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**EMI TEST REPORT FOR CERTIFICATION
to
FCC PART 15 Subpart C (Section 15.247)**

FCC ID: SF5-00140

Test Sample: Crewsafe Tag

Radio Module: 2.4 GHz on-board Transceiver (MC13213)

Report Number: M081221_Cert_Tag

Tested for: Mobilarm Ltd

Issue Date: 16th April 2009

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FCC PART 15 Subpart C (Section 15.247)
EMC Technologies Report No. M081221_Cert_Tag
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FCC PART 15 Subpart C (Section 15.247)

Report No. M081221_Cert_Tag

Test Sample: Crewsafe Tag
MFP Number: 00140

Manufacturer: Mobilarm Ltd

Radio Module: 2.4 GHz on-board Transceiver (MC13213)

FCC ID: SF5-00140
Equipment Type: Intentional Radiator (Transceiver)

Tested for: Mobilarm Ltd
Address: 768 Canning Highway, Applecross
WA 6153, AUSTRALIA
Contact: Patrick Jones – Engineering Manager

Test Standards: FCC Part 15 – Radio Frequency Devices (July 2008)
FCC Part 15 Subpart C - Intentional Radiators
Section 15.247: 2400 – 2483.5 MHz Operation Bands
ANSI C63.4 – 2003
OET Bulletin No. 65

Test Dates: 15th December 2008 to 6th April 2009

Test Engineer:



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



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FCC PART 15 Subpart C (Section 15.247)

1.0 INTRODUCTION

EMI testing was performed on the Crewsafe Tag. The EUT is part of a system designed for the detection of 'Man Overboard (MOB) emergencies.

The Crewsafe product consists of the following individual units:

- One LED Display Console (Controller/ Internal Router)
- One External Router
- One or more Tags
- One or more Power Docks

The Tag results are reported in this application (FCC ID: SF5-00140).

The Display Console, External Router and Power Dock results are reported separately.

Refer to EMC Technologies' test report: M081218_Cert_Console_IRc (FCC ID: SF5-00130)

Refer to EMC Technologies' test report: M081221_Cert_External_Router (FCC ID: SF5-00110)

Refer to EMC Technologies' test report: M081220_Verification_Power_Dock.

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 15.247)
Section 15.203:	Antenna requirements
Section 15.205:	Restricted bands of operation
Section 15.207:	Conducted Emission Limits
Section 15.209:	Radiated Emission Limits (General requirements)
Section 15.247:	Operation in the bands 902-928 MHz, 2400-2483.5 MHz, 5725-5850 MHz

The test sample **complied** with the requirements of 47 CFR, Part 15 Subpart C - Section 15.247.

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.



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1.1 Summary of Results

FCC Subpart C, Section 15.247

FCC Part 15 Subpart C Clauses	Test Performed	Results
15.203	Antenna Requirement	Complies
15.205	Operation in Restricted Band	Complies
15.207	Conducted Emissions	Not Applicable EUT is not powered from AC mains
15.209	Radiated Emissions	Complies
15.247 (a)(2)	Channel Bandwidth	Complies
15.247 (b)(3)	Peak Output Power	Complies
15.247 (c)	Antenna Gain > 6 dBi	Not Applicable. Antenna gain < 6 dBi
15.247 (d)	Out of Band Emissions	Complies
15.247 (e)	Peak Power Spectral Density	Complies
15.247 (f)	*Hybrid Systems	Not Applicable. EUT does not employ a hybrid system
15.247 (g)	Frequency Hopping	Not Applicable. EUT does not employ frequency hopping
15.247 (h)	Frequency Hopping	Not Applicable. EUT does not employ frequency hopping
15.247 (i)	Radio Frequency Hazard	Complies

*Hybrid systems are those that employ a combination of both frequency hopping and digital modulations technique.

1.2 Modifications

No modifications were required.



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2.0 GENERAL INFORMATION

(Information supplied by the Client)

2.1 Transceiver Details

Personal Area Network: 2.4 GHz on-board Transceiver (MC13213)
Wireless Protocol: IEEE 802.15.4
Modulation Type: DSSS O-QPSK
Frequency Range: 2405 MHz to 2480 MHz
Number of Channels: 16
Carrier Spacing: 5.0 MHz
Antenna Type: Inverted F
Antenna gain: Max antenna gain is 3 dBi.

Frequency allocation:

Channel Number	Frequency (MHz)
11*	2405
12	2410
13	2415
.	.
17	2435
18*	2440
19	2445
.	.
24	2470
25	2475
26*	2480

*Channels tested and reported.

2.2 Crewsafe Tag Details

Tag MFP Number: 00140
Manufacturer: Mobilarm Ltd
Input Supply: 11 - 30 VDC

2.3 Description

The EUT is a 'Crewsafe' Tag which is a battery-powered, wearable device. It is designed with active "roaming" components within the Crewsafe network.

2.4 Test Configuration

A communications link was established between the Tag and the auxiliary equipment (Internal Router coordinator and External Router) to activate the transceiver.

Measurements were performed while the transceiver transmits and receives continuously.

2.5 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 1, 3 and 10 metres from the EUT. OET Bulletin 65 dated June 2001 was used for reference.



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2.6 Test Facility

2.6.1 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. Conducted measurements at an antenna ports were performed at EMC Technologies' laboratory in Keilor Park, Victoria Australia.

The above test sites have been accepted for testing by the Federal Communications Commission (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 3569B-1**.

2.6.2 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) and cable locating equipment (15.213).

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 (A²LA).

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.



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FCC 15.247 (DTS) RESULTS

3.0 CONDUCTED EMISSION MEASUREMENTS

Not applicable, the EUT is not connected to the AC mains network.

4.0 SPURIOUS EMISSION MEASUREMENTS

4.1 Test Procedure

Testing was performed in accordance with the requirements of FCC Part 15.247(d).

Radiated emission measurements were performed to the limits as per section 15.209 and 15.247. The measurements were made at the open area test site.

A calibrated Biconical antenna was used for measurements between 30 MHz and 232 MHz and a calibrated Logperiodic antenna was used for measurements between 230 MHz and 1000 MHz. Calibrated EMCO 3115 and ETS standard gain horn antennas were used for measurements between 1 to 25 GHz.

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

The measurement of emissions above 1000 MHz was measured using a following setting:

Peak measurements setting: RBW = VBW = 1 MHz

Average measurements setting: RBW = 1 MHz and VBW = 100 Hz

The receiver bandwidth was set to 6 dB.

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 Peak/Average Detectors. The measurement data for each frequency range was corrected for cable losses, antenna factors and preamplifier gain. 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:

$$34.0 + 9.2 + 1.9 - 20 = 25.1 \text{ dB}\mu\text{V/m}$$



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4.3 Radiated Emissions (Spurious and Harmonics)

4.3.1 Frequency Band: 1 – 25 GHz

Testing was performed at a distance of 1 and 3 metres.

The 74 dB μ V/m @ 3m and 54 dB μ V/m @ 3m limits are applied for emissions fall in the restricted bands. The limits for emission outside the restricted band (FCC 15.205) are 20 dB below the fundamental field strength.

Frequency MHz	Peak Detector dB μ V/m	Average Detector dB μ V/m	Peak Limit dB μ V/m	Average Limit dB μ V/m	Result
2405	108.5	62.6	Refer to section 5.0 - Peak Output Power		
2397.9	65.7	41.8	74.0	54.0	Complies
4810	69.7	43.6	74.0	54.0	Complies

Middle channel 2440 MHz was tested and found not worst than other channels. Refer to section 5.0 - Peak Output Power.

Frequency MHz	Peak Detector dBuV/m	Average Detector dBuV/m	Peak Limit dBuV/m	Average Limit dBuV/m	Result
2480	107.9	63.2	Refer to section 5.0 - Peak Output Power		
2483.5	72.3	46.1	74.0	54.0	Complies
4960	62.2	47.5	74.0	54.0	Complies

Result: Harmonic emissions were recorded up to 25 GHz. Other harmonics were confirmed low with both RBW and VBW reduced. Emissions complied with the FCC limits of sections 15.209 and 15.247 by a margin of 1.7 dB.

4.3.2 Frequency Band: 30 - 1000 MHz

Testing was performed at a distance of 10 metres.

Emissions complied with the FCC 15.209 Class B limit.

4.3.3 RF Conducted Measurements at the Antenna Terminal

Not applicable as the EUT had an internal antenna.

4.3.4 Band Edge Measurements

Complied (refer to section 4.3.1).



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5.0 PEAK OUTPUT POWER - Section 15.247 (b)(3)

Testing was performed in accordance with the requirements of FCC Part 15.247(b)(3).

Measurements were performed while the transmitter continuously transmitted.

The resolution bandwidth of 3 MHz and the video bandwidth of 3 MHz were utilised.

Measurements were performed at an Open Area Test Site (OATS). The fundamental level is recorded in dBuV and is then converted to dBm and subsequently into an absolute power level (mW).

The radiated power is determined by adding factors for the cable loss, antenna gain and path loss.

Frequency MHz	P dBm	Limit dBm	P mW	Limit mW	Result
2405	13.4	30	21.6	1000	Complies
2440	13.2	30	20.9	1000	Complies
2480	13.1	30	20.3	1000	Complies

Antenna gain = 3 dBi

6.0 CHANNEL BANDWIDTH

Testing was performed in accordance with the requirements of FCC Part 15.247(a)(2)

In the bands 2400 - 2483.5 MHz the minimum 6 dB bandwidth was at least 500 kHz.

The measurements were performed at the open area test site.

The resolution bandwidth of 100 kHz and the video bandwidth of 3000 kHz were utilised

Frequency MHz	Operating Mode	Bandwidth MHz	Result	6 dB Bandwidth Plot
2405	Normal	1.60	Complies	Spectrum plot is similar to 2480 MHz Appendix H
2440	Normal	1.63	Complies	
2480	Normal	1.66	Complies	

7.0 PEAK POWER SPECTRAL DENSITY

Testing was performed in accordance with the requirements of FCC Part 15.247(e)

The measurements were performed at the open area test site.

The resolution bandwidth of 3 kHz and the video bandwidth of 30 kHz were utilised

The specification limit is 8 dBm in any 3 kHz band during a continuous transmission.

Frequency MHz	Operating Mode	Level dBm	Limit dBm	Result
2405	Normal	0.0	8.0	Complies
2440	Normal	0.1	8.0	Complies
2480	Normal	0.3	8.0	Complies

8.0 RADIO FREQUENCY EXPOSURE (HAZARD) INFORMATION

Testing was performed in accordance with the requirements of FCC Part 15.247(i)

Spread spectrum transmitters operating in the 2400 - 2483.5 MHz band is required to be operated in a manner that ensures that the public is not exposed to RF energy levels in accordance with CFR 47, Section 1.1307(b)(1).

In accordance with section 2.1093 this device has been defined as a portable device. And in accordance with FCC OET Bulletin 65, SAR testing is not required if average conducted output power is below the power threshold ($60/f$ (GHz)).

Average output power measured (2.48 GHz) = 1.5 mW

Power threshold ($60/f$ (GHz)) = 24 mW

Therefore, SAR testing is not required.

9.0 ANTENNA REQUIREMENT

This intentional radiator was designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.



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10.0 COMPLIANCE STATEMENT

The Crewsafe Tag tested on behalf of Mobilarm Ltd **complied** with the requirements of 47 CFR, Part 15 Subpart C - Rules for Radio Frequency Devices (intentional radiators), Section 15.247 - Operation in the frequency band 2400 - 2483.5 MHz.

Results were as follows:

FCC Subpart C, Section 15.247

FCC Part 15 Subpart C Clauses	Test Performed	Results
15.203	Antenna Requirement	Complies
15.205	Operation in Restricted Band	Complies
15.207	Conducted Emissions	Not Applicable EUT is not powered from AC mains
15.209	Radiated Emissions	Complies
15.247 (a)(2)	Channel Bandwidth	Complies
15.247 (b)(3)	Peak Output Power	Complies
15.247 (c)	Antenna Gain > 6 dBi	Not Applicable. Antenna gain < 6 dBi
15.247 (d)	Out of Band Emissions	Complies
15.247 (e)	Peak Power Spectral Density	Complies
15.247 (f)	*Hybrid Systems	Not Applicable. EUT does not employ a hybrid system
15.247 (g)	Frequency Hopping	Not Applicable. EUT does not employ frequency hopping
15.247 (h)	Frequency Hopping	Not Applicable. EUT does not employ frequency hopping
15.247 (i)	Radio Frequency Hazard	Complies

*Hybrid systems are those that employ a combination of both frequency hopping and digital modulations technique.

11.0 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:


Radiated Emissions:	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%.

12.0 TEST REPORT APPENDICES

- APPENDIX A: MEASUREMENT INSTRUMENT DETAILS
- APPENDIX B: PHOTOGRAPHS
- APPENDIX C: OPERATIONAL DESCRIPTION
- APPENDIX D: BLOCK DIAGRAM
- APPENDIX E: SCHEMATICS
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Attachment 1: RF Exposure Information

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