A RADIO TEST REPORT

FOR

HAMILTON & PALMER INSTALLATIONS Ltd

ON

3D TAG READER
DRIVER ID CHALLENGE AND RESPONSE SYSTEM

DOCUMENT NO. TRA-009740-W-NA-1

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UKAS TESTING
0026

TRaC Wireless Test Report : TRA-009740-W-NA-1

Applicant : Hamilton & Palmer Installations Ltd

Apparatus : 3D Tag Reader

Specification(s) : CFR47 Part 15 & RSS-Gen

Purpose of Test : **Certification**

FCCID : RW4-ADR2DID2

Certification Number : 10877A-ADR2DID2

Authorised by :

: Radio Product Manager

Issue Date :11th December 2013

Authorised Copy Number : *PDF*

Total number of pages: 33

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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 :

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1.3 Manufacturer

As Above

1.4 Apparatus Assessed

The following apparatus was assessed between 13th – 18th December 2012

3D Tag Reader
Driver ID Challenge and Response System

The 3D tag Reader is an inductive reader that operates at 125 kHz

A microprocessor driver validation system deigned to acknowledge that the driver is authorised to drive the vehicle.

This product has been designed to check that the driver of the vehicle (having the ignition keys) is the correct and authorised driver. This can include cars, lorries, vans, horse boxes, plant and machinery etc. Once the driver has been validated the attached equipment i.e. tracking system, will be disarmed. Should the driver not be validated the tracking system for example will not be disarmed or will send an alert to a secure operating centre. The attached equipment could be any security device, locking system or signalling system that requires a security tag to disarm it.

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
	RSS-Gen Issue 8 December 2010	Title 47 of the CFR: Part 15 Subpart (c)		
Spurious Emissions Radiated <1000MHz	RSS-Gen 7.2.5	15.209	ANSI C63.10:2009	Pass
Spurious Emissions Radiated >1000MHz	N/A	N/A	ANSI C63.10:2009	N/A
AC Power conducted emissions	N/A	N/A	ANSI C63.10:2009	N/A
Intentional Emission Frequency	RSS-Gen 7.2.5	15.209	ANSI C63.10:2009	Pass
Intentional Emission Field Strength	RSS-Gen 7.2.5	15.209	ANSI C63.10:2009	Pass
Intentional Emission Band Occupancy	RSS-Gen 4.6.1	15.215	ANSI C63.10:2009	Pass
Intentional Emission ERP (mW)	N/A	N/A	ANSI C63.10:2009	N/A
Unintentional Radiated Spurious Emissions	N/A	N/A	ANSI C63.10:2009	N/A
Antenna Arrangements Integral:	RSS-Gen 7.1.2	15.203	-	Pass
Antenna Arrangements External Connector	RSS-Gen 7.1.2	15.204	-	N/A
Restricted Bands	RSS-Gen 7.2.2	15.205	-	Pass
Maximum Frequency of Search	RSS-Gen 4.3	15.33	-	Pass
Extrapolation Factor	RSS-Gen 7.2.7	15.31(f)	-	Pass

Abbreviations used in the above table:

ANSI C 63.10:2009 is outside the scope of the laboratories UKAS accreditation.

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

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
Mod	: Modification
EUT	: Equipment Under Test
SE	: Support Equipment
L	: Live Power Line
N	: Neutral Power Line
E	: Earth Power Line
Pk	: Peak Detector
QP	: Quasi-Peak Detector
Av	: Average Detector
CDN	: Coupling & decoupling network

ALSR	: Absorber Lined Screened Room
OATS	: Open Area Test Site
ATS	: Alternative Test Site
Ref	: Reference
Freq	: Frequency
MD	: Measurement Distance
SD	: Spec Distance
Pol	: Polarisation
H	: Horizontal Polarisation
V	: Vertical Polarisation

A1 Transmitter Intentional Emission Radiated

Carrier power was verified with the EUT transmitting Test Details:	
Regulation	CFR: Part 15.209, RSS-Gen Section 7.2.5
Measurement standard	ANSI C63.10:2009
EUT sample number	S03, S06
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	21°C
Photographs (Appendix F)	1 & 2

FREQ. (kHz)	MEASUREMENT DISTANCE Meters	MEASUREMENT Rx. READING (dBµV/m)	EXTRAP. FACTOR (dB)	FIELD STRENGTH (µV/m)
125.0	1	109.30	101.30	2.512
125.0	3	88.00	80.00	2.512
Limit value @ fc		19.2 uV/m @ 300m		
Band occupancy @ -20 dBc		f lower	f higher	
		71.474358 kHz	128.525641 kHz	
		57.05 kHz		
Band occupancy @ 99%		f lower	f higher	
		70.576923 kHz	154.551282 kHz	
		83.974 kHz		

Notes:
1 Results quoted are extrapolated as indicated
2 Receiver detector @ fc = Average 10 kHz bandwidth
3 When battery powered the EUT was powered with new batteries
4 3 – 300m Extrapolation 80dB as per 15.31 (f) & Section 7.2.7
5 1 – 3m Extrapolation 21.3dB as measured.
6 1 – 300m Extrapolation 101.3 dB (80dB + 21.3dB)

Test Method:
1 As per Radio – Noise Emissions, ANSI C63.10:2009
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 orthagonal planes.
Maximum results recorded

A2 Radiated Electric Field Emissions

Preliminary scans were performed using a peak detector with the RBW = 100 kHz. The radiated electric filed emission test applies to all spurious emissions and harmonics emissions. 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 : [X]

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

Test Details:	
Regulation	CFR: Part 15.209, RSS-Gen Section 7.2.5
Measurement standard	ANSI C63.10:2009
Frequency range	9kHz – 1000MHz
EUT sample number	S03, S06
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	21^{o}C
Photographs (Appendix F)	1 & 2

The worst case radiated emission measurements for spurious emissions and harmonics that are within 10 dB of the limit are listed overleaf:

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	35.65	16.8	0.6	14.9	-	32.3	-	41.21	100
2	37.75	21.2	0.8	13.7	-	35.6	-	60.26	100
3	38.25	21.6	0.7	13.4	-	35.7	-	60.95	100
4	38.30	21.4	0.7	13.4	-	35.4	-	58.88	100
5	38.50	21.6	0.7	13.3	-	35.5	-	59.57	100
6	38.75	21.6	0.7	13.1	-	35.4	-	58.88	100
7	40.15	22.2	0.7	12.4	-	35.3	-	58.21	100
8	40.40	23.5	0.7	12.3	-	36.5	-	66.83	100
9	40.65	24.1	0.7	12.2	-	37.0	-	70.79	100
10	40.90	24.4	0.8	12.1	-	37.2	-	72.44	100
11	41.15	24.7	0.7	11.9	-	37.3	-	73.28	100
12	41.40	23.8	0.7	11.8	-	36.3	-	65.31	100
13	41.65	23.4	0.7	11.7	-	35.8	-	61.66	100
14	41.90	24.0	0.8	11.6	-	36.3	-	65.31	100
15	42.25	23.4	0.7	11.4	-	35.5	-	59.57	100
16	400.20	22.8	2.2	15.9	-	40.9	-	110.92	200
17	401.10	20.5	2.2	16.0	-	38.7	-	86.10	200
18	401.85	22.0	2.2	16.0	-	40.2	-	102.33	200
19	402.00	21.8	2.2	16.0	-	40.0	-	100.00	200
20	402.40	21.6	2.2	16.0	-	39.8	-	97.72	200
21	402.55	21.4	2.2	16.0	-	39.6	-	95.50	200
22	413.70	18.8	2.1	16.6	-	37.5	-	74.99	200
23	414.15	18.6	2.2	16.6	-	37.4	-	74.13	200
24	415.10	17.7	2.2	16.6	-	36.5	-	66.83	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:

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 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:

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

(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

Appendix B: Supporting Graphical Data

This appendix contains graphical data obtained during testing.

Notes:

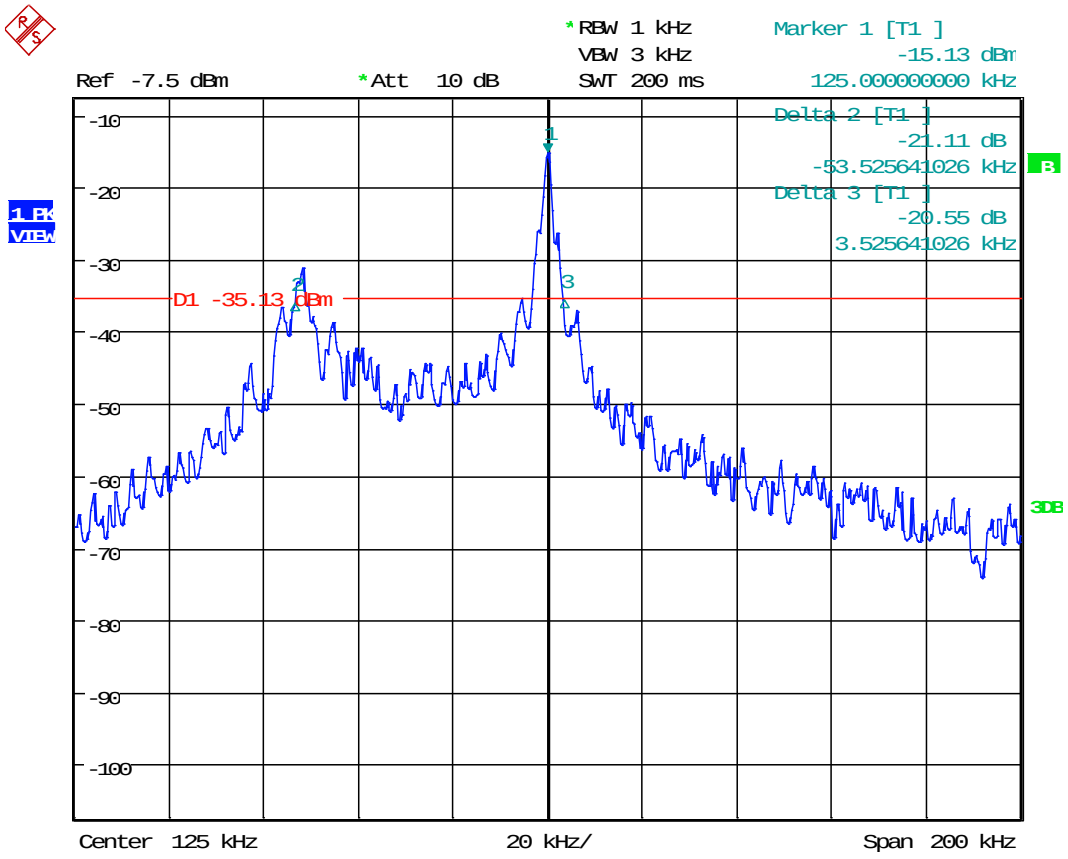
(a) The radiated electric field emissions and conducted emissions graphical data in this appendix is preview data. For details of formal results, refer to Appendix A and Appendix B.

(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.

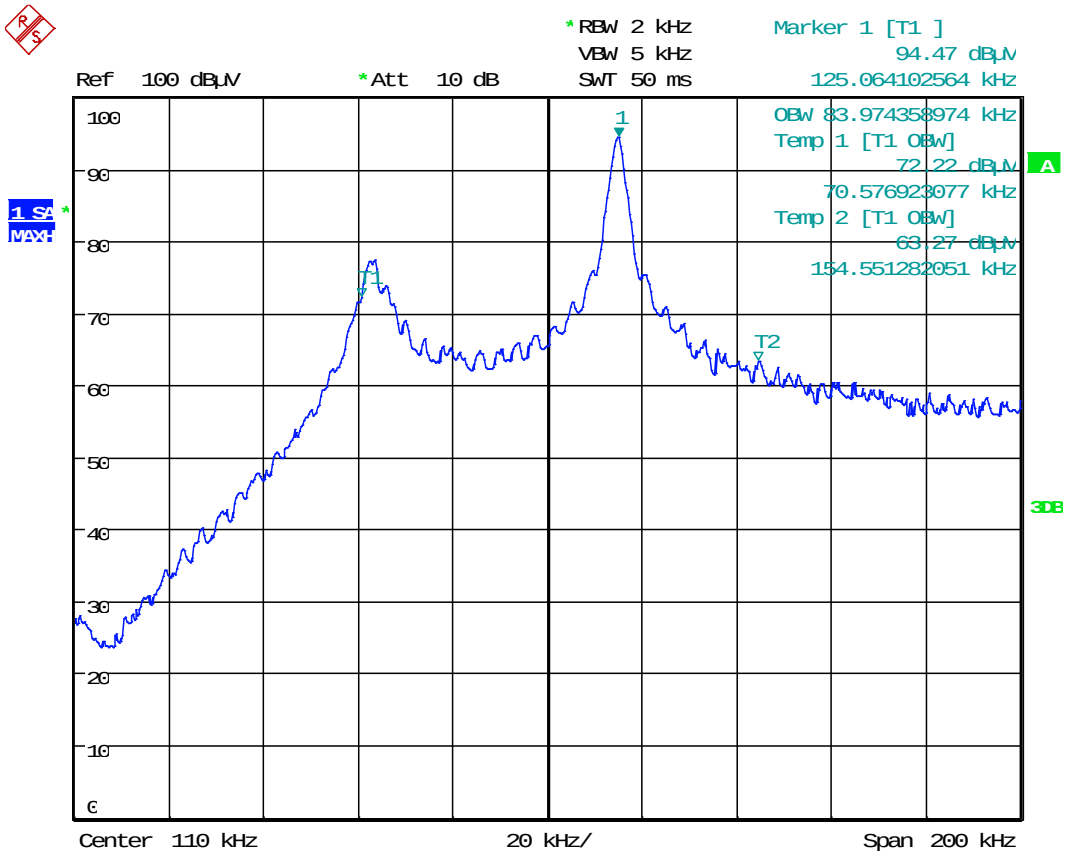
(d) Appendix C details the numbering system used to identify the sample and its modification state.

(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.

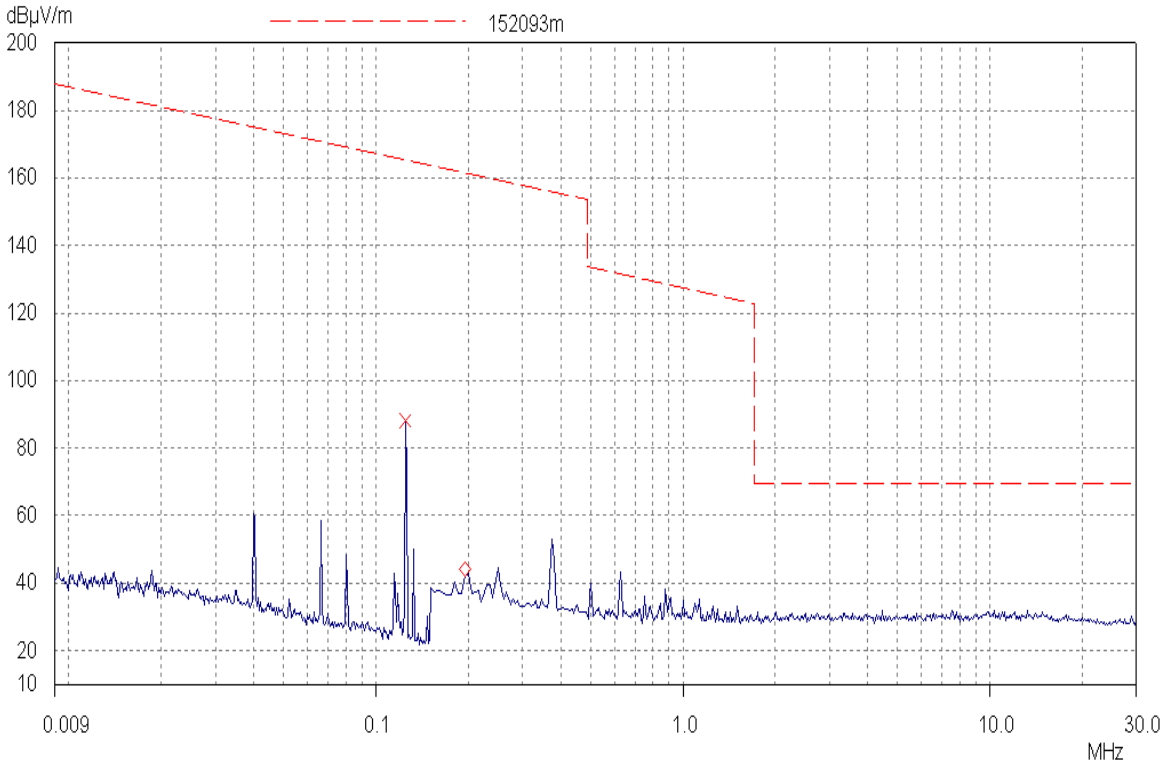


Date: 18.DEC.2012 14:32:55

20dB Bandwidth

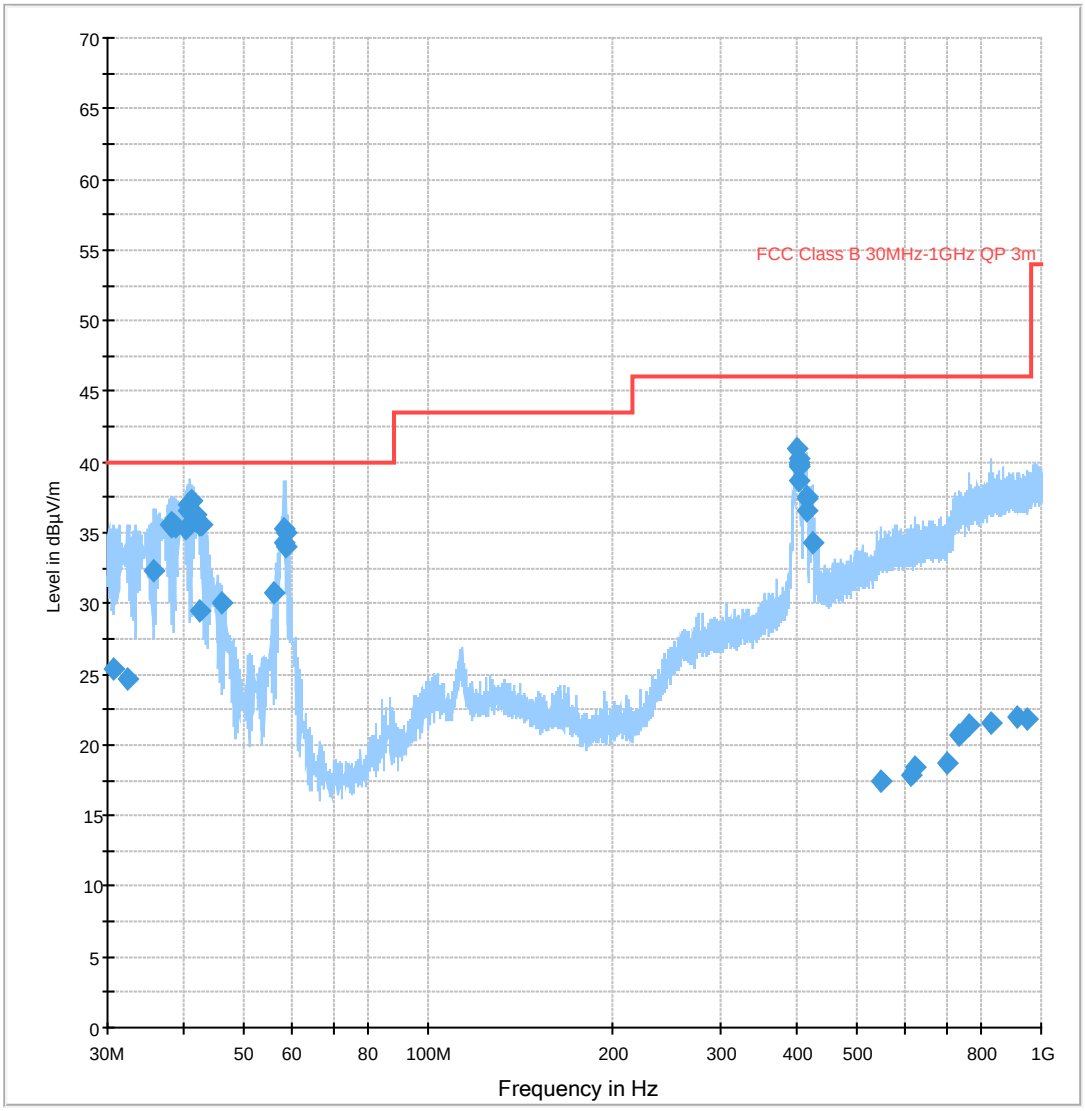


99% Bandwidth



Radiated spurious emissions 9kHz to 30MHz

FCC pt15.109 RE Class B 30MHz-1GHz ESVS10 + UH93 - 10thFeb2011



Radiated spurious emissions 30 MHz to 1 GHz

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 Global upon request.

C1) Test samples

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

Sample No.	Description	Identification
S03	DID interface	None
S06	DID unit inc loom with antenna	None

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

Sample No.	Description	Identification

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

Identification	Description

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 transmitting awaiting a ID tag.

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 : S03
Tests : Radiated Emissions

Port	Description of Cable Attached	Cable length	Equipment Connected
6 Way Molex	5 multi core individual wire loom	1m	Power Supply (Battery)
		1m	Inductive Loop

* Only connected during setup.

C5 Details of Equipment Used

For Radiated Measurements:

TRAC Ref	Type	Description	Manufacturer	Cal Date.	Period	Cal Due.
UH003	ESHS06	Receiver	R&S	16/02/2012	12	16/02/2013
UH004	ESVS06	Receiver	R&S	12/01/2012	12	12/01/2013
UH093	CBL6112B	Bilog	Chase	20/06/2011	24	20/06/2013
L007	hfh2	Loop Antenna	R&S	04/11/2011	24	04/11/2013
UH281	FSU46	Spectrum Analyser	R&S	09/02/2012	12	09/02/2013

Appendix D: Additional Information

No additional information is included within this test report.

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 x (Log_{10} 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.

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

e.g

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

0.07459 or 7.459%

Correction factor (dB) = 20 x (Log_{10} 0.07459) = -22.54dB

Duty cycle correction may not be applicable / required by the device covered in this report.
The correction factor above is for example of how the correction is calculated.
Any applicable duty cycle used will be recorded in the relevant results sections of this report.

Appendix F: Photographs and Figures

The following photographs were taken of the test samples:

1. Radiated magnetic field emissions arrangement: Overview.
2. Radiated electric field emissions arrangement: Overview.
3. Radiated emissions: Close up

Photograph 1

Photograph 2

Photograph 3

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