

**AN RADIO TEST REPORT**  
**FOR**  
**CONTROLLED ELECTRONIC MANAGEMENT SYSTEMS**  
**LIMITED**  
**ON**  
**EMERALD TSR V9**  
**DOCUMENT NO.TRA-021653-00-47-00A**

**HULL**

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**TRaC Wireless Test Report** : TRA-021653-00-47-00A

**Applicant** : Controlled Electronic Management Systems Limited

**Apparatus** : Emerald TSR V9

**Specification(s)** : CFR47 Part 15 (c) & RSS-210

**Purpose of Test** : Certification

**FCCID** : QABTSR105V910

**Certification Number** : 12009A-TSR105V910

**Authorised by** :



: Radio Product Manager

**Issue Date** : 6<sup>th</sup> August 2014

**Authorised Copy Number** : PDF

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**Section 1:****Introduction****1.1 General**

This report contains an assessment of an apparatus against Electromagnetic Compatibility Standards based upon tests carried out on samples submitted to the Laboratory.

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## **1.2 Tests Requested By**

This testing in this report was requested by:

Controlled Electronic Management  
Systems Limited  
t/a Tyco Security Products  
195 Airport Road  
Belfast  
Northern Ireland  
BT3 9ED

## **1.3 Manufacturer**

As Above

## **1.4 Apparatus Assessed**

The following apparatus was assessed between 01 July 2014 and 07 July 2014:

- Emerald TSR V9

The above device is a door access RFID reader. It has got two variants given below.

- Emerald TSR V9 powered by POE
- Emerald TSR V9 powered by 12V battery

Radiated spurious emission is done on both variants.

## 1.5 Test Result Summary

Full details of test results are contained within Appendix A. The following table summarises the results of the assessment.

The statements relating to compliance with the standards below apply ONLY as qualified in the notes and deviations stated in sections 1.6 to 1.7 of this test report.

Full details of test results are contained within Appendix A. The following table summarises the results of the assessment.

| Test Type                           | Regulations  |   | Measurement standard | Result |
|-------------------------------------|--|---|----------------------|--------|
|                                     | Title 47 of the CFR:<br>Part 15 Subpart (c)                  | RSS – 210 Issue<br>8 & RSS-Gen<br>Issue 3 |                      |        |
| In-Band Emissions                   | Title 47 of the CFR:<br>Part 15 Subpart (c) 15.225 (a)(b)(c) | RSS – 210 Issue<br>8 (A2.6)               | ANSI C63.10          | Pass   |
| Out-of-Band Emissions               | Title 47 of the CFR:<br>Part 15 Subpart (c) 15.225(d)        | RSS – 210 Issue<br>8 (A2.6)               | ANSI C63.10          | Pass   |
| Frequency Tolerance                 | Title 47 of the CFR:<br>Part 15 Subpart (c) 15.225(e)        | RSS – 210 Issue<br>8 (A2.6)               | ANSI C63.10          | Pass   |
| Intentional Emission Band Occupancy | Title 47 of the CFR:<br>Part 15 Subpart (c) 15.215(c)        | RSS – Gen Issue<br>3 4.6.1                | ANSI C63.10          | Pass   |
| AC Power conducted emissions        | Title 47 of the CFR:<br>Part 15 Subpart (c); 15.207          | RSS-GEN Issue 3<br>7.2.4                  | ANSI C63.10          | Pass   |

Abbreviations used in the above table:

CFR : Code of Federal Regulations  
REFE : Radiated Electric Field Emissions

ANSI : American National Standards Institution  
PLCE : Power Line Conducted Emissions

## **1.6 Notes Relating To the Assessment**

With regard to this assessment, the following points should be noted:

The results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.

The apparatus was set up and exercised using the configurations, modes of operation and arrangements defined in this report only.

Particular operating modes, apparatus monitoring methods and performance criteria required by the standards tested to have been performed except where identified in Section 1.7 of this test report (Deviations from Test Standards).

For emissions testing, throughout this test report, "Pass" indicates that the results for the sample as tested were below the specified limit (refer also to Section 2, Measurement Uncertainty).

Where relevant, the apparatus was only assessed using the monitoring methods and susceptibility criteria defined in this report.

All testing with the exception of testing at the Open Area Test Site was performed under the following environmental conditions:

|                     |                 |
|---------------------|-----------------|
| Temperature         | : 17 to 23 °C   |
| Humidity            | : 45 to 75 %    |
| Barometric Pressure | : 86 to 106 kPa |

All dates used in this report are in the format dd/mm/yy.

This assessment has been performed in accordance with the requirements of ISO/IEC 17025.

## **1.7 Deviations from Test Standards**

There were no deviations from the standards tested to.

**Section 2:****Measurement Uncertainty****2.1 Measurement Uncertainty Values**

For the test data recorded in accordance with note (iii) of Section 2.1 the following measurement uncertainty was calculated:

**Radio Testing – General Uncertainty Schedule**

*All statements of uncertainty are expanded standard uncertainty using a coverage factor of 1.96 to give a 95% confidence where no required test level exists.*

**[1] Adjacent Channel Power**

Uncertainty in test result = **1.86dB**

**[2] Carrier Power**

Uncertainty in test result (Power Meter) = **1.08dB**

Uncertainty in test result (Spectrum Analyser) = **2.48dB**

**[3] Effective Radiated Power**

Uncertainty in test result = **4.71dB**

**[4] Spurious Emissions**

Uncertainty in test result = **4.75dB**

**[5] Maximum frequency error**

Uncertainty in test result (Frequency Counter) = **0.113ppm**

Uncertainty in test result (Spectrum Analyser) = **0.265ppm**

**[6] Radiated Emissions, field strength OATS 14kHz-18GHz Electric Field**

Uncertainty in test result (14kHz – 30MHz) = **4.8dB**,

Uncertainty in test result (30MHz – 1GHz) = **4.6dB**,

Uncertainty in test result (1GHz – 18GHz) = **4.7dB**

**[7] Frequency deviation**

Uncertainty in test result = **3.2%**

**[8] Magnetic Field Emissions**

Uncertainty in test result = **2.3dB**

**[9] Conducted Spurious**

Uncertainty in test result – Up to 8.1GHz = **3.31dB**

Uncertainty in test result – 8.1GHz – 15.3GHz = **4.43dB**

Uncertainty in test result – 15.3GHz – 21GHz = **5.34dB**

Uncertainty in test result – Up to 26GHz = **3.14dB**

**[10] Channel Bandwidth**

Uncertainty in test result = **15.5%**



**[11] Amplitude and Time Measurement – Oscilloscope**

Uncertainty in overall test level = **2.1dB**,  
Uncertainty in time measurement = **0.59%**,  
Uncertainty in Amplitude measurement = **0.82%**

**[12] Power Line Conduction**

Uncertainty in test result = **3.4dB**

**[13] Spectrum Mask Measurements**

Uncertainty in test result = **2.59% (frequency)**  
Uncertainty in test result = **1.32dB (amplitude)**

**[14] Adjacent Sub Band Selectivity**

Uncertainty in test result = **1.24dB**

**[15] Receiver Blocking – Listen Mode, Radiated**

Uncertainty in test result = **3.42dB**

**[16] Receiver Blocking – Talk Mode, Radiated**

Uncertainty in test result = **3.36dB**

**[17] Receiver Blocking – Talk Mode, Conducted**

Uncertainty in test result = **1.24dB**

**[18] Receiver Threshold**

Uncertainty in test result = **3.23dB**

**[19] Transmission Time Measurement**

Uncertainty in test result = **7.98%**

## **Section 3:**

## **Modifications**

### **3.1 Modifications Performed During Assessment**

No modifications were performed during the assessment

**Appendix A:****Formal Emission Test Results**

Abbreviations used in the tables in this appendix:

|      |                                 |      |                                |
|------|---------------------------------|------|--------------------------------|
| Spec | : Specification                 | ALSR | : Absorber Lined Screened Room |
| Mod  | : Modification                  | OATS | : Open Area Test Site          |
|      |                                 | ATS  | : Alternative Test Site        |
| EUT  | : Equipment Under Test          |      |                                |
| SE   | : Support Equipment             | Ref  | : Reference                    |
|      |                                 | Freq | : Frequency                    |
| L    | : Live Power Line               |      |                                |
| N    | : Neutral Power Line            | MD   | : Measurement Distance         |
| E    | : Earth Power Line              | SD   | : Spec Distance                |
|      |                                 |      |                                |
| Pk   | : Peak Detector                 | Pol  | : Polarisation                 |
| QP   | : Quasi-Peak Detector           | H    | : Horizontal Polarisation      |
| Av   | : Average Detector              | V    | : Vertical Polarisation        |
|      |                                 |      |                                |
| CDN  | : Coupling & decoupling network |      |                                |

**A1 Transmitter Intentional Emission Radiated**

| <b>Test Details:</b>     |  |
|--------------------------|--|
| Regulation               | Part15 Subpart (c) 15.225(a), RSS-210 A2.6 |
| Measurement standard     | ANSI C63.10:2009                           |
| EUT sample number        | S01  |
| Modification state       | 0  |
| SE in test environment   | S07, S09                                   |
| SE isolated from EUT     | S03, S04                                   |
| EUT set up               | Refer to Appendix C                        |
| Temperature              | 24.2°C                                     |
| Photographs (Appendix F) | 1  |

| <b>FREQ.<br/>(MHz)</b> | <b>MEASUREMENT<br/>DISTANCE<br/>(Metres)</b> | <b>MEASUREMENT<br/>Rx. READING<br/>(dBµV/m)</b> | <b>EXTRAP.<br/>FACTOR<br/>(dB)</b> | <b>FIELD<br/>STRENGTH<br/>(µV/m)</b> |
|------------------------|--|---|------------------------------------|--------------------------------------|
| 13.56                  | 1  | 97.10   | 60.80                              | 65.31                                |
| 13.56                  | 3  | 76.30   | 40.00                              | 65.31                                |
| Limit value @ fc       |  | 15848 µV/m @ 30metres                           |                                    |                                      |

**Notes:**

- 1 Results quoted are extrapolated as indicated
- 2 Receiver detector @ fc = Quasi Peak with 120kHz bandwidth
- 3 Extrapolation <30 MHz 40dB/decade as per 15.31(f)(2) & RSS Gen 7.2.7
- 4 3 – 30 metre extrapolation 40 dB (40dB/decade) as per 15.31(f)(2)
- 5 1 – 3 metre extrapolation as measured (20.8dB)
- 6 1 – 30 metre extrapolation 60.8dB (40dB + 20.8dB)
- 7 All measurement below 30MHz made with loop antenna

**Test Method:**

- 1 As per Radio – Noise Emissions, ANSI C63.10:2009
- 2 Measuring distances 1m & 3m
- 3 EUT 0.8 metre above ground plane
- 4 Emissions maximised by rotation of EUT, on an automatic turntable.  
Raising and lowering the receiver antenna between 1m & 4m.  
Horizontal and vertical polarisations, of the receive antenna.  
EUT orientation in three orthogonal planes.  
Maximum results recorded

**A2 Frequency Tolerance**

| Test Details           |  |
|------------------------|--|
| Regulation             | Title 47 of the CFR: Part 15 Subpart (c) Clause 15.225(e) / RSS – 210 Issue 8 (A2.6) |
| Measurement standard   | ANSI C63.10:2009   |
| EUT sample number      | S01  |
| Modification state     | 0  |
| SE in test environment | None   |
| SE isolated from EUT   | None   |
| EUT set up             | Refer to Appendix C  |
| Temperature            | 20°C   |
| Humidity               | 32%  |

| Test Conditions   |           | Measured Frequency (MHz)                                   | Drift (kHz) |
|-------------------|-----------|--|-------------|
| $T_{nom}$ (+20°C) | $V_{nom}$ | 13.559356  | 0.000       |
| $T_{nom}$ (+20°C) | $V_{min}$ | 13.559356  | 0.000       |
| $T_{nom}$ (+20°C) | $V_{max}$ | 13.559356  | 0.000       |
| $T_{max}$ (+50°C) | $V_{nom}$ | 13.559361  | 0.005       |
| $T_{min}$ (-20°C) | $V_{nom}$ | 13.559399  | 0.043       |
| Limit             |           | $\pm 1.356$ kHz ( $\pm 0.01\%$ of the operating frequency) |             |
| Verdict           |           | Pass   |             |

**A3 Occupied Bandwidth**

| Test Details           |  |
|------------------------|--|
| Regulation             | Title 47 of the CFR: Part 15 Subpart (c) 15.215(c) / RSS – Gen Issue 3 4.6.1 |
| Measurement standard   | ANSI C63.10:2009   |
| EUT sample number      | S01  |
| Modification state     | 0  |
| SE in test environment | None   |
| SE isolated from EUT   | None   |
| EUT set up             | Refer to Appendix C  |
| Temperature            | 20°C   |
| Humidity               | 32%  |

|                           |                  |               |
|---------------------------|------------------|---------------|
| Band occupancy at -20 dBc | $f_L$            | $f_H$         |
|                           | 13.391074 MHz    | 13.730817 MHz |
|                           | BW = 339.744 kHz |               |
| 99% Band occupancy        | $f_L$            | $f_H$         |
|                           | 13.558641 MHz    | 13.560019 MHz |
|                           | BW = 1.378 kHz   |               |

#### A4 Radiated Electric Field Emissions

Preliminary scans were performed using a peak detector with the RBW = 100 kHz. The radiated electric field emission test applies to all spurious emissions and harmonics emissions. The maximum permitted field strength is listed in Section 15.225 and 15.209. The EUT was set to transmit as required.

The following test site was used for final measurements as specified by the standard tested to:

3m open area test site : ☐

3m alternative test site : ☒

The effect of the EUT set-up on the measurements is summarised in note (c) below.

| Test Details: Powered by 12v Battery |  |
|--------------------------------------|--|
| Regulation                           | Part 15 Subpart (c) Clause 15.209, RSS-Gen 7.2.5 |
| Measurement standard                 | ANSI C63.10:2009                                 |
| Frequency range                      | 9kHz – 1GHz                                      |
| EUT sample number                    | S01  |
| Modification state                   | 0  |
| SE in test environment               | S07, S09   |
| SE isolated from EUT                 | S03, S11, S12                                    |
| EUT set up                           | Refer to Appendix C                              |
| Temperature                          | 25°C   |
| Photographs (Appendix F)             | 1,2  |

The worst case radiated emission measurements for spurious emissions and harmonics are listed below:

| Ref No. | FREQ.<br>(MHz) | MEAS<br>Rx<br>(dBµV) | CABLE<br>LOSS<br>(dB) | ANT<br>FACT.<br>(dB/m) | PRE<br>AMP<br>(dB) | FIELD<br>ST'GH<br>(dBµV/m) | FIELD<br>ST'GH<br>(µV/m) | LIMIT<br>(µV/m) |
|---------|----------------|----------------------|-----------------------|------------------------|--------------------|----------------------------|--------------------------|-----------------|
| 1.      | 43.8           | 10.3                 | 0.9                   | 11.9                   | -                  | 23.1                       | 14.3                     | 100             |
| 2.      | 54.0           | 17.1                 | 1.0                   | 7.1                    | -                  | 25.2                       | 18.2                     | 100             |
| 3.      | 58.8           | 20.7                 | 1.0                   | 6.2                    | -                  | 27.9                       | 24.7                     | 100             |
| 4.      | 60.3           | 23                   | 1.0                   | 6.0                    | -                  | 30.0                       | 31.6                     | 100             |
| 5.      | 64.8           | 22.7                 | 1.1                   | 6.0                    | -                  | 29.8                       | 30.8                     | 100             |
| 6.      | 67.9           | 19.4                 | 1.2                   | 6.4                    | -                  | 27.0                       | 22.4                     | 100             |
| 7.      | 101.9          | 14.2                 | 1.3                   | 10.9                   | -                  | 26.4                       | 20.9                     | 150             |
| 8.      | 106.7          | 18.2                 | 1.4                   | 11.3                   | -                  | 30.9                       | 35.1                     | 150             |
| 9.      | 148.2          | 12.2                 | 1.7                   | 11.5                   | -                  | 25.4                       | 18.6                     | 150             |
| 10.     | 151.6          | 11.4                 | 1.7                   | 11.4                   | -                  | 24.5                       | 16.8                     | 150             |
| 11.     | 153.0          | 12.9                 | 1.7                   | 11.3                   | -                  | 25.9                       | 19.7                     | 150             |
| 12.     | 189.8          | 25.4                 | 2.0                   | 8.7                    | -                  | 36.1                       | 63.6                     | 150             |
| 13.     | 191.7          | 13.1                 | 2.0                   | 8.5                    | -                  | 23.6                       | 15.2                     | 150             |
| 14.     | 217.0          | 19.8                 | 2.0                   | 9.3                    | -                  | 31.1                       | 36.0                     | 200             |
| 15.     | 225.0          | 15.2                 | 2.1                   | 9.8                    | -                  | 27.1                       | 22.6                     | 200             |

| Ref No. | FREQ.<br>(MHz) | MEAS<br>Rx<br>(dBμV) | CABLE<br>LOSS<br>(dB) | ANT<br>FACT.<br>(dB/m) | PRE<br>AMP<br>(dB) | FIELD<br>ST'GH<br>(dBμV/m) | FIELD<br>ST'GH<br>(μV/m) | LIMIT<br>(μV/m) |
|---------|----------------|----------------------|-----------------------|------------------------|--------------------|----------------------------|--------------------------|-----------------|
| 16.     | 243.0          | 16.3                 | 2.2                   | 11.1                   | -                  | 29.6                       | 30.3                     | 200             |
| 17.     | 252.0          | 12.2                 | 2.3                   | 12.5                   | -                  | 27.0                       | 22.4                     | 200             |
| 18.     | 387.0          | 9.3                  | 2.7                   | 15.2                   | -                  | 27.2                       | 22.8                     | 200             |
| 19.     | 405.0          | 9.2                  | 2.9                   | 16.1                   | -                  | 28.2                       | 25.6                     | 200             |
| 20.     | 510.0          | 6.9                  | 3.3                   | 17.6                   | -                  | 27.8                       | 24.5                     | 200             |
| 21.     | 515.3          | 7.6                  | 3.3                   | 17.8                   | -                  | 28.7                       | 27.4                     | 200             |
| 22.     | 549.0          | 6.6                  | 3.4                   | 20.2                   | -                  | 30.1                       | 32.1                     | 200             |
| 23.     | 567.0          | 8.3                  | 3.3                   | 19.4                   | -                  | 31.0                       | 35.3                     | 200             |
| 24.     | 585.0          | 11.2                 | 3.5                   | 18.9                   | -                  | 33.6                       | 47.8                     | 200             |
| 25.     | 603.0          | 8.5                  | 3.6                   | 19.4                   | -                  | 31.5                       | 37.5                     | 200             |
| 26.     | 621.0          | 6.3                  | 3.7                   | 19.8                   | -                  | 29.8                       | 30.8                     | 200             |
| 27.     | 639.0          | 7.2                  | 3.7                   | 19.8                   | -                  | 30.7                       | 34.1                     | 200             |
| 28.     | 657.1          | 5.2                  | 3.7                   | 19.8                   | -                  | 28.7                       | 27.2                     | 200             |
| 29.     | 675.0          | 6.7                  | 3.8                   | 20.1                   | -                  | 30.5                       | 33.5                     | 200             |
| 30.     | 693.0          | 9.5                  | 3.8                   | 20.3                   | -                  | 33.6                       | 47.6                     | 200             |
| 31.     | 705.1          | 8.4                  | 3.8                   | 20.6                   | -                  | 32.8                       | 43.7                     | 200             |
| 32.     | 711.0          | 9                    | 3.9                   | 20.8                   | -                  | 33.6                       | 47.9                     | 200             |
| 33.     | 801.0          | 3.8                  | 4.1                   | 21.8                   | -                  | 29.7                       | 30.4                     | 200             |
| 34.     | 837.1          | 5.4                  | 4.2                   | 22.7                   | -                  | 32.3                       | 41.2                     | 200             |
| 35.     | 850.1          | 1.1                  | 4.2                   | 22.6                   | -                  | 27.9                       | 24.9                     | 200             |
| 36.     | 855.0          | 7.9                  | 4.2                   | 22.5                   | -                  | 34.6                       | 54.0                     | 200             |
| 37.     | 867.8          | 4.8                  | 4.3                   | 22.4                   | -                  | 31.5                       | 37.4                     | 200             |
| 38.     | 873.0          | 7.9                  | 4.3                   | 22.4                   | -                  | 34.5                       | 53.3                     | 200             |
| 39.     | 889.2          | 1                    | 4.3                   | 22.3                   | -                  | 27.6                       | 24.0                     | 200             |
| 40.     | 891.0          | 7                    | 4.3                   | 22.5                   | -                  | 33.8                       | 48.9                     | 200             |
| 41.     | 909.0          | 6.5                  | 4.4                   | 23.2                   | -                  | 34.1                       | 50.8                     | 200             |
| 42.     | 917.4          | 0.3                  | 4.5                   | 23.6                   | -                  | 28.3                       | 26.1                     | 200             |
| 43.     | 918.5          | 0.3                  | 4.5                   | 23.6                   | -                  | 28.4                       | 26.2                     | 200             |
| 44.     | 921.4          | 0.2                  | 4.5                   | 23.6                   | -                  | 28.3                       | 25.9                     | 200             |
| 45.     | 927.1          | 4.7                  | 4.5                   | 23.8                   | -                  | 33.0                       | 44.4                     | 200             |
| 46.     | 935.2          | 0.1                  | 4.5                   | 24.2                   | -                  | 28.8                       | 27.6                     | 200             |
| 47.     | 945.0          | 5.6                  | 4.5                   | 24.3                   | -                  | 34.4                       | 52.4                     | 200             |
| 48.     | 955.3          | -0.1                 | 4.6                   | 23.7                   | -                  | 28.2                       | 25.7                     | 200             |



| Test Details: Powered by PoE |  |
|------------------------------|--|
| Regulation                   | Part 15 Subpart (c) Clause 15.209, RSS-Gen 7.2.5 |
| Measurement standard         | ANSI C63.10:2009                                 |
| Frequency range              | 9kHz – 1GHz                                      |
| EUT sample number            | S01  |
| Modification state           | 0  |
| SE in test environment       | S07, S09, S14                                    |
| SE isolated from EUT         | S03, S04   |
| EUT set up                   | Refer to Appendix C                              |
| Temperature                  | 19°C   |
| Photographs (Appendix F)     | 1,2  |

The worst case radiated emission measurements for spurious emissions and harmonics are listed below:

| Ref No. | FREQ.<br>(MHz) | MEAS<br>Rx<br>(dBμV) | CABLE<br>LOSS<br>(dB) | ANT<br>FACT.<br>(dB/m) | PRE<br>AMP<br>(dB) | FIELD<br>ST'GH<br>(dBμV/m) | FIELD<br>ST'GH<br>(μV/m) | LIMIT<br>(μV/m) |
|---------|----------------|----------------------|-----------------------|------------------------|--------------------|----------------------------|--------------------------|-----------------|
| 1.      | 30.1           | 19.2                 | 0.7                   | 19.5                   | -                  | 39.4                       | 92.8                     | 100             |
| 2.      | 31.1           | 12.8                 | 0.7                   | 18.9                   | -                  | 32.4                       | 41.9                     | 100             |
| 3.      | 34.1           | 15.9                 | 0.7                   | 17.3                   | -                  | 33.9                       | 49.7                     | 100             |
| 4.      | 40.4           | 13.6                 | 0.8                   | 13.7                   | -                  | 28.1                       | 25.4                     | 100             |
| 5.      | 42.4           | 15.9                 | 0.9                   | 12.6                   | -                  | 29.4                       | 29.4                     | 100             |
| 6.      | 45.4           | 16.4                 | 0.9                   | 11.0                   | -                  | 28.3                       | 26.0                     | 100             |
| 7.      | 49.2           | 18.5                 | 0.9                   | 9.0                    | -                  | 28.4                       | 26.4                     | 100             |
| 8.      | 53.4           | 21.2                 | 1.0                   | 7.3                    | -                  | 29.5                       | 29.8                     | 100             |
| 9.      | 59.5           | 21.4                 | 1.0                   | 6.1                    | -                  | 28.5                       | 26.5                     | 100             |
| 10.     | 60.7           | 20.0                 | 1.0                   | 5.9                    | -                  | 26.9                       | 22.2                     | 100             |
| 11.     | 62.5           | 22.8                 | 1.0                   | 6.0                    | -                  | 29.8                       | 30.9                     | 100             |
| 12.     | 66.7           | 19.8                 | 1.2                   | 6.2                    | -                  | 27.2                       | 23.0                     | 100             |
| 13.     | 81.3           | 18.2                 | 1.2                   | 8.1                    | -                  | 27.5                       | 23.6                     | 100             |
| 14.     | 85.5           | 12.4                 | 1.2                   | 8.8                    | -                  | 22.4                       | 13.2                     | 100             |
| 15.     | 106.7          | 11.7                 | 1.4                   | 11.3                   | -                  | 24.4                       | 16.6                     | 150             |
| 16.     | 108.8          | 14.8                 | 1.7                   | 12.2                   | -                  | 28.7                       | 27.1                     | 150             |
| 17.     | 141.2          | 11.3                 | 1.7                   | 12.2                   | -                  | 25.2                       | 18.1                     | 150             |
| 18.     | 153.0          | 13.8                 | 1.7                   | 11.3                   | -                  | 26.8                       | 21.9                     | 150             |
| 19.     | 162.8          | 17.3                 | 1.8                   | 10.7                   | -                  | 29.8                       | 31.0                     | 150             |
| 20.     | 171.0          | 15.5                 | 1.8                   | 9.8                    | -                  | 27.1                       | 22.6                     | 150             |
| 21.     | 189.9          | 24.8                 | 2.0                   | 8.7                    | -                  | 35.5                       | 59.4                     | 150             |
| 22.     | 216.0          | 13.9                 | 2.0                   | 9.3                    | -                  | 25.2                       | 18.2                     | 150             |

| Ref No. | FREQ.<br>(MHz) | MEAS<br>Rx<br>(dBμV) | CABLE<br>LOSS<br>(dB) | ANT<br>FACT.<br>(dB/m) | PRE<br>AMP<br>(dB) | FIELD<br>ST'GH<br>(dBμV/m) | FIELD<br>ST'GH<br>(μV/m) | LIMIT<br>(μV/m) |
|---------|----------------|----------------------|-----------------------|------------------------|--------------------|----------------------------|--------------------------|-----------------|
| 23.     | 225.0          | 14.6                 | 2.1                   | 9.8                    | -                  | 26.5                       | 21.1                     | 200             |
| 24.     | 243.0          | 13.4                 | 2.2                   | 11.1                   | -                  | 26.7                       | 21.7                     | 200             |
| 25.     | 284.9          | 11.8                 | 2.7                   | 14.1                   | -                  | 28.6                       | 26.8                     | 200             |
| 26.     | 333.0          | 11.5                 | 2.7                   | 14.1                   | -                  | 28.3                       | 25.9                     | 200             |
| 27.     | 351.0          | 11.2                 | 2.6                   | 14.2                   | -                  | 28.0                       | 25.1                     | 200             |
| 28.     | 515.3          | 7.3                  | 3.3                   | 17.8                   | -                  | 28.4                       | 26.4                     | 200             |
| 29.     | 531.0          | 4.7                  | 3.4                   | 18.4                   | -                  | 26.4                       | 20.9                     | 200             |
| 30.     | 549.0          | 7.1                  | 3.4                   | 20.2                   | -                  | 30.6                       | 34.0                     | 200             |
| 31.     | 567.0          | 6.8                  | 3.3                   | 19.4                   | -                  | 29.5                       | 29.7                     | 200             |
| 32.     | 585.0          | 12.0                 | 3.5                   | 18.9                   | -                  | 34.4                       | 52.4                     | 200             |
| 33.     | 603.0          | 9.4                  | 3.6                   | 19.4                   | -                  | 32.4                       | 41.5                     | 200             |
| 34.     | 621.0          | 8.5                  | 3.7                   | 19.8                   | -                  | 32.0                       | 39.7                     | 200             |
| 35.     | 639.0          | 6.9                  | 3.7                   | 19.8                   | -                  | 30.4                       | 32.9                     | 200             |
| 36.     | 657.0          | 5.1                  | 3.7                   | 19.8                   | -                  | 28.6                       | 26.9                     | 200             |
| 37.     | 675.0          | 8.0                  | 3.8                   | 20.1                   | -                  | 31.8                       | 38.9                     | 200             |
| 38.     | 693.0          | 9.5                  | 3.8                   | 20.3                   | -                  | 33.6                       | 47.6                     | 200             |
| 39.     | 705.1          | 4.9                  | 3.8                   | 20.6                   | -                  | 29.3                       | 29.2                     | 200             |
| 40.     | 711.0          | 10.1                 | 3.9                   | 20.8                   | -                  | 34.7                       | 54.4                     | 200             |
| 41.     | 729.0          | 4.5                  | 3.9                   | 21.9                   | -                  | 30.3                       | 32.5                     | 200             |
| 42.     | 819.0          | 3.8                  | 4.2                   | 22.3                   | -                  | 30.2                       | 32.4                     | 200             |
| 43.     | 837.0          | 6.2                  | 4.2                   | 22.7                   | -                  | 33.1                       | 45.1                     | 200             |
| 44.     | 849.9          | 1.1                  | 4.2                   | 22.6                   | -                  | 27.9                       | 24.9                     | 200             |
| 45.     | 855.1          | 6.4                  | 4.2                   | 22.5                   | -                  | 33.1                       | 45.4                     | 200             |
| 46.     | 873.0          | 5.4                  | 4.3                   | 22.4                   | -                  | 32.0                       | 39.9                     | 200             |
| 47.     | 882.0          | 2.9                  | 4.3                   | 22.1                   | -                  | 29.3                       | 29.2                     | 200             |
| 48.     | 891.0          | 6.8                  | 4.3                   | 22.5                   | -                  | 33.6                       | 47.8                     | 200             |
| 49.     | 902.8          | 0.6                  | 4.4                   | 23.0                   | -                  | 28.0                       | 25.1                     | 200             |
| 50.     | 909.0          | 6.4                  | 4.4                   | 23.2                   | -                  | 34.0                       | 50.2                     | 200             |
| 51.     | 927.0          | 6.6                  | 4.5                   | 23.8                   | -                  | 34.9                       | 55.3                     | 200             |
| 52.     | 945.0          | 6.8                  | 4.5                   | 24.3                   | -                  | 35.6                       | 60.2                     | 200             |
| 53.     | 963.0          | 7.1                  | 4.6                   | 23.9                   | -                  | 35.5                       | 59.8                     | 501             |
| 54.     | 981.0          | 6.3                  | 4.6                   | 24.0                   | -                  | 34.9                       | 55.4                     | 501             |

**Notes:**

- 1 Any testing performed below 30 MHz was performed using a magnetic loop antenna in accordance with ANSI C63.10:2009: section 4.5, Table 1 For emissions below 30MHz the cable losses are assumed to be negligible.
- 2 In accordance with 15.35(b), above 1 GHz, emissions measured using a peak detector shall not exceed a level 20 dB above the average limit.
- 3 Testing was performed with the EUT orientated in three orthogonal planes and the maximum emissions level recorded. In addition, the EUT antenna was varied within its range of motion in order to maximise emissions.
- 4 For Frequencies below 1 GHz, RBW= 120 kHz, testing was performed with CISPR16 compliant test receiver with QP detector. Above 1 GHz tests were performed using a spectrum analyser using the following settings:

Peak                      RBW= 1MHz, VBW ≥ RBW  
Average                  RBW= 1MHz, VBW ≥ RBW

The upper and lower frequency of the measurement range was decided according to 47 CFR Part 15 Clause 15.33(a) and 15.33(a)(1).

Radiated emission limits 47 CFR Part 15: Clause 15.209 for all emissions:

| Frequency of emission (MHz) | Field strength $\mu\text{V/m}$ | Measurement Distance m | Field strength $\text{dB}\mu\text{V/m}$ |
|-----------------------------|--------------------------------|------------------------|---|
| 0.009-0.490                 | 2400/F(kHz)                    | 300                    | 67.6/F (kHz)                            |
| 0.490-1.705                 | 24000/F(kHz)                   | 30                     | 87.6/F (kHz)                            |
| 1.705-30                    | 30                             | 30                     | 29.5                                    |
| 30-88                       | 100                            | 3                      | 40.0                                    |
| 88-216                      | 150                            | 3                      | 43.5                                    |
| 216-960                     | 200                            | 3                      | 46.0                                    |
| Above 960                   | 500                            | 3                      | 54.0                                    |

- (a) Where results have been measured at one distance, and a signal level displayed at another, the results have been extrapolated using the following formula:

$$\text{Extrapolation (dB)} = 20 \log_{10} \left( \frac{\text{measurement distance}}{\text{specification distance}} \right)$$

- (b) The levels may have been rounded for display purposes.
- (c) The following table summarises the effect of the EUT operating mode, internal configuration and arrangement of cables / samples on the measured emission levels :

|  | See (i) | See (ii) | See (iii) | See (iv) |
|--|---------|----------|-----------|----------|
| Effect of EUT operating mode on emission levels  | ✓       |          |           |          |
| Effect of EUT internal configuration on emission levels  | ✓       |          |           |          |
| Effect of Position of EUT cables & samples on emission levels  | ✓       |          |           |          |
| (i) Parameter defined by standard and / or single possible, refer to Appendix D<br>(ii) Parameter defined by client and / or single possible, refer to Appendix D<br>(iii) Parameter had a negligible effect on emission levels, refer to Appendix D<br>(iv) Worst case determined by initial measurement, refer to Appendix D |         |          |           |          |

**A5 Power Line Conducted Emissions**

Preview power line conducted emission measurements were performed with a peak detector in a screened room. The effect of the EUT set-up on the measurements is summarised in note (b). Where applicable formal measurements of the emissions were performed with a peak, average and/or quasi peak detector.

| <b>Test Details:</b>     |  |
|--------------------------|--|
| Regulation               | Part 15 Subpart (c) Clause 15.207, RSS-Gen 7.2.4 |
| Measurement standard     | ANSI C63.10:2009                                 |
| Frequency range          | 150kHz to 30MHz                                  |
| EUT sample number        | S01  |
| Modification state       | 0  |
| SE in test environment   | S03, S04, S07, S09, S14                          |
| SE isolated from EUT     | None   |
| EUT set up               | Refer to Appendix C                              |
| Photographs (Appendix F) | 4  |

The worst-case power line conducted emission measurements are listed below:

**Results measured using the average detector compared to the average limit**

| Ref No.   | Freq (MHz) | Conductor | Result (dBuV) | Spec Limit (dBuV) | Margin (dB) | Result Summary |
|---|------------|-----------|---------------|-------------------|-------------|----------------|
| No emissions were detected within 20dB of the limit |            |           |               |                   |             |                |

**Results measured using the quasi-peak detector compared to the quasi-peak limit**

| Ref No.   | Freq (MHz) | Conductor | Result (dBuV) | Spec Limit (dBuV) | Margin (dB) | Result Summary |
|---|------------|-----------|---------------|-------------------|-------------|----------------|
| No emissions were detected within 20dB of the limit |            |           |               |                   |             |                |

**Specification limits :**

Conducted emission limits (47 CFR Part 15: Clause 15.207 & RSS-Gen 7.2.4):

Conducted disturbance at the mains ports.

| Frequency range MHz | Limits dB $\mu$ V     |                       |
|---------------------|-----------------------|-----------------------|
|                     | Quasi-peak            | Average               |
| 0.15 to 0.5         | 66 to 56 <sup>2</sup> | 56 to 46 <sup>2</sup> |
| 0.5 to 5            | 56                    | 46                    |
| 5 to 30             | 60                    | 50                    |

Notes:

1. The lower limit shall apply at the transition frequency.
2. The limit decreases linearly with the logarithm of the frequency in the range 0.15MHz to 0.5MHz.

Notes:

- (a) The levels may have been rounded for display purposes.
- (b) The following table summarises the effect of the EUT operating mode and internal configuration on the measured emission levels :

|   | See (i) | See (ii) | See (iii) | See (iv) |
|---|---------|----------|-----------|----------|
| Effect of EUT operating mode on emission levels         |         | ✓        |           |          |
| Effect of EUT internal configuration on emission levels |         | ✓        |           |          |

(i) Parameter defined by standard and / or single possible, refer to Appendix C  
(ii) Parameter defined by client and / or single possible, refer to Appendix C  
(iii) Parameter had a negligible effect on emission levels, refer to Appendix C  
(iv) Worst case determined by initial measurement, refer to Appendix C

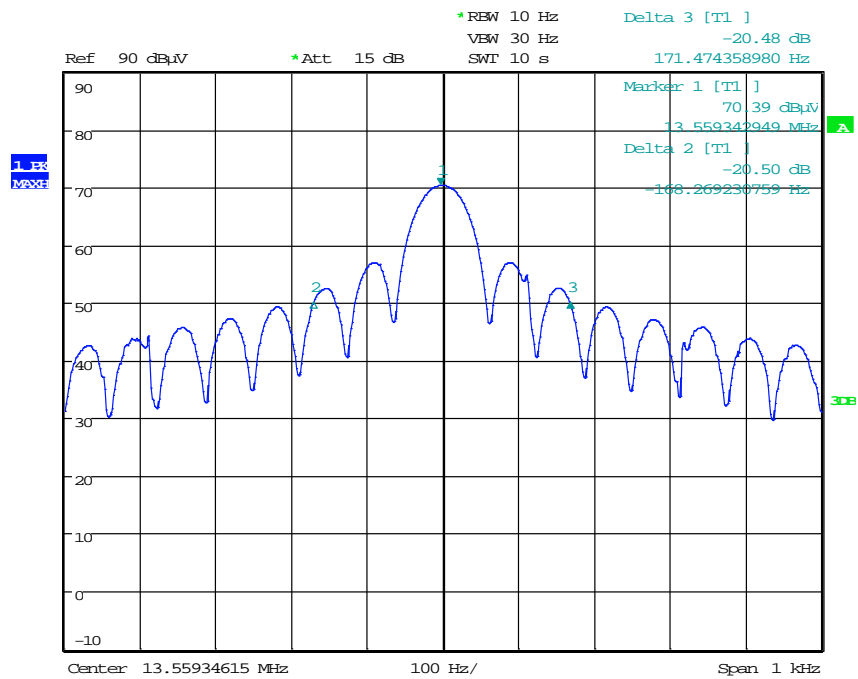
**Appendix B:****Supporting Graphical Data**

This appendix contains graphical data obtained during testing.

Notes:

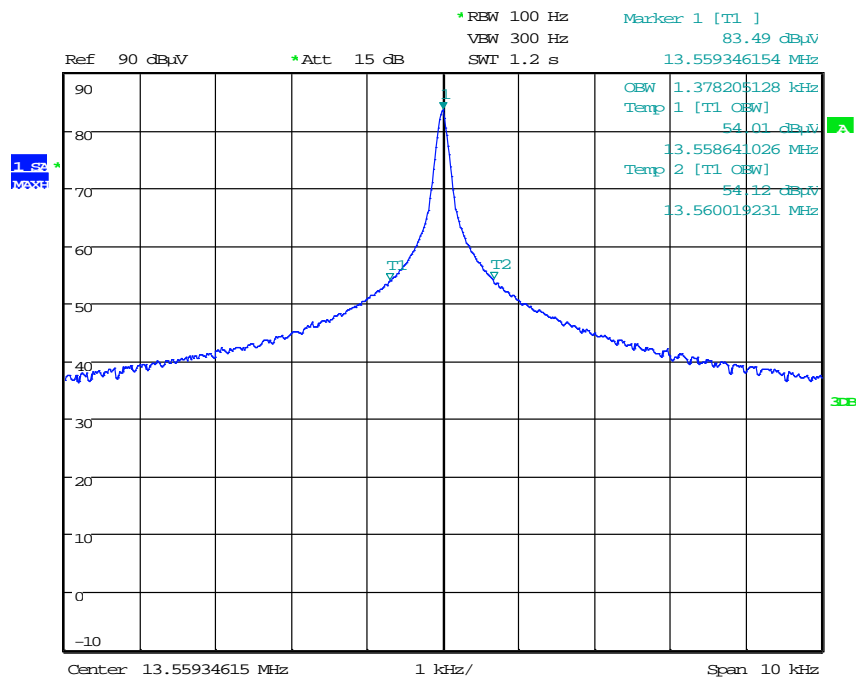
- (a) The radiated electric field emissions and conducted emissions graphical data in this appendix is preview data. For details of formal results, refer to Appendix A and Appendix B.
- (b) The time and date on the plots do not necessarily equate to the time of the test.
- (c) Where relevant, on power line conducted emission plots, the limit displayed is the average limit, which is stricter than the quasi peak limit.
- (d) Appendix C details the numbering system used to identify the sample and its modification state.
- (e) The plots presented in this appendix may not be a complete record of the measurements performed, but are a representative sample, relative to the final assessment.

## 20dB Bandwidth



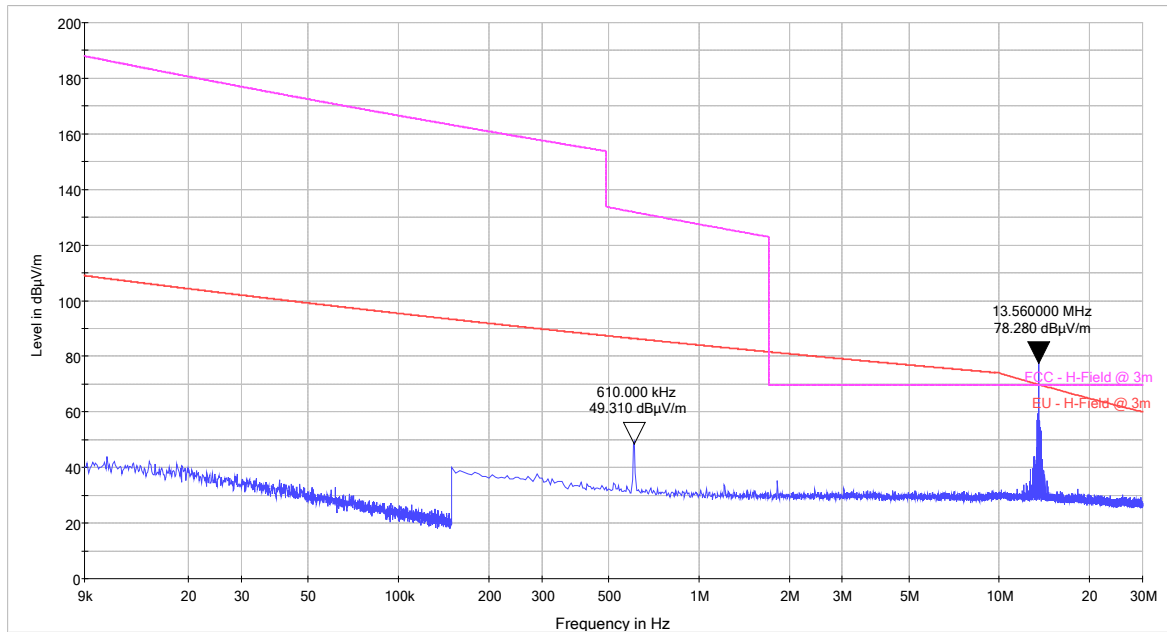
Date: 4.JUL.2014 17:52:57

## 99% Bandwidth

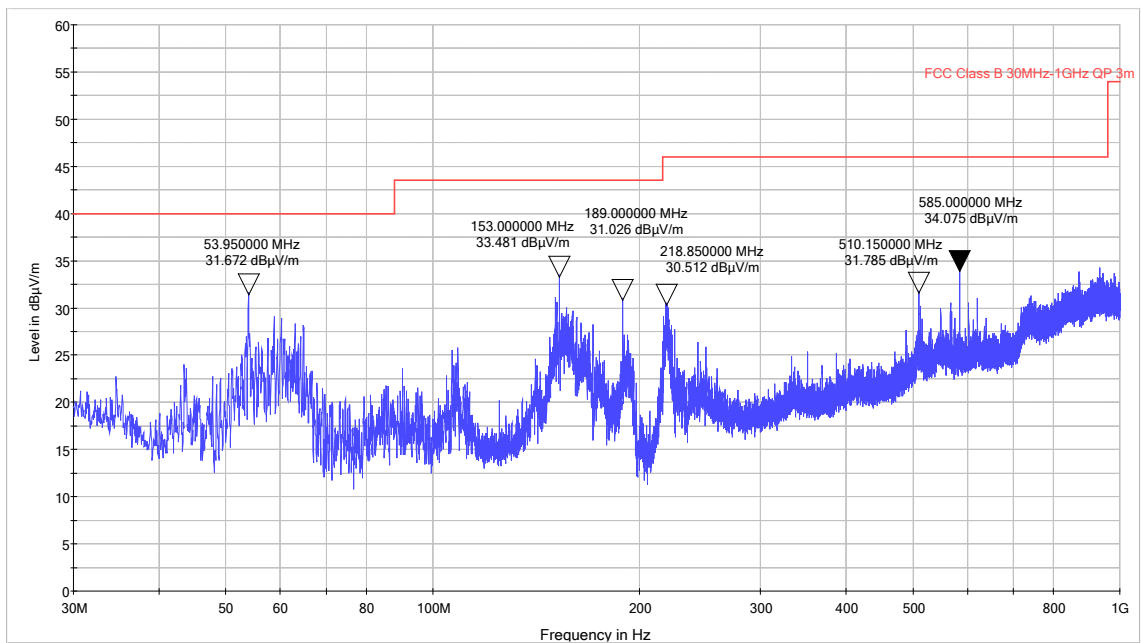


Date: 4.JUL.2014 17:29:05

Radiated spurious emissions – powered by 12v battery



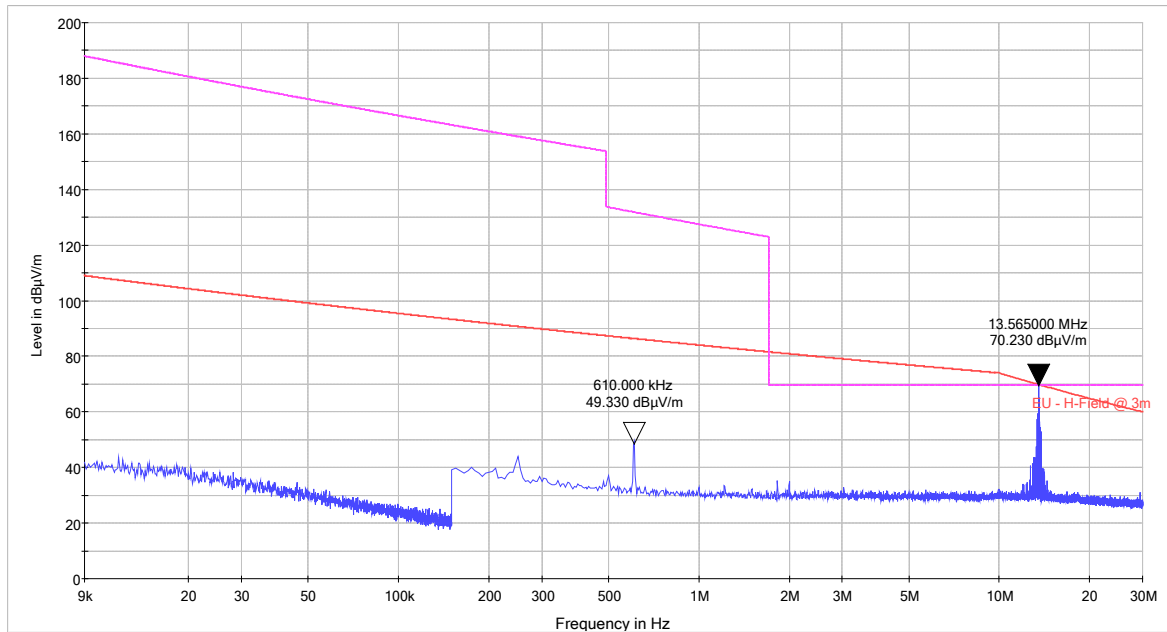
9 kHz to 30 MHz



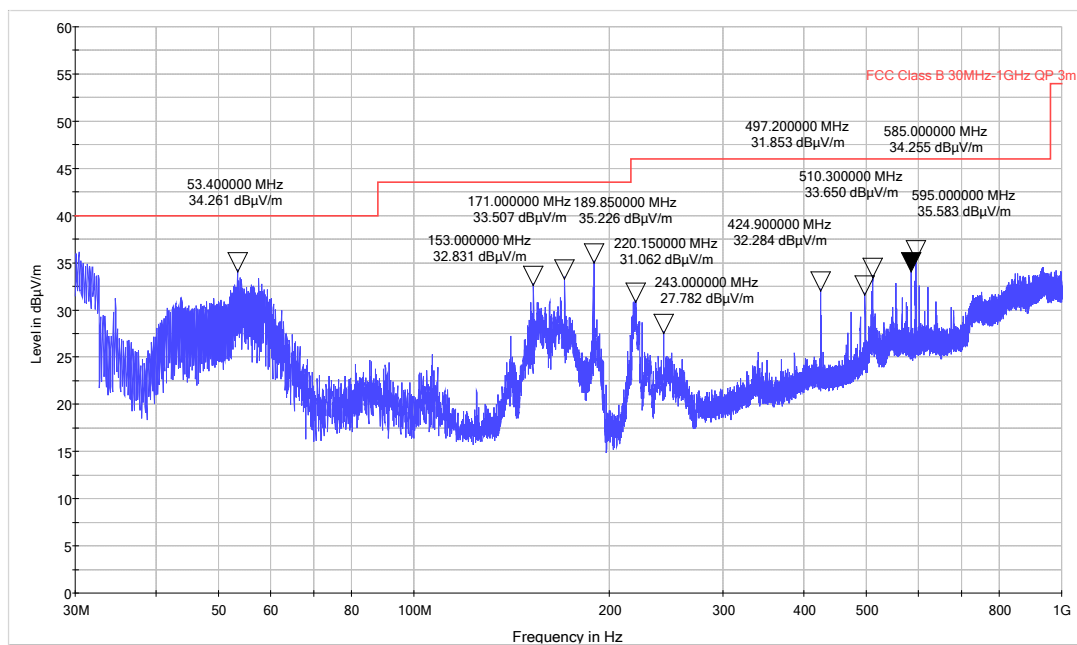
30 MHz to 1 GHz



# Radiated spurious emissions – powered by PoE

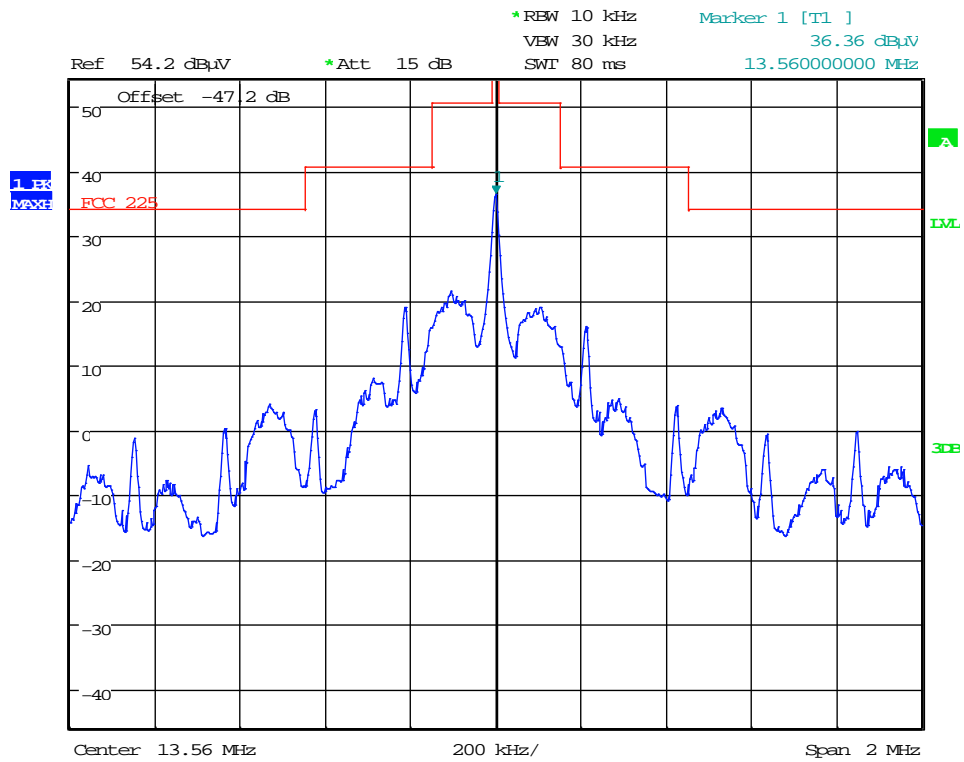


9 kHz to 30 MHz



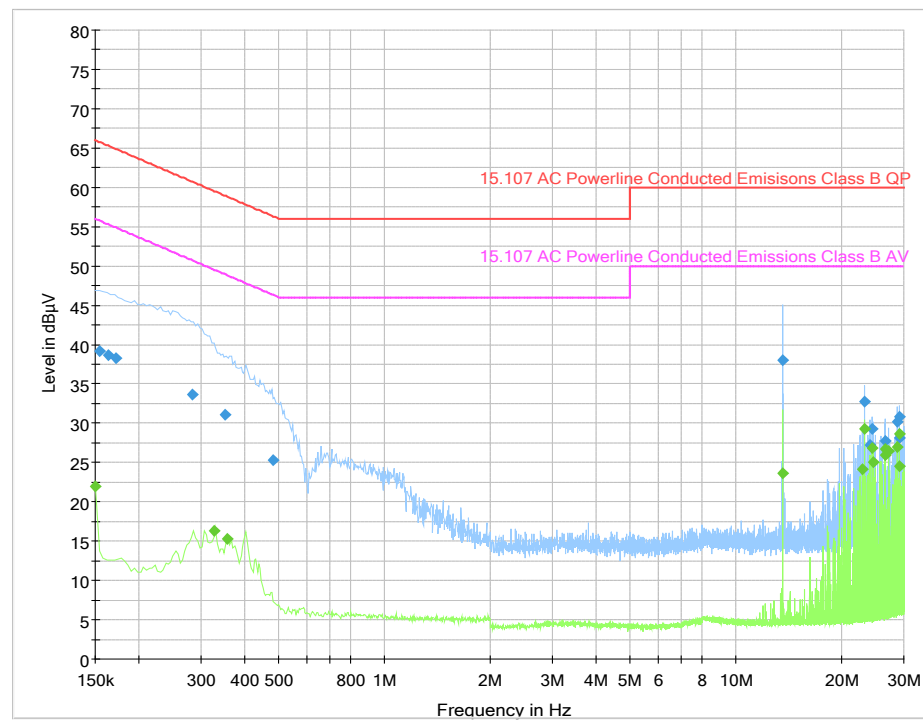
30 MHz to 1 GHz

### In-Band Emissions



Date: 4.JUL.2014 16:34:12

### AC Powerline Conducted Emissions



**Appendix C:****Additional Test and Sample Details**

This appendix contains details of:

1. The samples submitted for testing.
2. Details of EUT operating mode(s)
3. Details of EUT configuration(s) (see below).
4. EUT arrangement (see below).

Throughout testing, the following numbering system is used to identify the sample and it's modification state:

**Sample No:** Sxx Mod w

where:

|    |                       |           |
|----|-----------------------|-----------|
| xx | = sample number       | eg. S01   |
| w  | = modification number | eg. Mod 2 |

The following terminology is used throughout the test report:

**Support Equipment (SE)** is any additional equipment required to exercise the EUT in the applicable operating mode. Where relevant SE is divided into two categories:

SE in test environment: The SE is positioned in the test environment and is not isolated from the EUT (e.g. on the table top during REFE testing).

SE isolated from the EUT: The SE is isolated via filtering from the EUT. (e.g. equipment placed externally to the ALSR during REFE testing).

**EUT configuration** refers to the internal set-up of the EUT. It may include for example:

- Positioning of cards in a chassis.
- Setting of any internal switches.
- Circuit board jumper settings.
- Alternative internal power supplies.

Where no change in EUT configuration is **possible**, the configuration is described as "single possible configuration".

**EUT arrangement** refers to the termination of EUT ports / connection of support equipment, and where relevant, the relative positioning of samples (EUT and SE) in the test environment.

For further details of the test procedures and general test set ups used during testing please refer to the related document "EMC Test Methods - An Overview", which can be supplied by TRaC Global upon request.

**C1) Test samples**

The following samples of the apparatus were submitted by the client for testing:

| Sample No. | Description    | Identification |
|------------|----------------|----------------|
| S01        | Emerald TSR V9 | None           |

The following samples of apparatus were submitted by the client as host, support or drive equipment (auxiliary equipment):

| Sample No. | Description              | Identification |
|------------|--------------------------|----------------|
| S03        | Dell Laptop              | None           |
| S04        | PoE                      | None           |
| S07        | Magnetic Lock            | None           |
| S09        | Door Simulator           | None           |
| S11        | Ethernet Hub             | None           |
| S12        | 12V Power Supply         | None           |
| S14        | WURTH ELEKTRONIK Ferrite | 74271722       |

The following samples of apparatus were supplied by TRaC Global as support or drive equipment (auxiliary equipment):

| Identification | Description |
|----------------|-------------|
|                | None        |

**C2) EUT Operating Mode During Testing.**

During testing, the EUT was exercised as described in the following tables :

| Test                              | Description of Operating Mode:  |
|-----------------------------------|---|
| All tests detailed in this report | EUT is actively transmitting either waiting for a tag to be presented or reading a tag as required. |

**C3) EUT Configuration Information.**

The EUT was submitted for testing in one single possible configuration.

**C4) List of EUT Ports**

The tables below describe the termination of EUT ports:

Sample : S01

Tests : Radiated emissions / Powerline conducted emissions

| Port           | Description of Cable Attached              | Cable length | Equipment Connected |
|----------------|--|--------------|---------------------|
| Maglock        | Multiple wires Cable                       | 20cm         | S07                 |
| Door simulator | Multiple wires Cable                       | 20cm         | S09                 |
| Power          | 2 wires                                    | 1m           | S12                 |
| Ethernet       | Ethernet cable with 2 turns on ferrite S14 | 1m           | S04/S11             |

**C5 Details of Equipment Used**

| TRaC No | Equipment Type | Equipment Description | Manufacturer | Last Cal Calibration | Calibration Period | Due For Calibration |
|---------|----------------|-----------------------|--------------|----------------------|--------------------|---------------------|
| UH191   | CBL611/A       | Bilog                 | Chase        | 13/12/2012           | 24                 | 13/12/2014          |
| L317    | ESVS10         | Receiver              | R&S          | 12/02/2014           | 12                 | 12/02/2015          |
| REF940  | ATS            | Radio Chamber - PP    | Rainford EMC | 09/07/2013           | 24                 | 09/07/2015          |
| REF976  | 34405a         | Multimeter            | Agilent      | 19/02/2014           | 12                 | 19/02/2015          |
| L426    | 52 Series II   | Temperature Indicator | Fluke        | 22/05/2014           | 12                 | 22/05/2015          |
| UH396   | ENV216         | Lisn                  | R&S          | 22/05/2014           | 12                 | 22/05/2015          |
| L007    | hfh2           | Loop Antenna          | R&S          | 17/10/2013           | 24                 | 17/10/2015          |
| UH403   | ESCI 7         | Recevier              | R&S          | 12/08/2013           | 12                 | 12/08/2014          |
| UH100   | -              | PSU                   | Thandar      | Cal in use           |                    |                     |
| L011    | -              | Temp Chamber          | Sharetree    | Cal in use           |                    |                     |



**Appendix D:**

**Additional Information**

No additional information is included within this test report.

**Appendix E:****Calculation of the duty cycle correction factor**

Using a spectrum analyser in zero span mode, centred on the fundamental carrier frequency with a RBW of 1MHz and a video Bandwidth of 1MHz the sweep time was set accordingly to capture the pulse train. The transmit pulsewidths and period was measured. A plots of the pulse train is contained in Appendix B of this test report.

If the pulse train was less than 100 ms, including blanking intervals, the duty cycle was calculated by averaging the sum of the pulsewidths over one complete pulse train. However if the pulse train exceeds 100ms then the duty cycle was calculated by averaging the sum of the pulsewidths over the 100ms width with the highest average value. (The duty cycle is the value of the sum of the pulse widths in one period (or 100ms), divided by the length of the period (or 100ms). The duty cycle correction factor was then expressed in dB and the peak emissions adjusted accordingly to give an average value of the emission.

Correction factor dB =  $20 \times (\text{Log}_{10} \text{ Calculated Duty Cycle})$

Therefore the calculated duty cycle was determined:

The pulse train period was greater than >100ms and in as shown from the plots in contained in appendix B of this test report.

Duty cycle =  $\frac{\text{the sum of the highest average value pulsewidths over 100ms}}{100\text{ms}}$

e.g

$$= \frac{7.459\text{ms}}{100\text{ms}} = 0.07459$$

0.07459 or 7.459%

Correction factor (dB) =  $20 \times (\text{Log}_{10} 0.07459) = -22.54\text{dB}$

**Duty cycle correction may not be applicable.**

**Unless duty cycle correction is utilised in the results section of this report this section is included for information only**

## **Appendix F:**

## **Photographs and Figures**

The following photographs were taken of the test samples:

1. Radiated transmitter intentional emission arrangement: Overview
2. Radiated emissions arrangement: Overview
3. Radiated emissions arrangement: Close up showing the ferrite
4. Powerline conducted emissions arrangement: Overview

Photograph 1



Photograph 2



Photograph 3



Photograph 4



