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TEST REPORT

Report Number: 101394372LEX-001
Project Number: G101394372

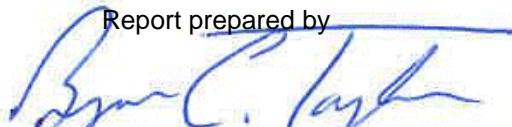
Report Issue Date: 10/29/2013

Product Name: RFID Module
Model Number: RFID Module
FCCID: ZKJ-EBX1532P001
ICID: 10229A-EBX1532P001

FCC Standards: Title 47 CFR Part 15 Subpart B and C
Industry Canada Standards: RSS-210 Issue 8 and ICES-003

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

Client:
GE Appliances
GE Appliance Park, AP2-126
Louisville, KY 40225

Report prepared by

Bryan Taylor, Team Leader

Report reviewed by

Jason Centers, Senior Project 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 Name	FCC Reference	IC Reference	Result
6	20dB Bandwidth	§ 2.1049	RSS-GEN (4.6.1)	Pass
7	In-Band Radiated Spurious Emissions (Transmitter)	§ 15.225(a)(b)(c)	RSS-210 (A2.6)	Pass
9	Out of Band Radiated Spurious Emissions (Transmitter)	§ 15.225(d), § 15.209	RSS-210 (A2.6)	Pass
11	FCC Part 15B Radiated Emissions	§ 15.109	ICES-003	Pass
15	AC Powerline Conducted Emissions	§ 15.107, § 15.207	RSS-Gen (7.2.4)	Pass
21	Frequency Stability	§ 15.225(e)	RSS-210 (A2.6)	Pass
22	Antenna Requirement per FCC Part 15.203	§ 15.203	RSS-Gen (7.1.2)	Pass

3 Description of Equipment Under Test

Equipment Under Test	
Manufacturer	GE Appliances
Model Number	RFID Module
Serial Number	AC1332A1400178
FCC Identifier	ZKJ-EBX1532P001
IC Identifier	10229A-EBX1532P001
Receive Date	10/18/2013
Test Start Date	10/28/2013
Test End Date	10/29/2013
Device Received Condition	Good
Test Sample Type	Production
Frequency Band	13.56MHz
Mode(s) of Operation	RFID
Transmission Control	Normal Operation
Antenna Type (15.203)	Internal
Power Supply	13.6VDC

Description of Equipment Under Test

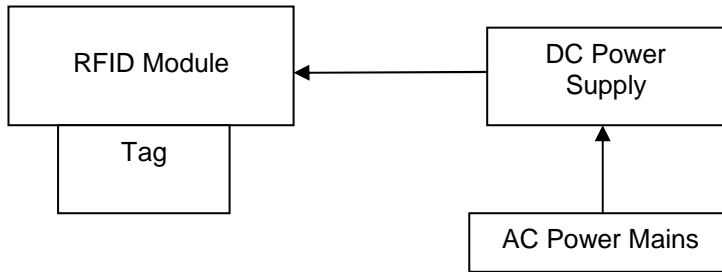
The RFID Module is an RFID transmitter module.

Operating modes of the EUT:

No.	Descriptions of EUT Exercising
1	Transmitting its normal 13.56MHz signal with the tag included.
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
DC Power Cable	1m	No	No	DC Power Supply	Test Sample

3.4 Support Equipment:

Support Equipment			
Description	Manufacturer	Model Number	Serial Number
DC power Supply	HP	6296A	1036

5 In-Band Radiated Spurious Emissions (Transmitter)

5.1 Test Limits

§ 15.225 Operation within the band 13.110-14.010 MHz.

- (a) The field strength of any emissions within the band 13.553-13.567 MHz shall not exceed 15,848 microvolts/meter at 30 meters.
- (b) Within the bands 13.410-13.553 MHz and 13.567-13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters.
- (c) Within the bands 13.110-13.410 MHz and 13.710-14.010 MHz the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters.

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:

$$RA = 19.48 \text{ dB}\mu\text{V}$$

$$AF = 18.52 \text{ dB}$$

$$CF = 0.78 \text{ dB}$$

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

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

5.4 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
EMI Test Receiver	10887490.26	Rohde & Schwarz	ESI26	9/11/2013	9/11/2014
Preamplifier	SF456200904	Mini-Circuits	ZX60-3018G-S+	9/11/2013	9/11/2014
Biconnilog Antenna	00051864	ETS	3142C	12/14/2012	12/14/2013
Active Loop Antenna	3416	ETS	6502	4/19/2013	4/19/2014
System Controller	121701-1	Sunol Sciences	SC99V	Calibration Not Required	Calibration Not Required

5.5 Results:

The spurious emissions listed in the following tables are the worst case emissions. Emissions not reported were at or below the measurement noise floor.

Worst Case Spurious Emissions (Radio Transmitting)

Radiated Emissions											
Test Engineer:	Bryan Taylor		Start Date:	10/28/2013		End Date:	10/28/2013				
Temperature:	23.8C		Humidity:	46.30%		Pressure:	988.4mBar				
Specification:	FCC Part 15C					Test Limit:	15.225(a)-(d)				
Notes:	Transmitting. In Band Measurements										
A	B	C	D	E	F	G	H	I	J	K	
Frequency	Raw Reading (dBuV)	Cab. (dB)	Ant. (dB)	3m Corr. Reading. (dBuV/m)	30m Corr Reading (dBuV/m)	30m Limit (dBuV/m)	Delta (dB)	RBW / Detector	Test Distance	Results	
13.198 MHz	2.36	0.54	10.87	13.77	-26.23	40.51	-66.74	9kHz / QPK	3m	Compliant	
13.501 MHz	2.12	0.55	10.86	13.53	-26.47	50.47	-76.94	9kHz / QPK	3m	Compliant	
13.56 MHz	50.83	0.55	10.86	62.24	22.24	84	-61.76	9kHz / QPK	3m	Compliant	
13.6 MHz	2.18	0.55	10.86	13.59	-26.41	50.47	-76.88	9kHz / QPK	3m	Compliant	
13.801 MHz	1.83	0.56	10.85	13.24	-26.76	40.51	-67.27	9kHz / QPK	3m	Compliant	
Calculations:				E = B + C + D		F = E - 40dB		H = F - G			

Notes:

- (1) The test sample was evaluated on three orthogonal axes since it was a module and could be used in any orientation.
- (2) All measurements were performed with a loop antenna positioned in three orthogonal axis with the level at the highest position being recorded.
- (3) Measurements were performed at 3m distance and the level extrapolated to the specified measurement distance of 30m. An inverse linear distance extrapolation factor of 40dB/decade (from part 15.31(f)) was used to facilitate this. Extrapolation Factor = $20\log(30/3)^2 = 40\text{dB}$.

6 Out of Band Radiated Spurious Emissions (Transmitter)

6.1 Test Limits

6.2 § 15.225 Operation within the band 13.110-14.010 MHz.

(d) The field strength of any emissions appearing outside of the 13.110-14.010 MHz band shall not exceed the general radiated emission limits in § 15.209.

Part 15.209(a): Field General 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

6.3 Test Procedure

ANSI C63.4: 2009

6.4 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:

$$RA = 19.48 \text{ dB}\mu\text{V}$$

$$AF = 18.52 \text{ dB}$$

$$CF = 0.78 \text{ dB}$$

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

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

6.5 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
EMI Test Receiver	10887490.26	Rohde & Schwarz	ESI26	9/11/2013	9/11/2014
Preamplifier	SF456200904	Mini-Circuits	ZX60-3018G-S+	9/11/2013	9/11/2014
Biconnilog Antenna	00051864	ETS	3142C	12/14/2012	12/14/2013
Active Loop Antenna	3416	ETS	6502	4/19/2013	4/19/2014
System Controller	121701-1	Sunol Sciences	SC99V	Calibration Not Required	Calibration Not Required

6.6 Results:

All of the out of band emissions were below the general limits from Part 15.209. The sample was tested from 9kHz – 1GHz excluding the in band 13.110 – 14.010 MHz range. The spurious emissions listed in the following tables are the worst case emissions.

Worst Case Out of Band Spurious Emissions (Radio Transmitting)

Radiated Emissions										
Test Engineer: Bryan Taylor		Start Date: 10/28/2013		End Date: 10/28/2013						
Temperature: 23.8C		Humidity: 46.30%		Pressure: 988.4mBar						
Specification: FCC Part 15C				Test Limit: 15.209 Class B						
Notes: Transmitting, Out of Band Measurements										
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
27.12 MHz	NA	19.18	0.74	8.98	28.9	69.54	-40.64	9kHz / QPK	3m	Compliant
54.236 MHz	V	39.11	-16.66	8.58	31.03	40	-8.97	120kHz / QPK	3m	Compliant
108.47 MHz	V	41.93	-16.49	8.5	33.94	43.52	-9.58	120kHz / QPK	3m	Compliant
162.72 MHz	V	43.18	-16.01	9.27	36.44	43.52	-7.08	120kHz / QPK	3m	Compliant
203.4 MHz	V	40.22	-15.73	10.5	34.99	43.52	-8.53	120kHz / QPK	3m	Compliant
122.04 MHz	H	50.47	-16.39	7.5	41.58	43.52	-1.94	120kHz / QPK	3m	Compliant
176.28 MHz	H	38.85	-15.9	9.73	32.68	43.52	-10.84	120kHz / QPK	3m	Compliant
Calculations:				F = C + D + E			H = F - G			

Notes:

- (1) The test sample was evaluated on three orthogonal axes since it was a module and could be used in any orientation.
- (2) All measurements below 30MHz were performed with a loop antenna positioned in three orthogonal axis with the level at the highest position being recorded.
- (3) All measurements above 30MHz were performed with a bilog antenna maximized from 1-4m in height and in vertical and horizontal polarities.
- (4) Measurements were performed at 3m distance.

7 FCC Part 15B Radiated Emissions**7.1 Method**

ANSI C63.4: 2009

7.2 Test Location

This test was performed at the Intertek offices located at the following address:

Intertek
731 Enterprise Drive
Lexington, KY 40510

7.3 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
EMI Test Receiver	10887490.26	Rohde & Schwarz	ESI26	9/11/2013	9/11/2014
Pre-amplifier	SF456200904	Mini-Circuits	ZX60-3018G-S+	9/11/2013	9/11/2014
Biconnilog Antenna	00051864	ETS	3142C	12/14/2012	12/14/2013
Active Loop Antenna	3416	ETS	6502	4/19/2013	4/19/2014
System Controller	121701-1	Sunol Sciences	SC99V	Calibration Not Required	Calibration Not Required

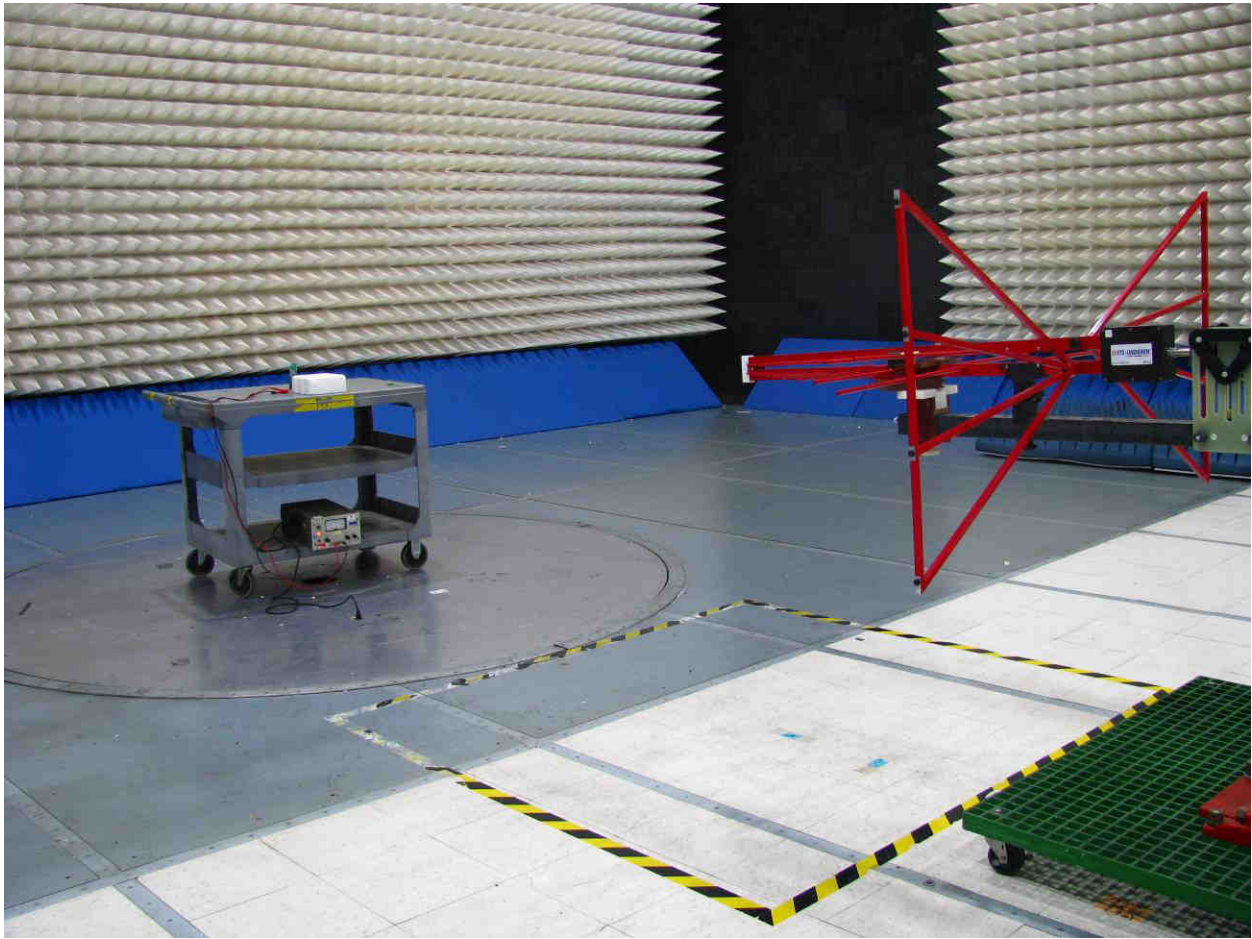
7.4 Results:

The sample tested was found to Comply.

7.5 Setup Photographs:

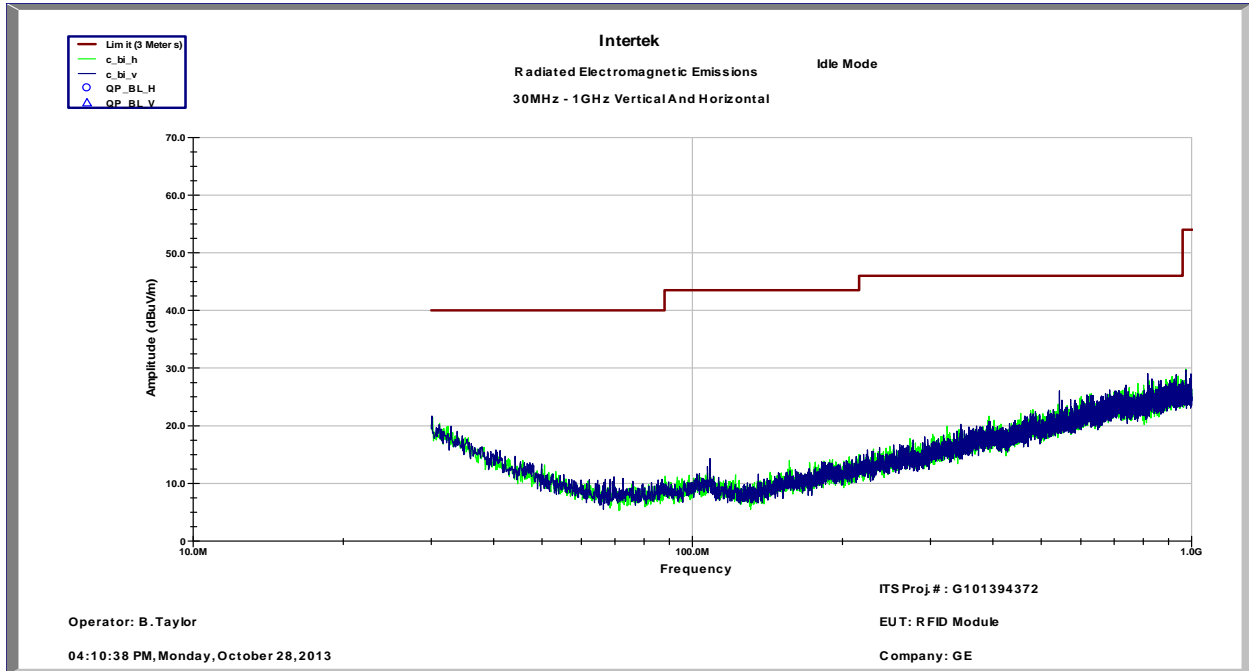


Test setup (Front)



Test setup (Back)

7.6 Plots:



7.1 Data:

Radiated Emissions										
Test Engineer: Bryan Taylor		Start Date: 10/28/2013		End Date: 10/28/2013						
Temperature: 23.8C		Humidity: 46.30%		Pressure: 988.4mBar						
Specification: FCC Part 15C				Test Limit: 15.209 Class B						
Notes: Transmitting. Out of Band Measurements										
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 spurious emissions were at least 15dB below the limit										
Calculations: $F = C + D + E$ $H = F - G$										

Deviations, Additions, or Exclusions: None

8 AC Powerline Conducted Emissions

8.1 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.

8.2 Test Procedure

ANSI C63.4: 2009

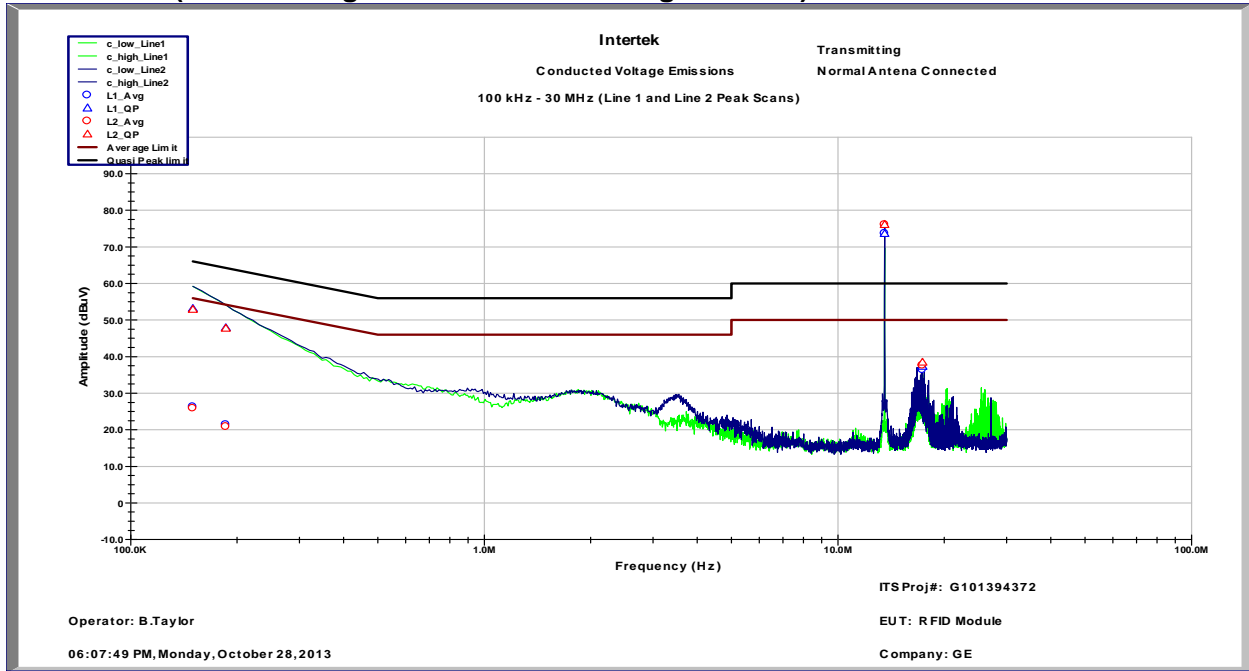
8.3 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
EMI Test Receiver	10887490.26	Rohde & Schwarz	ES126	9/11/2013	9/11/2014
LISN	3333	Teseq	NNB52	3/11/2013	3/11/2014

8.4 Results:

The sample tested was found to Comply.

8.1 Data (Transmitting with Normal Radiating Antenna):

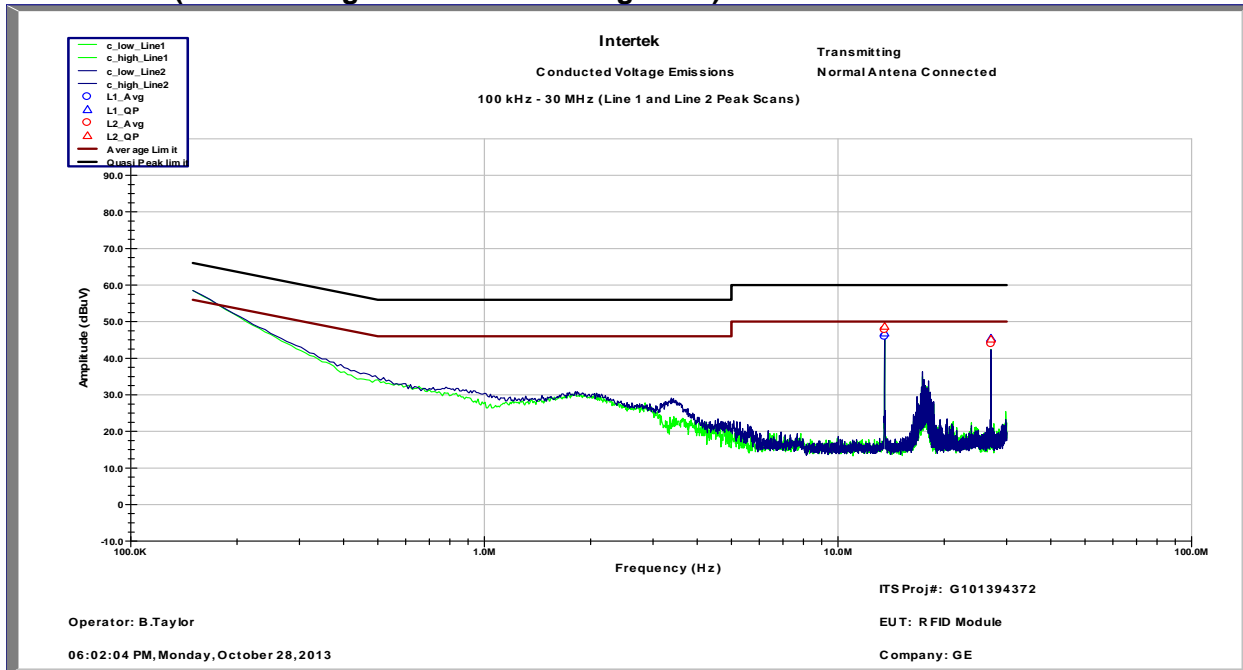


Conducted Voltage Emissions on Power Lines								
Test Engineer: Bryan Taylor		Start Date: 10/28/2013		End Date: 10/28/2013				
Temperature: 23.8C		Humidity: 46.30%		Pressure: 988.4mBar				
Specification: FCC Part 15		Test Limit: Class B		RBW: 9kHz				
Notes: Transmitting Mode. Normal Transmitting Antenna								
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	53.11	66	-12.89	26.27	56	-29.73	Compliant
	186.0 KHz	47.86	64.21	-16.35	21.36	54.21	-32.85	Compliant
	13.56 MHz	73.62	60	13.62	73.66	50	23.66	Note (1)
L2	17.348 MHz	37.32	60	-22.68	36.44	50	-13.56	Compliant
	150.0 KHz	52.89	66	-13.11	25.9	56	-30.1	Compliant
	186.0 KHz	47.69	64.21	-16.52	20.83	54.21	-33.38	Compliant
	13.56 MHz	76.1	60	16.1	76.09	50	26.09	Note (1)
	17.348 MHz	38.41	60	-21.59	37.59	50	-12.41	Compliant

Deviations, Additions, or Exclusions:

- (1) Compliance in the transmitting band (13.56MHz) is demonstrated with the TX antenna replaced with a non-radiating load. This was performed per KDB Number 174176.

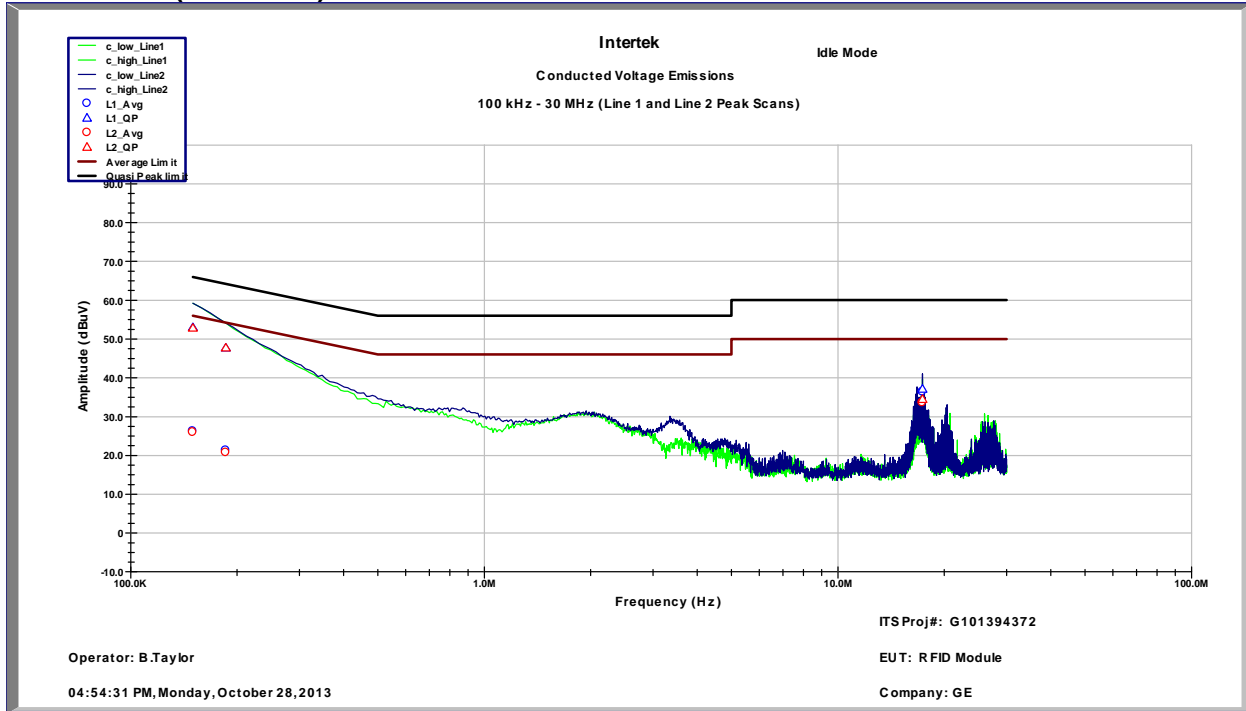
8.2 Data (Transmitting with Non-Radiating Load):



Conducted Voltage Emissions on Power Lines								
Test Engineer: Bryan Taylor		Start Date: 10/28/2013		End Date: 10/28/2013				
Temperature: 23.8C		Humidity: 46.30%		Pressure: 988.4mBar				
Specification: FCC Part 15		Test Limit: Class B		RBW: 9kHz				
Notes: Transmitting Mode. Antenna replaced with non-radiating load.								
Line	Frequency (MHz)	Quasi-Peak (dBuV)	Quasi-Peak Limit (dBuV)	Quasi-Peak Delta (dB)	Average (dBuV)	Average Limit (dBuV)	Average Delta (dB)	Results
L1	13.56 MHz	46.86	60	-13.14	45.88	50	-4.12	Compliant
	27.12 MHz	45.45	60	-14.55	44.15	50	-5.85	Compliant
L2	13.56 MHz	48.69	60	-11.31	47.72	50	-2.28	Compliant
	27.12 MHz	45.15	60	-14.85	43.88	50	-6.12	Compliant

Deviations, Additions, or Exclusions: None

8.3 Data (Idle Mode):



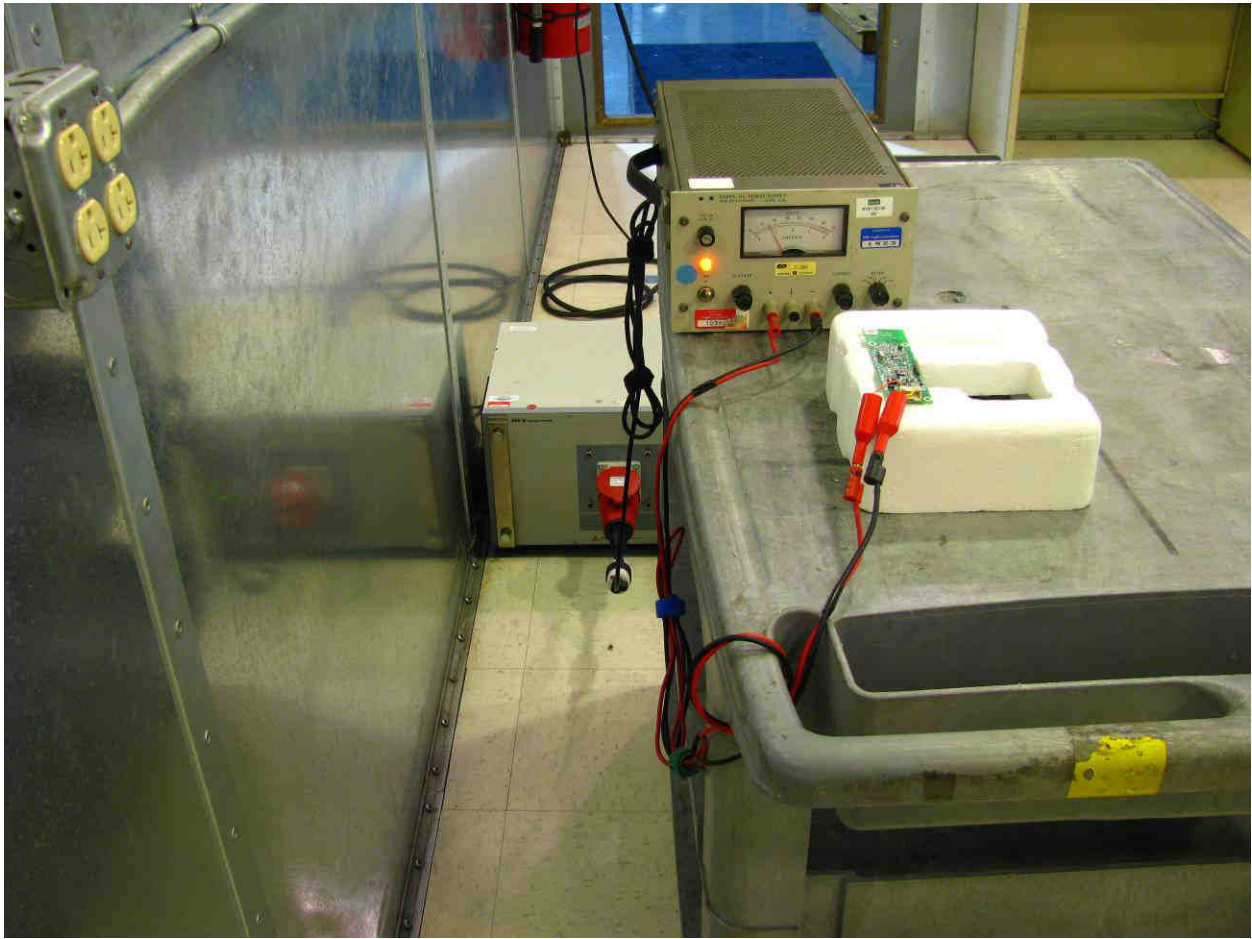
Conducted Voltage Emissions on Power Lines								
Test Engineer: Bryan Taylor		Start Date: 10/28/2013		End Date: 10/28/2013				
Temperature: 23.8C		Humidity: 46.30%		Pressure: 988.4mBar				
Specification: FCC Part 15B		Test Limit: Class B		RBW: 9kHz				
Notes: Idle Mode								
Line	Frequency (MHz)	Quasi-Peak (dBuV)	Quasi-Peak Limit (dBuV)	Quasi-Peak Delta (dB)	Average (dBuV)	Average Limit (dBuV)	Average Delta (dB)	Results
L1	150.0 KHz	52.97	66	-13.03	26.28	56	-29.72	Compliant
	186.0 KHz	47.71	64.21	-16.5	21.28	54.21	-32.93	Compliant
	17.349 MHz	37.13	60	-22.87	36.38	50	-13.62	Compliant
L2	150.0 KHz	52.82	66	-13.18	25.95	56	-30.05	Compliant
	186.0 KHz	47.69	64.21	-16.52	20.75	54.21	-33.46	Compliant
	17.349 MHz	34.49	60	-25.51	33.62	50	-16.38	Compliant

Deviations, Additions, or Exclusions: None

8.1 Setup Photographs:



Test setup (Front)



Test setup (Back)

9 Frequency Stability

9.1 Test Limits

9.2 § 15.225 Operation within the band 13.110-14.010 MHz.

(e) The frequency tolerance of the carrier signal shall be maintained within $\pm 0.01\%$ of the operating frequency over a temperature variation of -20 degrees to $+50$ degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

9.3 Results:

The data below shows that the test sample meets the frequency stability requirements from Part 15.225.

Frequency Stability Test Data

Operating Frequency:		13,560,000 Hz			
Channel:		RFID Single Channel			
Reference Voltage:		13.6 VDC			
Deviation Limit (+/-):		0.01 % =		1356 Hz	
Notes:					
Voltage (%)	Voltage (VDC)	Temp (°C)	Frequency (Hz)	Deviation (Hz)	Deviation (%)
100%	13.6	-30	13559894	-106	-0.000782
100%	13.6	-20	13559899	-101	-0.000745
100%	13.6	-10	13559849	-151	-0.001114
100%	13.6	0	13559852	-148	-0.001091
100%	13.6	10	13559850	-150	-0.001106
100%	13.6	20	13559948	-52	-0.000383
100%	13.6	30	13559856	-144	-0.001062
100%	13.6	40	13559888	-112	-0.000826
100%	13.6	50	13559864	-136	-0.001003
100%	13.6	60	13559852	-148	-0.001091
115%	15.64	20	13559948	-52	-0.000383
85%	11.56	20	13559948	-52	-0.000383

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 antenna was a pcb loop antenna permanently attached to the circuit board.

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	+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	

12 Revision History

Revision Level	Date	Report Number	Notes
0	10/29/2013	101394372LEX-001	Original Issue