

Radio Test Report

for

G4S Technology Ltd

on

S874 Mifare Wallplate Card Reader

DOCUMENT NO. TES-004377-01-W-US1

HULL

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TRaC Wireless Test Report : TES-004377-01-W-US1

Applicant : G4S Technology Ltd

Apparatus : S874 Mifare Wallplate Card Reader

Specification(s) : CFR47 Part 15.225

Purpose of Test : Certification

FCCID : OE5S874

Authorised by

: 

:Radio Products Manager

Issue Date :23rd February 2012

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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:

G4S Technology Ltd
Challenge House
International Drive
Tewkesbury
Gloucestershire GL20 8UQ
England, UK

1.3 Manufacturer

Same as above

1.4 Apparatus Assessed

The following apparatus was assessed between 11th and 18th January 2012:

S874 Mifare Wallplate Card Reader

The above device is an RFID card reader operating at 13.56 MHz

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	Regulation	Measurement standard	Result
Spurious Emissions Radiated <1000MHz	Title 47 of the CFR: Part 15 Subpart (c) 15.	ANSI C63.10	Pass
AC Power conducted emissions	Title 47 of the CFR: Part 15 Subpart (c) 15.207	ANSI C63.10	Pass
Intentional Emission Frequency	Title 47 of the CFR: Part 15 Subpart (c) 15.	ANSI C63.10	Pass
Intentional Emission Field Strength	Title 47 of the CFR: Part 15 Subpart (c) 15.	ANSI C63.10	Pass
Unintentional Radiated Spurious Emissions	Title 47 of the CFR: Part 15 Subpart (b) 15.109	ANSI C63.10	Pass

Abbreviations used in the above table:

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

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

1.6 Notes relating to the assessment

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

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

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

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

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

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

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

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

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

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

1.7 Deviations from Test Standards

There were no deviations from the standards tested to.

Section 2:

Measurement Uncertainty

2.1 Measurement Uncertainty Values

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

Radio Testing – General Uncertainty Schedule

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

[1] Adjacent Channel Power

Uncertainty in test result = **1.86dB**

[2] Carrier Power

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

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

[3] Effective Radiated Power

Uncertainty in test result = **4.71dB**

[4] Spurious Emissions

Uncertainty in test result = **4.75dB**

[5] Maximum frequency error

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

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

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

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

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

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

[7] Frequency deviation

Uncertainty in test result = **3.2%**

[8] Magnetic Field Emissions

Uncertainty in test result = **2.3dB**

[9] Conducted Spurious

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

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

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

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

[10] Channel Bandwidth

Uncertainty in test result = **15.5%**

[11] Amplitude and Time Measurement – Oscilloscope

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

[12] Power Line Conduction

Uncertainty in test result = **3.4dB**

[13] Spectrum Mask Measurements

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

[14] Adjacent Sub Band Selectivity

Uncertainty in test result = **1.24dB**

[15] Receiver Blocking – Listen Mode, Radiated

Uncertainty in test result = **3.42dB**

[16] Receiver Blocking – Talk Mode, Radiated

Uncertainty in test result = **3.36dB**

[17] Receiver Blocking – Talk Mode, Conducted

Uncertainty in test result = **1.24dB**

[18] Receiver Threshold

Uncertainty in test result = **3.23dB**

[19] Transmission Time Measurement

Uncertainty in test result = **7.98%**

Section 3:

Modifications

3.1 Modifications Performed During Assessment

No modifications were performed during the assessment

Appendix A:**Formal Emission Test Results**

Abbreviations used in the tables in this appendix:

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

A1 Transmitter Intentional Emission Radiated

Test Details	
Regulation	Title 47 of the CFR: Part15 Subpart (c) 15.209
Measurement standard	ANSI C63.10:2003
EUT sample number	S01
Modification state	0
SE in test environment	N/A
SE isolated from EUT	N/A
EUT set up	Refer to Appendix C
Temperature	20
Photographs	Appendix F

Frequency (MHz)	Receiver Level (dBμV/m)	Measurement Distance (m)	Specification Distance (m)	Extrapolation Factor (dB)	Field Strength (dBμV/m)	Field Strength (μV/m)
13.56	87.5	1	30	61.4	26.1	20.184
13.56	66.1	3	30	40.0	26.1	20.184
Limit value @ f _c			15848 μV/m at 30m			
Band occupancy @ -20 dBc			f _{lower} (MHz)		f _{higher} (MHz)	
			13.560125		13.56484	
			20dB Bandwidth = 4.721 kHz			

- Notes:**
- 1 Results quoted are extrapolated as indicated
 - 2 Receiver detector at f_c was Quasi Peak with 120kHz bandwidth
 - 3 When battery powered the EUT was powered with new batteries

- Test Method:**
- 1 As per Radio – Noise Emissions, ANSI C63.10
 - 2 Measuring distances 3m
 - 3 EUT 0.8 metre above ground plane
 - 4 Emissions maximised by rotation of EUT, on an automatic turntable
 - 5 EUT orientation in three orthogonal planes
 - 6 Maximum results recorded

A2 Radiated Magnetic Field Emissions

Preliminary scans were performed using a peak detector. The radiated magnetic field emissions test applies to all spurious emissions and harmonics emissions. The maximum permitted field strength is listed in Section 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	
Regulation	Title 47 of the CFR, Part 15 Subpart (c) Clause 15.209
Measurement standard	ANSI C63.10:2003
Frequency range	9kHz to 30MHz
EUT sample number	S01
Modification state	0
SE in test environment	N/A
SE isolated from EUT	N/A
EUT set up	Refer to Appendix C
Temperature	20°C
Photographs	Appendix F

The worst case radiated emission measurements for spurious emissions are listed below.

Frequency (MHz)	Pk Level (dBuV/m)	Pk Limit (dBuV/m)	Pk Delta (dB)	Result Summary
No Significant emissions detected within 20dB of the limit				

Notes:

- 1 Any testing performed below 30 MHz was performed using a magnetic loop antenna in accordance with ANSI C63.10: 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=VBW= 1MHz
Average RBW=VBW= 1MHz

The upper and lower frequency of the measurement range was decided according to 47 CFR part 15:2010 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 (µV/m)	Measurement Distance (m)	Field strength (dBµV/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:

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

Where **X** = 40 for frequencies <30MHz and 20 otherwise

- (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				

A3 Radiated Electric Field Emissions

Preliminary scans were performed using a peak detector with a measurement bandwidth of 100kHz. The radiated electric field emission test applies to all spurious emissions and harmonics emissions. The maximum permitted field strength is listed in Section 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	
Regulation	Title 47 of the CFR, Part 15 Subpart (c) Clause 15.209
Measurement standard	ANSI C63.10:2003
Frequency range	30MHz to 1GHz
EUT sample number	S01
Modification state	0
SE in test environment	N/A
SE isolated from EUT	N/A
EUT set up	Refer to Appendix C
Temperature	20 ⁰ C
Photographs	Appendix F

The worst case radiated emission measurements for spurious emissions and harmonics that fall within the restricted bands are listed below.

Ref No	Frequency (MHz)	Receiver Level (dBμV)	Cable Loss (dB)	Antenna factor (dB/m)	Pre-amp Gain (db)	Field Strength (dBμV/m)	Extrapolation Factor (dB)	Field Strength (μV/m)	Limit (μV/m)
No Significant emissions detected within 20dB of the limit									

Notes:

- 1 Any testing performed below 30 MHz was performed using a magnetic loop antenna in accordance with ANSI C63.10: 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=VBW= 1MHz
Average RBW=VBW= 1MHz

The upper and lower frequency of the measurement range was decided according to 47 CFR part 15:2010 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 (μV/m)	Measurement Distance (m)	Field strength (dBμV/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:

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

Where X = 40 for frequencies <30MHz and 20 otherwise

- (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			✓	
(v) Parameter defined by standard and / or single possible, refer to Appendix D (vi) Parameter defined by client and / or single possible, refer to Appendix D (vii) Parameter had a negligible effect on emission levels, refer to Appendix D (viii) Worst case determined by initial measurement, refer to Appendix D				

A4 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	Title 47 of the CFR: Part 15 Subpart (c) Clause 15.207
Measurement standard	ANSI C63.10:2003
Frequency range	150kHz to 30MHz
EUT sample number	S01
Modification state	0
SE in test environment	N/A
SE isolated from EUT	N/A
EUT set up	Refer to Appendix C
Photographs	Appendix F

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

Results measured using the average detector compared to the average limit

Ref No.	Frequency (MHz)	Conductor	Result (dBuV)	Spec Limit (dBuV)	Margin (dB)	Result Summary
No significant emissions detected within 20dB of the limit						

Results measured using the Quasi-peak detector compared to the Quasi-peak limit

Ref No.	Frequency (MHz)	Conductor	Result (dBuV)	Spec Limit (dBuV)	Margin (dB)	Result Summary
No significant emissions detected within 20dB of the limit						

Note:

The above measurements were taken with a dummy load connected to the antenna port of the EUT. The following levels were recorded without the load attached.

Ref No.	Frequency (MHz)	Conductor	Detector	Result (dBuV)	Spec Limit (dBuV)	Margin (dB)
1	13.565	L, N	QP	43.48	60	16.52
2	13.565	L, N	AV	31.20	50	18.80

Specification limits:

Conducted emission limits (47 CFR Part 15: Clause 15.207):

Conducted disturbance at the mains port shall not exceed the following values:

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				

A5 Frequency Stability

Test Details:	
Regulation	Title 47 of the CFR, Part 15 Subpart (c) Clause 15.225
Measurement standard	ANSI C63.10:2003
EUT sample number	S01
Modification state	0
SE in test environment	N/A
SE isolated from EUT	N/A
EUT set up	Refer to Appendix C

Vnom (Vdc)	Temperature (°C)	Frequency (MHz)	Deviation (kHz)	Limit = ± 0.01% = ±1.3562kHz
+12.0Vdc	+20 °C	13.56320513	-	-
+12.0Vdc	+55 °C	13.56320513	0.0000	Pass
+12.0Vdc	-20 °C	13.56320513	0.0000	Pass
Voltage (Vdc) 85% - 115%	Temperature (°C)	Frequency (MHz)	Deviation (kHz)	Limit = ± 0.01% = 1.3562kHz
85% = 10.20	+20 °C	13.56320513	0.0000	Pass
115% = 13.80	+20 °C	13.56320513	0.0000	Pass

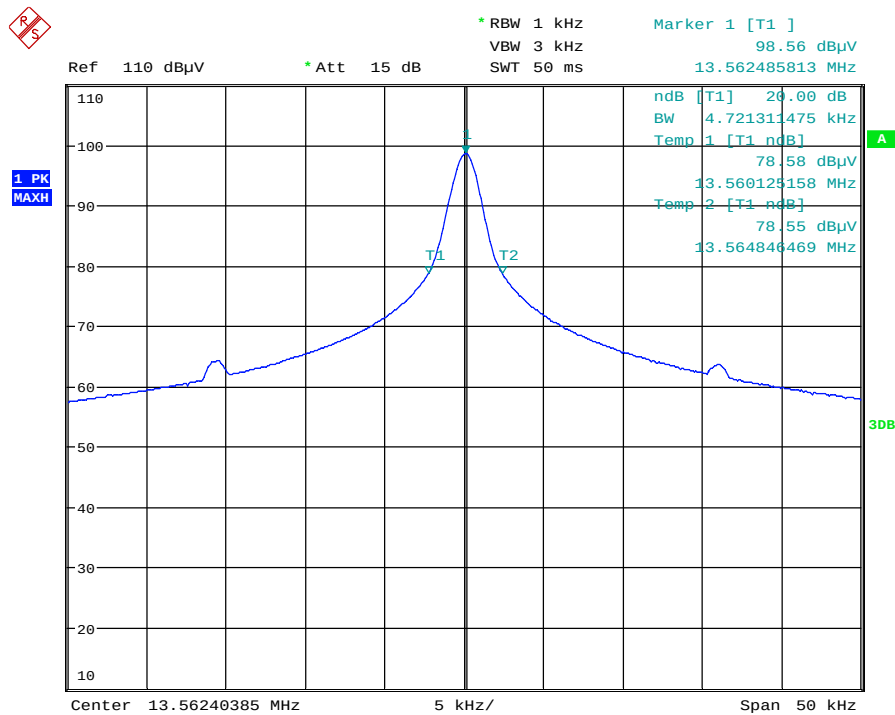
Appendix B:**Supporting Graphical Data**

This appendix contains graphical data obtained during testing.

Notes:

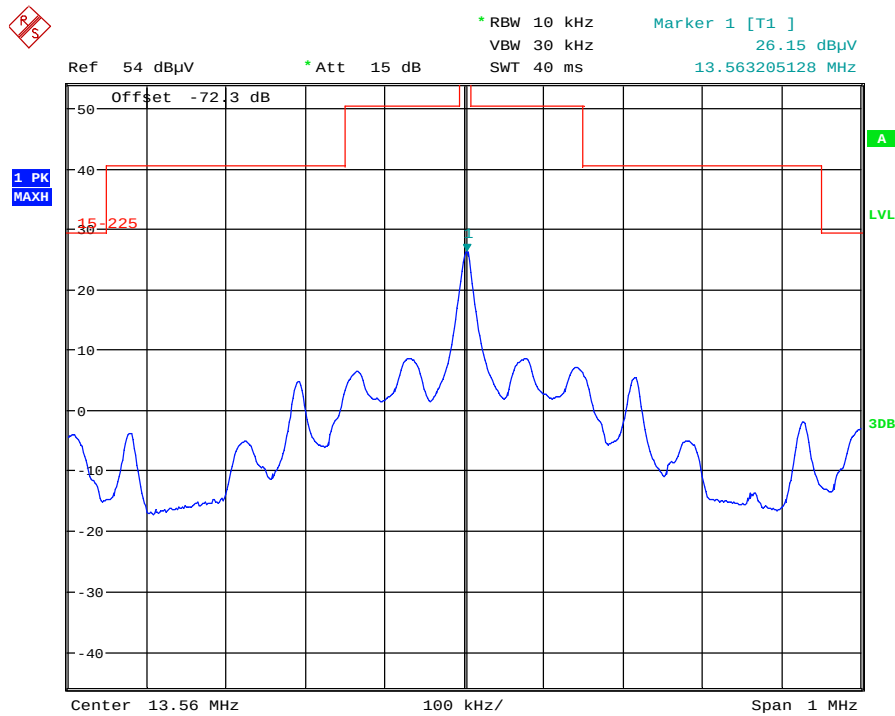
- (a) The radiated electric field emissions and conducted emissions graphical data in this appendix is preview data. For details of formal results, refer to Appendix A and Appendix B.
- (b) The time and date on the plots do not necessarily equate to the time of the test.
- (c) Where relevant, on power 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



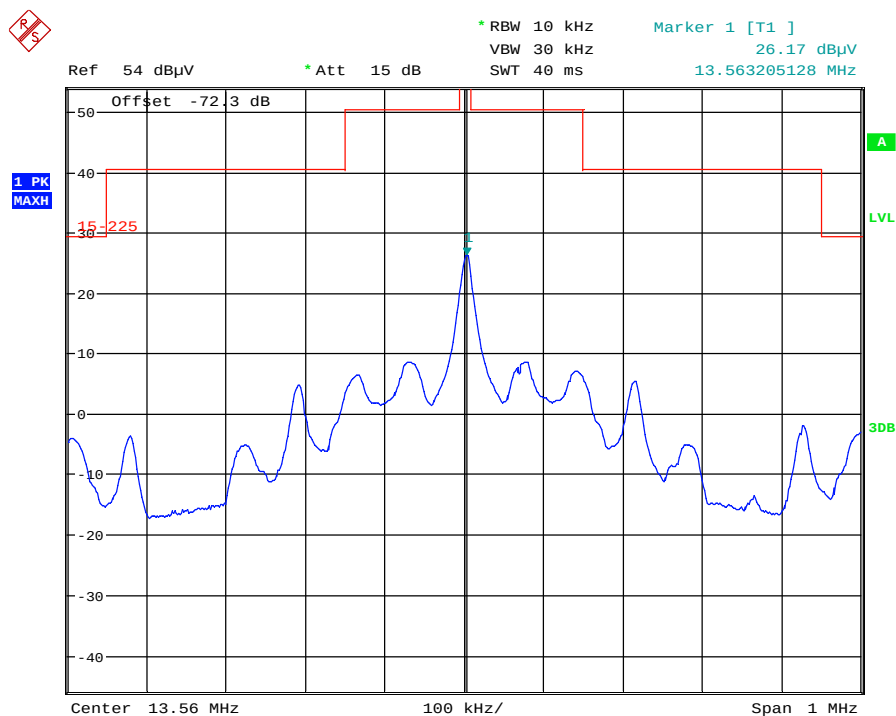
Date: 16.JAN.2012 15:00:55

Emissions Mask – Tnom, Vnom



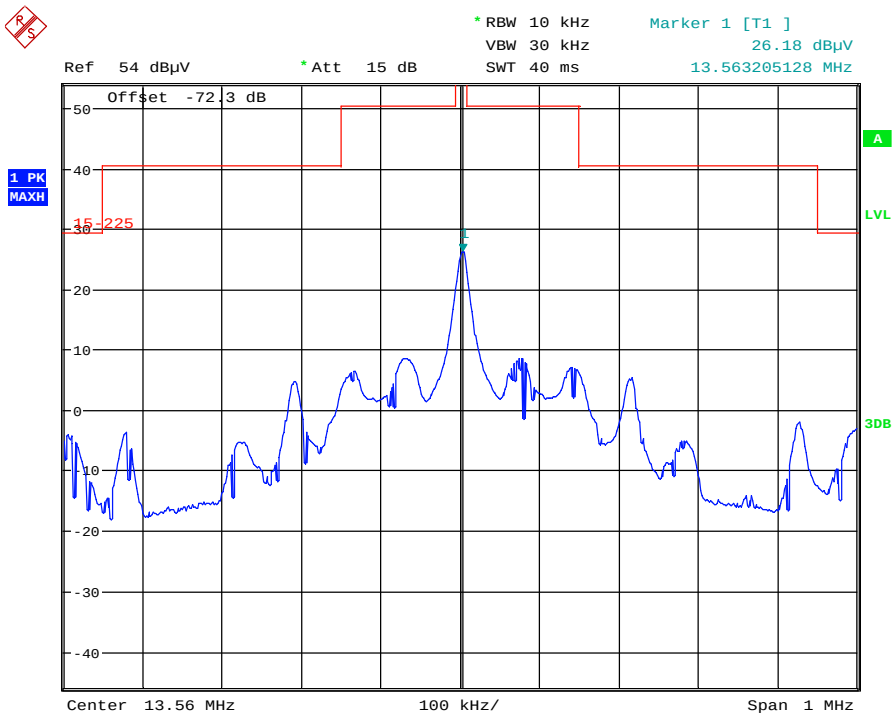
Date: 16.JAN.2012 11:01:01

Emissions Mask – Tnom, Vmin



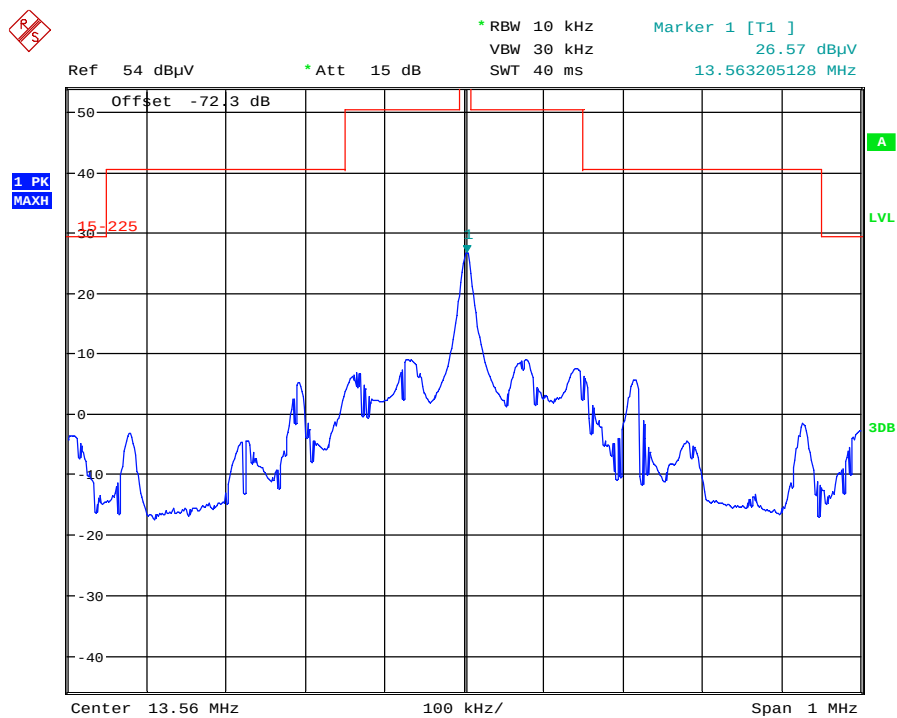
Date: 16.JAN.2012 11:07:13

Emissions Mask – Tnom, Vmax



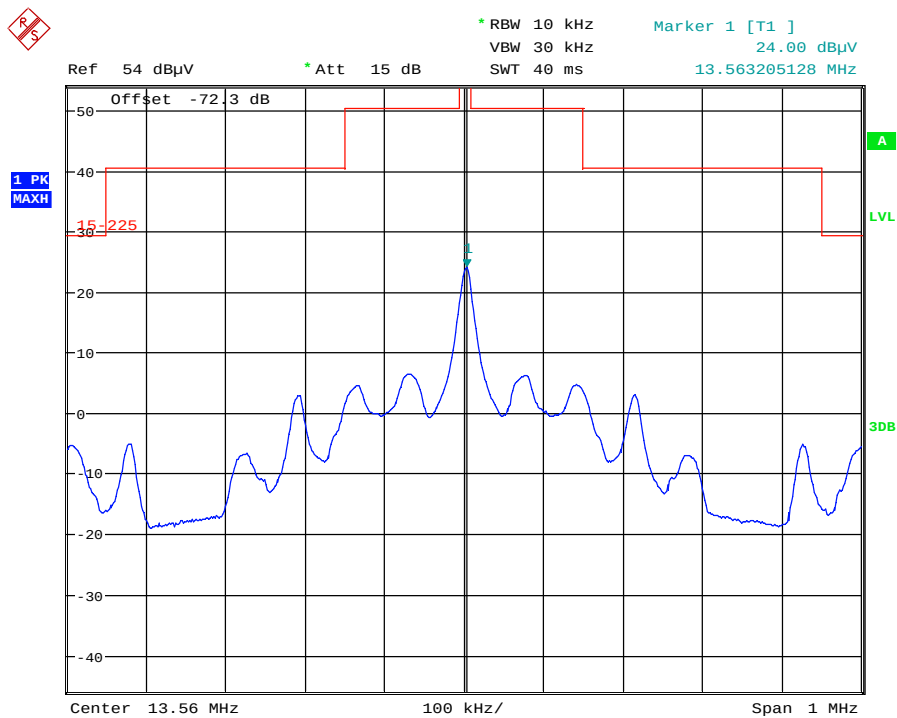
Date: 16.JAN.2012 11:10:29

Emissions Mask – Tmin, Vnom



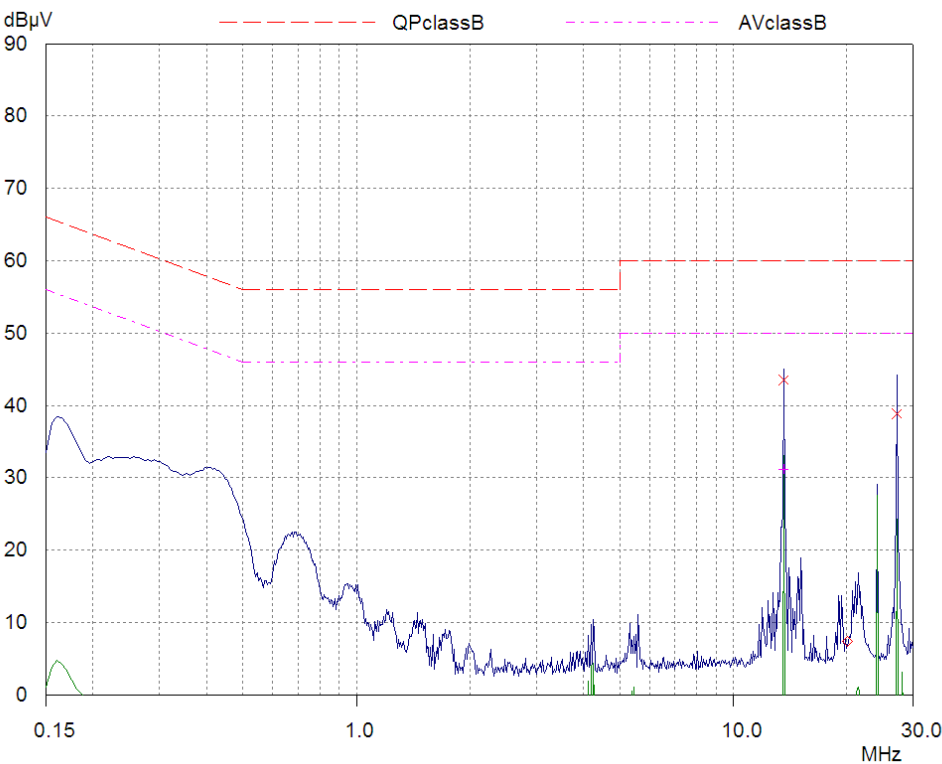
Date: 16.JAN.2012 13:54:01

Emissions Mask – Tmax, Vnom

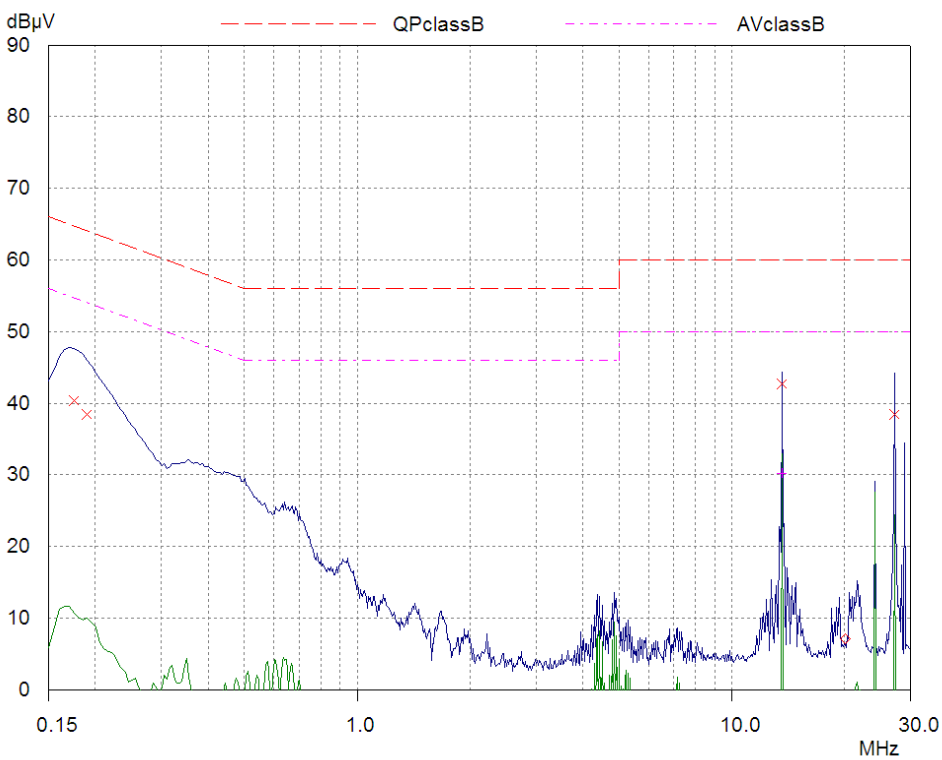


Date: 16.JAN.2012 12:18:16

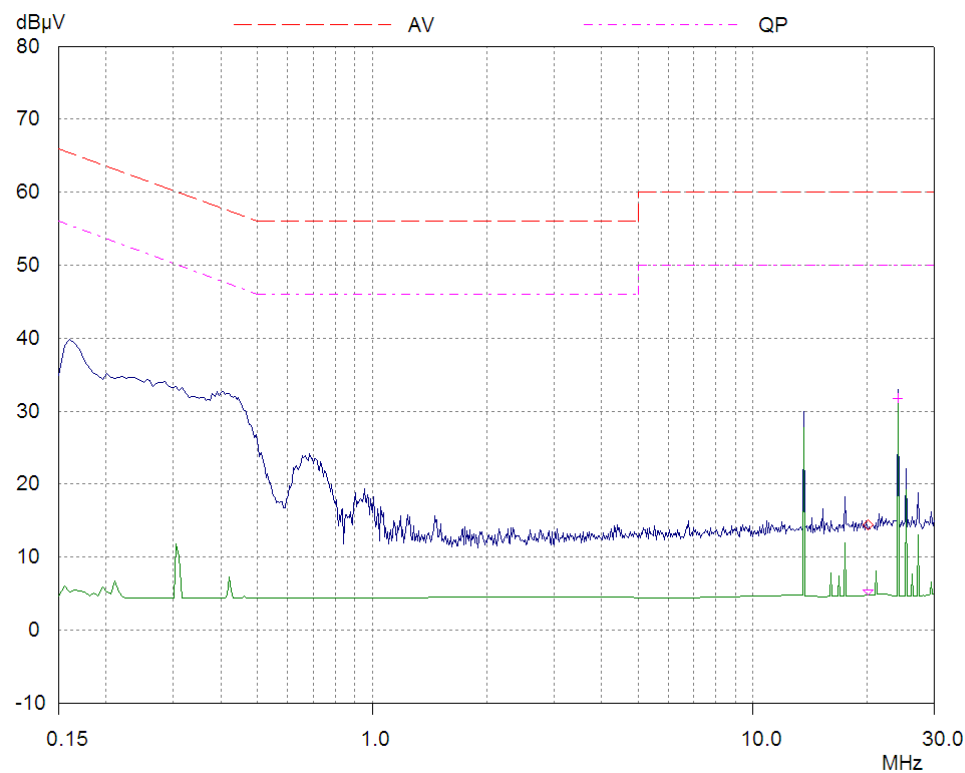
Powerline conducted emissions – Live line



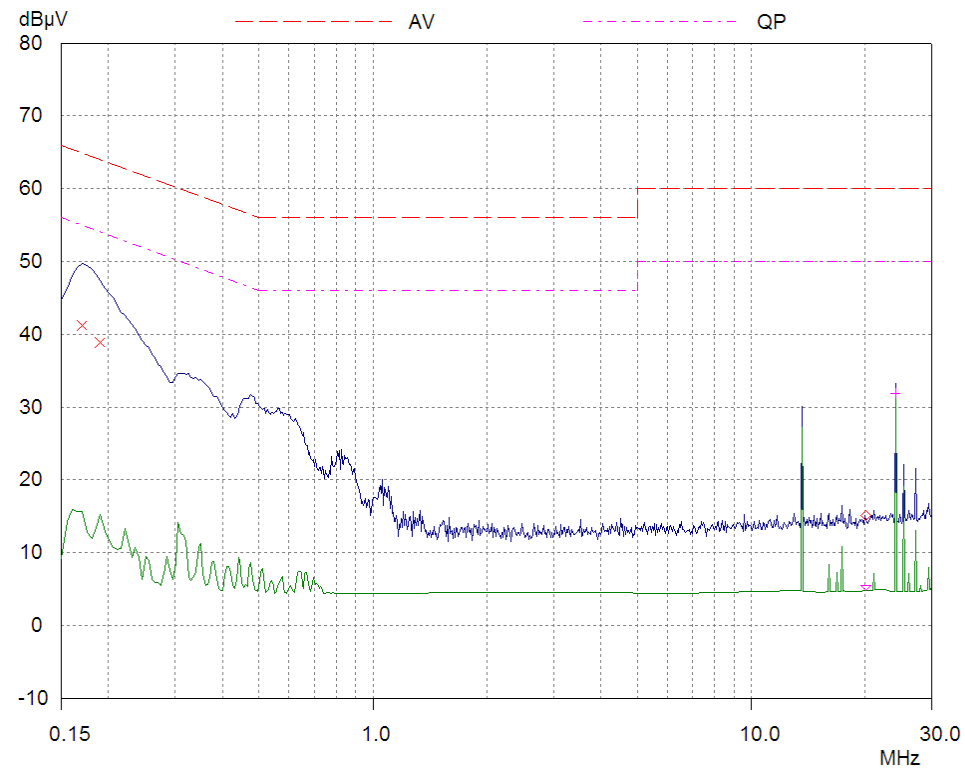
Powerline conducted emissions – Neutral line



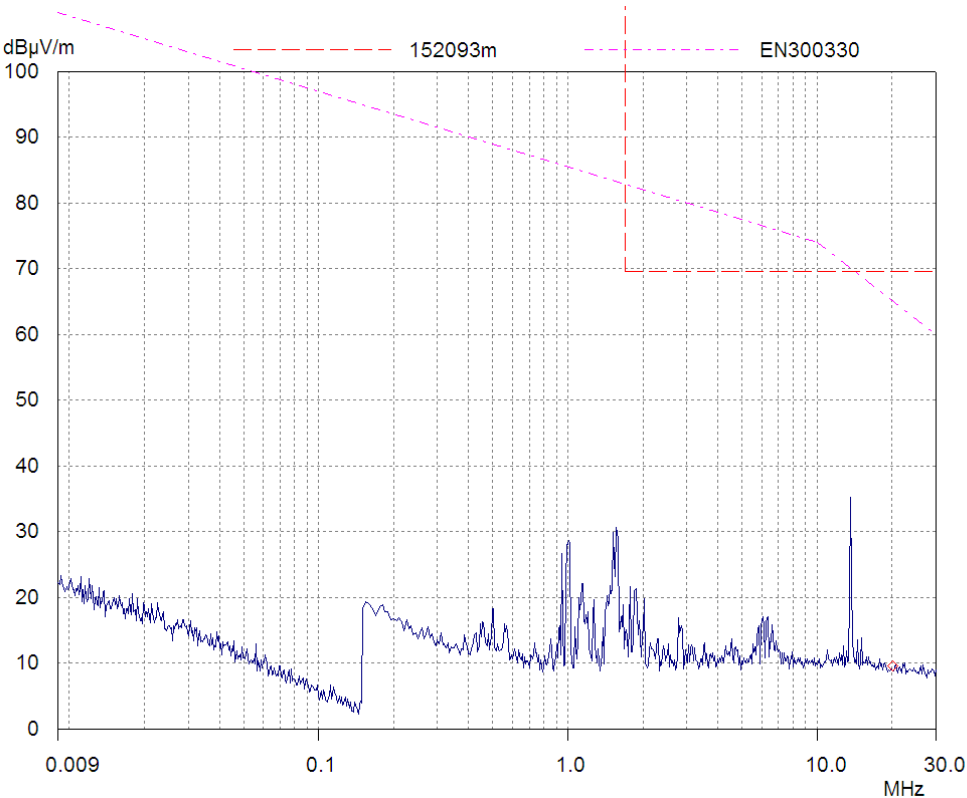
Powerline conducted emissions – Live line (with load)



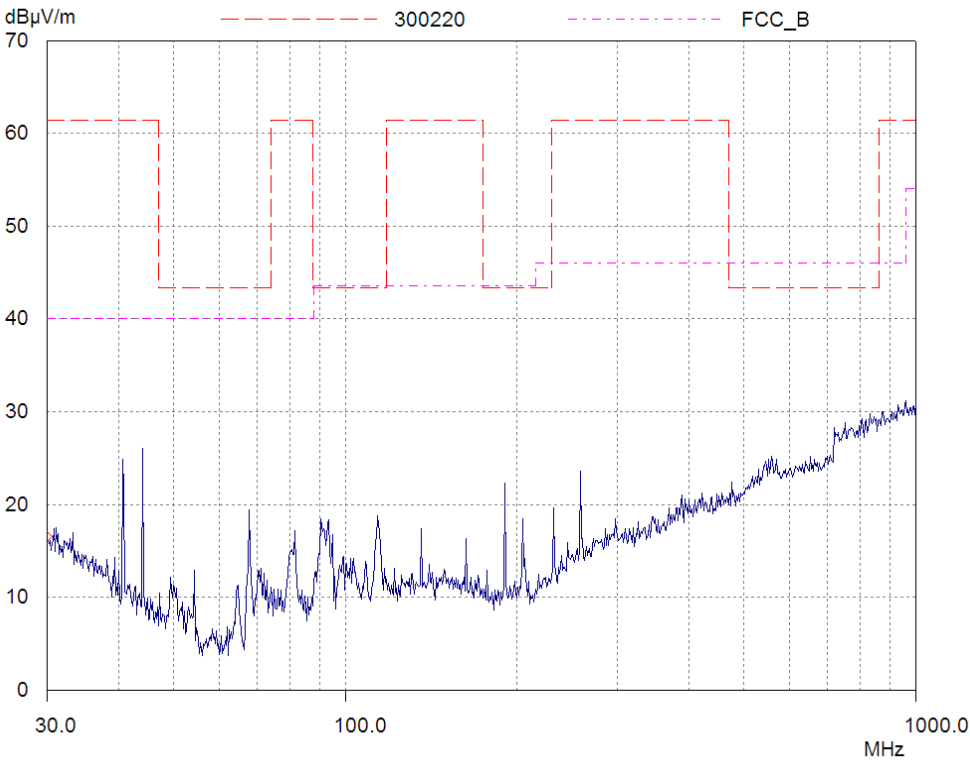
Powerline conducted emissions – Neutral line (with load)



Radiated H-field scan



Radiated E-field scan



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 its modification state:

Sample No: Sxx Mod w

where:

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

The following terminology is used throughout the test report:

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

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

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

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

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

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

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

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

C1 Test samples

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

Sample No.	Description	Identification
S01	S874 Mifare Wallplate Card Reader	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 actively transmitting

C3 EUT Configuration Information

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

C4 List of EUT Ports

The table below describes the termination of EUT ports:

Sample : S01

Tests : All

Port	Description of Cable Attached	Cable length	Equipment Connected
Power	Twister pair	N/A	12V dc supply

C5 Details of Equipment Used

TRaC Ref	Type	Description	Manufacturer	Date Calibrated
07	HFH2	Loop Antenna	R&S	04/11/2011
L187	ESHS10	Receiver	R&S	12/01/2012
UH93	CBL6112	Bilog Antenna	Chase	20/06/2011
L317	ESVS10	Receiver	R&S	21/12/2011
UH281	FSU	Spectrum Analyser	R&S	10/02/2011
426	52 Series II	Temperature Indicator	Fluke	04/03/2011
11	TCC125-815P	Environmental Chamber (Temp)	ShareTree	N/A

Appendix D:

Additional Information

No additional information is included within this test report.

Appendix E:

Photographs and Figures

The following photographs were taken of the test samples:

1. Radiated tests setup <30MHz (front view)
2. Powerline conducted emissions test setup

Photograph 1



Photograph 2



