

TEST REPORT

Report Number: 100616097LEX-001
Project Number: G100616097

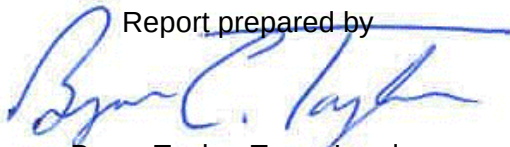
Report Issue Date: 3/9/2012

Product Name: EIA200MRF Module
Model Number: EiA200MRF
FCCID: A5FEIA200MRF
FCC Standards: CFR Title 47 Part 15 Subpart C

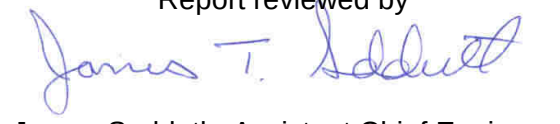
Tested by:
Intertek Testing Services NA, Inc.
731 Enterprise Drive
Lexington, KY 40510

Client:
Ei Electronics
Shannon Industrial Estate
Shannon , Co. Clare Ireland

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: 2009. 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	Occupied Bandwidth	§ 15.215	RSS-GEN(4.6.1)	Pass
9	Radiated Spurious Emissions (Transmitter)	§ 15.249(a)(c)(d)(e)	RSS-210 (A2.9)	Pass
15	Radiated Spurious Emissions (Receiver)	§ 15.109	RSS-Gen (7.2.3)	Pass
---	AC Powerline Conducted Emissions	§ 15.207	RSS-Gen (7.2.2)	NA ¹
18	Antenna Requirement per FCC Part 15.203	§ 15.203	RSS-Gen (7.1.4)	Pass

¹ This test was not applicable since there were no connections to the AC mains.

3 Description of Equipment Under Test

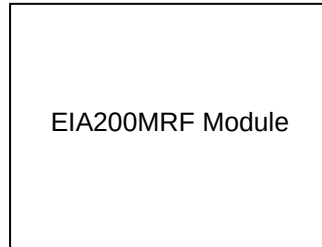
Equipment Under Test	
Manufacturer	Ei Electronics
Model Number	EiA200MRF
Serial Number	Sample 3
FCC Identifier	A5FEIA200MRF
Receive Date	12/27/2012
Test Start Date	12/27/2011
Test End Date	2/10/2012
Device Received Condition	Good
Test Sample Type	Production
Frequency Band	902.5MHz
Mode(s) of Operation	Transmitting at 902.5MHz
Transmission Control	Hard coded onto sample
Maximum Output Power	93.19dBuV/m at 3 Meters
Antenna Type (15.203)	Permanently connected wire.
Power Supply	3V Lithium Battery (CR17335)

Description of Equipment Under Test

The EiA200MRF was an RF module that installs into EiA 207 / 208 series carbon monoxide alarms.

Operating modes of the EUT:

No.	Descriptions of EUT Exercising
1	Transmitting continuously. A fresh battery was used for all testing.
2	Receive / idle mode. A fresh battery was used for all testing.

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:**

No cables were connected to the test sample.

3.4 Support Equipment:

No support equipment was used during the testing.

4 Occupied Bandwidth

4.1 Test Limits

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §15.217 through §15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage.

The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission (i.e. 20 dB bandwidth).

4.2 Test Procedure

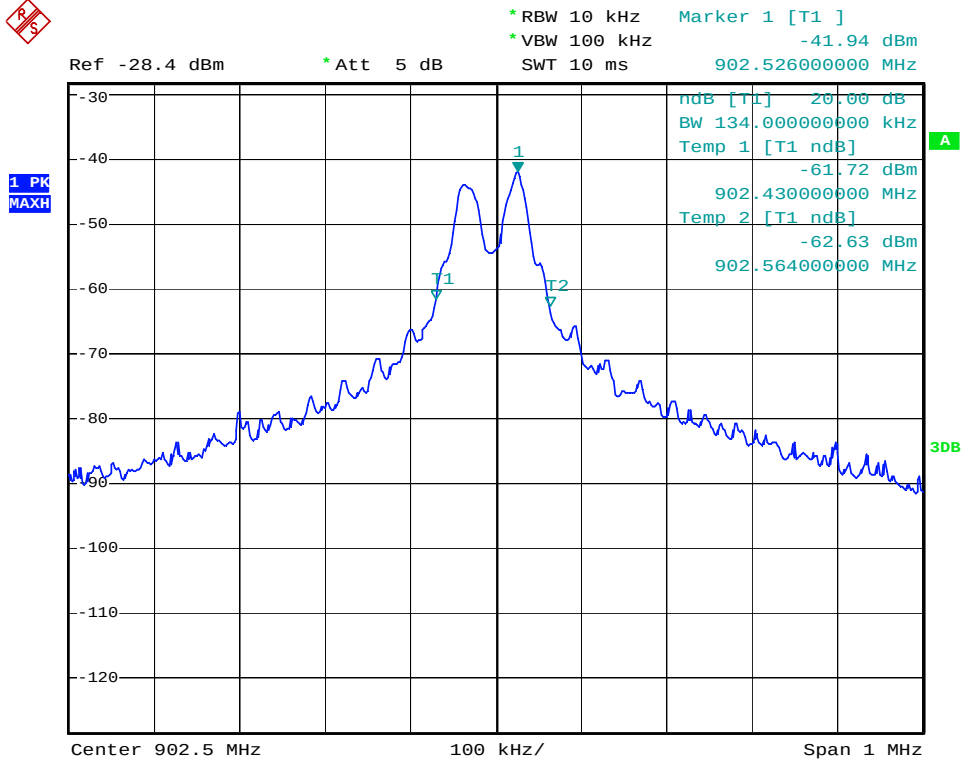
An over the air measurement was made with the test sample transmitting its normal modulation. The NdB down function was used to measure the 20dB bandwidth. The 99% power bandwidth function of the analyzer was used to measure the 99% bandwidth.

4.3 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

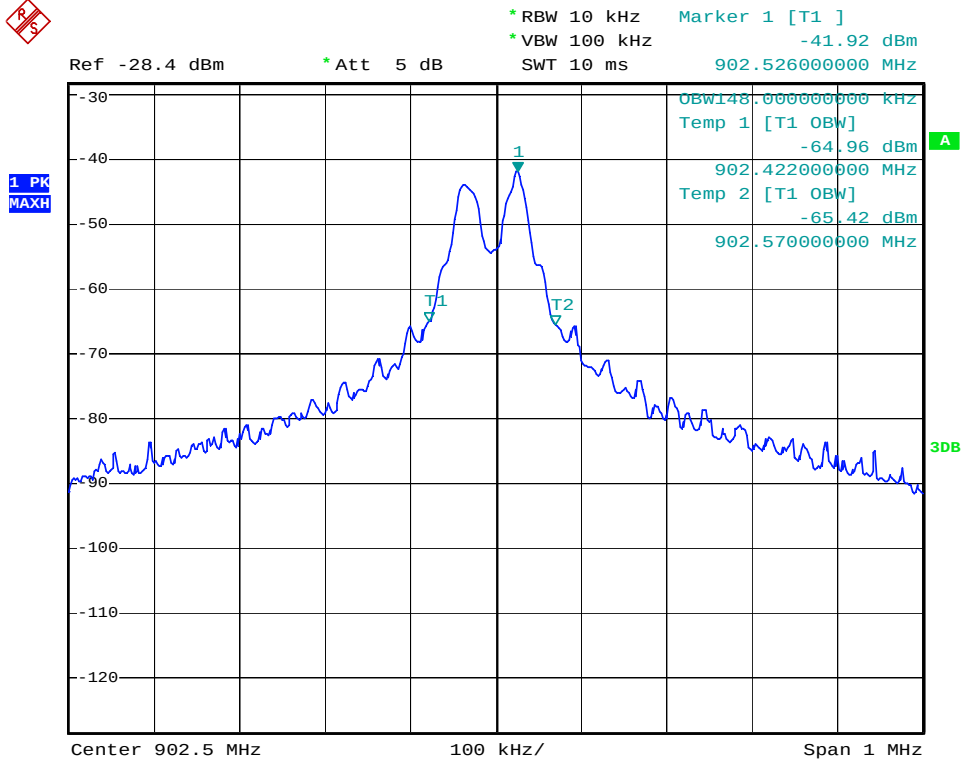
4.4 Results:

The measured 20dB bandwidth was 164kHz. The measured 99% bandwidth was 150kHz.



Date: 29.DEC.2011 15:42:41

20dB Bandwidth Plot



Date: 29.DEC.2011 15:43:22

99% Bandwidth Plot

5 Radiated Spurious Emissions (Transmitter)

5.1 Test Limits

§ 15.249 (a): Except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Part 15.249(a) Radiated Emission Limits

Fundamental frequency	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (microvolts/meter)
902–928 MHz	50 (94dBuV/m)	500 (54dBuV/m)
2400–2483.5 MHz	50 (94dBuV/m)	500 (54dBuV/m)
5725–5875 MHz	50 (94dBuV/m)	500 (54dBuV/m)
24.0–24.25 GHz	250	2500

§ 15.249 (d): Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

§ 15.249 (e): As shown in §15.35(b), for frequencies above 1000 MHz, the field strength limits in paragraphs (a) and (b) of this section are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For point-to-point operation under paragraph (b) of this section, the peak field strength shall not exceed 2500 millivolts/meter at 3 meters along the antenna azimuth.

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): General 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

5.2 Test Procedure

ANSI C63.10: 2009

5.3 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

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

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

5.4 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	9/12/2011	9/12/2012
Preamplifier	SF456200904	Mini-Circuits	ZX60-3018G-S+	9/12/2011	9/12/2012
Biconnilog Antenna	00051864	ETS	3142C	12/20/2011	12/20/2012
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	No Calibration Required	No Calibration Required
High Pass Filter	3986-01 DC0408	Microwave Circuits, Inc.	H3G020G2	Time of Use	Time of Use

5.5 Results:

The fundamental emission was lower than the field strength limit for Part 15.249(a). All spurious emissions were lower than the field strength limit for Part 15.249(a). Per 15.249(d) all other emissions were attenuated to below the general field strength limits. Per 15.249(e), emissions above 1GHz meet the limit using average detection as well as with peak detection (20dB higher than the average limit).

Fundamental Measurements

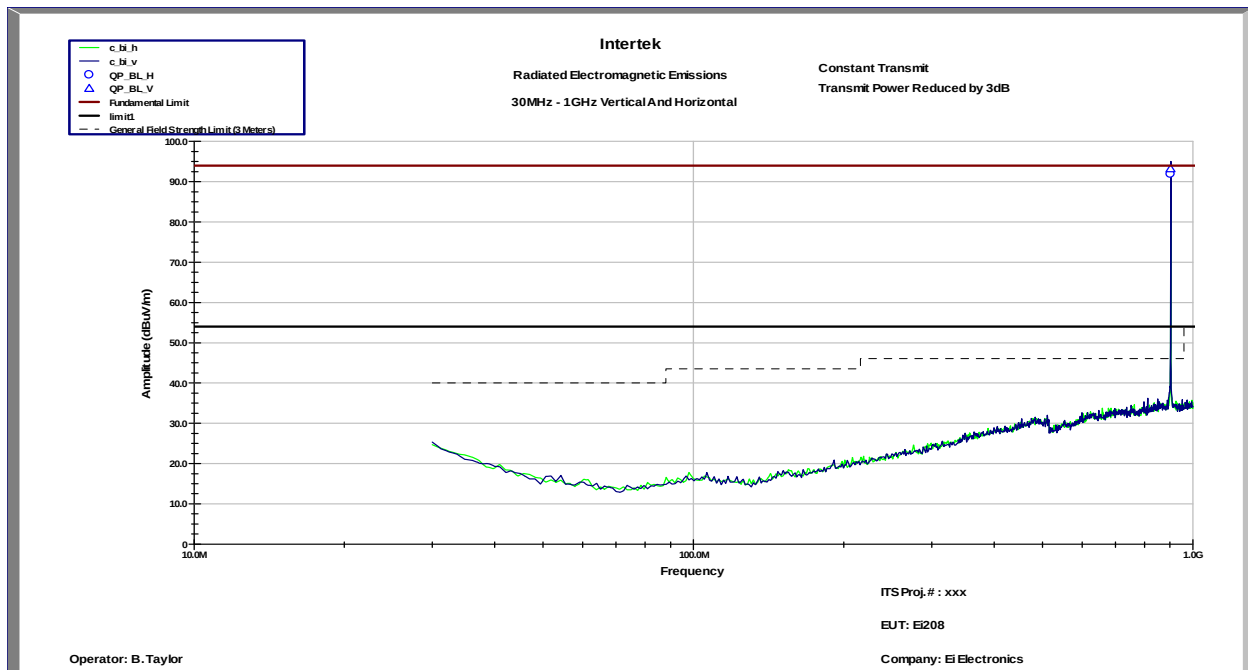
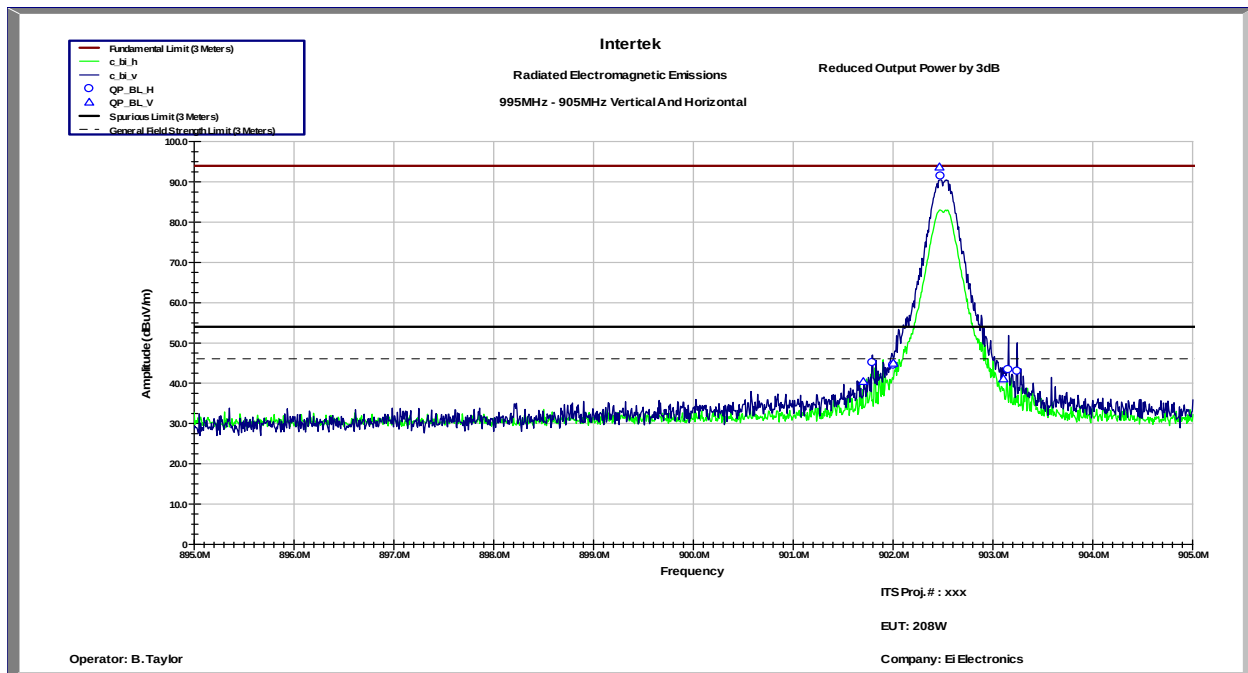
Radiated Emissions										
Test Engineer:	Bryan Taylor		Start Date:	1/23/2012		End Date:	1/23/2012			
Temperature:	25.1C		Humidity:	48.80%		Pressure:	975.2 mbar			
Specification:	FCC Part 15.249		Test Limit:	15.231b						
Notes:	Constant Transmit Fundamental Measurement. Reduced TX Power by 3dB. Sample Marked as 0dBm									
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
902.5 MHz	H	64.3	4.16	23.45	91.91	94	-2.09	120kHz / QP	3m	Compliant
902.5 MHz	V	65.58	4.16	23.45	93.19	94	-0.81	120kHz / QP	3m	Compliant
Calculations:					F = C + D + E		H = F - G			

Spurious Measurements Close to Fundamental

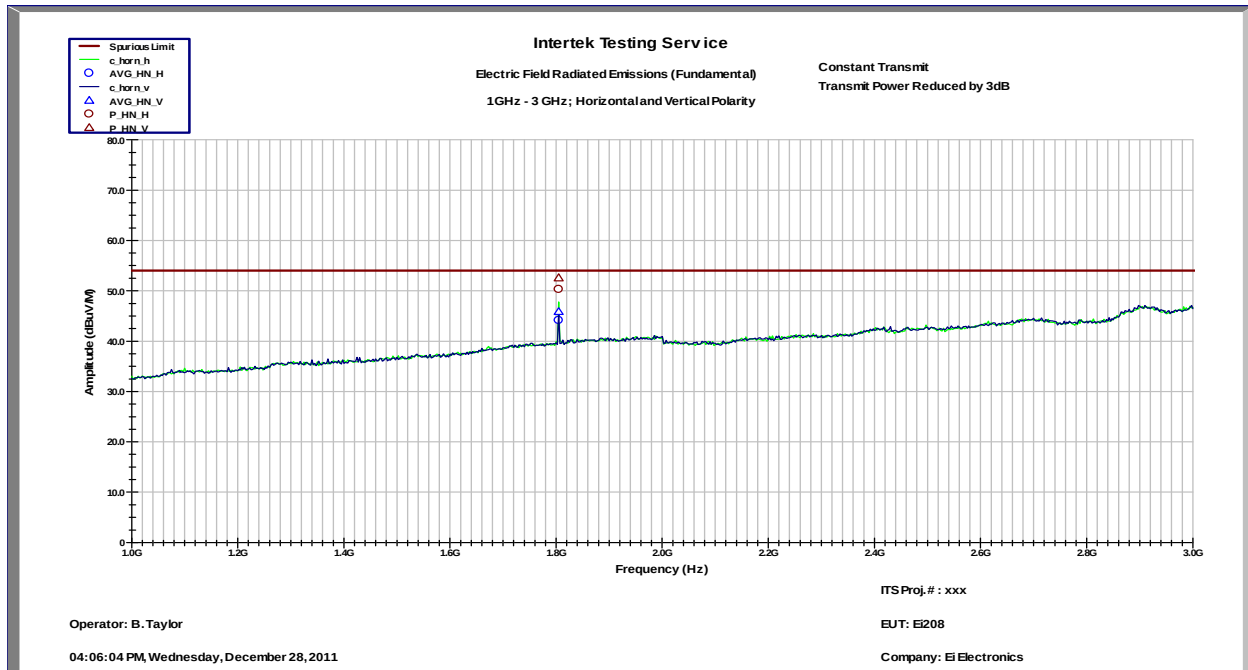
Radiated Spurious Emissions Close to Fundamental										
Test Engineer:	Bryan Taylor	Start Date:	3/9/2012	End Date:	3/9/2012					
Temperature:	23.3C	Humidity:	46.50%	Pressure:	988.3mBar					
Specification:	FCC Part 15.249	Test Limit:	15.249							
Notes:	Sample 3.									
A	B	C	D	E	F	G	H	I	J	K
Frequency	Polarity (H/V)	Raw Reading (dBuV)	Cab. (dB)	Ant. (dB)	Corr. Reading. (dBuV/m)	Limit (dBuV/m)	Delta (dB)	RBW / Detector	Test Distance	Results
901.7 MHz	V	12.66	4.15	23.57	40.38	46	-5.62	120kHz / QP	3m	Compliant
902.0 MHz	V	17.25	4.15	23.56	44.96	46	-1.04	120kHz / QP	3m	Compliant
903.1 MHz	V	13.35	4.16	23.54	41.05	46	-4.95	120kHz / QP	3m	Compliant
901.79 MHz	H	15.72	4.15	25.23	45.1	46	-0.9	120kHz / QP	3m	Compliant
902.0 MHz	H	15.71	4.15	23.56	44.5	46	-1.5	120kHz / QP	3m	Compliant
903.15 MHz	H	15.7	4.16	23.54	43.4	46	-2.6	120kHz / QP	3m	Compliant
903.24 MHz	H	15.3	4.16	23.54	43	46	-3	120kHz / QP	3m	Compliant
Calculations:				F = C + D + E			H = F - G			

Spurious Measurements Outside Transmit Band

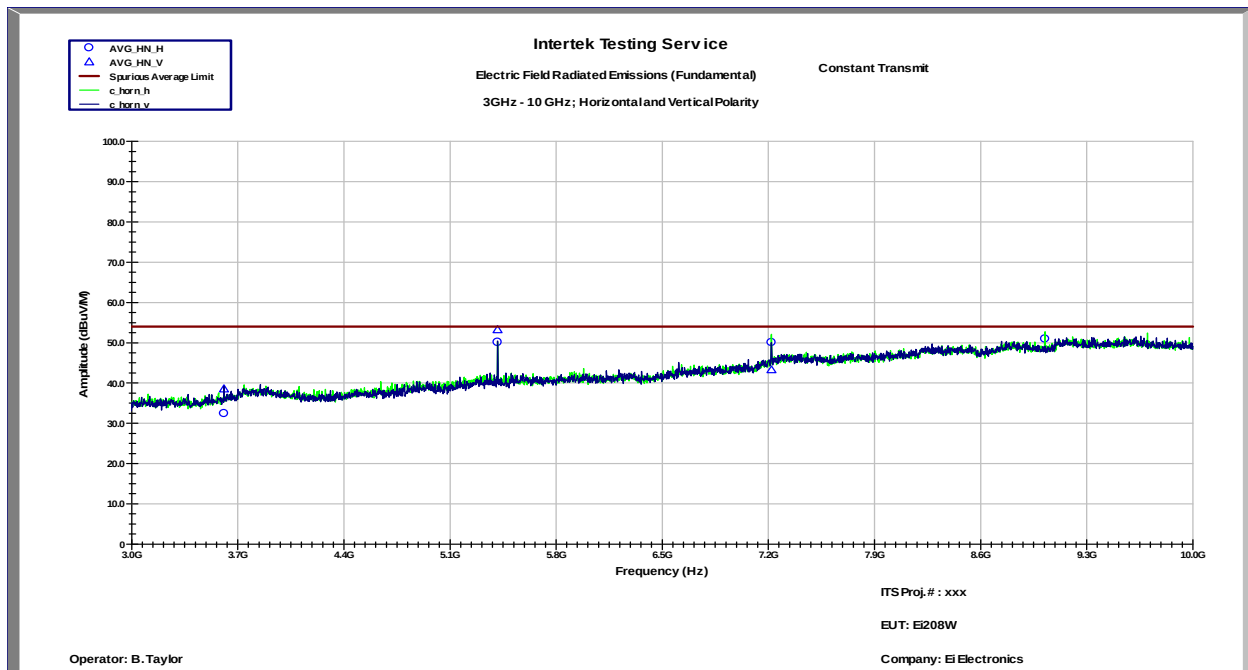
Radiated Spurious Emissions								
Test Engineer:	Bryan Taylor		Start Date:	12/27/2011		End Date:	12/28/2011	
Temperature:	25.1C		Humidity:	48.80%		Pressure:	975.2 mbar	
Specification:	FCC Part 15.249		Test Limit:	15.249				
Notes:	Constant Transmit Spurious Measurement							
TX Frequency	Spurious Frequency	Polarity	Corr. Peak Reading. (dBuV/m)	Corr. Avg Reading. (dBuV/m)	Peak Limit (dBuV/m)	Avg. Limit (dBuV/m)	Results	
902.5MHz	3.61 GHz	H	38.675	32.4	74	54	Compliant	
	5.4145 GHz	H	53.802	50.11	74	54	Compliant	
	7.2213 GHz	H	53.787	50.09	74	54	Compliant	
	9.025 GHz	H	52.3	50.95	74	54	Compliant	
	3.61 GHz	V	41.965	38.5	74	54	Compliant	
	5.4145 GHz	V	55.342	53.21	74	54	Compliant	
	7.2213 GHz	V	49.377	43.27	74	54	Compliant	



Fundamental and Spurious Emissions Below 1GHz



Spurious Emissions 1GHz – 3GHz



Spurious Emissions 3GHz – 10GHz

6 Radiated Spurious Emissions (Receiver)

6.1 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

6.2 Test Procedure

ANSI C63.4: 2009

6.3 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

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

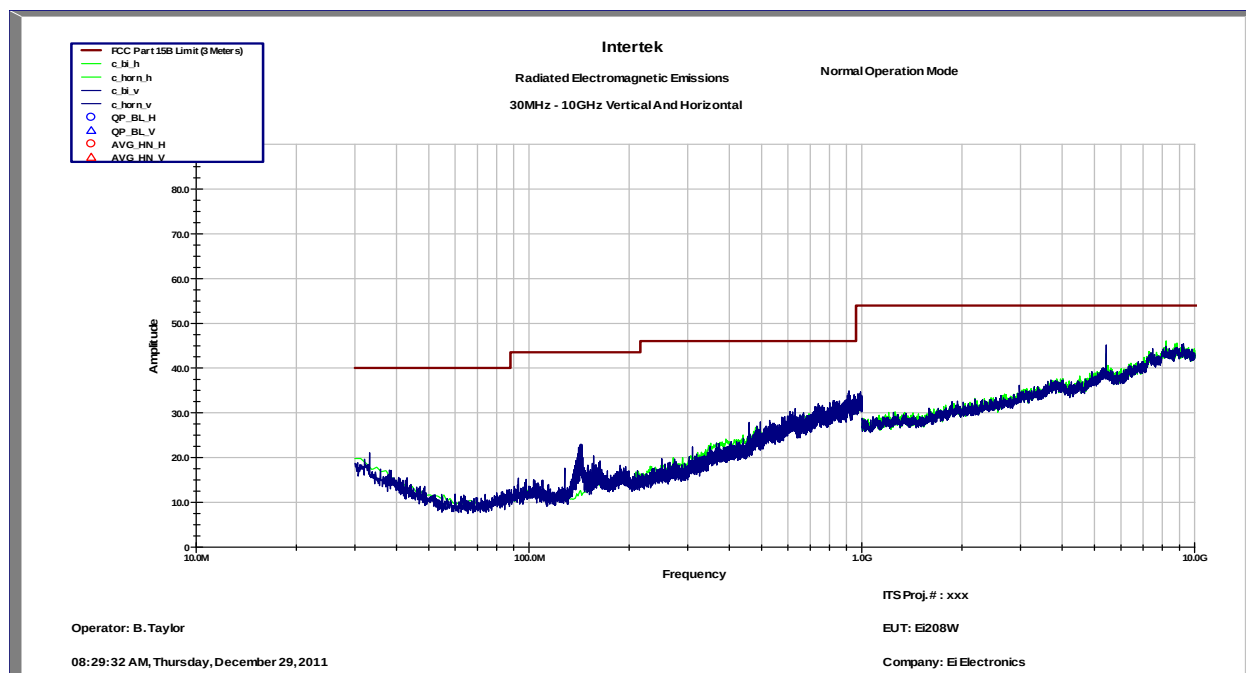
$$\text{Level in } \mu\text{V/m} = \text{Common Antilogarithm } [(38.78 \text{ dB}\mu\text{V/m})/20] = 86.89 \mu\text{V/m}$$

6.4 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	9/12/2011	9/12/2012
Preamplifier	SF456200904	Mini-Circuits	ZX60-3018G-S+	9/12/2011	9/12/2012
Biconnilog Antenna	00051864	ETS	3142C	12/20/2011	12/20/2012
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	Calibration Not Required	Calibration Not Required
High Pass Filter	3986-01 DC0408	Microwave Circuits, Inc.	H3G020G2	Time of Use	Time of Use

6.5 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.



Peak Scan (Receive Mode)

Radiated Emissions										
Test Engineer:	Bryan Taylor		Start Date:	12/29/2011		End Date:	12/29/2011			
Temperature:	25.1C		Humidity:	48.80%		Pressure:	975.2 mbar			
Specification:	FCC Part 15B		Test Limit:	Class B						
Notes:	Normal Operation Mode									
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
All emissions were at least 10dB below the limit.										Compliant
Calculations:					F = C + D + E		H = F - G			

Maximized Quasi Peak Emissions

7 Antenna Requirement per FCC Part 15.203

7.1 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.

7.2 Results:

The sample tested met the antenna requirement. The antenna utilized a permanently attached antenna.

8 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	$\pm 2.8\text{dB}$	

9 Revision History

Revision Level	Date	Report Number	Notes
0	3/9/2012	100616097LEX-001	Original Issue