TRaC Wireless Test Report : 8H1942WUS1

Applicant : Cambridge Silicon Radio Inc

Apparatus : BlueSlim Bluetooth Module

Specification : CFR47 Part 15.247 July 2008

Authorised by : 

: Radio Product Manager

Issue Date : 3rd July 2009

Authorised Copy Number : *PDF*

Total number of pages : 112

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
Unit E
South Orbital Trading Park
Hedon Road
Hull, HU9 1NJ.
United Kingdom.

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

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: D. Winstanley

Report author:. D. Winstanley

1.2 Tests Requested By

This testing in this report was requested by :

Cambridge Silicon Radio Inc
2425 N Central Expressway
Suite 1000
Richardson
Texas
USA
75080

1.3 Manufacturer

FoxConn (Taiwan)
Hon Hai Precision Industry Co., Ltd.
2 Zihyou Street, Tucheng City
Taipei County, 236
Taiwan

1.4 Apparatus Assessed

The following apparatus was assessed between 1st June and 19th June 2009:

BlueSlim Bluetooth Module BSMAN3

BlueSlim Bluetooth Module BSMAN4

BlueSlim is a Bluetooth Module that enables wireless communications within personal computers and Laptops.

1.5 Test Result Summary

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

The statements relating to compliance with the standards below apply ONLY as qualified in the notes and deviations stated in sections 1.6 to 1.7 of this test report.

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

Test Type	Regulation	Measurement standard	Result
Radiated spurious emissions (Restricted bands)	Title 47 of the CFR: 2008, Part 15 Subpart (c) 15.247	ANSI C63.4: 2003	Pass
Conducted spurious emissions (Non-restricted bands)	Title 47 of the CFR: 2008, Part 15 Subpart (c) 15.247	Public Notice DA 00-705 March 30, 2000	Pass
AC Power conducted emissions	Title 47 of the CFR: 2008, Part 15 Subpart (c) 15.207	ANSI C63.4: 2003	Pass
20dB Bandwidth and Channel Spacing	Title 47 of the CFR :2008, Part 15 Subpart (c) 15.247(a)(1)(i)	Public Notice DA 00-705 March 30, 2000	Pass
Conducted Carrier Power	Title 47 of the CFR :2008, Part 15 Subpart (c) 15.247(b)(2)	Public Notice DA 00-705 March 30, 2000	Pass
Hopping Frequencies	Title 47 of the CFR :2008, Part 15 Subpart (c) 15.247(a)(1)	Public Notice DA 00-705 March 30, 2000	Pass
Channel Occupancy	Title 47 of the CFR :2008, Part 15 Subpart (c) 15.247(a)(1)(i)	Public Notice DA 00-705 March 30, 2000	Pass
Unintentional Radiated Spurious Emissions	Title 47 of the CFR: 2008, Part 15 Subpart (c) 15.109	ANSI C63.4: 2003	Marginal

OR

*Marginal results were recorded. See Appendix A for details and Section 2.2 (iii).

Abbreviations used in the above table:

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

1.6 Notes Relating To The Assessment

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

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

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

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

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

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

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

Temperature	: 17 to 23 °C
Humidity	: 45 to 75 %
Barometric Pressure	: 86 to 106 kPa

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

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

1.7 Deviations from Test Standards

There were no deviations from the standards tested to.

Section 2: Measurement Uncertainty

2.1 Application of Measurement Uncertainty

The following table contains the measurement uncertainties for measurements

The following procedure is used when determining the result of a measurement :

(i) If specification limits are not exceeded by the measured result, extended by the positive component of the expanded uncertainty interval at a confidence level of 95%, then a pass result is recorded.

(ii) Where a specification limit is exceeded by the result even when the result is decreased by the negative component of the expanded uncertainty interval, a fail result is recorded.

(iii) Where measured result is below a limit, but by a margin less than the positive measurement uncertainty component, it is not possible to record a pass based on a 95% confidence level. However, the result indicates that a pass result is more probable than a fail result.

(iv) Where a measured result is above a limit, but by a margin less than the negative measurement uncertainty component, it is not possible to record a fail based on a 95% confidence level. However the result indicates that a fail is more probable than a pass.

2.2 Measurement Uncertainty Values

For the test data recorded in accordance with note (iii) of Section 2.1 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 (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

Conducted carrier power was verified using a spectrum analyser, the EUT transmitting on its lowest, centre and highest carrier frequency in turn.

Test Details:	
Regulation	Title 47 of the CFR 2008, Part15 Subpart (c) 15.247(b)(1)
EUT sample number	S21
Modification state	0
SE in test environment	S33, S46
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	24^{o}C
Photographs (Appendix F)	Photograph 4

Operational Data Rate = 1Mb/s

Channel No	Channel Frequency (MHz)	Measured Peak Conducted Carrier Power (W)	Limit (W) ≥ 79 channels	Result
01	2402	0.00243	1	Pass
39	2441	0.00215		Pass
79	2480	0.00224		Pass

Operational Data Rate = 2Mb/s

Channel No	Channel Frequency (MHz)	Measured Peak Conducted Carrier Power (W)	Limit (W) ≥ 79 channels	Result
01	2402	0.00256	1	Pass
39	2441	0.00237		Pass
79	2480	0.00243		Pass

Operational Data Rate = 3Mb/s

Channel No	Channel Frequency (MHz)	Measured Peak Conducted Carrier Power (W)	Limit (W) ≥ 79 channels	Result
01	2402	0.00248	1	Pass
39	2441	0.00230		Pass
79	2480	0.00237		Pass

Note
Measured Peak Carrier power includes highest gain of any antenna to be used with the modules
Highest Gain of any antenna to be used = +2dBi

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 CH01	
Regulation	Title 47 of the CFR 2008, Part 15 Subpart (c) Clause 15.247(d) and Clause 15.205
Measurement standard	ANSI C63.4:2003
Frequency range	9 kHz to 25 GHz
EUT sample number	S21
Modification state	0
SE in test environment	S33, S46
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	24^{o}C
Photographs (Appendix F)	Photograph 4

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

Operational Data Rate = 1Mb/s

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						

Operational Data Rate = 2Mb/s

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						

Operational Data Rate = 3Mb/s

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						

[1]See section 2.2 Note (iii).

RF Antenna Conducted Spurious Emissions continued:

Test Details CH39	
Regulation	Title 47 of the CFR 2008, Part 15 Subpart (c) Clause 15.247(d) and Clause 15.205
Measurement standard	ANSI C63.4:2003
Frequency range	9 kHz to 25 GHz
EUT sample number	S21
Modification state	0
SE in test environment	S33, S46
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	24^{o}C
Photographs (Appendix F)	Photograph 4

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

Operational Data Rate = 1Mb/s

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						

Operational Data Rate = 2Mb/s

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						

Operational Data Rate = 3Mb/s

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						

[1]See section 2.2 Note (iii).

RF Antenna Conducted Spurious Emissions continued:

Test Details CH79	
Regulation	Title 47 of the CFR 2008, Part 15 Subpart (c) Clause 15.247(d) and Clause 15.205
Measurement standard	ANSI C63.4:2003
Frequency range	9 kHz to 25 GHz
EUT sample number	S21
Modification state	0
SE in test environment	S33, S46
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	24^{o}C
Photographs (Appendix F)	Photograph 4

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

Operational Data Rate = 1Mb/s

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						

Operational Data Rate = 2Mb/s

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						

Operational Data Rate = 3Mb/s

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						

[1]See section 2.2 Note (iii).

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. All other emissions were at least 20dB below the test limit

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

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

Where:

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

Operational Data Rate = 1Mb/s					
Channel No.	Channel Frequency (MHz)	Measured Peak Conducted Carrier Power (W)	Measured Peak Conducted Carrier (dBμV)	Measured Peak Conducted Carrier – 20dB (dBμV)	Emission Limit 15.247(d) in 100 kHz RBW (dBμV)
01	2402	0.00243	103.86	103.86 – 20	83.86
39	2441	0.00215	103.33	103.33 – 20	83.33
79	2480	0.00224	103.50	103.50 – 20	83.50

Operational Data Rate = 2Mb/s					
Channel No.	Channel Frequency (MHz)	Measured Peak Conducted Carrier Power (W)	Measured Peak Conducted Carrier (dBμV)	Measured Peak Conducted Carrier – 20dB (dBμV)	Emission Limit 15.247(d) in 100 kHz RBW (dBμV)
01	2402	0.00256	104.08	104.08 – 20	84.08
39	2441	0.00237	103.75	103.75 – 20	83.75
79	2480	0.00243	103.85	103.85 – 20	83.85

Operational Data Rate = 2Mb/s					
Channel No.	Channel Frequency (MHz)	Measured Peak Conducted Carrier Power (W)	Measured Peak Conducted Carrier (dBμV)	Measured Peak Conducted Carrier – 20dB (dBμV)	Emission Limit 15.247(d) in 100 kHz RBW (dBμV)
01	2402	0.00248	103.95	103.95 – 20	83.95
39	2441	0.00230	103.61	103.61 – 20	83.61
79	2480	0.00237	103.75	103.75 – 20	83.75

A3 Radiated Electric Field Emissions Within The Restricted Bands of 15.205

Preliminary scans were performed using a peak detector with the RBW = 100kHz. The radiated electric filed emission test applies to spurious emissions and harmonics that fall within the restricted bands listed in Section 15.205. The maximum permitted field strength is listed in Section 15.209. The EUT was set to transmit on its lowest, centre and highest carrier frequency at each operational data rate in turn. 2 different combinations of connector/antenna were testing in the modes described.

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

3m open area test site : ☑ 3m alternative test site : ☐

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

Test Details: BSMAN3, 1Mb/s, 2402 MHz	
Regulation	Title 47 of the CFR 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	S21
Modification state	0
SE in test environment	S26, S46
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	18°C
Photographs (Appendix F)	Photograph 1 and 2

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

Ref No.	Freq (MHz)	Pol.	Result (dBμV/m)	Spec. Limit (dBμV/m)	Margin (dB)	Summary
1.	4804.144	V	42.12	54.00	-11.88	Pass

[1]See section 2.2 Note (iii).

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: BSMAN3, 1Mb/s, 2441 MHz	
Regulation	Title 47 of the CFR 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	S21
Modification state	0
SE in test environment	S26, S46
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	18^{o}C
Photographs (Appendix F)	Photograph 1 and 2

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

Ref No.	Freq (MHz)	Pol.	Result (dBμV/m)	Spec. Limit (dBμV/m)	Margin (dB)	Summary
1.	4882.048	V	47.47	54.00	-6.53	Pass

[1]See section 2.2 Note (iii).

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: BSMAN3, 1Mb/s, 2480 MHz	
Regulation	Title 47 of the CFR 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	S21
Modification state	0
SE in test environment	S26, S46
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	18^{o}C
Photographs (Appendix F)	Photograph 1 and 2

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

Ref No.	Freq (MHz)	Pol.	Result (dBμV/m)	Spec. Limit (dBμV/m)	Margin (dB)	Summary
1.	4960.080	V	48.33	54.00	-5.67	Pass
2.	4964.998	V	34.53	54.00	-19.47	Pass
3.	7440.256	H	45.35	54.00	-8.65	Pass

[1]See section 2.2 Note (iii).

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: BSMAN3, 2Mb/s, 2402 MHz	
Regulation	Title 47 of the CFR 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	S21
Modification state	0
SE in test environment	S26, S46
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	18^{o}C
Photographs (Appendix F)	Photograph 1 and 2

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

Ref No.	Freq (MHz)	Pol.	Result (dBμV/m)	Spec. Limit (dBμV/m)	Margin (dB)	Summary
No Significant Emissions Within 20 dB of the Limit						

[1]See section 2.2 Note (iii).

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: BSMAN3, 2Mb/s, 2441 MHz	
Regulation	Title 47 of the CFR 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	S21
Modification state	0
SE in test environment	S26, S46
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	18^{o}C
Photographs (Appendix F)	Photograph 1 and 2

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

Ref No.	Freq (MHz)	Pol.	Result (dBμV/m)	Spec. Limit (dBμV/m)	Margin (dB)	Summary
1.	4882.032	V	37.21	54.00	-16.79	Pass

[1]See section 2.2 Note (iii).

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: BSMAN3, 2Mb/s, 2480 MHz	
Regulation	Title 47 of the CFR 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	S21
Modification state	0
SE in test environment	S26, S46
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	18^{o}C
Photographs (Appendix F)	Photograph 1 and 2

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

Ref No.	Freq (MHz)	Pol.	Result (dBμV/m)	Spec. Limit (dBμV/m)	Margin (dB)	Summary
1.	4960.016	V	38.49	54.00	-15.51	Pass
2.	4965.000	V	34.64	54.00	-19.36	Pass
3.	7439.967	V	38.37	54.00	-15.63	Pass

[1]See section 2.2 Note (iii).

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: BSMAN3, 3Mb/s, 2402 MHz	
Regulation	Title 47 of the CFR 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	S21
Modification state	0
SE in test environment	S26, S46
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	18^{o}C
Photographs (Appendix F)	Photograph 1 and 2

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

Ref No.	Freq (MHz)	Pol.	Result (dBμV/m)	Spec. Limit (dBμV/m)	Margin (dB)	Summary
No Significant Emissions Within 20 dB of the Limit						

[1]See section 2.2 Note (iii).

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: BSMAN3, 3Mb/s, 2441 MHz	
Regulation	Title 47 of the CFR 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	S21
Modification state	0
SE in test environment	S26, S46
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	18^{o}C
Photographs (Appendix F)	Photograph 1 and 2

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

Ref No.	Freq (MHz)	Pol.	Result (dBμV/m)	Spec. Limit (dBμV/m)	Margin (dB)	Summary
1.	4882.064	V	36.32	54.00	-17.68	Pass

[1]See section 2.2 Note (iii).

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: BSMAN3, 3Mb/s, 2480 MHz	
Regulation	Title 47 of the CFR 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	S21
Modification state	0
SE in test environment	S26, S46
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	18^{o}C
Photographs (Appendix F)	Photograph 1 and 2

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

Ref No.	Freq (MHz)	Pol.	Result (dBμV/m)	Spec. Limit (dBμV/m)	Margin (dB)	Summary
1.	4960.000	V	37.67	54.00	-16.33	Pass
2.	7440.000	H	38.63	54.00	-15.37	Pass

[1]See section 2.2 Note (iii).

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: BSMAN4, 1Mb/s, 2402 MHz	
Regulation	Title 47 of the CFR 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	S40
Modification state	0
SE in test environment	S33, S46
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	18^{o}C
Photographs (Appendix F)	Photograph 1 and 2

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

Ref No.	Freq (MHz)	Pol.	Result (dBμV/m)	Spec. Limit (dBμV/m)	Margin (dB)	Summary
1.	4803.951	H	36.01	54.00	-17.99	Pass

[1]See section 2.2 Note (iii).

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: BSMAN4, 1Mb/s, 2441 MHz	
Regulation	Title 47 of the CFR 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	S40
Modification state	0
SE in test environment	S33, S46
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	18^{o}C
Photographs (Appendix F)	Photograph 1 and 2

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

Ref No.	Freq (MHz)	Pol.	Result (dBμV/m)	Spec. Limit (dBμV/m)	Margin (dB)	Summary
1.	4881.983	H	39.78	54.00	-14.12	Pass

[1]See section 2.2 Note (iii).

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: BSMAN4, 1Mb/s, 2480 MHz	
Regulation	Title 47 of the CFR 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	S40
Modification state	0
SE in test environment	S33, S46
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	18^{o}C
Photographs (Appendix F)	Photograph 1 and 2

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

Ref No.	Freq (MHz)	Pol.	Result (dBμV/m)	Spec. Limit (dBμV/m)	Margin (dB)	Summary
1.	4960.016	V	41.53	54.00	-12.47	Pass
2.	7439.506	H	42.47	54.00	-11.53	Pass

[1]See section 2.2 Note (iii).

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: BSMAN4, 2Mb/s, 2402 MHz	
Regulation	Title 47 of the CFR 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	S40
Modification state	0
SE in test environment	S33, S46
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	18^{o}C
Photographs (Appendix F)	Photograph 1 and 2

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

Ref No.	Freq (MHz)	Pol.	Result (dBμV/m)	Spec. Limit (dBμV/m)	Margin (dB)	Summary
No Significant Emissions Within 20 dB of the Limit						

[1]See section 2.2 Note (iii).

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: BSMAN4, 2Mb/s, 2441 MHz	
Regulation	Title 47 of the CFR 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	S40
Modification state	0
SE in test environment	S33, S46
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	18^{o}C
Photographs (Appendix F)	Photograph 1 and 2

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

Ref No.	Freq (MHz)	Pol.	Result (dBμV/m)	Spec. Limit (dBμV/m)	Margin (dB)	Summary
1.	4882.080	V	34.26	54.00	-19.74	Pass

[1]See section 2.2 Note (iii).

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: BSMAN4, 2Mb/s, 2480 MHz	
Regulation	Title 47 of the CFR 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	S40
Modification state	0
SE in test environment	S33, S46
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	18^{o}C
Photographs (Appendix F)	Photograph 1 and 2

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

Ref No.	Freq (MHz)	Pol.	Result (dBμV/m)	Spec. Limit (dBμV/m)	Margin (dB)	Summary
1.	4960.000	V	36.39	54.00	-17.61	Pass
2.	7439.951	H	37.69	54.00	-16.31	Pass

[1]See section 2.2 Note (iii).

~ **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: BSMAN4, 3Mb/s, 2402 MHz	
Regulation	Title 47 of the CFR 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	S40
Modification state	0
SE in test environment	S33, S46
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	18^{o}C
Photographs (Appendix F)	Photograph 1 and 2

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

Ref No.	Freq (MHz)	Pol.	Result (dBμV/m)	Spec. Limit (dBμV/m)	Margin (dB)	Summary
No Significant Emissions Within 20 dB of the Limit						

[1]See section 2.2 Note (iii).

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: BSMAN4, 3Mb/s, 2441 MHz	
Regulation	Title 47 of the CFR 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	S40
Modification state	0
SE in test environment	S33, S46
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	18^{o}C
Photographs (Appendix F)	Photograph 1 and 2

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

Ref No.	Freq (MHz)	Pol.	Result (dBμV/m)	Spec. Limit (dBμV/m)	Margin (dB)	Summary
1.	4882.114	V	34.49	54.00	-19.51	Pass

[1]See section 2.2 Note (iii).

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: BSMAN4, 3Mb/s, 2480 MHz	
Regulation	Title 47 of the CFR 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	S40
Modification state	0
SE in test environment	S33, S46
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	18^{o}C
Photographs (Appendix F)	Photograph 1 and 2

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

Ref No.	Freq (MHz)	Pol.	Result (dBμV/m)	Spec. Limit (dBμV/m)	Margin (dB)	Summary
1.	4960.000	V	35.85	54.00	-18.15	Pass
2.	7440.016	V	37.55	54.00	-16.45	Pass

[1]See section 2.2 Note (iii).

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 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 C63.4 and DA 00-705.

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

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

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

Radiated emission limits (47 CFR 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:

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

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

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

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

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

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

A4 Power Line Conducted Emissions

Preview power line conducted emission measurements were performed with a peak detector in a screened room. The effect of the EUT set-up on the measurements is summarised in note (b). Where applicable formal measurements of the emissions were performed with a peak, average and/or quasi peak detector. The EUT was set to transmit on its lowest, centre and highest carrier frequency in turn. The formal measurements are detailed below:

Test Details: BSMAN3	
Regulation	Title 47 of the CFR 2008, Part 15 Subpart (c) Clause 15.207
Measurement standard	ANSI C63.4:2003
Frequency range	150kHz to 30MHz
EUT sample number	S21
Modification state	0
SE in test environment	S26, S46
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Photographs (Appendix F)	Photograph 3

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

Results measured using the average detector compared to the average limit

Ref No.	Freq (MHz)	Conductor	Result (dBuV)	Spec Limit (dBuV)	Margin (dB)	Result Summary
1	0.174	Live	45.3	54.8	-9.5	Pass
2	0.270	Live	50.8	51.1	-0.3	Pass*
3	0.317	Live	41.3	49.8	-8.5	Pass
4	0.541	Live	42.8	46.0	-3.2	Pass*
5	0.581	Live	45.4	46.0	-0.6	Pass*
6	0.945	Live	35.0	46.0	-11.0	Pass
7	2.300	Live	26.1	46.0	-19.9	Pass
8	0.174	Neutral	51.5	54.8	-3.3	Pass*
9	0.270	Neutral	50.9	51.1	-0.2	Pass*
10	0.317	Neutral	40.3	49.8	-9.5	Pass
11	0.541	Neutral	41.8	46.0	-4.2	Pass
12	0.581	Neutral	44.5	46.0	-1.5	Pass*
13	0.945	Neutral	32.9	46.0	-13.1	Pass

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

Ref No.	Freq (MHz)	Conductor	Result (dBuV)	Spec Limit (dBuV)	Margin (dB)	Result Summary
1	0.174	Live	51.8	64.8	-13.0	Pass
2	0.270	Live	53.5	61.1	-7.6	Pass
3	0.317	Live	54.7	59.8	-5.1	Pass
4	0.541	Live	47.4	56.0	-8.6	Pass
5	0.581	Live	52.1	56.0	-3.9	Pass*
6	0.945	Live	48.6	56.0	-7.4	Pass
7	0.174	Neutral	53.0	64.8	-11.8	Pass
8	0.270	Neutral	52.9	61.1	-8.2	Pass
9	0.317	Neutral	53.9	59.8	-5.9	Pass
10	0.541	Neutral	47.9	56.0	-8.1	Pass
11	0.581	Neutral	51.0	56.0	-5.0	Pass
12	0.945	Neutral	46.4	56.0	-9.6	Pass

Test Details: BSMAN3	
Regulation	Title 47 of the CFR 2008, Part 15 Subpart (c) Clause 15.207
Measurement standard	ANSI C63.4:2003
Frequency range	150kHz to 30MHz
EUT sample number	S40
Modification state	0
SE in test environment	S33, S46
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Photographs (Appendix F)	Photograph 3

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

Results measured using the average detector compared to the average limit

Ref No.	Freq (MHz)	Conductor	Result (dBuV)	Spec Limit (dBuV)	Margin (dB)	Result Summary
1	0.174	Live	45.2	54.8	-9.6	Pass
2	0.270	Live	50.9	51.1	-0.2	Pass*
3	0.317	Live	41.5	49.8	-8.3	Pass
4	0.541	Live	42.8	46.0	-3.2	Pass*
5	0.581	Live	45.6	46.0	-0.4	Pass*
6	0.945	Live	35.1	46.0	-10.9	Pass
7	2.300	Live	26.1	46.0	-19.9	Pass
8	0.174	Neutral	51.7	54.8	-3.1	Pass*
9	0.270	Neutral	50.7	51.1	-0.4	Pass*
10	0.317	Neutral	40.6	49.8	-9.2	Pass
11	0.541	Neutral	41.6	46.0	-4.4	Pass
12	0.581	Neutral	44.6	46.0	-1.4	Pass*
13	0.945	Neutral	32.9	46.0	-13.1	Pass
14	2.300	Neutral	26.1	46.0	-19.9	Pass

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

Ref No.	Freq (MHz)	Conductor	Result (dBuV)	Spec Limit (dBuV)	Margin (dB)	Result Summary
1	0.174	Live	52.0	64.8	-12.8	Pass
2	0.270	Live	53.5	61.1	-7.6	Pass
3	0.317	Live	54.6	59.8	-5.2	Pass
4	0.541	Live	47.3	56.0	-8.7	Pass
5	0.581	Live	52.1	56.0	-3.9	Pass*
6	0.945	Live	48.7	56.0	-7.3	Pass
7	0.174	Neutral	52.8	64.8	-12.0	Pass
8	0.270	Neutral	53.0	61.1	-8.1	Pass
9	0.317	Neutral	54.2	59.8	-5.6	Pass
10	0.541	Neutral	47.9	56.0	-8.1	Pass
11	0.581	Neutral	51.1	56.0	-4.9	Pass
12	0.945	Neutral	46.4	56.0	-9.6	Pass

*See section 2.2 Note (iii).

Specification limits :

Conducted emission limits (47 CFR 15:2008 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	Title 47 of the CFR: 2008, Part 15 Subpart (c) 15.247(a)(1)(i)
EUT sample number	S21
Modification state	0
SE in test environment	S33, S46
SE isolated from EUT	None
Temperature	22^{o}C
EUT set up	Refer to Appendix C

Operational Data Rate	Measured 20 dB Bandwidth (kHz)	Limit	Result
1Mb/s	1130	N/A	N/A
2Mb/s	1370	N/A	N/A
3Mb/s	1360	N/A	N/A

Measured Channel Spacing (kHz)	Limit	Result
1000	(25kHz or ≥ Measured 20 dB Bandwidth kHz)	Pass

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

A6 Hopping frequencies

Hopping frequencies were verified using a spectrum analyser set to 20 MHz spans, displaying sub sets of the hopping channels in turn, while the EUT was operating in its normal frequency hopping mode.

Test Details:	
Regulation	Title 47 of the CFR :2008, Part 15 Subpart (c) 15.247(a)(1)(i)
EUT sample number	S21
Modification state	0
SE in test environment	S33, S46
SE isolated from EUT	None
Temperature	22^{o}C
EUT set up	Refer to Appendix C

No. of Hopping Channels	Requirement	Result
79	For 1W conducted carrier power Limit, greater than 75	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	Title 47 of the CFR2008, Part15 Subpart (c) 15.247(a)(1)
EUT sample number	S21
Modification state	0
SE in test environment	S33, S46
SE isolated from EUT	None
Temperature	22°C
EUT set up	Refer to Appendix C

Measured Channel Occupancy Time (µs)	Measured Channel Repetition Time (ms)	Calculated Average Channel retention Time (ms)	Average Channel Occupancy Time Limit (ms)	Result
464.87	98.79	148.7	400	Pass

Plots showing the channel occupancy time and time between successive transmissions are contained in Appendix B of this test report. These are identical for all modulation modes.

Average Channel Retention Time Calculation:

No. Of utilised hopping channels (N) = 79
Measured channel repetition time (T_{rep}) = 98.79ms
Measured channel occupancy time (T_{occ}) = 464.8µs

No. of transmission cycles in specified averaging period =

$$\frac{400\times10^{-3}\times \mathrm{N}}{\mathrm{T_{rep}}(ms)} = \text{cycles} \qquad \therefore \frac{400\times10^{-3}\times(79\ \text{channels})}{98.79(ms)} = 320\,\text{cycles}$$

$\therefore$ **The Average Retention Time =**

Total activation time T_{occ} x No. of transmission cycles in specified averaging period

Average Channel Occupancy Time = 464.8µs x 320 = 148.7 ms

A8 Antenna Gain

The maximum antenna gain for the antenna types to be used with the EUT, as declared by the client, is 2 dBi.

A9 Unintentional Radiated Electric Field Emissions - 15.109

Preliminary scans were performed using a peak detector with the RBW = 100kHz. The maximum permitted field strength is listed in Section 15.109. The EUT was set to receive mode only on its lowest, centre and highest carrier frequency in turn.

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

3m open area test site : ✓ 3m alternative test site : ☐

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

Test Details: BSMAN3, 2402 MHz	
Regulation	Title 47 of the CFR 2008, Part 15 Subpart (b) Clause 15.109
Measurement standard	ANSI C63.4:2003
Frequency range	30MHz to 25 GHz
EUT sample number	S21
Modification state	0
SE in test environment	S26, S46
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	18°C
Photographs (Appendix F)	Photograph 1 and 2

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

Ref No.	Freq (MHz)	Pol.	Result (dBμV/m)	Spec. Limit (dBμV/m)	Margin (dB)	Summary
1.	2400.576	V	39.55	54.00	-14.45	Pass

[1]See section 2.2 Note (iii).

Unintentional Radiated Electric Field Emissions 15.109 continued:

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

Test Details: BSMAN3, 2441 MHz	
Regulation	Title 47 of the CFR 2008, Part 15 Subpart (b) Clause 15.109
Measurement standard	ANSI C63.4:2003
Frequency range	30MHz to 25 GHz
EUT sample number	S21
Modification state	0
SE in test environment	S26, S46
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	18°C
Photographs (Appendix F)	Photograph 1 and 2

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

Ref No.	Freq (MHz)	Pol.	Result (dBμV/m)	Spec. Limit (dBμV/m)	Margin (dB)	Summary
1.	2439.548	V	36.43	54.00	-17.57	Pass

[1]See section 2.2 Note (iii).

Unintentional Radiated Electric Field Emissions 15.109 continued:

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

Test Details: BSMAN3, 2480 MHz	
Regulation	Title 47 of the CFR 2008, Part 15 Subpart (b) Clause 15.109
Measurement standard	ANSI C63.4:2003
Frequency range	30MHz to 25 GHz
EUT sample number	S21
Modification state	0
SE in test environment	S26, S46
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	18°C
Photographs (Appendix F)	Photograph 1 and 2

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

Ref No.	Freq (MHz)	Pol.	Result (dBμV/m)	Spec. Limit (dBμV/m)	Margin (dB)	Summary
1.	2478.484	V	33.99	54.00	-20.01	Pass

[1]See section 2.2 Note (iii).

Unintentional Radiated Electric Field Emissions 15.109 continued:

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

Test Details: BSMAN4, 2402 MHz	
Regulation	Title 47 of the CFR 2008, Part 15 Subpart (b) Clause 15.109
Measurement standard	ANSI C63.4:2003
Frequency range	30MHz to 25 GHz
EUT sample number	S40
Modification state	0
SE in test environment	S33, S46
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	18°C
Photographs (Appendix F)	Photograph 1 and 2

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

Ref No.	Freq (MHz)	Pol.	Result (dBμV/m)	Spec. Limit (dBμV/m)	Margin (dB)	Summary
1.	62.50	V	20.10	40.0	-19.9	Pass
2.	81.35	V	21.80	40.0	-18.2	Pass
3.	168.00	V	24.00	43.5	-19.5	Pass
4.	287.90	H	28.90	46.0	-17.1	Pass
5.	299.95	V	36.80	46.0	-9.2	Pass
6.	336.05	H	30.70	46.0	-15.3	Pass
7.	347.95	V	29.60	46.0	-16.4	Pass
8.	1600.032	V	35.70	54.0	-18.3	Pass
9.	2400.557	V	48.80	54.0	-5.2	Pass

[1]See section 2.2 Note (iii).

Unintentional Radiated Electric Field Emissions 15.109 continued:

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

Test Details: BSMAN4, 2441 MHz	
Regulation	Title 47 of the CFR 2008, Part 15 Subpart (b) Clause 15.109
Measurement standard	ANSI C63.4:2003
Frequency range	30MHz to 25 GHz
EUT sample number	S40
Modification state	0
SE in test environment	S33, S46
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	18°C
Photographs (Appendix F)	Photograph 1 and 2

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

Ref No.	Freq (MHz)	Pol.	Result (dBμV/m)	Spec. Limit (dBμV/m)	Margin (dB)	Summary
1.	62.50	V	20.10	40.0	-19.9	Pass
2.	81.35	V	21.80	40.0	-18.2	Pass
3.	168.00	V	24.00	43.5	-19.5	Pass
4.	287.90	H	28.90	46.0	-17.1	Pass
5.	299.95	V	36.80	46.0	-9.2	Pass
6.	336.05	H	30.70	46.0	-15.3	Pass
7.	347.95	V	29.60	46.0	-16.4	Pass
8.	1626.295	V	36.70	54.0	-17.3	Pass
9.	2439.487	V	49.70	54.0	-4.3	[1]Marginal

[1]See section 2.2 Note (iii).

Unintentional Radiated Electric Field Emissions 15.109 continued:

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

Test Details: BSMAN4, 2480 MHz	
Regulation	Title 47 of the CFR 2008, Part 15 Subpart (b) Clause 15.109
Measurement standard	ANSI C63.4:2003
Frequency range	30MHz to 25 GHz
EUT sample number	S40
Modification state	0
SE in test environment	S33, S46
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	18°C
Photographs (Appendix F)	Photograph 1 and 2

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

Ref No.	Freq (MHz)	Pol.	Result (dBμV/m)	Spec. Limit (dBμV/m)	Margin (dB)	Summary
1.	62.50	V	20.10	40.0	-19.9	Pass
2.	81.35	V	21.80	40.0	-18.2	Pass
3.	168.00	V	24.00	43.5	-19.5	Pass
4.	287.90	H	28.90	46.0	-17.1	Pass
5.	299.95	V	36.80	46.0	-9.2	Pass
6.	336.05	H	30.70	46.0	-15.3	Pass
7.	347.95	V	29.60	46.0	-16.4	Pass
8.	1652.320	V	34.80	54.0	-19.2	Pass
9.	2478.429	V	53.50	54.0	-0.50	[1]Marginal

[1]See section 2.2 Note (iii).

Appendix B: Supporting Graphical Data

This appendix contains graphical data obtained during testing.

Notes:

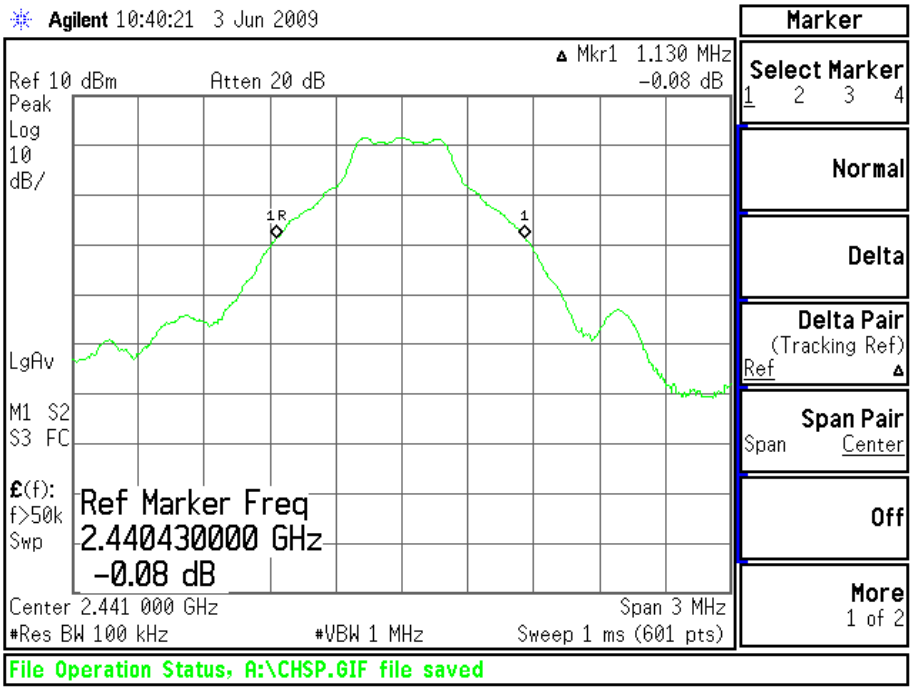
(a) The radiated electric field emissions and conducted emissions graphical data in this appendix is preview data. For details of formal results, refer to Appendix A and Appendix B.

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

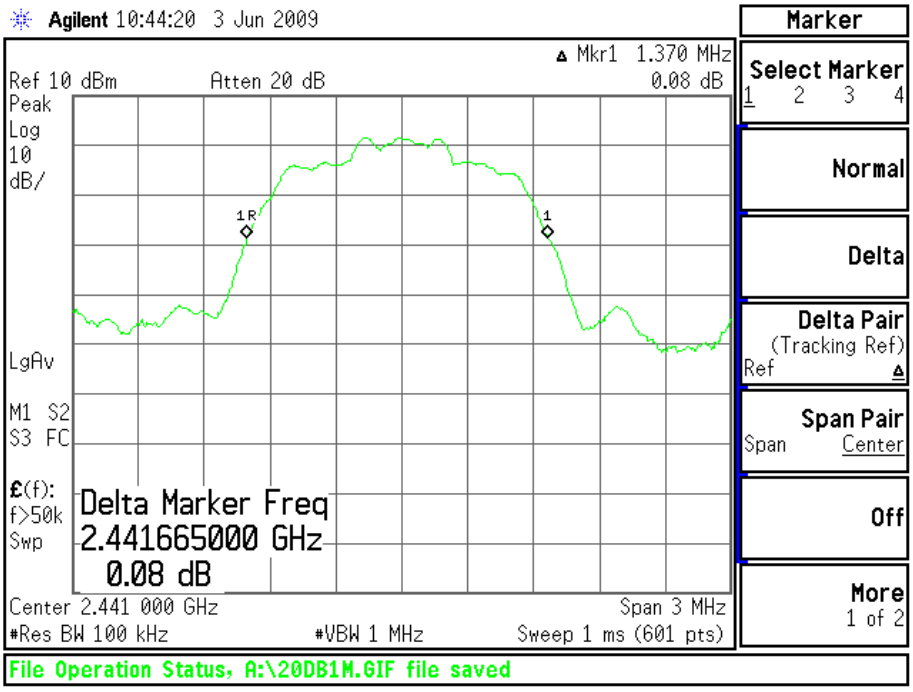
(c) Where relevant, on power line conducted emission plots, the limit displayed is the average limit, which is stricter than the quasi peak limit.

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

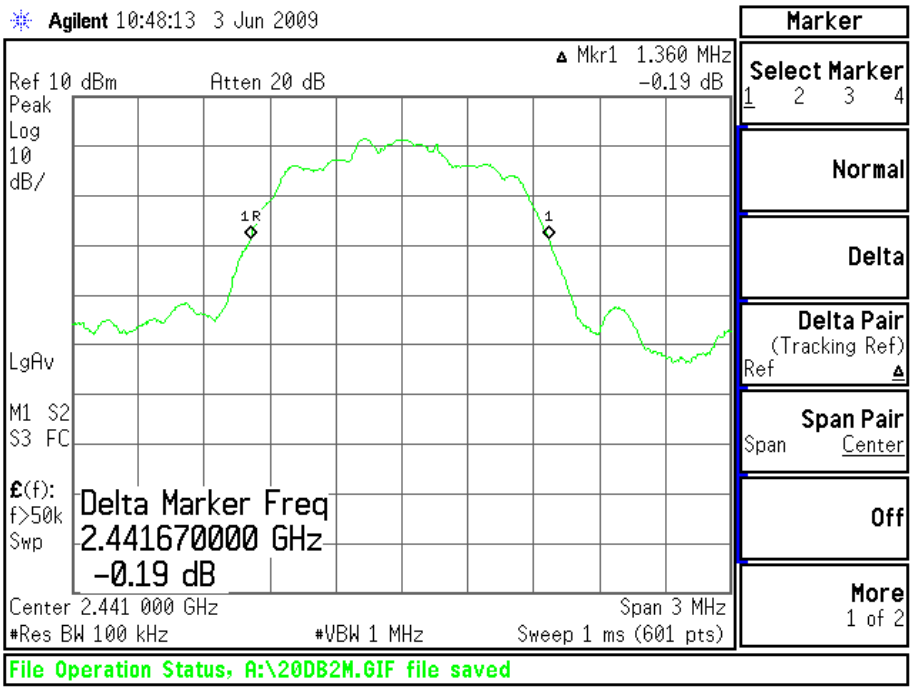
(e) The plots presented in this appendix may not be a complete record of the measurements performed, but are a representative sample, relative to the final assessment.



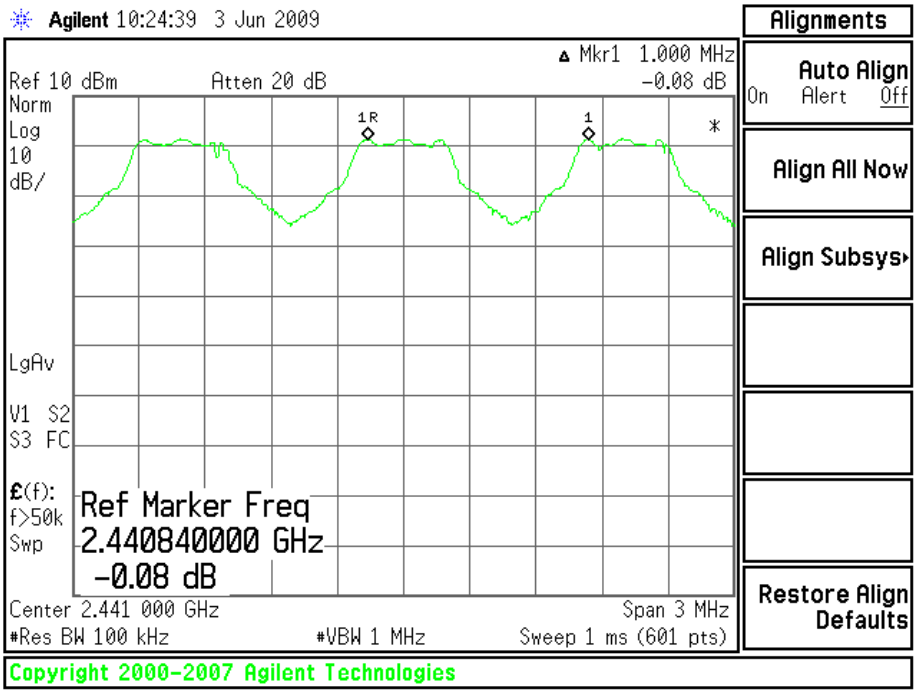
20dB Bandwidth 1Mb/s Operation



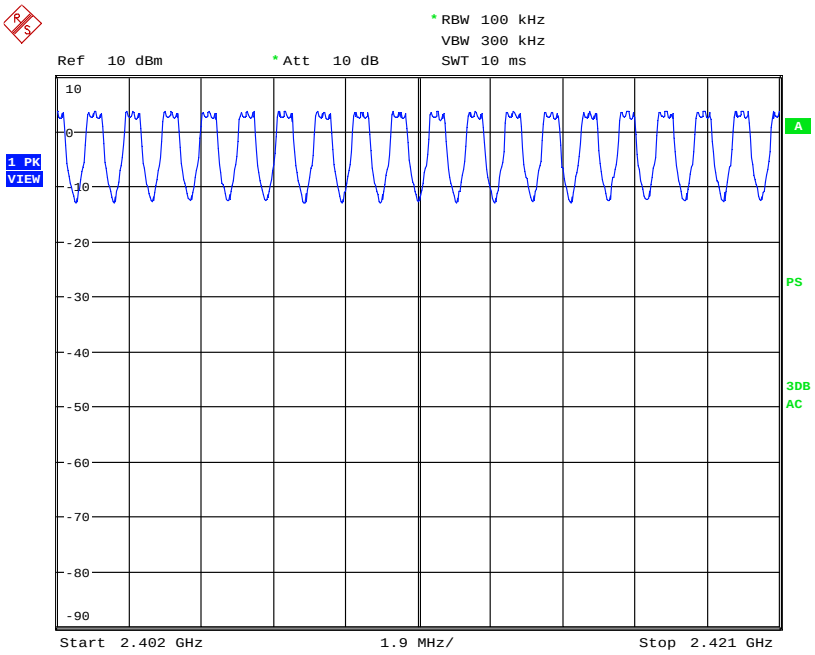
20dB Bandwidth 2Mb/s Operation



20dB Bandwidth 3Mb/s Operation

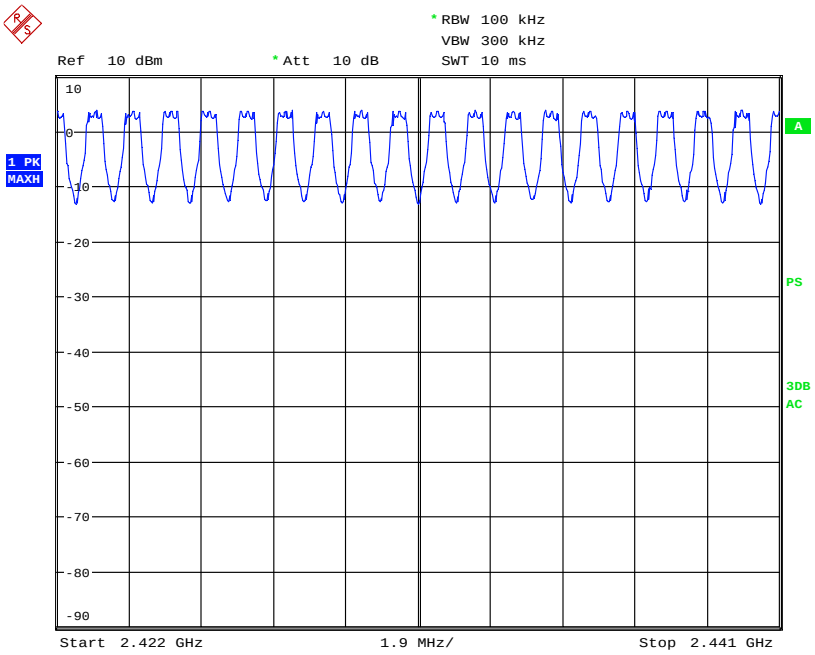


Channel Spacing



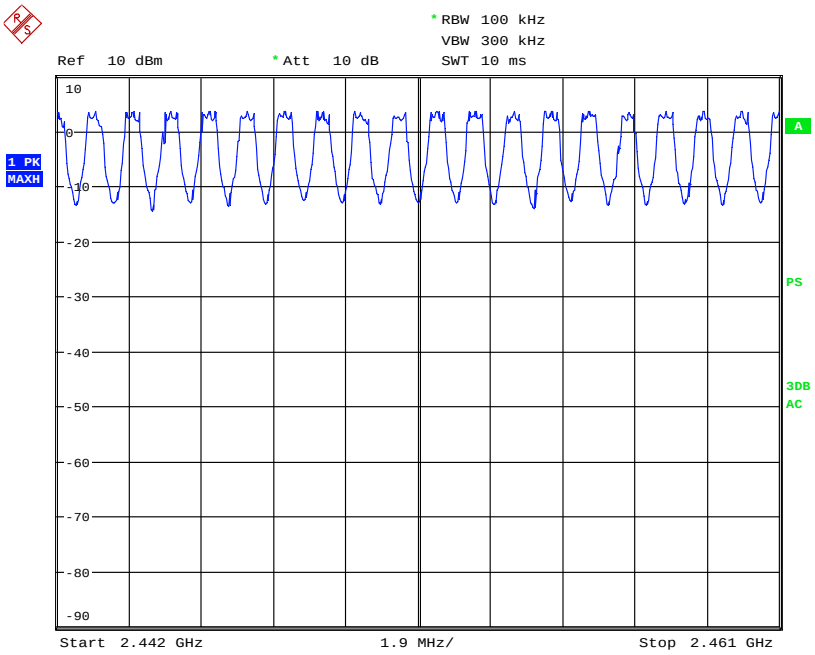
Date: 1.JUN.2009 16:53:45

Channels 0 to 19



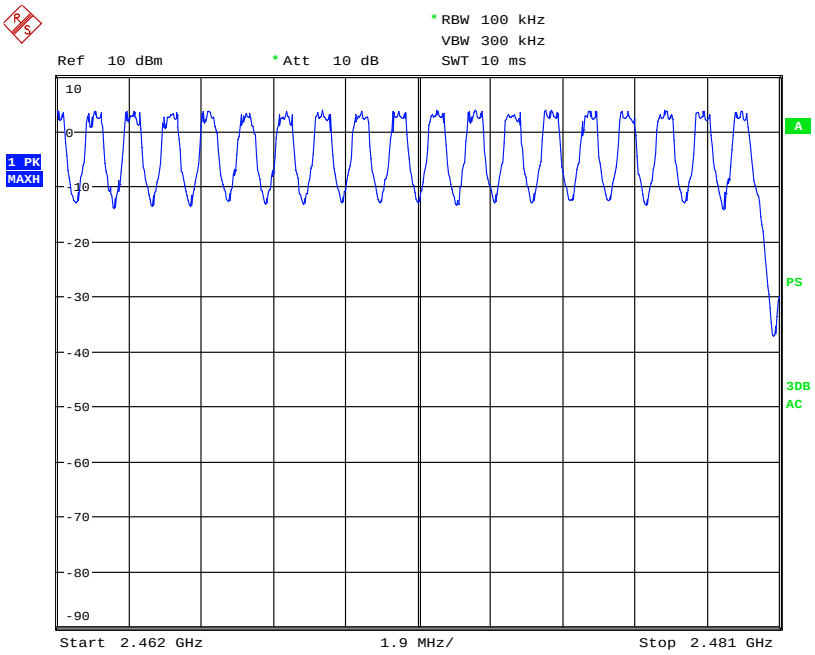
Date: 1.JUN.2009 17:02:57

Channels 20 to 39



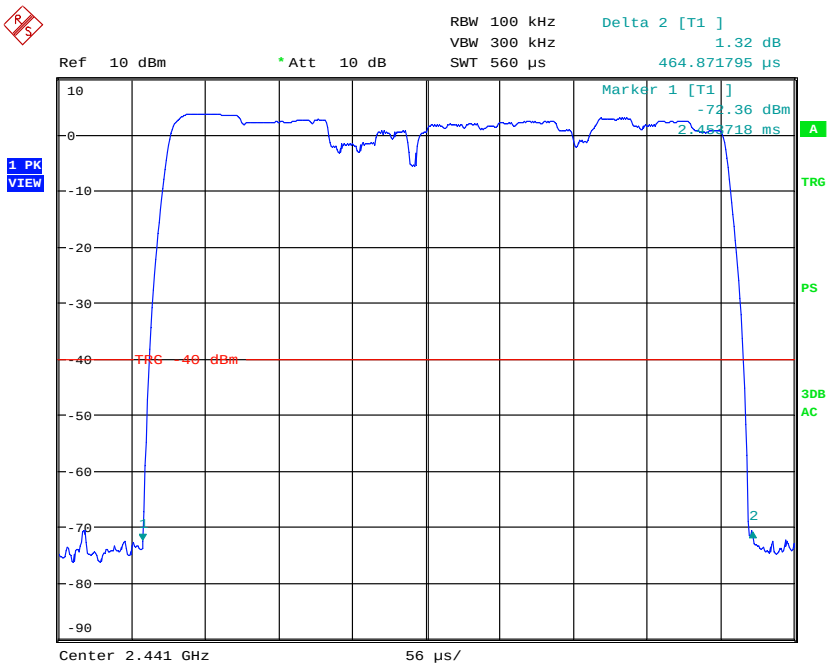
Date: 1.JUN.2009 17:06:50

Channels 40 to 59



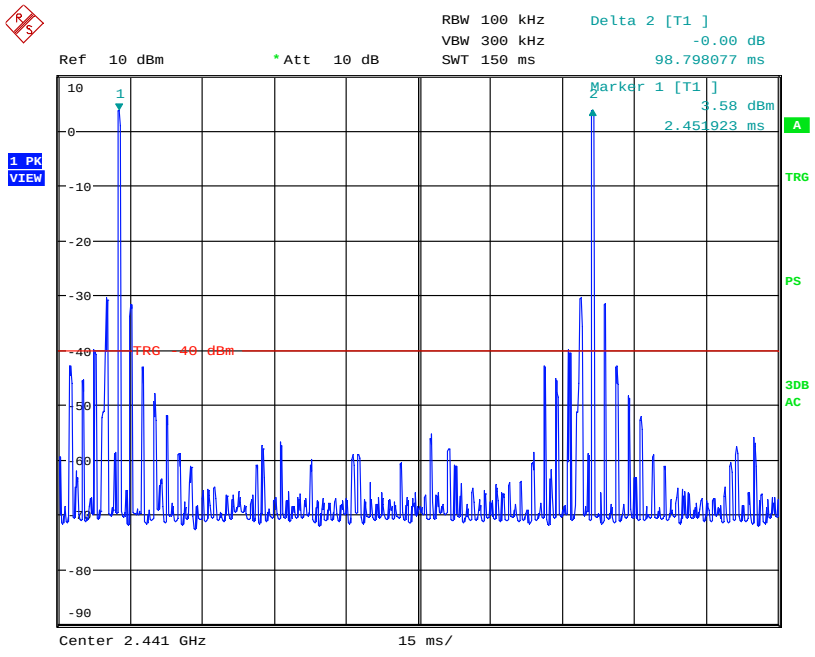
Date: 1.JUN.2009 17:10:56

Channels 60 to 78



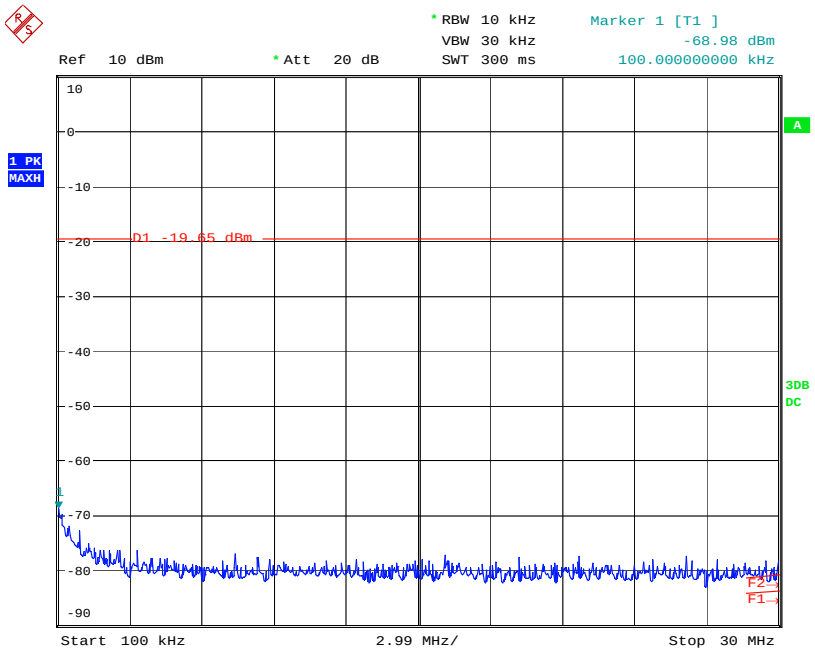
Date: 1.JUN.2009 17:36:36

Channel Occupancy Time



Date: 1.JUN.2009 17:39:59

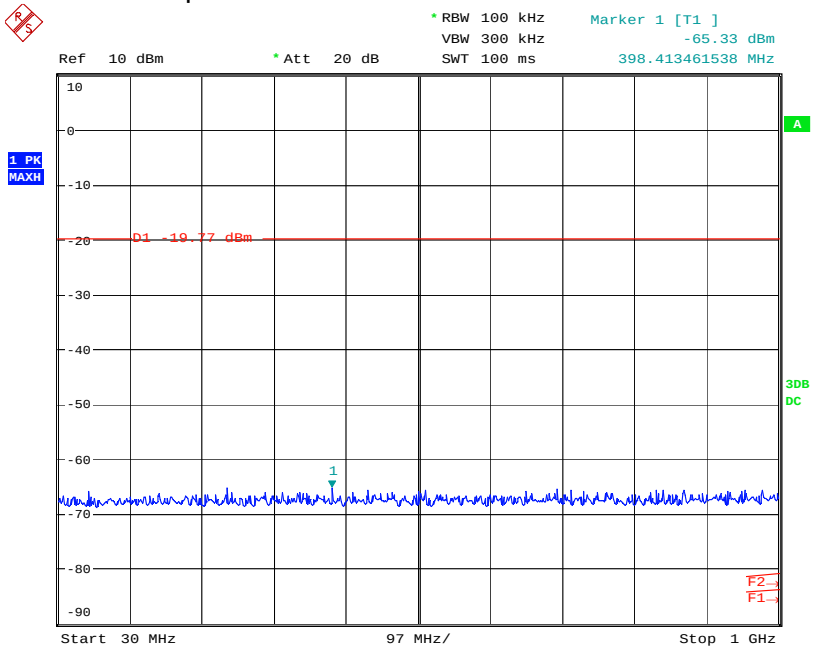
Channel repetition time



TET TYU

Date: 19.JUN.2009 15:59:58

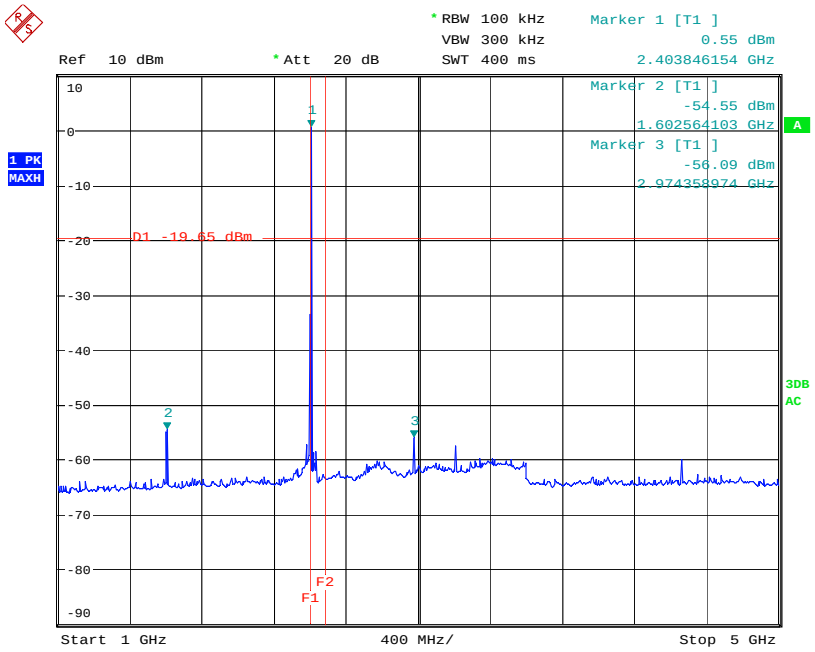
Conducted Spurious emissions 100kHz to 30 MHz – 2402MHz 1Mb/s



TET TYU

Date: 19.JUN.2009 16:05:37

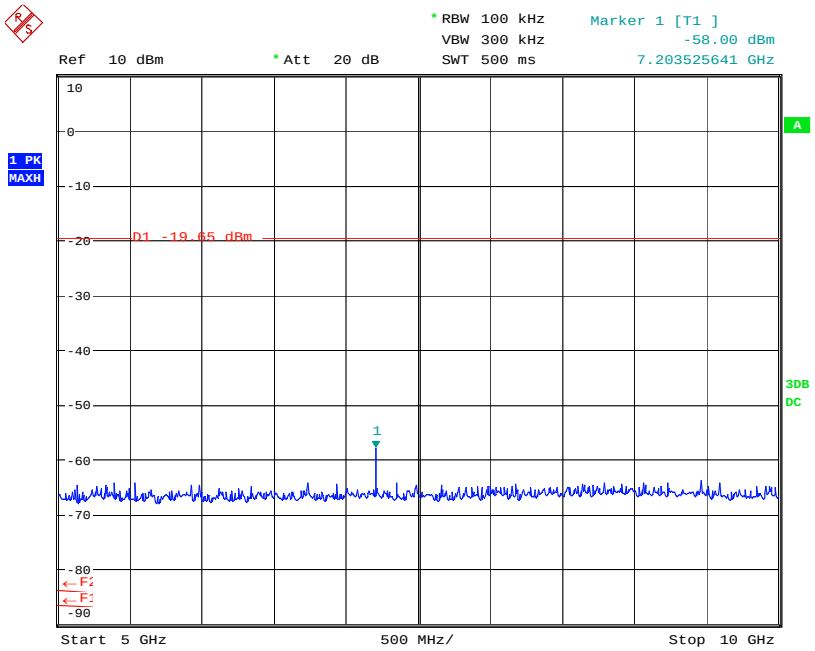
Conducted Spurious emissions 30 MHz to 1 GHz – 2402MHz 1Mb/s



TET TYU

Date: 19.JUN.2009 15:59:24

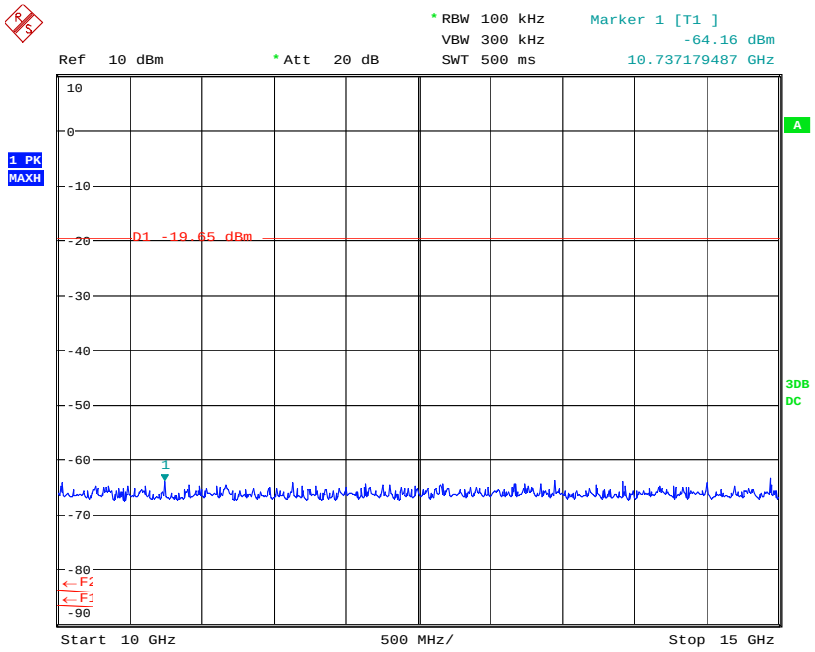
Conducted Spurious emissions 1 GHz to 5 GHz – 2402MHz 1Mb/s



TET TYU

Date: 19.JUN.2009 16:00:14

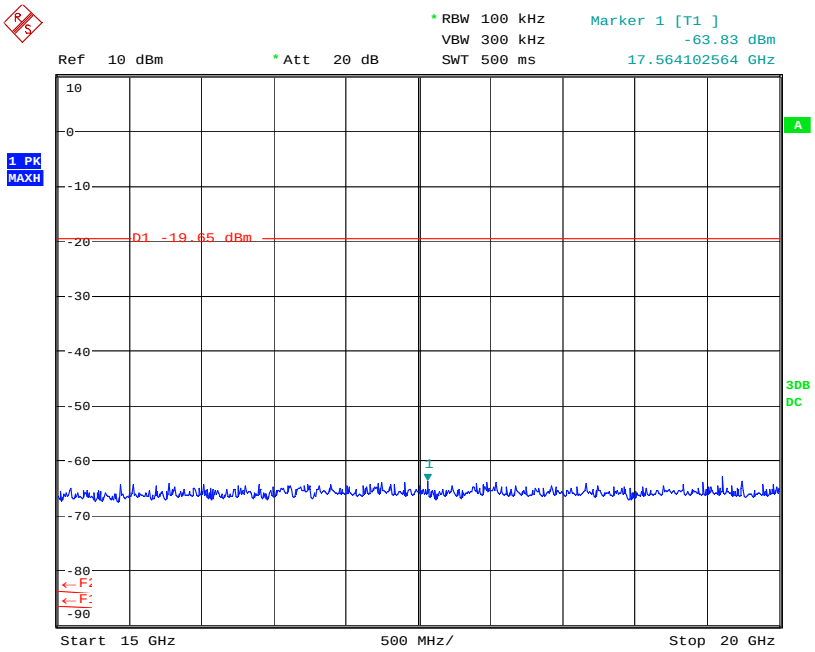
Conducted Spurious emissions 5 GHz to 10 GHz – 2402MHz 1Mb/s



TET TYU

Date: 19.JUN.2009 16:00:27

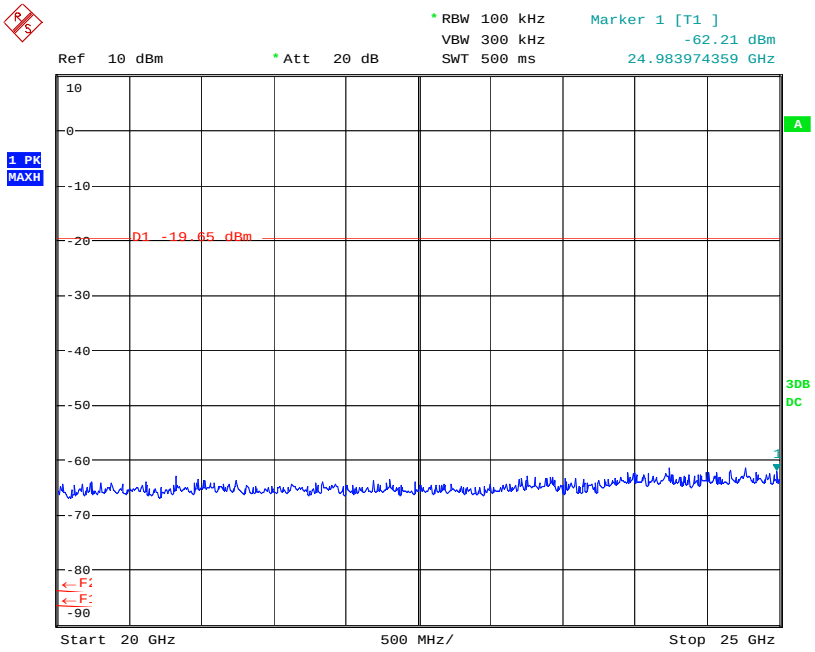
Conducted Spurious emissions 10 GHz to 1 G5Hz – 2402MHz 1Mb/s



TET TYU

Date: 19.JUN.2009 16:00:38

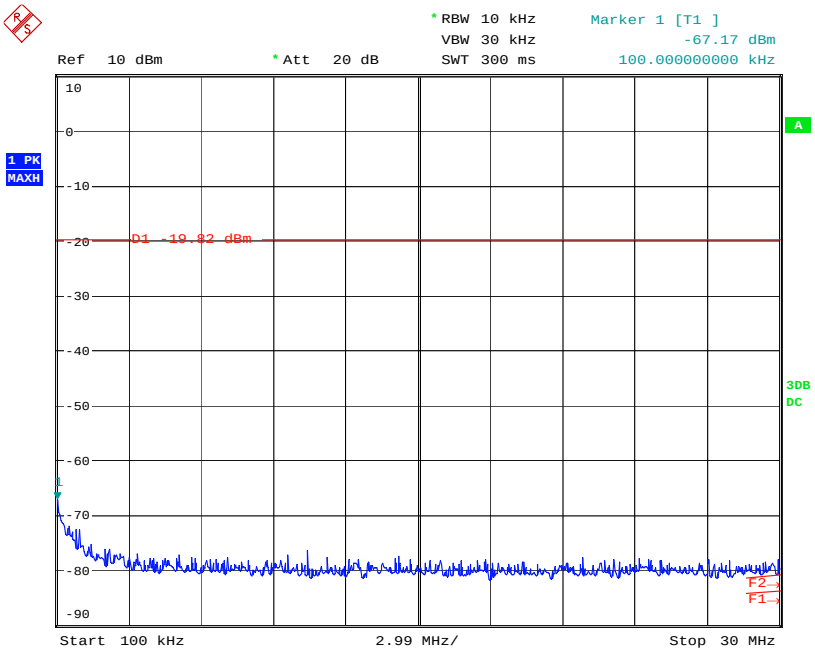
Conducted Spurious emissions 15 GHz to 20 GHz – 2402MHz 1Mb/s



TET TYU

Date: 19.JUN.2009 16:00:55

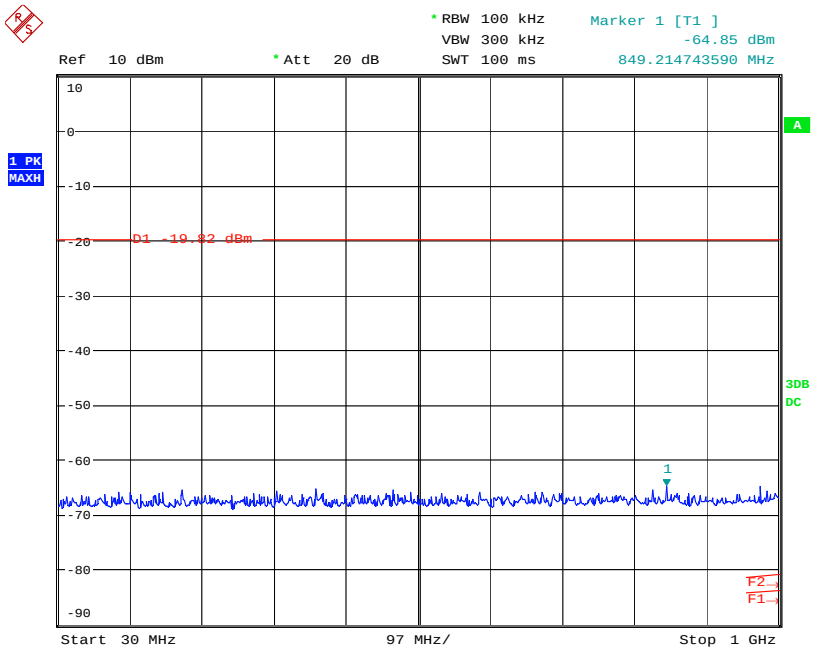
Conducted Spurious emissions 20 GHz to 25 GHz – 2402MHz 1Mb/s



TET TYU

Date: 19.JUN.2009 16:02:49

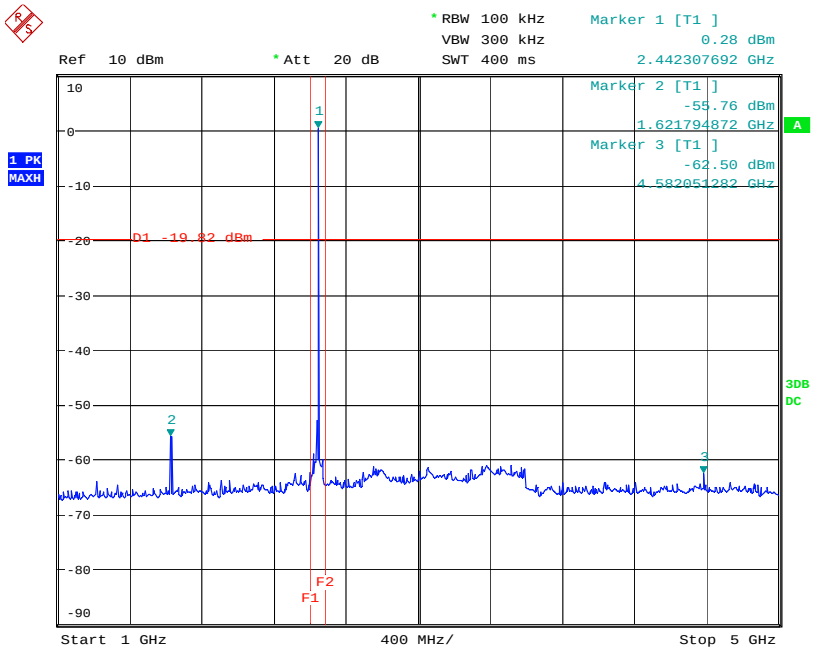
Conducted Spurious emissions 100kHz to 30 MHz – 2442MHz 1Mb/s



TET TYU

Date: 19.JUN.2009 16:03:07

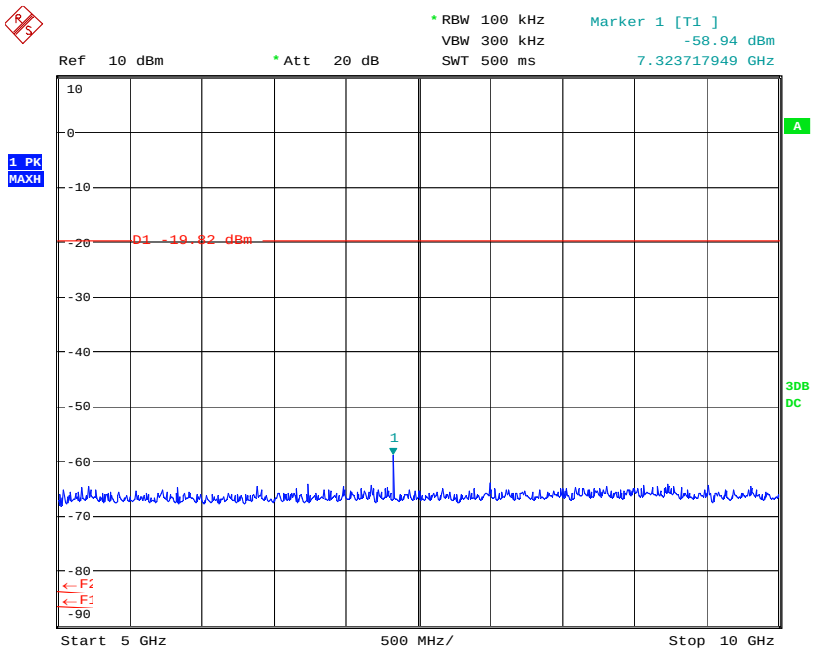
Conducted Spurious emissions 30 MHz to 1 GHz – 2442MHz 1Mb/s



TET TYU

Date: 19.JUN.2009 16:02:29

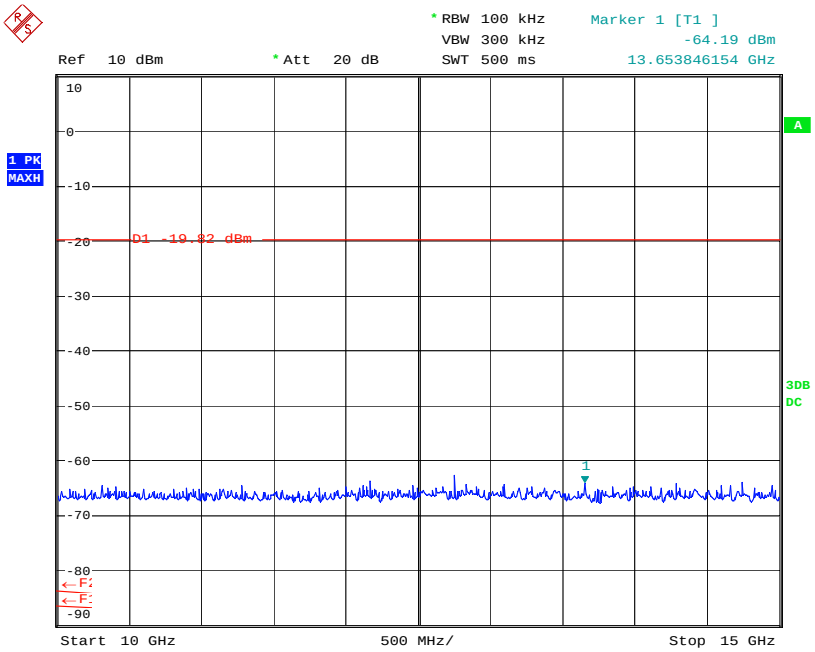
Conducted Spurious emissions 1 GHz to 5 GHz – 2442MHz 1Mb/s



TET TYU

Date: 19.JUN.2009 16:03:18

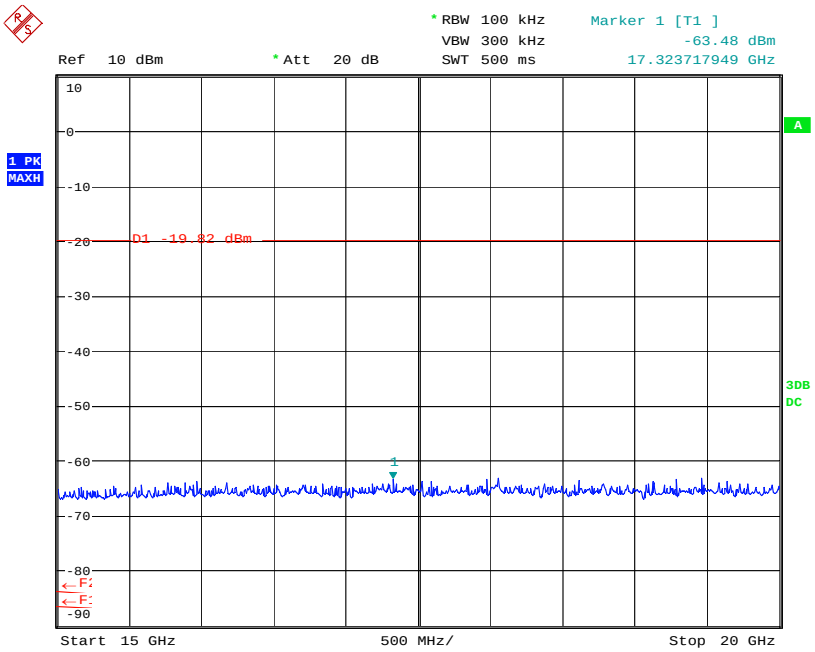
Conducted Spurious emissions 5 GHz to 10 GHz – 2442MHz 1Mb/s



TET TYU

Date: 19.JUN.2009 16:03:34

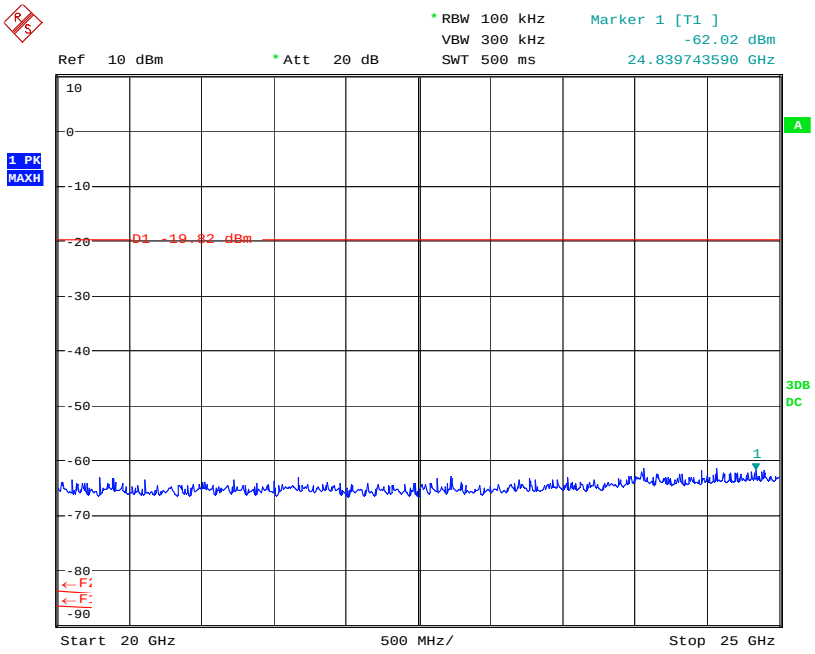
Conducted Spurious emissions 10 GHz to 15GHz – 2442MHz 1Mb/s



TET TYU

Date: 19.JUN.2009 16:03:52

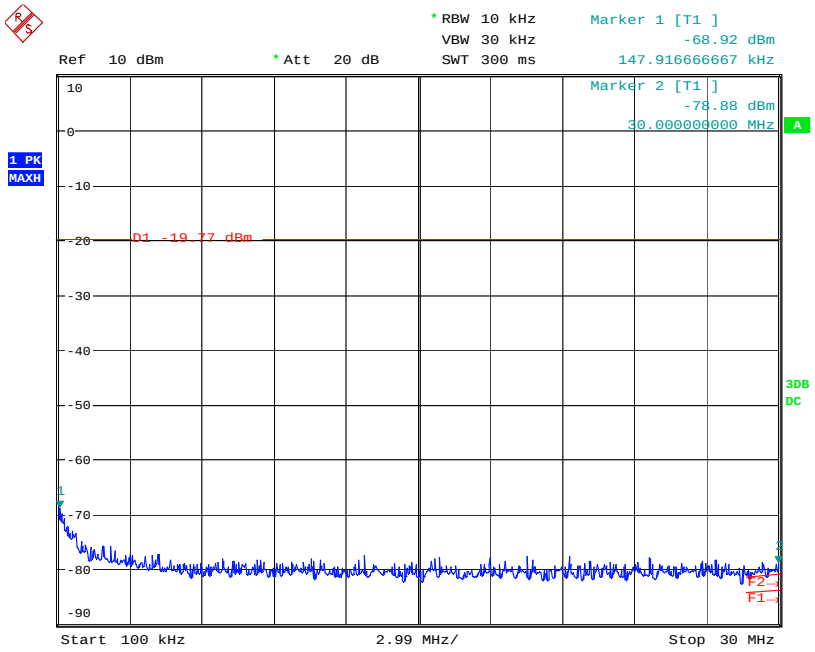
Conducted Spurious emissions 15 GHz to 20GHz – 2442MHz 1Mb/s



TET TYU

Date: 19.JUN.2009 16:04:03

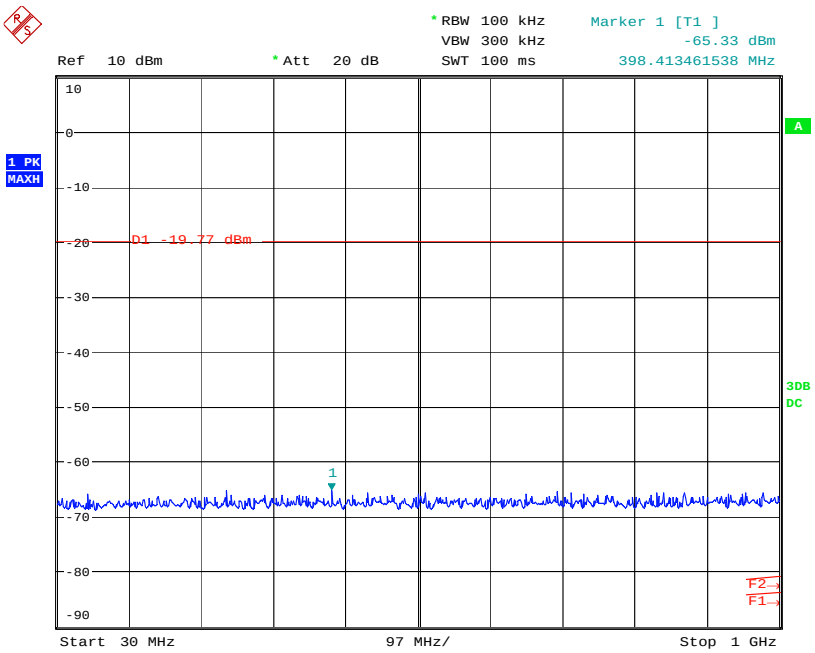
Conducted Spurious emissions 20 GHz to 25GHz – 2442MHz 1Mb/s



TET TYU

Date: 19.JUN.2009 16:05:22

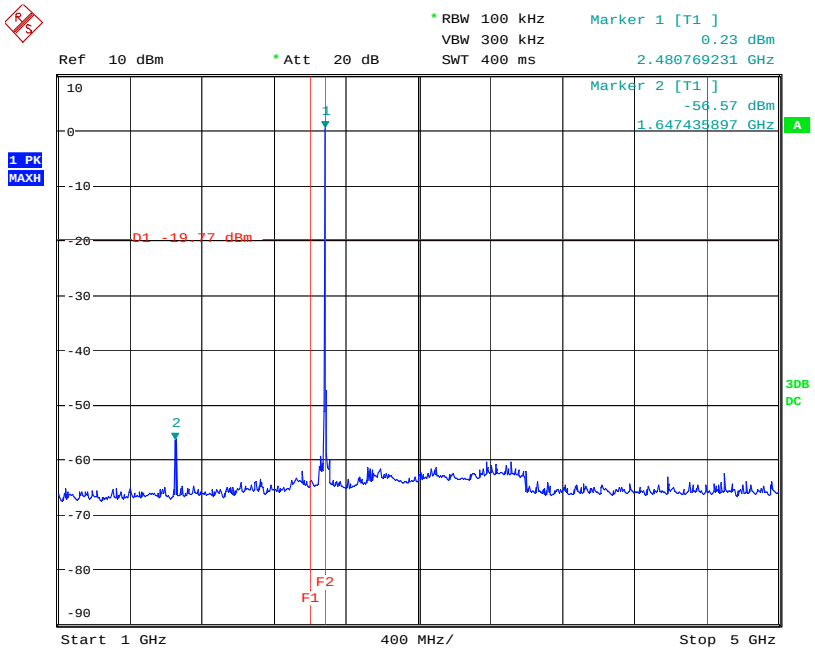
Conducted Spurious emissions 100 kHz to 30 MHz – 2480MHz 1Mb/s



TET TYU

Date: 19.JUN.2009 16:05:37

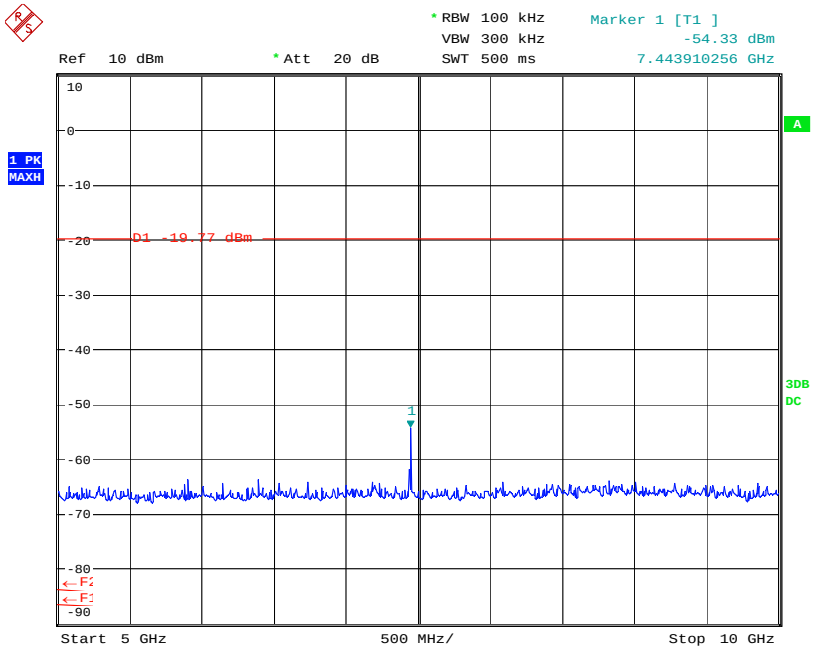
Conducted Spurious emissions 30 MHz to 1 GHz – 2480MHz 1Mb/s



TET TYU

Date: 19.JUN.2009 16:05:05

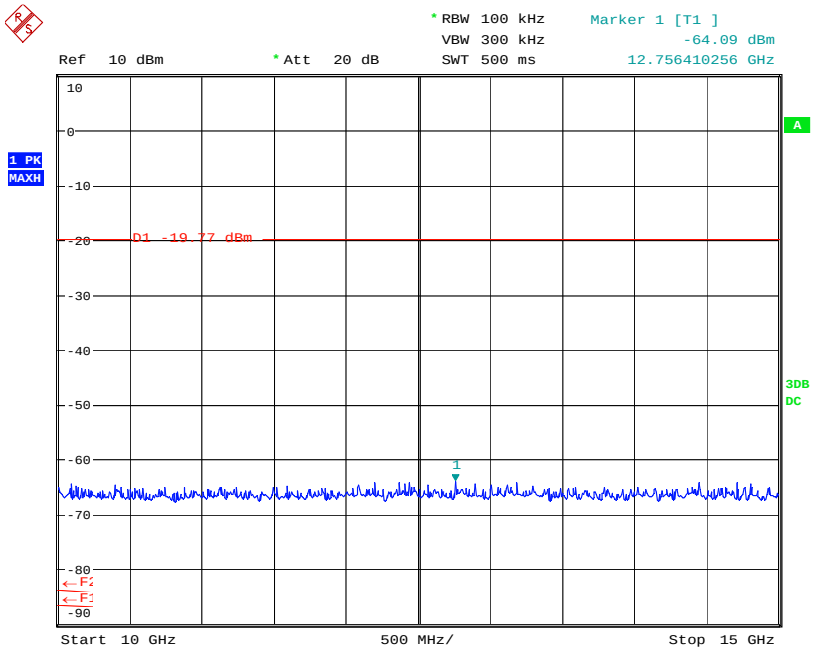
Conducted Spurious emissions 1 GHz to 5 GHz – 2480MHz 1Mb/s



TET TYU

Date: 19.JUN.2009 16:05:48

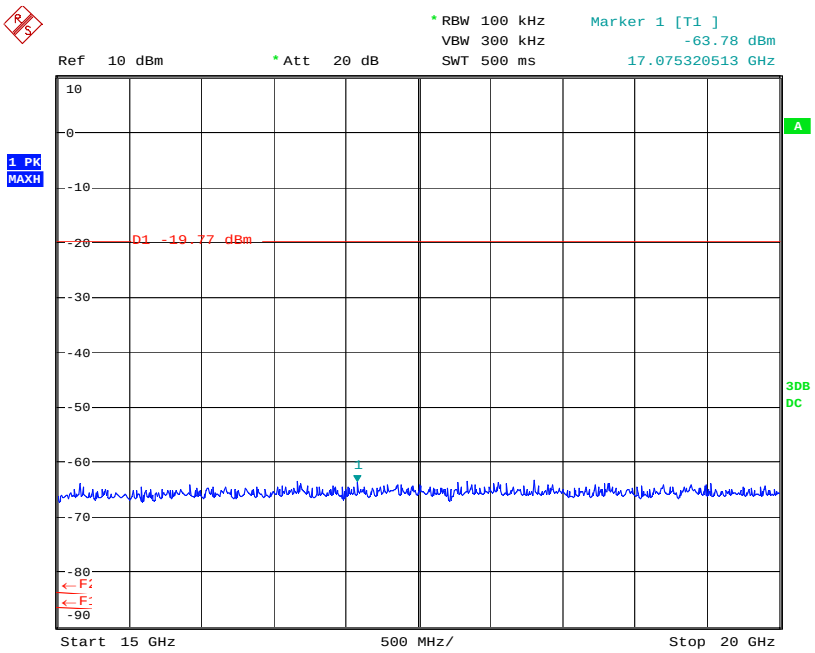
Conducted Spurious emissions 5 GHz to 10 GHz– 2480MHz 1Mb/s



TET TYU

Date: 19.JUN.2009 16:05:59

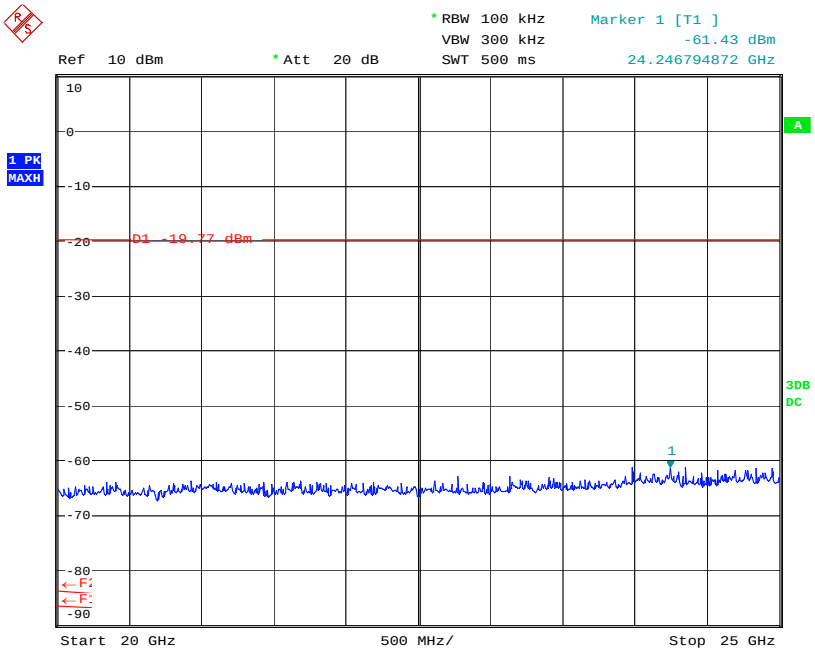
Conducted Spurious emissions 10 GHz to 15 GHz– 2480MHz 1Mb/s



TET TYU

Date: 19.JUN.2009 16:06:13

Conducted Spurious emissions 15 GHz to 20 GHz– 2480MHz 1Mb/s

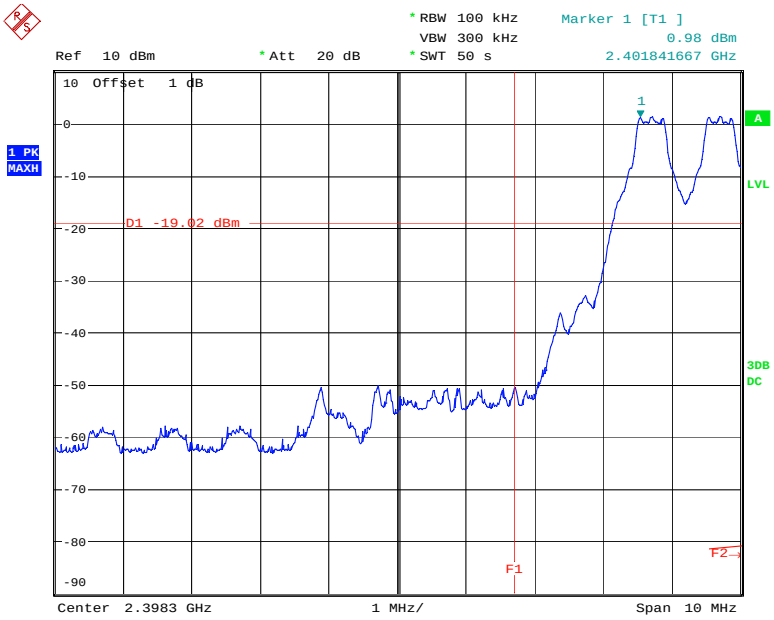


TET TYU

Date: 19.JUN.2009 16:06:24

Conducted Spurious emissions 20 GHz to 25 GHz– 2480MHz 1Mb/s

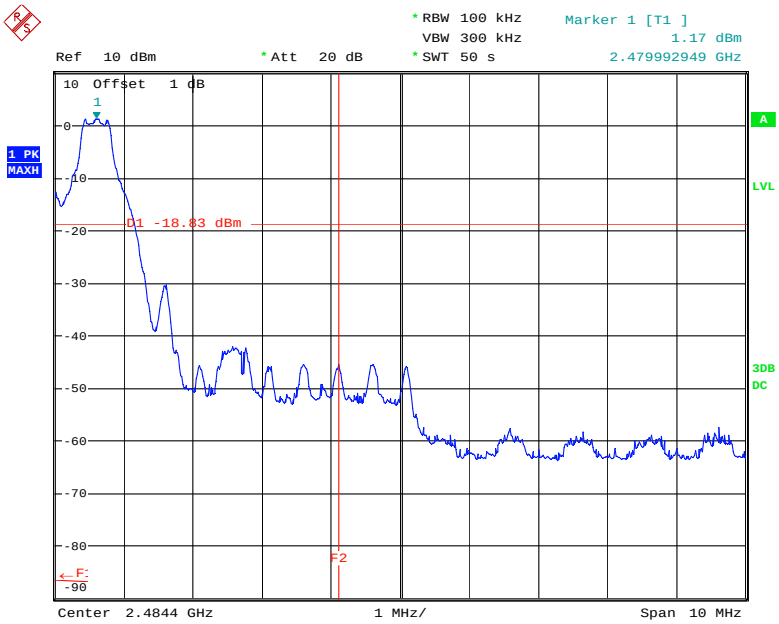
Conducted Bandedge Compliance



TET TYU

Date: 22.JUN.2009 12:07:34

Lower Bandedge - Operational Data Rate 1Mb/s

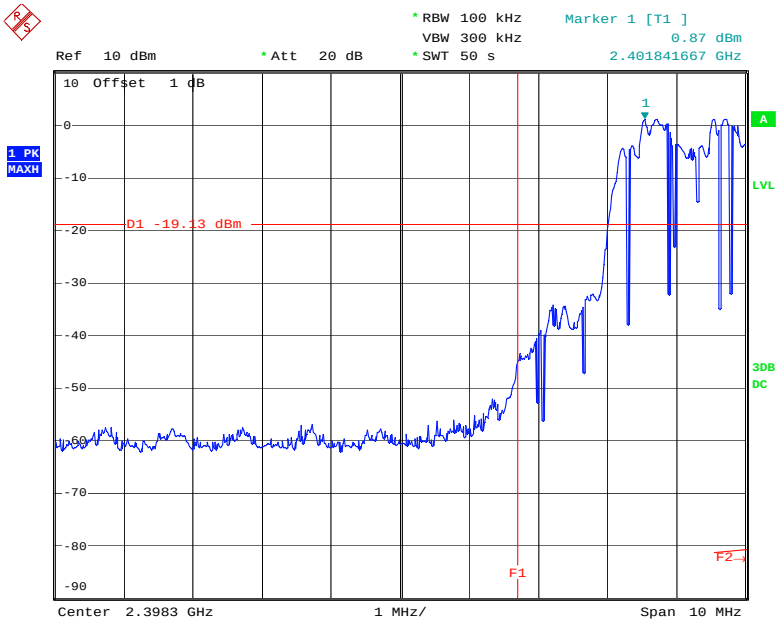


TET TYU

Date: 22.JUN.2009 12:11:40

Upper Bandedge - Operational Data Rate 1Mb/s

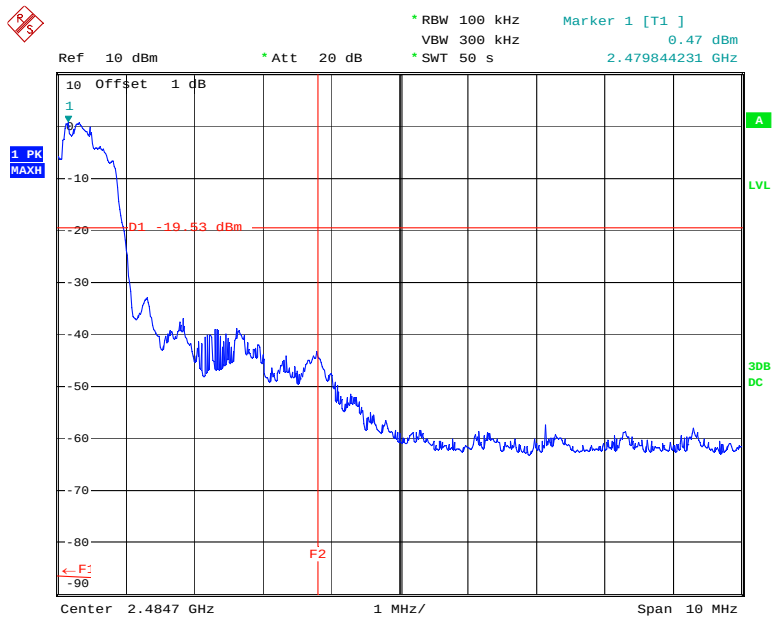
Conducted Bandedge Compliance



TET TYU

Date: 22.JUN.2009 12:02:08

Lower Bandedge - Operational Data Rate 2Mb/s

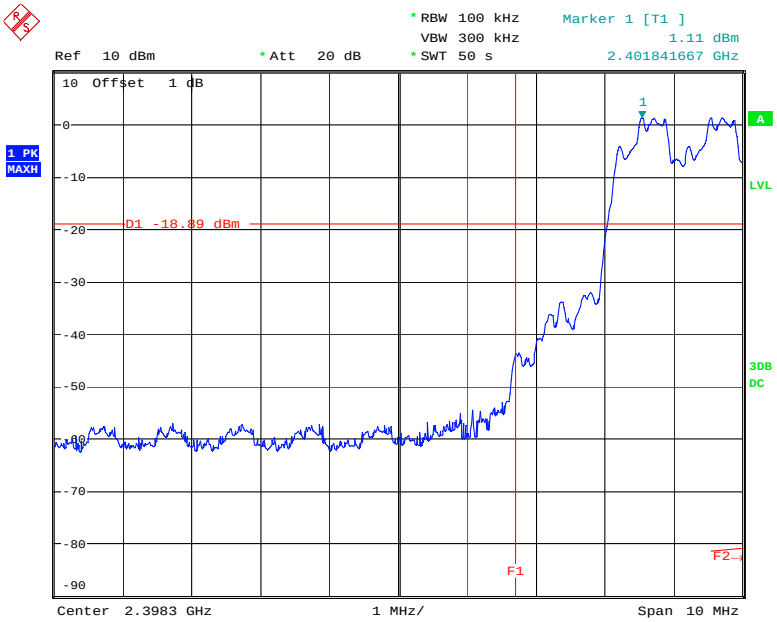


TET TYU

Date: 22.JUN.2009 11:58:10

Upper Bandedge - Operational Data Rate 2Mb/s

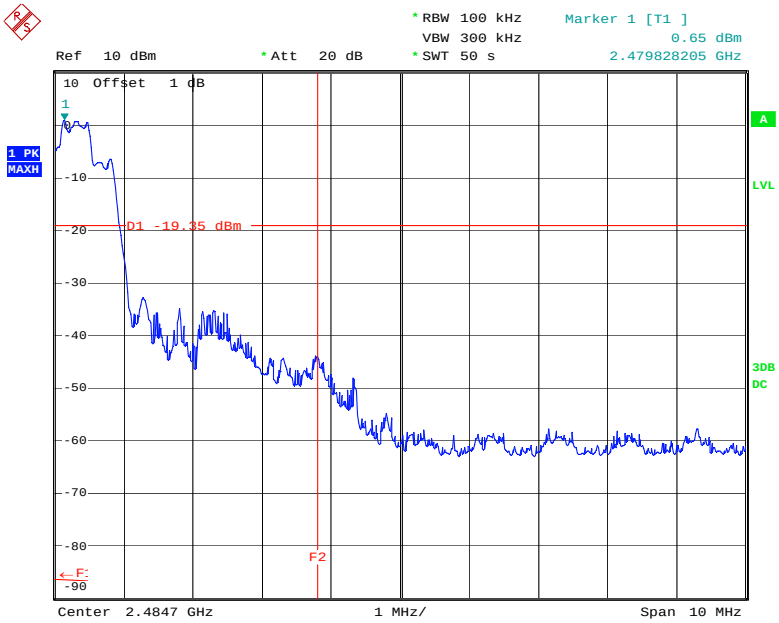
Conducted Bandedge Compliance



TET TYU

Date: 22.JUN.2009 11:52:28

Lower Bandedge - Operational Data Rate 3Mb/s

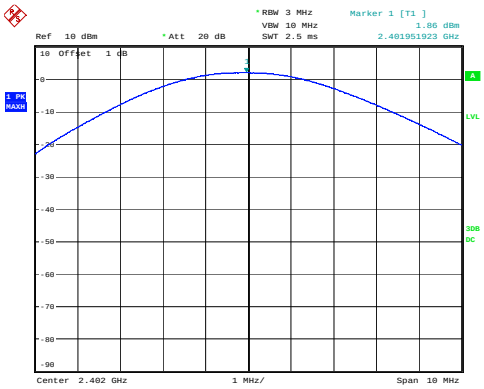


TET TYU

Date: 22.JUN.2009 11:55:19

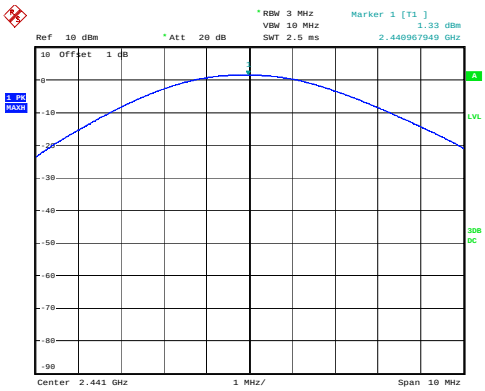
Upper Bandedge - Operational Data Rate 3Mb/s

Operational data Rate 1Mb/s



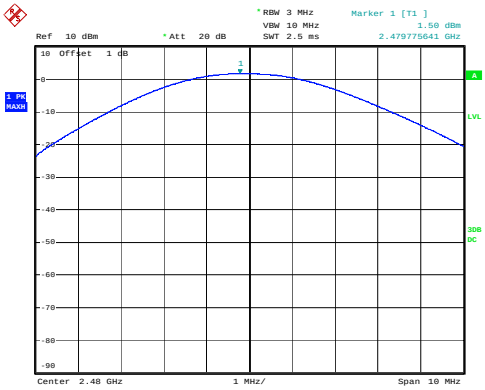
TET TYU
Date: 19.JUN.2009 16:44:20

Conducted carrier power 2402MHz



TET TYU
Date: 19.JUN.2009 16:44:41

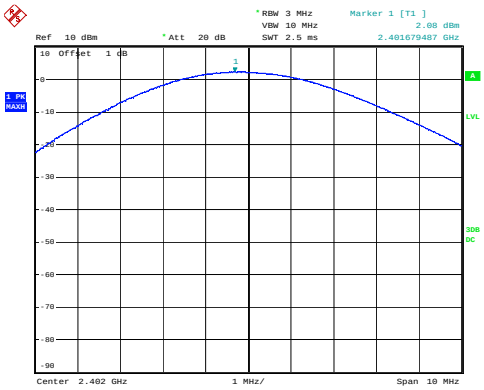
Conducted carrier power 2441 MHz



TET TYU
Date: 19.JUN.2009 16:45:03

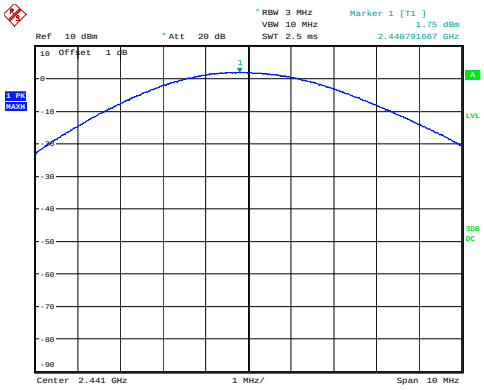
Conducted carrier power 2480 MHz

Operational data Rate 2Mb/s



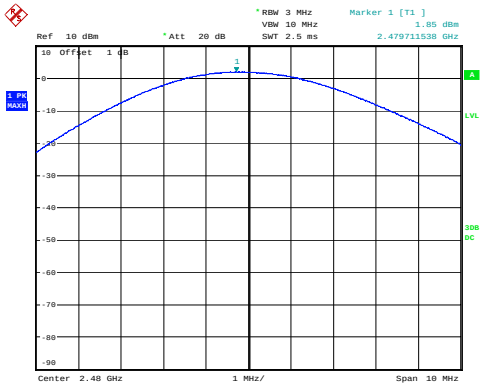
TET TYU
Date: 19.JUN.2009 16:43:26

Conducted carrier power 2402MHz



TET TYU
Date: 19.JUN.2009 16:42:57

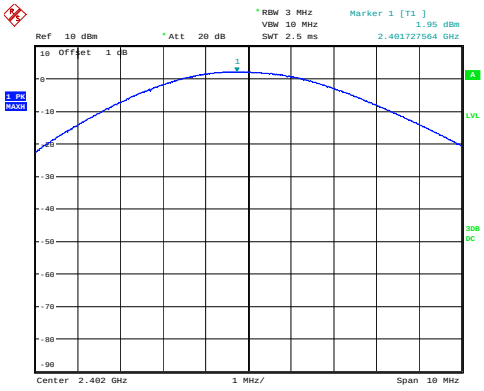
Conducted carrier power 2441 MHz



TET TYU
Date: 19.JUN.2009 16:42:33

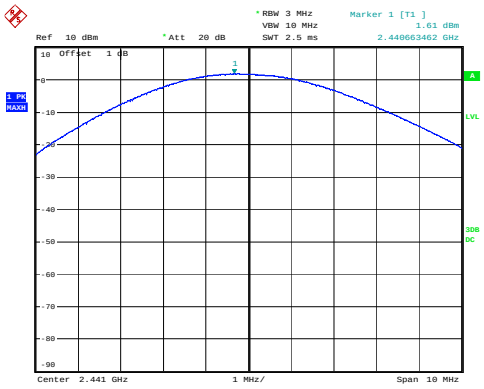
Conducted carrier power 2480 MHz

Operational data Rate 3Mb/s



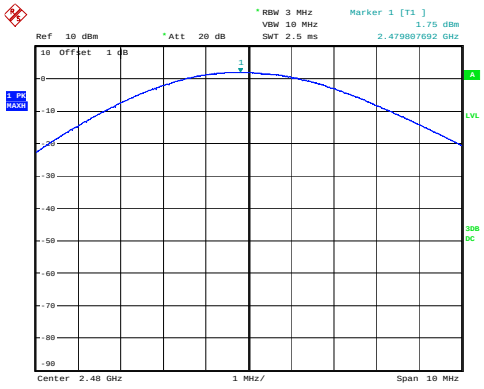
TET TYU
Date: 19.JUN.2009 16:40:50

Conducted carrier power 2402MHz



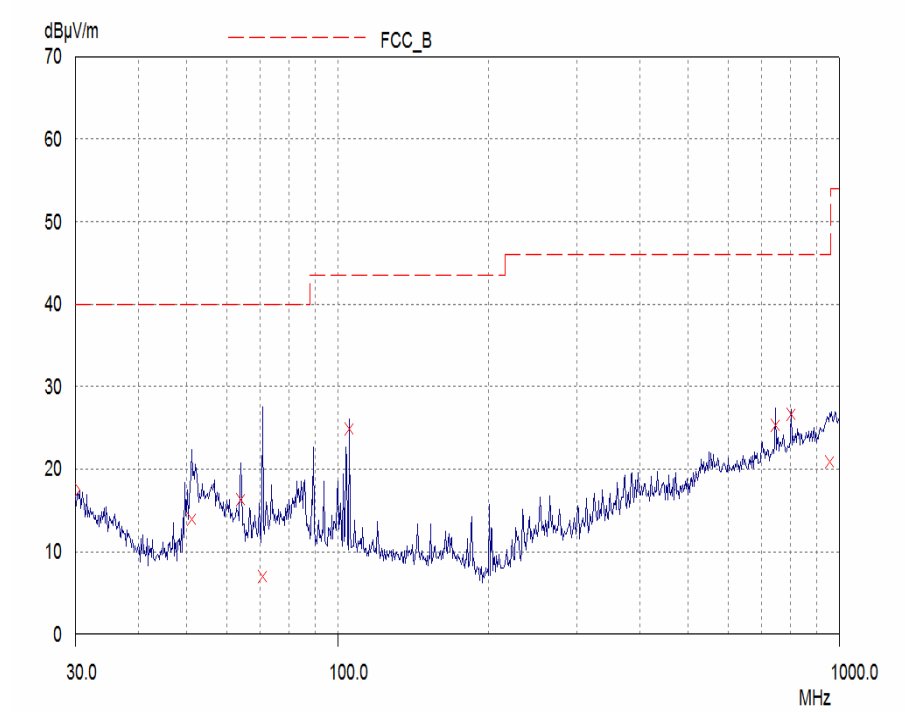
TET TYU
Date: 19.JUN.2009 16:41:21

Conducted carrier power 2441 MHz

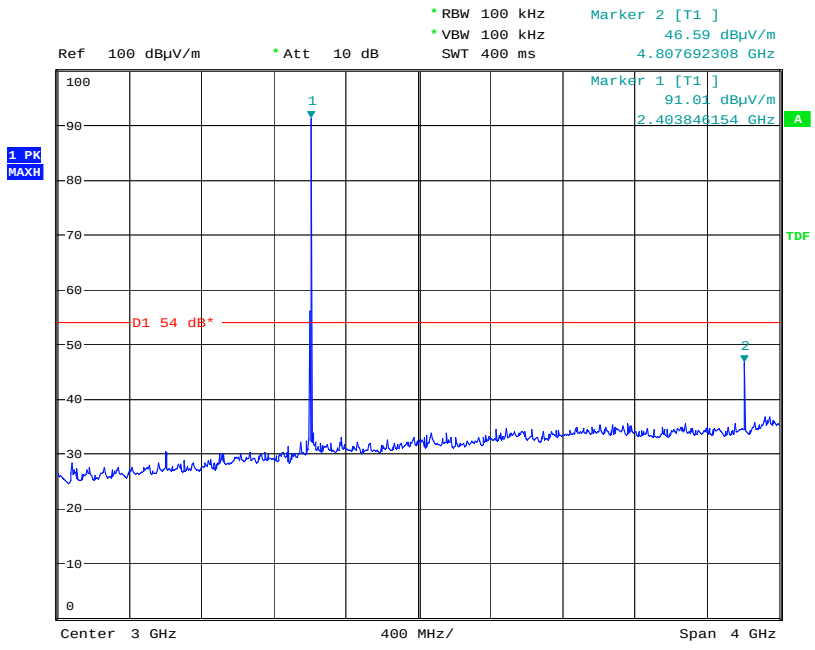


TET TYU
Date: 19.JUN.2009 16:41:56

Conducted carrier power 2480 MHz

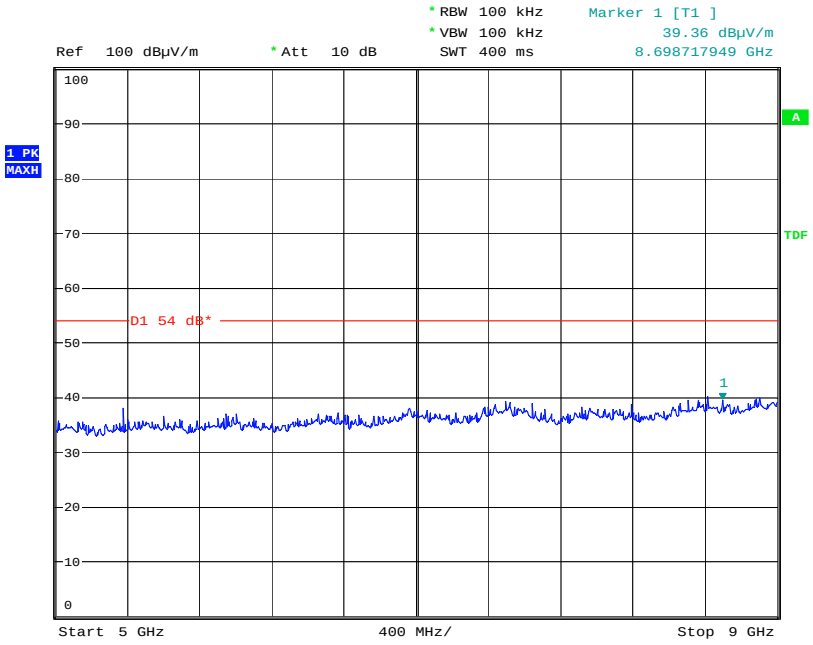


Radiated Spurious emissions 30 MHz to 1 GHz – 2402MHz 1Mb/s



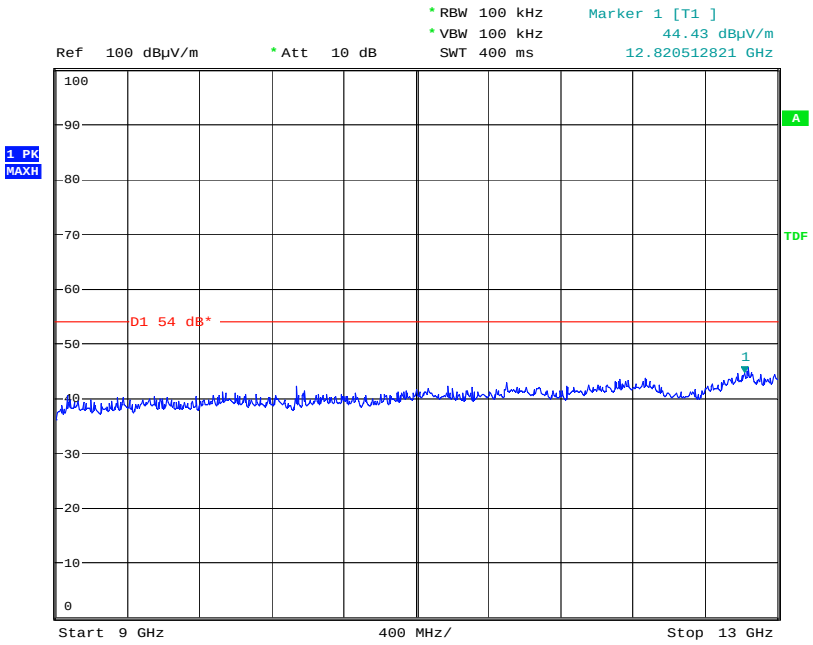
Date: 16.JUN.2009 10:37:50

Radiated Spurious emissions 1 GHz to 5 GHz – 2402MHz 1Mb/s



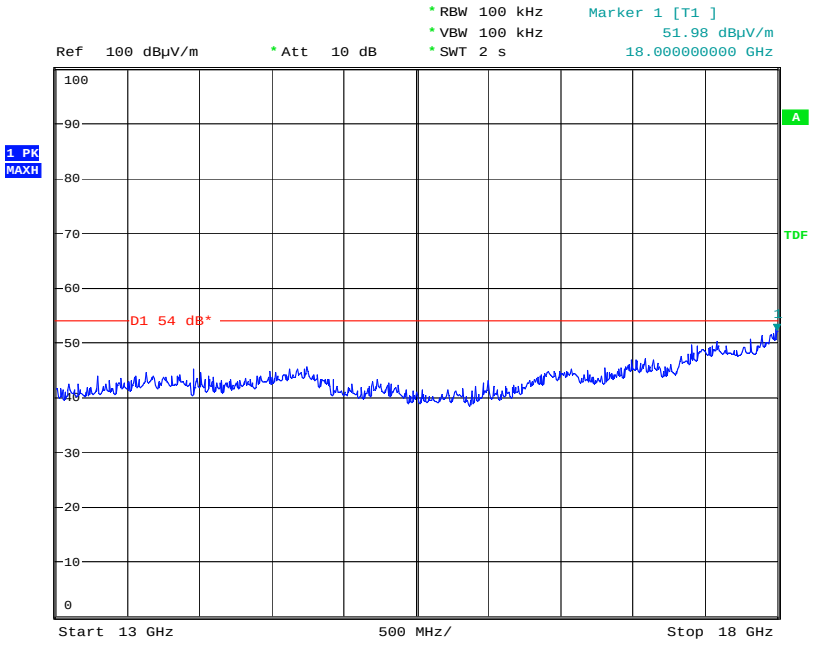
Date: 16.JUN.2009 10:38:31

Radiated Spurious emissions 5 GHz to 9 GHz – 2402MHz 1Mb/s



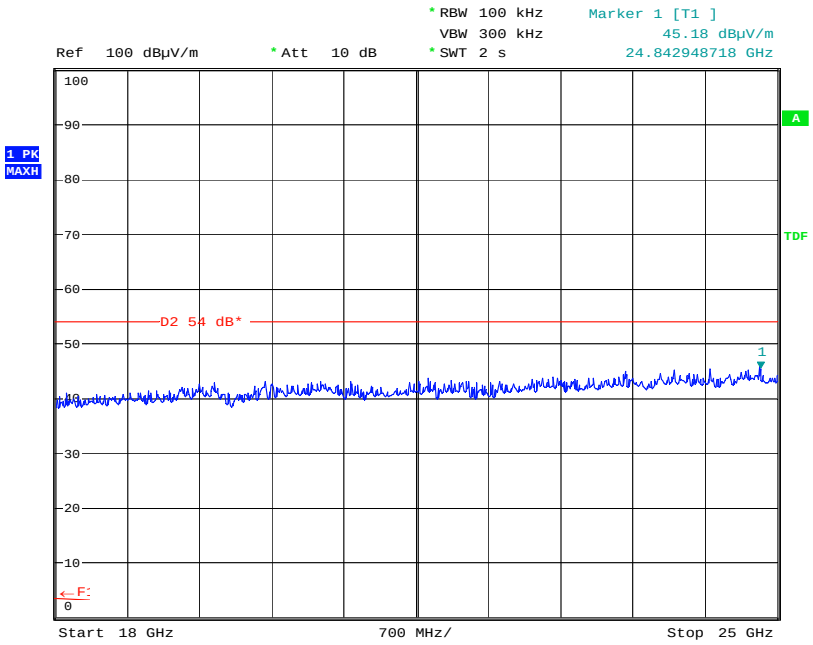
Date: 16.JUN.2009 10:38:48

Radiated Spurious emissions 9 GHz to 13 GHz – 2402MHz 1Mb/s



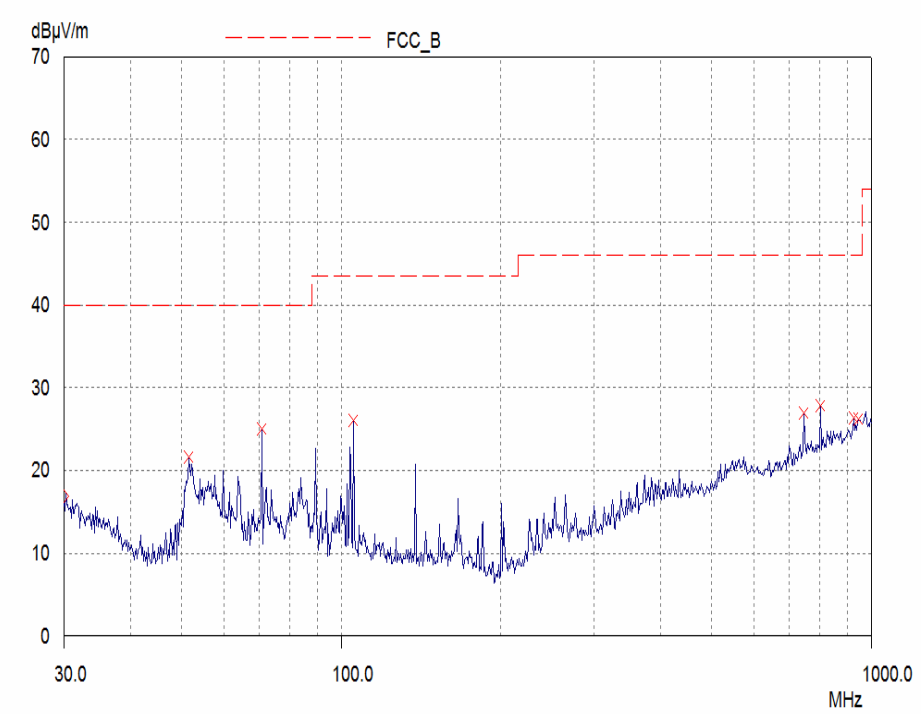
Date: 16.JUN.2009 10:39:07

Radiated Spurious emissions 13 GHz to 18GHz – 2402MHz 1Mb/s

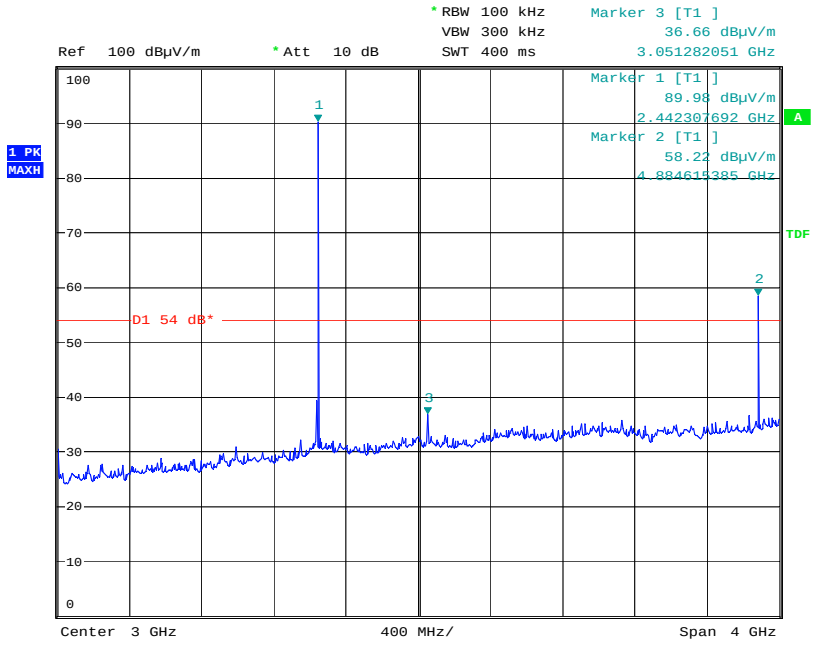


Date: 19.JUN.2009 09:22:23

Radiated Spurious emissions 18 GHz to 25 GHz – 2402MHz 1Mb/s

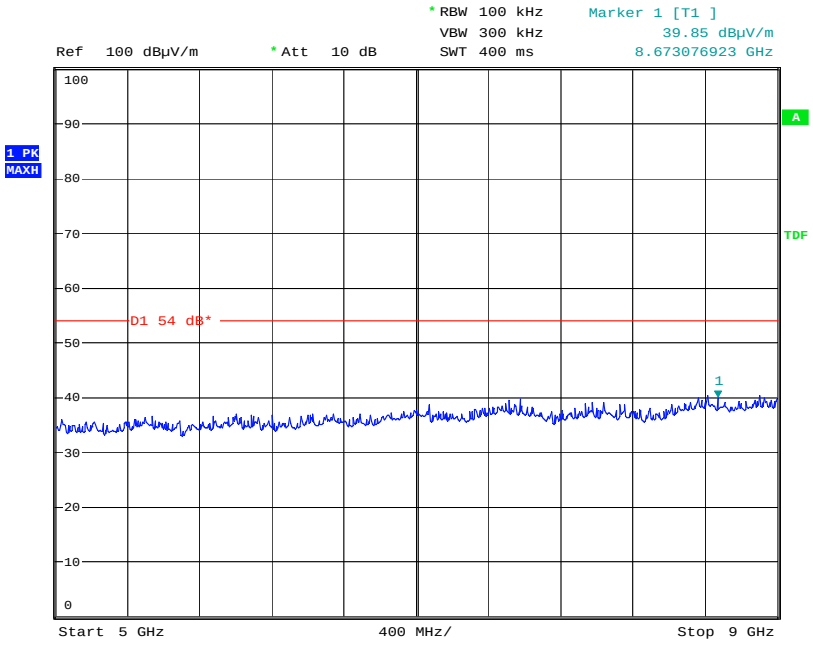


Radiated Spurious emissions 30 MHz to 1 GHz – 2441MHz 1Mb/s



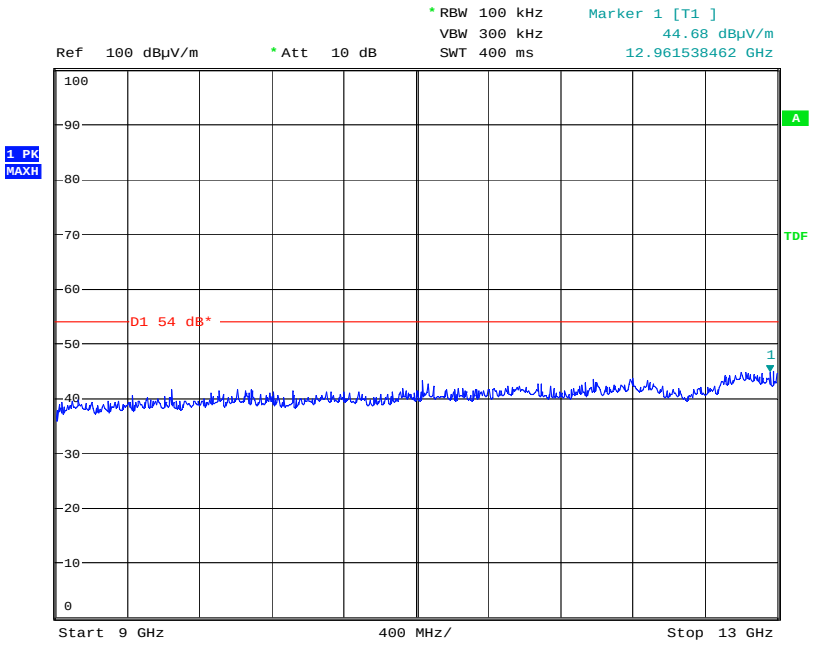
Date: 16.JUN.2009 10:56:23

Radiated Spurious emissions 1 GHz to 5 GHz – 2441MHz 1Mb/s



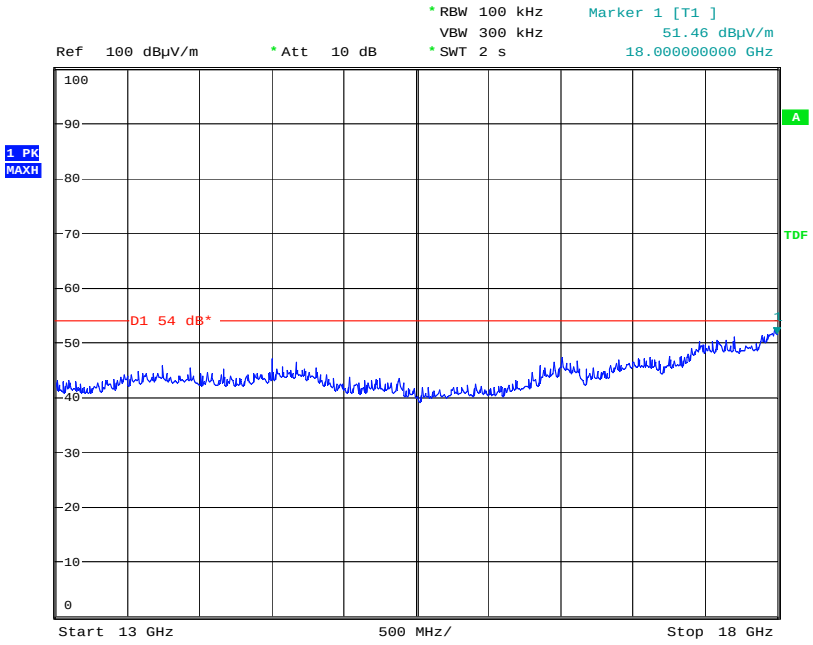
Date: 16.JUN.2009 10:56:42

Radiated Spurious emissions 5 GHz to 9 GHz – 2441MHz 1Mb/s



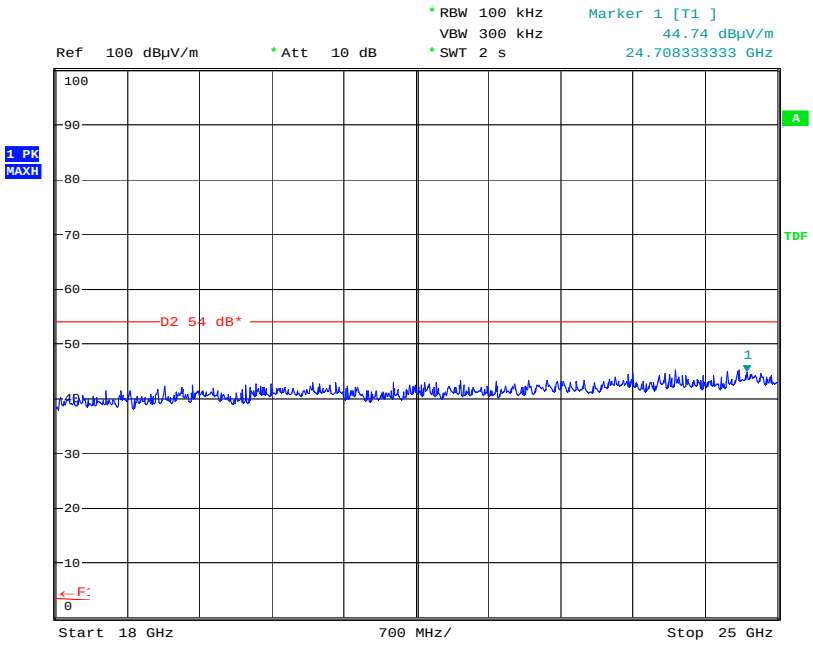
Date: 16.JUN.2009 10:56:57

Radiated Spurious emissions 9 GHz to 13 GHz – 2441MHz 1Mb/s



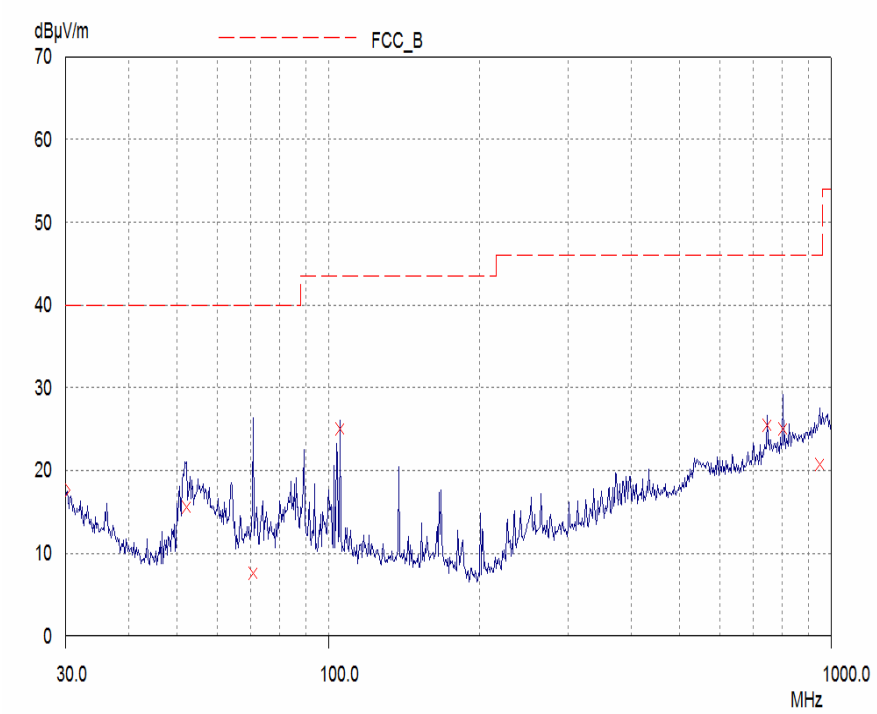
Date: 16.JUN.2009 10:57:16

Radiated Spurious emissions 13 GHz to 18GHz – 2441MHz 1Mb/s

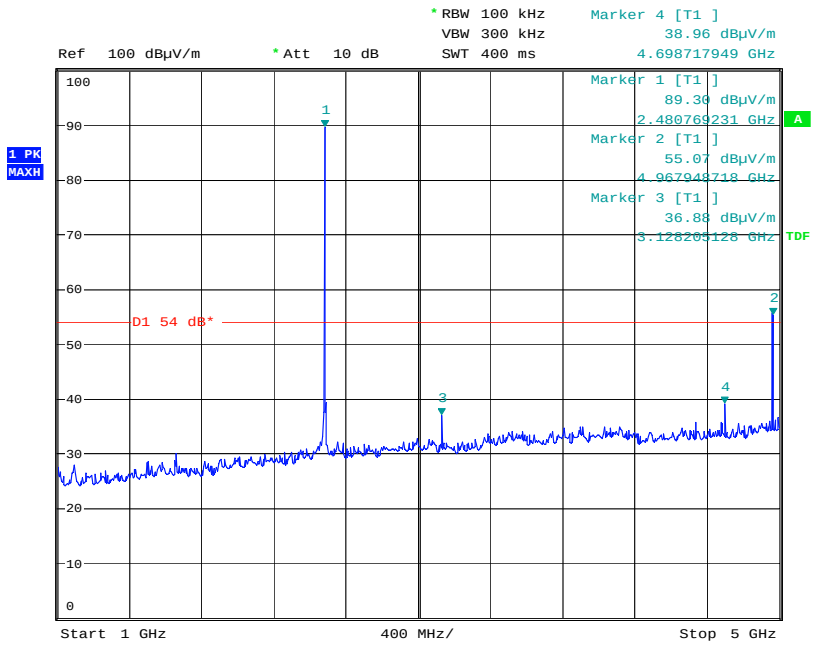


Date: 19.JUN.2009 09:21:08

Radiated Spurious emissions 18 GHz to 25 GHz – 2441MHz 1Mb/s

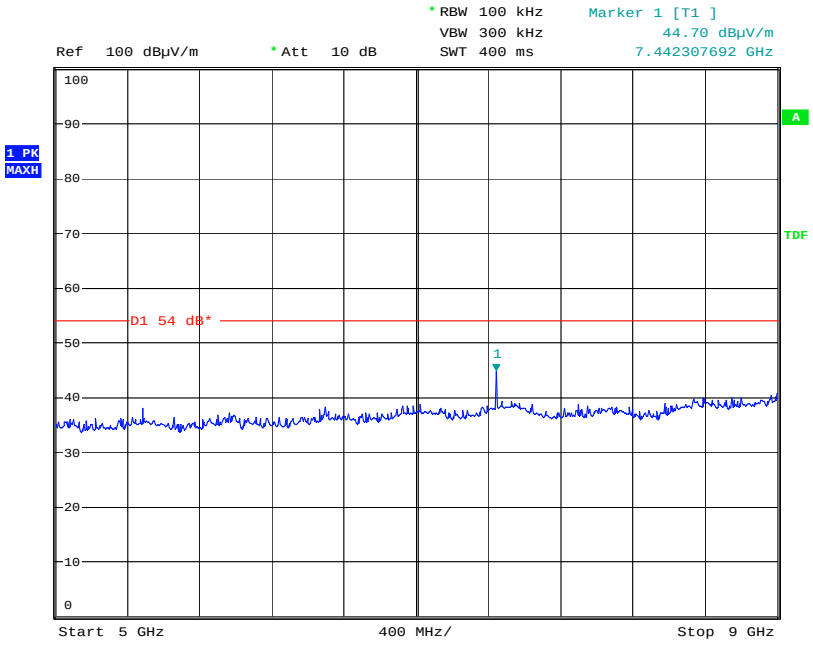


Radiated Spurious emissions 30 MHz to 1 GHz – 2480MHz 1Mb/s



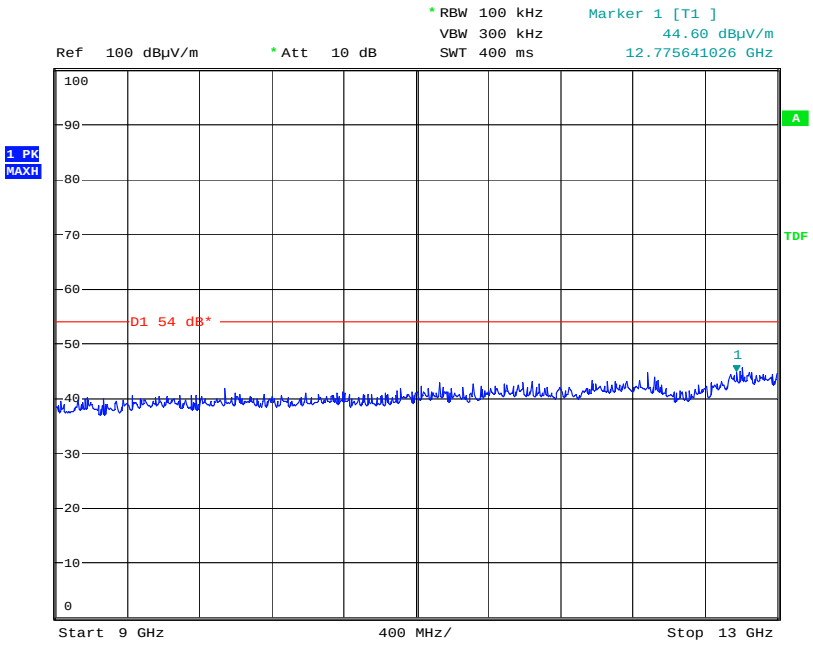
Date: 16.JUN.2009 11:11:46

Radiated Spurious emissions 1 GHz to 5 GHz – 2480MHz 1Mb/s



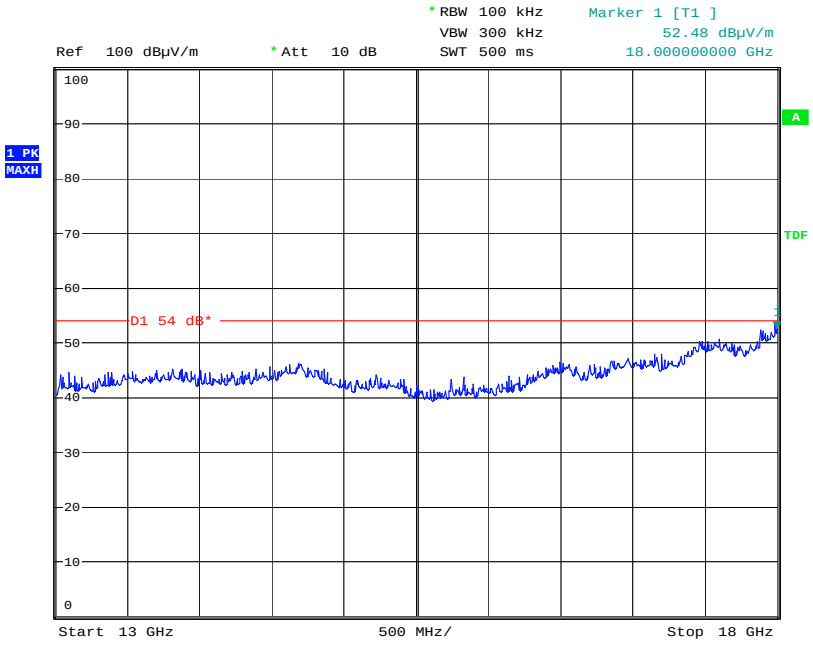
Date: 16.JUN.2009 11:12:33

Radiated Spurious emissions 5 GHz to 9 GHz – 2480MHz 1Mb/s



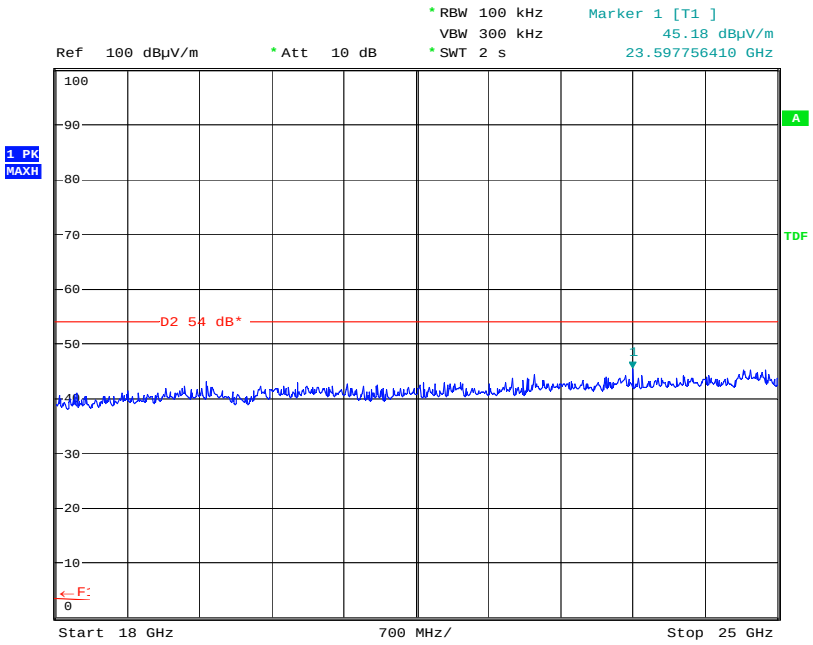
Date: 16.JUN.2009 11:13:58

Radiated Spurious emissions 9 GHz to 13 GHz – 2480MHz 1Mb/s



Date: 16.JUN.2009 11:14:13

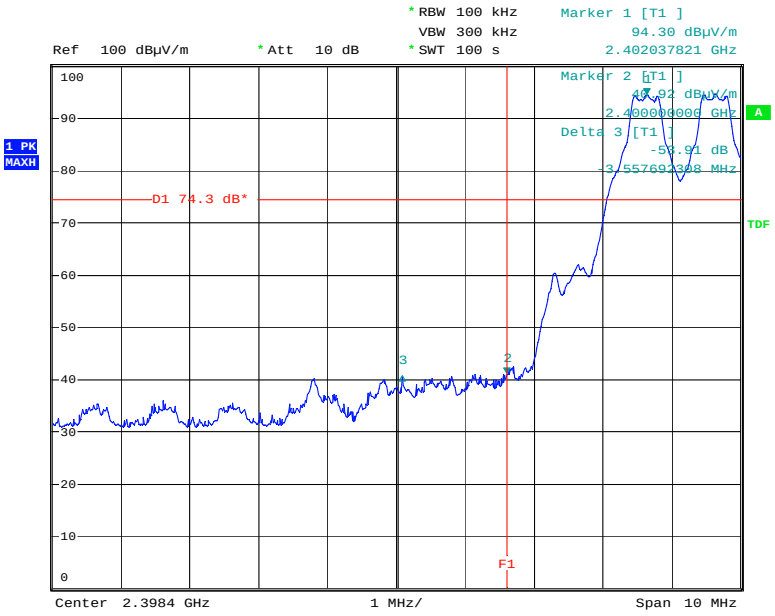
Radiated Spurious emissions 13 GHz to 18GHz – 2480MHz 1Mb/s



Date: 19.JUN.2009 09:19:32

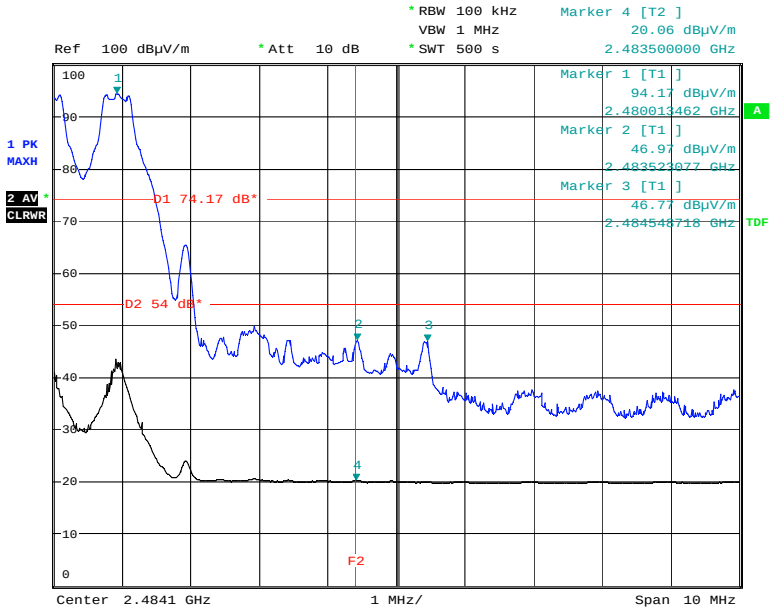
Radiated Spurious emissions 18 GHz to 25 GHz – 2480MHz 1Mb/s

Radiated Bandedge Compliance



Date: 18.JUN.2009 14:46:47

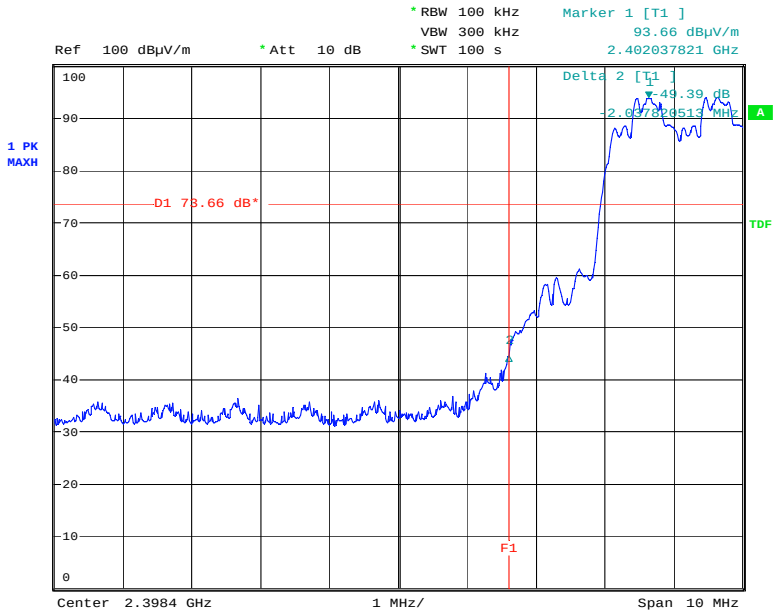
Lower Bandedge - Operational Data Rate 1Mb/s



Date: 18.JUN.2009 15:03:53

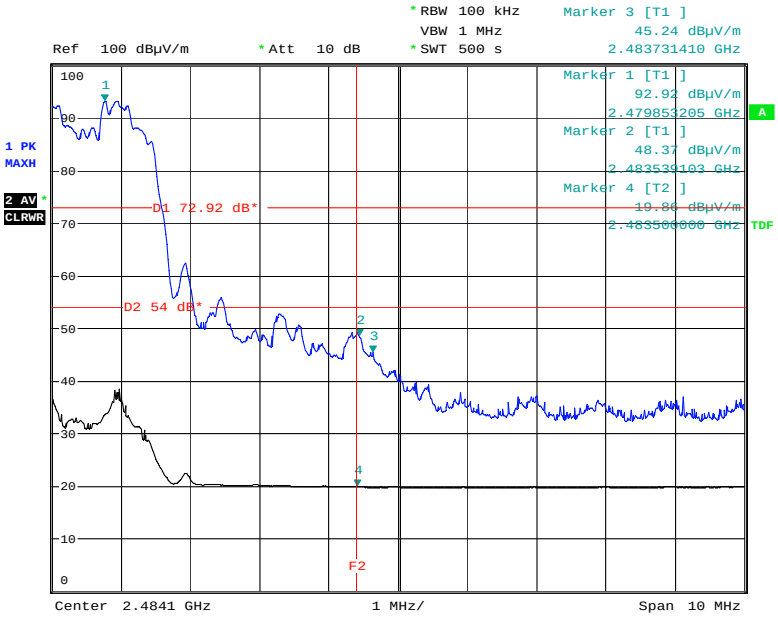
Upper Bandedge - Operational Data Rate 1Mb/s

Radiated Bandedge Compliance



Date: 18.JUN.2009 15:27:21

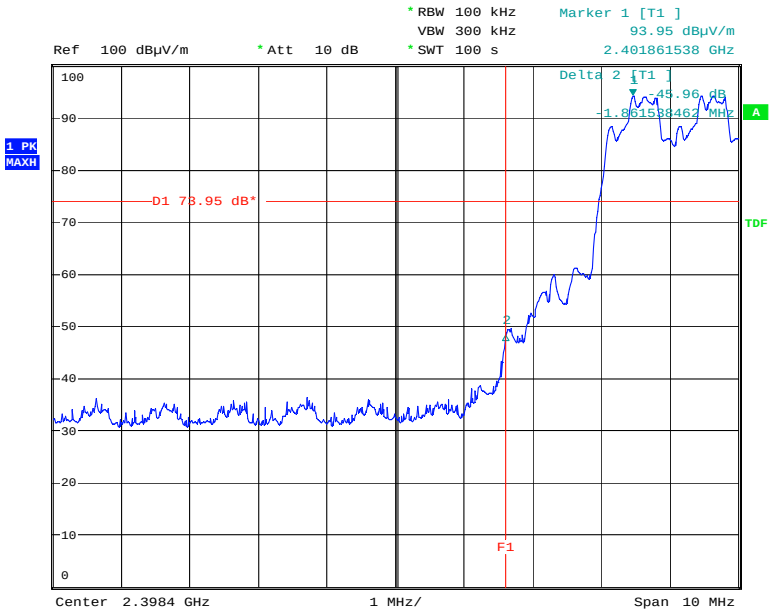
Lower Bandedge - Operational Data Rate 2Mb/s



Date: 18.JUN.2009 15:21:19

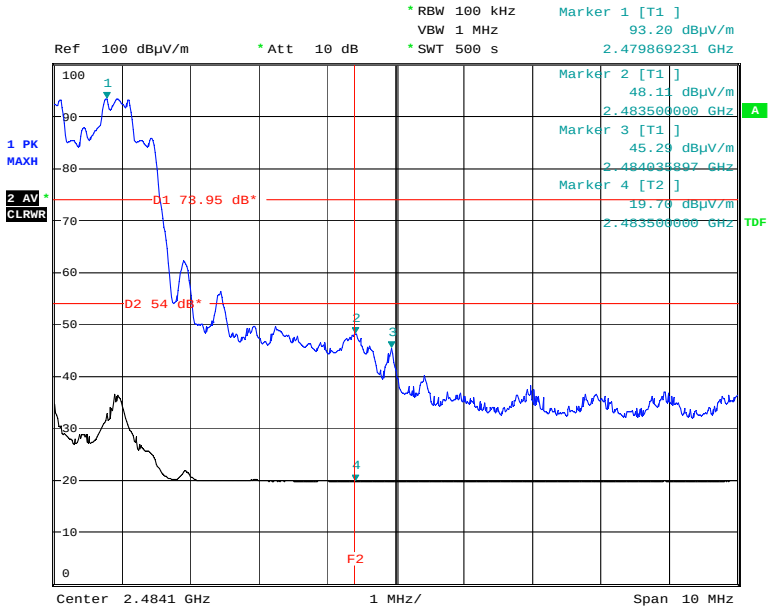
Upper Bandedge - Operational Data Rate 2Mb/s

Radiated Bandedge Compliance



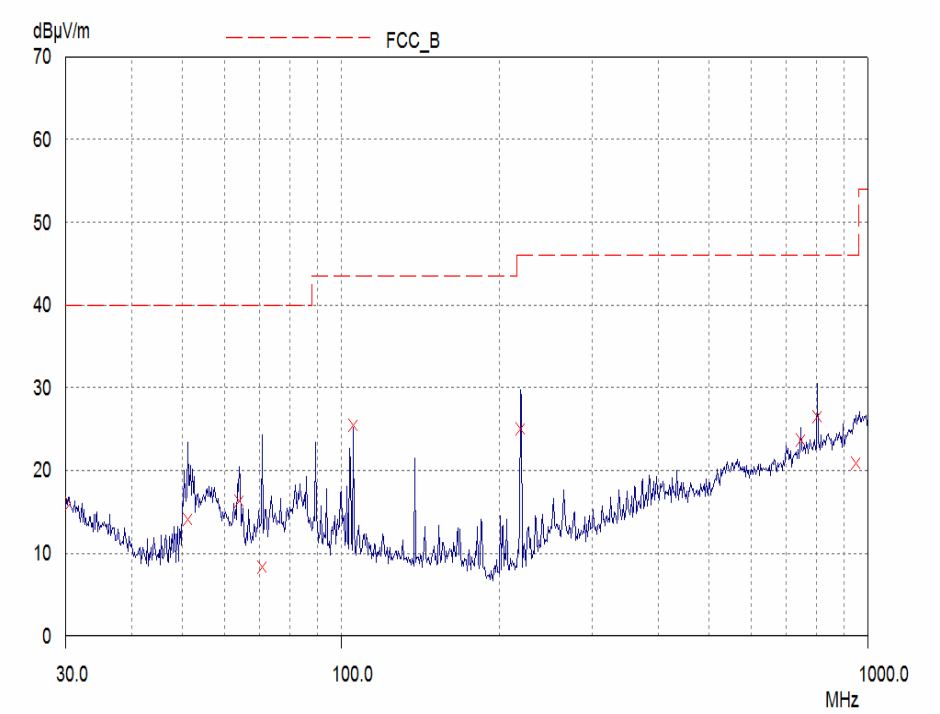
Date: 18.JUN.2009 15:33:01

Lower Bandedge - Operational Data Rate 3Mb/s

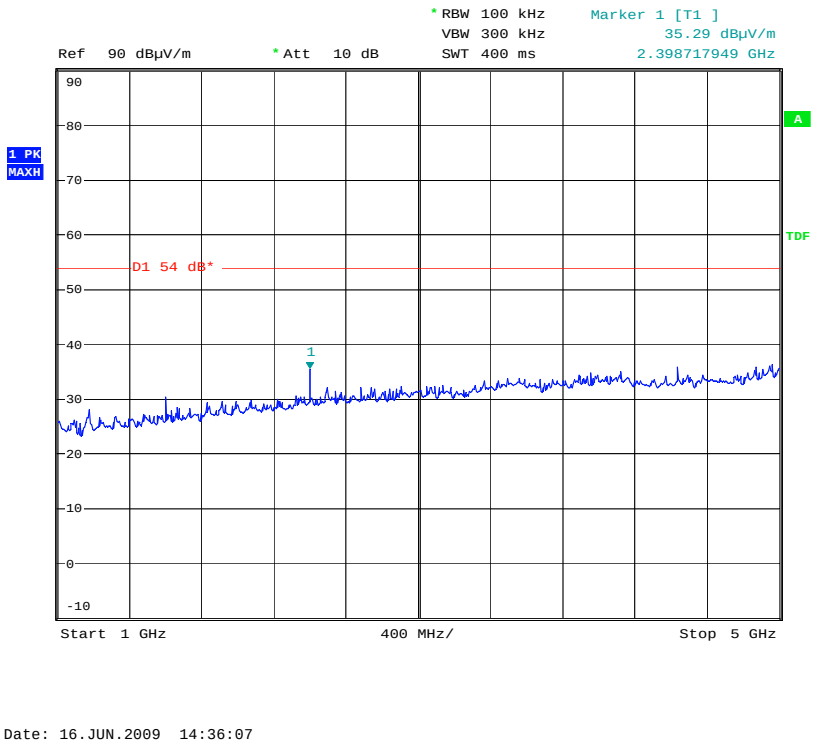


Date: 18.JUN.2009 15:50:33

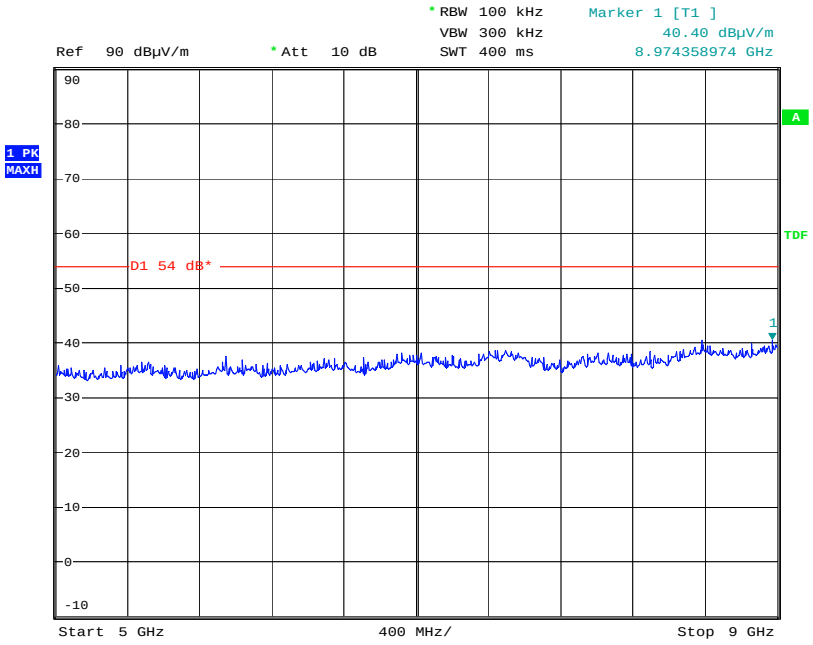
Upper Bandedge - Operational Data Rate 3Mb/s



Radiated Spurious emissions 30 MHz to 1 GHz – 2402MHz

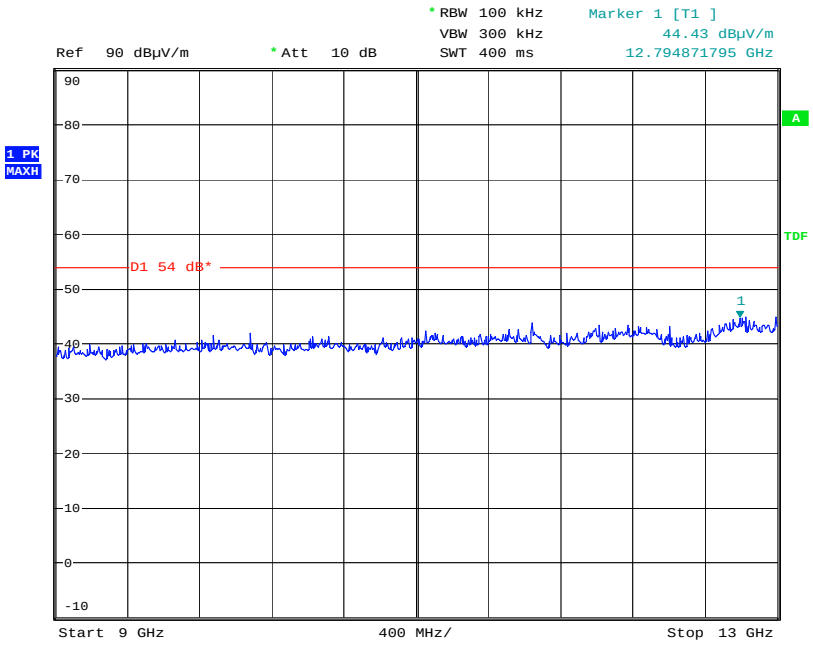


Radiated Spurious emissions 1 GHz to 5 GHz – 2402MHz



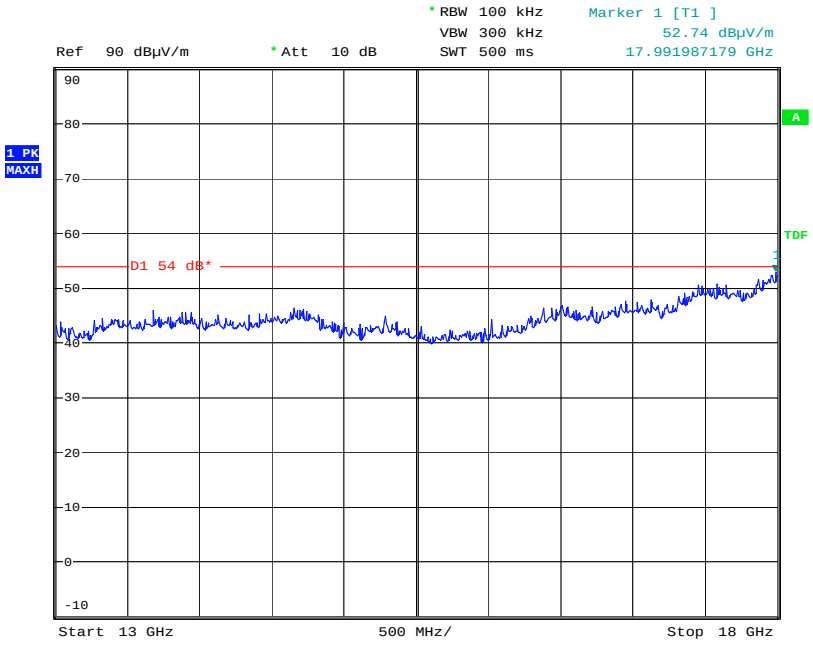
Date: 16.JUN.2009 14:36:37

Radiated Spurious emissions 5 GHz to 9 GHz – 2402MHz



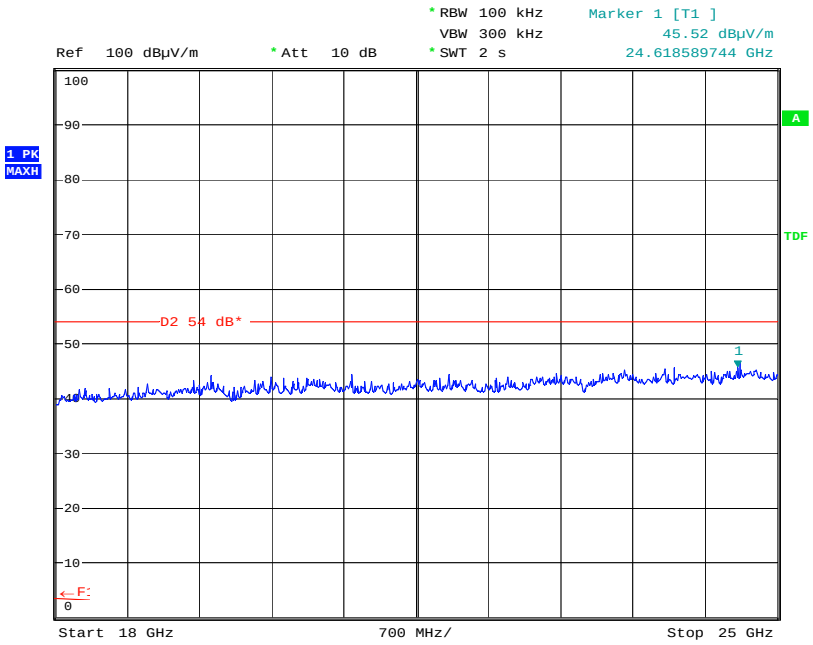
Date: 16.JUN.2009 14:36:50

Radiated Spurious emissions 9 GHz to 13 GHz – 2402MHz



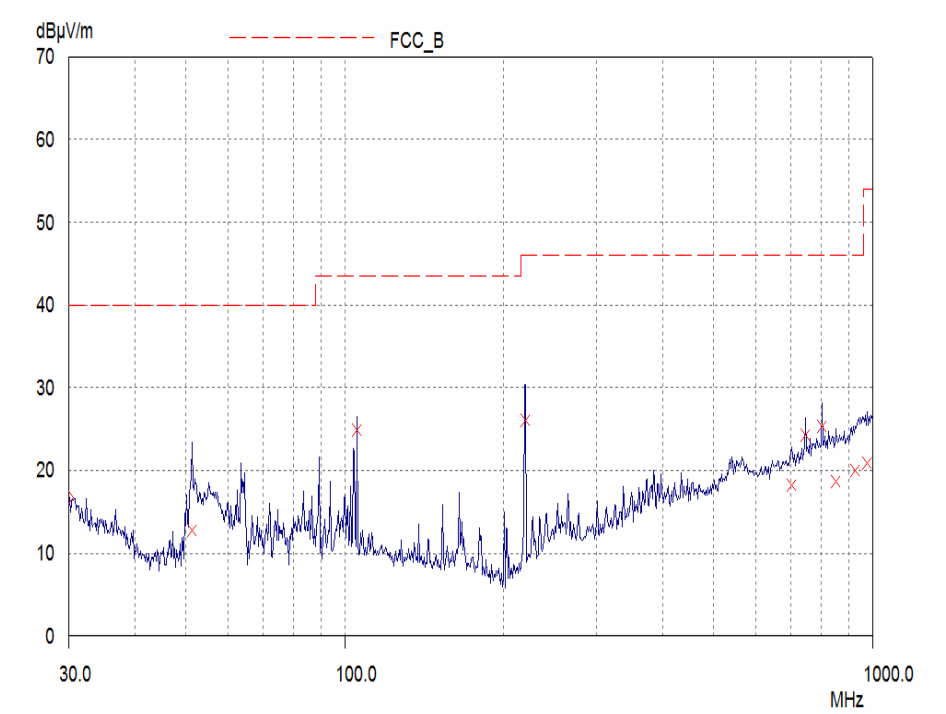
Date: 16.JUN.2009 14:37:01

Radiated Spurious emissions 13 GHz to 18GHz – 2402MHz

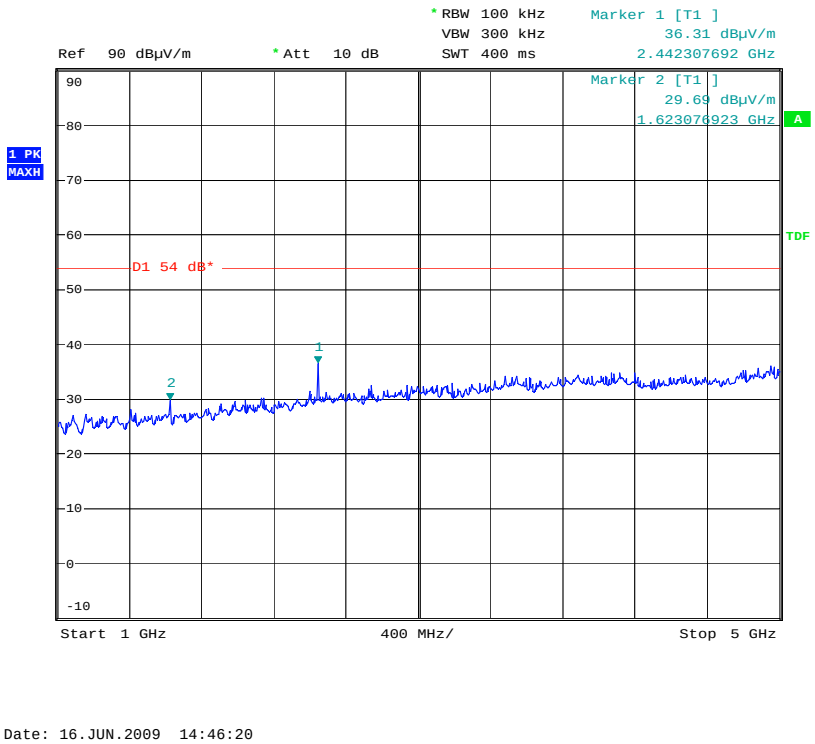


Date: 19.JUN.2009 09:26:03

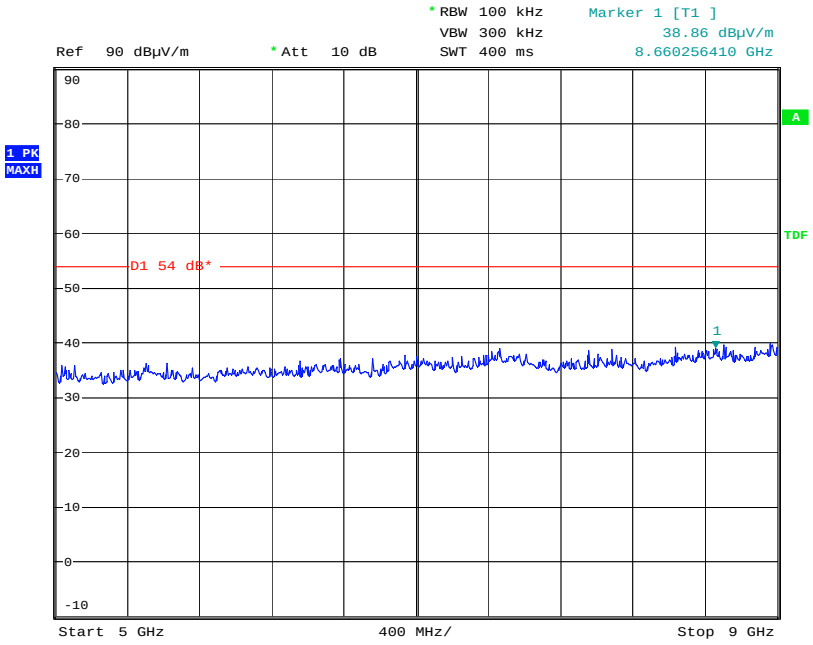
Radiated Spurious emissions 18 GHz to 25 GHz – 2402MHz



Radiated Spurious emissions 30 MHz to 1 GHz – 2441MHz

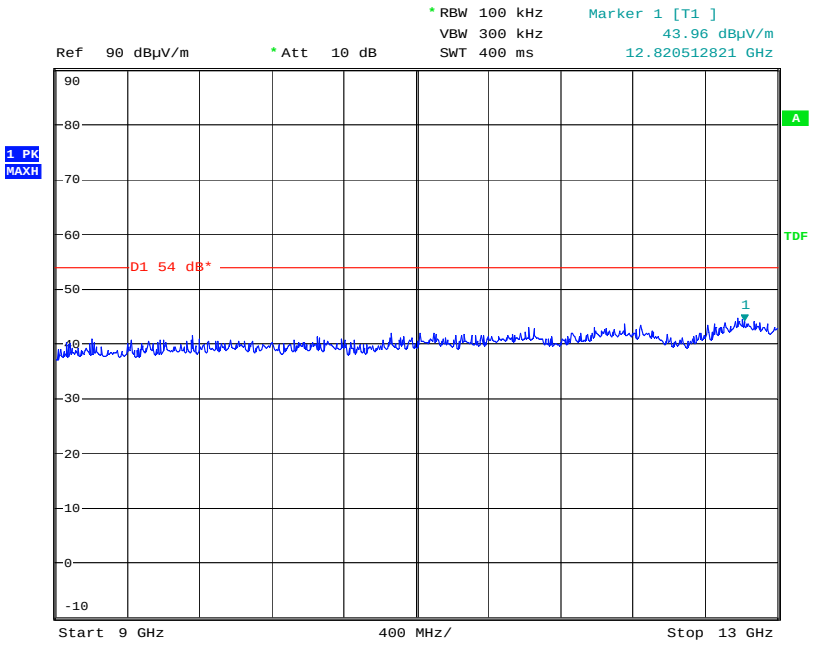


Radiated Spurious emissions 1 GHz to 5 GHz – 2441MHz



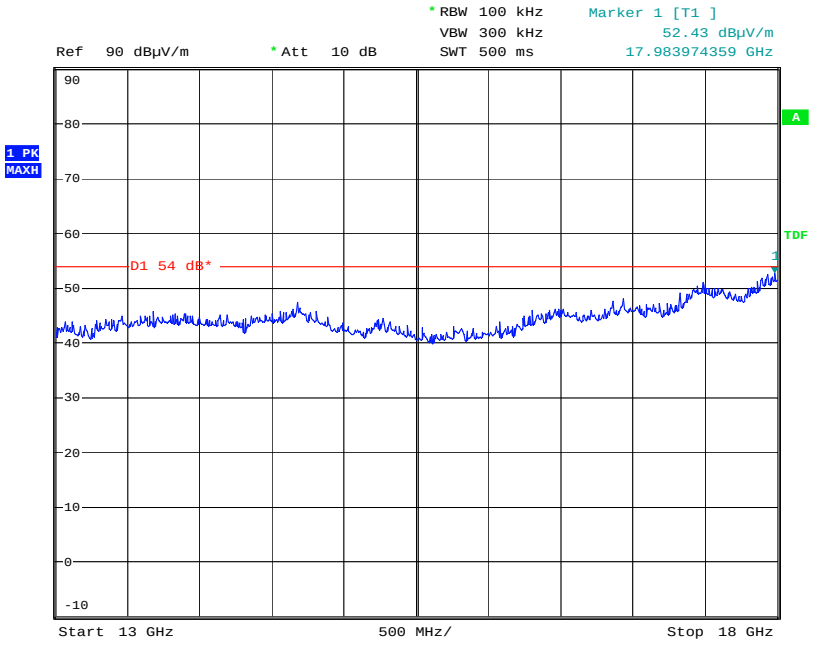
Date: 16.JUN.2009 14:46:40

Radiated Spurious emissions 5 GHz to 9 GHz – 2441MHz



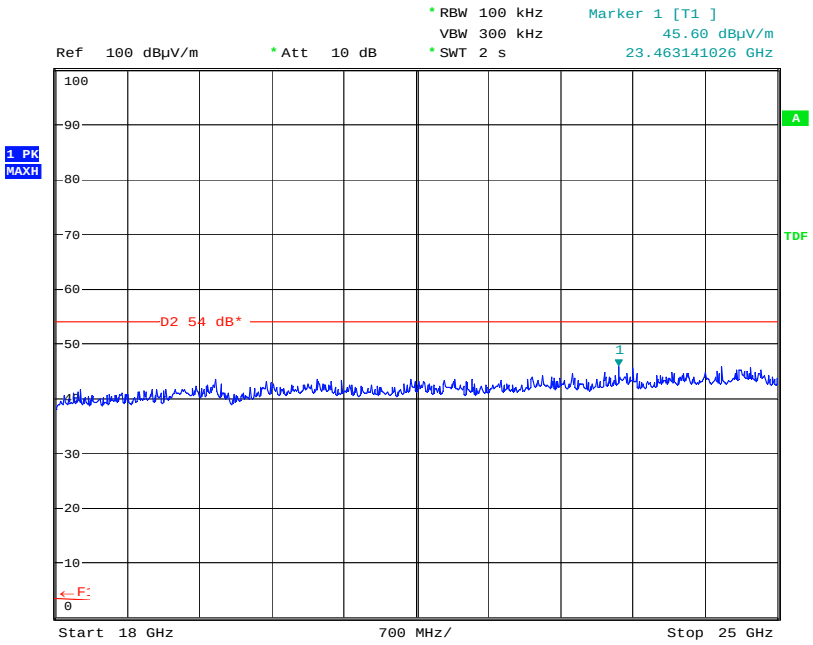
Date: 16.JUN.2009 14:46:54

Radiated Spurious emissions 9 GHz to 13 GHz – 2441MHz



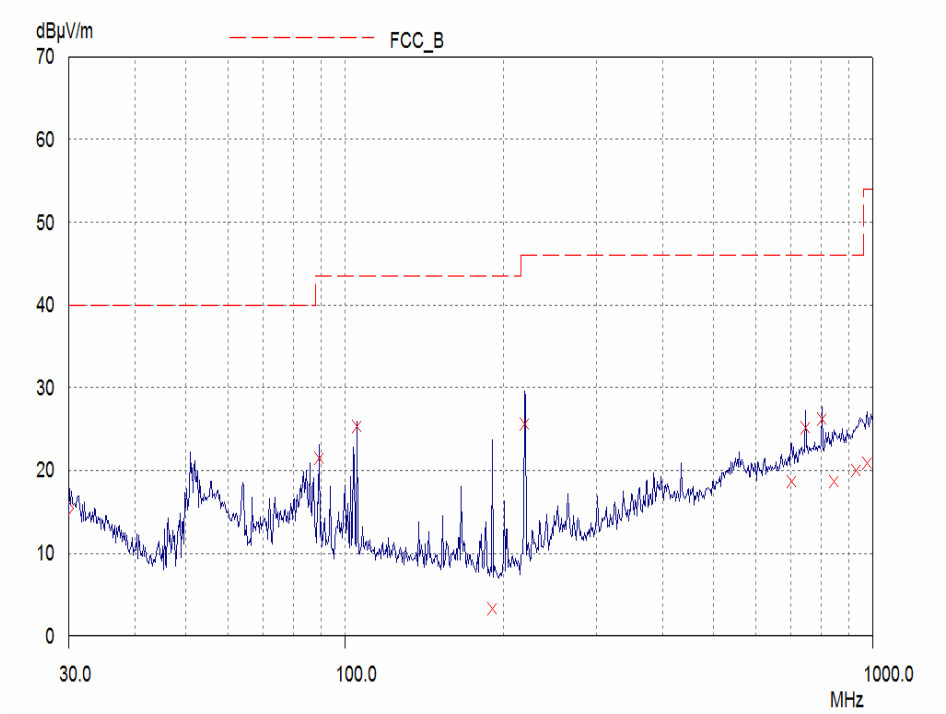
Date: 16.JUN.2009 14:47:07

Radiated Spurious emissions 13 GHz to 18GHz – 2441MHz

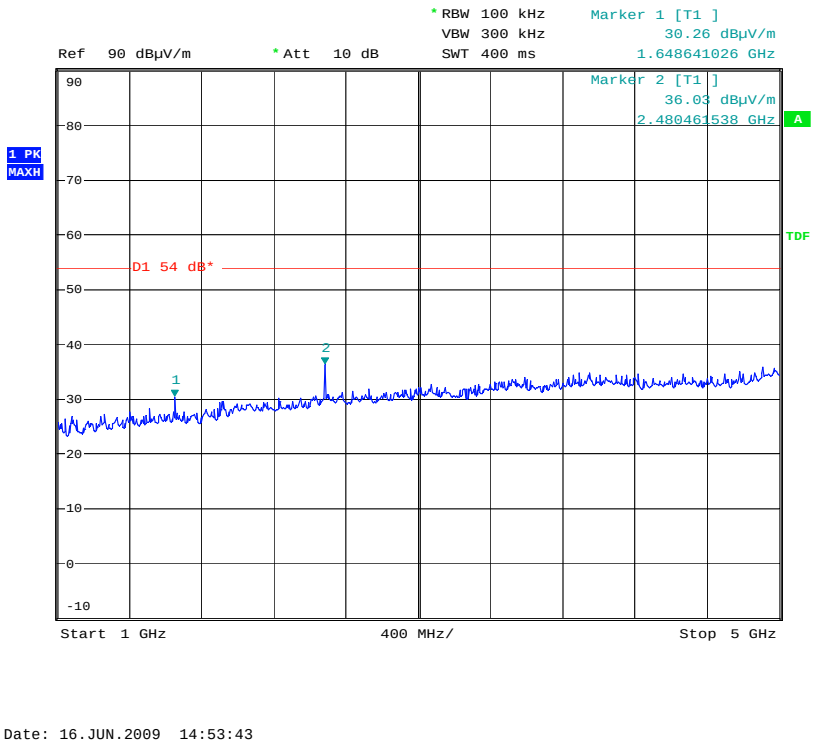


Date: 19.JUN.2009 09:24:43

Radiated Spurious emissions 18 GHz to 25 GHz – 2441MHz

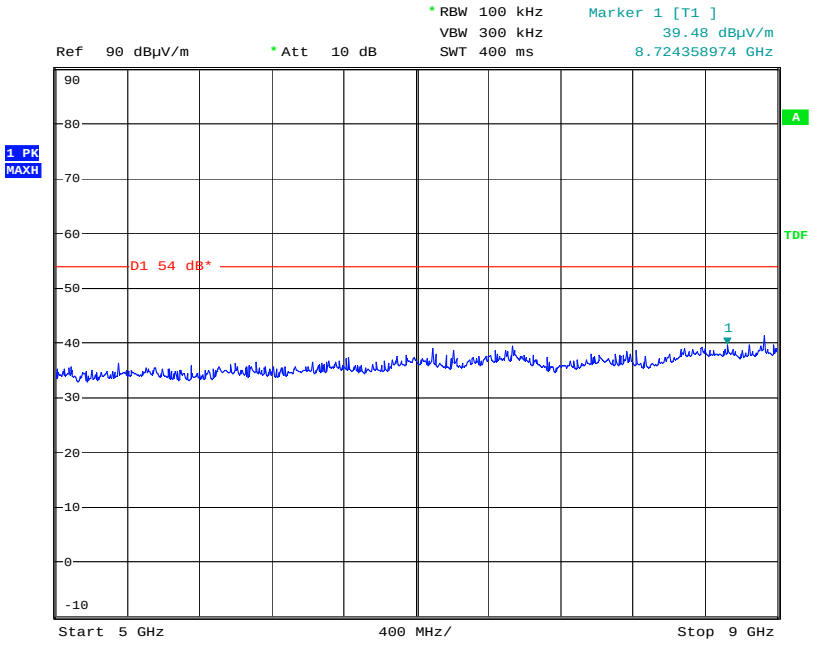


Radiated Spurious emissions 30 MHz to 1 GHz – 2480MHz



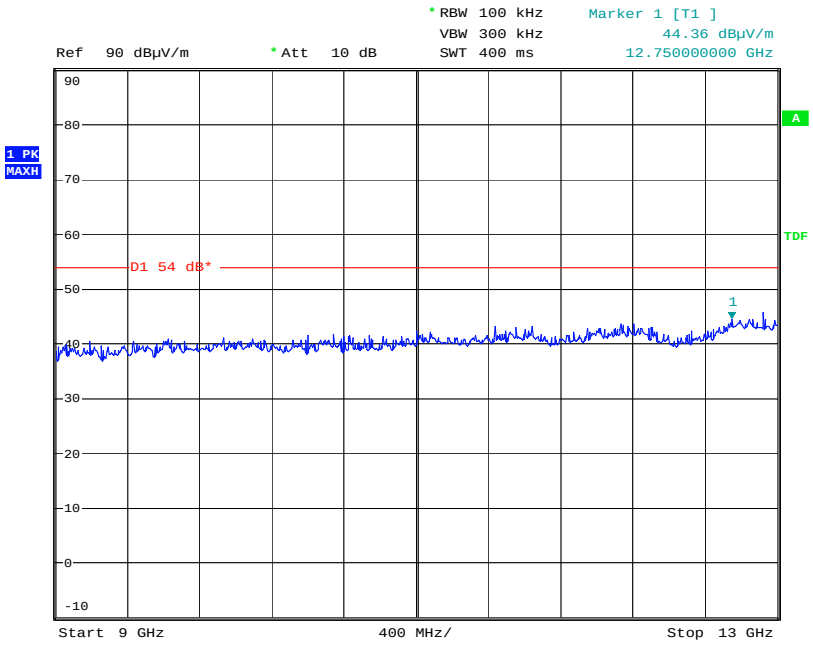
Date: 16.JUN.2009 14:53:43

Radiated Spurious emissions 1 GHz to 5 GHz – 2480MHz



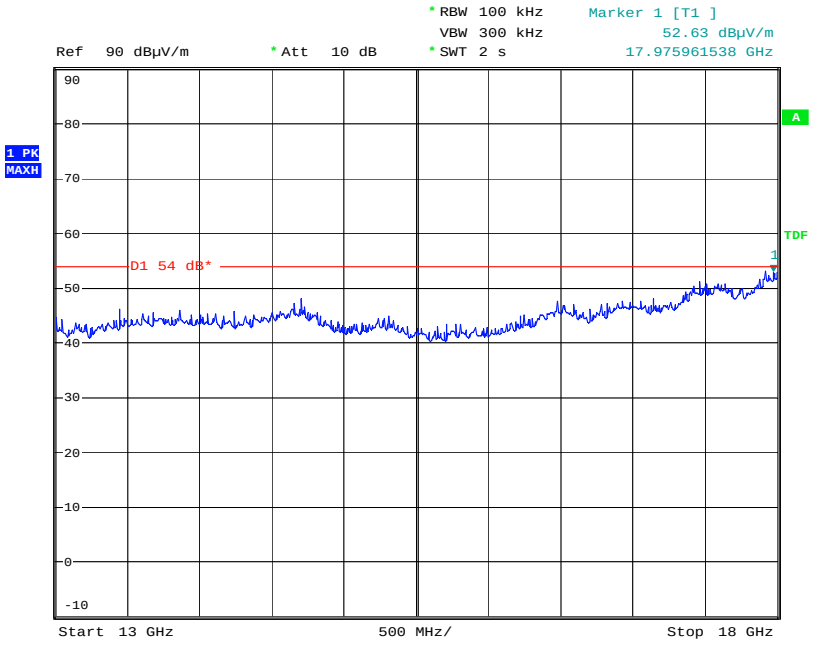
Date: 16.JUN.2009 14:53:59

Radiated Spurious emissions 5 GHz to 9 GHz – 2480MHz



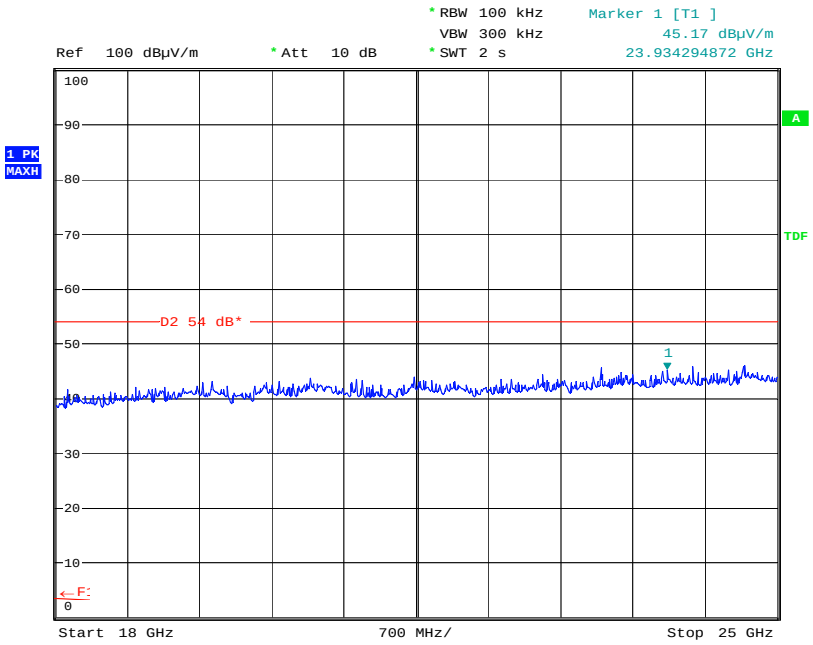
Date: 16.JUN.2009 14:54:15

Radiated Spurious emissions 9 GHz to 13 GHz – 2480MHz



Date: 16.JUN.2009 14:54:36

Radiated Spurious emissions 13 GHz to 18GHz – 2480MHz



Date: 19.JUN.2009 09:23:42

Radiated Spurious emissions 18 GHz to 25 GHz – 2480MHz

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 Telecoms & Radio upon request.

C1) Test samples

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

Sample No.	Description	Identification
S21	BSMAN4 Configuration BlueSlim Module	T009200086
S40	BSMAN3 Configuration BlueSlim Module	0024D2792C9B

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

Sample No.	Description	Identification
S46	Dell Latitude Laptop	008140
S33	USB – BSMAN4 Connector Adaptor	197960
S26	USB – BSMAN3 Connector Adaptor	197862

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

Identification	Description
REF838	Wireless Connectivity Test Set

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	Unless Specified as set to a specific frequency the EUT transmitting on maximum power using FHSS over 79 channels with 1 MHz channel spacing using DH1 packets with the following modulations: 1 Mb/s GFSK 2Mb/s π/4-DQPSK 3Mb/s 8DPSK

Test	Description of Operating Mode:
Receiver conducted and radiated (ERP) spurious emissions	EUT active but non-transmitting.

Test	Description of Operating Mode: **xxxx**
PLCE	

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 : S21
Tests : Conducted

Port	Description of Cable Attached	Cable length	Equipment Connected
Antenna Port	UF L to SMA Adaptor	10cm	TRLUH281
Host Connector	USB – Host Connector Adaptor		Dell Latitude Laptop

Sample : S21
Tests : Radiated Emissions

Port	Description of Cable Attached	Cable length	Equipment Connected
Antenna Port	UF L to SMA Adaptor	10cm	50 Ohm Load
Host Connector	USB – Host Connector Adaptor	N/A	Dell Latitude Laptop

Sample : S40
Tests : Radiated Emissions

Port	Description of Cable Attached	Cable length	Equipment Connected
Host Connector	USB – Host Connector Adaptor	N/A	Dell Latitude Laptop

* Only connected during setup.

C5 Details of Equipment Used

For Radiated Measurements:

TRAC Ref	Type	Description	Manufacturer	Date Calibrated.
TRLUH281	FSU46	Spectrum Analyser	Rhode & Schwarz	28/10/2008
TRL138	3115	1-18GHz Horn Antenna	EMCO	23/05/2007
TRL139	3115	1-18GHz Horn Antenna	EMCO	23/05/2007
TRL572	8499B	1 – 26.5 GHz Pre Amplifier	Agilent	04/07/2008
TRLUH186	ESHS10	Receiver	Rhode & Schwarz	03/04/2009
TRLUH191	CBL611/A	BiLog Periodic Antenna	York	01/10/2008
TRLUH28	UHALP 9108	Bicone elements	Schwarzbeck	30/05/2007
TRLUH29	VHBA	Log Periodic Antenna	Schwarzbeck	06/05/2007
TRL193	VHA 193 blau	Bicone elements	Chase	06/05/2008
TRL203	UPA6108	Log Periodic Antenna	Chase	06/05/2008
TRLUH372	6201-69	30MHz – 1 GHz Pre Amplifier	Watkins Johnson	27/11/2008
TRLUH340	83630B	Signal Generator	HP	03/06/2009
REF838	N4010A	Wireless Connectivity Test Set	Agilent	Ref Only

For Conducted Measurements

TRAC Ref	Type	Description	Manufacturer	Date Calibrated.
TRLUH281	FSU46	Spectrum Analyser	Rhode & Schwarz	28/10/2008
REF838	N4010A	Wireless Connectivity Test Set	Agilent	Ref Only

For Power Line Conducted Emissions

RFG No	Type	Description	Manufacturer	Date Calibrated
274	Lab 10	Ferrite Lined Chamber	TRAC	11/01/08
n/a	Lab 11	Small Screened Chamber	TRAC	-
n/a	Lab 14	Small Screened Chamber	TRAC	-
030	ESH3-Z5	Single-phase LISN	R & S	23/04/08
189	ESH3-Z5	Single-phase LISN	R & S	14/05/08
190	ESH3-Z2	Pulse Limiter	R & S	24/04/08
232	ESH3-Z2	Pulse Limiter	R & S	07/02/08
214	ESAI	Spec Analyser/Test Rxer (LF/HF)	R & S	22/01/08
012	ESH3	Test Receiver (LF)	R & S	05/02/08
125	ESHS 10	Test Receiver (LF)	R & S	22/11/07
127	HP8563E	Spectrum Analyser	HP	17/03/08
404	E4407B	Spectrum Analyser	Agilent	07/04/08
REF847	ESU	EMI Test Receiver (Spectrum analyser)	R&S	29/02/08
REF837	PSA E4440A	Spectrum Analyser	Agilent	21/02/08
267	N-type	RF coaxial cable (Lab 10)	TRAC	28/01/08
269	N-type	RF coaxial cable (Lab 10)	TRAC	28/01/08
293	BNC	RF coaxial cable (Lab 10)	TRAC	28/01/08
297	BNC	RF coaxial cable (Lab 11)	TRAC	28/01/08
298	BNC	RF coaxial cable (Lab 11)	TRAC	28/01/08
092	BNC	RF coaxial cable (Lab 14)	TRAC	28/01/08
295	BNC	RF coaxial cable (Lab 14)	TRAC	28/01/08

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%

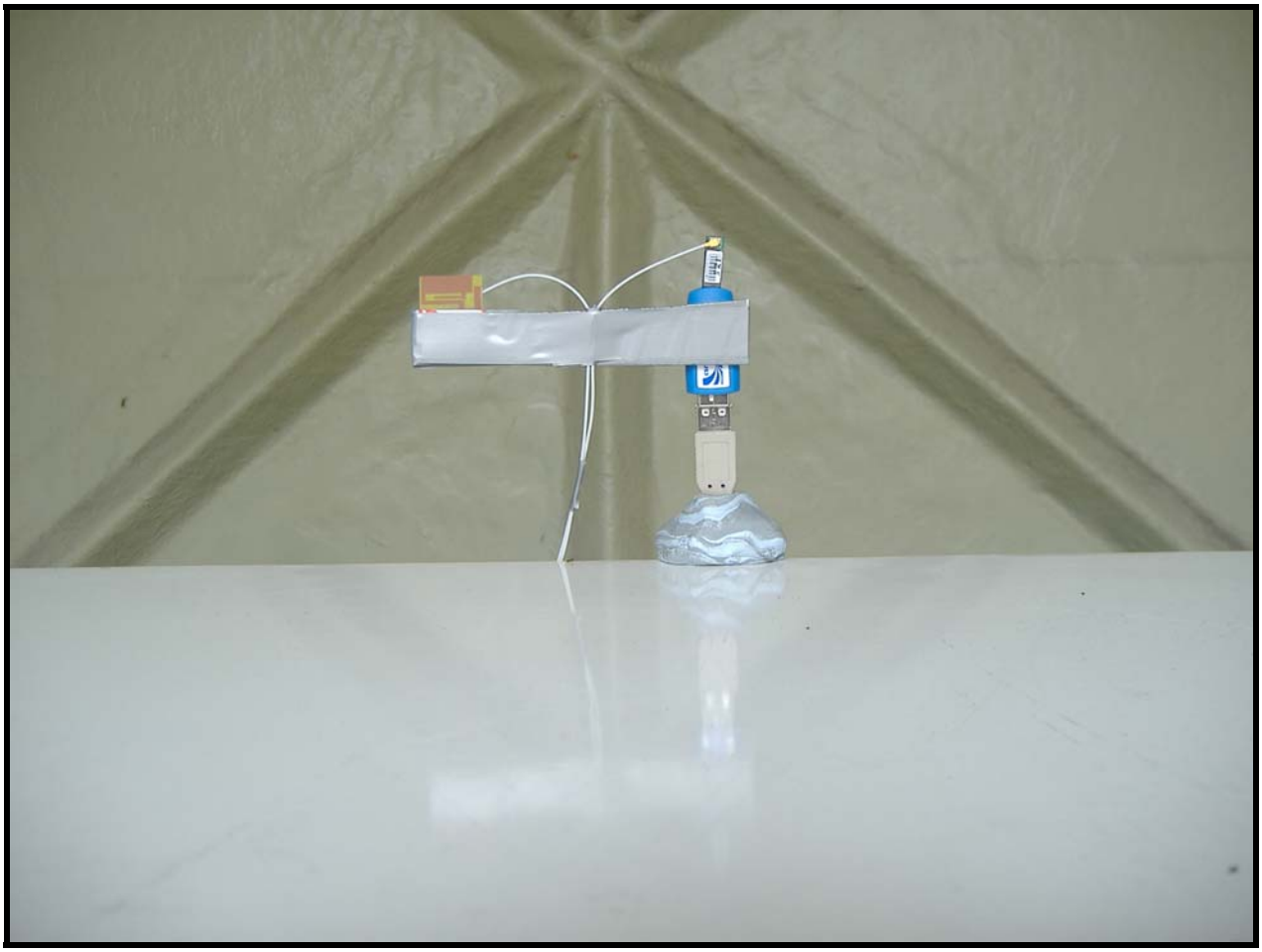
Correction factor (dB) = 20 x (Log_{10} 0.07459) = -22.54dB

Appendix F: Photographs and Figures

The following photographs were taken of the test samples:

1. Radiated electric field emissions arrangement: BSMAN4 front view.
2. Radiated electric field emissions arrangement: BSMAN4 close up.
3. Radiated electric field emissions arrangement: BSMAN3 front view.
4. Radiated electric field emissions arrangement: BSMAN3 close up.
5. Photo of the BSMAN4 Overview
6. Photo of the BSMAN3 Overview

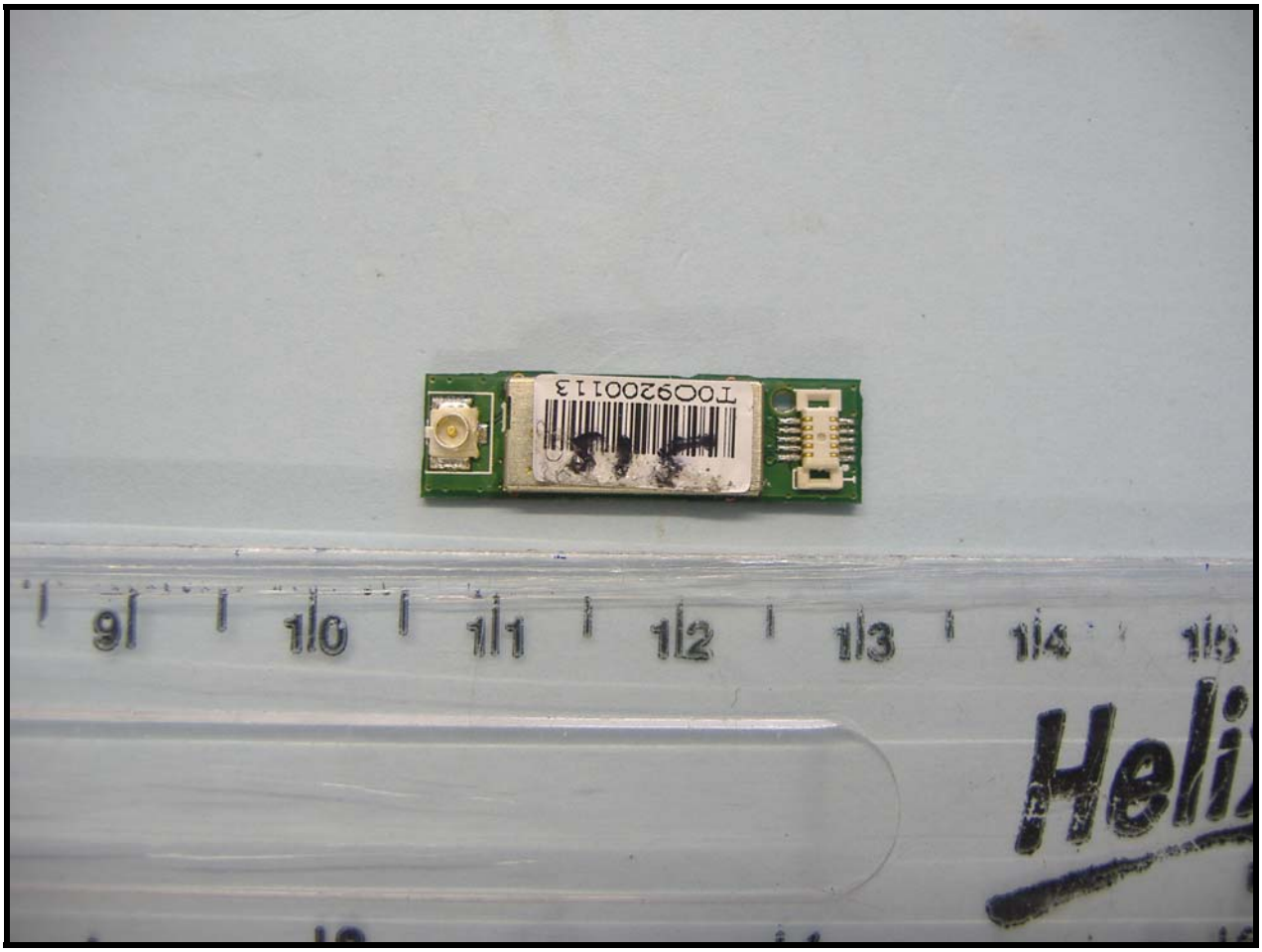
Photograph 1



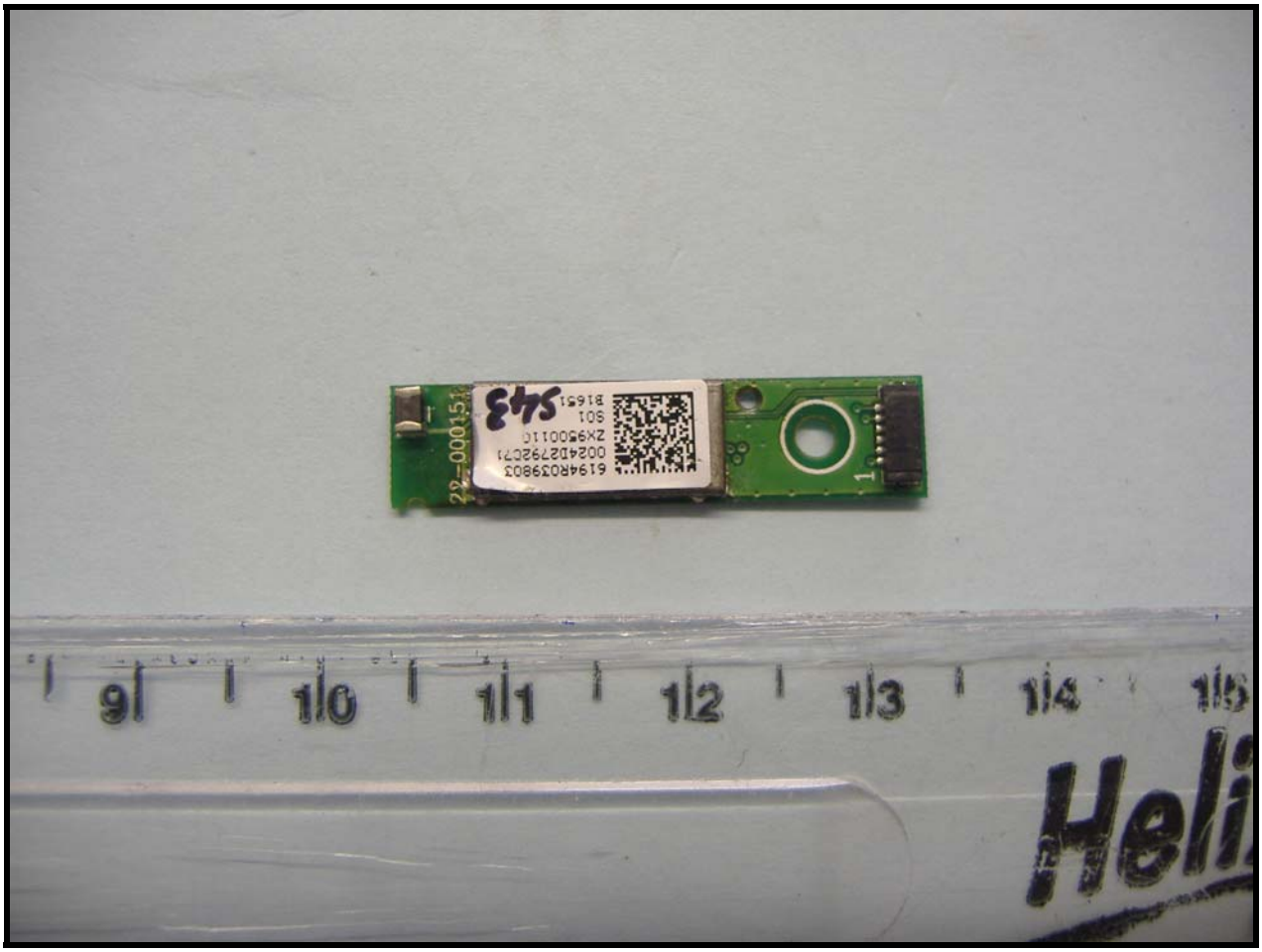
Photograph 2

Photograph 3

Photograph 4



Photograph 5



Photograph 6

Appendix G: MPE Calculation

OET Bulletin No. 65, Supplement C 01-01

47 CFR §§1.1307 and 2.1091

2.1091 Radio frequency radiation exposure evaluation: mobile devices.

For purposes of these requirements mobile devices are defined by the FCC as transmitters designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 centimetres is normally maintained between radiating structures and the body of the user or nearby persons. These devices are normally evaluated for exposure potential with relation to the MPE limits. As the 20cm separation specified under FCC rules may not be achievable under normal operation of the EUT, an RF exposure calculation is needed to show the minimum distance required to be less than 1mW/cm^2 power density limit, as required under FCC rules.

Prediction of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

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

where:

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

Note:

The EIRP measurement was performed using a signal substitution method.

Result

Prediction Frequency (MHz)	Maximum EIRP	Power density limit (S) (mW/cm^2)	Distance (R) cm required to be less than 1mW/cm^2
2402 MHz	2.56mW	1.00	0.5cm

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