

**REPORT ON THE RADIO TESTING**  
**FOR**  
**CONTROLLED ELECTRONIC MANAGEMENT SYSTEMS**  
**LIMITED**  
**ON**  
**EMERALD INTELLIGENT FINGERPRINT TERMINAL**  
**MODEL: TSR/300/618**  
**DOCUMENT NO. TRA-026673-12-47-00A**



Report Number: TRA-026673-12-47-00A  
Issue: A

REPORT ON THE RADIO TESTING OF A  
Controlled Electronic Management Systems Limited  
Emerald Intelligent Fingerprint Terminal  
Model: TSR/300/618  
WITH RESPECT TO SPECIFICATION  
FCC 47CFR 15.225 & IC RSS-210 Annex 2.6

TEST DATE: 10th - 14th August 2015



Tested by: A Tosif

A Tosif  
Radio Test Engineer

Approved by:

John Charters  
Radio Product Manager

Date: 21<sup>st</sup> September 2015

Disclaimers:

- [1] THIS DOCUMENT MAY BE REPRODUCED ONLY IN ITS ENTIRETY AND WITHOUT CHANGE
- [2] THE RESULTS CONTAINED IN THIS DOCUMENT RELATE ONLY TO THE ITEM(S) TESTED

1 Revision Record

| <i>Issue Number</i> | <i>Issue Date</i> | <i>Revision History</i> |
|---------------------|-------------------|-------------------------|
| A                   | 21/9/15           | Original                |
|                     |                   |                         |

## 2 Summary

|                             |                                                                                          |
|-----------------------------|------------------------------------------------------------------------------------------|
| TEST REPORT NUMBER:         | TRA-026673-12-47-00A                                                                     |
| WORKS ORDER NUMBER:         | TRA-026673-12                                                                            |
| PURPOSE OF TEST:            | Certification                                                                            |
| TEST SPECIFICATION(S):      | 47CFR15.225 & RSS-210 Annex 2.6                                                          |
| EQUIPMENT UNDER TEST (EUT): | Emerald Intelligent Fingerprint Terminal<br>Model: TSR/300/618                           |
| FCC IDENTIFIER:             | QABTSR618V93F                                                                            |
| IC IDENTIFIER:              | 12009A-TSR618V93F                                                                        |
| EUT SERIAL NUMBER:          | not applicable                                                                           |
| MANUFACTURER/AGENT:         | Controlled Electronic Management Systems<br>Limited                                      |
| ADDRESS:                    | Accounts Payable<br>Mailpoint 1006<br>PO Box 3572<br>Stone<br>ST15 9DX<br>United Kingdom |
| CLIENT CONTACT:             | Ewan Peyton<br>☎ 44 (0)28 9078 8026<br>✉ ewpeyton@tycoint.com                            |
| ORDER NUMBER:               | 038082                                                                                   |
| TEST DATE:                  | 10th - 14th August 2015                                                                  |
| TESTED BY:                  | A Tosif<br>TRaC Global Ltd.                                                              |

## 2.1 Test Summary

| Test Method and Description               | Requirement Clause        |                        | Applicable to this equipment        | Result / Note |
|-------------------------------------------|---------------------------|------------------------|-------------------------------------|---------------|
|                                           | RSS                       | 47CFR15                |                                     |               |
| Radiated spurious emissions, below 30 MHz | 210, A2.6(d)              | 15.225(d)              | <input checked="" type="checkbox"/> | Pass          |
| Radiated spurious emissions               | Gen, 6.13                 | 15.209                 | <input checked="" type="checkbox"/> | Pass          |
| AC power line conducted emissions         | Gen, 8.8                  | 15.207                 | <input checked="" type="checkbox"/> | Pass          |
| Occupied bandwidth                        | Gen, 6.6                  | 15.215(c)              | <input checked="" type="checkbox"/> | Pass          |
| Field strength of fundamental             | 210, A2.6(a), (b) and (c) | 15.225(a), (b) and (c) | <input checked="" type="checkbox"/> | Pass          |
| Frequency stability                       | 210, A2.6                 | 15.225(e)              | <input checked="" type="checkbox"/> | Pass          |

### Notes:

The results contained in this report relate only to the items tested, in the condition at time of test, 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. Any modifications made are identified in Section 8 of this report.

Particular operating modes, apparatus monitoring methods and performance criteria required by the standards tested to have been performed except where identified in Section 5.2 of this test report (Deviations from Test Standards).

### 3 Contents

|      |                                                                     |    |
|------|---------------------------------------------------------------------|----|
| 1    | Revision Record.....                                                | 3  |
| 2    | Summary.....                                                        | 4  |
| 2.1  | Test Summary.....                                                   | 5  |
| 3    | Contents.....                                                       | 6  |
| 4    | Introduction .....                                                  | 7  |
| 5    | Test Specifications.....                                            | 8  |
| 5.1  | Normative References .....                                          | 8  |
| 5.2  | Deviations from Test Standards .....                                | 8  |
| 6    | Glossary of Terms.....                                              | 9  |
| 7    | Equipment under Test.....                                           | 10 |
| 7.1  | EUT Identification.....                                             | 10 |
| 7.2  | System Equipment.....                                               | 10 |
| 7.3  | EUT Mode of Operation .....                                         | 11 |
| 7.4  | EUT Radio Parameters .....                                          | 11 |
| 7.5  | EUT Description .....                                               | 11 |
| 8    | Modifications .....                                                 | 12 |
| 9    | EUT Test Setup .....                                                | 13 |
| 9.1  | Block Diagram.....                                                  | 13 |
| 9.2  | General Set-up Photographs.....                                     | 14 |
| 10   | General Technical Parameters.....                                   | 15 |
| 10.1 | Normal Conditions.....                                              | 15 |
| 10.2 | Varying Test Conditions .....                                       | 15 |
| 11   | Radiated emissions below 30 MHz .....                               | 16 |
| 11.1 | Definitions .....                                                   | 16 |
| 11.2 | Test Parameters.....                                                | 16 |
| 11.3 | Test Method .....                                                   | 17 |
| 11.4 | Test Equipment.....                                                 | 18 |
| 11.5 | Test Results .....                                                  | 19 |
| 12   | Radiated emissions.....                                             | 20 |
| 12.1 | Definitions .....                                                   | 20 |
| 12.2 | Test Parameters.....                                                | 20 |
| 12.3 | Test Method .....                                                   | 21 |
| 12.4 | Test Equipment.....                                                 | 22 |
| 12.5 | Test Results .....                                                  | 23 |
| 13   | AC power-line conducted emissions .....                             | 28 |
| 13.1 | Definition .....                                                    | 28 |
| 13.2 | Test Parameters.....                                                | 28 |
| 13.3 | Test Method .....                                                   | 28 |
| 13.4 | Test Equipment.....                                                 | 30 |
| 13.5 | Test Results .....                                                  | 30 |
| 14   | Occupied Bandwidth .....                                            | 34 |
| 14.1 | Definition .....                                                    | 34 |
| 14.2 | Test Parameters.....                                                | 34 |
| 14.3 | Test Method .....                                                   | 34 |
| 14.4 | Test Equipment.....                                                 | 35 |
| 14.5 | Test Results .....                                                  | 35 |
| 15   | Transmitter output power (fundamental radiated emission) .....      | 36 |
| 15.1 | Definition .....                                                    | 36 |
| 15.2 | Test Parameters.....                                                | 36 |
| 15.3 | Test Method .....                                                   | 36 |
| 15.4 | Test Equipment.....                                                 | 37 |
| 15.5 | Test Results .....                                                  | 37 |
| 16   | Frequency stability .....                                           | 38 |
| 16.1 | Definition .....                                                    | 38 |
| 16.2 | Test Parameters.....                                                | 38 |
| 16.3 | Test Method .....                                                   | 38 |
| 16.4 | Test Equipment.....                                                 | 39 |
| 16.5 | Test Results .....                                                  | 39 |
| 17   | Additional Information .....                                        | 40 |
| 18   | Measurement Uncertainty.....                                        | 41 |
| 19   | General SAR test reduction and exclusion guidance/RF Exposure ..... | 42 |

## 4 Introduction

This report TRA-026673-12-47-00A presents the results of the Radio testing on a Controlled Electronic Management Systems Limited, Emerald Intelligent Fingerprint Terminal to specification 47CFR15 Radio Frequency Devices and RSS-210 Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment.

The testing was carried out for Controlled Electronic Management Systems Limited by TRaC Global Ltd, at the address(es) detailed below.

|                          |                                                                                          |                                     |                                                                                              |
|--------------------------|------------------------------------------------------------------------------------------|-------------------------------------|----------------------------------------------------------------------------------------------|
| <input type="checkbox"/> | TRaC Hull<br>Unit E<br>South Orbital Trading Park<br>Hedon Road<br>Hull<br>HU9 1NJ<br>UK | <input checked="" type="checkbox"/> | TRaC North West<br>Unit 1<br>Pendle Place<br>Skemersdale<br>West Lancashire<br>WN8 9PN<br>UK |
|--------------------------|------------------------------------------------------------------------------------------|-------------------------------------|----------------------------------------------------------------------------------------------|

This report details the configuration of the equipment, the test methods used and any relevant modifications where appropriate.

FCC Site Listing:

TRaC Global is accredited for the above sites under the US-EU MRA, Designation number UK0009.

IC Registration Number(s):

TRaC North West                      3930B-4

The test site requirements of ANSI C63.4-2014 are met up to 1GHz.

The test site SVSWR requirements of CISPR 16-1-4:2010 are met over the frequency range 1 GHz to 18 GHz.

## **5 Test Specifications**

### **5.1 Normative References**

- FCC 47 CFR Ch. I – Part 15 – Radio Frequency Devices.
- ANSI C63.10-2013 – American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.
- ANSI C63.4-2014 – 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.
- Industry Canada RSS-210, Issue 8, December 2010 – Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment.
- Industry Canada RSS-Gen, Issue 4, November 2014 – General Requirements for Compliance of Radio Apparatus

### **5.2 Deviations from Test Standards**

- There were no deviations from the test standard.

## 6 Glossary of Terms

|               |                                                                  |
|---------------|------------------------------------------------------------------|
| <b>§</b>      | denotes a section reference from the standard, not this document |
| <b>AC</b>     | Alternating Current                                              |
| <b>ANSI</b>   | American National Standards Institute                            |
| <b>BW</b>     | bandwidth                                                        |
| <b>C</b>      | Celsius                                                          |
| <b>CFR</b>    | Code of Federal Regulations                                      |
| <b>CW</b>     | Continuous Wave                                                  |
| <b>dB</b>     | decibel                                                          |
| <b>dBm</b>    | dB relative to 1 milliwatt                                       |
| <b>DC</b>     | Direct Current                                                   |
| <b>DSSS</b>   | Direct Sequence Spread Spectrum                                  |
| <b>EIRP</b>   | Equivalent Isotropically Radiated Power                          |
| <b>ERP</b>    | Effective Radiated Power                                         |
| <b>EUT</b>    | Equipment Under Test                                             |
| <b>FCC</b>    | Federal Communications Commission                                |
| <b>FHSS</b>   | Frequency Hopping Spread Spectrum                                |
| <b>Hz</b>     | hertz                                                            |
| <b>IC</b>     | Industry Canada                                                  |
| <b>ITU</b>    | International Telecommunication Union                            |
| <b>LBT</b>    | Listen Before Talk                                               |
| <b>m</b>      | metre                                                            |
| <b>max</b>    | maximum                                                          |
| <b>MIMO</b>   | Multiple Input and Multiple Output                               |
| <b>min</b>    | minimum                                                          |
| <b>MRA</b>    | Mutual Recognition Agreement                                     |
| <b>N/A</b>    | Not Applicable                                                   |
| <b>PCB</b>    | Printed Circuit Board                                            |
| <b>PDF</b>    | Portable Document Format                                         |
| <b>Pt-mpt</b> | Point-to-multipoint                                              |
| <b>Pt-pt</b>  | Point-to-point                                                   |
| <b>RF</b>     | Radio Frequency                                                  |
| <b>RH</b>     | Relative Humidity                                                |
| <b>RMS</b>    | Root Mean Square                                                 |
| <b>Rx</b>     | receiver                                                         |
| <b>s</b>      | second                                                           |
| <b>SVSWR</b>  | Site Voltage Standing Wave Ratio                                 |
| <b>Tx</b>     | transmitter                                                      |
| <b>UKAS</b>   | United Kingdom Accreditation Service                             |
| <b>V</b>      | volt                                                             |
| <b>W</b>      | watt                                                             |
| <b>Ω</b>      | ohm                                                              |

## 7 Equipment under Test

### 7.1 EUT Identification

- Name: Emerald Intelligent Fingerprint Terminal
- Serial Number: Not applicable
- Model Number: TSR/300/618
- Software Revision: 1.06.03
- Build Level / Revision Number: V9.33

Incorporating the following external cables / test ports;

Powered from 12 Vdc.

| <i>Type</i> |                          | <i>Description</i>                           | <i>Outdoor Cable Y / N</i> | <i>Test Length</i> | <i>Max Installation Length</i> |
|-------------|--------------------------|----------------------------------------------|----------------------------|--------------------|--------------------------------|
| 1           | Shielded 2 Core          | 12 V dc Supply Cable                         | N                          | < 3 m              | 30 m                           |
| 2           | Shielded 4 Core          | Door Simulator Cable                         | N                          | < 3 m              | 3 m                            |
| 3           | Shielded 2 Core          | Magnetic Lock Cable                          | N                          | < 3 m              | 3 m                            |
| 4           | Ethernet                 | Communication Cable                          | N                          | < 3 m              | 100 m                          |
| 5           | Würth ferrite 742-712-22 | 3 turns on ethernet cable external from EUT. | N/A                        | N/A                | N/A                            |

Powered from POE.

| <i>Type</i> |                          | <i>Description</i>                           | <i>Outdoor Cable Y / N</i> | <i>Test Length</i> | <i>Max Installation Length</i> |
|-------------|--------------------------|----------------------------------------------|----------------------------|--------------------|--------------------------------|
| 1           | Shielded 4 Core          | Door Simulator Cable                         | N                          | < 3 m              | 3 m                            |
| 2           | Shielded 2 Core          | Magnetic Lock Cable                          | N                          | < 3 m              | 3 m                            |
| 3           | Ethernet                 | Power and Communication Cable                | N                          | < 3 m              | 100 m                          |
| 4           | Würth ferrite 742-712-22 | 3 turns on ethernet cable external from EUT. | N/A                        | N/A                | N/A                            |

### 7.2 System Equipment

Equipment listed below forms part of the overall test setup and is required for equipment functionality and/or monitoring during testing. The compliance levels achieved in this report relate only to the EUT and not items given in the following list.

| <i>Description</i> | <i>Make</i>                      | <i>Model</i>   | <i>Serial Number</i> |
|--------------------|----------------------------------|----------------|----------------------|
| Laptop             | Dell                             | Latitude E5440 | 7F3kk12              |
| POE Supply         | Phihong                          | POE36U-1AT-R   | P42001009D1          |
| POE Supply         | PowerDsine                       | PD-8001/AC     | N06376060000855003   |
| Door Simulator     | Controlled Electronic Management | None           | None                 |
| Magnetic Lock      | Elite                            | None           | None                 |
| RFID Cards         | HID                              | Iclass GP      | None                 |

### 7.3 EUT Mode of Operation

The mode of operation was as follows.

| 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. |

### 7.4 EUT Radio Parameters

|                         |                |
|-------------------------|----------------|
| Frequency of operation: | 13.56 MHz      |
| Nominal Supply Voltage: | 12 Vdc and POE |
| Antenna                 | Integral       |

### 7.5 EUT Description

The EUT is a door access RFID reader. It has got two variants.

- Emerald Intelligent Fingerprint Terminal powered by POE
- Emerald Intelligent Fingerprint Terminal powered by 12 Vdc

Radiated spurious emissions and AC powerline conducted emissions were performed on both variants.

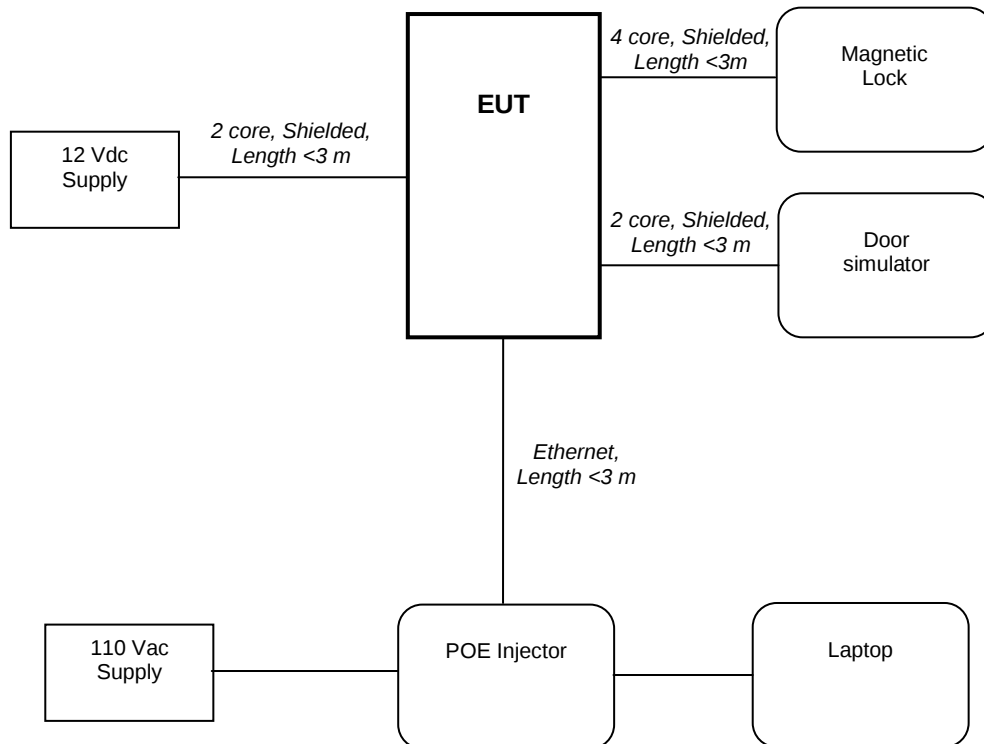
## **8 Modifications**

No modifications were performed during this assessment.

## 9 EUT Test Setup

### 9.1 Block Diagram

The following diagram shows basic EUT interconnections with cable type and cable lengths identified.



Note: The EUT was tested in two different configurations. The above diagram illustrates both modes with the equipment powered via an external 12 Vdc power supply and via POE. When EUT is powered from POE injector, 12 V dc supply was not connected and the connecting cable was not present. When it is powered by 12 V dc supply, power supply of POE injector was not connected.

## 9.2 General Set-up Photographs

The following photograph shows basic EUT set-up:



## 10 General Technical Parameters

### 10.1 Normal Conditions

The EUT was tested under the normal environmental conditions of the test laboratory, except where otherwise stated. The normal power source applied was approx.12 Vdc / POE

### 10.2 Varying Test Conditions

Variation of temperature is required to ensure stability of the declared fundamental frequency. During frequency error testing the following variations were made:

|   | <i>Category</i> | <i>Variation</i> |
|---|-----------------|------------------|
| ☒ | Standard        | -20 to +50 C     |

Variation of supply voltage is required to ensure stability of the declared output power and frequency. During carrier power and frequency error testing the following variations was made:

|   | <i>Category</i> | <i>Nominal</i> | <i>Variation</i>    |
|---|-----------------|----------------|---------------------|
| ☒ | DC              | 12 V           | 10.2 Vdc – 13.8 Vdc |

## 11 Radiated emissions below 30 MHz

### 11.1 Definitions

#### *Out-of-band emissions*

Emissions on a frequency or frequencies immediately outside the necessary bandwidth which result from the modulation process, but exclude spurious emissions.

#### *Spurious emissions*

Emissions on a frequency or frequencies which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products, but exclude out-of-band emissions.

#### *Restricted bands*

A frequency band in which intentional radiators are permitted to radiate only spurious emissions but not fundamental signals.

### 11.2 Test Parameters

|                                      |                                                                                           |
|--------------------------------------|-------------------------------------------------------------------------------------------|
| Test Location:                       | TRaC North West                                                                           |
| Test Chamber:                        | REF940                                                                                    |
| Test Standard and Clause:            | ANSI C63.10-2013, Clause 6.4                                                              |
| EUT Channels / Frequencies Measured: | 13.56 MHz                                                                                 |
| Measurement Distance:                | 3m                                                                                        |
| EUT Height:                          | 1m                                                                                        |
| Measurement Antenna and Height:      | 60cm shielded loop; 1m                                                                    |
| Measurement BW:                      | 9 kHz to 150 kHz: 200 Hz;<br>150 kHz to 30 MHz: 9 kHz                                     |
| Measurement Detector:                | 9 – 90 kHz and 110 – 490 kHz: Average, RMS<br>Other frequencies below 30 MHz: Quasi-peak. |

#### Environmental Conditions (Normal Environment)

|                      |                                |
|----------------------|--------------------------------|
| Temperature: 26 °C   | +15 °C to +35 °C (as declared) |
| Humidity: 39%RH      | 20%RH to 75%RH (as declared)   |
| Supply: 12 Vdc / POE | As declared                    |

#### Test Limits

Emissions from license-exempt transmitters shall comply with the field strength limits shown in the table below. Additionally, the level of any transmitter emission shall not exceed the level of the transmitter's fundamental emission.

#### General Field Strength Limits for License-Exempt Transmitters at Frequencies Below 30 MHz

| Frequency, f (kHz) | Field Strength                                 | Measurement Distance (m) |
|--------------------|------------------------------------------------|--------------------------|
| 9 – 490            | $2,400 / 377.f$ (μA/m)<br>$2,400 / f$ (μV/m)   | 300                      |
| 490 – 1,750        | $24,000 / 377.f$ (μA/m)<br>$24,000 / f$ (μV/m) | 30                       |
| 1,750 – 30,000     | 30 (μV/m)                                      | 30                       |

n.b. Devices operated pursuant to §15.225 / RSS-210 A2.6 are exempt from complying with the restricted band requirements for the 13.36–13.41 MHz band only.

### 11.3 Test Method

With the EUT setup as per section 9 of this report and connected as per Figure i, the EUT fundamental frequency was maximised by rotating the EUT through 360°, in three orthogonal planes, and adjusting the measurement antenna azimuth.

Radiated electromagnetic emissions from the EUT are checked first by preview scans. Preview scans for all spectrum and modulation characteristics are checked, using a peak detector and where applicable worst-case determined for function, operation, orientation, etc. for both vertical and horizontal polarisations. Pre-scan plots are shown with a peak detector and 9 kHz RBW.

If the EUT connects to auxiliary equipment and is table or floor standing, the configurations prescribed in ANSI C63.10 are followed. Alternatively, a layout closest to normal use (as declared by the provider) is employed, (see EUT setup photographs for more detail).

Emissions between 9 kHz and 30 MHz are measured using a calibrated 60cm active loop antenna. Pre-amplifiers and filters are used where required. Care is taken to ensure that test receiver resolution bandwidth, video bandwidth and detector type(s) meet the regulatory requirements.

Power values measured on the test receiver / analyzer are converted to field strength, FS, in  $\mu\text{V/m}$  at the regulatory distance, using:

$$FS = 10^{(PR - CF) / 20}$$

Where,

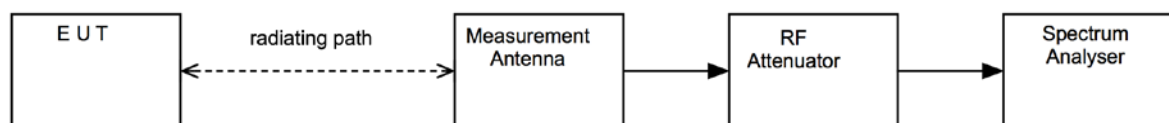
PR is the power recorded on the receiver / spectrum analyzer in dB $\mu\text{V}$  and includes any cable loss, antenna factor and pre-amplifier gain;

CF is the distance extrapolation factor in dB (where measurement distance different to limit distance);

Per FCC 47CFR15.31(f)(2) / RSS-Gen 6.4, an extrapolation factor of 40 dB per decade was used for measurements at distances closer than specified.

This field strength value is then compared with the regulatory limit.

**Figure i Test Setup**



Test Setup Photograph(s)

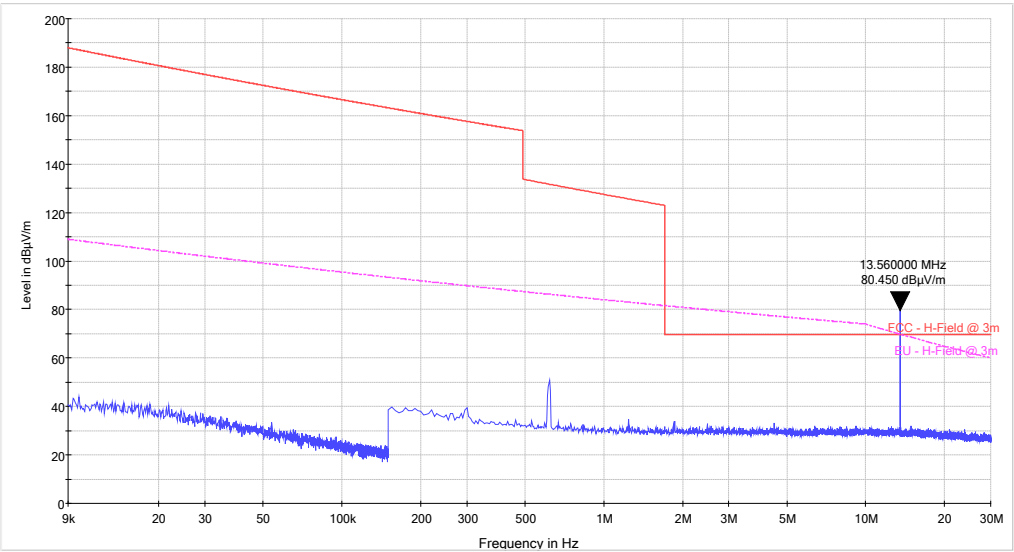


11.4 Test Equipment

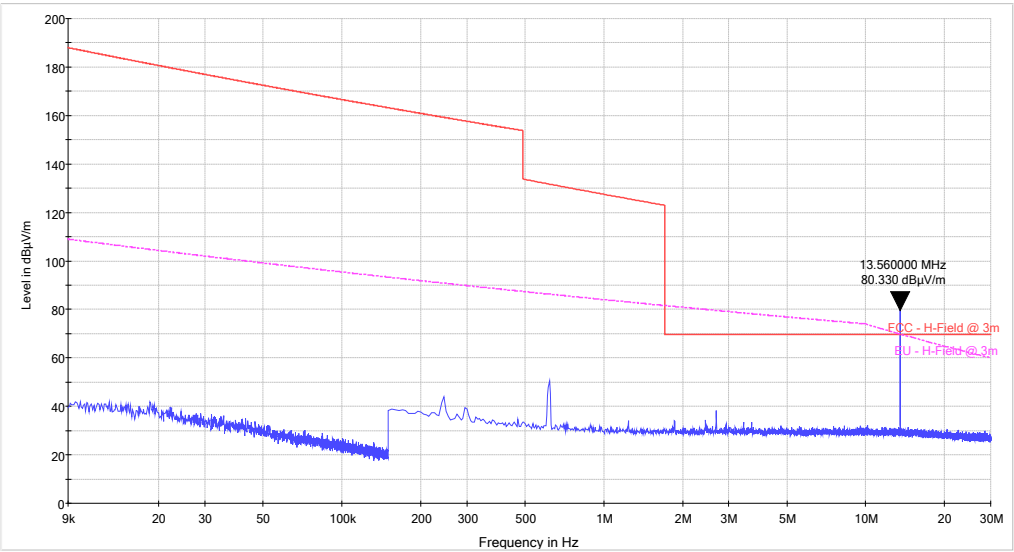
| Equipment Description | Manufacturer | Equipment Type | TRaC No | Last Cal Calibration | Calibration Period | Due For Calibration |
|-----------------------|--------------|----------------|---------|----------------------|--------------------|---------------------|
| Loop Antenna          | R&S          | hfh2           | L007    | 10/04/2015           | 24                 | 10/04/2017          |
| Receiver              | R&S          | ESHS10         | UH003   | 25/06/2015           | 12                 | 25/06/2016          |

11.5 Test Results

12V 9kHz – 30MHz



POE 9kHz – 30MHz



| Powered by 12 Vdc                                   |                         |                          |                    |                           |                       |        |
|-----------------------------------------------------|-------------------------|--------------------------|--------------------|---------------------------|-----------------------|--------|
| Emission Frequency (MHz)                            | Receiver Level (dBµV/m) | Measurement Distance (m) | Limit Distance (m) | Extrapolation Factor (dB) | Field Strength (µV/m) | Result |
| No emissions were detected within 20dB of the limit |                         |                          |                    |                           |                       |        |

| Powered by POE                                      |                         |                          |                    |                           |                       |        |
|-----------------------------------------------------|-------------------------|--------------------------|--------------------|---------------------------|-----------------------|--------|
| Emission Frequency (MHz)                            | Receiver Level (dBµV/m) | Measurement Distance (m) | Limit Distance (m) | Extrapolation Factor (dB) | Field Strength (µV/m) | Result |
| No emissions were detected within 20dB of the limit |                         |                          |                    |                           |                       |        |

## 12 Radiated emissions

### 12.1 Definitions

#### *Out-of-band emissions*

Emissions on a frequency or frequencies immediately outside the necessary bandwidth which result from the modulation process, but exclude spurious emissions.

#### *Spurious emissions*

Emissions on a frequency or frequencies which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products, but exclude out-of-band emissions.

#### *Restricted bands*

A frequency band in which intentional radiators are permitted to radiate only spurious emissions but not fundamental signals.

### 12.2 Test Parameters

|                                      |                                                                |
|--------------------------------------|----------------------------------------------------------------|
| Test Location:                       | TRaC North West                                                |
| Test Chamber:                        | REF940                                                         |
| Test Standard and Clause:            | ANSI C63.10-2013, Clause 6.5                                   |
| EUT Channels / Frequencies Measured: | 13.56 MHz                                                      |
| Measurement BW:                      | 30 MHz to 1 GHz: 120 kHz<br>1 GHz – 5 GHz: 100 KHz             |
| Measurement Detector:                | 30 MHz to 1 GHz: Quasi-peak<br>1 GHz – 5 GHz: Peak and Average |

#### Environmental Conditions (Normal Environment)

|                      |                                |
|----------------------|--------------------------------|
| Temperature: 21 °C   | +15 °C to +35 °C (as declared) |
| Humidity: 42%RH      | 20%RH to 75%RH (as declared)   |
| Supply: 12 Vdc / POE | As declared                    |

#### Test Limits

Emissions from license-exempt transmitters shall comply with the field strength limits shown in the table below. Additionally, the level of any transmitter emission shall not exceed the level of the transmitter's fundamental emission.

#### General Field Strength Limits for License-Exempt Transmitters at Frequencies Above 30 MHz

| Frequency (MHz) | Field Strength (µV/m at 3m) |
|-----------------|-----------------------------|
| 30-88           | 100                         |
| 88-216          | 150                         |
| 216-960         | 200                         |
| Above 960       | 500                         |

### 12.3 Test Method

With the EUT setup as per section 9 of this report and connected as per Figure ii, the emissions from the EUT were measured on a spectrum analyzer / EMI receiver.

Radiated electromagnetic emissions from the EUT are checked first by preview scans. Preview scans for all spectrum and modulation characteristics are checked, using a peak detector and where applicable worst-case determined for function, operation, orientation, etc. for both vertical and horizontal polarisations. Pre-scan plots are shown with a peak detector and 100kHz RBW.

If the EUT connects to auxiliary equipment and is table or floor standing, the configurations prescribed in ANSI C63.10 are followed. Alternatively, a layout closest to normal use (as declared by the provider) is employed, (see EUT setup photographs for more detail).

Emissions between 30 MHz and 1 GHz are measured using calibrated broadband antennas. Emissions above 1 GHz are characterized using standard gain horn antennas. Pre-amplifiers and filters are used where required. Care is taken to ensure that test receiver resolution bandwidth, video bandwidth and detector type(s) meet the regulatory requirements.

For both horizontal and vertical polarizations, the EUT is then rotated through 360 degrees in azimuth until the highest emission is detected. At the previously determined azimuth the test antenna is raised and lowered from 1 to 4 m in height until a maximum emission level is detected, this maximum value is recorded.

Power values measured on the test receiver / analyzer are converted to field strength, FS, in dBμV/m at the regulatory distance, using:

$$FS = PR + CL + AF - PA + DC - CF$$

Where,

PR is the power recorded on the receiver / spectrum analyzer in dBμV;

CL is the cable loss in dB;

AF is the test antenna factor in dB/m;

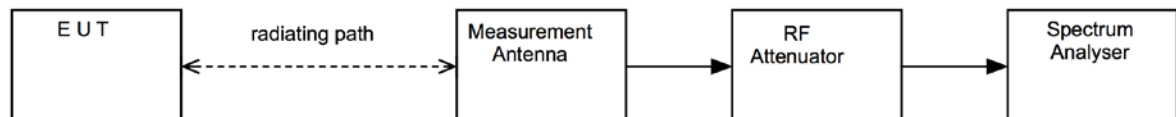
PA is the pre-amplifier gain in dB (where used);

DC is the duty correction factor in dB (where used, e.g. harmonics of pulsed fundamental);

CF is the distance factor in dB (where measurement distance different to limit distance);

This field strength value is then compared with the regulatory limit.

**Figure ii Test Setup**

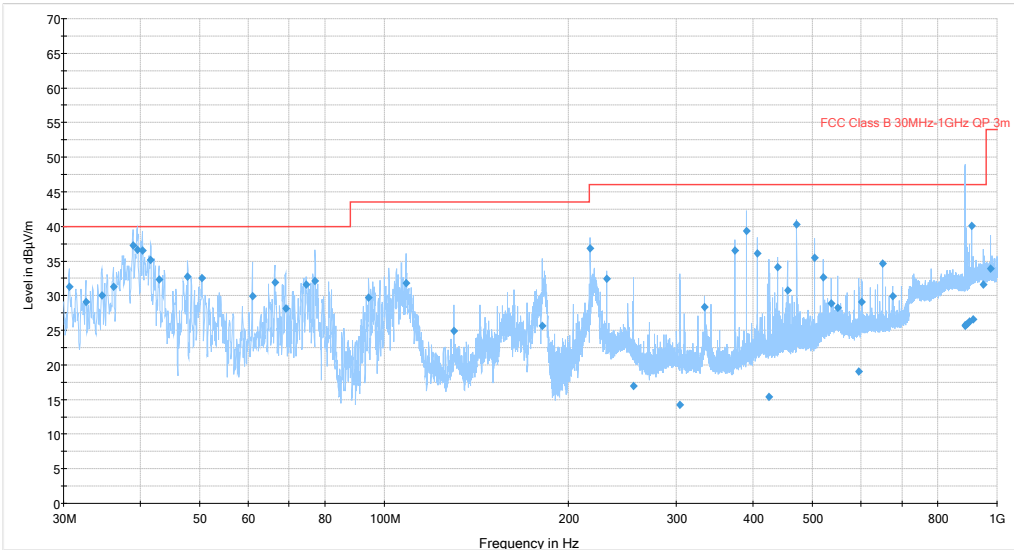


**Test Setup Photograph(s)****12.4 Test Equipment**

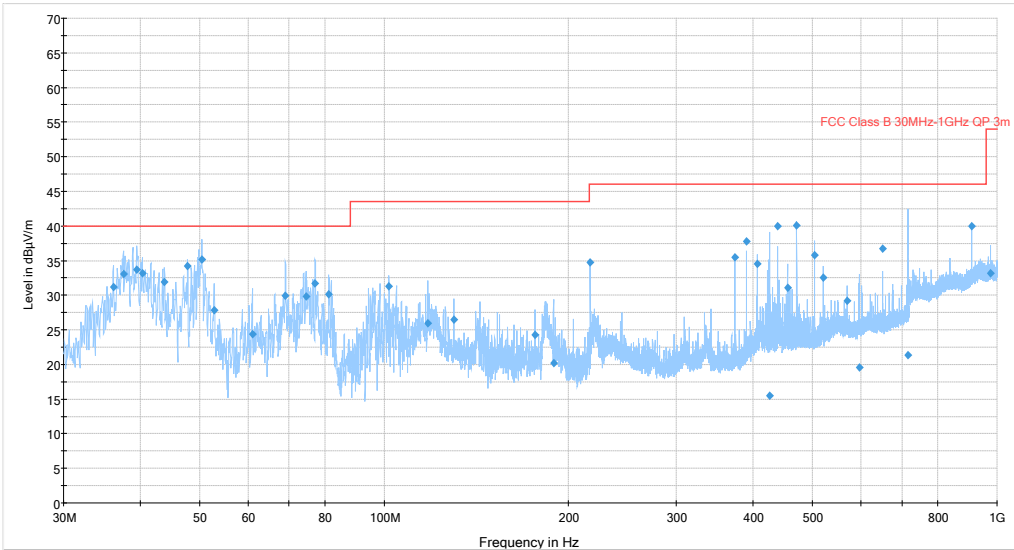
| Equipment Description     | Manufacturer | Equipment Type | TRaC No | Last Cal Calibration | Calibration Period | Due For Calibration |
|---------------------------|--------------|----------------|---------|----------------------|--------------------|---------------------|
| Spectrum Analyser         | R&S          | FSU26          | REF909  | 13/02/2015           | 12                 | 13/02/2016          |
| Radio Chamber - PP        | Rainford EMC | ATS            | REF940  | 08/09/2014           | 24                 | 08/09/2016          |
| IC Reg Radio Chamber - PP | Rainford EMC | ATS            | REF940  | 19/11/2014           | 36                 | 08/09/2017          |
| 1-18GHz Horn              | EMCO         | 3115           | L138    | 17/10/2013           | 24                 | 17/10/2015          |
| Bilog                     | Chase        | CBL611/A       | UH191   | 26/02/2015           | 24                 | 26/02/2016          |
| Pre Amp                   | Agilent      | 8449B          | L572    | 10/02/2015           | 12                 | 10/02/2016          |
| Receiver                  | R&S          | ESVS10         | L317    | 26/02/2015           | 12                 | 26/02/2015          |

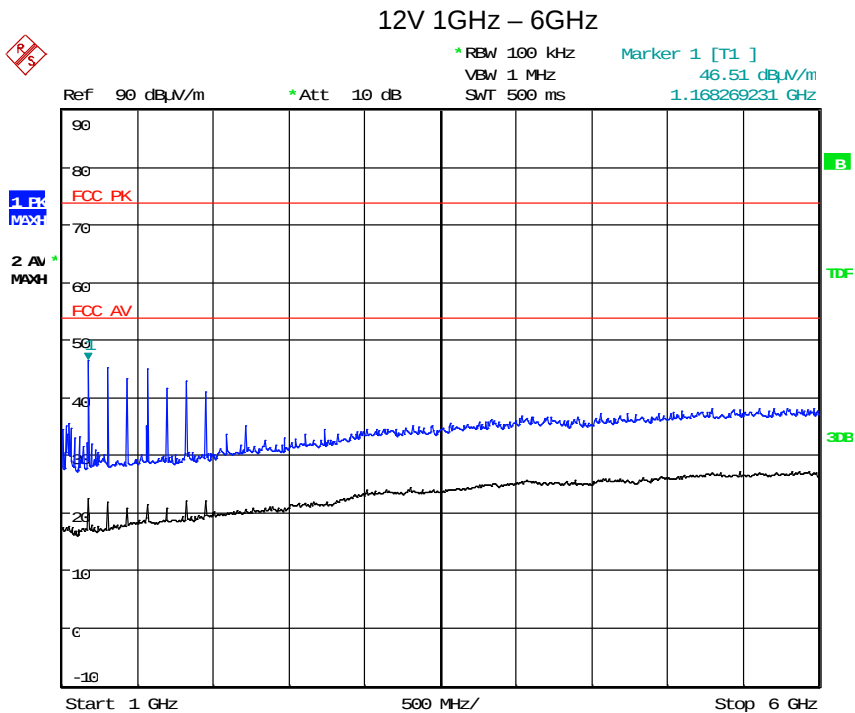
12.5 Test Results

12V 30MHz – 1GHz

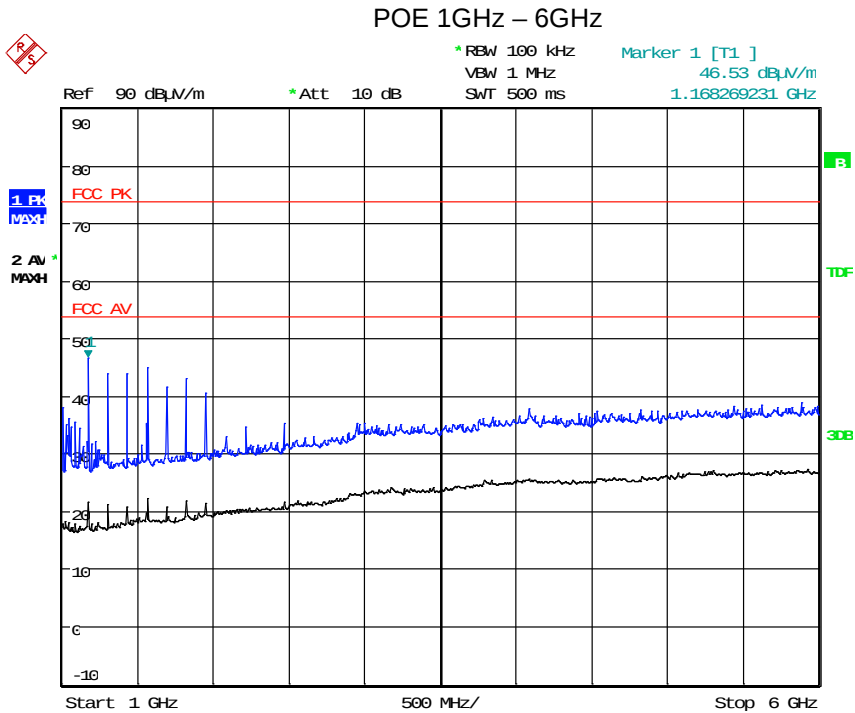


POE 30MHz – 1GHz





Date: 13.AUG.2015 14:35:52



Date: 13.AUG.2015 14:24:40

| Powered by POE |             |                        |                 |                       |                   |                         |                       |              |
|----------------|-------------|------------------------|-----------------|-----------------------|-------------------|-------------------------|-----------------------|--------------|
| Detector       | Freq. (MHz) | Meas'd Emission (dBμV) | Cable Loss (dB) | Antenna Factor (dB/m) | Pre-amp Gain (dB) | Field Strength (dBμV/m) | Field Strength (μV/m) | Limit (μV/m) |
| QP             | 36.2        | 14.5                   | 3.0             | 0.9                   | 15.8              | N/A                     | 31.2                  | 36.1         |
| QP             | 37.6        | 17.2                   | 3.0             | 0.9                   | 15.0              | N/A                     | 33.1                  | 45.0         |
| QP             | 39.5        | 18.9                   | 3.0             | 0.9                   | 13.9              | N/A                     | 33.7                  | 48.6         |
| QP             | 40.4        | 18.8                   | 3.0             | 1.0                   | 13.4              | N/A                     | 33.2                  | 45.8         |
| QP             | 43.8        | 19.4                   | 3.0             | 1.0                   | 11.5              | N/A                     | 31.9                  | 39.4         |
| QP             | 47.8        | 23.9                   | 3.0             | 1.0                   | 9.4               | N/A                     | 34.3                  | 52.0         |
| QP             | 50.5        | 26.1                   | 3.0             | 1.0                   | 8.1               | N/A                     | 35.2                  | 57.7         |
| QP             | 52.8        | 19.5                   | 3.0             | 1.0                   | 7.2               | N/A                     | 27.7                  | 24.4         |
| QP             | 61.0        | 17.4                   | 3.0             | 1.1                   | 5.9               | N/A                     | 24.4                  | 16.6         |
| QP             | 69.1        | 22.4                   | 3.0             | 1.2                   | 6.3               | N/A                     | 29.9                  | 31.3         |
| QP             | 74.6        | 21.7                   | 3.0             | 1.2                   | 6.9               | N/A                     | 29.8                  | 30.9         |
| QP             | 77.2        | 23.1                   | 3.0             | 1.3                   | 7.3               | N/A                     | 31.7                  | 38.5         |
| QP             | 81.3        | 20.9                   | 3.0             | 1.3                   | 7.9               | N/A                     | 30.1                  | 31.8         |
| QP             | 101.9       | 19.2                   | 3.0             | 1.5                   | 10.6              | N/A                     | 31.3                  | 36.7         |
| QP             | 117.8       | 12.3                   | 3.0             | 1.6                   | 12.1              | N/A                     | 26.0                  | 20.0         |
| QP             | 130.0       | 12.5                   | 3.0             | 1.5                   | 12.5              | N/A                     | 26.5                  | 21.2         |
| QP             | 176.3       | 12.9                   | 3.0             | 2.0                   | 9.5               | N/A                     | 24.4                  | 16.5         |
| QP             | 217.0       | 23.4                   | 3.0             | 2.0                   | 9.3               | N/A                     | 34.7                  | 54.5         |
| QP             | 373.8       | 18.2                   | 3.0             | 2.8                   | 14.6              | N/A                     | 35.6                  | 60.0         |
| QP             | 390.0       | 19.7                   | 3.0             | 2.8                   | 15.3              | N/A                     | 37.8                  | 78.0         |
| QP             | 406.3       | 15.7                   | 3.0             | 2.7                   | 16.0              | N/A                     | 34.4                  | 52.6         |
| QP             | 438.8       | 21.1                   | 3.0             | 2.9                   | 15.9              | N/A                     | 40.0                  | 99.8         |
| QP             | 455.0       | 11.4                   | 3.0             | 3.0                   | 16.6              | N/A                     | 31.0                  | 35.6         |
| QP             | 471.3       | 20.0                   | 3.0             | 3.1                   | 16.9              | N/A                     | 40.0                  | 100.0        |
| QP             | 503.8       | 15.2                   | 3.0             | 3.1                   | 17.5              | N/A                     | 35.8                  | 61.6         |
| QP             | 520.0       | 11.6                   | 3.0             | 3.1                   | 17.8              | N/A                     | 32.5                  | 42.3         |
| QP             | 568.8       | 6.7                    | 3.0             | 3.4                   | 19.2              | N/A                     | 29.3                  | 29.0         |
| QP             | 650.0       | 13.7                   | 3.0             | 3.5                   | 19.6              | N/A                     | 36.8                  | 69.0         |
| QP             | 910.0       | 12.3                   | 3.0             | 4.3                   | 23.3              | N/A                     | 39.9                  | 99.2         |
| AV             | 1003.6      | 46.0                   | 3.0             | 24.9                  | 38.0              | 35.9                    | 62.4                  | 500.0        |
| AV             | 1170.0      | 56.7                   | 3.3             | 25.5                  | 37.6              | 47.9                    | 248.6                 | 500.0        |
| AV             | 1300.0      | 55.5                   | 3.5             | 25.4                  | 37.2              | 47.1                    | 227.5                 | 500.0        |
| AV             | 1430.0      | 54.6                   | 3.7             | 25.8                  | 36.9              | 47.2                    | 228.3                 | 500.0        |
| AV             | 1560.0      | 54.6                   | 3.8             | 25.7                  | 36.7              | 47.5                    | 236.6                 | 500.0        |
| AV             | 1690.0      | 50.3                   | 3.8             | 26.0                  | 36.5              | 43.6                    | 150.7                 | 500.0        |
| AV             | 1820.0      | 50.2                   | 4.1             | 27.1                  | 36.4              | 45.0                    | 178.4                 | 500.0        |
| AV             | 1950.0      | 48.0                   | 4.1             | 27.5                  | 36.3              | 43.4                    | 147.4                 | 500.0        |

| Powered by 12 Vdc |             |                        |                 |                       |                   |                         |                       |              |
|-------------------|-------------|------------------------|-----------------|-----------------------|-------------------|-------------------------|-----------------------|--------------|
| Detector          | Freq. (MHz) | Meas'd Emission (dBμV) | Cable Loss (dB) | Antenna Factor (dB/m) | Pre-amp Gain (dB) | Field Strength (dBμV/m) | Field Strength (μV/m) | Limit (μV/m) |
| QP                | 30.7        | 11.9                   | 0.8             | 18.6                  | N/A               | 31.3                    | 36.6                  | 100.0        |
| QP                | 32.6        | 10.7                   | 0.8             | 17.6                  | N/A               | 29.1                    | 28.5                  | 100.0        |
| QP                | 34.7        | 12.6                   | 0.8             | 16.6                  | N/A               | 30.0                    | 31.7                  | 100.0        |
| QP                | 36.2        | 14.6                   | 0.9             | 15.8                  | N/A               | 31.3                    | 36.6                  | 100.0        |
| QP                | 39.0        | 22.2                   | 0.9             | 14.2                  | N/A               | 37.3                    | 73.6                  | 100.0        |
| QP                | 39.6        | 21.8                   | 0.9             | 13.9                  | N/A               | 36.6                    | 67.7                  | 100.0        |
| QP                | 40.4        | 22.1                   | 1.0             | 13.4                  | N/A               | 36.5                    | 66.9                  | 100.0        |
| QP                | 41.6        | 21.4                   | 1.0             | 12.7                  | N/A               | 35.1                    | 57.1                  | 100.0        |
| QP                | 43.0        | 19.4                   | 1.0             | 12.0                  | N/A               | 32.4                    | 41.8                  | 100.0        |
| QP                | 47.8        | 22.3                   | 1.0             | 9.4                   | N/A               | 32.7                    | 43.3                  | 100.0        |
| QP                | 50.5        | 23.5                   | 1.0             | 8.1                   | N/A               | 32.6                    | 42.8                  | 100.0        |
| QP                | 61.0        | 22.9                   | 1.1             | 5.9                   | N/A               | 29.9                    | 31.3                  | 100.0        |
| QP                | 66.3        | 24.6                   | 1.2             | 6.1                   | N/A               | 31.9                    | 39.5                  | 100.0        |
| QP                | 69.1        | 20.6                   | 1.2             | 6.3                   | N/A               | 28.1                    | 25.4                  | 100.0        |
| QP                | 74.6        | 23.5                   | 1.2             | 6.9                   | N/A               | 31.6                    | 38.0                  | 100.0        |
| QP                | 77.2        | 23.5                   | 1.3             | 7.3                   | N/A               | 32.1                    | 40.3                  | 100.0        |
| QP                | 94.4        | 18.5                   | 1.4             | 9.7                   | N/A               | 29.7                    | 30.4                  | 150.0        |
| QP                | 108.5       | 19.2                   | 1.5             | 11.2                  | N/A               | 31.9                    | 39.2                  | 150.0        |
| QP                | 130.0       | 10.9                   | 1.5             | 12.5                  | N/A               | 24.9                    | 17.6                  | 150.0        |
| QP                | 181.3       | 14.4                   | 1.9             | 9.4                   | N/A               | 25.7                    | 19.4                  | 150.0        |
| QP                | 217.0       | 25.5                   | 2.0             | 9.3                   | N/A               | 36.8                    | 69.4                  | 200.0        |
| QP                | 230.6       | 20.5                   | 2.2             | 9.7                   | N/A               | 32.4                    | 41.4                  | 200.0        |
| QP                | 333.0       | 11.8                   | 2.5             | 14.0                  | N/A               | 28.3                    | 25.9                  | 200.0        |
| QP                | 373.8       | 19.2                   | 2.8             | 14.6                  | N/A               | 36.6                    | 67.3                  | 200.0        |
| QP                | 390.0       | 21.3                   | 2.8             | 15.3                  | N/A               | 39.4                    | 93.8                  | 200.0        |
| QP                | 406.3       | 17.3                   | 2.7             | 16.0                  | N/A               | 36.0                    | 63.2                  | 200.0        |
| QP                | 438.8       | 15.3                   | 2.9             | 15.9                  | N/A               | 34.2                    | 51.2                  | 200.0        |
| QP                | 455.0       | 11.1                   | 3.0             | 16.6                  | N/A               | 30.7                    | 34.4                  | 200.0        |
| QP                | 471.3       | 20.2                   | 3.1             | 16.9                  | N/A               | 40.2                    | 102.3                 | 200.0        |
| QP                | 503.8       | 14.9                   | 3.1             | 17.5                  | N/A               | 35.5                    | 59.5                  | 200.0        |
| QP                | 520.0       | 11.7                   | 3.1             | 17.8                  | N/A               | 32.6                    | 42.8                  | 200.0        |
| QP                | 536.3       | 6.8                    | 3.3             | 18.8                  | N/A               | 28.9                    | 27.9                  | 200.0        |
| QP                | 549.0       | 5.0                    | 3.3             | 19.9                  | N/A               | 28.2                    | 25.6                  | 200.0        |
| QP                | 601.3       | 6.3                    | 3.5             | 19.2                  | N/A               | 29.1                    | 28.4                  | 200.0        |
| QP                | 650.0       | 11.5                   | 3.5             | 19.6                  | N/A               | 34.6                    | 53.6                  | 200.0        |

| Powered by 12 Vdc |                |                              |                       |                             |                         |                               |                             |                 |
|-------------------|----------------|------------------------------|-----------------------|-----------------------------|-------------------------|-------------------------------|-----------------------------|-----------------|
| Detector          | Freq.<br>(MHz) | Meas'd<br>Emission<br>(dBμV) | Cable<br>Loss<br>(dB) | Antenna<br>Factor<br>(dB/m) | Pre-amp<br>Gain<br>(dB) | Field<br>Strength<br>(dBμV/m) | Field<br>Strength<br>(μV/m) | Limit<br>(μV/m) |
| QP                | 675.0          | 6.2                          | 3.6                   | 20.1                        | N/A                     | 29.8                          | 30.9                        | 200.0           |
| QP                | 902.0          | -1.0                         | 4.3                   | 23.0                        | N/A                     | 26.3                          | 20.6                        | 200.0           |
| QP                | 910.0          | 12.5                         | 4.3                   | 23.3                        | N/A                     | 40.1                          | 101.5                       | 200.0           |
| QP                | 913.9          | -1.1                         | 4.4                   | 23.4                        | N/A                     | 26.6                          | 21.5                        | 200.0           |
| QP                | 949.4          | 3.2                          | 4.4                   | 24.0                        | N/A                     | 31.6                          | 37.9                        | 200.0           |
| AV                | 1003.6         | 46.0                         | 3.0                   | 24.9                        | 38.0                    | 35.9                          | 62.4                        | 500.0           |
| AV                | 1170.0         | 56.7                         | 3.3                   | 25.5                        | 37.6                    | 47.9                          | 248.6                       | 500.0           |
| AV                | 1300.0         | 55.5                         | 3.5                   | 25.4                        | 37.2                    | 47.1                          | 227.5                       | 500.0           |
| AV                | 1430.0         | 54.6                         | 3.7                   | 25.8                        | 36.9                    | 47.2                          | 228.3                       | 500.0           |
| AV                | 1560.0         | 54.6                         | 3.8                   | 25.7                        | 36.7                    | 47.5                          | 236.6                       | 500.0           |
| AV                | 1690.0         | 50.3                         | 3.8                   | 26.0                        | 36.5                    | 43.6                          | 150.7                       | 500.0           |
| AV                | 1820.0         | 50.2                         | 4.1                   | 27.1                        | 36.4                    | 45.0                          | 178.4                       | 500.0           |
| AV                | 1950.0         | 48.0                         | 4.1                   | 27.5                        | 36.3                    | 43.4                          | 147.4                       | 500.0           |

## 13 AC power-line conducted emissions

### 13.1 Definition

Line-to-ground radio-noise voltage that is conducted from all of the EUT current-carrying power input terminals that are directly (or indirectly via separate transformers or power supplies) connected to a public power network.

### 13.2 Test Parameters

|                                      |                                |
|--------------------------------------|--------------------------------|
| Test Location:                       | TRaC North West                |
| Test Chamber:                        | UH404                          |
| Test Standard and Clause:            | ANSI C63.10-2013, Clause 6.2   |
| EUT Channels / Frequencies Measured: | 13.56 MHz                      |
| Measurement BW:                      | 10 kHz                         |
| Measurement Detectors:               | Quasi-Peak and<br>Average, RMS |

### Environmental Conditions (Normal Environment)

|                      |                                |
|----------------------|--------------------------------|
| Temperature: 25 °C   | +15 °C to +35 °C (as declared) |
| Humidity: 40%RH      | 20%RH to 75%RH (as declared)   |
| Supply: 12 Vdc / POE | As declared                    |

### Test Limits

A radio apparatus that is designed to be connected to the public utility (AC) power line shall ensure that the radio frequency voltage, which is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz-30 MHz, shall not exceed the limits in Table 3.

**Table 3 – AC Power Line Conducted Emission Limits**

| Frequency<br>(MHz) | Conducted limit<br>(dB $\mu$ V) |           |
|--------------------|---------------------------------|-----------|
|                    | Quasi-Peak                      | Average** |
| 0.15 – 0.5         | 66 to 56*                       | 56 to 46* |
| 0.5 – 5.0          | 56                              | 46        |
| 5.0 – 30.0         | 60                              | 50        |

\* The level decreases linearly with the logarithm of the frequency.

\*\* A linear average detector is required.

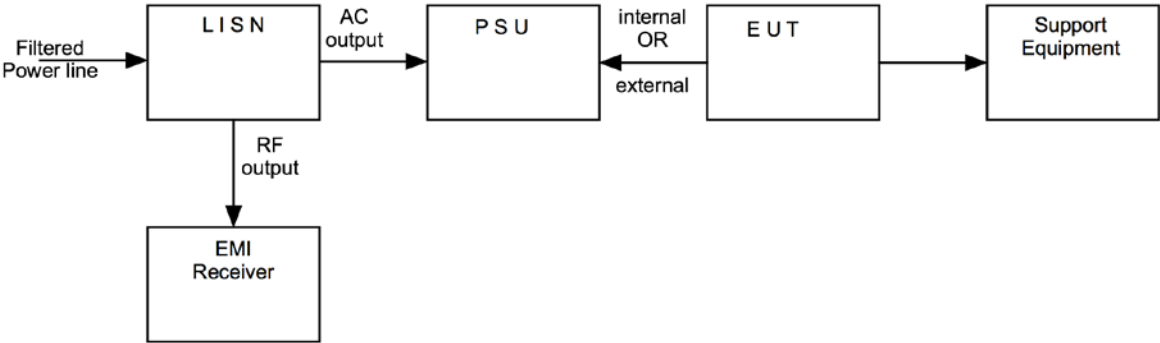
### 13.3 Test Method

With the EUT setup in a screened room, as per section 9 of this report and connected as per Figure iii, the power line emissions were measured on a spectrum analyzer / EMI receiver.

AC power line conducted emissions from the EUT are checked first by preview scans with peak and average detectors covering both live and neutral lines. A spectrum analyzer is used to determine if any periodic emissions are present.

Formal measurements using the correct detector(s) and bandwidth are made on frequencies identified from the preview scans. Final measurements were performed with EUT set at its maximum duty in transmit and receive modes.

#### Figure iii Test Setup



Test Setup Photograph(s)

AC power-line conducted emissions, Powered by 12 Vdc



AC power-line conducted emissions, Powered by POE

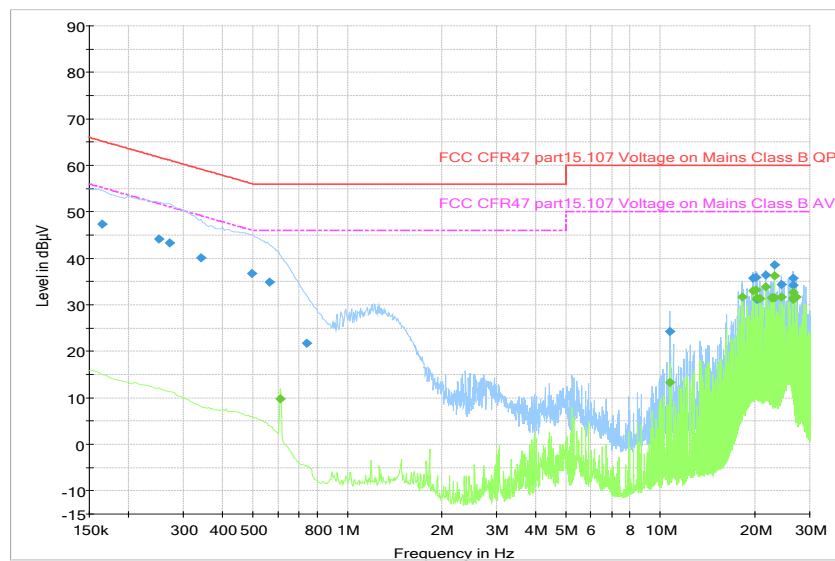


### 13.4 Test Equipment

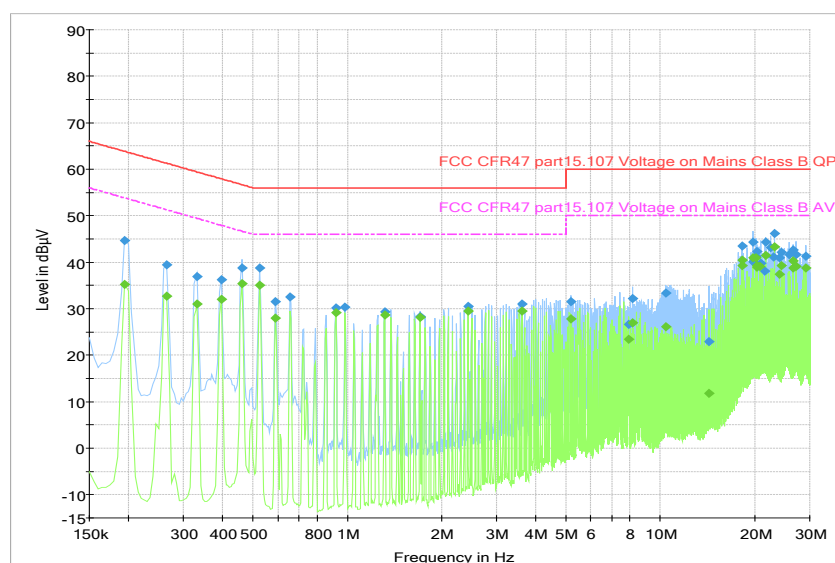
| Equipment Description | Manufacturer | Equipment Type | TRaC No | Last Cal Calibration | Calibration Period | Due For Calibration |
|-----------------------|--------------|----------------|---------|----------------------|--------------------|---------------------|
| Receiver              | R&S          | ESHS10         | UH003   | 25/06/2015           | 12                 | 25/06/2016          |
| Lisn                  | R&S          | ESH3-Z5.831.5  | UH195   | 04/06/2015           | 12                 | 04/06/2016          |
| Lisn                  | R&S          | ENV216         | UH396   | 01/07/2015           | 12                 | 01/07/2016          |

### 13.5 Test Results

AC power-line conducted emissions, Powered by 12 Vdc



AC power-line conducted emissions, Powered by POE



| AC power-line conducted emissions, Powered by 12 Vdc |                 |           |               |                            |             |                |
|------------------------------------------------------|-----------------|-----------|---------------|----------------------------|-------------|----------------|
| Results measured using the average detector          |                 |           |               |                            |             |                |
| Reference Number                                     | Frequency (MHz) | Conductor | Result (dBuV) | Specification Limit (dBuV) | Margin (dB) | Result Summary |
| 1.                                                   | 18.245          | L1        | 31.6          | 50.0                       | 18.4        | PASS           |
| 2.                                                   | 19.710          | L1        | 33.1          | 50.0                       | 16.9        | PASS           |
| 3.                                                   | 20.260          | L1        | 33.2          | 50.0                       | 16.8        | PASS           |
| 4.                                                   | 20.320          | L1        | 31.6          | 50.0                       | 18.4        | PASS           |
| 5.                                                   | 20.810          | L1        | 31.3          | 50.0                       | 18.7        | PASS           |
| 6.                                                   | 21.665          | L1        | 33.9          | 50.0                       | 16.1        | PASS           |
| 7.                                                   | 22.580          | L1        | 31.5          | 50.0                       | 18.5        | PASS           |
| 8.                                                   | 22.885          | L1        | 31.5          | 50.0                       | 18.5        | PASS           |
| 9.                                                   | 23.070          | L1        | 31.6          | 50.0                       | 18.4        | PASS           |
| 10.                                                  | 23.130          | L1        | 36.2          | 50.0                       | 13.8        | PASS           |
| 11.                                                  | 24.350          | L1        | 31.6          | 50.0                       | 18.4        | PASS           |
| 12.                                                  | 26.490          | L1        | 31.4          | 50.0                       | 18.6        | PASS           |
| 13.                                                  | 26.550          | L1        | 31.2          | 50.0                       | 18.8        | PASS           |
| 14.                                                  | 26.610          | L1        | 32.8          | 50.0                       | 17.2        | PASS           |
| 15.                                                  | 27.160          | L1        | 31.7          | 50.0                       | 18.3        | PASS           |

| AC power-line conducted emissions, Powered by 12 Vdc |                 |           |               |                            |             |                |
|------------------------------------------------------|-----------------|-----------|---------------|----------------------------|-------------|----------------|
| Results measured using the quasi-peak detector       |                 |           |               |                            |             |                |
| Reference Number                                     | Frequency (MHz) | Conductor | Result (dBuV) | Specification Limit (dBuV) | Margin (dB) | Result Summary |
| 1.                                                   | 0.165           | N         | 47.3          | 65.2                       | 17.9        | PASS           |
| 2.                                                   | 0.250           | N         | 44.1          | 61.8                       | 17.7        | PASS           |
| 3.                                                   | 0.270           | N         | 43.4          | 61.1                       | 17.7        | PASS           |
| 4.                                                   | 0.340           | N         | 40.1          | 59.2                       | 19.1        | PASS           |
| 5.                                                   | 0.495           | N         | 36.7          | 56.1                       | 19.4        | PASS           |

| AC power-line conducted emissions, Powered by POE |                 |           |               |                            |             |                |
|---------------------------------------------------|-----------------|-----------|---------------|----------------------------|-------------|----------------|
| Results measured using the average detector       |                 |           |               |                            |             |                |
| Reference Number                                  | Frequency (MHz) | Conductor | Result (dBuV) | Specification Limit (dBuV) | Margin (dB) | Result Summary |
| 1.                                                | 0.195           | L1        | 35.3          | 53.8                       | 18.5        | PASS           |
| 2.                                                | 0.265           | L1        | 32.6          | 51.3                       | 18.7        | PASS           |
| 3.                                                | 0.330           | L1        | 31.0          | 49.5                       | 18.5        | PASS           |
| 4.                                                | 0.395           | L1        | 32.0          | 48.0                       | 16.0        | PASS           |
| 5.                                                | 0.460           | L1        | 35.3          | 46.7                       | 11.4        | PASS           |
| 6.                                                | 0.525           | L1        | 35.0          | 46.0                       | 11.0        | PASS           |
| 7.                                                | 0.590           | N         | 27.9          | 46.0                       | 18.1        | PASS           |
| 8.                                                | 0.920           | N         | 29.2          | 46.0                       | 16.8        | PASS           |
| 9.                                                | 1.315           | N         | 28.6          | 46.0                       | 17.4        | PASS           |
| 10.                                               | 1.705           | N         | 28.1          | 46.0                       | 17.9        | PASS           |
| 11.                                               | 2.430           | N         | 29.5          | 46.0                       | 16.5        | PASS           |
| 12.                                               | 3.610           | N         | 29.5          | 46.0                       | 16.5        | PASS           |
| 13.                                               | 18.245          | N         | 40.4          | 50.0                       | 9.6         | PASS           |
| 14.                                               | 18.305          | N         | 39.2          | 50.0                       | 10.8        | PASS           |
| 15.                                               | 19.710          | N         | 41.0          | 50.0                       | 9.0         | PASS           |
| 16.                                               | 20.260          | N         | 41.0          | 50.0                       | 9.0         | PASS           |
| 17.                                               | 20.320          | N         | 39.3          | 50.0                       | 10.7        | PASS           |
| 18.                                               | 20.380          | N         | 38.9          | 50.0                       | 11.1        | PASS           |
| 19.                                               | 20.810          | N         | 39.1          | 50.0                       | 10.9        | PASS           |
| 20.                                               | 21.665          | N         | 41.5          | 50.0                       | 8.5         | PASS           |
| 21.                                               | 23.130          | N         | 43.3          | 50.0                       | 6.7         | PASS           |
| 22.                                               | 24.045          | N         | 37.5          | 50.0                       | 12.5        | PASS           |
| 23.                                               | 24.350          | N         | 39.3          | 50.0                       | 10.7        | PASS           |
| 24.                                               | 26.490          | N         | 38.8          | 50.0                       | 11.2        | PASS           |
| 25.                                               | 26.610          | N         | 40.2          | 50.0                       | 9.8         | PASS           |
| 26.                                               | 27.160          | L1        | 39.2          | 50.0                       | 10.8        | PASS           |
| 27.                                               | 29.235          | L1        | 38.8          | 50.0                       | 11.2        | PASS           |

| AC power-line conducted emissions, Powered by POE |                 |           |               |                            |             |                |
|---------------------------------------------------|-----------------|-----------|---------------|----------------------------|-------------|----------------|
| Results measured using the quasi-peak detector    |                 |           |               |                            |             |                |
| Reference Number                                  | Frequency (MHz) | Conductor | Result (dBuV) | Specification Limit (dBuV) | Margin (dB) | Result Summary |
| 1.                                                | 0.195           | L1        | 44.7          | 63.8                       | 19.1        | PASS           |
| 2.                                                | 0.460           | L1        | 38.7          | 56.7                       | 18.0        | PASS           |
| 3.                                                | 0.525           | L1        | 38.7          | 56.0                       | 17.3        | PASS           |
| 4.                                                | 18.245          | N         | 43.4          | 60.0                       | 16.6        | PASS           |
| 5.                                                | 19.710          | N         | 44.3          | 60.0                       | 15.7        | PASS           |
| 6.                                                | 20.255          | L1        | 41.3          | 60.0                       | 18.7        | PASS           |
| 7.                                                | 20.320          | N         | 42.4          | 60.0                       | 17.6        | PASS           |
| 8.                                                | 21.665          | L1        | 44.3          | 60.0                       | 15.7        | PASS           |
| 9.                                                | 22.460          | N         | 43.1          | 60.0                       | 16.9        | PASS           |
| 10.                                               | 23.065          | L1        | 41.2          | 60.0                       | 18.8        | PASS           |
| 11.                                               | 23.130          | N         | 46.1          | 60.0                       | 13.9        | PASS           |
| 12.                                               | 24.045          | N         | 40.9          | 60.0                       | 19.1        | PASS           |
| 13.                                               | 24.350          | N         | 42.1          | 60.0                       | 17.9        | PASS           |
| 14.                                               | 25.875          | L1        | 41.7          | 60.0                       | 18.3        | PASS           |
| 15.                                               | 26.610          | L1        | 42.7          | 60.0                       | 17.3        | PASS           |
| 16.                                               | 27.160          | L1        | 41.6          | 60.0                       | 18.4        | PASS           |
| 17.                                               | 29.235          | L1        | 41.3          | 60.0                       | 18.7        | PASS           |

## 14 Occupied Bandwidth

### 14.1 Definition

#### *Occupied bandwidth*

The width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to 0.5% of the emitted power. This is also known as the *99% emission bandwidth*. For transmitters in which there are multiple carriers, contiguous or non-contiguous in frequency, the occupied bandwidth is to be the sum of the occupied bandwidths of the individual carriers.

#### *20dB bandwidth*

The emission bandwidth (x dB) is defined as the frequency range between two points, one above and one below the carrier frequency, at which the spectral density of the emission is attenuated x dB below the maximum in-band spectral density of the modulated signal.

### 14.2 Test Parameters

|                                      |                              |
|--------------------------------------|------------------------------|
| Test Location:                       | TRaC North West              |
| Test Chamber:                        | Radio Lab                    |
| Test Standard and Clause:            | ANSI C63.10-2013, Clause 6.9 |
| EUT Channels / Frequencies Measured: | 13.56 MHz                    |

#### **Environmental Conditions (Normal Environment)**

|                    |                                |
|--------------------|--------------------------------|
| Temperature: 27 °C | +15 °C to +35 °C (as declared) |
| Humidity: 38%RH    | 20%RH to 75%RH (as declared)   |
| Supply: 12 Vdc     | As declared                    |

### Test Limits

#### Industry Canada:

When the occupied bandwidth limit is not stated in the applicable RSS or reference measurement method, the transmitted signal bandwidth shall be reported as the 99% emission bandwidth, as calculated or measured.

#### Federal Communications Commission:

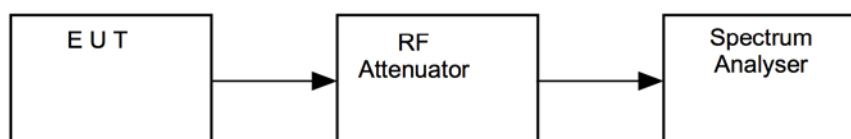
Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

### 14.3 Test Method

With the EUT setup as per section 9 of this report and connected as per Figure iv, the bandwidth of the EUT was measured on a spectrum analyser.

The measurements were performed with EUT set at its maximum duty. All modulation schemes, data rates and power settings were used to observe the worst-case configuration in each bandwidth.

**Figure iv Test Setup**

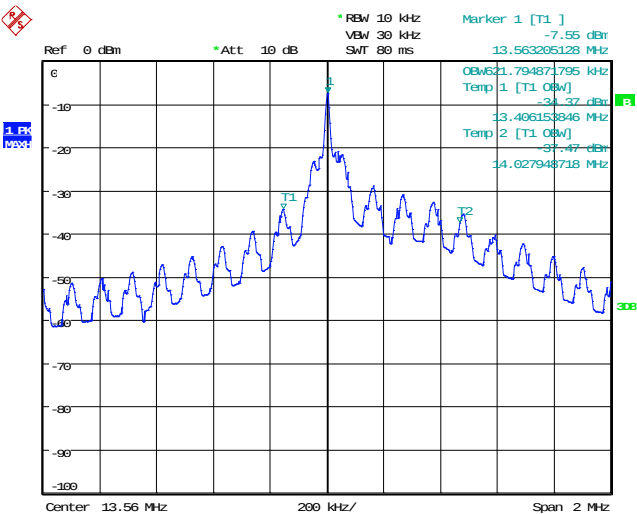


14.4 Test Equipment

| Equipment<br>Description | Manufacturer | Equipment<br>Type | TRaC<br>No | Last Cal<br>Calibration | Calibration<br>Period | Due For<br>Calibration |
|--------------------------|--------------|-------------------|------------|-------------------------|-----------------------|------------------------|
| Spectrum Analyser        | R&S          | FSU26             | REF909     | 13/02/2015              | 12                    | 13/02/2016             |

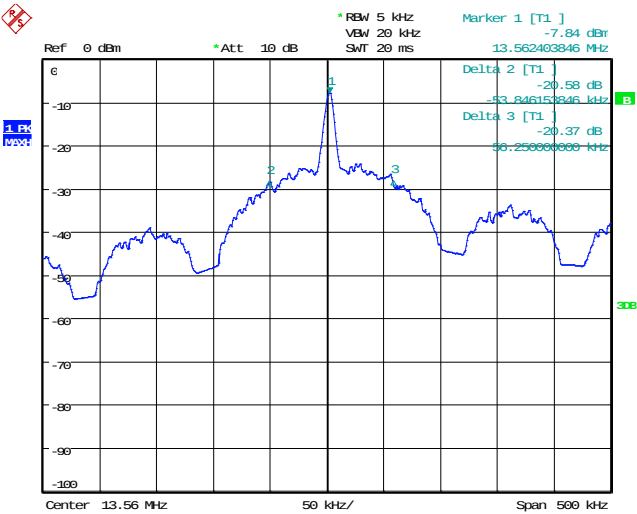
14.5 Test Results

| RSS-210. Modulation: ; Data rate: ; Power setting: |                         |                         |                        |
|----------------------------------------------------|-------------------------|-------------------------|------------------------|
| Channel Frequency<br>(MHz)                         | F <sub>L</sub><br>(MHz) | F <sub>H</sub><br>(MHz) | 99% Bandwidth<br>(kHz) |
| 13.56                                              | 13.406154               | 14.027949               | 621.795                |



Date: 13.AUG.2015 17:10:36

| 15.225. Modulation: ; Data rate: ; Power setting: |                         |                         |                         |
|---------------------------------------------------|-------------------------|-------------------------|-------------------------|
| Channel Frequency<br>(MHz)                        | F <sub>L</sub><br>(MHz) | F <sub>H</sub><br>(MHz) | 20dB Bandwidth<br>(kHz) |
| 13.56                                             | 13.508558               | 13.618654               | 110.096                 |



Date: 14.AUG.2015 08:47:25

## 15 Transmitter output power (fundamental radiated emission)

### 15.1 Definition

The RF power dissipated in the standard output termination when operating under the rated duty cycle selected by the applicant for approval.

### 15.2 Test Parameters

|                           |                                    |
|---------------------------|------------------------------------|
| Test Location:            | TRaC North West                    |
| Test Chamber:             | REF940                             |
| Test Antenna:             | Active 60cm loop                   |
| Test Standard and Clause: | ANSI C63.10-2013, Clause 6.3 / 6.4 |
| Measurement BW:           | 9 kHz                              |
| Measurement Detector:     | Quasi-peak                         |

### Environmental Conditions (Normal Environment)

|                      |                                |
|----------------------|--------------------------------|
| Temperature: 21 °C   | +15 °C to +35 °C (as declared) |
| Humidity: 42%RH      | 20%RH to 75%RH (as declared)   |
| Supply: 12 Vdc / POE | As declared                    |

### Test Limits

The field strength measured at 30 metres shall not exceed the limits in the following table:

**Field Strength Limits for License-Exempt Transmitters for Any Application**

| Frequency range (MHz) | Field strength (µV/m at 30m) | Field strength (dBµV/m at 30m) |
|-----------------------|------------------------------|--------------------------------|
| 13.110 – 13.410       | 106                          | 40.5                           |
| 13.410 – 13.553       | 334                          | 50.5                           |
| 13.553 – 13.567       | 15,848                       | 84.0                           |
| 13.567 – 13.710       | 334                          | 50.5                           |
| 13.710 – 14.010       | 106                          | 40.5                           |

### 15.3 Test Method

With the EUT setup as per section 9 of this report and connected as per Figure v, the resolution bandwidth of the spectrum analyser was increased above the EUT occupied bandwidth and the peak emission data noted.

The measurements were performed with EUT set at its maximum duty. All modulation schemes, data rates and power settings were used to observe the worst-case configuration in each bandwidth.

Power values measured on the test receiver / analyzer are converted to field strength, FS, in µV/m at the regulatory distance, using:

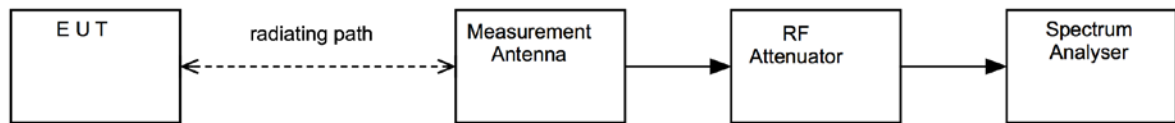
$$FS = 10^{(PR - CF) / 20}$$

Where,

PR is the power recorded on the receiver / spectrum analyzer in dBµV and includes any cable loss, antenna factor and pre-amplifier gain;  
CF is the distance extrapolation factor in dB (where measurement distance different to limit distance);

This field strength value is then compared with the regulatory limit.

Figure v Test Setup



#### 15.4 Test Equipment

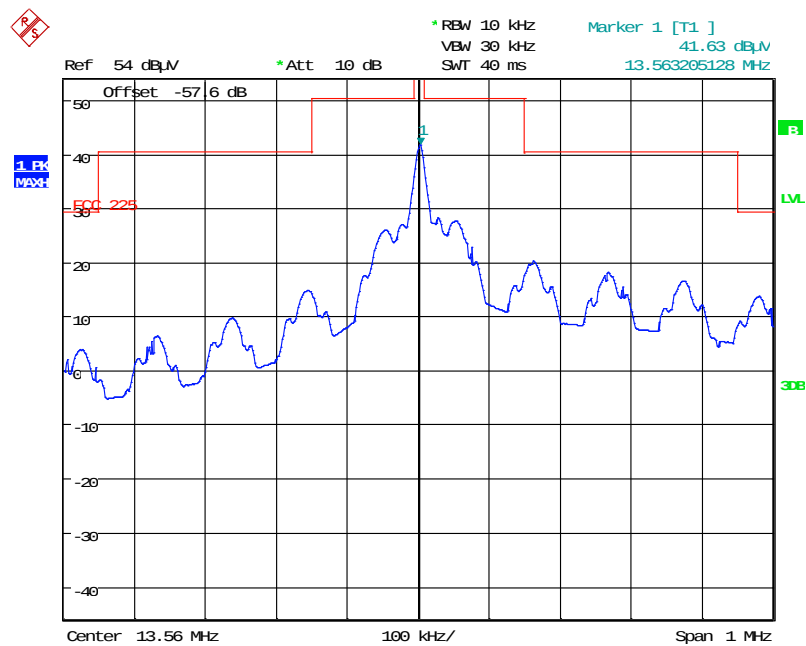
| Equipment Description | Manufacturer | Equipment Type | TRaC No | Last Cal Calibration | Calibration Period | Due For Calibration |
|-----------------------|--------------|----------------|---------|----------------------|--------------------|---------------------|
| Loop Antenna          | R&S          | hfh2           | L007    | 10/04/2015           | 24                 | 10/04/2017          |
| Receiver              | R&S          | ESHS10         | UH003   | 25/06/2015           | 12                 | 25/06/2016          |
| Spectrum Analyser     | R&S          | FSU26          | REF909  | 13/02/2015           | 12                 | 13/02/2016          |

#### 15.5 Test Results

| Modulation: ; Data rate: ; Power setting: |                         |                          |                    |                           |                       |        |
|-------------------------------------------|-------------------------|--------------------------|--------------------|---------------------------|-----------------------|--------|
| Channel Frequency (MHz)                   | Receiver Level (dBμV/m) | Measurement Distance (m) | Limit Distance (m) | Extrapolation Factor (dB) | Field Strength (μV/m) | Result |
| 13.56                                     | 81.10                   | 3                        | 30                 | 39.48                     | 120.44                | PASS   |
| 13.56                                     | 60.70                   | 10                       | 30                 | 19.08                     | 120.44                | PASS   |

Notes:

- Results quoted are extrapolated as indicated
- Extrapolation <30 MHz 40dB/decade as per 15.31(f)(2) & RSS-Gen 6.4
- 10 – 30 metre extrapolation 19.08 dB (40dB/decade)
- 3 – 10 metre extrapolation as measured (20.4 dB)
- 3 – 30 metre extrapolation 39.48 dB



Date: 14.AUG.2015 09:12:08

## 16 Frequency stability

### 16.1 Definition

Frequency stability is a measure of frequency drift due to temperature and supply voltage variations, with reference to the frequency measured at an appropriate reference temperature and the rated supply voltage.

### 16.2 Test Parameters

|                                             |                              |
|---------------------------------------------|------------------------------|
| Test Location:                              | TRaC North West              |
| Test Chamber:                               | Radio Lab                    |
| Test Standard and Clause:                   | ANSI C63.10-2013, Clause 6.8 |
| Modulation:                                 | Off                          |
| Temperature Extreme Environment Test Range: | -20 to +50 C                 |
| Voltage Extreme Environment Test Range:     | 10.2 Vdc – 13.8 Vdc          |

#### Environmental Conditions (Normal Environment)

|                   |                              |
|-------------------|------------------------------|
| Temperature: 25°C | Standard Requirement: +20 °C |
| Humidity: 38%RH   | 20%RH to 75%RH (as declared) |
| Supply: 12 Vdc    | As declared                  |

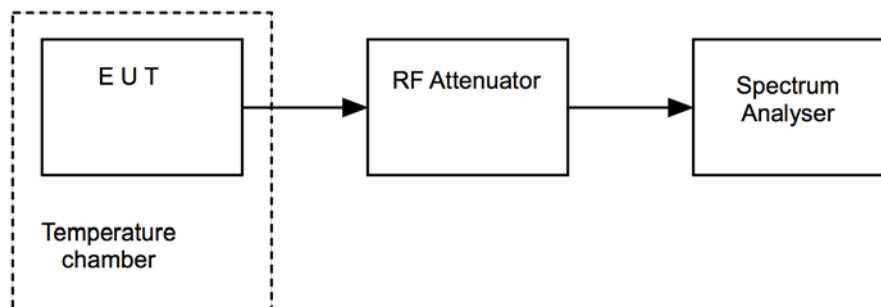
#### Test Limits

Carrier frequency stability shall be maintained to  $\pm 0.01\%$  ( $\pm 100$  ppm).

### 16.3 Test Method

With the EUT setup as per section 9 of this report and connected as per Figure v, the frequency was measured under varying conditions of temperature and supply voltage. The measurements were performed with EUT set in a CW mode of operation.

**Figure v Test Setup**



**16.4 Test Equipment**

| Equipment Description | Manufacturer | Equipment Type | TRaC No | Last Cal Calibration | Calibration Period | Due For Calibration |
|-----------------------|--------------|----------------|---------|----------------------|--------------------|---------------------|
| Spectrum Analyser     | R&S          | FSU26          | REF909  | 13/02/2015           | 12                 | 13/02/2016          |
| Multimeter            | Agilent      | 34405a         | REF976  | 03/06/2015           | 12                 | 03/06/2016          |
| Temperature Indicator | Fluke        | 52 Series II   | L426    | 30/05/2015           | 12                 | 30/05/2016          |
| PSU                   | Thandar      | -              | UH100   | Cal with REF976      |                    |                     |
| Temp Chamber          | Sharetree    | -              | L011    | Cal with L426        |                    |                     |

**16.5 Test Results**

| Test Conditions  |                  | Measured Frequency (MHz) | Drift (kHz) |
|------------------|------------------|--------------------------|-------------|
| T <sub>nom</sub> | V <sub>nom</sub> | 13.562029                | N/A         |
| T <sub>nom</sub> | V <sub>min</sub> | 13.562029                | 0.000       |
| T <sub>nom</sub> | V <sub>max</sub> | 13.562029                | 0.000       |
| T <sub>max</sub> | V <sub>nom</sub> | 13.562022                | -0.006      |
| T <sub>min</sub> | V <sub>nom</sub> | 13.562144                | 0.115       |

## 17 Additional Information

Client declaration regarding model numbers:-

Please be advised that all following emerald fingerprint models - TSR/300/618, TSR/300/115, TSR/300/116, TSR/300/117, TSR/300/118, TSR/200/618, TSR/200/115, TSR/200/116, TSR/200/117, TSR/200/118, TSR/100/618, TSR/100/115, TSR/100/116, TSR/100/117 and TSR/100/118 are electronically identical, all RF measurements and test results are the same. All 15 versions are built to one hardware and Firmware build. The only difference is the SAM card which is required for compatibility with Picopass/iClass /iClass SE smart cards. The emerald models - TSR/\*00/115 and TSR/\*00/117 do not have the SAM card fitted. Without the SAM card fitted the emerald (TSR) is compatible with only Mifare CSN and/or CEM Desfire smart card formats.

The TSR/\*00/618 is the fingerprint version of this product, called emerald Intelligent Fingerprint Terminal. It is classed as multi smart, this means that it can work with most 13.56MHz RFID card formats i.e. Picopass, iClass, iClass SE, Mifare CSN, DESFire and CEM Desfire. When the TSR/\*00/618 is connected to an AC2000 system it automatically downloads the card database and card format data from the system it has been connected too. This is the point when the card format that the emerald (TSR) unit will respond to is selected.

The TSR/\*00/618 is to be marketed as a multi smart card reader compatible with Mifare CSN, Picopass, CEM Desfire and iClass / iClass SE card formats.

The TSR/\*00/115 is identical in both hardware and firmware to the TSR/\*00/618 but has No SAM fitted, it is to be marketed for Mifare CSN card format.

The TSR/\*00/116 is identical in both hardware and firmware to the TSR/\*00/618 with SAM fitted, it is to be marketed for Picopass card format.

The TSR/\*00/117 is identical in both hardware and firmware to the TSR/\*00/618 but has No SAM fitted, it is to be marketed for CEM Desfire card format.

The TSR/\*00/118 is identical in both hardware and firmware to the TSR/\*00/618 with SAM fitted, it is to be marketed for iClass / iClass SE card formats.

The differences between the 100, 200 & 300 models are purely functional and are controlled by product licensing. The 300 model is fully featured; the 200 and 100 models have subsets of the features offered by the 300 model. These are as follows:-

The TSR/100/\*\* is the base level Intelligent Fingerprint Terminal with fingerprint access control functionality.

The TSR/200/\*\* is the mid range level Intelligent Fingerprint Terminal with fingerprint access control and additional VoIP intercom facility enabled.

The TSR/300/\*\* is the top level Intelligent Fingerprint Terminal with fingerprint access control, VoIP and additional Remote Applications enabled.

## 18 Measurement Uncertainty

### Calculated Measurement Uncertainties

All statements of uncertainty are expanded standard uncertainty using a coverage factor of 1.96 to give a 95% confidence:

#### [1] Radiated emissions below 30MHz

Uncertainty in test result (9kHz – 30MHz) = **2.3dB**,

#### [2] Spurious emissions

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

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

#### [3] AC power line conducted emissions

Uncertainty in test result = **3.4dB**

#### [4] Occupied bandwidth

Uncertainty in test result = **15.5%**

#### [5] Maximum frequency error

Uncertainty in test result (Power Meter) = **0.113ppm**

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

## 19 General SAR test reduction and exclusion guidance/RF Exposure

### Section 4.3 General SAR test reduction and exclusion guidance

For Standalone SAR exclusion consideration, when SAR Exclusion Threshold requirement in KDB 447498 is satisfied, standalone SAR evaluation for general population exposure conditions by measurement or numerical simulation is not required.

The SAR Test Exclusion Threshold for frequency range below 100 MHz will be determined as follows.

$$\text{SAR Exclusion Threshold (SARET)} = (\text{Step 1} + \text{Step 2}) * \text{Step 3}$$

#### Step 1

$$NT = [(MP/TSD^A) * \sqrt{f_{\text{GHz}}}]$$

NT = Numeric Threshold (3.0 for 1-g SAR and 7.5 for 10-g SAR)

MP = Max Power of channel (mW) (including tune-up tolerance)

$TSD^A$  = Min Test separation Distance or 50mm (whichever is lower) = 5mm (in this case)

We can transpose this formula to allow us to find the maximum power of a channel allowed and compare this to the measured maximum power.

$$= [(NT * TSD^A) / \sqrt{f_{\text{GHz}}}]$$

For Distances Greater than 50 mm Step 2 applies

#### Step 2

$$(TSD^B - 50\text{mm}) * 10$$

Where:

$$TSD^B = \text{Min Test separation Distance (mm)} = 50$$

Note: Step 2 doesn't apply here as the  $TSD^A$  is less than 50 mm

#### Step 3

- the power threshold at the corresponding test separation distance at 100 MHz in step 2 is multiplied by  $[1 + \log(100/f_{\text{MHz}})]$  for test separation distances > 50 mm and < 200 mm
- the power threshold determined by the equation in steps 1 for 50 mm and 100 MHz is multiplied by  $1/2$  for test separation distances  $\leq 50$  mm

$$\text{SARET} = [(NT * TSD^A) / \sqrt{f_{\text{GHz}}}] * 1/2$$

$$\text{SARET} = [(3.0 * 50) / \sqrt{0.1}] * 1/2$$

$$\text{SARET} = 474.34 \text{ mW}$$

| Channel Frequency (MHz) | EIRP (mW)             | SAR Exclusion Threshold (mW) | SAR Evaluation |
|-------------------------|-----------------------|------------------------------|----------------|
| 13.56                   | $4.36 \times 10^{-5}$ | 474.34                       | Not Required   |

Therefore standalone SAR evaluation for general population exposure conditions by measurement or numerical simulation is not required.

**Prediction of MPE limit at a given distance**

$$S = \frac{EIRP}{4\pi R^2} \text{ re - arranged } R = \sqrt{\frac{EIRP}{S 4\pi}}$$

Where:

S = power density

R = distance to the centre of radiation of the antenna

EIRP = EUT Maximum power

Note: The EIRP value was calculated using the E-Field measurement.

**FCC Result**

| Prediction Frequency (MHz) | Maximum EIRP (mW)      | Power density limit (S) (mW/cm <sup>2</sup> ) | Distance (R) cm required to be less than 0.98 mW/cm <sup>2</sup> |
|----------------------------|------------------------|-----------------------------------------------|------------------------------------------------------------------|
| 13.56                      | 4.36 x10 <sup>-4</sup> | 0.98                                          | 0.006                                                            |

**IC Result**

| Prediction Frequency (MHz) | Maximum EIRP (W)       | Exemption limit (W) | RF Exposure calculation |
|----------------------------|------------------------|---------------------|-------------------------|
| 13.56                      | 4.36 x10 <sup>-7</sup> | 1.00                | Not Required            |