

AN RADIO TEST REPORT
FOR
CONTROLLED ELECTRONIC MANAGEMENT SYSTEMS
LIMITED
ON
emerald multi smart card reader
Model : TSR/300/608
DOCUMENT NO.TRA-021653-00-47-01B

HULL

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TRaC Wireless Test Report : TRA-021653-01-47-01B

Applicant : Controlled Electronic Management Systems Limited

Apparatus : emerald multi smart card reader

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

Purpose of Test : Certification

FCCID : QABTSR608V930

Certification Number : 12009A-TSR608V920

Authorised by :

: Radio Product Manager

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

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

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1.2 Tests Requested By

This testing in this report was requested by:

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

1.3 Manufacturer

As Above

1.4 Apparatus Assessed

The following apparatus was assessed between 17th November 2014 – 8th January 2015

Model Name	emerald multi smart card reader
Model Number	TSR/300/608
Hardware Version	V9.3
Firmware Revision	1.4T

(T is for the test version, production will be 1.4x with x being incremented by any bug fixes as they are found)

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

- Emerald multi smart card reader powered by POE
- Emerald multi smart card reader powered by 12V Supply

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

1.5 Test Result Summary

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

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

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

Test Type	Title 47 of the CFR: Part 15 Subpart (c)	RSS-210	Measurement standard	Result
Spurious Emissions Radiated <1000MHz	15.209	RSS-Gen 6.11 & 8.9	ANSI C63.10:2009	Pass
Spurious Emissions Radiated >1000MHz	15.209	RSS-Gen 6.11 & 8.9	ANSI C63.10:2009	N/A
AC Power conducted emissions	15.207	RSS-Gen 8.8	ANSI C63.10:2009	Pass
Intentional Emission Frequency	15.225(a)	RSS-210 A2.6	ANSI C63.10:2009	Pass
Intentional Emission Field Strength	15.225(a)	RSS-210 A2.6	ANSI C63.10:2009	Pass
Intentional Emission Band Occupancy	15.215 (c)	RSS-Gen 6.6	ANSI C63.10:2009	Pass
Frequency Stability	15.225(e)	RSS-210 A2.6 RSS-Gen 6.11 & 8.11	ANSI C63.10:2009	Pass
Unintentional Radiated Spurious Emissions	Subpart (b) 15.109	RSS-Gen 7.1	ANSI C63.10:2009	Pass
Antenna Arrangements Integral:	15.203	RSS-Gen 8.3	-	Pass
Antenna Arrangements External Connector	15.204	RSS-Gen 8.3	-	N/A
Restricted Bands	15.205	RSS-Gen 8.10	-	Pass
Maximum Frequency of Search	15.33	RSS-Gen 6.13	-	Pass
Extrapolation Factor	15.31(f)	RSS-Gen 6.4 and 6.5	-	Pass

Abbreviations used in the above table:

CFR : Code of Federal Regulations
 REFE : Radiated Electric Field Emissions
 RSS-GEN : RSS-GEN Issue 4 November 2014

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

1.6 Notes Relating To the Assessment

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

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

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

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

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

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

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

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

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

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

1.7 Deviations from Test Standards

There were no deviations from the standards tested to.

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

For the test data recorded the following measurement uncertainty was calculated:

Radio Testing – General Uncertainty Schedule

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

[1] Adjacent Channel Power

Uncertainty in test result = **1.86dB**

[2] Carrier Power

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

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

[3] Effective Radiated Power

Uncertainty in test result = **4.71dB**

[4] Spurious Emissions

Uncertainty in test result = **4.75dB**

[5] Maximum frequency error

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

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

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

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

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

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

[7] Frequency deviation

Uncertainty in test result = **3.2%**

[8] Magnetic Field Emissions

Uncertainty in test result = **2.3dB**

[9] Conducted Spurious

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

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

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

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

[10] Channel Bandwidth

Uncertainty in test result = **15.5%**

[11] Amplitude and Time Measurement – Oscilloscope

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

[12] Power Line Conduction

Uncertainty in test result = **3.4dB**

[13] Spectrum Mask Measurements

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

[14] Adjacent Sub Band Selectivity

Uncertainty in test result = **1.24dB**

[15] Receiver Blocking – Listen Mode, Radiated

Uncertainty in test result = **3.42dB**

[16] Receiver Blocking – Talk Mode, Radiated

Uncertainty in test result = **3.36dB**

[17] Receiver Blocking – Talk Mode, Conducted

Uncertainty in test result = **1.24dB**

[18] Receiver Threshold

Uncertainty in test result = **3.23dB**

[19] Transmission Time Measurement

Uncertainty in test result = **7.98%**

Section 3:

Modifications

3.1 Modifications Performed During Assessment

No modifications were performed during the assessment

Section 4

General Test Procedures

4.1 Radiated Test Setup and Procedures

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

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).

For devices with intentional emissions below 30 MHz, a shielded loop antenna is used as the test antenna. It is placed at a 1 meter receive height and appropriate low frequency magnetic field extrapolation to the regulatory limit distance is employed. The EUT is rotated through 360° in the azimuth.

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° 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.

Where regulations allow for direct measurement of field strength, power values measured on the test receiver / analyzer are converted to dBuV/m at the regulatory distance, using:

$$FS = PR + AF + CL - PA + KG + DC - CF \text{ (dBuV/m)}$$

Where:

PR is the power recorded on receiver / spectrum analyzer (dBuV),

AF is the test antenna factor in dB/m,

CL is the cable loss in dB,

PA is the pre-amplifier gain dB (when applicable),

DC is duty correction factor (when applicable) in dB, and

CF is a distance correction (employed only for measurements at alternate distance to limit) in dB.

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

If effective radiated power (ERP) or effective isotropic radiated power (EIRP) is required, it is computed as per ANSI C63.10

$$P = \frac{(Ed)^2}{30G}$$

Where

P is the power, in W

E is the measured peak field strength, in V/m

d is the distance at which the measurement was made, in m

G is the numeric gain of the radiating element

If the gain of the radiating element is not known, then either the effective radiated power (ERP) or the effective isotropic radiated power (EIRP) may be calculated from the measured peak field strength, by using either $G = 1.64$ or $G = 1$, respectively.

4.2 AC Powerline Conducted Emissions Test Setup and Procedures

AC Powerline Conducted Emissions from the EUT are checked first by preview scans with Peak and average detectors covering both live and neutral lines. A spectrum analyser is used to determine if any periodic emissions are present. Preview scans are performed in standby or receive mode if the device is subject to these requirements. For transmit mode of operation the device is set to one of the following modes.

- Transmitting operating at full power (single mode device)
- Transmitting at freq / modulation that gives highest output power (multi mode device)
- Transmitter operating in normal TX mode (e.g. FHSS, TDMA etc)

Formal measurements using the correct detector(s) and bandwidth are made on frequencies identified from the preview scans.

Battery Power devices are not subject to power line conducted emissions measurements when it is powered solely by its internal battery.

4.3 Antenna Port Conducted Emissions

Antenna port conducted emissions can include, but are not limited to, Carrier power, Power Spectral Density, Occupied bandwidth and spurious emission.

Spurious Emissions from the EUT are checked first by preview scans. Preview scans for all spectrum and modulation characteristics are checked to identify frequencies to perform formal measurements on.

Formal measurements are made on frequencies identified from the preview scans and fundamental emission(s). Measurements are made using the correct instrumentation (inc. power meter, receiver, spectrum analyser) that operate with the required detector(s) and bandwidth.

Care is taken to ensure the measurement instrument is not overloaded by the presence of the transmitted signal by use of external attenuation and filtering where required.

Measured levels are corrected for cables, attenuators, and filters. If applicable, for the specific measurement, antenna gain is also taken into account.

4.4 Power Supply Variation

Tests at extreme supply voltages are made if required by the procedures specified in the test standard, and results of this testing are detailed in this report.

In the case the EUT is designed for operation from a lead-acid battery power source, the extreme test voltages are evaluated between 90% and 130% of the nominal battery voltage declared by the manufacturer.

For float charge applications using gel-cell type batteries, extreme test voltages are evaluated between 85% and 115% of the nominal battery voltage declared.

For all battery operated equipment, worst case intentional and spurious emissions are re-checked employing a new (fully charged) battery.

4.5 Thermal Variation

Tests at extreme temperatures are made if required by the procedures specified in the test standard, and results of this testing are detailed in this report.

Tests are performed at the upper and lower extremes as required and typically at 10° steps between.

Before any temperature measurements are made, the equipment is allowed to reach a thermal balance in the test chamber.

4.6 Time Domain Measurements

Time domain measurements are made for (but not limited to) use in duty cycle correction, to ensure compliance with time restrictions on certain types of devices.

If measurements of a transmitter's on time are required these are performed with a spectrum analyser in the time domain or with an oscilloscope and RF detector. If time on a specific frequency is required (e.g. FHSS timing) the measurement can only be made with a spectrum analyser.

The triggering, timescale and amplitude settings are adjusted according to the signal to be measured on a case by case basis.

For devices with sharp rise/fall times measurements are made between RF reaching full power (T_{on}) and RF dropping to the measurement instrument noise floor (T_{off}). For longer rise times measurements are made for T_{on} and T_{off} at the RF level required by the occupied bandwidth measurement (e.g. 6 dB, 20 dB etc).

Appendix A:**Formal Emission Test Results**

Abbreviations used in the tables in this appendix:

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

A1 Transmitter Intentional Emission Radiated

Test Details:	
Regulation	Part15.225(a), RSS-210 A2.6
Measurement standard	ANSI C63.10:2009
EUT sample number	S15, S14
Modification state	0
SE in test environment	S07, S09
SE isolated from EUT	S03, S04, S12
EUT set up	Refer to Appendix C
Temperature	24 °C
Photographs (Appendix F)	1

FREQ. (MHz)	MEASUREMENT DISTANCE (Metres)	MEASUREMENT Rx. READING (dBµV/m)	EXTRAP. FACTOR (dB)	FIELD STRENGTH (µV/m)
13.56	3	78.40	37.98	104.896
13.56	10	59.50	19.08	104.896
Limit value @ fc		15848 µV/m @ 30metres		

Notes:

- 1 Results quoted are extrapolated as indicated
- 2 Receiver detector @ fc = Quasi Peak with 120kHz bandwidth
- 3 Extrapolation <30 MHz 40dB/decade as per 15.31(f)(2) & RSS-Gen 6.4 and 6.5
- 4 10 – 30 metre extrapolation 19.08 dB (40dB/decade)
- 5 3 – 10 metre extrapolation as measured (18.9 dB)
- 6 3 – 30 metre extrapolation 37.98 dB
- 7 All measurement below 30MHz made with loop antenna

Test Method:

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

A2 Frequency Tolerance

Test Details	
Regulation	Part 15.225(e) / RSS – 210 Issue 8 (A2.6)
Measurement standard	ANSI C63.10:2009
EUT sample number	S15
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	20°C
Humidity	32%

Test Conditions		Measured Frequency (MHz)	Drift (kHz)
$T_{nom} (+20^{\circ}C)$	V_{nom}	13.5619	N/A
$T_{nom} (+20^{\circ}C)$	V_{min}	13.5619	0.0000
$T_{nom} (+20^{\circ}C)$	V_{max}	13.5619	0.0000
$T_{max} (+50^{\circ}C)$	V_{nom}	13.5619	0.0000
$T_{min} (-20^{\circ}C)$	V_{nom}	13.562	0.1000
Limit		$\pm 1.356 \text{ kHz } (\pm 0.01\% \text{ of the operating frequency})$	
Verdict		Pass	

A3 Occupied Bandwidth

Test Details	
Regulation	Part15.215(c) / RSS – Gen 6.6
Measurement standard	ANSI C63.10:2009
EUT sample number	S15, S14
Modification state	0
SE in test environment	S07, S09
SE isolated from EUT	S03, S04, S12
EUT set up	Refer to Appendix C
Temperature	20°C
Humidity	32%

Band occupancy at -20 dBc	f_L	f_H
	13.46254808 MHz	13.77985577 MHz
	BW = 317.3076923 kHz	
99% Band occupancy	f_L	f_H
	13.34395833 MHz	14.05870192 MHz
	BW = 714.74359 kHz	

A4 Radiated Electric Field Emissions

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

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

3m open area test site :

☐

3m alternative test site :

☒

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

Test Details: Powered by 12v Battery	
Regulation	Part 15 Subpart (c) Clause 15.209, RSS-Gen 8.9
Measurement standard	ANSI C63.10:2009
Frequency range	9kHz – 1GHz
EUT sample number	S15
Modification state	0
SE in test environment	S07, S09
SE isolated from EUT	S03, S11, S12
EUT set up	Refer to Appendix C
Temperature	25°C
Photographs (Appendix F)	1,2

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

Powered by 12v Supply								
Ref No.	FREQ. (MHz)	MEAS Rx (dBμV)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	FIELD ST'GH (dBμV/m)	FIELD ST'GH (μV/m)	LIMIT (μV/m)
1	30.60	17.9	0.5	17.5	N/A	35.8	61.66	100
2	32.60	14.9	0.5	16.4	N/A	31.8	38.90	100
3	34.65	12.2	0.5	15.3	N/A	28.0	25.12	100
4	37.55	12.6	0.5	13.8	N/A	26.9	22.13	100
5	40.35	8.9	0.5	12.2	N/A	21.7	12.16	100
6	47.80	18.9	0.6	8.6	N/A	28.1	25.41	100
7	50.45	24.7	0.6	7.5	N/A	32.8	43.65	100
8	55.30	33.3	0.6	6.0	N/A	39.9	98.86	100
9	56.55	30.0	0.6	5.8	N/A	36.4	66.07	100
10	64.80	28.8	0.7	5.1	N/A	34.5	53.09	100
11	66.30	27.4	0.7	5.1	N/A	33.2	45.71	100
12	74.55	26.7	0.7	5.9	N/A	33.3	46.24	100
13	77.20	25.9	0.7	6.3	N/A	32.9	44.16	100
14	85.50	23.5	0.8	7.8	N/A	32.1	40.27	100
15	86.05	24.9	0.8	7.9	N/A	33.6	47.86	100
16	98.50	21.6	0.8	10.1	N/A	32.5	42.17	150
17	101.90	21.4	0.8	10.6	N/A	32.8	43.65	150
18	108.80	20.3	0.9	11.3	N/A	32.5	42.17	150
19	135.60	14.1	1.0	11.2	N/A	26.3	20.65	150
20	144.70	14.3	1.0	10.5	N/A	25.8	19.50	150
21	153.00	15.4	1.0	9.8	N/A	26.2	20.42	150
22	162.00	15.8	1.1	9.3	N/A	26.1	20.18	150
23	207.00	26.4	1.2	8.8	N/A	36.4	66.07	150
24	214.80	15.9	1.2	8.2	N/A	25.3	18.41	150
25	261.00	17.2	1.3	13.4	N/A	31.9	39.36	200
26	264.10	11.9	1.4	13.6	N/A	26.8	21.88	200
27	325.50	17.4	1.5	13.8	N/A	32.7	43.15	200
28	369.00	12.2	1.6	14.8	N/A	28.5	26.61	200
29	387.00	18.6	1.6	15.3	N/A	35.5	59.57	200
30	423.00	15.2	1.7	16.7	N/A	33.6	47.86	200
31	432.00	11.4	1.7	16.4	N/A	29.5	29.85	200
32	515.35	11.7	1.9	17.6	N/A	31.2	36.31	200
33	585.00	8.1	2.0	18.8	N/A	28.9	27.86	200
34	639.00	10.5	2.2	19.0	N/A	31.6	38.02	200
35	693.00	10.4	2.2	19.1	N/A	31.7	38.46	200
36	747.00	10.2	2.3	19.8	N/A	32.3	41.21	200
37	765.00	9.5	2.4	20.4	N/A	32.2	40.74	200
38	909.00	8.2	2.6	20.9	N/A	31.7	38.46	200
39	949.35	8.0	2.7	21.2	N/A	31.9	39.36	200

Powered by PoE								
Ref No.	FREQ. (MHz)	MEAS Rx (dBμV)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	FIELD ST'GH (dBμV/m)	FIELD ST'GH (μV/m)	LIMIT (μV/m)
1	30.60	14.9	0.5	17.5	N/A	32.8	43.65	100
2	32.60	12.2	0.5	16.4	N/A	29.1	28.51	100
3	34.65	11.8	0.5	15.3	N/A	27.6	23.99	100
4	37.50	12.8	0.5	13.8	N/A	27.1	22.65	100
5	41.05	13.3	0.5	11.9	N/A	25.7	19.28	100
6	43.80	16.0	0.6	10.5	N/A	27.1	22.65	100
7	48.45	18.5	0.6	8.3	N/A	27.4	23.44	100
8	50.45	24.2	0.6	7.5	N/A	32.3	41.21	100
9	54.20	28.5	0.6	6.3	N/A	35.4	58.88	100
10	58.70	28.8	0.6	5.4	N/A	34.8	54.95	100
11	64.80	26.9	0.7	5.1	N/A	32.6	42.66	100
12	66.30	26.1	0.7	5.1	N/A	31.9	39.36	100
13	74.55	27.1	0.7	5.9	N/A	33.7	48.42	100
14	77.20	26.5	0.7	6.3	N/A	33.5	47.32	100
15	81.20	24.4	0.7	6.9	N/A	32.1	40.27	100
16	86.05	26.0	0.8	7.9	N/A	34.7	54.33	100
17	94.40	27.7	0.8	9.5	N/A	38.0	79.43	150
18	104.75	21.3	0.9	11.0	N/A	33.1	45.19	150
19	106.70	20.3	0.9	11.2	N/A	32.3	41.21	150
20	125.00	12.9	0.9	11.6	N/A	25.4	18.62	150
21	139.25	15.0	1.0	11.0	N/A	27.0	22.39	150
22	143.30	15.8	1.0	10.7	N/A	27.5	23.71	150
23	161.15	18.9	1.1	9.4	N/A	29.3	29.17	150
24	162.00	18.1	1.1	9.3	N/A	28.4	26.30	150
25	179.95	18.9	1.1	8.3	N/A	28.3	26.00	150
26	189.85	22.1	1.1	8.4	N/A	31.6	38.02	150
27	203.45	18.5	1.2	8.8	N/A	28.5	26.61	150
28	230.55	22.4	1.3	9.9	N/A	33.5	47.32	200
29	261.00	16.9	1.3	13.4	N/A	31.6	38.02	200
30	333.00	17.6	1.5	13.9	N/A	33.0	44.67	200
31	351.00	13.8	1.6	14.4	N/A	29.7	30.55	200
32	387.00	17.9	1.6	15.3	N/A	34.8	54.95	200
33	405.00	17.4	1.7	16.2	N/A	35.2	57.54	200
34	441.00	12.7	1.8	16.3	N/A	30.8	34.67	200
35	693.00	11.2	2.2	19.1	N/A	32.5	42.17	200
36	747.00	9.9	2.3	19.8	N/A	32.0	39.81	200
37	765.00	9.5	2.4	20.4	N/A	32.2	40.74	200
38	895.10	7.9	2.6	20.9	N/A	31.4	37.15	200
39	945.00	6.0	2.7	21.1	N/A	29.8	30.90	200

Notes:

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

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

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

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

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

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

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

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

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

A5 Power Line Conducted Emissions

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

Test Details:	
Regulation	Part 15 Subpart (c) Clause 15.207, RSS-Gen 8.8
Measurement standard	ANSI C63.10:2009
Frequency range	150kHz to 30MHz
EUT sample number	S15
Modification state	0
SE in test environment	S03, S04, S07, S09, S14
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Photographs (Appendix F)	4

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

Powered by +12Vdc						
Results measured using the average detector compared to the average limit						
Ref No.	Freq (MHz)	Conductor	Result (dBuV)	Spec Limit (dBuV)	Margin (dB)	Result Summary
1	13.562	L1	34.1	50.0	15.9	Pass
2	23.130	L1	30.3	50.0	19.7	Pass
3	25.870	L1	31.9	50.0	18.1	Pass

Results measured using the quasi-peak detector compared to the quasi-peak limit						
Ref No.	Freq (MHz)	Conductor	Result (dBuV)	Spec Limit (dBuV)	Margin (dB)	Result Summary
1	0.194	N	46.5	63.9	17.4	Pass
2	0.238	N	45.1	62.2	17.1	Pass
3	0.258	N	44.3	61.5	17.2	Pass
4	0.346	L1	41.1	59.1	17.9	Pass
5	0.434	L1	38.0	57.2	19.2	Pass
6	13.562	L1	50.7	60.0	9.3	Pass

Powered by POE						
Results measured using the average detector compared to the average limit						
Ref No.	Freq (MHz)	Conductor	Result (dBuV)	Spec Limit (dBuV)	Margin (dB)	Result Summary
1	0.194	L1	43.3	53.9	10.6	Pass
2	0.198	L1	43.8	53.7	9.9	Pass
3	0.262	L1	45.1	51.4	6.2	Pass
4	0.394	L1	38.9	48.0	9.1	Pass
5	0.526	L1	39.8	46.0	6.2	Pass
6	13.258	N	35.8	50.0	14.2	Pass
7	13.562	N	30.7	50.0	19.3	Pass
8	14.022	N	34.9	50.0	15.1	Pass
9	26.266	N	38.3	50.0	11.7	Pass
10	26.514	L1	34.7	50.0	15.3	Pass
11	27.022	L1	31.4	50.0	18.6	Pass
12	27.282	N	37.7	50.0	12.3	Pass
13	27.534	L1	37.1	50.0	12.9	Pass
14	27.790	N	33.1	50.0	16.9	Pass
15	28.042	L1	34.7	50.0	15.3	Pass
16	28.302	N	40.9	50.0	9.1	Pass
17	28.562	N	39.2	50.0	10.8	Pass
18	28.814	N	47.9	50.0	2.1	Pass
19	29.066	N	42.0	50.0	8.0	Pass
20	29.322	N	44.7	50.0	5.3	Pass
21	29.578	N	48.5	50.0	1.5	Pass
22	29.834	N	47.8	50.0	2.2	Pass

Results measured using the quasi-peak detector compared to the quasi-peak limit						
Ref No.	Freq (MHz)	Conductor	Result (dBuV)	Spec Limit (dBuV)	Margin (dB)	Result Summary
1	0.194	L1	49.2	63.9	14.7	Pass
2	0.198	L1	49.6	63.7	14.1	Pass
3	0.262	L1	49.3	61.4	12.1	Pass
4	0.394	L1	42.3	58.0	15.7	Pass
5	0.526	L1	41.9	56.0	14.1	Pass
6	13.562	N	47.0	60.0	13.0	Pass
7	26.266	N	41.1	60.0	18.9	Pass
8	26.522	N	43.1	60.0	16.9	Pass
9	26.778	N	43.3	60.0	16.7	Pass
10	27.282	N	45.2	60.0	14.8	Pass
11	27.282	N	45.2	60.0	14.8	Pass
12	27.534	L1	44.4	60.0	15.6	Pass
13	27.790	N	42.3	60.0	17.7	Pass
14	28.042	L1	43.7	60.0	16.3	Pass
15	28.306	N	47.5	60.0	12.5	Pass
16	28.562	N	47.6	60.0	12.4	Pass
17	28.814	N	49.7	60.0	10.3	Pass
18	29.062	N	46.0	60.0	14.0	Pass
19	29.326	N	50.4	60.0	9.6	Pass
20	29.582	N	51.5	60.0	8.5	Pass
21	29.838	N	50.6	60.0	9.4	Pass

Specification limits :

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

Conducted disturbance at the mains ports.

Frequency range MHz	Limits dB μ V	
	Quasi-peak	Average
0.15 to 0.5	66 to 56 ²	56 to 46 ²
0.5 to 5	56	46
5 to 30	60	50

Notes:

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

Notes:

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

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

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

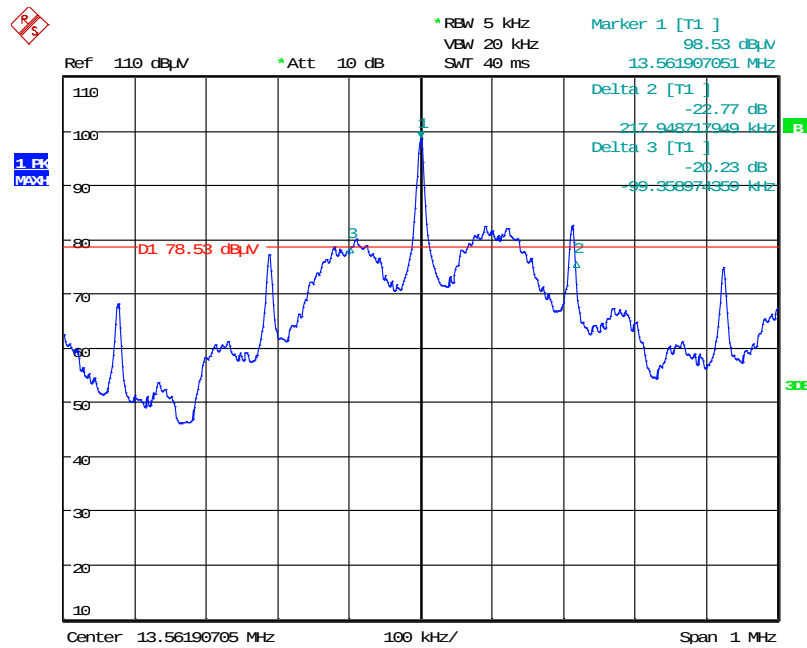
Appendix B:**Supporting Graphical Data**

This appendix contains graphical data obtained during testing.

Notes:

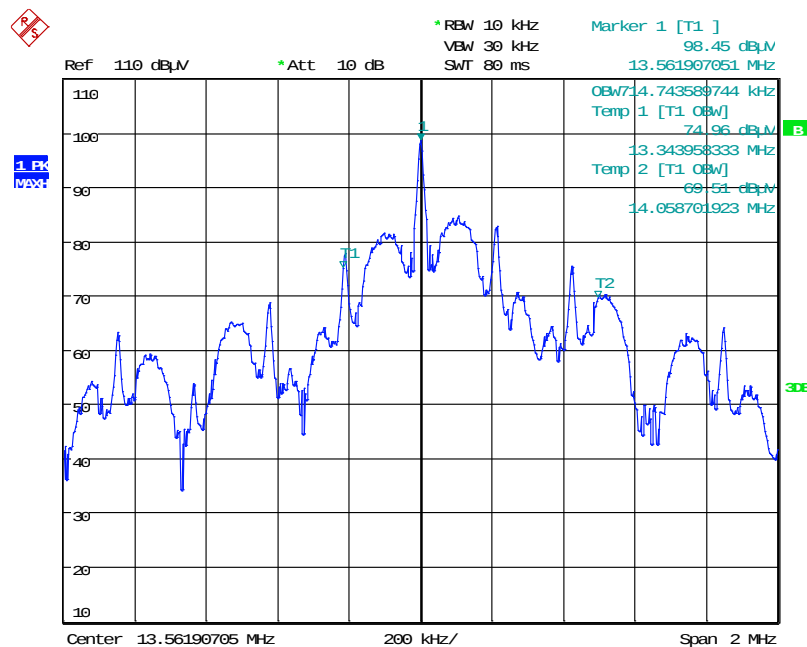
- (a) The radiated electric field emissions and conducted emissions graphical data in this appendix is preview data. For details of formal results, refer to Appendix A and Appendix B.
- (b) The time and date on the plots do not necessarily equate to the time of the test.
- (c) Where relevant, on power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

20dB Bandwidth



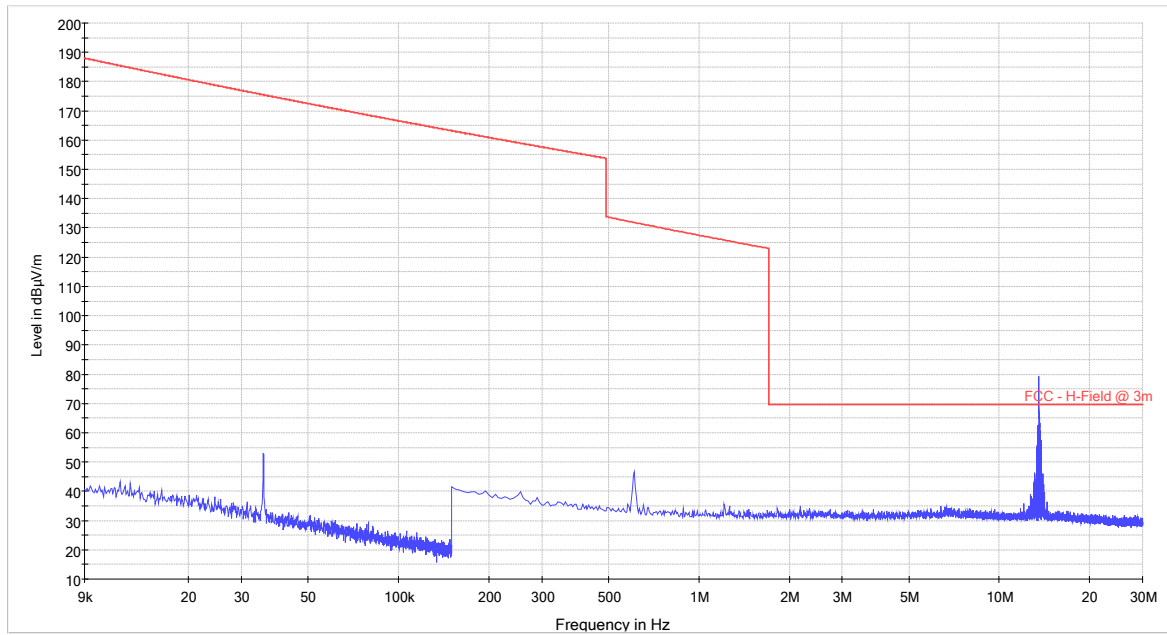
Date: 18.NOV.2014 14:51:54

99% Bandwidth

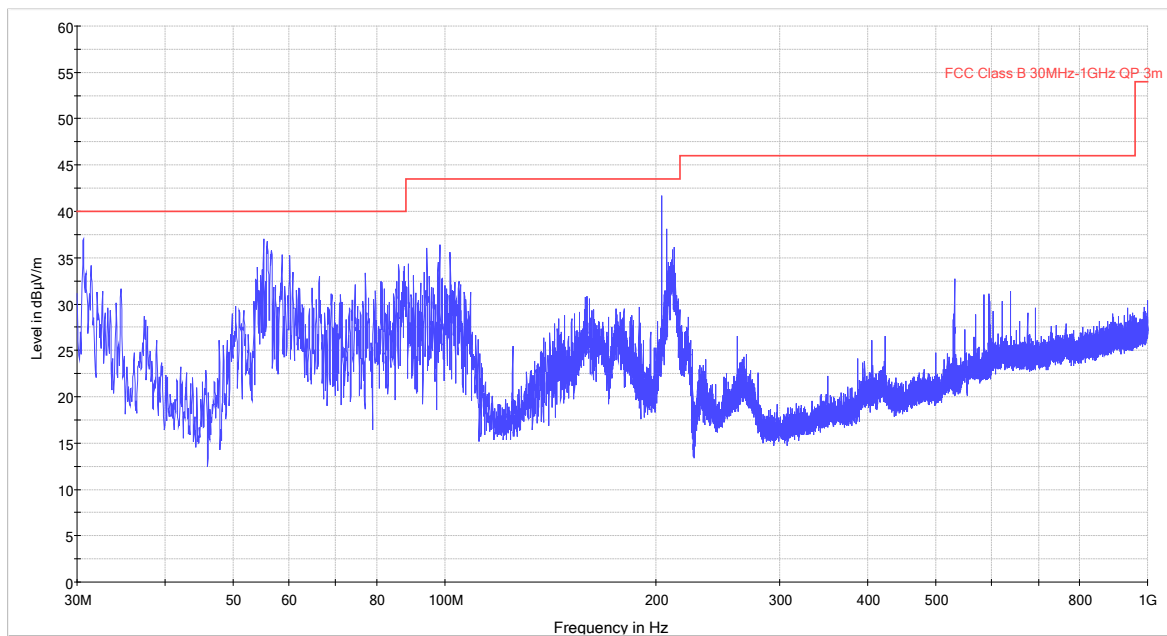


Date: 18.NOV.2014 14:23:24

Radiated spurious emissions – powered by 12v battery

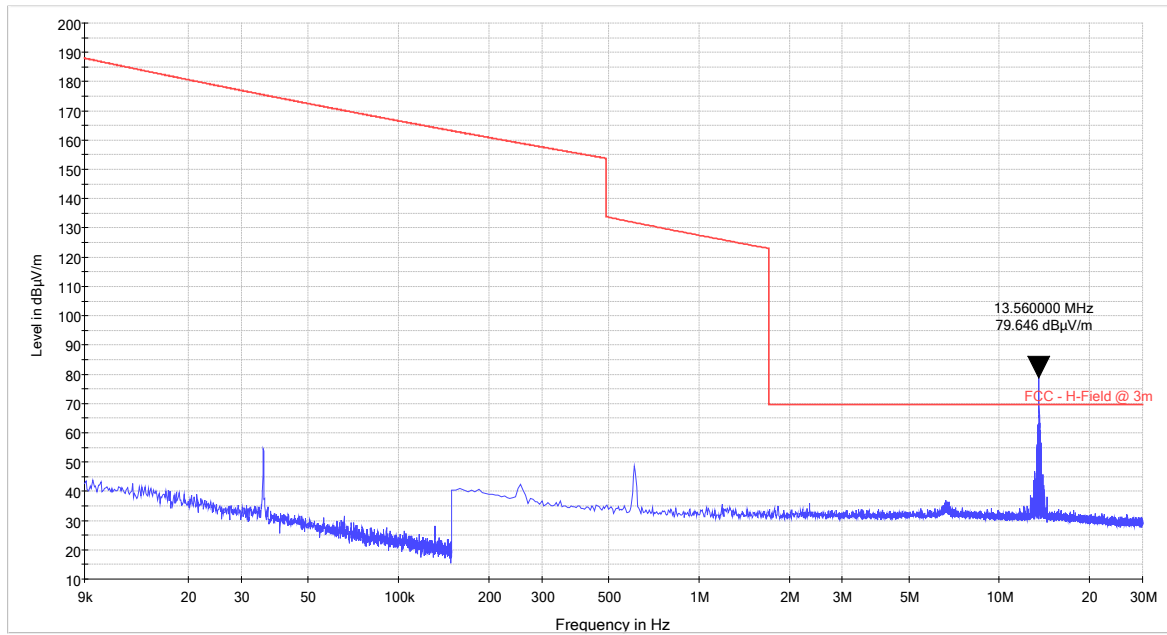


9 kHz to 30 MHz

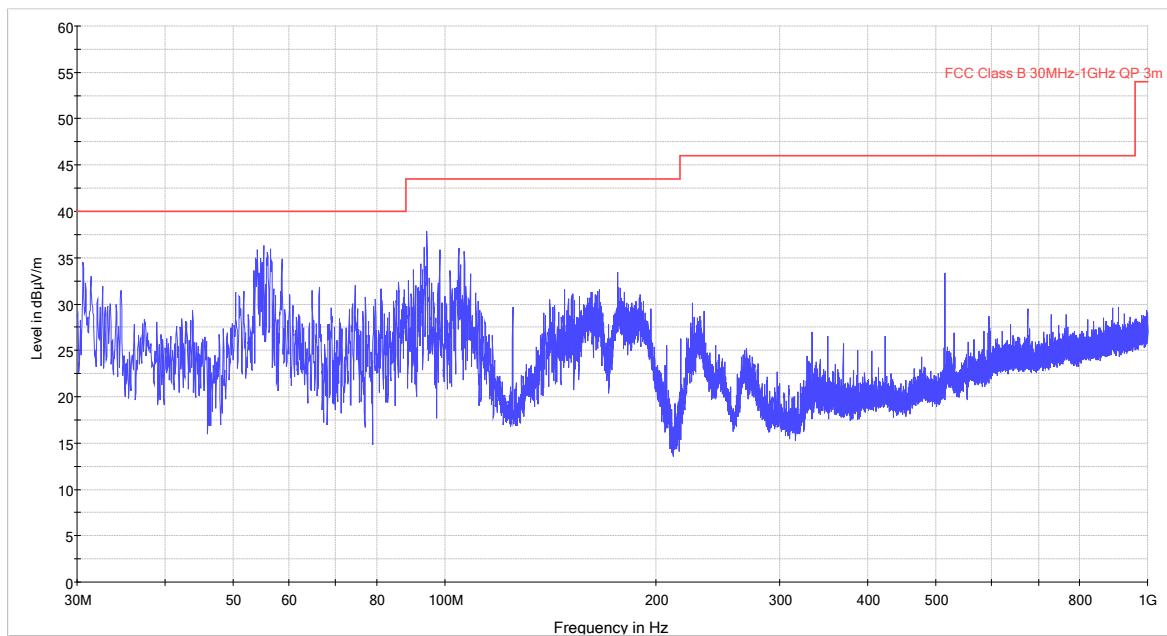


30 MHz to 1 GHz

Radiated spurious emissions – powered by PoE

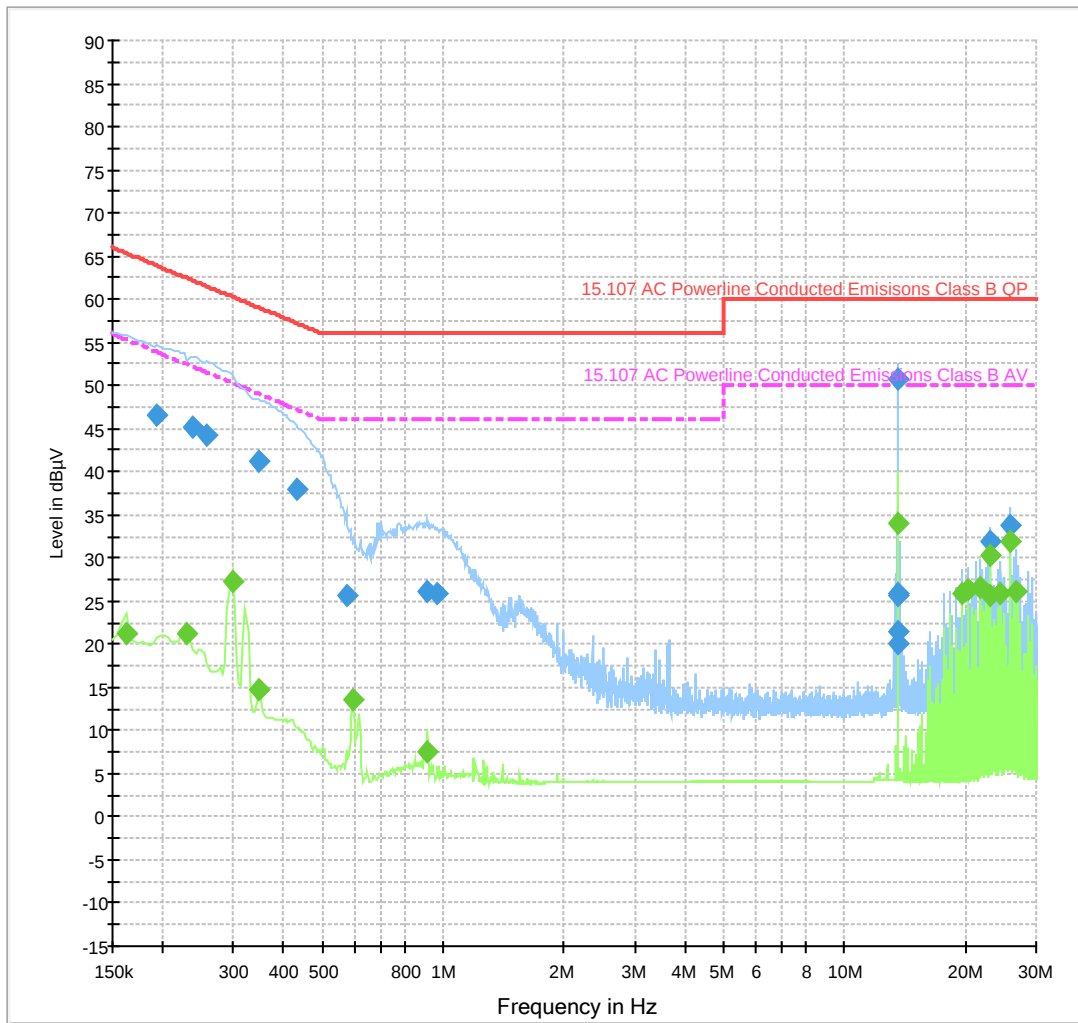


9 kHz to 30 MHz



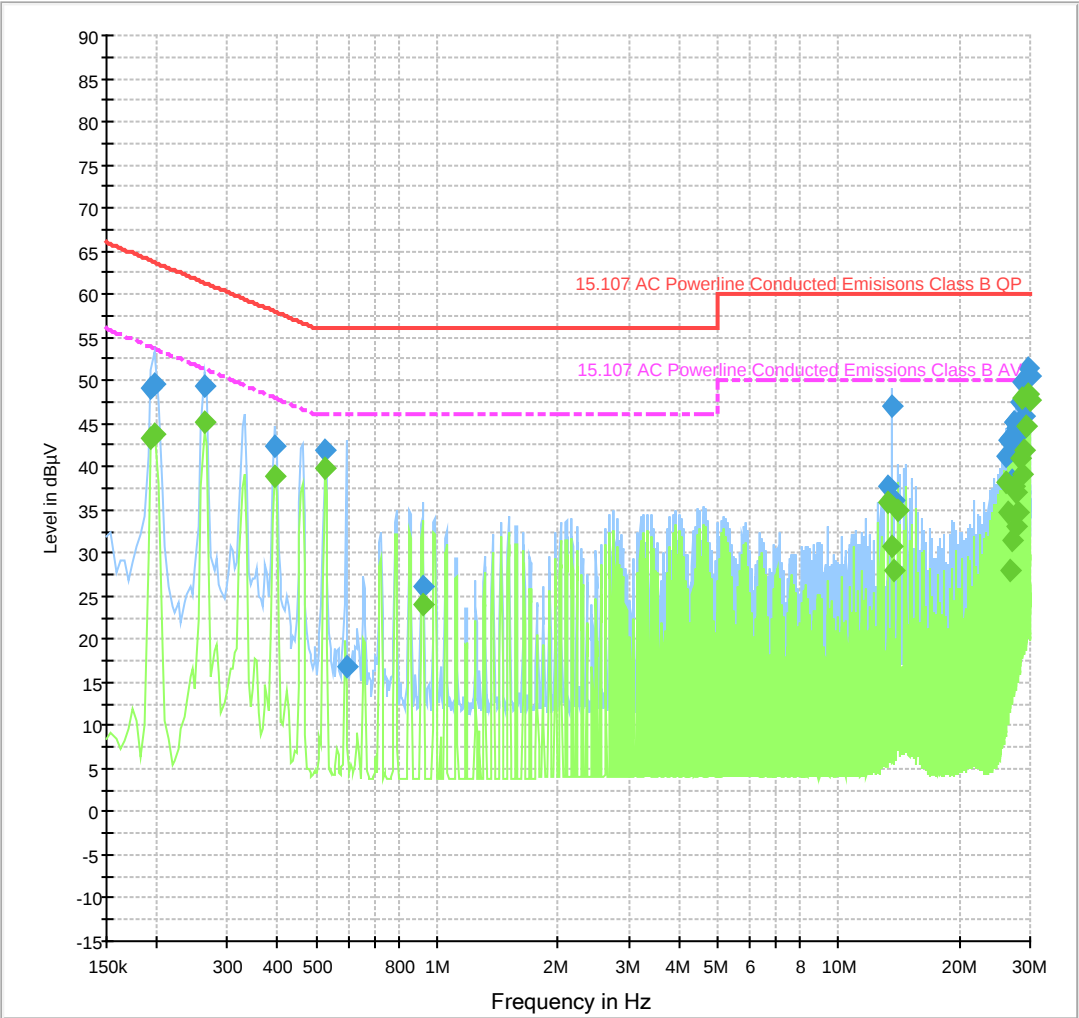
30 MHz to 1 GHz

FCC Class B Conducted emissions on Mains 150kHz-30MHz ESHS10 + UH396 Rx prescans

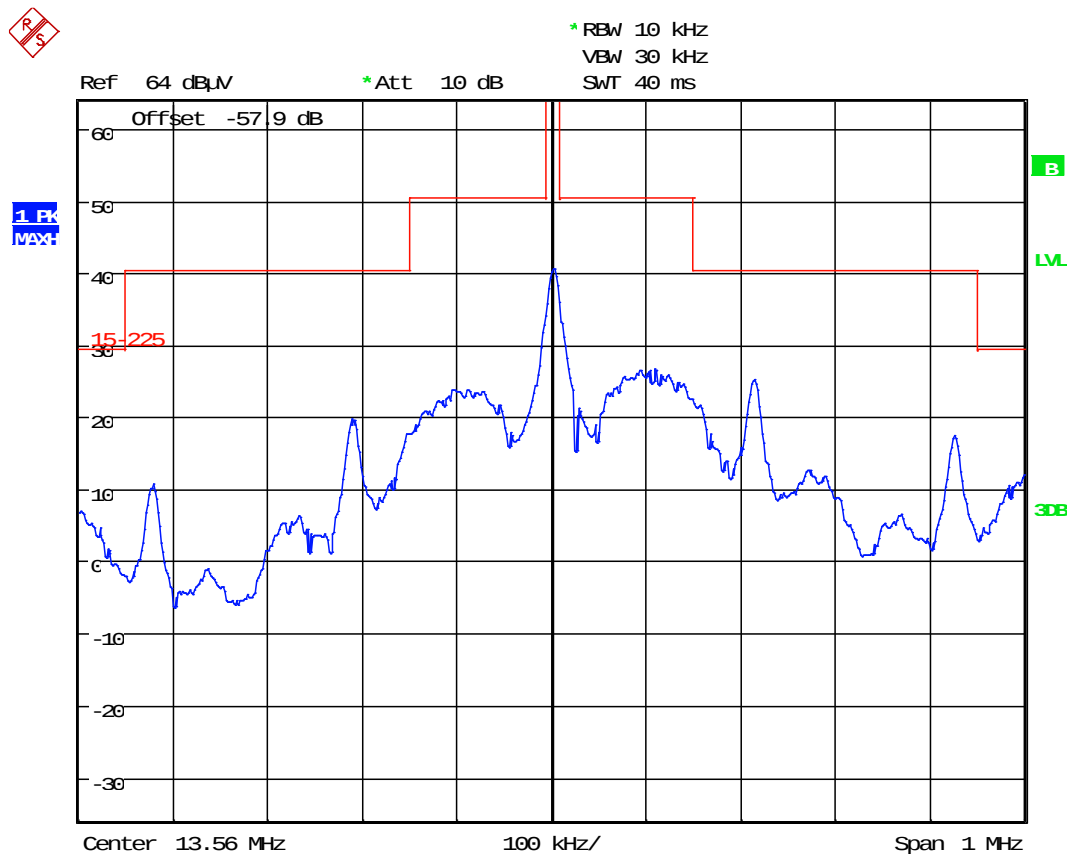


AC Powerline Conducted Emissions— powered by +12Vdc

FCC Class B Conducted emissions on Mains 150kHz-30MHz ESHS10 + UH396 Rx prescans



AC Powerline Conducted Emissions– powered by PoE



Date: 18.NOV.2014 10:52:23

Tnom Vnom

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

This appendix contains details of:

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

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

Sample No: Sxx Mod w

where:

xx	= sample number	eg. S15
w	= modification number	eg. Mod 2

The following terminology is used throughout the test report:

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

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

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

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

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

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

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

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

C1) Test samples

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

Sample No.	Description	Identification
S15	Emerald multi smart card reader	None

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

Sample No.	Description	Identification
S03	Dell Laptop	None
S04	PoE	None
S07	Magnetic Lock	None
S09	Door Simulator	None
S12	12V Power Supply	None
S14	WURTH ELEKTRONIK Ferrite	742 727 22

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

Identification	Description
	None

C2) EUT Operating Mode During Testing.

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

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

C3) EUT Configuration Information.

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

C4) List of EUT Ports

The tables below describe the termination of EUT ports:

Sample : S15

Tests : Radiated emissions / Powerline conducted emissions

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

C5 Details of Equipment Used

TRaC No	Equipment Type	Equipment Description	Manufacturer	Last Cal Calibration	Calibration Period	Due For Calibration
L290	CBL611/A	Bilog	Chase	13/12/2012	24	13/12/2014
UH420	CBL6112	Bilog	Chase	25/07/2014	24	25/07/2016
UH456	ESR7	EMI Receiver	R&S	16/04/2014	12	16/04/2015
UH403	ESCI 7	Recevier	R&S	20/08/2014	12	20/08/2015
UH387	ATS	Chamber 1	Rainford EMC	04/07/2013	24	04/07/2015
REF940	ATS	Radio Chamber - PP	Rainford EMC	09/07/2013	24	09/07/2015
REF976	34405a	Multimeter	Agilent	19/02/2014	12	19/02/2015
L426	52 Series II	Temperature Indicator	Fluke	22/05/2014	12	22/05/2015
UH396	ENV216	Lisn	R&S	22/05/2014	12	22/05/2015
UH195	ESH3-Z5.831.5	Lisn	R&S	21/07/2014	12	21/07/2015
UH003	ESHS10	Receiver	R&S	03/07/2014	12	03/07/2015
UH187	ESHS10	Receiver	R&S	19/02/2014	12	19/02/2015
L007	hfh2	Loop Antenna	R&S	17/10/2013	24	17/10/2015
UH100	-	PSU	Thandar	Cal in use		
L011	-	Temp Chamber	Sharetree	Cal in use		

Appendix D:**Additional Information**

Client declaration regarding model numbers:-

We have the 3 functional levels which are licence controlled. All units listed below are one hardware build, the same as was tested.

The TSR/*00 /108 and TSR/*00 /608 use the same firmware it just depends on which card format is down loaded to the TSR by the system it is connected too, as to which cards technology it will read.

<u>Product code</u>	<u>Card technology</u>	<u>Functionality</u>
TSR/100/108	iClass	(Intelligent access terminal)
TSR/200/108 intercom)	iClass	(Intelligent access terminal with integrated VoIP
TSR/300/108 intercom & Remote)	iClass	(Intelligent access terminal with integrated VoIP
TSR/100/608	MultiSmart	(Intelligent access terminal)
TSR/200/608 intercom)	MultiSmart	(Intelligent access terminal with integrated VoIP
TSR/300/608 intercom & Remote)	MultiSmart	(Intelligent access terminal with integrated VoIP

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

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

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

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

Therefore the calculated duty cycle was determined:

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

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

e.g

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

0.07459 or 7.459%

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

Duty cycle correction may not be applicable.

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

Appendix F:

Photographs and Figures

The following photographs were taken of the test samples:

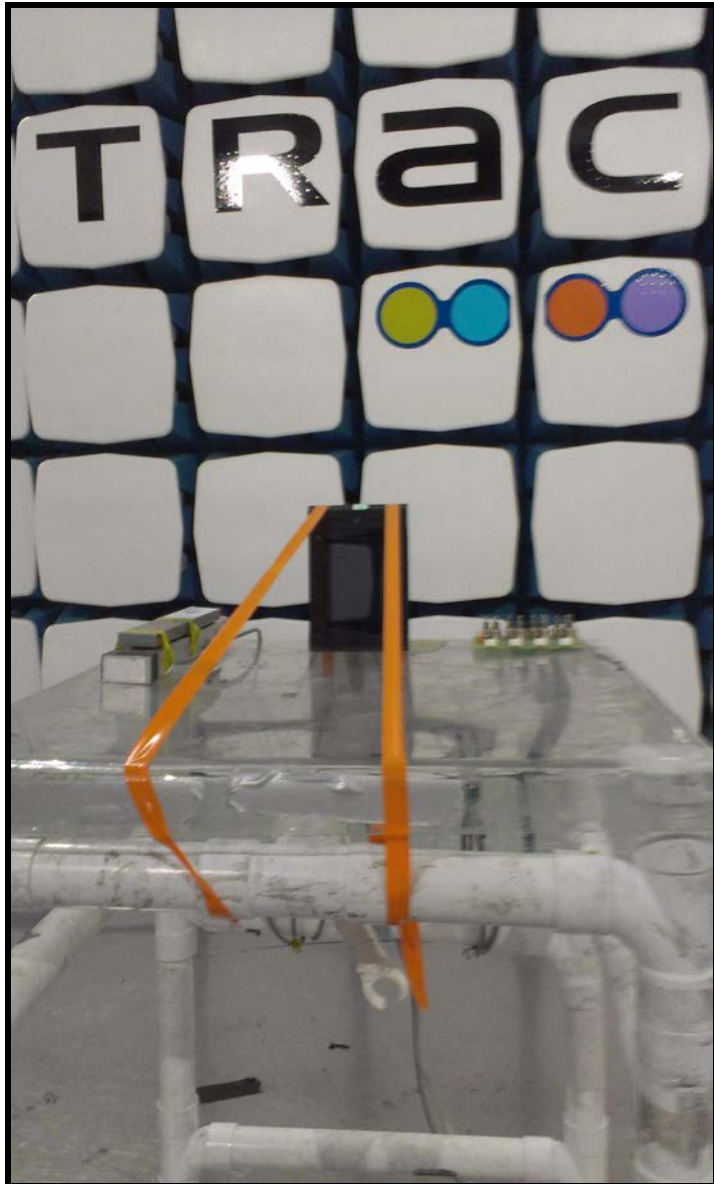
1. H Field Radiated emissions arrangement: Overview
2. E Field Radiated emissions arrangement: Overview
3. Radiated emissions arrangement: Close up
4. Powerline conducted emissions arrangement: Overview + 12Vdc
5. Powerline conducted emissions arrangement: Overview POE



Photograph 1



Photograph 2



Photograph 3



Photograph 4

Appendix G: General SAR test reduction and exclusion guidance

KDB 447498 & RSS-102

Section 4.3 General SAR test reduction and exclusion guidance

For Standalone SAR exclusion consideration, when the considering 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.

In the frequency range below 100 MHz and test separation distance ≤ 50 mm, the SAR Test Exclusion Threshold will be determined as follows

SAR Exclusion Threshold (SARET)

$$\text{SAR Exclusion Threshold} = ([\text{Step 1} + \text{Step 2}] * \text{Step 3a}) * \text{Step 3b}$$

Step 1

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

NT	=	Numeric Threshold (3.0 for 1-g SAR and 7.5 for 10-g SAR)
MP	=	Max Power of channel (mW) (inc tune up)
TSD ^A	=	Min Test separation Distance or 50mm (whichever is lower) = 50
f _{GHz}	=	Transmit frequency (or 100MHz if lower)

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.

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

For Distances Greater than 50 mm Step 2 applies

Step 2

$$(\text{TSD}^B - 50\text{mm}) * f_{(\text{MHz})}/150$$

Where:

f _{MHz} ^B	=	Transmit frequency
TSD ^B	=	Min Test separation Distance (mm) = 50

Step 3

3a) 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

3b) The power threshold determined by the equation in steps 1 and 2 for 50 mm and 100 MHz is multiplied by $1/2$ for *test separation distances* ≤ 50 mm

$$\begin{aligned} \text{SARET} &= (\{ [(\text{NT} * \text{TSD}^A) / \sqrt{f_{\text{GHz}}}] + (\text{TSD}^B - 50) * [100/150] \} * (1 + \text{Log} [100 / F_{\text{MHz}}])) * 1/2 \\ \text{SARET} &= (\{ [(3.0 * 50) / \sqrt{0.1}] + (50 - 50) * [100/150] \} * (1 + \text{Log} [100 / F_{\text{MHz}}])) * 1/2 \\ \text{SARET} &= (474 * (1 + \text{Log} [100 / 13.56])) * 1/2 \\ \text{SARET} &= 442.65 \text{ mW} \end{aligned}$$

The calculated output power is 1.09×10^{-10} mW (eirp) is less than the SAR Exclusion Threshold of 468 mW, at 5 mm test separation distance, for general population and uncontrolled exposure.

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

For purposes of these requirements mobile devices are defined by the Industry Canada as transmitters designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 centimetres is normally maintained between radiating structures and the body of the user or nearby persons. These devices are normally evaluated for exposure potential with relation to the MPE limits. As the 20 cm separation specified under Industry Canada rules may not be achievable under normal operation of the EUT, an RF exposure calculation is needed to show the minimum distance required to be less than 1.67 W/m^2 power density limit, as required under Industry Canada rules.

Equation from IEEE C95.1

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

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 peak E Field measurement.

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	2.4×10^{-7}	0.98	0.0052

