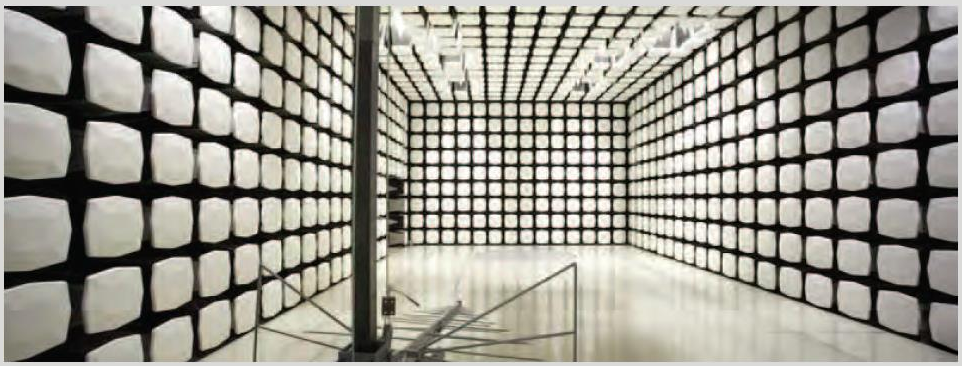
Electric Imp, Inc.

IMP004M

EN 300 328 V2.1.1:2016

Bluetooth LE Radio

Report # ELIM0016.1



NVLAP LAB CODE: 200676-0

CERTIFICATE OF TEST

Last Date of Test: May 31, 2017
Electric Imp, Inc.
Model: IMP004M

Radio Equipment Testing

Standards

Specification	Method
EN 300 328 V2.1.1:2016	EN 300 328 V2.1.1:2016

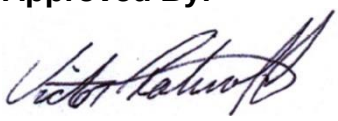
Results

Method Clause	Test Description	Applied	Results	Comments
5.4.2	RF Output Power	Yes	Pass	
5.4.2	Medium Utilization	No	N/A	Not required for adaptive equipment.
5.4.3	Power Spectral Density	Yes	Pass	
5.4.4	Duty Cycle, Tx-Sequence, Tx-Gap	No	N/A	Not required for adaptive equipment.
5.4.4	Accumulated Transmit Time, Frequency Occupation, Hopping Sequence	No	N/A	Not required unless EUT is a FHSS device.
5.4.5	Hopping Frequency Separation	No	N/A	Not required unless EUT is a FHSS device.
5.4.6	Adaptivity	No	N/A	Not required for devices with output power less than 10 dBm eirp.
5.4.7	Occupied Channel Bandwidth	Yes	Pass	
5.4.8	Transmitter Unwanted Emissions in the OOB Domain	Yes	Pass	
5.4.9	Transmitter Unwanted Emissions in the Spurious Domain	Yes	Pass	
5.4.10	Receiver Spurious Emissions	Yes	Pass	
5.4.11	Receiver Blocking	No	N/A	Not required.
N/A	Geo-Location Capability	No	N/A	Not required. Manufacturer's declaration if implemented.

Deviations From Test Standards

None

Approved By:



Victor Ratinoff, Operations Manager

Product compliance is the responsibility of the client; therefore, the tests and equipment modes of operation represented in this report were agreed upon by the client, prior to testing. The results of this test pertain only to the sample(s) tested. The specific description is noted in each of the individual sections of the test report supporting this certificate of test. This report reflects only those tests from the referenced standards shown in the certificate of test. It does not include inspection or verification of labels, identification, marking or user information. As indicated in the Statement of Work sent with the quotation, Element's standard process is to always use the latest published version of the test methods even when earlier versions are cited in the test specification. Issuance of a purchase order was de facto acceptance of this approach. Otherwise, the client would have advised Element in writing of the specific version of the test methods they wanted applied to the subject testing.

REVISION HISTORY

Revision Number	Description	Date (yyyy-mm-dd)	Page Number
00	None		

ACCREDITATIONS AND AUTHORIZATIONS

United States

FCC - Designated by the FCC as a Telecommunications Certification Body (TCB). Certification chambers, Open Area Test Sites, and conducted measurement facilities are listed with the FCC.

A2LA - Accredited by A2LA to ISO / IEC 17065 as a product certifier. This allows Element to certify transmitters to FCC and IC specifications.

NVLAP - Each laboratory is accredited by NVLAP to ISO 17025

Canada

ISED - Recognized by Innovation, Science and Economic Development Canada as a Certification Body (CB). Certification chambers and Open Area Test Sites are filed with ISED.

European Union

European Commission – Within Element, we have a EU Notified Body validated for the EMCD and RED Directives.

Australia/New Zealand

ACMA - Recognized by ACMA as a CAB for the acceptance of test data.

Korea

MSIT / RRA - Recognized by KCC's RRA as a CAB for the acceptance of test data.

Japan

VCCI - Associate Member of the VCCI. Conducted and radiated measurement facilities are registered.

Taiwan

BSMI – Recognized by BSMI as a CAB for the acceptance of test data.

NCC - Recognized by NCC as a CAB for the acceptance of test data.

Singapore

IDA – Recognized by IDA as a CAB for the acceptance of test data.

Israel

MOC – Recognized by MOC as a CAB for the acceptance of test data.

Hong Kong

OFCA – Recognized by OFCA as a CAB for the acceptance of test data.

Vietnam

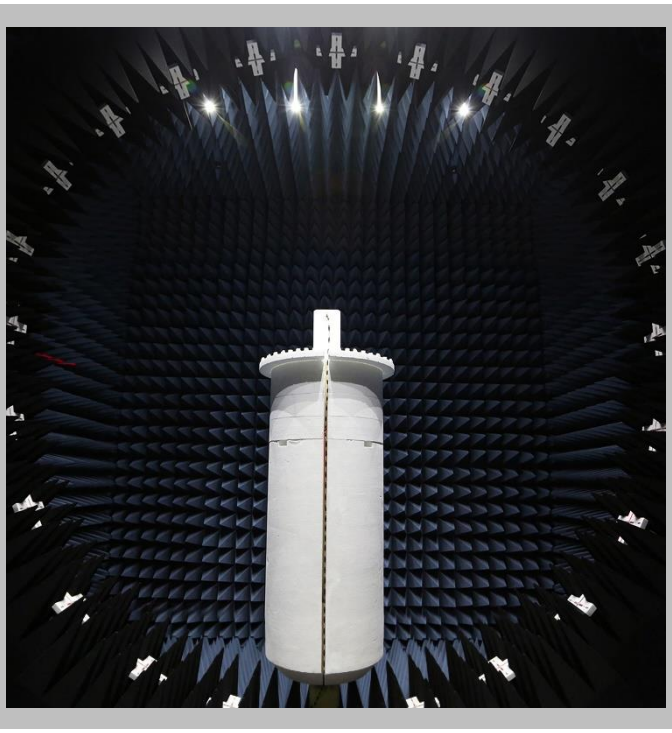
MIC – Recognized by MIC as a CAB for the acceptance of test data.

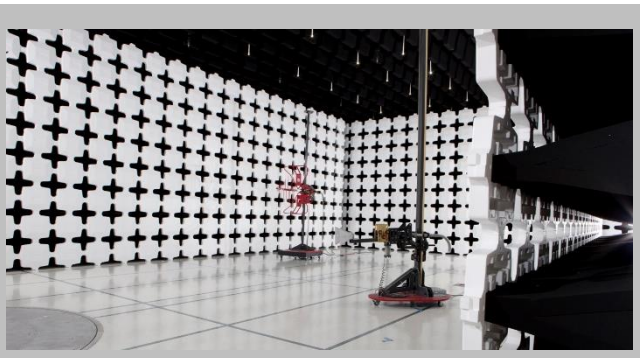
SCOPE

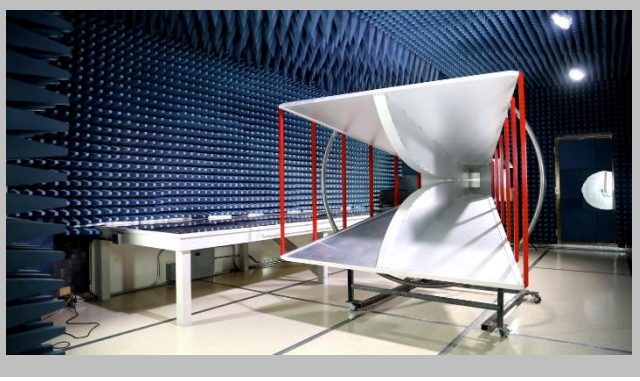
For details on the Scopes of our Accreditations, please visit:
https://www.nwemc.com/emc-testing-accreditations

FACILITIES

California	Minnesota	New York	Oregon	Texas	Washington
Labs OC01-17 41 Tesla Irvine, CA 92618 (949) 861-8918	Labs MN01-10 9349 W Broadway Ave. Brooklyn Park, MN 55445 (612)-638-5136	Labs NY01-04 4939 Jordan Rd. Elbridge, NY 13060 (315) 554-8214	Labs EV01-12 6775 NE Evergreen Pkwy #400 Hillsboro, OR 97124 (503) 844-4066	Labs TX01-09 3801 E Plano Pkwy Plano, TX 75074 (469) 304-5255	Labs NC01-05 19201 120th Ave NE Bothell, WA 98011 (425)984-6600
NVLAP					
NVLAP Lab Code: 200676-0	NVLAP Lab Code: 200881-0	NVLAP Lab Code: 200761-0	NVLAP Lab Code: 200630-0	NVLAP Lab Code:201049-0	NVLAP Lab Code: 200629-0
Innovation, Science and Economic Development Canada					
2834B-1, 2834B-3	2834E-1, 2834E-3	N/A	2834D-1, 2834D-*2*	2834G-1	2834F-1
BSMI					
SL2-IN-E-1154R	SL2-IN-E-1152R	N/A	SL2-IN-E-1017	SL2-IN-E-1158R	SL2-IN-E-1153R
VCCI					
A-0029	A-0109	N/A	A-0108	A-0201	A-0110
Recognized Phase I CAB for ACMA, BSMI, IDA, KCC/RRA, MIC, MOC, NCC, OFCA					
US0158	US0175	N/A	US0017	US0191	US0157

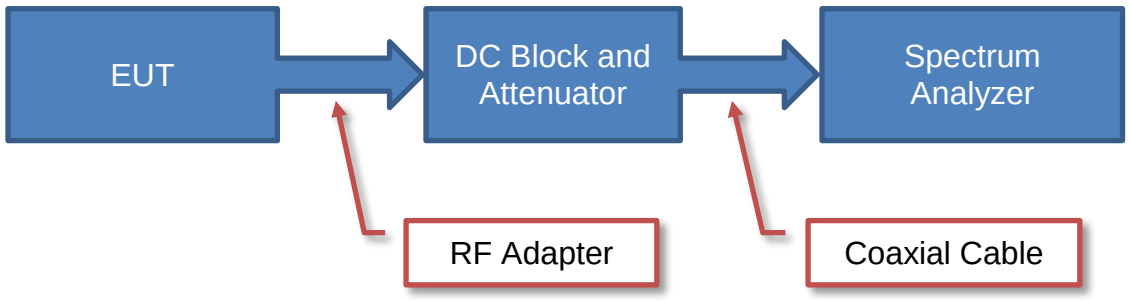




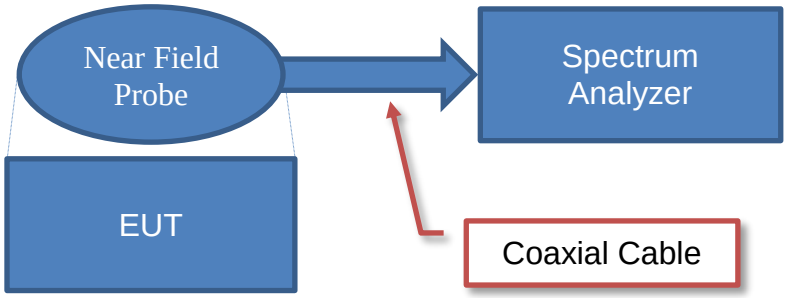


Test Setup Block Diagrams

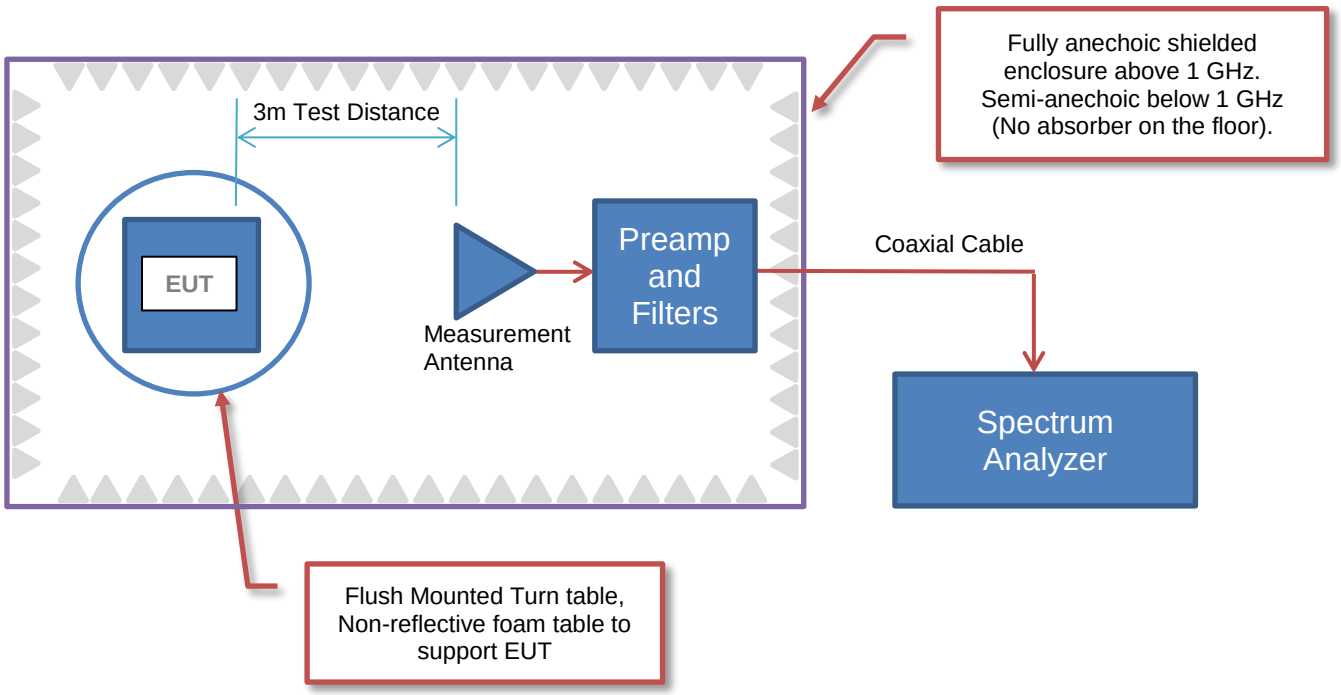
Antenna Port Conducted Measurements



Near Field Test Fixture Measurements



Spurious Radiated Emissions



MEASUREMENT UNCERTAINTY

TMU.2015.07.10

Measurement Uncertainty

When a measurement is made, the result will be different from the true or theoretically correct value. The difference is the result of tolerances in the measurement system that cannot be completely eliminated. To the extent that technology allows us, it has been our aim to minimize this error. Measurement uncertainty is a statistical expression of measurement error qualified by a probability distribution.

A measurement uncertainty estimation has been performed for each test per our internal quality document QM205.4.6. The estimation is used to compare the measured result with its "true" or theoretically correct value. The expanded measurement uncertainty (K=2) can be found included as part of the applicable test description page. Our measurement data meets or exceeds the measurement uncertainty requirements of the applicable specification; therefore, the test data can be compared directly to the specification limit to determine compliance. The calculations for estimating measurement uncertainty are based upon ETSI TR 100 028 (or CISPR 16-4-2 as applicable), and are available upon request.

The following table represents the Measurement Uncertainty (MU) budgets for each of the tests that may be contained in this report.

Test	+ MU	- MU
Frequency Accuracy (Hz)	0.0007%	-0.0007%
Amplitude Accuracy (dB)	1.2 dB	-1.2 dB
Conducted Power (dB)	0.3 dB	-0.3 dB
Radiated Power via Substitution (dB)	0.7 dB	-0.7 dB
Temperature (degrees C)	0.7°C	-0.7°C
Humidity (% RH)	2.5% RH	-2.5% RH
Voltage (AC)	1.0%	-1.0%
Voltage (DC)	0.7%	-0.7%
Field Strength (dB)	5.2 dB	-5.2 dB
AC Powerline Conducted Emissions (dB)	2.4 dB	-2.4 dB

PRODUCT DESCRIPTION

Client and Equipment Under Test (EUT) Information

Company Name:	Electric Imp, Inc.
Address:	5150 El Camino Real, Ste C-31
City, State, Zip:	Los Altos, CA 94022
Test Requested By:	Hugo Fiennes
Model:	IMP004M
First Date of Test:	May 23, 2017
Last Date of Test:	May 31, 2017
Receipt Date of Samples:	May 23, 2017
Equipment Design Stage:	Production
Equipment Condition:	No Damage
Purchase Authorization:	Verified

Information Provided by the Party Requesting the Test

Functional Description of the EUT:
802.11bgn SISO radio WiFi module with added Bluetooth radio, with embedded OS that works with the Electric Imp cloud to allow internet connectivity for devices that use this WiFi/BT module.

Testing Objective:
To demonstrate compliance of the Bluetooth LE radio to Article 3.2 of the Radio Equipment Directive.

CONFIGURATIONS

Configuration ELIM0013- 1

EUT			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
WiFi Radio Module	Electric Imp, Inc.	IMP004M	0107

Peripherals in test setup boundary			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
Host Laptop	HP	15-ba009dx	CND71420K3
Laptop Power Supply	HP	HSTNN-DA40	1WFTLD0CAR63O5H

Cables					
Cable Type	**Shield**	**Length (m)**	**Ferrite**	**Connection 1**	**Connection 2**
USB Cable	No	2.0m	No	USB Extension	WiFi Radio Module
AC Cable	No	1.1m	No	AC Mains	Laptop Power Supply
DC Cable	No	2.0m	No	Host Laptop	Laptop Power Supply

Configuration ELIM0013- 2

EUT			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
WiFi Radio Module	Electric Imp, Inc.	IMP004M	0104

Peripherals in test setup boundary			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
Host Laptop	HP	15-ba009dx	CND71420K3
Laptop Power Supply	HP	HSTNN-DA40	1WFTLD0CAR63O5H

Cables					
Cable Type	**Shield**	**Length (m)**	**Ferrite**	**Connection 1**	**Connection 2**
USB Cable	No	2.0m	No	USB Extension	WiFi Radio Module
AC Cable	No	1.1m	No	AC Mains	Laptop Power Supply
DC Cable	No	2.0m	No	Host Laptop	Laptop Power Supply
USB Extension Cable	No	2.0m	No	Host Laptop	USB Cable

MODIFICATIONS

Equipment Modifications

Item	Date	Test	Modification	Note	Disposition of EUT
1	2017-05-23	Receiver Spurious Emissions	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
2	2017-05-26	Transmitter Unwanted Emissions in the Spurious Domain	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
3	2017-05-31	RF Output power	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
4	2017-05-31	Power Spectral Density	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
5	2017-05-31	Occupied Channel Bandwidth	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
6	2017-05-31	Transmitter Unwanted Emissions in the OOB Domain.xls	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.

RF OUTPUT POWER

XMit 2017.02.08

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Meter - Power	ETS Lindgren	7002-006	SRB	12/6/2016	12/6/2017
Generator - Signal	Agilent	E8257D	TGU	2/5/2015	2/5/2018
Attenuator	Fairview Microwave	SA18E-20	TKS	3/6/2017	3/6/2018
Block - DC	Aeroflex	INMET 8535	AMO	3/27/2017	3/27/2018
Cable	Fairview Microwave	SCA1814-0101-120	OCZ	NCR	NCR
Thermometer	Omega Engineering, Inc.	HH311	DUC	10/3/2014	10/3/2017
Chamber - Temperature/Humidity	Cincinnati Sub Zero (CSZ)	ZPHS-32-3.5-SCT/AC	TBE	NCR	NCR

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The power measurement was then made using a direct connection between the RF output of the EUT and an ETSI EN 300 328 compliant RF Power Sensor which only measures across the high time of the burst of the carrier.

The RF output power was measured with the EUT set to the channels and modes called out in the data sheets.

The observed duty cycle was noted but not needed to calculate the EIRP.

EIRP = Max Measured Power + Antenna gain (dBi)

The measurements were made under normal test and extreme test conditions.

RF OUTPUT POWER

TbtTx 2017.01.27 XMit 2017.02.08

EUT:	IMP004M			**Work Order:**	ELIM0013
Serial Number:	0104			**Date:**	05/31/17
Customer:	Electric Imp, Inc.			**Temperature:**	21.3 °C
Attendees:	Jonathan Dillon			**Humidity:**	49% RH
Project:	None			**Barometric Pres.:**	1014 mbar
Tested by:	Mike Tran	**Power:**	5VDC via USB Power	**Job Site:**	OC13

TEST SPECIFICATIONS	Test Method
EN 300 328 V2.1.1:2016	EN 300 328 V2.1.1:2016

COMMENTS

Total Offset 22.92dB (20dB pad + DC Block + coax cable + client provided patch cable) at 2.4GHz

DEVIATIONS FROM TEST STANDARD

None

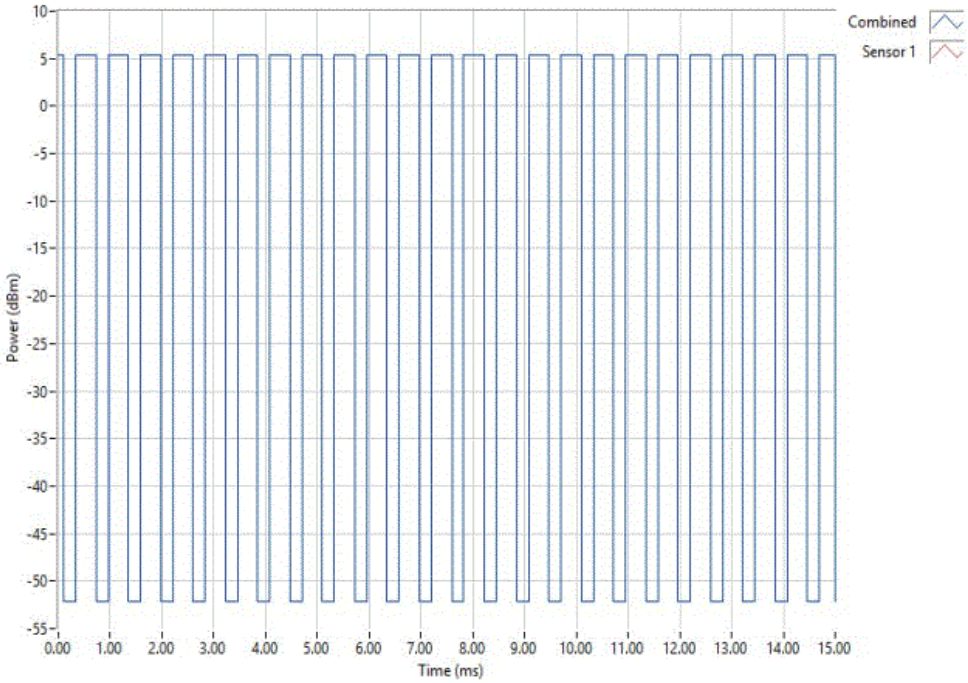
Configuration #	2	Signature

	Avg Cond Pwr (dBm)	Duty Cycle (%)	Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)	Results
Normal Test Conditions						
BLE/GFSK Low Channel, 2402 MHz	5.42	63.43	3.55	9	20	Pass
BLE/GFSK Mid Channel, 2440 MHz	6.2	63.44	3.55	9.8	20	Pass
BLE/GFSK High Channel, 2480 MHz	6.1	63.447	3.55	9.6	20	Pass
Extreme Temperature, +70°C						
BLE/GFSK Low Channel, 2402 MHz	5.29	63.435	3.55	8.8	20	Pass
BLE/GFSK Mid Channel, 2440 MHz	5.96	63.44	3.55	9.5	20	Pass
BLE/GFSK High Channel, 2480 MHz	6.49	63.451	3.55	10	20	Pass
Extreme Temperature, -30°C						
BLE/GFSK Low Channel, 2402 MHz	5.65	63.434	3.55	9.2	20	Pass
BLE/GFSK Mid Channel, 2440 MHz	5.79	63.441	3.55	9.3	20	Pass
BLE/GFSK High Channel, 2480 MHz	5.92	63.439	3.55	9.5	20	Pass

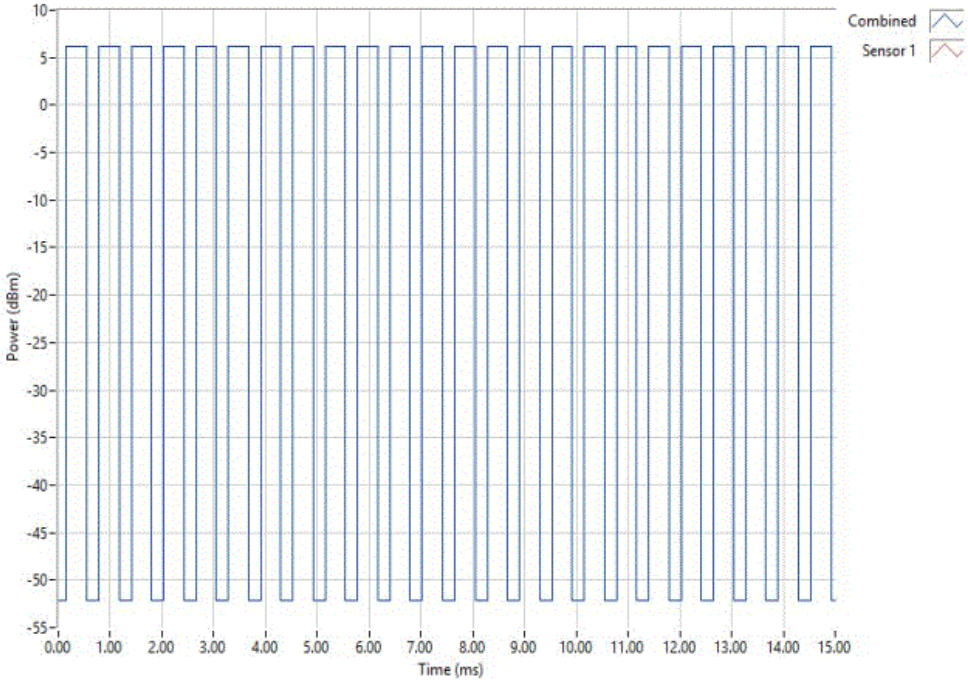
RF OUTPUT POWER

TbtTx 2017.01.27 XMit 2017.02.08

Normal Test Conditions, BLE/GFSK Low Channel, 2402 MHz						
	Avg Cond Pwr (dBm)	Duty Cycle (%)	Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)	Results
	5.42	63.43	3.55	9	20	Pass



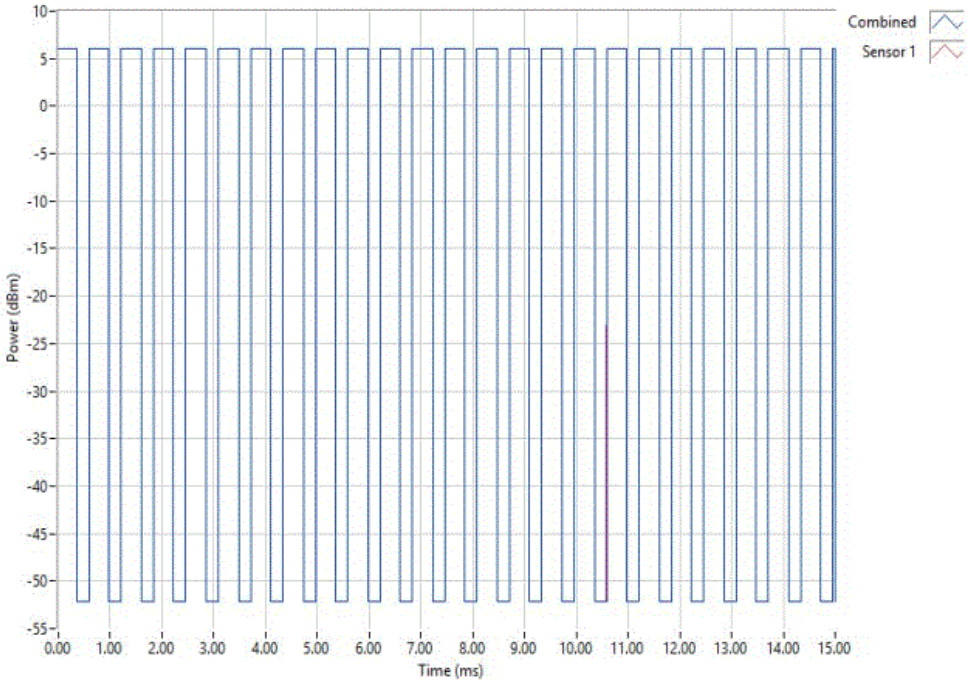
Normal Test Conditions, BLE/GFSK Mid Channel, 2440 MHz						
	Avg Cond Pwr (dBm)	Duty Cycle (%)	Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)	Results
	6.2	63.44	3.55	9.8	20	Pass



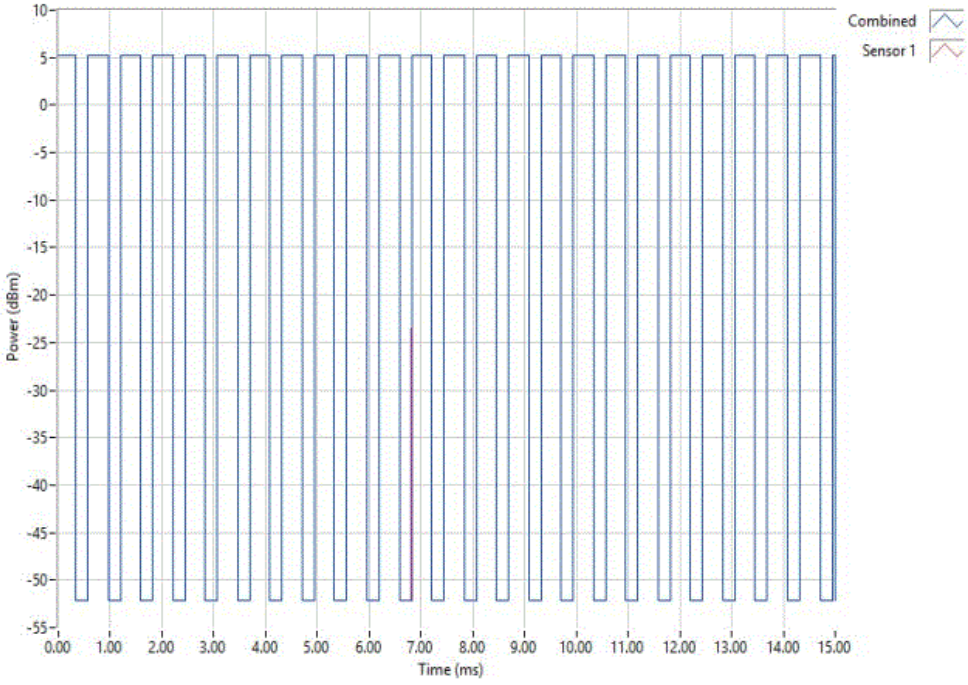
RF OUTPUT POWER

TbtTx 2017.01.27 XMit 2017.02.08

Normal Test Conditions, BLE/GFSK High Channel, 2480 MHz						
	Avg Cond Pwr (dBm)	Duty Cycle (%)	Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)	Results
	6.1	63.447	3.55	9.6	20	Pass

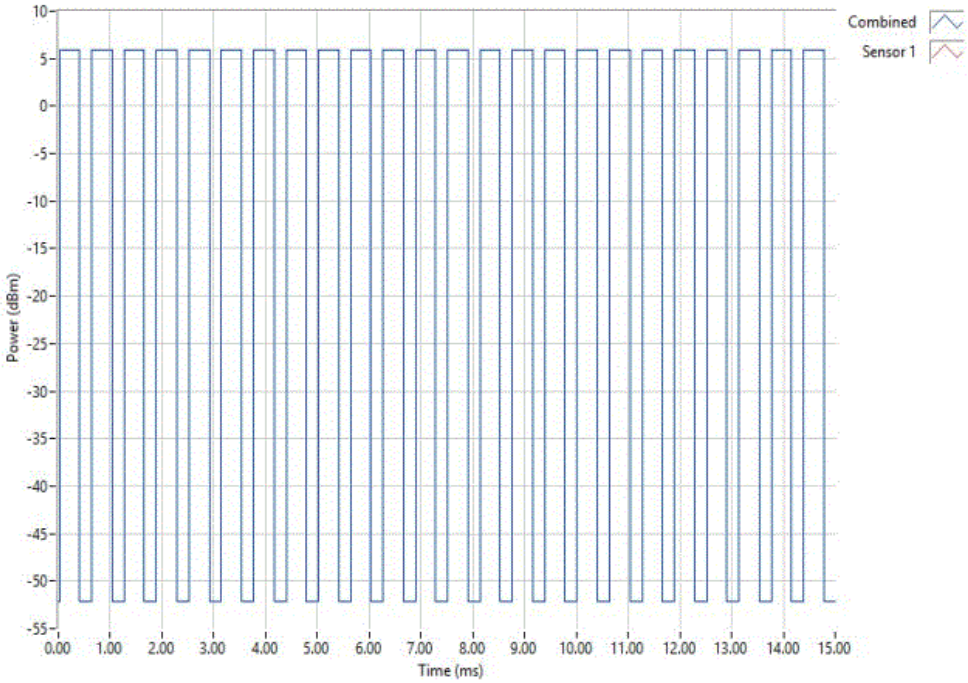


Extreme Temperature, +70°C, BLE/GFSK Low Channel, 2402 MHz						
	Avg Cond Pwr (dBm)	Duty Cycle (%)	Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)	Results
	5.29	63.435	3.55	8.8	20	Pass

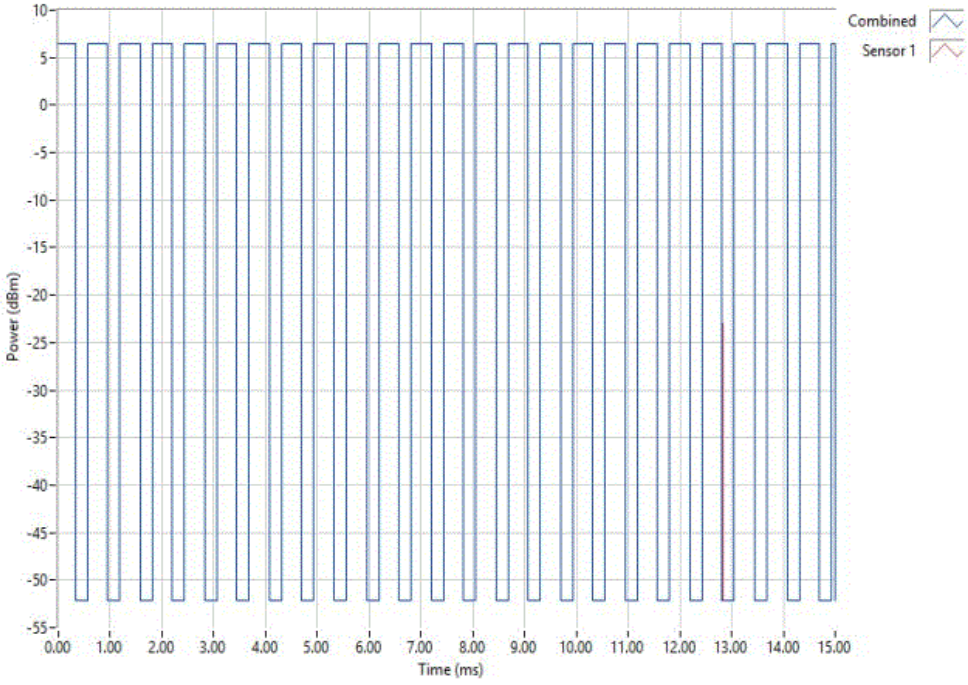


RF OUTPUT POWER

Extreme Temperature, +70°C, BLE/GFSK Mid Channel, 2440 MHz						
	Avg Cond Pwr (dBm)	Duty Cycle (%)	Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)	Results
	5.96	63.44	3.55	9.5	20	Pass

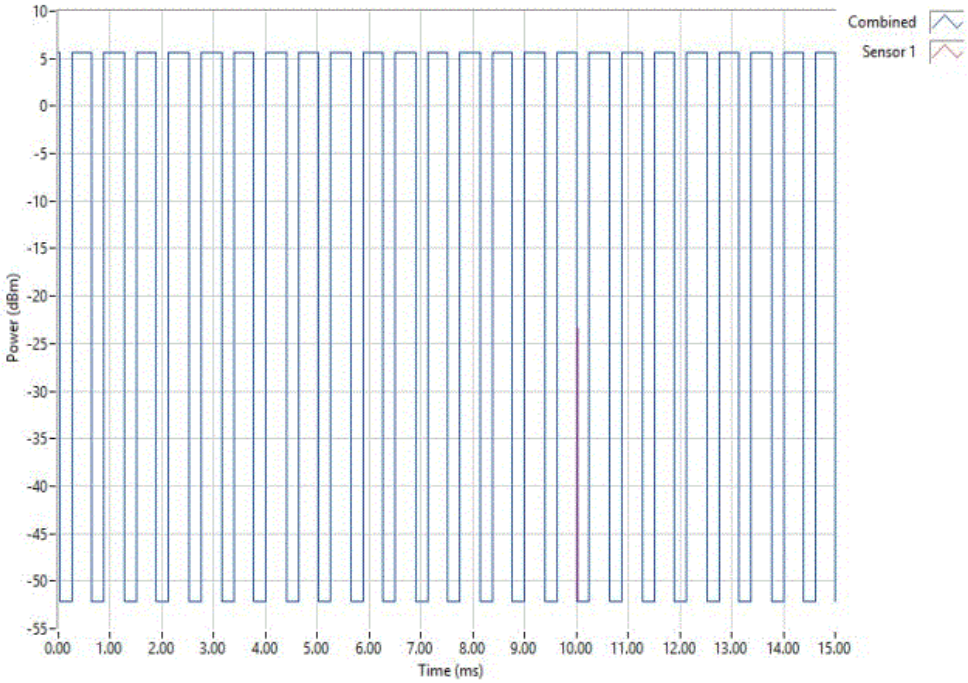


Extreme Temperature, +70°C, BLE/GFSK High Channel, 2480 MHz						
	Avg Cond Pwr (dBm)	Duty Cycle (%)	Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)	Results
	6.49	63.451	3.55	10	20	Pass

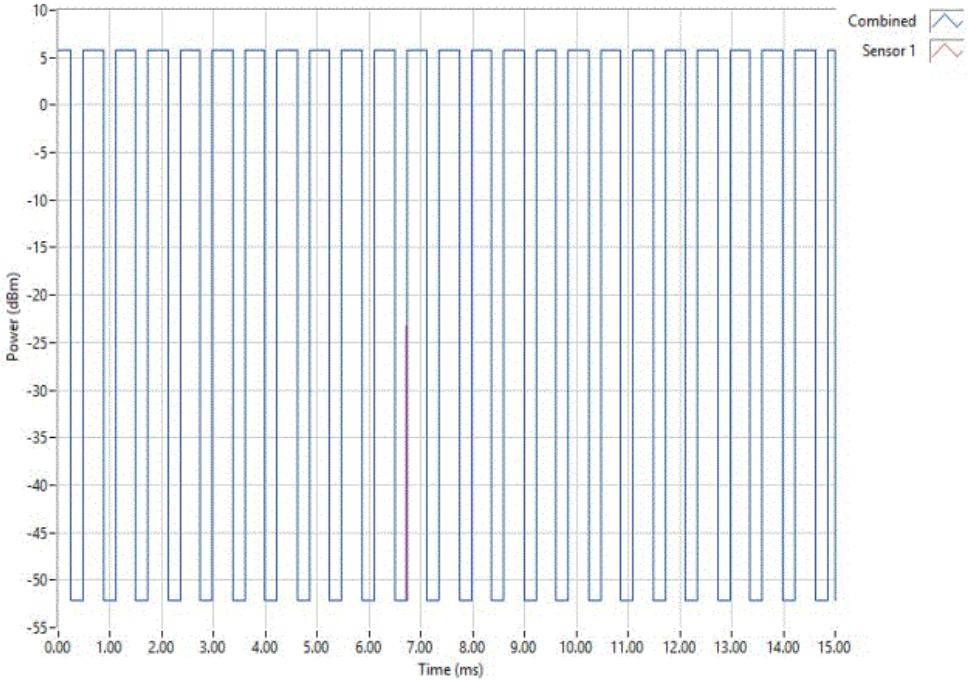


RF OUTPUT POWER

Extreme Temperature, -30°C, BLE/GFSK Low Channel, 2402 MHz						
	Avg Cond Pwr (dBm)	Duty Cycle (%)	Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)	Results
	5.65	63.434	3.55	9.2	20	Pass



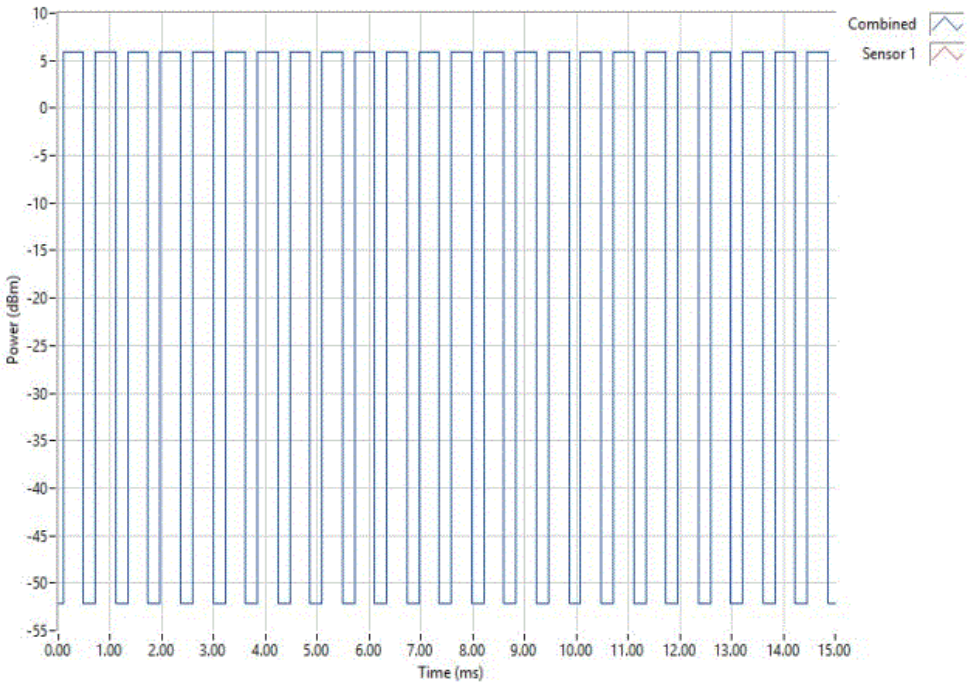
Extreme Temperature, -30°C, BLE/GFSK Mid Channel, 2440 MHz						
	Avg Cond Pwr (dBm)	Duty Cycle (%)	Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)	Results
	5.79	63.441	3.55	9.3	20	Pass



RF OUTPUT POWER

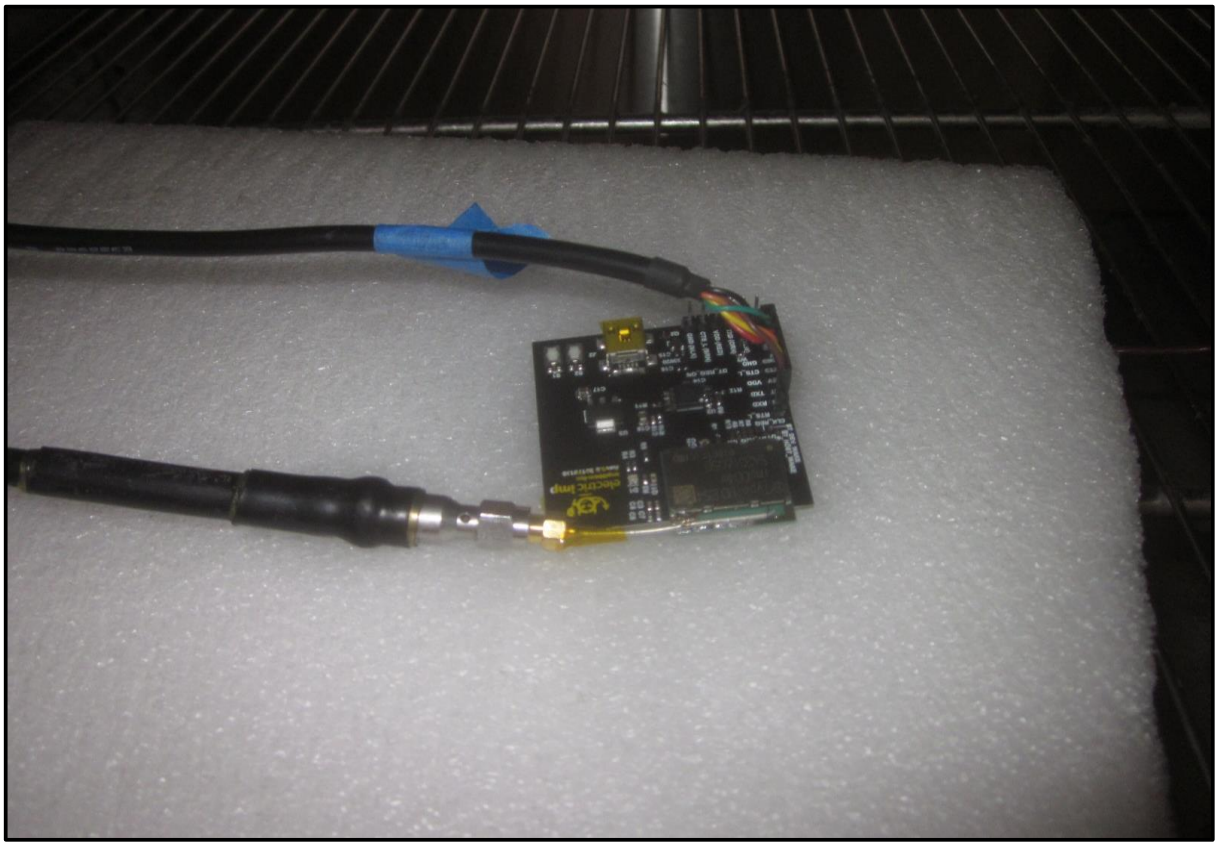
TbtTx 2017.01.27 XMit 2017.02.08

Extreme Temperature, -30°C, BLE/GFSK High Channel, 2480 MHz						
	Avg Cond Pwr (dBm)	Duty Cycle (%)	Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)	Results
	5.92	63.439	3.55	9.5	20	Pass



RF OUTPUT POWER

XMit 2017.02.08



POWER SPECTRAL DENSITY

XMit 2017.02.08

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	E8257D	TGU	2/5/2015	2/5/2018
Attenuator	Fairview Microwave	SA18E-20	TKS	3/6/2017	3/6/2018
Block - DC	Aeroflex	INMET 8535	AMO	3/27/2017	3/27/2018
Cable	Fairview Microwave	SCA1814-0101-120	OCZ	NCR	NCR
Analyzer - Spectrum Analyzer	Agilent	E4440A	AFA	11/2/2016	11/2/2017

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The Power Spectral Density was measured with the EUT set to the channels and modes called out in the data sheets.

The EUT antenna gain and duty cycle were used to calculate the output power of the EUT, and included in the calculations for Power Spectral Density. The measurements were made under normal test conditions.

The spectrum analyzer was set to a 10kHz RBW and 30kHz VBW, while utilizing an RMS detector. A total of 8350 points were captured across the spectrum. The traces were captured both graphically and in point format. The data points were normalized based on antenna power measurements located elsewhere in this report.

The reported Power Spectral Density is the highest sum for any 1MHz window in the specified spectrum.
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POWER SPECTRAL DENSITY

TbtTx 2017.01.27 XMit 2017.02.08

EUT:	**IMP004M**			**Work Order:**	**ELIM0013**
Serial Number:	**0104**			**Date:**	**05/31/17**
Customer:	**Electric Imp, Inc.**			**Temperature:**	**21.3 °C**
Attendees:	**Jonathan Dillon**			**Humidity:**	**49% RH**
Project:	**None**			**Barometric Pres.:**	**1014 mbar**
Tested by:	**Mike Tran**	**Power:**	**5VDC via USB Power**	**Job Site:**	**OC13**

TEST SPECIFICATIONS	**Test Method**
EN 300 328 V2.1.1:2016	EN 300 328 V2.1.1:2016

COMMENTS

Total Offset 22.92dB (20dB pad + DC Block + coax cable + client provided patch cable) at 2.4GHz

DEVIATIONS FROM TEST STANDARD

None

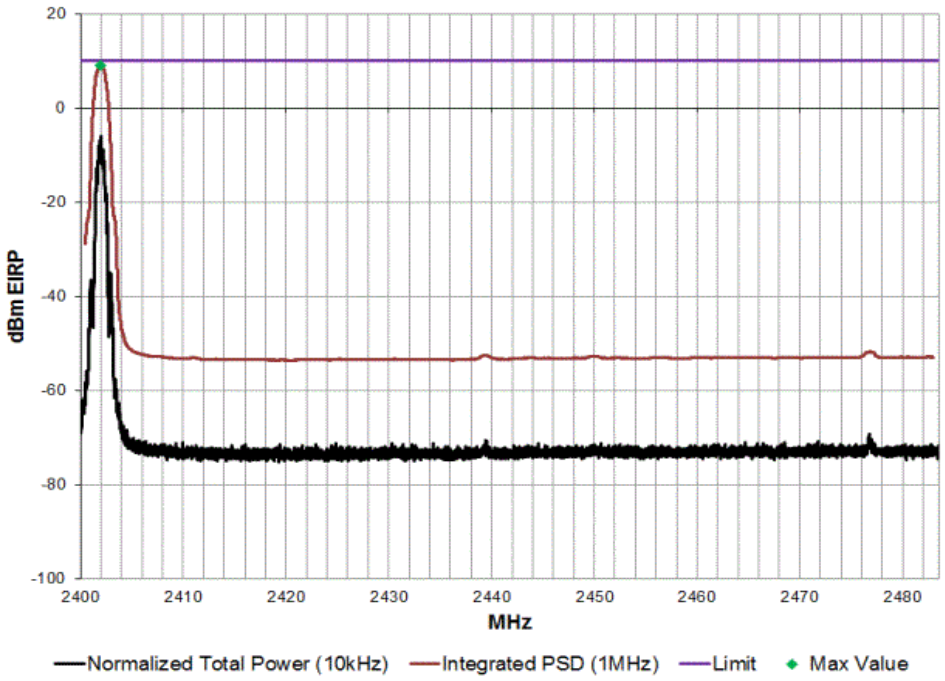
Configuration #	**2**	*Signature*

	EIRP (dBm)	EIRP PSD (dBm/MHz)	Limit (dBm/MHz)	Results
Normal Test Conditions				
BLE/GFSK Low Channel, 2402 MHz	9	8.9	10	Pass
BLE/GFSK Mid Channel, 2440 MHz	9.8	9.7	10	Pass
BLE/GFSK High Channel, 2480 MHz	9.6	9.5	10	Pass

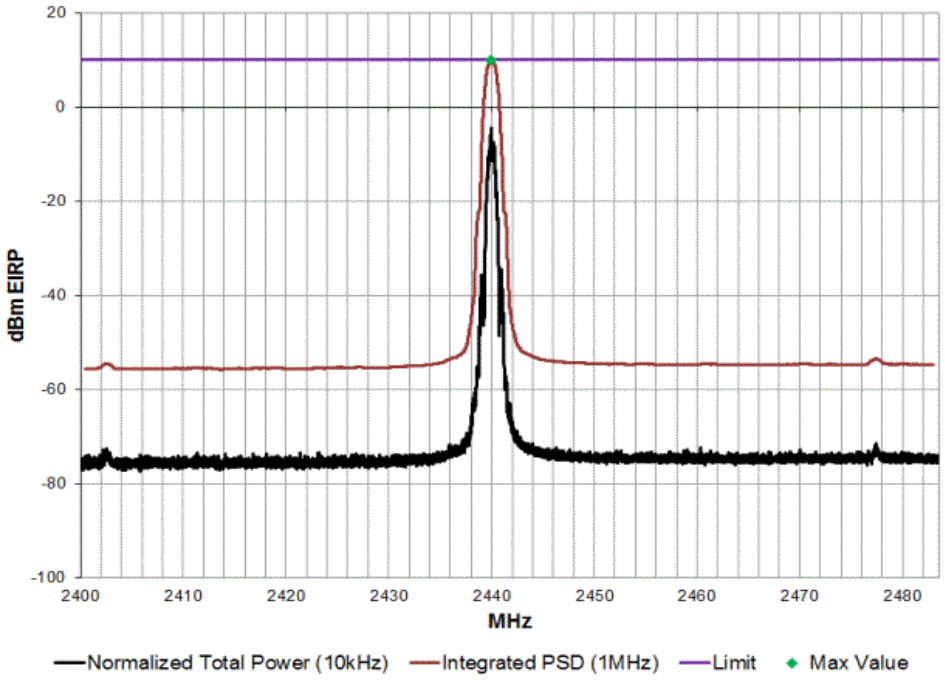
POWER SPECTRAL DENSITY

TbtTx 2017.01.27 XMit 2017.02.08

Normal Test Conditions, BLE/GFSK Low Channel, 2402 MHz						
	EIRP (dBm)			EIRP PSD (dBm/MHz)	Limit (dBm/MHz)	Results
	9			8.9	10	Pass



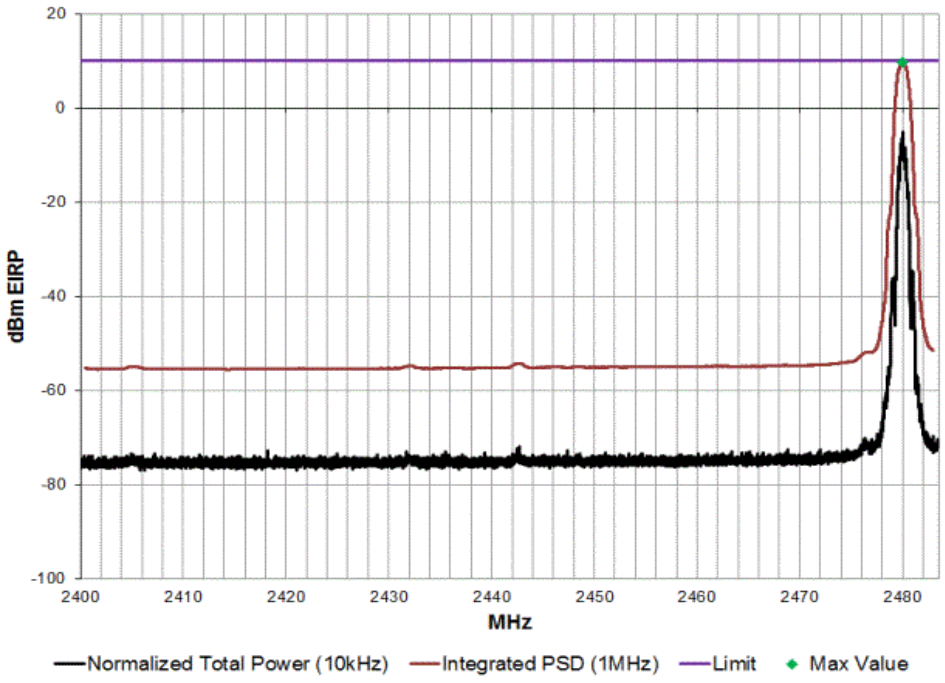
Normal Test Conditions, BLE/GFSK Mid Channel, 2440 MHz						
	EIRP (dBm)			EIRP PSD (dBm/MHz)	Limit (dBm/MHz)	Results
	9.8			9.7	10	Pass



POWER SPECTRAL DENSITY

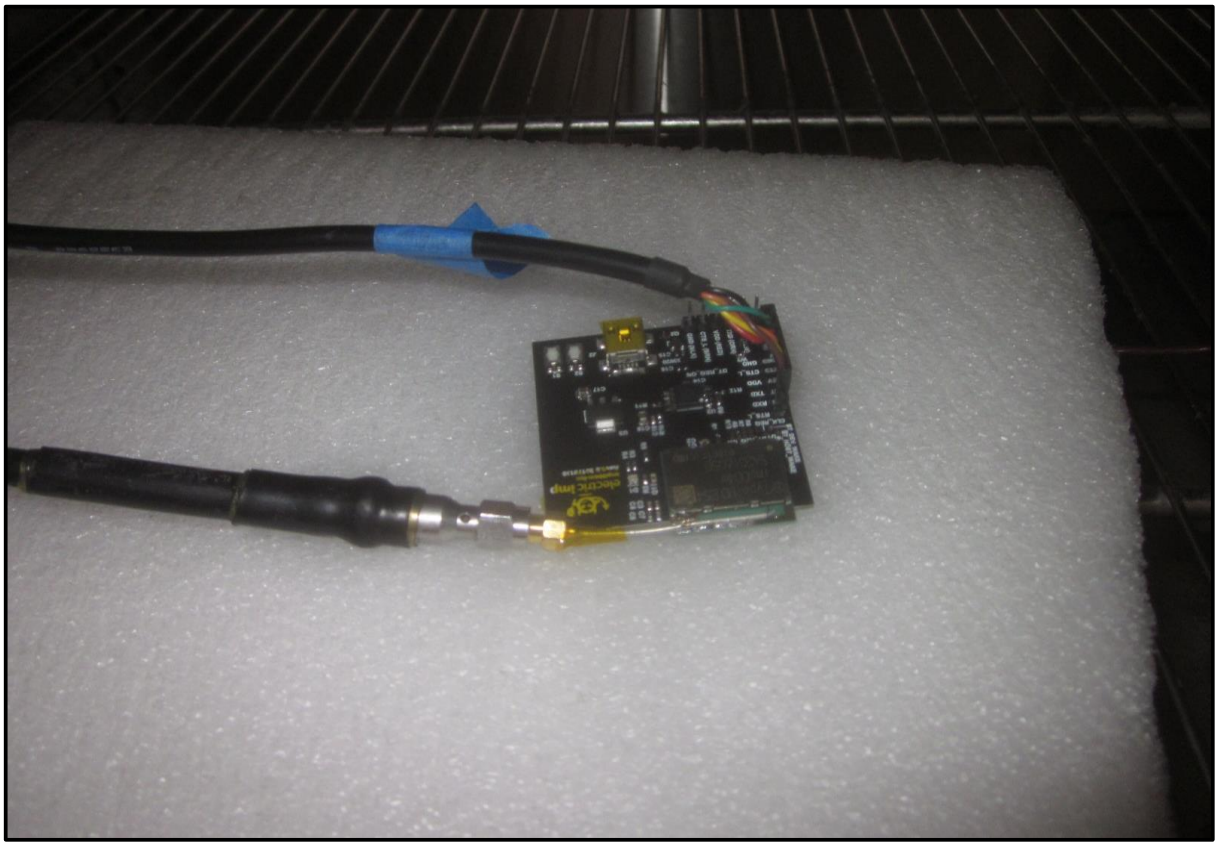
TbtTx 2017.01.27 XMit 2017.02.08

Normal Test Conditions, BLE/GFSK High Channel, 2480 MHz						
	EIRP (dBm)			EIRP PSD (dBm/MHz)	Limit (dBm/MHz)	Results
	9.6			9.5	10	Pass



POWER SPECTRAL DENSITY

XMit 2017.02.08



OCCUPIED CHANNEL BANDWIDTH

XMit 2017.02.08

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Analyzer - Spectrum Analyzer	Agilent	E4440A	AFA	11/2/2016	11/2/2017
Cable	Fairview Microwave	SCA1814-0101-120	OCZ	NCR	NCR
Block - DC	Aeroflex	INMET 8535	AMO	3/27/2017	3/27/2018
Attenuator	Fairview Microwave	SA18E-20	TKS	3/6/2017	3/6/2018
Generator - Signal	Agilent	E8257D	TGU	2/5/2015	2/5/2018

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The occupied channel bandwidth was measured with the EUT set to the channels and modes as listed on the data sheets. The EUT was transmitting at the data rate(s) listed in the datasheet in a no-hop mode. The 99% occupied bandwidth measurement was made using the Agilent built in Occupied Bandwidth measurement function. The analyzer was set to a span equaling 2 times the nominal bandwidth, with a RBW of 1% of the span, VBW of 3 times the RBW, and utilizing an RMS detector.

OCCUPIED CHANNEL BANDWIDTH

TbtTx 2017.01.27 XMit 2017.02.08

EUT:	**IMP004M**			**Work Order:**	**ELIM0013**
Serial Number:	**0104**			**Date:**	**05/31/17**
Customer:	**Electric Imp, Inc.**			**Temperature:**	**21.3 °C**
Attendees:	**Jonathan Dillon**			**Humidity:**	**49% RH**
Project:	**None**			**Barometric Pres.:**	**1014 mbar**
Tested by:	**Mike Tran**	**Power:**	**5VDC via USB Power**	**Job Site:**	**OC13**

TEST SPECIFICATIONS	**Test Method**
EN 300 328 V2.1.1:2016	EN 300 328 V2.1.1:2016

COMMENTS

Total Offset 22.92dB (20dB pad + DC Block + coax cable + client provided patch cable) at 2.4GHz

DEVIATIONS FROM TEST STANDARD

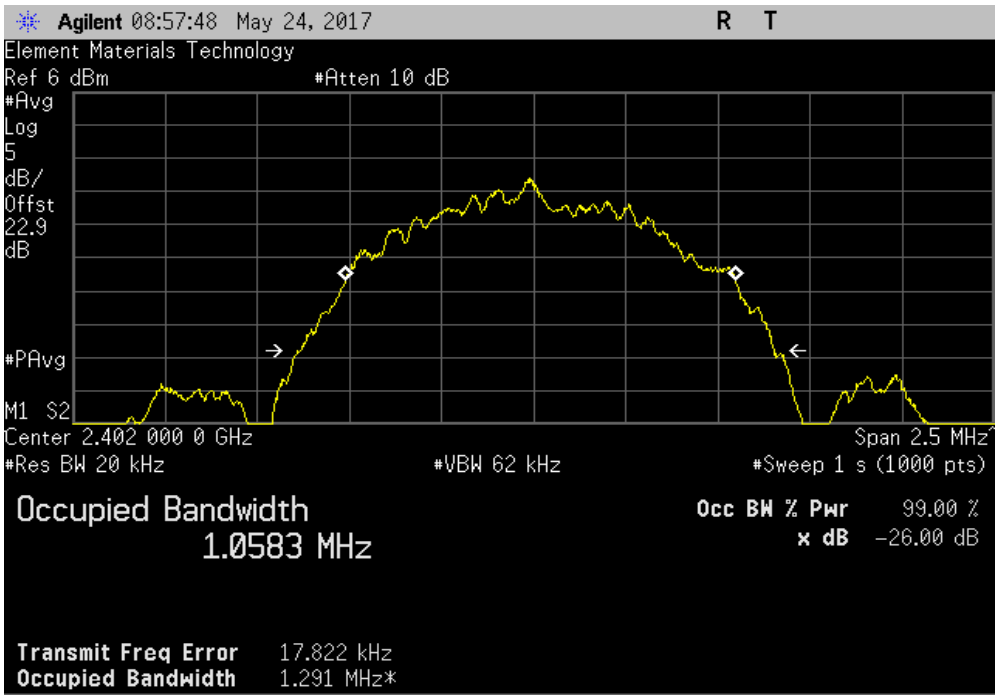
None

Configuration #	**2**	*Signature*

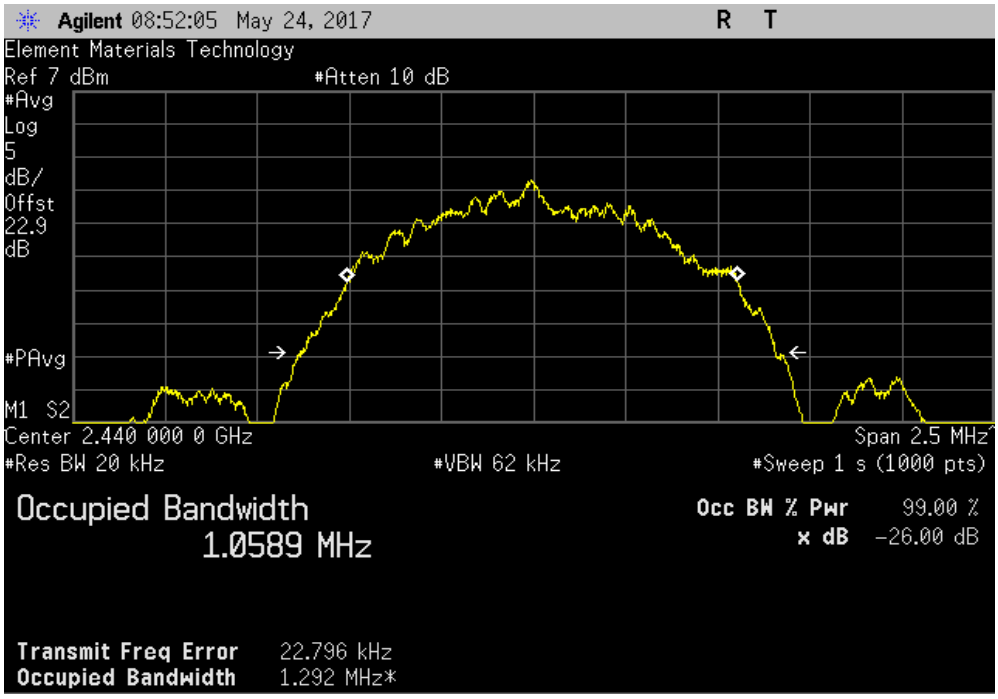
	Value	**Limit (≤)**	**Result**
BLE/GFSK Low Channel, 2402 MHz	1.058 MHz	20 MHz	Pass
BLE/GFSK Mid Channel, 2442 MHz	1.059 MHz	20 MHz	Pass
BLE/GFSK High Channel, 2480 MHz	1.059 MHz	20 MHz	Pass

OCCUPIED CHANNEL BANDWIDTH

BLE/GFSK Low Channel, 2402 MHz						
				Value	Limit (≤)	Result
				1.058 MHz	20 MHz	Pass



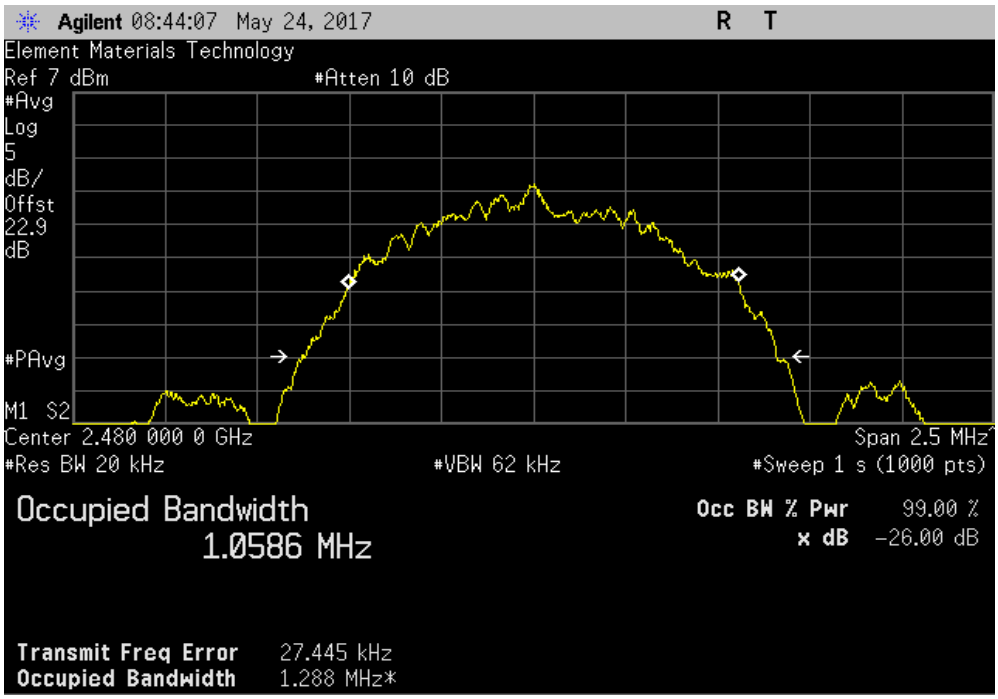
BLE/GFSK Mid Channel, 2442 MHz						
				Value	Limit (≤)	Result
				1.059 MHz	20 MHz	Pass



OCCUPIED CHANNEL BANDWIDTH

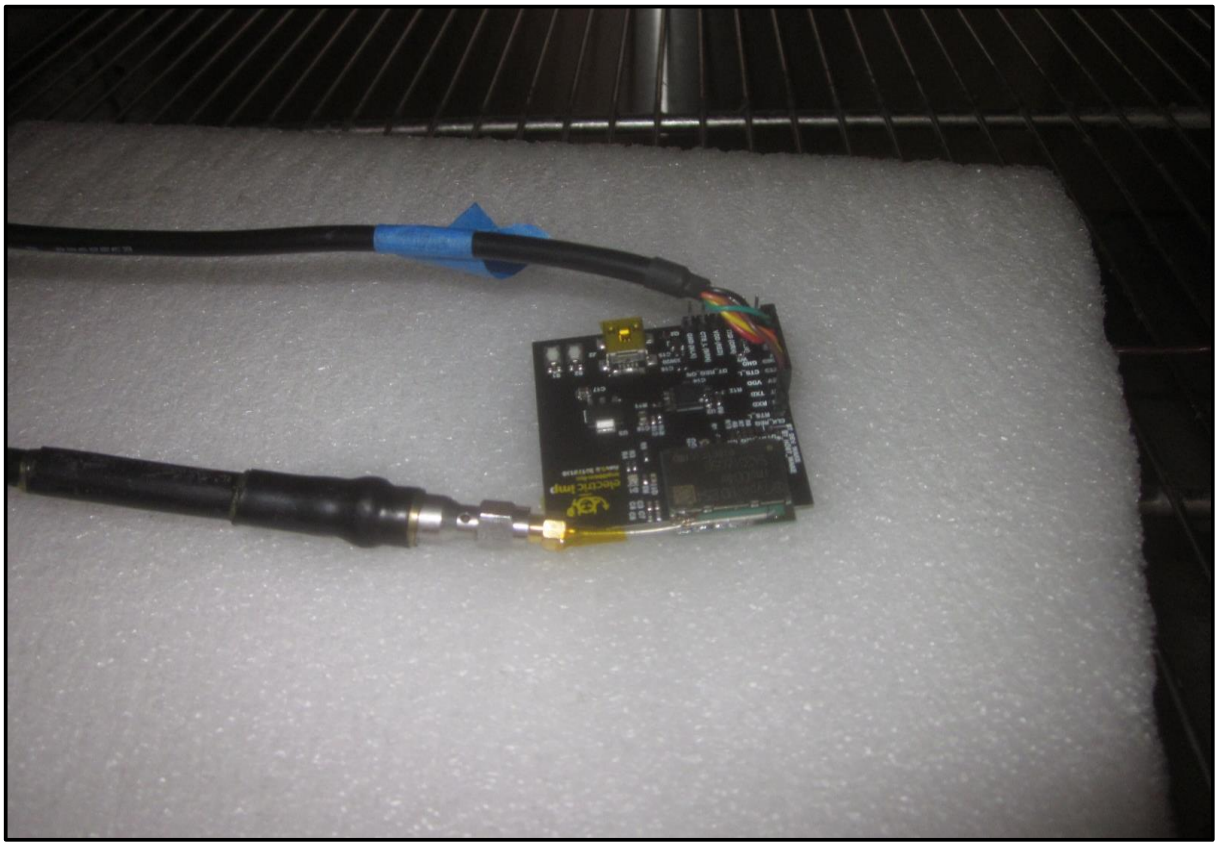
TbtTx 2017.01.27 XMit 2017.02.08

BLE/GFSK High Channel, 2480 MHz						
				Value	Limit (≤)	Result
				1.059 MHz	20 MHz	Pass



OCCUPIED CHANNEL BANDWIDTH

XMit 2017.02.08



TRANSMITTER UNWANTED EMISSIONS IN THE OOB DOMAIN

XMit 2017.02.08

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Analyzer - Spectrum Analyzer	Agilent	E4440A	AFA	11/2/2016	11/2/2017
Cable	Fairview Microwave	SCA1814-0101-120	OCZ	NCR	NCR
Block - DC	Aeroflex	INMET 8535	AMO	3/27/2017	3/27/2018
Attenuator	Fairview Microwave	SA18E-20	TKS	3/6/2017	3/6/2018
Generator - Signal	Agilent	E8257D	TGU	2/5/2015	2/5/2018

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The measurement was made using a RMS detector, with a 1 MHz RBW and 3 MHz VBW.
The frequency ranges of the limit steps are dependent on the measured Occupied Channel Bandwidth (contained elsewhere in the report)
The declared antenna assembly gain (dBi) was added to the measurement system offset.
The Screen Captures show compliance to each OOB steps/spans as defined in the Transmit Mask.

TRANSMITTER UNWANTED EMISSIONS IN THE OOB DOMAIN

TbtTx 2017.01.27 XMit 2017.02.08

EUT:	IMP004M			**Work Order:**	ELIM0013
Serial Number:	0104			**Date:**	05/31/17
Customer:	Electric Imp, Inc.			**Temperature:**	21.3 °C
Attendees:	Jonathan Dillon			**Humidity:**	49% RH
Project:	None			**Barometric Pres.:**	1014 mbar
Tested by:	Mike Tran	**Power:**	5VDC via USB Power	**Job Site:**	OC13

TEST SPECIFICATIONS	Test Method
EN 300 328 V2.1.1:2016	EN 300 328 V2.1.1:2016

COMMENTS

Total Offset 22.92dB (20dB pad + DC Block + coax cable + client provided patch cable) at 2.4GHz

DEVIATIONS FROM TEST STANDARD

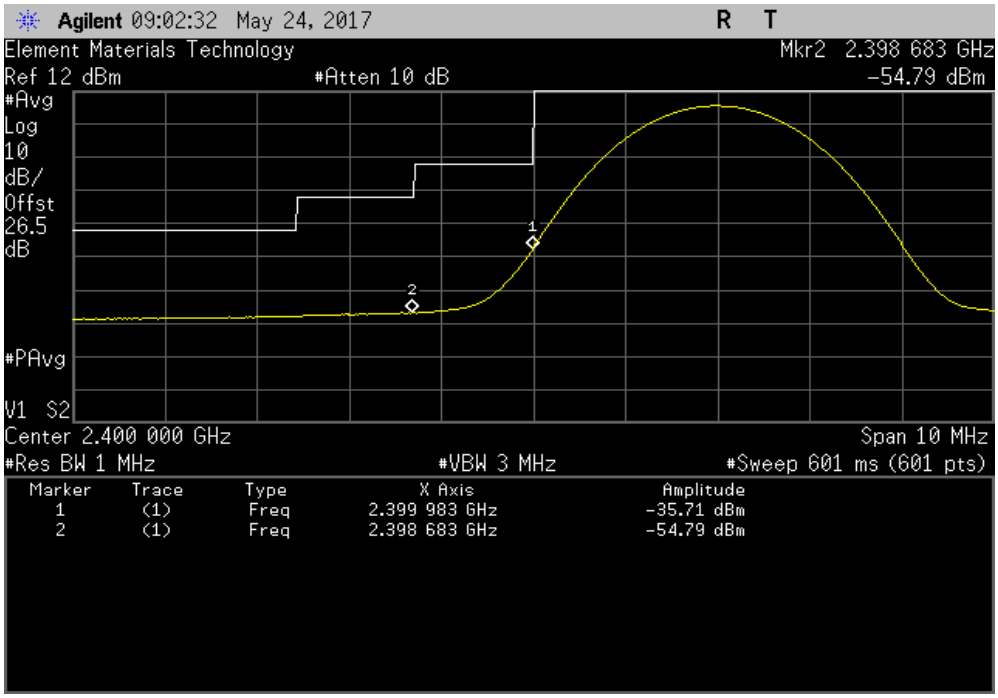
None

Configuration #	2	Signature

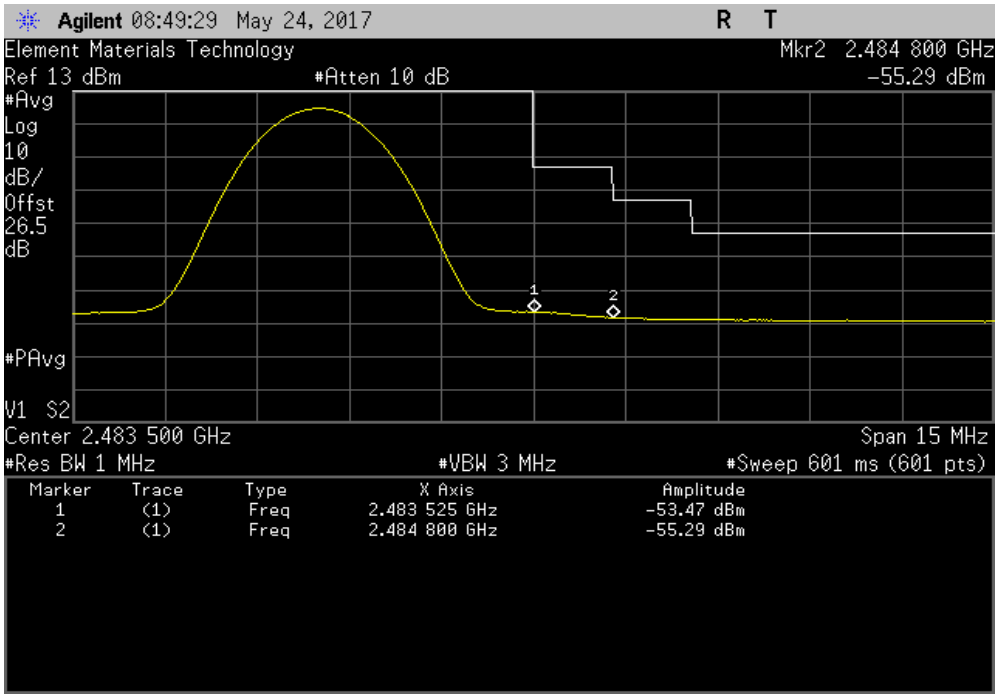
	Value (dBm/MHz)	Limit (dBm/MHz)	Value (dBm/MHz)	Limit (dBm/MHz)	Result
BLE/GFSK Low Channel, 2402 MHz	-35.71	-10	-54.79	-20	Pass
BLE/GFSK High Channel, 2480 MHz	-53.47	-10	-55.29	-20	Pass

TRANSMITTER UNWANTED EMISSIONS IN THE OOB DOMAIN

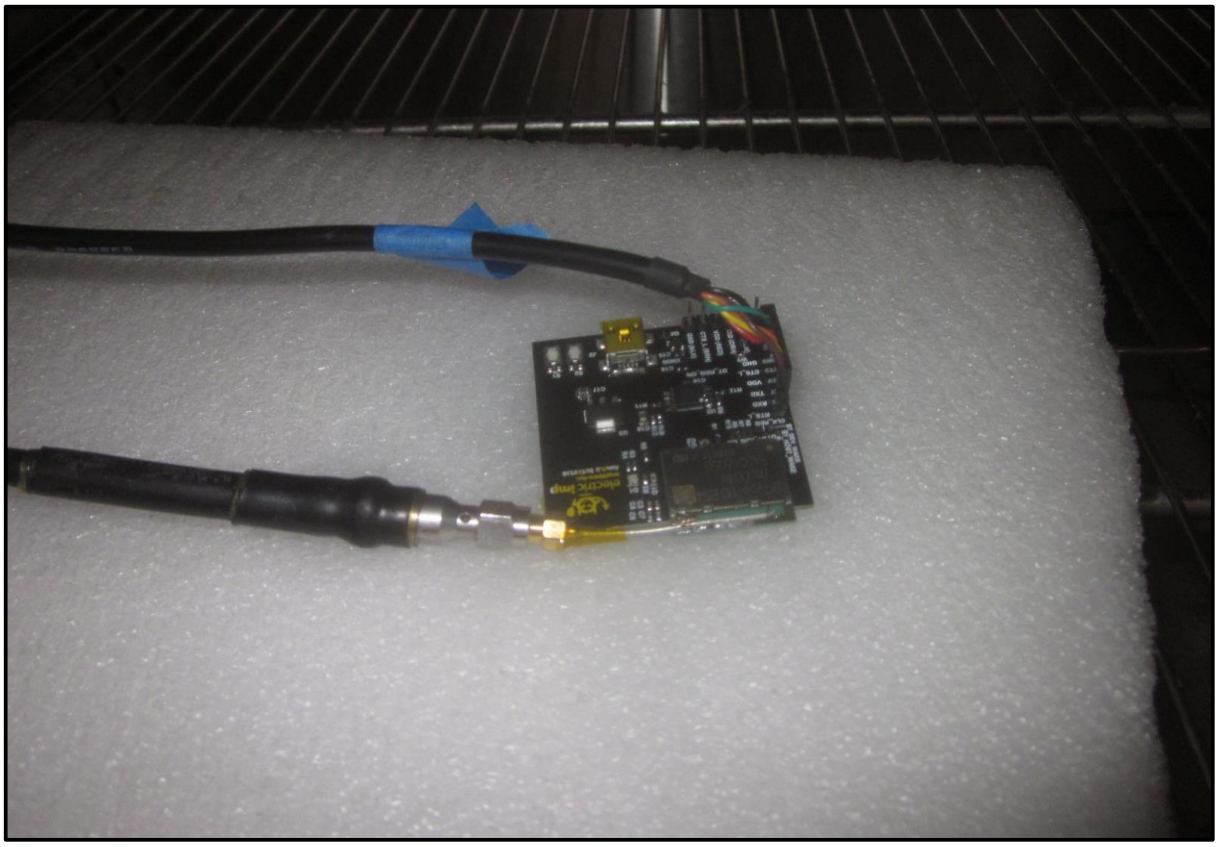
BLE/GFSK Low Channel, 2402 MHz						
		Value (dBm/MHz)	Limit (dBm/MHz)	Value (dBm/MHz)	Limit (dBm/MHz)	Result
		-35.71	-10	-54.79	-20	Pass



BLE/GFSK High Channel, 2480 MHz						
		Value (dBm/MHz)	Limit (dBm/MHz)	Value (dBm/MHz)	Limit (dBm/MHz)	Result
		-53.47	-10	-55.29	-20	Pass



XMit 2017.02.08



TRANSMITTER UNWANTED EMISSIONS IN THE SPURIOUS DOMAIN

PSA-ESCI 2017.01.26

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data. The test data represents the configuration / operating mode/ model that produced the highest emission levels as compared to the specification limit.

MODES OF OPERATION

Transmitting BLE at Low Ch 0-2402MHz, High Ch 39-2480MHz

POWER SETTINGS INVESTIGATED

5VDC via USB Power

CONFIGURATIONS INVESTIGATED

ELIM0013 - 1

FREQUENCY RANGE INVESTIGATED

Start Frequency	30 MHz	Stop Frequency	12750 MHz

SAMPLE CALCULATIONS

Radiated Emissions: Field Strength = Measured Level + Antenna Factor + Cable Factor - Amplifier Gain + Distance Adjustment Factor + External Attenuation

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Interval
Generator - Signal	Agilent	E8257D	TGU	2/5/2015	36 mo
Power Sensor	Hewlett Packard	8481	SQP	1/26/2017	12 mo
Meter - Power	Hewlett Packard	E4418A	SPA	1/26/2017	12 mo
Cable	ESM Cable Corp.	8-18GHz cables	OCY	5/15/2017	12 mo
Amplifier - Pre-Amplifier	Miteq	JSDWK42-18004000-60-5P	PAN	1/4/2017	12 mo
Cable	ESM Cable Corp.	1-8GHz cables	OCX	5/15/2017	12 mo
Cable	D-Coax	None	OC4	1/4/2017	12 mo
Antenna - Double Ridge	A.H. Systems, Inc.	SAS-574	AXV	5/3/2016	24 mo
Amplifier - Pre-Amplifier	Miteq	AMF-6F-12001800-30-10P	AVP	8/15/2016	12 mo
Amplifier - Pre-Amplifier	Miteq	AMF-6F-08001200-30-10P	AVL	10/17/2016	12 mo
Amplifier - Pre-Amplifier	Miteq	AMF-3D-00100800-32-13P	AVJ	8/15/2016	12 mo
Antenna - Double Ridge	ETS Lindgren	3115	AIR	6/23/2016	24 mo
Antenna - Standard Gain	ETS Lindgren	3160-07	AHX	NCR	0 mo
Antenna - Standard Gain	EMCO	3160-08	AHK	NCR	0 mo
Cable	ESM Cable Corp.	30-1GHz cables	OCW	5/15/2017	12 mo
Amplifier - Pre-Amplifier	Miteq	AM-1616-1000	PAD	8/15/2016	12 mo
Analyzer - Spectrum Analyzer	Agilent	E4446A	AAY	10/25/2016	12 mo

TEST DESCRIPTION

The EUT was operated in a worst-case configuration in transmit mode. The spectrum was scanned from 30 MHz to 12.75 GHz with the EUT set to low and high transmit frequencies. The EUT was transmitting at its maximum data rate. While scanning, emissions from the EUT were maximized by rotating the EUT, adjusting the measurement antenna height (1-4 meters) and polarization. A preamp and high pass filter were used for this test in order to provide sufficient measurement sensitivity. The amplitude and frequency of the highest emissions were noted. The EUT was then replaced with a ½ wave dipole that was successively tuned to each of the highest spurious emissions. A signal generator was connected to the dipole (horn antenna for frequencies above 1 GHz), and its output was adjusted to match the level previously noted for each frequency. The output of the signal generator was recorded, and by factoring in the cable loss to the dipole antenna and its gain (dBi); the effective radiated power for each radiated spurious emission was determined.

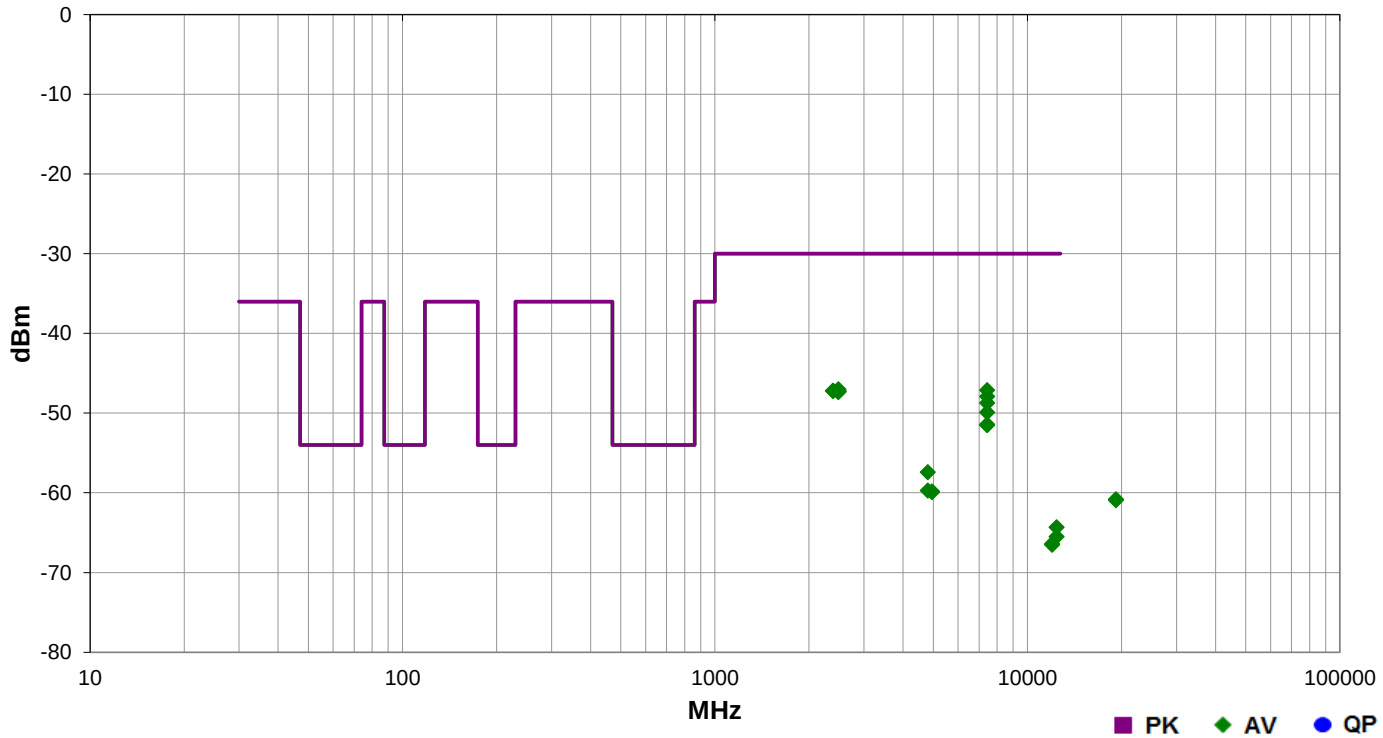
TRANSMITTER UNWANTED EMISSIONS IN THE SPURIOUS DOMAIN

EmiR5 2017.01.25 PSA-ESCI 2017.01.26

Work Order:	ELIM0013	**Date:**	05/25/17		
Project:	None	**Temperature:**	22.4 °C		
Job Site:	OC07	**Humidity:**	44.3% RH		
Serial Number:	0107	**Barometric Pres.:**	1014 mbar	**Tested by:**	Mike Tran
EUT:	IMP004M				
Configuration:	1				
Customer:	Electric Imp, Inc.				
Attendees:	Jonathan Dillon				
EUT Power:	5VDC via USB Power				
Operating Mode:	Transmitting BLE at Low Ch 0-2402MHz, High Ch 39-2480MHz				
Deviations:	None				
Comments:	TX Power value = 5.				

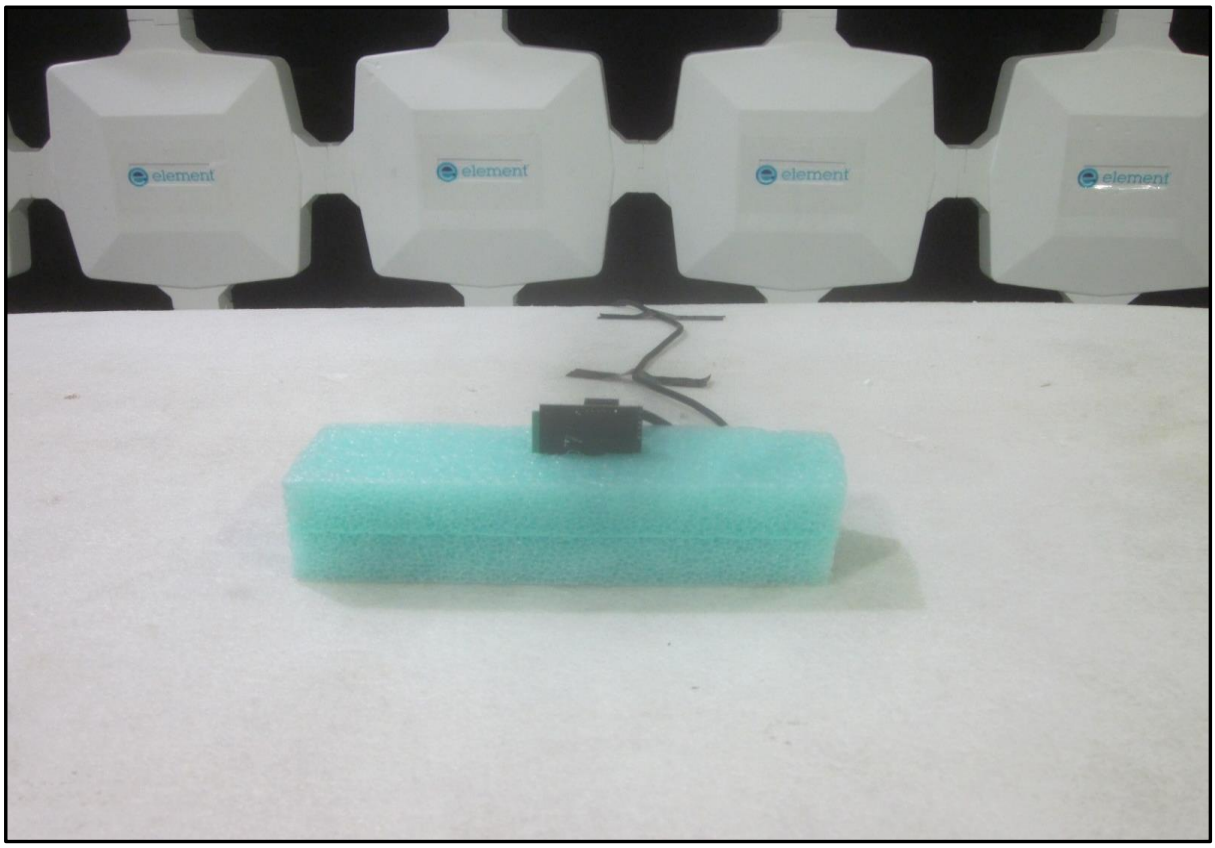
Test Specifications	**Test Method**
EN 300 328 V2.1.1:2016	EN 300 328 V2.1.1:2016

Run #	29	**Test Distance (m)**	3	**Antenna Height(s)**	1 to 4(m)	**Results**	Pass



	EUT (MHz)	Antenna Height (meters)	Azimuth (degrees)	Polarity/ Transducer Type	Detector	EIRP (Watts)	EIRP (dBm)	Spec. Limit (dBm)	Compared to Spec. (dB)	Comments
	2483.967	1.0	345.0	Vert	AV	1.98E-08	-47.0	-30.0	-17.0	EUT Vert, High Ch
	7439.495	2.4	259.0	Vert	AV	1.94E-08	-47.1	-30.0	-17.1	EUT Ver, High Ch
	2388.703	1.0	279.0	Horz	AV	1.89E-08	-47.2	-30.0	-17.2	EUT Hor, Low Ch
	2387.833	1.8	177.0	Vert	AV	1.89E-08	-47.2	-30.0	-17.2	EUT Vert, Low Ch
	2484.107	1.0	196.0	Vert	AV	1.89E-08	-47.2	-30.0	-17.2	EUT on Side, High Ch

	EUT (MHz)	Antenna Height (meters)	Azimuth (degrees)	Polarity/ Transducer Type	Detector	EIRP (Watts)	EIRP (dBm)	Spec. Limit (dBm)	Compared to Spec. (dB)	Comments
	2483.600	1.2	85.0	Horz	AV	1.89E-08	-47.2	-30.0	-17.2	EUT Hor, High Ch
	2484.670	1.0	359.0	Horz	AV	1.85E-08	-47.3	-30.0	-17.3	EUT Vert, High Ch
	2483.860	2.6	124.0	Vert	AV	1.85E-08	-47.3	-30.0	-17.3	EUT Hor, High Ch
	2484.703	1.0	7.0	Horz	AV	1.85E-08	-47.3	-30.0	-17.3	EUT on Side, High Ch
	7439.500	1.0	276.0	Horz	AV	1.61E-08	-47.9	-30.0	-17.9	EUT Hor, High Ch
	7439.610	1.1	76.0	Horz	AV	1.34E-08	-48.7	-30.0	-18.7	EUT Ver, High Ch
	7439.305	1.0	164.0	Vert	AV	1.02E-08	-49.9	-30.0	-19.9	EUT Hor, High Ch
	7438.685	3.3	169.0	Horz	AV	7.20E-09	-51.4	-30.0	-21.4	EUT on Side, High Ch
	7438.920	1.0	8.0	Vert	AV	7.03E-09	-51.5	-30.0	-21.5	EUT on Side, High Ch
	4803.705	1.0	329.0	Horz	AV	1.81E-09	-57.4	-30.0	-27.4	EUT Hor, Low Ch
	4803.870	1.5	164.0	Vert	AV	1.06E-09	-59.7	-30.0	-29.7	EUT Ver, Low Ch
	4958.880	1.0	158.0	Horz	AV	1.04E-09	-59.8	-30.0	-29.8	EUT Hor, High Ch
	4958.855	1.6	17.0	Vert	AV	1.02E-09	-59.9	-30.0	-29.9	EUT Ver, High Ch
	19216.120	1.0	186.0	Horz	AV	8.26E-10	-60.8	100.0	-160.8	EUT Hor, Low Ch
	19216.580	1.0	113.0	Vert	AV	8.07E-10	-60.9	100.0	-160.9	EUT Vert, Low Ch
	12397.540	1.0	231.0	Vert	AV	3.69E-10	-64.3	-30.0	-34.3	EUT Vert, High Ch
	12397.630	1.3	321.0	Horz	AV	2.80E-10	-65.5	-30.0	-35.5	EUT Hor, High Ch
	12011.500	3.1	121.0	Vert	AV	2.28E-10	-66.4	-30.0	-36.4	EUT Ver, Low Ch
	12011.140	1.3	277.0	Horz	AV	2.22E-10	-66.5	-30.0	-36.5	EUT Horz, Low Ch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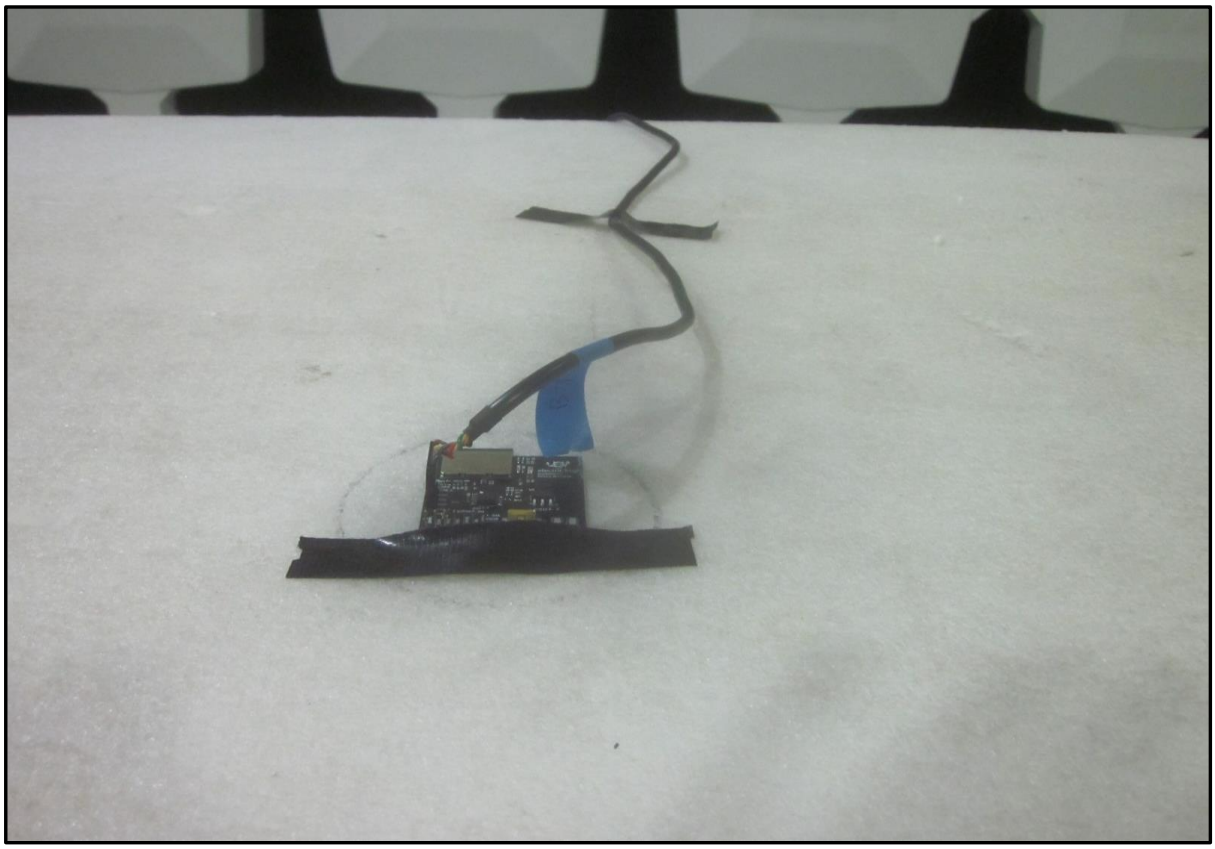
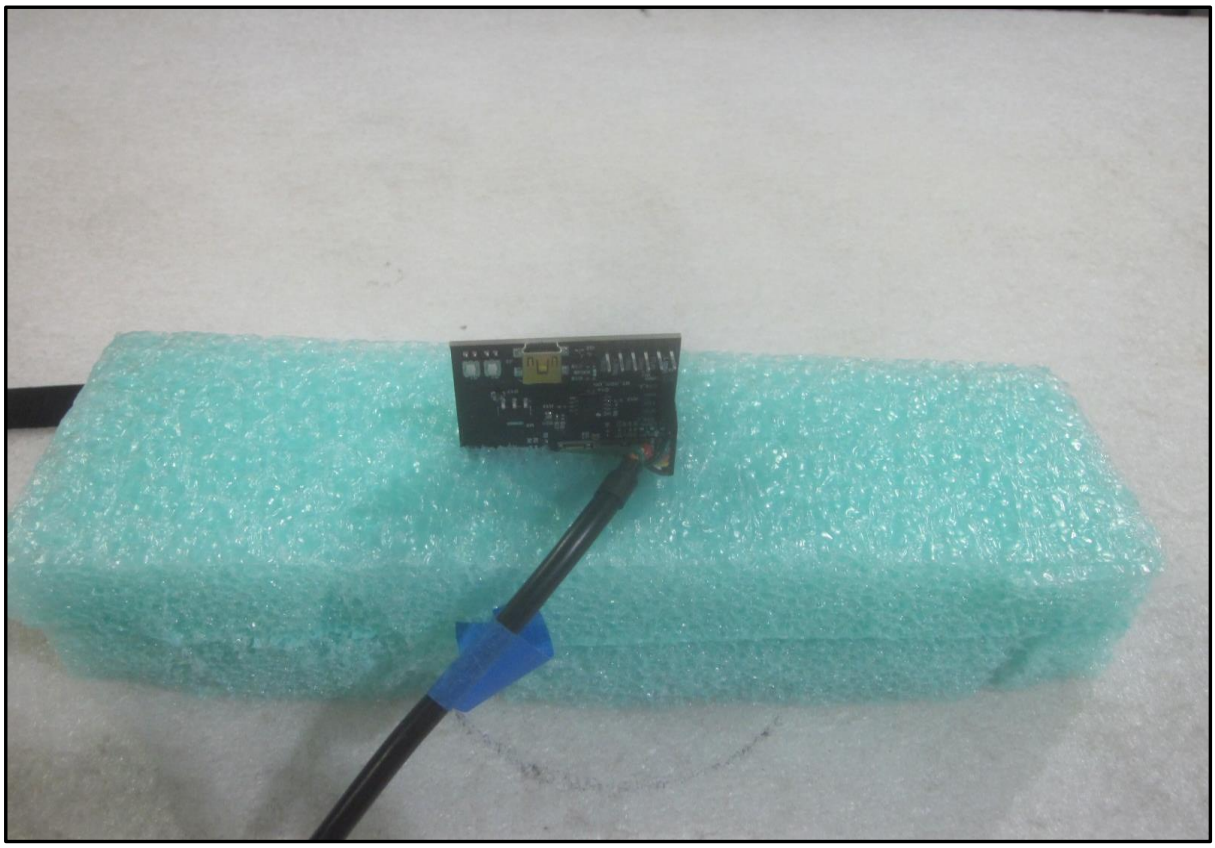
PSA-ESCI 2017.01.26





RECEIVER SPURIOUS EMISSIONS

PSA-ESCI 2017.01.26

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data. The test data represents the configuration / operating mode/ model that produced the highest emission levels as compared to the specification limit.

MODES OF OPERATION

Transmitting BLE at Low Ch 0-2402MHz, High Ch 39-2480MHz

POWER SETTINGS INVESTIGATED

5VDC via USB Power

CONFIGURATIONS INVESTIGATED

ELIM0013 - 1

FREQUENCY RANGE INVESTIGATED

Start Frequency	30 MHz	Stop Frequency	12750 MHz

SAMPLE CALCULATIONS

Radiated Emissions: Field Strength = Measured Level + Antenna Factor + Cable Factor - Amplifier Gain + Distance Adjustment Factor + External Attenuation

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Interval
Generator - Signal	Agilent	E8257D	TGU	2/5/2015	36 mo
Power Sensor	Hewlett Packard	8481	SQP	1/26/2017	12 mo
Meter - Power	Hewlett Packard	E4418A	SPA	1/26/2017	12 mo
Cable	ESM Cable Corp.	8-18GHz cables	OCY	5/15/2017	12 mo
Amplifier - Pre-Amplifier	Miteq	JSDWK42-18004000-60-5P	PAN	1/4/2017	12 mo
Cable	ESM Cable Corp.	1-8GHz cables	OCX	5/15/2017	12 mo
Cable	D-Coax	None	OC4	1/4/2017	12 mo
Antenna - Double Ridge	A.H. Systems, Inc.	SAS-574	AXV	5/3/2016	24 mo
Amplifier - Pre-Amplifier	Miteq	AMF-6F-12001800-30-10P	AVP	8/15/2016	12 mo
Amplifier - Pre-Amplifier	Miteq	AMF-6F-08001200-30-10P	AVL	10/17/2016	12 mo
Amplifier - Pre-Amplifier	Miteq	AMF-3D-00100800-32-13P	AVJ	8/15/2016	12 mo
Antenna - Double Ridge	ETS Lindgren	3115	AIR	6/23/2016	24 mo
Antenna - Standard Gain	ETS Lindgren	3160-07	AHX	NCR	0 mo
Antenna - Standard Gain	EMCO	3160-08	AHK	NCR	0 mo
Cable	ESM Cable Corp.	30-1GHz cables	OCW	5/15/2017	12 mo
Amplifier - Pre-Amplifier	Miteq	AM-1616-1000	PAD	8/15/2016	12 mo
Analyzer - Spectrum Analyzer	Agilent	E4446A	AAY	10/25/2016	12 mo

TEST DESCRIPTION

The EUT was operated in a worst-case configuration in receive mode. The spectrum was scanned from 30 MHz to 12.75 GHz with the EUT set to low and high receive frequencies. While scanning, emissions from the EUT were maximized by rotating the EUT, adjusting the measurement antenna height (1-4 meters) and polarization. A preamp and high pass filter were used for this test in order to provide sufficient measurement sensitivity. The amplitude and frequency of the highest emissions were noted. The EUT was then replaced with a ½ wave dipole that was successively tuned to each of the highest spurious emissions. A signal generator was connected to the dipole (horn antenna for frequencies above 1 GHz), and its output was adjusted to match the level previously noted for each frequency. The output of the signal generator was recorded, and by factoring in the cable loss to the dipole antenna and its gain (dBi); the effective radiated power for each radiated spurious emission was determined.

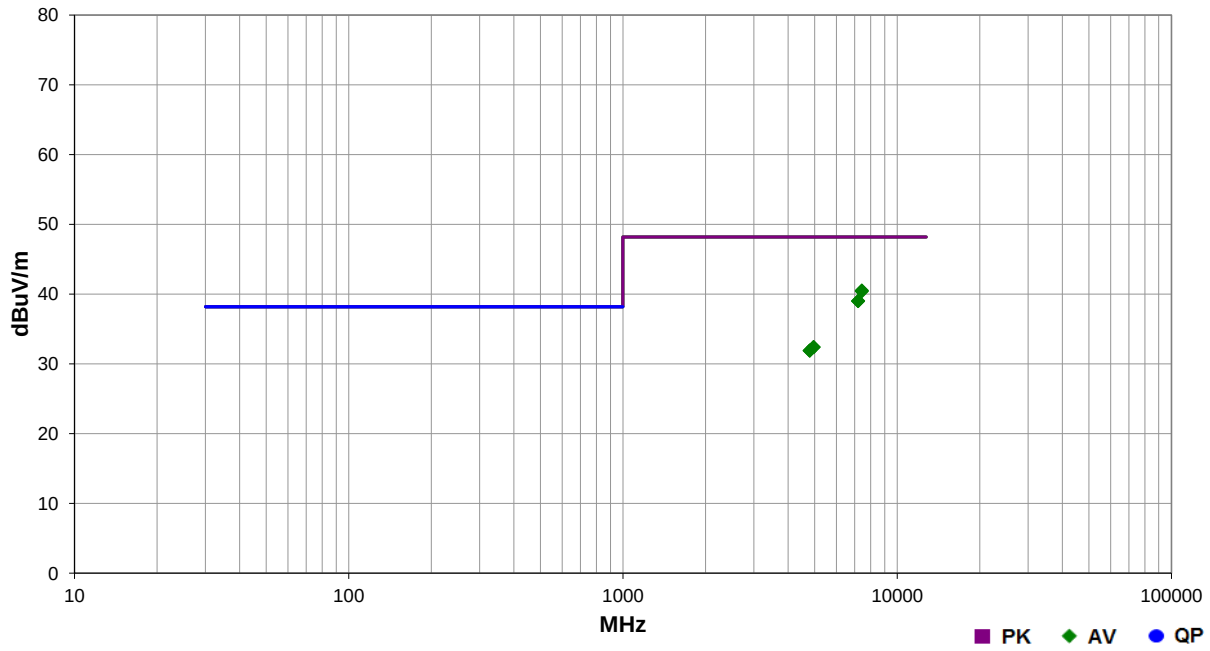
RECEIVER SPURIOUS EMISSIONS

EmiR5 2017.01.25 PSA-ESCI 2017.01.26

Work Order:	ELIM0013	**Date:**	05/26/17		
Project:	None	**Temperature:**	20.9 °C		
Job Site:	OC07	**Humidity:**	47.8% RH		
Serial Number:	0107	**Barometric Pres.:**	1017 mbar	**Tested by:**	Mike Tran
EUT:	IMP004M				
Configuration:	1				
Customer:	Electric Imp, Inc.				
Attendees:	Jonathan Dillon				
EUT Power:	5VDC via USB Power				
Operating Mode:	Transmitting BLE at Low Ch 0-2402MHz, High Ch 39-2480MHz				
Deviations:	None				
Comments:	TX Power value = 5.				

Test Specifications	**Test Method**
EN 300 328 V2.1.1:2016	EN 300 328 V2.1.1:2016

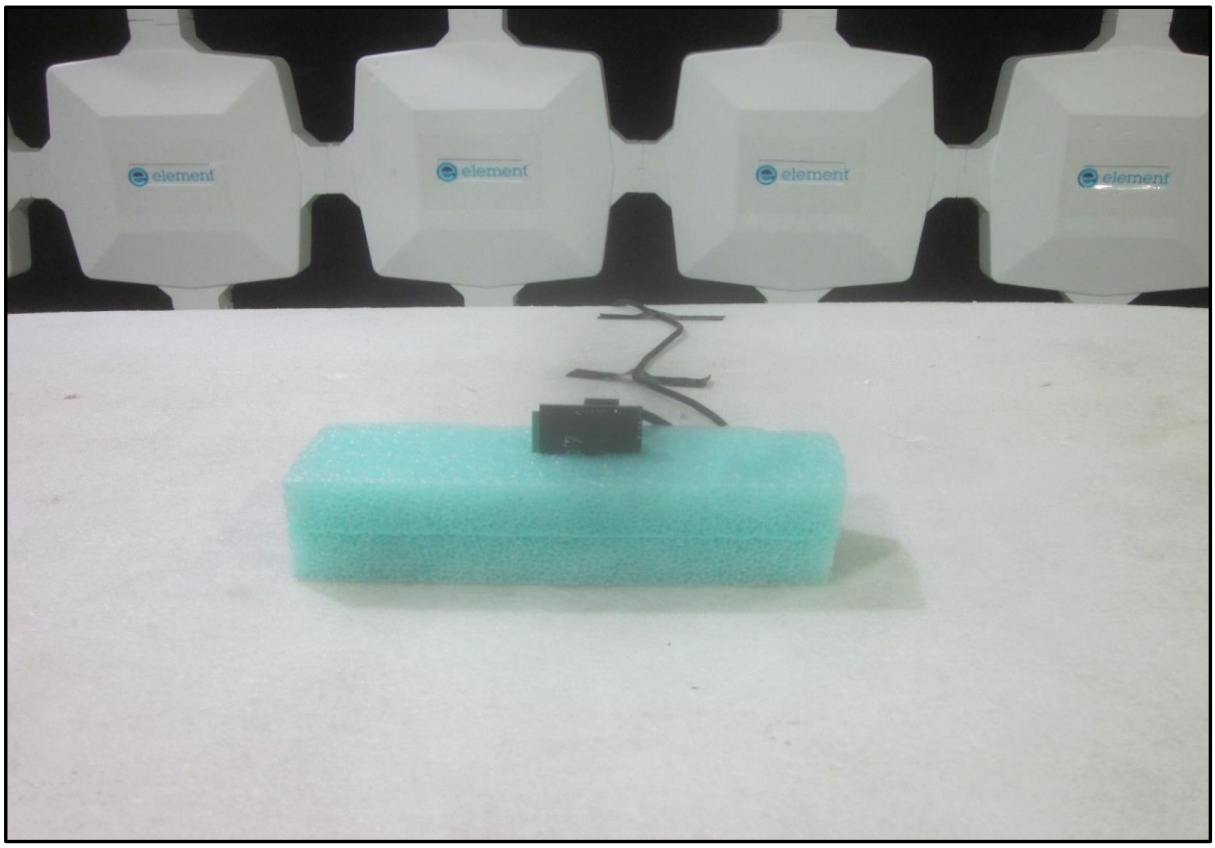
Run #	51	**Test Distance (m)**	3	**Antenna Height(s)**	1 to 4(m)	**Results**	Pass



Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Antenna Height (meters)	Azimuth (degrees)	Test Distance (meters)	External Attenuation (dB)	Polarity/ Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)	Comments
7438.675	28.5	12.0	3.0	4.0	3.0	0.0	Horz	AV	0.0	40.5	48.2	-7.7	EUT Hor, High Ch
7438.550	28.4	12.0	1.0	142.0	3.0	0.0	Vert	AV	0.0	40.4	48.2	-7.8	EUT Vert, High Ch
7207.490	29.1	9.9	1.5	171.0	3.0	0.0	Horz	AV	0.0	39.0	48.2	-9.2	EUT Hor, Low Ch
7207.375	29.1	9.9	1.0	348.0	3.0	0.0	Vert	AV	0.0	39.0	48.2	-9.2	EUT Vert, Low Ch
4958.505	28.0	4.4	1.0	175.0	3.0	0.0	Horz	AV	0.0	32.4	48.2	-15.8	EUT Hor, High Ch
4958.515	28.0	4.4	3.8	256.0	3.0	0.0	Vert	AV	0.0	32.4	48.2	-15.8	EUT Vert, High Ch
4803.405	28.3	3.6	1.0	306.0	3.0	0.0	Horz	AV	0.0	31.9	48.2	-16.3	EUT Hor, Low Ch
4804.250	28.3	3.6	1.0	256.0	3.0	0.0	Vert	AV	0.0	31.9	48.2	-16.3	EUT Vert, Low Ch

RECEIVER SPURIOUS EMISSIONS

PSA-ESCI 2017.01.26



RECEIVER SPURIOUS EMISSIONS

PSA-ESCI 2017.01.26