



Report Number : KSQ-FCC101118

FCC ID : YZ8NM930308001M

TEST REPORT

1. Applicant

Name : Neo Reflection
Address : 1 Floor, Bongmyung-Dong, Yoosung-Gu,
Daejeon, South Korea

2. Products

Name : Neo Mouse
Model/Type : NM930308001M
Manufacturer : Neo Reflection
3. Test Standard : 47 CFR FCC Part 15 Subpart C 15.249
4. Test Method : ANSI C63.4-2009
5. Test Result : Positive
6. Date of receipt : November 25, 2010
7. Date of Issue : November 16, 2010

Tested by

YoungRyul, Jo

Test Engineer:

Approved by

SungBum, Hong

Compliance Engineer:

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Korea Standard Quality Laboratories
Testing Laboratories for EMC and Safety Compliance
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1. GENERAL

These tests were performed using the test procedure outlined in ANSI C63.4, 2003 for intentional radiators, and in accordance with the limits set forth in FCC Part 15.249

The EUT (Equipment Under Test) has been shown to be capable of compliance with the applicable technical standards.

We attest to the accuracy of data. All measurements reported herein were performed by Korea Standard Quality Laboratories and were made under Chief Engineer's supervision.

We assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

2. TEST SITE

Korea Standard Quality Laboratories

2.1 Location

#102, Jangduk Dong, Hwasung City, Kyunggi Do, South Korea

(FCC Registered Test Site Number: 100384)

This test site is in compliance with ISO/IEC 17025 for general requirements for the competence of testing and calibration laboratories.

2.2 Test Date

Date of Test: November 22, 2010 ~ November 23, 2010

2.3 Test Environment

See each test item's description.

3. DESCRIPTION OF THE EQUIPMENT UNDER TEST

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

3.1 Rating and Physical Characteristics

Power source	DC 3.7 V
Transmit Frequency	2402 ~ 2482 MHz (81 channels)
X-tal or Oscillator	X-tal: 16 MHz
Antenna Type	Integral (Chip Antenna, Gain: 2.9 dBi max.)
Type of Modulation	GFSK

3.2 Equipment Modifications

None.

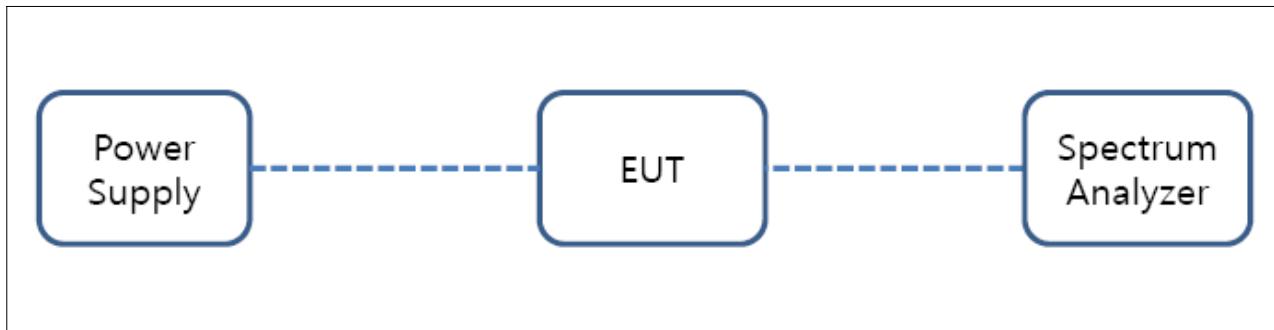
3.3 Submitted Documents

Block diagram
Schematic diagram
Antenna Specification
External photos
Test setup photos
Part List
Operational Description
Label Location
User manual

4. MEASUREMENT CONDITIONS

4.1 Description of test configuration

The measurements were taken in continuous transmitting mode using the TEST MODE. For controlling the EUT as TEST MODE, the test program and the cable assembly were provided by the applicant.



[System Block Diagram of Test Configuration]

4.2 List of Peripherals

Equipment Type	Manufacturer	Model	S/N
-	-	-	-
-	-	-	-

** For control of the RF module in the EUT. For radiated spurious emission measurements, setting the EUT to TEST MODE.

4.3 Type of Used Cables

#	START		END		CABLE	
	NAME	I/O PORT	NAME	I/O PORT	LENGTH(m)	SHIELDED
1	-	-	-	-	-	-
2						

5. TEST AND MEASUREMENT

Summary of Test Results

Requirement	CFR 47 Section	Report Section	Test Result
Antenna Requirement	15.203	5.1	PASS
20dB Bandwidth	15.215(c)	5.2	PASS
Spurious Emission, Band Edge, and Restricted bands	15.249(a) (d), 15.205(a), 15.209(a)	5.3	PASS
Receiver Spurious Emissions	-	5.4	PASS

5.1 ANTENNA REQUIREMENT

5.1.1 Regulation

According to §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. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

5.1.2 Result :

PASS

The transmitter has an integral Chip antenna. The directional gain of the antenna is 2.9 dBi.

5.2. 20dB BANDWIDTH

5.2.1 Regulation

According to §15.215(c), Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in Sub-part E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

5.2.2. Test Condition

- Set RBW of Spectrum analyzer to 10 kHz, Span=3MHz, Sweep=auto
- The transmitter output (antenna Port) was connected to the spectrum analyzer.
- Set spectrum analyzer's RBW and VBW to applicable value with Reak in Max Hold.
- A PEAK output reading was taken, a DISPLAY line was drawn 20dB lower than PEAK level.
- The 20dB bandwidth was determined from where the channel output spectrum intersected the display line.

5.2.3. Test result :

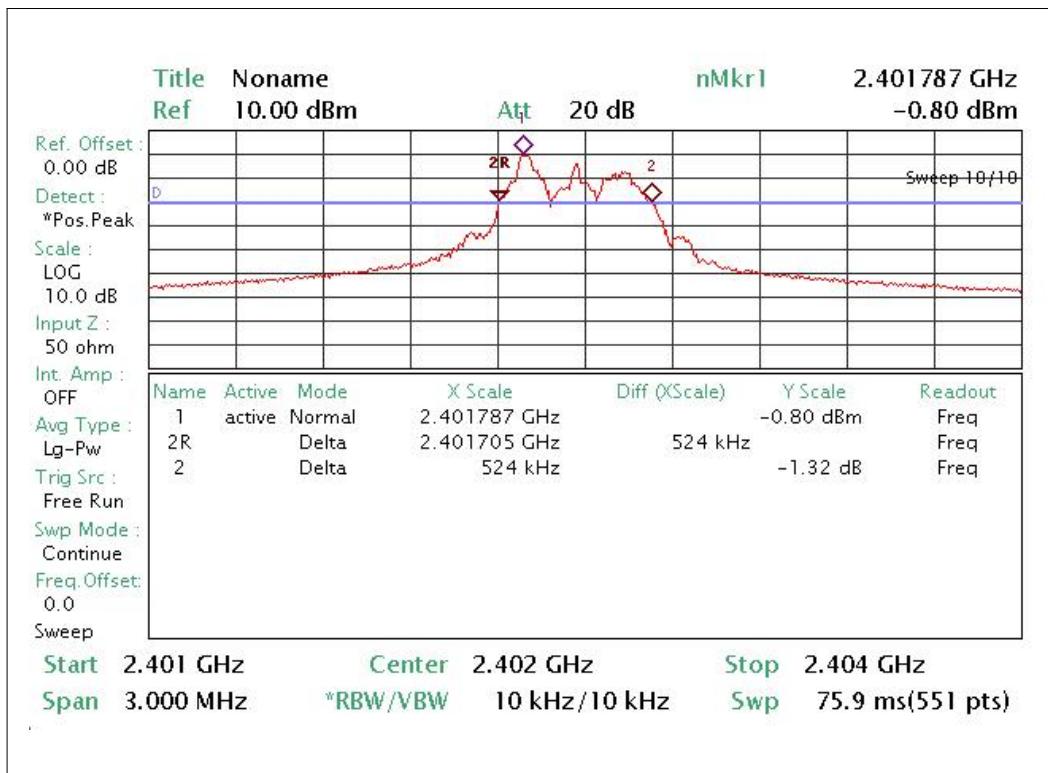
PASS

Table 1 : Measured values of the 20dB Bandwidth

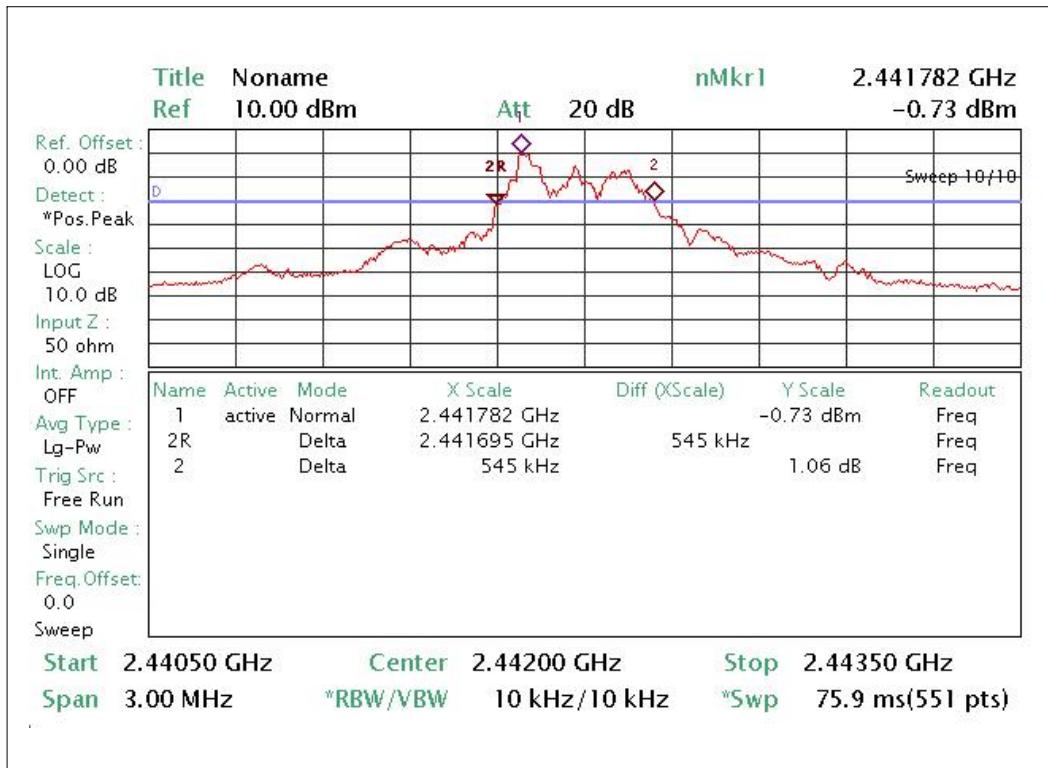
Modulation	Frequency (MHz)	Result (kHz)	Verdict
GFSK	2402	524	Pass
	2442	545	Pass
	2482	535	Pass

Figure 1. Plot of the 20dB Channel Bandwidth

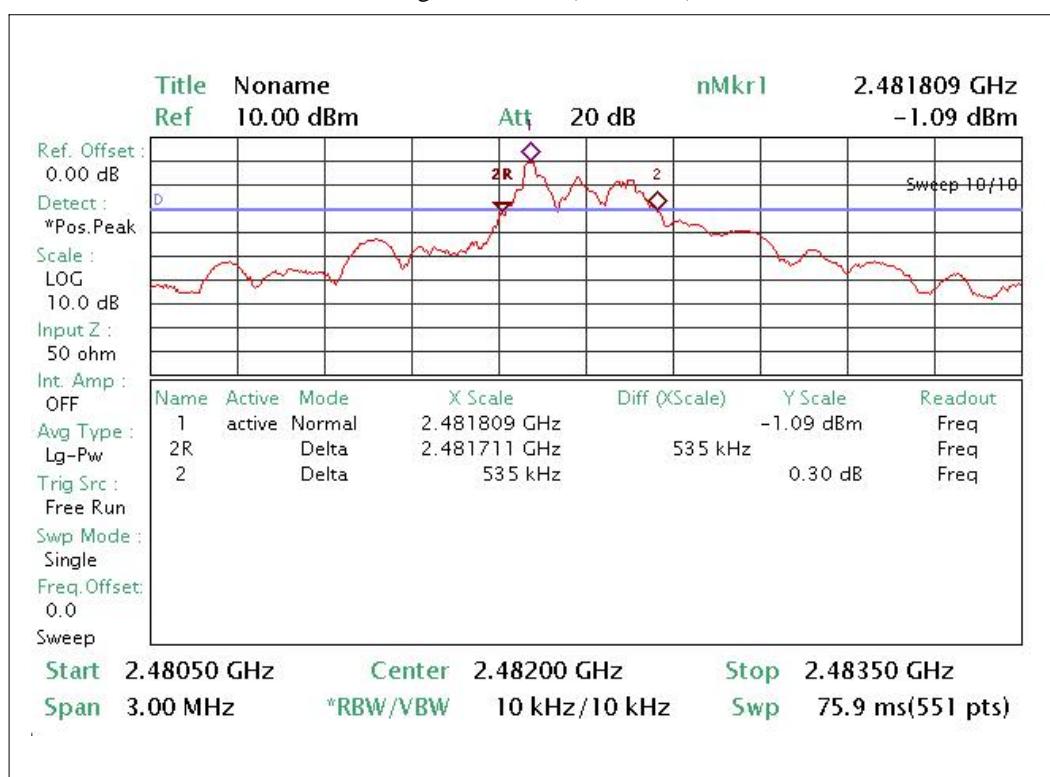
Lowest Channel (2402 MHz)



Middle Channel (2442 MHz)



Highest Channel (2482 MHz)



5.3 SPURIOUS EMISSIONS, BAND EDGE, AND RESTRICTED BANDS**5.3.1 Regulation**

According to §15.249(a) (d), (a) Except as provided in paragraph.

(b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental frequency(MHz)	Field strength of fundamental (millivolts/ meter)	Field strength of harmonics (microvolts/ meter)
902–928	50	500
2400–2483.5	50	500
5725–5875	50	500
24.0–24.25	250	2500

(d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

According to §15.209(a), for an intentional device, the general requirement of field strength of radiated emissions from intentional radiators at a distance of 3 meters shall not exceed the following values:

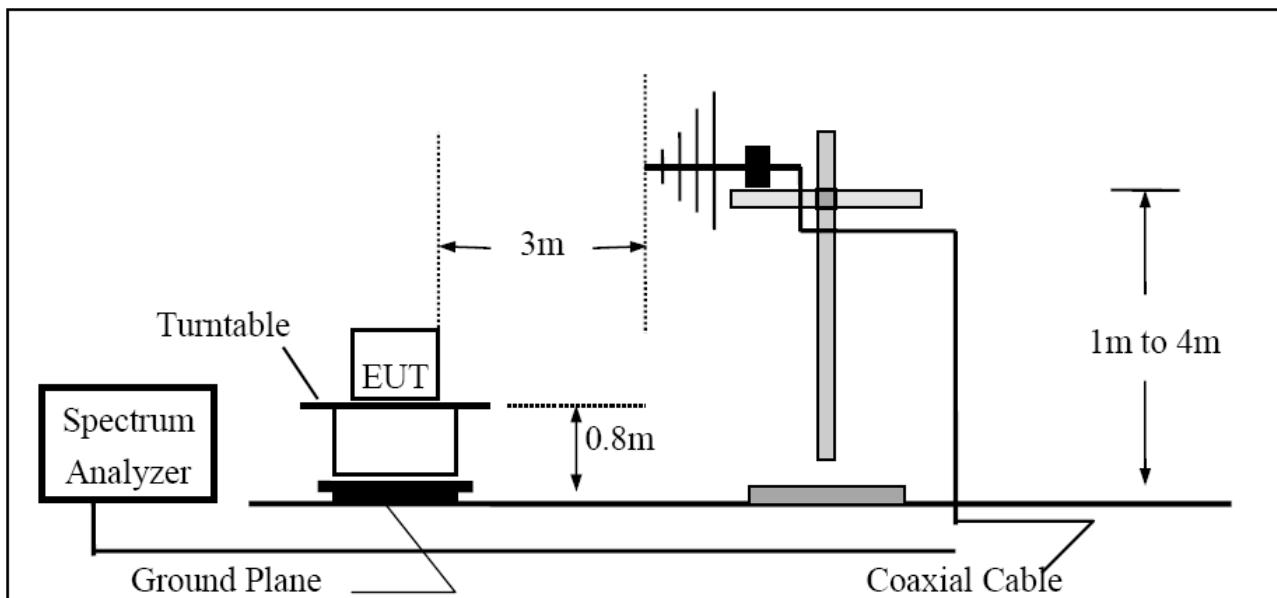
Frequency (MHz)	Field strength (μ V/m @ 3m)	Field strength (dB μ V/m @ 3m)
30–88	100	40.0
88–216	150	43.5
216–960	200	46.0
Above 960	500	54.0

According to §15.109(a), for an unintentional device, except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the above table.

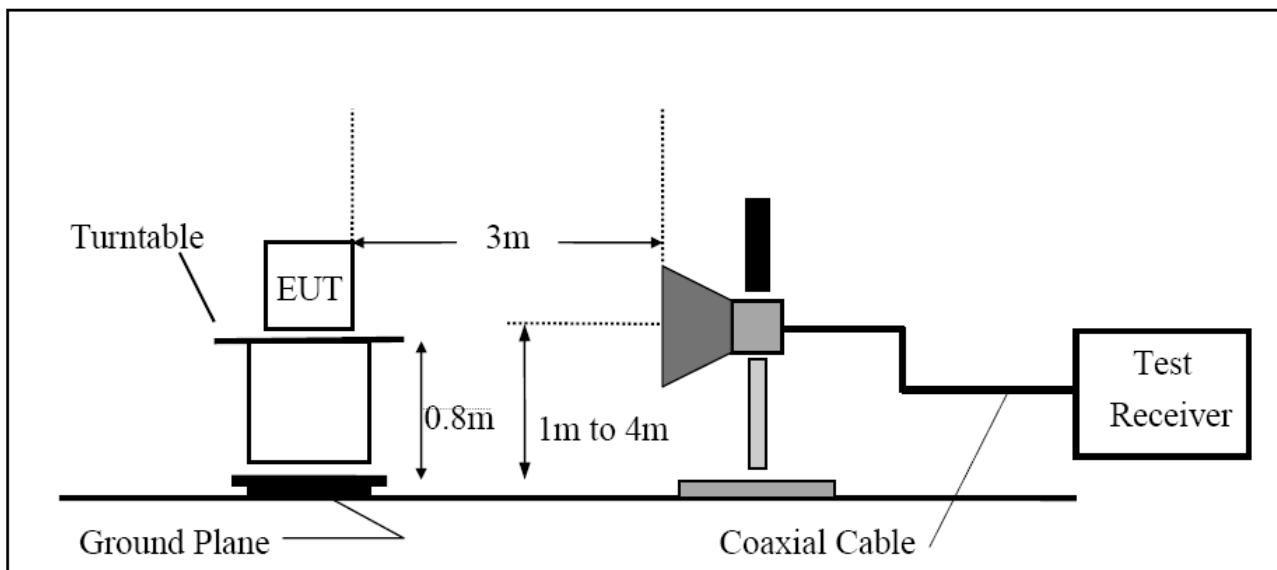
** The emission limits shown in the above table are based on measurement instrumentation employing a CISPR quasi-peak detector and above 1000 MHz are based on the average value of measured emissions.

5.3.2 Test Setup Layout

5.3.2.1 Radiated Emission Test Set-Up, Frequency Below 1000MHz



5.3.2.2 Radiated Emission Test Set-UP Frequency Over 1000MHz



5.3.3 Test Procedure

1) Band-edge Compliance of RF Conducted Emissions

1. Set the spectrum analyzer as follows:

Span = wide enough to capture the peak level of the emission operating on the channel closest to the bandedge, as well as any modulation products which fall outside of the authorized band of operation

RBW \geq 1% of the span

VBW \geq RBW

Sweep = auto

Detector function = peak

Trace = max hold

2. Allow the trace to stabilize. Set the marker on the emission at the band-edge, or on the highest modulation product outside of the band, if this level is greater than that at the band-edge. Enable the marker-delta function, and then use the marker-to-peak function to move the marker to the peak of the in-band emission.

3. Now, using the same instrument settings, enable the hopping function of the EUT. Allow the trace to stabilize. Follow the same procedure listed above to determine if any spurious emissions caused by the hopping function also comply with the specified limit.

2) Spurious RF Conducted Emissions:

1. Set the spectrum analyzer as follows:

Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, several plots are required to cover this entire span.

RBW = 100 kHz

VBW \geq RBW

Sweep = auto

Detector function = peak

Trace = max hold

2. Allow the trace to stabilize. Set the marker on the peak of any spurious emission recorded.

3) Spurious Radiated Emissions:

1. The preliminary radiated measurements were performed to determine the frequency producing the maximum emissions in an anechoic chamber at a distance of 3 meters for above 30 MHz, and at 1 meter distance for below 30 MHz.

2. The EUT was placed on the top of the 0.8-meter height, 1 \times 1.5 meter non-metallic table. To find the maximum emission levels, the height of a measuring antenna was changed and the turntable was rotated 360°.

3. The antenna polarization was also changed from vertical to horizontal. The spectrum was scanned from 9 kHz to 30 MHz using the loop antenna, from 30 to 1000 MHz using the Trilog broadband antenna, and from 1 GHz to tenth harmonic of the highest fundamental frequency using the horn antenna.
4. To obtain the final measurement data, the EUT was arranged on a turntable situated on a 4×4 meter at the Open Area Test Site. The EUT was tested at a distance 3 meters.
5. Each frequency found during preliminary measurements was re-examined and investigated. The test-receiver system was set up to average, peak, and quasi-peak detector function with specified bandwidth.
6. The EUT is situated in three orthogonal planes (if appropriate)
7. The presence of ambient signals was verified by turning the EUT off. In case an ambient signal was detected, the measurement bandwidth was reduced temporarily and verification was made that an additional adjacent peak did not exist. This ensures that the ambient signal does not hide any emissions from the EUT.
8. If the emission on which a radiated measurement must be made is located at the edge of the authorized band of operation, then the alternative "marker-delta" method may be employed.

4) Marker-Delta Method at the edge of the authorized band of operation:

1. Perform an in-band field strength measurement of the fundamental emission using the RBW and detector function as the above Spurious Radiated Emissions test procedure.
2. Choose a spectrum analyzer span that encompasses both the peak of the fundamental emission and the band-edge emission under investigation. Set the analyzer RBW to 1% of the total span (but never less than 30 kHz) with a video bandwidth equal to or greater than the RBW. Record the peak levels of the fundamental emission and the relevant band-edge emission (i.e., run several sweeps in peak hold mode). Observe the stored trace and measure the amplitude delta between the peak of the fundamental and the peak of the band-edge emission. This is not a field strength measurement; it is only a relative measurement to determine the amount by which the emission drops at the band-edge relative to the highest fundamental emission level.
3. Subtract the delta measured in step (2) from the field strengths measured in step (1). The resultant field strengths (CISPR QP, average, or peak, as appropriate) are then used to determine band-edge compliance as required by Section 15.205.
4. The above "delta" measurement technique may be used for measuring emissions that are up to two "standard" bandwidths away from the band-edge, where a "standard" bandwidth is the bandwidth specified by C63.4 for the frequency being measured. For example, for band-edge measurements in the restricted band that begins at 2483.5 MHz, C63.4 specifies a measurement bandwidth of at least 1 MHz. Therefore you may use the "delta" technique for measuring emissions up to 2 MHz removed from the band-edge. Radiated emissions that are removed by more than two "standard" bandwidths must be measured as the above Spurious Radiated Emissions test procedure.

5.3.4 Test Results:
PASS
Table 2 : Measured values of the Field strength of fundamental & harmonics

Frequency (MHz)	Detect Mode	Polarization (V/H)	Measured Value (dB μ V)	Antenna Factor + Cable Loss (dB/m)	Amplifier Gain (dB)	Emission Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
2402	Peak	V	79.67	35.6	-23.2	92.07	114	21.93
	Average	V	22.68	35.6	-23.2	35.08	94	58.92
	Peak	H	79.24	35.6	-23.2	91.64	114	22.36
	Average	H	22.36	35.6	-23.2	34.76	94	59.24
2442	Peak	V	79.62	36.7	-23.2	93.12	114	20.88
	Average	V	22.41	36.7	-23.2	35.91	94	58.09
	Peak	H	79.19	36.7	-23.2	92.69	114	21.31
	Average	H	22.38	36.7	-23.2	35.88	94	58.12
2482	Peak	V	79.76	37.4	-23.2	93.96	114	20.04
	Average	V	22.16	37.4	-23.2	36.36	94	57.64
	Peak	H	79.28	37.4	-23.2	93.48	114	20.52
	Average	H	22.12	37.4	-23.2	36.32	94	57.68

Band-edge compliance of RF conducted/radiated emissions was shown in the Figure 2 and Figure 3

NOTE: We took the insertion loss of the cable loss into consideration within the measuring instrument.

Spurious RF conducted emissions were shown in the Figure 4

NOTE: We took the insertion loss of the cable loss into consideration within the measuring instrument.

Table 3 : Measured values of the Field strength of spurious emission (Transmit mode)

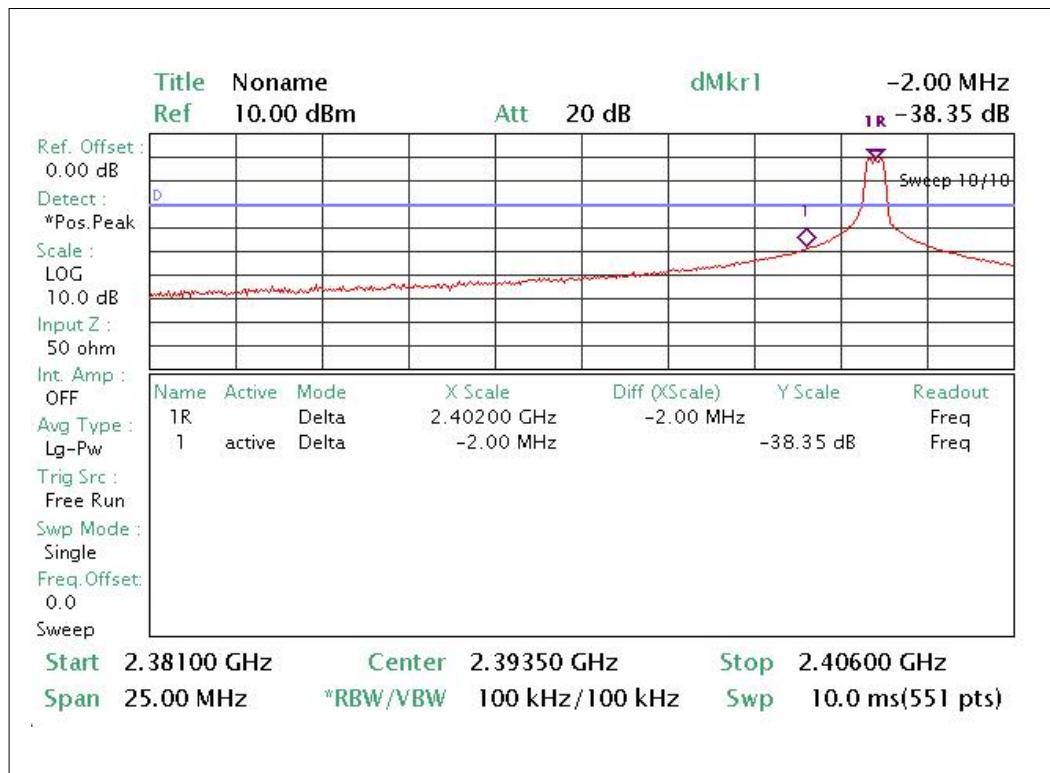
Frequency (MHz)	Detect Mode	Polarization (V/H)	Turn Table (degree)	Measured Value (dB μ V)	Antenna Factor + Cable Loss (dB/m)	Amplifier Gain (dB)	Emission Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	
Average/Peak/Quasi-peak data, emissions below 30 MHz										
No Spurious Radiated Emissions Found										
Quasi-peak data, emissions below 1000 MHz										
No Spurious Radiated Emissions Found										
Peak/Average data, emissions above 1000 MHz										
CH 0 (2402MHz)	4804	Peak	V	95	26.72	40.3	-23.2	43.82	74	30.18
	4804	Average	V	95	22.45	40.3	-23.2	39.55	54	14.45
	4804	Peak	H	52	26.28	40.3	-23.2	43.38	74	30.62
	4804	Average	H	52	20.36	40.3	-23.2	37.46	54	16.54
CH 39 (2442MHz)	4884	Peak	V	114	25.29	40.7	-23.2	42.79	74	31.21
	4884	Average	V	114	22.34	40.7	-23.2	39.84	54	14.16
	4884	Peak	H	37	26.12	40.7	-23.2	43.62	74	30.38
	4884	Average	H	37	20.37	40.7	-23.2	37.87	54	16.13
CH 78 (2482MHz)	4964	Peak	V	145	26.42	41.2	-23.2	44.42	74	29.58
	4964	Average	V	145	20.69	41.2	-23.2	38.69	54	15.31
	4964	Peak	H	77	25.33	41.2	-23.2	43.33	74	30.67
	4964	Average	H	77	21.47	41.2	-23.2	39.47	54	14.53

1. Margin (dB) = Limit – Emission Level

2. H = Horizontal, V = Vertical Polarization

Figure 2. Plot of the Band Edge (Conducted)

Lowest Channel (2402 MHz)



Middle Channel (2482 MHz)

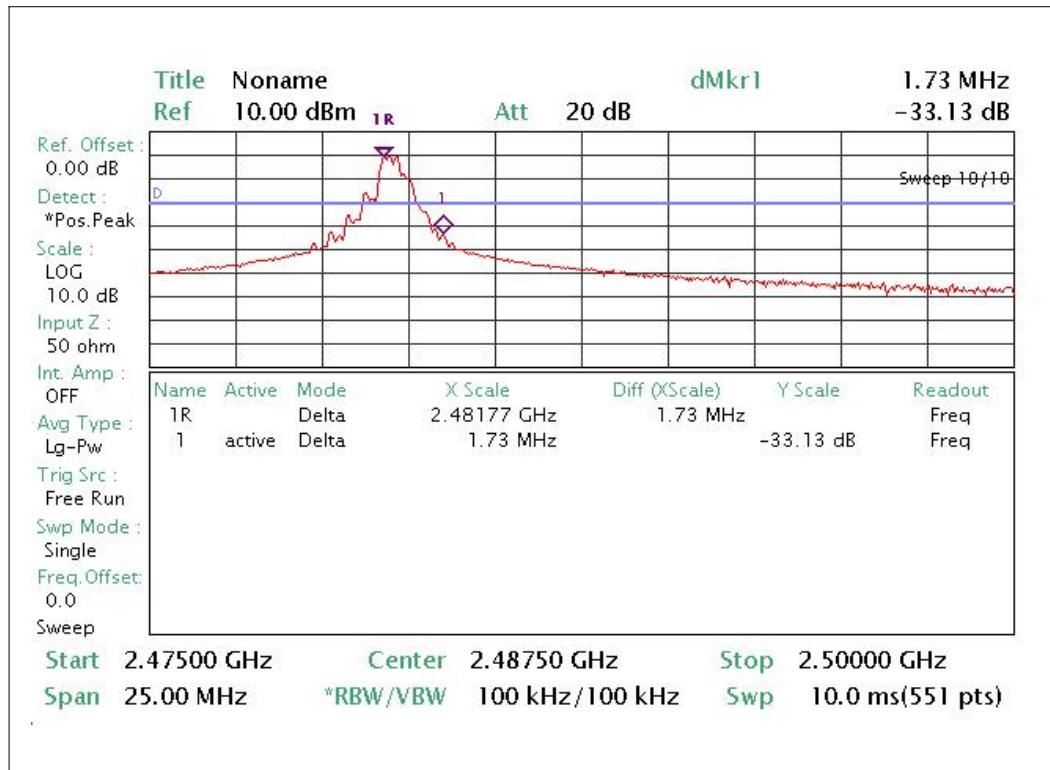
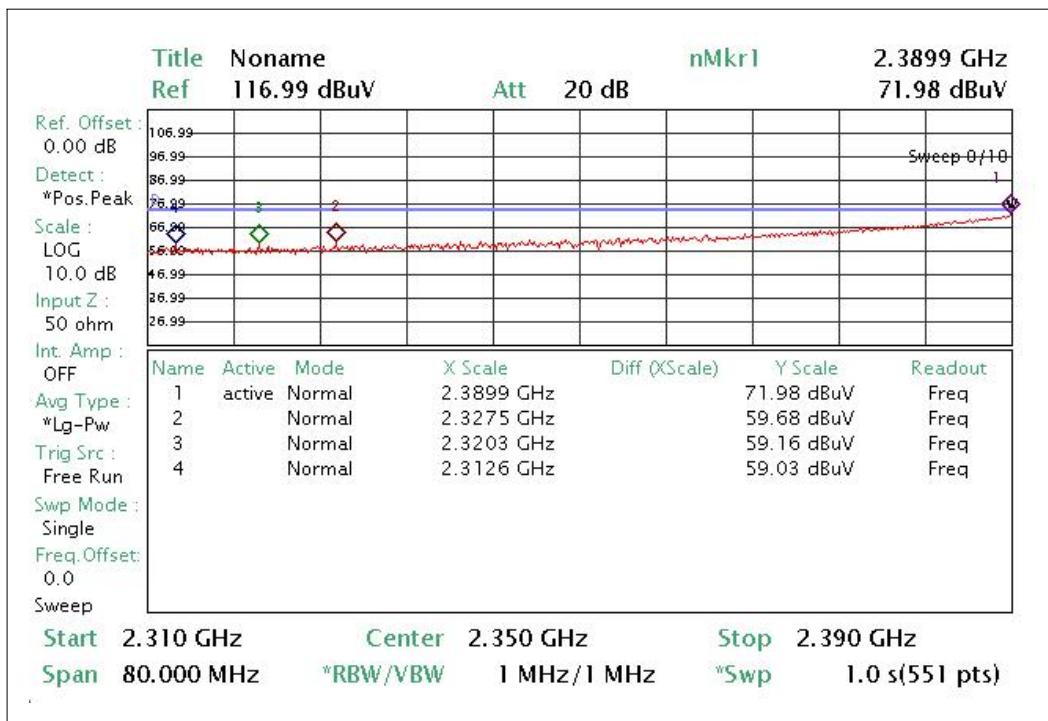
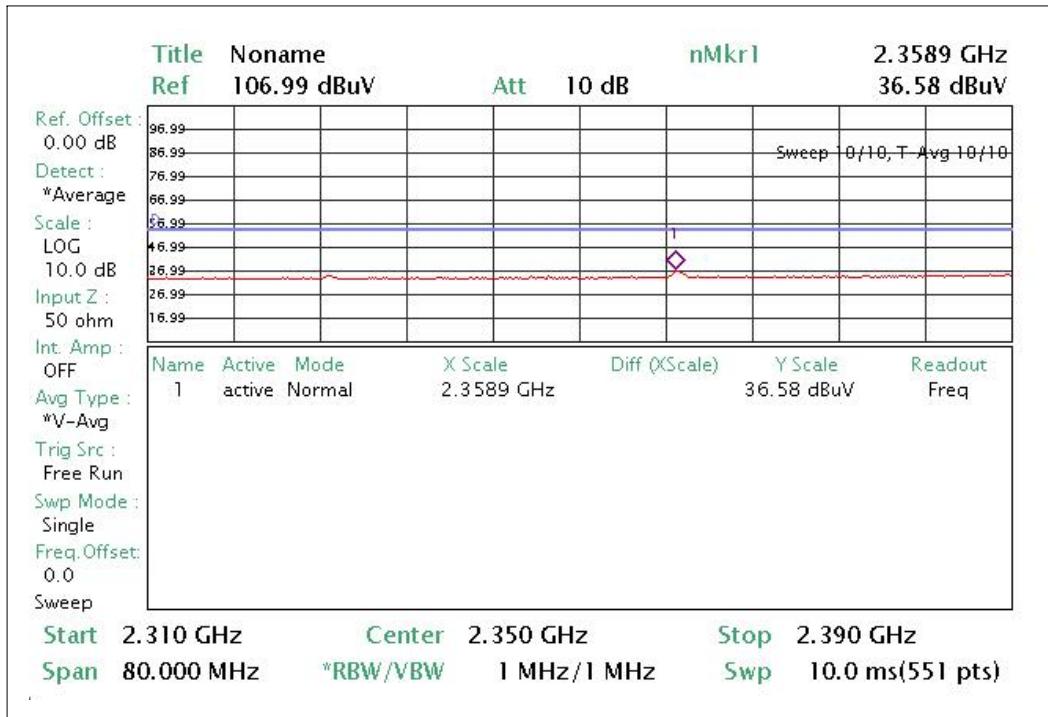


Figure 3. Plot of the Band Edge (Radiated)

Lowest Channel (2402 MHz)-Peak



Lowest Channel (2402 MHz)-Average



Highest Channel (2482 MHz)-Peak

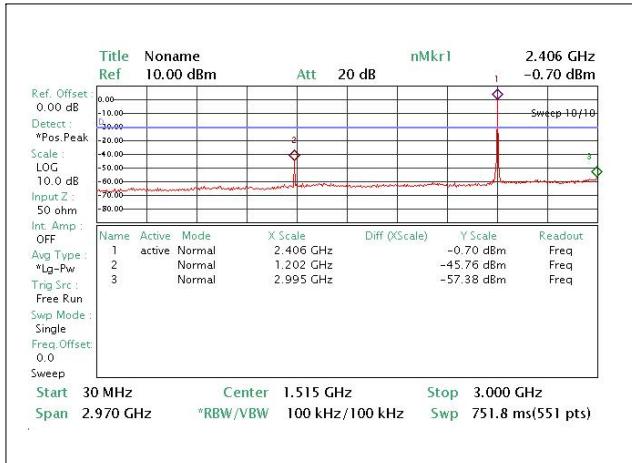
Title	Noname			nMkr1	2.48510 GHz
Ref	106.99 dBuV	Att	10 dB		56.26 dBuV
Ref. Offset:					
0.00 dB					
Detect:					Sweep 10/10
*Pos.Peak	76.99	1			
Scale:	56.99	◇			
LOG	46.99				
10.0 dB	26.99				
Input Z:	26.99				
50 ohm	16.99				
Int. Amp:					
OFF					
Avg Type:					
*Lg-Pwr					
Trig Src:					
Free Run					
Swp Mode:					
Single					
Freq. Offset:					
0.0					
Sweep					
Start	2.48300 GHz	Center	2.49150 GHz	Stop	2.50000 GHz
Span	17.00 MHz	*RBW/VBW	1 MHz/1 MHz	Swp	10.0 ms(551 pts)

Highest Channel (2482 MHz)-Average

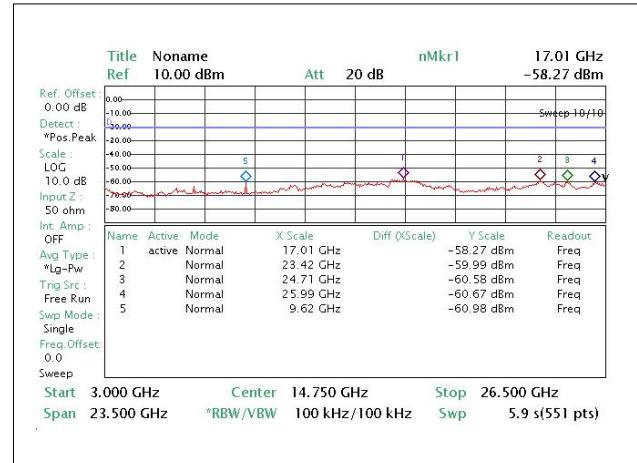
Title	Noname			nMkr1	2.48631 GHz
Ref	106.99 dBuV	Att	10 dB		36.20 dBuV
Ref. Offset:					
0.00 dB					
Detect:					Sweep 10/10, T-Avg 10/10
*Average	76.99				
Scale:	66.99				
LOG	56.99	1			
10.0 dB	46.99	◇			
Input Z:	26.99				
50 ohm	16.99				
Int. Amp:					
OFF					
Avg Type:					
*V-Avg					
Trig Src:					
Free Run					
Swp Mode:					
Single					
Freq. Offset:					
0.0					
Sweep					
Start	2.48300 GHz	Center	2.49150 GHz	Stop	2.50000 GHz
Span	17.00 MHz	*RBW/VBW	1 MHz/1 MHz	Swp	10.0 ms(551 pts)

Figure 4. Plot of the Spurious RF conducted emissions

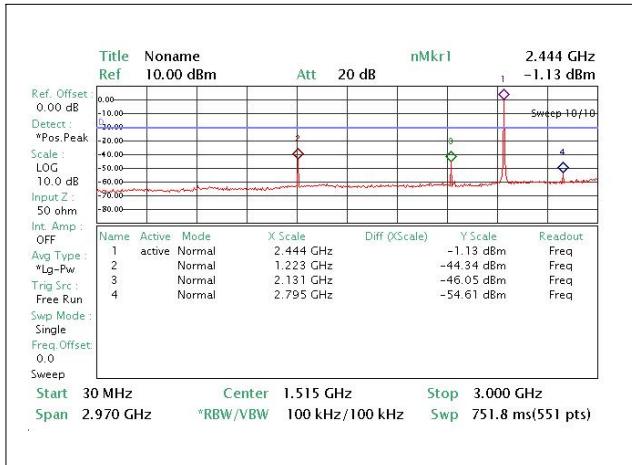
Lowest Channel (2402 MHz) : 30MHz ~ 3GHz



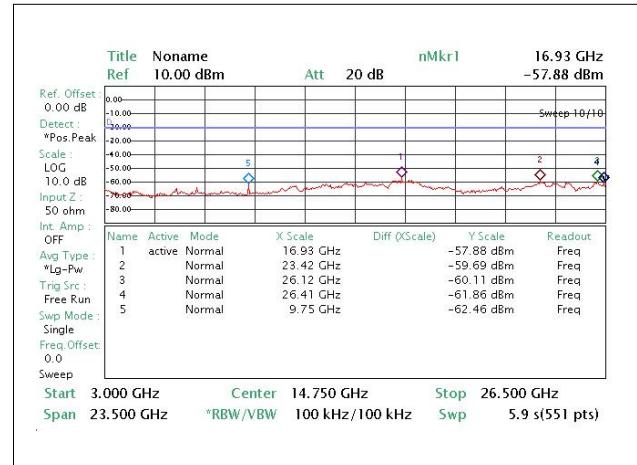
Lowest Channel (2402 MHz) : 3GHz ~ 26.5GHz



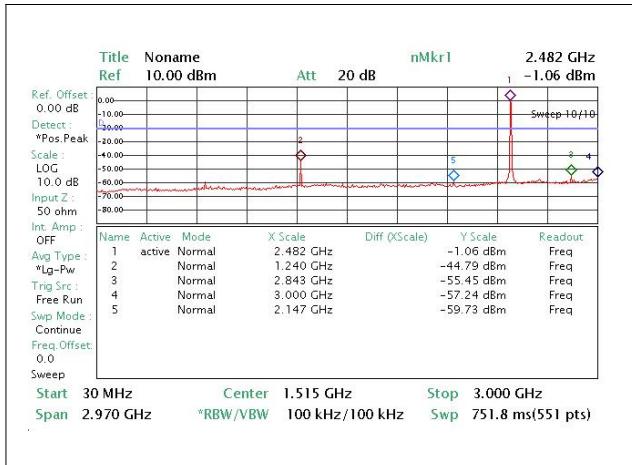
Middle Channel (2442 MHz) : 30MHz ~ 3GHz



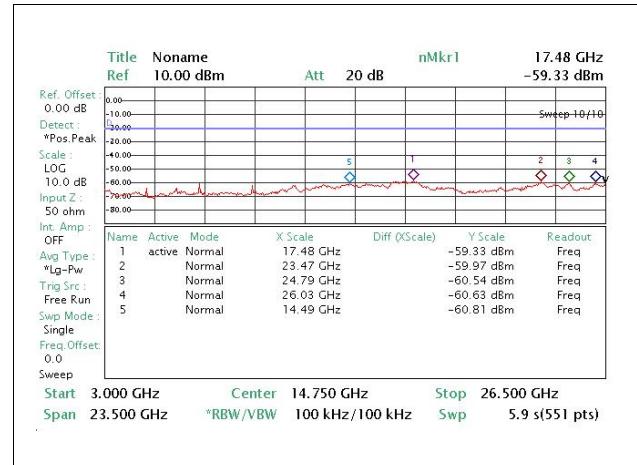
Middle Channel (2442 MHz) : 3GHz ~ 26.5GHz



Highest Channel (2482 MHz) : 30MHz ~ 3GHz



Highest Channel (2482 MHz) : 3GHz ~ 26.5GHz



5.4 RECEIVER SPURIOUS EMISSIONS

5.4.1 Regulation

The following receiver spurious emission limits shall be complied with:

(a) If a radiated measurement is made, all spurious emissions shall comply with the limits of Table 1. The resolution bandwidth of the spectrum analyzer shall be 100 kHz for spurious emission measurements below 1.0 GHz, and 1.0 MHz for measurements above 1.0 GHz.

Spurious Emission Limit for Receivers

Frequency (MHz)	Field strength (μ V/m @ 3m)	Field strength (dB μ V/m @ 3m)
30–88	100	40.0
88–216	150	43.5
216–960	200	46.0
Above 960	500	54.0

* Use quasi-peak below 1000 MHz and averaging meter above 1000 MHz.

5.4.2 Test Results:
PASS
Table 4 : Measured values of the Receiver Spurious Emissions

Frequency (MHz)	Detect Mode	Polarization (V/H)	Turn Table (degree)	Measured Value (dB μ V)	Antenna Factor + Cable Loss (dB/m)	Amplifier Gain (dB)	Emission Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	
Quasi-peak data, emissions below 1000 MHz										
No Spurious Radiated Emissions Found										
Peak/Average data, emissions above 1000 MHz										
CH 0 (2402MHz)	2403.5	Peak	V	204	35.21	35.6	-23.2	52.31	74	26.39
	2403.5	Average	V	204	23.68	35.6	-23.2	40.78	54	17.92
	2403.5	Peak	H	70	34.36	35.6	-23.2	51.46	74	27.24
	2403.5	Average	H	70	24.67	35.6	-23.2	41.77	54	16.93
CH 39 (2442MHz)	2443.5	Peak	V	314	34.61	36.7	-23.2	52.11	74	25.89
	2443.5	Average	V	314	23.15	36.7	-23.2	40.65	54	17.35
	2443.5	Peak	H	34	34.56	36.7	-23.2	52.06	74	25.94
	2443.5	Average	H	34	23.48	36.7	-23.2	40.98	54	17.02
CH 78 (2482MHz)	2483.5	Peak	V	18	35.17	37.4	-23.2	53.17	74	24.63
	2483.5	Average	V	18	24.26	37.4	-23.2	42.26	54	15.54
	2483.5	Peak	H	254	34.41	37.4	-23.2	52.41	74	25.39
	2483.5	Average	H	254	24.23	37.4	-23.2	42.23	54	15.57

1. Margin (dB) = Limit – Emission Level

2. H = Horizontal, V = Vertical Polarization

APPENDIX
TEST EQUIPMENT USED FOR TESTS

No.	Description	Manufacturer	Model No.	Specifications	Next Cal. Data	Used equipment
1	EMI Test Receiver	LIG Nex1	LSA-265	3Hz~26.5GHz	10.12.18	■
2	Dipole ANT	ElectroMetrics	TDA-30/1-4	30~1GHz	12.03.23	□
3	Biconical ANT	ElectroMetrics	BIA-30S	30~300MHz	12.03.23	■
4	Log periodic ANT	ElectroMetrics	LPA-30	0.2~1GHz	12.03.23	■
5	Bilog Antenna	Schaffner-Chase EMC Ltd.	CBL6140A	50V, 5A	12.05.07	■
6	Turn Table	KEI	KEI-TURN	1500×1000×800	N/A	□
7	Turn Table	KEI	KEI-TURN	1500×1000×800	N/A	■
8	Loop ANT.	Com-Power	AL-130	9kHz~30MHz	11.03.24	□
9	Spectrum Analyzer	LIG Nex1	ISA-265	1kHz~26.5GHz	11.05.20	■
10	Function Generator	Agilent	33120A	15MHz sine&square	11.06.09	□
11	Frequency Counter	HP	5350B	10Hz~20GHz	11.06.09	□
12	Modulation Analyzer	Agilent	8901B	10MHz~1.3GHz	11.06.09	□
13	Audio Analyaer	Agilent	8903B	20Hz~100kHz	11.06.09	□
14	Attenuator	Agilent	8494B	0~11dB, 18GHz	11.06.09	□
15	Attenuator	Agilent	8496B	0~110dB, 18GHz	11.06.09	□
16	Attenuator	Agilent	8495B	0~70dB, 18GHz	11.06.09	□
17	Attenuator	TAE SUNG	SMA-1	6dB	11.09.02	□
18	Attenuator	TAE SUNG	SMA-2	6dB	11.09.02	□
19	Power Meter	Agilent	E4418B	100kHz~110GHz, 0.0001uW~25100mW	11.06.09	■
20	Power Sensor	HP	8485A	50MHz~26.5GHz	11.06.09	■
21	Vibration Tester	Gana	GNV-400	10~60Hz, 0~4mm	11.09.09	□
22	RF Cable	Gigalane	SMS-LL280-SMS -1.5M	1.5m	N/A	■
23	Temp & Humidity Chamber	Seoksan Tech Leader	SE-CT-02	-40~150°C, 30~98%	11.06.09	■
24	Signal Generator	Electronics	3220	100kHz~1.3GHz	11.06.09	■
25	Oscilloscope	Tektronix	TDS-350	200MHz	11.09.02	□
26	Drop Tester	Self-made	KSQ-01	150cm	N/A	□
27	Pre Amplifier	GTC	GA-1825A	0.1~18GHz	11.06.09	■
28	Continuous operation tester	GTC	CT-100	Local Control	N/A	□
29	CW Generator	HP	83711B	1~20GHz	11.06.09	■
30	POWER DIVIDER	Agilent	11636B	26.5GHz	11.06.09	□
31	Power Sensor	Agilent	8482B	100kHz ~ 4.2GHz	11.06.09	□
32	Attenuator	Winswell	53-30-33	dc-2.5GHz, 500W	11.06.09	□
33	DC Power Supply	Hanil	HPS-505A	50V, 5A	11.09.02	□
34	Slidacs	Hanchang	5KV	5kW, 300V	11.09.02	□
35	Termination	Kwang Yeok	KYTE-NJ-150W	150W	11.09.02	□
36	Band-limited filter	MITECH	KSQ-02	600Ω	11.09.02	□
37	Signal Generator	WILTRON	6759B	10MHz ~ 26.5GHz	11.09.02	□
38	Digital Multimeter	DONG HWA	DM-300A	AC/DC 500V Max,320mA Max	11.09.02	■
39	Horn ANT.	SCHWARZBECK	BBHA 9120D	700MHz ~ 18GHz	11.09.23	■
40	DC Power Supply	ALINCO	DM-340MW	15V, 30A	11.09.02	■

APPENDIX

1. EUT photo

