



# TEST REPORT

**Test Report No. : UL-RPT-RP88980JD05A V3.0**

**Manufacturer** : J.J MacKay Canada Limited / MacKay Meters, Inc.  
**Model No.** : Mackay Guardian Solo  
**FCC ID** : ZPZ0213MGSOLO  
**IC Certification No.** : 9753A-MGSOLO  
**Test Standard(s)** : FCC Parts 15.209(a), 15.225 & RSS-Gen 4.6.1, 4.7, 4.8, 4.9 & RSS-210 A2.6

1. This test report shall not be reproduced in full or partial, without the written approval of RFI Global Services Ltd trading as UL.
2. The results in this report apply only to the sample(s) tested.
3. This sample tested is in compliance with the above standard(s).
4. The test results in this report are traceable to the national or international standards.
5. Version 3.0 supersedes all previous versions

**Date of Issue:**

22 March 2013

**Checked by:**

Sarah Williams  
WiSE Laboratory Engineer

**Issued by :**

pp

John Newell  
Group Quality Manager, WiSE  
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UL Verification Services



This laboratory is accredited by UKAS.  
The tests reported herein have been  
performed in accordance with its' terms  
of accreditation.

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**1. Manufacturer**









<b>Company Name:</b>	J.J MacKay Canada Limited / MacKay Meters, Inc.
<b>Address:</b>	1342 Abercrombie Road New Glasgow Nova Scotia Canada B2H 5E3

## **2. Summary of Testing**

### **2.1. General Information**

<b>Specification Reference:</b>	47CFR15.225
<b>Specification Title:</b>	Code of Federal Regulations Volume 47 (Telecommunications) 2012: Part 15 Subpart C (Radio Frequency Devices) - Section 15.225
<b>Specification Reference:</b>	47CFR15.209
<b>Specification Title:</b>	Code of Federal Regulations Volume 47 (Telecommunications) 2012: Part 15 Subpart C (Intentional Radiators) - Section 15.209
<b>Specification Reference:</b>	RSS-Gen Issue 3 December 2010
<b>Specification Title:</b>	General Requirements and Information for the Certification of Radio Apparatus
<b>Specification Reference:</b>	RSS-210 Issue 8 December 2010
<b>Specification Title:</b>	Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment.
<b>Site Registration:</b>	FCC: 209735; Industry Canada: 3245B-2
<b>Location of Testing:</b>	RFI Global Services Ltd trading as UL, Wade Road, Basingstoke, Hampshire, RG24 8AH.
<b>Test Dates:</b>	11 December 2012 to 19 December 2012

### **2.2. Summary of Test Results**

<b>FCC Reference (47CFR)</b>	<b>IC Reference</b>	<b>Measurement</b>	<b>Result</b>
Part 15.225(a)(b)(c)(d)	RSS-Gen 4.8 RSS-210 A2.6	Transmitter Fundamental Field Strength	
Part 15.209(a)/ 15.225(d)	RSS-Gen 4.9 RSS-210 A2.6	Transmitter Radiated Emissions	
Part 15.209(a)/ 15.225(c)(d)	RSS-Gen 4.9 RSS-210 A2.6	Transmitter Band Edge Radiated Emissions	
Part 2.1049	RSS-Gen 4.6.3	Transmitter 20 dB Bandwidth	
N/A	RSS-Gen 4.6.1	Transmitter 99% Occupied Bandwidth	
Part 15.225(e)	RSS-Gen 4.7 RSS-210 A2.6	Transmitter Frequency Stability (Temperature & Voltage Variation)	
<b>Key to Results</b>  = Complied  = Did not comply			

**2.3. Methods and Procedures**

<b>Reference:</b>	ANSI C63.4 (2009)
<b>Title:</b>	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
<b>Reference:</b>	ANSI C63.10 (2009)
<b>Title:</b>	American National Standard for Testing Unlicensed Wireless Devices

**2.4. Deviations from the Test Specification**

For the measurements contained within this test report, there were no deviations from, additions to, or exclusions from the test specification identified above.

### **3. Equipment Under Test (EUT)**

#### **3.1. Identification of Equipment Under Test (EUT)**

Brand Name:	Mackay Meters
Model Name or Number:	Mackay Guardian Solo
Serial Number:	9000002
Hardware Version Number:	002
Software Version Number:	001
FCC ID:	ZPZ0213MGSOLO
IC Certification Number:	9753A-MGSOLO

#### **3.2. Description of EUT**

The equipment under test was a parking meter fitted with an RFID module transmitting at 127 kHz and 13.56 MHz.

#### **3.3. Modifications Incorporated in the EUT**

No modifications were applied to the EUT during testing.

#### **3.4. Additional Information Related to Testing**

Tested Technology:	RFID	
Category of Equipment:	Transceiver	
Channel Spacing:	Single channel device	
Transmit Frequency Range:	13.56 MHz	
Power Supply Requirement:	Nominal	9.0 VDC
	Minimum	7.65 VDC
	Maximum	10.35 VDC
Tested Temperature Range:	Minimum	-20°C
	Maximum	50°C

### **3.5. Support Equipment**

The following support equipment was used to exercise the EUT during testing:

<b>Description:</b>	Diagnosis Card
<b>Brand Name:</b>	Not marked or stated
<b>Model Name or Number:</b>	Not marked or stated
<b>Serial Number:</b>	Not marked or stated

<b>Description:</b>	Battery
<b>Brand Name:</b>	House of Batteries
<b>Model Name or Number:</b>	PN1300-L23C
<b>Serial Number:</b>	Not marked or stated



## **4. Operation and Monitoring of the EUT during Testing**

### **4.1. Operating Modes**

The EUT was tested in the following operating mode(s):

- Constantly transmitting at full power with a modulated carrier in test mode.

### **4.2. Configuration and Peripherals**

The EUT was tested in the following configuration(s):

- The test mode was enabled by inserting a Diagnosis Card into the EUT and pressing a sequence of buttons to active the transmitter. The Customer supplied instructions on how to configure the EUT for test purposes.
- A fully charged battery was fitted before the testing commenced and the voltage levels were monitored during testing.

## **5. Measurements, Examinations and Derived Results**

### **5.1. General Comments**

Measurement uncertainties are evaluated in accordance with current best practice. Our reported expanded uncertainties are based on standard uncertainties, which are multiplied by an appropriate coverage factor to provide a statistical confidence level of approximately 95%. Please refer to *Section 6: Measurement Uncertainties* for details.

In accordance with UKAS requirements all the measurement equipment is on a calibration schedule. All equipment was within the calibration period on the date of testing.

## 5.2. Test Results

### 5.2.1. Transmitter Fundamental Field Strength

#### Test Summary:

Test Engineer:	Andrew Edwards	Test Date:	11 December 2012
Test Sample Serial Number:	9000002		

FCC Reference:	Parts 15.225(a)(b)(c)(d)
Industry Canada Reference:	RSS-Gen 4.8 & RSS-210 A2.6
Test Method Used:	As detailed in ANSI C63.10 Section 6.4

#### Environmental Conditions:

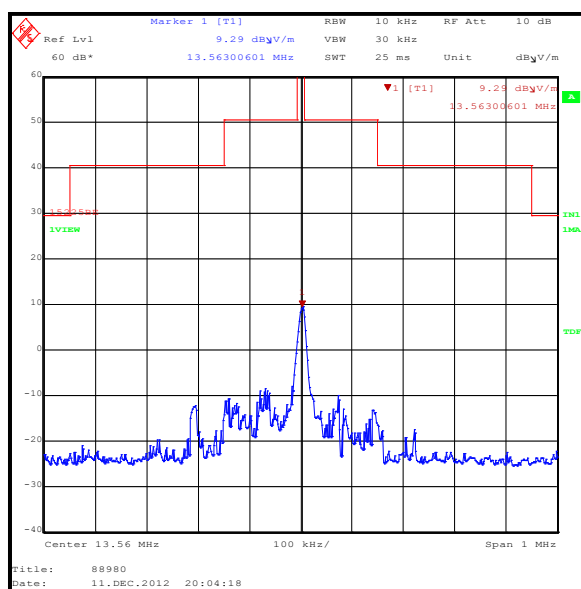
Temperature (°C):	24
Relative Humidity (%):	28

#### Note(s):

1. The limit is specified at a test distance of 30 metres. However, as specified by FCC Section 15.31 (f)(2), measurements may be performed at a closer distance and the measured level corrected to the specified measurement distance by using the square of an inverse linear distance extrapolation factor (40 dB/decade).
2. A transducer factor on the measuring instrument was used to extrapolate the results at 3 metres to a distance of 30 metres. A distance extrapolation factor of 40 dB was used.

#### Results: Quasi Peak

Frequency (MHz)	Antenna Polarity	Level (dB $\mu$ V/m)	Limit at 30 m (dB $\mu$ V/m)	Margin (dB)	Result
13.56	90° to EUT	9.4	84.0	74.6	Complied



**Transmitter Fundamental Field Strength (continued)****Test Equipment Used:**

RFI No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
K0001	5m RSE Chamber	Rainford EMC	N/A	N/A	24 Oct 2013	12
M1273	Test Receiver	Rohde & Schwarz	ESIB 26	100275	03 Feb 2013	12
M1536	Magnetic Loop Antenna	Rohde & Schwarz	HFH2-Z2	879284/2	27 Jan 2013	12

### **5.2.2. Transmitter Radiated Spurious Emissions**

#### **Test Summary:**

<b>Test Engineers:</b>	Andrew Edwards & Nick Steele	<b>Test Dates:</b>	11 December 2012 & 12 December 2012
<b>Test Sample Serial Number:</b>	9000002		

<b>FCC Reference:</b>	Parts 15.225(d) & 15.209(a)
<b>Industry Canada Reference:</b>	RSS-Gen 4.9 & RSS-210 A2.6
<b>Test Method Used:</b>	As detailed in ANSI C63.10 Sections 6.3, 6.4 and 6.5 referencing ANSI C63.4
<b>Frequency Range:</b>	9 kHz to 1000 MHz

#### **Environmental Conditions:**

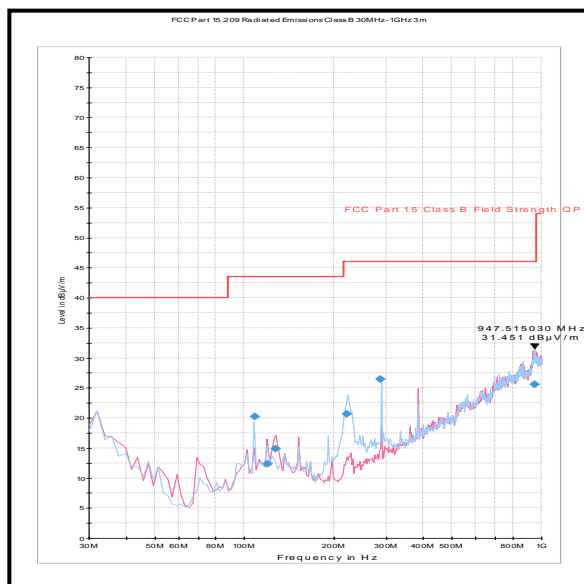
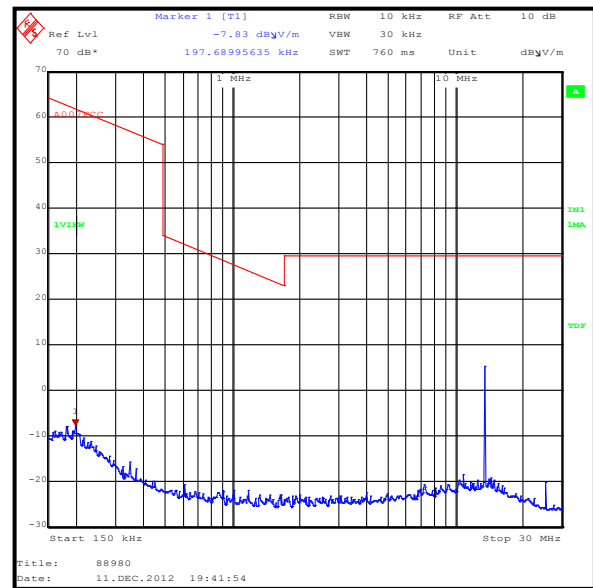
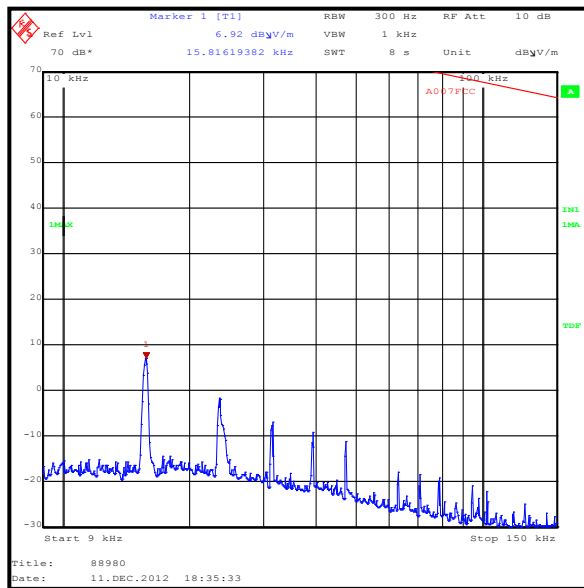
<b>Temperature (°C):</b>	23 to 25
<b>Relative Humidity (%):</b>	27 to 28

#### **Note(s):**

1. Limits below 30 MHz are specified at a test distance of 30 metres, whilst below 0.49 MHz they are specified at a test distance of 300 metres. However, as specified by FCC Section 15.31 (f)(2), measurements may be performed at a closer distance and the measured level corrected to the specified measurement distance by using the square of an inverse linear distance extrapolation factor (40dB/decade).
2. A transducer factor on the measuring instrument was used to extrapolate the results at 3 metres to a distance of 30 metres where required. A distance extrapolation factor of 40 dB was used.
3. Final measurement values include corrections for antenna factor and cable losses.
4. The emission shown at approximately 13.56 MHz is the fundamental.
5. All emissions on the 9 kHz to 150 kHz plot were investigated and found to be radiating from the test site turntable.
6. All other emissions shown on the pre-scan plots were investigated and found to be >20 dB below the applicable limit or below the measurement system noise floor.
7. Measurements in the range 30 MHz to 1 GHz were performed in a semi-anechoic chamber (RFI Asset Number K0001) at a distance of 3 metres. The EUT was placed at a height of 80 cm above the reference ground plane in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.

#### **Results: Quasi Peak**

<b>Frequency (MHz)</b>	<b>Antenna Polarity</b>	<b>Level (dB<math>\mu</math>V/m)</b>	<b>Limit (dB<math>\mu</math>V/m)</b>	<b>Margin (dB)</b>	<b>Result</b>
108.491	Horizontal	20.2	43.5	23.3	Complied

**Transmitter Radiated Spurious Emissions (continued)**

Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying table.

**Test Equipment Used:**

RFI No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
A1834	Attenuator	Hewlett Packard	8491B	10444	29 Jan 2013	12
A553	Antenna	Chase	CBL6111A	1593	15 Feb 2013	12
G0543	Amplifier	Sonoma	310N	230801	02 Jan 2013	3
K0001	5m RSE Chamber	Rainford EMC	N/A	N/A	24 Oct 2013	12
M1273	Test Receiver	Rohde & Schwarz	ESIB 26	100275	03 Feb 2013	12
M1536	Magnetic Loop Antenna	Rohde & Schwarz	HFH2-Z2	879284/2	27 Jan 2013	12

**5.2.3. Transmitter Band Edge Radiated Emissions****Test Summary:**

Test Engineer:	Andrew Edwards	Test Date:	11 December 2012
Test Sample Serial Number:	9000002		

FCC Reference:	Parts 15.225(d) & 15.209(a)
Industry Canada Reference:	RSS-Gen 4.9 & RSS-210 A2.6
Test Method Used:	As detailed in ANSI C63.10 Section 6.9.2

**Environmental Conditions:**

Temperature (°C):	24
Relative Humidity (%):	38

**Note(s):**

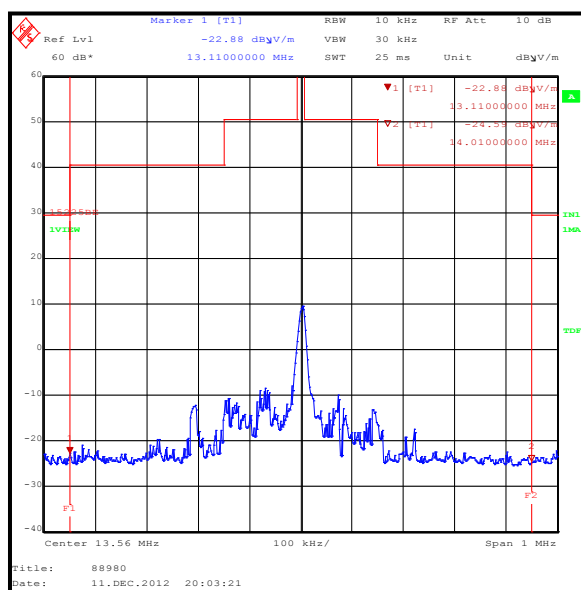
1. A transducer factor on the measuring instrument was used to extrapolate the results at 3 metres to a distance of 30 metres where required. A distance extrapolation factor of 40 dB was used.

**Results: Quasi Peak Lower Band Edge**

Frequency (MHz)	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
13.11	-31.4	29.5	60.9	Complied

**Results: Quasi Peak Upper Band Edge**

Frequency (MHz)	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
14.01	-32.2	29.5	61.7	Complied



**Transmitter Band Edge Radiated Emissions (continued)****Test Equipment Used:**

RFI No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
K0001	5m RSE Chamber	Rainford EMC	N/A	N/A	24 Oct 2013	12
M1273	Test Receiver	Rohde & Schwarz	ESIB 26	100275	03 Feb 2013	12
M1536	Magnetic Loop Antenna	Rohde & Schwarz	HFH2-Z2	879284/2	27 Jan 2013	12



**5.2.4. Transmitter 20 dB Bandwidth****Test Summary:**

Test Engineer:	Sarah Williams	Test Date:	19 December 2012
Test Sample Serial Number:	9000002		

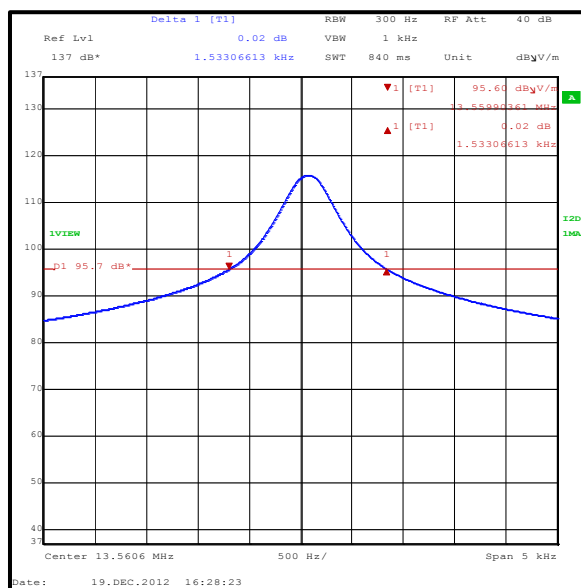
FCC Reference:	Part 2.1049
Industry Canada Reference:	RSS-Gen 4.6.3
Test Method Used:	As detailed in ANSI C63.10 Section 6.9.1

**Environmental Conditions:**

Temperature (°C):	27
Relative Humidity (%):	30

**Results:**

<b>20 dB Bandwidth (kHz)</b>
1.533

**Test Equipment Used:**

RFI No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1379	Test Receiver	Rohde & Schwarz	ESIB 7	100330	15 Oct 2013	12
M1536	Magnetic Loop Antenna	Rohde & Schwarz	HFH2-Z2	879284/2	27 Jan 2013	12

**5.2.5. Transmitter 99% Occupied Bandwidth****Test Summary:**

Test Engineer:	Sarah Williams	Test Date:	19 December 2012
Test Sample Serial Number:	9000002		

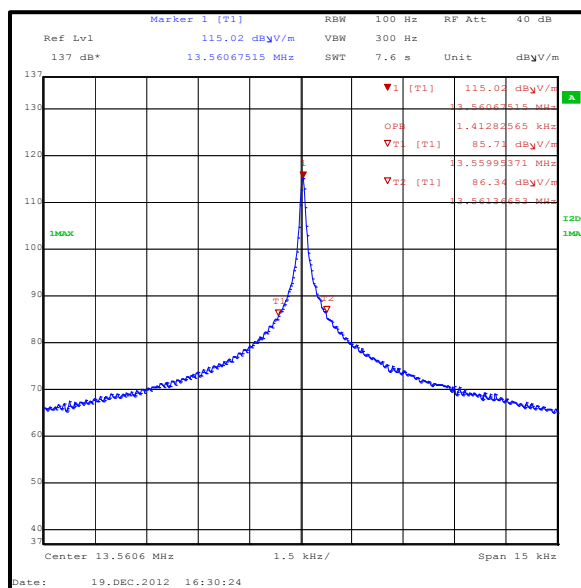
FCC Reference:	N/A
Industry Canada Reference:	RSS-Gen 4.6.1
Test Method Used:	Test receiver 99% occupied bandwidth function

**Environmental Conditions:**

Temperature (°C):	27
Relative Humidity (%):	30

**Results:**

<b>99% Emission Bandwidth (kHz)</b>
1.413

**Test Equipment Used:**

RFI No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1379	Test Receiver	Rohde & Schwarz	ESIB 7	100330	15 Oct 2013	12
M1536	Magnetic Loop Antenna	Rohde & Schwarz	HFH2-Z2	879284/2	27 Jan 2013	12

**5.2.6. Transmitter Frequency Stability (Temperature & Voltage Variation)****Test Summary:**

<b>Test Engineer:</b>	Andrew Edwards	<b>Test Date:</b>	12 December 2012
<b>Test Sample Serial Number:</b>	9000002		

<b>FCC Reference:</b>	Part 15.225€
<b>Industry Canada Reference:</b>	RSS-Gen 4.7 & RSS-210 A2.6
<b>Test Method Used:</b>	As detailed in ANSI C63.10 Section 6.8.1 and 6.8.2

**Environmental Conditions:**

<b>Temperature (°C):</b>	25
<b>Relative Humidity (%):</b>	26

**Results: Maximum frequency error of the EUT with variations in ambient temperature**

Temperature (°C)	Time after Start-up			
	0 minutes	2 minutes	5 minutes	10 minutes
-20	13.560574 MHz	13.560608 MHz	13.560612 MHz	13.560611 MHz
20	13.560645 MHz	13.560642 MHz	13.560641 MHz	13.560641 MHz
50	13.560702 MHz	13.560703 MHz	13.560704 MHz	13.560704 MHz

Frequency with Worst Case Deviation (MHz)	Frequency Error (Hz)	Frequency Error (%)	Limit (%)	Margin (%)	Result
13.560704	704	0.0052	0.01	0.0048	Complied

**Results: Maximum frequency error of the EUT with variations in nominal operating voltage at an ambient temperature of 20°C**

Supply Voltage (V)	Nominal Frequency (MHz)	Measured Frequency (MHz)	Frequency Error (Hz)	Frequency Error (%)	Limit (%)	Margin (%)	Result
7.65	13.56	13.560643	643	0.0047	0.01	0.0053	Complied
9.0	13.56	13.560645	645	0.0048	0.01	0.0052	Complied
10.35	13.56	13.560642	642	0.0047	0.01	0.0053	Complied

**Transmitter Frequency Stability (Temperature & Voltage Variation) (continued)****Test Equipment Used:**

RFI No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
E013	Environmental Chamber	Sanyo	MTH-4200PR	None	Calibrated before use	-
M1269	Multimeter	Fluke	179	90250210	30 Jul 2013	12
M1630	Test Receiver	Rohde & Schwarz	ESU 40	100233	06 Feb 2013	12
M1642	Thermometer	Fluke	52II	18890119	21 Feb 2013	12
S021	Dual DC power supply	Thurlby Thandar Instruments	CPX200	061034	Calibrated before use	-

## **6. Measurement Uncertainty**

No measurement or test can ever be perfect and the imperfections give rise to error of measurement in the results. Consequently the result of a measurement is only an approximation to the value of the measurand (the specific quantity subject to measurement) and is only complete when accompanied by a statement of the uncertainty of the approximation.

The expression of uncertainty of a measurement result allows realistic comparison of results with reference values and limits given in specifications and standards.

The uncertainty of the result may need to be taken into account when interpreting the measurement results.

The reported expanded uncertainties below are based on a standard uncertainty multiplied by an appropriate coverage factor such that a confidence level of approximately 95% is maintained. For the purposes of this document “approximately” is interpreted as meaning “effectively” or “for most practical purposes”.

Measurement Type	Range	Confidence Level (%)	Calculated Uncertainty
20 dB Bandwidth	13 MHz to 14 MHz	95%	±0.92 ppm
99% Occupied Bandwidth	13 MHz to 14 MHz	95%	±0.92 ppm
Frequency Stability	13 MHz to 14 MHz	95%	±0.92 ppm
Radiated Spurious Emissions	9 kHz to 30 MHz	95%	±3.53 dB
Radiated Spurious Emissions	30 MHz to 1000 MHz	95%	±2.94 dB
Transmitter Fundamental Field Strength	13 MHz to 14 MHz	95%	±3.53 dB

The methods used to calculate the above uncertainties are in line with those recommended within the various measurement specifications. Where measurement specifications do not include guidelines for the evaluation of measurement uncertainty the published guidance of the appropriate accreditation body is followed.

**7. Report Revision History**

Version Number	Revision Details		
	Page No(s)	Clause	Details
1.0	-	-	Initial Version
2.0	-	-	Update to Manufacturers name
3.0	-	-	FCC ID updated