



EMC Technologies Pty Ltd

ABN 82 057 105 549

57 Assembly Drive

Tullamarine Victoria Australia 3043

Ph: + 613 9335 3333

Fax: + 613 9338 9260

email: melb@emctech.com.au

**EMI TEST REPORT FOR CERTIFICATION to
FCC PART 15 Subpart C (Section 15.245)**

FCC ID: UXEMWSSTSR2

Test Samples: Microwave Sensors

Model Numbers: MWS-ST-2 and MWS-SR-2

Report Number M060937_Cert_MWS_ST_SR

Tested for: WADECO Ltd

Issue Date: 19th January 2006

EMC Technologies Pty Ltd reports apply only to the specific samples tested under stated test conditions. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. EMC Technologies Pty Ltd shall have no liability for any deductions, inferences or generalisations drawn by the client or others from EMC Technologies Pty Ltd issued reports. This report shall not be used to claim, constitute or imply product endorsement by EMC Technologies Pty Ltd.

The tests, calibrations or measurements covered by this document have been performed in accordance with NATA requirements which include the requirements of ISO/IEC 17025 and are traceable to national standards of measurement. This document shall not be reproduced, except in full.

EMI TEST REPORT FOR CERTIFICATION
to
FCC PART 15 Subpart C (Section 15.245)
EMC Technologies Report No. M060937_Cert_MWS_ST_SR
Issue Date: 19th January 2006

CONTENTS

1.0	INTRODUCTION
2.0	GENERAL INFORMATION
3.0	CONDUCTED EMI MEASUREMENTS
4.0	RADIATED EMI MEASUREMENTS
5.0	ANTENNA REQUIREMENT
6.0	COMPLIANCE STATEMENT

APPENDIX A:	MEASUREMENT INSTRUMENT DETAILS
APPENDIX B:	REPORT PHOTOGRAPHS
APPENDIX C:	OPERATIONAL DESCRIPTION
APPENDIX D:	BLOCK DIAGRAM
APPENDIX E:	SCHEMATICS
APPENDIX F:	FCC LABELLING DETAILS
APPENDIX G:	USER MANUAL
APPENDIX H:	GRAPHS of EMI MEASUREMENTS
APPENDIX I:	BANDEDGE PLOTS

EMI TEST REPORT FOR CERTIFICATION
to
FCC PART 15 Subpart C (Section 15.245)

Report Number: M060937_Cert_MWS_ST_SR

Test Samples: Microwave Sensors
Model Numbers: MWS-ST-2 (Transmitter)
MWS-SR-2 (Transceiver)
Manufacturer: WADECO Ltd


FCC ID: UXEMWSSTR2
Equipment Type: Intentional Radiator (Transmitter and Transceiver)

Tested for: WADECO Ltd
Address: 1-9-27 Jokoji, Amagasaki-shi
Hyogo-ken 660-0811, JAPAN
Contact: Michael Hartnett

Test Standards: FCC Part 15, Subpart C – Intentional Radiators
Section 15.245: Operation within the bands 902 – 928 MHz, 2435 – 2465
MHz, 5785 – 5815 MHz, 10500 – 10550 MHz and 24075 – 24175 MHz.
ANSI C63.4 – 2003
OET Bulletin No. 65

Test Dates: 11th October 2006 to 13th January 2007

Test Officers:



Chieu Huynh **B.Eng (Hons) Electronics**
Kevin Hansen

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:



Chris Zombolas
Technical Director
EMC Technologies Pty Ltd

**EMI TEST REPORT FOR CERTIFICATION
to
FCC PART 15 Subpart C (Section 15.245)**

1.0 INTRODUCTION

EMI testing was performed on the Microwave Sensors, Model: MWS-ST-2 and MWS-SR-2.

The test sample **complied** with the requirements of 47 CFR, Part 15 Subpart C - Section 15.245.

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 15.245)
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 15.245:	Operation within the bands 902 – 928 MHz, 2435 – 2465 MHz, 5785 – 5815 MHz, 10500 – 10550 MHz and 24075 – 24175 MHz.

1.1 Summary of Results

FCC Part 15, Subpart C Clauses	Test Performed	Result
15.203	Antenna Requirement	Not Applicable
15.205	Operation in Restricted Band	Complies
15.207	Conducted Emissions	Complies
15.209	Radiated Emissions	Complies
15.245 (b)	Fundamental Field Strength	Complies
15.245 (b)	Harmonics and Spurious Emissions	Complies

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 Samples:	Microwave Sensors
Model Numbers:	MWS-ST-2 (Transmitter) MWS-SR-2 (Transceiver)
Transmit Frequencies:	24.111 GHz (MWS-ST-2) 24.153 GHz (MWS-SR-2)
Manufacturer:	WADECO Ltd
Nominal Voltage:	100 VAC

2.2 Operational Description

The MWS-ST/SR type microwave sensor is a level switch consisting of a MWS-ST and a MWS-SR installed face-to-face.

The MWS-ST emits a continuous, low power microwave beam towards the MWS-SR and an output relay is released when the beam is obstructed.

2.3 Test Configuration

The test samples were transmitting and receiving continuously during the test.

The device has no antenna port; all tests were performed as radiated measurement. The antenna type is a cone horn antenna, Ø22mm, gain of 13.7 dBi.

2.4 Block Diagram

Refer to Appendix D - Block Diagram

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.

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 emission measurements were performed at EMC Technologies' laboratory in Tullamarine, Victoria Australia.

The above sites have been fully described in a report submitted to the FCC office, and accepted in a letter dated June 14, 2002, **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**, (Registration Date - November 5th 2001).

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), 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 Laboratory (NML) 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 Units of Measurements

2.7.1 Conducted Emissions

Measurements are reported in units of dB relative to one microvolt. (dB μ V).

2.7.2 Radiated Emissions

Measurements are reported in units of dB relative to one microvolt per metre (dB μ V/m).

2.8 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 Laboratory (NML). All equipment calibration is traceable to Australia national standards at the National Measurements Laboratory. The reference antenna calibration was performed by NML 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

2.9 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

Testing was performed in accordance with the requirements of FCC Part 15.207

3.1 Test Procedure

The arrangement specified in ANSI C63.4-2003 was adhered to for the conducted EMI measurements. The EUT was placed in the RF screened enclosure and a CISPR EMI Receiver as defined in ANSI C63.2-1996 was used to perform the measurements.

The EMI Receiver was operated under program control using the Max-Hold function and automatic frequency scanning, measurement and data logging techniques. The specified 0.15 MHz to 30 MHz frequency range was sub-divided into sub-ranges to ensure that all short duration peaks were captured.

3.2 Peak Maximising Procedure

The various operating modes of the system were investigated. For each of the sub-ranges, the EMI receiver was set to continuous scan with the Peak detector set to Max-Hold mode. The Quasi-Peak detector and the Average detector were then invoked to measure the actual Quasi-Peak and Average level of the most significant peaks, which were detected.

3.3 Calculation of Voltage Levels

The voltage levels were automatically measured in software and compared to the test limit. The method of calculation was as follows:

$$VEMI = VRx + LBPF$$

Where: **VEMI** = the Measured EMI voltage in dB μ V to be compared to the limit.
VRx = the Voltage in dB μ V read directly at the EMI receiver.
LBPF = the loss in dB of the cables and the Limiter and Band pass Filter.

3.4 Plotting of Conducted Emission Measurement Data

The measurement data pertaining to each frequency sub-range were then concatenated to form a single graph of (peak) amplitude versus frequency. This was performed for both Active and Neutral lines and the composite graph were subsequently plotted. A list of the highest relevant peaks and the respective Quasi-Peak and Average values were also plotted on the graph.

3.5 Results of Conducted Emission Measurements (AC Mains Ports)

Initial investigations were performed with all four channels. No significant differences in emissions were observed. Final testing was performed while the transmitter continuously operated with channel 0.

All emissions complied with the quasi peak and average limits by margins of greater than 20 dB. The measurement uncertainty was ± 2.0 dB. Refer to Appendix H (graphs 1 & 2) for plots of the conducted EMI measurements.

Result: Complies

4.0 RADIATED EMISSION MEASUREMENTS

4.1 Test Procedure

Testing was performed in accordance with the requirements of FCC Part 15.245(b).

Radiated emission measurements were performed to the limits as per section 15.209. 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 40 GHz.

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 - 40 GHz was measured with the resolution bandwidth of 1000 kHz and the video bandwidth of 1000 kHz.

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 dB μ V/m.

V = EMI Receiver Voltage in dB μ V. (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 dB μ V 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:

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

Measurement uncertainty with a confidence interval of 95% is:

- Free radiation tests (1000 MHz – 18,000 MHz) \pm 4.1 dB
- (30 MHz – 1,000 MHz) \pm 3.7 dB

4.3 Fundamental and Spurious Emissions

4.3.1 Frequency Band: 1 – 40 GHz

All measurements above 1 GHz were initially made over a distance of 3 metres. This was decreased to 1.0 metre as the emission levels from the device were very low.

The 54 dB μ V/m limit at 3 metres has been converted to 64 dB μ V/m at 1 metre using a factor of 20 dB per decade where emissions were located in the restricted bands.

Initial investigations were performed with all four channels. No significant differences in emissions were observed. Final testing was performed while the transmitter continuously operated with channel 0.

EUT Model	Transmit Frequency GHz	Field Strength Measured @ 3m dB μ V/m	Limit @ 3 m dB μ V/m	Margin \pm dB
MWS-ST-2	24.111	124.7	128.0	-3.3
MWS-SR-2	24.153	120.5	128.0	-7.5

Results: The fundamental frequencies were complied with the FCC limits in sections 15.209 and 15.245. No other emissions (from 1 to 40 GHz) were observed to be within 20 dB of the limits.

4.3.2 Frequency Band 40 GHz up to 3rd Harmonic of Transmitter Frequency.

Refer to TIMCO ENGINEERING INC, Florida test report number WADECO_UXE/200UT7 for results.

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 10 metres.

Initial investigations were performed with all four channels. No significant differences in emissions were observed. Final testing was performed while the transmitter continuously operated with channel 0.

Frequency MHz	Polarisation	QP Measured dB μ V/m	QP Limit dB μ V/m	Δ QP \pm dB
60.01	Vertical	25.6	29.5	-3.9
55.03	Vertical	24.3	29.5	-5.2
80.01	Vertical	23.9	29.5	-5.6
40.02	Vertical	21.4	29.5	-8.1

Results: The highest radiated emission peak occurred at 60.01 MHz (Vertical Polarity) and complied with FCC quasi peak limit by a margin of 3.9 dB. The measurement uncertainty in this band was \pm 3.7 dB. Refer to Appendix H (graphs 3 & 4) for plots of the radiated EMI measurements.

4.3.4 RF Conducted Measurements at the Antenna Terminal

Not applicable, as EUT has no antenna port.

4.3.5 Band Edge Measurements

In the 1000 kHz bandwidth within the operating band, the highest emissions (spurious/harmonics) level that is produced by the intentional radiator shall be at least 50 dB below.

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

Refer to Appendix I for band edge plots.

Results: Complied.

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 Microwave Sensors, Model: MWS-ST-2 and MWS-SR-2 tested on behalf of WADECO Ltd, **complies** with the requirements of 47 CFR, Part 15 Subpart C - Rules for Radio Frequency Devices (intentional radiators), Section 15.245 - Operation within the bands 902 – 928 MHz, 2435 – 2465 MHz, 5785 – 5815 MHz, 10500 – 10550 MHz and 24075 – 24175 MHz.

Results were as follows:

FCC Part 15, Subpart C Clauses	Test Performed	Result
15.203	Antenna Requirement	Not Applicable
15.205	Operation in Restricted Band	Complies
15.207	Conducted Emissions	Complies
15.209	Radiated Emissions	Complies
15.245 (b)	Fundamental Field Strength	Complies
15.245 (b)	Harmonics and Spurious Emissions	Complies

TEST REPORT APPENDICES

APPENDIX A: MEASUREMENT INSTRUMENT DETAILS
APPENDIX B: REPORT PHOTOGRAPHS
APPENDIX C: OPERATIONAL DESCRIPTION
APPENDIX D: BLOCK DIAGRAM
APPENDIX E: SCHEMATICS
APPENDIX F: FCC LABELLING DETAILS
APPENDIX G: USER MANUAL
APPENDIX H: GRAPHS of EMI MEASUREMENTS
APPENDIX I: BANDEDGE PLOTS