

Dates of Tests: SEP 14 ~ OCT 10, 2006
Test Report S/N: LR500110609D
Test Site : LTA CO., LTD.

CERTIFICATIO OF COMPLIANCE

FCC ID.

UNTLM2400R

APPLICANT

RadioPulse Inc.

FCC Classification	:	Digital Transmission System (DTS)
Manufacturing Description	:	ZigBee Module
Manufacturer	:	RadioPulse Inc.
Model name	:	LM2400-R
Test Device Serial No.:	:	8601-600160-30
Rule Part(s)	:	FCC Part 15.247 Subpart C; ANSI C-63.4-2003
Frequency Range	:	2405MHz ~ 2475MHz
Max. Output Power	:	5.75 dBm Peak Conducted
Data of issue	:	October 10, 2006

This test report is issued under the authority of:

The test was supervised by:



Dong -Min JUNG, Technical Manager



Kyung-Taek LEE, 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. This report must not be used by the applicant to claim product endorsement by any agency.



NVLAP LAB Code.: 200723-0

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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
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	2006-09-30	ECT accredited Lab.
RRL	KOREA	KR0049	2007-07-13	EMC accredited Lab.
FCC	U.S.A	610755	2008-03-28	FCC filing
VCCI	JAPAN	R2133, C2307	2008-06-22	VCCI registration
IC	CANADA	IC5799	2008-04-23	IC filing

2. Information's about test item

2-1 Client / Manufacturer

Company name : RadioPulse Inc.
 Address : 2nd fl., Hans B/D, 111-55 Seongnae-dong, Gangdong-gu, Seoul, Korea
 Tel / Fax : +82-2-478-2963/ +82-2-478-2967

2-2 Equipment Under Test (EUT)

Trade name : ZigBee Module
 FCC ID : UNTLM2400R
 Model name : LM2400-R
 Serial number : Identification
 Date of receipt : September 2, 2006
 EUT condition : Production, not damaged
 Antenna type : External antenna Gain 2.0 dBi (Left handed SMA connector)
 Frequency Range : 2405 MHz ~ 2475 MHz
 RF output power : 5.75 dBm Peak Conducted
 Channel spacing : 5 MHz
 Number of channels : 15
 Type of Modulation : O-QPSK
 Duty cycle TX power : 93.9% (Bluetooth)
 Power Source : 3.0Vdc from Test Jig

2-3 Tested frequency

	LOW	MID	HIGH
Frequency (MHz)	2405	2445	2475

2-4 Ancillary Equipment

Equipment	Model No.	Serial No.	Manufacturer
Notebook	Latitude D505	8N29F1S	DELL
Test Jig	MG2400-F48	-	RadioPulse

3. Test Report

3.1 Summary of tests

FCC Part Section(s)	Parameter	Limit	Test Condition	Status (note 1)
15.247(b)	Transmitter Output Power	< 1 Watt	Conducted	C
15.247(d)	Conducted Spurious emission	> 20 dBc		C
15.247(d)	Band Edge	> 20 dBc		C
15.247(a)	6 dB Bandwidth	> 500kHz		C
15.247(d)	Transmitter Power Spectral Density	< 8dBm @ 3kHz		C
15.209	Field Strength of Harmonics	< 54 dBuV (at 3m)	Radiated	C
15.207	AC Conducted Emissions	EN 55022	Line Conducted	NA
	MPE Calculation	-	-	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.

The sample was tested according to the following specification:

FCC Parts 15.247; ANSI C-63.4-2003

3.2 Technical Characteristics Test

3.2.1 6 dB Bandwidth

Procedure:

The bandwidth at 6dB below the highest in-band spectral density was 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 set the marker to the peak of the emission. Use the marker-delta function to measure 6dB down one side of the emission. Reset the marker-delta function, and move the marker to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is the 6 dB bandwidth of the emission.

The spectrum analyzer is set to:

Center frequency = the highest, middle and the lowest channels

RBW = 100 kHz

Span = 5 MHz

VBW = 100 kHz (VBW \geq RBW)

Sweep = auto

Trace = max hold

Detector function = peak

Measurement Data:

Frequency (MHz)	Test Results	
	Measured Bandwidth (MHz)	Result
2405	1.563	Complies
2445	1.550	Complies
2475	1.575	Complies

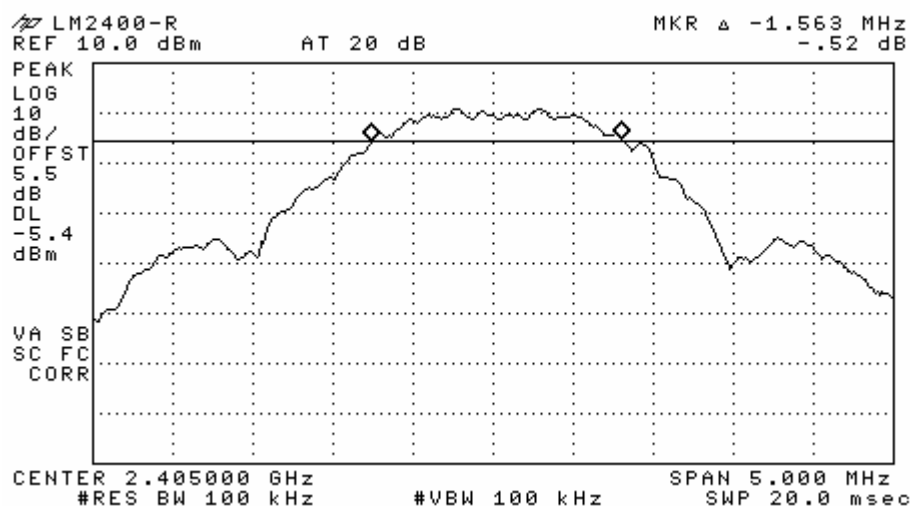
- See next pages for actual measured spectrum plots.

Minimum Standard:

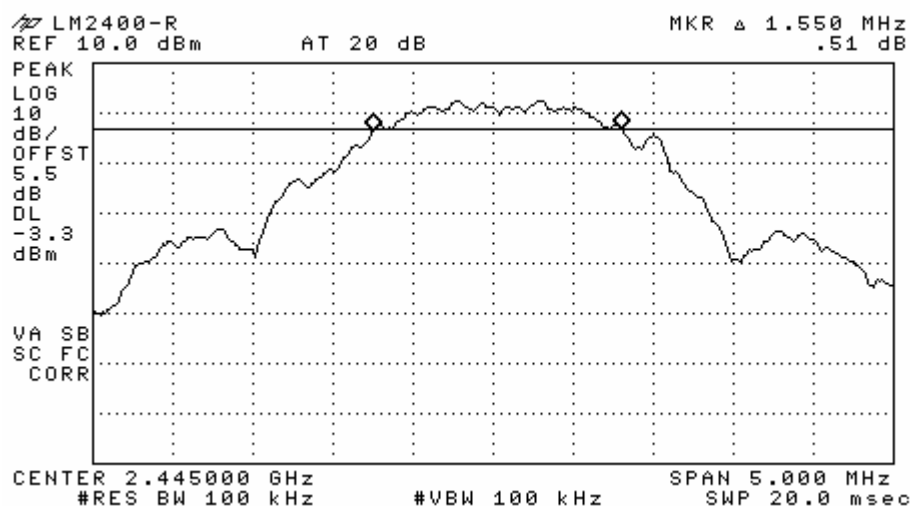
6 dB Bandwidth > 500kHz

Measurement Setup

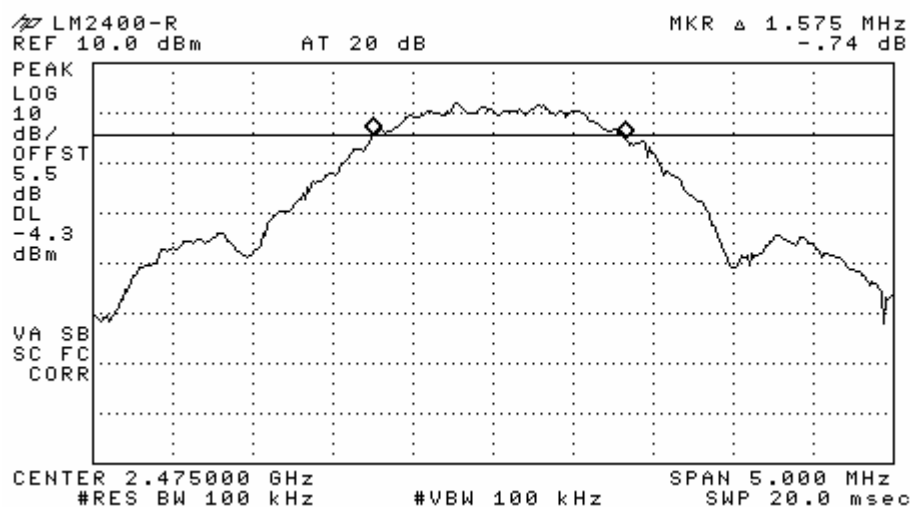
Same as the Chapter 3.2.1 (Figure 1)



RL



RL



RL

3.2.2 Output Power Measurement

Procedure:

The peak output power was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function disabled at the highest, middle and the lowest available channels..

After the trace being stable, Use the marker-to-peak function to set the marker to the peak of the emission. The indicated level is the peak output power.

The spectrum analyzer is set to:

Center frequency = the highest, middle and the lowest channels

Span = 10 MHz (approximately 5 times of the 20 dB bandwidth)

RBW = 3 MHz (greater than the 20dB bandwidth of the emission being measured)

VBW = 3 MHz (VBW \geq RBW)

Detector function = peak

Trace = max hold

Sweep = auto

Measurement Data:

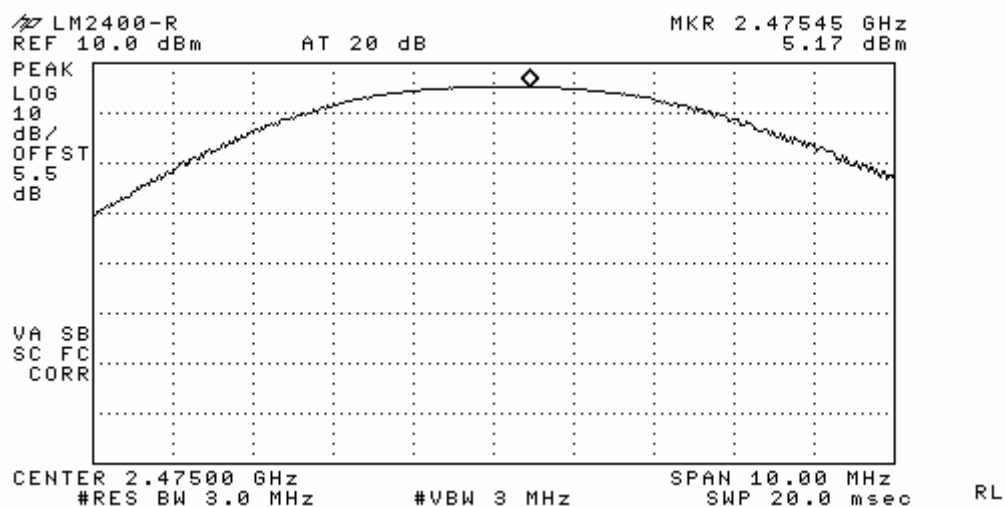
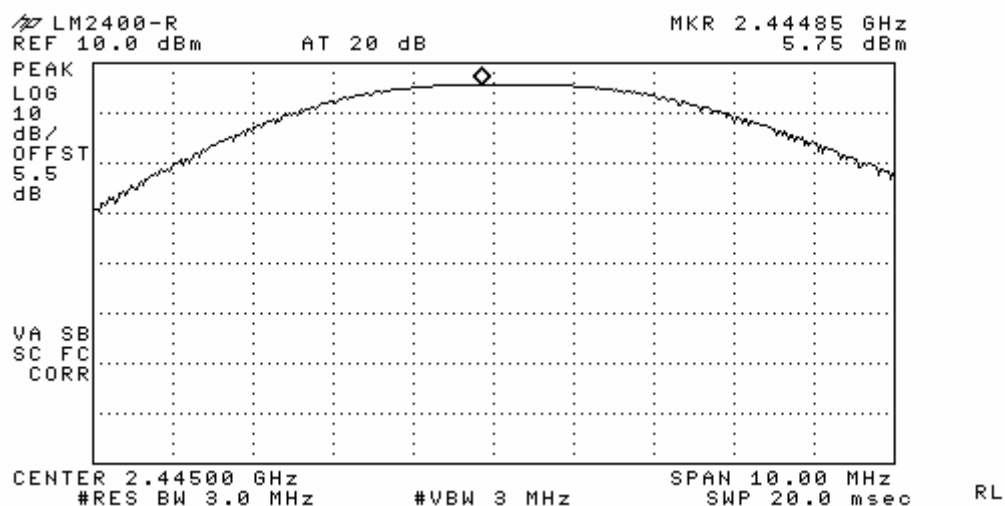
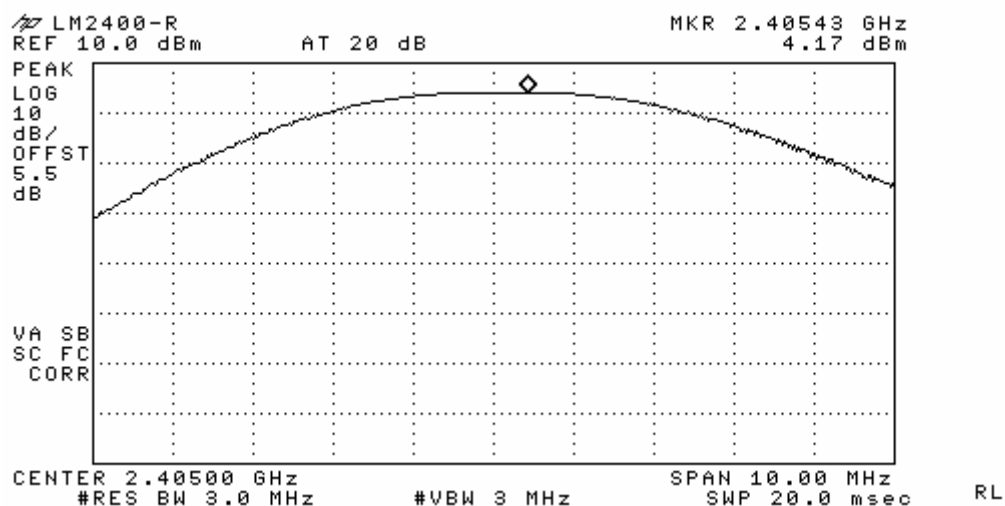
Frequency (MHz)	Test Results		
	dBm	mW	Result
2405	4.17	2.612	Complies
2445	5.75	3.758	Complies
2475	5.17	3.289	Complies

- See next pages for actual measured spectrum plots.

Minimum Standard:	< 1W
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Measurement Setup

Same as the Chapter 3.2.1 (Figure 1)



3.2.3 Power Spectral Density

Procedure:

The peak power density is measured with a spectrum analyzer connected to the antenna terminal while the EUT is operating in transmission mode at the appropriate frequencies.

The spectrum analyzer is set to:

RBW = VBW = 3 kHz

Span = 100 KHz

Sweep = 1000 sec

Trace = max hold

Detector function = peak

Measurement Data:

Frequency (MHz)	Test Results	
	dBm	Result
2405	-10.32	Complies
2445	-8.85	Complies
2475	-9.62	Complies

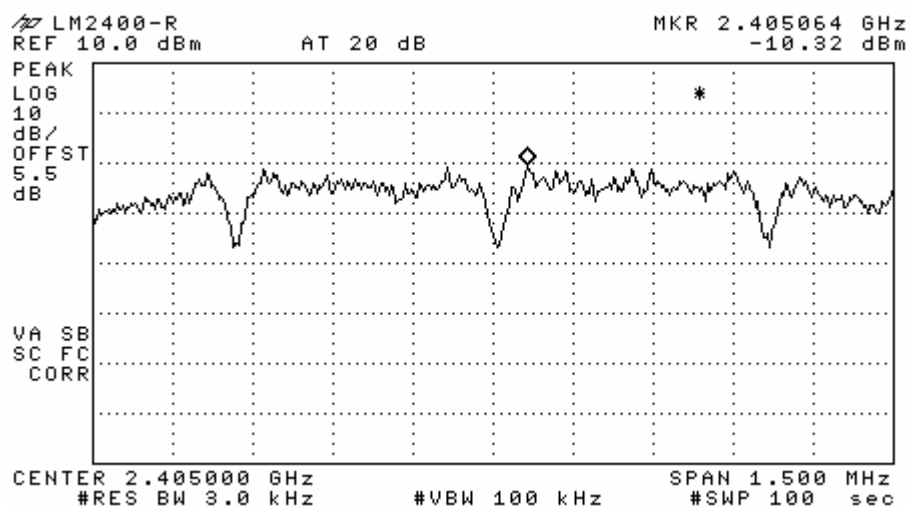
- See next pages for actual measured spectrum plots.

Minimum Standard:

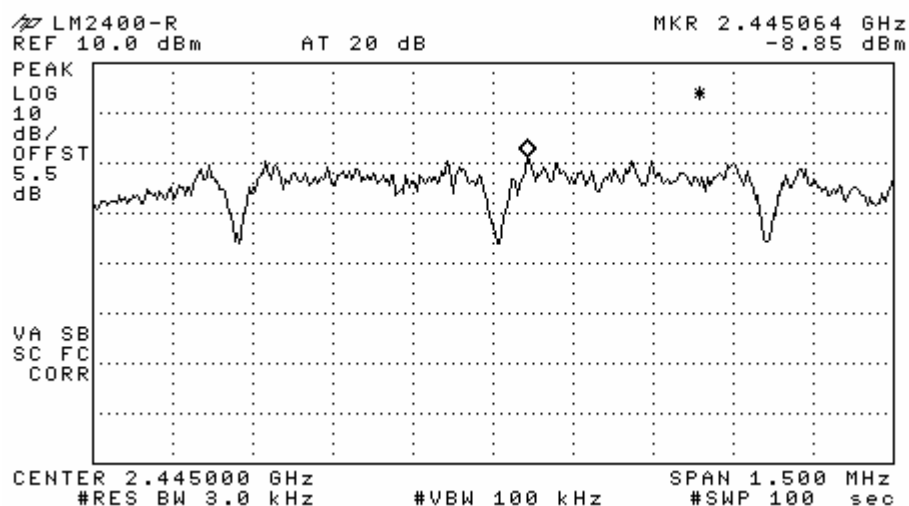
Power Spectral Density	< 8dBm @ 3kHz BW
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Measurement Setup

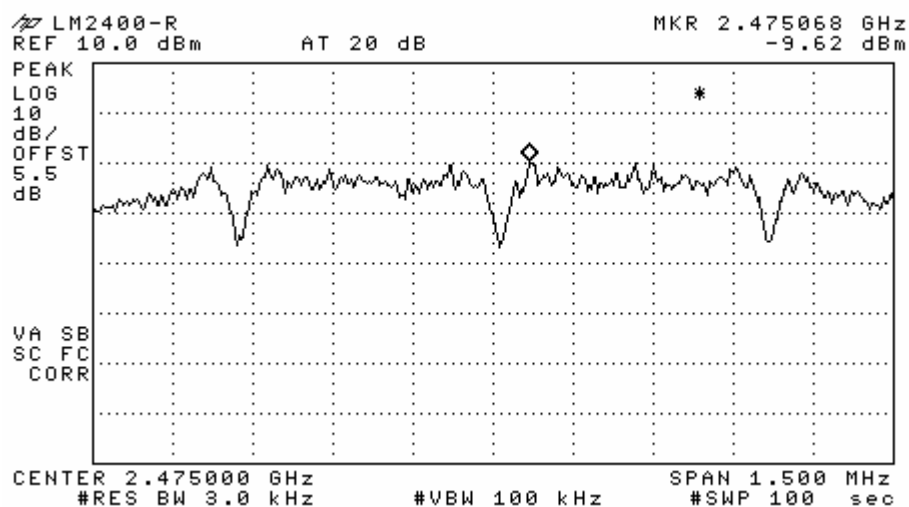
Same as the Chapter 3.2.1 (Figure 1)



RL



RL



RL

3.2.4 Band - edge

Procedure:

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:

Center frequency = the highest, middle and the lowest channels

RBW = 100 kHz

VBW = 100 kHz

Span = 20 MHz

Detector function = peak

Trace = max hold

Sweep = auto

Measurement Data: Complies

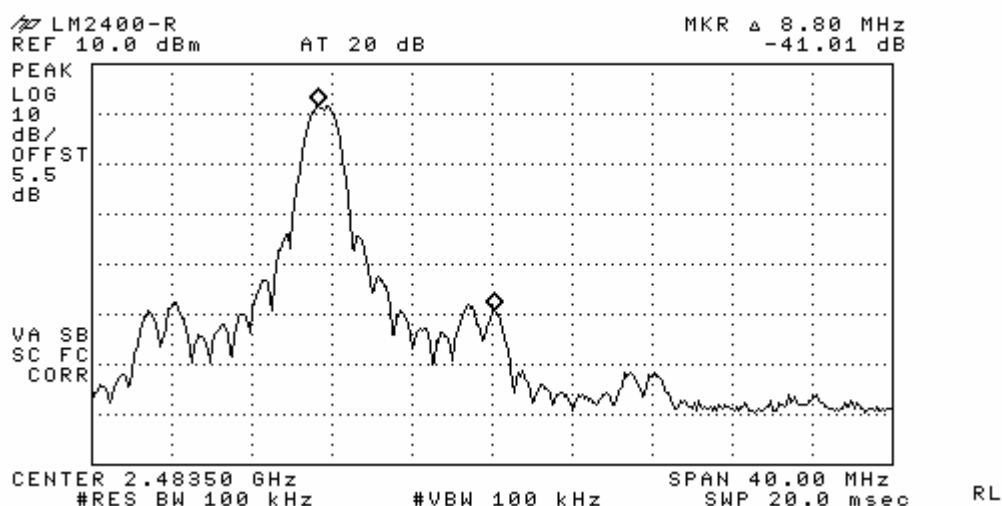
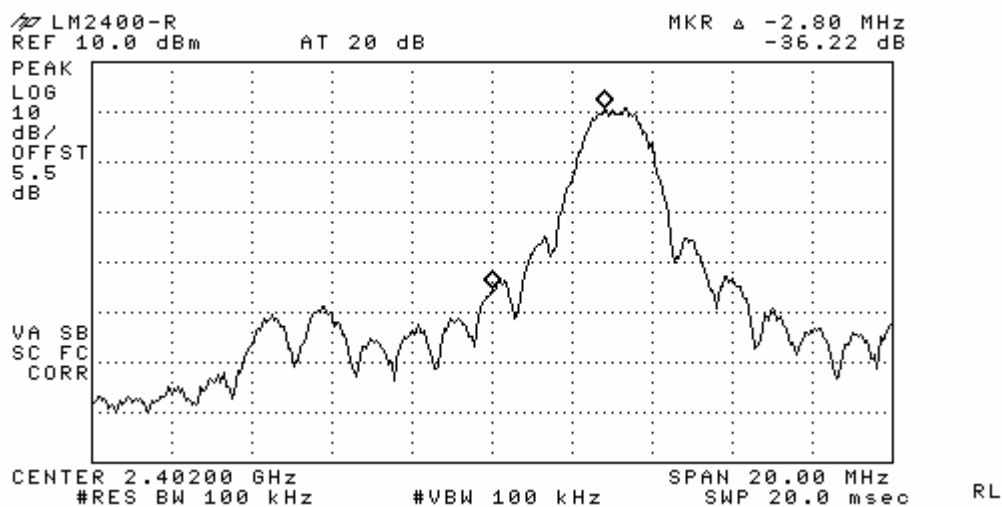
- All conducted emission in any 100kHz bandwidth outside of the spread spectrum band was at least 20dB lower than the highest inband spectral density. Therefore the applying equipment meets the requirement.
- See next pages for actual measured spectrum plots.

Minimum Standard:	> 20 dBc
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Measurement Setup

Same as the Chapter 3.2.1 (Figure 1)

Band-edge Measurements



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

- Document DA 00-705 Marker Delta Method

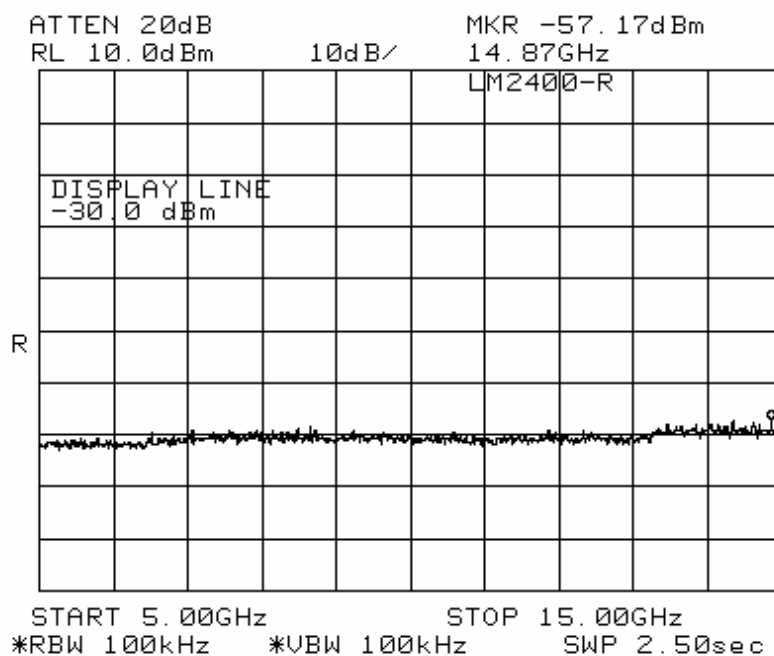
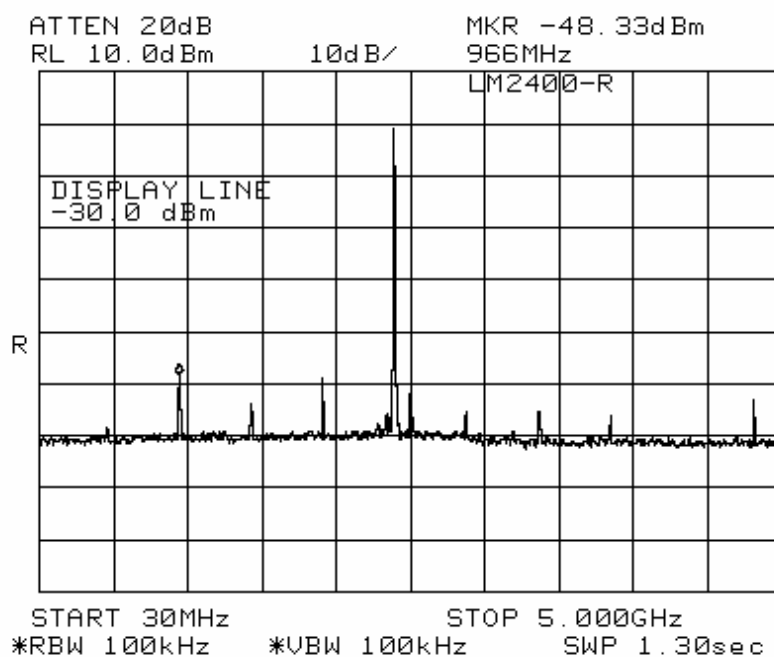
Frequency (MHz)	Detect mode	Pol.	Reading (dBuV/m)	T.F (dB)	Step 1 Data	delta	Step 3 Data	Limit
2475	PK	V	67.7	34.6	102.3	41.01	61.29	74
	AV	V	58.1	34.6	92.7	41.01	51.69	54

Note) Step 1 = Reading + T.F

T.F = Ant.F + Cable loss

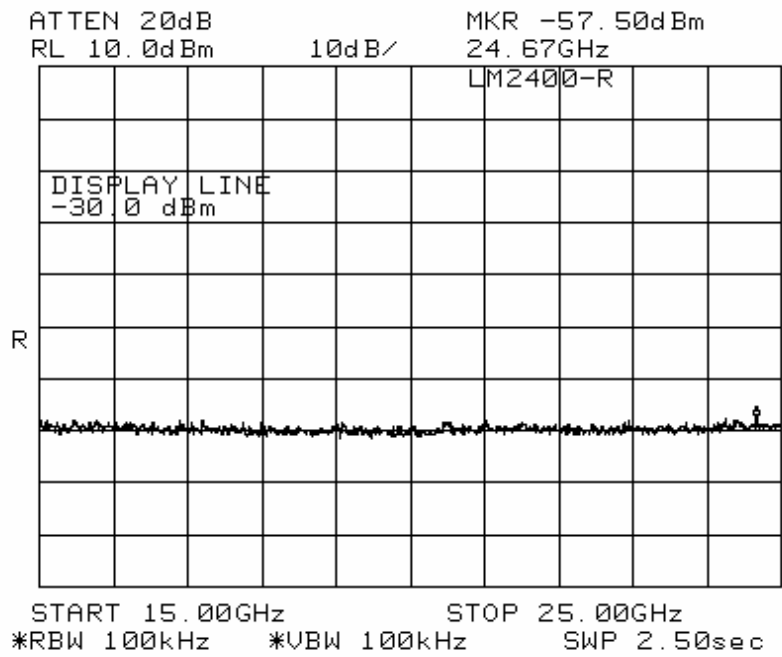
Step 3 = Step 1 – Delta Value

Band - edge (at 20 dB blow) – Low channel
Frequency Range = 30 MHz ~ 10th harmonic.

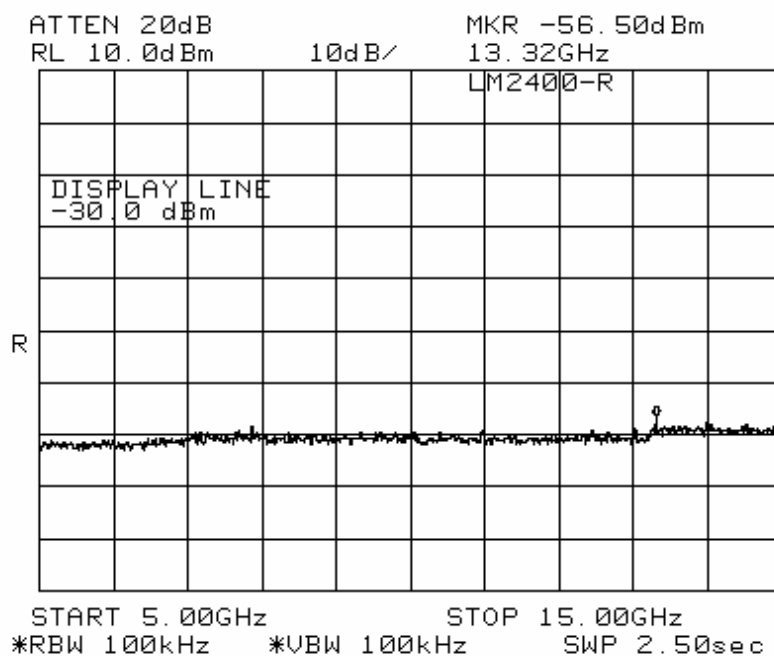
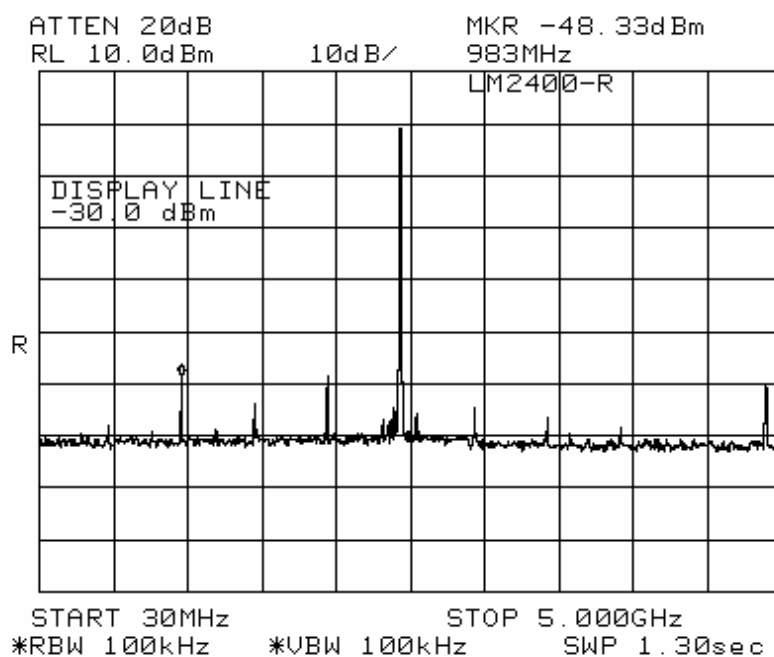


Band - edge (at 20 dB blow) – Low channel
Frequency Range = 30 MHz ~ 10th harmonics.

- Continues

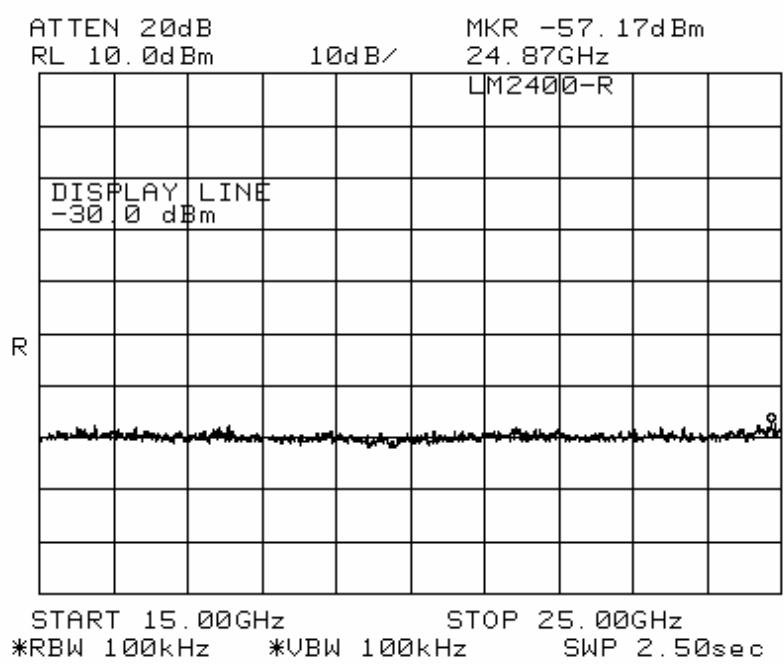


Band - edge (at 20 dB blow) – Mid channel
Frequency Range = 30 MHz ~ 10th harmonic.

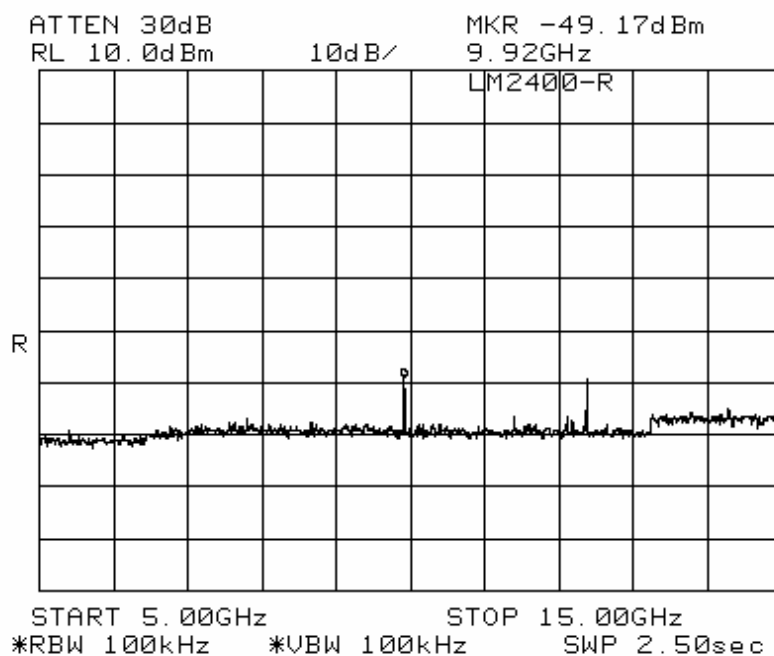
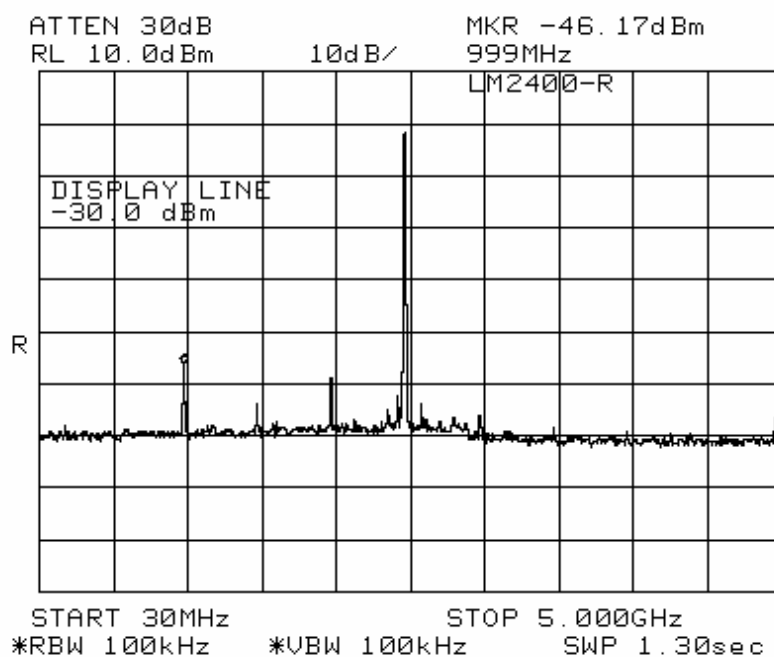


Band - edge (at 20 dB blow) – Mid channel
Frequency Range = 30 MHz ~ 10th harmonics.

- Continues

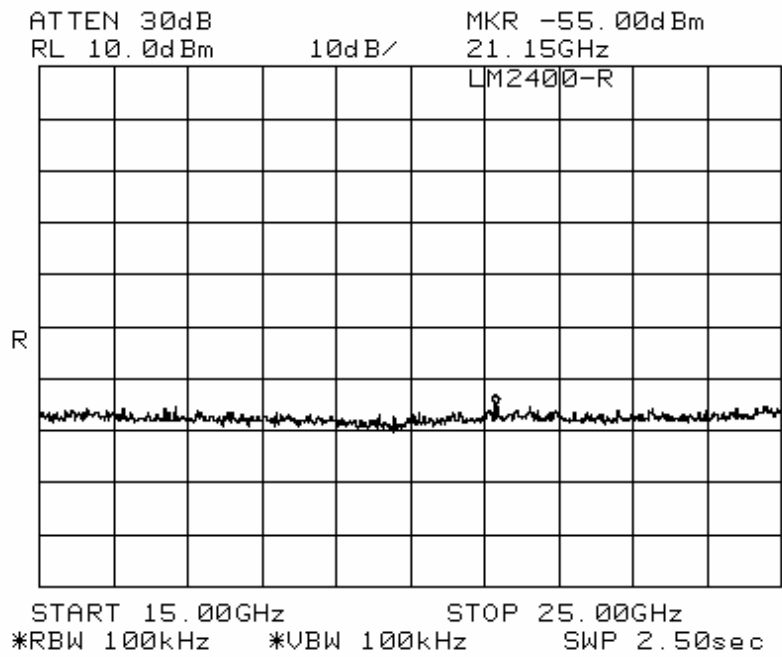


Band - edge (at 20 dB blow) – High channel
Frequency Range = 30 MHz ~ 10th harmonic.



Band - edge (at 20 dB blow) – High channel
Frequency Range = 30 MHz ~ 10th harmonics.

- Continues



3.2.5 Field Strength of Harmonics

Procedure:

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:

Center frequency = the worst channel

Frequency Range = 30 MHz ~ 10th harmonic.

RBW = 100 kHz (30MHz ~ 1 GHz)

VBW ≥ RBW

= 1 MHz (1 GHz ~ 10th harmonic)

Span = 100 MHz

Detector function = peak

Trace = max hold

Sweep = auto

Measurement Data: Complies

Low channel		Mid channel		High channel	
Frequency (MHz)	Level (dBuV/m)	Frequency (MHz)	Level (dBuV/m)	Frequency (MHz)	Level (dBuV/m)
961.025	47.9	979.05	47.5	989.03	49.1
-	-	-	-	-	-
-	-	-	-	-	-
Measurement uncertainty		± 6 dB			

Remark: No other emissions were detected at a level greater than 10dB below limit.

Minimum Standard: FCC Part 15.209(a)

Frequency (MHz)	Limit (uV/m) @ 3m
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.



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Fax:+82-31-3236010

EUT/Model No.: LM2400-R

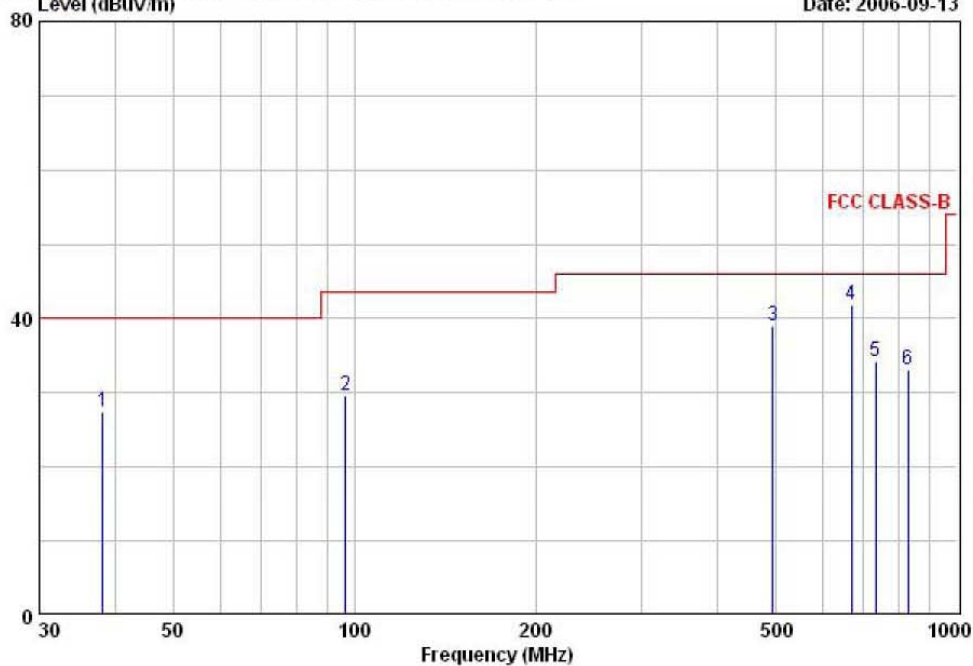
Temp/Humi: 21 / 58

Test Mode : OP mode

Tested by: K.T.LEE

Data: 11 File: E:\LTA_OATS\LTA_OATS_09-2.EMI (11)

Date: 2006-09-13



	Freq MHz	Reading(QP) dBuV	C.F dB	Result (QP) dBuV/m	Limit dBuV/m	Margin dB	Height cm	Polarity
1	38.30	40.30	-12.84	27.46	40.00	12.54	100	VERTICAL
2	96.70	44.70	-14.96	29.74	43.50	13.76	100	VERTICAL
3	495.60	44.70	-5.60	39.10	46.00	6.90	107	VERTICAL
4	668.10	44.60	-2.69	41.91	46.00	4.09	100	VERTICAL
5	731.90	35.20	-0.93	34.27	46.00	11.73	230	HORIZONTAL
6	830.40	32.10	1.06	33.16	46.00	12.84	100	VERTICAL

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

- See next pages for actual measured spectrum plots.
- No emissions were detected at a level greater than 10dB below limit.

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

Frequency Range (MHz)	Conducted Limit (dBuV)	
	Quasi-Peak	Average
0.15 ~ 0.5	66 to 56 *	56 to 46 *
0.5 ~ 5	56	46
5 ~ 30	60	50

* Decreases with the logarithm of the frequency

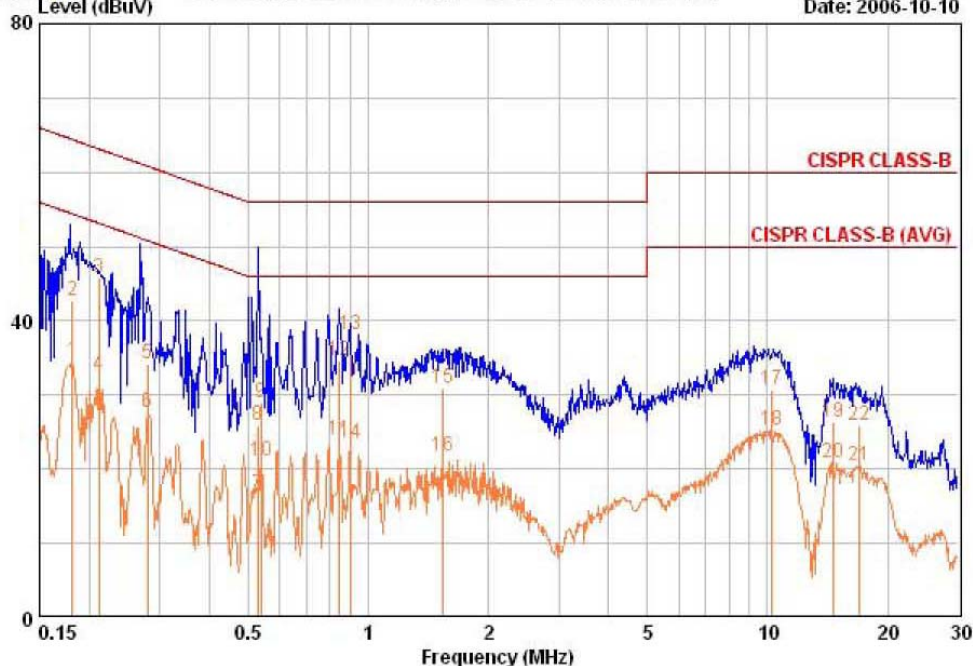
AC Conducted Emissions –Line



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Fax:+82-31-323-6010

EUT / Model No. : LM2400-R	Phase : LINE
Test Mode : Normal mode	Test Power : 120 / 60
Temp./Humi. : 21 / 70	Test Engineer : K. T. LEE

Data: 90 File: E:\00_e3 EMI DATA\LTA_Conduction_06010-1.EMI (92) Date: 2006-10-10



Freq	RD	RD	C.F	Result	Result	Limit	Limit	Margin	Margin
MHz	QP	AV		QP	AV	QP	AV	QP	AV
	dBuV	dBuV	dB	dBuV	dBuV	dBuV	dBuV	dB	dB
0.182	42.30	34.26	0.33	42.63	34.59	64.42	54.42	21.79	19.83
0.212	45.60	32.57	0.19	45.79	32.76	63.14	53.14	17.35	20.38
0.280	34.00	27.36	0.26	34.26	27.62	60.81	50.81	26.54	23.18
0.529	25.60	16.26	0.29	25.89	16.55	56.00	46.00	30.11	29.45
0.538	28.60	20.87	0.29	28.89	21.16	56.00	46.00	27.11	24.84
0.848	34.30	23.47	0.41	34.71	23.88	56.00	46.00	21.29	22.12
0.899	37.80	23.08	0.41	38.21	23.49	56.00	46.00	17.79	22.51
1.535	30.60	21.34	0.37	30.97	21.71	56.00	46.00	25.03	24.29
10.288	29.80	24.43	0.91	30.71	25.34	60.00	50.00	29.29	24.66
14.672	25.20	19.71	1.15	26.35	20.86	60.00	50.00	33.65	29.14
16.928	24.50	19.10	1.36	25.86	20.46	60.00	50.00	34.14	29.54

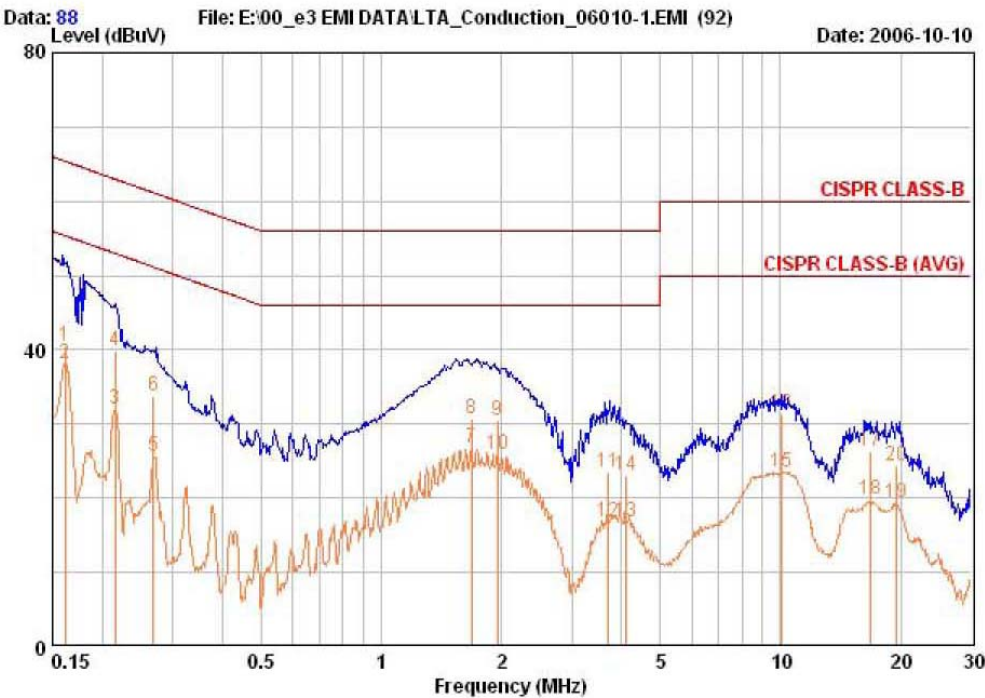
Remarks: C.F (Correction Factor) = Insertion loss + Cable loss

AC Conducted Emissions -Neutral



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EUT / Model No. : LM2400-R	Phase : NEUTRAL
Test Mode : Normal mode	Test Power : 120 / 60
Temp./Humi. : 21 / 70	Test Engineer : K. T. LEE



Freq	RD	RD	C.F	Result	Result	Limit	Limit	Margin	Margin
MHz	QP	AV		QP	AV	QP	AV	QP	AV
	dBuV	dBuV	dB	dBuV	dBuV	dBuV	dBuV	dB	dB
0.162	40.00	37.57	0.48	40.48	38.05	65.38	55.38	24.90	17.33
0.215	39.60	31.81	0.20	39.80	32.01	63.01	53.01	23.21	21.00
0.269	33.60	25.53	0.25	33.85	25.78	61.16	51.16	27.31	25.38
1.680	30.30	26.51	0.37	30.67	26.88	56.00	46.00	25.33	19.12
1.959	30.20	25.49	0.41	30.61	25.90	56.00	46.00	25.39	20.10
3.700	23.00	16.26	0.45	23.45	16.71	56.00	46.00	32.55	29.29
4.092	22.70	16.30	0.38	23.08	16.68	56.00	46.00	32.92	29.32
10.072	30.60	22.63	0.88	31.48	23.51	60.00	50.00	28.52	26.49
16.839	25.20	18.70	1.23	26.43	19.93	60.00	50.00	33.57	30.07
19.532	23.20	18.05	1.27	24.47	19.32	60.00	50.00	35.53	30.68

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

APPENDIX

TEST EQUIPMENT USED FOR TESTS

	Description	Model No.	Serial No.	Manufacturer	Next Cal. Date
1	Spectrum Analyzer	8594E	3649A03649	HP	Dec-06
2	Signal Generator	8657A	3430U02049	HP	Dec-06
3	Attenuator (3dB)	8491A	37822	HP	Dec-06
4	Attenuator (3dB)	8491A	28881	HP	Dec-06
5	EMI Test Receiver	ESVD	843748/001	R&S	Dec-06
6	Spectrum Analyzer	8591E	3649A05888	HP	Jan-07
7	Spectrum Analyzer	8563E	3425A02505	HP	Jan-07
8	RF Amplifier	8447D	2949A02670	HP	Jan-07
9	RF Amplifier	8447D	2439A09058	HP	Jan-07
10	RF Amplifier	8449B	3008A02126	HP	Jun-07
11	TRILOG Antenna	VULB 9160	9160-3172	SCHWARZBECK	Feb-07
12	Log.-Per. Antenna	VULP 9118	9118 A 401	SCHWARZBECK	Feb-07
13	Biconical Antenna	BBA 9106	VHA 9103-2315	SCHWARZBECK	Feb-07
14	Horn Antenna	3115	00055005	ETS LINDGREN	Jun-07
15	Horn Antenna	BBHA 9120D	0499	Schwarzbeck	Jun-07
16	Hygro-Thermograph	THB-36	0041557-01	ISUZU	Feb-07
17	Splitter (BNC)	ZFM-150	15542	Mini-Circuits	-
18	Splitter (SMA)	ZFSC-2-2500	SF617800326	Mini-Circuits	-
19	Power Divider	11636A	6243	HP	Apr-07
20	DC Power Supply	6622A	3448A03079	HP	Apr-07
21	Attenuator (30dB)	8498A	1801A06689	HP	Apr-07
22	Attenuator (10dB)	8491A	63196	HP	Apr-07
23	Power Meter	EPM-441A	GB32481702	HP	Apr-07
24	Power Sensor	8481A	2702A64048	HP	Apr-07
25	Audio Analyzer	8903B	3729A18901	HP	May-07
26	Modulation Analyzer	8901B	3749A05878	HP	May-07
27	Dipole Antenna	VHA9103	2116	Schwarzbeck	Oct-06
28	Dipole Antenna	VHA9103	2117	Schwarzbeck	Oct-06
29	Dipole Antenna	UHA9105	2261	Schwarzbeck	Oct-06
30	Dipole Antenna	UHA9105	2262	Schwarzbeck	Oct-06
31	Digital Multimeter	34401A	US36062141	HP	Apr-07
32	LISN	KNW-407	8-1430-1	Kyoritsu	Jan-07
33	Two-Line V-Network	ESH3-Z5	893045/017	R&S	Jan-07
34	Test Receiver	ESHS10	828404009	R&S	Jan-07
35	TEMP & HUMIDITY Chamber	YJ-500	L05022	JinYoung Tech	-