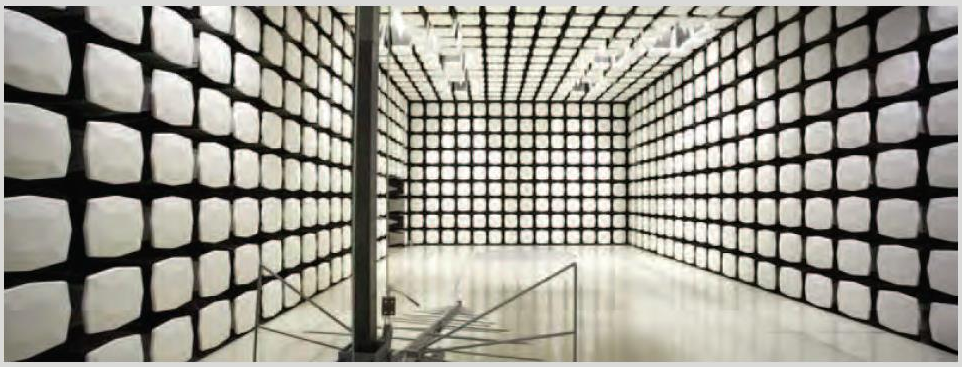
Quext

Radio Thermostat

FCC 15.249:2022
DXX Transceiver

Report: F3EN0068.9 Rev. 1, Issue Date: July 26, 2022



ACCREDITED
CERT #3310.03

CERTIFICATE OF TEST

Last Date of Test: July 13, 2022
Quext
EUT: Radio Thermostat

Radio Equipment Testing

Standards

Specification	Method
FCC 15.207:2022	ANSI C63.10:2013, KDB 558074
FCC 15.215:2022	
FCC 15.249:2022	

Results

Method Clause	Test Description	Applied	Results	Comments
6.2	Powerline Conducted Emissions	Yes	Pass	
6.5, 6.6	Field Strength of Harmonics and Spurious Radiated Emission	Yes	Pass	
6.5, 6.6	Band Edge	Yes	Pass	
6.5	Field Strength of Fundamental	Yes	Pass	
11.6	Duty Cycle	Yes	Pass	
6.9.2	Occupied Bandwidth	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	Updated last date of test.	2022-07-14	2, 10, 12
	Added configuration F3EN0068-7.	2022-07-14	14
	Updated power table.	2022-07-14	11
	Replaced Duty Cycle with new retest data.	2022-07-14	29
	Replaced Occupied Bandwidth with new retest data.	2022-07-14	35-39
	Updated Field Strength of Harmonics and Spurious Radiated Emissions in photos only report	2022-07-14	N/A
	Added Occupied Bandwidth to photos only report.	2022-07-14	N/A
	Removed Duty Cycle from photos only report.	2022-07-14	N/A
	Updated the duty cycle correction factor.	2022-07-14	26
	Updated radio on cover page to read DXX Transceiver.	2022-07-14	1
	Added new Band Edge data	2022-07-18	27-30
	Added new Field Strength of Fundamental data	2022-07-18	31-33

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

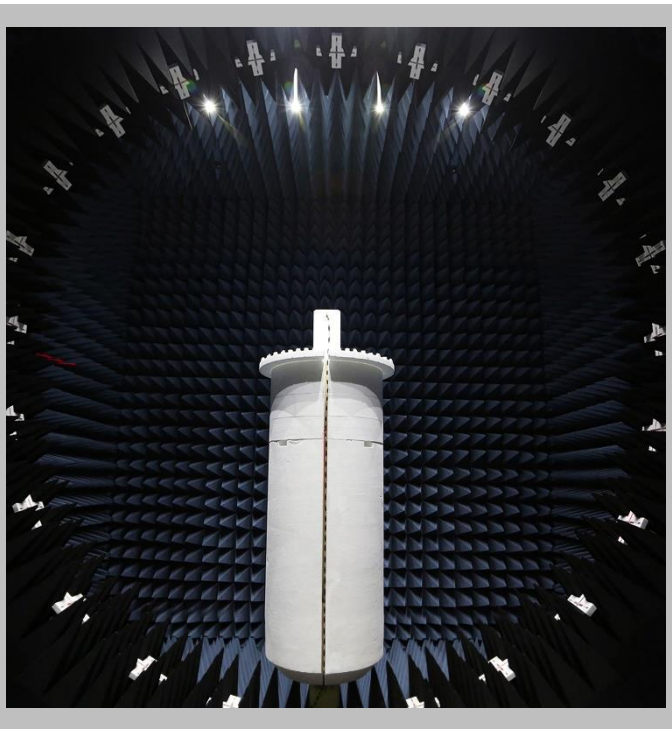
For details on the Scopes of our Accreditations, please visit:

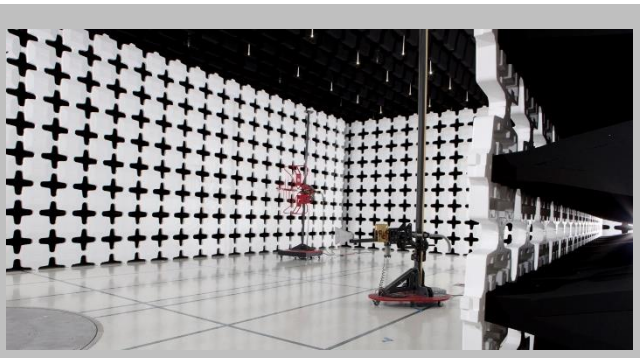
California Minnesota Oregon Texas Washington

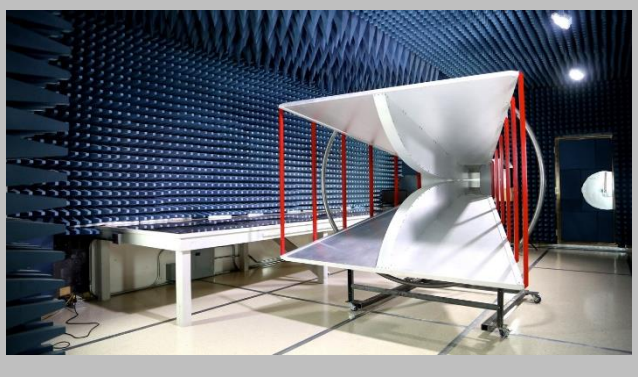
FACILITIES

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

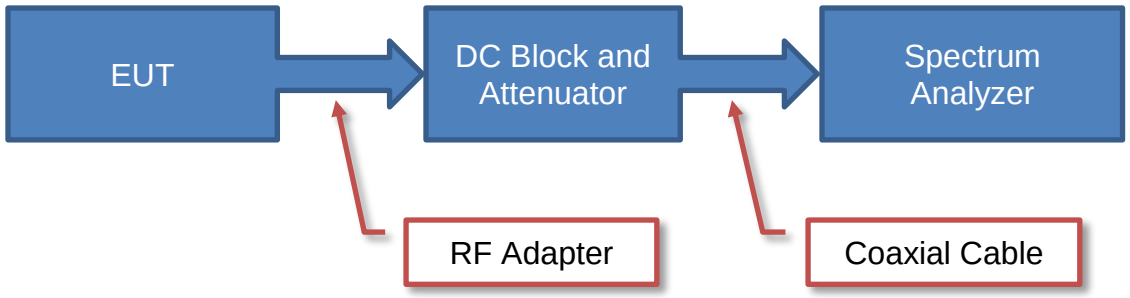
TEST SETUP BLOCK DIAGRAMS

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.

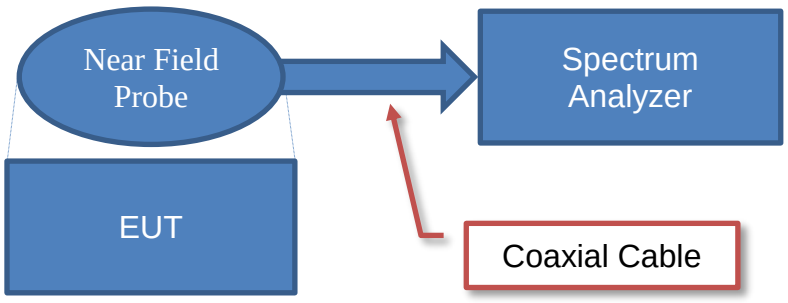
Antenna Port Conducted Measurements



Sample Calculation (logarithmic units)

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

Near Field Test Fixture Measurements

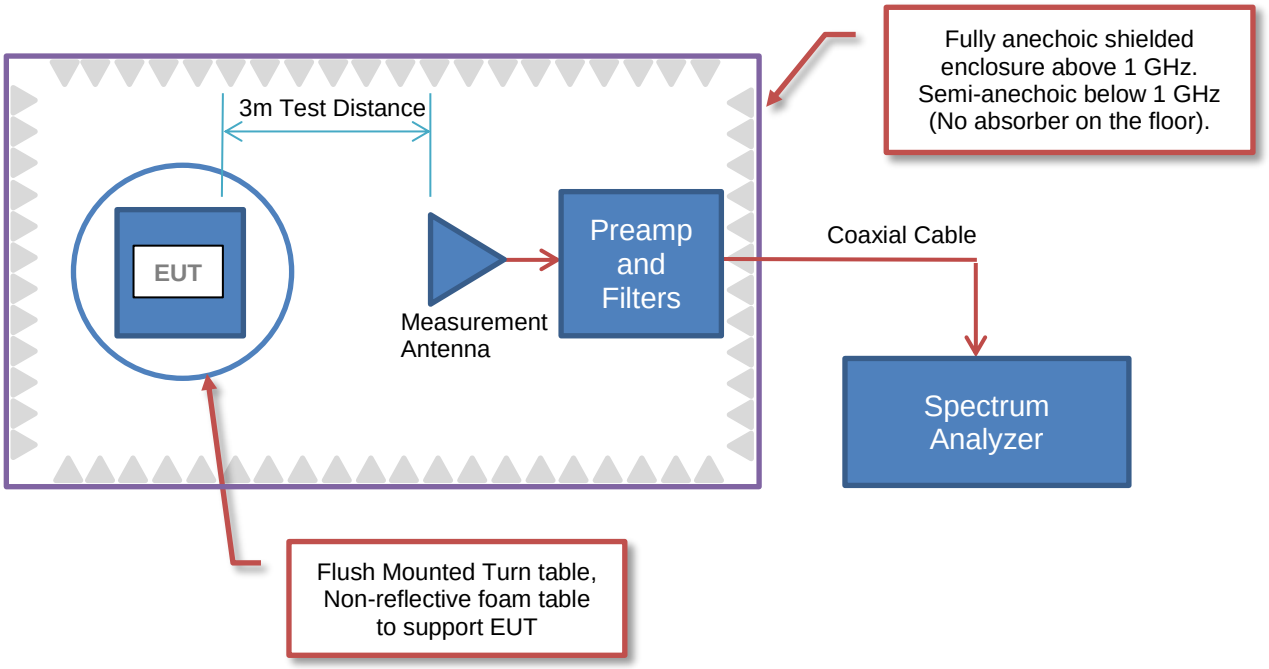


Sample Calculation (logarithmic units)

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**

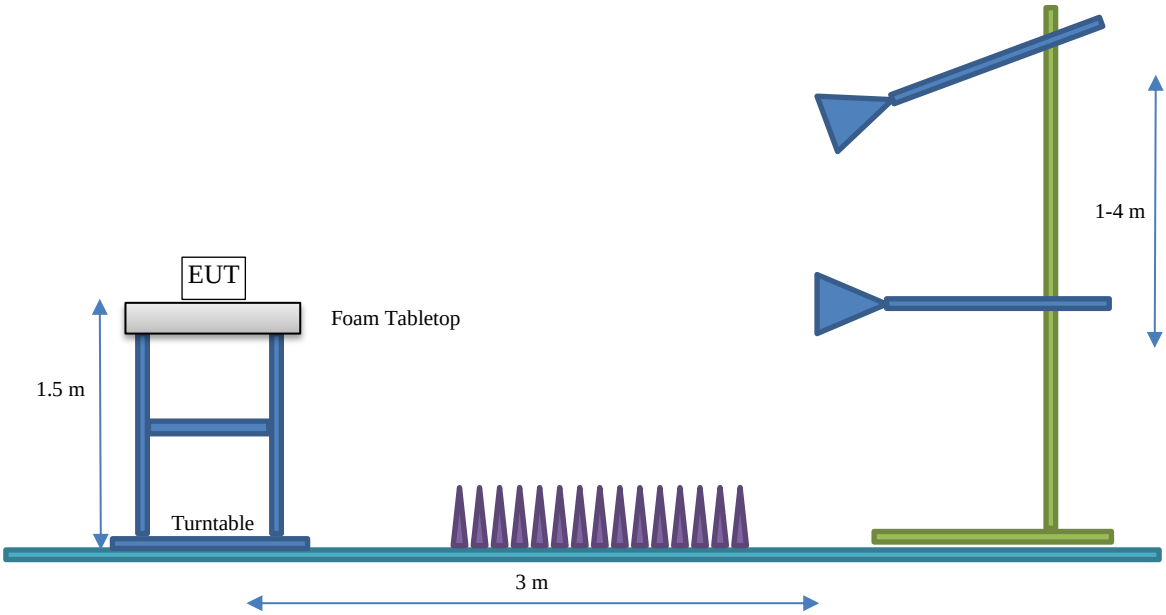
Conducted Emissions:

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:	Lubbock, TX 79424
Test Requested By:	Tray Johnson
EUT:	Radio Thermostat
First Date of Test:	December 7, 2021
Last Date of Test:	July 13, 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 15.249 for operation in the 902 – 928 MHz 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	Johanson Technology, Inc.	902 - 928	1.0

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

SETTINGS FOR ALL TESTS IN THIS REPORT

Baud Rate / Modulation	Position (if multiple channels)	Software Maximum Power Setting
9.6k, 40k, 100k / GFSK	Low Channel (908.4 MHz)	13
	High Channel (916 MHz)	20

CONFIGURATIONS

Configuration F3EN0068- 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	DUT2

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

Cables					
Cable Type	**Shield**	**Length (m)**	**Ferrite**	**Connection 1**	**Connection 2**
USB to IO Cable	No	1.2m	No	Radio Thermostat	Laptop
DC Cable	Yes	2.1m	No	Laptop	AC/DC Adapter (Laptop)
AC Cable	No	1.5m	No	AC Mains	AC/DC Adapter (Laptop)
24VAC Cable	No	1.4m	No	Radio Thermostat	AC/AC Transformer
120VAC Cable	No	1.0m	No	AC/AC Transformer	AC Mains / Not Energized
USB Mouse Cable	Yes	1.5m	No	Laptop	Mouse (Laptop)

CONFIGURATIONS

Configuration F3EN0068- 2

EUT			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
Radio Thermostat	Quext	Quext 1	DUT4

Remote Equipment Outside of 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**
24VAC Cable	No	1.4m	No	Radio Thermostat	AC/AC Transformer
120VAC Cable	No	1.0m	No	AC/AC Transformer	AC Mains / Not Energized

Configuration F3EN0068- 4

EUT			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
Radio Thermostat	Quext	Quext 1	DUT 11

Remote Equipment Outside of 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**
24VAC Cable	No	1.4m	No	Radio Thermostat	AC/AC Transformer
120VAC Cable	No	1.0m	No	AC/AC Transformer	AC Mains / Not Energized

CONFIGURATIONS

Configuration F3EN0068- 7

Software/Firmware Running During Test	
Description	**Version**
Tera Term	1.0.0.26
Tera Term	4.8.6

EUT			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
Radio Thermostat	Quext	Quext 1	DUT2

Peripherals in Test Setup Boundary			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
AC/AC Adapter (Thermostat)	None	None	None
Laptop	Lenovo	X201	3249ERU
AC/DC Adapter (Laptop)		92P1109	11S92P1109Z1ZBTZ9729GV

Cables					
Cable Type	**Shield**	**Length (m)**	**Ferrite**	**Connection 1**	**Connection 2**
USB to IO Cable	No	1.2m	No	Radio Thermostat	Laptop
24VAC Cable	No	1.4m	No	Radio Thermostat	AC/AC Adapter (Thermostat)
120VAC Cable	No	1.0m	no	AC/AC Adapter (Thermostat)	AC Mains
AC Cable (Laptop)	No	1.7m	No	AC Mains	AC/DC Adapter (Laptop)
DC Cable (Laptop)	No	1.6m	Yes	AC/DC Adapter (Laptop)	Laptop

MODIFICATIONS

Equipment Modifications

Item	Date	Test	Modification	Note	Disposition of EUT
1	2021-12-07	Field Strength of Harmonics and 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	2022-01-06	Powerline Conducted Emissions	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	Scheduled testing was completed.
3	2022-07-12	Field Strength of Fundamental	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	2022-07-12	Band Edge	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	2022-07-13	Occupied Bandwidth	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 2021.09.09.0
PSA-ESCI 2021.12.10.0

TEST DESCRIPTION

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
Receiver	Gauss Instruments	TDEMI 30M	ARL	2021-03-23	2022-03-23
LISN	Solar Electronics	9252-50-R-24-BNC	LJK	2021-08-06	2022-08-06
Power Source/Analyzer	Hewlett Packard	6841A	THC	NCR	NCR
Cable - Conducted Cable Assembly	Northwest EMC	TXA, HFC, TQU	TXAA	2021-01-26	2022-01-26

MEASUREMENT UNCERTAINTY

Description		
Expanded k=2	3.1 dB	-3.1 dB

CONFIGURATIONS INVESTIGATED

F3EN0068-2

MODES INVESTIGATED

Thermostat On, Z-Wave Radio enabled, 100 kHz baudrate, 916 Mhz, all other radios disabled
Thermostat On, Z-Wave Radio enabled, 40 kHz baudrate, 908.4 Mhz, all other radios disabled

POWERLINE CONDUCTED EMISSIONS

element
WTD.2021.09.21.0
EmiR5 2021.09.09.0
PSA-ESCI 2021.12.10.0

EUT:	Radio Thermostat	Work Order:	F3EN0068
Serial Number:	DUT4	Date:	2022-01-06
Customer:	Quext	Temperature:	23°C
Attendees:	None	Relative Humidity:	22.6%
Customer Project:	None	Bar. Pressure (PMSL):	1025 mb
Tested By:	Travis Glasser	Job Site:	TX01
Power:	110VAC/60Hz	Configuration:	F3EN0068-2

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.207:2022	ANSI C63.10:2013

TEST PARAMETERS

Run #:	25	Line:	High Line	Add. Ext. Attenuation (dB):	0

COMMENTS

None

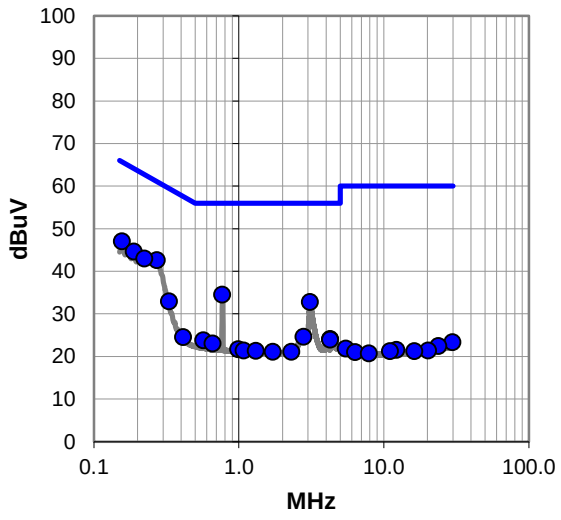
EUT OPERATING MODES

Thermostat On, Z-Wave Radio enabled, 100 kHz baudrate, 916 Mhz, all other radios disabled

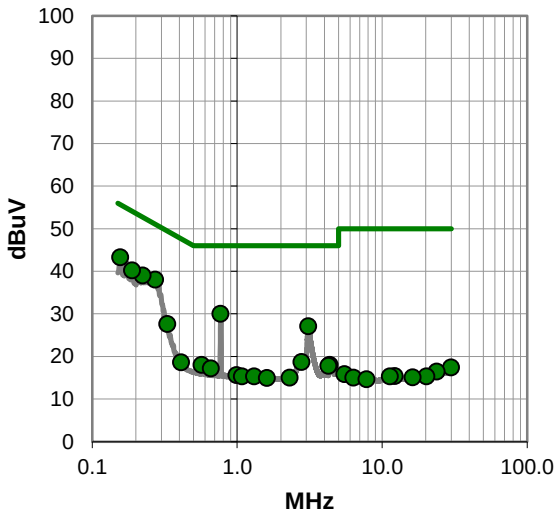
DEVIATIONS FROM TEST STANDARD

None

Quasi Peak Data - vs - Quasi Peak Limit



Average Data - vs - Average Limit



POWERLINE CONDUCTED EMISSIONS

element
WTD.2021.09.21.0
EmiR5 2021.09.09.0
PSA-ESCI 2021.12.10.0

RESULTS - Run #25

Quasi Peak Data - vs - Quasi Peak Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
0.272	22.2	20.4	42.6	61.1	-18.5
0.156	26.6	20.4	47.0	65.7	-18.7
0.188	24.2	20.4	44.6	64.1	-19.5
0.223	22.6	20.4	43.0	62.7	-19.7
0.769	14.3	20.2	34.5	56.0	-21.5
3.099	12.5	20.3	32.8	56.0	-23.2
0.330	12.7	20.2	32.9	59.5	-26.6
2.793	4.3	20.3	24.6	56.0	-31.4
4.274	3.8	20.3	24.1	56.0	-31.9
4.265	3.6	20.3	23.9	56.0	-32.1
0.570	3.6	20.2	23.8	56.0	-32.2
0.660	2.8	20.2	23.0	56.0	-33.0
0.412	4.3	20.2	24.5	57.6	-33.1
0.989	1.5	20.2	21.7	56.0	-34.3
1.081	1.2	20.2	21.4	56.0	-34.6
1.311	1.0	20.3	21.3	56.0	-34.7
1.711	0.8	20.3	21.1	56.0	-34.9
2.298	0.8	20.3	21.1	56.0	-34.9
29.854	0.7	22.6	23.3	60.0	-36.7
23.835	0.3	22.1	22.4	60.0	-37.6
5.474	1.4	20.4	21.8	60.0	-38.2
12.205	0.5	21.0	21.5	60.0	-38.5
20.239	-0.2	21.6	21.4	60.0	-38.6
11.050	0.4	20.8	21.2	60.0	-38.8
16.247	-0.2	21.4	21.2	60.0	-38.8

Average Data - vs - Average Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
0.156	22.9	20.4	43.3	55.7	-12.4
0.272	17.6	20.4	38.0	51.1	-13.1
0.223	18.6	20.4	39.0	52.7	-13.7
0.188	19.8	20.4	40.2	54.1	-13.9
0.769	9.8	20.2	30.0	46.0	-16.0
3.098	6.8	20.3	27.1	46.0	-18.9
0.330	7.4	20.2	27.6	49.5	-21.9
2.779	-1.6	20.3	18.7	46.0	-27.3
0.570	-2.2	20.2	18.0	46.0	-28.0
4.349	-2.3	20.3	18.0	46.0	-28.0
4.270	-2.5	20.3	17.8	46.0	-28.2
0.660	-3.0	20.2	17.2	46.0	-28.8
0.411	-1.6	20.2	18.6	47.6	-29.0
0.989	-4.6	20.2	15.6	46.0	-30.4
1.079	-4.9	20.2	15.3	46.0	-30.7
1.311	-5.0	20.3	15.3	46.0	-30.7
2.303	-5.3	20.3	15.0	46.0	-31.0
1.604	-5.4	20.3	14.9	46.0	-31.1
29.937	-5.2	22.6	17.4	50.0	-32.6
23.834	-5.7	22.1	16.4	50.0	-33.6
5.501	-4.6	20.4	15.8	50.0	-34.2
12.204	-5.6	21.0	15.4	50.0	-34.6
11.298	-5.6	20.9	15.3	50.0	-34.7
20.233	-6.3	21.6	15.3	50.0	-34.7
16.246	-6.3	21.4	15.1	50.0	-34.9

CONCLUSION

Pass

Tested By

POWERLINE CONDUCTED EMISSIONS

element
WTD.2021.09.21.0
EmiR5 2021.09.09.0
PSA-ESCI 2021.12.10.0

EUT:	Radio Thermostat	Work Order:	F3EN0068
Serial Number:	DUT4	Date:	2022-01-06
Customer:	Quext	Temperature:	23°C
Attendees:	None	Relative Humidity:	22.6%
Customer Project:	None	Bar. Pressure (PMSL):	1025 mb
Tested By:	Travis Glasser	Job Site:	TX01
Power:	110VAC/60Hz	Configuration:	F3EN0068-2

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.207:2022	ANSI C63.10:2013

TEST PARAMETERS

Run #:	26	Line:	Neutral	Add. Ext. Attenuation (dB):	0

COMMENTS

None

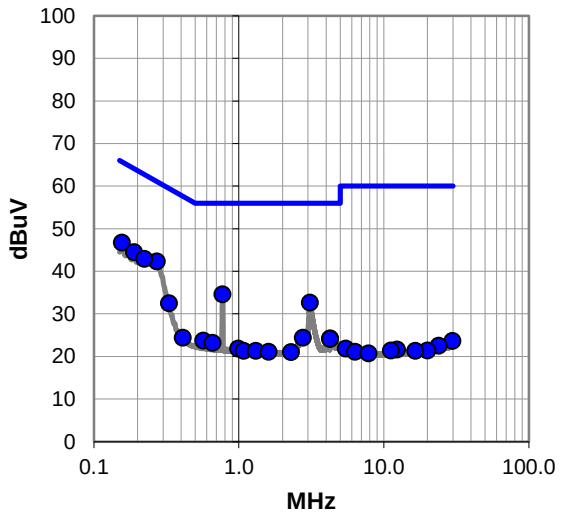
EUT OPERATING MODES

Thermostat On, Z-Wave Radio enabled, 100 kHz baudrate, 916 Mhz, all other radios disabled

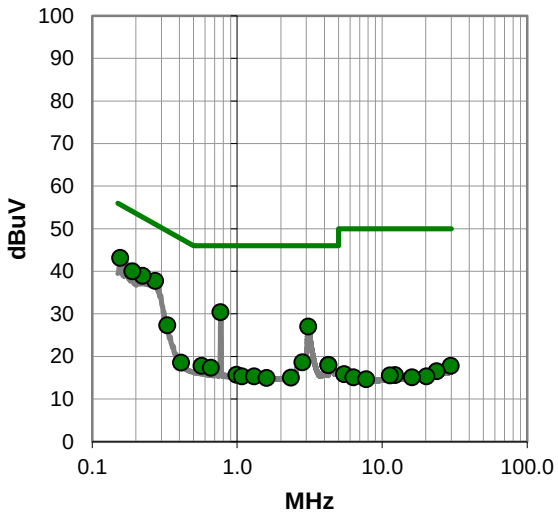
DEVIATIONS FROM TEST STANDARD

None

Quasi Peak Data - vs - Quasi Peak Limit



Average Data - vs - Average Limit



POWERLINE CONDUCTED EMISSIONS

element
WTD.2021.09.21.0
EmiR5 2021.09.09.0
PSA-ESCI 2021.12.10.0

RESULTS - Run #26

Quasi Peak Data - vs - Quasi Peak Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
0.272	21.9	20.4	42.3	61.1	-18.8
0.156	26.3	20.4	46.7	65.7	-19.0
0.190	24.1	20.4	44.5	64.1	-19.6
0.223	22.5	20.4	42.9	62.7	-19.8
0.771	14.4	20.2	34.6	56.0	-21.4
3.096	12.3	20.3	32.6	56.0	-23.4
0.330	12.3	20.2	32.5	59.5	-27.0
2.764	4.1	20.3	24.4	56.0	-31.6
4.267	3.9	20.3	24.2	56.0	-31.8
4.274	3.8	20.3	24.1	56.0	-31.9
0.570	3.5	20.2	23.7	56.0	-32.3
0.660	3.0	20.2	23.2	56.0	-32.8
0.411	4.2	20.2	24.4	57.6	-33.2
0.991	1.6	20.2	21.8	56.0	-34.2
1.079	1.1	20.2	21.3	56.0	-34.7
1.311	1.0	20.3	21.3	56.0	-34.7
1.604	0.8	20.3	21.1	56.0	-34.9
2.297	0.7	20.3	21.0	56.0	-35.0
29.854	1.0	22.6	23.6	60.0	-36.4
23.917	0.4	22.1	22.5	60.0	-37.5
5.474	1.4	20.4	21.8	60.0	-38.2
12.372	0.6	21.0	21.6	60.0	-38.4
11.214	0.5	20.9	21.4	60.0	-38.6
20.036	-0.2	21.6	21.4	60.0	-38.6
16.462	-0.1	21.4	21.3	60.0	-38.7

Average Data - vs - Average Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
0.156	22.7	20.4	43.1	55.7	-12.6
0.272	17.3	20.4	37.7	51.1	-13.4
0.223	18.5	20.4	38.9	52.7	-13.8
0.190	19.6	20.4	40.0	54.1	-14.1
0.769	10.2	20.2	30.4	46.0	-15.6
3.098	6.7	20.3	27.0	46.0	-19.0
0.330	7.1	20.2	27.3	49.5	-22.2
2.828	-1.7	20.3	18.6	46.0	-27.4
4.267	-2.3	20.3	18.0	46.0	-28.0
4.274	-2.4	20.3	17.9	46.0	-28.1
0.570	-2.4	20.2	17.8	46.0	-28.2
0.660	-2.9	20.2	17.3	46.0	-28.7
0.411	-1.7	20.2	18.5	47.6	-29.1
0.989	-4.5	20.2	15.7	46.0	-30.3
1.081	-4.9	20.2	15.3	46.0	-30.7
1.311	-5.0	20.3	15.3	46.0	-30.7
2.346	-5.3	20.3	15.0	46.0	-31.0
1.601	-5.4	20.3	14.9	46.0	-31.1
29.856	-4.8	22.6	17.8	50.0	-32.2
23.835	-5.6	22.1	16.5	50.0	-33.5
5.483	-4.6	20.4	15.8	50.0	-34.2
12.288	-5.4	21.0	15.6	50.0	-34.4
11.298	-5.4	20.9	15.5	50.0	-34.5
20.190	-6.3	21.6	15.3	50.0	-34.7
6.336	-5.3	20.4	15.1	50.0	-34.9

CONCLUSION

Pass

Tested By

POWERLINE CONDUCTED EMISSIONS

element
WTD.2021.09.21.0
EmiR5 2021.09.09.0
PSA-ESCI 2021.12.10.0

EUT:	Radio Thermostat	Work Order:	F3EN0068
Serial Number:	DUT4	Date:	2022-01-06
Customer:	Quext	Temperature:	23°C
Attendees:	None	Relative Humidity:	22.6%
Customer Project:	None	Bar. Pressure (PMSL):	1025 mb
Tested By:	Travis Glasser	Job Site:	TX01
Power:	110VAC/60Hz	Configuration:	F3EN0068-2

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.207:2022	ANSI C63.10:2013

TEST PARAMETERS

Run #:	27	Line:	High Line	Add. Ext. Attenuation (dB):	0

COMMENTS

None

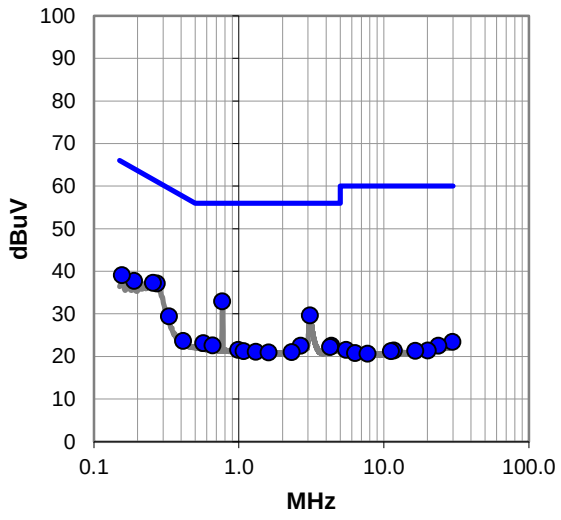
EUT OPERATING MODES

Thermostat On, Z-Wave Radio enabled, 40 kHz baudrate, 908.4 Mhz, all other radios disabled

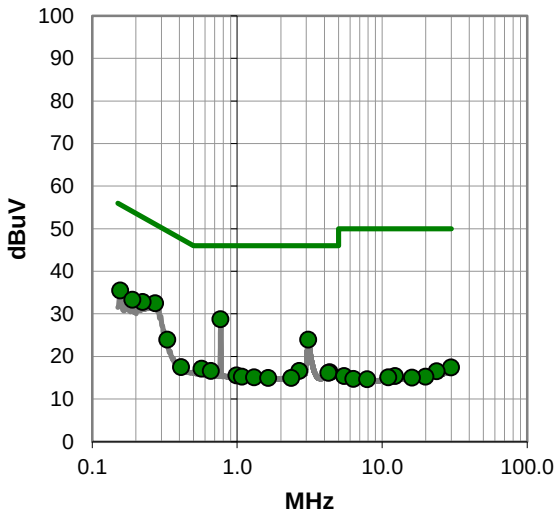
DEVIATIONS FROM TEST STANDARD

None

Quasi Peak Data - vs - Quasi Peak Limit



Average Data - vs - Average Limit



POWERLINE CONDUCTED EMISSIONS

element
WTD.2021.09.21.0
EmiR5 2021.09.09.0
PSA-ESCI 2021.12.10.0

RESULTS - Run #27

Quasi Peak Data - vs - Quasi Peak Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
0.769	12.7	20.2	32.9	56.0	-23.1
0.272	16.7	20.4	37.1	61.1	-24.0
0.255	16.9	20.4	37.3	61.6	-24.3
0.190	17.3	20.4	37.7	64.1	-26.4
3.098	9.3	20.3	29.6	56.0	-26.4
0.156	18.7	20.4	39.1	65.7	-26.6
0.330	9.2	20.2	29.4	59.5	-30.1
0.570	2.9	20.2	23.1	56.0	-32.9
0.660	2.4	20.2	22.6	56.0	-33.4
2.666	2.2	20.3	22.5	56.0	-33.5
4.347	2.2	20.3	22.5	56.0	-33.5
4.267	1.9	20.3	22.2	56.0	-33.8
0.412	3.4	20.2	23.6	57.6	-34.0
0.989	1.3	20.2	21.5	56.0	-34.5
1.079	1.0	20.2	21.2	56.0	-34.8
1.311	0.8	20.3	21.1	56.0	-34.9
2.314	0.7	20.3	21.0	56.0	-35.0
1.606	0.6	20.3	20.9	56.0	-35.1
29.854	0.8	22.6	23.4	60.0	-36.6
23.835	0.4	22.1	22.5	60.0	-37.5
5.498	1.1	20.4	21.5	60.0	-38.5
11.713	0.5	20.9	21.4	60.0	-38.6
20.111	-0.2	21.6	21.4	60.0	-38.6
16.482	-0.1	21.4	21.3	60.0	-38.7
11.217	0.3	20.9	21.2	60.0	-38.8

Average Data - vs - Average Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
0.769	8.5	20.2	28.7	46.0	-17.3
0.272	12.1	20.4	32.5	51.1	-18.6
0.223	12.4	20.4	32.8	52.7	-19.9
0.156	15.1	20.4	35.5	55.7	-20.2
0.190	12.9	20.4	33.3	54.1	-20.8
3.098	3.6	20.3	23.9	46.0	-22.1
0.330	3.7	20.2	23.9	49.5	-25.6
0.570	-3.1	20.2	17.1	46.0	-28.9
0.660	-3.6	20.2	16.6	46.0	-29.4
2.680	-3.7	20.3	16.6	46.0	-29.4
4.347	-4.0	20.3	16.3	46.0	-29.7
4.265	-4.2	20.3	16.1	46.0	-29.9
0.411	-2.7	20.2	17.5	47.6	-30.1
0.989	-4.7	20.2	15.5	46.0	-30.5
1.079	-5.0	20.2	15.2	46.0	-30.8
1.311	-5.2	20.3	15.1	46.0	-30.9
1.642	-5.4	20.3	14.9	46.0	-31.1
2.364	-5.4	20.3	14.9	46.0	-31.1
29.937	-5.2	22.6	17.4	50.0	-32.6
23.835	-5.6	22.1	16.5	50.0	-33.5
5.466	-5.0	20.4	15.4	50.0	-34.6
12.288	-5.6	21.0	15.4	50.0	-34.6
19.944	-6.4	21.6	15.2	50.0	-34.8
11.050	-5.7	20.8	15.1	50.0	-34.9
16.079	-6.4	21.4	15.0	50.0	-35.0

CONCLUSION

Pass

Tested By

POWERLINE CONDUCTED EMISSIONS

element
WTD.2021.09.21.0
EmiR5 2021.09.09.0
PSA-ESCI 2021.12.10.0

EUT:	Radio Thermostat	Work Order:	F3EN0068
Serial Number:	DUT4	Date:	2022-01-06
Customer:	Quext	Temperature:	23°C
Attendees:	None	Relative Humidity:	22.6%
Customer Project:	None	Bar. Pressure (PMSL):	1025 mb
Tested By:	Travis Glasser	Job Site:	TX01
Power:	110VAC/60Hz	Configuration:	F3EN0068-2

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.207:2022	ANSI C63.10:2013

TEST PARAMETERS

Run #:	28	Line:	Neutral	Add. Ext. Attenuation (dB):	0

COMMENTS

None

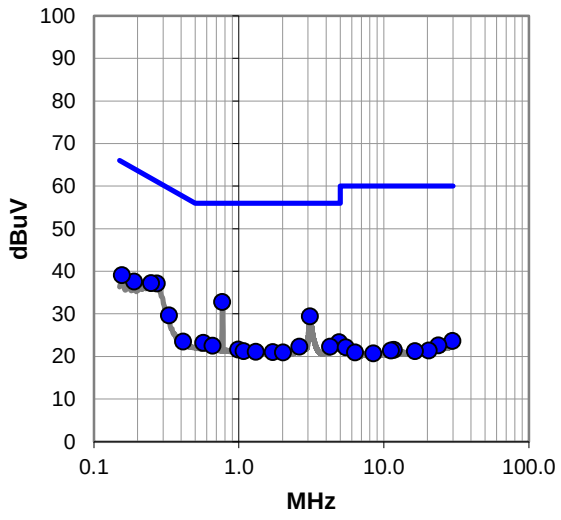
EUT OPERATING MODES

Thermostat On, Z-Wave Radio enabled, 40 kHz baudrate, 908.4 Mhz, all other radios disabled

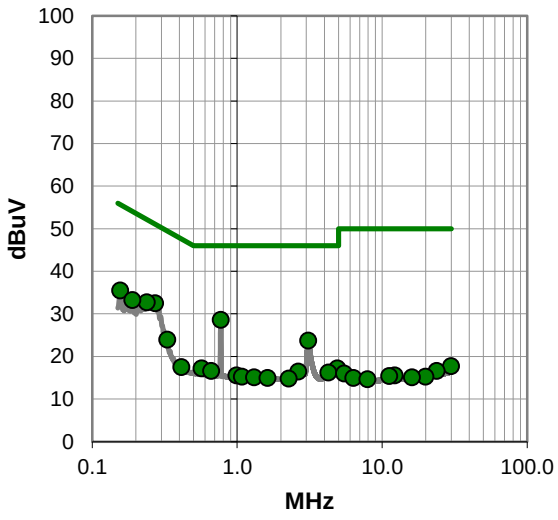
DEVIATIONS FROM TEST STANDARD

None

Quasi Peak Data - vs - Quasi Peak Limit



Average Data - vs - Average Limit



POWERLINE CONDUCTED EMISSIONS

element
WTD.2021.09.21.0
EmiR5 2021.09.09.0
PSA-ESCI 2021.12.10.0

RESULTS - Run #28

Quasi Peak Data - vs - Quasi Peak Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
0.769	12.6	20.2	32.8	56.0	-23.2
0.272	16.7	20.4	37.1	61.1	-24.0
0.248	16.8	20.4	37.2	61.8	-24.6
0.190	17.2	20.4	37.6	64.1	-26.5
0.156	18.7	20.4	39.1	65.7	-26.6
3.098	9.1	20.3	29.4	56.0	-26.6
0.330	9.4	20.2	29.6	59.5	-29.9
4.929	3.0	20.3	23.3	56.0	-32.7
0.570	3.0	20.2	23.2	56.0	-32.8
0.660	2.3	20.2	22.5	56.0	-33.5
2.614	2.0	20.3	22.3	56.0	-33.7
4.267	2.0	20.3	22.3	56.0	-33.7
0.412	3.3	20.2	23.5	57.6	-34.1
0.991	1.4	20.2	21.6	56.0	-34.4
1.079	1.0	20.2	21.2	56.0	-34.8
1.311	0.8	20.3	21.1	56.0	-34.9
1.714	0.7	20.3	21.0	56.0	-35.0
2.016	0.6	20.3	20.9	56.0	-35.1
29.854	1.0	22.6	23.6	60.0	-36.4
23.834	0.5	22.1	22.6	60.0	-37.4
5.472	1.7	20.4	22.1	60.0	-37.9
11.711	0.6	20.9	21.5	60.0	-38.5
11.217	0.5	20.9	21.4	60.0	-38.6
20.426	-0.2	21.6	21.4	60.0	-38.6
16.459	-0.2	21.4	21.2	60.0	-38.8

Average Data - vs - Average Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
0.771	8.4	20.2	28.6	46.0	-17.4
0.272	12.1	20.4	32.5	51.1	-18.6
0.238	12.3	20.4	32.7	52.1	-19.4
0.156	15.1	20.4	35.5	55.7	-20.2
0.190	12.8	20.4	33.2	54.1	-20.9
3.098	3.4	20.3	23.7	46.0	-22.3
0.330	3.7	20.2	23.9	49.5	-25.6
0.570	-3.0	20.2	17.2	46.0	-28.8
4.927	-3.1	20.3	17.2	46.0	-28.8
0.661	-3.6	20.2	16.6	46.0	-29.4
2.648	-3.9	20.3	16.4	46.0	-29.6
4.267	-4.1	20.3	16.2	46.0	-29.8
0.412	-2.7	20.2	17.5	47.6	-30.1
0.991	-4.7	20.2	15.5	46.0	-30.5
1.081	-5.0	20.2	15.2	46.0	-30.8
1.311	-5.2	20.3	15.1	46.0	-30.9
1.624	-5.4	20.3	14.9	46.0	-31.1
2.271	-5.5	20.3	14.8	46.0	-31.2
29.938	-4.9	22.6	17.7	50.0	-32.3
23.834	-5.5	22.1	16.6	50.0	-33.4
5.472	-4.4	20.4	16.0	50.0	-34.0
12.205	-5.5	21.0	15.5	50.0	-34.5
11.215	-5.5	20.9	15.4	50.0	-34.6
19.952	-6.4	21.6	15.2	50.0	-34.8
16.087	-6.3	21.4	15.1	50.0	-34.9

CONCLUSION

Pass

Tested By

FIELD STRENGTH OF HARMONICS AND SPURIOUS RADIATED EMISSIONS

element

PSA-ESCI 2021.03.17.0

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.

FREQUENCIES OF OPERATION

Z-wave Low Frequency 908.4 MHz, Power Level 13
Z-wave High Frequency 916.0 MHz, Power Level 20

MODES OF OPERATION

Z-wave Low Injection Side, 9.6k Baud Rate (Low Frequency Only)
Z-wave High Injection Side, 9.6k Baud Rate (Low Frequency Only)
Z-wave Low Injection Side, 40k Baud Rate (Low Frequency Only)
Z-wave High Injection Side, 40k Baud Rate (Low Frequency Only)
Z-wave Low Injection Side, 100k Baud Rate (High Frequency Only)
Z-wave High Injection Side, 100k Baud Rate (High Frequency Only)

POWER SETTINGS INVESTIGATED

110VAC/60Hz
3.0VDC via Battery

CONFIGURATIONS INVESTIGATED

F3EN0068 - 2

FREQUENCY RANGE INVESTIGATED

Start Frequency	30 MHz	Stop Frequency	12500 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
Filter - High Pass	Micro-Tronics	HPM50108	HGD	2021-09-13	2022-09-13
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
Filter - Band Reject	Wainwright Instruments	WTRCTV5-750-1000-20-70-60EEK	CUL	2022-01-27	2023-01-27
Amplifier - Pre-Amplifier	Miteq	AMF-6F-08001200-30-10P	PAK	2021-09-13	2022-09-13
Cable	Northwest EMC	8-18GHz	TXD	2021-04-30	2022-04-30
Antenna - Standard Gain	ETS Lindgren	3160-07	AJF	NCR	NCR
Amplifier - Pre-Amplifier	Miteq	AMF-3D-00100800-32-13P	PAJ	2021-05-24	2022-05-24
Cable	Northwest EMC	1-8.2 GHz	TXC	2021-05-24	2022-05-24
Antenna - Double Ridge	ETS Lindgren	3115	AJL	2020-10-20	2022-10-20
Filter - Low Pass	Micro-Tronics	LPM50004	HHV	2021-07-27	2022-07-27
Amplifier - Pre-Amplifier	Fairview Microwave	FMAM63001	PAS	2021-05-24	2022-05-24
Cable	Northwest EMC	RE 9kHz - 1GHz	TXB	2021-05-24	2022-05-24
Antenna - Biconilog	ETS Lindgren	3143B	AYF	2020-06-25	2022-06-25
Analyzer - Spectrum Analyzer	Agilent	N9010A	AFL	2021-03-11	2022-03-11

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, 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.

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.

FIELD STRENGTH OF HARMONICS AND SPURIOUS RADIATED EMISSIONS

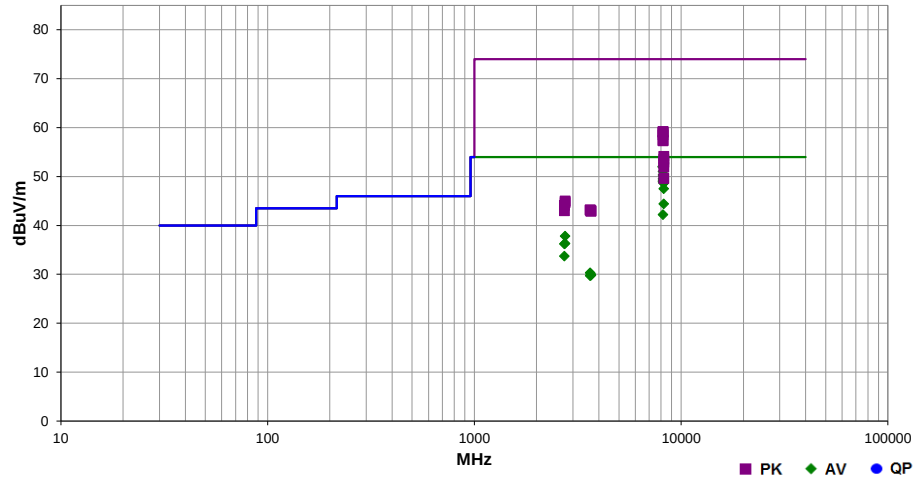
element

EmiRS 2021.09.09.0 PSA-ESCI 2021.03.17.0

Work Order:	F3EN0068	**Date:**	2021-12-07		
Project:	None	**Temperature:**	22.3 °C		
Job Site:	TX02	**Humidity:**	31.1% RH		
Serial Number:	DUT4	**Barometric Pres.:**	1022 mbar	**Tested by:**	Brandon Hobbs
EUT:	Radio Thermostat				
Configuration:	2				
Customer:	Quext				
Attendees:	None				
EUT Power:	Refer to data comments				
Operating Mode:	Z-wave On, Please reference the data comments for EUT orientation, Frequency, Injection, Baud Rate and EUT Power				
Deviations:	None				
Comments:	In the field, the radio has a maximum on-time of 63.5 ms every 100 ms. DCCF of 10*LOG10(63.5/100) = -1.97 applied. Tested at higher power setting than will be used. Final Power setting High channel 916 MHz: 20, Final Power setting Low channel 908.4 MHz: 13				

Test Specifications	**Test Method**
FCC 15.249:2022	ANSI C63.10:2013

Run #	8	**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 (meters)	External Attenuation (dB)	Polarity/ Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)	Comments
8175.780	41.0	13.1	1.5	318.0	-2.0	0.0	Vert	AV	0.0	52.1	54.0	-1.9	EUT Side, Low Freq 908.4MHz, Injection High, 9.6k BR, 63 pwr lvl, VAC 110/60Hz
8175.530	40.9	13.1	1.7	54.0	-2.0	0.0	Horz	AV	0.0	52.0	54.0	-2.0	EUT Side, Low Freq 908.4 MHz, Inject Low, 40k BR, 63 pwr lvl, Battery 3.0VDC
8175.535	40.9	13.1	1.7	54.0	-2.0	0.0	Horz	AV	0.0	52.0	54.0	-2.0	EUT Horz, Low Freq 908.4MHz, Inject Low, 40k BR, 63 pwr lvl, VAC 110/60Hz
8175.700	40.8	13.1	1.5	319.0	-2.0	0.0	Vert	AV	0.0	51.9	54.0	-2.1	EUT Side, Low Freq 908.4 MHz, Inject Low, 40k BR, 63 pwrl, Battery 3.0VDC
8175.710	40.8	13.1	1.5	319.0	-2.0	0.0	Vert	AV	0.0	51.9	54.0	-2.1	EUT Side, Low Freq 908.4MHz, Injection Low, 9.6k BR, 63 pwr lvl, VAC 110/60Hz
8175.535	39.9	13.1	2.2	333.0	-2.0	0.0	Vert	AV	0.0	51.0	54.0	-3.0	EUT Side, Low Freq 908.4MHz, Inject Low, 40k BR, 63 pwr lvl, VAC 110/60Hz
8175.542	39.2	13.1	1.5	320.0	-2.0	0.0	Horz	AV	0.0	50.3	54.0	-3.7	EUT Side, 908.4 MHz, Injection Low, 40k baud, 13 pwr lvl, VAC 110/60Hz
8243.900	58.5	-6.4	2.4	321.8	-2.0	0.0	Horz	AV	0.0	50.1	54.0	-3.9	EUT Side, 916.0 MHz, Injection Low, 100k BR 20 pwr lvl, VAC 110/60Hz
8243.933	58.4	-6.4	3.1	207.0	-2.0	0.0	Horz	AV	0.0	50.0	54.0	-4.0	EUT Vert, 916.0 MHz, Injection Low, 100k BR, 63 pwr lvl, VAC 110/60Hz
8243.917	58.1	-6.4	2.4	321.8	-2.0	0.0	Horz	AV	0.0	49.7	54.0	-4.3	EUT Side, 916.0 MHz, Injection Low, 100k BR 15 pwr lvl, VAC 110/60Hz
8175.445	38.4	13.1	1.5	321.0	-2.0	0.0	Horz	AV	0.0	49.5	54.0	-4.5	EUT Vert, Low Freq 908.4MHz, Inject Low, 40k BR, 63 pwr lvl, VAC 110/60Hz
8243.892	57.6	-6.4	3.4	4.9	-2.0	0.0	Vert	AV	0.0	49.2	54.0	-4.8	EUT Side, 916.0 MHz, Injection Low, 100k BR, 63 pwr lvl, VAC 110/60Hz
8175.508	38.0	13.1	1.5	320.0	-2.0	0.0	Horz	AV	0.0	49.1	54.0	-4.9	EUT Side, 908.4 MHz, Injection Low, 40k baud, 11 pwr lvl, VAC 110/60Hz
8175.515	37.8	13.1	1.5	316.9	-2.0	0.0	Vert	AV	0.0	48.9	54.0	-5.1	EUT Side, Low Freq 908.4MHz, Injection High, 40k BR, 63 pwr lvl, VAC 110/60Hz
8243.908	57.1	-6.4	2.4	321.8	-2.0	0.0	Horz	AV	0.0	48.7	54.0	-5.3	EUT Side, 916.0 MHz, Injection Low, 100k BR 13 pwr lvl, VAC 110/60Hz
8243.917	57.0	-6.4	1.4	57.0	-2.0	0.0	Horz	AV	0.0	48.6	54.0	-5.4	EUT Horz, 916.0 MHz, Injection Low, 100k BR, 63 pwr lvl, VAC 110/60Hz
8243.900	55.9	-6.4	1.4	9.0	-2.0	0.0	Vert	AV	0.0	47.5	54.0	-6.5	EUT Horz, 916.0 MHz, Injection Low, 100k BR, 63 pwr lvl, VAC 110/60Hz
8244.042	52.8	-6.4	1.0	333.0	-2.0	0.0	Vert	AV	0.0	44.4	54.0	-9.6	EUT Side, 916.0 MHz, Injection High, 100k BR, 63 pwr lvl, VAC 110/60Hz
8175.417	31.1	13.1	1.5	320.0	-2.0	0.0	Horz	AV	0.0	42.2	54.0	-11.8	EUT Side, 908.4 MHz, Injection Low, 40k BR, 03 pwrl, VAC 110/60Hz
8175.970	46.1	13.1	1.5	319.0	0.0	0.0	Vert	PK	0.0	59.2	74.0	-14.8	EUT Side, Low Freq 908.4MHz, Injection Low, 9.6k BR, 63 pwr lvl, VAC 110/60Hz
8175.205	46.0	13.1	1.7	54.0	0.0	0.0	Horz	PK	0.0	59.1	74.0	-14.9	EUT Horz, Low Freq 908.4MHz, Inject Low, 40k BR, 63 pwr lvl, VAC 110/60Hz
8175.335	45.9	13.1	1.5	318.0	0.0	0.0	Vert	PK	0.0	59.0	74.0	-15.0	EUT Side, Low Freq 908.4MHz, Injection High, 9.6k BR, 63 pwr lvl, VAC 110/60Hz
8175.415	45.4	13.1	2.2	333.0	0.0	0.0	Vert	PK	0.0	58.5	74.0	-15.5	EUT Side, Low Freq 908.4MHz, Inject Low, 40k BR, 63 pwr lvl, VAC 110/60Hz
2748.050	43.1	-3.3	2.6	315.0	-2.0	0.0	Horz	AV	0.0	37.8	54.0	-16.2	EUT Side, 916.0 MHz, Injection Low, 100k BR, 63 pwr lvl, VAC 110/60Hz
8175.805	44.3	13.1	1.5	321.0	0.0	0.0	Horz	PK	0.0	57.4	74.0	-16.6	EUT Vert, Low Freq 908.4MHz, Inject Low, 40k BR, 63 pwr lvl, VAC 110/60Hz
8175.400	44.2	13.1	1.5	316.9	0.0	0.0	Vert	PK	0.0	57.3	74.0	-16.7	EUT Side, Low Freq 908.4MHz, Injection High, 40k BR, 63 pwr lvl, VAC 110/60Hz
2748.042	41.6	-3.3	1.4	330.0	-2.0	0.0	Vert	AV	0.0	36.3	54.0	-17.7	EUT Vert, 916.0 MHz, Injection Low, 100k BR, 63 pwr lvl, VAC 110/60Hz
2725.205	41.6	-3.4	1.5	332.0	-2.0	0.0	Vert	AV	0.0	36.2	54.0	-17.8	EUT Vert, Low Freq 908.4MHz, Inject Low, 40k BR, 63 pwr lvl, VAC 110/60Hz
8243.683	60.5	-6.4	3.1	207.0	0.0	0.0	Horz	PK	0.0	54.1	74.0	-19.9	EUT Vert, 916.0 MHz, Injection Low, 100k BR, 63 pwr lvl, VAC 110/60Hz
2725.185	39.1	-3.4	1.5	331.0	-2.0	0.0	Horz	AV	0.0	33.7	54.0	-20.3	EUT Side, Low Freq 908.4MHz, Injection Low, 40k BR, 63 pwr lvl, VAC 110/60Hz
8243.950	59.9	-6.4	3.4	4.9	0.0	0.0	Vert	PK	0.0	53.5	74.0	-20.5	EUT Side, 916.0 MHz, Injection Low, 100k BR, 63 pwr lvl, VAC 110/60Hz
8244.083	59.3	-6.4	1.4	57.0	0.0	0.0	Horz	PK	0.0	52.9	74.0	-21.1	EUT Horz, 916.0 MHz, Injection Low, 100k BR, 63 pwr lvl, VAC 110/60Hz
8244.167	58.3	-6.4	1.4	9.0	0.0	0.0	Vert	PK	0.0	51.9	74.0	-22.1	EUT Horz, 916.0 MHz, Injection Low, 100k BR, 63 pwr lvl, VAC 110/60Hz
3633.585	31.0	1.3	4.0	297.9	-2.0	0.0	Vert	AV	0.0	30.3	54.0	-23.7	EUT Vert, Low Freq 908.4MHz, Inject Low, 40k BR, 63 pwr lvl, VAC 110/60Hz
3663.942	30.5	1.5	1.5	230.0	-2.0	0.0	Horz	AV	0.0	30.0	54.0	-24.0	EUT Side, 916.0 MHz, Injection Low, 100k BR, 63 pwr lvl, VAC 110/60Hz
3664.533	30.3	1.5	1.5	51.0	-2.0	0.0	Vert	AV	0.0	29.8	54.0	-24.2	EUT Vert, 916.0 MHz, Injection Low, 100k BR, 63 pwr lvl, VAC 110/60Hz
3633.400	30.4	1.3	1.5	325.0	-2.0	0.0	Horz	AV	0.0	29.7	54.0	-24.3	EUT Side, Low Freq 908.4MHz, Injection Low, 40k BR, 63 pwr lvl, VAC 110/60Hz
8244.292	56.0	-6.4	1.0	333.0	0.0	0.0	Vert	PK	0.0	49.6	74.0	-24.4	EUT Side, 916.0 MHz, Injection High, 100k BR, 63 pwr lvl, VAC 110/60Hz
2748.008	48.3	-3.3	2.6	315.0	0.0	0.0	Horz	PK	0.0	45.0	74.0	-29.0	EUT Side, 916.0 MHz, Injection Low, 100k BR, 63 pwr lvl, VAC 110/60Hz
2747.983	48.0	-3.3	1.4	330.0	0.0	0.0	Vert	PK	0.0	44.7	74.0	-29.3	EUT Vert, 916.0 MHz, Injection Low, 100k BR, 63 pwr lvl, VAC 110/60Hz
2725.000	47.5	-3.4	1.5	332.0	0.0	0.0	Vert	PK	0.0	44.1	74.0	-29.9	EUT Vert, Low Freq 908.4MHz, Inject Low, 40k BR, 63 pwr lvl, VAC 110/60Hz
3633.645	41.9	1.3	4.0	297.9	0.0	0.0	Vert	PK	0.0	43.2	74.0	-30.8	EUT Vert, Low Freq 908.4MHz, Inject Low, 40k BR, 63 pwr lvl, VAC 110/60Hz
3634.190	41.8	1.3	1.5	325.0	0.0	0.0	Horz	PK	0.0	43.1	74.0	-30.9	EUT Side, Low Freq 908.4MHz, Injection Low, 40k BR, 63 pwr lvl, VAC 110/60Hz
2725.160	46.4	-3.4	1.5	331.0	0.0	0.0	Horz	PK	0.0	43.0	74.0	-31.0	EUT Side, Low Freq 908.4MHz, Injection Low, 40k BR, 63 pwr lvl, VAC 110/60Hz
3665.950	41.5	1.5	1.5	230.0	0.0	0.0	Horz	PK	0.0	43.0	74.0	-31.0	EUT Side, 916.0 MHz, Injection Low, 100k BR, 63 pwr lvl, VAC 110/60Hz
3661.900	41.4	1.5	1.5	51.0	0.0	0.0	Vert	PK	0.0	42.9	74.0	-31.1	EUT Vert, 916.0 MHz, Injection Low, 100k BR, 63 pwr lvl, VAC 110/60Hz

BAND EDGE

element
WTD.2022.02.22.0
EmiR5 2022.07.06.0
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, 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.

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.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Analyzer - Spectrum Analyzer	Agilent	E4440A	AFG	2022-05-18	2023-05-18
Amplifier - Pre-Amplifier	Miteq	AM-1064-9079 and SA18E-10	AOO	2022-01-24	2023-01-24
Cable	Element	Biconilog Cable	MNX	2022-01-24	2023-01-24
Antenna - Biconilog	Ametek	CBL 6141B	AYS	2021-03-09	2023-03-09
Filter - Low Pass	Micro-Tronics	LPM50003	HGL	2021-09-10	2022-09-10
Attenuator	Coaxicom	3910-10	AWZ	2021-09-10	2022-09-10

MEASUREMENT UNCERTAINTY

Description		
Expanded k=2	4.7 dB	-4.7 dB

BAND EDGE

element
WTD.2022.02.22.0
EmiR5 2022.07.06.0
PSA-ESCI 2022.1.12.0

FREQUENCY RANGE INVESTIGATED

900 MHz TO 930 MHz

POWER INVESTIGATED

110VAC/60Hz

CONFIGURATIONS INVESTIGATED

F3EN0068-4

MODES INVESTIGATED

Transmitting Z-wave Low Channel 908.4 MHz, Pwr 13, 40k and 9.6k, High Channel 916 MHz, Pwr 20, 100k; modulated

BAND EDGE

element
WTD.2022.02.22.0
EmiR5 2022.07.06.0
PSA-ESCI 2022.1.12.0

EUT:	Radio Thermostat	Work Order:	F3EN0068
Serial Number:	DUT11	Date:	2022-07-12
Customer:	Quext	Temperature:	20.4°C
Attendees:	None	Relative Humidity:	55.6%
Customer Project:	None	Bar. Pressure (PMSL):	1014 mb
Tested By:	Chris Patterson	Job Site:	MN09
Power:	110VAC/60Hz	Configuration:	F3EN0068-4

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.249:2022	ANSI C63.10:2013

TEST PARAMETERS

Run #:	6	Test Distance (m):	3	Ant. Height(s) (m):	1 to 4(m)

COMMENTS

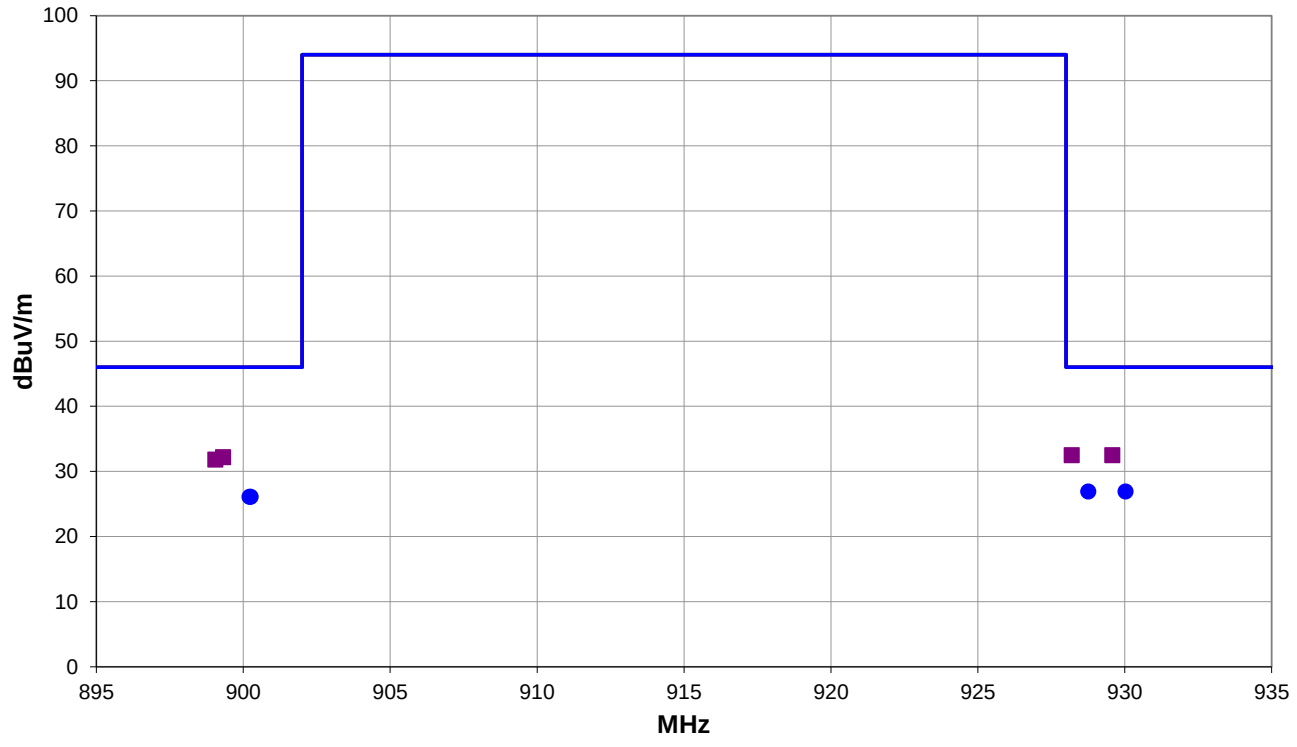
None

EUT OPERATING MODES

Transmitting Z-wave Low Channel 908.4 MHz, Pwr 13, 40k and 9.6k, High Channel 916 MHz, Pwr 20, 100k; modulated

DEVIATIONS FROM TEST STANDARD

None



Run #: 6 PK AV QP

BAND EDGE

element
WTD.2022.02.22.0
EmiR5 2022.07.06.0
PSA-ESCI 2022.1.12.0

RESULTS - Run #6

Freq (MHz)	Amplitude (dBuV)	Factor (dB/m)	Antenna Height (meters)	Azimuth (degrees)	Test Distance (meters)	External Attenuation (dB)	Polarity/ Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)	Comments
928.195	21.5	11.0	3.05	229.0	3.0	0.0	Horz	PK	0.0	32.5	46.0	-13.5	EUT Vert, High Ch, 100k
929.575	21.4	11.1	1.0	219.0	3.0	0.0	Vert	PK	0.0	32.5	46.0	-13.5	EUT Vert, High Ch, 100k
899.310	22.0	10.2	1.0	33.0	3.0	0.0	Vert	PK	0.0	32.2	46.0	-13.8	EUT On Side, Low Ch, 40k
899.045	21.6	10.2	3.3	43.0	3.0	0.0	Horz	PK	0.0	31.8	46.0	-14.2	EUT On Side, Low Ch, 40k
930.030	15.8	11.1	3.05	229.0	3.0	0.0	Horz	QP	0.0	26.9	46.0	-19.1	EUT Vert, High Ch, 100k
928.759	15.8	11.1	1.0	219.0	3.0	0.0	Vert	QP	0.0	26.9	46.0	-19.1	EUT Vert, High Ch, 100k
900.252	15.8	10.3	3.3	43.0	3.0	0.0	Horz	QP	0.0	26.1	46.0	-19.9	EUT On Side, Low Ch, 40k
900.209	15.8	10.3	1.0	33.0	3.0	0.0	Vert	QP	0.0	26.1	94.0	-67.9	EUT On Side, Low Ch, 40k

CONCLUSION

Pass

Tested By

FIELD STRENGTH OF FUNDAMENTAL

element
WTD.2022.02.22.0
EmiR5 2022.07.06.0
PSA-ESCI 2022.1.12.0

TEST DESCRIPTION

The antennas to be used with the EUT were tested. The EUT was transmitting and while set at the lowest channel, a middle channel, and the highest channel available. While scanning, emissions from the EUT were maximized by rotating the EUT, adjusting the measurement antenna height and polarization, and manipulating the EUT and EUT antenna in 3 orthogonal planes.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Analyzer - Spectrum Analyzer	Agilent	E4440A	AFG	2022-05-18	2023-05-18
Amplifier - Pre-Amplifier	Miteq	AM-1064-9079 and SA18E-10	AOO	2022-01-24	2023-01-24
Cable	Element	Biconilog Cable	MNX	2022-01-24	2023-01-24
Antenna - Biconilog	Ametek	CBL 6141B	AYS	2021-03-09	2023-03-09
Filter - Low Pass	Micro-Tronics	LPM50003	HGL	2021-09-10	2022-09-10
Attenuator	Coaxicom	3910-10	AWZ	2021-09-10	2022-09-10

MEASUREMENT UNCERTAINTY

Description		
Expanded k=2	4.7 dB	-4.7 dB

FREQUENCY RANGE INVESTIGATED

900 MHz TO 930 MHz

POWER INVESTIGATED

110VAC/60Hz

CONFIGURATIONS INVESTIGATED

F3EN0068-4

MODES INVESTIGATED

Transmitting Z-wave Low Channel 908.4 MHz, Pwr 13, 40k and 9.6k, High Channel 916 MHz, Pwr 20, 100k; modulated

FIELD STRENGTH OF FUNDAMENTAL

element
WTD.2022.02.22.0
EmiR5 2022.07.06.0
PSA-ESCI 2022.1.12.0

EUT:	Radio Thermostat	Work Order:	F3EN0068
Serial Number:	DUT11	Date:	2022-07-12
Customer:	Quext	Temperature:	20.4°C
Attendees:	None	Relative Humidity:	55.6%
Customer Project:	None	Bar. Pressure (PMSL):	1014 mb
Tested By:	Chris Patterson	Job Site:	MN09
Power:	110VAC/60Hz	Configuration:	F3EN0068-4

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.249:2022	ANSI C63.10:2013

TEST PARAMETERS

Run #:	6	Test Distance (m):	3	Ant. Height(s) (m):	1 to 4(m)

COMMENTS

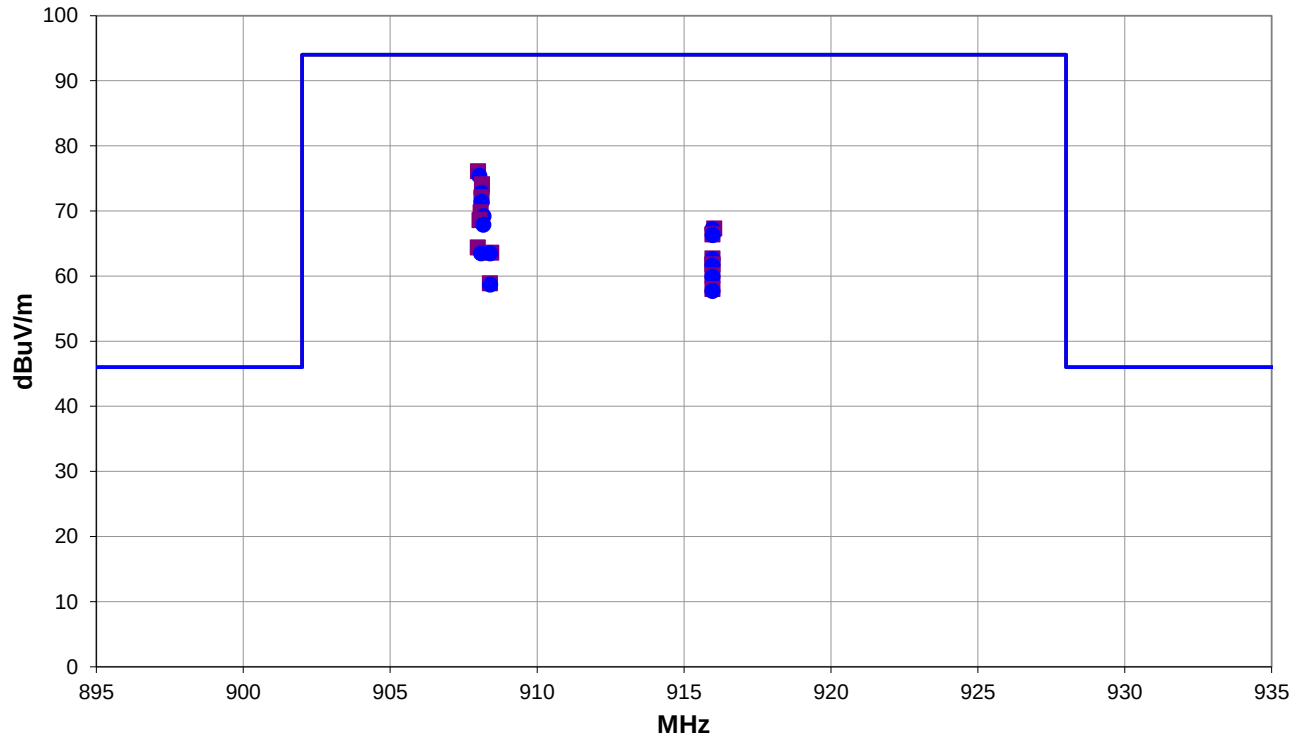
None

EUT OPERATING MODES

Transmitting Z-wave Low Channel 908.4 MHz, Pwr 13, 40k and 9.6k, High Channel 916 MHz, Pwr 20, 100k; modulated

DEVIATIONS FROM TEST STANDARD

None



Run #: 6 PK AV QP

FIELD STRENGTH OF FUNDAMENTAL

element
WTD.2022.02.22.0
EmiR5 2022.07.06.0
PSA-ESCI 2022.1.12.0

RESULTS - Run #6

Freq (MHz)	Amplitude (dBuV)	Factor (dB/m)	Antenna Height (meters)	Azimuth (degrees)	Test Distance (meters)	External Attenuation (dB)	Polarity/ Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)	Comments
907.990	65.8	10.3	1.0	40.0	3.0	0.0	Horz	PK	0.0	76.1	94.0	-17.9	EUT On Side, Low Ch, 40k
908.031	65.1	10.3	1.0	40.0	3.0	0.0	Horz	QP	0.0	75.4	94.0	-18.6	EUT On Side, Low Ch, 40k
908.120	63.8	10.3	1.0	45.0	3.0	0.0	Horz	PK	0.0	74.1	94.0	-19.9	EUT Horz, Low Ch, 40k
908.112	62.5	10.3	1.0	45.0	3.0	0.0	Horz	QP	0.0	72.8	94.0	-21.2	EUT Horz, Low Ch, 40k
908.105	61.8	10.3	1.28	315.0	3.0	0.0	Vert	PK	0.0	72.1	94.0	-21.9	EUT On Side, Low Ch, 40k
908.110	61.1	10.3	1.28	315.0	3.0	0.0	Vert	QP	0.0	71.4	94.0	-22.6	EUT On Side, Low Ch, 40k
908.075	59.5	10.3	1.15	53.0	3.0	0.0	Vert	PK	0.0	69.8	94.0	-24.2	EUT Vert, Low Ch, 40k
908.177	58.9	10.3	1.15	53.0	3.0	0.0	Vert	QP	0.0	69.2	94.0	-24.8	EUT Vert, Low Ch, 40k
908.040	58.3	10.3	1.0	219.0	3.0	0.0	Horz	PK	0.0	68.6	94.0	-25.4	EUT Vert, Low Ch, 40k
908.168	57.6	10.3	1.0	219.0	3.0	0.0	Horz	QP	0.0	67.9	94.0	-26.1	EUT Vert, Low Ch, 40k
916.025	56.8	10.5	1.0	1.0	3.0	0.0	Horz	PK	0.0	67.3	94.0	-26.7	EUT Vert, High Ch, 100k
915.970	56.7	10.5	1.0	1.0	3.0	0.0	Horz	QP	0.0	67.2	94.0	-26.8	EUT Vert, High Ch, 100k
915.970	55.9	10.5	1.0	13.0	3.0	0.0	Horz	PK	0.0	66.4	94.0	-27.6	EUT On Side, High Ch, 100k
915.972	55.8	10.5	1.0	13.0	3.0	0.0	Horz	QP	0.0	66.3	94.0	-27.7	EUT On Side, High Ch, 100k
907.980	54.1	10.3	1.02	184.0	3.0	0.0	Vert	PK	0.0	64.4	94.0	-29.6	EUT Horz, Low Ch, 40k
908.435	53.3	10.3	1.0	60.0	3.0	0.0	Horz	PK	0.0	63.6	94.0	-30.4	EUT On Side, Low Ch, 9.6k
908.090	53.2	10.3	1.02	184.0	3.0	0.0	Vert	QP	0.0	63.5	94.0	-30.5	EUT Horz, Low Ch, 40k
908.399	53.2	10.3	1.0	60.0	3.0	0.0	Horz	QP	0.0	63.5	94.0	-30.5	EUT On Side, Low Ch, 9.6k
915.965	52.2	10.5	1.09	12.0	3.0	0.0	Vert	PK	0.0	62.7	94.0	-31.3	EUT Vert, High Ch, 100k
915.971	52.1	10.5	1.09	12.0	3.0	0.0	Vert	QP	0.0	62.6	94.0	-31.4	EUT Vert, High Ch, 100k
915.970	51.3	10.5	1.0	111.0	3.0	0.0	Horz	PK	0.0	61.8	94.0	-32.2	EUT Vert, High Ch, 100k
915.970	51.1	10.5	1.0	111.0	3.0	0.0	Horz	QP	0.0	61.6	94.0	-32.4	EUT Vert, High Ch, 100k
915.965	49.6	10.5	1.0	295.0	3.0	0.0	Vert	PK	0.0	60.1	94.0	-33.9	EUT On Side, High Ch, 100k
915.971	49.4	10.5	1.0	295.0	3.0	0.0	Vert	QP	0.0	59.9	94.0	-34.1	EUT On Side, High Ch, 100k
908.395	48.6	10.3	1.19	178.0	3.0	0.0	Vert	PK	0.0	58.9	94.0	-35.1	EUT On Side, Low Ch, 9.6k
908.399	48.4	10.3	1.19	178.0	3.0	0.0	Vert	QP	0.0	58.7	94.0	-35.3	EUT On Side, Low Ch, 9.6k
915.970	47.5	10.5	1.08	95.0	3.0	0.0	Vert	PK	0.0	58.0	94.0	-36.0	EUT Vert, High Ch, 100k
915.970	47.2	10.5	1.08	95.0	3.0	0.0	Vert	QP	0.0	57.7	94.0	-36.3	EUT Vert, High Ch, 100k

CONCLUSION

Pass

Tested By

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.

OCCUPIED 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
Attenuator	Fairview Microwave	18B5W-26	RFY	2022-05-30	2023-05-30
Block - DC	Fairview Microwave	SD3379	AMI	2021-08-13	2022-08-13
Cable	Micro-Coax	UFD150A-1-0720-200200	MNL	2021-09-12	2022-09-12
Analyzer - Spectrum Analyzer	Agilent	E4446A	AAQ	2022-06-10	2023-06-10
Generator - Signal	Agilent	N5182A	TIF	2020-08-29	2023-08-29

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer.

Per FCC part 15.215, the 20 dB occupied bandwidth was measured with the EUT set to low and high transmit frequencies in the band. The EUT was transmitting at the data rate(s) listed in the datasheet. The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts.

The 20 dB occupied bandwidth was measured and used to determine the Resolution Bandwidth needed during Output Power measurement.

OCCUPIED BANDWIDTH

XMit 2022.02.07.0

EUT:	**Radio Thermostat**			**Work Order:**	**F3EN0068**
Serial Number:	**DUT2**			**Date:**	**13-Jul-22**
Customer:	**Quext**			**Temperature:**	**20.4 °C**
Attendees:	**None**			**Humidity:**	**54.8% RH**
Project:	**None**			**Barometric Pres.:**	**1020 mbar**
Tested by:	**Kyle McMullan**	**Power:**	**110VAC/60Hz**	**Job Site:**	**MN08**

TEST SPECIFICATIONS	**Test Method**
FCC 15.215:2022	ANSI C63.10:2013

COMMENTS

None

DEVIATIONS FROM TEST STANDARD

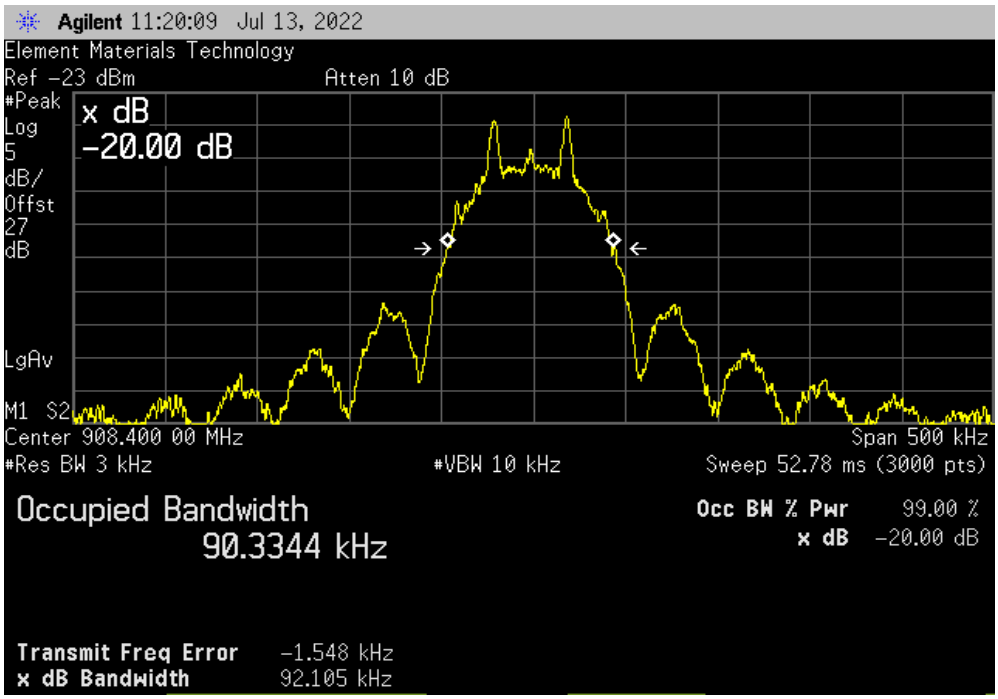
None

Configuration #	**7**	*Signature*

		Value	**Limit**	**Result**
Z-Wave 902 - 928 MHz Band				
LO injection Side Low				
40k baudrate				
	Low Frequency 908.4 MHz	92.105 kHz	N/A	N/A
9.6k baudrate				
	Low Frequency 908.4 MHz	97.540 kHz	N/A	N/A
100k baudrate				
	High Frequency 916 MHz	123.849 kHz	N/A	N/A
LO injection Side High				
40k baudrate				
	Low Frequency 908.4 MHz	89.214 kHz	N/A	N/A
9.6k baudrate				
	Low Frequency 908.4 MHz	97.386 kHz	N/A	N/A
100k baudrate				
	High Frequency 916 MHz	124.348 kHz	N/A	N/A

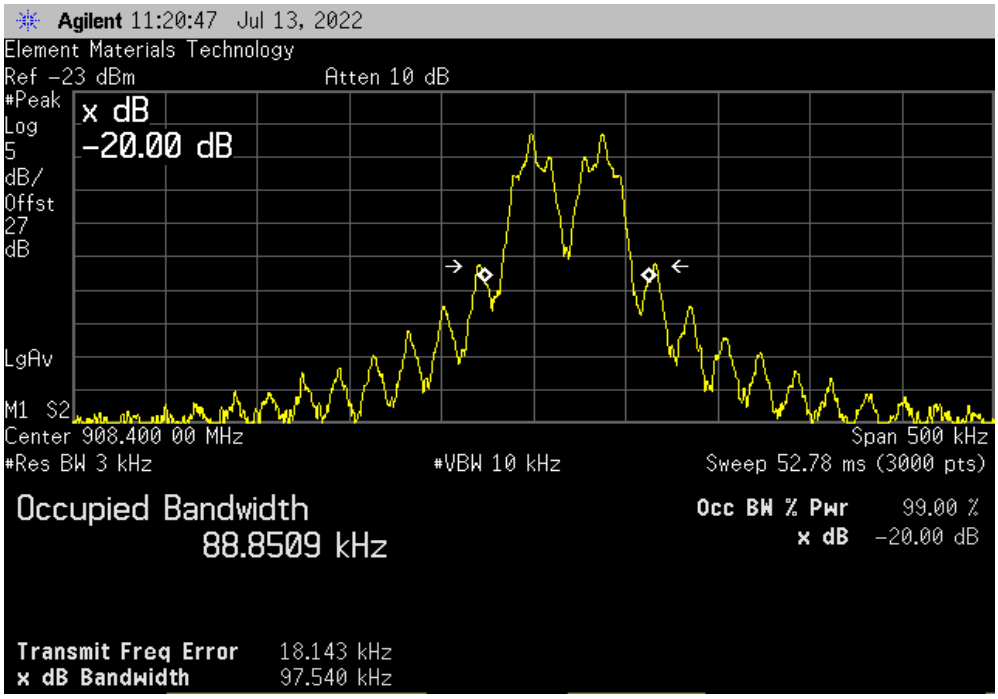
Z-Wave 902 - 928 MHz Band, LO injection Side Low, 40k baudrate, Low Frequency 908.4 MHz

				Value	Limit	Result
				92.105 kHz	N/A	N/A



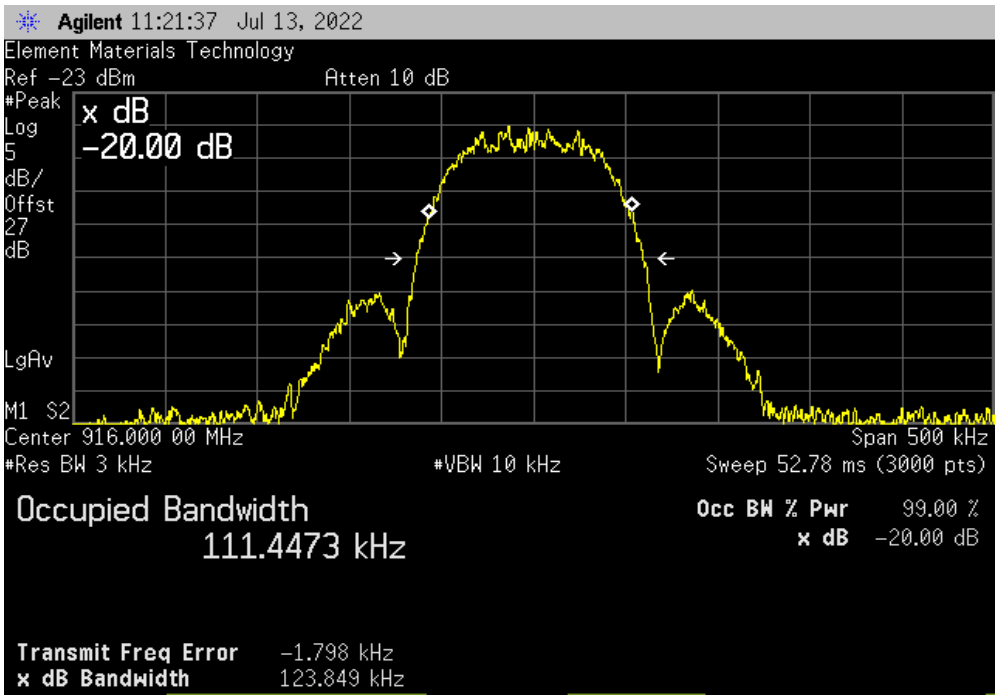
Z-Wave 902 - 928 MHz Band, LO injection Side Low, 9.6k baudrate, Low Frequency 908.4 MHz

				Value	Limit	Result
				97.540 kHz	N/A	N/A



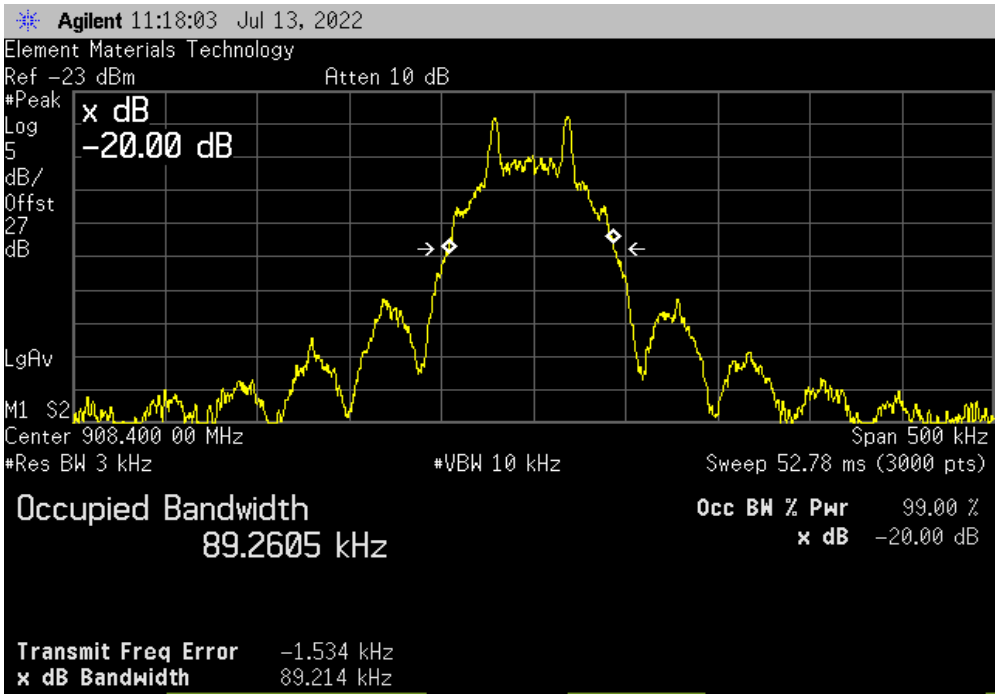
Z-Wave 902 - 928 MHz Band, LO injection Side Low, 100k baudrate, High Frequency 916 MHz

				Value	Limit	Result
				123.849 kHz	N/A	N/A



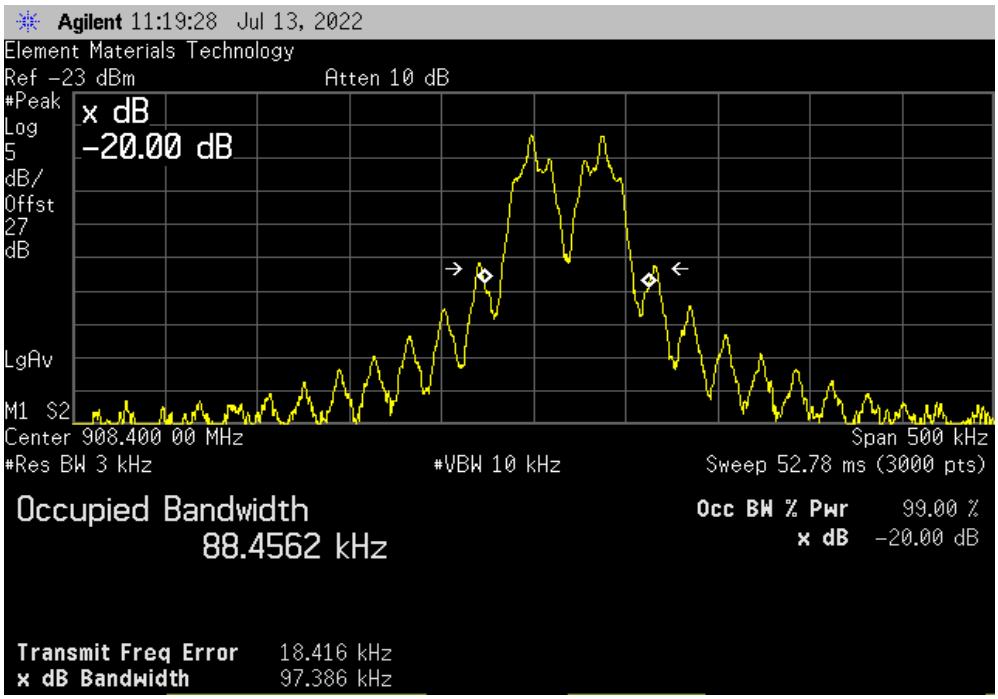
Z-Wave 902 - 928 MHz Band, LO injection Side High, 40k baudrate, Low Frequency 908.4 MHz

				Value	Limit	Result
				89.214 kHz	N/A	N/A



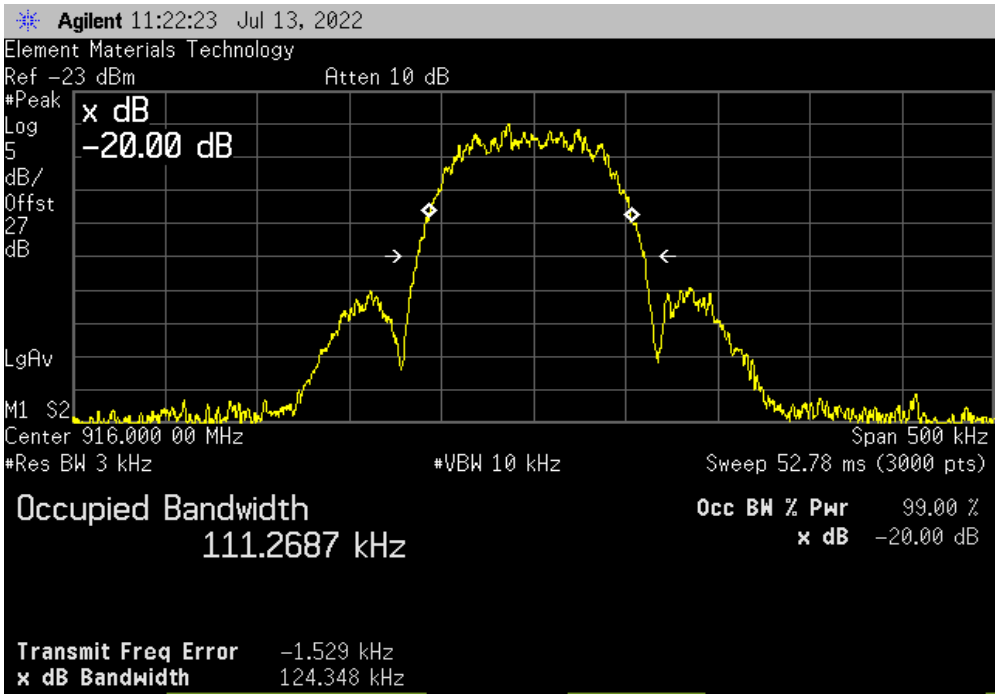
Z-Wave 902 - 928 MHz Band, LO injection Side High, 9.6k baudrate, Low Frequency 908.4 MHz

				Value	Limit	Result
				97.386 kHz	N/A	N/A



Z-Wave 902 - 928 MHz Band, LO injection Side High, 100k baudrate, High Frequency 916 MHz

				Value	Limit	Result
				124.348 kHz	N/A	N/A



End of Test Report