Radio Test Report

for

Iridium Satellite LLC

on

9523 Voice & Data Transceiver Module

Document No: TRA-006099-00-W-US1

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TRaC Wireless Test Report	**:** TRA-006099-00-W-US1
Applicant	**:** Iridium Satellite LLC
Apparatus	**:** 9523 Voice & Data Transceiver Module
Specification(s)	**:** CFR47 Part 25 & CFR47 Part 15
Purpose of Test	**:** Certification
FCCID	**: Q639523**
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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.

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1.2 Tests Requested By

This testing in this report was requested by:

Iridium Satellite LLC
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1.3 Manufacturer

Same as above

1.4 Apparatus Assessed

The following apparatus was assessed between 29th July 2011 & 4th August 2011:

9523 Voice & Data Transceiver Module

The above device consists of an L-Band Transceiver (LBT) capable of simultaneous transmit and receive (duplex) operation covering the frequency range of 1616MHz to 1626.5MHz. The frequency accesses used for duplex channels are organised into sub-bands each of which contains eight frequency accesses. Each sub-band, therefore occupies 333.33 kHz (i.e. 8x41.667kHz). Up to 30 sub-bands containing 240 frequency accesses may be used for duplex channels.

1.5 Test Result Summary

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

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

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

Test Type	FCC Part 2	FCC Part 25	Result
RF Power Output	2.1046	25.204 (a)	Pass
Emissions Limitations	2.1049	25.202 (f)	Pass
Spurious Emissions at Antenna Terminals	2.1051	25.202 (f) 25.213	Pass
Protection of the Radio Navigation Satellite Service	-	25.216(c) 25.216(f)	Pass
Spurious Emissions Radiated	2.1053	25.202 (f) 25.213	Pass
Frequency Stability Temperature	2.1055	25.202 (d)	Pass
Frequency Stability Voltage	2.1055	25.202 (d)	Pass
AC Powerline Conducted Emissions	-	15.107	Pass
Unintentional Radiated Spurious Emissions	2.1053	15.109	Pass

Abbreviations used in the above table:

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

1.6 Standard References

47 CFR 2 10-1-03 Edition	Code of Federal Regulations, Title 47, Part 2, “Frequency allocations and Radio Telemetry Matters; General Rules and Regulations”
47 CFR 25 10-1-03 Edition	Code of Federal Regulations, Title 47, Part 25,”Satellite Communications” Subpart C, “Technical Matters”
47 CFR 15 20-09-07 Edition	Code of Federal Regulations, Title 47, Part 15,”Radio Frequency Devices” Subpart B, “Unintentional Radiators”
C63.4-2003	American National Standards Institute (ANSI), “Methods of Measurement of Radio Noise Emissions from Low Voltage Electrical and Electronic Equipment in the Range 9 kHz to 40 GHz”

1.7 Notes Relating To 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.

1.8 Deviations from Test Standards

There were no deviations from the standards tested to.

Section 2: Measurement Uncertainty

2.1 Measurement Uncertainty Values

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%**

[12] Power Line Conduction

Uncertainty in test result = **3.4dB**

[13] Spectrum Mask Measurements

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

[14] Adjacent Sub Band Selectivity

Uncertainty in test result = **1.24dB**

[15] Receiver Blocking – Listen Mode, Radiated

Uncertainty in test result = **3.42dB**

[16] Receiver Blocking – Talk Mode, Radiated

Uncertainty in test result = **3.36dB**

[17] Receiver Blocking – Talk Mode, Conducted

Uncertainty in test result = **1.24dB**

[18] Receiver Threshold

Uncertainty in test result = **3.23dB**

[19] Transmission Time Measurement

Uncertainty in test result = **7.98%**

Section 3: Modifications

3.1 Modifications Performed During Assessment

No modifications were performed during the assessment

Appendix A: Formal Emission Test Results

Abbreviations used in the tables in this appendix:

Spec	: Specification
Mod	: Modification
EUT	: Equipment Under Test
SE	: Support Equipment
L	: Live Power Line
N	: Neutral Power Line
E	: Earth Power Line
Pk	: Peak Detector
QP	: Quasi-Peak Detector
Av	: Average Detector
CDN	: Coupling & decoupling network

ALSR	: Absorber Lined Screened Room
OATS	: Open Area Test Site
ATS	: Alternative Test Site
Ref	: Reference
Freq	: Frequency
MD	: Measurement Distance
SD	: Spec Distance
Pol	: Polarisation
H	: Horizontal Polarisation
V	: Vertical Polarisation

A1 RF Output Power

Test Details	
Regulation	Title 47 of the CFR: Part 25.204(a)
Measurement standard	Title 47 of the CFR: Part 2.1046
EUT sample number	S01
Modification state	0
SE in test environment	N/A
SE isolated from EUT	S02
EUT set up	Refer to Appendix C

Frequency (MHz)	Attenuator and cable loss (dB)	Level at Power Meter (dBm)	Antenna Gain (dB)	Mean Carrier Power (dBm)	Duty Cycle Factor (dB)	Peak Carrier power (dBm)	Carrier power (dBW)	Limit (dBW)
Channel 1	50.55	-23.77	3	29.78	-10.30	40.08	10.08	40
Channel 75	50.55	-23.75	3	29.80	-10.30	40.10	10.10	40
Channel 150	50.55	-23.72	3	29.83	-10.30	40.13	10.13	40
Channel 240	50.55	-23.73	3	29.82	-10.30	40.12	10.12	40

Notes:

1. Duty Cycle Factor = 10 log (**X**) Where **X=** (Ton / Tframe). See appendix B for duty cycle plots
2. Correction Factor for dBm to dBW = -30dB
3. Antenna gain of 3dBi is the worst case gain over an isotropic antenna as declared by manufacturer
4. Further Calculation on Duty Cycle Correction Factor is provided in appendix E

A2 Emissions Limitations

Test Details	
Regulation	Title 47 of the CFR: Part 25.202(f)
Measurement standard	Title 47 of the CFR: Part 2.1049
EUT sample number	S01
Modification state	0
SE in test environment	N/A
SE isolated from EUT	S02
EUT set up	Refer to Appendix C

The unit was tested on four channels .The unit was put into test mode and set to operate at maximum power and with a random modulating signal using test commands sent from a PC via the MAMBO Box.

To enable an average measurement to be taken the gated input trigger of the spectrum analyser was used.

The Spurious limit is as follows:

On any frequency removed from the assigned frequency by the following percentage of the authorised bandwidth

±50%	-	100%	-25 dBc
±100%	-	250 %	-35 dBc
> ±250%		At least 43 + 10 log PdB	

$(10\log P_{watts}) - (43+10\log (P_{watts} * 1000)) = LIMIT = -13$ dBm

Where the Authorised Bandwidth = 41.667 kHz

Note

1. The 3 kHz to 4 kHz bandwidth correction, cable and attenuator losses and antenna gain have been taken into account in the Ref level offset figure.

Result:

The unit was found to comply with the limits.

See plots in Appendix B.

A3 Spurious Emissions Conducted

Test Details	
Regulation	Title 47 of the CFR: Part 25.202(f) & 25.216
Measurement standard	Title 47 of the CFR: Part 2.1051
EUT sample number	S01
Modification state	0
SE in test environment	N/A
SE isolated from EUT	S02
EUT set up	Refer to Appendix C

Frequency Range (MHz)	Ch No	Freq. of Emission	Spectrum Analyser Level (dBm)	Attenuator & Cable Losses (dB)	Spurious Emission Level (dBm)	Limit dBm
30MHz – 1559MHz	No Significant Emissions Within 10 dB of the limit					-13
1559MHz – 1605MHz						-40 (note 6)
1605MHz – 1610MHz						-40 (Note 4)
1626.5MHz – 16.3 GHz						-13

Notes :

1. Emissions Checked up to 10 times Fc
2. Reference level offset of Scan plots in Appendix B already have approximate attenuator losses taken into account
3. Average measurement in a carrier on state were taken in the bands 1599MHz to 1605MHz and 1605MHz -1610MHz. All other scans were peak hold for worst case.
4. -40 to -10 Linearly interpolated in dBm Vs frequency offset.
5. Correction Factor for dBm to dBW = -30dB.
6. This limit reduces to -50 dBm for discrete emissions of less than 700Hz bandwidth.
7. Not a discrete emissions of less than 700Hz bandwidth.

Result:

The unit was found to comply with the limits.

A4 Radiated Electric Field Emissions

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

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

3m open area test site : [ ] 3m alternative test site : [X]

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

Test Details	
Regulation	Title 47 of the CFR: Part 25.202(f) & 25.216
Measurement standard	Title 47 of the CFR: Part 2.1053
Frequency range	30MHz – 16.3GHz
EUT sample number	S01
Modification state	0
SE in test environment	S02, S03
SE isolated from EUT	N/A
EUT set up	Refer to Appendix C
Temperature	20° C
Photographs (Appendix F)	1, 2, 3

Frequency (MHz)	Channel Number	EIRP (dBm)	Limit (dBm)	Margin (dB)
3231.92	1	-38.2	-13	-25.23
3251.75	240	-38.0	-13	-25
4847.86	1	-39.0	-13	-25.97
4877.78	240	-38.6	-13	-25.6

Result:

The unit was found to comply with the limits.

Notes:

1. Emissions Checked up to 10 times Fc.
2. Scan plots of channels 1 & 240 with in Appendix B.
3. The unit was mounted on a turntable and rotated through 360^0 and in 3 orthogonal planes to find the worst case emission.
4. -40 to -10 Linearly interpolated in dBm Vs frequency offset.
5. Correction Factor for dBm to dBW = -30dB.
6. This limit reduces to -50 dBm for discrete emissions of less than 700Hz bandwidth.
7. For Frequencies below 1 GHz, RBW = 120 kHz, testing was performed with CISPR16 compliant test receiver with QP detector. Above 1 GHz tests were performed using a spectrum analyser using the following settings:

   Peak Detector RBW = 1MHz; VBW = ≥RBW

The upper and lower frequency of the measurement range was decided according to 47 CFR Part 2.1057.

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

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

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

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

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

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

A5 Frequency Stability - Temperature

Test Details	
Regulation	Title 47 of the CFR: Part 25.202(d)
Measurement standard	Title 47 of the CFR: Part 2.1055
EUT sample number	S01
Modification state	0
SE in test environment	N/A
SE isolated from EUT	S02
EUT set up	Refer to Appendix C

Temperature (^{0}C)	Frequency (MHz)			
	Channel 1	Channel 75	Channel 150	Channel 240
+60	1616.02056	1619.10389	1622.22886	1625.97886
+50	1616.02071	1619.10395	1622.22895	1625.97894
+40	1616.02085	1619.10415	1622.22914	1625.97914
+30	1616.02091	1619.10423	1622.22925	1625.97926
+20	1616.02085	1619.10426	1622.22927	1625.97927
+10	1616.02090	1619.10426	1622.22930	1625.97927
0	1616.02089	1619.10421	1622.22920	1625.97920
-10	1616.02087	1619.10426	1622.22931	1625.97934
-20	1616.02073	1619.10405	1622.22899	1625.97889
-30	1616.02045	1619.10372	1622.22872	1625.97872

Limit:

± 10ppm (See Appendix B for frequency stability plots versus limit)

Result:

The unit was found to comply with the limits.

A6 Frequency Stability - Voltage

Test Details	
Regulation	Title 47 of the CFR: Part 25.202(d)
Measurement standard	Title 47 of the CFR: Part 2.1055
EUT sample number	S01
Modification state	0
SE in test environment	N/A
SE isolated from EUT	S02
EUT set up	Refer to Appendix C

Voltage (V ac)	Frequency (MHz)			
	Channel 1	Channel 75	Channel 150	Channel 240
93.5	1616.02099	1619.10429	1622.22928	1625.97928
99	1616.02099	1619.10429	1622.22928	1625.97928
104.5	1616.02099	1619.10429	1622.22928	1625.97928
110	1616.02096	1619.10429	1622.22925	1625.97928
115.5	1616.02099	1619.10429	1622.22928	1625.97928
121	1616.02099	1619.10432	1622.22928	1625.97928
126.5	1616.02096	1619.10426	1622.22928	1625.97928

Limit:

± 10ppm (See Appendix B for frequency stability plots verses limit)

Result:

The unit was found to comply with the limits.

A7 Power Line Conducted Emissions

Preview power line conducted emission measurements were performed with a peak & average 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 an average and/or quasi peak detector.

Test Details	
Regulation	Title 47 of the CFR: Part 15 Subpart (c) Clause 15.107 & 15.207
Measurement standard	ANSI C63.10:2003
Frequency range	150kHz to 30MHz
EUT sample number	S01
Modification state	0
SE in test environment	N/A
SE isolated from EUT	S02
EUT set up	Refer to Appendix C
Photographs (Appendix F)	4

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)	EUT Mode	Conductor	Result (dBuV)	Spec Limit (dBuV)	Margin (dB)	Result Summary
1	0.31	Transmit	Live	35.4	49.97	14.57	Pass
2	0.47	Transmit	Live	33.09	46.51	13.42	Pass
3	0.535	Transmit	Neutral	32.78	46	13.22	Pass
4	0.545	Receive	Live	31.63	46	14.37	Pass
5	0.53	Receive	Neutral	29.75	46	16.25	Pass

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

Ref No.	Freq (MHz)	EUT Mode	Conductor	Result (dBuV)	Spec Limit (dBuV)	Margin (dB)	Result Summary
1	0.185	Transmit	Neutral	46.53	64.26	17.73	Pass
2	0.19	Transmit	Neutral	45.36	64.04	18.68	Pass
3	0.525	Transmit	Neutral	39.72	56	16.28	Pass
4	0.54	Transmit	Neutral	38.96	56	17.04	Pass
5	0.305	Transmit	Live	43.33	60.11	16.78	Pass

Specification limits:

Conducted emission limits (47 CFR Part 15: Clauses 15.107 & 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

A8 Unintentional Radiated Emissions

Preliminary scans were performed using a peak detector with the RBW = 100 kHz. The radiated electric filed emission test applies to all spurious emissions on directly related to the transmitter. The maximum permitted field strength is listed in Section 15.109. The EUT was set to operate in a transmit standby / receive mode.

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

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

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

Test Details	
Regulation	Title 47 of the CFR, Part 15 Subpart (c) Clause 15.109
Measurement standard	ANSI C63.10:2003
Frequency range	30MHz – 16.3GHz
EUT sample number	S01
Modification state	0
SE in test environment	S02, S03
SE isolated from EUT	N/A
EUT set up	Refer to Appendix C
Temperature	20^{o} C
Photographs (Appendix F)	1, 2, 3

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

Ref No.	Frequency (MHz)	Measuring Rx Level (dBµV)	Cable Loss (dB)	Antenna Factor (dB/m)	PreAmp Gain (dB)	Field Strength (dBµV/m)	Extrp. Factor (dB)	Field Strength (µV/m)	Limit (µV/m)
1	30.60	5.5	0.4	18.3	-	24.2	-	16.22	100
2	31.20	6.7	0.4	18.0	-	25.1	-	17.99	100
3	31.75	4.9	0.4	17.6	-	22.9	-	13.96	100
4	32.30	2.9	0.4	17.3	-	20.6	-	10.72	100
5	37.40	4.3	0.4	14.4	-	19.1	-	9.02	100
6	72.00	24.2	0.6	5.6	-	30.4	-	33.11	100
7	82.60	17.6	0.6	7.5	-	25.7	-	19.28	100
8	84.00	18.9	0.6	7.7	-	27.2	-	22.91	100
9	87.00	19.3	0.6	8.2	-	28.1	-	25.41	100
10	92.75	19.0	0.6	9.0	-	28.6	-	26.92	150
11	99.15	16.4	0.6	9.7	-	26.7	-	21.63	150
12	101.65	15.1	0.6	10.1	-	25.8	-	19.50	150
13	101.70	14.7	0.6	10.1	-	25.4	-	18.62	150
14	120.00	13.1	0.7	11.6	-	25.4	-	18.62	150
15	143.95	11.1	0.7	11.1	-	22.9	-	13.96	150
16	144.00	16.0	0.7	11.1	-	27.8	-	24.55	150
17	144.95	14.8	0.7	10.9	-	26.4	-	20.89	150
18	146.30	16.3	0.7	10.8	-	27.8	-	24.55	150
19	148.00	15.1	0.7	10.6	-	26.4	-	20.89	150
20	150.50	12.4	0.8	10.5	-	23.7	-	15.31	150
21	150.75	14.9	0.8	10.5	-	26.2	-	20.42	150
22	151.05	13.5	0.8	10.5	-	24.8	-	17.38	150
23	151.70	14.8	0.8	10.5	-	26.1	-	20.18	150
24	151.85	15.0	0.8	10.5	-	26.3	-	20.65	150
25	152.35	14.6	0.8	10.5	-	25.9	-	19.72	150
26	168.00	18.6	0.9	9.3	-	28.8	-	27.54	150
27	192.10	10.9	0.9	7.9	-	19.7	-	9.66	150
28	240.00	15.0	1.0	10.4	-	26.4	-	20.89	200
29	317.15	6.4	1.1	13.6	-	21.1	-	11.35	200
30	373.70	2.5	1.3	15.2	-	19.0	-	8.91	200
31	399.95	4.0	1.3	16.3	-	21.6	-	12.02	200
32	406.25	6.4	1.3	16.5	-	24.2	-	16.22	200
33	452.70	4.0	1.4	16.8	-	22.2	-	12.88	200
34	466.00	2.4	1.5	17.3	-	21.2	-	11.48	200
35	529.75	0.1	1.5	19.0	-	20.6	-	10.72	200
36	551.15	-0.9	1.5	20.6	-	21.2	-	11.48	200
37	571.25	2.2	1.6	20.0	-	23.8	-	15.49	200
38	642.05	-2.7	1.6	20.6	-	19.5	-	9.44	200
39	692.85	-2.0	1.7	21.0	-	20.7	-	10.84	200
40	739.55	-2.4	1.8	23.2	-	22.6	-	13.49	200
41	793.20	-1.8	1.8	23.0	-	23.0	-	14.13	200
42	851.35	-1.5	2.0	23.5	-	24.0	-	15.85	200
43	926.45	-1.7	2.1	24.5	-	24.9	-	17.58	200
44	973.40	0.5	2.1	25.0	-	27.6	-	23.99	500
45	4227.722	47.52	1.70	32.10	35.60	45.72	-9.54	579.43	500
46	8454.439	41.06	2.50	37.30	36.50	44.36	-9.54	495.45	500
47	1399.080	54.40	0.80	25.60	36.80	44.00	-9.54	475.34	500
48	8394.697	43.96	2.40	37.30	36.50	47.16	-9.54	683.91	500

Notes:

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

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

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

Radiated emission limits 47 CFR Part 15: Clause 15.109 for all emissions:

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

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

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

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

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

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

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

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.

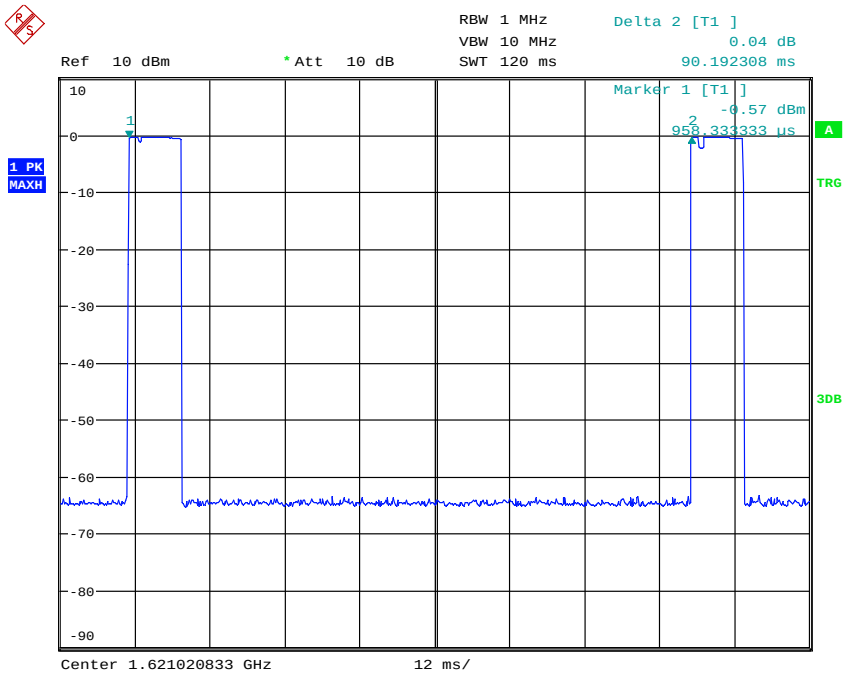
(c) Where relevant, on power line conducted emission plots, the limit displayed is the average limit, which is stricter than the quasi peak limit.

(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.

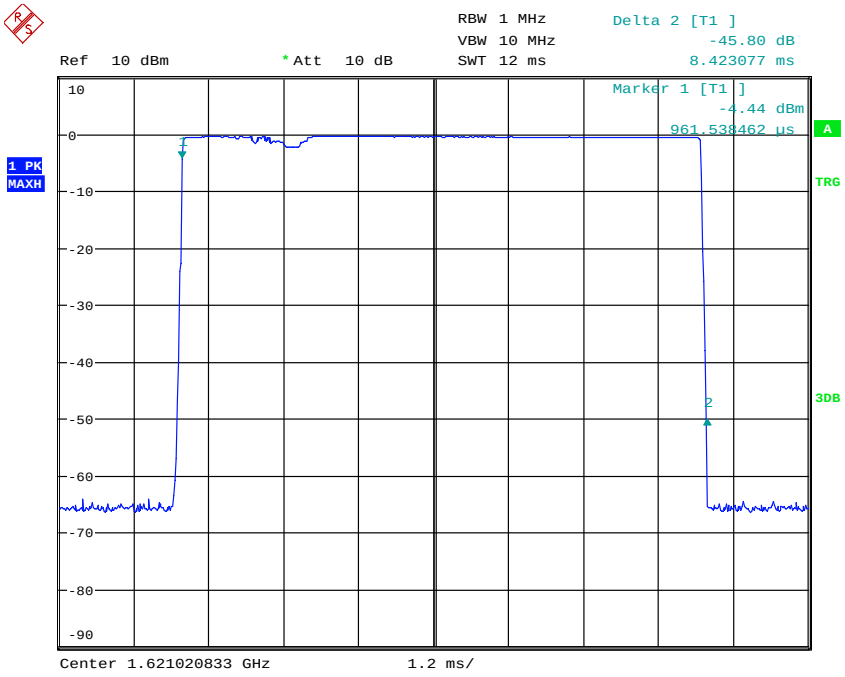
Duty Cycle Plots

T_{frame} = 90.192 mS



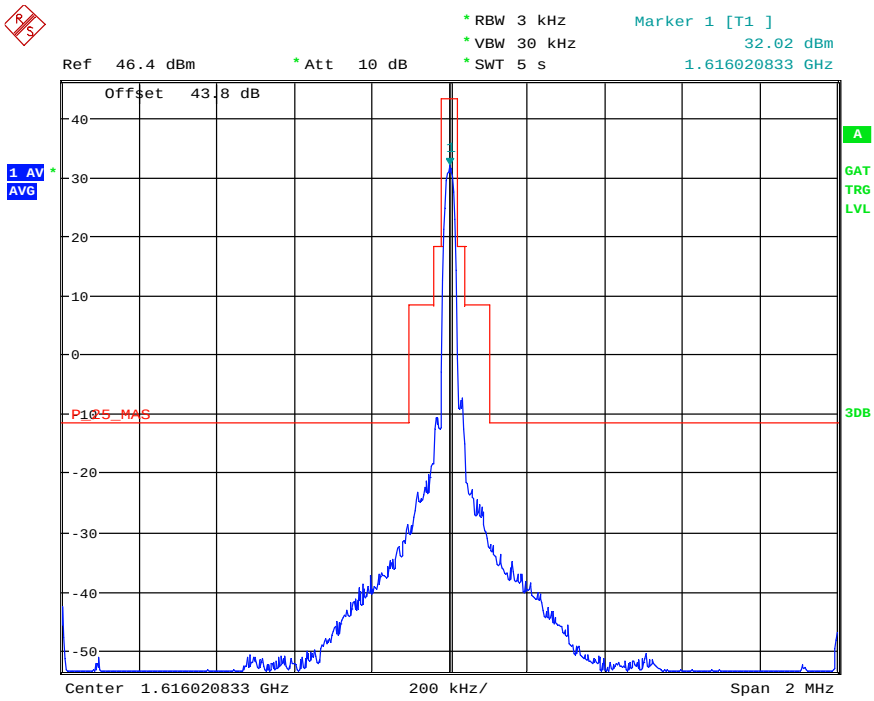
Date: 28.JUL.2011 14:29:03

T_{on} = 8.423 mS



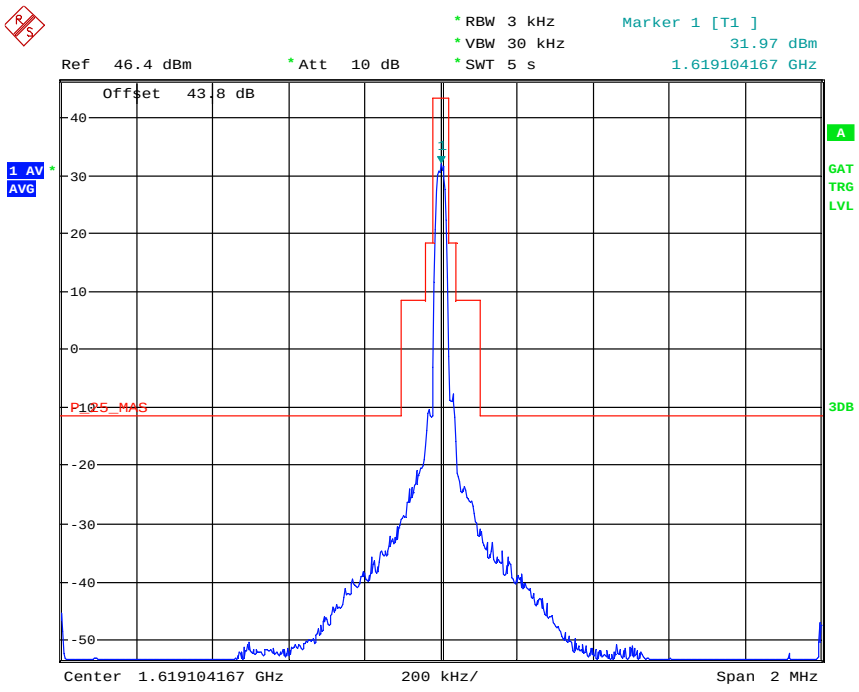
Date: 28.JUL.2011 14:31:25

Emissions Limitation Channel 1



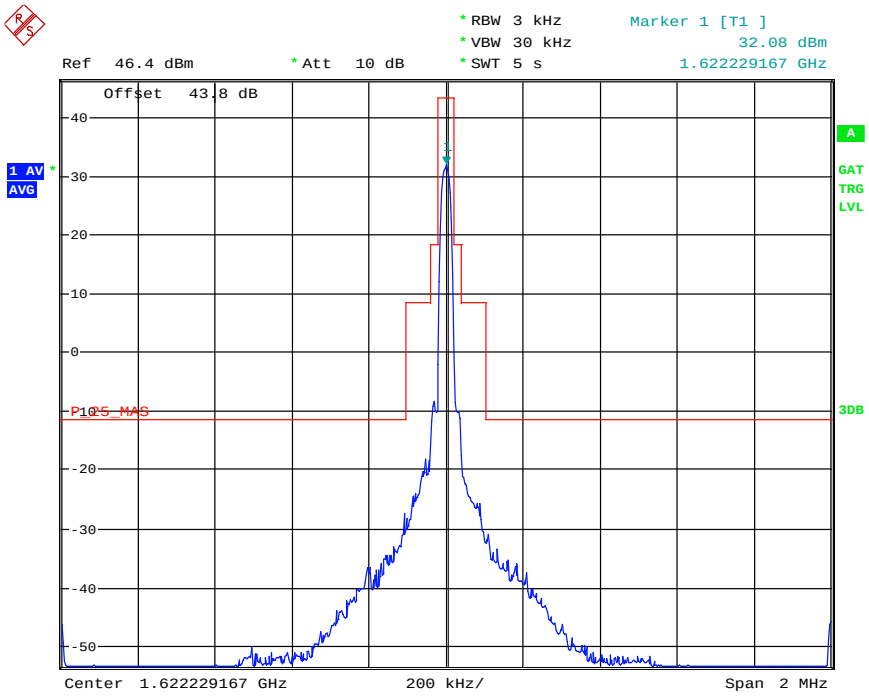
Date: 29.JUL.2011 07:57:09

Emissions Limitation Channel 75



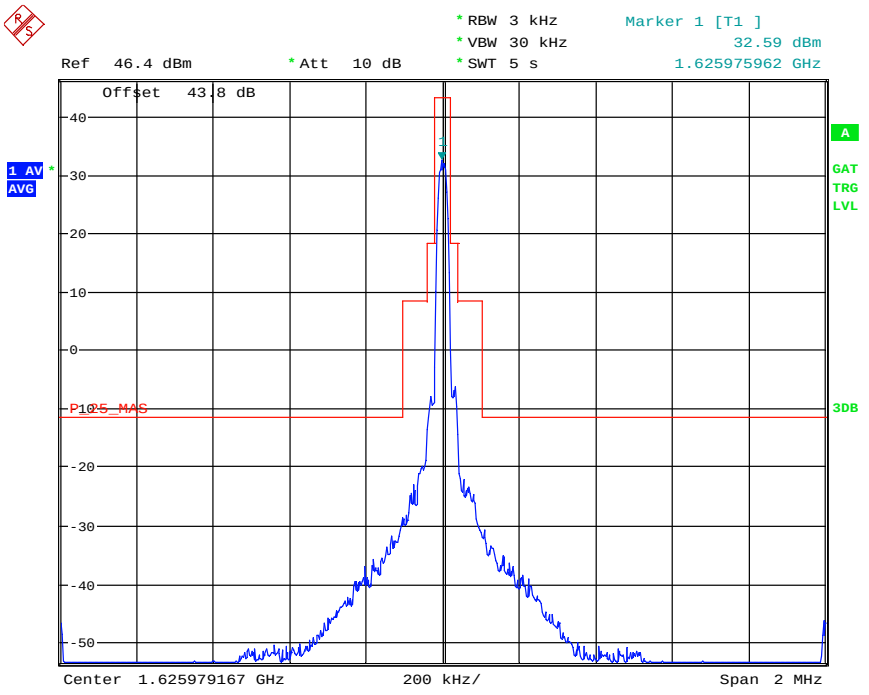
Date: 29.JUL.2011 07:53:02

Emissions Limitation Channel 150



Date: 29.JUL.2011 08:00:11

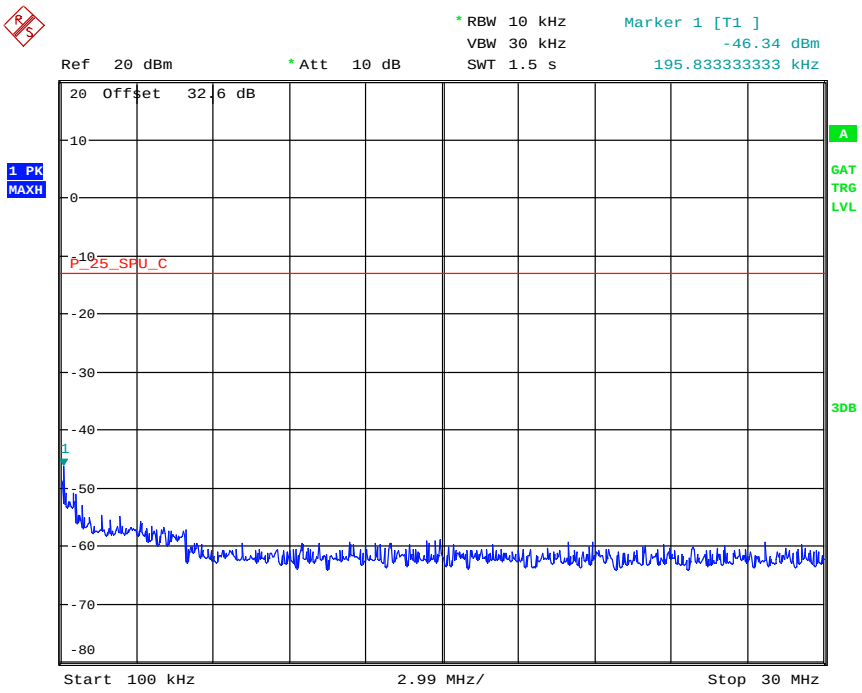
Emissions Limitation Channel 240



Date: 29.JUL.2011 08:05:16

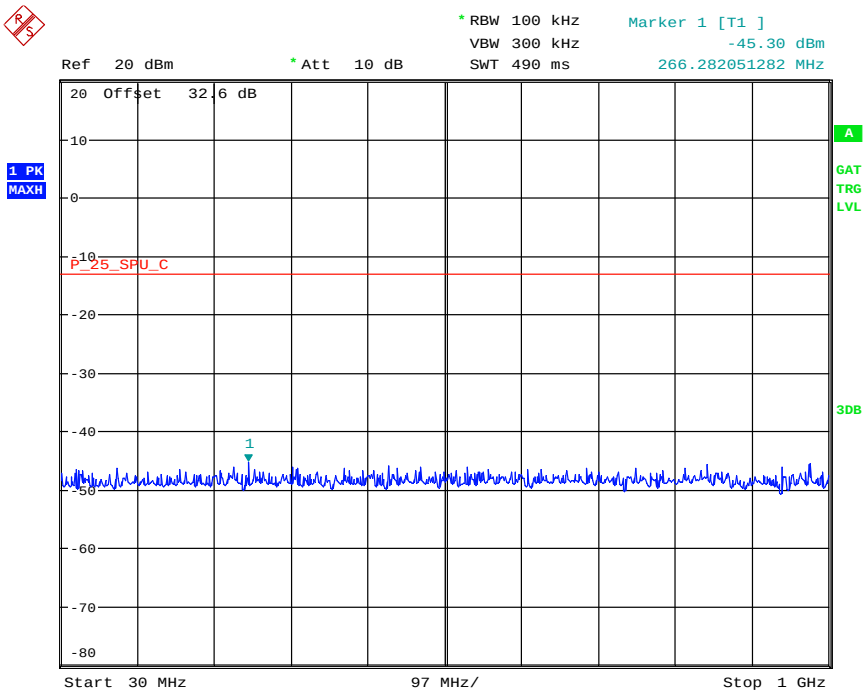
Transmitter Spurious Emissions – Conducted (Channel 1)

100 kHz – 30MHz



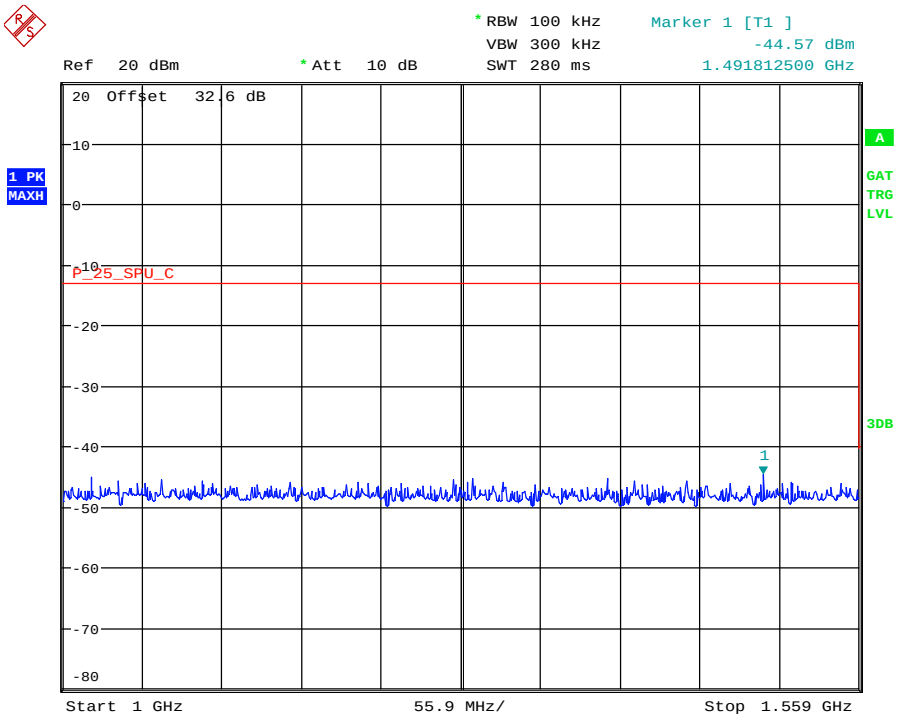
Date: 29.JUL.2011 09:31:09

30MHz – 1000MHz



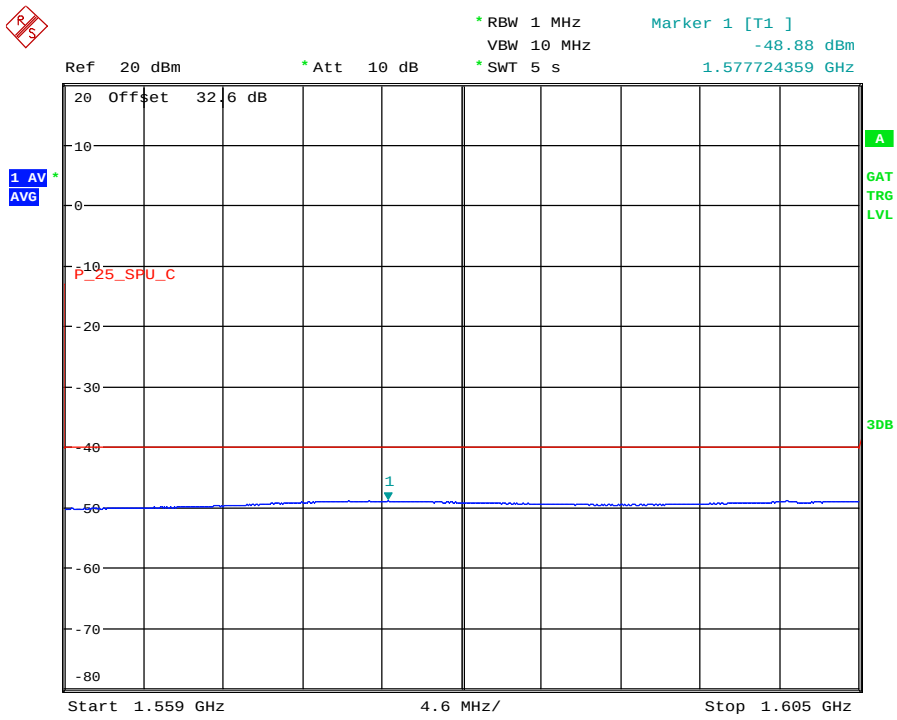
Date: 29.JUL.2011 09:32:00

1000MHz – 1559MHz



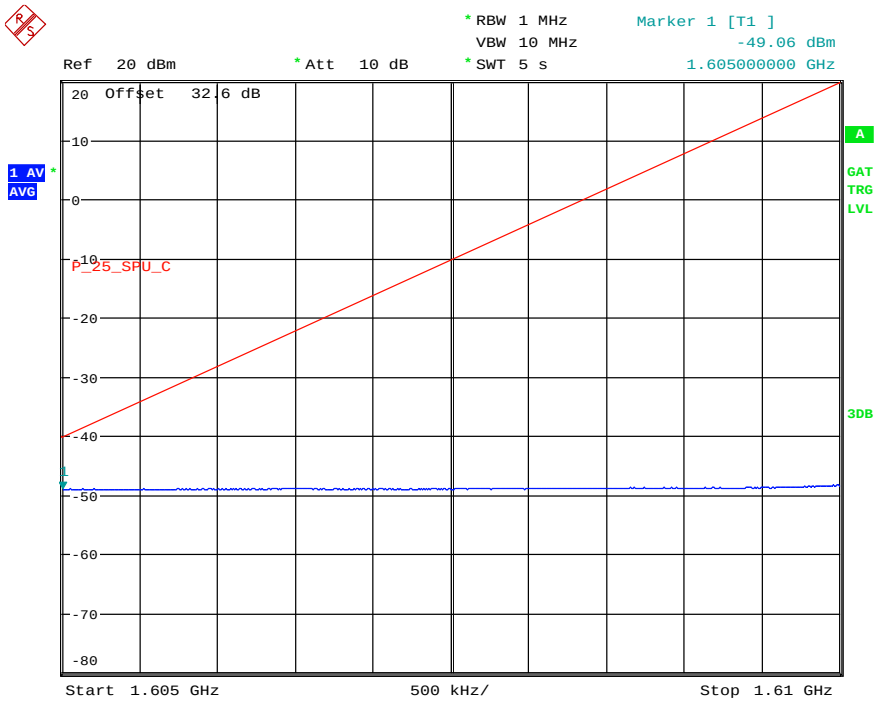
Date: 29.JUL.2011 09:32:39

1559MHz – 1605MHz



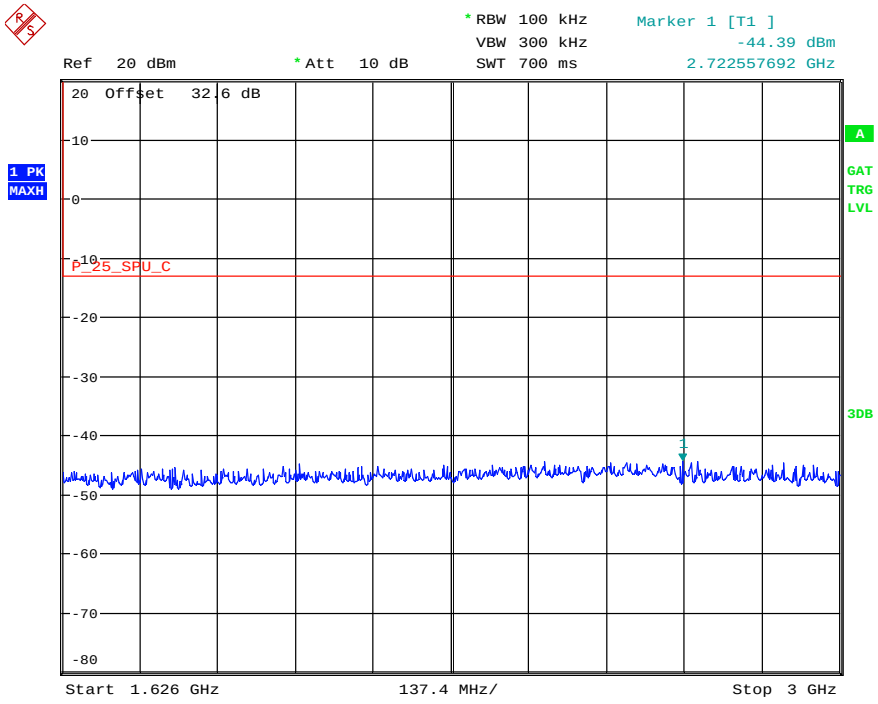
Date: 29.JUL.2011 09:34:39

1605MHz – 1610MHz



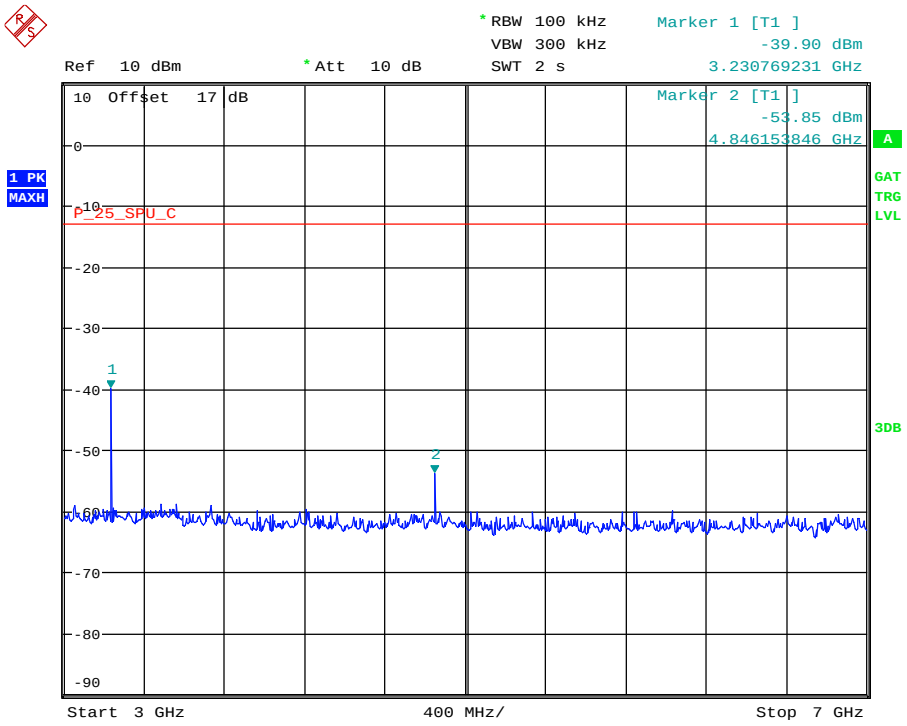
Date: 29.JUL.2011 09:38:08

1626.5MHz – 3000MHz



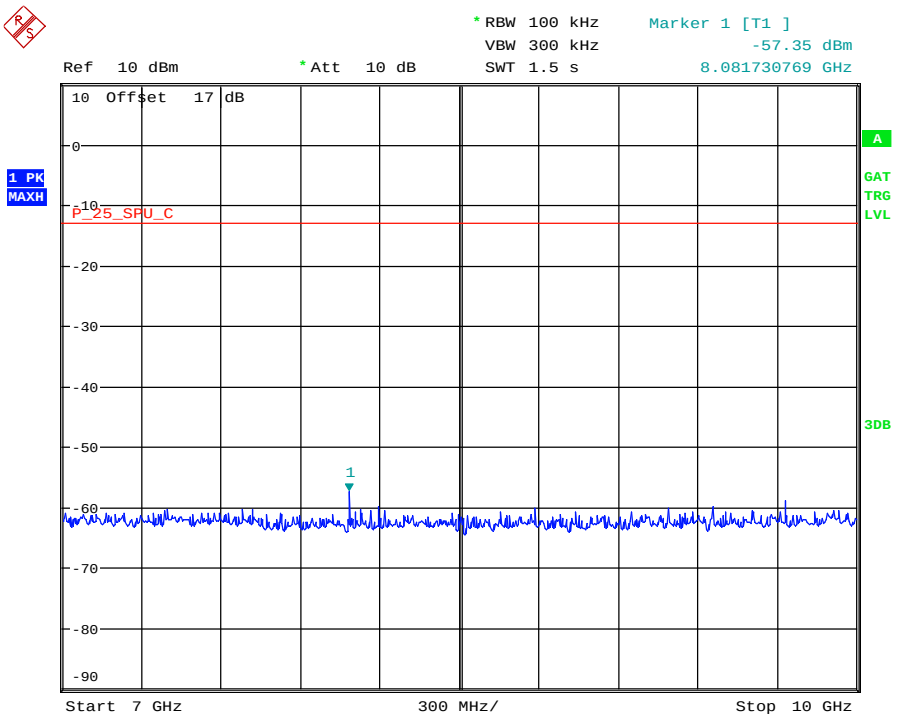
Date: 29.JUL.2011 09:38:50

3GHz – 7GHz



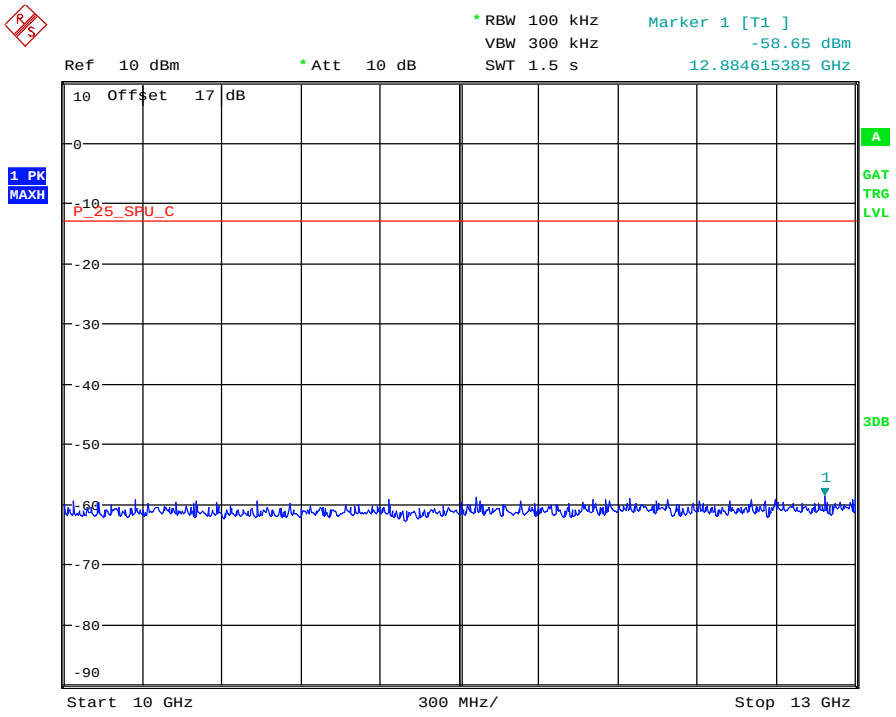
Date: 29.JUL.2011 10:12:15

7GHz – 10GHz



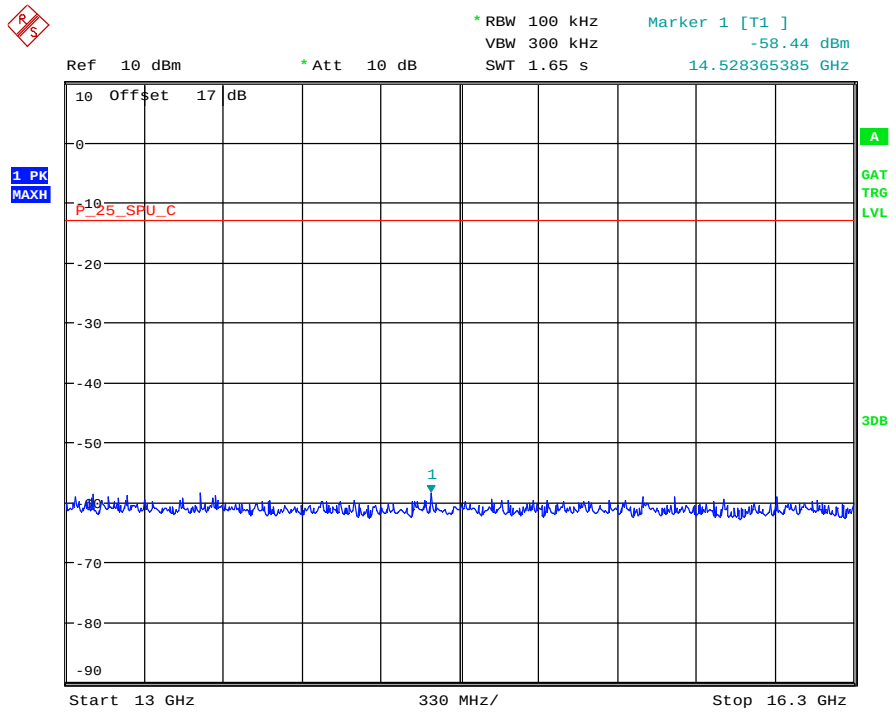
Date: 29.JUL.2011 10:12:50

10GHz – 13GHz



Date: 29.JUL.2011 10:14:38

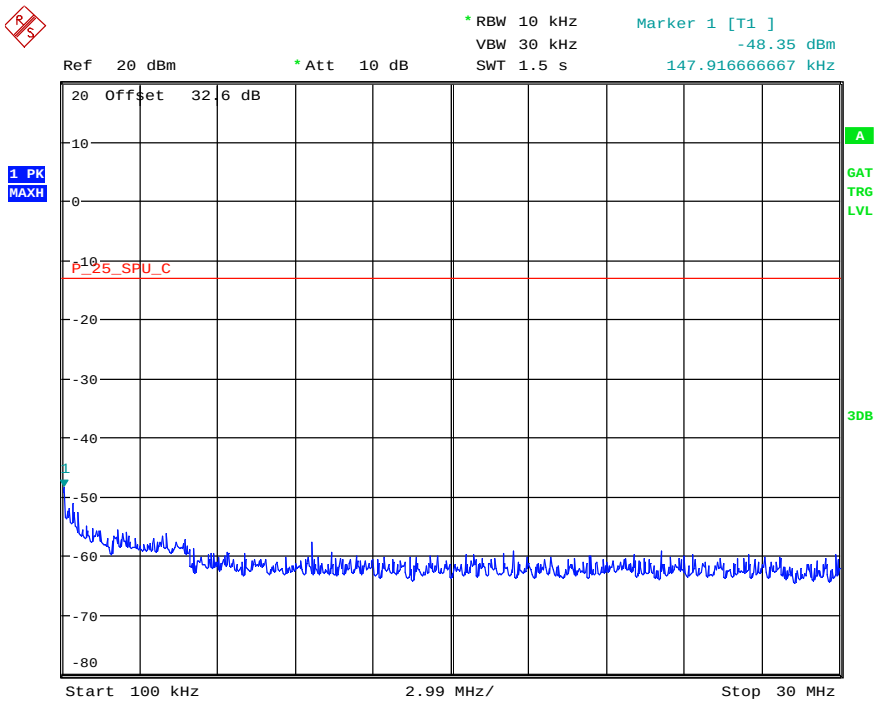
13GHz – 16.3GHz



Date: 29.JUL.2011 10:11:30

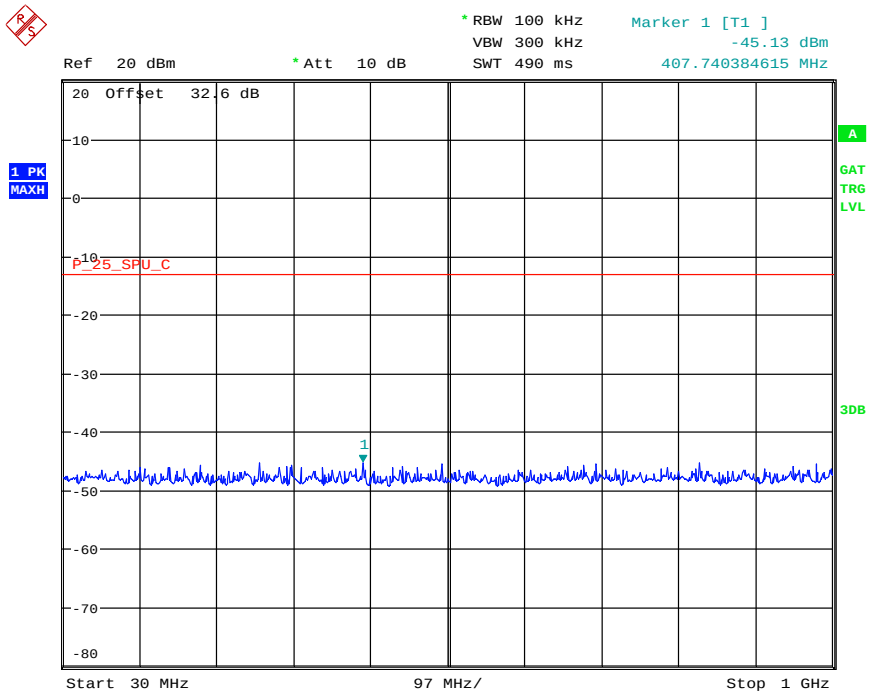
Transmitter Spurious Emissions – Conducted (Channel 240)

100 kHz – 30MHz



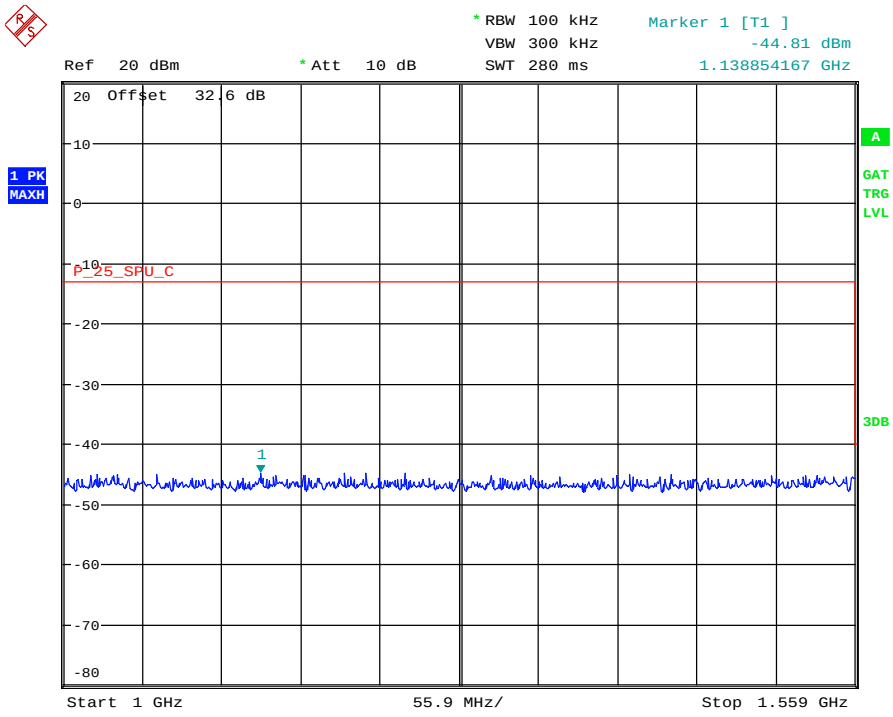
Date: 29.JUL.2011 09:42:49

30MHz – 1000MHz



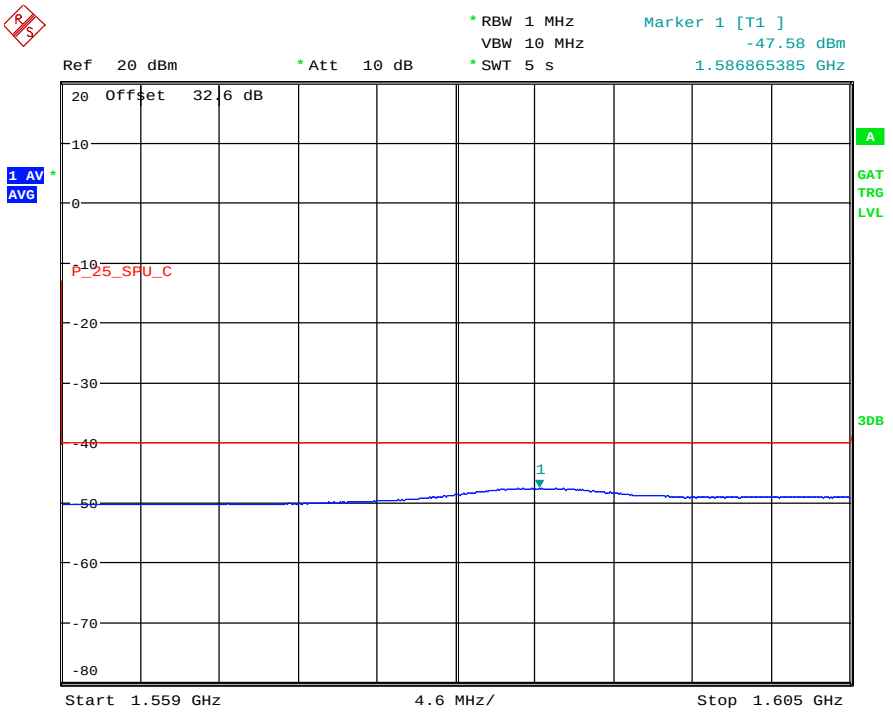
Date: 29.JUL.2011 09:43:31

1000MHz – 1559MHz



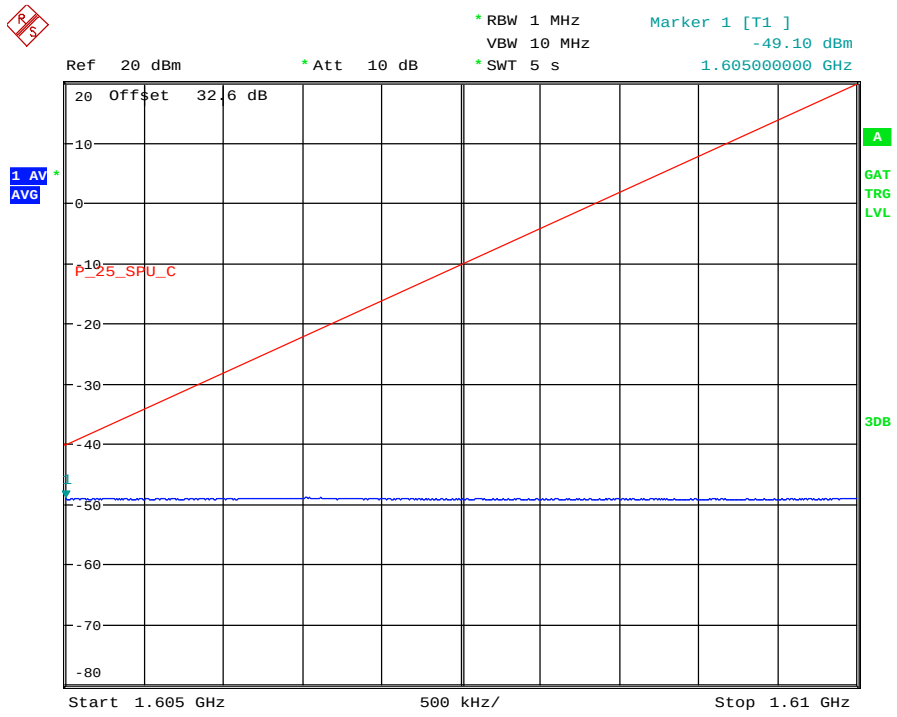
Date: 29.JUL.2011 09:45:44

1559MHz – 1605MHz



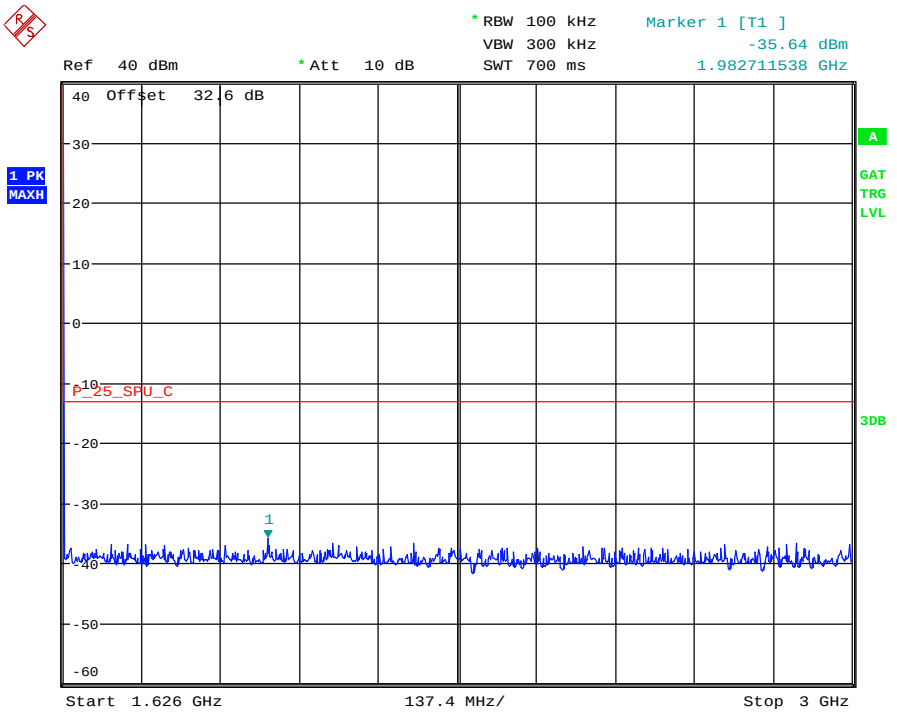
Date: 29.JUL.2011 09:47:35

1605MHz – 1610MHz



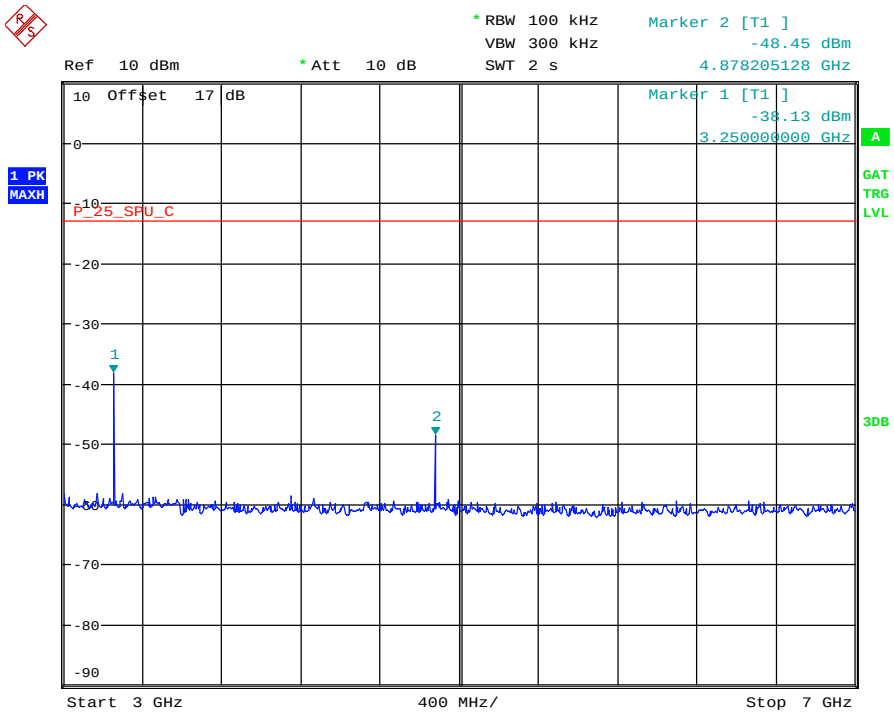
Date: 29.JUL.2011 09:49:05

1626.5MHz – 3000MHz



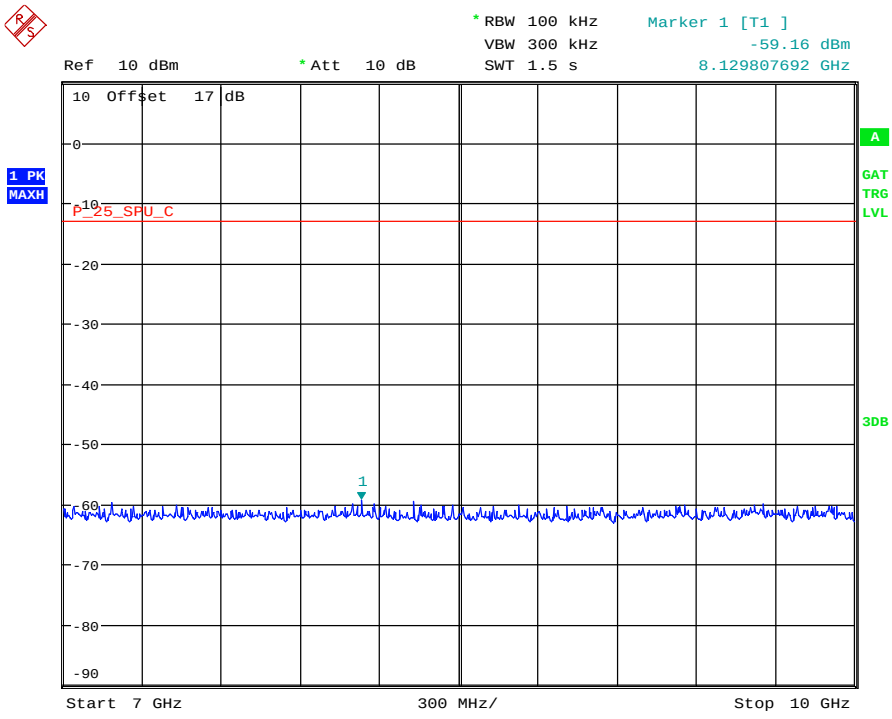
Date: 29.JUL.2011 09:41:48

3GHz – 7GHz



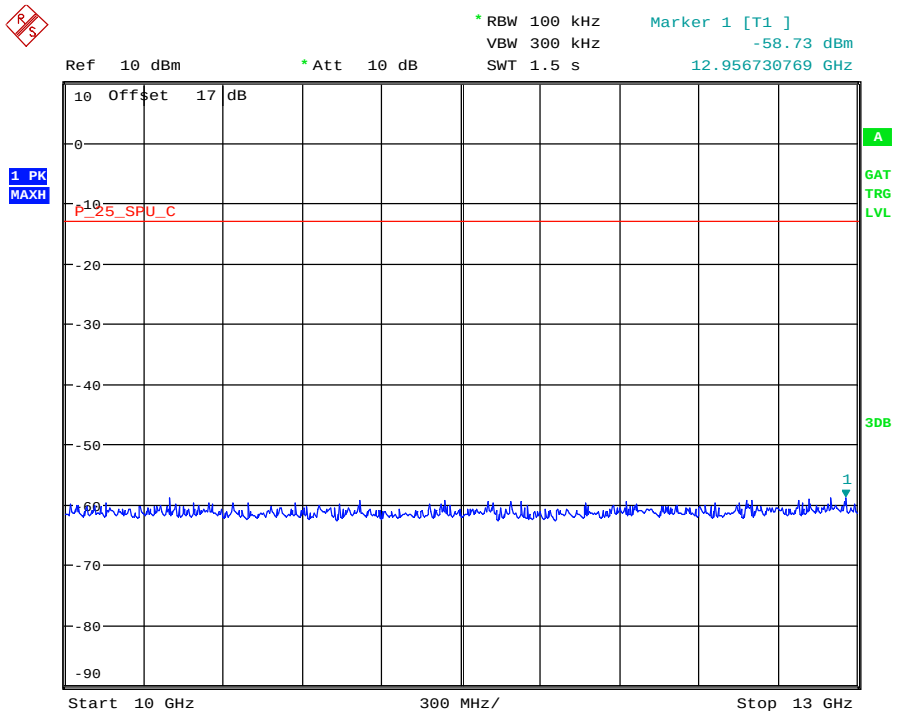
Date: 29.JUL.2011 10:06:15

7GHz – 10GHz



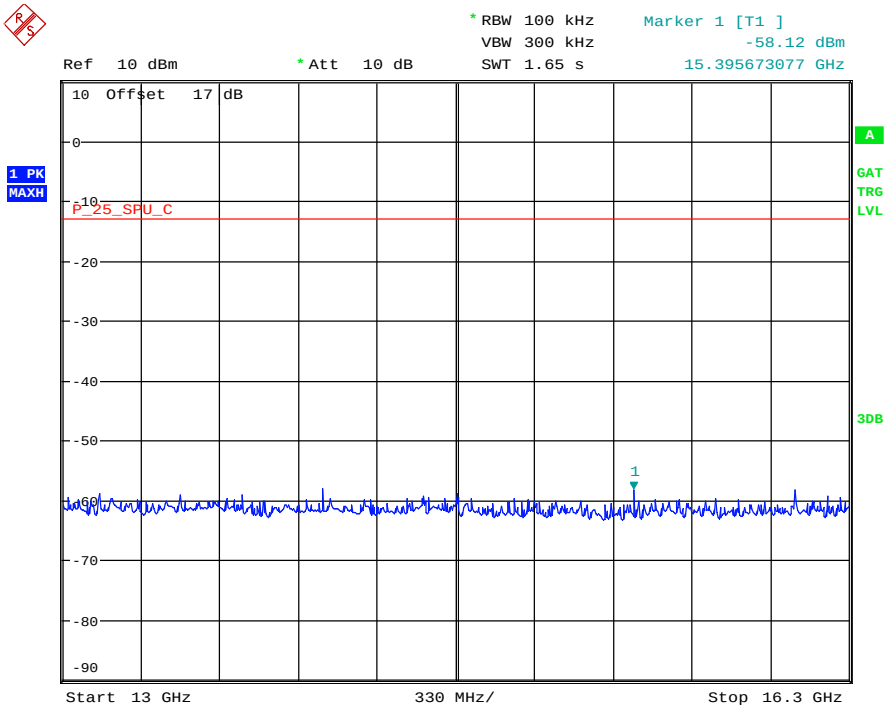
Date: 29.JUL.2011 10:07:41

10GHz – 13GHz



Date: 29.JUL.2011 10:09:08

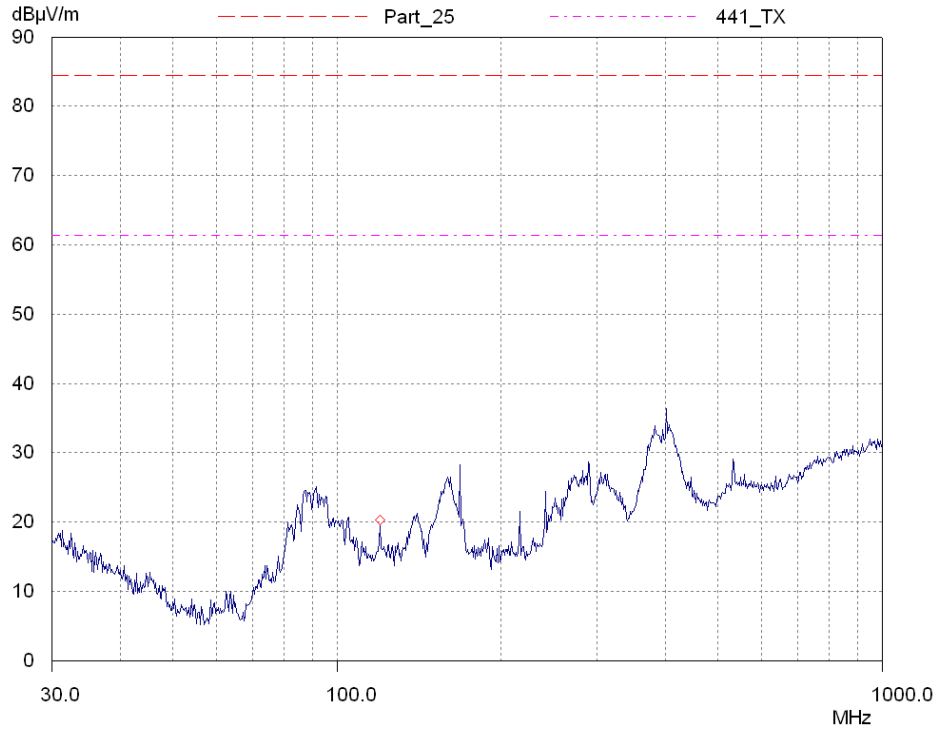
13GHz – 16.3GHz



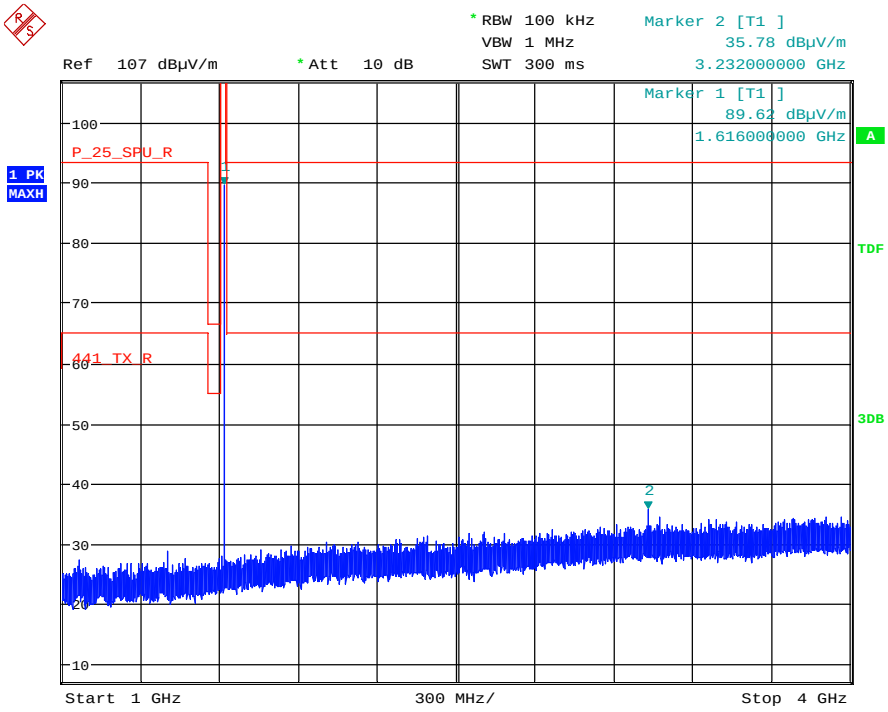
Date: 29.JUL.2011 10:09:58

Transmitter Spurious Emissions – Radiated (Channel 1)

30MHz – 1000MHz

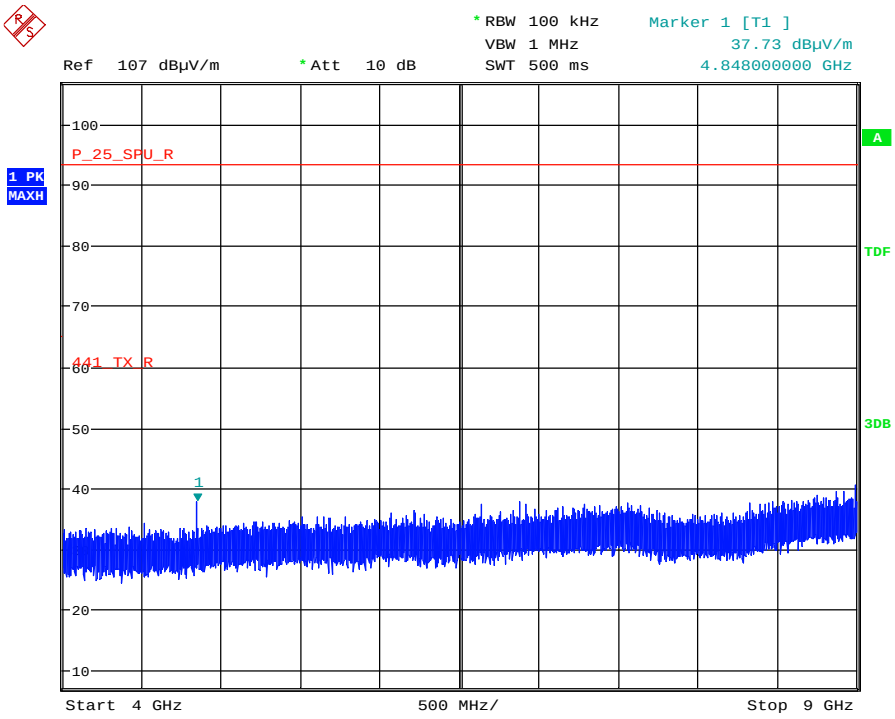


1000MHz – 4000MHz



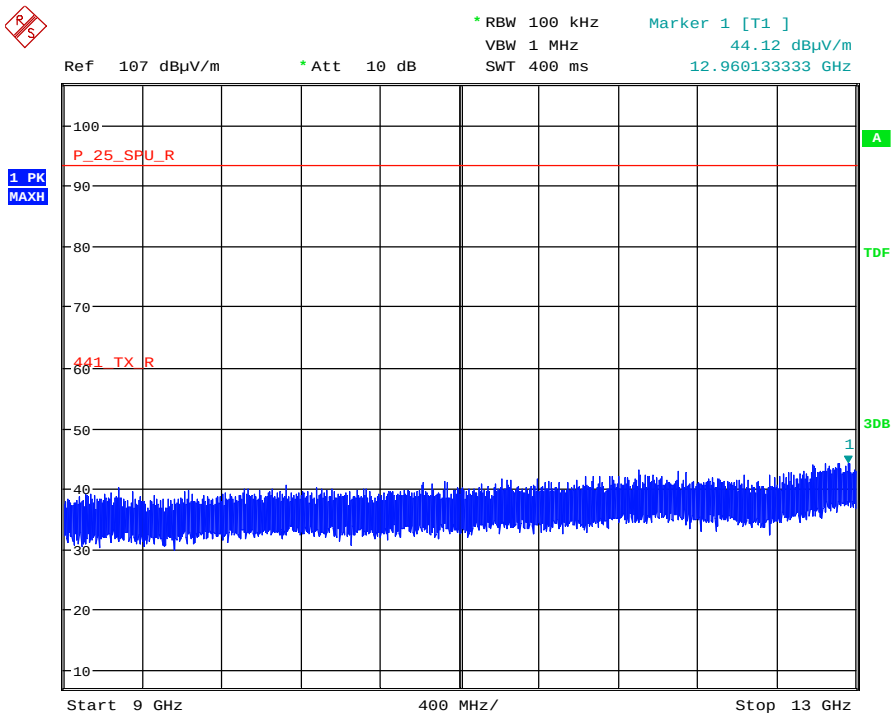
Date: 3.AUG.2011 15:04:03

4GHz – 9GHz



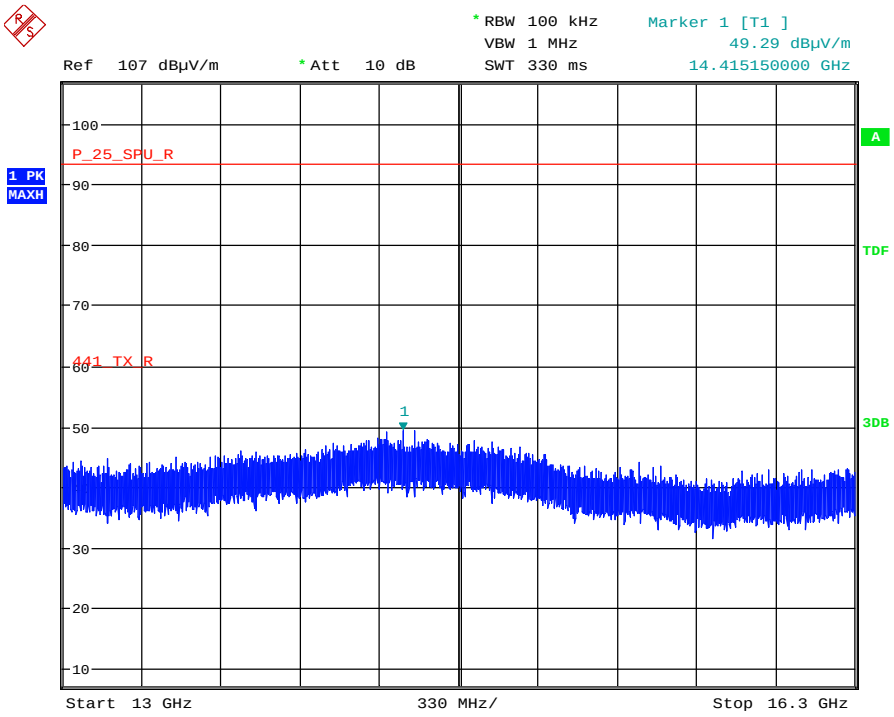
Date: 3.AUG.2011 15:02:38

9GHz – 13GHz



Date: 3.AUG.2011 15:01:38

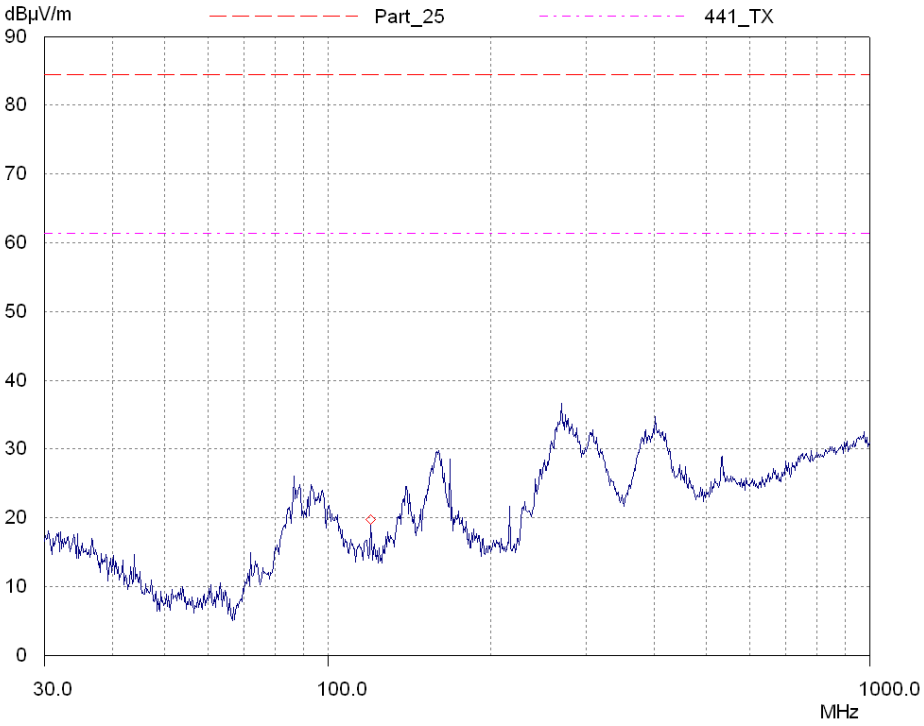
13GHz – 17GHz



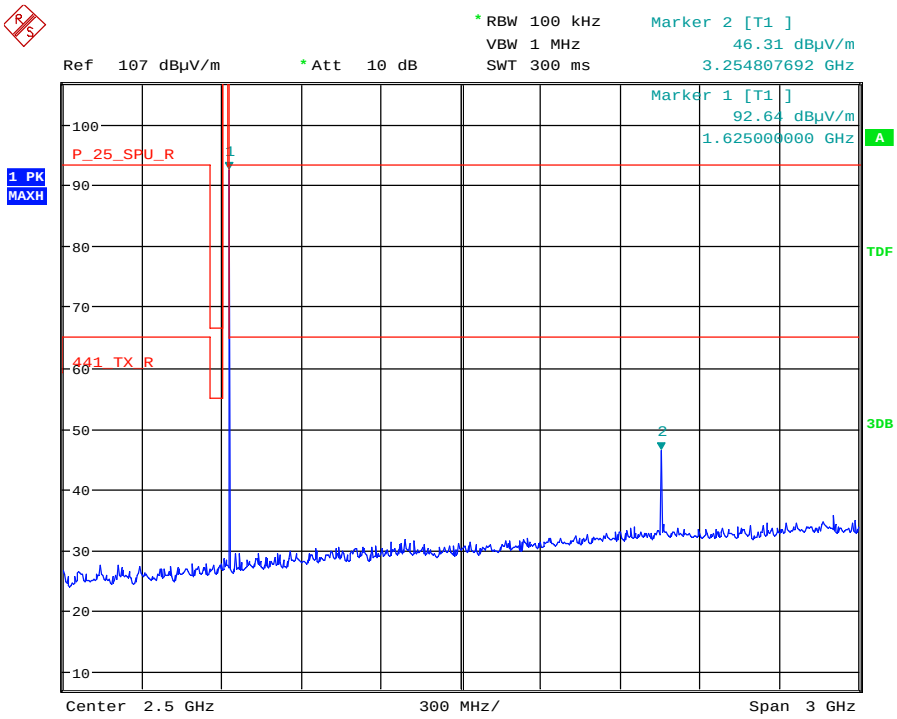
Date: 3.AUG.2011 15:01:03

Transmitter Spurious Emissions – Radiated (Channel 240)

30MHz – 1000MHz

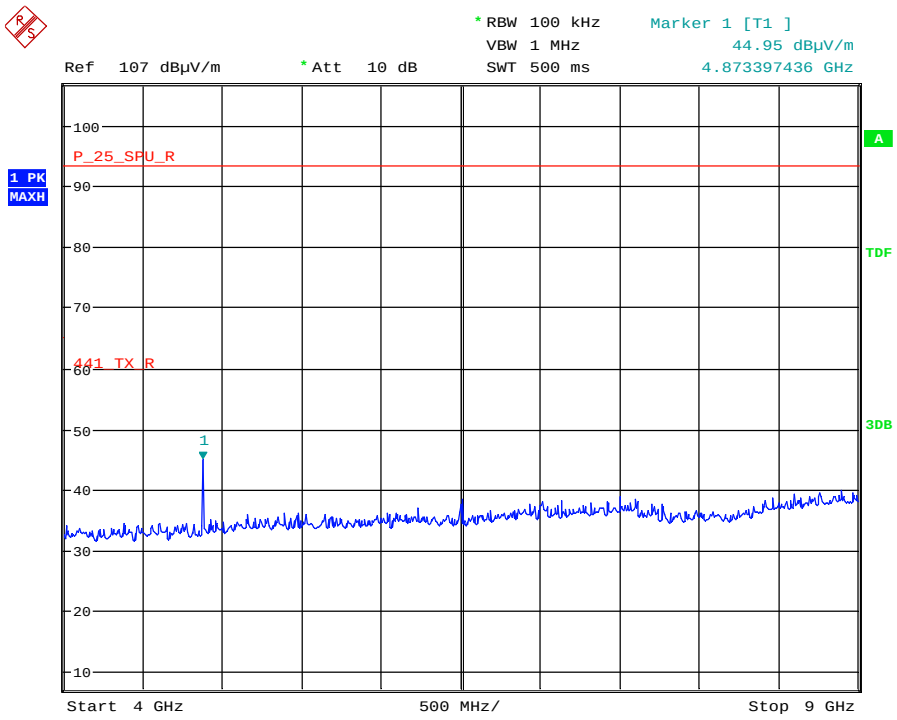


1GHz – 4GHz



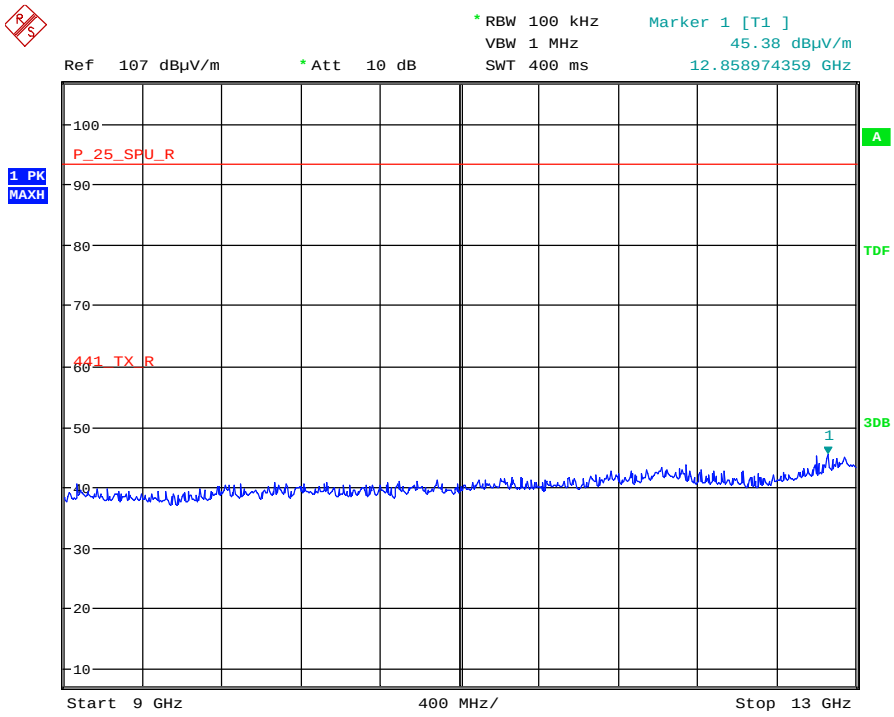
Date: 3.AUG.2011 15:53:14

4GHz – 9GHz



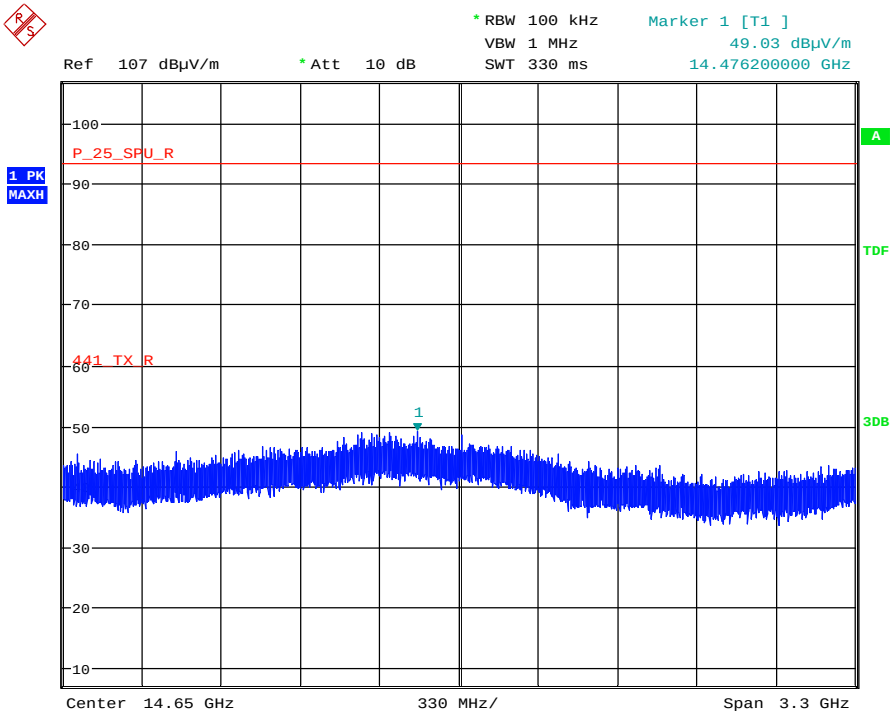
Date: 3.AUG.2011 15:53:40

9GHz – 13GHz

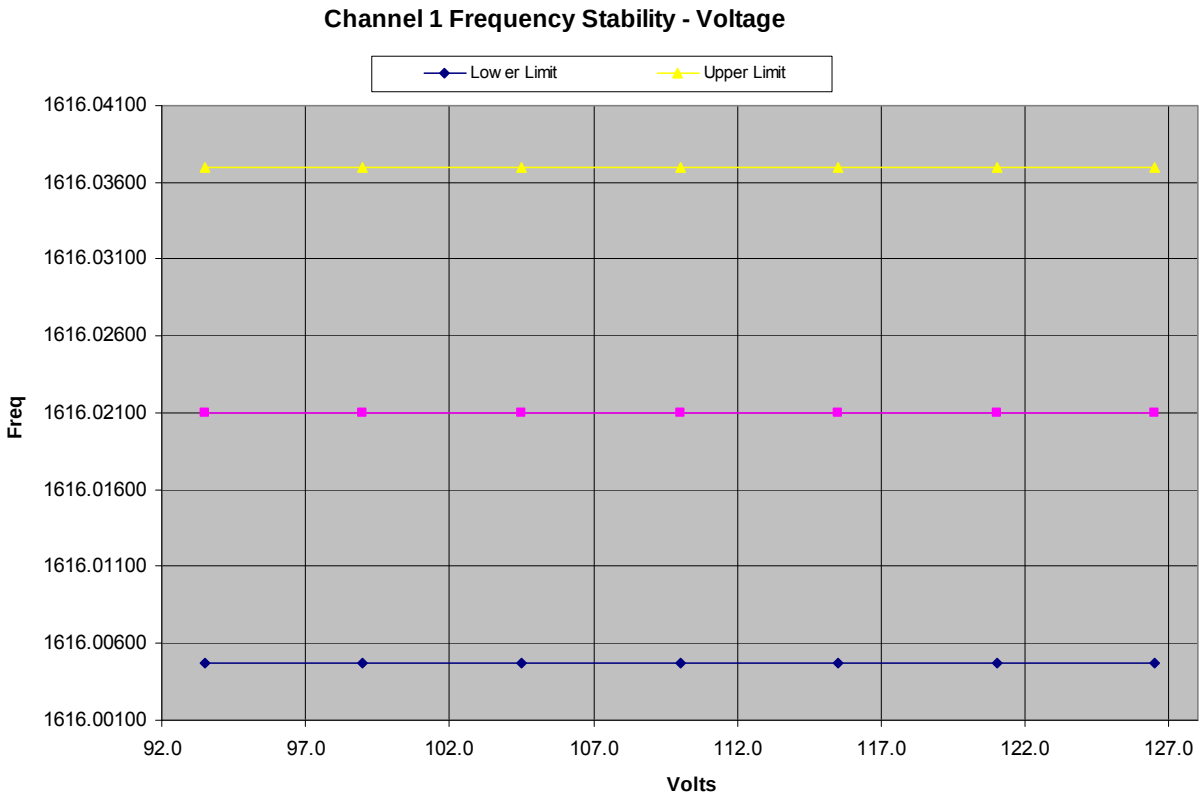


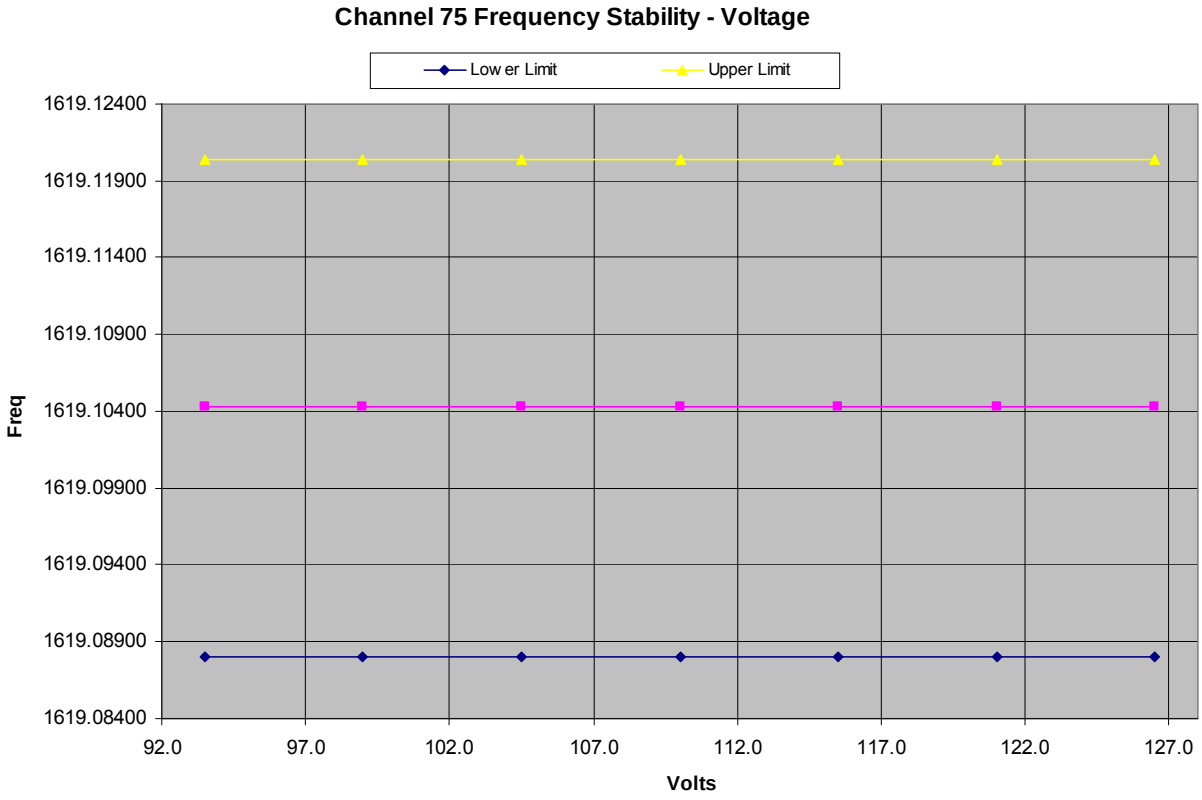
Date: 3.AUG.2011 15:54:08

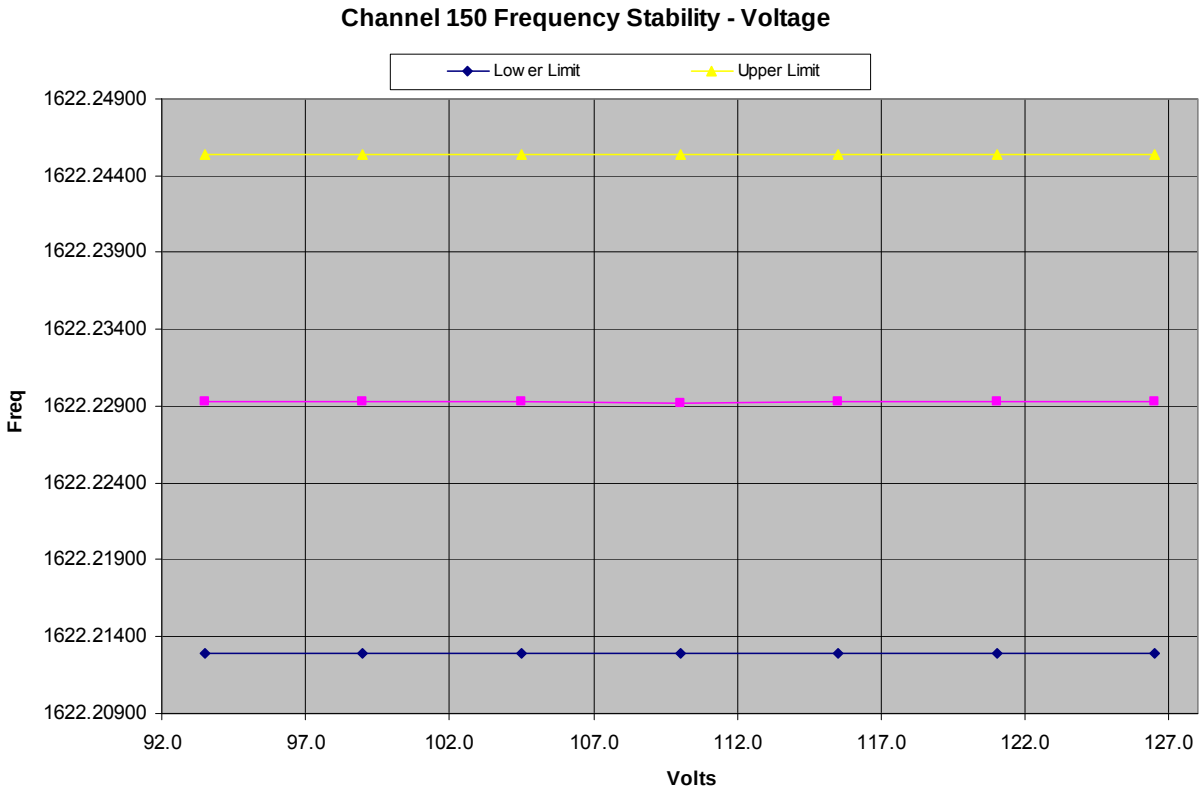
13GHz – 17GHz

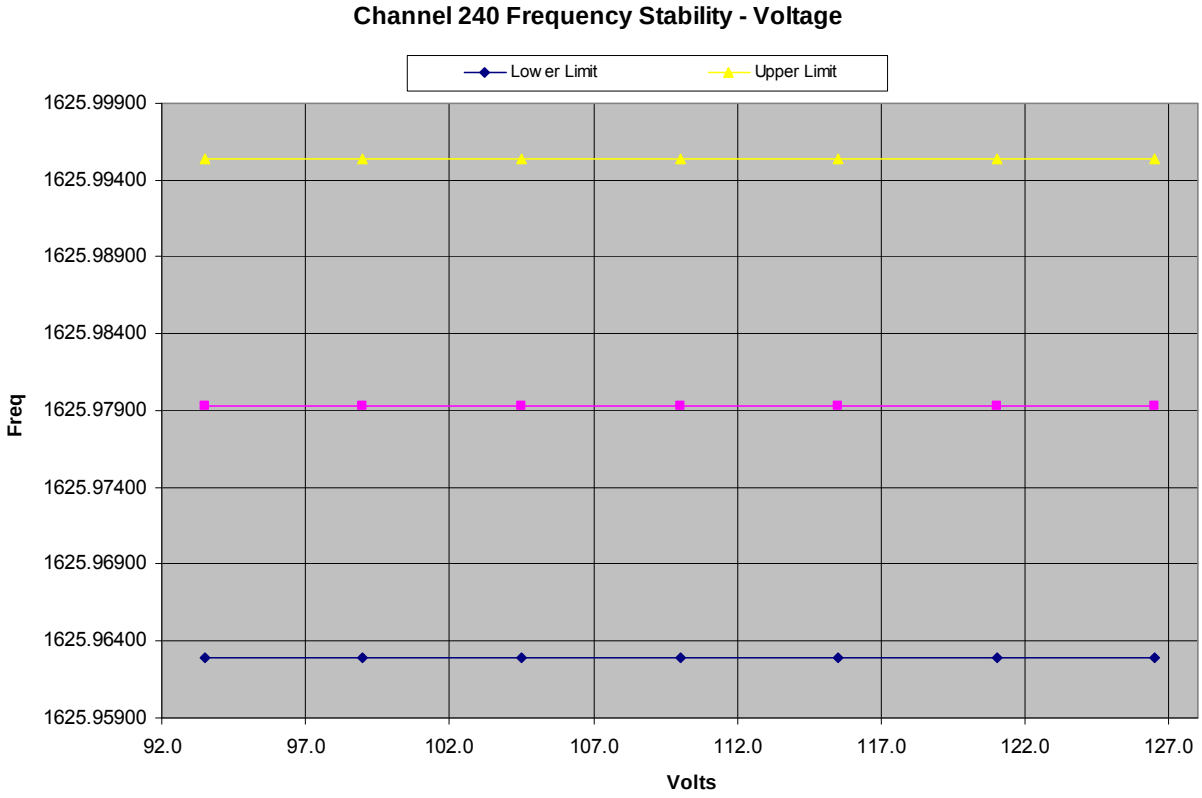


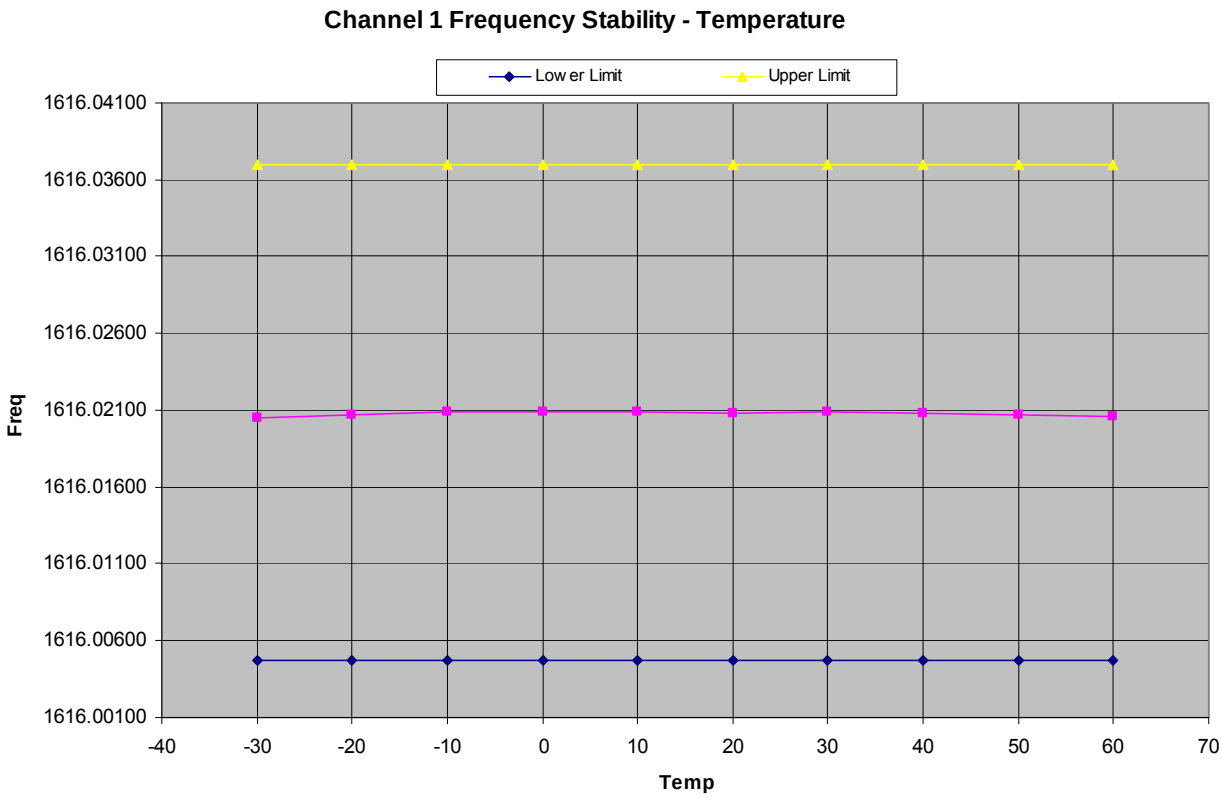
Date: 3.AUG.2011 15:55:08

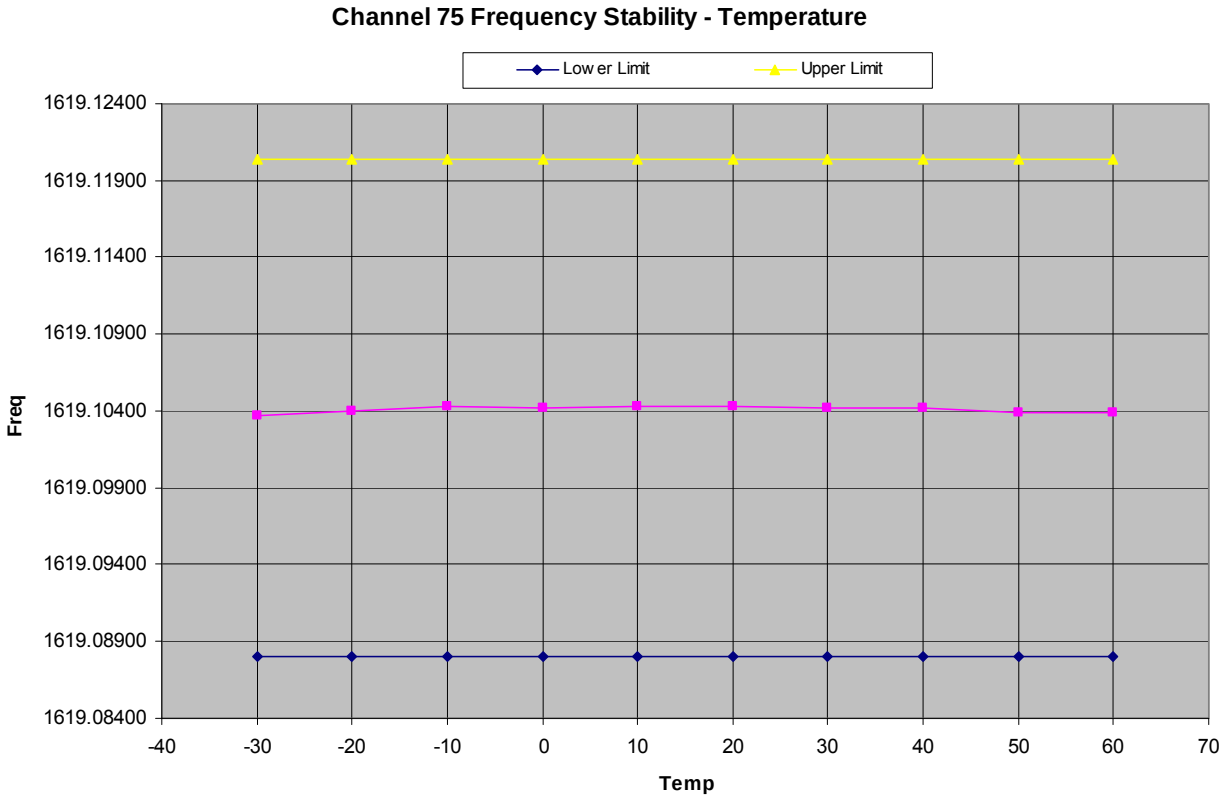

Channel 1 Frequency Stability - Voltage
Low er Limit
Upper Limit
1616.04100
1616.03600
1616.03100
1616.02600
1616.02100
1616.01600
1616.01100
1616.00600
1616.00100
Freq
92.0
97.0
102.0
107.0
112.0
117.0
122.0
127.0
Volts

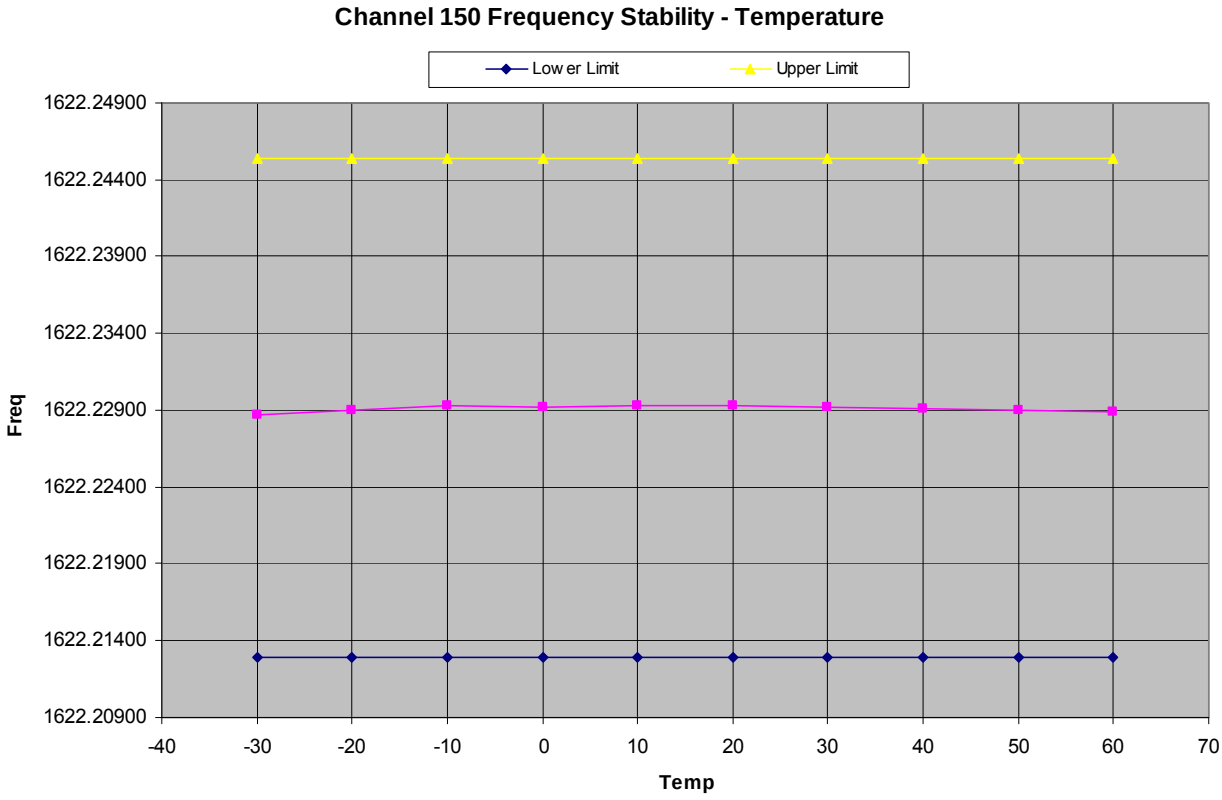

Channel 75 Frequency Stability - Voltage
Low er Limit
Upper Limit
1619.12400
1619.11900
1619.11400
1619.10900
1619.10400
1619.09900
1619.09400
1619.08900
1619.08400
Freq
92.0
97.0
102.0
107.0
112.0
117.0
122.0
127.0
Volts

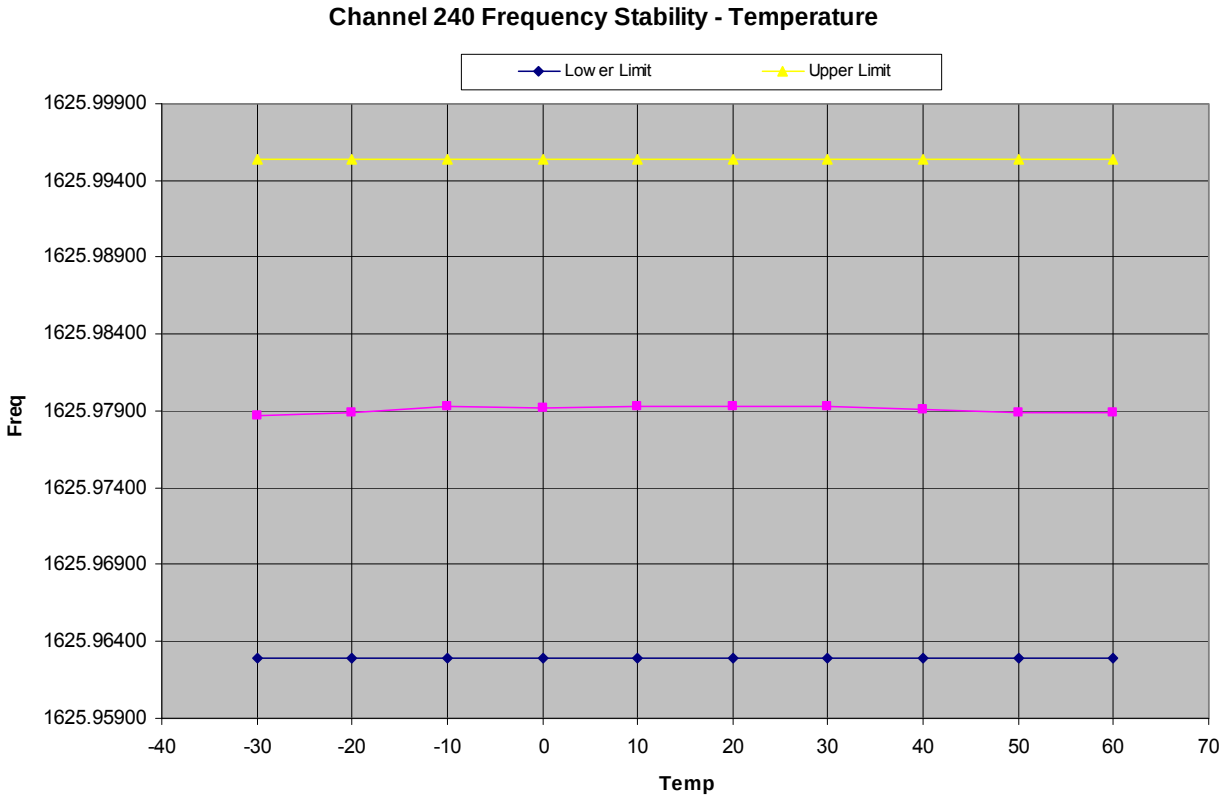

Channel 150 Frequency Stability - Voltage
Lower Limit
Upper Limit
1622.24900
1622.24400
1622.23900
1622.23400
1622.22900
1622.22400
1622.21900
1622.21400
1622.20900
Freq
92.0
97.0
102.0
107.0
112.0
117.0
122.0
127.0
Volts


Channel 240 Frequency Stability - Voltage
Lower Limit
Upper Limit
1625.99900
1625.99400
1625.98900
1625.98400
1625.97900
1625.97400
1625.96900
1625.96400
1625.95900
Freq
92.0
97.0
102.0
107.0
112.0
117.0
122.0
127.0
Volts


Channel 1 Frequency Stability - Temperature
Lower Limit
Upper Limit
1616.04100
1616.03600
1616.03100
1616.02600
1616.02100
1616.01600
1616.01100
1616.00600
1616.00100
Freq
-40
-30
-20
-10
0
10
20
30
40
50
60
70
Temp

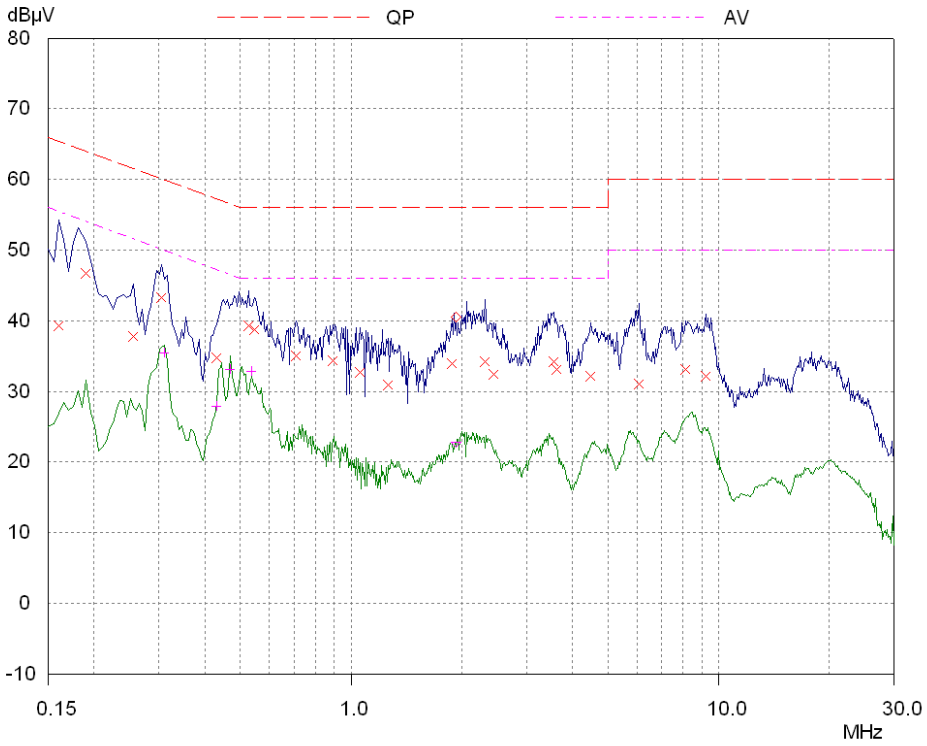

Channel 75 Frequency Stability - Temperature
Lower Limit
Upper Limit
1619.12400
1619.11900
1619.11400
1619.10900
1619.10400
1619.09900
1619.09400
1619.08900
1619.08400
Freq
-40
-30
-20
-10
0
10
20
30
40
50
60
70
Temp


Channel 150 Frequency Stability - Temperature
Lower Limit
Upper Limit
1622.24900
1622.24400
1622.23900
1622.23400
1622.22900
1622.22400
1622.21900
1622.21400
1622.20900
Freq
-40
-30
-20
-10
0
10
20
30
40
50
60
70
Temp

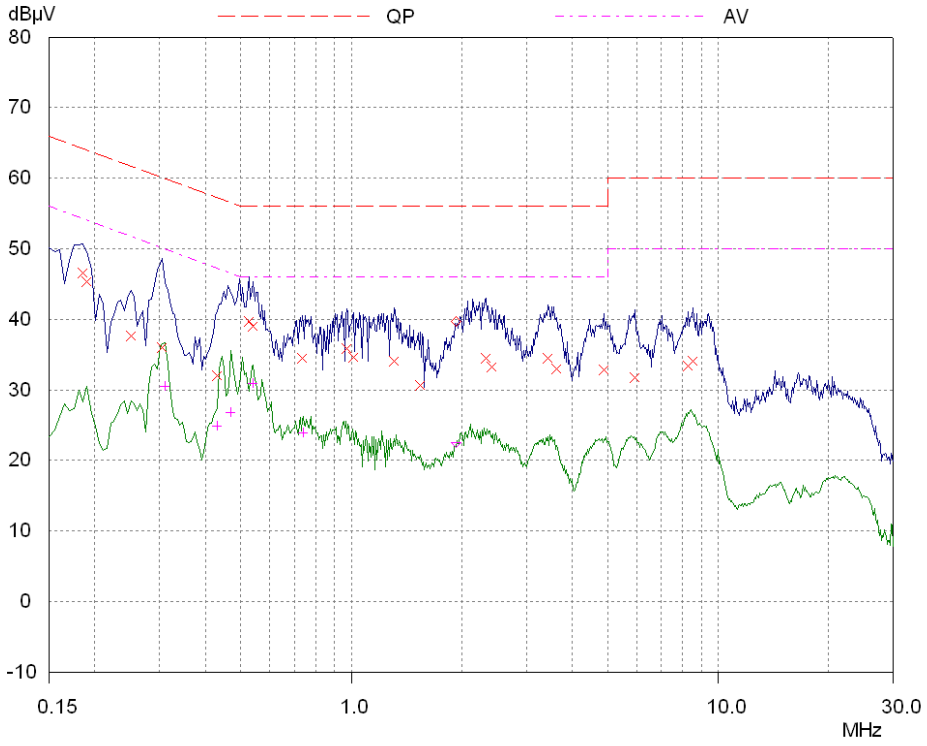

Channel 240 Frequency Stability - Temperature
Lower Limit
Upper Limit
1625.99900
1625.99400
1625.98900
1625.98400
1625.97900
1625.97400
1625.96900
1625.96400
1625.95900
Freq
-40
-30
-20
-10
0
10
20
30
40
50
60
70
Temp

AC Powerline Conducted Emissions

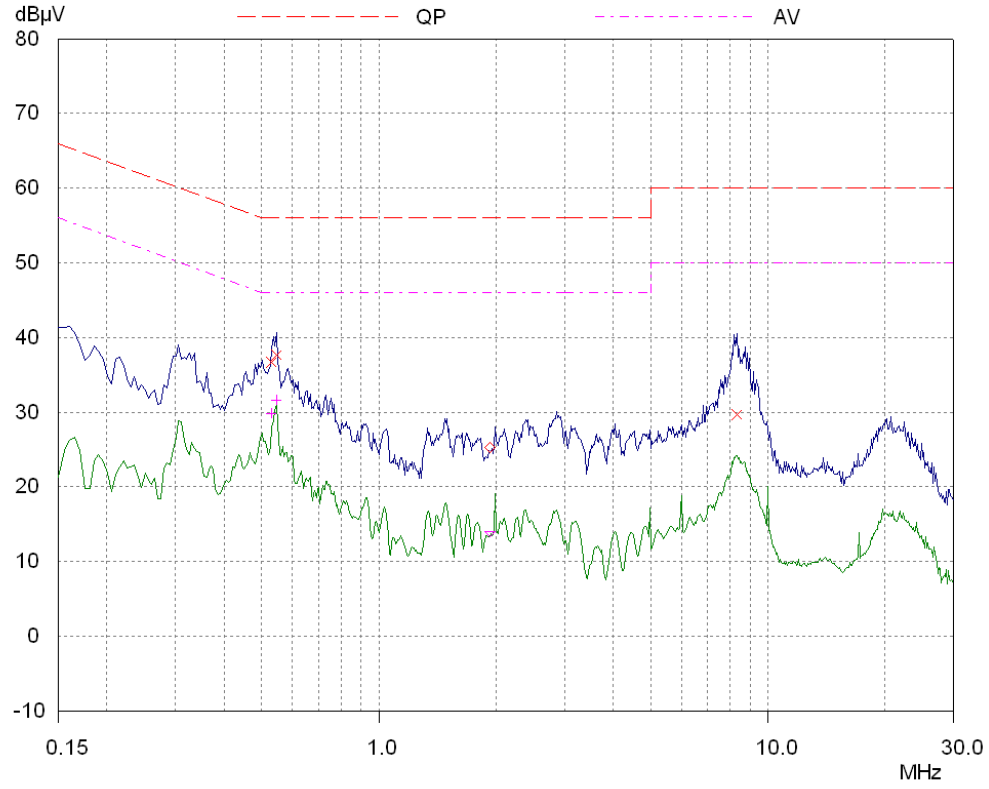
Transmit Mode, Live Line



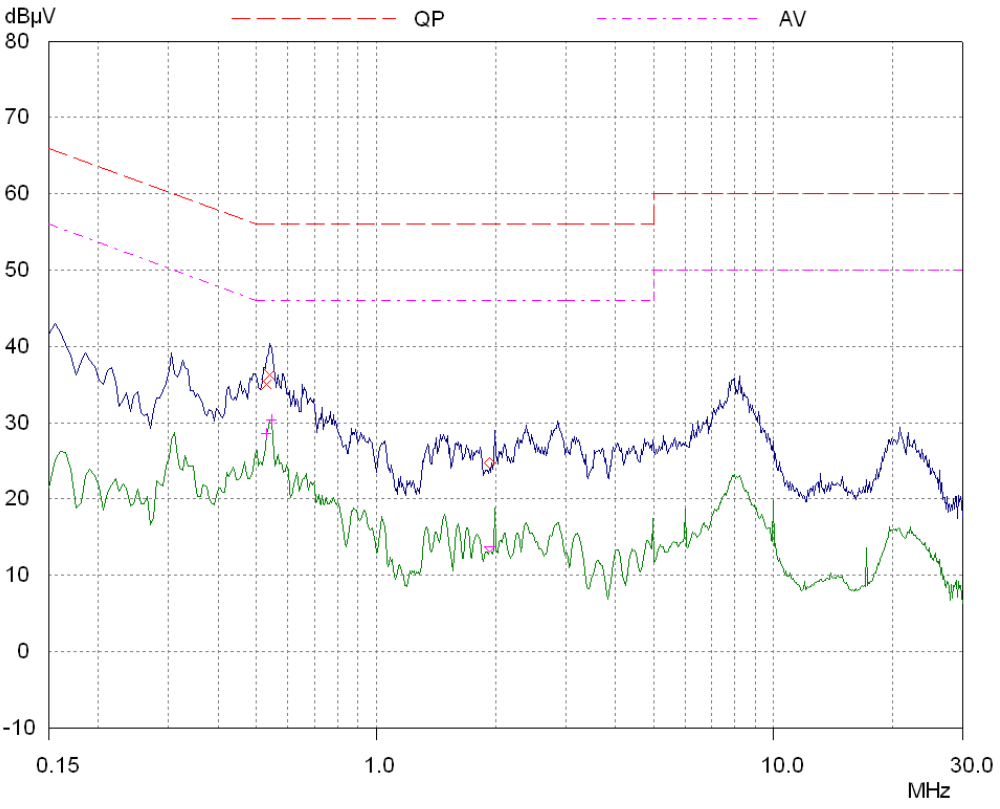
Transmit Mode, Neutral Line



Receive Mode, Live Line

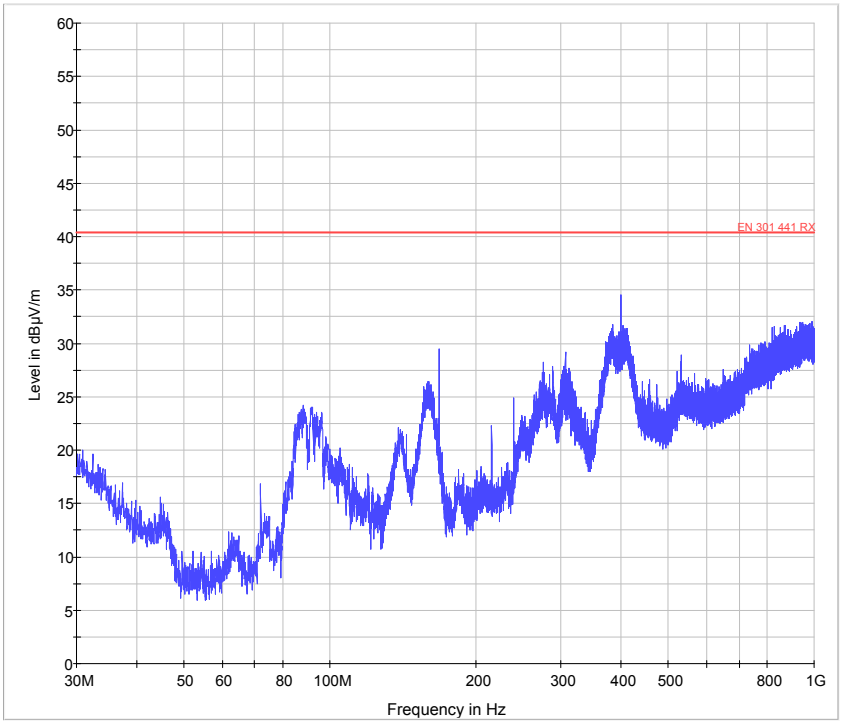


Receive Mode, Neutral Line

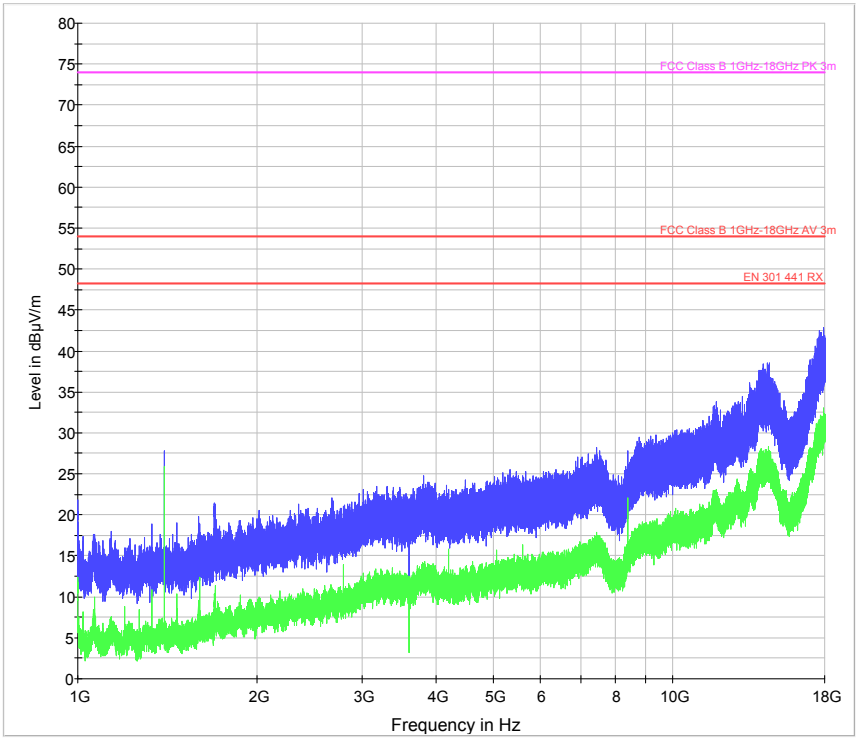


Unintentional Radiated Spurious Emissions – Channel 1

30 MHz - 1 GHz

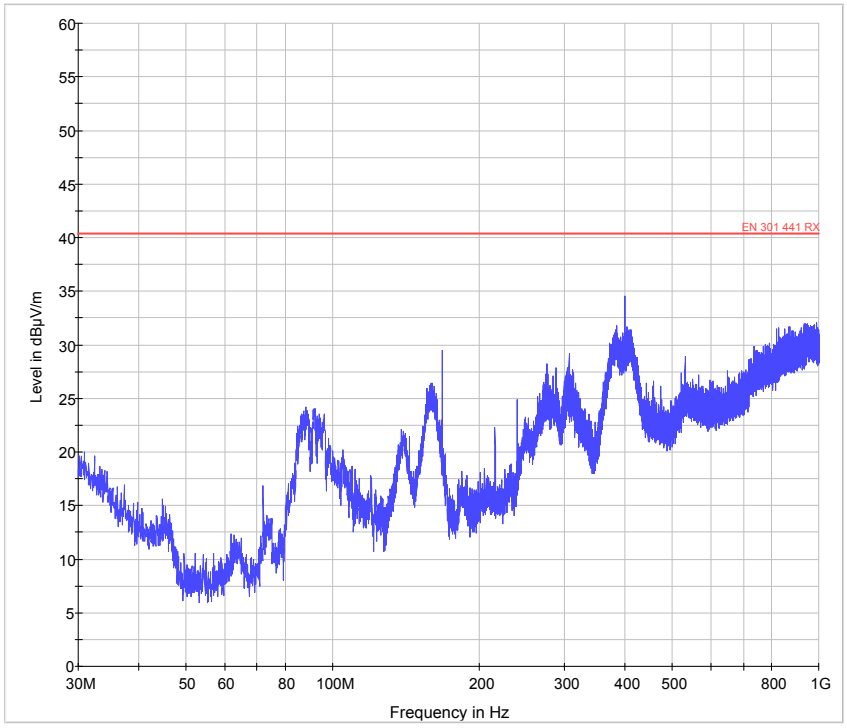


1GHz – 18GHz

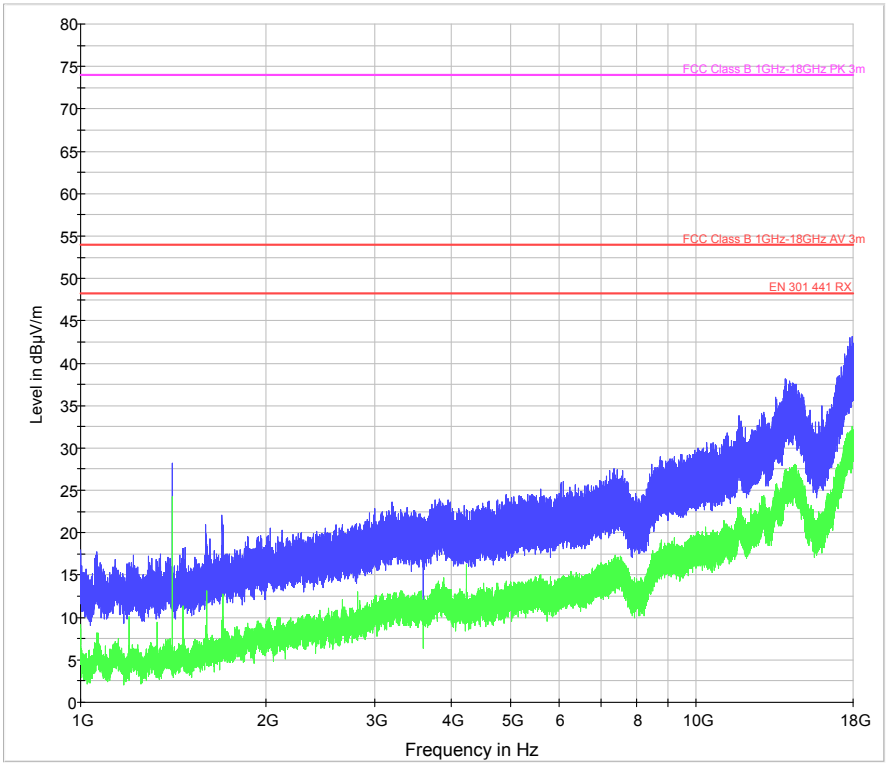


Unintentional Radiated Spurious Emissions – Channel 240

30MHz – 1GHz



1GHz - 18GHz



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

This appendix contains details of:

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

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

Sample No: Sxx Mod w

where:

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

The following terminology is used throughout the test report:

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

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

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

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

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

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

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

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

C1 Test samples

Sample No.	Description	Identification
S01	9523 Voice & Data Transceiver Module	None
S02	Power Supply Unit	None
S03	Headphones	None

C2 EUT operating mode during testing

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

Test	Description of Operating Mode
RF Power, Duty cycle, Unwanted emissions within & outside the band, Power line conducted emissions, Frequency stability tests	Transmit
Unwanted emissions in carrier off state, Power line conducted emissions	Receive/Standby mode

C3 EUT Configuration Information

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
Tests : Conducted, Radiated

Port	Description of Cable Attached/ Equipment Connected
Antenna	50 ohm load or equivalent
Power	Power Supply Unit
Interface	9 way D-type connected to PC
Audio	Headphones

C5 Details of Equipment Used

TRaC Ref.	Type	Description	Manufacturer	Date Calibrated
TRL11	TCC 125-815P	Temp Chamber	Shartree	Use TRL426
TRL103	8308-200	Attenuator	Bird	Cal In Use
TRL135	68030.17.A	Attenuator	Shuner	Cal In Use
TRL138	3115	Horn	Emco	10/09/2009
TRL139	3115	Horn	Emco	17/08/2009
TRL176	2042	Signal Generator	Marconi	08/07/2010
TRL193	VHA 9103 balu	Bicone Antenna	Chase	06/05/2008
TRL203	UPA6108	Log Periodic	Chase	06/05/2008
TRL222	8304-100-N	Attenuator	Bird	Cal In Use
TRL246	8304-0600N	Attenuator	Bird	Cal In Use
TRL426	52 SERIES II	Temp Indicator	Fluke	04/03/2011
TRL572	8449B	Pre Amplifier	Agilent	24/11/2010
TRLUH04	ESHS10	Receiver	R&S	14/12/2010
TRLUH28	UHALP 9108	Log Periodic	Schwarzbeck	14/08/2009
TRLUH29	VHBA 9123	Bicone Antenna	Schwarzbeck	13/08/2009
TRLUH41	M3004	Multimeter	Avometer	04/03/2011
TRLUH93	CBL6112	Bilog Antenna	Chase	03/06/2009
TRLUH96	6960B	Power Meter	Marconi	11/11/2010
TRLUH100	PL32QMD	Psu	Thandar	Use TRLUH41
TRLUH186	ESVS10	Receiver	R&S	14/12/2010
TRLUH191	CBL611/A	Bilog Antenna	York	08/11/2010
TRLUH195	ESH3-Z5.831.5518.52	Lisn	R&S	01/03/2011
TRLUH228	6920	Power Sensor	Marconi	11/11/2010
TRLUH281	FSU 46	Spectrum Analyser	R&S	10/02/2011
TRLUH287	11708A	Attenuator	Hp	Cal In Use
TRLUH302	8472A	Crystal Detector	Hp	Info Only
TRLUH314	117310	Directional Coupler	Singer	Cal In Use
TRLUH372	6201-69	Pre Amplifier	Watkins Johnson	14/04/2010
TRLUH377	ESU26	Emi Receiver	R&S	11/06/2010
TRLUH387	ATS	Chamber 1	Rainford EMC	26/06/2010
TRLUH388	ATS	Chamber 2	Rainford EMC	23/06/2010
TRLUH396	ENV216	LISN	R&S	14/01/2011
REF 901	2-18A-MFN-06	Attenuator	Bird	Cal In Use
REF902	2-18A-MFN-06	Attenuator	Bird	Cal In Use
REF910	FSU 46	Spectrum Analyser	R&S	27/10/2010
N/A	SH4141	High Pass Filter	BSC	Cal In Use

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.

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 = $10 \log_{10}$ (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.

$$\text{Duty Cycle} = \frac{\text{the sum of the highest average value pulsewidths}}{\text{length of the period}}$$

For the EUT,

Duty Cycle ‘x’ = 8.423 ms / 90.192 ms = 9.33 %

Correction factor = $10 \log_{10} x$ = -10.3 dB

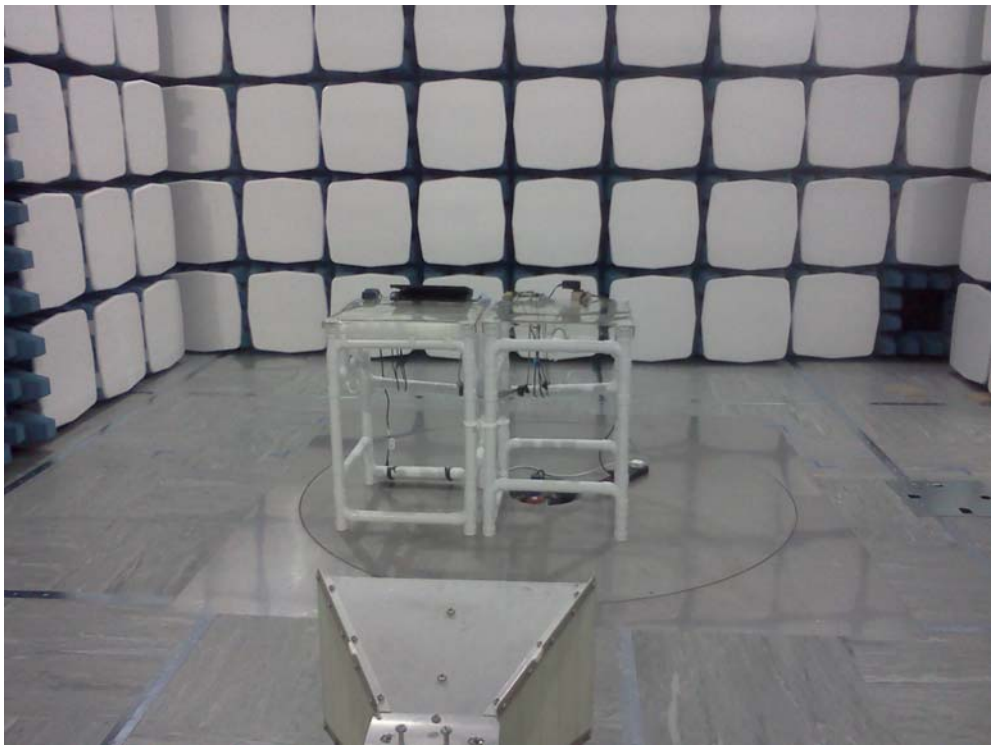
Appendix F: Photographs and Figures

The following photographs were taken of the test samples:

1. Radiated spurious emissions setup (< 1GHz)
2. Radiated spurious emissions setup (> 1GHz)
3. Radiated test setup (Close up)
4. Power line conducted emissions setup

Photograph 1

Photograph 2



Photograph 3

Photograph 4

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