



TRaC RADIO TEST REPORT

FOR

Navtech Radar Ltd

ON

TS350x 77 GHz Position Sensing Radar

DOCUMENT NO. TRA-011336-W-US-3

HULL

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TRaC Wireless Test Report : TRA-010248-W-US-3

Applicant : Navtech Radar Ltd

Apparatus : TS350X 77 GHz Position Sensing Radar

Specification(s) : CFR47 Part 15 C 15.253: October 2012

FCCID : S7Y-TS350X-001

Purpose of Test : Certification

Authorised by :



: Radio Product Manager

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Contents

Section 1: Introduction	4
1.1 General	4
1.2 Tests Requested By	5
1.3 Manufacturer	5
1.4 Apparatus Assessed	6
1.5 Test Result Summary	7
1.6 Notes Relating To The Assessment	8
1.7 Deviations from Test Standards	8
Section 2: Measurement Uncertainty	9
2.1 Measurement Uncertainty Values	9
Section 3: Modifications	10
3.1 Modifications Performed During Assessment	10
Appendix A: Formal Emission Test Results	11
A1 Radiated Carrier power	12
A2 Transmit Radiated Electric Field Emissions below 40 GHz	13
A3 Transmit Radiated Electric Field Emissions above 40 GHz	15
A4 Transmitter Bandwidth	17
A5 Unintentional Radiated Electric Field Emissions - 15.109 (Receiver/Digital circuitry)	18
A6 ac Power Line Conducted Emissions 15.107 (Receiver/Digital circuitry)	20
Appendix B: Supporting Graphical Data	23
Appendix C: Additional Test and Sample Details	29
Appendix D: Additional Information	35
Appendix E: Photographs and Figures	36
Appendix F: MPE Calculation	40

Section 1:

Introduction

1.1 General

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

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Report author: K J Anderson

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1.2 Tests Requested By

This testing in this report was requested by:

Navtech Radar Ltd
16 Home Farm
Ardington
Wantage
Oxfordshire
OX12 8PD
United Kingdom

1.3 Manufacturer

As Above

1.4 Apparatus Assessed

The following apparatus was assessed between: 01/11/12 and 17/11/12

TS350X 77GHz Position Sensing Radar

The above consists of an swept frequency transmitter / receiver operating in the 76 to 77 GHz ISM band.

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
Radiated Carrier Power	Title 47 of the CFR: Part 15 Subpart C; 15.253(d)	ANSI C63.4	Pass
Radiated spurious emissions below 40 GHz	Title 47 of the CFR: Part 15 Subpart C; 15.253(e)(1)	ANSI C63.4	Pass
Radiated Spurious Emissions above 40 MHz	Title 47 of the CFR: Part 15 Subpart C; 15.253(e)(2)(ii) and 15.253(e)(3)	ANSI C63.4	Pass
Transmitter bandwidth	Title 47 of the CFR: Part 15 Subpart C; 15.253(f)	-	Pass
Radiated Spurious Emissions from digital circuitry	Title 47 of the CFR: Part 15 Subpart B; 15.109	ANSI C63.4	Pass
RF Safety	Title 47 of the CFR : Part 2.1091 and Part 15 Subpart C; 15.253(g)	-	Pass

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 test data recorded, the following measurement uncertainty was calculated:

Radiated Electric Field Emissions

Quantity Range	Quantity	Expanded Uncertainty
9kHz to 150 kHz	Amplitude dB(μ V/m)	± 1.6 dB
150 kHz to 30 MHz	Amplitude dB(μ V/m)	± 2.1 dB
30MHz to 300MHz Horizontal	Amplitude dB(μ V/m)	± 5.1 dB
30MHz to 300MHz Vertical	Amplitude dB(μ V/m)	± 5.2 dB
300MHz to 1GHz Horizontal	Amplitude dB(μ V/m)	± 5.4 dB
300MHz to 1GHz Vertical	Amplitude dB(μ V/m)	± 5.2 dB
1GHz to 18GHz Horizontal	Amplitude dB(μ V/m)	± 4.4 dB
1GHz to 18GHz Vertical	Amplitude dB(μ V/m)	± 4.4 dB
18GHz to 26.5GHz Horizontal	Amplitude dB(μ V/m)	± 4.2 dB
18GHz to 26.5GHz Vertical	Amplitude dB(μ V/m)	± 4.2 dB
26.5GHz to 40GHz Horizontal	Amplitude dB(μ V/m)	± 4.3 dB
26.5GHz to 40GHz Vertical	Amplitude dB(μ V/m)	± 4.3 dB

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 Radiated Carrier power

Preliminary scans were performed using a peak detector with the RBW = 1MHz .

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; 15.253(d)
Measurement standard	ANSI C63.4
Frequency range	76 to 77 GHz
EUT sample number	TRA-009790S05
Modification state	0
SE in test environment	TRA-007874S04
SE isolated from EUT	TRA-007874S03
EUT set up	Refer to Appendix C

Frequency (GHz)	Detector	Level (dBm)	Limit (dBm)	Margin (dB)	Result
76.500	Peak	37.5	55.0	-17.5	Pass
76.500	Average	34.9	50.0	-15.1	Pass

Limit 15.253(d):

The radiated emission limits within the band 76.0–77.0 GHz are as follows:

- (1) The average power density of any emission within the bands specified in this section shall not exceed $88 \mu\text{W}/\text{cm}^2$ at a distance of 3 meters from the exterior surface of the radiating structure (average EIRP of 50 dBm).
- (2) The peak power density of any emission within the band 76–77 GHz shall not exceed $279 \text{ W}/\text{cm}^2$ at a distance of 3 meters from the exterior surface of the radiating structure (peak EIRP of 55 dBm).

A2 Transmit Radiated Electric Field Emissions below 40 GHz

Preliminary scans were performed using a peak detector with the RBW = 100kHz below 1GHz and a RBW = 1MHz >1GHz.

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; 15.253(e)(1)
Measurement standard	ANSI C63.4
Frequency range	30MHz to 40GHz
EUT sample number	TRA-009790S05
Modification state	0
SE in test environment	TRA-007874S04
SE isolated from EUT	TRA-007874S03
EUT set up	Refer to Appendix C

The worst case radiated emission measurements for spurious emissions:

Ref No.	FREQ. (MHz)	DET	MEAS Rx (dBµV)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	FIELD ST'GH (dBµV/m)	EXTRAP FACT (dB)	FIELD ST'GH (dBµV/m)	LIMIT (dBµV/m)
1	52.685	QP	27.8	0.5	6.4	0	34.7	0	34.7	40
2	60.210	QP	32.8	0.3	4.7	0	37.8	0	37.8	40
3	81.791	QP	26	0.5	7.6	0	34.1	0	34.1	40
4	100.093	QP	24.4	0.5	9.7	0	34.6	0	34.6	43.5
5	190.225	QP	20.7	0.8	8	0	29.5	0	29.5	43.5
6	202.111	QP	33.6	0.8	7.7	0	42.1	0	42.1	46
7	299.988	QP	22.4	1.1	12.9	0	36.4	0	36.4	46
8	699.995	QP	16.6	1.5	20.6	0	38.7	0	38.7	46
9	782.198	QP	16.3	1.7	22.2	0	40.2	0	40.2	46
10	799.993	QP	15.4	1.7	22.2	0	39.3	0	39.3	46
11	959.886	QP	12.5	2.0	24.8	0	39.3	0	39.3	46
12	38305.000	Pk	26.6	6.0	35.4	0	68.0	-9.5	58.5	74
13	38305.0000	Av	20.3	6.0	35.4	0	61.7	-9.5	52.2	54

Limits

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:

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

The results displayed take into account applicable antenna factors and cable losses.

- (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 Transmit Radiated Electric Field Emissions above 40 GHz

Preliminary scans were performed using a peak detector with the RBW of the analyser set to 1 MHz.

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; 15.253(e)(2)(ii) and 15.253(e)(3)
Measurement standard	ANSI C63.4
Frequency range	40 GHz to 231 GHz
EUT sample number	TRA-009790S05
Modification state	0
SE in test environment	TRA-007874S04
SE isolated from EUT	TRA-007874S03
EUT set up	Refer to Appendix C

No emissions within 20 dB of the test limits were detected.

Specification limits 15.253(e):

The power density of any emissions outside the operating band shall consist solely of spurious emissions and shall not exceed the following:

- (1) Radiated emissions below 40 GHz shall not exceed the general limits in § 15.209.
- (2) Radiated emissions outside the operating band and between 40 GHz and 200 GHz shall not exceed the following:
 - (i) For field disturbance sensors operating in the band 46.7–46.9 GHz: 2 pW/cm² (68.8 dBµV/m) at a distance of 3 meters from the exterior surface of the radiating structure.
 - (ii) For field disturbance sensors operating in the band 76–77 GHz: 600 pW/cm² (93.5 dBµV/m) at a distance of 3 meters from the exterior surface of the radiating structure.
- (3) For radiated emissions above 200 GHz from field disturbance sensors operating in the 76–77 GHz band: the power density of any emission shall not exceed 1000 pW/cm² (95.6 dBµV/m) at a distance of 3 meters from the exterior surface of the radiating structure.

Notes:

- (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:

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

The results displayed take into account applicable antenna factors and cable losses.

- (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 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.				

A4 Transmitter Bandwidth

A scan was performed of the transmitter bandwidth using an RMS detector with the RBW/VBW of the analyser set to 1 MHz. The bandwidth was measured at the -20dB points on the modulation envelope.

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; 15.253(f)
Frequency range	76 GHz to 77GHz
EUT sample number	TRA-009790S05
Modification state	0
SE in test environment	TRA-007874S04
SE isolated from EUT	TRA-007874S03
EUT set up	Refer to Appendix C

Temperature (°C)	Lower Edge of Fundamental Emission (GHz)	Upper Edge of Fundamental Emission (GHz)	Allowable Frequency Band (GHz)		Result
-20	76.197	76.853	76.000	77.000	Pass
-10	76.197	76.853	76.000	77.000	Pass
0	76.197	76.853	76.000	77.000	Pass
10	76.200	76.850	76.000	77.000	Pass
20	76.200	76.850	76.000	77.000	Pass
30	76.200	76.850	76.000	77.000	Pass
40	76.203	76.847	76.000	77.000	Pass
50	76.203	76.840	76.000	77.000	Pass

Note:

No variation in frequency was observed when the supply voltage was varied between 85% and 115% of the nominal value.

A5 Unintentional Radiated Electric Field Emissions - 15.109 (Receiver/Digital circuitry)

Test Details: Receive Mode	
Regulation	Title 47 of the CFR: Part 15 Subpart (b) Clause 15.109
Measurement standard	ANSI C63.4
Class	B – refer to specification limit table below.
Frequency range	30 MHz to 40 GHz
EUT sample number	TRA-009790S05
Modification state	0
SE in test environment	TRA-007874S04
SE isolated from EUT	TRA-007874S03
EUT set up	Refer to Appendix C

The EUT is an FMCW (Frequency-Modulated Continuous-Wave) radar and by design it continuously transmits and receives. It therefore has no distinct receive mode in which it is not transmitting. All emissions from digital circuitry were therefore measured as part of the measurement of spurious emissions below 40 GHz (see Appendix A.2 for details).

Specification limits :

The upper frequency of the measurement range was decided according to 47 CFR Part 15 Clause 15.33.

Radiated emission limits (47 CFR Part 15 Clause 15.109):

Except for a Class A digital device, the field strength of radiated emissions from unintentional radiators at a distance of 3m shall not exceed the following values:

Frequency of emission (MHz)	Field strength $\mu\text{V/m}$	Field strength $\text{dB}\mu\text{V/m}$
30-88	100	40.0 (quasi-peak)
88-216	150	43.5 (quasi-peak)
216-960	200	46.0 (quasi-peak)
960-1000	500	54.0 (quasi-peak)
Above 1000	500	54.0 (average)
Above 1000	-	74.0 (peak)

Notes:

- (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:

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

The results displayed take into account applicable antenna factors and cable losses.

- (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 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.				

A6 ac Power Line Conducted Emissions 15.107 (Receiver/Digital circuitry)

Test Details	
Regulation	Title 47 of the CFR, Part 15 Subpart (b)
Measurement standard	ANSI C63.4:2003
Class	B – refer to specification limit table below.
Frequency range	150kHz to 30MHz
EUT sample number	TRA-009790S05
Modification state	0
SE in test environment	RFG464
SE isolated from EUT	Laptop
EUT set up	Refer to Appendix C
Photographs	Photograph 3

The worst case ac power line port 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	0.150	Live	19.6	56.0	-36.4	Pass
2	0.200	Live	14.1	53.6	-39.5	Pass
3	0.300	Live	11.5	50.2	-38.7	Pass
4	0.400	Live	10.5	47.9	-37.4	Pass
5	0.500	Live	9.4	46.0	-36.6	Pass
6	0.600	Live	8.4	46.0	-37.6	Pass
7	0.700	Live	7.5	46.0	-38.5	Pass
8	0.800	Live	7.3	46.0	-38.7	Pass
9	0.900	Live	7.1	46.0	-38.9	Pass
10	0.150	Neutral	19.5	56.0	-36.5	Pass
11	0.200	Neutral	14.7	53.6	-38.9	Pass
12	0.300	Neutral	13.5	50.2	-36.7	Pass
13	0.400	Neutral	12.4	47.9	-35.5	Pass
14	0.500	Neutral	11.2	46.0	-34.8	Pass
15	0.600	Neutral	10.0	46.0	-36.0	Pass
16	0.700	Neutral	8.9	46.0	-37.1	Pass
17	0.800	Neutral	7.8	46.0	-38.2	Pass
18	0.900	Neutral	7.3	46.0	-38.7	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	0.150	Live	46.5	66.0	-19.5	Pass
2	0.200	Live	42.6	63.6	-21.0	Pass
3	0.300	Live	39.1	60.2	-21.1	Pass
4	0.400	Live	38.4	57.9	-19.5	Pass
5	0.500	Live	36.9	56.0	-19.1	Pass
6	0.600	Live	35.2	56.0	-20.8	Pass
7	0.700	Live	33.1	56.0	-22.9	Pass
8	0.800	Live	31.1	56.0	-24.9	Pass
9	0.900	Live	29.0	56.0	-27.0	Pass
10	0.150	Neutral	46.5	66.0	-19.5	Pass
11	0.200	Neutral	43.7	63.6	-19.9	Pass
12	0.300	Neutral	42.5	60.2	-17.7	Pass
13	0.400	Neutral	41.4	57.9	-16.5	Pass
14	0.500	Neutral	39.9	56.0	-16.1	Pass
15	0.600	Neutral	38.1	56.0	-17.9	Pass
16	0.700	Neutral	36.1	56.0	-19.9	Pass
17	0.800	Neutral	34.2	56.0	-21.8	Pass
18	0.900	Neutral	32.3	56.0	-23.7	Pass

Specification limits :

ac power port conducted emission limits (47 CFR 15:209 Clause 15.107):

Conducted disturbance at the ac power line ports of Class A information technology equipment.

Frequency range MHz	Limits dB μ V	
	Quasi-peak	Average
0.15 to 0.5	79	66
0.5 to 30	73	60

Notes:
1. The lower limit shall apply at the transition frequency.

Conducted disturbance at the ac power line ports of Class B information technology equipment.

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 :

AND

- (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

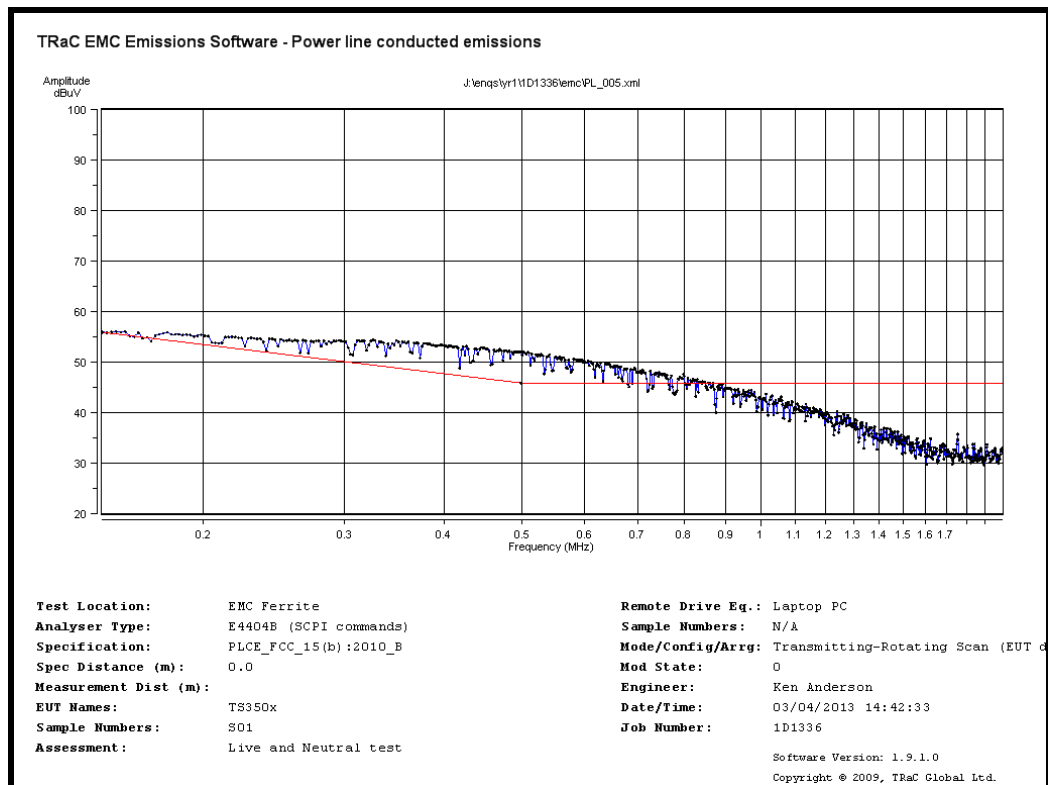
	See 1)	See 2)	See 3)	See 4)
Effect of EUT operating mode on emission levels		✓		
Effect of EUT internal configuration on emission levels		✓		
Effect of Position of EUT cables & samples on emission levels		✓		
1) Parameter defined by standard and / or single possible. 2) Parameter defined by client and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

Appendix B:**Supporting Graphical Data**

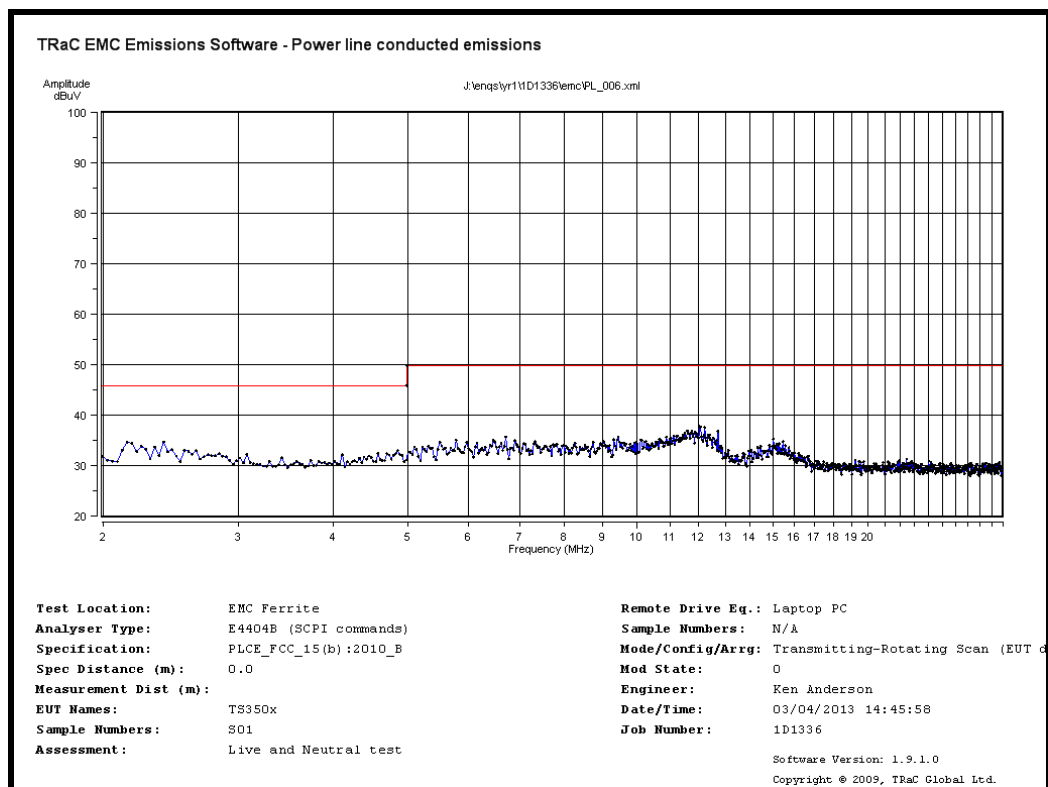
This appendix contains graphical data obtained during testing.

Notes:

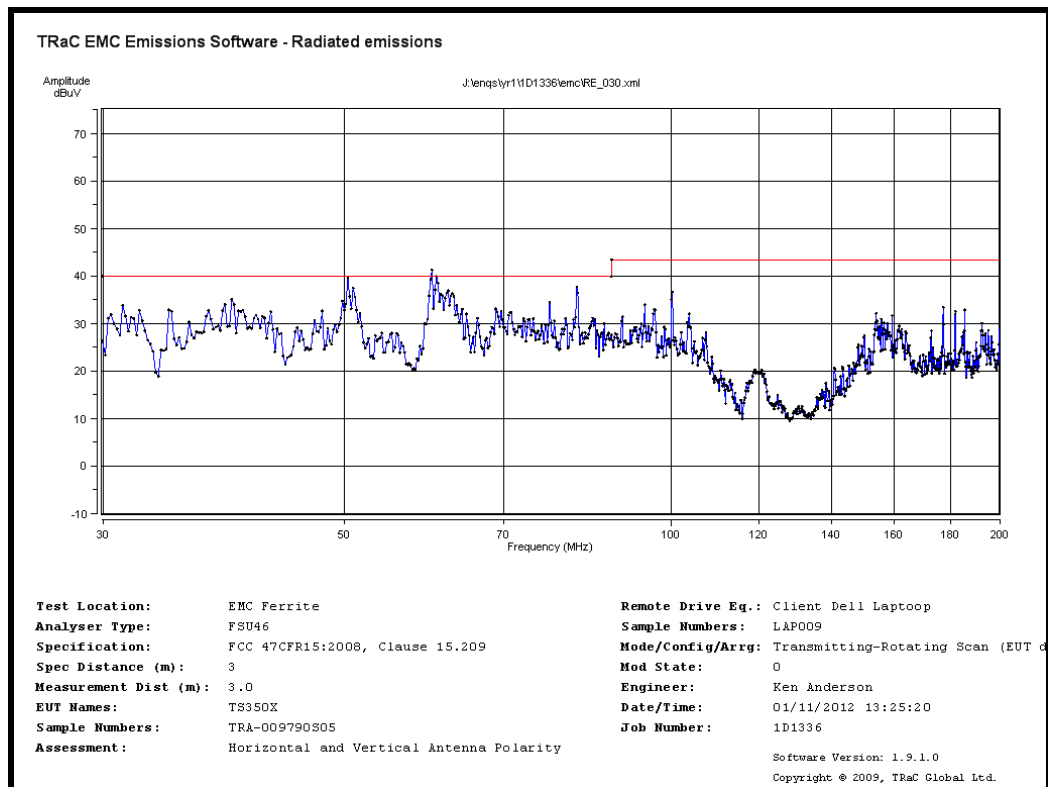
- (a) The radiated electric field emissions and conducted emissions graphical data in this appendix is preview data. For details of formal results, refer to Appendix A.
- (b) The time and date on the plots do not necessarily equate to the time of the test.
- (c) Where relevant, on power line conducted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



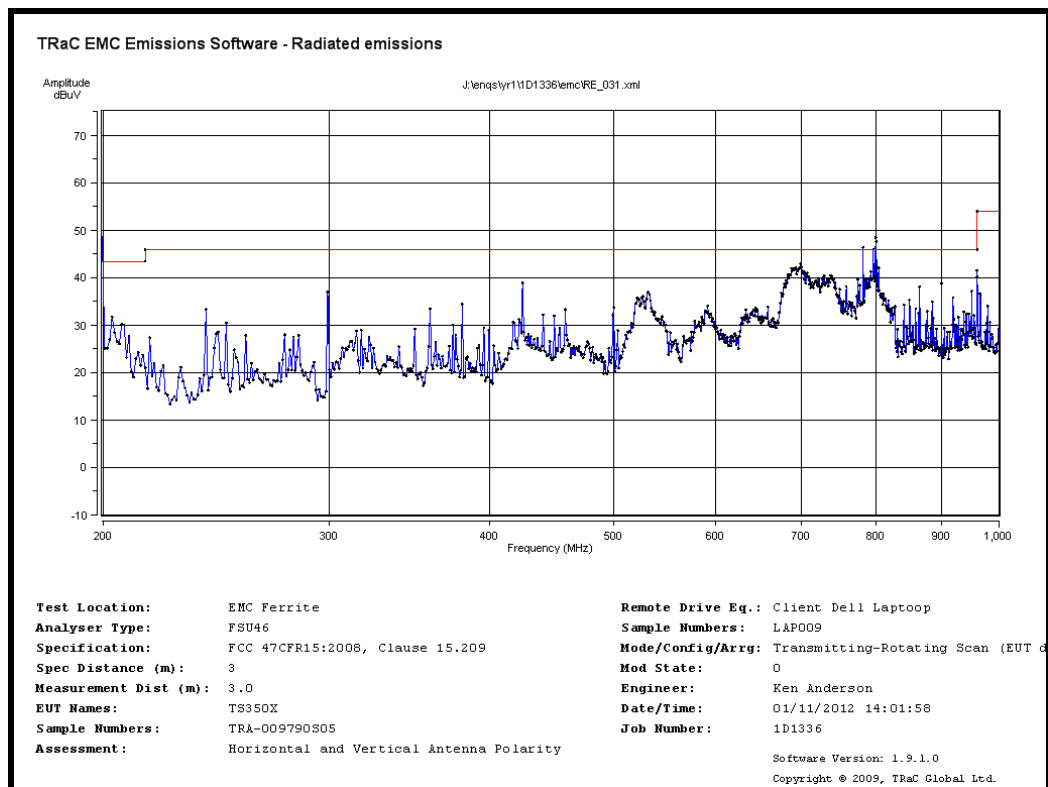
Power Line emissions 150 kHz to 2 MHz



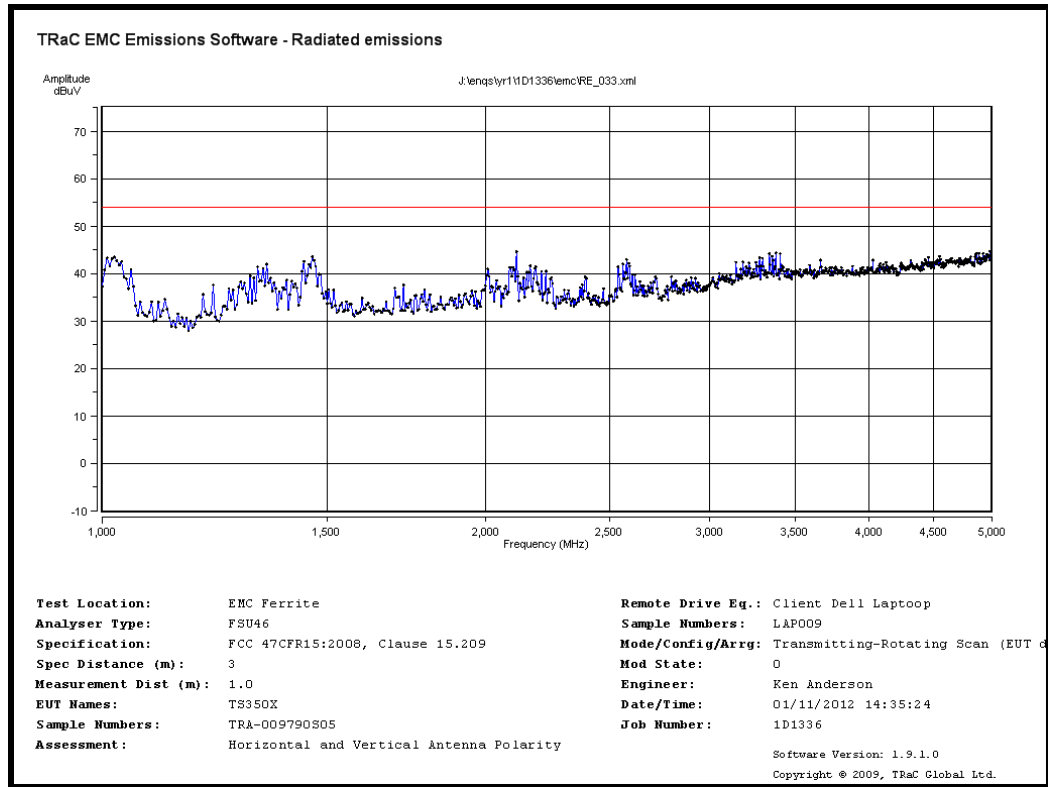
Power Line emissions 2 MHz to 30 MHz



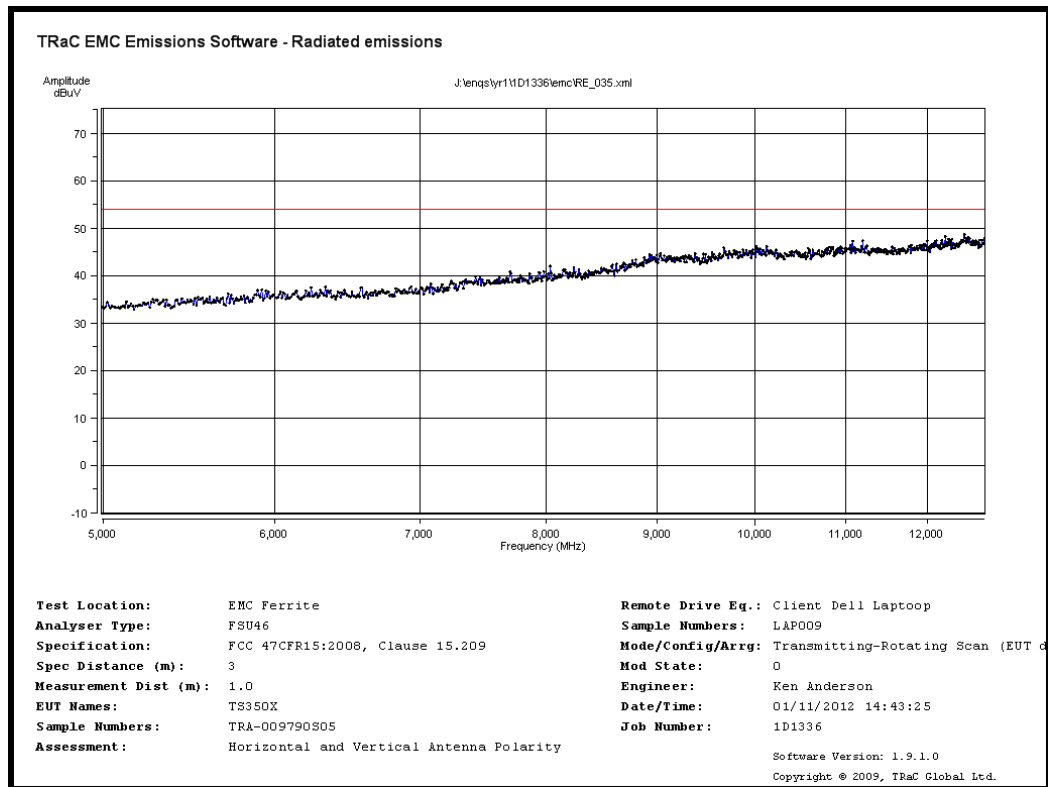
Radiated Emissions 30 MHz to 200 MHz



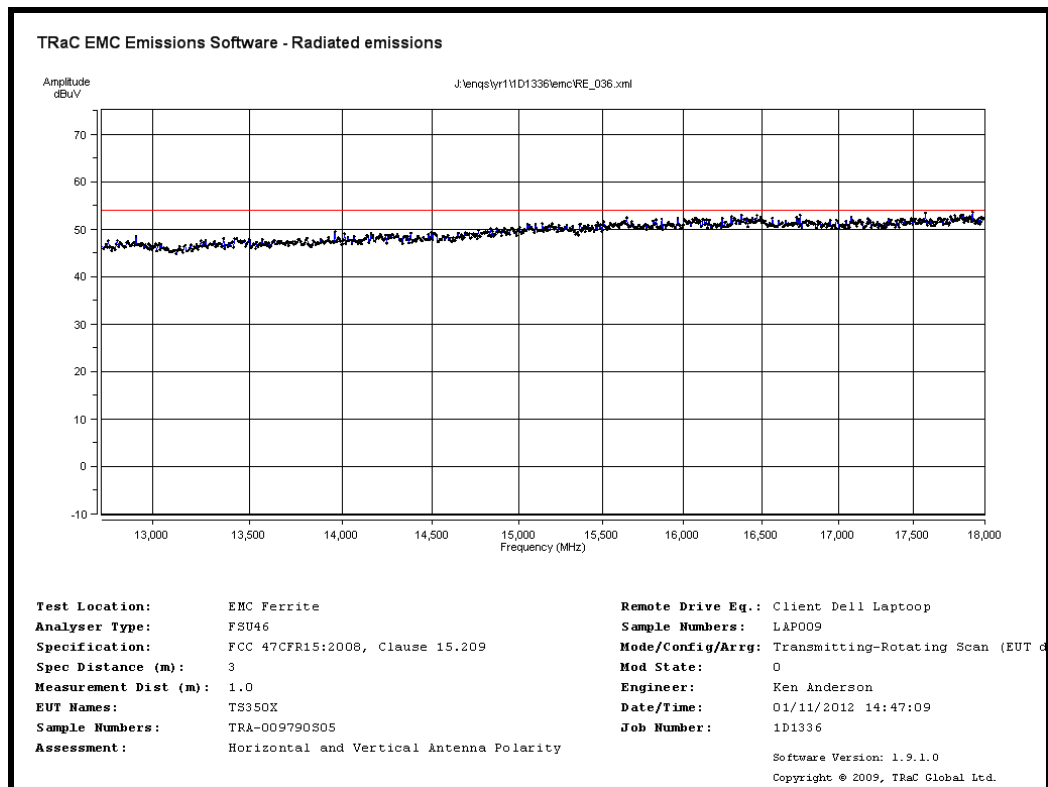
Radiated Emissions 200 MHz to 1000 MHz



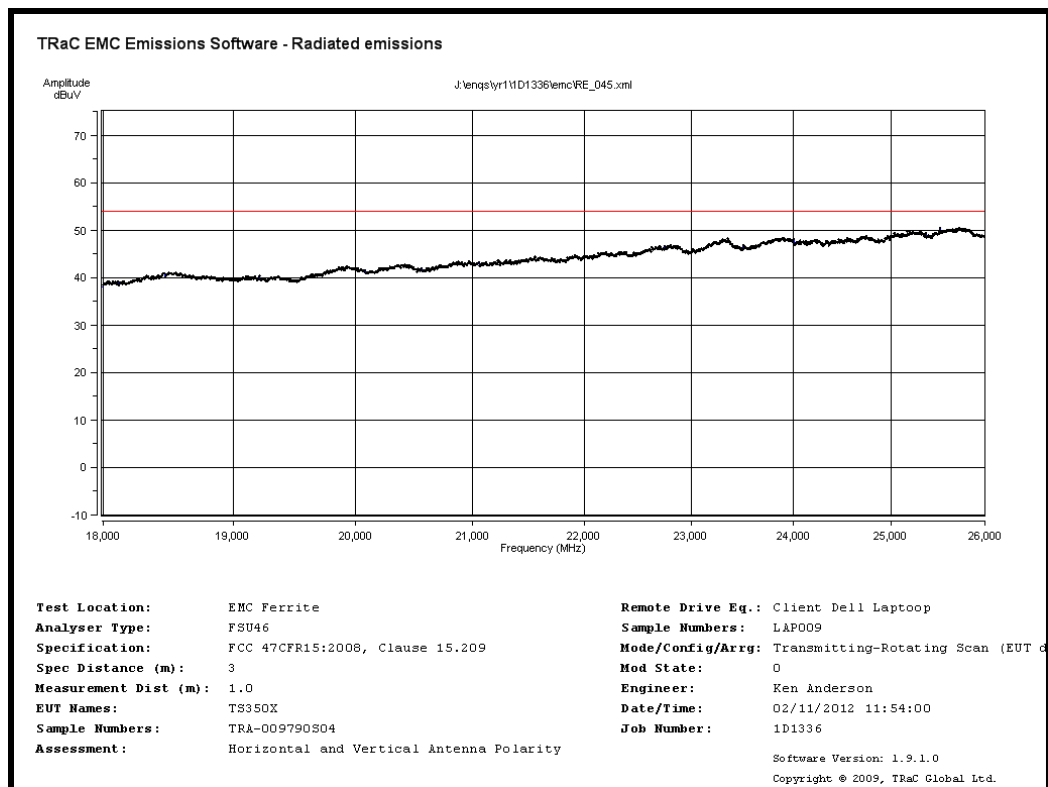
Radiated Emissions 1000 MHz to 5000 MHz



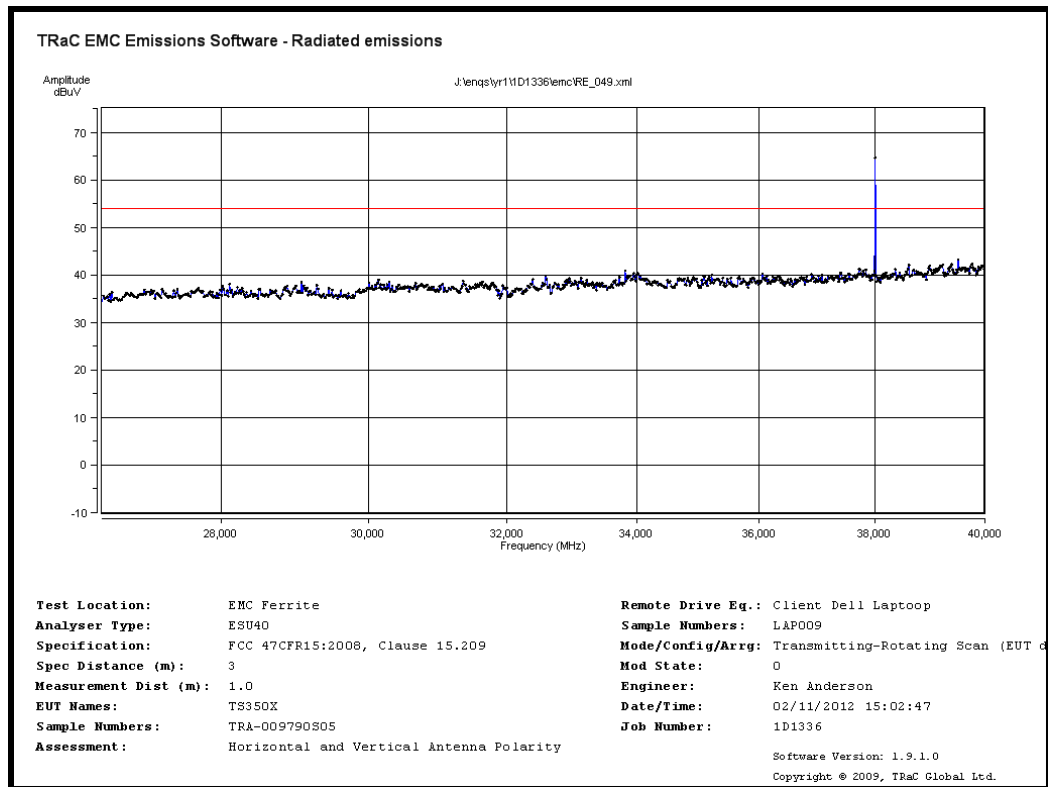
Radiated Emissions 5000 MHz to 12750 MHz



Radiated Emissions 12750 MHz to 18000 MHz



Radiated Emissions 18000 MHz to 26000 MHz



Radiated Emissions 26000 MHz to 40000 MHz

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
TRA-009790S05	TS350X 77GHz Position Sensing Radar	6110

The following samples of the apparatus were submitted by the client as support equipment :

Sample No.	Description	Identification
TRA-007874S03	Laptop PC	None
TRA-007874S04	ac to dc Supply	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 except Radiated Peak and Mean Power Density	The EUT was transmitting at maximum output power sweeping around a centre frequency of 76.5MHz with a total sweep range of 300 MHz
Radiated Peak and Mean Power Density	The EUT was transmitting at maximum output power at a fixed frequency of 76.5MHz.

C3) EUT Configuration Information.

Sample	Internal Configuration Details
TRA-009790S05	Single possible internal configuration

C4) List of EUT Ports

The table below describes the termination of EUT ports:

Sample : TRA-009790S05

Tests : All

Port	Description of Cable Attached	Cable length	Equipment Connected
Data port	Multicore unscreened	10m	TRA-007874S03 (Setup Only)
dc power port	2 core unscreened	1.5m	TRA-007874S04

Sample : TRA-007874S04

Tests : All

Port	Description of Cable Attached	Cable length	Equipment Connected
dc power port	2 core unscreened	1.5m	TRA-009790S05
ac Power Port	2 core unscreened	2m	ac Mains Supply

C5 Details of Equipment Used

For Radiated Electric Field Emissions 30MHz to 1GHz:

Lab 10				
RFG/REF No	Type	Description	Manufacturer	Date Calibrated.
274	ATS	Ferrite Lined Chamber	Panashield	10/07/11
679	CBL6111	Blue Bilog Antenna (0.03 – 1GHz)	Chase	05/05/11
008	8447D	Pre-amp (0.1 – 1300MHz)	H & P	16/02/11
126	ESV20	Test Receiver	R & S	18/05/11
404	E4407B	Spectrum Analyser	Agilent	17/05/11
643	N-type	Sucotest Microwave Cable 1m	Huber & Suhner	17/09/10
651	N-type	Sucotest Microwave Cable 7m	Huber & Suhner	17/09/10
678	N-type	Sucotest Microwave Cable 2m	Huber & Suhner	28/03/11
636	NSG1007	110Vac / 60Hz	Schaffner	N/A
REF887	34405A	Multi-meter	Agilent	25/08/10

For Radiated Electric Field Emissions 1GHz to 18GHz:

Lab 10				
RFG/REF No	Type	Description	Manufacturer	Date Calibrated
274	ATS	Ferrite Lined Chamber	Panashield	10/07/11
129	3115	Horn Antennas	EMCO	11/08/09
307	HP8449B	Microwave Pre-Amp (1-26.5GHz)	HP	01/03/10
643	N-type	Sucotest Microwave Cable 1m	Huber & Suhner	17/09/10
651	N-type	Sucotest Microwave Cable 7m	Huber & Suhner	17/09/10
678	N-type	Sucotest Microwave Cable 2m	Huber & Suhner	28/03/11
404	E4407B	Spectrum Analyser	Agilent	17/05/11
636	NSG1007	110Vac / 60Hz	Schaffner	N/A
REF887	34405A	Multi-meter	Agilent	25/08/10

For Radiated Electric Field Emissions 1GHz to 18GHz:

Lab 16				
RFG/REF No	Type	Description	Manufacturer	Date Calibrated
REF886	Lab 16	Large Anechoic Chamber	Rainford EMC systems	27/07/10
REF880	HL050	Log Perodic Antenna (1-26.5GHz)	R&S	14/05/10
913	HP8449B	Microwave Pre-Amp (1-26.5GHz)	HP	07/01/11
404	E4407B	Spectrum Analyser	Agilent	17/05/11
452	SMA	1m 50Ohm coaxial UTIFLEX cable	Teledyne Reynolds	25/05/11
REF881	N-type	50Ohm coaxial HF RF coaxial cable	Teledyne Reynolds	06/06/11
REF882	N-type	50Ohm coaxial HF RF coaxial cable	Teledyne Reynolds	06/06/11
REF884	N-type	50Ohm coaxial HF RF coaxial cable	Teledyne Reynolds	06/06/11
REF885	N-type	50Ohm coaxial HF RF coaxial cable	Teledyne Reynolds	06/06/11
REF915	PCR500L	ac/dc Power Supply	Kikusui	N/A
REF887	34405A	Multi-meter	Agilent	25/08/10

Appendix D:

Additional Information

The following is a declaration from the client regarding receive mode emissions

The TS350X is an FMCW (Frequency-Modulated Continuous-Wave) radar and by design it continuously transmits and receives. It therefore has no distinct receive mode in which it is not transmitting.

Appendix E:

Photographs and Figures

Photograph 1 Radiated Spurious Emissions - Front View
Photograph 2 Radiated Spurious Emissions - Rear View
Photograph 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

EIRP = Equivalent Isotropic Radiated power

R = distance to the centre of radiation of the antenna

Sample No.	TRA-009790S05	
Maximum peak EIRP:	37.5	dBm
Maximum peak EIRP:	5623	mW
Power density limit	1	mW/cm ²
Prediction frequency:	76500	MHz

Result

Prediction Frequency (MHz)	Maximum peak EIRP: (mW)	Power density limit (S) (mW/cm ²)	Distance (R) cm required to be less than 1mW/cm ²
76500	5623	1.000000	21.2

HULL

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