



TEST REPORT

Test Report No. : UL-RPT-RP81979JD06A V2.0

Manufacturer : Connected Development LLC
Model No. : Mackay Guardian Solo MGSOLO
FCC ID : ZPZ0711MGSOLO
IC Certification No. : 9753A-MGSOLO
Technology : RFID – 13.56 MHz
Test Standard(s) : FCC Part 15.225: Subpart C
Industry Canada RSS-210 Issue 8 & RSS-Gen Issue 3

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2. The results in this report apply only to the sample(s) tested.
3. The 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 2.0 supersedes Test Report Serial Number RFI-RPT-RP81979JD06A. The original test report was issued under the previous company name of RFI Global Services Ltd.

Date of Issue: 31 July 2015

Checked by:

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Senior Engineer, Radio Laboratory

Issued by :

pp
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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.Customer Information

| | |
|----------------------|--|
| Company Name: | Connected Development LLC |
| Address: | 5020 Weston Parkway Suite 215 Cary, NC 27513 United States |

2. Summary of Testing

2.1. General Information

| | |
|---------------------------------|---|
| Specification Reference: | 47CFR15.225 |
| Specification Title: | Code of Federal Regulations Volume 47 (Telecommunications) 2010: Part 15 Subpart C (Radio Frequency Devices) - Section 15.225 |
| Specification Reference: | 47CFR15.109 |
| Specification Title: | Code of Federal Regulations Volume 47 (Telecommunications) 2010: Part 15 Subpart B (Radio Frequency Devices) – Section 15.109 |
| Specification Reference: | 47CFR15.209 |
| Specification Title: | Code of Federal Regulations Volume 47 (Telecommunications) 2010: Part 15 Subpart C (Intentional Radiators) - Section 15.209 |
| Specification Reference: | RSS-Gen Issue 3 December 2010 |
| Specification Title: | General Requirements and Information for the Certification of Radio Apparatus |
| Specification Reference: | RSS-210 Issue 8 December 2010 |
| Specification Title: | Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment. |
| Site Registration: | FCC: 209735; Industry Canada: 3245B-2 |
| Location of Testing: | UL VS LTD, Unit 3 Horizon, Wade Road, Kingsland Business Park, Basingstoke, Hampshire, RG24 8AH, United Kingdom |
| Test Dates: | 21 July 2011 to 28 July 2011 |

2.2. Summary of Test Results

| FCC Reference (47CFR) | IC Reference | Measurement | Result |
|---------------------------------|-----------------------------|---|--------|
| Part 15.109 | RSS-Gen 4.10/6.1 | Receiver/Idle Mode Radiated Spurious Emissions | ✓ |
| 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 4.6.1/4.6.3 | Transmitter 20 dB Bandwidth | ✓ |
| Part 15.225(e) | RSS-Gen 4.7 RSS-210 A2.6 | Transmitter Frequency Stability (Temperature & Voltage Variation) | ✓ |
| Key to Results | | | |
| ✓ = Complied | ✗ = Did not comply | | |

2.3.Methods and Procedures

| | |
|-------------------|---|
| Reference: | ANSI C63.4 (2009) |
| Title: | 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 |
| Reference: | ANSI C63.10 (2009) |
| Title: | 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 Guardian Solo |
| Model Number: | MGSOLO |
| Serial Number: | 9000001 |
| Hardware Version Number: | 001 |
| Software Version Number: | 001 |
| FCC ID: | ZPZ0711MGSOLO |
| IC Certification Number: | 9753A-MGSOLO |

3.2. Description of EUT

The equipment under test was a parking meter fitted with an RFID module.

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 | |
| Receive Frequency Range: | 13.56 MHz | |
| Power Supply Requirement: | Nominal | 4.8 V |
| | Minimum | 3.8 V |
| | Maximum | 5.2 V |
| Tested Temperature Range: | Minimum | -20°C |
| | Maximum | 50°C |

3.5. Support Equipment

No following support equipment was used to exercise the EUT during testing.

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):

- Test mode was enabled by pressing the right hand green tick key on the front panel of the EUT. A test mode was implemented on the device for test purposes only.
- A fully charged battery was fitted before testing commenced.

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.

5.2. Test Results

5.2.1. Transmitter Fundamental Field Strength

Test Summary:

| | | | |
|------------------------|----------------|------------|--------------|
| Test Engineer: | Andrew Edwards | Test Date: | 21 July 2011 |
| Test Sample Serial No: | 9000001 | | |

| | |
|-------------------|--|
| FCC Part: | 15.225(a)(b)(c)(d) |
| Test Method Used: | As detailed in ANSI C63.10 Section 6.4 |

Environmental Conditions:

| | |
|------------------------|----|
| Temperature (°C): | 29 |
| Relative Humidity (%): | 36 |

Results: Quasi Peak

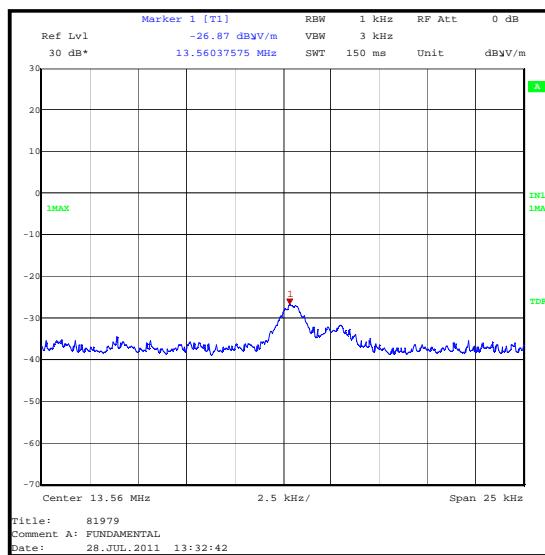
| Frequency (MHz) | Antenna Polarity | Level (dB μ V/m) | Limit at 30 m (dB μ V/m) | Margin (dB) | Result |
|-----------------|------------------|----------------------|------------------------------|-------------|----------|
| 13.56 | 90° to EUT | -5.4 | 84.0 | 89.4 | Complied |

Note(s):

1. The limit is specified at a test distance of 30 metres. However, as specified by FCC Part 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. A distance extrapolation factor of 40 dB was used.
3. At 10 kHz resolution bandwidth the Fundamental field strength was below the noise floor, therefore the Fundamental field strength was measured with 1 kHz bandwidth

Note: An additional 20 dB has been added to attain the final value shown in the table; this is to account for a transducer factor that was not included during the original measurement.

$$i.e.: -25.4 \text{ dBuV/m} + 20 \text{ dB} = -5.4 \text{ dBuV/m}$$

Transmitter Fundamental Field Strength (continued)

5.2.2. Transmitter Radiated Spurious Emissions**Test Summary:**

| | | | |
|------------------------|----------------|------------|--------------------------------|
| Test Engineer: | Andrew Edwards | Test Date: | 21 July 2011 & 28 July 2011 |
| Test Sample Serial No: | 9000001 | | |

| | |
|-------------------|---|
| FCC Part: | 15.225(d) & 15.209(a) |
| Test Method Used: | As detailed in ANSI C63.10 Sections 6.3, 6.4 and 6.5 referencing ANSI C63.4 |
| Frequency Range: | 9 kHz to 1000 MHz |

Environmental Conditions:

| | |
|------------------------|----|
| Temperature (°C): | 29 |
| Relative Humidity (%): | 34 |

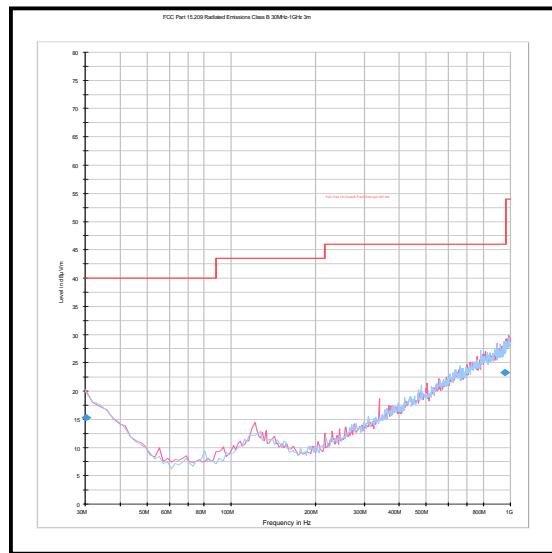
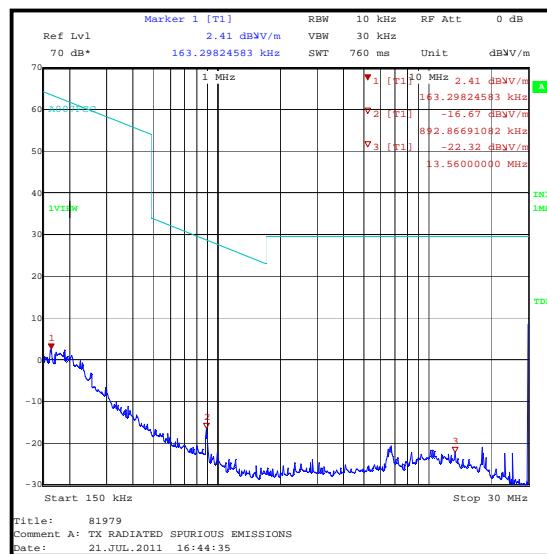
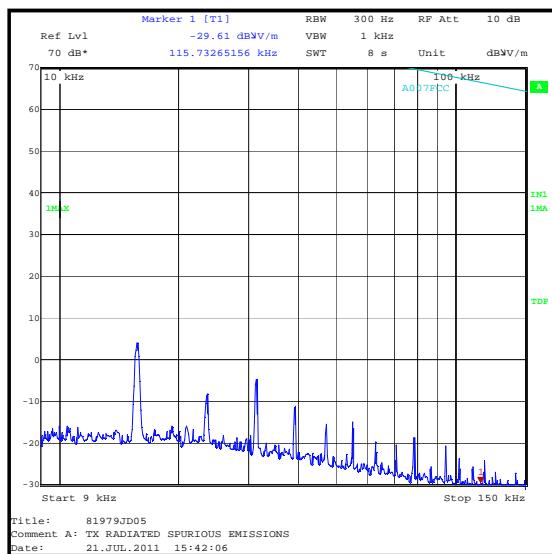
Results: Quasi Peak

| Frequency (MHz) | Antenna Polarity | Level (dB μ V/m) | Limit (dB μ V/m) | Margin (dB) | Result |
|-----------------|------------------|----------------------|----------------------|-------------|----------|
| 30.341 | Vertical | 15.2 | 40.0 | 24.8 | Complied |
| 958.173 | Vertical | 23.3 | 46.0 | 22.7 | Complied |

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 (UL 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.

Transmitter Radiated Spurious Emissions (continued)



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

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

| | | | |
|------------------------|----------------|------------|--------------|
| Test Engineer: | Andrew Edwards | Test Date: | 28 July 2011 |
| Test Sample Serial No: | 9000001 | | |

| | |
|-------------------|--|
| FCC Part: | 15.225(c)(d) & 15.209(a) |
| Test Method Used: | As detailed in ANSI C63.10 Section 6.9.2 |

Environmental Conditions:

| | |
|------------------------|----|
| Temperature (°C): | 29 |
| Relative Humidity (%): | 30 |

Results: Quasi Peak Lower Band Edge

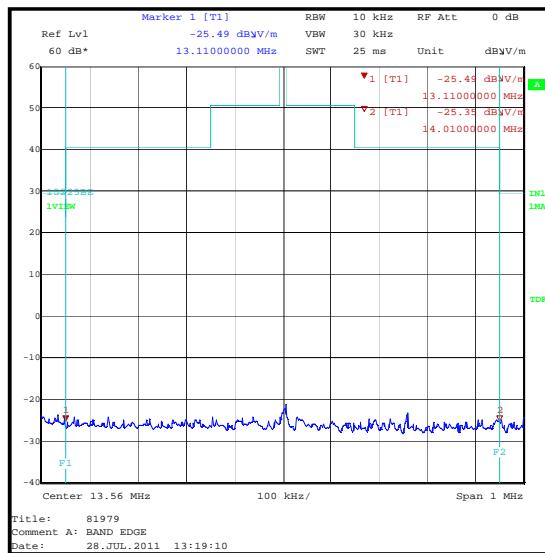
| Frequency (MHz) | Level (dB μ V/m) | Limit (dB μ V/m) | Margin (dB) | Result |
|-----------------|----------------------|----------------------|-------------|----------|
| 13.11 | -12.9 | 29.5 | 42.4 | Complied |

Results: Quasi Peak Upper Band Edge

| Frequency (MHz) | Level (dB μ V/m) | Limit (dB μ V/m) | Margin (dB) | Result |
|-----------------|----------------------|----------------------|-------------|----------|
| 14.01 | -13.0 | 29.5 | 42.5 | Complied |

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.
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. The band edge emission plot shown below is low by a factor of 20 dB, due to the absence of a transducer factor at the time of measurement. An additional 20 dB was subsequently added to any band edge measurements, for comparisons with the limit, when determining compliance.

Transmitter Band Edge Radiated Emissions (continued)

5.2.4. Transmitter 20 dB Bandwidth

Test Summary:

| | | | |
|-------------------------------|----------------|-------------------|--------------|
| Test Engineer: | Andrew Edwards | Test Date: | 28 July 2011 |
| Test Sample Serial No: | 9000001 | | |

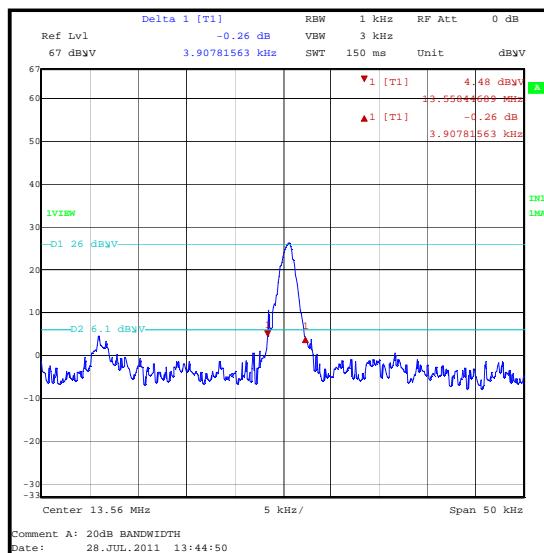
| | |
|--------------------------|--|
| FCC Part: | 2.1049 |
| Test Method Used: | As detailed in ANSI C63.10 Section 6.9.1 |

Environmental Conditions:

| | |
|-------------------------------|----|
| Temperature (°C): | 30 |
| Relative Humidity (%): | 29 |

Results:

| 20 dB Bandwidth (kHz) | |
|----------------------------------|-------|
| | 3.908 |



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

| | | | |
|------------------------|----------------|------------|--------------|
| Test Engineer: | Andrew Edwards | Test Date: | 28 July 2011 |
| Test Sample Serial No: | 9000001 | | |

| | |
|-------------------|--|
| FCC Part: | 15.225(e) |
| Test Method Used: | As detailed in ANSI C63.10 Section 6.8.1 and 6.8.2 |

Environmental Conditions:

| | |
|--------------------------------|----|
| Ambient Temperature (°C): | 20 |
| Ambient Relative Humidity (%): | 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 | 13.560562 MHz | 13.560561 MHz | 13.560547 MHz | 13.560542 MHz |
| 20 | 13.560497 MHz | 13.560494 MHz | 13.560493 MHz | 13.560493 MHz |
| 50 | 13.560422 MHz | 13.560406 MHz | 13.560402 MHz | 13.560401 MHz |

| Frequency with Worst Case Deviation (MHz) | Frequency Error (Hz) | Frequency Error (%) | Limit (%) | Margin (%) | Result |
|---|----------------------|---------------------|-----------|------------|----------|
| 13.560562 | 562 | 0.004145 | 0.01 | 0.00586 | 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 |
|--------------------|-------------------------|--------------------------|----------------------|---------------------|-----------|------------|----------|
| 3.8 | 13.56 | 13.560494 | 494 | 0.0036 | 0.01 | 0.0064 | Complied |
| 4.5 | 13.56 | 13.560497 | 497 | 0.0037 | 0.01 | 0.0063 | Complied |
| 5.2 | 13.56 | 13.560495 | 495 | 0.0037 | 0.01 | 0.0063 | Complied |

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 |
| 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 | 10 & 14 | - | Corrected previously reported emissions levels by +20 dB |

Appendix 1. Test Equipment Used

| UL No. | Instrument | Manufacturer | Type No. | Serial No. | Date Calibration Due | Cal. Interval (Months) |
|--------|-------------------|-----------------|----------|-------------|----------------------|------------------------|
| A1834 | Attenuator | Hewlett Packard | 8491B | 10444 | 26 Jul 2012 | 12 |
| A553 | Antenna | Chase | CBL6111A | 1593 | 26 Mar 2012 | 12 |
| K0001 | 5m RSE Chamber | Rainford EMC | N/A | N/A | 29 May 2012 | 12 |
| M1068 | Thermometer | Iso-Tech | RS55 | 93102884 | 10 Nov 2011 | 12 |
| M127 | Spectrum Analyser | Rohde & Schwarz | FSEB 30 | 842 659/016 | 15 Sep 2011 | 12 |
| M1273 | Test Receiver | Rohde & Schwarz | ESIB 26 | 100275 | 04 Feb 2012 | 12 |
| M1568 | Magnetic Loop | Rohde & Schwarz | HFH2-Z2 | 879284/2 | 27 Jan 2012 | 12 |

NB In accordance with UKAS requirements all the measurement equipment is on a calibration schedule.

--- END OF REPORT ---