

Edwin McAuley Electronics Ltd.

Application
For
Certification
(FCC ID: ML6RX2)

Transmitter

0300013
DL/Sandy
April 24, 2003

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MEASUREMENT/TECHNICAL REPORT

Edwin McAuley Electronics Ltd.

**MODEL: Orbit RX-2, Orbit 57071, Orbit 57271, Virtual Rain RX-2,
Virtual Rain 27681, Orbit RX-3, Orbit 57070, Orbit 57270,
Virtual Rain RX-3, Virtual Rain 27680
FCC ID: ML6RX2**

April 24, 2003

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

Equipment Type: Low Power Transmitter (example: computer, printer, modem, etc.)

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.pdf
Operation Description	Technical Description	descri.pdf
Test Setup Photo	Radiated Emission	radiated photos.pdf
Test Report	Bandwidth Plot	bw.pdf
External Photo	External Photo	external photos.pdf
Internal Photo	Internal Photo	internal photos.pdf
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
Test Report	Timing Diagram	timing.pdf

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EXHIBIT 1

GENERAL DESCRIPTION

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1.0 General Description

1.1 Product Description

The Equipment Under Test (EUT) is a transmitter operating at 315MHz. The EUT is powered by 6V d.c. (2 x 3V “CR2032” batteries) or solar cell and 6.0V rechargeable battery. The operation of the transmitter is as follow:

1. When rain occurred, it will transmit “raining” command to the corresponding receiver and prevent the timer which is connected to the receiver from watering.
2. When no rain occurred, it will transmit “no rain” command to the corresponding receiver and the timer which is connected to the receiver can be set to watering.
3. If the temperature is below 3°C, it will transmit “OFF” signal to the corresponding receiver and prevent the timer connected with the receiver from watering.
4. If there is low battery detected, low battery signal will be sent to the receiver and the low battery indicator on the receiver will be turned on.

The duration for each transmission is less than two seconds.

Antenna Type : External, Integral

Model Orbit RX-3 is same as Orbit RX-2 in hardware aspect except that Orbit RX-2 is powered by lithium batteries and Orbit RX-3 is powered by solar cell and rechargeable battery.

Model: Orbit 57071, Orbit 57271, Virtual Rain RX-2 and Virtual Rain 27681 are same as Orbit RX-2 in hardware aspect. The difference in model serves as marketing strategy.

Model: Orbit 57070, Orbit 57270, Virtual Rain RX-3 and Virtual Rain 27680 are same as Orbit RX-3 in hardware aspect. The difference in model serves as marketing strategy.

For electronic filing, the brief circuit description is saved with filename: descri.pdf.

1.2 Related Submittal(s) Grants

This is a single application for certification of a transmitter. The receiver associated with the transmitter is subjected to DOC procedure.

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1.3 Test Methodology

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. For each scan, the procedure for maximizing emissions in Appendices D and E were followed. All Radiated tests were performed at an antenna to EUT distance of 3 meters, unless stated otherwise in the **“Justification Section”** of this Application.

1.4 Test Facility

The open area test site and conducted measurement facility used to collect the emission 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.

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EXHIBIT 2

SYSTEM TEST CONFIGURATION

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2.0 System Test Configuration

2.1 Justification

The system was configured for testing in a typical fashion (as a customer would normally use it), and in the confines as outlined in ANSI C63.4 (1992).

The EUT was powered from 2 x new 3V "CR2032" batteries for Orbit RX-2
or solar cell for Orbit RX-3.

For maximizing emissions, the EUT was rotated through 360°, the antenna height was varied from 1 meter to 4 meters above the ground plane, and the antenna polarization was changed. This step by step procedure for maximizing emissions led to the data reported in Exhibit 3.0.

The unit was operated standalone and placed in the center of the turntable.

The equipment under test (EUT) was configured for testing in a typical fashion (as a customer would normally use it). The EUT was placed on turntable, which enabled the engineer to maximize emissions through its placement in the three orthogonal axes. The worst case bit sequence was applied during test.

For simplicity of testing, the unit was wired to transmit continuously.

The frequency range from 315MHz to 3.2GHz was searched for spurious emissions from the device. Only those emissions reported were detected. All other emissions were at least 20 dB below the applicable limits.

2.2 EUT Exercising Software

There was no special software to exercise the device. Once the button is depressed, the unit transmits the typical signal. For simplicity of testing, the unit was wired to transmit continuously.

2.3 Special Accessories

There are no special accessories necessary for compliance of this product.

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2.4 Equipment Modification

Any modifications installed previous to testing by Edwin McAuley Electronics Ltd. will be incorporated in each production model sold/leased in the United States.

No modifications were installed by Intertek Testing Services.

2.5 Measurement Uncertainty

When determining of the test conclusion, the Measurement Uncertainty of test has been considered.

2.6 Support Equipment List and Description

This product was tested in a standalone configuration.

All the items listed under section 2.0 of this report are

Confirmed by:

*Derek Leung
Supervisor
Intertek Testing Services Hong Kong Ltd.
Agent for Edwin McAuley Electronics Ltd.*



Signature

April 24, 2003

Date

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EXHIBIT 3

EMISSION RESULTS

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3.0 **Emission Results**

Data is included 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.

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3.1 Field Strength Calculation

The field strength is calculated by adding the reading on the Spectrum Analyzer to the factors associated with preamplifiers (if any), antennas, cables, pulse desensitization and average factors (when specified limit is in average and measurements are made with peak detectors). A sample calculation is included below.

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

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

PD = Pulse Desensitization in dB

AV = Average Factor in -dB

In the radiated emission table which follows, the reading shown on the data table may reflect the preamplifier gain. An example of the calculations, where the reading does not reflect the preamplifier gain, follows:

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

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3.1 Field Strength Calculation (cont'd)

Example

Assume a receiver reading of 62.0 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. The pulse desensitization factor of the spectrum analyzer was 0 dB, and the resultant average factor was -10 dB. The net field strength for comparison to the appropriate emission limit is 32 dB μ V/m. This value in dB μ V/m was converted to its corresponding level in μ V/m.

$$RA = 62.0 \text{ dB}\mu\text{V}$$

$$AF = 7.4 \text{ dB}$$

$$CF = 1.6 \text{ dB}$$

$$AG = 29.0 \text{ dB}$$

$$PD = 0 \text{ dB}$$

$$AV = -10 \text{ dB}$$

$$FS = 62 + 7.4 + 1.6 - 29 + 0 + (-10) = 32 \text{ dB}\mu\text{V/m}$$

$$\text{Level in mV/m} = \text{Common Antilogarithm} [(32 \text{ dB}\mu\text{V/m})/20] = 39.8 \mu\text{V/m}$$

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3.2 Radiated Emission Configuration Photograph

Worst Case Radiated Emission
at
314.868 MHz

For electronic filing, the worst case radiated emission configuration photograph is saved with filename: radiated photos.pdf.

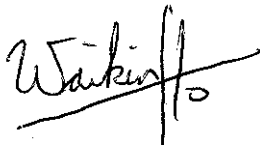
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3.3 Radiated Emission Data

The data on the following page lists the significant emission frequencies, the limit and the margin of compliance. Numbers with a minus sign are below the limit.

Judgement: Passed by 0.6 dB

TEST PERSONNEL:



Signature

Ben W. K. Ho, Compliance Engineer
Typed/Printed Name

April 24, 2003

Date

INTERTEK TESTING SERVICES

Company: Edwin McAuley Electronics Ltd.
Model: Orbit RX-3

Date of Test: January 14, 2003

Table 1

Radiated Emissions

Polarity	Frequency (MHz)	Reading (dB μ V)	Antenna Factor (dB)	Pre-Amp Gain (dB)	Average Factor (-dB)	Net at 3m (dB μ V/m)	Limit at 3m (dB μ V/m)	Margin (dB)
H	314.868	94.7	14.3	16	18	75.0	75.6	-0.6
H	629.760	56.8	19.2	16	18	42.0	55.6	-13.6
H	944.604	37.8	22.8	16	18	26.6	55.6	-29.0
V	1259.469	46.4	24.2	34	18	18.6	55.6	-37.0
V	#1574.339	43.5	26.5	34	18	18.0	54.0	-36.0
V	1889.280	45.5	26.5	34	18	20.0	55.6	-35.6

- Notes:
1. Peak Detector Data unless otherwise stated.
 2. All measurements were made at 3 meter. 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 is used for the emission over 1000MHz.
- # Emissions within the restricted band fulfil the requirement of Section 15.209.

Test Engineer: Ben W. K. Ho

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Company: Edwin McAuley Electronics Ltd.
Model: Orbit RX-2

Date of Test: January 14, 2003

Table 2

Radiated Emissions

Polarity	Frequency (MHz)	Reading (dB μ V)	Antenna Factor (dB)	Pre-Amp Gain (dB)	Average Factor (-dB)	Net at 3m (dB μ V/m)	Limit at 3m (dB μ V/m)	Margin (dB)
H	314.868	92.4	14.3	16	18	72.7	75.6	-2.9
H	629.760	60.4	19.2	16	18	45.6	55.6	-10.0
H	944.604	38.2	22.8	16	18	27.0	55.6	-28.6
V	1259.469	45.8	24.2	34	18	18.0	55.6	-37.6
V	#1574.338	43.6	26.5	34	18	18.1	54.0	-35.9
V	1889.280	45.5	26.5	34	18	20.0	55.6	-35.6

- Notes:
1. Peak Detector Data unless otherwise stated.
 2. All measurements were made at 3 meter. 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 is used for the emission over 1000MHz.
- # Emissions within the restricted band fulfil the requirement of Section 15.209.

Test Engineer: Ben W. K. Ho

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EXHIBIT 4

EQUIPMENT PHOTOGRAPHS

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4.0 Equipment Photographs

For electronic filing, the photographs of the tested EUT are saved with filename: external photos.pdf & internal photos.pdf.

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EXHIBIT 5

PRODUCT LABELLING

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5.0 **Product Labelling**

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

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EXHIBIT 6

TECHNICAL SPECIFICATIONS

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6.0 Technical Specifications

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

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EXHIBIT 7

INSTRUCTION MANUAL

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7.0 **Instruction Manual**

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

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

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EXHIBIT 8

MISCELLANEOUS INFORMATION

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8.0 Miscellaneous Information

This miscellaneous information includes details of the measured bandwidth, the test procedure and calculation of factors such as pulse desensitization and averaging factor.

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8.1 Measured Bandwidth

For electronic filing, the plot shows the fundamental emission when modulated is saved with filename: bw.pdf. From the plot, the bandwidth is observed to be 66.3 kHz, at 20 dBc where the bandwidth limit is 787 kHz.

Therefore, the unit meets the requirement of section 15.231(c).

Figure 8.1 Bandwidth

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8.2 Discussion of Pulse Desensitization

The determination of pulse desensitivity was made in accordance with Hewlett Packard Application Note 150-2, *Spectrum Analysis ... Pulsed RF*.

The effective period (T_{eff}) was approximately 0.5 ms for a digital "1" bit, as shown in the plots of Exhibit 8.3. With a resolution bandwidth (3 dB) of 100 kHz, the pulse desensitivity factor was 0 dB.

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8.3 Calculation of Average Factor

Averaging factor in dB = $20 \log (\text{duty cycle})$

The specification for output field strengths in accordance with the FCC rules specify measurements with an average detector. During testing, a spectrum analyzer incorporating a peak detector was used. Therefore, a reduction factor can be applied to the resultant peak signal level and compared to the limit for measurement instrumentation incorporating an average detector.

The time period over which the duty cycle is measured is 100 milliseconds, or the repetition cycle, whichever is a shorter time frame. The worst case (highest percentage on) duty cycle is used for the calculation. The duty cycle is measured by placing the spectrum analyzer in zero scan (receiver mode) and linear mode at maximum bandwidth (3 MHz at 3 dB down) and viewing the resulting time domain signal output from the analyzer on a Tektronix oscilloscope. The oscilloscope is used because of its superior time base and triggering facilities.

The duty cycle is simply the on-time divided by the period:

The duration of one cycle = 100 ms
Effective period of the cycle = $(25 \times 0.5) \text{ ms} = 12.5 \text{ ms}$

$DC = 12.5 \text{ ms} / 100 \text{ ms} = 0.125$

Therefore, the averaging factor is found by $20 \log_{10} 0.125 = -18.0 \text{ dB}$

For electronic filing, the plot shows the transmission timing is saved with filename: timing.pdf.

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8.4 Emissions Test Procedures

The following is a description of the test procedure used by Intertek Testing Services in the measurements of transmitters operating under Part 15, Subpart C rules.

The test set-up and procedures described below are designed to meet the requirements of ANSI C63.4 - 1992.

The transmitting equipment under test (EUT) is placed on a wooden turntable which is four feet in diameter and approximately one meter in height above the ground plane. During the radiated emissions test, the turntable is rotated and any cables leaving the EUT are manipulated to find the configuration resulting in maximum emissions. The EUT is adjusted through all three orthogonal axes to obtain maximum emission levels. The antenna height and polarization are varied during the testing to search for maximum signal levels. The height of the antenna is varied from one to four meters.

Detector function for radiated emissions is in peak mode. Average readings, when required, are taken by measuring the duty cycle of the equipment under test and subtracting the corresponding amount in dB from the measured peak readings. A detailed description for the calculation of the average factor can be found in Exhibit 8.3.

The frequency range scanned is from the lowest radio frequency signal generated in the device which is greater than 9 kHz to the tenth harmonic of the highest fundamental frequency or 40 GHz, whichever is lower. For line conducted emissions, the range scanned is 150 kHz to 30 MHz.

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8.4 Emissions Test Procedures (cont'd)

The EUT is warmed up for 15 minutes prior to the test.

AC power to the unit is varied from 85% to 115% nominal and variation in the fundamental emission field strength is recorded. If battery powered, a new, fully charged battery is used.

Conducted measurements are made as described in ANSI C63.4 - 1992.

The IF bandwidth used for measurement of radiated signal strength was 100 kHz or greater when frequency is below 1000 MHz. Where pulsed transmissions of short enough pulse duration warrant, a greater bandwidth is selected according to the recommendations of Hewlett Packard Application Note 150-2. A discussion of whether pulse desensitivity is applicable to this unit is included in this report (See Exhibit 8.2). Above 1000 MHz, a resolution bandwidth of 1 MHz is used.

Transmitter measurements are normally conducted at a measurement distance of three meters. However, to assure low enough noise floor in the forbidden bands and above 1 GHz, signals are acquired at a distance of one meter or less. All measurements are extrapolated to three meters using inverse scaling, unless otherwise reported. Measurements taken at a closer distance are so marked.