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

0026

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

Digitally signed by John Charters
DN: cn=John Charters, o=TRAC Global Ltd, ou=Radio Product Manager, email=john.charters@tracglobal.com, c=GB
Date: 2015.09.21 13:54:42 +01'00'

John Charters
Radio Product Manager

Date: 21st September 2015

1 Revision Record

Issue Number	*Issue Date*	*Revision History*
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 Model: TSR/300/618
FCC IDENTIFIER:	QABTSR618V93F
IC IDENTIFIER:	12009A-TSR618V93F
EUT SERIAL NUMBER:	not applicable
MANUFACTURER/AGENT:	Controlled Electronic Management Systems Limited
ADDRESS:	Accounts Payable Mailpoint 1006 PO Box 3572 Stone ST15 9DX United Kingdom
CLIENT CONTACT:	Ewan Peyton ☎ 44 (0)28 9078 8026 ✉ ewpeyton@tycoint.com
ORDER NUMBER:	038082
TEST DATE:	10th - 14th August 2015
TESTED BY:	A Tosif 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)	☒	*Pass*
Radiated spurious emissions	Gen, 6.13	15.209	☒	*Pass*
AC power line conducted emissions	Gen, 8.8	15.207	☒	*Pass*
Occupied bandwidth	Gen, 6.6	15.215(c)	☒	*Pass*
Field strength of fundamental	210, A2.6(a), (b) and (c)	15.225(a), (b) and (c)	☒	*Pass*
Frequency stability	210, A2.6	15.225(e)	☒	*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

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.

☐ TRaC Hull
Unit E
South Orbital Trading Park
Hedon Road
Hull
HU9 1NJ
UK

☒ TRaC North West
Unit 1
Pendle Place
Skemersdale
West Lancashire
WN8 9PN
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

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

Type		***Description***	***Outdoor Cable Y / N***	***Test Length***	***Max Installation Length***
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	Wurth ferrite 742-712-22	3 turns on ethernet cable external from EUT.	N/A	N/A	N/A

Powered from POE.

Type		***Description***	***Outdoor Cable Y / N***	***Test Length***	***Max Installation Length***
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	Wurth 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.

Description	***Make***	***Model***	***Serial Number***
Laptop	Dell	LattitudeE5440	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.

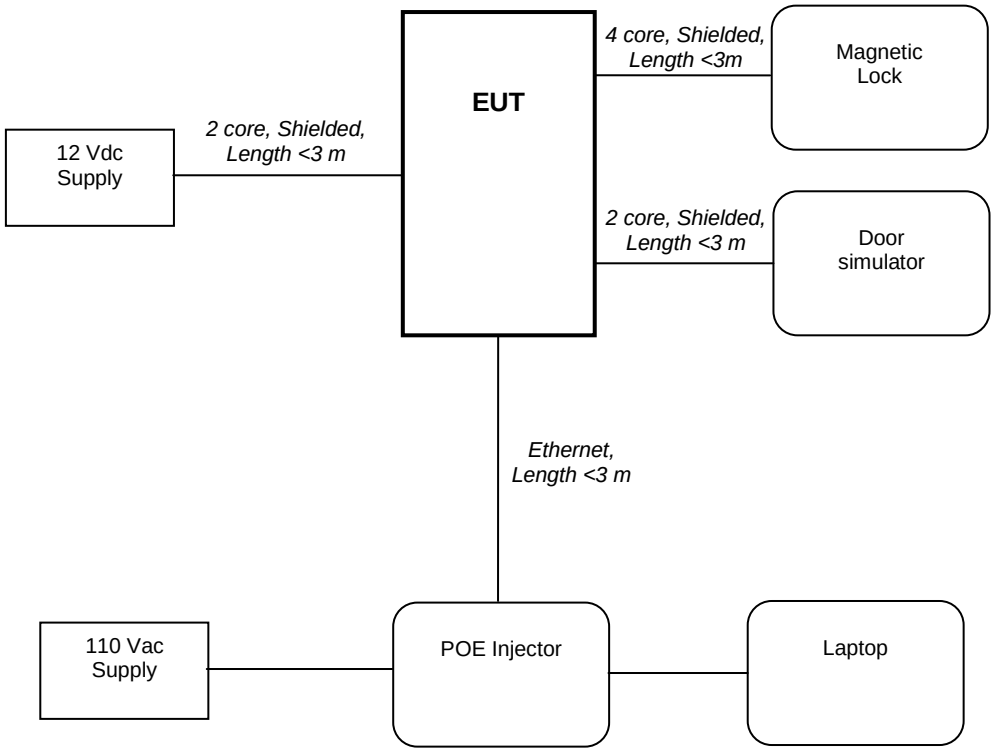
8 Modifications

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:

	Category	***Variation***
☒	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:

	Category	***Nominal***	***Variation***
☒	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; 150 kHz to 30 MHz: 9 kHz
Measurement Detector:	9 – 90 kHz and 110 – 490 kHz: Average, RMS Other frequencies below 30 MHz: Quasi-peak.

Environmental Conditions (Normal Environment)

Temperature:	26 °C	+15 ºC to +35 ºC (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) 2,400 / f (µV/m)	300
490 – 1,750	24,000 / 377.f (µA/m) 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 360º, 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 µV/m at the regulatory distance, using:

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

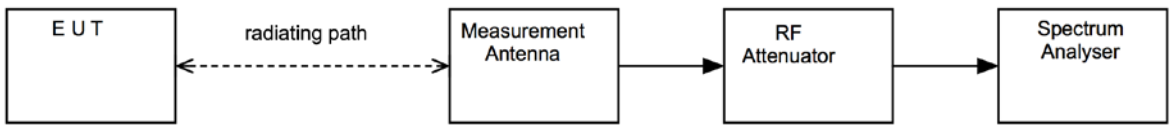
Where,

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);

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



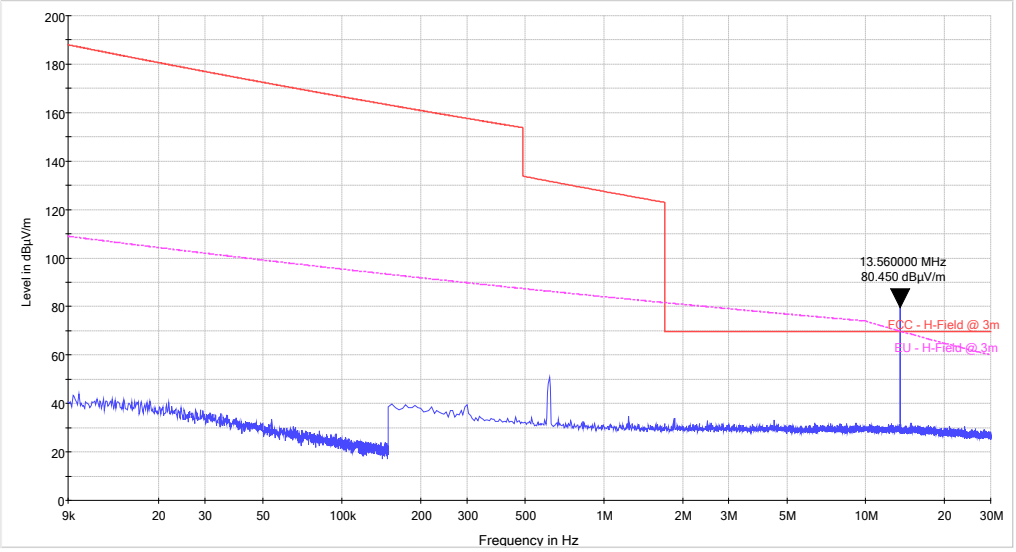
Test Setup Photograph(s)

11.4 Test Equipment

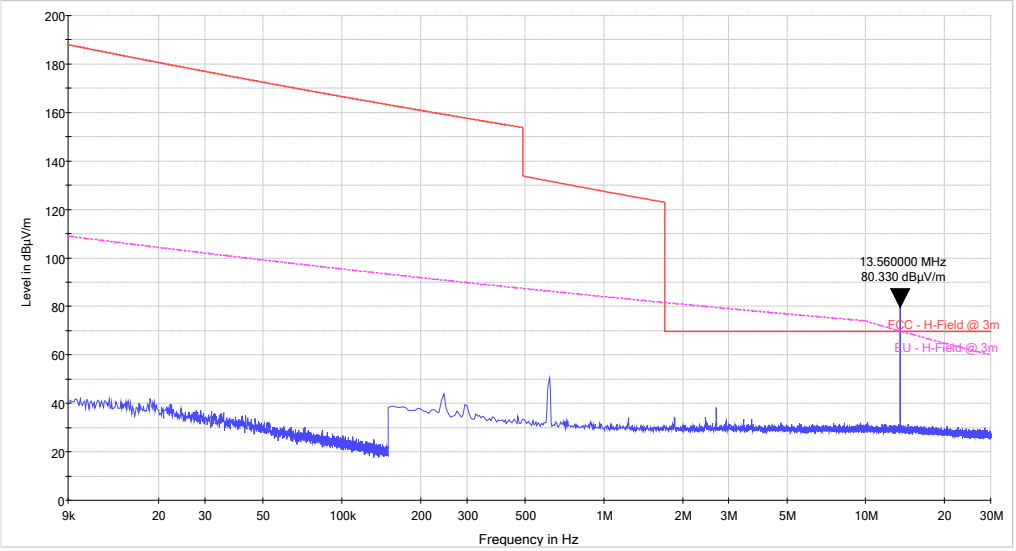
Equipment Description	Manufacturer	Equipment Type	TRaC No	Last Cal Calibration	Calibration Period	Due For Calibration
Loop Antenna	R&S	hfh2	L007	10/04/2015	24	10/04/2017
Receiver	R&S	ESHS10	UH003	25/06/2015	12	25/06/2016

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 1 GHz – 5 GHz: 100 KHz
Measurement Detector:	30 MHz to 1 GHz: Quasi-peak 1 GHz – 5 GHz: Peak and Average

Environmental Conditions (Normal Environment)

Temperature:	21 °C	+15 ºC to +35 ºC (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:

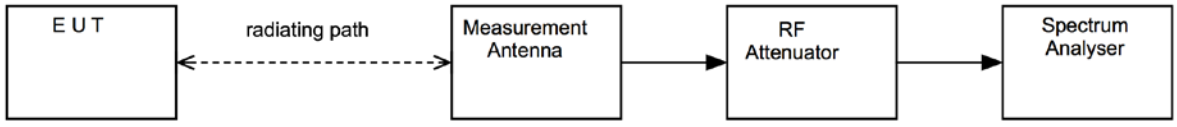
$$FS = PR + CL + AF – PA + DC – CF$$

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



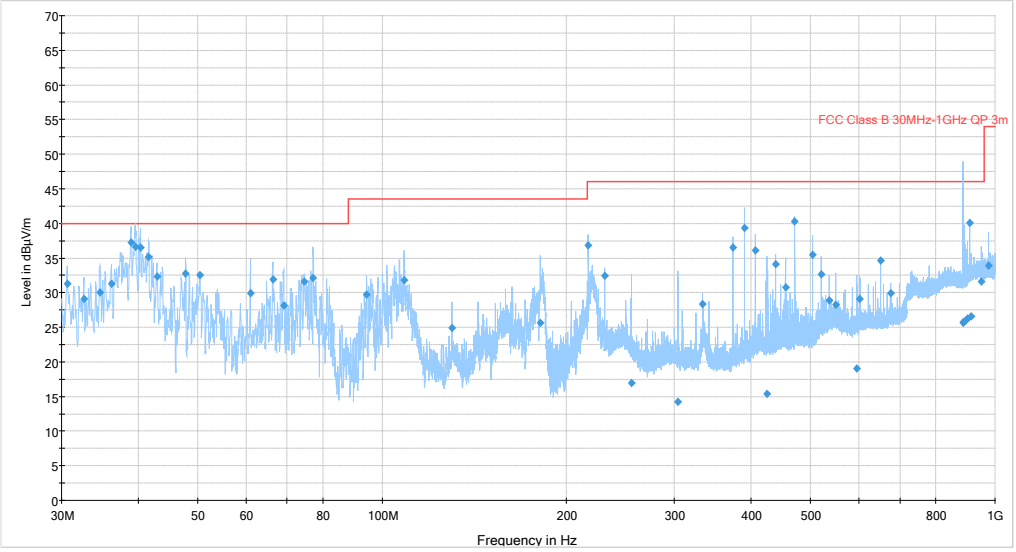
Test Setup Photograph(s)

12.4 Test Equipment

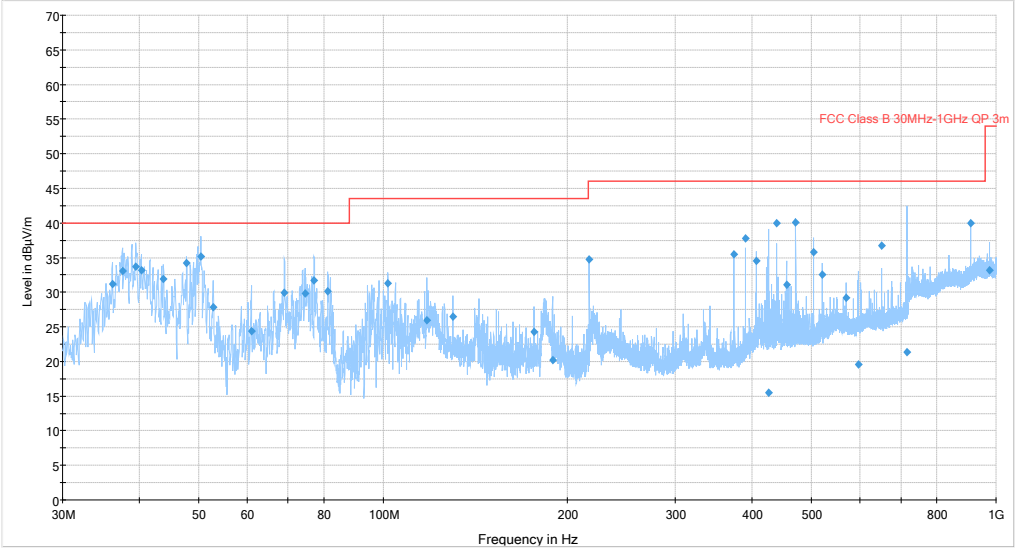
Equipment Description	Manufacturer	Equipment Type	TRaC No	Last Cal Calibration	Calibration Period	Due For Calibration
Spectrum Analyser	R&S	FSU26	REF909	13/02/2015	12	13/02/2016
Radio Chamber - PP	Rainford EMC	ATS	REF940	08/09/2014	24	08/09/2016
IC Reg Radio Chamber - PP	Rainford EMC	ATS	REF940	19/11/2014	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

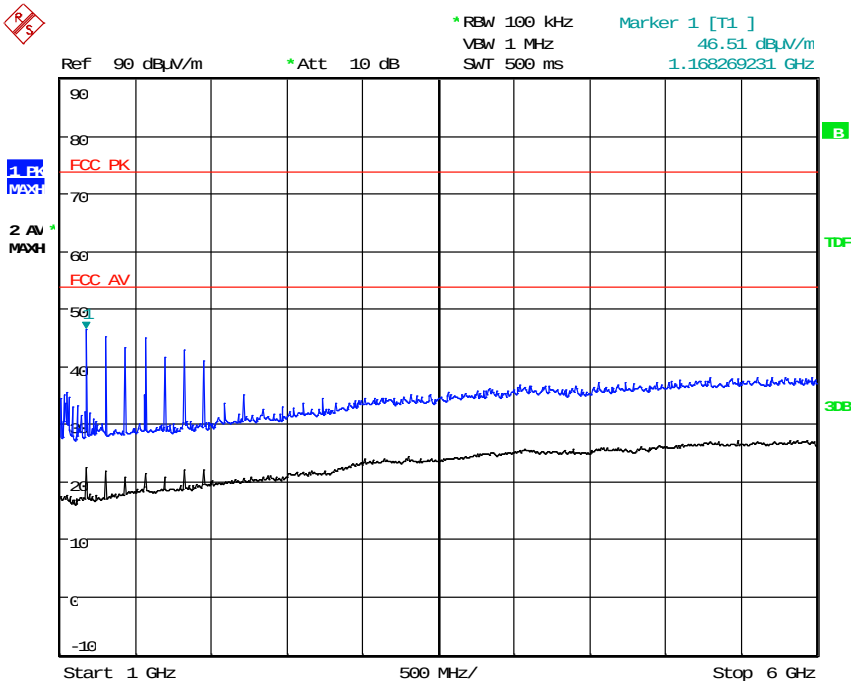
12V 30MHz – 1GHz



POE 30MHz – 1GHz



12V 1GHz – 6GHz



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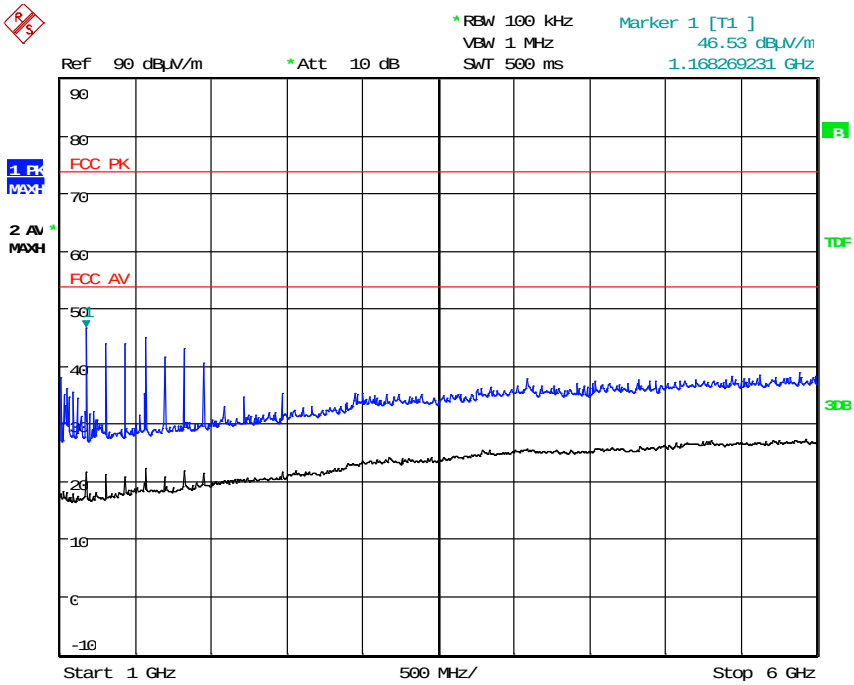
POE 1GHz – 6GHz



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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. (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	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 Average, RMS

Environmental Conditions (Normal Environment)

Temperature: 25 °C	+15 ºC to +35 ºC (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 (MHz)	Conducted limit (dBµV)	
	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.

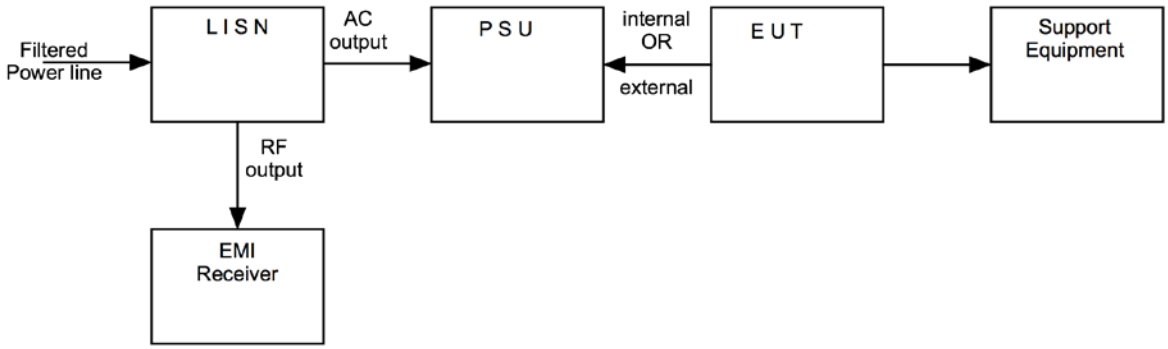
13.3 Test Method

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.

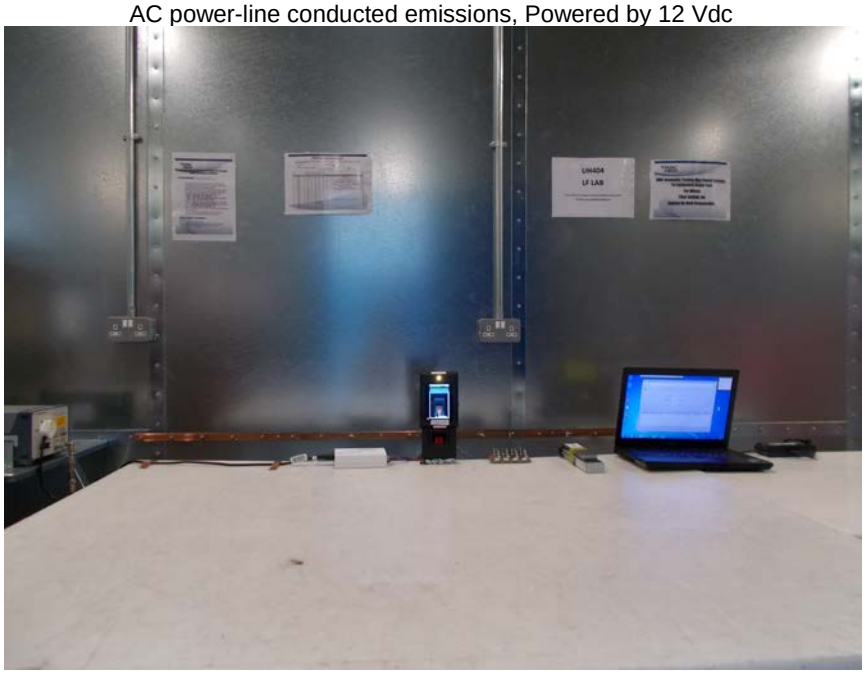
Formal measurements using the correct detector(s) and bandwidth are made on frequencies identified from the preview scans. Final measurements were performed with EUT set at its maximum duty in transmit and receive modes.

Figure iii Test Setup

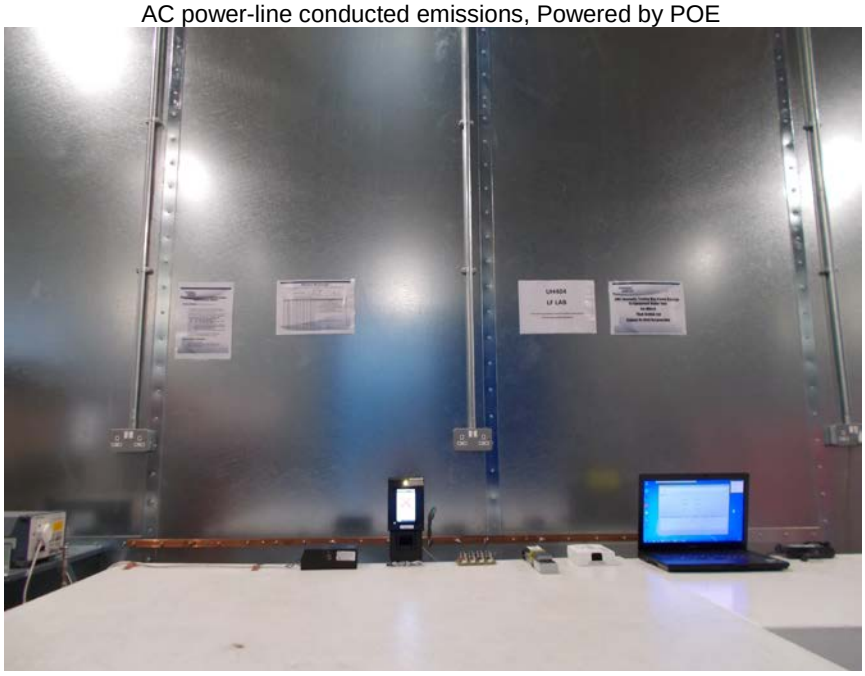


Test Setup Photograph(s)

AC power-line conducted emissions, Powered by 12 Vdc



AC power-line conducted emissions, Powered by POE

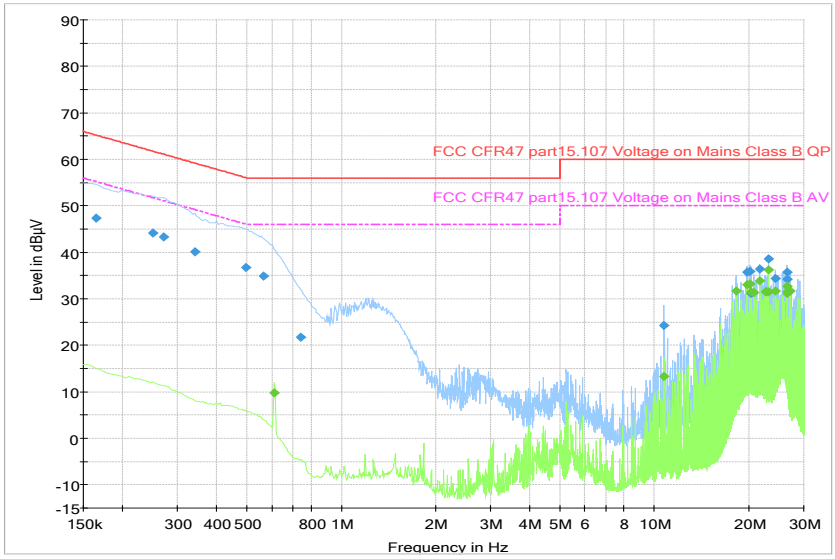


13.4 Test Equipment

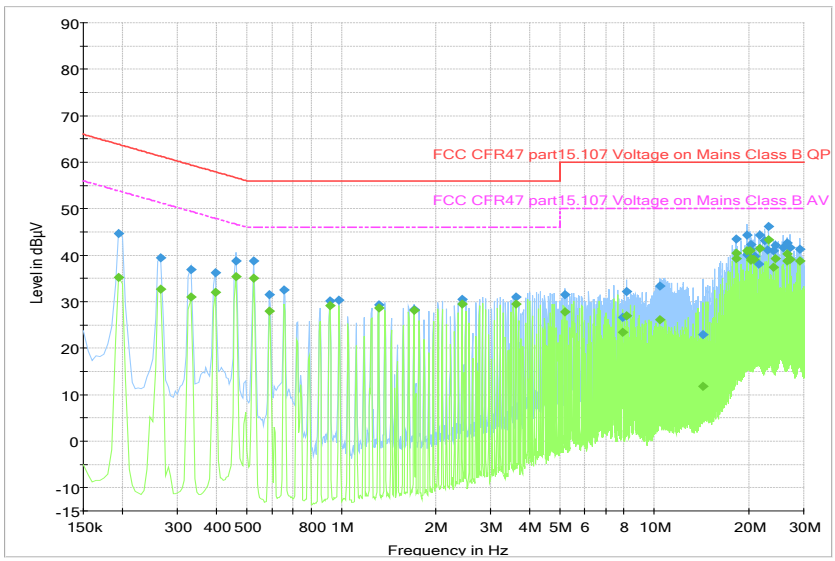
Equipment Description	Manufacturer	Equipment Type	TRaC No	Last Cal Calibration	Calibration Period	Due For Calibration
Receiver	R&S	ESHS10	UH003	25/06/2015	12	25/06/2016
Lisn	R&S	ESH3-Z5.831.5	UH195	04/06/2015	12	04/06/2016
Lisn	R&S	ENV216	UH396	01/07/2015	12	01/07/2016

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 ºC to +35 ºC (as declared)
Humidity: 38%RH	20%RH to 75%RH (as declared)
Supply: 12 Vdc	As declared

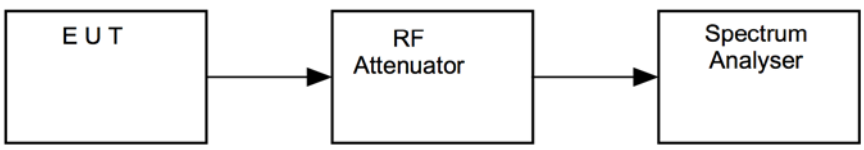
Test Limits
Industry Canada:
When the occupied bandwidth limit is not stated in the applicable RSS or reference measurement method, the transmitted signal bandwidth shall be reported as the 99% emission bandwidth, as calculated or measured.

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

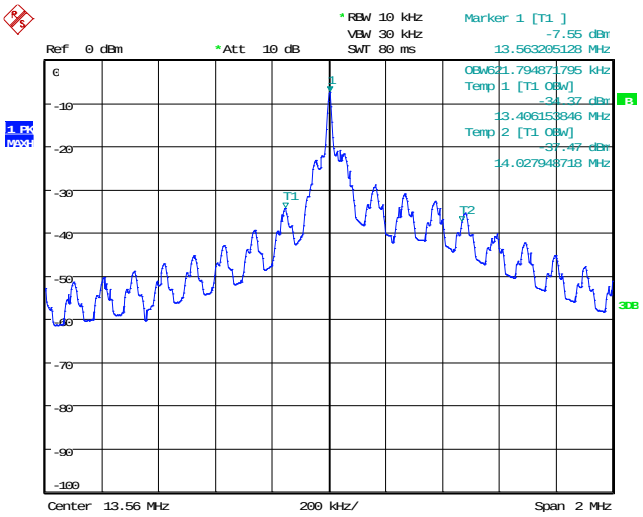


14.4 Test Equipment

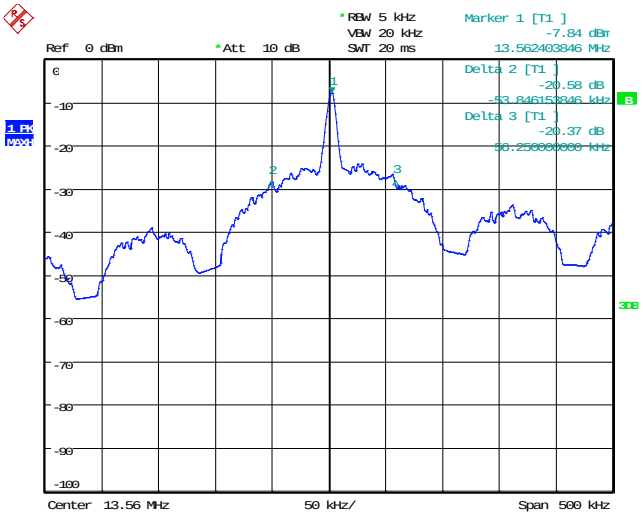
Equipment Description	Manufacturer	Equipment Type	TRaC No	Last Cal Calibration	Calibration Period	Due For Calibration
Spectrum Analyser	R&S	FSU26	REF909	13/02/2015	12	13/02/2016

14.5 Test Results

RSS-210. Modulation: ; Data rate: ; Power setting:			
Channel Frequency (MHz)	F_L (MHz)	F_H (MHz)	99% Bandwidth (kHz)
13.56	13.406154	14.027949	621.795



15.225. Modulation: ; Data rate: ; Power setting:			
Channel Frequency (MHz)	FL (MHz)	FH (MHz)	20dB Bandwidth (kHz)
13.56	13.508558	13.618654	110.096



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 ºC to +35 ºC (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:

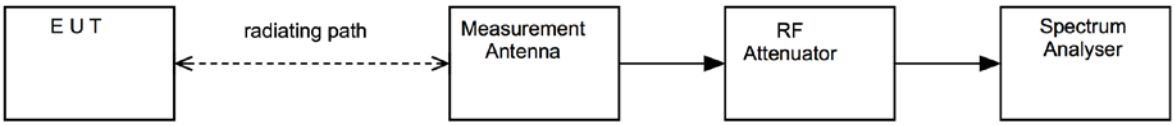
$$FS = 10^{(PR - CF) / 20}$$

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

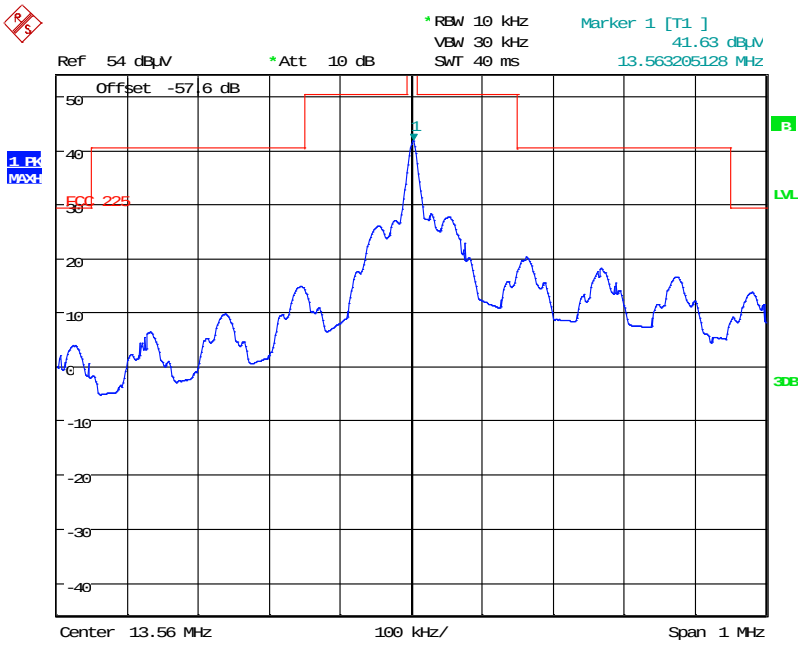
Equipment Description	Manufacturer	Equipment Type	TRaC No	Last Cal Calibration	Calibration Period	Due For Calibration
Loop Antenna	R&S	hfh2	L007	10/04/2015	24	10/04/2017
Receiver	R&S	ESHS10	UH003	25/06/2015	12	25/06/2016
Spectrum Analyser	R&S	FSU26	REF909	13/02/2015	12	13/02/2016

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:

1. Results quoted are extrapolated as indicated
2. Extrapolation <30 MHz 40dB/decade as per 15.31(f)(2) & RSS-Gen 6.4
3. 10 – 30 metre extrapolation 19.08 dB (40dB/decade)
4. 3 – 10 metre extrapolation as measured (20.4 dB)
5. 3 – 30 metre extrapolation 39.48 dB



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 ºC
Humidity: 38%RH	20%RH to 75%RH (as declared)
Supply: 12 Vdc	As declared

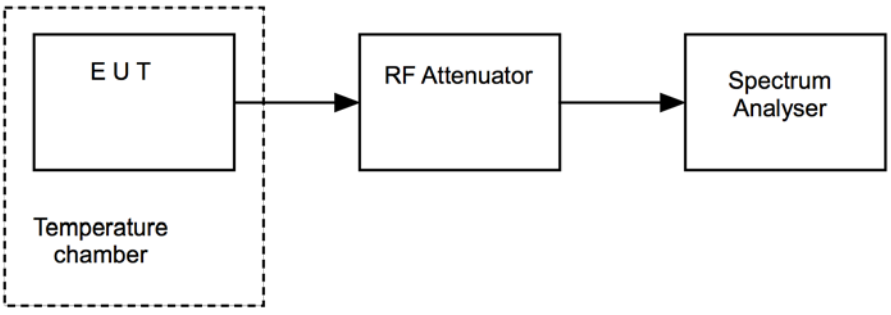
Test Limits

Carrier frequency stability shall be maintained to ±0.01% (±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_{nom}	V_{nom}	13.562029	N/A
T_{nom}	V_{min}	13.562029	0.000
T_{nom}	V_{max}	13.562029	0.000
T_{max}	V_{nom}	13.562022	-0.006
T_{min}	V_{nom}	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.

SAR Exclusion Threshold (SARET) = (Step 1 + Step 2) * Step 3

Step 1

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

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.

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

For Distances Greater than 50 mm Step 2 applies

Step 2

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

Where:

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

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

Step 3

a) the power threshold at the corresponding test separation distance at 100 MHz in step 2 is multiplied by [1 + log (100/ f_{MHz}))] for test separation distances > 50 mm and < 200 mm

b) the power threshold determined by the equation in steps 1 for 50 mm and 100 MHz is multiplied by ½ for test separation distances ≤ 50 mm

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

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

SARET = 474.34 mW

Channel Frequency (MHz)	EIRP (mW)	SAR Exclusion Threshold (mW)	SAR Evaluation
13.56	4.36×10^{-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

$$S = \frac{EIRP}{4\pi R^2} \quad \text{re-arranged } R = \sqrt{\frac{EIRP}{S4\pi}}$$

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^2)	Distance (R) cm required to be less than 0.98 mW/cm^2
13.56	4.36×10^{-4}	0.98	0.006

IC Result

Prediction Frequency (MHz)	Maximum EIRP (W)	Exemption limit (W)	RF Exposure calculation
13.56	4.36×10^{-7}	1.00	Not Required