TRaC Radio Test Report	**:** TRA-020107-00-47-00A
Applicant	**:** Telegesis (UK) Ltd
Apparatus	**:** sETRX357-LRS and sETRX357HR-LRS radio modules
Specification(s)	**:** CFR47 Part 15.247 July 2010 & RSS-210, Issue 8
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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:

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1.3 Manufacturer

As above

1.4 Apparatus Assessed

The following apparatus was assessed between: 01/0/14 and 16/04/14

sETRX357-LRS and sETRX357HR-LRS radio modules

Radiated testing was performed using 3 antenna types (chip, quarter-wave and half-wave).
Conducted tests were performed on a sample with a coaxial cable fitted to the antenna terminal.

The sETRX357-LRS consists of:

sETRX357-LRS
sETRX357-LRS8 (identical to sETRX357-LRS with additional 8Mbit flash on board)

The sETRX357-LRS module was selected as worst case by initial measurements.

The sETRX357HR-LRS consists of:

sETRX357HR-LRS (identical to sETRX357-LRS with antenna connector and two ext. antennas)
sETRX357HR-LRS8 (identical to sETRX357HR-LRS with additional 8Mbit flash on board)

The sETRX357HR-LRS module was selected as worst case by initial measurements.

1.5 Test Result Summary

Full details of test results are contained within Appendices 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.

Test Type	Regulations		Measurement standard	Result
Radiated spurious emissions (Restricted bands)	RSS-210 Issue 8 December 2010 Annex 8, A8.5	Title 47 of the CFR: Part 15 Subpart C; 15.247	ANSI C63.10:2009	Pass
Conducted spurious emissions (Non-restricted bands)	RSS-210 Issue 8 December 2010 Annex 8.A4(4	Title 47 of the CFR: Part 15 Subpart C; 15.247	ANSI C63.10:2009	Pass
AC Power conducted emissions	RSS-GEN Issue 3 December 2010 Annex 7, 7.2.4	Title 47 of the CFR: Part 15 Subpart C; 15.207	ANSI C63.10:2009	N/A
Occupied Bandwidth	RSS-210 Issue 8 December 2010 Annex 8.A8.2a	Title 47 of the CFR : Part 15 Subpart C; 15.247(a)(2)	ANSI C63.10:2009	Pass
Conducted Carrier Power	RSS-210 Issue 8 December 2010 Annex 8.A4(4).	Title 47 of the CFR : Part 15 Subpart C; 15.247(b)	ANSI C63.10:2009	Pass
Power Spectral Density	RSS-210 Issue 8 December 2010 Annex 8.A8.2b	Title 47 of the CFR : Part 15 Subpart C; 15.247(d)	ANSI C63.10:2009	Pass
Unintentional Radiated Spurious Emissions	RSS-GEN Issue 3 December 2010 7.2.2(c)	Title 47 of the CFR: Part 15 Subpart B; 15.109	ANSI C63.10:2009	Pass
RF Safety	RSS-102	Title 47 of the CFR : Part 15 Subpart C; 15.247(b)(5)	-	Pass

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 Measurement Uncertainty Values

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

Radio Testing – General Uncertainty Schedule

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

[1] Adjacent Channel Power

Uncertainty in test result = **1.86dB**

[2] Carrier Power

Uncertainty in test result (Power Meter) = **1.08dB**
Uncertainty in test result (Spectrum Analyser) = **2.48dB**

[3] Effective Radiated Power

Uncertainty in test result = **4.71dB**

[4] Spurious Emissions

Uncertainty in test result = **4.75dB**

[5] Maximum frequency error

Uncertainty in test result (Frequency Counter) = **0.113ppm**
Uncertainty in test result (Spectrum Analyser) = **0.265ppm**

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

Uncertainty in test result (14kHz – 30MHz) = **4.8dB**,
Uncertainty in test result (30MHz – 1GHz) = **4.6dB**,
Uncertainty in test result (1GHz – 18GHz) = **4.7dB**

[7] Frequency deviation

Uncertainty in test result = **3.2%**

[8] Magnetic Field Emissions

Uncertainty in test result = **2.3dB**

[9] Conducted Spurious

Uncertainty in test result – Up to 8.1GHz = **3.31dB**
Uncertainty in test result – 8.1GHz – 15.3GHz = **4.43dB**
Uncertainty in test result – 15.3GHz – 21GHz = **5.34dB**
Uncertainty in test result – Up to 26GHz = **3.14dB**

[10] Channel Bandwidth

Uncertainty in test result = **15.5%**

[11] Amplitude and Time Measurement – Oscilloscope

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

[12] Power Line Conduction

Uncertainty in test result = **3.4dB**

[13] Spectrum Mask Measurements

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

[14] Adjacent Sub Band Selectivity

Uncertainty in test result = **1.24dB**

[15] Receiver Blocking – Listen Mode, Radiated

Uncertainty in test result = **3.42dB**

[16] Receiver Blocking – Talk Mode, Radiated

Uncertainty in test result = **3.36dB**

[17] Receiver Blocking – Talk Mode, Conducted

Uncertainty in test result = **1.24dB**

[18] Receiver Threshold

Uncertainty in test result = **3.23dB**

[19] Transmission Time Measurement

Uncertainty in test result = **7.98%**

Section 3: **Modifications**

3.1 Modifications Performed During Assessment

No modifications were performed during the assessment

Appendix A: Test Results

Abbreviations used in the tables in this appendix:

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

A1 6 dB Bandwidth

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

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

Test Details:	
Regulation	Part 15 Subpart (c) 15.247(a)(2), RSS-210 Annex 8.A8.2a
EUT sample number	S09
Modification state	0
SE in test environment	S02
SE isolated from EUT	TRaC Laptop
EUT set up	Refer to Appendix C

Antenna Port

Channel Frequency (MHz)	Transmit Power Setting (dBm)	Measured 6 dB Bandwidth (MHz)	Limit (kHz)	Result
2405	-7	1.619	>500	Pass
2445	-7	1.587	>500	Pass
2470	-7	1.619	>500	Pass
2475	-8	1.635	>500	Pass
2480	-26	1.619	>500	Pass

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

A2 Transmitter Peak Output Power

Carrier power was verified with the EUT transmitting on its lowest, centre and highest carrier frequency in turn.

Test Details:	
Regulation	Part15 Subpart (c) 15.247(b)(3), RSS-210 Annex 8.A4(4)
Measurement standard	ANSI C63.10
EUT sample number	S09
Modification state	0
SE in test environment	S02
SE isolated from EUT	TRaC Laptop
EUT set up	Refer to Appendix C

Chip Antenna:

Channel Frequency (MHz)	Peak Carrier Power (W)	Antenna Gain dBi	Radiated Power (W) (EIRP)	Limit (W)	Result
2405	0.03917	2.1	0.06353	1.0000	Pass
2445	0.05035	2.1	0.08166	1.0000	Pass
2470	0.05000	2.1	0.08110	1.0000	Pass
2475	0.04027	2.1	0.06531	1.0000	Pass
2480	0.00064	2.1	0.00104	1.0000	Pass

Quarter-wave Antenna:

Channel Frequency (MHz)	Peak Carrier Power (W)	Antenna Gain dBi	Radiated Power (W) (EIRP)	Limit (W)	Result
2405	0.03917	0	0.03917	1.0000	Pass
2445	0.05035	0	0.05035	1.0000	Pass
2470	0.05000	0	0.05000	1.0000	Pass
2475	0.04027	0	0.04027	1.0000	Pass
2480	0.00064	0	0.00064	1.0000	Pass

Half-wave Antenna:

Channel Frequency (MHz)	Peak Carrier Power (W)	Antenna Gain dBi	Radiated Power (W) (EIRP)	Limit (W)	Result
2405	0.03917	2.0	0.06209	1.0000	Pass
2445	0.05035	2.0	0.07980	1.0000	Pass
2470	0.05000	2.0	0.07925	1.0000	Pass
2475	0.04027	2.0	0.06383	1.0000	Pass
2480	0.00064	2.0	0.00101	1.0000	Pass

Notes:

Conducted Measurement

Measured Peak Carrier power includes the gain of each of the antennas. Highest Gain of any antenna to be used = 2.1 dBi. Conducted measurements were performed with a direct cable connection to the antenna port on the board. An EUT power setting of -7dBm was used except for the 2475MHz and 2480MHz channels, where -8dBm and -26dBm power settings were used respectively.

A3 Transmitter Power Spectral Density

Transmitter Power Spectral Density was verified with the EUT transmitting on its lowest, centre and highest carrier frequency in turn.

Test Details:	
Regulation	Part15 Subpart (c) 15.247(b)(3), RSS-210 Annex 8.A8.2b
Measurement standard	ANSI C63.10
EUT sample number	S09
Modification state	0
SE in test environment	S02
SE isolated from EUT	TRaC Laptop
EUT set up	Refer to Appendix C

Antenna Port:

Channel Frequency (MHz)	Transmit Power Setting (dBm)	Peak Power Spectral Density (dBm/3kHz)	Limit (dBm/3kHz)	Result
2405	-7	0.84	8.0	Pass
2445	-7	1.80	8.0	Pass
2470	-7	1.78	8.0	Pass
2475	-8	1.06	8.0	Pass
2480	-26	-16.53	8.0	Pass

Notes:

Conducted Measurement

Measured Power Spectral Density includes highest gain of any antenna to be used. Highest Gain of any antenna to be used = 2.1 dBi. Conducted measurements were performed with a direct cable connection to the EUT antenna port. The resolution bandwidth on the analyser was set to 3kHz and trace set to max hold. The span was set to 2.5 MHz.

A4 RF Antenna Conducted Spurious Emissions

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

Test Details: 2405MHz	
Regulation	Part 15 Subpart (c) Clause 15.247(d), RSS-210 Annex 8.A8.5
Measurement standard	ANSI C63.10
Frequency range	9 kHz to 25 GHz
EUT sample number	S09
Modification state	0
SE in test environment	S02
SE isolated from EUT	TRaC Laptop
EUT set up	Refer to Appendix C

No emissions were detected within 20 dB of the test limit from the antenna port.

Test Details: 2445MHz	
Regulation	Part 15 Subpart (c) Clause 15.247(d), RSS-210 Annex 8.A8.5
Measurement standard	ANSI C63.10
Frequency range	9 kHz to 25 GHz
EUT sample number	S09
Modification state	0
SE in test environment	S02
SE isolated from EUT	TRaC Laptop
EUT set up	Refer to Appendix C

No emissions were detected within 20 dB of the test limit from either antenna port.

RF Antenna Conducted Spurious Emissions continued:

Test Details: 2480MHz	
Regulation	Part 15 Subpart (c) Clause 15.247(d), RSS-210 Annex 8.A8.5
Measurement standard	ANSI C63.10
Frequency range	9 kHz to 25 GHz
EUT sample number	S09
Modification state	0
SE in test environment	S02
SE isolated from EUT	TRaC Laptop
EUT set up	Refer to Appendix C

No emissions were detected within 20 dB of the test limit from either antenna port.

Notes:

The conducted emission limit for emissions are based on a transmitted carrier level of 15.247(b) / Annex 8, A8.4(2). 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) and Annex 8, A8.5 using a peak detector.
The RBW = 100 kHz, Video bandwidth (VBW) > RBW and the radio spectrum was investigated up to the 10th harmonic in accordance15.33 (a)(1) and RSS-GEN 4.9.
The measurements at 2400 MHz and 2483.5 MHz were made to ensure band edge compliance.
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) and Annex 8, A8.5:

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

Where:

The maximum peak conducted power was measured using a spectrum analyser using a 100kHz resolution bandwidth.

Antenna Port:

Channel No.	Channel Frequency (MHz)	Measured Peak Carrier in 100kHz RBW (dBm)	Measured Peak Carrier –20dB (dBm)	Emission Limit In a 100 kHz RBW (dBm)
11	2405	12.22	-7.78	-7.78
19	2445	13.34	-6.66	-6.66
26	2480	-5.55	-25.55	-25.55

A5 Antenna Gain

The maximum antenna gain for the antenna type to be used with the EUT, as declared by the client, is 2.1 dBi Peak gain for the chip antenna.

For reference the Peak Gains of the other antenna types are 0 dBi for the Quarter-wave antenna and 2.0 dBi for the Half-wave antenna.

A6 Radiated Electric Field Emissions

Preliminary scans were performed using a peak detector with the RBW = 100kHz. The radiated electric field 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 and RSS – 210 Annex 8, A8.5. The EUT was set to transmit on its lowest, centre and highest carrier frequency.

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

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

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

Test Details:	
Regulation	Part 15 Subpart (c) Clause 15.247(d), RSS – 210 Annex 8, A8.5
Measurement standard	ANSI C63.10
Frequency range	30MHz to 25 GHz
EUT sample number	S07 (Chip Antenna) S09 with S05 (Quarter-wave Antenna) S09 with S01 (Half-wave Antenna)
Modification state	0
SE in test environment	S02
SE isolated from EUT	None
EUT set up	Refer to Appendix C

Initial preview results were obtained with all module types, the sETRX357-LRS and sETRX357HR-LRS modules were selected as the worst case and all remaining tests were carried out on these modules alone.

The worst case radiated emission measurements for spurious emissions:

Chip Antenna, Channel 11:

Ref No.	FREQ. (MHz)	DETECTOR	FIELD ST'GH (dBµV/m)	Duty Cycle Fact (dB)	FIELD ST'GH (dBµV/m)	LIMIT (dBµV/m)
1.	4810.865	Pk	57.74	0	57.74	74
2.	4810.865	Av	50.09	0	50.09	54
3.	7216.396	Pk	53.72	0	53.72	74
4.	7216.396	Av	40.96	0	40.96	54

Chip Antenna, Channel 19:

Ref No.	FREQ. (MHz)	DETECTOR	FIELD ST'GH (dBµV/m)	Duty Cycle Fact (dB)	FIELD ST'GH (dBµV/m)	LIMIT (dBµV/m)
5.	4888.974	Pk	60.14	0	60.14	74
6.	4888.974	Av	52.80	0	52.80	54
7.	7336.06	Pk	57.14	0	57.14	74
8.	7336.06	Av	46.60	0	46.60	54

Chip Antenna, Channel 24:

Ref No.	FREQ. (MHz)	DETECTOR	FIELD ST'GH (dBµV/m)	Duty Cycle Fact (dB)	FIELD ST'GH (dBµV/m)	LIMIT (dBµV/m)
9.	4938.958	Pk	59.95	0	59.95	74
10.	4938.958	Av	52.68	0	52.68	54
11.	7408.445	Pk	57.94	0	57.94	74
12.	7408.445	Av	48.47	0	48.47	54

Chip Antenna, Channel 25:

Ref No.	FREQ. (MHz)	DETECTOR	FIELD ST'GH (dBµV/m)	Duty Cycle Fact (dB)	FIELD ST'GH (dBµV/m)	LIMIT (dBµV/m)
13.	4949.001	Pk	59.42	0	59.42	74
14.	4949.001	Av	52.29	0	52.29	54
15.	7423.564	Pk	59.29	0	59.29	74
16.	7423.564	Av	50.29	0	50.29	54

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

Quarter-wave Antenna, Channel 11:

Ref No.	FREQ. (MHz)	DETECTOR	FIELD ST'GH (dBµV/m)	Duty Cycle Fact (dB)	FIELD ST'GH (dBµV/m)	LIMIT (dBµV/m)
17.	4808.99	Pk	55.44	0	55.44	74
18.	4808.99	Av	46.82	0	46.82	54
19.	7213.51	Pk	53.54	0	53.54	74
20.	7213.51	Av	41.47	0	41.47	54

Quarter-wave Antenna, Channel 19:

Ref No.	FREQ. (MHz)	DETECTOR	FIELD ST'GH (dBµV/m)	Duty Cycle Fact (dB)	FIELD ST'GH (dBµV/m)	LIMIT (dBµV/m)
21.	4888.913	Pk	57.28	0	57.28	74
22.	4888.913	Av	48.81	0	48.81	54
23.	7336.638	Pk	59.14	0	59.14	74
24.	7336.638	Av	48.81	0	48.81	54

Quarter-wave Antenna, Channel 24:

Ref No.	FREQ. (MHz)	DETECTOR	FIELD ST'GH (dBµV/m)	Duty Cycle Fact (dB)	FIELD ST'GH (dBµV/m)	LIMIT (dBµV/m)
25.	4940.949	Pk	57.56	0	57.56	74
26.	4940.949	Av	50.21	0	50.21	54
27.	7411.334	Pk	61.94	0	61.94	74
28.	7411.334	Av	53.91	0	53.91	54

Quarter-wave Antenna, Channel 25:

Ref No.	FREQ. (MHz)	DETECTOR	FIELD ST'GH (dBµV/m)	Duty Cycle Fact (dB)	FIELD ST'GH (dBµV/m)	LIMIT (dBµV/m)
29.	4948.99	Pk	59.25	0	59.25	74
30.	4948.99	Av	51.59	0	51.59	54
31.	7423.46	Pk	60.01	0	60.01	74
32.	7423.46	Av	50.97	0	50.97	54

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

Half-wave Antenna, Channel 11:

Ref No.	FREQ. (MHz)	DETECTOR	FIELD ST'GH (dBµV/m)	Duty Cycle Fact (dB)	FIELD ST'GH (dBµV/m)	LIMIT (dBµV/m)
33.	4808.974	Pk	55.13	0	55.13	74
34.	4808.974	Av	46.44	0	46.44	54
35.	7216.513	Pk	53.43	0	53.43	74
36.	7216.513	Av	40.09	0	40.09	54

Half-wave Antenna, Channel 19:

Ref No.	FREQ. (MHz)	DETECTOR	FIELD ST'GH (dBµV/m)	Duty Cycle Fact (dB)	FIELD ST'GH (dBµV/m)	LIMIT (dBµV/m)
37.	4890.917	Pk	57.64	0	57.64	74
38.	4890.917	Av	49.84	0	49.84	54
39.	7336.641	Pk	58.46	0	58.46	74
40.	7336.641	Av	48.71	0	48.71	54

Half-wave Antenna, Channel 24:

Ref No.	FREQ. (MHz)	DETECTOR	FIELD ST'GH (dBµV/m)	Duty Cycle Fact (dB)	FIELD ST'GH (dBµV/m)	LIMIT (dBµV/m)
41.	4940.981	Pk	59.07	0	59.07	74
42.	4940.981	Av	51.43	0	51.43	54
43.	7411.561	Pk	61.03	0	61.03	74
44.	7411.561	Av	52.51	0	52.51	54

Half-wave Antenna, Channel 25:

Ref No.	FREQ. (MHz)	DETECTOR	FIELD ST'GH (dBµV/m)	Duty Cycle Fact (dB)	FIELD ST'GH (dBµV/m)	LIMIT (dBµV/m)
45.	4949.006	Pk	60.19	0	60.19	74
46.	4949.006	Av	52.85	0	52.85	54
47.	7423.529	Pk	61.24	0	61.24	74
48.	7423.529	Av	52.29	0	52.29	54

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

Notes:

1 Any testing performed below 30 MHz was performed using a magnetic loop antenna in accordance with ANSI C63.10: section 4.5, Table 1

2 In accordance with 15.35(b), above 1 GHz, emissions measured using a peak detector shall not exceed a level 20 dB above the average limit.

3 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= 100 kHz, testing was performed with CISPR16 compliant test receiver with QP detector. Above 1 GHz tests were performed using a spectrum analyser using the following settings:

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

These settings as per ANSI C63.10

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

Radiated emission limits (CFR 47 Part 15: 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 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

A7 Unintentional Radiated Spurious Emissions

Preliminary scans were performed using a peak detector with the RBW = 100kHz. The radiated electric field 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 15.109 and in RSS- GEN Section 7.2.3. The EUT was set to transmit on its lowest, centre and highest carrier frequency.

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

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

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

Test Details:	
Regulation	Part 15 Subpart (b) Clause 15.109, RSS – GEN Section 7.2.3
Measurement standard	ANSI C63.10
Frequency range	30MHz to 25 GHz
EUT sample number	S07 (Chip Antenna) S09 with S05 (Quarter-wave Antenna) S09 with S01 (Half-wave Antenna)
Modification state	0
SE in test environment	S02
SE isolated from EUT	None
EUT set up	Refer to Appendix C

The worst case radiated emission measurements for spurious emissions:

Ref No.	FREQ. (MHz)	DETECTOR	FIELD ST'GH (dBµV/m)	Duty Cycle Fact (dB)	FIELD ST'GH (dBµV/m)	LIMIT (dBµV/m)
1.	48.000	Qp	24.4	0	24.4	40.00
2.	52.100	Qp	21.7	0	21.7	40.00
3.	52.250	Qp	20.5	0	20.5	40.00
4.	52.600	Qp	23.8	0	23.8	40.00
5.	96.000	Qp	28.8	0	28.8	43.50

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

Notes:

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

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

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

Radiated emission limits 47 CFR Part 15: Clause 15.109 and RSS – GEN Section 7.2.3 for all emissions:

Frequency of emission (MHz)	Field strength μV/m	Measurement Distance m	Field strength dBμV/m
30-88	100	3	40.0
88-216	150	3	43.5
216-960	200	3	46.0
Above 960	500	3	54.0

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:

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

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

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

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

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

Appendix B: **Supporting Graphical Data**

This appendix contains graphical data obtained during testing.

Notes:

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

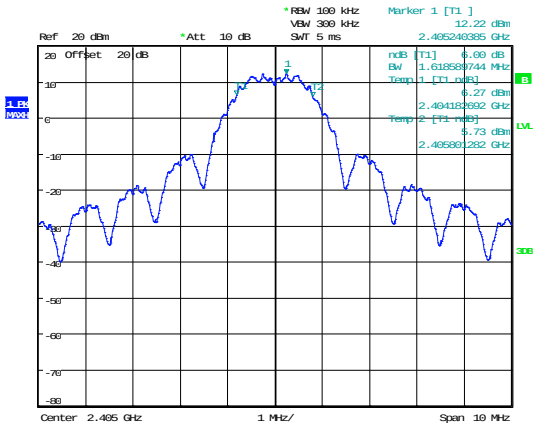
(b) The time and date on the plots do not necessarily equate to the time of the test.

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

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

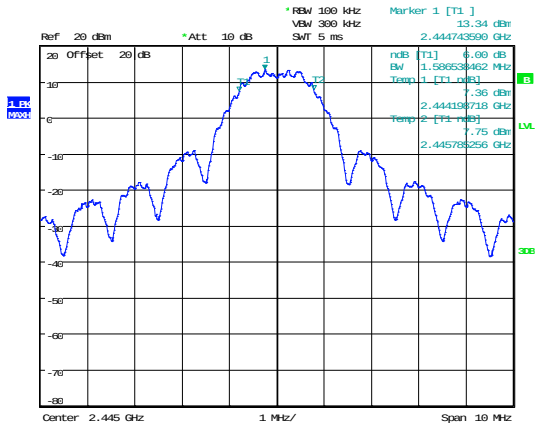
(e) The plots presented in this appendix may not be a complete record of the measurements performed, but are a representative sample, relative to the final assessment.

6dB Bandwidth



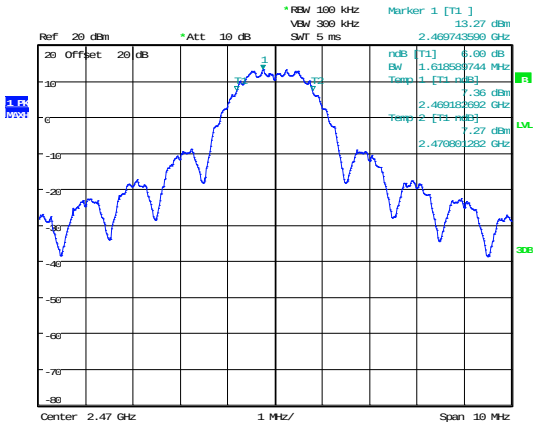
Date: 16.APR.2014 11:24:47

6dB Bandwidth (-7dBm) 2405 MHz



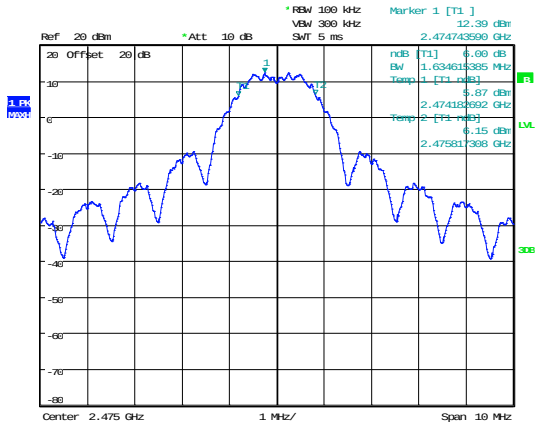
Date: 16.APR.2014 11:26:50

6dB Bandwidth (-7dBm) 2445 MHz



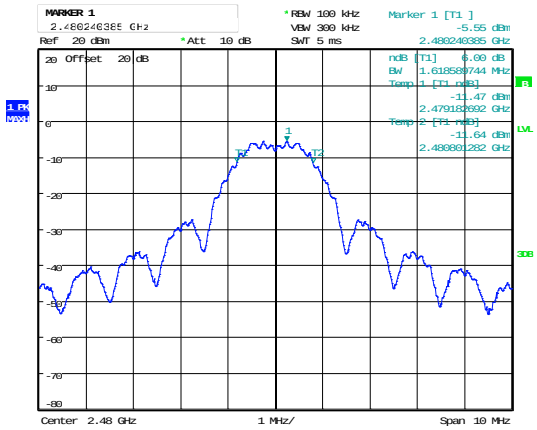
Date: 16.APR.2014 11:28:41

6dB Bandwidth (-7dBm) 2470 MHz



Date: 16.APR.2014 11:33:51

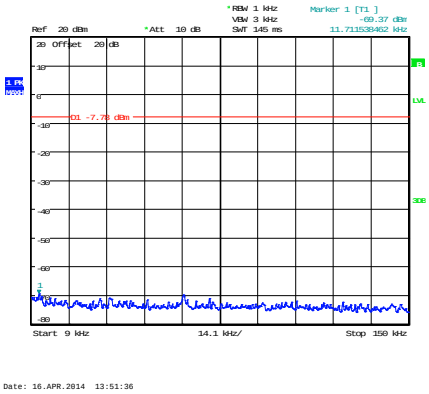
6dB Bandwidth (-8dBm) 2475 MHz



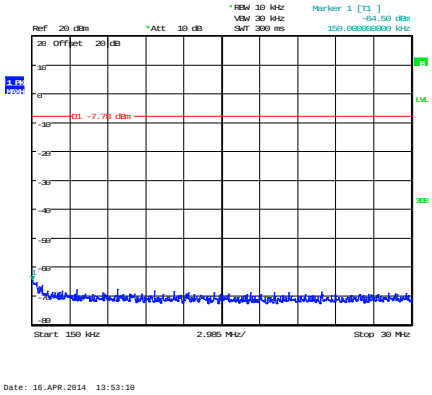
Date: 16.APR.2014 11:37:19

6dB Bandwidth (-26dBm) 2480 MHz

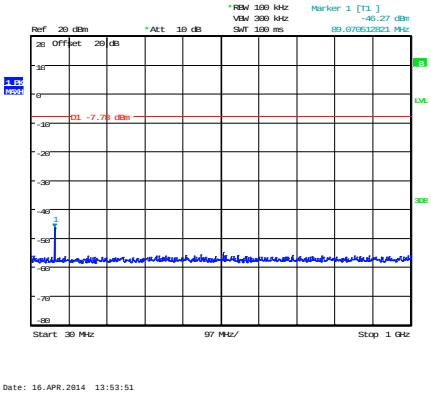
Conducted Spurious Emissions – 2405MHz



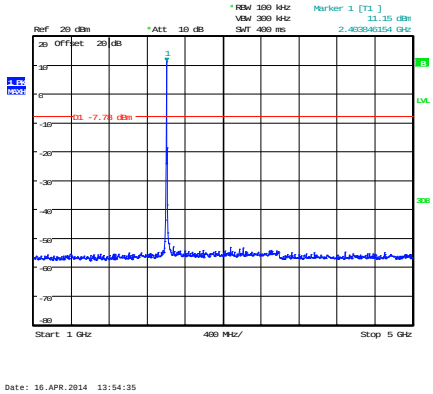
9kHz to 150 kHz



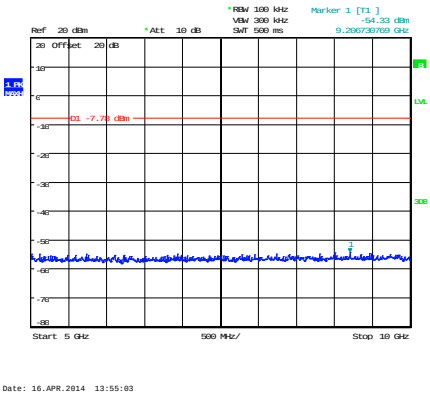
150 kHz to 30 MHz



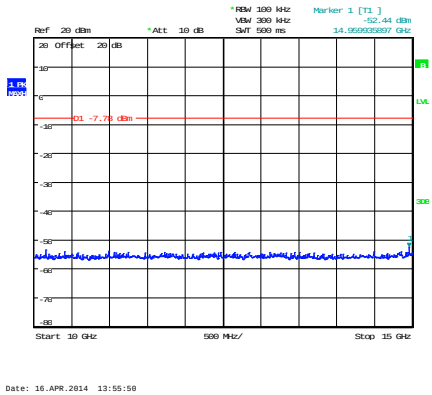
30 MHz to 1 GHz



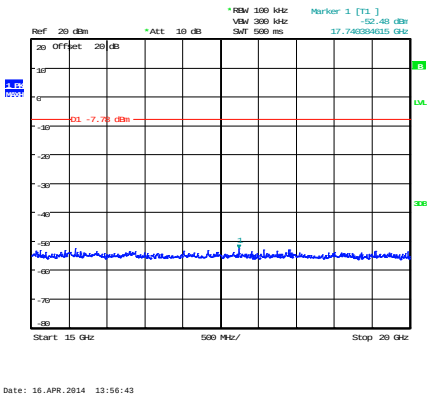
1 GHz to 5 GHz



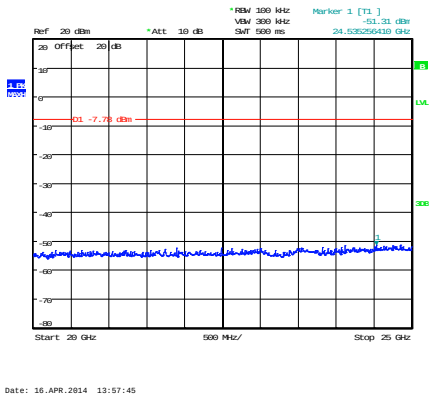
5 GHz to 10 GHz



10 GHz to 15 GHz

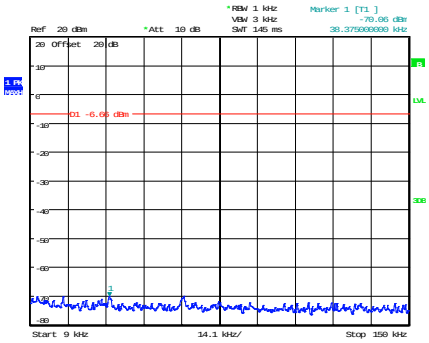


15 GHz to 20 GHz



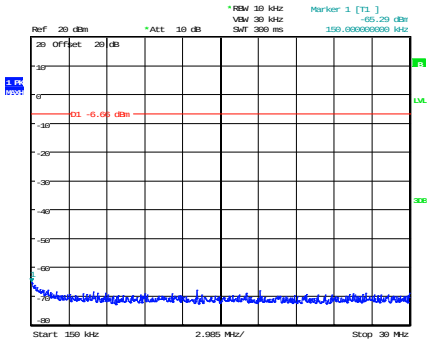
20 GHz to 25 GHz

Conducted Spurious Emissions – 2445MHz



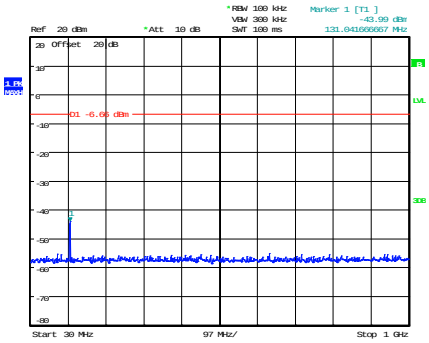
Date: 16.APR.2014 14:02:52

9kHz to 150 kHz



Date: 16.APR.2014 14:03:42

150 kHz to 30 MHz



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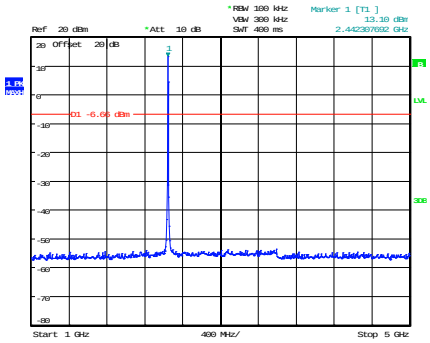
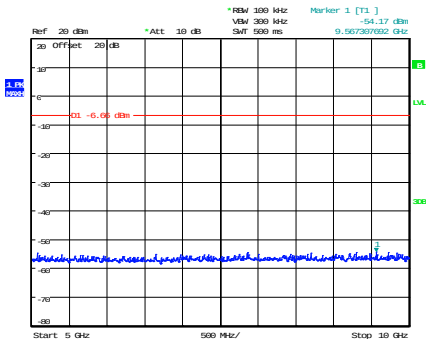
30 MHz to 1 GHz



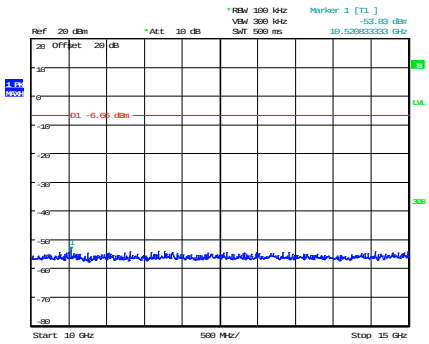
Date: 16.APR.2014 14:06:05

1 GHz to 5 GHz



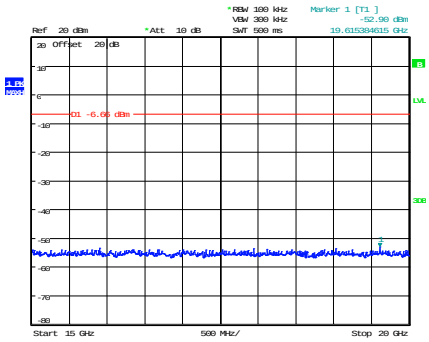
Date: 16.APR.2014 14:06:29

5 GHz to 10 GHz



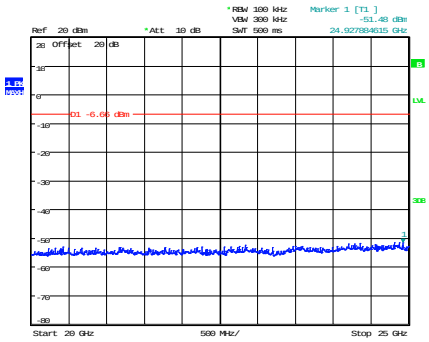
Date: 16.APR.2014 14:06:58

10 GHz to 15 GHz



Date: 16.APR.2014 14:07:27

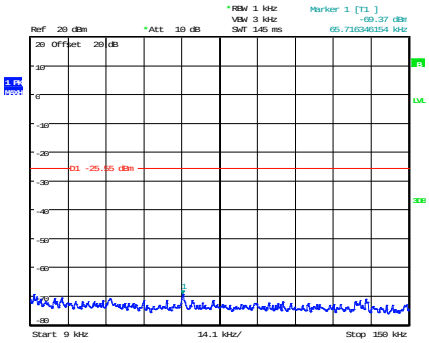
15 GHz to 20 GHz



Date: 16.APR.2014 14:08:00

20 GHz to 25 GHz

Conducted Spurious Emissions – 2480MHz



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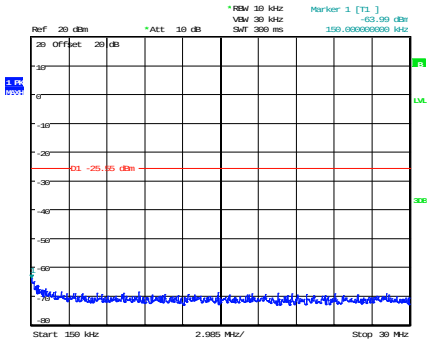
9kHz to 150 kHz



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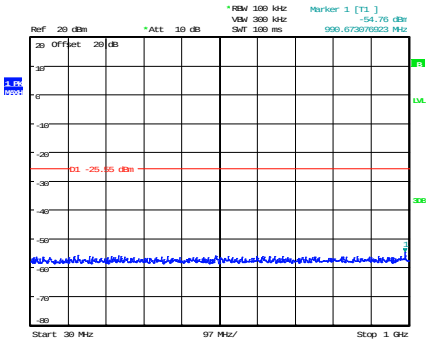
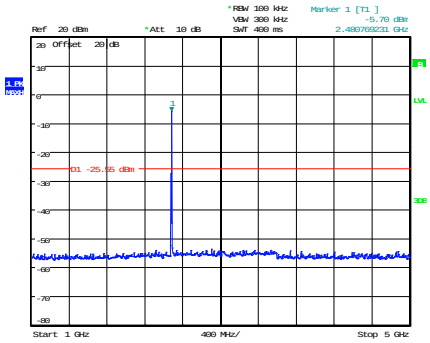
150 kHz to 30 MHz



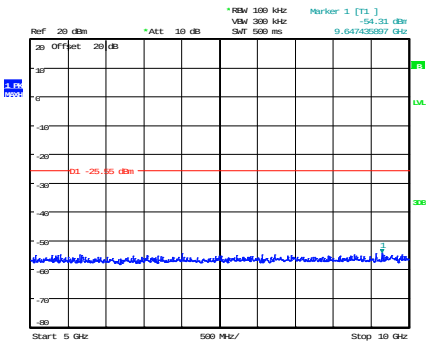
Date: 16.APR.2014 14:21:17

30 MHz to 1 GHz



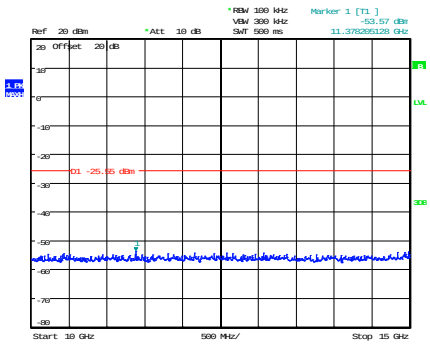
Date: 16.APR.2014 14:15:26

1 GHz to 5 GHz



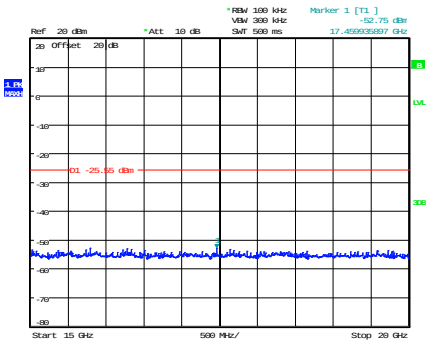
Date: 16.APR.2014 14:15:56

5 GHz to 10 GHz



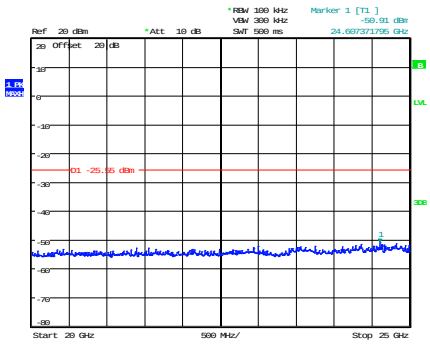
Date: 16.APR.2014 14:16:20

10 GHz to 15 GHz



Date: 16.APR.2014 14:16:55

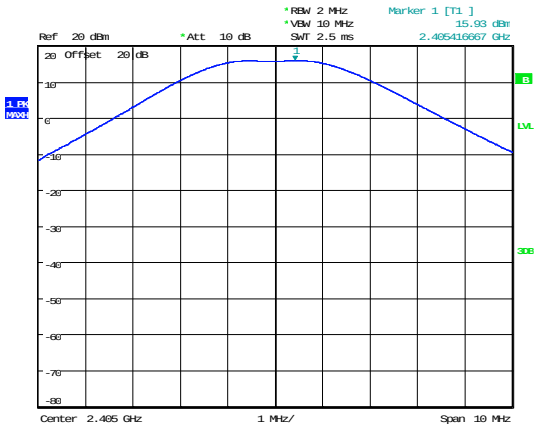
15 GHz to 20 GHz



Date: 16.APR.2014 14:17:52

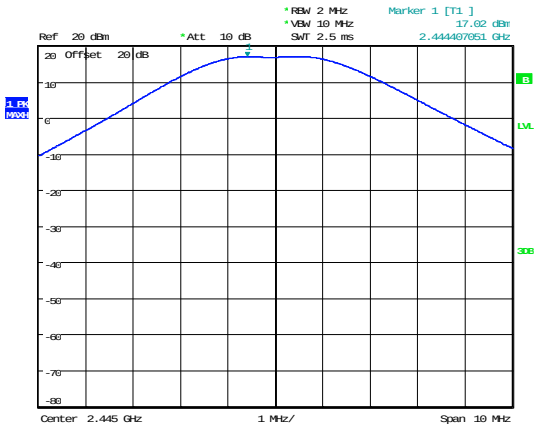
20 GHz to 25 GHz

Conducted carrier power



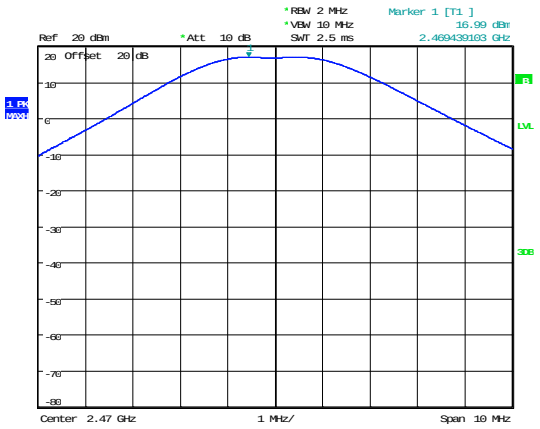
Date: 16.APR.2014 11:58:09

Conducted carrier power (-7dBm) 2405 MHz



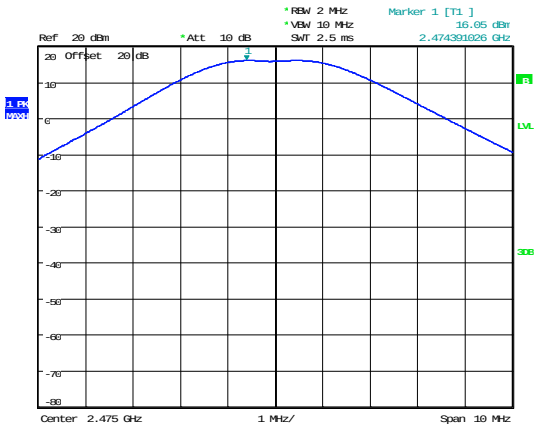
Date: 16.APR.2014 11:59:08

Conducted carrier power (-7dBm) 2445 MHz



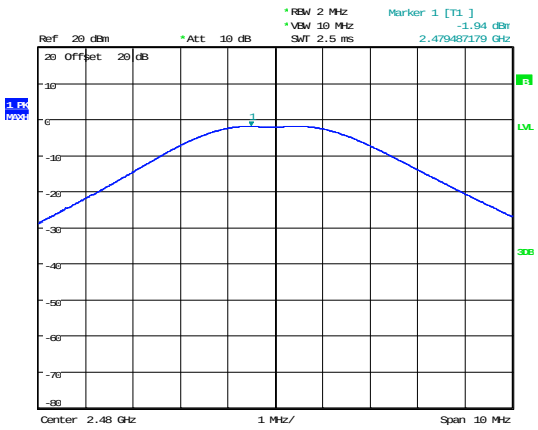
Date: 16.APR.2014 11:59:58

Conducted carrier power (-7dBm) 2405 MHz



Date: 16.APR.2014 12:01:10

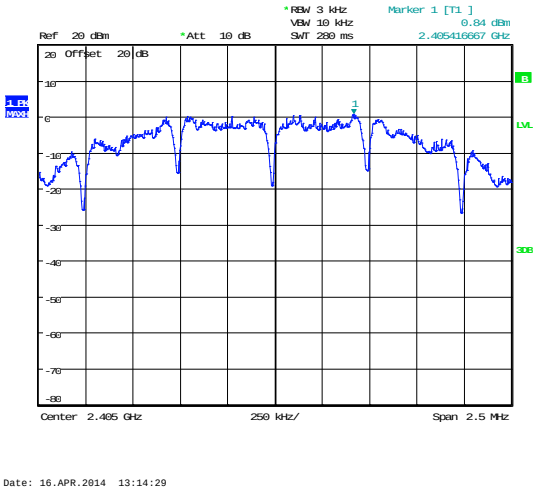
Conducted carrier power (-8dBm) 2445 MHz



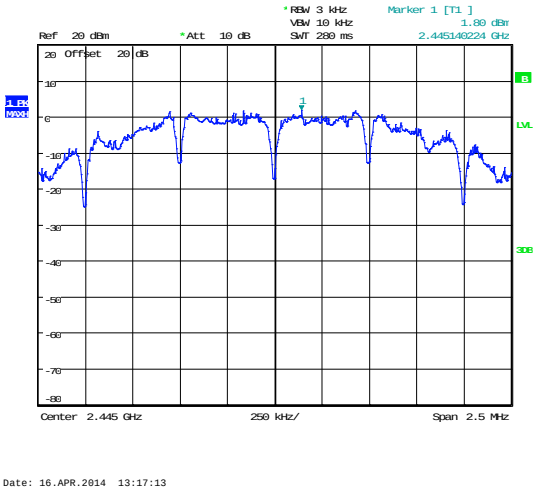
Date: 16.APR.2014 11:56:55

Conducted carrier power (-26dBm) 2445 MHz

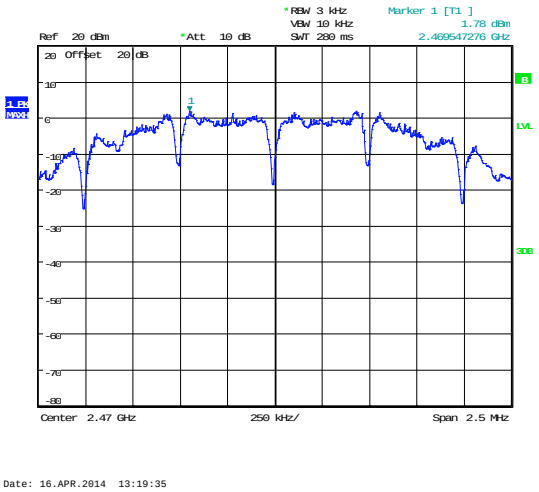
Conducted Power Spectral Density



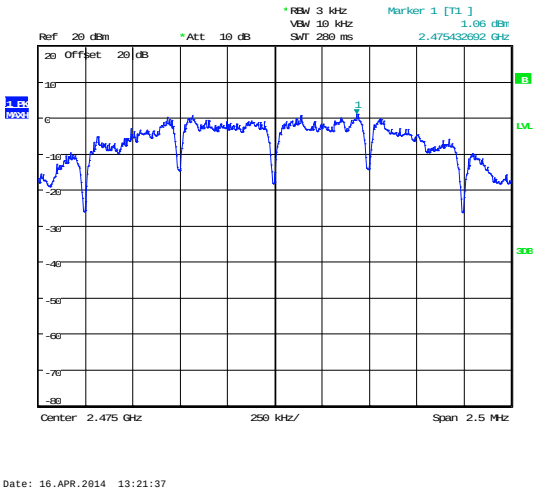
power spectral density (-7dBm) 2405 MHz



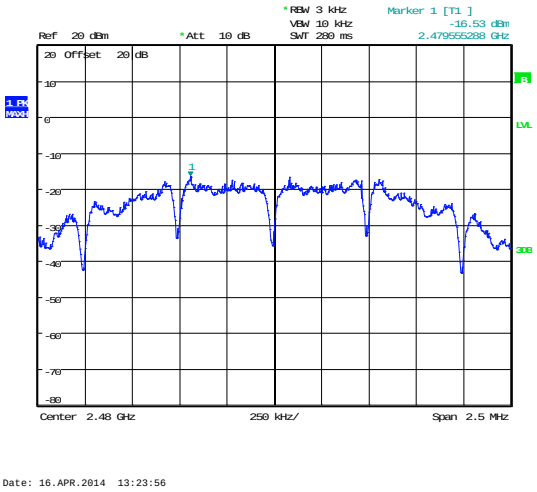
power spectral density (-7dBm) 2445 MHz



power spectral density (-7dBm) 2470 MHz

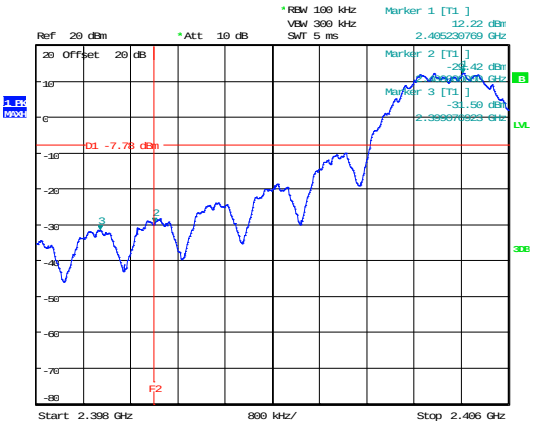


power spectral density (-8dBm) 2475 MHz



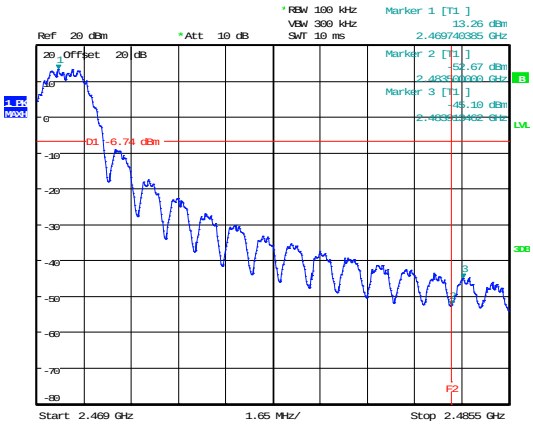
power spectral density (-26dBm) 2480 MHz

Conducted Band Edge Compliance



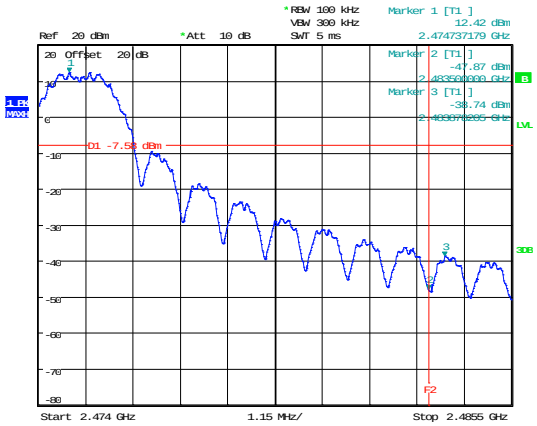
Date: 16.APR.2014 14:52:52

Lower Band Edge (-7dBm) – 2405 MHz



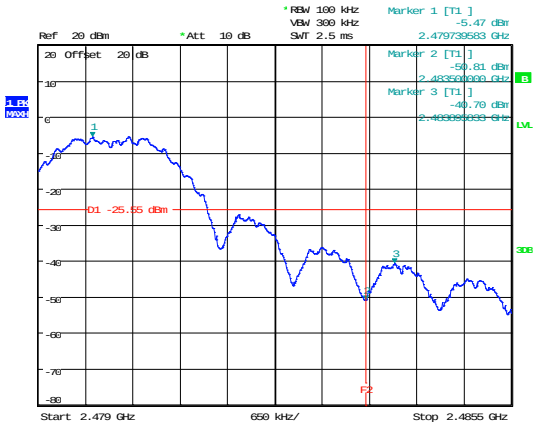
Date: 16.APR.2014 14:49:24

Upper Band Edge (-7dBm) – 2470 MHz



Date: 16.APR.2014 14:47:14

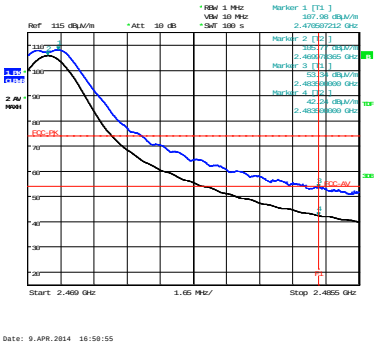
Upper Band Edge (-8dBm) – 2475 MHz



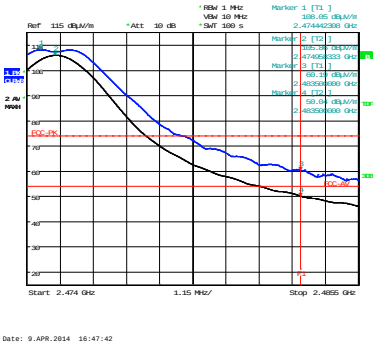
Date: 16.APR.2014 14:43:43

Upper Band Edge (-26dBm) – 2480 MHz

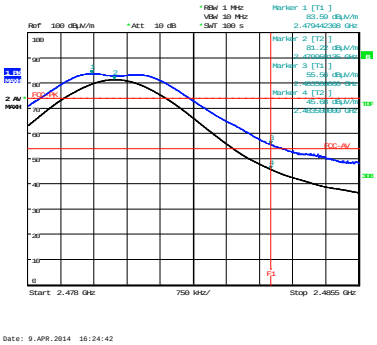
Radiated Band Edge - Chip Antenna



2470 MHz (-7dBm)

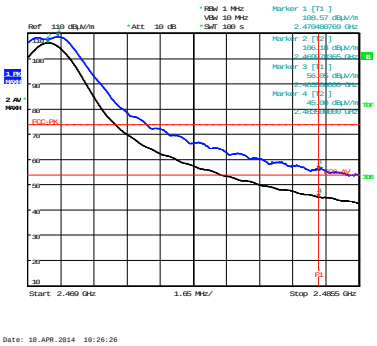


2475 MHz (-7dBm)

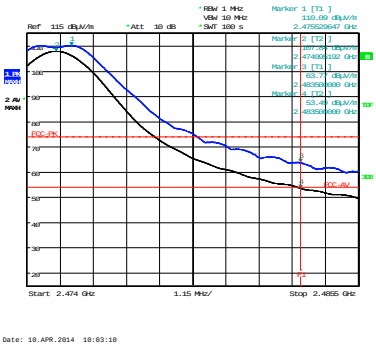


2480 MHz (-26dBm)

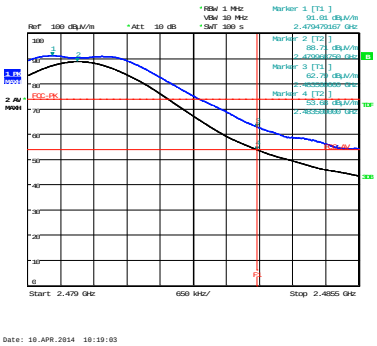
Radiated Band Edge – Quarter Wave Antenna



2470 MHz (-8dBm)

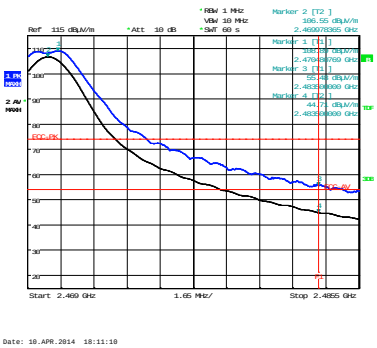


2475 MHz (-8dBm)

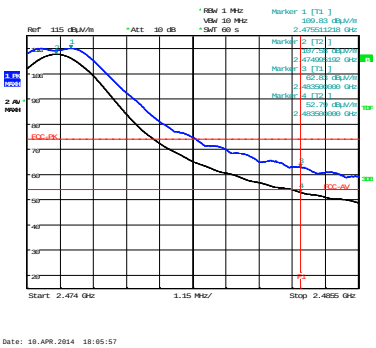


2480 MHz (-26dBm)

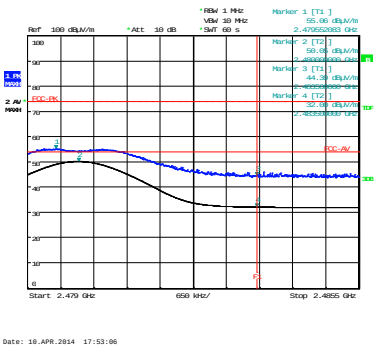
Radiated Band Edge – Half Wave Antenna



2470 MHz (-9dBm)

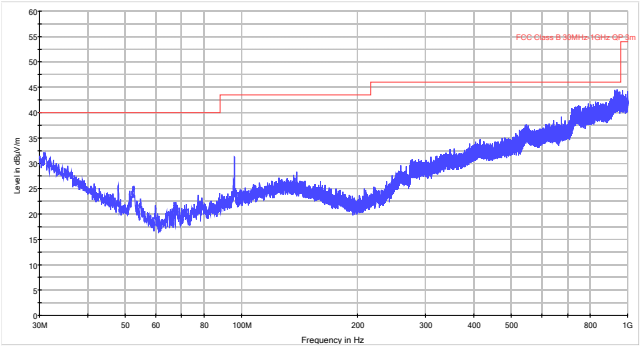


2475 MHz (-9dBm)

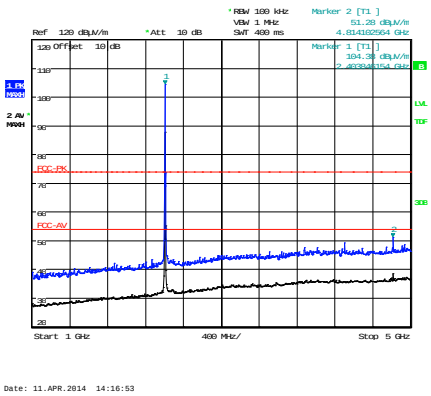


2480 MHz (-43dBm)

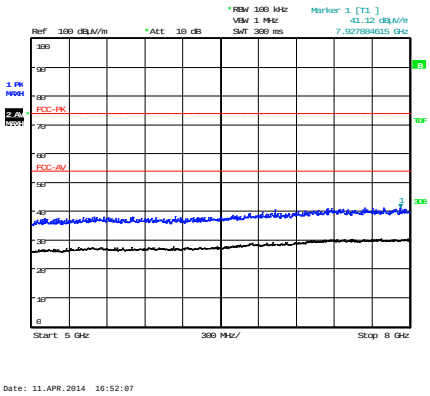
Radiated Transmitter Emissions 2405MHz - Chip Antenna



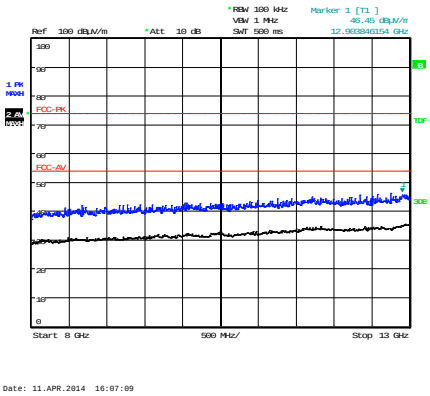
30MHz -1GHz



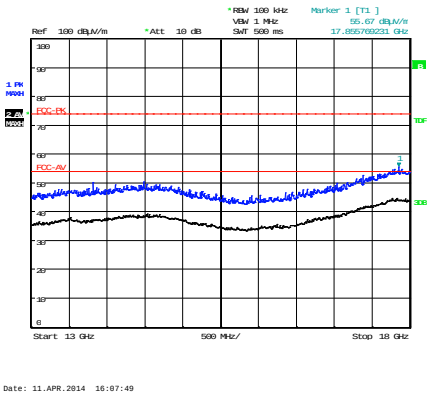
1GHz - 5GHz



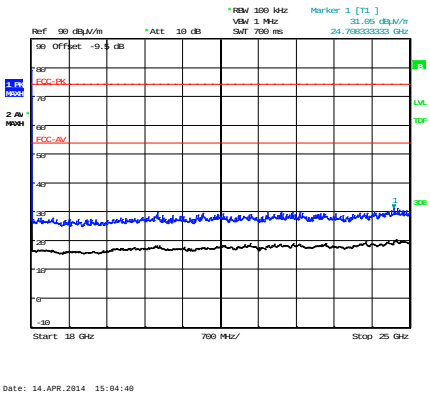
5GHz - 8GHz



8GHz - 13GHz

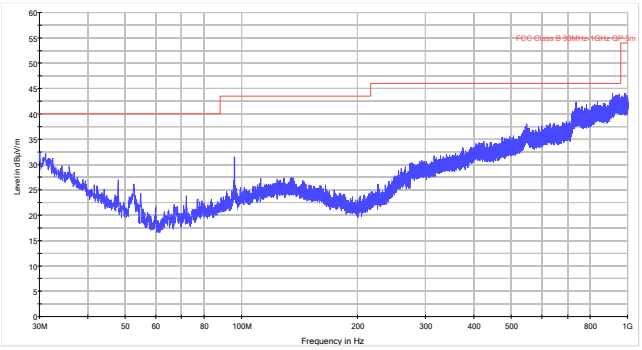


13GHz - 18GHz

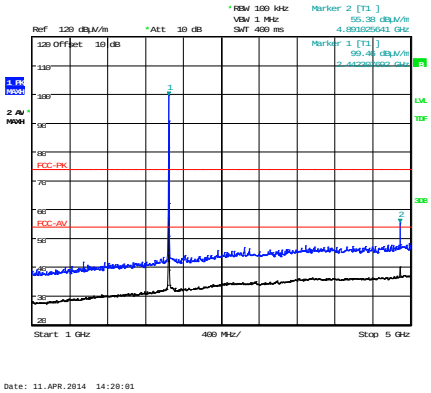


18GHz – 25GHz

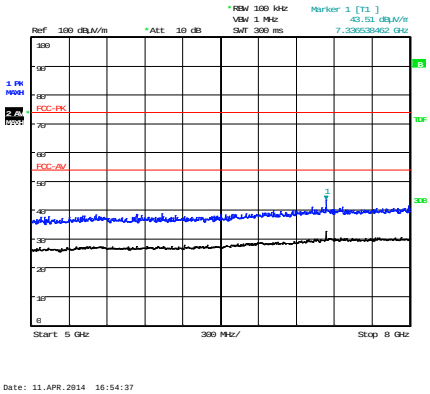
Radiated Transmitter Emissions 2445MHz - Chip Antenna



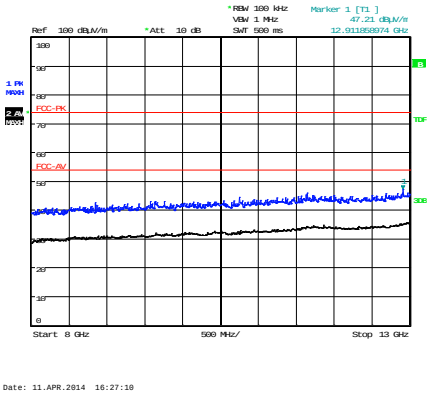
30MHz -1GHz



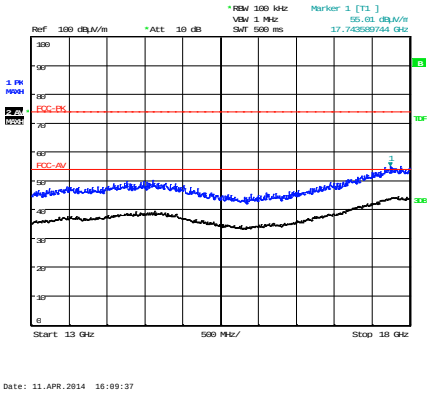
1GHz - 5GHz



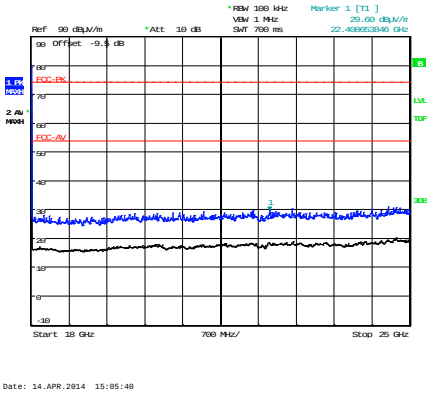
5GHz - 8GHz



8GHz - 13GHz

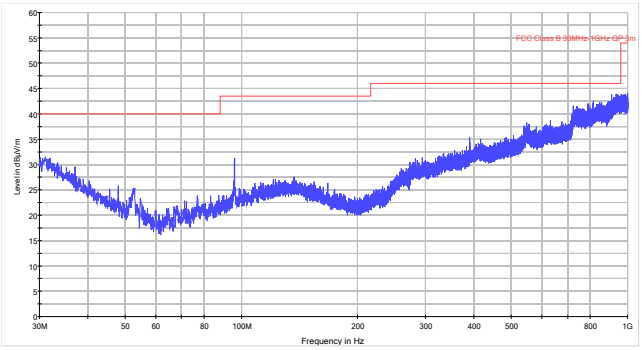


13GHz - 18GHz

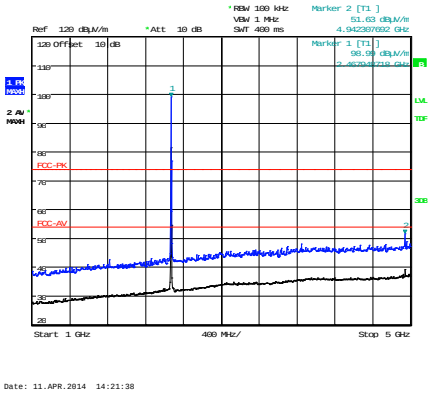


18GHz – 25GHz

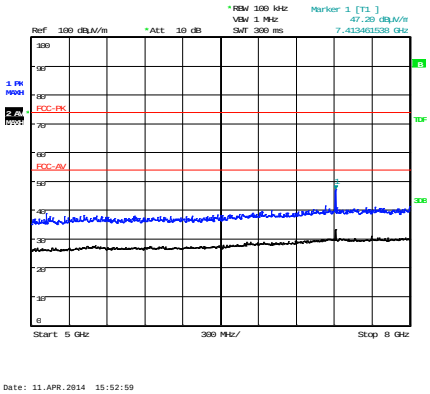
Radiated Transmitter Emissions 2470MHz - Chip Antenna



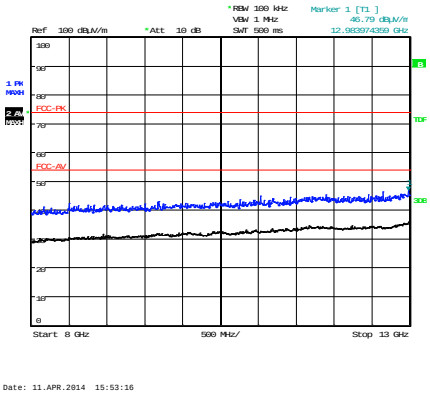
30MHz -1GHz



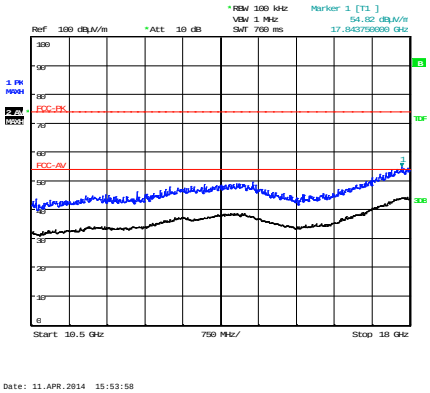
1GHz - 5GHz



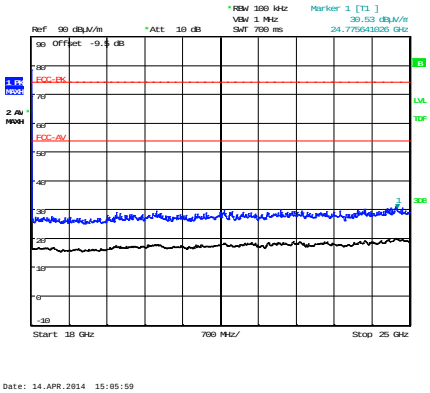
5GHz - 8GHz



8GHz - 13GHz

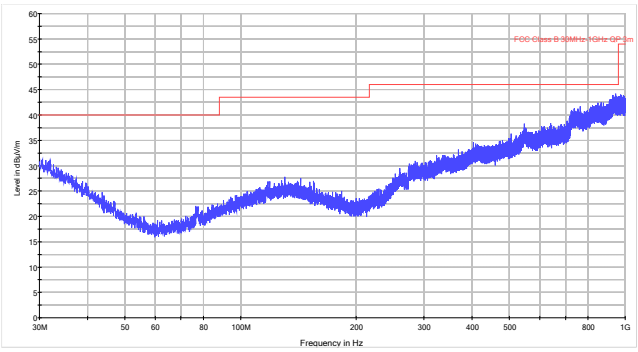


13GHz - 18GHz

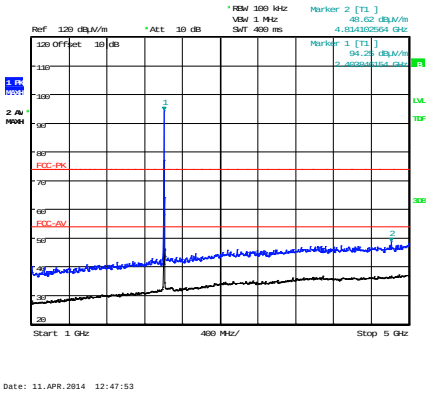


18GHz – 25GHz

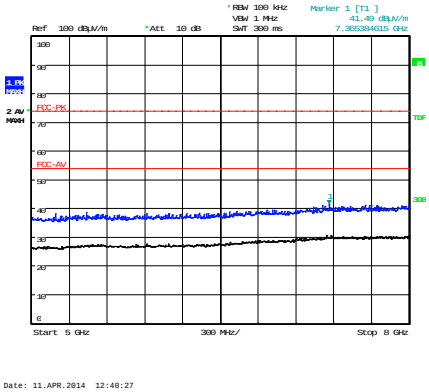
Radiated Transmitter Emissions 2405MHz – Half Wave Antenna



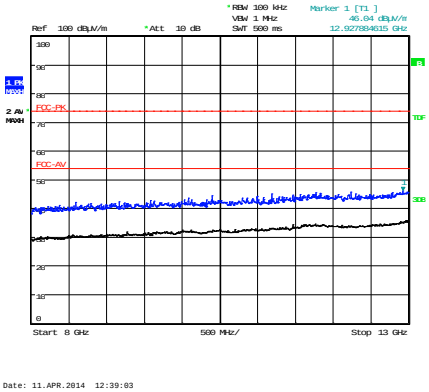
30MHz -1GHz



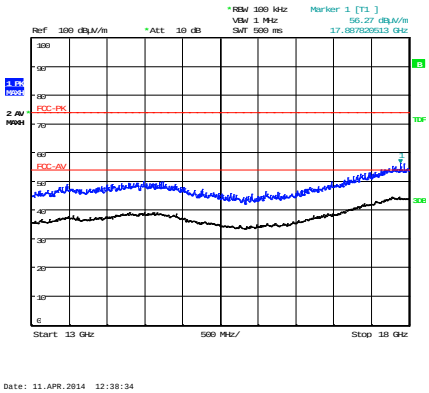
1GHz - 5GHz



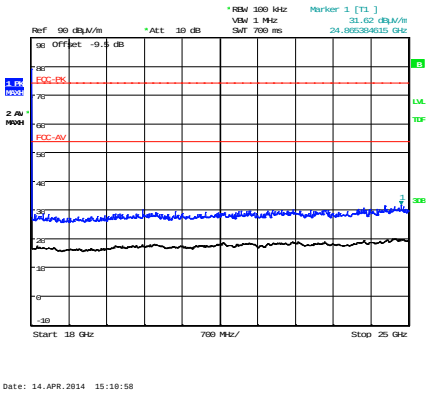
5GHz - 8GHz



8GHz - 13GHz



13GHz - 18GHz



18GHz – 25GHz