

TEST REPORT

Report Number: 101025780LEX-001
Project Number: G101025780

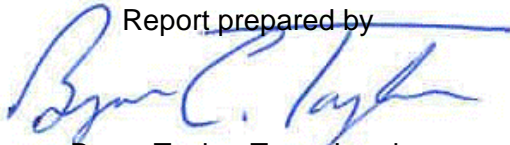
Report Issue Date: 2/21/2013

Product Name: TT10315
Model Number Tested: TT10315
FCCID: ZPV-TT10315
ICID: 9772A-TT10315
FCC Standards: Title 47 CFR Part 15 Subpart B and C
Industry Canada Standards: RSS-210 Issue 8 & RSS-GEN Issue 3

Tested by:
Intertek Testing Services NA, Inc.
731 Enterprise Drive
Lexington, KY 40510

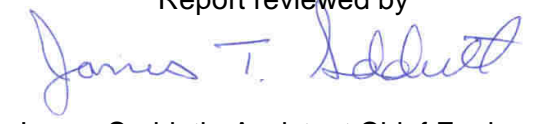
Client:
Twistthink, LLC
130 Central Avenue, Suite 400
Holland, MI 49423

Report prepared by



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1 Introduction and Conclusion

The tests indicated in Section 2 were performed on the product constructed as described in Section 3. The remaining test sections are the verbatim text from the actual data sheets used during the investigation. These test sections include the test name, the specified test method, a list of the actual test equipment used, documentation photos, results and raw data. No additions, deviations, or exclusions have been made from the standard(s) unless specifically noted.

Based on the results of our investigation, we have concluded the product tested complied with the requirements of the standard(s) indicated. The results obtained in this test report pertain only to the item(s) tested.

All testing was performed at the Intertek office located at 731 Enterprise Drive, Lexington Kentucky, 40510. The radiated emission test site is a 10-meter semi-anechoic chamber. The chamber meets the characteristics of CISPR 16-1 and ANSI C63.4. For measurements, a remotely controlled flush-mount metal-top turntable is used to rotate the EUT a full 360 degrees. A remote controlled non-conductive antenna mast is used to scan the antenna height from one to four meters. The test site is listed with the FCC under Registration Number 485103. The test site is listed with Industry Canada under Site Number IC 2042M-1.

2 Test Summary

Page	Test full name	FCC Reference	IC Reference	Result
6	Peak Conducted Power	§ 15.247(b)(3)(4)	RSS210 A8.4 (4)	Pass
10	Occupied Bandwidth	§ 15.247(a)(2)	RSS210 A8.2(A)	Pass
15	Conducted Spurious Emissions	§ 15.247(d)	RSS210 (A8.5)	Pass
24	Power Spectral Density	§ 15.247(e)	RSS210 A8.2(B)	Pass
28	Radiated Spurious Emissions (Transmitter)	§ 15.247(d), § 15.209, and § 15.205	RSS-210 (2.2)	Pass
34	AC Powerline Conducted Emissions	§ 15.207	RSS-Gen (7.2.2)	Pass
37	Antenna Requirement per FCC Part 15.203	§ 15.203	RSS-Gen (7.1.4)	Pass

3 Description of Equipment Under Test

Equipment Under Test	
Manufacturer	Twistthink, LLC
Model Number	TT10315
Serial Number	Test Sample 1
FCC Identifier	ZPV-TT10315
Industry Canada Identifier	9772A-TT10315
Receive Date	1/15/2013
Test Start Date	1/15/2013
Test End Date	1/29/2013
Device Received Condition	Good
Test Sample Type	Production
Frequency Band	2405MHz – 2480MHz
Mode(s) of Operation	Zigbee
Modulation Type	QPSK
Transmission Control	Test Commands
Maximum Output Power	15.91dBm
Test Channels	11, 18, 26
Antenna Type (15.203)	Internal PCB
Operating Voltage	12VDC

Description of Equipment Under Test

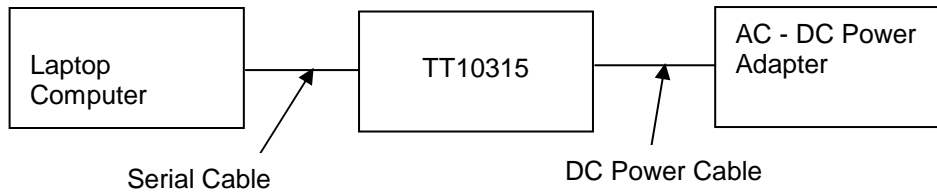
This device is designed to enable remote connection of sensors and machines to cloud services via a cellular carrier.

Operating modes of the EUT:

No.	Descriptions of EUT Exercising
1	Transmitting on channels 11, 18, or 26
2	Receive / idle mode

3.1 System setup including cable interconnection details, support equipment and simplified block diagram

3.2 EUT Block Diagram:



3.3 Cables Connected to Test Sample:

Cables					
Description	Length	Shielding	Ferrites	Connection	
				From	To
DC Power Cable	5ft	None	None	AC - DC Power Adapter	DC Input
Serial Cable	5ft	Yes	None	Serial Port	Laptop Computer
Ethernet Cable	5ft	None	None	Ethernet Port	Un-Terminated

3.4 Support Equipment:

Support Equipment			
Description	Manufacturer	Model Number	ID Number
Laptop Computer	HP	Elitebook	RF Laptop
Power Supply	HP	6296A	1036
Digital Volt Meter	Fluke	87	2189

4 Peak Conducted Power

4.1 Test Limits

§ 15.247(b)(3): For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the *maximum conducted output power* is the highest total transmit power occurring in any mode.

§ 15.247(b)(4): The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

4.2 Test Procedure

ANSI C63.10: 2009 and KDB Publication No. 558074: Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247)

4.3 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
Spectrum Analyzer	100253	Rohde & Schwarz	FSEK30	11/26/2012	11/26/2013

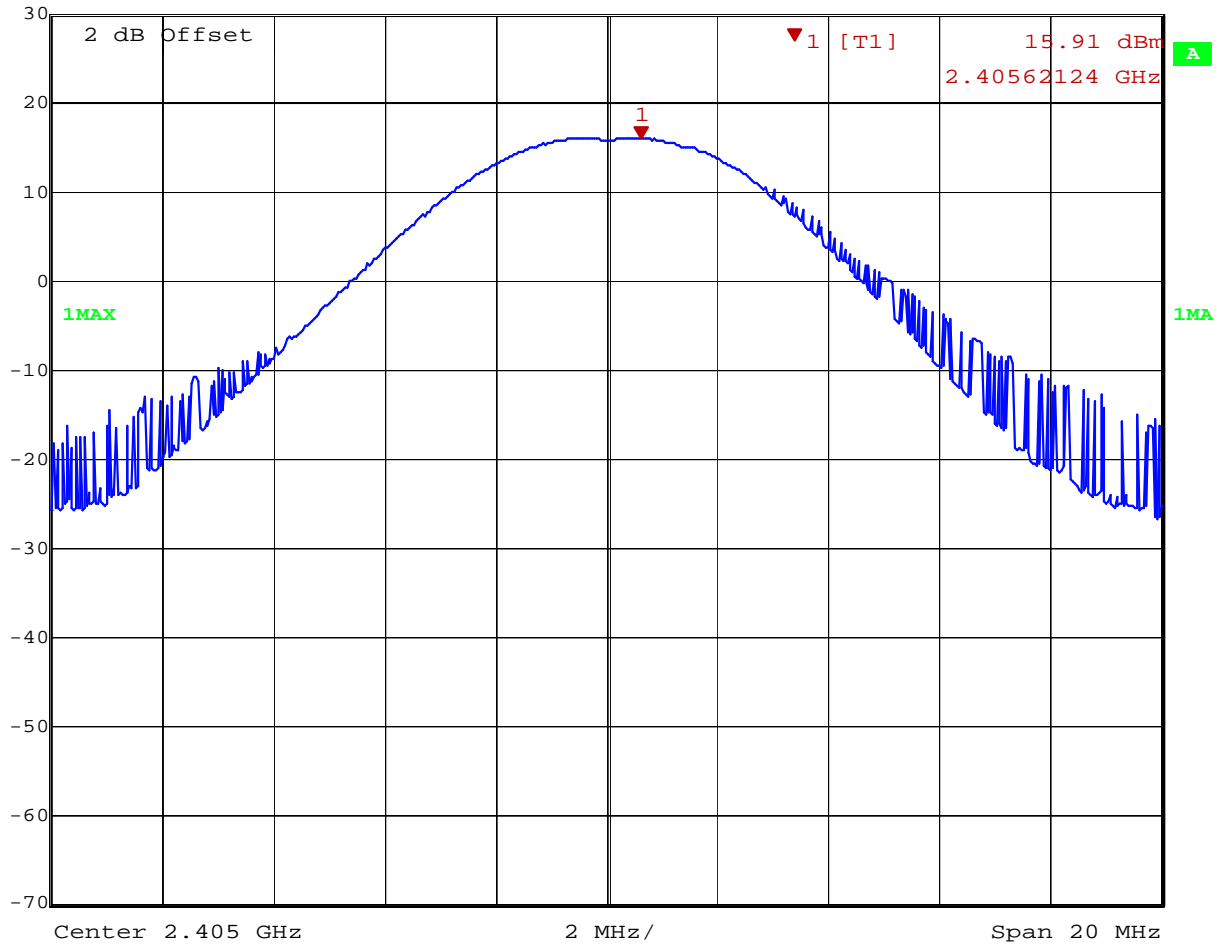
4.4 Results:

Channel Number	Frequency (MHz)	Peak Conducted Power (dBm)	Peak Conducted Power Limit (dBm)	Margin (dB)	Result
11	2405	15.91dBm	30	14.09dB	Pass
18	2440	15.46dBm	30	14.54dB	Pass
26	2480	14.72dBm	30	15.28dB	Pass

Peak Output Power Plot (Channel 11)



Marker 1 [T1] RBW 3 MHz RF Att 40 dB
 Ref Lvl 15.91 dBm VBW 10 MHz
 30 dBm 2.40562124 GHz SWT 5 ms Unit dBm

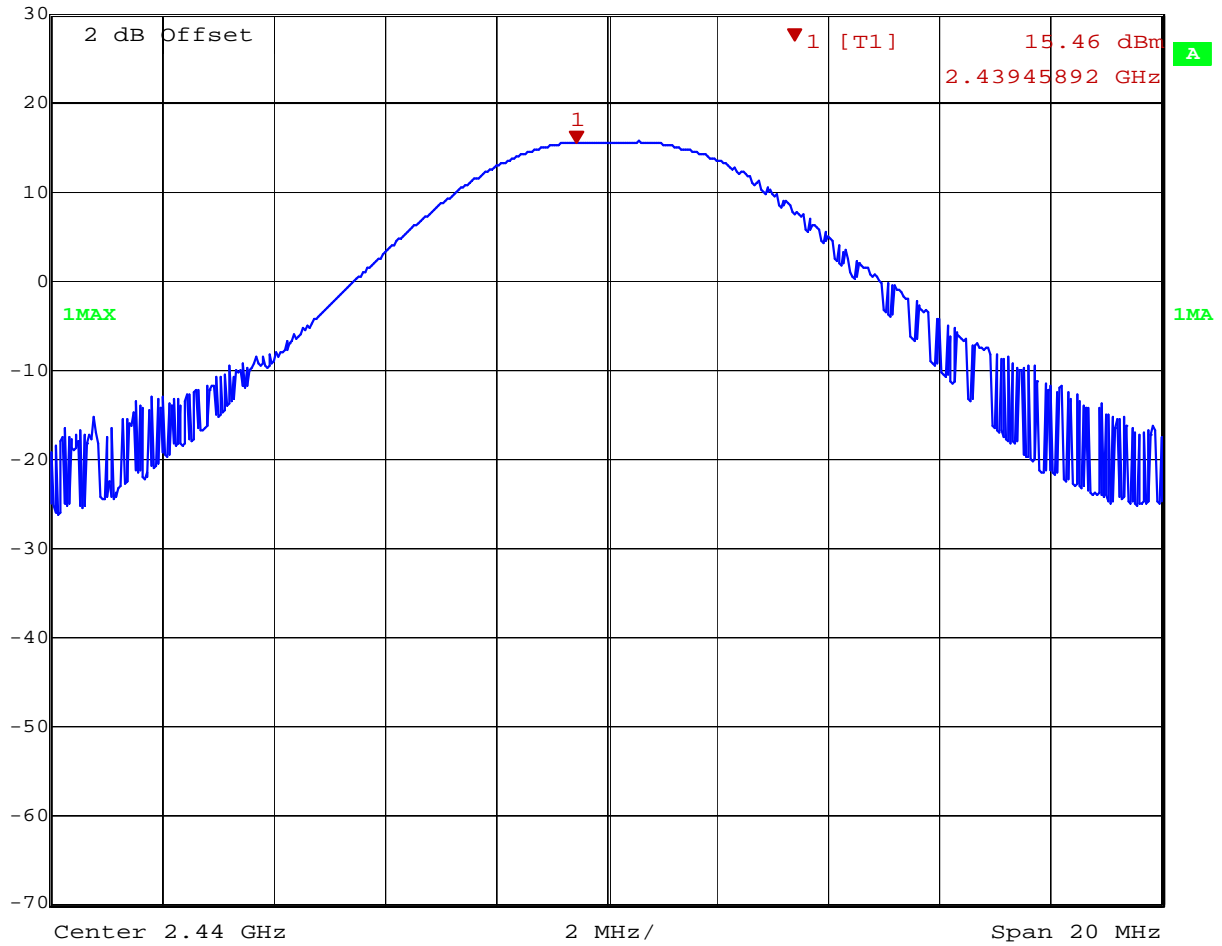


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Peak Output Power Plot (Channel 18)



Marker 1 [T1] RBW 3 MHz RF Att 40 dB
 Ref Lvl 15.46 dBm VBW 10 MHz
 30 dBm 2.43945892 GHz SWT 5 ms Unit dBm



Date: 16.JAN.2013 12:51:22

Peak Output Power Plot (Channel 26)

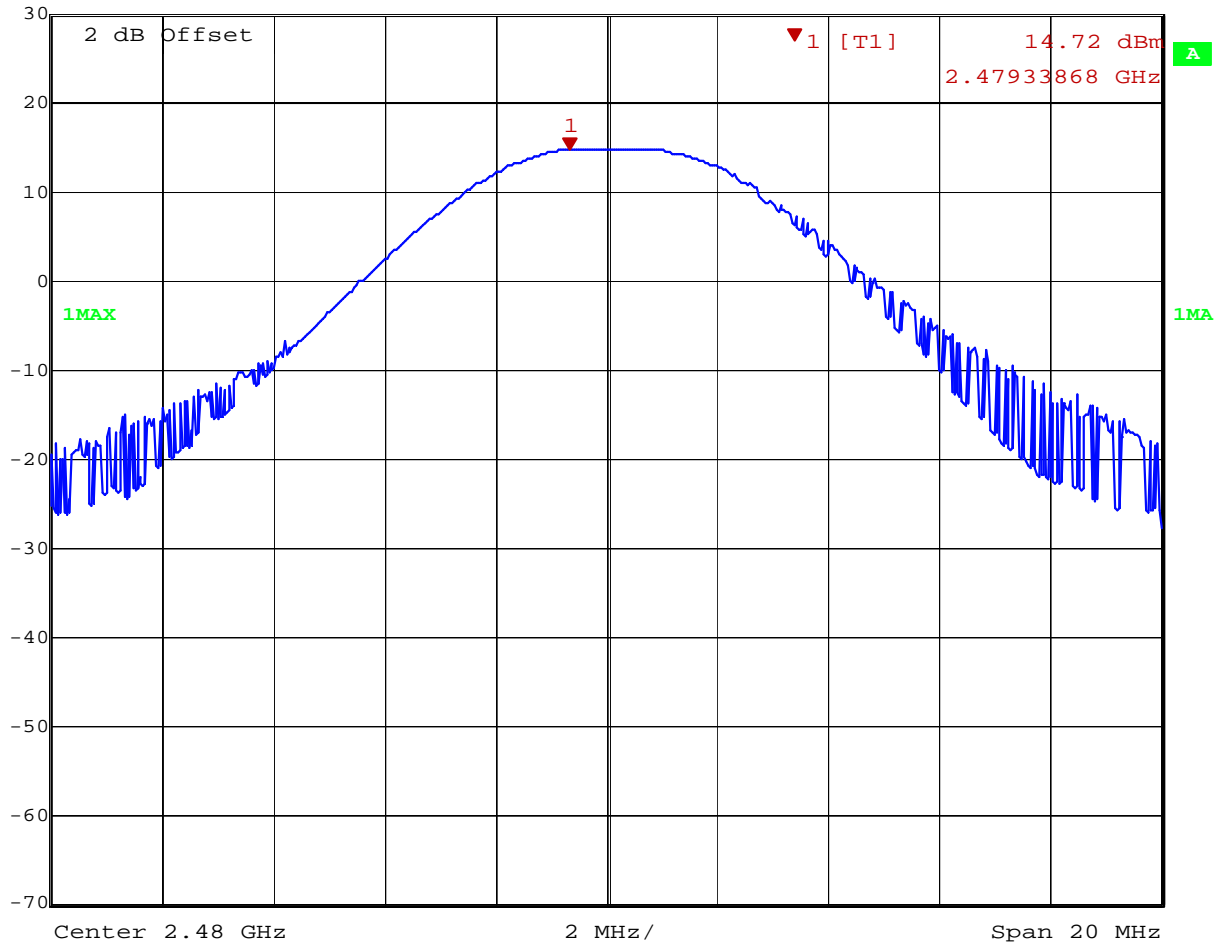


Ref Lvl
30 dBm

Marker 1 [T1]

14.72 dBm
2.47933868 GHz

RBW 3 MHz RF Att 40 dB
VBW 10 MHz
SWT 5 ms Unit dBm



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5 Occupied Bandwidth

5.1 Test Limits

§ 15.247(a)(2): For digital modulation systems, the minimum 6dB bandwidth shall be at least 500kHz.

5.2 Test Procedure

ANSI C63.10: 2009 and KDB Publication No. 558074: Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247)

5.3 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
Spectrum Analyzer	100253	Rohde & Schwarz	FSEK30	11/26/2012	11/26/2013

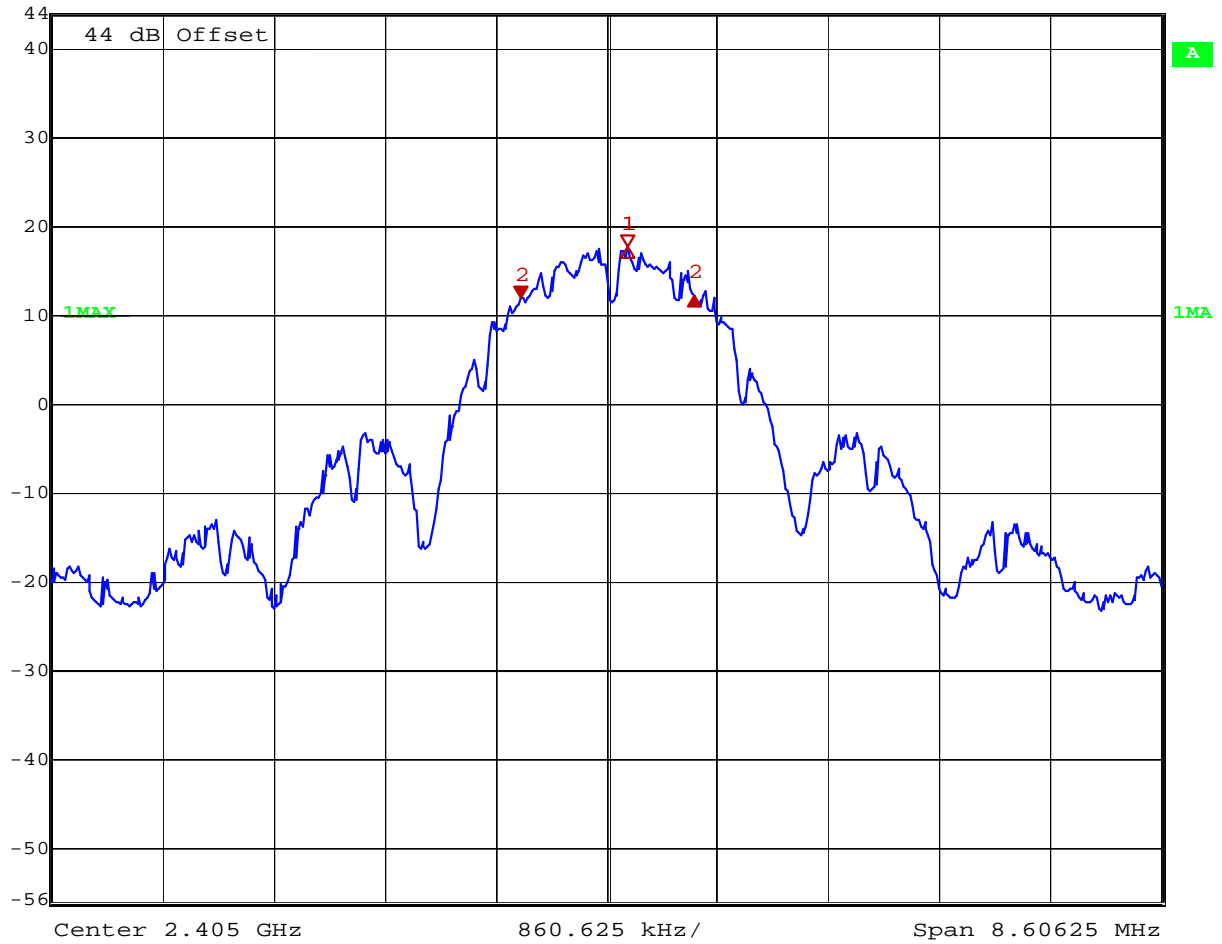
5.4 Results:

Channel Number	Frequency (MHz)	6dB Bandwidth	99% Power Bandwidth	Result
11	2405	1.34MHz	---	Pass
18	2440	1.36MHz	2.53MHz	Pass
26	2480	1.50MHz	---	Pass

6dB Bandwidth Plot (Channel 11)



Ref Lvl	Delta 2 [T1]	RBW	30 kHz	RF Att	30 dB
44 dBm	0.20 dB	VBW	100 kHz		
	1.34526553 MHz	SWT	24 ms	Unit	dBm

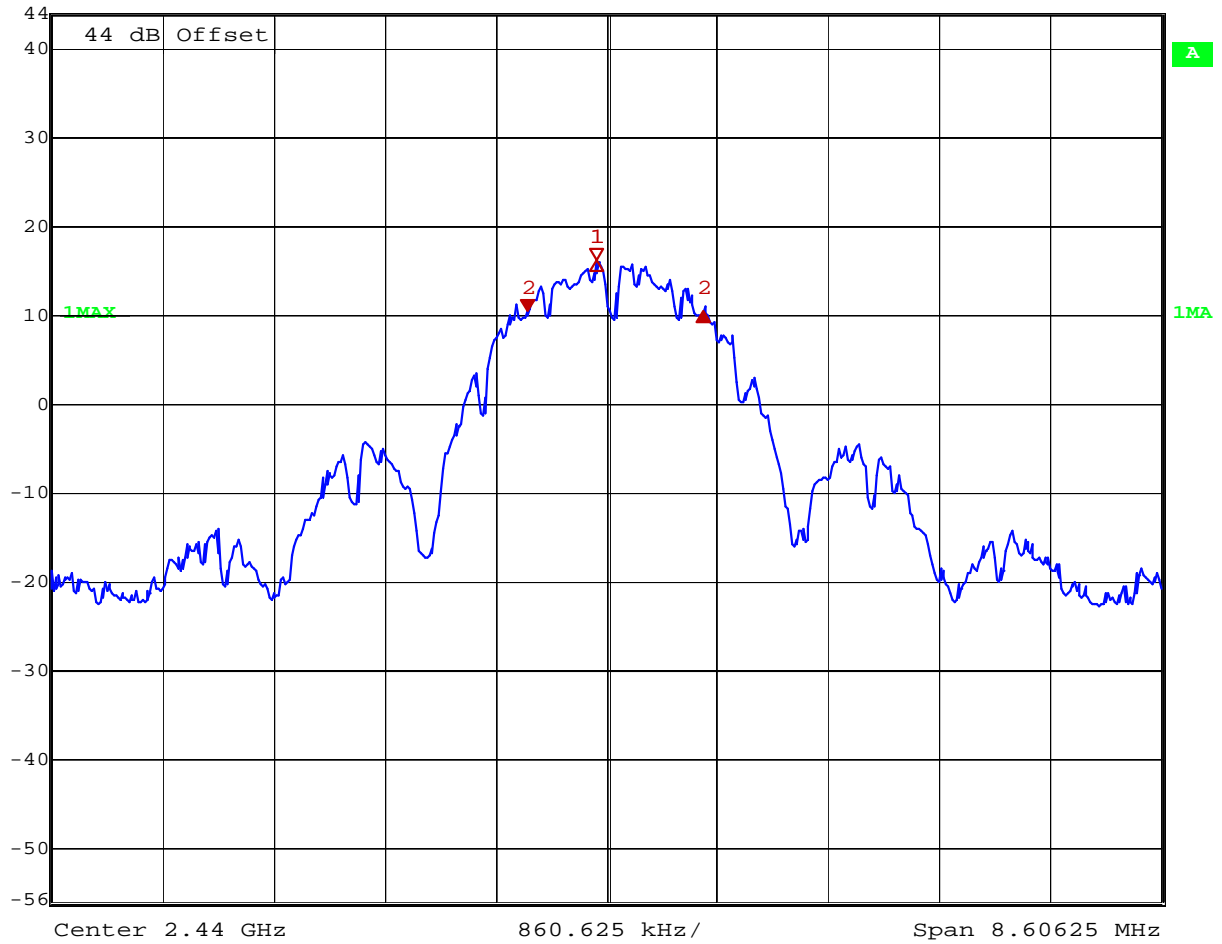


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6dB Bandwidth Plot (Channel 18)



Delta 2 [T1] RBW 30 kHz RF Att 30 dB
 Ref Lvl 0.05 dB VBW 100 kHz
 44 dBm 1.36251253 MHz SWT 24 ms Unit dBm

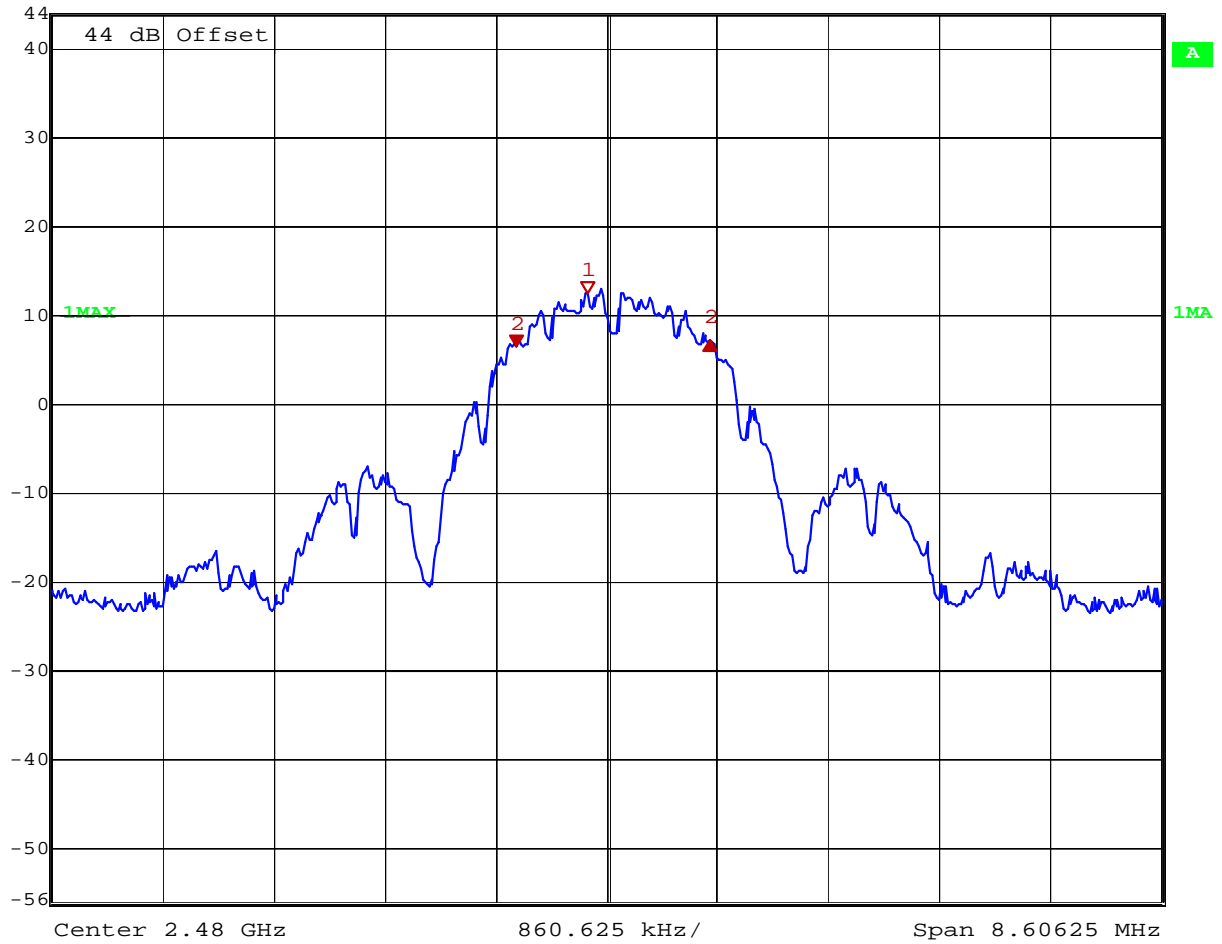


Date: 15.JAN.2013 13:30:53

6dB Bandwidth Plot (Channel 26)



Delta 2 [T1] RBW 30 kHz RF Att 30 dB
 Ref Lvl 0.56 dB VBW 100 kHz
 44 dBm 1.50048848 MHz SWT 24 ms Unit dBm

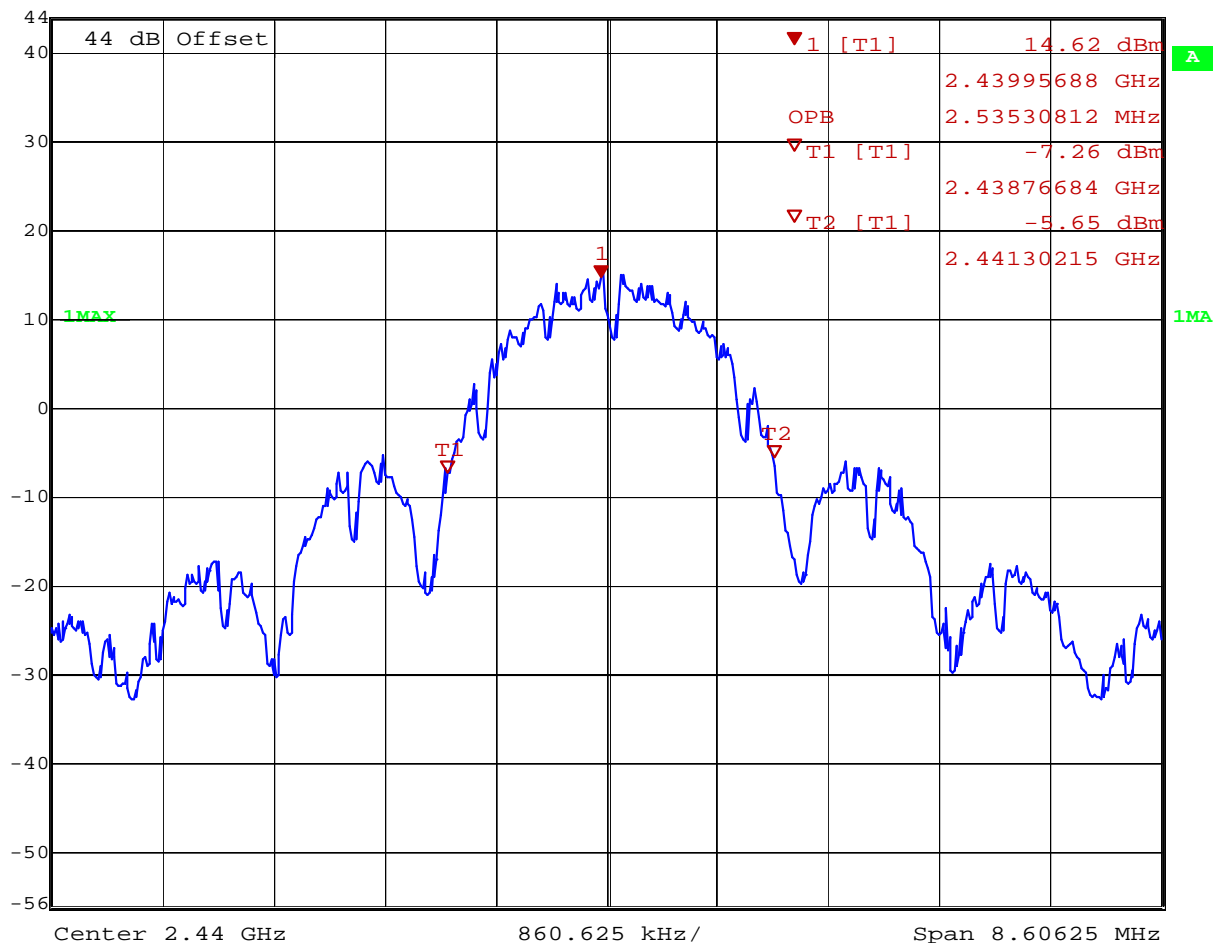


Date: 15.JAN.2013 13:38:29

99% Bandwidth Plot (Channel 18)



Marker 1 [T1] RBW 30 kHz RF Att 20 dB
 Ref Lvl 14.62 dBm VBW 100 kHz
 44 dBm 2.43995688 GHz SWT 24 ms Unit dBm



Date: 15.JAN.2013 13:43:58

6 Conducted Spurious Emissions

6.1 Test Limits

§ 15.247(d): In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

6.2 Test Procedure

ANSI C63.10: 2009 and KDB Publication No. 558074: Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247)

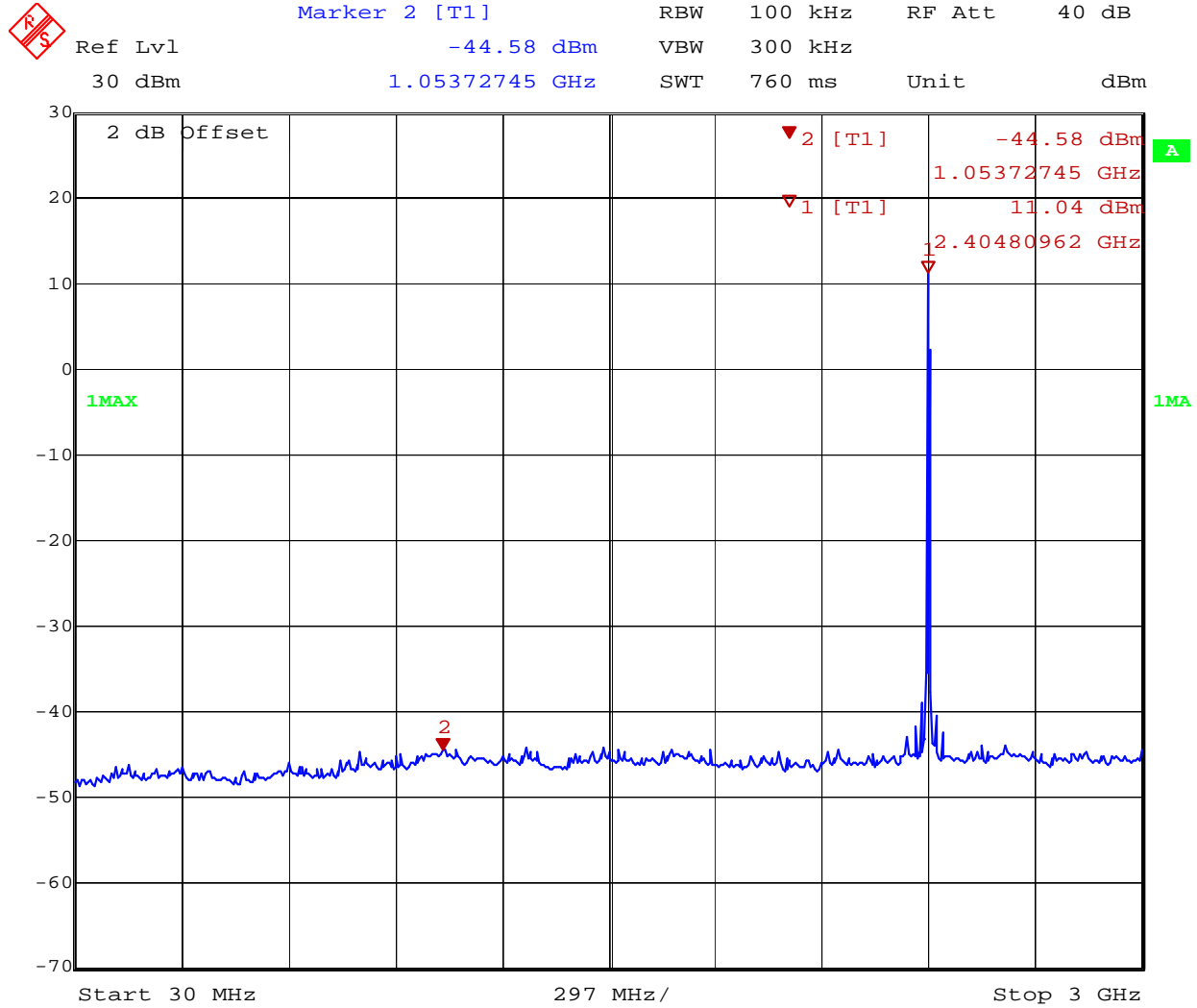
6.3 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
Spectrum Analyzer	100253	Rohde & Schwarz	FSEK30	11/26/2012	11/26/2013

6.4 Results:

The following plots show that there are no conducted spurious emissions exceeding the 20dB down criteria.

30MHz – 3GHz Conducted Spurious Emissions (Channel 11)

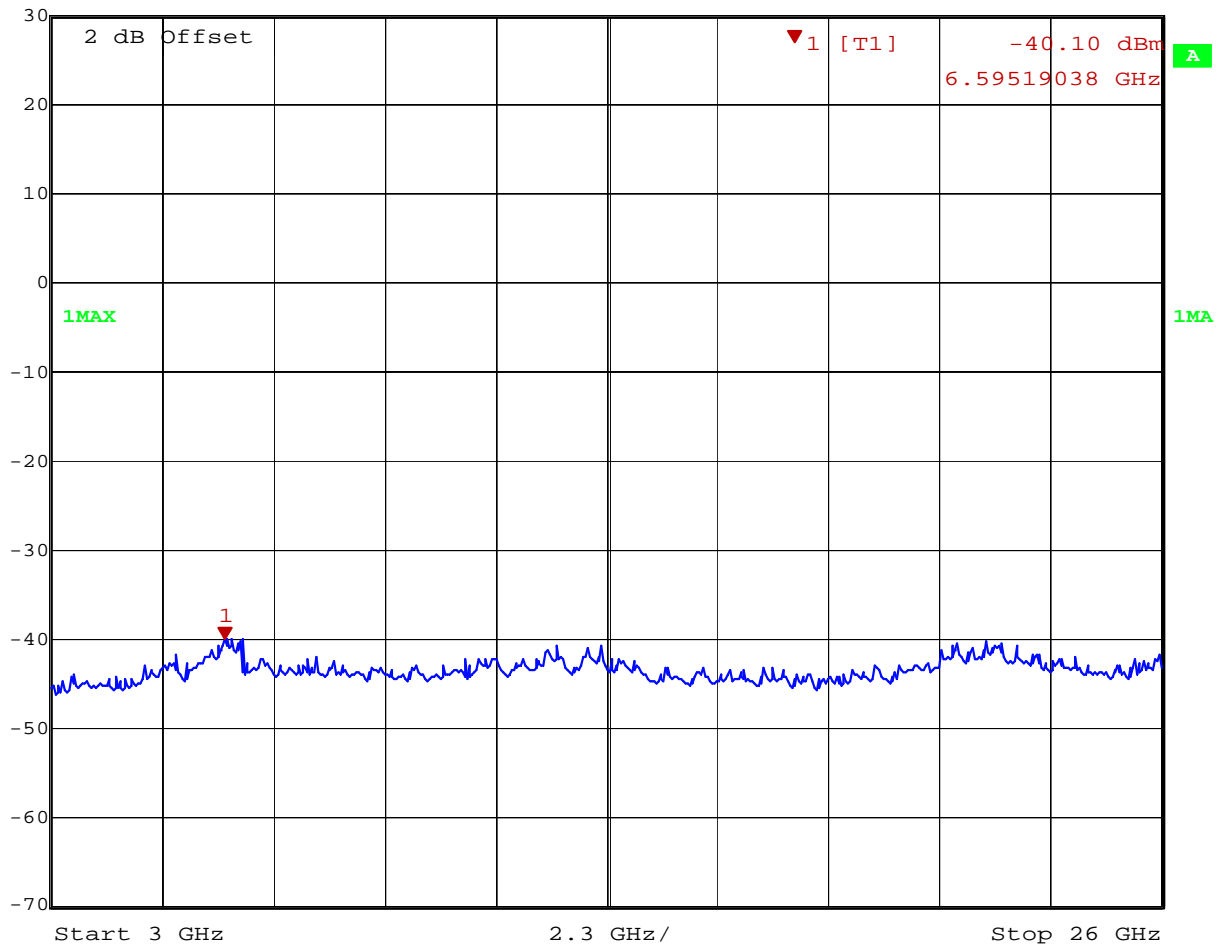


Date: 16.JAN.2013 13:06:36

3GHz – 26GHz Conducted Spurious Emissions (Channel 11)



Ref Lvl 30 dBm
 Marker 1 [T1] -40.10 dBm
 6.59519038 GHz
 RBW 100 kHz RF Att 40 dB
 VBW 300 kHz
 SWT 5.8 s Unit dBm



Date: 16.JAN.2013 13:07:46

Conducted Spurious Emissions Near the Transmit Band Edge (Channel 11)

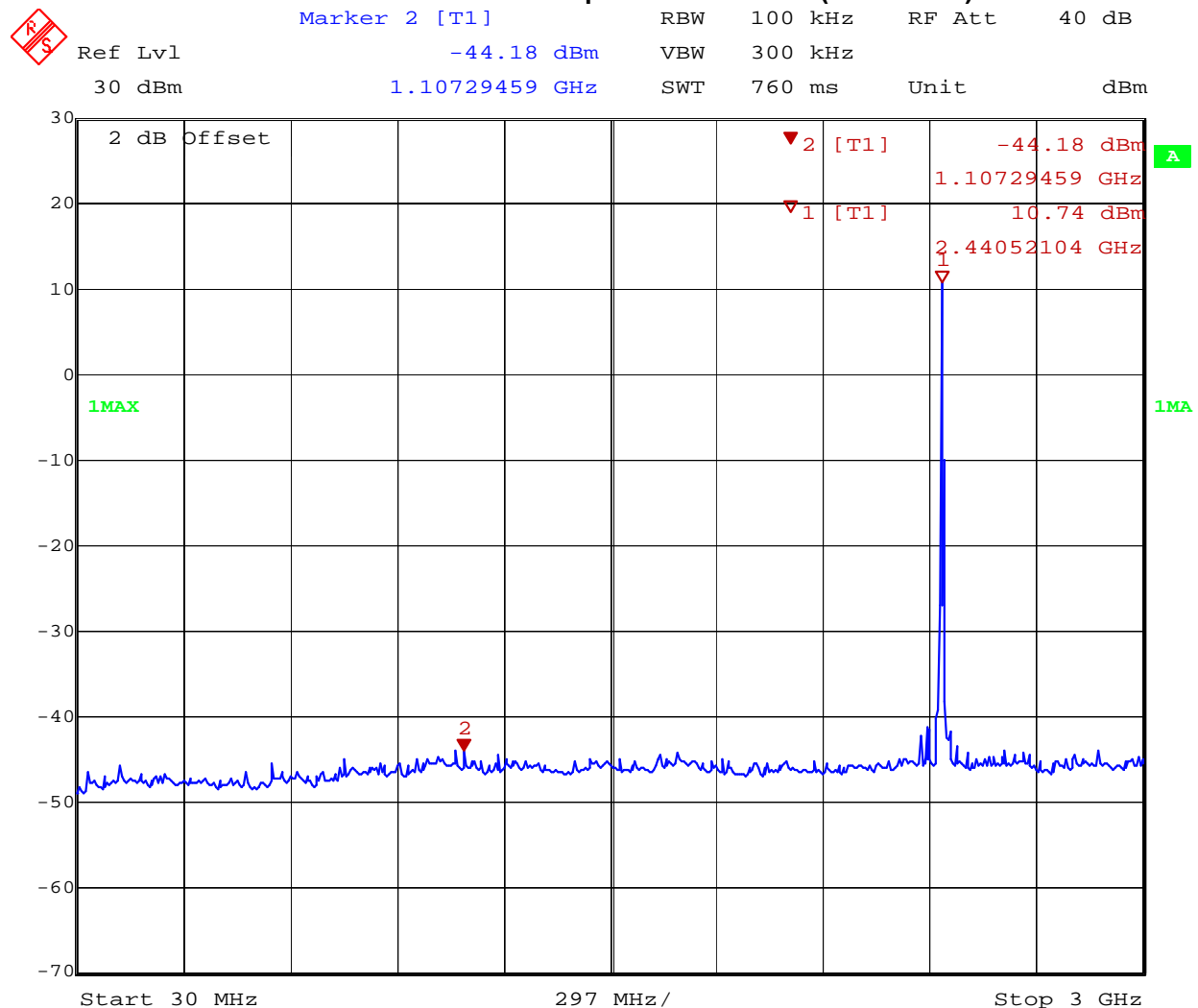


Delta 1 [T1] RBW 100 kHz RF Att 40 dB
 Ref Lvl -46.84 dB VBW 300 kHz
 30 dBm -4.55911824 MHz SWT 6.5 ms Unit dBm



Date: 16.JAN.2013 13:24:03

30MHz – 3GHz Conducted Spurious Emissions (Channel 18)

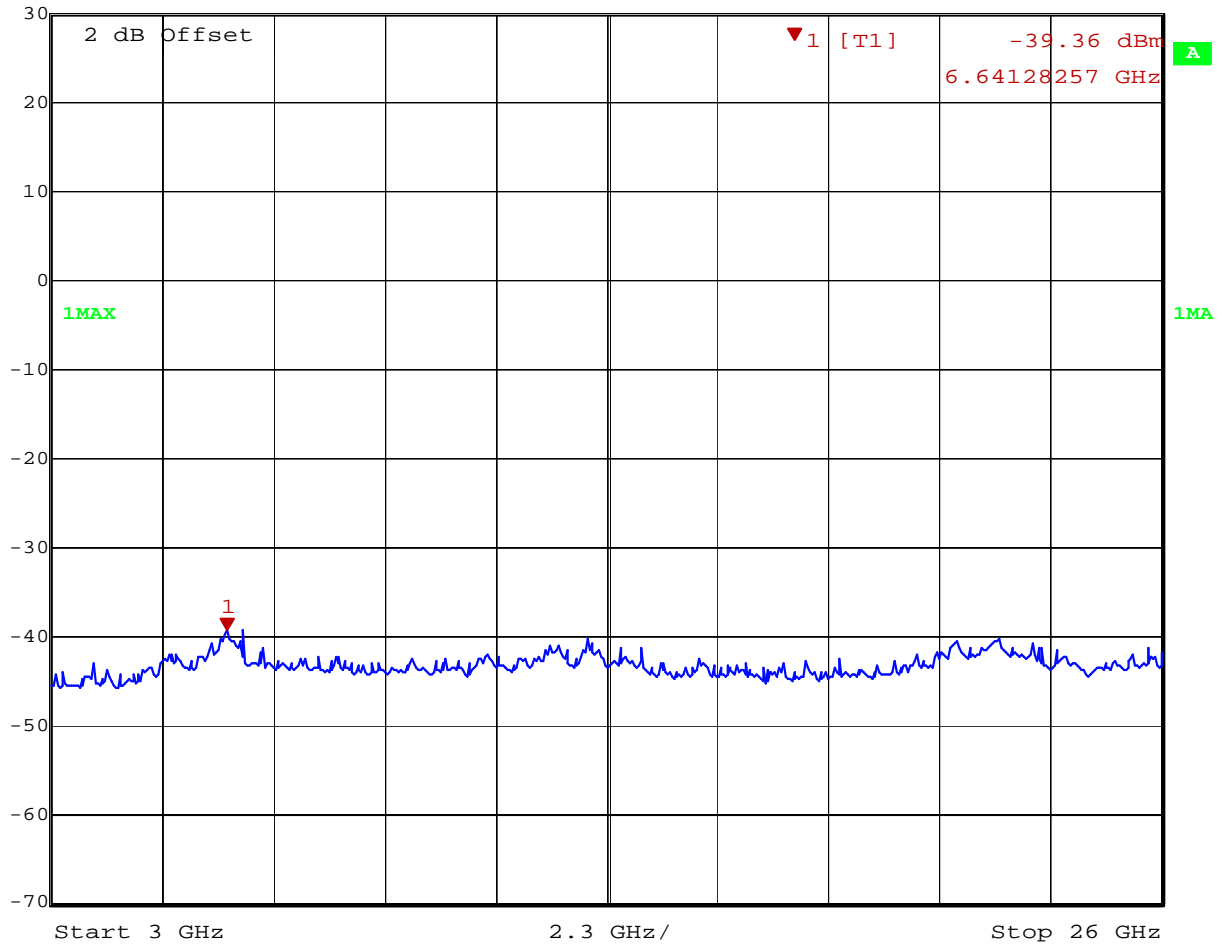


Date: 16.JAN.2013 13:05:09

3GHz – 26GHz Conducted Spurious Emissions (Channel 18)

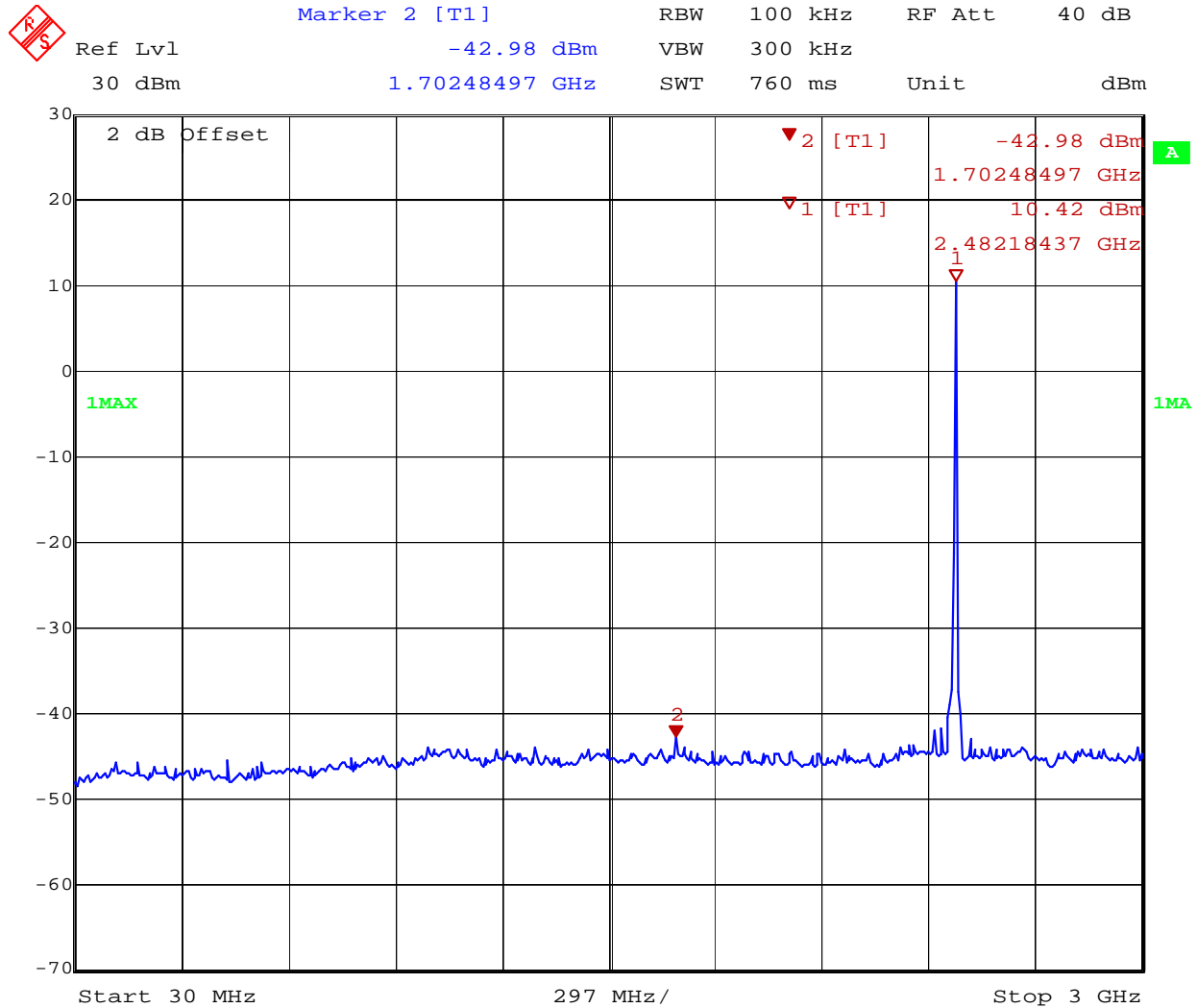


Marker 1 [T1] RBW 100 kHz RF Att 40 dB
 Ref Lvl -39.36 dBm VBW 300 kHz
 30 dBm 6.64128257 GHz SWT 5.8 s Unit dBm



Date: 16.JAN.2013 13:09:13

30MHz – 3GHz Conducted Spurious Emissions (Channel 26)

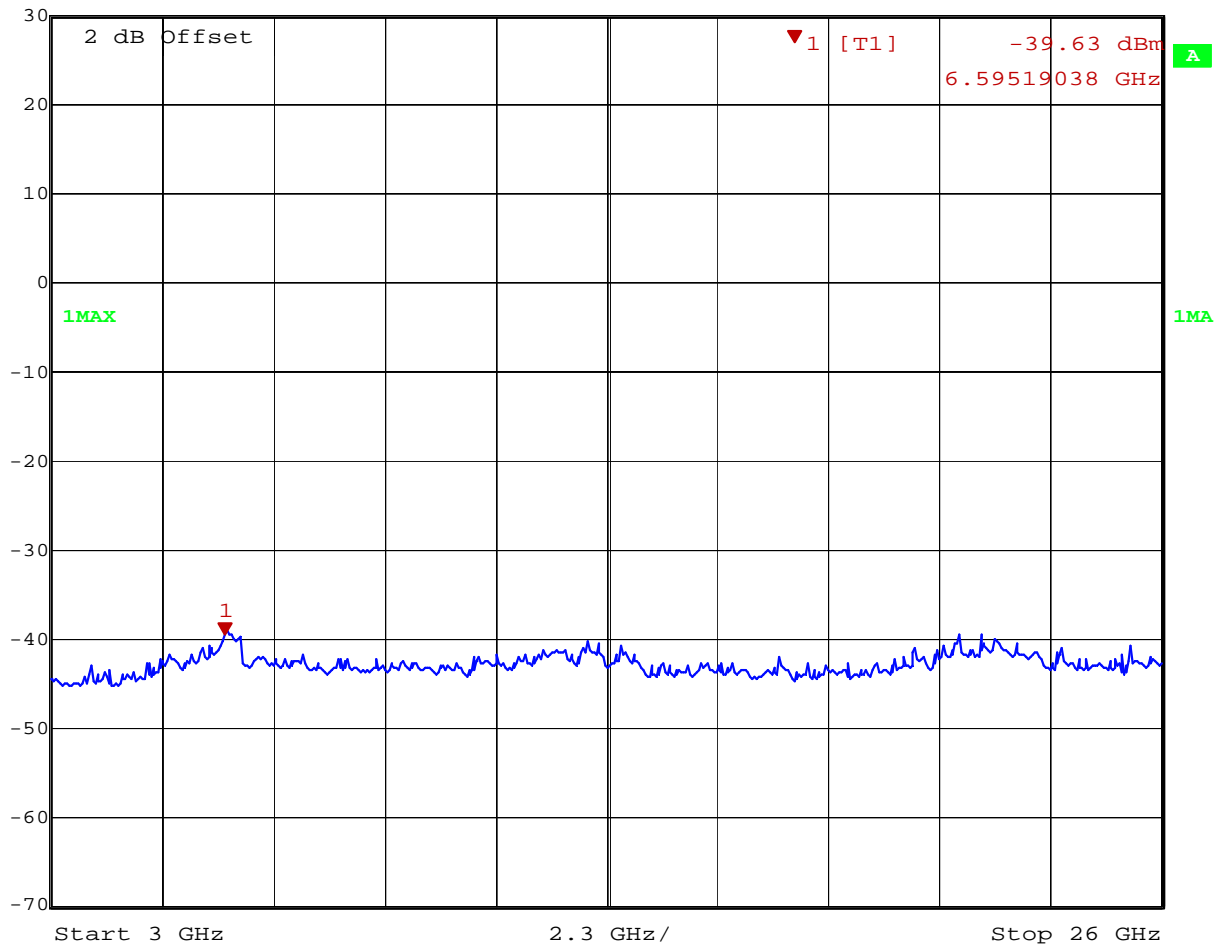


Date: 16.JAN.2013 13:03:14

3GHz – 26GHz Conducted Spurious Emissions (Channel 26)



Ref Lvl 30 dBm
 Marker 1 [T1] -39.63 dBm
 6.59519038 GHz
 RBW 100 kHz RF Att 40 dB
 VBW 300 kHz
 SWT 5.8 s Unit dBm

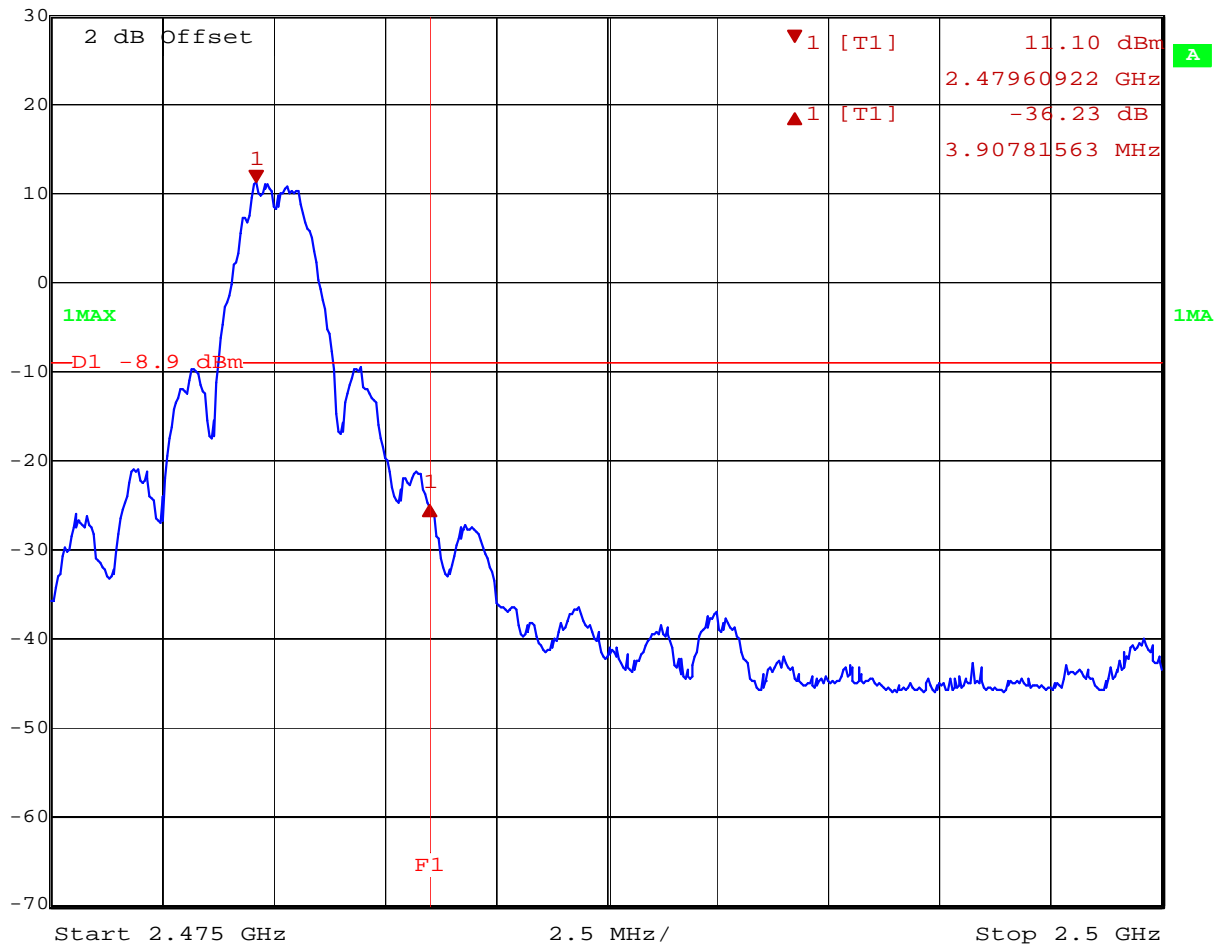


Date: 16.JAN.2013 13:12:21

Conducted Spurious Emissions Near the Transmit Band Edge (Channel 26)



Delta 1 [T1] RBW 100 kHz RF Att 40 dB
 Ref Lvl -36.23 dB VBW 300 kHz
 30 dBm 3.90781563 MHz SWT 6.5 ms Unit dBm



Date: 16.JAN.2013 13:21:23

7 Power Spectral Density

7.1 Test Limits

§ 15.247(e): For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

7.2 Test Procedure

ANSI C63.10: 2009 and KDB Publication No. 558074: Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247) PSD Option 1 Method

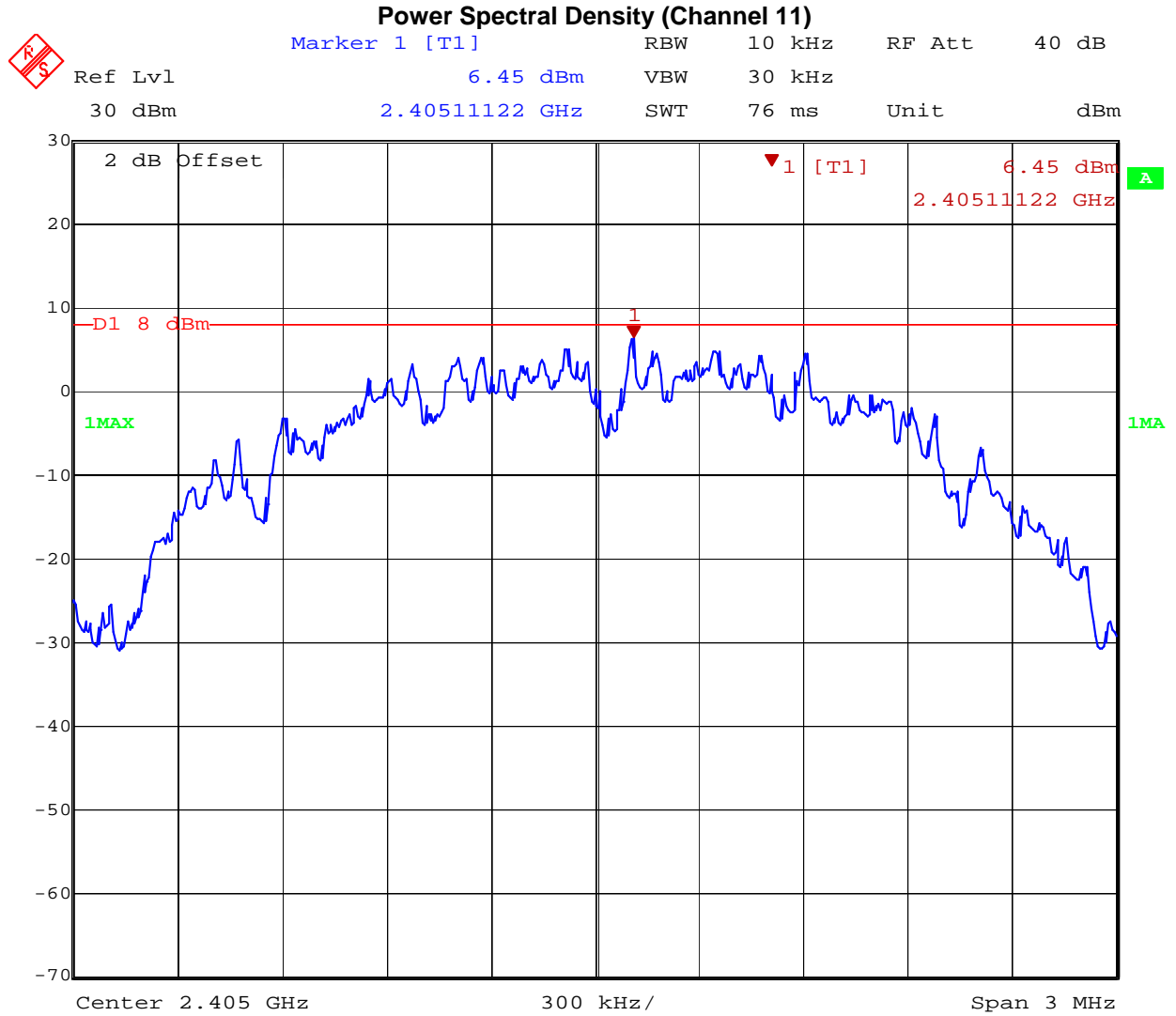
7.3 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
Spectrum Analyzer	100253	Rohde & Schwarz	FSEK30	11/26/2012	11/26/2013

7.4 Results:

*PSD Option 1 Method

Channel Number	PSD in 3kHz BW (dBm)	Limit (dBm)	Margin (dB)	Result
11	6.45dBm	8	1.55dB	Pass
18	5.96dBm	8	2.04dB	Pass
26	5.67dBm	8	2.33dB	Pass

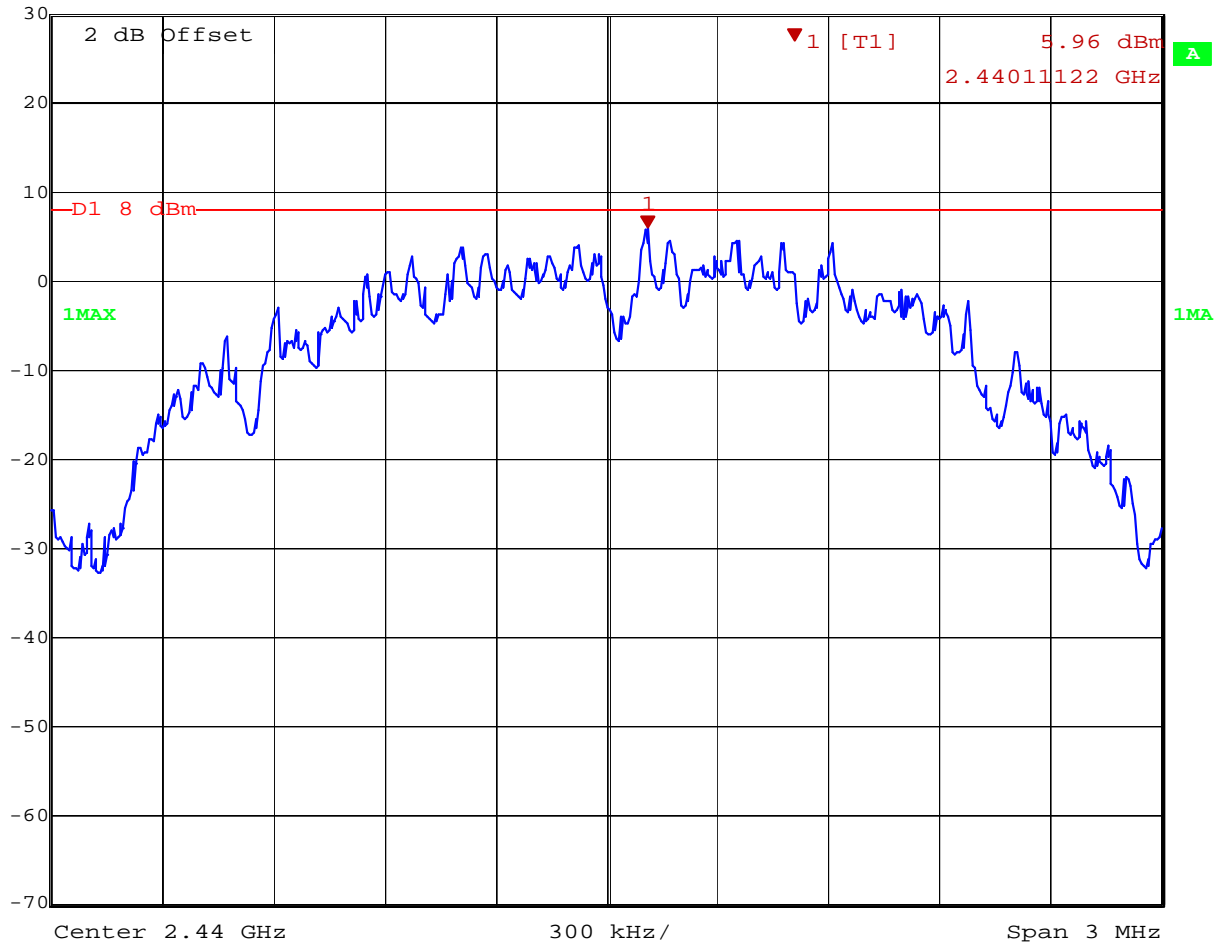


Date: 16.JAN.2013 13:36:48

Power Spectral Density (Channel 18)



Marker 1 [T1] RBW 10 kHz RF Att 40 dB
 Ref Lvl 5.96 dBm VBW 30 kHz
 30 dBm 2.44011122 GHz SWT 76 ms Unit dBm

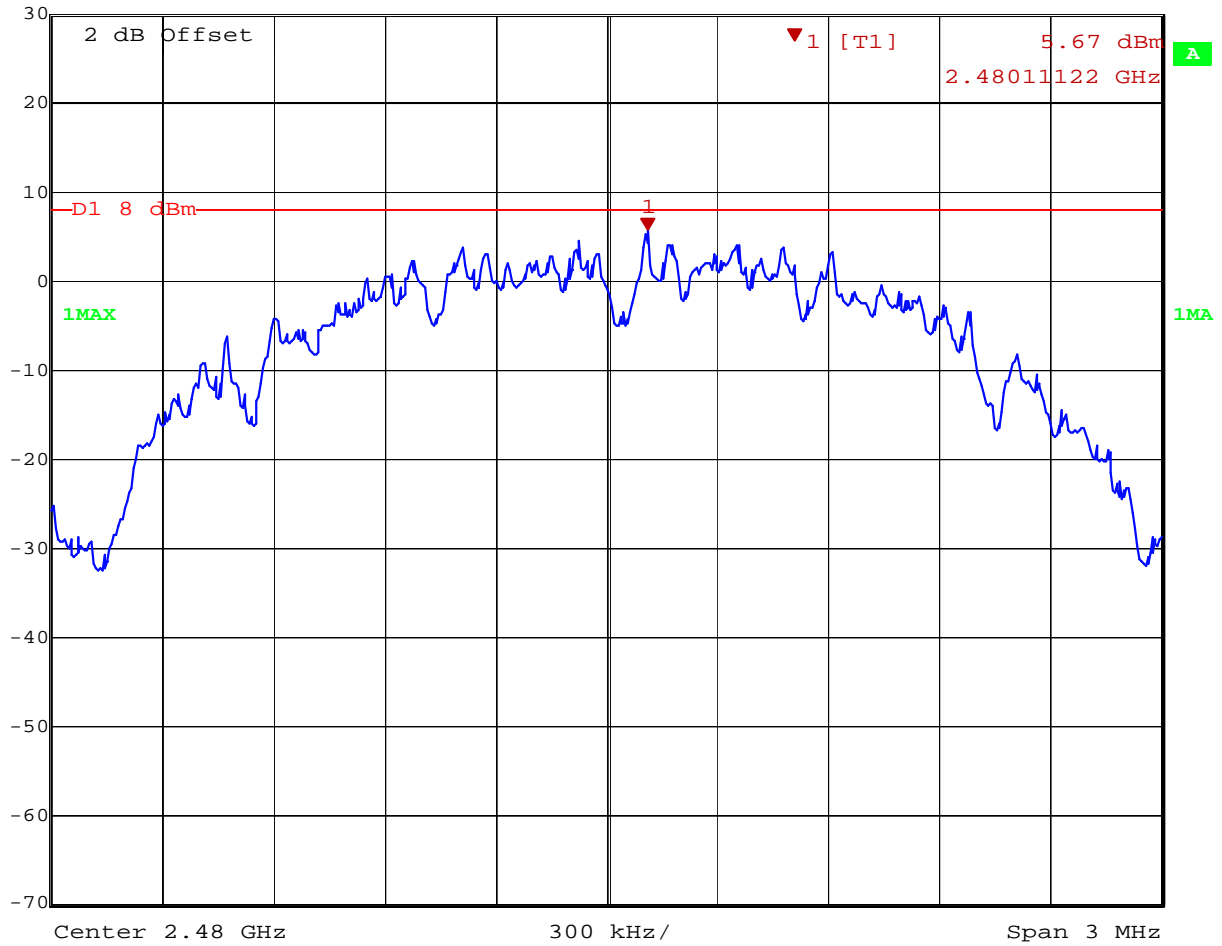


Date: 16.JAN.2013 13:38:25

Power Spectral Density (Channel 26)



Marker 1 [T1] RBW 10 kHz RF Att 40 dB
 Ref Lvl 5.67 dBm VBW 30 kHz
 30 dBm 2.48011122 GHz SWT 76 ms Unit dBm



Date: 16.JAN.2013 13:43:33

8 Radiated Spurious Emissions (Transmitter)

8.1 Test Limits

§ 15.247(d): In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

Part 15.205(a): Restricted Bands of Operations

MHz	MHz	MHz	GHz
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
¹ 0.495–0.505	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225	123–138	2200–2300	14.47–14.5
8.291–8.294	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675	156.7–156.9	2655–2900	22.01–23.12
8.41425–8.41475	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025	240–285	3345.8–3358	36.43–36.5
12.57675–12.57725	322–335.4	3600–4400	(²)
13.36–13.41			

¹ Until February 1, 1999, this restricted band shall be 0.490–0.510 MHz.

² Above 38.6

Part 15.209(a): Field Strength Limits for Restricted Bands of Operation

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 - 0.490	2,400 / F (kHz)	300
0.490 - 1.705	24,000 / F (kHz)	30
1.705 - 30.0	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

8.2 Test Procedure

ANSI C63.10: 2009 and KDB Publication No. 558074: Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247)

8.3 Example of Field Strength Calculation Method:

The measured field strength was calculated by summing the readings taken from the spectrum analyzer with the appropriate correction factors associated with the antenna losses and cable losses. The calculation formula and sample calculations are listed below:

Formula:

$$FS = RA + AF + CF$$

FS = Field Strength in dB μ V/m

RA = Receiver Amplitude in dB μ V

AF = Antenna Factor in dB

CF = Cable Attenuation Factor in dB (Including preamplifier and filter attenuation)

Example Calculation:

RA = 19.48 dB μ V

AF = 18.52 dB

CF = 0.78 dB

$$FS = 19.48 + 18.52 + 0.78 = 38.78 \text{ dB}\mu\text{V/m}$$

$$\text{Level in } \mu\text{V/m} = \text{Common Antilogarithm } [(38.78 \text{ dB}\mu\text{V/m})/20] = 86.89 \mu\text{V/m}$$

8.4 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
EMI Test Receiver	10887490.26	Rohde & Schwarz	ESI26	9/15/2012	9/14/2013
Preamplifier	987410	Miteq	AFS44-00102000-30-10P-44	9/4/2012	9/4/2013
Preamplifier	SF456200904	Mini-Circuits	ZX60-3018G-S+	9/4/2012	9/4/2013
Biconnilog Antenna	00051864	ETS	3142C	12/14/2012	12/14/2013
Horn Antenna	6556	ETS	3115	8/7/2012	8/7/2013
Horn Antenna	1096	Antenna Research	DRG-118/A	9/13/2012	9/13/2013
System Controller	121701-1	Sunol Sciences	SC99V	Not Required	Not Required
High Pass Filter	3986-01 DC0408	Microwave Circuits, Inc.	H3G020G2	Verify At Time of Use	Verify At Time of Use

8.5 Results:

For each channel it was verified that no change in radiated signal level occurred with the input power varied from 85% to 115% of nominal voltage. All spurious emissions were attenuated by at least 20dB below the level of the fundamental as required by Part 15.247(d). Additionally, all emissions falling within restricted bands of operation and at the band edges were found to be below the limit specified in Part 15.209(a). The spurious emissions listed in the following tables are the worst case emissions. The emissions were measured to 10 times the fundamental with the test sample in three orthogonal positions. The worst case data is reported below.

Worst Case Spurious Measurements (Peak Readings Channel 11)

Radiated Emissions												
Test Engineer: B. Taylor		Start Date: 1/17/2012		End Date: 1/17/2012								
Temperature: 25.3°C		Humidity: 24.80%		Pressure: 985.1 mbar								
Specification: FCC Part 15C		Test Limit: Class B General Limit										
Notes: Channel 11. Blue measurements are the fundamental												
A	B	C	D	E	F	G	H	I	J	K	L	
	Polarity (H/V)	Raw Reading (dBuV)	Cab. (dB)	Ant. (dB)	Duty Cycle Factor (dB)	Corr. Reading. (dBuV/m)	Limit (dBuV/m)	Delta (dB)	RBW / Detector	Test Distance	Results	
2.405	V	66.5	7.9	28.5	0	102.9	x	x	1MHz / PK	3m	Fundamental	
4.81	V	45.4	-32.1	32.9	0	46.2	74	-27.8	1MHz / PK	3m	Compliant	
7.215	V	37.09	-26.6	36.6	0	47.09	74	-26.91	1MHz / PK	3m	Compliant	
9.62	V	34.06	-22.7	37.7	0	49.06	74	-24.94	1MHz / PK	3m	Compliant	
12.025	V	33.56	-22.3	38.8	0	50.06	74	-23.94	1MHz / PK	3m	Compliant	
2.405	H	63.58	7.9	28.5	0	99.98	x	x	1MHz / PK	3m	Fundamental	
4.81	H	51.18	-32.1	32.9	0	51.98	74	-22.02	1MHz / PK	3m	Compliant	
7.215	H	38.72	-26.6	36.6	0	48.72	74	-25.28	1MHz / PK	3m	Compliant	
9.62	H	34.19	-22.7	37.7	0	49.19	74	-24.81	1MHz / PK	3m	Compliant	
12.025	H	34.13	-22.3	38.8	0	50.63	74	-23.37	1MHz / PK	3m	Compliant	
Calculations:					G=C+D+E-F			I=G-H				

Worst Case Spurious Measurements (Average Readings Channel 11)

Radiated Emissions											
Test Engineer:	B. Taylor	Start Date:	1/17/2012		End Date:	1/17/2012					
Temperature:	25.3°C	Humidity:	24.80%		Pressure:	985.1 mbar					
Specification:	FCC Part 15C	Test Limit:	Class B General Limit								
Notes:	Channel 11. Blue measurements are the fundamental										
A	B	C	D	E	F	G	H	I	J	K	L
	Polarity	Raw Reading			Duty Cycle Factor	Corr. Reading.	Limit		RBW / Detector	Test Distance	
Frequency (GHz)	(H/V)	(dBuV)	Cab. (dB)	Ant. (dB)	(dB)	(dBuV/m)	(dBuV/m)	Delta (dB)			Results
2.405	V	65.12	7.9	28.5	0	101.52	x	x	1MHz / Avg	3m	Fundamental
4.81	V	40.25	-32.1	32.9	0	41.05	54	-12.95	1MHz / Avg	3m	Compliant
7.215	V	29.31	-26.6	36.6	0	39.31	54	-14.69	1MHz / Avg	3m	Compliant
9.62	V	26.62	-22.7	37.7	0	41.62	54	-12.38	1MHz / Avg	3m	Compliant
12.025	V	25.74	-22.3	38.8	0	42.24	54	-11.76	1MHz / Avg	3m	Compliant
2.405	H	62.52	7.9	28.5	0	98.92	x	x	1MHz / Avg	3m	Fundamental
4.81	H	46.89	-32.1	32.9	0	47.69	54	-6.31	1MHz / Avg	3m	Compliant
7.215	H	32.17	-26.6	36.6	0	42.17	54	-11.83	1MHz / Avg	3m	Compliant
9.62	H	27.58	-22.7	37.7	0	42.58	54	-11.42	1MHz / Avg	3m	Compliant
12.025	H	25.77	-22.3	38.8	0	42.27	54	-11.73	1MHz / Avg	3m	Compliant
Calculations:					G=C+D+E-F			I=G-H			

Worst Case Spurious Measurements (Peak Readings Channel 18)

Radiated Emissions											
Test Engineer:	B. Taylor	Start Date:	1/17/2012		End Date:	1/17/2012					
Temperature:	25.3°C	Humidity:	24.80%		Pressure:	985.1 mbar					
Specification:	FCC Part 15C	Test Limit:	Class B General Limit								
Notes:	Channel 18. Blue measurements are the fundamental										
A	B	C	D	E	F	G	H	I	J	K	L
	Polarity	Raw Reading			Duty Cycle	Corr.	Limit		RBW /	Test	
Frequency (GHz)	(H/V)	(dBuV)	Cab. (dB)	Ant. (dB)	Factor (dB)	Reading. (dBuV/m)	(dBuV/m)	Delta (dB)	Detector	Distance	Results
2.44	V	67.67	7.9	28.5	0	104.07	x	x	1MHz / PK	3m	Fundamental
4.88	V	50.53	-32.1	32.9	0	51.33	74	-22.67	1MHz / PK	3m	Compliant
7.32	V	32.67	-26.6	36.6	0	42.67	74	-31.33	1MHz / PK	3m	Compliant
9.76	V	32.91	-22.7	37.7	0	47.91	74	-26.09	1MHz / PK	3m	Compliant
12.2	V	32.66	-22.3	38.8	0	49.16	74	-24.84	1MHz / PK	3m	Compliant
2.44	H	65.35	7.9	28.5	0	101.75	x	x	1MHz / PK	3m	Fundamental
4.88	H	47.08	-32.1	32.9	0	47.88	74	-26.12	1MHz / PK	3m	Compliant
7.32	H	35.67	-26.6	36.6	0	45.67	74	-28.33	1MHz / PK	3m	Compliant
9.76	H	36.93	-22.7	37.7	0	51.93	74	-22.07	1MHz / PK	3m	Compliant
12.2	H	34.46	-22.3	38.8	0	50.96	74	-23.04	1MHz / PK	3m	Compliant
Calculations:						G=C+D+E-F		I=G-H			

Worst Case Spurious Measurements (Average Readings Channel 18)

Radiated Emissions											
Test Engineer: B. Taylor		Start Date: 1/17/2012		End Date: 1/17/2012							
Temperature: 25.3°C		Humidity: 24.80%		Pressure: 985.1 mbar							
Specification: FCC Part 15C		Test Limit: Class B General Limit									
Notes: Channel 18. Blue measurements are the fundamental											
A	B	C	D	E	F	G	H	I	J	K	L
	Polarity	Raw Reading			Duty Cycle Factor	Corr. Reading.	Limit		RBW / Detector	Test Distance	
Frequency (GHz)	(H/V)	(dBuV)	Cab. (dB)	Ant. (dB)	(dB)	(dBuV/m)	(dBuV/m)	Delta (dB)			Results
2.44	V	65.57	7.9	28.5	0	101.97	x	x	1MHz / Avg	3m	Fundamental
4.88	V	46.95	-32.1	32.9	0	47.75	54	-6.25	1MHz / Avg	3m	Compliant
7.32	V	27.56	-26.6	36.6	0	37.56	54	-16.44	1MHz / Avg	3m	Compliant
9.76	V	26.45	-22.7	37.7	0	41.45	54	-12.55	1MHz / Avg	3m	Compliant
12.2	V	25.27	-22.3	38.8	0	41.77	54	-12.23	1MHz / Avg	3m	Compliant
2.44	H	63.44	7.9	28.5	0	99.84	x	x	1MHz / Avg	3m	Fundamental
4.88	H	43.25	-32.1	32.9	0	44.05	54	-9.95	1MHz / Avg	3m	Compliant
7.32	H	29.54	-26.6	36.6	0	39.54	54	-14.46	1MHz / Avg	3m	Compliant
9.76	H	32.38	-22.7	37.7	0	47.38	54	-6.62	1MHz / Avg	3m	Compliant
12.2	H	26.3	-22.3	38.8	0	42.8	54	-11.2	1MHz / Avg	3m	Compliant
Calculations:						G=C+D+E-F		I=G-H			

Worst Case Spurious Measurements (Peak Readings Channel 26)

Radiated Emissions											
Test Engineer:	B. Taylor		Start Date:	1/17/2012		End Date:	1/17/2012				
Temperature:	25.3°C		Humidity:	24.80%		Pressure:	985.1 mbar				
Specification:	FCC Part 15C		Test Limit:	Class B General Limit							
Notes:	Channel 26. Blue measurements are the fundamental										
A	B	C	D	E	F	G	H	I	J	K	L
	Polarity (H/V)	Raw Reading (dBuV)	Cab. (dB)	Ant. (dB)	Duty Cycle Factor (dB)	Corr. Reading. (dBuV/m)	Limit (dBuV/m)	Delta (dB)	RBW / Detector	Test Distance	Results
2.48	V	66.21	7.9	28.5	0	102.61	x	x	1MHz / PK	3m	Fundamental
4.96	V	49.39	-32.1	32.9	0	50.19	74	-23.81	1MHz / PK	3m	Compliant
7.44	V	33.15	-26.6	36.6	0	43.15	74	-30.85	1MHz / PK	3m	Compliant
9.92	V	32.65	-22.7	37.7	0	47.65	74	-26.35	1MHz / PK	3m	Compliant
12.4	V	31.28	-22.3	38.8	0	47.78	74	-26.22	1MHz / PK	3m	Compliant
2.48	H	62.09	7.9	28.5	0	98.49	x	x	1MHz / PK	3m	Fundamental
4.96	H	46.33	-32.1	32.9	0	47.13	74	-26.87	1MHz / PK	3m	Compliant
7.44	H	35.41	-26.6	36.6	0	45.41	74	-28.59	1MHz / PK	3m	Compliant
9.92	H	31.16	-22.7	37.7	0	46.16	74	-27.84	1MHz / PK	3m	Compliant
12.4	H	31.84	-22.3	38.8	0	48.34	74	-25.66	1MHz / PK	3m	Compliant
Calculations:						G=C+D+E-F		I=G-H			

Worst Case Spurious Measurements (Average Readings Channel 26)

Radiated Emissions												
Test Engineer: B. Taylor		Start Date: 1/17/2012		End Date: 1/17/2012								
Temperature: 25.3°C		Humidity: 24.80%		Pressure: 985.1 mbar								
Specification: FCC Part 15C		Test Limit: Class B General Limit										
Notes: Channel 26. Blue measurements are the fundamental												
A	B	C	D	E	F	G	H	I	J	K	L	
	Polarity (H/V)	Raw Reading (dBuV)	Cab. (dB)	Ant. (dB)	Duty Cycle Factor (dB)	Corr. Reading. (dBuV/m)	Limit (dBuV/m)	Delta (dB)	RBW / Detector	Test Distance	Results	
2.48	V	64.74	7.9	28.5	0	101.14	x	x	1MHz / Avg	3m	Fundamental	
4.96	V	47.15	-32.1	32.9	0	47.95	54	-6.05	1MHz / Avg	3m	Compliant	
7.44	V	26.33	-26.6	36.6	0	36.33	54	-17.67	1MHz / Avg	3m	Compliant	
9.92	V	26.21	-22.7	37.7	0	41.21	54	-12.79	1MHz / Avg	3m	Compliant	
12.4	V	24.11	-22.3	38.8	0	40.61	54	-13.39	1MHz / Avg	3m	Compliant	
2.48	H	63.44	7.9	28.5	0	99.84	x	x	1MHz / Avg	3m	Fundamental	
4.96	H	43.12	-32.1	32.9	0	43.92	54	-10.08	1MHz / Avg	3m	Compliant	
7.44	H	30.06	-26.6	36.6	0	40.06	54	-13.94	1MHz / Avg	3m	Compliant	
9.92	H	23.59	-22.7	37.7	0	38.59	54	-15.41	1MHz / Avg	3m	Compliant	
12.4	H	24.65	-22.3	38.8	0	41.15	54	-12.85	1MHz / Avg	3m	Compliant	
Calculations:					G=C+D+E-F			I=G-H				

Radiated Band Edge Measurement: Channel 11

Radiated Emissions											
Test Engineer:	B. Taylor	Start Date:	1/17/2012		End Date:	1/17/2012					
Temperature:	25.3°C	Humidity:	24.80%		Pressure:	985.1 mbar					
Specification:	FCC Part 15C	Test Limit:	Class B General Limit								
Notes:	Channel 11. Low Band Edge Measurements										
A	B	C	D	E	F	G	H	I	J	K	L
Frequency (GHz)	Polarity (H/V)	Raw Reading (dBuV)	Cab. (dB)	Ant. (dB)	Duty Cycle Factor (dB)	Corr. Reading. (dBuV/m)	Limit (dBuV/m)	Delta (dB)	RBW / Detector	Test Distance	Results
2.39	V	18.53	7.9	28.5	0	54.93	74	-19.07	1MHz / PK	3m	Compliant
2.39	V	9.8	7.9	28.5	0	46.2	54	-7.8	1MHz / Avg	3m	Compliant
2.39	H	17.12	7.9	28.5	0	53.52	74	-20.48	1MHz / PK	3m	Compliant
2.39	H	10.41	7.9	28.5	0	46.81	54	-7.19	1MHz / Avg	3m	Compliant
Calculations:				G=C+D+E-F				I=G-H			

Radiated Restricted Band Edge Measurement: Channel 25

Radiated Emissions											
Test Engineer:	B. Taylor		Start Date:	1/17/2012		End Date:	1/18/2012				
Temperature:	25.3°C		Humidity:	24.80%		Pressure:	985.1 mbar				
Specification:	FCC Part 15C		Test Limit:	Class B General Limit							
Notes:	Channel 25. High Band Edge Measurements										
A	B	C	D	E	F	G	H	I	J	K	L
	Polarity	Raw Reading			Duty Cycle Factor	Corr. Reading.	Limit		RBW / Detector	Test Distance	
Frequency (GHz)	(H/V)	(dBuV)	Cab. (dB)	Ant. (dB)	(dB)	(dBuV/m)	(dBuV/m)	Delta (dB)			Results
2.4835	V	24.06	7.9	28.5	0	60.46	74	-13.54	1MHz / PK	3m	Compliant
2.4835	V	14.92	7.9	28.5	0	51.32	54	-2.68	1MHz / Avg	3m	Compliant
2.4835	H	22.24	7.9	28.5	0	58.64	74	-15.36	1MHz / PK	3m	Compliant
2.4835	H	13.34	7.9	28.5	0	49.74	54	-4.26	1MHz / Avg	3m	Compliant
Calculations:						G=C+D+E-F		I=G-H			

Radiated Restricted Band Edge Measurement: Channel 26

Radiated Emissions												
Test Engineer: B. Taylor		Start Date: 1/29/2013		End Date: 1/29/2013								
Temperature: 25.3°C		Humidity: 24.80%		Pressure: 985.1 mbar								
Specification: FCC Part 15C		Test Limit: Class B General Limit										
Notes: Channel 26. High Band Edge Measurements. Reduced Power Setting (g, -4.9dBm)												
A	B	C	D	E	F	G	H	I	J	K	L	
Frequency (GHz)	Polarity (H/V)	Raw Reading (dBuV)	Cab. (dB)	Ant. (dB)	Duty Cycle Factor (dB)	Corr. Reading. (dBuV/m)	Limit (dBuV/m)	Delta (dB)	RBW / Detector	Test Distance	Results	
	2.4835	V	32.32	7.9	28.5	0	68.72	74	-5.28	1MHz / PK	3m	Compliant
	2.4835	V	28.82	7.9	28.5	11.3	53.92	54	-0.08	1MHz / Avg	3m	Compliant
	2.4835	H	32.11	7.9	28.5	0	68.51	74	-5.49	1MHz / PK	3m	Compliant
	2.4835	H	27.28	7.9	28.5	11.3	52.38	54	-1.62	1MHz / Avg	3m	Compliant
	Calculations:					G=C+D+E-F			I=G-H			

9 AC Powerline Conducted Emissions

9.1 Test Limits

§ 15.107(e): Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μ H/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency of emission (MHz)	Conducted limit (dB μ V)	
	Quasi-peak	Average
0.15–0.5	66 to 56*	56 to 46*
0.5–5	56	46
5–30	60	50

*Decreases with the logarithm of the frequency.

9.2 Test Procedure

ANSI C63.4: 2009

9.3 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
EMI Test Receiver	10887490.26	Rohde & Schwarz	ES126	9/15/2012	9/14/2013
LISN	3333	Teseq	NNB52	3/8/2012	3/8/2013

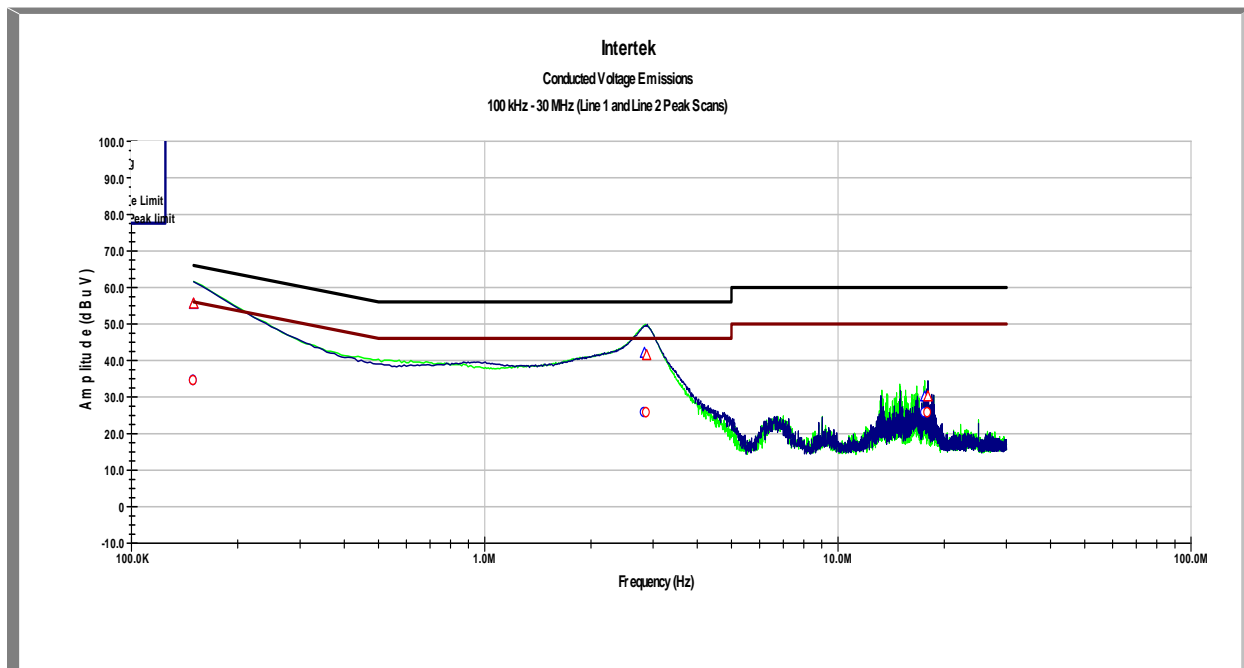
9.4 Results:

Conducted Voltage Emissions on Power Lines								
Test Engineer: Toby Carrier		Start Date: 1/21/2013		End Date: 1/21/2013				
Temperature: 23.4C		Humidity: 34.60%		Pressure: 988.9mBar				
Specification: FCC Part 15		Test Limit: Class B		RBW: 9kHz				
Notes: Transmitting on Channel 18								
Line	Frequency (MHz)	Quasi-Peak (dBuV)	Quasi-Peak Limit (dBuV)	Quasi-Peak Delta (dB)	Average (dBuV)	Average Limit (dBuV)	Average Delta (dB)	Results
Line 1	150.0 KHz	55.44	66	-10.56	34.39	56	-21.61	Compliant
Line 1	2.8352 MHz	42	56	-14	25.6	46	-20.4	Compliant
Line 1	17.614 MHz	30.1	60	-29.9	25.51	50	-24.49	Compliant
Line 2	150.0 KHz	55.52	66	-10.48	34.28	56	-21.72	Compliant
Line 2	2.8731 MHz	41.38	56	-14.62	25.53	46	-20.47	Compliant
Line 2	17.968 MHz	30.11	60	-29.89	25.52	50	-24.48	Compliant

Transmitting on Middle Channel

Quasi-Peak and Average Measurements

Testing performed on the AC Input to the AC – DC power adapter



Transmitting on Middle Channel

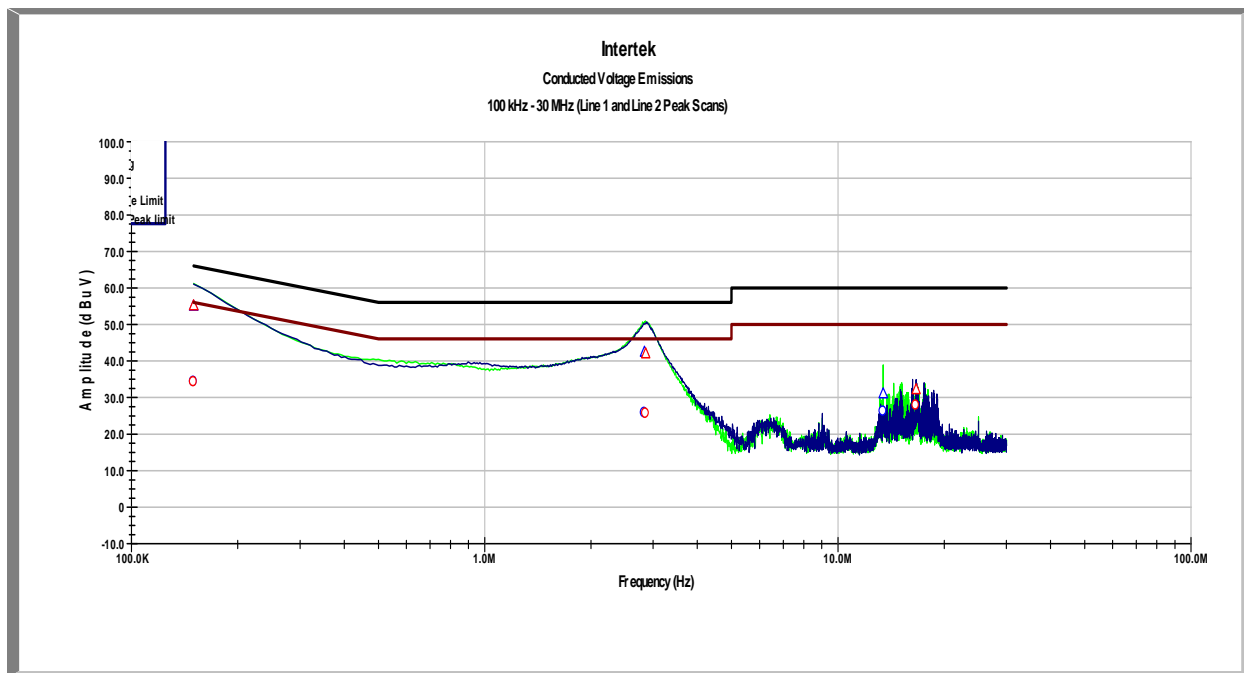
Peak Scan (Line 1 and 2)

Conducted Voltage Emissions on Power Lines								
Test Engineer: Toby Carrier		Start Date: 1/21/2013		End Date: 1/21/2013				
Temperature: 23.4C		Humidity: 34.60%		Pressure: 988.9mBar				
Specification: FCC Part 15		Test Limit: Class B		RBW: 9kHz				
Notes: Idle Mode								
Line	Frequency (MHz)	Quasi-Peak (dBuV)	Quasi-Peak Limit (dBuV)	Quasi-Peak Delta (dB)	Average (dBuV)	Average Limit (dBuV)	Average Delta (dB)	Results
Line 1	150.0 KHz	55.03	66	-10.97	34.27	56	-21.73	Compliant
Line 1	2.8358 MHz	42.46	56	-13.54	25.7	46	-20.3	Compliant
Line 1	13.436 MHz	31.04	60	-28.96	26.15	50	-23.85	Compliant
Line 2	150.0 KHz	55.14	66	-10.86	34.17	56	-21.83	Compliant
Line 2	2.856 MHz	42	56	-14	25.54	46	-20.46	Compliant
Line 2	16.648 MHz	32.23	60	-27.77	27.73	50	-22.27	Compliant

Idle Mode

Quasi-Peak and Average Measurements

Testing performed on the AC Input to the AC – DC power adapter



Idle Mode

Peak Scan (Line 1 and 2)

10 Antenna Requirement per FCC Part 15.203

10.1 Test Limits

§ 15.203: An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of §15.211, §15.213, §15.217, §15.219, or §15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

10.2 Results:

The sample tested met the antenna requirement. The test sample utilized an onboard PCB antenna that meets the requirements of Part 15.203.

11 Measurement Uncertainty

The measured value related to the corresponding limit will be used to decide whether the equipment meets the requirements.

The measurement uncertainty figures were calculated and correspond to a coverage factor of $k = 2$, providing a confidence level of respectively 95.45 % in the case where the distributions characterizing the actual measurement uncertainties are normal (Gaussian).

Measurement uncertainty Table

Parameter	Uncertainty	Notes
Radiated emissions, 30 to 1000 MHz	$\pm 3.9\text{dB}$	
Radiated emissions, 1 to 18 GHz	$\pm 4.2\text{dB}$	
Radiated emissions, 18 to 40 GHz	$\pm 4.3\text{dB}$	
Power Port Conducted emissions, 150kHz to 30 MHz	$\pm 2.8\text{dB}$	

12 Revision History

Revision Level	Date	Report Number	Notes
0	2/21/2013	101025780LEX-001	Original Issue