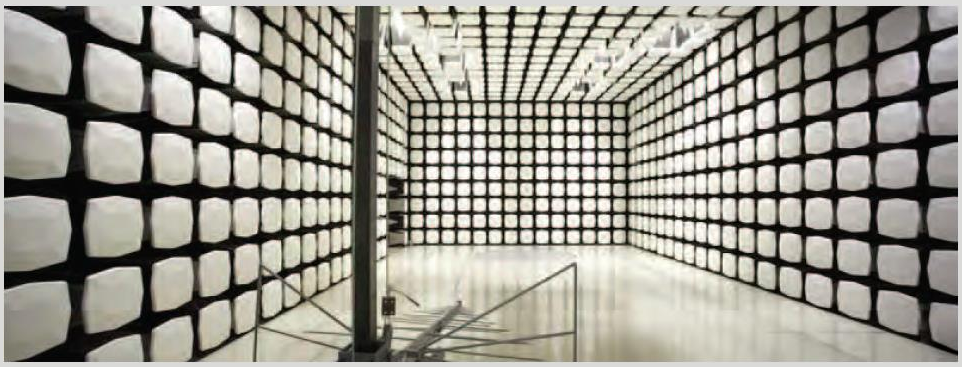
Quext

Radio Thermostat

FCC 15.247:2022
ZigBee Transceiver

Report: F3EN0068.3 Rev. 1, Issue Date: June 23, 2022



CERT #3310.03

CERTIFICATE OF TEST

Last Date of Test: April 25, 2022
Quext
EUT: Radio Thermostat

Radio Equipment Testing

Standards

Specification	Method
FCC 15.247:2022	ANSI C63.10:2013, KDB 558074

Results

Method Clause	Test Description	Applied	Results	Comments
6.2	Powerline Conducted Emissions (Transmitter)	Yes	Pass	
6.5, 6.6	Spurious Radiated Emissions	Yes	Pass	
7.5	Duty Cycle	Yes	Pass	
7.8.5	Output Power	Yes	Pass	
7.8.5	Equivalent Isotropic Radiated Power	Yes	Pass	
7.8.6	Band Edge Compliance	Yes	Pass	
7.8.7	Occupied Bandwidth	Yes	Pass	
7.8.8	Spurious Conducted Emissions	Yes	Pass	
11.10.2	Power Spectral Density	Yes	Pass	

Deviations From Test Standards

None

Approved By:

James E Morris

James Morris, Operations Manager

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

REVISION HISTORY

Revision Number	Description	Date (yyyy-mm-dd)	Page Number
01	Corrected date for item 2	2022-06-23	14
	Added values in MU table	2022-06-23	15
	Corrected configurations numbers	2022-06-23	15-19
	Added Ch Freq and modulation type. Used comment "The EUT was tested using the maximum power settings provided by the manufacturer:"	2022-06-23	11
	Updated to the new test description	2022-06-23	41

ACCREDITATIONS AND AUTHORIZATIONS

element
2021.09.01

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 - Each laboratory is accredited by A2LA to ISO / IEC 17025, and as a product certifier to ISO / IEC 17065 which allows Element to certify transmitters to FCC and IC specifications.

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 – Recognized as an EU Notified Body validated for the EMCD and RED Directives.

United Kingdom

BEIS – Recognized by the UK as an Approved Body under the UK Radio Equipment and UK EMC Regulations.

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

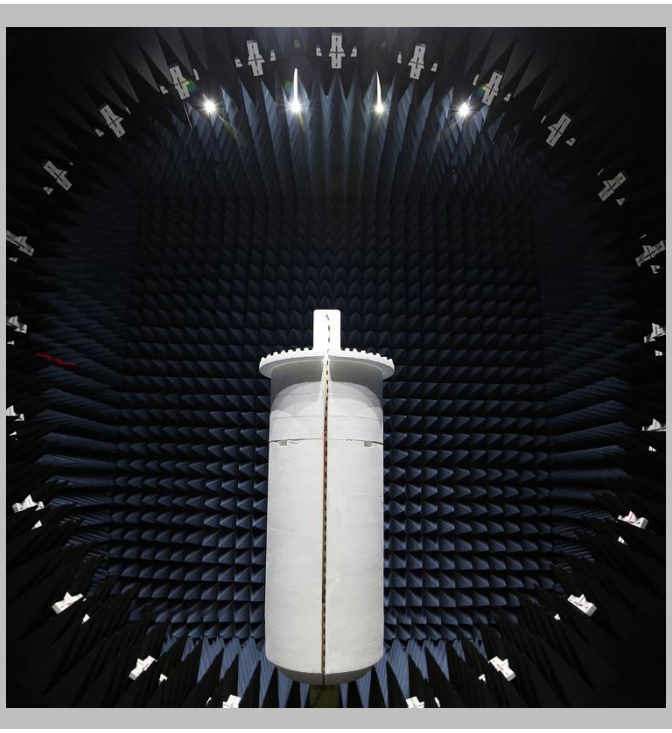
For details on the Scopes of our Accreditations, please visit:

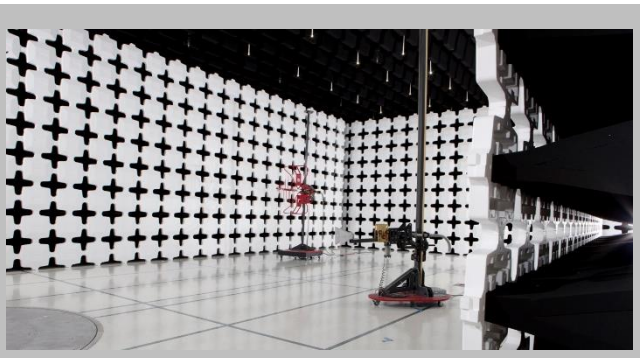
California Minnesota Oregon Texas Washington

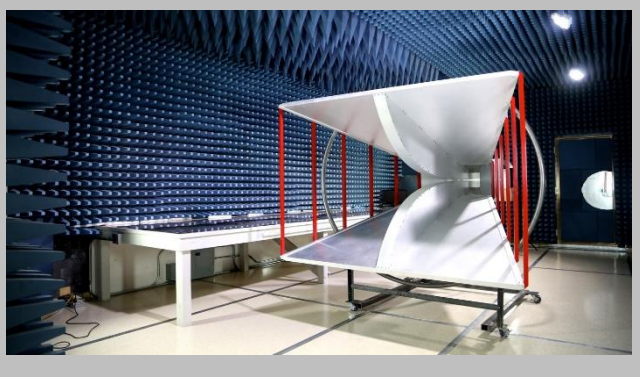
FACILITIES

element
2020.12.15

California	Minnesota	Oregon	Texas	Washington
Labs OC01-17 41 Tesla Irvine, CA 92618 (949) 861-8918	Labs MN01-11 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
A2LA				
Lab Code: 3310.04	Lab Code: 3310.05	Lab Code: 3310.02	Lab Code: 3310.03	Lab Code: 3310.06
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 in the table below. A lab specific value may also be found in the applicable test description section. 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)	5.1 dB	-5.1 dB
AC Powerline Conducted Emissions (dB)	3.1 dB	-3.1 dB

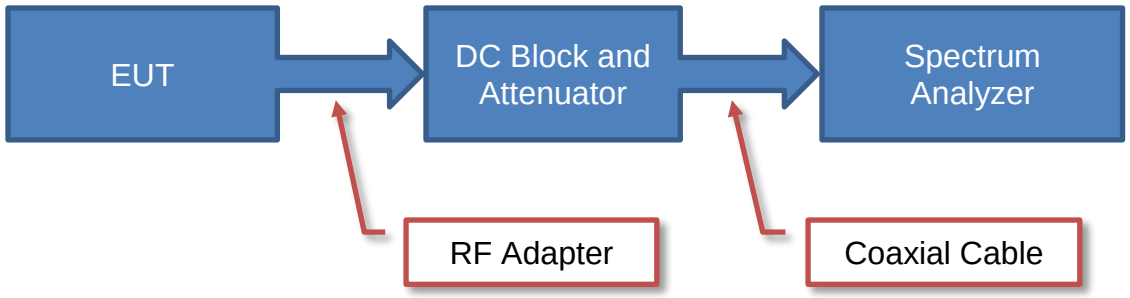
TEST SETUP BLOCK DIAGRAMS

Measurement Bandwidths

Frequency Range (MHz)	Peak Data (kHz)	Quasi-Peak Data (kHz)	Average Data (kHz)
0.01 - 0.15	1.0	0.2	0.2
0.15 - 30.0	10.0	9.0	9.0
30.0 - 1000	100.0	120.0	120.0
Above 1000	1000.0	N/A	1000.0

Unless otherwise stated, measurements were made using the bandwidths and detectors specified. No video filter was used.

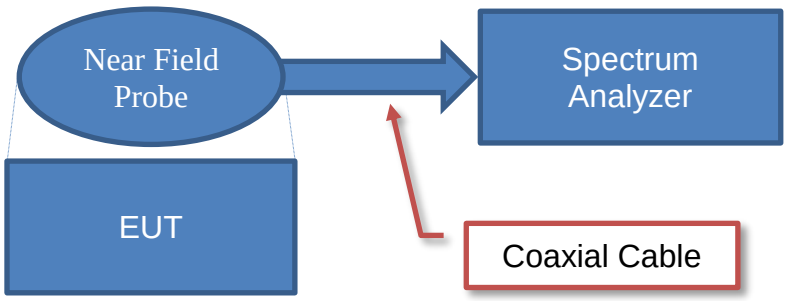
Antenna Port Conducted Measurements



Sample Calculation (logarithmic units)

Measured Value		Measured Level		Reference Level Offset
71.2	=	42.6	+	28.6

Near Field Test Fixture Measurements

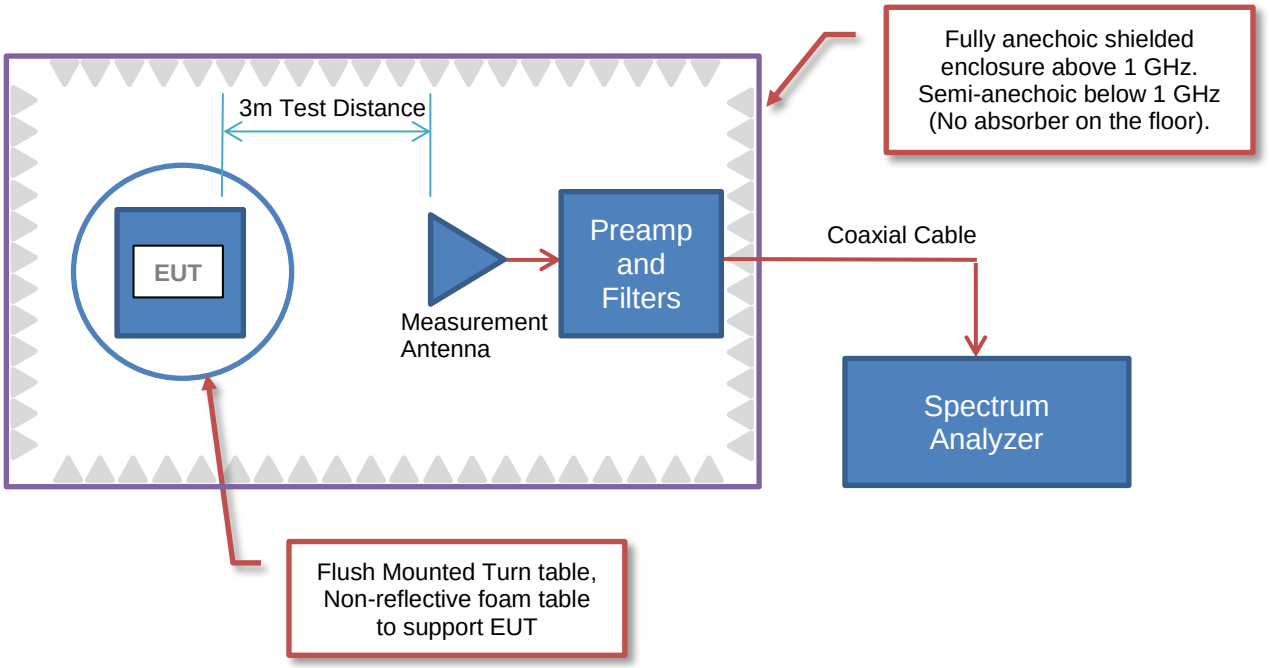


Sample Calculation (logarithmic units)

Measured Value		Measured Level		Reference Level Offset
71.2	=	42.6	+	28.6

TEST SETUP BLOCK DIAGRAMS

Emissions Measurements



Sample Calculation (logarithmic units)

Radiated Emissions:

Measured Level (Amplitude)		Factor: Antenna Factor		Factor: Cable Factor		Factor: Amplifier Gain		Distance Adjustment Factor		External Attenuation		Field Strength
42.6	+	28.6	+	3.1	-	40.8	+	0.0	+	0.0	=	**33.5**

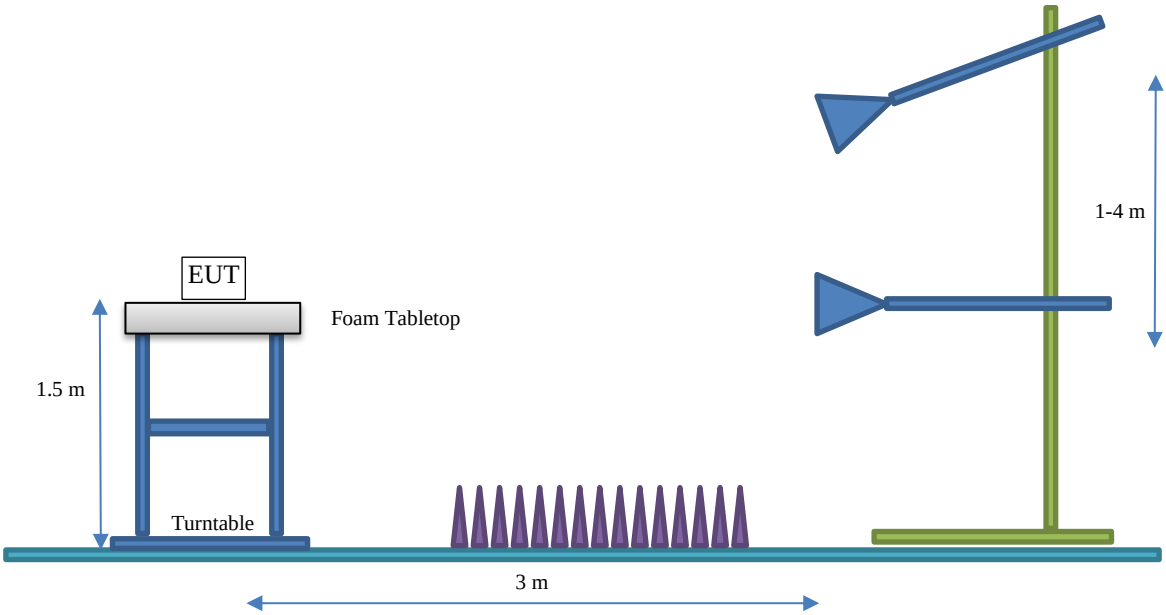
Conducted Emissions:

Measured Level (Amplitude)		Factor: Transducer Factor		Factor: Cable Factor		External Attenuation		Adjusted Level
26.7	+	0.3	+	0.1	+	20.0	=	**47.1**

TEST SETUP BLOCK DIAGRAMS

Bore Sighting (>1GHz)

The diameter of the illumination area is the dimension of the line tangent to the EUT formed by 3 dB beamwidth of the measurement antenna at the measurement distance. At a 3 meter test distance, the diameter of the illumination area was 3.8 meters at 1 GHz and greater than 2.1 meters up to 6 GHz. Above 1 GHz, when required by the measurement standard, the antenna is pointed for both azimuth and elevation to maintain the receive antenna within the cone of radiation from the EUT. The specified measurement detectors were used for comparison of the emissions to the peak and average specification limits.



PRODUCT DESCRIPTION

Client and Equipment Under Test (EUT) Information

Company Name:	Quext
Address:	5214 68th St, Ste 201
City, State, Zip:	Luboock, TX 79424
Test Requested By:	Tray Johnson
EUT:	Radio Thermostat
First Date of Test:	April 21, 2022
Last Date of Test:	April 25, 2022
Receipt Date of Samples:	December 3, 2021
Equipment Design Stage:	Production
Equipment Condition:	No Damage
Purchase Authorization:	Verified

Information Provided by the Party Requesting the Test

Functional Description of the EUT:
This is a physically and radio-controlled thermostat. It contains a LoRa radio (500kHz DTS and 125kHz Hybrid), a Z-wave radio and a Bluetooth Low Energy/Zigbee radio. The Bluetooth and Zigbee radio technologies share one antenna type and one antenna port.

Testing Objective:
To demonstrate compliance under FCC 15.247:2022 for operation in the 2.4 GHz band.

POWER SETTINGS AND ANTENNAS

The power settings, antenna gain value(s) and cable loss (if applicable) used for the testing contained in this report were provided by the customer and will affect the validity of the results. Element assumes no responsibility for the accuracy of this information.

ANTENNA GAIN (dBi)

Type	Provided by:	Frequency Range (MHz)	Gain (dBi)
Surface mount Ceramic Chip	Unictron Technologies Corp.	2400 - 2500	-0.3

The EUT was tested using the maximum power settings provided by the manufacturer:

SETTINGS FOR ALL TESTS IN THIS REPORT

Radio Type	Modulation Type	Position	Frequency (MHz)	Power Setting
802.15.4 Zigbee (DTS)	DSSS	Low Channel	2405	0
		Mid Channel	2440	1
		High Channel	2480	4

CONFIGURATIONS

Configuration F3EN0120- 1

Software/Firmware Running During Test	
Description	**Version**
Tera Term	1.0.0.26

EUT			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
Radio Thermostat	Quext	Quext 1	DUT1

Peripherals in Test Setup Boundary			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
AC/AC Transformer	None	None	None
AC/DC Adapter (Laptop)	Lenovo	SK90200325	None
Laptop	Lenovo	T450	None
Mouse (Laptop)	Logitech	810-004116	1829HS0566P8

Cables					
Cable Type	**Shield**	**Length (m)**	**Ferrite**	**Connection 1**	**Connection 2**
AC Cable	No	1.5m	No	AC/DC Adaptor (Laptop)	AC Mains
120VAC Cable	No	1.0m	No	AC/AC Transformer	AC Mains
24VAC Cable	No	1.4m	No	Radio Thermostat	AC/AC Transformer
DC Cable	Yes	2.1m	No	Laptop	AC/DC Adapter (Laptop)
USB Mouse Cable	Yes	1.5m	No	Mouse	Laptop
USB to IO Cable	No	1.2m	No	Radio Thermostat	Laptop

CONFIGURATIONS

Configuration F3EN0120- 2

Software/Firmware Running During Test	
Description	**Version**
Tera Term	1.0.0.26

EUT			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
Radio Thermostat	Quext	Quext 1	DUT11

Peripherals in Test Setup Boundary			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
AC/AC Transformer	None	None	None

Cables					
Cable Type	**Shield**	**Length (m)**	**Ferrite**	**Connection 1**	**Connection 2**
120VAC Cable	No	1.0m	No	AC/AC Transformer	AC Mains
24VAC Cable	No	1.4m	No	Radio Thermostat	AC/AC Transformer

MODIFICATIONS

Equipment Modifications

Item	Date	Test	Modification	Note	Disposition of EUT
1	2022-04-21	Spurious Radiated Emissions	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
2	2022-04-24	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	2022-04-24	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.
4	2022-04-24	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.
5	2022-04-24	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.
6	2022-04-24	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.
7	2022-04-24	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.
8	2022-04-25	Powerline Conducted 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.2021.09.21.0
EmiR5 2022.03.10.0
PSA-ESCI 2022.1.12.0

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	Gauss Instruments	TDEMI 30M	ARL	2022-03-28	2023-03-28
Power Source/Analyzer	Hewlett Packard	6841A	THC	NCR	NCR
Cable - Conducted Cable Assembly	Northwest EMC	TXA, HFC, TQU	TXAA	2022-01-24	2023-01-24
LISN	Solar Electronics	9252-50-R-24-BNC	LJK	2021-08-06	2022-08-06

MEASUREMENT UNCERTAINTY

Description		
Expanded k=2	+ 3.1	- 3.1

CONFIGURATIONS INVESTIGATED

F3EN0120-2

MODES INVESTIGATED

Thermostat On, ZigBee: Mid Ch 18 (2440 MHz)

POWERLINE CONDUCTED EMISSIONS

element
WTD.2021.09.21.0
EmiR5 2022.03.10.0
PSA-ESCI 2022.1.12.0

EUT:	Radio Thermostat	Work Order:	F3EN0120
Serial Number:	DUT11	Date:	2022-04-25
Customer:	Quext	Temperature:	20.9°C
Attendees:	None	Relative Humidity:	49%
Customer Project:	None	Bar. Pressure (PMSL):	1026 mb
Tested By:	Mark Baytan	Job Site:	TX01
Power:	110VAC/60Hz	Configuration:	F3EN0120-2

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.247:2022	ANSI C63.10:2013

TEST PARAMETERS

Run #:	2	Line:	High Line	Add. Ext. Attenuation (dB):	0

COMMENTS

None

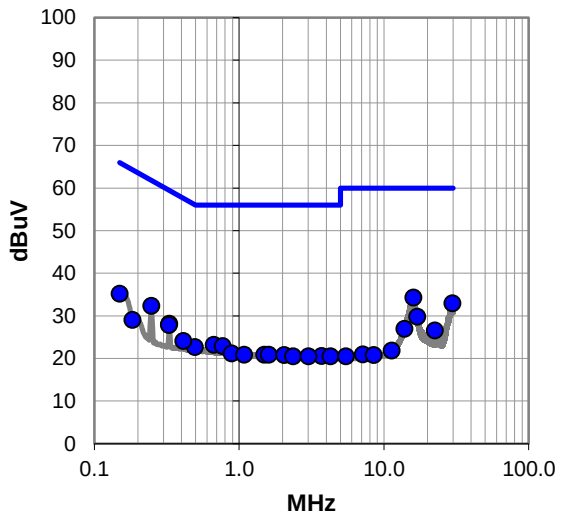
EUT OPERATING MODES

Thermostat On, ZigBee: Mid Ch 18 (2440 MHz)

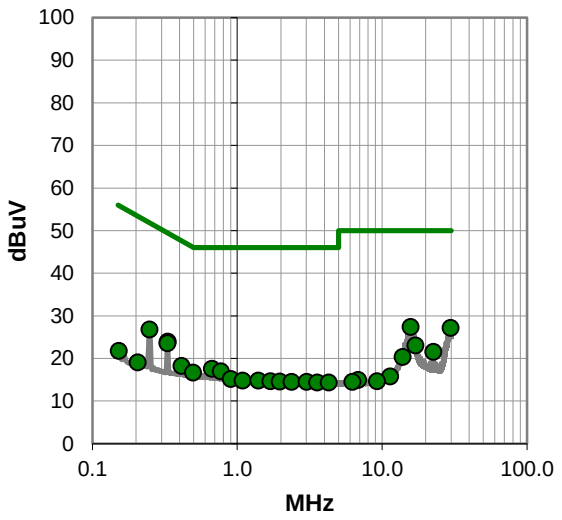
DEVIATIONS FROM TEST STANDARD

None

Quasi Peak Data - vs - Quasi Peak Limit



Average Data - vs - Average Limit



POWERLINE CONDUCTED EMISSIONS

element
WTD.2021.09.21.0
EmiR5 2022.03.10.0
PSA-ESCI 2022.1.12.0

RESULTS - Run #2

Quasi Peak Data - vs - Quasi Peak Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
15.973	13.2	21.1	34.3	60.0	-25.7
29.696	10.5	22.5	33.0	60.0	-27.0
0.248	11.8	20.6	32.4	61.8	-29.4
16.966	8.6	21.2	29.8	60.0	-30.2
0.150	14.6	20.6	35.2	66.0	-30.8
0.330	7.9	20.3	28.2	59.5	-31.3
0.329	7.6	20.3	27.9	59.5	-31.6
0.667	3.0	20.2	23.2	56.0	-32.8
13.885	6.1	20.9	27.0	60.0	-33.0
0.769	2.7	20.2	22.9	56.0	-33.1
22.527	4.9	21.7	26.6	60.0	-33.4
0.495	2.5	20.2	22.7	56.1	-33.4
0.412	3.8	20.3	24.1	57.6	-33.5
0.887	1.0	20.2	21.2	56.0	-34.8
1.084	0.9	20.0	20.9	56.0	-35.1
1.490	0.7	20.2	20.9	56.0	-35.1
1.606	0.7	20.2	20.9	56.0	-35.1
0.184	8.5	20.6	29.1	64.3	-35.2
2.044	0.6	20.2	20.8	56.0	-35.2
3.719	0.4	20.2	20.6	56.0	-35.4
2.365	0.3	20.2	20.5	56.0	-35.5
3.006	0.3	20.2	20.5	56.0	-35.5
4.277	0.3	20.2	20.5	56.0	-35.5
11.322	1.2	20.7	21.9	60.0	-38.1
7.170	0.7	20.3	21.0	60.0	-39.0

Average Data - vs - Average Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
15.744	6.4	21.0	27.4	50.0	-22.6
29.696	4.7	22.5	27.2	50.0	-22.8
0.248	6.2	20.6	26.8	51.8	-25.0
0.330	3.7	20.3	24.0	49.5	-25.5
0.329	3.3	20.3	23.6	49.5	-25.9
16.966	1.9	21.2	23.1	50.0	-26.9
0.666	-2.6	20.2	17.6	46.0	-28.4
22.527	-0.1	21.7	21.6	50.0	-28.4
0.769	-3.2	20.2	17.0	46.0	-29.0
0.412	-2.0	20.3	18.3	47.6	-29.3
0.495	-3.5	20.2	16.7	46.1	-29.4
13.881	-0.5	20.9	20.4	50.0	-29.6
0.899	-5.0	20.2	15.2	46.0	-30.8
1.085	-5.2	20.0	14.8	46.0	-31.2
1.397	-5.4	20.2	14.8	46.0	-31.2
1.690	-5.5	20.2	14.7	46.0	-31.3
1.963	-5.6	20.2	14.6	46.0	-31.4
2.373	-5.7	20.2	14.5	46.0	-31.5
3.006	-5.7	20.2	14.5	46.0	-31.5
3.559	-5.8	20.2	14.4	46.0	-31.6
4.274	-5.8	20.2	14.4	46.0	-31.6
0.152	1.2	20.6	21.8	55.9	-34.1
11.381	-4.9	20.7	15.8	50.0	-34.2
0.205	-1.5	20.6	19.1	53.4	-34.3
6.816	-5.2	20.2	15.0	50.0	-35.0

CONCLUSION

Pass

Tested By

POWERLINE CONDUCTED EMISSIONS

element
WTD.2021.09.21.0
EmiR5 2022.03.10.0
PSA-ESCI 2022.1.12.0

EUT:	Radio Thermostat	Work Order:	F3EN0120
Serial Number:	DUT11	Date:	2022-04-25
Customer:	Quext	Temperature:	20.9°C
Attendees:	None	Relative Humidity:	49%
Customer Project:	None	Bar. Pressure (PMSL):	1026 mb
Tested By:	Mark Baytan	Job Site:	TX01
Power:	110VAC/60Hz	Configuration:	F3EN0120-2

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.247:2022	ANSI C63.10:2013

TEST PARAMETERS

Run #:	3	Line:	Neutral	Add. Ext. Attenuation (dB):	0

COMMENTS

None

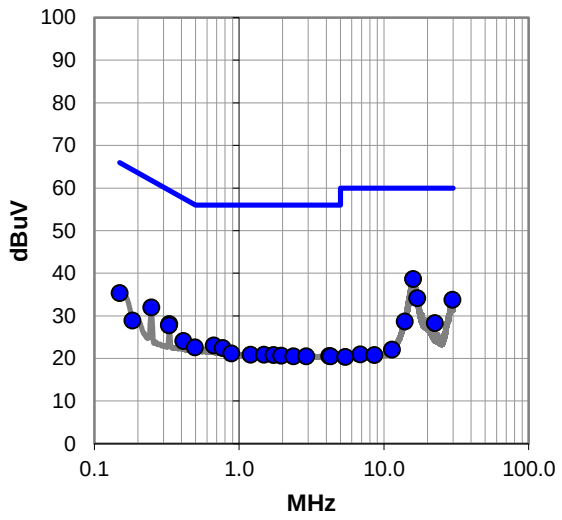
EUT OPERATING MODES

Thermostat On, ZigBee: Mid Ch 18 (2440 MHz)

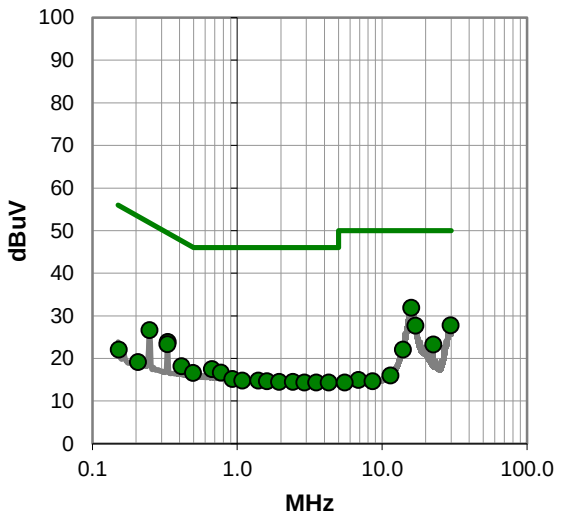
DEVIATIONS FROM TEST STANDARD

None

Quasi Peak Data - vs - Quasi Peak Limit



Average Data - vs - Average Limit



POWERLINE CONDUCTED EMISSIONS

element
WTD.2021.09.21.0
EmiR5 2022.03.10.0
PSA-ESCI 2022.1.12.0

RESULTS - Run #3

Quasi Peak Data - vs - Quasi Peak Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
15.918	17.6	21.1	38.7	60.0	-21.3
16.966	13.0	21.2	34.2	60.0	-25.8
29.696	11.3	22.5	33.8	60.0	-26.2
0.248	11.4	20.6	32.0	61.8	-29.8
0.150	14.8	20.6	35.4	66.0	-30.6
13.904	7.8	20.9	28.7	60.0	-31.3
0.330	7.8	20.3	28.1	59.5	-31.4
0.329	7.5	20.3	27.8	59.5	-31.7
22.527	6.6	21.7	28.3	60.0	-31.7
0.667	2.9	20.2	23.1	56.0	-32.9
0.412	3.8	20.3	24.1	57.6	-33.5
0.495	2.4	20.2	22.6	56.1	-33.5
0.769	2.3	20.2	22.5	56.0	-33.5
0.885	1.0	20.2	21.2	56.0	-34.8
1.200	0.9	20.0	20.9	56.0	-35.1
1.488	0.7	20.2	20.9	56.0	-35.1
1.729	0.6	20.2	20.8	56.0	-35.2
1.957	0.5	20.2	20.7	56.0	-35.3
0.184	8.3	20.6	28.9	64.3	-35.4
4.201	0.4	20.2	20.6	56.0	-35.4
2.367	0.3	20.2	20.5	56.0	-35.5
2.904	0.3	20.2	20.5	56.0	-35.5
4.273	0.3	20.2	20.5	56.0	-35.5
11.365	1.4	20.7	22.1	60.0	-37.9
6.876	0.8	20.2	21.0	60.0	-39.0

Average Data - vs - Average Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
15.899	10.8	21.1	31.9	50.0	-18.1
29.696	5.3	22.5	27.8	50.0	-22.2
16.966	6.5	21.2	27.7	50.0	-22.3
0.248	6.1	20.6	26.7	51.8	-25.1
0.330	3.6	20.3	23.9	49.5	-25.6
0.329	3.1	20.3	23.4	49.5	-26.1
22.527	1.6	21.7	23.3	50.0	-26.7
13.913	1.2	20.9	22.1	50.0	-27.9
0.666	-2.7	20.2	17.5	46.0	-28.5
0.769	-3.5	20.2	16.7	46.0	-29.3
0.412	-2.1	20.3	18.2	47.6	-29.4
0.495	-3.6	20.2	16.6	46.1	-29.5
0.925	-5.0	20.2	15.2	46.0	-30.8
1.082	-5.2	20.0	14.8	46.0	-31.2
1.397	-5.4	20.2	14.8	46.0	-31.2
1.603	-5.5	20.2	14.7	46.0	-31.3
1.943	-5.7	20.2	14.5	46.0	-31.5
2.419	-5.7	20.2	14.5	46.0	-31.5
2.900	-5.8	20.2	14.4	46.0	-31.6
3.508	-5.8	20.2	14.4	46.0	-31.6
4.273	-5.8	20.2	14.4	46.0	-31.6
0.152	1.5	20.6	22.1	55.9	-33.8
11.436	-4.7	20.7	16.0	50.0	-34.0
0.206	-1.4	20.6	19.2	53.3	-34.1
6.876	-5.2	20.2	15.0	50.0	-35.0

CONCLUSION

Pass

Tested By

SPURIOUS RADIATED EMISSIONS

element

PSA-ESCI 2022.1.12.0

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

Thermostat On, ZigBee: Low Ch 11 (2405 MHz), Mid Ch 18 (2440 MHz), High Ch 26 (2480 MHz)

POWER SETTINGS INVESTIGATED

110VAC/60Hz

Battery

CONFIGURATIONS INVESTIGATED

F3EN0120 - 2

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.	Cal. Due
Amplifier - Pre-Amplifier	Miteq	JSDWK42-18004000-60-5P	PAM	2021-09-15	2022-09-15
Cable	Northwest EMC	18-40GHz	TXE	2021-09-13	2022-09-13
Antenna - Double Ridge	A.H. Systems, Inc.	SAS-574	AXW	2020-09-02	2022-09-02
Amplifier - Pre-Amplifier	Miteq	AMF-6F-12001800-30-10P	PAL	2021-09-13	2022-09-13
Antenna - Standard Gain	ETS Lindgren	3160-08	AJG	NCR	NCR
Amplifier - Pre-Amplifier	Miteq	AMF-6F-08001200-30-10P	PAK	2021-09-13	2022-09-13
Cable	Northwest EMC	8-18GHz	TXD	2022-04-12	2023-04-12
Antenna - Standard Gain	ETS Lindgren	3160-07	AJF	NCR	NCR
Amplifier - Pre-Amplifier	Miteq	AMF-3D-00100800-32-13P	PAJ	2022-04-19	2023-04-19
Cable	Northwest EMC	1-8.2 GHz	TXC	2022-04-19	2023-04-19
Antenna - Double Ridge	ETS Lindgren	3115	AJL	2020-10-20	2022-10-20
Filter - High Pass	Micro-Tronics	HPM50111	HGC	2022-02-23	2023-02-23
Attenuator	Weinschel Corp	4H-20	AWB	2022-02-23	2023-02-23
Filter - Low Pass	Micro-Tronics	LPM50004	HHV	2021-07-27	2022-07-27
Amplifier - Pre-Amplifier	Fairview Microwave	FMAM63001	PAS	2022-04-19	2023-04-19
Cable	Northwest EMC	RE 9kHz - 1GHz	TXB	2022-04-19	2023-04-19
Antenna - Biconilog	ETS Lindgren	3143B	AYF	2020-06-25	2022-06-25
Analyzer - Spectrum Analyzer	Agilent	N9010A	AFL	2022-03-22	2023-03-22

MEASUREMENT BANDWIDTHS

Frequency Range (MHz)	Peak Data (kHz)	Quasi-Peak Data (kHz)	Average Data (kHz)
0.01 - 0.15	1.0	0.2	0.2
0.15 - 30.0	10.0	9.0	9.0
30.0 - 1000	100.0	120.0	120.0
Above 1000	1000.0	N/A	1000.0

SPURIOUS RADIATED EMISSIONS

PSA-ESCI 2022.1.12.0

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 within 2 MHz of the allowable band may have been taken using the integration method from ANSI C63.10 clause 11.13.3. This procedure uses the channel power feature of the spectrum analyzer to integrate the power of the emission within a 1 MHz bandwidth.

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(1/dc).

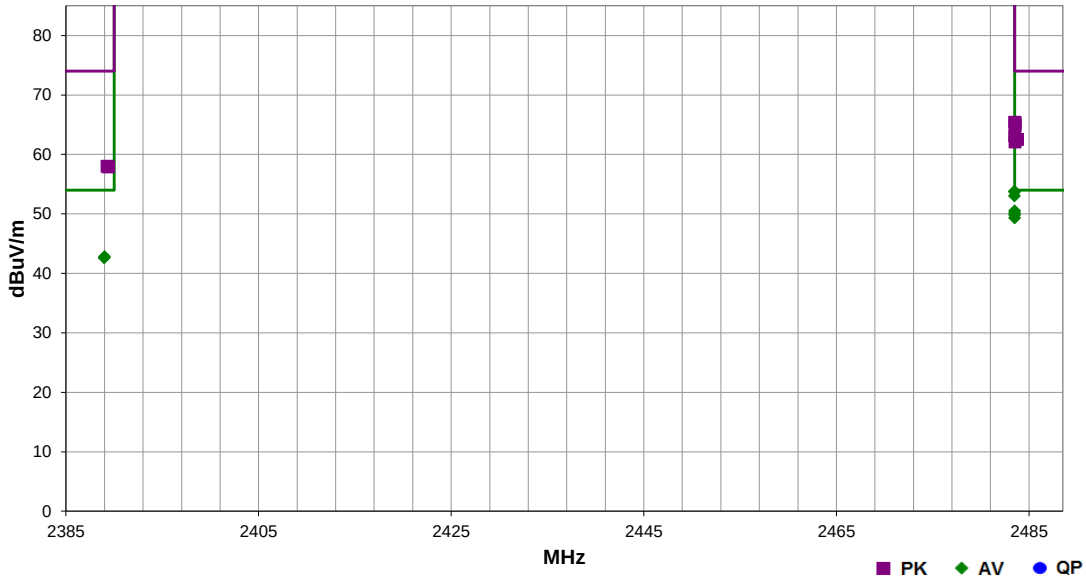
SPURIOUS RADIATED EMISSIONS

EmiR5 2022.03.10.0 PSA-ESCI 2022.1.12.0

Work Order:	F3EN0120	**Date:**	2022-04-24		
Project:	None	**Temperature:**	24.4 °C		
Job Site:	TX02	**Humidity:**	52.6% RH		
Serial Number:	DUT11	**Barometric Pres.:**	1015 mbar	**Tested by:**	Mark Baytan
EUT:	Radio Thermostat				
Configuration:	2				
Customer:	Quext				
Attendees:	None				
EUT Power:	See Comments				
Operating Mode:	Thermostat On, ZigBee: Low Ch 11 (2405 MHz), High Ch 26 (2480 MHz)				
Deviations:	None				
Comments:	The client provided real world protocol limited duty cycle in any 100 mSec period evaluates to be 10*LOG10(42.6/100) = -3.7 dB. The EUT was operating at 100% duty cycle during testing.				

Test Specifications	**Test Method**
FCC 15.247:2022	ANSI C63.10:2013

Run #	19	**Test Distance (m)**	3	**Antenna Height(s)**	1 to 4(m)	**Results**	Pass



Freq (MHz)	Amplitude (dBuV)	Factor (dB/m)	Antenna Height (meters)	Azimuth (degrees)	Duty Cycle Correction Factor (dB)	External Attenuation (dB)	Polarity/ Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)	Comments
2483.500	43.5	-6.0	3.2	147.0	-3.7	20.0	Horz	AV	0.0	53.8	54.0	-0.2	High Ch, EUT Horz, 110V/60Hz, Pwr=4
2483.503	43.4	-6.0	3.7	284.0	-3.7	20.0	Horz	AV	0.0	53.7	54.0	-0.3	High Ch, EUT Horz, Battery, Pwr=4
2483.500	42.7	-6.0	3.0	188.0	-3.7	20.0	Horz	AV	0.0	53.0	54.0	-1.0	High Ch, EUT on Side, 110V/60Hz, Pwr=4
2483.503	40.2	-6.0	2.9	262.9	-3.7	20.0	Vert	AV	0.0	50.5	54.0	-3.5	High Ch, EUT Vert, 110V/60Hz, Pwr=4
2483.503	39.8	-6.0	2.9	302.0	-3.7	20.0	Vert	AV	0.0	50.1	54.0	-3.9	High Ch, EUT on Side, 110V/60Hz, Pwr=4
2483.513	39.5	-6.0	3.8	252.0	-3.7	20.0	Vert	AV	0.0	49.8	54.0	-4.2	High Ch, EUT Horz, 110V/60Hz, Pwr=4
2483.507	39.0	-6.0	3.3	344.0	-3.7	20.0	Horz	AV	0.0	49.3	54.0	-4.7	High Ch, EUT Vert, 110V/60Hz, Pwr=4
2483.503	51.4	-6.0	3.2	147.0	0.0	20.0	Horz	PK	0.0	65.4	74.0	-8.6	High Ch, EUT Horz, 110V/60Hz, Pwr=4
2483.567	51.3	-6.0	3.7	284.0	0.0	20.0	Horz	PK	0.0	65.3	74.0	-8.7	High Ch, EUT Horz, Battery, Pwr=4
2483.570	50.9	-6.0	3.0	188.0	0.0	20.0	Horz	PK	0.0	64.9	74.0	-9.1	High Ch, EUT on Side, 110V/60Hz, Pwr=4
2483.510	49.1	-6.0	2.9	262.9	0.0	20.0	Vert	PK	0.0	63.1	74.0	-10.9	High Ch, EUT Vert, 110V/60Hz, Pwr=4
2389.007	32.8	-6.3	3.1	86.0	-3.7	20.0	Horz	AV	0.0	42.8	54.0	-11.2	Low Ch, EUT Horz, 110V/60Hz, Pwr=0
2483.607	48.6	-6.0	3.8	252.0	0.0	20.0	Vert	PK	0.0	62.6	74.0	-11.4	High Ch, EUT Horz, 110V/60Hz, Pwr=4
2388.963	32.6	-6.3	2.4	194.0	-3.7	20.0	Vert	AV	0.0	42.6	54.0	-11.4	Low Ch, EUT Horz, 110V/60Hz, Pwr=0
2483.810	48.5	-6.0	2.9	302.0	0.0	20.0	Vert	PK	0.0	62.5	74.0	-11.5	High Ch, EUT on Side, 110V/60Hz, Pwr=4
2483.550	48.1	-6.0	3.3	344.0	0.0	20.0	Horz	PK	0.0	62.1	74.0	-11.9	High Ch, EUT Vert, 110V/60Hz, Pwr=4
2389.257	44.3	-6.3	2.4	194.0	0.0	20.0	Vert	PK	0.0	58.0	74.0	-16.0	Low Ch, EUT Horz, 110V/60Hz, Pwr=0
2389.427	44.2	-6.3	3.1	86.0	0.0	20.0	Horz	PK	0.0	57.9	74.0	-16.1	Low Ch, EUT Horz, 110V/60Hz, Pwr=0

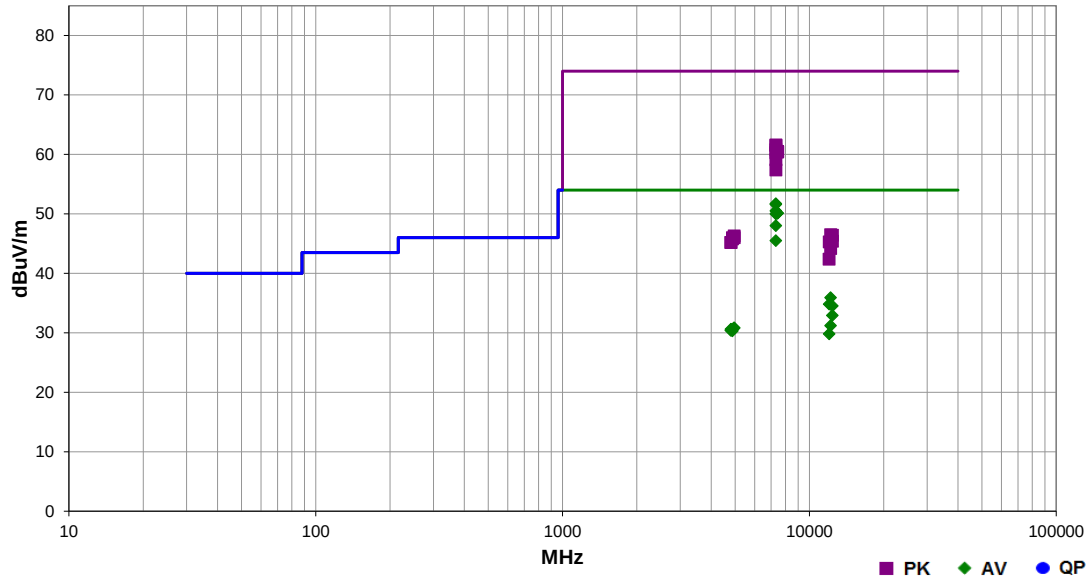
SPURIOUS RADIATED EMISSIONS

EmiR5 2022.03.10.0 PSA-ESCI 2022.1.12.0

Work Order:	F3EN0120	**Date:**	2022-04-21		
Project:	None	**Temperature:**	22 °C		
Job Site:	TX02	**Humidity:**	52.4% RH		
Serial Number:	DUT11	**Barometric Pres.:**	1020 mbar	**Tested by:**	Mark Baytan
EUT:	Radio Thermostat				
Configuration:	2				
Customer:	Quext				
Attendees:	None				
EUT Power:	110VAC/60Hz				
Operating Mode:	Thermostat On, ZigBee: Low Ch 11 (2405 MHz), Mid Ch 18 (2440 MHz), High Ch 26 (2480 MHz)				
Deviations:	None				
Comments:	The client provided real world protocol limited duty cycle in any 100 mSec period evaluates to be 10*LOG10(42.6/100) = -3.7 dB. The EUT was operating at 100% duty cycle during testing.				

Test Specifications	**Test Method**
FCC 15.247:2022	ANSI C63.10:2013

Run #	14	**Test Distance (m)**	3	**Antenna Height(s)**	1 to 4(m)	**Results**	Pass



Freq (MHz)	Amplitude (dBuV)	Factor (dB/m)	Antenna Height (meters)	Azimuth (degrees)	Duty Cycle Correction Factor (dB)	External Attenuation (dB)	Polarity/ Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)	Comments
7321.383	44.1	11.3	1.6	290.0	-3.7	0.0	Horz	AV	0.0	51.7	54.0	-2.3	Mid Ch, EUT on Side, 110V/60Hz, Pwr=1
7321.483	44.0	11.3	1.8	31.0	-3.7	0.0	Vert	AV	0.0	51.6	54.0	-2.4	Mid Ch, EUT Horz, 110V/60Hz, Pwr=1
7321.467	42.9	11.3	3.4	202.9	-3.7	0.0	Vert	AV	0.0	50.5	54.0	-3.5	Mid Ch, EUT Vert, 110V/60Hz, Pwr=1
7438.675	42.4	11.4	1.6	24.0	-3.7	0.0	Vert	AV	0.0	50.1	54.0	-3.9	High Ch, EUT Horz, 110V/60Hz, Pwr=4
7438.633	42.4	11.4	1.5	285.9	-3.7	0.0	Horz	AV	0.0	50.1	54.0	-3.9	High Ch, EUT on Side, 110V/60Hz, Pwr=4
7321.458	42.4	11.3	2.8	171.0	-3.7	0.0	Horz	AV	0.0	50.0	54.0	-4.0	Mid Ch, EUT Vert, 110V/60Hz, Pwr=1
7321.467	40.4	11.3	1.5	352.9	-3.7	0.0	Horz	AV	0.0	48.0	54.0	-6.0	Mid Ch, EUT Horz, 110V/60Hz, Pwr=1
7321.417	37.9	11.3	1.5	277.0	-3.7	0.0	Vert	AV	0.0	45.5	54.0	-8.5	Mid Ch, EUT on Side, 110V/60Hz, Pwr=1
7321.533	50.3	11.3	1.8	31.0	0.0	0.0	Vert	PK	0.0	61.6	74.0	-12.4	Mid Ch, EUT Horz, 110V/60Hz, Pwr=1
7318.658	50.2	11.3	1.6	290.0	0.0	0.0	Horz	PK	0.0	61.5	74.0	-12.5	Mid Ch, EUT on Side, 110V/60Hz, Pwr=1
7321.467	49.5	11.3	3.4	202.9	0.0	0.0	Vert	PK	0.0	60.8	74.0	-13.2	Mid Ch, EUT Vert, 110V/60Hz, Pwr=1
7438.533	49.1	11.4	1.6	24.0	0.0	0.0	Vert	PK	0.0	60.5	74.0	-13.5	High Ch, EUT Horz, 110V/60Hz, Pwr=4
7438.467	49.0	11.4	1.5	285.9	0.0	0.0	Horz	PK	0.0	60.4	74.0	-13.6	High Ch, EUT on Side, 110V/60Hz, Pwr=4
7321.450	49.0	11.3	2.8	171.0	0.0	0.0	Horz	PK	0.0	60.3	74.0	-13.7	Mid Ch, EUT Vert, 110V/60Hz, Pwr=1
7321.583	47.8	11.3	1.5	352.9	0.0	0.0	Horz	PK	0.0	59.1	74.0	-14.9	Mid Ch, EUT Horz, 110V/60Hz, Pwr=1
7318.717	46.1	11.3	1.5	277.0	0.0	0.0	Vert	PK	0.0	57.4	74.0	-16.6	Mid Ch, EUT on Side, 110V/60Hz, Pwr=1
12197.690	43.1	-3.5	1.4	220.9	-3.7	0.0	Horz	AV	0.0	35.9	54.0	-18.1	Mid Ch, EUT on Side, 110V/60Hz, Pwr=1
12027.520	43.0	-4.5	1.5	247.0	-3.7	0.0	Horz	AV	0.0	34.8	54.0	-19.2	Low Ch, EUT on Side, 110V/60Hz, Pwr=0
12397.650	41.2	-3.0	2.1	271.0	-3.7	0.0	Horz	AV	0.0	34.5	54.0	-19.5	High Ch, EUT on Side, 110V/60Hz, Pwr=4
12397.720	39.6	-3.0	3.4	200.0	-3.7	0.0	Vert	AV	0.0	32.9	54.0	-21.1	High Ch, EUT Horz, 110V/60Hz, Pwr=4
12197.750	38.4	-3.5	1.3	187.0	-3.7	0.0	Vert	AV	0.0	31.2	54.0	-22.8	Mid Ch, EUT Horz, 110V/60Hz, Pwr=1
4961.025	29.5	5.0	1.5	62.0	-3.7	0.0	Vert	AV	0.0	30.8	54.0	-23.2	High Ch, EUT Horz, 110V/60Hz, Pwr=4
4960.842	29.5	5.0	1.5	295.0	-3.7	0.0	Horz	AV	0.0	30.8	54.0	-23.2	High Ch, EUT on Side, 110V/60Hz, Pwr=4
4879.175	29.3	5.0	1.5	334.9	-3.7	0.0	Vert	AV	0.0	30.6	54.0	-23.4	Mid Ch, EUT Horz, 110V/60Hz, Pwr=1
4811.058	29.1	5.2	3.5	246.0	-3.7	0.0	Vert	AV	0.0	30.6	54.0	-23.4	Low Ch, EUT Horz, 110V/60Hz, Pwr=0
4807.658	28.9	5.2	1.5	42.0	-3.7	0.0	Horz	AV	0.0	30.4	54.0	-23.6	Low Ch, EUT on Side, 110V/60Hz, Pwr=0
4878.775	29.0	5.0	1.5	314.0	-3.7	0.0	Horz	AV	0.0	30.3	54.0	-23.7	Mid Ch, EUT on Side, 110V/60Hz, Pwr=1

Freq (MHz)	Amplitude (dBuV)	Factor (dB/m)	Antenna Height (meters)	Azimuth (degrees)	Duty Cycle Correction Factor (dB)	External Attenuation (dB)	Polarity/ Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)	Comments
12027.530	38.0	-4.5	1.5	192.0	-3.7	0.0	Vert	AV	0.0	29.8	54.0	-24.2	Low Ch, EUT Horz, 110V/60Hz, Pwr=0
12197.680	50.0	-3.5	1.4	220.9	0.0	0.0	Horz	PK	0.0	46.5	74.0	-27.5	Mid Ch, EUT on Side, 110V/60Hz, Pwr=1
12397.830	49.4	-3.0	2.1	271.0	0.0	0.0	Horz	PK	0.0	46.4	74.0	-27.6	High Ch, EUT on Side, 110V/60Hz, Pwr=4
4958.842	41.3	5.0	1.5	295.0	0.0	0.0	Horz	PK	0.0	46.3	74.0	-27.7	High Ch, EUT on Side, 110V/60Hz, Pwr=4
4879.667	41.0	5.0	1.5	334.9	0.0	0.0	Vert	PK	0.0	46.0	74.0	-28.0	Mid Ch, EUT Horz, 110V/60Hz, Pwr=1
4959.525	41.0	5.0	1.5	62.0	0.0	0.0	Vert	PK	0.0	46.0	74.0	-28.0	High Ch, EUT Horz, 110V/60Hz, Pwr=4
4879.850	40.8	5.0	1.5	314.0	0.0	0.0	Horz	PK	0.0	45.8	74.0	-28.2	Mid Ch, EUT on Side, 110V/60Hz, Pwr=1
12397.490	48.4	-3.0	3.4	200.0	0.0	0.0	Vert	PK	0.0	45.4	74.0	-28.6	High Ch, EUT Horz, 110V/60Hz, Pwr=4
12027.410	49.8	-4.5	1.5	247.0	0.0	0.0	Horz	PK	0.0	45.3	74.0	-28.7	Low Ch, EUT on Side, 110V/60Hz, Pwr=0
4811.425	40.0	5.2	1.5	42.0	0.0	0.0	Horz	PK	0.0	45.2	74.0	-28.8	Low Ch, EUT on Side, 110V/60Hz, Pwr=0
4808.667	40.0	5.2	3.5	246.0	0.0	0.0	Vert	PK	0.0	45.2	74.0	-28.8	Low Ch, EUT Horz, 110V/60Hz, Pwr=0
12202.450	47.6	-3.4	1.3	187.0	0.0	0.0	Vert	PK	0.0	44.2	74.0	-29.8	Mid Ch, EUT Horz, 110V/60Hz, Pwr=1
12022.700	46.9	-4.5	1.5	192.0	0.0	0.0	Vert	PK	0.0	42.4	74.0	-31.6	Low Ch, EUT Horz, 110V/60Hz, Pwr=1

DUTY CYCLE

TEST DESCRIPTION

The Duty Cycle (x) were measured for each of the EUT operating modes. The measurements were made using a zero span on the spectrum analyzer to see the pulses in the time domain. The transmit power was set to its default maximum.

The duty cycle was calculated by dividing the transmission pulse duration (T) by the total period of a single on and total off time.

The EUT operates at 100% Duty Cycle.

OUTPUT POWER

XMit 2022.02.07.0

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

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	N5173B	TIW	2020-07-17	2023-07-17
Cable	UtiFlex Micro-Coax	UFD1150A-1-0720-200200	TXK	2021-09-13	2022-09-13
Attenuator	Fairview Microwave	SA4018-20	TYE	2021-09-15	2022-09-15
Block - DC	Fairview Microwave	SD3239	ANE	2022-03-02	2023-03-02
Analyzer - Spectrum Analyzer	Agilent	E4440A	AFD	2021-08-25	2022-08-25

TEST DESCRIPTION

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

TbtTx 2021.12.14.1 XMit 2022.02.07.0

EUT:	**Radio Thermostat**			**Work Order:**	**F3EN0120**
Serial Number:	**DUT1**			**Date:**	**24-Apr-22**
Customer:	**Quext**			**Temperature:**	**21.3 °C**
Attendees:	**None**			**Humidity:**	**51.1% RH**
Project:	**None**			**Barometric Pres.:**	**1013 mbar**
Tested by:	**Mark Baytan**	**Power:**	**110VAC/60Hz**	**Job Site:**	**TX09**

TEST SPECIFICATIONS	**Test Method**
FCC 15.247:2022	**ANSI C63.10:2013**

COMMENTS

None

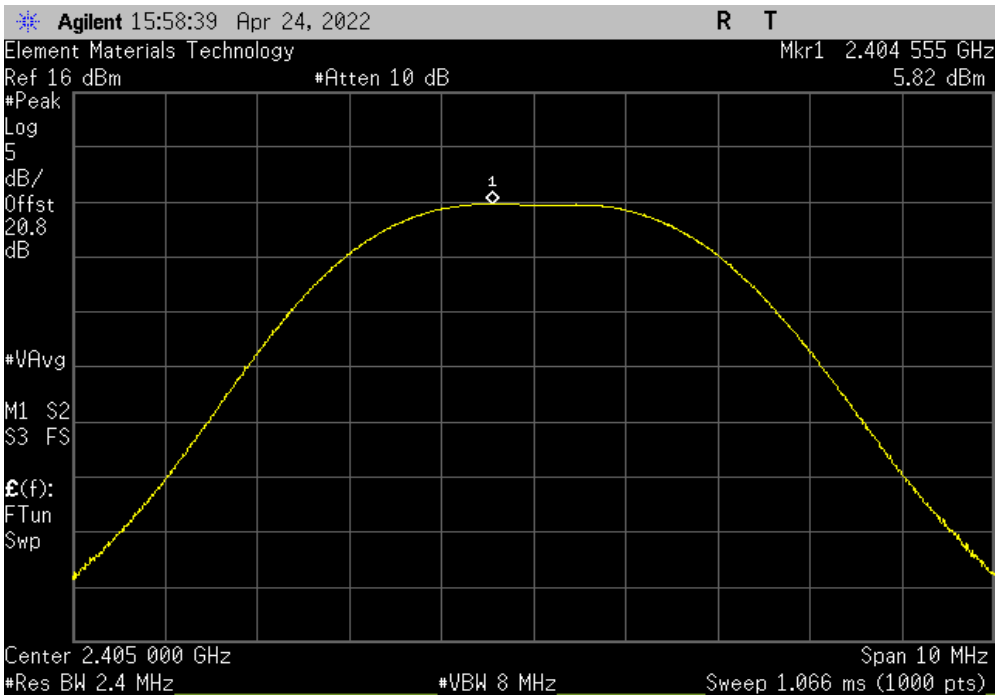
DEVIATIONS FROM TEST STANDARD

None

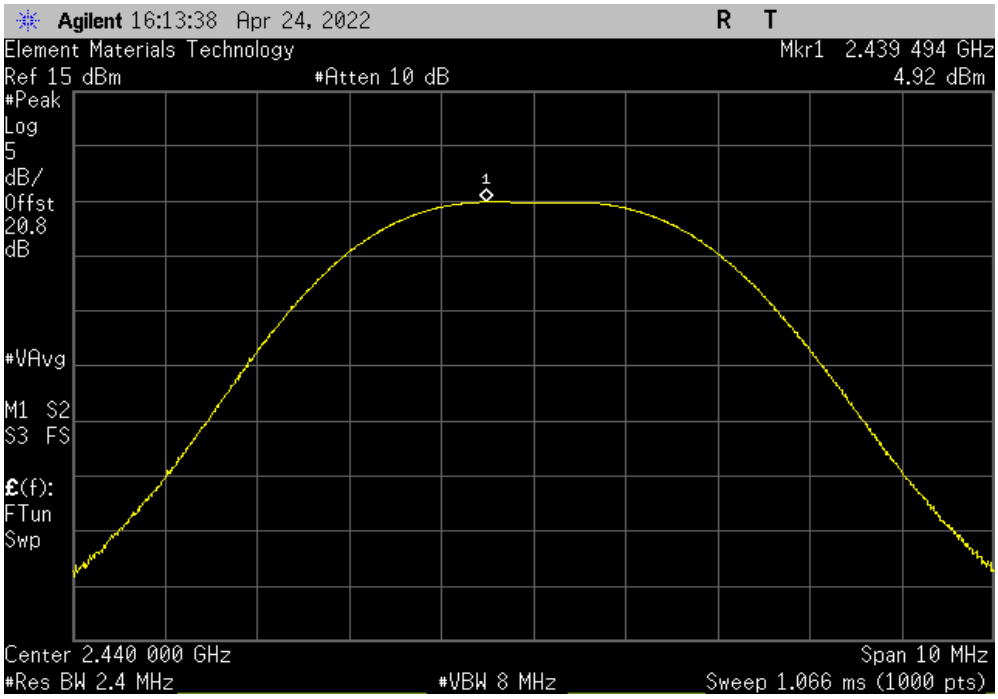
Configuration #	**1**	*Signature*

	Out Pwr (dBm)	**Limit (dBm)**	**Result**
802.15.4 ZigBee			
Low Channel, 2405 MHz	5.816	30	Pass
Mid Channel, 2440 MHz	4.917	30	Pass
High Channel, 2480 MHz	-0.059	30	Pass

802.15.4 ZigBee, Low Channel, 2405 MHz						
				Out Pwr (dBm)	Limit (dBm)	Result
				5.816	30	Pass

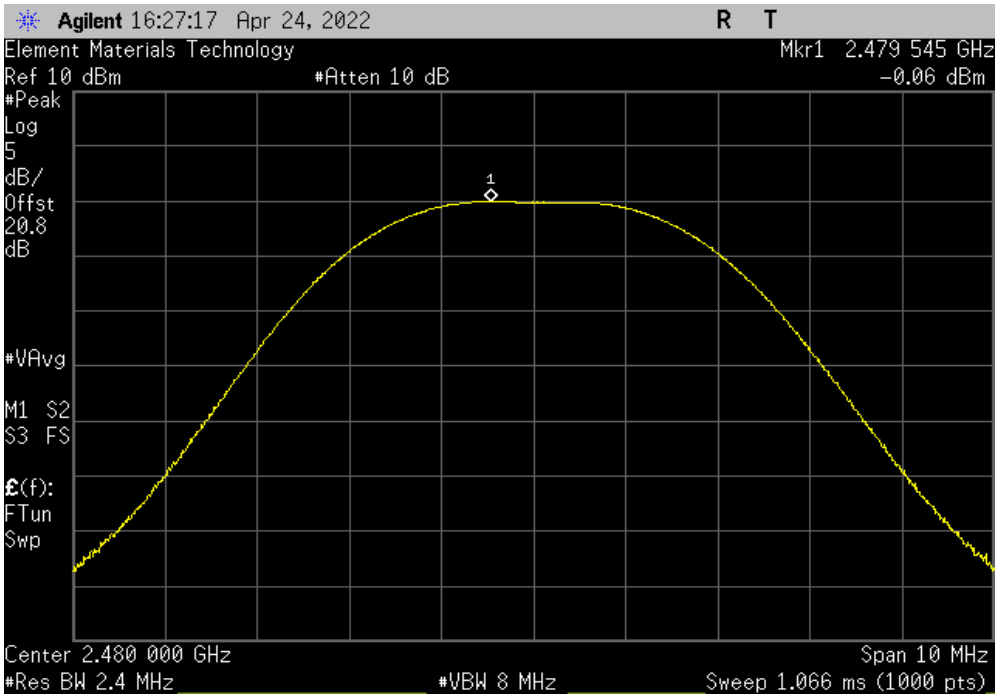


802.15.4 ZigBee, Mid Channel, 2440 MHz						
				Out Pwr (dBm)	Limit (dBm)	Result
				4.917	30	Pass



OUTPUT POWER

802.15.4 ZigBee, High Channel, 2480 MHz						
				Out Pwr (dBm)	Limit (dBm)	Result
				-0.059	30	Pass



EQUIVALENT ISOTROPIC RADIATED POWER (EIRP)

XMit 2022.02.07.0

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

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	N5173B	TIW	2020-07-17	2023-07-17
Cable	UtiFlex Micro-Coax	UFD1150A-1-0720-200200	TXK	2021-09-13	2022-09-13
Attenuator	Fairview Microwave	SA4018-20	TYE	2021-09-15	2022-09-15
Block - DC	Fairview Microwave	SD3239	ANE	2022-03-02	2023-03-02
Analyzer - Spectrum Analyzer	Agilent	E4440A	AFD	2021-08-25	2022-08-25

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.

Equivalent Isotropic Radiated Power (EIRP) = Max Measured Power + Antenna gain (dBi)

EQUIVALENT ISOTROPIC RADIATED POWER (EIRP)

TbtTx 2021.12.14.1 XMit 2022.02.07.0

EUT:	Radio Thermostat			**Work Order:**	F3EN0120
Serial Number:	DUT1			**Date:**	24-Apr-22
Customer:	Quext			**Temperature:**	21.3 °C
Attendees:	None			**Humidity:**	51.1% RH
Project:	None			**Barometric Pres.:**	1013 mbar
Tested by:	Mark Baytan	**Power:**	110VAC/60Hz	**Job Site:**	TX09

TEST SPECIFICATIONS	Test Method
FCC 15.247:2022	ANSI C63.10:2013

COMMENTS

None

DEVIATIONS FROM TEST STANDARD

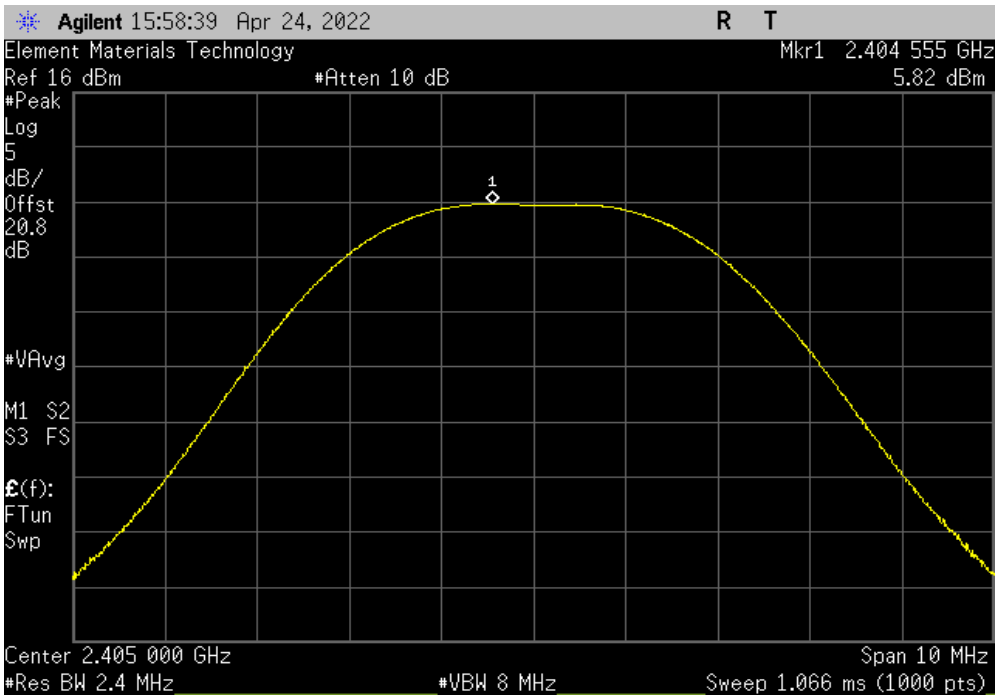
None

Configuration #	1	Signature

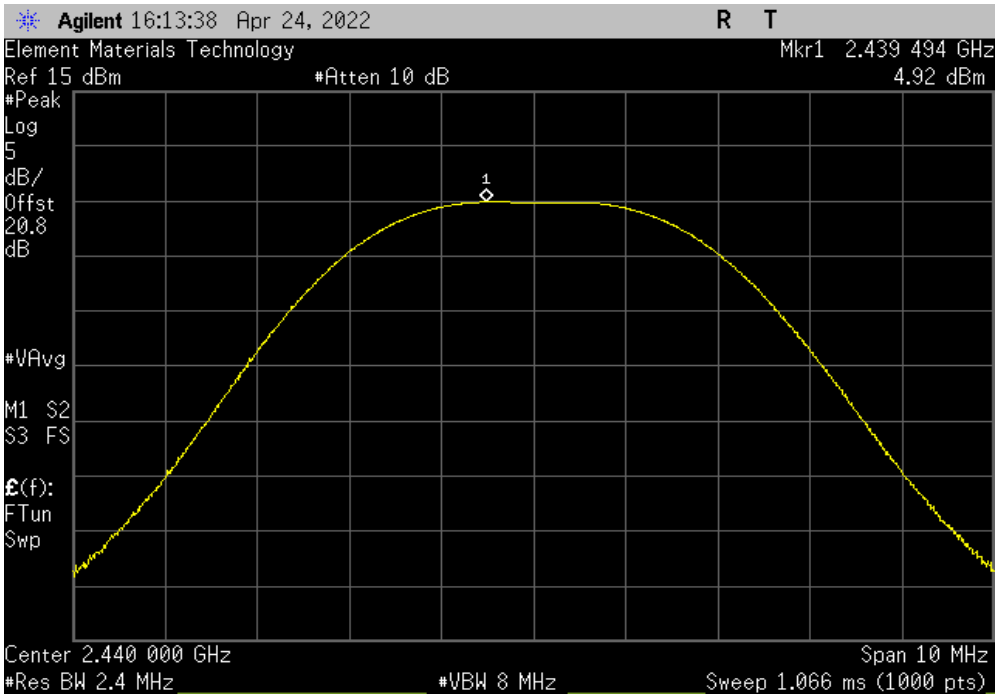
	Out Pwr (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Result
802.15.4 ZigBee					
Low Channel, 2405 MHz	5.816	-0.3	5.516	36	Pass
Mid Channel, 2440 MHz	4.917	-0.3	4.617	36	Pass
High Channel, 2480 MHz	-0.059	-0.3	-0.359	36	Pass

EQUIVALENT ISOTROPIC RADIATED POWER (EIRP)

802.15.4 ZigBee, Low Channel, 2405 MHz						
		Out Pwr (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Result
		5.816	-0.3	5.516	36	Pass

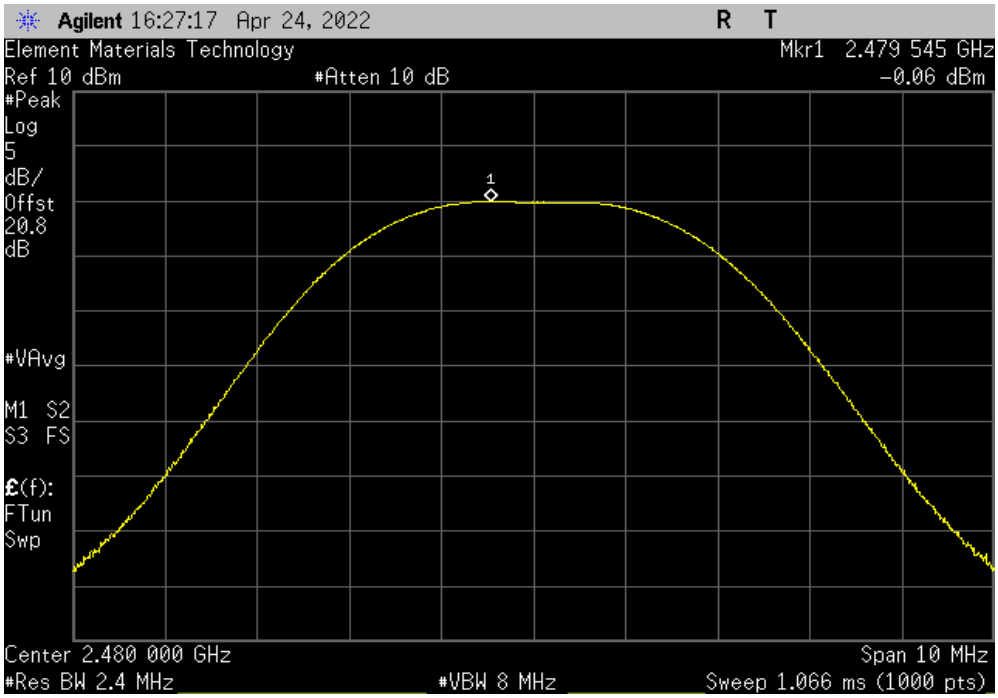


802.15.4 ZigBee, Mid Channel, 2440 MHz						
		Out Pwr (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Result
		4.917	-0.3	4.617	36	Pass



EQUIVALENT ISOTROPIC RADIATED POWER (EIRP)

802.15.4 ZigBee, High Channel, 2480 MHz						
		Out Pwr (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Result
		-0.059	-0.3	-0.359	36	Pass



BAND EDGE COMPLIANCE

XMit 2022.02.07.0

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

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	N5173B	TIW	2020-07-17	2023-07-17
Cable	UtiFlex Micro-Coax	UFD1150A-1-0720-200200	TXK	2021-09-13	2022-09-13
Attenuator	Fairview Microwave	SA4018-20	TYE	2021-09-15	2022-09-15
Block - DC	Fairview Microwave	SD3239	ANE	2022-03-02	2023-03-02
Analyzer - Spectrum Analyzer	Agilent	E4440A	AFD	2021-08-25	2022-08-25

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

TbtTx 2021.12.14.1 XMit 2022.02.07.0

EUT:	**Radio Thermostat**			**Work Order:**	**F3EN0120**
Serial Number:	**DUT1**			**Date:**	**24-Apr-22**
Customer:	**Quext**			**Temperature:**	**21.3 °C**
Attendees:	**None**			**Humidity:**	**51.1% RH**
Project:	**None**			**Barometric Pres.:**	**1013 mbar**
Tested by:	**Mark Baytan**	**Power:**	**110VAC/60Hz**	**Job Site:**	**TX09**

TEST SPECIFICATIONS	**Test Method**
FCC 15.247:2022	**ANSI C63.10:2013**

COMMENTS

None

DEVIATIONS FROM TEST STANDARD

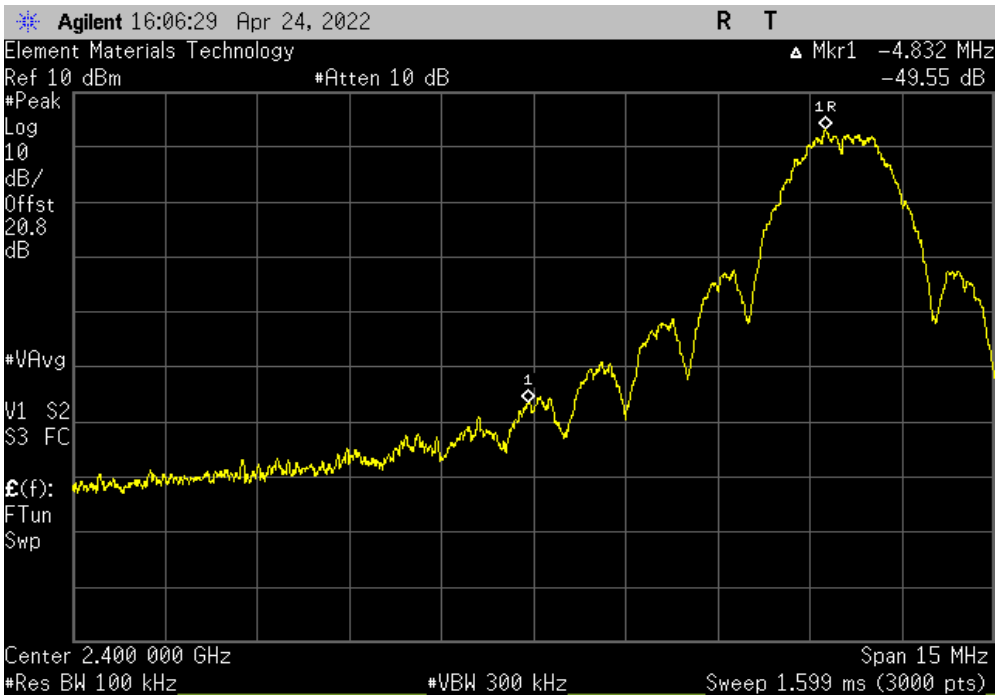
None

Configuration #	**1**	*Signature*

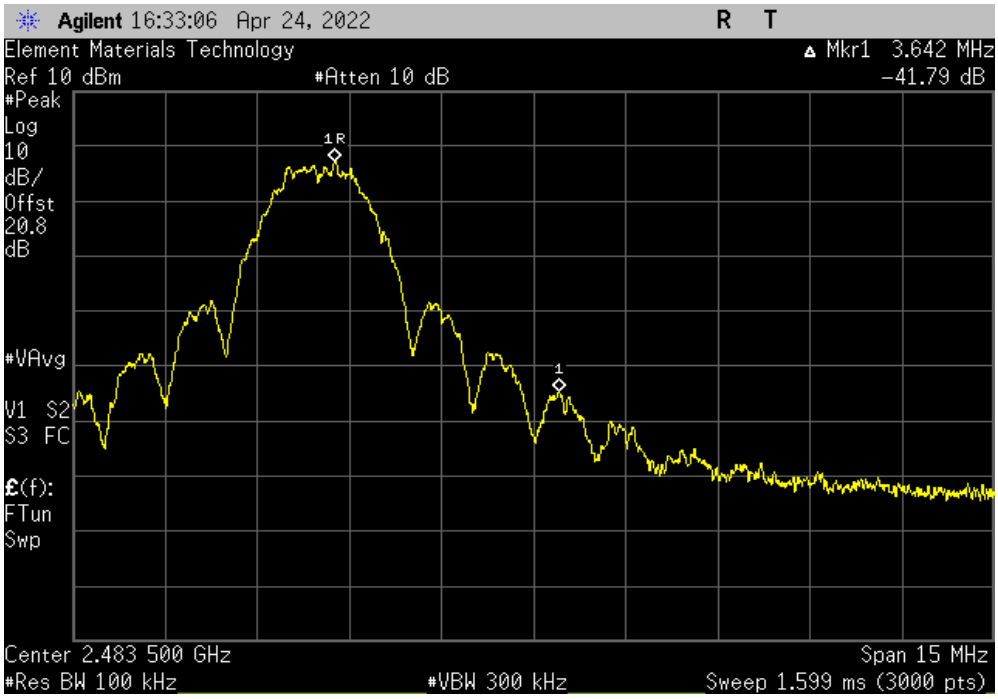
	Value (dBc)	**Limit ≤ (dBc)**	**Result**
802.15.4 ZigBee			
Low Channel, 2405 MHz	-49.55	-20	Pass
High Channel, 2480 MHz	-41.79	-20	Pass

BAND EDGE COMPLIANCE

802.15.4 ZigBee, Low Channel, 2405 MHz						
				Value (dBc)	Limit ≤ (dBc)	Result
				-49.55	-20	Pass



802.15.4 ZigBee, High Channel, 2480 MHz						
				Value (dBc)	Limit ≤ (dBc)	Result
				-41.79	-20	Pass



DTS BANDWIDTH

XMit 2022.02.07.0

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

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	N5173B	TIW	2020-07-17	2023-07-17
Cable	UtiFlex Micro-Coax	UFD1150A-1-0720-200200	TXK	2021-09-13	2022-09-13
Attenuator	Fairview Microwave	SA4018-20	TYE	2021-09-15	2022-09-15
Block - DC	Fairview Microwave	SD3239	ANE	2022-03-02	2023-03-02
Analyzer - Spectrum Analyzer	Agilent	E4440A	AFD	2021-08-25	2022-08-25

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 DTS bandwidth was measured using 100 kHz resolution bandwidth and 300 kHz video bandwidth. The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts.

DTS BANDWIDTH

TbtTx 2021.12.14.1 XMit 2022.02.07.0

EUT:	Radio Thermostat			**Work Order:**	F3EN0120
Serial Number:	DUT1			**Date:**	24-Apr-22
Customer:	Quext			**Temperature:**	21.3 °C
Attendees:	None			**Humidity:**	51.1% RH
Project:	None			**Barometric Pres.:**	1013 mbar
Tested by:	Mark Baytan	**Power:**	110VAC/60Hz	**Job Site:**	TX09

TEST SPECIFICATIONS	Test Method
FCC 15.247:2022	ANSI C63.10:2013

COMMENTS

None

DEVIATIONS FROM TEST STANDARD

None

Configuration #	1	Signature

		Value	Limit (>)	Result
802.15.4 ZigBee				
	Low Channel, 2405 MHz	1.587 MHz	500 kHz	Pass
	Mid Channel, 2440 MHz	1.558 MHz	500 kHz	Pass
	High Channel, 2480 MHz	1.537 MHz	500 kHz	Pass

802.15.4 ZigBee, Low Channel, 2405 MHz						
				Value	Limit (>)	Result
				1.587 MHz	500 kHz	Pass

802.15.4 ZigBee, Mid Channel, 2440 MHz						
				Value	Limit (>)	Result
				1.558 MHz	500 kHz	Pass

802.15.4 ZigBee, High Channel, 2480 MHz

					Value	Limit (>)	Result
					1.537 MHz	500 kHz	Pass

SPURIOUS CONDUCTED EMISSIONS

XMit 2022.02.07.0

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

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	N5173B	TIW	2020-07-17	2023-07-17
Cable	UtiFlex Micro-Coax	UFD1150A-1-0720-200200	TXK	2021-09-13	2022-09-13
Attenuator	Fairview Microwave	SA4018-20	TYE	2021-09-15	2022-09-15
Block - DC	Fairview Microwave	SD3239	ANE	2022-03-02	2023-03-02
Analyzer - Spectrum Analyzer	Agilent	E4440A	AFD	2021-08-25	2022-08-25

TEST DESCRIPTION

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 fundamental was measured with a 100 kHz resolution bandwidth and the highest value was recorded. The rest of the spectrum was then measured with a 100 kHz resolution bandwidth and the highest value was found. The difference between the value found on the fundamental and the rest of the spectrum was compared against the limit to determine compliance.

The reference level offset for the fundamental screen capture was based on a measured value of the loss between the spectrum analyzer and the EUT which was verified at the time of test. The remaining screen capture(s) use an internal transducer factor on the analyzer to correct the displayed trace based on the cable loss over frequency. The reference level offset for the additional screen capture(s) is then based on the expected attenuator value and any other losses.

Fundamental Offset = Ref Lvl Offset showing measured composite factor of all losses

Remaining Screen capture(s) Offset = “Internal” cable loss factor not shown on screen capture + Ref Lvl Offset showing expected attenuator value and any other losses

SPURIOUS CONDUCTED EMISSIONS

TbtTx 2021.12.14.1 XMit 2022.02.07.0

EUT:	**Radio Thermostat**			**Work Order:**	**F3EN0120**
Serial Number:	**DUT1**			**Date:**	**24-Apr-22**
Customer:	**Quext**			**Temperature:**	**21.3 °C**
Attendees:	**None**			**Humidity:**	**51.1% RH**
Project:	**None**			**Barometric Pres.:**	**1013 mbar**
Tested by:	**Mark Baytan**	**Power:**	**110VAC/60Hz**	**Job Site:**	**TX09**

TEST SPECIFICATIONS	**Test Method**
FCC 15.247:2022	**ANSI C63.10:2013**

COMMENTS

None

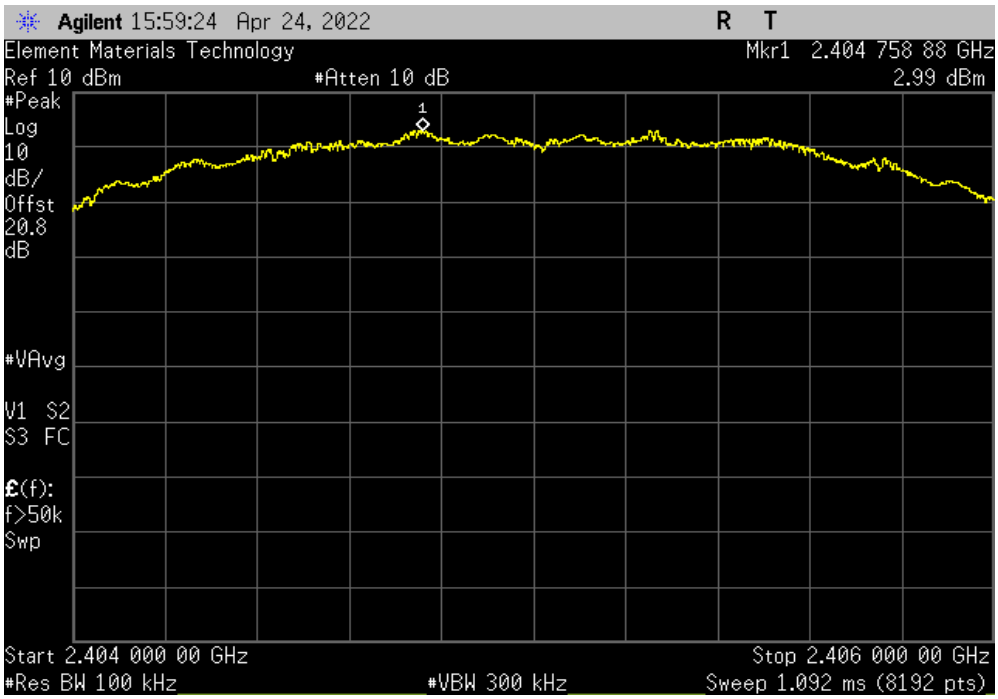
DEVIATIONS FROM TEST STANDARD

None

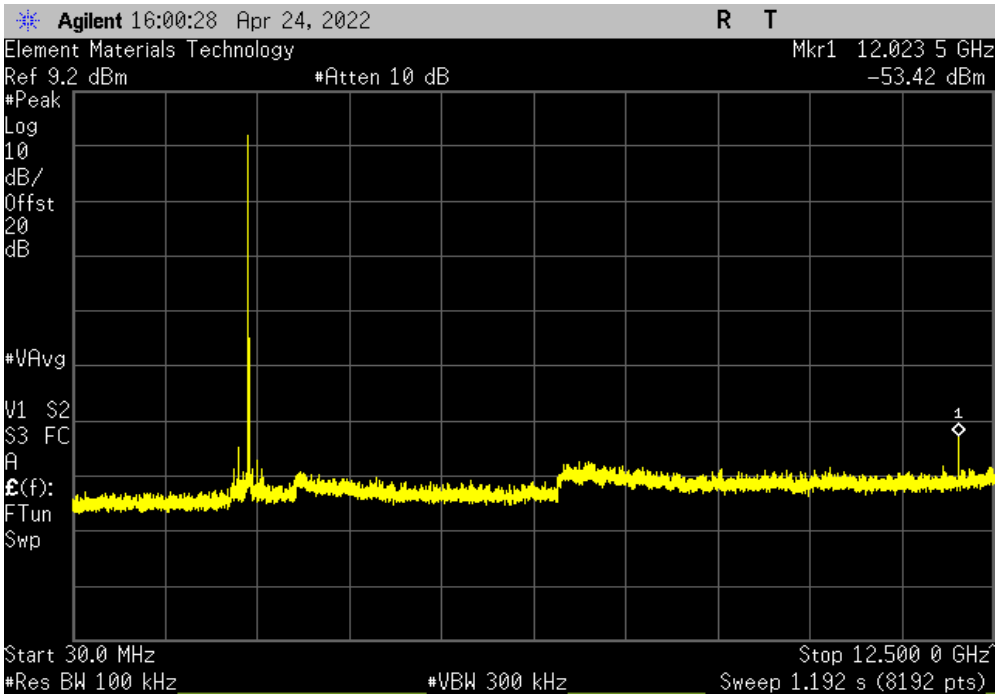
Configuration #	**1**	*Signature*

		Frequency Range	Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
802.15.4 ZigBee						
	Low Channel, 2405 MHz	Fundamental	2404.76	N/A	N/A	N/A
	Low Channel, 2405 MHz	30 MHz - 12.5 GHz	12023.5	-56.41	-20	Pass
	Low Channel, 2405 MHz	12.5 GHz - 25 GHz	13777.3	-57.79	-20	Pass
	Mid Channel, 2440 MHz	Fundamental	2440.28	N/A	N/A	N/A
	Mid Channel, 2440 MHz	30 MHz - 12.5 GHz	12197	-55.76	-20	Pass
	Mid Channel, 2440 MHz	12.5 GHz - 25 GHz	13649.1	-56.05	-20	Pass
	High Channel, 2480 MHz	Fundamental	2480.28	N/A	N/A	N/A
	High Channel, 2480 MHz	30 MHz - 12.5 GHz	7022.4	-54.84	-20	Pass
	High Channel, 2480 MHz	12.5 GHz - 25 GHz	13635.4	-52.29	-20	Pass

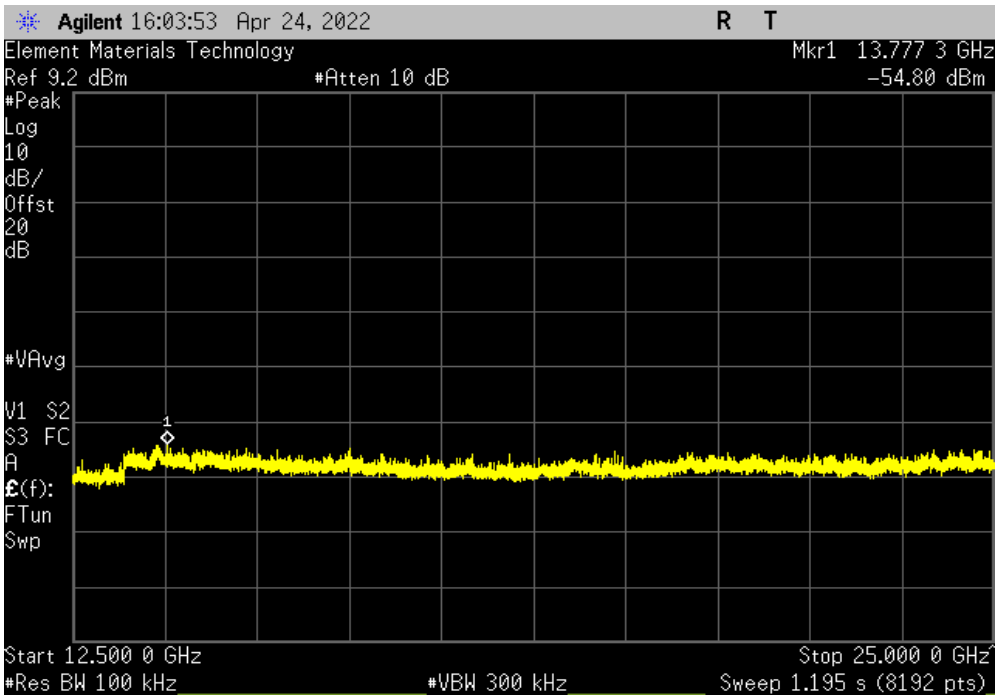
802.15.4 ZigBee, Low Channel, 2405 MHz					
Frequency Range		Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
	Fundamental	2404.76	N/A	N/A	N/A



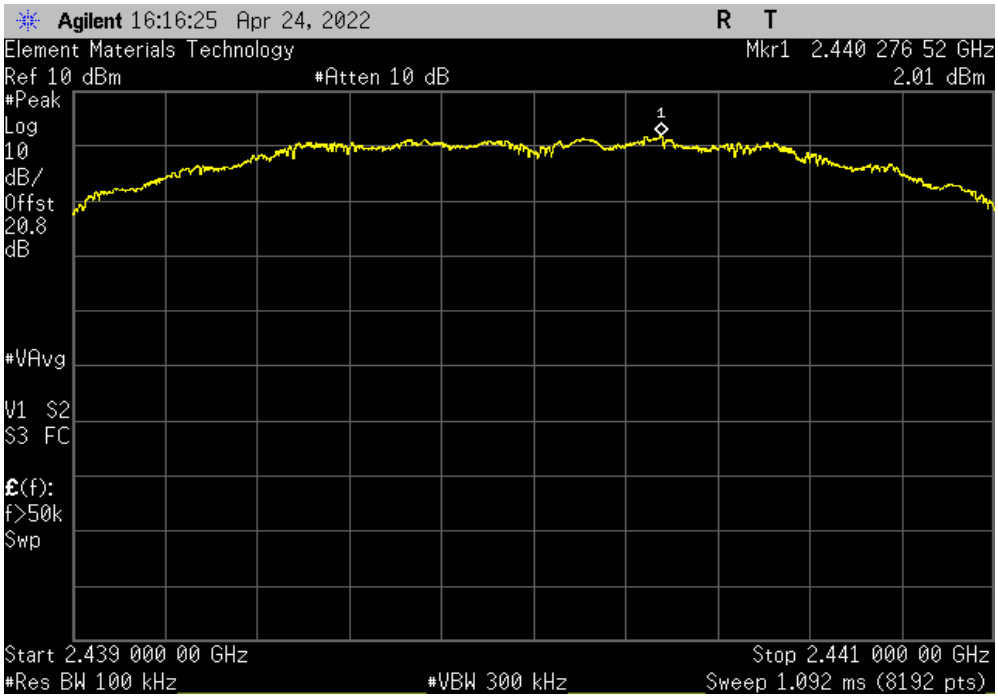
802.15.4 ZigBee, Low Channel, 2405 MHz				
Frequency Range	Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
30 MHz - 12.5 GHz	12023.5	-56.41	-20	Pass



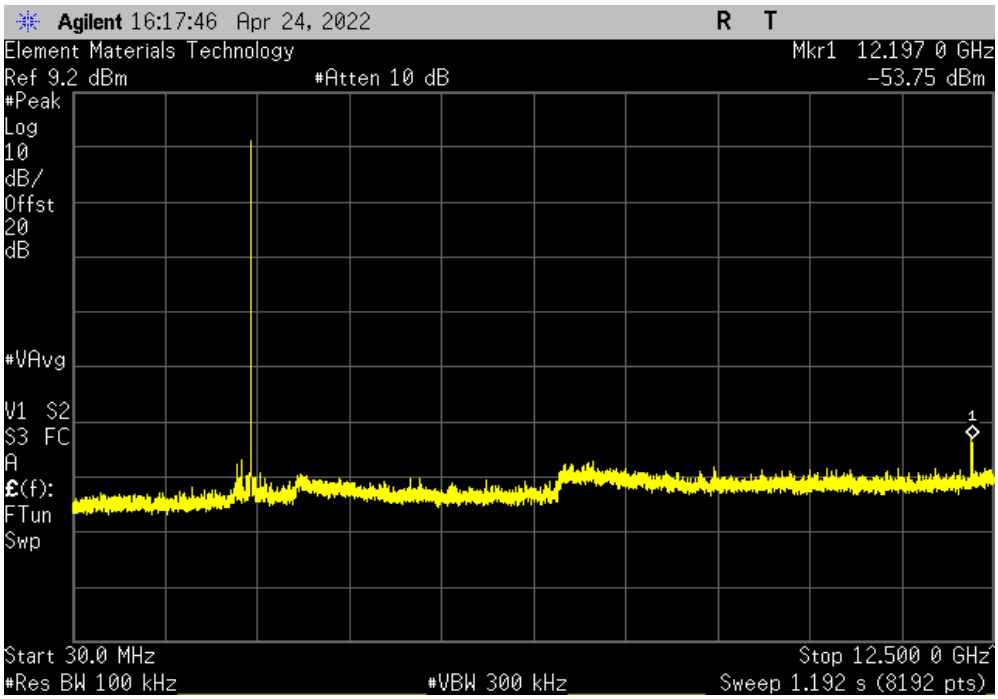
802.15.4 ZigBee, Low Channel, 2405 MHz				
Frequency Range	Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
12.5 GHz - 25 GHz	13777.3	-57.79	-20	Pass



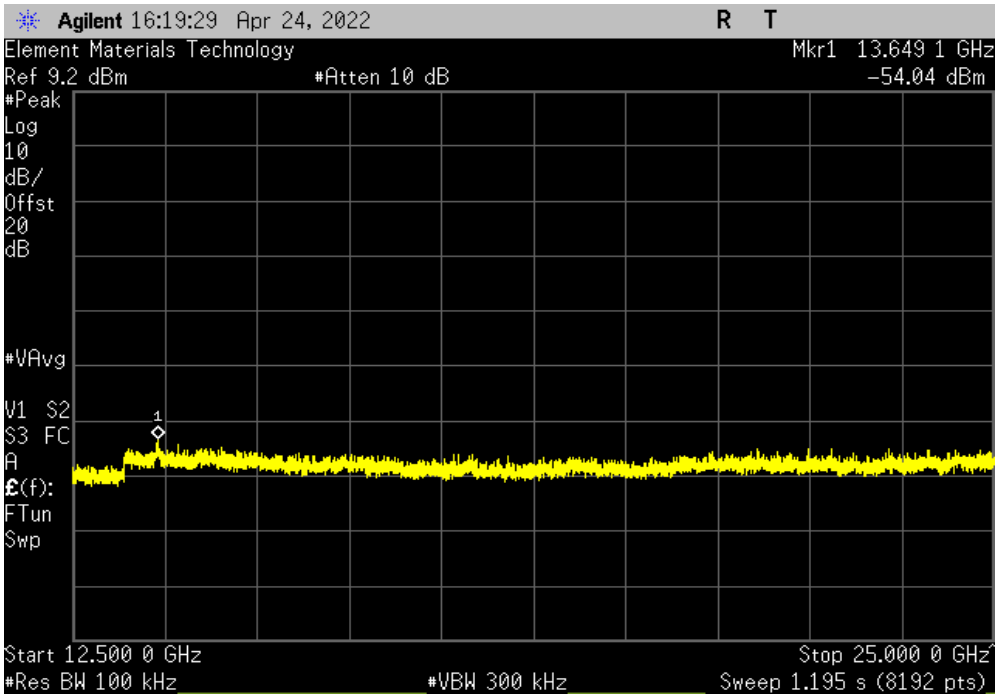
802.15.4 ZigBee, Mid Channel, 2440 MHz					
Frequency Range		Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
Fundamental		2440.28	N/A	N/A	N/A



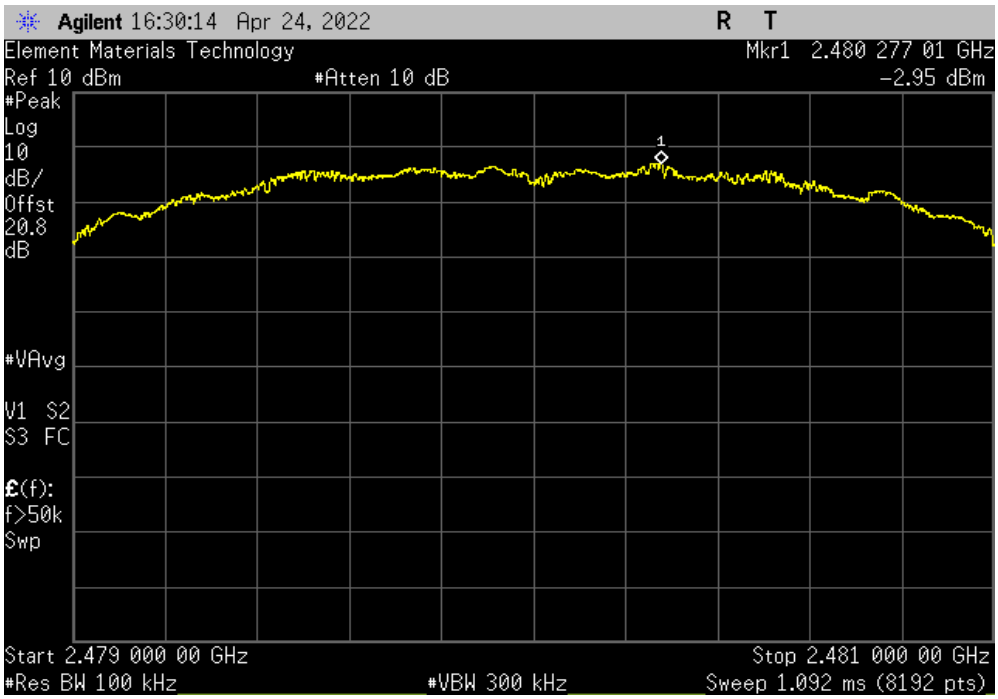
802.15.4 ZigBee, Mid Channel, 2440 MHz				
Frequency Range	**Measured Freq (MHz)**	**Max Value (dBc)**	**Limit ≤ (dBc)**	**Result**
30 MHz - 12.5 GHz	12197	-55.76	-20	Pass



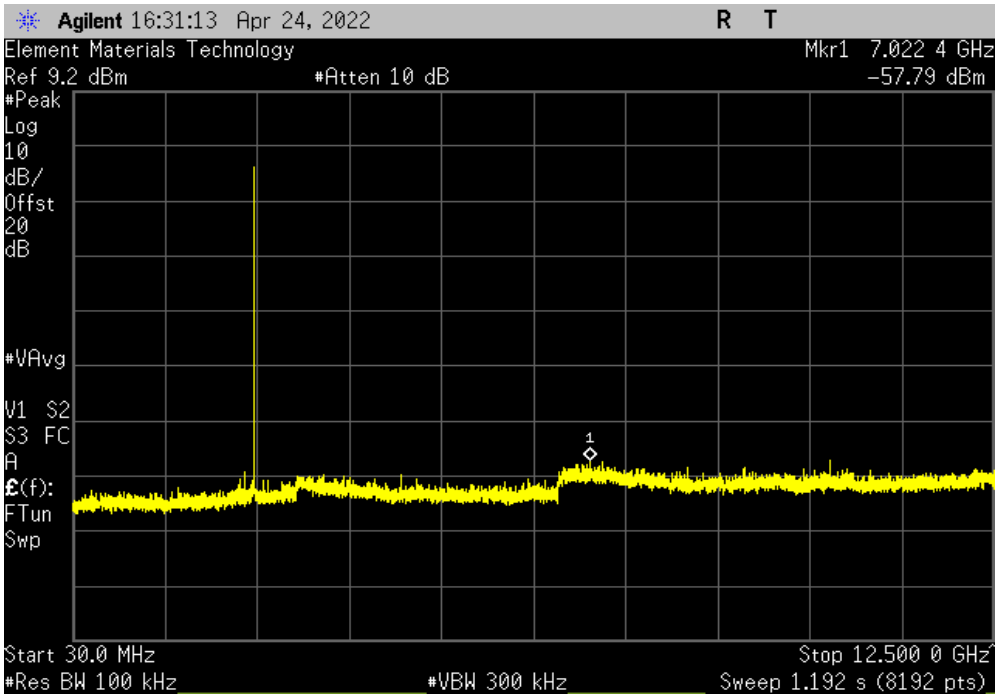
802.15.4 ZigBee, Mid Channel, 2440 MHz				
Frequency Range	**Measured Freq (MHz)**	**Max Value (dBc)**	**Limit ≤ (dBc)**	**Result**
12.5 GHz - 25 GHz	13649.1	-56.05	-20	Pass



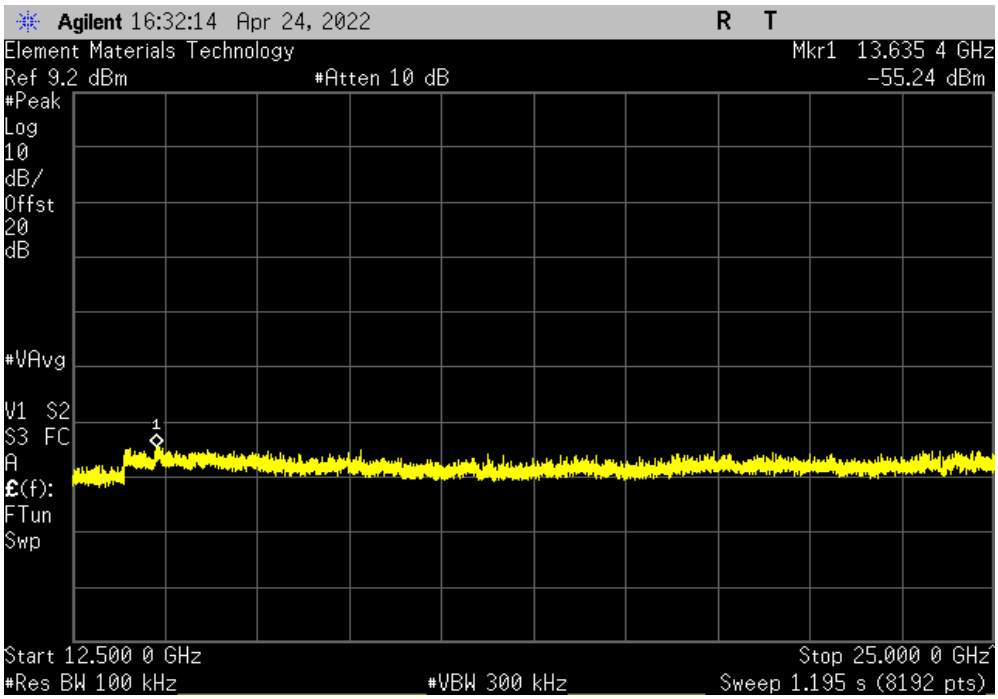
802.15.4 ZigBee, High Channel, 2480 MHz					
Frequency Range		Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
	Fundamental	2480.28	N/A	N/A	N/A



802.15.4 ZigBee, High Channel, 2480 MHz				
Frequency Range	Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
30 MHz - 12.5 GHz	7022.4	-54.84	-20	Pass



802.15.4 ZigBee, High Channel, 2480 MHz				
Frequency Range	**Measured Freq (MHz)**	**Max Value (dBc)**	**Limit ≤ (dBc)**	**Result**
12.5 GHz - 25 GHz	13635.4	-52.29	-20	Pass



POWER SPECTRAL DENSITY

XMit 2022.02.07.0

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

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	N5173B	TIW	2020-07-17	2023-07-17
Cable	UtiFlex Micro-Coax	UFD1150A-1-0720-200200	TXK	2021-09-13	2022-09-13
Attenuator	Fairview Microwave	SA4018-20	TYE	2021-09-15	2022-09-15
Block - DC	Fairview Microwave	SD3239	ANE	2022-03-02	2023-03-02
Analyzer - Spectrum Analyzer	Agilent	E4440A	AFD	2021-08-25	2022-08-25

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

TbtTx 2021.12.14.1 XMit 2022.02.07.0

EUT:	**Radio Thermostat**			**Work Order:**	**F3EN0120**
Serial Number:	**DUT1**			**Date:**	**24-Apr-22**
Customer:	**Quext**			**Temperature:**	**21.3 °C**
Attendees:	**None**			**Humidity:**	**51.1% RH**
Project:	**None**			**Barometric Pres.:**	**1013 mbar**
Tested by:	**Mark Baytan**	**Power:**	**110VAC/60Hz**	**Job Site:**	**TX09**

TEST SPECIFICATIONS	**Test Method**
FCC 15.247:2022	**ANSI C63.10:2013**

COMMENTS

None

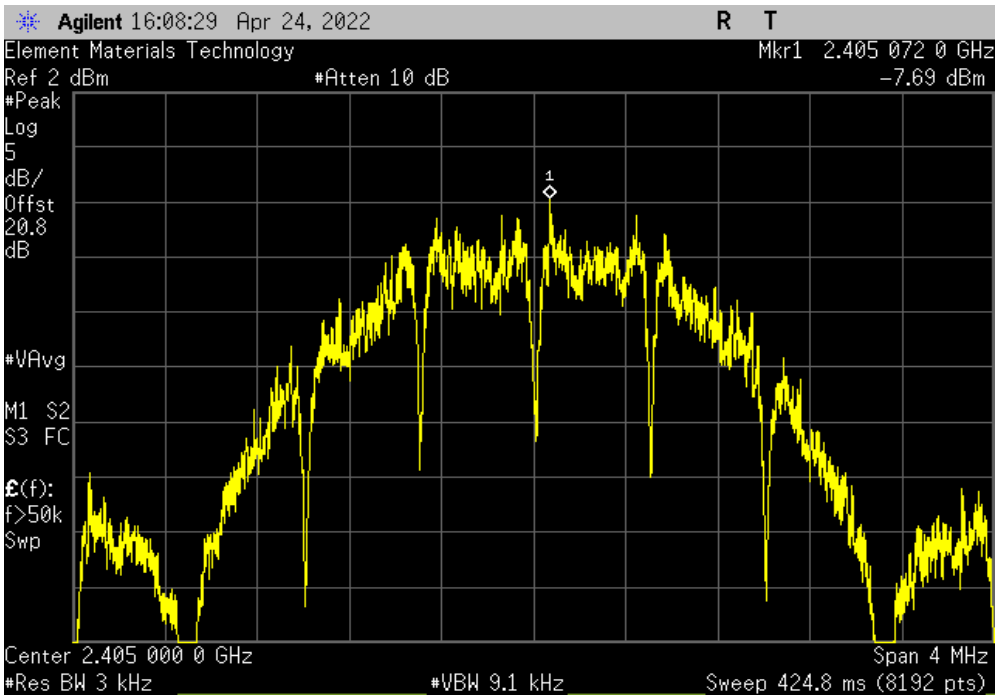
DEVIATIONS FROM TEST STANDARD

None

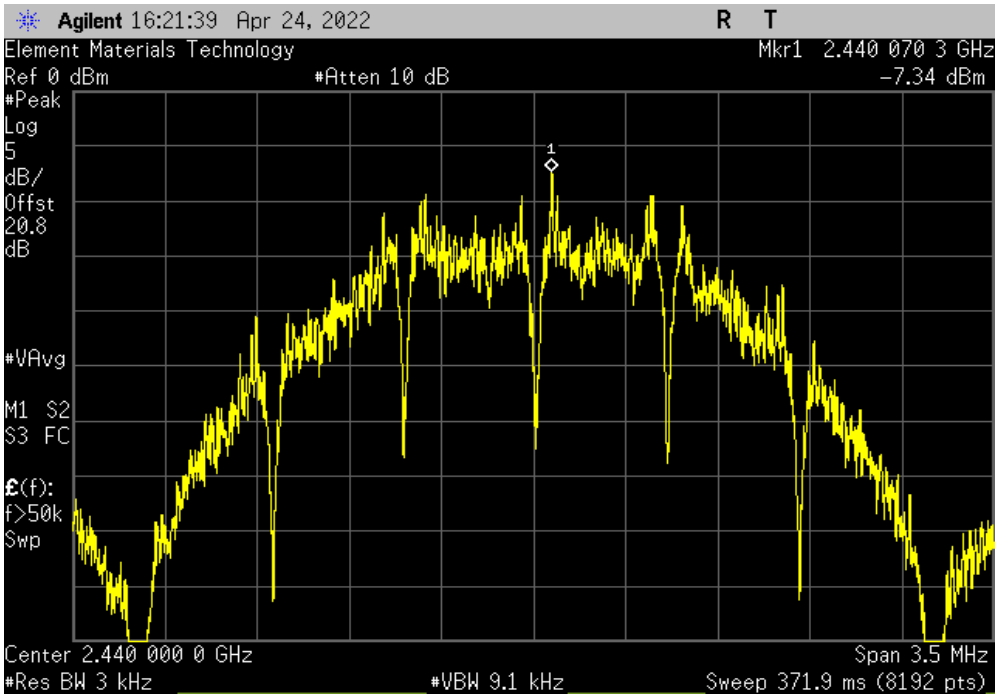
Configuration #	**1**	*Signature*

	Value dBm/3kHz	**Limit < dBm/3kHz**	**Results**
802.15.4 ZigBee			
Low Channel, 2405 MHz	-7.694	8	Pass
Mid Channel, 2440 MHz	-7.34	8	Pass
High Channel, 2480 MHz	-14.217	8	Pass

802.15.4 ZigBee, Low Channel, 2405 MHz						
				Value dBm/3kHz	Limit < dBm/3kHz	Results
				-7.694	8	Pass



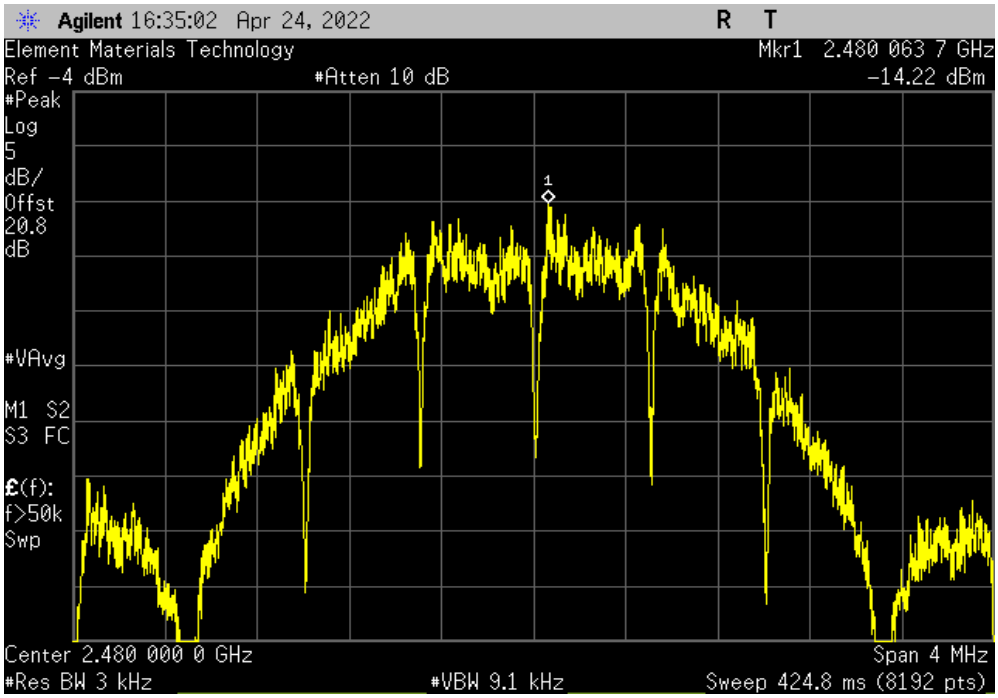
802.15.4 ZigBee, Mid Channel, 2440 MHz						
				Value dBm/3kHz	Limit < dBm/3kHz	Results
				-7.34	8	Pass



POWER SPECTRAL DENSITY

TbtTx 2021.12.14.1 XMit 2022.02.07.0

802.15.4 ZigBee, High Channel, 2480 MHz						
				Value dBm/3kHz	Limit < dBm/3kHz	Results
				-14.217	8	Pass



End of Test Report