



element

Quext

Radio Thermostat

FCC 15.247:2022
LoRa DSS Transceiver

Report: F3EN0068.5 Rev. 1, Issue Date: July 26, 2022



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CERTIFICATE OF TEST

Last Date of Test: July 7, 2022

Quext

EUT: Radio Thermostat

Radio Equipment Testing

Standards

Specification	Method
FCC 15.207:2022	ANSI C63.10:2013, KDB 558074
FCC 15.247:2022	

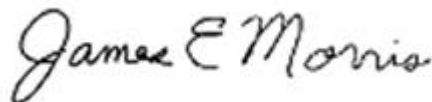
Results

Method Clause	Test Description	Applied	Results	Comments
6.2	Powerline Conducted Emissions (Transmitter)	Yes	Pass	
6.5, 6.6	Spurious Radiated Emissions	Yes	Pass	
6.5, 6.6	Spurious Radiated Emissions - Simultaneous Transmissions	No	N/A	Not required.
7.5	Duty Cycle	Yes	Pass	
7.8.2	Carrier Frequency Separation	Yes	Pass	
7.8.3	Number of Hopping Frequencies	Yes	Pass	
7.8.4	Dwell Time	Yes	Pass	
11.9.1	Output Power	Yes	Pass	
11.9.1	Equivalent Isotropic Radiated Power	Yes	Pass	
7.8.6	Band Edge Compliance	Yes	Pass	
7.8.6	Band Edge Compliance - Hopping Mode	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 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	Added type of modulation for this radio in the Power Settings and Antenna page.	2022-07-14	11
	Updated CoT to reflect the 11.9 section for output power.	2022-07-14	2
	Replaced old Dwell Time data with new retest	2022-07-14	33-41
	Added configuration F3EN0068-7 from new Dwell time data	2022-07-14	17
	Updated spurious radiated emissions photos in the photos only report.	2022-07-14	N/A
	Updated last date of test.	2022-07-14	2, 10, 17

ACCREDITATIONS AND AUTHORIZATIONS



United States

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

A2LA - 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

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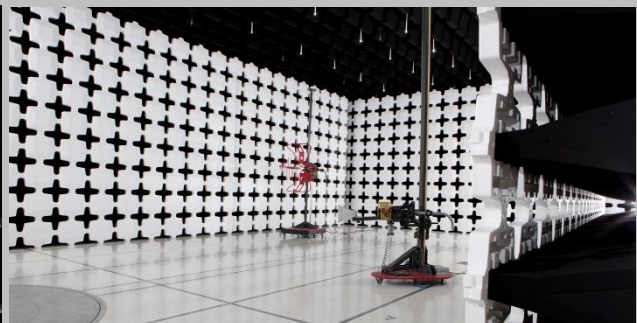
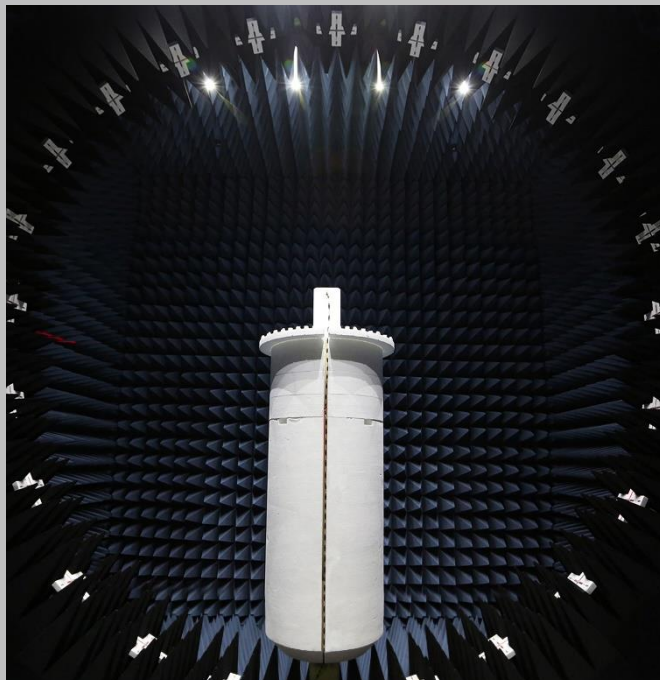
[Texas](#)

[Washington](#)

FACILITIES



California Labs OC01-17 41 Tesla Irvine, CA 92618 (949) 861-8918	Minnesota Labs MN01-11 9349 W Broadway Ave. Brooklyn Park, MN 55445 (612)-638-5136	Oregon Labs EV01-12 6775 NE Evergreen Pkwy #400 Hillsboro, OR 97124 (503) 844-4066	Texas Labs TX01-09 3801 E Plano Pkwy Plano, TX 75074 (469) 304-5255	Washington Labs NC01-05 19201 120 th 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

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

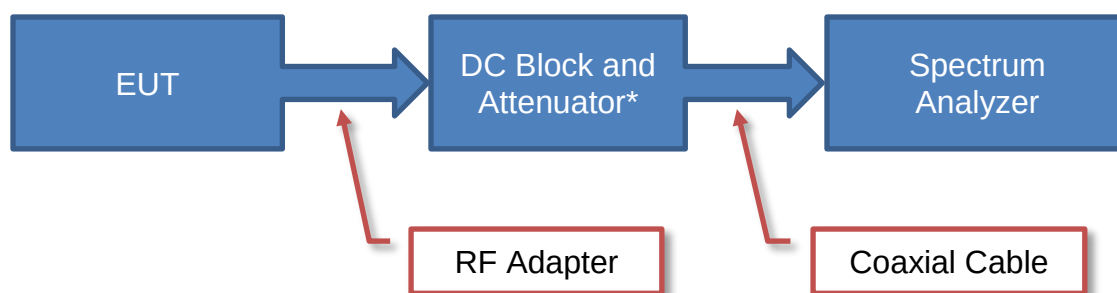
TEST SETUP BLOCK DIAGRAMS

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

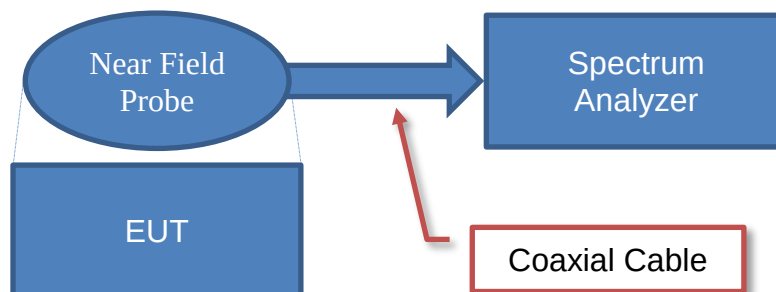


Sample Calculation (logarithmic units)

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

*Note: reference level offset included losses due to pigtail connection to EUT

Near Field Test Fixture Measurements

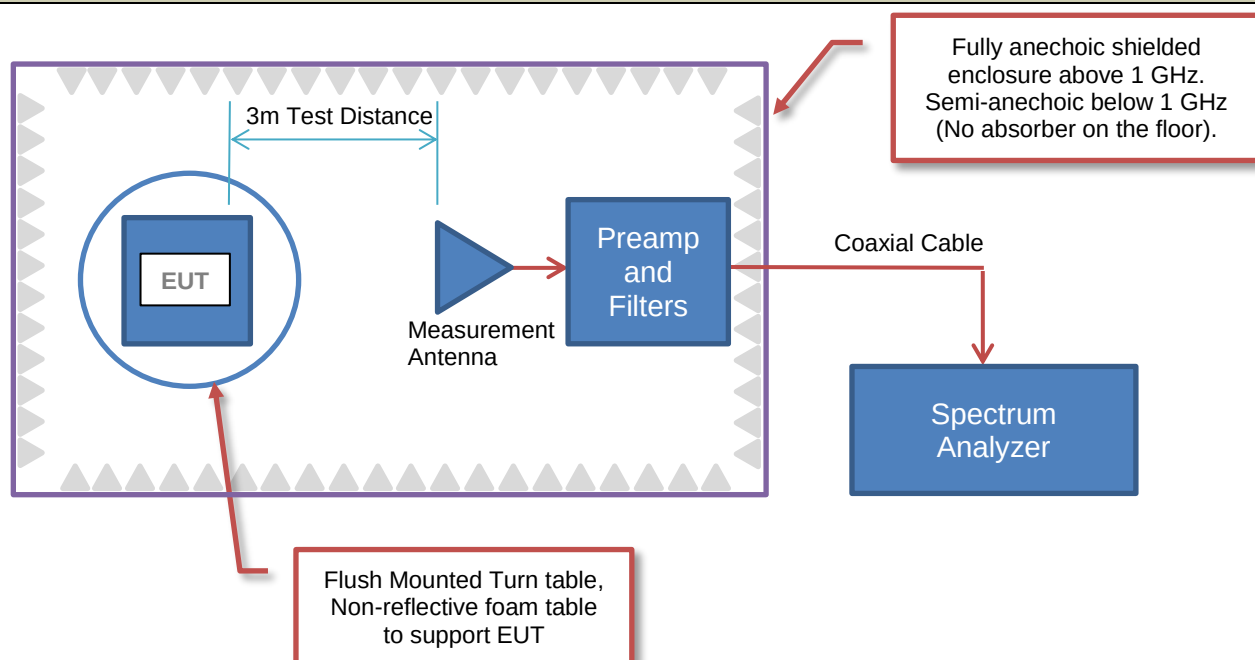


Sample Calculation (logarithmic units)

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				Distance Adjustment Factor	External Attenuation	Field Strength
	Antenna Factor	Cable Factor	Amplifier Gain				
42.6	28.6	3.1	40.8	+	0.0	0.0	= 33.5

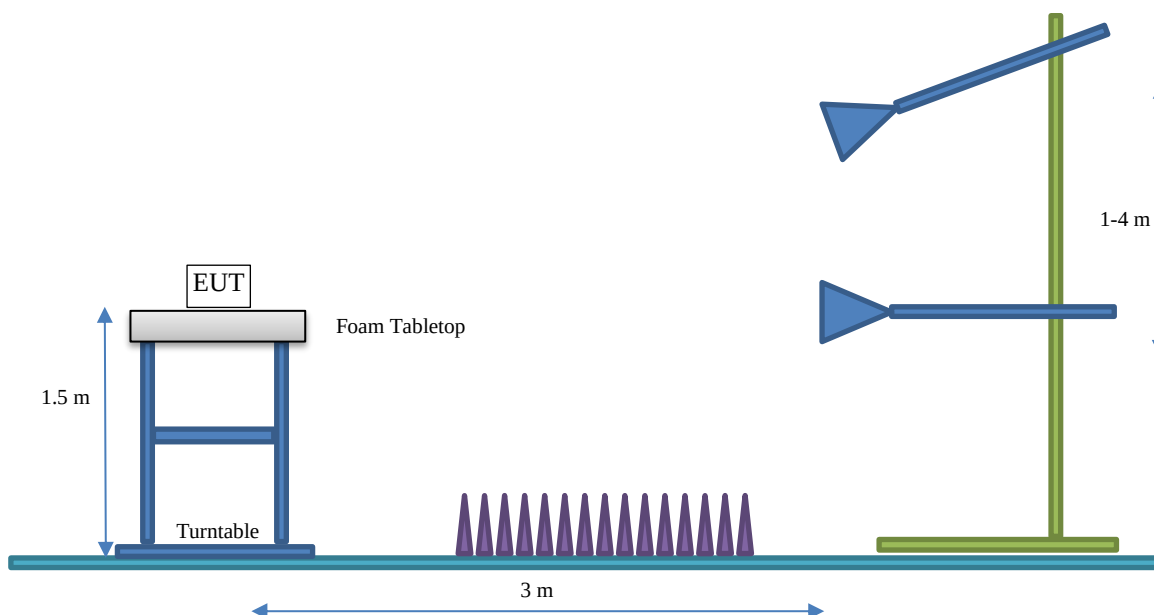
Conducted Emissions:

Measured Level (Amplitude)	Factor			External Attenuation	Adjusted Level
	Transducer Factor	Cable Factor			
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 68 th St, Ste 201
City, State, Zip:	Lubbock, TX 79424
Test Requested By:	Tray Johnson
EUT:	Radio Thermostat
First Date of Test:	December 14, 2021
Last Date of Test:	July 7, 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 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)
Integrated Ceramic Chip	Unictron Technologies Corp.	902 - 928	0.9

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

SETTINGS FOR ALL TESTS IN THIS REPORT

Bandwidth / Modulation Types	Position (if multiple channels)	Software Maximum Power Setting
125 kHz (Hybrid) / Spreading Factor 7 / CSS	Low Ch. 902.3 MHz	17
	Mid Ch. 903.1 MHz	17
	High Ch. 903.8 MHz	17

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- 5

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	Shielded Direct Connect

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- 6

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	Shielded Direct Connect

Peripherals in Test Setup Boundary			
Description	Manufacturer	Model/Part Number	Serial Number
AC/DC Adapter (Laptop)	Lenovo	SK90200325	None
AC/AC Transformer	None	None	None
Mouse (Laptop)	Logitech	810-004116	1829HS0566P8
Laptop	Lenovo	L530	None

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- 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	2021-12-14	Carrier Frequency Separation	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	2021-12-14	Number of Hopping Frequencies	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	2021-12-14	Band Edge Compliance – Hopping Mode	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	2022-01-06	Powerline Conducted Emissions	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
5	2022-01-14	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.
6	2022-01-28	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.
7	2022-01-28	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.
8	2022-01-28	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.
9	2022-01-28	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.
10	2022-01-28	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.
11	2022-03-23	Occupied Bandwidth – 99%	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
12	2022-04-12	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.
13	2022-07-07	Dwell Time	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	Scheduled testing was completed.

POWERLINE CONDUCTED EMISSIONS

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, LoRa Radio enabled, 125 kHz bandwidth, mid-channel, all other radios disabled

POWERLINE CONDUCTED EMISSIONS

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 #:	17	Line:	High Line	Add. Ext. Attenuation (dB):	0
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COMMENTS

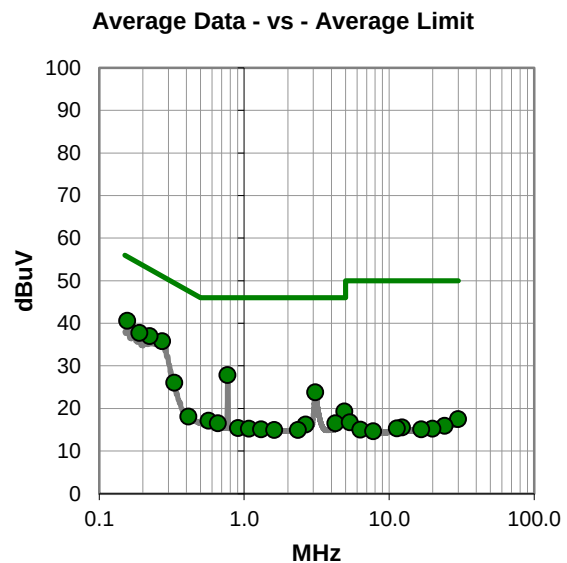
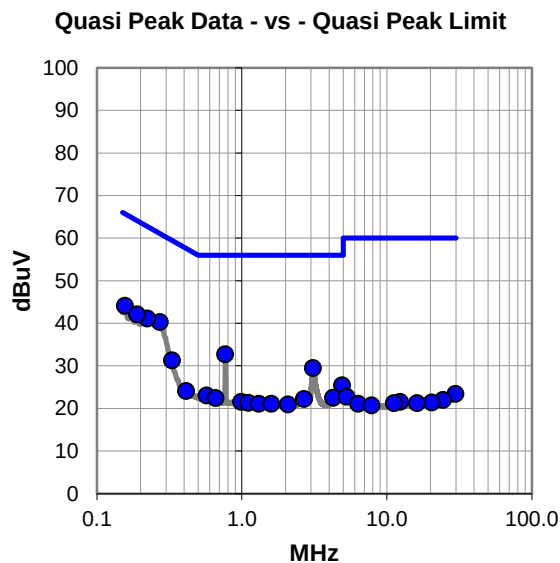
None

EUT OPERATING MODES

Thermostat On, LoRa Radio enabled, 125 kHz bandwidth, mid-channel, all other radios disabled
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DEVIATIONS FROM TEST STANDARD

None



POWERLINE CONDUCTED EMISSIONS

RESULTS - Run #17

Quasi Peak Data - vs - Quasi Peak Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
0.272	19.9	20.4	40.3	61.1	-20.8
0.156	23.7	20.4	44.1	65.7	-21.6
0.223	20.7	20.4	41.1	62.7	-21.6
0.190	21.7	20.4	42.1	64.1	-22.0
0.769	12.5	20.2	32.7	56.0	-23.3
3.090	9.2	20.3	29.5	56.0	-26.5
0.330	11.1	20.2	31.3	59.5	-28.2
4.929	5.1	20.3	25.4	56.0	-30.6
0.571	2.8	20.2	23.0	56.0	-33.0
0.412	3.9	20.2	24.1	57.6	-33.5
4.267	2.2	20.3	22.5	56.0	-33.5
0.660	2.2	20.2	22.4	56.0	-33.6
2.678	1.9	20.3	22.2	56.0	-33.8
0.991	1.3	20.2	21.5	56.0	-34.5
1.107	1.1	20.2	21.3	56.0	-34.7
1.311	0.8	20.3	21.1	56.0	-34.9
1.600	0.8	20.3	21.1	56.0	-34.9
2.079	0.6	20.3	20.9	56.0	-35.1
29.856	0.8	22.6	23.4	60.0	-36.6
5.278	2.4	20.3	22.7	60.0	-37.3
24.407	-0.2	22.2	22.0	60.0	-38.0
12.372	0.5	21.0	21.5	60.0	-38.5
20.475	-0.2	21.6	21.4	60.0	-38.6
11.217	0.3	20.9	21.2	60.0	-38.8
16.197	-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	20.2	20.4	40.6	55.7	-15.1
0.272	15.4	20.4	35.8	51.1	-15.3
0.223	16.6	20.4	37.0	52.7	-15.7
0.190	17.3	20.4	37.7	54.1	-16.4
0.769	7.6	20.2	27.8	46.0	-18.2
3.096	3.5	20.3	23.8	46.0	-22.2
0.330	5.8	20.2	26.0	49.5	-23.5
4.927	-1.0	20.3	19.3	46.0	-26.7
0.570	-3.1	20.2	17.1	46.0	-28.9
0.412	-2.1	20.2	18.1	47.6	-29.5
0.660	-3.7	20.2	16.5	46.0	-29.5
4.267	-3.8	20.3	16.5	46.0	-29.5
2.663	-4.1	20.3	16.2	46.0	-29.8
0.907	-4.9	20.3	15.4	46.0	-30.6
1.079	-5.0	20.2	15.2	46.0	-30.8
1.311	-5.2	20.3	15.1	46.0	-30.9
1.615	-5.4	20.3	14.9	46.0	-31.1
2.355	-5.4	20.3	14.9	46.0	-31.1
29.937	-5.1	22.6	17.5	50.0	-32.5
5.373	-3.6	20.3	16.7	50.0	-33.3
24.165	-6.2	22.1	15.9	50.0	-34.1
12.288	-5.5	21.0	15.5	50.0	-34.5
11.299	-5.6	20.9	15.3	50.0	-34.7
19.944	-6.4	21.6	15.2	50.0	-34.8
16.664	-6.3	21.4	15.1	50.0	-34.9

CONCLUSION

Pass



Tested By

POWERLINE CONDUCTED EMISSIONS

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 #:	18	Line:	Neutral	Add. Ext. Attenuation (dB):	0
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COMMENTS

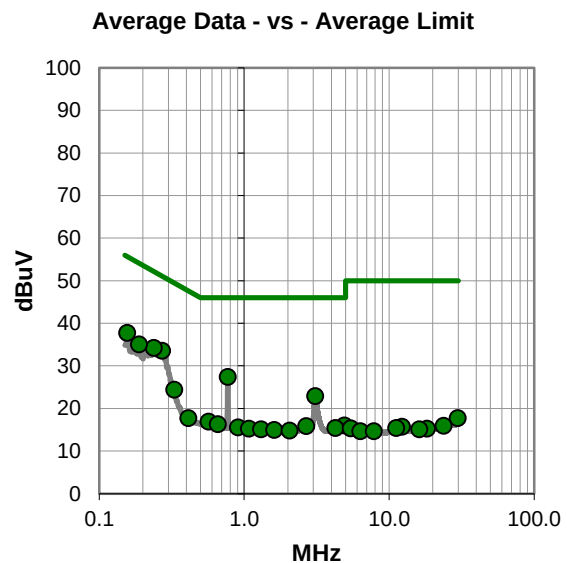
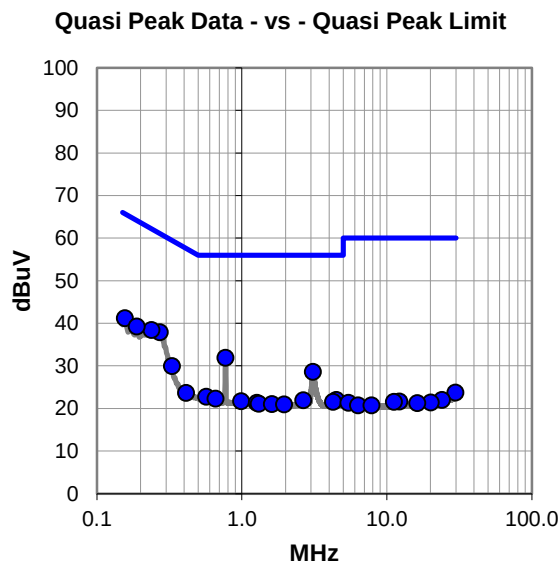
None

EUT OPERATING MODES

Thermostat On, LoRa Radio enabled, 125 kHz bandwidth, mid-channel, all other radios disabled

DEVIATIONS FROM TEST STANDARD

None



POWERLINE CONDUCTED EMISSIONS

RESULTS - Run #18

Quasi Peak Data - vs - Quasi Peak Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
0.272	17.5	20.4	37.9	61.1	-23.2
0.238	18.0	20.4	38.4	62.1	-23.7
0.771	11.7	20.2	31.9	56.0	-24.1
0.156	20.8	20.4	41.2	65.7	-24.5
0.188	18.8	20.4	39.2	64.1	-24.9
3.099	8.3	20.3	28.6	56.0	-27.4
0.330	9.7	20.2	29.9	59.5	-29.6
0.570	2.5	20.2	22.7	56.0	-33.3
0.660	2.1	20.2	22.3	56.0	-33.7
0.412	3.4	20.2	23.6	57.6	-34.0
4.482	1.7	20.3	22.0	56.0	-34.0
2.663	1.6	20.3	21.9	56.0	-34.1
0.991	1.5	20.2	21.7	56.0	-34.3
4.267	1.2	20.3	21.5	56.0	-34.5
1.268	1.0	20.3	21.3	56.0	-34.7
1.311	0.8	20.3	21.1	56.0	-34.9
1.612	0.7	20.3	21.0	56.0	-35.0
1.954	0.6	20.3	20.9	56.0	-35.1
29.856	1.1	22.6	23.7	60.0	-36.3
24.081	-0.1	22.1	22.0	60.0	-38.0
12.205	0.6	21.0	21.6	60.0	-38.4
11.217	0.6	20.9	21.5	60.0	-38.5
20.108	-0.2	21.6	21.4	60.0	-38.6
5.434	0.9	20.4	21.3	60.0	-38.7
16.267	-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)
0.272	13.1	20.4	33.5	51.1	-17.6
0.238	13.8	20.4	34.2	52.1	-17.9
0.156	17.3	20.4	37.7	55.7	-18.0
0.771	7.2	20.2	27.4	46.0	-18.6
0.188	14.6	20.4	35.0	54.1	-19.1
3.098	2.6	20.3	22.9	46.0	-23.1
0.330	4.2	20.2	24.4	49.5	-25.1
0.570	-3.3	20.2	16.9	46.0	-29.1
0.660	-3.9	20.2	16.3	46.0	-29.7
0.412	-2.5	20.2	17.7	47.6	-29.9
4.926	-4.3	20.3	16.0	46.0	-30.0
2.680	-4.5	20.3	15.8	46.0	-30.2
0.908	-4.8	20.3	15.5	46.0	-30.5
4.267	-4.9	20.3	15.4	46.0	-30.6
1.079	-5.0	20.2	15.2	46.0	-30.8
1.311	-5.2	20.3	15.1	46.0	-30.9
1.616	-5.4	20.3	14.9	46.0	-31.1
2.063	-5.5	20.3	14.8	46.0	-31.2
29.856	-4.9	22.6	17.7	50.0	-32.3
23.751	-6.2	22.1	15.9	50.0	-34.1
12.288	-5.3	21.0	15.7	50.0	-34.3
11.217	-5.5	20.9	15.4	50.0	-34.6
5.443	-5.1	20.4	15.3	50.0	-34.7
18.278	-6.3	21.5	15.2	50.0	-34.8
16.212	-6.3	21.4	15.1	50.0	-34.9

CONCLUSION

Pass



Tested By

SPURIOUS RADIATED EMISSIONS



PSA-ESCI 2021.12.10.0

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

LoRa 125kHz BW, Pwr lvl 17, Spreading Factor 7, Low Channel 902.3 MHz

LoRa 125kHz BW, Pwr lvl 17, Spreading Factor 7, Mid Channel 903.1 MHz

LoRa 125kHz BW, Pwr lvl 17, Spreading Factor 7, High Channel 903.8 MHz

POWER SETTINGS INVESTIGATED

110VAC/60Hz

3.0VDC via Battery

CONFIGURATIONS INVESTIGATED

F3EN0068 - 4

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	2021-02-17	2022-02-17
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 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 $10 \cdot \log(1/dc)$.

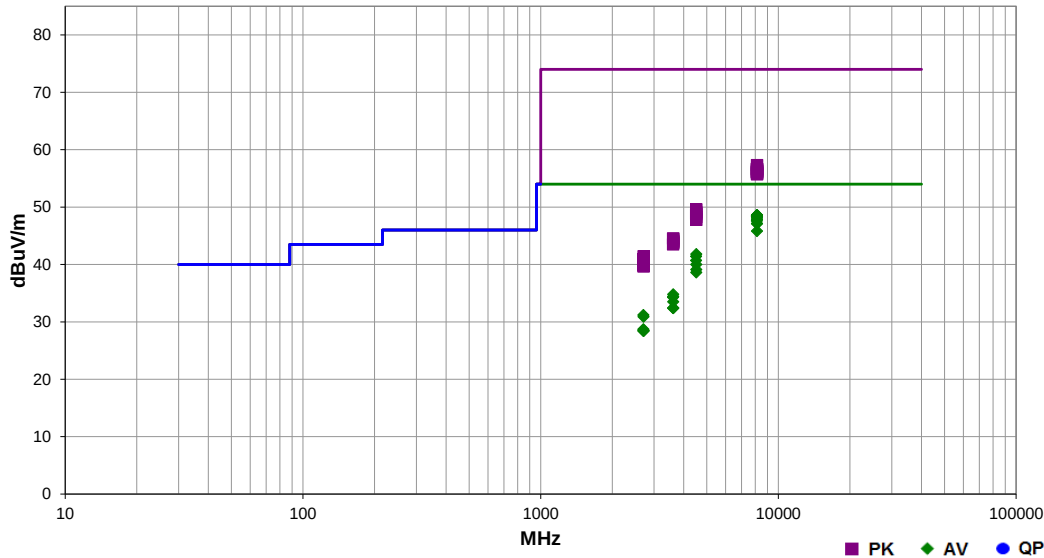
SPURIOUS RADIATED EMISSIONS



Work Order:	F3EN0068	Date:	2022-01-14	
Project:	None	Temperature:	21.1 °C	
Job Site:	TX02	Humidity:	22.4% RH	
Serial Number:	DUT11	Barometric Pres.:	1028 mbar	
EUT:	Radio Thermostat			Tested by: Brandon Hobbs
Configuration:	4			
Customer:	Quext			
Attendees:	None			
EUT Power:	Please reference data comments			
Operating Mode:	Thermostat On, LoRa 125kHz BW, Pwr M 17, Spreading Factor 7, Please reference the data comments for EUT orientation, Channel and EUT Power			
Deviations:	None			
Comments:	100% duty cycle in test mode			

Test Specifications	FCC 15.247:2022	Test Method	ANSI C63.10:2013
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Run #	129	Test Distance (m)	3	Antenna Height(s)	1 to 4(m)	Results	Pass
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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
8134.300	35.8	12.8	3.33	81.9	3.0	0.0	Horz	AV	0.0	48.6	54.0	-5.4	EUT Horz, High Ch 903.8 MHz, 110VAC/60Hz
8134.292	35.8	12.8	1.64	42.0	3.0	0.0	Horz	AV	0.0	48.6	54.0	-5.4	EUT On Side, High Ch 903.8 MHz, 110VAC/60Hz
8127.908	35.8	12.8	3.32	78.0	3.0	0.0	Horz	AV	0.0	48.6	54.0	-5.4	EUT Horz, Mid Ch 903.1MHz, 110VAC/60Hz
8120.783	35.7	12.7	3.2	51.9	3.0	0.0	Horz	AV	0.0	48.4	54.0	-5.6	EUT Horz, Low Ch 902.3MHz, 110VAC/60Hz
8134.342	35.5	12.8	1.5	57.0	3.0	0.0	Vert	AV	0.0	48.3	54.0	-5.7	EUT Horz, High Ch 903.8 MHz, 110VAC/60Hz
8127.908	35.5	12.8	1.5	244.9	3.0	0.0	Vert	AV	0.0	48.3	54.0	-5.7	EUT Horz, Mid Ch 903.1MHz, 110VAC/60Hz
8134.200	35.3	12.8	1.5	250.9	3.0	0.0	Vert	AV	0.0	48.1	54.0	-5.9	EUT On Side, High Ch 903.8 MHz, 110VAC/60Hz
8134.250	35.0	12.8	2.82	74.0	3.0	0.0	Horz	AV	0.0	47.8	54.0	-6.2	EUT Horz, High Ch 903.8 MHz, 3.0 VDC Battery
8120.892	34.9	12.7	1.5	138.0	3.0	0.0	Vert	AV	0.0	47.6	54.0	-6.4	EUT Horz, Low Ch 902.3MHz, 110VAC/60Hz
8134.242	34.3	12.8	1.8	237.0	3.0	0.0	Horz	AV	0.0	47.1	54.0	-6.9	EUT Vert, High Ch 903.8 MHz, 110VAC/60Hz
8134.375	34.3	12.8	1.63	54.0	3.0	0.0	Vert	AV	0.0	47.1	54.0	-6.9	EUT Horz, High Ch 903.8 MHz, 3.0 VDC Battery
8134.275	33.0	12.8	2.14	99.0	3.0	0.0	Vert	AV	0.0	45.8	54.0	-8.2	EUT Vert, High Ch 903.8 MHz, 110VAC/60Hz
4515.558	37.4	4.4	2.23	168.0	3.0	0.0	Horz	AV	0.0	41.8	54.0	-12.2	EUT Horz, Mid Ch 903.1MHz, 110VAC/60Hz
4511.558	37.1	4.3	2.06	169.0	3.0	0.0	Horz	AV	0.0	41.4	54.0	-12.6	EUT Horz, Low Ch 902.3MHz, 110VAC/60Hz
4511.533	36.4	4.3	2.81	153.0	3.0	0.0	Vert	AV	0.0	40.7	54.0	-13.3	EUT Horz, Low Ch 902.3MHz, 110VAC/60Hz
4519.075	35.6	4.4	2.5	210.0	3.0	0.0	Vert	AV	0.0	40.0	54.0	-14.0	EUT Horz, High Ch 903.8 MHz, 110VAC/60Hz
4515.542	34.7	4.4	2.96	145.0	3.0	0.0	Vert	AV	0.0	39.1	54.0	-14.9	EUT Horz, Mid Ch 903.1MHz, 110VAC/60Hz
4518.992	34.2	4.4	1.5	200.0	3.0	0.0	Horz	AV	0.0	38.6	54.0	-15.4	EUT Horz, High Ch 903.8 MHz, 110VAC/60Hz
8134.167	44.5	12.8	1.64	42.0	3.0	0.0	Horz	PK	0.0	57.3	74.0	-16.7	EUT On Side, High Ch 903.8 MHz, 110VAC/60Hz
8120.717	44.0	12.7	3.2	51.9	3.0	0.0	Horz	PK	0.0	56.7	74.0	-17.3	EUT Horz, Low Ch 902.3MHz, 110VAC/60Hz
8134.092	43.8	12.8	3.33	81.9	3.0	0.0	Horz	PK	0.0	56.6	74.0	-17.4	EUT Horz, High Ch 903.8 MHz, 110VAC/60Hz
8134.267	43.8	12.8	1.5	57.0	3.0	0.0	Vert	PK	0.0	56.6	74.0	-17.4	EUT Horz, High Ch 903.8 MHz, 110VAC/60Hz
8128.325	43.6	12.8	3.32	78.0	3.0	0.0	Horz	PK	0.0	56.4	74.0	-17.6	EUT Horz, Mid Ch 903.1MHz, 110VAC/60Hz
8128.042	43.5	12.8	1.5	244.9	3.0	0.0	Vert	PK	0.0	56.3	74.0	-17.7	EUT Horz, Mid Ch 903.1MHz, 110VAC/60Hz
8134.325	43.4	12.8	1.5	250.9	3.0	0.0	Vert	PK	0.0	56.2	74.0	-17.8	EUT On Side, High Ch 903.8 MHz, 110VAC/60Hz
8120.850	43.4	12.7	1.5	138.0	3.0	0.0	Vert	PK	0.0	56.1	74.0	-17.9	EUT Horz, Low Ch 902.3MHz, 110VAC/60Hz
8134.533	43.2	12.8	2.82	74.0	3.0	0.0	Horz	PK	0.0	56.0	74.0	-18.0	EUT Horz, High Ch 903.8 MHz, 3.0 VDC Battery
8134.842	43.2	12.8	1.63	54.0	3.0	0.0	Vert	PK	0.0	56.0	74.0	-18.0	EUT Horz, High Ch 903.8 MHz, 3.0 VDC Battery
8134.308	43.0	12.8	1.8	237.0	3.0	0.0	Horz	PK	0.0	55.8	74.0	-18.2	EUT Vert, High Ch 903.8 MHz, 110VAC/60Hz
8134.200	42.9	12.8	2.14	99.0	3.0	0.0	Vert	PK	0.0	55.7	74.0	-18.3	EUT Vert, High Ch 903.8 MHz, 110VAC/60Hz
3612.417	33.6	1.2	4.0	231.0	3.0	0.0	Vert	AV	0.0	34.8	54.0	-19.2	EUT Horz, Mid Ch 903.1MHz, 110VAC/60Hz

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
3612.475	33.2	1.2	3.11	304.9	3.0	0.0	Horz	AV	0.0	34.4	54.0	-19.6	EUT Horz, Mid Ch 903.1MHz, 110VAC/60Hz
3609.150	33.1	1.2	2.98	61.0	3.0	0.0	Vert	AV	0.0	34.3	54.0	-19.7	EUT Horz, Low Ch 902.3MHz, 110VAC/60Hz
3615.208	32.3	1.2	3.58	174.0	3.0	0.0	Vert	AV	0.0	33.5	54.0	-20.5	EUT Horz, High Ch 903.8 MHz, 110VAC/60Hz
3617.650	31.2	1.2	1.5	229.0	3.0	0.0	Horz	AV	0.0	32.4	54.0	-21.6	EUT Horz, High Ch 903.8 MHz, 110VAC/60Hz
3609.325	31.2	1.2	1.65	188.0	3.0	0.0	Horz	AV	0.0	32.4	54.0	-21.6	EUT Horz, Low Ch 902.3MHz, 110VAC/60Hz
2706.942	34.7	-3.5	2.76	129.0	3.0	0.0	Vert	AV	0.0	31.2	54.0	-22.8	EUT Horz, Low Ch 902.3MHz, 110VAC/60Hz
2709.342	34.4	-3.5	4.0	322.9	3.0	0.0	Vert	AV	0.0	30.9	54.0	-23.1	EUT Horz, Mid Ch 903.1MHz, 110VAC/60Hz
4518.567	45.2	4.4	2.5	210.0	3.0	0.0	Vert	PK	0.0	49.6	74.0	-24.4	EUT Horz, High Ch 903.8 MHz, 110VAC/60Hz
4515.300	44.7	4.4	2.23	168.0	3.0	0.0	Horz	PK	0.0	49.1	74.0	-24.9	EUT Horz, Mid Ch 903.1MHz, 110VAC/60Hz
4511.558	44.6	4.3	2.06	169.0	3.0	0.0	Horz	PK	0.0	48.9	74.0	-25.1	EUT Horz, Low Ch 902.3MHz, 110VAC/60Hz
4511.433	44.4	4.3	2.81	153.0	3.0	0.0	Vert	PK	0.0	48.7	74.0	-25.3	EUT Horz, Low Ch 902.3MHz, 110VAC/60Hz
2706.958	32.2	-3.5	1.5	195.0	3.0	0.0	Horz	AV	0.0	28.7	54.0	-25.3	EUT Horz, Low Ch 902.3MHz, 110VAC/60Hz
2709.125	32.0	-3.5	1.5	15.9	3.0	0.0	Horz	AV	0.0	28.5	54.0	-25.5	EUT Horz, Mid Ch 903.1MHz, 110VAC/60Hz
2709.692	31.9	-3.5	1.5	159.9	3.0	0.0	Horz	AV	0.0	28.4	54.0	-25.6	EUT Horz, High Ch 903.8 MHz, 110VAC/60Hz
2709.017	31.9	-3.5	1.5	90.0	3.0	0.0	Vert	AV	0.0	28.4	54.0	-25.6	EUT Horz, High Ch 903.8 MHz, 110VAC/60Hz
4516.017	43.9	4.4	2.96	145.0	3.0	0.0	Vert	PK	0.0	48.3	74.0	-25.7	EUT Horz, Mid Ch 903.1MHz, 110VAC/60Hz
4519.075	43.4	4.4	1.5	200.0	3.0	0.0	Horz	PK	0.0	47.8	74.0	-26.2	EUT Horz, High Ch 903.8 MHz, 110VAC/60Hz
3612.575	43.3	1.2	4.0	231.0	3.0	0.0	Vert	PK	0.0	44.5	74.0	-29.5	EUT Horz, Mid Ch 903.1MHz, 110VAC/60Hz
3609.467	43.3	1.2	2.98	61.0	3.0	0.0	Vert	PK	0.0	44.5	74.0	-29.5	EUT Horz, Low Ch 902.3MHz, 110VAC/60Hz
3612.342	43.0	1.2	3.11	304.9	3.0	0.0	Horz	PK	0.0	44.2	74.0	-29.8	EUT Horz, Mid Ch 903.1MHz, 110VAC/60Hz
3615.250	42.8	1.2	3.58	174.0	3.0	0.0	Vert	PK	0.0	44.0	74.0	-30.0	EUT Horz, High Ch 903.8 MHz, 110VAC/60Hz
3616.675	42.6	1.2	1.5	229.0	3.0	0.0	Horz	PK	0.0	43.8	74.0	-30.2	EUT Horz, High Ch 903.8 MHz, 110VAC/60Hz
3608.583	42.3	1.2	1.65	188.0	3.0	0.0	Horz	PK	0.0	43.5	74.0	-30.5	EUT Horz, Low Ch 902.3MHz, 110VAC/60Hz
2709.275	44.9	-3.5	4.0	322.9	3.0	0.0	Vert	PK	0.0	41.4	74.0	-32.6	EUT Horz, Mid Ch 903.1MHz, 110VAC/60Hz
2707.067	44.4	-3.5	2.76	129.0	3.0	0.0	Vert	PK	0.0	40.9	74.0	-33.1	EUT Horz, Low Ch 902.3MHz, 110VAC/60Hz
2708.708	43.6	-3.5	1.5	15.9	3.0	0.0	Horz	PK	0.0	40.1	74.0	-33.9	EUT Horz, Mid Ch 903.1MHz, 110VAC/60Hz
2707.008	43.5	-3.5	1.5	195.0	3.0	0.0	Horz	PK	0.0	40.0	74.0	-34.0	EUT Horz, Low Ch 902.3MHz, 110VAC/60Hz
2710.842	43.2	-3.5	1.5	159.9	3.0	0.0	Horz	PK	0.0	39.7	74.0	-34.3	EUT Horz, High Ch 903.8 MHz, 110VAC/60Hz
2708.925	43.2	-3.5	1.5	90.0	3.0	0.0	Vert	PK	0.0	39.7	74.0	-34.3	EUT Horz, High Ch 903.8 MHz, 110VAC/60Hz

DUTY CYCLE



XMIT 2020.12.30.0

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 DESCRIPTION

The Duty Cycle (x) of the single channel operation of the radio as controlled by the provided test software was measured for each of the EUT operating modes.

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

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

CARRIER FREQUENCY SEPARATION



XMHt 2020.12.30.0

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	Keysight	N5182B	TEV	2021-04-27	2024-04-27
Analyzer - Spectrum Analyzer	Agilent	E4440A	AFD	2021-08-25	2022-08-25
Block - DC	Fairview Microwave	SD3379	AMT	2021-09-14	2022-09-14
Attenuator	Fairview Microwave	SA4018-20	TYE	2021-09-15	2022-09-15
Cable	UtiFlex Micro-Coax	UFD1150A-1-0720-200200	TXK	2021-09-13	2022-09-13

TEST DESCRIPTION

The channel carrier frequencies in the 902-928 MHz band must be separated by 25 kHz or the 20dB bandwidth of the hopping channel, whichever is greater. The EUT was operated in pseudorandom hopping mode. The spectrum was scanned across two adjacent peaks. The separation between the peaks of these channels was measured.

CARRIER FREQUENCY SEPARATION



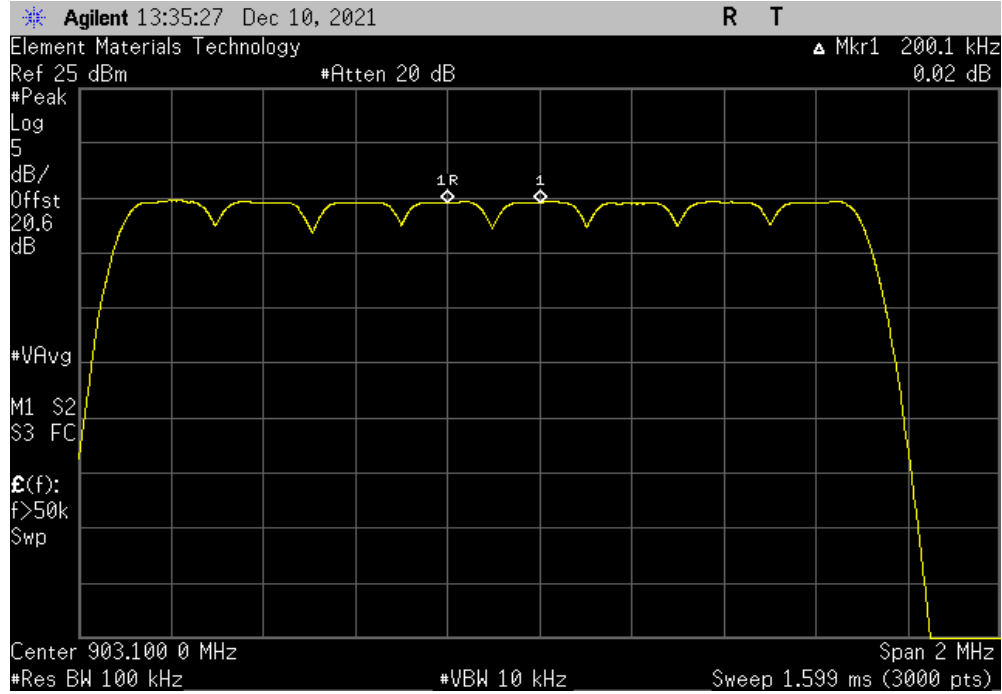
EUT: Radio Thermostat		Work Order: F3EN0068	
Serial Number: DUT2		Date: 14-Dec-21	
Customer: Quext		Temperature: 22.4 °C	
Attendees: None		Humidity: 46.3% RH	
Project: None		Barometric Pres.:	
Tested by: Brandon Hobbs		Power: 110VAC/60Hz	
		Job Site: TX09	
TEST SPECIFICATIONS		Test Method	
FCC 15.247:2021		ANSI C63.10:2013	
COMMENTS			
None			
DEVIATIONS FROM TEST STANDARD			
None			
Configuration #	1	Signature 	
		Value	Limit (≥) Results
LoRa Radio 902 - 928 MHz Band			
125 kHz Bandwidth			
Spreading Factor 7			
Mid Channel 903.1 MHz		200 kHz	25 kHz Pass

CARRIER FREQUENCY SEPARATION



TbTx 2021.10.29.2 XMt 2020.12.30.0

LoRa Radio 902 - 928 MHz Band, 125 kHz Bandwidth, Spreading Factor 7, Mid Channel 903.1 MHz						
				Value	Limit	Results
				200 kHz	25 kHz	Pass



NUMBER OF HOPPING FREQUENCIES



XMIT 2020.12.30.0

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	Keysight	N5182B	TEV	2021-04-27	2024-04-27
Analyzer - Spectrum Analyzer	Agilent	E4440A	AFD	2021-08-25	2022-08-25
Block - DC	Fairview Microwave	SD3379	AMT	2021-09-14	2022-09-14
Attenuator	Fairview Microwave	SA4018-20	TYE	2021-09-15	2022-09-15
Cable	UtiFlex Micro-Coax	UFD1150A-1-0720-200200	TXK	2021-09-13	2022-09-13

TEST DESCRIPTION

The number of hopping frequencies was measured across the authorized band. The hopping function of the EUT was enabled.

NUMBER OF HOPPING FREQUENCIES



TstTx 2021.10.29.2 XMR 2020.12.30.0

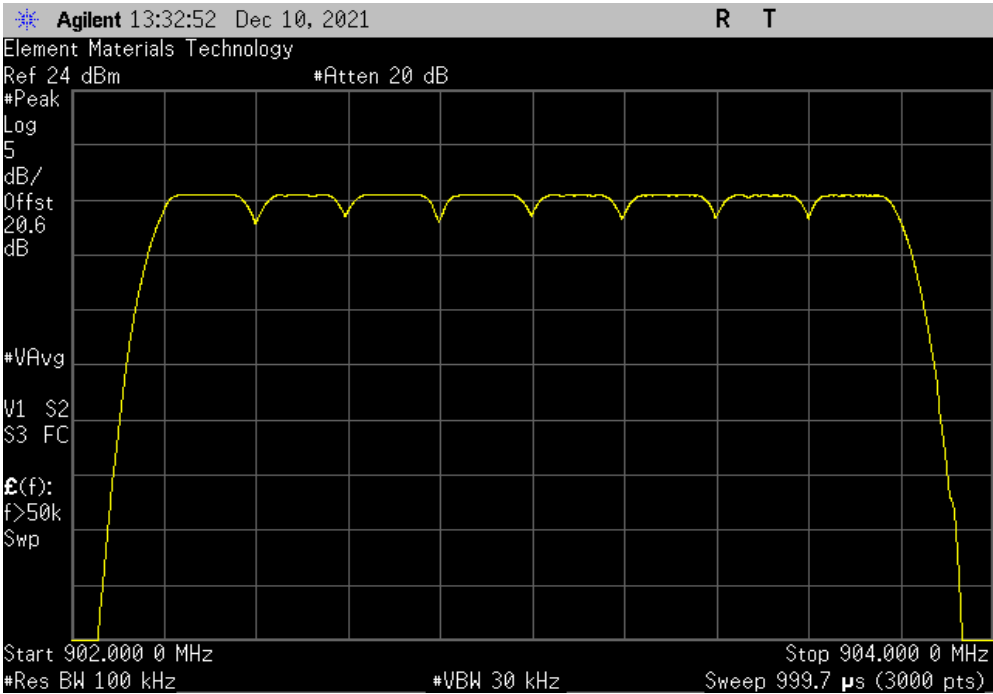
EUT: Radio Thermostat		Work Order: F3EN0068	
Serial Number: DUT2		Date: 14-Dec-21	
Customer: Quext		Temperature: 21.1 °C	
Attendees: None		Humidity: 48.2% RH	
Project: None		Barometric Pres.: 1024 mbar	
Tested by: Brandon Hobbs		Power: 110VAC/60Hz	
		Job Site: TX09	
TEST SPECIFICATIONS		Test Method	
FCC 15.247:2021		ANSI C63.10:2013	
COMMENTS			
None			
DEVIATIONS FROM TEST STANDARD			
None			
Configuration #	1	Signature 	
		Number of Channels	Limit (≥)
			Results
LoRa Radio 902 - 928 MHz Band			
125 kHz Bandwidth			
Spreading Factor 7			
Mid Channel 903.1 MHz		8	N/A
			N/A

NUMBER OF HOPPING FREQUENCIES



TbTx 2021.10.29.2 XMt 2020.12.30.0

LoRa Radio 902 - 928 MHz Band, 125 kHz Bandwidth, Spreading Factor 7, Mid Channel 903.1 MHz						
				Number of Channels	Limit (≥)	Results
				8	N/A	N/A



DWELL TIME



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	N5182A	TIF	2020-08-29	2023-08-29
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

TEST DESCRIPTION

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

The average dwell time per hopping channel was measured at one hopping channel in the middle of the authorized band. The hopping function of the EUT was enabled.

The dwell time limit is based on the Number of Hopping Channels * 400 mS. For a LoRa radio this would be 8 Channels * 400mS = 3.2 Seconds.

On Time during 3.2 Sec = Pulse Width * Average Number of Pulses * Scale Factor

Average Number of Pulses is based on 4 samples.

Scale Factor = 3.2 Sec / Screen Capture Sweep Time = 3.2 Sec / 3.2 Sec = 1

DWELL TIME



XMR 2022 02.07.0

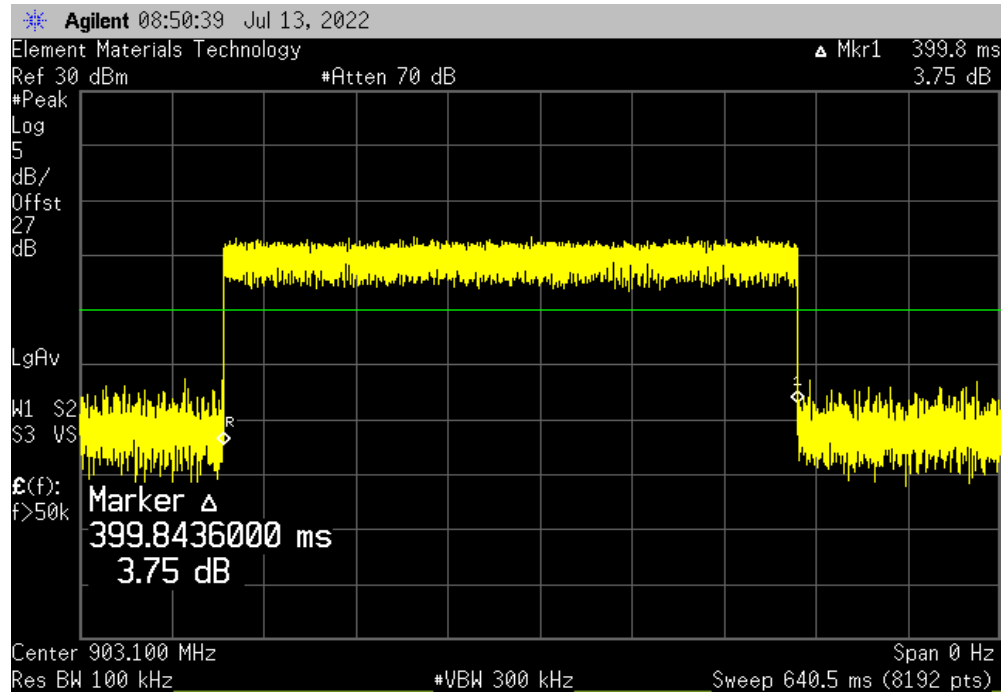
EUT: Radio Thermostat		Work Order: F3EN0068	
Serial Number: DUT2		Date: 7-Jul-22	
Customer: Quext		Temperature: 20.4 °C	
Attendees: None		Humidity: 34.2% RH	
Project: None		Barometric Pres.: 1016 mbar	
Tested by: Kyle McMullan		Power: 110VAC/60Hz	
		Job Site: MN08	
TEST SPECIFICATIONS			
FCC 15.247:2022		Test Method	
		ANSI C63.10:2013	
COMMENTS			
All settings per client's provided setup documentation. Data taken on 13-Jul-22 had conditions of 20.3 °C, 57.5% R, and 1018 mbar.			
DEVIATIONS FROM TEST STANDARD			
None			
Configuration #	7	Signature <i>Kyle McMullan</i>	
		Pulse Width (ms)	Number of Pulses
		Average No. of Pulses	On Time Over 3200 ms
		Limit (ms)	Result
LoRa Hopping Hybrid Mode			
Spreading Factor 7			
	Mid Channel, 903.1 MHz	399.8	N/A
	Sample 1	N/A	1
	Sample 2	N/A	1
	Sample 3	N/A	1
	Sample 4	N/A	1
	Sample 5	N/A	1
	Sample 6	N/A	1
	Sample 7	N/A	1
	Sample 8	N/A	1
	Sample 9	N/A	1
	Sample 10	N/A	1
	Calculations	399.8	N/A
	Long Dwell		N/A

DWELL TIME

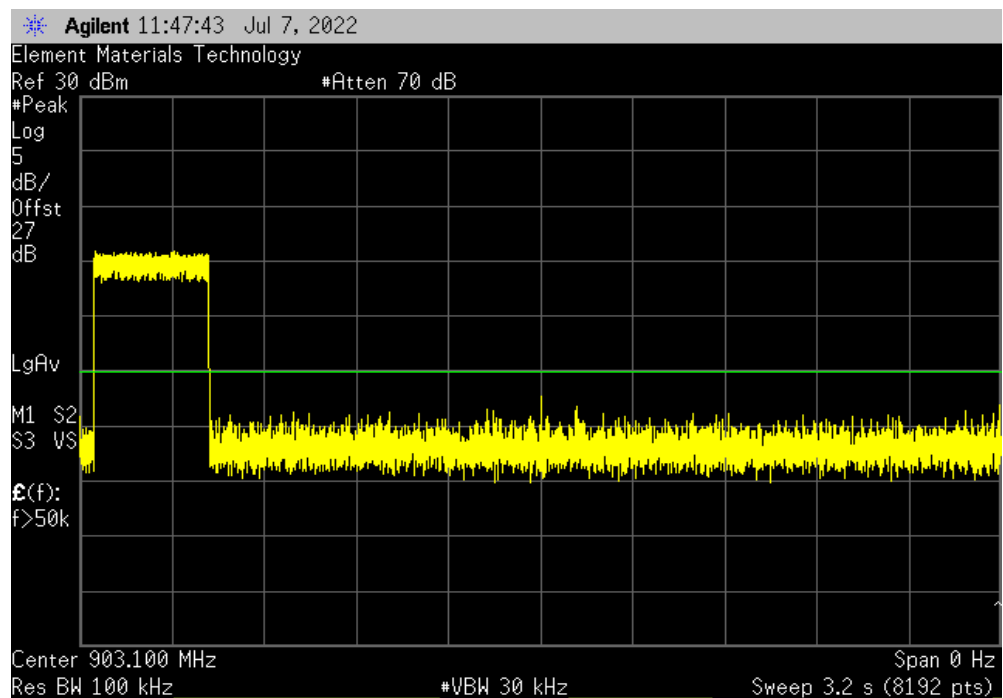


XMR 2022.02.07.0

LoRa Hopping Hybrid Mode, Spreading Factor 7, Mid Channel, 903.1 MHz						
Pulse Width (ms)	Number of Pulses	Average No. of Pulses	On Time Over 3200 ms	Limit (ms)	Result	
399.8	N/A	N/A	N/A	N/A	N/A	



LoRa Hopping Hybrid Mode, Spreading Factor 7, Sample 1						
Pulse Width (ms)	Number of Pulses	Average No. of Pulses	On Time Over 3200 ms	Limit (ms)	Result	
N/A	1	N/A	N/A	N/A	N/A	

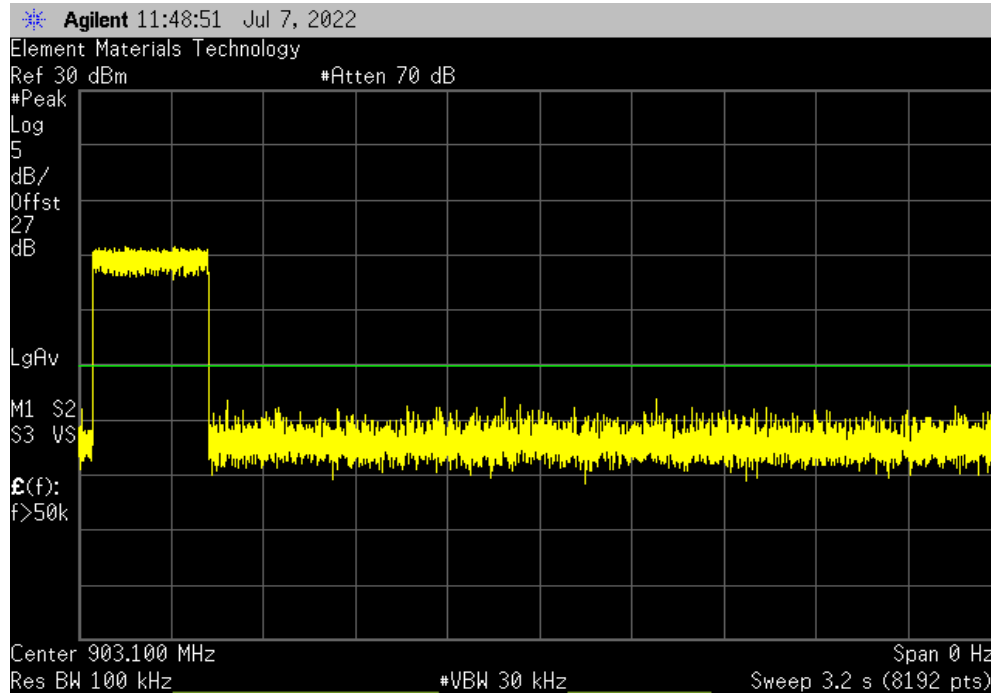


DWELL TIME

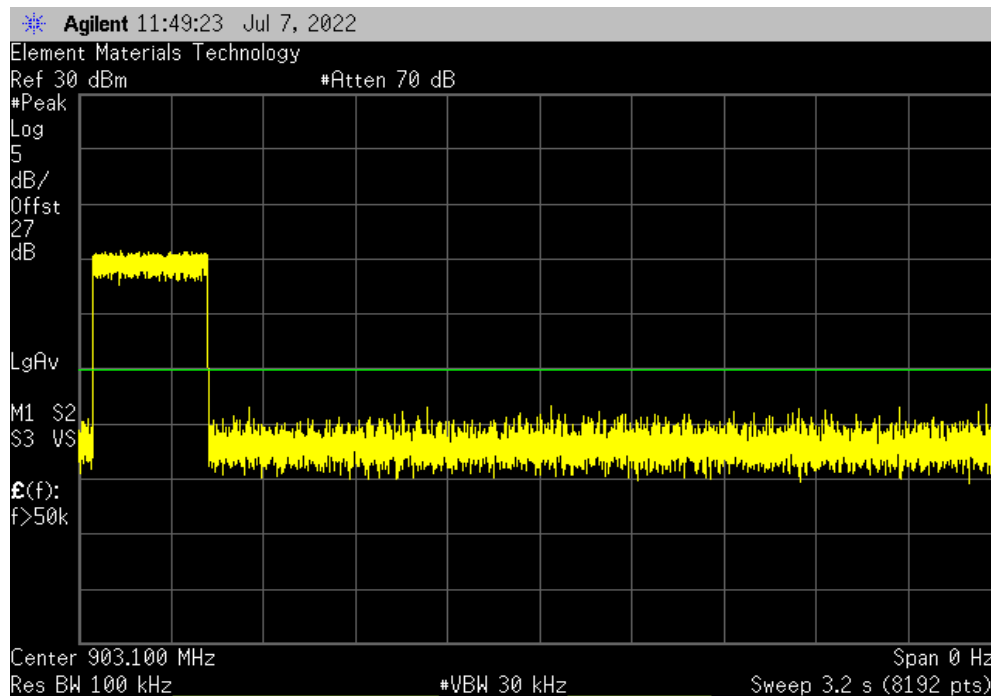


XMR 2022.02.07.0

LoRa Hopping Hybrid Mode, Spreading Factor 7, Sample 2						
Pulse Width (ms)	Number of Pulses	Average No. of Pulses	On Time Over 3200 ms	Limit (ms)	Result	
N/A	1	N/A	N/A	N/A	N/A	



LoRa Hopping Hybrid Mode, Spreading Factor 7, Sample 3						
Pulse Width (ms)	Number of Pulses	Average No. of Pulses	On Time Over 3200 ms	Limit (ms)	Result	
N/A	1	N/A	N/A	N/A	N/A	

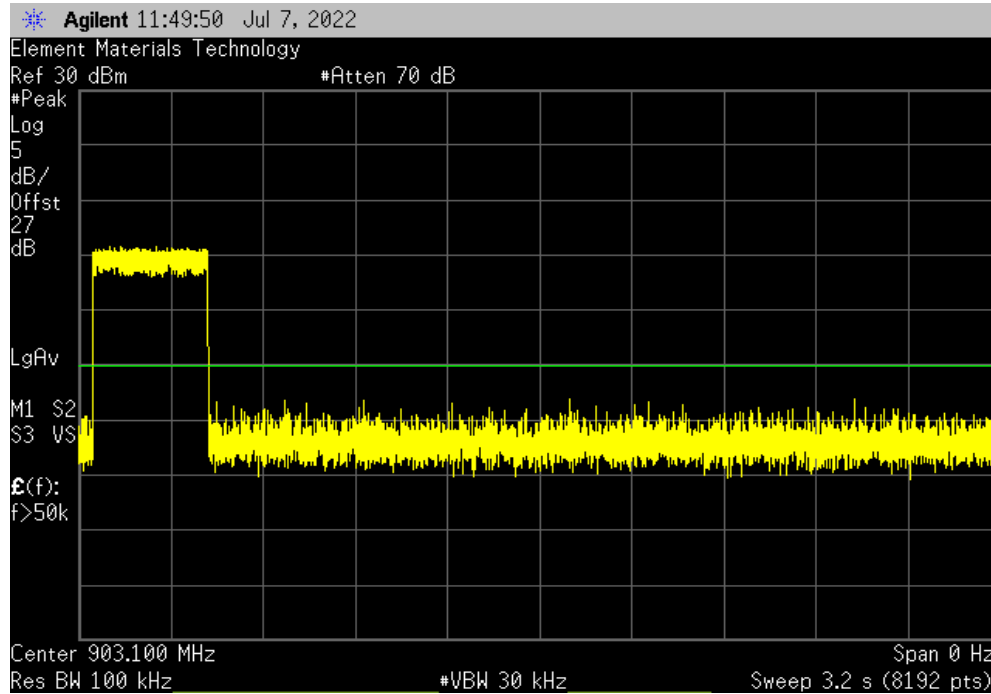


DWELL TIME

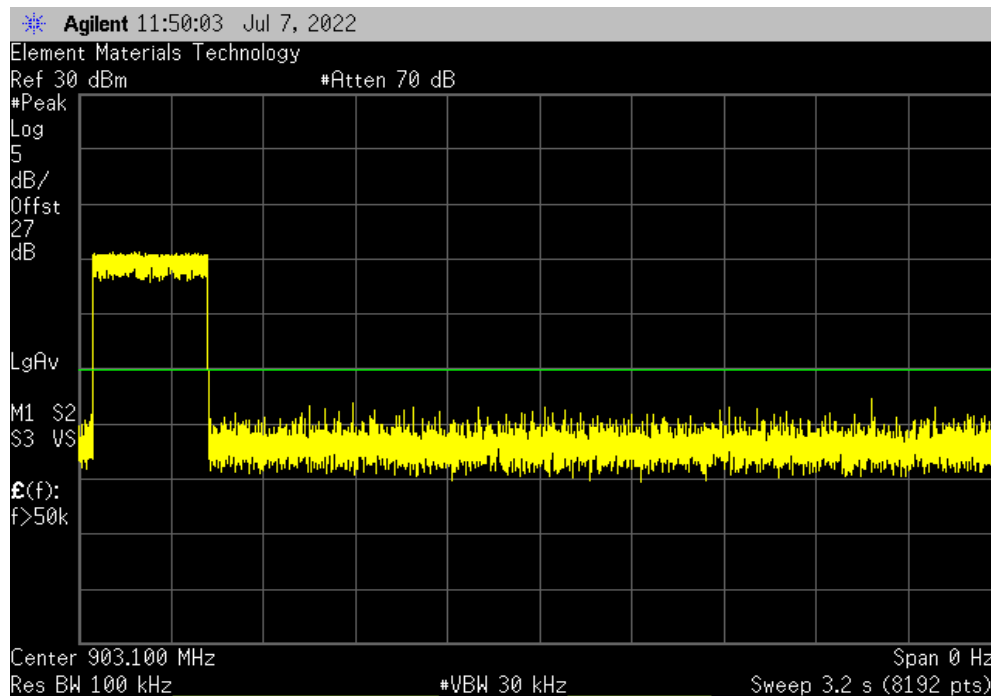


XMR 2022.02.07.0

LoRa Hopping Hybrid Mode, Spreading Factor 7, Sample 4						
Pulse Width (ms)	Number of Pulses	Average No. of Pulses	On Time Over 3200 ms	Limit (ms)	Result	
N/A	1	N/A	N/A	N/A	N/A	



LoRa Hopping Hybrid Mode, Spreading Factor 7, Sample 5						
Pulse Width (ms)	Number of Pulses	Average No. of Pulses	On Time Over 3200 ms	Limit (ms)	Result	
N/A	1	N/A	N/A	N/A	N/A	

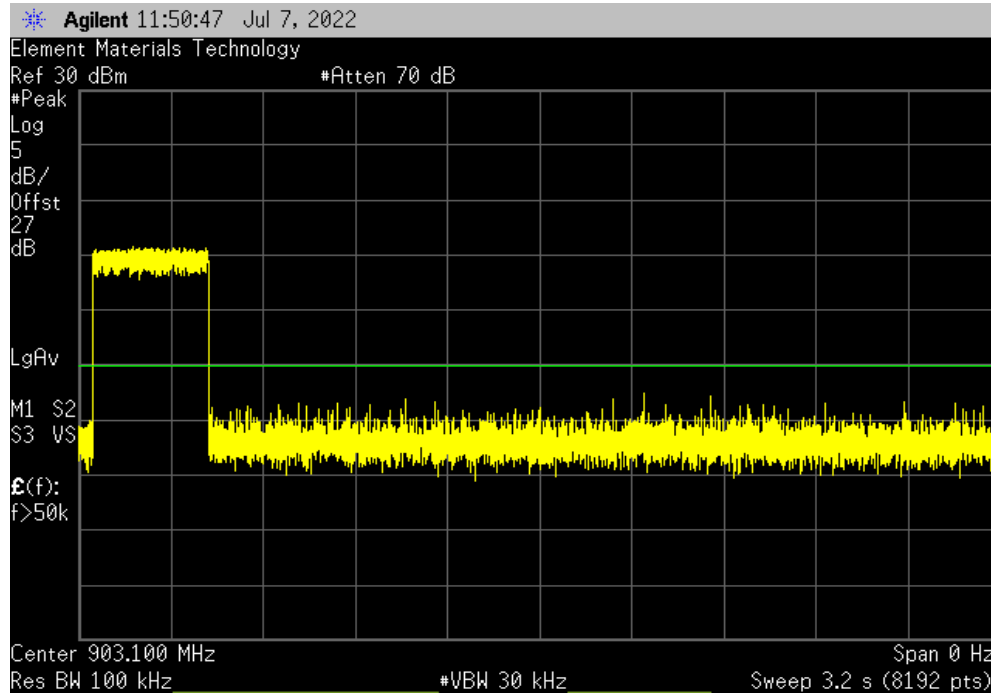


DWELL TIME

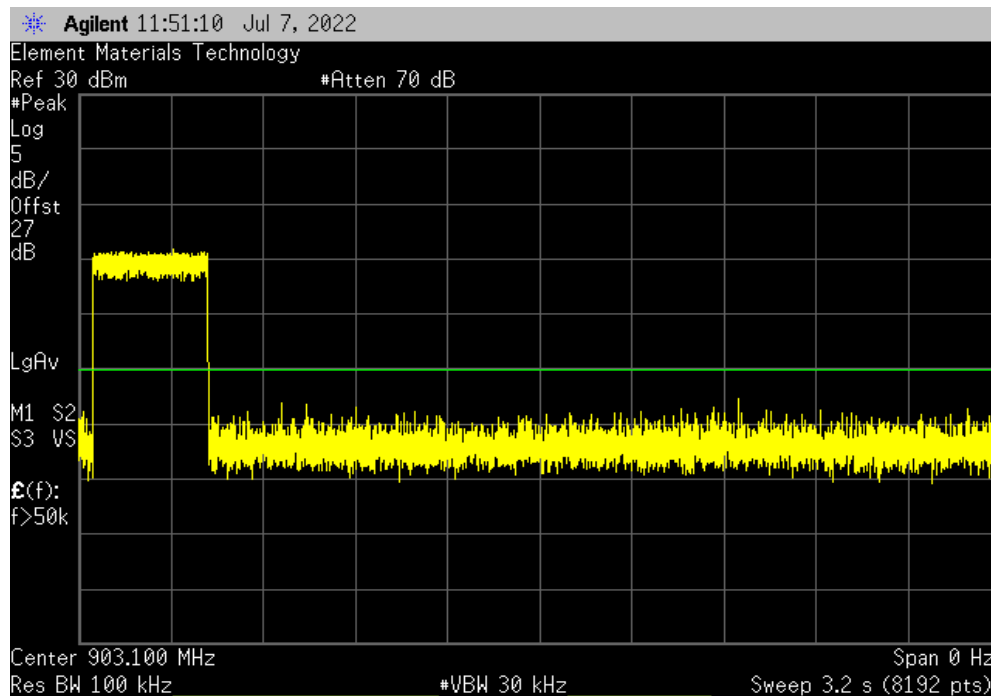


XMR 2022.02.07.0

LoRa Hopping Hybrid Mode, Spreading Factor 7, Sample 6						
Pulse Width (ms)	Number of Pulses	Average No. of Pulses	On Time Over 3200 ms	Limit (ms)	Result	
N/A	1	N/A	N/A	N/A	N/A	



LoRa Hopping Hybrid Mode, Spreading Factor 7, Sample 7						
Pulse Width (ms)	Number of Pulses	Average No. of Pulses	On Time Over 3200 ms	Limit (ms)	Result	
N/A	1	N/A	N/A	N/A	N/A	

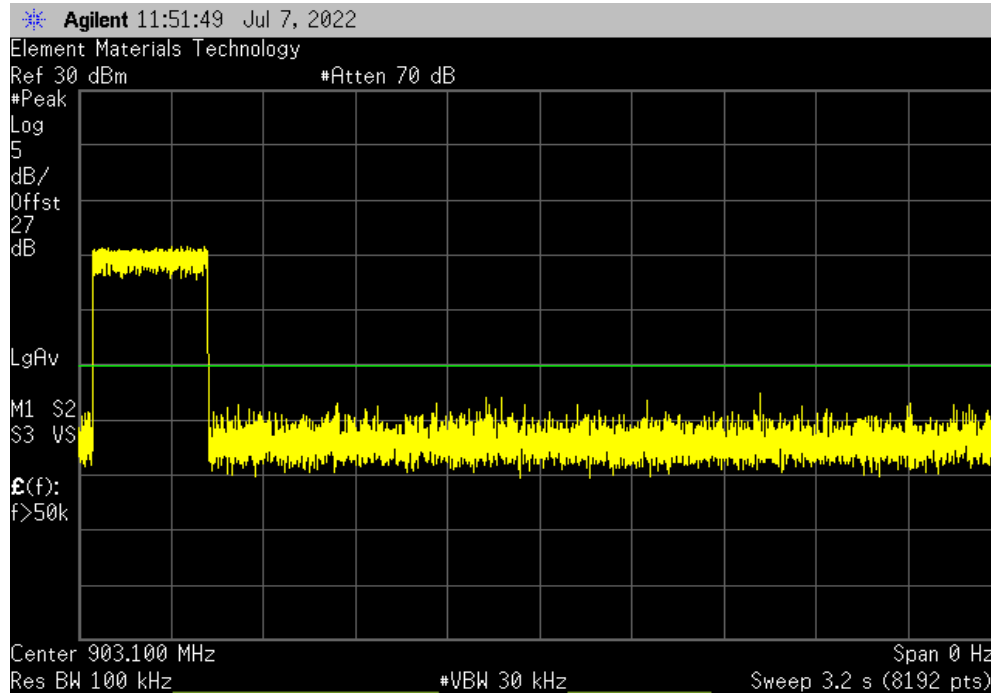


DWELL TIME

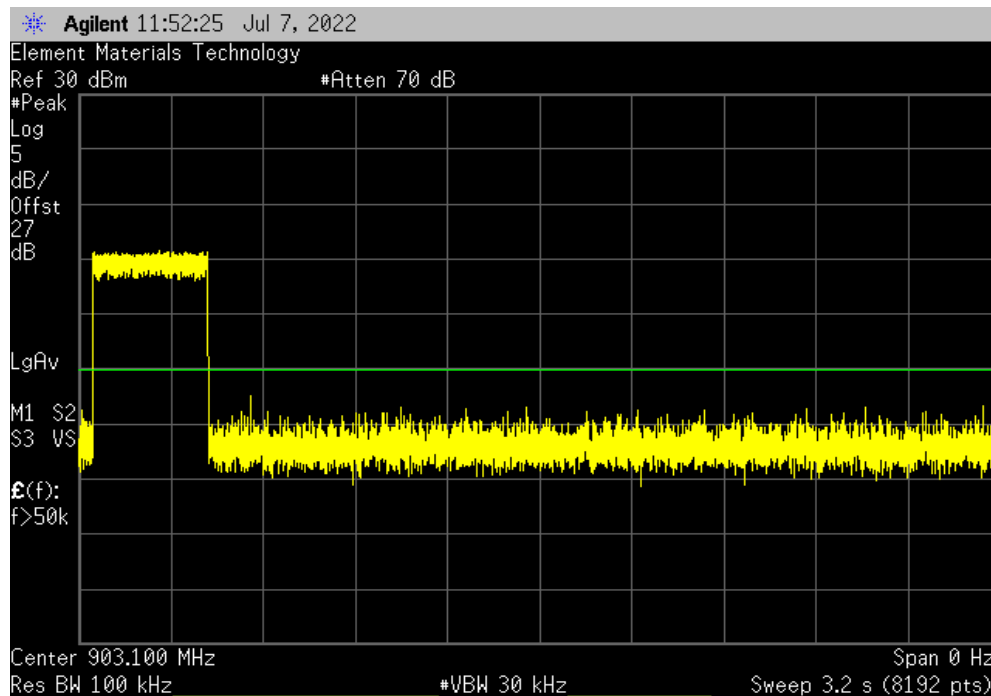


XMR 2022.02.07.0

LoRa Hopping Hybrid Mode, Spreading Factor 7, Sample 8						
Pulse Width (ms)	Number of Pulses	Average No. of Pulses	On Time Over 3200 ms	Limit (ms)	Result	
N/A	1	N/A	N/A	N/A	N/A	



LoRa Hopping Hybrid Mode, Spreading Factor 7, Sample 9						
Pulse Width (ms)	Number of Pulses	Average No. of Pulses	On Time Over 3200 ms	Limit (ms)	Result	
N/A	1	N/A	N/A	N/A	N/A	

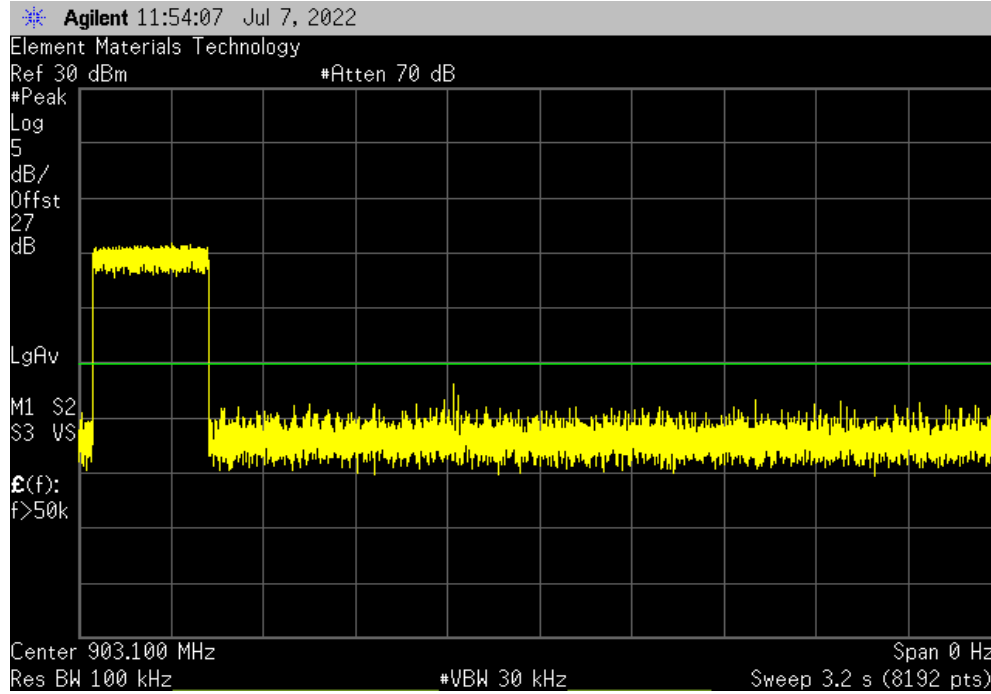


DWELL TIME



XMR 2022.02.07.0

LoRa Hopping Hybrid Mode, Spreading Factor 7, Sample 10						
	Pulse Width (ms)	Number of Pulses	Average No. of Pulses	On Time Over 3200 ms	Limit (ms)	Result
	N/A	1	N/A	N/A	N/A	N/A



LoRa Hopping Hybrid Mode, Spreading Factor 7, Calculations						
	Pulse Width (ms)	Number of Pulses	Average No. of Pulses	On Time Over 3200 ms	Limit (ms)	Result
	399.8	N/A	1	399.8	400	Pass

Calculation Only

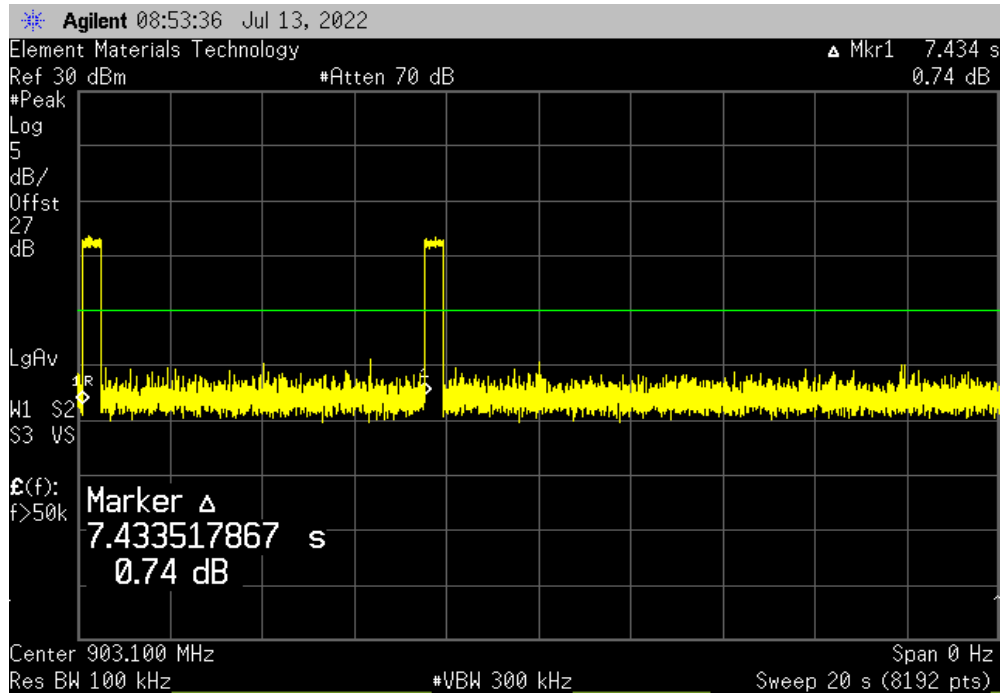
No Screen Capture Required

DWELL TIME



XMR 2022.02.07.0

LoRa Hopping Hybrid Mode, Spreading Factor 7, Long Dwell						
Pulse Width (ms)	Number of Pulses	Average No. of Pulses	On Time Over 3200 ms	Limit (ms)	Result	
	N/A	N/A	N/A	N/A	N/A	



OUTPUT POWER



XMIT 2020.12.30.0

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	Keysight	N5182B	TEV	2021-04-27	2024-04-27
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFN	2022-01-19	2023-01-19
Block - DC	Fairview Microwave	SD3379	AMM	2021-09-14	2022-09-14
Attenuator	Fairview Microwave	SA4018-20	TYE	2021-09-15	2022-09-15
Cable	UtiFlex Micro-Coax	UFD1150A-1-0720-200200	TXK	2021-09-13	2022-09-13

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 20 dB bandwidth (B) was measured. The 20 dB bandwidth is greater than the 6 dB DTS bandwidth.

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



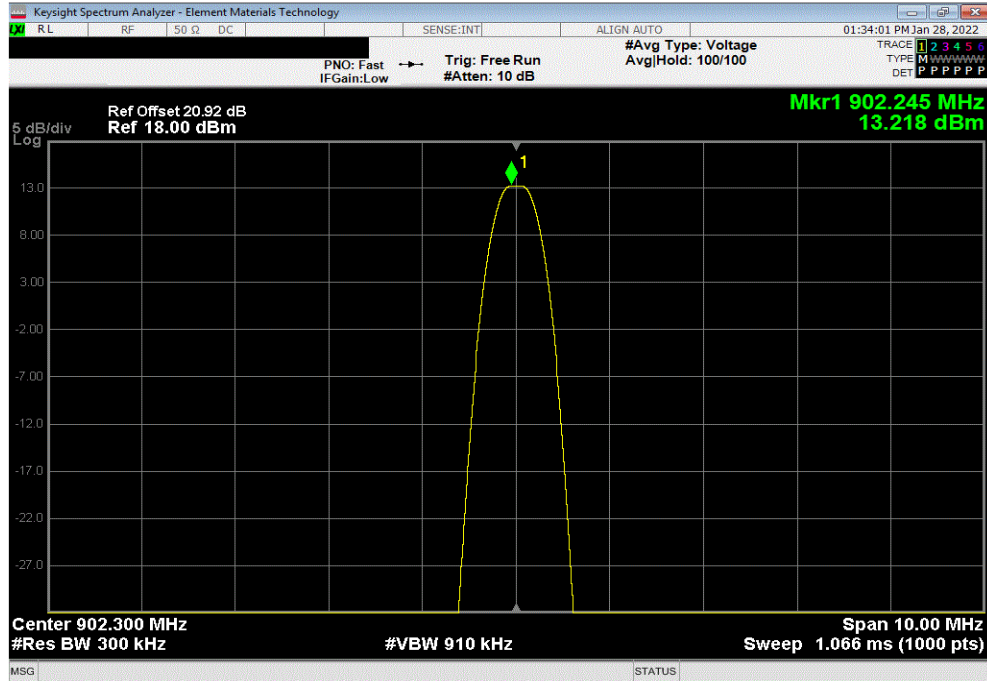
EUT: Radio Thermostat		Work Order: F3EN0068	
Serial Number: Shielded Unit		Date: 28-Jan-22	
Customer: Quext		Temperature: 21.7 °C	
Attendees: None		Humidity: 24.2% RH	
Project: None		Barometric Pres.: 1034 mbar	
Tested by: Brandon Hobbs		Power: 110VAC/60Hz	
		Job Site: TX09	
TEST SPECIFICATIONS			
FCC 15.247:2022		ANSI C63.10:2013	
COMMENTS			
None			
DEVIATIONS FROM TEST STANDARD			
None			
Configuration #	5	Signature 	
		Out Pwr (dBm)	Limit (dBm)
LoRa Radio 902 - 928 MHz Band			Result
125 kHz Bandwidth			
Spreading Factor 7			
Low Channel 902.3 MHz		13.218	30 Pass
Mid Channel 903.1 MHz		13.195	30 Pass
High Channel 903.8 MHz		13.172	30 Pass

OUTPUT POWER

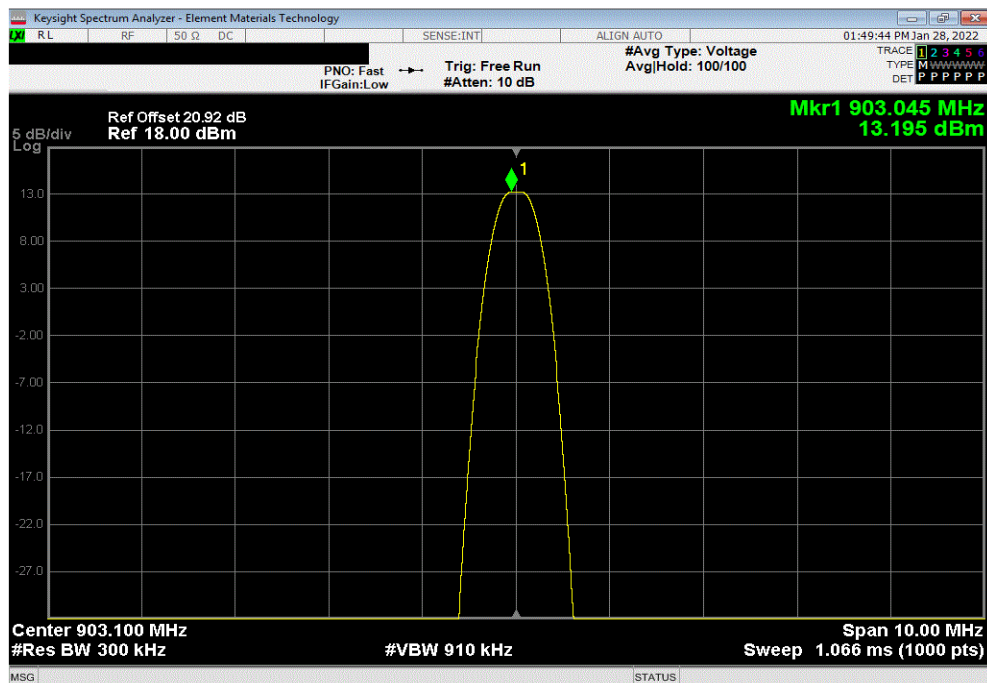


TbTx 2021.10.29.2 XMt 2020.12.30.0

LoRa Radio 902 - 928 MHz Band, 125 kHz Bandwidth, Spreading Factor 7, Low Channel 902.3 MHz						
				Out Pwr (dBm)	Limit (dBm)	Result
				13.218	30	Pass



LoRa Radio 902 - 928 MHz Band, 125 kHz Bandwidth, Spreading Factor 7, Mid Channel 903.1 MHz						
				Out Pwr (dBm)	Limit (dBm)	Result
				13.195	30	Pass

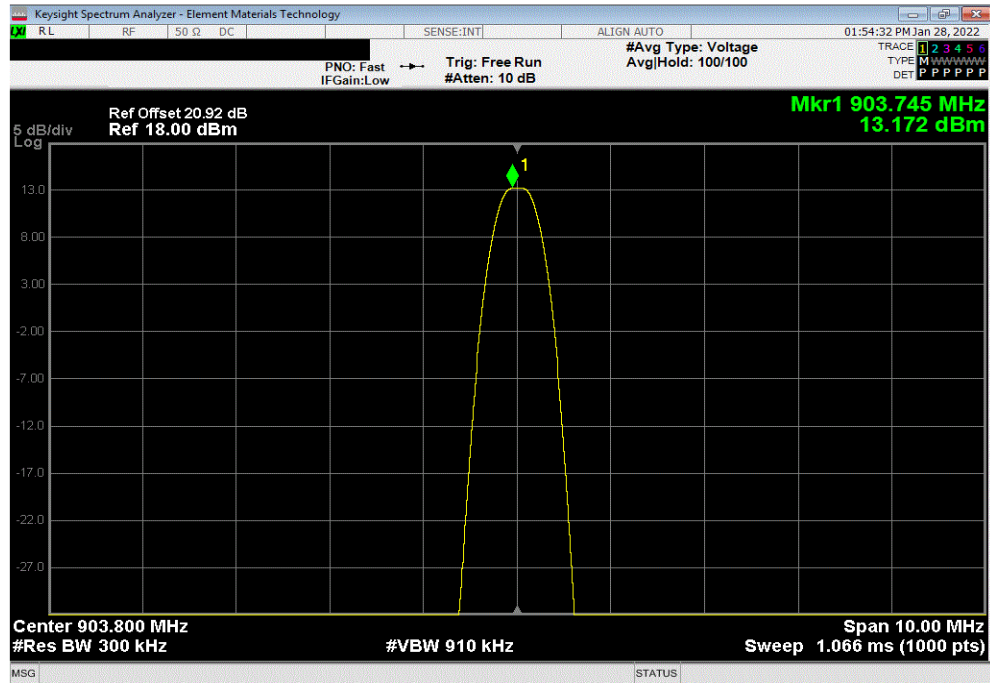


OUTPUT POWER



TbTx 2021.10.29.2 XMt 2020.12.30.0

LoRa Radio 902 - 928 MHz Band, 125 kHz Bandwidth, Spreading Factor 7, High Channel 903.8 MHz						
				Out Pwr (dBm)	Limit (dBm)	Result
				13.172	30	Pass



EQUIVALENT ISOTROPIC RADIATED POWER (EIRP)



XMIT 2020.12.30.0

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
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFN	2022-01-19	2023-01-19
Generator - Signal	Keysight	N5182B	TEV	2021-04-27	2024-04-27
Block - DC	Fairview Microwave	SD3379	AMM	2021-09-14	2022-09-14
Attenuator	Fairview Microwave	SA4018-20	TYE	2021-09-15	2022-09-15
Cable	UtiFlex Micro-Coax	UFD1150A-1-0720-200200	TXK	2021-09-13	2022-09-13

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 20 dB bandwidth (B) was measured. The 20 dB bandwidth is greater than the 6 dB DTS bandwidth.

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)



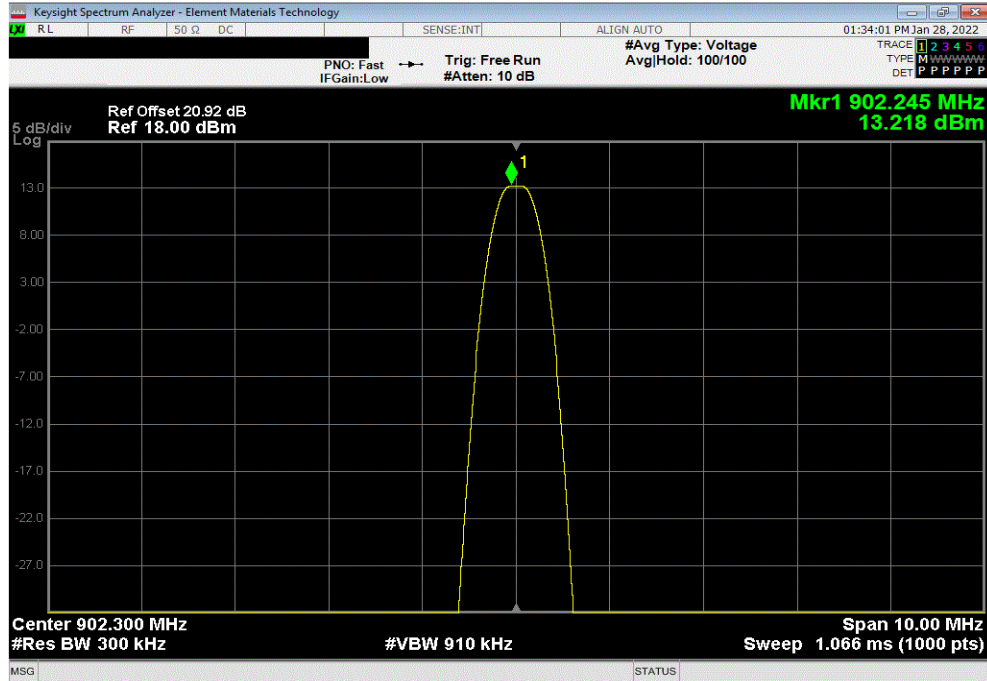
EUT: Radio Thermostat		Work Order: F3EN0068	
Serial Number: Shielded Unit		Date: 28-Jan-22	
Customer: Quext		Temperature: 21.7 °C	
Attendees: None		Humidity: 24.2% RH	
Project: None		Barometric Pres.: 1034 mbar	
Tested by: Brandon Hobbs	Power: 110VAC/60Hz	Job Site: TX09	
TEST SPECIFICATIONS		Test Method	
FCC 15.247:2022		ANSI C63.10:2013	
COMMENTS			
None			
DEVIATIONS FROM TEST STANDARD			
None			
Configuration #	5	Signature	
		Out Pwr (dBm)	Antenna Gain (dBi)
LoRa Radio 902 - 928 MHz Band		EIRP (dBm)	EIRP Limit (dBm)
125 kHz Bandwidth			Result
Spreading Factor 7			
Low Channel 902.3 MHz		13.22	0.9
Mid Channel 903.1 MHz		13.20	0.9
High Channel 903.8 MHz		13.17	0.9
		14.12	36
		14.10	36
		14.07	36
			Pass
			Pass
			Pass

EQUIVALENT ISOTROPIC RADIATED POWER (EIRP)

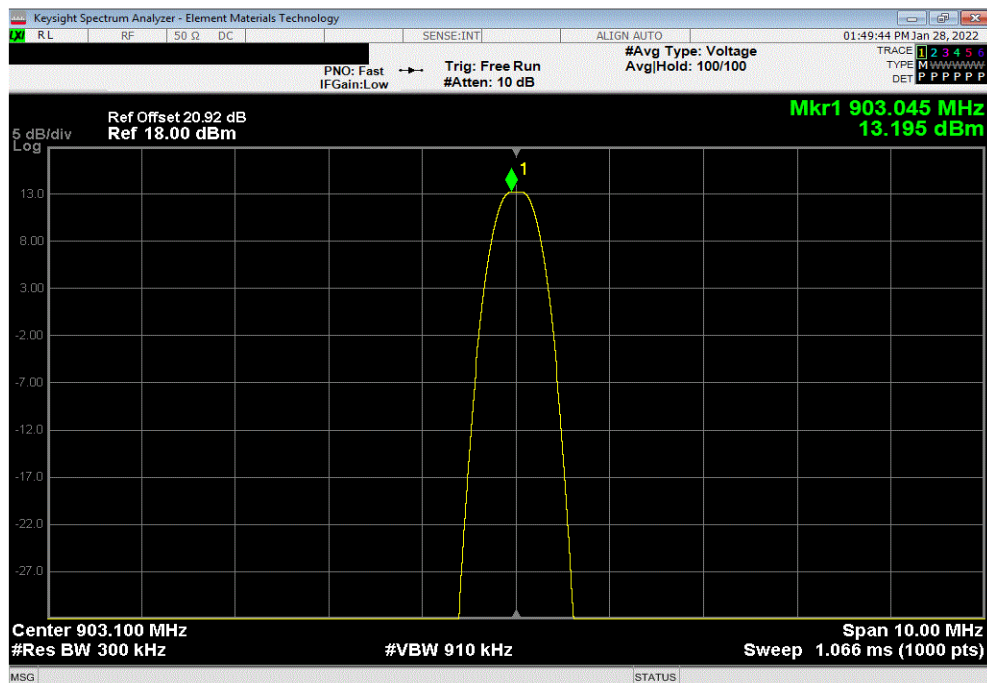


TbTx 2021.10.29.2 XMt 2020.12.30.0

LoRa Radio 902 - 928 MHz Band, 125 kHz Bandwidth, Spreading Factor 7, Low Channel 902.3 MHz						
	Out Pwr (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Result	
	13.218	0.9	14.118	36	Pass	



LoRa Radio 902 - 928 MHz Band, 125 kHz Bandwidth, Spreading Factor 7, Mid Channel 903.1 MHz						
	Out Pwr (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Result	
	13.195	0.9	14.095	36	Pass	

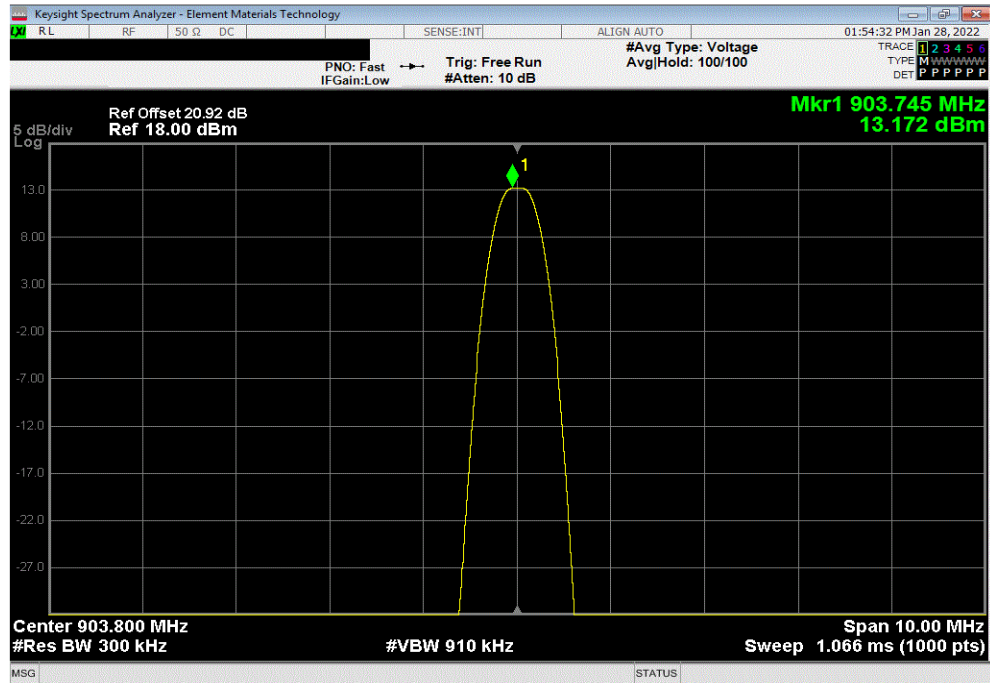


EQUIVALENT ISOTROPIC RADIATED POWER (EIRP)



TbTx 2021.10.29.2 XMt 2020.12.30.0

LoRa Radio 902 - 928 MHz Band, 125 kHz Bandwidth, Spreading Factor 7, High Channel 903.8 MHz					
	Out Pwr (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Result
	13.172	0.9	14.072	36	Pass



BAND EDGE COMPLIANCE



XMI 2020.12.30.0

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
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFN	2022-01-19	2023-01-19
Generator - Signal	Keysight	N5182B	TEV	2021-04-27	2024-04-27
Block - DC	Fairview Microwave	SD3379	AMM	2021-09-14	2022-09-14
Attenuator	Fairview Microwave	SA4018-20	TYE	2021-09-15	2022-09-15
Cable	UtiFlex Micro-Coax	UFD1150A-1-0720-200200	TXK	2021-09-13	2022-09-13

TEST DESCRIPTION

The spurious RF conducted emissions at the edges of the authorized band were measured with the EUT set to low and high transmit frequencies. The EUT was transmitting at the data rate(s) listed in the datasheet in a no hop mode. The channels closest to the band edges were selected.

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

BAND EDGE COMPLIANCE



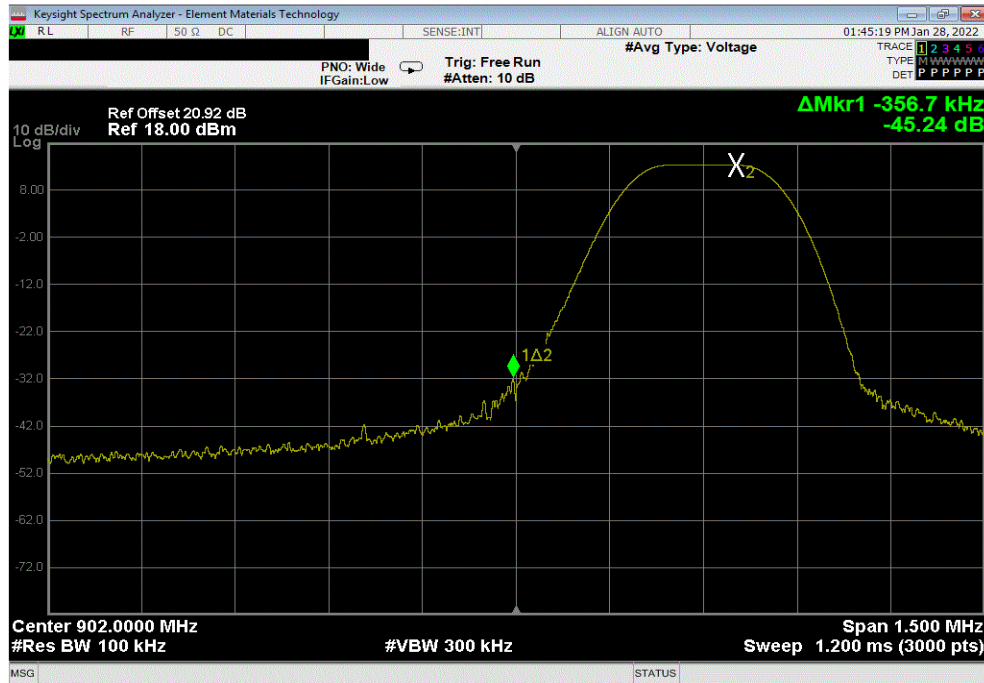
EUT: Radio Thermostat		Work Order: F3EN0068	
Serial Number: Shielded Unit		Date: 28-Jan-22	
Customer: Quext		Temperature: 21.7 °C	
Attendees: None		Humidity: 24.2% RH	
Project: None		Barometric Pres.: 1035 mbar	
Tested by: Brandon Hobbs		Power: 110VAC/60Hz	
		Job Site: TX09	
TEST SPECIFICATIONS		Test Method	
FCC 15.247:2022		ANSI C63.10:2013	
COMMENTS			
None			
DEVIATIONS FROM TEST STANDARD			
None			
Configuration #	5	Signature	
		Value (dBc)	Limit ≤ (dBc) Result
LoRa Radio 902 - 928 MHz Band			
125 kHz Bandwidth			
Spreading Factor 7			
Low Channel 902.3 MHz		-45.24	-20 Pass
High Channel 903.8 MHz		-69.94	-20 Pass

BAND EDGE COMPLIANCE

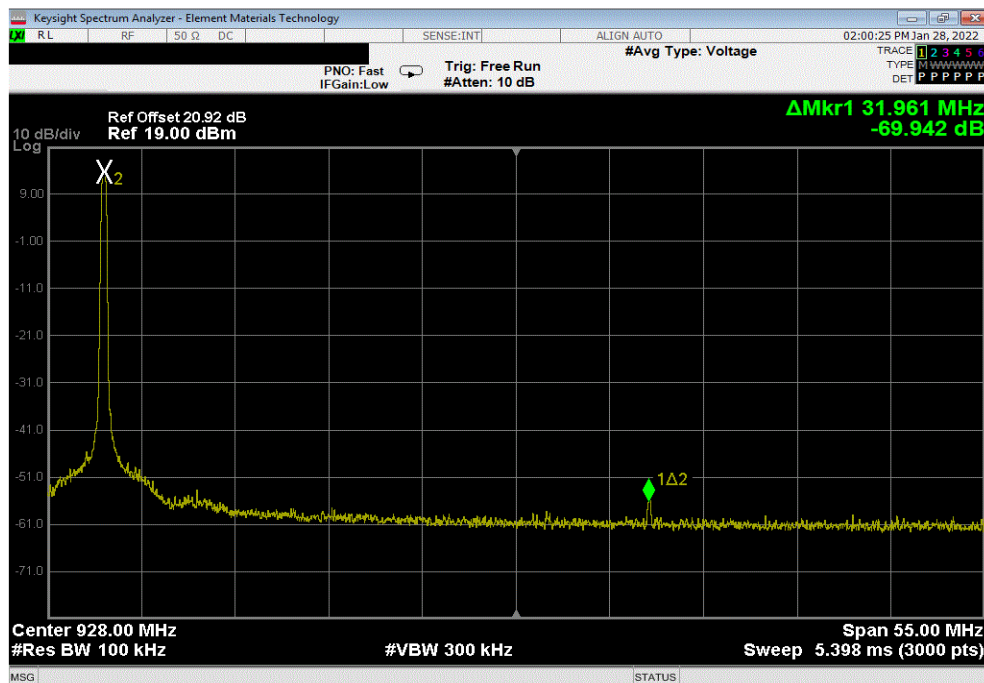


TbTtx 2021.10.29.2 XMt 2020.12.30.0

LoRa Radio 902 - 928 MHz Band, 125 kHz Bandwidth, Spreading Factor 7, Low Channel 902.3 MHz						
				Value (dBc)	Limit ≤ (dBc)	Result
				-45.24	-20	Pass



LoRa Radio 902 - 928 MHz Band, 125 kHz Bandwidth, Spreading Factor 7, High Channel 903.8 MHz						
				Value (dBc)	Limit ≤ (dBc)	Result
				-69.94	-20	Pass



BAND EDGE COMPLIANCE -HOPPING MODE



XMIT 2020.12.30.0

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	Keysight	N5182B	TEV	2021-04-27	2024-04-27
Analyzer - Spectrum Analyzer	Agilent	E4440A	AFD	2021-08-25	2022-08-25
Block - DC	Fairview Microwave	SD3379	AMT	2021-09-14	2022-09-14
Attenuator	Fairview Microwave	SA4018-20	TYE	2021-09-15	2022-09-15
Cable	UtiFlex Micro-Coax	UFD1150A-1-0720-200200	TXK	2021-09-13	2022-09-13

TEST DESCRIPTION

The spurious RF conducted emissions at the edges of the authorized band were measured with the EUT set to its normal pseudo-random hopping sequence. 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 -HOPPING MODE



TstTx 2021.10.29.2 XMR 2020.12.30.0

EUT: Radio Thermostat		Work Order: F3EN0068	
Serial Number: DUT2		Date: 14-Dec-21	
Customer: Quext		Temperature: 22.5 °C	
Attendees: None		Humidity: 46.8% RH	
Project: None		Barometric Pres.: 1024 mbar	
Tested by: Brandon Hobbs		Power: 110VAC/60Hz	
		Job Site: TX09	
TEST SPECIFICATIONS			
FCC 15.247:2021		Test Method	
		ANSI C63.10:2013	
COMMENTS			
None			
DEVIATIONS FROM TEST STANDARD			
None			
Configuration #	1	Signature 	
		Value (dBc)	Limit ≤ (dBc) Result
LoRa Radio 902 - 928 MHz Band			
125 kHz Bandwidth			
Spreading Factor 7			
Low Channel 902.3 MHz		-58.23	-20 Pass
High Channel 903.8 MHz		-66.71	-20 Pass

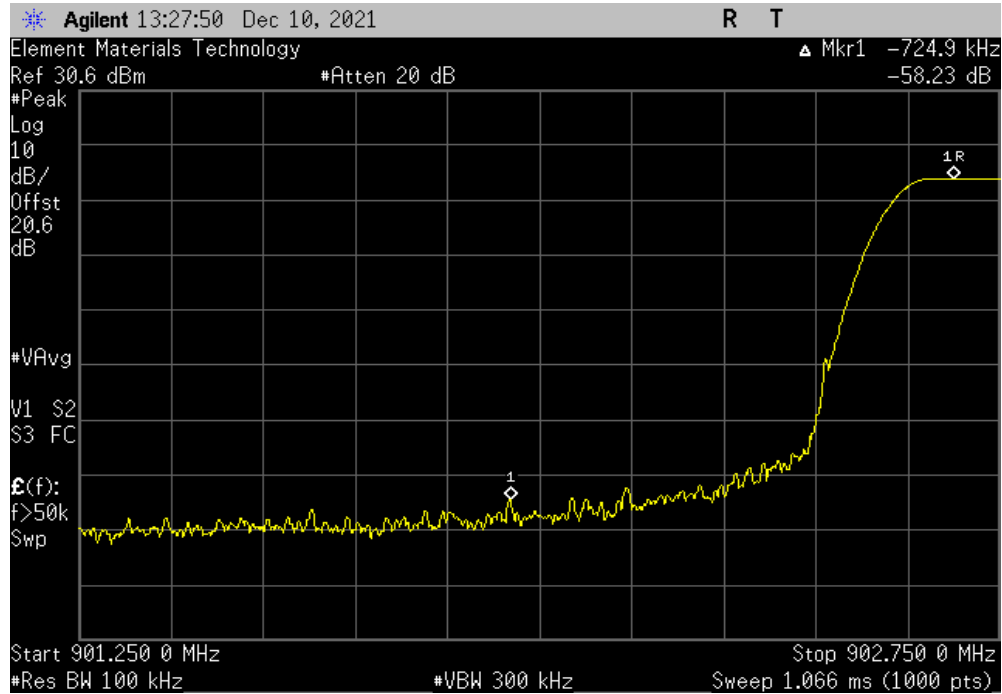
BAND EDGE COMPLIANCE -HOPPING MODE



TbTx 2021.10.29.2 XMt 2020.12.30.0

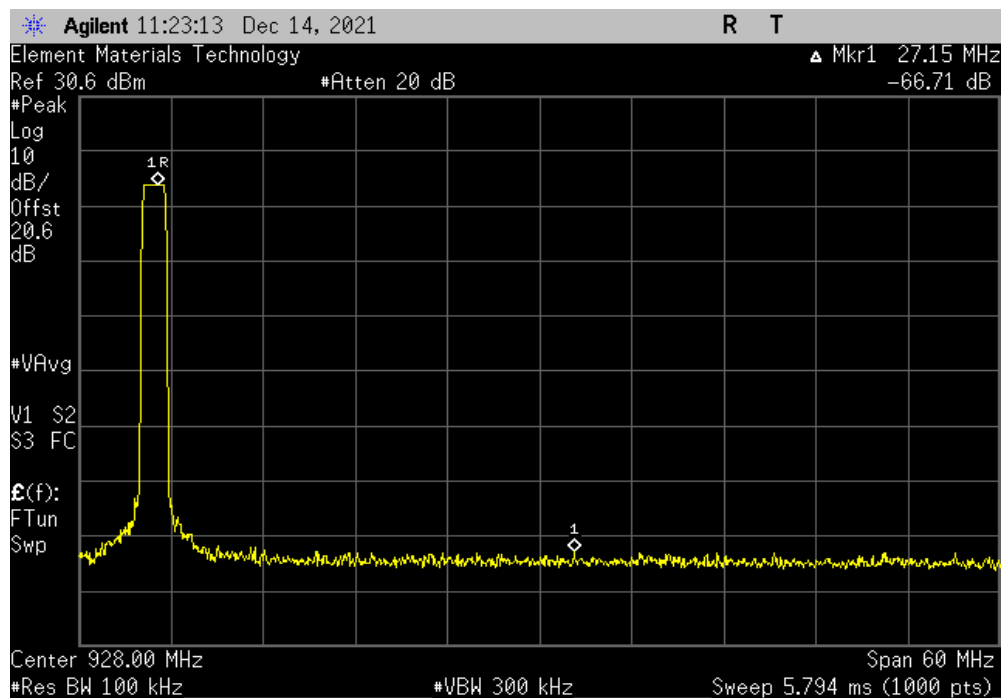
LoRa Radio 902 - 928 MHz Band, 125 kHz Bandwidth, Spreading Factor 7, Low Channel 902.3 MHz

	Value (dBc)	Limit ≤ (dBc)	Result
	-58.23	-20	Pass



LoRa Radio 902 - 928 MHz Band, 125 kHz Bandwidth, Spreading Factor 7, High Channel 903.8 MHz

	Value (dBc)	Limit ≤ (dBc)	Result
	-66.71	-20	Pass



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
Block - DC	Fairview Microwave	SD3379	AMM	2021-09-14	2022-09-14
Attenuator	Fairview Microwave	SA18E 1913	TZV	2021-09-15	2022-09-15
Cable	UtiFlex Micro-Coax	UFD1150A-1-0720-200200	TXJ	2021-09-13	2022-09-13
Generator - Signal	Agilent	N5173B	TIW	2020-07-17	2023-07-17
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFQ	2022-01-17	2023-01-17

TEST DESCRIPTION

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

The 20 dB occupied bandwidth was measured with the EUT set to low, medium and high transmit frequencies in the band. The EUT was transmitting at the data rate(s) listed in the datasheet in a no-hop mode. The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts.

Per FCC KDB 558074 Section 10(b)(3), there is no requirement for hybrid systems to comply with the 500 kHz minimum 6dB bandwidth for DTS devices.

The 99.0% occupied bandwidth was measured and used to determine the Resolution Bandwidth needed during Output Power measurement.

ThiTx 2021.10.29.2 XMit 2022.02.07.0

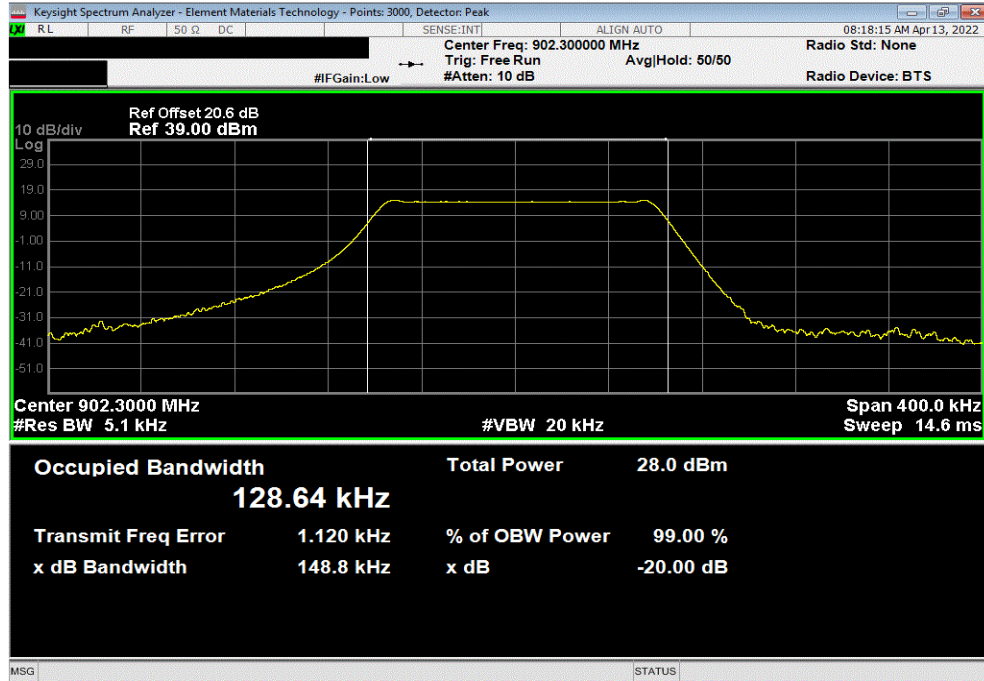
OCCUPIED BANDWIDTH



TbTx 2021.10.29.2 XbTx 2022.02.07.0

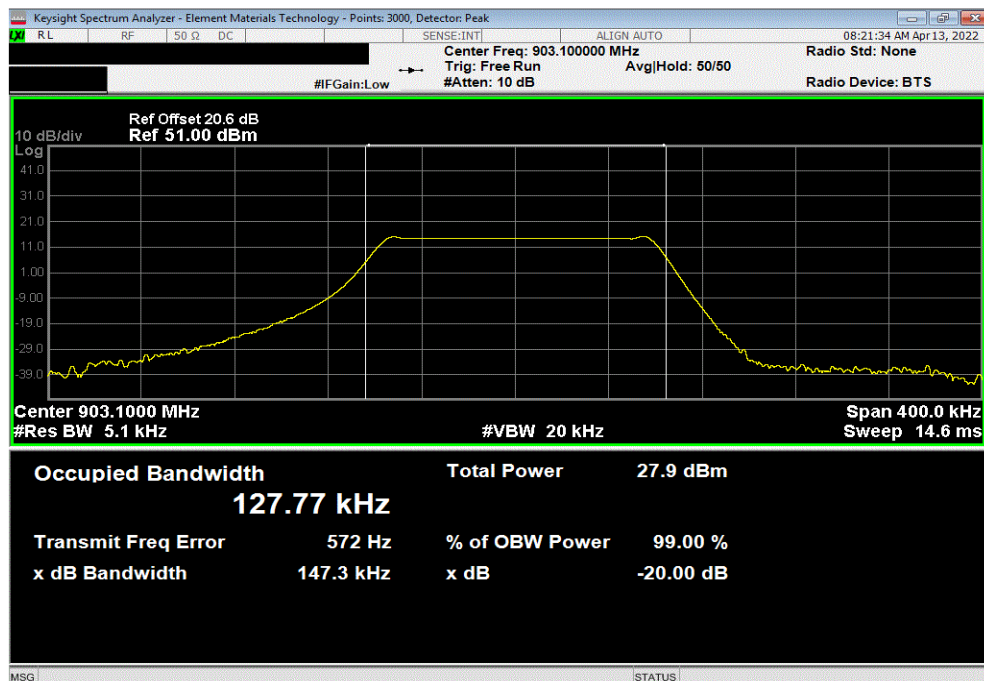
LoRa Radio 902 - 928 MHz Band, 125 kHz Bandwidth, Spreading Factor 7, Low Channel 902.3 MHz

	Value	Limit	Result
	148.838 kHz	N/A	N/A



LoRa Radio 902 - 928 MHz Band, 125 kHz Bandwidth, Spreading Factor 7, Mid Channel 903.1 MHz

	Value	Limit	Result
	147.316 kHz	N/A	N/A

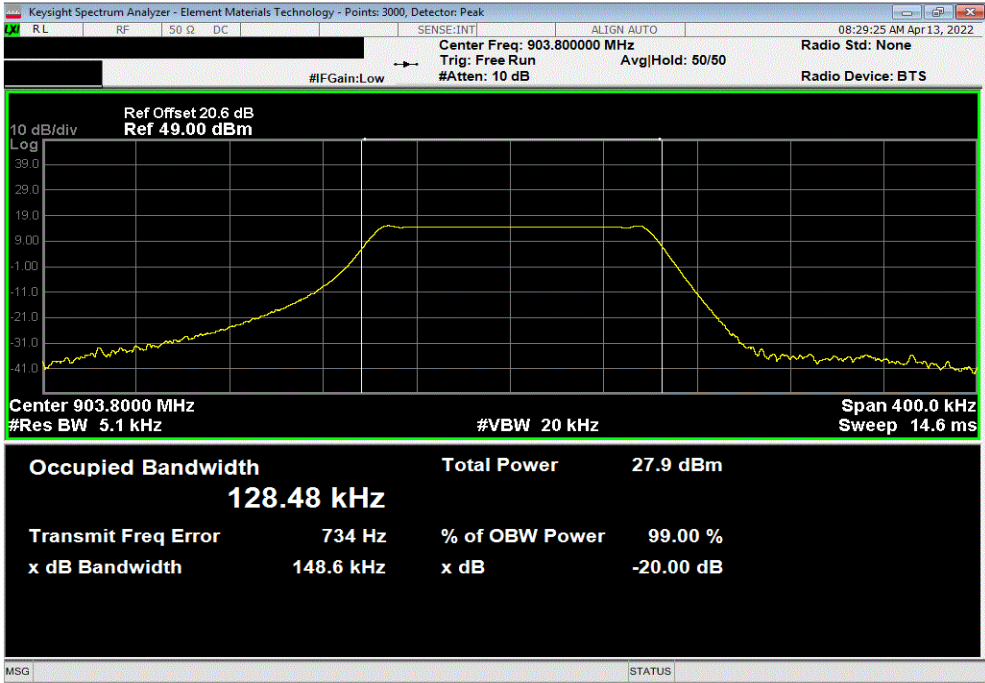


OCCUPIED BANDWIDTH



TbTtX 2021.10.29.2 XMR 2022.02.07.0

LoRa Radio 902 - 928 MHz Band, 125 kHz Bandwidth, Spreading Factor 7, High Channel 903.8 MHz						
			Value	Limit	Result	
			148.619 kHz	N/A	N/A	



OCCUPIED BANDWIDTH 99%



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
Analyzer - Spectrum Analyzer	Agilent	E4440A	AFD	2021-08-25	2022-08-25
Generator - Signal	Agilent	N5173B	TIW	2020-07-17	2023-07-17
Cable	UtiFlex Micro-Coax	UFD1150A-1-0720-200200	TXJ	2021-09-13	2022-09-13
Attenuator	Fairview Microwave	SA18E 1913	TZV	2021-09-15	2022-09-15
Block - DC	Fairview Microwave	SD3379	AMM	2021-09-14	2022-09-14

TEST DESCRIPTION

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

The 99% occupied bandwidth was measured with the EUT configured for continuous modulated operation.

Per ANSI C63.10:2013, 6.9.3, the spectrum analyzer was configured as follows:

The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts.

The resolution bandwidth (RBW) of the spectrum analyzer was set to the range of 1% to 5% of the occupied bandwidth (OBW) and video bandwidth (VBW) bandwidth was set to at least 3 times the resolution bandwidth. The analyzer sweep time was set to auto to prevent video filtering or averaging. A sample detector was used unless the device was not able to be operated in a continuous transmit mode, in which case a peak detector was used.

The spectrum analyzer occupied bandwidth measurement function was used to sum the power of the transmission in linear terms to obtain the 99% bandwidth.

OCCUPIED BANDWIDTH 99%



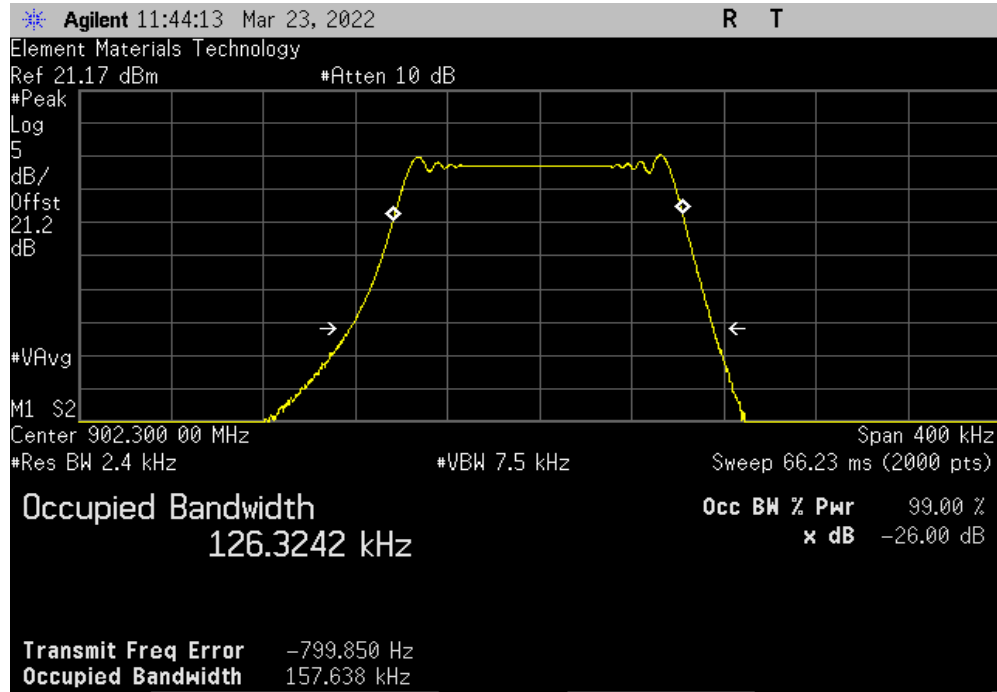
EUT: Radio Thermostat		Work Order: F3EN0068	
Serial Number: Shielded Direct Connect		Date: 23-Mar-22	
Customer: Quext		Temperature: 22.7 °C	
Attendees: None		Humidity: 27.4% RH	
Project: None		Barometric Pres.: 1017 mbar	
Tested by: Brandon Hobbs, Jarrod Brenden		Power: 110VAC/60Hz	
		Job Site: TX04	
TEST SPECIFICATIONS		Test Method	
FCC 15.247:2022		ANSI C63.10:2013	
COMMENTS			
None			
DEVIATIONS FROM TEST STANDARD			
None			
Configuration #	6	Signature	
		Value (kHz)	Limit (<)
LoRa 125kHz BW, Spreading Factor 7			Result
Low Channel, 902.3 MHz		126.324	N/A
Mid Channel, 903.1 MHz		126.490	N/A
High Channel, 903.8 MHz		126.571	N/A

OCCUPIED BANDWIDTH 99%

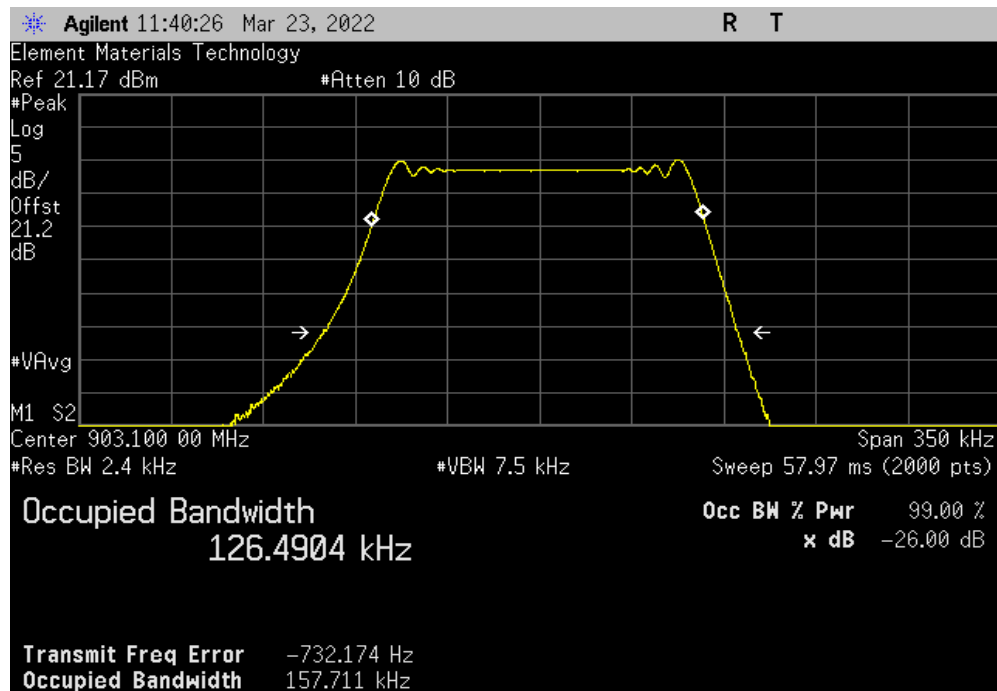


TUTx 2021.12.14.1 XMR 2022.02.07.0

LoRa 125kHz BW, Spreading Factor 7, Low Channel, 902.3 MHz						
				Value (kHz)	Limit ($\leq$)	Result
				126.324	N/A	N/A



LoRa 125kHz BW, Spreading Factor 7, Mid Channel, 903.1 MHz						
				Value (kHz)	Limit ($\leq$)	Result
				126.49	N/A	N/A



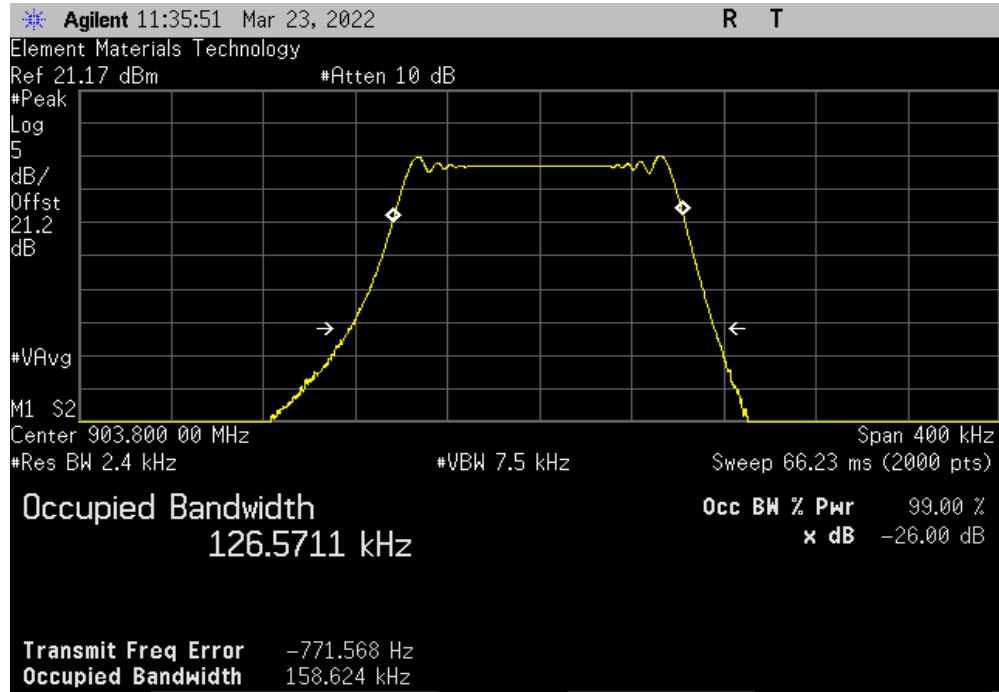
OCCUPIED BANDWIDTH 99%



TbTx 2021.12.14.1 XMt 2022.02.07.0

LoRa 125kHz BW, Spreading Factor 7, High Channel, 903.8 MHz

	Value (kHz)	Limit (<)	Result
	126.571	N/A	N/A



SPURIOUS CONDUCTED EMISSIONS



XMIT 2020.12.30.0

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	Keysight	N5182B	TEV	2021-04-27	2024-04-27
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFN	2022-01-19	2023-01-19
Block - DC	Fairview Microwave	SD3379	AMM	2021-09-14	2022-09-14
Attenuator	Fairview Microwave	SA4018-20	TYE	2021-09-15	2022-09-15
Cable	UtiFlex Micro-Coax	UFD1150A-1-0720-200200	TXK	2021-09-13	2022-09-13

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

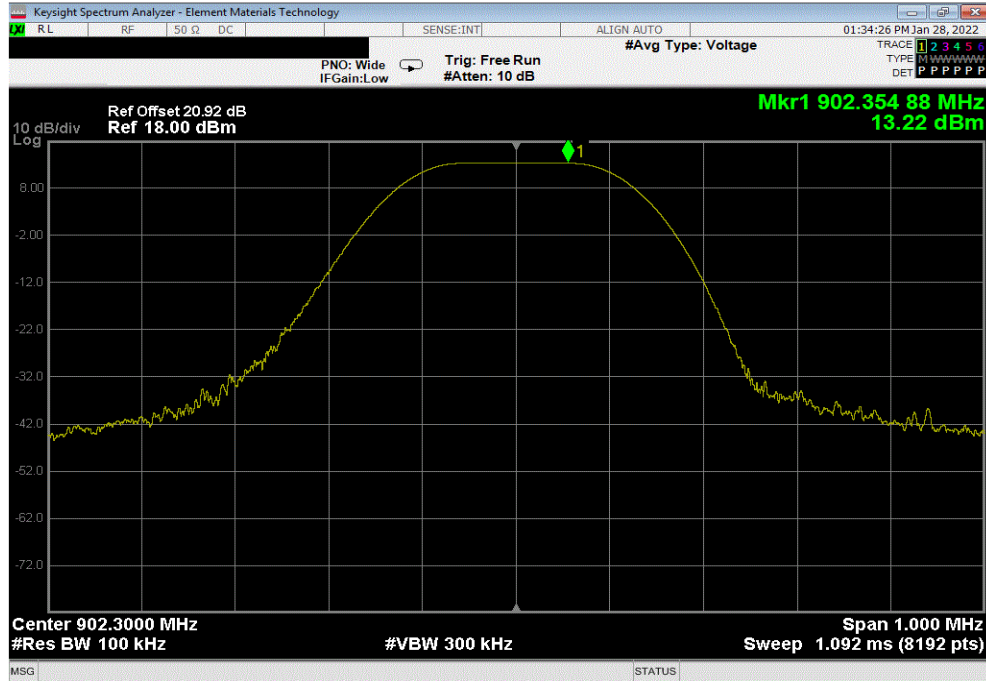
ThiTx 2021.10.29.2 XMit 2020.12.30.0

SPURIOUS CONDUCTED EMISSIONS

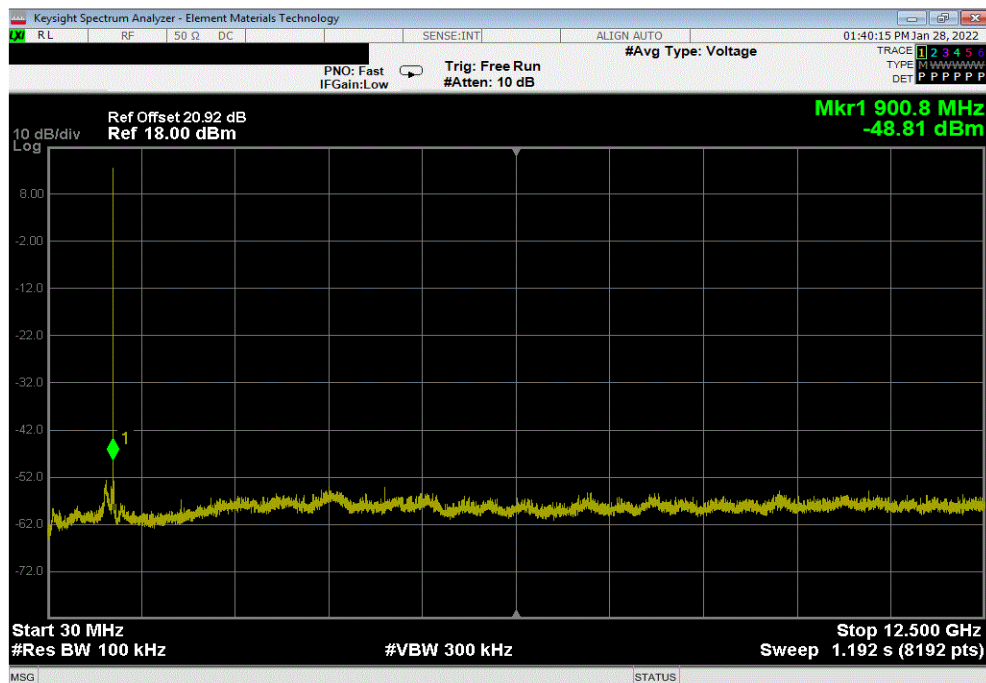


TbTtX 2021.10.29.2 XMt 2020.12.30.0

LoRa Radio 902 - 928 MHz Band, 125 kHz Bandwidth, Spreading Factor 7, Low Channel 902.3 MHz						
Frequency Range	Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result		
Fundamental	902.35	N/A	N/A	N/A		



LoRa Radio 902 - 928 MHz Band, 125 kHz Bandwidth, Spreading Factor 7, Low Channel 902.3 MHz						
Frequency Range	Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result		
30 MHz - 12.5 GHz	900.81	-62.03	-20	Pass		

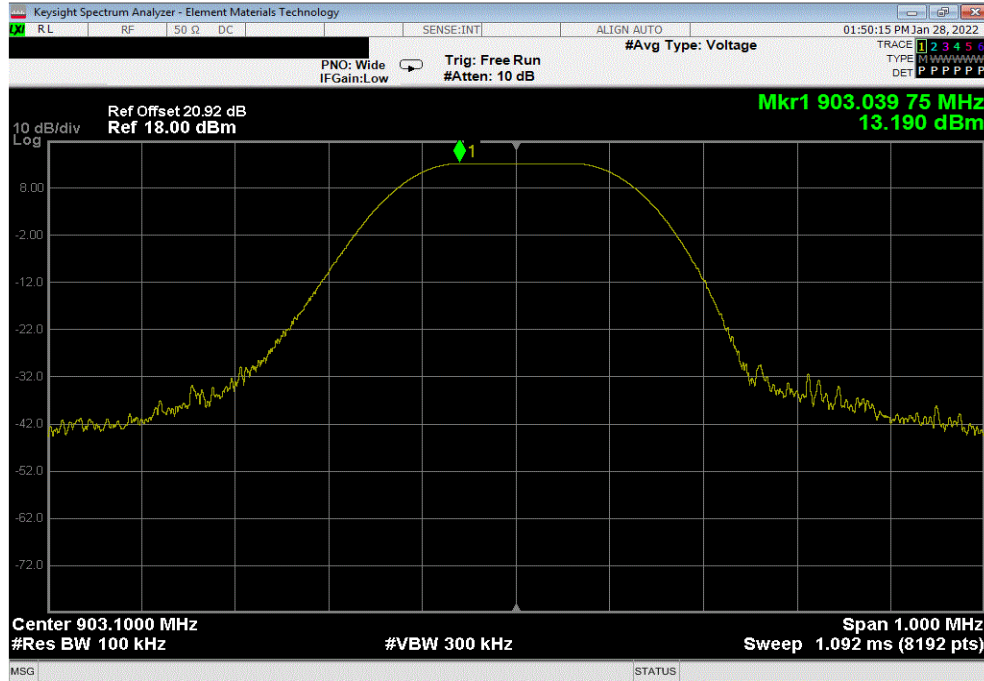


SPURIOUS CONDUCTED EMISSIONS

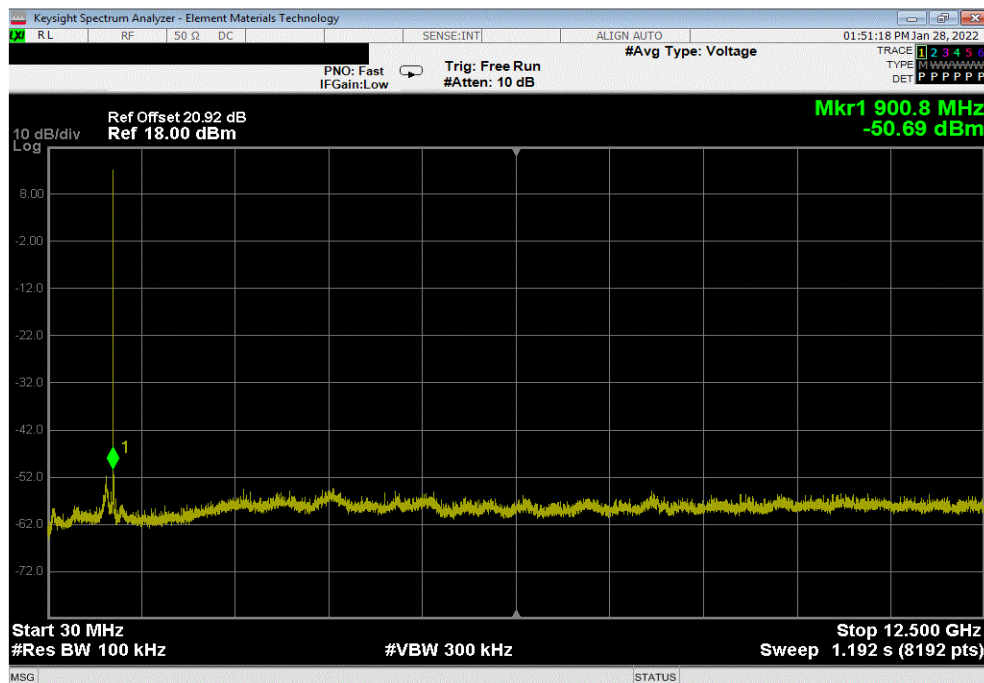


TbTtX 2021.10.29.2 XMt 2020.12.30.0

LoRa Radio 902 - 928 MHz Band, 125 kHz Bandwidth, Spreading Factor 7, Mid Channel 903.1 MHz						
Frequency Range	Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result		
Fundamental	903.04	N/A	N/A	N/A		



LoRa Radio 902 - 928 MHz Band, 125 kHz Bandwidth, Spreading Factor 7, Mid Channel 903.1 MHz						
Frequency Range	Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result		
30 MHz - 12.5 GHz	900.81	-63.88	-20	Pass		

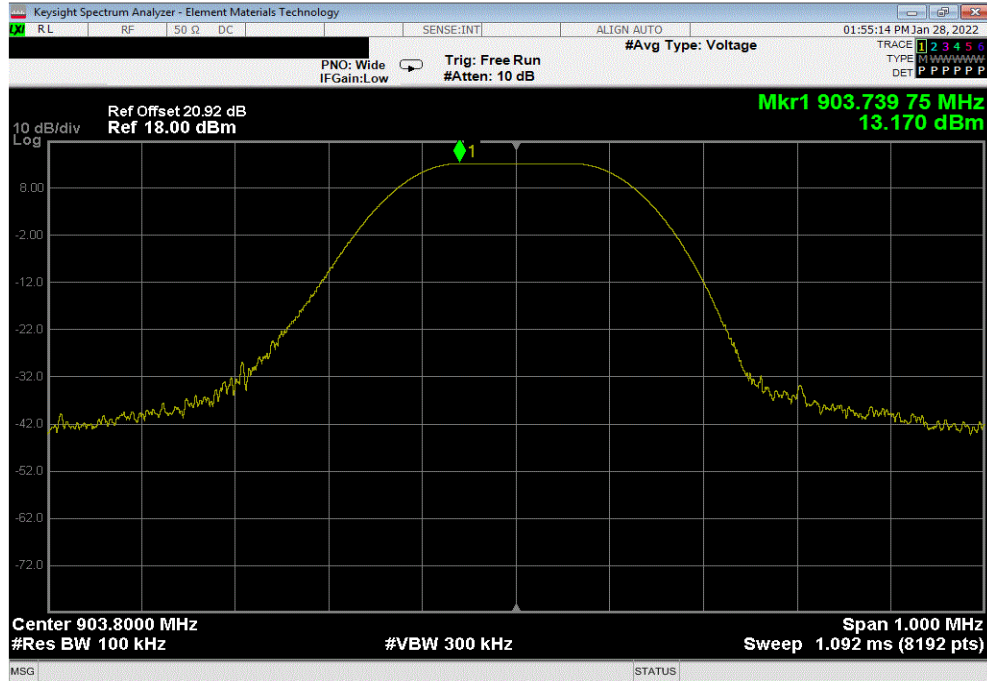


SPURIOUS CONDUCTED EMISSIONS

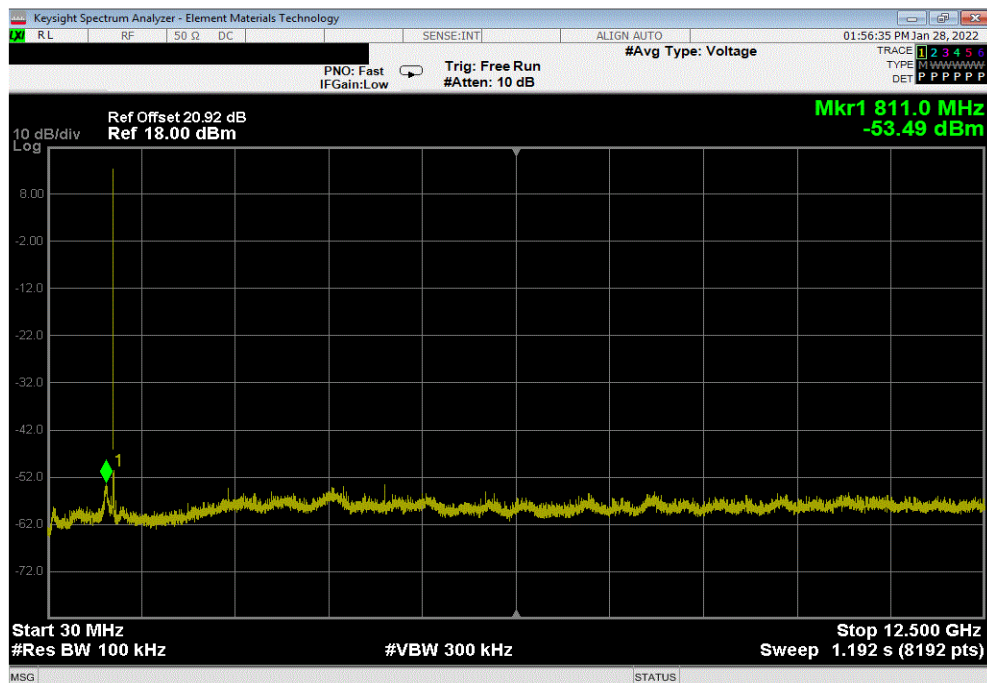


TbTx 2021.10.29.2 XMt 2020.12.30.0

LoRa Radio 902 - 928 MHz Band, 125 kHz Bandwidth, Spreading Factor 7, High Channel 903.8 MHz						
Frequency Range	Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result		
Fundamental	903.74	N/A	N/A	N/A		



LoRa Radio 902 - 928 MHz Band, 125 kHz Bandwidth, Spreading Factor 7, High Channel 903.8 MHz						
Frequency Range	Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result		
30 MHz - 12.5 GHz	810.99	-66.66	-20	Pass		



POWER SPECTRAL DENSITY



XMI 2020.12.30.0

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
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFN	2022-01-19	2023-01-19
Generator - Signal	Keysight	N5182B	TEV	2021-04-27	2024-04-27
Block - DC	Fairview Microwave	SD3379	AMM	2021-09-14	2022-09-14
Attenuator	Fairview Microwave	SA4018-20	TYE	2021-09-15	2022-09-15
Cable	UtiFlex Micro-Coax	UFD1150A-1-0720-200200	TXK	2021-09-13	2022-09-13

TEST DESCRIPTION

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



EUT: Radio Thermostat		Work Order: F3EN0068	
Serial Number: Shielded Unit		Date: 28-Jan-22	
Customer: Quext		Temperature: 21.7 °C	
Attendees: None		Humidity: 24.2% RH	
Project: None		Barometric Pres.: 1034 mbar	
Tested by: Brandon Hobbs		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 #	5	Signature 	
		Value dBm/3kHz	Limit < dBm/3kHz
LoRa Radio 902 - 928 MHz Band			Results
125 kHz Bandwidth			
Spreading Factor 7			
Low Channel 902.3 MHz		6.72	8 Pass
Mid Channel 903.1 MHz		6.53	8 Pass
High Channel 903.8 MHz		6.66	8 Pass

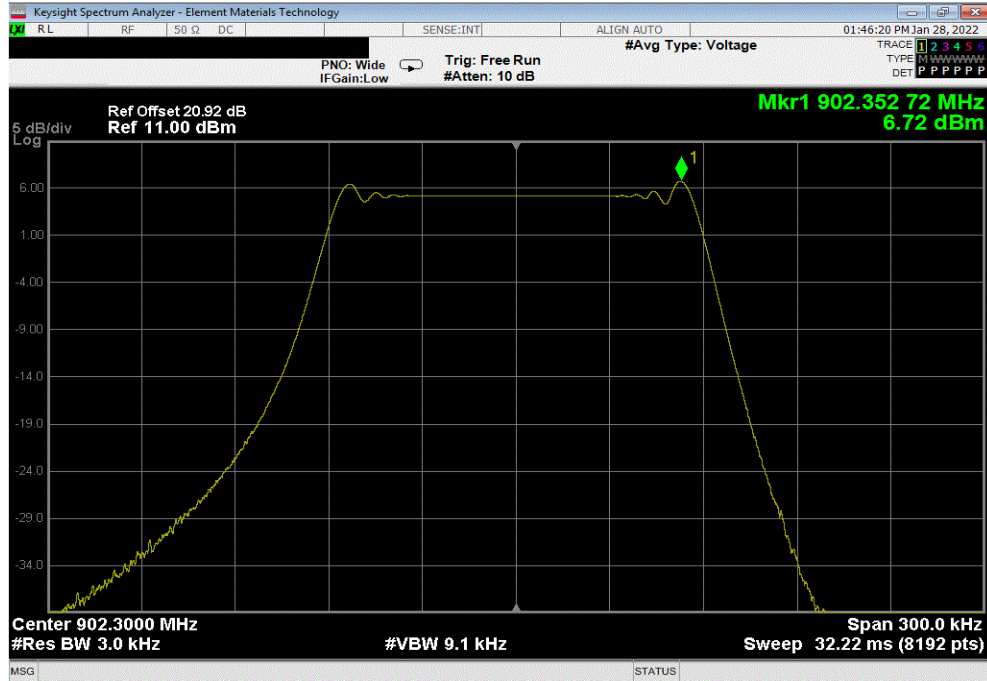
POWER SPECTRAL DENSITY



TbTx 2021.10.29.2 XMt 2020.12.30.0

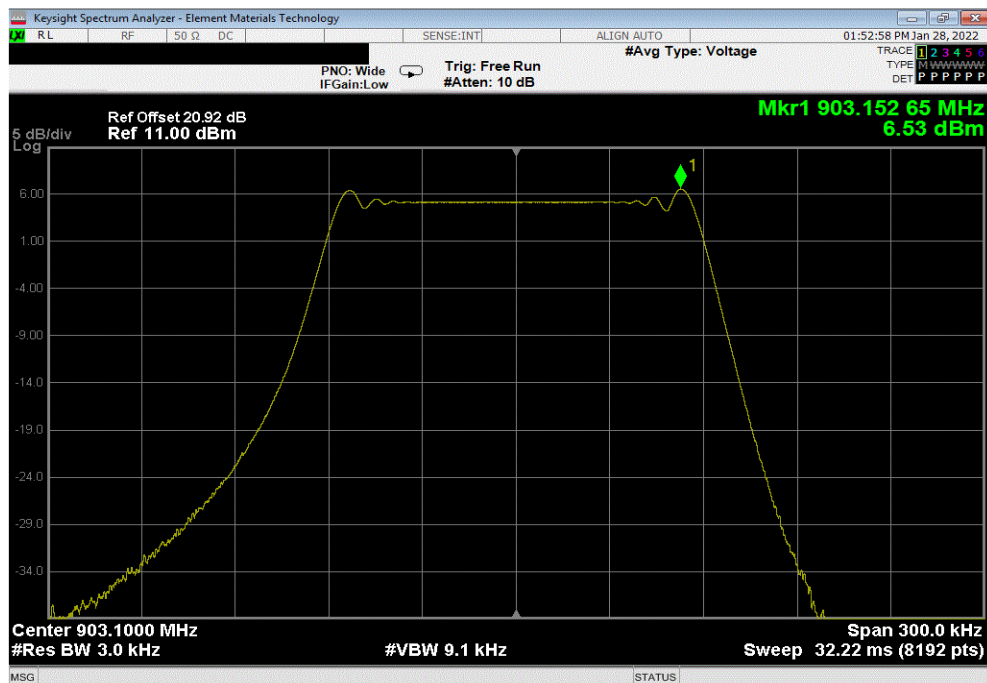
LoRa Radio 902 - 928 MHz Band, 125 kHz Bandwidth, Spreading Factor 7, Low Channel 902.3 MHz

	Value	Limit	Results
	dBm/3kHz	< dBm/3kHz	
	6.715	8	Pass



LoRa Radio 902 - 928 MHz Band, 125 kHz Bandwidth, Spreading Factor 7, Mid Channel 903.1 MHz

	Value	Limit	Results
	dBm/3kHz	< dBm/3kHz	
	6.528	8	Pass

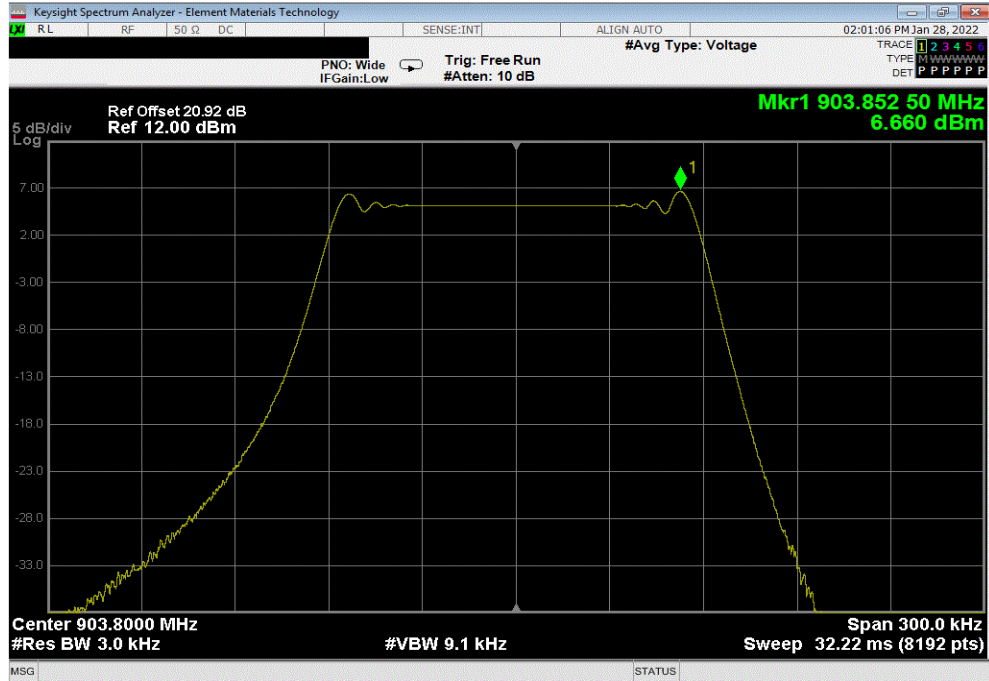


POWER SPECTRAL DENSITY



TbTx 2021.10.29.2 XMt 2020.12.30.0

LoRa Radio 902 - 928 MHz Band, 125 kHz Bandwidth, Spreading Factor 7, High Channel 903.8 MHz						
	Value	Limit				
	dBm/3kHz	< dBm/3kHz	Results			
	6.66	8	Pass			



End of Test Report