RADIO TEST REPORT

FOR

Technology Solutions (UK) Ltd

ON

1153 UHF RFID Reader

DOCUMENT NO. TRA-022433WUS1

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Applicant	**:** Technology Solutions Ltd
Apparatus	**:** 1153 UHF RFID Reader
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Section 1: Introduction

1.1 General

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

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1.2 Tests Requested By

This testing in this report was requested by :

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1.3 Manufacturer

As Above

1.4 Apparatus Assessed

The following apparatus was assessed between: 03/09/14 and 15/09/14

1153 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 1153 Bluetooth UHF RFID reader is powered by an internal rechargeable lithium polymer battery. The battery is recharged using a standard USB power supply.

The Bluetooth connection has not been assessed apart from the co-located transmitters test.

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
Radiated 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
Co-located transmitter Radiated Spurious Emissions	Title 47 of the CFR: Part 15 Subpart (c) 15.247	ANSI C63.10:2009	Pass

Abbreviations used in the above table:

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

Power-line Conducted Emissions

Quantity Range	Quantity	Expanded Uncertainty
9kHz to 150 kHz	Amplitude dB(µV)	±3.7dB
150 kHz to 30 MHz	Amplitude dB(µV)	±3.4dB

Section 3: Modifications

3.1 Modifications Performed During Assessment

A small clip-on ferrite core (supplied by the client) was fitted to the EUT end of the micro-USB cable connecting the EUT to the Netbook used during the testing for the Barcode reader mode.

Section 4 **General Test Procedures**

4.1 Radiated Test Setup and Procedures

Radiated electromagnetic emissions from the EUT are checked first by preview scans. Preview scans for all spectrum and modulation characteristics are checked, using a peak detector and where applicable worst case determined for function, operation, orientation etc for both vertical and horizontal polarisations

If the EUT connects to auxiliary equipment and is table or floor standing, the configurations prescribed in ANSI C63.10 are followed. Alternatively, a layout closest to normal use (as declared by the provider) is employed, (see EUT setup photographs for more detail).

For devices with intentional emissions below 30 MHz, a shielded loop antenna is used as the test antenna. It is placed at a 1 meter receive height and appropriate low frequency magnetic field extrapolation to the regulatory limit distance is employed. The EUT is rotated through 360˚ in the azimuth.

Emissions between 30 MHz and 1 GHz are measured using calibrated broadband antennas. Emissions above 1 GHz are characterized using standard gain horn antennas. Pre-amplifiers and filters are used where required. Care is taken to ensure that test receiver resolution bandwidth, video bandwidth and detector type(s) meet the regulatory requirements.

For both horizontal and vertical polarizations, the EUT is then rotated through 360˚ in azimuth until the highest emission is detected. At the previously determined azimuth the test antenna is raised and lowered from 1 to 4 m in height until a maximum emission level is detected, this maximum value is recorded.

Where regulations allow for direct measurement of field strength, power values measured on the test receiver / analyzer are converted to dBuV/m at the regulatory distance, using:

$$FS = PR + AF + CL - PA + KG + DC - CF \text{ (dBuV/m)}$$

Where:

PR is the power recorded on receiver / spectrum analyzer (dBuV),
AF is the test antenna factor in dB/m,
CL is the cable loss in dB,
PA is the pre-amplifier gain dB (when applicable),
DC is duty correction factor (when applicable) in dB, and
CF is a distance correction (employed only for measurements at alternate distance to limit) in dB.

This field strength value is then compared with the regulatory limit.

If effective radiated power (ERP) or effective isotropic radiated power (EIRP) is required, it is computed as per ANSI C63.10

$$P = \frac{(Ed)^2}{30G}$$

Where

P is the power, in W
E is the measured peak field strength, in V/m
d is the distance at which the measurement was made, in m
G is the numeric gain of the radiating element

If the gain of the radiating element is not known, then either the effective radiated power (ERP) or the effective isotropic radiated power (EIRP) may be calculated from the measured peak field strength, by using either G = 1.64 or G = 1, respectively.

4.2 AC Powerline Conducted Emissions Test Setup and Procedures

AC Powerline Conducted Emissions from the EUT are checked first by preview scans with Peak and average detectors covering both live and neutral lines. A spectrum analyser is used to determine if any periodic emissions are present. Preview scans are performed in standby or receive mode if the device is subject to these requirements. For transmit mode of operation the device is set to one of the following modes.

- Transmitting operating at full power (single mode device)
- Transmitting at freq / modulation that gives highest output power (multi mode device)
- Transmitter operating in normal TX mode (e.g. FHSS, TDMA etc)

Formal measurements using the correct detector(s) and bandwidth are made on frequencies identified from the preview scans.

Battery Power devices are not subject to power line conducted emissions measurements when it is powered solely by its internal battery.

4.3 Antenna Port Conducted Emissions

Antenna port conducted emissions can include, but are not limited to, Carrier power, Power Spectral Density, Occupied bandwidth and spurious emission.

Spurious Emissions from the EUT are checked first by preview scans. Preview scans for all spectrum and modulation characteristics are checked to identify frequencies to perform formal measurements on.

Formal measurements are made on frequencies identified from the preview scans and fundamental emission(s). Measurements are made using the correct instrumentation (inc. power meter, receiver, spectrum analyser) that operate with the required detector(s) and bandwidth.

Care is taken to ensure the measurement instrument is not overloaded by the presence of the transmitted signal by use of external attenuation and filtering where required.

Measured levels are corrected for cables, attenuators, and filters. If applicable, for the specific measurement, antenna gain is also taken into account.

4.4 Power Supply Variation

Tests at extreme supply voltages are made if required by the procedures specified in the test standard, and results of this testing are detailed in this report.

In the case the EUT is designed for operation from a lead-acid battery power source, the extreme test voltages are evaluated between 90% and 130% of the nominal battery voltage declared by the manufacturer.

For float charge applications using gel-cell type batteries, extreme test voltages are evaluated between 85% and 115% of the nominal battery voltage declared.

For all battery operated equipment, worst case intentional and spurious emissions are re-checked employing a new (fully charged) battery.

4.5 Thermal Variation

Tests at extreme temperatures are made if required by the procedures specified in the test standard, and results of this testing are detailed in this report.

Tests are performed at the upper and lower extremes as required and typically at 10˚ steps between.

Before any temperature measurements are made, the equipment is allowed to reach a thermal balance in the test chamber.

4.6 Time Domain Measurements

Time domain measurements are made for (but not limited to) use in duty cycle correction, to ensure compliance with time restrictions on certain types of devices.

If measurements of a transmitter's on time are required these are performed with a spectrum analyser in the time domain or with an oscilloscope and RF detector. If time on a specific frequency is required (e.g. FHSS timing) the measurement can only be made with a spectrum analyser.

The triggering, timescale and amplitude settings are adjusted according to the signal to be measured on a case by case basis.

For devices with sharp rise/fall times measurements are made between RF reaching full power (T_{on}) and RF dropping to the measurement instrument noise floor (T_{off}). For longer rise times measurements are made for T_{on} and T_{off} at the RF level required by the occupied bandwidth measurement (e.g. 6 dB, 20 dB etc).

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
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C

Channel Frequency (MHz)	Peak Carrier Power (W)	Limit (W)	Result
917.1	0.414	1.000	Pass
922.1	0.386		Pass
926.9	0.376		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 = 1 dBic (which corresponds to -2dBi).
Conducted measurements were performed with a temporary antenna connector provided by the client.

A2 RF Antenna Radiated Spurious Emissions

Preliminary scans were performed using a peak detector with the RBW = 100kHz. The radiated electric field emission test applies to spurious emissions and harmonics that fall outside the restricted bands listed in Section 15.205. The maximum permitted field strength is listed in Section 15.247(d). 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: 917.1 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	30 MHz to 10 GHz
EUT sample number	S12
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C

No spurious emissions were detected within 10dB of the specification limit.

Test Details: 922.1 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	30 MHz to 10 GHz
EUT sample number	S12
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C

No spurious emissions were detected within 10dB of the specification limit.

RF Antenna Radiated Spurious Emissions continued:

Test Details: 926.9 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	30 MHz to 10 GHz
EUT sample number	S12
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C

No spurious emissions were detected within 10dB of the specification limit.

Notes:

1. The 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.

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 Carrier)-20dB

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 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 : [X]

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

Test Details: 917.1 MHz	
Regulation	Part 15 Subpart (c) Clause 15.247(d) and Clause 15.205
Measurement standard	ANSI C63.10:2009
Frequency range	30 MHz – 10 GHz
EUT sample number	S12
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Photographs (Appendix F)	Photograph 1 and 2

No spurious emissions were detected within 10dB of the specification limit.

Test Details: 922.1 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	30 MHz to 10 GHz
EUT sample number	S12
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Photographs (Appendix F)	Photograph 1 and 2

No spurious emissions were detected within 10dB of the specification limit.

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: 926.9 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	30 MHz to 10 GHz
EUT sample number	S12
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Photographs (Appendix F)	Photograph 1 and 2

No spurious emissions were detected within 10dB of the specification limit.

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 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

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	S12, S14
Modification state	0
SE in test environment	None
SE isolated from EUT	None
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

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.345000	22.7	15000.0	10.000	GND	L1	10.2	26.4	49.1
0.470000	10.2	15000.0	10.000	GND	L1	10.1	36.3	46.5
0.595000	10.7	15000.0	10.000	GND	L1	10.1	35.3	46.0
0.810000	7.1	15000.0	10.000	GND	L1	10.1	38.9	46.0
0.990000	7.7	15000.0	10.000	GND	N	10.1	38.3	46.0
6.890000	12.9	15000.0	10.000	GND	N	10.4	37.1	50.0

Results measured using the quasi-peak detector compared to the quasi–peak limit

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.345000	31.6	15000.0	10.000	GND	L1	10.2	27.5	59.1
0.470000	23.6	15000.0	10.000	GND	L1	10.1	32.9	56.5
0.595000	22.2	15000.0	10.000	GND	L1	10.1	33.8	56.0
0.810000	18.7	15000.0	10.000	GND	L1	10.1	37.3	56.0
0.990000	14.8	15000.0	10.000	GND	N	10.1	41.2	56.0
6.890000	20.1	15000.0	10.000	GND	N	10.4	39.9	60.0

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
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C

Channel Frequency (MHz)	Measured 20 dB Bandwidth (kHz)
917.1	68.317
922.1	68.234
926.9	67.549

Measured Channel Spacing (kHz)	Limit	Result
200.3	(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	S013
Modification state	0
SE in test environment	None
SE isolated from EUT	None
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 (922.1 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
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C

Measured Channel Occupancy Time (ms)	Measured Channel Repetition Time (s)	Calculated average time of occupancy in a 20s period (ms)	Average Channel Occupancy Time Limit (ms)	Result
55.5	23.29	47.7	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 = 55.5 ms x (20/23.29) = 47.7ms

A8 Antenna Gain

The maximum antenna gain for the antenna types to be used with the EUT, as measured, is 1 dBic.

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:	
Regulation	Title 47 of the CFR: Part 15 Subpart (b) Clause 15.109
Measurement standard	ANSI C63.10:2009
Frequency range	30MHz to 10 GHz
EUT sample number	S12
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Photographs (Appendix F)	Photographs 1 and 2

No spurious emissions were detected within 10dB of the limit line.

A10 Co-located Transmitter Radiated Electric Field Emissions

Preliminary scans were performed using a peak detector with the RBW = 100kHz. The radiated electric field emission test was performed to assess the levels of emissions due to intermodulation products and other effects of co-located transmitters (RFID and Bluetooth). The maximum permitted field strength is listed in Section 15.209. The EUTs were set to transmit on their lowest and highest carrier frequencies.

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: 917.1 MHz and Bluetooth Bottom Channel	
Regulation	Part 15 Subpart (c) Clause 15.247(d) and Clause 15.205
Measurement standard	ANSI C63.10:2009
Frequency range	30 MHz – 18 GHz
EUT sample number	S12
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Photographs (Appendix F)	Photograph 1 and 2

No spurious emissions were detected within 10dB of the specification limit.

Test Details: 926.9 MHz and Bluetooth Top Channel	
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	30 MHz to 18 GHz
EUT sample number	S12
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Photographs (Appendix F)	Photograph 1 and 2

Spurious emissions apparent on the pre-scan plot were either harmonically related to the Bluetooth transmitter (and outside of the scope of this assessment) or transient in nature and could not be found when examined for formal measurement. No spurious emissions due to interaction between the co-located transmitters were detected within 10dB of the specification limit.

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 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=VBW= 1MHz

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

5 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 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

A11 Barcode Reader Radiated Electric Field Emissions

Preliminary scans were performed using a peak detector with the RBW = 100kHz. The radiated electric field emission test was performed to assess the levels of emissions due to the operation of the Barcode Reader with the RFID transmitter disabled. The maximum permitted field strength is listed in Section 15.109. The EUTs was set to continuously read bar codes.

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: Barcode Reader Active	
Regulation	Part 15 Subpart (b) Clause 15.109
Measurement standard	ANSI C63.10:2009
Frequency range	30 MHz – 13 GHz
EUT sample number	S12
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Photographs (Appendix F)	Photograph 4 and 5

The worst case radiated emission measurements for spurious emissions are listed below:

Ref No.	FREQ. (MHz)	Detector	MEAS Rx (dBµV)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	FIELD ST'GH (dBµV/m)	EXTRAP FACT (dB)	FIELD ST'GH (µV/m)	LIMIT (µV/m)
1.	98.305	QP	54.3	1.5	9.2	31.6	33.4	0	46.8	150
2.	144.001	QP	53.0	1.9	12.4	31.5	35.8	0	61.7	150
3.	252.199	QP	48.8	2.0	11.5	31.5	30.8	0	34.7	200
4.	309.000	QP	50.3	1.8	14.5	31.5	35.1	0	56.9	200
5.	331.707	QP	51.3	2.0	14.1	31.5	35.9	0	62.4	200
6.	439.767	QP	56.5	2.5	16.0	31.5	43.5	0	149.6	200
7.	882.738	QP	46.4	4.3	22.5	30.9	42.3	0	130.3	200
8.	945.775	QP	38.5	4.6	23.1	30.3	35.9	0	62.4	200
9.	1009.125	Pk	66.4	3.3	25.3	35.6	59.4	-9.5	312.6	5000
10.	1009.125	Av	44.7	3.3	25.3	35.6	37.8	-9.5	26.0	500
11.	1067.817	Pk	65.8	3.5	25.4	35.5	59.2	-9.5	305.5	5000
12.	1067.817	Av	43.4	3.5	25.4	35.5	36.9	-9.5	23.4	500
13.	1661.658	Pk	66.8	4.4	26.2	34.7	62.8	-9.5	462.4	5000
14.	1661.658	Av	42.4	4.4	26.2	34.7	38.3	-9.5	27.5	500

Notes:

1 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.
2 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.
3 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.

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 15.109):

Frequency of emission (MHz)	Field strength μV/m	Measurement Distance m	Field strength dBμV/m
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 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

Appendix B: Supporting Graphical Data

This appendix contains graphical data obtained during testing.

Notes:

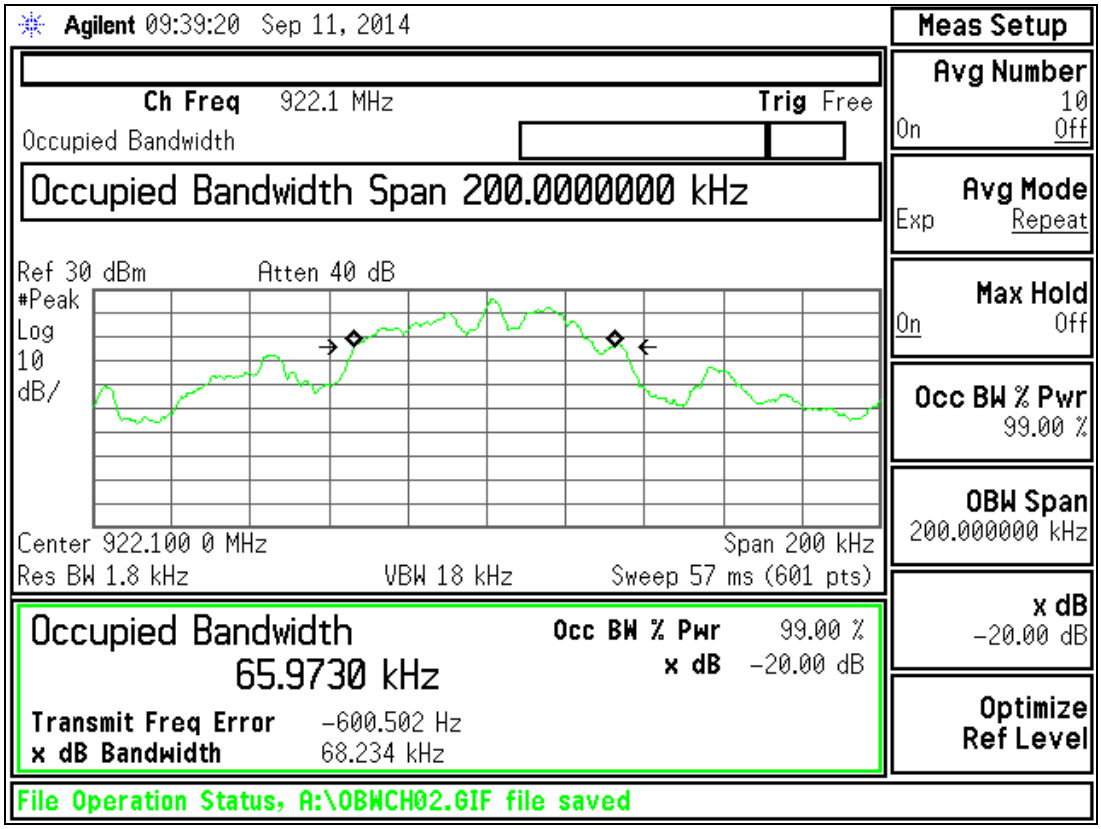
(a) The radiated electric field emissions and conducted emissions graphical data in this appendix is preview data. For details of formal results, refer to Appendix A and Appendix B.

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

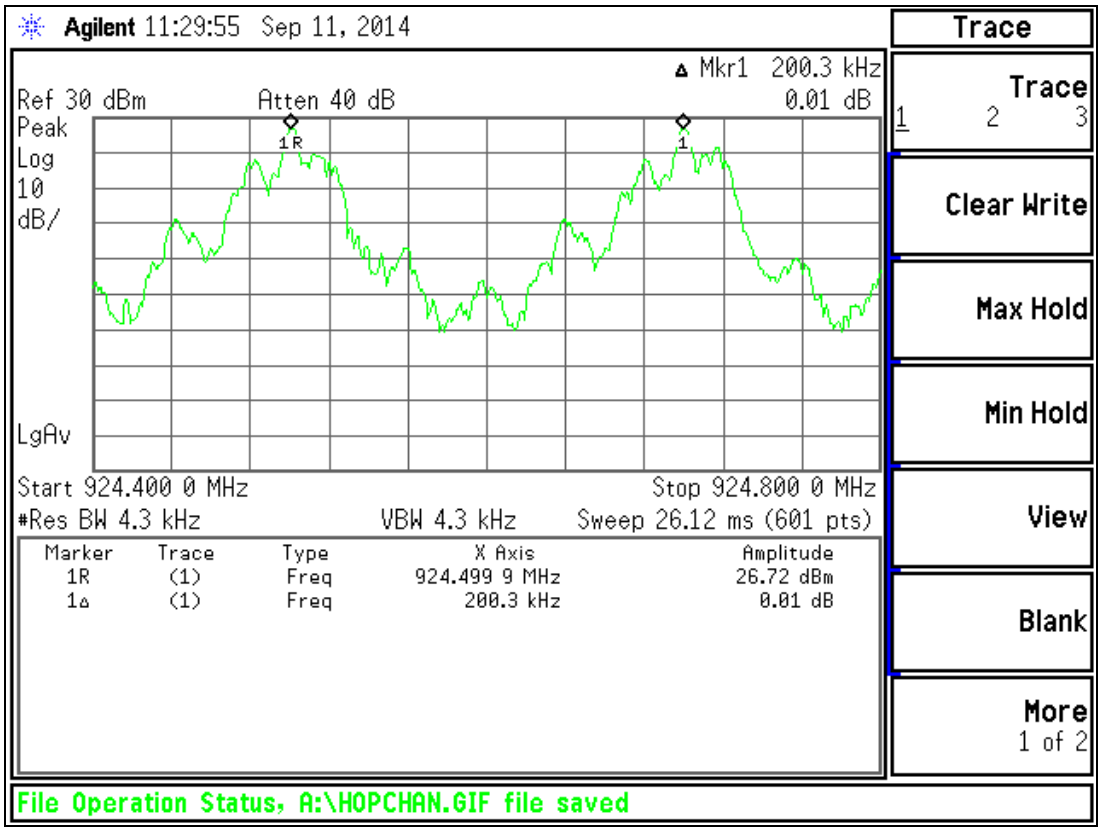
(c) Where relevant, on power line conducted emission plots, the limit displayed is the average limit, which is stricter than the quasi peak limit.

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

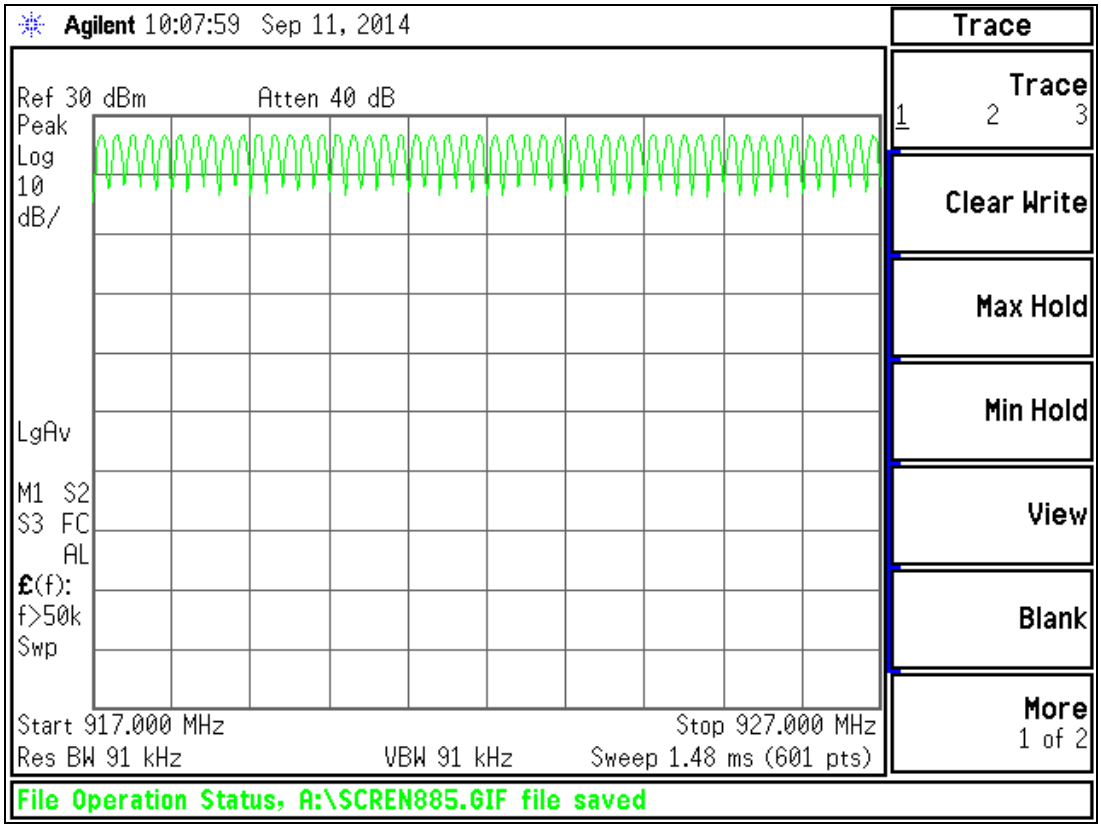
(e) The plots presented in this appendix may not be a complete record of the measurements performed, but are a representative sample, relative to the final assessment.



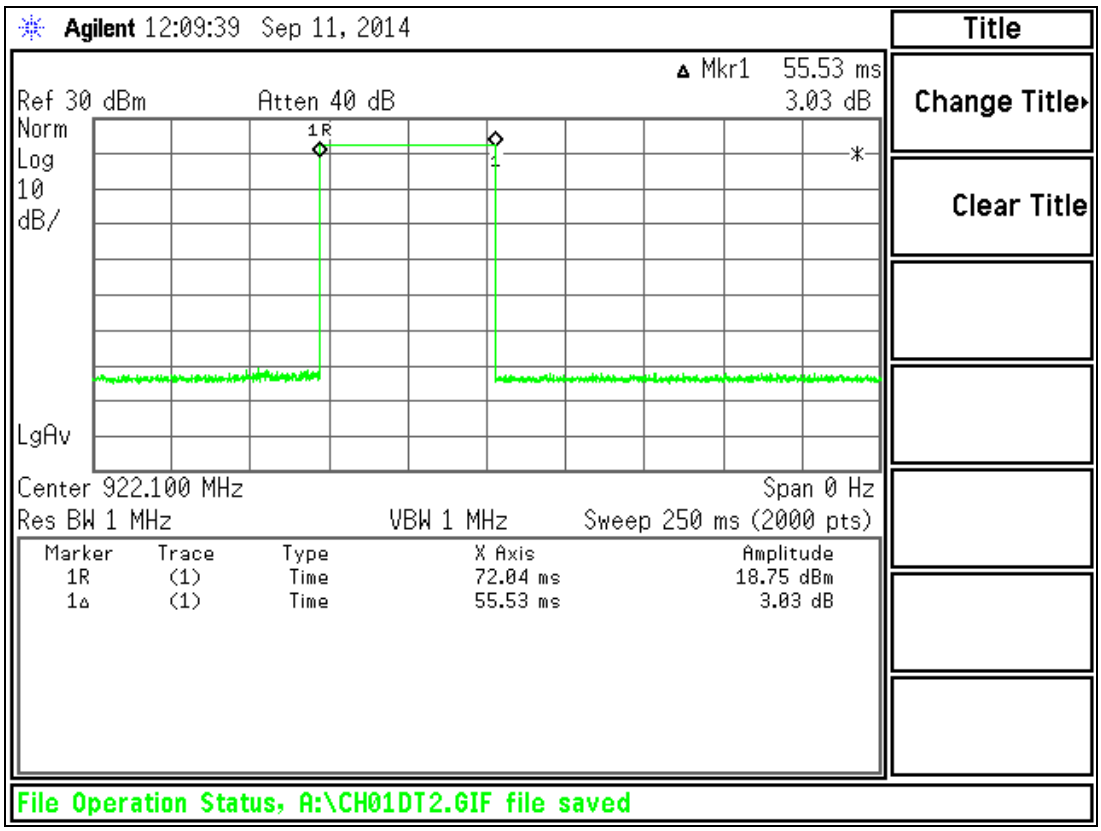
20dB Bandwidth



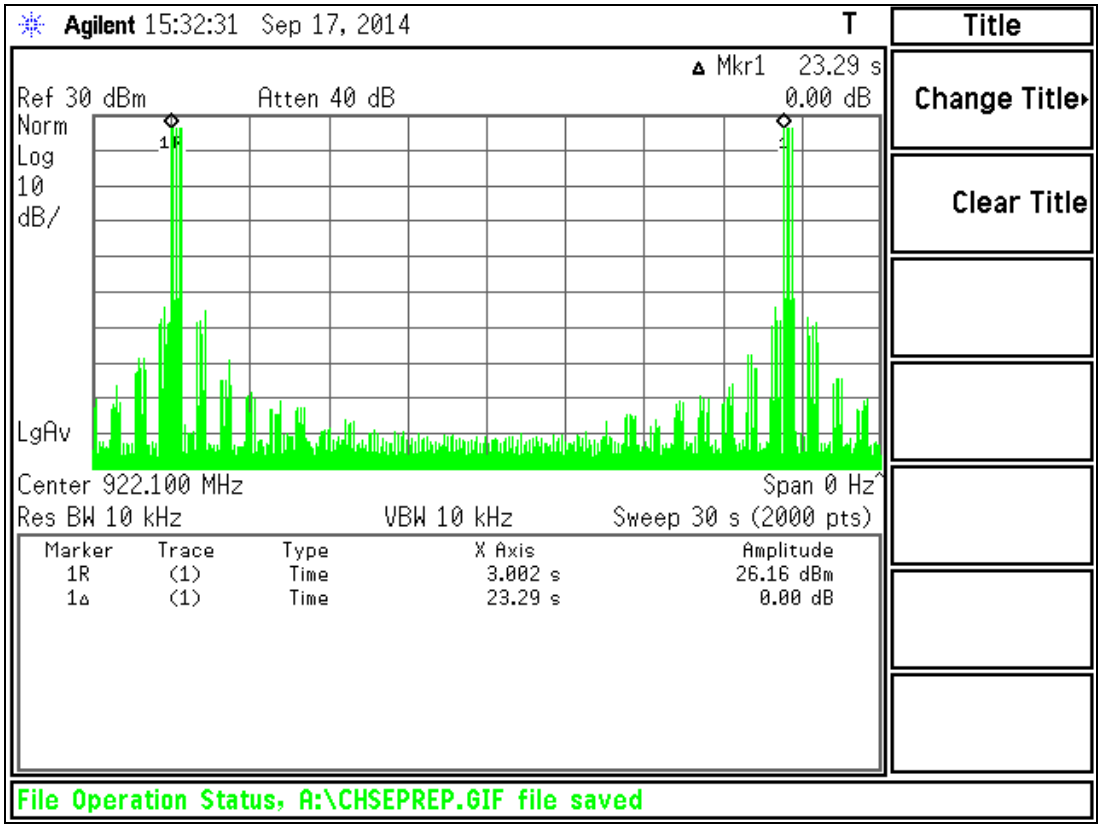
Channel Spacing



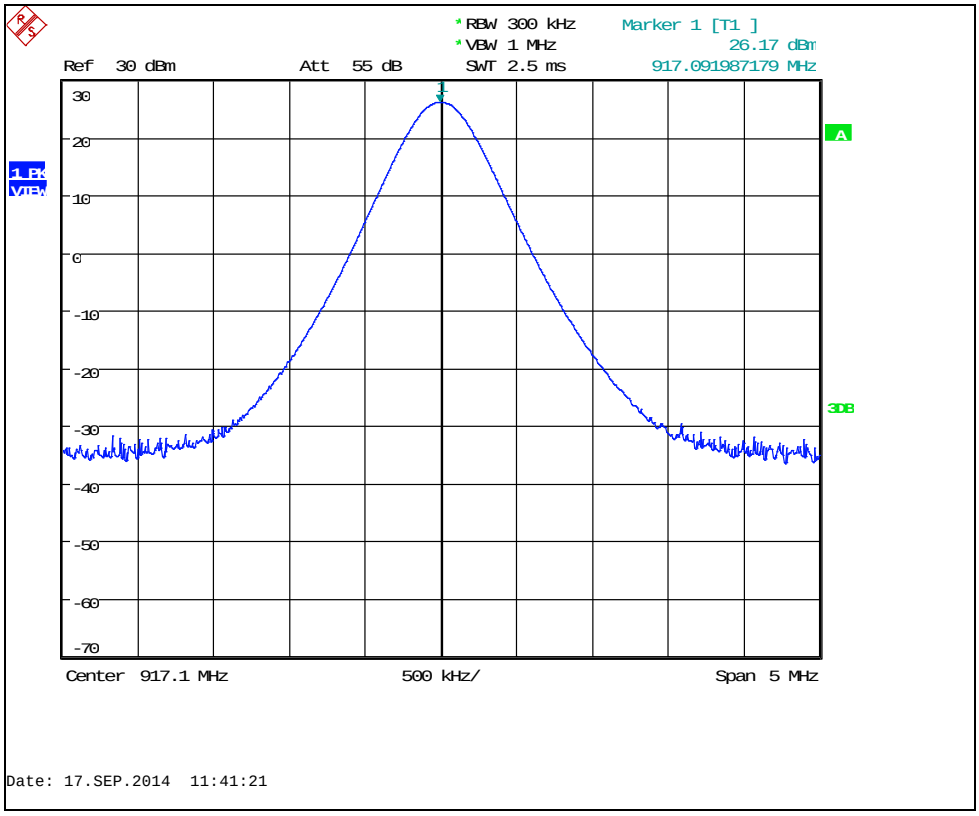
Channels 0 to 50



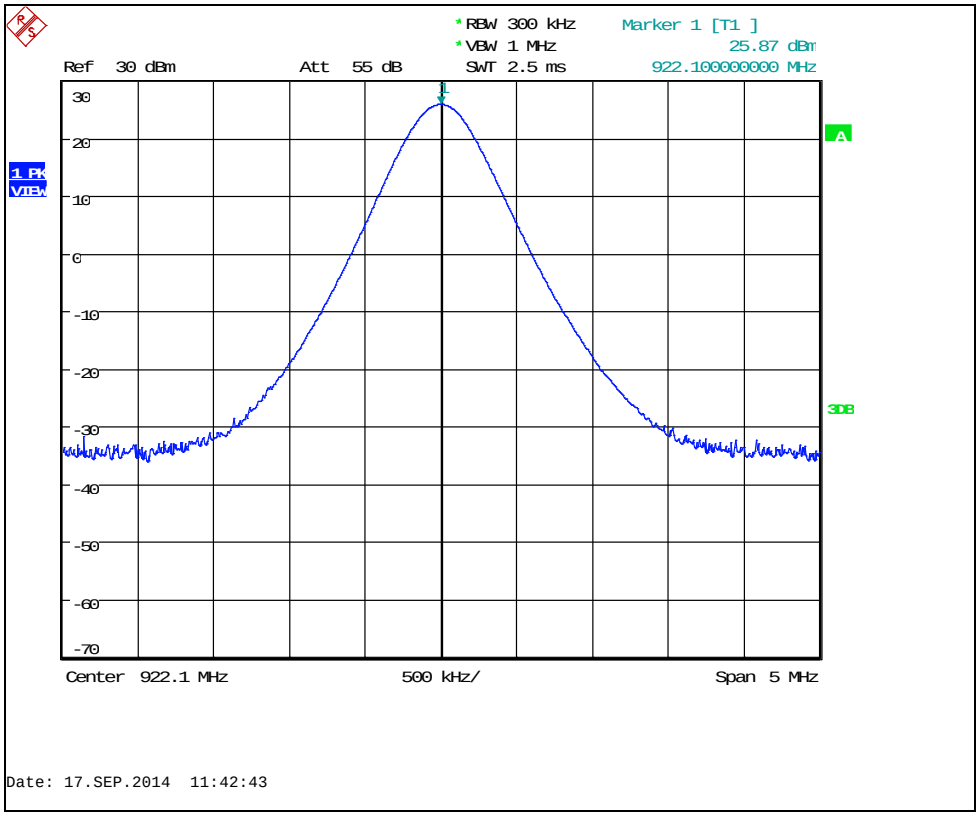
Channel Occupancy Time



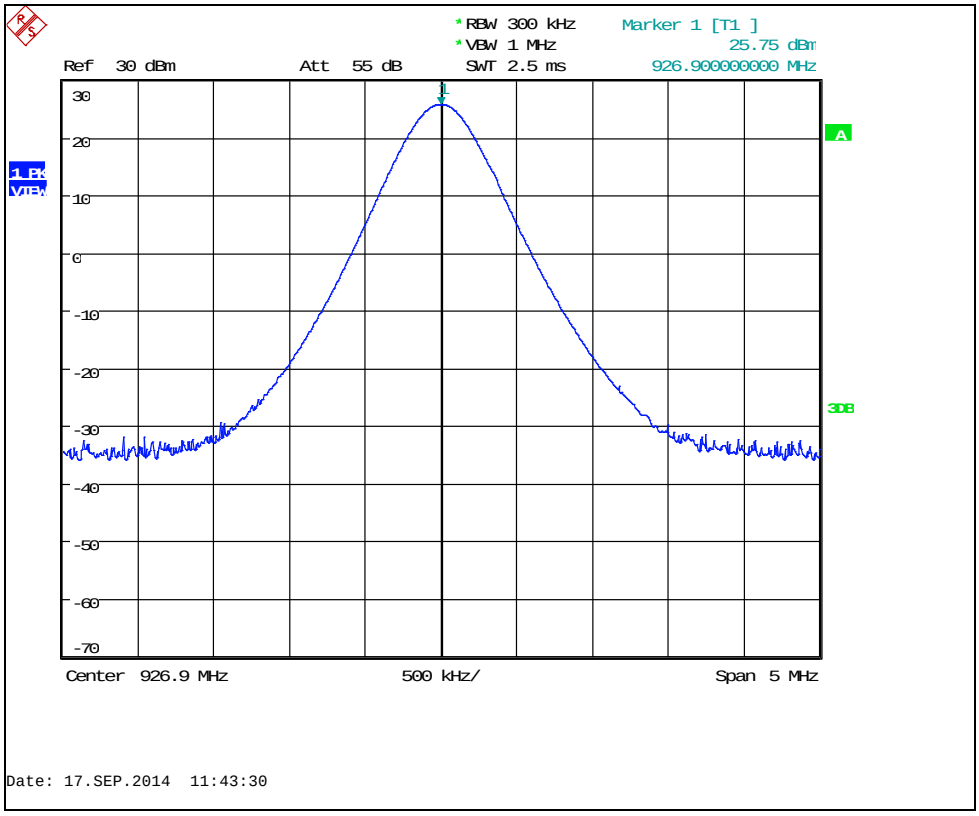
Channel repetition time



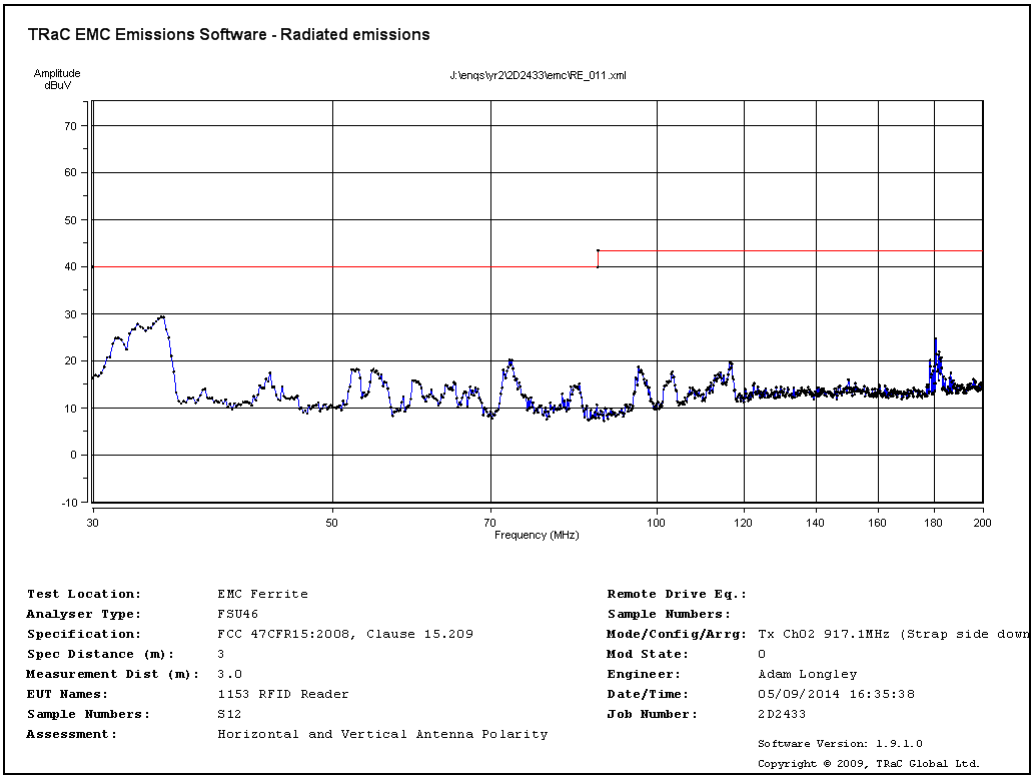
Conducted carrier power 917.1 MHz



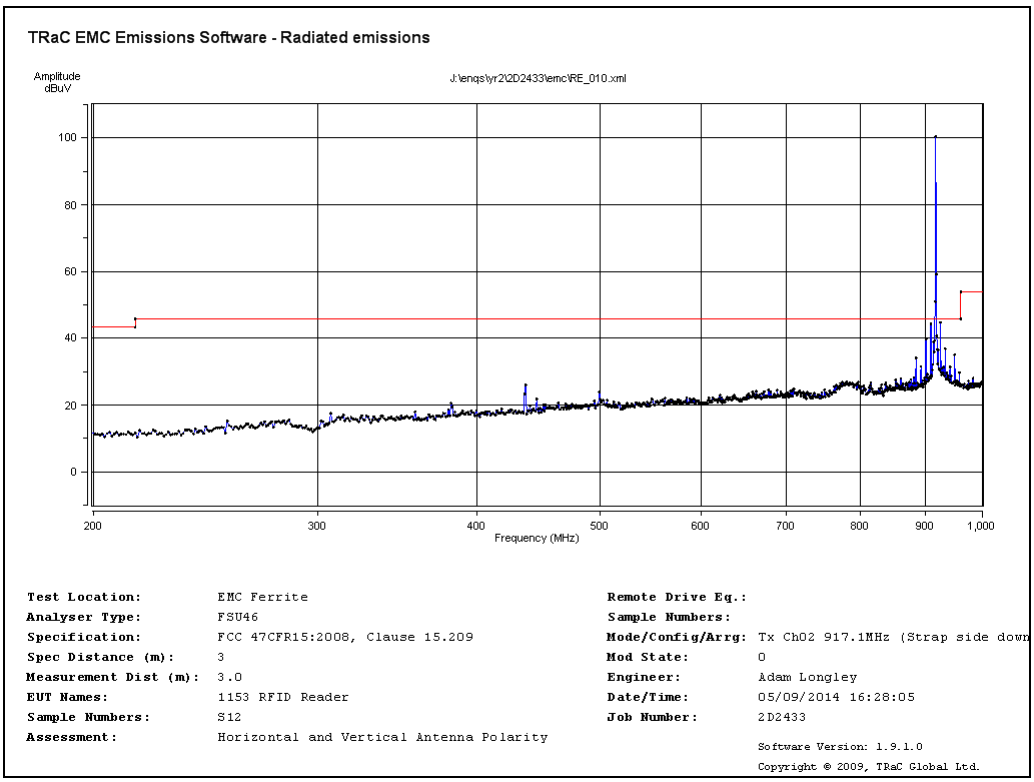
Conducted carrier power 922.1 MHz



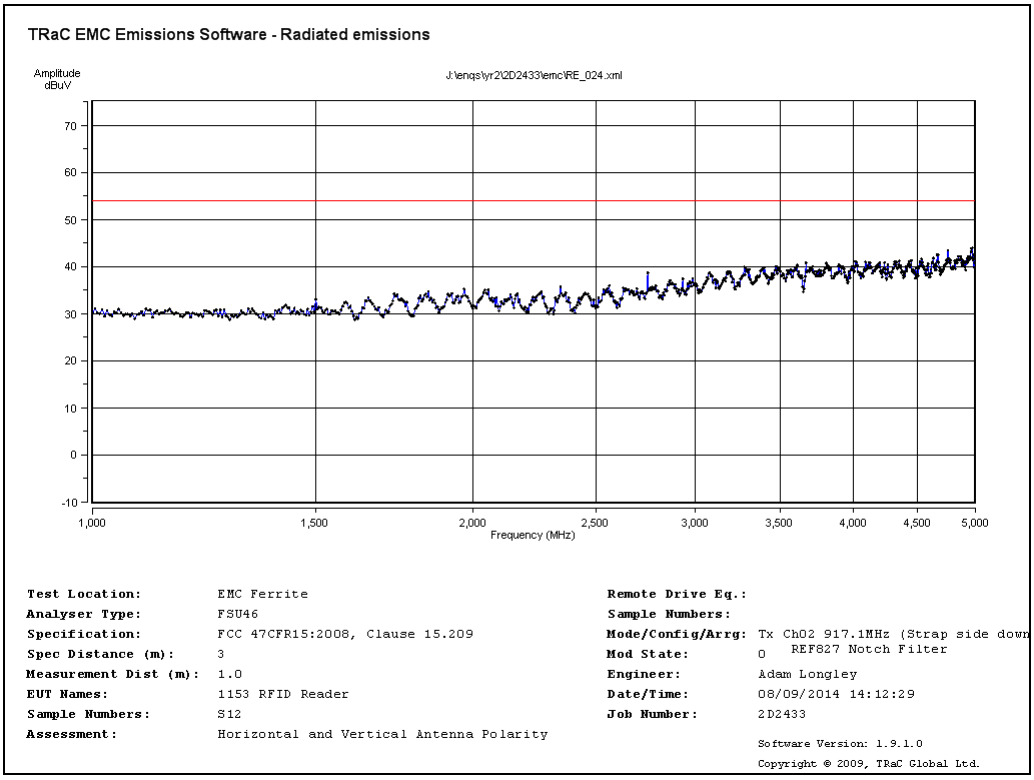
Conducted carrier power 926.9 MHz



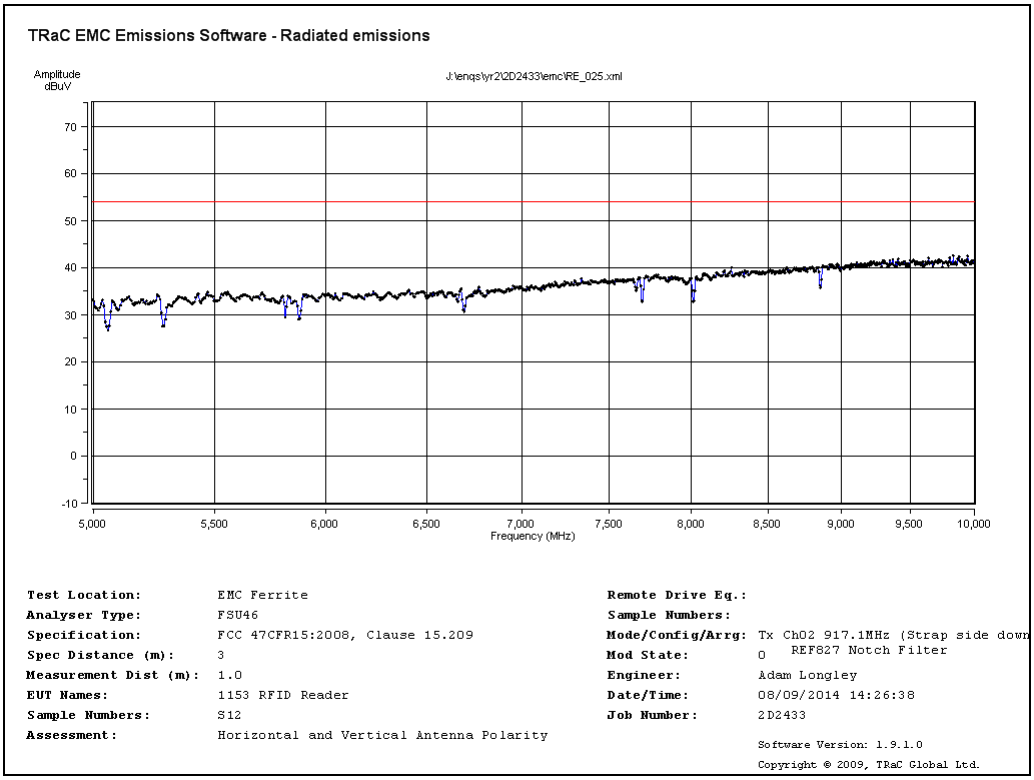
Radiated Spurious emissions 30 MHz to 200MHz – 917.1 MHz



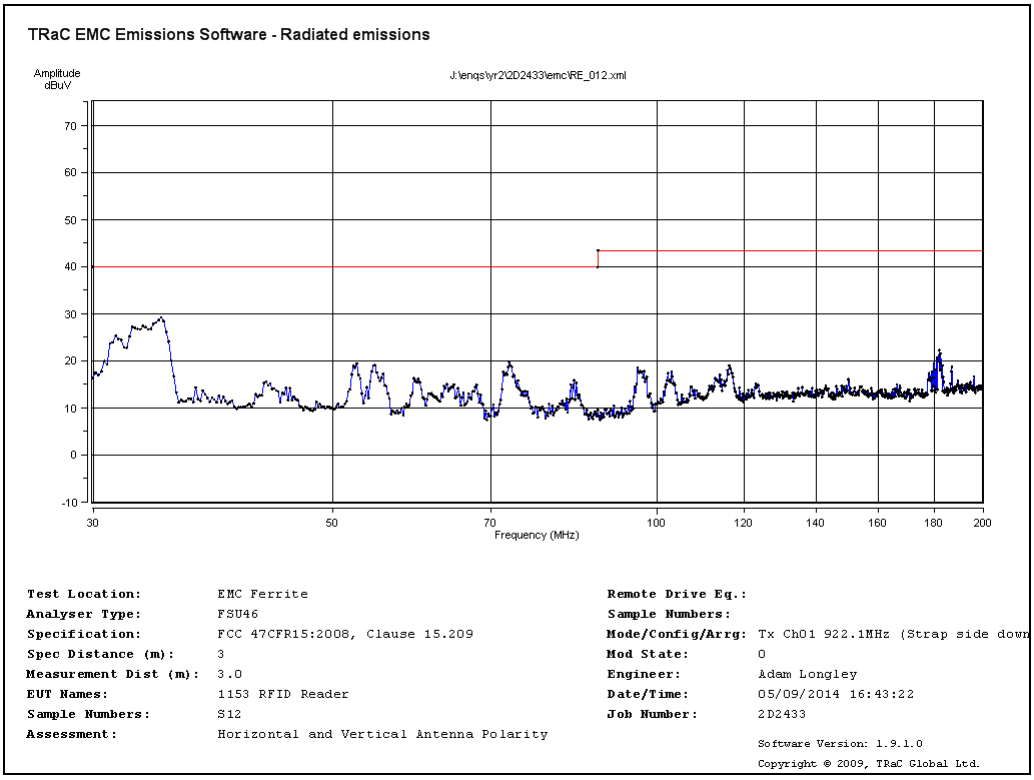
Radiated Spurious emissions 200 MHz to 1GHz – 917.1 MHz



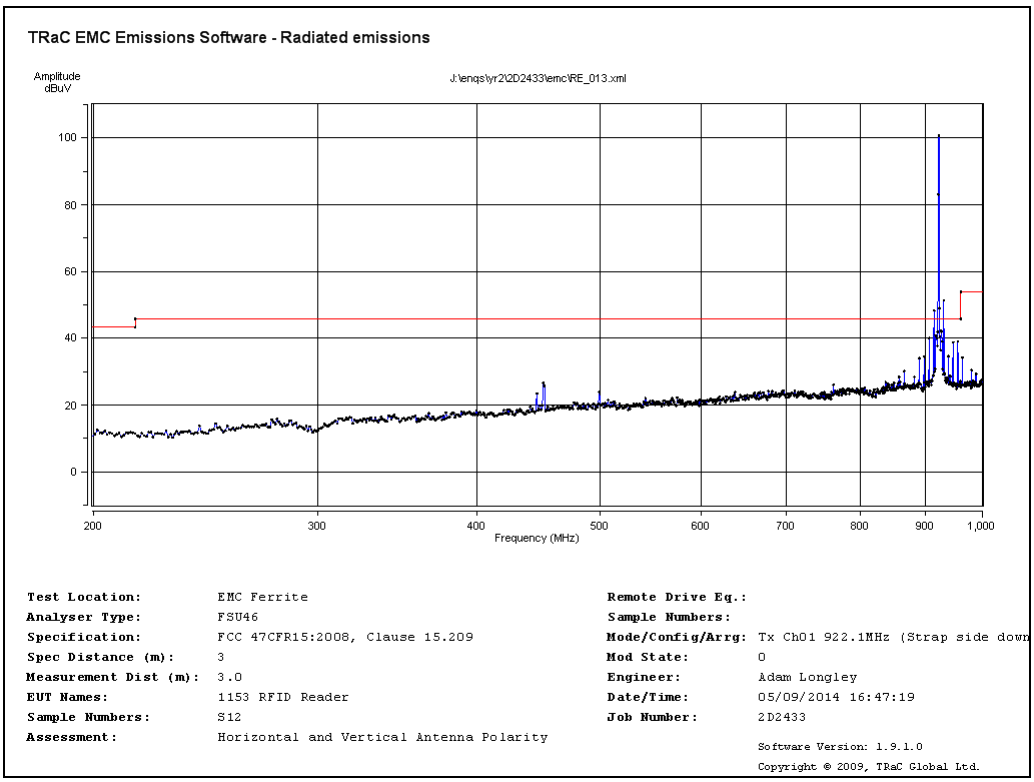
Radiated Spurious emissions 1 GHz to 5 GHz – 917.1 MHz



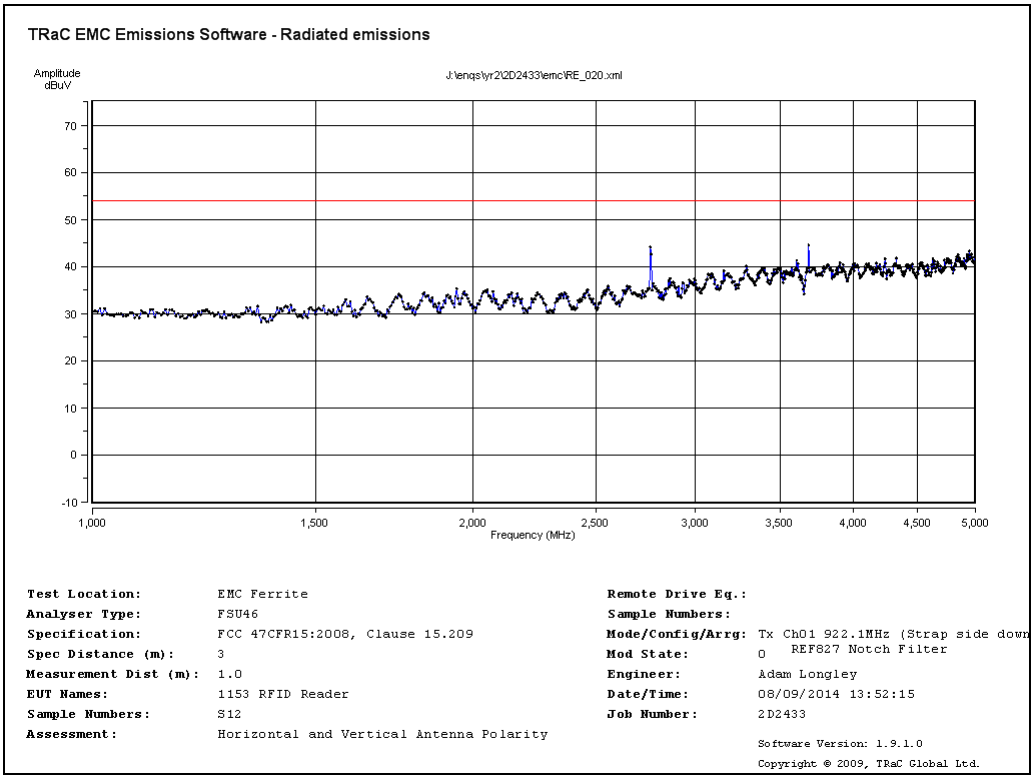
Radiated Spurious emissions 5 GHz to 10 GHz – 917.1MHz



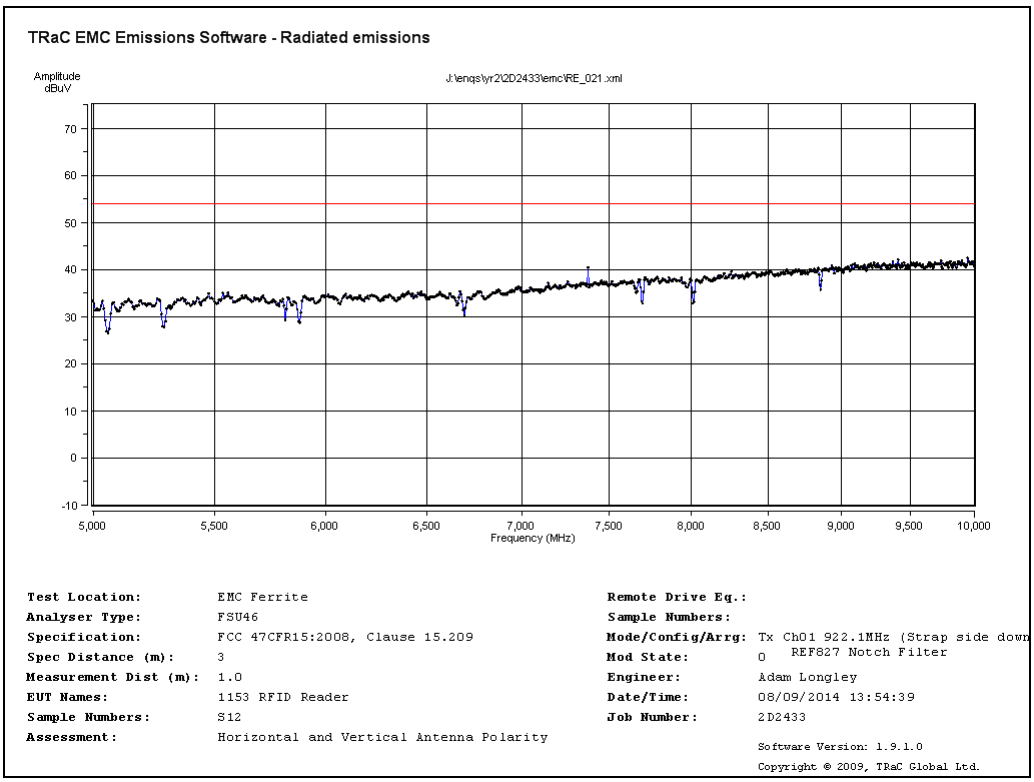
Radiated Spurious emissions 30 MHz to 200 MHz – 922.1 MHz



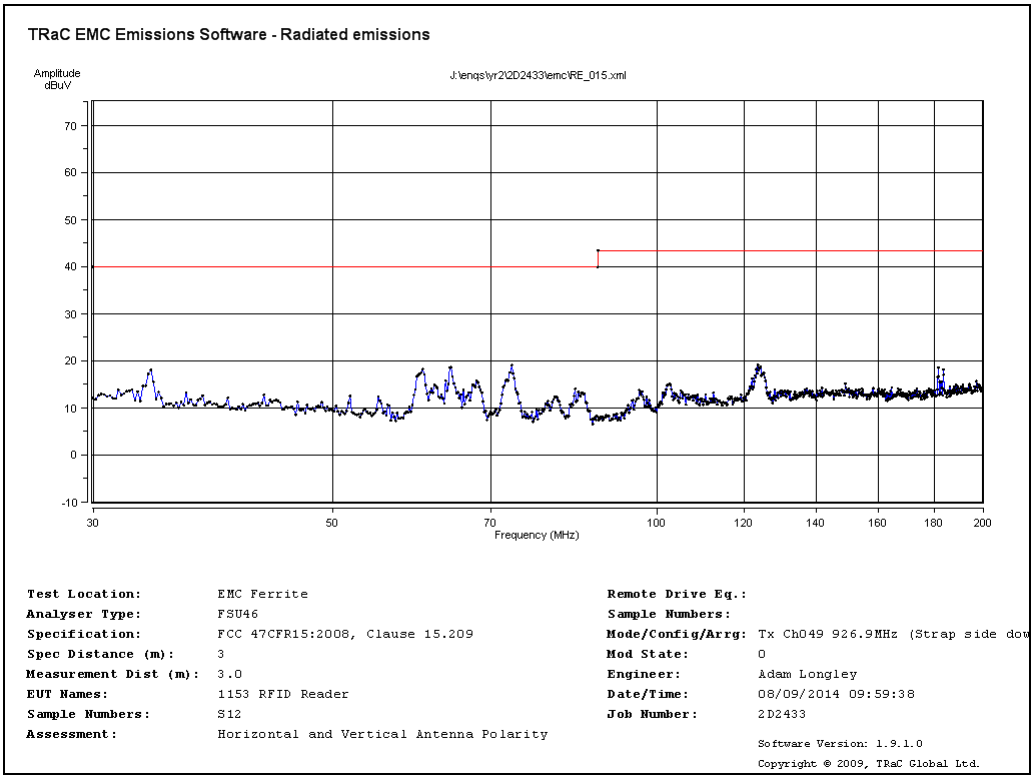
Radiated Spurious emissions 200 MHz to 1 GHz – 922.1 MHz



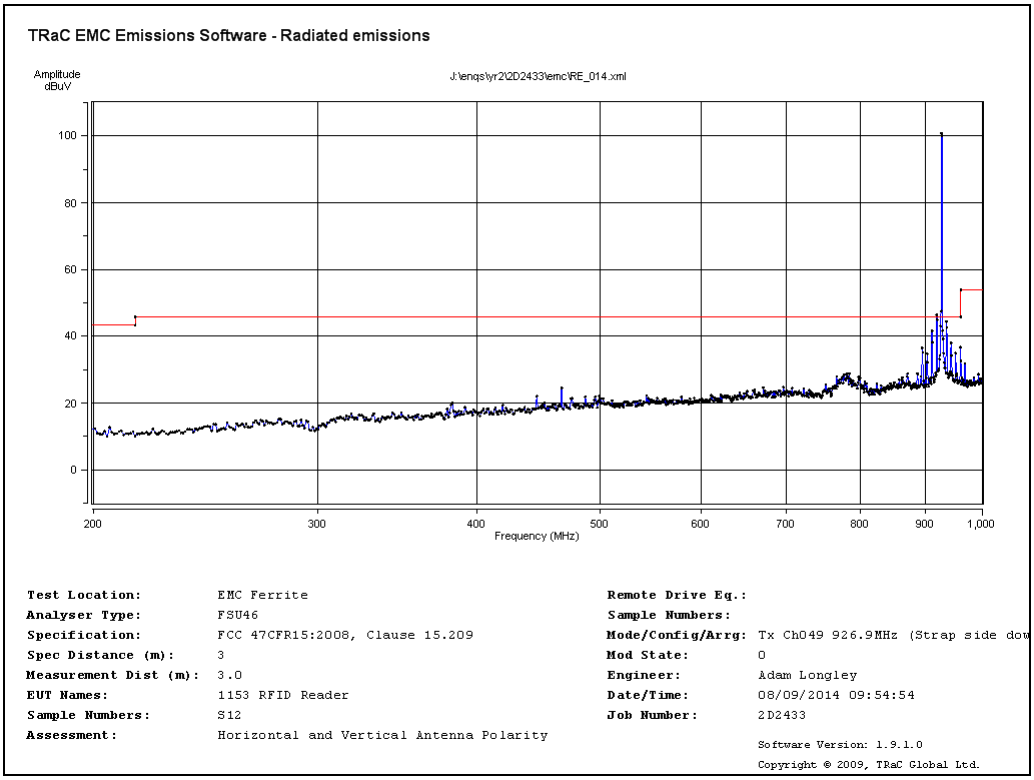
Radiated Spurious emissions 1 GHz to 5 GHz – 922.1 MHz



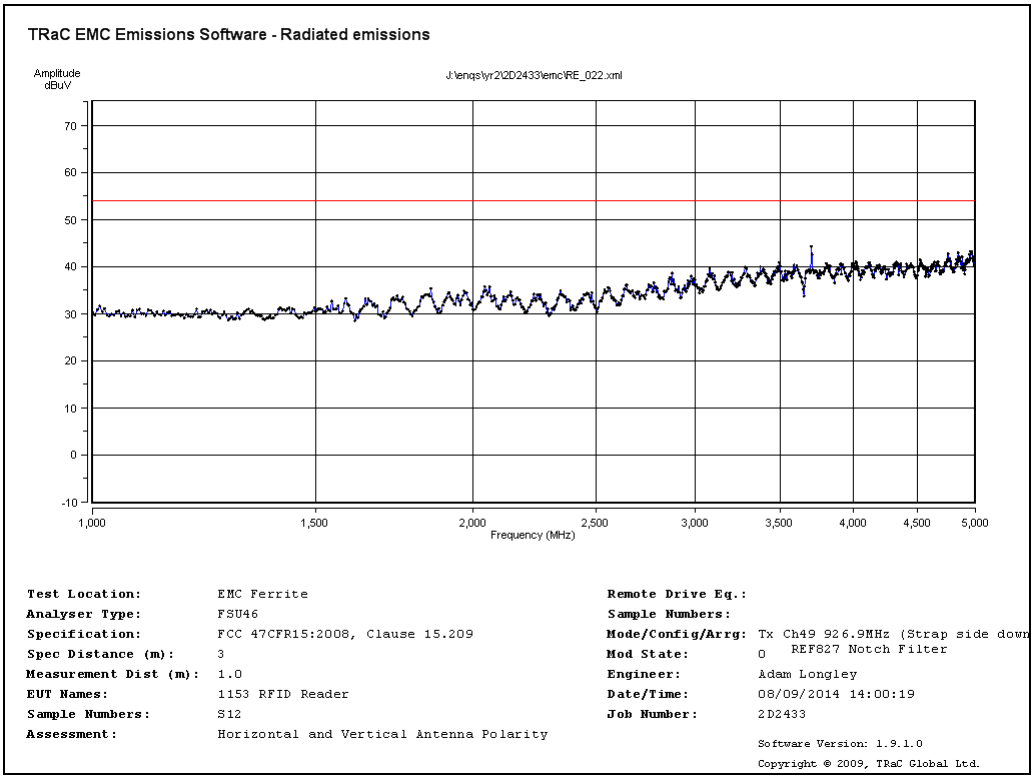
Radiated Spurious emissions 5 GHz to 10 GHz – 922.1 MHz



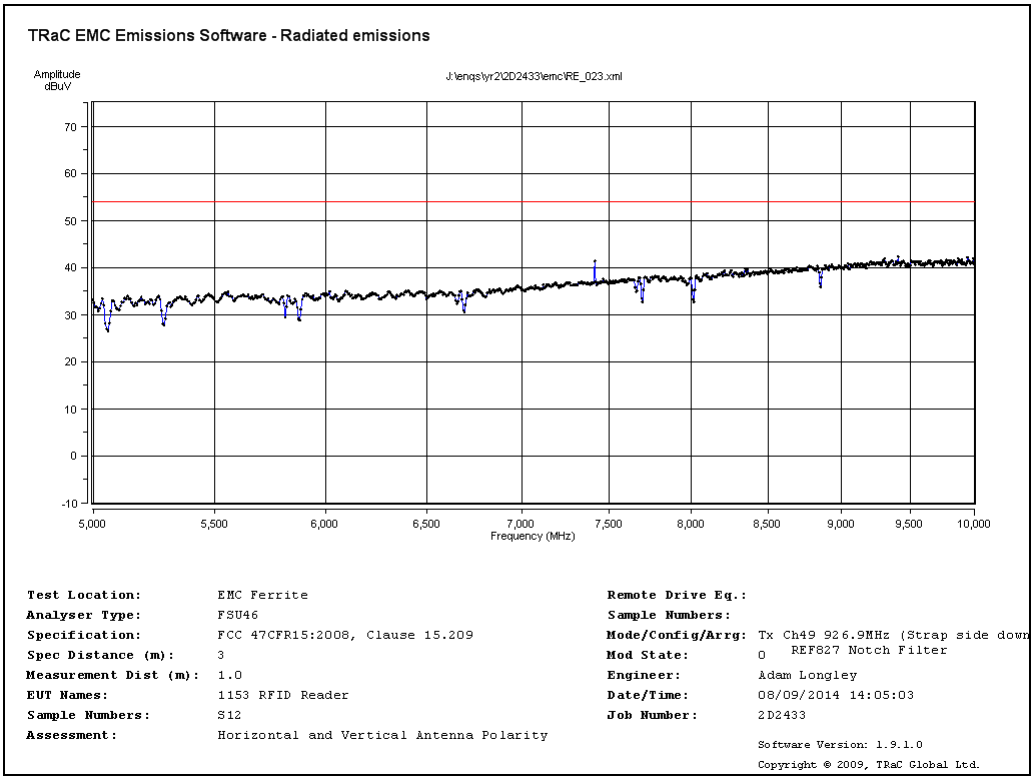
Radiated Spurious emissions 30 MHz to 200 MHz – 926.9 MHz



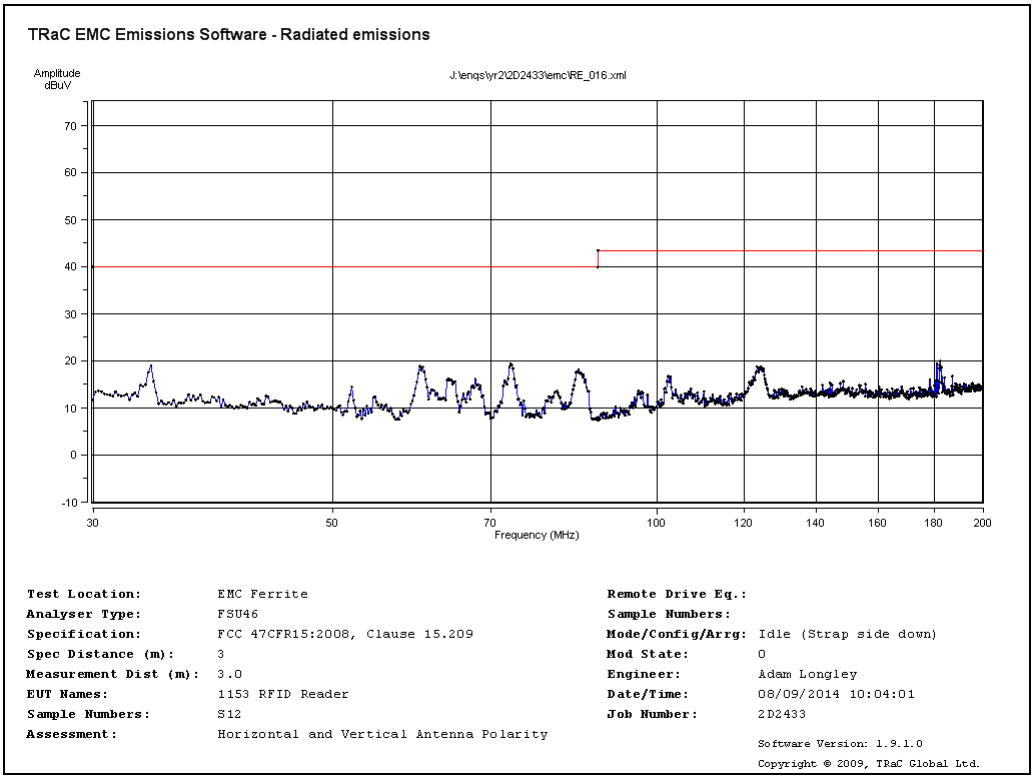
Radiated Spurious emissions 200 MHz to 1 GHz – 926.9 MHz



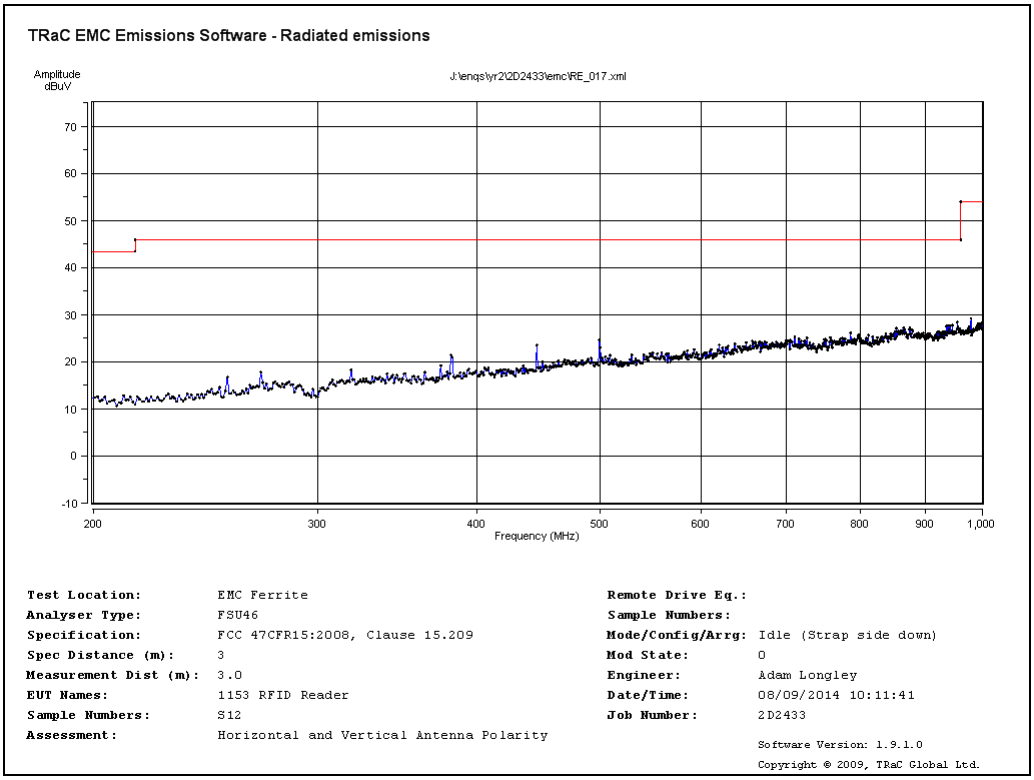
Radiated Spurious emissions 1 GHz to 5 GHz – 926.9 MHz



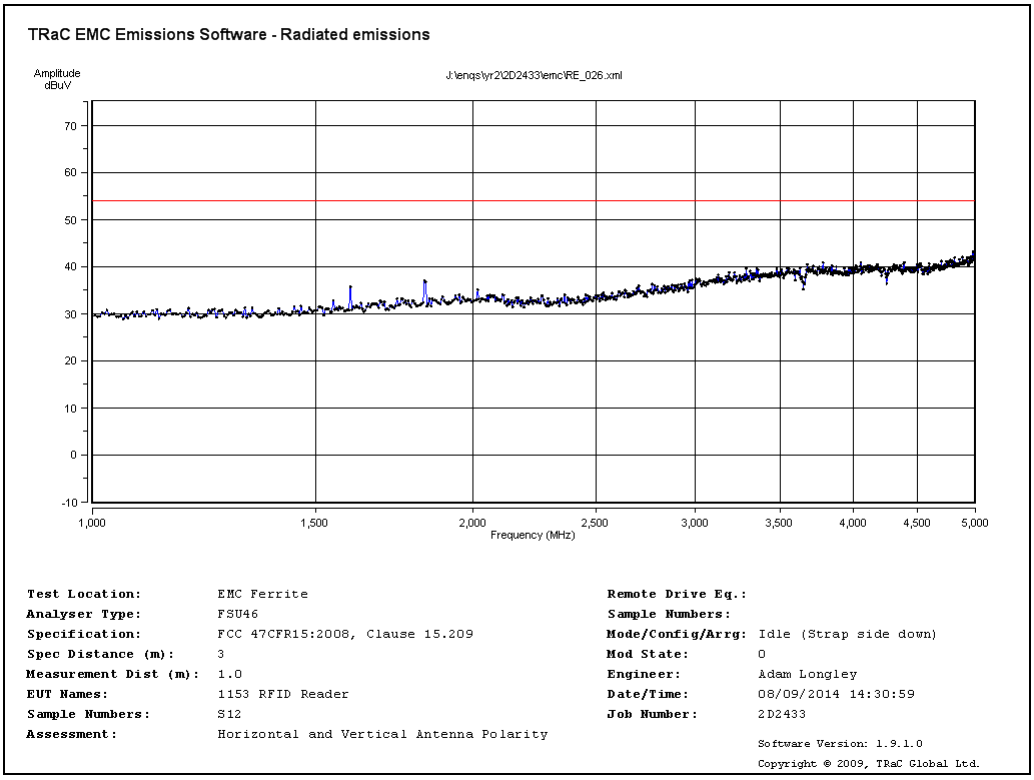
Radiated Spurious emissions 5 GHz to 10 GHz – 926.9 MHz



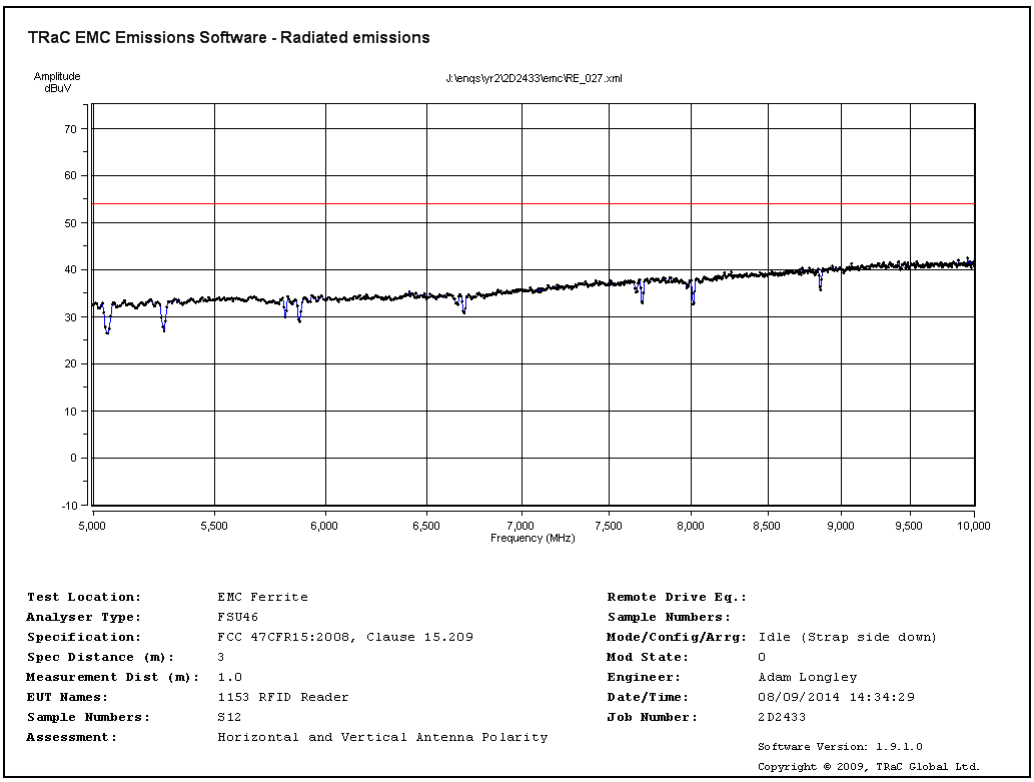
Radiated Spurious emissions 30 MHz to 200 MHz – Idle



Radiated Spurious emissions 200 MHz to 1 GHz – Idle

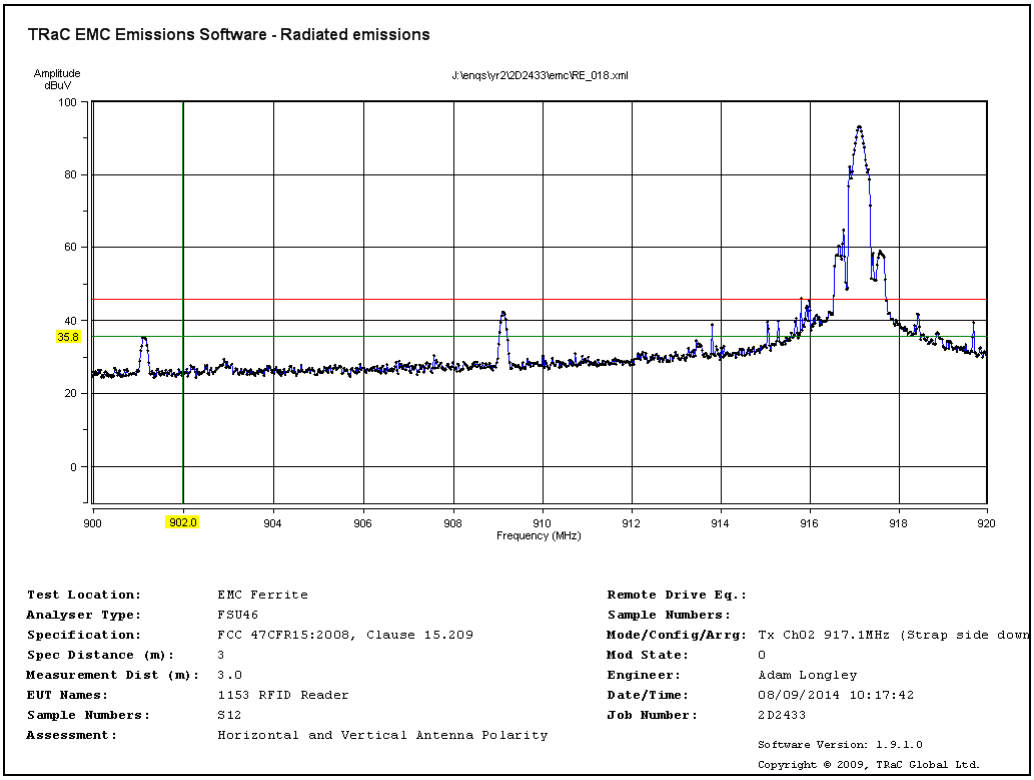


Radiated Spurious emissions 1 GHz to 5 GHz – Idle

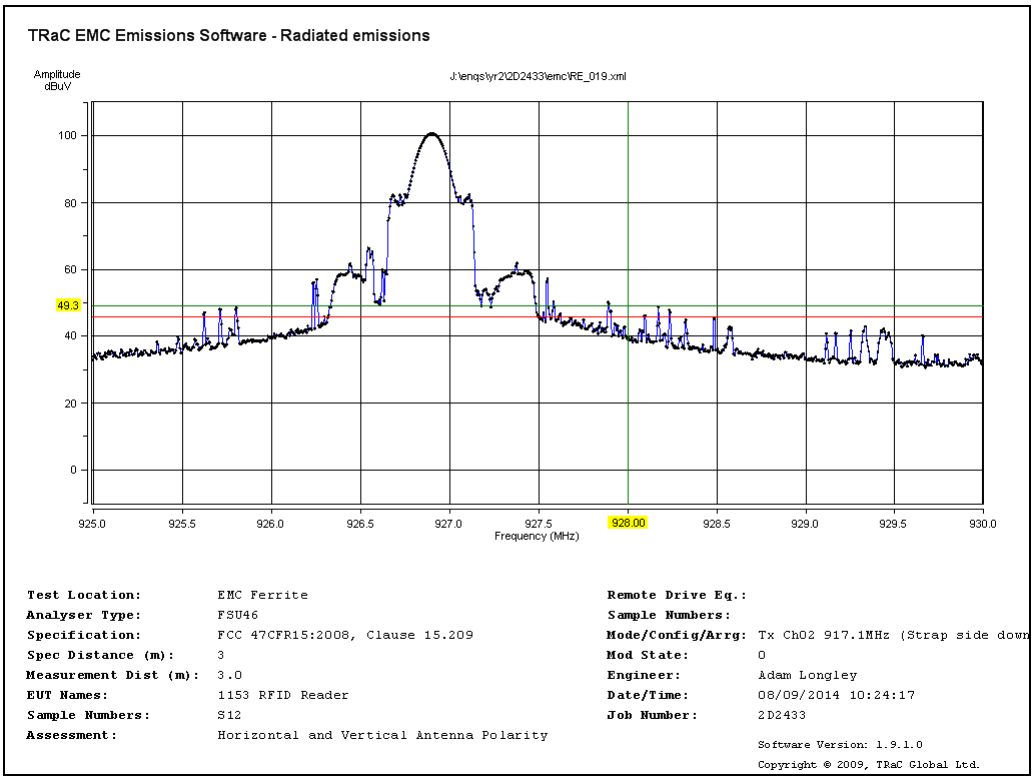


Radiated Spurious emissions 5 GHz to 10 GHz – Idle

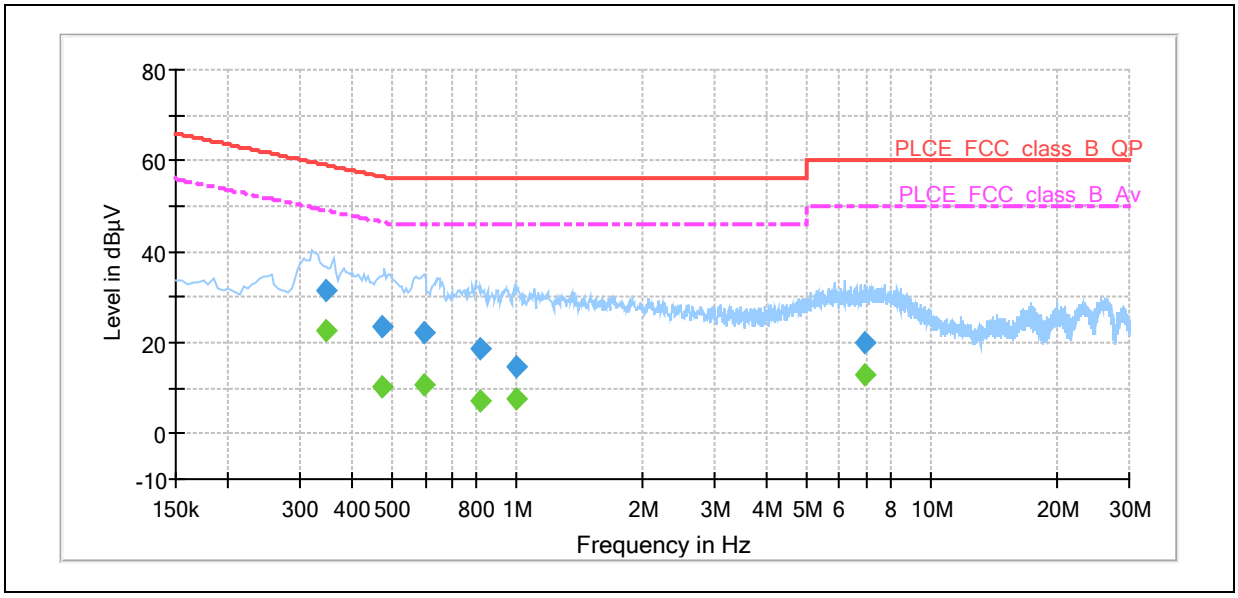
Radiated Bandedge Compliance



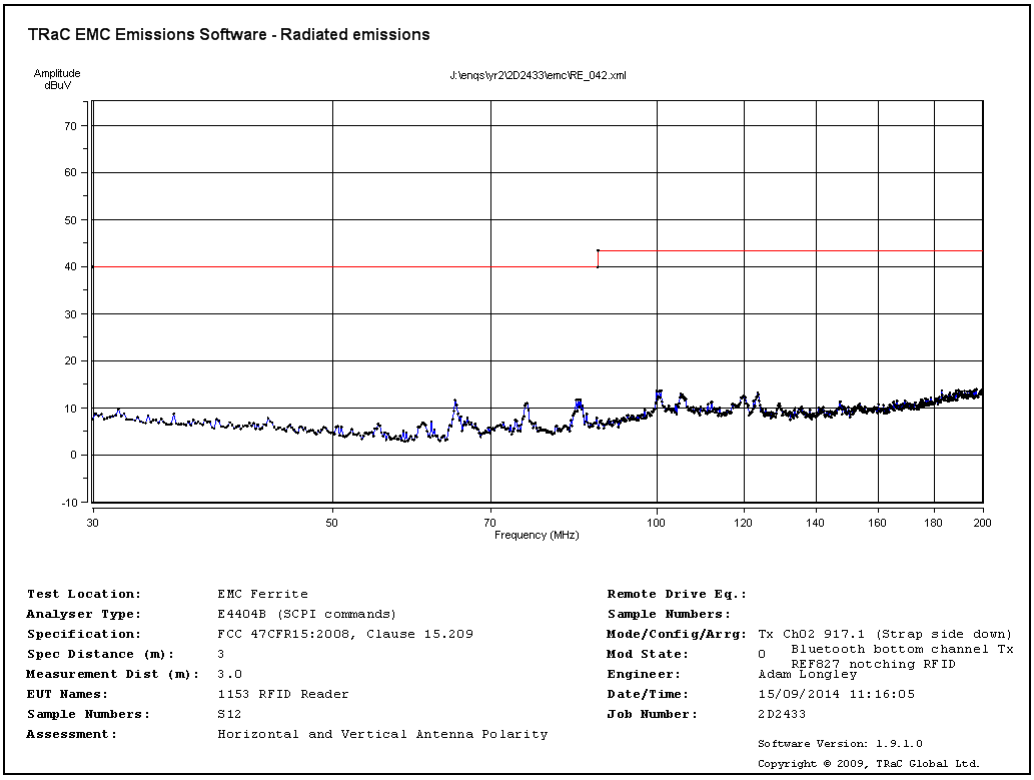
Lower Bandedge



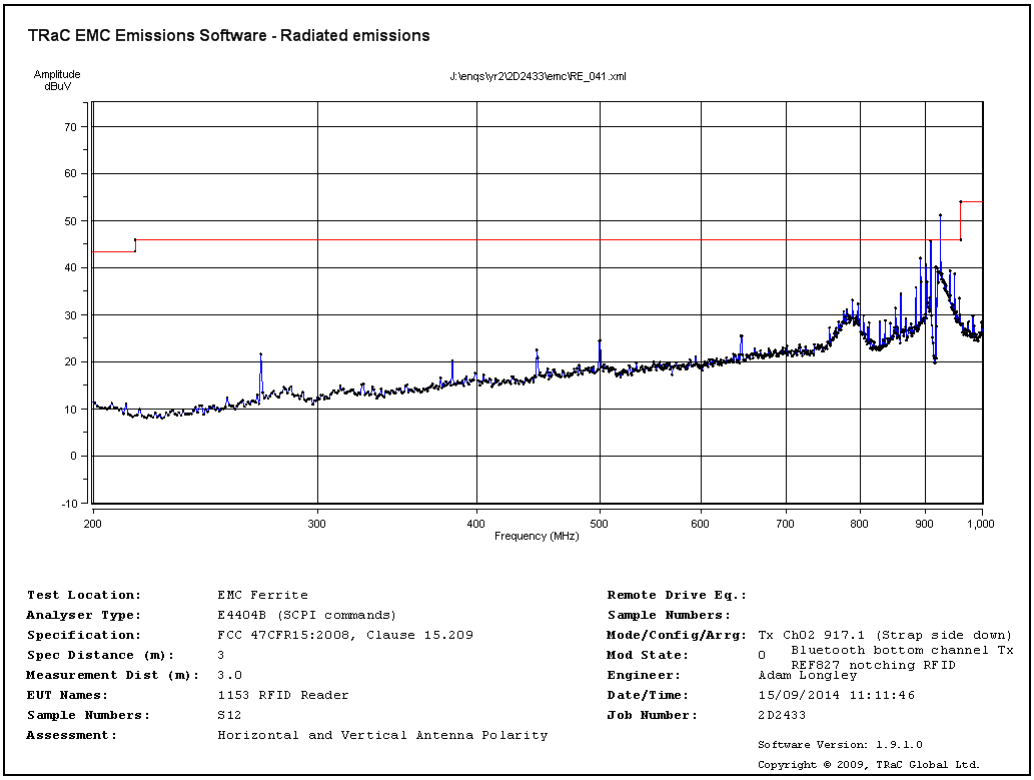
Upper Bandedge



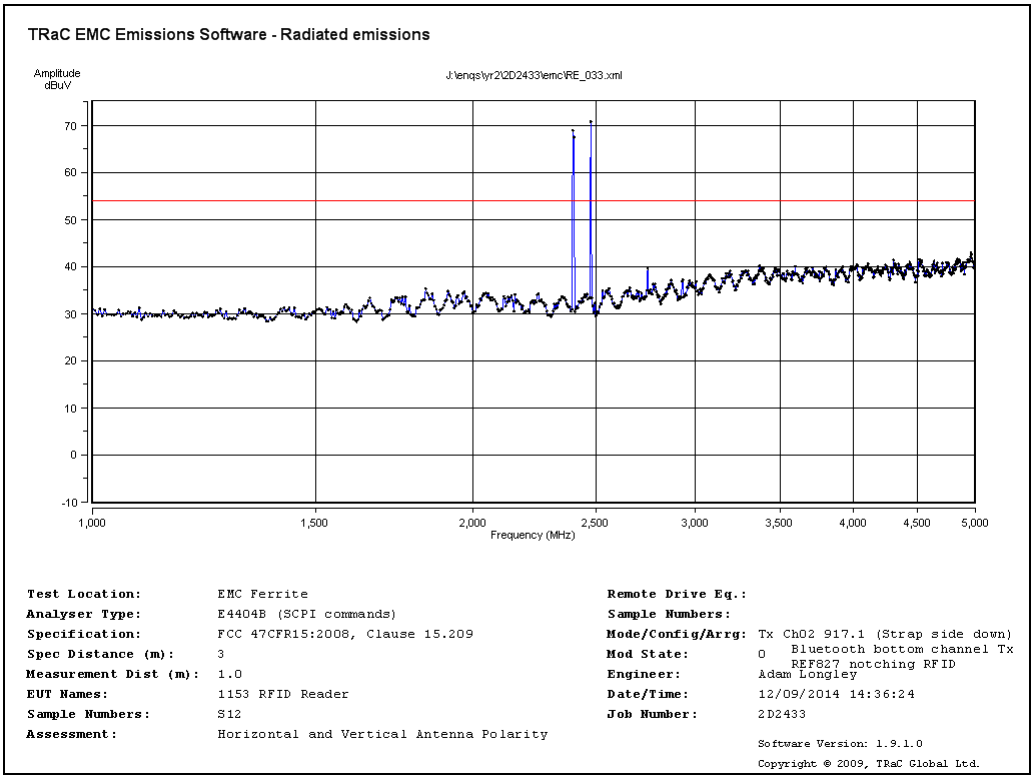
Power line conducted emissions 0.15 to 30 MHz



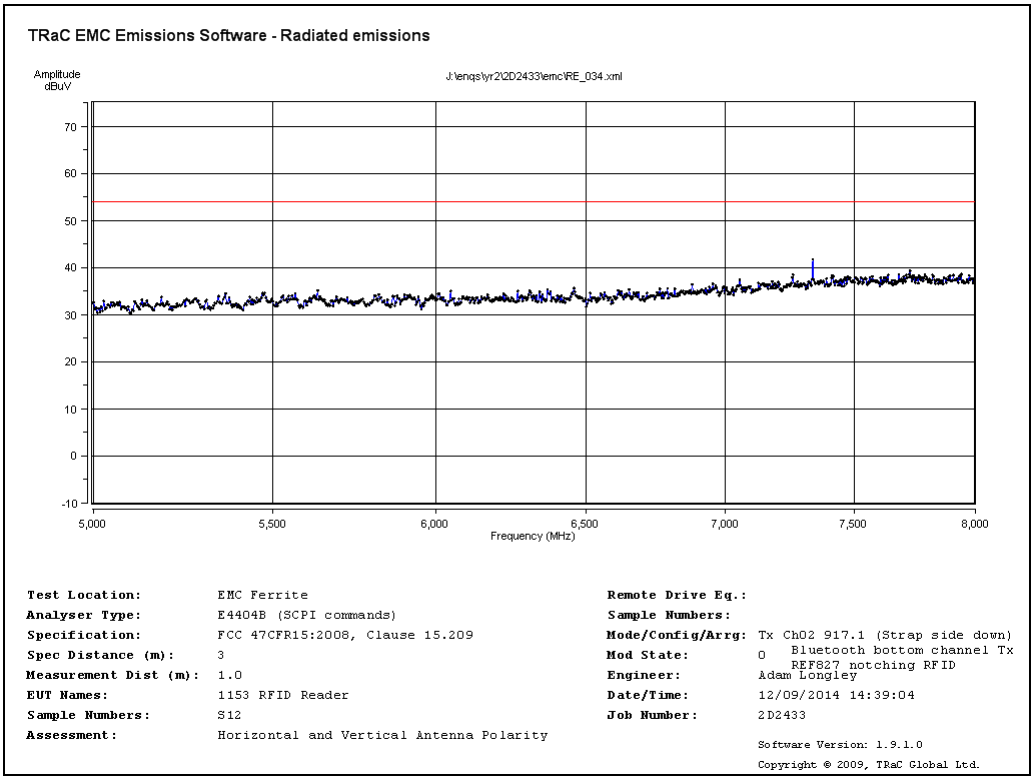
Co-located transmitters Radiated Spurious emissions 30 MHz to 200 MHz – Bottom Channels



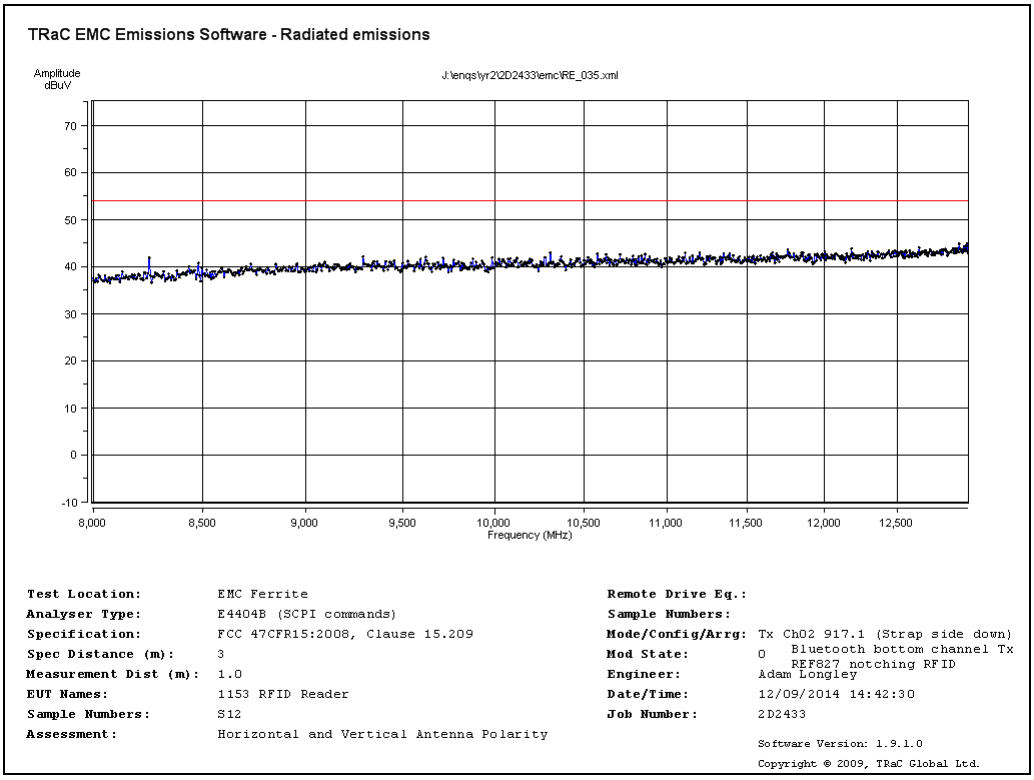
Co-located transmitters Radiated Spurious emissions 200 MHz to 1 GHz – Bottom Channels



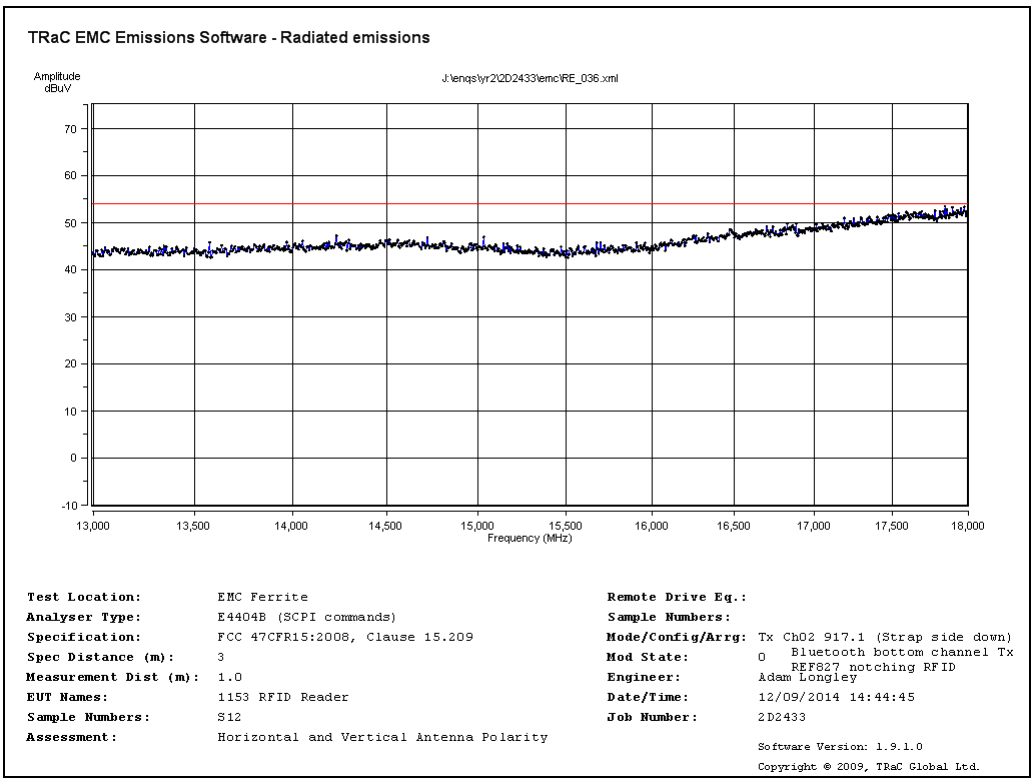
Co-located transmitters Radiated Spurious emissions 1 GHz to 5 GHz – Bottom Channels



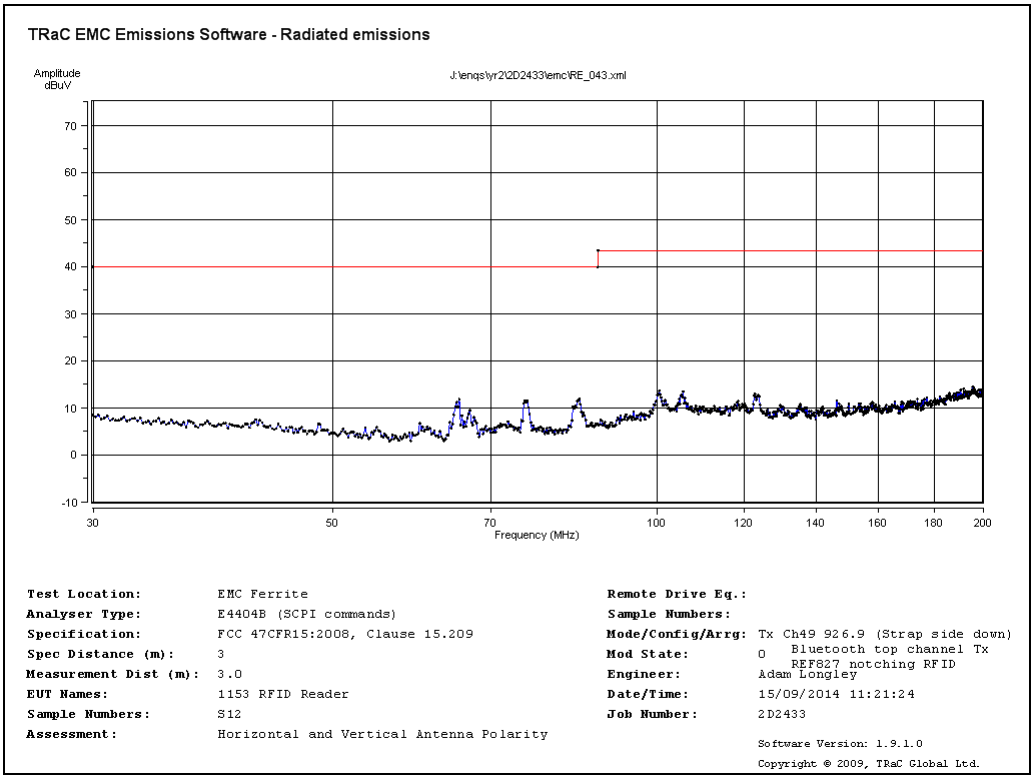
Co-located transmitters Radiated Spurious emissions 5 GHz to 8 GHz – Bottom Channels



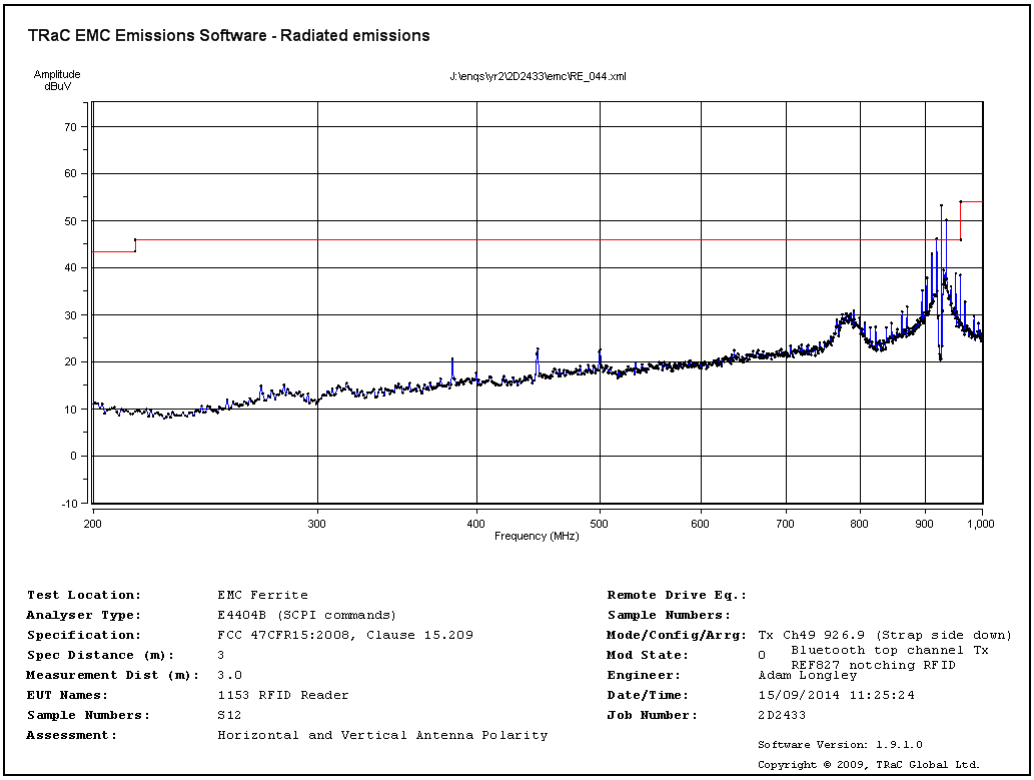
Co-located transmitters Radiated Spurious emissions 8 GHz to 13 GHz – Bottom Channels



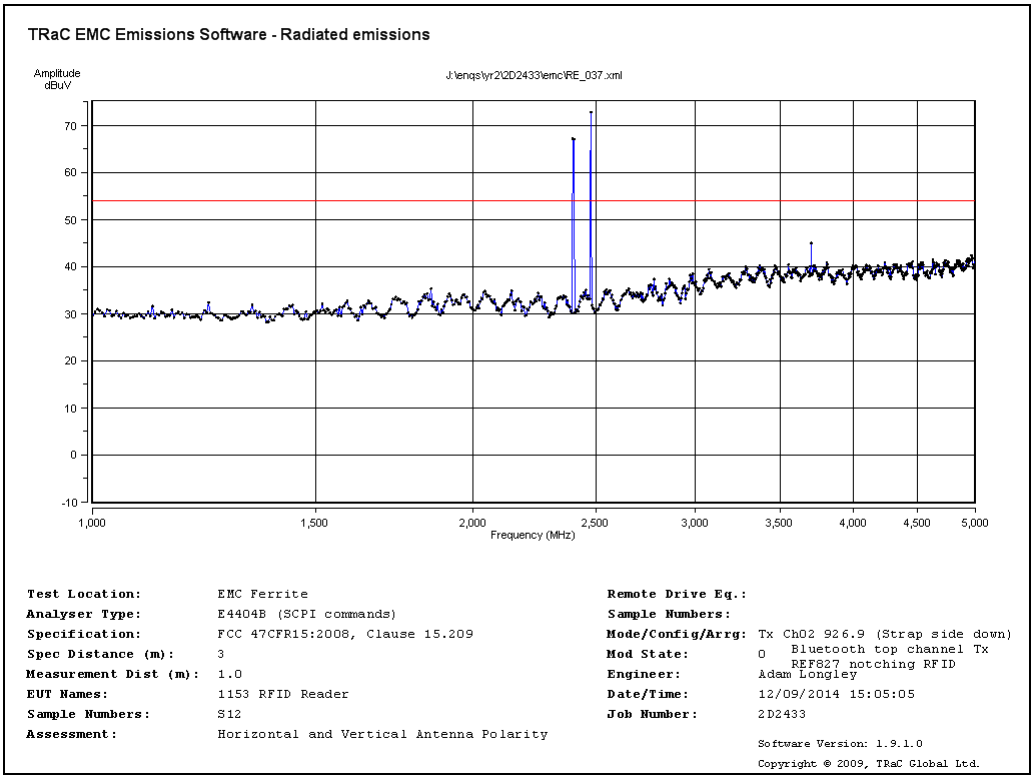
Co-located transmitters Radiated Spurious emissions 13 GHz to 18 GHz – Bottom Channels



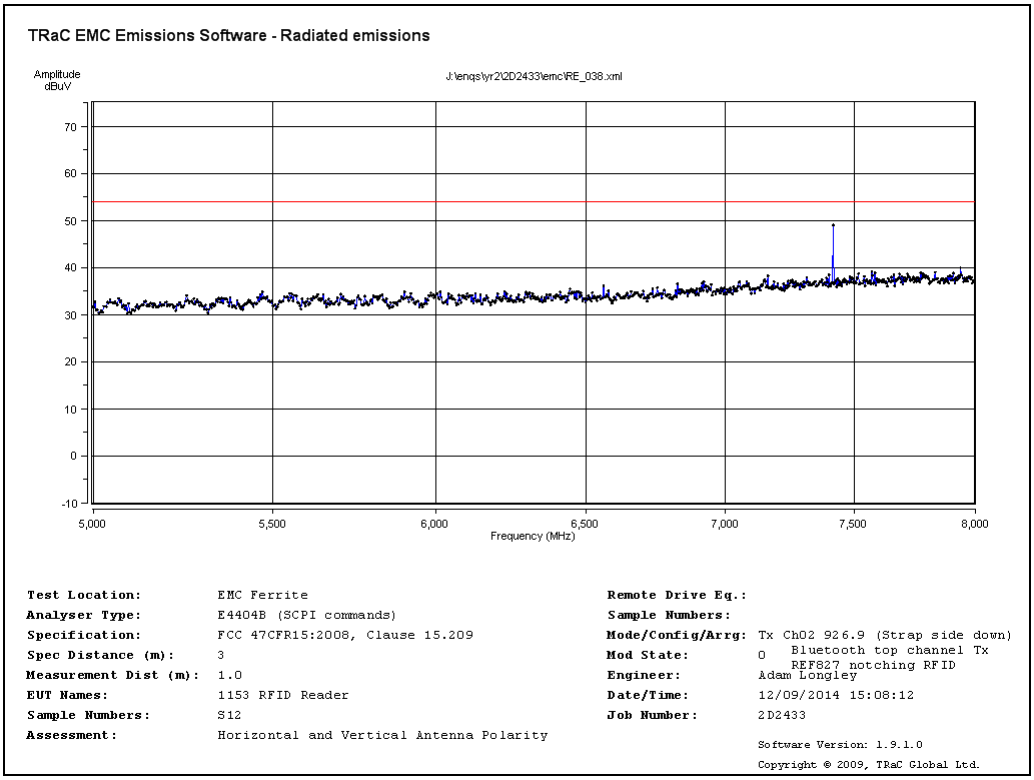
Co-located transmitters Radiated Spurious emissions 30 MHz to 200 MHz – Top Channels



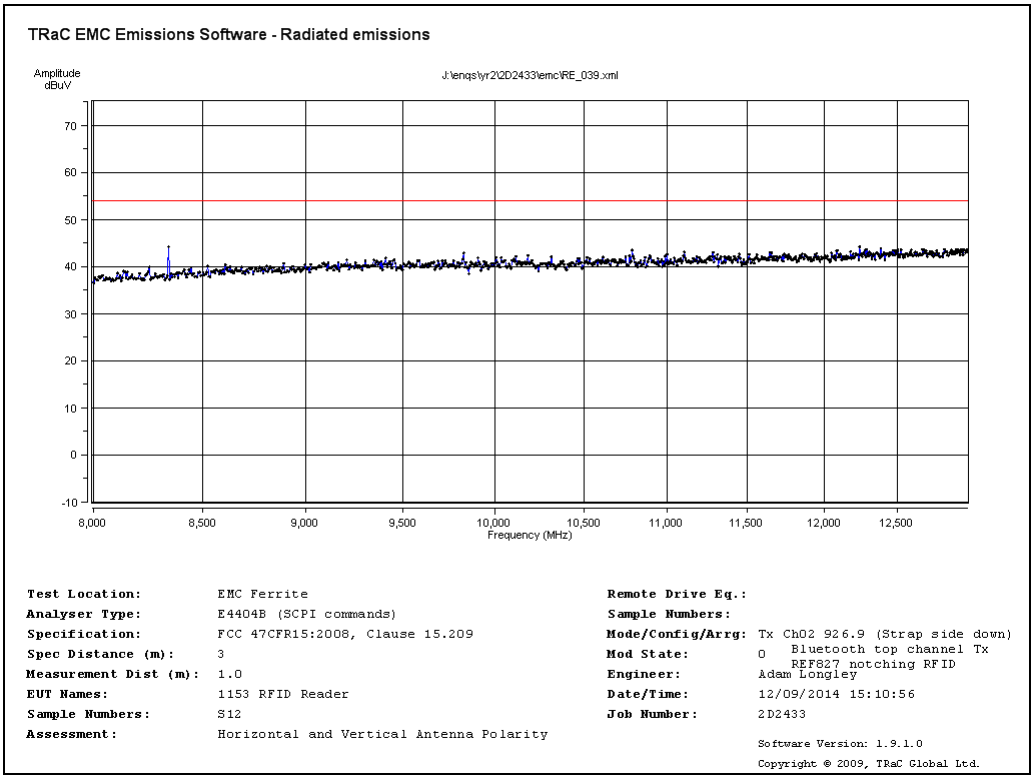
Co-located transmitters Radiated Spurious emissions 200 MHz to 1 GHz – Top Channels



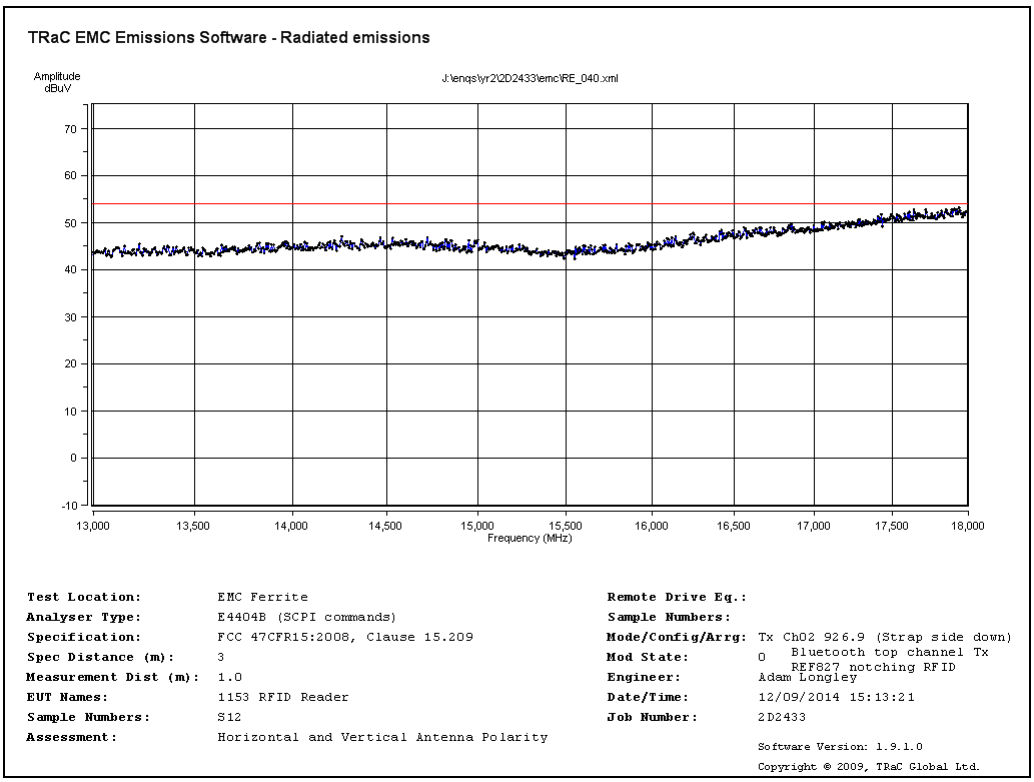
Co-located transmitters Radiated Spurious emissions 1 GHz to 5 GHz – Top Channels



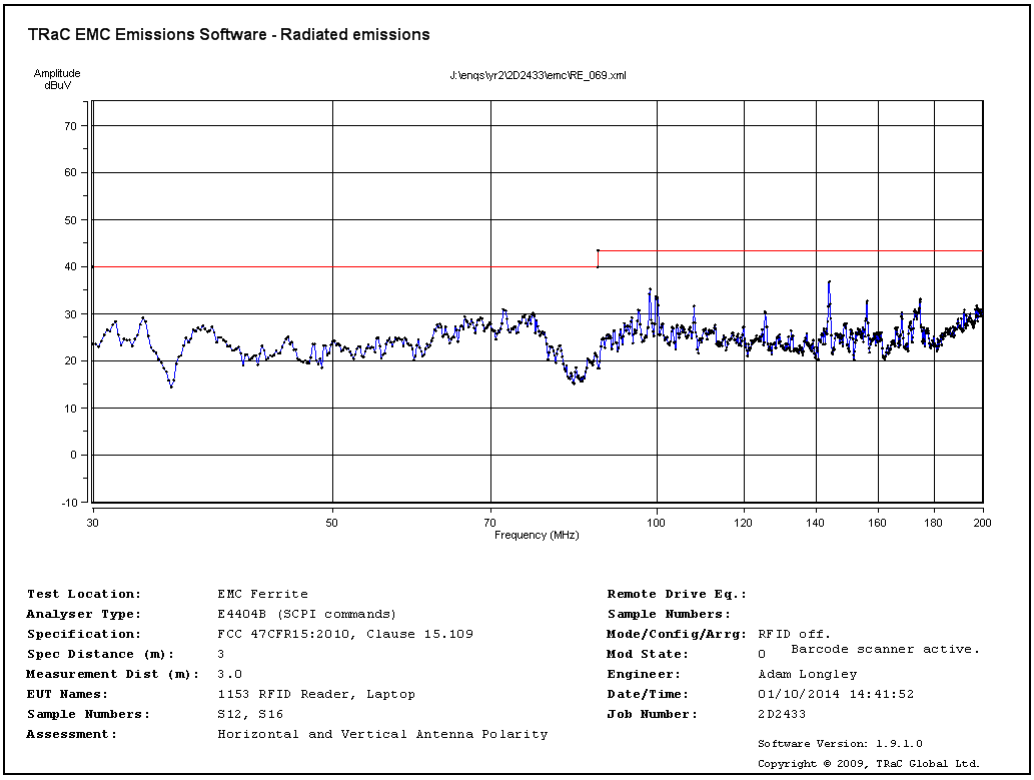
Co-located transmitters Radiated Spurious emissions 5 GHz to 8 GHz – Top Channels



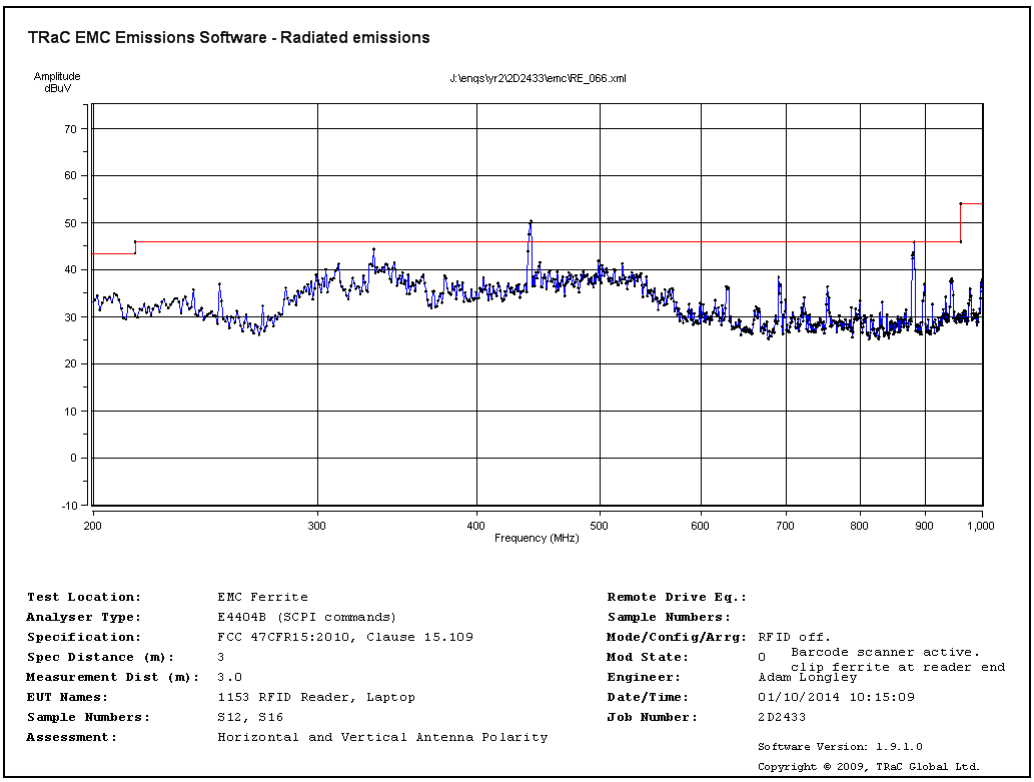
Co-located transmitters Radiated Spurious emissions 8 GHz to 13 GHz – Top Channels



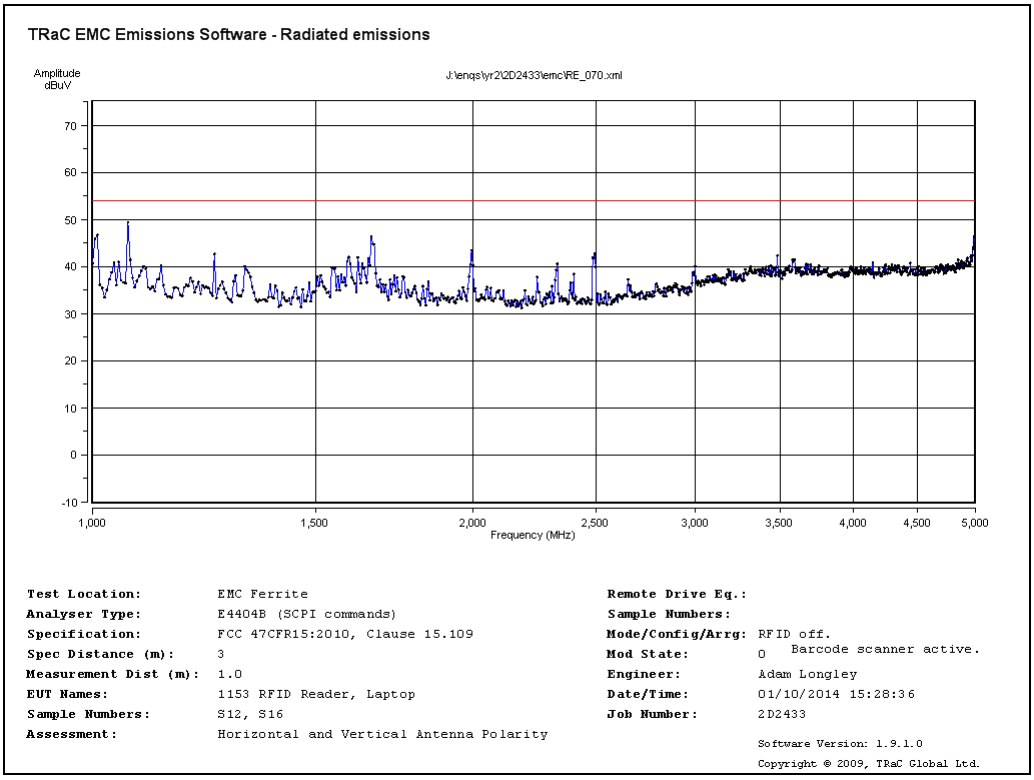
Co-located transmitters Radiated Spurious emissions 13 GHz to 18 GHz – Top Channels



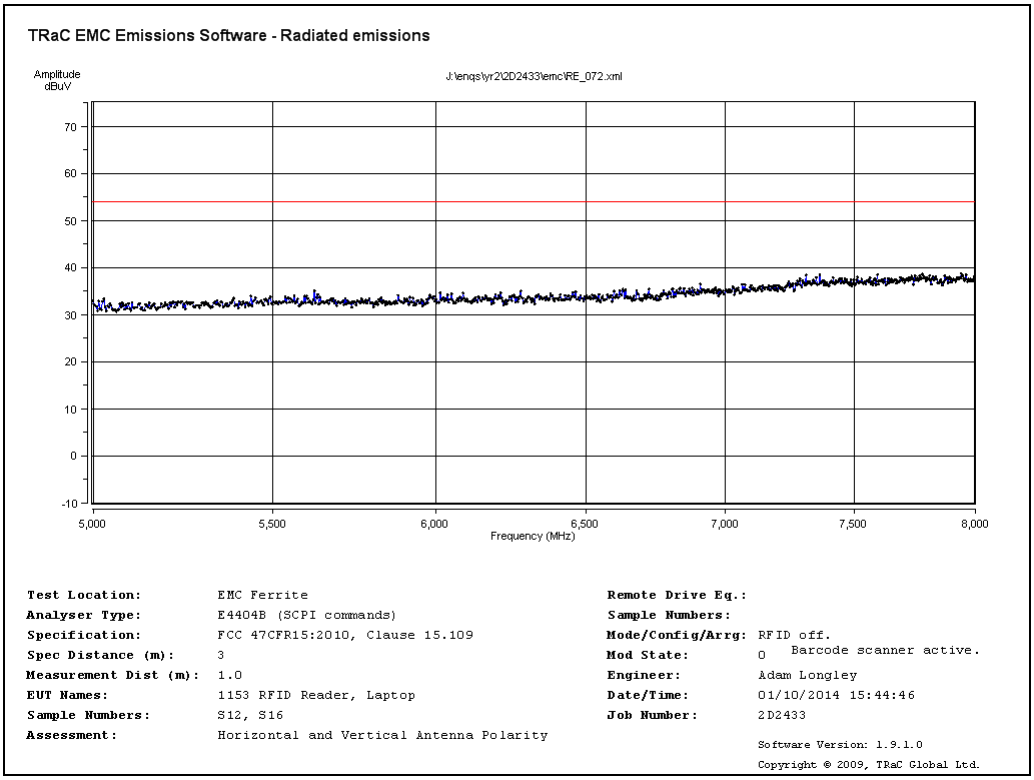
Barcode Reader Radiated Spurious emissions 30 MHz to 200 MHz



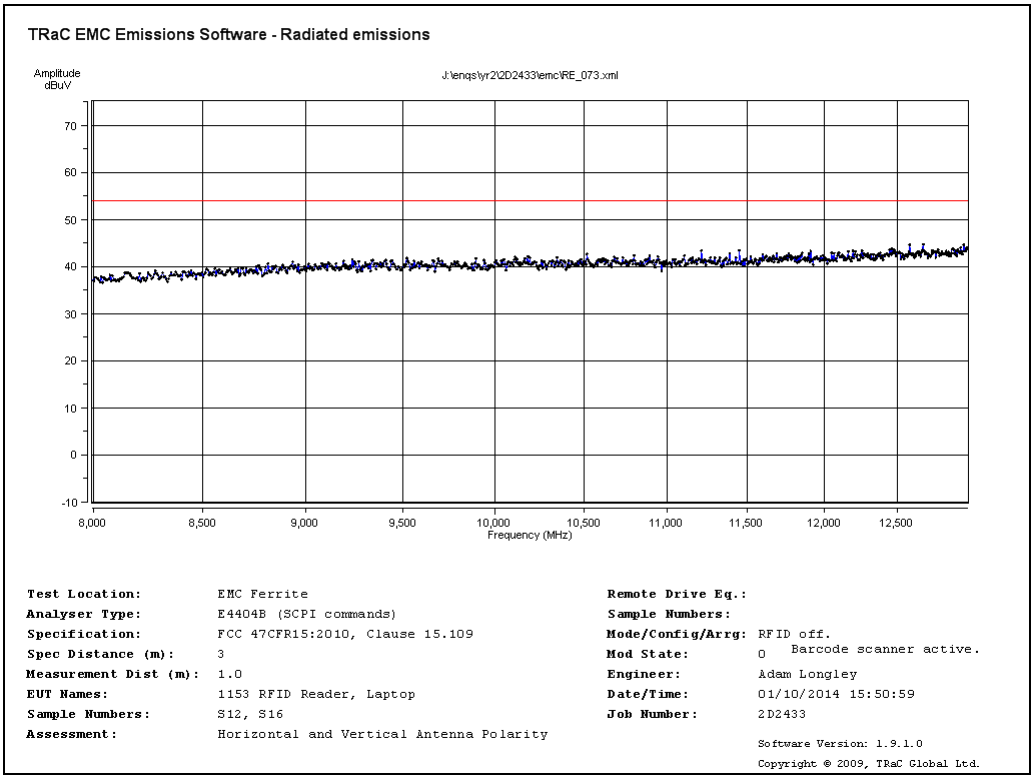
Barcode Reader Radiated Spurious emissions 200 MHz to 1 GHz



Barcode Reader Radiated Spurious emissions 1 GHz to 5 GHz



Barcode Reader Radiated Spurious emissions 5 GHz to 8 GHz



Barcode Reader Radiated Spurious emissions 8 GHz to 13 GHz

Appendix C: Additional Test and Sample Details

This appendix contains details of:

1. The samples submitted for testing.
2. Details of EUT operating mode(s)
3. Details of EUT configuration(s) (see below).
4. EUT arrangement (see below).

Throughout testing, the following numbering system is used to identify the sample and it's modification state:

Sample No: Sxx Mod w

where:

xx = sample number eg. S01
w = modification number eg. Mod 2

The following terminology is used throughout the test report:

Support Equipment (SE) is any additional equipment required to exercise the EUT in the applicable operating mode. Where relevant SE is divided into two categories:

SE in test environment: The SE is positioned in the test environment and is not isolated from the EUT (e.g. on the table top during REFE testing).

SE isolated from the EUT: The SE is isolated via filtering from the EUT. (e.g. equipment placed externally to the ALSR during REFE testing).

EUT configuration refers to the internal set-up of the EUT. It may include for example:

Positioning of cards in a chassis.
Setting of any internal switches.
Circuit board jumper settings.
Alternative internal power supplies.

Where no change in EUT configuration is **possible**, the configuration is described as “single possible configuration”.

EUT arrangement refers to the termination of EUT ports / connection of support equipment, and where relevant, the relative positioning of samples (EUT and SE) in the test environment.

For further details of the test procedures and general test set ups used during testing please refer to the related document "EMC Test Methods - An Overview", which can be supplied by TRaC Global upon request.

C1) Test samples

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

Sample No.	Description	Identification
S12	1153 RFID Reader (radiated sample)	1153-US-000102
S13	1153 RFID Reader (conducted sample)	1153-US-000101

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

Sample No.	Description	Identification
S01	Sony Vaio Laptop VGN-FZ11S	28201060 5001321
S03	Sony AC adapter	0028484
S14	Stontronics Plug-top USB power supply	DSC-5CU-05 050100
S15	Stontronics Plug-top USB power supply	DSC-5CU-05 050100
S16	Samsung NP-N150 Netbook	ZN7193KZ501545X
S18	AC adapter for Samsung Netbook	AA-PA2N40W

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 PR-ASK modulation on 917.1MHz, 922.1 MHz and 926.9 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.

Test	Description of Operating Mode:
Barcode reader spurious emissions	EUT Barcode Reader active and communicating data to the Netbook via the USB connection, radio circuitry not transmitting.

C3) EUT Configuration Information.

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

C4) List of EUT Ports

The tables below describe the termination of EUT ports:

Sample : S13
Tests : Conducted

Port	Description of Cable Attached	Cable length	Equipment Connected
SMA	SMA to SMA coaxial RF cable	2m	Measurement Instrument
Micro USB	None	-	N/A

Sample : S12
Tests : Radiated Emissions

Port	Description of Cable Attached	Cable length	Equipment Connected
Micro USB	None	-	N/A

Sample : S12
Tests : Power Line Conducted Emissions

Port	Description of Cable Attached	Cable length	Equipment Connected
Micro USB	Micro USB lead	1m	S14

Sample : S14
Tests : Power Line Conducted Emissions

Port	Description of Cable Attached	Cable length	Equipment Connected
USB	Micro USB lead	1m	S14
Mains	Mains extension	1m	AC Supply

Sample : S12
Tests : Radiated Emissions

Port	Description of Cable Attached	Cable length	Equipment Connected
Micro USB	microUSB	1m	S16

C5 Details of Equipment Used

For Radiated Measurements:

TRAC REF/RFG No.	Type	Description	Manufacturer	Date Calibrated.	Calibration Due
REF886	ATS	Ferrite Lined Chamber	TRaC	21/07/14	21/07/15
095		Biconical Antenna	EMCO	09/05/13	09/05/16
191		Log Periodic Antenna	EMCO	09/05/13	09/05/16
RFG682	HL050	GHz Log Periodic Antenna	Rhode & Schwarz	16/07/14	16/07/16
RFG629		Horn Antenna	Q-Par	19/09/14	19/07/16
REF927	310	Pre-Amp (9kHz – 1GHz)	Sonoma	01/07/14	01/07/16
REF913	8449B	Pre-Amp (1 – 26.5GHz)	Agilent	05/02/14	05/02/15
RFG452		SMA RF coaxial cable		03/07/13	03/07/15
REF881		N-Type RF coaxial cable		01/07/13	01/07/15
REF882		N-Type RF coaxial cable		01/07/13	01/07/15
REF884		N-Type RF coaxial cable		01/07/13	01/07/15
REF885		N-Type RF coaxial cable		01/07/13	01/07/15
RFG832		K-Type RF coaxial cable	Teleydyne	17/07/14	17/07/15
RFG919		K-Type RF coaxial cable	Teleydyne	17/07/14	17/07/15
REF910	FSU	Spectrum Analyser	Rhode & Schwarz	31/03/14	31/03/15
REF837	E4440A	Spectrum Analyser	Agilent	19/05/14	19/05/15

For Conducted RF Measurements

TRAC REF/RFG No.	Type	Description	Manufacturer	Date Calibrated.	Calibration Due
REF910	FSU	Spectrum Analyser	Rhode & Schwarz	31/03/14	31/03/15
REF837	E4440A	Spectrum Analyser	Agilent	19/05/14	19/05/15

For Power Line Conducted Measurements

TRAC REF/RFG No.	Type	Description	Manufacturer	Date Calibrated.	Calibration Due
RFG680	ESH3-Z2	Pulse Limiter	R & S	01/07/14	01/07/15
RFG295	-	BNC coaxial cable	-	24/12/13	24/12/14
RFG299	-	BNC coaxial cable	-	24/12/13	24/12/14
RFG189	ESH3-Z5	LISN	R & S	04/09/14	04/09/15
RFG125	ESHS10	Measuring Receiver	R & S	24/04/14	24/04/15

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: Wide view.
2. Radiated electric field emissions arrangement: Close view
3. Power line conducted emissions arrangement
4. Radiated electric field emissions Barcode arrangement: Front view.
5. Radiated electric field emissions Barcode arrangement: Rear view.

Photograph 1

Photograph 2

Photograph 3

Photograph 4

Photograph 5

Appendix G: General SAR test reduction and exclusion guidance and MPE calculation

KDB 447498

Section 4.3 General SAR test reduction and exclusion guidance

For Standalone SAR exclusion consideration, when SAR Exclusion Threshold requirement in KDB 447498 is satisfied, standalone SAR evaluation for general population exposure conditions by measurement or numerical simulation is not required.

In the frequency range below 100 MHz to 6 GHz and test separation distance of 50mm, the SAR Test Exclusion Threshold for operation in the 2400 – 2483.5 MHz band will be determined as follows

In the frequency range below 100 MHz to 6 GHz and test separation distance of 50mm, the SAR Test Exclusion Threshold for operation in the 2400 – 2483.5 MHz band will be determined as follows

SAR Exclusion Threshold (SARET)

SAR Exclusion Threshold = Step 1 + Step 2

Step 1

$$NT = [(MP/TSD^{A}) * \sqrt{f_{GHz}}]$$

NT	=	Numeric Threshold (3.0 for 1-g SAR and 7.5 for 10-g SAR)
MP	=	Max Power of channel (mW) (inc tune up)
TSD^{A}	=	Min Test separation Distance or 50mm (whichever is lower) = 50

We can transpose this formula to allow us to find the maximum power of a channel allowed and compare this to the measured maximum power.

$$= [(NT \times TSD^{A}) / \sqrt{f_{GHz}}]$$

For Distances Greater than 50 mm Step 2 applies

Step 2

Not applicable TSD^{A} = 50mm

Operating Frequency 917.1MHz

MP= [(7.5 x 50) / √0.9171]
MP= [375 / 0.9577]
MP= 391.6mW

The calculated output power 261.2mW (Peak) is less than the SAR Exclusion Threshold of 391.6mW.

Operating Frequency 922.1MHz

MP= [(7.5 x 50) / √0.9221]
MP= [375 / 0.9603]
MP= 390.5mW

The calculated output power 243.6mW (Peak) is less than the SAR Exclusion Threshold of 390.5mW.

Operating Frequency 926.9 MHz

MP= [(7.5 x 50) / √0.9269]
MP= [375 / 0.9628]
MP= 389.5mW

The calculated output power 237.3mW (Peak) is less than the SAR Exclusion Threshold of 389.5mW.

Therefore standalone SAR evaluation for general population exposure conditions by measurement or numerical simulation is not required.

As per KDB 447498

47 CFR §§1.1307 and 2.1091

2.1091 Radio frequency radiation exposure evaluation: Portable 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 0.6mW/cm^2 power density limit, as required under FCC rules

Prediction of MPE limit at a given distance

Equation from KDB 447498 D01

$$S = \frac{1.64ERP}{4\pi R^2} \quad \text{re-arranged } R = \sqrt{\frac{1.64ERP}{S4\pi}}$$

where:

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

Result:

Prediction Frequency (MHz)	Maximum ERP (mW)	Power density limit (S) (mW/cm^2)	Distance (R) cm required to be less than 0.6mW/cm^2 (cm)
917.1	159.27	0.6	5.9

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.