A RADIO TEST REPORT

FOR

SILENT HERDSMAN LTD

ON

SILENT HERDSMAN BASE STATION

DOCUMENT NO. TRA-022673-47-00-A

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

UKAS TESTING
0026

TRaC Wireless Test Report	**:** TRA-022673-47-00-A
Applicant	**:** Silent Herdsman Ltd
Apparatus	**:** Silent Herdsman Base station
Specification(s)	**:** CFR47 Part 15.247 & RSS-210 Annex 8
Purpose of Test	**: Certification**
FCCID	**:2ABHT2110010**
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: 2015.02.20 13:24:27 Z
	: Radio Product Manager

Total number of pages : 63

UKAS TESTING
0026

Contents

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 at:

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: D Winstanley

Report author: D Winstanley

1.2 Tests Requested By

This testing in this report was requested by :

Silent Herdsman Ltd
Unit 9000
Academy Park
51 Gower Street
Glasgow, G51 1PR

1.3 Manufacturer

As Above

1.4 Apparatus Assessed

The following apparatus was assessed between 25th November – 19th December 2014

Silent Herdsman Base station

The above equipment was a DSSS transmitter operating in the 2400 MHz to 2483.5 MHz band. The equipment operates on 5 frequencies separated by 5MHz. These frequencies are 2455 MHz, 2460MHz, 2465 MHz, 2470 MHz and 2475MHz.

The device is to be professionally installed with either 9 dBi or 15 dBi gain antenna. Testing performed with the highest gain antenna only.

The base station assessed contains the following:-

- Single Board computer (Ledato module)
  - software: v1.5
  - PCB 17.127.01
- RF Daughter card (Dresden module)
  - software: v1.0
  - Unable to see serial no. but their FCC test was done with version 1.0 of PCB
- Interposer PCB
  - No software here – passive PCB
  - PCB: V1.2

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	Regulation		Measurement standard	Result
	RSS-210 Issue 8 December 2010	Title 47 of the CFR: Part 15 Subpart C;		
Radiated spurious emissions (Restricted bands)	Annex 8, A8.5	15.247 (d) 15.209	ANSI C63.10:2009	Pass
Conducted spurious emissions (Non-restricted bands)	Annex 8.A4(4)	15.247(d)	ANSI C63.10:2009	Pass
AC Power conducted emissions	RSS-Gen Issue 4 Annex 8.8	15.207	ANSI C63.10:2009	Pass
Occupied Bandwidth	Annex 8.A8.2a	15.247(a)(1)(i) 15.247(a)(2)	ANSI C63.10:2009	Pass
Conducted Carrier Power	Annex 8.A4(4).	15.247(b)	ANSI C63.10:2009	Pass
Power Spectral Density	Annex 8.A8.2b	15.247(d)	ANSI C63.10:2009	Pass
Unintentional Radiated Spurious Emissions	RSS-Gen Issue 4 Annex 7.1	Title 47 of the CFR: Part 15 Subpart B; 15.109	ANSI C63.10:2009	Pass
RF Safety	RSS-102	Title 47 of the CFR : Part 15 Subpart C; KDB 447498	-	Pass
Unique antenna connector	-	15.203	-	Pass
Digital Modulation	-	Title 47 of the CFR: Part 15 Subpart C; 15.403	-	Pass

Abbreviations used in the above table:

Mod	: Modification		
CFR	: Code of Federal Regulations	ANSI	: American National Standards Institution
REFE	: Radiated Electric Field Emissions	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 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
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 6 dB Bandwidth

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

RSS-210 Issue 8 December 2010 requires the measurement of the bandwidth of the transmission between the -6 dB points on the transmitted spectrum.

Test Details:	
Regulation	Part15 Subpart (c) 15.247(b)(3), RSS-210 Annex 8.A8.2b
Measurement standard	ANSI C63.10, KDB Document: 558074
EUT sample number	S23
Modification state	0
SE in test environment	S15, S33
SE isolated from EUT	S10, S12, S13, S37, S38, S31
Temperature	21˚C
EUT set up	Refer to Appendix C

Channel Frequency (MHz)	F_{lower} (MHz)	F_{Higher} (MHz)	Measured 20 dB Bandwidth (kHz)	Limit	Result
2455	2454.262821	2455.865385	1602.564	>500 kHz	Pass
2465	2464.262821	2465.849359	1586.538	>500 kHz	Pass
2475	2474.278846	2475.849359	1570.513	>500 kHz	Pass

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

A2 Transmitter Peak Output Power

Carrier power was verified with the EUT transmitting on all operating frequencies in turn.

Test Details:	
Regulation	Part15 Subpart (c) 15.247(b)(3), RSS-210 Annex 8 A4(4)
Measurement standard	ANSI C63.10, KDB Document: 558074
EUT sample number	S23
Modification state	0
SE in test environment	S15, S33
SE isolated from EUT	S10, S12, S13, S37, S38, S31
EUT set up	Refer to Appendix C
Temperature	21˚C
Photographs	Appendix F

Channel Frequency (MHz)	Conducted Carrier Power (dBm)	Conducted Carrier Power (W)	Limit (W)	Result
2455	2.17	1.65 mW	1	Pass
2465	2.15	1.64 mW	1	Pass
2475	2.14	1.64 mW	1	Pass

Notes:

1. Measured peak output power does not include the gain of any antenna being used
2. Measurements were performed as per section 5.2.1.2 of the OET guidance notes

A3 Transmitter Power Spectral Density

Transmitter Power Spectral Density was verified with the EUT transmitting on all operating frequencies in turn.

Test Details:	
Regulation	Part15 Subpart (c) 15.247(b)(3), RSS-210 Annex 8.A8.2b
Measurement standard	ANSI C63.10, KDB Document: 558074
EUT sample number	S23
Modification state	0
SE in test environment	S15, S33
SE isolated from EUT	S10, S12, S13, S37, S38, S31
EUT set up	Refer to Appendix C
Temperature	21˚C
Photographs	Appendix F

Channel Frequency (MHz)	PSD (dBm)	Limit (dBm)	Result
2455.0	-2.84	-1	Pass
2465.0	-2.71	-1	Pass
2470.0	-3.04	-1	Pass

Notes:

1. Measured Power Spectral Density does not include the gain of any antenna being used
2. Measurements were performed as per section 5.3.1 of the OET guidance notes
3. As Per 15.247 (e) PSD Limit of 8 dBm, Antenna Gain of 15 dBi,
4. As Per 15.247 (b) If antenna gain exceeds 6 dBi Limit reduced by 1 dB for every dB over
5. 15 dBi - 6 dBi = 9 dBi therefore PSD limit = 8 dBm - 9dBi = -1dBm

A4 RF Antenna Conducted Spurious Emissions

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

Test Details:	
Regulation	Part 15 Subpart (c) Clause 15.247(d), RSS – 210 Annex 8, A8.5
Measurement standard	ANSI C63.10, KDB Document: 558074
Frequency range	9 kHz to 25 GHz
EUT sample number	S23
Modification state	0
SE in test environment	S15, S33
SE isolated from EUT	S10, S12, S13, S37, S38, S31
Temperature	25 ^{o}C
EUT set up	Refer to Appendix C

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

2455						
Ref No.	**Emission Freq (MHz)**	**Det.**	**Restricted band? (Y/N)**	**Emission power (RBW =100kHz) (dBm)**	**15.247(d) Limit (dBm)**	**Summary**
No emissions detected within 20dB of the limit						

2465						
Ref No.	**Emission Freq (MHz)**	**Det.**	**Restricted band? (Y/N)**	**Emission power (RBW =100kHz) (dBm)**	**15.247(d) Limit (dBm)**	**Summary**
No emissions detected within 20dB of the limit						

2475						
Ref No.	**Emission Freq (MHz)**	**Det.**	**Restricted band? (Y/N)**	**Emission power (RBW =100kHz) (dBm)**	**15.247(d) Limit (dBm)**	**Summary**
No emissions detected within 20dB of the limit						

Notes:

1. The conducted emission limit for emissions outside the restricted bands, defined in 47CFR15.205(a) are based on a transmitted carrier level of 15.247(b). With the EUT transmitting on its lowest, centre and highest carrier frequencies in turn, emissions from the EUT are required to be 20 dB below the level of the highest fundamental as measured within a 100 kHz RBW in accordance with 15.247(d) using a peak detector.
2. The RBW = 100 kHz, Video bandwidth (VBW) > RBW and the radio spectrum was investigated up to the 10th harmonic in accordance15.33 (a)(1).
3. The measurements at 2400 MHz and 2483.5 MHz were made to ensure band edge compliance.
4. The carrier level was measured whilst varying the supply voltage between 85% and 105% of the nominal supply voltage as required by 15.31(e). No variation in carrier level was observed.
5. The plots for operating mode producing the highest output power can be found in Appendix B

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

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

A5 Radiated Electric Field Emissions

Preliminary scans were performed using a peak detector with the RBW = 100kHz. The maximum permitted field strength is listed in Section 15.209 and per RSS – 210 Annex 8, A8.5. The EUT was set to transmit.

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:	
Regulation	Part 15 Subpart (c) Clause 15.247(d), RSS – 210 Annex 8, A8.5
Measurement standard	ANSI C63.10, KDB Document: 558074
Frequency range	30MHz – 25GHz
EUT sample number	S23, S06
Modification state	0
SE in test environment	S15, S33
SE isolated from EUT	S10, S12, S13, S37, S38, S31
EUT set up	Refer to Appendix C
Temperature	21˚C
Photographs (Appendix F)	1 & 2

The worst case radiated emission measurements for spurious emissions and harmonics that fall within the restricted bands are listed below:

Det	FREQ. (MHz)	MEAS Rx (dBµV)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	FIELD ST'GH (dBµV/m)	EXTRAP FACT (dB)	FIELD ST'GH (µV/m)	LIMIT (µV/m)
2455.0 MHz									
Pk	4910.96	52.62	3.9	33.1	35.6	54.06	0.00	504.66	5011.87
Av	4910.96	44.06	3.9	33.1	35.6	45.50	0.00	188.36	500.00
2465.0 MHz									
Pk	4931.06	53.38	4.0	33.2	35.6	55.03	0.00	564.29	5011.87
Av	4931.06	45.13	4.0	33.2	35.6	46.78	0.00	218.27	500.00
2475.0 MHz									
Pk	4951.12	53.89	3.8	33.2	35.6	55.34	0.00	584.79	5011.87
Av	4951.12	45.30	3.8	33.2	35.6	46.75	0.00	217.52	500.00

Emission not directly related the transmitter can be found in section A7 unintentional radiated emissions.

Notes:

1 Any testing performed below 30 MHz was performed using a magnetic loop antenna in accordance with ANSI C63.10: section 4.5, Table 1
2 In accordance with 15.35(b), above 1 GHz, emissions measured using a peak detector shall not exceed a level 20 dB above the average limit.
3 Measurements at 2400 & 2483.5 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

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) and RSS-Gen 4.3.

Radiated emission limits for emissions falling within the restricted bands defined in

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:

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

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

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

(c) The following table summarises the effect of the EUT operating mode, internal configuration and arrangement of cables / samples on the measured emission levels :

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

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

A6 Antenna Gain

See below for details, provided by the manufacturer, of maximum gain antenna to be used

15dBi Antenna Specifications

Frequency	2400~2500Mhz
Impedance	50 Ω
S.W.R	<1.5:1
Gain	15dBi
Polarisation	Vertical
Beam width	H-plane 360° E-plane 8° (-3dB points)
Connector	N Socket
Length	1m
Weight	1.5Kg
Temperature	-45°C~+80°C
Antenna Mount	Pole mount included

A7 Unintentional Radiated Electric Field Emissions

Preliminary scans were performed using a peak detector with the RBW = 100kHz. The maximum permitted field strength is listed in Section 15.109 and in RSS- GEN Section 7.2.3. 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: 2455.0 MHz	
Regulation	Part 15 Subpart (b) Clause 15.109, RSS – GEN Section 7.2.3
Measurement standard	ANSI C63.10
Frequency range	30MHz to 25 GHz
EUT sample number	S23, S06
Modification state	0
SE in test environment	S15, S33
SE isolated from EUT	S10, S12, S13, S37, S38, S31
EUT set up	Refer to Appendix C
Temperature	21˚C
Photographs (Appendix F)	1 & 2

The worst case radiated emission measurements for spurious emissions:

Det	FREQ. (MHz)	MEAS Rx (dBµV)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	FIELD ST'GH (dBµV/m)	EXTRAP FACT (dB)	FIELD ST'GH (µV/m)	LIMIT (µV/m)
Common Emissions									
Qp	30.60	13.7	0.8	18.7	N/A	33.2	-	45.71	100
Qp	32.60	16.3	0.8	17.7	N/A	34.8	-	54.95	100
Qp	33.45	14.5	0.8	17.3	N/A	32.6	-	42.76	100
Qp	34.10	16.2	0.8	17.0	N/A	34.0	-	50.29	100
Qp	34.65	17.5	0.8	16.7	N/A	35.0	-	55.91	100
Qp	39.45	17.4	0.9	14.1	N/A	32.5	-	41.98	100
Qp	40.35	18.9	1.0	13.6	N/A	33.5	-	47.37	100
Qp	41.60	20.8	1.0	12.9	N/A	34.7	-	54.58	100
Qp	42.10	20.1	1.0	12.7	N/A	33.8	-	48.70	100
Qp	42.95	22.0	1.0	12.2	N/A	35.2	-	57.74	100
Qp	43.80	25.3	1.0	11.8	N/A	38.1	-	80.35	100
Qp	44.40	21.9	1.0	11.5	N/A	34.4	-	52.24	100
Qp	45.25	24.0	1.0	11.0	N/A	36.0	-	62.95	100
Qp	45.75	19.9	1.0	10.7	N/A	31.6	-	38.15	100
Qp	50.45	22.4	1.0	8.5	N/A	31.9	-	39.22	100
Qp	55.30	27.7	1.0	6.9	N/A	35.6	-	60.33	100
Qp	55.90	27.1	1.0	6.7	N/A	34.8	-	55.14	100
Qp	58.70	26.1	1.1	6.2	N/A	33.3	-	46.45	100
Qp	60.25	25.2	1.1	6.1	N/A	32.4	-	41.45	100
Qp	62.25	27.1	1.1	6.1	N/A	34.3	-	51.76	100
Qp	62.75	27.8	1.1	6.0	N/A	34.9	-	55.78	100
Qp	63.40	24.8	1.1	6.0	N/A	31.9	-	39.17	100
Qp	64.20	26.9	1.1	5.9	N/A	34.0	-	49.83	100
Qp	64.80	28.1	1.2	6.0	N/A	35.2	-	57.74	100
Qp	66.30	24.7	1.2	6.1	N/A	32.0	-	39.81	100
Qp	81.20	20.5	1.3	7.8	N/A	29.6	-	30.34	100
Qp	87.65	18.5	1.4	8.9	N/A	28.8	-	27.54	100
Qp	101.90	23.2	1.5	10.8	N/A	35.5	-	59.50	150
Qp	104.75	22.2	1.5	11.0	N/A	34.7	-	54.20	150
Qp	106.75	20.4	1.5	11.3	N/A	33.2	-	45.45	150

Det	FREQ. (MHz)	MEAS Rx (dBµV)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	FIELD ST'GH (dBµV/m)	EXTRAP FACT (dB)	FIELD ST'GH (µV/m)	LIMIT (µV/m)
Qp	250.00	20.1	2.4	12.3	N/A	34.8	-	54.83	200
Qp	375.00	14.4	2.8	14.7	N/A	31.8	-	39.08	200
Qp	500.00	16.6	3.1	17.6	N/A	37.3	-	73.28	200
Qp	625.00	11.4	3.7	19.6	N/A	34.7	-	54.26	200
Qp	660.40	3.1	3.4	19.7	N/A	26.2	-	20.42	200
Qp	750.00	14.7	3.9	21.6	N/A	40.2	-	101.98	200
Qp	950.00	12.5	4.4	24.4	N/A	41.3	-	115.48	200
Pk	1001.28	64.34	1.9	24.9	37.8	53.33	-9.54	154.66	5011.87
Av	1001.28	59.27	1.9	24.9	37.8	48.26	-9.54	86.27	500.00
Pk	1124.94	60.13	2.1	25.7	37.5	50.43	-9.54	110.76	5011.87
Av	1124.94	53.57	2.1	25.7	37.5	43.87	-9.54	52.04	500.00
Pk	1399.96	58.15	2.2	25.8	36.8	49.34	-9.54	97.70	5011.87
Av	1399.96	52.66	2.2	25.8	36.8	43.85	-9.54	51.93	500.00
Pk	1599.94	54.52	2.3	25.6	36.5	45.95	-9.54	66.13	5011.87
Av	1599.94	47.37	2.3	25.6	36.5	38.80	-9.54	29.03	500.00
2455.0 MHz									
Pk	2453.01	51.99	2.4	28.3	36.0	46.73	-9.54	72.34	5011.87
Av	2453.01	45.47	2.4	28.3	36.0	40.21	-9.54	34.15	500.00
Pk	4906.02	55.82	3.7	33.1	35.6	57.06	-9.54	237.62	5011.87
Av	4906.02	52.80	3.7	33.1	35.6	54.04	-9.54	167.83	500.00
2465.0 MHz									
Pk	2463.02	53.15	2.4	28.4	36.0	47.99	-9.54	83.63	5011.87
Av	2463.02	47.75	2.4	28.4	36.0	42.59	-9.54	44.91	500.00
Pk	4926.08	55.98	3.7	33.1	35.6	57.23	-9.54	242.31	5011.87
Av	4926.08	53.30	3.7	33.1	35.6	54.55	-9.54	177.98	500.00
2475.0 MHz									
Pk	2473.01	53.60	2.4	28.4	36.0	48.44	-9.54	88.08	5011.87
Av	2473.01	47.83	2.4	28.4	36.0	42.67	-9.54	45.33	500.00
Pk	4946.08	56.31	3.6	33.2	35.6	57.56	-9.54	251.70	5011.87
Av	4946.08	53.70	3.6	33.2	35.6	54.95	-9.54	186.37	500.00

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= 1MHz, VBW ≥ RBW
Average	RBW= 1MHz, VBW ≥ RBW

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) and RSS-Gen 4.3.

Radiated emission limits 47 CFR Part 15: Clause 15.209 and RSS – GEN Section 7.2.3 for all emissions:

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

(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:

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

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

(c) The following table summarises the effect of the EUT operating mode, internal configuration and arrangement of cables / samples on the measured emission levels :

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

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

A8 Power Line Conducted Emissions

Preview power line conducted emission measurements were performed with a peak detector in a screened room. Where applicable formal measurements of the emissions were performed with an average and/or quasi peak detector.

Test Details:	
Regulation	Title 47 of the CFR: Part 15 Subpart (c) Clause 15.207
Measurement standard	ANSI C63.10
Frequency range	150kHz to 30MHz
EUT sample number	S23, S06
Modification state	0
SE in test environment	S15, S33
SE isolated from EUT	S10, S12, S13, S37, S38, S31
EUT set up	Refer to Appendix C
Photographs (Appendix F)	Photograph 3

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

Ac Power line Conducted Emissions Transmit Mode						
Results measured using the average detector						
Ref No.	Freq (MHz)	Conductor	Result (dBuV)	Spec Limit (dBuV)	Margin (dB)	Result Summary
1	0.49	L1	43.20	46.10	2.90	Pass
2	0.58	L1	37.50	46.00	8.50	Pass
3	0.96	L1	32.60	46.00	13.40	Pass
4	1.02	L1	34.50	46.00	11.50	Pass
5	1.50	L1	34.90	46.00	11.10	Pass
6	1.86	N	35.30	46.00	10.70	Pass
7	2.30	L1	36.10	46.00	9.90	Pass
8	2.68	L1	35.90	46.00	10.10	Pass
9	3.09	L1	35.50	46.00	10.50	Pass
10	3.56	N	35.60	46.00	10.40	Pass
11	3.97	N	36.00	46.00	10.00	Pass
12	4.37	N	35.80	46.00	10.20	Pass
13	4.78	N	35.30	46.00	10.70	Pass
14	10.25	N	37.30	50.00	12.70	Pass
15	10.67	N	37.90	50.00	12.10	Pass
Results measured using the Quasi Peak detector						
Ref No.	Freq (MHz)	Conductor	Result (dBuV)	Spec Limit (dBuV)	Margin (dB)	Result Summary
1	0.17	L1	48.30	65.20	16.90	Pass
2	0.49	L1	51.10	56.20	5.10	Pass
3	0.59	L1	42.50	56.00	13.50	Pass
4	1.00	L1	41.50	56.00	14.50	Pass
5	1.40	L1	41.40	56.00	14.60	Pass
6	1.91	L1	42.20	56.00	13.80	Pass
7	2.30	L1	42.40	56.00	13.60	Pass
8	2.70	L1	41.80	56.00	14.20	Pass
9	3.13	L1	41.20	56.00	14.80	Pass
10	3.56	N	41.30	56.00	14.70	Pass
11	3.63	N	40.10	56.00	15.90	Pass
12	3.97	N	41.60	56.00	14.40	Pass
13	4.40	N	41.50	56.00	14.50	Pass
14	4.78	N	41.00	56.00	15.00	Pass
15	10.89	N	41.70	60.00	18.30	Pass

AC Power line Conducted Emissions Receive Mode						
Results measured using the average detector						
Ref No.	Freq (MHz)	Conductor	Result (dBuV)	Spec Limit (dBuV)	Margin (dB)	Result Summary
1	0.17	L1	48.10	65.20	17.10	Pass
2	0.49	L1	51.20	56.20	5.10	Pass
3	0.59	L1	43.10	56.00	12.90	Pass
4	0.99	L1	41.00	56.00	15.00	Pass
5	1.46	L1	41.20	56.00	14.80	Pass
6	1.91	L1	41.60	56.00	14.40	Pass
7	2.28	L1	42.30	56.00	13.70	Pass
8	2.70	L1	41.60	56.00	14.40	Pass
9	3.15	L1	40.90	56.00	15.10	Pass
10	3.57	L1	40.90	56.00	15.10	Pass
11	3.99	N	41.90	56.00	14.10	Pass
12	4.31	N	41.80	56.00	14.20	Pass
13	4.83	N	41.40	56.00	14.60	Pass
14	10.34	N	42.20	60.00	17.80	Pass
15	10.65	N	42.60	60.00	17.40	Pass
Results measured using the Quasi Peak detector						
Ref No.	Freq (MHz)	Conductor	Result (dBuV)	Spec Limit (dBuV)	Margin (dB)	Result Summary
1	0.49	L1	43.30	46.20	2.90	Pass
2	0.58	L1	37.40	46.00	8.60	Pass
3	0.96	L1	32.20	46.00	13.80	Pass
4	1.02	L1	34.10	46.00	11.90	Pass
5	1.47	L1	34.60	46.00	11.40	Pass
6	1.89	L1	35.50	46.00	10.50	Pass
7	2.26	L1	36.10	46.00	9.90	Pass
8	2.70	L1	35.50	46.00	10.50	Pass
9	3.12	L1	35.40	46.00	10.60	Pass
10	3.56	N	35.60	46.00	10.40	Pass
11	3.97	N	36.40	46.00	9.60	Pass
12	4.36	N	37.00	46.00	9.00	Pass
13	4.78	N	36.60	46.00	9.40	Pass
14	10.26	N	37.50	50.00	12.50	Pass
15	10.64	N	37.90	50.00	12.10	Pass

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.

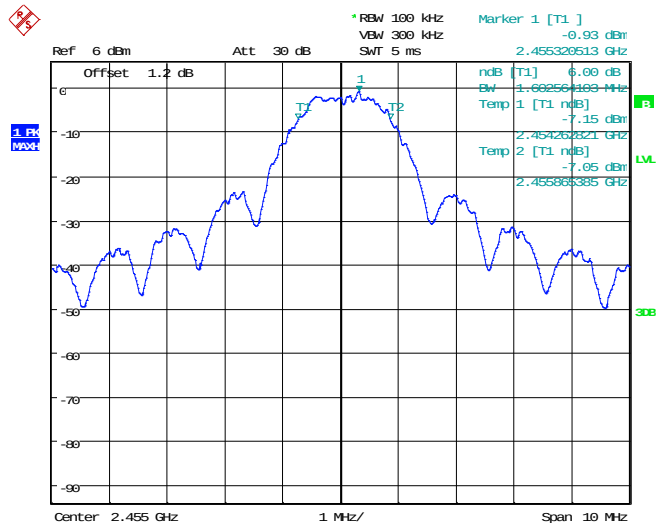
(b) The time and date on the plots do not necessarily equate to the time of the test.

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

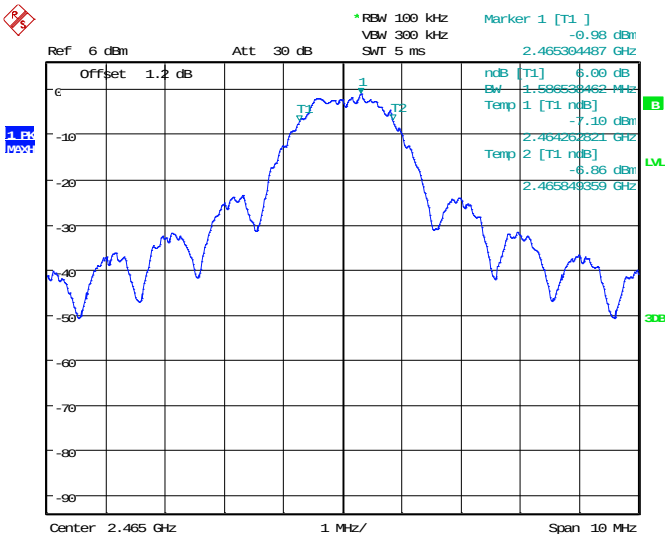
(d) Appendix C details the numbering system used to identify the sample and its modification state.

(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.

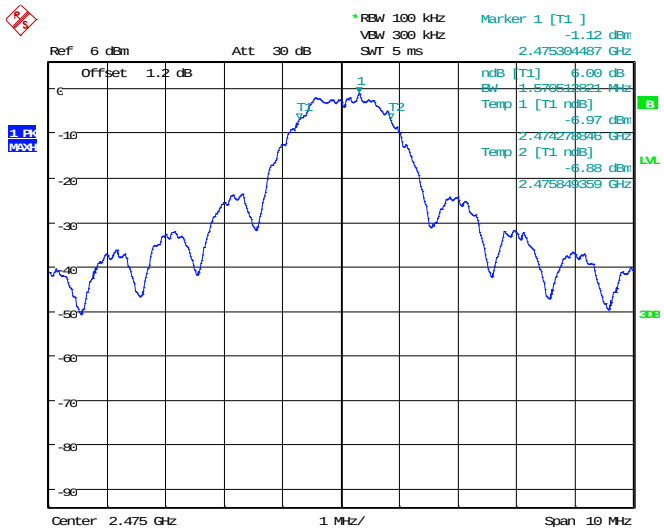
6dB Bandwidth



2455 MHz

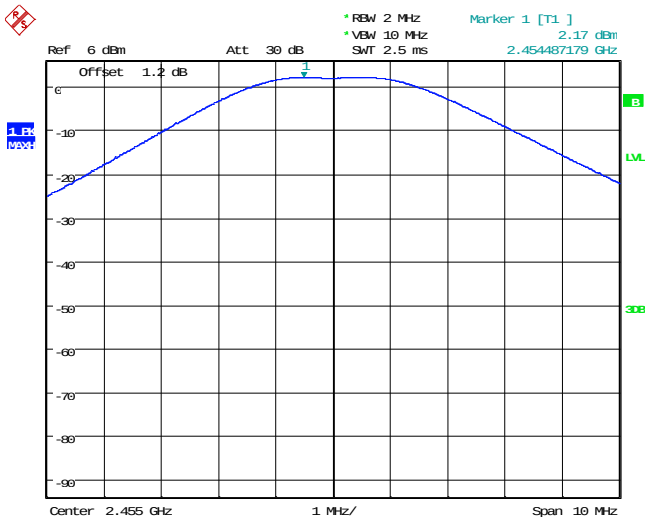


2465 MHz

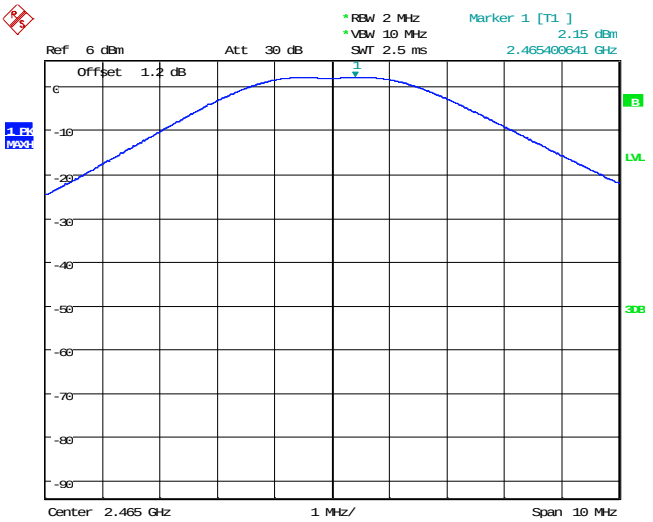


2475 MHz

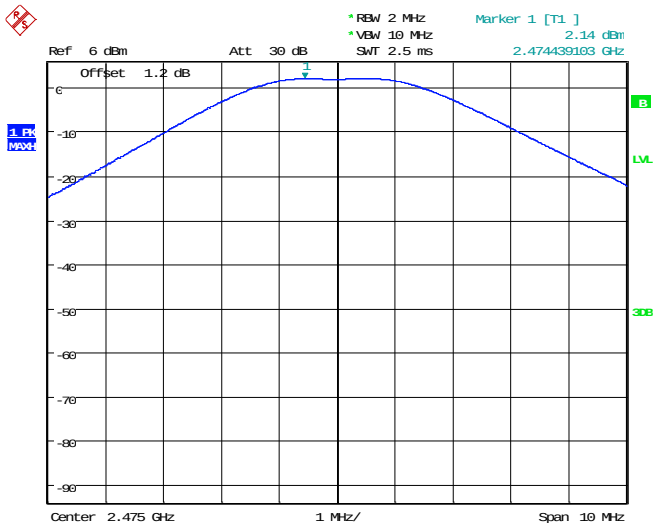
Conducted Carrier power



2455 MHz

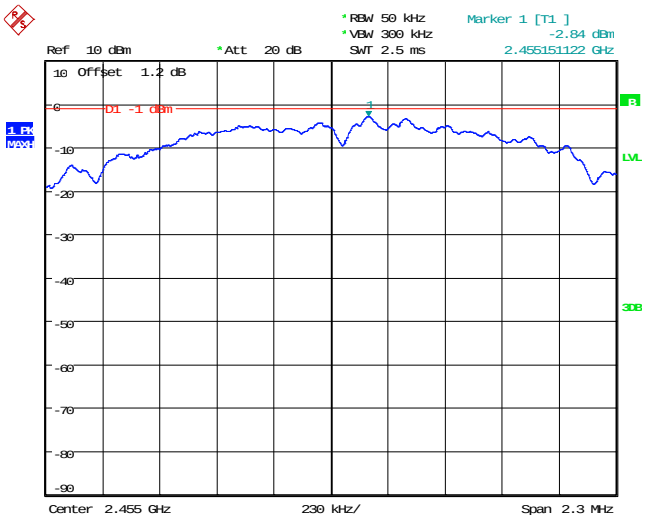


2465 MHz

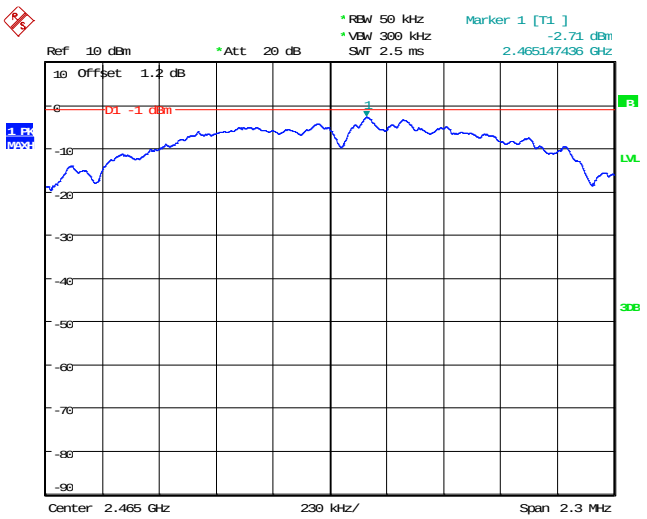


2475 MHz

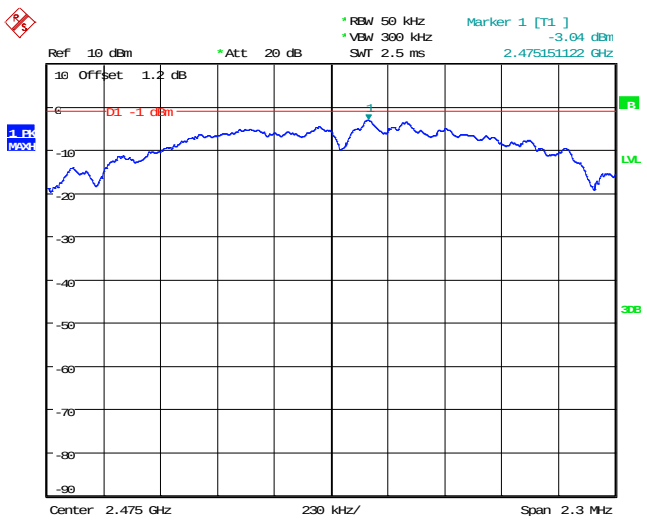
Conducted Power Spectral Density



2455 MHz

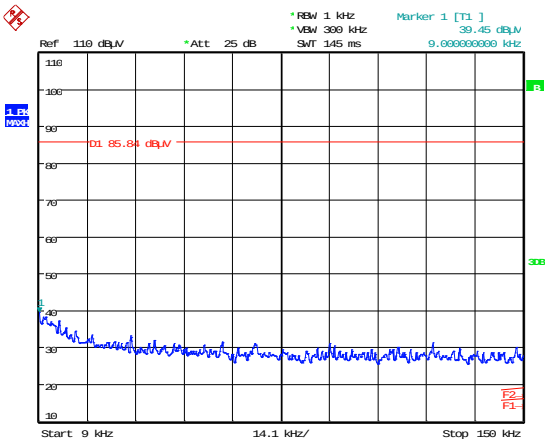


2465 MHz

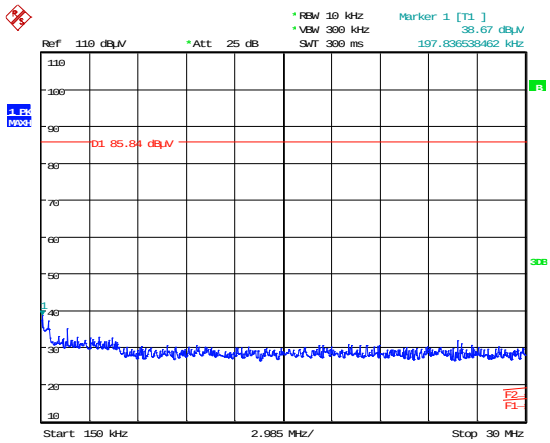


2475 MHz

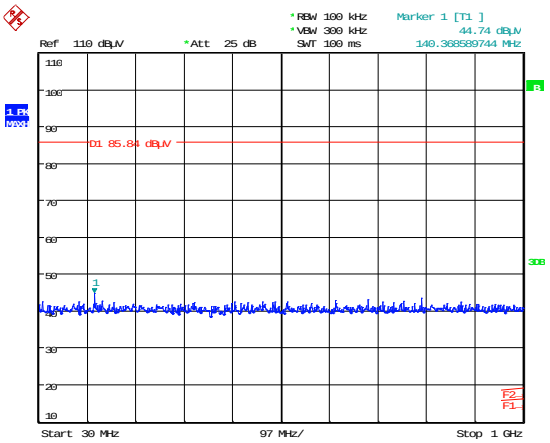
Conducted Spurious emissions 2455 MHz



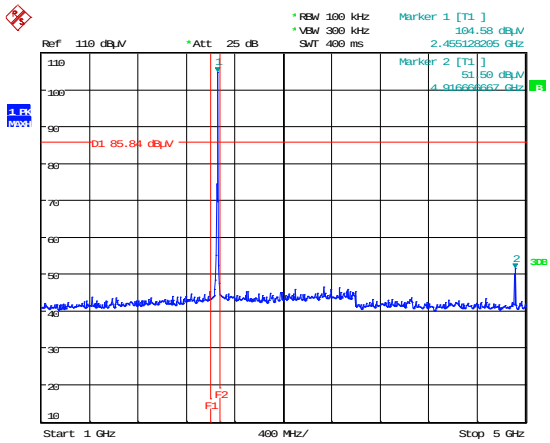
9kHz – 150 kHz



150kHz – 30 MHz

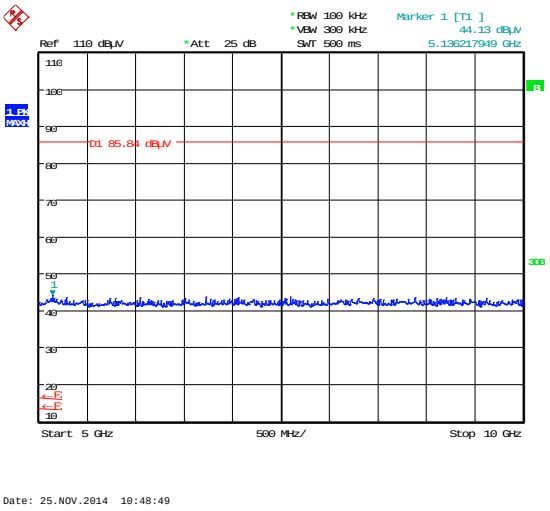


30 MHz to 1 GHz



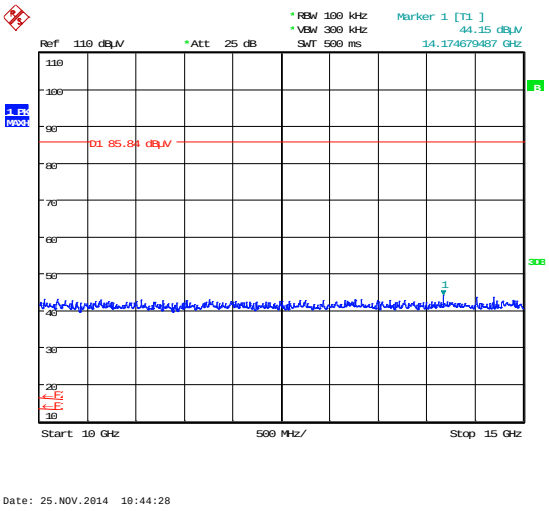
1 GHz to 5 GHz

Conducted Spurious emissions 2455 MHz



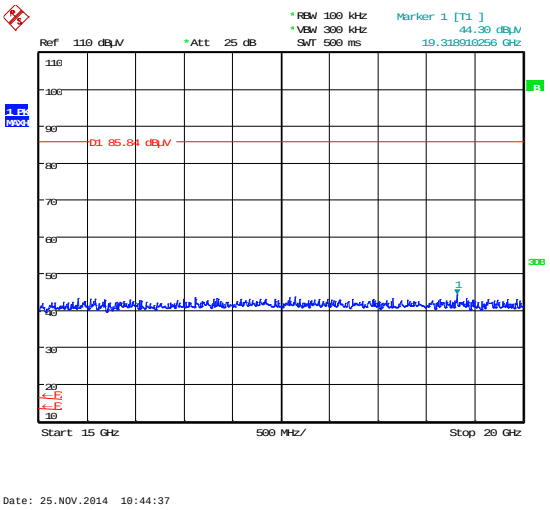
Date: 25.NOV.2014 10:48:49

5 GHz to 10 GHz



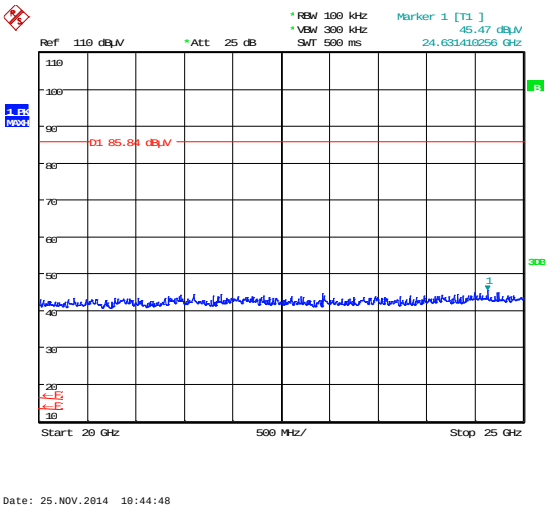
Date: 25.NOV.2014 10:44:28

10 GHz to 15 GHz



Date: 25.NOV.2014 10:44:37

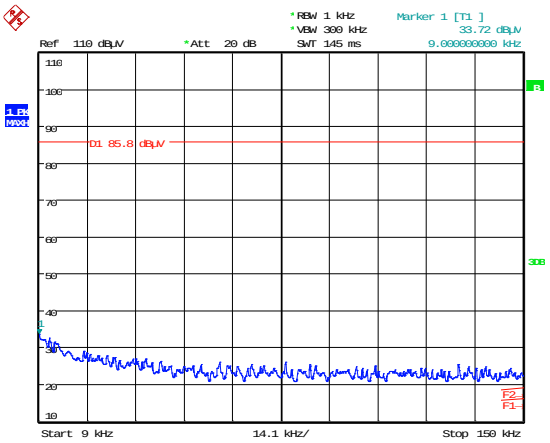
15 GHz to 20 GHz



Date: 25.NOV.2014 10:44:48

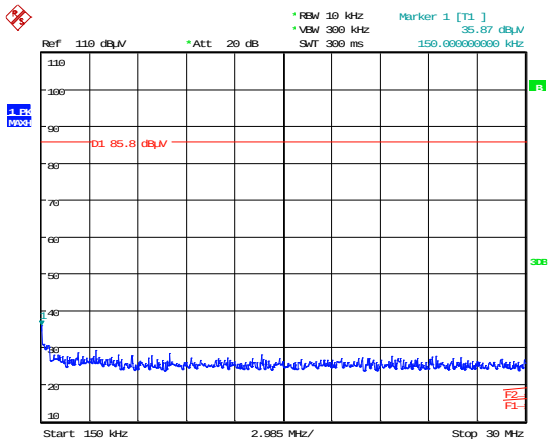
20 GHz to 25 GHz

Conducted Spurious emissions 2465 MHz



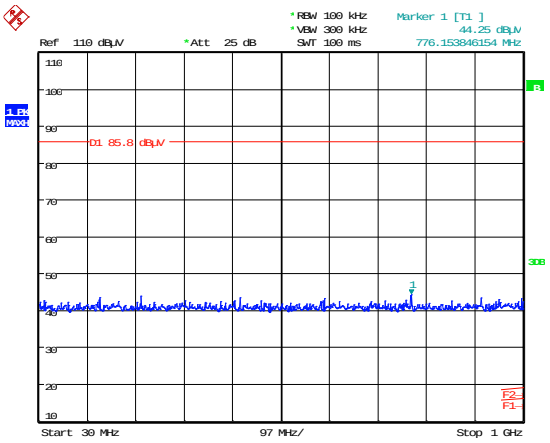
Date: 25.NOV.2014 10:35:51

9kHz – 150 kHz



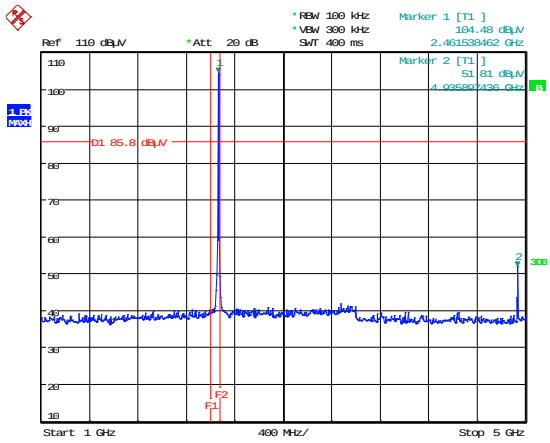
Date: 25.NOV.2014 10:35:33

150kHz – 30 MHz



Date: 25.NOV.2014 10:41:10

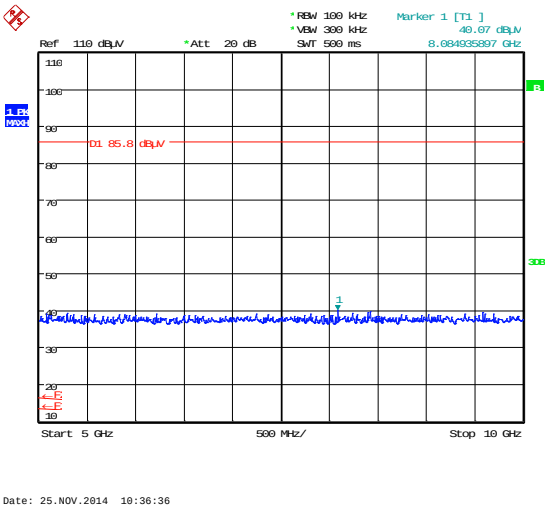
30 MHz to 1 GHz



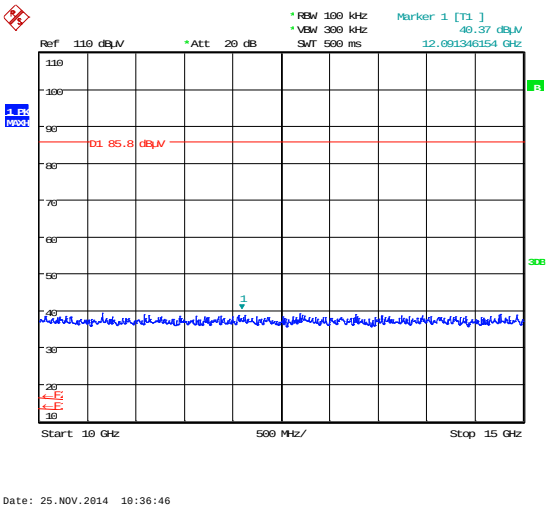
Date: 25.NOV.2014 10:36:13

1 GHz to 5 GHz

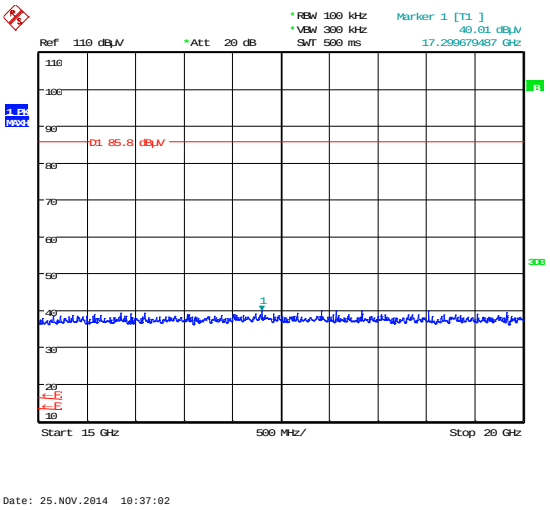
Conducted Spurious emissions 2465 MHz



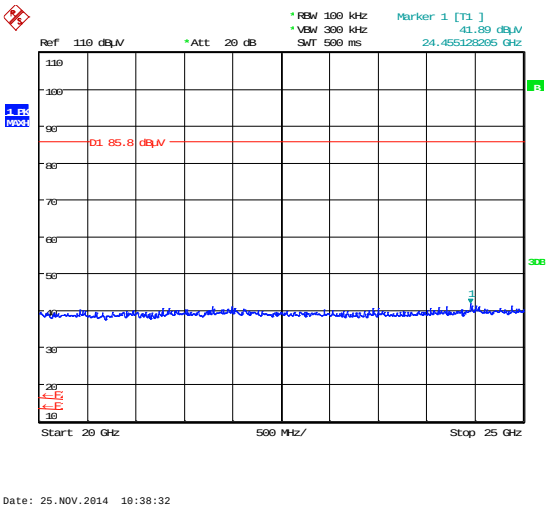
5 GHz to 10 GHz



10 GHz to 15 GHz

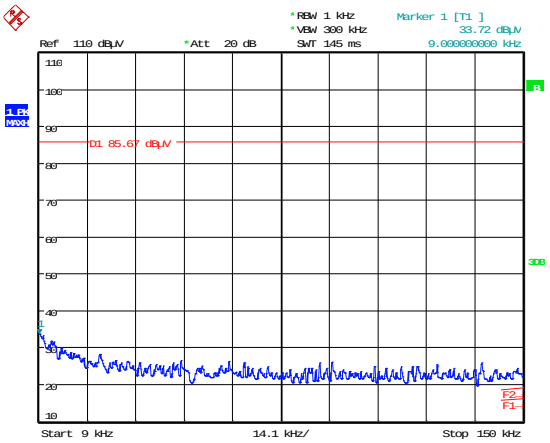


15 GHz to 20 GHz



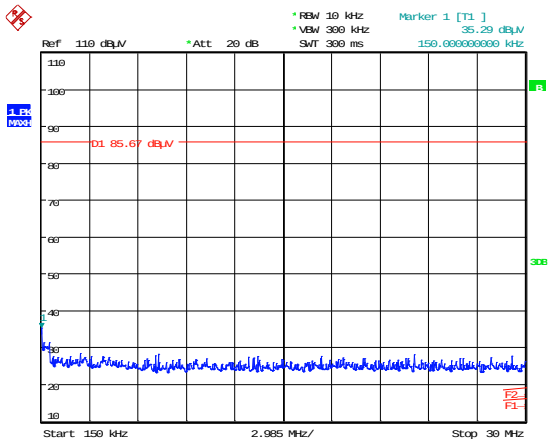
20 GHz to 25 GHz

Conducted Spurious emissions 2475 MHz



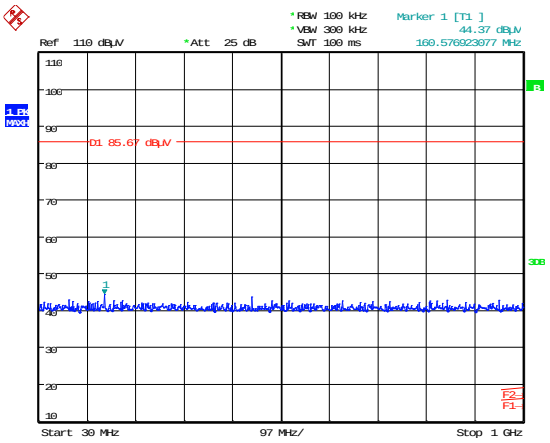
Date: 25.NOV.2014 10:33:49

9kHz – 150 kHz



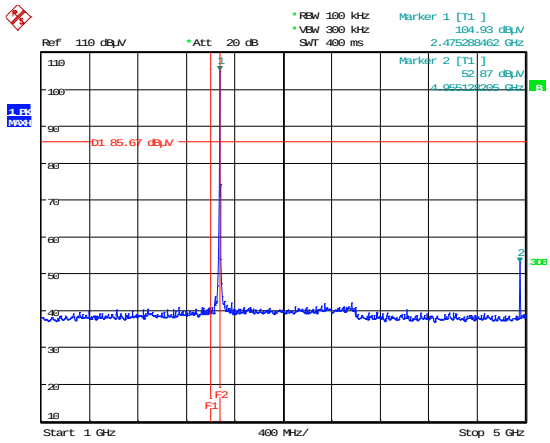
Date: 25.NOV.2014 10:34:04

150kHz – 30 MHz



Date: 25.NOV.2014 10:46:48

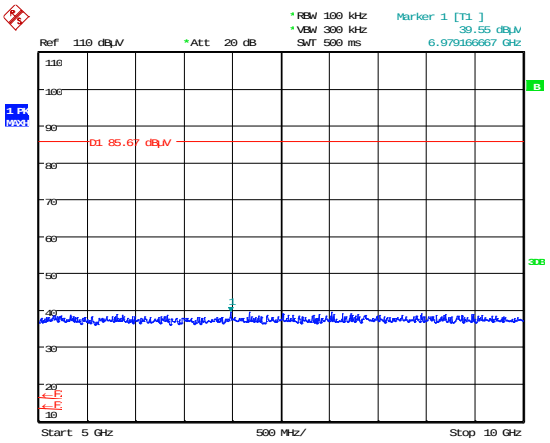
30 MHz to 1 GHz



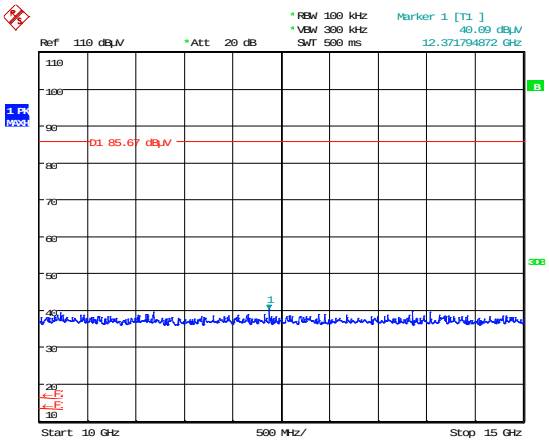
Date: 25.NOV.2014 10:32:41

1 GHz to 6 GHz

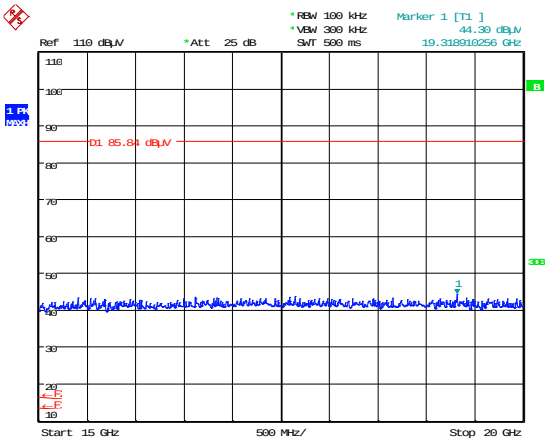
Conducted Spurious emissions 2475 MHz



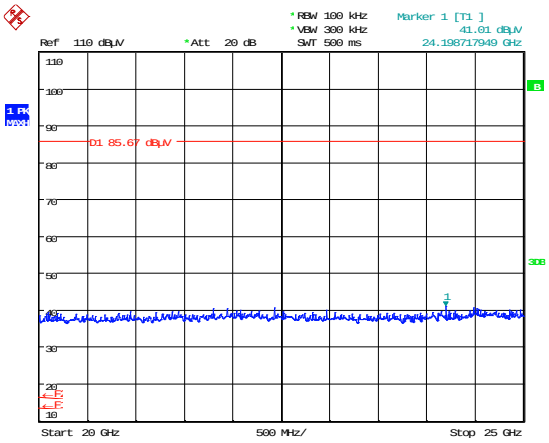
5 GHz to 10 GHz



10 GHz to 15 GHz

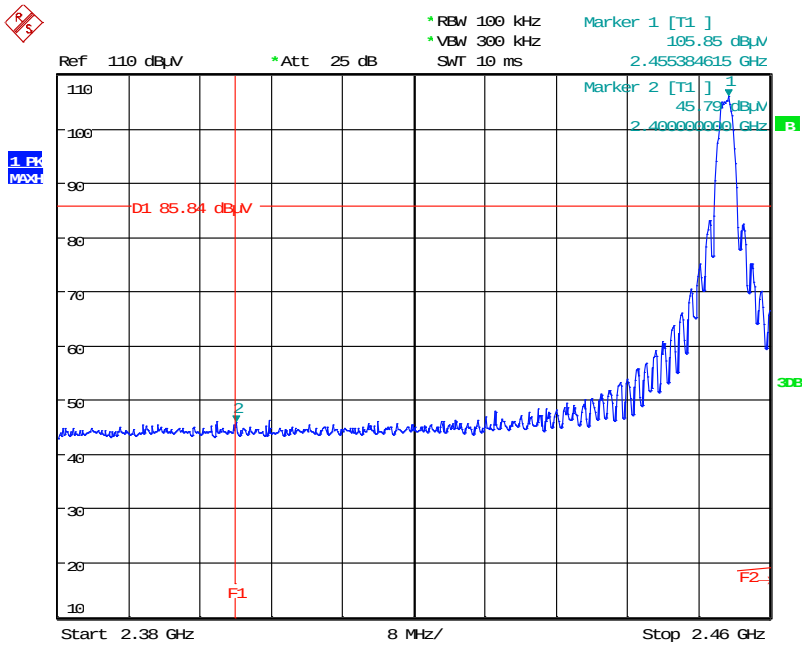


15 GHz to 20 GHz



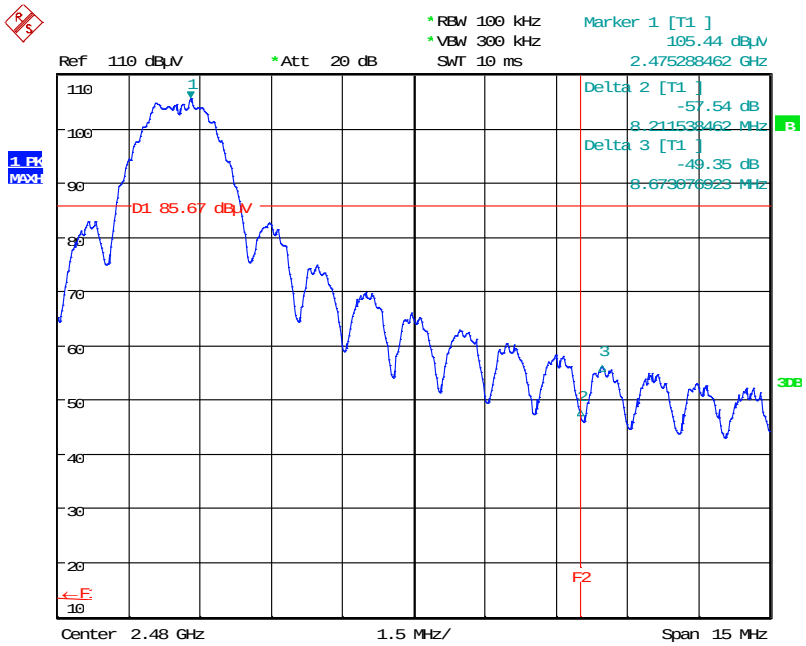
20 GHz to 25 GHz

Conducted band-edge compliance



Date: 25.NOV.2014 10:43:31

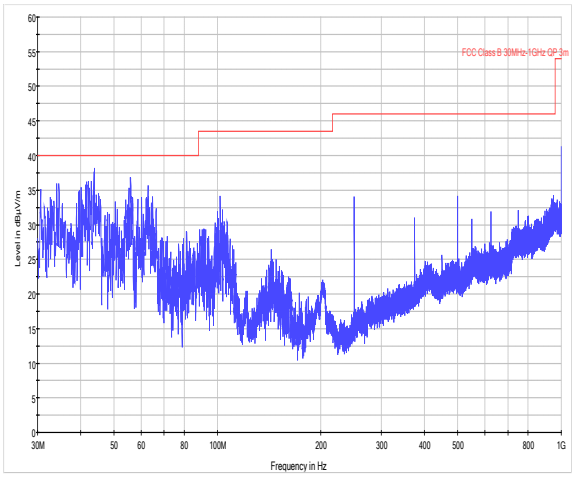
lower band edge



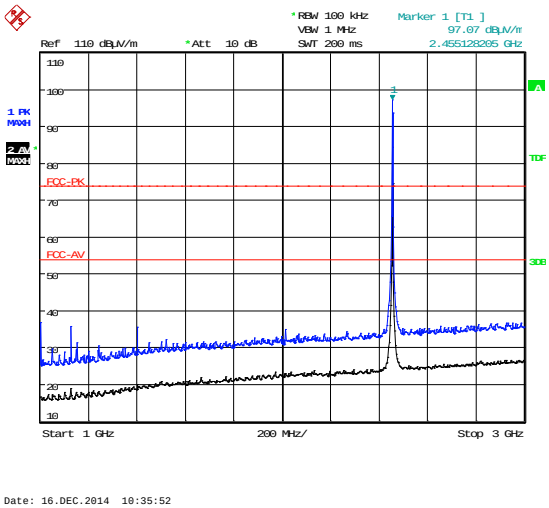
Date: 25.NOV.2014 10:31:45

upper band-edge

Radiated Spurious emissions– 2455.0MHz

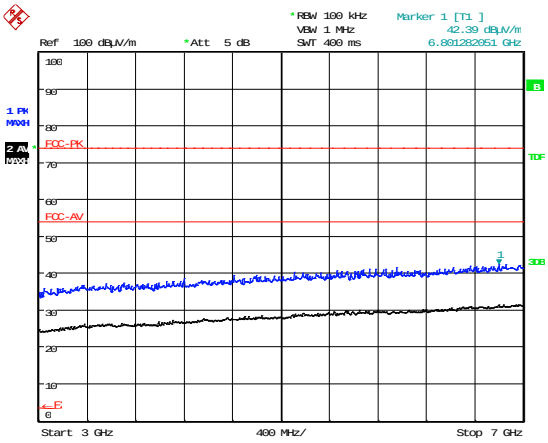


30 MHz to 1 GHz



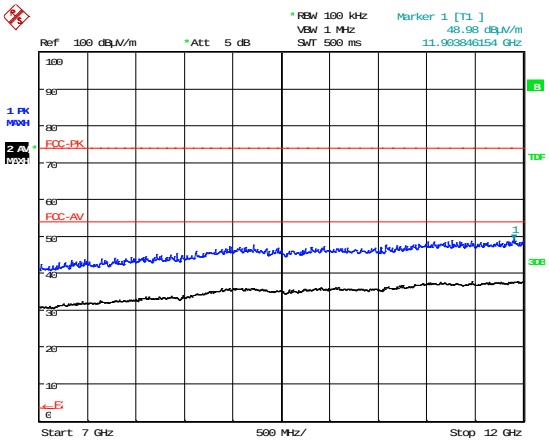
Date: 16.DEC.2014 10:35:52

1 GHz to 3 GHz



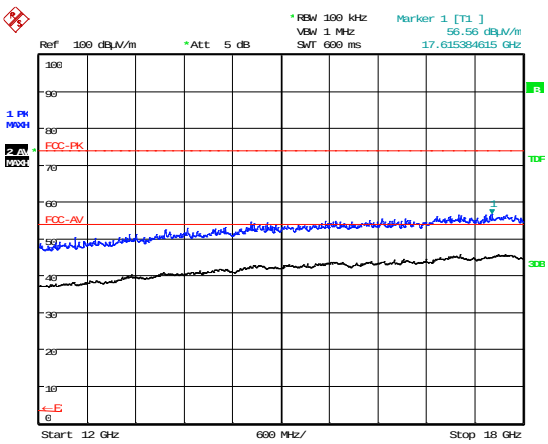
Date: 16.DEC.2014 11:21:12

3 GHz to 7 GHz



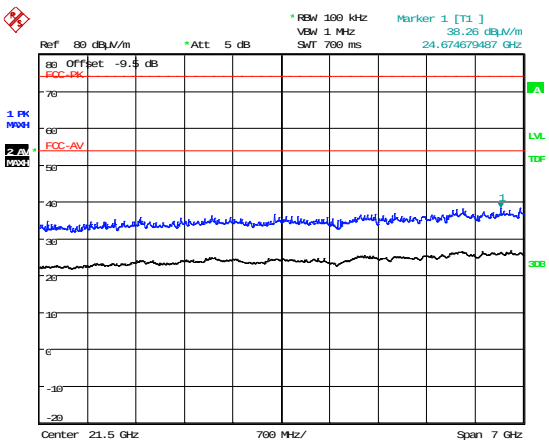
Date: 16.DEC.2014 11:23:13

7 GHz to 12 GHz



Date: 16.DEC.2014 11:24:04

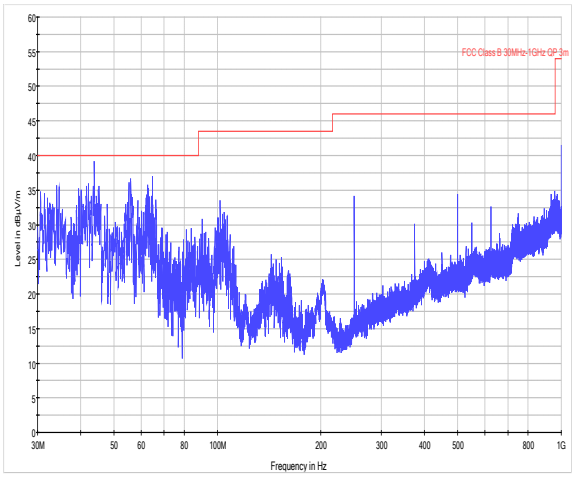
12 GHz to 18GHz



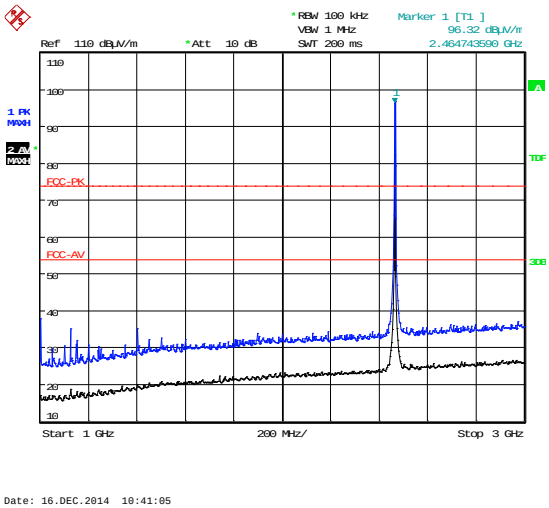
Date: 16.DEC.2014 15:46:25

18 GHz to 25 GHz

Radiated Spurious emissions– 2465.0MHz

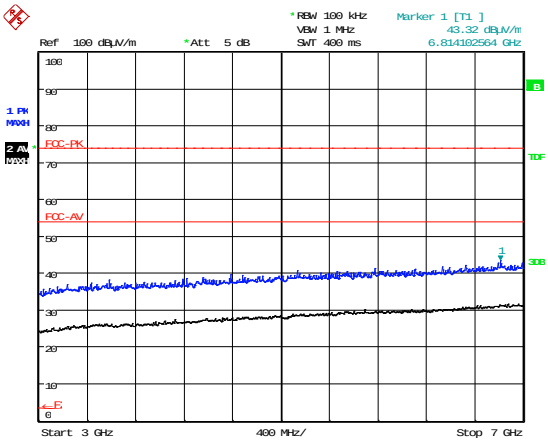


30 MHz to 1 GHz



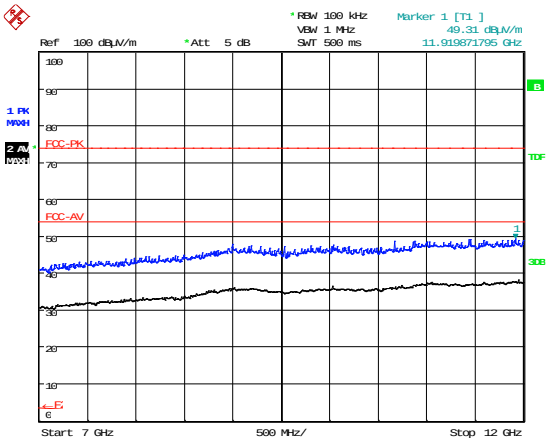
Date: 16.DEC.2014 10:41:05

1 GHz to 3 GHz



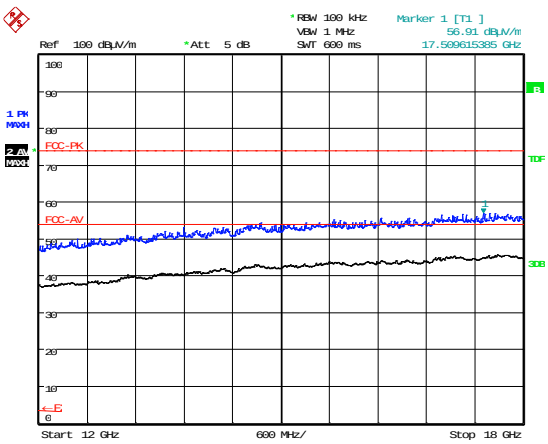
Date: 16.DEC.2014 11:16:13

3 GHz to 7 GHz



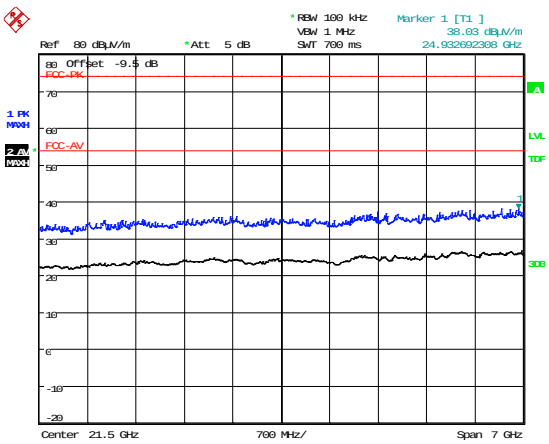
Date: 16.DEC.2014 11:14:14

7 GHz to 12 GHz



Date: 16.DEC.2014 11:11:26

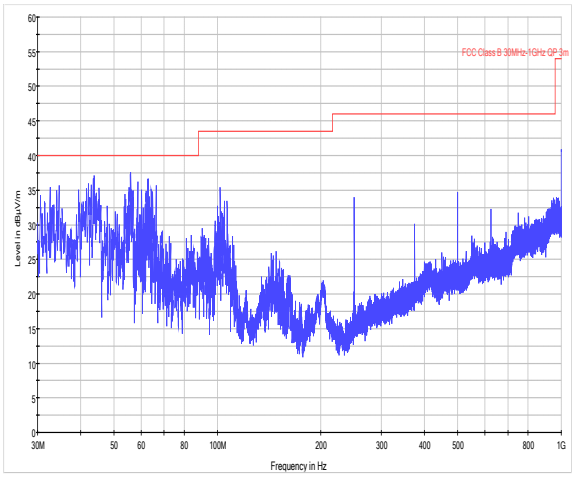
12 GHz to 18GHz



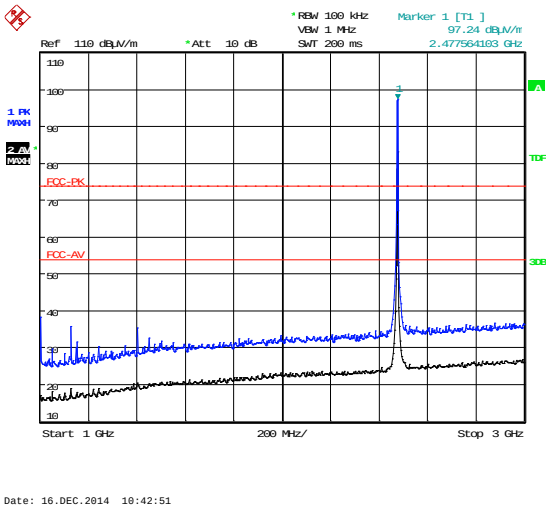
Date: 16.DEC.2014 15:47:23

18 GHz to 25 GHz

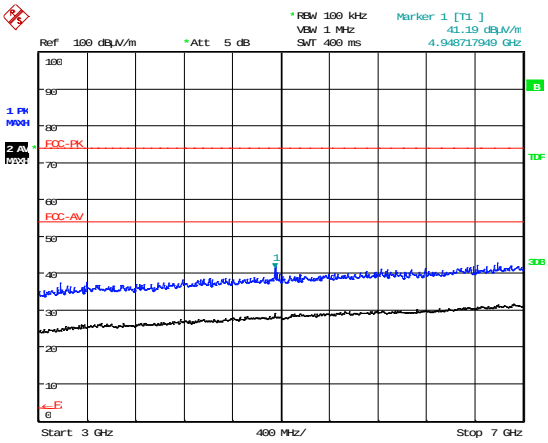
Radiated Spurious emissions– 2475.0MHz



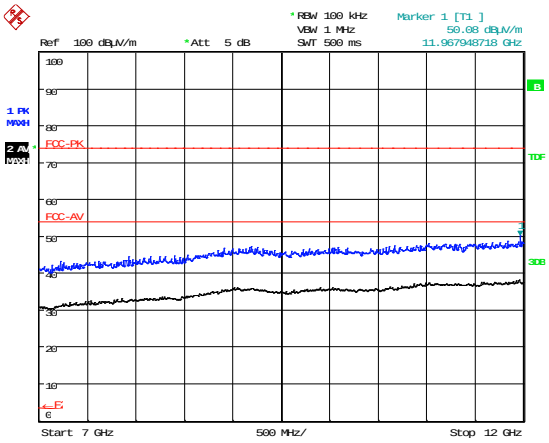
30 MHz to 1 GHz



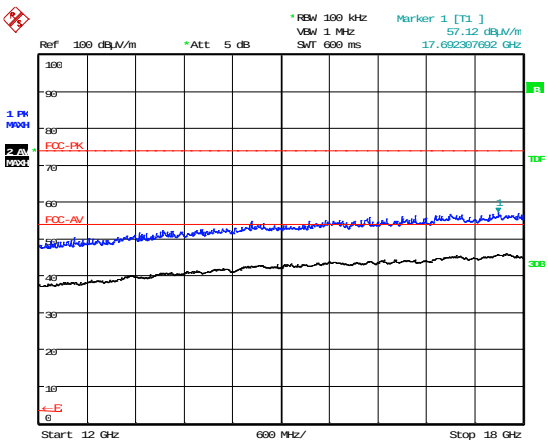
1 GHz to 3 GHz



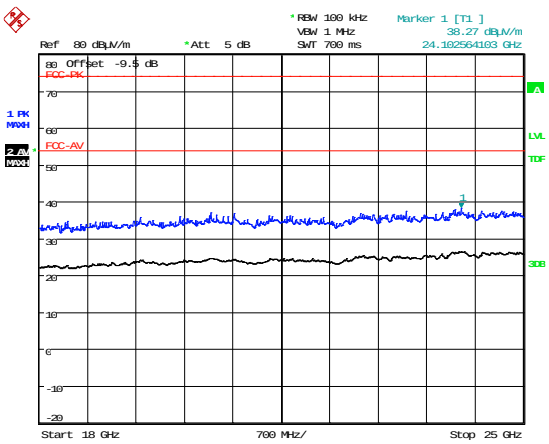
3 GHz to 7 GHz



7 GHz to 12 GHz

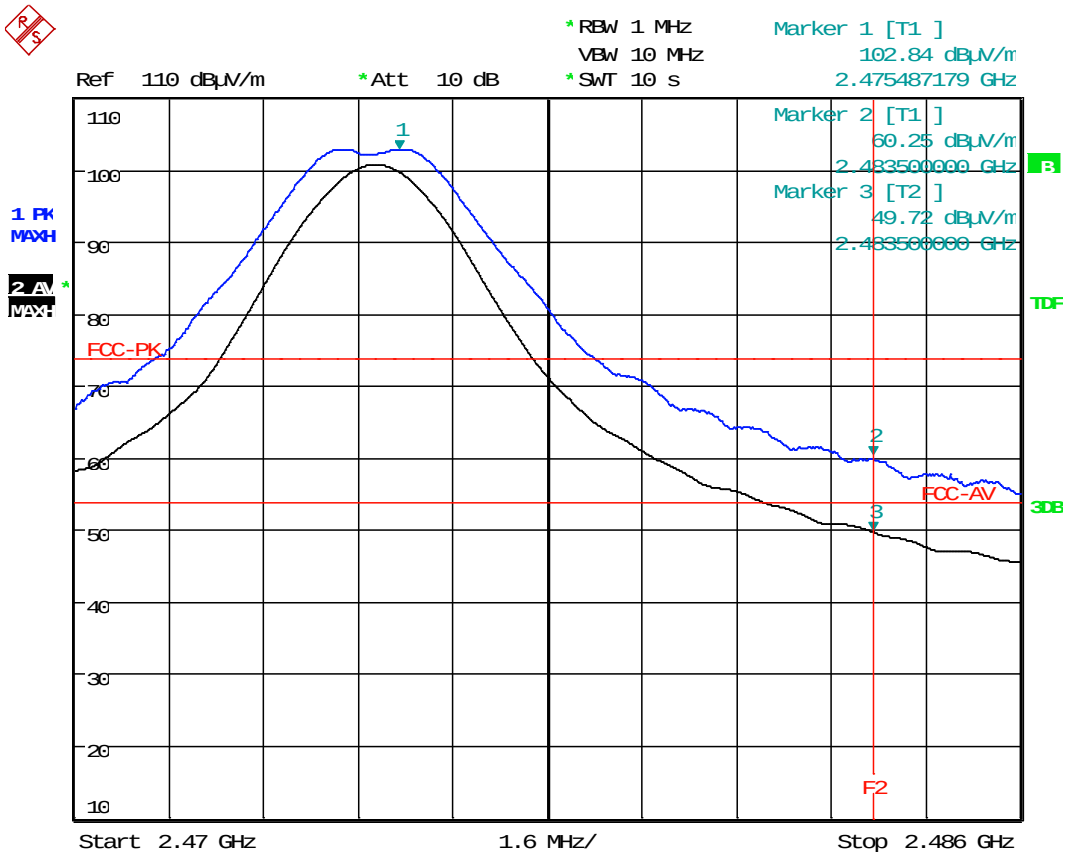


12 GHz to 18GHz



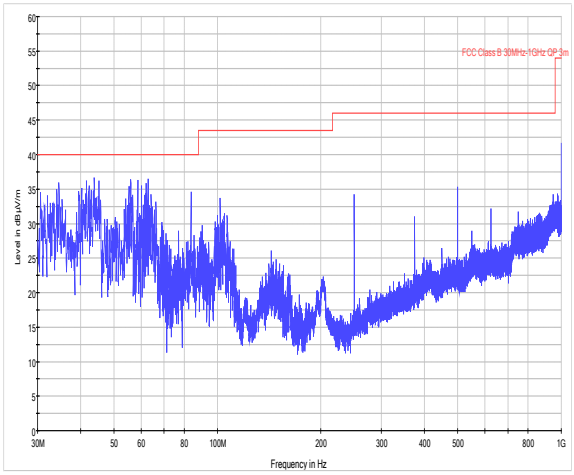
18 GHz to 25 GHz

Radiated Bandedge Compliance

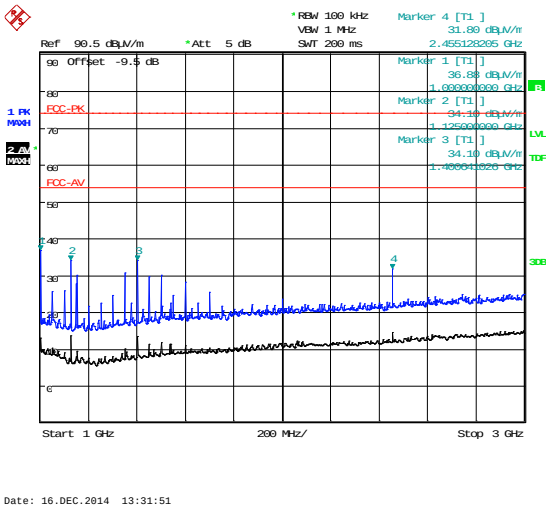


Date: 16.DEC.2014 10:48:42

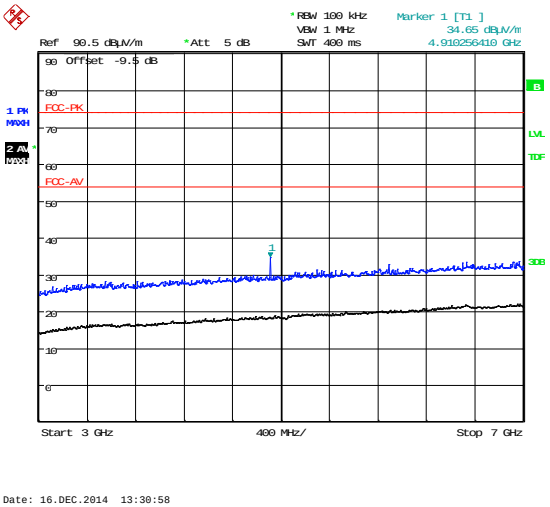
Unintentional Radiated Spurious emissions– 2455.0MHz



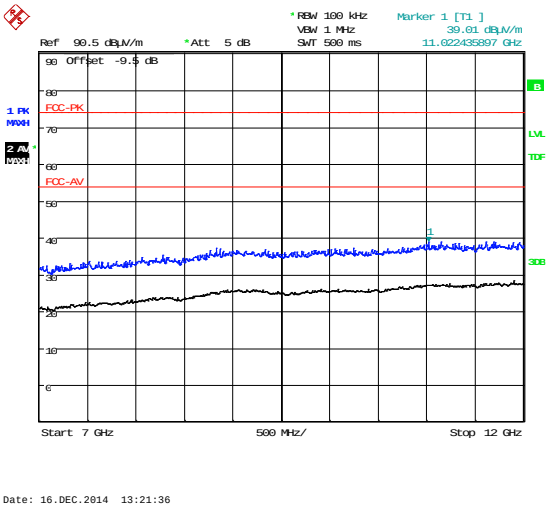
30 MHz to 1 GHz



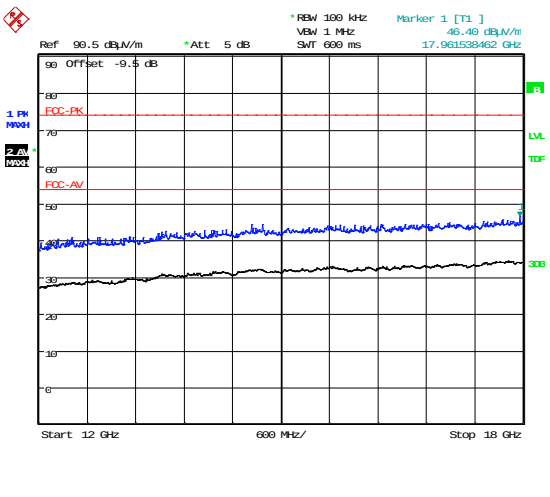
1 GHz to 3 GHz



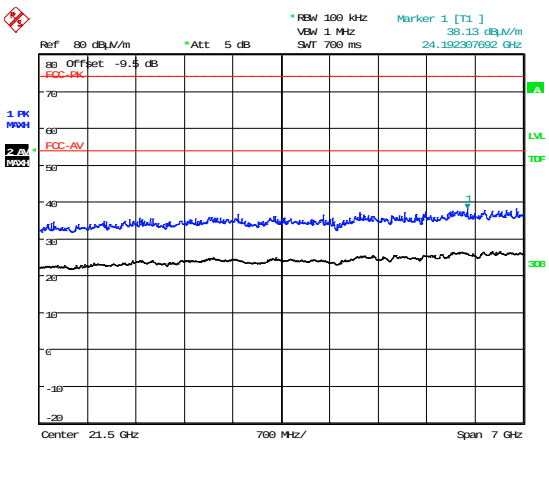
3 GHz to 7 GHz



7 GHz to 12 GHz

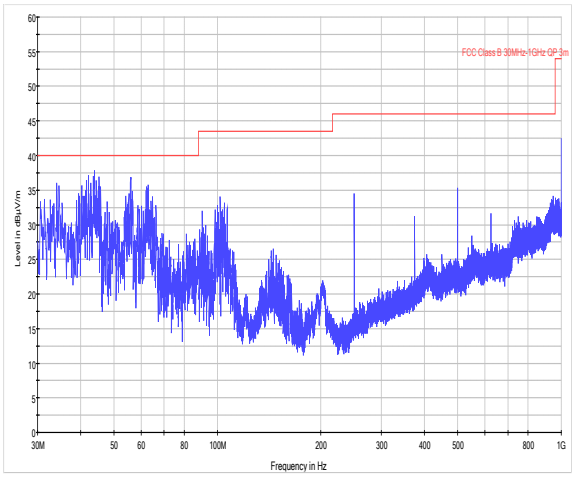


12 GHz to 18GHz

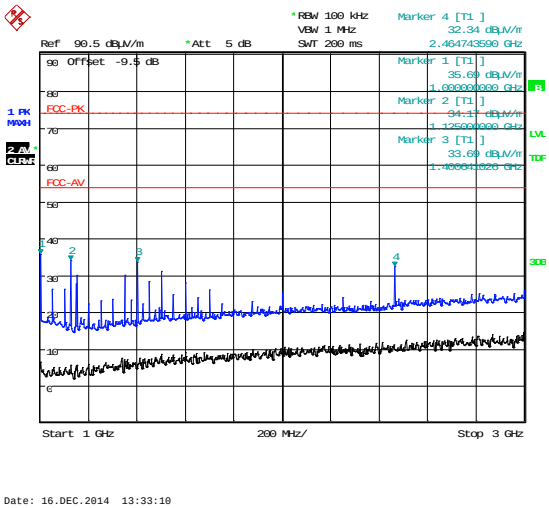


18 GHz to 25 GHz

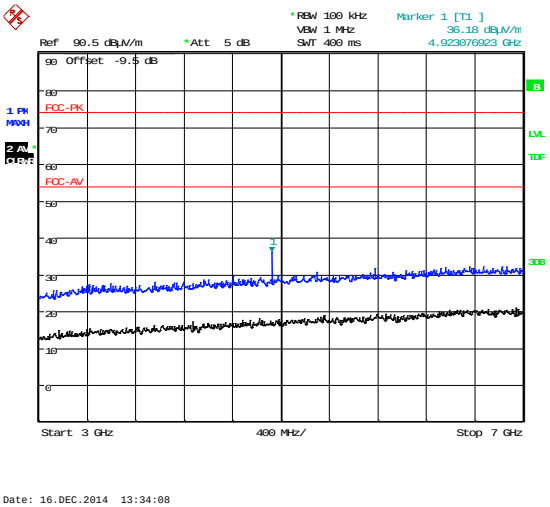
Unintentional Radiated Spurious emissions– 2465.0MHz



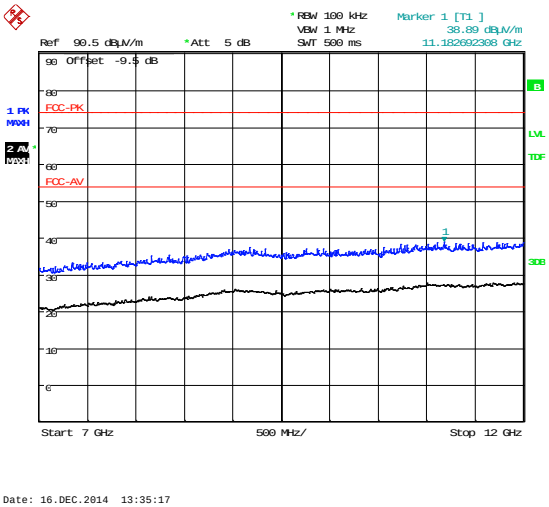
30 MHz to 1 GHz



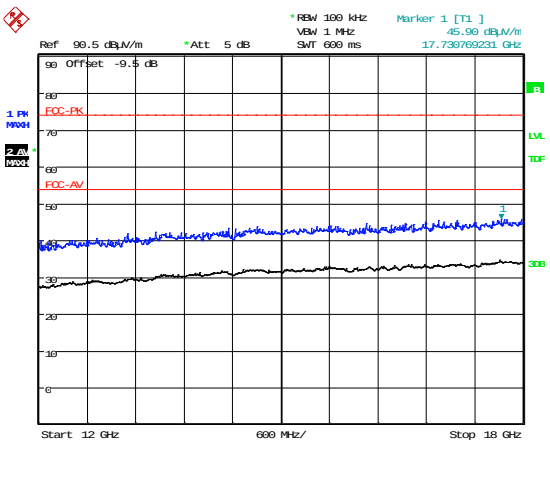
1 GHz to 3 GHz



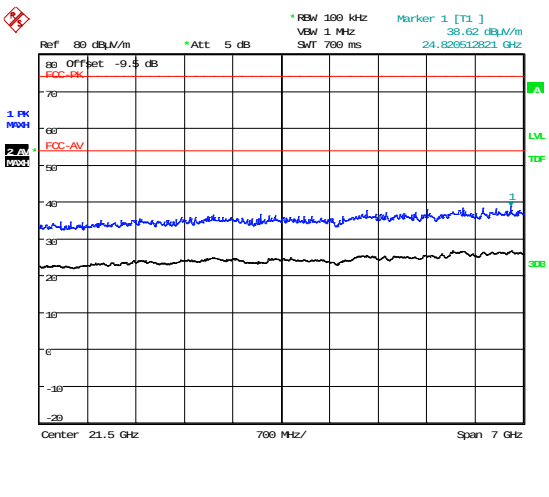
3 GHz to 7 GHz



7 GHz to 12 GHz

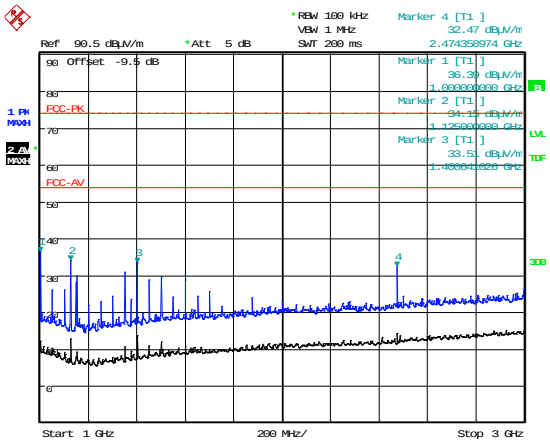


12 GHz to 18GHz

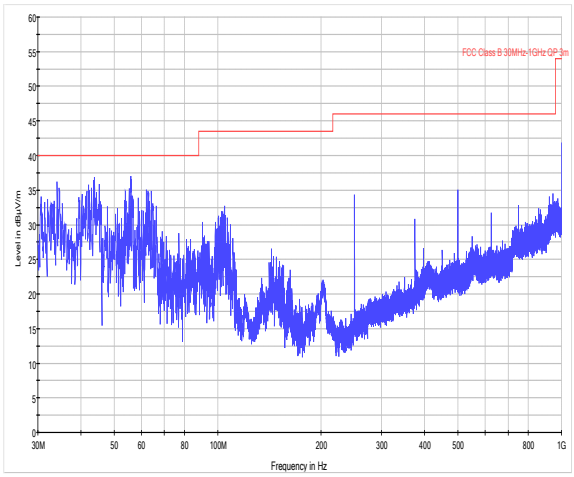


18 GHz to 25 GHz

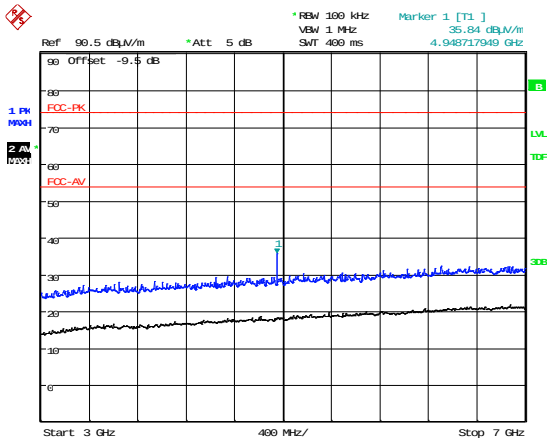
Unintentional Radiated Spurious emissions– 2475.0MHz



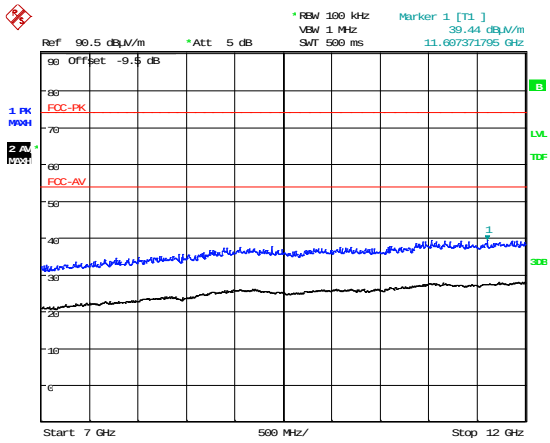
30 MHz to 1 GHz



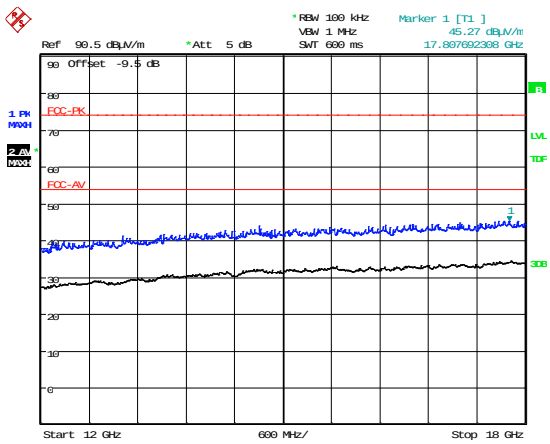
1 GHz to 3 GHz



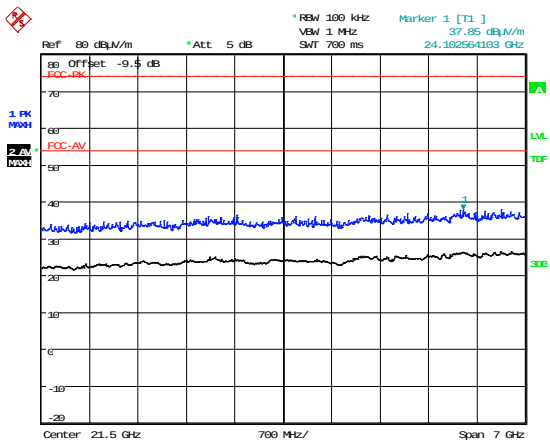
3 GHz to 7 GHz



7 GHz to 12 GHz



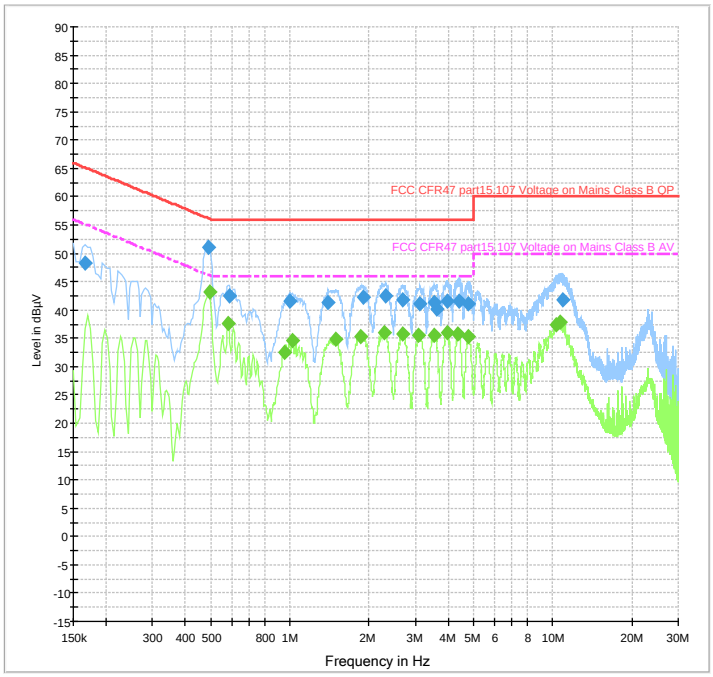
12 GHz to 18GHz



18 GHz to 25 GHz

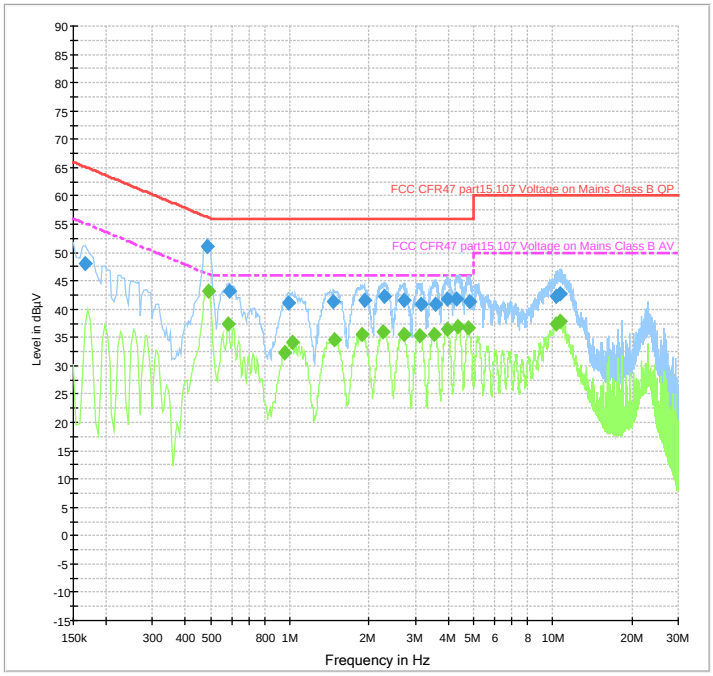
AC Powerline Conducted Emissions

Fcc Class B Conducted emissions on Mains 150kHz-30MHz ESHS10 + UH195 Rx prescans



Transmit mode

Fcc Class B Conducted emissions on Mains 150kHz-30MHz ESHS10 + UH195 Rx prescans



Receive Mode

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	Unit Serial No.
6	15 dBi Antenna	N/A
7	1m N-Type to N-Type Cable	N/A
9	5m Ethernet Cable	N/A
10	5m Ethernet Cable	N/A
11	5m Ethernet Cable	N/A
12	25cm Ethernet Cable	N/A
13	25cm Ethernet Cable	N/A
14	25cm Ethernet Cable	N/A
15	1m Ethernet Cable	N/A
16	1m Ethernet Cable	N/A
17	1m Ethernet Cable	N/A
22	USB to Serial Converter	N/A
23	Base Station RF Compliance	N/A
24	Base Station RF Compliance	N/A
31	Winmate R15IDT7T-OFC3 PC plus charger, tools and CD	N/A
32	Null modem cable	N/A
33	RP-TNC to Ntype adapter	N/A
34	Range tester	N/A
35	1M RP-TNC plug to N-type plug	N/A
36	9dBi antenna RP-TNC-Type	N/A
37	XRT-401F Router	N/A
38	POE Injector POE 151	N/A
39	POE Injector POE 151	N/A

C2) EUT Operating Mode During Testing.

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

Test	Description of Operating Mode
All tests detailed in this report	EUT transmitting a Modulated carrier

Test	Description of Operating Mode:
Receiver radiated spurious emissions	EUT active but non-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 : S02
Tests : Radiated Emissions

Port	Description of Cable Attached	Cable length	Equipment Connected
None			

* Only connected during setup.

C5 Details of Equipment Used

TRaC No	Equipment Type	Equipment Description	Manufacturer	Last Cal Calibration	Calibration Period	Due For Calibration
UH004	ESVS10	Receiver	R&S	27/02/2014	12	27/02/2015
UH028	UHALP 9108	Log Periodic Ant	Schwarbeck	08/07/2013	24	08/07/2015
UH029	VHBA 9123	Bicone Antenna	Schwarbeck	19/08/2013	24	19/08/2015
UH093	CBL6112B	Bilog	Chase	08/07/2013	24	08/07/2015
UH187	ESHS10	Receiver	R&S	19/02/2014	12	19/02/2015
UH191	CBL611/A	Bilog	Chase	13/12/2012	24	13/12/2014
UH281	FSU46	Spectrum Analyser	R&S	26/03/2014	12	26/03/2015
UH387	ATS	Chamber 1	Rainford EMC	04/07/2013	24	04/07/2015
UH388	ATS	Chamber 2	Rainford EMC	04/07/2013	24	04/07/2015
UH403	ESCI 7	Recevier	R&S	20/08/2014	12	20/08/2015
UH405	FSU26	Spectrum Analyser	R&S	16/04/2014	12	16/04/2015
UH420	CBL6112	Bilog	Chase	25/07/2014	24	25/07/2016
L138	3115	1-18GHz Horn	EMCO	17/10/2013	24	17/10/2015
L139	3115	1-18GHz Horn	EMCO	20/09/2013	24	20/09/2015
L193	VHA 9103 balu	Bicone Antenna	Chase	25/06/2014	24	25/06/2016
L203	UPA6108	Log Periodic Ant	Chase	25/06/2014	24	25/06/2016
L290	CBL611/A	Bilog	Chase	02/12/2014	24	02/12/2016
L300	20240-20	Horn 18-26GHz (&UH330)	Flann	10/02/2014	24	10/02/2016
L317	ESVS10	Receiver	R&S	12/02/2014	12	12/02/2015
L572	8449B	Pre Amp	Agilent	11/02/2014	12	11/02/2015
REF940	ATS	Radio Chamber - PP	Rainford EMC	08/09/2014	24	08/09/2016
REF976	34405a	Multimeter	Agilent	19/05/2014	12	19/05/2015
REF977	SH4141	High Pass Filter	BSC	25/02/2013	24	25/02/2015
REF2083	RPR3006W	Power Meter	DARE	13/11/2014	12	13/11/2015

Appendix D: Additional Information

No additional information is included within this test report.

Appendix E: Calculation of the duty cycle correction factor

Using a spectrum analyser in zero span mode, centred on the fundamental carrier frequency with a RBW of 1MHz and a video Bandwidth of 1MHz the sweep time was set accordingly to capture the pulse train. The transmit pulsewidths and period was measured. A plots of the pulse train is contained in Appendix B of this test report.

If the pulse train was less than 100 ms, including blanking intervals, the duty cycle was calculated by averaging the sum of the pulsewidths over one complete pulse train. However if the pulse train exceeds 100ms then the duty cycle was calculated by averaging the sum of the pulsewidths over the 100ms width with the highest average value. (The duty cycle is the value of the sum of the pulse widths in one period (or 100ms), divided by the length of the period (or 100ms). The duty cycle correction factor was then expressed in dB and the peak emissions adjusted accordingly to give an average value of the emission.

Correction factor dB = 20 x (Log_{10} Calculated Duty Cycle)

Therefore the calculated duty cycle was determined:

The pulse train period was greater than >100ms and in as shown from the plots in contained in appendix B of this test report.

Duty cycle = $\frac{\text{the sum of the highest average value pulsewidths over 100ms}}{\text{100ms}}$

e.g

$$= \frac{7.459ms}{100ms} = 0.07459$$

0.07459 or 7.459%

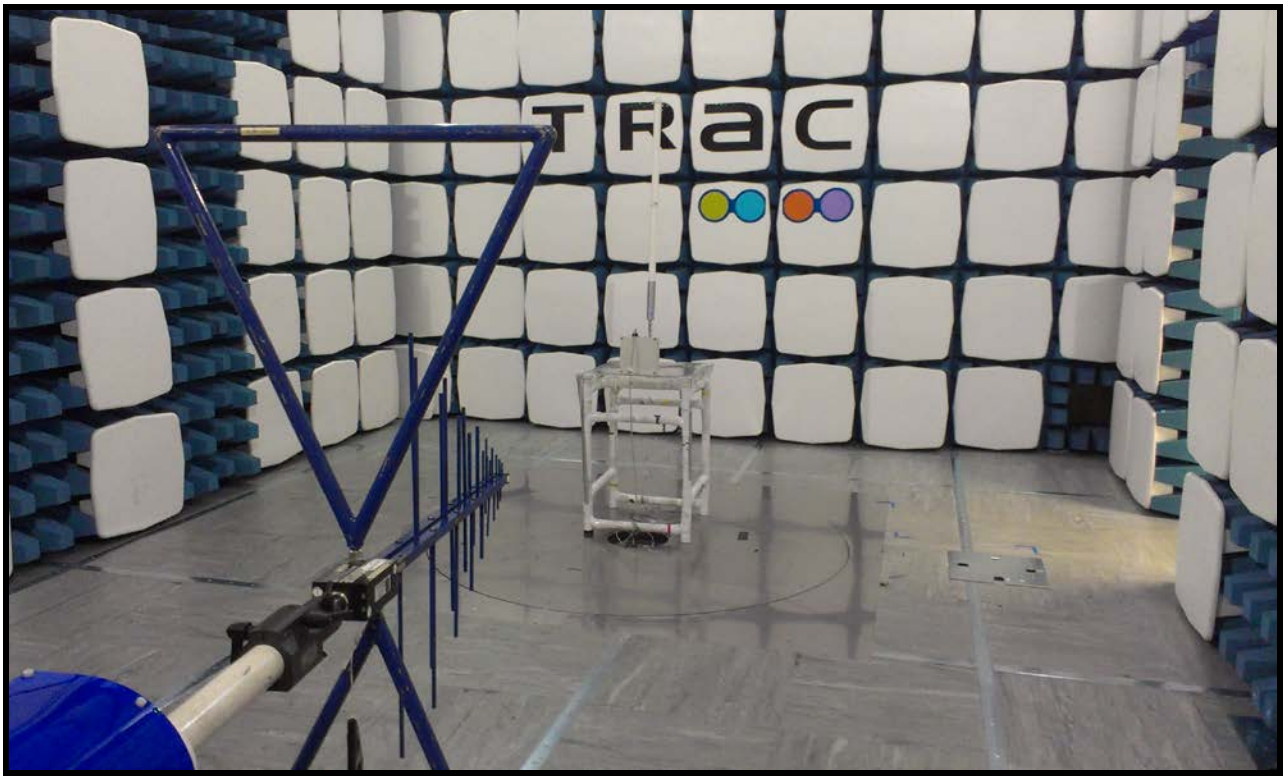
Correction factor (dB) = 20 x (Log_{10} 0.07459) = -22.54dB

Duty cycle correction may not be applicable / required by the device covered in this report.
The correction factor above is for example of how the correction is calculated.
Any applicable duty cycle used will be recorded in the relevant results sections of this report.

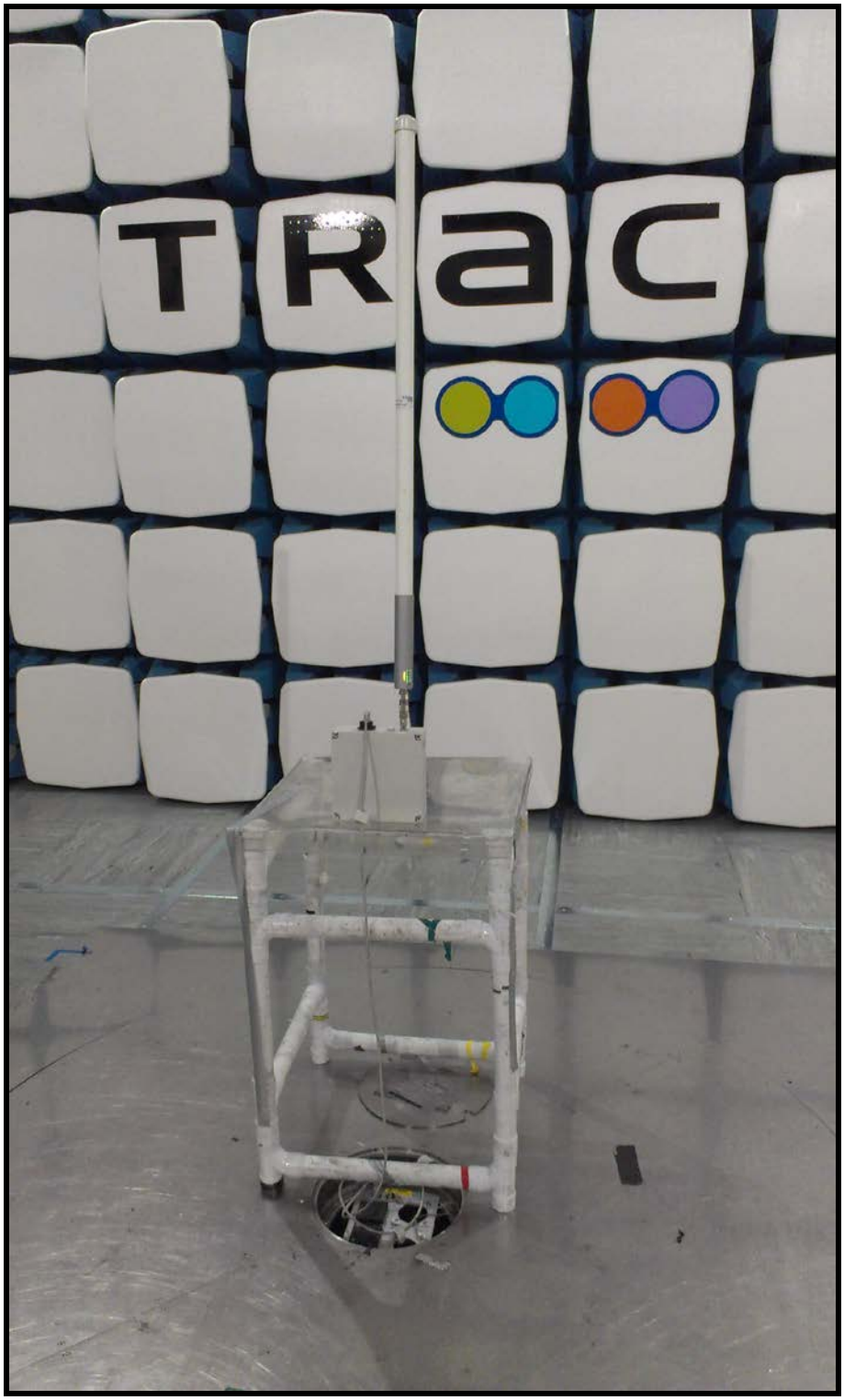
Appendix F: Photographs and Figures

The following photographs were taken of the test samples:

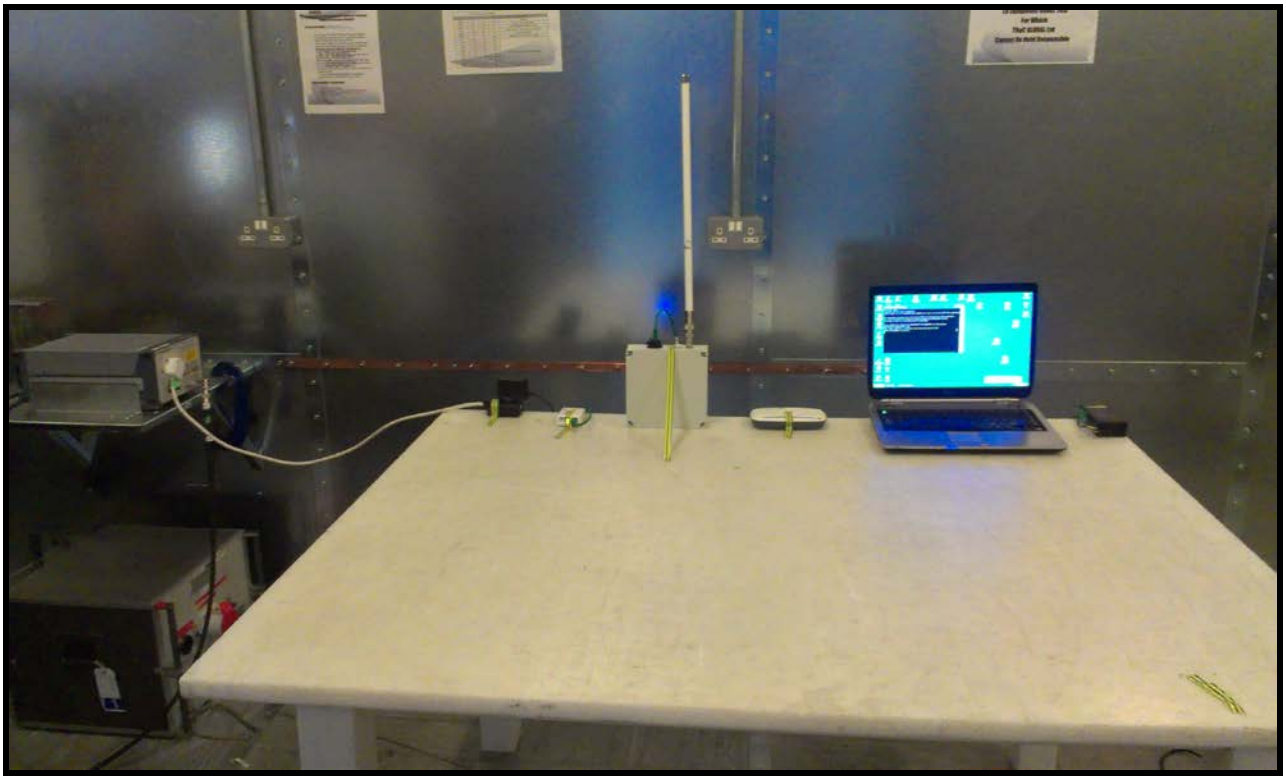
1. Radiated electric field emissions arrangement: overview.
2. Radiated electric field emissions arrangement: close up.
3. AC powerline conducted emissions arrangement: overview.



Photograph 1



Photograph 2



Photograph 2

Appendix G: SAR Exclusion & 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

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

$$(TSD^{B} – 50mm) * 10\}$$

Where:
TSD^{B} = Min Test separation Distance (mm) = 50

Operating Frequency 2.455 GHz

SARET = [(3.0 x 50) / √2.412] + { (50 – 50) * 10 }
SARET = [150 / 1.55] + (0 * 10 }
SARET = 96.77mW

Operating Frequency 2.465 GHz

SARET = [(3.0 x 50) / √2.437] + { (50 – 50) * 10 }
SARET = [150 / 1.56] + (0 * 10 }
SARET = 96.15mW

Operating Frequency 2.475 GHz

SARET = [(3.0 x 50) / √2.462] + { (50 – 50) * 10 }
SARET = [150 / 1.57] + (0 * 10 }
SARET = 95.54mW

Channel Frequency (MHz)	Conducted Carrier Power (dBm)	Maximum Antenna Gain (dBi)	EIRP (mW)	SAR Exclusion Threshold	SAR Evaluation
2455	2.17	15	52.12	96.77	Not Required
2465	2.15	15	51.88	96.15	Not Required
2475	2.14	15	51.76	95.54	Not Required

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

where:

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

Note:

The EIRP was calculated by addition on the maximum conducted carrier power 7.95 dBm (6.24 mW) and based on a antenna gain of 0 dBi

Result

Prediction Frequency (MHz)	Maximum EIRP (mW)	Power density limit (S) (mW/cm^2)	Distance (R) cm required to be less than 1 mW/cm^2
2455	52.12	1	2.04

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