

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

Test Report No. : E128R-033

AGR No. : A127A-030

Applicant : Golfzon Co., Ltd.
Address : 898, Taprip-dong, Yuseong-gu, Daejeon, Korea

Manufacturer : IDRO Co., Ltd
Address : Room#703, 1017, Ingye-dong, Paldal-gu, Suwon-si, Gyeonggi-do, Korea, 442-070

Type of Equipment : UHF RFID Reader

FCC ID : N5Y-IDRO900F2

IC Certification No. : 10324A-IDRO900F2

Model Name : IDRO900F2

Serial number : N/A

Total page of Report : 68 pages (including this page)

Date of Incoming : August 16, 2012

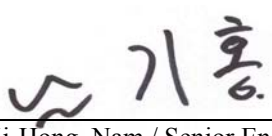
Date of issue : August 24, 2012

SUMMARY

The equipment complies with the regulation; **FCC PART 15 SUBPART C SECTION 15.247 and Industry Canada RSS-210, Issue 8 & RSS-Gen Issue 3.**

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.

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ONETECH Corp.

Reviewed by: 
Y. K. Kwon / Exe. Managing Director
ONETECH Corp.

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Revision History

Issued Report No.	Issued Date	Revisions	Effect Section
E128R-033	August 24, 2012	Initial Issue	All

1. VERIFICATION OF COMPLIANCE

APPLICANT : Golfzon Co., Ltd.
 ADDRESS : 898, Taprip-dong, Yuseong-gu, Daejeon, Korea
 CONTACT PERSON : Jong-Sun, Kim / Advisory Research Engineer
 TELEPHONE NO : +82-70-8660-4025
 FCC ID : N5Y-IDRO900F2
 IC Certification No. : 10324A-IDRO900F2
 MODEL NAME : IDRO900F2
 SERIAL NUMBER : N/A
 DATE : August 24, 2012

DEVICE TYPE	FCC: DSS-PART15 Spread Spectrum Transmitter IC: Lower Power License - Exempt Radio-communication Devices
KIND OF EQUIPMENT	UHF RFID Reader
THIS REPORT CONCERNS	Original Grant
MEASUREMENT PROCEDURES	ANSI C63.4: 2003
TYPE OF EQUIPMENT TESTED	Pre-Production
KIND OF EQUIPMENT AUTHORIZATION REQUESTED	Certification
EQUIPMENT WILL BE OPERATED UNDER IC RULES PART(S)	FCC PART 15 SUBPART C Section 15.247 RSS-210 Issue 8, RSS-Gen Issue 3
MODIFICATIONS ON THE EQUIPMENT TO ACHIEVE COMPLIANCE	None
FINAL TEST WAS CONDUCTED ON	3 m open area test site

- The above equipment was tested by ONETECH Corp. for compliance with the requirement set forth in the FCC & IC Rules and Regulations. This said equipment in the configuration described in this report, shows the maximum emission levels emanating from equipment are within the compliance requirements.

2. TEST SUMMARY

2.1 Test items and results

SECTION		TEST ITEMS	RESULTS
FCC	IC		
15.247(a)(1)(i)	RSS-210, A8.1(c)	Carrier Frequency Separation	PASS
15.247(a)(1)(i)	RSS-210, A8.1(c)	Minimum Number of Hopping Channels	PASS
15.247(a)(1)(i)	RSS-210, A8.1(d)	Average Time of Occupancy	PASS
15.247(b)(2)	RSS-210, A8.4(1)	Maximum Peak Conducted Output Power	PASS
15.247(d)	RSS-210, A8.5	100 kHz Bandwidth Outside the Frequency Band	PASS
15.247(d)	RSS-210, A8.5	Radiated Emission which fall in the Restricted Band	PASS
15.209	RSS-Gen, Section 7.2.5	Radiated Emission Limits	PASS
15.207	RSS-Gen, Section 7.2.4	Conducted Limits	PASS
15.203	RSS-Gen, Section 7.1.2	Antenna 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 section 15.225 and the IC requirements stated in section 6 of the regulation, RSS-Gen Issue 3.

2.5 Test Methodology

Both conducted and radiated testing was performed according to the procedures in ANSI C63.4: 2009 and RSS-210, Issue 8 & RSS-Gen Issue 3. Radiated testing was performed at a distance of 3 m from EUT to the antenna.

2.6 Test Facility

The open area test site and conducted measurement facilities are located on at 301-14, Daessangnyeong-ri, Chowol-eup, Gwangju-si, Gyeonggi-do, 464-862, Korea. The Onetech Corp. has been accredited as a Conformity Assessment Body (CAB) with designation number KR0013 and was submitted to the Industry Canada on April 14, 2009. (Registration Number: IC 3736A-2).

The open area test site and conducted measurement facilities are located on at 307-51 Daessangnyeong-ri, Chowol-eup, Gwangju-si, Gyeonggi-do, 464-862, Korea. Description details of test facilities were submitted to the Industry Canada on April 14, 2009. (Registration Number: IC 3736A-2)

3. GENERAL INFORMATION

3.1 Product Description

The Golfzon Co., Ltd., Model IDRO900F2 (referred to as the EUT in this report) is a UHF RFID Reader. The product specification described herein was obtained from product data sheet or user's manual.

DEVICE TYPE	UHF RFID Reader
TEMPERATURE RANGE	-20 °C ~ +55 °C
OPERATING FREQUENCY	902.75~927.25 MHz
RF OUTPUT POWER	27.2 dBm
NUMBER OF CHANNEL	50 Channels
MODULATION TYPE	ASK
ANTENNA CONNECTOR TYPE	Patch Antenna
ANTENNA GAIN	6 dBi
LIST OF EACH OSC. OR CRYSTAL. FREQ.(FREQ. >= 1 MHz)	20 MHz
NUMBER OF LAYER	MODULE : 6 LAYER POWER B'D : 2 LAYER
EXRERNAL CONNECTOR	ANT PORT(SMA(F)), RS232, DC_JACK

3.2 Alternative type(s)/model(s); also covered by this test report.

-. None

4. EUT MODIFICATIONS

-. None

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	IC Certificate No.
Main Board	N/A	IDRO900F2	N/A
Antenna Board	N/A	HiZen-100RF-ANT REV1.1	N/A

5.2 Peripheral equipment

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

Model	Manufacturer	FCC ID No.	Description	Connected to
IDRO900F2	Golfzon Co., Ltd.	N5Y-IDRO900F2	UHF RFID Reader (EUT)	-
NT-919-CP	NETHOM	N/A	ANTENNA	EUT
NT-919-CP	NETHOM	N/A	ANTENNA	EUT
Latitude D505	DELL	DoC	Notebook PC	EUT

5.3 Mode of operation during the test

The EUT has 2 antennas, but the EUT has RF switch in the device, so multi-continuous transmission shall not be possible, so each antenna operating mode was tested.

For the testing, software used to control the EUT for staying in continuous transmitting and receiving mode is programmed. For final testing, UHF RFID Reader was set at Low Channel (902.75 MHz), Middle Channel (914.75 MHz), and High Channel (927.25 MHz).

5.4 Cable Description for the EUT

Ports Name	Shielded	Ferrite Bead	Metal Shell	Length (m)	Connected to
ANT PORT(SMA(F)),	N	N	N	1.5	ANTENNA
RS232	N	N	N	1.5	Notebook PC
DC JACK	N	N	N	1.5	

5.5 Configuration of Test System

Line Conducted Test: The EUT was connected to adaptor and power adaptor was connected to LISN. All supporting equipments were connected to another LISN. Preliminary Power line Conducted Emission tests were performed by using the procedure in ANSI C63.4: 2009 7.3.3 to determine the worse operating conditions.

Radiated Emission Test: Preliminary radiated emissions test were conducted using the procedure in ANSI C63.4: 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, and RSS-Gen Issue 3, Section 7.1.2, 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)
TX mode	X
RX mode	-

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)
TX mode	X
RX mode	-

7. CARRIER FREQUENCY SEPARATION

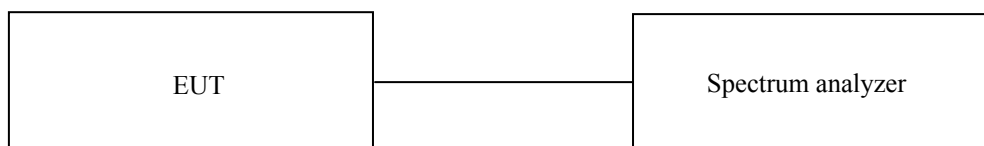
7.1. 20 dB BANDWIDTH & 99 % Occupied Bandwidth

7.1.1 Operating environment

Temperature : 25 °C
Relative humidity : 46 % R.H.

7.1.2 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 and 99 % Occupied Bandwidth is defined.



7.1.3 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
■ - FSV30	Rohde & Schwarz	Signal Analyzer	101372	May 31, 2012(1Y)

All test equipment used is calibrated on a regular basis.

7.1.4 20 dB Bandwidth

-. Test Date : August 16, 2012

-. Test Result : Pass

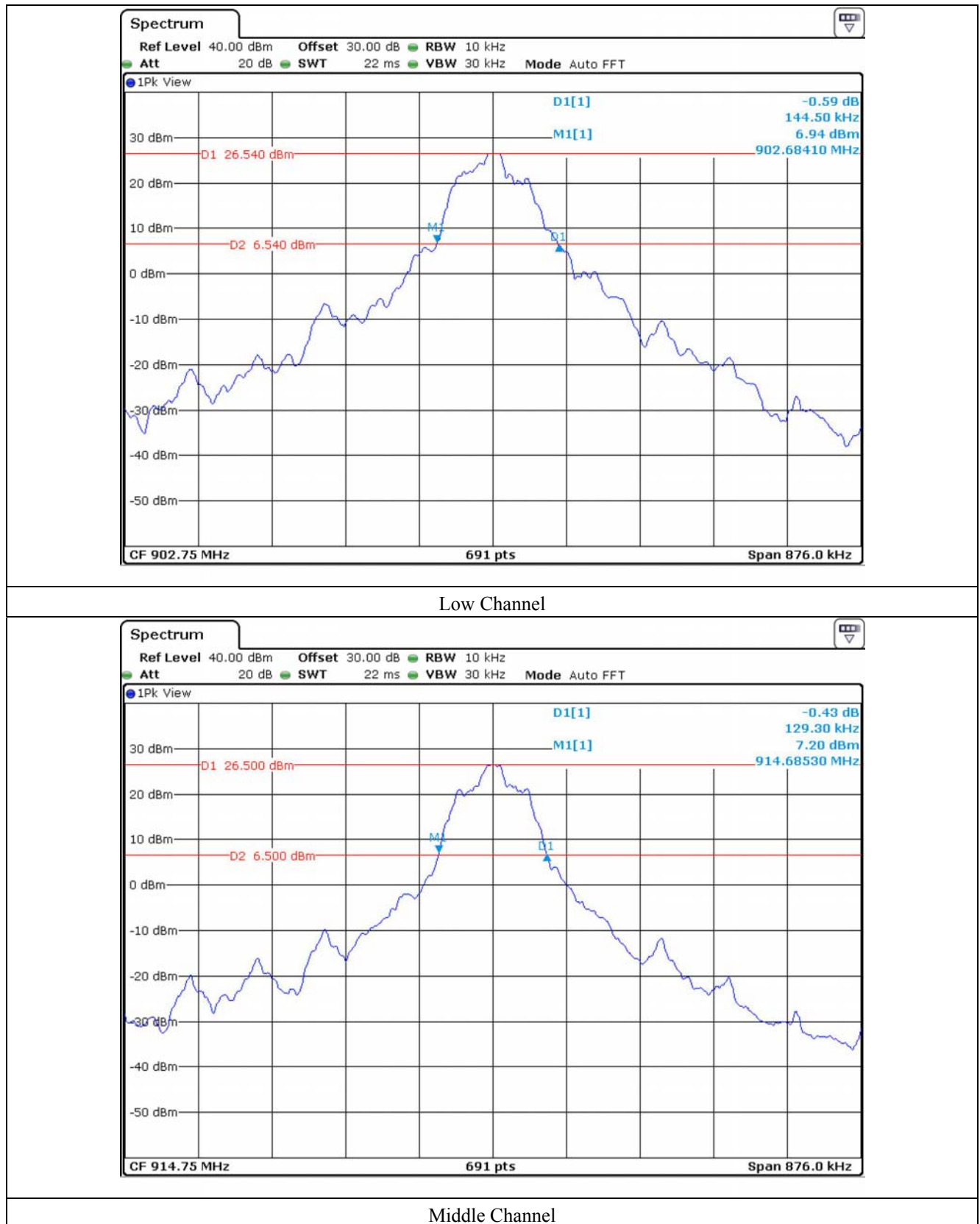
Antenna No.	CHANNEL	FREQUENCY(MHz)	MEASURED VLAUE (kHz)
1	Low	902.75	144.5
	Middle	914.75	129.3
	High	927.25	136.9
2	Low	902.75	144.5
	Middle	914.75	130.6
	High	927.25	139.5

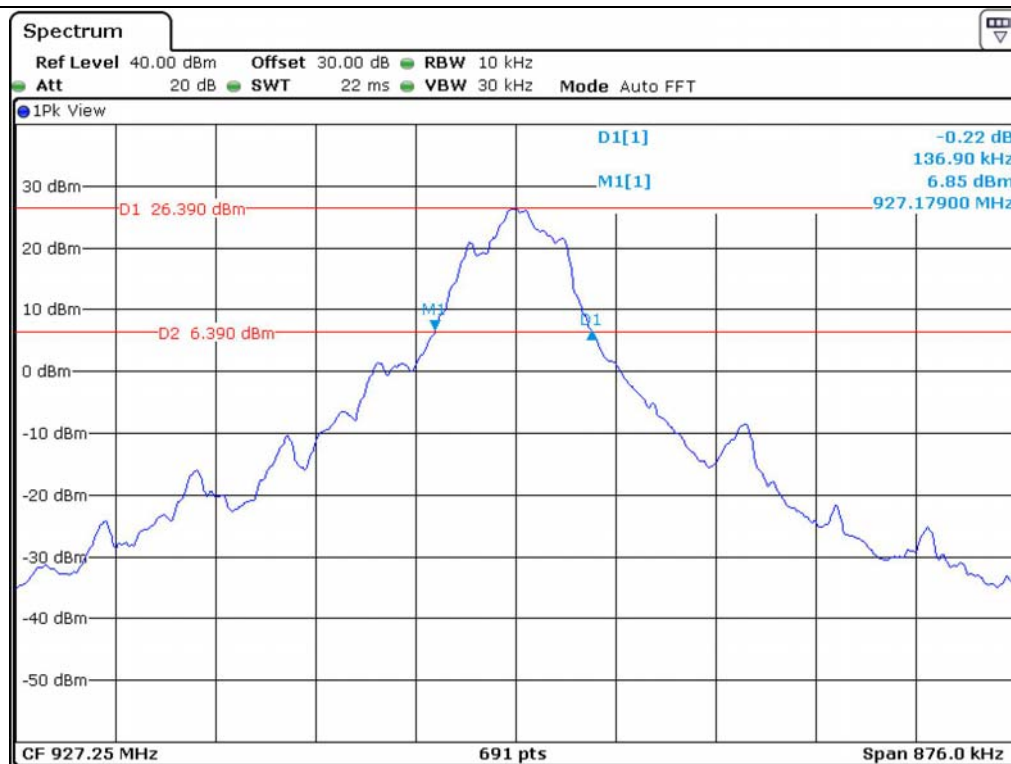
Remark: See next page for an overview sweep performed with peak detector.



Tested by: Chang-Uk, Jun / Engineer

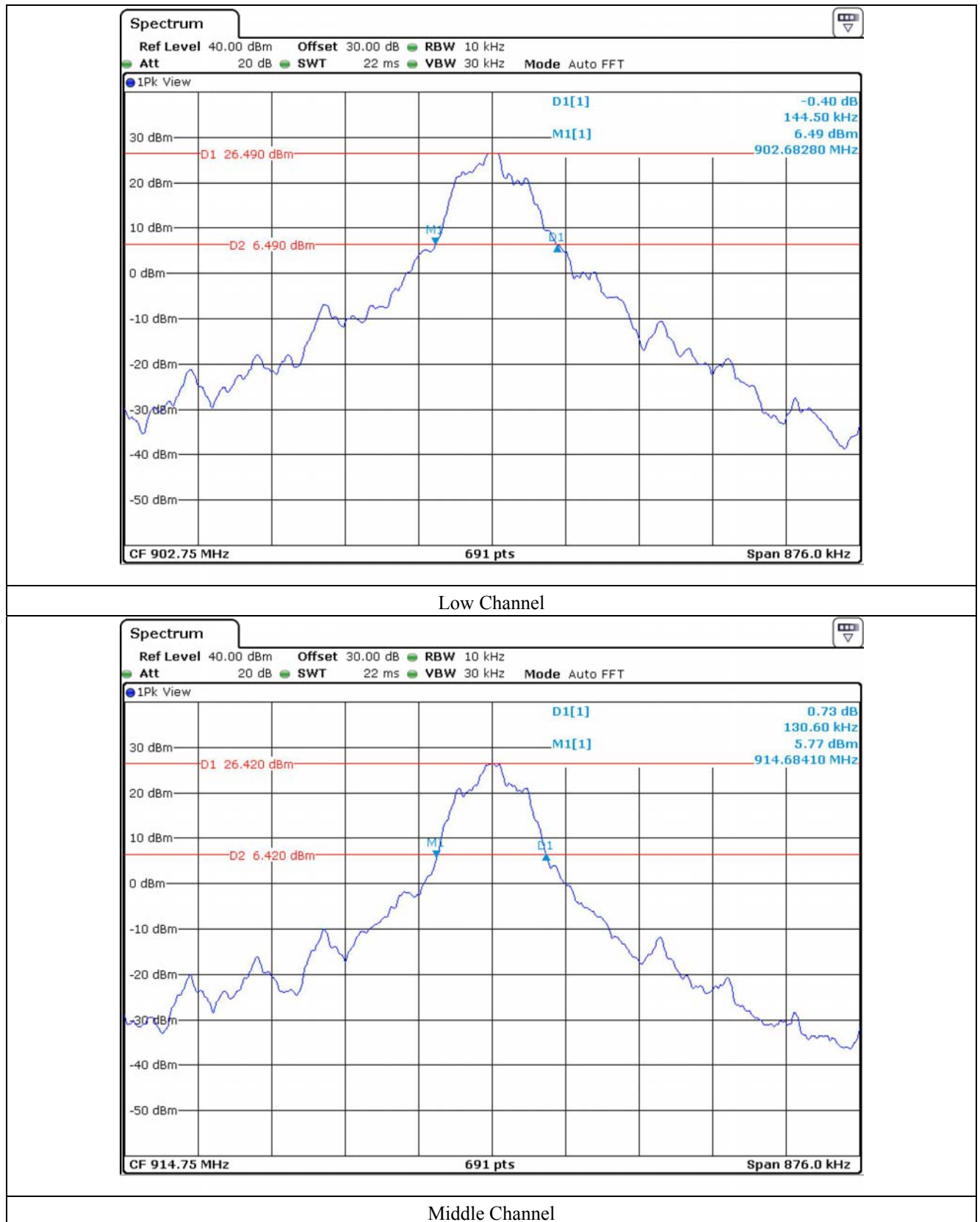
7.1.4.1 Test data for Antenna #1

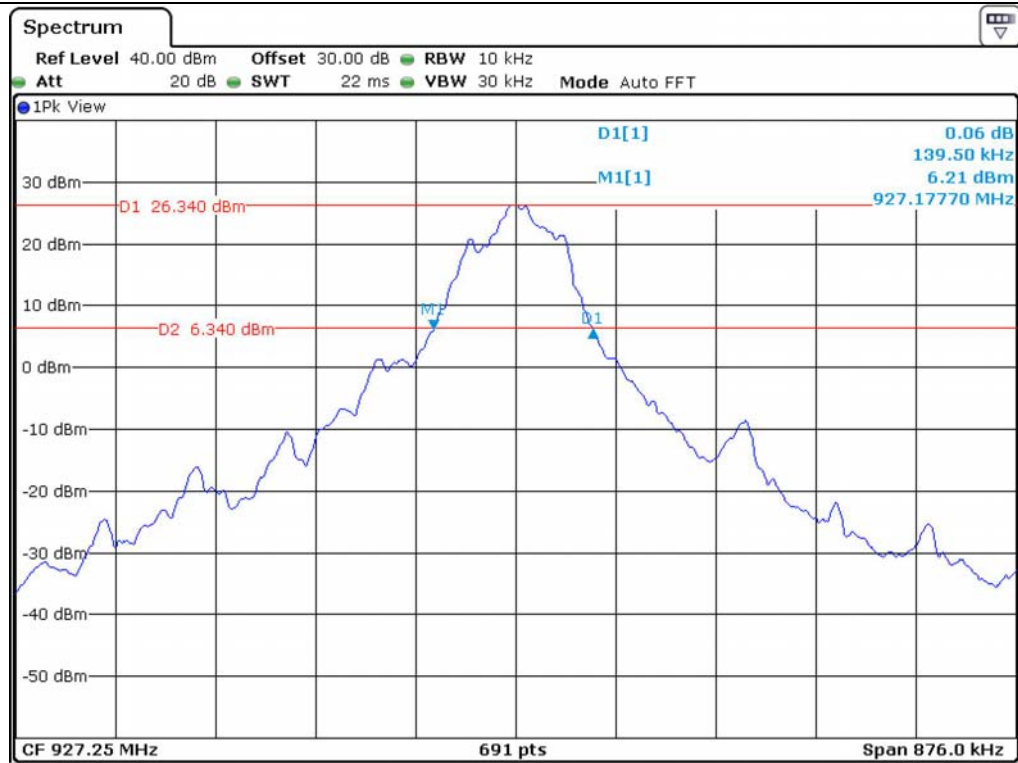




High Channel

7.1.4.2 Test data for Antenna #2





High Channel

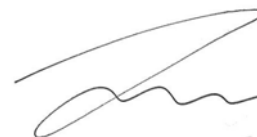
7.1.5 99 % Occupied Bandwidth

- Test Date : August 16, 2012

- Test Result : Pass

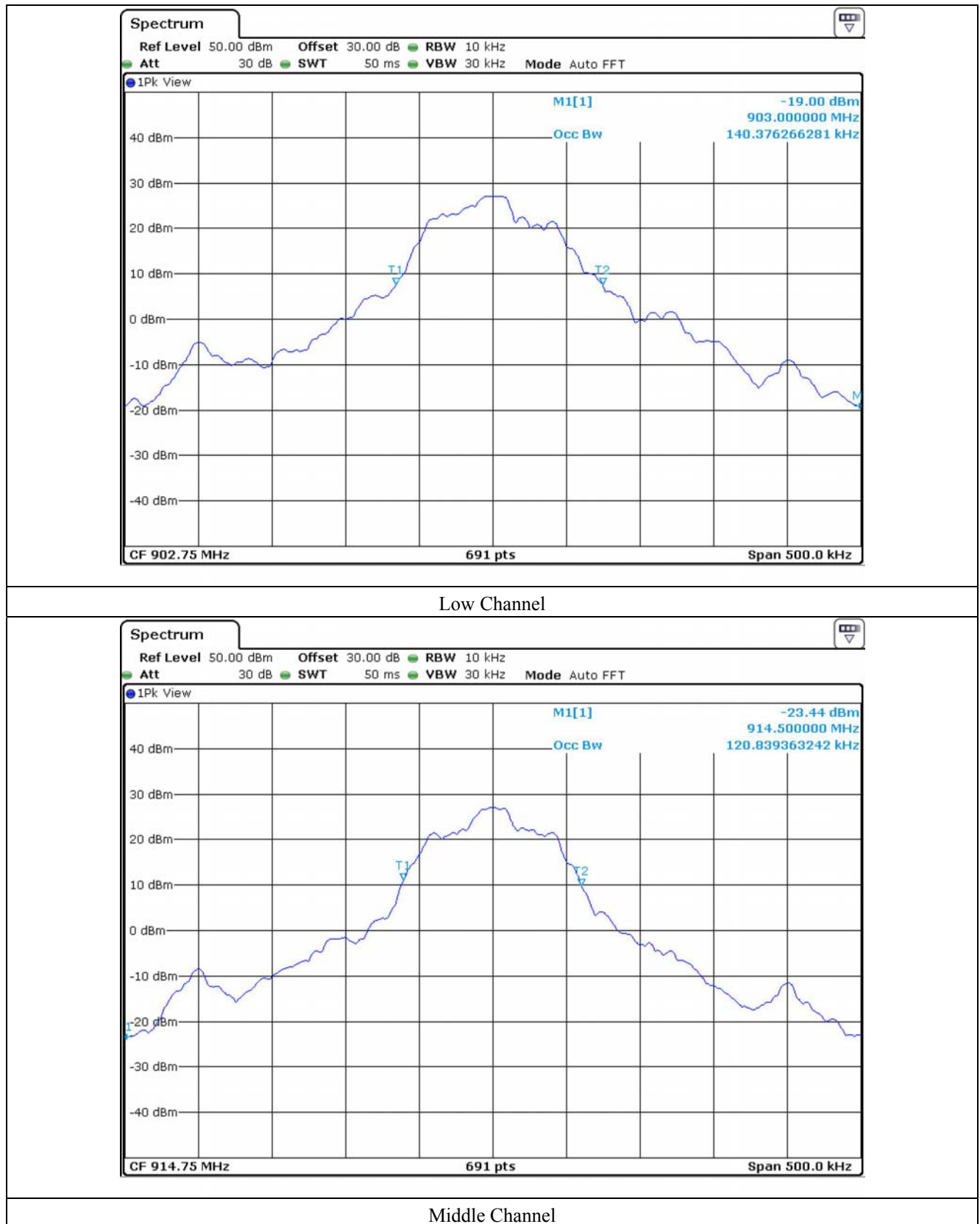
Antenna No.	CHANNEL	FREQUENCY(MHz)	MEASURED VLAUE (kHz)
1	Low	902.75	140.3
	Middle	914.75	120.8
	High	927.25	132.4
2	Low	902.75	141.0
	Middle	914.75	120.1
	High	927.25	141.0

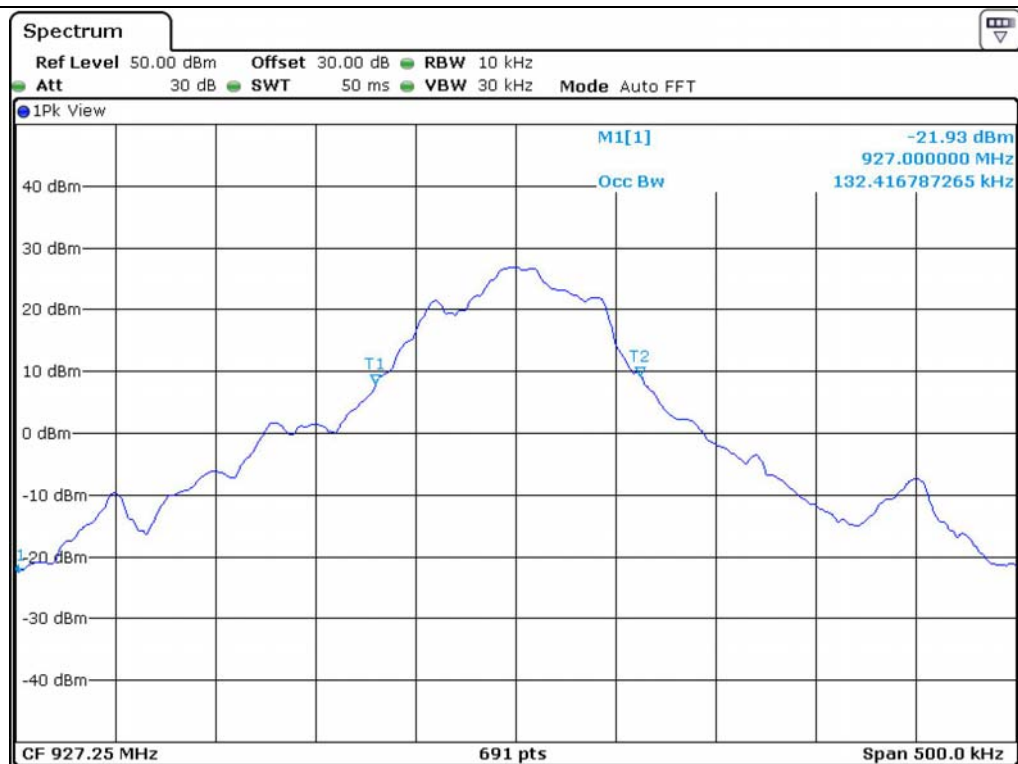
Remark: See next page for an overview sweep performed with peak detector.



Tested by: Chang-Uk, Jun / Engineer

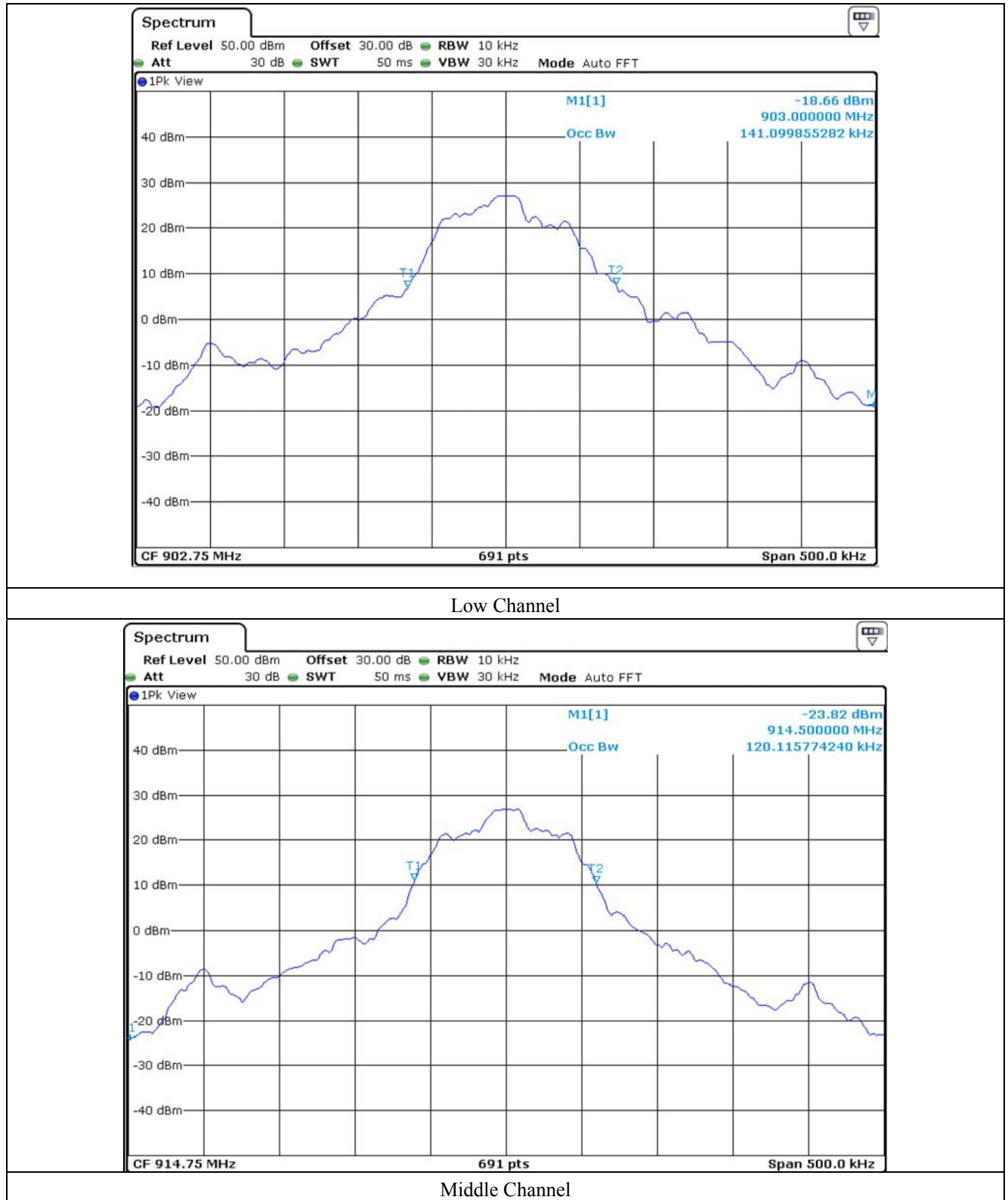
7.1.5.1 Test data for Antenna #1

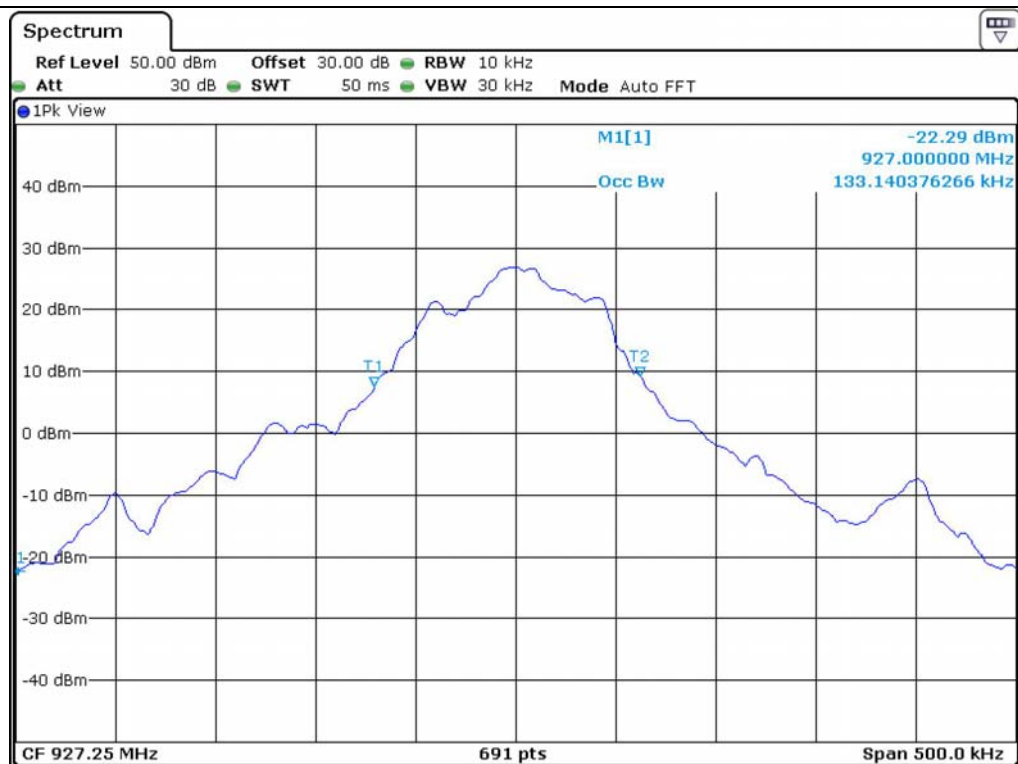




High Channel

7.1.5.2 Test data for Antenna #2





High Channel

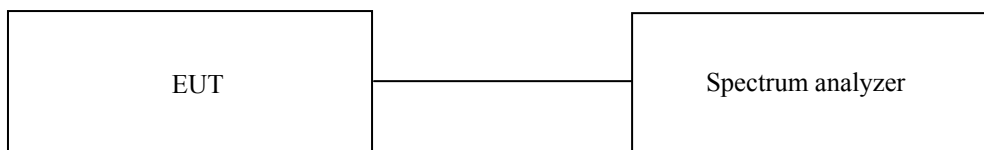
7.2. HOPPING FREQUENCY SEPARATION

7.2.1 Operating environment

Temperature : 25 °C
Relative humidity : 46 % R.H.

7.2.2 Test set-up

The antenna output of the EUT was connected to the spectrum analyzer. The frequency span is set to 3 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.



7.2.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
■ -	FSV30	Rohde & Schwarz	Signal Analyzer	101372	May 31, 2012(1Y)

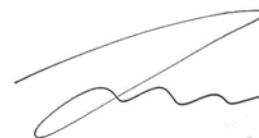
All test equipment used is calibrated on a regular basis.

7.2.4 Test data

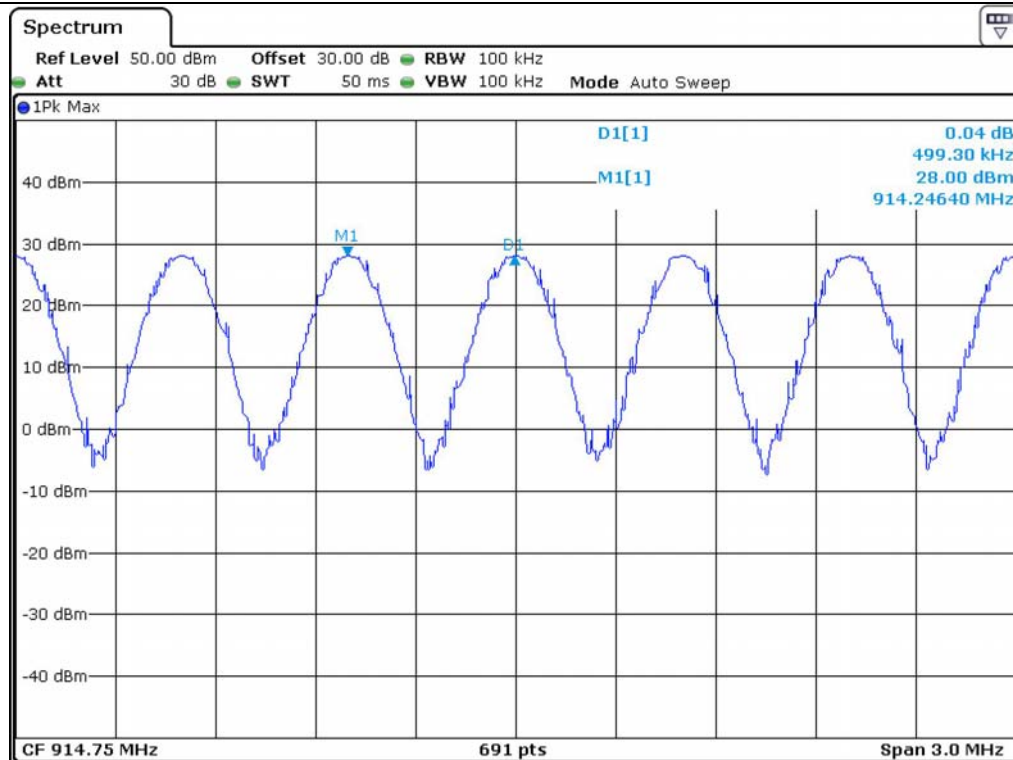
- Test Date : August 16, 2012

- Test Result : Pass

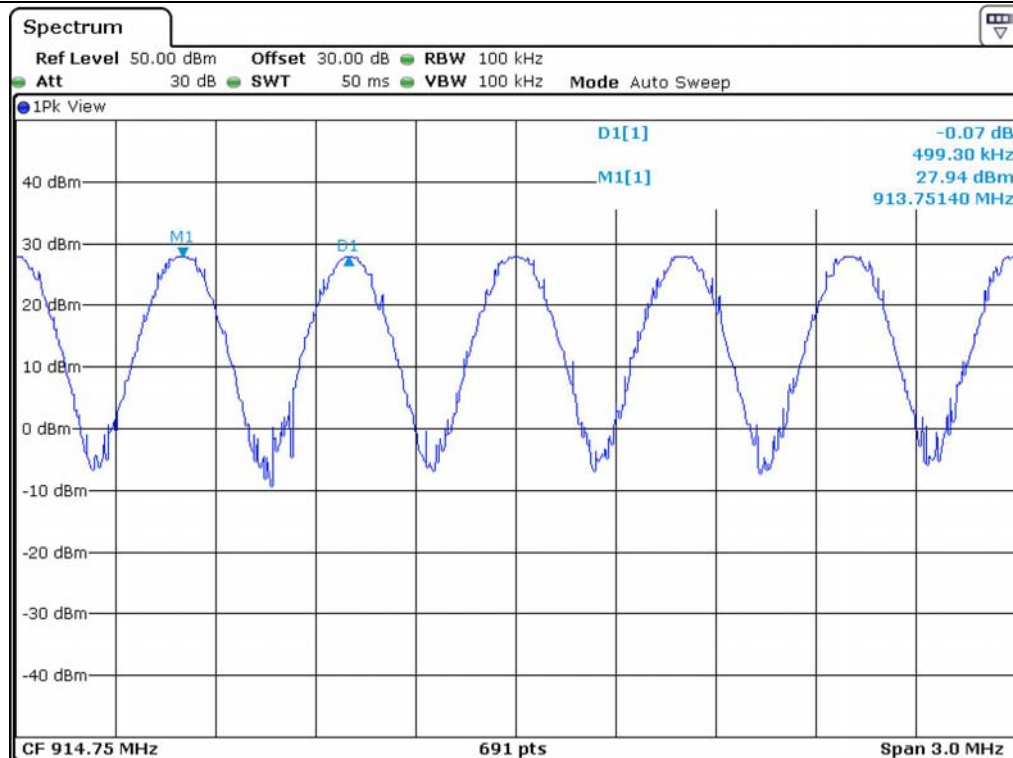
Antenna No.	Frequency (MHz)	Measured Value (kHz)	Limit (MHz)
1	914.75	499.30	Minimum of 25 kHz or the 20 dB Bandwidth
2	914.75	499.30	



Tested by: Chang-Uk, Jun / Engineer



Antenna #1



Antenna #2

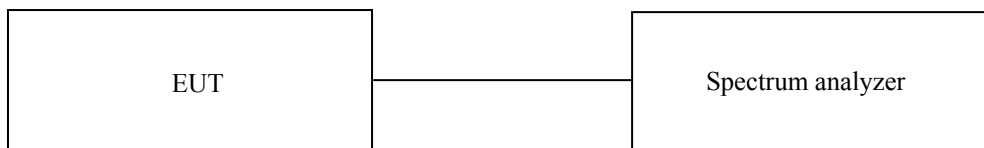
7.3. NUMBER OF HOPPING CHANNELS

7.3.1 Operating environment

Temperature : 25 °C
Relative humidity : 46 % R.H.

7.3.2 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.



7.3.3 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
■ - FSV30	Rohde & Schwarz	Signal Analyzer	101372	Aug. 29, 2011(1Y)

All test equipment used is calibrated on a regular basis.

7.3.4 Test data

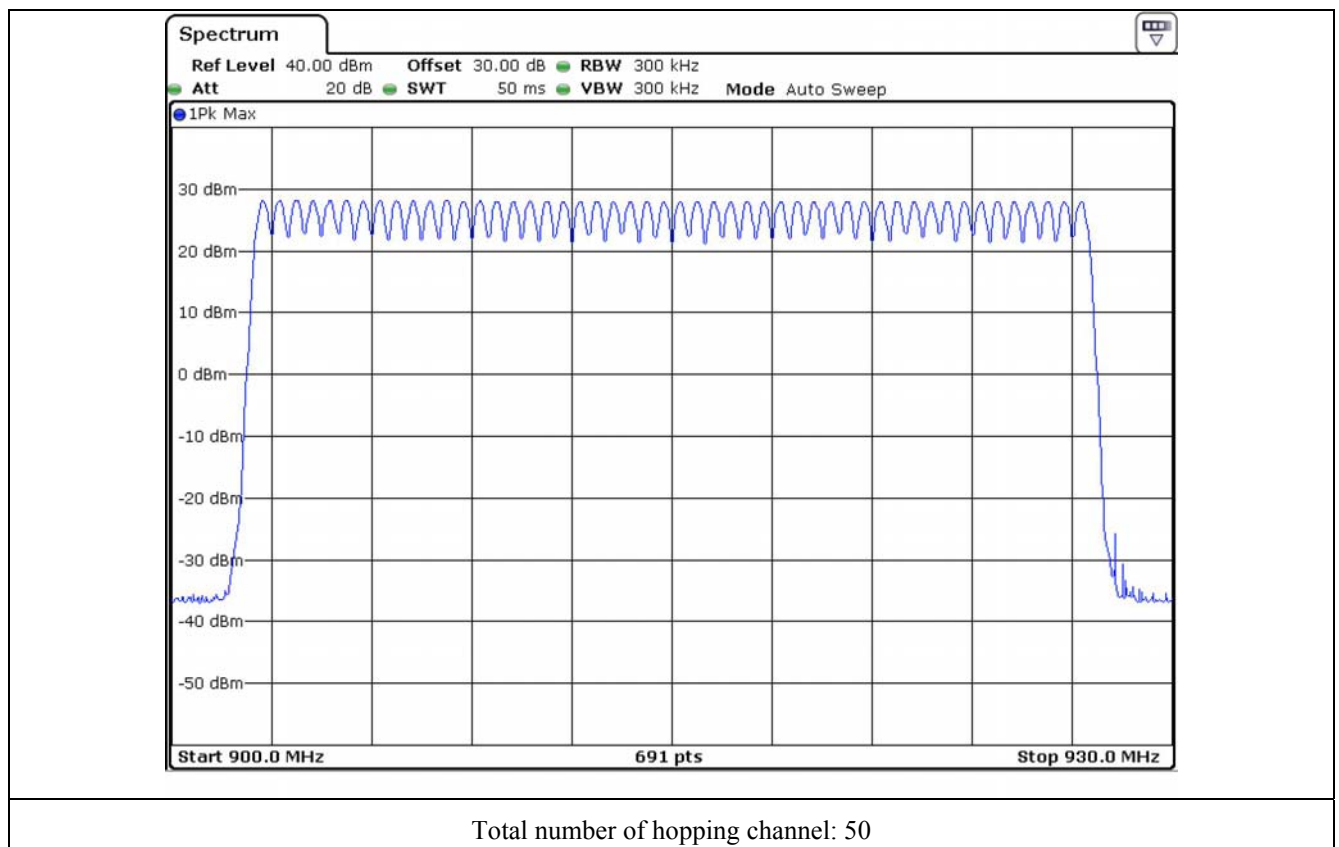
- Test Date : August 16, 2012
- Test Result : Pass

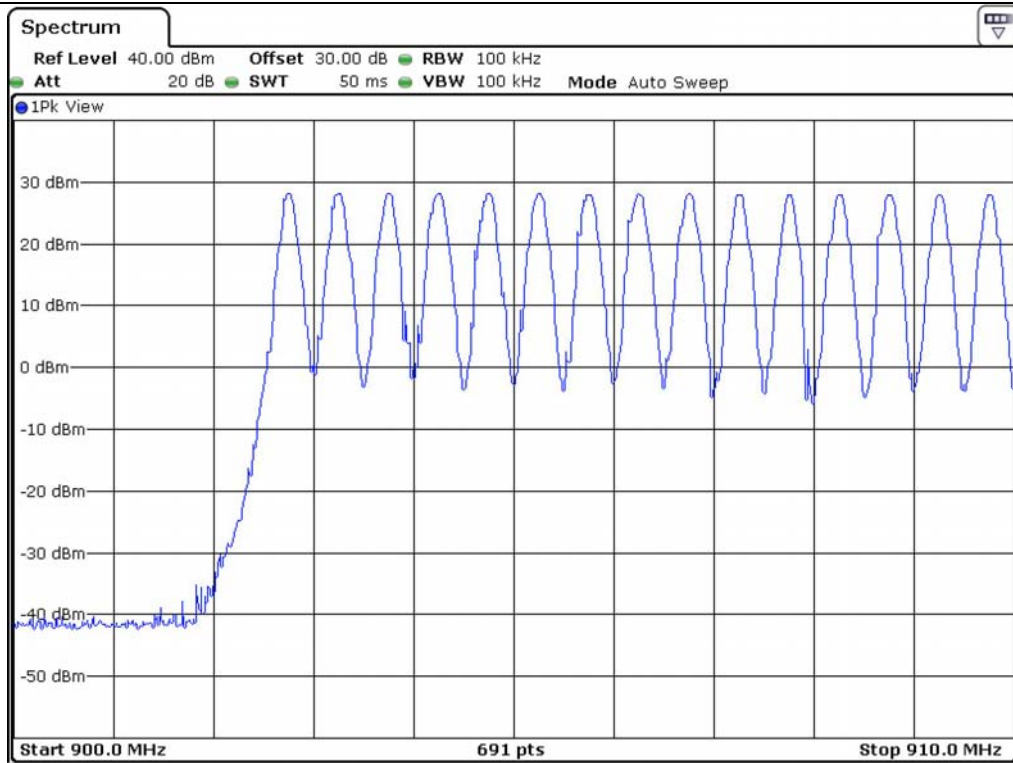
Frequency Range (MHz)	Measured Value (Number)	20 dB Bandwidth (kHz)	Limit
902 ~ 928	50	< 250	≥ 50

Note: Above result is same at antenna #2

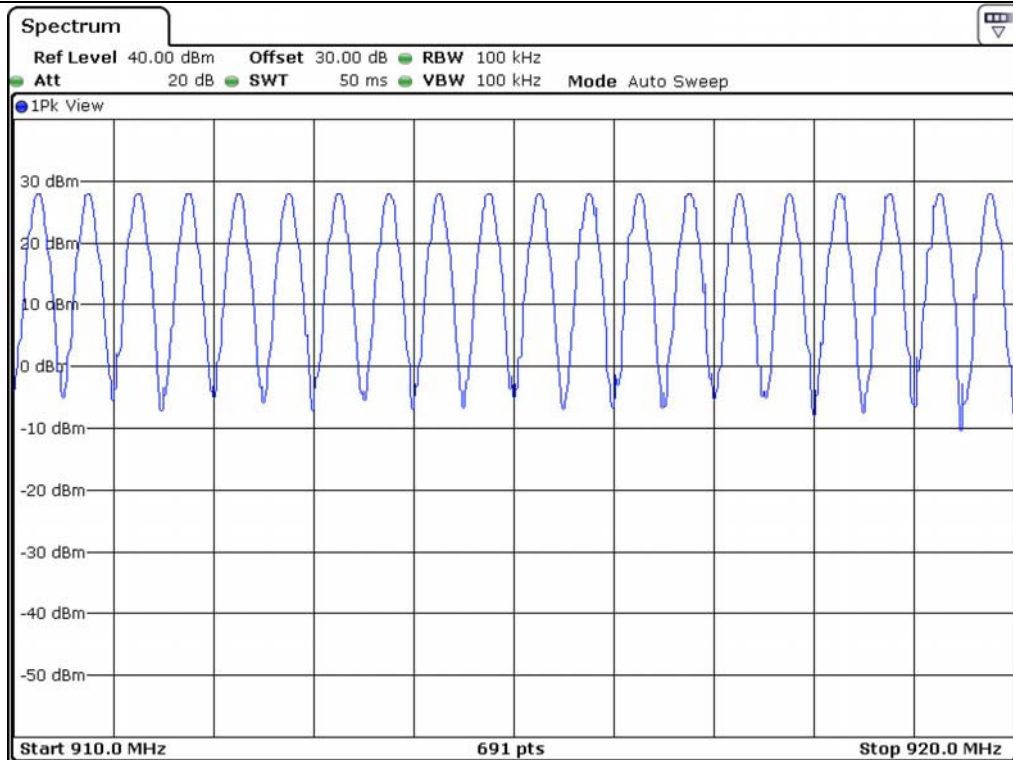


Tested by: Chang-Uk, Jun / Engineer

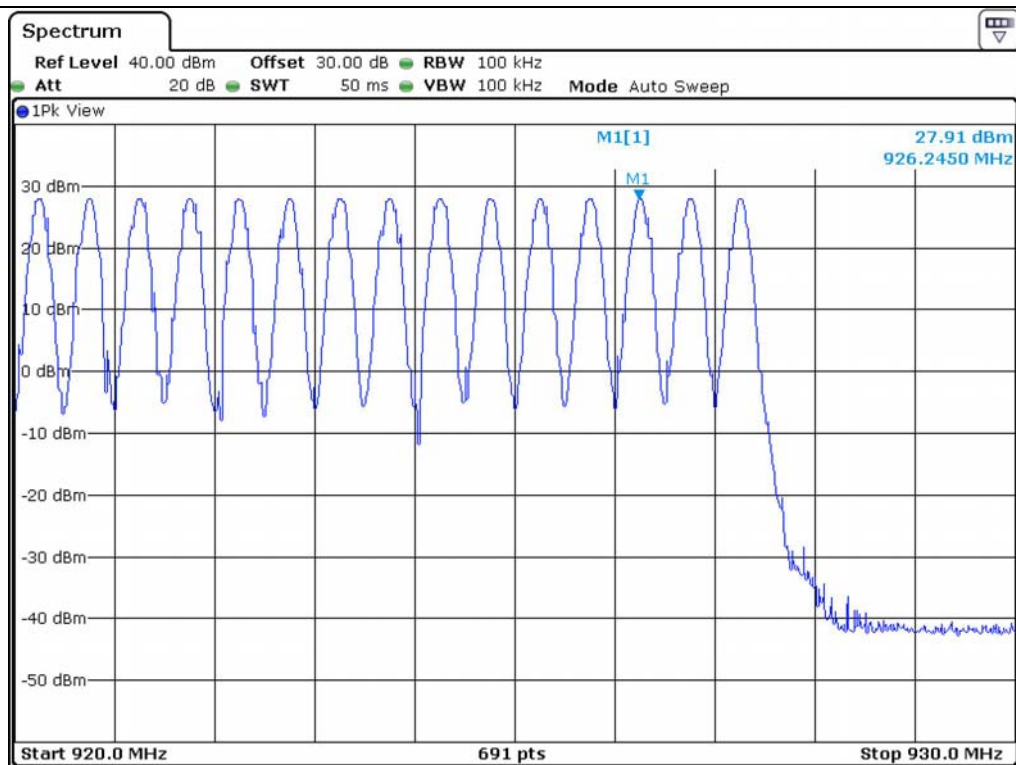




Number of hopping channel: 15



Number of hopping channel: 20



Number of hopping channel: 15

7.4 TIME OF OCCUPANCY

7.4.1 Operating environment

Temperature : 25 °C
Relative humidity : 46 % R.H.

7.4.2 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.



7.4.3 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
■ - FSV30	Rohde & Schwarz	Signal Analyzer	101372	Aug. 29, 2011(1Y)

All test equipment used is calibrated on a regular basis.

7.4.4 Test data

- Test Date : August 16, 2012

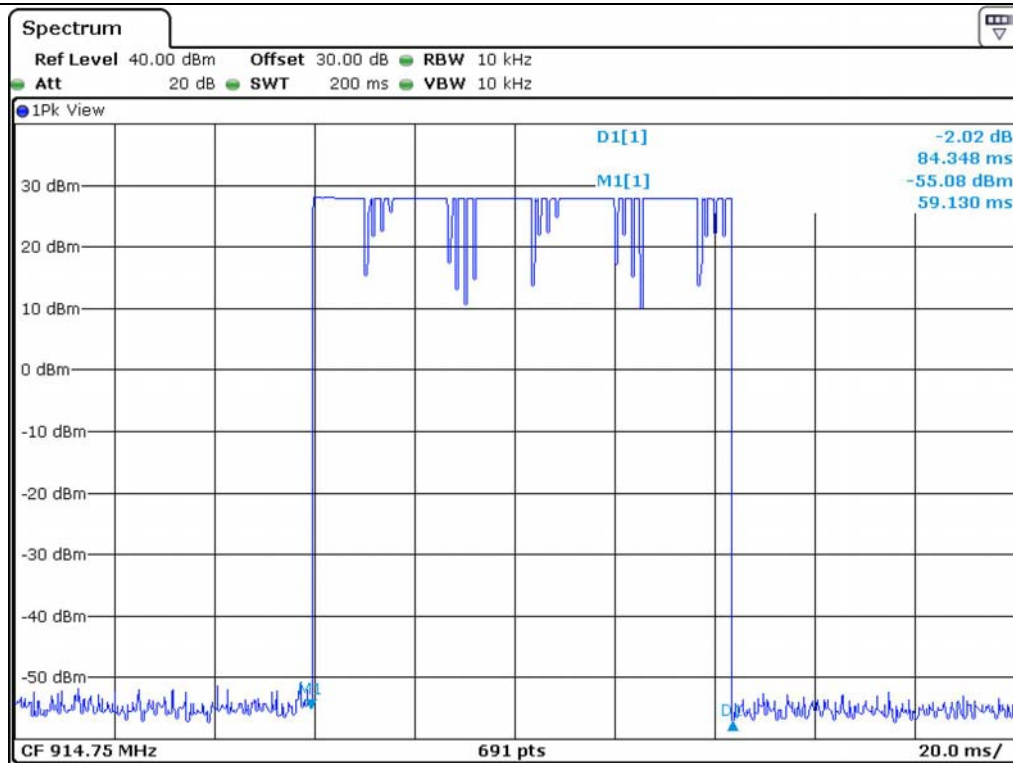
- Test Result : Pass

Frequency Range (MHz)	20 dB Bandwidth (kHz)	Pulse Time (ms)	Number of Transmission (20 s period)	Dwell Time (ms)	Limit (ms)
902 ~ 928	< 250	84	3	252	< 400

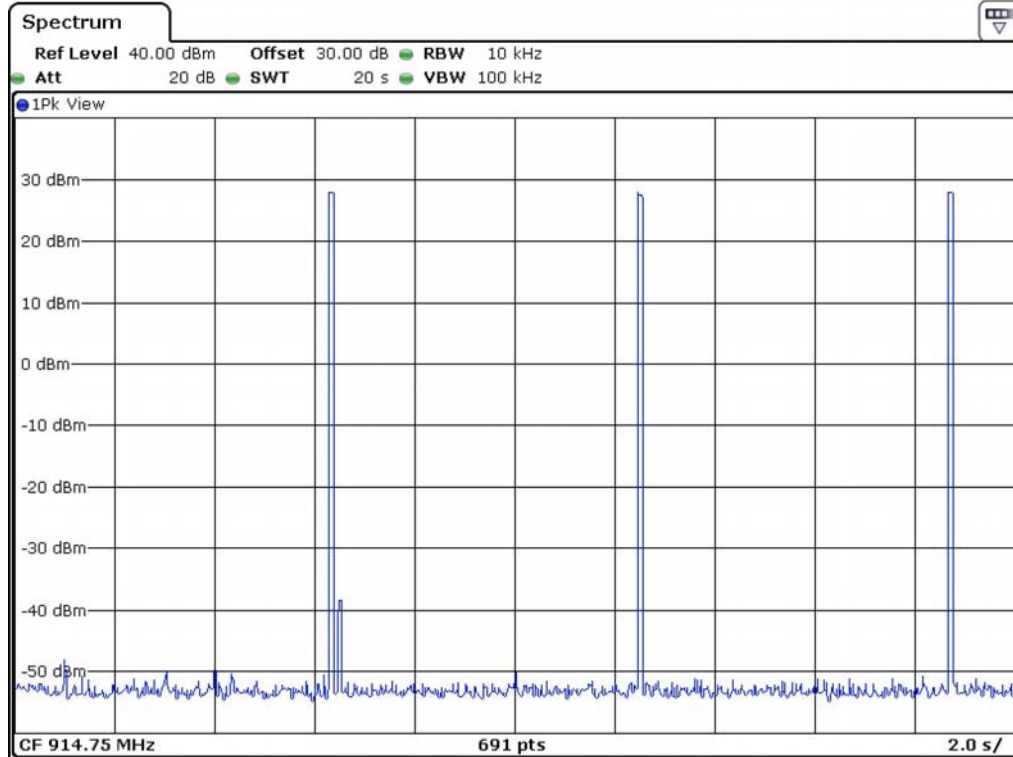
Note: Dwell Time (s) = Pulse Time * Number of Transmissions during a 20 second period



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Pulse Time



Number of Transmissions during a 20 second period

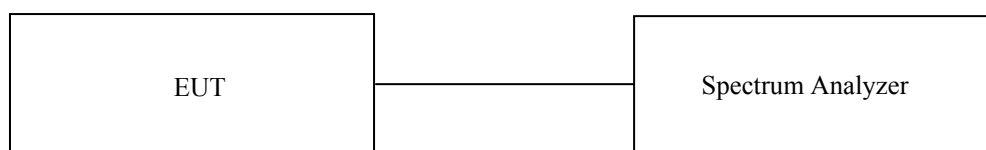
7.5 MAXIMUM PEAK OUTPUT POWER

7.5.1 Operating environment

Temperature : 25 °C
Relative humidity : 46 % R.H.

7.5.2 Test set-up

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



7.5.3 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
■ - FSV30	Rohde & Schwarz	Signal Analyzer	101372	Aug. 29, 2011(1Y)

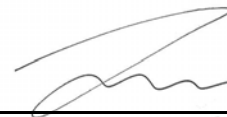
All test equipment used is calibrated on a regular basis.

7.5.4 Test data

- Test Date : August 16, 2012

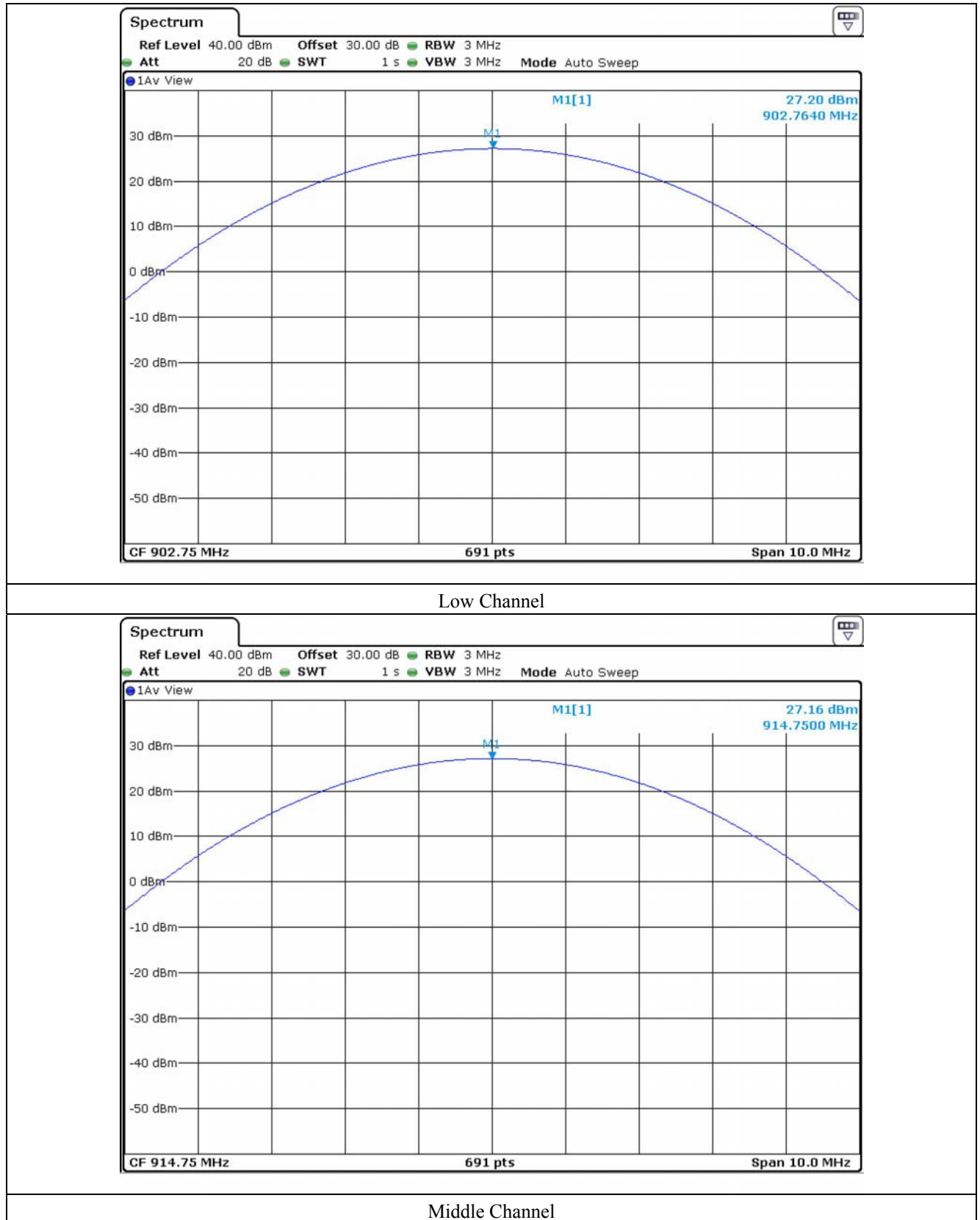
- Test Result : Pass

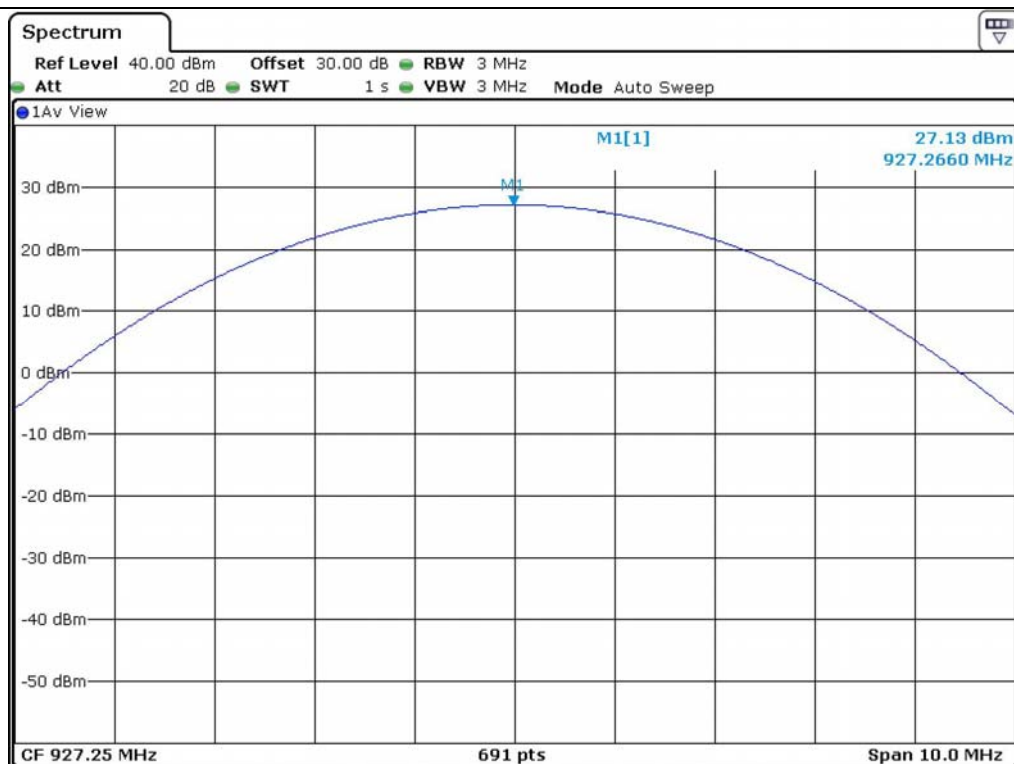
Antenna No	Channel	Frequency (MHz)	Measured Value (dBm)	Limit (dBm)
# 1	Low	902.75	27.20	30 dBm
	Middle	914.75	27.16	
	High	927.25	27.13	
# 2	Low	902.75	27.18	30 dBm
	Middle	914.75	27.12	
	High	927.25	27.09	



Tested by: Chang-Uk, Jun / Engineer

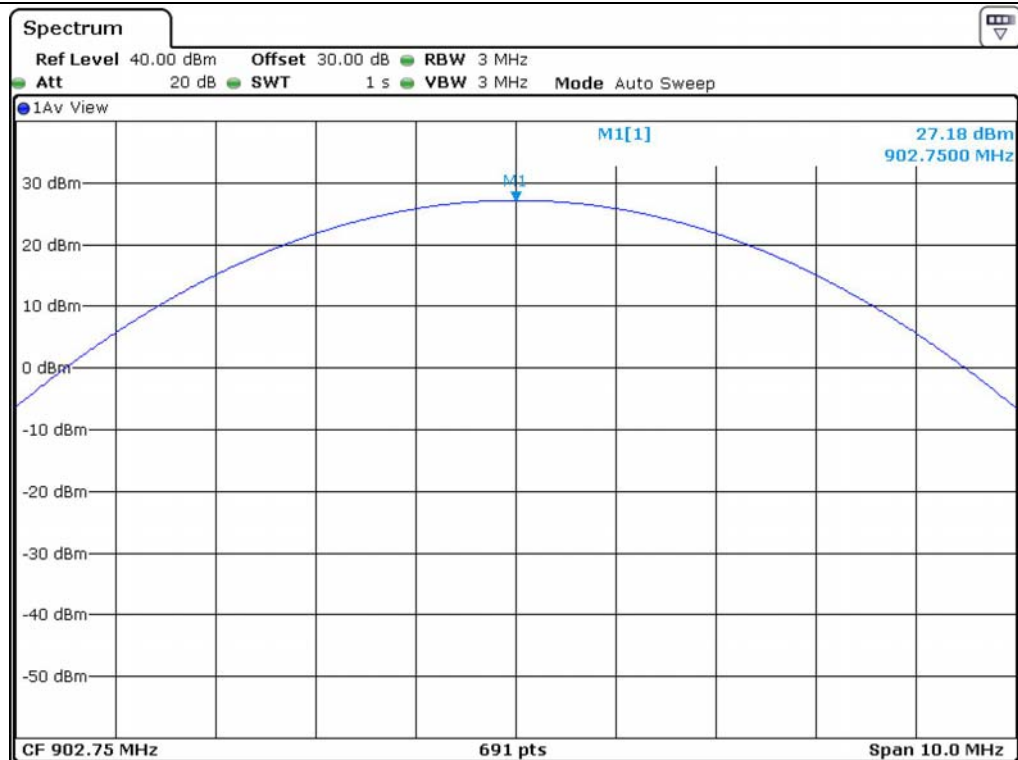
7.5.4.1 Test data for Antenna #1



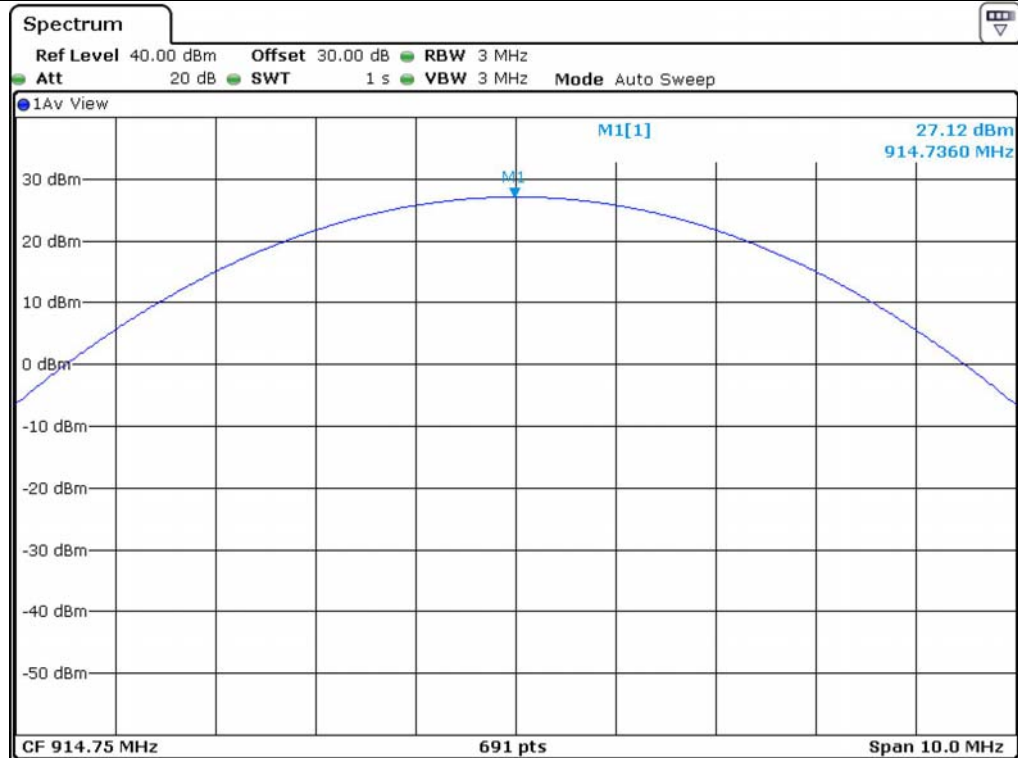


High Channel

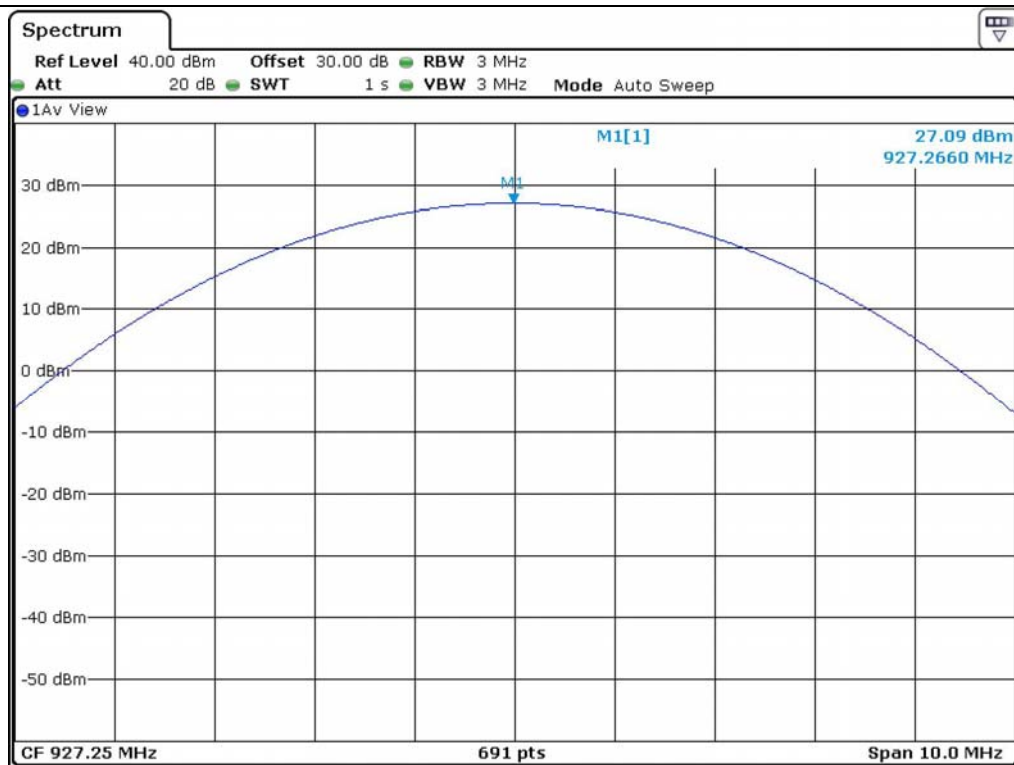
7.5.4.2 Test data for Antenna #2



Low Channel



Middle Channel



High Channel

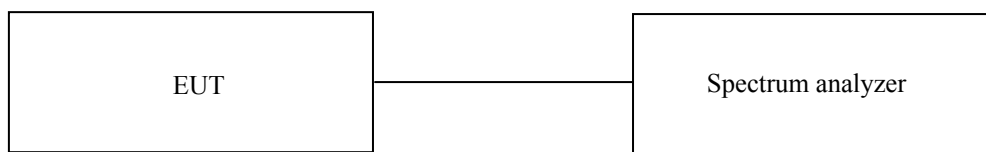
7.6 100 kHz BANDWIDTH OUTSIDE THE FREQUENCY BAND

7.6.1 Operating environment

Temperature : 25 °C
Relative humidity : 46 % R.H.

7.6.2 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.



7.6.3 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 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 m in order to determine the maximum emission levels. This procedure was performed for horizontal and vertical polarization of the receiving antenna.

7.6.4 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal.(Interval)
■ -	ESCI	Rohde & Schwarz	EMI Test Receiver	101012	Feb. 06, 2012 (1Y)
■ -	8564E	HP	Spectrum Analyzer	3650A00756	Apr. 04, 2012 (1Y)
■	FSV30	Rohde & Schwarz	Signal Analyzer	101372	Aug. 29, 2011(1Y)
■ -	SCU-18	Rohde & Schwarz	PRE-AMPLIFIER	10041	Dec 15, 2011 (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
□ -	VHA9103	Schwarzbeck	Biconical Antenna	91031852	Apr. 06, 2012 (2Y)
□ -	HFH2-Z2	Rohde & Schwarz	Loop Antenna	889 285 / 26	Nov. 08, 2010(2Y)
■ -	BBHA9120D	Schwarzbeck	Horn Antenna	BBHA9120D295	Jun. 17, 2011 (2Y)
■ -	VULB9163	Schwarzbeck	TRILOG Broadband Antenna	VULB9163-202	Oct. 07, 2010 (2Y)

All test equipment used is calibrated on a regular basis.

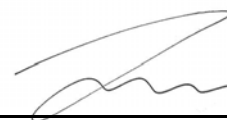
7.6.5 Test data

7.6.5.1 Test data for conducted measurement

-. Test Date : August 16, 2012

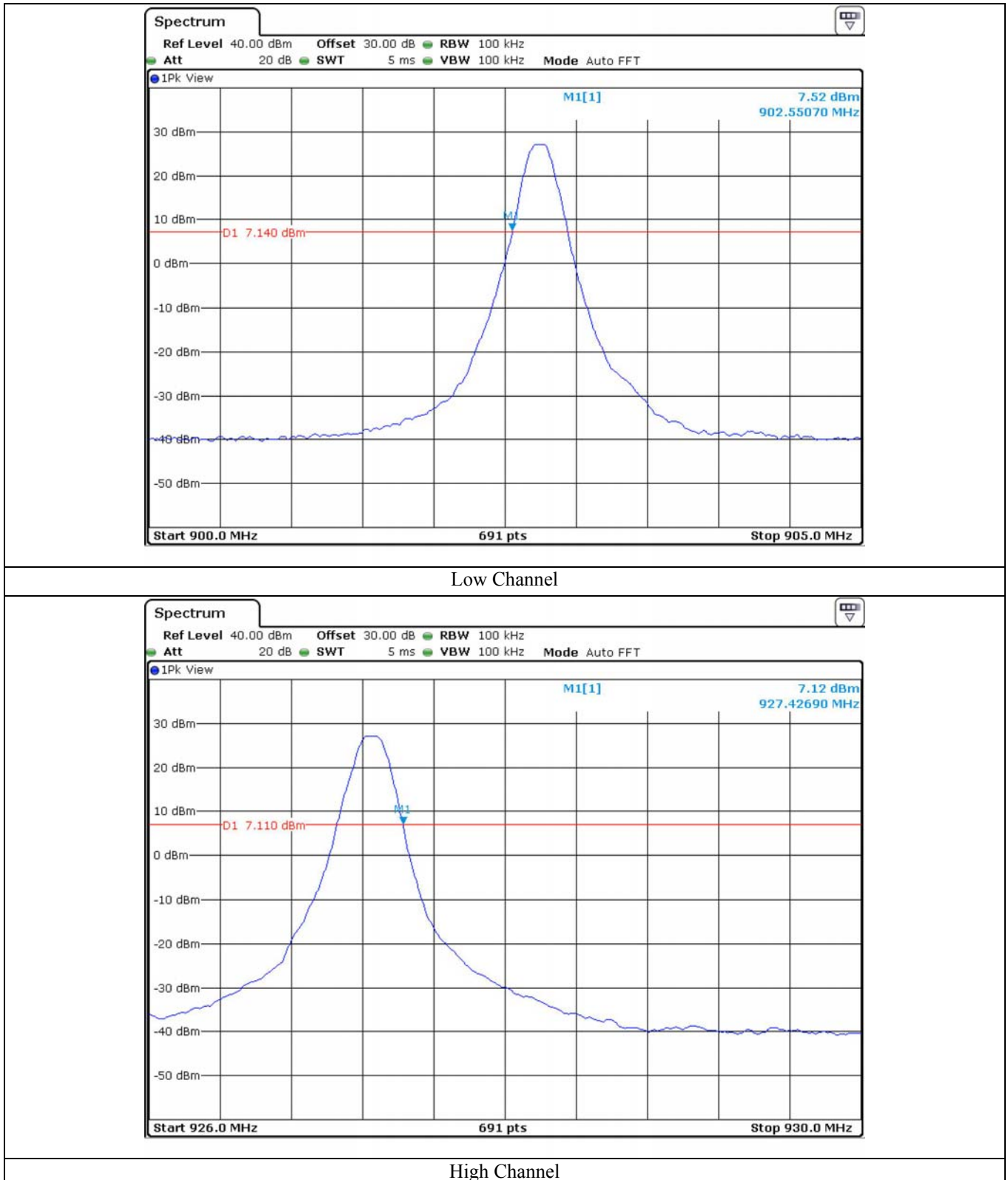
-. Test Result : Pass

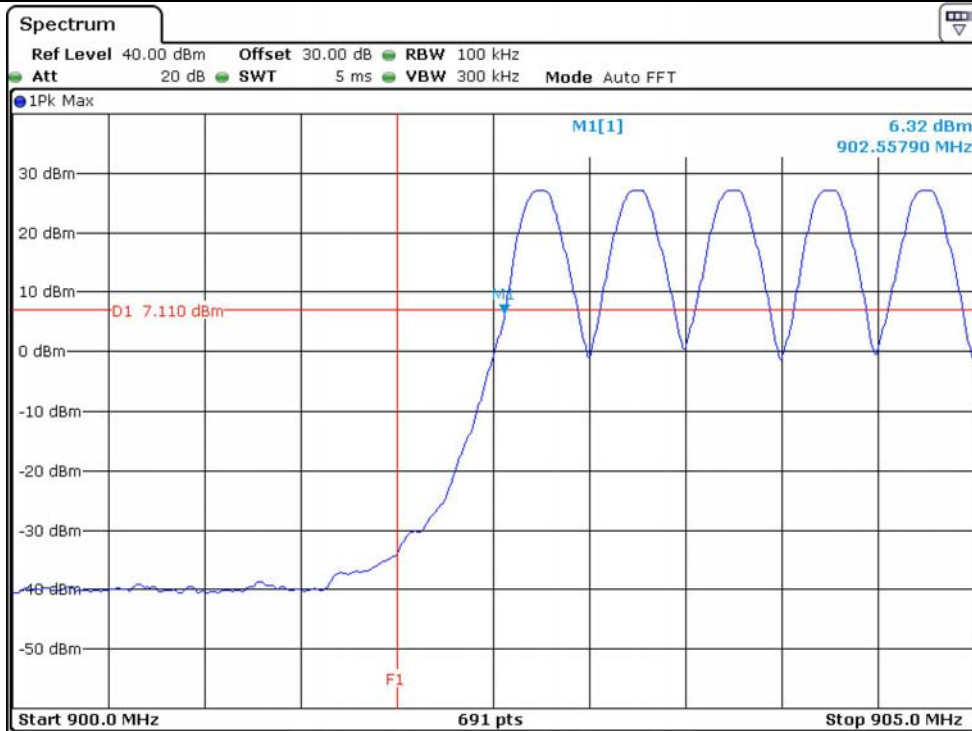
Antenna No	Channel	Frequency (MHz)	Measured Value (dBm)	Limit (dBc)
# 1	Low	902	-36.4	≤ -20
	High	928	-30.0	
# 2	Low	902	-33.6	≤ -20
	High	928	-31.2	



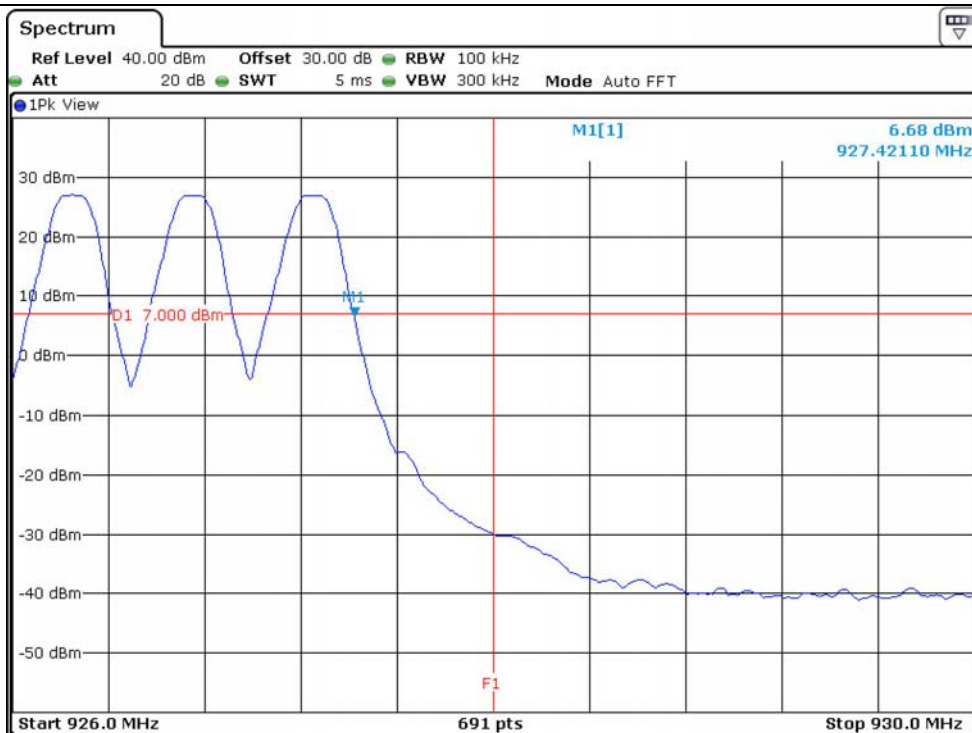
Tested by: Chang-Uk, Jun / Engineer

7.6.5.1.1 Conducted test data for Antenna #1

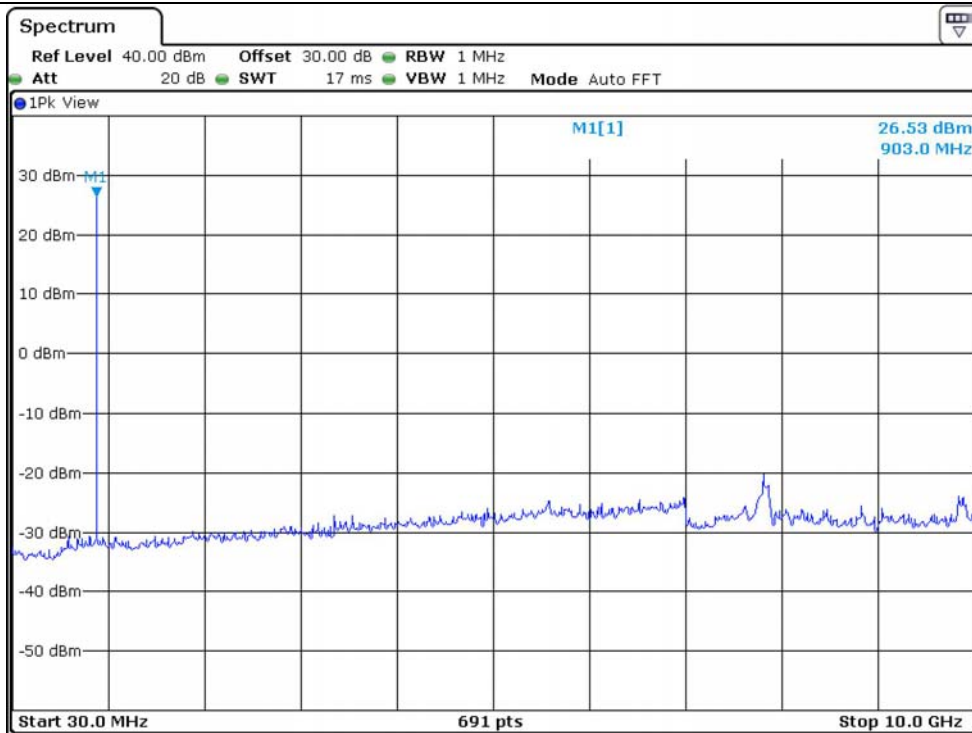




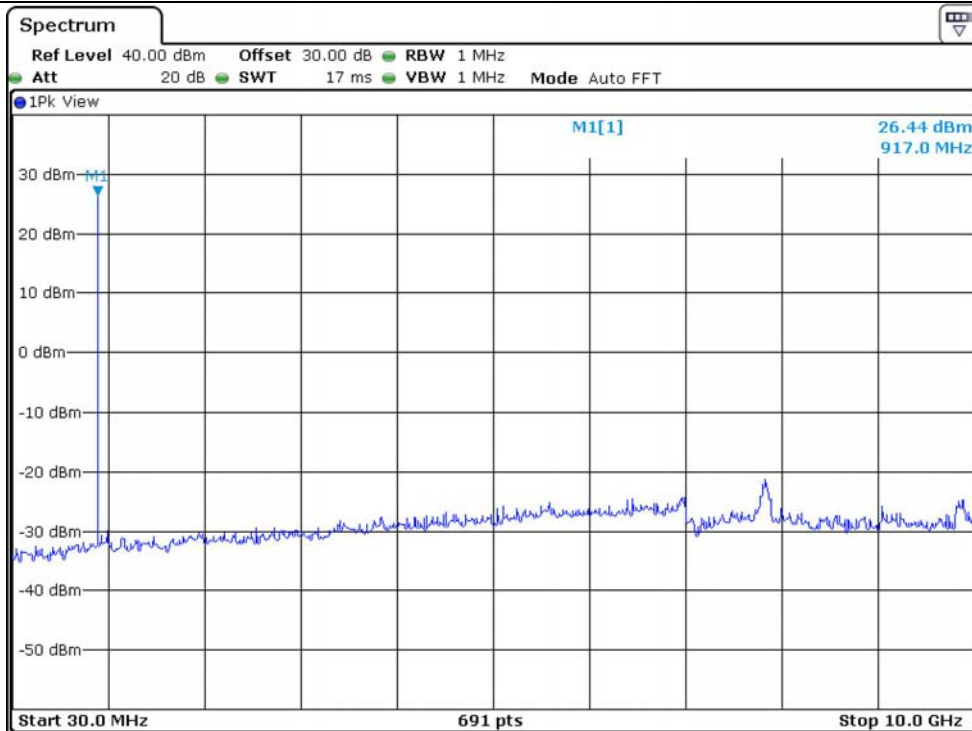
Low Channel



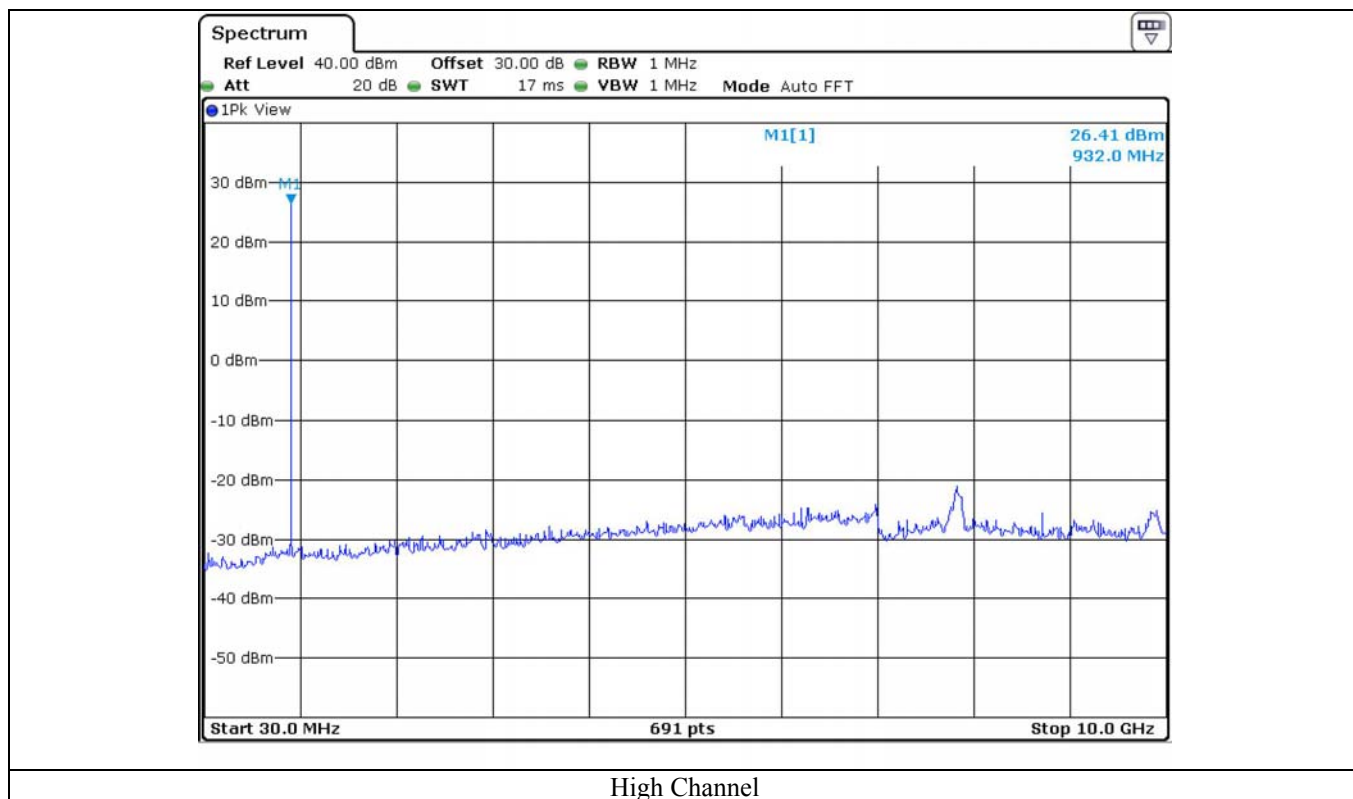
High Channel



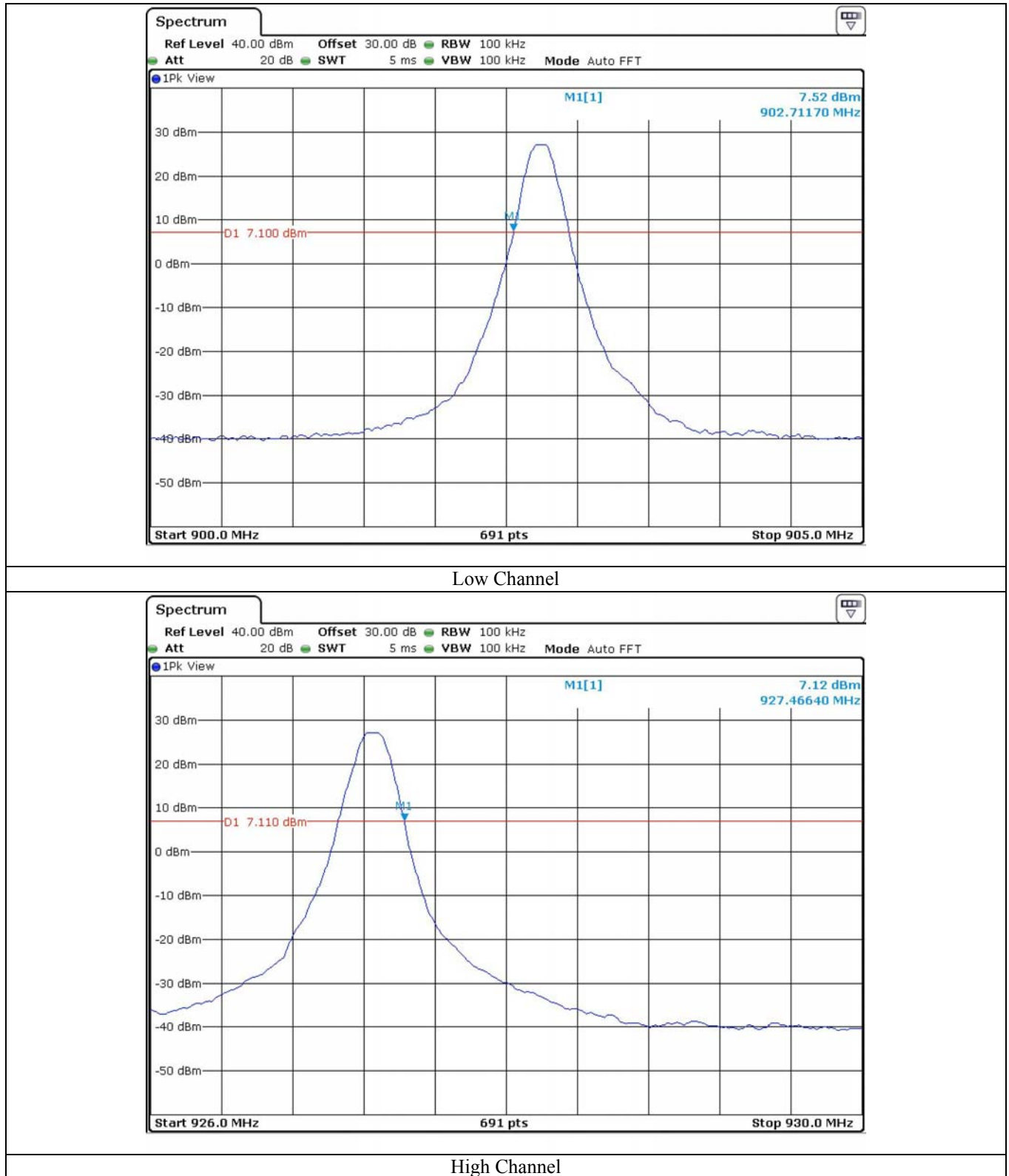
Low Channel

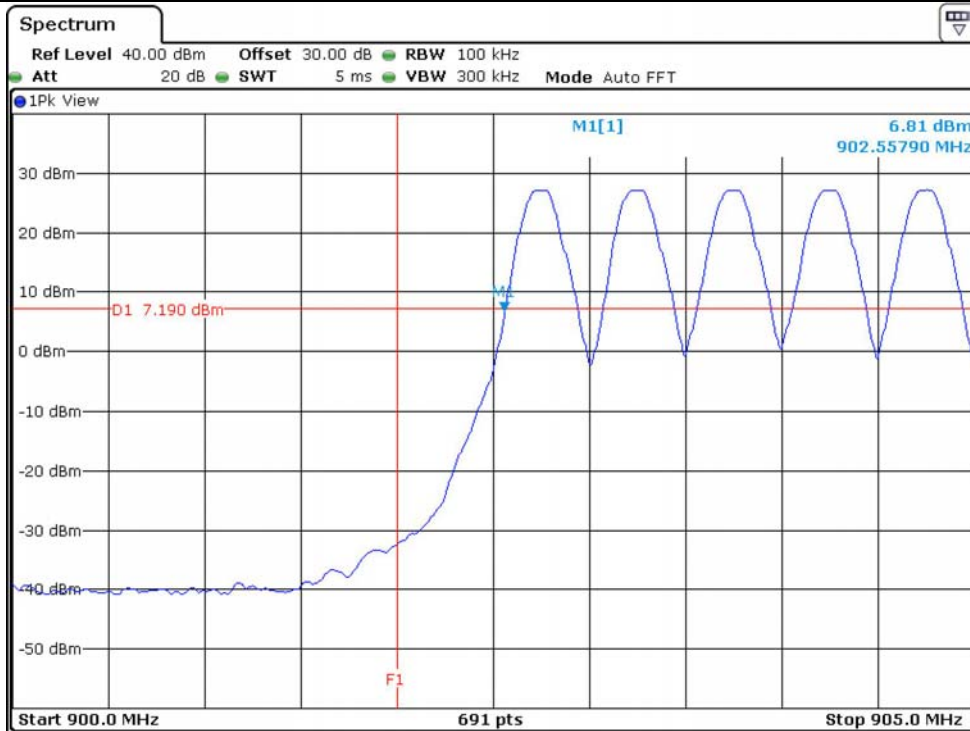


Middle Channel

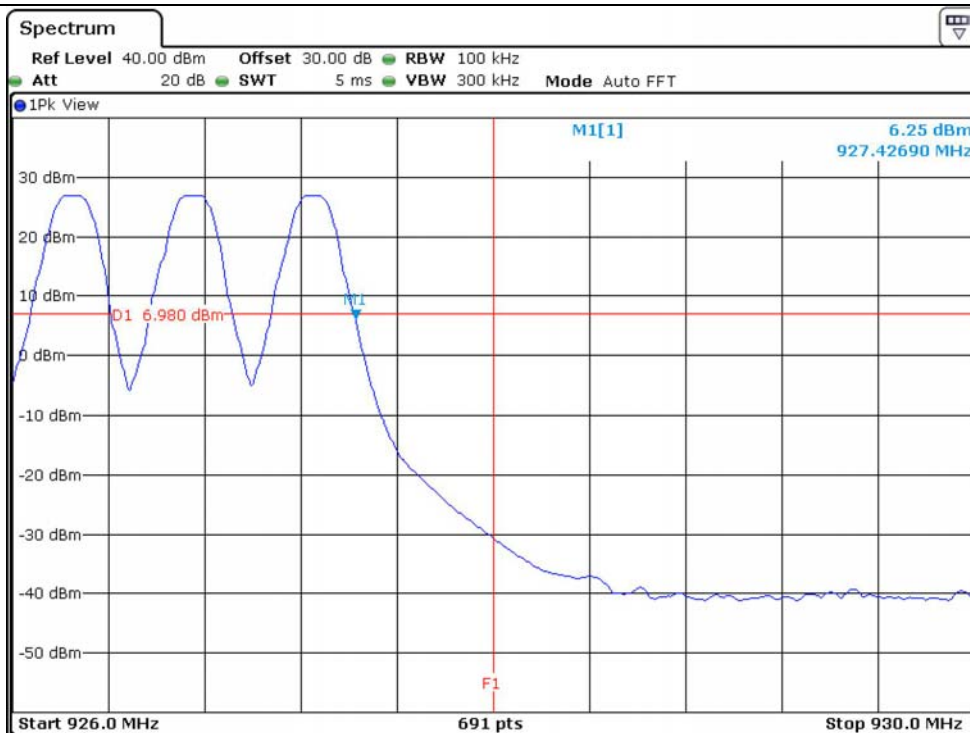


7.6.5.1.2 Conducted test data for Antenna #2

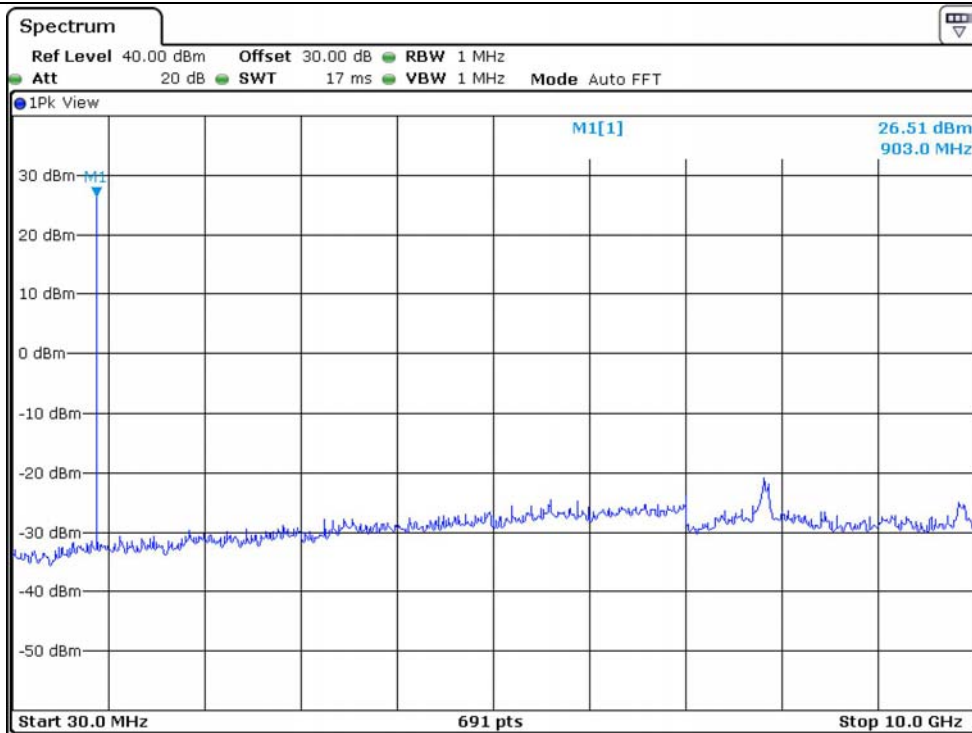




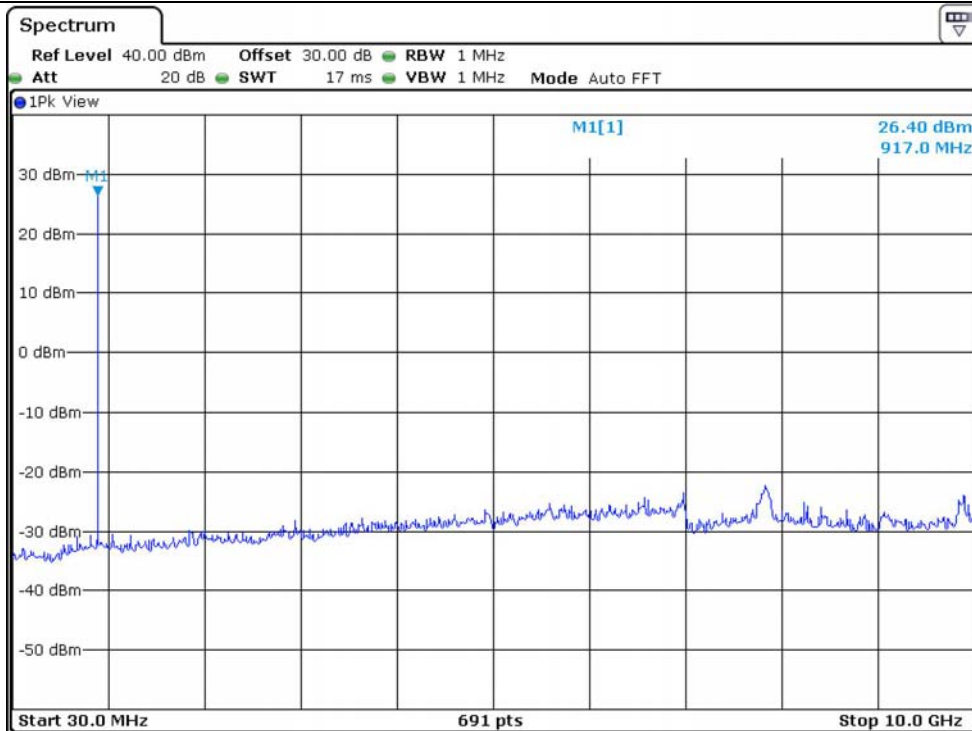
Low Channel



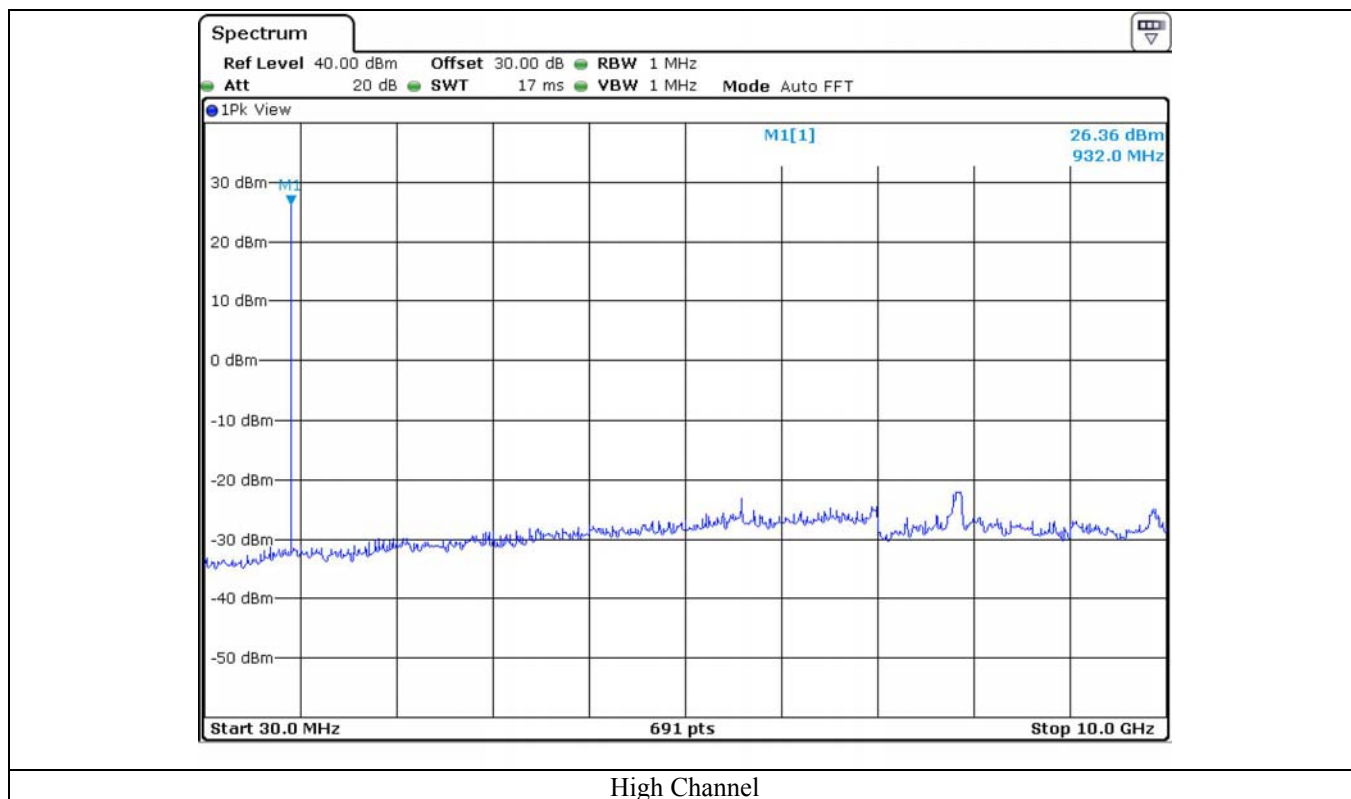
High Channel



Low Channel



Middle Channel



High Channel

7.6.5.2 Test data for radiated measurement

7.6.5.2.1 Test Data for Antenna # 1

- Test Date : August 17, 2012
- Resolution bandwidth : 1 MHz for Peak and Average Mode for the emissions fall in restricted band,
100 kHz for Peak Mode for the emissions outside restricted band
- Video bandwidth : 1 MHz for Peak Mode, 10 Hz for Average Mode
- Frequency range : 1 GHz ~ 10 GHz
- Measurement distance : 3 m
- Result : PASSED

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel									
902.75	118.72	Peak	V	23.40	6.10	32.10	116.12	-	
	115.68	Average					113.08	-	
1805.50*	66.45	Peak	H	26.20	6.00	42.7	55.95	96.12	-40.17
	65.05	Average	H				54.55	93.08	-38.53
	71.58	Peak	V				61.08	96.12	-35.04
	70.60	Average	V				60.10	93.08	-32.98
2708.25	61.37	Peak	H	28.00	7.50	43.1	53.77	74.00	-20.23
	57.79	Average	H				50.19	54.00	-3.81
	60.90	Peak	V				53.30	74.00	-20.70
	57.02	Average	V				49.42	54.00	-4.58
Test Data for Middle Channel									
914.75	118.74	Peak	V	23.50	6.20	32.00	116.44	-	
	115.71	Average					113.41	-	
1829.50*	61.25	Peak	H	26.20	6.00	42.7	50.75	96.44	-45.69
	58.20	Average	H				47.70	93.41	-45.71
	66.68	Peak	V				56.18	96.44	-40.26
	65.91	Average	V				55.41	93.41	-38.00
2744.25	59.73	Peak	H	28.00	7.50	43.1	52.13	74.00	-21.87
	56.18	Average	H				48.58	54.00	-5.42
	58.52	Peak	V				50.92	74.00	-23.08
	55.59	Average	V				47.99	54.00	-6.01

Tabulated test data for Restricted Band

-Continued

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for High Channel									
927.25	118.71	Peak	V	23.60	6.20	31.90	116.61	-	
	115.65	Average					113.55	-	
1854.50*	61.37	Peak	H	26.20	6.00	42.7	50.87	96.61	-45.74
	61.11	Average	H				50.61	93.55	-42.94
	68.07	Peak	V				57.57	96.61	-39.04
	67.18	Average	V				56.68	93.55	-36.87
2781.75	61.38	Peak	H	28.00	7.50	43.1	53.78	74.00	-20.22
	57.74	Average	H				50.14	54.00	-3.86
	59.23	Peak	V				51.63	74.00	-22.37
	56.79	Average	V				49.19	54.00	-4.81

Tabulated test data for Restricted Band

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



Tested by: Chang-Uk, Jun / Engineer

7.6.5.2.2 Test Data for Antenna # 2

- . Test Date : August 17, 2012
- . Resolution bandwidth : 1 MHz for Peak and Average Mode for the emissions fall in restricted band,
100 kHz for Peak Mode for the emissions outside restricted band
- . Video bandwidth : 1 MHz for Peak Mode, 10 Hz for Average Mode
- . Frequency range : 1 GHz ~ 10 GHz
- . Measurement distance : 3 m
- . Result : PASSED

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel									
902.75	118.71	Peak	V	23.40	6.10	32.10	116.11	-	
	115.66	Average					113.06	-	
1805.50*	66.45	Peak	H	26.20	6.00	42.7	55.95	96.11	-40.17
	65.05	Average	H				54.55	93.06	-38.53
	71.58	Peak	V				61.08	96.11	-35.04
	70.60	Average	V				60.10	93.06	-32.98
2708.25	61.37	Peak	H	28.00	7.50	43.1	53.77	74.00	-20.23
	57.79	Average	H				50.19	54.00	-3.81
	60.90	Peak	V				53.30	74.00	-20.70
	57.02	Average	V				49.42	54.00	-4.58
Test Data for Middle Channel									
914.75	118.75	Peak	V	23.50	6.20	32.00	116.45	-	
	115.72	Average					113.42	-	
1829.50*	61.25	Peak	H	26.20	6.00	42.7	50.75	96.45	-45.69
	58.20	Average	H				47.70	93.42	-45.71
	66.68	Peak	V				56.18	96.45	-40.26
	65.91	Average	V				55.41	93.42	-38.00
2744.25	59.73	Peak	H	28.00	7.50	43.1	52.13	74.00	-21.87
	56.18	Average	H				48.58	54.00	-5.42
	58.52	Peak	V				50.92	74.00	-23.08
	55.59	Average	V				47.99	54.00	-6.01

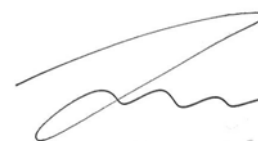
Tabulated test data for Restricted Band

-Continued

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for High Channel									
927.25	118.73	Peak	V	23.60	6.20	31.90	116.63	-	
	115.68	Average					113.58	-	
1854.50*	61.37	Peak	H	26.20	6.00	42.7	50.87	96.63	-45.74
	61.11	Average	H				50.61	93.58	-42.94
	68.07	Peak	V				57.57	96.63	-39.04
	67.18	Average	V				56.68	93.58	-36.87
2781.75	61.38	Peak	H	28.00	7.50	43.1	53.78	74.00	-20.22
	57.74	Average	H				50.14	54.00	-3.86
	59.23	Peak	V				51.63	74.00	-22.37
	56.79	Average	V				49.19	54.00	-4.81

Tabulated test data for Restricted Band

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



Tested by: Chang-Uk, Jun / Engineer

8. MAXIMUM PERMISSIBLE EXPOSURE

8.1 RF Exposure Calculation

According to the FCC rule 1.1310 table 1B, the limit for the maximum permissible RF exposure for an uncontrolled environment is $f/1500 \text{ mW/cm}^2$ for the frequency range between 300 MHz and 1500 MHz.

The electric field generated for a 1 mW/cm^2 exposure is calculated as follows:

$$E = \sqrt{(30 * P * G) / d}, \text{ and } S = E^2 / Z = E^2 / 377, \text{ because } 1 \text{ mW/cm}^2 = 10 \text{ W/m}^2$$

Where

S = Power density in mW/cm^2 , Z = Impedance of free space, 377Ω

E = Electric field strength in V/m , G = Numeric antenna gain, and d = distance in meter

Combining equations and rearranging the terms to express the distance as a function of the remaining variable

$$d = \sqrt{(30 * P * G) / (377 * S)}$$

Changing to units of mW and cm , using $P (\text{mW}) = P (\text{W}) / 1000$, $d (\text{cm}) = 100 * d (\text{m})$

$$d = 0.282 * \sqrt{(P * G) / S}$$

Where

d = distance in cm , P = Power in mW , G = Numeric antenna gain, and S = Power density in mW/cm^2

8.2 Calculated MPE Safe Distance

According to above equation, the following result was obtained.

Peak Output Power		Antenna Gain		Safe Distance	Power Density (mW/cm^2)	FCC Limit
(dBm)	(mW)	Log	Linear	(cm)	@ 20 cm Separation	(mW/cm^2)
27.20	524.81	6.00	3.98	16.63	0.42	0.60

According to above table, safe distance, $D = 0.282 * \sqrt{524.81 * 3.98 / 0.60} = 16.63 \text{ cm}$.

For getting power density at 25 cm separation in above table, following formula was used.

$$S = P * G / (4\pi * R^2) = 524.81 * 1.58 / (4 * 3.14 * 20^2) = 0.42$$

Where:

S = Power Density,

P = Power input to the external antenna (Output power from the EUT antenna port (dBm) – cable loss (dB)),

G = Gain of Transmit Antenna (linear gain), R = Distance from Transmitting Antenna

Note: End users and installers must be provided with antenna installation instructions and transmitter operating conditions for satisfying RF exposure compliance, because the applicant does not provide an antenna for sale with the EUT.

9. RADIATED EMISSION TEST

9.1 Operating environment

Temperature : 28 °C
Relative humidity : 45 % R.H.

9.2 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 10 000 MHz 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.

9.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
■ -	ESVD	Rohde & Schwarz	Test Receiver	838453/018	Oct. 20, 2011 (1Y)
■ -	8566B	HP	Spectrum Analyzer	3407A08547	May. 31, 2012 (1Y)
■ -	FSV30	Rohde & Schwarz	Signal Analyzer	101372	May 31, 2012 (1Y)
■ -	8447D	Hewlett Packard	Amplifier	2727A04987	Jun. 11, 2012 (1Y)
■ -	SCU 18	ROHDE&SCHWARZ	Amplifier	10041	Jan. 25, 2012 (1Y)
■ -	BBHA9120D	Schwarzbeck	Horn Antenna	BBHA9120D294	Aug. 23, 2011 (2Y)
■ -	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
■ -	VULB9163	Schwarzbeck	TRILOG Broadband Antenna	VULB9163-419	Mar 23, 2011 (2Y)

All test equipment used is calibrated on a regular basis.

9.4 Test Data for Antenna # 1

- Test Date : August 17, 2012
- Resolution bandwidth : 120 kHz
- Frequency range : 30 MHz ~ 1 000 MHz
- Measurement distance : 3 m
- Channel : Low

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)
147.37	29.30	H	1.00	360.00	7.93	2.67	39.90	43.52	-3.62
298.69	11.10	V	1.00	220.00	19.63	3.49	34.22	46.02	-11.80
321.97	12.40	H	1.00	214.00	13.88	3.54	29.82	46.02	-16.20
386.96	10.40	V	1.50	64.00	15.44	3.97	29.81	46.02	-16.21
756.52	13.20	H	1.00	95.00	20.43	5.79	39.42	46.02	-6.60
800.17	12.20	V	1.00	84.20	20.99	6.40	39.59	46.02	-6.43

- Channel : Middle

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)
147.37	23.80	V	1.00	360.00	7.93	2.67	34.40	43.52	-9.12
148.34	29.20	H	1.00	90.00	7.95	2.68	39.83	43.52	-3.69
500.45	13.10	H	1.50	120.00	17.38	4.60	35.08	46.02	-10.94
746.82	12.40	V	1.50	180.00	20.31	5.68	38.39	46.02	-7.63
766.22	12.80	H	1.00	360.00	20.56	5.93	39.29	46.02	-6.73
800.17	13.20	V	1.30	90.00	20.99	6.40	40.59	46.02	-5.43

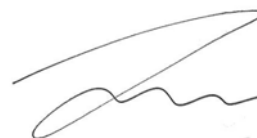
-. Channel : High

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)
144.46	29.10	H	1.00	360.00	7.87	2.64	39.61	43.52	-3.91
148.34	27.40	V	1.00	360.00	7.95	2.68	38.03	43.52	-5.49
271.53	17.50	H	1.50	120.00	12.90	3.40	33.80	46.02	-12.22
299.66	11.70	V	1.50	120.00	19.63	3.50	34.83	46.02	-11.19
440.31	14.50	H	1.00	90.00	16.40	4.42	35.32	46.02	-10.70
780.77	15.40	H	1.00	180.00	20.74	6.13	42.27	46.02	-3.75

Tabulated test data for Radiated Electromagnetic Field

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

$$\text{Margin (dB)} = \text{Emission Level (dB}\mu\text{V/m)} - \text{Limits (dB}\mu\text{V/m)}$$



Tested by: Chang-Uk, Jun / Engineer

9.5 Test Data for Antenna # 2

- Test Date : August 17, 2012
- Resolution bandwidth : 120 kHz
- Frequency range : 30 MHz ~ 1 000 MHz
- Measurement distance : 3 m
- Channel : Low

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)
146.40	29.00	H	1.00	360.00	7.91	2.66	39.57	43.52	-3.95
148.34	26.50	V	1.00	360.00	7.95	2.68	37.13	43.52	-6.39
440.31	10.50	H	1.00	170.00	16.40	4.42	31.32	46.02	-14.70
500.45	12.80	H	1.50	270.00	17.38	4.60	34.78	46.02	-11.24
758.46	14.40	H	1.50	50.00	20.46	5.82	40.68	46.02	-5.34
800.17	12.40	V	1.00	360.00	20.99	6.40	39.79	46.02	-6.23

- Channel : Middle

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)
148.34	23.50	V	1.00	360.00	7.95	2.68	34.13	43.52	-9.39
148.34	29.30	H	1.00	360.00	7.95	2.68	39.93	43.52	-3.59
250.19	20.20	H	1.50	90.00	12.56	3.40	36.16	46.02	-9.86
386.96	14.20	V	1.50	270.00	15.44	3.97	33.61	46.02	-12.41
449.04	15.20	V	1.00	270.00	16.54	4.49	36.23	46.02	-9.79
500.45	18.40	H	1.30	270.00	17.38	4.60	40.38	46.02	-5.64

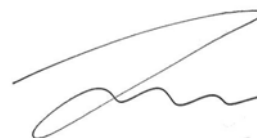
-. Channel : High

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)
146.40	27.10	V	1.00	360.00	7.91	2.66	37.67	43.52	-5.85
147.37	29.20	H	1.00	360.00	7.93	2.67	39.80	43.52	-3.72
440.31	14.50	H	1.00	180.00	16.40	4.42	35.32	46.02	-10.70
440.31	12.10	V	1.00	180.00	16.40	4.42	32.92	46.02	-13.10
780.77	15.30	H	1.50	60.00	20.74	6.13	42.17	46.02	-3.85
780.77	11.40	V	1.50	60.00	20.74	6.13	38.27	46.02	-7.75

Tabulated test data for Radiated Electromagnetic Field

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

$$\text{Margin (dB)} = \text{Emission Level (dB}\mu\text{V/m)} - \text{Limits (dB}\mu\text{V/m)}$$



Tested by: Chang-Uk, Jun / Engineer

9.6 Spurious Emission at Receiving mode for Antenna # 1

- Test Date : August 17, 2012
- Resolution bandwidth : 120 kHz / 1 MHz
- Frequency range : 30 MHz ~ 10 GHz
- Measurement distance : 3 m
- 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)
398.60	16.30	V	1.00	90.00	15.72	4.09	36.11	46.02	-9.91
440.31	18.10	H	1.00	95.00	16.40	4.42	38.92	46.02	-7.10
456.80	16.90	H	1.20	360.00	16.67	4.51	38.08	46.02	-7.94
500.45	20.20	H	1.20	180.00	17.38	4.60	42.18	46.02	-3.84
529.55	14.40	V	1.00	90.00	17.90	4.84	37.14	46.02	-8.88
900.08	10.70	V	1.20	90.00	22.29	7.40	40.39	46.02	-5.63
Other frequencies were not observed any emissions up to 10 GHz.									

Tabulated test data for Radiated Electromagnetic Field

Remark: "H": Horizontal, "V": Vertical

Margin (dB) = Emission Level (dBμV/m) – Limits (dBμV/m)



Tested by: Chang-Uk, Jun / Engineer

9.7 Spurious Emission at Receiving mode for Antenna # 2

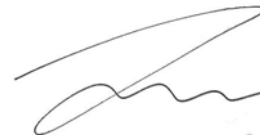
- Test Date : August 17, 2012
- Resolution bandwidth : 120 kHz / 1 MHz
- Frequency range : 30 MHz ~ 10 GHz
- Measurement distance : 3 m
- Result : PASSED

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)
398.60	16.50	V	1.00	90.00	15.72	4.09	36.31	46.02	-9.71
440.31	18.20	H	1.00	95.00	16.40	4.42	39.02	46.02	-7.00
456.80	16.40	H	1.20	360.00	16.67	4.51	37.58	46.02	-8.44
500.45	19.90	H	1.20	180.00	17.38	4.60	41.88	46.02	-4.14
529.55	15.80	V	1.00	90.00	17.90	4.84	38.54	46.02	-7.48
900.08	11.20	V	1.20	90.00	22.29	7.40	40.89	46.02	-5.13
Other frequencies were not observed any emissions up to 10 GHz.									

Tabulated test data for Radiated Electromagnetic Field

Remark: "H": Horizontal, "V": Vertical

Margin (dB) = Emission Level (dBμV/m) – Limits (dBμV/m)



Tested by: Chang-Uk, Jun / Engineer

10. CONDUCTED EMISSION TEST

10.1 Operating environment

Temperature : 21 °C
Relative humidity : 43 % R.H.

10.2 Test set-up

The EUT was placed on a wooden table, 0.8 m height above the floor. The EUT was connected to adaptor and power of adaptor was fed to the EUT through a 50 Ω / 50 μ H + 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.

10.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal.(Interval)
☐ -	ESiB26	R&S	Test Receiver	100296	Apr. 13, 2012 (1Y)
☒ -	ESHS10	Rohde & Schwarz	Test Receiver	834467/007	Jun. 21, 2012 (1Y)
☐ -	NSLK 8126	Schwarzbeck	AMN	8126-404	Jun. 11, 2012 (1Y)
☒ -	NSLK 8128	Schwarzbeck	AMN	8128-216	Jun. 11, 2012 (1Y)
☐ -	3825/2	EMCO	AMN	9109-1867	May 30, 2012 (1Y)
☐ -	3825/2	EMCO	AMN	9109-1869	May 30, 2012 (1Y)
☐ -	N/A	KNORR-BREMSE	Artificial Hand	12844	N/A

All test equipment used is calibrated on a regular basis.

10.4 Test data for Antenna #1

- Test Date : August 17, 2012
- Resolution bandwidth : 9 kHz
- Frequency range : 0.15 MHz ~ 30 MHz
- Test Result : PASSED BY -14.38 dB at 0.17 MHz

Frequency (MHz)	Line	Peak (dBμV)		Margin (dB)
		Emission level	Q.P Limits	
0.16	N	50.80	65.73	14.93
0.19	H	43.44	64.04	20.60
0.46	N	35.97	56.78	20.81
20.95	N	34.45	56.00	21.55
22.74	N	27.90	60.00	32.10
26.55	H	31.04	60.00	28.96
Frequency (MHz)	Line	Average (dBμV)		Margin (dB)
		Emission level	Limits	
0.46	N	23.61	46.78	23.17
0.95	N	26.81	46.00	19.19
26.25	H	27.37	50.00	22.63
26.54	N	24.64	50.00	25.36

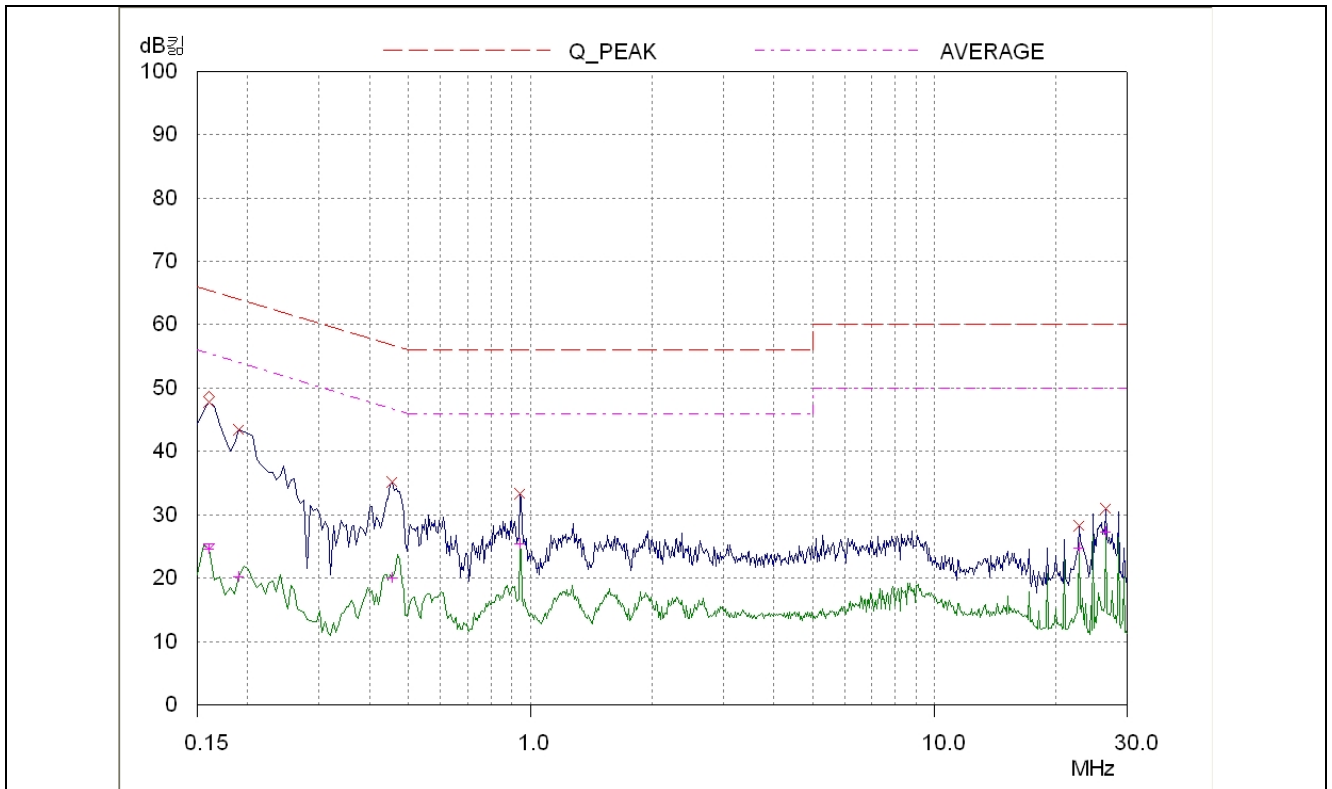
Line Conducted Emissions Tabulated Data

Remark : “H”: Hot Line, “N”: Neutral Line

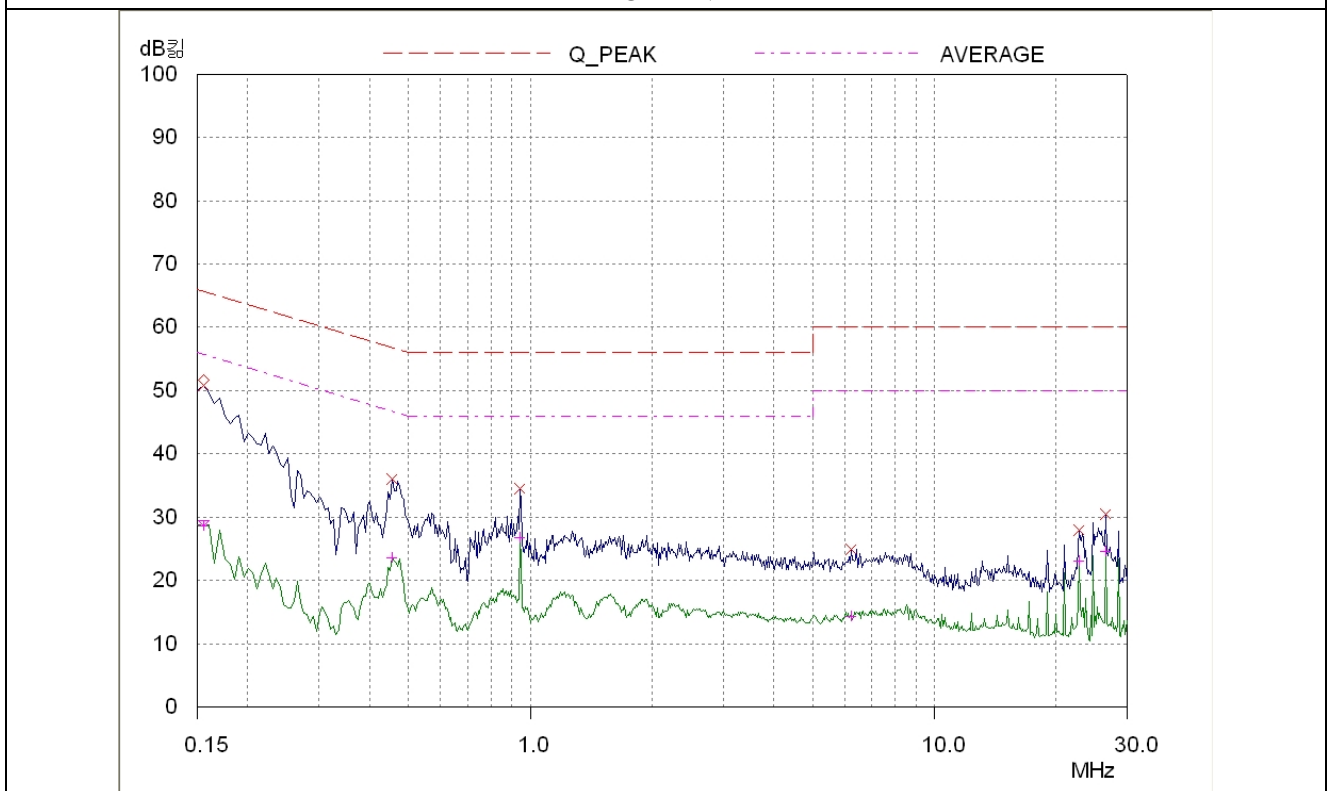
See next page for an overview sweep performed with peak and average detector mode.



Tested by: Chang-Uk, Jun / Engineer



HOT LINE



NEUTRAL LINE

10.5 Test data for Antenna # 2

- Test Date : August 17, 2012
- Resolution bandwidth : 9 kHz
- Frequency range : 0.15 MHz ~ 30 MHz
- Test Result : PASSED BY -14.38 dB at 0.17 MHz

Frequency (MHz)	Line	Peak (dBμV)		Margin (dB)
		Emission level	Q.P Limits	
0.15	N	49.86	66.00	16.14
0.16	H	52.56	65.73	13.17
0.18	N	46.00	64.72	18.72
0.19	N	46.68	64.26	17.58
0.95	H	36.03	56.00	19.97
0.20	N	42.62	63.61	20.99
Frequency (MHz)	Line	Average (dBμV)		Margin (dB)
		Emission level	Limits	
0.16	N	32.20	55.73	23.53
0.85	N	29.62	46.00	16.83
2.55	N	14.98	46.00	31.02
9.23	N	16.80	50.00	33.20

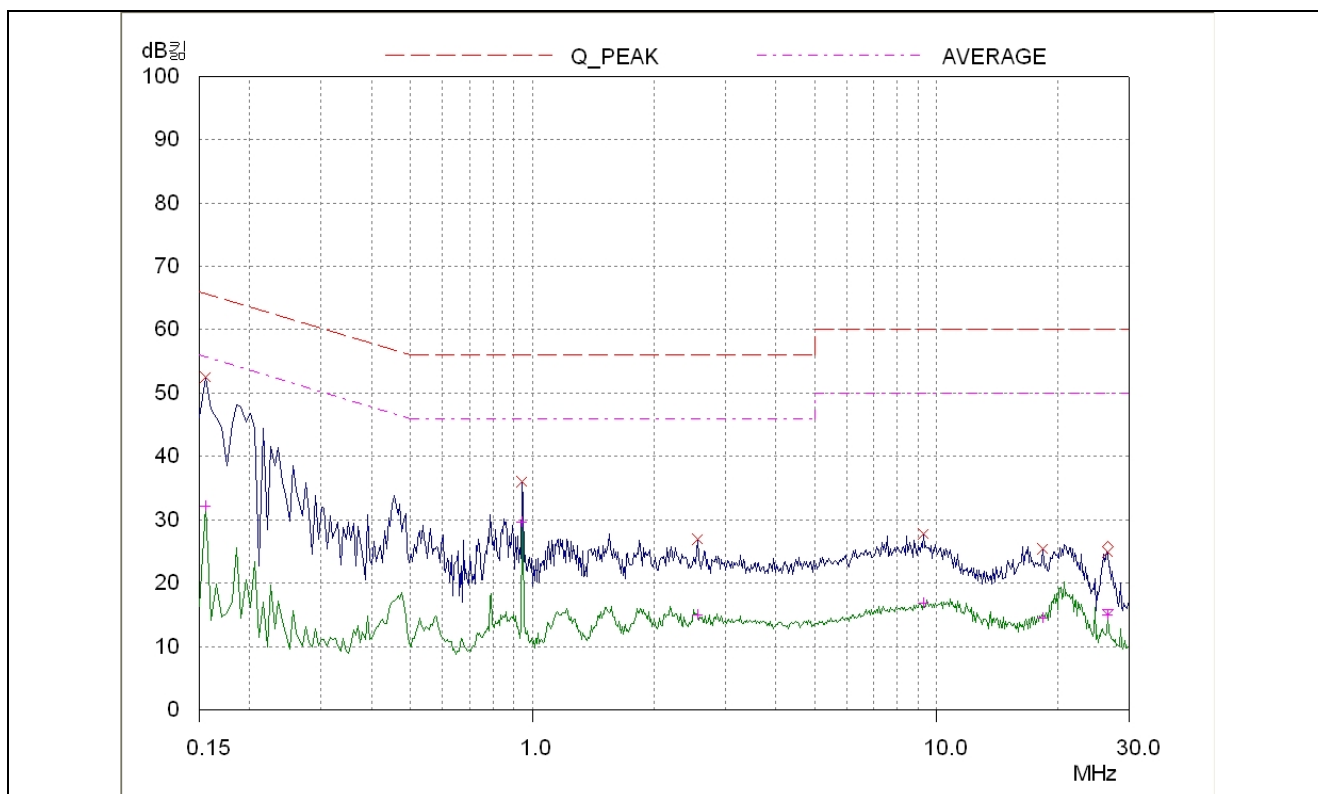
Line Conducted Emissions Tabulated Data

Remark : "H": Hot Line, "N": Neutral Line

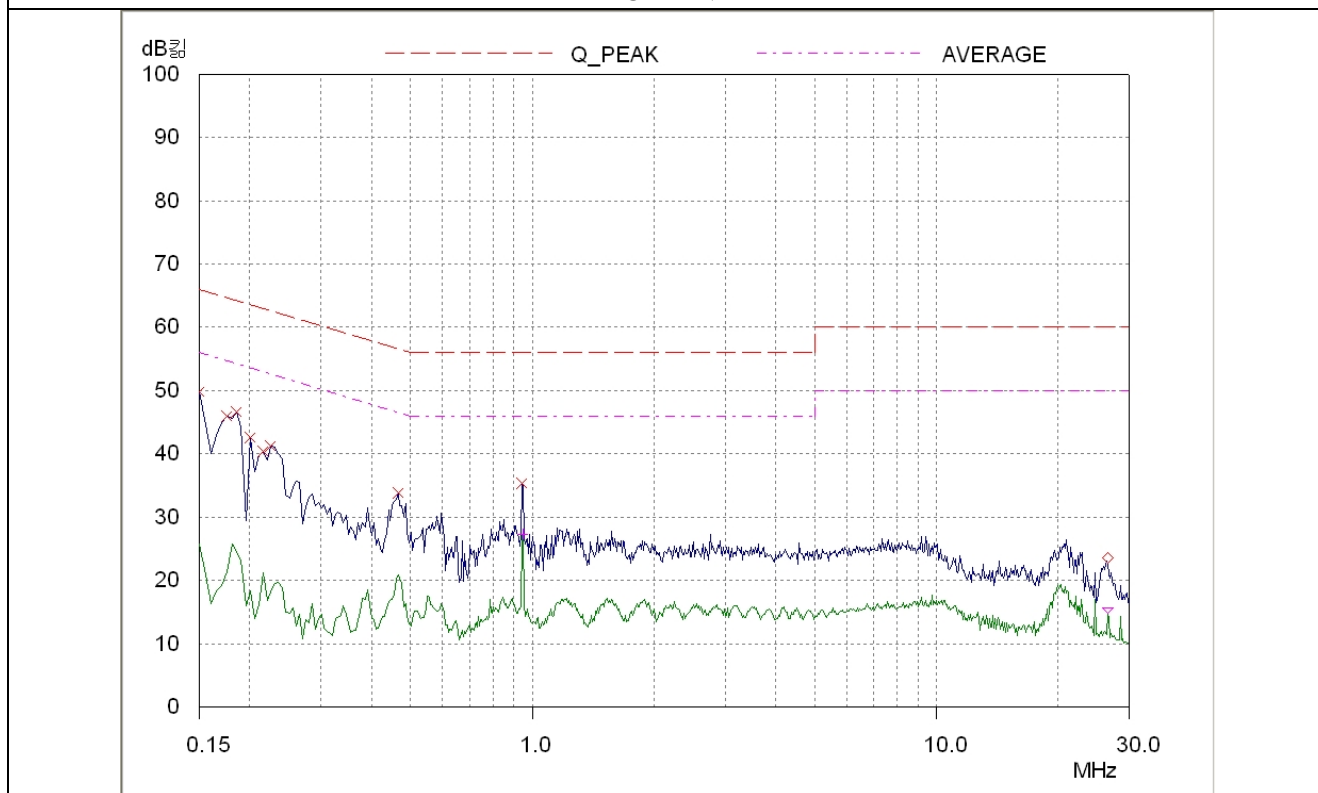
See next page for an overview sweep performed with peak and average detector mode.



Tested by: Chang-Uk, Jun / Engineer



HOT LINE



NEUTRAL LINE

10.6 Test data at Receiving mode for Antenna # 1

- Test Date : August 17, 2012
- Resolution bandwidth : 9 kHz
- Frequency range : 0.15 MHz ~ 30 MHz
- Test Result : PASSED BY -26.06 dB at 0.45 MHz

Frequency (MHz)	Line	Peak (dBμV)		Margin (dB)
		Emission level	Q.P Limits	
0.20	N	36.42	63.61	27.19
0.21	H	35.92	63.41	27.49
0.45	N	30.82	56.88	26.06
0.60	N	25.59	56.00	30.41
1.93	N	20.50	56.00	35.50
26.20	H	25.55	60.00	34.45
Frequency (MHz)	Line	Average (dBμV)		Margin (dB)
		Emission level	Limits	
0.45	N	16.36	46.88	30.52
2.07	H	12.69	46.00	33.31
11.17	H	14.53	50.00	35.47
21.11	N	15.30	50.00	34.70

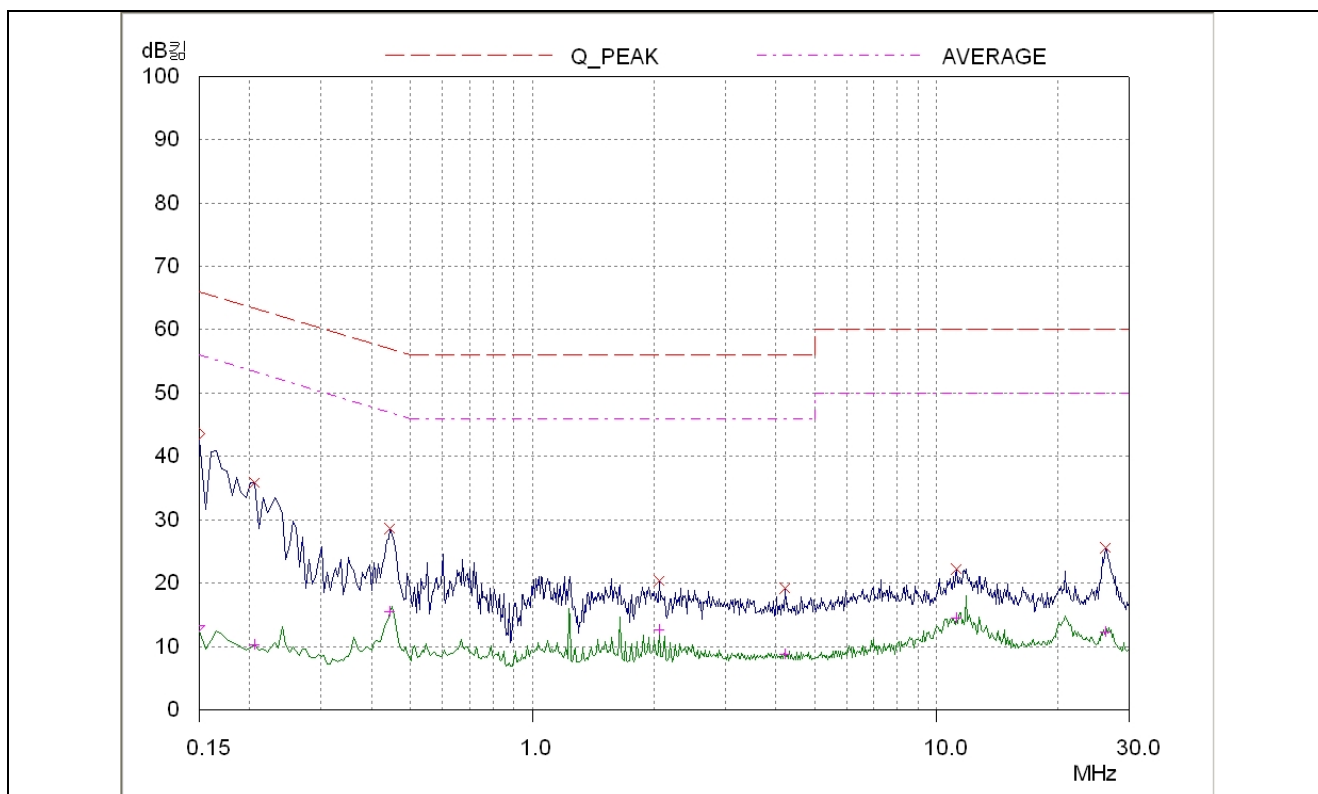
Line Conducted Emissions Tabulated Data

Remark : “H”: Hot Line, “N”: Neutral Line

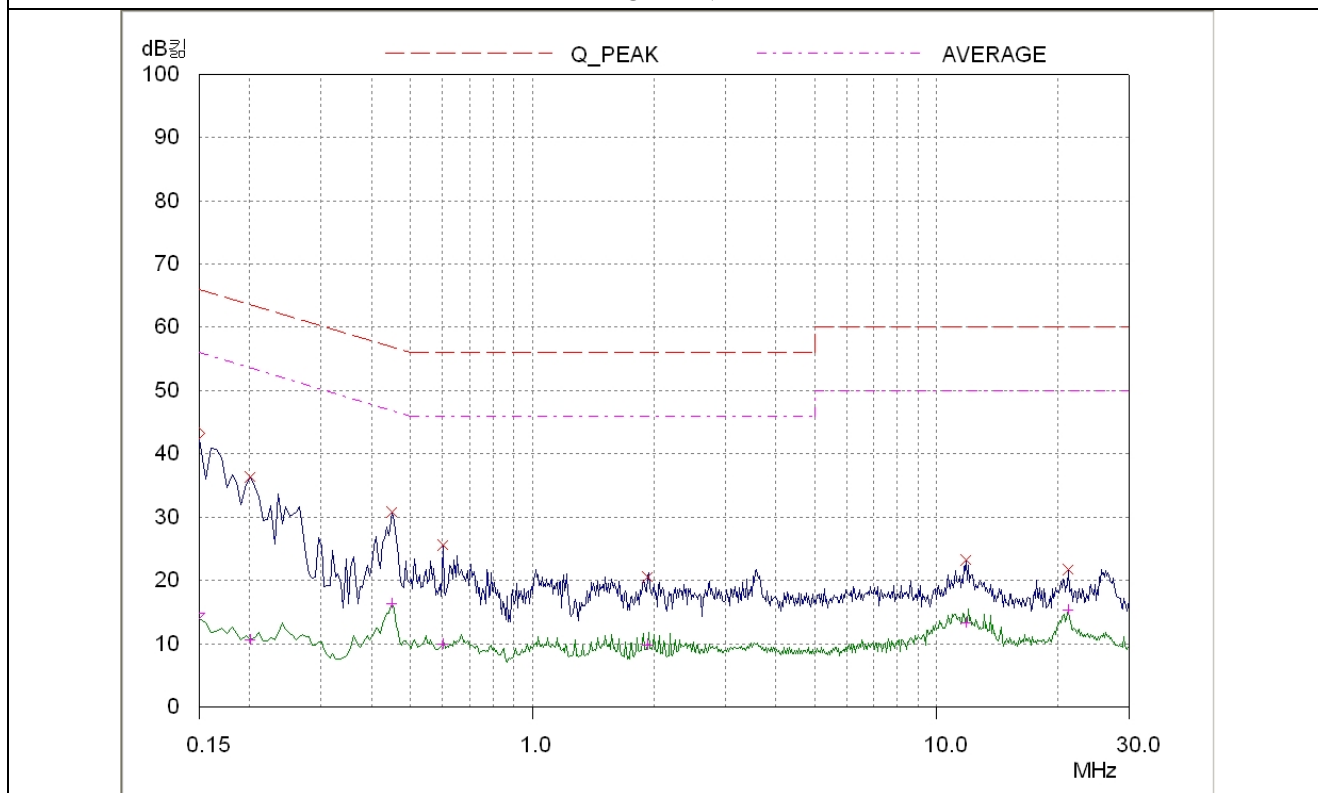
See next page for an overview sweep performed with peak and average detector mode.



Tested by: Chang-Uk, Jun / Engineer



HOT LINE



NEUTRAL LINE

10.7 Test data at Receiving mode for Antenna # 2

- Test Date : August 17, 2012
- Resolution bandwidth : 9 kHz
- Frequency range : 0.15 MHz ~ 30 MHz
- Test Result : PASSED BY -26.06 dB at 0.45 MHz

Frequency (MHz)	Line	Peak (dBμV)		Margin (dB)
		Emission level	Q.P Limits	
0.17	N	38.58	65.21	26.63
0.19	H	38.17	64.26	26.09
0.45	H	30.87	56.88	26.01
0.69	N	23.66	56.00	32.34
1.03	H	22.16	56.00	33.84
3.60	N	22.70	56.00	33.30
Frequency (MHz)	Line	Average (dBμV)		Margin (dB)
		Emission level	Limits	
0.45	H	16.53	46.88	30.35
1.03	H	11.02	46.00	34.98
1.82	H	11.56	46.00	34.44
13.56	N	15.42	50.00	34.58

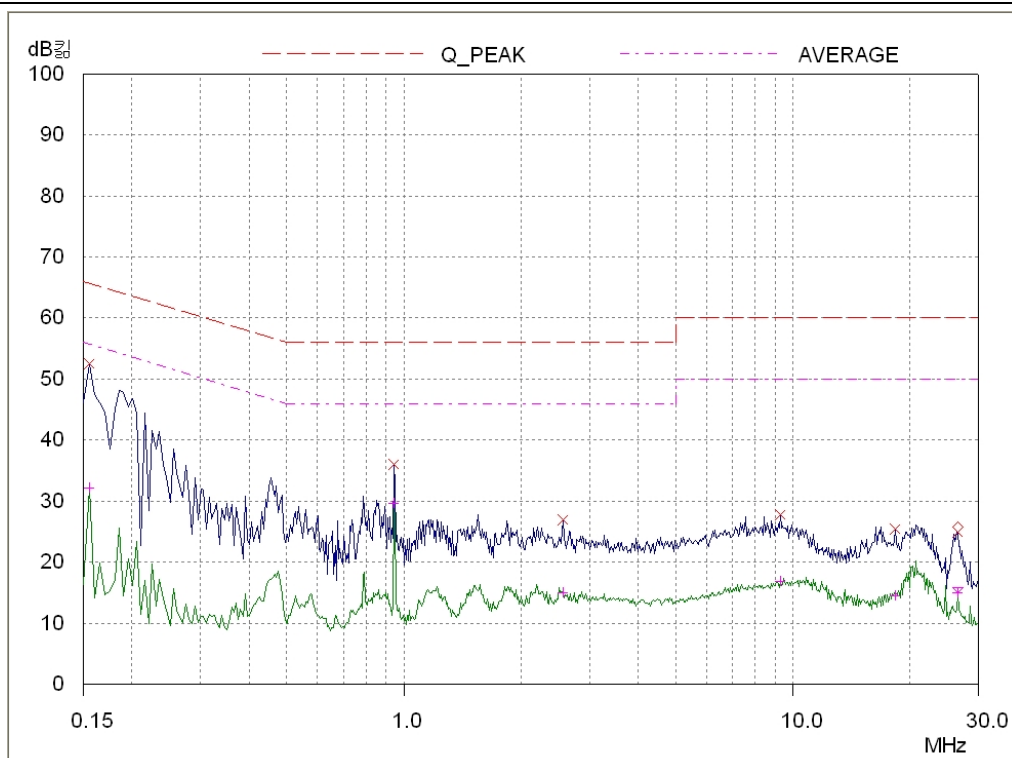
Line Conducted Emissions Tabulated Data

Remark : “H”: Hot Line, “N”: Neutral Line

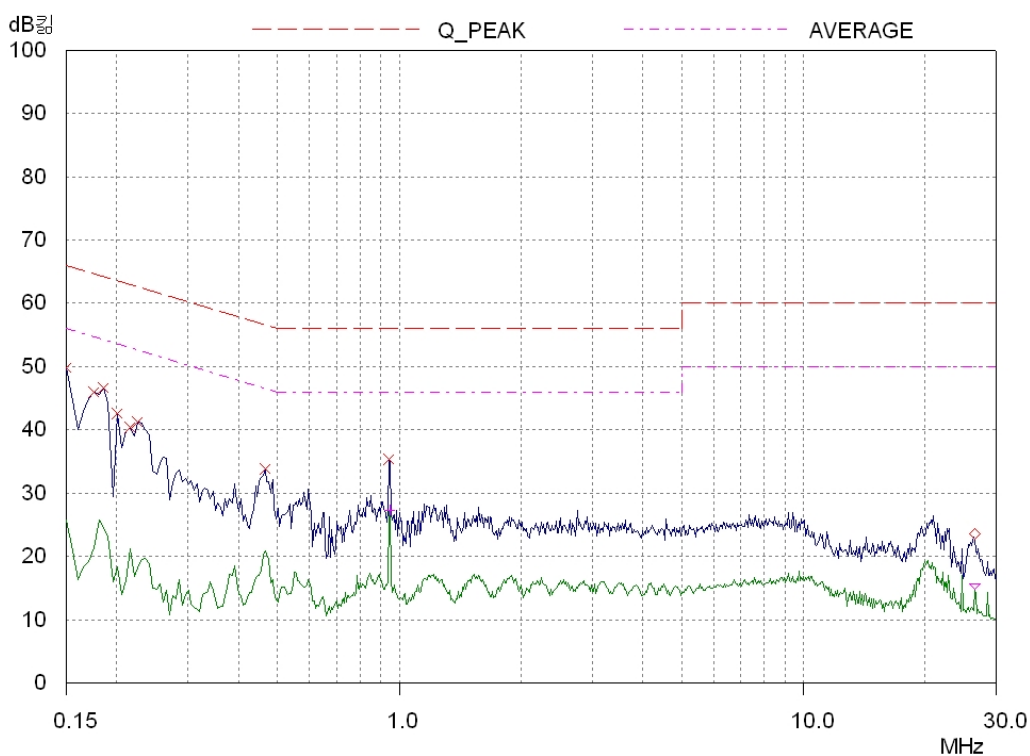
See next page for an overview sweep performed with peak and average detector mode.



Tested by: Chang-Uk, Jun / Engineer



HOT LINE



NEUTRAL LINE