

Radio Test Report

for

G4S Technology Ltd

on

S870

Document No: TRA-008148-W-US1



TRaC Wireless Test Report: TRA-008148-W-US1

Applicant : G4S Technology Ltd

Apparatus: S870

Specification(s) : CFR47 Part 15.209, July 2011

Purpose of Test : Certification

FCC ID : OE5S870

Authorised by

Radio Products Manager

John Charters

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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.

Test performed by: TRaC Global []

Unit E

South Orbital Trading Park

Hedon Road Hull, HU9 1NJ. United Kingdom.

Telephone: +44 (0) 1482 801801 Fax: +44 (0) 1482 801806

TRaC Global [X]

Unit 1

Pendle Place Skelmersdale

West Lancashire, WN8 9PN

United Kingdom

Telephone: +44 (0) 1695 556666 Fax: +44 (0) 1695 577077

Email: test@tracglobal.com
Web site: http://www.tracglobal.com

Tests performed by: S Hodgkinson, D Winstanley

Report author: S Bharat

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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 GL20 8UQ Gloucestershire, UK

1.3 Manufacturer

Same as above

1.4 Apparatus Assessed

The following apparatus was assessed between 12th April and 20th April 2012:

S870

The above equipment is an RFID card reader with a radio transmitter operating at 125.3 kHz.

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) 15.209	ANSI C63.10	Pass
Spurious Emissions Radiated >1000MHz	Title 47 of the CFR: Part 15 Subpart (c) 15.209		
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) 15.209	ANSI C63.10	Pass
Intentional Emission Field Strength	Title 47 of the CFR: Part 15 Subpart (c) 15.209	ANSI C63.10	Pass
Intentional Emission Band Occupancy	Title 47 of the CFR: Part 15 Subpart (c) 15.209	ANSI C63.10	Pass
Intentional Emission ERP (mW)	Title 47 of the CFR: Part 15 Subpart (c) 15.209	ANSI C63.10	Pass
Unintentional Radiated Spurious Emissions	Title 47 of the CFR: Part 15 Subpart (b) 15.109	ANSI C63.10	Pass
Antenna Arrangements Integral:	Title 47 of the CFR: Part 15 Subpart (c) 15.203	-	N/A
Antenna Arrangements External Connector	Title 47 of the CFR: Part 15 Subpart (c) 15.204		
Restricted Bands	Title 47 of the CFR: Part 15 Subpart (c) 15.205	-	N/A
Maximum Frequency of Search	Title 47 of the CFR: Part 15 Subpart (c) 15.33		
Extrapolation Factor	Title 47 of the CFR: Part 15 Subpart (c) 15.31(f)	-	N/A

Abbreviations used in the above table:

CFR : Code of Federal Regulations ANSI : American National Standards Institution REFE : Radiated Electric Field Emissions 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

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Uncertainty in test result (14kHz - 30MHz) = 4.8dB, Uncertainty in test result (30MHz - 1GHz) = 4.6dB, Uncertainty in test result (1GHz - 18GHz) = 4.7dB
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[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
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[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

QP : Quasi-Peak Detector H : Horizontal Polarisation
Av : Average Detector V : Vertical Polarisation

CDN : Coupling & decoupling network

Α1 **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 E)	None			

Frequency (kHz)	Measurement Distance (m)	Measurement Rx. Reading (dBµV/m)	Extrapo Facto		Field Strength at 300m (µV/m)
125.3	1	96.0	102.8		0.457
125.3	3	73.2	80		0.457
Limit a	t 300m	19.15 μV/m			
		f _L f _H			f _H
Band occupa	ncy at -20 dBc	124.53 kHz 126.06 kHz			126.06 kHz
			BW = 1.	.53 kHz	

Notes:

- 1 Results quoted are extrapolated as indicated
- 2 Receiver detector @ fc = Average / Quasi Peak with 10kHz / 120kHz bandwidth appropriately
- 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: 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 orthagonal planes.

Maximum results recorded

A2 Radiated Spurious 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 15.209. The EUT was set to transmit as required.

The following test site was used for fire	nal measurement	s as specified by the stan	dard tested to:
3m open area test site :		3m alternative test site :	X
The effect of the EUT set-up on the m	easurements is s	summarised in note (c) be	low.

	Test Details				
Regulation	Title 47 of the CFR, Part 15 Subpart (c) Clause 15.209				
Measurement standard	ANSI C63.10:2003				
Frequency range	9kHz – 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				
Photographs (Appendix E)	1				

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

Frequency (MHz)	Meas Rx (dBuV)	Cable Loss (dB)	Antenna Fact (dB/m)	Pre- amp (dB)	Field Strength (dBuV/m)	Extrap Fact	Field Strength (uV/m)	Limit (uV/m)
30	11.56	0.84	18.6	-	31	-	35.48	100
30.15	6.83	0.84	18.53	-	26.2	-	20.42	100
30.45	10.38	0.84	18.38	-	29.6	_	30.20	100
30.95	11.72	0.85	18.13	_	30.7	_	34.28	100
33.2	19.15	0.87	16.78	_	36.8	_	69.18	100
33.45	14.19	0.88	16.63	_	31.7	_	38.46	100
33.7	19.74	0.88	16.48	_	37.1	_	71.61	100
34	19.62	0.88	16.3	_	36.8	_	69.18	100
34.25	20.24	0.88	16.18	_	37.3	_	73.28	100
34.35	15.49	0.88	16.13	_	32.5	_	42.17	100
34.5	15.16	0.89	16.05	_	32.1		40.27	100
34.65	15.10	0.89	15.98		31.9	_	39.36	100
35.65	16.05	0.89	15.35	-	32.3	-	41.21	100
36.2	16.05	0.9	15.35		32.3	-	41.69	
			14.73	-		-		100
36.75	21.67	0.9	_	-	37.3	-	73.28	100
37	17.2	0.9	14.6	-	32.7	-	43.15	100
37.2	17.5	0.9	14.5	-	32.9	-	44.16	100
37.45	17.51	0.91	14.38	-	32.8	-	43.65	100
37.65	17.11	0.91	14.28	-	32.3	-	41.21	100
37.85	18.01	0.91	14.18	-	33.1	-	45.19	100
38.2	22.51	0.91	13.98	-	37.4	-	74.13	100
38.35	18.4	0.91	13.89	-	33.2	-	45.71	100
38.45	22.76	0.91	13.83	-	37.5	-	74.99	100
38.6	18.55	0.91	13.74	-	33.2	-	45.71	100
38.7	22.81	0.91	13.68	-	37.4	-	74.13	100
38.85	18.2	0.91	13.59	-	32.7	-	43.15	100
39	22.58	0.92	13.5	-	37	-	70.79	100
39.2	22.48	0.92	13.4	-	36.8	-	69.18	100
39.3	17.13	0.92	13.35	-	31.4	-	37.15	100
39.45	22	0.92	13.28	-	36.2	-	64.57	100
39.75	20.95	0.92	13.13	-	35	-	56.23	100
44.85	21.86	0.95	10.29	-	33.1	-	45.19	100
46.35	19.36	0.95	9.59	-	29.9	-	31.26	100
54.9	19.41	1.05	5.94	-	26.4	-	20.89	100
55.15	19.98	1.05	5.87	-	26.9	-	22.13	100
56.9	22.12	1.06	5.52	-	28.7	-	27.23	100
57.1	20.85	1.06	5.49	-	27.4	-	23.44	100
57.35	20.67	1.06	5.47	-	27.2	-	22.91	100
59.1	19.35	1.07	5.18	-	25.6	-	19.05	100
59.4	20.41	1.07	5.12	-	26.6	-	21.38	100
59.9	21.1	1.08	5.02	-	27.2	-	22.91	100
67.65	22.72	1.11	5.27	-	29.1	-	28.51	100
67.9	22.5	1.11	5.29	_	28.9	_	27.86	100
68.2	22.49	1.11	5.3	_	28.9	_	27.86	100
68.4	22.48	1.12	5.3	-	28.9	_	27.86	100
68.7	22.40	1.12	5.3	-	28.6	-	26.92	100
68.95	22.10	1.12	5.3	-	29.3	-	29.17	100
69.2	22.45	1.13	5.32	-	28.9	_	27.86	100
69.45	21.92	1.13	5.35	-	28.4		26.30	100
				- -		-		
85.45	16.62	1.19	7.89	_	25.7	_	19.28	100

86.45	18.31	1.2	8.09	-	27.6	-	23.99	100
86.7	17.36	1.2	8.14	-	26.7	-	21.63	100
86.95	17.41	1.2	8.19	-	26.8	-	21.88	100
87.2	18.15	1.21	8.24	-	27.6	-	23.99	100
87.45	17.3	1.21	8.29	-	26.8	-	21.88	100
88.75	17.9	1.22	8.48	-	27.6	-	23.99	150
89	18.18	1.22	8.5	-	27.9	-	24.83	150
89.25	18.08	1.22	8.5	-	27.8	•	24.55	150
89.45	18.28	1.22	8.5	-	28	-	25.12	150

There were no further emissions within 20dB of the limit.

Notes:

- 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.
- 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.
- 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.
- 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 15.209 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:

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

A3 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 E)	2				

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

Results measured using the average detector compared to the average limit

Ref No.	Freq (MHz)	Conduct or	Result (dBuV)	Spec Limit (dBuV)	Margin (dB)	Result Summary
1	29.945	Neutral	32.98	50	17.02	Pass

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

Ref No.	Freq (MHz)	Conduct or	Result (dBuV)	Spec Limit (dBuV)	Margin (dB)	Result Summary
1	23.43	Neutral	43.71	60	16.29	Pass
2	29.945	Neutral	45.89	60	14.11	Pass
3	22.93	Live	43.26	60	16.74	Pass

Specification limits:

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

Conducted disturbance at the mains ports shall be no more than the following values.

Frequency range (MHz)	Limits (dBμV)		
Trequency range (Min2)	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:

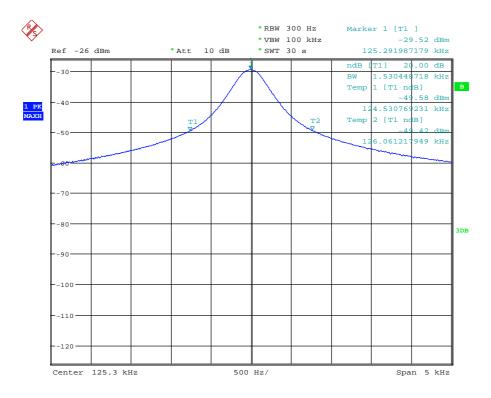
Supporting Graphical Data

This appendix contains graphical data obtained during testing.

Notes:

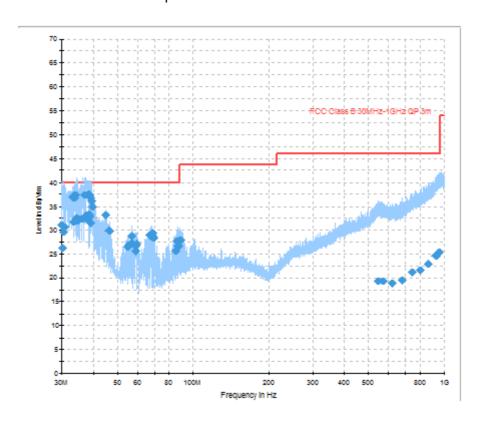
- (a) The radiated electric field emissions and conducted emissions graphical data in this appendix is preview data. For details of formal results, refer to Appendix A and Appendix B.
- (b) The time and date on the plots do not necessarily equate to the time of the test.
- (c) Where relevant, on power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

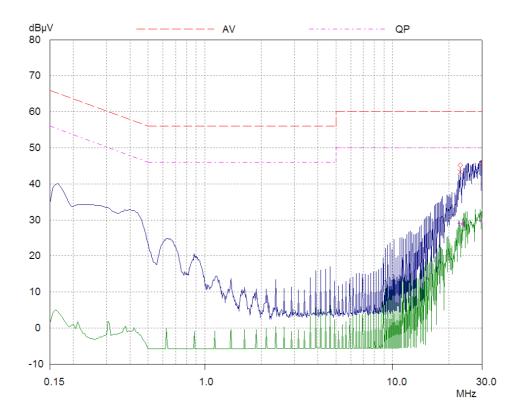


Date: 10.APR.2012 12:56:24

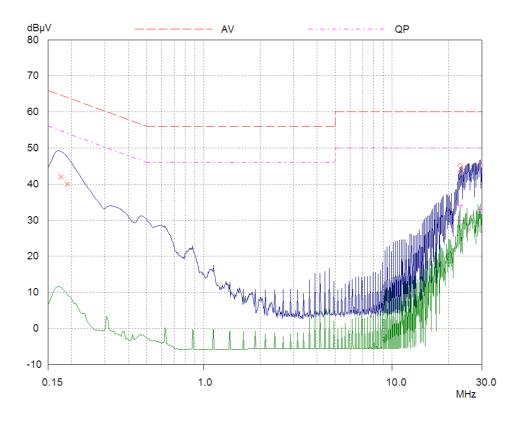
Radiated spurious emissions 30 MHz to 1 GHz



Powerline Conducted Emissions - Live



Powerline Conducted Emissions - Neutral



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)
- Details of EUT configuration(s) (see below).
- 4. EUT arrangement (see below).

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

Sample No: Sxx Mod w

where:

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

The following terminology is used throughout the test report:

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

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

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

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

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

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

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

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

C1 Test samples

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

Sample No	Description	Identification
S01	S870	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 tables below describe the termination of EUT ports:

Sample : S01

Port	Description of Cable Attached	Cable length	Equipment Connected
Power	Shielded power cable	1m	Power supply

C5 Details of Equipment Used

Ref	Туре	Description	Manufacturer	Date Calibrated
REF940	ATS	Ferrite Lined Chamber	Rainford EMC	13/07/2011
TRL007	hfh2	Loop Antenna	R&S	04/11/2011
UH191	CBL611/A	Bilog Antenna	Chase	08/11/2010
UH281	FSU46	Spectrum Analyser	R&S	09/02/2012
REF470	45	Multimeter	Agilent	26/01/2012
UH004	ESVS10	E-field Receiver	R&S	12/01/2012
UH003	ESHS10	H-field Receiver	R&S	16/02/2012

Appendix D:	Additional Information
No additional information is included within this test report.	

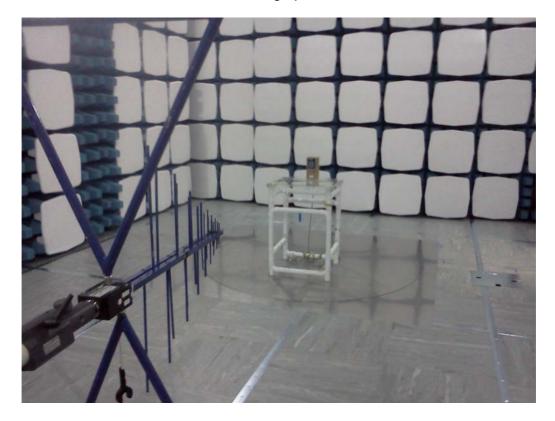
Appendix E:

Photographs and Figures

The following photographs were taken of the test samples:

- 1. Radiated electric field emissions arrangement
- 2. Powerline conducted emissions setup

Photograph 1



Photograph 2





