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

FCC ID:	XKS-SMPLUG03
Industry Canada ID:	8376A-SMPLUG03
Test Sample:	Sensear smartPlug
Model:	SMPLUG03
Report Number:	M141112-3
Issue Date:	20 January 2015

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CONTENTS

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Report No. M141112-3

Test Sample:	Sensear smartPlug
Model:	SMPLUG03
FCC ID:	XKS-SMPLUG03
Industry Canada ID:	8376A-SMPLUG03
Equipment Type:	Intentional Radiator/Low power FM transmitter
Manufacturer/ Tested For:	Sensear Pty Ltd
Address:	197-199 Great Eastern Highway Belmont, WA 6104, Australia
Contact:	Frank Lin
Email:	frnak.lin@sensear.com
Standards:	FCC Part 15 – *Radio Frequency Devices* FCC Part 15 Subpart C – *Intentional Radiators* Section 15.239: *Operation in the Band 88 - 108 MHz* ANSI C63.4 – 2009 RSS-210 Issue 8 – *Low Power Licence-Exempt RadioCommunication Devices. Annex 2 (A2.8): Operation in the Band 88 - 108 MHz* RSS-Gen Issue 4 – *General Requirements and Information for the Certification of RadioCommunication Equipment*
Test Dates:	17th, 28th November 2014, 16th January 2015
Test Officer:	**Mahan Ghassempouri**
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** **Managing Director** **EMC Technologies Pty Ltd**

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

1.0 INTRODUCTION

Radio testing was performed on the Sensear smartPlug, Model: SMPLUG03.

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 15.205:	Restricted bands of operation
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 8 - 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 C63.4-2009. The instrumentation conformed to the requirements of ANSI C63.2-2009.

1.1 Summary of Results

FCC Part 15 Subpart C Clauses	Industry Canada RSS-210 Issue 8 and RSS-Gen Clauses	Test Performed	Results
15.203	RSS-Gen (8.3)	Antenna Requirement	**Complies**
15.207	RSS-Gen (8.8)	Conducted Emissions	**Not Applicable**
15.209	RSS-Gen (8.9)	Radiated Emissions	**Complies**
15.239 (a)	RSS-210 (A2.8)	Channel Bandwidth	**Complies**
15.239 (b)	RSS-210 (A2.8)	In Band Emissions	**Complies**
15.239 (c)	RSS-210 (A2.8)	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

Test Sample:	Sensear smartPlug
Model Number:	SMPLUG03
Serial Number:	PCAA006824690123
Internal Clock:	200 MHz
Supply Voltage	5 VDC internal battery charged by auxiliary AC/DC Adapter
EUT Modulation Type:	FM
Intentional Transmitter Frequency:	88.1-107.9 MHz

2.2 Test Configuration

The level of input to the EUT's modulator was an adjustable 1 kHz sinusoidal tone, to achieve a desired frequency deviation from carrier frequency. Frequency deviation of ±75 kHz was used as required by the standard.

2.3 Test Procedure

RF emission measurements were performed in accordance with the procedures of ANSI C63.4-2009. Radiated emissions tests were performed at a distance of 10 metres from the EUT.

EUT transmit frequency was adjustable by 100 kHz steps. Tests have been performed on low, middle and high transmit frequency where required. Low, middle and high frequency were selected according to below table:

Channel	Frequency (MHz)
Low	88.1
Middle	98.0
High	107.9

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 and 18 of the FCC Commission's rules – **Registration Number 494713 and 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-Gen - **Industry Canada OATS number - IC 3569B-2.**

Radiated Emission measurements were performed at EMC Technologies Open Area Test Site (OATS) situated at 176 Harrick Road, Keilor Park 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

3.0 CONDUCTED EMISSION MEASUREMENTS

Not applicable, as EUT is not intended to be operated while connected to the AC/DC charger.

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 BiLog antenna was used for measurements between 30 MHz and 1000 MHz and a calibrated Horn antenna used for measurements between 1000 MHz and 2000 MHz. Measurements were performed at 10 metre separation distance for frequencies below 1000 MHz and at 3 metres separation distance for frequencies between 1000 MHz and 2000 MHz.

The following bandwidth settings were used:

RBW = 120 kHz, VBW = 300 kHz for frequency band 30 MHz – 1000 MHz
RBW = 120 kHz, VBW = 10 Hz (average detector) for ±100 kHz of carrier frequency
RBW = 1 MHz, VBW = 1 MHz (peak detector) and VBW = 10 Hz (average detector) for emissions above 1 GHz

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)

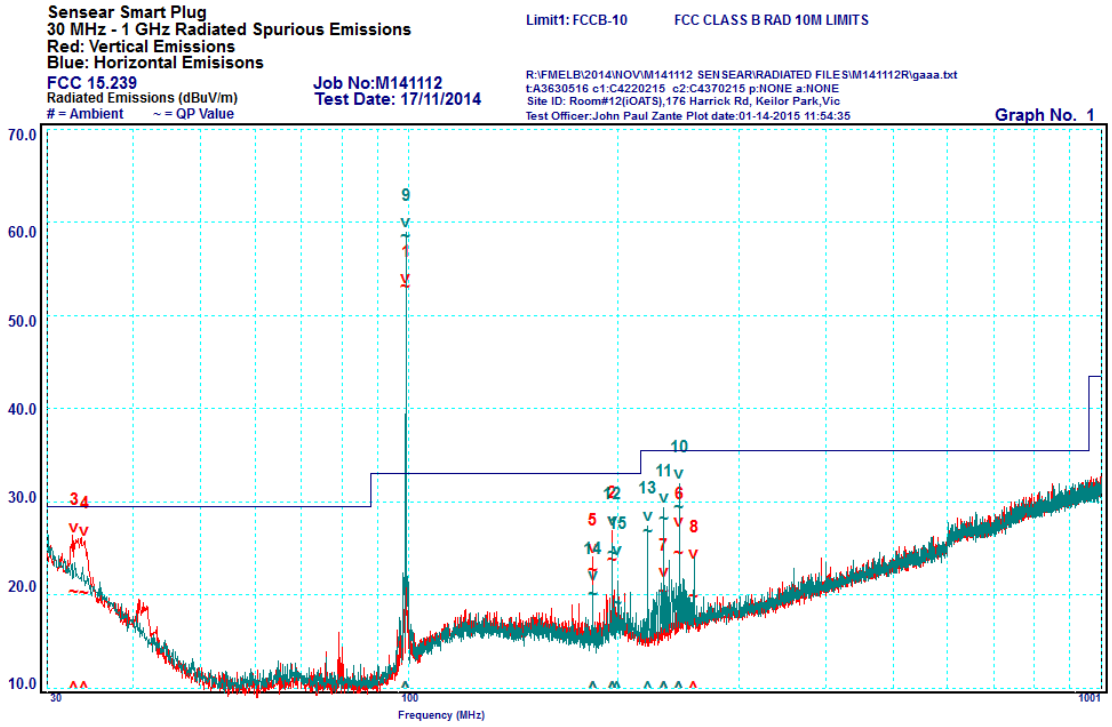
- **Example Field Strength Calculation**

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 dBμV/m

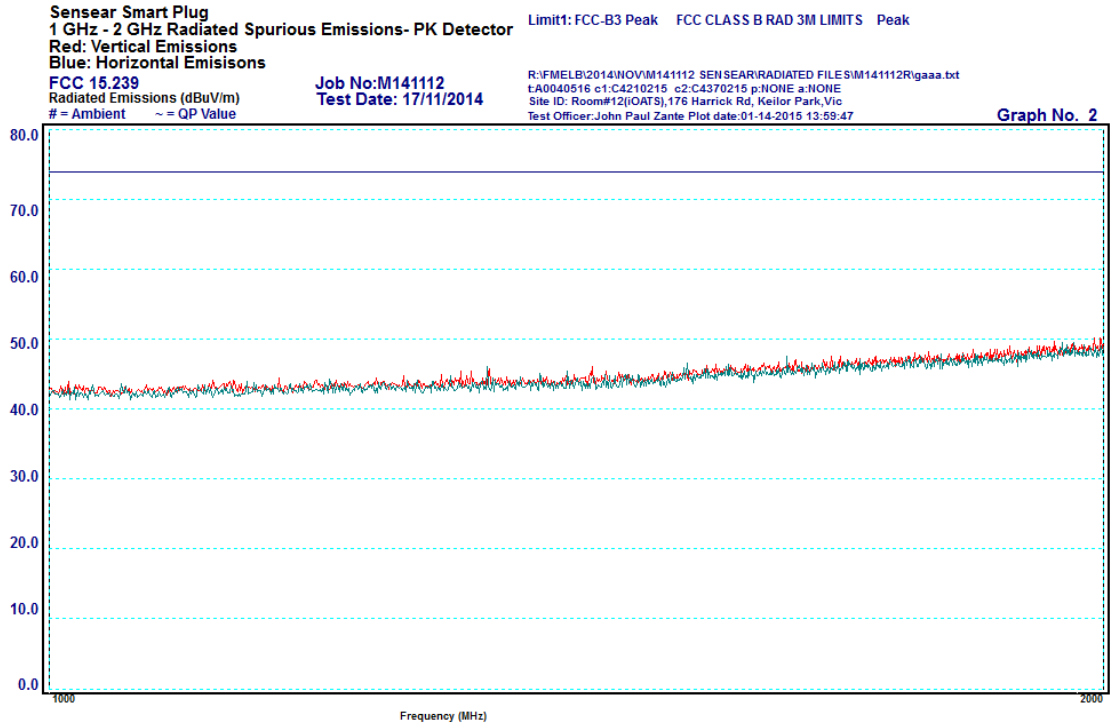
4.3 Out of Band Measurements

Measurements were performed from 30 MHz to 2000 MHz. Results are shown in the following graphs and tables.

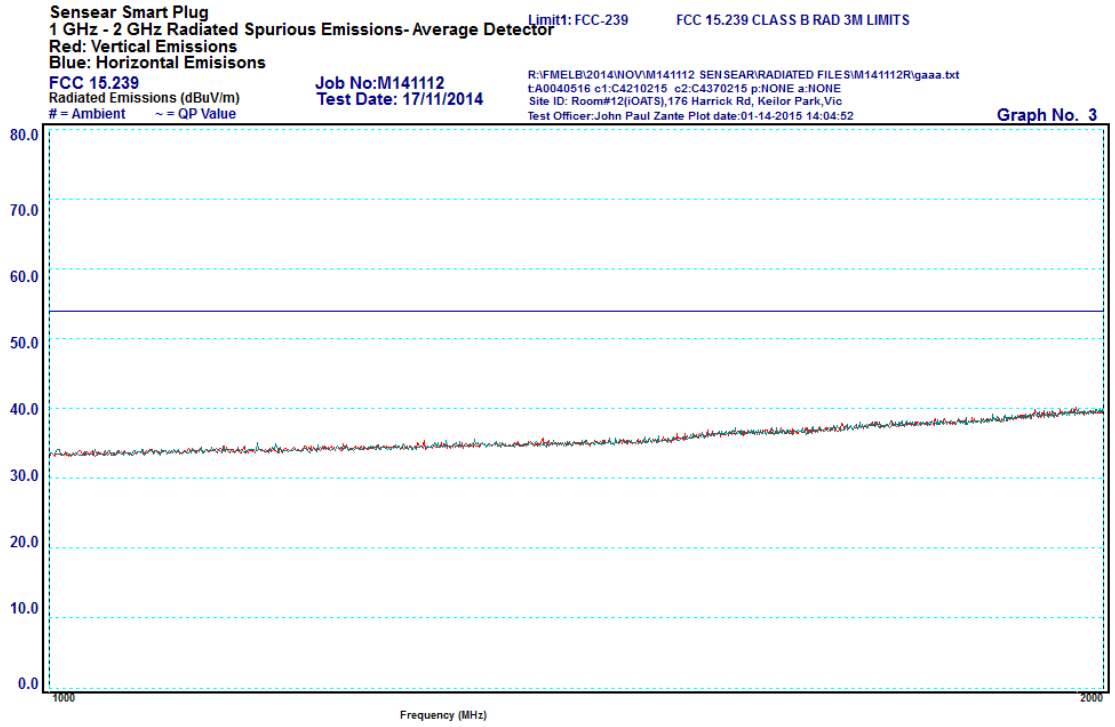


Point	Frequency (MHz)	Polarisation	Field Strength Measured (dBµV/m)	Spurious emission limits (dBµV/m)	Margin (dB)
2	196.62	Vertical	23.7	33.0	-9.3
3	32.90	Vertical	20.2	29.5	-9.3
4	34.01	Vertical	20.1	29.5	-9.4
5	184.33	Vertical	22.5	33.0	-10.5
6	245.77	Vertical	24.5	35.5	-11
7	233.48	Vertical	20.3	35.5	-15.2
8	258.06	Vertical	19.8	35.5	-15.7
10	245.77	Horizontal	29.3	35.5	-6.2
11	233.48	Horizontal	28.1	35.5	-7.4
12	196.62	Horizontal	24.5	33.0	-8.5
13	221.19	Horizontal	26.8	35.5	-8.7
14	184.33	Horizontal	20.0	33.0	-13
15	200.00	Horizontal	19.0	33.0	-14

Intentional transmitter was excluded from measurement (points 1 and 9). For intentional transmitter measurement refer to section 4.4 of this report.



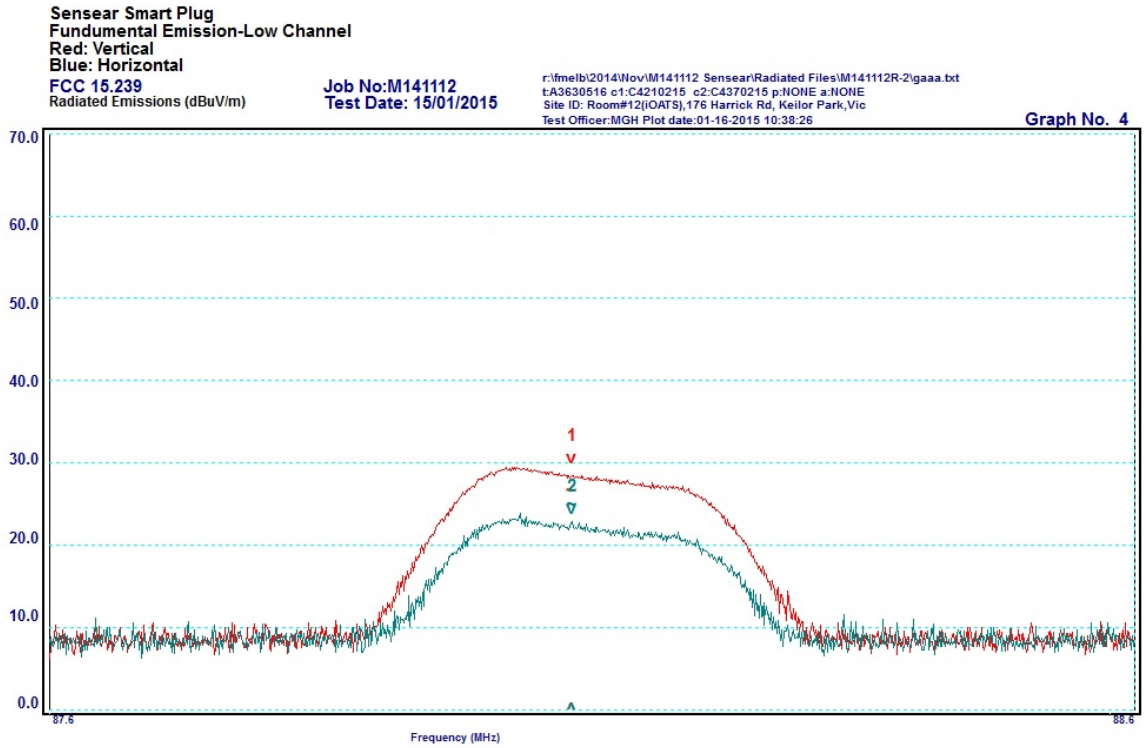
All emissions were more than 10 dB below the limit



All emissions were more than 10 dB below the limit

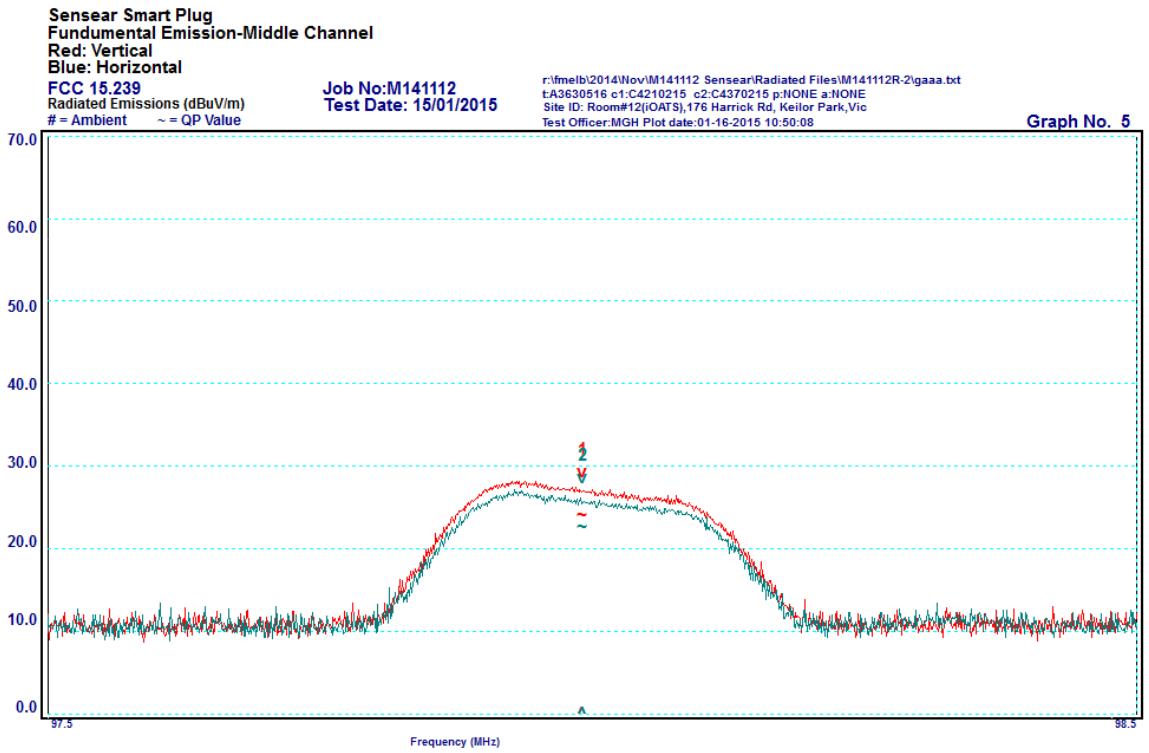
4.4 In-Band Emissions

Emissions were measured within a 200 kHz bandwidth centred on the carrier frequency using an average detector. Initial scans were performed using a peak detector to ensure that emissions are not exceeding the peak limit (20 dB above the average limit). The limit of 250 μV/m (37.5 dBμV/m) using the average detector was applied. Measurements were made at a distance of 3 metres. Measurement results are shown in the following graphs.



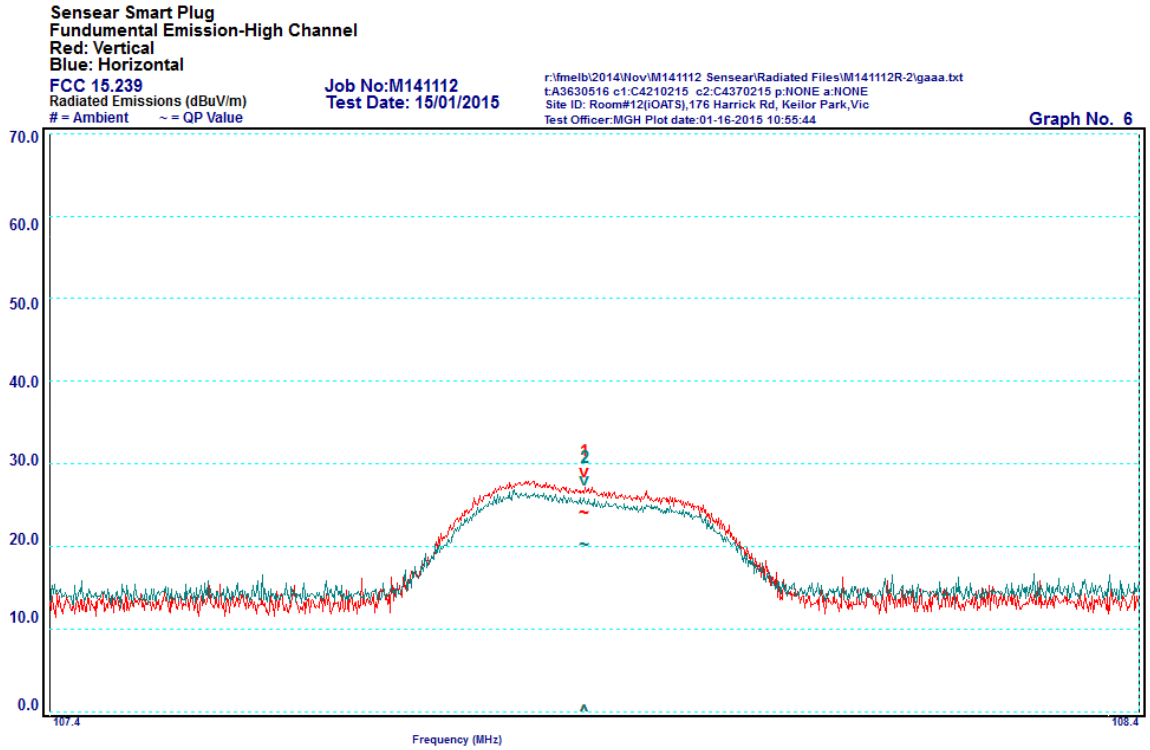
Point	Frequency (MHz)	Polarisation	Measured Average (dBμV/m)	Average Limit (dBμV/m)	Margin (dB)
1	88.08	Vertical	26.6	37.5	-10.9
2	88.08	Horizontal	24.8	37.5	-12.7

Point	Frequency (MHz)	Polarisation	Measured Peak (dBμV/m)	Peak Limit (dBμV/m)	Margin (dB)
1	88.08	Vertical	29.4	57.5	-28.1
2	88.08	Horizontal	23.2	57.5	-34.3



Point	Frequency (MHz)	Polarisation	Measured Average (dBµV/m)	Average Limit (dBµV/m)	Margin (dB)
1	97.99	Vertical	24.0	37.5	-13.5
2	97.99	Horizontal	22.5	37.5	-15.0

Point	Frequency (MHz)	Polarisation	Measured Peak (dBµV/m)	Peak Limit (dBµV/m)	Margin (dB)
1	97.99	Vertical	28.0	57.5	-29.5
2	97.99	Horizontal	27.3	57.5	-30.2



Point	Frequency (MHz)	Polarisation	Measured Average (dBµV/m)	Average Limit (dBµV/m)	Margin (dB)
1	107.89	Vertical	24.0	37.5	-13.5
2	107.89	Horizontal	20.2	37.5	-17.3

Point	Frequency (MHz)	Polarisation	Measured Peak (dBµV/m)	Peak Limit (dBµV/m)	Margin (dB)
1	107.89	Vertical	27.7	57.5	-30.2
2	107.89	Horizontal	26.7	57.5	-30.8

5.0 CHANNEL BANDWIDTH and BAND EDGE

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

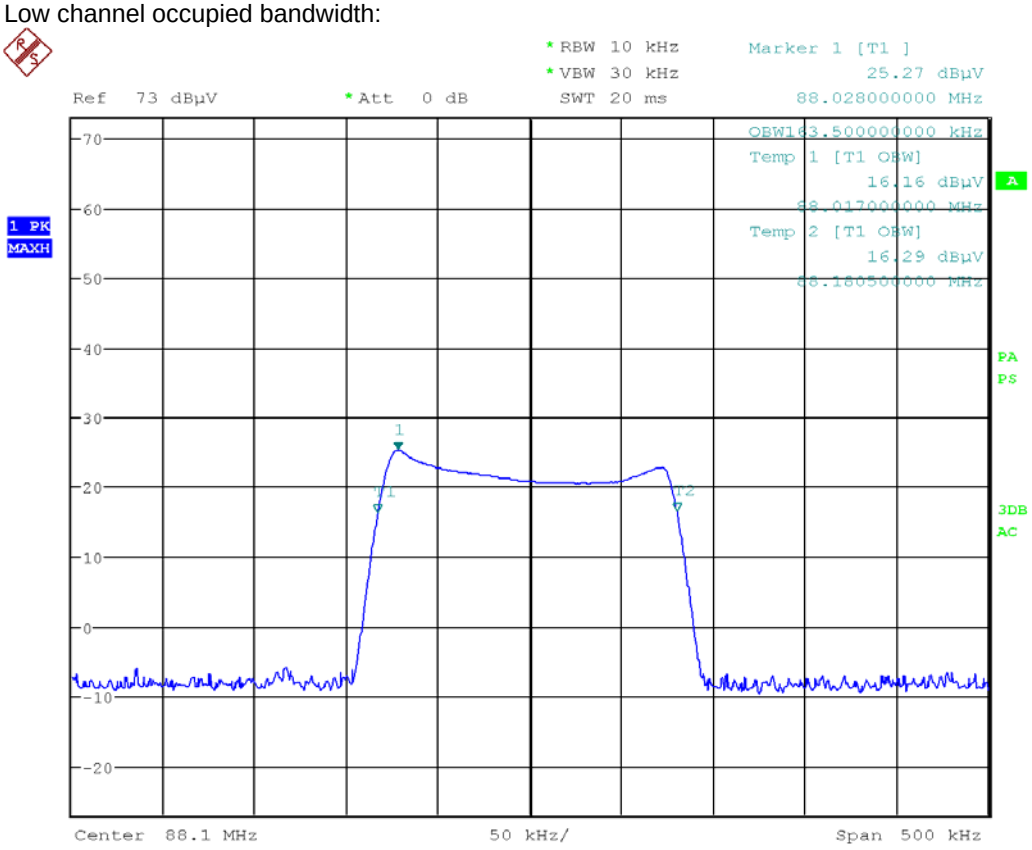
A resolution bandwidth of 10 kHz and video bandwidth of 30 kHz were utilised.

Measurements were performed on low, middle and high channel. The input of the modulator was supplied with the highest adjustable level to implement the highest deviation from the carrier, representing the worst case.

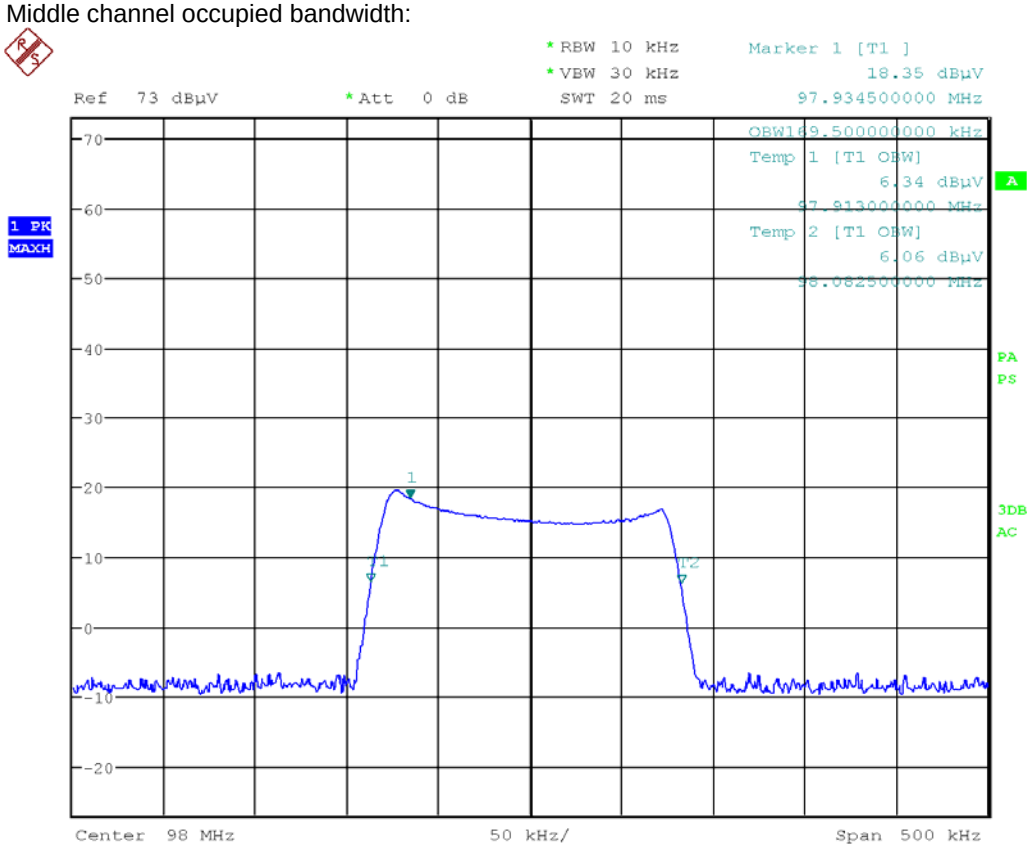
Channel	F_L (MHz)	F_H (MHz)	Measured BW (kHz)	Limit (MHz)			Results
				F_L (MHz)	F_H (MHz)	BW (kHz)	
Low	**88.02**	88.19	163.5	88	108	200	Complied
Middle	97.91	98.08	169.5	88	108	200	Complied
High	107.82	**107.98**	162.0	88	108	200	Complied

Results are shown in the following graphs.

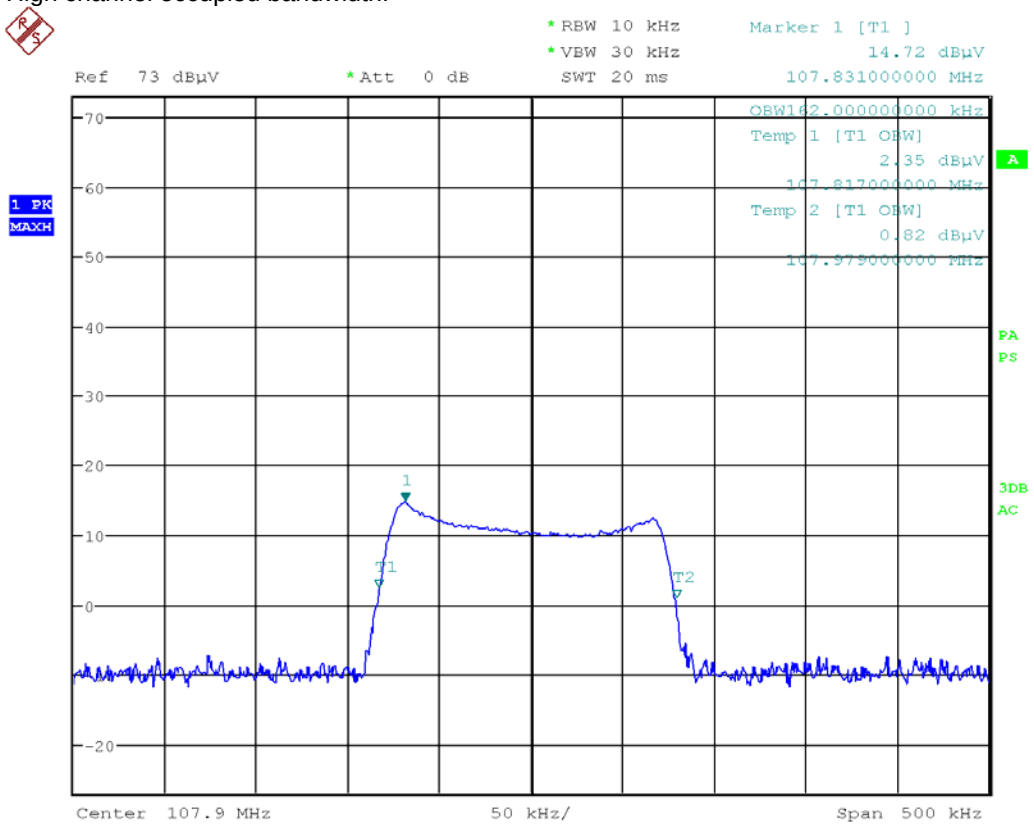
Low channel occupied bandwidth:



Middle channel occupied bandwidth:



High channel occupied bandwidth:



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 Sensear smartPlug, Model: SMPLUG03 **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 8 - 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 8 and RSS-Gen Clauses	Test Performed	Results
15.203	RSS-Gen (8.3)	Antenna Requirement	**Complies**
15.207	RSS-Gen (8.8)	Conducted Emissions	**Not Applicable**
15.209	RSS-Gen (8.9)	Radiated Emissions	**Complies**
15.239 (a)	RSS-210 (A2.8)	Channel Bandwidth	**Complies**
15.239 (b)	RSS-210 (A2.8)	Fundamental	**Complies**
15.239 (c)	RSS-210 (A2.8)	Out of Band Emissions	**Complies**
15.239 (d)	-	Telemetry Intentional Radiator	**Not Applicable**

8.0 MEASUREMENT UNCERTAINTY

EMC Technologies has evaluated the equipment and the methods used to perform the emissions testing. The estimated measurement uncertainty 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%.

APPENDIX A
MEASUREMENT INSTRUMENT DETAILS

Equipment Type	Make/Model/Serial Number	Last Cal. dd/mm/yy	Due Date dd/mm/yy	Cal. Interval
Chamber	Frankonia SAC-10-2 (R-139)	30/01/2015	06/02/2016	1 Year, *1
EMI Receiver	RandS ESU40 20 Hz – 40 GHz Sn: 100182 (R-037)	09/10/2014	09/10/2015	1 Year, *2
Antennas	SUNOL JB6 BICONILOG 30 – 6000 MHz Sn. A012312 (A-363)	16/05/2014	16/05/2015	1 Year, *2
	EMCO 3115 Broadband Horn 1 – 18 GHz Sn. 8908-3282 (A-004)	16/01/2012	16/01/2015	3 Year, *1
Cables	Room 12 Inbuilt cable Panel 1 to 3m (C-421)	4/02/2014	4/02/2015	1 Year, *1
	Room 12 Inbuilt cable Panel 1 to 10m (C-422)	6/02/2014	6/02/2015	1 Year, *1
	Room 12 Cable mast (C-437)	6/02/2014	6/02/2015	1 Year, *1

Note *1. Internal NATA calibration.
Note *2. External NATA / A2LA calibration