

TEST REPORT



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FORMAL REPORT ON TESTING IN ACCORDANCE WITH

FCC Part 15C:2000
FCC Part 1.1310:2000
OF AN
IEEE 802.11b Wireless LAN Access Point
[Model : AP-I002]
[FCC ID: PXP000001]

TEST FACILITY Telecoms & EMC, Testing Group, PSB Corporation Pte Ltd
1 Science Park Drive, Singapore 118221

FCC REGISTRATION NO. 90937 (3m & 10m OATS)
99142 (10m Anechoic Chamber)

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JOB NUMBER 56S00258

TEST PERIOD 16 August 2001 – 14 September 2001

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Your product quality and safety mark

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TEST SUMMARY

The product was tested in accordance with the customer's specifications.

Test Results Summary

FCC Paragraph	Descriptions	Pass / Fail
15.207	Conducted Emissions	Pass
15.209 & 15.205	Radiated Emissions	Pass
15.247 (a)(2)	Spectrum Bandwidth (6dB Spectrum Bandwidth Measurement)	Pass
15.247 (b)	Maximum Peak Power	Pass
15.247 (c)	RF Conducted Spurious Emission at the Transmitter Antenna Terminal	Pass
15.247 (d)	Transmitted Power Density	Pass
15.247 (e)	Processing Gain	Pass ^{*see Note 1}
1.1310	Maximum Permissible Exposure	Pass

Notes:

1. No processing gain measurement was conducted as the manufacturer declared that the EUT LAN card has shown compliance to the test. Please refer to the Annex G for the LAN card Processing Gain data, which was provided by the manufacturer as a proof of the compliance.
2. Three channels, namely Channels 1, 5, and 11, which represent the lower, middle and upper channels, were chosen and tested. For each channel, two modulation schemes were investigated, QPSK and CCK. The transmission rate of QPSK is 2Mbps while CCK has a transmission rate of 11Mbps.

PRODUCT DESCRIPTION

Description	:	The Equipment Under Test (EUT) is an IEEE 802.11b Wireless LAN Point.
Manufacturer	:	RFNet Technologies Pte Ltd
Model Number	:	AP-I002
Serial Number	:	Nil
Microprocessor	:	MPC855T
Operating / Transmitting Frequency	:	2.4GHz – 2.4835GHz
Clock / Oscillator Frequency	:	50MHz
Port / Connectors	:	1 x RJ45 1 x 5V DC Jack
Rated Input Power	:	110VAC, 60Hz

Modifications

The EUT was modified as shown below before bring into compliance:

1. The RF antenna connector was grounded to motherboard ground to reduce the spurious emissions between 30MHz to 300MHz.
2. A 5.6nH series inductor and a 0.5pF shunt capacitor were added before the RF antenna to reduce the second harmonics of channels 1,5 and 11.
3. A ground connection from the daughter board was added to the motherboard to reduce the spurious emissions between 300MHz to 600MHz.
4. A 0.2mm thick steel casing with ground connections from the motherboard was added to the bottom of the board to reduce the harmonics of 50MHz.
5. The shield of the wireless LAN module was extended to reduce the spurious emissions between 300MHz to 600MHz.
6. The resistor values of R609, R614 and R613 were changed from 33 ohm to 51ohm to reduce the harmonics of 50MHz.

TEST RESULTS

FCC Part 15C: 2000 (15.207) Conducted Emission Results

Frequency (MHz)	Q-P Value (dB μ V)	Q-P Margin (dB)	Line	Transmitting Channel / Transmitting Rate
1.4611	43.7	-4.2	Neutral	Ch1 / 11 Mbps
1.9477	43.8	-4.1	Neutral	Ch11 / 11 Mbps
2.9965	46.0	-1.9	Live	Ch11 / 11 Mbps
3.0005	45.9	-2.0	Neutral	Ch11 / 11 Mbps
3.2361	46.1	-1.8	live	Ch5 / 2 Mbps
3.4415	44.4	-3.5	Live	Ch1 / 2 Mbps

FCC Part 15C: 2000 (15.209) Radiated Emission Results

Test Distance : 3m

Frequency (MHz)	Q-P Value (dB μ V/m)	Q-P Margin (dB)	Pol (H/V)	Height (m)	Azimuth (Degrees)
99.9805	40.7	-2.8	V	1.43	52
224.9844	42.7	-3.4	V	1.16	180
499.9865	40.9	-5.1	H	1.05	275
649.9778	42.8	-3.2	V	1.04	319
799.9871	41.4	-4.6	V	1.09	157
899.9737	42.1	-3.9	V	1.00	196

Notes

1. All possible modes of operation were investigated. Only the 6 worst case emissions measured, using the correct CISPR detectors, are reported. All other emissions were relatively insignificant.
2. The transmitting antenna was found to be in the worst case condition when it was orientated in a vertical position.
3. A "-ve" margin indicates a PASS as it refers to the margin present below the limit line at the particular frequency.
4. The upper frequency of radiated emission investigations were according to requirements stated in Section 15.33 (a) for intentional radiators & Section 15.33 (b) for unintentional radiators.
5. The emissions in restricted bands (FCC Part 15C: 2000 Section 15.205) were found to be spurious emissions and showed compliance to the limits of conducted and radiated emissions.
6. Conducted Emissions Measurement Uncertainty
All test measurements carried out are traceable to national standards. The uncertainty of the measurement at a confidence level of approximately 95%, with a coverage factor of 2, in the range 9kHz – 30MHz (Average & Quasi-peak) is ± 2.4 dB.
7. Radiated Emissions Measurement Uncertainty
All test measurements carried out are traceable to national standards. The uncertainty of the measurement at a confidence level of approximately 95%, with a coverage factor of 2, in the range 30MHz – 25GHz (QP only @ 3m & 10m) is ± 4.3 dB (for EUTs < 0.5m X 0.5m X 0.5m).

TEST RESULTS

FCC Part 15C: 2000 (15.247(a)(2)) 6dB Spectrum Bandwidth Measurement Results

Channel Frequency (GHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)	Transmission Rate
Channel 1			
2.41325	17.39	0.5	2 Mbps
2.41325	9.15	0.5	11Mbps
Channel 5			
2.43289	10.48	0.5	2 Mbps
2.43301	9.86	0.5	11Mbps
Channel 11			
2.46301	10.30	0.5	2 Mbps
2.46301	9.56	0.5	11Mbps

Note:

1. Please refer to attached Plots 1 – 6 for details.

FCC Part 15C: 2000 (15.247(b)) Maximum Peak Power Results

The maximum peak power for Channels 1, 5 and 11 with transmission rate at 2Mbps and 11Mbps were investigated and found below 30dBm (1Watt).

Channel	Transmission Rate (Mbps)	Maximum Peak Power (dBm)	Limit (dBm)
1	2	16.35	30
1	11	16.37	30
5	2	15.99	30
5	11	16.02	30
11	2	16.22	30
11	11	16.51	30

FCC Part 15C: 2000 (15.247(c)) RF Conducted Spurious Emission at the Transmitter Antenna Terminal Results

The emissions were scanned from 10MHz to 25GHz for Channels 1, 5, and 11 with transmission rate at 2Mbps and 11Mbps. No significant signal was found. Refer to attached Plots 7 – 60 in Annex F for details.

TEST RESULTS

FCC Part 15C: 2000 (15.247 (d)) Transmitted Power Density of a Direct Sequence Spread Spectrum System Results

Channel Frequency (GHz)	RF Power Level in 3KHz Bandwidth (dBm)	Limit (dBm)	Margin (dB)	Transmission Rate
Channel 1				
2.41271	-9.30	8.0	-17.30	2 Mbps
2.41276	-9.08	8.0	-17.08	11 Mbps
Channel 5				
2.43255	-10.09	8.0	-18.09	2 Mbps
2.43275	-9.48	8.0	-17.48	11 Mbps
Channel 11				
2.46291	-11.22	8.0	-19.22	2 Mbps
2.46291	-10.64	8.0	-18.64	11 Mbps

Note:

1. Please refer to attached Plots 67 – 72 in Annex F for details.
2. A "-ve" margin indicates a PASS as it refers to the margin present below the limit line at the particular frequency.

FCC Part 1.1310 Maximum Permissible Exposure (MPE) Results

Frequency (MHz)	Power Density Value (mW/cm ²)	Averaging Time (min)	Limit (mW/cm ²)	Margin (mW/cm ²)	Mode
2400 – 2483.5	< 0.01	30	1.00	-0.99	Ch11, 5.5 Mbps
2400 – 2483.5	< 0.01	30	1.00	-0.99	Ch11, 11 Mbps

Notes

1. All possible modes of operation were investigated. Only the worst case, highest radiation levels were measured. Measurements were taken at the required averaging time. All other radiation levels were relatively insignificant.
2. A "-ve" margin indicates a PASS as it refers to the margin present below the limit line at the particular frequency.
3. Measurement Uncertainty
All test measurements carried out are traceable to national standards. The uncertainty of the measurement at a confidence level of approximately 95%, with a coverage factor of 2, in the range 0.1MHz – 3GHz is ±15% .