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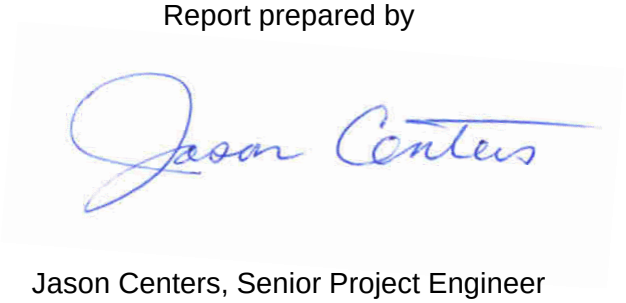
TEST REPORT

Report Number:	**100350432LEX-003**
Project Number:	**G100350432**
Report Issue Date:	**9/12/2011**
Product Name:	**Wireless Control Tablet**
Model Number:	**TCA200**
FCCID:	**G95TCA200**
ICIC:	**431C-TCA200**
FCC Standards:	**Title 47 CFR Part 15 Subpart B and C**
Industry Canada	**RSS-210 Issue 8 & RSS-GEN Issue 3**

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

Client:
Technicolor USA, Inc.
101 W 103rd Street
Indianapolis, IN 46290

Report prepared by



Jason Centers, Senior Project Engineer

Report reviewed by

Jeremy Pickens, Senior Staff Engineer

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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.

The INTERTEK-Lexington is 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
7	Occupied Bandwidth	§ 15.247(a)(2)	RSS210 A8.2(A)	Pass
12	Conducted Spurious Emissions	§ 15.247(d)	RSS210 (A8.5)	Pass
16	Power Spectral Density	§ 15.247(e)	RSS210 A8.2(B)	Pass
20	Radiated Spurious Emissions (Transmitter)	§ 15.247(d), § 15.209, and § 15.205	RSS-210 (2.2)	Pass
27	Radiated Spurious Emissions (Receiver)	§ 15.109	RSS-Gen (7.2.3)	Pass
30	AC Powerline Conducted Emissions	§ 15.207	RSS-Gen (7.2.2)	Pass
32	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	Technicolor USA, Inc.
Model Number	TCA200
Serial Number	TCA2001281001000103
FCC Identifier	G95TCA200
IC Identifier	431C-TCA200
Receive Date	8/1/2011
Test Start Date	8/1/2011
Test End Date	8/16/2011
Device Received Condition	Good
Test Sample Type	Production
Frequency Band	2425MHz – 2475MHz
Mode(s) of Operation	Zigbee
Modulation Type	QPSK
Duty Cycle	66%
Transmission Control	Test Commands via Ember InSight Adapter
Maximum Output Power	18.87dBm (conducted output)
Test Channels	15, 20, 25 (Declared by Manufacturer)
Antenna Type (15.203)	Internal Gain = 2.41dBi
Operating Voltage	115VAC/60Hz
Power Supply	AC Bel, Model: WAA019, Sn: V123400271

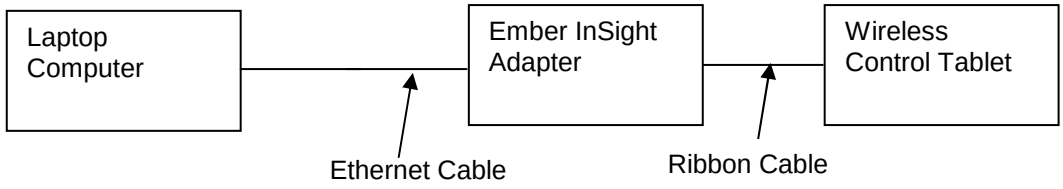
Description of Equipment Under Test
The TCA200 is a touch screen alarm panel.

Operating modes of the EUT:

No.	Descriptions of EUT Exercising
1	Transmitting on channels 15, 20, or 25.
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:

Cables					
Description	Length	Shielding	Ferrites	Connection	
				From	To
Power Cable	6 ft	No	Yes	AC/DC Power Converter	DC Input
Ethernet Cable	25 ft	No	No	Ethernet Port	Ethernet Switch
Speaker Cable	3 ft	No	No	Headphone Port	Headphones

3.4 Support Equipment:

Support Equipment			
Description	Manufacturer	Model Number	Serial Number
Programming Adapter	Ember	InSight ISA3	Not Labeled
Laptop Computer	Toshiba	Tecra PTA83U-03202C	76104530H

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	3099	Rohde & Schwarz	FSP7	8/27/2010	8/27/2011

4.4 Results:

Channel Number	Frequency (MHz)	Peak Conducted Power (dBm)	Peak Conducted Power Limit (dBm)	Margin (dB)	Result
15	2425	18.41	30	-11.59	Pass
20	2450	18.87	30	-11.13	Pass
25	2475	17.14	30	-12.86	Pass

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)

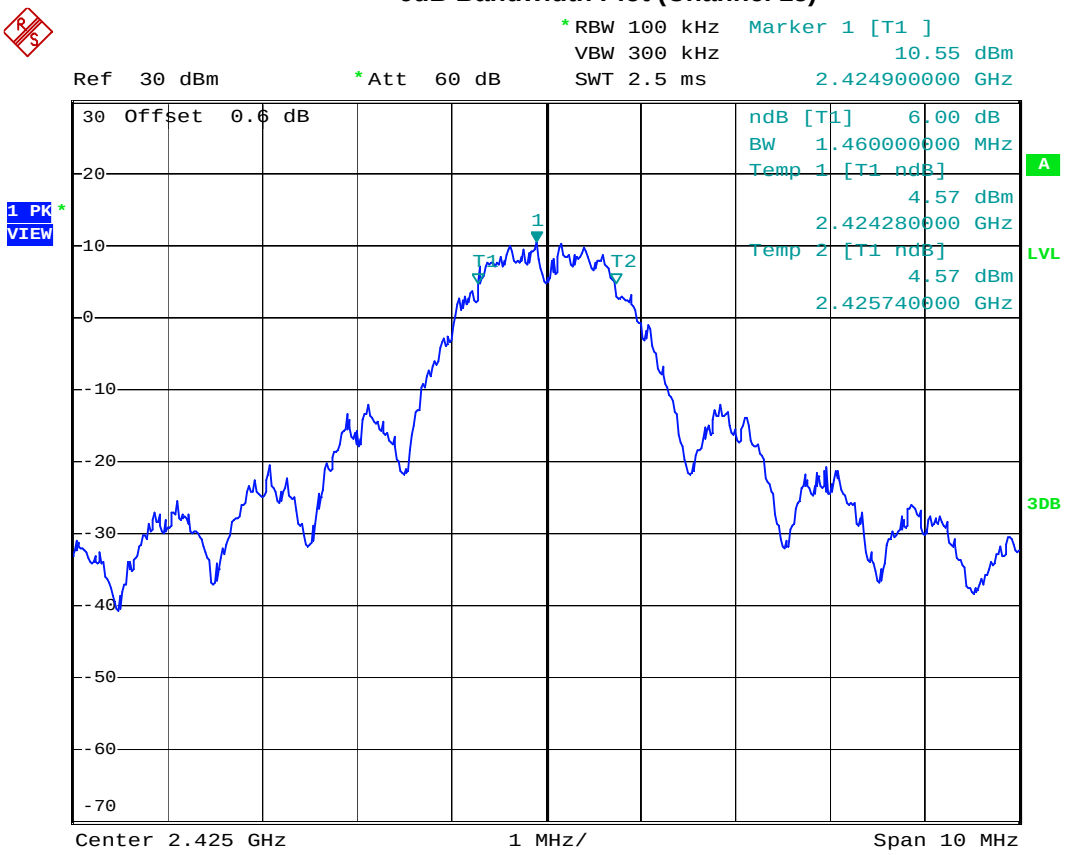
5.3 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
Spectrum Analyzer	3099	Rohde & Schwarz	FSP7	8/27/2010	8/27/2011

5.4 Results:

Channel Number	Frequency (MHz)	6dB Bandwidth	99% Power Bandwidth	Result
15	2425	1.46 MHz	---	Pass
20	2450	1.5 MHz	2.4 MHz	Pass
25	2475	1.6 MHz	---	Pass

6dB Bandwidth Plot (Channel 15)



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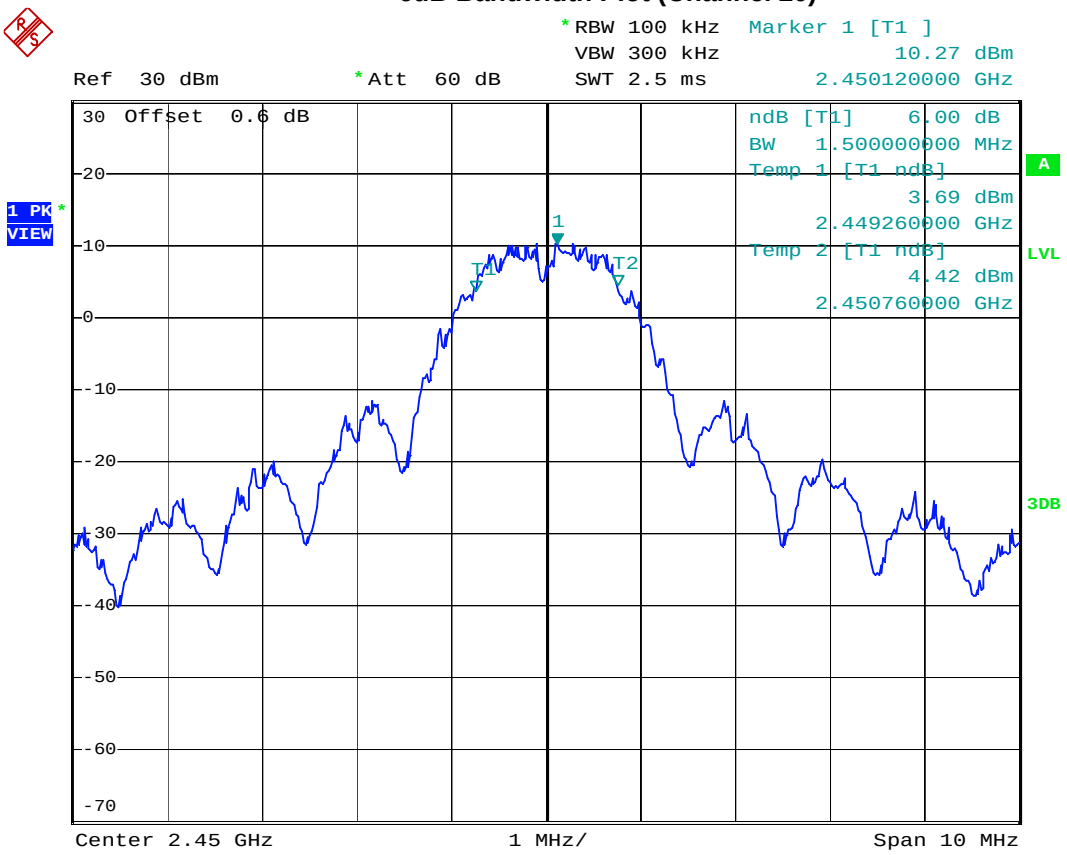
6dB Bandwidth Plot (Channel 20)



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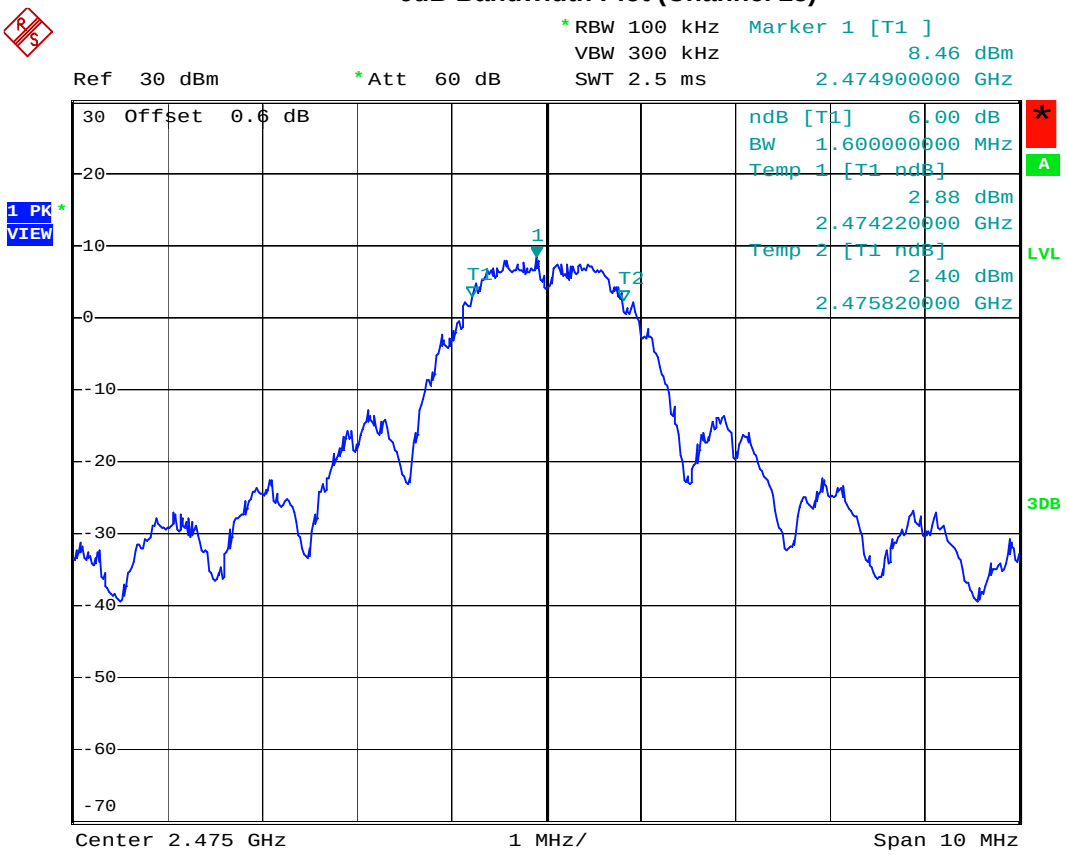
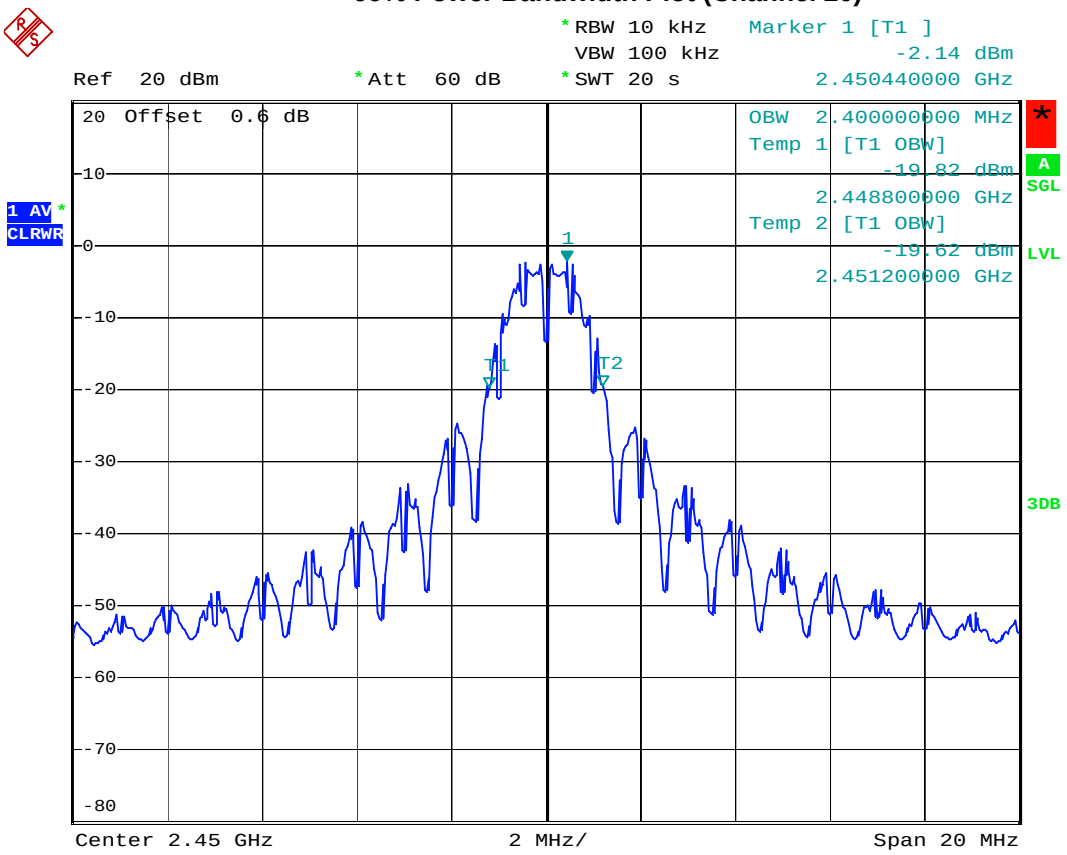
6dB Bandwidth Plot (Channel 25)



99% Power Bandwidth Plot (Channel 20)



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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)

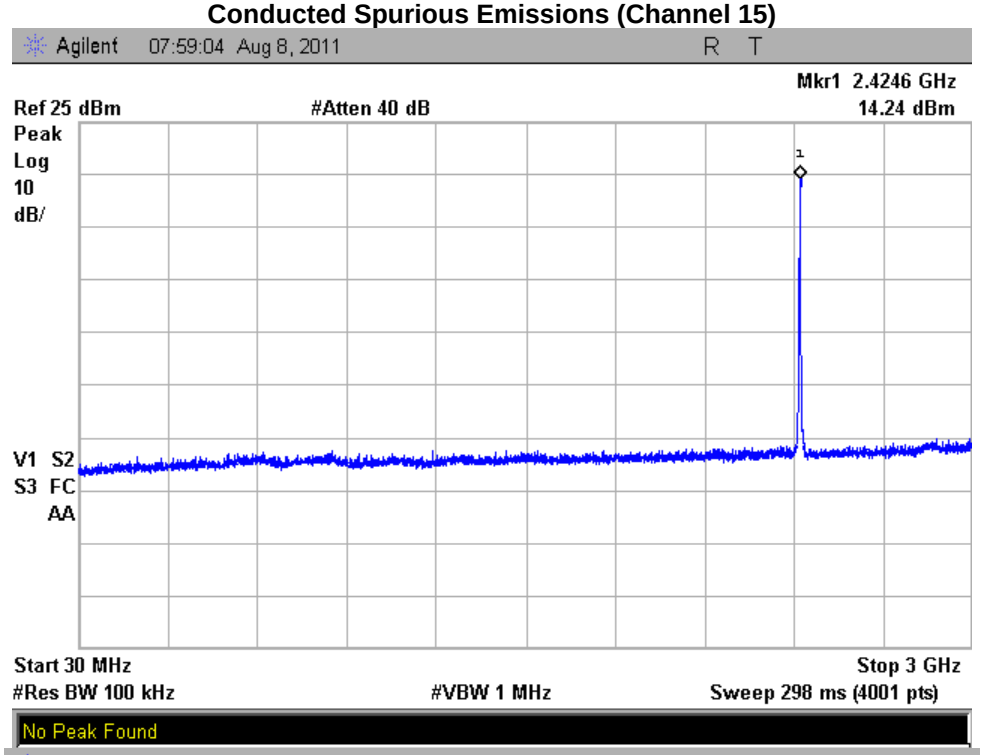
6.3 Test Equipment Used:

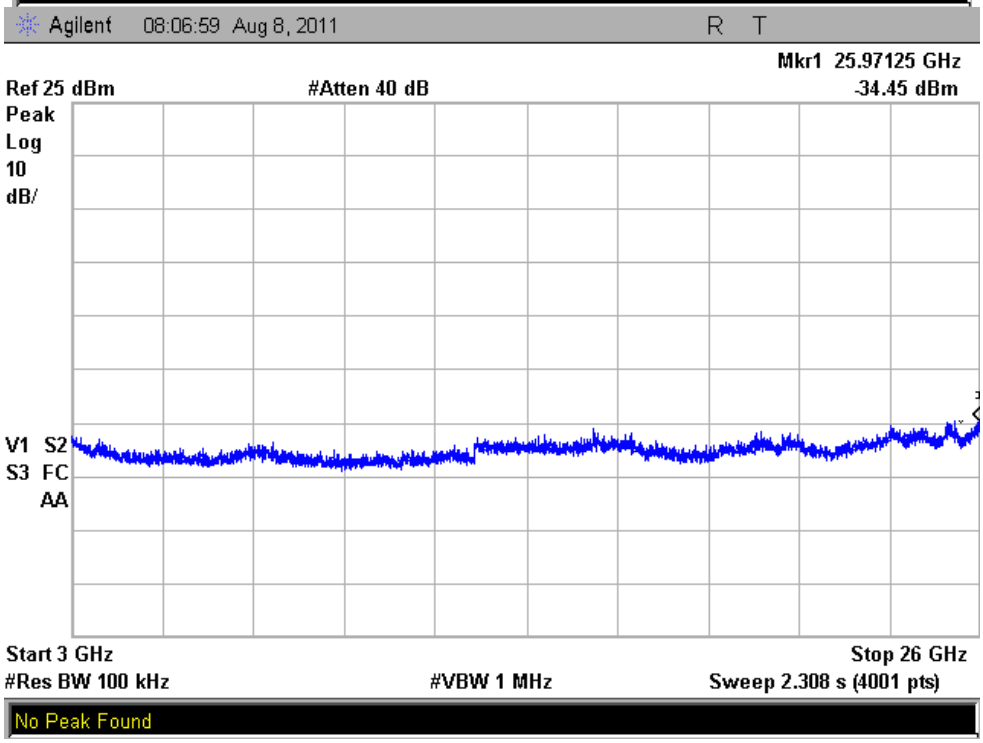
Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
EMC Analyzer	2142	HP	E7405	9/1/2010	9/1/2011

6.4 Results:

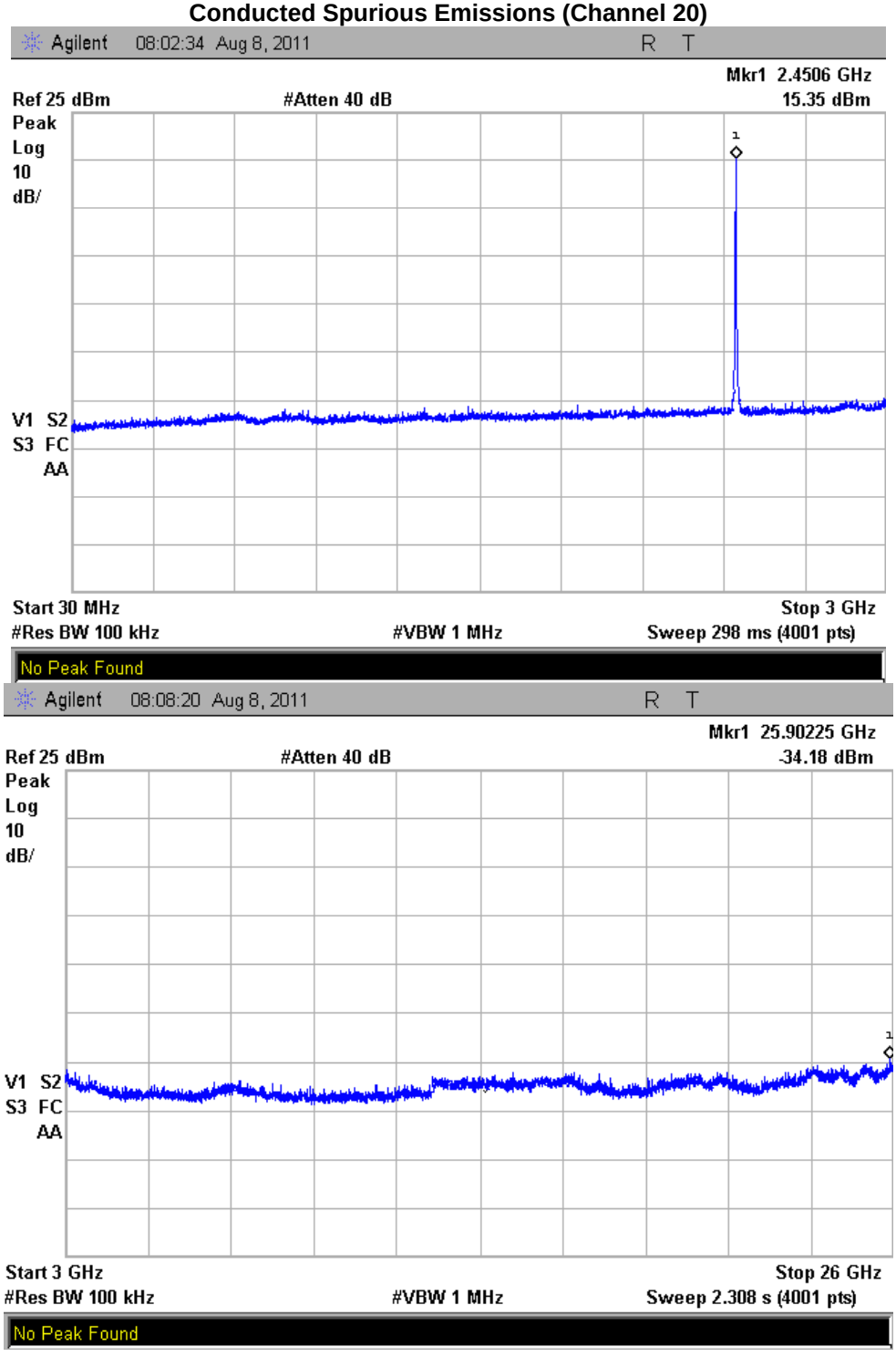
The following plots show that there are no conducted spurious emissions exceeding the 20dB down criteria.

Conducted Spurious Emissions (Channel 15)

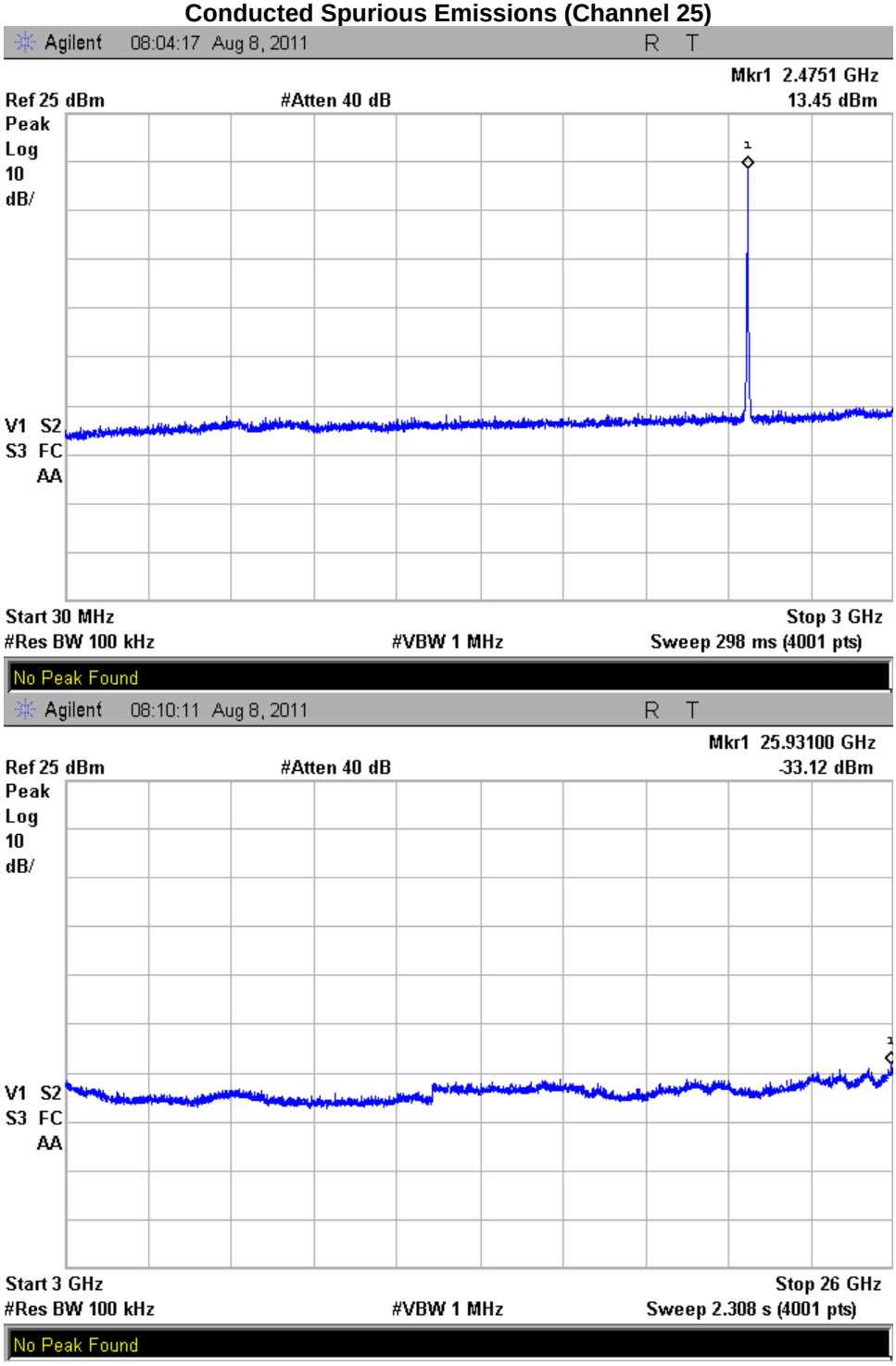




Conducted Spurious Emissions (Channel 20)



Conducted Spurious Emissions (Channel 25)



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:

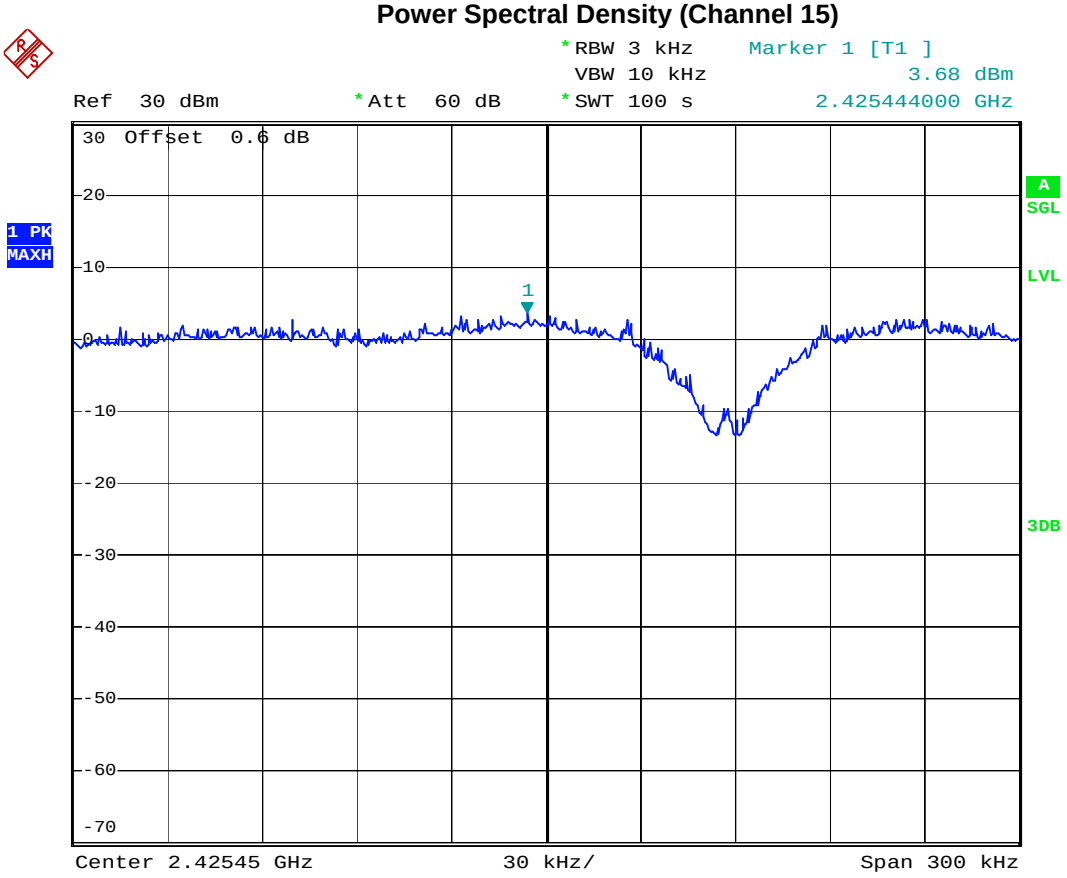
Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
Spectrum Analyzer	3099	Rohde & Schwarz	FSP7	8/27/2010	8/27/2011

7.4 Results:

*PSD Option 1 Method

Channel Number	Frequency (MHz)	PSD in 3kHz BW (dBm)	Limit (dBm)	Margin (dB)	Result
15	2425	3.68	8	-4.32	Pass
20	2450	3.83	8	-4.17	Pass
25	2475	1.23	8	-6.77	Pass

Power Spectral Density (Channel 15)



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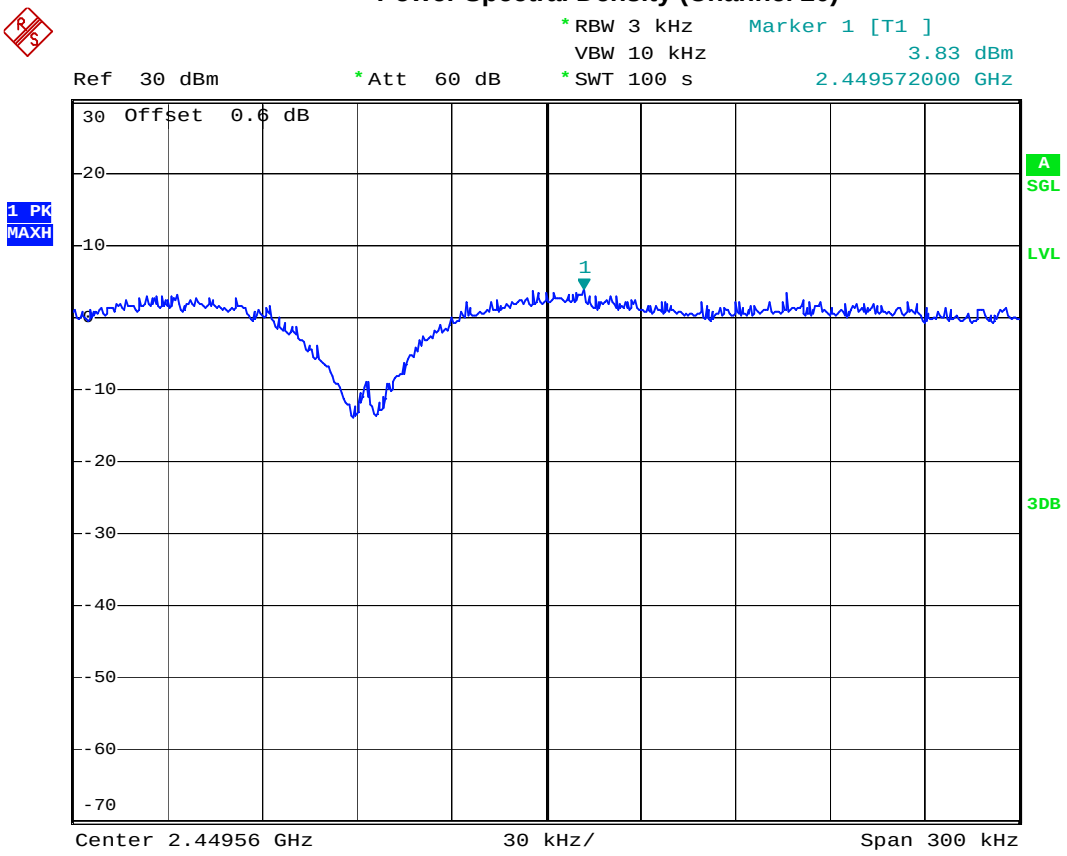
Power Spectral Density (Channel 20)



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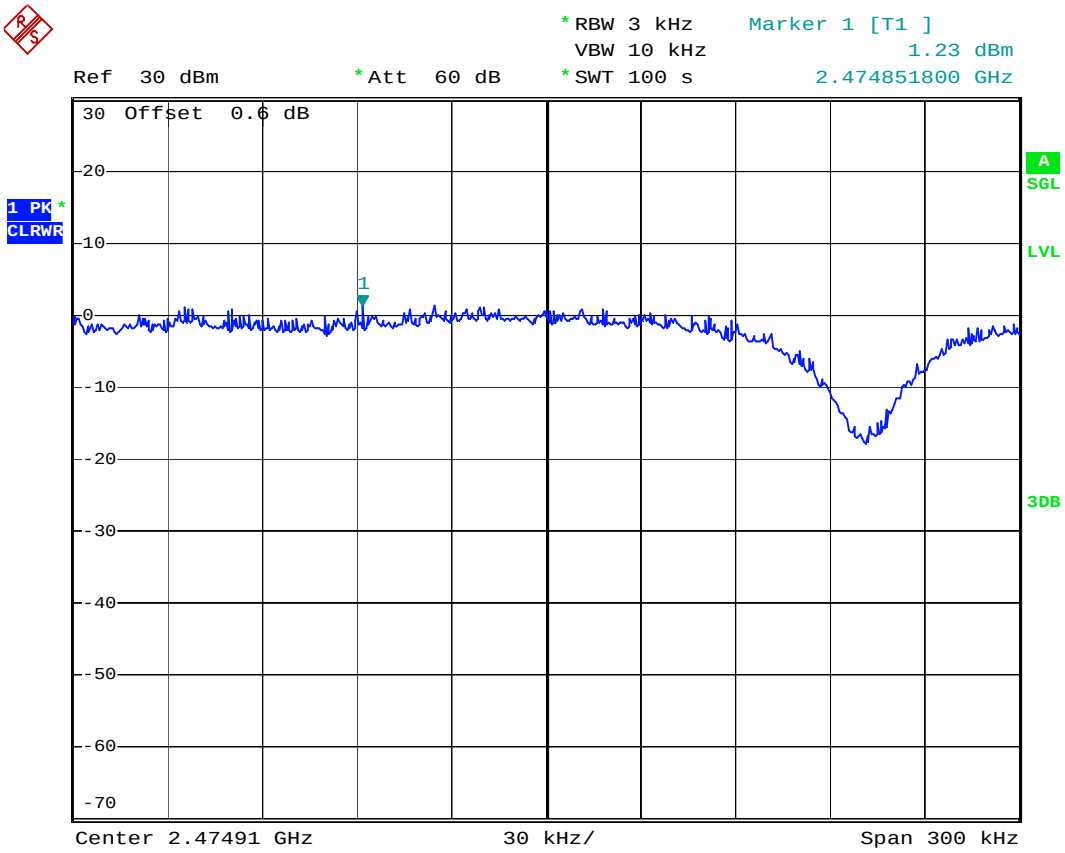
Power Spectral Density (Channel 25)



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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 dBμV/m
RA = Receiver Amplitude in dBμV
AF = Antenna Factor in dB
CF = Cable Attenuation Factor in dB (Including preamplifier and filter attenuation)

Example Calculation:

RA = 19.48 dBμV
AF = 18.52 dB
CF = 0.78 dB

FS = 19.48 + 18.52 + 0.78 = 38.78 dBμV/m
Level in μV/m = Common Antilogarithm [(38.78 dBμV/m)/20] = 86.89 μV/m

8.4 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
EMI Test Receiver	10887490.26	Rohde & Schwarz	ESI26	6/29/2011	6/29/2012
Preamplifier	987410	Miteq	AFS44-00102000-30-10P-44	2/4/2011	2/4/2012
Preamplifier	SF456200904	Mini-Circuits	ZX60-3018G-S+	2/4/2011	2/4/2012
Biconnilog Antenna	00051864	ETS	3142C	12/20/2010	12/20/2011
Horn Antenna	6556	ETS	3115	8/24/2011	8/24/2012
Horn Antenna	1096	Antenna Research	DRG-118/A	7/20/2011	7/20/2012
System Controller	121701-1	Sunol Sciences	SC99V	Time of Use	Time of Use
High Pass Filter	3986-01 DC0408	Microwave Circuits, Inc.	H3G020G2	Time of Use	Time of Use

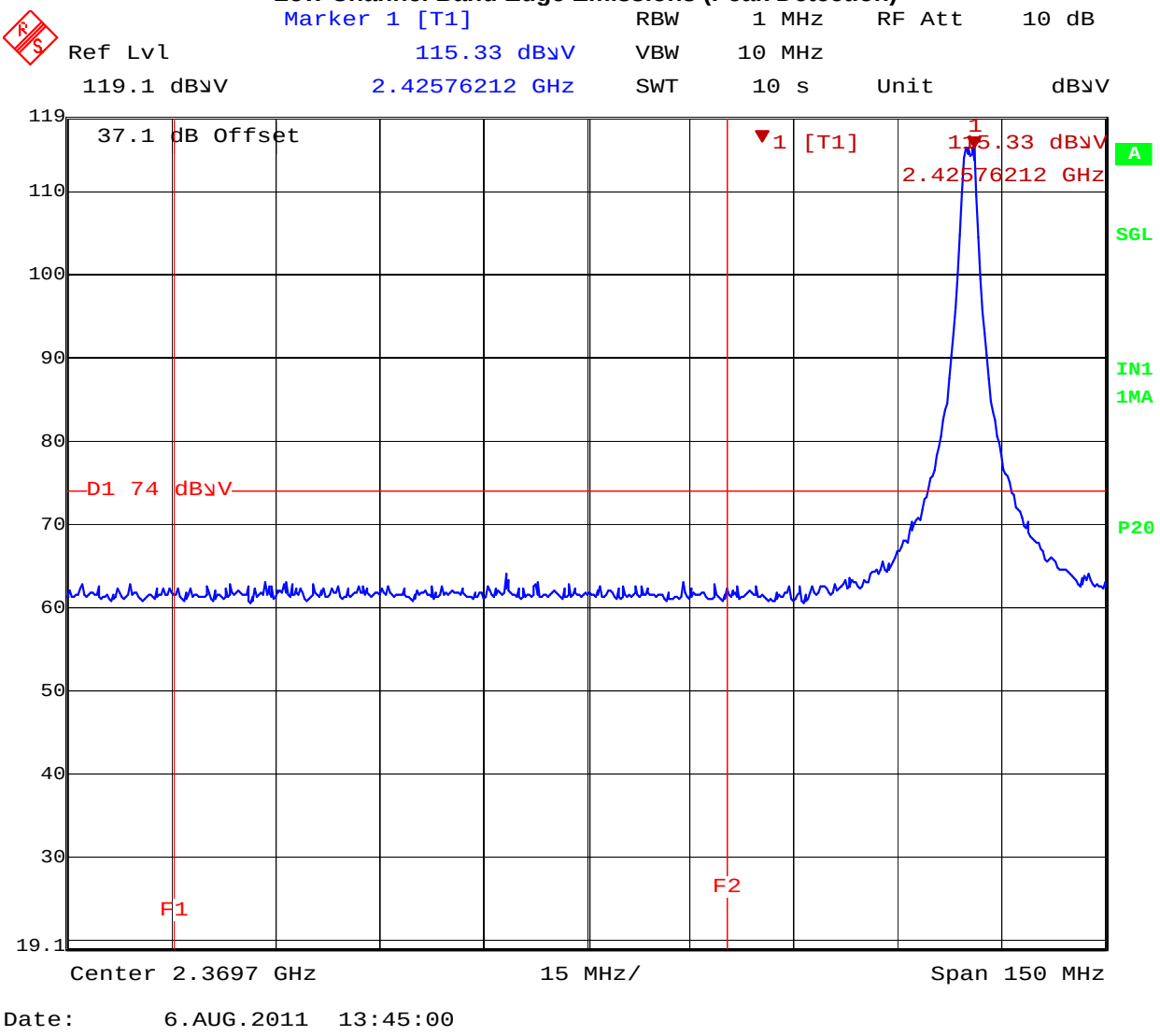
8.5 Results:

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.

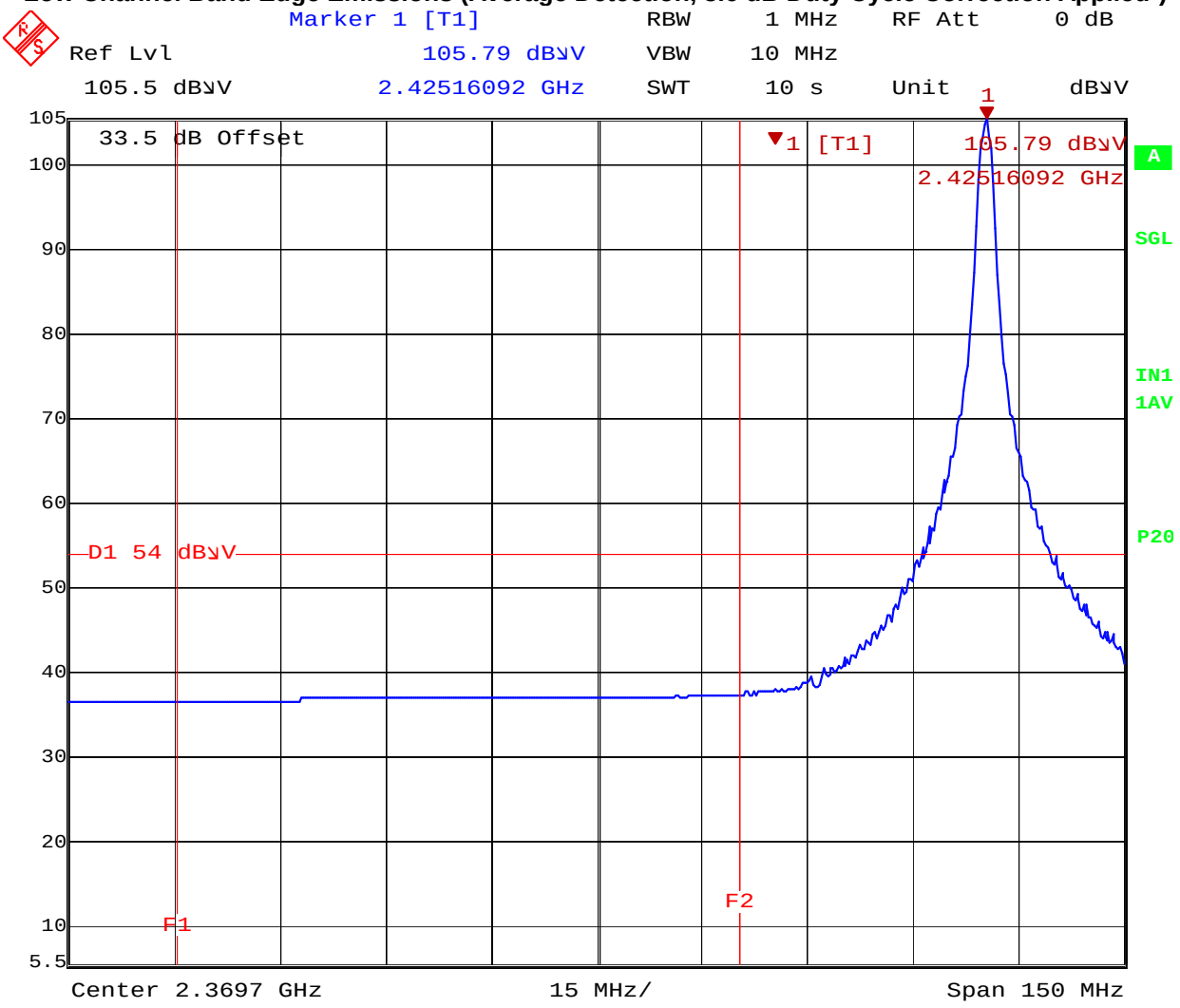
Worst Case Spurious Measurements

TX Channel	Spurious Frequency	Polarity	Corr. Peak Reading. (dBuV/m)	Avg Reading. (dBuV/m)	Duty Cycle Factor (dB)	Corr. Avg Reading. (dBuV/m)	Peak Limit (dBuV/m)	Avg. Limit (dBuV/m)	Results	Comments
15	4.8511 GHz	V	52.85	43.542	0	43.542	74	54	Compliant	
15	7.2766 GHz	V	53.755	42.935	0	42.935	74	54	Compliant	
15	12.123 GHz	V	53.091	39.373	0	39.373	74	54	Compliant	
15	4.851 GHz	H	57.384	50.364	0	50.364	74	54	Compliant	
15	7.2736 GHz	H	52.25	40.89	0	40.89	74	54	Compliant	
15	12.119 GHz	H	51.119	39.229	0	39.229	74	54	Compliant	
20	4.9011 GHz	V	55.009	45.66	0	45.66	74	54	Compliant	
20	7.3516 GHz	V	58.705	49.755	0	49.755	74	54	Compliant	
20	12.253 GHz	V	55.53	42.71	0	42.71	74	54	Compliant	
20	4.899 GHz	H	58.698	51.648	0	51.648	74	54	Compliant	
20	7.3514 GHz	H	59.169	49.769	0	49.769	74	54	Compliant	
20	12.253 GHz	H	53.678	41.148	0	41.148	74	54	Compliant	
25	4.9489 GHz	V	55.444	47.524	0	47.524	74	54	Compliant	
25	7.4236 GHz	V	61.645	53.655	0	53.655	74	54	Compliant	
25	12.377 GHz	V	53.09	42.33	0	42.33	74	54	Compliant	
25	4.9511 GHz	H	57.14	49.54	0	49.54	74	54	Compliant	
25	7.4236 GHz	H	58.425	49.475	0	49.475	74	54	Compliant	
25	12.378 GHz	H	55.892	41.462	0	41.462	74	54	Compliant	

Low Channel Band Edge Emissions (Peak Detection)

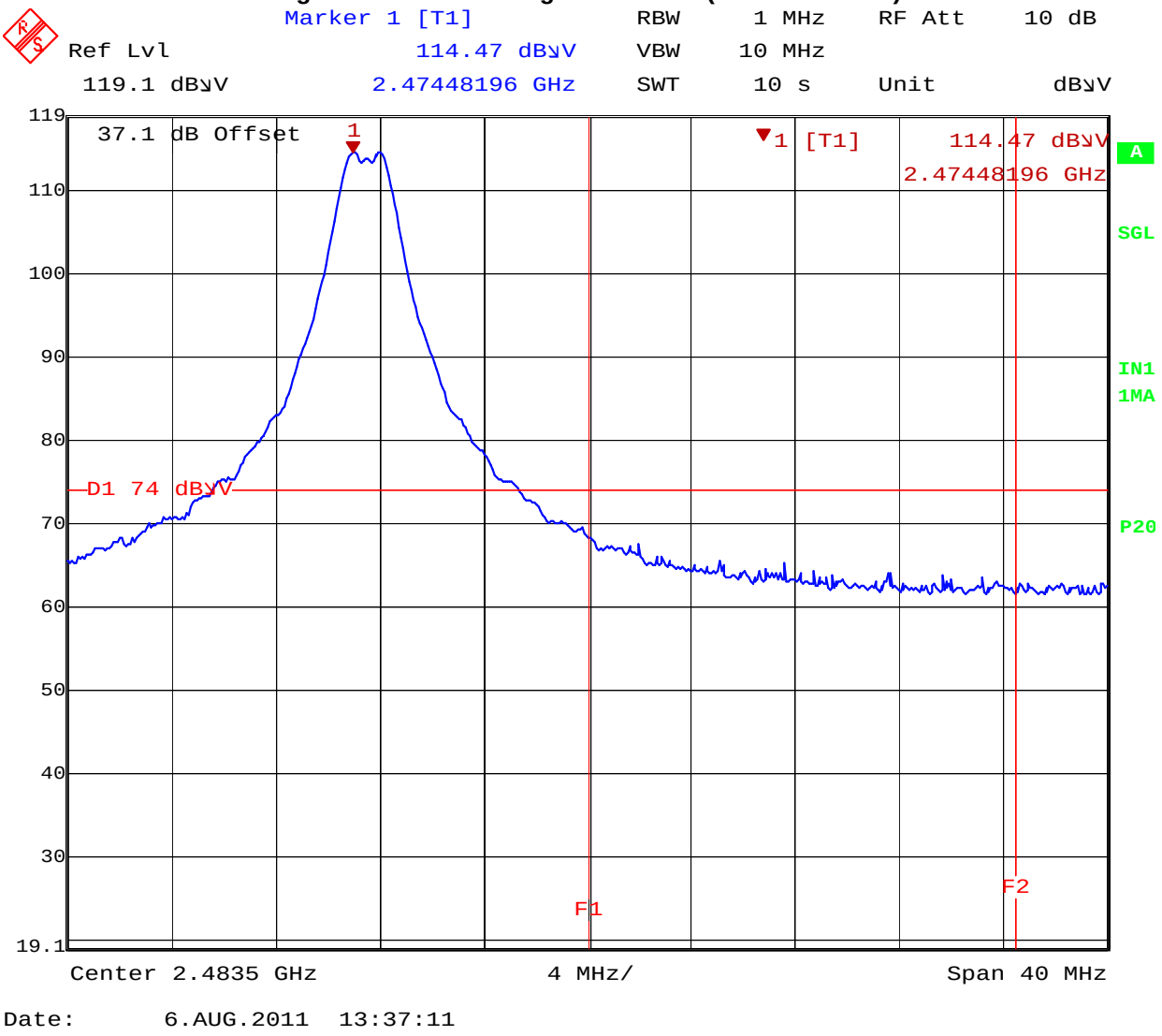


Low Channel Band Edge Emissions (Average Detection, 3.6 dB Duty Cycle Correction Applied[1])



1 See Section 12 for duty cycle determination.

High Channel Band Edge Emissions (Peak Detection)



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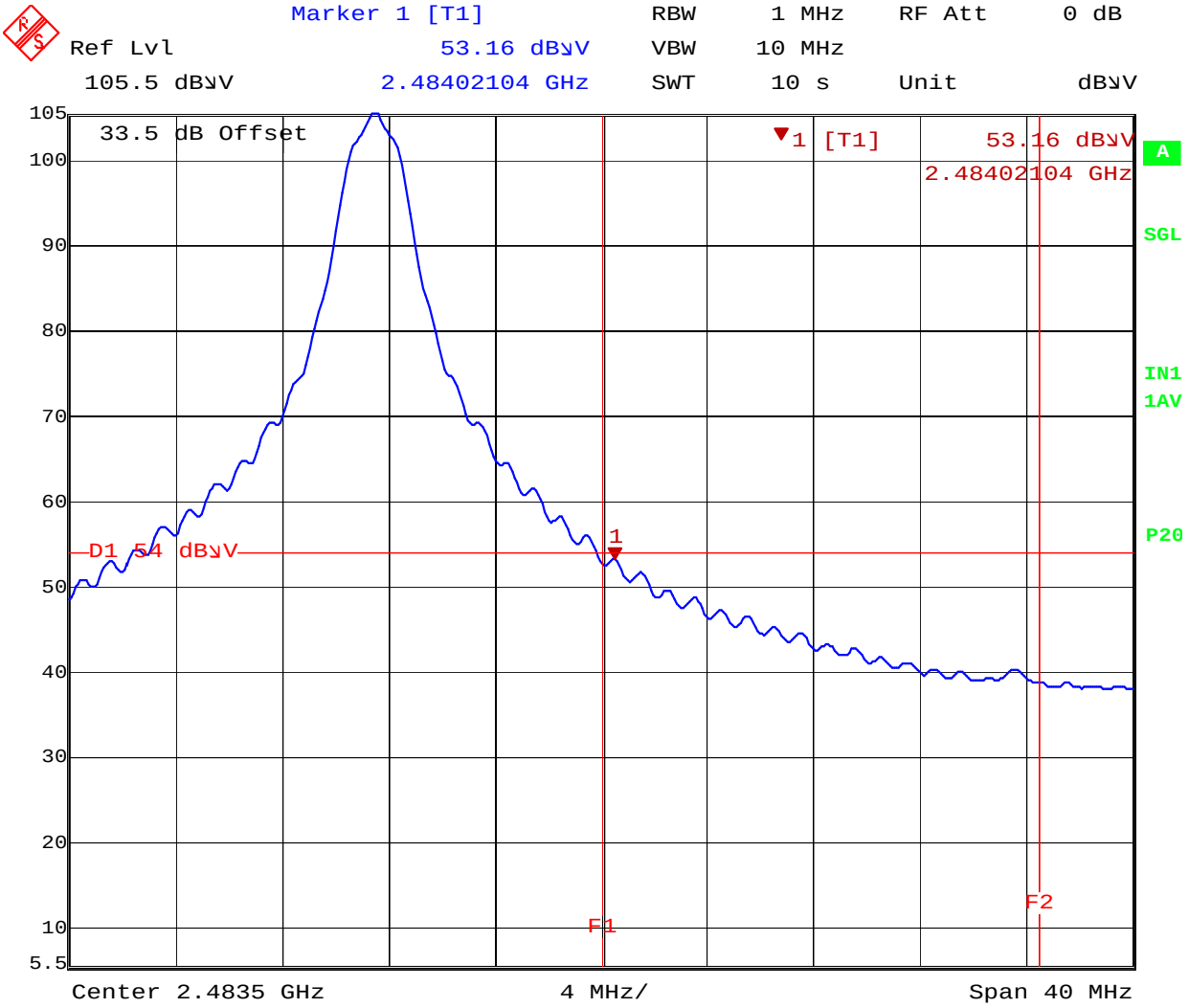
High Channel Band Edge Emissions (Average Detection, Duty Cycle Correction Applied[2])



2 See Section 12 for duty cycle determination.

9 Radiated Spurious Emissions (Receiver)

9.1 Test Limits

§ 15.109: Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

Frequency of emission (MHz)	Field strength (microvolts/meter)	Field strength (dBuV/m)
30–88	100	40
88–216	150	43.5
216–960	200	46
Above 960	500	54

9.2 Test Procedure

ANSI C63.4: 2009

9.3 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 dBµV/m
RA = Receiver Amplitude in dBµV
AF = Antenna Factor in dB
CF = Cable Attenuation Factor in dB (Including preamplifier and filter attenuation)

Example Calculation:

RA = 19.48 dBµV
AF = 18.52 dB
CF = 0.78 dB

FS = 19.48 + 18.52 + 0.78 = 38.78 dBµV/m
Level in µV/m = Common Antilogarithm [(38.78 dBµV/m)/20] = 86.89 µV/m

9.4 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
EMI Test Receiver	10887490.26	Rohde & Schwarz	ESI26	6/29/2011	6/29/2012
Preamplifier	987410	Miteq	AFS44-00102000-30-10P-44	2/4/2011	2/4/2012
Preamplifier	SF456200904	Mini-Circuits	ZX60-3018G-S+	2/4/2011	2/4/2012
Biconnilog Antenna	00051864	ETS	3142C	12/20/2010	12/20/2011
Horn Antenna	6556	ETS	3115	8/24/2011	8/24/2012
Horn Antenna	1096	Antenna Research	DRG-118/A	7/20/2011	7/20/2012
System Controller	121701-1	Sunol Sciences	SC99V	Time of Use	Time of Use

9.5 Results:

All spurious emissions with the test sample in receive mode were below the limits specified in Part 15.109 for a class B digital device.

Maximized Quasi Peak Emissions

Radiated Emissions

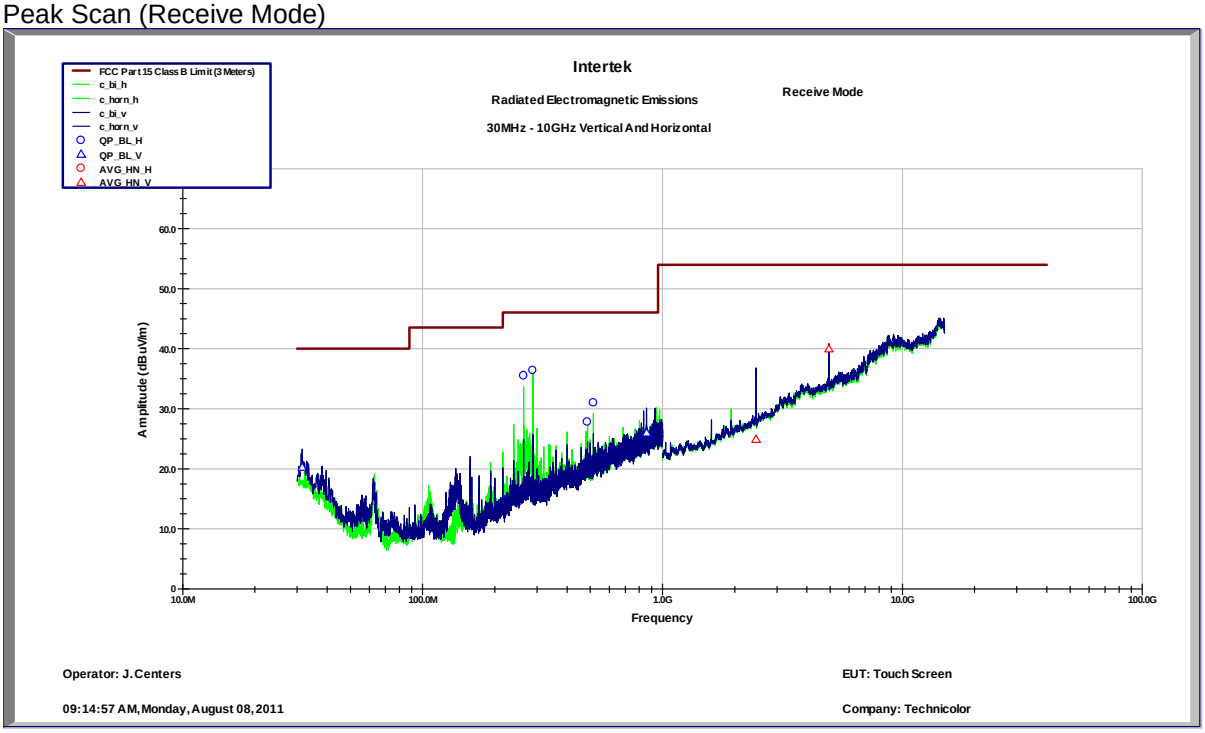
Test Engineer: J. Centers **Start Date:** 8/8/2011 **End Date:** 8/8/2011
Temperature: 24.8C **Humidity:** 47.30% **Pressure:** 978.67 mbar

Specification: FCC Part 15B **Test Limit:** Class B
Notes:

A	B	C	D	E	F	G	H	I	J	K
Frequency	Polarity (H/V)	Raw Reading (dBuV)	Cab. (dB)	Ant. (dB)	Corr. Reading. (dBuV/m)	Limit (dBuV/m)	Delta (dB)	RBW / Detector	Test Distance	Results
31.5 MHz	V	19.14	-16.13	17.25	20.26	40	-19.74	120kHz/QP	3m	**Compliant**
859.1 MHz	V	14.41	-11.4	22.95	25.96	46.02	-20.06	120kHz/QP	3m	**Compliant**
264.01 MHz	H	36.64	-14.26	13.12	35.5	46.02	-10.52	120kHz/QP	3m	**Compliant**
288.0 MHz	H	37.44	-14.19	13.12	36.38	46.02	-9.64	120kHz/QP	3m	**Compliant**
486.85 MHz	H	22.41	-13.13	18.5	27.78	46.02	-18.24	120kHz/QP	3m	**Compliant**
515.47 MHz	H	25.62	-13.01	18.35	30.96	46.02	-15.06	120kHz/QP	3m	**Compliant**
2.455 GHz	V	29.47	-33.12	28.54	24.89	53.98	-29.09	1MHz/AVG	3m	**Compliant**
4.9421 GHz	V	35.14	-28.28	33.1	39.96	53.98	-14.02	1MHz/AVG	3m	**Compliant**

Calculations: F = C + D + E H = F - G

Peak Scan (Receive Mode)



10 AC Powerline Conducted Emissions

10.1 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 μH/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 (dBμV)	
	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.

10.2 Test Procedure

ANSI C63.4: 2009

10.3 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
EMI Test Receiver	10887490.26	Rohde & Schwarz	ESI26	6/29/2011	6/29/2012
LISN	3333	Teseq	NNB52	3/3/2011	3/3/2012

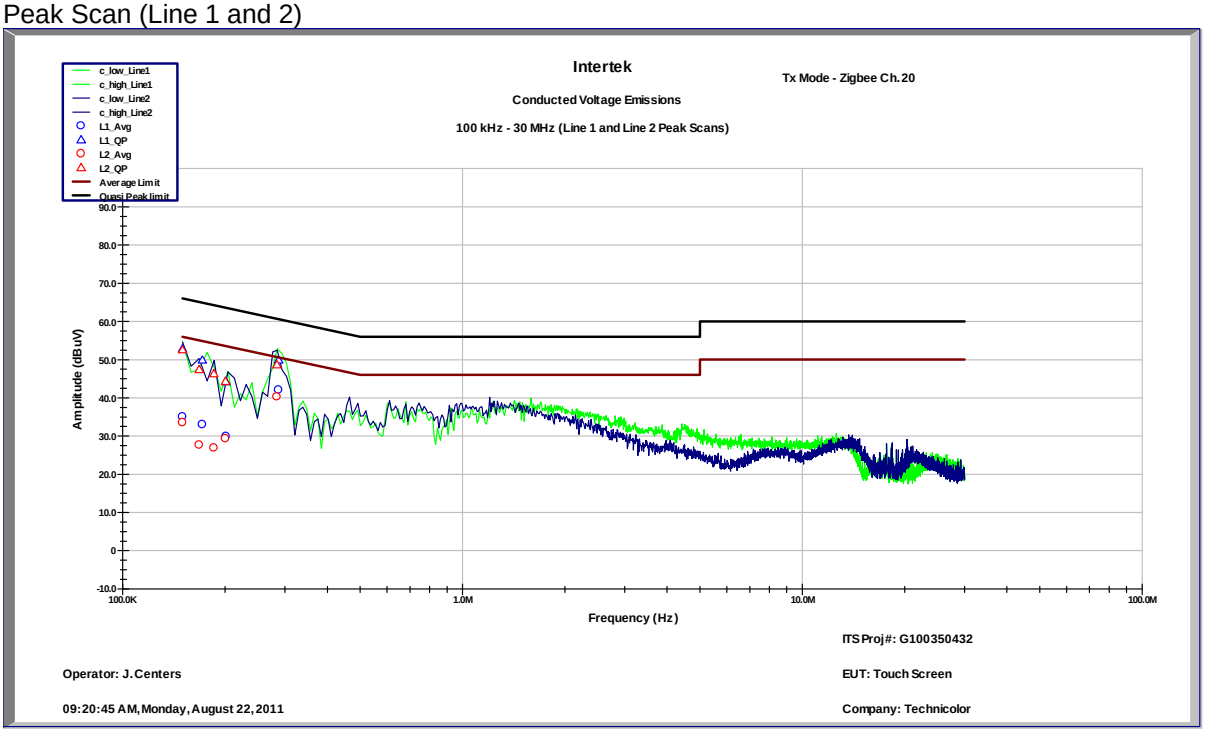
10.4 Results:

Quasi-Peak and Average Measurements

Conducted Voltage Emissions on Power Lines							
Test Engineer:	J. Centers	**Start Date:**	8/22/2011	**End Date:**	8/22/2011		
Temperature:	24.7C	**Humidity:**	48.50%	**Pressure:**	985.4mbar		
Specification:	FCC Part 15	**Test Limit:**	15.107/15.207	**RBW:**	9kHz		
Notes:							

Line	Frequency (MHz)	Quasi-Peak (dBuV)	Quasi-Peak Limit (dBuV)	Quasi-Peak Delta (dB)	Average (dBuV)	Average Limit (dBuV)	Average Delta (dB)	Results
L1	150.0 KHz	52.83	66	-13.17	35.01	56	-20.99	**Compliant**
L1	171.6 KHz	49.86	64.88	-15.03	32.96	54.88	-21.93	**Compliant**
L1	201.3 KHz	44.2	63.56	-19.36	29.84	53.56	-23.72	**Compliant**
L1	287.6 KHz	49.84	60.59	-10.75	42.01	50.59	-8.58	**Compliant**
L2	150.0 KHz	52.55	66	-13.45	33.48	56	-22.52	**Compliant**
L2	168.0 KHz	47.39	65.06	-17.66	27.64	55.06	-27.41	**Compliant**
L2	185.5 KHz	46.28	64.24	-17.95	26.85	54.24	-27.38	**Compliant**
L2	200.6 KHz	44.28	63.59	-19.31	29.29	53.59	-24.3	**Compliant**
L2	284.2 KHz	48.63	60.69	-12.06	40.25	50.69	-10.44	**Compliant**

Peak Scan (Line 1 and 2)



11 Antenna Requirement per FCC Part 15.203

11.1 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.

11.2 Results:

The sample tested met the antenna requirement. The antenna utilized a U.fl connector to connect to the PCB.

12 Duty Cycle Correction Factor Determination

The worst case duty cycle over a 100ms windows was calculated by the manufacture to determine the duty cycle factor.

Goal: Calculate the worse case time a ZigBee Node will be in TX Mode in any 100ms Time Window.
Correction Factor is: 20*Log10(Duty Cycle)

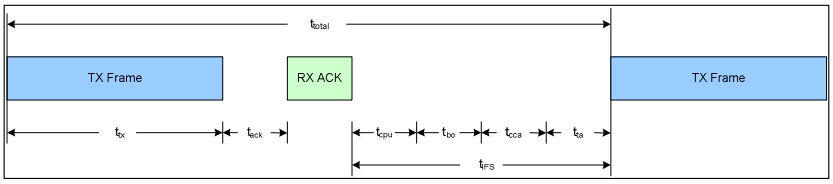
Procedure: In order to calculate the worse case TX on time, Ember started by reviewing the IEEE 802.15.4 MAC and PHY constants. In addition, Ember used the slotted ACK LIFS and SIFS scenarios. Each scenario is described below.

Worst Case Scenario: The worst case scenario utilizes LIFS, and a TX, RX ACK, TX, RX ACK… from a single node. It has been proven through calculation, this scenario keeps the node in TX Mode for the longest

Summary: ***If you are using EmberZNet Stack SW, the TX duty cycle: 66%***

IEEE 802.15.4-2003 2.4 GHz PHY Constants

Data Rate	250000	bits / sec	
	31250	bytes / sec	
Symbols/byte	2	sym / bytes	
Symbol Timing	62500	sym / sec	
	0.000016	sec / sym	
Byte Timing	0.000032	sec / byte	
PHY PSDU	6	bytes	4 Pramble, SPD, Length
Max Length	127	bytes	
Total Packet Length	133	bytes	
Maximum Time TX PKT	0.004256	sec	



Long Frame Scenario:
1) TX Frame — Assume Frame is Data Frame
2) Wait for ACK
3) RX ACK
4) CPU Processing of ACK
5) Wait for Backoff
6) Repeat 1)

MAC-Level Calculation (LIFS)

Long InterFrame Spacing (Slotted w/ ACK)			
Long Frame	127	bytes	
Data Frame Payload	102	bytes	
ACK Frame	5	bytes	
tack	12	sym	
LIFS	40	sym	
Backoff Period	20	sym	
Maximum Backoff	7		Random between 0 and 7
Backoff Required	2		
Backoff Time	70	sym	Average at 3.5

Transmit Time	
TX Time (Packet)	0.004256
Total TX Time (sec)	0.004256

NOT Transmit time (RX or Idle)		
Wait for ACK (tack)	0.000192	
RX Time (ACK)	0.000352	
Backoff Time (tbo)	0.00112	(Backoff Time * Backoff Period)
CPU Processing (tcpu)	0.0002	(0.2ms average on EM2xx running EmberZNet)
CCA Assessment (tcca)	0.000128	(averaged over 8 symbols in RX Mode)
Turn Around Time (RX to TX)	0.000192	(After CCA, Radio turns over to TX in 12 symbols)
Total Off Time (sec)	0.002184	

Total Time (ttotal)	0.00644
Number of RX / TX cycles in 100ms	15.5279503

Worse Case (100ms window)

TX Frame 10 times	0.04256
RX or IDLE 10 Times	0.02184
Sum	0.0644

MAC TX Duty Cycle (On /total)	66.09%		Represents theoretical ZigBee / MAC performance
	3.59768496	dB	

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	±3.9dB	
Radiated emissions, 1 to 18 GHz	±4.2dB	
Radiated emissions, 18 to 40 GHz	±4.3dB	
Power Port Conducted emissions, 150kHz to 30 MHz	±2.8dB	

13 Revision History

Revision Level	Date	Report Number	Notes
0	9/12/2011	100350432LEX-003	Original Issue
1	10/1/2011	100350432LEX-003	Added Duty Cycle Calculation