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EMI TEST REPORT FOR CERTIFICATION to FCC PART 15 Subpart C (Section 15.239) & RSS-210

FCC ID:	XKS-SM1XSR
Industry Canada ID:	8376A-SM1XSR
Test Sample:	Electronic Communication Hearing Protector with FM Communication
Model:	SM1XSR
Report Number:	M090663R_Cert_FM_SM1XSR
Issue Date:	11th August 2009

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Test Sample:	Electronic Communication Hearing Protector with FM Communication
Model:	SM1XSR
FCC ID:	XKS-SM1XSR
Industry Canada ID:	8376A-SM1XSR
Equipment Type:	Intentional Radiator
Manufacturer/ Tested For:	Sensear Pty Ltd
Address:	197-199 Great Eastern Highway Belmont WA 6104 Australia
Contact:	David Ward
Test Standards:	FCC Part 15 – Radio Frequency Devices (July 2008) FCC Part 15 Subpart C - Intentional Radiators Section 15.239: Operation in the Band 88 – 108 MHz ANSI C63.4 – 2003 RSS-210 Issue 7 Low Power Licence-Exempt RadioCommunication Devices. Annex 2 (A2.8): Operation in the Band 88 – 108 MHz RSS-Gen Issue 2 - General Requirements and Information for the Certification of RadioCommunication Equipment
Test Dates:	2nd July to 11th August 2009
Senior Engineer:	**Chieu Huynh - B.Eng (Hons) Electronics**
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** **Senior EMC Engineer** **EMC Technologies Pty Ltd**

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1.0 INTRODUCTION

EMI testing was performed on the Electronic Communication Hearing Protector with FM Communication, Model: SM1XSR.

The SM1XSR is identical to the SM1X with the addition of an FM transmitter/receiver. The SM1X was previously tested by EMC Technologies to FCC Subpart B, Section 15.101 Verification. Refer to EMCT report number: M081019F.

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 15.239)
Section 15.203:	Antenna requirements
Section 15.207:	Conducted Emission Limits
Section 15.209:	Radiated Emission Limits (General requirements)
Section 15.239:	Operation in the bands 88 - 108 MHz

The test sample **complied** with the requirements of 47 CFR, Part 15 Subpart C - Section 15.239.

The test sample also complied with the Industry Canada RSS-210 issue 7 - Low Power Licence-Exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment, Annex 2 (A2.8).

The measurement procedure used was in accordance with ANSI C63.4-2003. The instrumentation conformed to the requirements of ANSI C63.2-1996.

1.1 Summary of Results

FCC Part 15 Subpart C Clauses	Industry Canada RSS-210 Issue 7 and RSS-Gen Clauses	Test Performed	Results
15.203	RSS-Gen (7.1.4)	Antenna Requirement	**Complies**
15.207	RSS-Gen (7.2.2)	Conducted Emissions	**Not Applicable**
15.209	RSS-Gen (6)	Radiated Emissions	**Complies**
15.239 (a)	A2.8 (b)	Channel Bandwidth	**Complies**
15.239 (b)	A2.8 (a)	Fundamental	**Complies**
15.239 (c)	A2.8 (b)	Out of Band Emissions	**Complies**
15.239 (d)		Telemetry Intentional Radiator	**Not Applicable**

1.2 Modifications by EMC Technologies

No modifications were required.

2.0 GENERAL INFORMATION

(Information supplied by the Client)

2.1 EUT Details

EUT:	Electronic Communication Hearing Protector with FM Communication
Model:	SM1XSR
Microprocessor:	TMS320VC5509 DSP
Crystal Frequency:	12.0 MHz
Input Supply:	Battery operated 3.6V
Manufacturer:	Sensear Pty Ltd

2.2 Test Configuration

The EUT was set-up to transmit continuously in the frequency band 88.1 MHz to 97.0 MHz. Songs were played from the laptop (support equipment) with maximum audio input

2.3 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.

2.4 Test Facility

2.4.1 General

EMC Technologies Pty Ltd is listed by the FCC as a test laboratory able to perform compliance testing for the public. EMC Technologies is listed as an FCC part 47CFR2.948 test lab and may perform the testing required under Parts 15 and 18 – **FCC Registration Number 90560**

EMC Technologies Pty Ltd has also been accredited as a Conformity Assessment Body (CAB) by Australian Communications and Media Authority (ACMA) under the APECTEL MRA and is designated to perform compliance testing on equipment subject to Declaration of Conformity (DoC) and Certification under Parts 15 & 18 of the FCC Commission's rules – **Registration Number 494713 & Designation number AU0001.**

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 OATS number - IC 3569B-1.**

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.

2.4.2 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).

2.5 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

2.6 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

Not applicable, as EUT is battery powered.

4.0 RADIATED EMISSION MEASUREMENTS

4.1 Test Procedure

Testing was performed in accordance with the requirements of FCC Part 15.239.

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 30 MHz to 1000 MHz 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 and 232 MHz and a calibrated Logperiodic antenna used for measurements between 230 MHz and 1000 MHz.

The following bandwidth settings were used:
RBW = 120 kHz and VBW = 300 kHz for frequency band 30 MHz – 1000 MHz
RBW = 120 kHz and VBW = 10 Hz within transmit frequency band ±200 kHz

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 Plotting of Measurement Data for Radiated Emissions

The stored measurement data was combined to form a single graph which comprised of all the frequency sub-ranges over the range 30 - 1000 MHz. The accumulated EMI (EUT ON) was plotted as the Red trace while the Ambient signals (AMBIENT) were plotted as Green trace. The worst case radiated EMI *peak* measurements as recorded using the Max-Hold data are presented as the upper or **RED** trace while the respective ambient signals are presented as the lower or **GREEN** trace. Occasionally, an intermittent ambient arose during the EUT ON measurement (RED trace) and could not be captured when the Ambient trace was being stored.

The ambient peaks of significant amplitude with respect to the limit are tagged with the "#" symbol while EMI peaks are identified with a numeral. Ambient peaks that were present during the EUT ON measurement (RED trace) and not captured during the AMBIENT measurement were also tagged with the "#" symbol.

The highest recorded EMI signals are shown on the Peaks List on the bottom right side of the graph. For radiated EMI, each numbered peak is listed as a frequency, peak field strength, quasi-peak field strength and the margin relative to the limit in dB. A negative margin is the deviation of the recorded value below the limit.

At times, the quasi peak level may appear to be higher than the peak level. This happens because the individual peak is further maximised with the QP detector. This will be apparent when the peaks list at the foot of the graphs shows the quasi peak level higher than the peak level.

4.3 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

4.4 Radiated EMI Results

Testing was performed at a distance of 3 metres.

4.4.1 FM Tuned to 88.1 MHz

Frequency MHz	Polarisation	Measured Level dBµV/m	LIMIT dBµV/m	Δ ±dB
88.04	Vertical	36.7	48.0	-11.3
576.01	Vertical	30.1	46.0	-15.9
176.13	Vertical	25.6	43.5	-17.9
88.00	Vertical	17.7	43.5	-25.8

Frequency MHz	Polarisation	Measured Level dBµV/m	LIMIT dBµV/m	Δ ±dB
88.07	Horizontal	41.9	48.0	-6.1
576.02	Horizontal	32.4	46.0	-13.6
176.13	Horizontal	27.4	43.5	-16.2
88.00	Horizontal	22.3	43.5	-21.2

* Fundamental Frequency - average detector was used.
**Band-Edge and other peaks were measured with peak detector.

Results: Complied. Refer to Appendix H, Graphs 1 & 2

4.4.2 FM Tuned to 97.0 MHz

Frequency MHz	Polarisation	Measured Level dBμV/m	LIMIT dBμV/m	Δ ±dB
97.0	Vertical	39.0	48.0	-9.0
576.01	Vertical	31.8	46.0	-14.2
193.93	Vertical	23.7	43.5	-19.8
108.00	Vertical	17.0	43.5	-26.5

Frequency MHz	Polarisation	Measured Level dBμV/m	LIMIT dBμV/m	Δ ±dB
97.0	Horizontal	45.6	48.0	-2.4
193.94	Horizontal	27.6	43.5	-15.9
108.00	Horizontal	20.3	43.5	-23.2

* Fundamental Frequency - average detector was used.
**Band-Edge and other peaks were measured with peak detector.

Results: Complied. Refer to Appendix H, Graphs 3 & 4.

5.0 CHANNEL BANDWIDTH

Testing was performed in accordance with the requirements of FCC Part 15.239(a).

A resolution bandwidth of 1 kHz and the video bandwidth of 1 kHz were utilised.

Frequency MHz	Bandwidth kHz	Result	20 dB Bandwidth Plot
88.1	Similar to 97.0 MHz		
97.0	54.4	Complies	Appendix I

6.0 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.

7.0 COMPLIANCE STATEMENT

The Electronic Communication Hearing Protector with FM Communication, Model: SM1XSR **complied** with the requirements of 47 CFR, Part 15 Subpart C - Rules for Radio Frequency Devices (intentional radiators), Section 15.239 - Operation in the band 88 – 108 MHz.

The test sample also complied with the Industry Canada RSS-210 issue 7 - Low Power Licence-Exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment, Annex 2 (A2.8).

Results were as follows:

FCC Part 15 Subpart C Clauses	Industry Canada RSS-210 Issue 7 and RSS-Gen Clauses	Test Performed	Results
15.203	RSS-Gen (7.1.4)	Antenna Requirement	**Complies**
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15.239 (c)	A2.8 (b)	Out of Band Emissions	**Complies**
15.239 (d)		Telemetry Intentional Radiator	**Not Applicable**

8.0 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:	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%.

9.0 TEST REPORT APPENDICES

APPENDIX A: MEASUREMENT INSTRUMENT DETAILS
APPENDIX B: PHOTOGRAPHS
APPENDIX C: OPERATIONAL DESCRIPTION
APPENDIX D: BLOCK DIAGRAM
APPENDIX E: SCHEMATIC
APPENDIX F: FCC LABELLING DETAILS
APPENDIX G: USER MANUAL
APPENDIX H: RADIATED PLOTS
APPENDIX I: BANDWIDTH PLOT

Attachment 1: Bluetooth Letter
Attachment 2: Collocation Letter