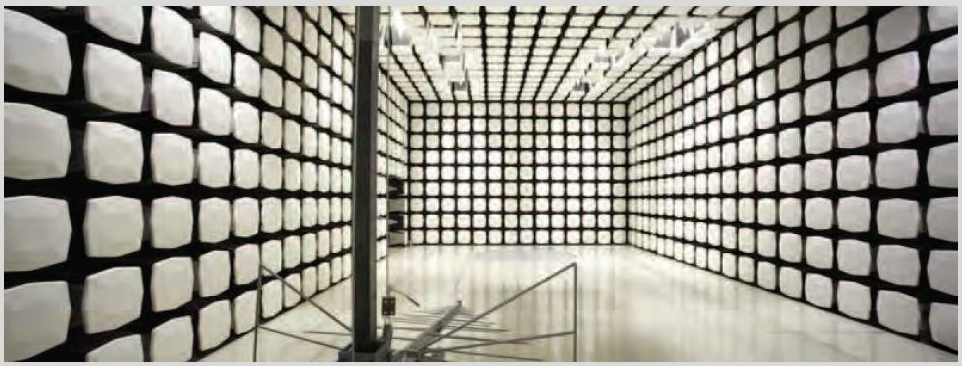
Apricity Code

ARA LTE Water Heater Controller

FCC 15.247:2020

Bluetooth Low Energy (DTS) Radio

Report # APRI0004.1



NVLAP LAB CODE: 200881-0

CERTIFICATE OF TEST

Last Date of Test: January 3, 2020
Apricity Code
EUT: ARA LTE Water Heater Controller

Radio Equipment Testing

Standards

Specification	Method
FCC 15.207:2020	ANSI C63.10:2013, KDB 558074
FCC 15.247:2020	

Results

Method Clause	Test Description	Applied	Results	Comments
6.2	Powerline Conducted Emissions	Yes	Pass	
11.12.1, 11.13.2, 6.5, 6.6	Spurious Radiated Emissions	Yes	Pass	
11.6	Duty Cycle	Yes	Pass	
11.8.2	Occupied Bandwidth	Yes	Pass	
11.9.1.1	Output Power	Yes	Pass	
11.9.1.1	Equivalent Isotropic Radiated Power	Yes	Pass	
11.10.2	Power Spectral Density	Yes	Pass	
11.11	Band Edge Compliance	Yes	Pass	
11.11	Spurious Conducted Emissions	Yes	Pass	

Deviations From Test Standards

None

Approved By:

Eric Brandon, Department 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) and as a CAB for the acceptance of test data.

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

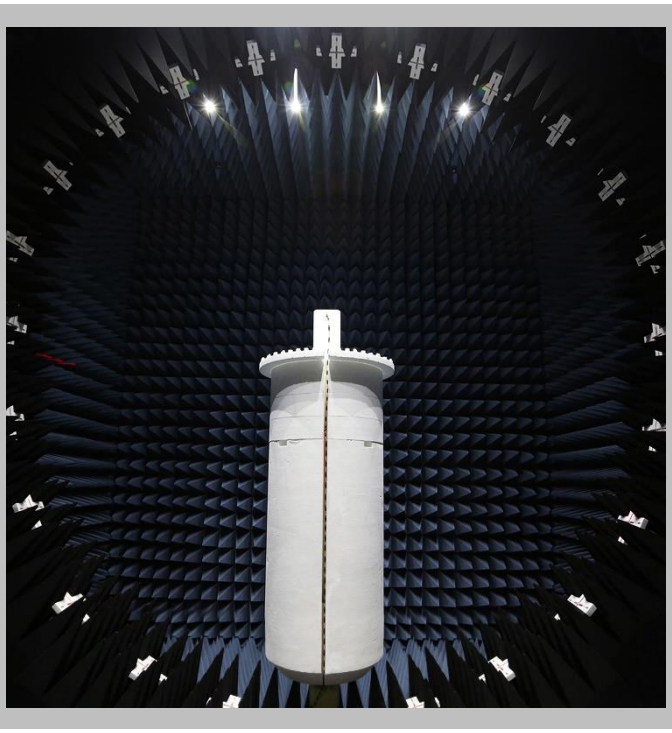
MIC – Recognized by MIC as a CAB for the acceptance of test data.

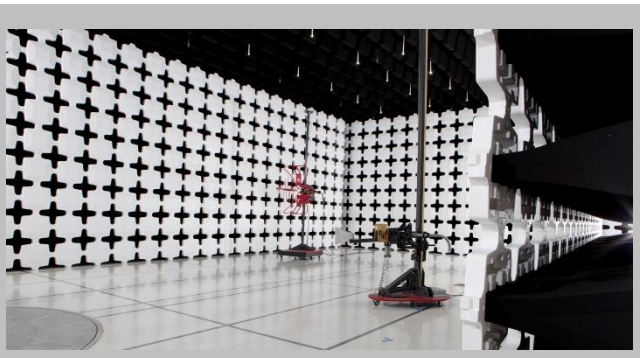
SCOPE

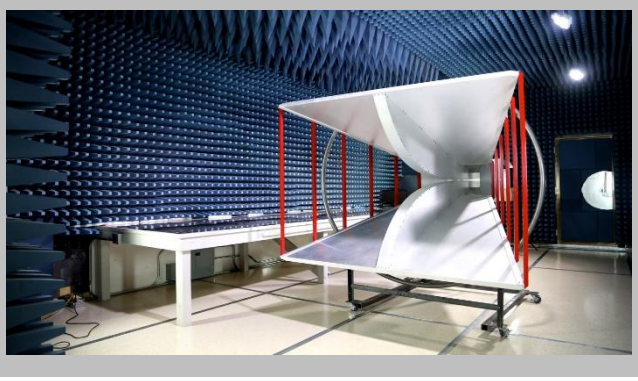
For details on the Scopes of our Accreditations, please visit:
https://www.nwemc.com/emc-testing-accreditations

FACILITIES

California	Minnesota	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 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: 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	2834D-1	2834G-1	2834F-1
BSMI				
SL2-IN-E-1154R	SL2-IN-E-1152R	SL2-IN-E-1017	SL2-IN-E-1158R	SL2-IN-E-1153R
VCCI				
A-0029	A-0109	A-0108	A-0201	A-0110
Recognized Phase I CAB for ISED, ACMA, BSMI, IDA, KCC/RRA, MIC, MOC, NCC, OFCA				
US0158	US0175	US0017	US0191	US0157







MEASUREMENT UNCERTAINTY

element
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.

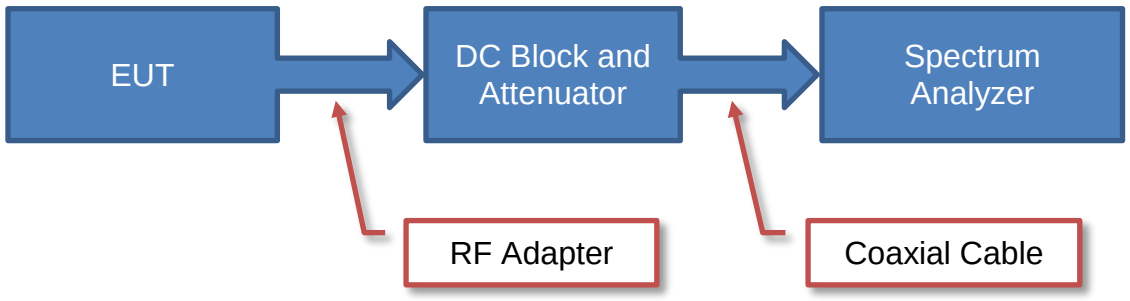
A measurement uncertainty estimation has been performed for each test per our internal quality document QM205.4.6. The estimation is used to compare the measured result with its "true" or theoretically correct value. The expanded measurement uncertainty (K=2) can be found included as part of the applicable 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.

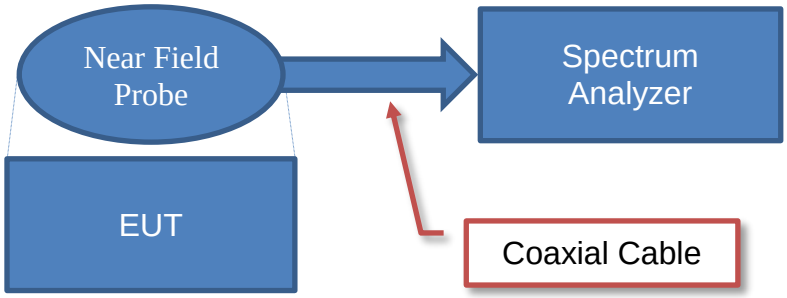
Test	+ MU	- MU
Frequency Accuracy	0.0007%	-0.0007%
Amplitude Accuracy (dB)	1.2 dB	-1.2 dB
Conducted Power (dB)	1.2 dB	-1.2 dB
Radiated Power via Substitution (dB)	0.7 dB	-0.7 dB
Temperature (degrees C)	0.7°C	-0.7°C
Humidity (% RH)	2.5% RH	-2.5% RH
Voltage (AC)	1.0%	-1.0%
Voltage (DC)	0.7%	-0.7%
Field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

Test Setup Block Diagrams

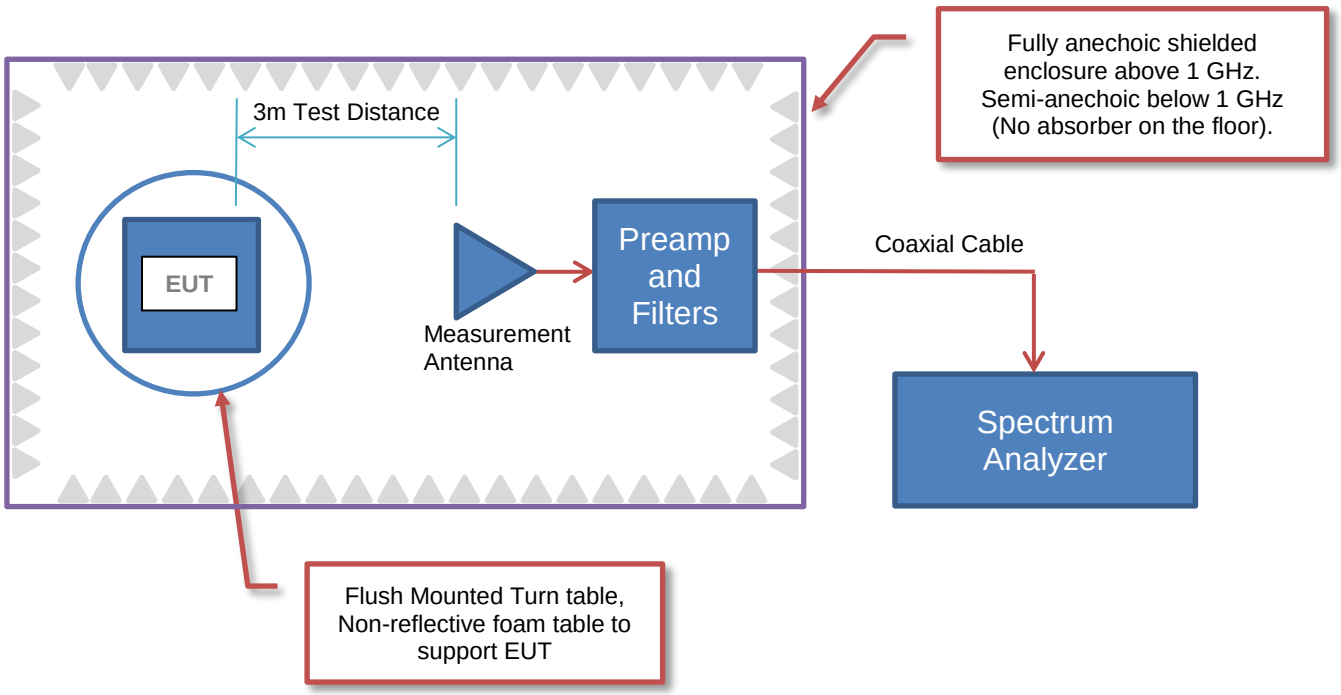
Antenna Port Conducted Measurements



Near Field Test Fixture Measurements



Spurious Radiated Emissions



PRODUCT DESCRIPTION

Client and Equipment Under Test (EUT) Information

Company Name:	Apricity Code
Address:	2783 NW Lolo Dr., Suite 130
City, State, Zip:	Bend, OR 97702
Test Requested By:	Justin Olexy
EUT:	ARA LTE Water Heater Controller
First Date of Test:	January 2, 2020
Last Date of Test:	January 3, 2020
Receipt Date of Samples:	January 2, 2020
Equipment Design Stage:	Production
Equipment Condition:	No Damage
Purchase Authorization:	Verified

Information Provided by the Party Requesting the Test

Functional Description of the EUT:
ARA LTE Water Heater Controller (Model using NRF52840)

Testing Objective:
To demonstrate compliance of the Bluetooth Low Energy (DTS) radio to FCC 15.247 requirements. Testing was completed with the radio circuitry outside of the plastic enclosure. This is a worst case configuration.

CONFIGURATIONS

Configuration APRI0004- 1

EUT			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
ARA LTE Water Heater Controller	Apricity Code	010-001-005	008

Peripherals in test setup boundary			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
J-Link	Segger	8.08.00	50105144
Laptop	Dell	Inspiron 3583	FBRXZX2
Power Supply (Laptop)	Dell	HA45NM140	CN-00285K-CH200-974-035V-A07

Cables					
Cable Type	**Shield**	**Length (m)**	**Ferrite**	**Connection 1**	**Connection 2**
Leads (x6)	No	0.2 m	No	ARA LTE Water Heater Controller	J-Link
Leads (x2)	No	0.2 m	No	ARA LTE Water Heater Controller	Unterminated
USB Data Cable	Yes	1.5 m	No	J-Link	Laptop
AC Cable	No	0.9 m	No	AC Mains	Power Supply (Laptop)
DC Cable	No	1.8 m	Yes	Power Supply (Laptop)	Laptop

CONFIGURATIONS

Configuration APRI0004- 2

EUT			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
ARA LTE Water Heater Controller	Apricity Code	010-001-005	008

Peripherals in test setup boundary			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
J-Link	Segger	8.08.00	50105144
LTE Antenna	Linx Technologies	ANT-LPL-FPC-100	Unknown
BLE Antenna	PulseLarson Antennas	W3334B0150	N/A

Remote Equipment Outside of Test Setup Boundary			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
Laptop	Dell	Inspiron 3583	FBRXZX2
Power Supply (Laptop)	Dell	HA45NM140	CN-00285K-CH200-974-035V-A07

Cables					
Cable Type	**Shield**	**Length (m)**	**Ferrite**	**Connection 1**	**Connection 2**
Leads (x6)	No	0.2 m	No	ARA LTE Water Heater Controller	J-Link
Leads (x2)	No	0.2 m	No	ARA LTE Water Heater Controller	Unterminated
USB Data Cable	Yes	1.5 m	No	J-Link	Laptop
AC Cable	No	0.9 m	No	AC Mains	Power Supply (Laptop)
DC Cable	No	1.8 m	Yes	Power Supply (Laptop)	Laptop

Configuration APRI0004- 5

EUT			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
ARA LTE Water Heater Controller	Apricity Code	010-001-005	008

Peripherals in test setup boundary			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
LTE Antenna	Linx Technologies	ANT-LPL-FPC-100	Unknown
BLE Antenna	PulseLarson Antennas	W3334B0150	N/A
DC Power Supply	EZ Digital Co., Ltd.	GP-4303D	TQK

Cables					
Cable Type	**Shield**	**Length (m)**	**Ferrite**	**Connection 1**	**Connection 2**
DC Leads (x2)	No	0.15 m	No	BNC Cable	ARA LTE Water Heater Controller
BNC Cable	Yes	0.9 m	No	DC Power Supply	DC Leads (x2)

MODIFICATIONS

Equipment Modifications

Item	Date	Test	Modification	Note	Disposition of EUT
1	2020-01-02	Occupied 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.
2	2020-01-02	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.
3	2020-01-02	Equivalent Isotropic Radiated 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	2020-01-02	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	2020-01-02	Band Edge Compliance	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	2020-01-02	Spurious Conducted 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.
7	2020-01-03	Powerline Conducted 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.
8	2020-01-03	Spurious Radiated Emissions	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	Scheduled testing was completed.

POWERLINE CONDUCTED EMISSIONS

element
WTD.2019.10.29.0

TEST DESCRIPTION

Using the mode of operation and configuration noted within this report, conducted emissions tests were performed. The frequency range investigated (scanned), is also noted in this report. Conducted power line measurements are made, unless otherwise specified, over the frequency range from 150 kHz to 30 MHz to determine the line-to-ground radio-noise voltage that is conducted from the EUT power-input terminals that are directly (or indirectly via separate transformer or power supplies) connected to a public power network. Per the standard, an insulating material was also added to ground plane between the EUT's power and remote I/O cables. Equipment is tested with power cords that are normally used or that have electrical or shielding characteristics that are the same as those cords normally used. Typically those measurements are made using a LISN (Line Impedance Stabilization Network), the 50ohm measuring port is terminated by a 50ohm EMI meter or a 50ohm resistive load. All 50ohm measuring ports of the LISN are terminated by 50ohm. The test data represents the configuration / operating mode/ model that produced the highest emission levels as compared to the specification limit.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Receiver	Rohde & Schwarz	ESR7	ARI	2019-07-08	2020-07-08
Cable - Conducted Cable Assembly	Northwest EMC	MNC, HGN, TYK	MNCA	2019-03-13	2020-03-13
LISN	Solar Electronics	9252-50-R-24-BNC	LIY	2019-03-15	2020-03-15
Power Supply - DC	EZ Digital Co., Ltd.	GP-4030D	TQK	NCR	NCR

MEASUREMENT UNCERTAINTY

Description		
Expanded k=2	2.4 dB	-2.4 dB

CONFIGURATIONS INVESTIGATED

APRI0004-5

MODES INVESTIGATED

Transmitting on Mid channel (2442 MHz), BLE

POWERLINE CONDUCTED EMISSIONS

element
WTD.2019.10.29.0

EUT:	ARA LTE Water Heater Controller	Work Order:	APRI0004
Serial Number:	008	Date:	2020-01-03
Customer:	Apricity Code	Temperature:	22.7°C
Attendees:	None	Relative Humidity:	26.7%
Customer Project:	None	Bar. Pressure:	1013 mb
Tested By:	Andrew Rogstad	Job Site:	MN03
Power:	5 VDC via 120 VAC/60 Hz	Configuration:	APRI0004-5

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.207:2020	ANSI C63.10:2013

TEST PARAMETERS

Run #:	7	Line:	Neutral	Add. Ext. Attenuation (dB):	0

COMMENTS

Testing was completed with the radio circuitry outside of the plastic enclosure. This is a worst case configuration.

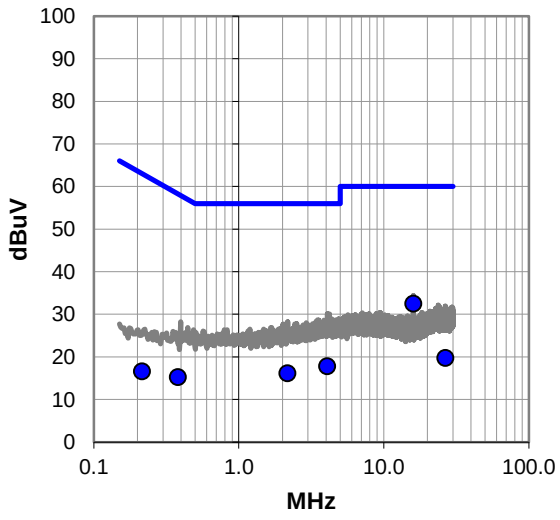
EUT OPERATING MODES

Transmitting on Mid channel (2442 MHz), BLE

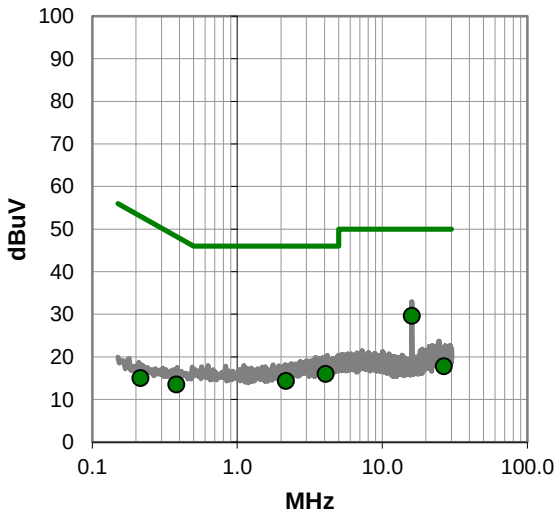
DEVIATIONS FROM TEST STANDARD

None

Quasi Peak Data - vs - Quasi Peak Limit



Average Data - vs - Average Limit



POWERLINE CONDUCTED EMISSIONS

element
WTD.2019.10.29.0

RESULTS - Run #7

Quasi Peak Data - vs - Quasi Peak Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
16.0	11.600	20.9	32.5	60.0	-27.5
4.1	-3.000	20.8	17.8	56.0	-38.2
2.2	-4.600	20.7	16.1	56.0	-39.9
26.6	-1.700	21.4	19.7	60.0	-40.3
0.4	-5.400	20.6	15.2	58.3	-43.1
0.2	-4.100	20.7	16.6	63.0	-46.4

Average Data - vs - Average Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
16.0	8.700	20.9	29.6	50.0	-20.4
4.1	-4.800	20.8	16.0	46.0	-30.0
2.2	-6.400	20.7	14.3	46.0	-31.7
26.6	-3.600	21.4	17.8	50.0	-32.2
0.4	-7.100	20.6	13.5	48.3	-34.8
0.2	-5.700	20.7	15.0	53.0	-38.0

CONCLUSION

Pass

Tested By

POWERLINE CONDUCTED EMISSIONS

element
WTD.2019.10.29.0

EUT:	ARA LTE Water Heater Controller	Work Order:	APRI0004
Serial Number:	008	Date:	2020-01-03
Customer:	Apricity Code	Temperature:	22.7°C
Attendees:	None	Relative Humidity:	26.7%
Customer Project:	None	Bar. Pressure:	1013 mb
Tested By:	Andrew Rogstad	Job Site:	MN03
Power:	5 VDC via 120 VAC/60 Hz	Configuration:	APRI0004-5

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.207:2020	ANSI C63.10:2013

TEST PARAMETERS

Run #:	8	Line:	High Line	Add. Ext. Attenuation (dB):	0

COMMENTS

Testing was completed with the radio circuitry outside of the plastic enclosure. This is a worst case configuration.

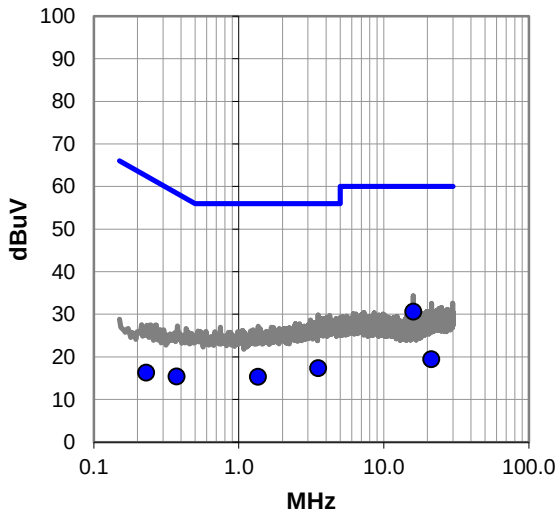
EUT OPERATING MODES

Transmitting on Mid channel (2442 MHz), BLE

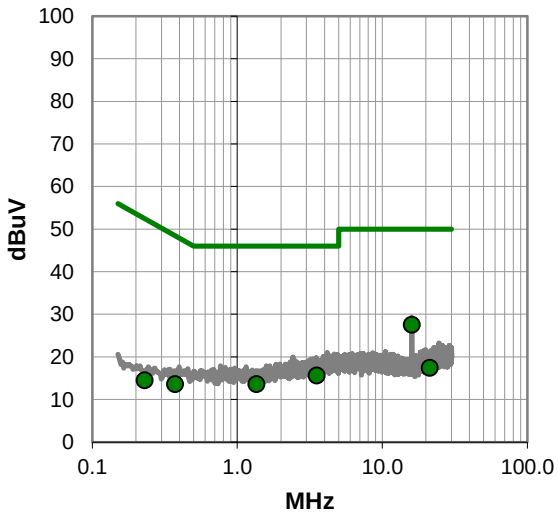
DEVIATIONS FROM TEST STANDARD

None

Quasi Peak Data - vs - Quasi Peak Limit



Average Data - vs - Average Limit



POWERLINE CONDUCTED EMISSIONS

element
WTD.2019.10.29.0

RESULTS - Run #8

Quasi Peak Data - vs - Quasi Peak Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
16.0	9.700	20.9	30.6	60.0	-29.4
3.5	-3.500	20.8	17.3	56.0	-38.7
21.3	-1.800	21.2	19.4	60.0	-40.6
1.4	-5.300	20.6	15.3	56.0	-40.7
0.4	-5.200	20.6	15.4	58.4	-43.0
0.2	-4.400	20.7	16.3	62.5	-46.2

Average Data - vs - Average Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
16.0	6.600	20.9	27.5	50.0	-22.5
3.5	-5.200	20.8	15.6	46.0	-30.4
1.4	-7.000	20.6	13.6	46.0	-32.4
21.3	-3.800	21.2	17.4	50.0	-32.6
0.4	-7.000	20.6	13.6	48.4	-34.8
0.2	-6.200	20.7	14.5	52.5	-38.0

CONCLUSION

Pass

Tested By

SPURIOUS RADIATED EMISSIONS

PSA-ESCI 2019.05.10

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 on Low channel (2402 MHz), Mid channel (2442 MHz), and High channel (2480 MHz), BLE 1 Mbps

POWER SETTINGS INVESTIGATED

DC voltage via 120VAC/60Hz

CONFIGURATIONS INVESTIGATED

APRI0004 - 2
APRI0004 - 5

FREQUENCY RANGE INVESTIGATED

Start Frequency	30 MHz	Stop Frequency	26500 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
Filter - High Pass	Micro-Tronics	HPM50111	LFN	12-Sep-2019	12 mo
Filter - Low Pass	Micro-Tronics	LPM50004	LFK	17-Sep-2019	12 mo
Attenuator	Fairview Microwave	SA18E-20	TWZ	17-Sep-2019	12 mo
Amplifier - Pre-Amplifier	Miteq	AM-1616-1000	AVO	18-Oct-2019	12 mo
Cable	ESM Cable Corp.	Bilog Cables	MNH	18-Oct-2019	12 mo
Antenna - Biconilog	Teseq	CBL 6141B	AYD	25-Jan-2018	24 mo
Amplifier - Pre-Amplifier	Miteq	JSD4-18002600-26-8P	APU	11-Sep-2019	12 mo
Cable	ESM Cable Corp.	TTBJ141 KMKM-72	MNP	11-Sep-2019	12 mo
Antenna - Standard Gain	ETS Lindgren	3160-09	AHG	NCR	0 mo
Amplifier - Pre-Amplifier	Miteq	AMF-6F-12001800-30-10P	AVW	8-Feb-2019	12 mo
Antenna - Standard Gain	ETS Lindgren	3160-08	AIQ	NCR	0 mo
Amplifier - Pre-Amplifier	Miteq	AMF-6F-08001200-30-10P	AVV	8-Feb-2019	12 mo
Cable	ESM Cable Corp.	Standard Gain Horn Cables	MNJ	8-Mar-2019	12 mo
Antenna - Standard Gain	ETS Lindgren	3160-07	AXP	NCR	0 mo
Amplifier - Pre-Amplifier	Miteq	AMF-3D-00100800-32-13P	AVT	8-Feb-2019	12 mo
Cable	ESM Cable Corp.	Double Ridge Guide Horn Cables	MNI	17-Sep-2019	12 mo
Antenna - Double Ridge	ETS-Lindgren	3115	AJQ	16-Jan-2019	24 mo
Analyzer - Spectrum Analyzer	Keysight	N9010A (EXA)	AFQ	21-Dec-2019	12 mo

TEST DESCRIPTION

The highest gain antenna of each type to be used with the EUT was tested. The EUT was configured for the required transmit frequencies and the modes as showed in the data sheets.

For each configuration, the spectrum was scanned throughout the specified range as part of the exploratory investigation of the emissions. These “pre-scans” are not included in the report. Final measurements on individual emissions were then made and included in this test report.

The individual emissions from the EUT were maximized by rotating the EUT on a turntable, adjusting the position of the EUT and EUT antenna in three orthogonal axis if required, and adjusting the measurement antenna height and polarization (per ANSI C63.10). A preamp and high pass filter (and notch filter) were used for this test in order to provide sufficient measurement sensitivity.

Measurements were made with the required detectors and annotated on the data for each individual point using the following annotation:

QP = Quasi-Peak Detector
PK = Peak Detector
AV = RMS Detector

Measurements were made to satisfy the specific requirements of the test specification for out of band emissions as well as the restricted band requirements.

If there are no detectable emissions above the noise floor, the data included may show noise floor measurements for reference only.

Measurements at the edges of the allowable band may be presented in an alternative method as provided for in the ANSI C63.10 Marker-Delta method. This method involves performing an in-band fundamental measurement followed by a screen capture of the fundamental and out-of-band emission using reduced measurement instrumentation bandwidths. The amplitude delta measured on this screen capture is applied to the fundamental emission value to show the out-of-band emission level as applied to the limit.

Where the radio test software does not provide for a duty cycle at continuous transmit conditions (> 98%) and the RMS (power average) measurements were made across the on and off times of the EUT transmissions, a duty cycle correction is added to the measurements using the formula of 10*LOG(dc).

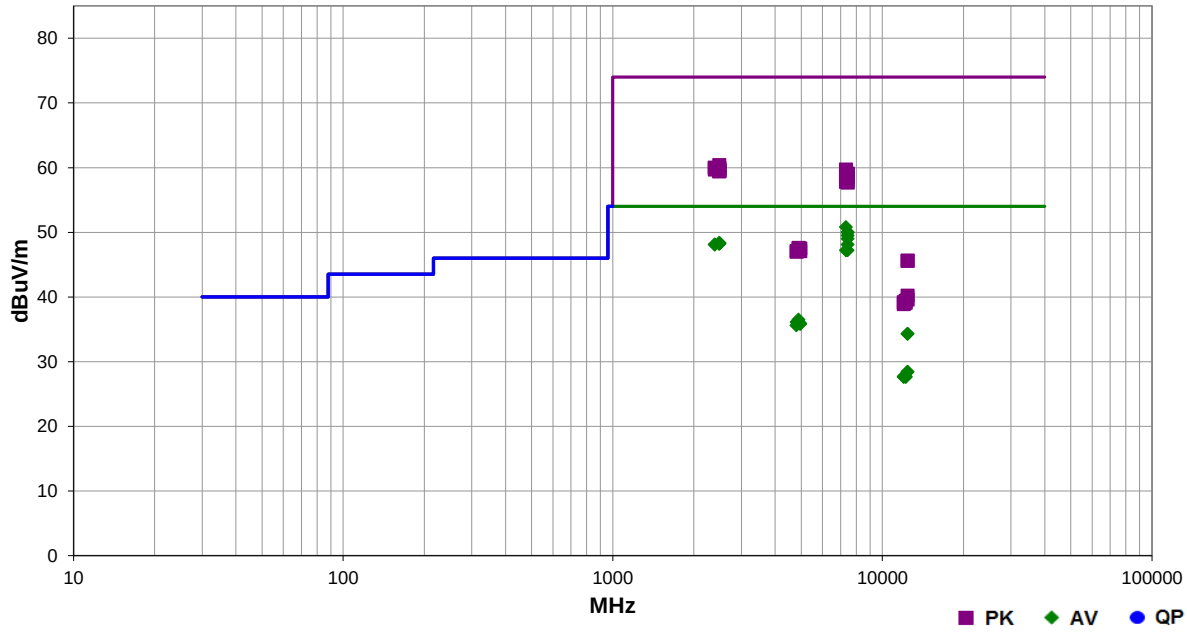
SPURIOUS RADIATED EMISSIONS

EmiR5 2019.08.15.1 PSA-ESCI 2019.05.10

Work Order:	APRI0004	**Date:**	3-Jan-2020		
Project:	None	**Temperature:**	22.9 °C		
Job Site:	MN05	**Humidity:**	26.5% RH		
Serial Number:	008	**Barometric Pres.:**	1012 mbar	**Tested by:**	Andrew Rogstad
EUT:	ARA LTE Water Heater Controller				
Configuration:	2,5				
Customer:	Apricity Code				
Attendees:	None				
EUT Power:	DC voltage via 120VAC/60Hz				
Operating Mode:	Transmitting on Low channel (2402 MHz), Mid channel (2442 MHz), and High channel (2480 MHz), BLE 1 Mbps				
Deviations:	None				
Comments:	EUT was operating at 100% duty cycle. Testing was completed with the radio circuitry outside of the plastic enclosure. This is a worst case configuration. Measurements below were taken with Configuration 5. Configuration 2 was used for evaluation from 30-1000 MHz.				

Test Specifications	**Test Method**
FCC 15.247:2020	ANSI C63.10:2013

Run #	47	**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
7326.825	37.3	13.5	1.5	307.1	3.0	0.0	Horz	AV	0.0	50.8	54.0	-3.2	EUT on side, Mid ch.
7440.883	36.8	13.2	1.6	286.9	3.0	0.0	Horz	AV	0.0	50.0	54.0	-4.0	EUT on side, High ch.
7440.875	36.8	13.2	2.8	192.9	3.0	0.0	Vert	AV	0.0	50.0	54.0	-4.0	EUT horz, High ch.
7440.900	36.3	13.2	1.8	210.9	3.0	0.0	Horz	AV	0.0	49.5	54.0	-4.5	EUT horz, High ch.
7440.883	35.8	13.2	1.4	353.0	3.0	0.0	Vert	AV	0.0	49.0	54.0	-5.0	EUT on side, High ch.
2486.627	32.0	-3.7	1.5	213.0	3.0	20.0	Horz	AV	0.0	48.3	54.0	-5.7	EUT horz, High ch.
2487.120	32.0	-3.7	4.0	114.9	3.0	20.0	Horz	AV	0.0	48.3	54.0	-5.7	EUT on side, High ch.
2485.040	32.1	-3.8	2.3	198.0	3.0	20.0	Vert	AV	0.0	48.3	54.0	-5.7	EUT on side, High ch.
2487.373	32.0	-3.7	1.5	282.9	3.0	20.0	Horz	AV	0.0	48.3	54.0	-5.7	EUT vert, High ch.
2487.120	32.0	-3.7	1.5	193.9	3.0	20.0	Vert	AV	0.0	48.3	54.0	-5.7	EUT vert, High ch.
2483.740	32.0	-3.8	1.5	200.9	3.0	20.0	Vert	AV	0.0	48.2	54.0	-5.8	EUT horz, High ch.
7440.858	34.9	13.2	1.5	342.0	3.0	0.0	Vert	AV	0.0	48.1	54.0	-5.9	EUT vert, High ch.
2389.860	31.7	-3.6	1.5	196.0	3.0	20.0	Horz	AV	0.0	48.1	54.0	-5.9	EUT horz, Low ch.
2389.620	31.7	-3.6	1.5	102.0	3.0	20.0	Vert	AV	0.0	48.1	54.0	-5.9	EUT horz, Low ch.
7440.892	34.0	13.2	1.5	296.0	3.0	0.0	Horz	AV	0.0	47.2	54.0	-6.8	EUT vert, High ch.
7326.958	33.7	13.5	2.9	19.0	3.0	0.0	Vert	AV	0.0	47.2	54.0	-6.8	EUT horz, Mid ch.
2483.640	44.2	-3.8	1.5	213.0	3.0	20.0	Horz	PK	0.0	60.4	74.0	-13.6	EUT horz, High ch.
2388.273	43.6	-3.6	1.5	102.0	3.0	20.0	Vert	PK	0.0	60.0	74.0	-14.0	EUT horz, Low ch.

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
2485.887	43.6	-3.7	1.5	200.9	3.0	20.0	Vert	PK	0.0	59.9	74.0	-14.1	EUT horz, High ch.
7325.425	46.2	13.5	1.5	307.1	3.0	0.0	Horz	PK	0.0	59.7	74.0	-14.3	EUT on side, Mid ch.
2484.893	43.5	-3.8	4.0	114.9	3.0	20.0	Horz	PK	0.0	59.7	74.0	-14.3	EUT on side, High ch.
2389.727	43.3	-3.6	1.5	196.0	3.0	20.0	Horz	PK	0.0	59.7	74.0	-14.3	EUT horz, Low ch.
2487.213	43.2	-3.7	2.3	198.0	3.0	20.0	Vert	PK	0.0	59.5	74.0	-14.5	EUT on side, High ch.
2484.147	43.3	-3.8	1.5	193.9	3.0	20.0	Vert	PK	0.0	59.5	74.0	-14.5	EUT vert, High ch.
2484.293	43.2	-3.8	1.5	282.9	3.0	20.0	Horz	PK	0.0	59.4	74.0	-14.6	EUT vert, High ch.
7440.517	45.9	13.2	2.8	192.9	3.0	0.0	Vert	PK	0.0	59.1	74.0	-14.9	EUT horz, High ch.
7441.458	45.8	13.2	1.6	286.9	3.0	0.0	Horz	PK	0.0	59.0	74.0	-15.0	EUT on side, High ch.
7439.608	45.7	13.2	1.8	210.9	3.0	0.0	Horz	PK	0.0	58.9	74.0	-15.1	EUT horz, High ch.
7441.183	45.3	13.2	1.4	353.0	3.0	0.0	Vert	PK	0.0	58.5	74.0	-15.5	EUT on side, High ch.
7439.567	44.8	13.2	1.5	342.0	3.0	0.0	Vert	PK	0.0	58.0	74.0	-16.0	EUT vert, High ch.
7326.975	44.3	13.5	2.9	19.0	3.0	0.0	Vert	PK	0.0	57.8	74.0	-16.2	EUT horz, Mid ch.
7439.550	44.5	13.2	1.5	296.0	3.0	0.0	Horz	PK	0.0	57.7	74.0	-16.3	EUT vert, High ch.
4883.842	31.8	4.7	1.5	57.0	3.0	0.0	Horz	AV	0.0	36.5	54.0	-17.5	EUT on side, Mid ch.
4884.225	31.5	4.7	1.5	117.9	3.0	0.0	Vert	AV	0.0	36.2	54.0	-17.8	EUT horz, Mid ch.
4804.450	31.5	4.6	1.5	303.1	3.0	0.0	Horz	AV	0.0	36.1	54.0	-17.9	EUT on side, Low ch.
4959.900	31.1	4.8	1.5	72.1	3.0	0.0	Horz	AV	0.0	35.9	54.0	-18.1	EUT on side, High ch.
4959.842	31.0	4.8	2.4	95.9	3.0	0.0	Vert	AV	0.0	35.8	54.0	-18.2	EUT horz, High ch.
4801.617	31.0	4.6	1.5	90.1	3.0	0.0	Vert	AV	0.0	35.6	54.0	-18.4	EUT horz, Low ch.
12400.770	28.9	5.4	1.5	171.9	3.0	0.0	Vert	AV	0.0	34.3	54.0	-19.7	EUT horz, High ch.
12400.200	28.9	5.4	2.2	301.9	3.0	0.0	Horz	AV	0.0	34.3	54.0	-19.7	EUT on side, High ch.
12399.300	29.0	-0.6	1.5	290.0	3.0	0.0	Horz	AV	0.0	28.4	54.0	-25.6	EUT on side, High ch.
12399.200	29.0	-0.6	1.5	101.0	3.0	0.0	Vert	AV	0.0	28.4	54.0	-25.6	EUT horz, High ch.
12009.230	29.9	-2.2	1.5	202.0	3.0	0.0	Horz	AV	0.0	27.7	54.0	-26.3	EUT on side, Low ch.
12209.170	29.4	-1.7	1.5	346.0	3.0	0.0	Vert	AV	0.0	27.7	54.0	-26.3	EUT horz, Mid ch.
4885.092	42.9	4.7	1.5	57.0	3.0	0.0	Horz	PK	0.0	47.6	74.0	-26.4	EUT on side, Mid ch.
12009.730	29.8	-2.2	1.5	252.0	3.0	0.0	Vert	AV	0.0	27.6	54.0	-26.4	EUT horz, Low ch.
12211.000	29.3	-1.7	1.5	94.0	3.0	0.0	Horz	AV	0.0	27.6	54.0	-26.4	EUT on side, Mid ch.
4961.367	42.6	4.9	2.4	95.9	3.0	0.0	Vert	PK	0.0	47.5	74.0	-26.5	EUT horz, High ch.
4884.817	42.7	4.7	1.5	117.9	3.0	0.0	Vert	PK	0.0	47.4	74.0	-26.6	EUT horz, Mid ch.
4958.208	42.3	4.8	1.5	72.1	3.0	0.0	Horz	PK	0.0	47.1	74.0	-26.9	EUT on side, High ch.
4804.117	42.5	4.6	1.5	303.1	3.0	0.0	Horz	PK	0.0	47.1	74.0	-26.9	EUT on side, Low ch.
4804.483	42.4	4.6	1.5	90.1	3.0	0.0	Vert	PK	0.0	47.0	74.0	-27.0	EUT horz, Low ch.
12400.180	40.2	5.4	1.5	171.9	3.0	0.0	Vert	PK	0.0	45.6	74.0	-28.4	EUT horz, High ch.
12400.850	40.2	5.4	2.2	301.9	3.0	0.0	Horz	PK	0.0	45.6	74.0	-28.4	EUT on side, High ch.
12399.590	40.8	-0.6	1.5	290.0	3.0	0.0	Horz	PK	0.0	40.2	74.0	-33.8	EUT on side, High ch.
12399.090	40.2	-0.6	1.5	101.0	3.0	0.0	Vert	PK	0.0	39.6	74.0	-34.4	EUT horz, High ch.
12209.860	41.1	-1.7	1.5	94.0	3.0	0.0	Horz	PK	0.0	39.4	74.0	-34.6	EUT on side, Mid ch.
12009.230	41.4	-2.2	1.5	202.0	3.0	0.0	Horz	PK	0.0	39.2	74.0	-34.8	EUT on side, Low ch.
12209.520	40.8	-1.7	1.5	346.0	3.0	0.0	Vert	PK	0.0	39.1	74.0	-34.9	EUT horz, Mid ch.
12008.730	41.1	-2.2	1.5	252.0	3.0	0.0	Vert	PK	0.0	38.9	74.0	-35.1	EUT horz, Low ch.

DUTY CYCLE

XMit 2019.09.05

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.

There is no compliance requirement to be met by this test, so therefore no Pass / Fail criteria.

The test software provided for operation in a fixed, single channel mode allows the EUT to operate continuously at 100% Duty Cycle.

OCCUPIED BANDWIDTH

XMit 2019.09.05

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	Keysight	N5182B	TFX	22-Oct-18	22-Oct-21
Cable	ESM Cable Corp.	TTBJ141 KMKM-72	MNO	7-Jun-19	7-Jun-20
Attenuator	S.M. Electronics	SA26B-20	TZP	9-Nov-19	9-Nov-20
Block - DC	Fairview Microwave	SD3379	AMZ	9-Nov-19	9-Nov-20
Analyzer - Spectrum Analyzer	Keysight	N9010A (EXA)	AFQ	21-Dec-19	21-Dec-20

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The EUT was set to the channels and modes listed in the datasheet.

The 6dB occupied bandwidth was measured using 100 kHz resolution bandwidth and 300 kHz video bandwidth. The 99.0% occupied bandwidth was also measured at the same time which can be needed during Output Power depending on the applicable method.

OCCUPIED BANDWIDTH

element

TbtTx 2019.08.30.0 XMit 2019.09.05

EUT:	**ARA LTE Water Heater Controller**			**Work Order:**	**APRI0004**
Serial Number:	**008**			**Date:**	**2-Jan-20**
Customer:	**Apricity Code**			**Temperature:**	**22 °C**
Attendees:	**None**			**Humidity:**	**28.7% RH**
Project:	**None**			**Barometric Pres.:**	**1003 mbar**
Tested by:	**Andrew Rogstad**	**Power:**	**DC voltage via 120VAC/60Hz**	**Job Site:**	**MN05**

TEST SPECIFICATIONS	**Test Method**
FCC 15.247:2020	ANSI C63.10:2013

COMMENTS

None

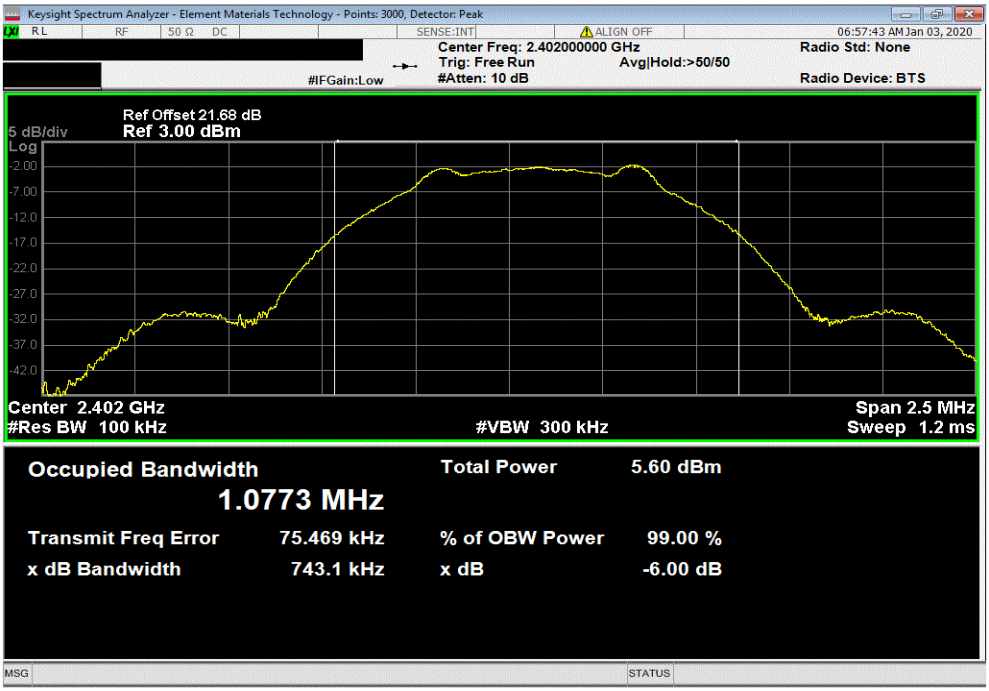
DEVIATIONS FROM TEST STANDARD

None

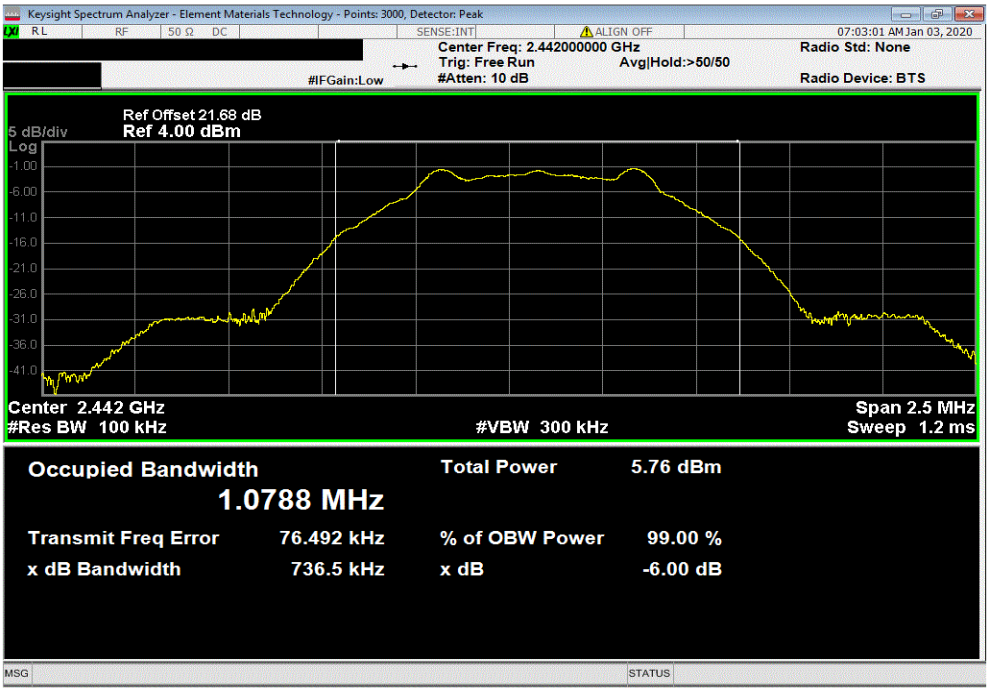
Configuration #	**1**	*Signature* Andrew Rogstad

	Value	Limit (≥)	Result
BLE/GFSK (1 Mbps) Low Channel, 2402 MHz	743.144 kHz	500 kHz	Pass
BLE/GFSK (1 Mbps) Mid Channel, 2442 MHz	736.529 kHz	500 kHz	Pass
BLE/GFSK (1 Mbps) High Channel, 2480 MHz	750.792 kHz	500 kHz	Pass

BLE/GFSK (1 Mbps) Low Channel, 2402 MHz						
				Value	Limit (≥)	Result
				743.144 kHz	500 kHz	Pass

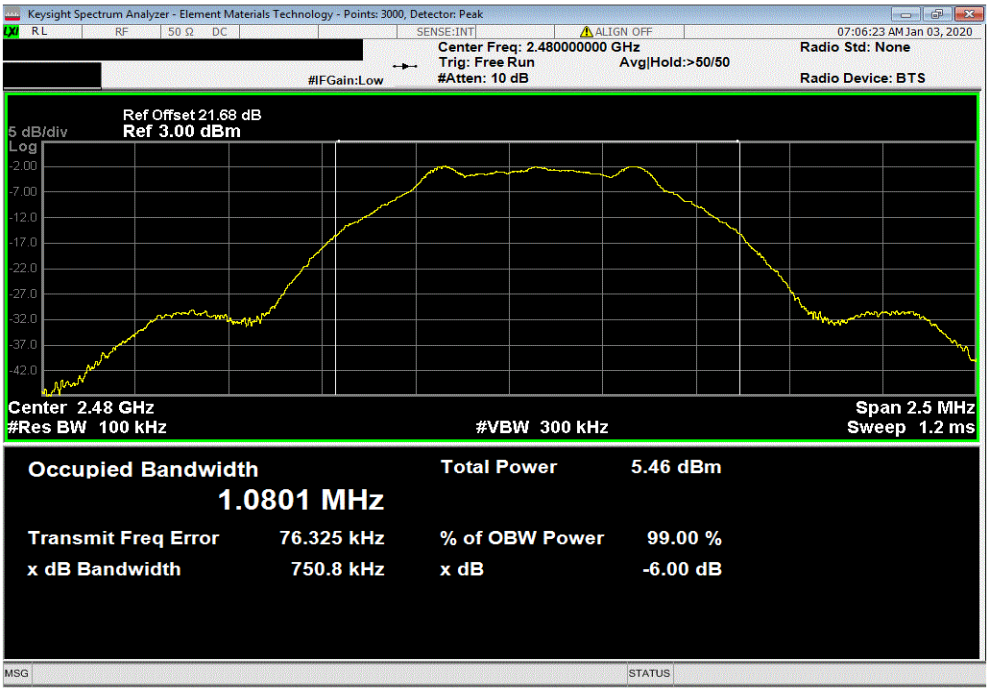


BLE/GFSK (1 Mbps) Mid Channel, 2442 MHz						
				Value	Limit (≥)	Result
				736.529 kHz	500 kHz	Pass



OCCUPIED BANDWIDTH

BLE/GFSK (1 Mbps) High Channel, 2480 MHz							
					Value	Limit (≥)	Result
					750.792 kHz	500 kHz	Pass



OUTPUT POWER

XMit 2019.09.05

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	Keysight	N5182B	TFX	22-Oct-18	22-Oct-21
Cable	ESM Cable Corp.	TTBJ141 KMKM-72	MNO	7-Jun-19	7-Jun-20
Attenuator	S.M. Electronics	SA26B-20	TZP	9-Nov-19	9-Nov-20
Block - DC	Fairview Microwave	SD3379	AMZ	9-Nov-19	9-Nov-20
Analyzer - Spectrum Analyzer	Keysight	N9010A (EXA)	AFQ	21-Dec-19	21-Dec-20

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The transmit frequency was set to the required channels in each band. The transmit power was set to its default maximum.

Prior to measuring peak transmit power the DTS bandwidth (B) was measured.

The method found in ANSI C63.10:2013 Section 11.9.1.1 was used because the RBW on the analyzer was greater than the DTS Bandwidth of the radio.

OUTPUT POWER

element

TbtTx 2019.08.30.0 XMit 2019.09.05

EUT:	**ARA LTE Water Heater Controller**			**Work Order:**	**APRI0004**
Serial Number:	**008**			**Date:**	**2-Jan-20**
Customer:	**Apricity Code**			**Temperature:**	**21.9 °C**
Attendees:	**None**			**Humidity:**	**28.9% RH**
Project:	**None**			**Barometric Pres.:**	**1003 mbar**
Tested by:	**Andrew Rogstad**	**Power:**	**DC voltage via 120VAC/60Hz**	**Job Site:**	**MN05**

TEST SPECIFICATIONS	**Test Method**
FCC 15.247:2020	ANSI C63.10:2013

COMMENTS

None

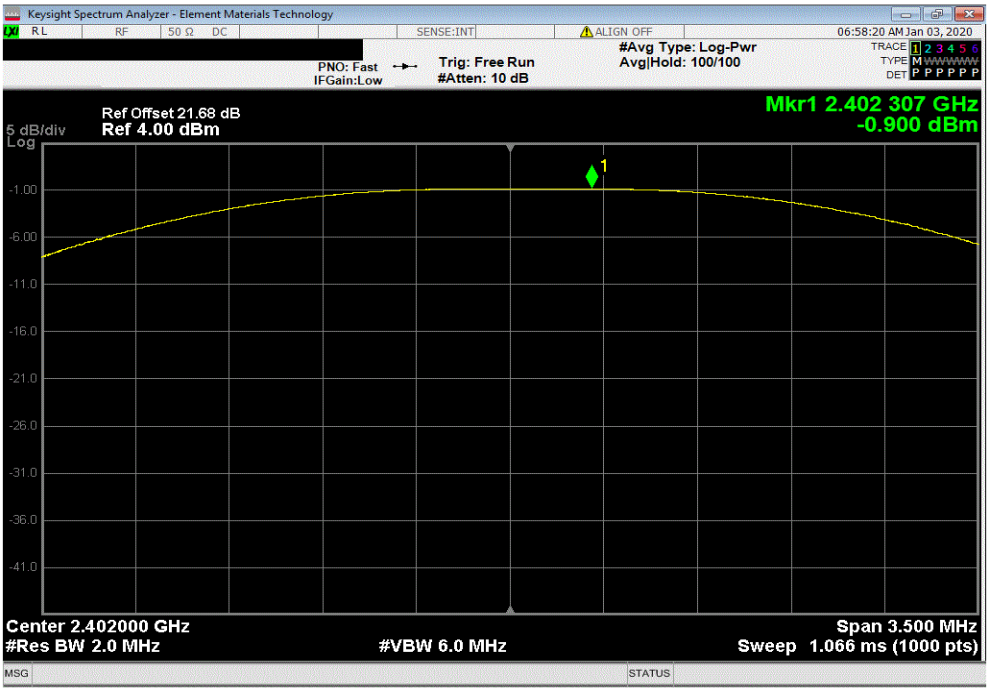
DEVIATIONS FROM TEST STANDARD

None

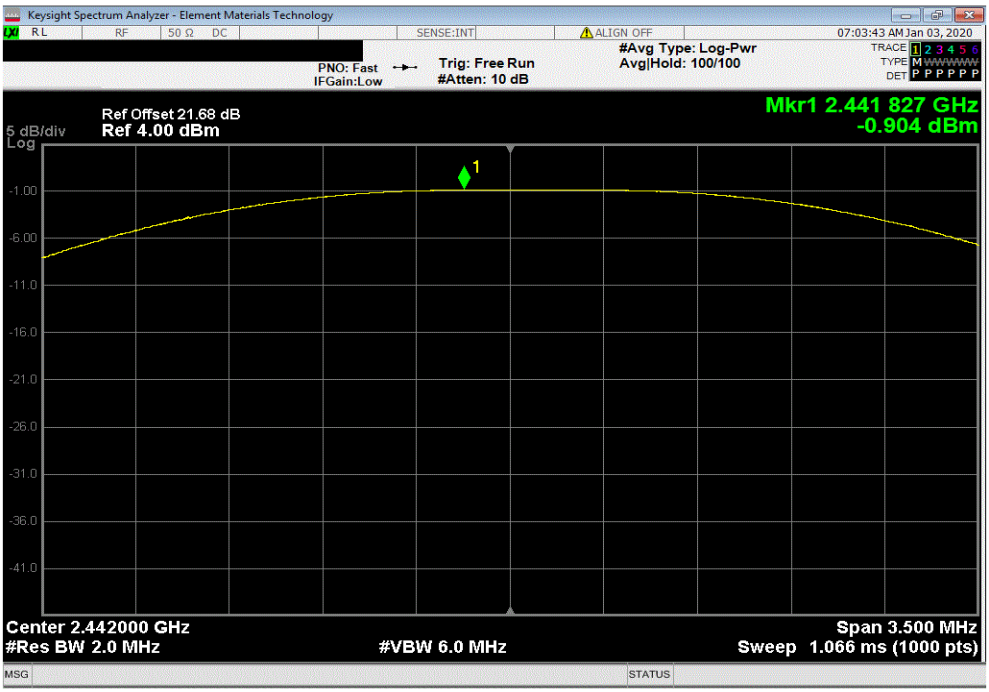
Configuration #	**1**	*Signature* Andrew Rogstad

	Out Pwr (dBm)	**Limit (dBm)**	**Result**
BLE/GFSK (1 Mbps) Low Channel, 2402 MHz	-0.9	30	Pass
BLE/GFSK (1 Mbps) Mid Channel, 2442 MHz	-0.904	30	Pass
BLE/GFSK (1 Mbps) High Channel, 2480 MHz	-1.047	30	Pass

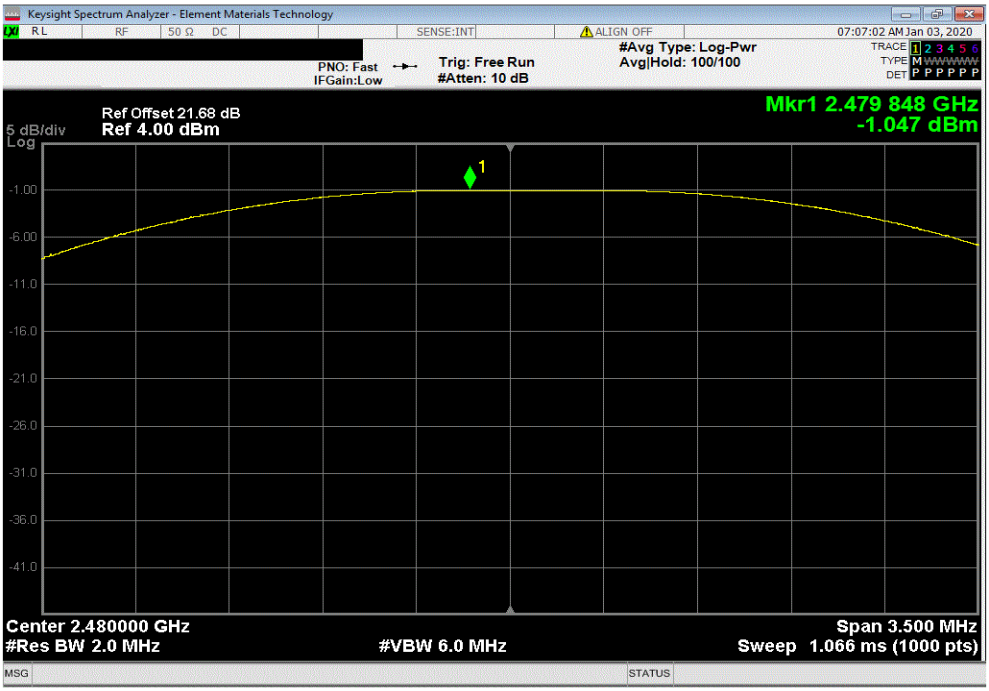
BLE/GFSK (1 Mbps) Low Channel, 2402 MHz						
				Out Pwr (dBm)	Limit (dBm)	Result
				-0.9	30	Pass



BLE/GFSK (1 Mbps) Mid Channel, 2442 MHz						
				Out Pwr (dBm)	Limit (dBm)	Result
				-0.904	30	Pass



BLE/GFSK (1 Mbps) High Channel, 2480 MHz							
					Out Pwr (dBm)	Limit (dBm)	Result
					-1.047	30	Pass



EQUIVALENT ISOTROPIC RADIATED POWER (EIRP)

XMit 2019.09.05

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	Keysight	N5182B	TFX	22-Oct-18	22-Oct-21
Cable	ESM Cable Corp.	TTBJ141 KMKM-72	MNO	7-Jun-19	7-Jun-20
Attenuator	S.M. Electronics	SA26B-20	TZP	9-Nov-19	9-Nov-20
Block - DC	Fairview Microwave	SD3379	AMZ	9-Nov-19	9-Nov-20
Analyzer - Spectrum Analyzer	Keysight	N9010A (EXA)	AFQ	21-Dec-19	21-Dec-20

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The transmit frequency was set to the required channels in each band. The transmit power was set to its default maximum.

Prior to measuring peak transmit power the DTS bandwidth (B) was measured.

The method found in ANSI C63.10:2013 Section 11.9.1.1 was used because the RBW on the analyzer was greater than the DTS Bandwidth of the radio.

The antenna gain was added to out the conducted output power value to calculate the EIRP

EQUIVALENT ISOTROPIC RADIATED POWER (EIRP)

element

TbtTx 2019.08.30.0 XMit 2019.09.05

EUT:	**ARA LTE Water Heater Controller**			**Work Order:**	**APRI0004**
Serial Number:	**008**			**Date:**	**2-Jan-20**
Customer:	**Apricity Code**			**Temperature:**	**22.1 °C**
Attendees:	**None**			**Humidity:**	**28.7% RH**
Project:	**None**			**Barometric Pres.:**	**1004 mbar**
Tested by:	**Andrew Rogstad**	**Power:**	**DC voltage via 120VAC/60Hz**	**Job Site:**	**MN05**

TEST SPECIFICATIONS	**Test Method**
FCC 15.247:2020	ANSI C63.10:2013

COMMENTS

None

DEVIATIONS FROM TEST STANDARD

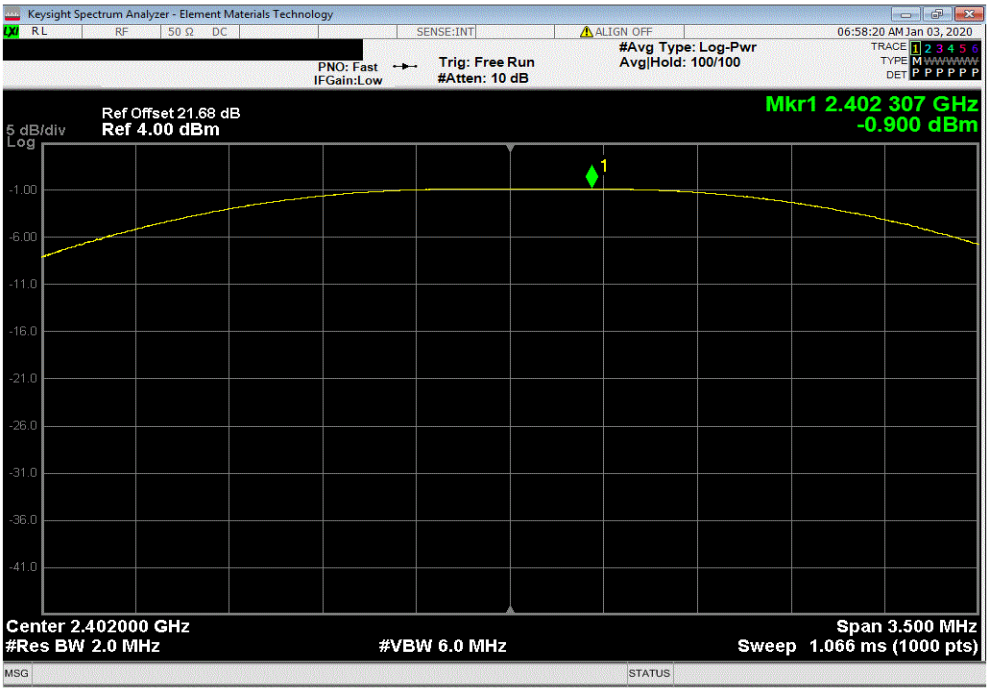
None

Configuration #	**1**	*Signature* Andrew Rogstad

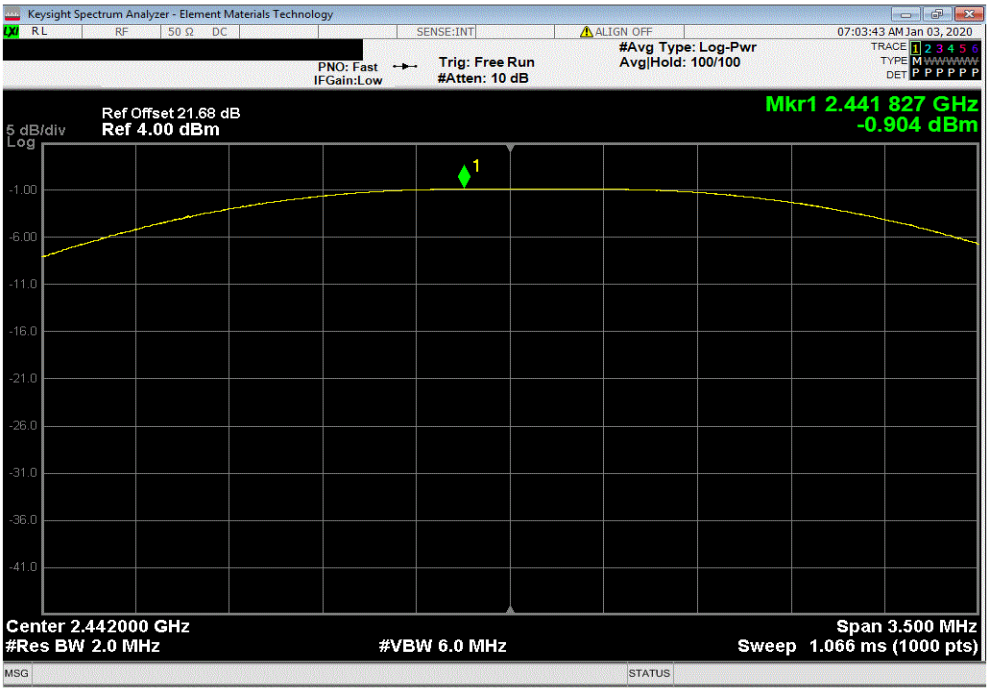
	Out Pwr (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Result
BLE/GFSK (1 Mbps) Low Channel, 2402 MHz	-0.9	5.5	4.6	36	Pass
BLE/GFSK (1 Mbps) Mid Channel, 2442 MHz	-0.904	5.5	4.596	36	Pass
BLE/GFSK (1 Mbps) High Channel, 2480 MHz	-1.047	5.5	4.453	36	Pass

EQUIVALENT ISOTROPIC RADIATED POWER (EIRP)

BLE/GFSK (1 Mbps) Low Channel, 2402 MHz						
		Out Pwr (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Result
		-0.9	5.5	4.6	36	Pass

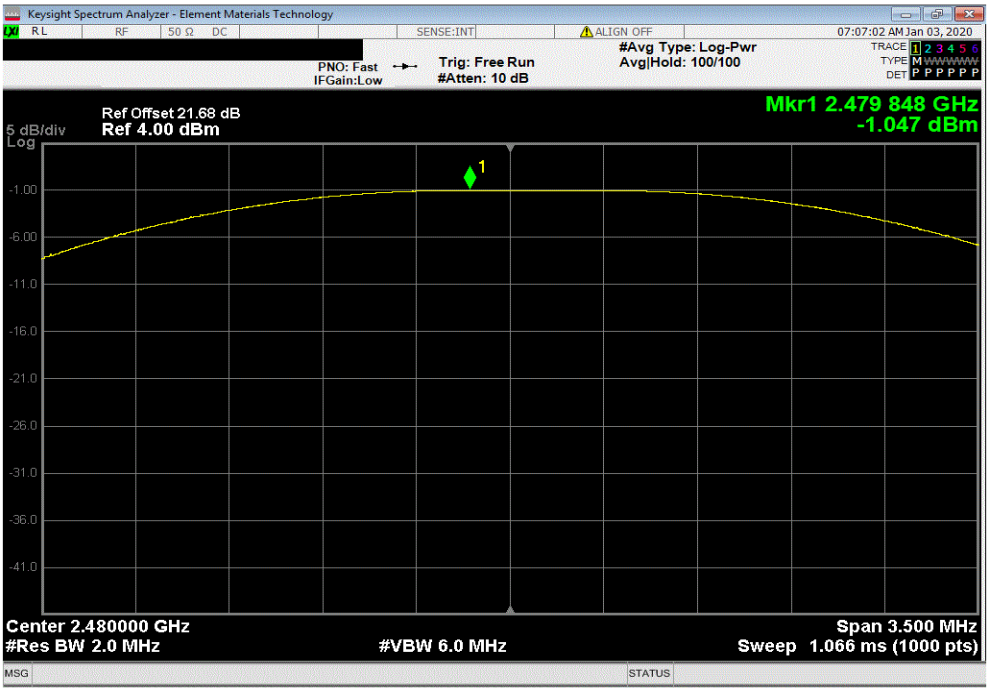


BLE/GFSK (1 Mbps) Mid Channel, 2442 MHz						
		Out Pwr (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Result
		-0.904	5.5	4.596	36	Pass



EQUIVALENT ISOTROPIC RADIATED POWER (EIRP)

BLE/GFSK (1 Mbps) High Channel, 2480 MHz						
		Out Pwr (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Result
		-1.047	5.5	4.453	36	Pass



POWER SPECTRAL DENSITY

XMit 2019.09.05

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	Keysight	N5182B	TFX	22-Oct-18	22-Oct-21
Cable	ESM Cable Corp.	TTBJ141 KMKM-72	MNO	7-Jun-19	7-Jun-20
Attenuator	S.M. Electronics	SA26B-20	TZP	9-Nov-19	9-Nov-20
Block - DC	Fairview Microwave	SD3379	AMZ	9-Nov-19	9-Nov-20
Analyzer - Spectrum Analyzer	Keysight	N9010A (EXA)	AFQ	21-Dec-19	21-Dec-20

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The maximum power spectral density measurements was measured using the channels and modes as called out on the following data sheets.

Per the procedure outlined in ANSI C63.10 the peak power spectral density was measured in a 3 kHz RBW.

POWER SPECTRAL DENSITY

element

TbtTx 2019.08.30.0 XMit 2019.09.05

EUT:	**ARA LTE Water Heater Controller**			**Work Order:**	**APRI0004**
Serial Number:	**008**			**Date:**	**2-Jan-20**
Customer:	**Apricity Code**			**Temperature:**	**22.1 °C**
Attendees:	**None**			**Humidity:**	**28.6% RH**
Project:	**None**			**Barometric Pres.:**	**1003 mbar**
Tested by:	**Andrew Rogstad**	**Power:**	**DC voltage via 120VAC/60Hz**	**Job Site:**	**MN05**

TEST SPECIFICATIONS	**Test Method**
FCC 15.247:2020	ANSI C63.10:2013

COMMENTS

None

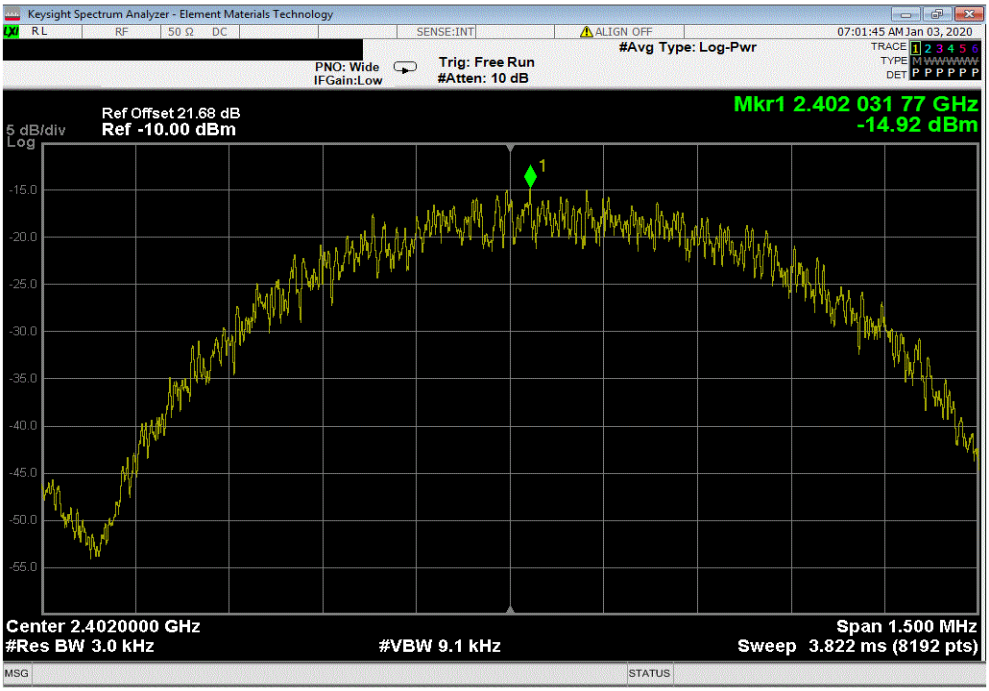
DEVIATIONS FROM TEST STANDARD

None

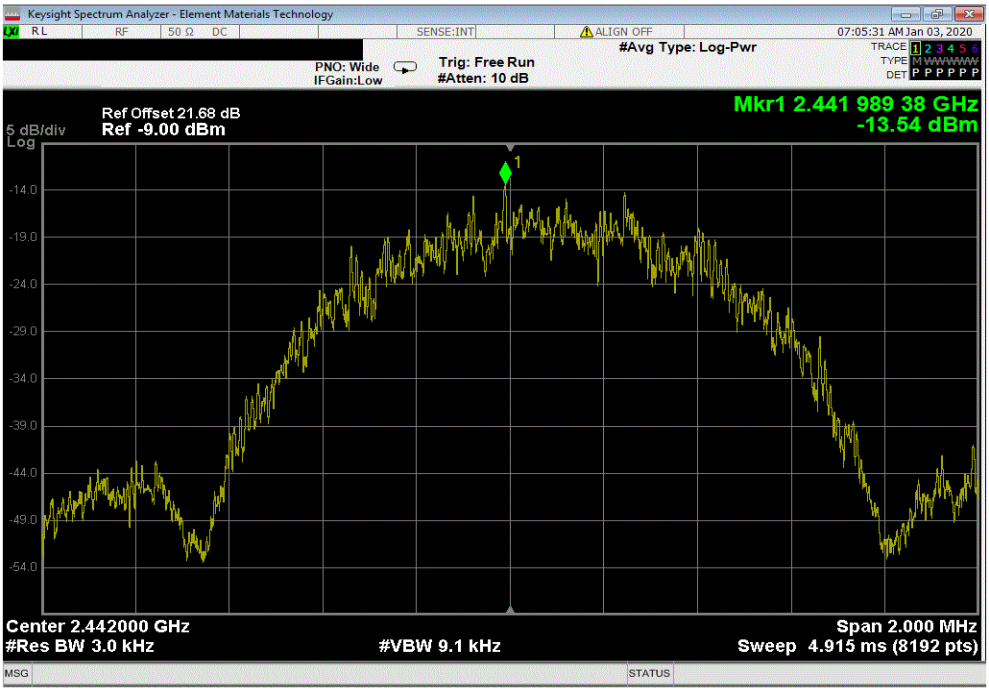
Configuration #	**1**	*Signature* Andrew Rogstad

	Value dBm/3kHz	**Limit < dBm/3kHz**	**Results**
BLE/GFSK (1 Mbps) Low Channel, 2402 MHz	-14.915	8	Pass
BLE/GFSK (1 Mbps) Mid Channel, 2442 MHz	-13.537	8	Pass
BLE/GFSK (1 Mbps) High Channel, 2480 MHz	-14.759	8	Pass

BLE/GFSK (1 Mbps) Low Channel, 2402 MHz						
				Value dBm/3kHz	Limit < dBm/3kHz	Results
				-14.915	8	Pass

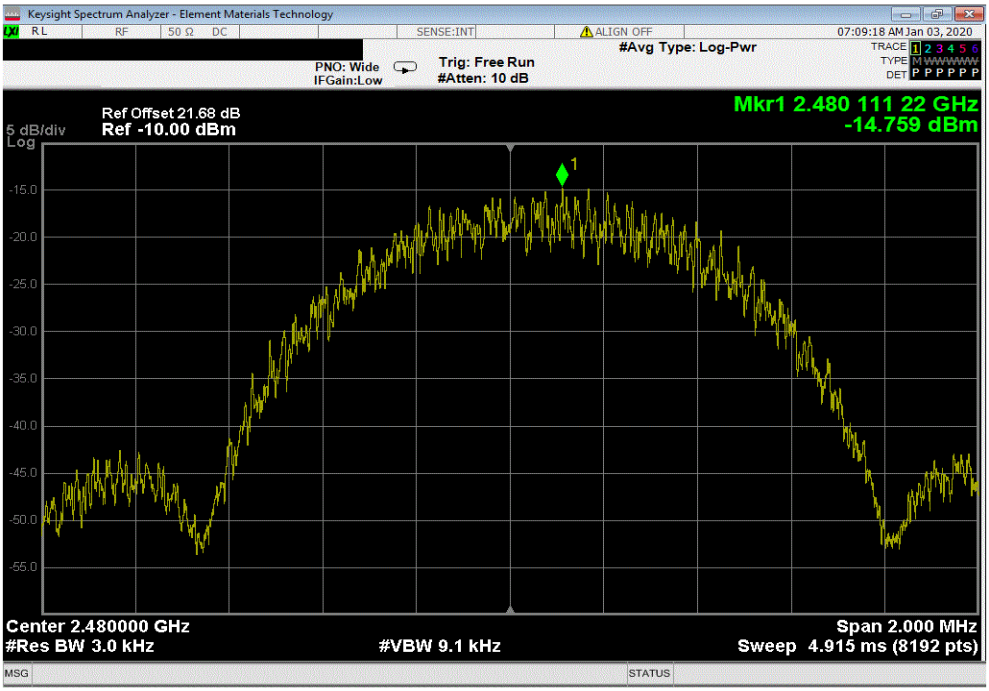


BLE/GFSK (1 Mbps) Mid Channel, 2442 MHz						
				Value dBm/3kHz	Limit < dBm/3kHz	Results
				-13.537	8	Pass



POWER SPECTRAL DENSITY

BLE/GFSK (1 Mbps) High Channel, 2480 MHz						
				Value dBm/3kHz	Limit < dBm/3kHz	Results
				-14.759	8	Pass



BAND EDGE COMPLIANCE

XMit 2019.09.05

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	Keysight	N5182B	TFX	22-Oct-18	22-Oct-21
Cable	ESM Cable Corp.	TTBJ141 KMKM-72	MNO	7-Jun-19	7-Jun-20
Attenuator	S.M. Electronics	SA26B-20	TZP	9-Nov-19	9-Nov-20
Block - DC	Fairview Microwave	SD3379	AMZ	9-Nov-19	9-Nov-20
Analyzer - Spectrum Analyzer	Keysight	N9010A (EXA)	AFQ	21-Dec-19	21-Dec-20

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The spurious RF conducted emissions at the edges of the authorized bands were measured with the EUT set to low and high transmit frequencies in each available band. The channels closest to the band edges were selected. The EUT was transmitting at the data rate(s) listed in the datasheet.

The spectrum was scanned below the lower band edge and above the higher band edge.

BAND EDGE COMPLIANCE

element

TbtTx 2019.08.30.0 XMit 2019.09.05

EUT:	**ARA LTE Water Heater Controller**			**Work Order:**	**APRI0004**
Serial Number:	**008**			**Date:**	**2-Jan-20**
Customer:	**Apricity Code**			**Temperature:**	**21.9 °C**
Attendees:	**None**			**Humidity:**	**28.9% RH**
Project:	**None**			**Barometric Pres.:**	**1003 mbar**
Tested by:	**Andrew Rogstad**	**Power:**	**DC voltage via 120VAC/60Hz**	**Job Site:**	**MN05**

TEST SPECIFICATIONS	**Test Method**
FCC 15.247:2020	ANSI C63.10:2013

COMMENTS

None

DEVIATIONS FROM TEST STANDARD

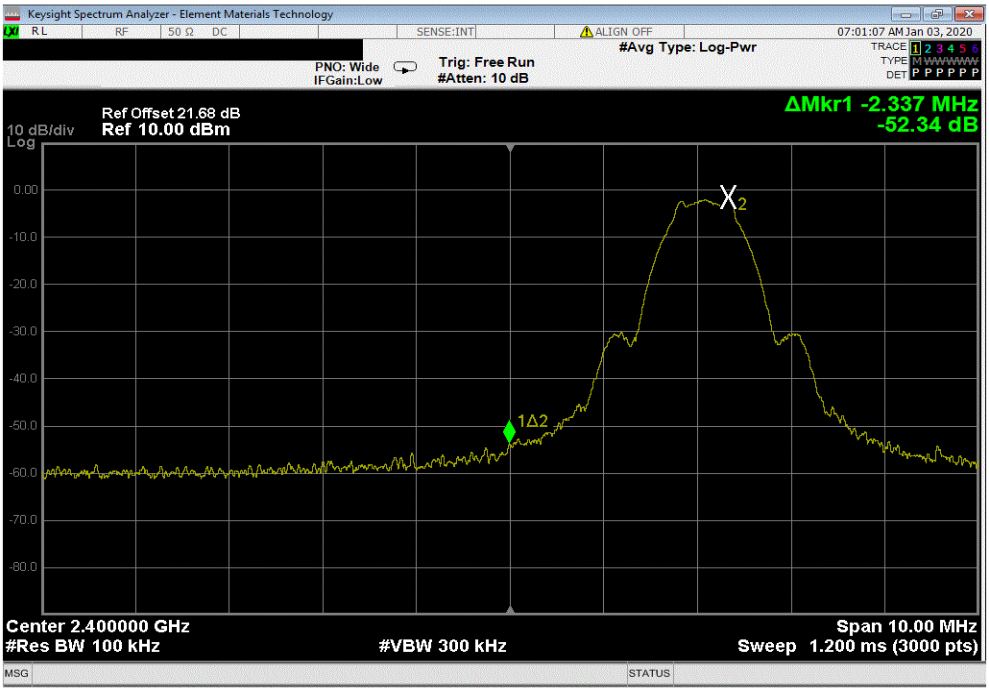
None

Configuration #	**1**	*Signature* Andrew Rogstad

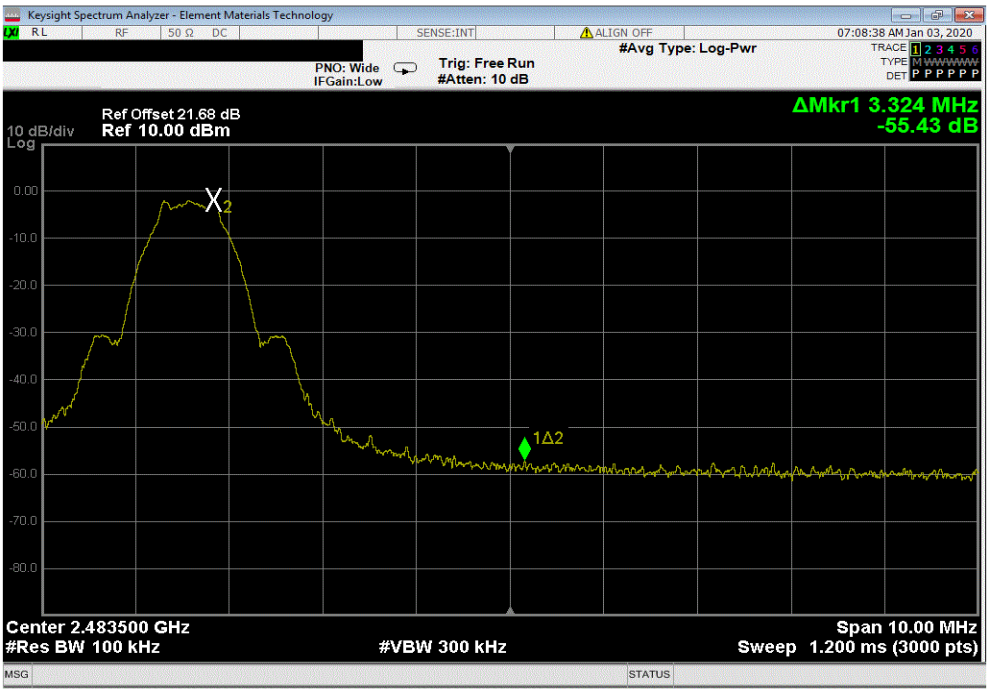
	Value (dBc)	**Limit ≤ (dBc)**	**Result**
BLE/GFSK (1 Mbps) Low Channel, 2402 MHz	-52.34	-20	Pass
BLE/GFSK (1 Mbps) High Channel, 2480 MHz	-55.43	-20	Pass

BAND EDGE COMPLIANCE

BLE/GFSK (1 Mbps) Low Channel, 2402 MHz						
				Value (dBc)	Limit ≤ (dBc)	Result
				-52.34	-20	Pass



BLE/GFSK (1 Mbps) High Channel, 2480 MHz						
				Value (dBc)	Limit ≤ (dBc)	Result
				-55.43	-20	Pass



SPURIOUS CONDUCTED EMISSIONS

XMit 2019.09.05

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	Keysight	N5182B	TFX	22-Oct-18	22-Oct-21
Cable	ESM Cable Corp.	TTBJ141 KMKM-72	MNO	7-Jun-19	7-Jun-20
Attenuator	S.M. Electronics	SA26B-20	TZP	9-Nov-19	9-Nov-20
Block - DC	Fairview Microwave	SD3379	AMZ	9-Nov-19	9-Nov-20
Analyzer - Spectrum Analyzer	Keysight	N9010A (EXA)	AFQ	21-Dec-19	21-Dec-20

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The spurious RF conducted emissions were measured with the EUT set to low, medium and high transmit frequencies. The EUT was transmitting at the data rate(s) listed in the datasheet. For each transmit frequency, the spectrum was scanned throughout the specified frequency range.

SPURIOUS CONDUCTED EMISSIONS

TbtTx 2019.08.30.0 XMit 2019.09.05

EUT:	**ARA LTE Water Heater Controller**			**Work Order:**	**APRI0004**
Serial Number:	**008**			**Date:**	**2-Jan-20**
Customer:	**Apricity Code**			**Temperature:**	**22.1 °C**
Attendees:	**None**			**Humidity:**	**28.7% RH**
Project:	**None**			**Barometric Pres.:**	**1003 mbar**
Tested by:	**Andrew Rogstad**	**Power:**	**DC voltage via 120VAC/60Hz**	**Job Site:**	**MN05**

TEST SPECIFICATIONS	**Test Method**
FCC 15.247:2020	ANSI C63.10:2013

COMMENTS

None

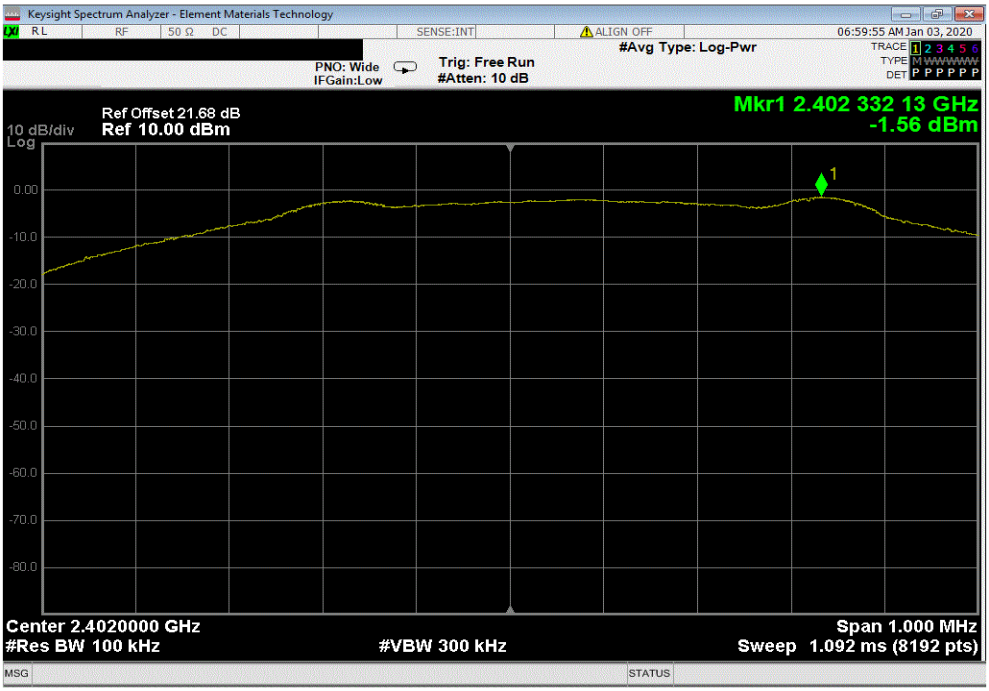
DEVIATIONS FROM TEST STANDARD

None

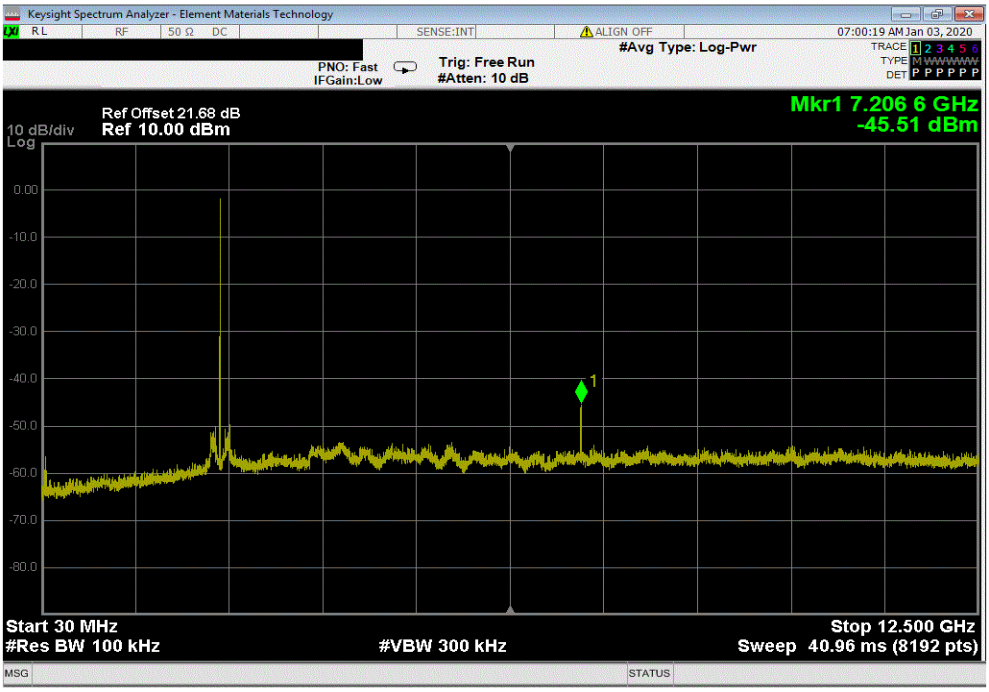
Configuration #	**1**	*Signature*

	Frequency Range	Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
BLE/GFSK (1 Mbps) Low Channel, 2402 MHz	Fundamental	2402.33	N/A	N/A	N/A
BLE/GFSK (1 Mbps) Low Channel, 2402 MHz	30 MHz - 12.5 GHz	7206.61	-43.95	-20	Pass
BLE/GFSK (1 Mbps) Low Channel, 2402 MHz	12.5 GHz - 25 GHz	24703.94	-48.3	-20	Pass
BLE/GFSK (1 Mbps) Mid Channel, 2442 MHz	Fundamental	2442.33	N/A	N/A	N/A
BLE/GFSK (1 Mbps) Mid Channel, 2442 MHz	30 MHz - 12.5 GHz	7326.88	-45.38	-20	Pass
BLE/GFSK (1 Mbps) Mid Channel, 2442 MHz	12.5 GHz - 25 GHz	23924.12	-48.61	-20	Pass
BLE/GFSK (1 Mbps) High Channel, 2480 MHz	Fundamental	2479.82	N/A	N/A	N/A
BLE/GFSK (1 Mbps) High Channel, 2480 MHz	30 MHz - 12.5 GHz	7439.53	-46	-20	Pass
BLE/GFSK (1 Mbps) High Channel, 2480 MHz	12.5 GHz - 25 GHz	23858.5	-47.67	-20	Pass

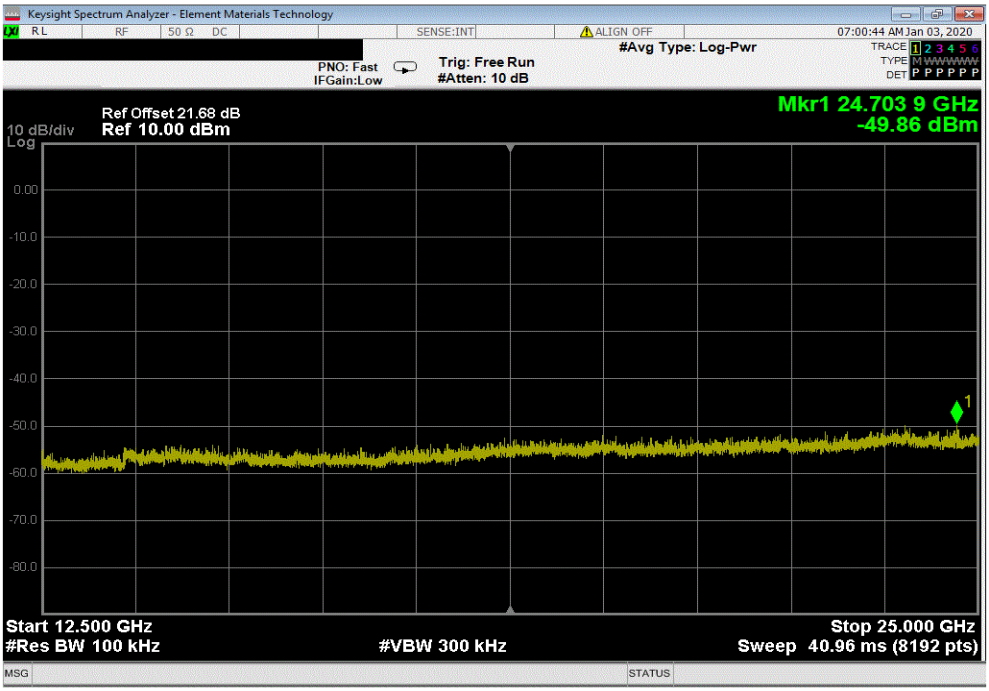
BLE/GFSK (1 Mbps) Low Channel, 2402 MHz					
Frequency Range		Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
	Fundamental	2402.33	N/A	N/A	N/A



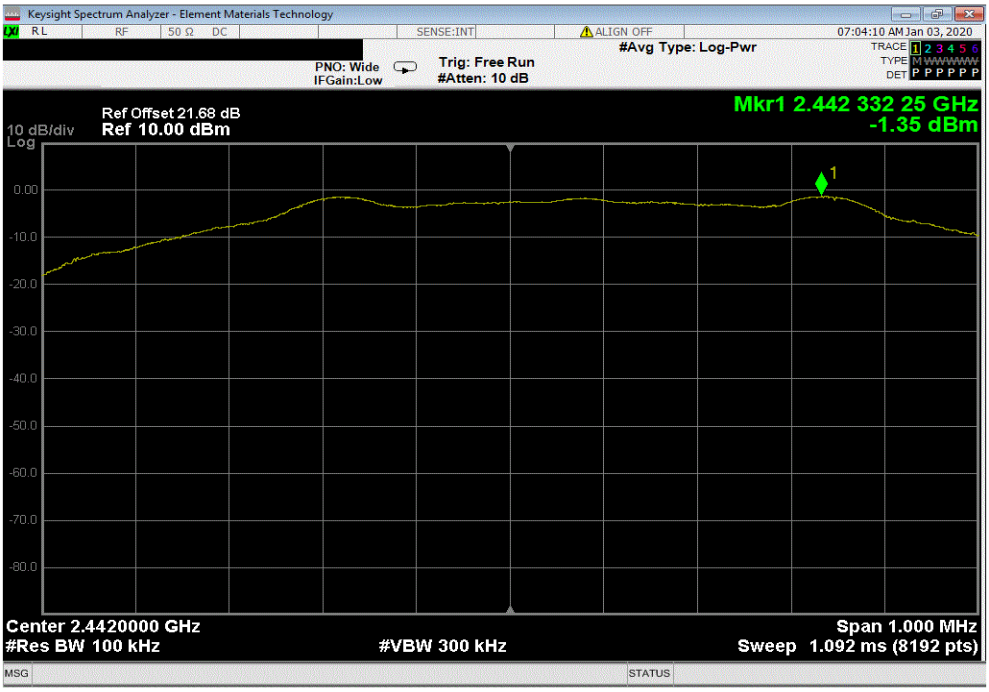
BLE/GFSK (1 Mbps) Low Channel, 2402 MHz				
Frequency Range	Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
30 MHz - 12.5 GHz	7206.61	-43.95	-20	Pass



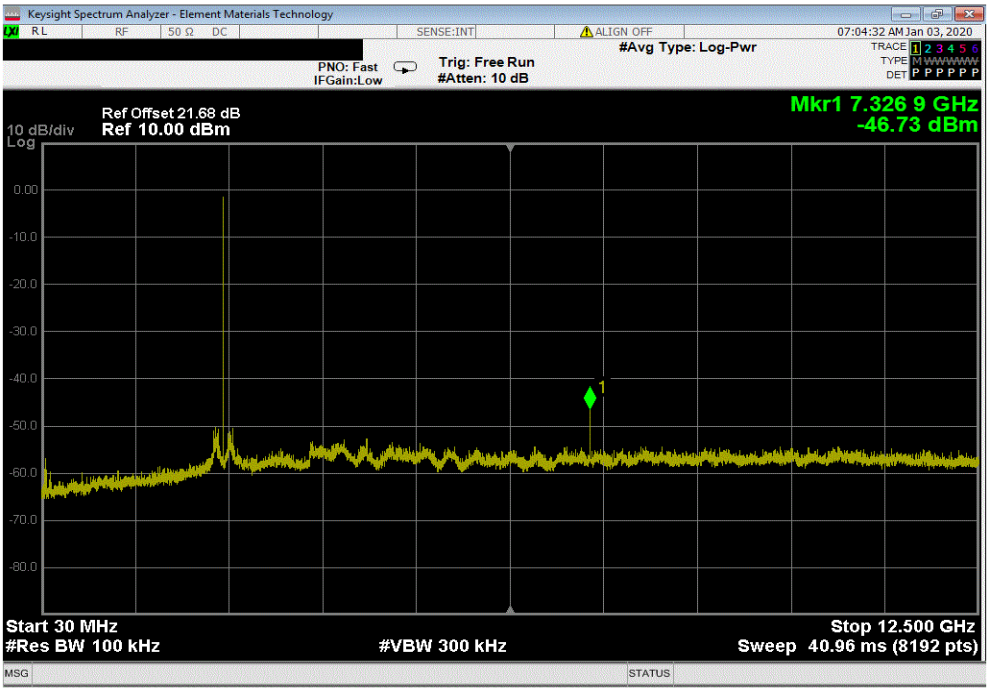
BLE/GFSK (1 Mbps) Low Channel, 2402 MHz				
Frequency Range	Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
12.5 GHz - 25 GHz	24703.94	-48.3	-20	Pass



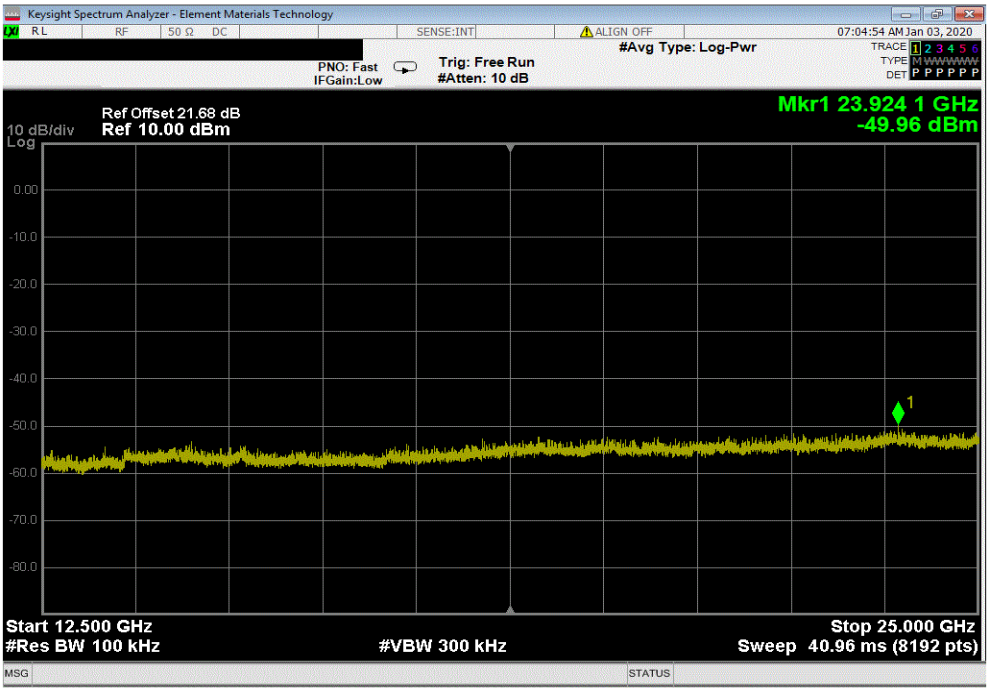
BLE/GFSK (1 Mbps) Mid Channel, 2442 MHz					
Frequency Range		Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
	Fundamental	2442.33	N/A	N/A	N/A



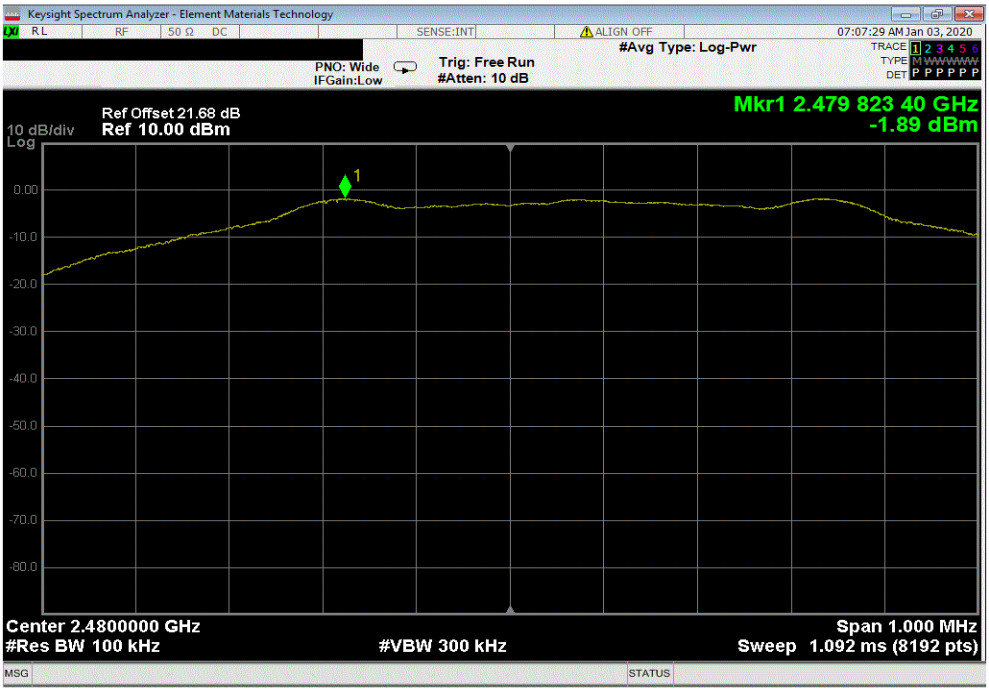
BLE/GFSK (1 Mbps) Mid Channel, 2442 MHz				
Frequency Range	**Measured Freq (MHz)**	**Max Value (dBc)**	**Limit ≤ (dBc)**	**Result**
30 MHz - 12.5 GHz	7326.88	-45.38	-20	Pass



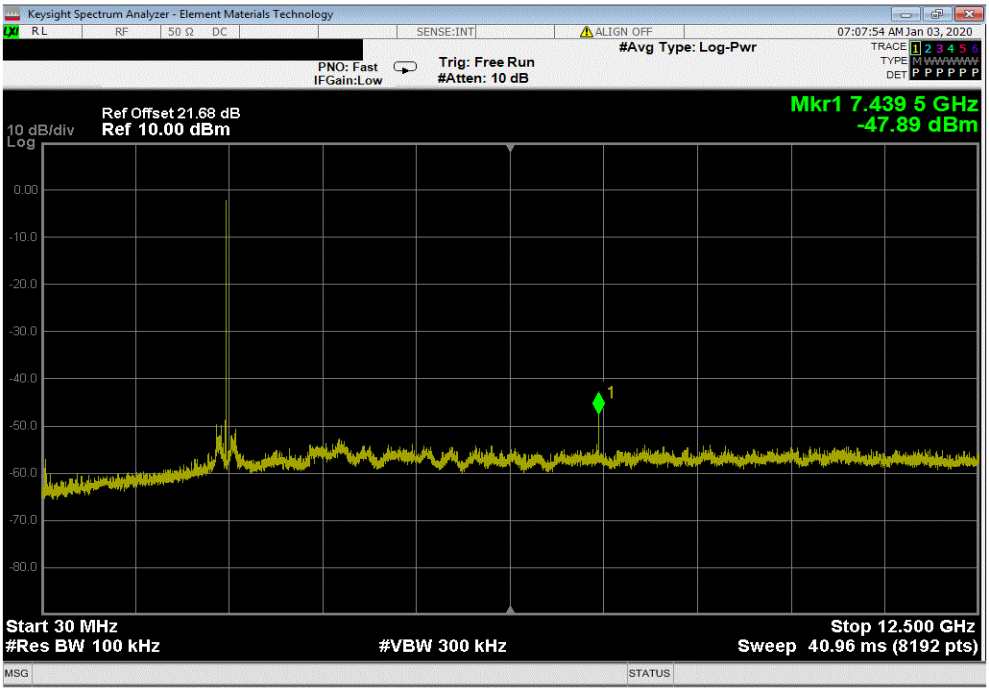
BLE/GFSK (1 Mbps) Mid Channel, 2442 MHz				
Frequency Range	**Measured Freq (MHz)**	**Max Value (dBc)**	**Limit ≤ (dBc)**	**Result**
12.5 GHz - 25 GHz	23924.12	-48.61	-20	Pass



BLE/GFSK (1 Mbps) High Channel, 2480 MHz					
Frequency Range		Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
	Fundamental	2479.82	N/A	N/A	N/A



BLE/GFSK (1 Mbps) High Channel, 2480 MHz				
Frequency Range	Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
30 MHz - 12.5 GHz	7439.53	-46	-20	Pass



BLE/GFSK (1 Mbps) High Channel, 2480 MHz				
Frequency Range	**Measured Freq (MHz)**	**Max Value (dBc)**	**Limit ≤ (dBc)**	**Result**
12.5 GHz - 25 GHz	23858.5	-47.67	-20	Pass