

Renex Technology Limited

Application
For
Certification

2.4GHz Spread Spectrum Wireless Modem

(FCC ID: QNT-PT108-0001001)

WO# 0214436
TL/Ann Choy
November 13, 2002

- The test results reported in this report shall refer only to the sample actually tested and shall not refer or be deemed to refer to bulk from which such a sample may be said to have been obtained.
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FCC ID: QNT-PT108-0001001

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MEASUREMENT/TECHNICAL REPORT

Renex Technology Limited - MODEL: PT-108U
FCC ID: QNT-PT108-0001001

This report concerns (check one) Original Grant X Class II Change

Equipment Type: DSS-Part 15 Spread Spectrum Transmitter and Class B Personal Computer Peripheral

Deferred grant requested per 47 CFR 0.457(d)(1)(ii)? Yes No X

If yes, defer until :
date

Company Name agrees to notify the Commission by:
date

of the intended date of announcement of the product so that the grant can be issued on that date.

Transition Rules Request per 15.37? Yes No X

If no, assumed Part 15, Subpart C for intentional radiator - the new 47 CFR [08-20-02 Edition] provision.

Report prepared by:

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List of attached file

Exhibit type	File Description	filename
Test Report	Test Report	report.doc
Operation Description	Technical Description	descri.pdf
Test Setup Photo	Radiated Emission	config photos.doc
Test Report	6 dB Bandwidth Plot	6dB.pdf
Test Report	Maximum Power Density Plot	powden.pdf
Test Report	Out of Band Conducted Emission plot	obantcon.pdf
External Photo	External Photo	external photos.doc
Internal Photo	Internal Photo	internal photos.doc
Block Diagram	Block Diagram	block.pdf
Schematics	Circuit Diagram	circuit.pdf
ID Label/Location	Label Artwork and Location	label.pdf
User Manual	User Manual	manual.pdf
User Manual	FCC Information	FCC information.pdf
RF Exposure Info	RF Safety	RF exposure info.pdf

EXHIBIT 1
SUMMARY OF TEST RESULTS

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1.0 Summary of Test

Renex Technology Limited - MODEL: PT-108U
FCC ID: QNT-PT108-0001001

TEST	REFERENCE	RESULTS
Max. Output power	15.247(b)	Pass
6 dB Bandwidth	15.247(a)(2)	Pass
Max. Power Density	15.247(d)	Pass
Radiated Emission in Restricted Bands	15.247(c)	Pass
Radiated Emission from Digital Part	15.109	Pass
Antenna Requirement	15.203	Pass (See Notes)

Notes: The EUT uses a UMP-to-reverse-SMA assembly (Non-standard) to connect to the antenna (model no.: RO-IK-0502 from Radiall), which in accordance to Section 15.203 is considered sufficient to comply with the provisions of this section.

EXHIBIT 2
GENERAL DESCRIPTION

2.0 **General Description**

2.1 Product Description

The PT-108U is a 2.4GHz Spread Spectrum Wireless Modem. It operates at frequency of 2442MHz and is designed to provide a long distance, high data rate and robust platform for applications. It offers data communication capabilities to application equipment via a standard RS232 interface. Neither additional hardware nor software modification is required in the application equipment to work with PT-108U. By using a pair of PT-108U modems, users can transfer data between almost any types of equipment that use asynchronous serial interfaces. The small size and superior performance of PT-108U make it an ideal solution for many applications. Typical examples are:

- Traffic control
- Remote monitoring
- Telemetry
- Remote camera/robot control
- Mobile video transmission
- Environmental monitoring
- emergency rescue
- Premises security
- Logistics

The antenna is a sleeve dipole antenna with 1.5dBi and connect by a non-standard connector of UMP-to-reverse-SMA assembly, and the test sample is a prototype.

The circuit description is saved with filename: descri.pdf.

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2.2 Related Submittal(s) Grants

This is an application for Certification of a DSS-Part 15 Spread Spectrum Transmitter and a Class B Personal Computer Peripheral.

2.3 Test Methodology

Both AC mains line-conducted and radiated emission measurements were performed according to the procedures in ANSI C63.4 (1992). All measurements were performed in Open Area Test Sites. Preliminary scans were performed in the Open Area Test Sites only to determine worst case modes. All Radiated tests were performed at an antenna to EUT distance of 3 meters, unless stated otherwise in the "**Justification Section**" of this Application. All other measurements were made in accordance with the procedures in part 2 of CFR 47.

2.4 Test Facility

The open area test site and conducted measurement facility used to collect the radiated data is located at Garment Centre, 576 Castle Peak Road, Kowloon, Hong Kong. This test facility and site measurement data have been fully placed on file with the FCC.

EXHIBIT 3
SYSTEM TEST CONFIGURATION

3.0 **System Test Configuration**

3.1 Justification

For emission testing, the equipment under test (EUT) was configured for testing in a typical fashion (as a customer would normally use it). During testing, all cables were manipulated to produce worst case emissions. The EUT was powered by a DC power supply.

The signal is maximized through rotation and placement in the three orthogonal axes if necessary. The antenna height and polarization are varied during the search for maximum signal level. The antenna height is varied from 1 to 4 meters. Radiated emissions are taken at three meters unless the signal level is too low for measurement at that distance. If necessary, a pre-amplifier is used and/or the test is conducted at a closer distance.

All readings are extrapolated back to the equivalent three meter reading using inverse scaling with distance. Analyzer resolution is 100 kHz or greater for frequencies below 1000MHz. The resolution is 1MHz or greater for frequencies above 1000MHz. All emissions greater than 20 dB below the permissible value is not reported.

Radiated emission measurement were performed from the lowest radio frequency signal generated in the device which is greater than 9kHz to 25GHz.

3.2 EUT Exercising Software

The EUT exercise program used during radiated and conducted testing was designed to exercise the various system components in a manner similar to a typical use.

For emissions testing, the units were setup to transmit continuously to simplify the measurement methodology. Care was taken to ensure proper power supply voltages during testing.

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3.3 Support Equipment List and Description

The FCC ID's for all equipment, plus descriptions of all cables used in the tested system (included inserted cards, which have grants) are:

HARDWARE:

The unit was operated standalone. An DC power supply of 7.4VDC was used to power the device. Its description is listed below.

CABLES:

- (1) 1 x 1.1m length of RS-232 DB9 shielded cable with ferrite (supplied by Manufacturer)
- (2) 1 x 3m length of USB cable (supplied by Manufacturer)

OTHERS:

- (1) Compaq Computer, Model D510S, S/N: 3Z2AKN9ZJ023
- (2) Topvision LCD Monitor, Model: 03761428, S/N: M0034H02390020
- (3) HP Keyboard, Model: SK-2502C, S/N: M991112642
- (4) HP Mouse, Model: M-S34, S/N: LZE93708518, FCC ID: DZL211209
- (5) Hayes Modem, Model: 6800CN, FCC ID: BFFJ9D907-00038

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3.4 Equipment Modification

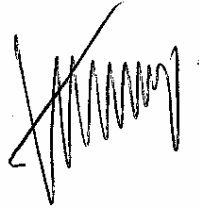
Any modifications installed previous to testing by Renex Technology Limited will be incorporated in each production model sold/leased in the United States.

No modifications were installed by ETL Division, Intertek Testing Services Hong Kong Ltd.

All the items listed under section 2.0 of this report are confirmed by:

Confirmed by:

*Tommy Leung
Assistant Supervisor
Intertek Testing Services Hong Kong Ltd.
Agent for Renex Technology Limited*



Signature

November 9, 2002 Date

EXHIBIT 4
MEASUREMENT RESULTS

INTERTEK TESTING SERVICE

Company: Renex Technology Limited
Model: PT-108U

Date of Test: October 17, 2002

4.0 Measurement Results

4.1 Maximum Conducted Output Power at Antenna Terminals, FCC Rules 15.247(b) :

☒ The antenna power of the EUT was connected to the input of a power meter. Power was read directly and cable loss correction was added to the reading to obtain power at the EUT antenna terminals.

☐ The antenna port of the EUT was connected to the input of a spectrum analyzer. The analyzer was set for maximum RES BW and power was read directly in dBm. External attenuation and cable loss were compensated by adding to SA raw reading.

For antennas with gains of 6 dBi or less, maximum allowed transmitter output is 1 watt (+30 dBm).

For antennas with gains greater than 6 dBi, transmitter output level must be decreased by an amount equal to (GAIN - 6) dBm.

Max. Antenna Gain = 1.5 dBi		
Frequency (MHz)	Output in dBm	Output in mWatt
Low Channel: 2442.000	26.9	489.8

Cable loss : 3.4 dB External Attenuation : 20 dB

Cable loss, external attenuation: ☐ included in OFFSET function
☐ added to SA raw reading

EUT Transmit Antenna Gain(dBi) + dBm max. output level = 28.4dBm (36 dBm or less)

INTERTEK TESTING SERVICE

Company: Renex Technology Limited
Model: PT-108U

Date of Test: October 17, 2002

4.2 Minimum 6 dB RF Bandwidth, FCC Rule 15.247(a)(2):

The antenna port of the EUT was connected to the input of a spectrum analyzer. Analyzer RES BW was set to 100kHz. For each RF output channel investigated, the spectrum analyzer center frequency was set to the channel carrier. A PEAK output reading was taken, a DISPLAY line was drawn 6 dB lower than PEAK level. The 6dB bandwidth was determined from where the channel output spectrum intersected the display line.

Frequency (MHz)	6 dB Bandwidth (kHz) Limit: 500kHz
2442	5.43MHz

For electronic filing, the minimum 6dB RF bandwidth is saved with filename: 6dB.pdf

INTERTEK TESTING SERVICE

Company: Renex Technology Limited
Model: PT-108U

Date of Test: October 17, 2002

4.3 Maximum Power Density Reading, FCC Rule 15.247(d) :

The spectrum analyzer RES BW was set to 3 kHz. The START and STOP frequencies were set to the band edges of the maximum output passband. If there is no clear maximum amplitude in any given portion of the band, it may be necessary to make measurements at a number of bands defined by several START and STOP frequency pairs. The specification calls for a 1 second interval at each 3 kHz bandwidth; total SWEEP TIME is calculated as follows:

$$\text{SWEEP TIME (SEC)} = (\text{Fstop, kHz} - \text{Fstart, kHz}) / 3\text{kHz}$$

Antenna output of the EUT was coupled directly to spectrum analyzer; if an external attenuator and/or cable was used, these losses are compensated by adding to the SA raw reading.

Frequency (MHz)	Power Density (dBm) Limit: 8dBm
2443.664	4.1

Frequency Span = 1.5MHz

Sweep Time = Frequency Span/3kHz
= 500 seconds

For electronic filing, the maximum power density is saved with filename: powden.pdf

INTERTEK TESTING SERVICE

Company: Renex Technology Limited
Model: PT-108U

Date of Test: October 17, 2002

4.4 Out of Band Conducted Emissions, FCC Rule 15.247(c):

In any 100 kHz bandwidth outside the EUT passband, the RF power produced by the modulation products of the spreading sequence, the information sequence, and the carrier frequency shall be at least 20dB below that of the maximum in-band 100 kHz emission, or else shall meet the general limits for radiated emissions at frequencies outside the passband, whichever results in lower attenuation.

All other types of emissions from the EUT shall meet the general limits for radiated frequencies outside the passband.

Refer to the following plots for out of band conducted emissions data:

Plot 4a.1 - 4a.4 and 4b: Single Channel

- 1 = Passband
- 2 = 1MHz ~ 2.5GHz
- 3 = 2.0G ~ 10GHz
- 4 = 2.0G ~ 25GHz
- 5 = Modulation Products Emissions at 2483.5MHz

The plots showed the 2nd harmonic and modulation products at the band edges of 2400 MHz and 2483.5 MHz. In addition, all spurious emission and up to the tenth harmonic was measured and they were found to be at least 40 dB below the highest level of the desired power in the passband.

Furthermore, delta measurement technique for measuring bandedge emissions was incorporated in the test of the edge at 2483.5MHz.

For electronic filing, the above plots are saved with filenames: obantcon.pdf.

INTERTEK TESTING SERVICE

Company: Renex Technology Limited
Model: PT-108U

Date of Test: October 17, 2002

4.5 Out of Band Radiated Emissions (for emissions in 4.4 above that are less than 26dB below carrier), FCC Rule 15.247(c):

For out of band emissions that are close to or that exceed the 20dB attenuation requirement described in the specification, radiated measurements were performed at a 3m separation distance to determine whether these emissions complied with the general radiated emission requirement.

- ☒ Not required
☐ See attached data sheet

4.6 Transmitter Radiated Emissions in Restricted Bands, FCC Rule 15.35(b), (c):

Data is included of the worst case configuration (the configuration which resulted in the highest emission levels). A sample calculation, configuration photographs and data tables of the emissions are included. All measurements were performed with peak detection unless otherwise specified.

The data on the following pages list the significant emission frequencies, the limit and the margin of compliance.

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4.7 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CF - AG$$

where FS = Field Strength in dB μ V/m
 RA = Receiver Amplitude (including preamplifier) in dB μ V
 CF = Cable Attenuation Factor in dB
 AF = Antenna Factor in dB
 AG = Amplifier Gain in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows:-

$$FS = RR + LF$$

where FS = Field Strength in dB μ V/m
 RR = RA - AG in dB μ V
 LF = CF + AF in dB

Assume a receiver reading of 52.0 dB μ V is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 dB μ V/m. This value in dB μ V/m was converted to its corresponding level in μ V/m.

RA = 52.0 dB μ V/m	
AF = 7.4 dB	RR = 23.0 dB μ V
CF = 1.6 dB	LF = 9.0 dB
AG = 29.0 dB	
FS = RR + LF	
FS = 23 + 9 = 32 dB μ V/m	

Level in μ V/m = Common Antilogarithm [(32 dB μ V/m)/20] = 39.8 μ V/m

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4.8 Radiated Emission Configuration Photograph

Worst Case Radiated Emission
at
7326.000 MHz

For electronic filing, the worst case radiated emission configuration photographs are saved with filename: config photos.doc

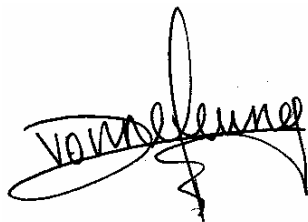
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4.9 Radiated Emission Data

The data on the following pages list the significant emission frequencies, the limit and the margin of compliance.

Judgement : Passed by 15.8 dB

TEST PERSONNEL:



Tester Signature

Yvonne Leung, Engineer
Typed/Printed Name

November 9, 2002
Date

INTERTEK TESTING SERVICE

Company: Renex Technology Limited
Model: PT-108U
Mode : TX-Channel 1

Date of Test: October 17, 2002

Table 1

Radiated Emissions

Polarity	Frequency (MHz)	Reading (dBμV)	Antenna Factor (dB)	Pre-Amp Gain (dB)	Net at 3m (dBμV/m)	Limit (dBμV/m)	Margin (dB)
V	**2442.000	99.0	29.1	34	94.1	---	---
H	*4884.000	38.0	34.0	34	38.0	54	-16.0
V	*7326.000	35.2	37.0	34	38.2	54	-15.8

- NOTES:
1. Quasi-peak Detector is used below or equal to 1000MHz.
 2. All measurements were made at 3 meters. Harmonic emissions not detected at the 3-meter distance were measured at 0.3-meter and an inverse proportional extrapolation was performed to compare the signal level to the 3-meter limit. No other harmonic emissions than those reported were detected at a test distance of 0.3-meter.
 3. Negative value in the margin column shows emission below limit.
 4. Horn antenna and average detector are used for the emission over 1000MHz.
- * Emission within the restricted band meets the requirement of part 15.205. The corresponding limit as per 15.209 is based on Quasi peak detector data for frequencies below 1000 MHz and average detector data for frequencies over 1000 MHz. The radio frequency emissions above 1GHz also meet corresponding 20dB permitted peak limit with a peak detector function.
- ** Fundamental emission was measured for determining bandedge compliance of using delta measurement technique.

Test Engineer: Yvonne Leung

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Company: Renex Technology Limited
Model: PT-108U

Date of Test: October 17, 2002

4.10 Radiated Emissions from Digital Section of Transceiver (Transmitter) and Class B Personal Computer Peripheral, FCC Ref: 15.109

- ☐ Not required - No digital part
- ☒ Test results are attached
- ☐ Included in the separated DOC report.

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Company: Renex Technology Limited
Model: PT-108U
Mode: USB Port operation

Date of Test: October 17, 2002

Table 2

Radiated Emissions

Polarity	Frequency (MHz)	Reading (dBμV)	Antenna Factor (dB)	Pre-Amp Gain (dB)	Net at 3m (dBμV/m)	Limit (dBμV/m)	Margin (dB)
H	192.006	36.7	17.1	16	37.8	43.5	-5.7
H	216.043	35.4	11.8	16	31.2	46.0	-14.8
H	252.009	44.6	12.4	16	41.0	46.0	-5.0
H	264.009	37.4	12.4	16	33.8	46.0	-12.2
V	276.009	39.5	13.3	16	36.8	46.0	-9.2
H	324.023	39.3	14.3	16	37.6	46.0	-8.4
H	348.008	39.5	14.6	16	38.1	46.0	-7.9
H	396.023	39.2	15.4	16	38.6	46.0	-7.4
H	420.023	41.3	15.9	16	41.2	46.0	-4.8
H	444.022	43.7	16.3	16	44.0	46.0	-2.0
H	456.023	38.4	16.8	16	39.2	46.0	-6.8
H	480.023	33.2	17.3	16	34.5	46.0	-11.5

- NOTES:
1. Quasi-peak Detector used below or equal to 1000MHz.
 2. All measurements were made at 3 meters. Harmonic emissions not detected at the 3-meter distance were measured at 0.3-meter and an inverse proportional extrapolation was performed to compare the signal level to the 3-meter limit. No other harmonic emissions than those reported were detected at a test distance of 0.3-meter.
 3. Negative value in the margin column shows emission below limit.
 4. Horn antenna and average detector are used for the emission over 1000MHz.

Test Engineer: Yvonne Leung

INTERTEK TESTING SERVICE

Company: Renex Technology Limited
Model: PT-108U

Date of Test: October 17, 2002

4.11 Transmitter Duty Cycle Calculation and Measurements, FCC Rule 15.35(b), (c)

The EUT antenna output port was connected to the input of the spectrum analyzer. The analyzer center frequency was set to EUT RF channel carrier. The SWEP function on the analyzer was set to ZERO SPAN. The transmitter ON time was determined from the resultant time-amplitude display:

Duty cycle = Maximum ON time in 100 msec/100

Duty cycle correction, dB = $20 \cdot \log(\text{DC})$

	See attached spectrum analyzer chart (s) for transmitter timing
	See transmitter timing diagram provided by manufacturer
X	Not applicable, duty cycle was not used.

EXHIBIT 5
EQUIPMENT PHOTOGRAPHS

5.0 **Equipment Photographs**

For electronic filing, the photographs are saved with filename: external photos.doc & internal photos.doc

EXHIBIT 6
PRODUCT LABELLING

6.0 **Product Labelling**

For electronic filing, the FCC ID label artwork and location is saved with filename:
label.pdf

EXHIBIT 7
TECHNICAL SPECIFICATIONS

7.0 **Technical Specifications**

For electronic filing, the block diagram and circuit diagram are saved with filename: block.pdf and circuit.pdf respectively.

EXHIBIT 8
INSTRUCTION MANUAL

INTERTEK TESTING SERVICE

8.0 Instruction Manual

For electronic filing, a preliminary copy of the Instruction Manual is saved with filename: manual.pdf.

Please note that the required FCC Information to the User is saved with filename: FCC information.pdf.

This manual will be provided to the end-user with each unit sold/leased in the United States.

For RF safety, the information is saved with filename: RF exposure info.pdf.