

TRaC Wireless Test Report : TTR003012WUS1

Applicant : G4S Technology Ltd.

Apparatus : S854

Specification(s) : CFR47 Part 15.225 July 2008

Purpose of Test : **Certification**

FCCID : **OE5S854**

Authorised by :



: Radio Product Manager

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Contents

Section 1:	Introduction	3
1.1	General	3
1.2	Tests Requested By	4
1.3	Manufacturer	4
1.4	Apparatus Assessed	4
1.5	Test Result Summary	5
1.6	Notes Relating To The Assessment	6
1.7	Deviations from Test Standards	6
Section 2:	Measurement Uncertainty	7
2.1	Measurement Uncertainty Values	7
Section 3:	Modifications	9
3.1	Modifications Performed During Assessment	9
Appendix A:	Formal Emission Test Results	10
A1	Transmitter Intentional Emission Radiated	11
A2	Radiated Electric Field Emissions	12
A3	Power Line Conducted Emissions	15
A4	Frequency Stability	17
Appendix B:	Supporting Graphical Data	18
Appendix C:	Additional Test and Sample Details	23
Appendix D:	Additional Information	29
Appendix E:	Photographs and Figures	30

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 :

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1.3 Manufacturer

As above.

1.4 Apparatus Assessed

The following apparatus was assessed between 1st - 3rd November 2010.

The S854 is a HF RFID card reader operating on 13.56MHz.

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) 15.225 -15.209	ANSI C63.10	Pass
Spurious Emissions Radiated >1000MHz	Title 47 of the CFR: Part 15 Subpart (c)	ANSI C63.10	N/A
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) 15.255	ANSI C63.10	Pass
Intentional Emission Field Strength	Title 47 of the CFR: Part 15 Subpart (c) 15.225	ANSI C63.10	Pass
Intentional Emission Band Occupancy	Title 47 of the CFR: Part 15 Subpart (c) 15.225	ANSI C63.10	Pass
Antenna Arrangements Integral:	Title 47 of the CFR: Part 15 Subpart (c) 15.203	-	Pass
Antenna Arrangements External Connector	Title 47 of the CFR: Part 15 Subpart (c) 15.204	-	Pass
Restricted Bands	Title 47 of the CFR: Part 15 Subpart (c) 15.205	-	Pass
Maximum Frequency of Search	Title 47 of the CFR: Part 15 Subpart (c) 15.33	-	N/A
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
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****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 (Equipment - TRLUH120) = **2.18dB**

Uncertainty in test result (Equipment – TRL05) = **1.08dB**

Uncertainty in test result (Equipment – TRL479) = **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 (Equipment - TRLUH120) = **119ppm**

Uncertainty in test result (Equipment – TRL05) = **0.113ppm**

Uncertainty in test result (Equipment – TRL479) = **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 (Equipment TRL479) Up to 8.1GHz = **3.31dB**

Uncertainty in test result (Equipment TRL479) 8.1GHz – 15.3GHz = **4.43dB**

Uncertainty in test result (Equipment TRL479) 15.3GHz – 21GHz = **5.34dB**

Uncertainty in test result (Equipment TRLUH120) 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%**

[11] Power Line Conduction

Uncertainty in test result = **3.4dB**

[12] Spectrum Mask Measurements

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

[13] Adjacent Sub Band Selectivity

Uncertainty in test result = **1.24dB**

[14] Receiver Blocking – Listen Mode, Radiated

Uncertainty in test result = **3.42dB**

[15] Receiver Blocking – Talk Mode, Radiated

Uncertainty in test result = **3.36dB**

[16] Receiver Blocking – Talk Mode, Conducted

Uncertainty in test result = **1.24dB**

[17] Receiver Threshold

Uncertainty in test result = **3.23dB**

[18] 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
EUT	: Equipment Under Test	ATS	: Alternative Test Site
SE	: Support Equipment	Ref	: Reference
L	: Live Power Line	Freq	: Frequency
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

Carrier power was verified with the EUT transmitting Test Details:	
Regulation	Title 47 of the CFR: Part15 Subpart (c) 15.225(a)
Measurement standard	ANSI C63.10:2003
EUT sample number	S01
Modification state	0
SE in test environment	N/A
SE isolated from EUT	none
EUT set up	Refer to Appendix C
Temperature	20°C
Photographs (Appendix F)	2

FREQ. (MHz)	MEASUREMENT DISTANCE Meters	MEASUREMENT Rx. READING (dB μ V/m)	EXTRAP. FACTOR (dB)	FIELD STRENGTH (μ V/m)
13.5623	3	72.0	40.0	39.81
13.5623	1	93.2	61.20	39.81
Limit value @ fc		15848 μ V/m @ 30m		
Band occupancy @ -20 dBc		f lower	f higher	
		13.559823718MHz	13.564967949MHz	
		5.144kHz		

- Notes:**
- 1 Results quoted are extrapolated as indicated
 - 2 Receiver detector @ fc = Quasi Peak 10kHz bandwidth
 - 3 When battery powered the EUT was powered with new batteries
 - 4 For emissions with in the band see analyser plot in appendix B

- 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.
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 Radiated Electric Field Emissions

Preliminary scans were performed using a peak detector with the RBW = 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	9kHz – 30MHz
EUT sample number	S01
Modification state	0
SE in test environment	N/A
SE isolated from EUT	none
EUT set up	Refer to Appendix C
Temperature	20°C
Photographs (Appendix F)	1

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

Ref No.	FREQ. (MHz)	MEAS Rx (dBµV)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	FIELD ST'GH (dBµV/m)	EXTRAP FACT (dB)	FIELD ST'GH (µV/m)	LIMIT (µV/m)
1.	162.75	22.7	1.5	9.8	-	34.0	-	50.2	43.5
2.	176.35	22.2	1.5	9.0	-	32.7	-	43.2	43.5
3.	203.45	29.4	1.6	8.0	-	39.0	-	89.1	43.5
4.	230.5	23.3	1.7	9.4	-	34.4	-	52.5	46.0
5.	244.15	23.8	1.8	11.4	-	37.0	-	70.8	46.0
6.	257.65	23	1.8	13.2	-	38.0	-	79.4	46.0
7.	331.95	24.8	2.0	14.2	-	41.0	-	112.2	46.0
8.	393.35	17.1	2.3	15.9	-	35.3	-	58.2	46.0
9.	420.40	15.2	2.4	16.6	-	34.2	-	51.3	46.0
10.	434.0	10.9	2.4	16.7	-	30.0	-	31.6	46.0
11.	447.55	15.6	2.5	16.8	-	34.9	-	55.5	46.0
12.	515.40	7.2	2.6	18.2	-	28.0	-	25.1	46.0

Ref No.	FREQ. (MHz)	MEAS Rx (dB μ V)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	FIELD ST'GH (dB μ V/m)	EXTRAP FACT (dB)	FIELD ST'GH (μ V/m)	LIMIT (μ V/m)
13.	542.45	9.6	2.7	19.4	-	31.7	-	38.5	46.0
14.	556.0	5.9	2.7	20.4	-	29.0	-	28.2	46.0
15.	569.60	13.6	2.7	20.6	-	36.9	-	70.0	46.0
16.	596.75	12.2	2.7	19.9	-	34.8	-	54.9	46.0
17.	623.85	12.9	2.7	20.4	-	36.0	-	63.1	46.0
18.	637.45	7	2.7	20.4	-	30.1	-	31.9	46.0
19.	651.0	12.5	2.7	20.3	-	35.5	-	59.6	46.0
20.	732.40	8.4	2.7	22.4	-	33.5	-	47.3	46.0
21.	759.50	10.1	2.8	22.4	-	35.3	-	58.2	46.0
22.	786.65	8.3	2.8	22.9	-	34.0	-	50.1	46.0
23.	827.30	4.4	2.8	22.5	-	29.7	-	30.5	46.0

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 15:2008 Clause 15.33(a) and 15.33(a)(1).

Radiated emission limits 47 CFR 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				

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	01
Modification state	0
SE in test environment	
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Photographs (Appendix F)	3

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)	Conductor	Result (dBuV)	Spec Limit (dBuV)	Margin (dB)	Result Summary
1	13.565	L	43.55	50.0	6.45	Pass
2	27.125	L	17.13	50.0	32.87	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	0.15	N	40.87	66.0	25.17	Pass
2	0.2	N	37.85	63.61	25.76	Pass
3	0.23	N	35.37	62.45	27.08	Pass
4	0.38	N	27.52	58.28	30.76	Pass
5	13.56	N	54.66	60.0	5.34	Pass
6	27.125	N	28.8	60.0	31.2	Pass

Specification limits :

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

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

A4 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	01
Modification state	0
SE in test environment	None
SE isolated from EUT	S02
EUT set up	Refer to Appendix C

Vnom (Vdc)	Temperature (°C)	Frequency (MHz)	Result (MHz)	Limit = ± 0.01% = ±1.3562kHz
+12.0Vdc	10 °C	13.562371795	-	-
+12.0Vdc	-20 °C	13.5625160626	-0.00014	PASS
+12.0Vdc	+55 °C	13.562259616	0.000112	PASS
Voltage (Vdc) 85% - 115%	Temperature (°C)	Frequency (MHz)	Result(MHz)	Limit = ± 0.01% = 1.3562kHz
85% = 10.20	+20 °C	13.562395833	-0.000024	PASS
115% = 13.80	+20 °C	13.562259615	0.000112	PASS

Appendix B:

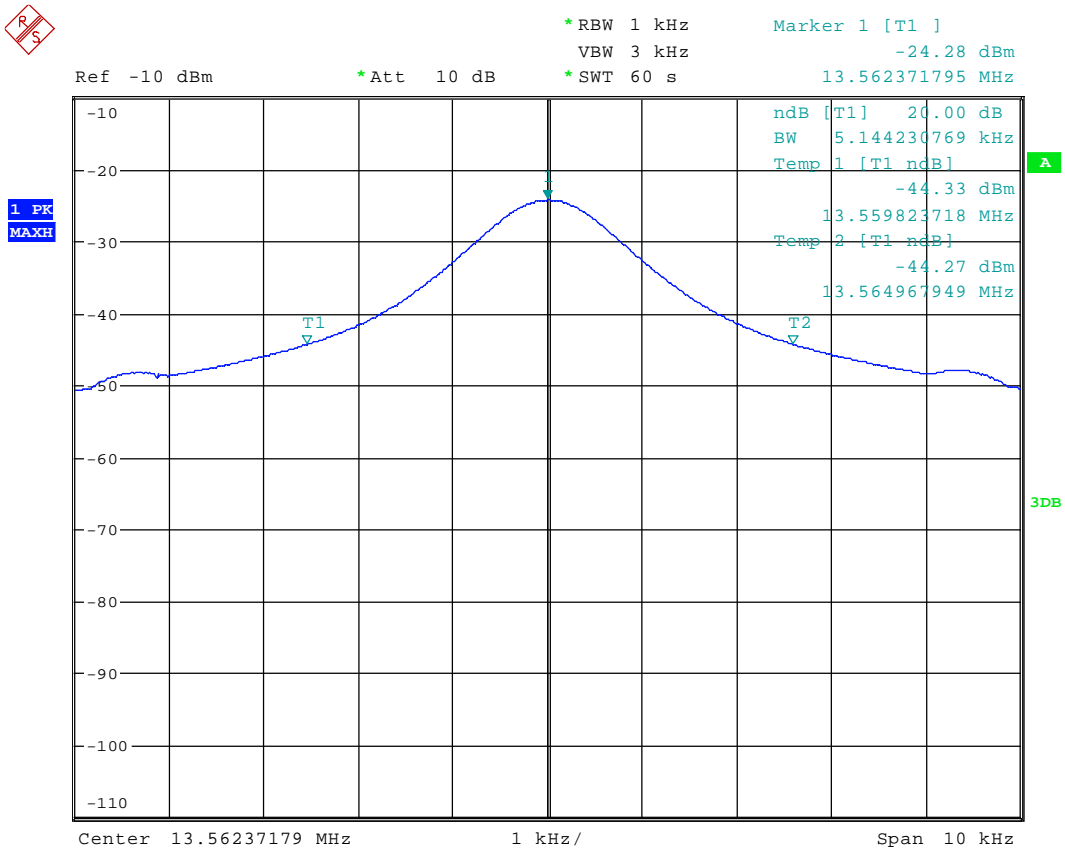
Supporting Graphical Data

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

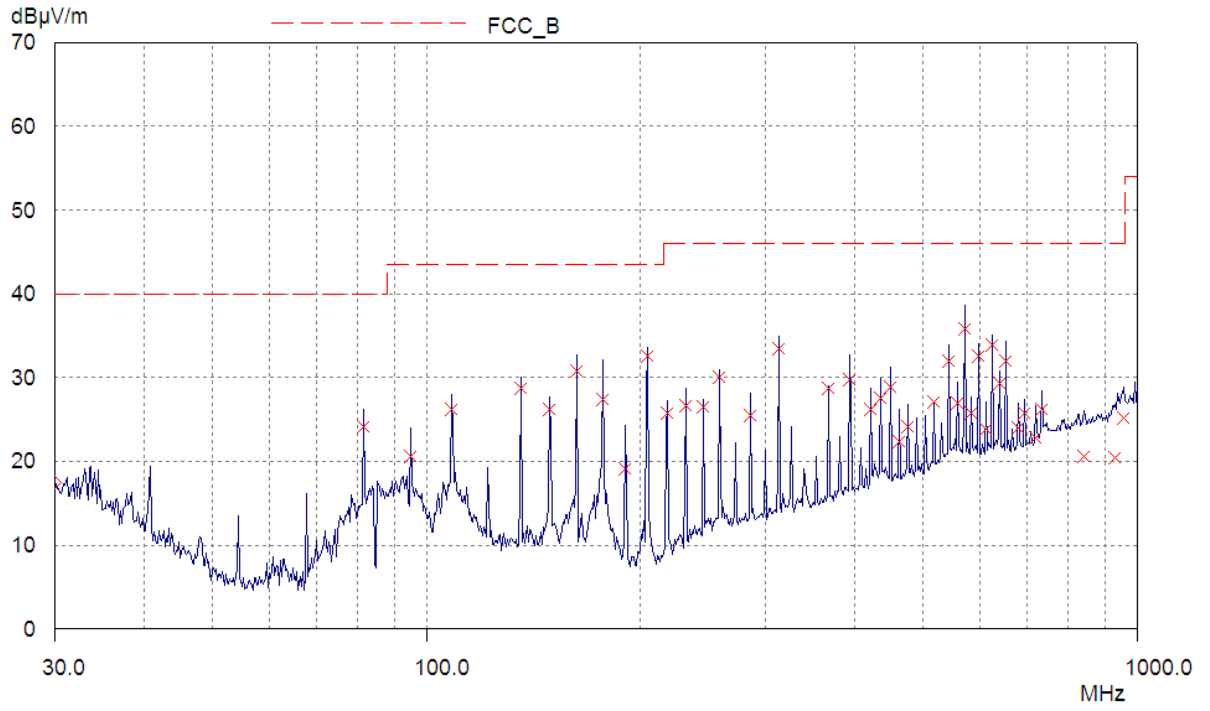


Date: 2.NOV.2010 10:50:39

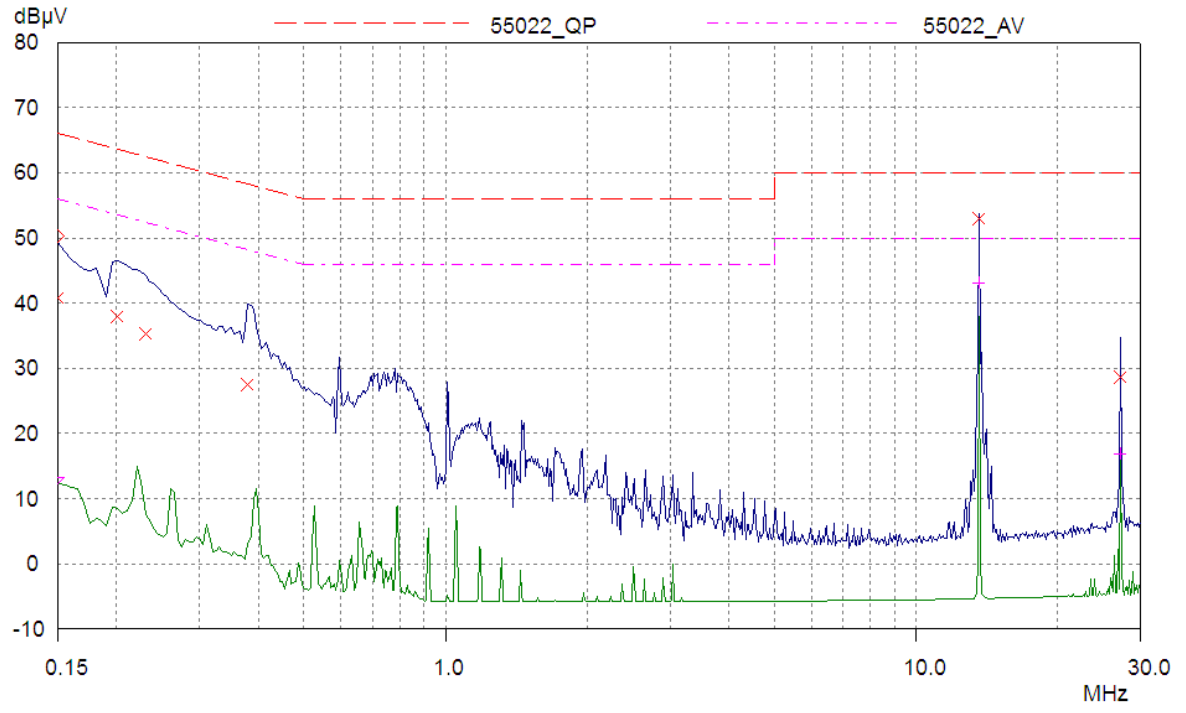
f1 = 13.559823718MHz
 fh = 13.564967949MHz

20dB Bandwidth = 5.144kHz

Radiated spurious emissions 30 MHz to 1 GHz



AC Powerline Conducted Emissions



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. 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 Telecoms & Radio upon request.

C1) Test samples

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

Sample No.	Description	Identification
S01	S854 RFID Card reader	N/A

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

Sample No.	Description	Identification
N/A	Not applicable	N/A

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

Identification	Description	Identification
N/A	Not applicable	N/A

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 Constantly transmitting, with and without the RFID card placed within the RF field.

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 :
Tests : A/C Conducted emissions

Port	Description of Cable Attached	Cable length	Equipment Connected
DC Supply	supply cable	1 mtr	Power supply

Sample :
Tests : Radiated Emissions

Port	Description of Cable Attached	Cable length	Equipment Connected
DC Supply	supply cable	1 mtr	Power supply

* Only connected during setup.

C5 Details of Equipment Used

For Radiated Measurements:

TRAC Ref	Type	Description	Manufacturer	Date Calibrated.
TRLUH281	FSU46	Spectrum Analyser	Rhode & Schwarz	29/01/2010
TRLUH04	ESVS10	Receiver	Rhode & Schwarz	10/12/2009
TRLUH372	6201-69	Pre amp	Watkins& Johnson	27/11/2009
TRLUH93	CBL6112B	Antenna	Chase	03/06/2009
TRLUH377	FSU	Spectrum Analyser	Rhode & Schwarz	101/01/2010
TRLUH191	CBL611/A	Antenna	York	01/10/2008
TRLUH195	ESH3	Lisn	Rhode & Schwarz	27/01/10
TRLUH04	ESVS10	Receiver	Rhode & Schwarz	10/12/2009
TRLUH372	6201-69	Pre amp	Watkins& Johnson	27/11/2009
TRL07	HFH2	Loop Antenna	Rhode & Schwarz	26/08/2010

Appendix D:

Additional Information

No additional information is included within this test report.

Appendix E:

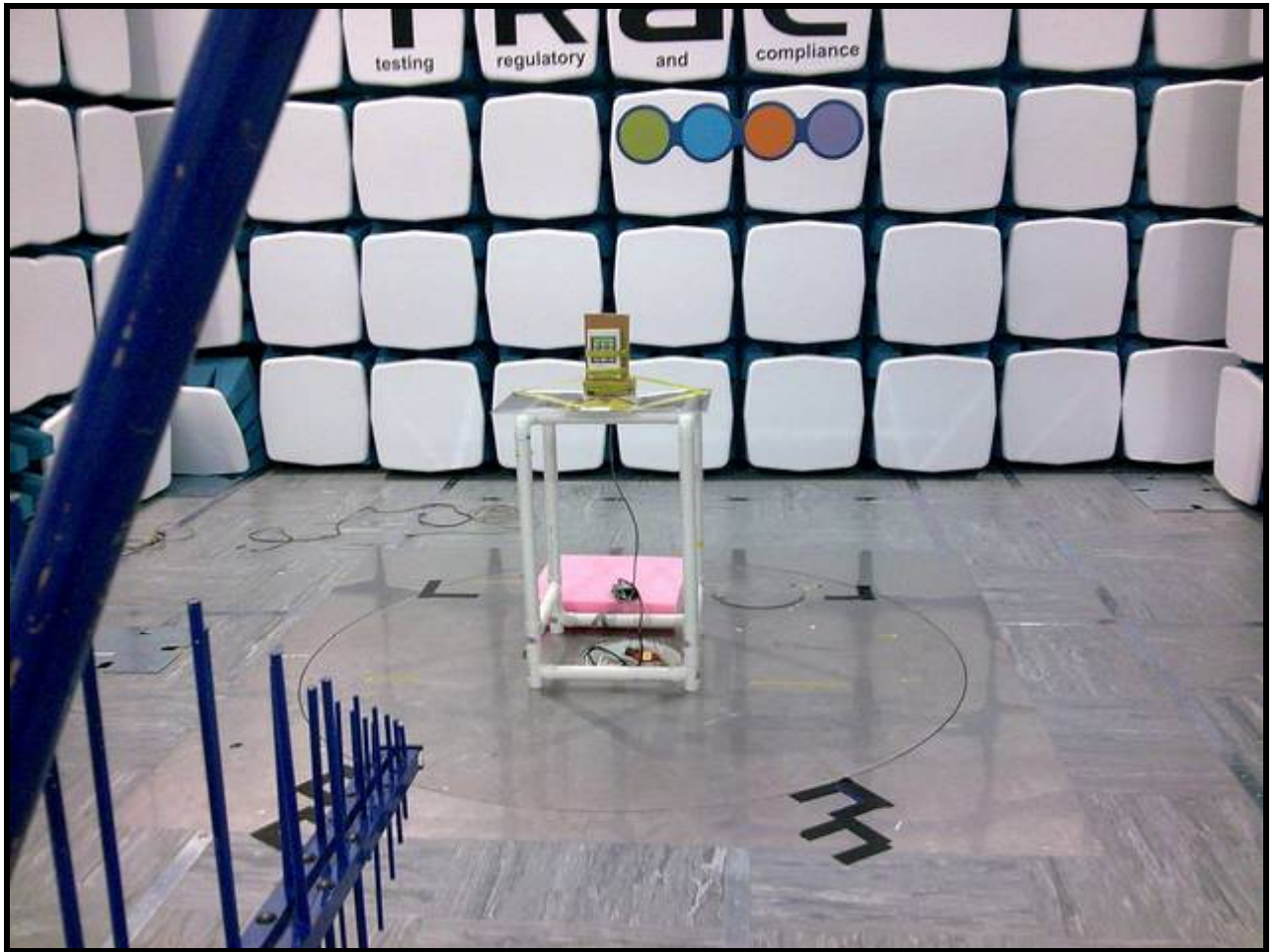
Photographs and Figures

The following photographs were taken of the test samples:

1. Test set up
2. Test set up
3. Test set up
4. Front and rear overview
5. Cover removed
6. Front and rear views of PCBs
7. Top and underside view of PCBs
8. Top and underside view of PCBs

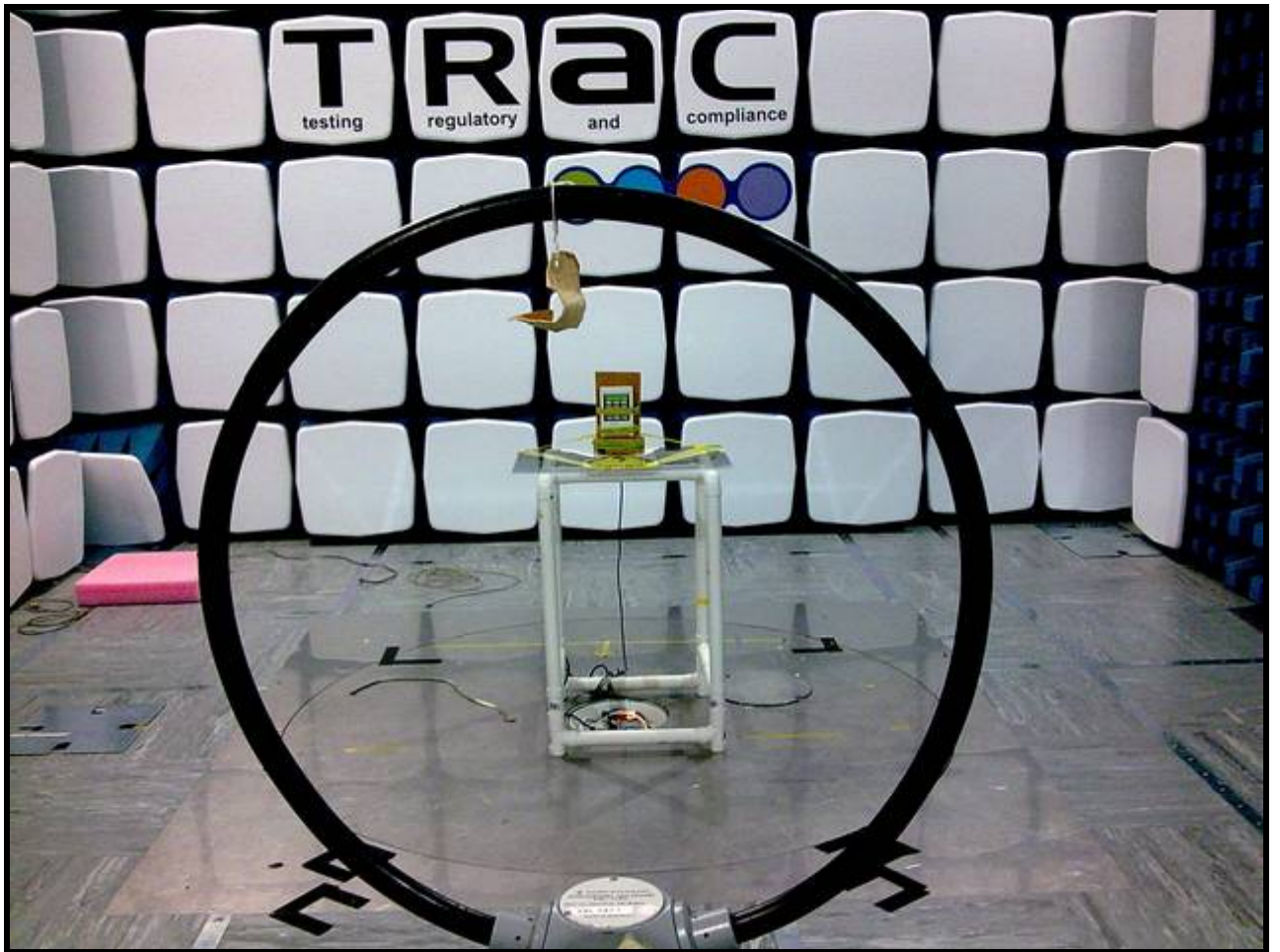
Photograph 1

Test set up



Photograph 2

Test set up



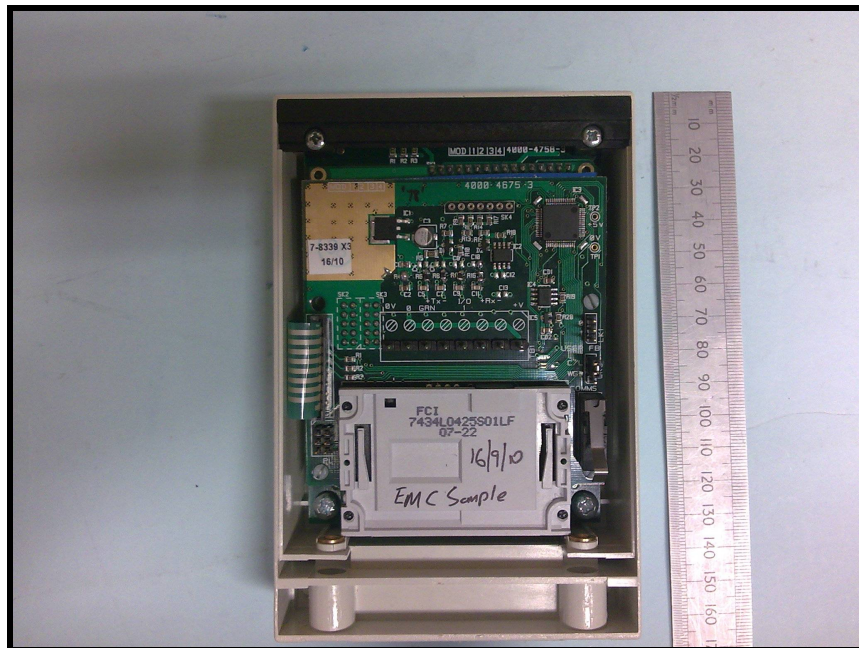
Photograph 3

Test set up



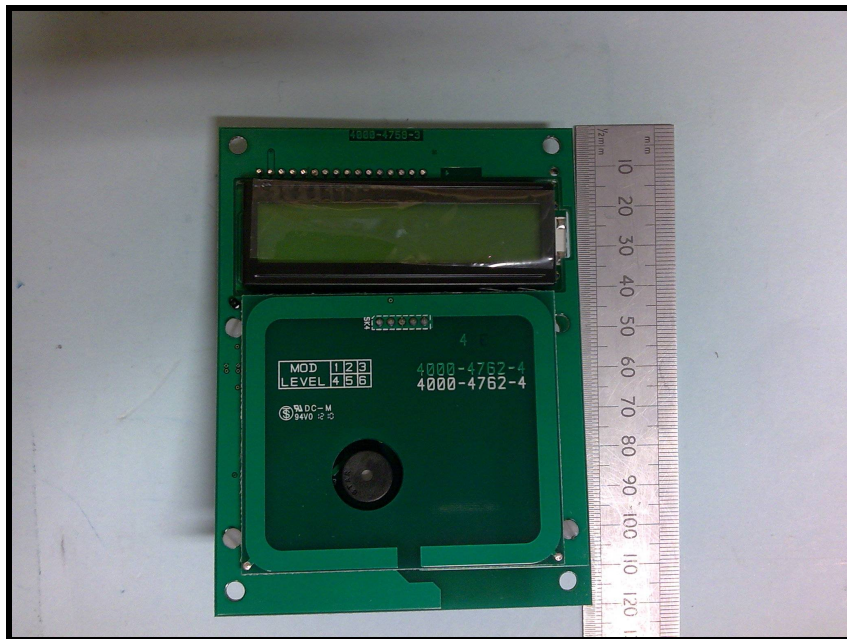
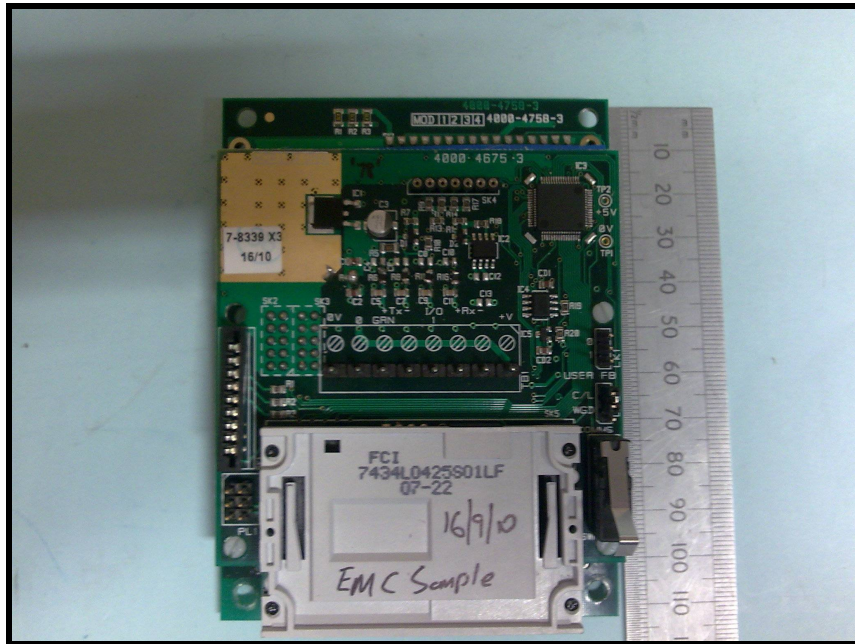
Photograph 4

Overview



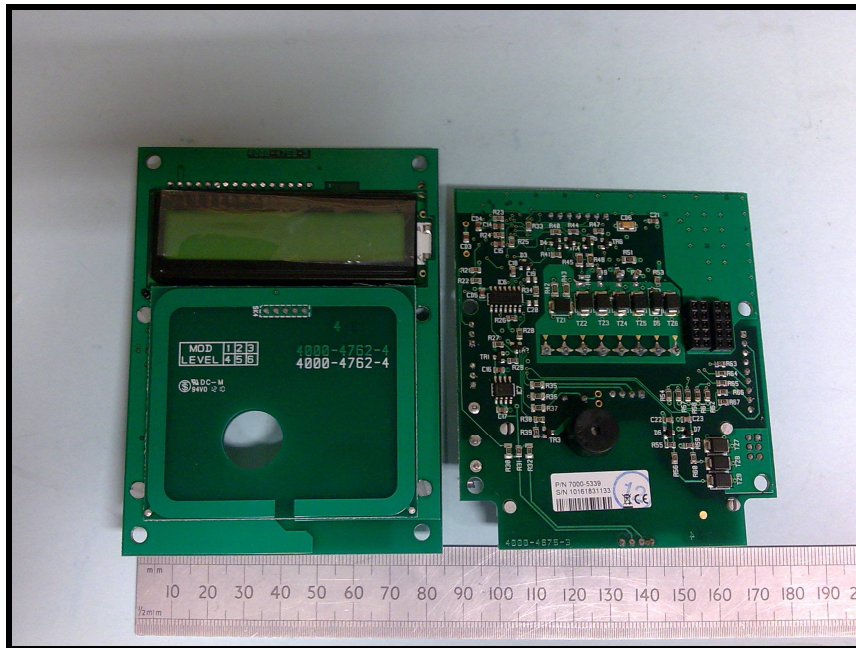
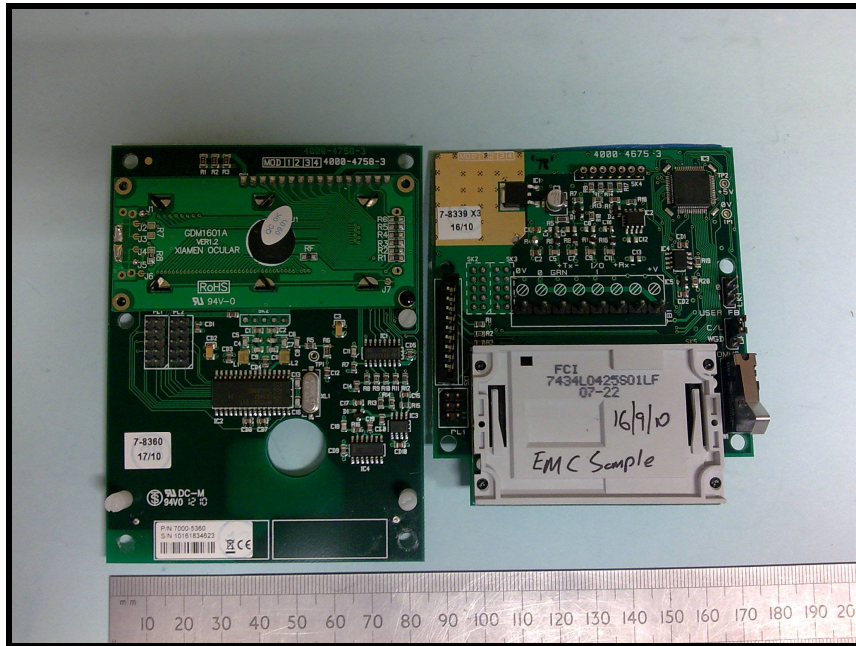
Photograph 5

cover removed



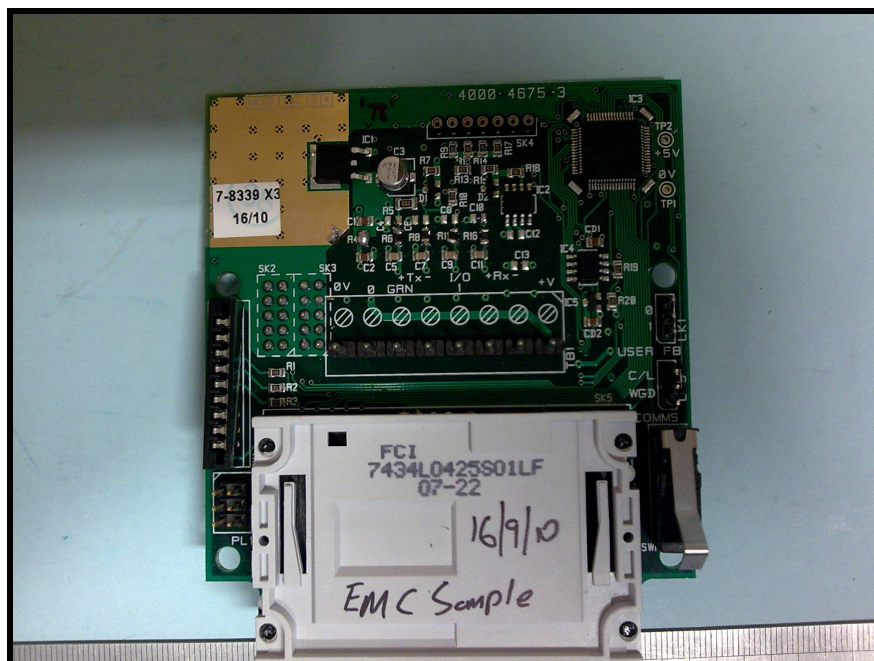
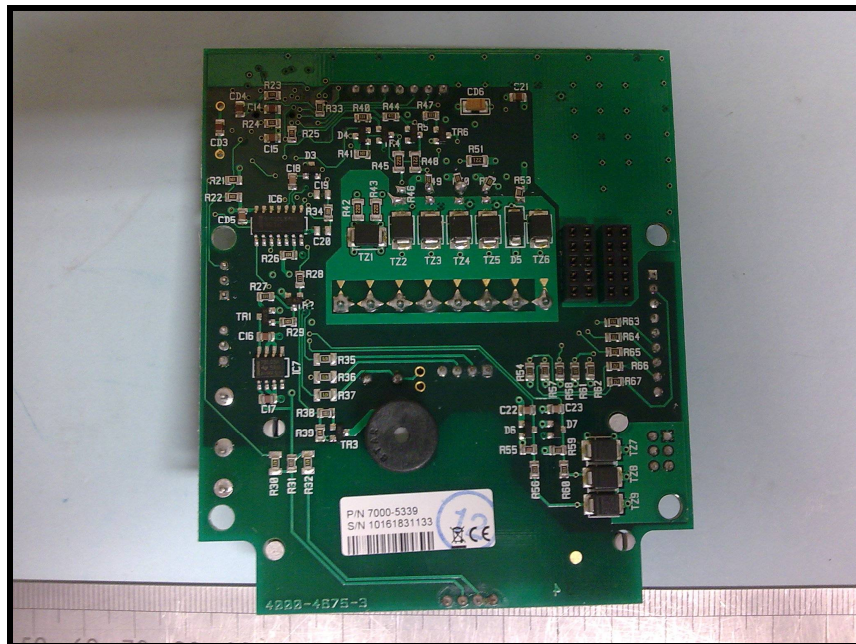
Photograph 6

front and rear views of PCBs



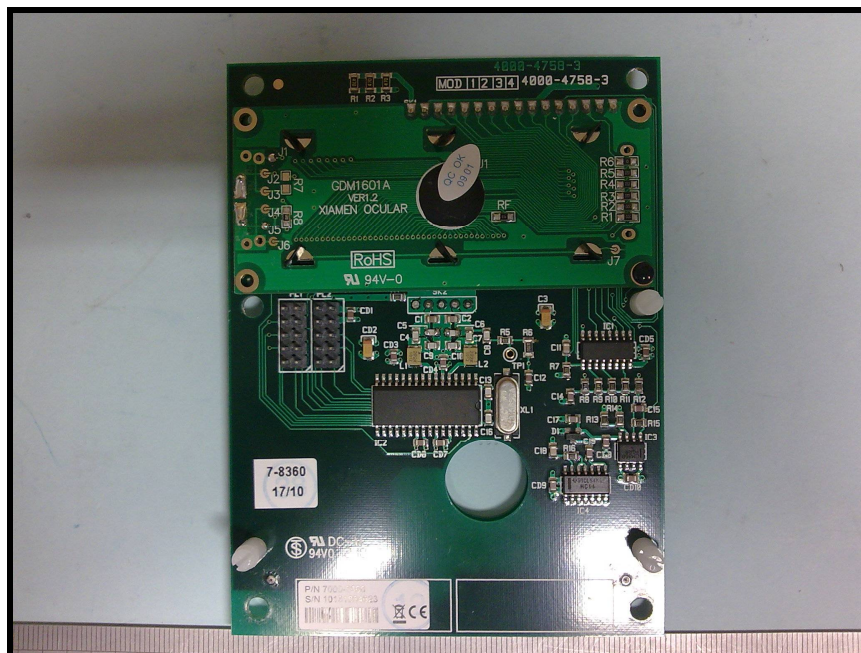
Photograph 7

top and underside view of PCB



Photograph 8

Top and underside view of PCBs





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