



243 Jubug-Ri, Yangji-Myeon, Yongin-Si, Gyeonggi-Do, Korea 449-822  
 Tel: +82-31-323-6008 Fax: +82-31-323-6010  
<http://www.ltalab.com>



Dates of Tests: April 15~24, 2013  
 Test Report S/N: LR500111304I  
 Test Site : LTA CO., LTD.

## CERTIFICATION OF COMPLIANCE

FCC ID.

**VSOTD-2400MD**

APPLICANT

**Yeonhwa M Tech Co., Ltd.**

<b>Equipment Class</b>	:	<b>Digital Transmission System (DTS)</b>
<b>Manufacturing Description</b>	:	<b>Zigbee Data Modem Module</b>
<b>Manufacturer</b>	:	<b>Yeonhwa M Tech Co., Ltd.</b>
<b>Model name</b>	:	<b>TD-2400MD</b>
<b>Variant Model name</b>	:	<b>XR-2400D</b>
<b>Test Device Serial No.:</b>	:	<b>Identical prototype</b>
<b>Rule Part(s)</b>	:	<b>FCC Part 15.247 Subpart C ; ANSI C-63.4-2003</b>
<b>Frequency Range</b>	:	<b>2405MHz</b>
<b>Max. Output Power</b>	:	<b>Max 27.78dBm – Conducted</b>
<b>Data of issue</b>	:	<b>April 24, 2013</b>

This test report is issued under the authority of:

Kyu-Hyun Lee, Manager

The test was supervised by:

Jung-Moo Her, Test Engineer

**This test result only responds to the tested sample. It is not allowed to copy this report even partly without the allowance of the test laboratory. The report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.**



NVLAP LAB Code.: 200723-0

---

## TABLE OF CONTENTS

1. GENERAL INFORMATION'S	3
2. INFORMATION'S ABOUT TEST ITEM	4
3. TEST REPORT	5
3.1 SUMMARY OF TESTS	5
3.2 TECHNICAL CHARACTERISTICS TEST	6
3.2.1 6dB BANDWIDTH	6
3.2.2 PEAK OUTPUT POWER	8
3.2.3 POWER SPECTRAL DENSITY	10
3.2.4 BAND – EDGE & SPURIOUS	12
3.2.5 FIELD STRENGTH OF HARMONICS	16
3.2.6 AC CONDUCTED EMISSIONS	19
<b>APPENDIX</b>	
APPENDIX TEST EQUIPMENT USED FOR TESTS	22

## 1. General information's

### 1-1 Test Performed

Company name : LTA Co., Ltd.  
 Address : 243, Jubug-ri, Yangji-Myeon, Youngin-Si, Kyunggi-Do, Korea. 449-822  
 Web site : <http://www.ltalab.com>  
 E-mail : [chahn@ltalab.com](mailto:chahn@ltalab.com)  
 Telephone : +82-31-323-6008  
 Facsimile : +82-31-323-6010

Quality control in the testing laboratory is implemented as per ISO/IEC 17025 which is the “General requirements for the competents of calibration and testing laboratory”.

### 1-2 Accredited agencies

LTA Co., Ltd. is approved to perform EMC testing by the following agencies:

Agency	Country	Accreditation No.	Validity	Reference
NVLAP	U.S.A	200723-0	2013-09-30	ECT accredited Lab.
RRA	KOREA	KR0049	2013-04-24	EMC accredited Lab.
FCC	U.S.A	610755	2014-04-27	FCC filing
FCC	U.S.A	649054	UPDATING	FCC CAB
VCCI	JAPAN	R2133(10m), C2307	2014-06-21	VCCI registration
VCCI	JAPAN	T-2009	2013-12-23	VCCI registration
VCCI	JAPAN	G-563	2015-05-28	VCCI registration
IC	CANADA	5799A-1	2015-06-21	IC filing

## 2. Information's about test item

### 2-1 Client & Manufacturer

Company name : Yeonhwa M Tech Co., Ltd.  
 Address : 141, KwangMyung Factory Apt 201, Haan-Dong, Kwangmyung-City,  
 KyongGi-Do, Korea  
 Tel / Fax : +82-2-3281-7270 / +82-2-3281-7271

### 2-2 Equipment Under Test (EUT)

Trade name : Zigbee Data Modem Module  
 FCC ID : VSOTD-2400MD  
 Model name : TD-2400MD  
 Variant Model name : XR-2400D  
 Serial number : Identical prototype  
 Date of receipt : April 15, 2013  
 EUT condition : Pre-production, not damaged  
 Antenna type : Dipole antenna (M/N: HS-2405TO) Max Gain 4.23 dBi  
 Frequency Range : 2405MHz (DSSS)  
 RF output power : Max 27.78dBm - Conducted  
 Number of channels : 1  
 Type of Modulation : O-QPSK  
 Power Source : DC 5.0 V  
 Firmware Version : V1.0.0

### 2-3 Tested frequency

	LOW	MID	HIGH
Frequency (MHz)	2405	-	-

### 2-4 Ancillary Equipment

Equipment	Model No.	Serial No.	Manufacturer
-	-	-	-

### 3. Test Report

#### 3.1 Summary of tests

FCC Part Section(s)	Parameter	Limit	Test Condition	Status (note 1)
15.247(a)	DTS Bandwidth	> 500kHz	Conducted	C
15.247(b)	Transmitter Peak Output Power	< 1Watt		C
15.247(d)	Transmitter Peak Power Spectral Density	< 8dBm @ 3kHz		C
15.247(d)	Band Edge & Spurious	> 20 dBc		C
15.209	Field Strength of Harmonics	Emission	Radiated	C
15.207	AC Conducted Emissions	Emissions	Conducted	C
15.203	Antenna requirement	-	-	C

*Note 1:* C=Complies NC=Not Complies NT=Not Tested NA=Not Applicable

*Note 2:* The data in this test report are traceable to the national or international standards.

#### → Antenna Requirement

The Yeonhwa M Tech Co., Ltd. FCC ID:VSOTD-2400MD unit complies with the requirement of §15.203. The antenna is Dipole Antenna, the antenna connector adheres to the antenna permanently with the glue.

The sample was tested according to the following specification:

\*FCC Parts 15.247; ANSI C-63.4-2003

\*FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v03r01

\*FCC TCB Workshop 2012, April

## 3.2 Technical Characteristics Test

### 3.2.1 DTS Bandwidth

#### Procedure:

\*The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v03r01 and TCB Workshop 2012, April.

The automatic bandwidth measurement capability of an instrument may be employed using the X dB bandwidth mode with X set to 6 dB, if the functionality described above (i.e., RBW = 100 kHz, VBW  $\geq$  3  $\times$  RBW, peak detector with maximum hold) is implemented by the instrumentation function. When using this capability, care shall be taken so that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be  $\geq$  6 dB.

The spectrum analyzer is set to:

Frequency = 2405 MHz

RBW = 100 kHz

VBW = 300 kHz (VBW  $\geq$  3 x RBW)

Trace = max hold

Span = 10 MHz

Sweep = auto

Detector function = peak

#### Measurement Data:

Frequency (MHz)	Test Results	
	Measured Bandwidth (MHz)	Result
2405	1.375	Complies
-	-	-
-	-	-

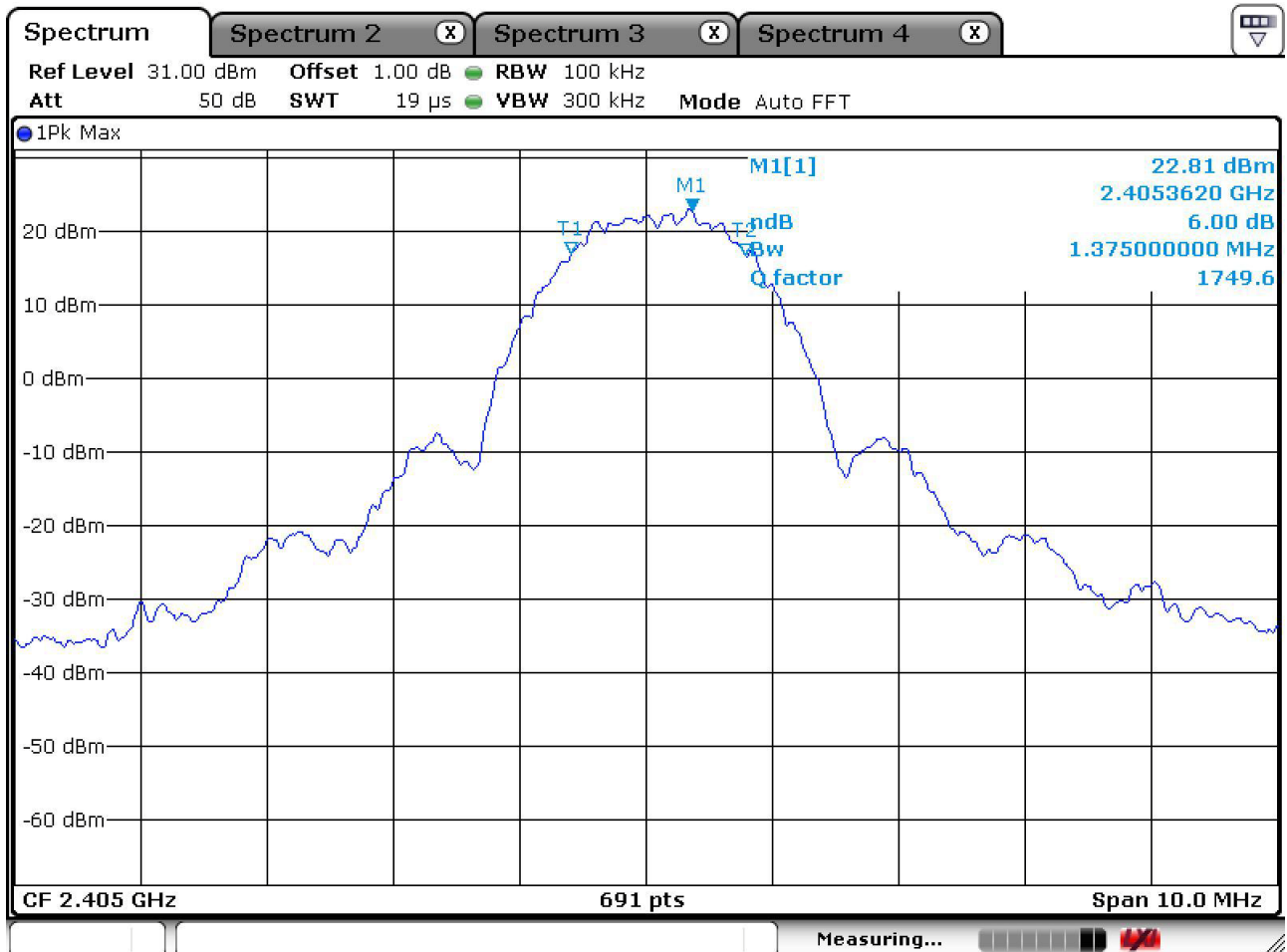
- See next pages for actual measured spectrum plots.

#### Minimum Standard:

6 dB Bandwidth > 500kHz

#### Measurement Setup

Same as the Chapter 3.2.1 (Figure 1)



### 3.2.2 Peak Output Power Measurement

**Procedure:**

\*The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v03r01 and TCB Workshop 2012, April.

Use the instrument’s band/channel power measurement function with the band limits set equal to the DTS bandwidth edges (for some instruments, this may require a manual override to select peak detector). If the instrument does not have a band power function, sum the spectrum levels (in linear power units) at intervals equal to the RBW extending across the DTS bandwidth.

The spectrum analyzer is set to:

Frequency = 2405 MHz

RBW = 1MHz

VBW = 3MHz (VBW ≥ 3 x RBW)

Detector function = peak

Span = 1.5 x DTS bandwidth(1.375MHz)

Sweep = auto

Trace mode = max hold

**Measurement Data:**

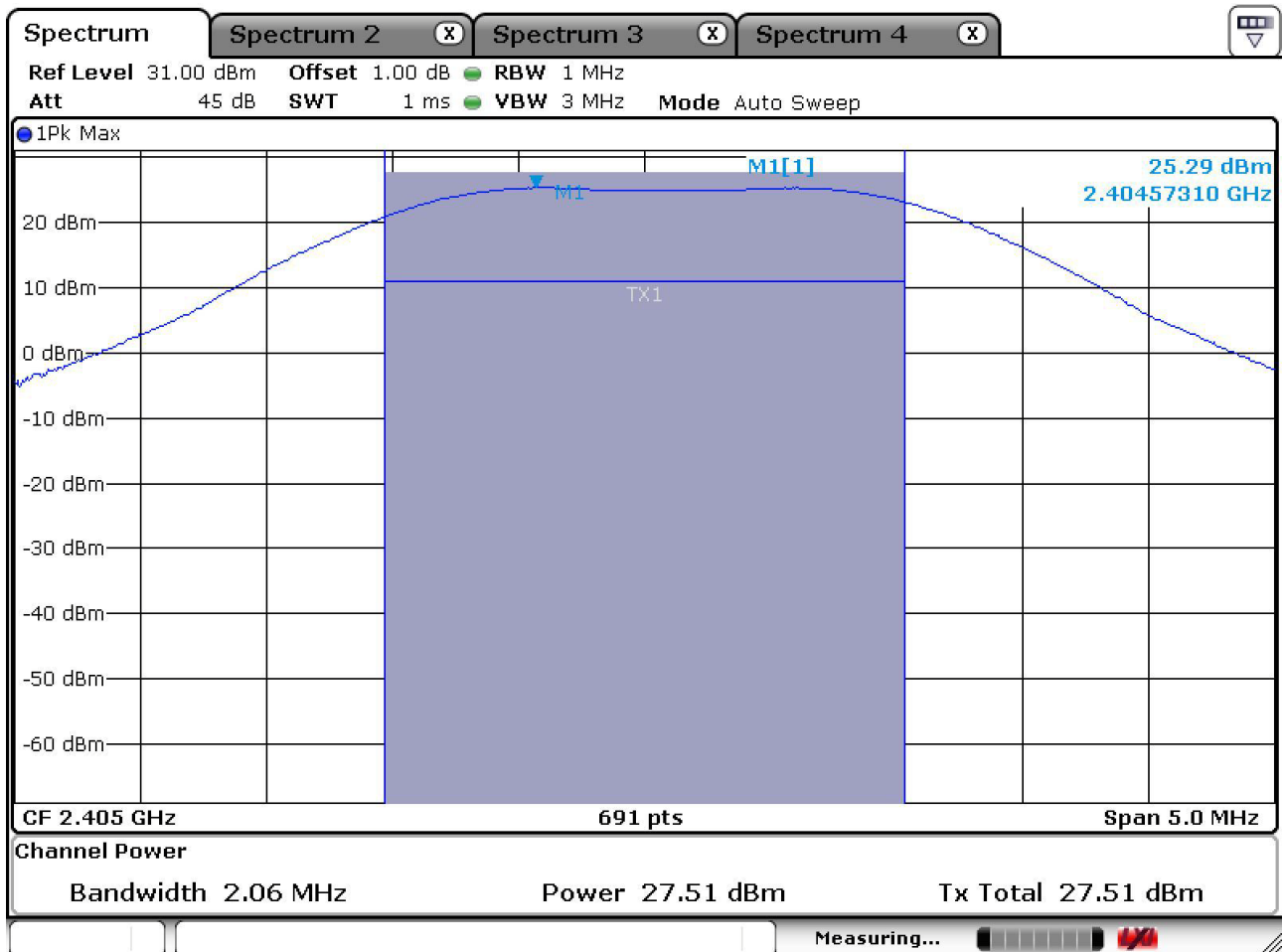
Frequency (MHz)	Test Results		
	dBm	mW	Result
2405	27.51	563.64	Complies
-	-	-	-
-	-	-	-

- See next pages for actual measured spectrum plots.

**Minimum Standard:**

Peak output power	< 1W
-------------------	------





### 3.2.3 Peak Power Spectral Density

**Procedure:**

\*The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v03r01 and TCB Workshop 2012, April.

This procedure shall be used if maximum peak conducted output power was used to demonstrate compliance, and is optional if the maximum conducted (average) output power was used to demonstrate compliance.

The spectrum analyzer is set to:

RBW = 3kHz (3 kHz ≤ RBW ≤ 100 kHz)      Span = 1.5 times the DTS Bandwidth(1.375MHz)  
 VBW = 10kHz (VBW ≥ 3 x RBW)      Sweep = auto  
 Detector function = peak      Trace = max hold

**Measurement Data:**

Frequency (MHz)	Test Results	
	dBm	Result
2405	6.64	Complies
-	-	-
-	-	-

- See next pages for actual measured spectrum plots.

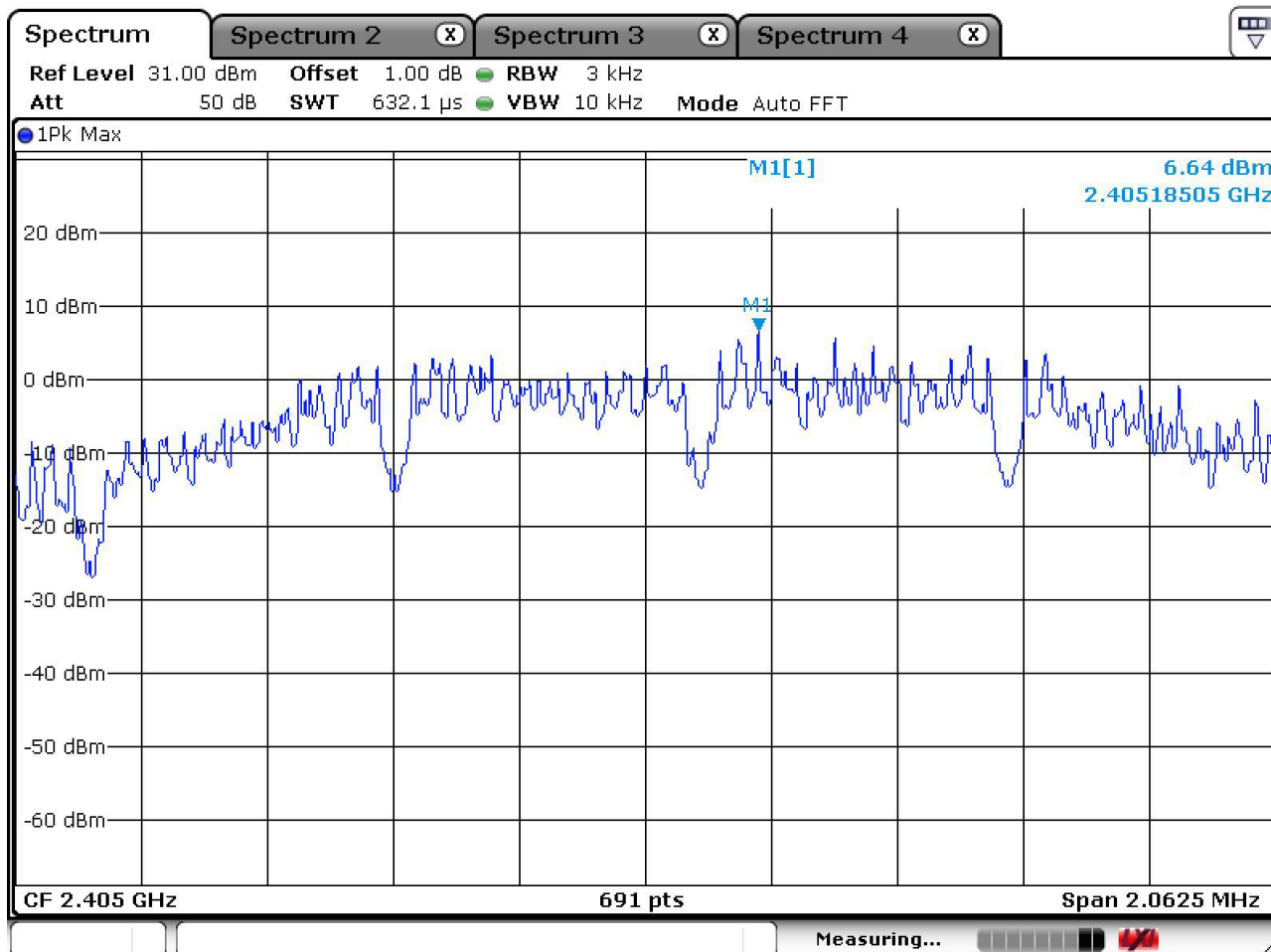
**Minimum Standard:**

Power Spectral Density	< 8dBm @ 3kHz BW
------------------------	------------------

**Measurement Setup**

Same as the Chapter 3.2.1 (Figure 1)

### Power Density Measurement



### 3.2.4 Band - edge & Spurious

**Procedure:**

\*The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v03r01 and TCB Workshop 2012, April.

The bandwidth at 20dB down from the highest inband spectral density is measured with a spectrum analyzer connected to the antenna terminal, while EUT is operating in transmission mode at the appropriate frequencies.

After the trace being stable, Use the marker-to-peak function to measure 20 dB down both sides of the intentional emission.

The spectrum analyzer is set to:

Frequency = 2405 MHz

RBW = 100 kHz

Span = 50 MHz

Trace = max hold

VBW = 100 kHz

Detector function = peak

Sweep = auto

Radiated emissions which fall in the restricted bands, as defined in 15.205(a), must also comply with the radiated emission limits specified in 15.209(a)

The spectrum analyzer is set to:

Frequency = 2405 MHz

PEAK:

Average:

Measurement Distance:

Polarization:

RBW = VBW = 1MHz, Sweep=Auto

RBW = 1MHz, VBW=10Hz, Sweep=Auto

3m

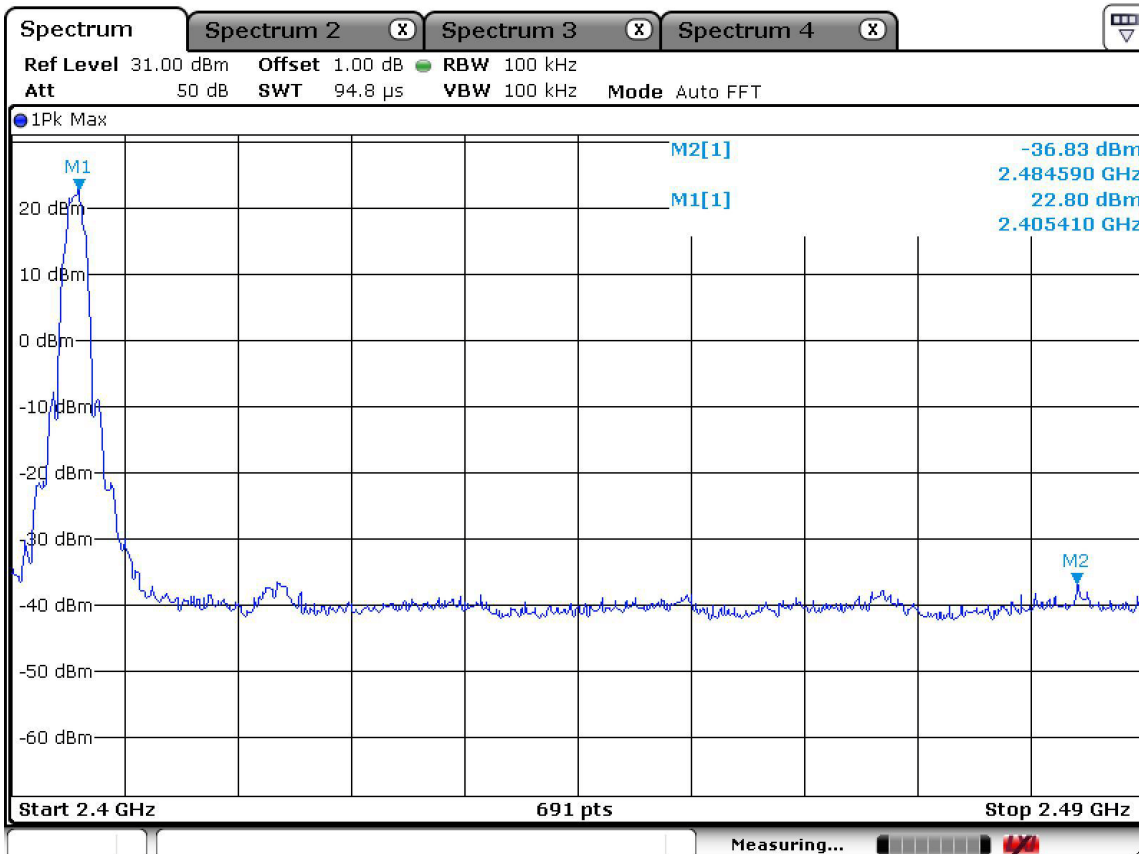
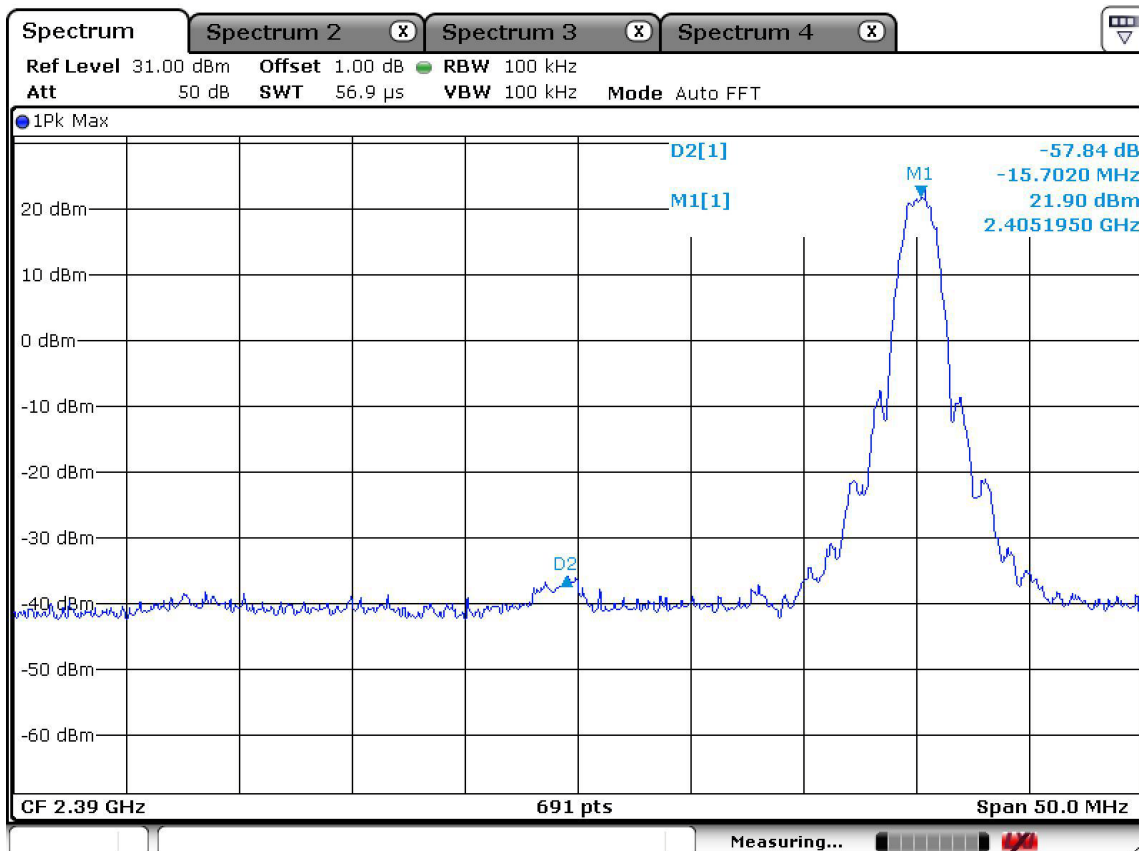
Horizontal / Vertical

**Measurement Data: Complies**

- All conducted emission in any 100kHz bandwidth outside of the spread spectrum band was at least 20dB lower than the highest inband spectral density. Therefore the applying equipment meets the requirement.
- See next pages for actual measured spectrum plots.

<b>Minimum Standard:</b>	> 20 dBc
--------------------------	----------

### Band-edge



**Band-edges in the restricted band 2310-2390 MHz measurement**

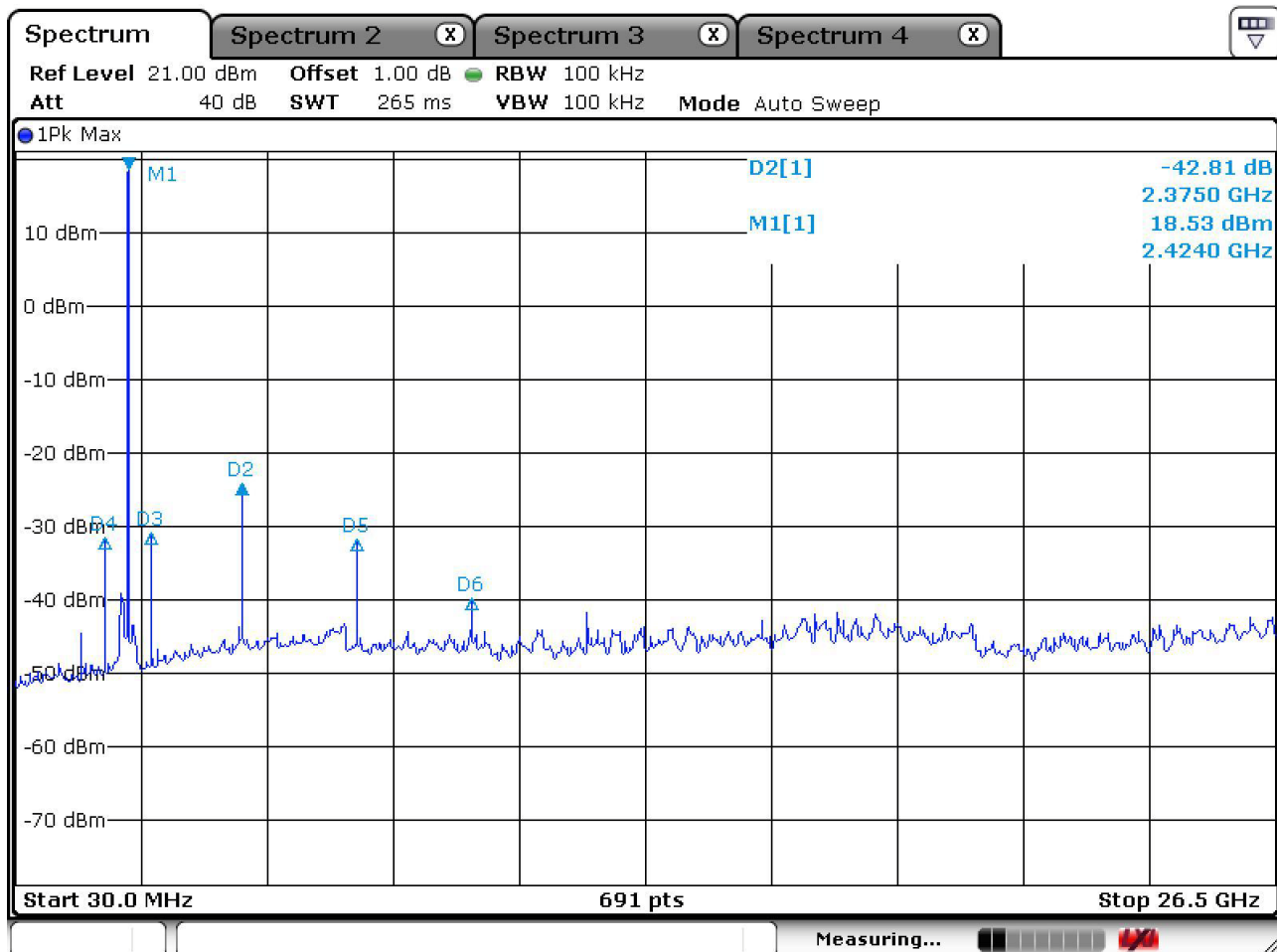
Frequency [MHz]	Reading [dBuV/m]		Pol.	Correction Factor			Limits [dBuV/m]		Result [dBuV/m]		Margin [dB]	
	AV / Peak			Antenna	Amp. Gain	Cable	AV / Peak		AV / Peak		AV / Peak	
2389.6	54.2	69.2	H	25.4	37.1	4.0	54.0	74.0	46.5	61.5	7.6	12.6

**Band-edges in the restricted band 2483.5-2500 MHz measurement**

Frequency [MHz]	Reading [dBuV/m]		Pol.	Correction Factor			Limits [dBuV/m]		Result [dBuV/m]		Margin [dB]	
	AV / Peak			Antenna	Amp. Gain	Cable	AV / Peak		AV / Peak		AV / Peak	
2483.5	42.2	50.5	V	25.4	37.1	4.0	54.0	74.0	34.5	42.8	19.6	31.3

**Note : This EUT was tested in 3 orthogonal positions and the worst-case data was presented.**

Frequency Range = 30 MHz ~ 10<sup>th</sup> harmonic.



### 3.2.5 Field Strength of Harmonics

#### Procedure:

\* The testing follows TCB Workshop 2012, April and fulfills ANSI C63.4-2003 and the guidelines in ANSI C63.10-2009 test requirement. The EUT was placed on a 0.8m high wooden table inside a shielded enclosure. An antenna was placed near the EUT and measurements of frequencies and amplitudes of field strengths were recorded for reference during final measurements. For final radiated testing, measurements were performed in OATS. Measurements were performed with the EUT oriented in 3 orthogonal axis and rotated 360 degrees to determine worst-case orientation for maximum emissions.

The spectrum analyzer is set to:

Frequency = 2405 MHz

Frequency Range = 9 kHz ~ 10<sup>th</sup> harmonic.

RBW = 100 kHz ( 9 kHz ~ 1 GHz)

= 1 MHz (1 GHz ~ 10<sup>th</sup> harmonic )

Span = 100 MHz

Trace = max hold

Peak: VBW  $\geq$  RBW

Average: VBW= 10Hz

Detector function = peak

Sweep = auto

#### Measurement Data: Complies

- See next pages for actual measured data.
- No other emissions were detected at a level greater than 20dB below limit.
- The three antennas were used with this EUT during the Testing.

#### Minimum Standard: FCC Part 15.209(a)

Frequency (MHz)	Limit (uV/m) @ 3m
0.009 ~ 0.490	2400/F(kHz) (@ 300m)
0.490 ~ 1.705	24000/F(kHz) (@ 30m)
1.705 ~ 30	30(@ 30m)
30 ~ 88	100 **
88 ~ 216	150 **
216 ~ 960	200 **
Above 960	500

\*\* Except as provided in 15.209(g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88MHz, 174-216MHz or 470-806MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g. 15.231 and 15.241.



**Measurement Data: (Above 1GHz)**

Frequency [MHz]	Reading [dBuV/m]		Pol.	Correction Factor			Limits [dBuV/m]		Result [dBuV/m]		Margin [dB]	
	AV / Peak			Antenna	Amp. Gain	Cable	AV / Peak		AV / Peak		AV / Peak	
4810.6	47.8	58.0	H	31.4	36.5	5.7	54.0	74.0	48.5	58.7	5.5	15.3
-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-

\*No other emissions were detected at a level greater than 20dB below limit.

**Measurement Data: (9kHz - 30MHz)**

Frequency [MHz]	Reading [dBuV/m]		Pol.	Correction Factor		Limits [dBuV/m]		Result [dBuV/m]		Margin [dB]		
	AV / Peak			Antenna	Amp.Gain+Cable	AV / Peak		AV / Peak		AV / Peak		
-	-	-	-	-	-	-	-	-	-	-	-	
No emissions were detected at a level greater than 20dB below limit.												
-	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	

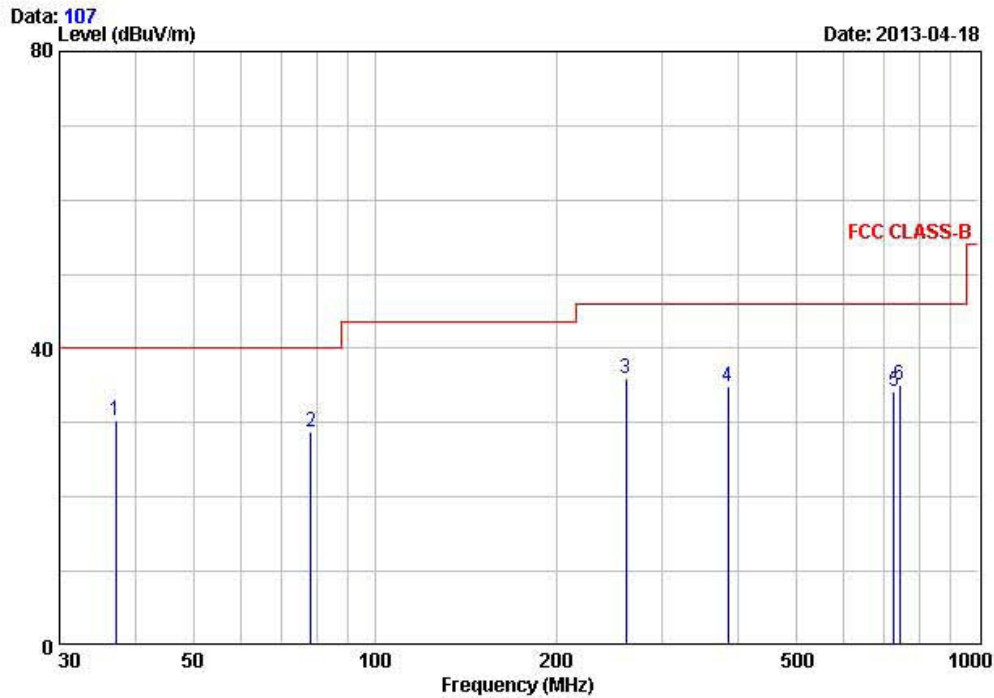
**Radiated Emissions (30MHz – 1GHz)**



243 Jubug-ri, yangji-Myeon, Youngin-si,  
Gyeonggi-do 449-822 Korea  
Tel :+82-31-3236008,9  
Fax:+82-31-3236010

EUT/Model No.: TD-2400MD TEST MODE: ZIGBEE mode

Temp Humi : 21 / 37 Tested by: PARK.H.W



	Freq	Reading	C.F	Result	Limit	Margin	Height	Angle	Polarity
	MHz	dBuV/m	dB/m	dBuV/m	dBuV/m	dB	cm	deg	
1	37.20	46.90	-16.67	30.23	40.00	9.77	100	112	VERTICAL
2	78.40	47.80	-18.95	28.85	40.00	11.15	100	278	VERTICAL
3	260.57	47.20	-11.33	35.87	46.00	10.13	103	213	HORIZONTAL
4	385.15	40.80	-5.81	34.99	46.00	11.01	216	343	HORIZONTAL
5	725.15	29.80	4.43	34.23	46.00	11.77	344	54	HORIZONTAL
6	742.45	30.10	5.02	35.12	46.00	10.88	148	205	HORIZONTAL

Remarks: C.F (Correction Factor) = Antenna factor + Cable loss - Preamp gain

### 3.2.6 AC Conducted Emissions

**Procedure:**

The conducted emissions are measured in the shielded room with a spectrum analyzer in peak hold. While the measurement, EUT had its hopping function disabled at the middle channels in line with Section 15.31(m). Emissions closest to the limit are measured in the quasi-peak mode (QP) with the tuned receiver using a bandwidth of 9 kHz. The emissions are maximized further by cable manipulation and Exerciser operation. The highest emissions relative to the limit are listed.

**Measurement Data: Complies**

- Refer to the next page.
- No other emissions were detected at a level greater than 20dB below limit
- It gave the worse case emissions

**Minimum Standard: FCC Part 15.207(a)/EN 55022**

Frequency Range	quasi-peak	Average
0.15 ~ 0.5	66 to 56 *	56 to 46 *
0.5 ~ 5	56	46
5 ~ 30	60	50

\* Note: The limits will decrease with the frequency logarithmically within 0.15MHz to 0.5MHz

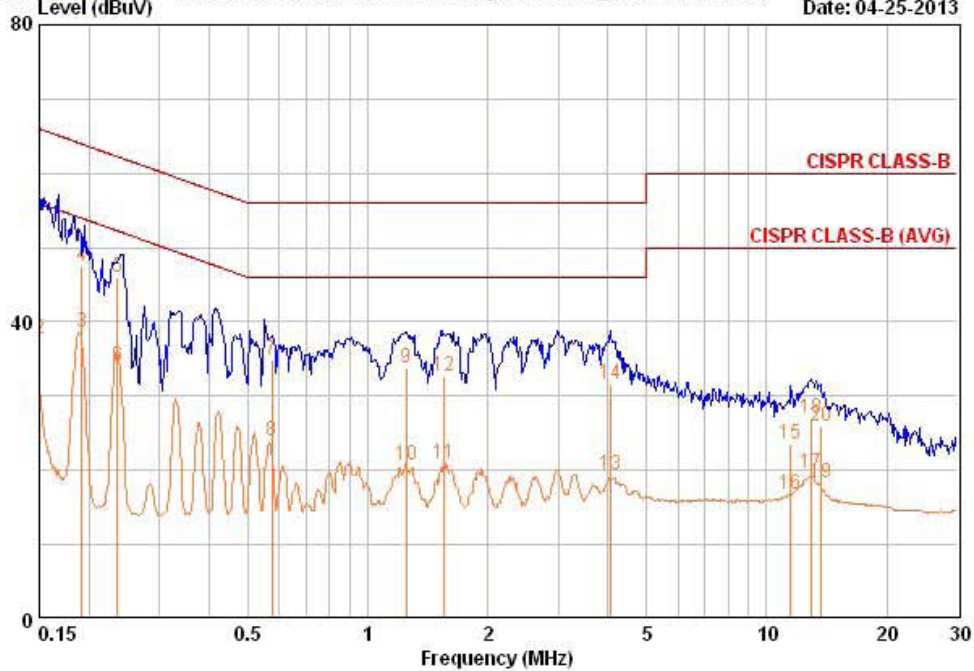
**AC Conducted Emission – LINE-**



243 Jubug-ri, yangji-Myeon, Youngin-si,  
Gyeonggi-do 449-822 Korea  
Tel :+82-31-3236008,9  
Fax:+82-31-3236010

EUT / Model No. : TD-2400MD Phase : LINE  
 Test Mode : ZIGBEE mode Test Power : 120 / 60  
 Temp./Humi. : 25 / 43 Test Engineer : PARK H W

Data: 248 File: C:\Conducted Data\2013\LTA\_Conduction\_1304-3.EMI (250) Date: 04-25-2013



Freq	RD	RD	C.F	Result	Result	Limit	Limit	Margin	Margin
MHz	QP	AV	dB	QP	AV	QP	AV	QP	AV
	dBuV	dBuV		dBuV	dBuV	dBuV	dBuV	dB	dB
0.150	40.14	28.24	9.58	49.72	37.82	66.00	56.00	16.28	18.18
0.192	38.05	28.95	9.58	47.63	38.53	63.95	53.95	16.32	15.42
0.236	36.45	24.45	9.58	46.03	34.03	62.24	52.24	16.21	18.21
0.574	25.15	14.45	9.62	34.77	24.07	56.00	46.00	21.23	21.93
1.248	24.15	11.05	9.62	33.77	20.67	56.00	46.00	22.23	25.33
1.544	23.15	11.25	9.61	32.76	20.86	56.00	46.00	23.24	25.14
4.048	21.96	9.76	9.73	31.69	19.49	56.00	46.00	24.31	26.51
11.498	13.69	6.89	9.79	23.48	16.68	60.00	50.00	36.52	33.32
12.988	17.20	9.80	9.77	26.97	19.57	60.00	50.00	33.03	30.43
13.622	16.20	8.50	9.77	25.97	18.27	60.00	50.00	34.03	31.73

Remarks: C.F (Correction Factor) = Insertion loss + Cable loss

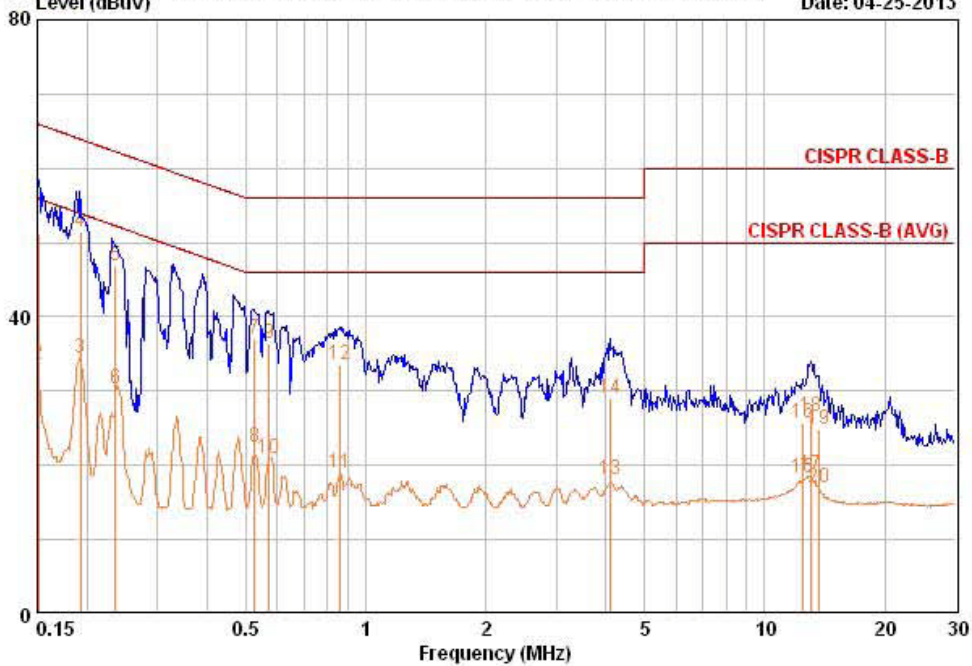
## AC Conducted Emission – NEUTRAL-



243 Jubug-ri, yangji-Myeon, Youngin-si,  
Gyeonggi-do 449-822 Korea  
Tel :+82-31-3236008,9  
Fax:+82-31-3236010

EUT / Model No. : TD-2400MD	Phase : NEUTRAL
Test Mode : ZIGBEE mode	Test Power : 120 / 60
Temp./Humi. : 25 / 43	Test Engineer : PARK H W

Data: 250 Level (dBuV) File: C:\Conducted Data\2013\LTA\_Conduction\_1304-3.EMI (250) Date: 04-25-2013



Freq MHz	RD		C.F	Result		Limit		Margin	
	QP dBuV	AV dBuV		QP dBuV	AV dBuV	QP dBuV	AV dBuV	QP dB	AV dB
0.151	41.64	24.04	9.62	51.26	33.66	65.94	55.94	14.69	22.29
0.193	41.85	24.95	9.58	51.43	34.53	63.91	53.91	12.48	19.38
0.235	37.25	20.65	9.58	46.83	30.23	62.27	52.27	15.45	22.05
0.527	27.45	12.85	9.62	37.07	22.47	56.00	46.00	18.93	23.53
0.571	26.85	11.35	9.61	36.46	20.96	56.00	46.00	19.54	25.04
0.857	24.05	9.45	9.58	33.63	19.03	56.00	46.00	22.37	26.97
4.091	19.26	8.46	9.68	28.94	18.14	56.00	46.00	27.06	27.86
12.449	15.80	8.50	9.86	25.65	18.35	60.00	50.00	34.35	31.65
13.057	16.80	8.90	9.88	26.68	18.78	60.00	50.00	33.32	31.22
13.623	14.90	7.20	9.90	24.80	17.10	60.00	50.00	35.20	32.90

Remarks: C.F (Correction Factor) = Insertion loss + Cable loss

## APPENDIX

### TEST EQUIPMENT USED FOR TESTS

	Description	Model No.	Serial No.	Manufacturer	Expiration date of Calibration
1	Spectrum Analyzer (~30GHz)	FSV-30	100757	R&S	2014-01-15
2	Spectrum Analyzer (~2.9GHz)	8594E	3649A03649	HP	2014-03-26
3	Signal Generator (~3.2GHz)	8648C	3623A02597	HP	2014-03-25
4	Signal Generator (1~20GHz)	83711B	US34490456	HP	2014-03-25
5	Attenuator (3dB)	8491A	37822	HP	2014-09-22
6	Attenuator (10dB)	8491A	63196	HP	2014-09-22
7	Test Receiver (~30MHz)	ESHS10	828404/009	R&S	2014-03-25
8	EMI Test Receiver (~7GHz)	ESCI7	100722	R&S	2013-09-22
9	RF Amplifier (~1.3GHz)	8447D	2439A09058	HP	2014-09-22
10	RF Amplifier (1~18GHz)	8449B	3008A02126	HP	2014-03-26
11	Horn Antenna (1~18GHz)	BBHA 9120D	9120D122	SCHWARZBECK	2014-12-21
12	Horn Antenna (18 ~ 40GHz)	SAS-574	154	Schwarzbeck	2014-03-15
13	Horn Antenna (18 ~ 40GHz)	SAS-574	155	Schwarzbeck	2014-03-15
14	TRILOG Antenna	VULB 9160	9160-3172	SCHWARZBECK	2014-09-20
15	Hygro-Thermograph	THB-36	0041557-01	ISUZU	2013-09-26
16	Splitter (SMA)	ZFSC-2-2500	SF617800326	Mini-Circuits	-
17	Power Divider	11636A	6243	HP	2014-09-22
18	DC Power Supply	6622A	3448A03079	HP	-
19	Frequency Counter	5342A	2826A12411	HP	2014-03-25
20	Power Meter	EPM-441A	GB32481702	HP	2014-03-25
21	Power Sensor	8481A	US41030291	HP	2013-09-22
22	Audio Analyzer	8903B	3729A18901	HP	2013-09-22
23	Modulation Analyzer	8901B	3749A05878	HP	2013-09-22
24	TEMP & HUMIDITY Chamber	YJ-500	LTAS06041	JinYoung Tech	2013-09-22
25	Stop Watch	HS-3	601Q09R	CASIO	2014-03-26
26	LISN	ENV216	100408	R&S	2013-09-22
27	UNIVERSAL RADIO COMMUNICATION TESTER	CMU200	106243	R&S	2014-06-27
28	Highpass Filter	WHKX1.5/15G-10SS	74	Wainwright Instruments	-
29	Highpass Filter	WHKX3.0/18G-10SS	118	Wainwright Instruments	-
30	Active Loop Antenna	FMZB 1519	1519-031	SCHWARZBECK	2014-12-14