

A Radio Test Report
FOR
Promethean Ltd
ON
ActivBoard Pen
Model No. PRM-AS1-01

Document No. TRA-020152-06-47-00C

HULL

Unit E, South Orbital Trading Park, Hedon Road, Hull, HU9 1NJ, UK.
T +44 (0)1482 801801 **F** +44 (0)1482 801806 **E** test@tracglobal.com
www.tracglobal.com

TRaC Wireless Test Report : TRA-020152-06-47-00C

Applicant : Promethean Ltd

Apparatus : ActivBoard Pen (Model No. PRM-AS1-01)

Specification(s) : FCC CFR47 Part 15.249 & RSS-210 Issue 8

Purpose of Test : Certification

FCC ID : QAM017

IC ID : 5459A-017

Authorised by : John Charters

Digitally signed by John Charters
DN: cn=John Charters, o=TRAC Global
Ltd, ou=Radio Product Manager,
email=john.charters@tracglobal.com,
c=GB
Date: 2015.01.22 09:56:37 Z

: Radio Product Manager

Issue Date : 22nd January 2015

Authorised Copy Number : PDF

Contents

Section 1:	Introduction	4
1.1	General	4
1.2	Tests Requested By	5
1.3	Manufacturer	5
1.4	Apparatus Assessed	5
1.5	Test Result Summary	6
1.6	Notes relating to the assessment	7
1.7	Deviations from Test Standards	7
Section 2:	Measurement Uncertainty	8
2.1	Measurement Uncertainty Values	8
Section 3:	Modifications	10
3.1	Modifications Performed During Assessment	10
Section 4	General Test Procedures	11
4.1	Radiated Test Setup and Procedures	11
4.2	AC Powerline Conducted Emissions Test Setup and Procedures	12
4.3	Antenna Port Conducted Emissions	12
4.4	Power Supply Variation	13
4.5	Thermal Variation	13
4.6	Time Domain Measurements	13
Appendix A:	Formal Emission Test Results	14
A1	Transmitter Intentional Emission Radiated	15
A2	Transmitter Bandwidth	16
A3	Radiated Electric Field Emissions	17
A4	Unintentional Radiated Emissions - Standby	20
Appendix B:	Supporting Graphical Data	22
Appendix C:	Additional Test and Sample Details	30
C1	Test samples	31
C2	EUT operating mode during testing	32
C3	EUT Configuration Information	33
C4	List of EUT Ports	34
C5	Details of Equipment Used	35
Appendix D:	Additional Information	36
Appendix E:	Photographs and Figures	37
Appendix F:	MPE Calculation	39
Appendix G:	General SAR test reduction and exclusion guidance	40

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.

Test performed by: TRaC Global []
Unit E
South Orbital Trading Park
Hedon Road
Hull, HU9 1NJ.
United Kingdom.

Telephone: +44 (0) 1482 801801
Fax: +44 (0) 1482 801806

TRaC Global [X]
Unit 1
Pendle Place
Skelmersdale
West Lancashire, WN8 9PN
United Kingdom

Telephone: +44 (0) 1695 556666
Fax: +44 (0) 1695 577077

Email: test@tracglobal.com
Web site: <http://www.tracglobal.com>

Tests performed by: A Tosif

Report author: A Tosif

This report must not be reproduced except in full without prior written permission from TRaC Global Ltd.

1.2 Tests Requested By

This testing in this report was requested by:

Promethean Ltd
Promethean House
Lower Philips Road
Blackburn
BB1 5SN

1.3 Manufacturer

As above

1.4 Apparatus Assessed

The following apparatus was assessed between: 2nd December 2014 and 19th December 2014

- ActivBoard Pen (Model No. PRM-AS1-01)

ActivBoard Pen is a 2.4GHz Bluetooth LE (transmitter only) device whose primary function is to interact with ActiveBoard 6 Touch and ActivPanel 2

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	FCC Regulation	IC Regulation	Measurement standard	Result
Spurious Emissions Radiated	Title 47 of the CFR: Part 15 Subpart (c) 15.249(a)(d)	RSS-210 Issue 8 December 2010 Annex 2 A2.9	ANSI C63.10	Pass
Unintentional Radiated Spurious Emissions	Title 47 of the CFR: Part 15 Subpart (b) 15.109	RSS-Gen Issue 4 November 2014 Section 7.1.2	ANSI C63.10	Pass
AC Power conducted emissions	Title 47 of the CFR: Part 15 Subpart (c) 15.207	RSS-Gen Issue 4 November 2014 Section 8.8	ANSI C63.10	N/A*
Intentional Emission Frequency	Title 47 of the CFR: Part 15 Subpart (c) 15.249 (a)	RSS-210 Issue 8 December 2010 Annex 2 A2.9	ANSI C63.10	Pass
Intentional Emission Field Strength	Title 47 of the CFR: Part 15 Subpart (c) 15.249 (a)	RSS-210 Issue 8 December 2010 Annex 2 A2.9	ANSI C63.10	Pass
Intentional Emission Band Occupancy	Title 47 of the CFR: Part 15 Subpart (c) 15.215 (c)	RSS-Gen Issue 4 November 2014 Section 4.6.1	ANSI C63.10	Pass

* EUT is a battery powered device

Abbreviations used in the above table:

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	: 20 to 22 °C
Humidity	: 45 to 75 %

All dates used in this report are in the format dd/mm/yy.

This assessment has been performed in accordance with the requirements of ISO/IEC 17025.

1.7 Deviations from Test Standards

There were no deviations from the standards tested to.

Section 2:**Measurement Uncertainty****2.1 Measurement Uncertainty Values**

For the test data recorded the following measurement uncertainty was calculated:

Radio Testing – General Uncertainty Schedule

All statements of uncertainty are expanded standard uncertainty using a coverage factor of 1.96 to give a 95% confidence where no required test level exists.

[1] Adjacent Channel Power

Uncertainty in test result = **1.86dB**

[2] Carrier Power

Uncertainty in test result (Power Meter) = **1.08dB**

Uncertainty in test result (Spectrum Analyser) = **2.48dB**

[3] Effective Radiated Power

Uncertainty in test result = **4.71dB**

[4] Spurious Emissions

Uncertainty in test result = **4.75dB**

[5] Maximum frequency error

Uncertainty in test result (Power Meter) = **0.113ppm**

Uncertainty in test result (Spectrum Analyser) = **0.265ppm**

[6] Radiated Emissions, field strength OATS 14kHz-18GHz Electric Field

Uncertainty in test result (14kHz – 30MHz) = **4.8dB**,

Uncertainty in test result (30MHz – 1GHz) = **4.6dB**,

Uncertainty in test result (1GHz – 18GHz) = **4.7dB**

[7] Frequency deviation

Uncertainty in test result = **3.2%**

[8] Magnetic Field Emissions

Uncertainty in test result = **2.3dB**

[9] Conducted Spurious

Uncertainty in test result – Up to 8.1GHz = **3.31dB**

Uncertainty in test result – 8.1GHz – 15.3GHz = **4.43dB**

Uncertainty in test result – 15.3GHz – 21GHz = **5.34dB**

Uncertainty in test result – Up to 26GHz = **3.14dB**

[10] Channel Bandwidth

Uncertainty in test result = **15.5%**

[11] Amplitude and Time Measurement – Oscilloscope

Uncertainty in overall test level = **2.1dB**,
Uncertainty in time measurement = **0.59%**,
Uncertainty in Amplitude measurement = **0.82%**

[12] Power Line Conduction

Uncertainty in test result = **3.4dB**

[13] Spectrum Mask Measurements

Uncertainty in test result = **2.59% (frequency)**
Uncertainty in test result = **1.32dB (amplitude)**

[14] Adjacent Sub Band Selectivity

Uncertainty in test result = **1.24dB**

[15] Receiver Blocking – Listen Mode, Radiated

Uncertainty in test result = **3.42dB**

[16] Receiver Blocking – Talk Mode, Radiated

Uncertainty in test result = **3.36dB**

[17] Receiver Blocking – Talk Mode, Conducted

Uncertainty in test result = **1.24dB**

[18] Receiver Threshold

Uncertainty in test result = **3.23dB**

[19] Transmission Time Measurement

Uncertainty in test result = **7.98%**

Section 3:

Modifications

3.1 Modifications Performed During Assessment

No modifications were performed during the assessment

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

A1 Transmitter Intentional Emission Radiated

Test Details	
Regulation	Part15 Subpart (c) 15.249 (a) / RSS-210 Issue 8 Annex 2 A2.9
Measurement standard	ANSI C63.10
EUT sample number	S01
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	23°C

Frequency (MHz)	Detector	Field Strength (dBµV/m)	Field Strength (mV/m)	Limit (mV/m)	Verdict
2401.9	Peak	82.8	13.9	500.0	Pass
2401.9	Average	82.2	12.9	50.0	Pass
2425.9	Peak	82.7	13.6	500.0	Pass
2425.9	Average	82.0	12.6	50.0	Pass
2479.9	Peak	81.0	11.2	500.0	Pass
2479.9	Average	80.3	10.4	50.0	Pass

- Notes:**
- 1 Receiver detector @ fc = Peak & Average / 1MHz bandwidth
 - 2 When battery powered the EUT was powered with new batteries

- Test Method:**
- 1 As per Radio – Noise Emissions, ANSI C63.10
 - 2 Measuring distances 3m
 - 3 EUT 0.8 metre above ground plane
 - 4 Emissions maximised by rotation of EUT, on an automatic turntable. Raising and lowering the receiver antenna between 1m & 4m. Horizontal and vertical polarisations of the receive antenna. EUT orientation in three orthogonal planes. Maximum results recorded

A2 Transmitter Bandwidth

Test Details:	
Regulation	Part 15.215 (c) / RSS-Gen Issue 4 Section 6.6
Measurement standard	ANSI C63.10
EUT sample number	S01
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	23°C

Band occupancy @ -20 dBc			
FREQ. (MHz)	f lower (MHz)	f higher (MHz)	Occupied BW (kHz)
2402	2401.328526	2402.549679	1221.153846
2426	2425.330128	2426.541667	1211.538462
2480	2479.312500	2480.538462	1225.961538

The 20dB Bandwidth of the carrier must be contained within the frequency band 2400MHz to 2483.5MHz.

99% Band occupancy			
FREQ. (MHz)	f lower (MHz)	f higher (MHz)	Occupied BW (kHz)
2402	2401.410256	2402.467949	1057.692308
2426	2425.411859	2426.469551	1057.692308
2480	2479.394231	2480.451923	1057.692308

A3 Radiated Electric Field Emissions

Preliminary scans were performed using a peak detector with the RBW = 100 kHz. The radiated electric field emission test applies to all spurious emissions and harmonics emissions. The EUT was set to transmit as required.

The following test site was used for final measurements as specified by the standard tested to:

3m open area test site : ☐

3m alternative test site : ☒

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

Test Details: Smart Beacon with Landline	
Regulation	Part 15 Subpart (c) Clause 15.249 (a)(d) / RSS-210 Issue 8 Annex 2 A2.9
Measurement standard	ANSI C63.10
Frequency range	30MHz-10GHz
EUT sample number	S01
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	23°C

The worst case emissions are listed below:

Ref No.	Freq. (MHz)	Detector	Meas Rx (dBµV)	Cable Loss (dB)	Ant Factor (dB/m)	Pre-Amp (dB)	Field Strength (dBµV/m)	Field Strength (µV/m)	Limit (µV/m)
2402 MHz									
1.	4805.9	Peak	53.5	3.8	32.7	35.6	54.4	524.8	5000.0
2.	4805.9	Average	49.0	3.8	32.7	35.6	49.9	314.1	500.0
2426 MHz									
3.	4853.9	Peak	54.5	3.7	32.9	35.6	55.5	594.3	5000.0
4.	4853.9	Average	50.8	3.7	32.9	35.6	51.8	389.9	500.0
2480 MHz									
5.	4957.9	Peak	53.5	3.6	33.2	35.6	54.7	545.1	5000.0
6.	4957.9	Average	48.1	3.6	33.2	35.6	49.4	294.1	500.0

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

Radiated Electric Field Emissions – Bandedge Compliance

Lower Bandedge Compliance		
Detector	Peak	Average
Carrier power (1MHz RBW) (dBμV/m)	82.83	82.21
Delta in 100KHz (dB)	-40.44	-41.91
Maximum Power within 2MHz of Bandedge (dBμV/m)	42.39	40.30
Limit (dBμV/m)	74.00	54.00
Margin (dB)	31.61	13.70
Result	Compliant	Compliant

Upper Bandedge Compliance		
Detector	Peak	Average
Carrier power (1MHz RBW) (dBμV/m)	80.96	80.31
Delta in 100KHz (dB)	-43.23	-46.53
Maximum Power within 2MHz of Bandedge (dBμV/m)	37.73	33.78
Limit (dBμV/m)	74.00	54.00
Margin (dB)	36.27	20.22
Result	Compliant	Compliant

Plots are contained in appendix B

Notes:

- 1 Any testing performed below 30 MHz was performed using a magnetic loop antenna in accordance with ANSI C63.10: section 4.5, Table 1. For emissions below 30MHz the cable losses are assumed to be negligible.
- 2 In accordance with 15.35(b), above 1 GHz, emissions measured using a peak detector shall not exceed a level 20 dB above the average limit.
- 3 Testing was performed with the EUT orientated in three orthogonal planes and the maximum emissions level recorded. In addition, the EUT antenna was varied within its range of motion in order to maximise emissions.
- 4 For Frequencies below 1 GHz, RBW= 120 kHz, testing was performed with CISPR16 compliant test receiver with QP detector. Above 1 GHz tests were performed using a spectrum analyser using the following settings:

Peak	RBW=VBW= 1MHz
Average	RBW=VBW= 1MHz

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

Radiated emission limits 47 CFR part 15 Clause 15.249 (a) / RSS-210 Issue 8 Annex 2 A2.9 for harmonics is 500uV/m. Radiated emission limits 47 CFR part 15 Clause 15.249 (d) / RSS-210 Issue 8 Annex 2 A2.9 for all emission outside the specified frequency band, except for harmonic, shall be attenuated by at least 50dB below the level of the fundamental or to the general radiated emission limits in 47 CFR part 15 Clause 15.209 / RSS-Gen Issue 4 Section 7.1.2 (given below), whichever is the lesser attenuation.

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

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

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

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

	See (i)	See (ii)	See (iii)	See (iv)
Effect of EUT operating mode on emission levels	✓			
Effect of EUT internal configuration on emission levels	✓			
Effect of Position of EUT cables & samples on emission levels				✓
(i) Parameter defined by standard and / or single possible, refer to Appendix 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 Unintentional Radiated Emissions - Standby

Preliminary scans were performed using a peak detector with the RBW = 100 kHz. The maximum permitted field strength is listed in Section 15.109 and in RSS- GEN Section 7.1.2. The EUT was set in the standby mode.

The following test site was used for final measurements as specified by the standard tested to:

3m open area test site :

☐

3m alternative test site :

☒

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

Test Details	
Regulation	Part 15 Subpart (c) Clause 15.109 / RSS-Gen Issue 4 Section 7.1.2
Measurement standard	ANSI C63.10
Frequency range	30MHz – 10GHz
EUT sample number	S01
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	23°C

No emissions were detected within 20dB of the limit.

Notes:

- 1 Any testing performed below 30 MHz was performed using a magnetic loop antenna in accordance with ANSI C63.10: section 4.5, Table 1. For emissions below 30MHz the cable losses are assumed to be negligible.
- 2 In accordance with 15.35(b), above 1 GHz, emissions measured using a peak detector shall not exceed a level 20 dB above the average limit.
- 3 Testing was performed with the EUT orientated in three orthogonal planes and the maximum emissions level recorded. In addition, the EUT antenna was varied within its range of motion in order to maximise emissions.
- 4 For Frequencies below 1 GHz, RBW = 120 kHz, testing was performed with CISPR16 compliant test receiver with QP detector. Above 1 GHz tests were performed using a spectrum analyser using the following settings:

Peak (pk)	RBW=VBW= 1MHz
Average (Av)	RBW=VBW= 1MHz

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

Radiated emission limits 47 CFR Part 15: Clause 15.109 / RSS-Gen Issue 4 section 7.1.2 for all emissions:

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

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

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

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

	See (i)	See (ii)	See (iii)	See (iv)
Effect of EUT operating mode on emission levels	✓			
Effect of EUT internal configuration on emission levels	✓			
Effect of Position of EUT cables & samples on emission levels				✓
(i) Parameter defined by standard and / or single possible, refer to Appendix 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				

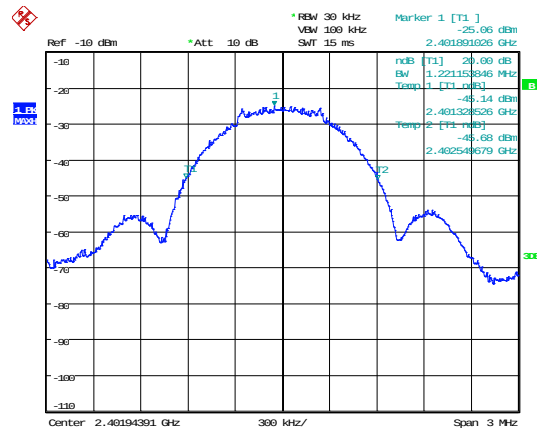
Appendix B:**Supporting Graphical Data**

This appendix contains graphical data obtained during testing.

Notes:

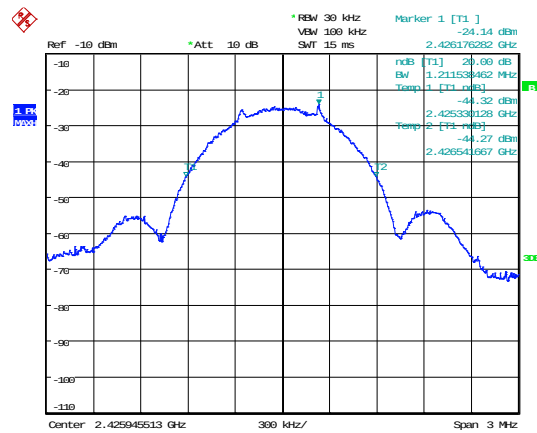
- (a) The radiated electric field emissions and conducted emissions graphical data in this appendix is preview data. For details of formal results, refer to Appendix A.
- (b) The time and date on the plots do not necessarily equate to the time of the test.
- (c) Where relevant, on power line conducted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



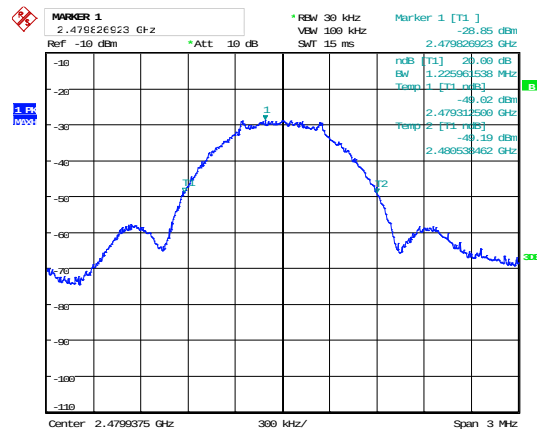
Date: 11.DEC.2014 12:08:30

20dB Bandwidth 2402MHz



Date: 11.DEC.2014 11:46:28

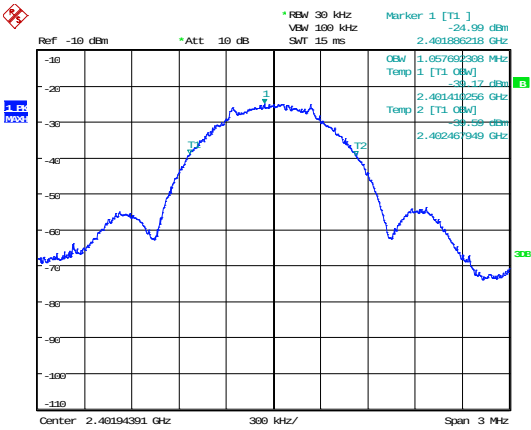
20dB Bandwidth 2426MHz



Date: 11.DEC.2014 12:04:27

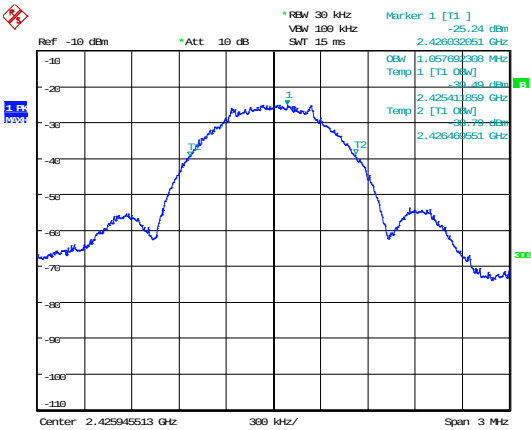
20dB Bandwidth 2480MHz

99% Bandwidth



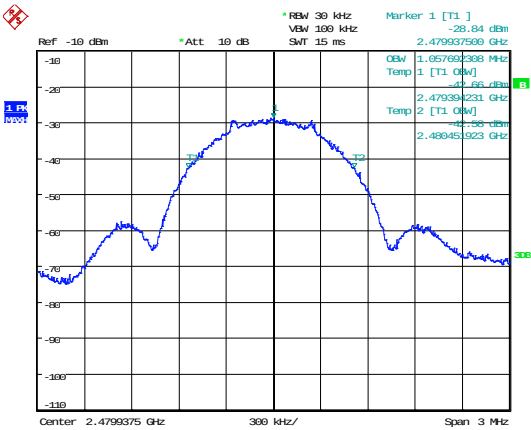
Date: 11.DEC.2014 12:09:50

99% Bandwidth 2402MHz



Date: 11.DEC.2014 11:59:35

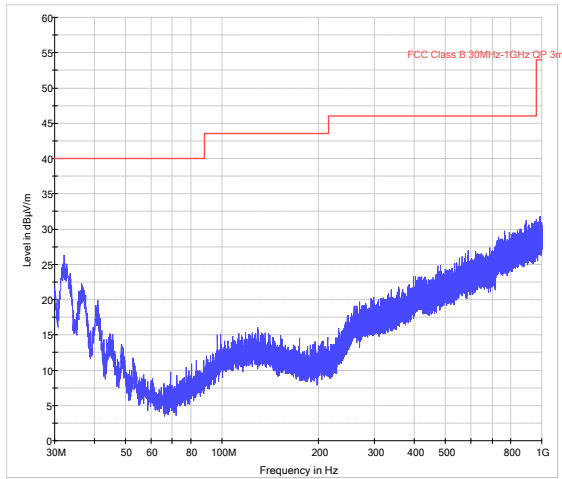
99% Bandwidth 2426MHz



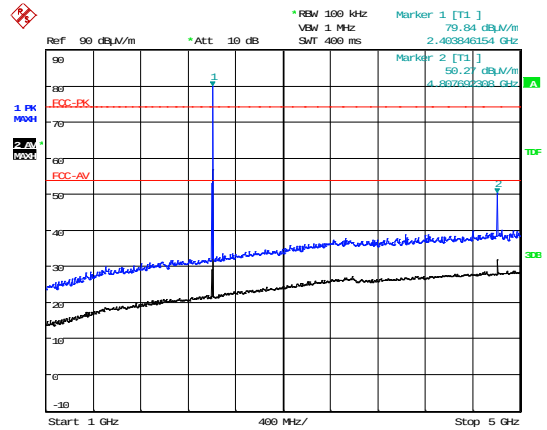
Date: 11.DEC.2014 12:03:15

99% Bandwidth 2480MHz

Radiated Transmitter Emissions – 2402MHz

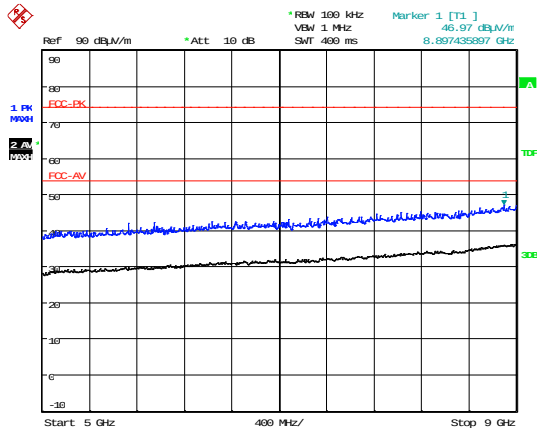


30MHz – 1GHz



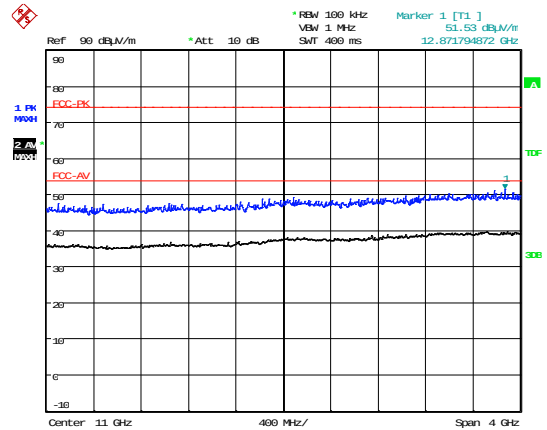
Date: 3.DEC.2014 16:33:27

1GHz – 5GHz



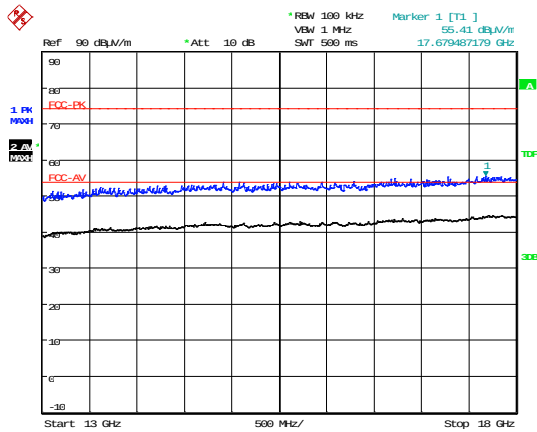
Date: 3.DEC.2014 16:42:19

5GHz – 9GHz



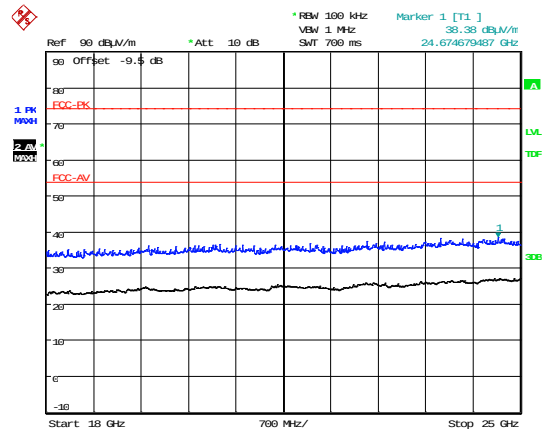
Date: 3.DEC.2014 16:41:17

9GHz – 13GHz



Date: 3.DEC.2014 16:39:22

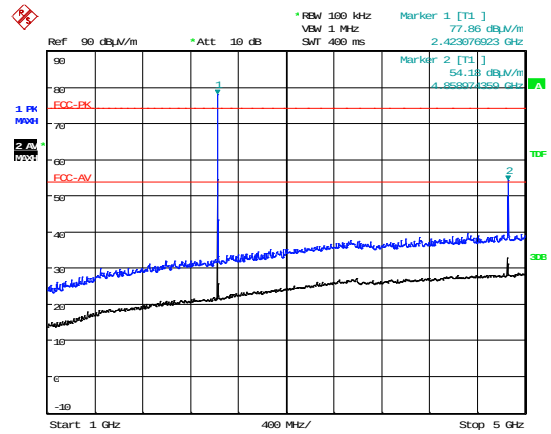
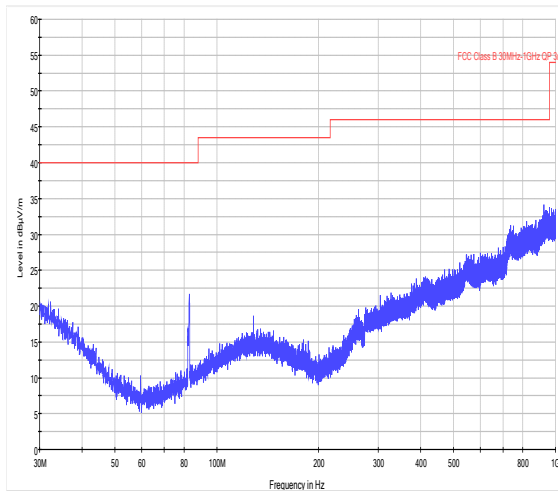
13GHz – 18GHz



Date: 4.DEC.2014 14:19:49

18GHz – 25GHz

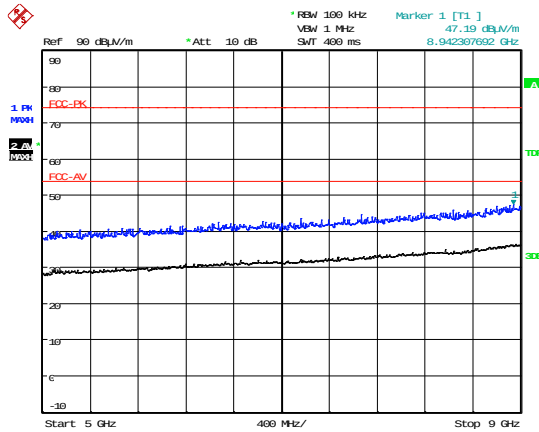
Radiated Transmitter Emissions – 2426MHz



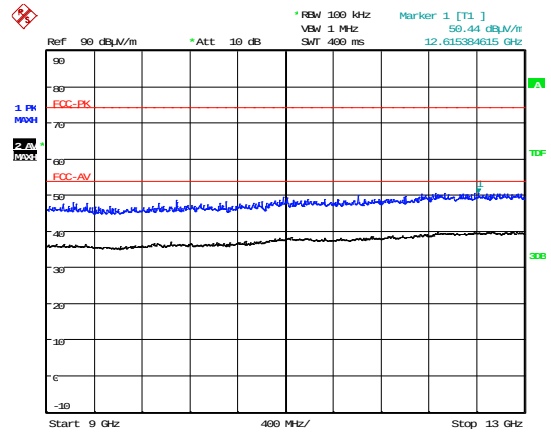
Date: 11.DEC.2014 11:07:49

30MHz – 1GHz

1GHz – 5GHz



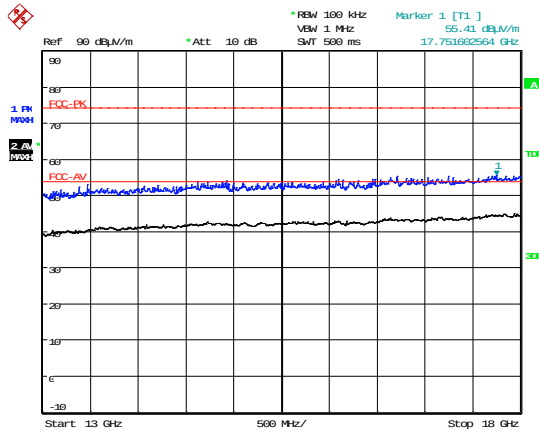
Date: 11.DEC.2014 11:06:59



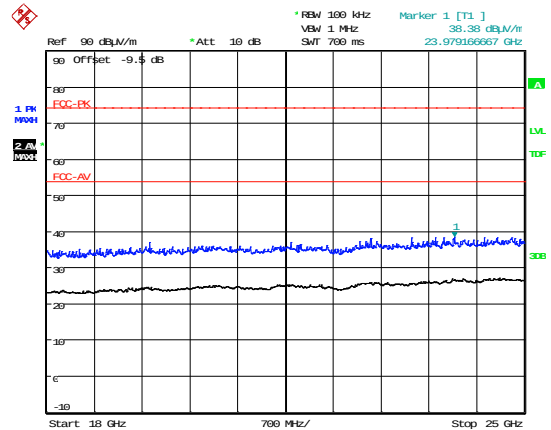
Date: 11.DEC.2014 11:06:19

5GHz – 9GHz

9GHz – 13GHz



Date: 11.DEC.2014 11:05:31

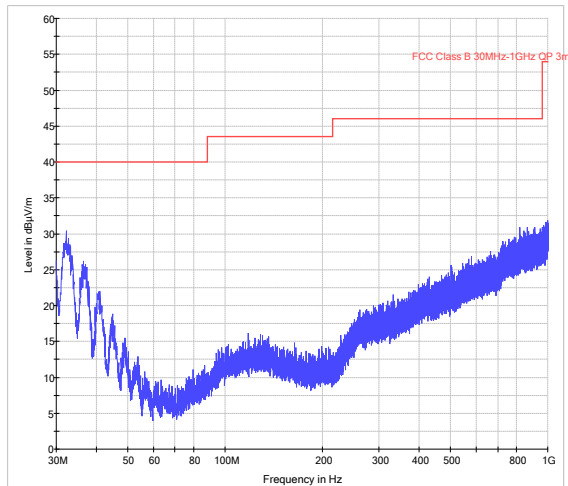


Date: 11.DEC.2014 12:35:49

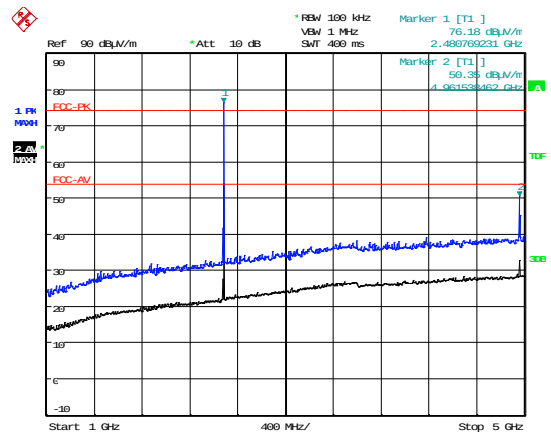
13GHz – 18GHz

18GHz – 25GHz

Radiated Transmitter Emissions – 2480MHz

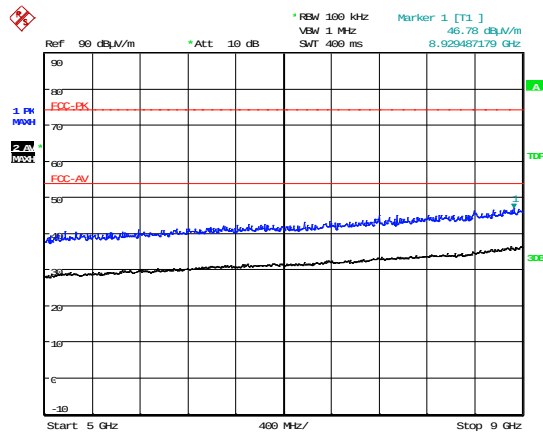


30MHz – 1GHz



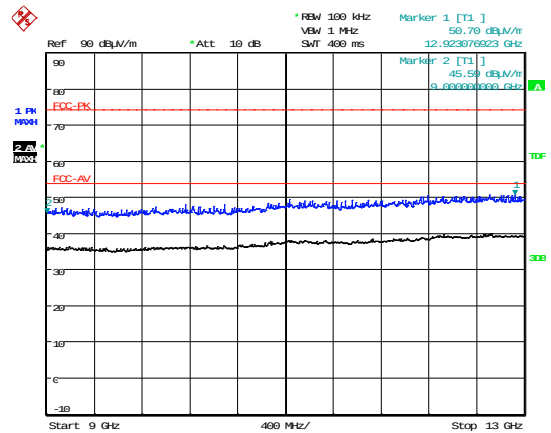
Date: 3.DEC.2014 16:45:03

1GHz – 5GHz



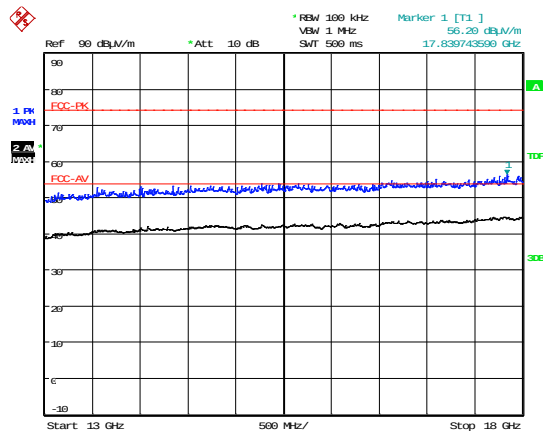
Date: 3.DEC.2014 16:44:00

5GHz – 9GHz



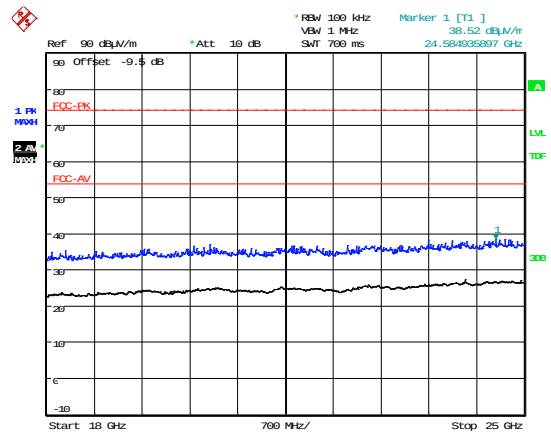
Date: 3.DEC.2014 16:45:55

9GHz – 13GHz



Date: 3.DEC.2014 16:47:09

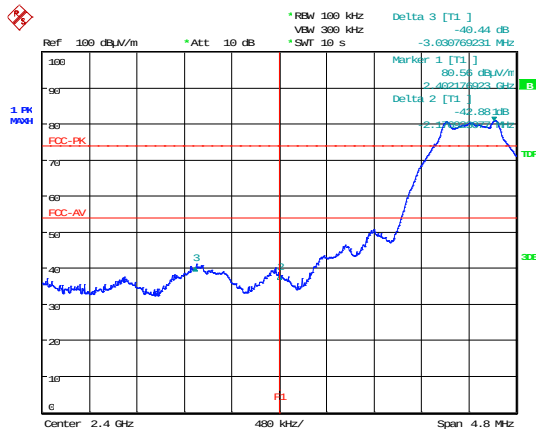
13GHz – 18GHz



Date: 4.DEC.2014 14:18:11

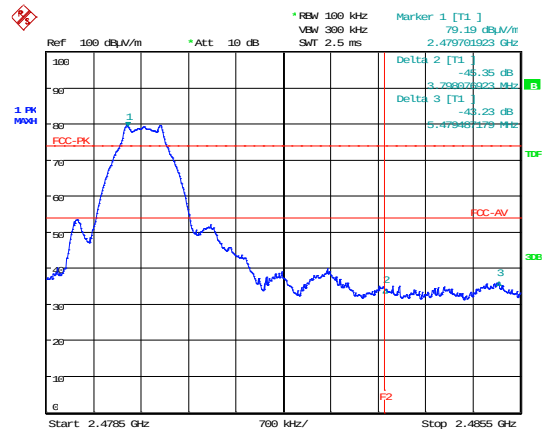
18GHz – 25GHz

Bandedge Compliance – Delta in 100 KHz RBW



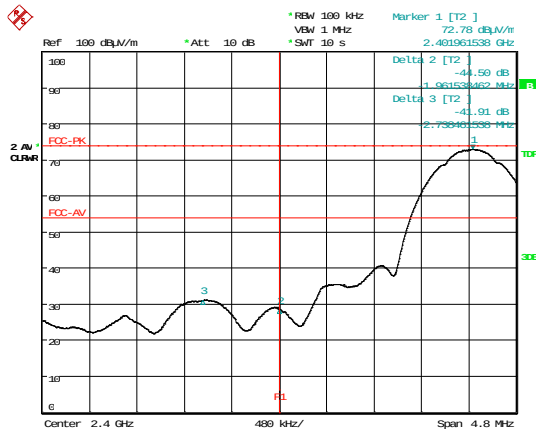
Date: 16.DEC.2014 10:00:49

Lower Bandedge Compliance – Peak



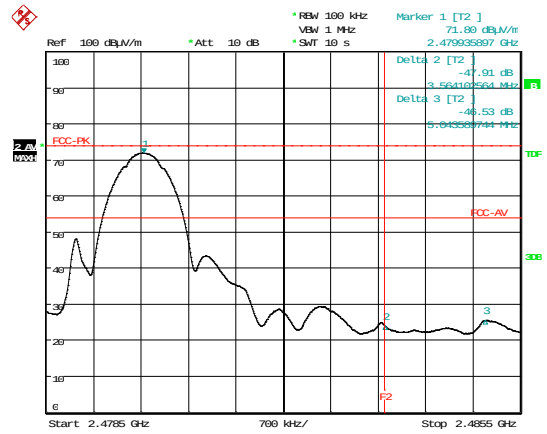
Date: 16.DEC.2014 10:07:27

Upper Bandedge Compliance – Peak



Date: 16.DEC.2014 10:01:17

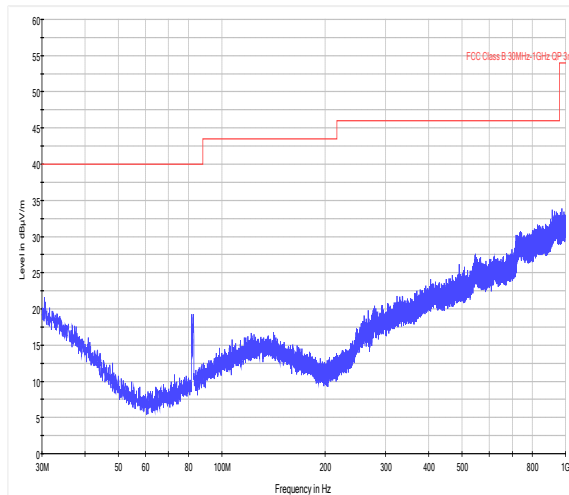
Lower Bandedge Compliance – Average



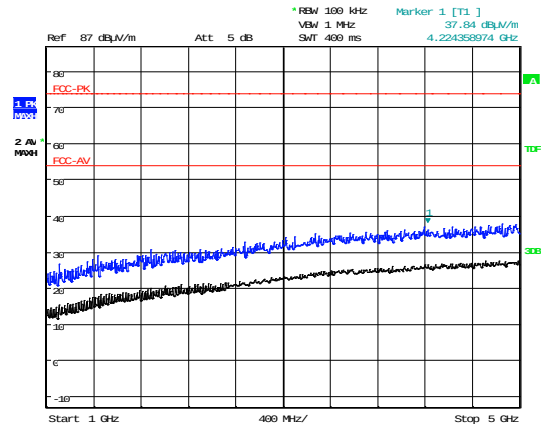
Date: 16.DEC.2014 10:08:31

Upper Bandedge Compliance - Average

Unintentional Radiated Emissions – Standby

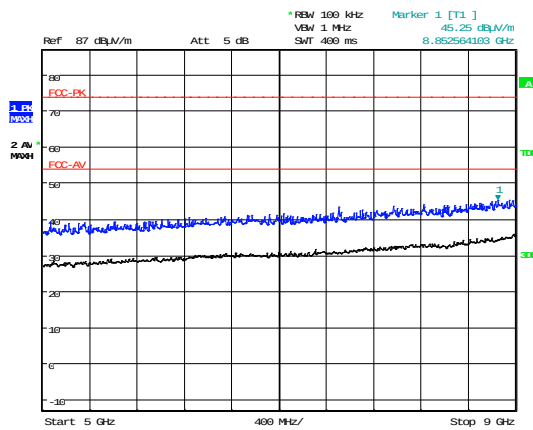


30MHz – 1GHz



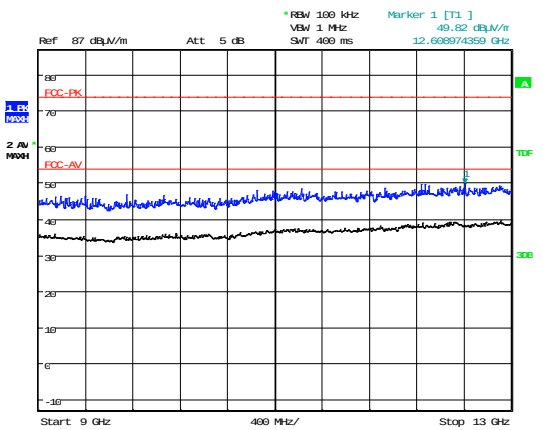
Date: 19.DEC.2014 16:15:57

1GHz – 5GHz



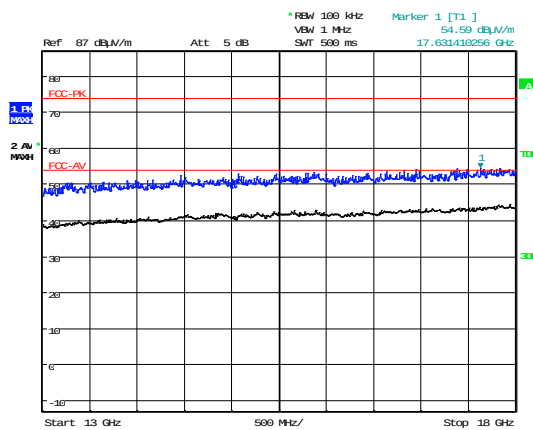
Date: 19.DEC.2014 16:17:11

5GHz – 9GHz



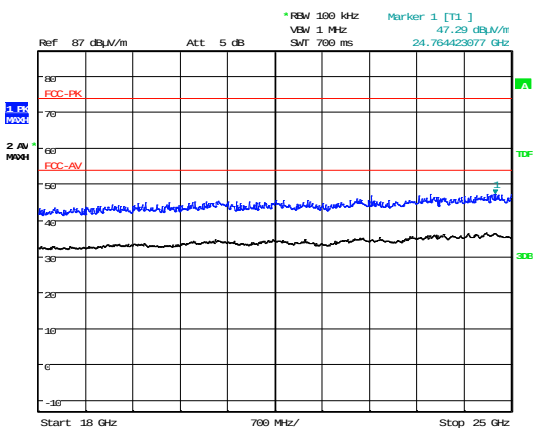
Date: 19.DEC.2014 16:18:08

9GHz – 13GHz



Date: 19.DEC.2014 16:19:03

13GHz – 18GHz



Date: 19.DEC.2014 16:21:16

18GHz – 25GHz

Appendix C:**Additional Test and Sample Details**

This appendix contains details of:

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

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

Sample No: Sxx Mod w

where:

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

The following terminology is used throughout the test report:

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

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

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

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

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

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

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

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

C1 Test samples

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

Sample No.	Description	Identification
S01	ActivBoard Pen (Model No. PRM-AS1-01)	None

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

Sample No.	Description	Identification
None		

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

Identification	Description
None	

C2 EUT operating mode during testing

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

Test	Description of Operating Mode: Transmit
All tests detailed in this report	EUT actively transmitting on required channels, with and without modulation as required

C3 EUT Configuration Information

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

C4 List of EUT Ports

The tables below describe the termination of EUT ports:

Sample : S01
Tests : All

Port	Description of Cable Attached	Cable length	Equipment Connected
EUT is a battery powered device with no external ports			

C5 Details of Equipment Used

TRaC No	Equipment Type	Equipment Description	Manufacturer	Last Cal Calibration	Calibration Period	Due For Calibration
REF940	ATS	Radio Chamber - PP	Rainford EMC	08/09/2014	24	08/09/2016
UH388	ATS	Chamber 2	Rainford EMC	04/07/2013	24	04/07/2015
L352	ESVS10	Receiver	R&S	21/03/2014	12	21/03/2015
L290	CBL611/A	Bilog	Chase	02/12/2014	24	02/12/2016
UH405	FSU26	Spectrum Analyser	R&S	16/04/2014	12	16/04/2015
L138	3115	1-18GHz Horn	EMCO	17/10/2013	24	17/10/2015
L300	20240-20	Horn 18-26GHz (&UH330)	Flann	10/02/2014	24	10/02/2016
L572	8449B	Pre Amp	Agilent	11/02/2014	12	11/02/2015

Appendix D:

Additional Information

This report contains no additional information.

Appendix E:

Photographs and Figures

The following photographs were taken of the test samples:

1. Radiated electric field emissions arrangement: overview
2. Radiated electric field emissions arrangement: close up

Photograph 1



Photograph 2



Appendix F:**MPE Calculation****Prediction of MPE limit at a given distance**

For purposes of these requirements mobile devices are defined by the Industry Canada 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 centimeters 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 Industry Canada 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 10W/m² power density limit, as required under Industry Canada rules.

Equation from IEEE C95.1

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

Where:

S = power density

R = distance to the centre of radiation of the antenna

EIRP = EUT Maximum power

Result

Prediction Frequency (MHz)	Maximum EIRP (W)	Power density limit (S) (W/m ²)	Distance (R) cm required to be less than 10W/m ²
2402	0.00006	10	0.0007

Appendix G: General SAR test reduction and exclusion guidance**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.

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) = 5mm (in this case)

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

$$(TSD^B - 50mm) * 10\}$$

Where:

TSD^B = Min Test separation Distance (mm) = 50

Note: Step 2 is not required here as the TSD^A is 5mm.

Operating Frequency 2.402 GHz

$$\begin{aligned} \text{SARET} &= [(3.0 \times 5) / \sqrt{2.402}] \\ \text{SARET} &= 9.68\text{mW} \end{aligned}$$

Operating Frequency 2.426 GHz

$$\begin{aligned} \text{SARET} &= [(3.0 \times 5) / \sqrt{2.426}] \\ \text{SARET} &= 9.63\text{mW} \end{aligned}$$

Operating Frequency 2.480 GHz

$$\begin{aligned} \text{SARET} &= [(3.0 \times 5) / \sqrt{2.480}] \\ \text{SARET} &= 9.53\text{mW} \end{aligned}$$

Channel Frequency (MHz)	EIRP (mW)	SAR Exclusion Threshold (mW)	SAR Evaluation
2402	0.06	9.68	Not Required
2426	0.06	9.63	Not Required
2480	0.04	9.53	Not Required

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

