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EMI TEST REPORT FOR CERTIFICATION to FCC PART 15 Subpart C (Section 15.249)

FCC ID:	WAY-CNQ1
IC ID:	7716A-CNQ1
Test Sample:	CinQo Bicycle Power / Cadence (RPM) Meter
Model Number:	J406002PB
Report Number	M080337
Tested for:	Quarq Technology Inc.
Issue Date:	16th May 2008

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Model Number:	J406002PB
Manufacturer:	Quarq Technology Inc.
FCC ID:	WAY-CNQ1
IC:	7716A-CNQ1
Equipment Type:	Intentional Radiator (Transmitter and Transceiver)
Tested for:	Quarq Technology Inc
Address:	2928 4th Avenue, Spearfish SD 57783, USA
Contact:	James Meyer
Test Standards:	FCC Part 15, Subpart C – Intentional Radiators Section 15.249: Operation within the bands 902 – 928 MHz, 2400 – 2483.5 MHz, 5725 – 5875 MHz and 24.0 – 24.25 GHz. ANSI C63.4 – 2003 OET Bulletin No. 65
Test Dates:	26th March - 18th April 2008
Test Officer:	**Rob Weir**
Attestation:	*I hereby certify that the device(s) described herein were tested as described in this report and that the data included is that which was obtained during such testing.*
Authorised Signatory:	**Chieu Huynh** **EMC Technologies Pty Ltd**

EMI TEST REPORT FOR CERTIFICATION to FCC PART 15 Subpart C (Section 15.249)

1.0 INTRODUCTION

EMI testing was performed on the CinQo Bicycle Power / Cadence (RPM) Meter, Model: J406002PB.

The test sample **complied** with the requirements of 47 CFR, Part 15 Subpart C - Section 15.249.

Test results and procedures were performed in accordance with the following Federal Communications Commission (FCC) standards/regulations:

47 CFR, Part 15, Subpart C:	Rules for intentional radiators (particularly section 15.249)
Section 15.203:	Antenna requirements
Section 15.209:	Radiated Emission Limits (General requirements)
Section 15.249:	Operation within the bands 902 – 928 MHz, 2400 – 2483.5 MHz, 5725 – 5875 MHz and 24.0 – 24.25 GHz.

1.1 Summary of Results

FCC Part 15, Subpart C	RSS-210 Issue 7	Test Performed	Result
15.203	**5.5**	Antenna Requirement	**Not Applicable**
15.207	**6.6**	Conducted Emissions	**Not Applicable**
15.209	**6.3**	Radiated Emissions	**Complies**
15.249 (a)	**A2.9(a)**	Fundamental Field Strength	**Complies**
15.249 (a)	**A2.9(a)**	Harmonics Emissions	**Complies**
15.249 (b)		Fixed, point to point	**Not Applicable**
15.249 (c)		Limits @ 3 metres	**Noted**
15.249 (d)	**2.7 and A2.9(b)**	Spurious Emissions	**Complies**
15.249 (e)		20 dB Peak to Average	**Complies**
15.249 (f)		Requirements – Manufacturing, etc	**Noted**

The measurement procedure used was in accordance with ANSI C63.4-2003 and OET Bulletin No. 65. The instrumentation conformed to the requirements of ANSI C63.2-1996.

1.2 Modifications

No modifications were performed.

2.0 GENERAL INFORMATION

(Information supplied by the Client)

2.1 Product Details

Test Sample:	CinQo Bicycle Power / Cadence (RPM) Meter
Model Number:	J406002PB
Microprocessor:	MSP430F2272
Transceiver:	nRF24AP1
Operating Frequencies:	2402 MHz to 2482 MHz
Manufacturer:	Quarq Technology Inc.
Nominal Voltage:	3Vdc (coin cell)

2.2 Operational Description

The CinQo was a crankset based bicycle power measurement sensor, utilising a torque transducer and cadence sensor. It incorporated a Nordic nRF24AP1 2.4 GHz transceiver using the ANT+SPORT protocol.

2.3 Test Configuration

The test samples were transmitting continuously during the test. The device was programmed to operate at 2402 MHz, 2441 MHz or 2482 MHz, selected as the bottom, middle and top of the useable frequency range.

The device had no antenna port; all tests were performed as radiated measurements. An on board chip antenna is used.

2.4 Test Procedure

Emissions measurements were performed in accordance with the procedures of ANSI C63.4-2003. Radiated emissions tests were performed at a distance of 3 metres from the EUT. OET Bulletin 65 dated June 2001 was used for reference.

2.5 Test Facility

2.5.1 General

Radiated Emission measurements were performed at EMC Technologies open area test site (OATS) situated at Lerderderg Gorge, near the township of Bacchus Marsh in Victoria, Australia.

The above site has been fully described in a report submitted to & accepted by the FCC.
FCC Registration Number, 90560.

EMC Technologies open area test site (OATS) has also been accepted by Industry Canada for the performance of radiated measurements in accordance with RSS 212, Issue 1 (Provisional).
Industry Canada File Number, IC 4161.

2.5.2 NATA Accreditation

EMC Technologies is accredited in Australia to test to the following standards by the National Association of Testing Authorities (NATA).

"FCC Part 15 unintentional and intentional emitters in the frequency range 9kHz to 18 GHz excluding TV receivers (15.117 and 15.119), TV interface devices (15.115), cable ready consumer electronic equipment (15.118), cable locating equipment (15.213) and unlicensed national information infrastructure devices (Sub part E)."

The current full scope of accreditation can be found on the NATA website: www.nata.asn.au
It also includes a large number of emissions, immunity, SAR, EMR and Safety standards.

NATA is the Australian national laboratory accreditation body and has accredited EMC Technologies to operate to the IEC/ISO17025 requirements. A major requirement for accreditation is the assessment of the company and its personnel as being technically competent in testing to the standards. This requires fully documented test procedures, continued calibration of all equipment to the National Standard at the National Measurements Institute (NMI) and an internal quality system to ISO 9002. NATA has mutual recognition agreements with the National Voluntary Laboratory Accreditation Program (NVLAP) and the American Association for Laboratory Accreditation (A^2LA).

2.6 Units of Measurements

2.6.1 Conducted Emissions
Measurements are reported in units of dB relative to one microvolt. (dBμV).

2.6.2 Radiated Emissions
Measurements are reported in units of dB relative to one microvolt per metre (dBμV/m).

2.7 Test Equipment Calibration

All measurement instrumentation and transducers were calibrated in accordance with the applicable standards by an independent NATA registered laboratory such as Agilent Technologies (Australia) Pty Ltd or the National Measurement Institute (NMI). All equipment calibration is traceable to Australia national standards at the National Measurements Institute. The reference antenna calibration was performed by NMI and the working antennas (biconical and log-periodic) calibrated by the NATA approved procedures. The complete list of test equipment used for the measurements, including calibration dates and traceability is contained in Appendix A

2.8 Ambients at OATS

The Open Area Test Site (OATS) is an area of low background ambient signals. No significant broadband ambients are present however commercial radio and TV signals exceed the limit in the FM radio, VHF and UHF television bands. Radiated prescan measurements were performed in the shielded enclosure to check for possible radiated emissions at the frequencies where the OATS ambient signals exceeded the test limit.

3.0 CONDUCTED EMISSION MEASUREMENTS

Conducted emission testing was not applicable as the EUT is battery powered.

4.0 RADIATED EMISSION MEASUREMENTS

4.1 Test Procedure

Testing was performed in accordance with the requirements of FCC Part 15.249.

The measurements were made at the open area test site.

The EUT was set up on the table top (placed on turntable) of total height 80 cm above the ground plane, and operated as described in section 2 of this report. The EMI Receiver was operated under software control via the PC Controller through the IEEE.488 Interface Bus Card Adaptor. The test frequency range was sub-divided into smaller bands with sufficient frequency resolution to permit reliable display and identification of possible EMI peaks while also permitting fast frequency scan times. A calibrated Biconical antenna was used for measurements between 30 MHz to 232 MHz and a calibrated Logperiodic antenna used for measurements between 230 MHz to 1000 MHz. Calibrated EMCO 3115, EMCO 3116 and ETS standard gain horn antennas were used for measurements between 1 to 25 GHz.

The Receiver bandwidth was set to 6.0 dB.

The measurement of emissions between 30 MHz - 1000 MHz was measured with the resolution bandwidth of 120 kHz and the video bandwidth of 300 kHz.

The measurement of emissions between 1 GHz - 25 GHz was measured with the resolution bandwidth of 1000 kHz and the video bandwidth of 1000 kHz (Reduced video bandwidth was also used).

The EUT was slowly rotated with the Peak Detector set to Max-Hold. This was performed for two antenna heights. When an emission was located, it was positively identified and its maximum level found by rotating the automated turntable, and by varying the antenna height. Each significant peak was investigated with the Quasi-Peak/Average Detectors. The software for cable losses automatically corrected the measurement data for each frequency range, antenna factors and preamplifier gain and all data was then stored on disk in sequential data files. This process was performed for both horizontal and vertical antenna polarisations.

4.2 Calculation of field strength

The field strength was calculated automatically by the software using all the pre-stored calibration data. The method of calculation is shown below:

E = V + AF - G + L Where:

E = Radiated Field Strength in dBμV/m.
V = EMI Receiver Voltage in dBμV. (measured value)
AF = Antenna Factor in dB(m^{-1}). (stored as a data array)
G = Preamplifier Gain in dB. (stored as a data array)
L = Cable loss in dB. (stored as a data array of Insertion Loss versus frequency)

- **Example Field Strength Calculation**

Assuming a receiver reading of 34.0 dBμV is obtained at 90 MHz, the Antenna Factor at that frequency is 9.2 dB. The cable loss is 1.9 dB while the preamplifier gain is 20 dB. The resulting Field Strength is therefore as follows:

34.0 + 9.2 + 1.9 - 20 = 25.1 dBμV/m

4.3 Fundamental and Spurious Emissions

4.3.1 Duty Cycle Correction Factor

Period = 250 ms
On time = 200 μs
Duty cycle = 0.0008

Correction factor is therefore 20log(0.001) = -62 dB. However, the requirements of 15.249(e) state that the peak emission using any modulation is not to exceed 20 dB above the average limit. Hence the correction factor is reduced to -20 dB.

4.3.2 Frequency Band: 1 – 25 GHz

All measurements above 1 GHz were initially made over a distance of 3 metres.

Transmitter:
Three frequencies (Low, Middle and High) were tested. Highest emissions were reported when the device was transmitting continuously at high frequency (2482 MHz). Average levels were corrected by 20 dB (duty cycle correction) from peak measurements.

Frequency GHz	Peak Measured @ 3m dBμV/m	Corrected level (-20dB) dBμV/m	Average Limit @ 3 m dBμV/m	Margin ± dB
2.482	80.7	60.7	94.0	-33.3
4.964	68.2	48.2	54.0	-5.8
7.446	52.6	32.6	54.0	-21.4

Results: The fundamental and harmonic emissions complied with the FCC limits in sections 15.209 and 15.249. No other emissions were observed to be within 20 dB of the limits.

Receiver:
Initial investigations were performed with all three frequencies. No significant differences in emissions were observed.

Results: No emissions were measured within 20 dB of the FCC Class B limit.

4.3.3 Frequency Band: 30 - 1000 MHz

Testing was performed in accordance with the requirements of FCC Part 15.209

Testing was performed at a distance of 3 metres.

Transmitter:
Initial investigations were performed with all three frequencies. No significant differences in emissions were observed. Final testing was performed while the transmitter continuously operated at 2.482 GHz.

Results: No emissions were measured within 10 dB of the FCC Class B limit.
Refer to Appendix H (graphs 1 & 2) for plots of the radiated EMI measurements.

Receiver:
Initial investigations were performed with all three frequencies. No significant differences in emissions were observed.

Results: No emissions were measured within 10 dB of the FCC Class B limit.
Refer to Appendix H (graphs 3 & 4) for plots of the radiated EMI measurements.

4.3.4 Band Edge Measurements

The radiated emissions at 2400 MHz and 2483.5 MHz were measured when the device was transmitting at 2402 MHz and 2482 MHz respectively.

Frequency GHz	Peak Measured @ 3m dBμV/m	Corrected level (-20dB) dBμV/m	Average Limit @ 3 m dBμV/m	Margin ± dB
2.400	46.2	26.2	54.0	-27.8
2.4835	48.8	28.8	54.0	-25.2

The resolution bandwidth of 1000 kHz and the video bandwidth of 1000 kHz were utilised.

Results: The emissions complied with the FCC limits in section 15.209.

5.0 ANTENNA REQUIREMENT

Testing to the requirements of FCC Part 15.203 was not applicable as this intentional radiator was designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

6.0 COMPLIANCE STATEMENT

The CinQo Bicycle Power / Cadence (RPM) Meter, Model: J406002PB tested on behalf of Quarq Technology Inc., **complies** with the requirements of 47 CFR, Part 15 Subpart C - Rules for Radio Frequency Devices (intentional radiators), Section 15.249 - Operation within the bands 902 – 928 MHz, 2400 – 2483.5 MHz, 5725 – 5875 MHz and 24.0 – 24.25 GHz.

Results were as follows:

FCC Part 15, Subpart C	RSS-210 Issue 7	Test Performed	Result
15.203	**5.5**	Antenna Requirement	**Not Applicable**
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15.249 (b)		Fixed, point to point	**Not Applicable**
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15.249 (d)	**2.7 and A2.9(b)**	Spurious Emissions	**Complies**
15.249 (e)		20 dB Peak to Average	**Complies**
15.249 (f)		Requirements – Manufacturing, etc	**Noted**

7.0 MEASUREMENT UNCERTAINTIES

EMC Technologies has evaluated the equipment and the methods used to perform the emissions testing. The estimated measurement uncertainties for emissions tests shown within this report are as follows:

Conducted Emissions:	9 kHz to 30 MHz	±3.2 dB
Radiated Emissions:	9 kHz to 30 MHz	±4.1 dB
	30 MHz to 300 MHz	±5.1 dB
	300 MHz to 1000 MHz	±4.7 dB
	1 GHz to 18 GHz	±4.6 dB

The above expanded uncertainties are based on standard uncertainties multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95%.