

# **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	ANSI C03. 10.2013, NDB 330074

#### 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.

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# **REVISION HISTORY**



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

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# 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: <a href="https://www.nwemc.com/emc-testing-accreditations">https://www.nwemc.com/emc-testing-accreditations</a>

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# **FACILITIES**







California	Minnesota	Oregon	Texas	Washington	
Labs OC01-17	Labs MN01-10	Labs EV01-12	Labs TX01-09	Labs NC01-05	
41 Tesla	9349 W Broadway Ave.	6775 NE Evergreen Pkwy #400	3801 E Plano Pkwy	19201 120 <sup>th</sup> Ave NE	
Irvine, CA 92618 (949) 861-8918	Brooklyn Park, MN 55445 (612)-638-5136	Hillsboro, OR 97124 (503) 844-4066	Plano, TX 75074 (469) 304-5255	Bothell, WA 98011 (425)984-6600	
(343) 001-0310	(012)-030-3130	(303) 044 4000	(403) 304-3233	(+23)304-0000	
		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	
Re	Recognized Phase I CAB for ISED, ACMA, BSMI, IDA, KCC/RRA, MIC, MOC, NCC, OFCA				
US0158	US0175	US0017	US0191	US0157	



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## MEASUREMENT UNCERTAINTY



#### **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.

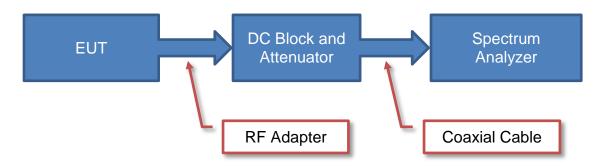
Test	+ MU	- MU
Frequency Accuracy	0.0007%	-0.0007%
Amplitude Accuracy (dB)	1.2 dB	-1.2 dB
Conducted Power (dB)	1.2 dB	-1.2 dB
Radiated Power via Substitution (dB)	0.7 dB	-0.7 dB
Temperature (degrees C)	0.7°C	-0.7°C
Humidity (% RH)	2.5% RH	-2.5% RH
Voltage (AC)	1.0%	-1.0%
Voltage (DC)	0.7%	-0.7%
Field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

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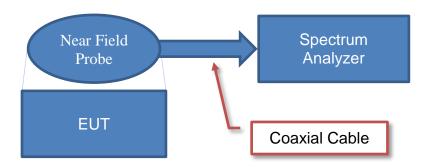
# **Test Setup Block Diagrams**



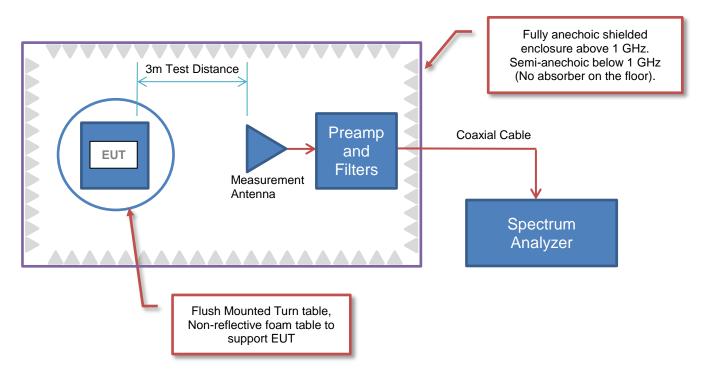
#### **Antenna Port Conducted Measurements**



#### **Near Field Test Fixture Measurements**



#### **Spurious Radiated Emissions**



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# 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
<b>Equipment Design Stage:</b>	Production
<b>Equipment Condition:</b>	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.

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# **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

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# **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	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)			

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# **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.

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#### **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

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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.

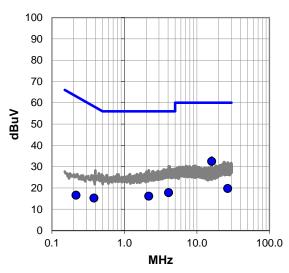
#### **EUT OPERATING MODES**

Transmitting on Mid channel (2442 MHz), BLE

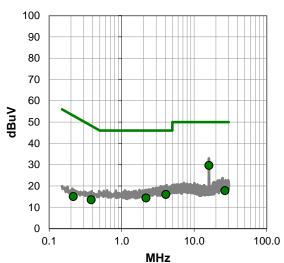
#### **DEVIATIONS FROM TEST STANDARD**

None

#### Quasi Peak Data - vs - Quasi Peak Limit



#### Average Data - vs - Average Limit



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#### **RESULTS - Run #7**

Quasi Peak Data - vs - Quasi Peak Limit

	Quadri dan Pana 10 Quadri dan Inin								
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



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 L	ine Add. Ext. Attenuation (dB): 0	
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#### **COMMENTS**

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

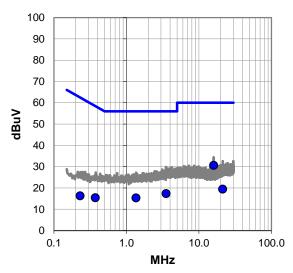
#### **EUT OPERATING MODES**

Transmitting on Mid channel (2442 MHz), BLE

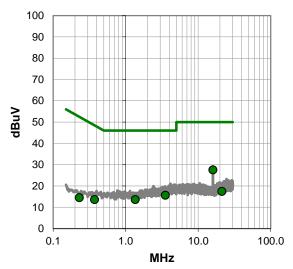
#### **DEVIATIONS FROM TEST STANDARD**

None

#### Quasi Peak Data - vs - Quasi Peak Limit



#### Average Data - vs - Average Limit



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#### **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
Start Frequency   30 MHz	Stop Frequency	20300 WI12

#### 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

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#### **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**



									1	EmiR5 2019.08.15.1		PSA-ESCI 2019.05.10	<u> </u>
W	ork Order:			<b></b>	Date:		-2020	_	7	1 1	4	15	
	Project: Job Site:				nperature: Humidity:		9 °C % RH	0	-	Ros	day	t	
Seria	al Number:				tric Pres.:		mbar		Tested by:	Andrew Ro	gstad		_
		ARA LTE V	Vater Heate	er Controlle	r			•					<del>-</del> -
	figuration:		do										_
	Attendees:	Apricity Coo	ue										_
		DC voltage	via 120VA	C/60Hz									=
Operat	ting Mode:	Transmitting	g on Low c	hannel (240	02 MHz), Mi	id channel	(2442 MHz)	, and High	channel (24	80 MHz), E	LE 1 Mbps	3	<del>_</del>
		None											_
D	Deviations:	None											
		EUT was o	perating at	100% duty	cycle. Test	ing was co	mpleted wit	h the radio	circuitry out	side of the	plastic enc	losure.	<b>=</b>
С	Comments:	This is a wo			. Measuren	nents below	v were take	n with Conf	figuration 5.	Configurati	on 2 was u	ised for	
		evaluation f	from 30-100	00 MHz.									
Test Spec							Test Meth						_
FCC 15.24	47:2020						ANSI C63.	10:2013					
·						11 1 14()		4 . 4		- L			=
Run #	47	l est Dis	tance (m)	3	Antenna	Height(s)		1 to 4(m)		Results	Pa	ass	_
80 +													
											<del>- </del>		
70 -												++	
60													
_ 50 -													
ا " ع							•		<b>3</b>   <b>3</b>				
<b>w//ngp</b>													
<b>6</b> 40 +													
									<b>│</b>				
30 -												++	
20 -													
10													
0												Ш	
10	0		100			1000			10000			100000	
						MHz				■ PK	<b>Δ</b> Δ\/	• QP	
											• AV	<u> </u>	
						External	Polarity/ Transducer		Distance			Compared to	
Freq	Amplitude (dBuV)	Factor (dB)	Antenna Height (meters)	Azimuth (degrees)	Test Distance (meters)	Attenuation	Туре	Detector	Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Spec. (dB)	
(MHz)						(dB)							Comments
7326.825 7440.883	37.3 36.8	13.5 13.2	1.5 1.6	307.1 286.9	3.0 3.0	0.0 0.0	Horz Horz	AV AV	0.0 0.0	50.8 50.0	54.0 54.0	-3.2 -4.0	EUT on side, Mid ch. 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 2486.627	35.8 32.0	13.2 -3.7	1.4 1.5	353.0 213.0	3.0 3.0	0.0 20.0	Vert Horz	AV AV	0.0 0.0	49.0 48.3	54.0 54.0	-5.0 -5.7	EUT on side, High ch. 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 2487.120	32.0 32.0	-3.7 -3.7	1.5 1.5	282.9 193.9	3.0 3.0	20.0 20.0	Horz Vert	AV AV	0.0 0.0	48.3 48.3	54.0 54.0	-5.7 -5.7	EUT vert, High ch. 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 2389.620	31.7 31.7	-3.6 -3.6	1.5 1.5	196.0 102.0	3.0 3.0	20.0 20.0	Horz Vert	AV AV	0.0 0.0	48.1 48.1	54.0 54.0	-5.9 -5.9	EUT horz, Low ch. 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 2388.273	44.2 43.6	-3.8 -3.6	1.5 1.5	213.0 102.0	3.0 3.0	20.0 20.0	Horz Vert	PK PK	0.0 0.0	60.4 60.0	74.0 74.0	-13.6 -14.0	EUT horz, High ch. EUT horz, Low ch.
2000.210	.0.0	5.0	0	. 52.0	5.0	_5.0		. 13	3.0	00.0	. 1.0	. 4.0	- : ::::=, =2" VIII

Report No. APRI0004.1 19/47

							Polarity/						
F	A 124 1				Test Distance	External	Transducer		Distance		0 1: "	Compared to	
Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Antenna Height (meters)	Azimuth (degrees)	(meters)	Attenuation (dB)	Туре	Detector	Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Spec. (dB)	
(141112)	( , , ,	( , ,	, , , ,	(**************************************	( ,				( ,	( , , , ,	(, , , ,	( ,	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 1.5	57.0	3.0 3.0	0.0	Horz	AV	0.0	36.5	54.0	-17.5 -17.8	EUT on side, Mid ch. EUT horz, Mid ch.
4884.225	31.5 31.5	4.7 4.6	1.5	117.9 303.1	3.0	0.0 0.0	Vert	AV AV	0.0	36.2 36.1	54.0	-17.8 -17.9	EUT on side, Low ch.
4804.450		4.6	1.5	72.1	3.0	0.0	Horz Horz	AV	0.0 0.0	35.9	54.0 54.0	-17.9	EUT on side, High ch.
4959.900	31.1	4.8 4.8		95.9	3.0			AV	0.0	35.9 35.8		-18.1	EUT horz, High ch.
4959.842	31.0	4.8 4.6	2.4 1.5	90.1	3.0	0.0 0.0	Vert Vert	AV	0.0	35.6 35.6	54.0 54.0	-18.2 -18.4	EUT horz, Low ch.
4801.617 12400.770	31.0 28.9	4.6 5.4	1.5	90.1 171.9	3.0	0.0	Vert	AV	0.0	35.6 34.3	54.0 54.0	-18.4 -19.7	EUT horz, High ch.
12400.770	28.9	5.4 5.4	2.2	301.9	3.0	0.0	Horz	AV	0.0	34.3 34.3	54.0 54.0	-19.7 -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.

Report No. APRI0004.1 20/47

### **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.

Report No. APRI0004.1 21/47



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		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.

Report No. APRI0004.1 22/47



						IDL1X 2019.06.30.0	AIMIL 2019.09.05
EUT: ARA L	TE Water Heater Contro	oller			Work Order:	APRI0004	
Serial Number: 008					Date:	2-Jan-20	
Customer: Apricit	y Code				Temperature:	22 °C	
Attendees: None					Humidity:	28.7% RH	
Project: None					Barometric Pres.:	1003 mbar	
Tested by: Andrew	w 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		To K	12			
		Signature	100	og such			
						Limit	
					Value	(≥)	Result
BLE/GFSK (1 Mbps) Low Ch	nannel, 2402 MHz				743.144 kHz	500 kHz	Pass
BLE/GFSK (1 Mbps) Mid Ch	annel, 2442 MHz				736.529 kHz	500 kHz	Pass
BLE/GFSK (1 Mbps) High C	hannel, 2480 MHz				750.792 kHz	500 kHz	Pass

Report No. APRI0004.1 23/47

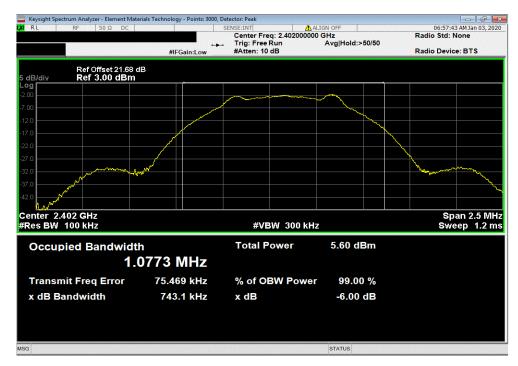


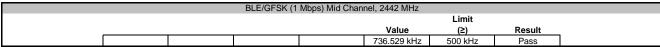
BLE/GFSK (1 Mbps) Low Channel, 2402 MHz

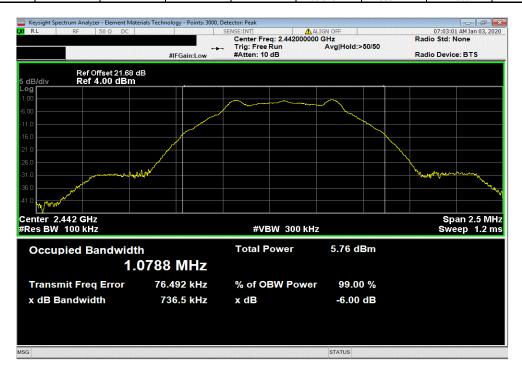
Limit

Value (2) Result

743.144 kHz 500 kHz Pass







Report No. APRI0004.1 24/47

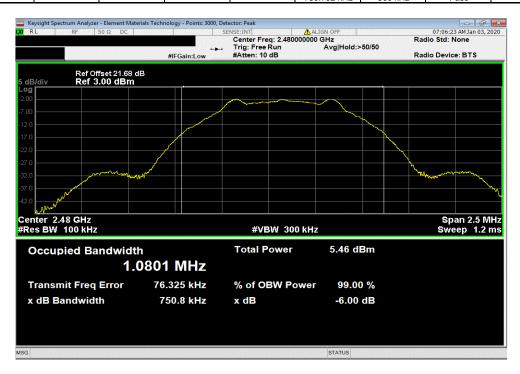


BLE/GFSK (1 Mbps) High Channel, 2480 MHz

Limit

Value (≥) Result

750.792 kHz 500 kHz Pass



Report No. APRI0004.1 25/47



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.

Report No. APRI0004.1



				TbtTx 2019.08.30.0	XMit 2019.09.05
EUT: ARA	A LTE Water Heater Controller		Work Order:	APRI0004	
Serial Number: 008			Date:	2-Jan-20	
Customer: April	icity Code		Temperature:	21.9 °C	
Attendees: None	ne		Humidity:	28.9% RH	
Project: None	ne		Barometric Pres.:	1003 mbar	
Tested by: And	Irew Rogstad	Power: DC voltage via 120VAC/60Hz	Job Site:	MN05	
TEST SPECIFICATIONS		Test Method			
FCC 15.247:2020		ANSI C63.10:2013			
COMMENTS					
None					
<b>DEVIATIONS FROM TES</b>	ST STANDARD				
None					
Configuration #	1	The Roostand			
	Signature				
			Out Pwr	Limit	
			(dBm)	(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	h Channel, 2480 MHz		-1.047	30	Pass

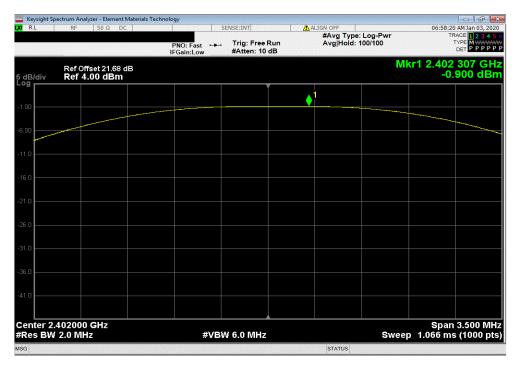
Report No. APRI0004.1 27/47



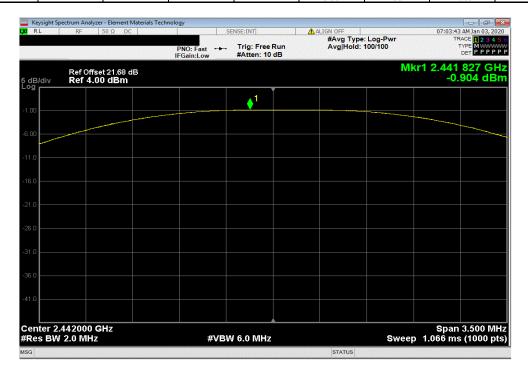
BLE/GFSK (1 Mbps) Low Channel, 2402 MHz

Out Pwr Limit
(dBm) (dBm) Result

-0.9 30 Pass



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



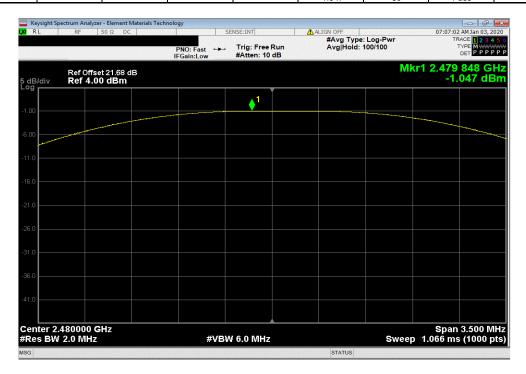
Report No. APRI0004.1 28/47



BLE/GFSK (1 Mbps) High Channel, 2480 MHz

Out Pwr Limit
(dBm) (dBm) Result

-1.047 30 Pass



Report No. APRI0004.1 29/47



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

Report No. APRI0004.1

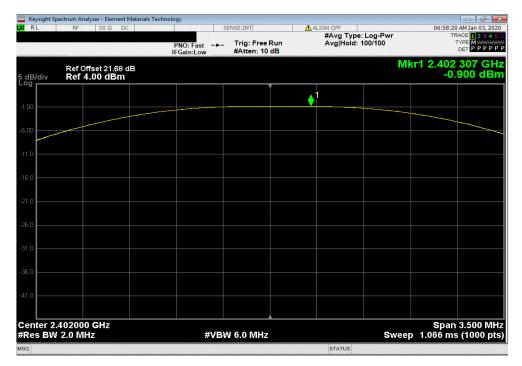


								TbtTx 2019.08.30.0	XMit 2019.09.05
EUT:	<b>ARA LTE Water Heater Co</b>	ontroller					Work Order:	APRI0004	
Serial Number:	008						Date:	2-Jan-20	
Customer:	Apricity Code						Temperature:	22.1 °C	
Attendees:							Humidity:	28.7% RH	
Project:	None						Barometric Pres.:	1004 mbar	
	Andrew Rogstad			Power: DC voltage via 120	VAC/60Hz		Job Site:	MN05	
TEST SPECIFICATI				Test Method					
FCC 15.247:2020				ANSI C63.10:2013					
COMMENTS									
None									
None									
DEVIATIONS EDON	TEST STANDARD								
	I IESI SIANDARD								
None									
Configuration #	1	Signature	as	Rogertan					
	•				Out Pwr	Antenna	EIRP	EIRP Limit	
					(dBm)	Gain (dBi)	(dBm)	(dBm)	Result
BLE/GFSK (1 Mbps)	Low Channel, 2402 MHz				-0.9	5.5	4.6	36	Pass
	Mid Channel, 2442 MHz				-0.904	5.5	4.596	36	Pass
	High Channel, 2480 MHz				-1.047	5.5	4.453	36	Pass
DEE/OF OR (1 Mibps	riigii Orianiici, 2400 Miliz				1.047	0.0	4.400	55	1 433

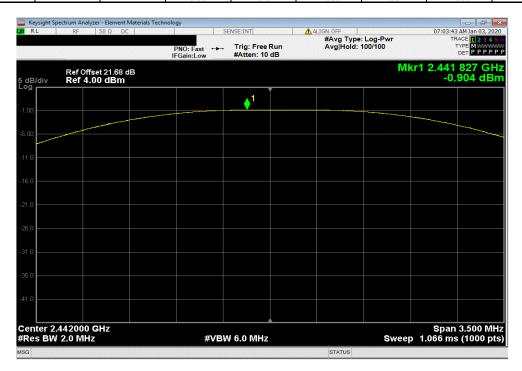
Report No. APRI0004.1 31/47



			DI E/CESK (1	Mhas) Low Chan	nol 2402 MUz			
BLE/GFSK (1 Mbps) Low Channel, 2402 MHz								
			Out Pwr	Antenna	EIRP	EIRP Limit		
			(dBm)	Gain (dBi)	(dBm)	(dBm)	Result	_
			-0.9	5.5	4.6	36	Pass	



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



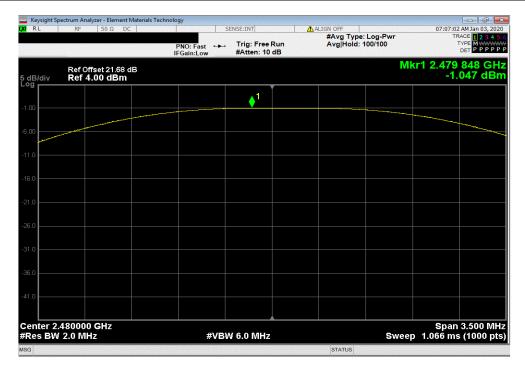
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BLE/GFSK (1 Mbps) High Channel, 2480 MHz

Out Pwr Antenna EIRP EIRP Limit
(dBm) Gain (dBi) (dBm) (dBm) Result

-1.047 5.5 4.453 36 Pass



Report No. APRI0004.1 33/47



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.

Report No. APRI0004.1



		TbtTx 2019.08.30.0	XMit 2019.09.08
EUT: ARA LTE Water Heater Controller	Work Order:		
Serial Number: 008	Date:	2-Jan-20	
Customer: Apricity Code	Temperature:	22.1 °C	
Attendees: None		28.6% RH	
Project: None	Barometric Pres.:		
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 Rogalish			
Signature			
	Value	Limit	
	dBm/3kHz	< 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

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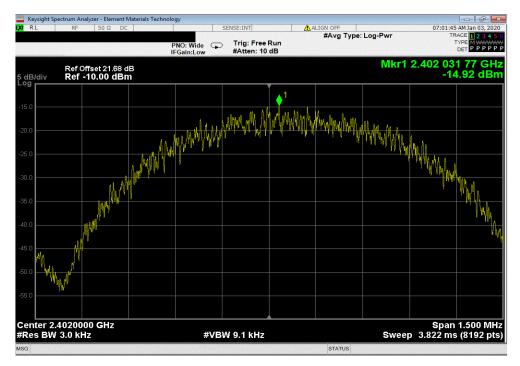


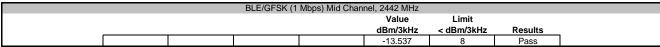
BLE/GFSK (1 Mbps) Low Channel, 2402 MHz

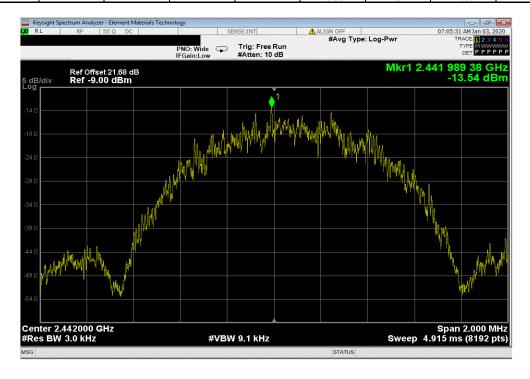
Value Limit

dBm/3kHz < dBm/3kHz Results

-14.915 8 Pass







Report No. APRI0004.1 36/47

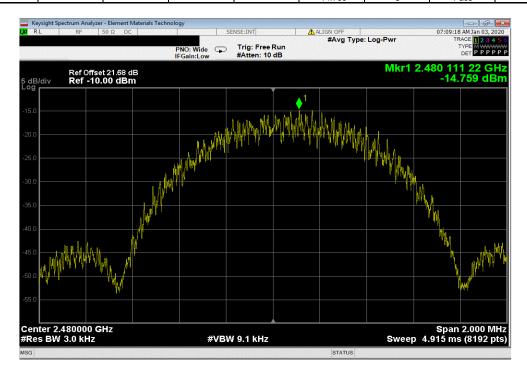


BLE/GFSK (1 Mbps) High Channel, 2480 MHz

Value Limit

dBm/3kHz < dBm/3kHz Results

-14.759 8 Pass



Report No. APRI0004.1 37/47

### **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.

Report No. APRI0004.1

# **BAND EDGE COMPLIANCE**



				TbtTx 2019.08.30.0	XMit 2019.09.08
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 SPECIFICATI	ONS	Test Method			
FCC 15.247:2020		ANSI C63.10:2013			
COMMENTS					
None					
DEVIATIONS FROM	I TEST STANDARD				
None					
Configuration #	1 Signature	No Rogelas			
			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

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#### **BAND EDGE COMPLIANCE**

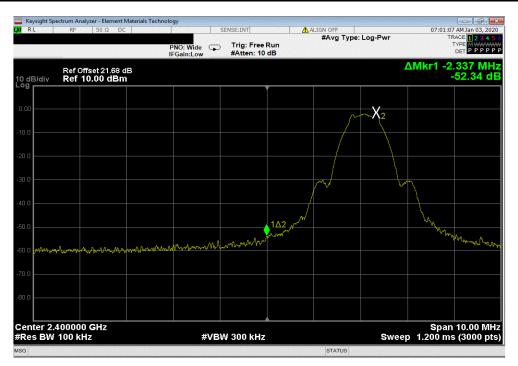


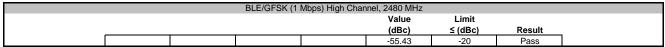
BLE/GFSK (1 Mbps) Low Channel, 2402 MHz

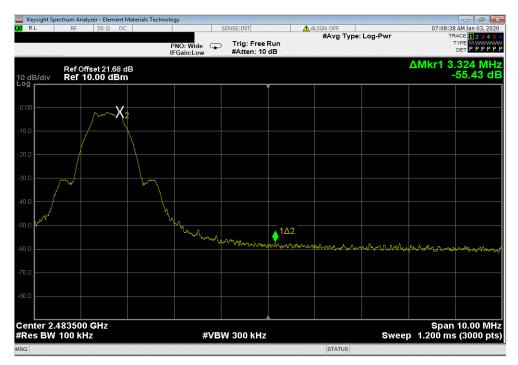
Value

(dBc) ≤ (dBc) Result

-52.34 -20 Pass







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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.

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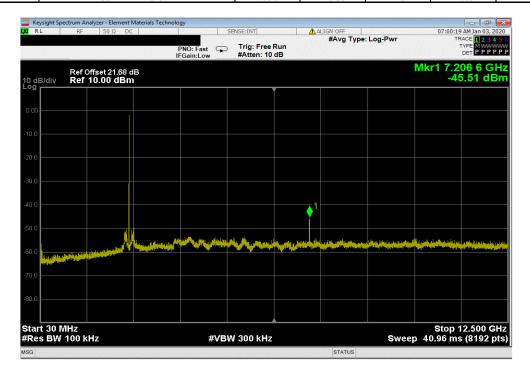
				TbtTx 2019.08.30.0	XMit 2019.09.05
EUT: ARA LTE Water Heater Controller			Work Order:		
Serial Number: 008				2-Jan-20	
Customer: Apricity Code			Temperature:		
Attendees: None				28.7% RH	
Project: None			Barometric Pres.:		
Tested by: Andrew Rogstad	Power: DC voltage via 120VAC/60Hz		Job Site:	MN05	
TEST SPECIFICATIONS	Test Method				
FCC 15.247:2020	ANSI C63.10:2013				
COMMENTS					
None					
DEVIATIONS FROM TEST STANDARD					
None					
Configuration # 1	- 1 n 4 n				
Signature	Chy Rogstarl				
	Frequency	Measured	Max Value	Limit	
	Range	Freq (MHz)	(dBc)	≤ (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

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



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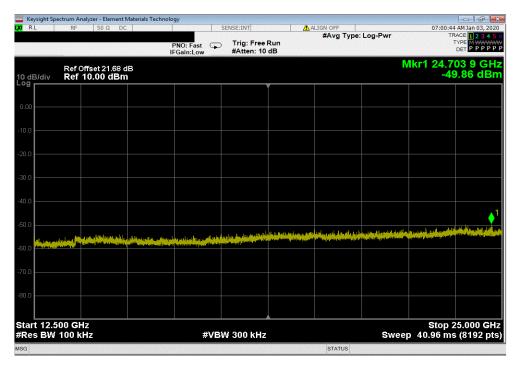


BLE/GFSK (1 Mbps) Low Channel, 2402 MHz

Frequency Measured Max Value Limit

Range Freq (MHz) (dBc) ≤ (dBc) Result

12.5 GHz - 25 GHz 24703.94 -48.3 -20 Pass



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



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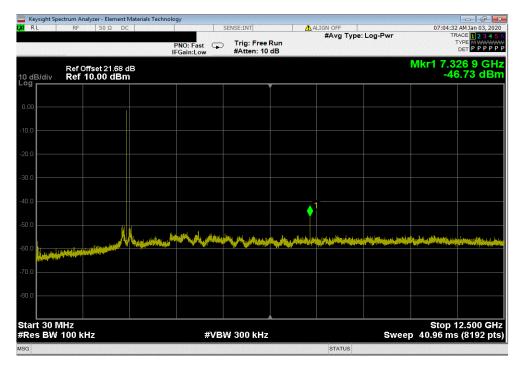


BLE/GFSK (1 Mbps) Mid Channel, 2442 MHz

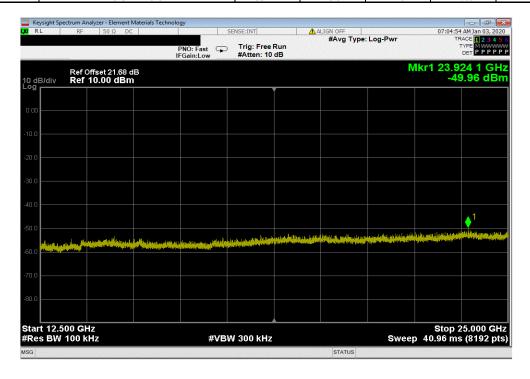
Frequency Measured Max Value Limit

Range Freq (MHz) (dBc) ≤ (dBc) Result

30 MHz - 12.5 GHz 7326.88 -45.38 -20 Pass



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



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 BLE/GFSK (1 Mbps) High Channel, 2480 MHz

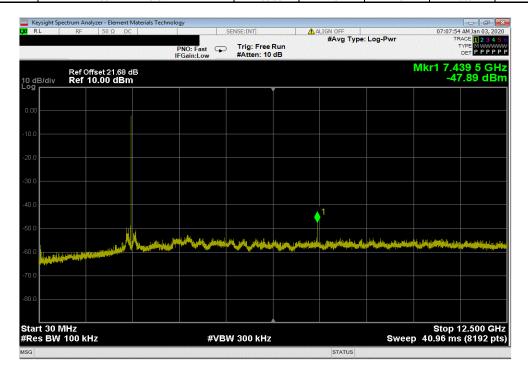
 Frequency
 Measured
 Max Value
 Limit

 Range
 Freq (MHz)
 (dBc)
 ≤ (dBc)
 Result

 Fundamental
 2479.82
 N/A
 N/A
 N/A



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



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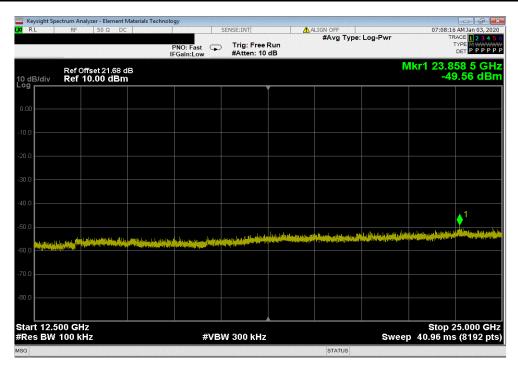


 BLE/GFSK (1 Mbps) High Channel, 2480 MHz

 Frequency
 Measured
 Max Value
 Limit

 Range
 Freq (MHz)
 (dBc)
 ≤ (dBc)
 Result

 12.5 GHz - 25 GHz
 23858.5
 -47.67
 -20
 Pass



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