

TRaC RADIO TEST REPORT

FOR

Savox

ON

Clarity

DOCUMENT NO. TRA-010248-W-US-3

HULL

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

Applicant : Savox Communications UK

Apparatus : Clarity

Specification(s) : CFR47 Part 15 C 15.247:October 2012

FCCID : TUF078

Purpose of Test : Certification

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:

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1.3 Manufacturer

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1.4 Apparatus Assessed

The following apparatus was assessed between: 04/10/12 and 29/11/12

Clarity

The apparatus is a neck worn radio controller designed to be used with the Savox WPTT containing an IEE 802.15.4 radio module.

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 spurious emissions (Restricted bands)	Title 47 of the CFR: Part 15 Subpart C; 15.247	ANSI C63.10	Pass
Conducted spurious emissions (Non-restricted bands)	Title 47 of the CFR: Part 15 Subpart C; 15.247	ANSI C63.10	Pass
AC Power conducted emissions	Title 47 of the CFR: Part 15 Subpart C; 15.207	ANSI C63.10	Pass
AC Power conducted emissions	Title 47 of the CFR: Part 15 Subpart B; 15.107	ANSI C63.4	Pass
Occupied Bandwidth	Title 47 of the CFR : Part 15 Subpart C; 15.247(a)(2)	ANSI C63.10	Pass
Conducted Carrier Power	Title 47 of the CFR : Part 15 Subpart C; 15.247(b)	ANSI C63.10	Pass
Power Spectral Density	Title 47 of the CFR : Part 15 Subpart C; 15.247(d)	ANSI C63.10	Pass
Unintentional Radiated Spurious Emissions	Title 47 of the CFR: Part 15 Subpart B; 15.109	ANSI C63.4	Pass
Digital Modulation	Title 47 of the CFR: Part 15 Subpart C; 15.403	-	Pass
RF Safety	Title 47 of the CFR : Part 15 Subpart C; 15.247(i)	-	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)	\pm 1.6dB
150 kHz to 30 MHz	Amplitude dB(μ V/m)	\pm 2.1dB
30MHz to 300MHz Horizontal	Amplitude dB(μ V/m)	\pm 5.1dB
30MHz to 300MHz Vertical	Amplitude dB(μ V/m)	\pm 5.2dB
300MHz to 1GHz Horizontal	Amplitude dB(μ V/m)	\pm 5.4dB
300MHz to 1GHz Vertical	Amplitude dB(μ V/m)	\pm 5.2dB
1GHz to 18GHz Horizontal	Amplitude dB(μ V/m)	\pm 4.4dB
1GHz to 18GHz Vertical	Amplitude dB(μ V/m)	\pm 4.4dB
18GHz to 26.5GHz Horizontal	Amplitude dB(μ V/m)	\pm 4.2dB
18GHz to 26.5GHz Vertical	Amplitude dB(μ V/m)	\pm 4.2dB
26.5GHz to 40GHz Horizontal	Amplitude dB(μ V/m)	\pm 4.3dB
26.5GHz to 40GHz Vertical	Amplitude dB(μ V/m)	\pm 4.3dB

Power Line Conducted Emissions

Quantity Range	Quantity	Expanded Uncertainty
9kHz to 150kHz	Amplitude dB(μ V)	\pm 4.2dB
150kHz to 30MHz	Amplitude dB(μ V)	\pm 3.1dB

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 6 dB Bandwidth

Title 47 of the CFR: Part 15 Subpart (c) 15.247(a)(2) requires the measurement of the bandwidth of the transmission between the -6 dB points on the transmitted spectrum.

Test Details	
Regulation	Title 47 of the CFR: Part 15 Subpart (c) 15.247(a)(2)
EUT sample number	S17
Modification state	0
SE in test environment	None
SE isolated from EUT	Test Laptop
EUT set up	Refer to Appendix C

Frequency (MHz)	Measured 6dB Bandwidth (kHz)	Limit (kHz)	Result
2405	1765	>500	Pass
2440	1761	>500	Pass
2480	1734	>500	Pass

Plots of the 6 dB bandwidth are contained in Appendix B of this test report.

A2 Transmitter Peak Output Power

Conducted carrier power was verified using a peak power meter, the EUT transmitting on its lowest, centre and highest carrier frequency in turn.

Test Details	
Regulation	Title 47 of the CFR: Part15 Subpart (c) 15.247(b)(3)
Measurement standard	ANSI C63.10
EUT sample number	S17
Modification state	0
SE in test environment	None
SE isolated from EUT	Test Laptop
EUT set up	Refer to Appendix C

Channel Frequency (MHz)	Conducted Peak Carrier Power (dBm)	Antenna Gain dBi	Radiated Power (W) (EIRP)	Limit (W)	Result
2405	-13.7	0.5	0.00005	1	Pass
2440	-13.9	0.5	0.00005	1	Pass
2480	-13.8	0.5	0.00005	1	Pass

Notes:

Conducted Measurement

Measured Peak Carrier power includes highest gain of any antenna to be used. Highest Gain of any antenna was declared by the client.

Conducted measurements were performed with a temporary antenna connector provided by the client.

A3 Antenna Gain

The conducted output power limit specified in paragraph (b) is based on the use of antennas with directional gains that do not exceed 6dBi

Calculated Antenna Gain

Declared Maximum Antenna Gain dBi	Limit dBi
0.5	6

In general:

The conducted output power limit specified in paragraph 15.247(b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

A4 Transmitter Power Spectral Density

Transmitter Power Spectral Density was verified with the EUT transmitting on its lowest, centre and highest carrier frequency in turn.

Test Details	
Regulation	Title 47 of the CFR: Part15 Subpart (c) 15.247(e)
Measurement standard	ANSI C63.10
EUT sample number	S17
Modification state	0
SE in test environment	None
SE isolated from EUT	Test Laptop
EUT set up	Refer to Appendix C

Channel Frequency (MHz)	Antenna port Peak Power Spectral Density (dBm/3kHz)	Antenna Gain dBi	Peak Power Spectral Density (dBm/3kHz)	Limit (dBm/3kHz)	Result
2405	-38.2	0.5	-37.7	8.0	Pass
2440	-38.5	0.5	-38.0	8.0	Pass
2480	-38.4	0.5	-37.9	8.0	Pass

Notes:

Conducted Measurement

Measured Power Spectral Density includes highest gain of any antenna to be used.

Highest Gain of any antenna to be used = 0.5 dBi

Conducted measurements were performed with a temporary antenna connector provided by the client.

A5 RF Antenna Conducted Spurious Emissions

Measurement of conducted spurious emissions at the antenna port was performed using a peak detector with the RBW set to 100kHz and the VBW>RBW. Frequencies were scanned up through to the 10th harmonic with the EUT transmitting on its lowest, centre and highest carrier frequency in turn.

Test Details TX: 2405 MHz	
Regulation	Title 47 of the CFR: Part 15 Subpart (c) Clause 15.247(d) and Clause 15.205
Measurement standard	ANSI C63.10
Frequency range	9 kHz to 25 GHz
EUT sample number	S17
Modification state	0
SE in test environment	None
SE isolated from EUT	Test Laptop
EUT set up	Refer to Appendix C

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

RF Antenna Conducted Spurious Emissions continued:

Test Details TX: 2440 MHz	
Regulation	Title 47 of the CFR: Part 15 Subpart (c) Clause 15.247(d) and Clause 15.205
Measurement standard	ANSI C63.10
Frequency range	9 kHz to 25 GHz
EUT sample number	S17
Modification state	0
SE in test environment	None
SE isolated from EUT	Test Laptop
EUT set up	Refer to Appendix C

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

RF Antenna Conducted Spurious Emissions continued:

Test Details TX: 2480 MHz	
Regulation	Title 47 of the CFR: Part 15 Subpart (c) Clause 15.247(d) and Clause 15.205
Measurement standard	ANSI C63.10
Frequency range	9 kHz to 25 GHz
EUT sample number	S17
Modification state	0
SE in test environment	None
SE isolated from EUT	Test Laptop
EUT set up	Refer to Appendix C

No emissions were detected within 20 dB of the test limit

Notes:

1. The conducted emission limit for emissions outside the restricted bands, defined in 47CFR Part 15.205(a) are based on a transmitted carrier level of 15.247(b). With the EUT transmitting on its lowest, centre and highest carrier frequencies in turn, emissions from the EUT are required to be 20 dB below the level of the highest fundamental as measured within a 100 kHz RBW in accordance with 15.247(d) using a peak detector.
2. The RBW = 100 kHz, Video bandwidth (VBW) > RBW and the radio spectrum was investigated up to the 10th harmonic in accordance 15.33 (a)(1).
3. The measurements at 2400 MHz and 2483.5 MHz were made to ensure band edge compliance.
4. The carrier level was measured whilst varying the supply voltage between 85% and 105% of the nominal supply voltage as required by 15.31(e). No variation in carrier level was observed. All other emissions were at least 20dB below the test limit

The limit outside the restricted band in 100 kHz RBW is defined using the following formula in accordance with 15.247(d):

$$\text{The limit in 100 kHz RBW} = (\text{Maximum Peak Conducted Carrier measured in 100kHz RBW}) - 20\text{dB}$$

Where:

The maximum peak conducted power was measured using a spectrum analyser using a 100 kHz resolution bandwidth.

Channel No.	Channel Frequency (MHz)	Measured Peak Carrier (dBm)	Measured Peak Carrier -20dB (dBm)	Emission Limit In a 100 kHz RBW (dBm)
11	2425	-10.2	-10.2-20	-30.2
18	2450	-10.1	-10.1-20	-30.1
26	2475	-10.0	-10.0-20	-30

A6 Transmit Radiated Electric Field Emissions 15.209 and within the Restricted Bands of 15.205

Preliminary scans were performed using a peak detector with the RBW = 100kHz below 1GHz and a RBW = 1MHz >1GHz. The radiated electric field emission test applies to spurious emissions and harmonics that fall within the restricted bands listed in Section 15.205. The maximum permitted field strength is listed in Section 15.209. The EUT was set to transmit on its lowest, centre and highest carrier frequency.

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: 2405 MHz	
Regulation	Title 47 of the CFR: Part 15 Subpart C; 15.247 Clause 15.205 and 15.209
Measurement standard	ANSI C63.10
Frequency range	30MHz to 25GHz
EUT sample number	S13
Modification state	0
SE in test environment	None
SE isolated from EUT	Test Laptop
EUT set up	Refer to Appendix C

The worst case radiated emission measurements for spurious emissions:

TX 2405 MHz											
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)	Duty cycle correction (dB)	FIELD ST'GH (dBµV/m)	LIMIT (dBµV/m)
1	2400	Pk	47.6	5.3	29.6	34.6	47.9	-9.5	N/A	-38.5	56.1

Emission at 2400 MHz was to determine band edge compliance, the limit is based on the measured peak carrier field strength.

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

Test Details: 2440 MHz	
Regulation	Title 47 of the CFR: Part 15 Subpart (b) Clause 15.209
Measurement standard	ANSI C63.10
Frequency range	30MHz to 25 GHz
EUT sample number	S13
Modification state	0
SE in test environment	None
SE isolated from EUT	Test Laptop
EUT set up	Refer to Appendix C

The worst case radiated emission measurements for spurious emissions:

TX 2440 MHz											
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)	Duty cycle correction (dB)	FIELD ST'GH (dBμV/m)	LIMIT (dBμV/m)
1	All emissions were at least 20 dB below the test limit.										

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

Test Details: 2480 MHz	
Regulation	Title 47 of the CFR: Part 15 Subpart (b) Clause 15.209
Measurement standard	ANSI C63.10
Frequency range	30MHz to 25 GHz
EUT sample number	S13
Modification state	0
SE in test environment	None
SE isolated from EUT	Test Laptop
EUT set up	Refer to Appendix C

The worst case radiated emission measurements for spurious emissions:

TX 2480 MHz											
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)	Duty cycle correction (dB)	FIELD ST'GH (dBµV/m)	LIMIT (dBµV/m)
1	2483.5	Av	48.2	4.9	29.9	34.6	48.4	-9.5	N/A	38.9	54.0

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

Test Details: Radiated Carrier (dBuV/m)	
Regulation	Title 47 of the CFR: Part 15 Subpart (c) Clause 15.209
Measurement standard	ANSI C63.10
Frequency range	2405MHz, 2440MHz and 2480MHz
EUT sample number	S13
Modification state	0
SE in test environment	None
SE isolated from EUT	Test Laptop
EUT set up	Refer to Appendix C

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	2405.000	Pk	51.1	4.9	29.6	0	85.6	-9.5	76.1	137.0
2	2440.000	Pk	51.6	4.7	29.8	0	86.1	-9.5	76.6	137.0
3	2480.000	Pk	51.2	4.9	29.9	0	86.0	-9.5	76.5	137.0

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
- 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= 100 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= 1 MHz, VBW = 10 Hz or using an average detector.

These settings as per ANSI C63.10

The upper and lower frequency of the measurement range was decided according to 47 CFR Part 15: Clauses 15.33(a) and 15.33(a)(1).

Limits

Radiated emission limits (47 CFR Part 15: Clause 15.209) for emissions falling within the restricted bands defined in 15.205(a):

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				

A7 ac Power Line Conducted Emissions (15.207)

No ac Power Line emissions were performed as the EUT is exclusively battery powered.

A8 Unintentional Radiated Electric Field Emissions - 15.109 (Receiver/Digital circuitry)

Preliminary scans were performed using a peak detector with the RBW = 100kHz. The maximum permitted field strength is listed in Section 15.109. The EUT was set to receive mode only on its lowest, centre and highest carrier frequency in turn.

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 :

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	30MHz to 25 GHz
EUT sample number	S13
Modification state	0
SE in test environment	None
SE isolated from EUT	Test Laptop
EUT set up	Refer to Appendix C

No emissions were found within 20 dB of the emissions limit.

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.				

A9 ac Power Line Conducted Emissions 15.107 (Receiver/Digital circuitry)

No ac Power Line emissions were performed as the EUT is exclusively battery powered

Appendix B:

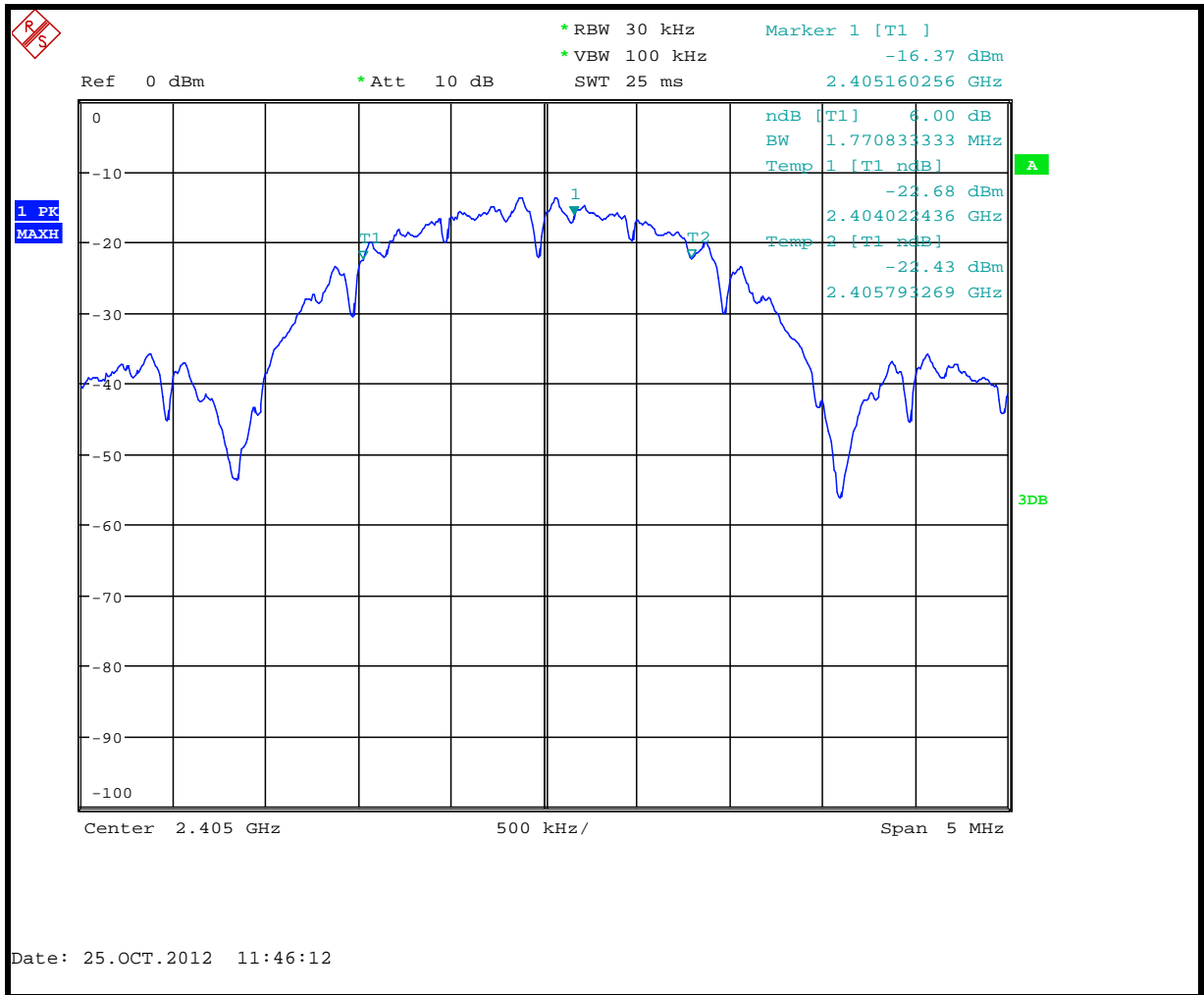
Supporting Graphical Data

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.

B1 Conducted Graphical Data



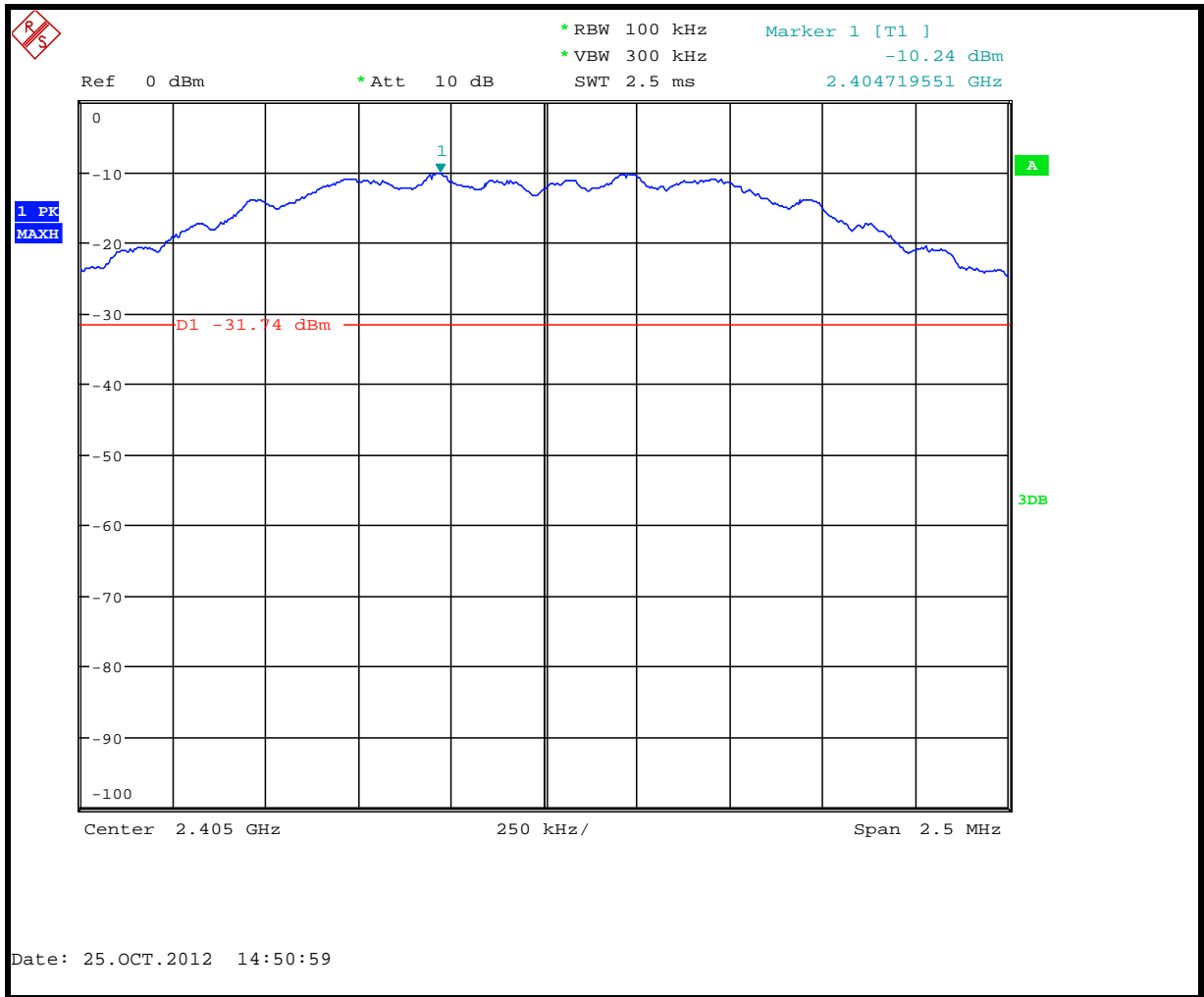
6dB Bandwidth: Channel 11 2405MHz



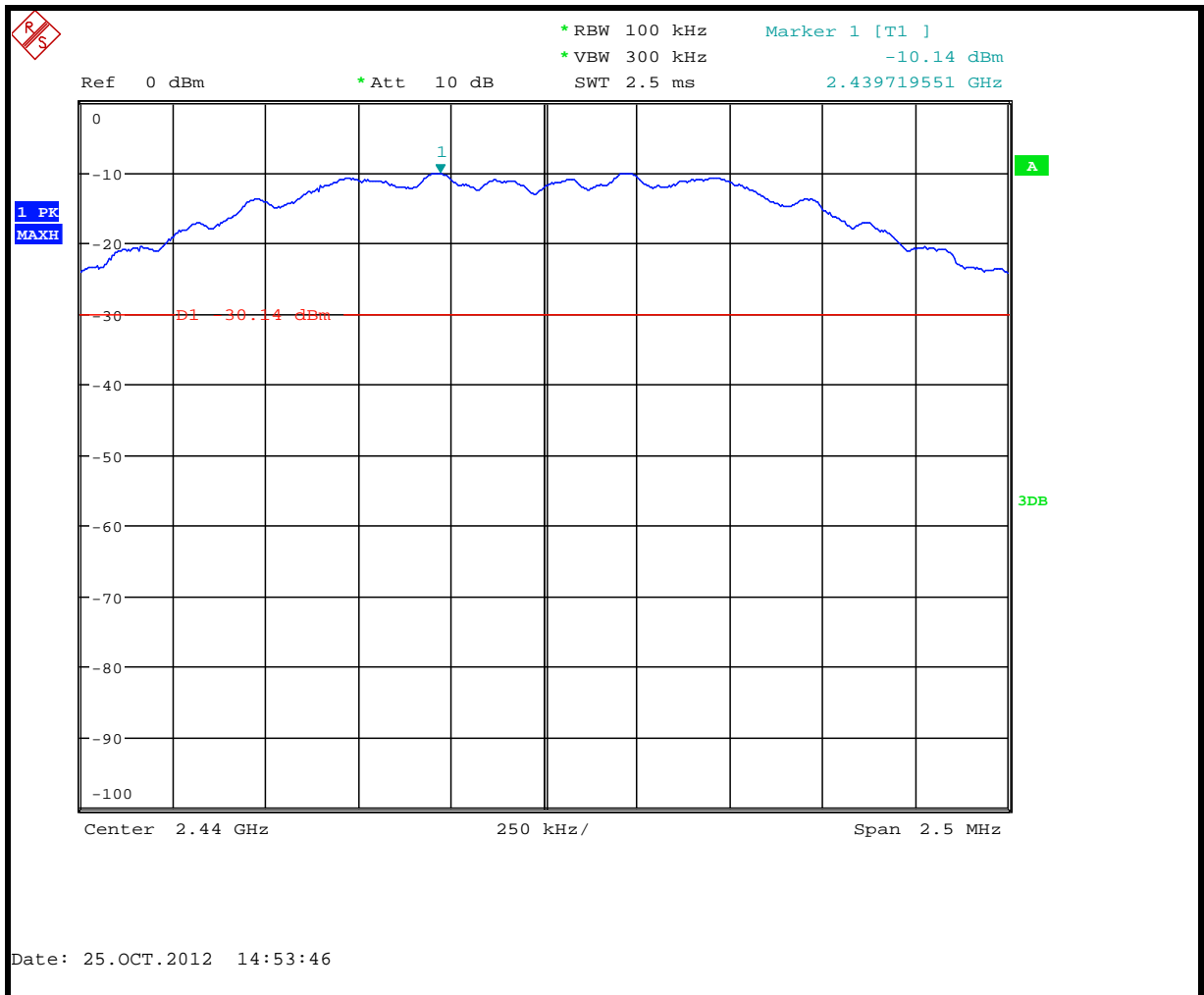
6dB Bandwidth: Channel 18 2440MHz



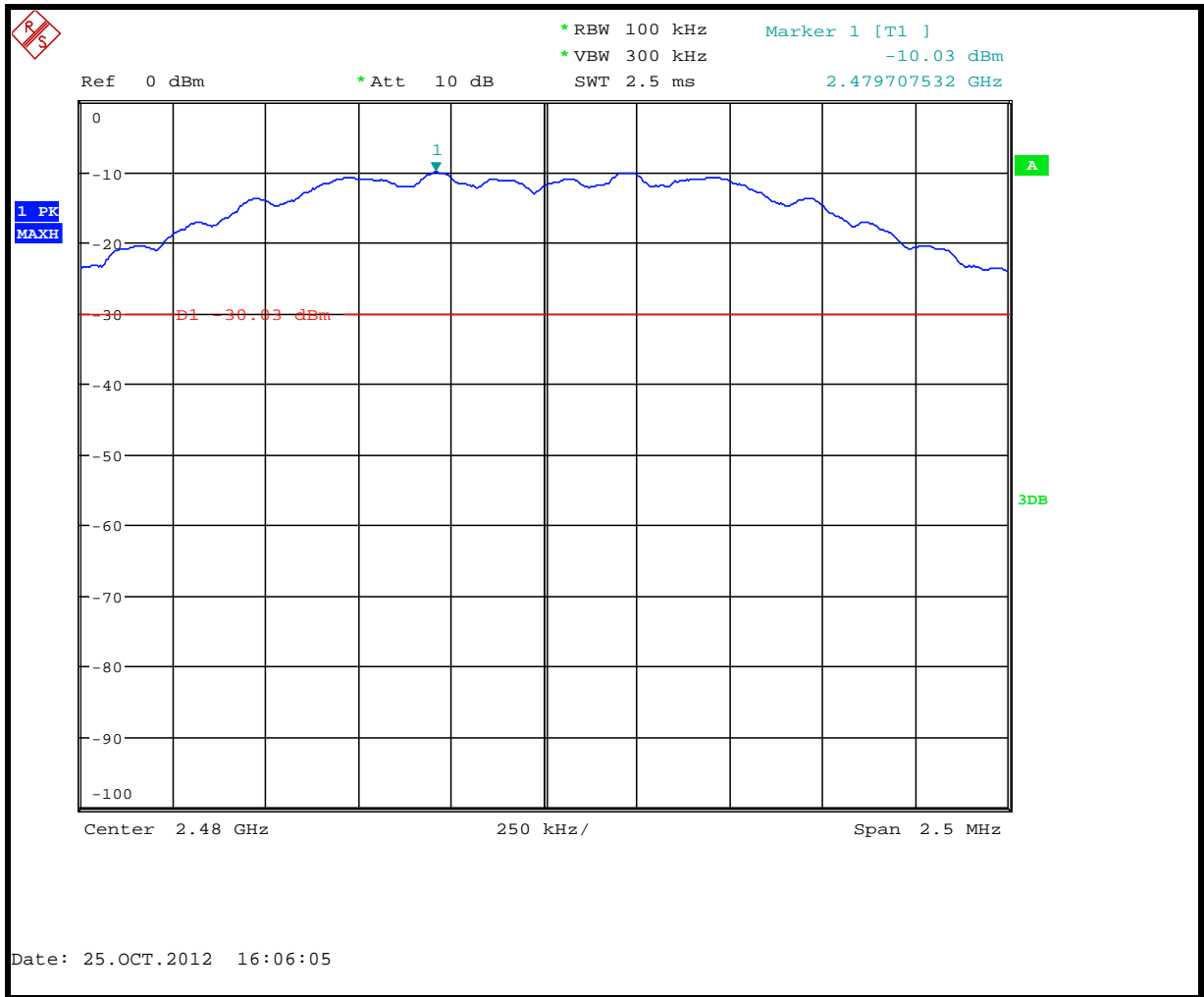
6dB Bandwidth: Channel 26 2480MHz



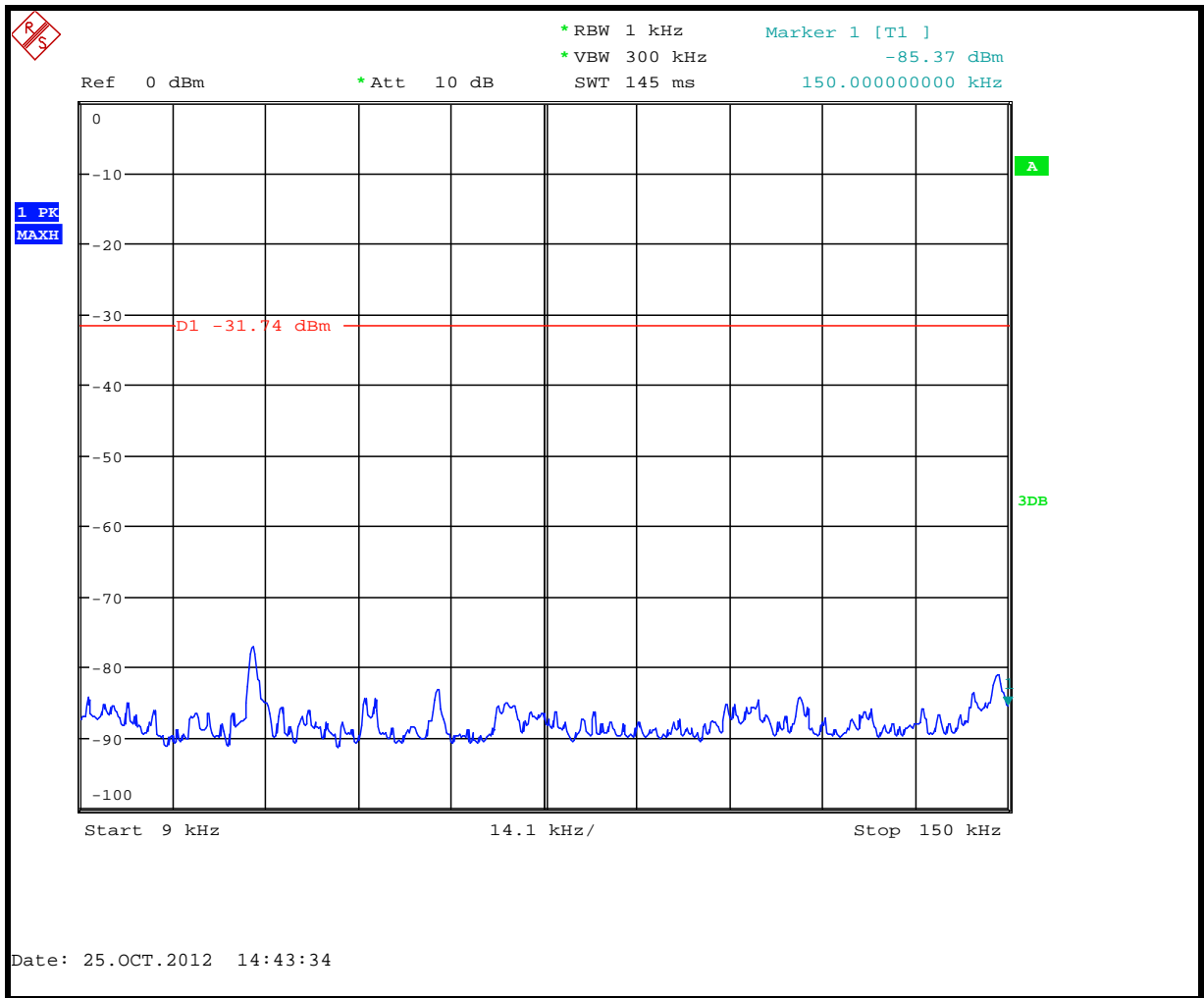
Power Spectral Density: Channel 11 2405MHz



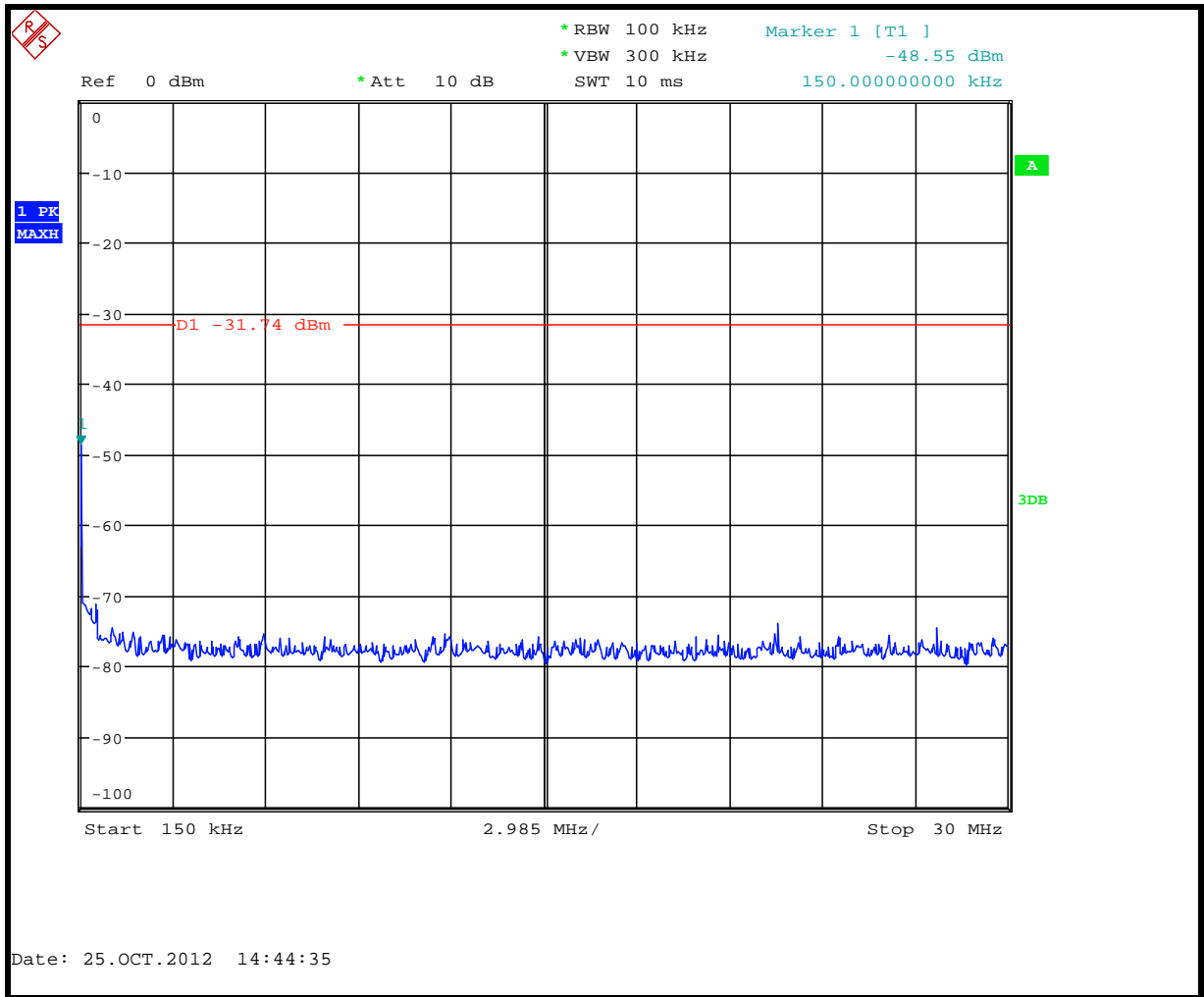
Power Spectral Density: Channel 18 2440MHz



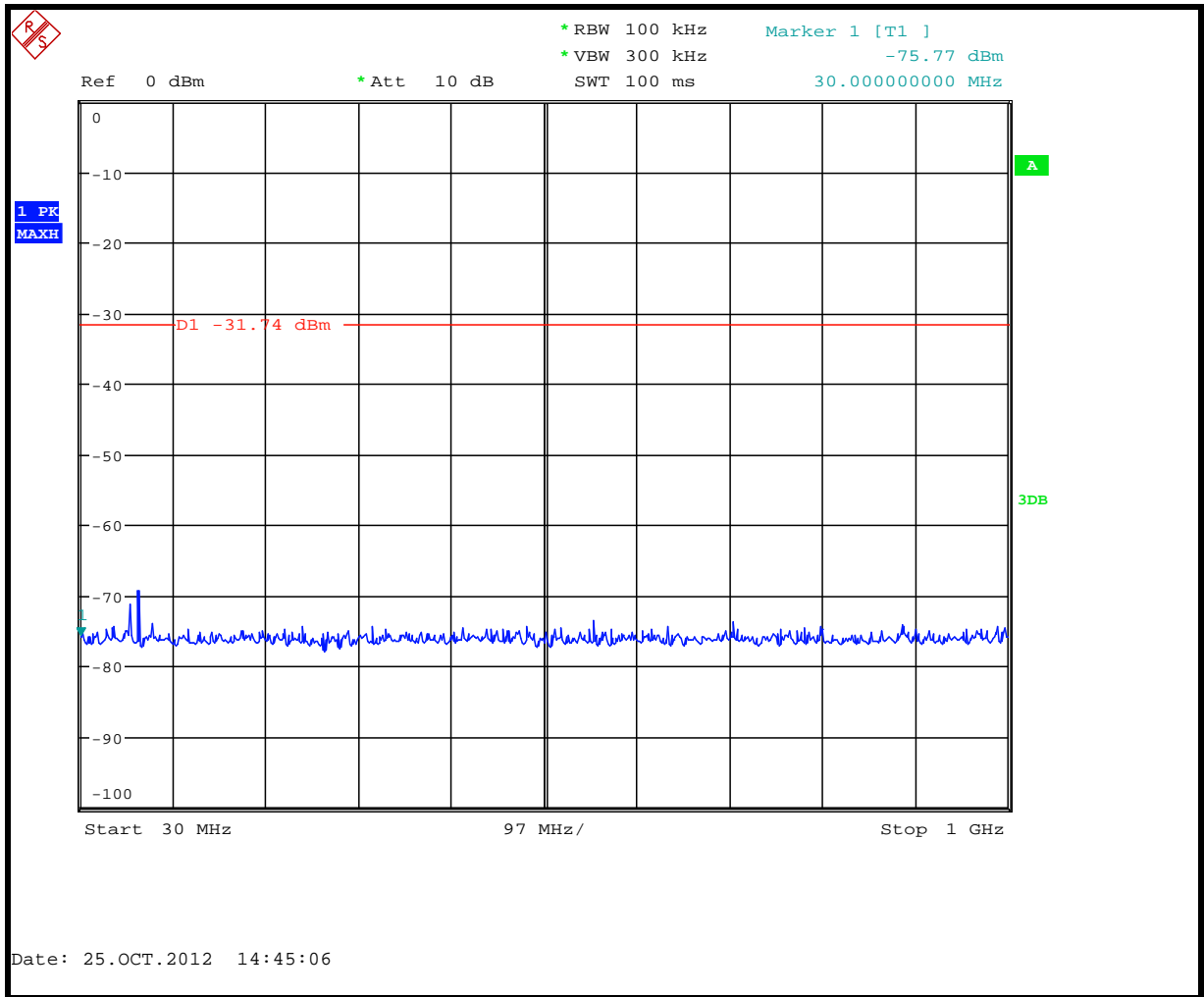
Power Spectral Density: Channel 26 2480MHz



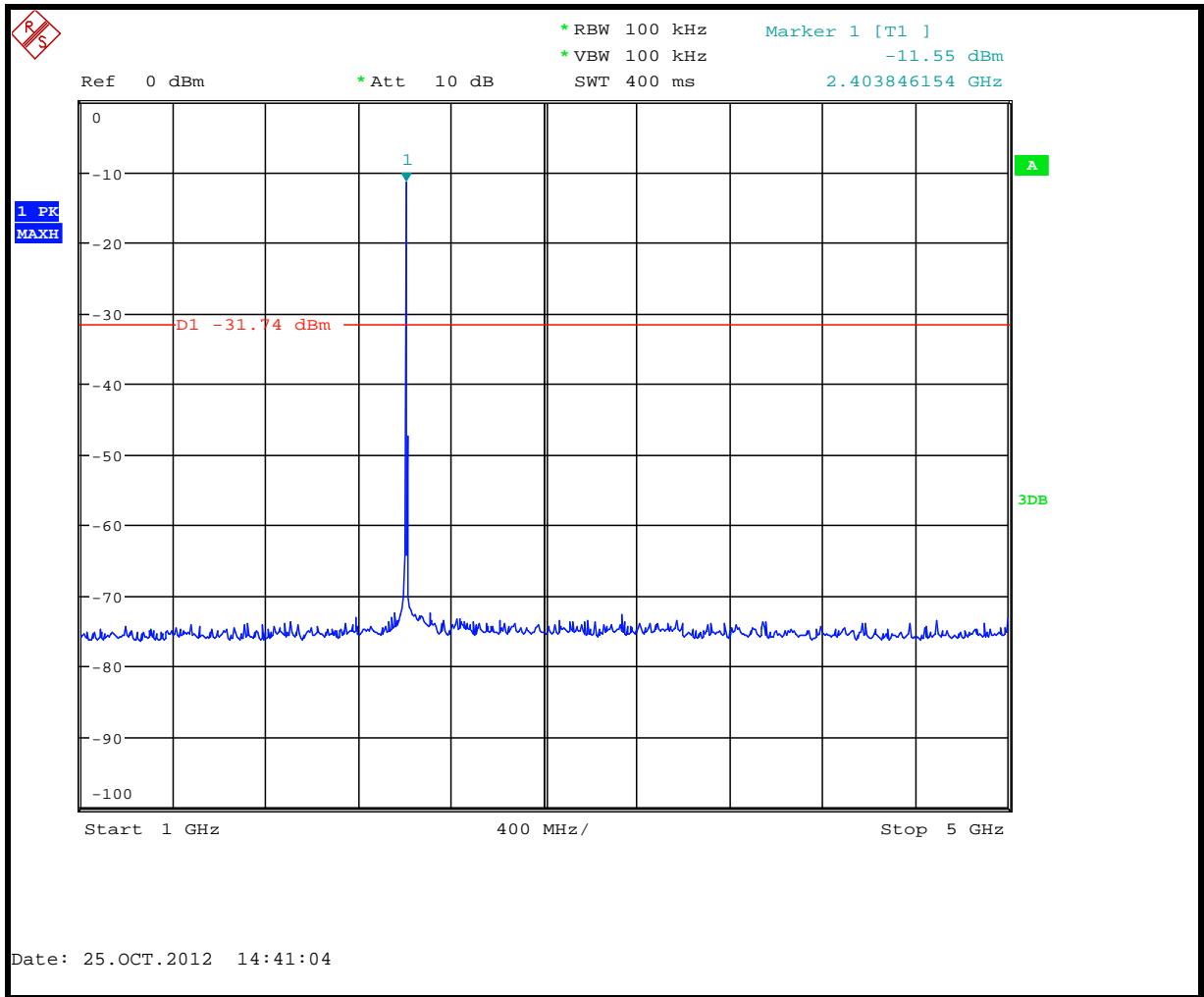
Conducted Emissions Channel 11 2405MHz



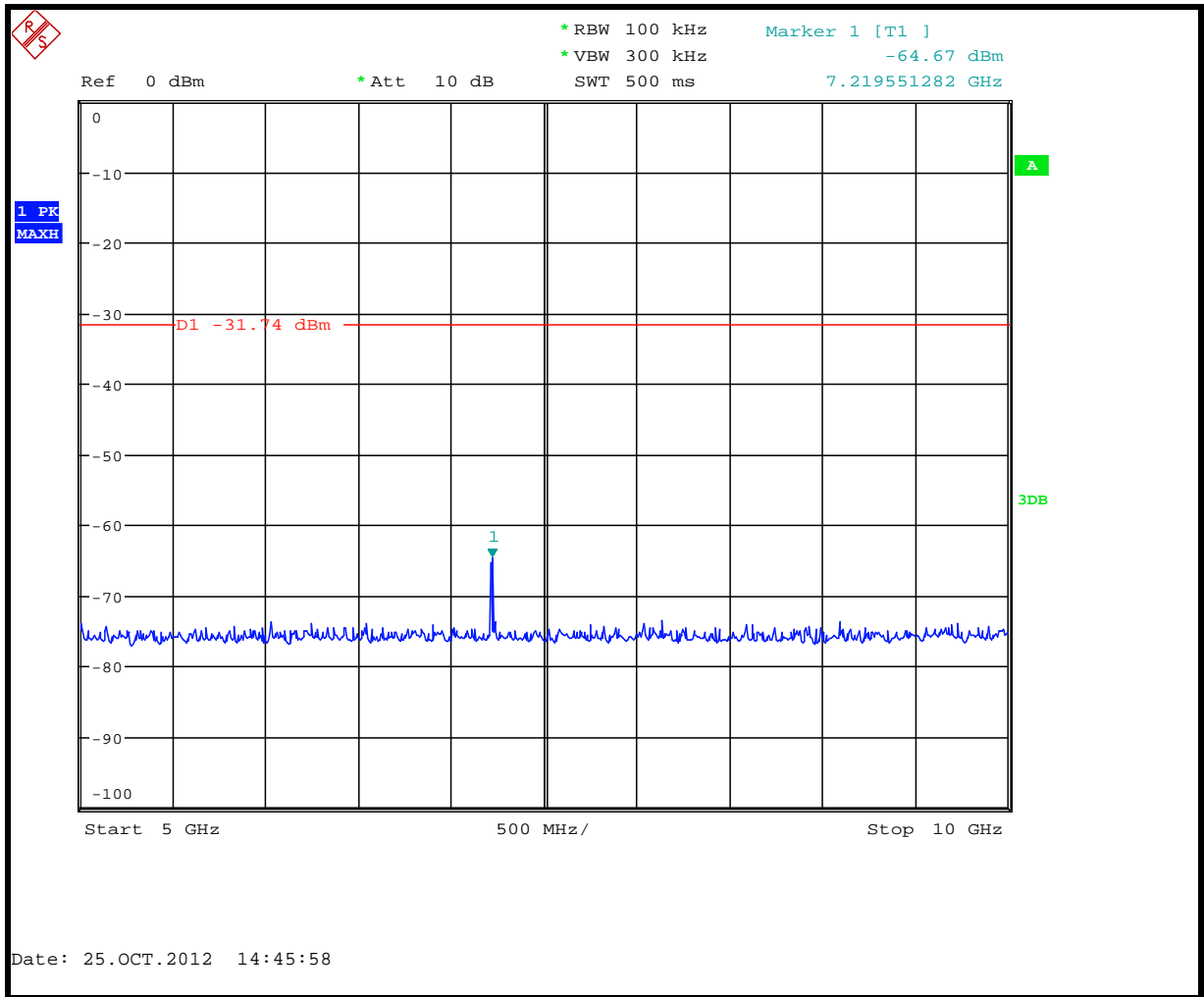
Conducted Emissions Channel 11 2405MHz



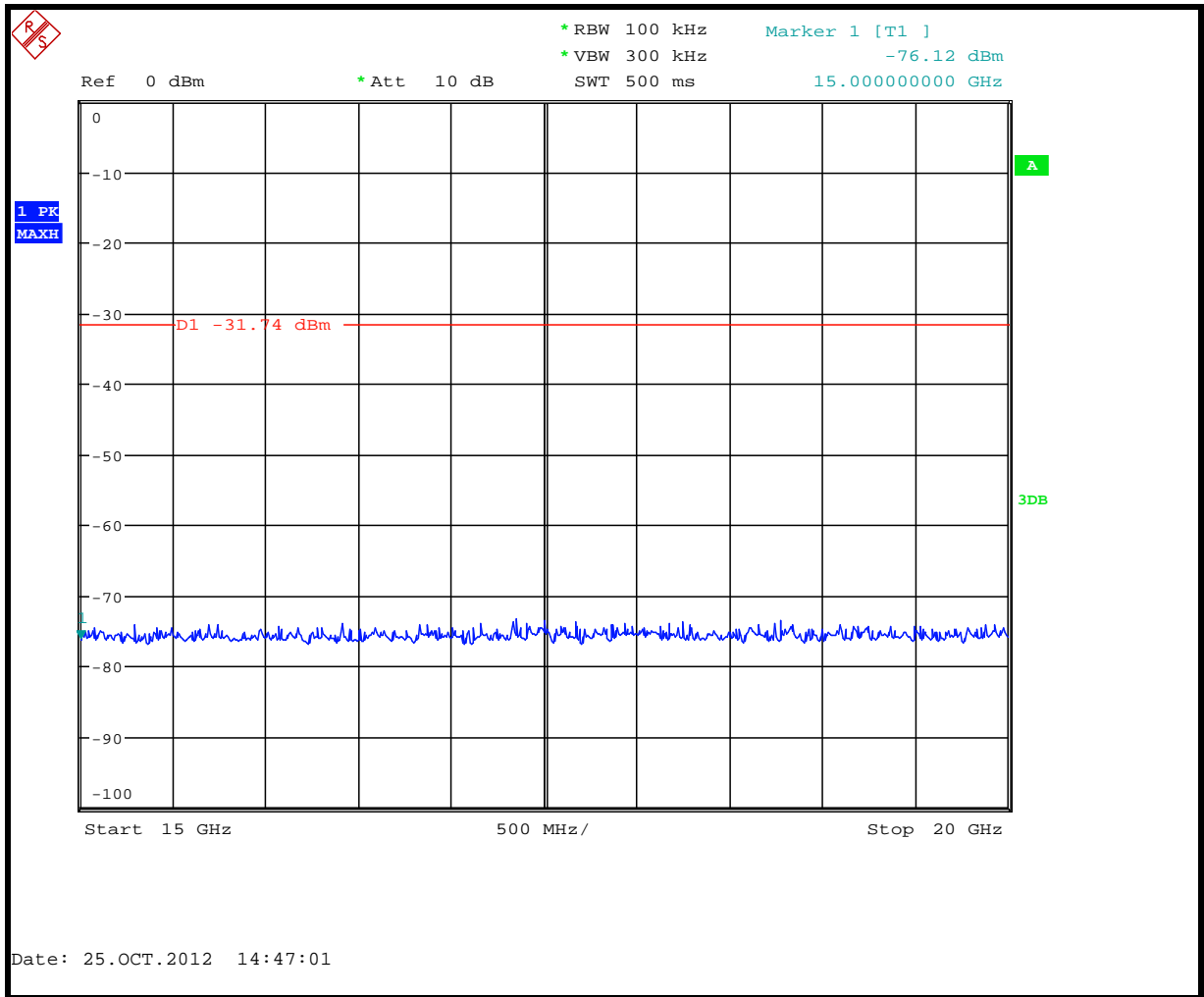
Conducted Emissions Channel 11 2405MHz



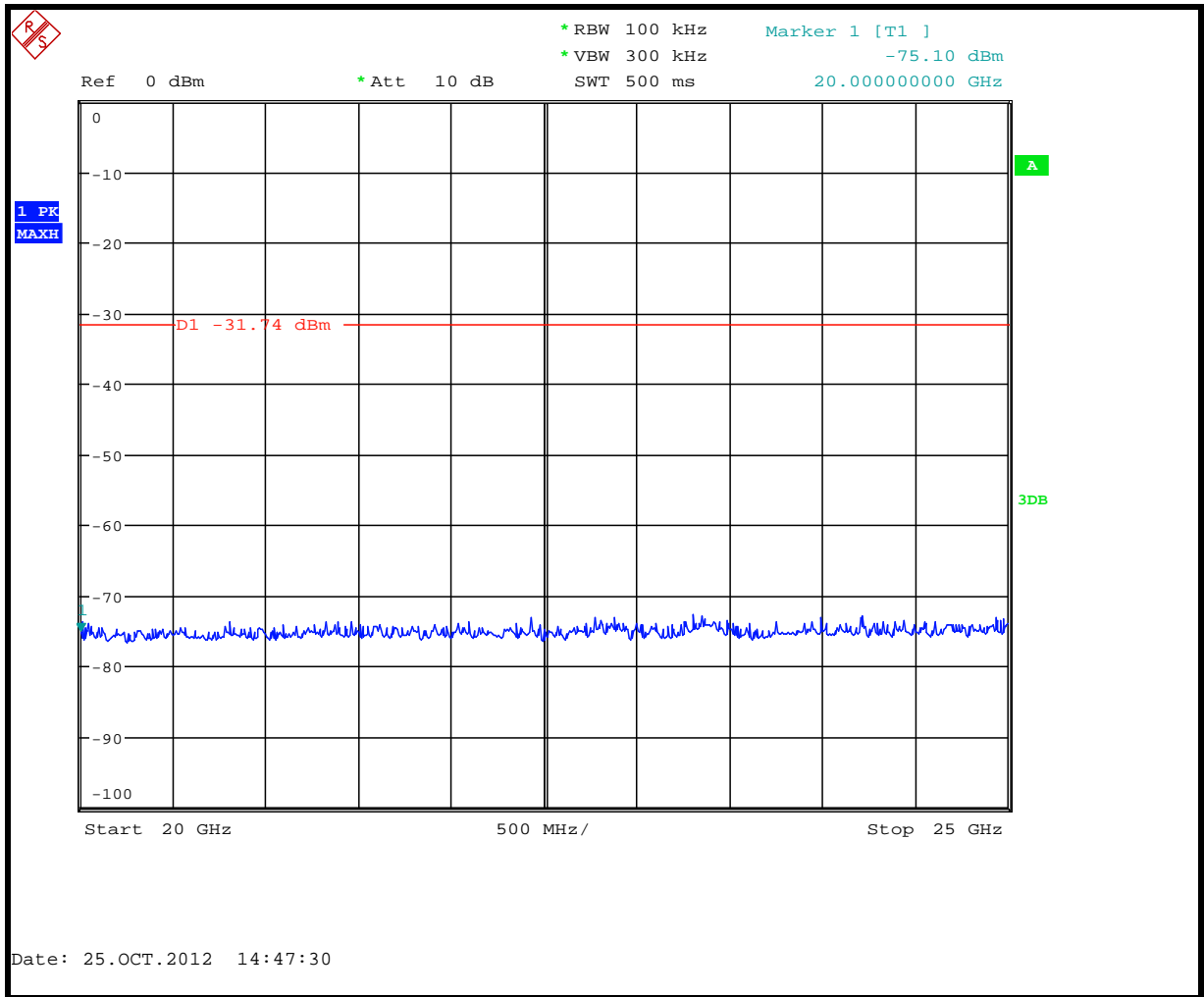
Conducted Emissions Channel 11 2405MHz



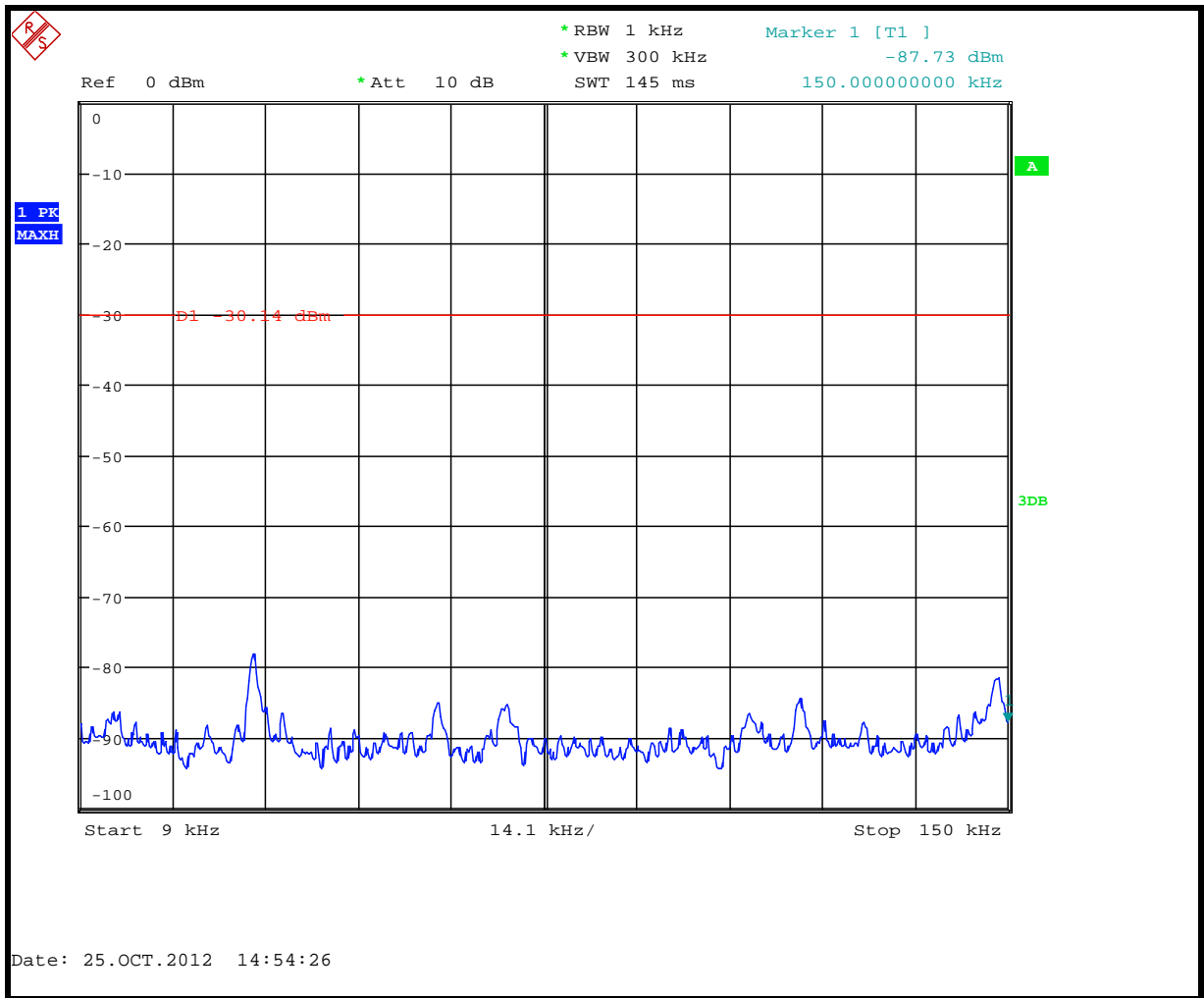
Conducted Emissions Channel 11 2405MHz



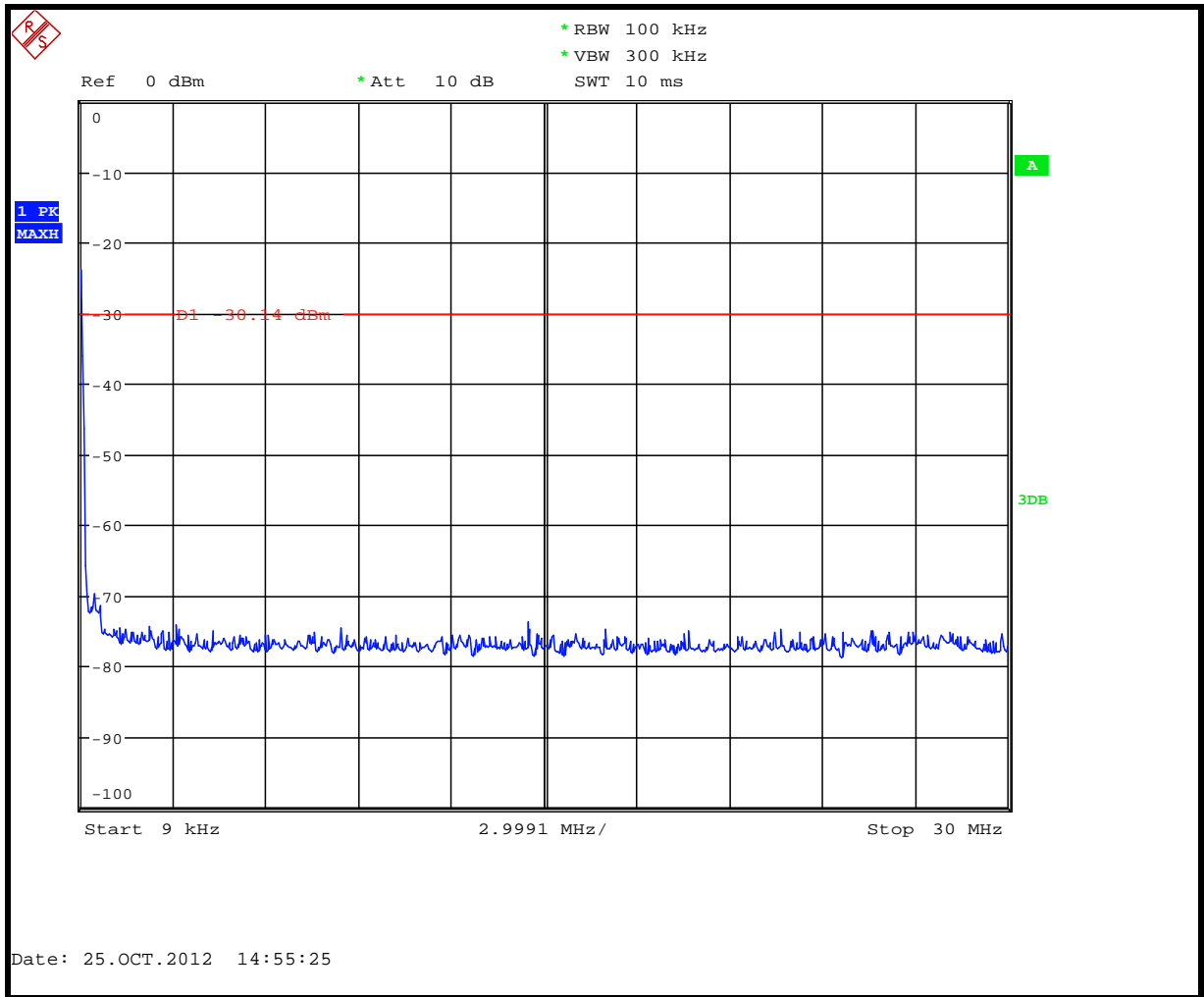
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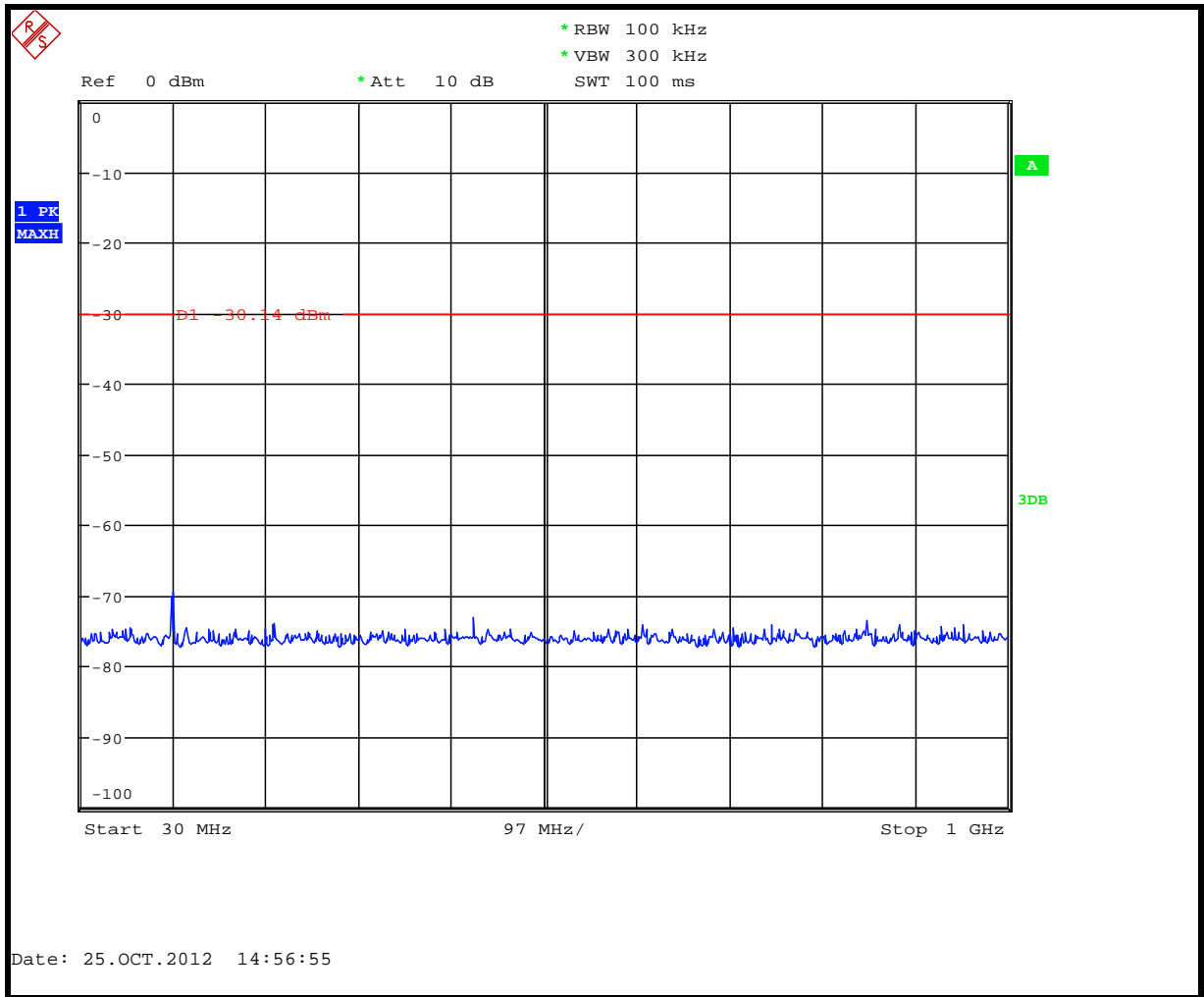
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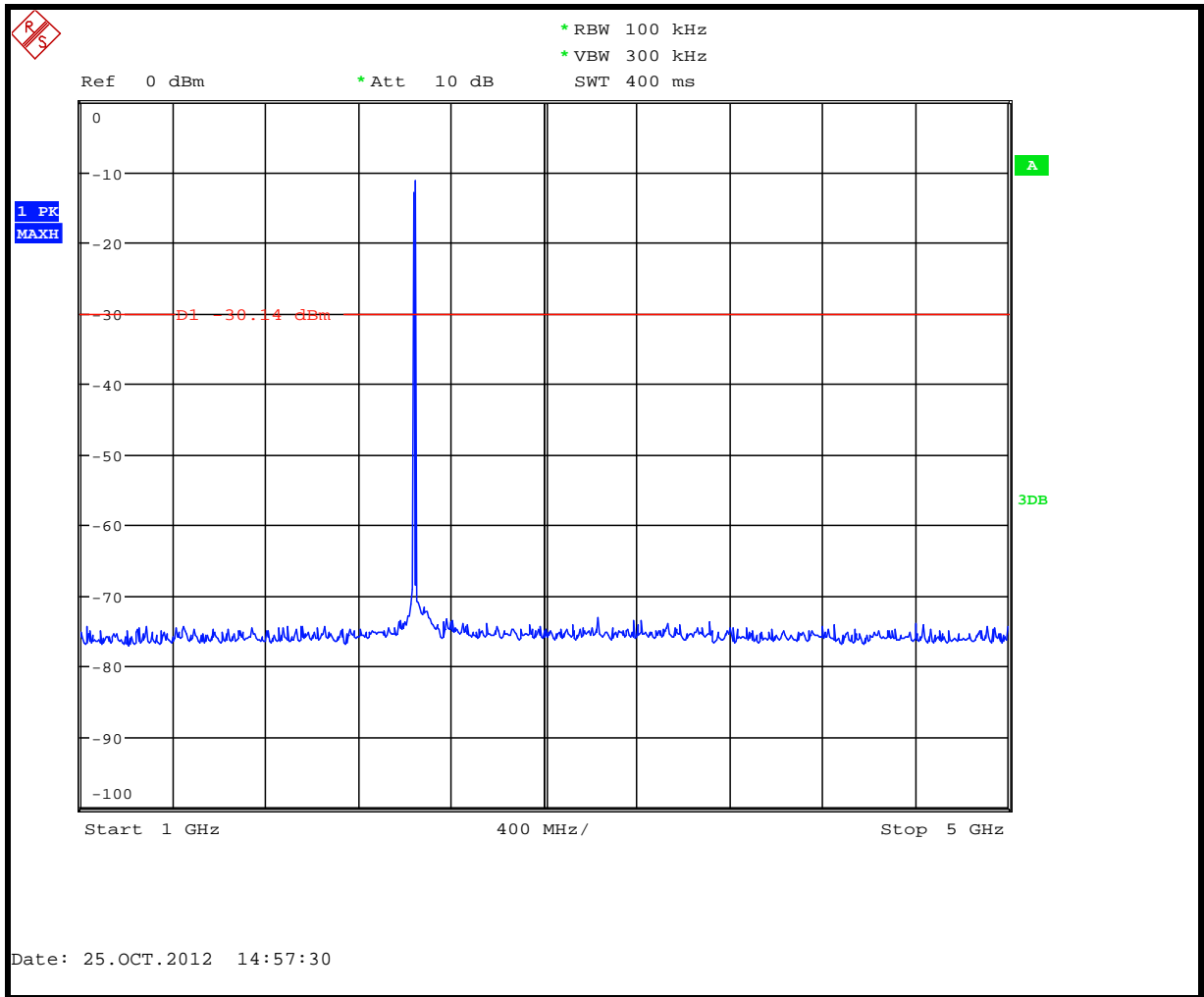
Conducted Emissions Channel 18 2440MHz



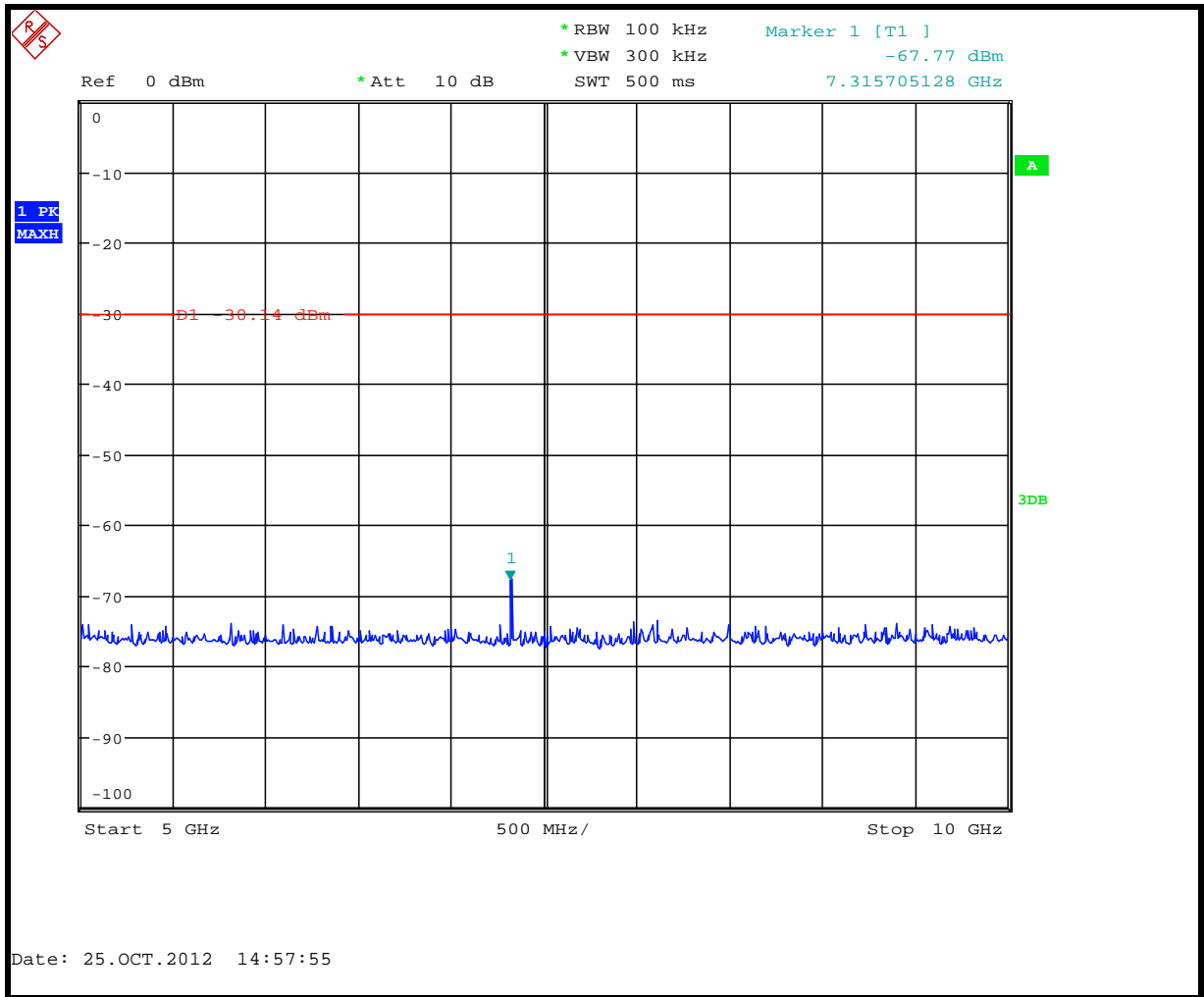
Conducted Emissions Channel 18 2440MHz



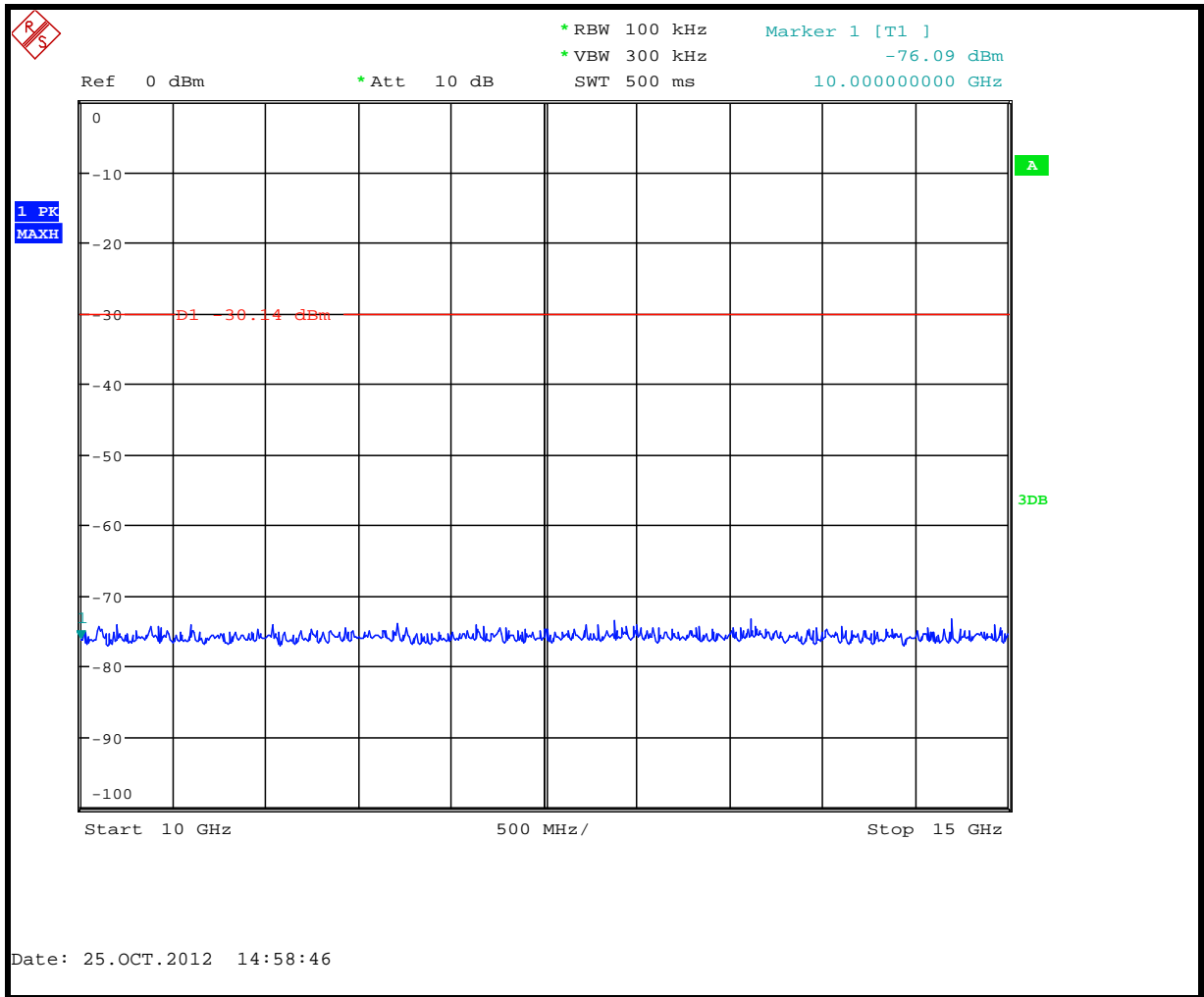
Conducted Emissions Channel 18 2440MHz



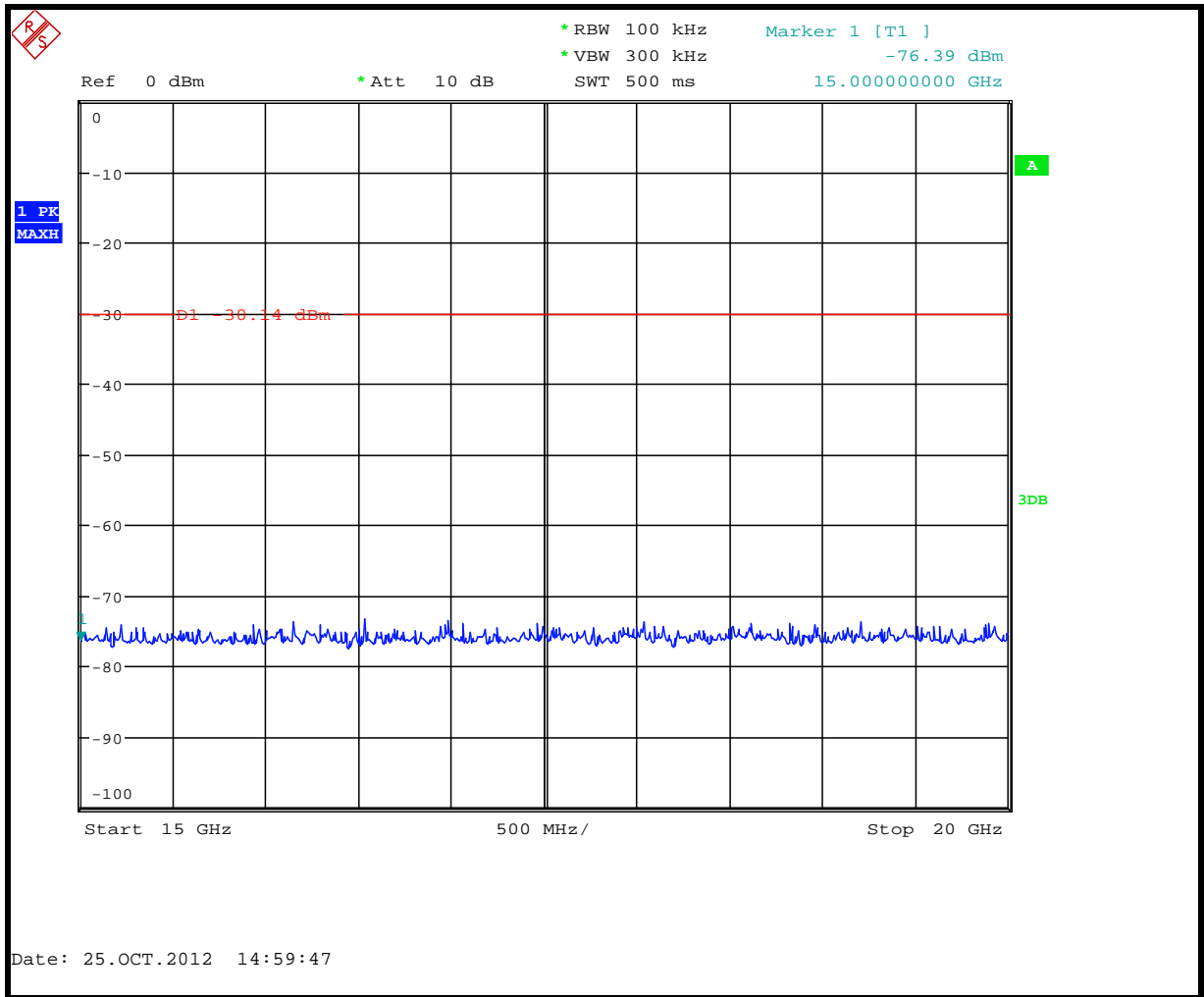
Conducted Emissions Channel 18 2440MHz



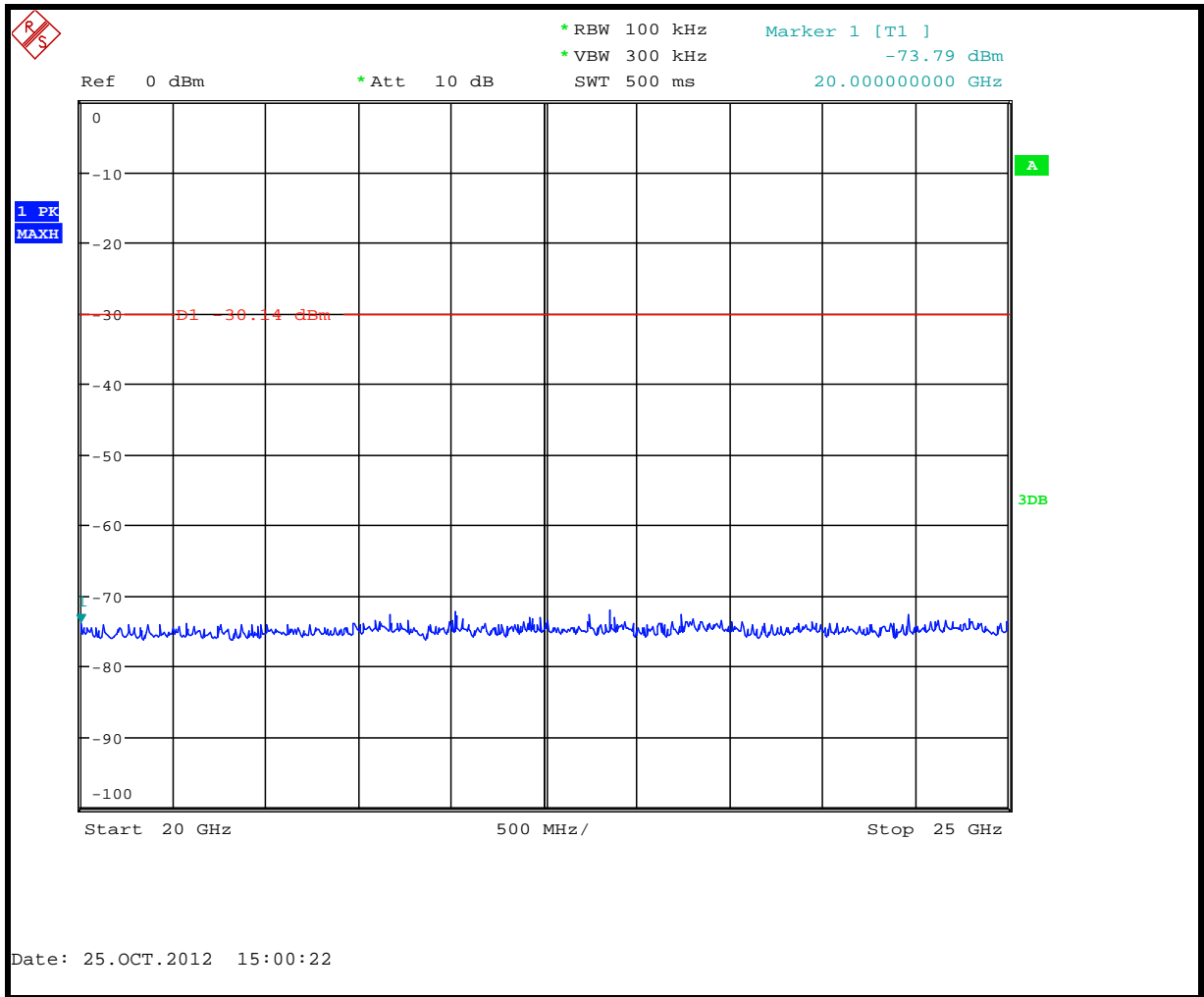
Conducted Emissions Channel 18 2440MHz



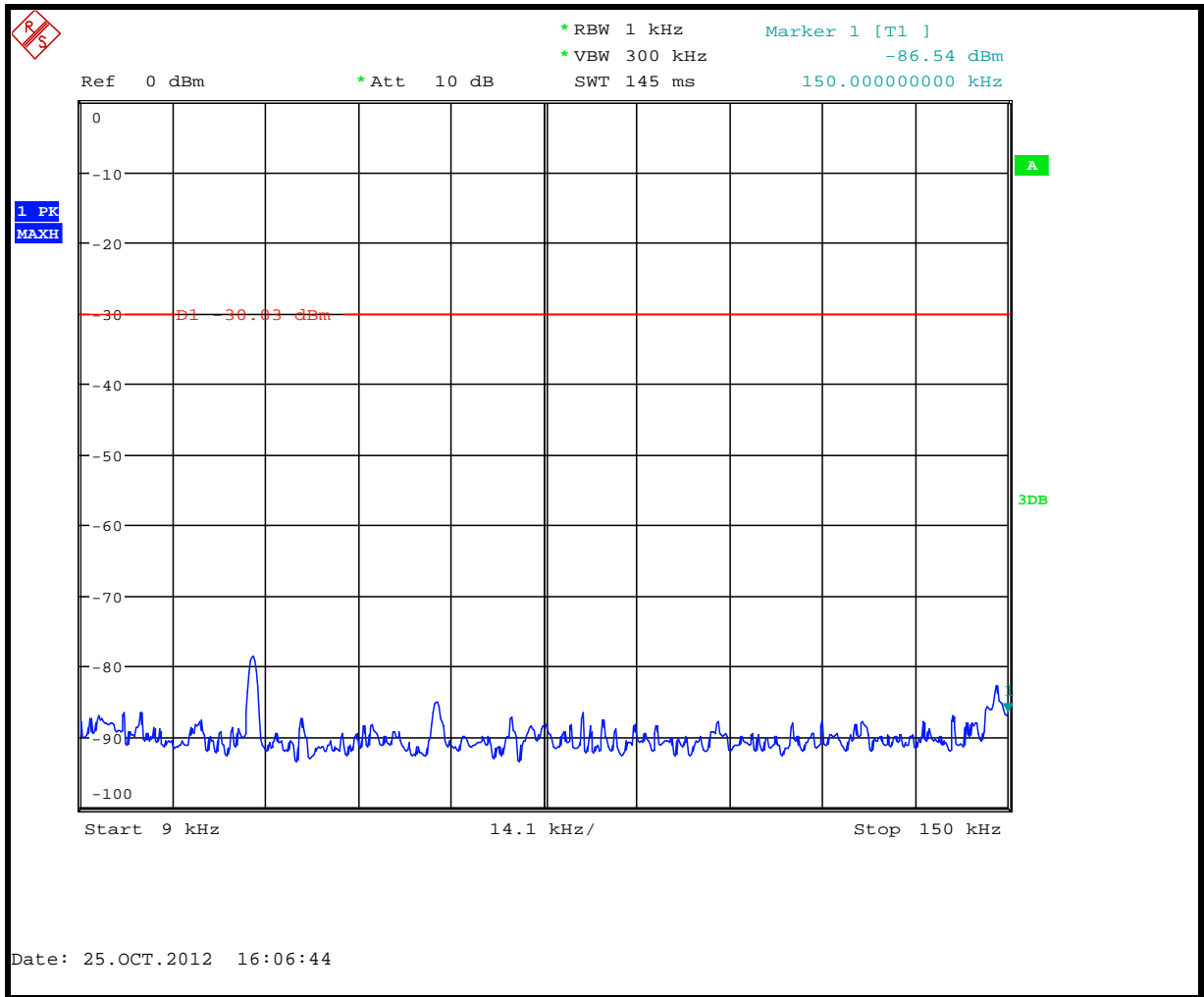
Conducted Emissions Channel 18 2440MHz



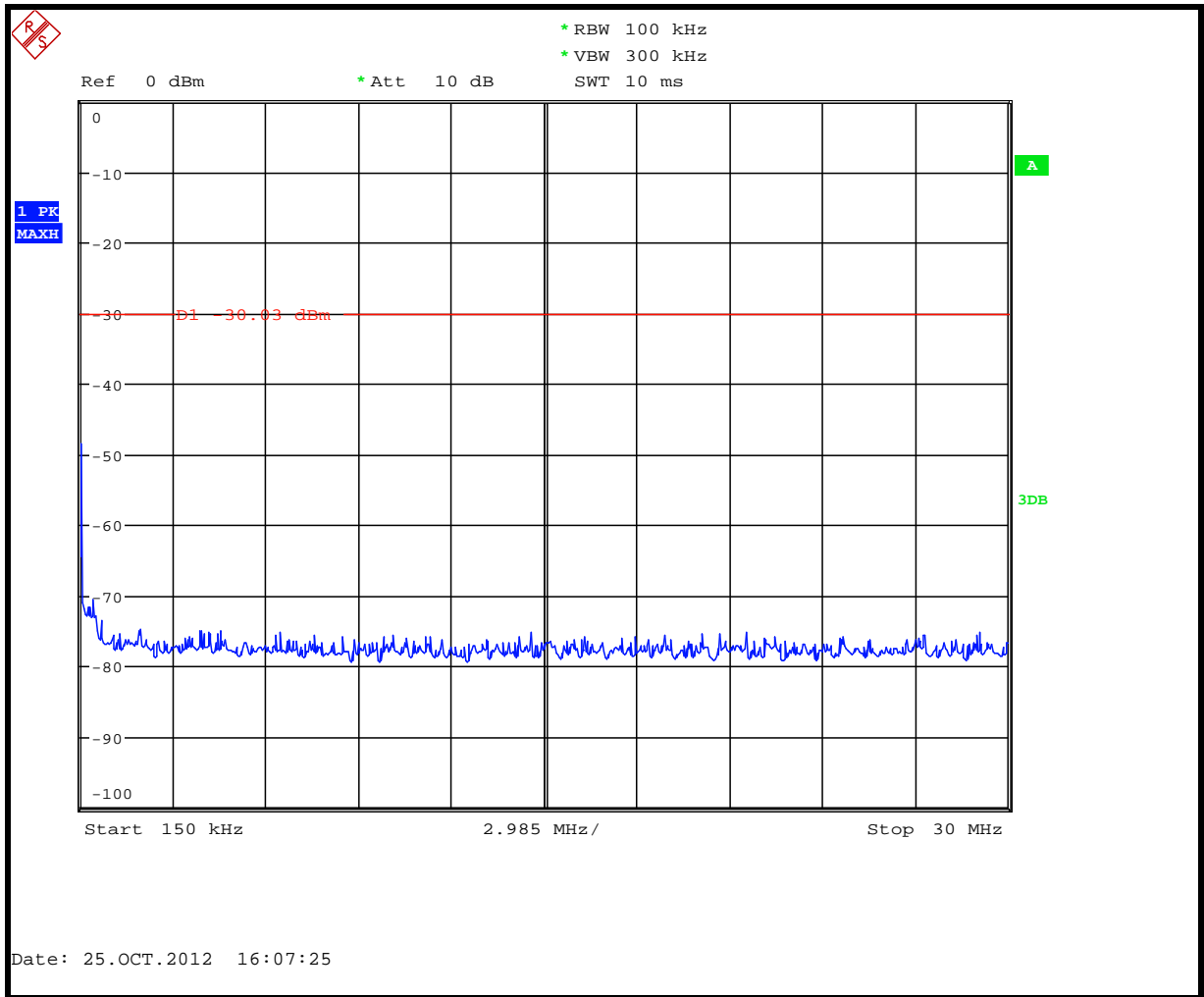
Conducted Emissions Channel 18 2440MHz



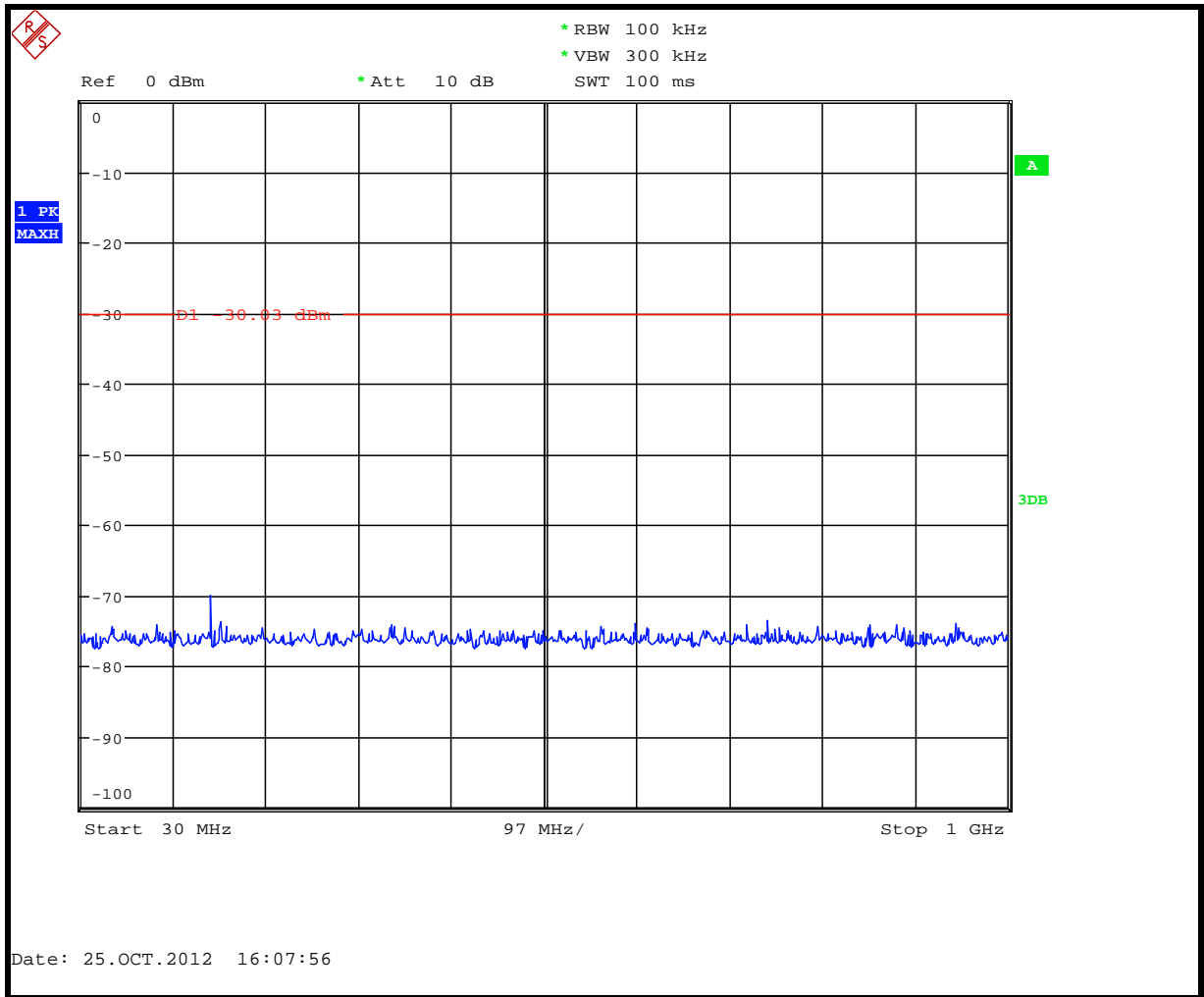
Conducted Emissions Channel 18 2440MHz



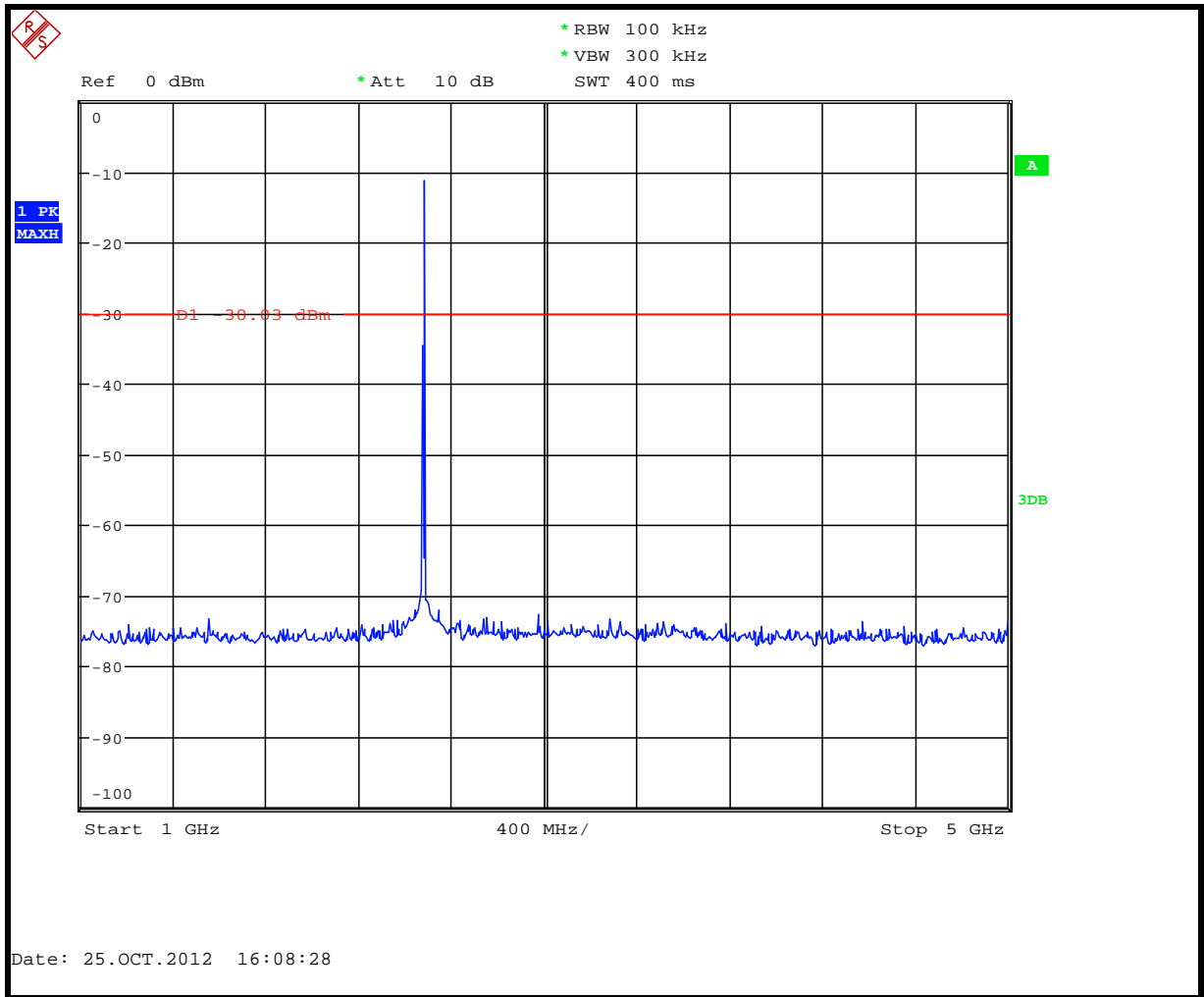
Conducted Emissions Channel 26 2480MHz



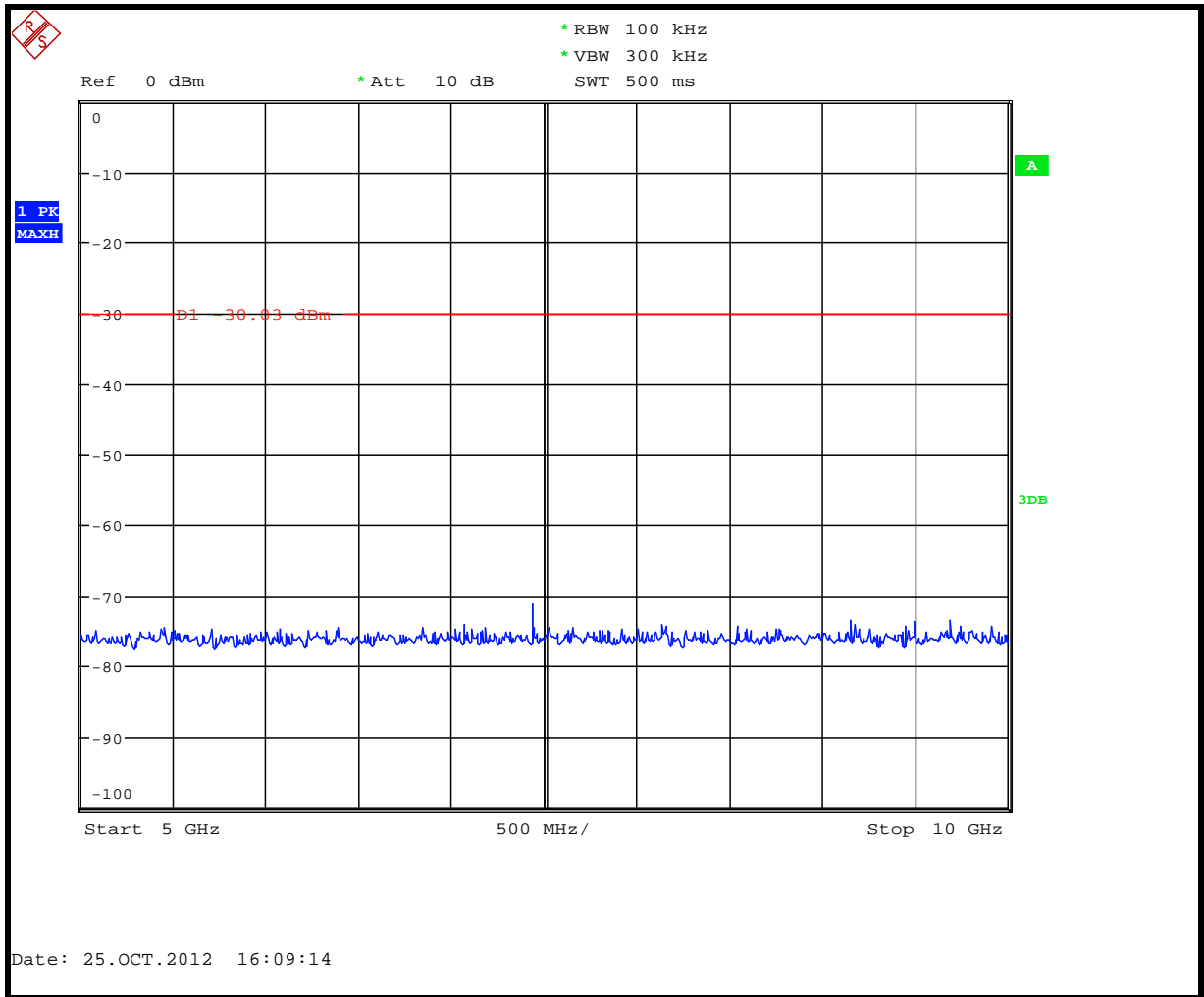
Conducted Emissions Channel 26 2480MHz



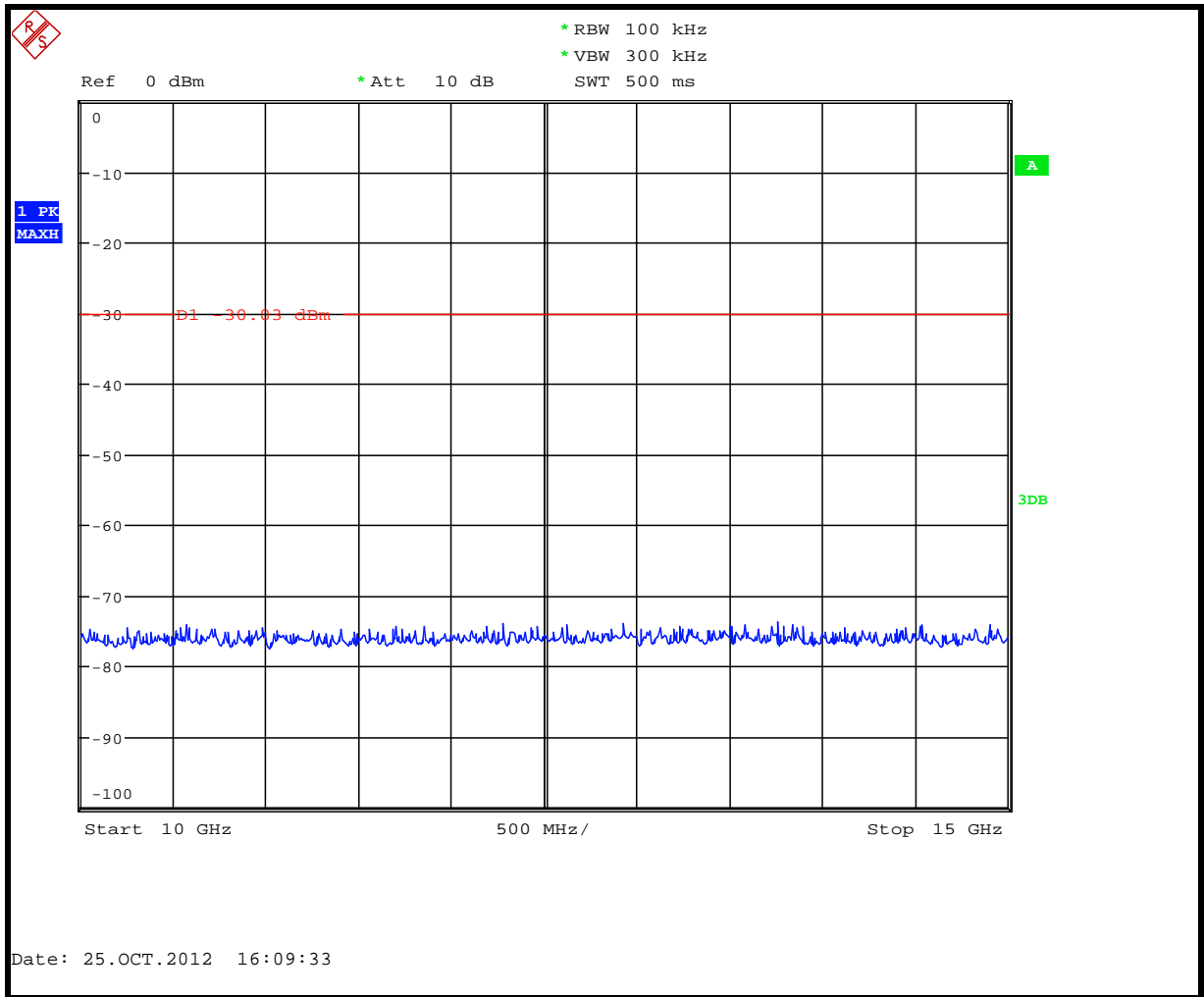
Conducted Emissions Channel 26 2480MHz



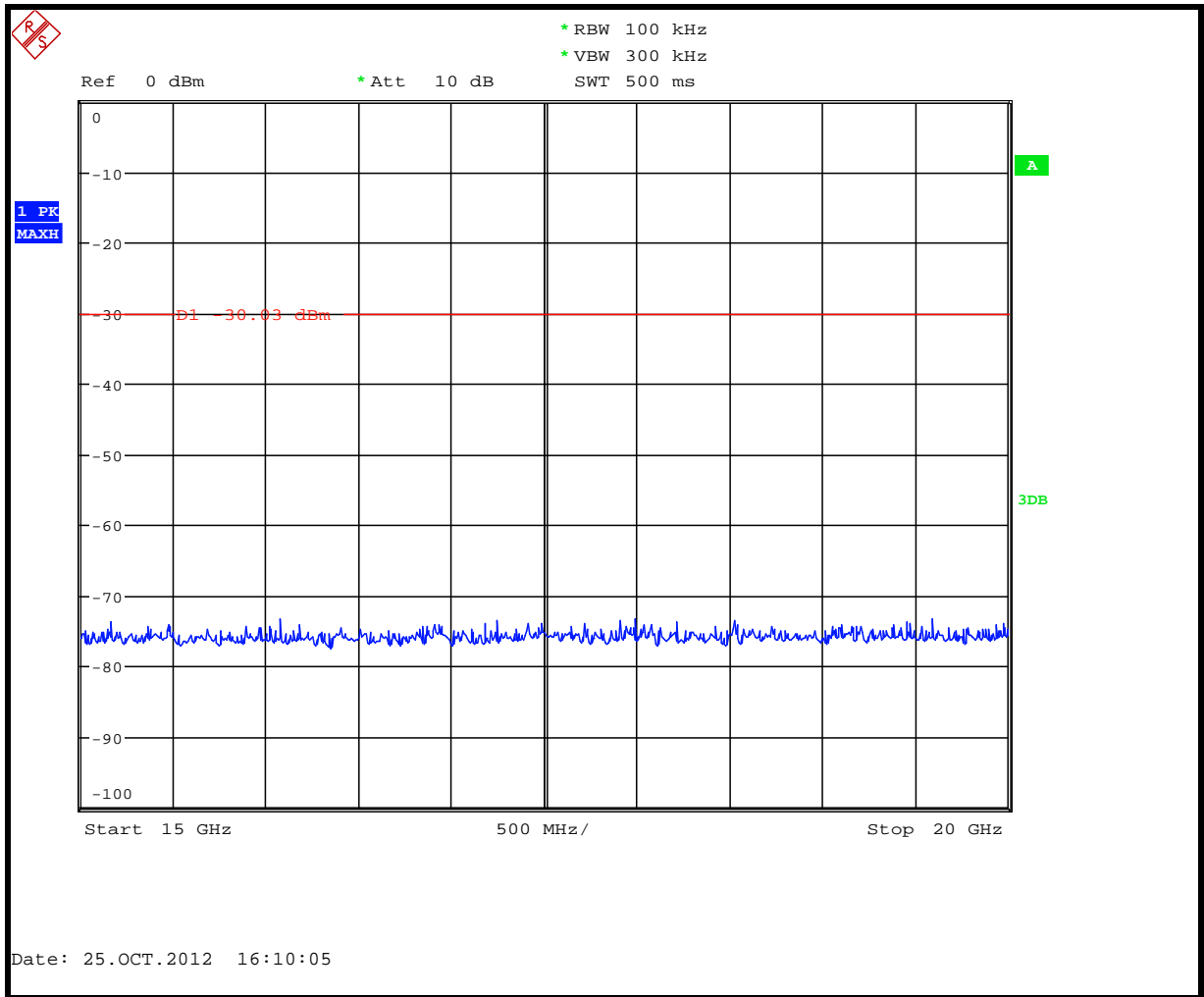
Conducted Emissions Channel 26 2480MHz



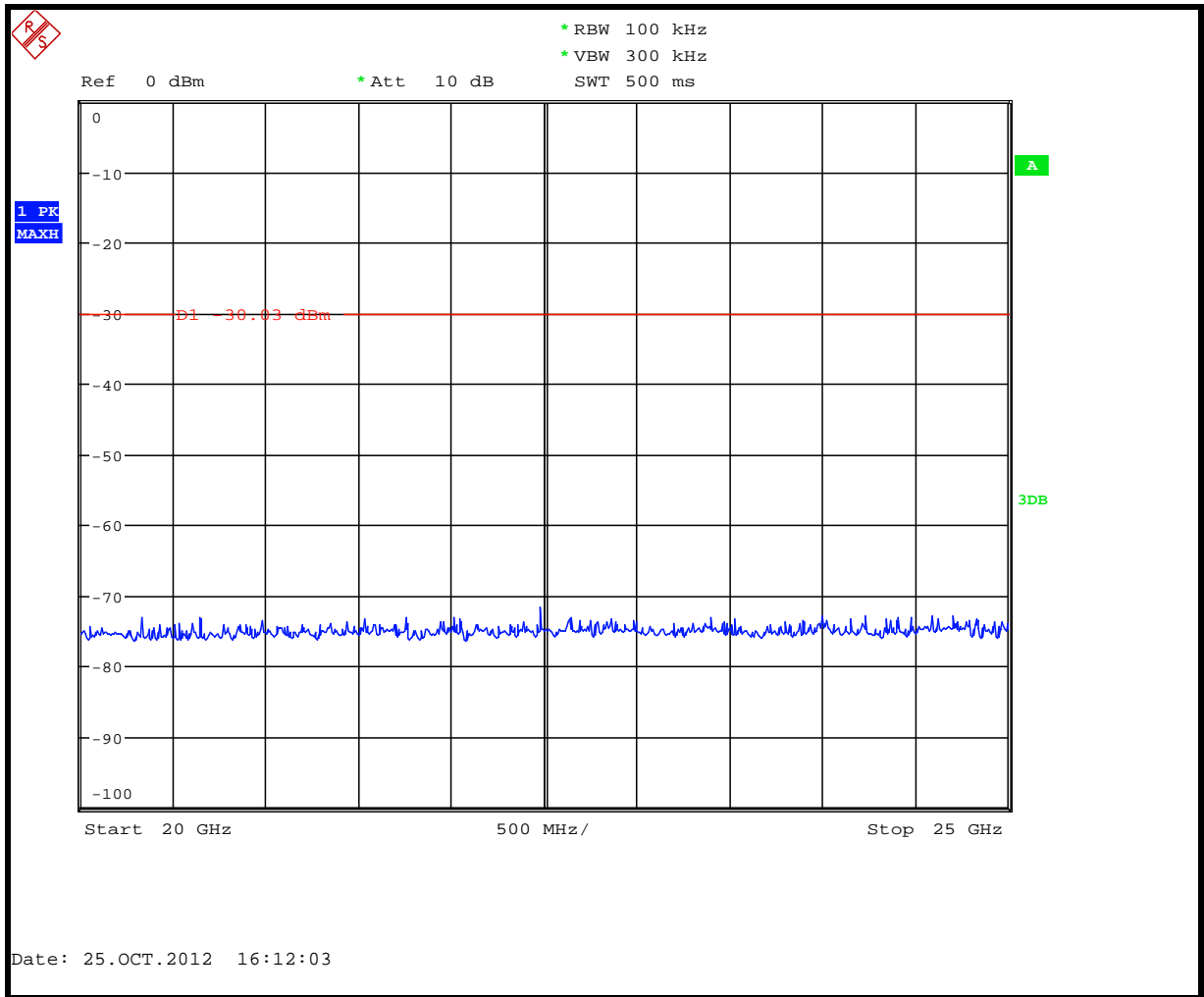
Conducted Emissions Channel 26 2480MHz



Conducted Emissions Channel 26 2480MHz

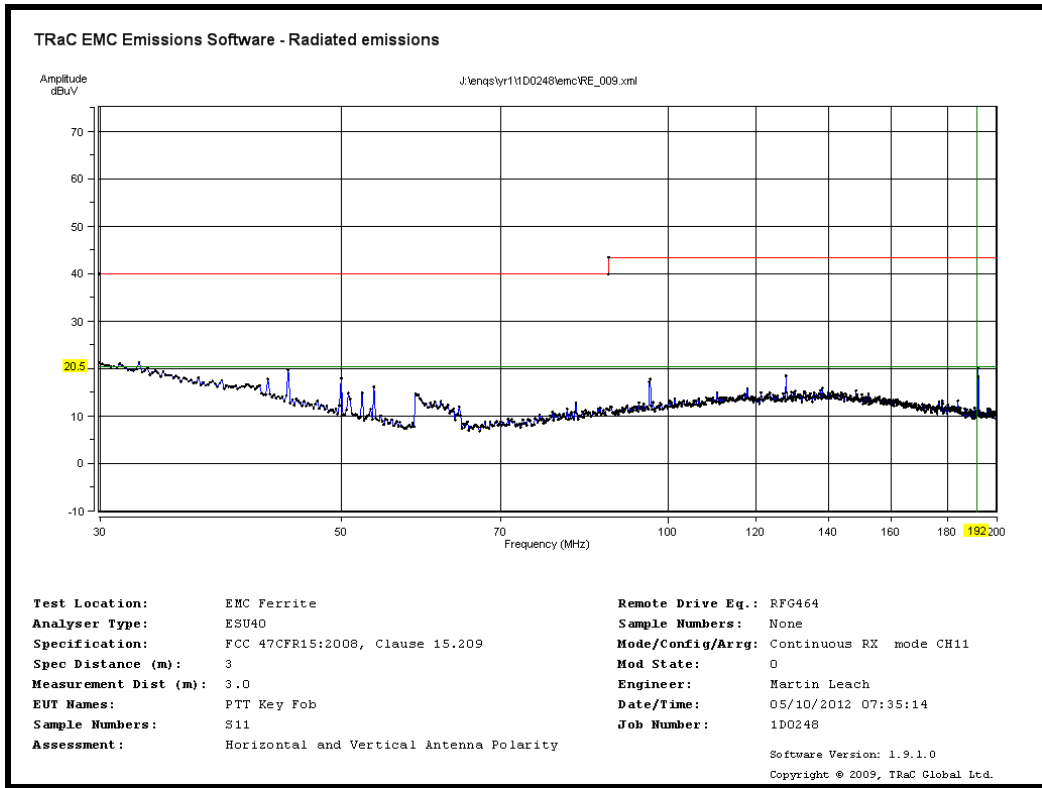


Conducted Emissions Channel 26 2480MHz



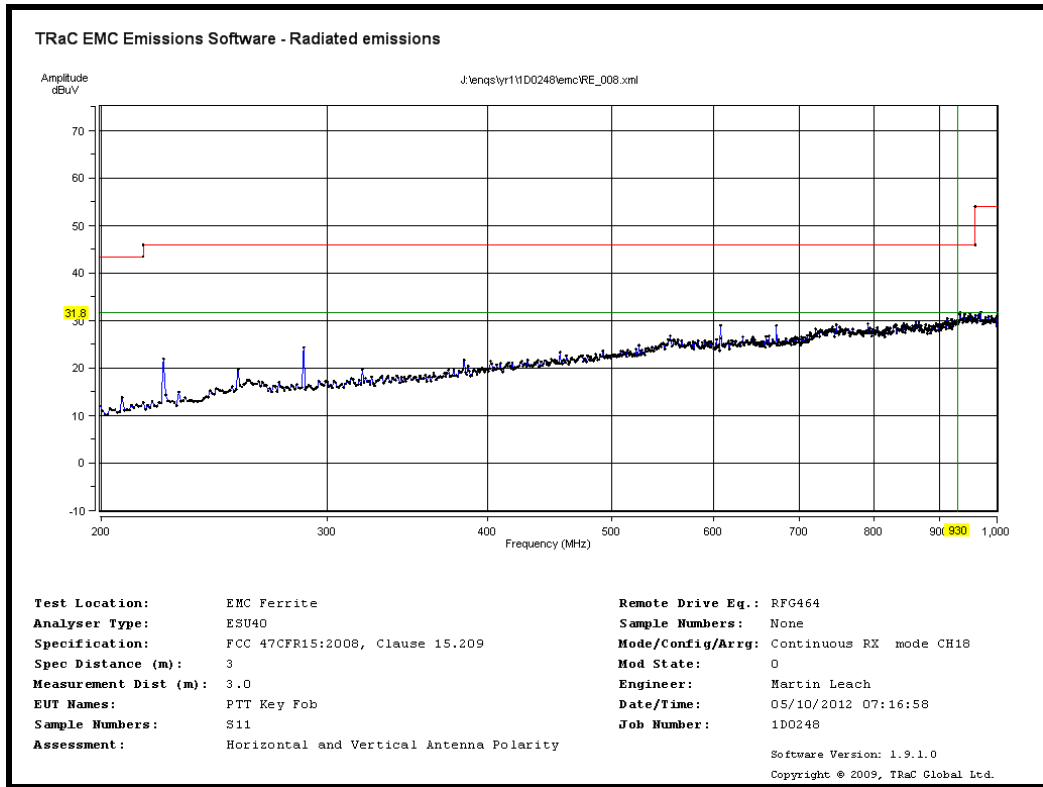
Conducted Emissions Channel 26 2480MHz

B2 Radiated Graphical Data

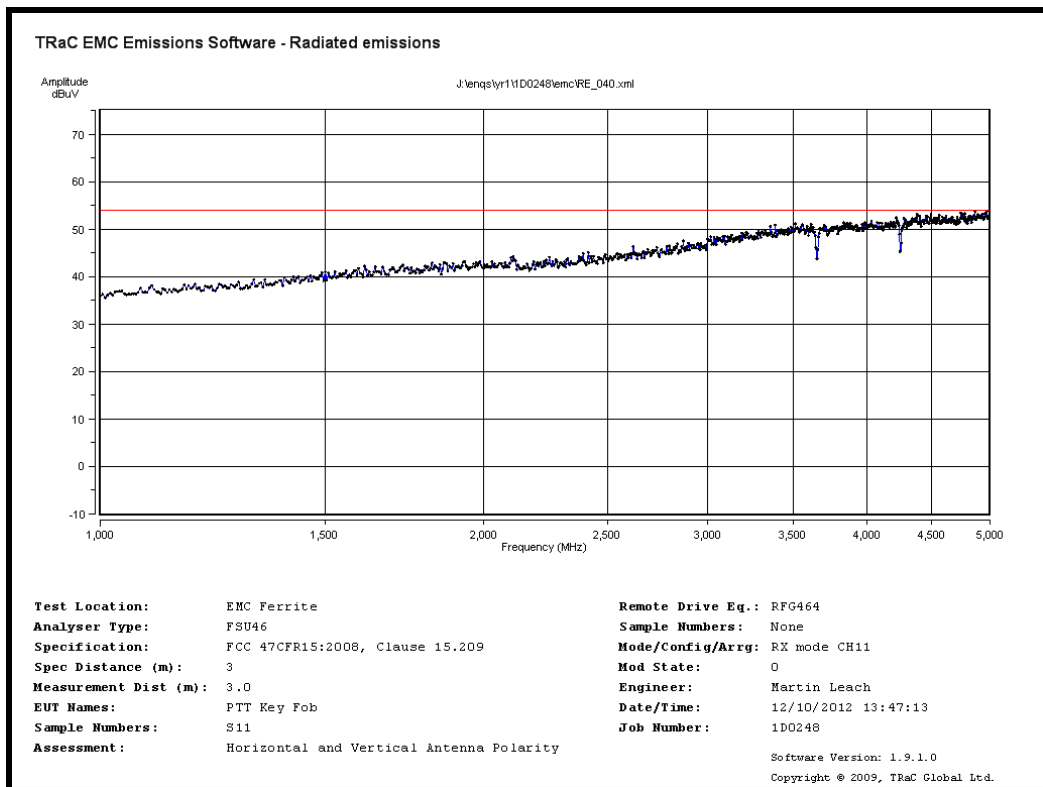


Radiated RX Mode Ch11 2405MHz Emissions (15.109)

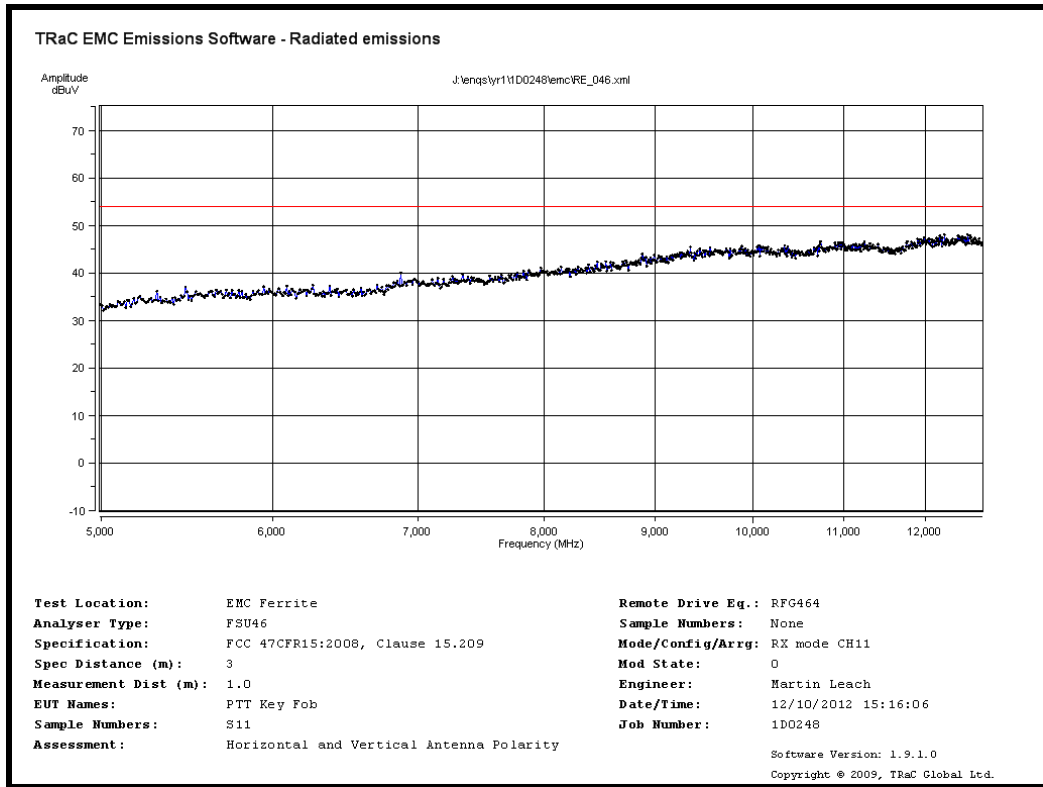
Radiated RX Mode Ch15 Emissions (15.109)



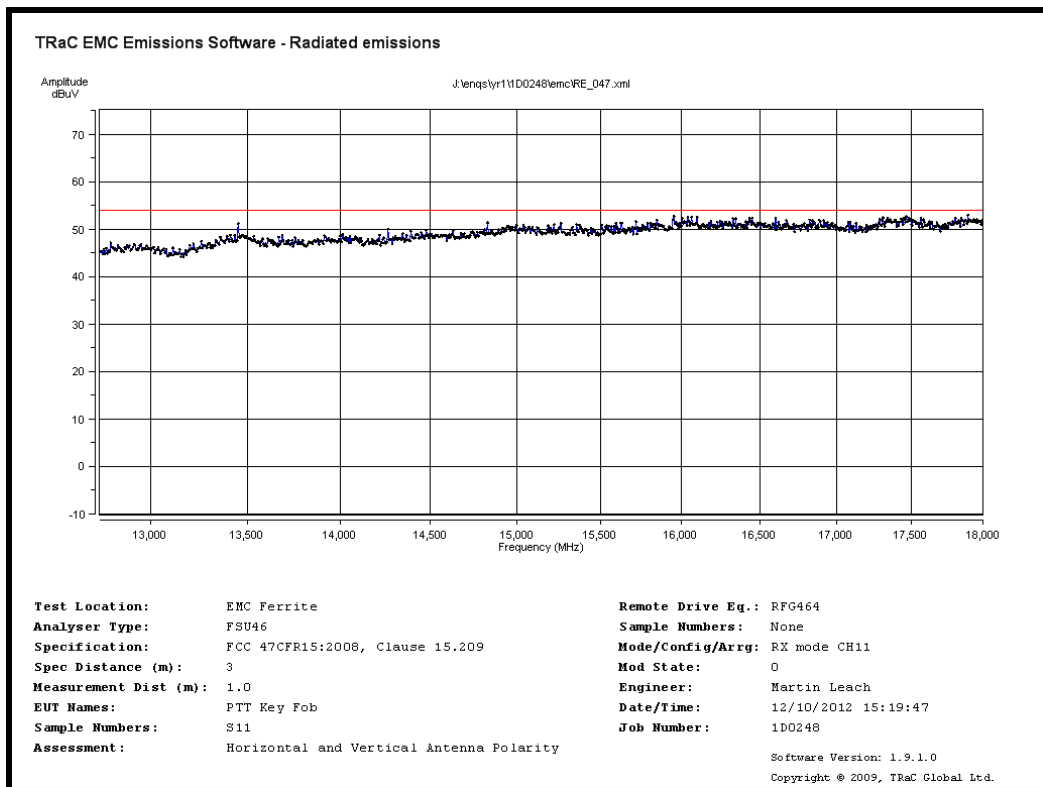
Radiated RX Mode Ch11 2405MHz Emissions (15.109)



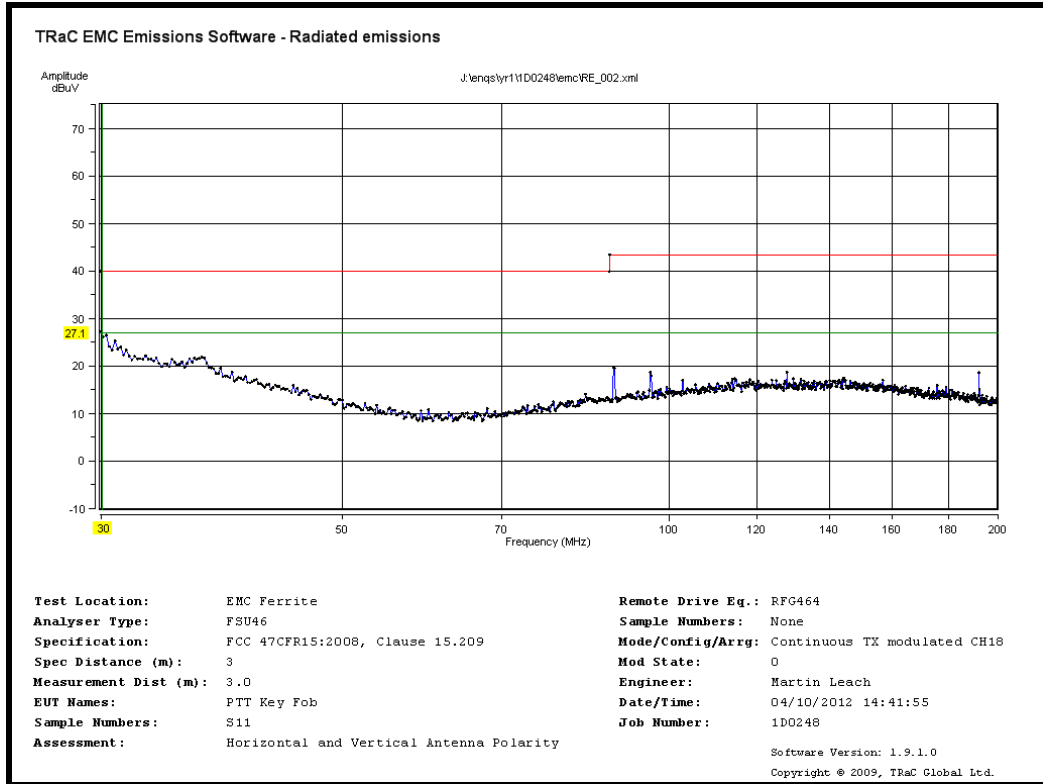
Radiated RX Mode Ch11 2405MHz Emissions (15.109)



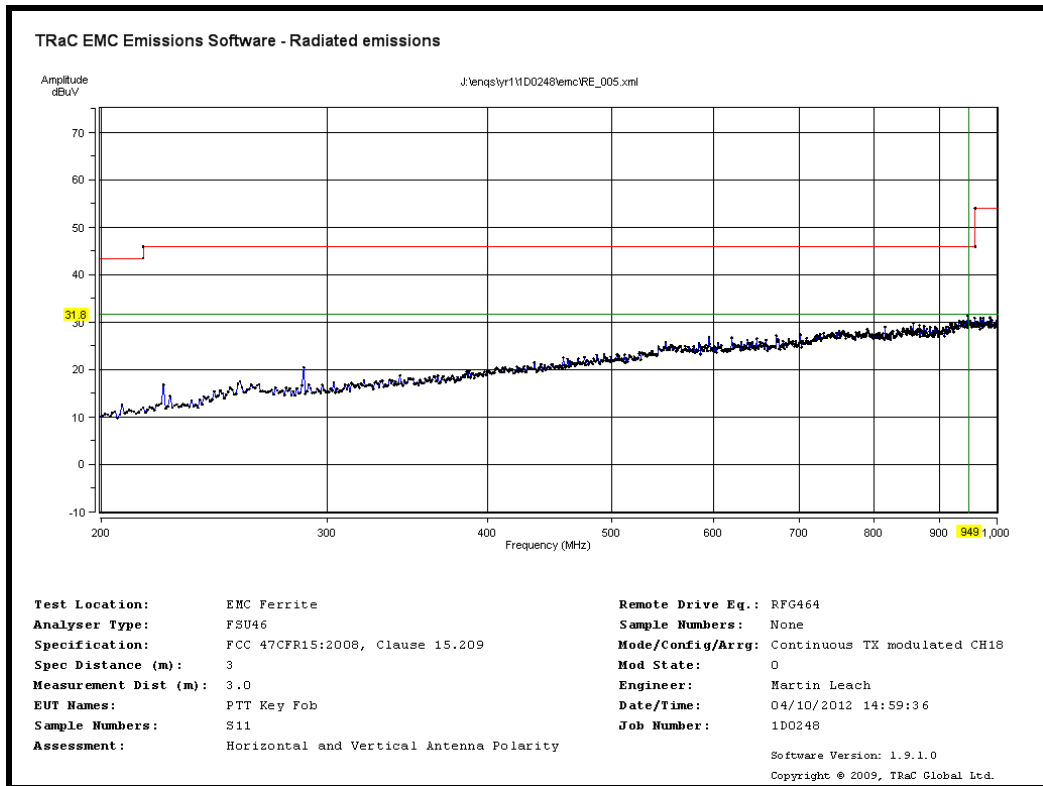
Radiated RX Mode Ch11 2405MHz Emissions (15.109)



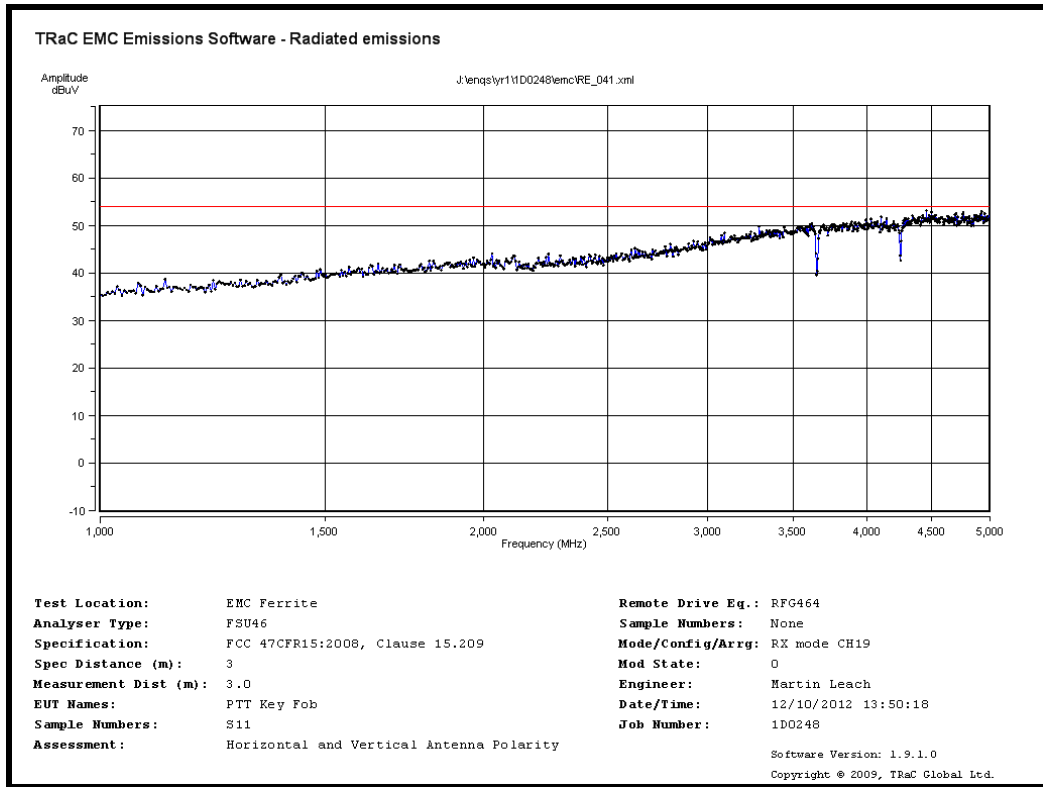
Radiated RX Mode Ch11 2405MHz Emissions (15.109)



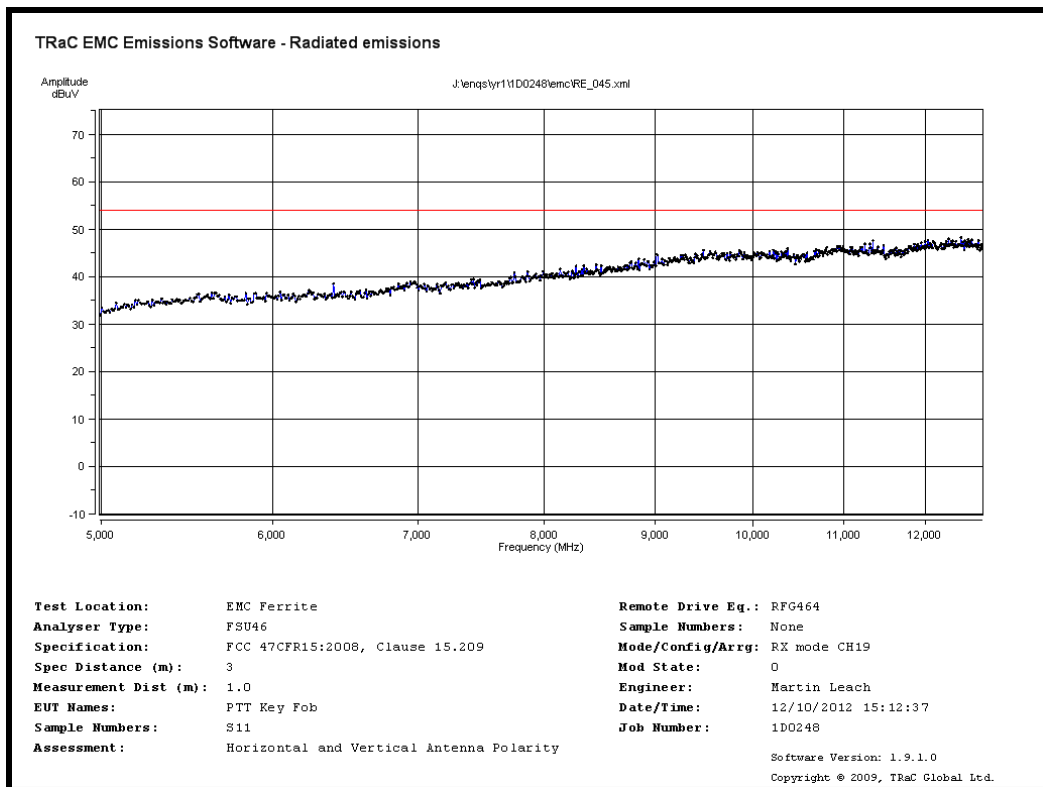
Radiated RX Mode Ch20 2450MHz Emissions (15.109)



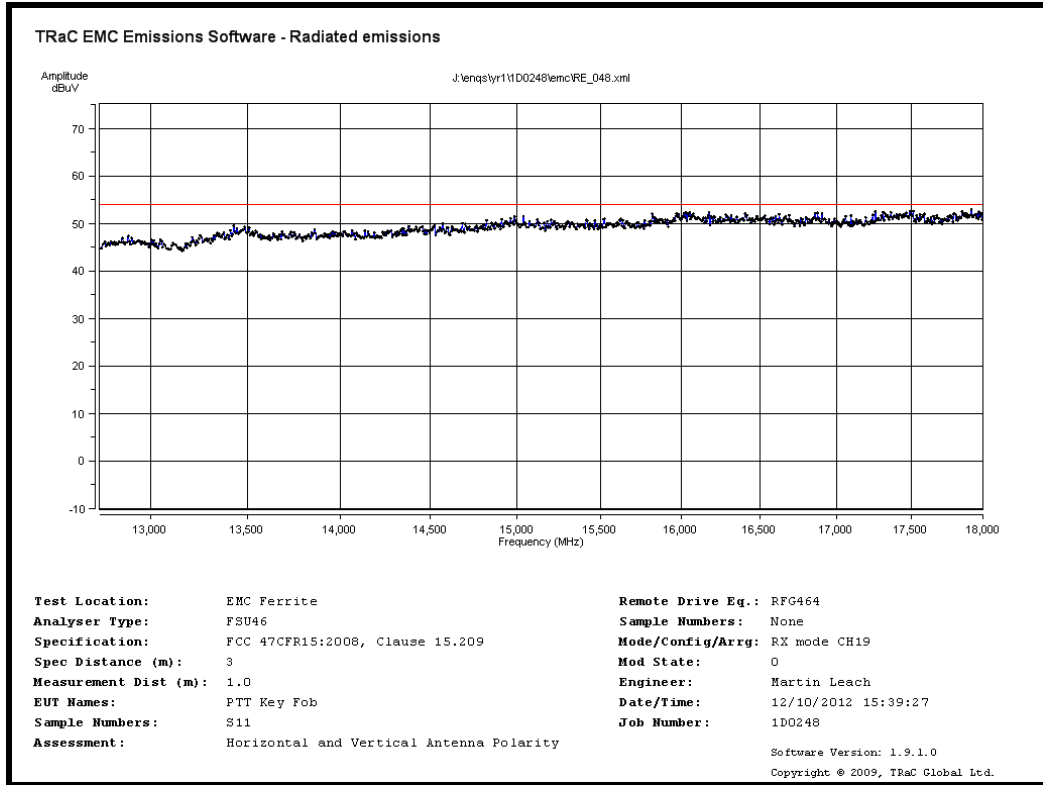
Radiated RX Mode Ch20 2450MHz Emissions (15.109)



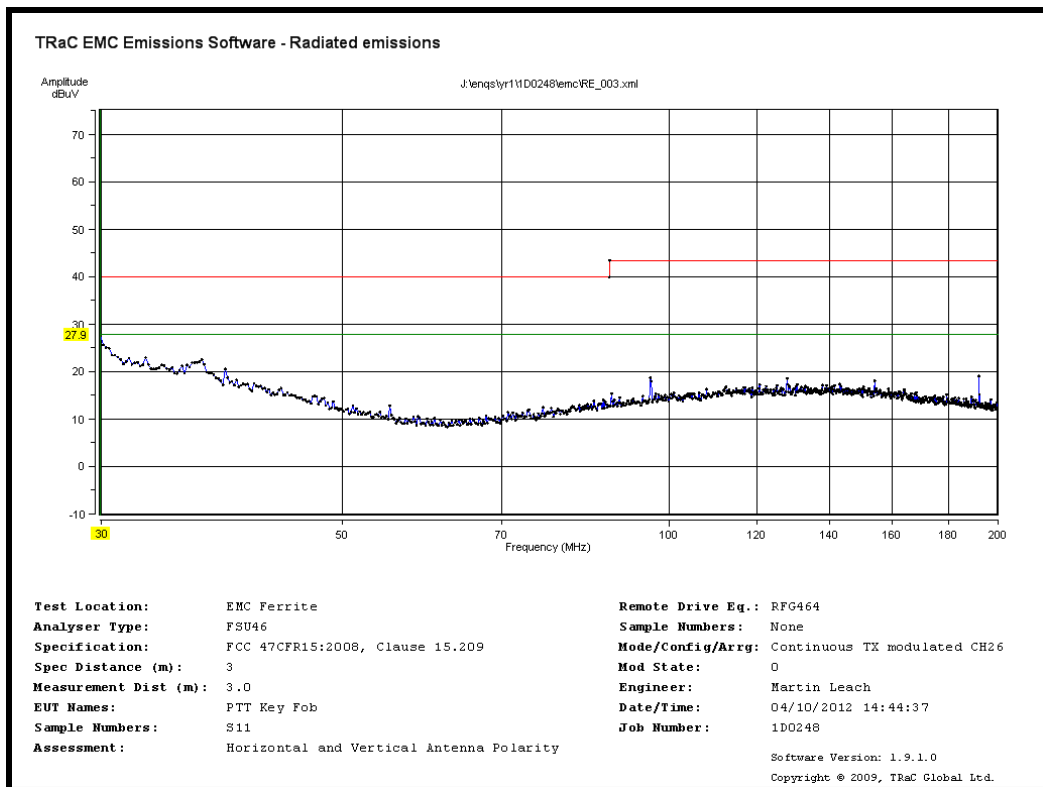
Radiated RX Mode Ch20 2450MHz Emissions (15.109)



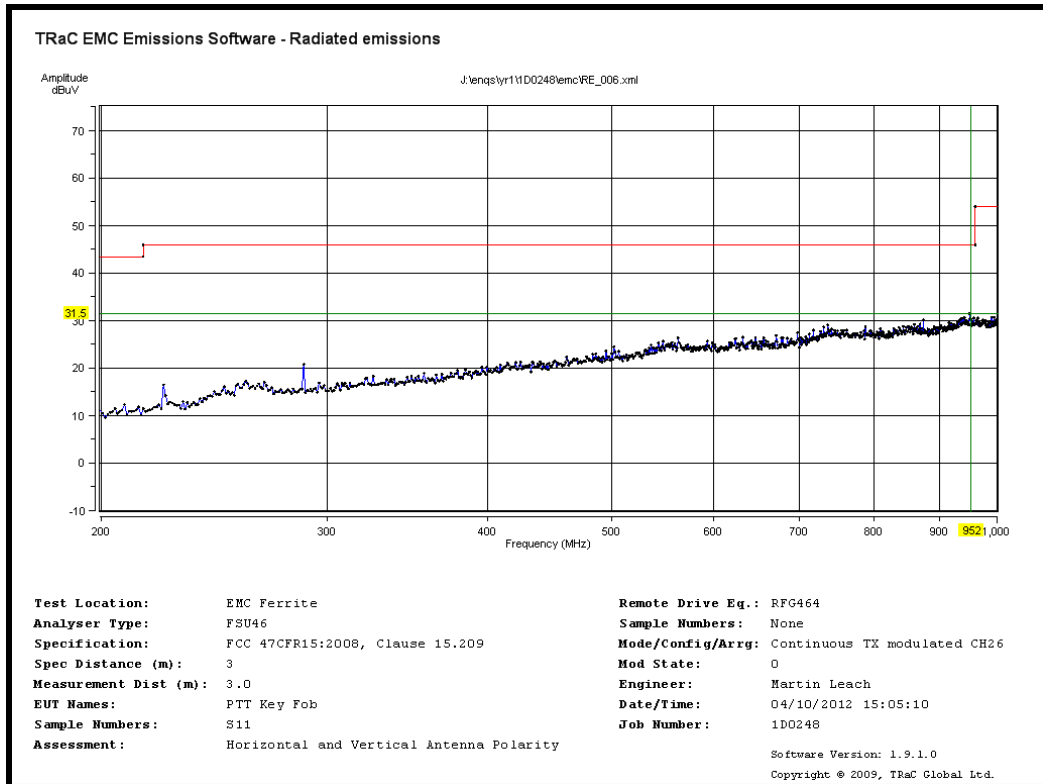
Radiated RX Mode Ch20 2450MHz Emissions (15.109)



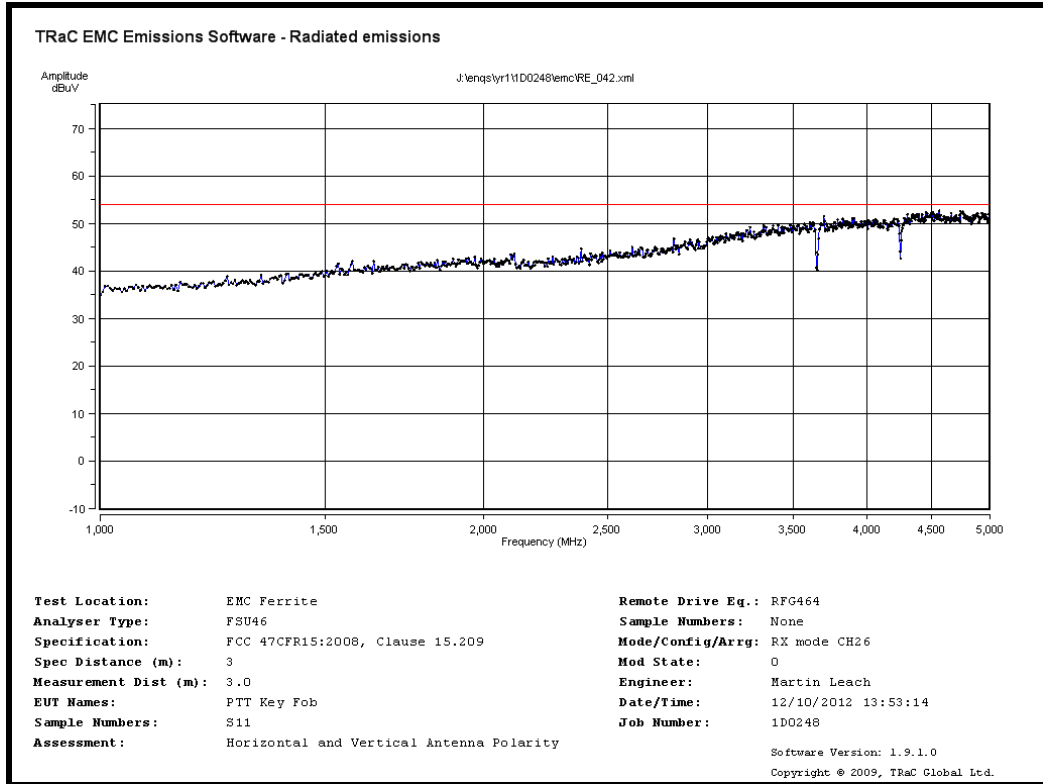
Radiated RX Mode Ch20 2450MHz Emissions (15.109)



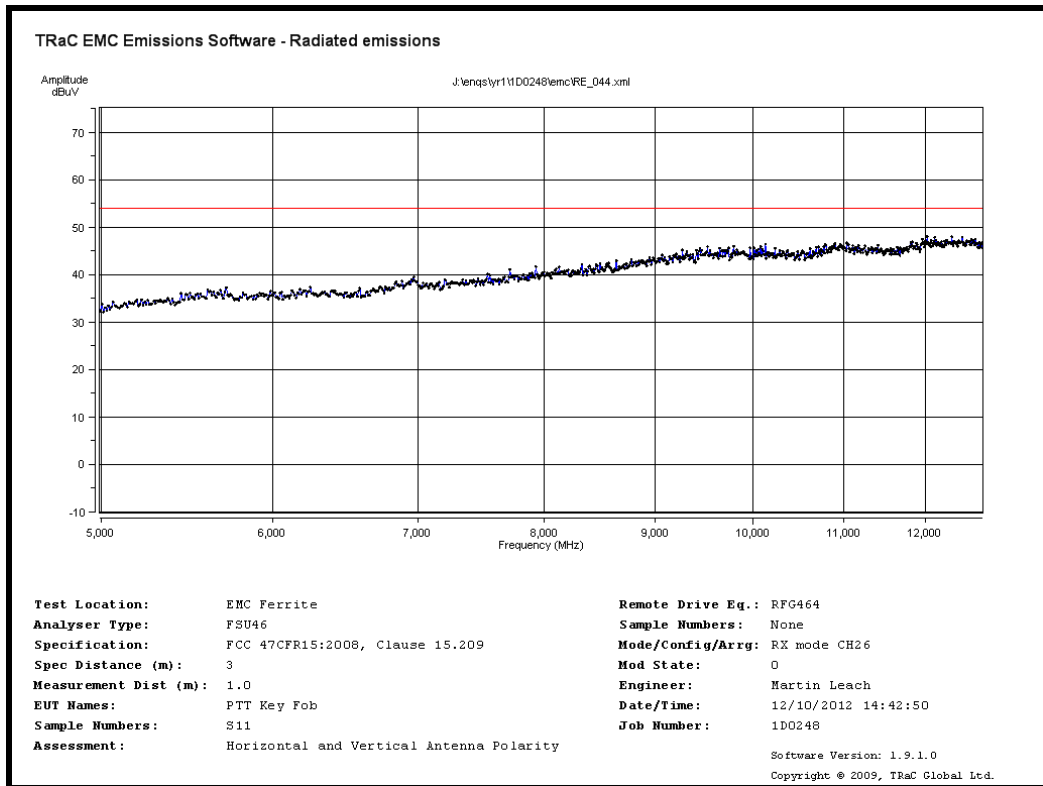
Radiated RX Mode Ch26 2480MHz Emissions (15.109)



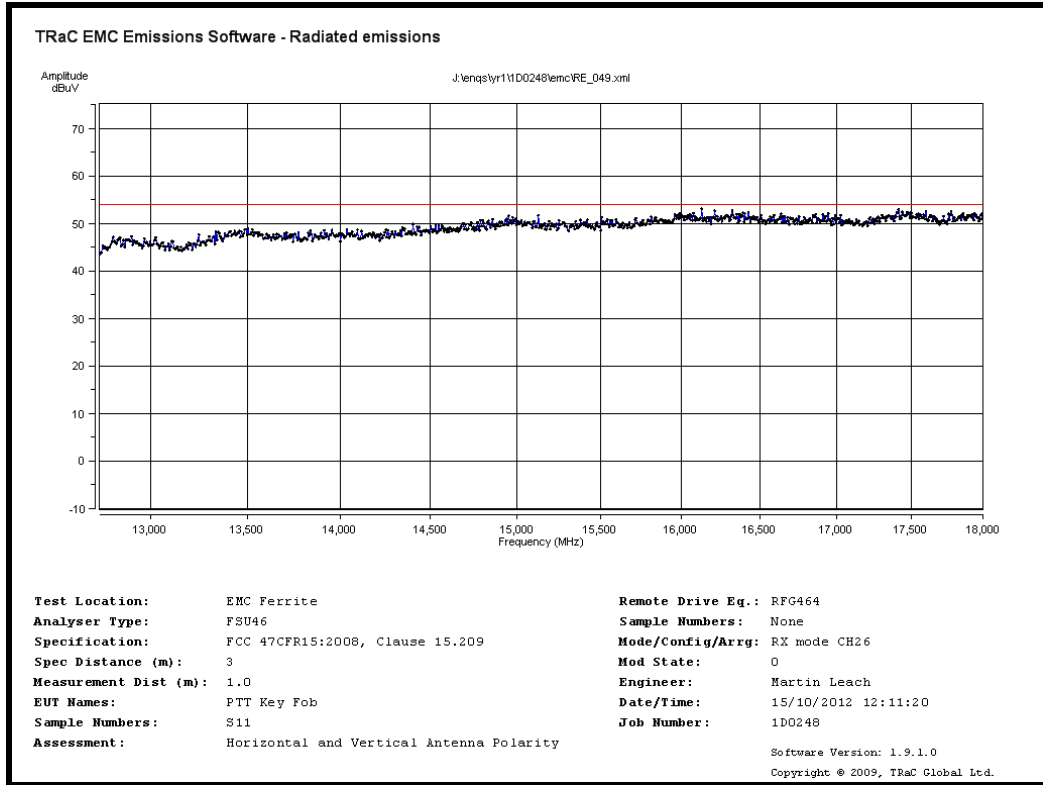
Radiated RX Mode Ch26 2480MHz Emissions (15.109)



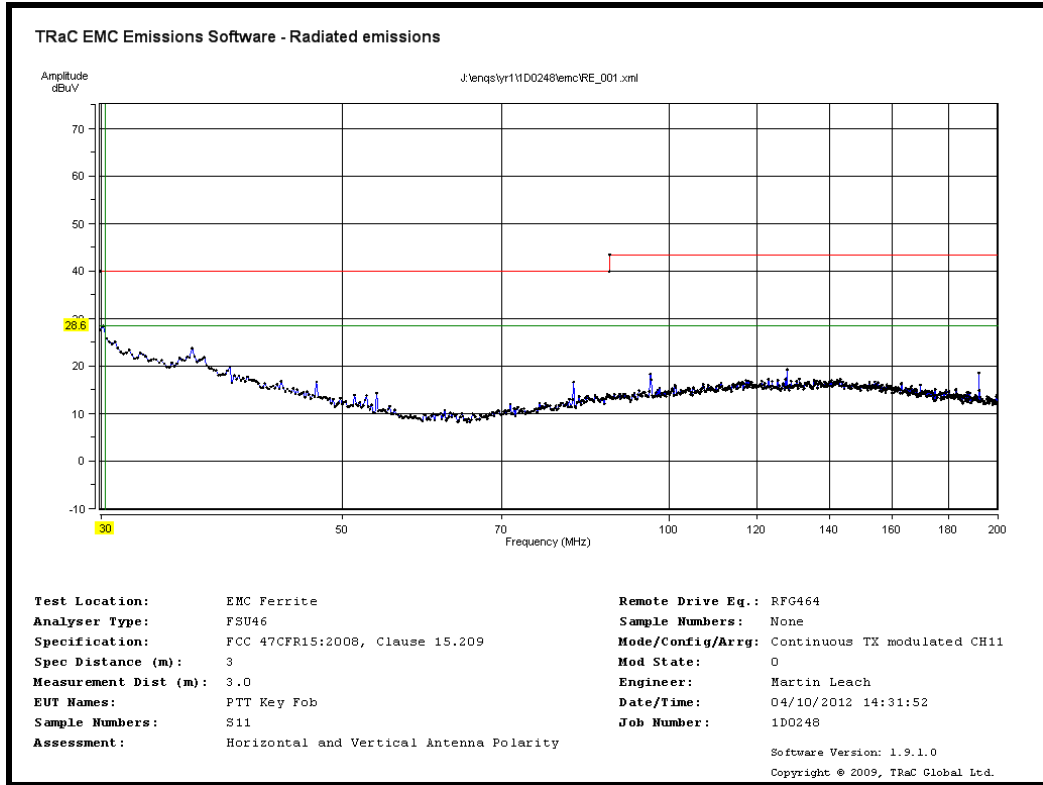
Radiated RX Mode Ch26 2480MHz Emissions (15.109)



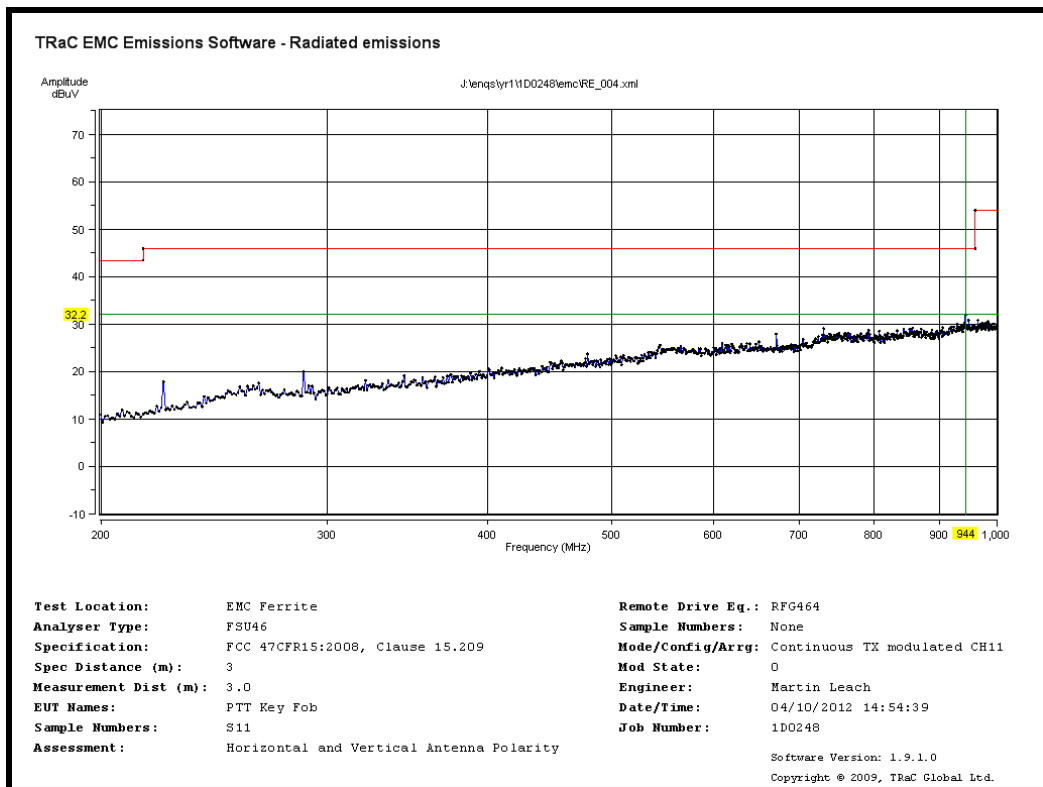
Radiated Ch26 2480MHz Emissions (15.109)



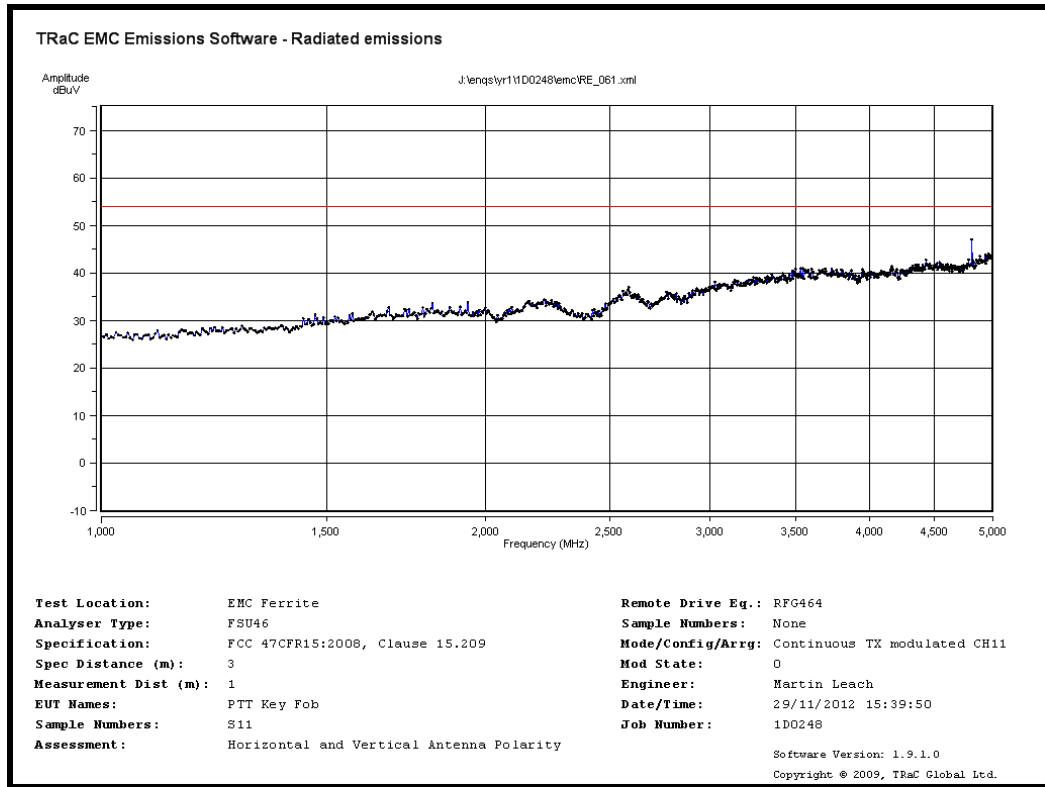
Radiated RX Mode Ch26 2480MHz Emissions (15.109)



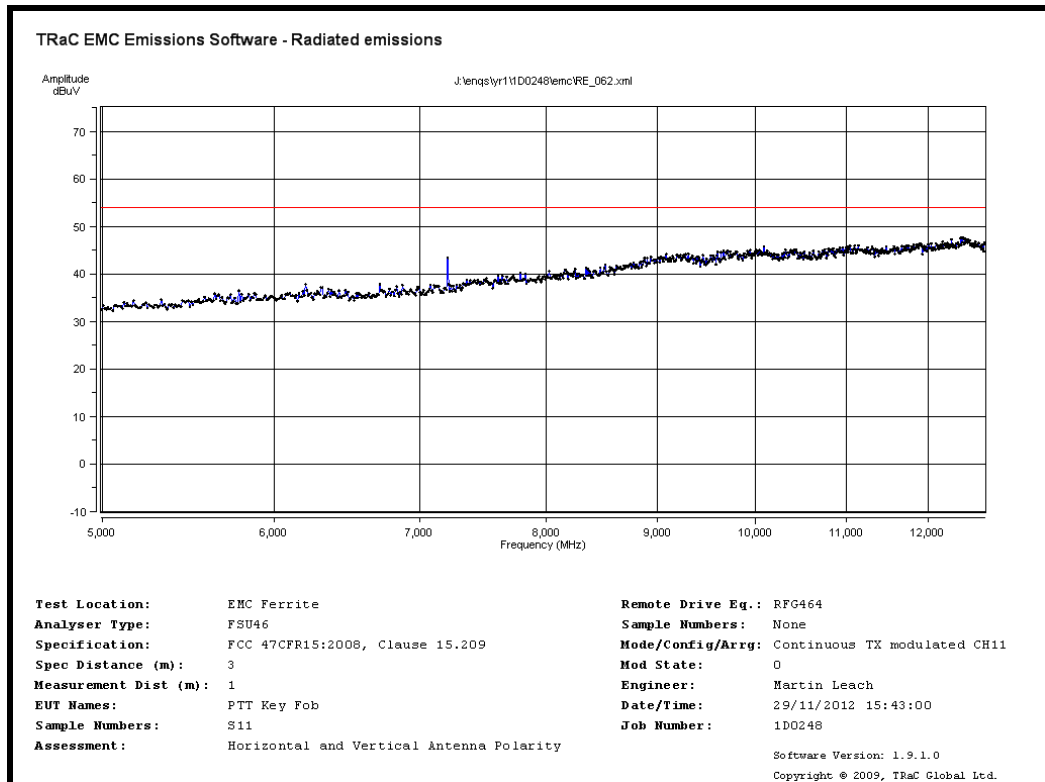
Radiated Transmitter Emissions Channel 11 2405MHz (15.209)



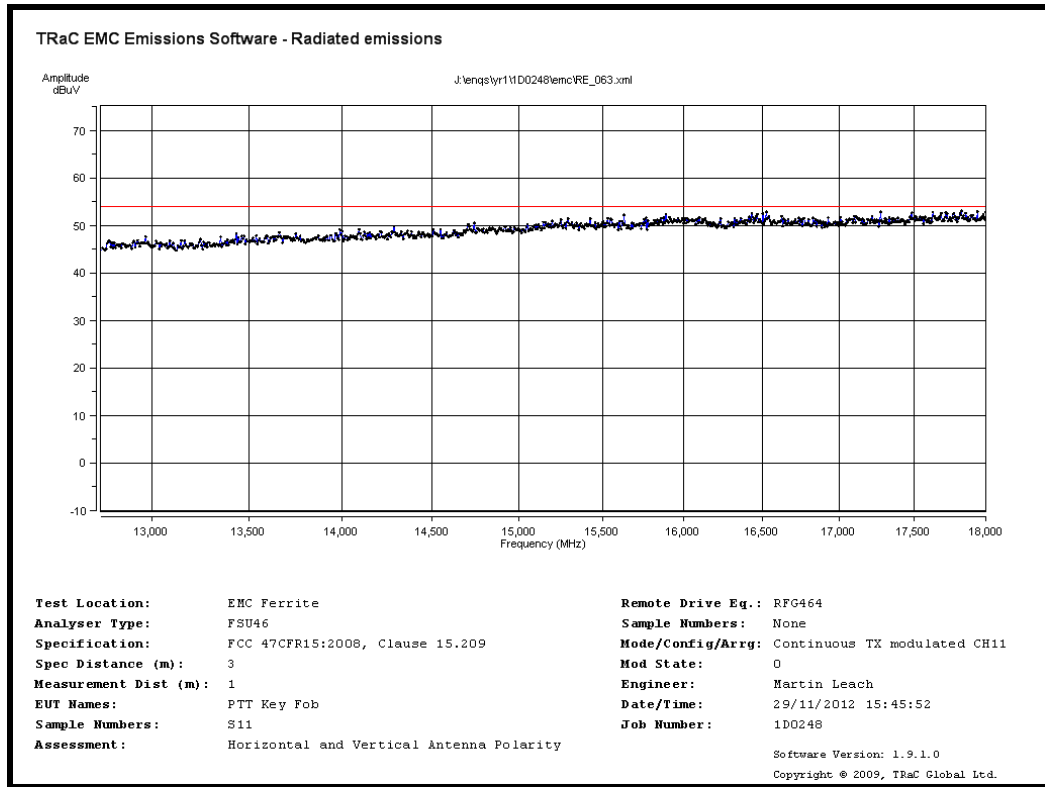
Radiated Transmitter Emissions Channel 11 2405MHz (15.209)



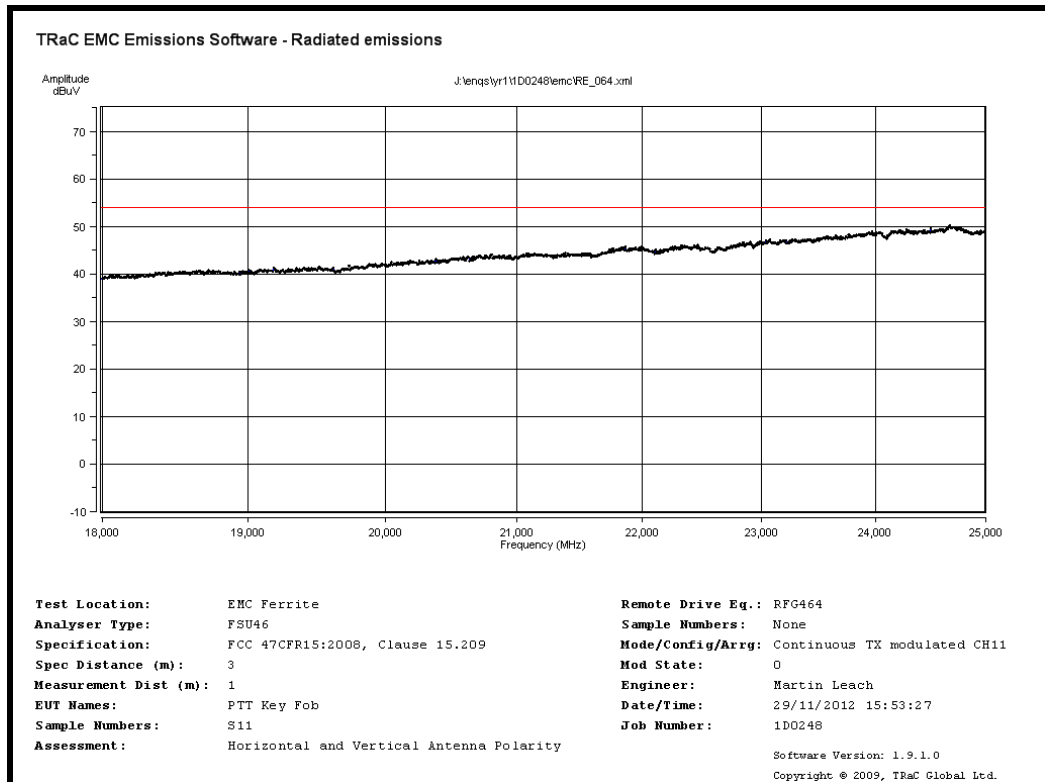
Radiated Transmitter Emissions Channel 11 2405MHz (15.209)



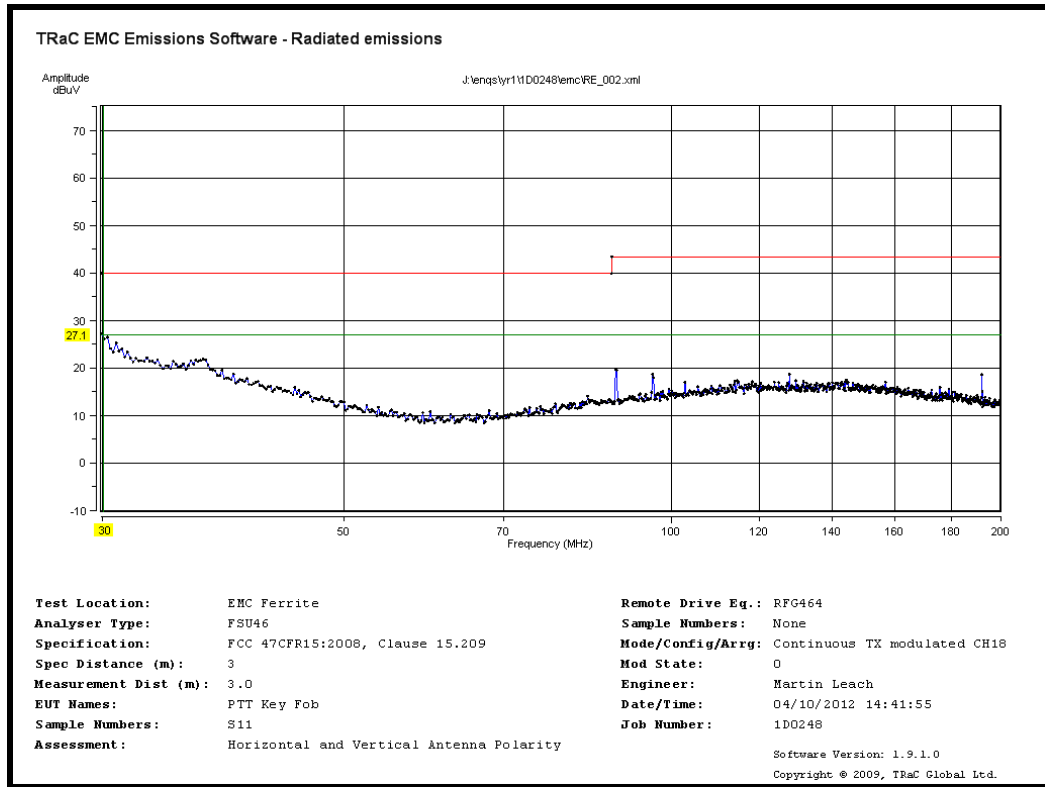
Radiated Transmitter Emissions Channel 11 2405MHz (15.209)



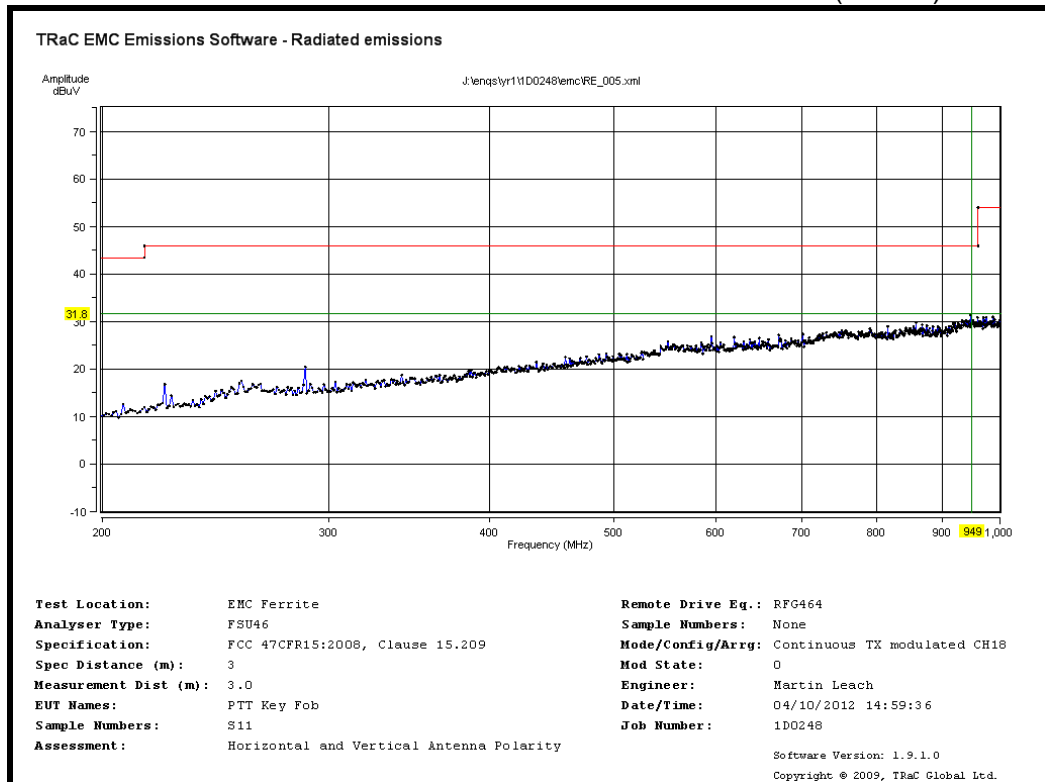
Radiated Transmitter Emissions Channel 11 2405MHz (15.209)



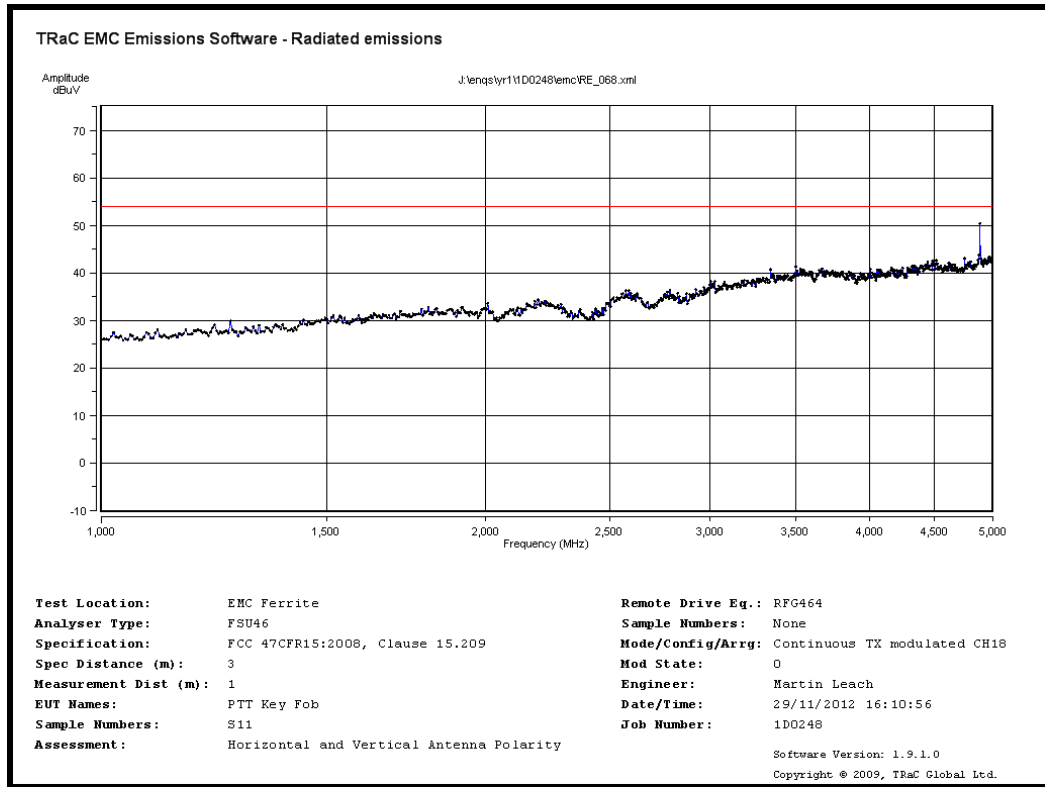
Radiated Transmitter Emissions Channel 11 2405MHz (15.209)



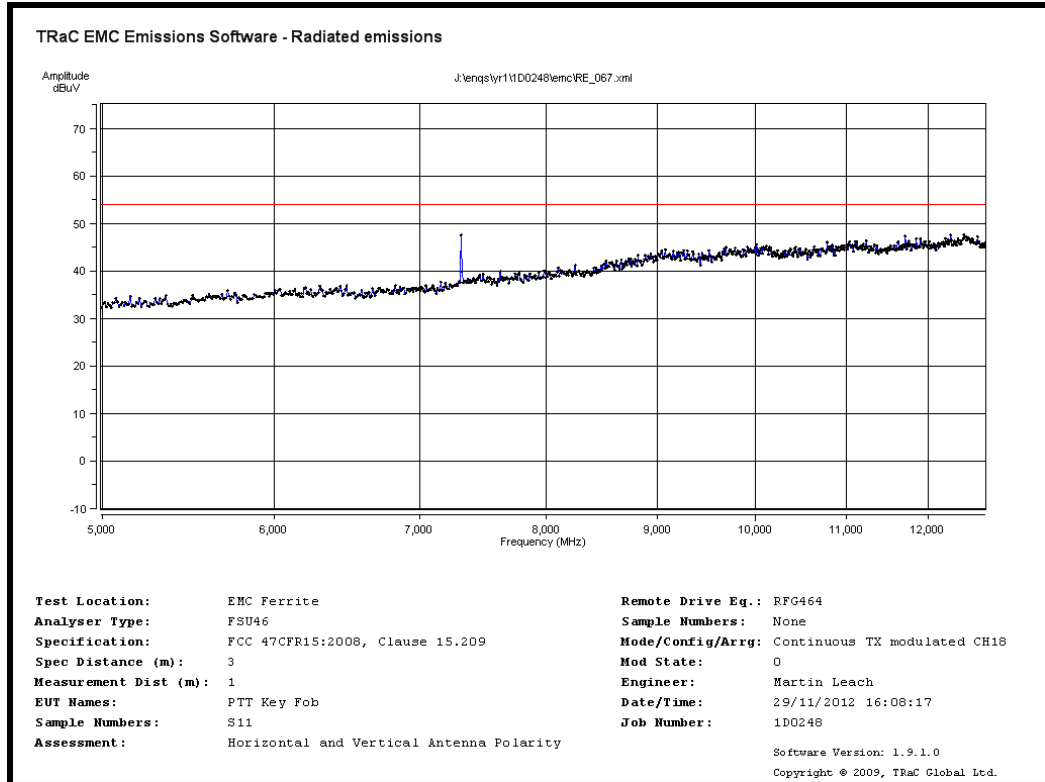
Radiated Transmitter Emissions Channel 18 2440MHz (15.209)



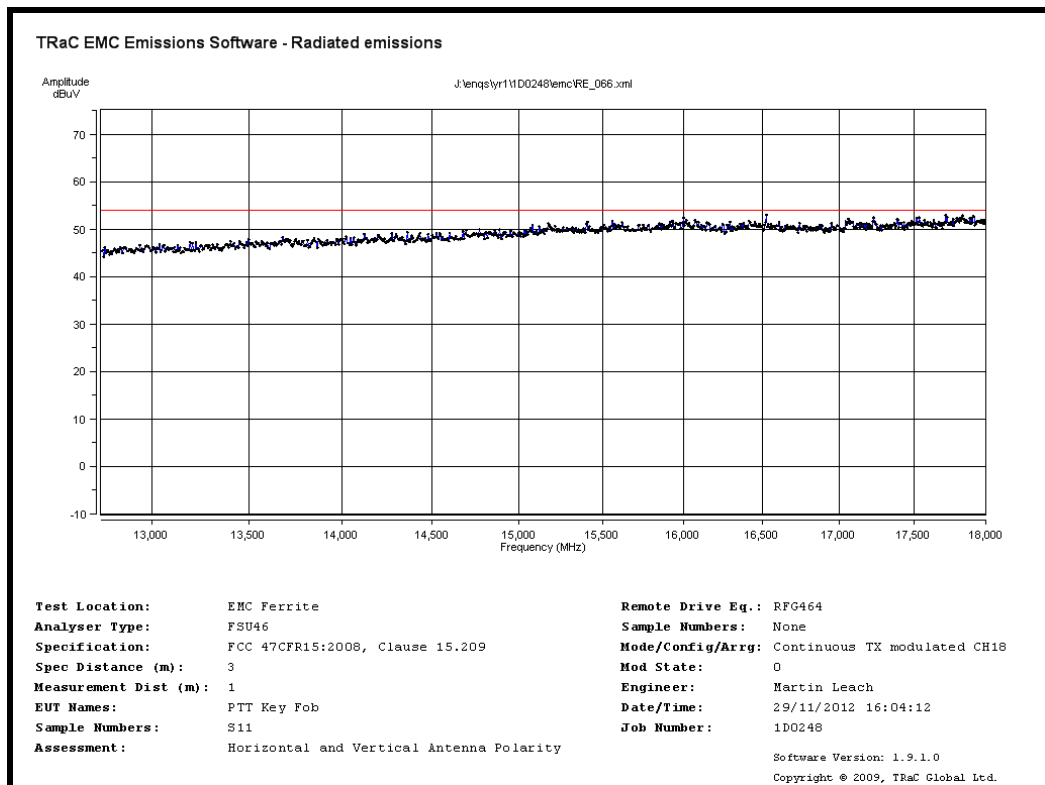
Radiated Transmitter Emissions Channel 18 2440MHz (15.209)



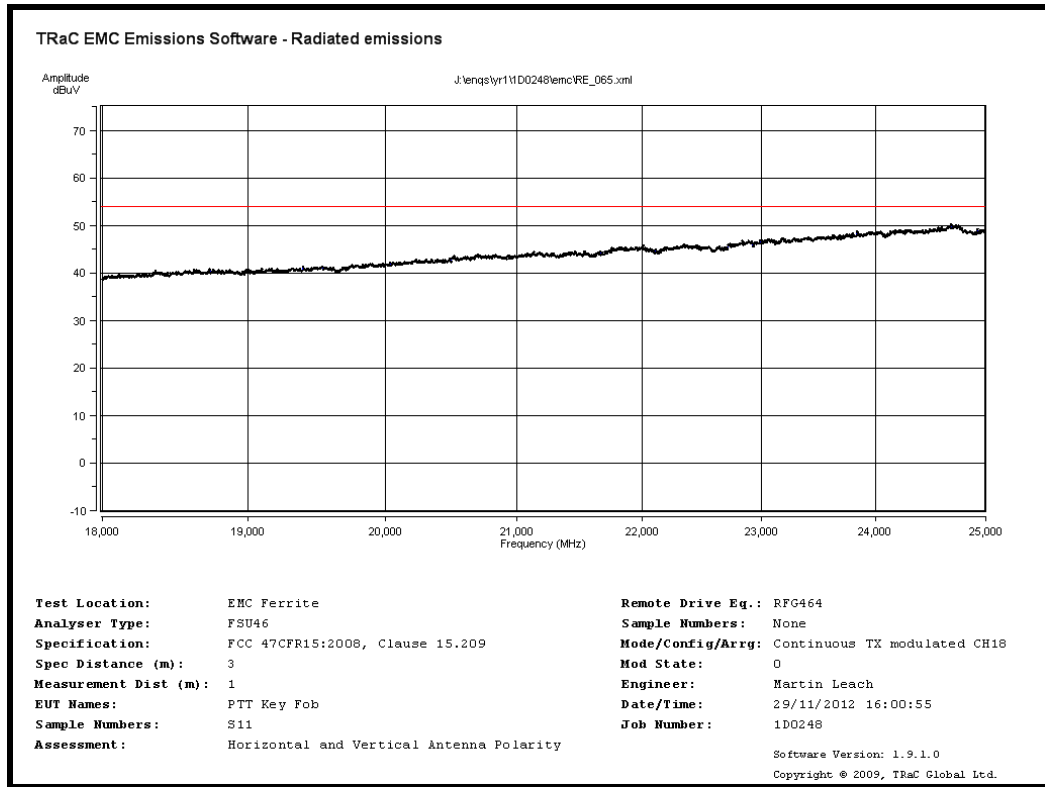
Radiated Transmitter Emissions Channel 18 2440MHz (15.209)



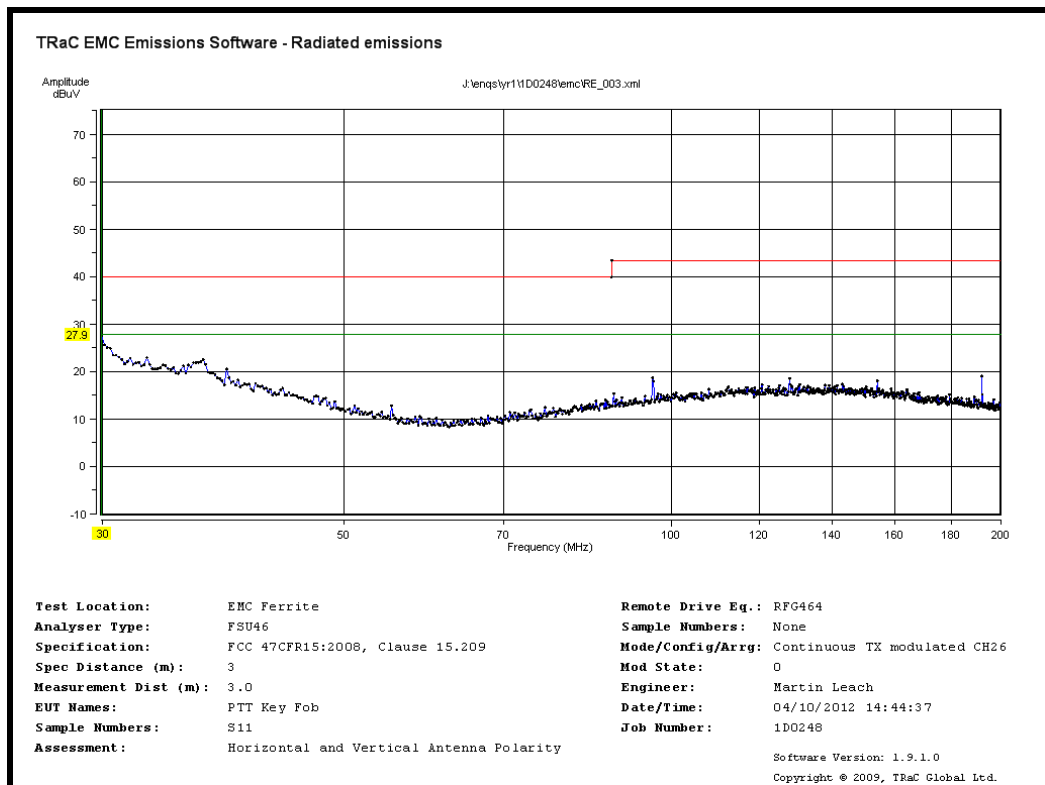
Radiated Transmitter Emissions Channel 18 2440MHz (15.209)



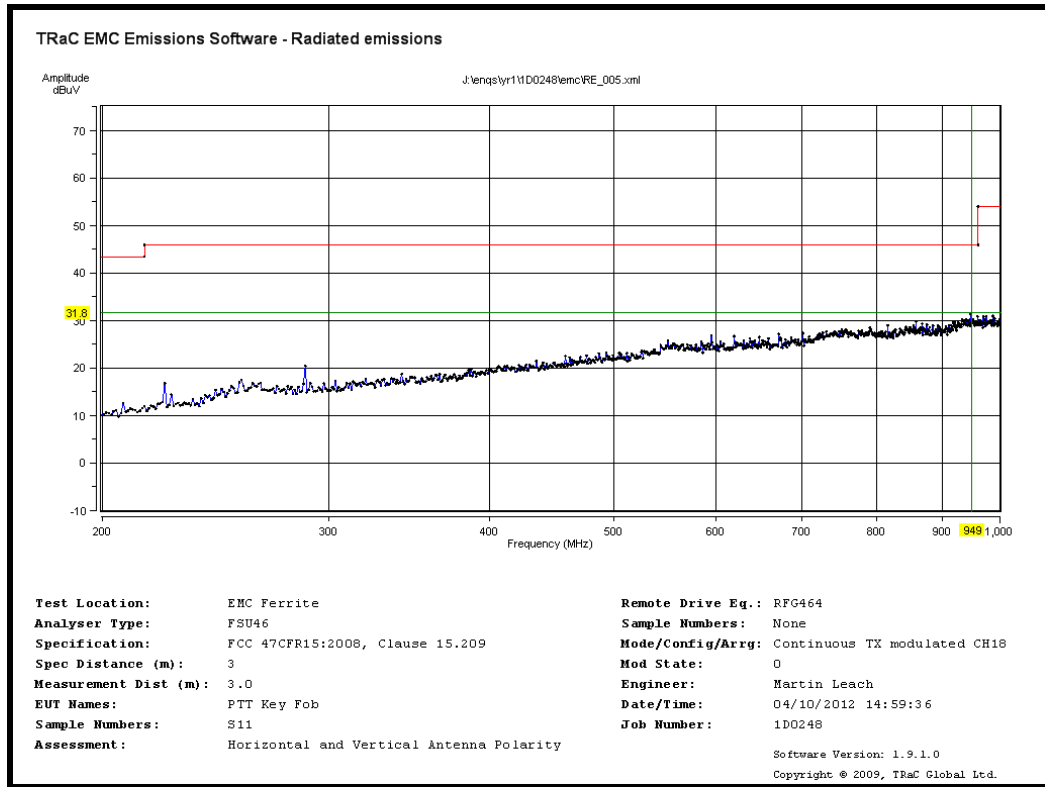
Radiated Transmitter Emissions Channel 18 2440MHz (15.209)



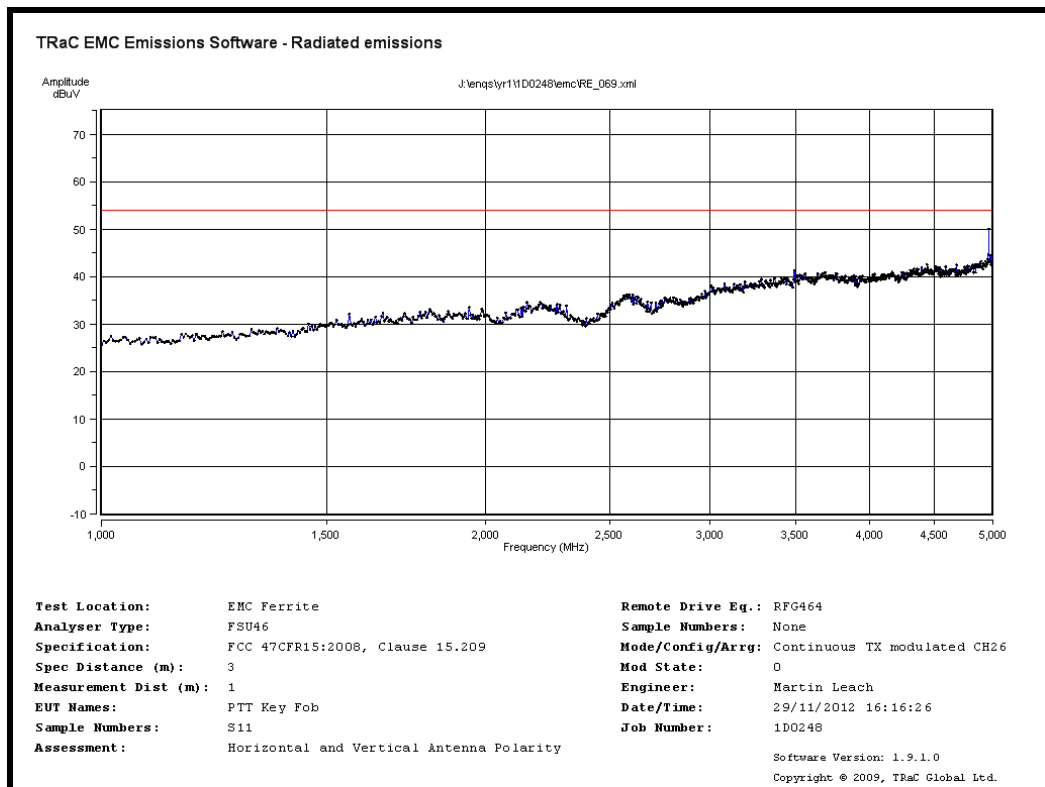
Radiated Transmitter Emissions Channel 18 2440MHz (15.209)



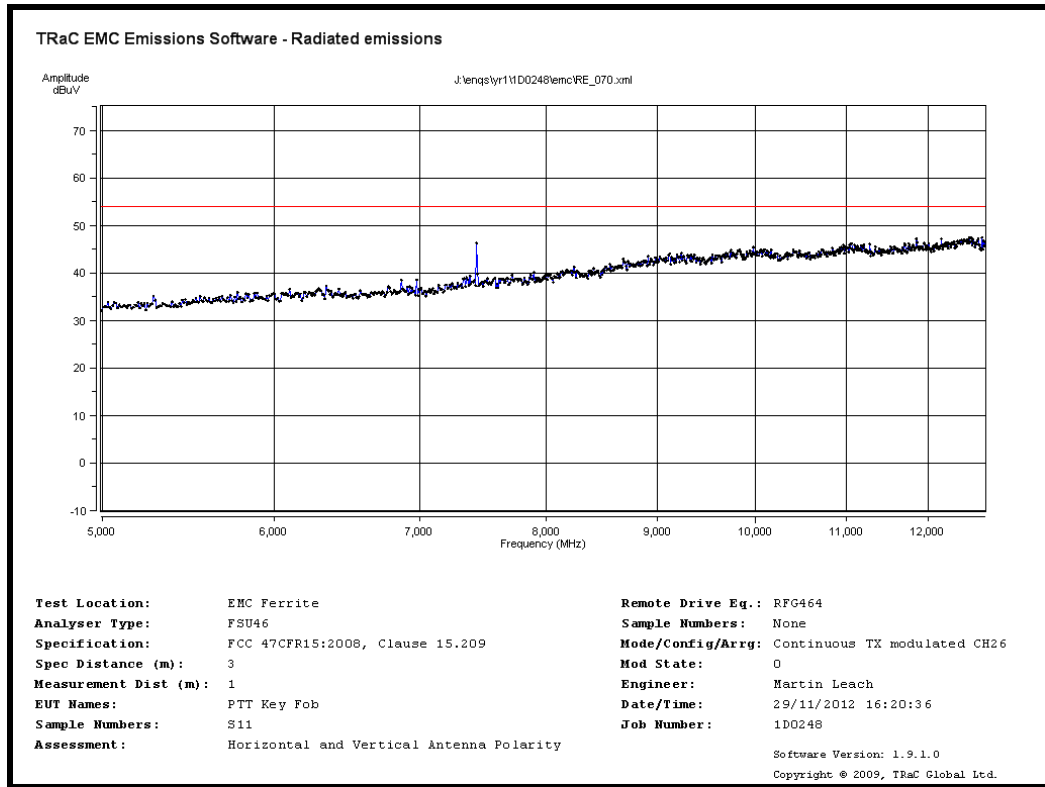
Radiated Transmitter Emissions Channel 26 2480MHz (15.209)



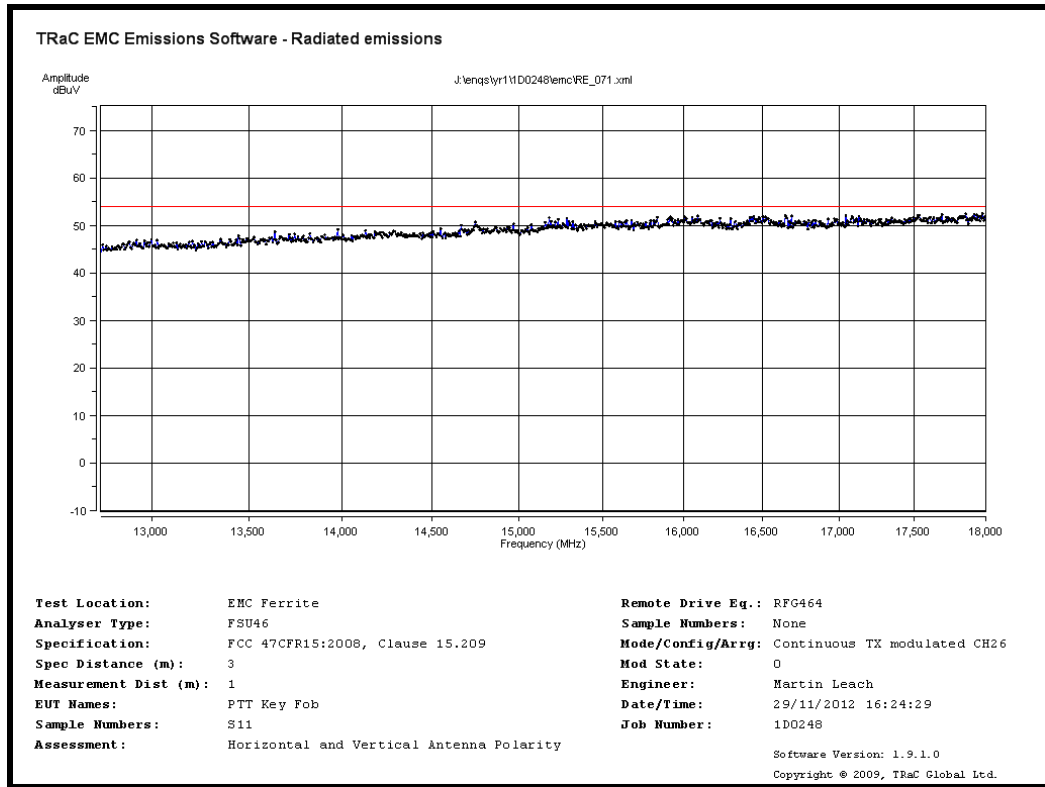
Radiated Transmitter Emissions Channel 26 2480MHz (15.209)



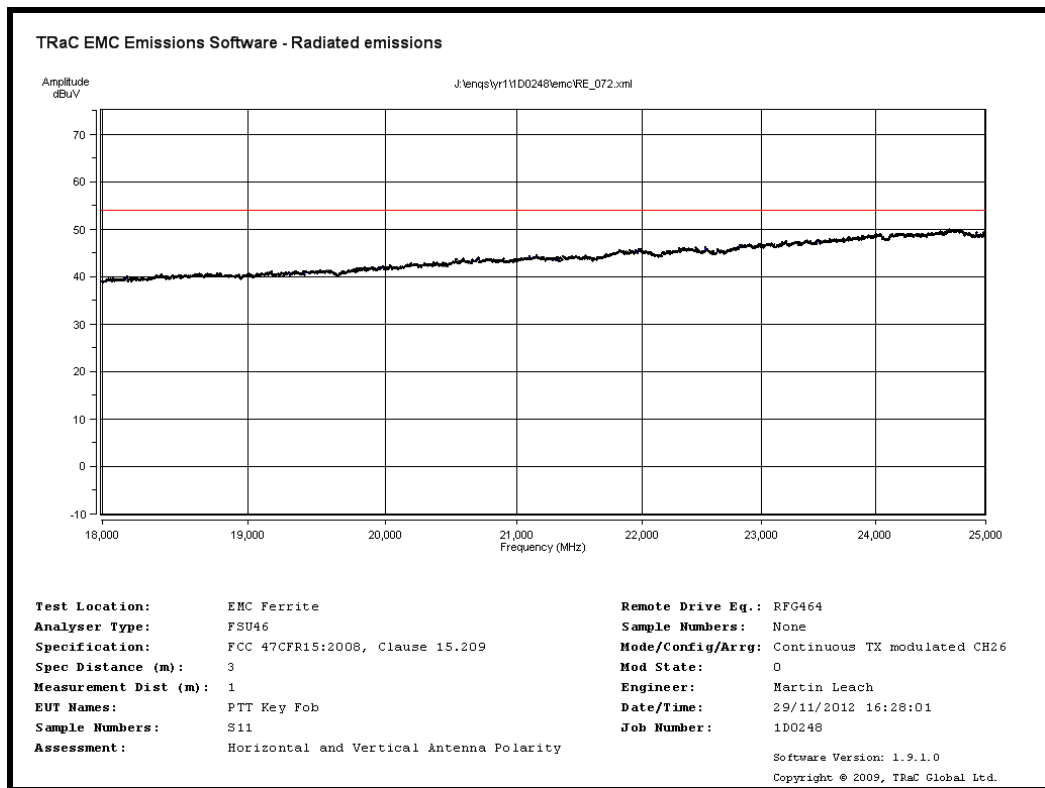
Radiated Transmitter Emissions Channel 26 2480MHz (15.209)



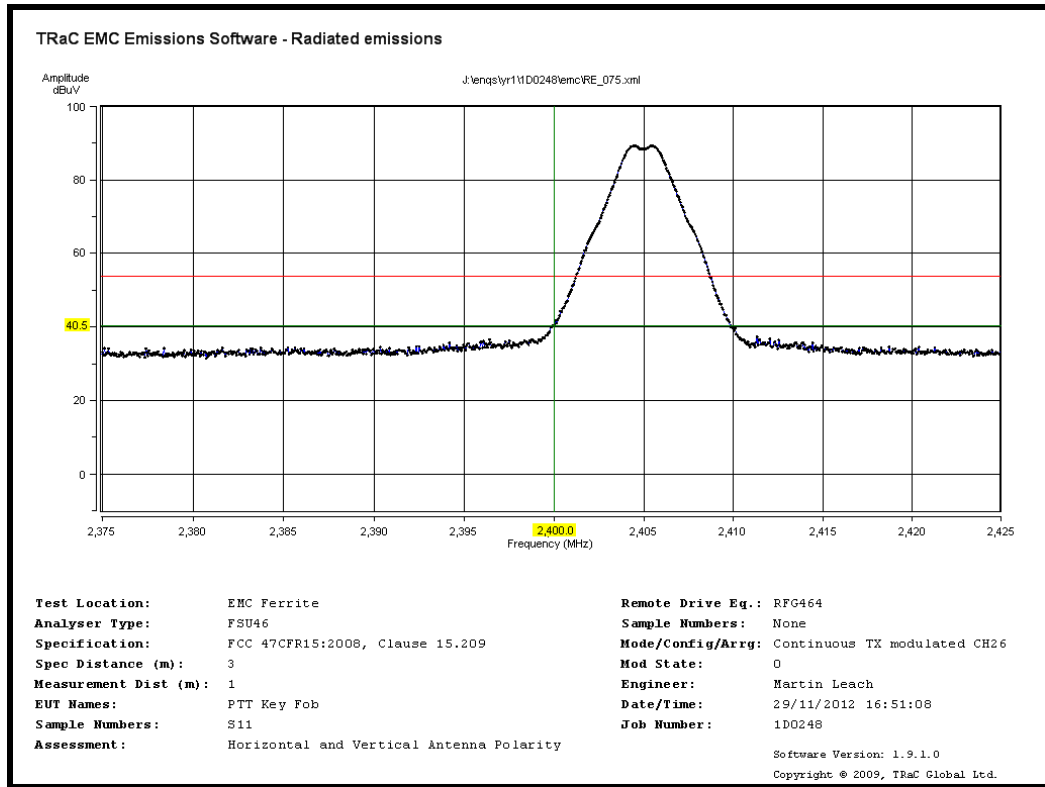
Radiated Transmitter Emissions Channel 26 2480MHz (15.209)



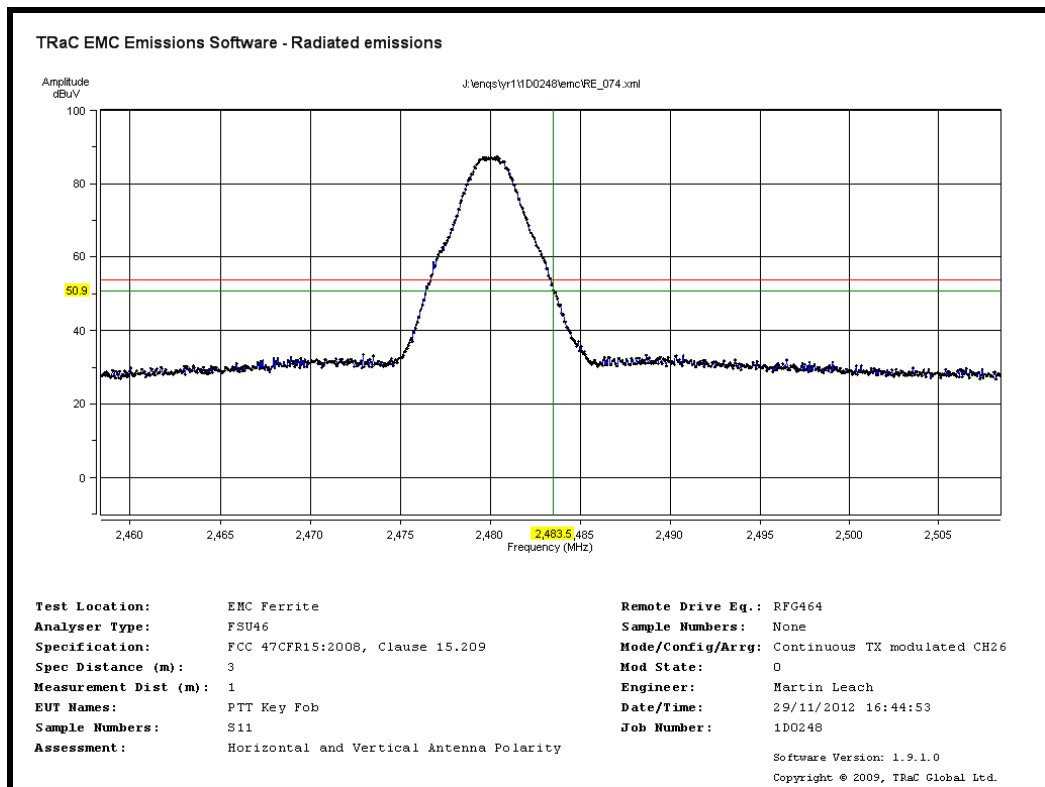
Radiated Transmitter Emissions Channel 26 2480MHz (15.209)



Radiated Transmitter Emissions Channel 26 2480MHz (15.209)



Radiated Transmitter Emissions Channel 11 2405MHz (15.209) Band Edge Compliance



Radiated Transmitter Emissions Channel 26 2405MHz (15.209) Band Edge Compliance

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 :

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

Sample No.	Description	Identification
S13	Clarity Radiated Sample	None
S17	Clarity Conducted Sample	None

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

TRaC Identification	Description
	Test Laptop

C2) EUT Operating Mode During Testing.

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

Test	Description of Operating Mode: TX
All tests detailed in this report excluding: REFE (15.109)	The EUT was transmitting on maximum power using O-QPSK with half-sine pulse-shaping - 8-symbol listen-before send for CSMA-CA - Bit rate 250kb/s, symbol rate 62.5ksymbol/s with 4-bit 16-ary orthogonal symbols, chip rate 2000kchip/s) modulation at centre frequencies $F_c = 2405 + 5 (k - 11)$ in MHz

Test	Description of Operating Mode RX
Radiated Electric Field Emissions 15.109 digital circuitry	The EUT was placed in continuous receive mode during the test.

C3) EUT Configuration Information.

The EUT was submitted for testing in one single possible configuration.

C4) List of EUT Ports

The table below describes the termination of EUT ports:

Sample : S13/S17
Tests : all

Port	Description of Cable Attached	Cable length	Equipment Connected
Battery	2 core unshielded	1.5m	dc PSU
Serial data*	Multicore unshielded	20 cm	Laptop

*used only during setup

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

Details of Equipment Used continued:

For power line conducted emissions:

RFG/REF No	Type	Description	Manufacturer	Date Calibrated
n/a	Lab 5	Small Screened Chamber	TRaC	N/A
189	ESH3-Z5	Single-phase LISN	R & S	09/06/11
680	ESH3-Z2	Pulse Limiter	R & S	20/06/11
214	ESAI	Spec Analyser/Test Receiver (LF/HF)	R & S	31/03/11
294	BNC	RF coaxial cable (Lab 5)	TRaC	17/09/10
298	BNC	RF coaxial cable (Lab 5)	TRaC	17/09/10
636	NSG1007	110Vac / 60Hz	Schaffner	N/A
REF887	34405A	Multi-meter	Agilent	25/08/10

For Conducted Measurements:

RFG/REF No	Type	Description	Manufacturer	Date Calibrated.
404	E4407B	Spectrum Analyser	Agilent	17/05/11
REF 835/836	N10149 N1911A	Power head and meter	Agilent	10/08/10
REF887	34405A	Multi-meter	Agilent	25/08/10
REF915	PCR500L	ac/dc Power Supply	Kikusui	N/A

Appendix D:

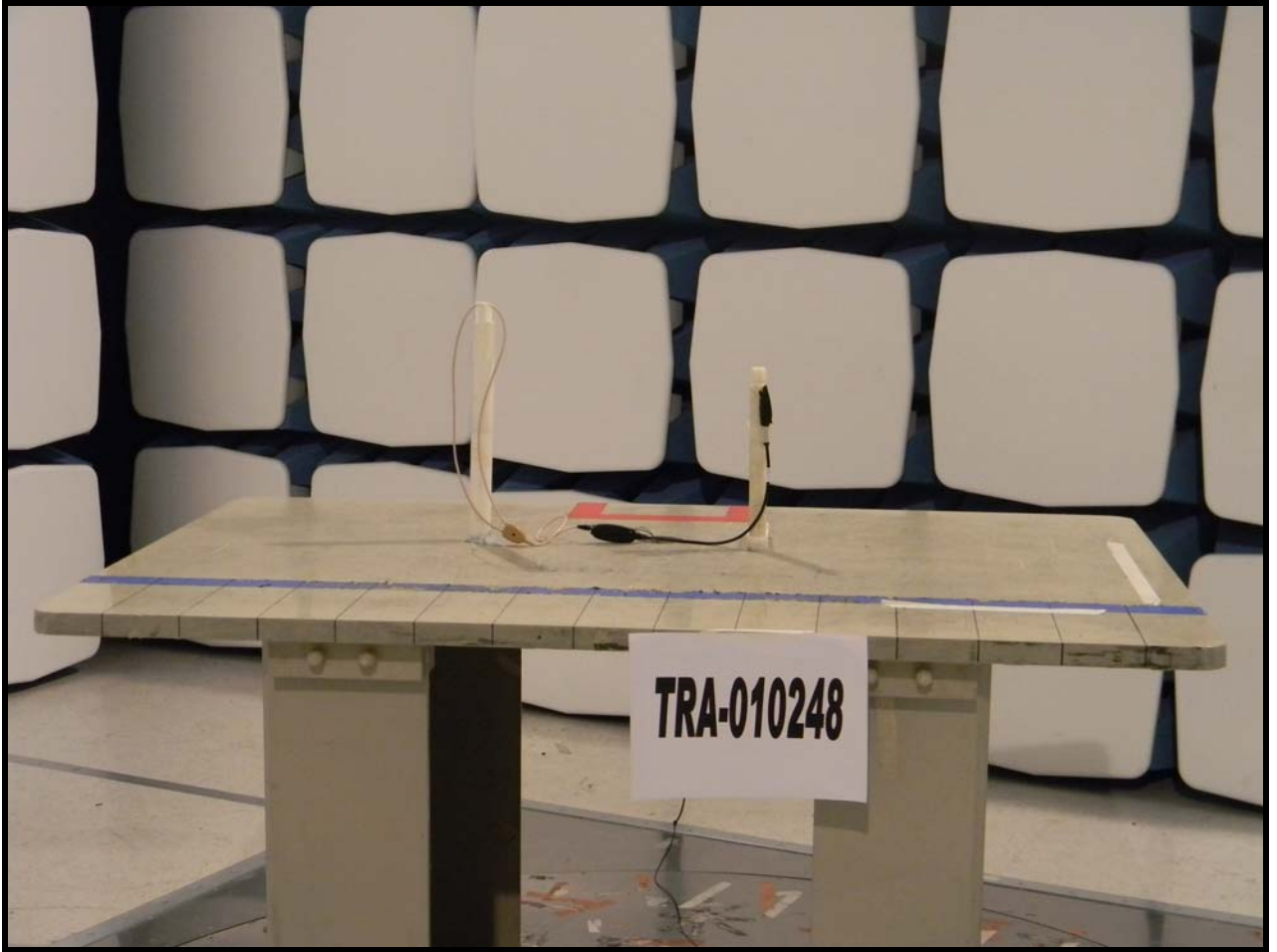
Additional Information

No additional information is included within this test report.

Appendix E:

Photographs and Figures

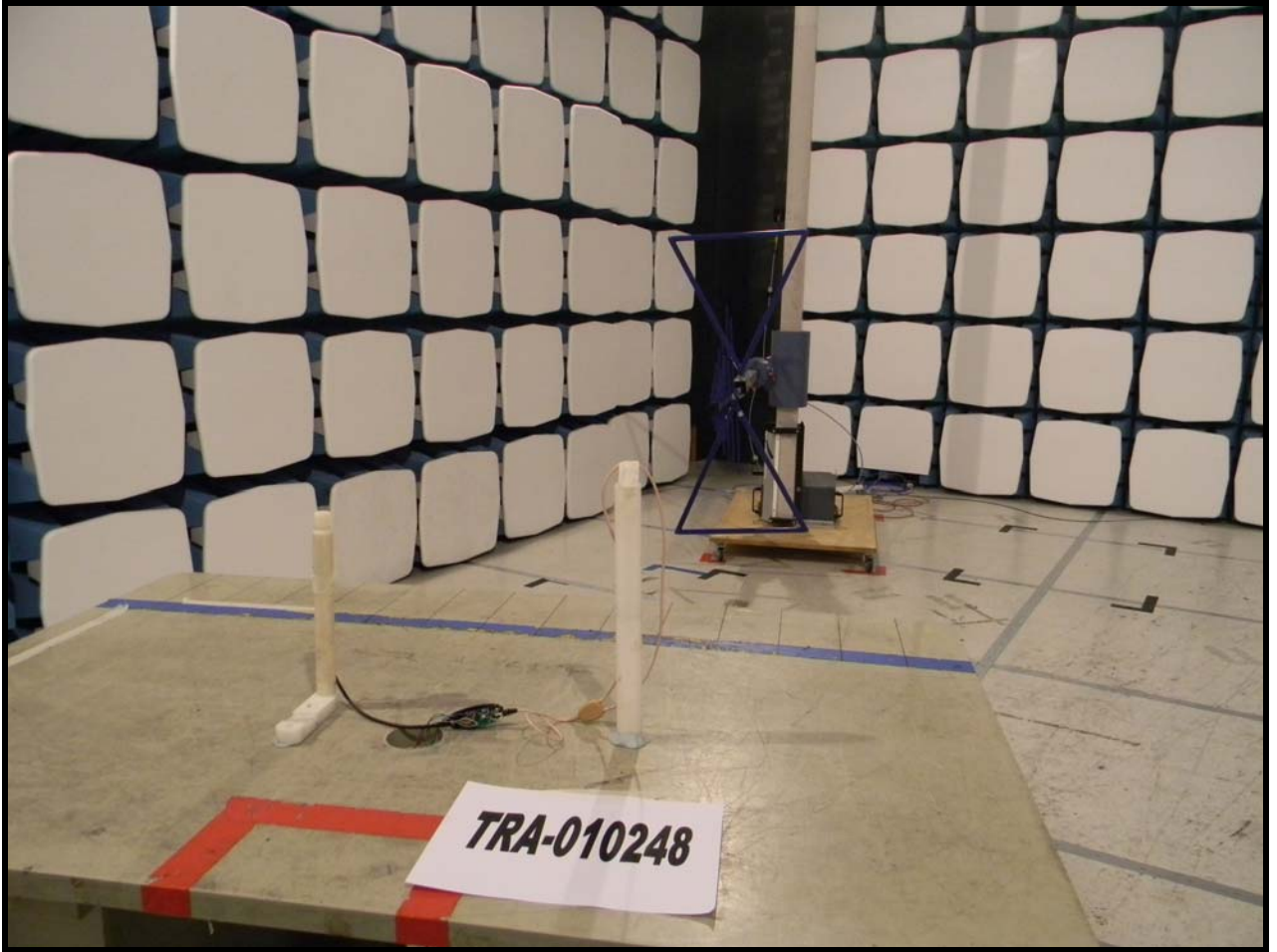
- Photograph 1 Radiated Spurious Emissions - Front View
- Photograph 2 Radiated Spurious Emissions - Front View Close Up
- Photograph 3 Radiated Spurious Emissions - Rear View



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.	S13	
Maximum peak EIRP:	-9.1	dBm
Maximum peak EIRP:	0.12	mW
Power density limit	1	mW/cm ²
Prediction frequency:	2440	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
2440	0.12	1.000000	0.1



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