

A RADIO TEST REPORT

FOR

PRINCIP a.s

ON

Puzzle Cube, MODEL: PSC01

DOCUMENT NO. TRA-011395-W-US-1

HULL

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TRaC Wireless Test Report : TRA-011395-W-US-1

Applicant : PRINCIP a.s.

Apparatus : Electronic puzzle cube
: MODEL: PSC01

Specification(s) : CFR47 Part 15 (c)

Purpose of Test : **Certification**

FCCID :QH2PSC01

Authorised by :



: Radio Product Manager

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

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

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1.2 Tests Requested By

This testing in this report was requested by :

PRINCIP a.s.
Radlická 204/503,
Praha 5,
Jinoce, 158 00,
Prague,
Czech Republic

1.3 Manufacturer

PRINCIP a.s.
Radlická 204/503,
Praha 5,
Jinoce, 158 00,
Prague,
Czech Republic

1.4 Apparatus Assessed

The following apparatus was assessed between 27/09/2012 and 15/11/2012:

Electronic puzzle cube model PSC01

The apparatus is an electronic puzzle containing a 2.4 GHz transceiver to allow for dual player modes.

Testing was performed with the unit operating at the following frequencies

- 2402 MHz (Ch1)
- 2420 MHz (Ch3)
- 2470 MHz (Ch5)

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 & 15.249(a)	ANSI C63.10:2009	Pass
Spurious Emissions Radiated >1000MHz	Title 47 of the CFR: Part 15 Subpart (c) 15.209 & 15.249(a)	ANSI C63.10:2009	Pass
AC Power conducted emissions	Title 47 of the CFR: Part 15 Subpart (c) 15.207	ANSI C63.10:2009	N/A
Intentional Emission Frequency	Title 47 of the CFR: Part 15 Subpart (c) 15.249(a)	ANSI C63.10:2009	Pass
Intentional Emission Field Strength	Title 47 of the CFR: Part 15 Subpart (c) 15.249(a)	ANSI C63.10:2009	Pass
20 dB bandwidth	Title 47 of the CFR: Part 15 Subpart (c) 15.215(c)	ANSI C63.10:2009	Pass
Intentional Emission ERP (mW)	Title 47 of the CFR: Part 15 Subpart (c)	ANSI C63.10:2009	N/A
Unintentional Radiated Spurious Emissions	Title 47 of the CFR: Part 15 Subpart (b) 15.109	ANSI C63.10:2009	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	-	N/A
Restricted Bands	Title 47 of the CFR: Part 15 Subpart (c) 15.205	-	-
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)	-	-

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
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

Carrier power was verified with the EUT transmitting Test Details:	
Regulation	Title 47 of the CFR: Part15 Subpart (c) 15.249(b)(1)
Measurement standard	ANSI C63.10:2009
EUT sample number	S02
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	17°C
Photographs (Appendix F)	1&2

FREQ. (MHz)	MEASUREMENT Rx. READING (dBµV)	CABLE LOSS (dB)	ANT FACTOR (dB/m)	PRE AMP (dB)	FIELD STRENGTH (dBµV/m)	FIELD STRENGTH (mV/m)
2400.895	60.8	3.3	29.5	-	93.6	47.9
2421.933	60.4	3.4	29.6	-	93.4	46.8
2470.312	60.0	3.5	29.8	-	93.3	46.2
Limit value @ fc			50mV/m @ 3m			

- Notes:**
- 1 Results quoted are extrapolated as indicated
 - 2 Receiver detector @ fc = Peak 1MHz bandwidth
 - 3 When battery powered the EUT was powered with new batteries

- Test Method:**
- 1 As per, 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 20 dB Bandwidth

Test Details:	
Regulation	Title 47 of the CFR: Part15 Subpart (c) 15.215(c)
Measurement standard	ANSI C63.10:2009
EUT sample number	S01
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	23°C

Frequency	20 dB Bandwidth (kHz)
2402	798.349
2422	748.734
2470	910.824

Notes: 1 The EUT was powered with a freshly charged battery

Test Method: 1 As per ANSI C63.10

A3 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: CH1	
Regulation	Title 47 of the CFR, Part 15 Subpart (c) Clause 15.209
Measurement standard	ANSI C63.10:2009
Frequency range	30MHz – 10GHz
EUT sample number	S02
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

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.	4801.8	46.3	5.3	35.9	34.3	53.2	0	457	500

All other emissions were at least 20 dB below the test limit

Test Details: CH3	
Regulation	Title 47 of the CFR, Part 15 Subpart (c) Clause 15.209
Measurement standard	ANSI C63.10:2009
Frequency range	30MHz – 25GHz
EUT sample number	S01
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

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.	4844.091	44.9	5.5	36.0	34.3	52.1	0	403	500

All other emissions were at least 20 dB below the test limit

Test Details: CH5	
Regulation	Title 47 of the CFR, Part 15 Subpart (c) Clause 15.209
Measurement standard	ANSI C63.10:2009
Frequency range	30MHz – 25GHz
EUT sample number	S02
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	17°C
Photographs (Appendix F)	1&2

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.	4801.8	43.4	5.6	36.2	34.3	50.9	0	351	500

All other emissions were at least 20 dB below the test 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 Clause 15.33(a) and 15.33(a)(1).

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

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

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

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

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

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

A4 Unintentional Radiated Emissions

Preliminary scans were performed using a peak detector with the RBW = 100kHz. The radiated electric field emission test applies to all spurious emissions on directly related to the transmitter. The maximum permitted field strength is listed in Section 15.109. The EUT was set to operate in a transmit standby / receive mode.

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: RX Mode	
Regulation	Title 47 of the CFR, Part 15 Subpart (c) Clause 15.109
Measurement standard	ANSI C63.10:2009
Frequency range	30MHz – 25GHz
EUT sample number	S01
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	17°C
Photographs (Appendix F)	1&2

The worst case radiated emission measurements for spurious emissions 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)
No Emissions Within 20 dB of the limit were found									

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 Clause 15.33(a) and 15.33(a)(1).

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

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

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

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

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

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

A5 ac Power Line Conducted Emissions

Preview ac power line port 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) below.

Where applicable formal measurements of the emissions were performed with a peak, average and/or quasi peak detector. The formal measurements are detailed below:

Test Details	
Regulation	Title 47 of the CFR, Part 15 Subpart (c) Clause 15.207
Measurement standard	ANSI C63.10:2009
Frequency range	150 kHz - 30MHz
EUT sample number	S01
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Photographs	Photograph 3

Ref No.	Freq (MHz)	Conductor	Result (dBuV)	Spec Limit (dBuV)	Margin (dB)	Result Summary
All emissions were a minimum of 20 dB below the test limit						

Specification limits :

ac power port conducted emission limits (47 CFR Part15: Clause 15.207):

Frequency range MHz	Limits dB μ V	
	Quasi-peak	Average
0.15 to 0.5	66 to 56	56 to 46
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 :

- (c) When the average limit was met using the peak detector, the EUT was deemed to meet both the average detector and quasi-peak detector limits and measurement with the average detector and quasi-peak detector was not required

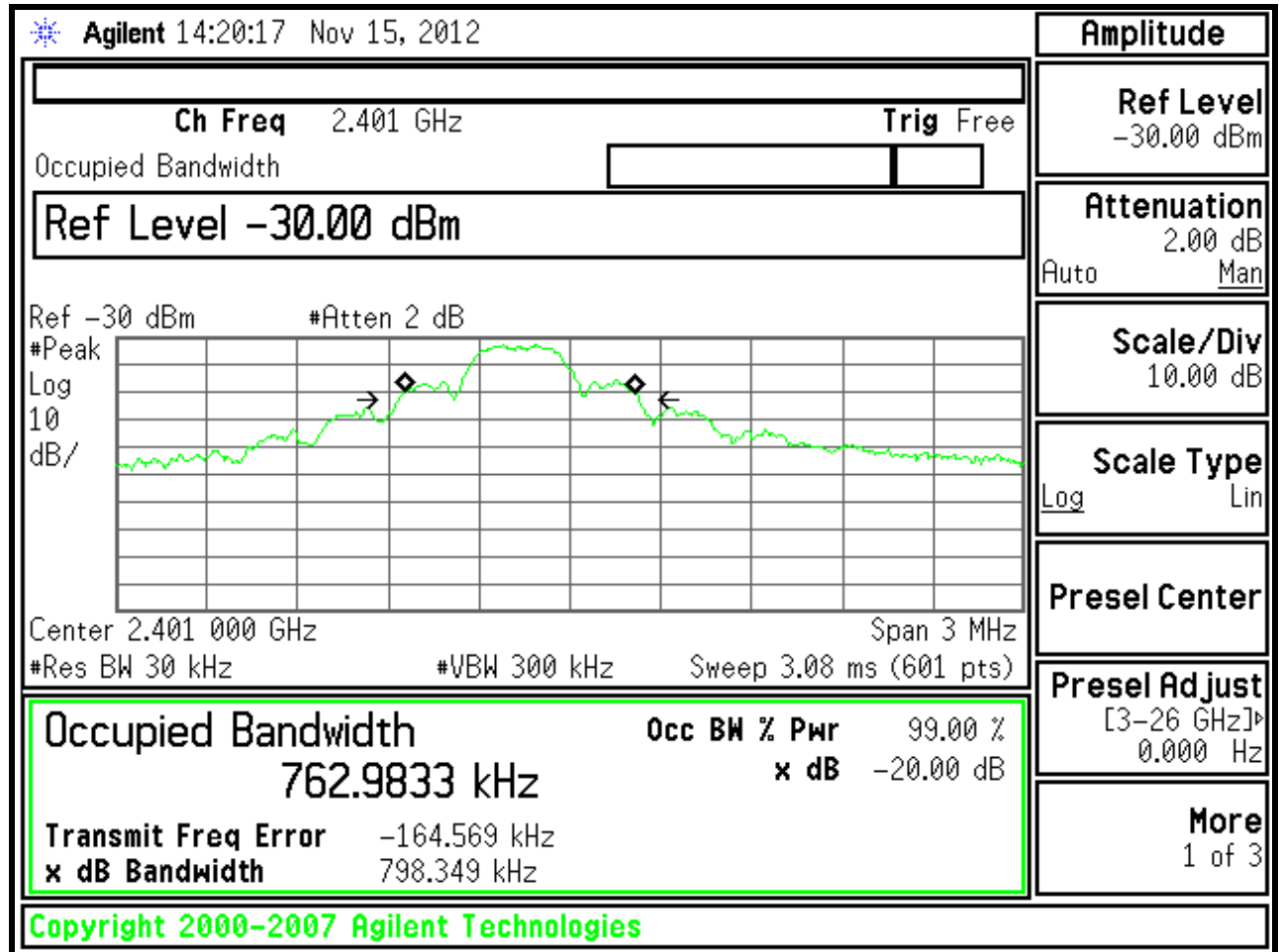
	See 1)	See 2)	See 3)	See 4)
Effect of EUT operating mode on emission levels		✓		
Effect of EUT internal configuration on emission levels		✓		
Effect of Position of EUT cables & samples on emission levels		✓		
1) Parameter defined by standard and / or single possible. 2) Parameter defined by client and / or single possible. 3) Parameter had a negligible effect on emission levels. 4) Worst case determined by initial measurement.				

Appendix B:**Supporting Graphical Data**

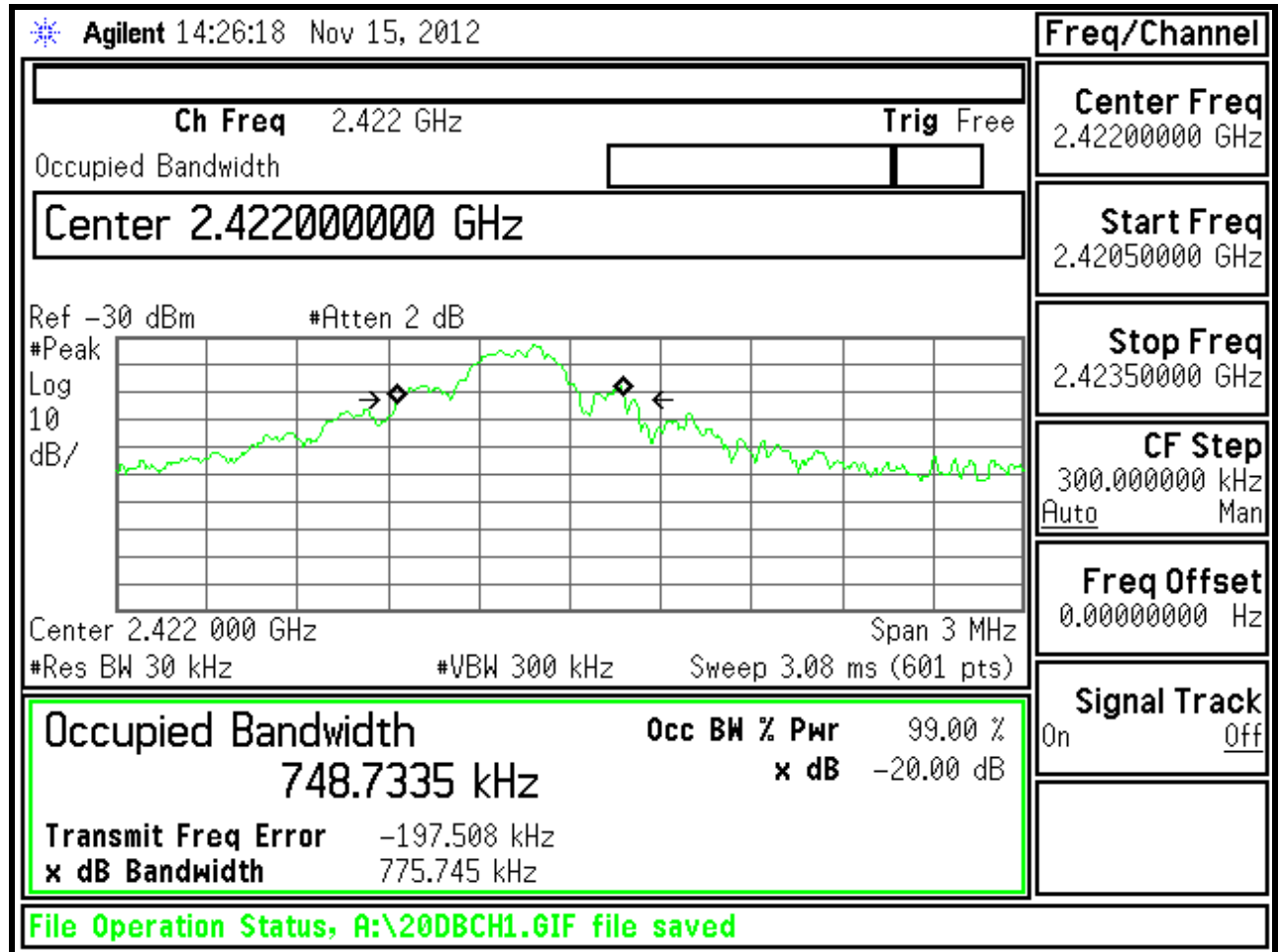
This appendix contains graphical data obtained during testing.

Notes:

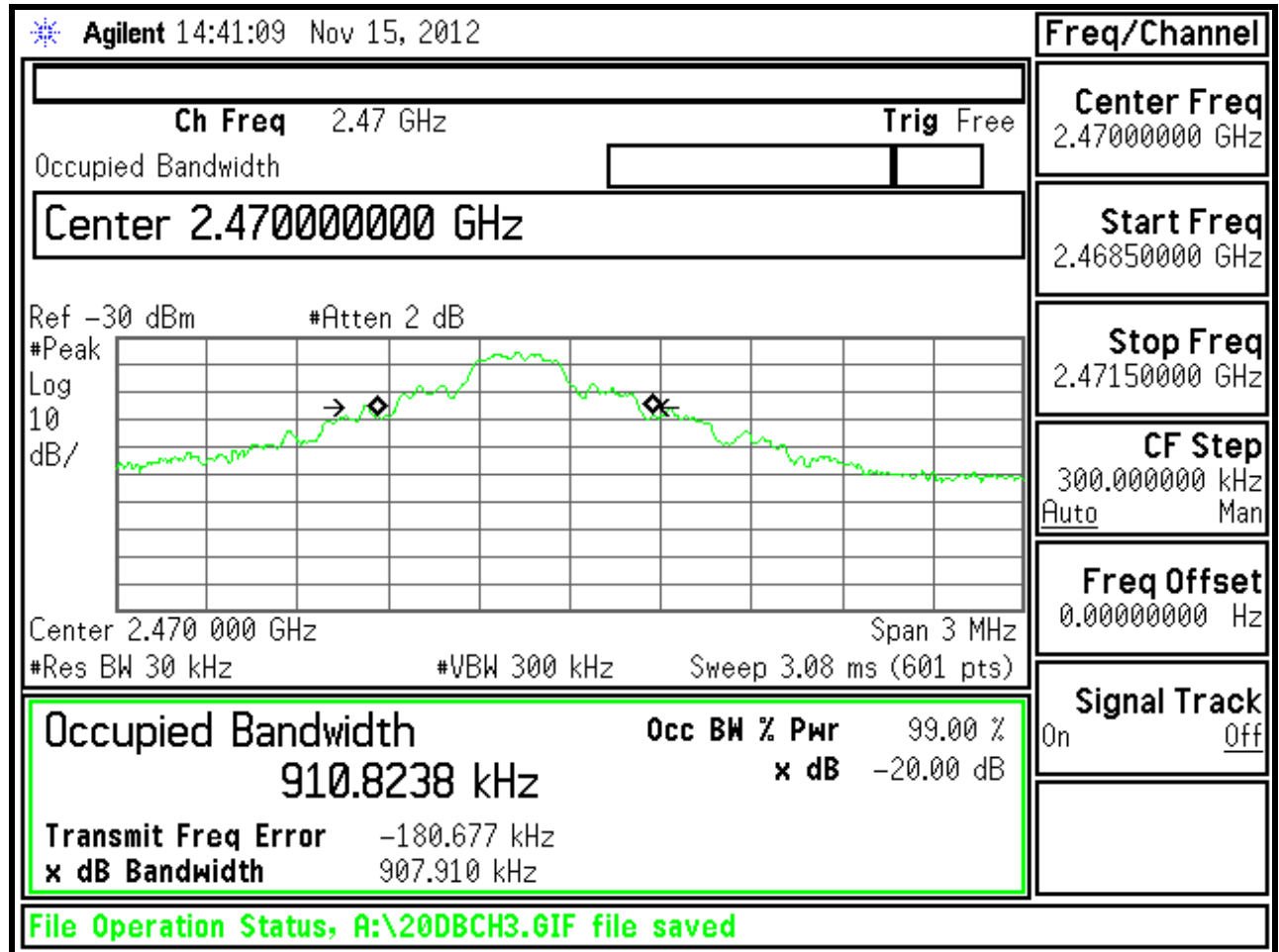
- (a) The radiated electric field emissions and conducted emissions graphical data in this appendix is preview data. For details of formal results, refer to Appendix A and Appendix B.
- (b) The time and date on the plots do not necessarily equate to the time of the test.
- (c) Where relevant, on power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



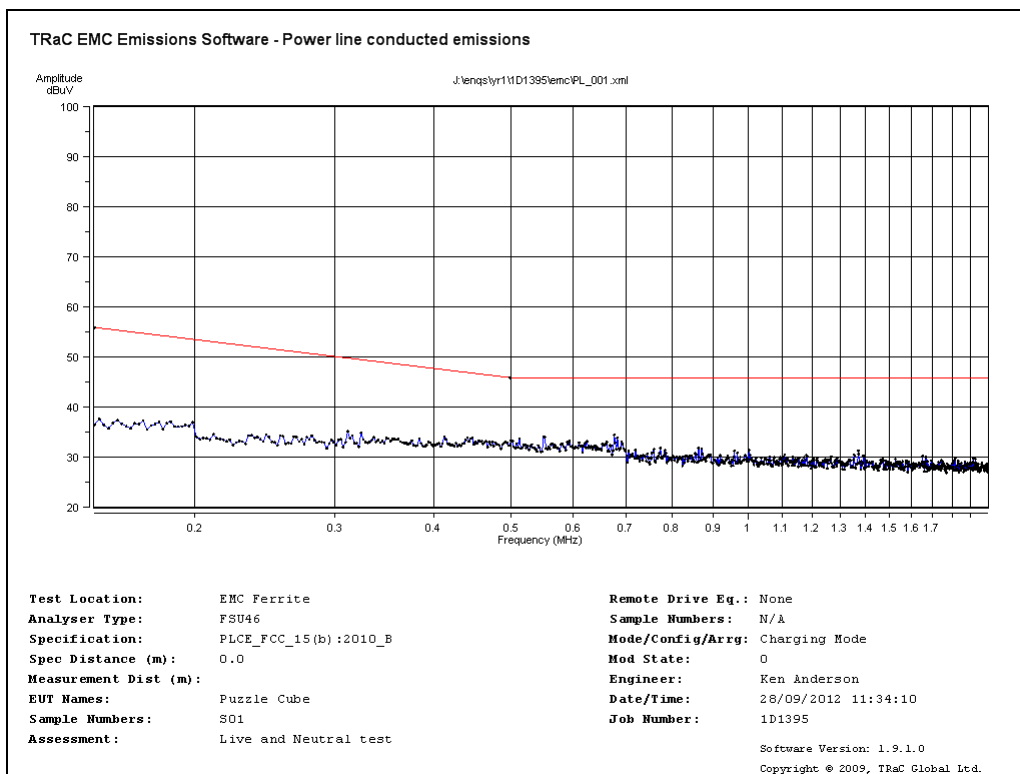
20dB Bandwidth – Ch1



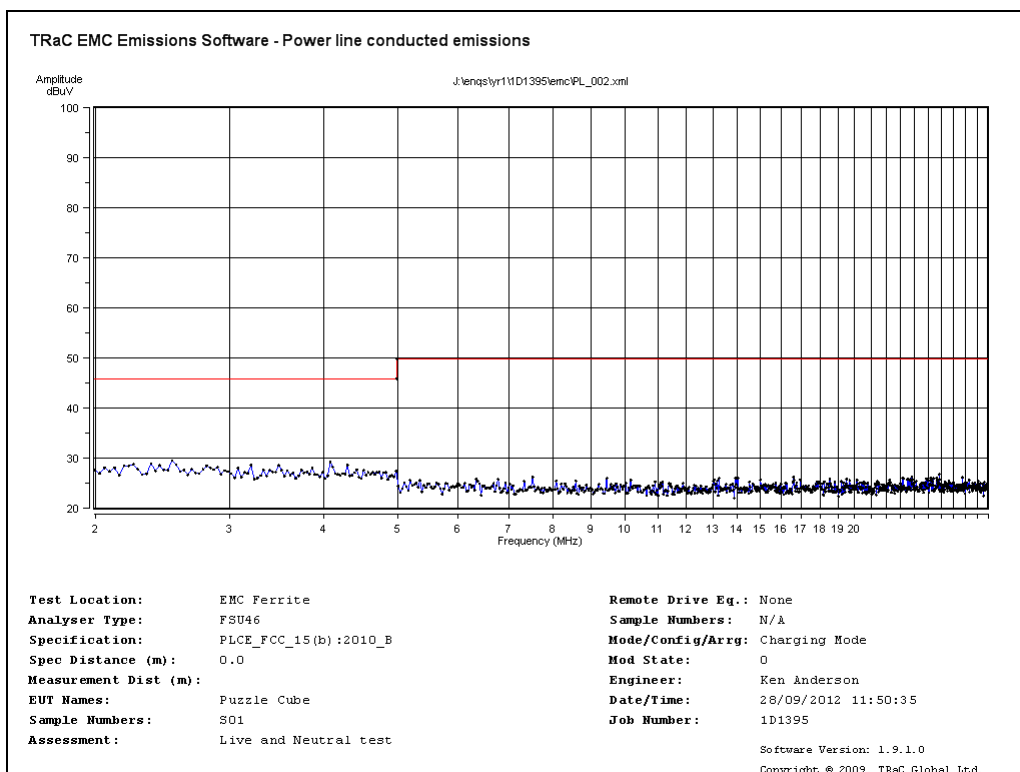
20dB Bandwidth – Ch3



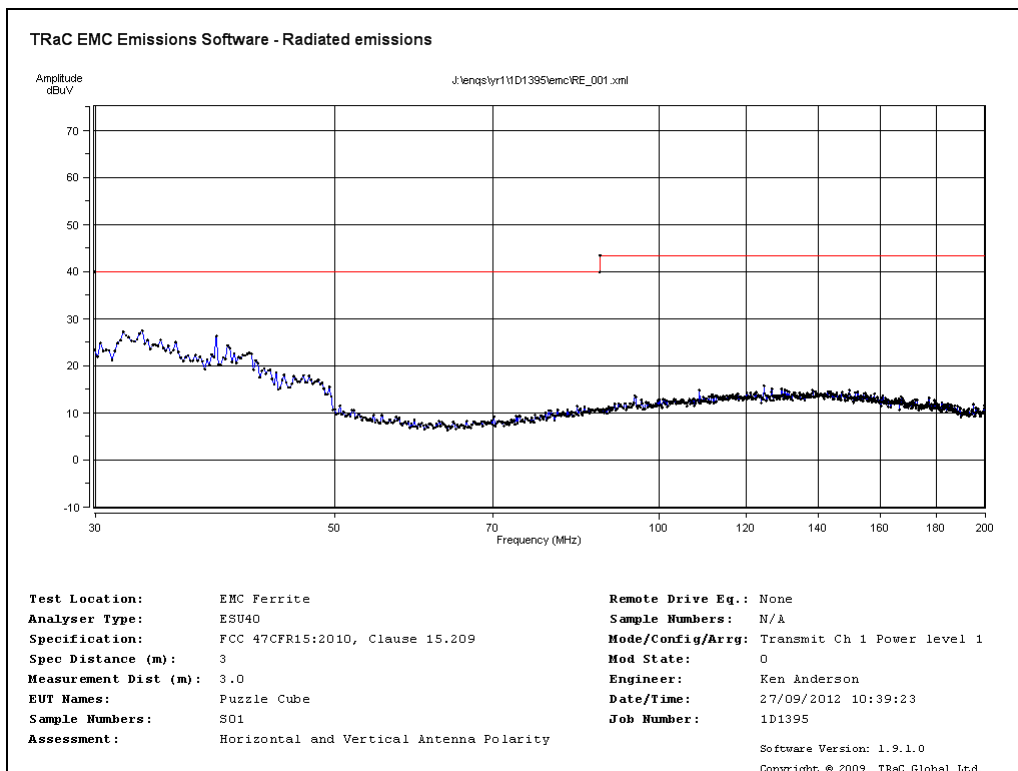
20dB Bandwidth – Ch5



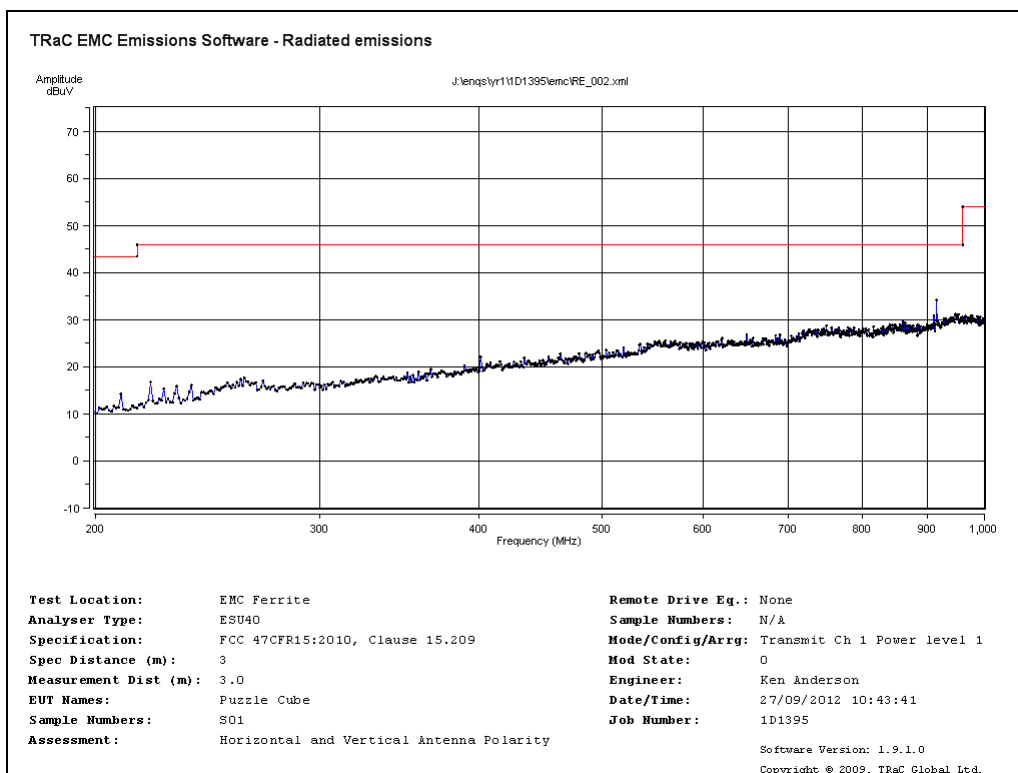
Power Line Conducted Emissions 0.15 MHz to 2 MHz



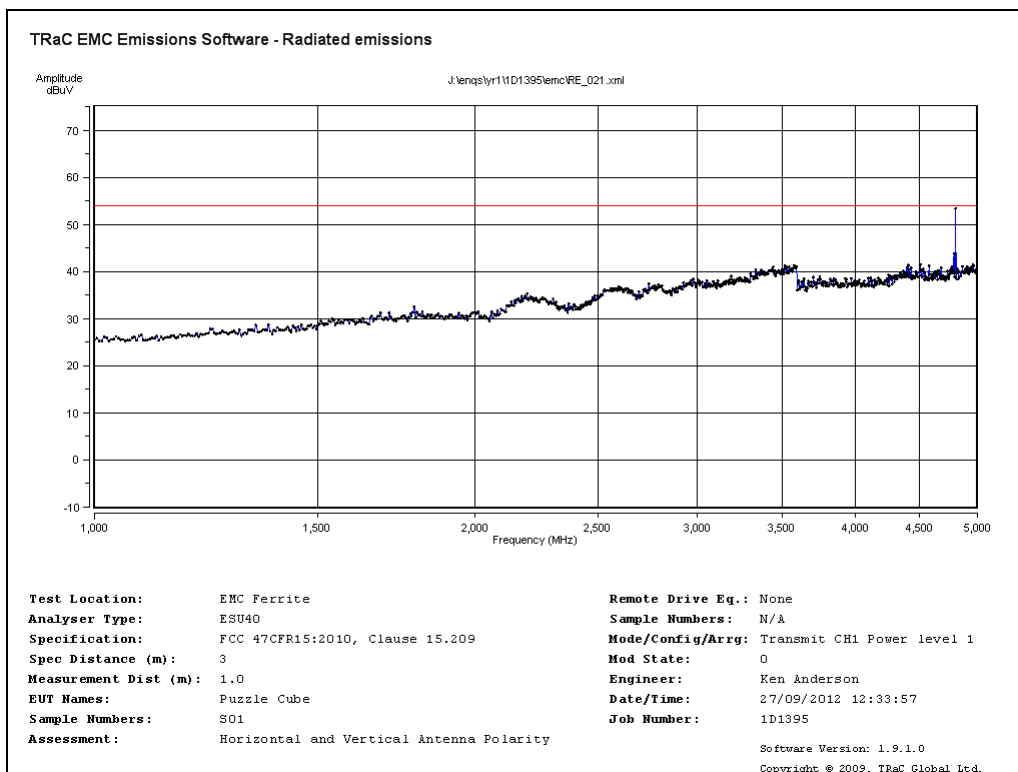
Power Line Conducted Emissions 2 MHz to 30 MHz



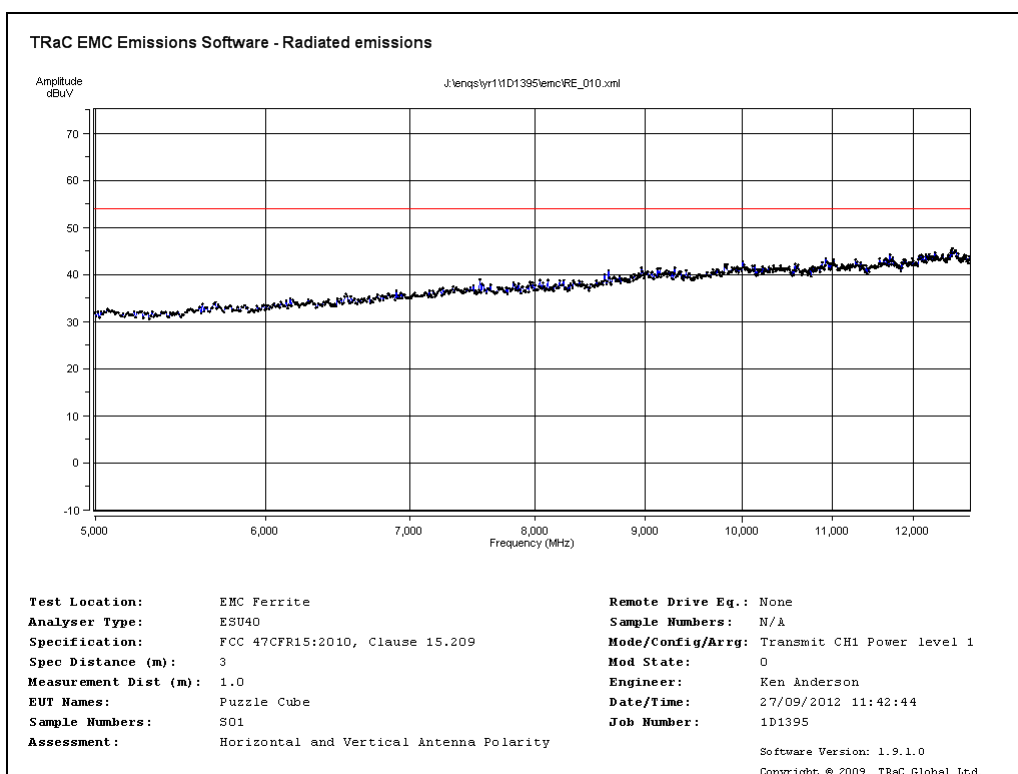
Radiated spurious emissions 30 MHz to 200 MHz – CH1



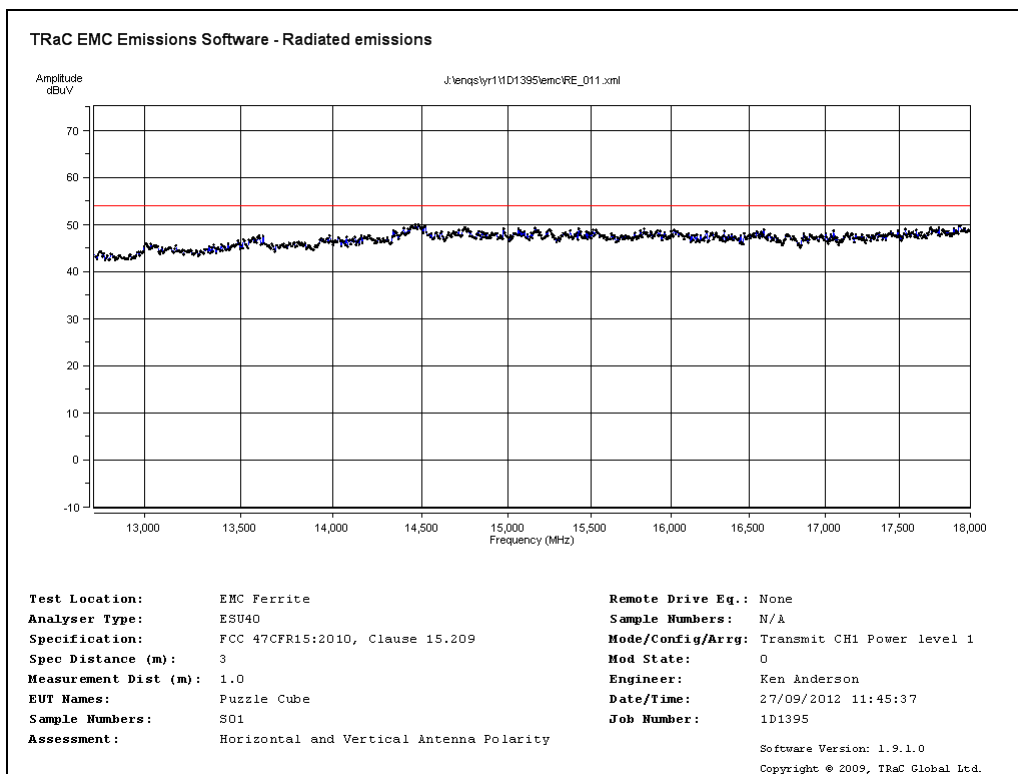
Radiated spurious emissions 200 MHz to 1 GHz – CH1



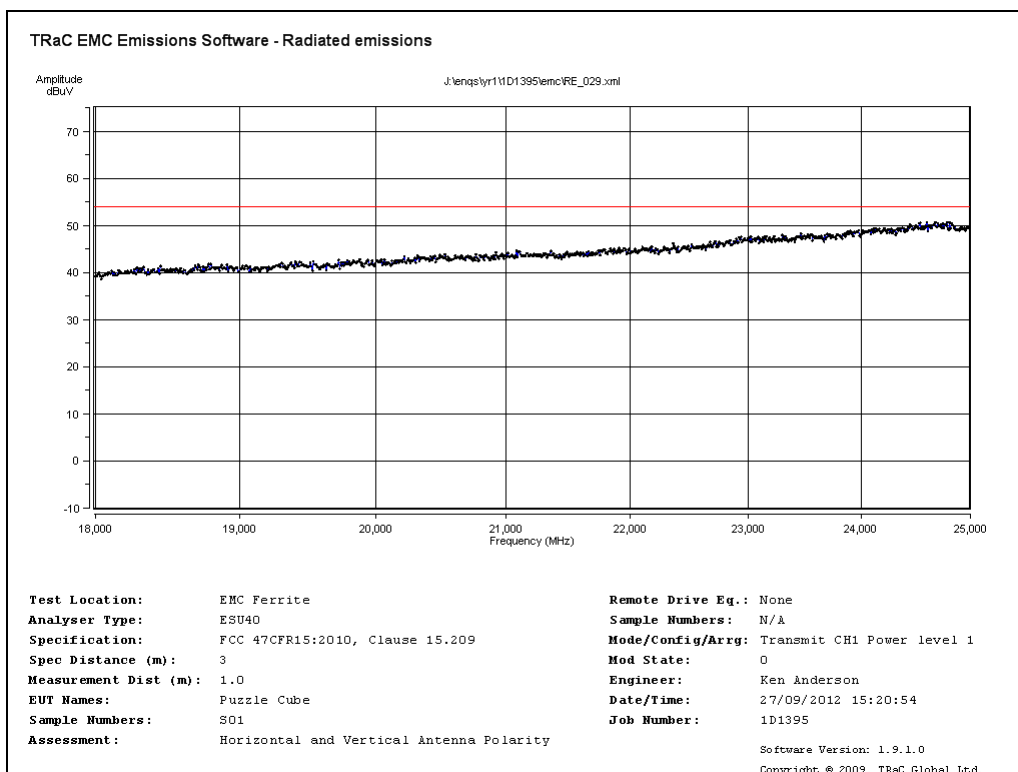
Radiated spurious emissions 1 GHz to 5 GHz – CH1



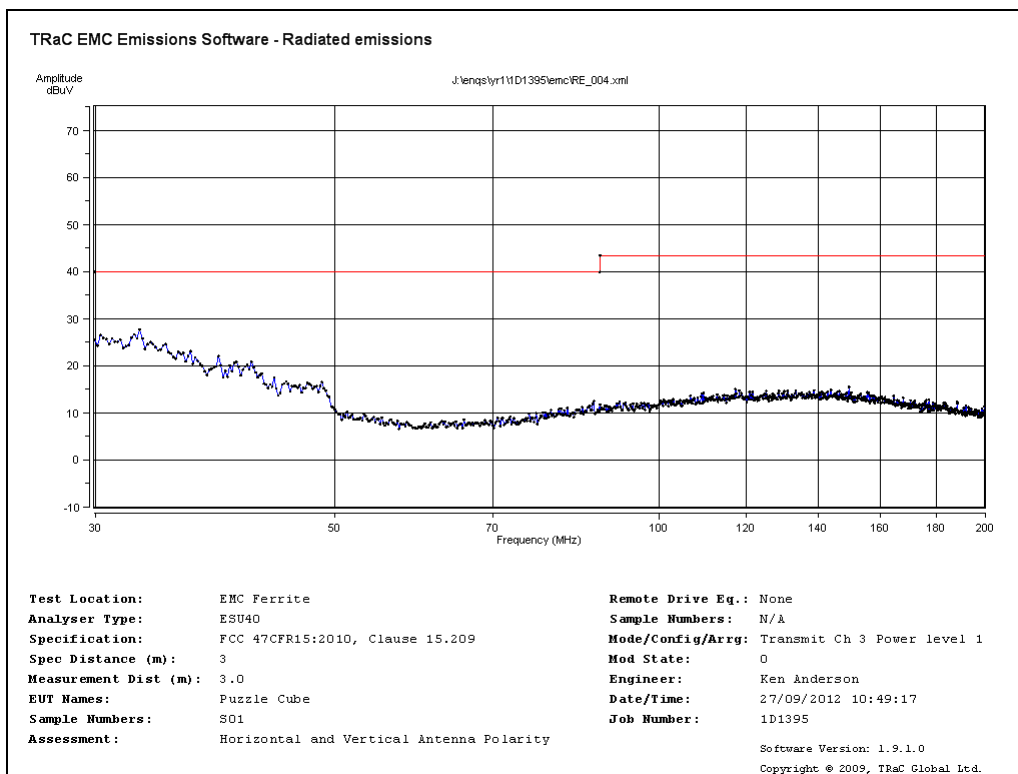
Radiated spurious emissions 5 GHz to 12.75 GHz – CH1



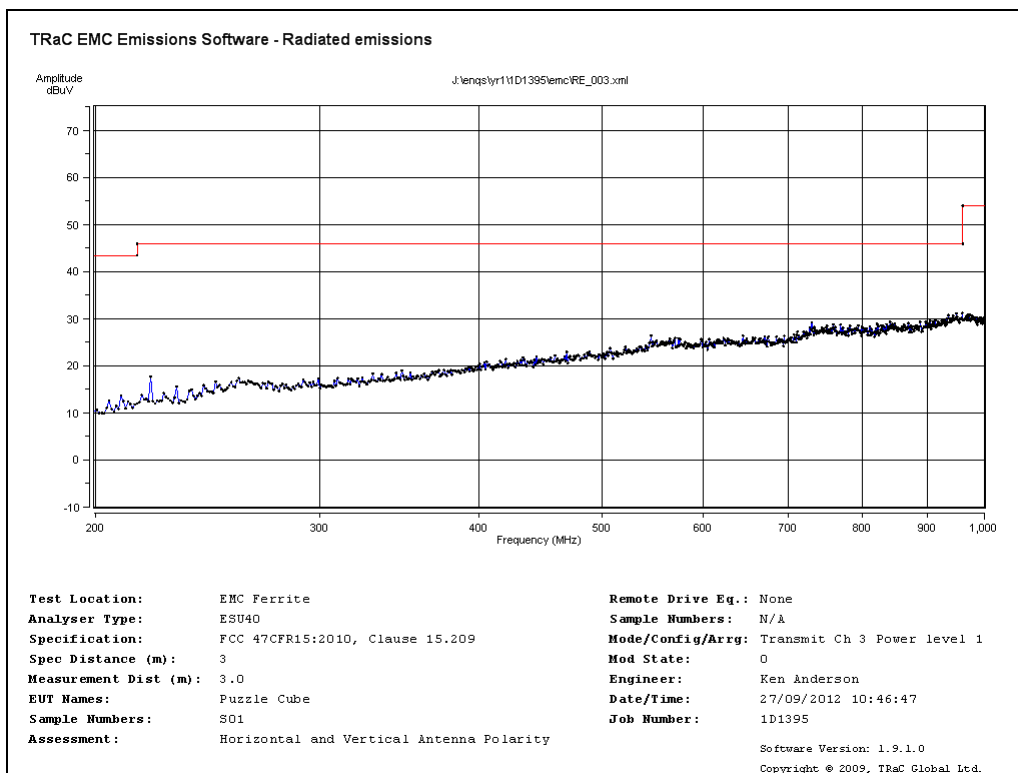
Radiated spurious emissions 12.75 GHz to 18 GHz – CH1



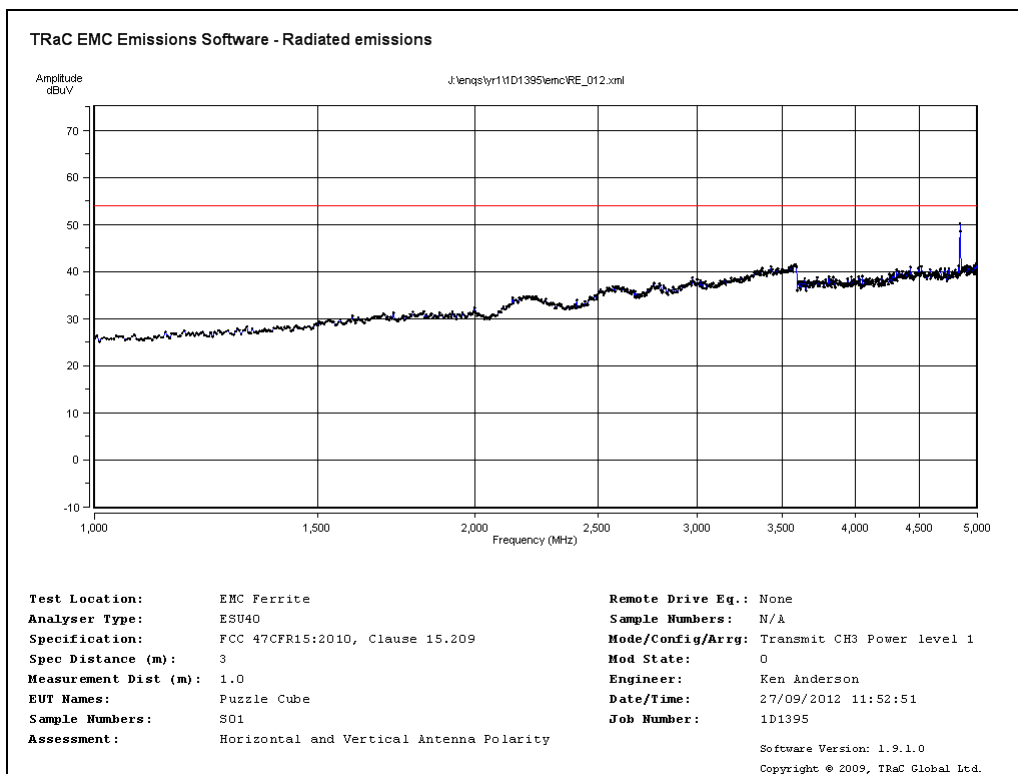
Radiated spurious emissions 18 GHz to 25 GHz – CH1



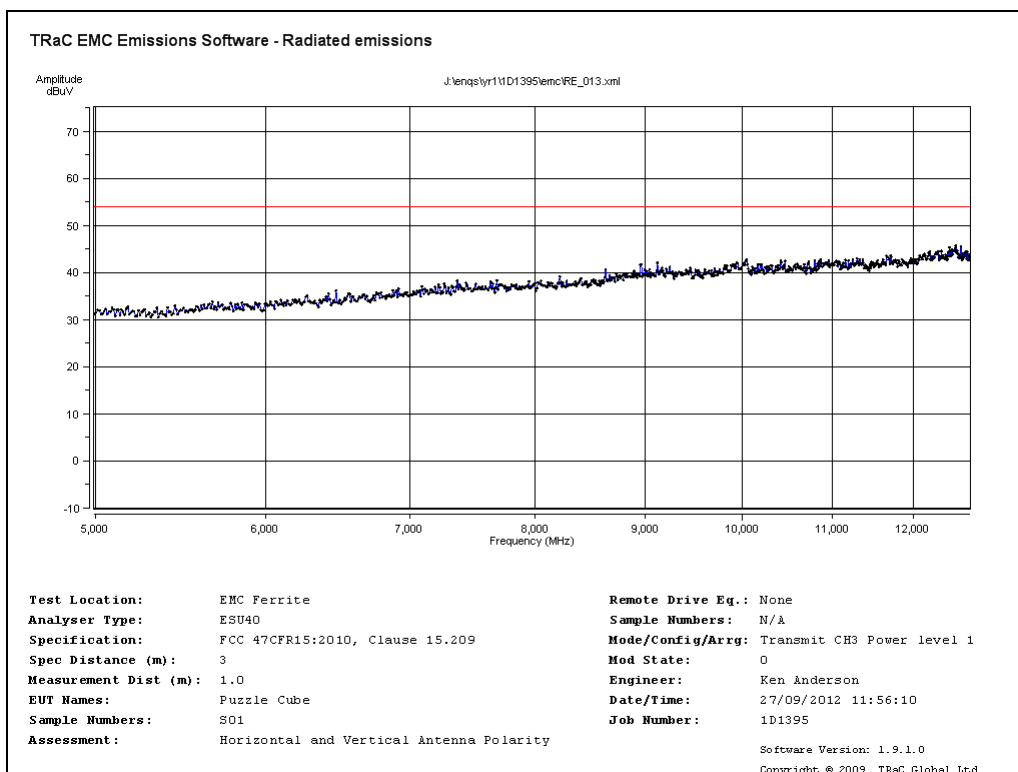
Radiated spurious emissions 30 MHz to 200 MHz – CH3



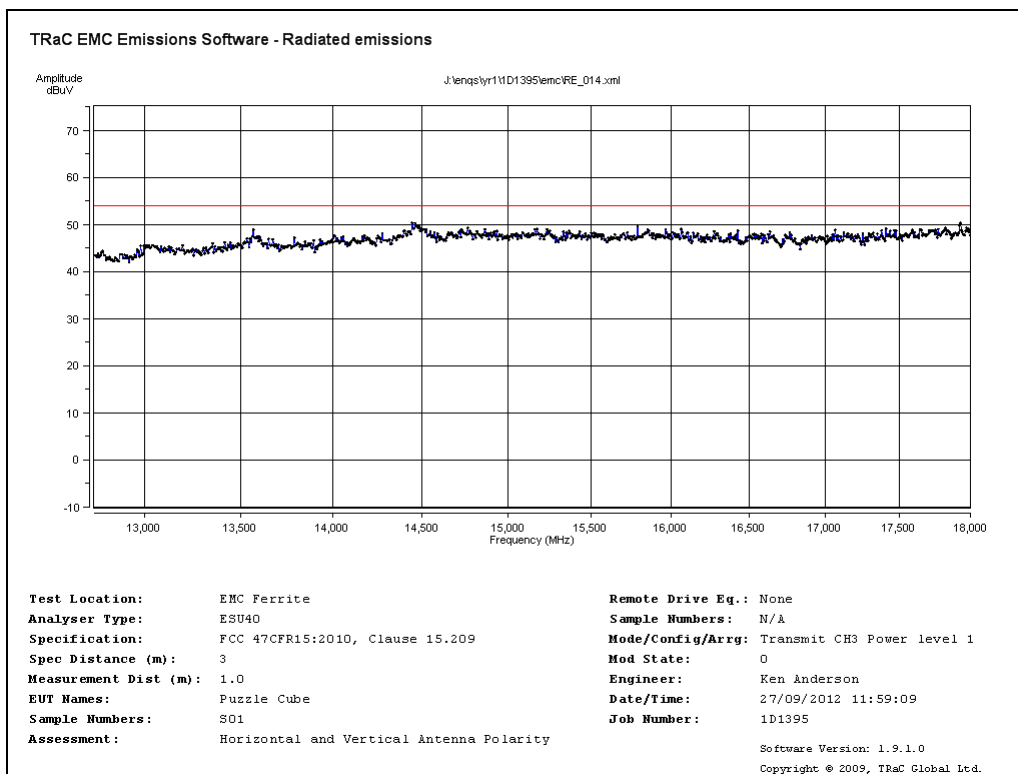
Radiated spurious emissions 200 MHz to 1 GHz – CH3



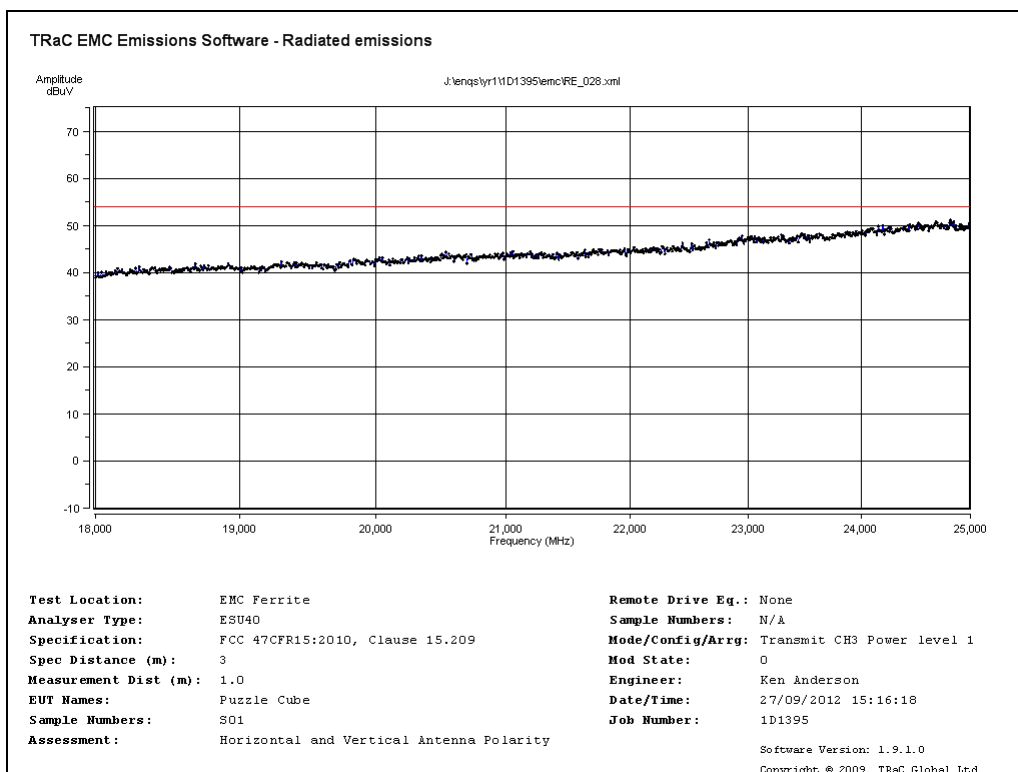
Radiated spurious emissions 1 GHz to 5 GHz – CH3



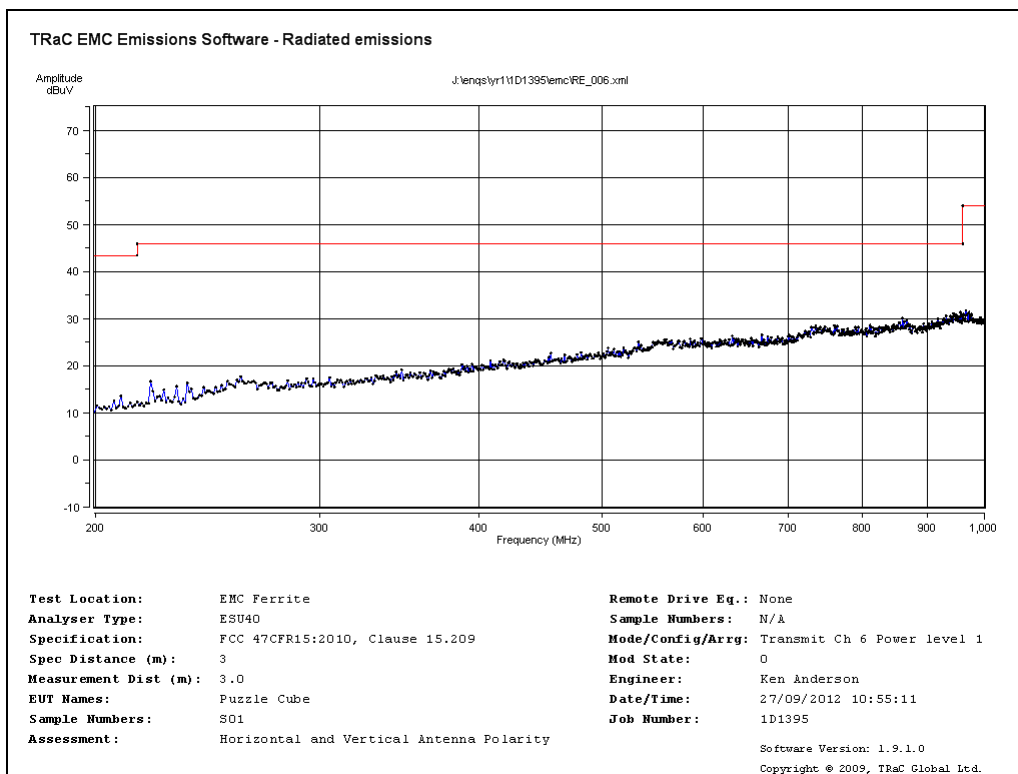
Radiated spurious emissions 5 GHz to 12.75 GHz – CH3



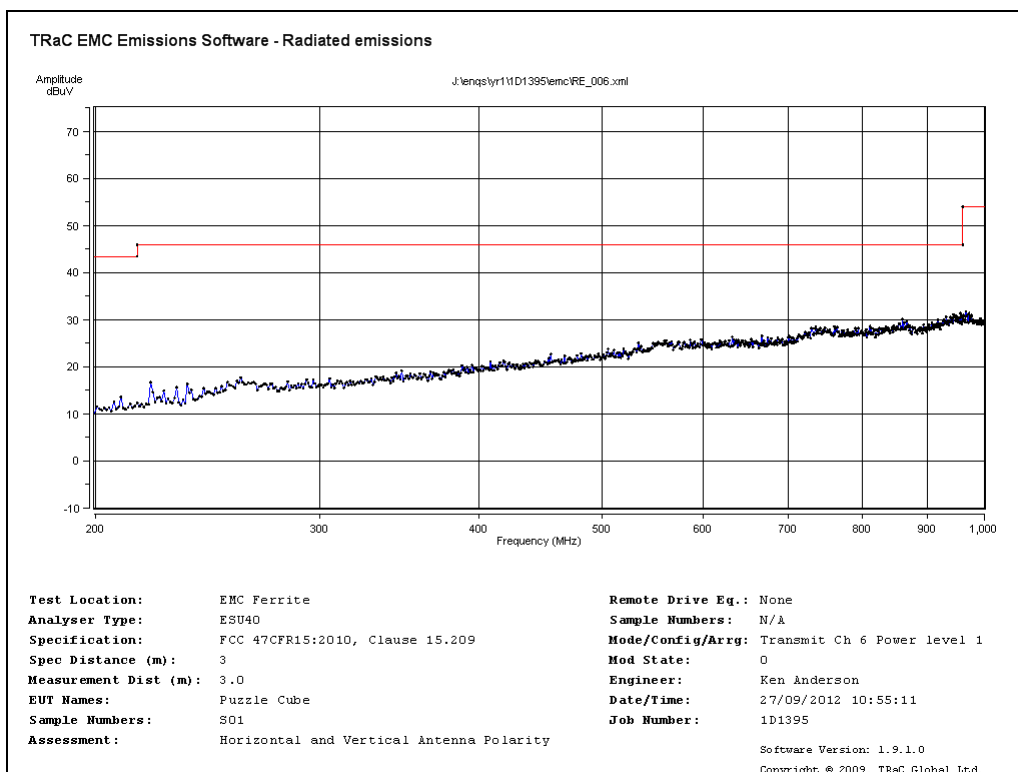
Radiated spurious emissions 12.75 GHz to 18 GHz – CH3



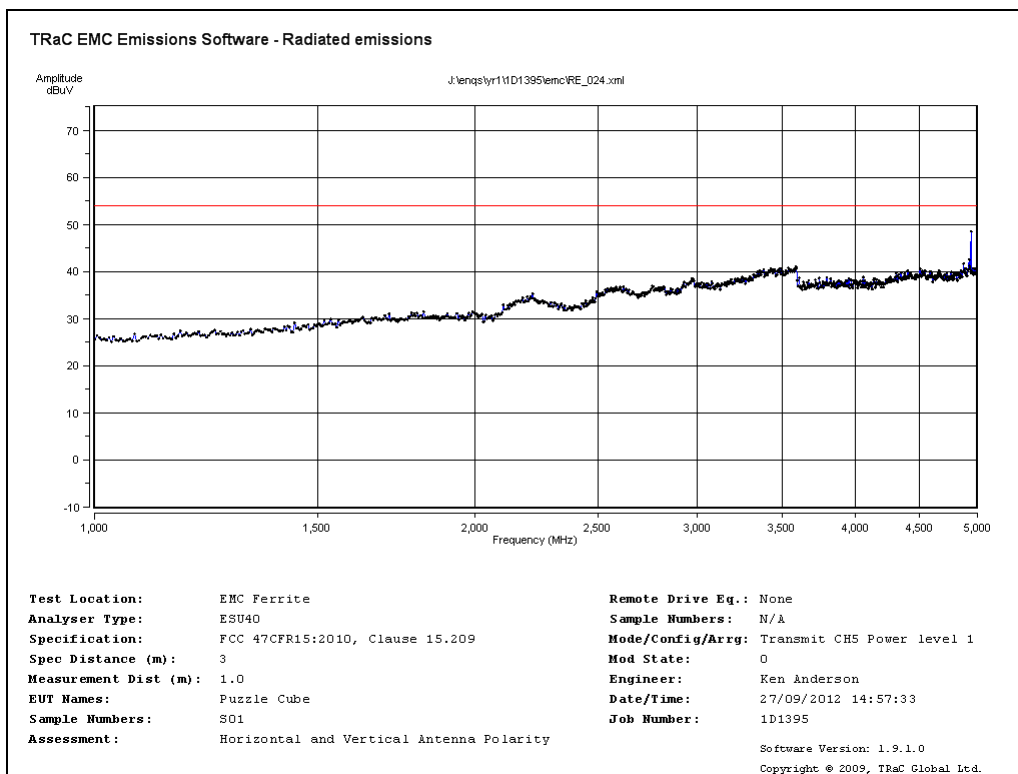
Radiated spurious emissions 18 GHz to 25 GHz – CH3



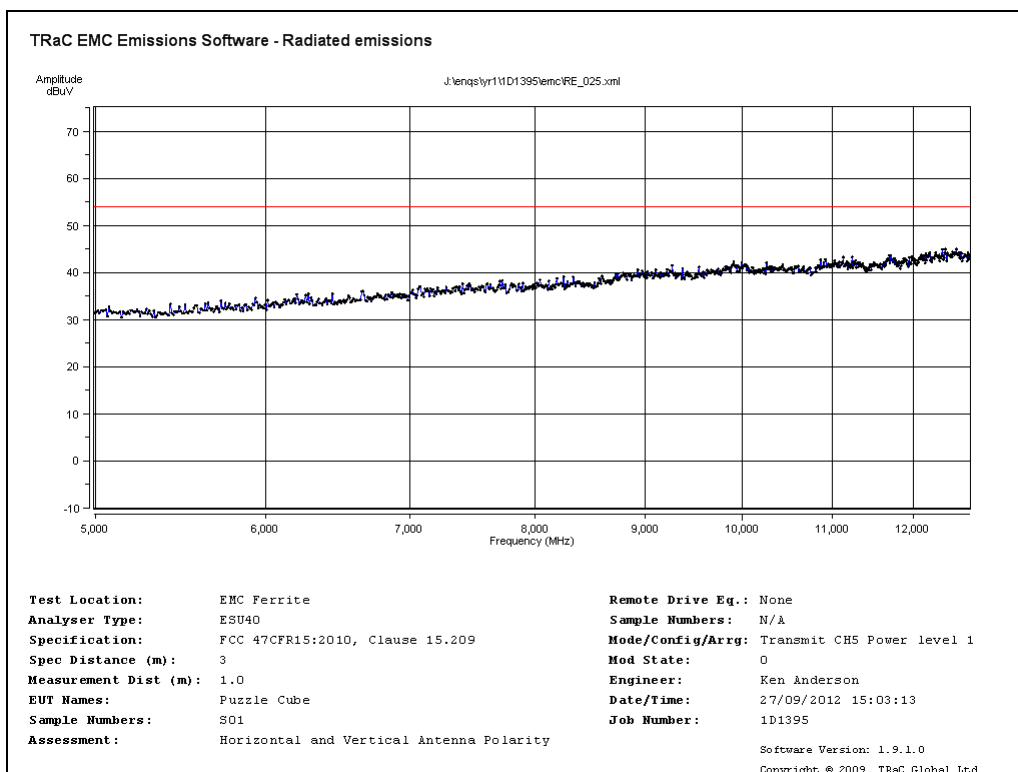
Radiated spurious emissions 30 MHz to 200 MHz – CH5



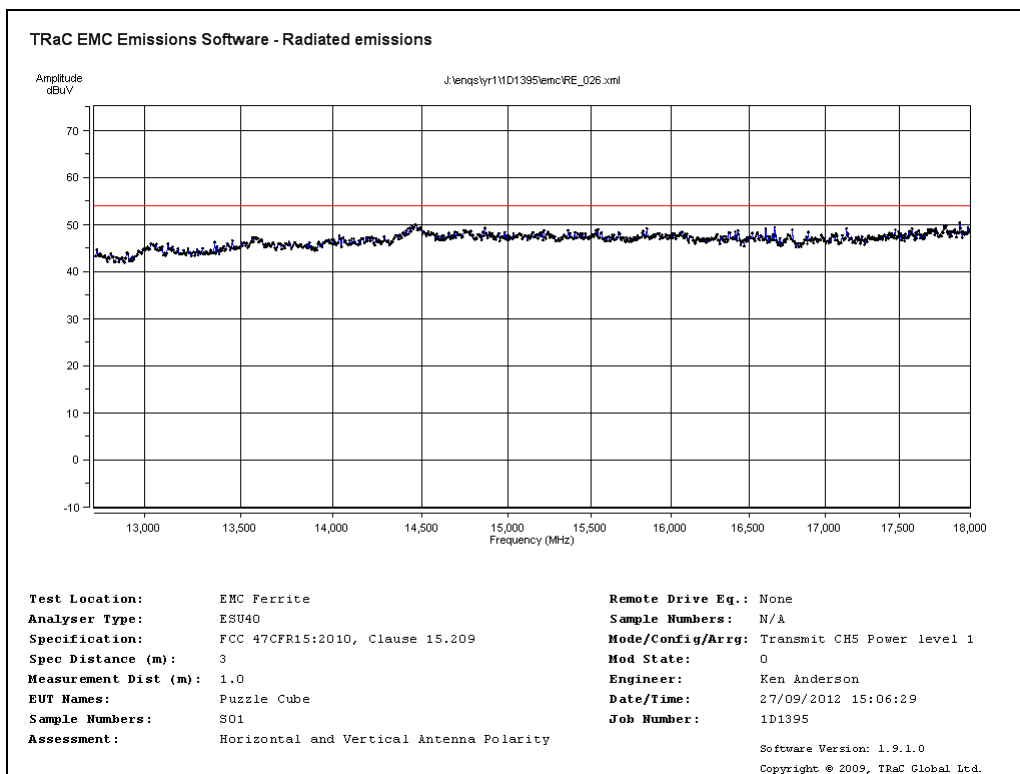
Radiated spurious emissions 200 MHz to 1 GHz – CH5



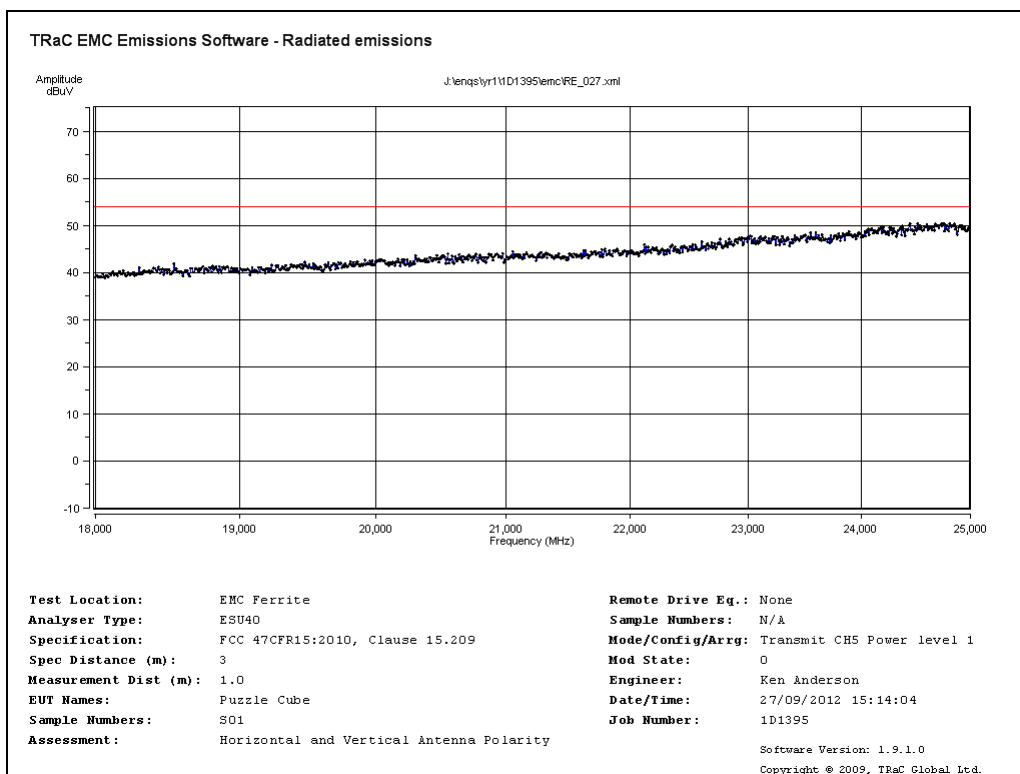
Radiated spurious emissions 1 GHz to 5 GHz – CH5



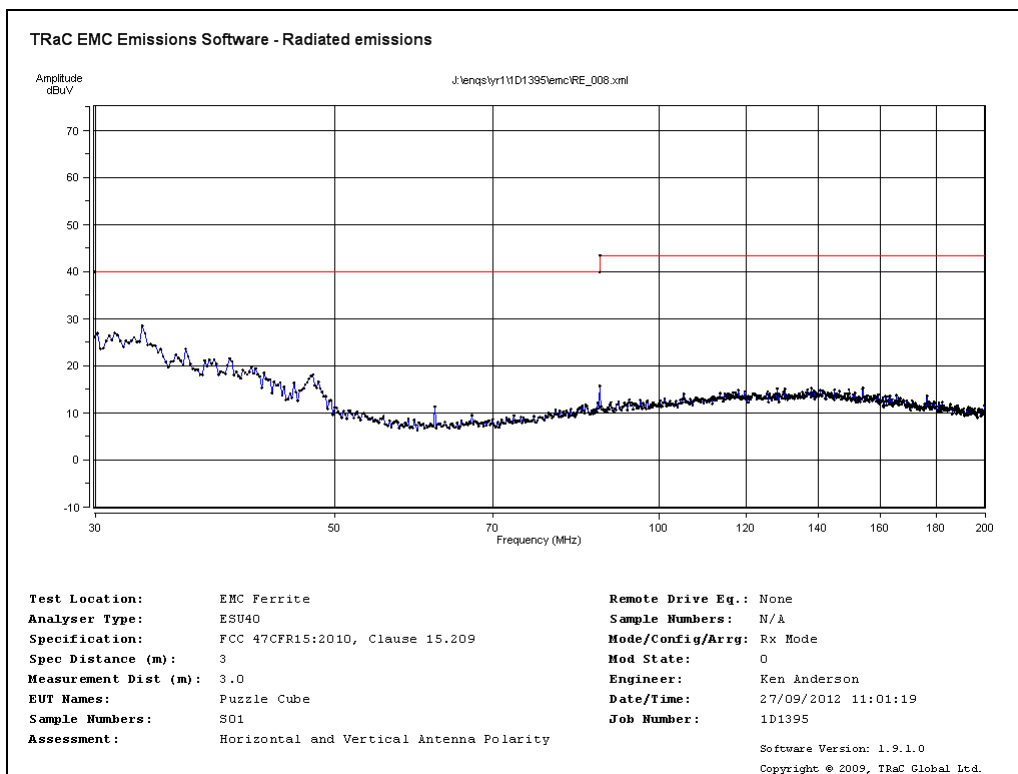
Radiated spurious emissions 5 GHz to 12.75 GHz – CH5



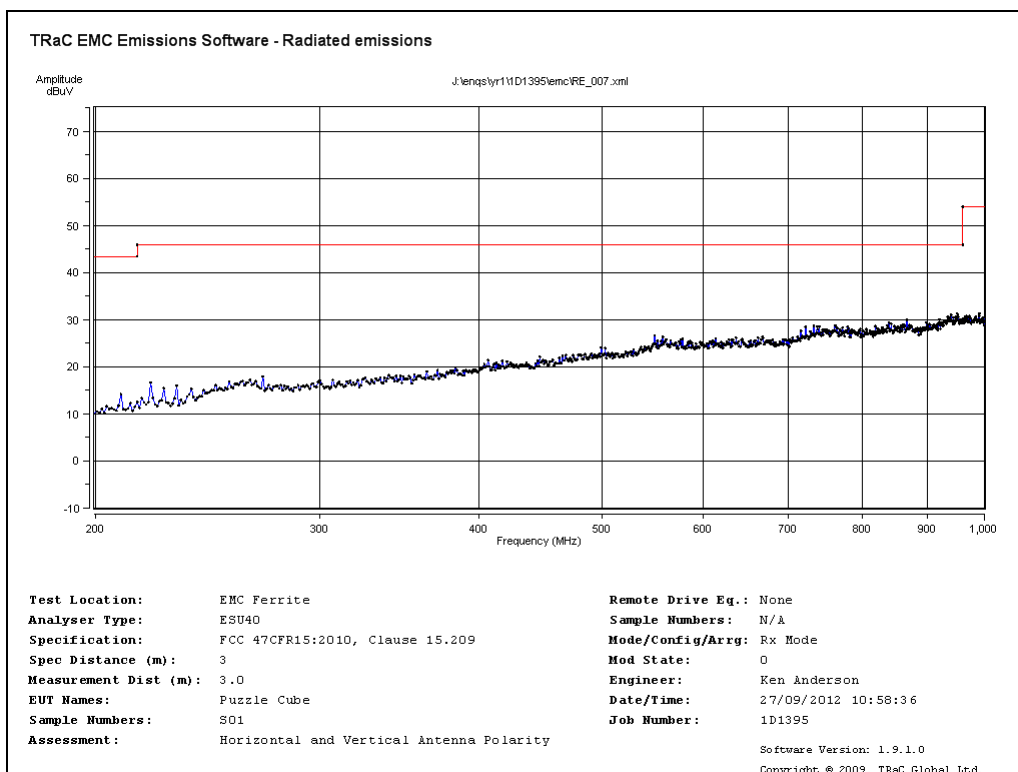
Radiated spurious emissions 12.75 GHz to 18 GHz – CH5



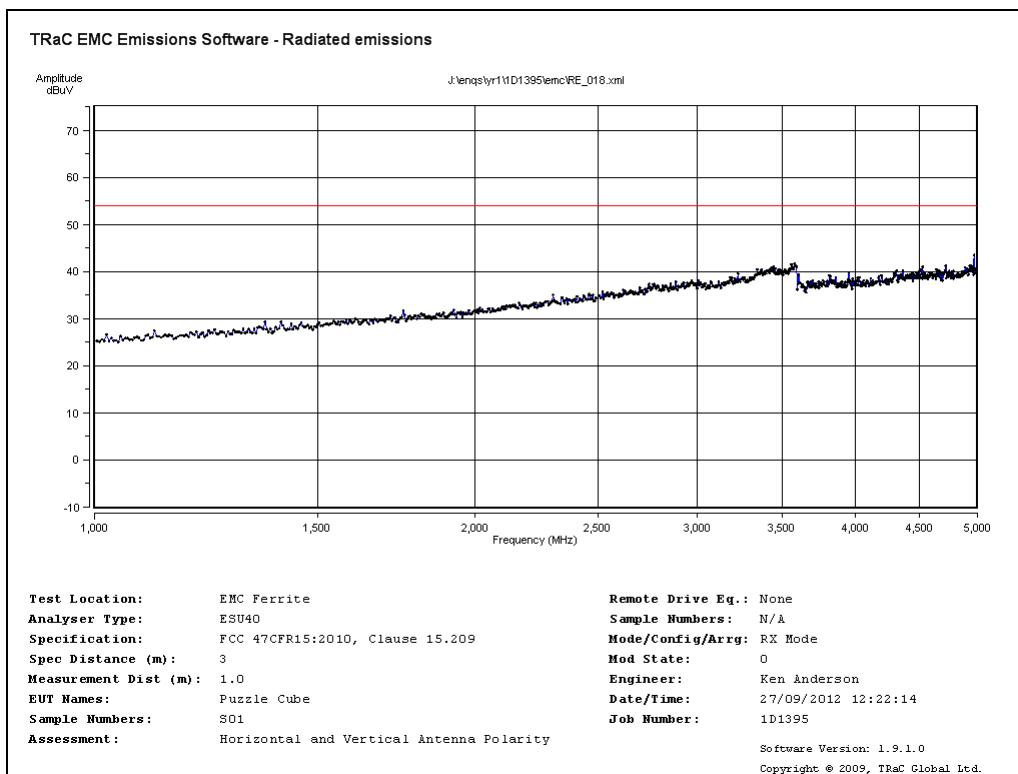
Radiated spurious emissions 18 GHz to 25 GHz – CH5



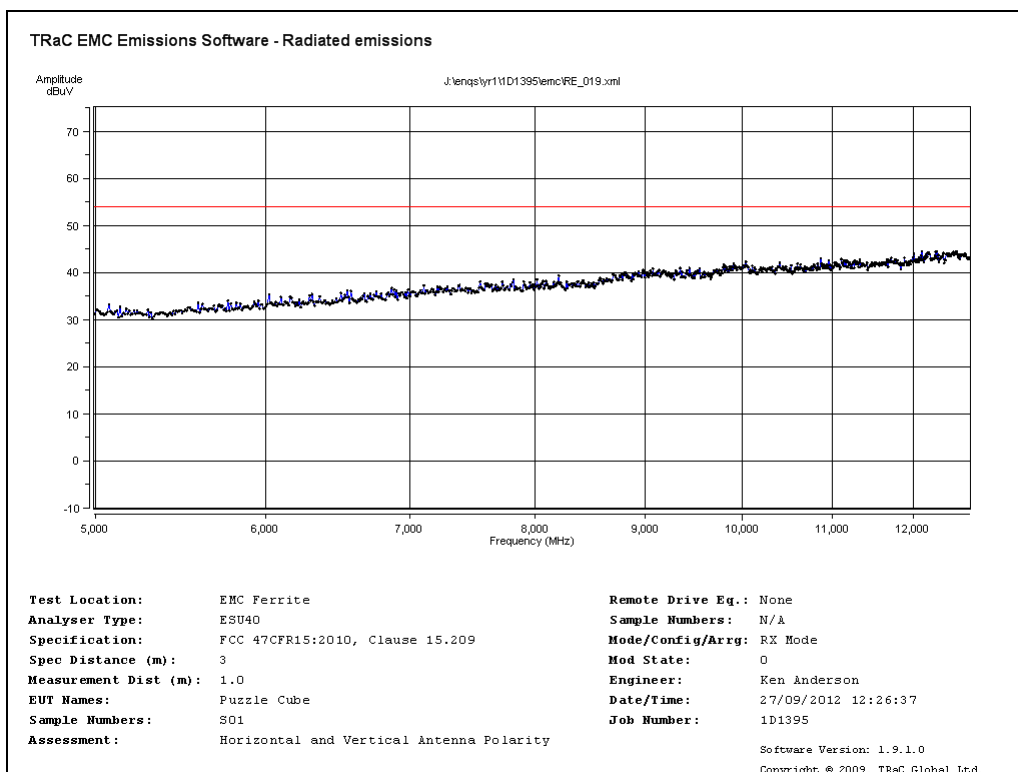
Radiated spurious emissions 30 MHz to 200 MHz – RX Mode



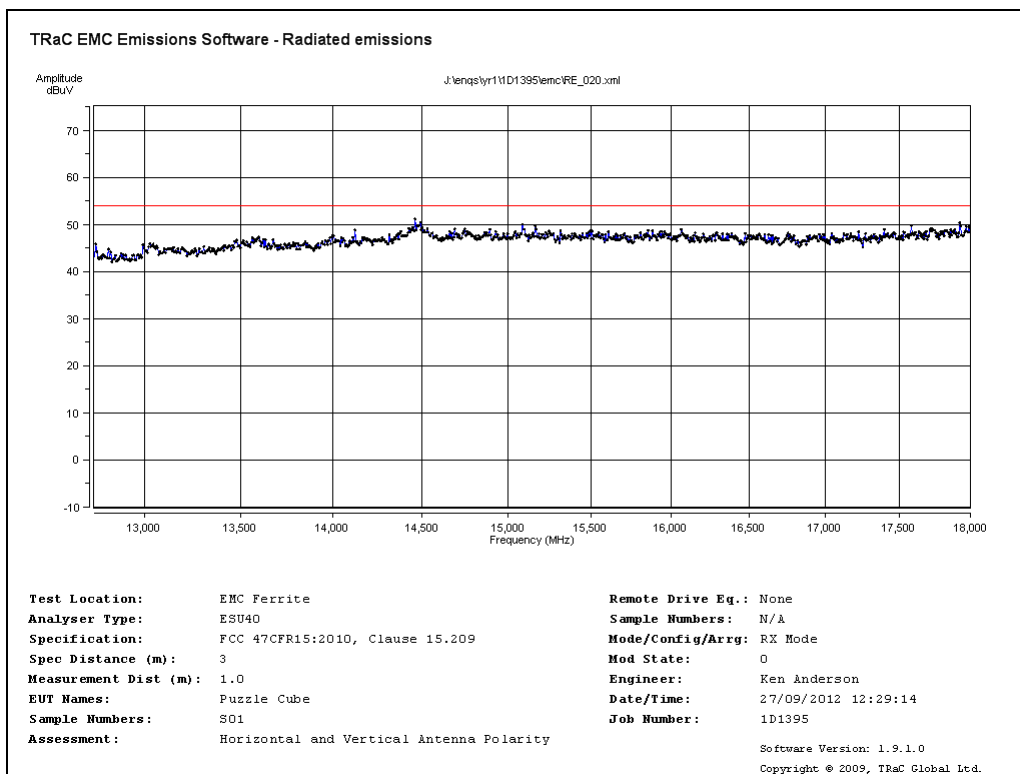
Radiated spurious emissions 200 MHz to 1 GHz – RX Mode



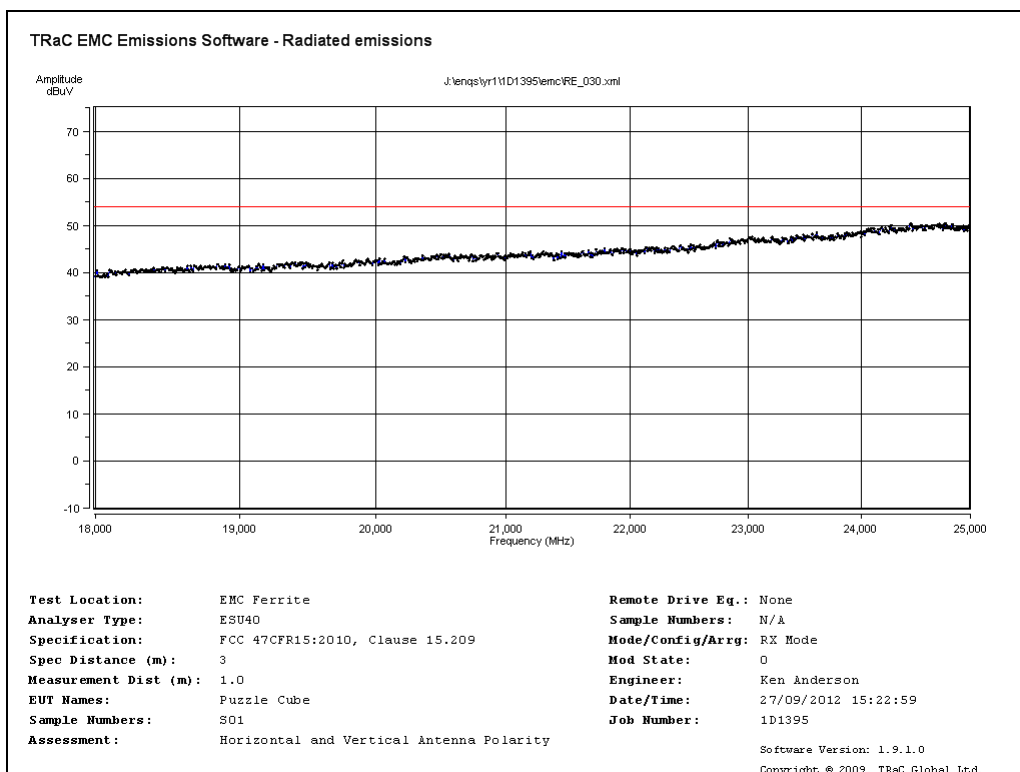
Radiated spurious emissions 1 GHz to 5 GHz – RX Mode



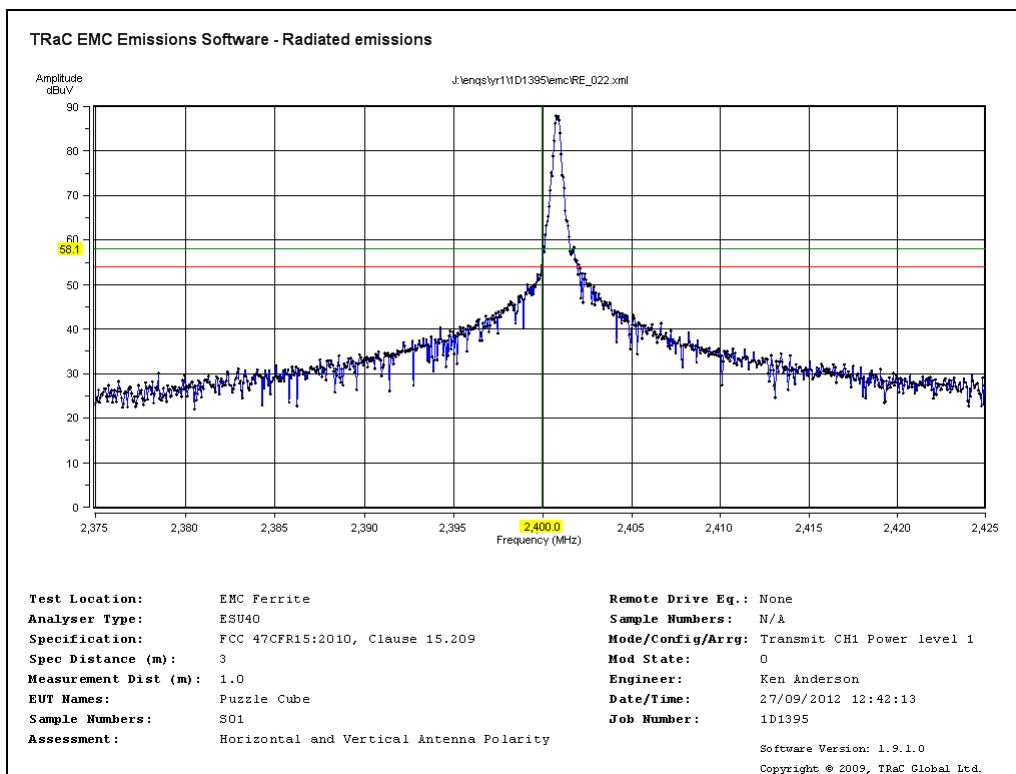
Radiated spurious emissions 5 GHz to 12.75 GHz– RX Mode



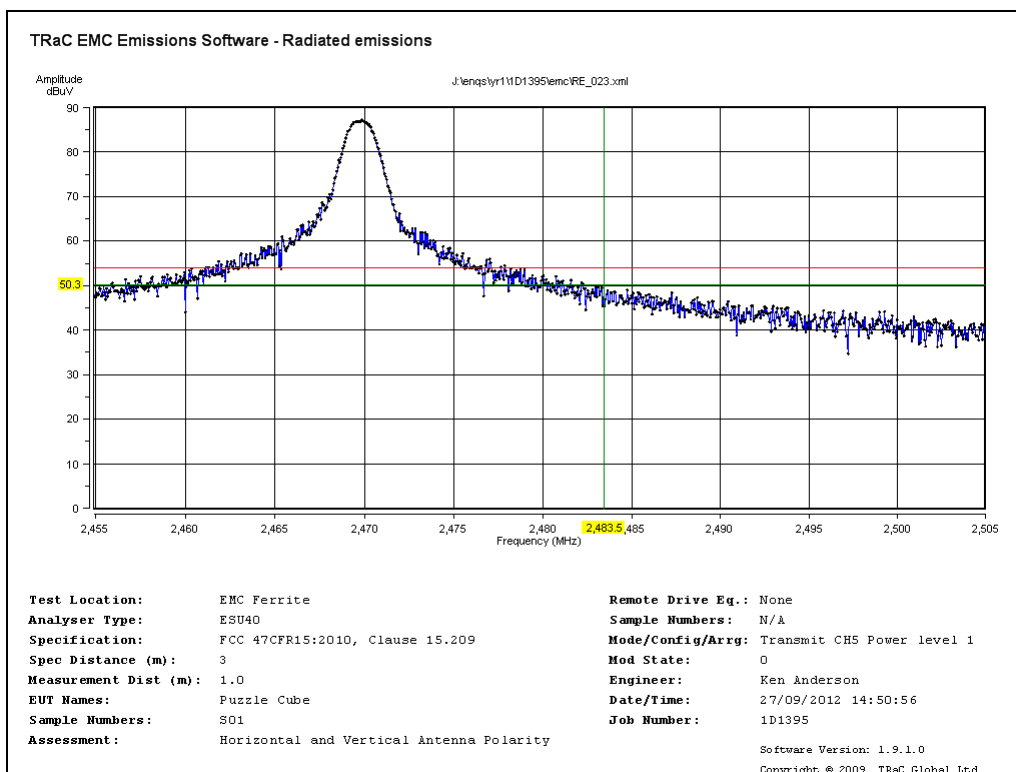
Radiated spurious emissions 12.75 GHz to 18 GHz– RX Mode



Radiated spurious emissions 18 GHz to 25 GHz– RX Mode



Band Edge Emissions – CH1



Band Edge Emissions – CH5

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
S01	Puzzle Cube	Model: PSC01

C2) EUT Operating Mode During Testing.

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

Test	Description of Operating Mode:
All Transmitter Tests detailed in this report	EUT active and transmitting a permanently modulated carrier.

Test	Description of Operating Mode:
Unintentional radiated spurious emissions	EUT active but non-transmitting.

Test	Description of Operating Mode:
Power line conducted emissions	EUT battery charging (non-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
Tests : Radiated Emissions and 20 dB Bandwidth

Port	Description of Cable Attached	Cable length	Equipment Connected
No External Ports			

Sample : S01
Tests : Power Line Conducted Emissions

Port	Description of Cable Attached	Cable length	Equipment Connected
USB Charge	4 Core Unscreened	1m	dc PSU

C5 Details of Equipment Used

For Radiated Measurements:

RFG No	Type	Description	Manufacturer	Date Calibrated
REF886	Lab 16	Large Anechoic Chamber	Rainford	27/07/12
095	3109	Bicon Antenna (30-200MHz)	Eaton	12/05/10
191	3146	Log Periodic Antenna (200-100MHz)	EMCO	12/05/10
REF880	HL050	Log-Periodic antenna (1-26.5GHz)	R & S	26/05/11
REF927		Pre-Amp	Sonoma	15/09/11
REF913	8449B	Pre-Amp (1 to 26.5GHz)	HP	09/01/12
REF847	ESU40	Spectrum Analyser / Test Receiver (LF/HF)	R & S	18/10/11
REF909	FSU46	Spectrum Analyser		02/12/11
RFG452		HF RF coaxial cable	UTIFLEX	02/07/11
REF881		HF RF coaxial cable	Teledyne Reynolds	02/07/11
REF882		HF RF coaxial cable	Teledyne Reynolds	02/07/11
REF884		HF RF coaxial cable	Teledyne Reynolds	02/07/11
REF885		HF RF coaxial cable	Teledyne Reynolds	02/07/11
REF832		HF RF coaxial cable	Teledyne Reynolds	02/07/11
REF919	219-8004-4000 0311	Type K Male to Type K Male Cable 4.0m	Teledyne Reynolds	26/03/12

For 20dB Bandwidth Measurements:

RFG No	Type	Description	Manufacturer	Date Calibrated
REF837	E4440	PSA Spectrum Analyser	Agilent	04/05/12
REF832	Type K male to K male	50Ohm Coax	Teledyne Reynolds	Test Jig
RFG408	7429-1	Loop Antenna	Solar Electronics	Test jig

For power line conducted emissions:

RFG No	Type	Description	Manufacturer	Date Calibrated
n/a	Lab 7	Small Screened Chamber	TRaC	-
189	ESH3-Z5	Single-phase LISN	R & S	27/06/12
674	ESH3-Z2	Pulse Limiter	R & S	30/05/12
125	ESHS 10	Test Receiver (LF)	R & S	03/05/12
657	E4404B	Spectrum Analyser	Agilent	01/05/12
092	BNC	RF coaxial cable (Lab 7)	TRaC	12/09/12
295	BNC	RF coaxial cable (Lab 7)	TRaC	12/09/12

Appendix D:

Additional Information

No additional information is contained within this report

Appendix E:

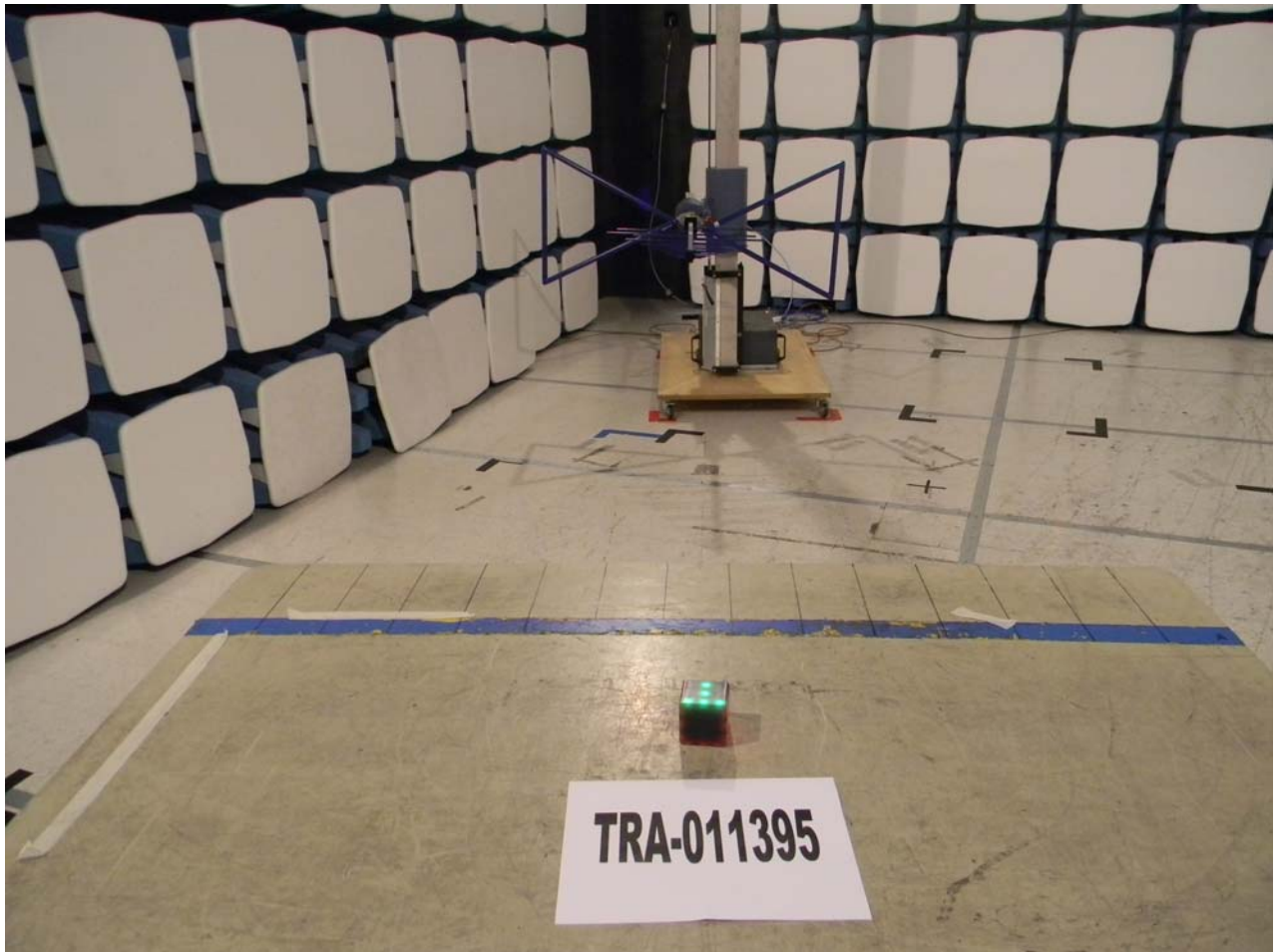
Photographs and Figures

The following photographs were taken of the test samples:

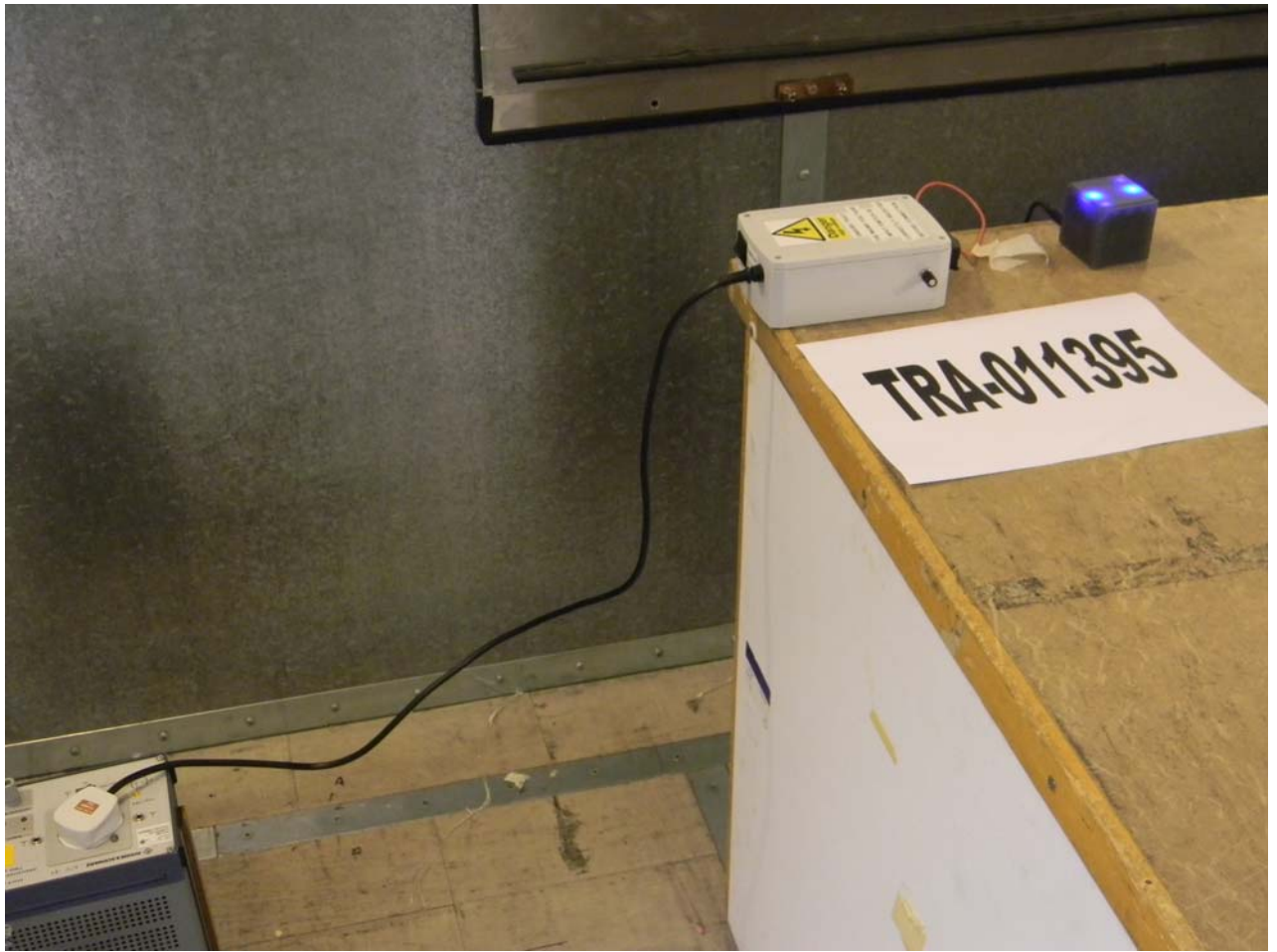
1. Radiated electric field emissions arrangement: Front view.
2. Radiated electric field emissions arrangement: Rear view.
3. Power Line Conducted Emissions



Photograph 1



Photograph 2



Photograph 3

Appendix F:**MPE Calculation**

OET Bulletin No. 65, Supplement C 01-01

47 CFR §§1.1307 and 2.1091

2.1091 Radio frequency radiation exposure evaluation: mobile devices.

For purposes of these requirements mobile devices are defined by the FCC as transmitters designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 centimetres is normally maintained between radiating structures and the body of the user or nearby persons. These devices are normally evaluated for exposure potential with relation to the MPE limits. As the 20cm separation specified under FCC rules may not be achievable under normal operation of the EUT, an RF exposure calculation is needed to show the minimum distance required to be less than 1mW/cm² power density limit, as required under FCC rules.

Prediction of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

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

where:

S = power density

R = distance to the centre of radiation of the antenna

EIRP = EUT Maximum power

Note:

The EIRP measurement was based on the carrier field strength at 3m.

Result

Prediction Frequency (MHz)	Maximum EIRP (mW)	Power density limit (S) (mW/cm ²)	Distance (R) cm required to be less than 1mW/cm ²
2401	0.676	1	0.23

