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<http://www.ltalab.com>

Dates of Tests: August 10 – 27, 2009

Test Report S/N: LR500190908I

Test Site : LTA CO., LTD.

CERTIFICATION OF COMPLIANCE

FCC ID.

WQWNL-RF1000

APPLICANT

NESSLAB Co., Ltd.

FCC Classification	:	FHSS Sequence Spread Spectrum (FHSS)
Manufacturing Description	:	UHF RFID Reader
Manufacturer	:	NESSLAB Co., Ltd.
Model name	:	NL-RF1000
Test Device Serial No.:	:	-
Rule Part(s)	:	FCC Part 15.247 Subpart C; ANSI C-63.4-2003
Frequency Range	:	902.75 ~ 927.25MHz
RF power	:	0.733 W - Conducted
Data of issue	:	August 27, 2009

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>
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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	2009-09-30	ECT accredited Lab.
RRL	KOREA	KR0049	2011-06-20	EMC accredited Lab.
FCC	U.S.A	610755	2011-04-22	FCC filing
VCCI	JAPAN	R2133, C2307	2011-06-21	VCCI registration
IC	CANADA	IC5799	2010-05-03	IC filing

2. Information's about test item

2-1 Client

Company name : NESSLAB Co., Ltd.
 Address : 489-2, Maetan 3-dong, Yeong Tong-gu, Suwon-si, Gyeonggi-do Korea
 Tel / Fax : +82-31-206-1774 / +82-31-206-1780

2-2 Equipment Under Test (EUT)

Trade name : UHF RFID Reader
 FCC ID : WQWNL-RF1000
 Model name : NL-RF1000
 Serial number : -
 Date of receipt : August 10, 2009
 EUT condition : Pre-production, not damaged
 Antenna type : Patch Antenna Gain 5.45 dBi
 Antenna Connector Type : Reverse Polarity SMA Type
 Frequency Range : 902.75 ~ 927.25MHz
 RF output power : 0.733 W- Conducted
 Number of channels : 50
 Channel spacing : 500KHz
 Channel Access Protocol : Frequency Hopping
 Power Source : 5VDC by Adaptor

2-3 Tested frequency

	LOW	MID	HIGH
Frequency (MHz)	902.75	914.75	927.25

2-4 Ancillary Equipment

Equipment	Model No.	Serial No.	Manufacturer
PC	HP Compaq dx7400 Microtower	CNG8330J95	HP
Monitor	HPL1710	CNC816QH92	HP
KEYBOARD	SK-8115	68A-04Q6	DELL
MOUSE	MO56UOA	F0J00NOL	DELL
PRINTER	STYLUS C65	-	EPSON
Adaptor	KSAFC0500200W1US	-	KTEC

3. Test Report

3.1 Summary of tests

FCC Part Section(s)	Parameter	Limit	Test Condition	Status (note 1)
15.247(a)	Carrier Frequency Separation	> 25 kHz	Conducted	C
15.247(a)	Number of Hopping Frequencies	≥ 50 hops		C
15.247(a)	20 dB Bandwidth	-		C
15.247	Dwell Time	< 0.4 seconds		C
15.247(b)	Transmitter Output Power	< 1Watt		C
15.247(d)	Conducted Spurious emission	> 20 dBc		C
15.247(d)	Band Edge	> 20 dBc		C
15.249 / 15.209	Field Strength of Harmonics	< 54 dBuV (at 3m)	Radiated	C
15.207 /15.107	AC Conducted Emissions	EN 55022	Line Conducted	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

→ Antenna Requirement

The NESSLAB. NL-RF1000 unit complies with the requirement of §15.203.

The Antenna type is Reverse Polarity SMA Type ; Refer to the Extenal photo

3.2 Transmitter requirements

3.2.1 Carrier Frequency Separation

Procedure:

The carrier frequency separation was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function enabled.

After the trace being stable, the reading value between the peaks of the adjacent channels using the marker-delta function was recorded as the measurement results.

The spectrum analyzer is set to:

Span = 1 MHz (wide enough to capture the peaks of two adjacent channels)

RBW = 10 kHz (1% of the span or more) Sweep = auto

VBW = 10 kHz Detector function = peak

Trace = max hold

Measurement Data:

Test Results	
Carrier Frequency Separation (KHz)	Result
500.7	Complies

- See next pages for actual measured spectrum plots.

Minimum Standard:

The EUT shall have hopping channel carrier frequencies separated by a minimum of 25kHz or the 20dB bandwidth of the hopping channel, whichever is greater.

Measurement Setup

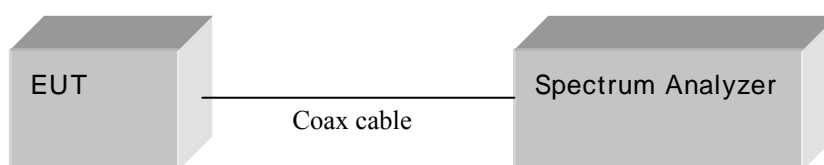


Figure 1: Measurement setup for the carrier frequency separation

Carrier Frequency Separation



3.2.2 Number of Hopping Frequencies

Procedure:

The number of hopping frequencies was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function enabled.

To get higher resolution, four frequency ranges within the 902 ~ 928 MHz FH band were examined.

The spectrum analyzer is set to:

Frequency range 1: Start = 900 MHz, Stop = 930 MHz

RBW = 100 kHz (1% of the span or more) Sweep = auto

VBW = 100 kHz (VBW RBW) Detector function = peak

Trace = max hold Span = 30MHz

Measurement Data: Complies

Total number of Hopping Channels	50
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- See next pages for actual measured spectrum plots.

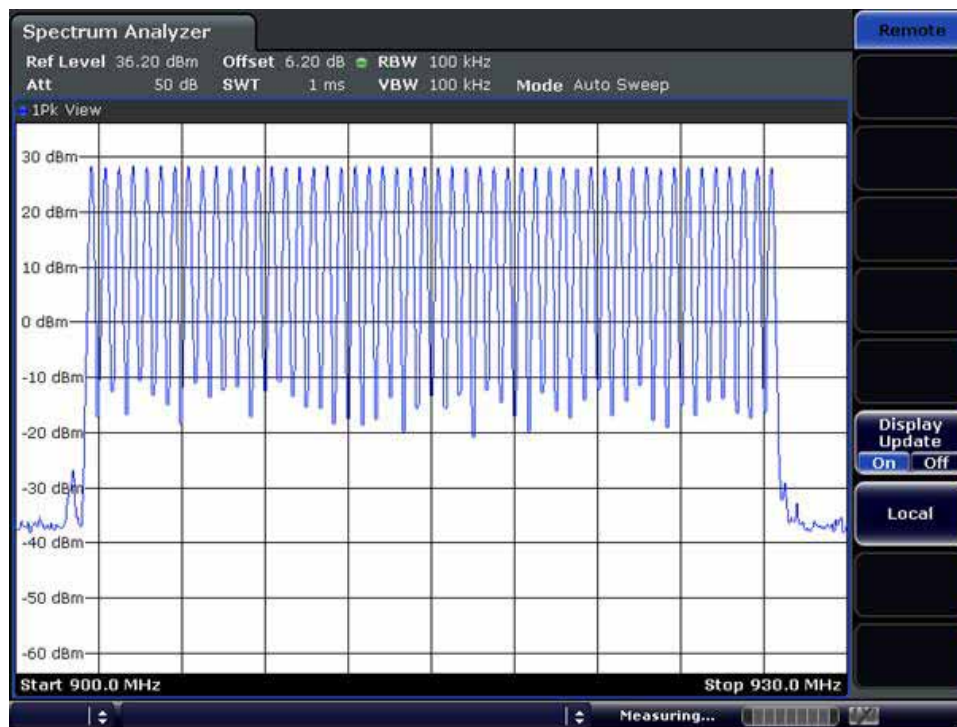
Minimum Standard:

At least 50 hopes

Measurement Setup

Same as the Chapter 3.2.1 (Figure 1)

Number of Hopping Frequencies



3.2.3 20 dB Bandwidth

Procedure:

The bandwidth at 20 dB below the highest inband spectral density 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. Use the marker-delta function to measure 20dB 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 20 dB bandwidth of the emission.

The spectrum analyzer is set to:

Center frequency = the highest, middle and the lowest channels

Span = 1 MHz (approximately 2 or 3 times of the 20 dB bandwidth)

RBW = 10 kHz

Sweep = auto

VBW = 10 kHz (VBW RBW)

Detector function = peak

Trace = max hold

Measurement Data:

Frequency (MHz)	Channel No.	Test Results	
		Measured Bandwidth (kHz)	Result
902.75	1	58.18	Complies
914.75	25	54.41	Complies
927.25	50	57.02	Complies

- See next pages for actual measured spectrum plots.

Minimum Standard:

-

Measurement Setup

Same as the Chapter 3.2.1 (Figure 1)

20 dB Bandwidth



3.2.4 Time of Occupancy (Dwell Time)

Procedure:

The dwell time was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function enabled.

The spectrum analyzer is set to:

Center frequency = 914.9 MHz

Span = zero

RBW = 10 MHz

VBW = 30 MHz (VBW RBW)

Trace = max hold

Detector function = peak

Measurement Data:

Channel Number	Channel Frequency (MHz)	Test Results			
		Length (ms)	number	Dwell Time (ms)	Result
25	914.75	389	1	389	Complies

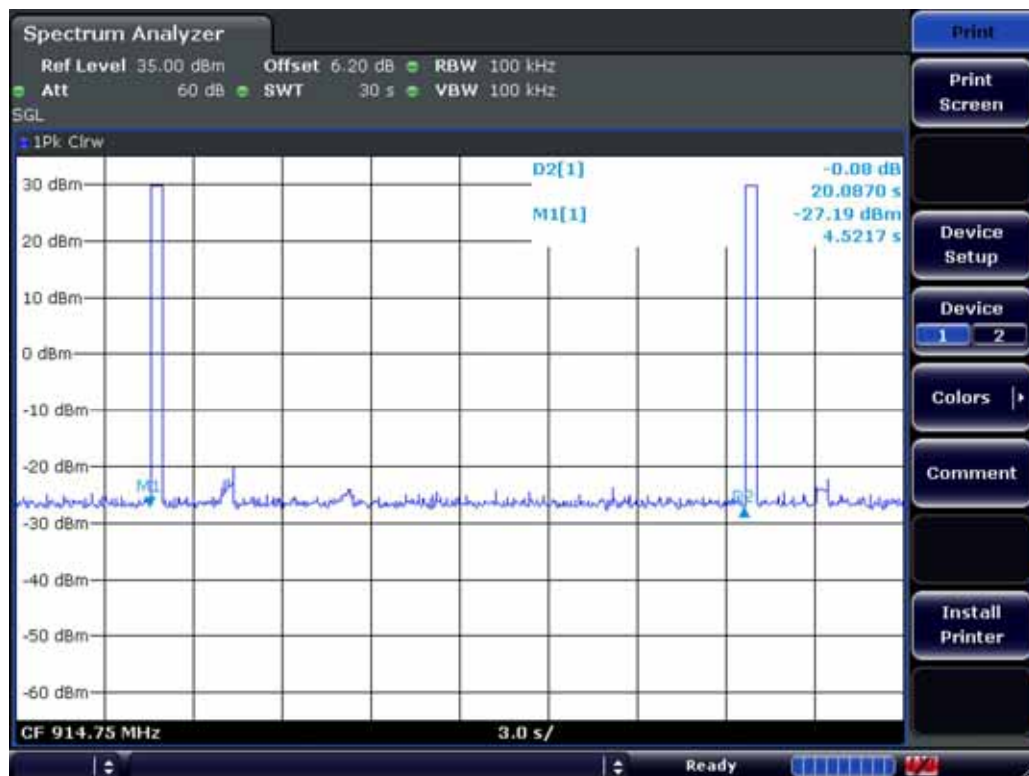
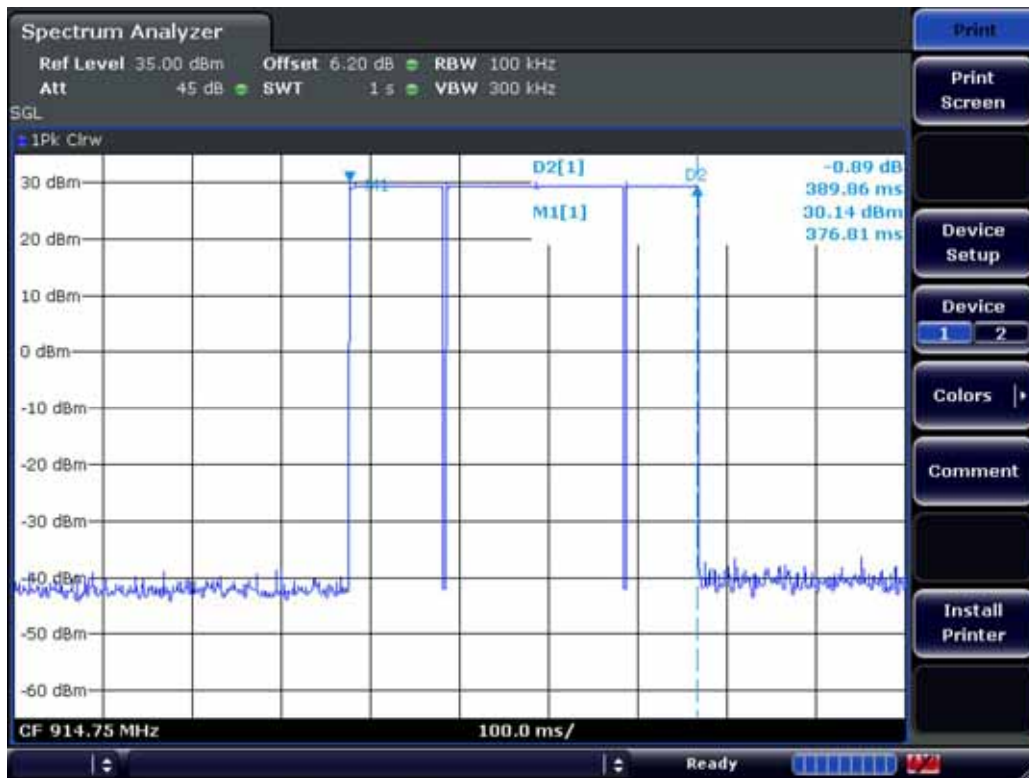
- See next pages for actual measured spectrum plots.

Minimum Standard:

0.4 seconds within a 20 second period per any frequency

Measurement Setup

Same as the Chapter 3.2.1 (Figure 1)



3.2.5 Transmitter Output Power

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

RBW = 1 MHz (greater than the 20dB bandwidth of the emission being measured)

VBW = 1 MHz (VBW RBW)

Detector function = peak

Trace = max hold

Sweep = auto

Measurement Data:

Frequency (MHz)	Ch.	Test Results		
		dBm	W	Result
902.75	1	28.65	0.733	Complies
914.75	26	28.27	0.671	Complies
927.25	50	28.17	0.656	Complies

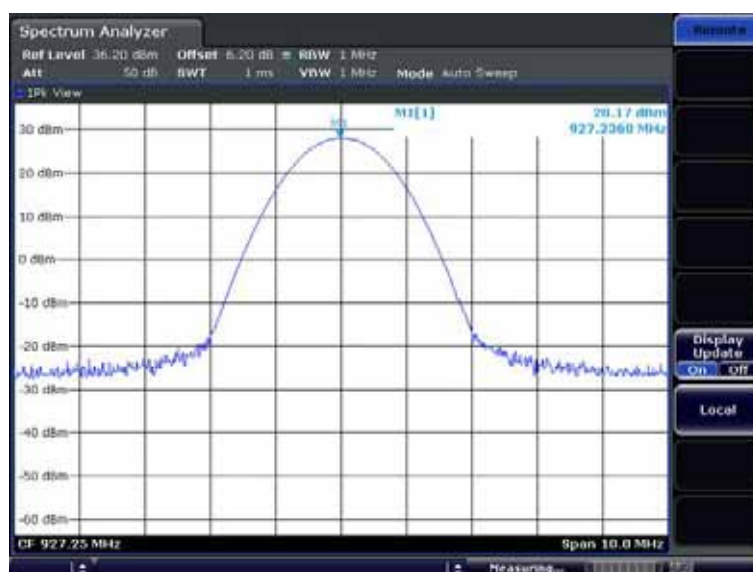
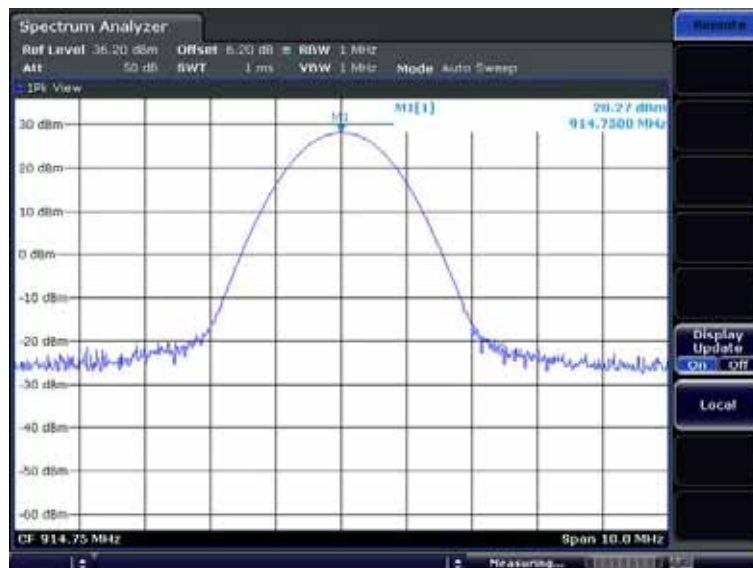
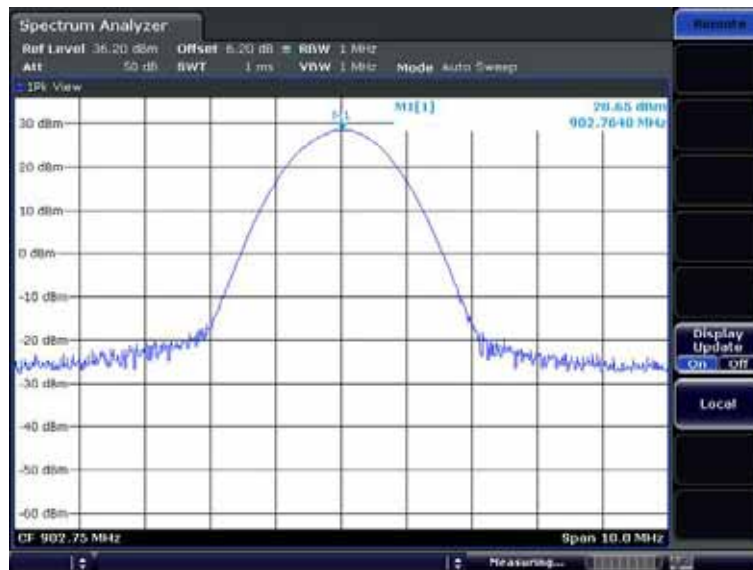
- See next pages for actual measured spectrum plots.

Minimum Standard:	< 1W
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Measurement Setup

Same as the Chapter 3.2.1 (Figure 1)

Peak Output Power



3.2.6 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 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 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 = 10 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



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



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



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



3.2.7 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)

= 1 MHz (1 GHz ~ 10th harmonic)

Span = 100 MHz

Trace = max hold

Peak mode: VBW = 1 MHz

Average mode: VBW = 10Hz

Detector function = Peak & average

Sweep = auto

Measurement Data:

→ Refer to the Next page

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.

Minimum Standard: FCC Part 15.109

Frequency (MHz)	Limit (uV/m) @ 10m
30 ~ 88	90
88 ~ 216	150
216 ~ 960	210
Above 960	300

Measurement Data: Peak mode

Low channel		Mid channel		High channel	
Frequency (MHz)	Level (dBuV/m)	Frequency (MHz)	Level (dBuV/m)	Frequency (MHz)	Level (dBuV/m)
1804.4	51.4	1830.6	50.24	1853	50.53
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
Measurement uncertainty		± 6 dB			

Note: Emissions attenuated more than 20 dB below the permissible value are not reported.

Measurement Data: Average mode

Low channel		Mid channel		High channel	
Frequency (MHz)	Level (dBuV/m)	Frequency (MHz)	Level (dBuV/m)	Frequency (MHz)	Level (dBuV/m)
1804.4	48.9	1830.6	48.45	1853	48.87
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
Measurement uncertainty		± 6 dB			

Note: Emissions attenuated more than 20 dB below the permissible value are not reported.

Measurement Data:



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EUT/Model No.: NL-RF1000

TEST MODE: WIRELESS mode

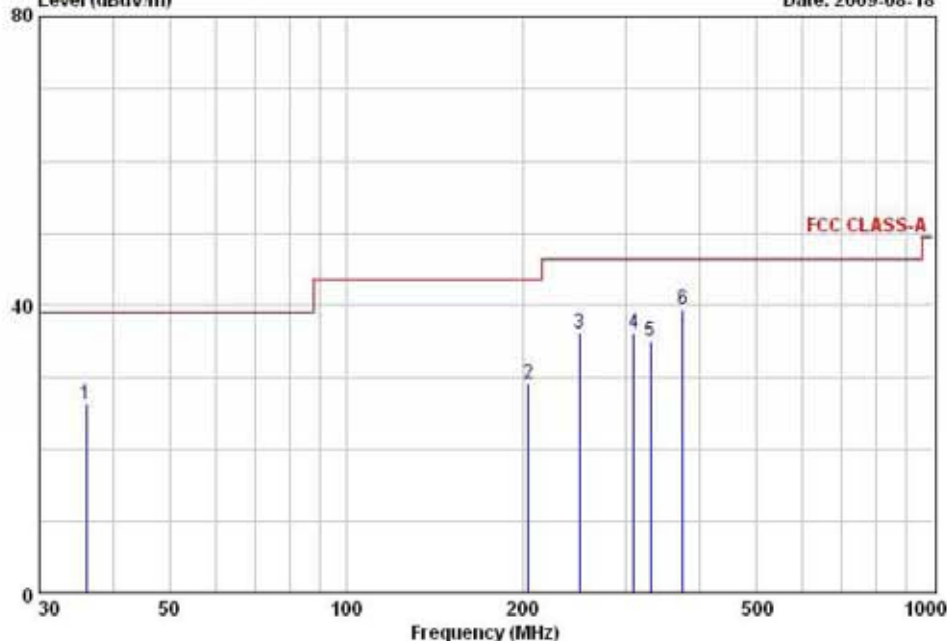
Temp Humi : 24 / 57

Tested by: B.S.KIM

Data: 164

Level (dBuV/m)

Date: 2009-08-18



	Freq	Reading	C.F	Result	Limit	Margin	Height	Angle	Polarity
	MHz	dBuV/m	dB/m	dBuV/m	QP	dB	cm	deg	
1	36.01	14.20	12.10	26.30	39.00	12.70	100	354	VERTICAL
2	204.41	14.90	14.29	29.19	43.50	14.31	376	112	HORIZONTAL
3	250.03	20.00	16.13	36.13	46.40	10.27	400	178	HORIZONTAL
4	308.91	18.20	18.01	36.21	46.40	10.19	400	176	HORIZONTAL
5	330.19	16.50	18.61	35.11	46.40	11.29	324	122	HORIZONTAL
6	375.01	19.70	19.76	39.46	46.40	6.94	260	59	HORIZONTAL

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

3.2.8 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

Class B

Frequency Range	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

Class A

Frequency Range	quasi-peak	Average
0.15 ~ 0.5 MHz	79 dBuV	66 dBuV
0.5 ~ 30 MHz	73 dBuV	60 dBuV

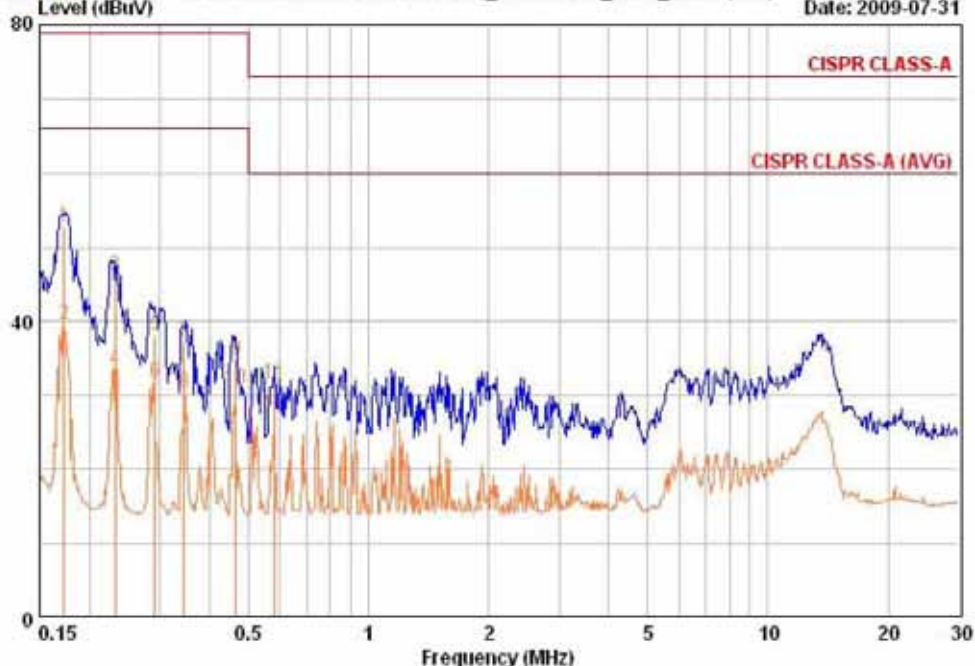
AC Conducted Emissions –Line



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EUT / Model No. : NL-RF1000	Phase : LINE
Test Mode : WIRELESS mode	Test Power : 120 / 60
Temp./Humi. : 24 / 61	Test Engineer : B.S.KIM

Data: 492 Level (dBuV) File: D:\Conducted Data\2009\LTA_Conduction_0907_2.EMI (628) Date: 2009-07-31



Freq	PD	PD	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
0.173	43.09	30.09	9.63	52.73	39.73	79.00	66.00	26.27	26.27
0.232	36.58	23.98	9.66	46.24	33.64	79.00	66.00	32.76	32.36
0.292	28.57	22.27	9.65	38.22	31.92	79.00	66.00	40.78	34.08
0.346	27.46	20.76	9.72	37.19	30.49	79.00	66.00	41.81	35.51
0.466	25.15	21.25	9.66	34.81	30.91	79.00	66.00	44.19	35.09
0.580	21.84	17.74	9.77	31.61	27.51	73.00	60.00	41.39	32.49

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

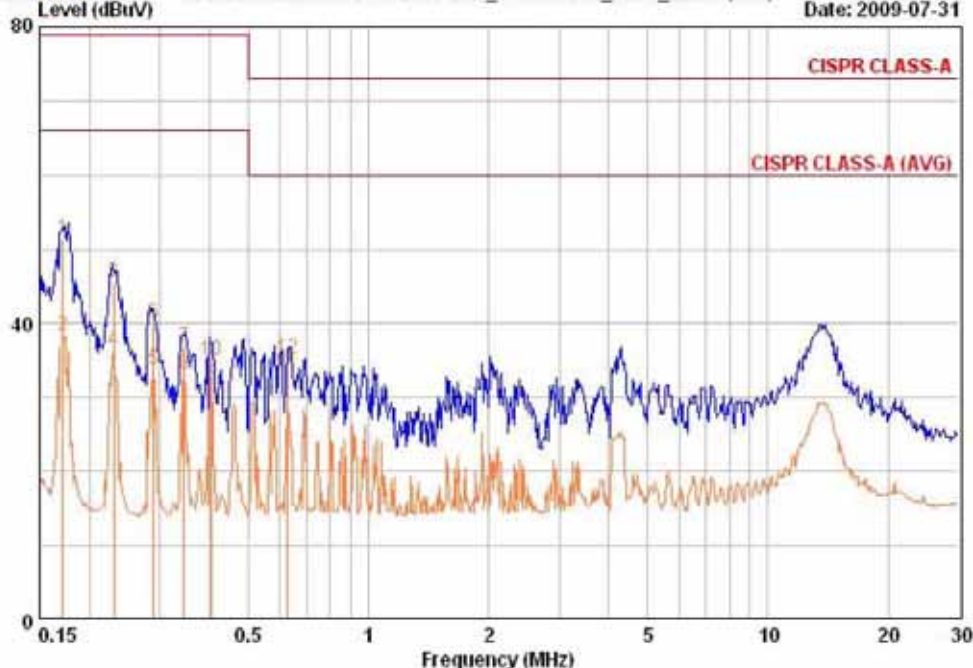
AC Conducted Emissions -Neutral



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EUT / Model No. : NL-RF1000	Phase : NEUTRAL
Test Mode : WIRELESS mode	Test Power : 120 / 60
Temp./Humi. : 24 / 61	Test Engineer : B.S.KIM

Data: 484 File: D:\Conducted Data\2009\LTA_Conduction_0907_2.EMI (628) Date: 2009-07-31



Freq	PD	PD	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
0.171	41.79	28.69	9.72	51.51	38.41	79.00	66.00	27.49	27.59
0.230	35.88	26.68	9.67	45.55	36.35	79.00	66.00	33.45	29.65
0.289	30.47	24.17	9.62	40.09	33.79	79.00	66.00	38.91	32.21
0.346	27.06	23.46	9.68	36.74	33.14	79.00	66.00	42.26	32.86
0.404	25.46	22.86	9.74	35.20	32.60	79.00	66.00	43.80	33.40
0.627	25.54	23.54	9.78	35.32	33.32	73.00	60.00	37.68	26.68

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	FSV-30	100757	R&S	Feb-10
2	Spectrum Analyzer	8563E	3425A02505	HP	Apr-10
3	Spectrum Analyzer	8594E	3710A04074	HP	Oct-09
4	Signal Generator	8648C	3623A02597	HP	Apr-10
5	Signal Generator	83711B	US34490456	HP	Apr-10
6	Attenuator (3dB)	8491A	37822	HP	Oct-09
7	Attenuator (10dB)	8491A	63196	HP	Oct-09
8	Attenuator (30dB)	8498A	1801A06689	HP	Oct-09
9	EMI Test Receiver	ESVD	843748/001	R&S	Apr-10
10	Horn Antenna(18 ~ 40GHz)	SAS-574	154	Schwarzbeck	Nov-10
11	Horn Antenna(18 ~ 40GHz)	SAS-574	155	Schwarzbeck	Nov-10
12	RF Amplifier	8447D	2949A02670	HP	Oct-10
13	RF Amplifier	8449B	3008A02126	HP	Apr-10
14	Test Receiver	ESHS10	828404/009	R&S	Apr-10
15	TRILOG Antenna	VULB 9160	9160-3212	SCHWARZBECK	Apr-11
16	Log.-Per. Antenna	VULP 9118	9118 A 401	SCHWARZBECK	Apr-11
17	Biconical Antenna	BBA 9106	VHA 9103-2315	SCHWARZBECK	Apr-11
18	Horn Antenna	3115	00055005	ETS LINDGREN	Mar-11
19	Horn Antenna	BBHA 9120D	9120D122	SCHWARZBECK	Dec-11
20	Dipole Antenna	VHA9103	2116	SCHWARZBECK	Nov-09
21	Dipole Antenna	VHA9103	2117	SCHWARZBECK	Nov-09
22	Dipole Antenna	VHA9105	2261	SCHWARZBECK	Nov-09
23	Dipole Antenna	VHA9105	2262	SCHWARZBECK	Nov-09
24	Hygro-Thermograph	THB-36	0041557-01	ISUZU	Apr-10
25	Splitter (SMA)	ZFSC-2-2500	SF617800326	Mini-Circuits	-
26	Signal Generator	E4436B	US39260781	Agilent	May-10
27	Power Divider	11636A	6243	HP	Oct-09
28	DC Power Supply	6622A	3448A03079	HP	Oct-09
29	Frequency Counter	5342A	2826A12411	HP	Apr-10
30	Power Meter	EPM-441A	GB32481702	HP	Apr-10
31	Power Sensor	8481A	2702A64048	HP	Apr-10
32	Audio Analyzer	8903B	3729A18901	HP	Oct-09
33	Modulation Analyzer	8901B	3749A05878	HP	Oct-09
34	TEMP & HUMIDITY Chamber	YJ-500	LTAS06041	JinYoung Tech	Oct-09
35	LOOP-ANTENNA	FMZB 1516	151602/94	SCHWARZBECK	Mar-11
36	Communication Equipment	E5515C	GB42230452	Agilent	July-10
37	LISN	ENV216	100408	R&S	Oct-09