

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

Test Report No. : E098R-011

AGR No. : A097A-039

Applicant : Dadam Micro INC.
Address : #707 Keumkang Hightech Valley, 133-1, Sangdaewon1-dong, Jungwon-gu,
Sungnam-si, 462-724, Korea

Manufacturer : Dadam Micro INC.
Address : #707 Keumkang Hightech Valley, 133-1, Sangdaewon1-dong, Jungwon-gu,
Sungnam-si, 462-724, Korea

Type of Equipment : WIRELESS THERMO-HYGROMONITOR

FCC ID. : TH7-GMS220ZB

Model Name : GMS-220ZB

Serial number : N/A

Total page of Report : 30 pages (including this page)

Date of Incoming : July 06, 2009

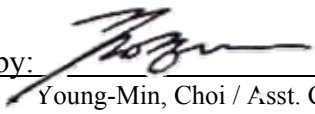
Date of issue : August 21, 2009

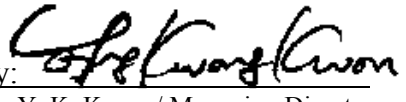
SUMMARY

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: 
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EMC/RF Center
ONETECH Corp.

Reviewed by: 
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ONETECH Corp.

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1. VERIFICATION OF COMPLIANCE

APPLICANT : Dadam Micro INC.
 ADDRESS : #707 Keumkang Hightech Valley, 133-1, Sangdaewon1-dong, Jungwon-gu,
 Sungnam-si, 462-724, Korea
 CONTACT PERSON : Mr. Duck-Bae, Yun / R&D Division Manager
 TELEPHONE NO : +82-31-777-5432
 FCC ID : TH7-GMS220ZB
 MODEL NAME : GMS-220ZB
 BRAND NAME : GreenOK-II
 SERIAL NUMBER : N/A
 DATE : August 07, 2009

EQUIPMENT CLASS	<i>DTS – DIGITAL TRNSMISSION SYSTEM</i>
KIND OF EQUIPMENT	WIRELESS THERMO-HYGROMONITOR
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 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 METER(S) OPEN AREA TEST SITE

-. 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.

2. TEST SUMMARY

2.1 Test items and results

SECTION	TEST ITEMS	RESULTS
15.247 (a) (2)	Minimum 6 dB Bandwidth	Met the Limit / PASS
15.247 (b) (3)	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
15.247 (e)	Power Spectral Density	Met the Limit / PASS
15.247 (i)	Radio Frequency Exposure Level	Met the Limit / PASS
15.209	Radiated Emission Limits	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 section 2.1.

2.5 Test Methodology

Radiated testing was performed according to the procedures in ANSI C63.4: 2003 at a distance of 3 meters from EUT to the antenna.

2.6 Test Facility

The open area test site and conducted measurement facilities are located on at 307-51 Daessangryung-ri, Chowol-eup, Gwangju-si, Gyeonggi-do, 464-862, Korea. Description details of test facilities were submitted to the Commission on August 21, 2008. (Registration Number: 340658)

3. GENERAL INFORMATION

3.1 Product Description

The Dadam Micro INC., WIRELESS THERMO-HYGROMONITOR (referred to as the EUT in this report) is a transceiver that measures and transmits the temperature and humidity via 2.4 GHz Zigbee wireless technology. This device is consisting of a Base Monitoring Unit (BMU), Model GMS-220ZB, FCC ID: TH7-GMS220ZB and associated Wireless Sensing Units (WSU), Model: Model No: GMS-120ZB, FCC ID: TH7-GMS120ZB, which can be installed anywhere within 300 meters radius from BMU. This report only covers BMU and WSU shall be issued another test report number.

The product specification described herein was obtained from product data sheet or user's manual.

DEVICE TYPE	WIRELESS THERMO-HYGROMONITOR
TEMPERATURE RANGE	-20 °C ~ +80 °C
OPERATING FREQUENCY	Tx: 2.405 GHz, Rx: 2.405 GHz
RF OUTPUT POWER	16.00 dBm
NUMBER OF CHANNEL	1 Channel
DATA TRANSFER RATE	Max. 1 Mbps
MODULATION TYPE	Q-QPSK
ANTENNA	MFR.: WINiZEN, Model No.: W5E-WO-01
ANTENNA CONNECTOR TYPE	External Dipole Antenna
ANTENNA GAIN	5 dBi
LIST OF EACH OSC. OR CRYSTAL. FREQ.(FREQ.>=1 MHz)	16 MHz
NUMBER OF LAYER	4 Layers
ELECTRICAL RATING	DC 5 V, 0.4 A from an adaptor
USED ADAPTOR	Mfg.: Best Technology Co., Ltd., Model Name: BPA-072(PLA10-5) Input: AC 100 V - 240 V~, 50/60 Hz, 0.3 A, Output: DC 5 V, 0.4 A
EXRERNAL CONNECTOR	DC In, Relay Out, Sensor In(3), ISP

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	FCC ID
Main Board	Dadam Micro	GMS-120.220 ZB	N/A

5.2 Peripheral equipment

Defined as equipment needed for correct operation of the EUT, but not considered as tested: None

5.3 Mode of operation during the test

For the testing, software used to control the EUT for staying in continuous transmitting and receiving mode is programmed at 2.405 GHz. To get a maximum emission levels from the EUT, the EUT was moved throughout the XY, XZ, and YZ planes.

5.4 Configuration of Test System

Line Conducted Test: The EUT was connected to adaptor and the power of adaptor was connected to LISN. All supporting equipments were connected to another LISN. Preliminary Power lines Conducted Emission tests were performed by using the procedure in ANSI C63.4: 2003 7.2.3 to determine the worse operating conditions.

Radiated Emission Test: Preliminary radiated emissions test were conducted using the procedure in ANSI C63.4: 2003 8.3.1.1 and 13.1.4.1 to determine the worse operating conditions. Final radiated emission tests were conducted at 3 meter 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

For intentional device, according to section 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

Antenna Construction:

The antenna of the EUT shall be molded with the cover of the EUT at the manufacturer side, so no consideration of replacement by the user.

It should not be reproduced except in full, without the written approval of ONETECH.

EMC-003 (Rev.1)

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(TEL: +82-31-746-8500, FAX: +82-31-746-8700)

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

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

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

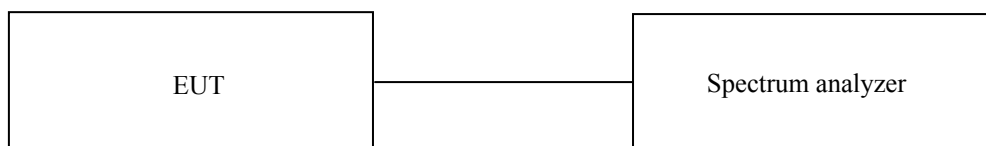
7. MINIMUM 6 dB BANDWIDTH

7.1 Operating environment

Temperature : 25 °C
Relative humidity : 48.5 %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 100 kHz, and peak detection was used. The 6 dB bandwidth is defined as the total spectrum over which the power is higher than the peak power minus 6 dB.



7.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ -	8564E	HP	Spectrum Analyzer	3650A00756	June 15, 2009

All test equipment used is calibrated on a regular basis.

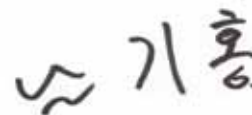
7.4 Test data

- Test Date : July 13, 2009

- Test Result : Pass

FREQUENCY(MHz)	MEASURED VLAUE (kHz)	LIMIT (kHz)	MARGIN (kHz)
2 405	1 555	500	-1 055

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



Tested by: Ki-Hong, Nam / Senior Engineer



8. MAXIMUM PEAK OUTPUT POWER

8.1 Operating environment

Temperature : 25 °C
Relative humidity : 48.5 %R.H.

8.2 Test set-up

The maximum peak output power was measured with the spectrum analyzer connected to the antenna output of the EUT. The spectrum analyzer's internal channel power integration function is used to integrate the power over a bandwidth greater than or equal to the 99 % bandwidth. The EUT was operating in transmit mode at the appropriate center frequency.



8.3 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ - 8564E	HP	Spectrum Analyzer	3650A00756	June 15, 2009

All test equipment used is calibrated on a regular basis.

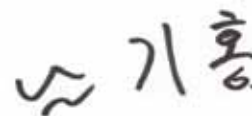
8.4 Test data

- Test Date : July 13, 2009

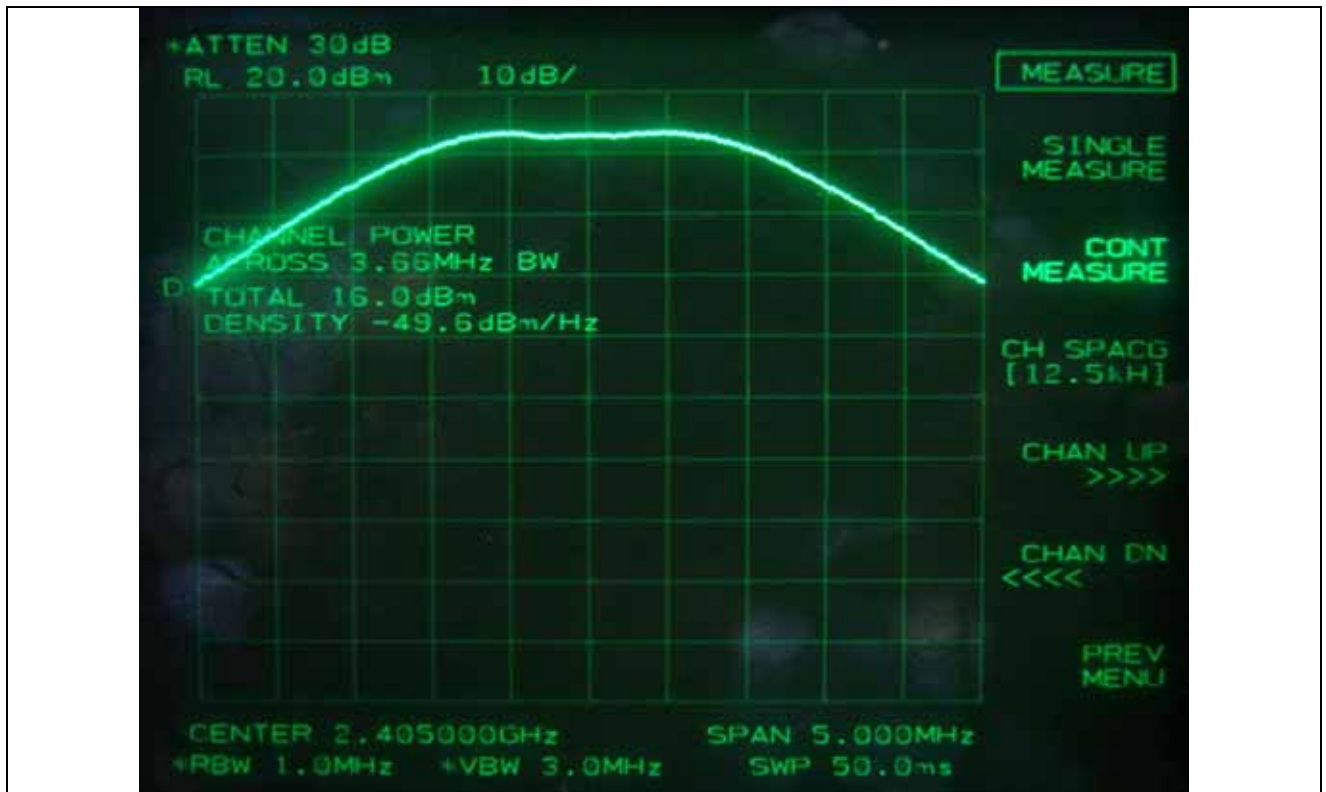
- Test Result : Pass

FREQUENCY (MHz)	99 % Occupied Bandwidth (MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
2 405	3.658	16.00	30.00	-14.00

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



Tested by: Ki-Hong, Nam / Senior Engineer



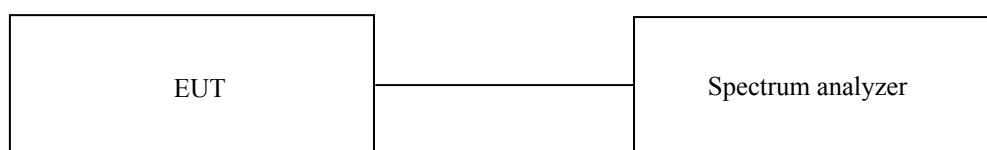
9. 100 kHz BANDWIDTH OUTSIDE THE FREQUENCY BAND

9.1 Operating environment

Temperature : 28.5 °C
Relative humidity : 48.8 %R.H.

9.2 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.



9.3 Test set-up for radiated measurement

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

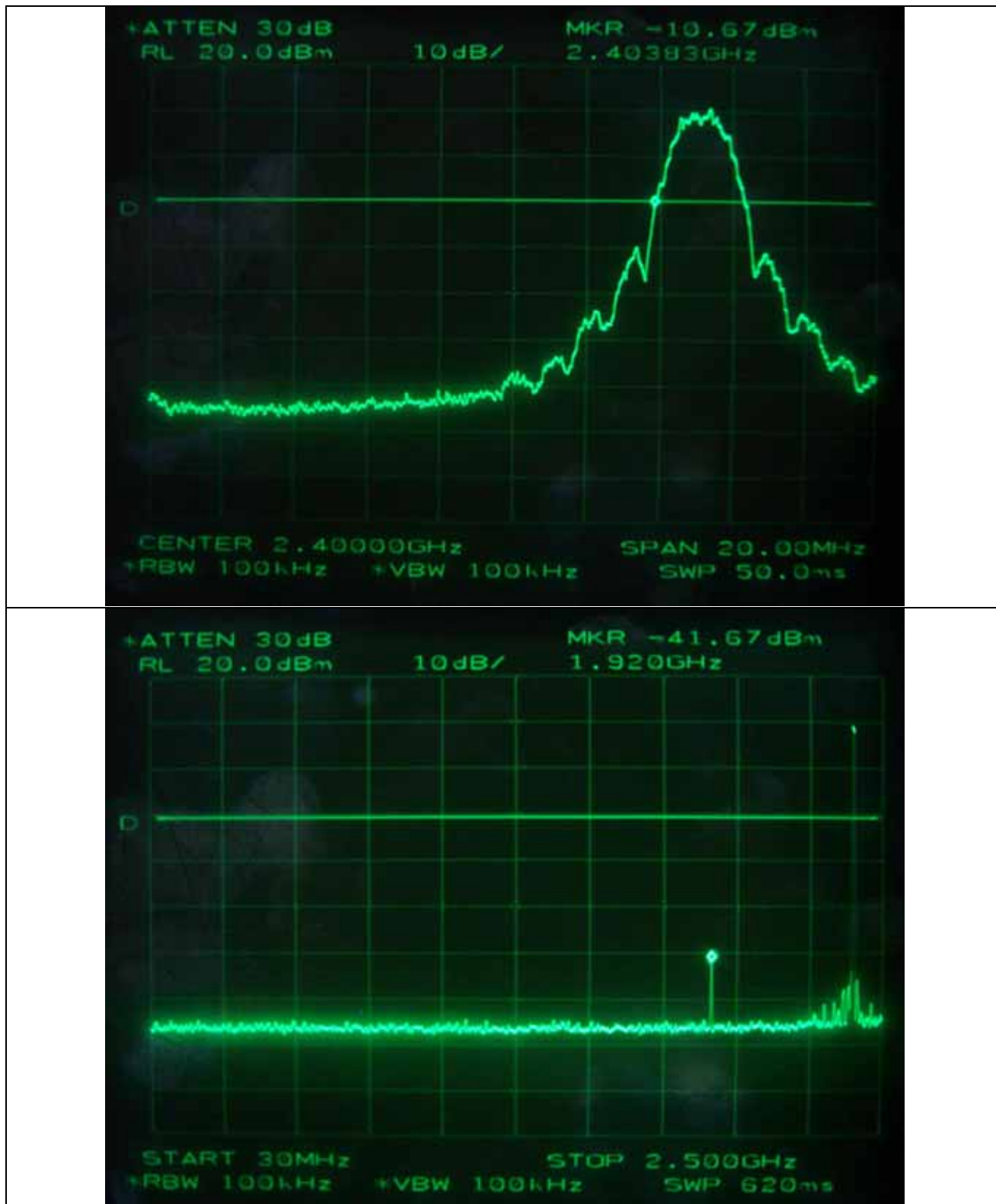
The frequency spectrum from 30 MHz to 25 GHz was scanned and maximum emission levels at each frequency recorded. The system was rotated 360°, and the antenna was varied in the height between 1.0 and 4.0 meters in order to determine the maximum emission levels. This procedure was performed for horizontal and vertical polarization of the receiving antenna.

9.4 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ -	8564E	Hewlett-Packard	Spectrum Analyzer	3650A00756	June 15, 2009
■ -	FSP	Rohde-Schwarz	Spectrum Analyzer	100123	Mar 18, 2009
■ -	8447D	Hewlett-Packard	Amplifier	2727A04987	June 15, 2009
■ -	83051A	Agilent	Preamplifier	3950M00201	June 15, 2009
■ -	F-40-5000-RF	RLC Electronics	Highpass Filter	0425	July 10, 2009
■ -	MA220	HD	Turn Table	N/A	N/A
■ -	HD240	HD	Antenna Mast	N/A	N/A
■ -	BBHA9120D	Schwarzbeck	Horn Antenna	BBHA9120D294	June 17, 2009(2Y)
■ -	YSE 500B	YoungShin Eng.	Frequency Converter	950413001	N/A
■ -	ETCR-10	DaeHa	Automatic Voltage Com.	N/A	N/A

All test equipment used is calibrated on a regular basis.

9.5. Test data for conducted emission





9.6. Test data for radiated emission

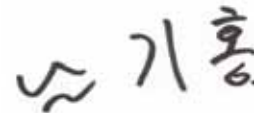
9.6.1 Radiated Emission which fall in the Restricted Band

- Test Date : August 20, 2009
- 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 ~ 25 GHz
- Measurement distance : 3 m
- Result : PASSED BY -6.66 dB

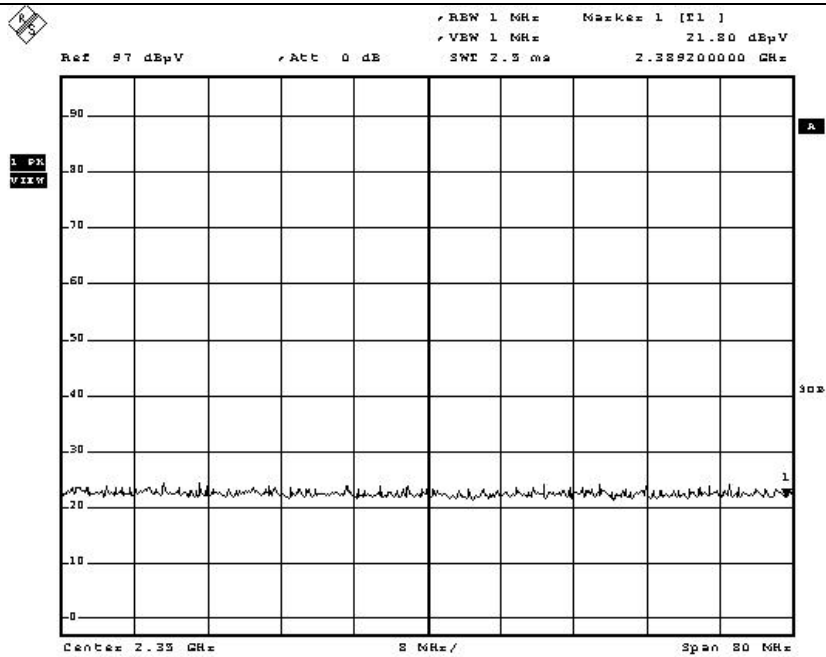
Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
2 389.52	21.80	Peak	H	27.05	3.13	51.98	74.00	-22.02
	12.50	Average	H			42.68	54.00	-11.32
	29.96	Peak	V			60.14	74.00	-13.86
	17.16	Average	V			47.34	54.00	-6.66

Tabulated test data for Restricted Band

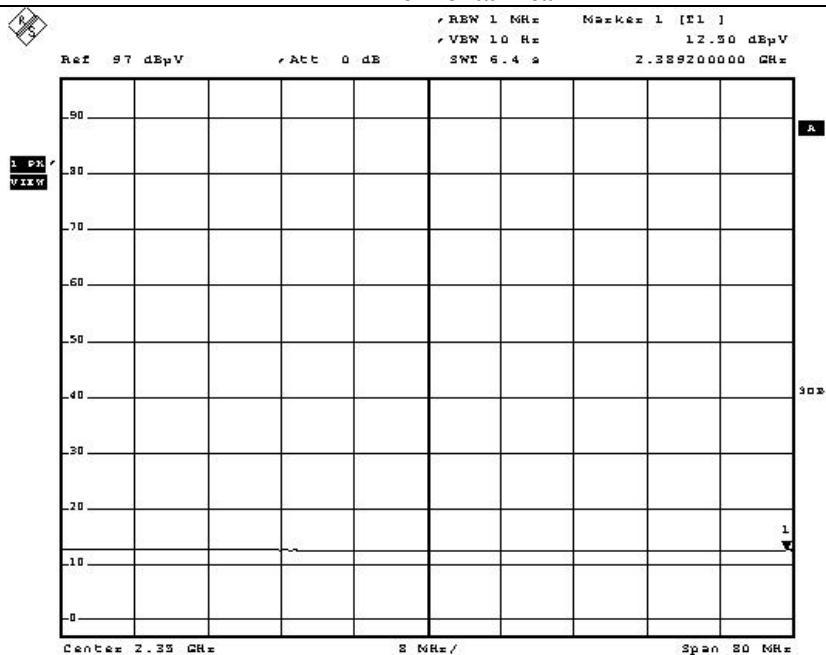
Remark: "H": Horizontal, "V": Vertical



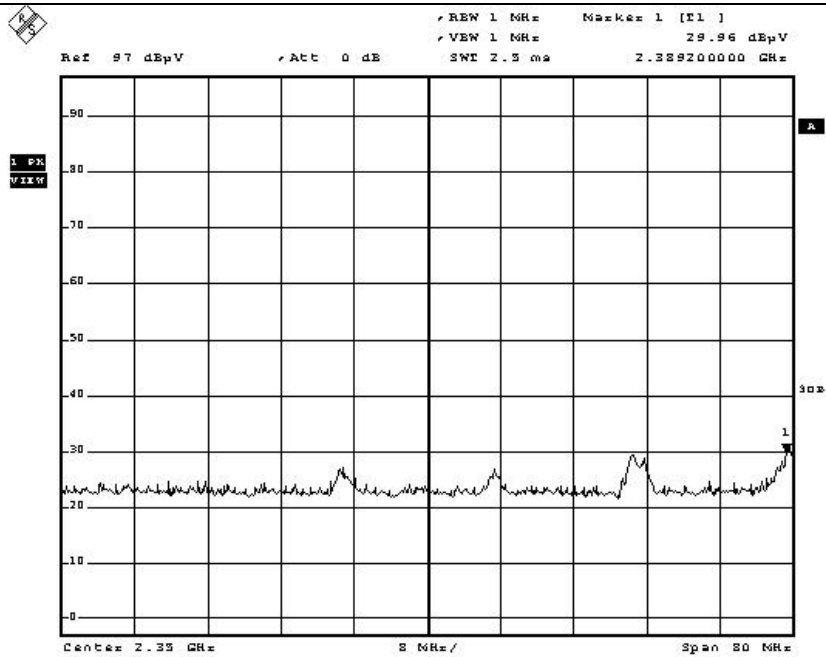
Tested by: Ki-Hong, Nam / Senior Engineer



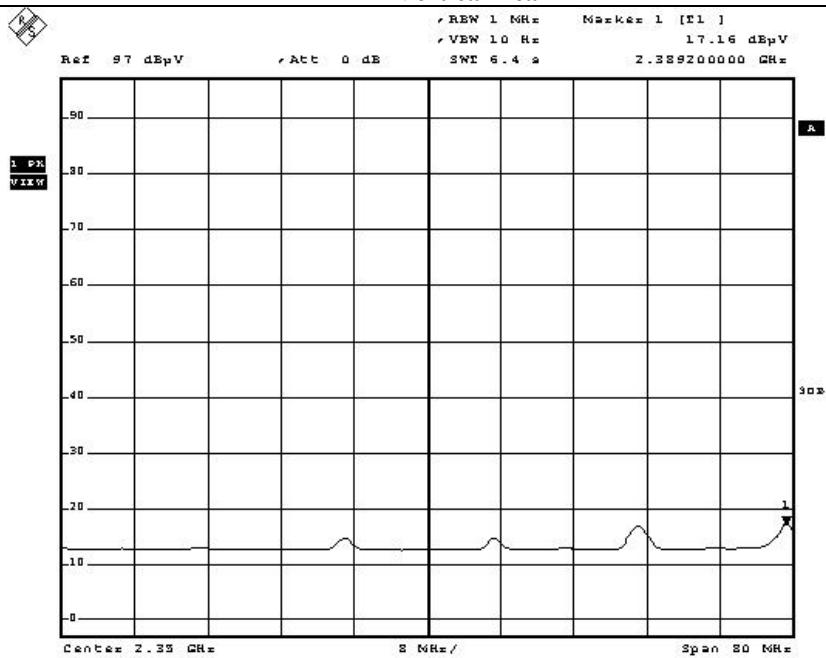
Horizontal-Peak



Horizontal-Average



Vertical-Peak



Vertical-Average

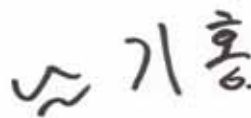
9.6.2 Spurious & Harmonic Radiated Emission

- Test Date : August 20, 2009
- 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 ~ 25 GHz
- Measurement distance : 3 m
- Result : PASSED BY -16.95 dB

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
2 405.00	66.70	Peak	H	27.09	3.16		96.95	-	
	85.93	Peak	V				116.18	-	
2 995.00	35.33	Peak	H	28.69	3.35	27.98	39.39	74.00	-34.61
	26.50	Average	H				30.56	54.00	-23.44
	36.00	Peak	V				40.06	74.00	-33.94
	27.17	Average	V				31.23	54.00	-22.77
4 810.00	38.25	Peak	H	31.08	4.10	28.80	44.63	74.00	-29.37
	30.00	Average	H				36.38	54.00	-17.62
	40.50	Peak	V				46.88	74.00	-27.12
	30.67	Average	V				37.05	54.00	-16.95

Tabulated test data for Restricted Band

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



Tested by: Ki-Hong, Nam / Senior Engineer

10. PEAK POWER SPECTRUL DENSITY

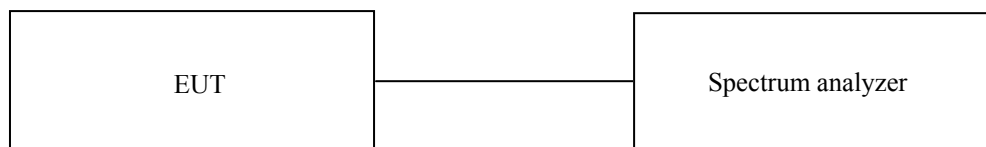
10.1 Operating environment

Temperature : 25 °C
Relative humidity : 48.5 %R.H.

10.2 Test set-up

The antenna output of the EUT was connected to the spectrum analyzer. The resolution bandwidth is set to 3 kHz, the video bandwidth is set to 3 times the resolution bandwidth, and sweep time was set to span / 3 kHz. The sweep time was allowed to be longer than span / 3 kHz for a full response of the mixer in the spectrum analyzer.

The maximum level from the EUT in a 3 kHz bandwidth was measured with above condition.



10.3 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ - 8564E	HP	Spectrum Analyzer	3650A00756	June 15, 2009

All test equipment used is calibrated on a regular basis.

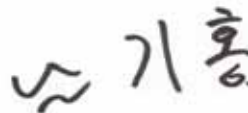
10.4 Test data

-. Test Date : July 13, 2009

-. Test Result : Pass

FREQUENCY(MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
2 405	2.33	8.00	-5.67

Remark: See next page for measurement data.



Tested by: Ki-Hong, Nam / Senior Engineer



11. RADIO FREQUENCY EXPOSURE

11.1 RF Exposure Limit

According to the FCC rule 1.1310 table 1B, the limit for the maximum permissible RF exposure for an uncontrolled environment is 1mW/cm².

The electric field generated for a 1mW/cm² 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/cm², Z = Impedance of free space, 377Ω

E = Electric field strength in Volts/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 (mW) = P (W) / 1000, d (cm) = 100 * d (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/cm²

11.2 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)	@ 20cm Separation	(mW/cm ²)
16.0	39.8	5.0	3.16	3.54	0.025	1

According to above table, safe separation distance, $D = 0.282 * \sqrt{50.0 * 3.16} = 3.54 \text{ cm}$.

For getting power density at 20 cm separation in above table, following formula was used.

$$S = P * G / (4\pi * R^2) = 39.8 * 3.16 / (4 * 3.14 * 20^2) = 0.025$$

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

12. RADIATED EMISSION TEST

12.1 Operating environment

Temperature : 25 °C
Relative humidity : 49 %R.H.

12.2 Test set-up

The radiated emissions measurements were on the 3 meters, open-field test site. 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 1 000 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 and 4.0 meters in order to determine the maximum emission levels. This procedure was performed for both horizontal and vertical polarization of the receiving antenna.

12.3 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ - ESVD	Rohde & Schwarz	Test Receiver	838453/018	Nov. 06, 2008
■ - 8566B	HP	Spectrum Analyzer	3407A08547	June 16, 2009
■ - 8447D	Hewlett Packard	Amplifier	2727A04987	June 16, 2009
■ - 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	Feb. 13, 2008(2Y)
■ - 9108-A(494)	Schwarzbeck	Log Periodic Antenna	62281001	Feb. 13, 2008(2Y)

All test equipment used is calibrated on a regular basis.

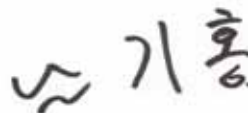
12.4 Test data

- Test Date : June 21, 2009
- Resolution bandwidth : 120 kHz
- Frequency range : 30 MHz ~ 1 000 MHz
- 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)
43.10	16.20	V	1.00	60.00	13.51	1.65	31.36	40.00	-8.64
55.10	17.20	V	1.50	100.00	9.19	1.41	27.80	40.00	-12.20
68.30	17.00	V	1.00	160.00	5.94	2.03	24.97	40.00	-15.03
155.10	15.20	H	1.00	150.00	15.05	2.65	32.90	43.52	-10.62
225.20	15.60	H	1.40	130.00	16.98	3.40	35.98	46.02	-10.04
403.10	15.10	V	1.60	110.00	17.29	4.02	36.41	46.02	-9.61

Tabulated test data for Radiated Electromagnetic Field

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



Tested by: Ki-Hong, Nam / Project Engineer

13. CONDUCTED EMISSION TEST

13.1 Operating environment

Temperature : 23 °C
Relative humidity : 48 %R.H.

13.2 Test set-up

The EUT was placed on a wooden table, 0.8 meters height above the floor. The EUT was connected to AC/DC adaptor and the power of AC/DC adaptor was connected through a 50 ohm/ 50 μ H + 5 ohm Artificial Mains Network (AMN). The ground plane was electrically bonded to the reference ground system and all power lines were filtered from ambient.

13.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ -	ESiB26	Rohde & Schwarz	EMI Test Receiver	100296	Apr. 03, 2009
■ -	NSLK 8126	Schwarzbeck	AMN	8126-404	June 15, 2009
□ -	3825/2	EMCO	AMN	9109-1867	June 15, 2009

All test equipment used is calibrated on a regular basis.

13.4 Test data

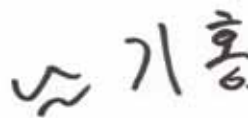
- . Type of Test : Intentional Radiator
- . Test Date : July 21, 2009
- . Resolution bandwidth : 9 kHz
- . Frequency range : 0.15 MHz ~ 30 MHz
- . Test Result : PASSED BY -16.20 dB at 0.58 MHz under average mode

Frequency (MHz)	Line	Quasi-Peak (dBμV)		Margin (dB)
		Emission level	Q.P Limits	
0.19	H	42.10	64.00	-21.90
0.29	H	37.20	60.40	-23.20
0.39	H	31.60	58.10	-26.50
0.49	N	30.10	56.20	-26.10
0.58	N	31.50	56.00	-24.50
0.68	H	29.10	56.00	-26.90
Frequency (MHz)	Line	Average (dBμV)		Margin (dB)
		Emission level	Limits	
0.19	H	37.50	53.80	-16.40
0.49	H	27.60	46.20	-18.60
0.58	N	29.80	46.00	-16.20
1.27	N	26.50	46.00	-19.50

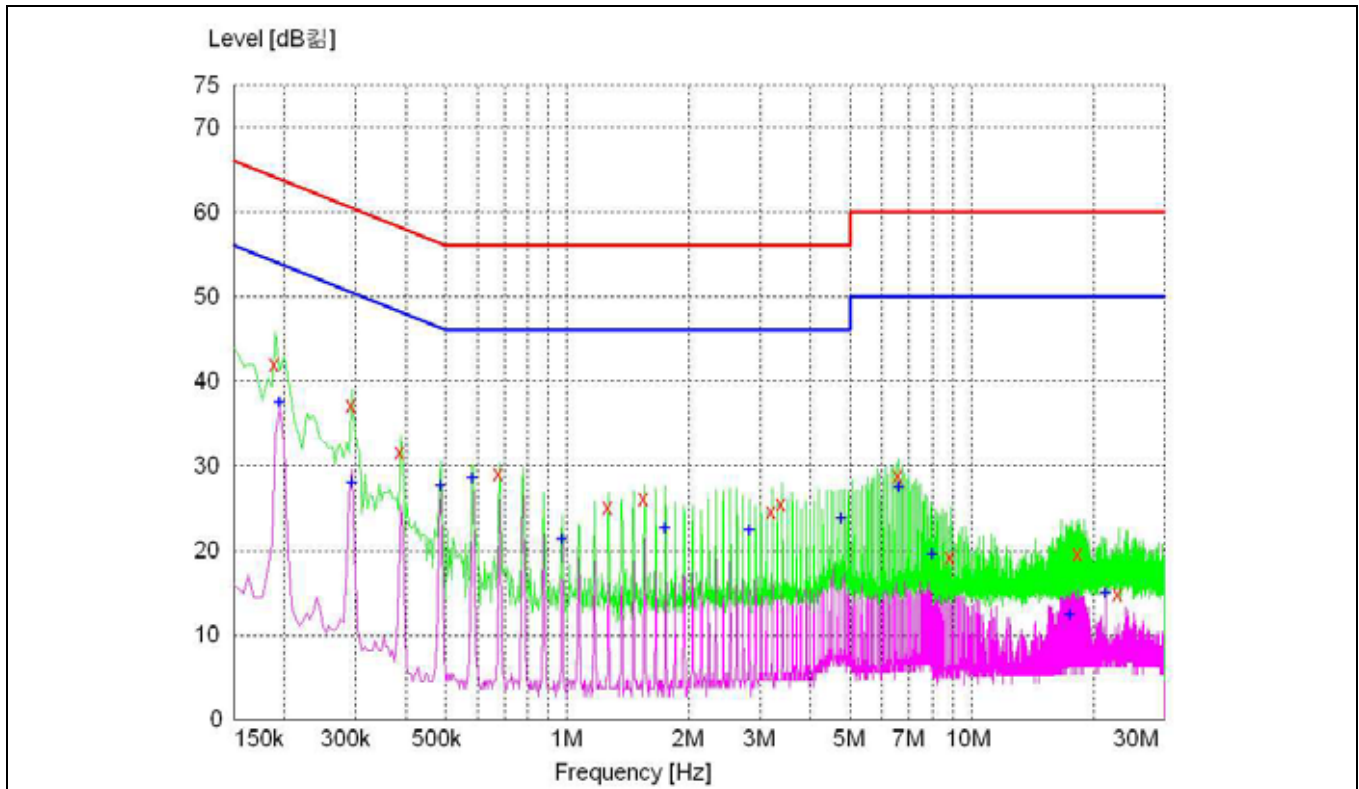
Line Conducted Emissions Tabulated Data

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

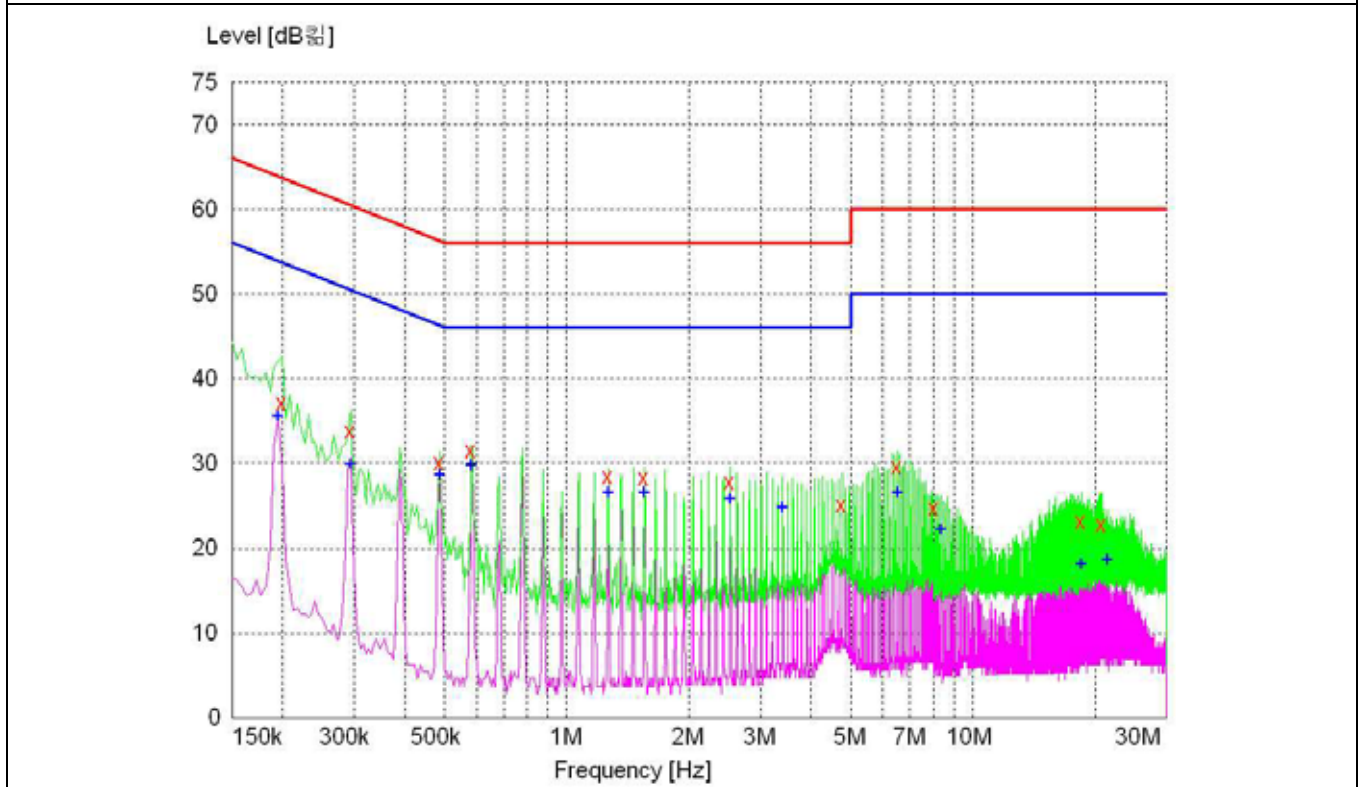
See next page for an overview sweep performed with quasi-peak detector modes.



Tested by: Ki-Hong, Nam / Senior Engineer



HOT LINE



NEUTRAL LINE

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EMC-003 (Rev.1)

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