RADIO TEST REPORT

FOR

Technology Solutions (UK) Ltd

ON

1128 UHF RFID Reader

DOCUMENT NO. TRA-013712-W-US-1

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TRaC Wireless Test Report	**:** TRA-013712-W-US-1
Applicant	**:** Technology Solutions Ltd
Apparatus	**:** 1128 UHF RFID Reader
Specification(s)	**:** CFR47 Part 15.247 October 2012 IC RSS210 Issue 8
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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

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1.4 Apparatus Assessed

The following apparatus was assessed between: 15/03/13 and 08/04/13

1128 RFID/Barcode Reader

The EUT is a handheld reader for UHF Radio Frequency Identification (RFID) tags and optionally barcodes. It connects to the host computer using a Bluetooth or USB connection. The 1128 Bluetooth UHF RFID reader is powered by an internal rechargeable lithium polymer battery. The battery is recharged using a standard USB power supply.

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 C63.10:2009	Pass
Conducted spurious emissions (Non-restricted bands)	Title 47 of the CFR: Part 15 Subpart (c) 15.247	ANSI C63.10:2009	Pass
AC Power conducted emissions	Title 47 of the CFR: Part 15 Subpart (c) 15.207	ANSI C63.10:2009	Pass
20dB Bandwidth and Channel Spacing	Title 47 of the CFR : Part 15 Subpart (c) 15.247(a)(1)(i)	ANSI C63.10:2009	Pass
Conducted Carrier Power	Title 47 of the CFR : Part 15 Subpart (c) 15.247(b)(2)	ANSI C63.10:2009	Pass
Hopping Frequencies	Title 47 of the CFR : Part 15 Subpart (c) 15.247(a)(1)	ANSI C63.10:2009	Pass
Channel Occupancy	Title 47 of the CFR : Part 15 Subpart (c) 15.247(a)(1)(i)	ANSI C63.10:2009	Pass
Unintentional Radiated Spurious Emissions	Title 47 of the CFR: Part 15 Subpart (b) 15.109	ANSI C63.10:2009	Pass

Abbreviations used in the above table:

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

Mod : Modification
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 test data recorded, the following measurement uncertainty was calculated:

Radiated Electric Field Emissions

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

Section 3: Modifications

3.1 Modifications Performed During Assessment

No modifications were performed during the assessment

Appendix A: Formal Emission Test Results

Abbreviations used in the tables in this appendix:

Spec	: Specification
Mod	: Modification
EUT	: Equipment Under Test
SE	: Support Equipment
L	: Live Power Line
N	: Neutral Power Line
E	: Earth Power Line
Pk	: Peak Detector
QP	: Quasi-Peak Detector
Av	: Average Detector
CDN	: Coupling & decoupling network
ALSR	: Absorber Lined Screened Room
OATS	: Open Area Test Site
ATS	: Alternative Test Site
Ref	: Reference
Freq	: Frequency
MD	: Measurement Distance
SD	: Spec Distance
Pol	: Polarisation
H	: Horizontal Polarisation
V	: Vertical Polarisation

A1 Transmitter Peak Output Power

Carrier power 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(b)(1)
Measurement standard	ANSI C63.10:2009
EUT sample number	S13, S19 and S23
Modification state	0
SE in test environment	S29
SE isolated from EUT	S31 and S32
EUT set up	Refer to Appendix C

Channel Frequency (MHz)	Peak Carrier Power (W)	Limit (W)	Result
902.75	0.721	1.000	Pass
915.25	0.684		Pass
927.25	0.637		Pass

Notes:

Number of hopping channels employed is 50

Conducted Measurement

Measured Peak Carrier power 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.

Radiated Measurement

Measuring distances 3m
EUT 0.8 metre above ground plane.
Emissions maximised by rotation of EUT, on an automatic turntable.
Raising and lowering the receiver antenna between 1m & 4m >30MHz
Horizontal and vertical polarisations, of the receive antenna.
EUT orientation in three orthagonal planes.
Maximum results recorded.
EUT was replaced by antenna and signal generator to produce EIRP level.

A2 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: 902.75 MHz	
Regulation	Title 47 of the CFR: Part 15 Subpart (c) Clause 15.247(d) and Clause 15.205
Measurement standard	ANSI C63.10:2009
Frequency range	9 kHz to 25 GHz
EUT sample number	S13, S19 and S23
Modification state	0
SE in test environment	S29
SE isolated from EUT	S31 and S32
EUT set up	Refer to Appendix C

The worst case conducted emission measurements at the antenna port are listed below:

Ref No.	Measured Freq (MHz)	Det.	Is measured Frequency within the Restricted bands (Y/N)	Measured Peak Conducted power (RBW =100kHz) (dBuV)	15.247(d) Limit (dBuV)	Summary
All emissions were at least 20 dB below the test limit						

RF Antenna Conducted Spurious Emissions continued:

Test Details: 915.25 MHz	
Regulation	Title 47 of the CFR: Part 15 Subpart (c) Clause 15.247(d) and Clause 15.205
Measurement standard	ANSI C63.10:2009
Frequency range	9 kHz to 25 GHz
EUT sample number	S13, S19 and S23
Modification state	0
SE in test environment	S29
SE isolated from EUT	S31 and S32
EUT set up	Refer to Appendix C

The worst case conducted emission measurements at the antenna port are listed below:

Ref No.	Measured Freq (MHz)	Det.	Is measured Frequency within the Restricted bands (Y/N)	Measured Peak Conducted power (RBW =100kHz) (dBuV)	15.247(d) Limit (dBuV)	Summary
All emissions were at least 20 dB below the test limit						

RF Antenna Conducted Spurious Emissions continued:

Test Details: 927.25 MHz	
Regulation	Title 47 of the CFR: Part 15 Subpart (c) Clause 15.247(d) and Clause 15.205
Measurement standard	ANSI C63.10:2009
Frequency range	9 kHz to 25 GHz
EUT sample number	S13, S19 and S23
Modification state	0
SE in test environment	S29
SE isolated from EUT	S31 and S32
EUT set up	Refer to Appendix C

The worst case conducted emission measurements at the antenna port are listed below:

Ref No.	Measured Freq (MHz)	Det.	Is measured Frequency within the Restricted bands (Y/N)	Measured Peak Conducted power (RBW =100kHz) (dBuV)	15.247(d) Limit (dBuV)	Summary
All emissions were at least 20 dB below the test limit						

Notes:

1. The conducted emission limit for emissions outside the restricted bands, defined in 47CFR15.205(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 accordance15.33 (a)(1).
3. The measurements at 902 MHz and 928 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):

The limit in 100 kHz RBW = (Maximum Peak Conducted Carrier)-20dB

Where:

The maximum peak conducted power was measured using a peak power meter. Please refer to section A1 of this test report.

A3 Radiated Electric Field Emissions Within The Restricted Bands of 15.205

Preliminary scans were performed using a peak detector with the RBW = 100kHz. The radiated electric filed 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 : [X]

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

Test Details: 902.75 MHz	
Regulation	Part 15 Subpart (c) Clause 15.247(d) and Clause 15.205
Measurement standard	ANSI C63.10:2009
Frequency range	30MHz – 10GHz
EUT sample number	S14, S15, S19 and S23
Modification state	0
SE in test environment	S29
SE isolated from EUT	S31 and S32
EUT set up	Refer to Appendix C
Photographs (Appendix F)	Photograph 1 and 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 (dBµV/m)**	**LIMIT (dBµV/m)**
1.	902.000	40.3	4.3	22.3	0	66.9	0	66.9	105.3
2.	2706.000	45.6	4.0	30.7	34.7	45.6	0	45.6	54.0
3.	3613.000	41.6	6.5	34.0	34.7	47.4	0	47.4	54.0

Radiated Electric Field Emissions Within The Restricted Band 15.205 continued:

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

Test Details: 915.25 MHz	
Regulation	Title 47 of the CFR: Part 15 Subpart (c) Clause 15.247(d) and Clause 15.205
Measurement standard	ANSI C63.10:2009
Frequency range	30MHz to 25 GHz
EUT sample number	S14, S15, S19 and S23
Modification state	0
SE in test environment	S29
SE isolated from EUT	S31 and S32
EUT set up	Refer to Appendix C
Photographs (Appendix F)	Photograph 1 and 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 (dBµV/m)	LIMIT (dBµV/m)
1.	2746.000	44.4	4.7	30.9	34.7	45.5	0	45.5	54.0
2.	3662.000	40.9	6.7	34.0	34.7	46.9	0	46.9	54.0

Radiated Electric Field Emissions Within The Restricted Band 15.205 continued:

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

Test Details: 927.25 MHz	
Regulation	Title 47 of the CFR: Part 15 Subpart (c) Clause 15.247(d) and Clause 15.205
Measurement standard	ANSI C63.10:2009
Frequency range	30MHz to 25 GHz
EUT sample number	S14, S15, S19 and S23
Modification state	0
SE in test environment	S29
SE isolated from EUT	S31 and S32
EUT set up	Refer to Appendix C
Photographs (Appendix F)	Photograph 1 and 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 (dBµV/m)	LIMIT (dBµV/m)
1.	928.000	32.6	4.3	22.3	0	59.5	0	59.5	105.3
2.	3710.000	39.7	6.6	34.0	34.7	45.5	0	45.5	54.0

Notes:

1 Any testing performed below 30 MHz was performed using a magnetic loop antenna in accordance with ANSI C63.10:2009: section 4.5, Table 1
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 Measurements at 902 & 928 MHz were made to ensure band edge compliance.
4 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.
5 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=VBW= 1MHz

These settings as per ANSI C63.10:2009 and DA 00-705.

6 In accordance with DA 00-705, the average level of the spurious radiated emission may be reduced by the duty cycle correction factor. If the dwell time per channel (refer to the measured channel occupancy time, section A7 of this test report) of the hopping signal is less than 100ms then the average measurement may be further adjusted by the duty cycle correction factor which is derived from

$$20\log_{10}\left(\frac{\text{dwell time}}{100ms}\right)$$

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 emissions falling within the restricted bands defined in 15.205(a):

Frequency of emission (MHz)	Field strength μV/m	Measurement Distance m	Field strength dBμV/m
0.009-0.490	2400/F(kHz)	300	67.6/F (kHz)
0.490-1.705	24000/F(kHz)	30	87.6/F (kHz
1.705-30	30	30	29.5
30-88	100	3	40.0
88-216	150	3	43.5
216-960	200	3	46.0
Above 960	500	3	54.0

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:

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

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

A4 Power Line Conducted Emissions

Preview power line conducted emission measurements were performed with a peak detector in a screened room. The effect of the EUT set-up on the measurements is summarised in note (b). Where applicable formal measurements of the emissions were performed with a peak, average and/or quasi peak detector. The EUT was set to transmit on its lowest, centre and highest carrier frequency in turn. 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	150kHz to 30MHz
EUT sample number	S14, S15, S19 and S23
Modification state	0
SE in test environment	S29
SE isolated from EUT	S31 and S32
EUT set up	Refer to Appendix C
Photographs (Appendix F)	Photograph 3

The worst-case power line conducted emission measurements are listed below:

Results measured using the average detector compared to the average limit

Ref No.	Freq (MHz)	Conductor	Result (dBuV)	Spec Limit (dBuV)	Margin (dB)	Result Summary
1	0.33187	L	27.0	49.4	-22.4	Pass
2	0.52511	L	23.6	46.0	-22.4	Pass
3	0.62353	L	22.2	46.0	-23.8	Pass
4	2.60000	L	17.2	46.0	-28.8	Pass
5	8.50000	L	22.2	50.0	-27.8	Pass
6	23.60000	L	18.7	50.0	-31.3	Pass
7	0.33187	N	29.7	49.4	-19.7	Pass
8	0.52511	N	23.9	46.0	-22.1	Pass
9	0.62353	N	22.7	46.0	-23.3	Pass
10	2.60000	N	19.4	46.0	-26.6	Pass
11	8.50000	N	20.0	50.0	-30.0	Pass
12	23.60000	N	19.4	50.0	-30.6	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	0.33187	L	38.7	59.4	-20.7	Pass
2	0.52511	L	35.8	56.0	-20.2	Pass
3	0.62353	L	34.8	56.0	-21.2	Pass
4	2.60000	L	27.2	56.0	-28.8	Pass
5	8.50000	L	32.9	60.0	-27.1	Pass
6	23.60000	L	29.3	60.0	-30.7	Pass
7	0.33187	N	38.3	59.4	-21.1	Pass
8	0.52511	N	32.6	56.0	-23.4	Pass
9	0.62353	N	32.4	56.0	-23.6	Pass
10	2.60000	N	27.6	56.0	-28.4	Pass
11	8.50000	N	29.6	60.0	-30.4	Pass
12	23.60000	N	31.8	60.0	-28.2	Pass

Specification limits :

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

Conducted disturbance at the mains ports.

Frequency range MHz	Limits dBμV	
	Quasi-peak	Average
0.15 to 0.5	66 to 56[2]	56 to 46[2]
0.5 to 5	56	46
5 to 30	60	50

Notes:
1. The lower limit shall apply at the transition frequency.
2. The limit decreases linearly with the logarithm of the frequency in the range 0.15MHz to 0.5MHz.

Notes:

(a) The levels may have been rounded for display purposes.

(b) The following table summarises the effect of the EUT operating mode and internal configuration on the measured emission levels :

	See (i)	See (ii)	See (iii)	See (iv)
Effect of EUT operating mode on emission levels		✓		
Effect of EUT internal configuration on emission levels		✓		

(i) Parameter defined by standard and / or single possible, refer to Appendix C
(ii) Parameter defined by client and / or single possible, refer to Appendix C
(iii) Parameter had a negligible effect on emission levels, refer to Appendix C
(iv) Worst case determined by initial measurement, refer to Appendix C

A5 20 dB Bandwidth and Carrier Frequency Separation

Title 47 of the CFR: Part 15 Subpart (c) 15.247(a)(1)(i) requires the measurement of the bandwidth of the transmission between the -20 dB points on the transmitted spectrum. The results of this test determine the limits for channel spacing. The channel separation shall be a minimum of 25 kHz or the 20 dB bandwidth, whichever is the greater. The formal measurements are detailed below:

Test Details:	
Regulation	Title 47 of the CFR: Part 15 Subpart (c) 15.247(a)(1)(i)
EUT sample number	S13, S19 and S23
Modification state	0
SE in test environment	S29
SE isolated from EUT	S31 and S32
EUT set up	Refer to Appendix C

Channel Frequency (MHz)	Measured 20 dB Bandwidth (kHz)	Limit	Result
915.25	75.641	N/A	N/A

Measured Channel Spacing (kHz)	Limit	Result
498.71	(25kHz or ≥ Measured 20 dB Bandwidth kHz)	Pass

Plots of the 20 dB bandwidth and channel spacing are contained in Appendix B of this test report.

A6 Hopping frequencies

Hopping frequencies were verified using a spectrum analyser, while the EUT was operating in its normal frequency hopping mode.

Test Details:	
Regulation	Title 47 of the CFR : Part 15 Subpart (c) 15.247(a)(1)(i)
EUT sample number	S13, S19 and S23
Modification state	0
SE in test environment	S29
SE isolated from EUT	S31 and S32
EUT set up	Refer to Appendix C

No. of Hopping Channels	Requirement	Result
50	≥50 for 1 W power limit	Pass

Plots showing the hopping channels are contained in Appendix B

A7 Channel Occupancy

Channel occupancy time was verified using a spectrum analyser in zero span mode, centred on the middle hopping channel frequency (915.25 MHz), while the EUT was operating in its normal frequency hopping mode. The other channels were then verified to ensure that the channel occupancy was identical for all channels.

Test Details:	
Regulation	Title 47 of the CFR: Part15 Subpart (c) 15.247(a)(1)
EUT sample number	S13, S19 and S23
Modification state	0
SE in test environment	S29
SE isolated from EUT	S31 and S32
EUT set up	Refer to Appendix C

Measured Channel Occupancy Time (µs)	Measured Channel Repetition Time (s)	Calculated average time of occupancy in a 20s period (ms)	Average Channel Occupancy Time Limit (ms)	Result
272.4	18.355	0.297	400	Pass

Plots showing the channel occupancy time and time between successive transmissions are contained in Appendix B of this test report.

Average Channel Retention Time Calculation:

The Average Retention Time in 20s =

Measured Channel Occupancy Time T_{occ} x (20/Repitition Time(s))

Average Channel Occupancy Time = 272.4 µs x (20/18.335) = 297 µs = 0.297ms

A8 Antenna Gain

The maximum antenna gain for the antenna types to be used with the EUT, as measured, is 0.5 dBi.

A9 Unintentional Radiated Electric Field Emissions - 15.109

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 : [X]

Test Details: ?BOTFREQ MHz	
Regulation	Title 47 of the CFR: Part 15 Subpart (b) Clause 15.109
Measurement standard	ANSI C63.10:2009
Frequency range	30MHz to 25 GHz
EUT sample number	S14, S15, S19 and S23
Modification state	0
SE in test environment	S29
SE isolated from EUT	S31 and S32
EUT set up	Refer to Appendix C
Photographs (Appendix F)	Photographs 1 and 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 (dBµV/m)	LIMIT (dBµV/m)
1.	32.000	24.2	0.7	12.5	0	37.4	0	37.4	40.0
2.	150.000	28.4	1.9	12.4	0	42.7	0	42.7	43.5
3.	280.000	24.5	1.7	13	0	39.2	0	39.2	46.0
4.	775.000	18.6	3.7	21.1	0	43.4	0	43.4	46.0

Appendix B: Supporting Graphical Data

This appendix contains graphical data obtained during testing.

Notes:

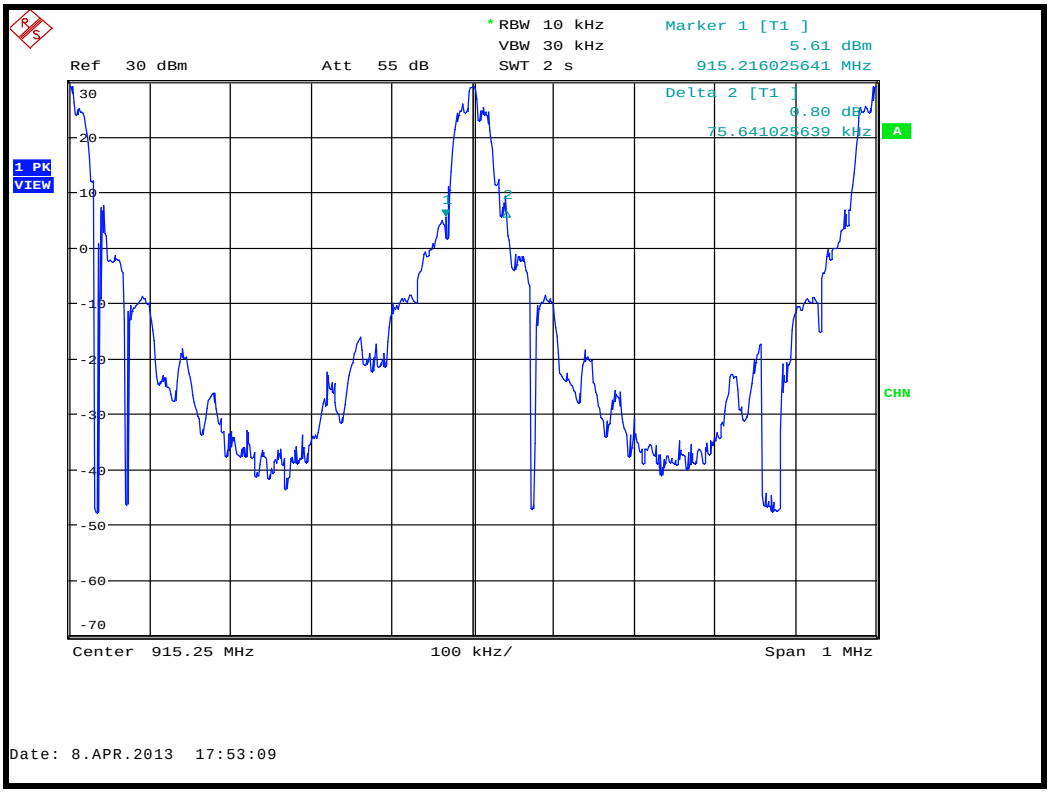
(a) The radiated electric field emissions and conducted emissions graphical data in this appendix is preview data. For details of formal results, refer to Appendix A and Appendix B.

(b) The time and date on the plots do not necessarily equate to the time of the test.

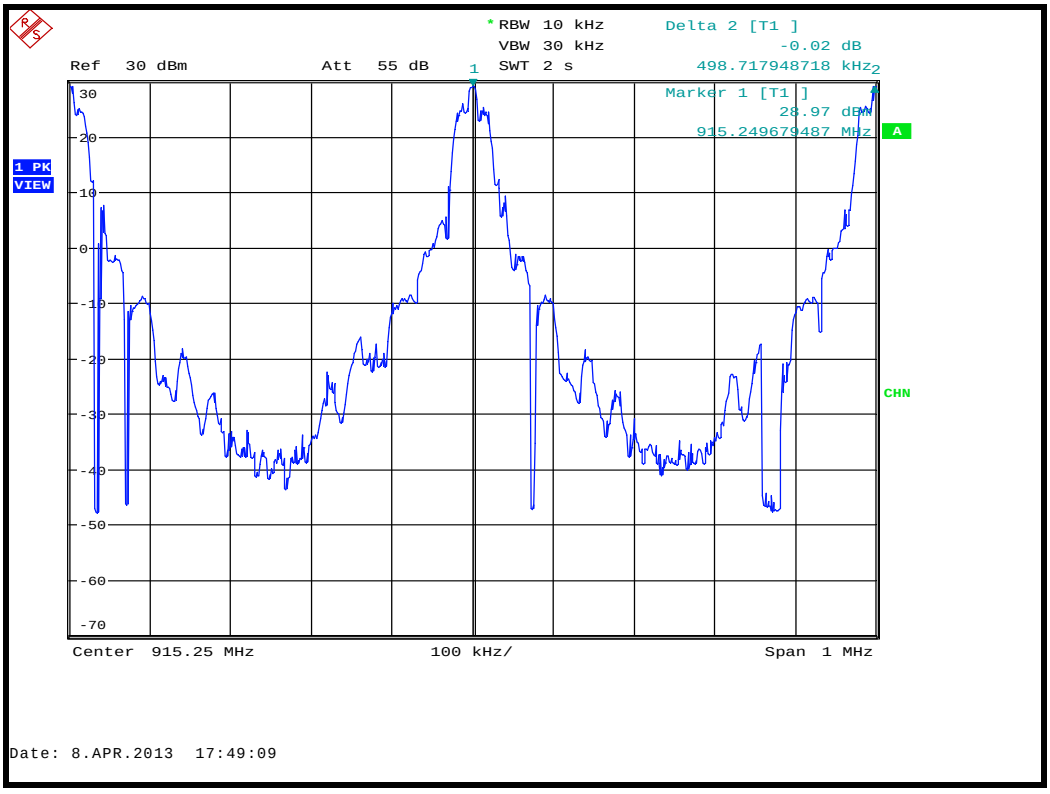
(c) Where relevant, on power line conducted emission plots, the limit displayed is the average limit, which is stricter than the quasi peak limit.

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

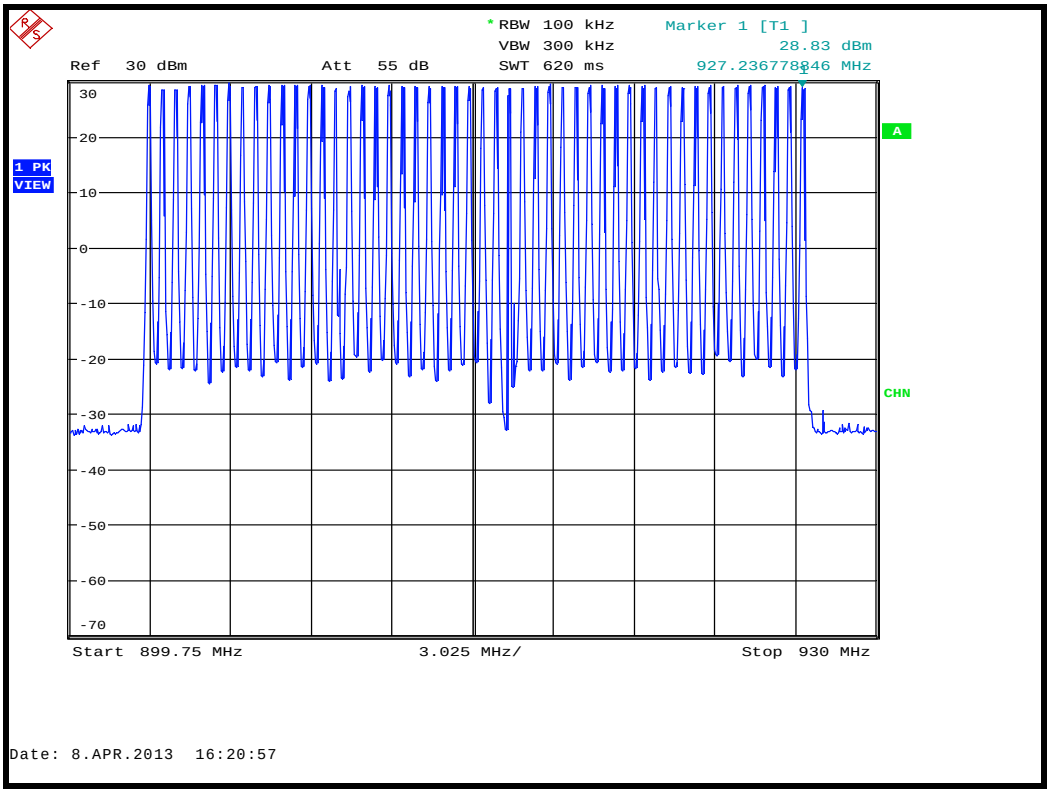
(e) The plots presented in this appendix may not be a complete record of the measurements performed, but are a representative sample, relative to the final assessment.



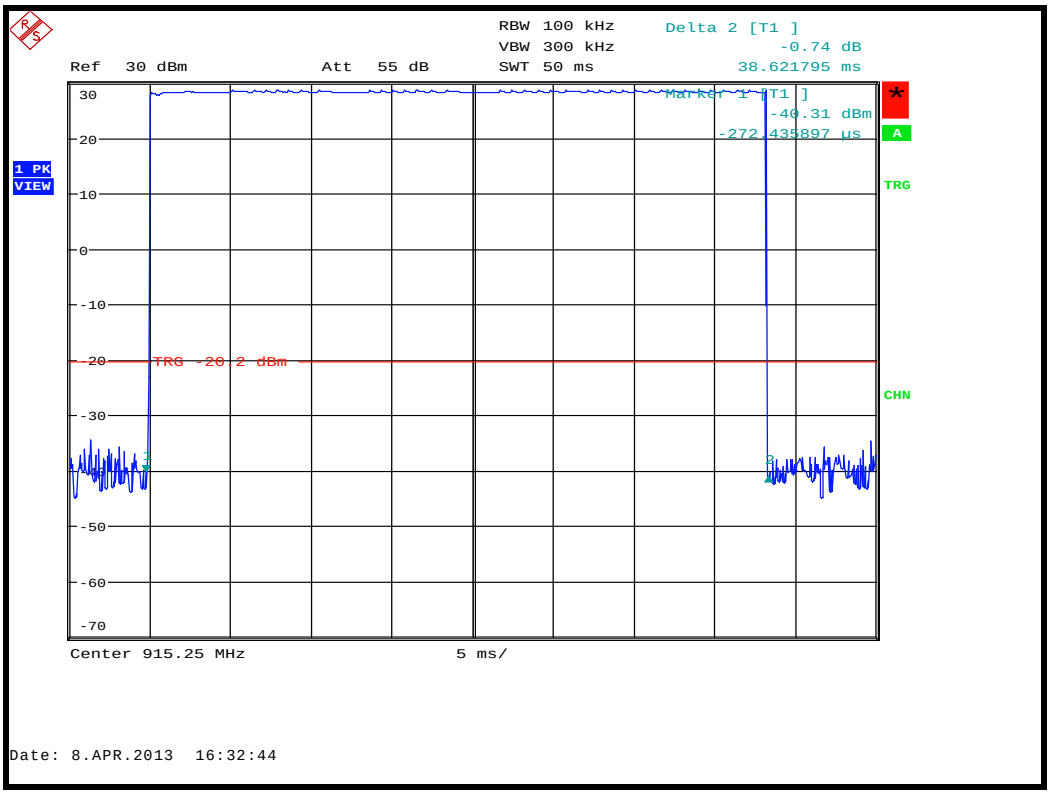
20dB Bandwidth



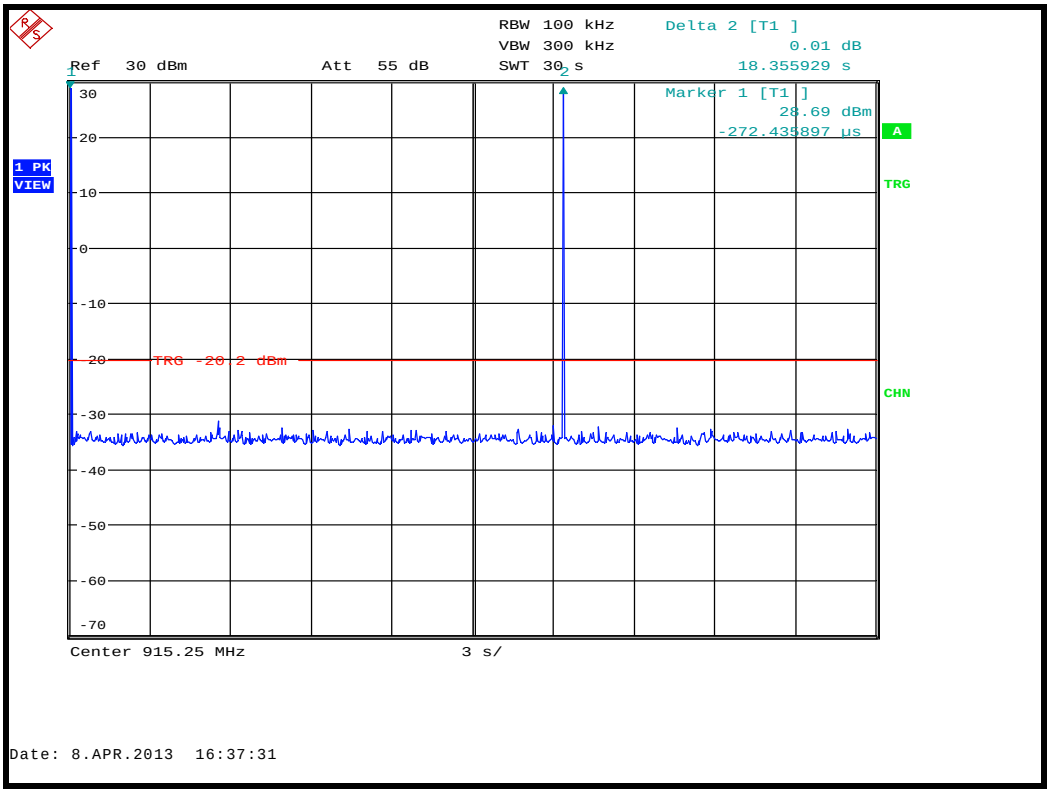
Channel Spacing



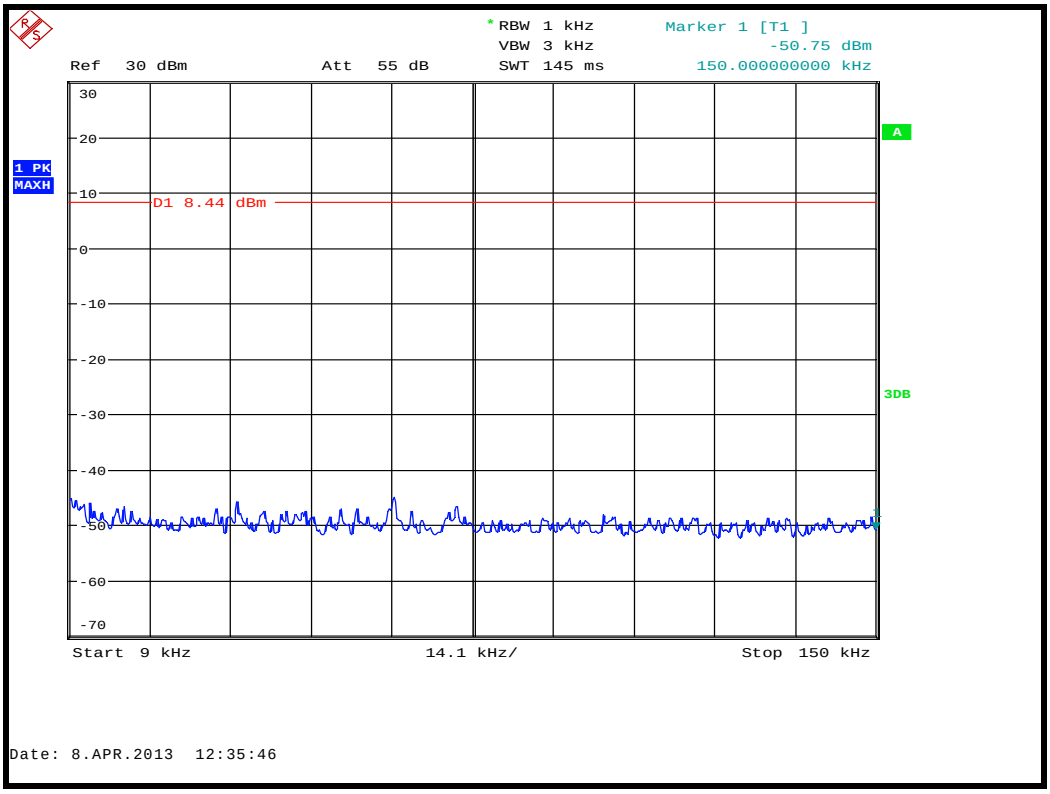
Channels 0 to 50



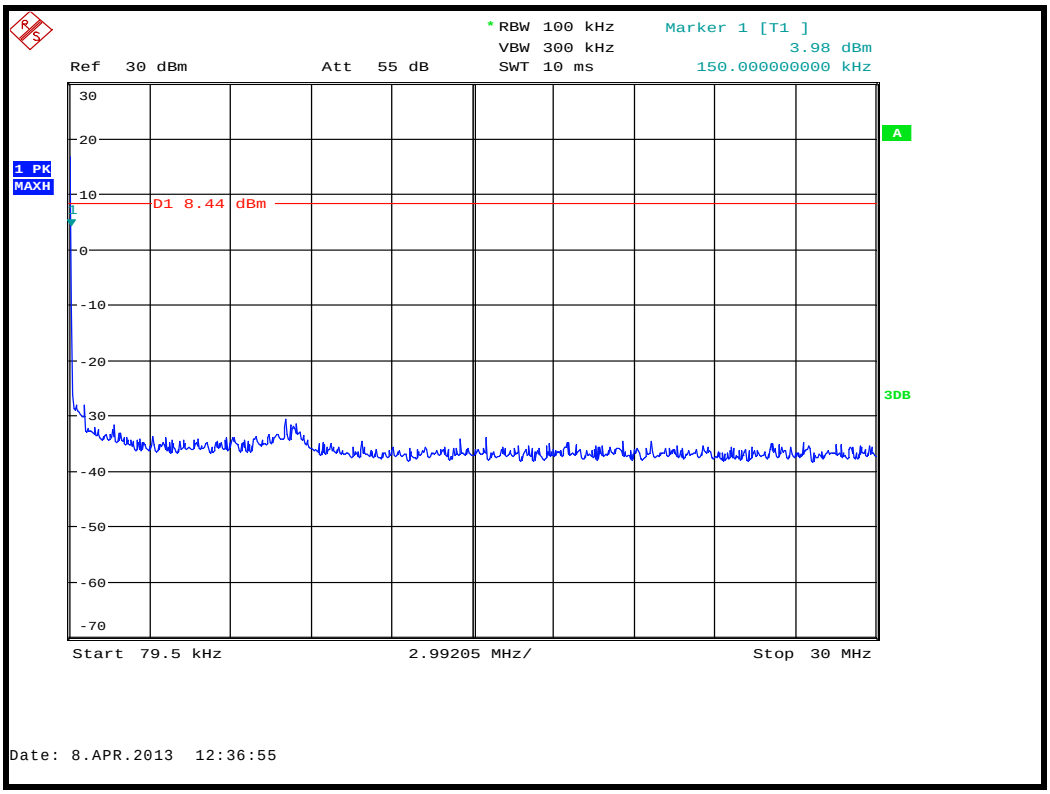
Channel Occupancy Time



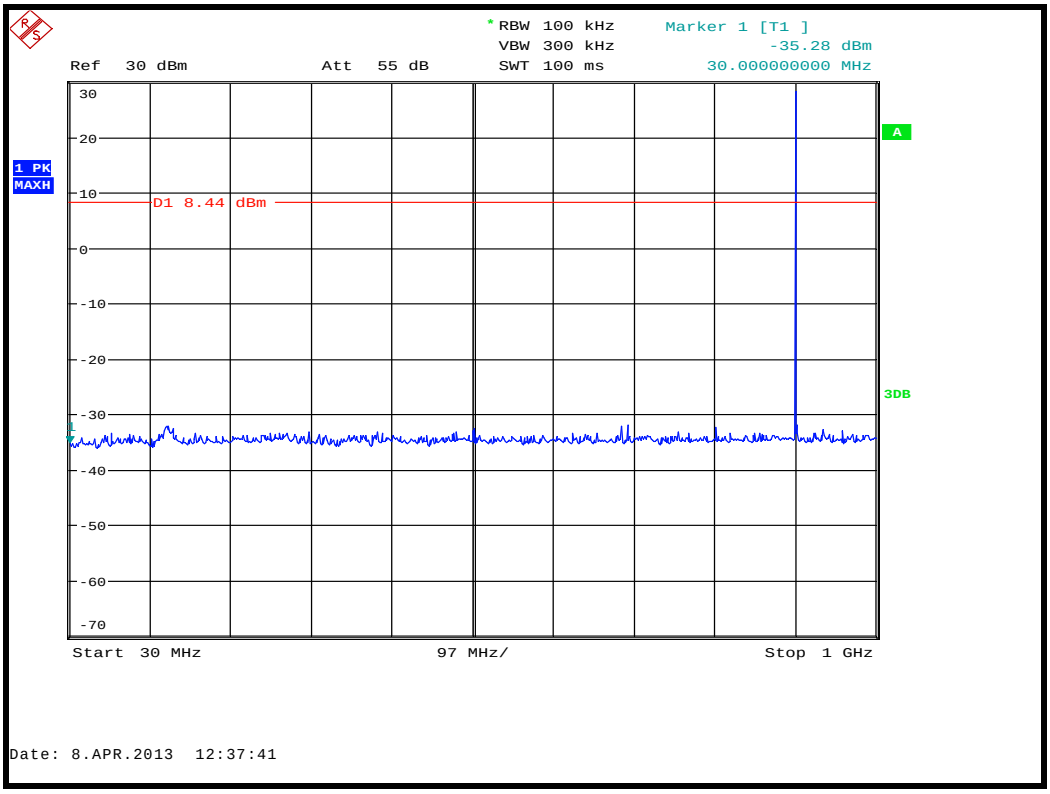
Channel repetition time



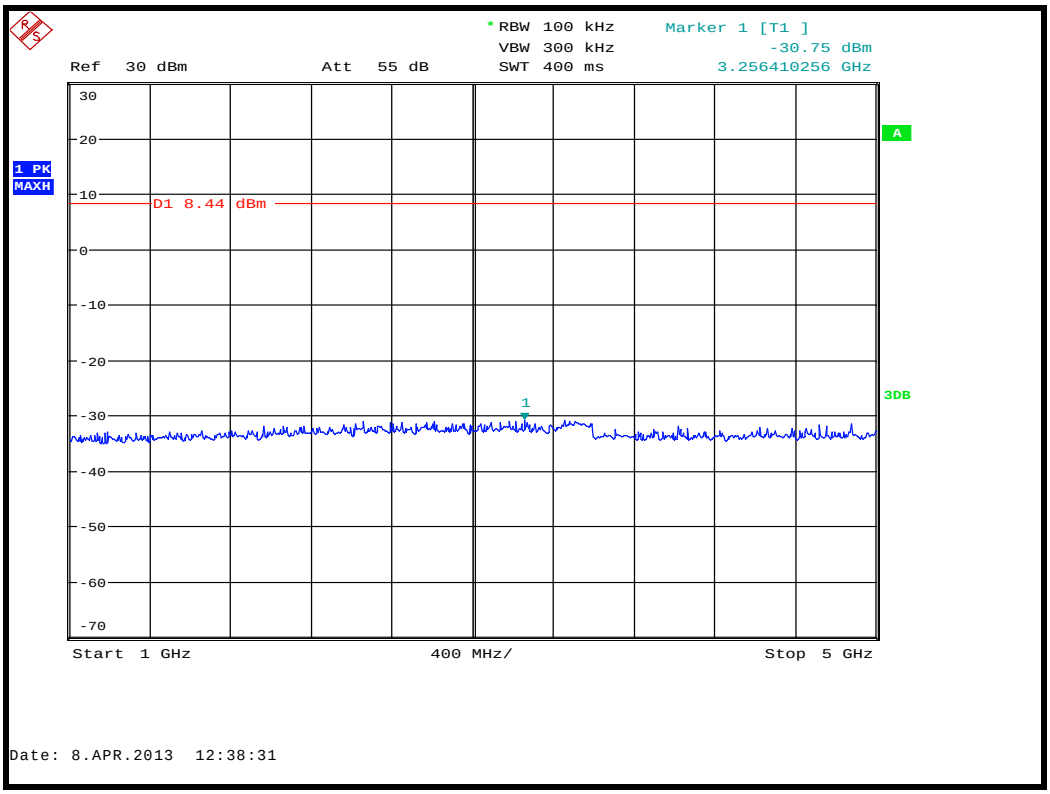
Conducted Spurious emissions 9kHz to 150 kHz – 902.75 MHz



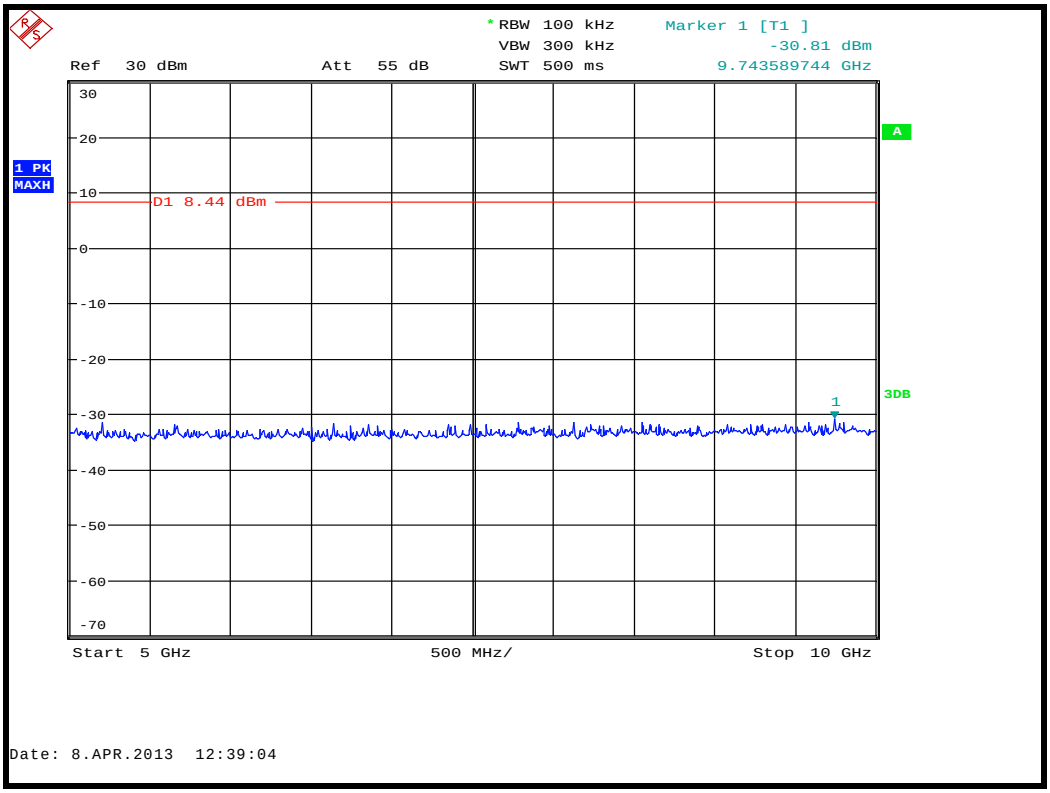
Conducted Spurious emissions 150kHz to 30 MHz – 902.75 MHz



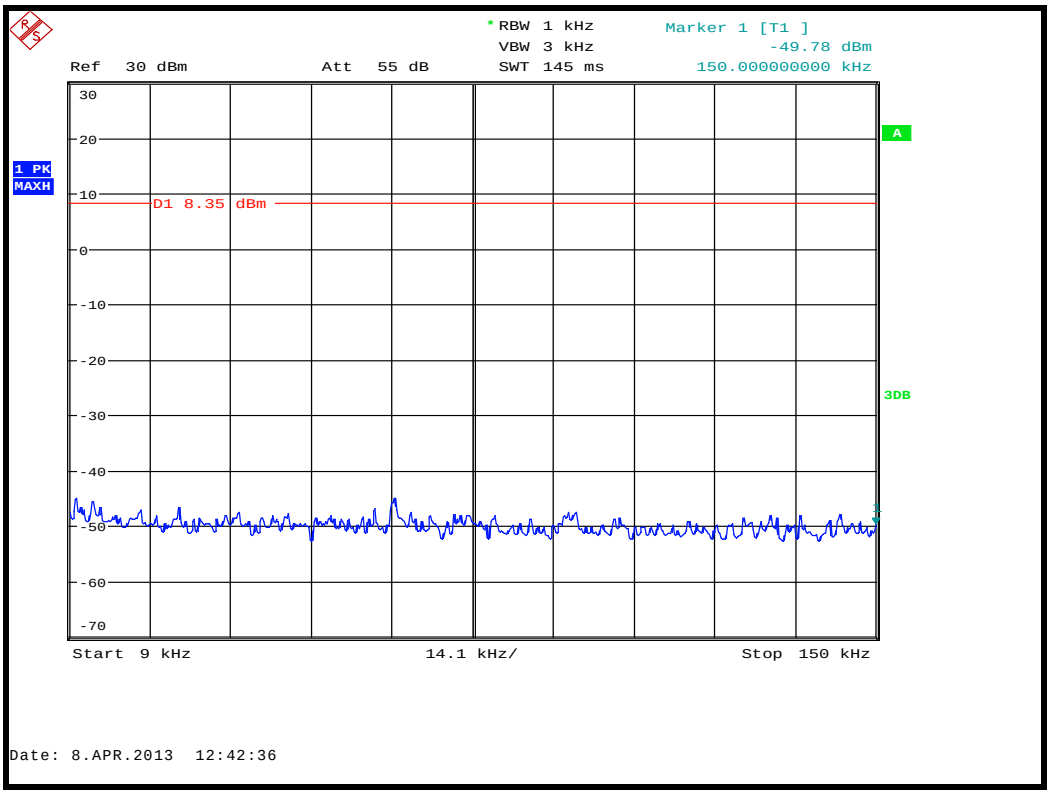
Conducted Spurious emissions 30 MHz to 1 GHz – 902.75 MHz



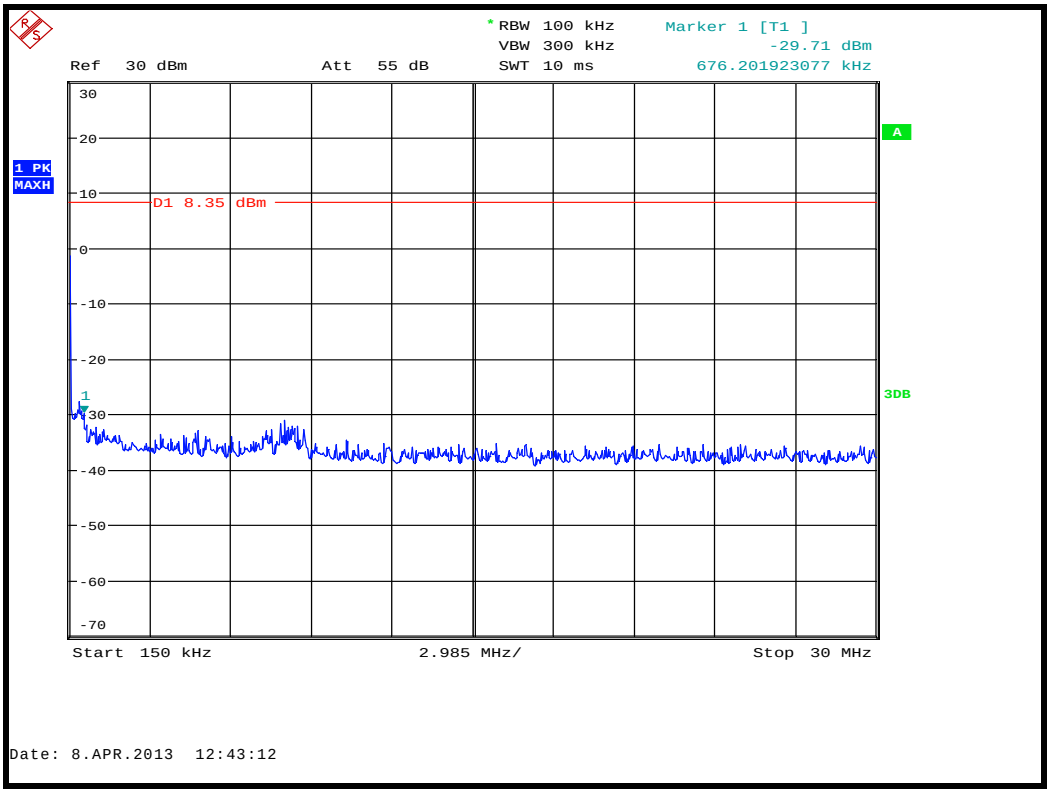
Conducted Spurious emissions 1 GHz to 5 GHz – 902.75 MHz



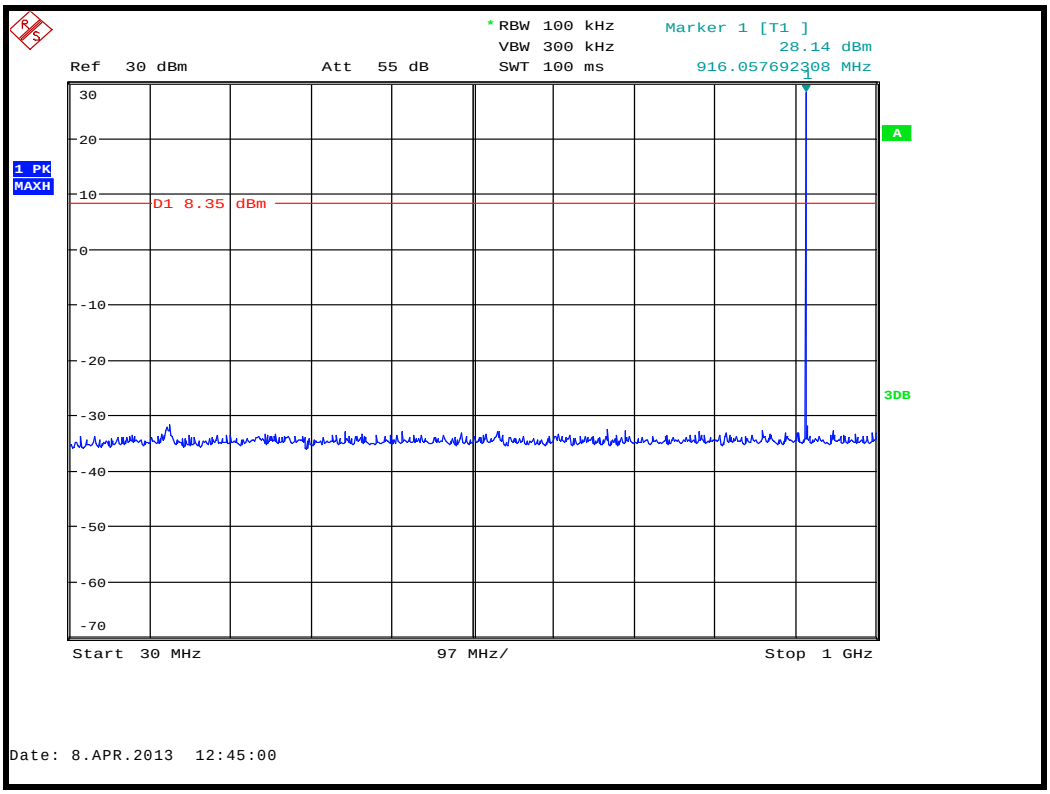
Conducted Spurious emissions 5 GHz to 10 GHz – 902.75 MHz



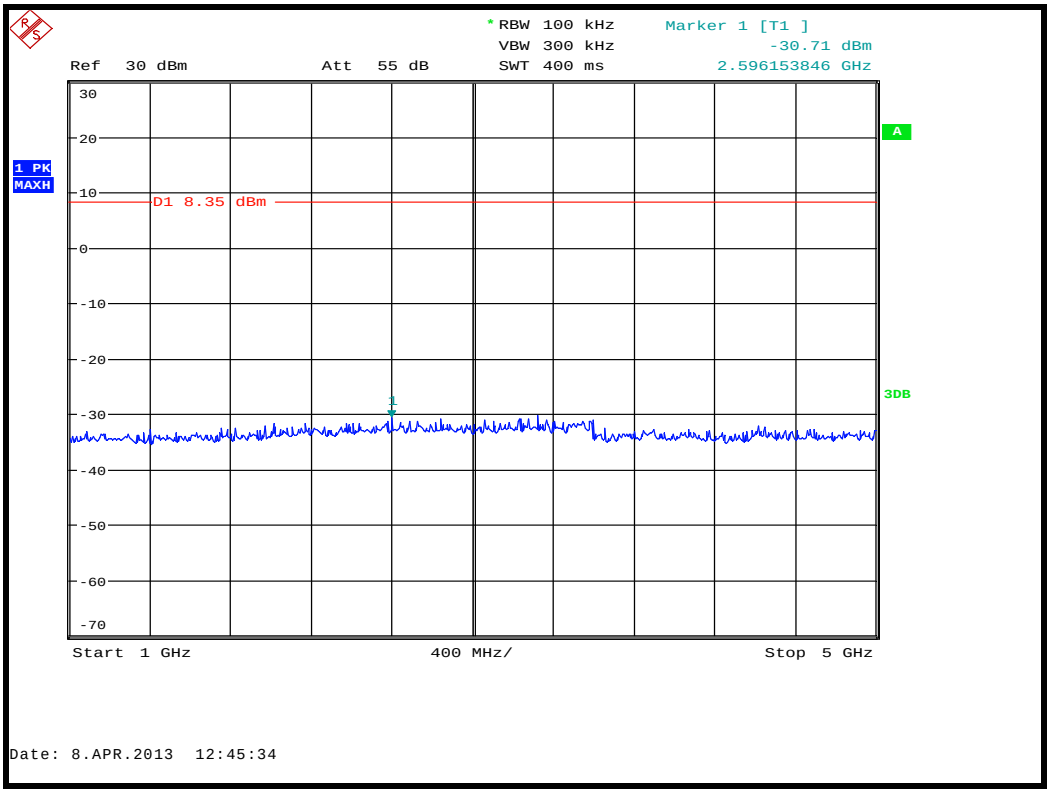
Conducted Spurious emissions 9kHz to 150 kHz – 915.25 MHz



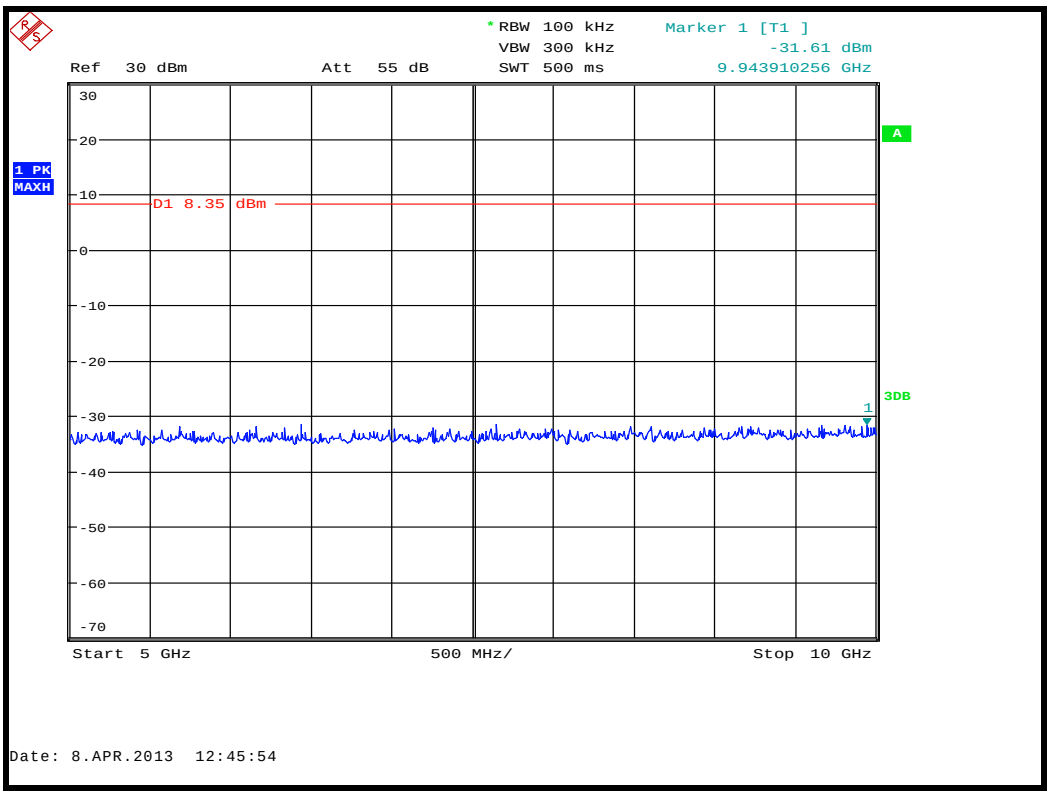
Conducted Spurious emissions 150kHz to 30 MHz – 915.25 MHz



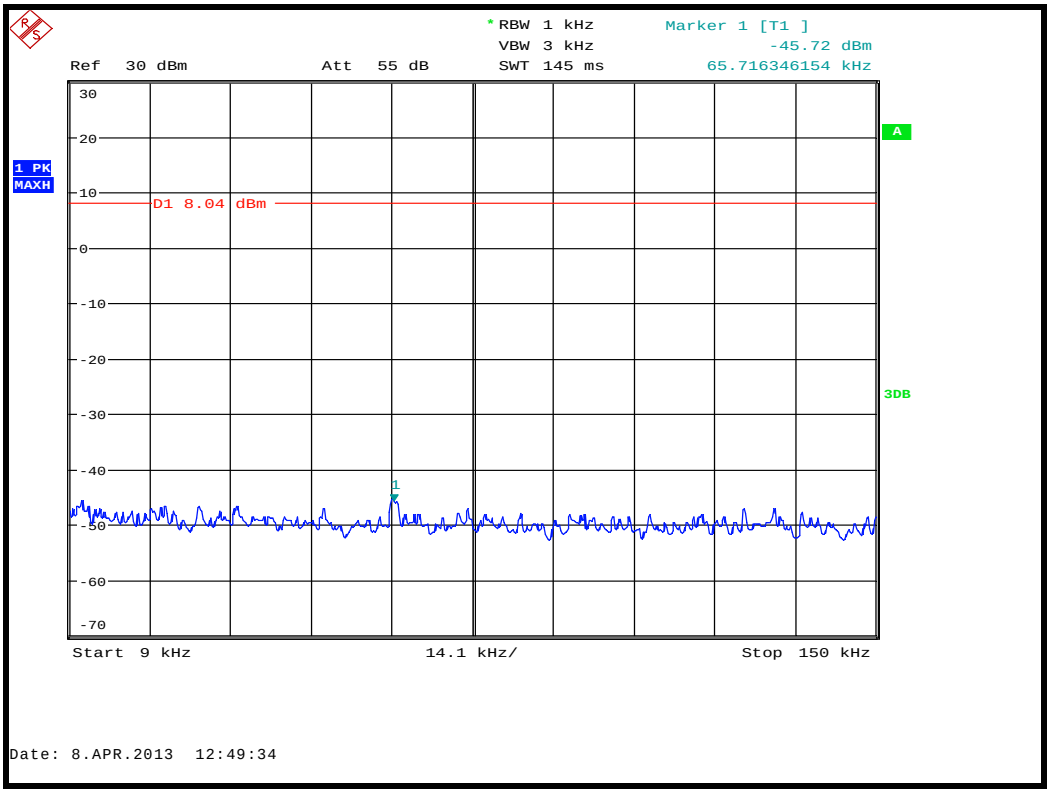
Conducted Spurious emissions 30 MHz to 1 GHz – 915.25 MHz



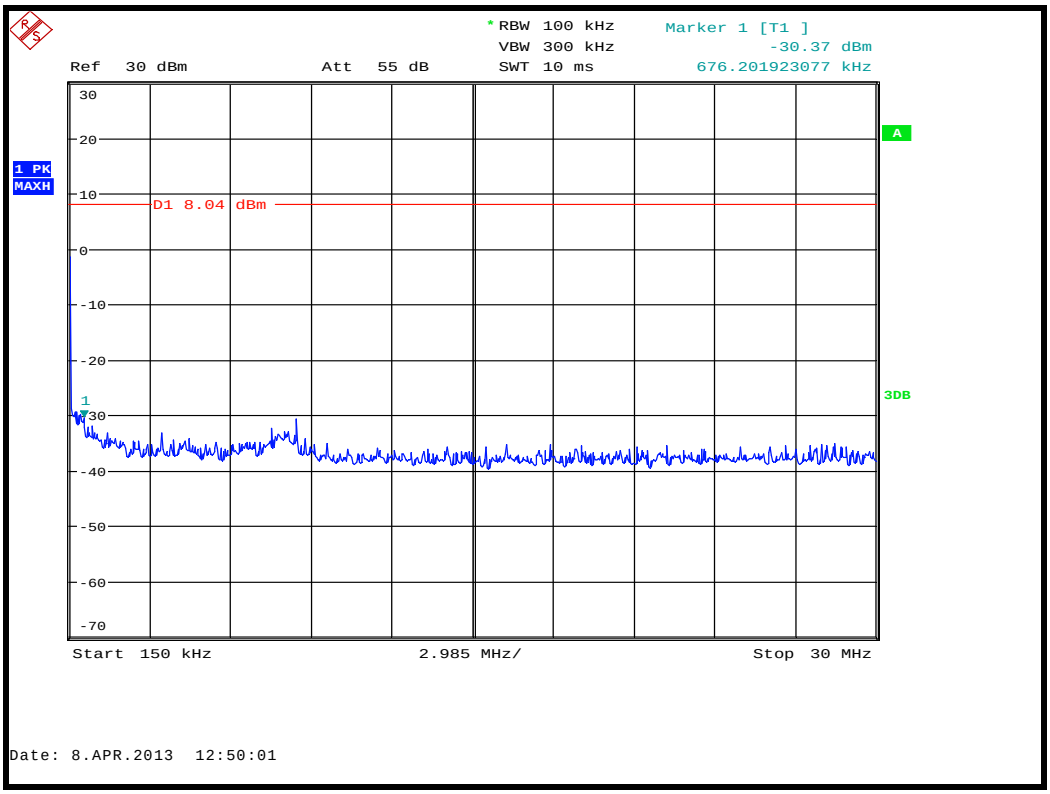
Conducted Spurious emissions 1 GHz to 5 GHz – 915.25 MHz



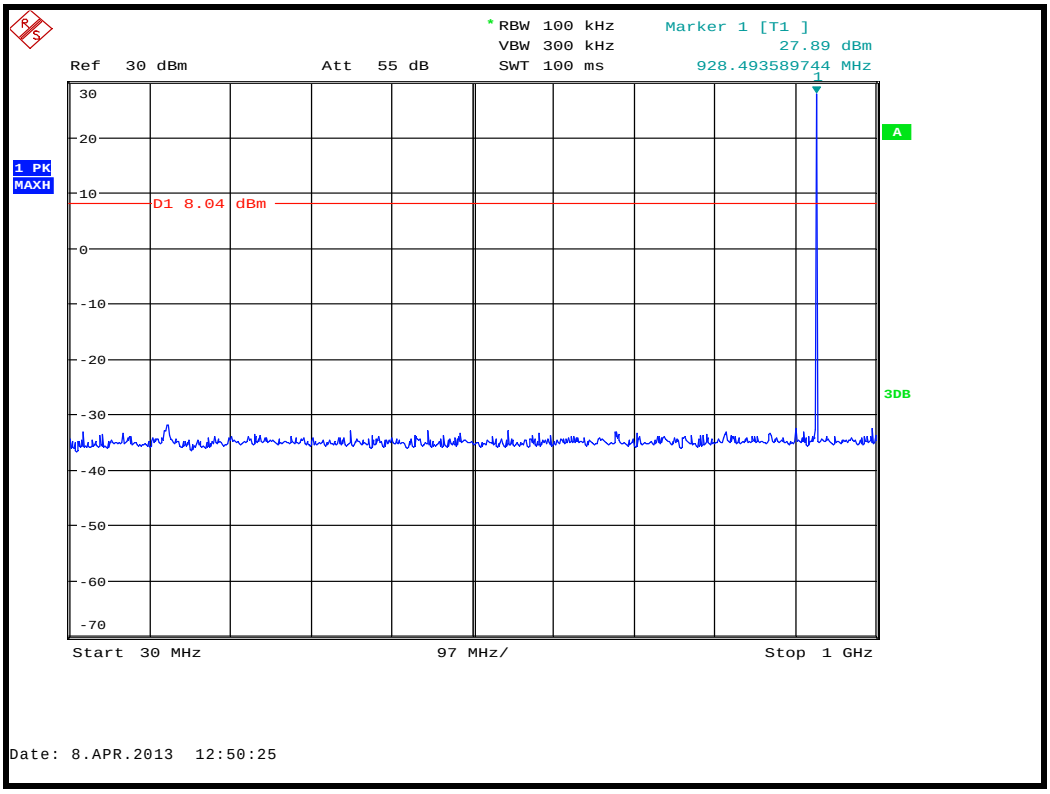
Conducted Spurious emissions 5 GHz to 10 GHz – 915.25 MHz



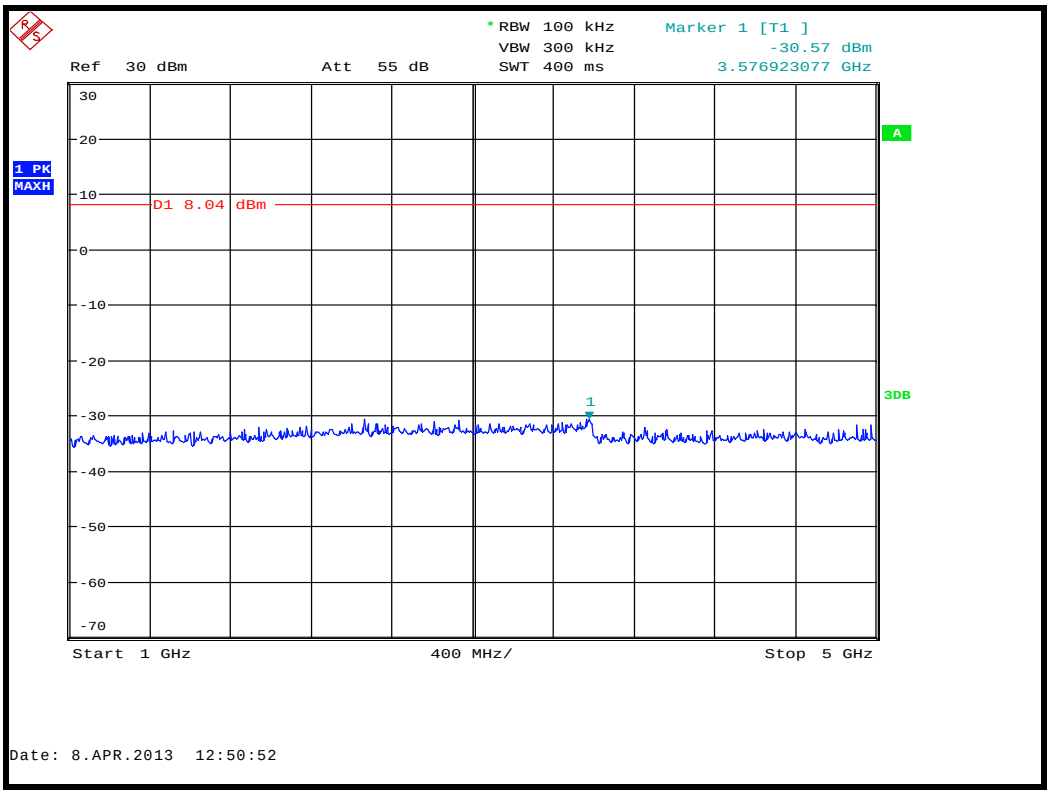
Conducted Spurious emissions 9kHz to 150 kHz – 927.25 MHz



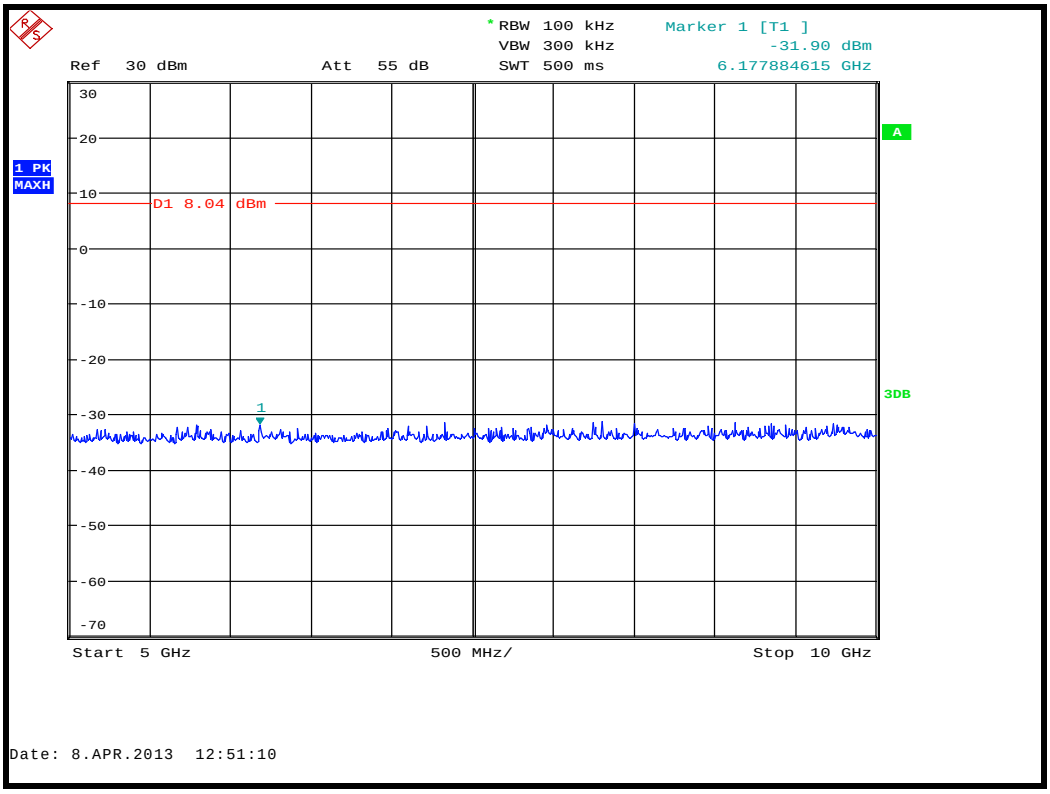
Conducted Spurious emissions 150 kHz to 30 MHz – 927.25 MHz



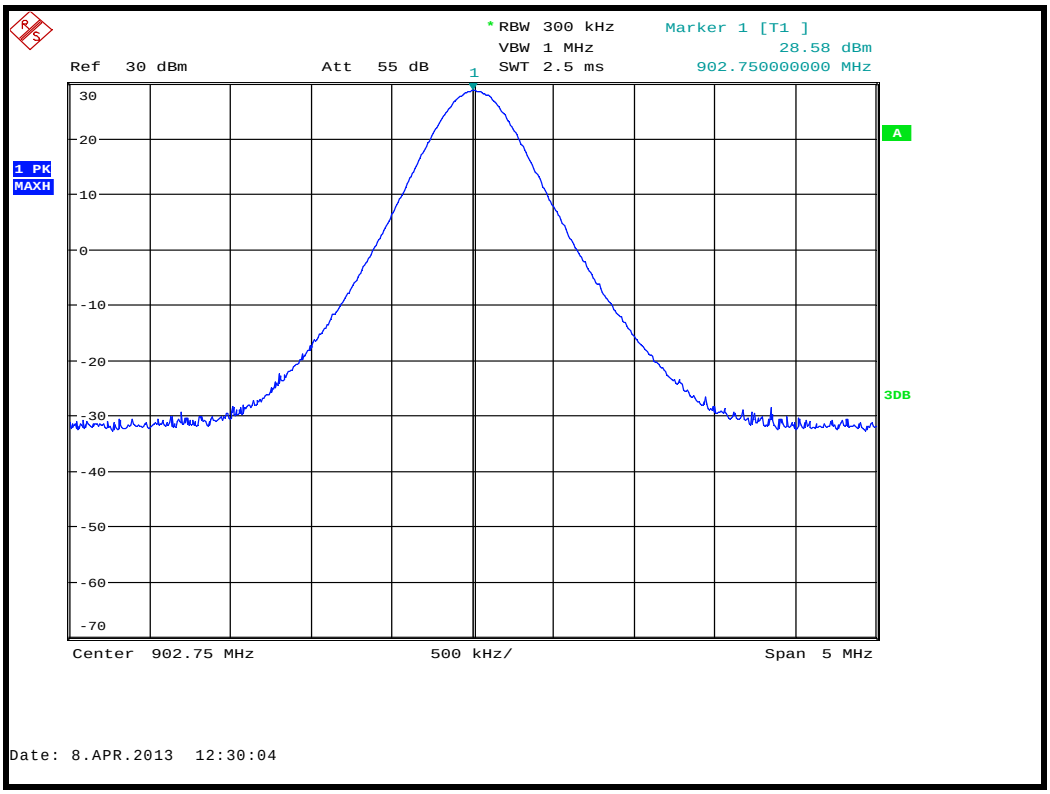
Conducted Spurious emissions 30 MHz to 1 GHz – 927.25 MHz



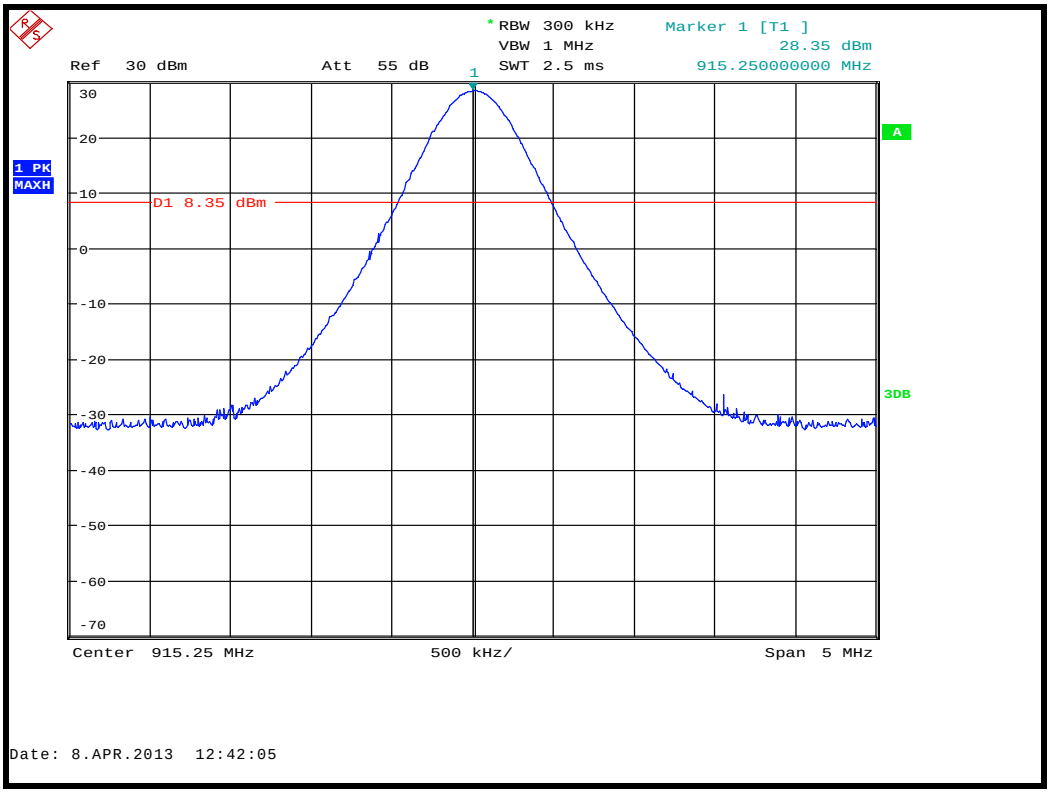
Conducted Spurious emissions 1 GHz to 5 GHz – 927.25 MHz



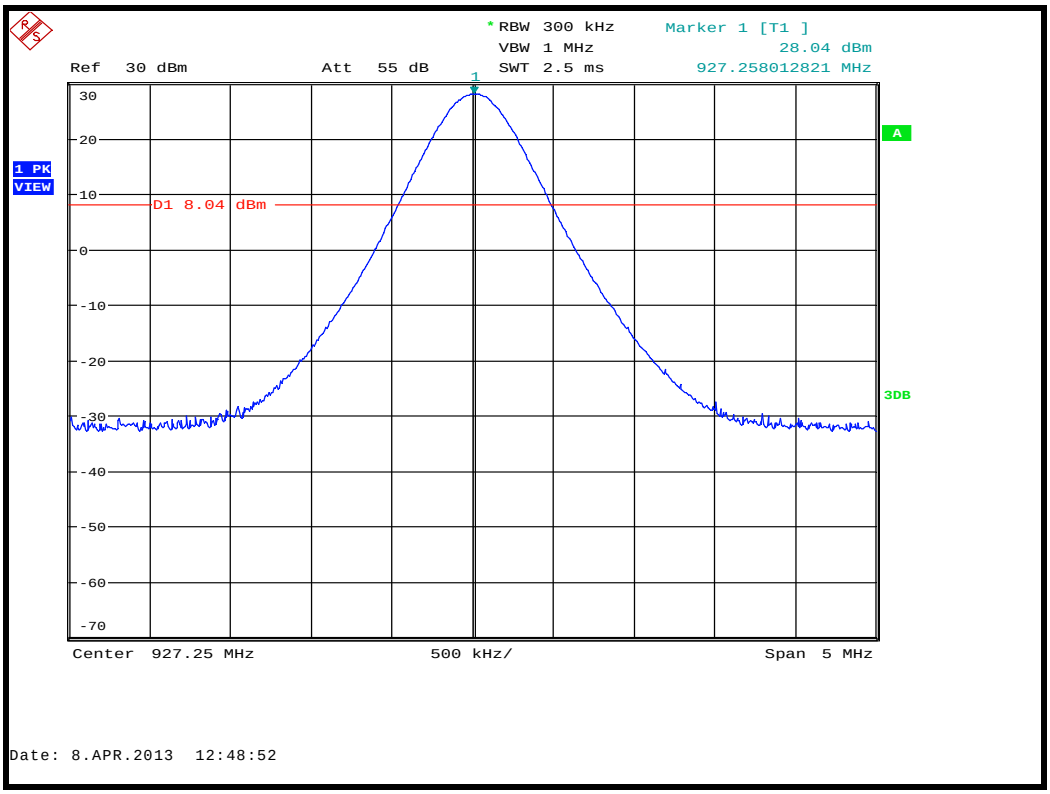
Conducted Spurious emissions 5 GHz to 10 GHz– 927.25 MHz



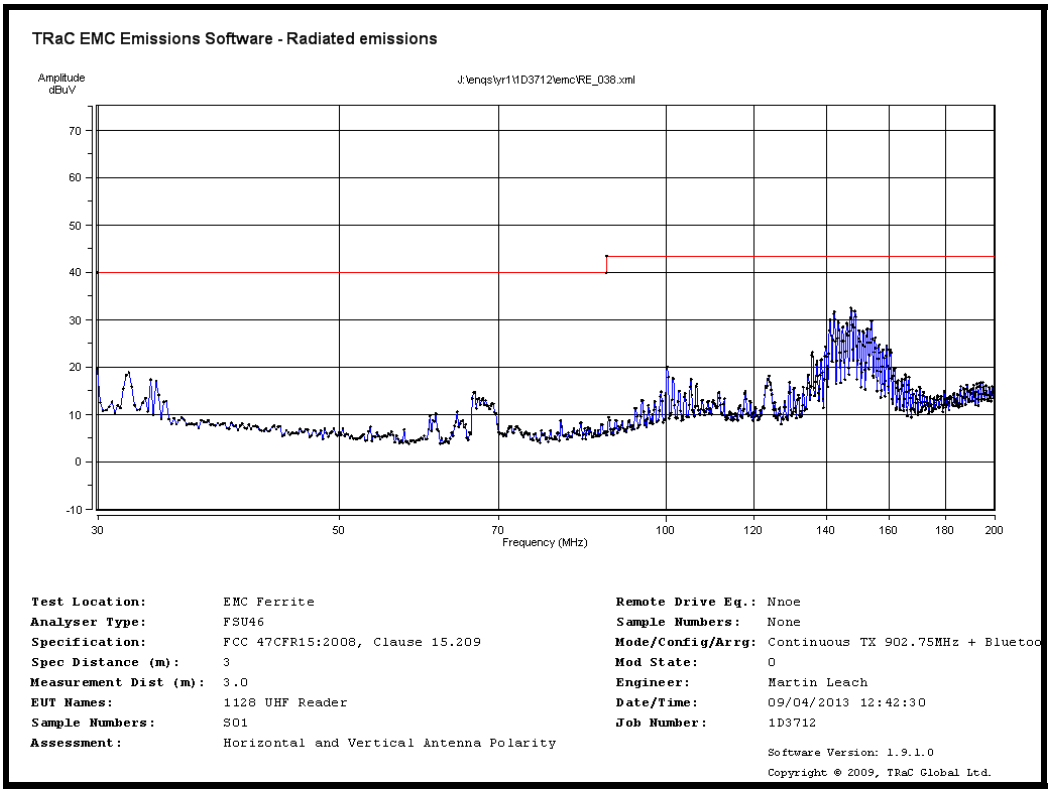
Conducted carrier power 902.75 MHz



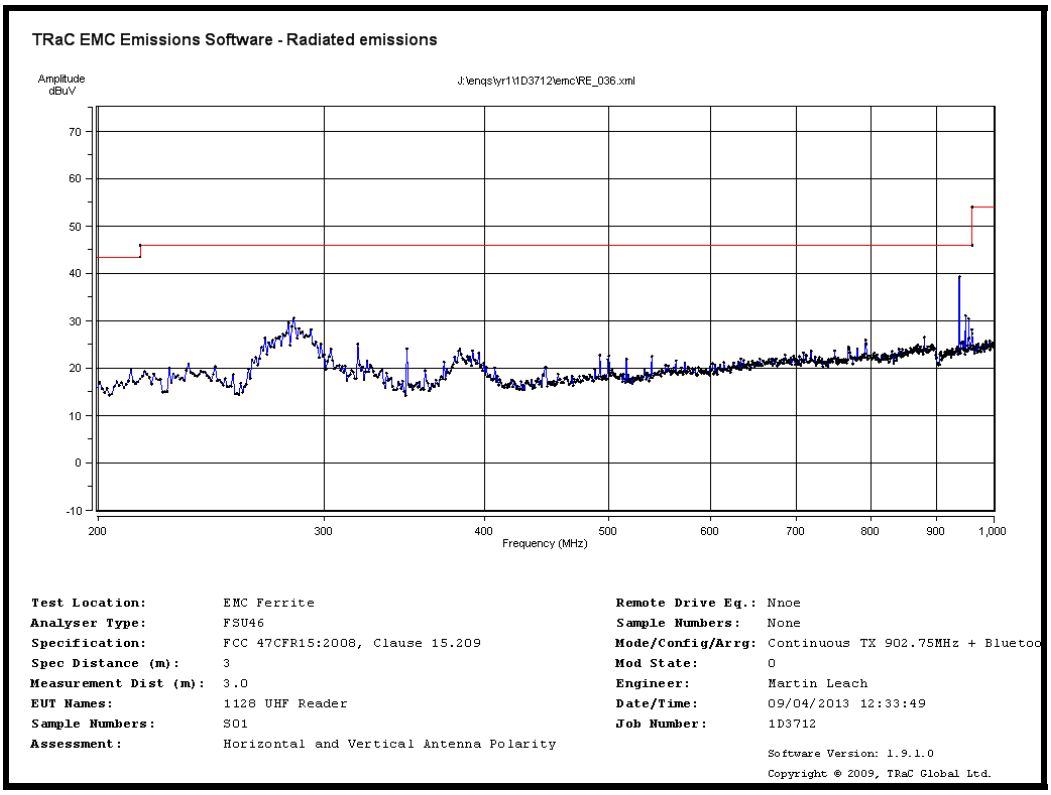
Conducted carrier power 915.25 MHz



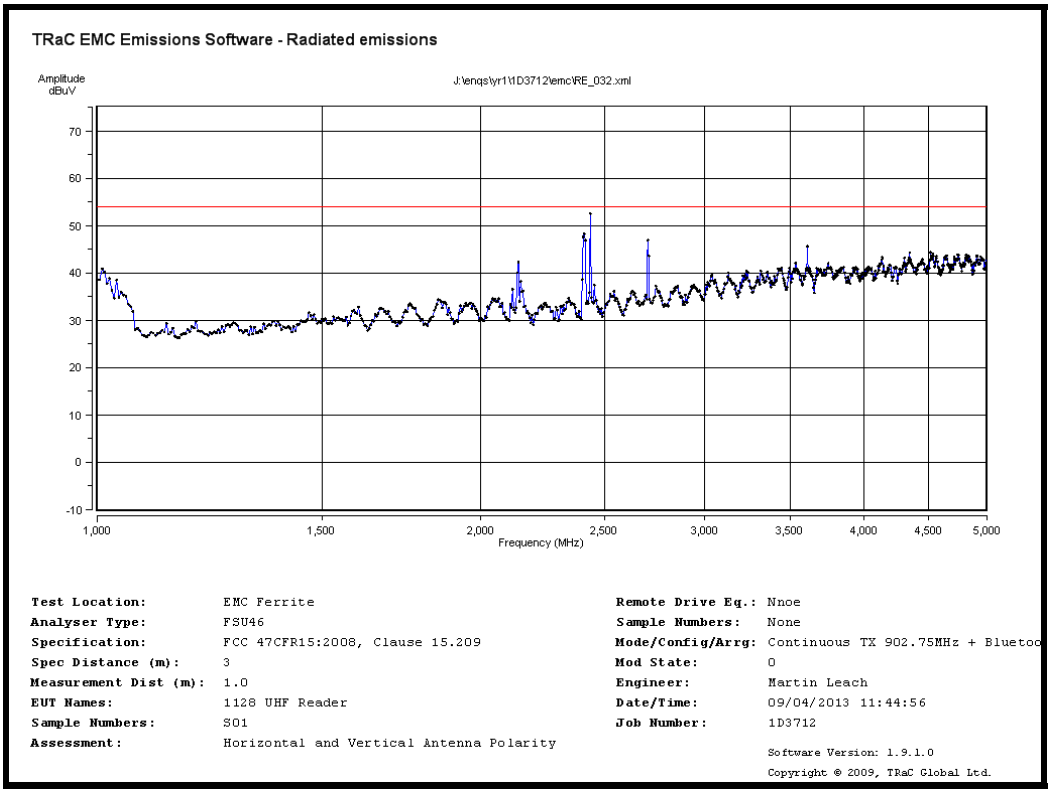
Conducted carrier power 927.25 MHz



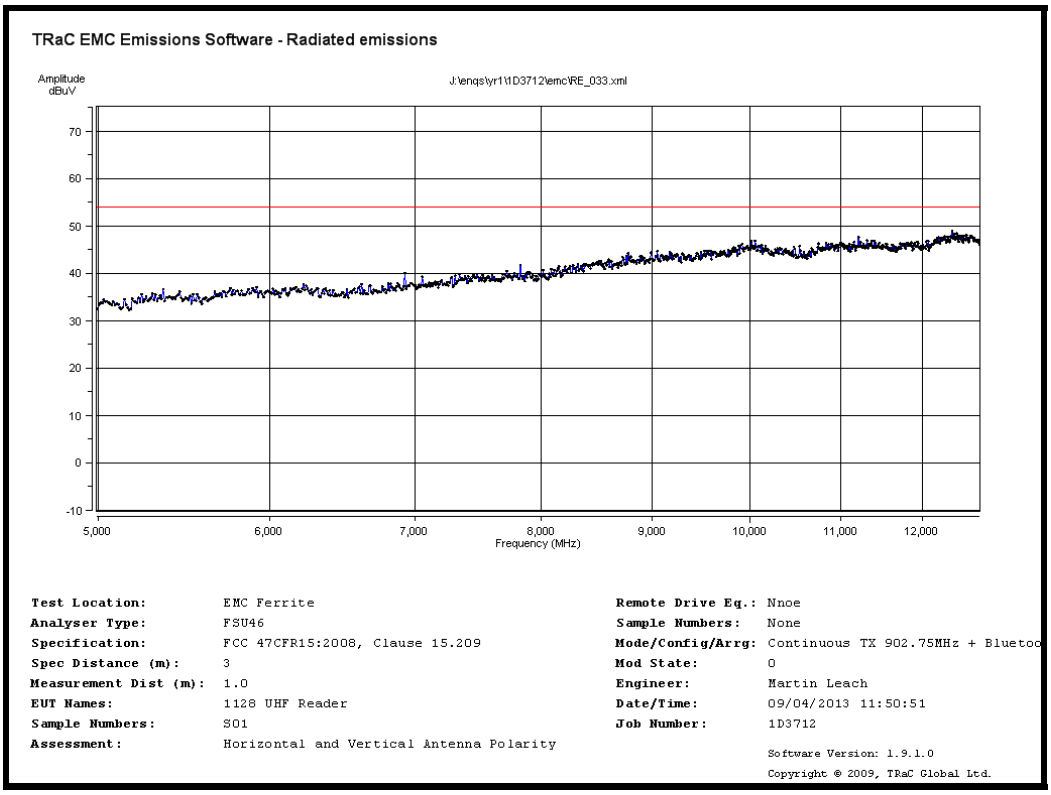
Radiated Spurious emissions 30 MHz to 200MHz – 902.25 MHz



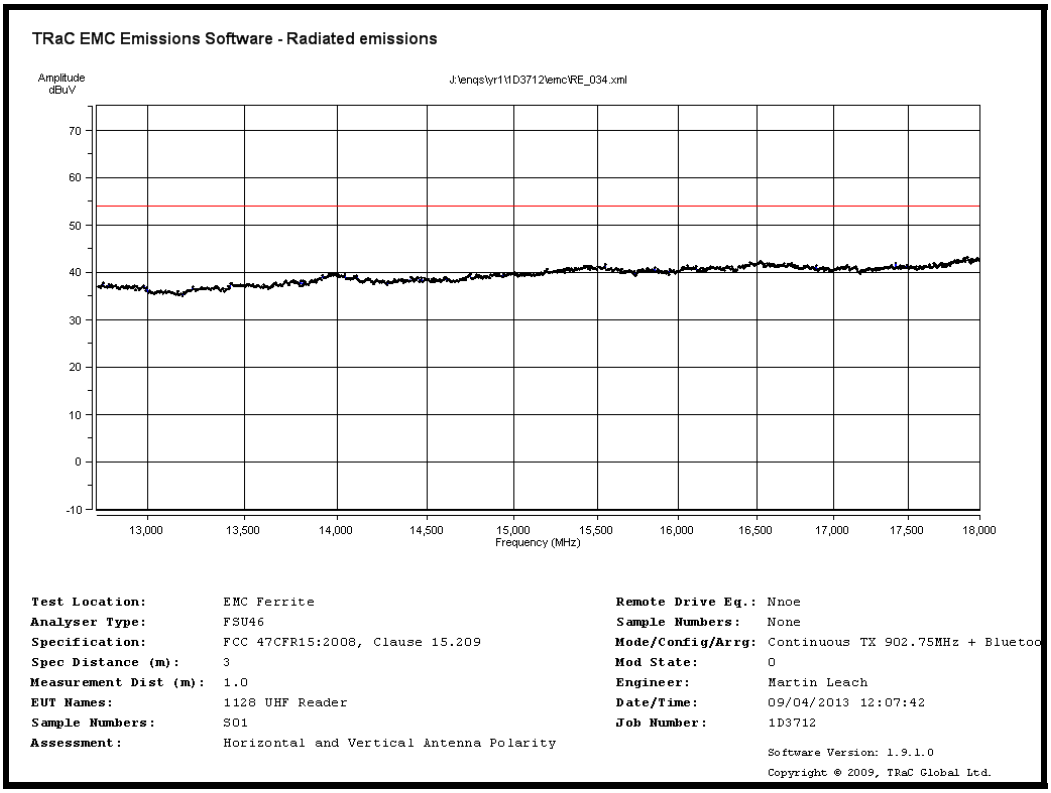
Radiated Spurious emissions 200 MHz to 1GHz – 902.25 MHz



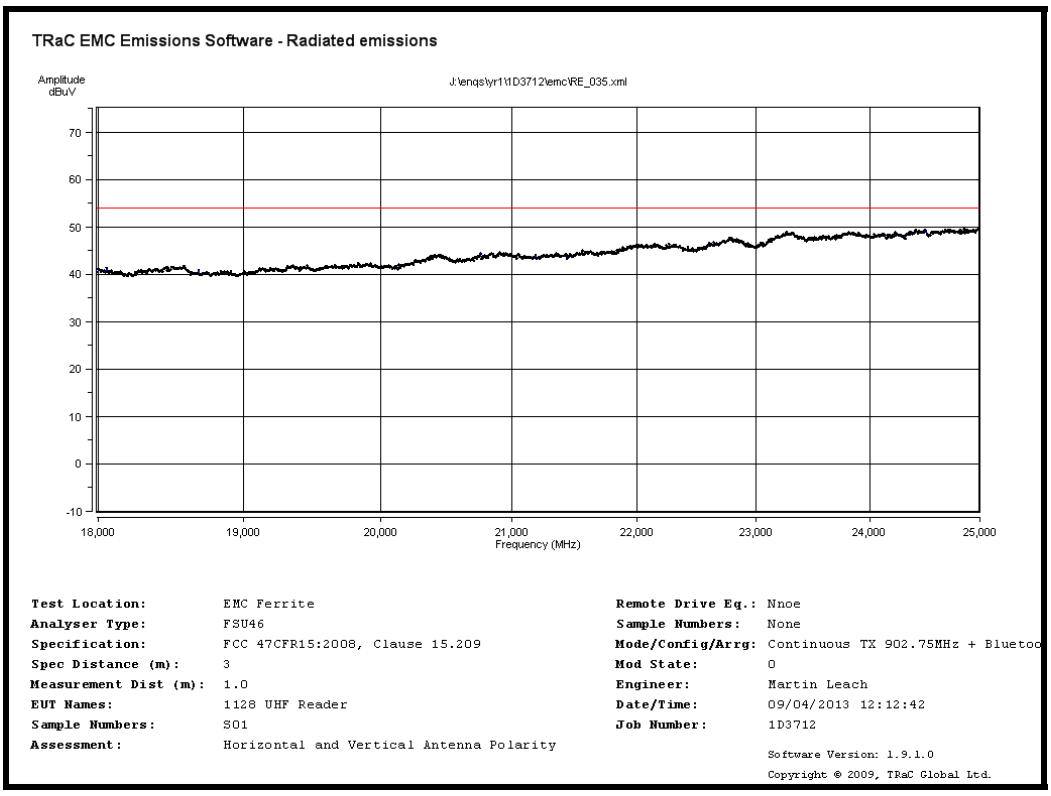
Radiated Spurious emissions 1 GHz to 5 GHz – 902.25 MHz



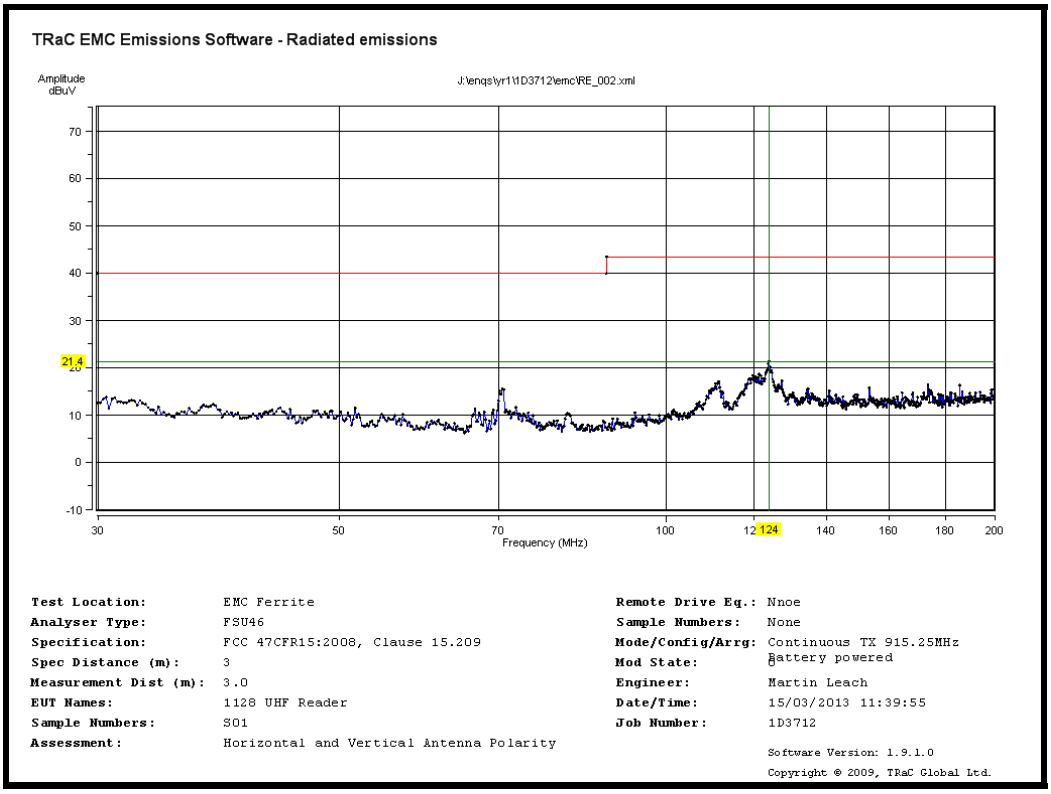
Radiated Spurious emissions 5 GHz to 12.75 GHz – 902.25 MHz



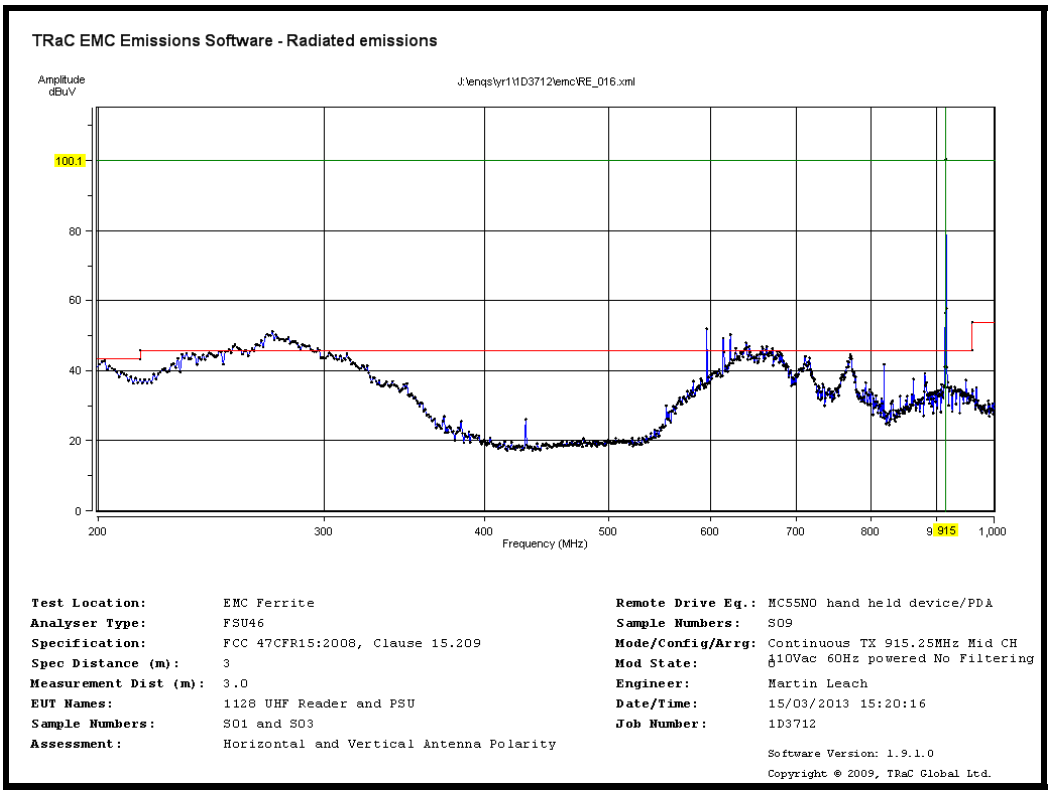
Radiated Spurious emissions 12.75 GHz to 18 GHz – 902.25 MHz



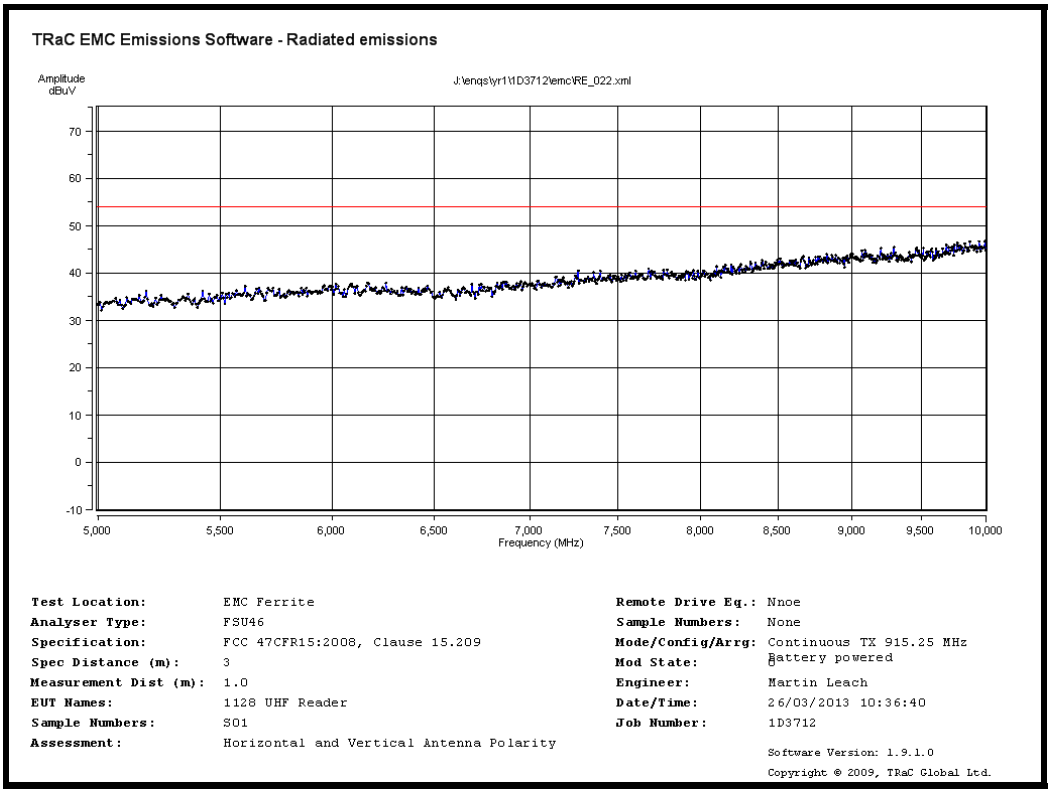
Radiated Spurious emissions 18 GHz to 25 GHz – 902.25 MHz



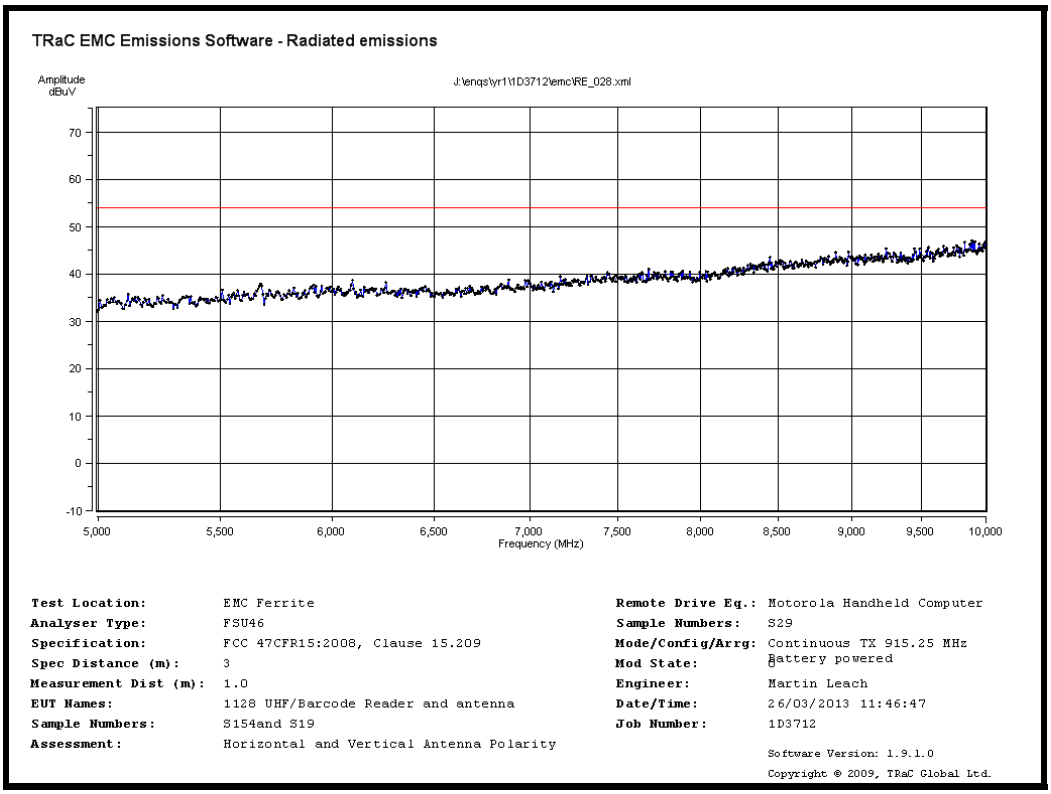
Radiated Spurious emissions 30 MHz to 200 MHz – 915.25 MHz



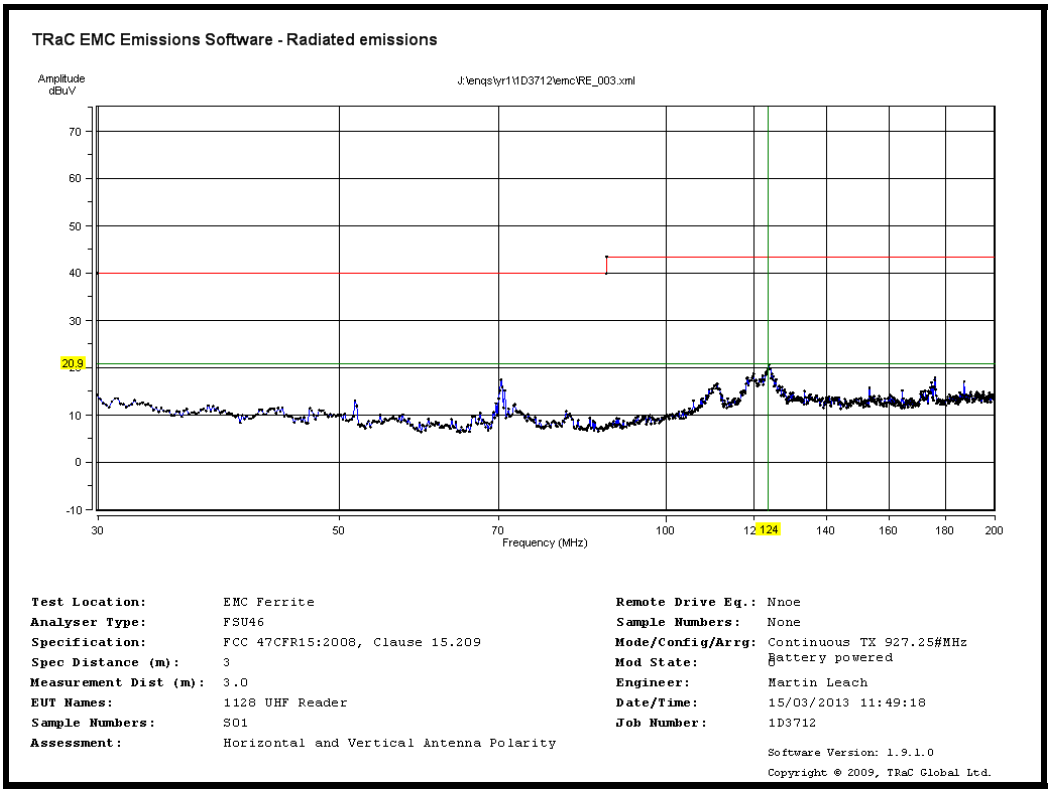
Radiated Spurious emissions 200 MHz to 1 GHz – 915.25 MHz



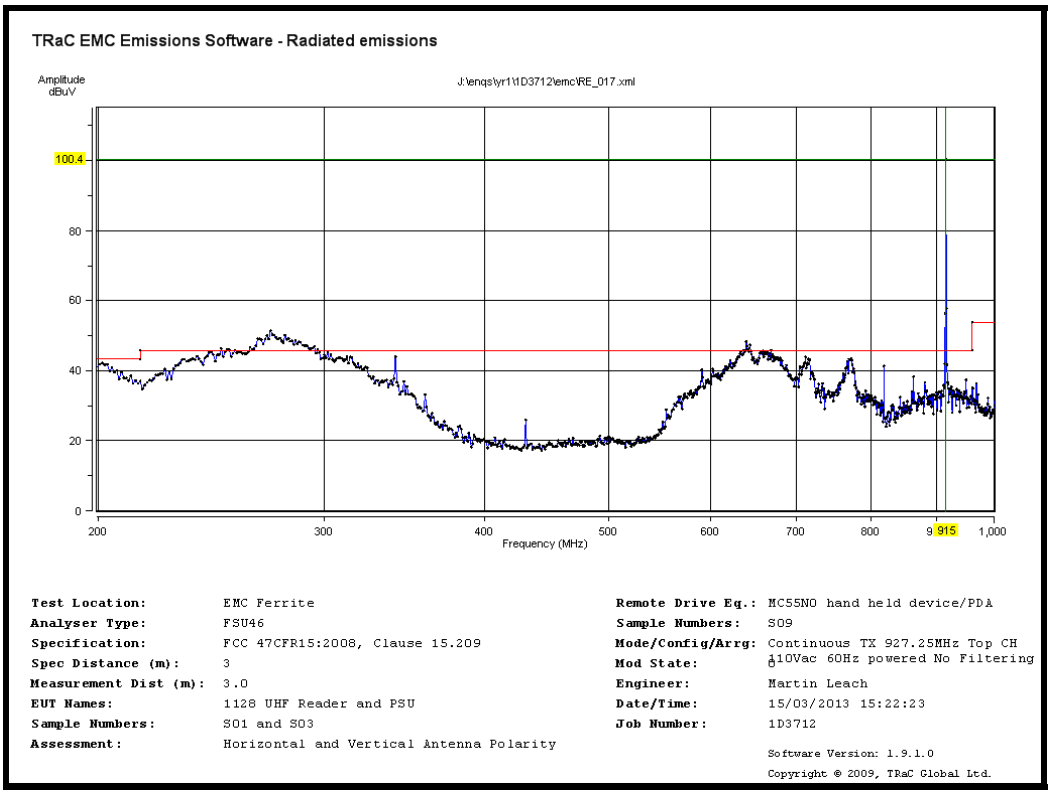
Radiated Spurious emissions 1 GHz to 5 GHz – 915.25 MHz



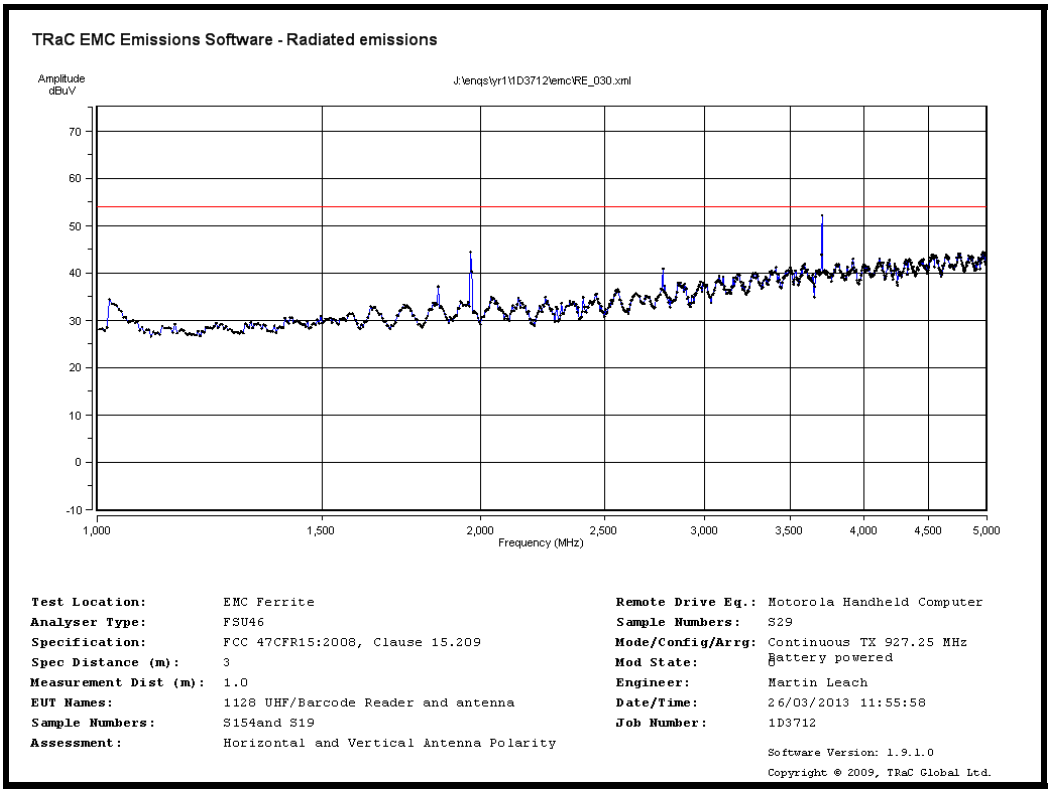
Radiated Spurious emissions 5 GHz to 10 GHz – 915.25 MHz



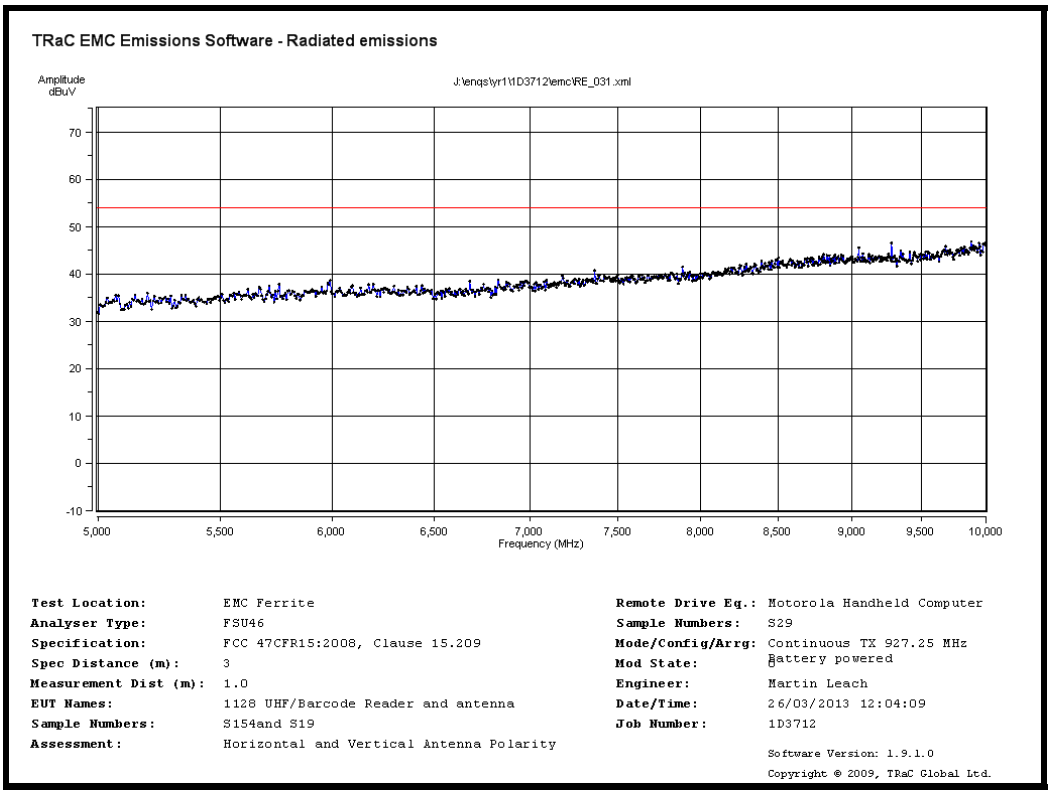
Radiated Spurious emissions 30 MHz to 200 MHz – 927.25 MHz



Radiated Spurious emissions 30 MHz to 1 GHz – 927.25 MHz

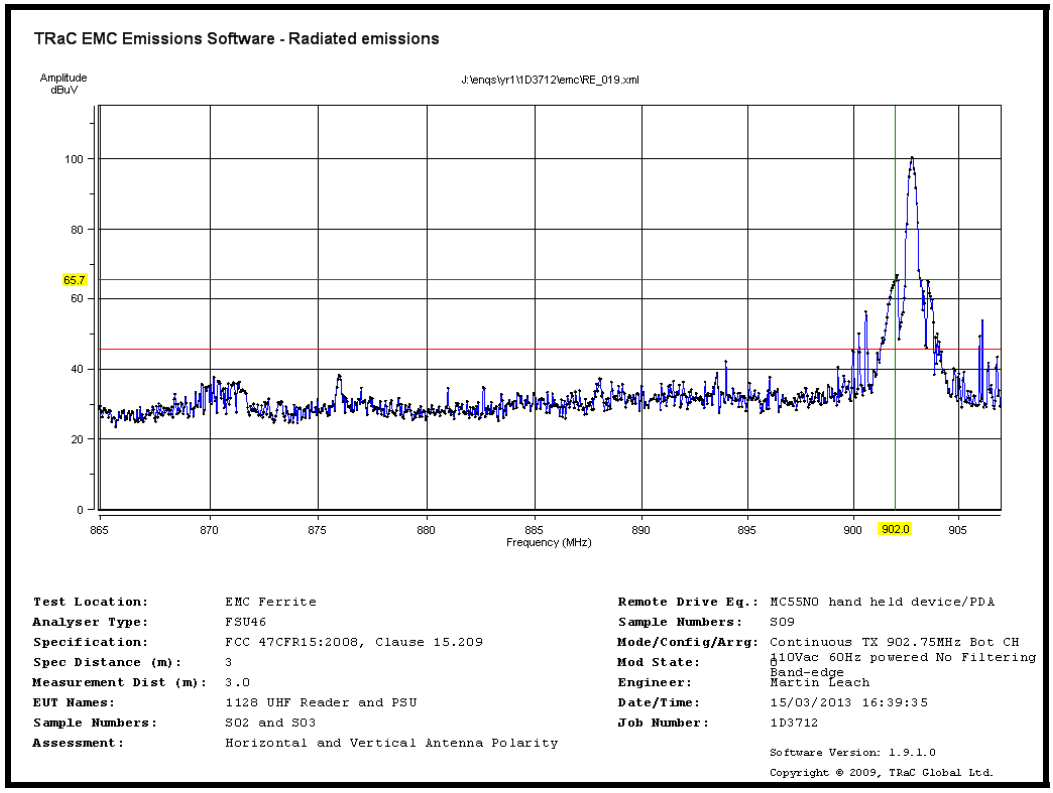


Radiated Spurious emissions 1 GHz to 5 GHz – 927.25 MHz

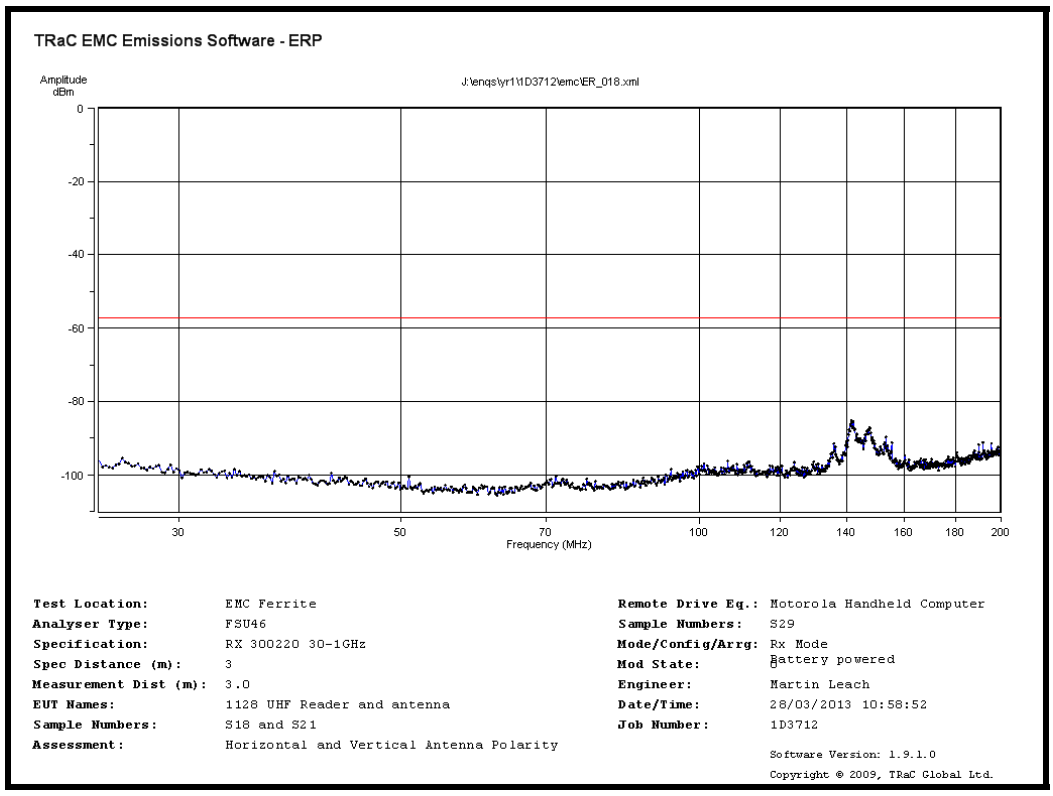


Radiated Spurious emissions 5 GHz to 10 GHz – 927.25 MHz

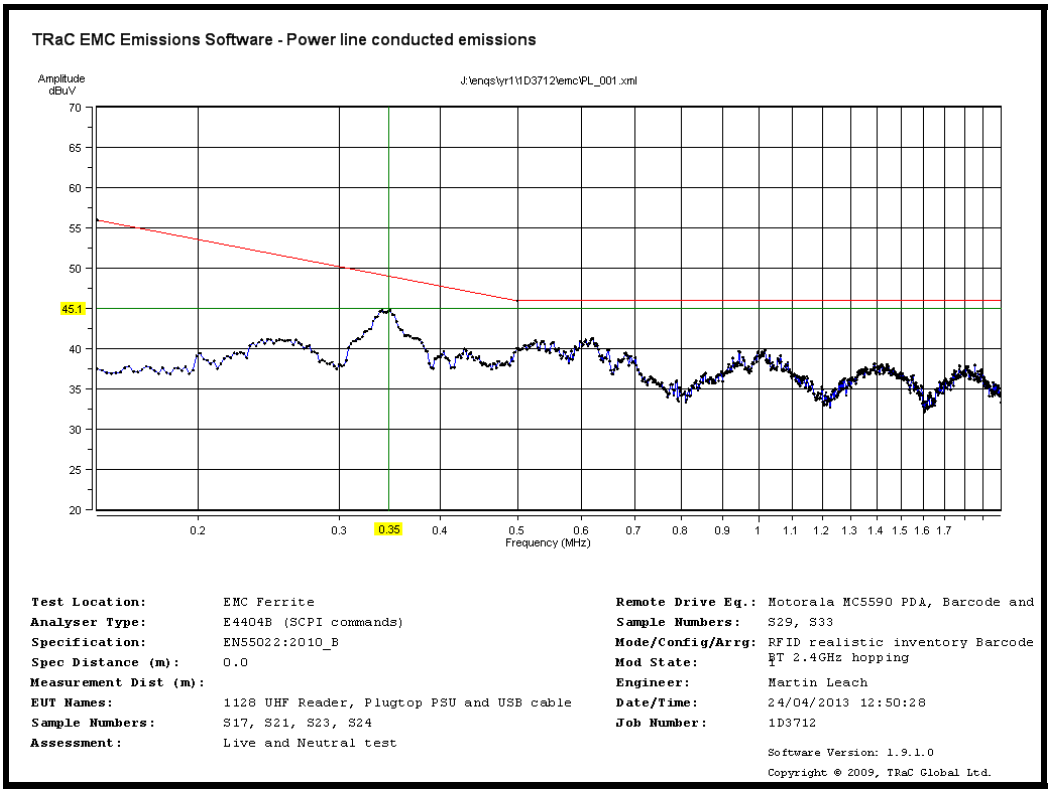
Radiated Bandedge Compliance



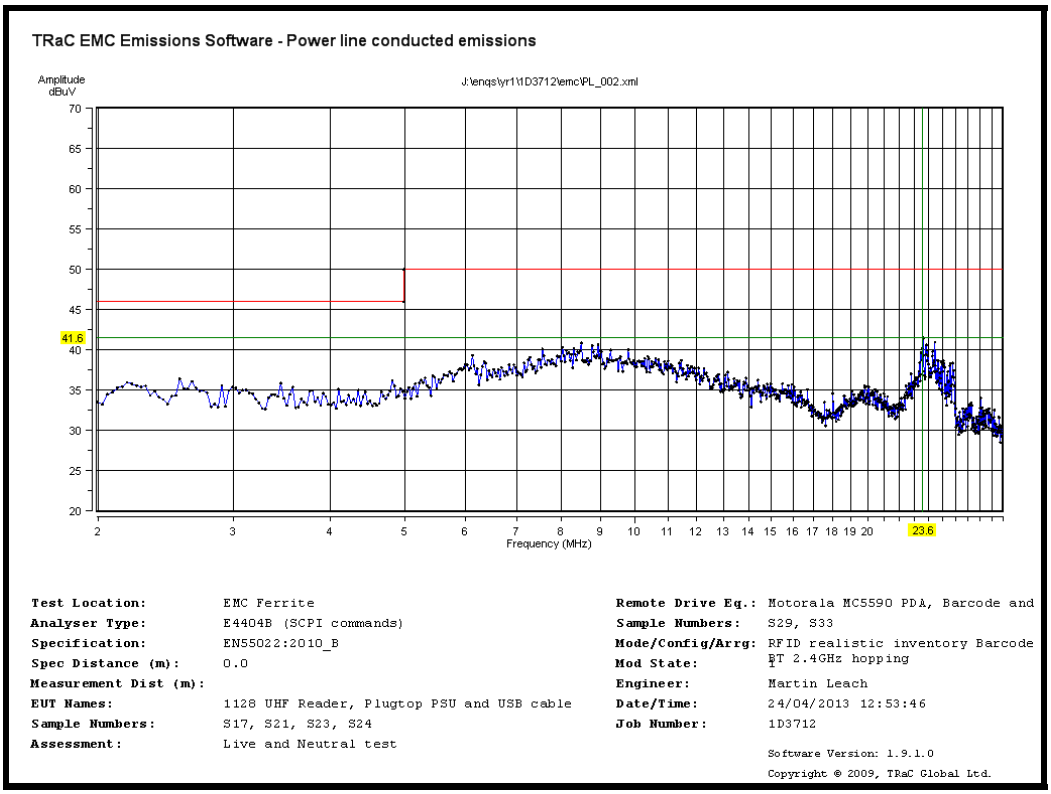
Lower Bandedge



Upper Bandedge



Power line conducted emissions 0.15 to 2 MHz



Power line conducted emissions 2 MHz to 30 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
S13	RFID Reader US (Conducted)	1128-S1-US-TEST2
S14	RFID/Barcode Reader US	1128-S1-US-000202
S15	RFID Reader US	1128-A1-US-000203
S19	RFID Reader US (Torch Style Grip)	1128-US-000203
S20	RFID Reader US (Torch Style Grip)	1128-US-000104
S23	USB Power Supply	N/A

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

Sample No.	Description	Identification
S25	EZPack XL Battery	N/A
S26	EZPack XL Battery	N/A
S27	Desktop Charger	1136-01-000104
S28	HIPRO PSU for S27	F33351049012390
S29	Motorola Handheld Computer	8288521402618
S30	Bilionton Bluetooth dongle	N/A
S31	Compaq Presario C500 Laptop	N/A
S32	PSU for S31	N/A

C2) EUT Operating Mode During Testing.

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

Test	Description of Operating Mode
All tests detailed in this report except receiver spurious emissions, hopping frequencies and channel occupancy.	EUT transmitting at maximum power using FSK modulation on 902.75MHz, 915.25 MHz and 927.25 MHz

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

Test	Description of Operating Mode
Hopping frequencies and channel occupancy.	EUT transmitting at maximum power using FHSS over 50 channels.

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 : S19
Tests : Conducted

Port	Description of Cable Attached	Cable length	Equipment Connected
Power	Multicore unscreened	1.3	S23

Sample : S19
Tests : Radiated Emissions

Port	Description of Cable Attached	Cable length	Equipment Connected
Power	Multicore unscreened	1.3	S23

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

No additional information is included within this test report.

Appendix E: Calculation of the duty cycle correction factor

No duty cycle correction was applied to the measurements made.

Appendix F: 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 arrangement

Photograph 1

Photograph 2

Photograph 3

Appendix G: MPE Calculation

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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/cm^2 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

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

where:

S = power density
R = distance to the centre of radiation of the antenna
EIRP = EUT Maximum power

Note:

The EIRP measurement was performed using a signal substitution method.

Result

Prediction Frequency (MHz)	Maximum EIRP	Power density limit (S) (mW/cm^2)	Distance (R) cm required to be less than 1mW/cm^2
902.75	721mW	1	7.6

Appendix H: FCC 47CFR Part 15 to RSS210 Cross Reference

1) All references made to the General Requirements and Information for the Certification of Radio Apparatus (RSS-Gen) is based on Issue 3 December 2010

2) All references made to the Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment is based on Issue 8 December 2010

RSS-210 Annex 8 is the same as FCC 47CFR Part 15.247 for frequency and type of operation.

RSS-Gen 7.2.4 and FCC 47CFR Part 15.207 both call for ac power line conducted emissions to be assessed and to demonstrate compliance if the intentional radiator is designed to be directly or indirectly connected to the public utility (AC) supply network.

The general radiated limits of RSS-Gen 7.2.5 and FCC 47CFR Part 15.209 are the same.

With the exception to the restricted bands listed below, the RSS-Gen Table 3 and FCC 47CFR Part 15.205 are the same. The 700018 meets the requirements of RSS-Gen Table 3.

MHz
3.020-3.026
5.677-5.683
108-138
960-1427
2655-2900
3500-4400

RSS-Gen 6.1 and Part 15.109 have the same limits for receiver spurious emissions

RSS-210 A8.4 (4) and Part 15.247(b)(3) both call for a conducted output power of 1 Watt or less.

RSS-210 A8.5 and Part 15.247(d) both call for measurements of spurious emissions in a 100 kHz measurement bandwidth. Any emission falling outside a restricted band must be 20dBc any emissions falling inside a restricted band must meet the general radiated limits.