

FCC TEST REPORT

for

DRAGINO TECHNOLOGY CO., LIMITED

Wireless Sensor Node

Model Number: MS14, FLM03B, MS14-P, MS14-S, MS14-MLC

FCC ID: ZHZMS14

Prepared for : DRAGINO TECHNOLOGY CO., LIMITED.
Address : Room 2073, Zi'An Commercial Building, Qian Jin 1 Road,
Xin'An 6th District, Bao'an District ; Shenzhen 518101,China

Prepared by : Keyway Testing Technology Co., Ltd.
Address : Baishun Industrial Zone, Zhangmutou Town,
Dongguan, Guangdong, China

Tel: 86-769-8718 2258
Fax: 86-769-8718 1058

Report No. : 13KWE11103807R
Date of Test : Nov. 11~22, 2013
Date of Report : Nov. 24, 2013

TABLE OF CONTENTS

Test Report Declaration	Page
1. TEST SUMMARY	4
2. GENERAL PRODUCT INFORMATION	5
2.1. Product Function	5
2.2. Description of Device (EUT)	5
2.3. Independent Operation Modes	5
3. TEST SITES	6
3.1. Test Facilities	6
3.2. List of Test and Measurement Instruments	7
4. TEST SET-UP AND OPERATION MODES	8
4.1. Principle of Configuration Selection	8
4.2. Block Diagram of Test Set-up	8
4.3. Test Operation Mode and Test Software	8
4.4. Special Accessories and Auxiliary Equipment	8
4.5. Countermeasures to Achieve EMC Compliance	8
5. EMISSION TEST RESULTS	9
5.1. Conducted Emission at the Mains Terminals Test	9
5.2. Radiated Emission Test	12
6. BAND EDGE COMPLIANCE TEST	27
6.1. Limits	27
6.2. Test setup	27
7. 6DB OCCUPY BANDWIDTH	36
7.1. Limits	36
8. OUTPUT POWER TEST	39
8.1. Limits	39
8.2. Test setup	39
8.3. Test result	39
9. POWER SPECTRAL DENSITY TEST	40
9.1. Limits	40
9.2. Test setup	40
9.3. Test result	40
10. ANTENNA REQUIREMENTS	47
10.1. Limits	47
10.2. Result	47
11. PHOTOGRAPHS OF TEST SET-UP	48
11.1. Set-up for Conducted Emission Test	48
11.2. Set-up for Radiated Emission Test	49
12. PHOTOGRAPHS OF THE EUT	50

Keyway Testing Technology Co., Ltd.

Applicant: Address:	DRAGINO TECHNOLOGY CO., LIMITED. Room 2073, Zi'An Commercial Building, Qian Jin 1 Road, Xin'An 6th District, Bao'an District ; Shenzhen 518101,China		
Manufacturer: Address:	DRAGINO TECHNOLOGY CO., LIMITED. Room 2073, Zi'An Commercial Building, Qian Jin 1 Road, Xin'An 6th District, Bao'an District ; Shenzhen 518101,China		
E.U.T:	Wireless Sensor Node		
Model Number:	MS14, FLM03B, MS14-P, MS14-S, MS14-MLC		
Trade Name:			
Date of Receipt:	Nov. 10, 2013	Date of Test:	Nov. 10~22, 2013
Test Specification:	FCC Part 15, Subpart C: Oct. 1, 2013 ANSI C63.4:2003 KDB558074 D01 V03		
Test Result:	The equipment under test was found to be compliance with the requirements of the standards applied.		
	Issue Date: Nov. 24, 2013		
Tested by:	Reviewed by:	Approved by:	
			
Andy Gao / Engineer	Jade Yang/ Supervisor	Chris Du / Manager	
Other Aspects:	None.		
<i>Abbreviations: OK/P=passed fail/F=failed n.a/N=not applicable E.U.T=equipment under tested</i>			
<i>This test report is based on a single evaluation of one sample of above mentioned products. It is not permitted to be duplicated in extracts without written approval of Keyway Testing Technology Co., Ltd.</i>			

1.TEST SUMMARY

Test Items	Test Requirement	Result
Conducted Emissions	15.207	PASS
Radiated Emissions	15.205(a) 15.209 15.247(d)	PASS
6dB Bandwidth	15.247(a)(2)	PASS
Power density	15.247(e)	PASS
Maximum Output Power	15.247(b)(3)	PASS
Emissions from out of band	15.247(d)	PASS
Antenna Requirement	15.203	PASS

2.GENERAL PRODUCT INFORMATION

2.1. Product Function

Refer to Technical Construction Form and User Manual.

2.2. Description of Device (EUT)

Product Name:	Wireless Sensor Node
Model No.:	MS14, FLM03B, MS14-P, MS14-S, MS14-MLC
Operation Frequency:	2412MHz~2462MHz (802.11b/802.11g/802.11n(H20)) 2422MHz~2452MHz (802.11n(H40)) 915MHz
Channel numbers:	11 for 802.11b/802.11g/802.11n(H20) ,7 for 802.11n(H40)
Channel separation:	5MHz for 802.11
Modulation technology: (IEEE 802.11b)	Direct Sequence Spread Spectrum (DSSS)
Modulation technology: (IEEE 802.11g/802.11n)	Orthogonal Frequency Division Multiplexing(OFDM)
Data speed (IEEE 802.11b):	1Mbps, 2Mbps, 5.5Mbps, 11Mbps
Data speed (IEEE 802.11g):	6Mbps, 9Mbps, 12Mbps, 18Mbps, 24Mbps, 36Mbps, 48Mbps,54Mbps
Data speed (IEEE 802.11n):	Up to 150Mbps
Antenna Type:	External for wifi Internal for 915MHz
Antenna gain:	2.0dBi for wifi(declare by Applicant) 0dBi for 915MHz(declare by Applicant)
Power supply:	DC 5V from adapter

2.3. Independent Operation Modes

The basic operation modes are:

2.3.1. EUT work 915MHz TX turn off continues WFI TX mode, and frequency as below:

	Channel	Frequency
802.11b	Low	2412MHz
	Middle	2437MHz
	High	2462MHz
802.11g	Low	2412MHz
	Middle	2437MHz
	High	2462MHz
802.11n(HT20)	Low	2412MHz
	Middle	2437MHz
	High	2462MHz
802.11 n(HT40)	Low	2422MHz
	Middle	2437MHz
	High	2452MHz

Remark: According to ANSI C63.4 standards, the test results are both the “worst case” and “worst setup” 11MHz for 802.11b,54MHz for 802.11g, 6.5Mbps for 802.11n(H20), 13Mbps for 802.11n(H40).

3. TEST SITES

3.1. Test Facilities

Lab Qualifications : 944 Shielded Room built by ETS-Lindgren, USA
Date of completion: March 28, 2011

966 Chamber built by ETS-Lindgren, USA
Date of completion: March 28, 2011

Certificated by TUV Rheinland, Germany.
Registration No.: UA 50207153
Date of registration: July 13, 2011

Certificated by UL, USA
Registration No.: 100567-237
Date of registration: September 1, 2011

Certificated by Intertek
Registration No.: 2011-RTL-L1-31
Date of registration: October 11, 2011

Certificated by Industry Canada
Registration No.: 9868A
Date of registration: December 8, 2011

Certificated by FCC, USA
Registration No.: 370994
Date of registration: February 21, 2012

Certificated by CNAS China
Registration No.: CNAS L5783
Date of registration: August 8, 2012

Name of Firm : Keyway Testing Technology Co., Ltd.

Site Location : Baishun Industrial Zone, Zhangmutou Town,
Dongguan, Guangdong, China

3.2. List of Test and Measurement Instruments

3.2.1. For conducted emission at the mains terminals test

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
EMI Test Receiver	Rohde&Schwarz	ESCI	101156	May 9,13	May 9,14
Artificial Mains Network	Rohde&Schwarz	ENV216	101315	May 9,13	May 9,14
Artificial Mains Network (AUX)	Rohde&Schwarz	ENV216	101314	May 9,13	May 9,14
RF Cable	FUJIKURA	3D-2W	944 Cable	May 9,13	May 9,14

3.2.2. For radiated emission test (Below 1GHz)

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
EMI Test Receiver	Rohde&Schwarz	ESCI	101156	May 9,13	May 9,14
Bilog Antenna	ETS-LINDGREEN	3142D	135452	May 20,13	May 20,14
Spectrum Analyzer	Agilent	E4411B	MY4511304	May 9,13	May 9,14
3m Semi-anechoic Chamber	ETS-LINDGREEN	966	KW01	May 9,13	May 9,14
Signal Amplifier	SONOMA	310	187016	May 9,13	May 9,14
Signal Amplifier	Agilent	8449B	3008A00251	May 9,13	May 9,14
RF Cable	IMRO	IMRO-400	966 Cable 1#	N/A	N/A
MULTI-DEVICE Controller	ETS-LINDGREEN	2090	126913	N/A	N/A

3.2.3. For above 1GHz radiated emission, output power,band edge, 6dB bandwidth test

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
Horn Antenna	DAZE	ZN30701	11003	May. 11,13	May. 11,14
Horn Antenna	SCHWARZBECK	BBHA9170	9170-068	May. 11,13	May. 11,14
Spectrum Analyzer	Agilent	8593E	3911A04271	May. 9,13	May. 9,14
Spectrum Analyzer	Agilent	E4408B	MY44211125	May. 9,13	May. 9,14
3m Semi-anechoic Chamber	ETS-LINDGREN	966	KW01	May. 9,13	May. 9,14
Signal Amplifier	DAZE	ZN3380C	11001	May. 9,13	May. 9,14
Signal Amplifier	Agilent	8449B	3008A00251	May. 9,13	May. 9,14
High Pass filter	Micro	HPM50111	324216	May. 9,13	May. 9,14
Power Meter	R&S	NRVS	101824	May. 9,13	May. 9,14
Power Sensor	Rohde&Schwarz	URV5-Z2	100655	May. 9,13	May. 9,14
RF Cable	IMRO	IMRO-400	966 Cable 1#	May. 9,13	May. 9,14
MULTI-DEVICE Controller	ETS-LINDGREN	2090	126913	N/A	N/A
Antenna Holder	ETS-LINDGREN	2070B	00109601	N/A	N/A

4. TEST SET-UP AND OPERATION MODES

4.1. Principle of Configuration Selection

Emission: The equipment under test (EUT) was configured to measure its highest possible radiation level. The test modes were adapted accordingly in reference to the Operating Instructions.

4.2. Block Diagram of Test Set-up

System Diagram of Connections between EUT and Simulators



(EUT: Wireless Sensor Node)

4.3. Test Operation Mode and Test Software

None.

4.4. Special Accessories and Auxiliary Equipment

Adapter:

Model Number:GQ07-120050-AU
I/P: AC 100~240V 50/60Hz
O/P: DC 12V 0.5A

4.5. Countermeasures to Achieve EMC Compliance

None.

5. EMISSION TEST RESULTS

5.1. Conducted Emission at the Mains Terminals Test

5.1.1. Limit 15.209 limits

FREQUENCY OF EMISSION (MHz)	CONDUCTED LIMIT (dBµV)	
	Quasi-peak	Average
0.15-0.5	66 to 56	56 to 46
0.5-5	56	46
5-30	60	50

5.1.2. Test Setup

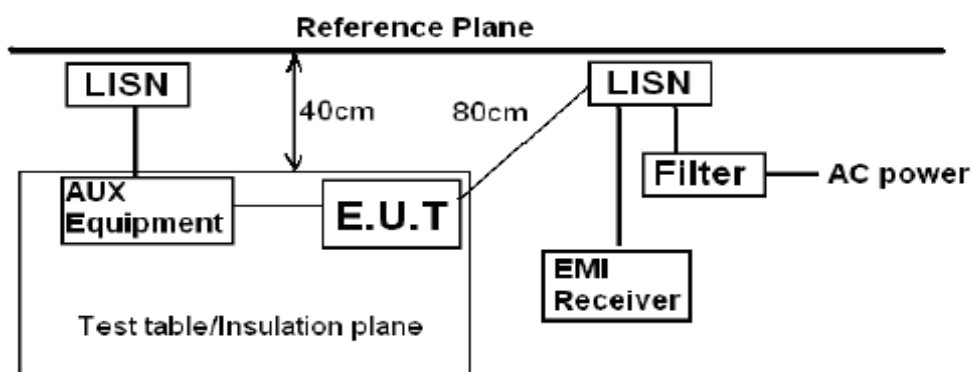
The EUT was put on a wooden table which was 0.8 m high above the ground and connected to the AC mains through the Artificial Mains Network (AMN). Where the mains cable supplied by the manufacture was longer than 0.8 m, the excess was folded back and forth parallel to the cable at the centre so as to form a bundle no longer than 0.4 m.

The EUT was kept 0.4 m from any other earthed conducting surface. Both sides of AC line were checked to find out the maximum conducted emission levels according to the test procedure during the conducted emission test.

The frequency range from 150 kHz to 30 MHz was investigated.

The bandwidth of the test receiver was set at 9 kHz.

Pretest for all mode, The test data of the worst case condition(s) was reported on the following page.

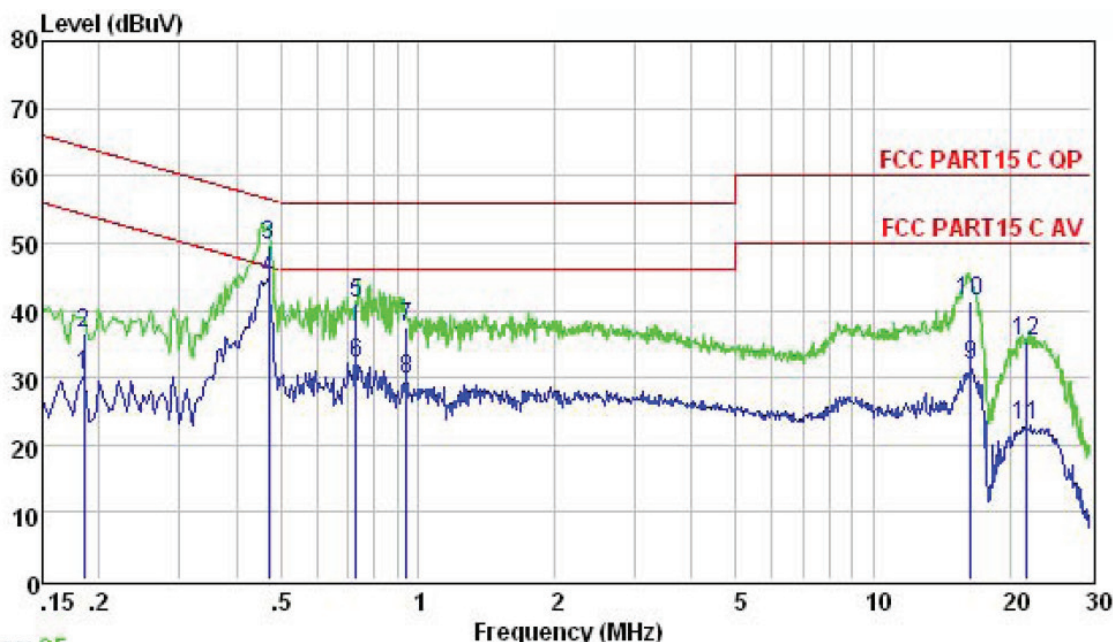


Remark:
 E.U.T: Equipment Under Test
 LISN: Line Impedance Stabilization Network
 Test table height=0.8m

5.1.3. Test Mode

EUT work 915MHz TX turn off continues WFI TX mode.

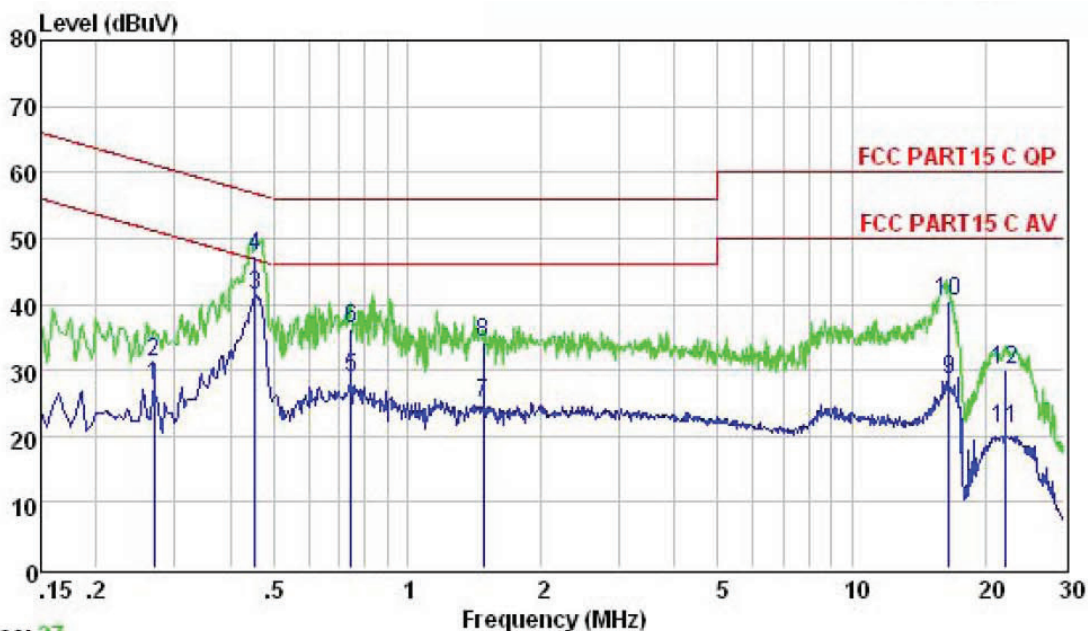
Test Data



Trace: 25

Site : 944 Shielded Room
 Condition : FCC PART15 C QP NEUTRAL
 EUT : Wireless Sensor Node
 POWER : DC 12V from adapter input AC 120V/60Hz
 M/N : MS14
 Test Engineer: Andy
 Comment : Temp:24.9';Humi:55%;Press;101.48kPa
 Test Mode : TX Mode WIFI

	Freq	Level	Limit	Over	Remark
	MHz	dBuV	dBuV	dB	
1	0.185	30.20	54.24	-24.04	Average
2	0.185	36.60	64.24	-27.64	QP
3	0.471	49.60	56.50	-6.90	QP
4	0.471	44.67	46.49	-1.82	Average
5	0.731	41.10	56.00	-14.90	QP
6	0.731	32.10	46.00	-13.90	Average
7	0.943	37.40	56.00	-18.60	QP
8	0.943	29.74	46.00	-16.26	Average
9	16.398	31.73	50.00	-18.27	Average
10	16.398	41.40	60.00	-18.60	QP
11	21.600	22.91	50.00	-27.09	Average
12	21.600	35.30	60.00	-24.70	QP



Trace: 27
 Site : 944 Shielded Room
 Condition : FCC PART15 C QP LINE
 EUT : Wireless Sensor Node
 POWER : DC 12V from adapter input AC 120V/60Hz
 M/N : MS14
 Test Engineer: Andy
 Comment : Temp:24.9';Humi:55%;Press:101.48kPa
 Test Mode : TX Mode WIFI

	Freq	Level	Limit	Over	Remark
	MHz	dBuV	dBuV	dB	
1	0.270	27.54	51.12	-23.58	Average
2	0.270	31.15	61.12	-29.97	QP
3	0.454	41.44	46.80	-5.36	Average
4	0.454	47.37	56.80	-9.43	QP
5	0.747	28.84	46.00	-17.16	Average
6	0.747	36.34	56.00	-19.66	QP
7	1.480	24.93	46.00	-21.07	Average
8	1.480	34.15	56.00	-21.85	QP
9	16.486	28.48	50.00	-21.52	Average
10	16.486	40.31	60.00	-19.69	QP
11	22.063	21.12	50.00	-28.88	Average
12	22.063	30.15	60.00	-29.85	QP

5.2. Radiated Emission Test

5.2.1. Limit 15.209 limits

FREQUENCY MHz	DISTANCE Meters	FIELD STRENGTHS LIMIT	
		$\mu\text{V}/\text{m}$	$\text{dB}(\mu\text{V})/\text{m}$
30 ~ 88	3	100	40.0
88 ~ 216	3	150	43.5
216 ~ 960	3	200	46.0
960 ~ 1000	3	500	54.0
Above 1000	3	74.0 $\text{dB}(\mu\text{V})/\text{m}$ (Peak) 54.0 $\text{dB}(\mu\text{V})/\text{m}$ (Average)	

5.2.2. Restricted bands of operation

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
¹ 0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2690 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	(²)

All the emissions appearing within 15.205 restricted frequency bands shall not exceed the limits shown in 15.209, all the other emissions shall be at least 20dB below the fundamental emissions, or comply with 15.209 limits.

5.2.3. Test setup

The EUT was placed on a turn table which was 0.8 m above the ground. The turn table can rotate 360 degrees to determine the position of the maximum emission level. The EUT was set 3 m away from the receiving antenna which was mounted on an antenna tower. The measuring antenna moved up and down to find out the maximum emission level. It moved from 1 m to 4 m for both horizontal and vertical polarizations.

The EUT was tested in the Chamber Site. It was pre-scanned with a Peak detector from the spectrum, and all the final readings from the test receiver were measured with the Quasi-Peak detector.

The bandwidth of the EMI test receiver is set at 120kHz for frequency range from 30MHz to 1000 MHz.

The bandwidth of the Spectrum's VBW is set at 3MHz and RBW is set at 1MHz for peak emissions measurement above 1GHz and 1MHz RBW, 10Hz VBW for average emissions measure above 1GHz, Both PK and AV measure, PK detector is used.

The frequency range from 30MHz to 10th harmonic (25GHz) are checked. and no any emissions were found from 18GHz to 25 GHz, So the radiated emissions from 18GHz to 25GHz were not record.

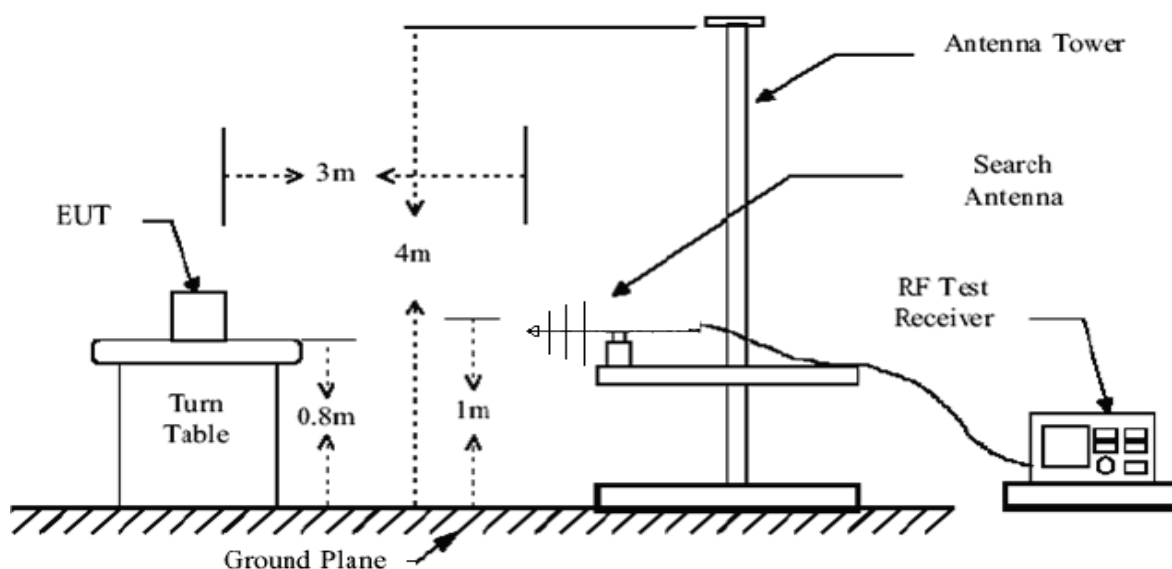
Notes: 1. Emission Level = Antenna Factor + Cable Loss + Meter Reading-Preamp Factor.

2. Measurement Uncertainty: ± 3.2 dB at a level of confidence of 95%.

3. For emissions above 1GHz, if peak level comply with average limit, then the average level is deemed to comply with average limit.

4. For emissions below 1GHz, pretest for all mode, The test data of the worst case condition(s) was reported on the following pages.

5. For Both PK and AV value above 1GHz, PK detector is used.



Test Data

Below 1GHz

Horizontal polarizations

	Freq	Preamp Factor	Read Level	Cable Loss	Antenna Factor	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dB	dB/m	dBuV/m	dBuV/m	dB	
1	31.94	31.40	44.03	0.56	17.66	30.85	40.00	-9.15	QP
2	61.04	31.34	53.40	0.75	7.32	30.13	40.00	-9.87	QP
3	131.85	31.20	50.94	1.12	8.32	29.18	43.50	-14.32	QP
4	146.40	31.23	52.62	1.22	8.78	31.39	43.50	-12.11	QP
5	216.24	31.02	51.07	1.53	11.78	33.36	46.00	-12.64	QP
6	340.40	30.71	43.78	2.10	15.12	30.29	46.00	-15.71	QP

Vertical polarizations

	Freq	Preamp Factor	Read Level	Cable Loss	Antenna Factor	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dB	dB/m	dBuV/m	dBuV/m	dB	
1	61.04	31.34	51.81	0.75	7.32	28.54	40.00	-11.46	QP
2	131.85	31.20	52.72	1.12	8.32	30.96	43.50	-12.54	QP
3	146.40	31.23	53.51	1.22	8.78	32.28	43.50	-11.22	QP
4	272.50	30.95	48.24	1.78	12.99	32.06	46.00	-13.94	QP
5	284.14	30.94	48.05	1.87	13.29	32.27	46.00	-13.73	QP
6	350.10	30.66	45.37	2.10	15.51	32.32	46.00	-13.68	QP

Above 1GHz

802.11b 2412MHz Horizontal polarizations

	Preamp Freq	Factor	Read Level	CableAntenna Loss	Antenna Factor	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dB	dB/m	dBuV/m	dBuV/m	dB	
1	4824.00	27.50	30.82	12.01	32.99	48.32	74.00	-25.68	Peak
2	7236.00	27.95	21.19	16.61	37.30	47.15	74.00	-26.85	Peak
3	10333.00	28.83	15.49	17.03	38.93	42.62	74.00	-31.38	Peak
4	13121.00	29.22	13.75	18.36	41.26	44.15	74.00	-29.85	Peak
5	13648.00	29.33	12.36	18.96	43.15	45.14	74.00	-28.86	Peak
6	16980.00	30.09	12.55	21.30	44.56	48.32	74.00	-25.68	Peak

802.11b 2412MHz Vertical polarizations

	Preamp Freq	Factor	Read Level	CableAntenna Loss	Antenna Factor	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dB	dB/m	dBuV/m	dBuV/m	dB	
1	4824.00	27.50	32.39	12.01	32.99	49.89	74.00	-24.11	Peak
2	7236.00	27.95	23.01	16.61	37.30	48.97	74.00	-25.03	Peak
3	10282.00	28.83	18.49	17.02	38.85	45.53	74.00	-28.47	Peak
4	11353.00	28.94	17.45	17.24	39.78	45.53	74.00	-28.47	Peak
5	12951.00	29.19	16.43	18.17	40.58	45.99	74.00	-28.01	Peak
6	13818.00	29.36	12.35	19.14	43.32	45.45	74.00	-28.55	Peak

802.11b 2437MHz Vertical polarizations

	Preamp Freq	Factor	Read Level	CableAntenna Loss	Antenna Factor	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dB	dB/m	dBuV/m	dBuV/m	dB	
1	4874.00	27.53	30.56	12.14	33.11	48.28	74.00	-25.72	Peak
2	7311.00	27.96	21.20	16.62	37.32	47.18	74.00	-26.82	Peak
3	10333.00	28.83	14.49	17.03	38.93	41.62	74.00	-32.38	Peak
4	13121.00	29.22	11.75	18.36	41.26	42.15	74.00	-31.85	Peak
5	13648.00	29.33	10.36	18.96	43.15	43.14	74.00	-30.86	Peak
6	15535.00	29.63	14.37	20.34	38.53	43.61	74.00	-30.39	Peak