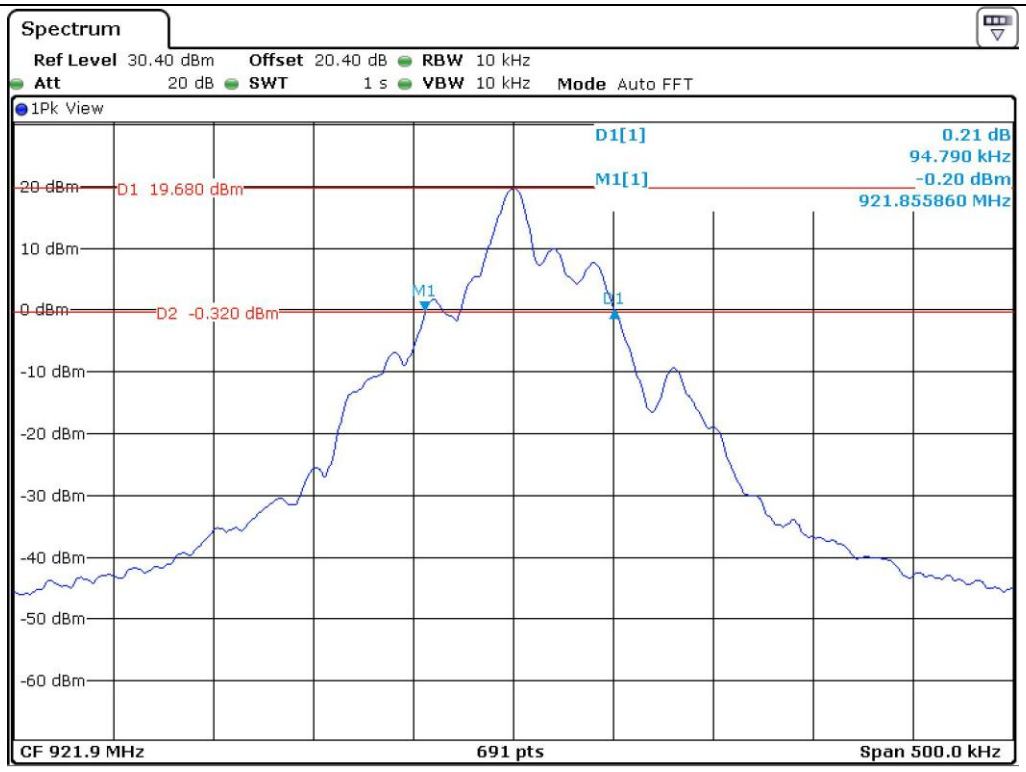
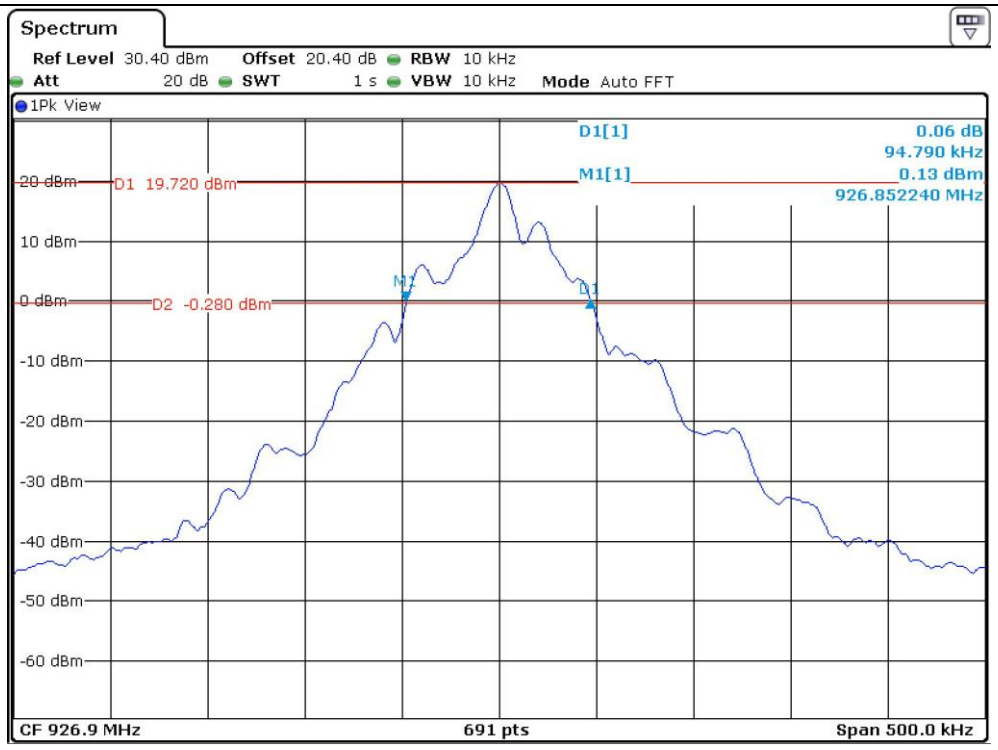


Middle Channel



High Channel

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8. HOPPING FREQUENCY SEPARATION

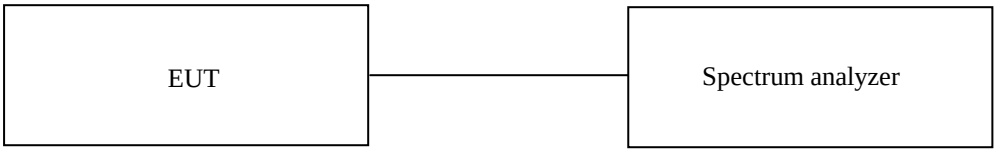
8.1 Operating environment

Temperature : 21.4 ℃

Relative humidity : 43.0 % 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. (Interval)
■ -	FSV30	Rohde & Schwarz	Signal Analyzer	101372	Apr. 28, 2014(1Y)

All test equipment used is calibrated on a regular basis.

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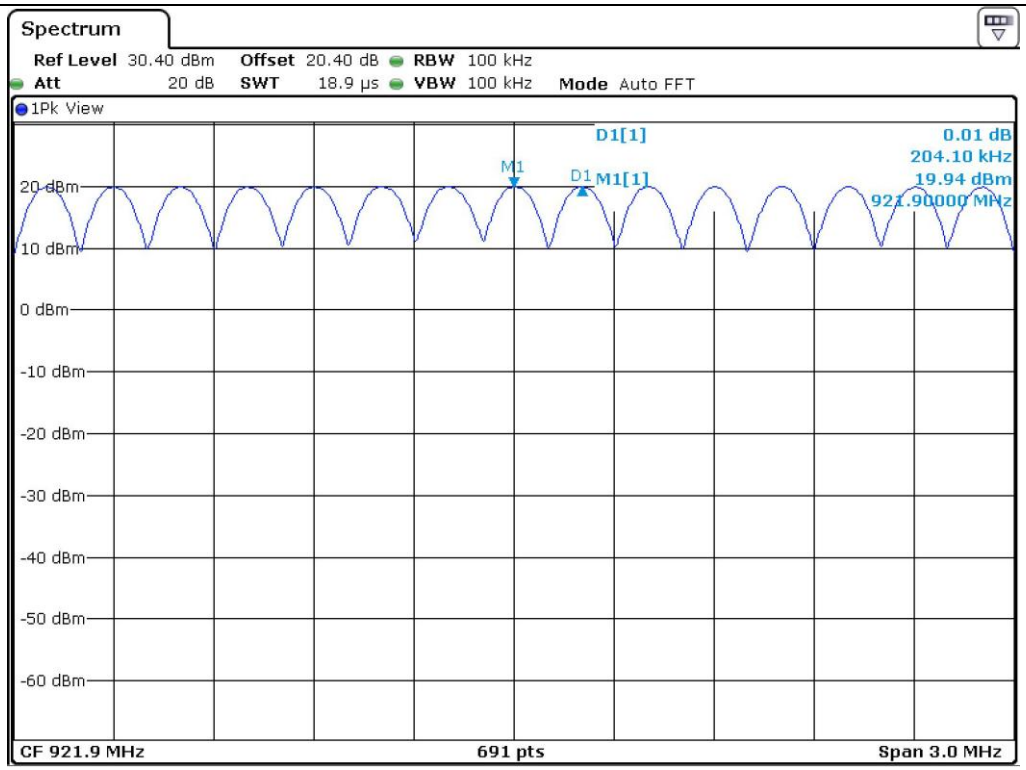
8.4 Test data

-. Test Date : November 09, 2014

-. Test Result : Pass

Frequency (MHz)	Measured Value (kHz)	LIMIT
921.90	204.00	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

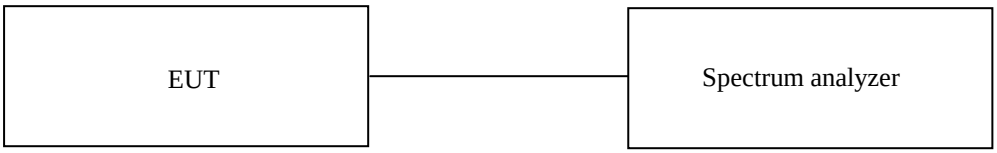
9.1 Operating environment

Temperature : 21.4 ℃

Relative humidity : 43.0 % 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. (Interval)
■ -	FSV30	Rohde & Schwarz	Signal Analyzer	101372	Apr. 28, 2014(1Y)

All test equipment used is calibrated on a regular basis.

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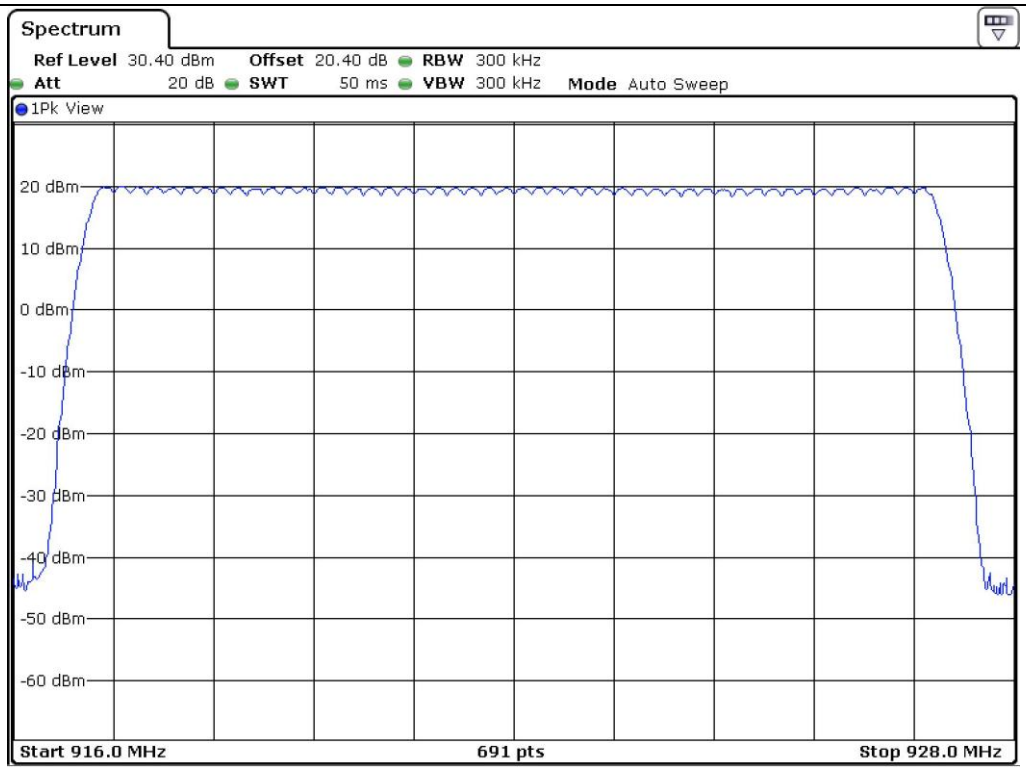
9.4 Test data

-. Test Date : November 09, 2014

-. 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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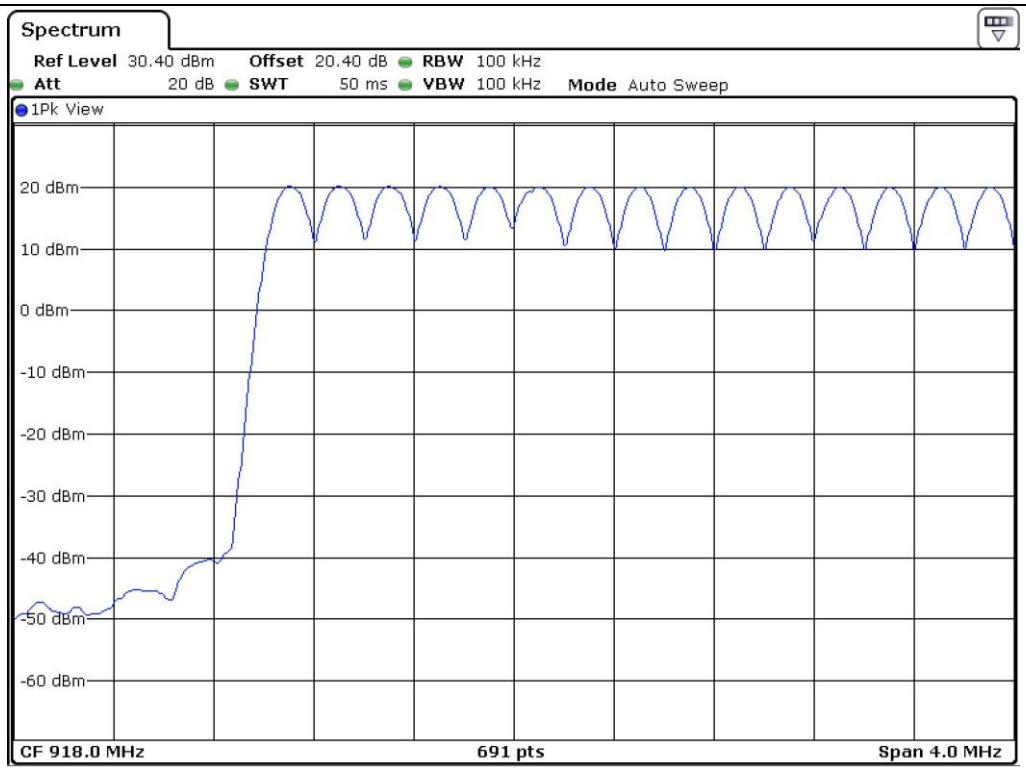
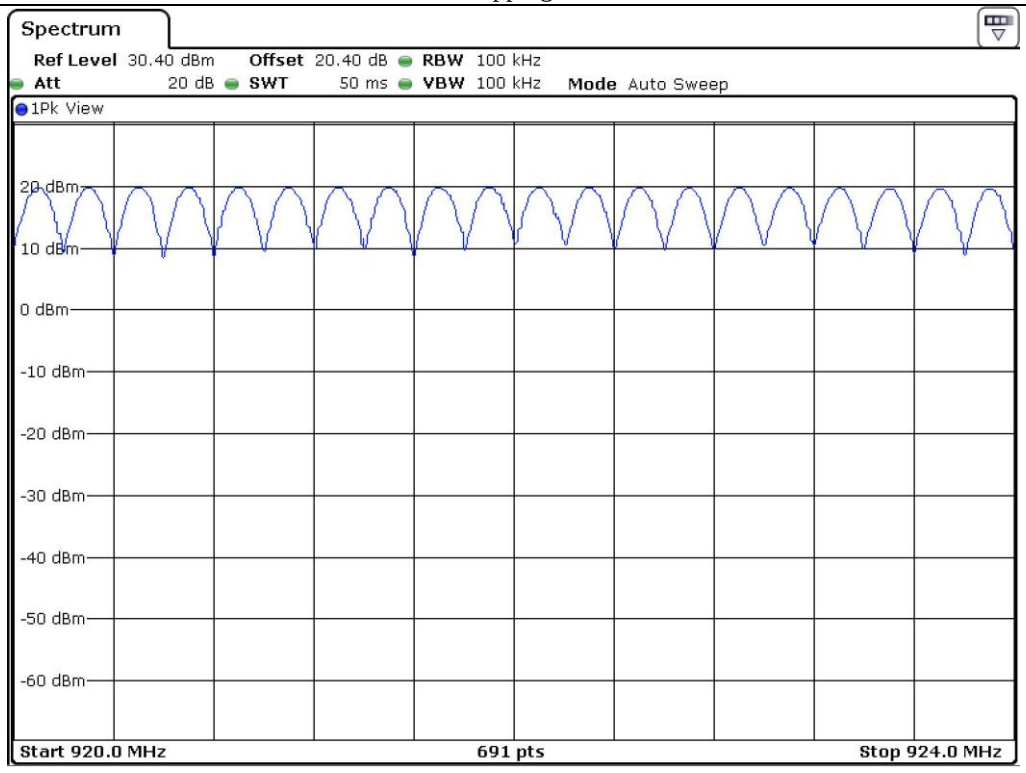


Number of hopping channel: 15



Number of hopping channel: 20

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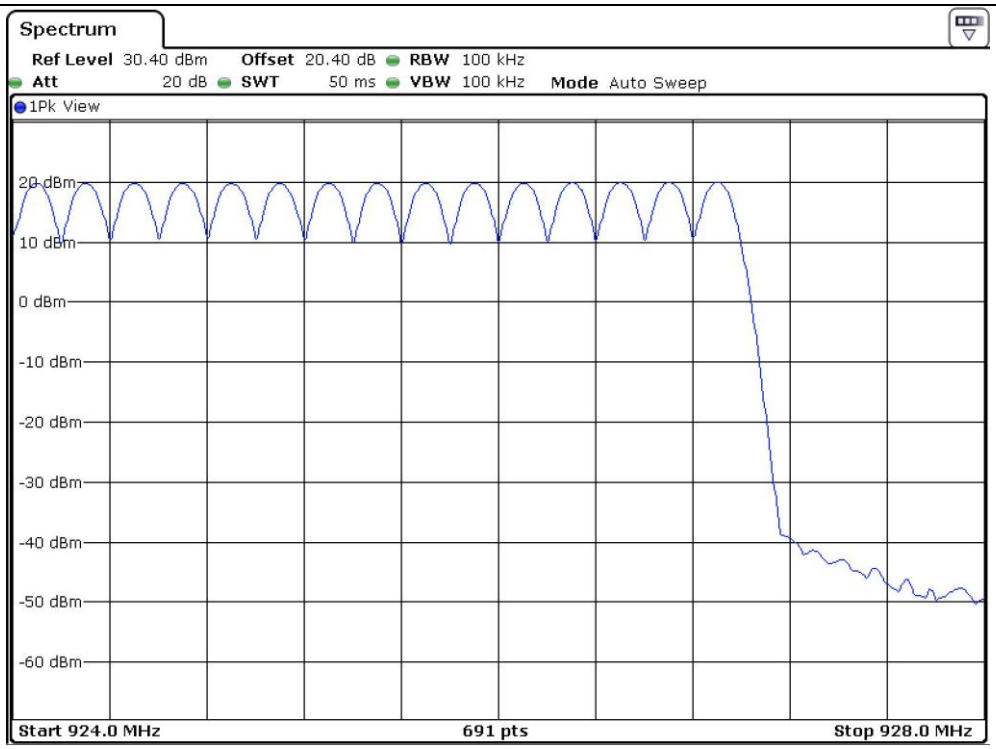

Number of hopping channel: 15

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10. TIME OF OCCUPANCY

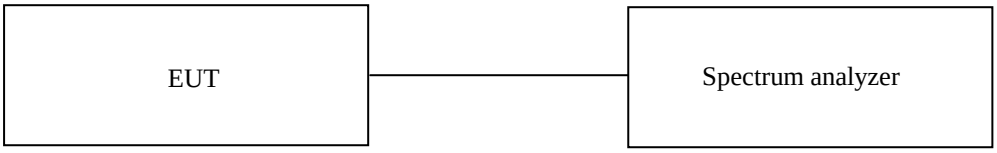
10.1 Operating environment

Temperature : 21.4 ℃

Relative humidity : 43.0 % 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. (Interval)
■ -	FSV30	Rohde & Schwarz	Signal Analyzer	101372	Apr. 28, 2014(1Y)

All test equipment used is calibrated on a regular basis.

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10.4 Test data

-. Test Date : November 09, 2014

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	100.000	3.0	300.00	< 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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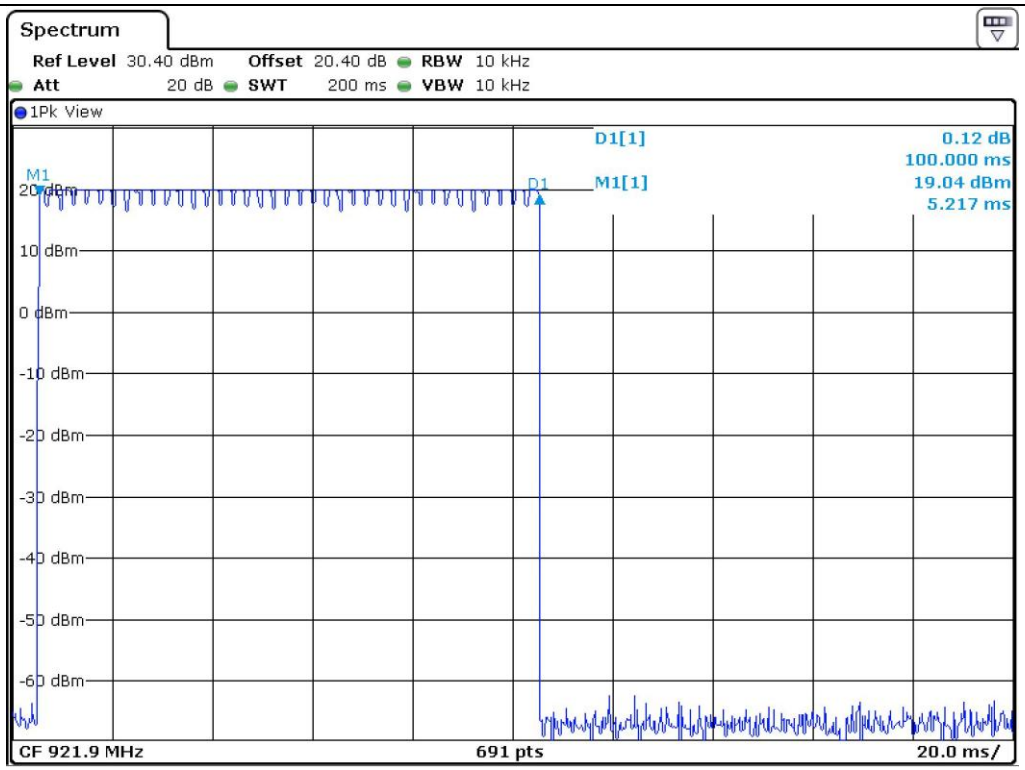
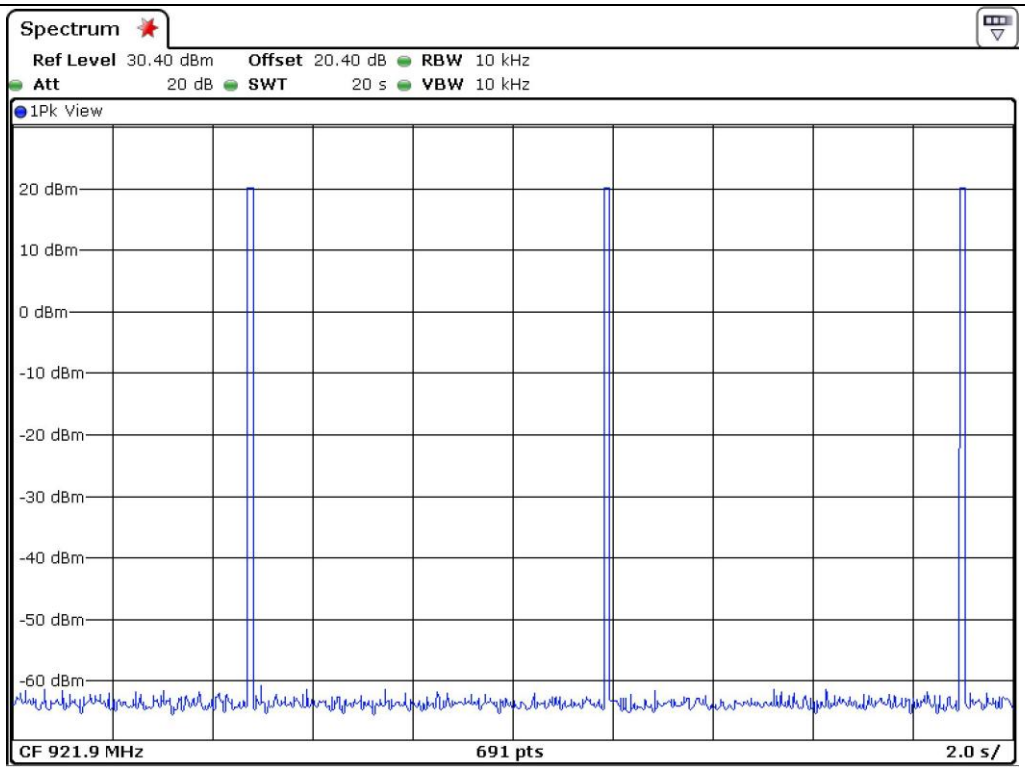


Pulse Time



Number of Transmissions during a 20 second period

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11. MAXIMUM PEAK OUTPUT POWER

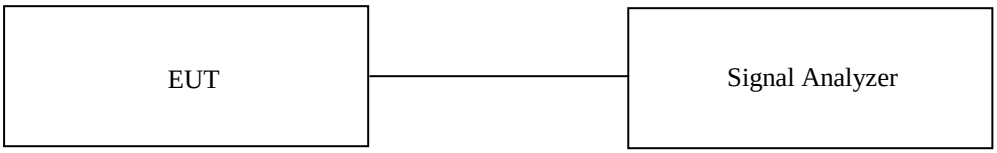
11.1 Operating environment

Temperature : 21.4 ℃

Relative humidity : 43.0 % 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. (Interval)
■ -	FSV30	Rohde & Schwarz	Signal Analyzer	101372	Apr. 28, 2014(1Y)

All test equipment used is calibrated on a regular basis.

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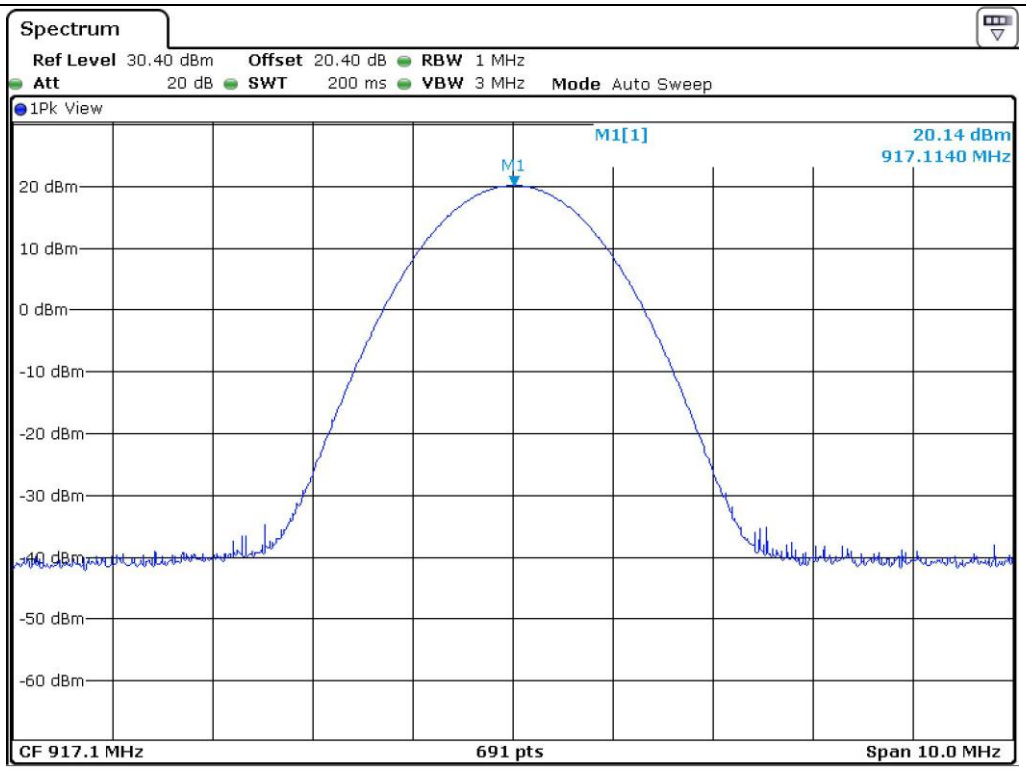
11.4 Test data

-. Test Date : November 09, 2014

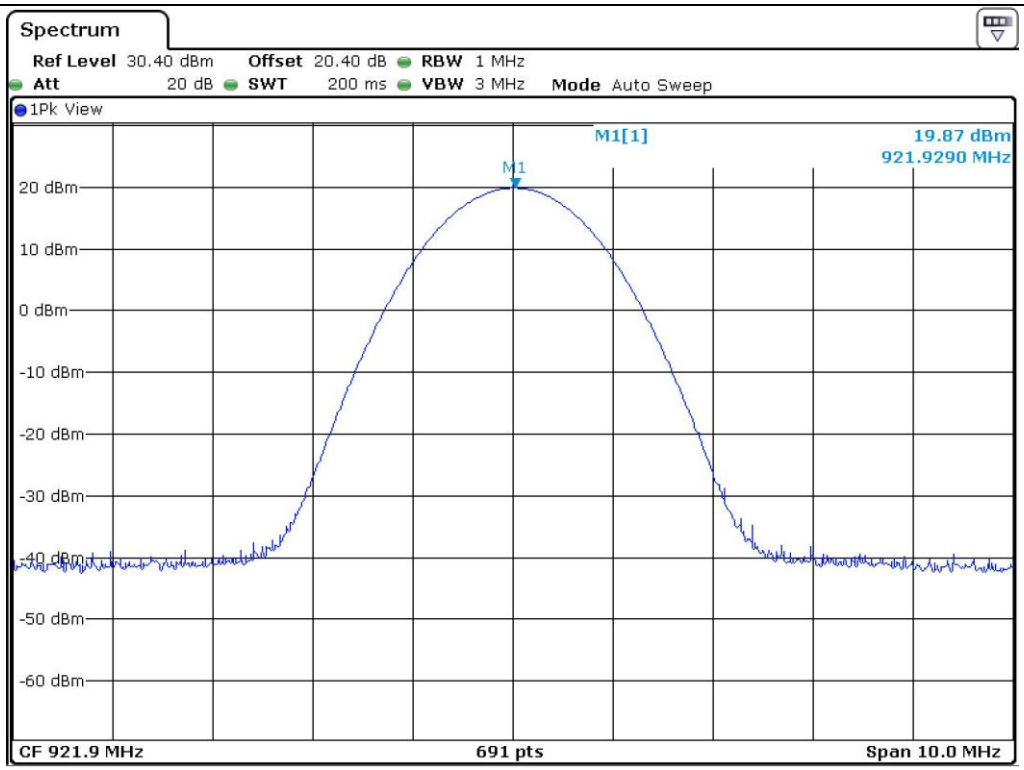
-. Test Result : Pass

CHANNEL	FREQUENCY (MHz)	MEASURED VLAUE (dBm)	MEASURED VLAUE (W)	LIMITS (dBm)	LIMITS (W)
Low	917.1	20.14	0.103	30.00	1.0
Middle	921.9	19.87	0.097	30.00	1.0
High	926.9	19.83	0.096	30.00	1.0

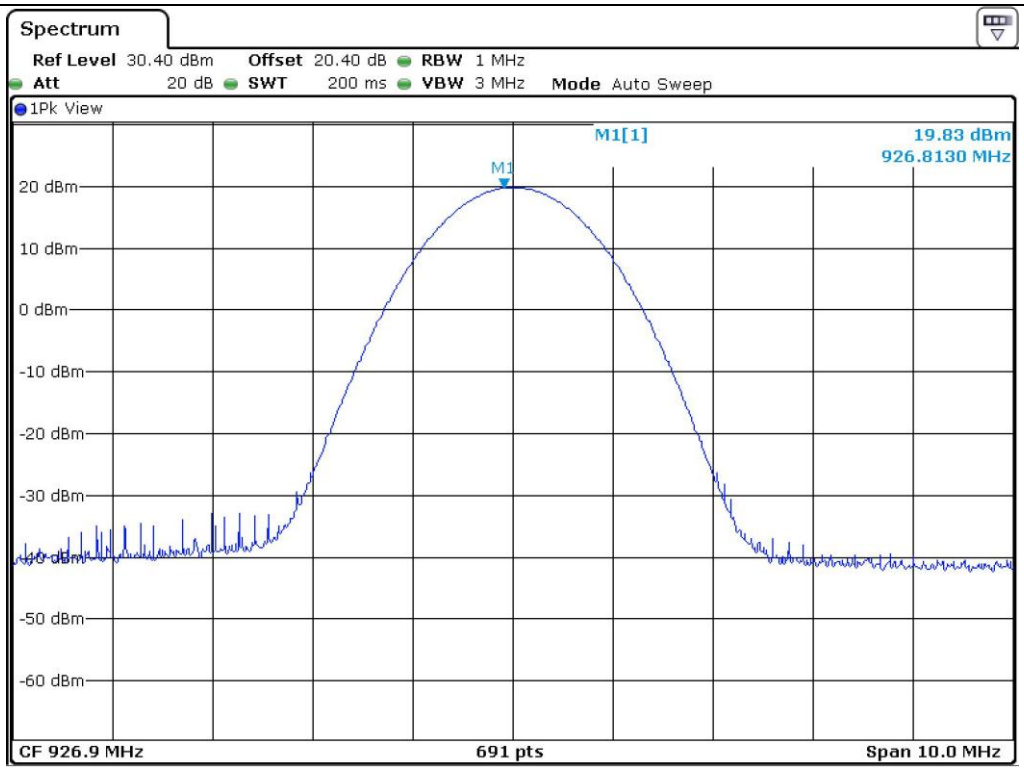
Tested by: Tae-Ho, Kim / Project Engineer



Low Channel



Middle Channel



High Channel

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12. 100 kHz BANDWIDTH OUTSIDE THE FREQUENCY BAND

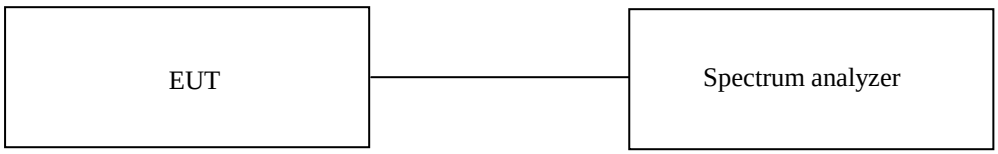
12.1 Operating environment

Temperature : 21.2 ℃

Relative humidity : 43.4 % 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 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)
☐ -	ESCI	Rohde & Schwarz	EMI Test Receiver	101012	Nov. 18, 2013(1Y)
■ -	ESU	Rohde & Schwarz	EMI Test Receiver	100261	Apr. 29, 2014(1Y)
☐ -	8564E	HP	Spectrum Analyzer	3650A00756	Apr. 28, 2014(1Y)
☐ -	FSP	Rohde & Schwarz	Spectrum Analyzer	100017	Nov. 05, 2013(1Y)
■ -	310N	Sonoma Instrument	AMPLIFIER	312544	Apr. 28, 2014(1Y)
■ -	FSV30	Rohde & Schwarz	Signal Analyzer	101372	Apr. 28, 2014(1Y)
■ -	SCU-18	Rohde & Schwarz	PRE-AMPLIFIER	10041	Jan. 20, 2014(1Y)
■ -	MA240	HD GmbH	Antenna Master	N/A	N/A
■ -	HD100	HD GmbH	Position Controller	N/A	N/A
■ -	DS420S	HD GmbH	Turn Table	N/A	N/A
■ -	HFH2-Z2	Rohde & Schwarz	Loop Antenna	879 285/26	Dec. 11, 2012(2Y)
■ -	VULB9163	Schwarzbeck	TRILOG Broadband Antenna	9163-255	May 05, 2014(2Y)
■ -	BBHA9120D	Schwarzbeck	Horn Antenna	BBHA9120D295	Sep. 05, 2013(2Y)
■ -	BBHA9170	Schwarzbeck	Horn Antenna	BBHA9170178	N/A
■ -	83051A	Agilent	Microwave System Preamplifer	3950M00201	Apr. 30, 2014(1Y)

All test equipment used is calibrated on a regular basis.

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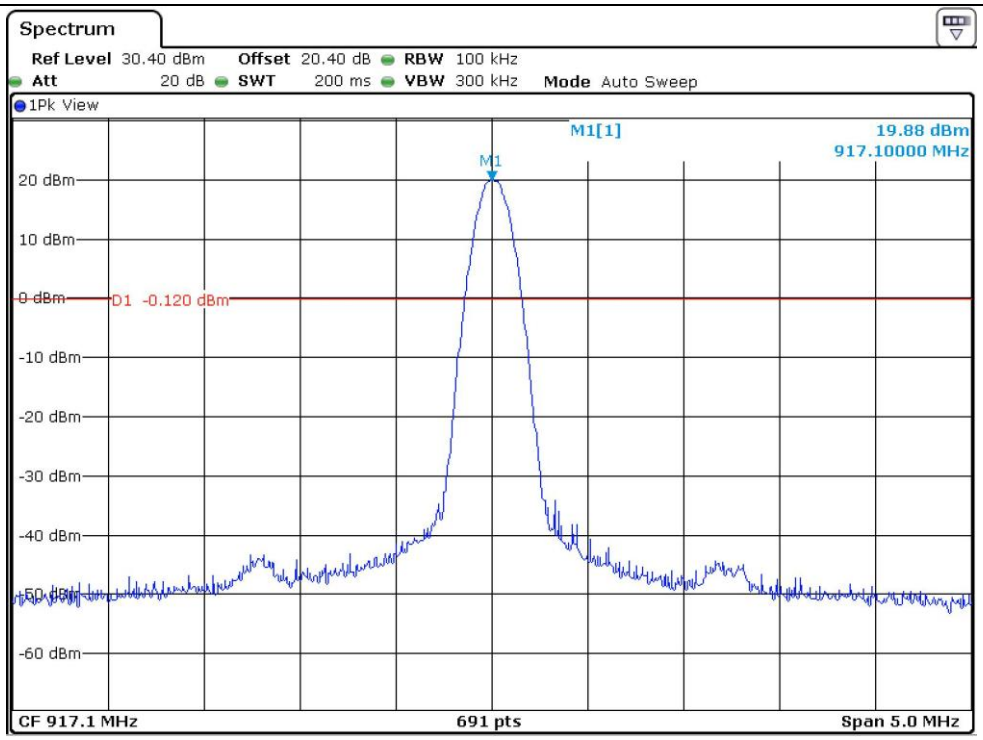
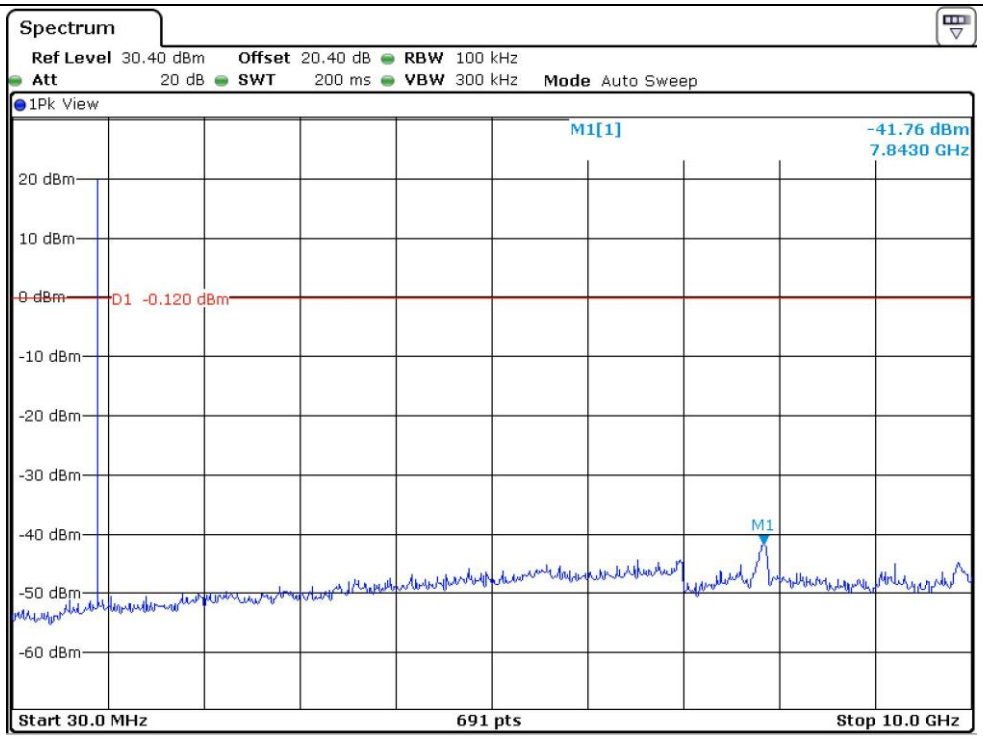
EMC Testing Div : 307-51 Daessangnyeong-ri, Chowol-eup, Gwangju-si, Gyeonggi-do 464-862 Korea (TEL: 82-31-765-8289, FAX: 82-31-766-2904)

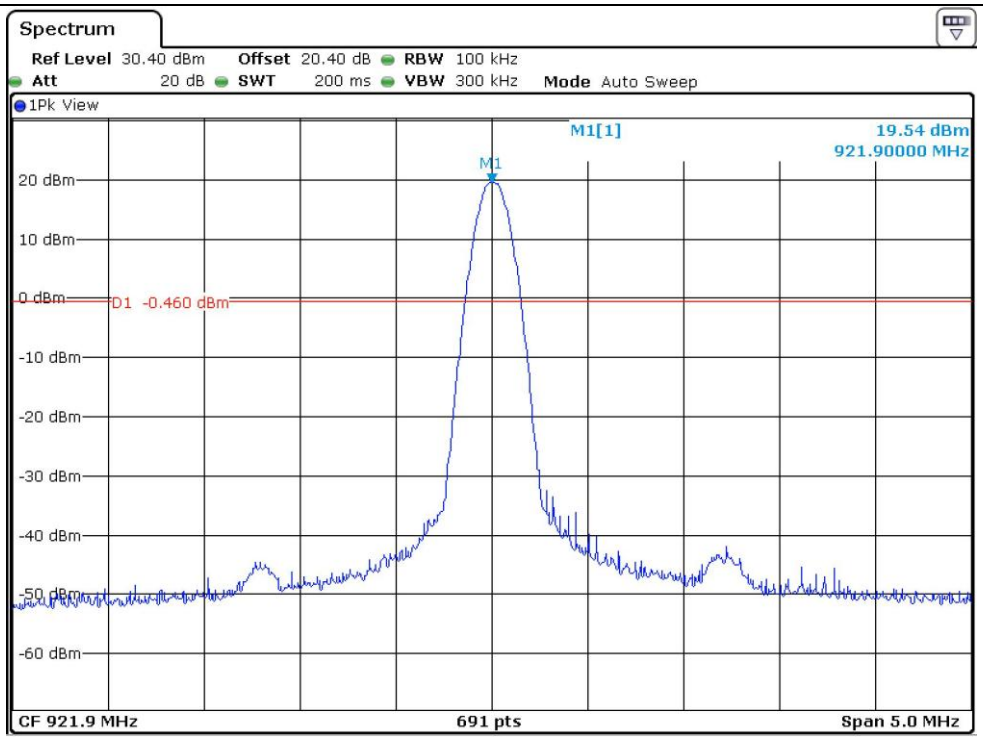
12.5 Test data for conducted emission



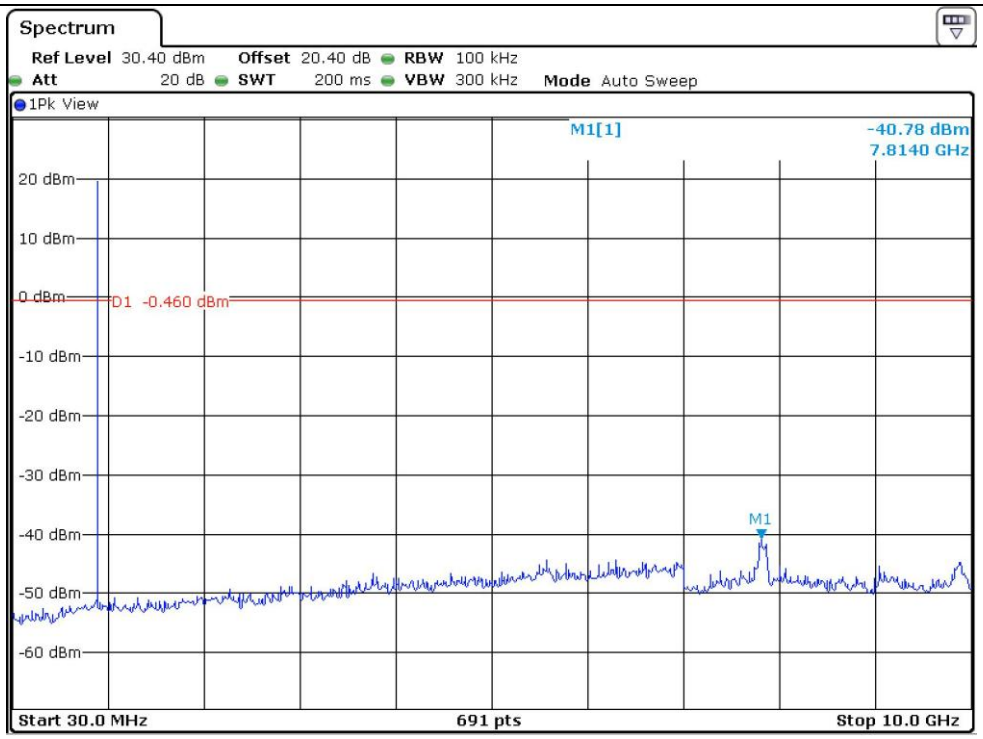
Low Channel



Low Channel



Middle Channel



Middle Channel

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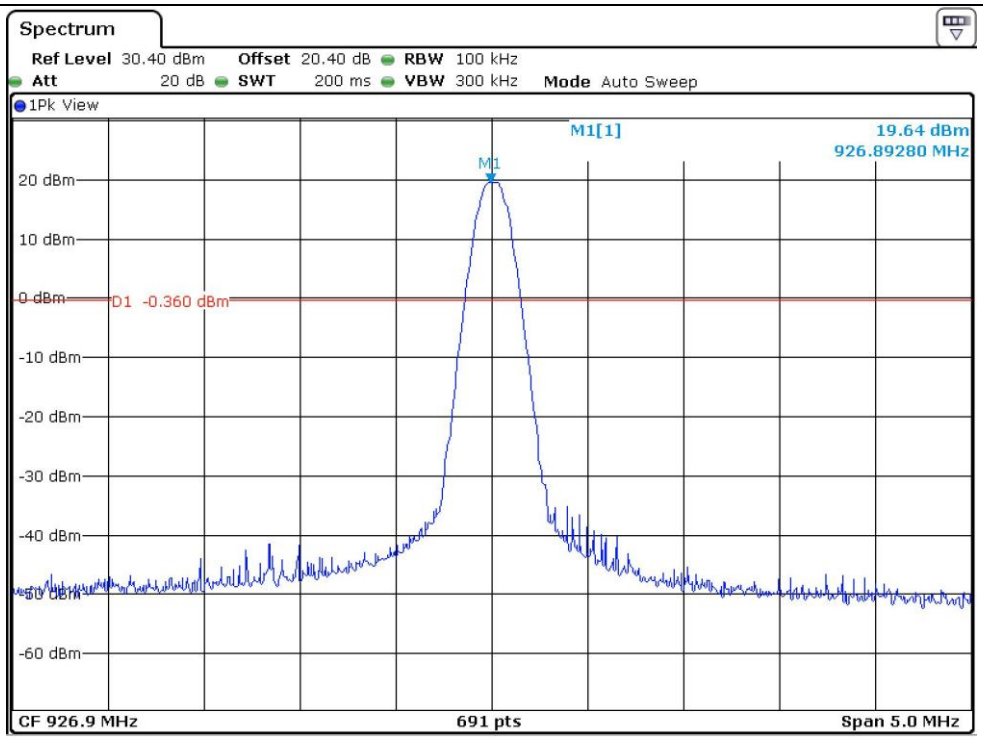
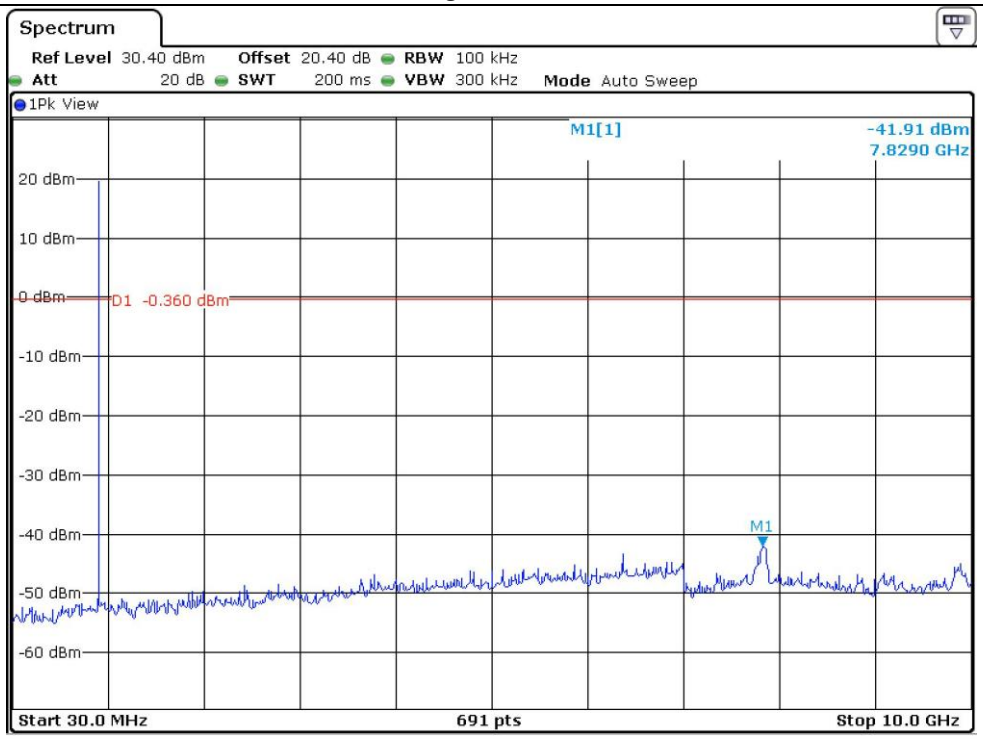


High Channel



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 Restricted Band

-. Test Date : November 09, 2014

-. 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)
901.90	37.48	Peak	H	21.90	12.30	32.30	39.38	53.98	14.60
928.45	37.77	Peak	V				39.67	53.98	14.31

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 : November 09

-. 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	109.60	Peak	H	21.90	12.30	32.30	111.50	-	111.50
	110.20	Peak	V				112.10	-	112.10
1 834.20	44.89	Peak	H	25.30	11.10	42.50	38.79	74.00	35.21
	37.38	Average	H				31.28	54.00	22.72
	46.42	Peak	V				40.32	74.00	33.68
	36.27	Average	V				30.17	54.00	23.83
Test Data for Middle Channel									
921.90	109.40	Peak	H	21.90	12.30	32.30	111.30	-	111.30
	110.50	Peak	V				112.40	-	112.40
1 843.80	44.18	Peak	H	25.30	11.20	42.50	38.18	74.00	35.82
	36.27	Average	H				30.27	54.00	23.73
	45.81	Peak	V				39.81	74.00	34.19
	36.11	Average	V				30.11	54.00	23.89

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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	109.10	Peak	H	21.90	12.30	32.30	111.00	-	111.00
	110.40	Peak	V				112.30	-	112.30
1 853.80	41.58	Peak	H	25.30	11.30	42.50	35.68	74.00	38.32
	36.64	Average	H				30.74	54.00	23.26
	45.57	Peak	V				39.67	74.00	34.33
	36.01	Average	V				30.11	54.00	23.89

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 : 43.4 % R.H. Temperature: 21.2 ℃

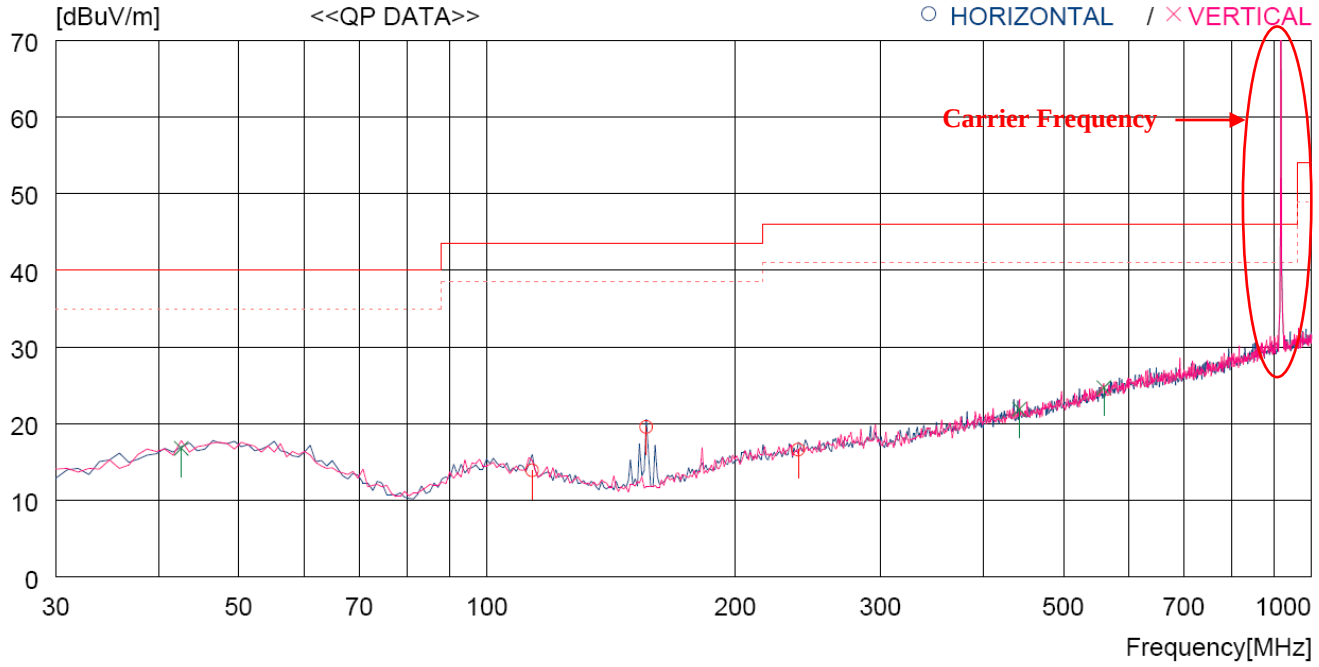
Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.247

Result : PASSED

EUT : RFID Reader Date: November 09, 2014

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	113.420	26.7	12.2	8.1	33.1	13.9	43.5	29.6	300	0
2	156.100	34.7	9.4	8.5	33.0	19.6	43.5	23.9	300	180
3	238.550	27.2	13.3	9.1	33.0	16.6	46.0	29.4	300	103
----- Vertical ------										
4	42.610	27.7	15.0	7.3	33.2	16.8	40.0	23.2	300	359
5	442.251	27.1	17.5	10.3	33.0	21.9	46.0	24.1	200	116
6	559.619	27.4	19.6	10.9	33.2	24.7	46.0	21.3	400	8

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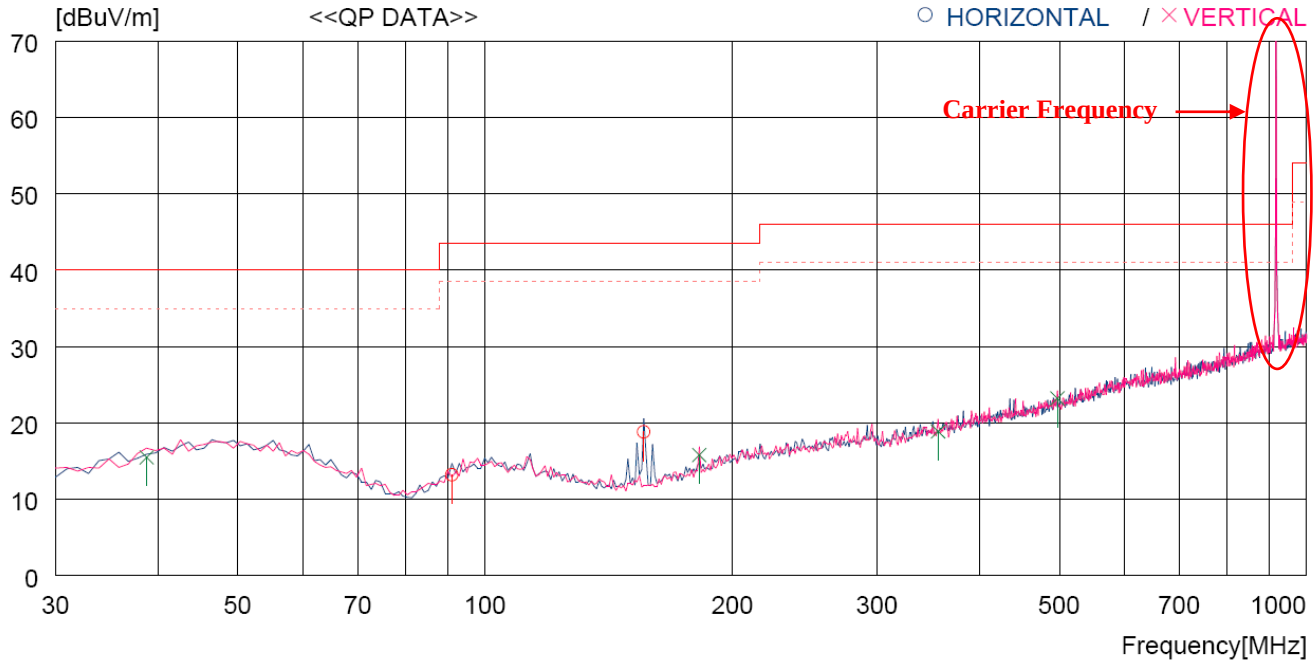
EMC Testing Div : 307-51 Daessangnyeong-ri, Chowol-eup, Gwangju-si, Gyeonggi-do 464-862 Korea (TEL: 82-31-765-8289, FAX: 82-31-766-2904)

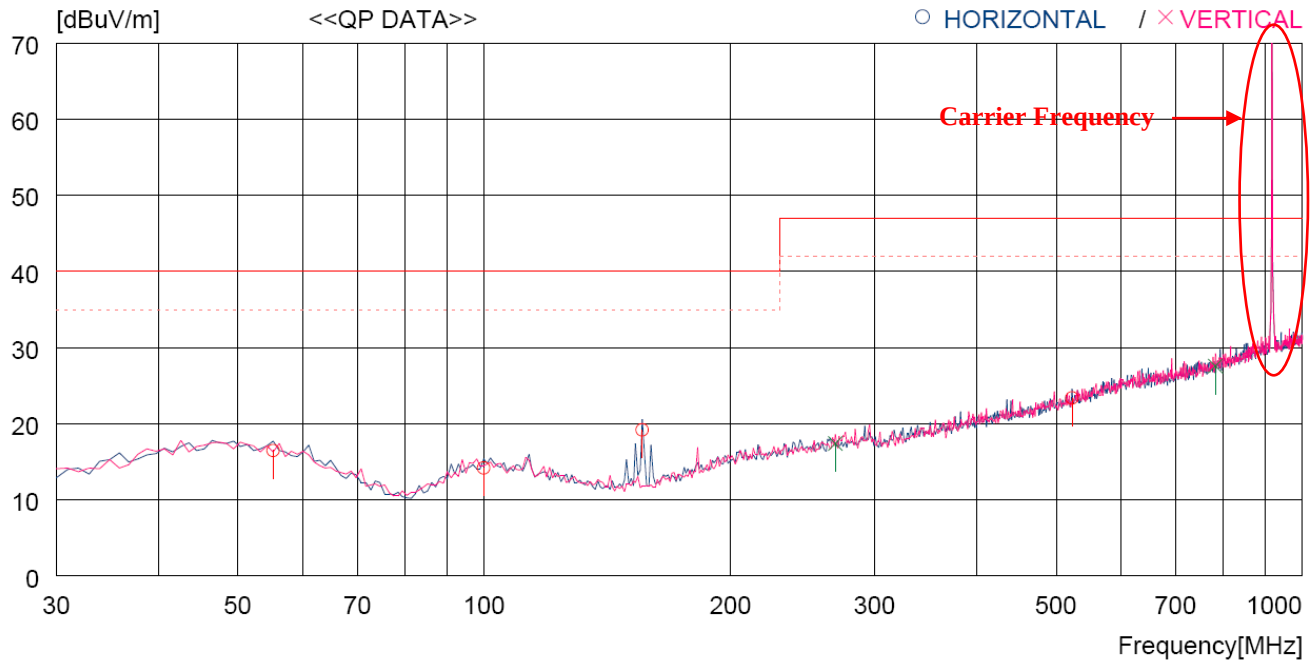
Operating condition : Middle Channel



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	91.110	26.9	11.6	7.8	33.1	13.2	43.5	30.3	300	0
2	156.100	33.9	9.4	8.5	33.0	18.8	43.5	24.7	300	180
----- Vertical ------										
3	38.730	27.1	14.4	7.2	33.2	15.5	40.0	24.5	300	359
4	182.290	30.1	10.0	8.7	33.0	15.8	43.5	27.7	100	359
5	355.920	26.1	16.0	9.8	33.0	18.9	46.0	27.1	300	230
6	497.541	27.3	18.4	10.6	33.1	23.2	46.0	22.8	400	0

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)

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]
----- Horizontal ------										
1	55.220	27.6	14.6	7.4	33.1	16.5	40.0	23.5	300	243
2	99.840	25.7	13.6	8.0	33.1	14.2	40.0	25.8	100	33
3	156.100	34.3	9.4	8.5	33.0	19.2	40.0	20.8	300	180
4	522.760	26.9	18.9	10.7	33.1	23.4	47.0	23.6	200	54
----- Vertical ------										
5	268.620	27.1	14.0	9.3	33.0	17.4	47.0	29.6	200	0
6	782.712	26.8	22.0	11.9	33.1	27.6	47.0	19.4	300	236

Tested by: Tae-Ho, Kim / Project Engineer

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)
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12.6.3.2 Test Data for Below 30 MHz

-. Test Date : November 09, 2014

-. 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 : November 09, 2014

-. 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.									

Tested by: Tae-Ho, Kim / Project Engineer

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)

13. RADIATED EMISSION TEST

13.1 Operating environment

Temperature : 21.2 ℃

Relative humidity : 43.4 % 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)
☐ -	ESCI	Rohde & Schwarz	EMI Test Receiver	101012	Nov. 18, 2013(1Y)
■ -	ESU	Rohde & Schwarz	EMI Test Receiver	100261	Apr. 29, 2014(1Y)
☐ -	8564E	HP	Spectrum Analyzer	3650A00756	Apr. 28, 2014(1Y)
☐ -	FSP	Rohde & Schwarz	Spectrum Analyzer	100017	Nov. 05, 2013(1Y)
■ -	310N	Sonoma Instrument	AMPLIFIER	312544	Apr. 28, 2014(1Y)
■ -	FSV30	Rohde & Schwarz	Signal Analyzer	101372	Apr. 28, 2014(1Y)
■ -	SCU-18	Rohde & Schwarz	PRE-AMPLIFIER	10041	Jan. 20, 2014(1Y)
■ -	MA240	HD GmbH	Antenna Master	N/A	N/A
■ -	HD100	HD GmbH	Position Controller	N/A	N/A
■ -	DS420S	HD GmbH	Turn Table	N/A	N/A
■ -	HFH2-Z2	Rohde & Schwarz	Loop Antenna	879 285/26	Dec. 11, 2012(2Y)
■ -	VULB9163	Schwarzbeck	TRILOG Broadband Antenna	9163-255	May 05, 2014(2Y)
☐ -	BBHA9120D	Schwarzbeck	Horn Antenna	BBHA9120D295	Sep. 05, 2013(2Y)
☐ -	BBHA9170	Schwarzbeck	Horn Antenna	BBHA9170178	N/A
■ -	83051A	Agilent	Microwave System Preamplifer	3950M00201	Apr. 30, 2014(1Y)

All test equipment used is calibrated on a regular basis.

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)

13.5 Test data for Charging Mode

13.5.1 Test data for 30 MHz ~ 1 000 MHz

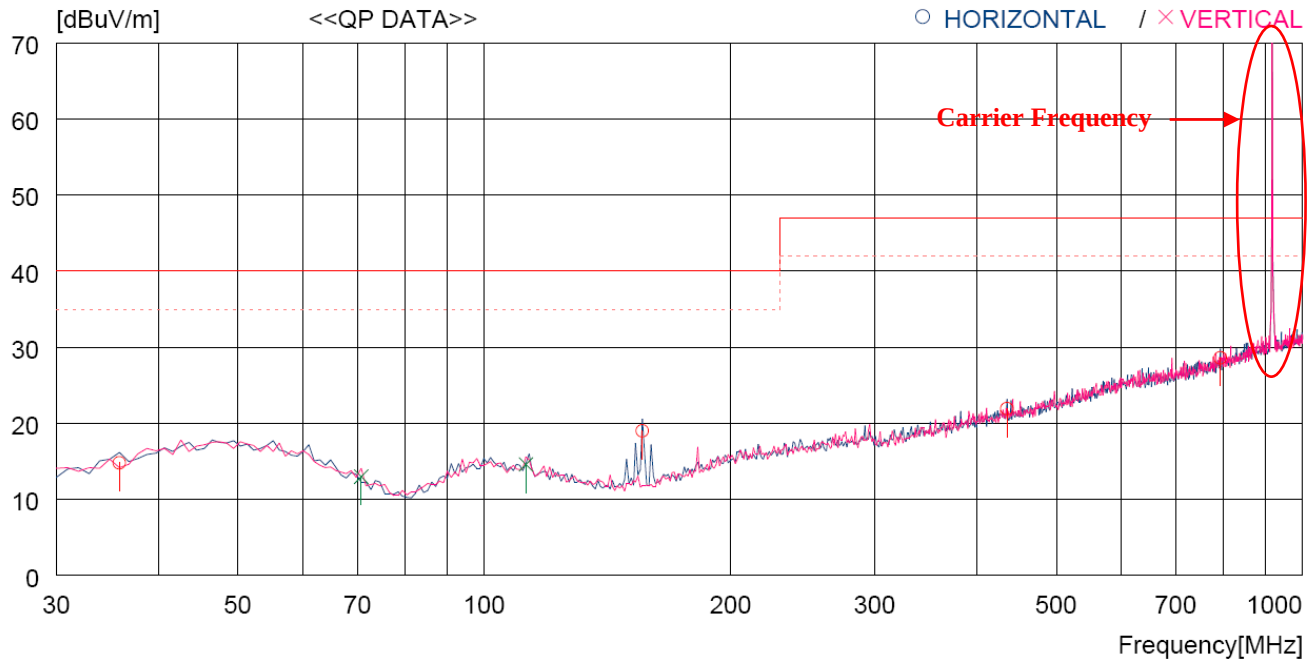
Humidity Level : 43.4 % R.H. Temperature: 21.2 ℃

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

Result : PASSED

EUT : RFID Reader Date: November 09, 2014

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	35.820	27.3	13.6	7.1	33.2	14.8	40.0	25.2	300	5
2	156.100	34.1	9.4	8.5	33.0	19.0	40.0	21.0	300	180
3	435.461	27.2	17.4	10.3	33.0	21.9	47.0	25.1	200	359
4	793.382	27.6	22.1	12.0	33.1	28.6	47.0	18.4	400	40
----- Vertical ------										
5	70.740	28.4	10.1	7.6	33.1	13.0	40.0	27.0	100	68
6	112.450	27.3	12.3	8.1	33.1	14.6	40.0	25.4	100	359

Tested by: Tae-Ho, Kim / Project Engineer

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13.5.2 Test data for Below 30 MHz

-. Test Date : November 09, 2014

-. 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 : November 09, 2014

-. 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 : 21.2 ℃

Relative humidity : 43.4 % 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)
■ -	ESHS10	Rohde & Schwarz	EMI Test Receiver	834467/007	Jul. 15, 2014 (1Y)
■ -	NSLK 8128	Schwarzbeck	LISN	8128-216	Apr. 11, 2014 (1Y)
☐ -	3825/2	EMCO	LISN	9109-1867	Apr. 29, 2014 (1Y)

All test equipment used is calibrated on a regular basis.

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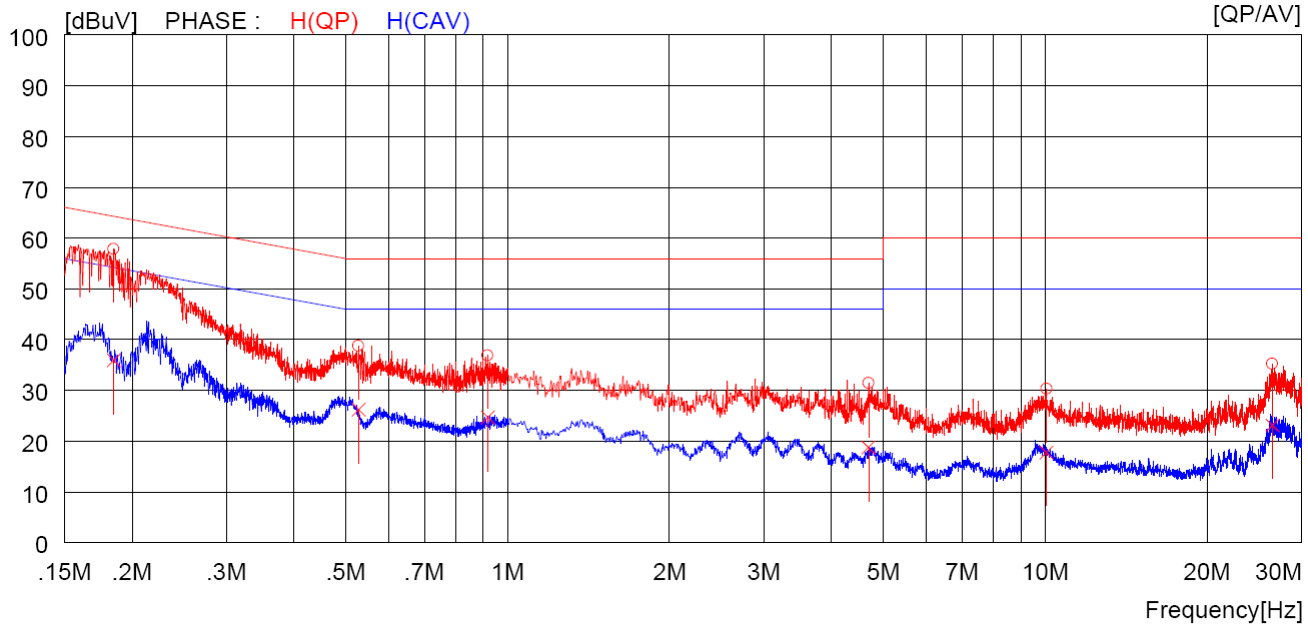
14.4 Test data for Charging Mode

-. Test Date : November 09, 2014

-. Resolution bandwidth : 9 kHz

-. Frequency range : 0.15 MHz ~ 30 MHz

-. Tested Line : HOT LINE



NO	FREQ	READING QP [dBuV]	READING AV [dBuV]	C.FACTOR [dB]	RESULT QP [dBuV]	RESULT AV [dBuV]	LIMIT QP [dBuV]	LIMIT AV [dBuV]	MARGIN QP [dBuV]	MARGIN AV [dBuV]	PHASE
	[MHz]										
1	0.18500	47.9	----	10.0	57.9	----	64.3	----	6.4	----	H(QP)
2	0.52800	28.8	----	10.0	38.8	----	56.0	----	17.2	----	H(QP)
3	0.91800	26.9	----	10.0	36.9	----	56.0	----	19.1	----	H(QP)
4	4.69200	21.3	----	10.1	31.4	----	56.0	----	24.6	----	H(QP)
5	10.05000	20.1	----	10.2	30.3	----	60.0	----	29.7	----	H(QP)
6	26.45000	24.5	----	10.7	35.2	----	60.0	----	24.8	----	H(QP)
7	0.18500	----	25.9	10.0	----	35.9	----	54.3	----	18.4	H(CAV)
8	0.52800	----	16.2	10.0	----	26.2	----	46.0	----	19.8	H(CAV)
9	0.91800	----	14.7	10.0	----	24.7	----	46.0	----	21.3	H(CAV)
10	4.69200	----	8.7	10.1	----	18.8	----	46.0	----	27.2	H(CAV)
11	10.05000	----	7.6	10.2	----	17.8	----	50.0	----	32.2	H(CAV)
12	26.45000	----	12.4	10.7	----	23.1	----	50.0	----	26.9	H(CAV)

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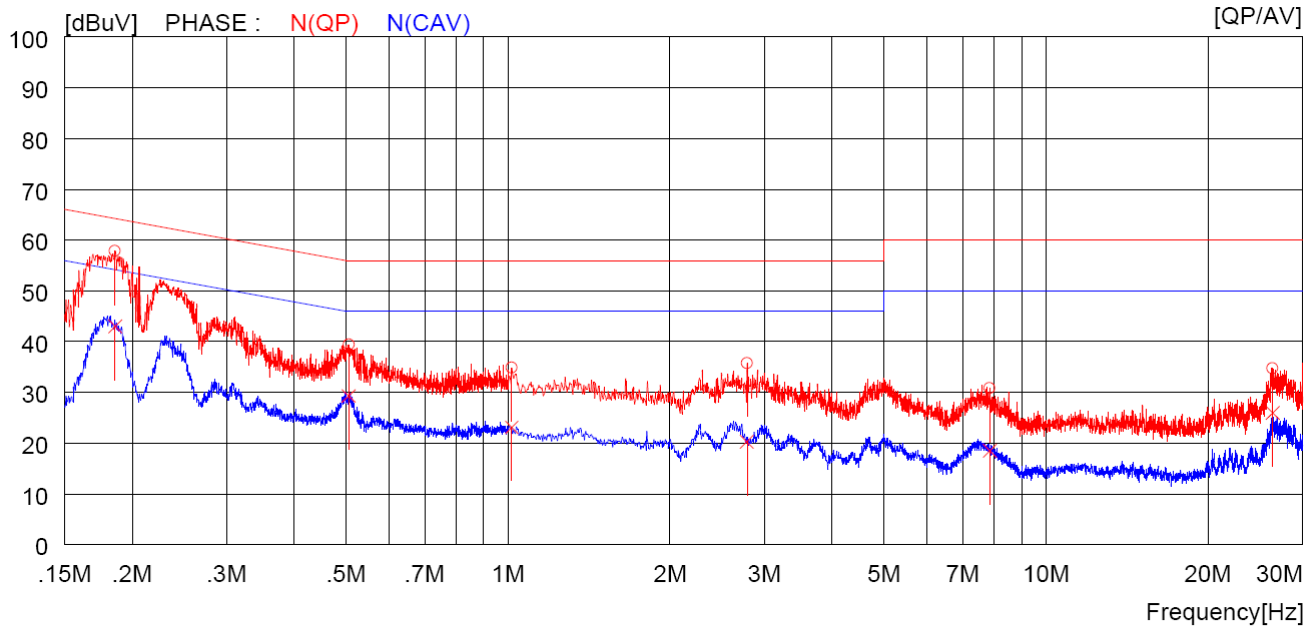
-. Tested Line : NEUTRAL LINE



NO	FREQ [MHz]	READING QP [dBuV]	READING AV [dBuV]	C.FACTOR [dB]	RESULT QP [dBuV]	RESULT AV [dBuV]	LIMIT QP [dBuV]	LIMIT AV [dBuV]	MARGIN QP [dBuV]	MARGIN AV [dBuV]	PHASE
1	0.18600	47.8	----	10.0	57.8	----	64.2	----	6.4	----	N(QP)
2	0.50600	29.4	----	10.0	39.4	----	56.0	----	16.6	----	N(QP)
3	1.01600	24.9	----	10.0	34.9	----	56.0	----	21.1	----	N(QP)
4	2.78000	25.8	----	10.0	35.8	----	56.0	----	20.2	----	N(QP)
5	7.85500	20.6	----	10.2	30.8	----	60.0	----	29.2	----	N(QP)
6	26.38000	24.1	----	10.7	34.8	----	60.0	----	25.2	----	N(QP)
7	0.18600	----	33.0	10.0	----	43.0	----	54.2	----	11.2	N(CAV)
8	0.50600	----	19.3	10.0	----	29.3	----	46.0	----	16.7	N(CAV)
9	1.01600	----	13.1	10.0	----	23.1	----	46.0	----	22.9	N(CAV)
10	2.78000	----	10.3	10.0	----	20.3	----	46.0	----	25.7	N(CAV)
11	7.85500	----	8.3	10.2	----	18.5	----	50.0	----	31.5	N(CAV)
12	26.38000	----	15.3	10.7	----	26.0	----	50.0	----	24.0	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.

Tested by: Tae-Ho, Kim / Project Engineer

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