TRaC Radio Test Report : 0F3058WUS1

Applicant : Promethean Ltd

Apparatus : Activslate60 PRM - RS3 - 01

FCC ID : QAM013

Authorised by : 

: Radio Product Manager

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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 by:TRaC Telecoms & Radio
Moss View
Nipe Lane
Up Holland
West Lancashire, WN8 9PY
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: S Hodgkinson, Radio Test Engineer

Report author: S Hodgkinson, Radio Test Engineer

1.2 Tests Requested By

This testing in this report was requested by :

Promethean Ltd
Promethean House
Lower Philips Road
Blackburn
Lancashire
BB1 5TH

1.3 Manufacturer

Promethean Ltd
Promethean House
Lower Philips Road
Blackburn
Lancashire
BB1 5TH

1.4 Apparatus Assessed

The following apparatus was assessed between: 01/06/10 and 09/06/10

The equipment was an Activslate60 PRM - RS3 – 01
FCC ID: QAM013

Activslate60 is a wireless, fully integrated, A4 sized mini-board; small enough to sit on a desk or to move around the classroom. It operates using the Activpen.

This Activslate60 is supplied with a USB cable which is used to charge the battery of the Activslate60, when connected to a PC USB socket.
The Activslate60 can also be charged via a universal voltage Power Supply Unit (PSU) branded "Promethean" type number FW7650L/05. This is the only approved type of PSU for charging the battery of this Activslate60.

1.5 **EXAMINATIONS REQUIRED**

Full details of test results are contained within Appendix A. The following table summarises the assessment.

EQUIPMENT TEST / EXAMINATIONS REQUIRED

TEST/EXAMINATION	RULE PART	DETECTOR	APPLICABILITY
Intentional Emission Frequency:	15.247	Peak	Yes
Intentional Emission Field Strength:	-	-	No
Intentional Emission Band Occupancy:	15.247(a)1	Peak	Yes
Intentional Emission EIRP (mW):	15.247(b)1	Peak	Yes
Spurious Emissions – Conducted:	-	-	No
Spurious Emissions – Conducted:	15.247	Peak	Yes
Spurious Emissions – Radiated <1000MHz:	15.209 ,15.247	Quasi Peak	Yes
Spurious Emissions – Radiated >1000MHz:	15.247 15.209	Peak average	Yes
Transmitter Carrier Frequency Separation:	15.247(a)(1)	Peak	Yes
Transmitter Maximum Peak Power Output Power:	15.247(b)(1)	Peak	Yes
Transmitter Band Edge Conducted Emissions:	15.247(c)	Peak	Yes
Transmitter Band Edge Radiated Emission:	15.247(c)	Peak	Yes
Extrapolation Factor:	15.31(f)	-	Yes
Maximum Frequency of Search:	15.33	-	Yes
Antenna Arrangements Integral:	15.203	-	Yes
Antenna Arrangements External Connector:	15.204	-	Yes
Restricted Bands:	15.205	-	Yes

Mod : Modification
CFR : Code of Federal Regulations
REFE : Radiated Electric Field Emissions
ANSI : American National Standards Institution
PLCE : Power Line Conducted Emissions

1.6 Notes Relating To The Assessment

With regard to this assessment, the following points should be noted:

The results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.

The apparatus was set up and exercised using the configurations, modes of operation and arrangements defined in this report only.

Particular operating modes, apparatus monitoring methods and performance criteria required by the standards tested to have been performed except where identified in Section 1.7 of this test report (Deviations from Test Standards).

For emissions testing, throughout this test report, “Pass” indicates that the results for the sample as tested were below the specified limit (refer also to Section 2, Measurement Uncertainty).

Where relevant, the apparatus was only assessed using the monitoring methods and susceptibility criteria defined in this report.

All testing with the exception of testing at the Open Area Test Site was performed under the following environmental conditions:

Temperature	: 19 to 26 °C
Humidity	: 41 to 57 %

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

1.7 Deviations from Test Standards

There were no deviations from the standards tested to.

Section 2: Measurement Uncertainty

2.1 Measurement Uncertainty Values

The following page contains the measurement uncertainties for measurements

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 (Equipment - TRLUH120) = **2.18dB**
Uncertainty in test result (Equipment – TRL05) = **1.08dB**
Uncertainty in test result (Equipment – TRL479) = **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 (Equipment - TRLUH120) = **119ppm**
Uncertainty in test result (Equipment – TRL05) = **0.113ppm**
Uncertainty in test result (Equipment – TRL479) = **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 (Equipment TRL479) Up to 8.1GHz = **3.31dB**
Uncertainty in test result (Equipment TRL479) 8.1GHz – 15.3GHz = **4.43dB**
Uncertainty in test result (Equipment TRL479) 15.3GHz – 21GHz = **5.34dB**
Uncertainty in test result (Equipment TRLUH120) 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%**

[11] Power Line Conduction

Uncertainty in test result = **3.4dB**

[12] Spectrum Mask Measurements

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

[13] Adjacent Sub Band Selectivity

Uncertainty in test result = **1.24dB**

[14] Receiver Blocking – Listen Mode, Radiated

Uncertainty in test result = **3.42dB**

[15] Receiver Blocking – Talk Mode, Radiated

Uncertainty in test result = **3.36dB**

[16] Receiver Blocking – Talk Mode, Conducted

Uncertainty in test result = **1.24dB**

[17] Receiver Threshold

Uncertainty in test result = **3.23dB**

[18] 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

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

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
CDN	: Coupling & decoupling network

A1 Conducted Fundamental Carrier Power

The EUT transmitting on its lowest channel centre and highest carrier frequency in turn.

Test Details:	
Regulation	CFR 47 2008, Part15 Subpart (c) 15.247(b)(1)
EUT sample number	S01
Modification state	0
SE in test environment	S02

Channel No	Channel Frequency (MHz)	Measured Peak Conducted Carrier Power (dBm)	Measured Peak Conducted Carrier Power (mW)	Limit (W)	Result
02	2401	6.20dBm	4.16	0.125	Pass
46	2440	5.83dBm	3.83		Pass
92	2480	5.64dBm	3.66		Pass

Note: Channel 02 is the lowest operating frequency, and channel 92 is the highest operating frequency.

For battery-operated equipment, the test was performed using a new battery as required by 15.31(e).

A2 RF Antenna Conducted Spurious Emissions

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

Test Details CH02	
Regulation	CFR 47 2008, Part 15 Subpart (c) Clause 15.247(d) and Clause 15.205
Measurement standard	ANSI C63.4:2003
Frequency range	30MHz to 25 GHz
EUT sample number	S01
Modification state	0
SE in test environment	S02

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

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

Notes:

1. The conducted emission limit for emissions outside the restricted bands, defined in CFR 47 Part 15.205(a) are based on a transmitted carrier level of 15.247(b). With the EUT transmitting on its lowest, centre and highest carrier frequencies in turn, emissions from the EUT are required to be 20 dB below the level of the highest fundamental as measured within a 100 kHz RBW in accordance with 15.247(d) using a peak detector.
2. The RBW = 100 kHz, Video bandwidth (VBW) > RBW and the radio spectrum was investigated up to the 10th harmonic in accordance15.33 (a)(1).
3. The measurements at 2400 MHz and 2483.5 MHz were made to ensure band edge compliance.

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

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

A3 Radiated Electric Field Emissions Within The Restricted Band 15.205

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

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

10m 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 CH02 Connected to Laptop	
Regulation	CFR 47 2008, Part 15 Subpart (c) Clause 15.247(d) and Clause 15.205
Measurement standard	ANSI C63.4:2003
Frequency range	30MHz to 25 GHz
EUT sample number	S01
Modification state	0
SE in test environment	S02
EUT set up	Refer to Appendix C
Photographs (Appendix F)	Photograph 1 and 2

The worst case radiated emission measurements for spurious emissions and harmonics that fall within the restricted bands are listed below and designated with (r).

Ref No.	FREQ. (MHz)	MEAS Rx (dBµV)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	FIELD ST'GH (dBµV/m)	EXTRAP FACT (dB)	FIELD ST'GH (µV/m)	LIMIT (µV/m)
1.	144.0	16.0	1.29	10.51	N/A	27.8	N/A	25.54	150
2.	383.95	10.04	2.23	15.23	N/A	27.5	N/A	23.71	200
3.	432.0	12.17	2.45	16.38	N/A	31.0	N/A	35.48	200
4.	4805.548(r)	52.17 48.59	2.35 2.35	33.65 33.65	36.45 36.45	51.72pk 48.14Av	N/A	385.47pk 255.47Av	500pk 5011Av
5.	7208.317	41.30 37.47	2.70 2.70	38.30 38.30	36.25 36.25	46.05pk 42.22Av	N/A	200.67pk 129.12Av	20dBc
6.	9611.042	49.73 40.67	2.40 2.40	38.50 38.50	37.00 37.00	53.63pk 44.57Av	N/A	480.83pk 169.23Av	20dBc

Note: For radiated emissions that fall within 30MHz -1GHz the required limits are as part 15.209.For other frequencies that do not fall into the restricted bands of operation that are ≥1 GHz the required Limit is 20dBc below the fundamental output power.

Radiated Electric Field Emissions Within The Restricted Band 15.205 continued:

Test Details CH46 Connected to Laptop	
Regulation	CFR 47 2008, Part 15 Subpart (c) Clause 15.247(d) and Clause 15.205
Measurement standard	ANSI C63.4:2003
Frequency range	30MHz to 25 GHz
EUT sample number	S01
Modification state	0
SE in test environment	S02
EUT set up	Refer to Appendix C
Photographs (Appendix F)	Photograph 1 and 2

The worst case radiated emission measurements for spurious emissions and harmonics that fall within the restricted bands are listed below and designated with (r).

Ref No.	FREQ. (MHz)	MEAS Rx (dBµV)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	FIELD ST'GH (dBµV/m)	EXTRAP FACT (dB)	FIELD ST'GH (µV/m)	LIMIT (µV/m)
1.	144.0	16.0	1.29	10.51	N/A	27.8	N/A	25.54	150
2.	383.95	10.04	2.23	15.23	N/A	27.5	N/A	23.71	200
3.	432.0	12.17	2.45	16.38	N/A	31.0	N/A	35.48	200
4.	4881.56(r)	54.09 48.49	2.35 2.35	33.65 33.65	36.50 36.50	53.59pk 47.99Av	N/A	478.07pk 250.90Av	500.0pk 5011.0Av
5.	7322.34(r)	47.27 38.98	2.70 2.70	38.30 38.30	36.30 36.30	51.97pk 43.68Av	N/A	396.73pk 152.75Av	500.0pk 5011.0Av
6.	9763.12	51.28 42.68	2.40 2.40	38.50 38.50	37.05 37.05	55.13pk 46.53Av	N/A	570.82pk 212.08Av	20dBc

Note: For radiated emissions that fall within 30MHz -1GHz the required limits are as part 15.209.For other frequencies that do not fall into the restricted bands of operation that are ≥1 GHz the required Limit is 20dBc below the fundamental output power.

Radiated Electric Field Emissions Within The Restricted Band 15.205 continued:

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

Test Details CH92 Connected to Laptop	
Regulation	CFR 47 2008, Part 15 Subpart (c) Clause 15.247(d) and Clause 15.205
Measurement standard	ANSI C63.4:2003
Frequency range	100 kHz to 25 GHz
EUT sample number	S01
Modification state	0
SE in test environment	S02
EUT set up	Refer to Appendix C
Photographs (Appendix F)	Photograph 1 and 2

The worst case radiated emission measurements for spurious emissions and harmonics that fall within the restricted bands are listed below and designated with (r).

Ref No.	FREQ. (MHz)	MEAS Rx (dBµV)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	FIELD ST'GH (dBµV/m)	EXTRAP FACT (dB)	FIELD ST'GH (µV/m)	LIMIT (µV/m)
1.	144.0	16.0	1.29	10.51	N/A	27.8	N/A	25.54	150
2.	383.95	10.04	2.23	15.23	N/A	27.5	N/A	23.71	200
3.	432.0	12.17	2.45	16.38	N/A	31.0	N/A	35.48	200
4.	4961.05(r)	57.22 52.29	2.35 2.35	33.65 33.65	36.60 36.60	56.62pk 51.69Av	N/A	677.64pk 384.14Av	500.0pk 5011.0Av
5.	7441.58(r)	46.93 37.81	2.70 2.70	38.30 38.30	36.10 36.10	51.83pk 42.71Av	N/A	390.39pk 136.61Av	500.0pk 5011.0Av
6.	9922.11	50.71 41.41	2.40 2.40	38.50 38.50	37.20 37.20	54.41pk 45.11Av	N/A	525.41pk 180.09Av	20dBc

Note: For radiated emissions that fall within 30MHz -1GHz the required limits are as part 15.209.For other frequencies that do not fall into the restricted bands of operation that are ≥1 GHz the required Limit is 20dBc below the fundamental output power.

A3 Radiated Electric Field Emissions Within The Restricted Band 15.205

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

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

10m 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 CH02 Connected to Power Supply	
Regulation	CFR 47 2008, Part 15 Subpart (c) Clause 15.247(d) and Clause 15.205
Measurement standard	ANSI C63.4:2003
Frequency range	30MHz to 25 GHz
EUT sample number	S01
Modification state	0
SE in test environment	S03
EUT set up	Refer to Appendix C
Photographs (Appendix F)	Photograph 1 and 2

The worst case radiated emission measurements for spurious emissions and harmonics that fall within the restricted bands are listed below and designated with (r).

Ref No.	FREQ. (MHz)	MEAS Rx (dBµV)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	FIELD ST'GH (dBµV/m)	EXTRAP FACT (dB)	FIELD ST'GH (µV/m)	LIMIT (µV/m)
1.	31.80	15.68	0.56	17.56	N/A	33.80	N/A	48.97	100.00
2.	33.35	18.59	0.60	16.41	N/A	35.60	N/A	60.25	100.00
3.	37.40	15.11	0.68	14.21	N/A	33.00	N/A	44.66	100.00
4.	39.35	16.31	0.72	13.07	N/A	30.10	N/A	31.98	100.00
5.	40.35	14.75	0.72	12.53	N/A	28.00	N/A	25.11	100.00
6.	42.95	12.75	0.72	11.53	N/A	25.00	N/A	17.78	100.00
7.	43.80	12.31	0.72	10.97	N/A	24.00	N/A	15.84	100.00
8.	47.05	11.23	0.78	8.99	N/A	21.00	N/A	11.22	100.00
9.	48.45	11.14	0.78	8.58	N/A	20.50	N/A	10.59	100.00
10.	50.00	12.92	0.84	7.74	N/A	21.50	N/A	11.88	100.00
11.	4805.548	52.17 48.59	2.35 2.35	33.65 33.65	36.45 36.45	51.72pk 48.14Av	N/A	385.47pk 255.47Av	500pk 5011Av
12.	7208.317	41.30 37.47	2.70 2.70	38.30 38.30	36.25 36.25	46.05pk 42.22Av	N/A	200.67pk 129.12Av	20dBc
13.	9611.042	49.73 40.67	2.40 2.40	38.50 38.50	37.00 37.00	53.63pk 44.57Av	N/A	480.83pk 169.23Av	20dBc

Note: For radiated emissions that fall within 30MHz -1GHz the required limits are as part 15.209.For other frequencies that do not fall into the restricted bands of operation that are ≥1 GHz the required Limit is 20dBc below the fundamental output power.

Radiated Electric Field Emissions Within The Restricted Band 15.205 continued:

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

Test Details CH46 Connected to Power Supply	
Regulation	CFR 47 2008, Part 15 Subpart (c) Clause 15.247(d) and Clause 15.205
Measurement standard	ANSI C63.4:2003
Frequency range	30MHz to 25 GHz
EUT sample number	S01
Modification state	0
SE in test environment	S03
EUT set up	Refer to Appendix C
Photographs (Appendix F)	Photograph 1 and 2

The worst case radiated emission measurements for spurious emissions and harmonics that fall within the restricted bands are listed below and designated with (r).

Ref No.	FREQ. (MHz)	MEAS Rx (dBµV)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	FIELD ST'GH (dBµV/m)	EXTRAP FACT (dB)	FIELD ST'GH (µV/m)	LIMIT (µV/m)
1.	31.80	15.68	0.56	17.56	N/A	33.80	N/A	48.97	100.00
2.	33.35	18.59	0.60	16.41	N/A	35.60	N/A	60.25	100.00
3.	37.40	15.11	0.68	14.21	N/A	33.00	N/A	44.66	100.00
4.	39.35	16.31	0.72	13.07	N/A	30.10	N/A	31.98	100.00
5.	40.35	14.75	0.72	12.53	N/A	28.00	N/A	25.11	100.00
6.	42.95	12.75	0.72	11.53	N/A	25.00	N/A	17.78	100.00
7.	43.80	12.31	0.72	10.97	N/A	24.00	N/A	15.84	100.00
8.	47.05	11.23	0.78	8.99	N/A	21.00	N/A	11.22	100.00
9.	48.45	11.14	0.78	8.58	N/A	20.50	N/A	10.59	100.00
10.	50.00	12.92	0.84	7.74	N/A	21.50	N/A	11.88	100.00
11.	4881.56	54.09 48.49	2.35 2.35	33.65 33.65	36.50 36.50	53.59pk 47.99Av	N/A	478.07pk 250.90Av	500.0pk 5011.0Av
12.	7322.34	47.27 38.98	2.70 2.70	38.30 38.30	36.30 36.30	51.97pk 43.68Av	N/A	396.73pk 152.75Av	500.0pk 5011.0Av
13.	9763.12	51.28 42.68	2.40 2.40	38.50 38.50	37.05 37.05	55.13pk 46.53Av	N/A	570.82pk 212.08Av	20dBc

Note: For radiated emissions that fall within 30MHz -1GHz the required limits are as part 15.209.For other frequencies that do not fall into the restricted bands of operation that are ≥1 GHz the required Limit is 20dBc below the fundamental output power.

Radiated Electric Field Emissions Within The Restricted Band 15.205 continued:

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

Test Details CH92 Connected to Power Supply	
Regulation	CFR 47 2008, Part 15 Subpart (c) Clause 15.247(d) and Clause 15.205
Measurement standard	ANSI C63.4:2003
Frequency range	100 kHz to 25 GHz
EUT sample number	S01
Modification state	0
SE in test environment	S03
EUT set up	Refer to Appendix C
Photographs (Appendix F)	Photograph 1 and 2

The worst case radiated emission measurements for spurious emissions and harmonics that fall within the restricted bands are listed below and designated with (r).

Ref No.	FREQ. (MHz)	MEAS Rx (dBµV)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	FIELD ST'GH (dBµV/m)	EXTRAP FACT (dB)	FIELD ST'GH (µV/m)	LIMIT (µV/m)
1.	31.80	15.68	0.56	17.56	N/A	33.80	N/A	48.97	100.00
2.	33.35	18.59	0.60	16.41	N/A	35.60	N/A	60.25	100.00
3.	37.40	15.11	0.68	14.21	N/A	33.00	N/A	44.66	100.00
4.	39.35	16.31	0.72	13.07	N/A	30.10	N/A	31.98	100.00
5.	40.35	14.75	0.72	12.53	N/A	28.00	N/A	25.11	100.00
6.	42.95	12.75	0.72	11.53	N/A	25.00	N/A	17.78	100.00
7.	43.80	12.31	0.72	10.97	N/A	24.00	N/A	15.84	100.00
8.	47.05	11.23	0.78	8.99	N/A	21.00	N/A	11.22	100.00
9.	48.45	11.14	0.78	8.58	N/A	20.50	N/A	10.59	100.00
10.	50.00	12.92	0.84	7.74	N/A	21.50	N/A	11.88	100.00
11.	4961.05	57.22 52.29	2.35 2.35	33.65 33.65	36.60 36.60	56.62pk 51.69Av	N/A	677.64pk 384.14Av	500.0pk 5011.0Av
12.	7441.58	46.93 37.81	2.70 2.70	38.30 38.30	36.10 36.10	51.83pk 42.71Av	N/A	390.39pk 136.61Av	500.0pk 5011.0Av
13.	9922.11	50.71 41.41	2.40 2.40	38.50 38.50	37.20 37.20	54.41pk 45.11Av	N/A	525.41pk 180.09Av	20dBc

Note: For radiated emissions that fall within 30MHz -1GHz the required limits are as part 15.209.For other frequencies that do not fall into the restricted bands of operation that are ≥1 GHz the required Limit is 20dBc below the fundamental output power.

Notes:

1 Any testing performed below 30 MHz was performed using a magnetic loop antenna in accordance with ANSI C63.4: 2003 section 8.2.1.

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 The measurements 2483.5 MHz was made to ensure band edge compliance.

4 Demonstration of band edge compliance at 2.4GHz (which lies outside the restricted bands as defined in section CFR47Part 15.205(a) is contained in section A2, RF Antenna Conducted Spurious Emissions and Appendix B of this test report.

5 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.

6 For Frequencies Below 1 GHz, RBW= 100 kHz, testing was performed with CISPR16 compliant test receiver with QP detector. Above 1 GHz tests were performed using a spectrum analyser using the following settings:

Peak	RBW=VBW= 1MHz
Average	RBW= 1 MHz, VBW = 10 Hz

These settings as per ANSI C63.4 and DA 00-705.

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

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

The upper and lower frequency of the measurement range was decided according to CFR 47 Part 15:2008 Clause 15.33(a) and 15.33(a)(1).

Radiated emission limits (CFR 47 Part 15:2008 Clause 15.209) for emissions falling within the restricted bands defined in 15.205(a):

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

Notes:

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

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

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

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

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

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

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

A4 Power Line Conducted Emissions

Preview power line conducted emission measurements were performed with a peak detector in a screened room.

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

Where applicable formal measurements of the emissions were performed with a peak, average and/or quasi peak detector. The EUT was set to transmit on its lowest, centre and highest carrier frequency in turn. The formal measurements are detailed below:

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

Test Details: 2.441 GHz	
Regulation	CFR 47 2008, Part 15 Subpart (c) Clause 15.207
Measurement standard	ANSI C63.4:2003
Frequency range	150kHz to 30MHz
EUT sample number	S01
Modification state	0
SE in test environment	S02 Dell Laptop
EUT set up	Refer to Appendix C
Photographs (Appendix F)	Photograph 3

The worst case power line conducted emission measurements are listed below:
The worst case was using the Activslate60 connected and charging the battery via the Laptop and USB cable.

Ref No.	Freq (MHz)	Conductor	Result (dBuV)	Detector	Spec Limit (dBuV)	Margin (dB)	Result
1	0.18	Live	48.55	Quasi Peak	64.49	15.94	Pass
2	0.18	Live	37.85	Average	54.49	16.64	Pass
3	0.36	Live	32.14	Average	48.73	16.59	Pass
4	0.42	Neutral	28.23	Average	47.45	19.22	Pass
5	0.66	Live	27.28	Average	46.00	18.72	Pass
6	0.72	Live	26.55	Average	46.00	19.45	Pass
7	0.96	Live	27.54	Average	46.00	18.46	Pass
8	1.205	Live	28.10	Average	46.00	17.90	Pass
9	1.505	Live	29.59	Average	46.00	16.41	Pass
10	1.865	Live	29.76	Average	46.00	16.24	Pass
11	1.925	Live	29.63	Average	46.00	16.37	Pass
12	4.450	Live	26.11	Average	46.00	19.89	Pass
13	4.510	Live	26.95	Average	46.00	19.05	Pass
14	4.635	Neutral	27.46	Average	46.00	18.54	Pass
15	4.995	Neutral	38.05	Quasi Peak	56.00	17.95	Pass
16	4.995	Neutral	26.67	Average	46.00	19.33	Pass

Specification limits :

Conducted emission limits (CFR 47 2008 :Clause 15.207).

Conducted disturbance at the mains ports.

Frequency range MHz	Limits dBμV	
	Quasi-peak	Average
0.15 to 0.5	66 to 56[2]	56 to 46[2]
0.5 to 5	56	46
5 to 30	60	50
Notes: 1. The lower limit shall apply at the transition frequency. 2. The limit decreases linearly with the logarithm of the frequency in the range 0.15MHz to 0.5MHz.		

Notes:

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

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

	See (i)	See (ii)	See (iii)	See (iv)
Effect of EUT operating mode on emission levels	✓			
Effect of EUT internal configuration on emission levels	✓			
(i) Parameter defined by standard and / or single possible, refer to Appendix C (ii) Parameter defined by client and / or single possible, refer to Appendix C (iii) Parameter had a negligible effect on emission levels, refer to Appendix C (iv) Worst case determined by initial measurement, refer to Appendix C				

A5 20 dB Bandwidth and Channel Spacing

Title 47 of the CFR: 2002, Part 15 Subpart (c) 15.247(a)(1)(i) requires the measurement of the bandwidth of the transmission between the -20 dB points on the transmitted spectrum. The results of this test determine the limits for channel spacing. The channel spacing shall be a minimum of 25 kHz or the 20 dB bandwidth, whichever is the greater. The formal measurements are detailed below:

Test Details:	
Regulation	CFR 47 2008, Part 15 Subpart (c) 15.247(a)(1)(i)
EUT sample number	S01
Modification state	0
SE in test environment	S02

Measured 20 dB Bandwidth (MHz)	Limit	Result
1.4935MHz	≥500kHz	Pass
fl = 2.403711539GHz		
fh = 2.405205128GHz		

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

A6 Hopping frequencies

Hopping frequencies were verified using a spectrum analyser set to 85 MHz spans, displaying a set of the hopping channels in turn, while the EUT was operating in its normal frequency hopping mode.

Test Details:	
Regulation	CFR 47 2008, Part 15 Subpart (c) 15.247(a)(1)(i)
EUT sample number	S01
Modification state	0
SE in test environment	S02 S03 S04
SE isolated from EUT	None

No. of Hopping Channels	Requirement	Result
46	0.125mW 2.400GHz – 2.4835GHz	Pass

Plots showing the hopping channels are contained in Appendix B

A7 Channel Occupancy

Channel occupancy time was verified using a spectrum analyser in zero span mode, centred on the middle hopping channel frequency (2441 MHz), while the EUT was operating in its normal frequency hopping mode. The other channels were then verified to ensure that the channel occupancy was identical for all channels.

Test Details:	
Regulation	CFR 47 2008, Part15 Subpart (c) 15.247(a)(1)
EUT sample number	S01
Modification state	0
SE in test environment	S02 S03

Measured Channel Occupancy Time (ms)	Calculated Average Channel Occupancy Time (ms)	Average Channel Occupancy Time Limit (ms)	Result
431.551282µs	20.70	400	Pass

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

A8 Antenna Gain

The maximum antenna gain for the antenna types to be used with the EUT, as declared by the client, is 0 dBi.

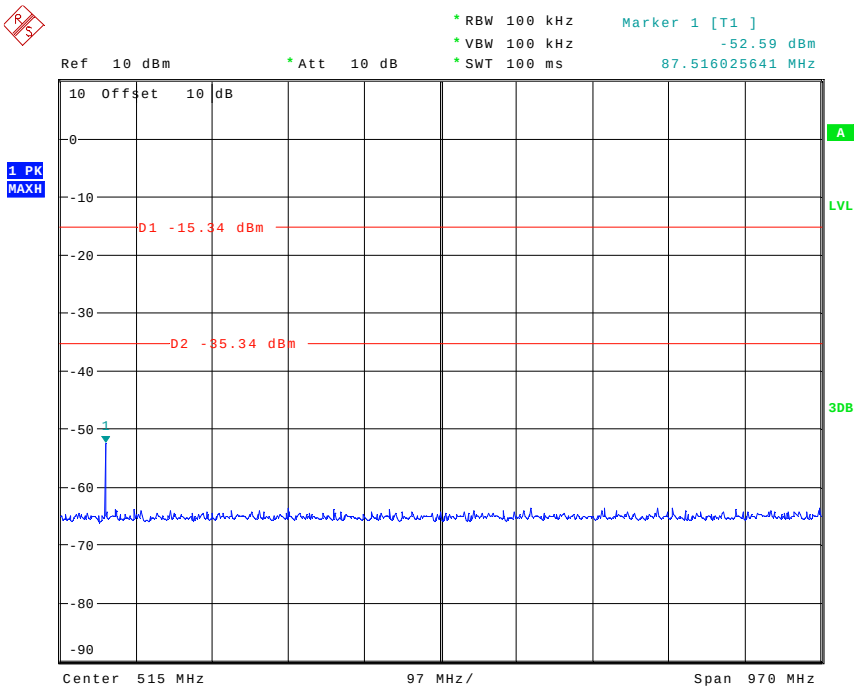
Appendix B: Supporting Graphical Data

This appendix contains graphical data obtained during testing.

Notes:

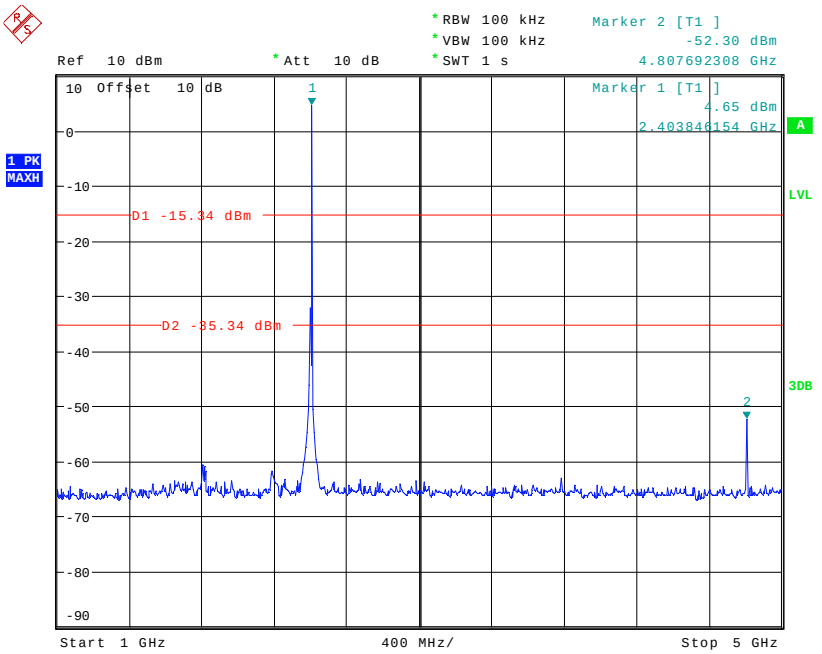
(a) The radiated electric field emissions and conducted emissions graphical data in this appendix is preview data. For details of formal results, refer to Appendix A and Appendix B.

Bottom Channel Conducted emissions 30MHz-1GHz



Date: 16.JUN.2010 14:05:02

Bottom Channel Conducted emissions 1GHz – 5GHz



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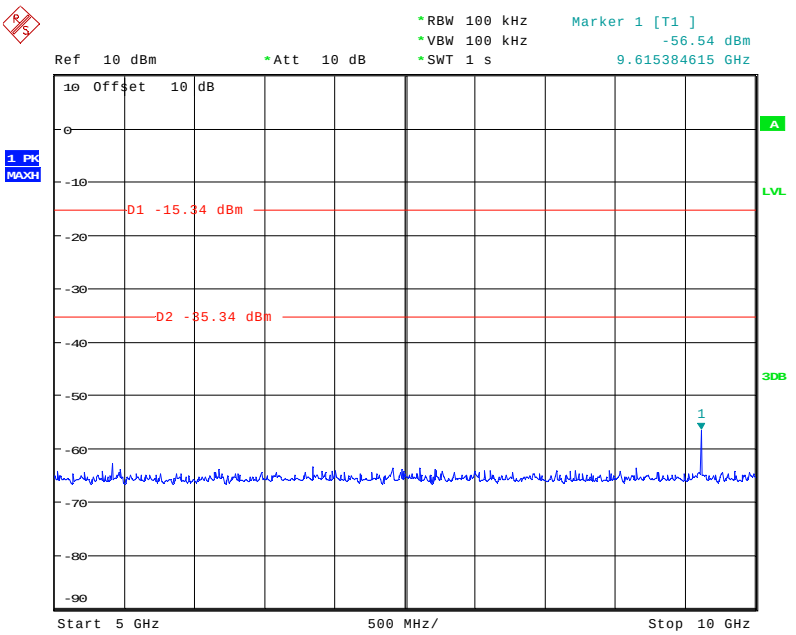
Bottom Channel Conducted emissions 5GHz – 10GHz



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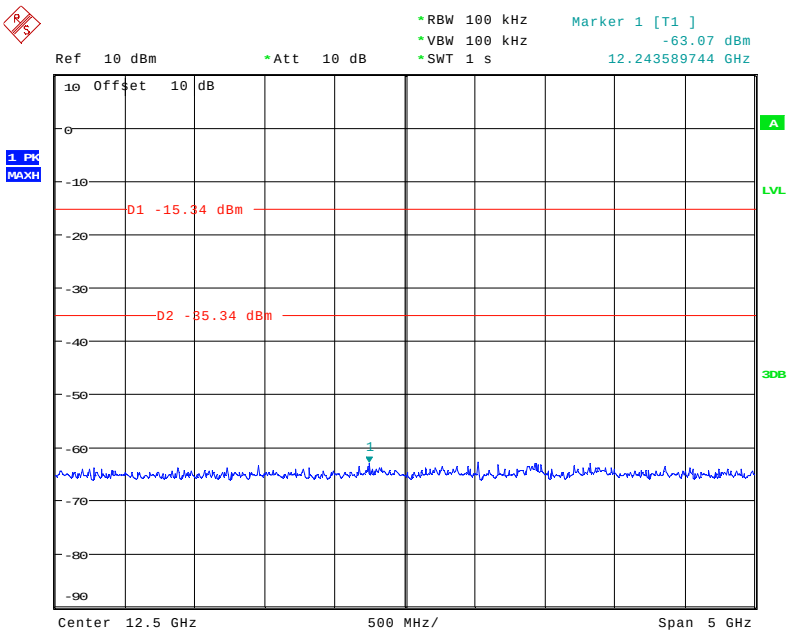
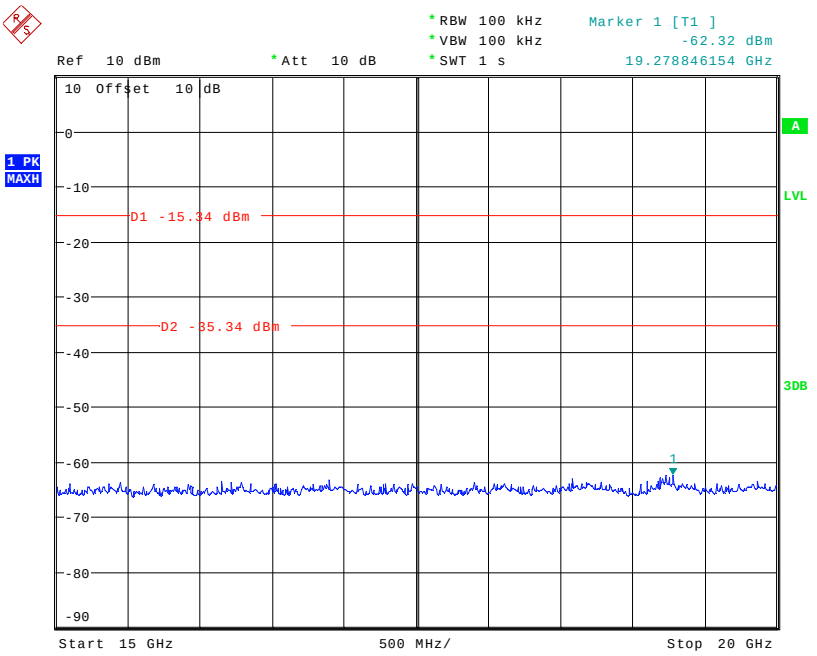
Bottom Channel Conducted emissions 10GHz -15GHz



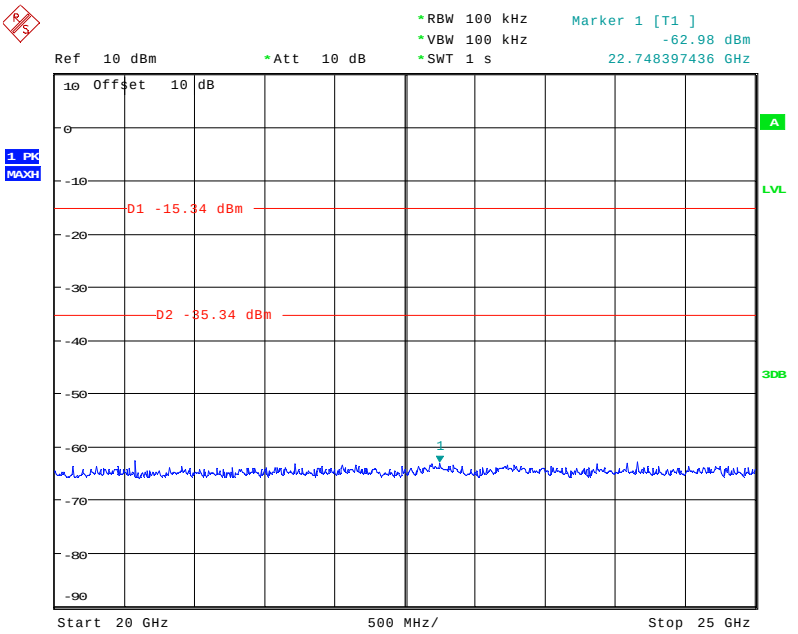
Date: 16.JUN.2010 14:09:25

Bottom Channel Conducted emissions 15GHz -20GHz



Date: 16.JUN.2010 14:10:29

Bottom Channel Conducted emissions 20GHz -25GHz



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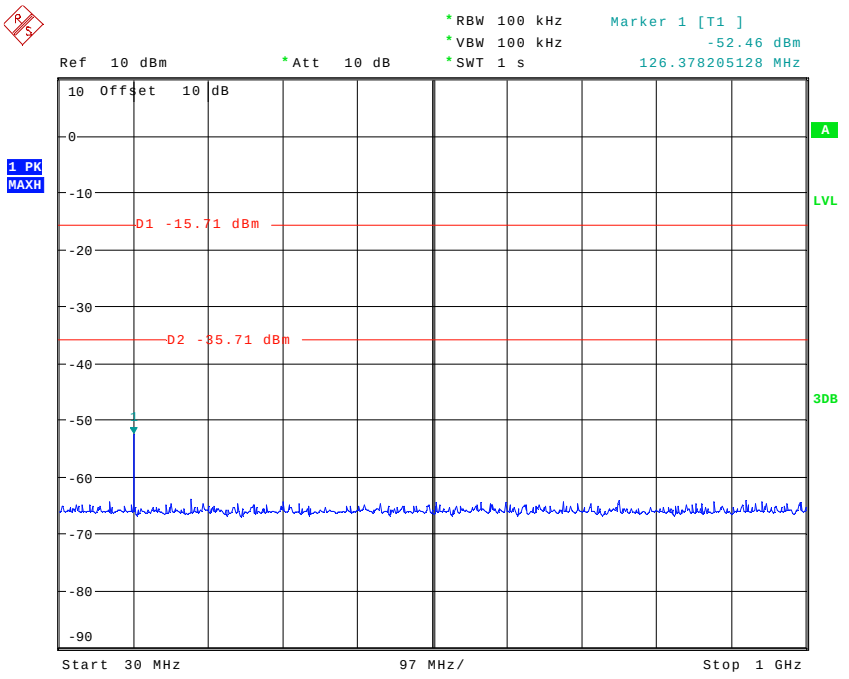
Middle Channel Conducted emissions 30MHz-1GHz



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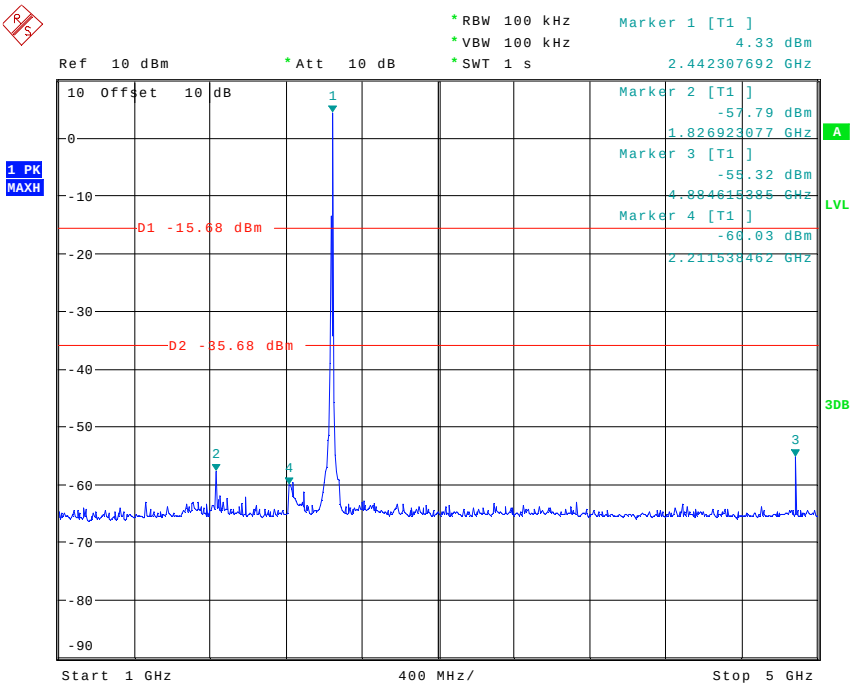
Middle Channel Conducted emissions 1GHz – 5GHz



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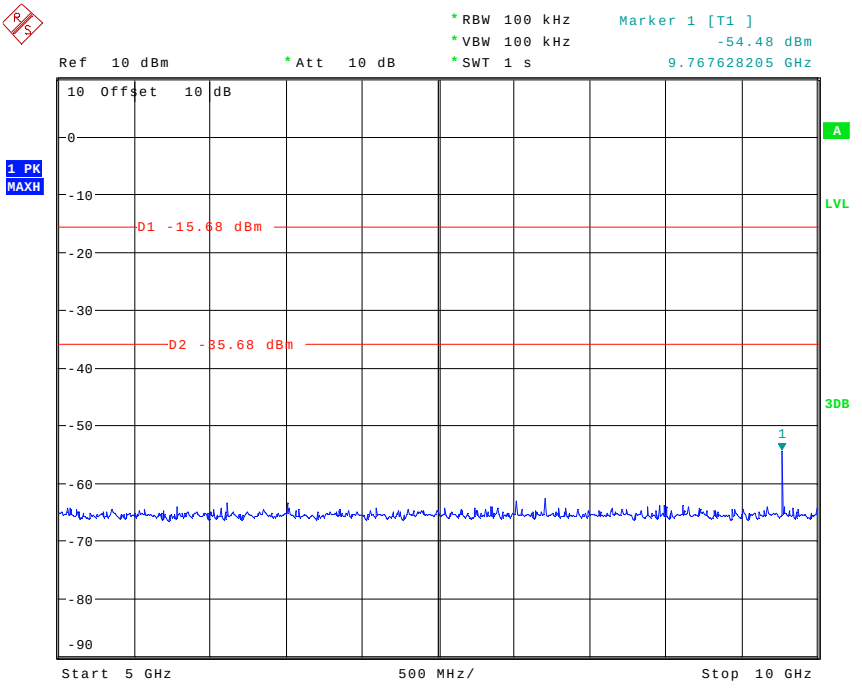
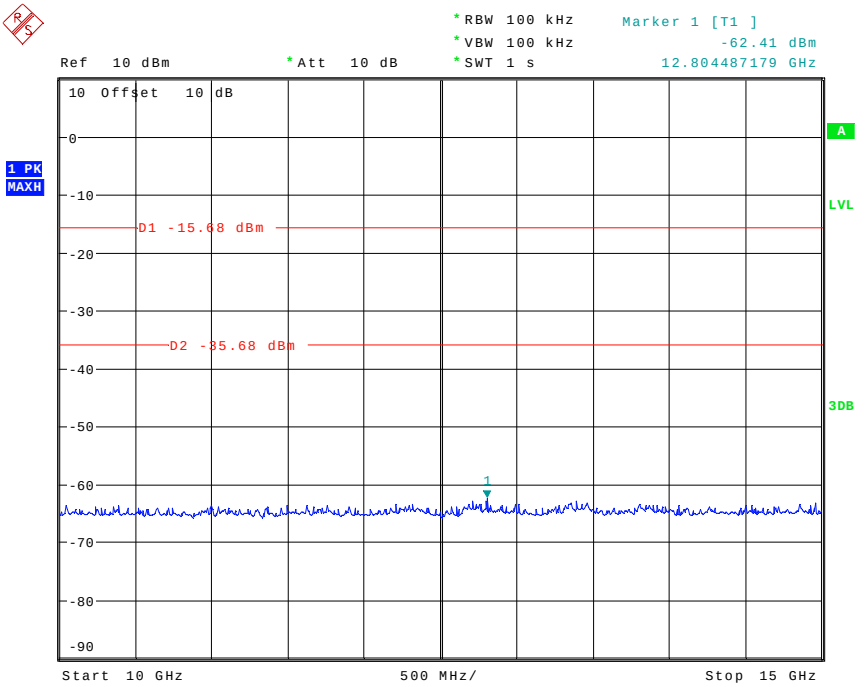
Middle Channel Conducted emissions 5GHz – 10GHz



Date: 16.JUN.2010 14:22:10

Middle Channel Conducted emissions 10GHz – 15GHz



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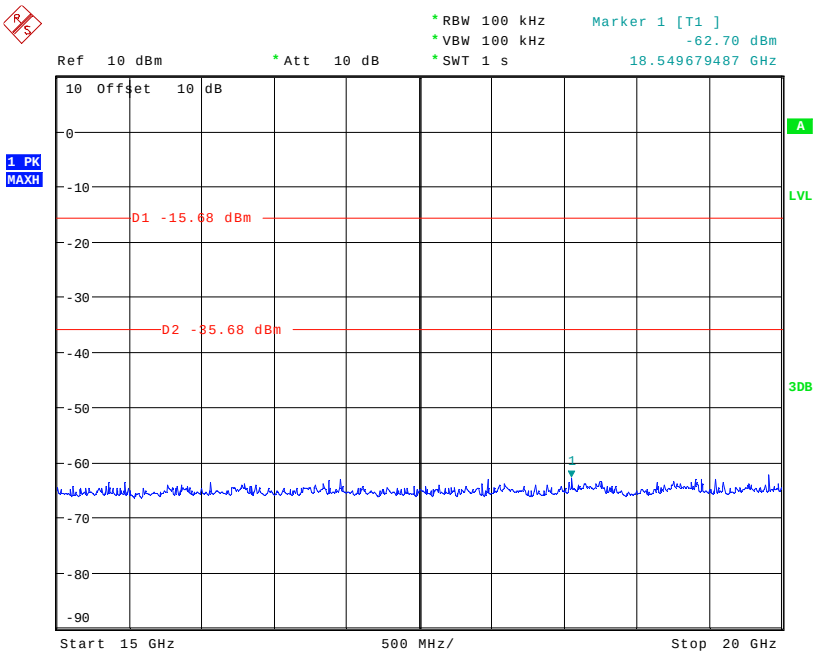
Middle Channel Conducted emissions 15GHz – 20GHz



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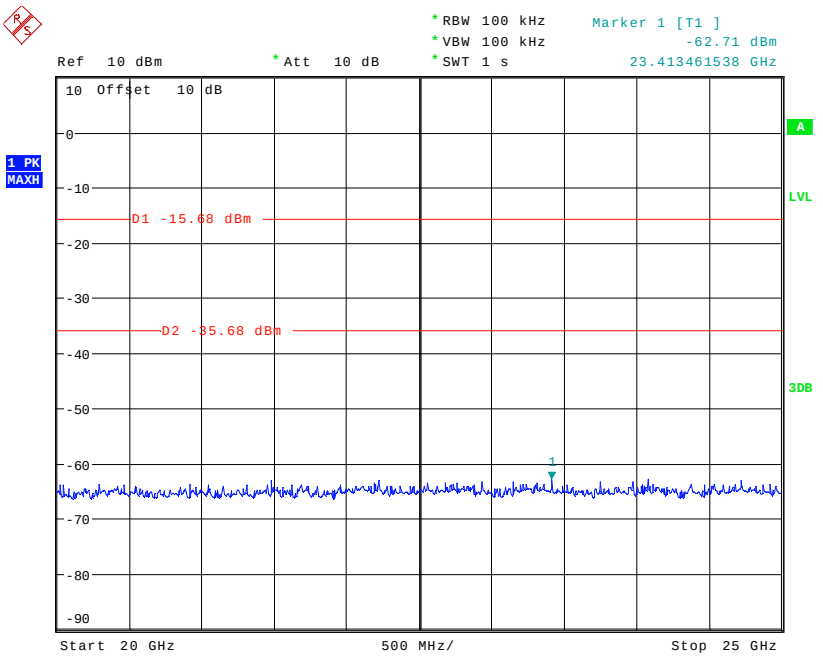
Middle Channel Conducted emissions 20GHz – 25GHz



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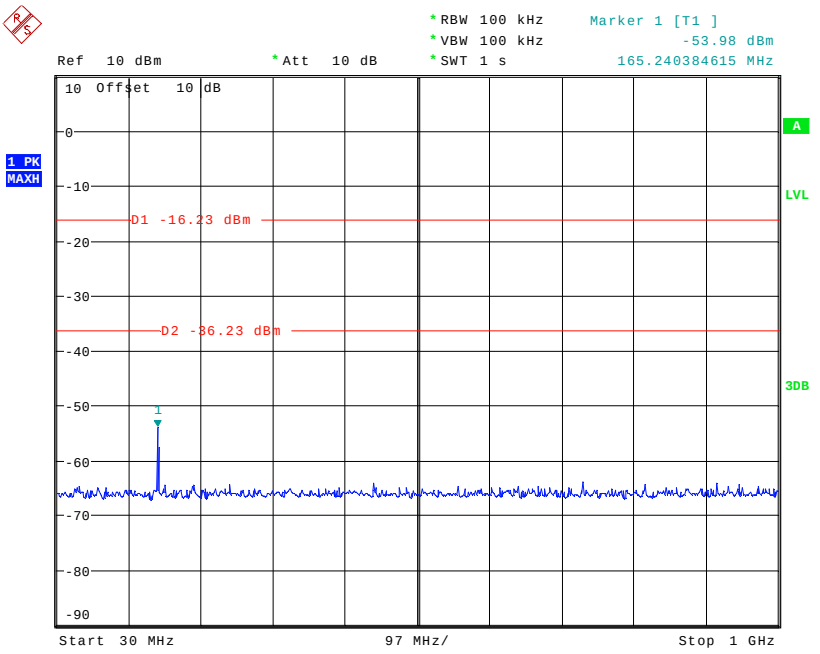
Top Channel Conducted emissions 30MHz-1GHz



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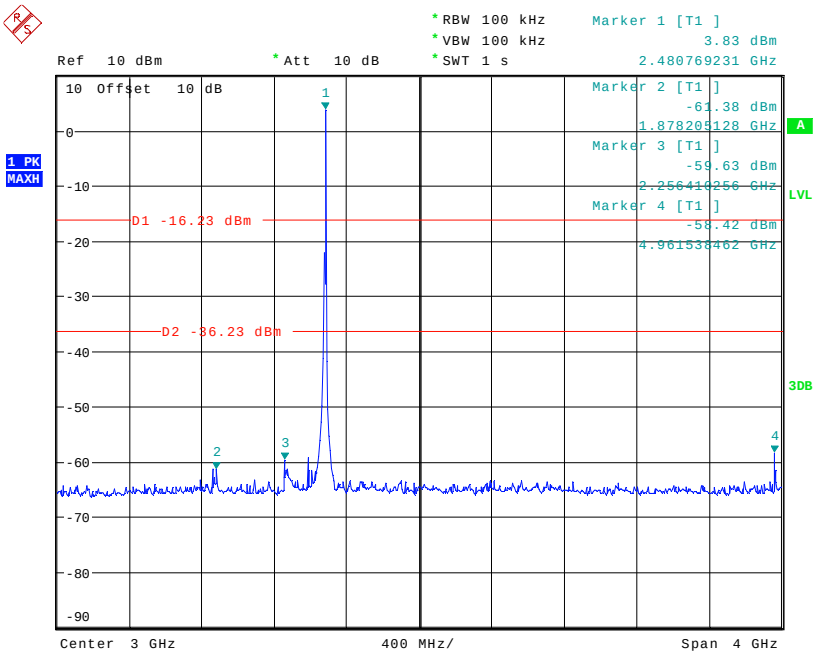
Top Channel Conducted emissions 1GHz – 5GHz



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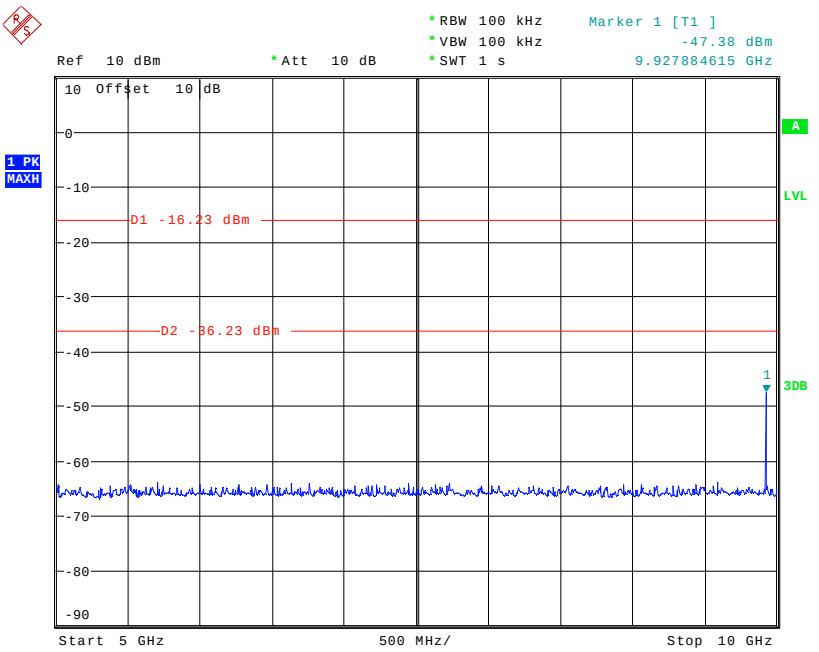
Top Channel Conducted emissions 5GHz – 10GHz



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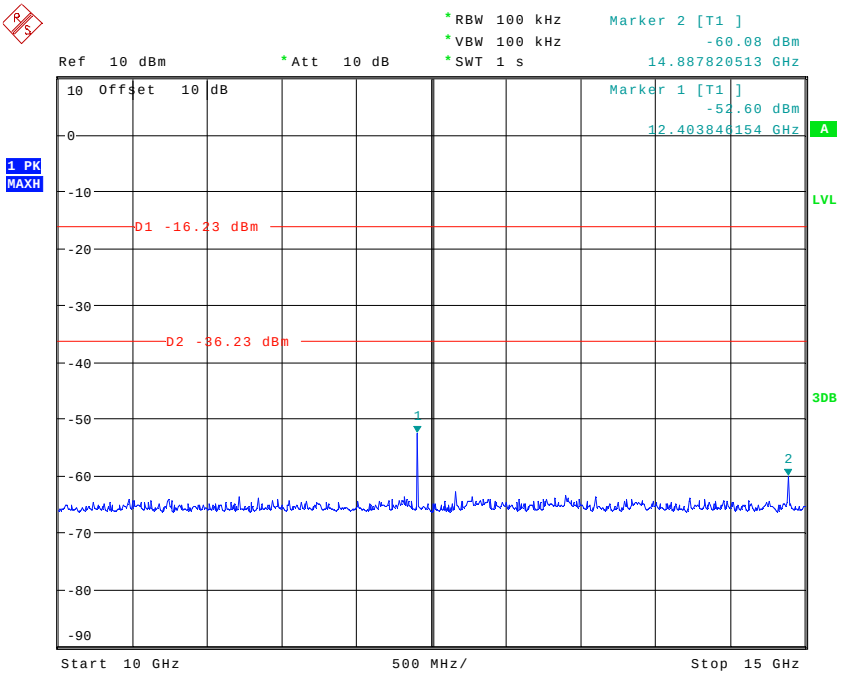
Top Channel Conducted emissions 10GHz – 15GHz



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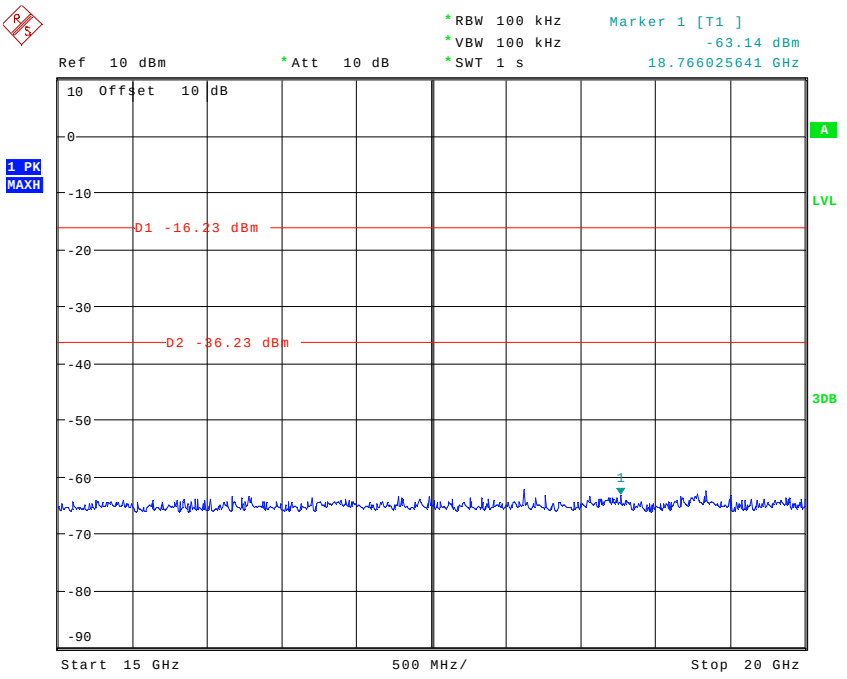
Top Channel Conducted emissions 15GHz – 20GHz



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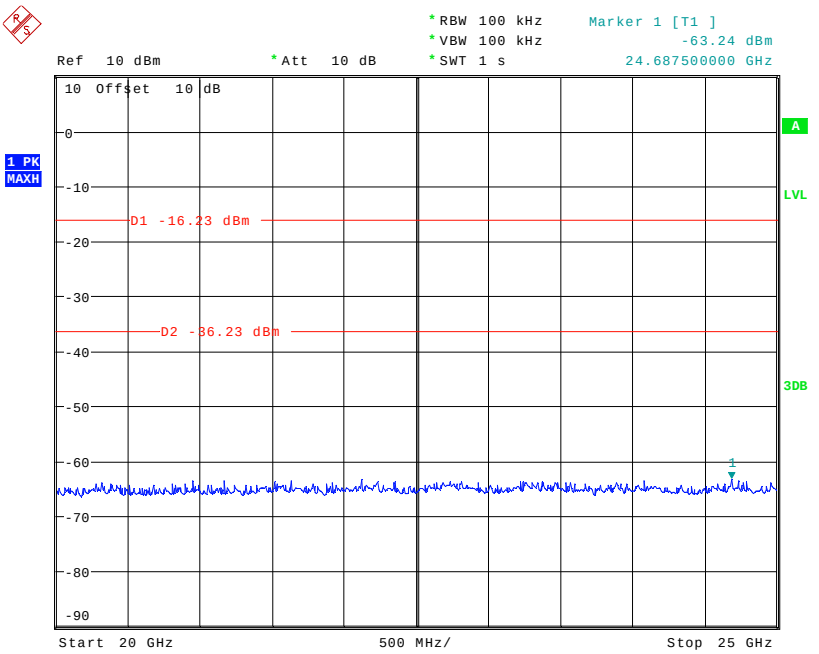
Top Channel Conducted emissions 20GHz – 25GHz



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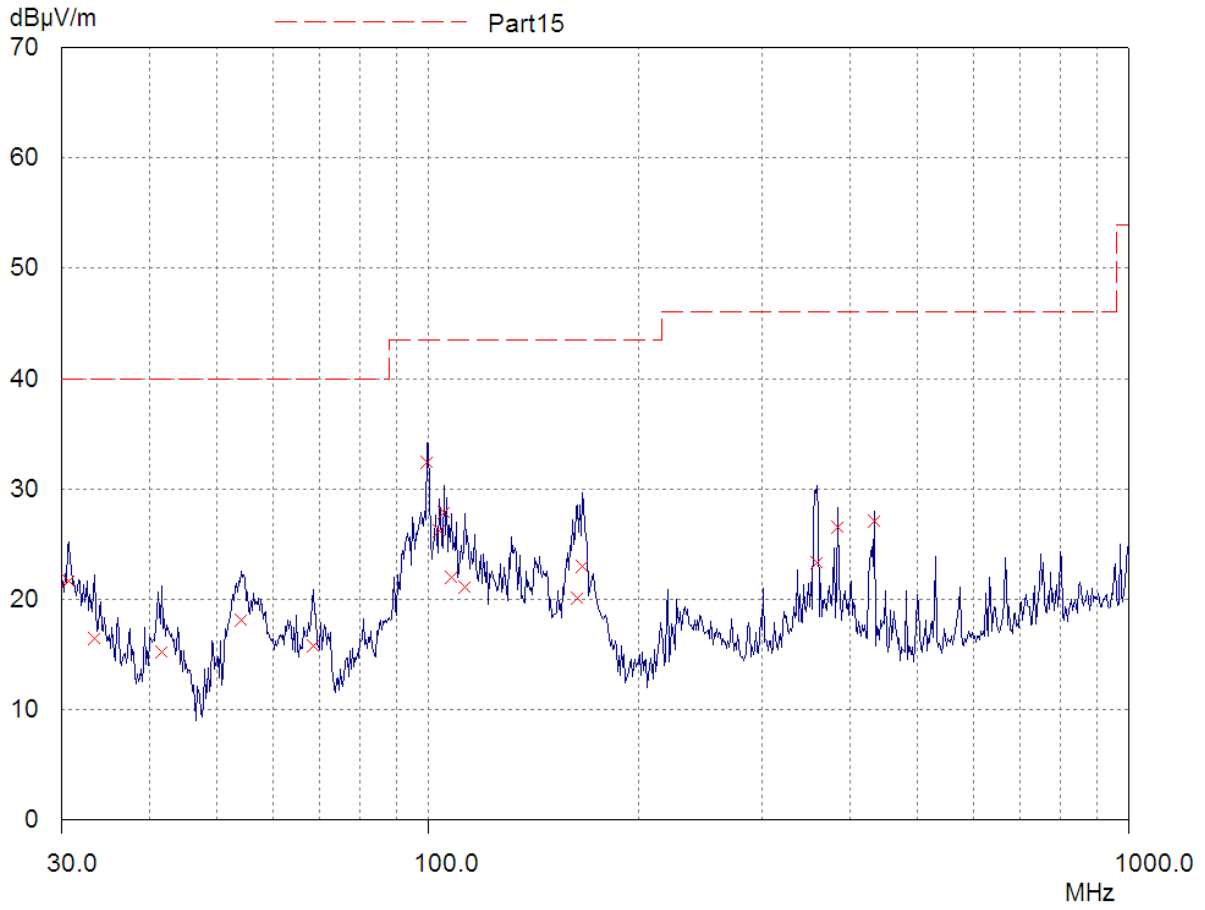
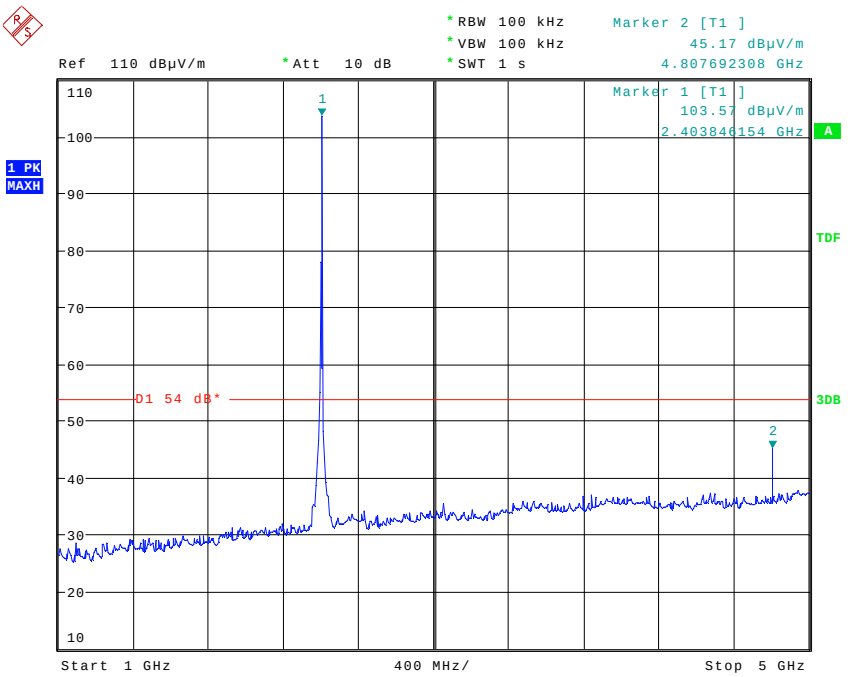
Bottom Channel Radiated emissions 30MHz-1GHz



Bottom Channel Radiated emissions Vertical 1GHz – 5GHz



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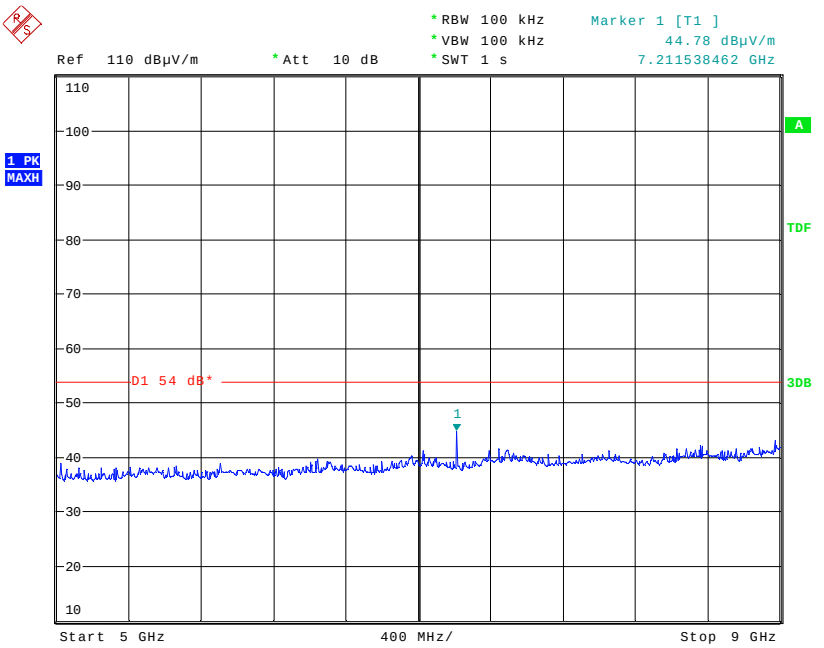
Bottom Channel Radiated emissions Vertical 5GHz – 9GHz



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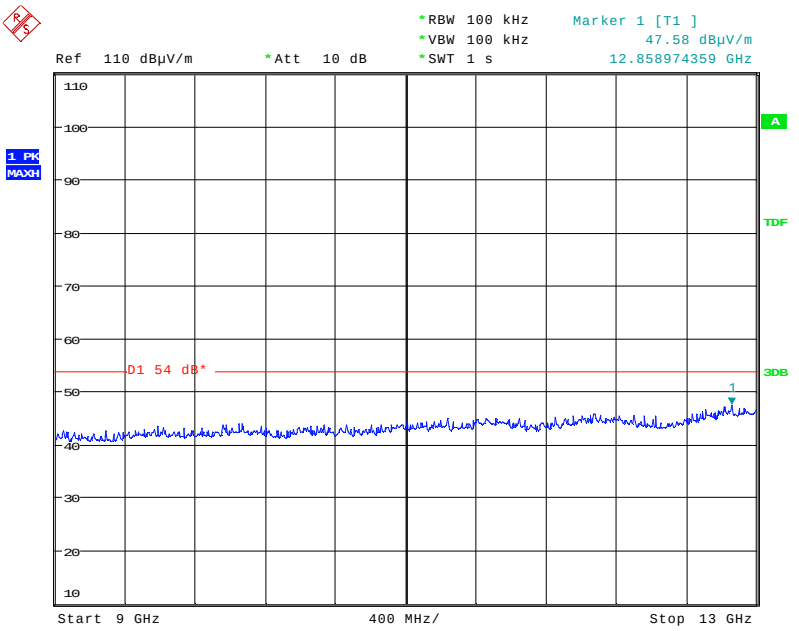
Bottom Channel Radiated emissions Vertical 9GHz – 13GHz



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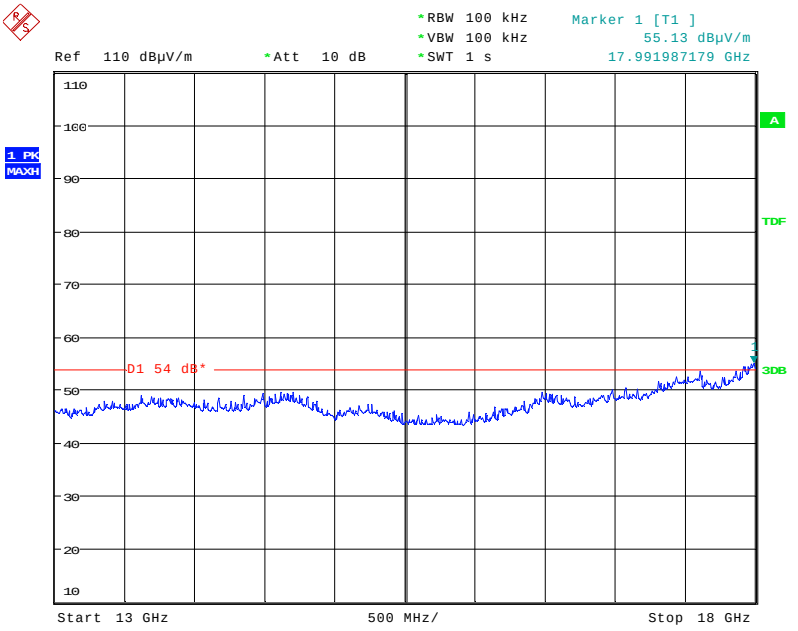
Bottom Channel Radiated emissions Vertical 13GHz – 18GHz



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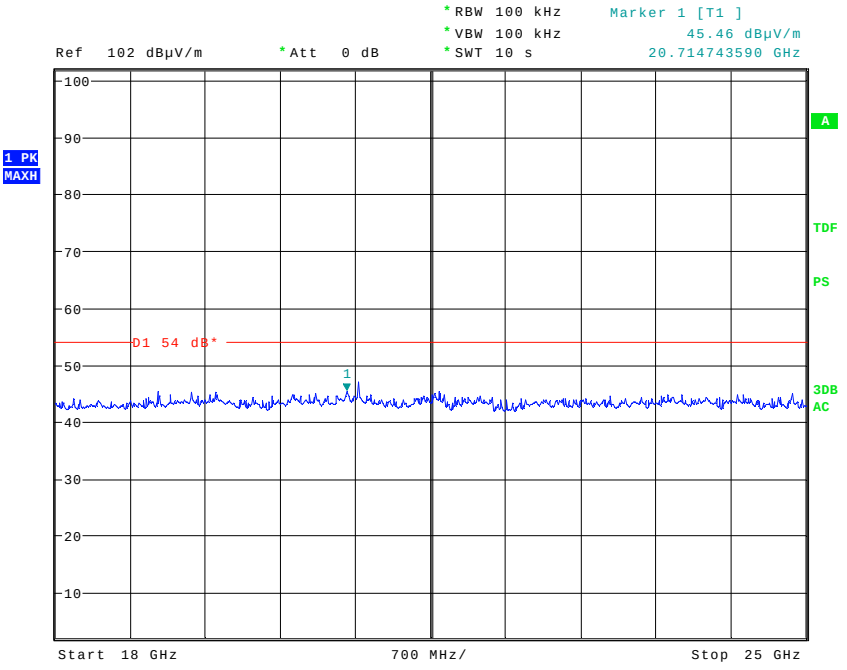
Bottom Channel Radiated emissions Vertical 18GHz – 25GHz



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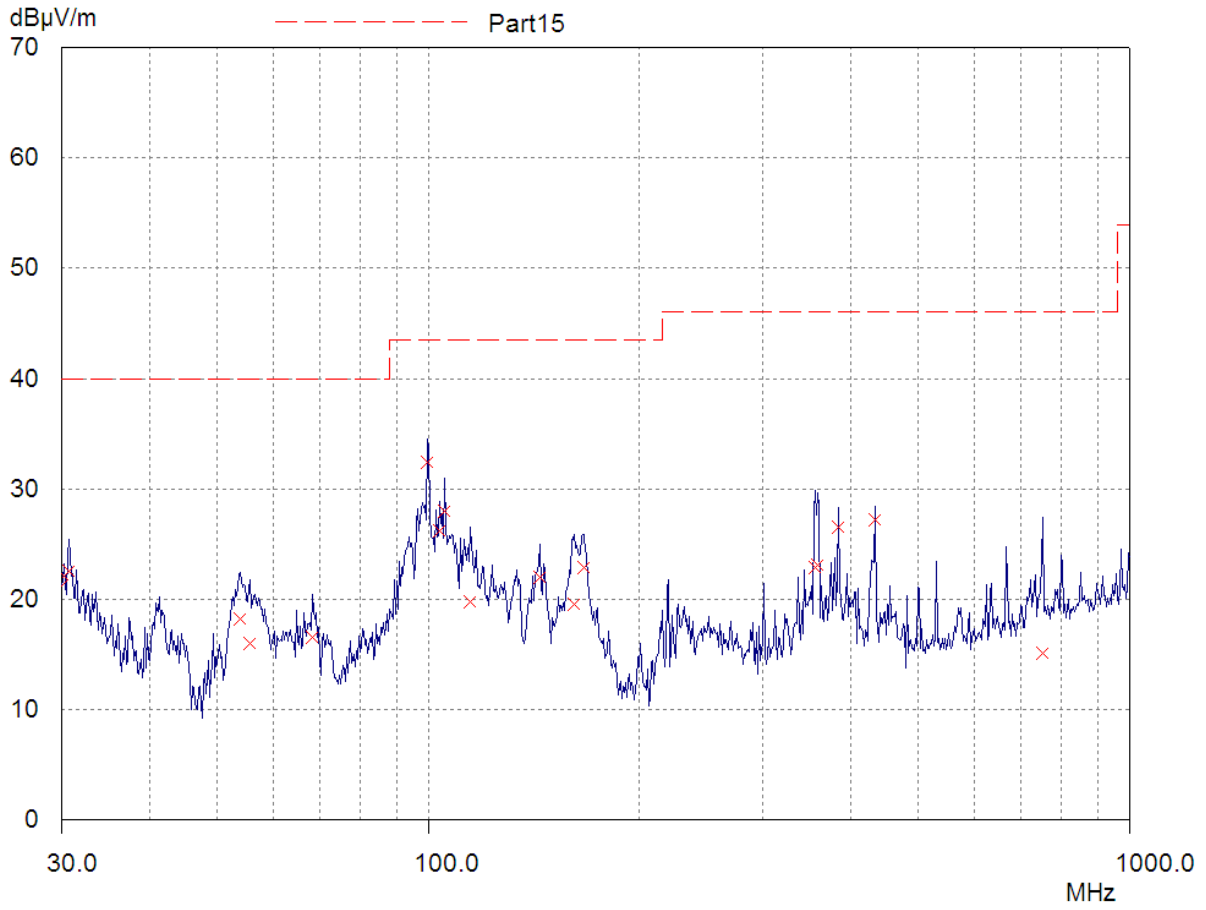
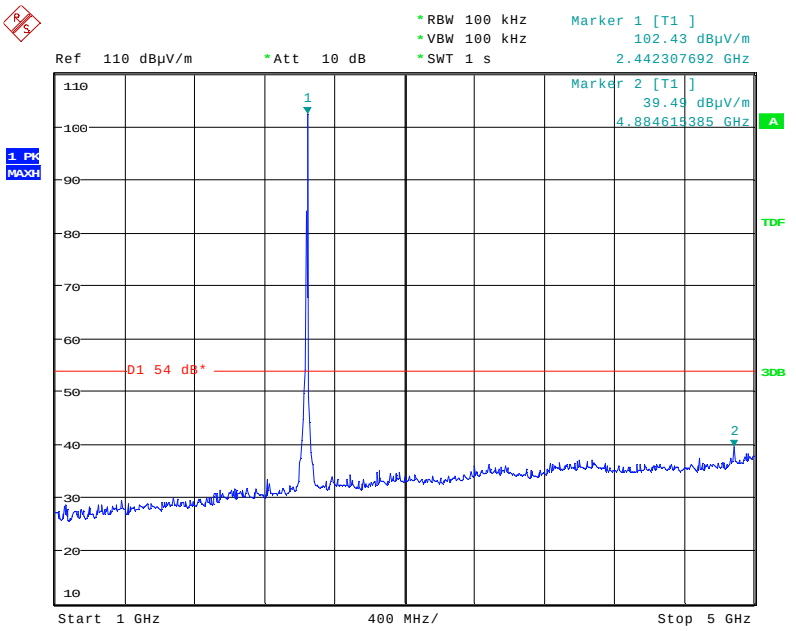
Middle Channel Radiated emissions Vertical 30MHz-1GHz



Middle Channel Radiated emissions Vertical 1GHz – 5GHz



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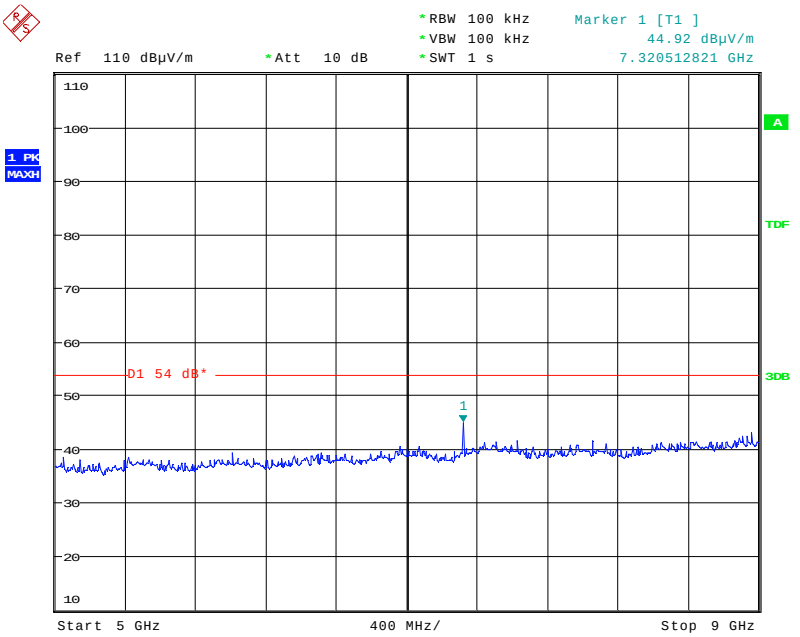
Middle Channel Radiated emissions Vertical 5GHz- 9GHz



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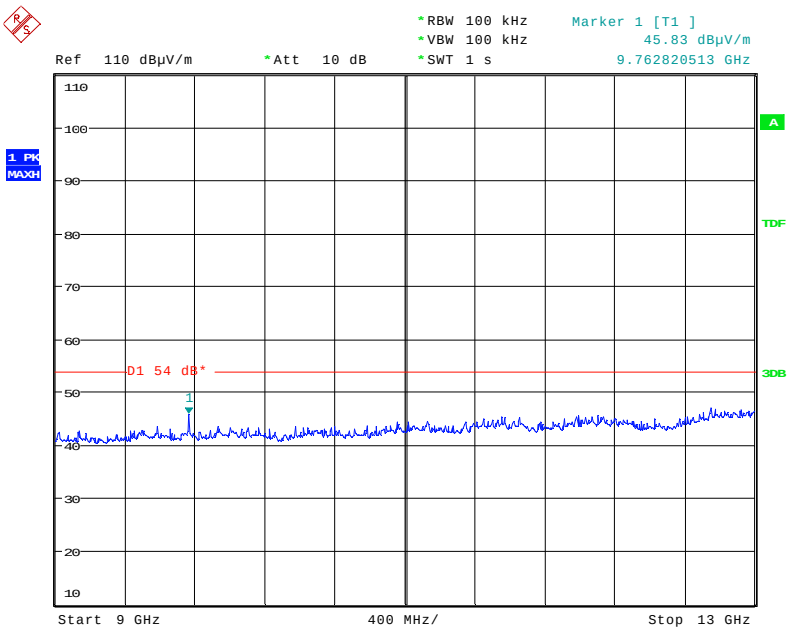
Middle Channel Radiated emissions Vertical 9GHz- 13GHz



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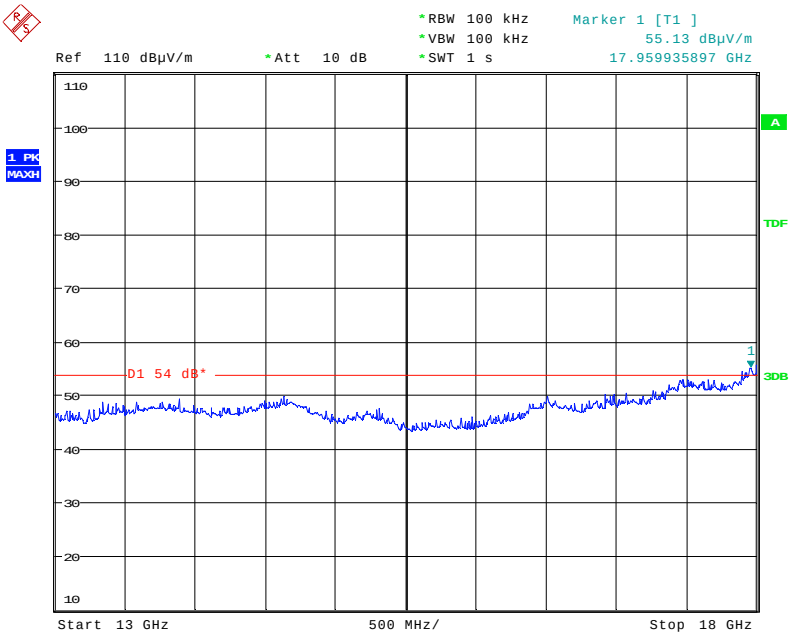
Middle Channel Radiated emissions Vertical 13GHz- 18GHz



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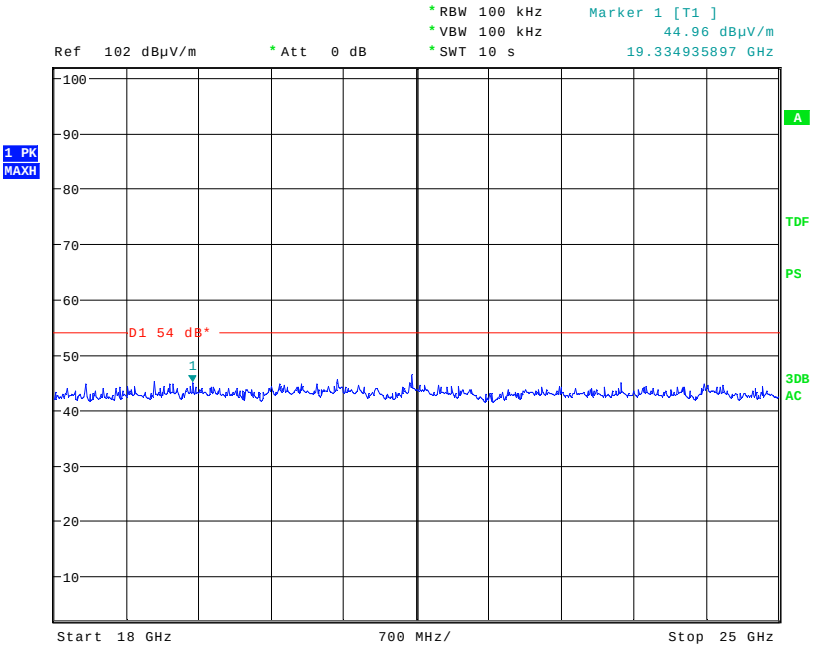
Middle Channel Radiated emissions Vertical 18GHz- 25GHz



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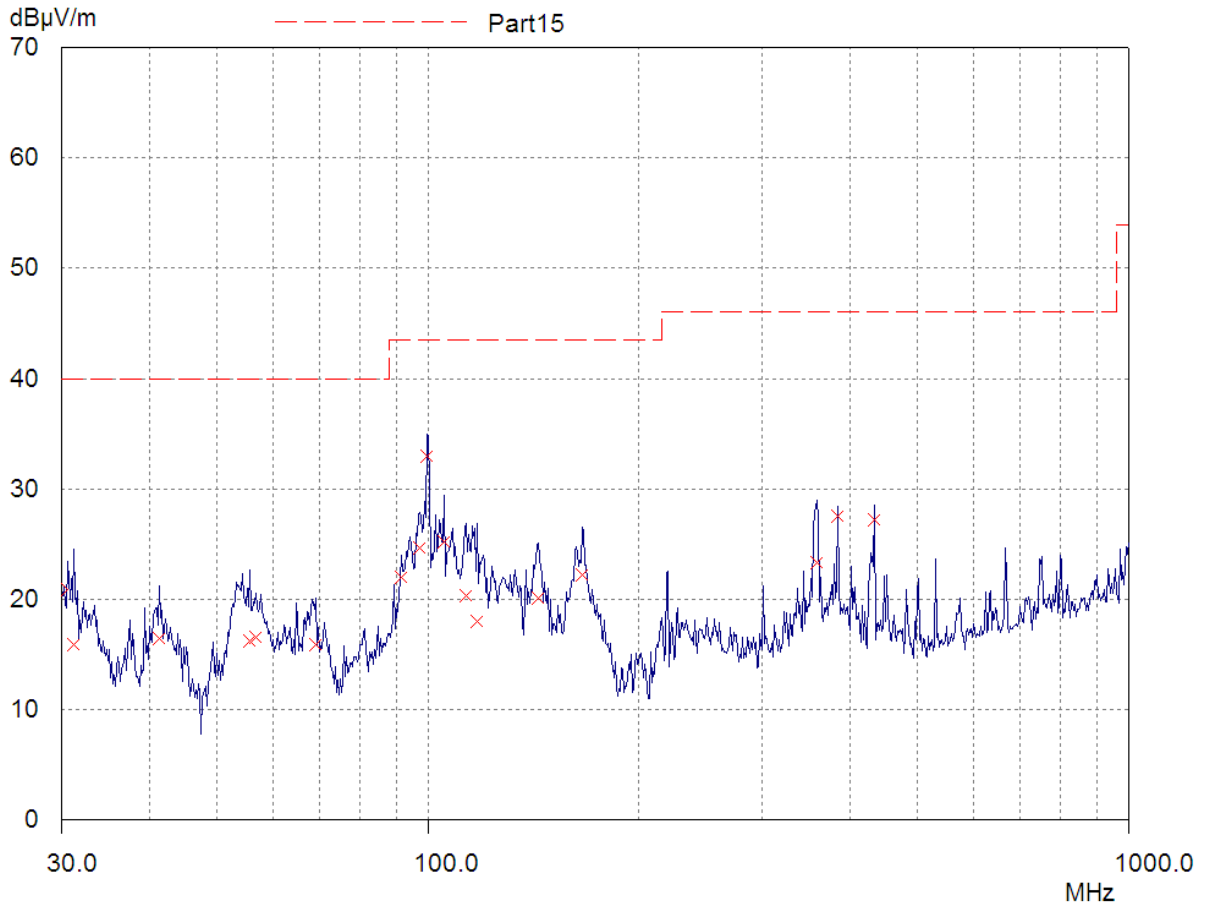
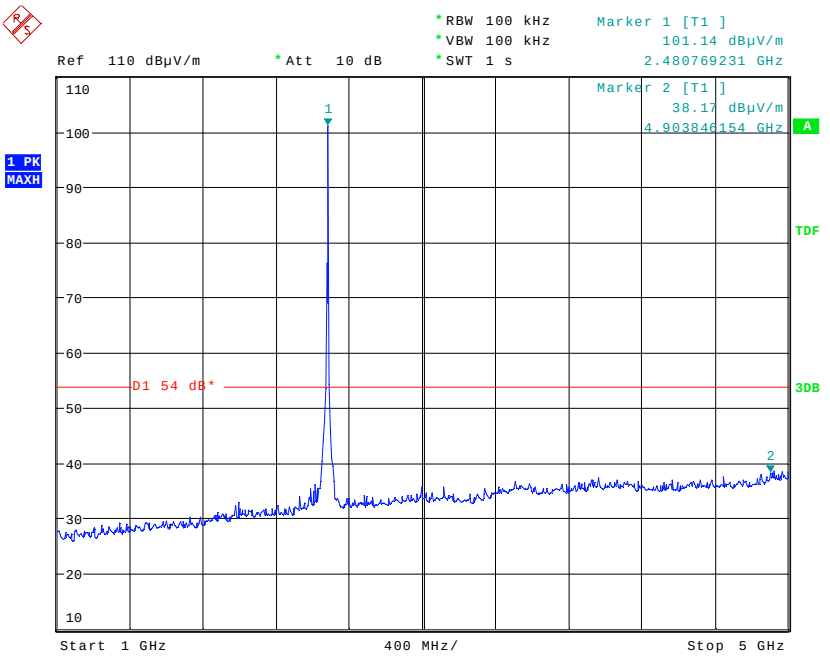
Top Channel Radiated emissions Vertical 30MHz-1GHz



Top Channel Radiated emissions Vertical 1GHz – 5GHz



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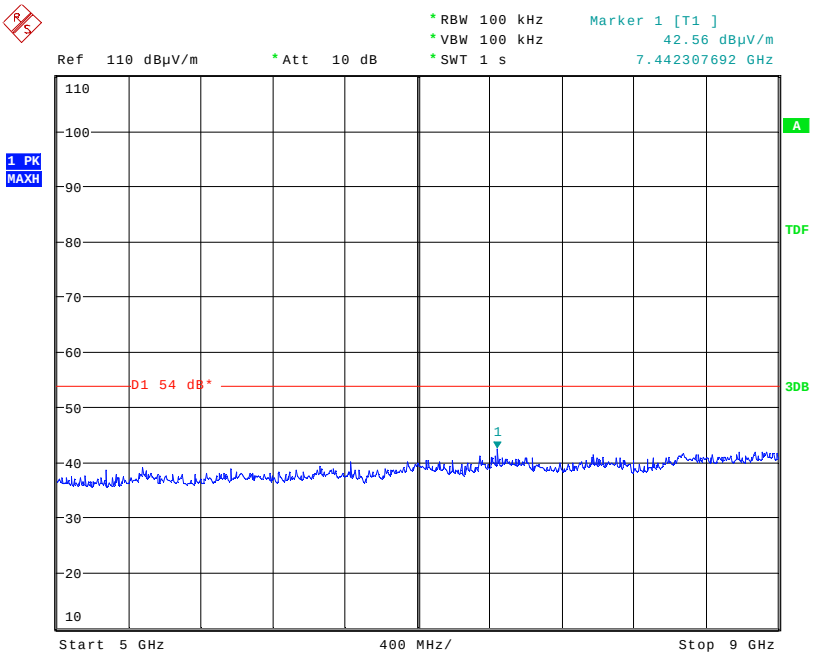
Top Channel Radiated emissions Vertical 5GHz - 9GHz



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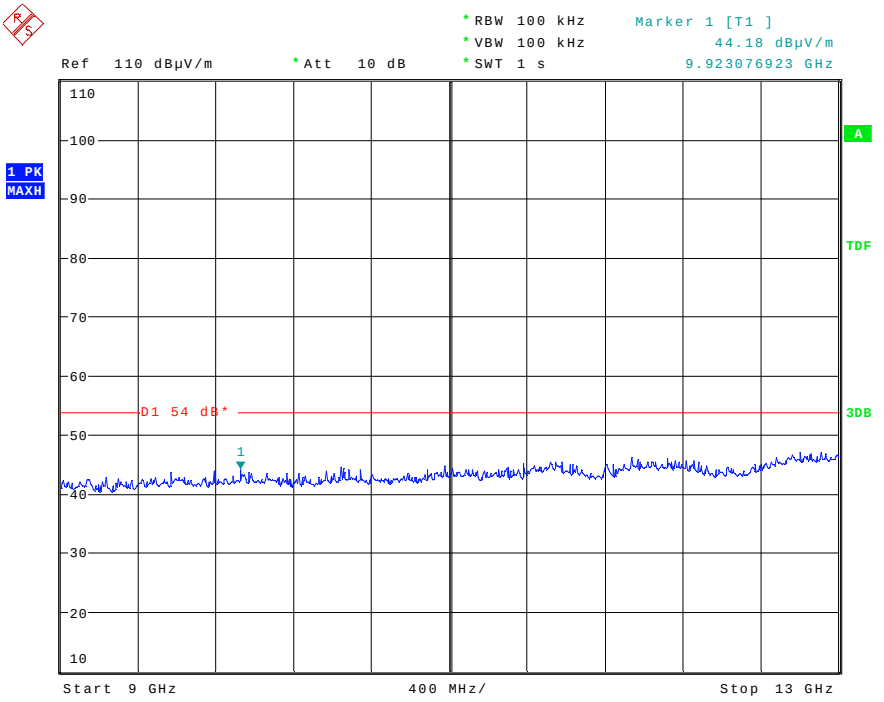
Top Channel Radiated emissions Vertical 9GHz – 13GHz



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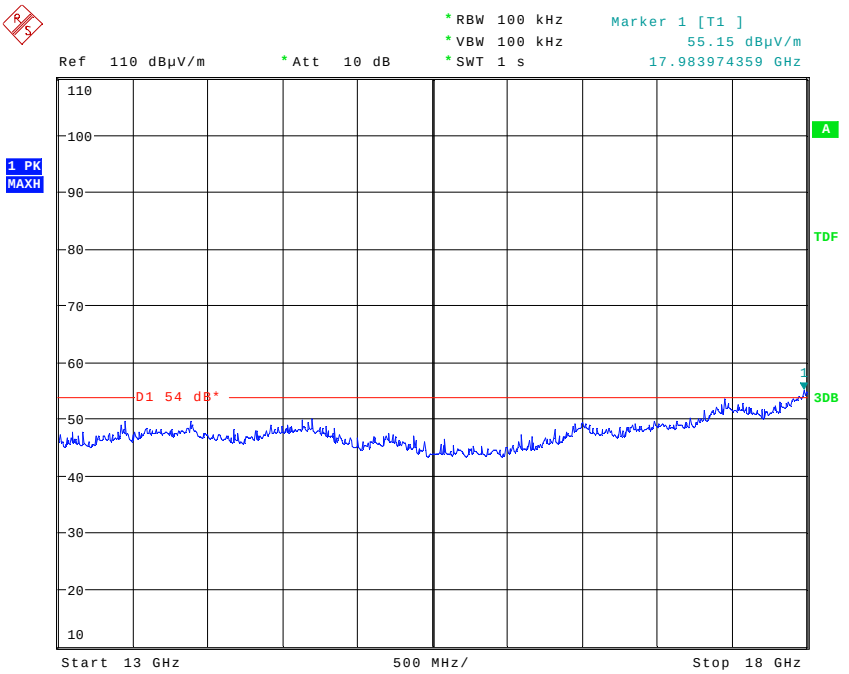
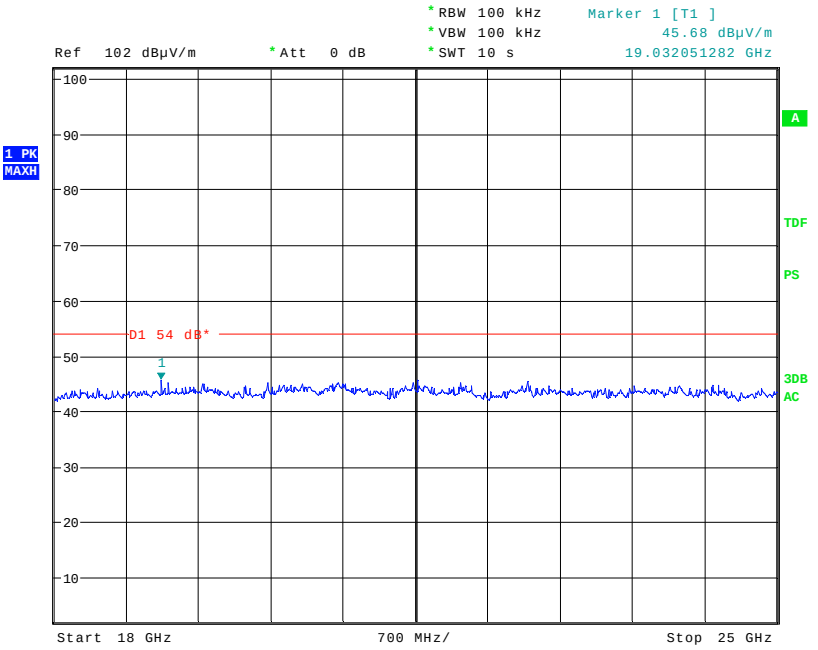
Top Channel Radiated emissions Vertical 13GHz – 18GHz



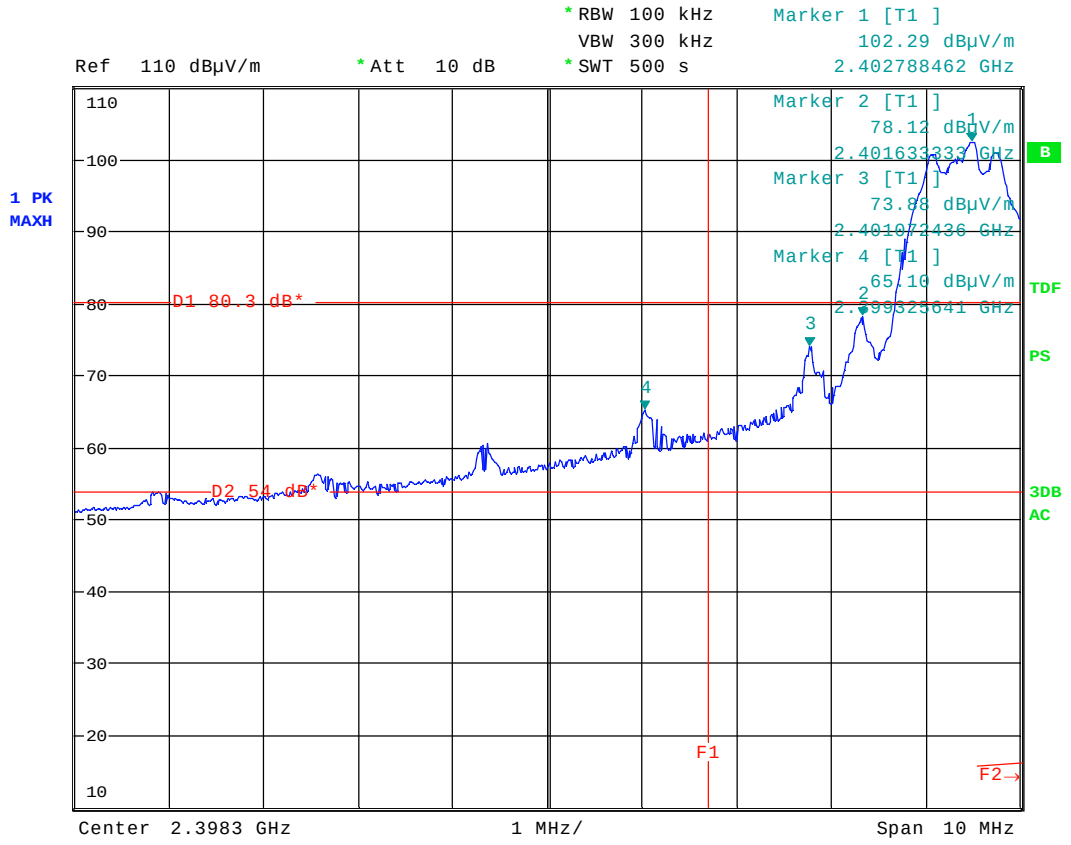
Date: 18.JUN.2010 14:58:26

Top Channel Radiated emissions Vertical 18GHz – 25GHz



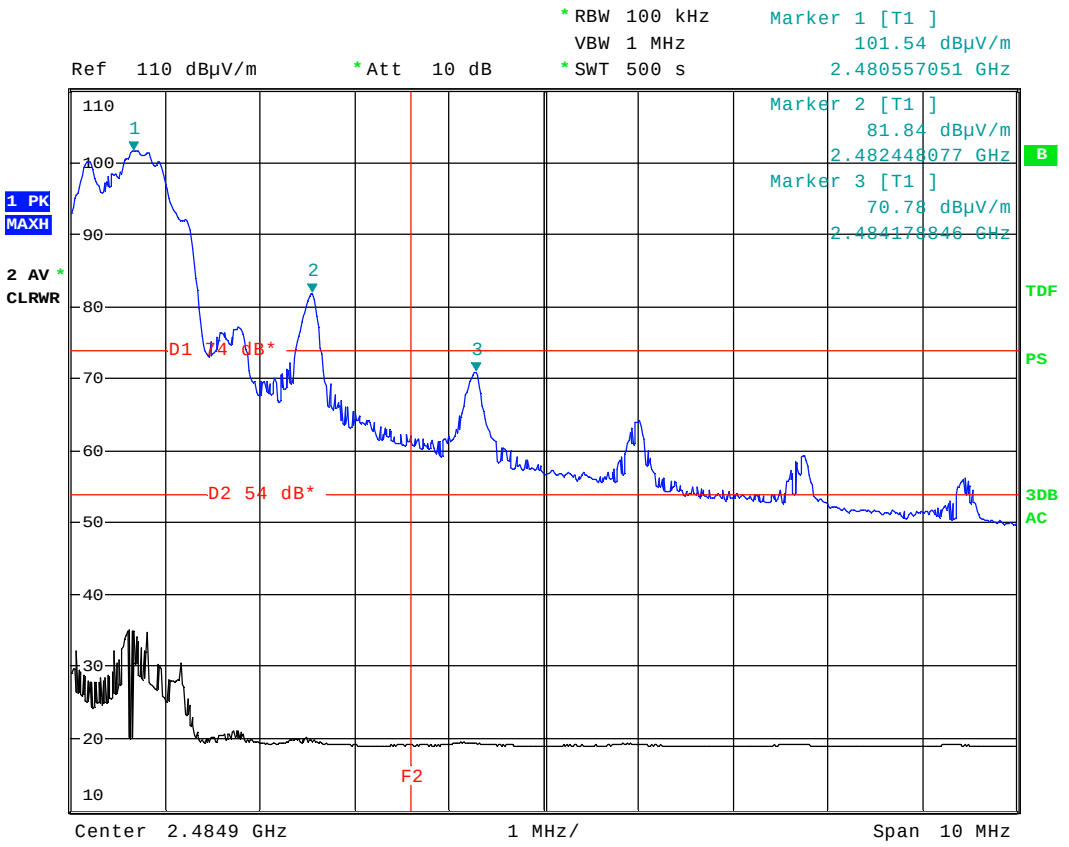
Date: 24.JUN.2010 13:09:14

Lower Band edge compliance

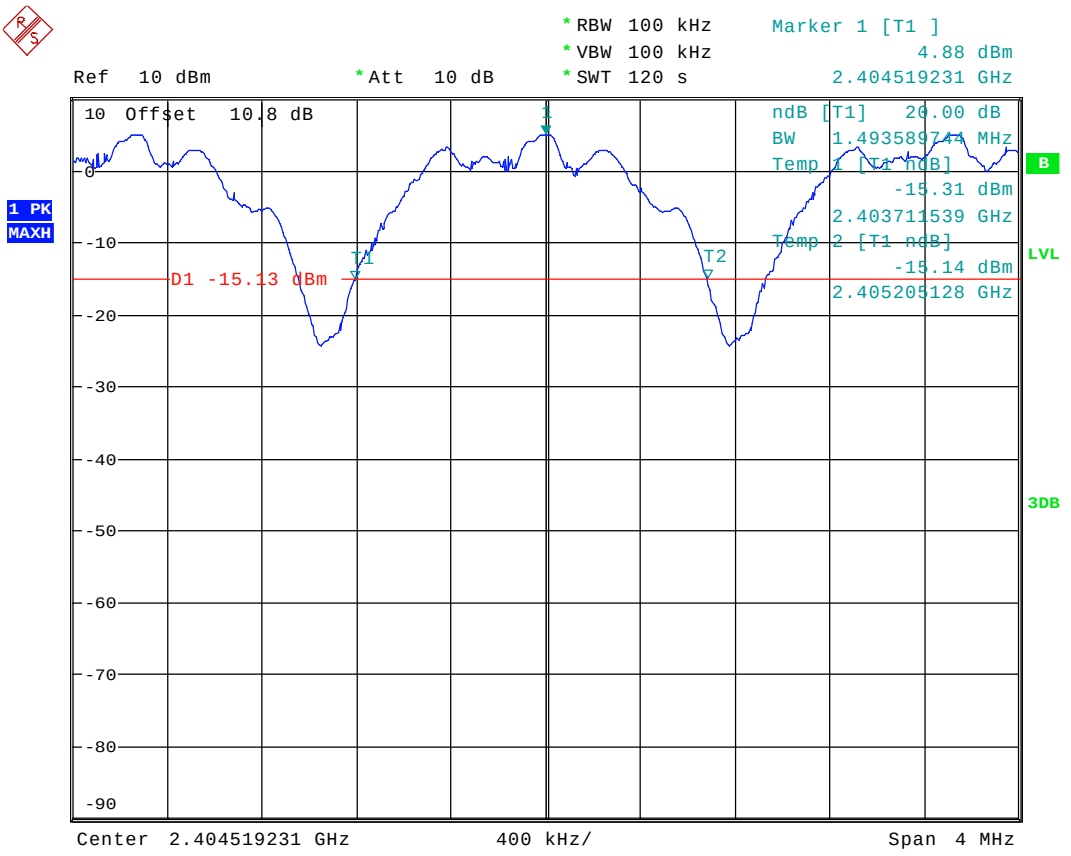


Date: 25.JUN.2010 11:38:48

Upper Band edge compliance



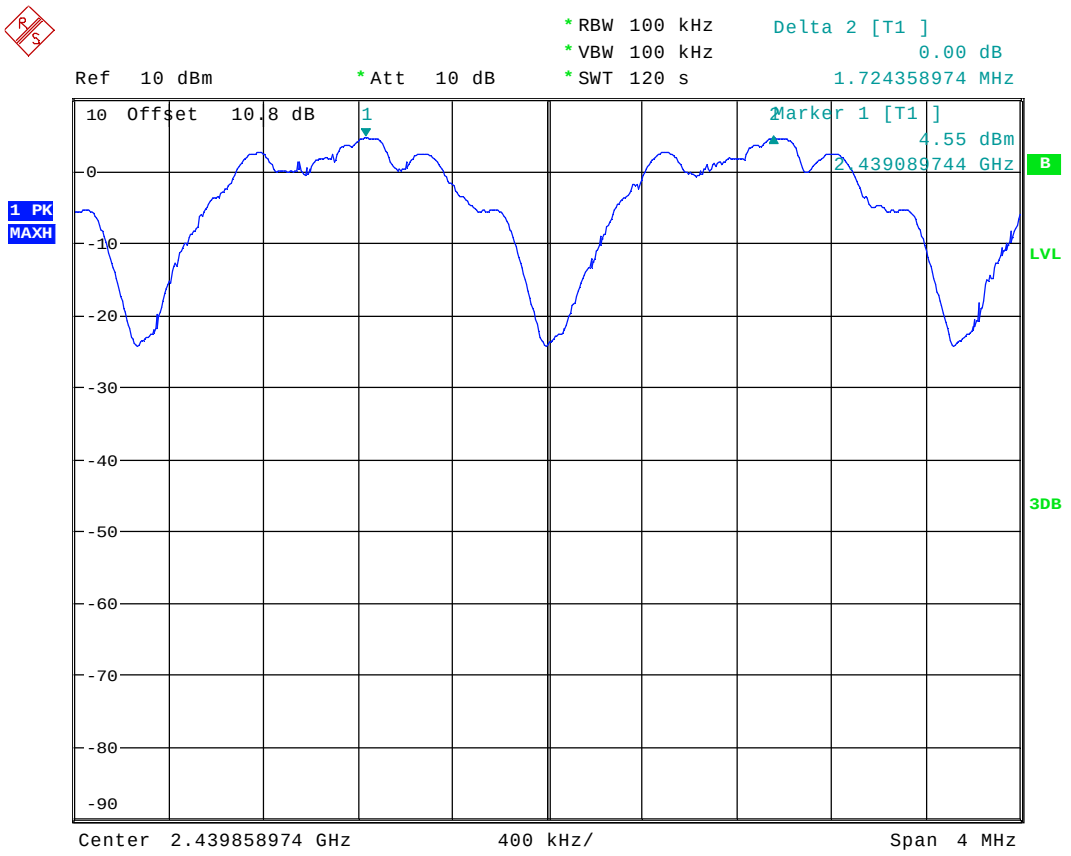
20dB Occupied Bandwidth



fl = 2.403711539GHz
fh = 2.405205128GHz

20dB occupied bandwidth = 1.4935MHz

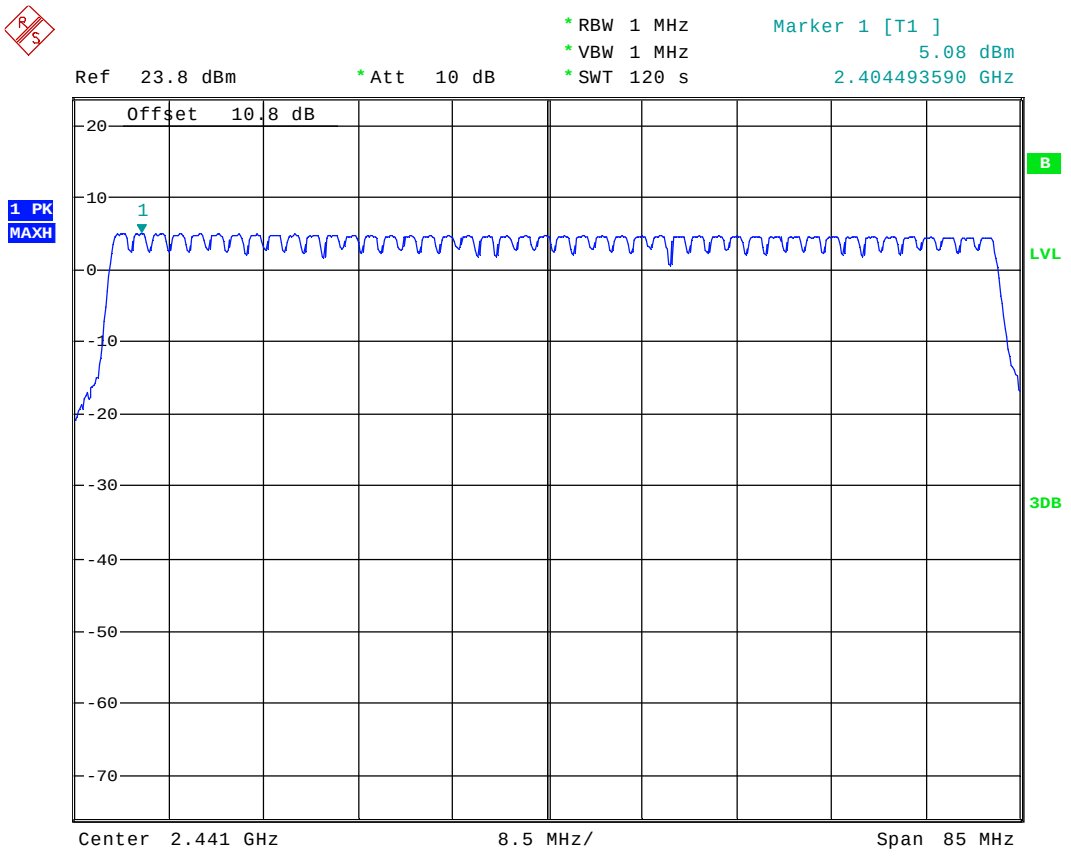
Carrier Frequency separation



Date: 9.JUN.2010 12:38:35

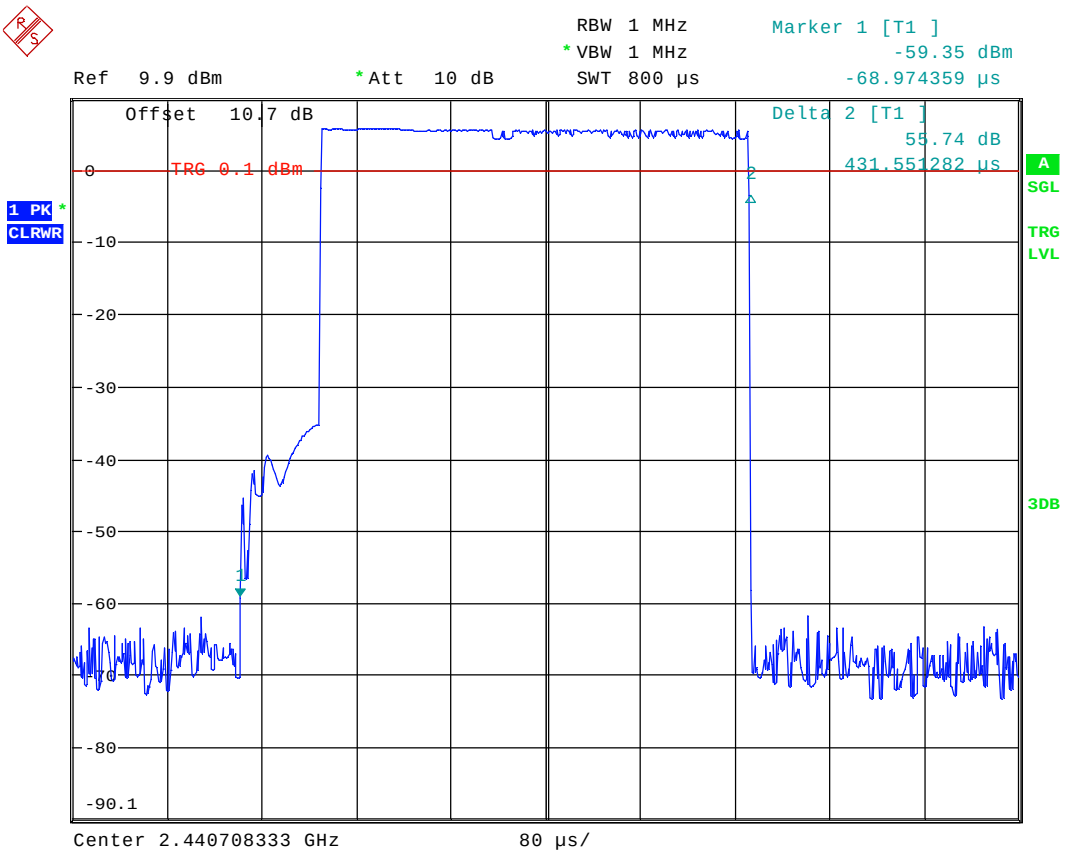
Carrier Frequency separation = 1.724MHz

Number of hopping channels



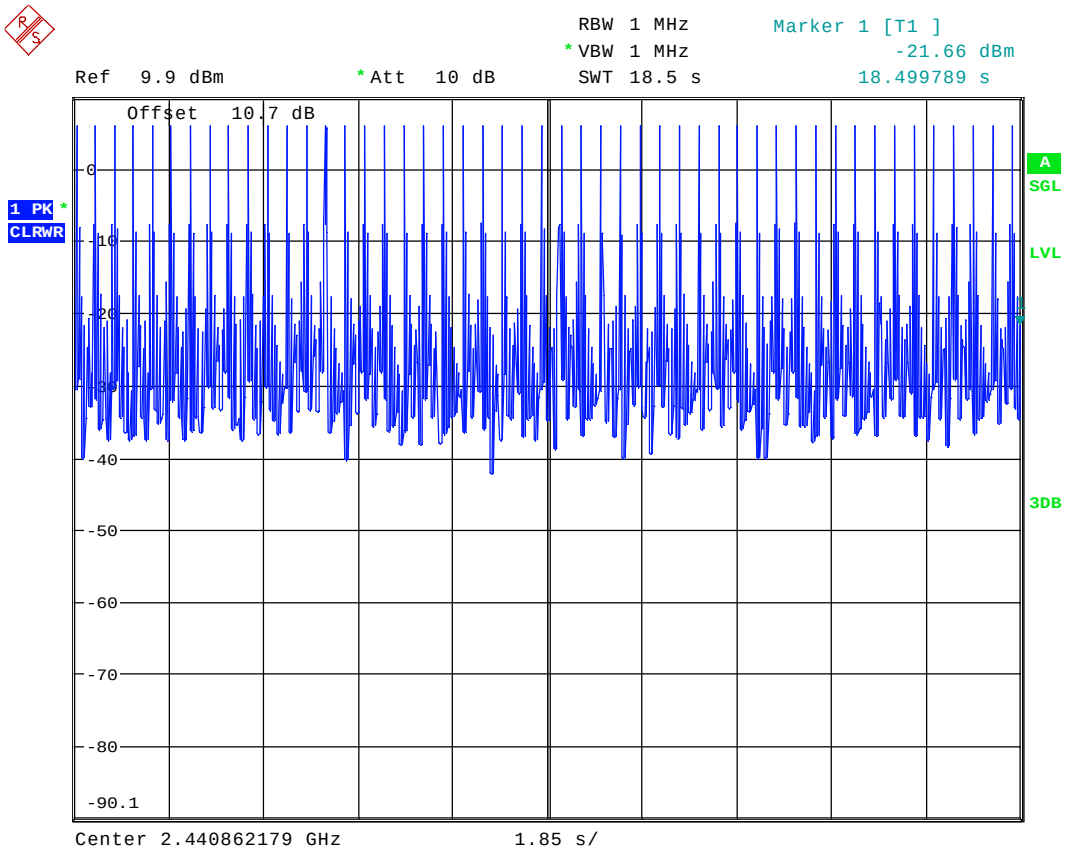
Number of hopping channels = 46 Channels

Channel occupancy



Channel occupancy = 431.551282µs

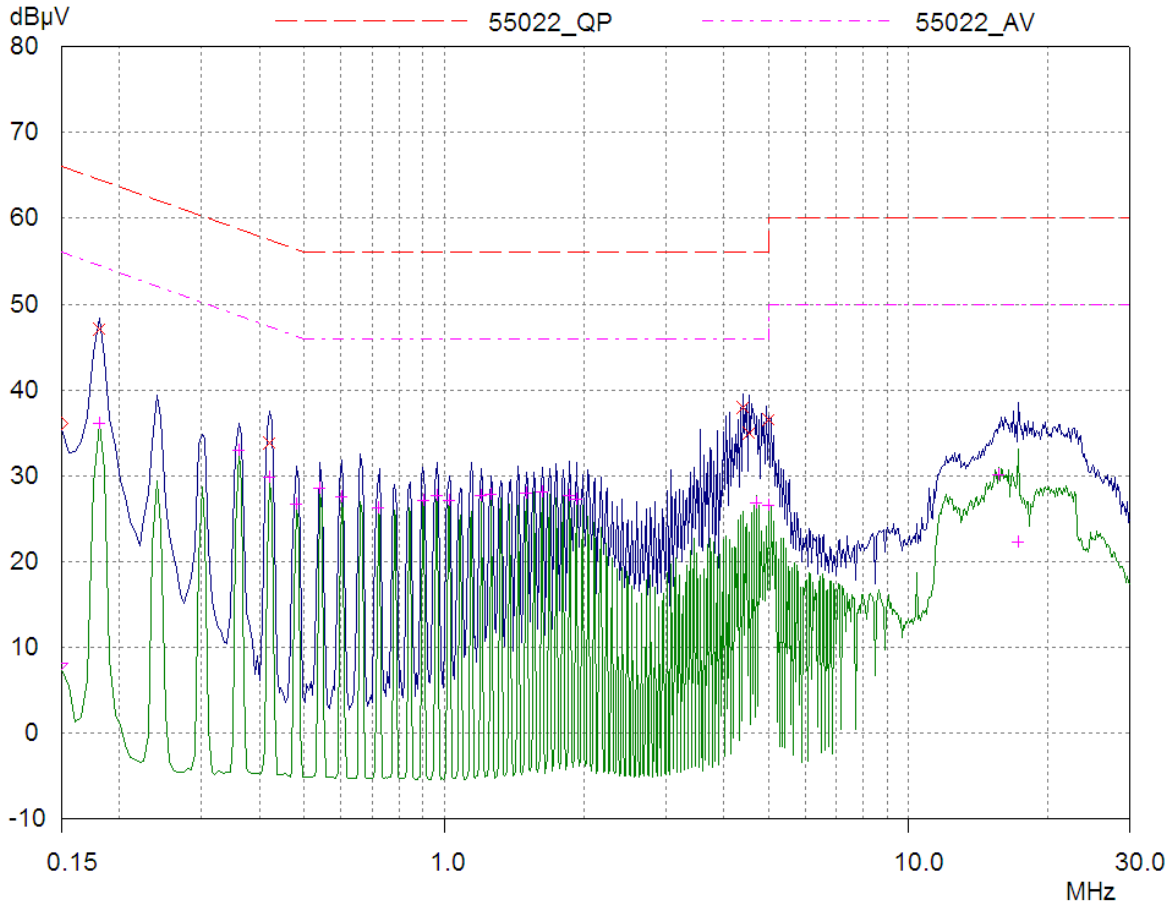
Channel repetition time



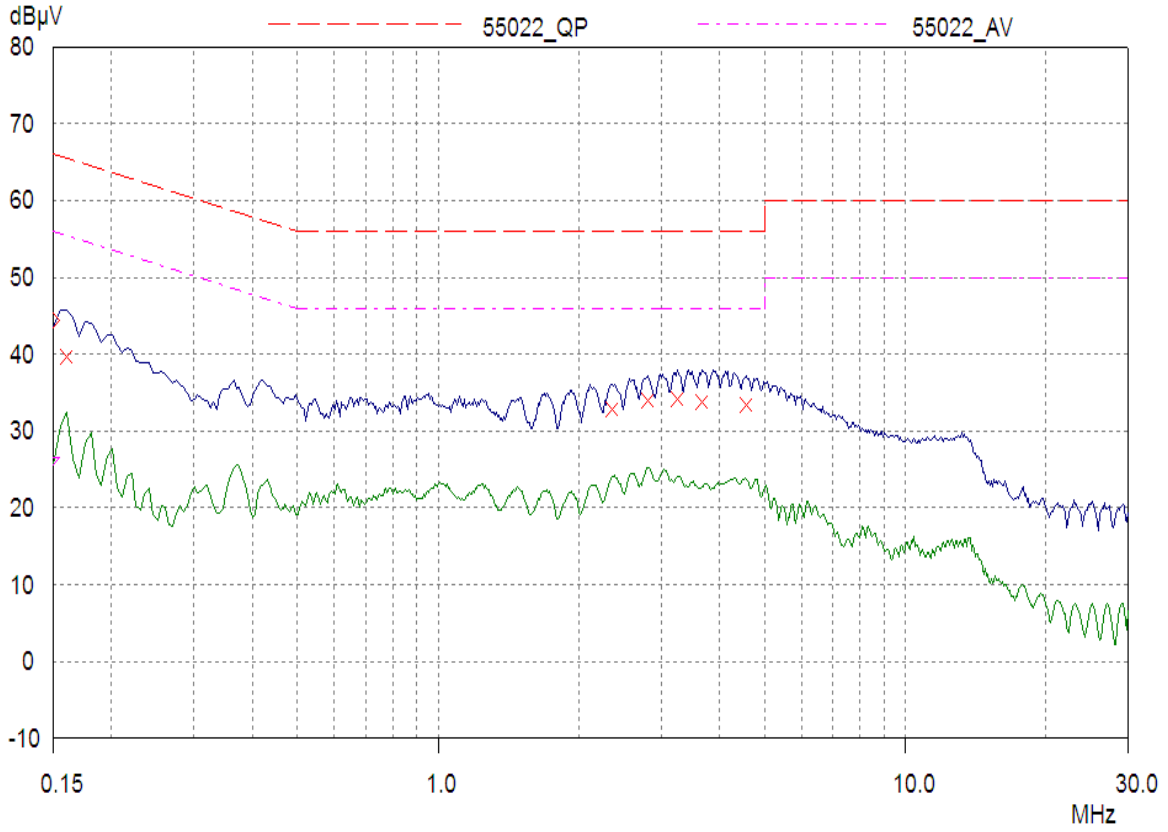
Date: 15.JUN.2010 10:05:19

46 channels X 0.4 seconds = 18.4 seconds

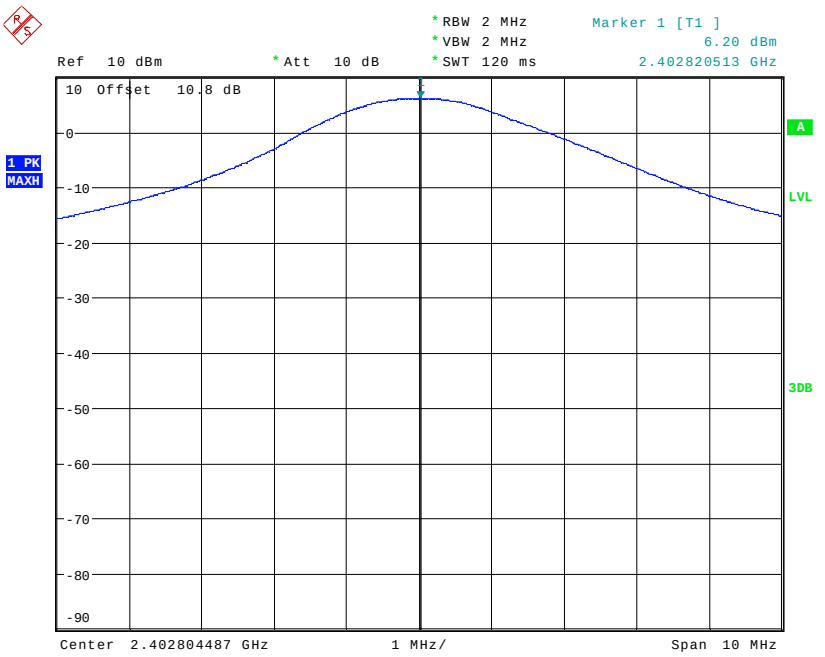
AC Power Line Emissions transmitting 2.4GHz Middle channel connected and charging the battery via the laptop and USB cable.



AC Power Line Emissions transmitting 2.4GHz Middle channel connected and charging the battery via the supplied power supply

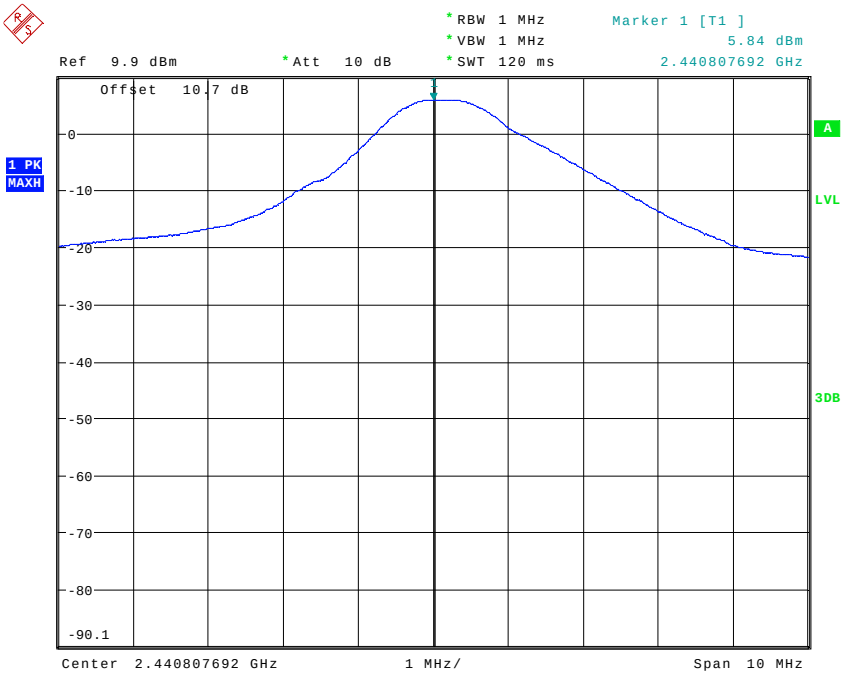


Conducted carrier power 2402MHz



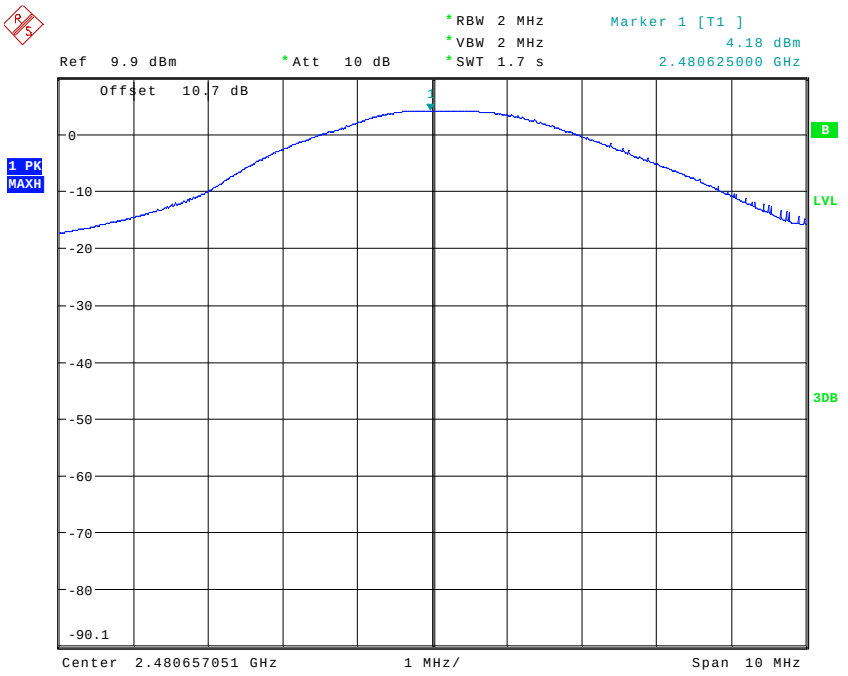
Date: 14.JUN.2010 15:55:32

Conducted carrier power 2440 MHz



Date: 14.JUN.2010 16:02:22

Conducted carrier power 2480 MHz



Date: 9.JUN.2010 15:15:44

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.

C1) Test samples

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

Sample No.	Description	Identification
S01	Activslate60	N/A

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

Sample No.	Description	Identification
S02	Dell Laptop	Service Tag 8Q0314J
S03	Power Supply	FW7650L/05
S04	Activhub	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 on maximum power using FHSS over 46 channels*

C3) EUT Configuration Information.

Sample	Internal Configuration Details
S01	Single possible internal configuration

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

C4) List of EUT Ports

The table below describes the termination of EUT ports:

Sample : S01

Port	Description of Cable Attached	Cable length	Equipment Connected
dc Power	*USB Power supply*	*1.2m*	*Activslate60*
dc Power	*Charging battery via USB cable to laptop*	*1.9m*	*Activslate60*

Only connected during setup.

Notes on the above:

A photograph showing the termination of EUT ports is contained within Appendix F

C5 Details of Equipment Used

TRAC Ref	Type	Description	Manufacturer	Date Calibrated.
TRLUH281	FSU46	Spectrum Analyser	Rhode & Schwarz	29/01/2010
TRL138	3115	Horn Antenna	Emco	10/09/2010
TRL139	3115	Horn Antenna	Emco	17/08/2009
TRL572	8449B	Pre amp	Agilent	15/07/2009
TRLUH04	ESVS10	Receiver	Rhode & Schwarz	10/12/2009
TRLUH372	6201-69	Pre amp	Watkins& Johnson	27/11/2009
TRLUH93	CBL6112B	Antenna	Chase	03/06/2009
TRLUH377	ESU	Spectrum Analyser	Rhode & Schwarz	11/06/2010
TRLUH191	CBL611/A	Antenna	York	01/10/2008
TRLUH195	ESH3	Lisn	Rhode & Schwarz	27/01/10

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.

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

e.g

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

0.07459 or 7.459%

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

OR

For EUT that uses Zigbee device technology the EUT is designed to be compliant with the requirements of IEEE 802.15.4, which in general assumes a maximum duty cycle of 1%. Therefore in accordance with CFR 47 Part 15.35(c), the emissions may be reduced by a factor of 100 (40 dB). Plots of the duty cycle showing the duty cycle to be less than 1% are contained in Appendix B of this report.

Appendix F: Photographs and Figures

The following photographs were taken of the test samples:

1: Test Setup Connected to Power Supply
1a: Test Setup Connected to Laptop
2&3: Power line conducted emissions arrangement.
4: Overview/ Case removed.
5: PCB'S removed from case/Overview of the RF section.
6: Screening can removed.

Photograph 1 Test Setup Connected to Power Supply

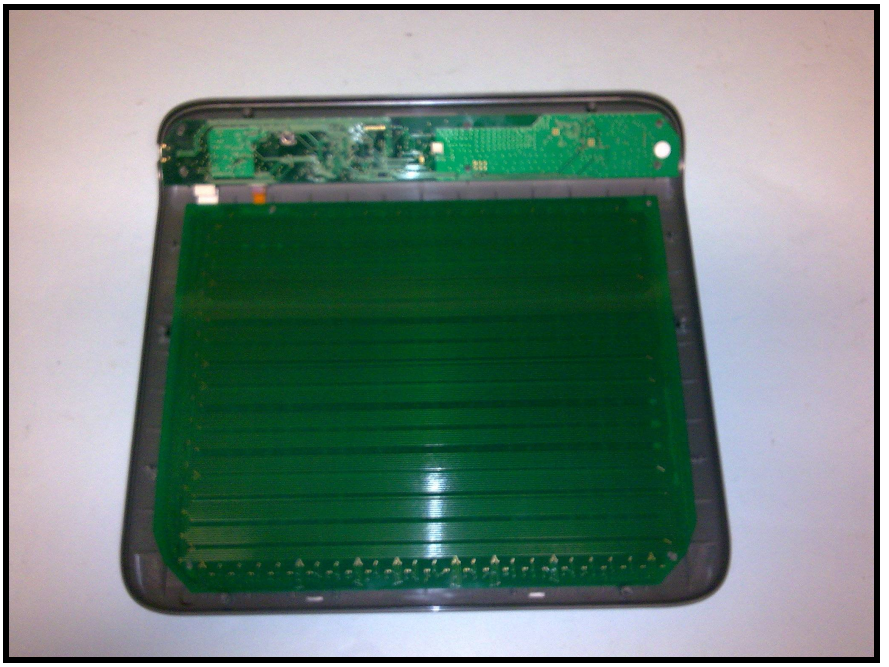
Photograph 1a Test Setup Connected to Laptop

Photograph 2 AC Powerline setup with Laptop

Photograph 3 AC Powerline setup with Power supply

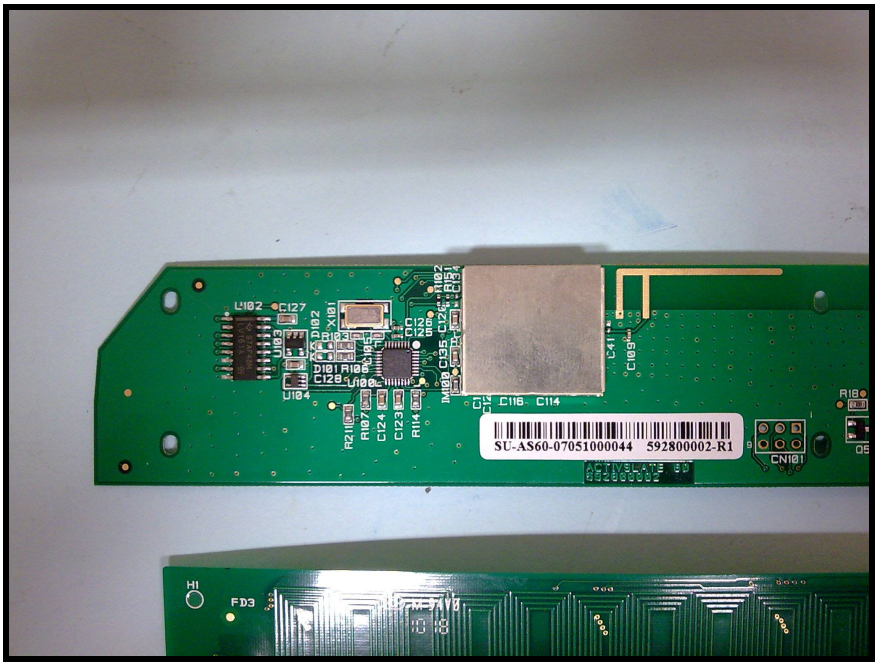
Photograph 4 Activboard60 Overview

Rear Case removed

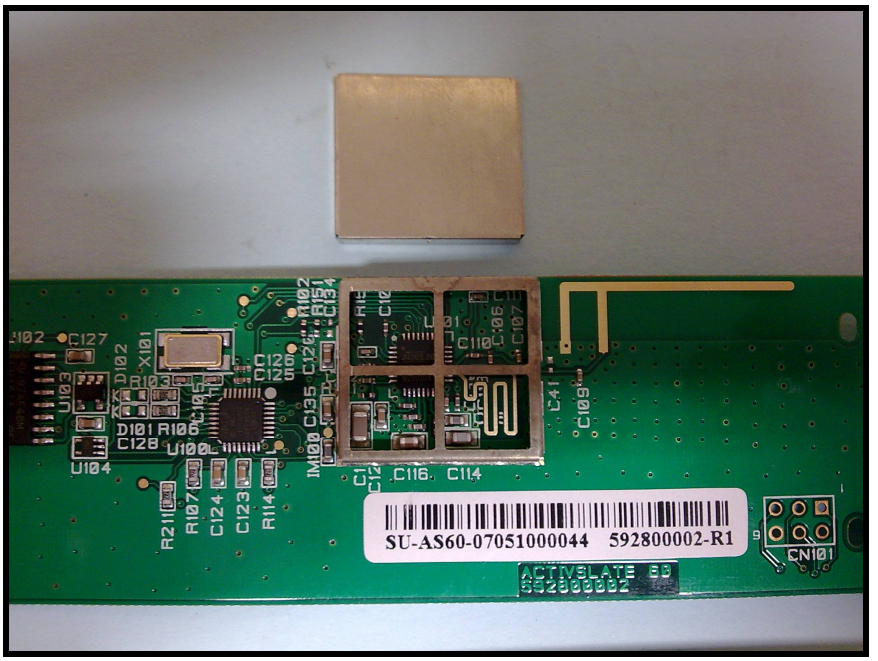


Photograph 5 PCB'S removed from case

Overview of the RF section



Photograph 6 Screening cover removed



UP HOLLAND
Moss View, Nipe Lane, Up Holland, West Lancashire, WN8 9PY, UK.
T +44 (0)1695 556666 **F** +44 (0)1695 557077 **E** test@tracglobal.com
www.tracglobal.com