IrriGreen, Inc.

Sprinkler (Model: 400104)

Bluetooth Radio

Report: IRRI0015.2 Rev. 1, Issue Date: February 28, 2024

ACCREDITED
CERT #3310.05

TABLE OF CONTENTS

element
2023.04.17

Section	Page Number

CERTIFICATE OF TEST

Last Date of Test: January 31, 2024
IrriGreen, Inc.
EUT: Sprinkler (Model: 400104)

Radio Equipment Testing

Standards

Specification	Method
FCC 15.247:2024	ANSI C63.10:2013
RSS-247 Issue 3:2023	
RSS-Gen Issue 5:2018+A1:2019+A2:2021	

A gap analysis was performed and the test report continues to show compliance with the latest version of the test standards. See below.

Results

Test Description	Result	FCC Section(s)	RSS Section(s)	ANSI C63.10 Section(s)	Comments
Powerline Conducted Emissions	Pass	15.207	RSS-Gen 8.8	6.2	
Duty Cycle	N/A	KDB 558074 -6.0	RSS-Gen 3.2	11.6	Characterization of radio operation.
DTS Bandwidth (6 dB)	Pass	15.247(a)(2), KDB 558074 -8.2	RSS-247 5.2(a)	11.8.2	
Occupied Bandwidth (99%)	Pass	KDB 558074 -2.1	RSS-Gen 6.7	6.9.3	
Output Power	Pass	15.247(b)(3), KDB 558074 - 8.3.1	RSS-247 5.4(d, f), RSS-Gen 6.12	11.9.1.1	
Equivalent Isotropic Radiated Power	Pass	15.247(b)(3), KDB 558074 - 8.3.1	RSS-247 5.4(d, f), RSS-Gen 6.12	11.9.1.1	
Power Spectral Density	Pass	15.247(e), KDB 558074 -8.4	RSS-247 5.2(b)	11.10.2	
Band Edge Compliance	Pass	15.247(d), KDB 558074 -8.5	RSS-247 5.5	11.11	
Spurious Conducted Emissions	Pass	15.247(d), KDB 558074 -8.5	RSS-247 5.5	11.11	
Spurious Radiated Emissions	Pass	15.247(d), KDB 558074 - 8.6, 8.7	RSS-247 5.5, RSS-Gen 6.13, 8.10	11.12.1, 11.13.2, 6.5, 6.6	

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.

CERTIFICATE OF TEST

The main changes for RSS-247 Issue 3 are listed below:

1. Modified section 6.2 to clarify that different measurement methods can apply depending on the operating frequency range of the device.
2. Added section 6.2.5 to introduce the requirements for devices operating from 5850 5895 MHz and channels that span across 5850 MHz.
3. Added section 6.2.5.1 to provide general information and definitions.
4. Added section 6.2.5.2 to identify the power limits associated with devices operating in the 5850-5895 MHz band.
5. Added section 6.2.5.3 to identify the unwanted emission limits associated with devices operating in the 5850-5895 MHz band.
6. Made editorial changes and clarifications, as appropriate.

Deviations From Test Standards

None

Approved By:

Trevor Buls, Principal EMC Test Engineer

REVISION HISTORY

Revision Number	Description	Date (yyyy-mm-dd)	Page Number
01	Replaced Powerline Conducted Emissions data with new data	2024-02-01	17-21
	Updated test dates	2024-02-01	3, 12, 16
	Updated EUT name	2024-02-24	1, 3, 12
	Updated CoT to latest version of test standards	2024-02-27	3

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.

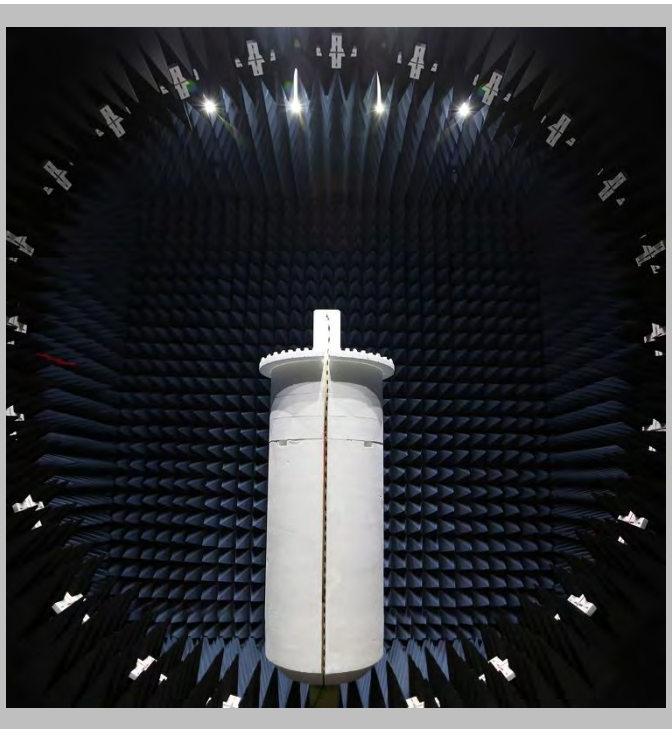
SCOPE

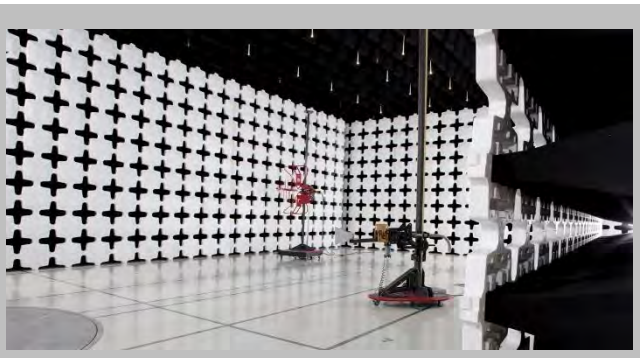
For details on the Scopes of our Accreditations, please visit:

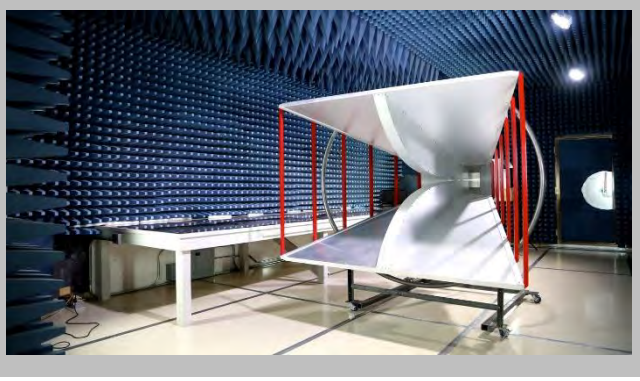
California Minnesota Oregon Texas Washington

FACILITIES

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
RP.2023.05.08.0

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 Location: Minneapolis

Test	+ MU	- MU
Frequency Accuracy	0.0007%	-0.0007%
Amplitude Accuracy (dB)	1.2 dB	-1.2 dB
Conducted Power (dB)	1.2 dB	-1.2 dB
Radiated Power via Substitution (dB)	0.7 dB	-0.7 dB
Temperature (degrees C)	0.7°C	-0.7°C
Humidity (% RH)	2.5% RH	-2.5% RH
Voltage (AC)	1.0%	-1.0%
Voltage (DC)	0.7%	-0.7%
Field Strength (dB)	5.2 dB	-5.2 dB
AC Powerline Conducted Emissions (dB)	3.2 dB	-3.2 dB

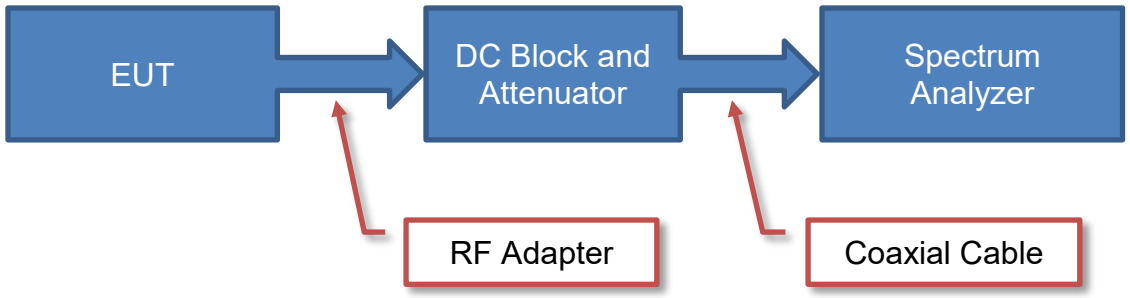
TEST SETUP BLOCK DIAGRAMS

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.

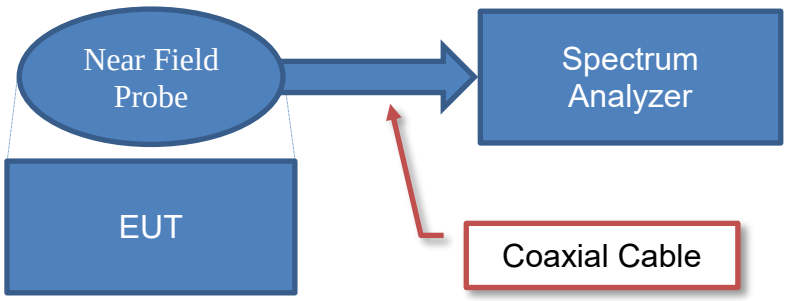
Antenna Port Conducted Measurements



Sample Calculation (logarithmic units)

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

Near Field Test Fixture Measurements

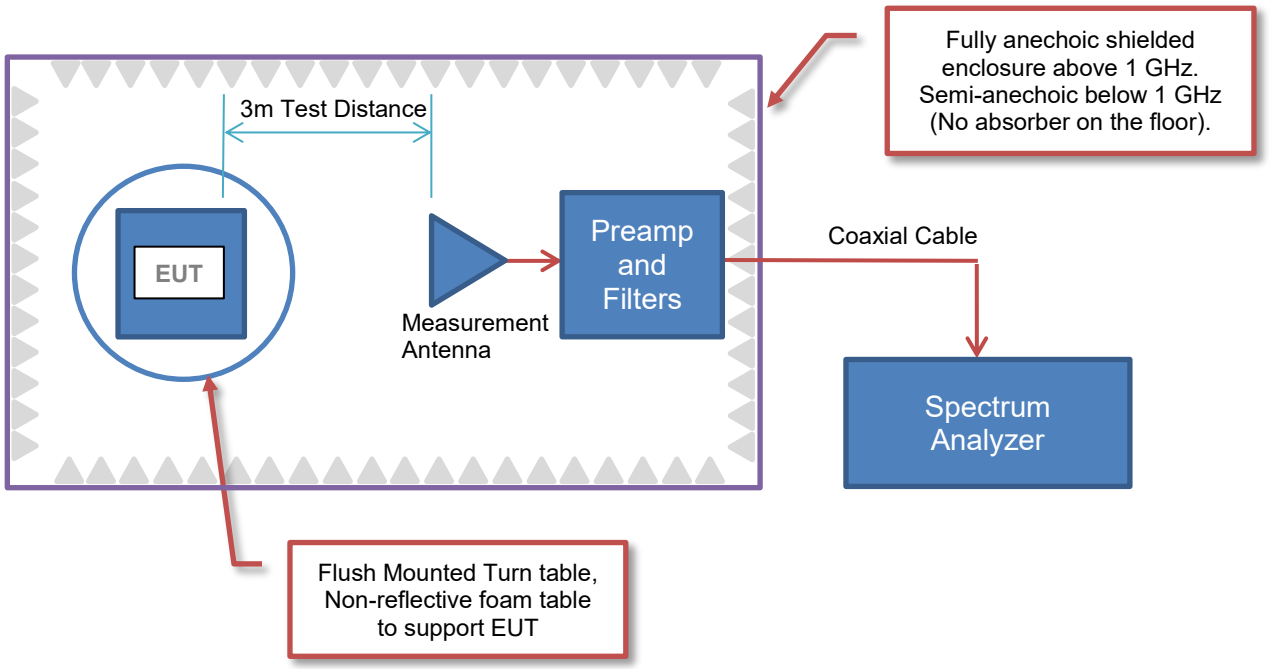


Sample Calculation (logarithmic units)

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**

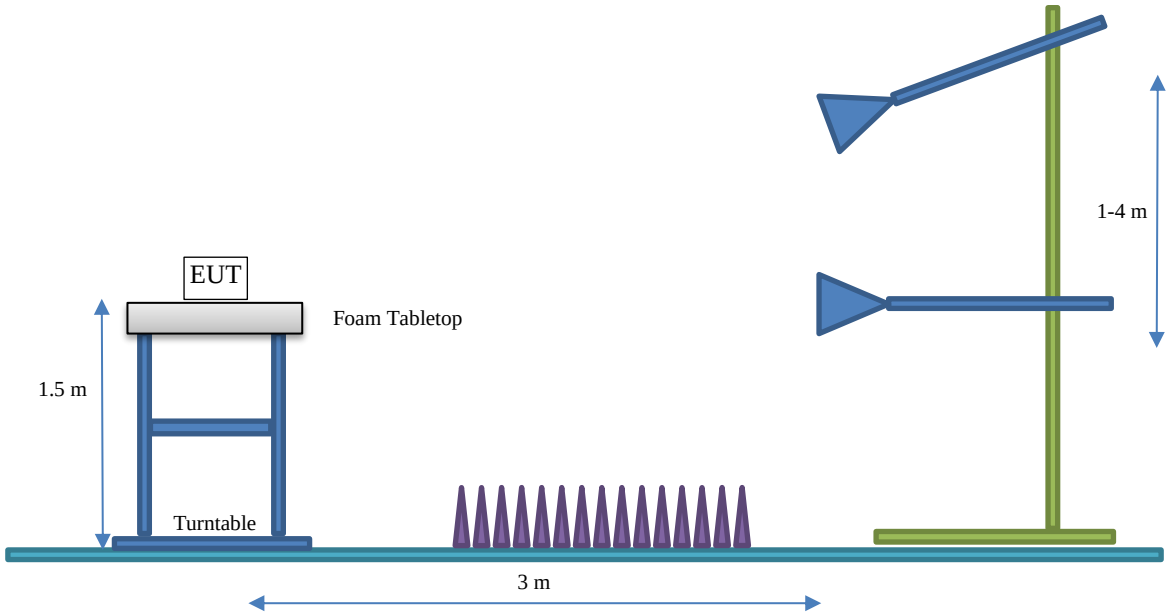
Radiated Power (ERP/EIRP) – Substitution Method:

Measured Level into Substitution Antenna (Amplitude dBm)		Substitution Antenna Factor (dBi)		EIRP to ERP (if applicable)		Measured power (dBm ERP/EIRP)
10.0	+	6.0	-	2.15	=	**13.9/16.0**

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:	IrriGreen, Inc.
Address:	5250 West 73rd Street Suite I
City, State, Zip:	Edina, MN 55439
Test Requested By:	Gary Klinefelter
EUT:	Sprinkler (Model: 400104)
First Date of Test:	August 15, 2023
Last Date of Test:	January 31, 2024
Receipt Date of Samples:	March 10, 2023
Equipment Design Stage:	Prototype
Equipment Condition:	No Damage
Purchase Authorization:	Verified

Information Provided by the Party Requesting the Test

Functional Description of the EUT:
Irrigation Sprinkler with a Bluetooth Low Energy radio

Client Justification:
Sprinkler and Sprinkler (Model: 400104) are the same device with different naming conventions.

Testing Objective:
To demonstrate compliance of the Bluetooth radio to FCC 15.247/RSS-247 requirements.

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. The power settings below reflect the maximum power that the EUT is allowed to transmit at during normal operation.

ANTENNA GAIN (dBi)

Type	Provided by:	Frequency Range (MHz)	Gain (dBi)
PCB Trace	IrriGreen, Inc	2400-2483.5	1.5

The EUT was tested using the power settings provided by the manufacturer which were based upon:

☐ Test software settings Test software/firmware installed on EUT:CC2652R7_BLE Rev B (1.1)
☒ Rated power settings

SETTINGS FOR ALL TESTS IN THIS REPORT

Modulation Types / Data Rates	Type	Channel	Frequency (MHz)	Power Setting
BLE GFSK 125 kbps, 500 kbps, 1 Mbps, 2 Mbps	DTS	0 or 37	2402	5
		20 or 18	2442	5
		39	2480	5

CONFIGURATIONS

Configuration IRRI0015-3

Software/Firmware Running During Test	
Description	**Version**
Smart RF Studio 7	7
CC2652R7_BLE	Rev B (1.1)

EUT			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
Sprinkler Circuit Board	IrriGreen, Inc.	900630 Rev C	1000824

Peripherals in Test Setup Boundary			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
Dev Board	Texas Instruments	LP-CC2652R7	None

Remote Equipment Outside of Test Setup Boundary			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
Laptop	Dell	Lattitude 5531	3525CS3

Cables					
Cable Type	**Shield**	**Length (m)**	**Ferrite**	**Connection 1**	**Connection 2**
USB Cable	Yes	0.5 m	No	Laptop	Dev Board
Programming Ribbon Cable	No	0.15 m	No	Dev Board	Sprinkler Circuit Board
Sprinkler Patch Cable	No	0.5 m	No	Sprinkler Circuit Board	Unterminated

CONFIGURATIONS

Configuration IRRI0015-8

Software/Firmware Running During Test	
Description	**Version**
Smart RF Studio 7	7
CC2652R7_BLE	Rev B (1.1)

EUT			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
Sprinkler	IrriGreen, Inc.	N/A	N/A
Sprinkler Circuit Board	IrriGreen, Inc.	900630 Rev C	2308

Peripherals in Test Setup Boundary			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
Dev Board	Texas Instruments	LP-CC2652R7	None

Remote Equipment Outside of Test Setup Boundary			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
Laptop	Dell	Lattitude 5531	3525CS3
Laptop Power Supply	Dell	0CW1FP	CN-0CW1FP-CH200-2C7-OBQI-A00

Cables					
Cable Type	**Shield**	**Length (m)**	**Ferrite**	**Connection 1**	**Connection 2**
Programming Ribbon Cable	No	0.15 m	No	Dev Board	Sprinkler Circuit Board
USB Extension Cable	Yes	1.7m	No	USB Cable	Laptop
USB Cable	Yes	0.5m	No	Dev Board	USB Extension Cable
AC Power	No	0.8m	No	AC Mains	Laptop Power Supply
DC Power	Yes	1.75m	No	Laptop Power Supply	Laptop

MODIFICATIONS

Equipment Modifications

Item	Date	Test	Modification	Note	Disposition of EUT
1	2023-08-15	Spurious Radiated Emissions	Modified from delivered configuration.	C105 was modified to 1.2pF.	EUT remained at Element following the test.
2	2023-08-17	DTS Bandwidth (6dB)	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	2023-08-17	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.
4	2023-08-17	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.
5	2023-08-17	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.
6	2023-08-17	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.
7	2023-08-17	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.
8	2023-08-17	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.
9	2024-01-31	Powerline Conducted Emissions	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	Scheduled testing was completed.

POWERLINE CONDUCTED EMISSIONS

element
WTD.2023.11.13.0
EmiR5 2023.08.29.0
PSA-ESCI 2023.04.25.0

TEST DESCRIPTION

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

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Receiver	Gauss Instruments	TDEMI 30M	ARS	2023-04-26	2024-04-26
Cable - Conducted Cable Assembly	Northwest EMC	MNC, HGN, TYK, VAE	MNCA	2023-03-09	2024-03-09
LISN	Solar Electronics	9252-50-R-24-BNC	LIY	2023-04-02	2024-04-02

MEASUREMENT UNCERTAINTY

Description		
Expanded k=2	3.2 dB	-3.2 dB

CONFIGURATIONS INVESTIGATED

IRRI0015-8

MODES INVESTIGATED

Transmitting BLE Mid Ch, 2442 MHz, 1 Mbps

POWERLINE CONDUCTED EMISSIONS

element
WTD.2023.11.13.0
EmiR5 2023.08.29.0
PSA-ESCI 2023.04.25.0

EUT:	Sprinkler	Work Order:	IRRI0015
Serial Number:	2308	Date:	2024-01-31
Customer:	IrriGreen, Inc.	Temperature:	23.3°C
Attendees:	Gary Klinefelter	Relative Humidity:	30.7%
Customer Project:	None	Bar. Pressure (PMSL):	1013 mb
Tested By:	Marcelo Aguayo	Job Site:	MN03
Power:	120VAC/60Hz	Configuration:	IRRI0015-8

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.207:2024	ANSI C63.10:2013

TEST PARAMETERS

Run #:	12	Line:	High Line	Add. Ext. Attenuation (dB):	0

COMMENTS

Board part number 900630 Rev C. Board is powered from the mains connection, not the laptop USB. Cables not bundled due to excessive weight/bulk.

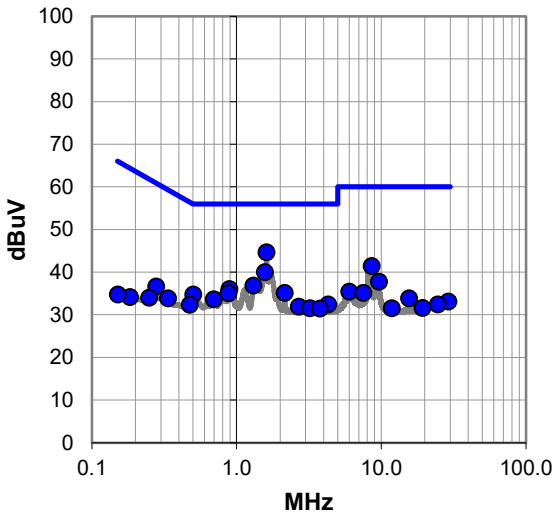
EUT OPERATING MODES

Transmitting BLE Mid Ch, 2442 MHz, 1 Mbps

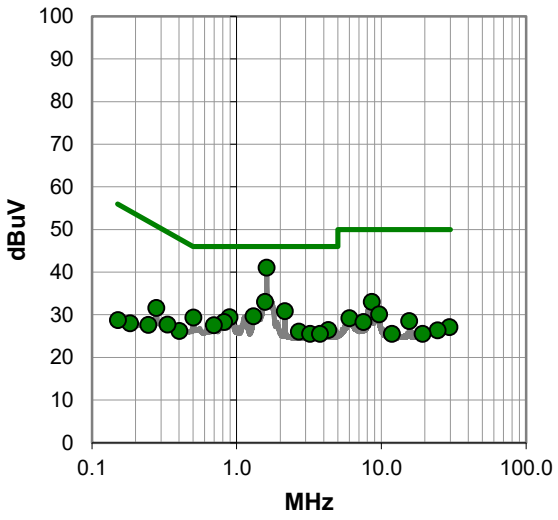
DEVIATIONS FROM TEST STANDARD

None

Quasi Peak Data - vs - Quasi Peak Limit



Average Data - vs - Average Limit



POWERLINE CONDUCTED EMISSIONS

element
WTD.2023.11.13.0
EmiR5 2023.08.29.0
PSA-ESCI 2023.04.25.0

RESULTS - Run #12

Quasi Peak Data - vs - Quasi Peak Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
1.615	24.7	19.9	44.6	56.0	-11.4
1.569	20.1	19.9	40.0	56.0	-16.0
8.612	20.9	20.5	41.4	60.0	-18.6
1.310	17.0	19.8	36.8	56.0	-19.2
0.896	16.2	19.8	36.0	56.0	-20.0
2.153	15.2	19.9	35.1	56.0	-20.9
0.882	15.2	19.8	35.0	56.0	-21.0
0.502	15.0	19.7	34.7	56.0	-21.3
9.694	17.2	20.5	37.7	60.0	-22.3
0.698	13.8	19.8	33.6	56.0	-22.4
4.306	12.2	20.2	32.4	56.0	-23.6
0.477	12.6	19.7	32.3	56.4	-24.1
2.695	11.8	20.1	31.9	56.0	-24.1
0.278	16.7	19.9	36.6	60.9	-24.3
3.229	11.4	20.1	31.5	56.0	-24.5
3.768	11.2	20.2	31.4	56.0	-24.6
6.041	15.2	20.2	35.4	60.0	-24.6
7.538	14.8	20.3	35.1	60.0	-24.9
0.336	14.1	19.7	33.8	59.3	-25.5
15.611	12.8	21.0	33.8	60.0	-26.2
29.209	10.1	23.0	33.1	60.0	-26.9
24.665	10.0	22.4	32.4	60.0	-27.6
0.249	14.0	20.0	34.0	61.8	-27.8
19.346	10.0	21.6	31.6	60.0	-28.4
11.842	10.8	20.7	31.5	60.0	-28.5

Average Data - vs - Average Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
1.616	21.1	19.9	41.0	46.0	-5.0
1.571	13.1	19.9	33.0	46.0	-13.0
2.153	10.9	19.9	30.8	46.0	-15.2
1.308	9.8	19.8	29.6	46.0	-16.4
0.896	9.6	19.8	29.4	46.0	-16.6
0.502	9.6	19.7	29.3	46.0	-16.7
8.614	12.5	20.5	33.0	50.0	-17.0
0.818	8.5	19.8	28.3	46.0	-17.7
0.696	7.7	19.8	27.5	46.0	-18.5
0.278	11.7	19.9	31.6	50.9	-19.3
4.306	6.2	20.2	26.4	46.0	-19.6
9.691	9.6	20.5	30.1	50.0	-19.9
2.694	5.9	20.1	26.0	46.0	-20.0
3.229	5.4	20.1	25.5	46.0	-20.5
3.768	5.3	20.2	25.5	46.0	-20.5
6.041	9.0	20.2	29.2	50.0	-20.8
15.611	7.5	21.0	28.5	50.0	-21.5
0.402	6.5	19.7	26.2	47.8	-21.6
0.333	8.0	19.7	27.7	49.4	-21.7
7.536	8.0	20.3	28.3	50.0	-21.7
29.607	4.0	23.1	27.1	50.0	-22.9
24.569	3.9	22.4	26.3	50.0	-23.7
0.246	7.6	20.0	27.6	51.9	-24.3
11.842	4.8	20.7	25.5	50.0	-24.5
19.305	3.9	21.6	25.5	50.0	-24.5

CONCLUSION

Pass

Tested By

POWERLINE CONDUCTED EMISSIONS

element
WTD.2023.11.13.0
EmiR5 2023.08.29.0
PSA-ESCI 2023.04.25.0

EUT:	Sprinkler	Work Order:	IRRI0015
Serial Number:	2308	Date:	2024-01-31
Customer:	IrriGreen, Inc.	Temperature:	23.3°C
Attendees:	Gary Klinefelter	Relative Humidity:	30.7%
Customer Project:	None	Bar. Pressure (PMSL):	1013 mb
Tested By:	Marcelo Aguayo	Job Site:	MN03
Power:	120VAC/60Hz	Configuration:	IRRI0015-8

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.207:2024	ANSI C63.10:2013

TEST PARAMETERS

Run #:	13	Line:	Neutral	Add. Ext. Attenuation (dB):	0

COMMENTS

Board part number 900630 Rev C. Board is powered from the mains connection, not the laptop USB. Cables not bundled due to excessive weight/bulk.

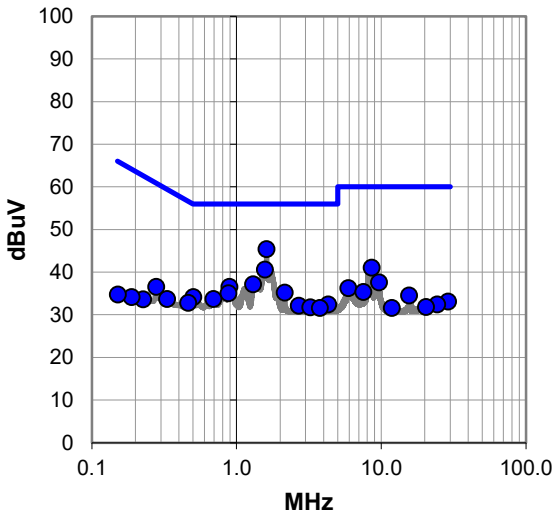
EUT OPERATING MODES

Transmitting BLE Mid Ch, 2442 MHz, 1 Mbps

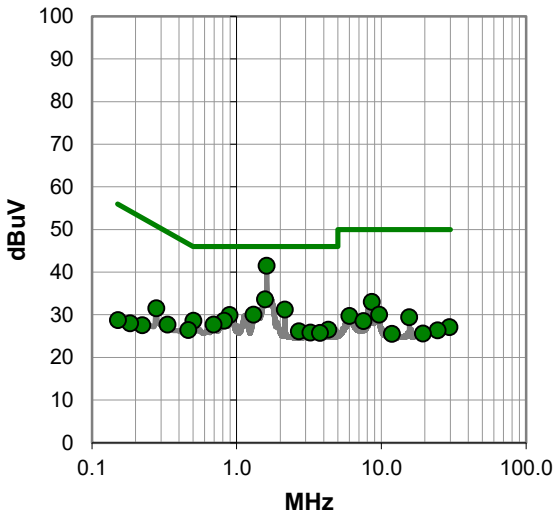
DEVIATIONS FROM TEST STANDARD

None

Quasi Peak Data - vs - Quasi Peak Limit



Average Data - vs - Average Limit



POWERLINE CONDUCTED EMISSIONS

element
WTD.2023.11.13.0
EmiR5 2023.08.29.0
PSA-ESCI 2023.04.25.0

RESULTS - Run #13

Quasi Peak Data - vs - Quasi Peak Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
1.616	25.5	19.9	45.4	56.0	-10.6
1.575	20.7	19.9	40.6	56.0	-15.4
1.305	17.3	19.8	37.1	56.0	-18.9
8.614	20.5	20.5	41.0	60.0	-19.0
0.896	16.7	19.8	36.5	56.0	-19.5
2.155	15.3	19.9	35.2	56.0	-20.8
0.879	15.2	19.8	35.0	56.0	-21.0
0.502	14.4	19.7	34.1	56.0	-21.9
0.695	13.9	19.8	33.7	56.0	-22.3
9.695	17.1	20.5	37.6	60.0	-22.4
4.308	12.2	20.2	32.4	56.0	-23.6
5.942	16.0	20.2	36.2	60.0	-23.8
0.463	13.1	19.7	32.8	56.6	-23.8
2.695	12.0	20.1	32.1	56.0	-23.9
3.234	11.6	20.1	31.7	56.0	-24.3
0.278	16.6	19.9	36.5	60.9	-24.4
3.768	11.4	20.2	31.6	56.0	-24.4
7.536	15.0	20.3	35.3	60.0	-24.7
15.614	13.5	21.0	34.5	60.0	-25.5
0.332	14.0	19.7	33.7	59.4	-25.7
29.020	10.1	23.0	33.1	60.0	-26.9
24.363	10.1	22.3	32.4	60.0	-27.6
20.462	10.1	21.7	31.8	60.0	-28.2
11.844	10.9	20.7	31.6	60.0	-28.4
0.226	13.6	20.0	33.6	62.6	-29.0

Average Data - vs - Average Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
1.616	21.6	19.9	41.5	46.0	-4.5
1.574	13.7	19.9	33.6	46.0	-12.4
2.153	11.3	19.9	31.2	46.0	-14.8
1.310	10.2	19.8	30.0	46.0	-16.0
0.896	10.1	19.8	29.9	46.0	-16.1
8.615	12.5	20.5	33.0	50.0	-17.0
0.504	8.9	19.7	28.6	46.0	-17.4
0.820	8.8	19.8	28.6	46.0	-17.4
0.695	7.9	19.8	27.7	46.0	-18.3
0.278	11.6	19.9	31.5	50.9	-19.4
4.308	6.3	20.2	26.5	46.0	-19.5
2.694	6.0	20.1	26.1	46.0	-19.9
9.691	9.5	20.5	30.0	50.0	-20.0
3.232	5.7	20.1	25.8	46.0	-20.2
0.463	6.7	19.7	26.4	46.6	-20.2
3.769	5.5	20.2	25.7	46.0	-20.3
6.020	9.5	20.2	29.7	50.0	-20.3
15.616	8.4	21.0	29.4	50.0	-20.6
7.538	8.2	20.3	28.5	50.0	-21.5
0.333	8.0	19.7	27.7	49.4	-21.7
29.612	4.0	23.1	27.1	50.0	-22.9
24.496	3.9	22.4	26.3	50.0	-23.7
19.381	4.0	21.6	25.6	50.0	-24.4
11.844	4.8	20.7	25.5	50.0	-24.5
0.223	7.5	20.0	27.5	52.7	-25.2

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.

DTS BANDWIDTH (6 dB)

element
TbtTx 2023.07.28.0 BETA
WTD.2023.08.03.0

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.

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

The EUT was set to the channels and modes listed in the datasheet.

The 6dB DTS bandwidth was measured using 100 kHz resolution bandwidth and 300 kHz video bandwidth. The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	N5183A	TIK	2022-01-24	2025-01-24
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFM	2023-05-01	2024-05-01
Cable	Micro-Coax	UFD150A-1-0720-200200	MNL	2022-09-10	2023-09-10
Block - DC	Fairview Microwave	SD3379	AMZ	2022-11-06	2023-11-06
Attenuator	Fairview Microwave	SA4014-20	AQI	2022-09-10	2023-09-10

DTS BANDWIDTH (6 dB)

element
TbtTx 2023.07.28.0 BETA
WTD.2023.08.03.0

EUT:	Sprinkler	Work Order:	IRRI0015
Serial Number:	1000824	Date:	2023-08-17
Customer:	IrriGreen, Inc.	Temperature:	22.1°C
Attendees:	Gary Klinefelter	Relative Humidity:	47.6%
Customer Project:	None	Bar. Pressure (PMSL):	1011 mbar
Tested By:	Christopher Heintzelman	Job Site:	MN11
Power:	5VDC VIA LAPTOP	Configuration:	IRRI0015-3

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.247:2023	ANSI C63.10:2013
RSS-247 Issue 2:2017	ANSI C63.10:2013

COMMENTS

Reference level offset includes measurement cable, attenuator, and DC block.

DEVIATIONS FROM TEST STANDARD

None

TESTED BY

Christopher Heintzelman

TEST RESULTS

	Value	Limit (≥)	Result
BLE/GFSK 125 kbps			
Low Channel, 2402 MHz	710.293 kHz	500 kHz	Pass
Mid Channel, 2442 MHz	720.708 kHz	500 kHz	Pass
High Channel, 2480 MHz	689.403 kHz	500 kHz	Pass
BLE/GFSK 500 kbps			
Low Channel, 2402 MHz	709.163 kHz	500 kHz	Pass
Mid Channel, 2442 MHz	685.592 kHz	500 kHz	Pass
High Channel, 2480 MHz	667.153 kHz	500 kHz	Pass
BLE/GFSK 1 Mbps			
Low Channel, 2402 MHz	701.257 kHz	500 kHz	Pass
Mid Channel, 2442 MHz	704.067 kHz	500 kHz	Pass
High Channel, 2480 MHz	699.821 kHz	500 kHz	Pass
BLE/GFSK 2 Mbps			
Low Channel, 2402 MHz	1.362 MHz	500 kHz	Pass
Mid Channel, 2442 MHz	1.363 MHz	500 kHz	Pass
High Channel, 2480 MHz	1.374 MHz	500 kHz	Pass

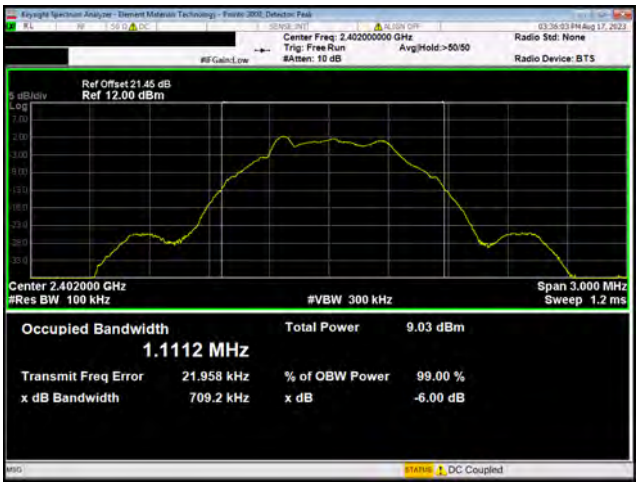
DTS BANDWIDTH (6 dB)

element
TbtTx 2023.07.28.0 BETA
WTD.2023.08.03.0

BLE/GFSK 125 kbps; Low Channel, 2402 MHz

BLE/GFSK 125 kbps; Mid Channel, 2442 MHz

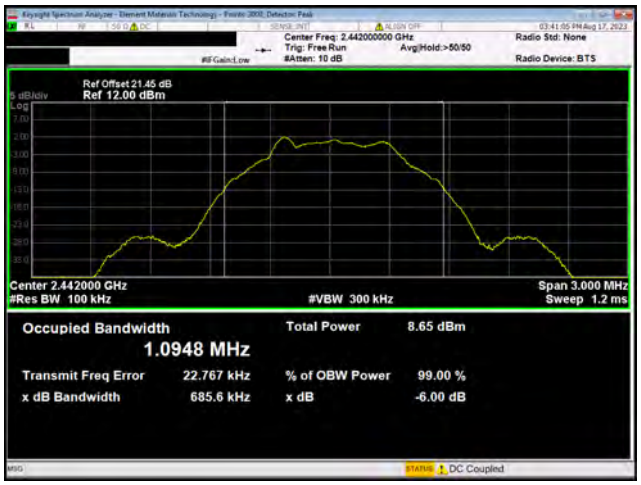
BLE/GFSK 125 kbps; High Channel, 2480 MHz



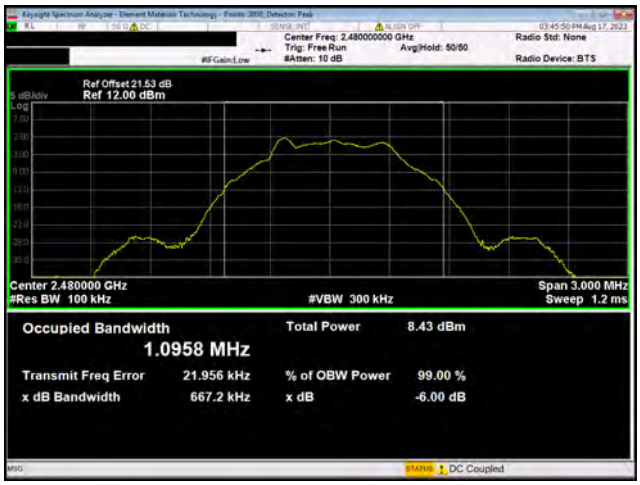
BLE/GFSK 500 kbps; Low Channel, 2402 MHz

DTS BANDWIDTH (6 dB)

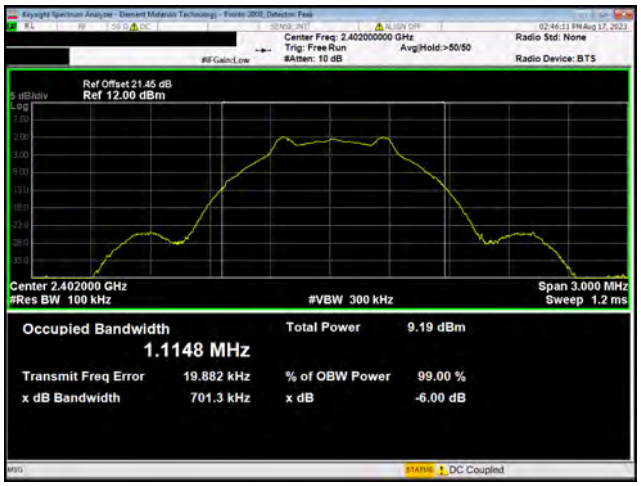
element
TbtTx 2023.07.28.0 BETA
WTD.2023.08.03.0



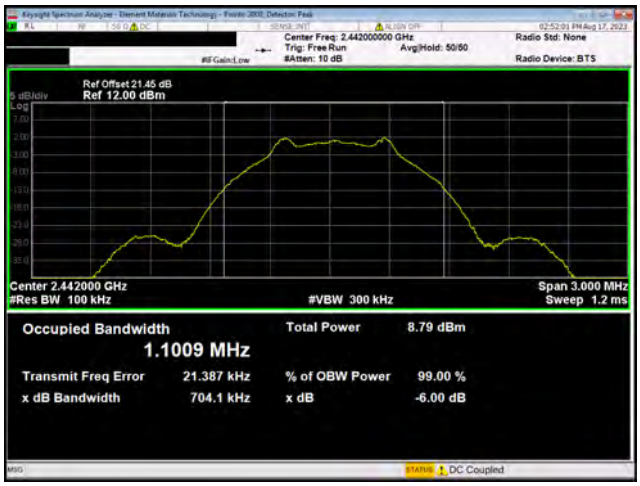
BLE/GFSK 500 kbps; Mid Channel, 2442 MHz



BLE/GFSK 500 kbps; High Channel, 2480 MHz

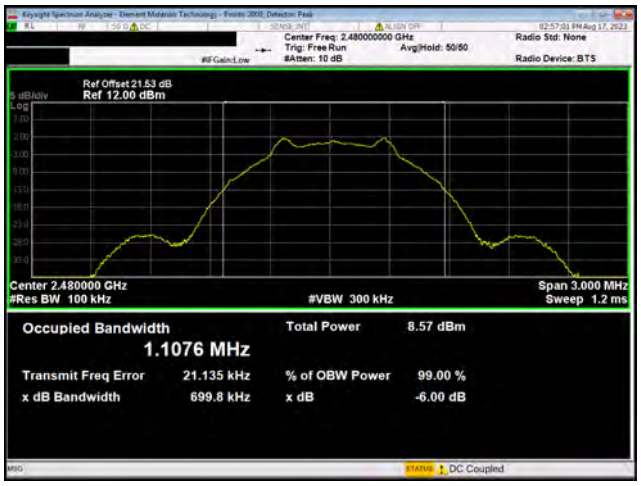


BLE/GFSK 1 Mbps; Low Channel, 2402 MHz

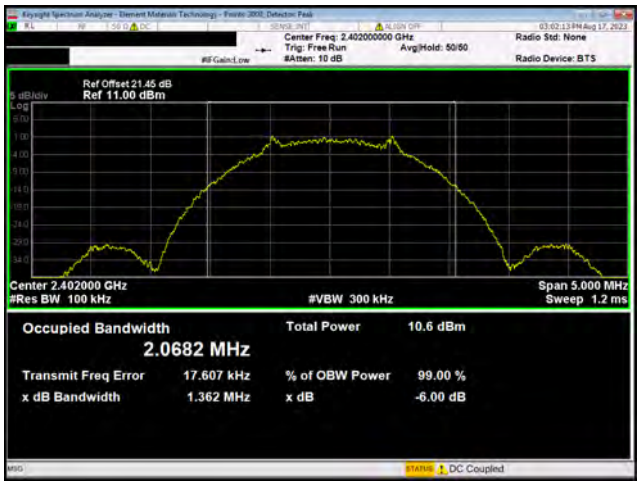


BLE/GFSK 1 Mbps; Mid Channel, 2442 MHz

DTS BANDWIDTH (6 dB)

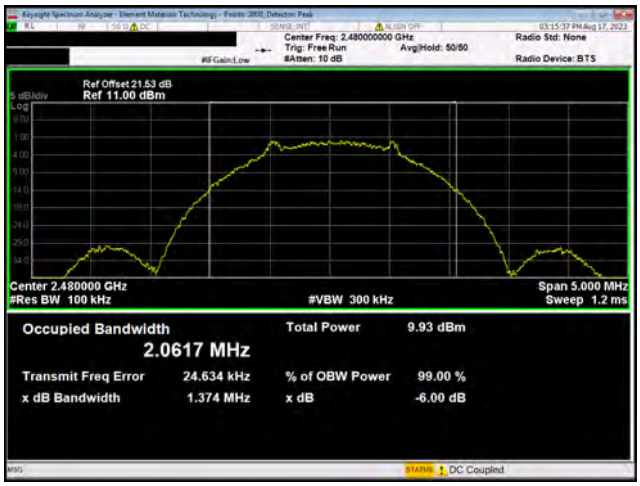


BLE/GFSK 1 Mbps; High Channel, 2480 MHz



BLE/GFSK 2 Mbps; Low Channel, 2402 MHz

BLE/GFSK 2 Mbps; Mid Channel, 2442 MHz



BLE/GFSK 2 Mbps; High Channel, 2480 MHz

OCCUPIED BANDWIDTH (99%)

element
TbtTx 2023.07.28.0 BETA
WTD.2023.08.03.0

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.

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.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	N5183A	TIK	2022-01-24	2025-01-24
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFM	2023-05-01	2024-05-01
Cable	Micro-Coax	UFD150A-1-0720-200200	MNL	2022-09-10	2023-09-10
Block - DC	Fairview Microwave	SD3379	AMZ	2022-11-06	2023-11-06
Attenuator	Fairview Microwave	SA4014-20	AQI	2022-09-10	2023-09-10

OCCUPIED BANDWIDTH (99%)

element
TbtTx 2023.07.28.0 BETA
WTD.2023.08.03.0

EUT:	Sprinkler	Work Order:	IRRI0015
Serial Number:	1000824	Date:	2023-08-17
Customer:	IrriGreen, Inc.	Temperature:	22°C
Attendees:	Gary Klinefelter	Relative Humidity:	48.3%
Customer Project:	None	Bar. Pressure (PMSL):	1011 mbar
Tested By:	Christopher Heintzelman	Job Site:	MN11
Power:	5VDC VIA LAPTOP	Configuration:	IRRI0015-3

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.247:2023	ANSI C63.10:2013
RSS-Gen Issue 5:2018+A1:2019+A2:2021	ANSI C63.10:2013

COMMENTS

Reference level offset includes measurement cable, attenuator, and DC block.

DEVIATIONS FROM TEST STANDARD

None

TESTED BY

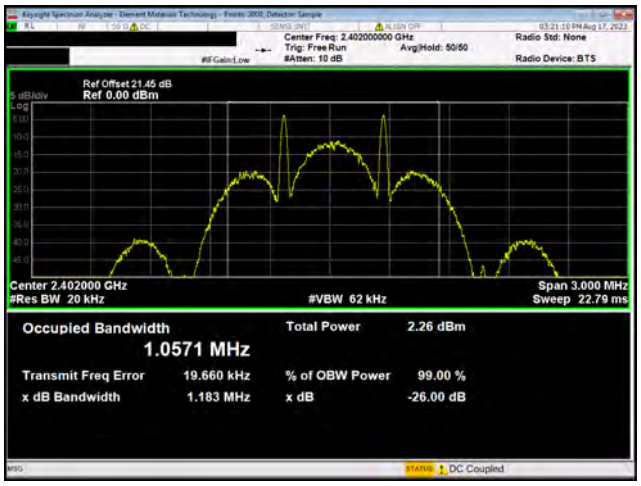
Christopher Heintzelman

TEST RESULTS

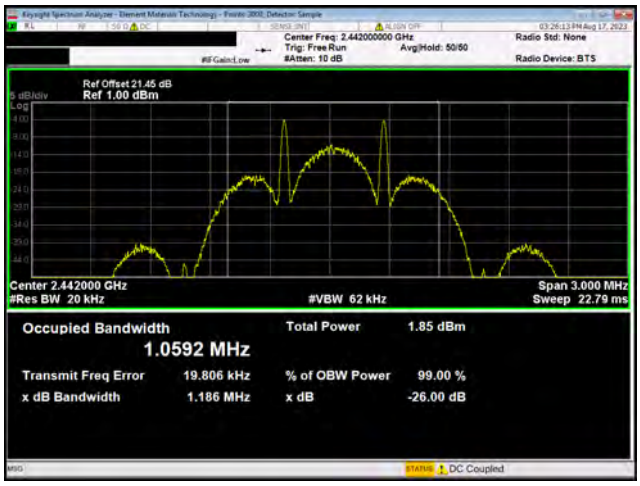
	Value	Limit	Result
BLE/GFSK 125 kbps			
Low Channel, 2402 MHz	1.057 MHz	N/A	N/A
Mid Channel, 2442 MHz	1.059 MHz	N/A	N/A
High Channel, 2480 MHz	1.053 MHz	N/A	N/A
BLE/GFSK 500 kbps			
Low Channel, 2402 MHz	1.098 MHz	N/A	N/A
Mid Channel, 2442 MHz	1.082 MHz	N/A	N/A
High Channel, 2480 MHz	1.085 MHz	N/A	N/A
BLE/GFSK 1 Mbps			
Low Channel, 2402 MHz	1.09 MHz	N/A	N/A
Mid Channel, 2442 MHz	1.087 MHz	N/A	N/A
High Channel, 2480 MHz	1.091 MHz	N/A	N/A
BLE/GFSK 2 Mbps			
Low Channel, 2402 MHz	2.081 MHz	N/A	N/A
Mid Channel, 2442 MHz	2.055 MHz	N/A	N/A
High Channel, 2480 MHz	2.066 MHz	N/A	N/A

OCCUPIED BANDWIDTH (99%)

element
TbtTx 2023.07.28.0 BETA
WTD.2023.08.03.0

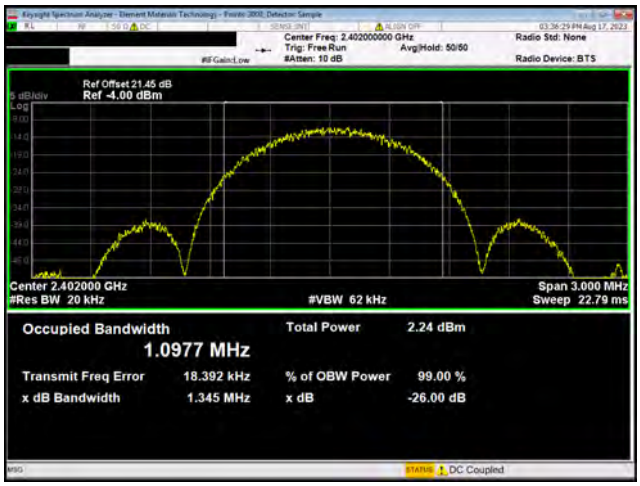


BLE/GFSK 125 kbps; Low Channel, 2402 MHz



BLE/GFSK 125 kbps; Mid Channel, 2442 MHz

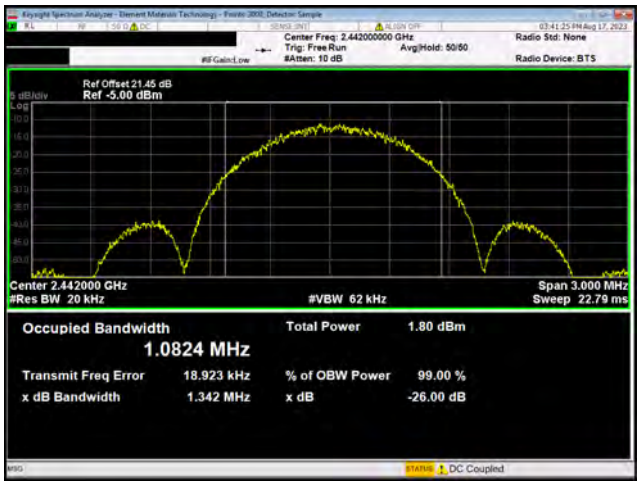
BLE/GFSK 125 kbps; High Channel, 2480 MHz



BLE/GFSK 500 kbps; Low Channel, 2402 MHz

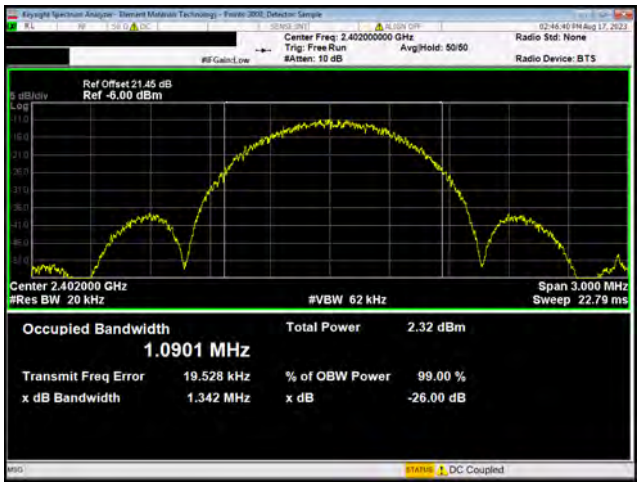
OCCUPIED BANDWIDTH (99%)

element
TbtTx 2023.07.28.0 BETA
WTD.2023.08.03.0

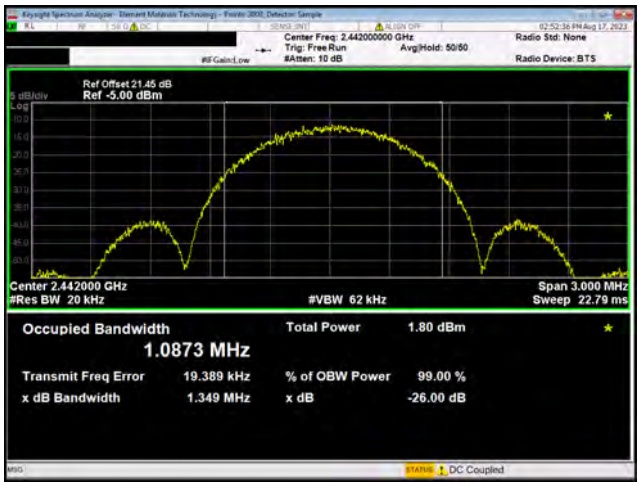


BLE/GFSK 500 kbps; Mid Channel, 2442 MHz

BLE/GFSK 500 kbps; High Channel, 2480 MHz



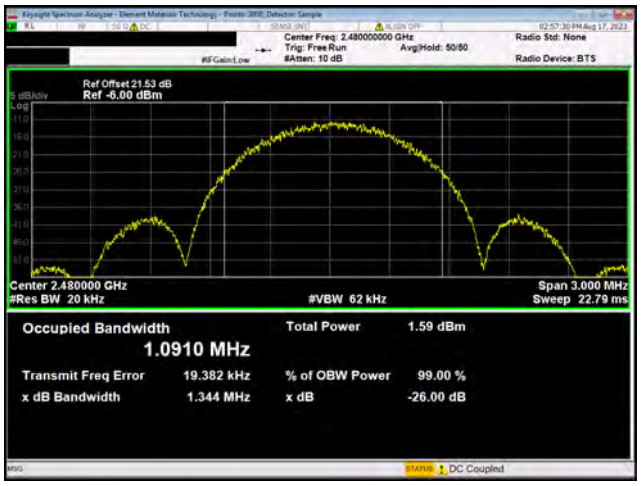
BLE/GFSK 1 Mbps; Low Channel, 2402 MHz



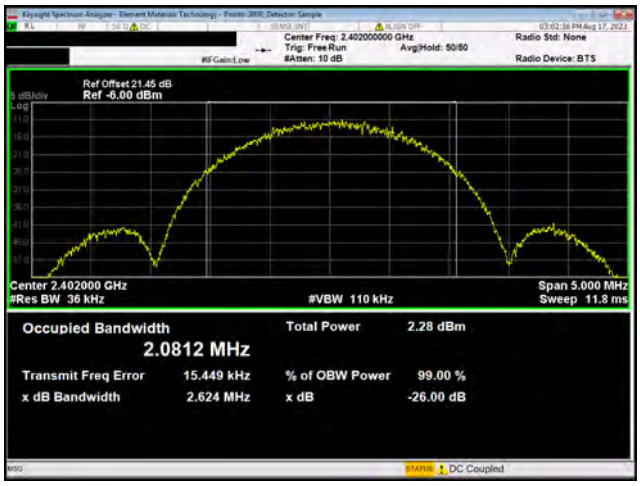
BLE/GFSK 1 Mbps; Mid Channel, 2442 MHz

OCCUPIED BANDWIDTH (99%)

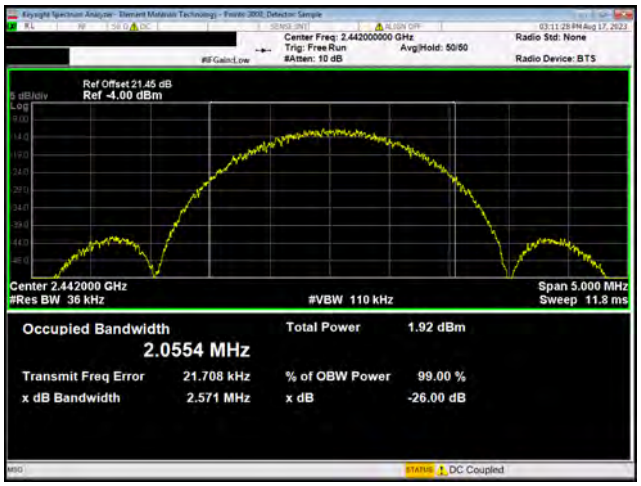
element
TbtTx 2023.07.28.0 BETA
WTD.2023.08.03.0



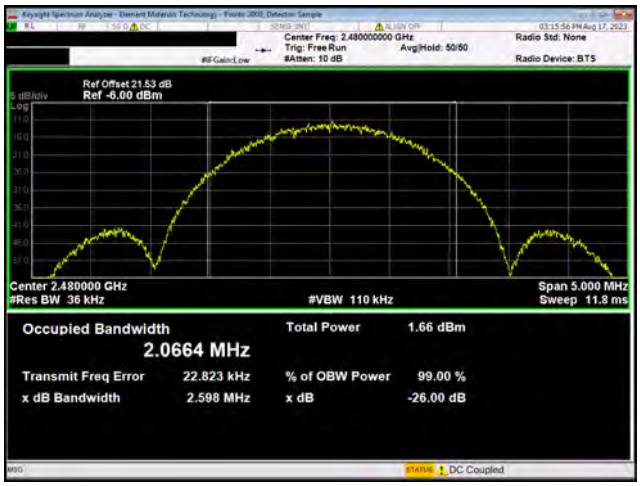
BLE/GFSK 1 Mbps; High Channel, 2480 MHz



BLE/GFSK 2 Mbps; Low Channel, 2402 MHz



BLE/GFSK 2 Mbps; Mid Channel, 2442 MHz



BLE/GFSK 2 Mbps; High Channel, 2480 MHz

OUTPUT POWER

element
TbtTx 2023.07.28.0 BETA
WTD.2023.08.03.0

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.

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

The transmit frequency was set to the required channels in each band. The transmit power was set to its default maximum.

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

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

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	N5183A	TIK	2022-01-24	2025-01-24
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFM	2023-05-01	2024-05-01
Cable	Micro-Coax	UFD150A-1-0720-200200	MNL	2022-09-10	2023-09-10
Block - DC	Fairview Microwave	SD3379	AMZ	2022-11-06	2023-11-06
Attenuator	Fairview Microwave	SA4014-20	AQI	2022-09-10	2023-09-10

OUTPUT POWER

element
TbtTx 2023.07.28.0 BETA
WTD.2023.08.03.0

EUT:	Sprinkler	Work Order:	IRRI0015
Serial Number:	1000824	Date:	2023-08-17
Customer:	IrriGreen, Inc.	Temperature:	22°C
Attendees:	Gary Klinefelter	Relative Humidity:	48.3%
Customer Project:	None	Bar. Pressure (PMSL):	1011 mbar
Tested By:	Christopher Heintzelman	Job Site:	MN11
Power:	5VDC VIA LAPTOP	Configuration:	IRRI0015-3

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.247:2023	ANSI C63.10:2013
RSS-247 Issue 2:2017	ANSI C63.10:2013
RSS-Gen Issue 5:2018+A1:2019+A2:2021	ANSI C63.10:2013

COMMENTS

Reference level offset includes measurement cable, attenuator, and DC block.

DEVIATIONS FROM TEST STANDARD

None

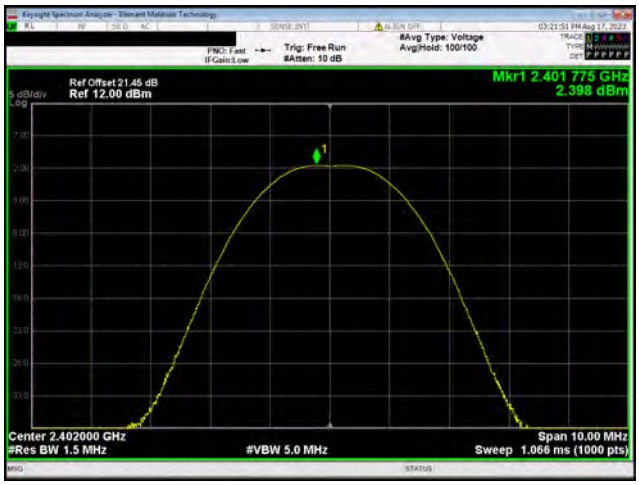
TESTED BY

Christopher Heintzelman

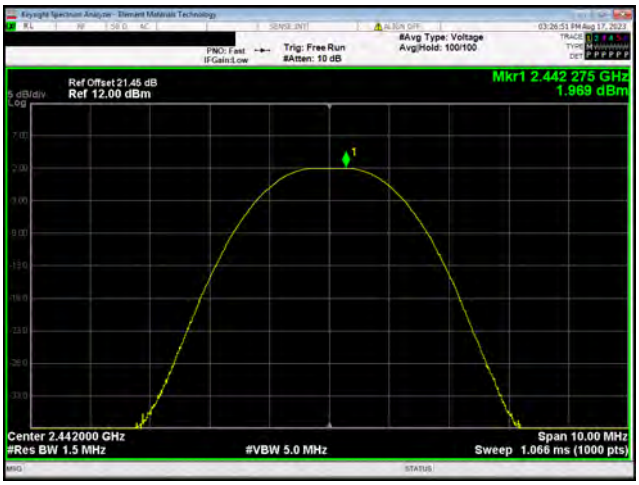
TEST RESULTS

	Out Pwr (dBm)	Limit (dBm)	Result
BLE/GFSK 125 kbps			
Low Channel, 2402 MHz	2.398	30	Pass
Mid Channel, 2442 MHz	1.969	30	Pass
High Channel, 2480 MHz	1.765	30	Pass
BLE/GFSK 500 kbps			
Low Channel, 2402 MHz	2.389	30	Pass
Mid Channel, 2442 MHz	1.961	30	Pass
High Channel, 2480 MHz	1.762	30	Pass
BLE/GFSK 1 Mbps			
Low Channel, 2402 MHz	2.402	30	Pass
Mid Channel, 2442 MHz	1.983	30	Pass
High Channel, 2480 MHz	1.769	30	Pass
BLE/GFSK 2 Mbps			
Low Channel, 2402 MHz	2.407	30	Pass
Mid Channel, 2442 MHz	1.994	30	Pass
High Channel, 2480 MHz	1.791	30	Pass

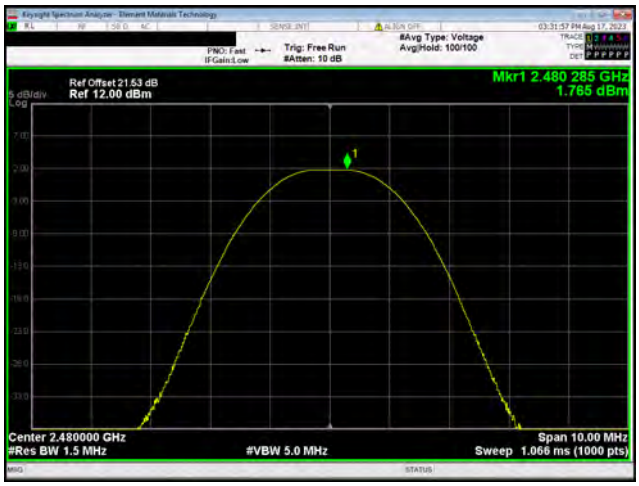
OUTPUT POWER



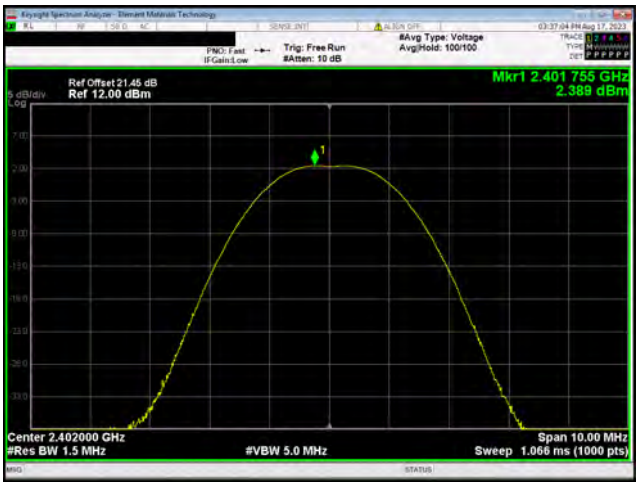
BLE/GFSK 125 kbps; Low Channel, 2402 MHz



BLE/GFSK 125 kbps; Mid Channel, 2442 MHz



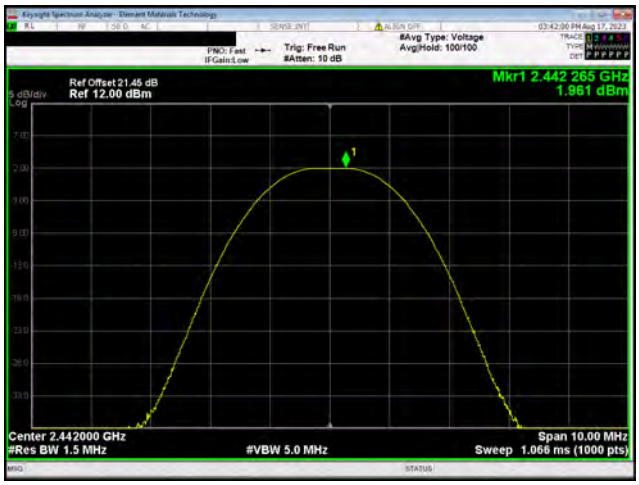
BLE/GFSK 125 kbps; High Channel, 2480 MHz



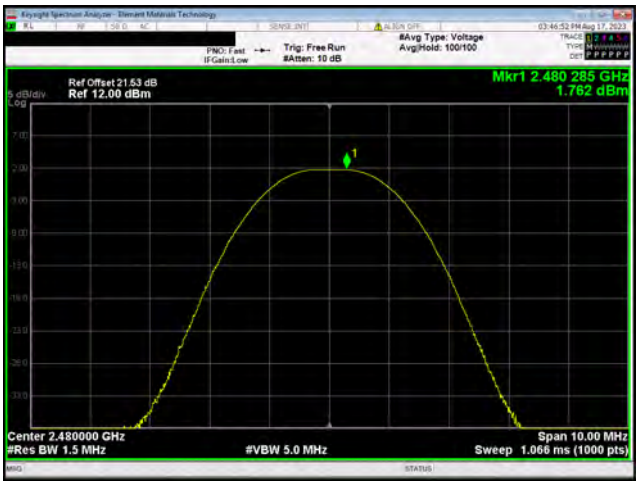
BLE/GFSK 500 kbps; Low Channel, 2402 MHz

OUTPUT POWER

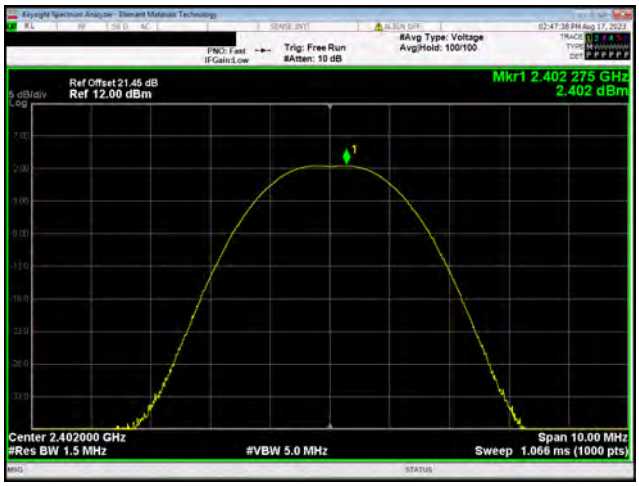
element
TbtTx 2023.07.28.0 BETA
WTD.2023.08.03.0



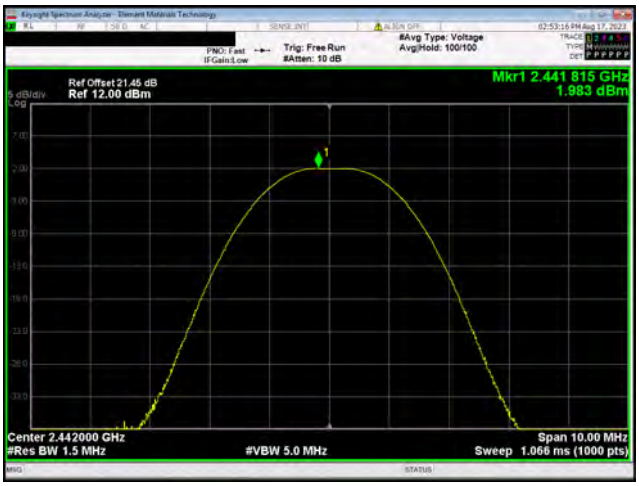
BLE/GFSK 500 kbps; Mid Channel, 2442 MHz



BLE/GFSK 500 kbps; High Channel, 2480 MHz



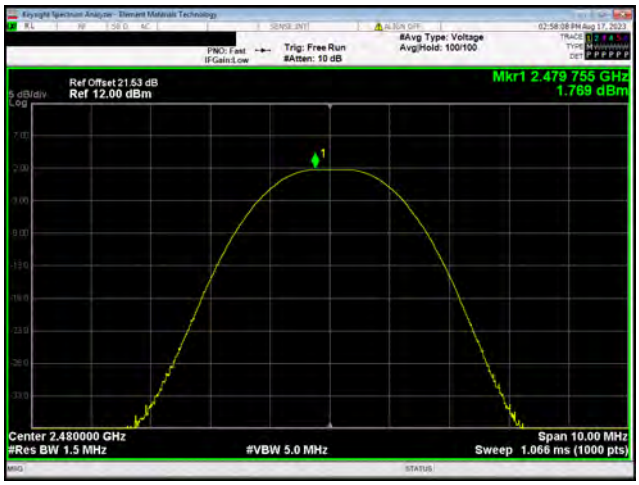
BLE/GFSK 1 Mbps; Low Channel, 2402 MHz



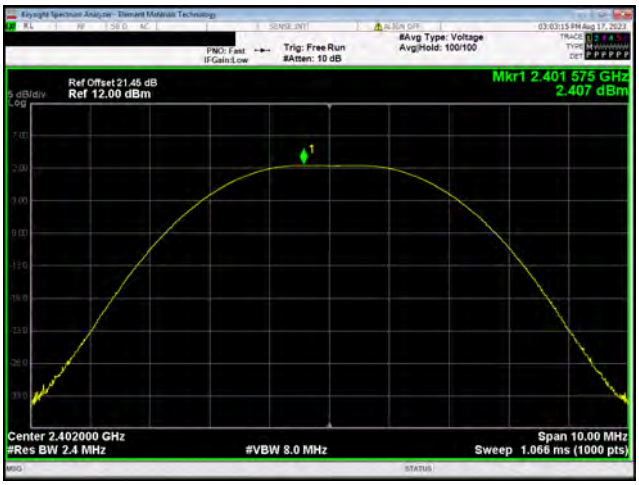
BLE/GFSK 1 Mbps; Mid Channel, 2442 MHz

OUTPUT POWER

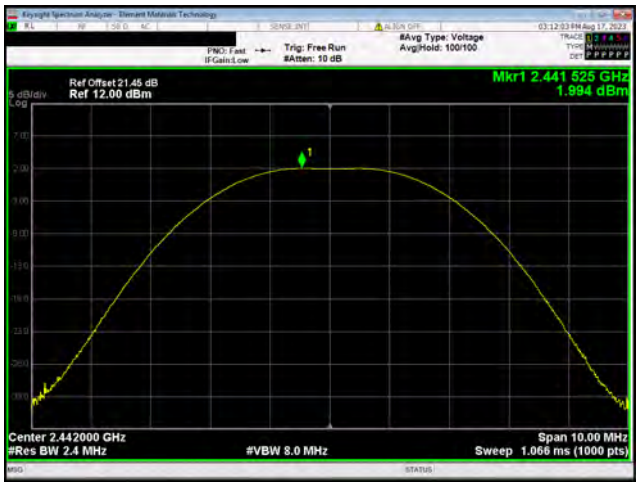
element
TbtTx 2023.07.28.0 BETA
WTD.2023.08.03.0



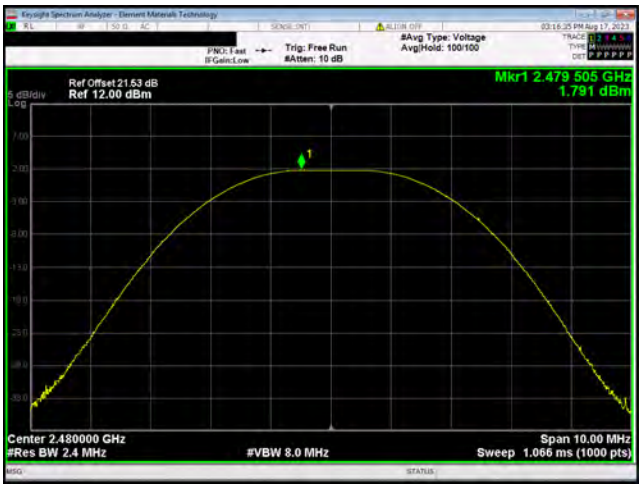
BLE/GFSK 1 Mbps; High Channel, 2480 MHz



BLE/GFSK 2 Mbps; Low Channel, 2402 MHz



BLE/GFSK 2 Mbps; Mid Channel, 2442 MHz



BLE/GFSK 2 Mbps; High Channel, 2480 MHz

EQUIVALENT ISOTROPIC RADIATED POWER (EIRP)

element
TbtTx 2023.07.28.0 BETA
WTD.2023.08.03.0

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.

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

The transmit frequency was set to the required channels in each band. The transmit power was set to its default maximum.

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

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

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

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	N5183A	TIK	2022-01-24	2025-01-24
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFM	2023-05-01	2024-05-01
Cable	Micro-Coax	UFD150A-1-0720-200200	MNL	2022-09-10	2023-09-10
Block - DC	Fairview Microwave	SD3379	AMZ	2022-11-06	2023-11-06
Attenuator	Fairview Microwave	SA4014-20	AQI	2022-09-10	2023-09-10

EQUIVALENT ISOTROPIC RADIATED POWER (EIRP)

element
TbtTx 2023.07.28.0 BETA
WTD.2023.08.03.0

EUT:	Sprinkler	Work Order:	IRRI0015
Serial Number:	1000824	Date:	2023-08-17
Customer:	IrriGreen, Inc.	Temperature:	22°C
Attendees:	Gary Klinefelter	Relative Humidity:	48.3%
Customer Project:	None	Bar. Pressure (PMSL):	1011 mbar
Tested By:	Christopher Heintzelman	Job Site:	MN11
Power:	5VDC VIA LAPTOP	Configuration:	IRRI0015-3

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.247:2023	ANSI C63.10:2013
RSS-247 Issue 2:2017	ANSI C63.10:2013
RSS-Gen Issue 5:2018+A1:2019+A2:2021	ANSI C63.10:2013

COMMENTS

Reference level offset includes measurement cable, attenuator, and DC block.

DEVIATIONS FROM TEST STANDARD

None

TESTED BY

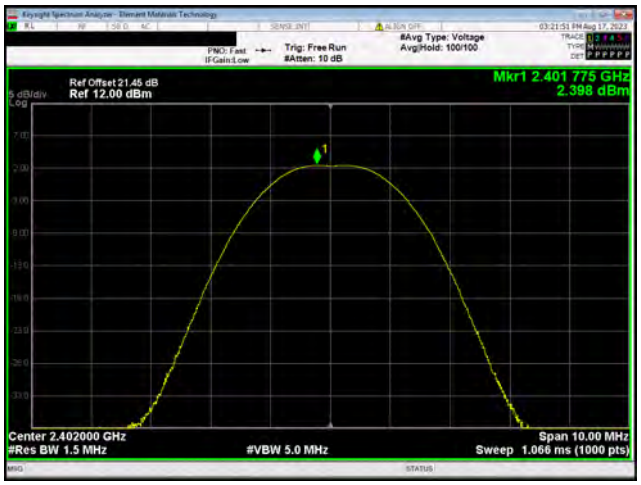
Christopher Heintzelman

TEST RESULTS

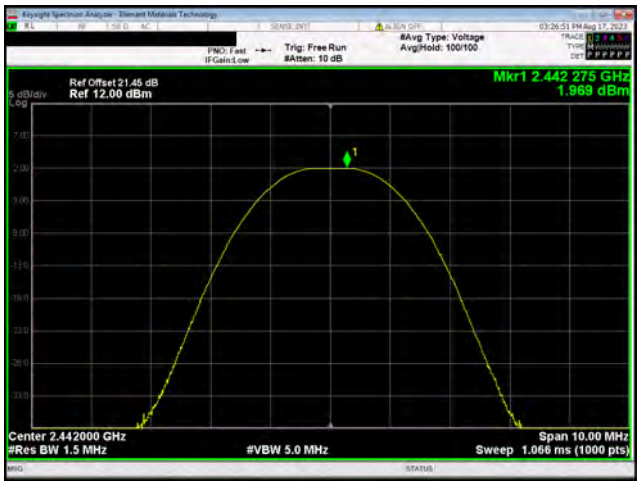
	Out Pwr (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Result
BLE/GFSK 125 kbps					
Low Channel, 2402 MHz	2.398	1.5	3.898	36	Pass
Mid Channel, 2442 MHz	1.969	1.5	3.469	36	Pass
High Channel, 2480 MHz	1.765	1.5	3.265	36	Pass
BLE/GFSK 500 kbps					
Low Channel, 2402 MHz	2.389	1.5	3.889	36	Pass
Mid Channel, 2442 MHz	1.961	1.5	3.461	36	Pass
High Channel, 2480 MHz	1.762	1.5	3.262	36	Pass
BLE/GFSK 1 Mbps					
Low Channel, 2402 MHz	2.402	1.5	3.902	36	Pass
Mid Channel, 2442 MHz	1.983	1.5	3.483	36	Pass
High Channel, 2480 MHz	1.769	1.5	3.269	36	Pass
BLE/GFSK 2 Mbps					
Low Channel, 2402 MHz	2.407	1.5	3.907	36	Pass
Mid Channel, 2442 MHz	1.994	1.5	3.494	36	Pass
High Channel, 2480 MHz	1.791	1.5	3.291	36	Pass

EQUIVALENT ISOTROPIC RADIATED POWER (EIRP)

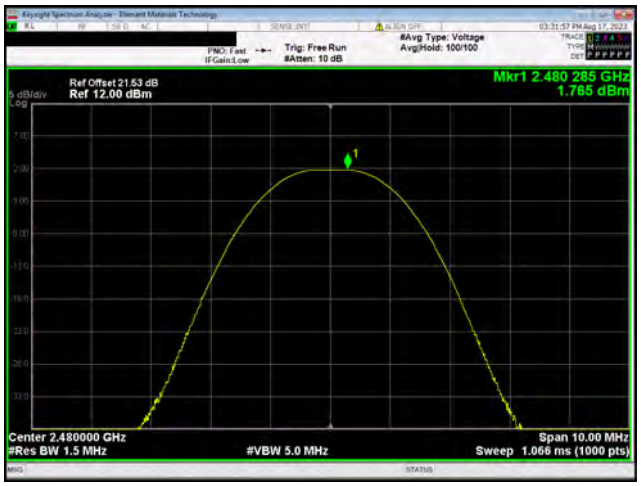
element
TbtTx 2023.07.28.0 BETA
WTD.2023.08.03.0



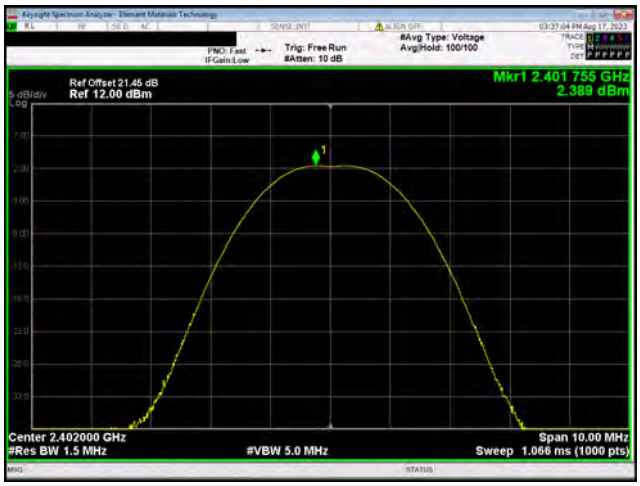
BLE/GFSK 125 kbps; Low Channel, 2402 MHz



BLE/GFSK 125 kbps; Mid Channel, 2442 MHz

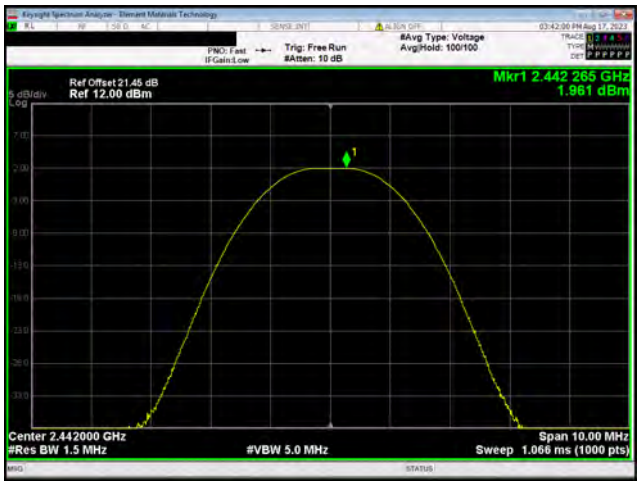


BLE/GFSK 125 kbps; High Channel, 2480 MHz

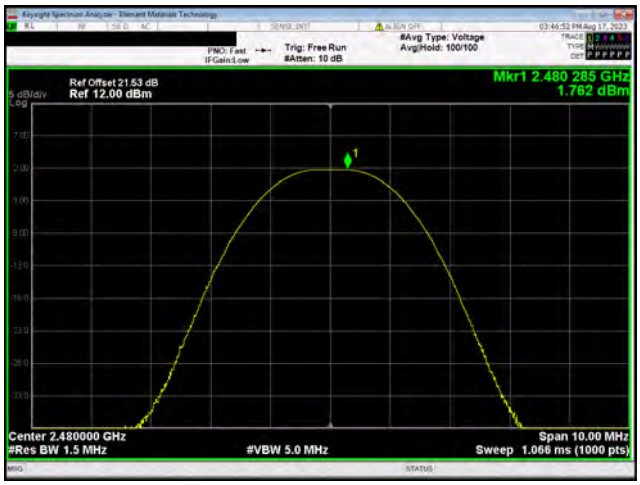


BLE/GFSK 500 kbps; Low Channel, 2402 MHz

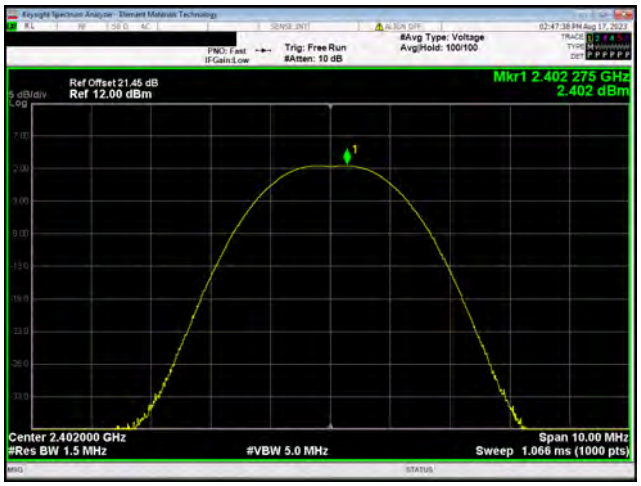
EQUIVALENT ISOTROPIC RADIATED POWER (EIRP)



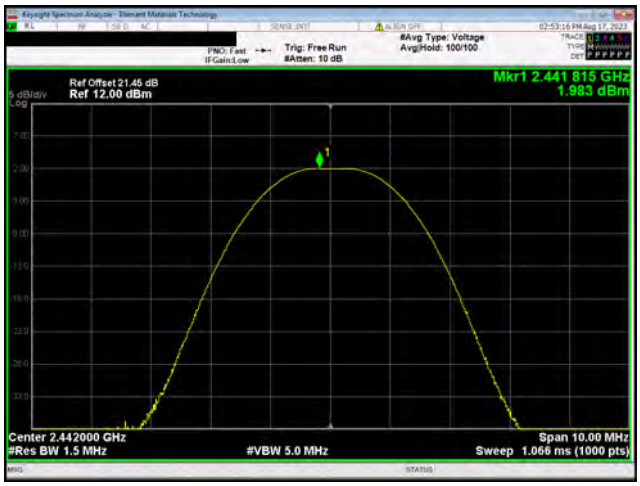
BLE/GFSK 500 kbps; Mid Channel, 2442 MHz



BLE/GFSK 500 kbps; High Channel, 2480 MHz



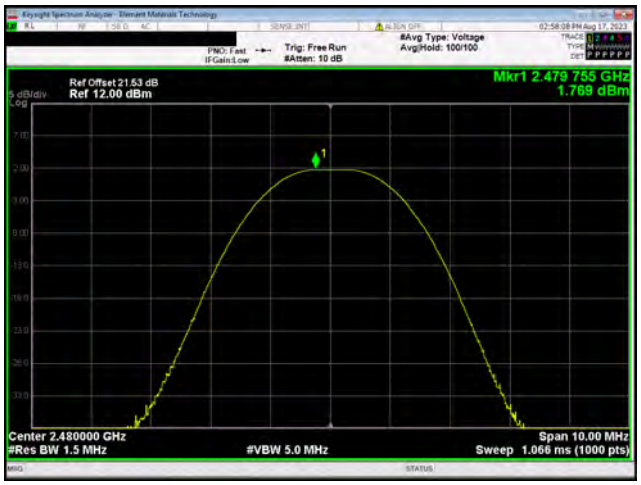
BLE/GFSK 1 Mbps; Low Channel, 2402 MHz



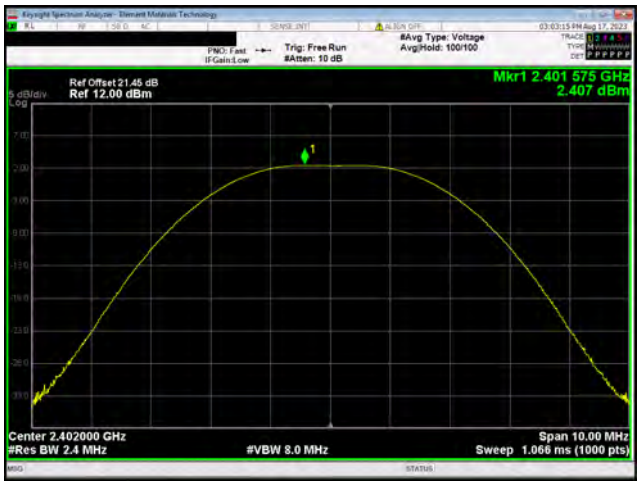
BLE/GFSK 1 Mbps; Mid Channel, 2442 MHz

EQUIVALENT ISOTROPIC RADIATED POWER (EIRP)

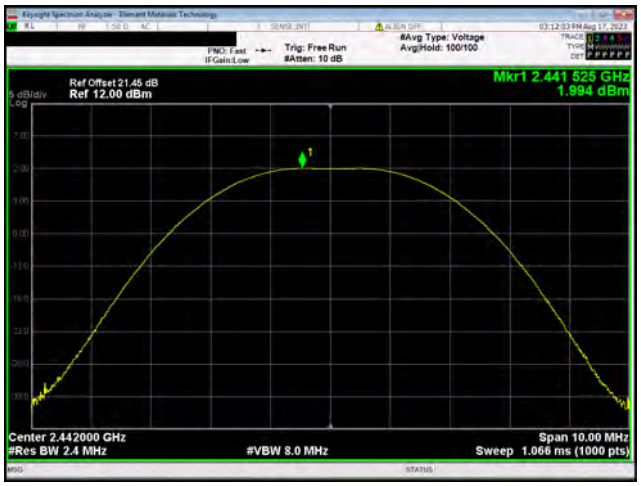
element
TbtTx 2023.07.28.0 BETA
WTD.2023.08.03.0



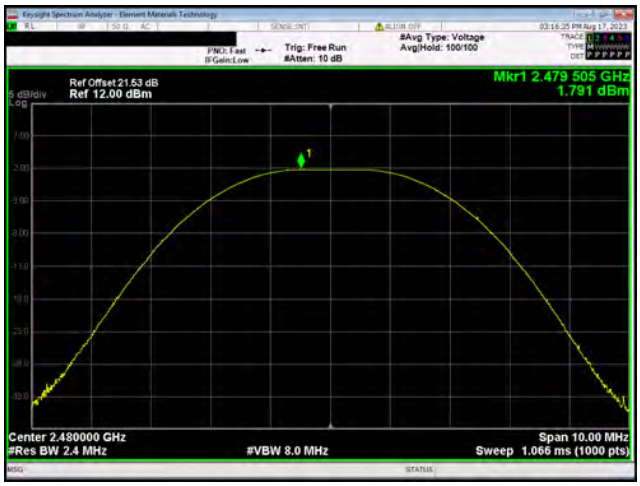
BLE/GFSK 1 Mbps; High Channel, 2480 MHz



BLE/GFSK 2 Mbps; Low Channel, 2402 MHz



BLE/GFSK 2 Mbps; Mid Channel, 2442 MHz



BLE/GFSK 2 Mbps; High Channel, 2480 MHz

POWER SPECTRAL DENSITY

element
TbtTx 2023.07.28.0 BETA
WTD.2023.08.03.0

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.

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

The power spectral density was measured using the channels and modes as called out on the following data sheets. The transmit power was set to its default maximum.

Per the procedure outlined in ANSI C63.10:2013 the peak power spectral density was measured in a 3 kHz RBW.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	N5183A	TIK	2022-01-24	2025-01-24
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFM	2023-05-01	2024-05-01
Cable	Micro-Coax	UFD150A-1-0720-200200	MNL	2022-09-10	2023-09-10
Block - DC	Fairview Microwave	SD3379	AMZ	2022-11-06	2023-11-06
Attenuator	Fairview Microwave	SA4014-20	AQI	2022-09-10	2023-09-10

POWER SPECTRAL DENSITY

element
TbtTx 2023.07.28.0 BETA
WTD.2023.08.03.0

EUT:	Sprinkler	Work Order:	IRRI0015
Serial Number:	1000824	Date:	2023-08-17
Customer:	IrriGreen, Inc.	Temperature:	22.1°C
Attendees:	Gary Klinefelter	Relative Humidity:	47.3%
Customer Project:	None	Bar. Pressure (PMSL):	1011 mbar
Tested By:	Christopher Heintzelman	Job Site:	MN11
Power:	5VDC VIA LAPTOP	Configuration:	IRRI0015-3

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.247:2023	ANSI C63.10:2013
RSS-247 Issue 2:2017	ANSI C63.10:2013

COMMENTS

Reference level offset includes measurement cable, attenuator, and DC block.

DEVIATIONS FROM TEST STANDARD

None

TESTED BY

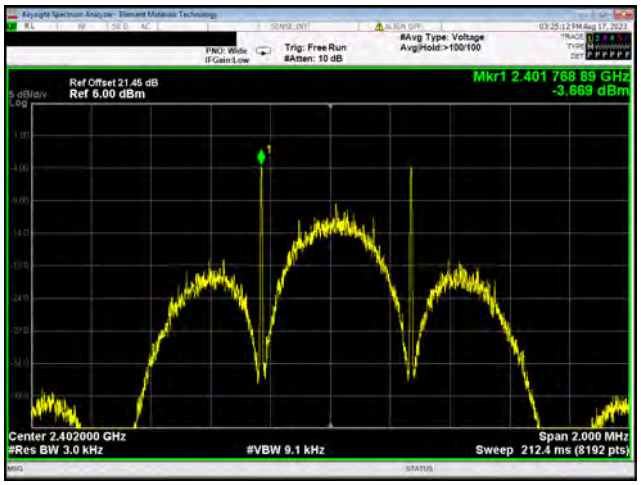
Christopher Heintzelman

TEST RESULTS

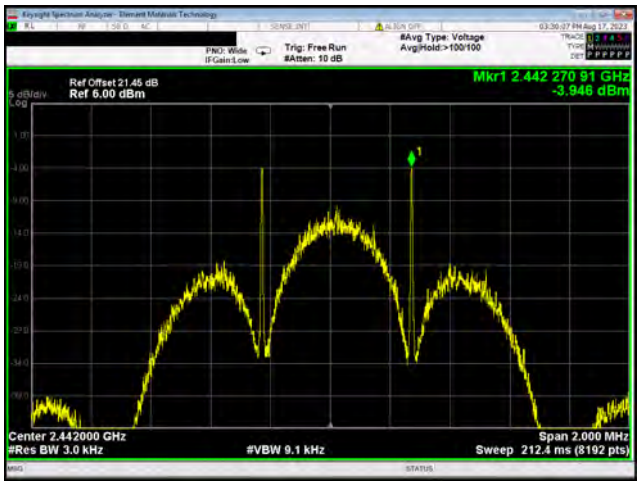
	Value dBm/3kHz	Limit ≤ (dBm/3kHz)	Results
BLE/GFSK 125 kbps			
Low Channel, 2402 MHz	-3.669	8	Pass
Mid Channel, 2442 MHz	-3.946	8	Pass
High Channel, 2480 MHz	-4.3	8	Pass
BLE/GFSK 500 kbps			
Low Channel, 2402 MHz	-9.899	8	Pass
Mid Channel, 2442 MHz	-9.572	8	Pass
High Channel, 2480 MHz	-10.042	8	Pass
BLE/GFSK 1 Mbps			
Low Channel, 2402 MHz	-6.989	8	Pass
Mid Channel, 2442 MHz	-7.384	8	Pass
High Channel, 2480 MHz	-7.568	8	Pass
BLE/GFSK 2 Mbps			
Low Channel, 2402 MHz	-12.643	8	Pass
Mid Channel, 2442 MHz	-11.405	8	Pass
High Channel, 2480 MHz	-11.866	8	Pass

POWER SPECTRAL DENSITY

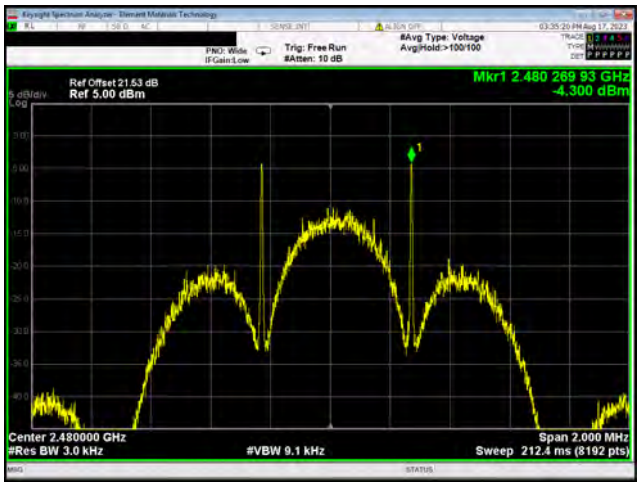
element
TbtTx 2023.07.28.0 BETA
WTD.2023.08.03.0



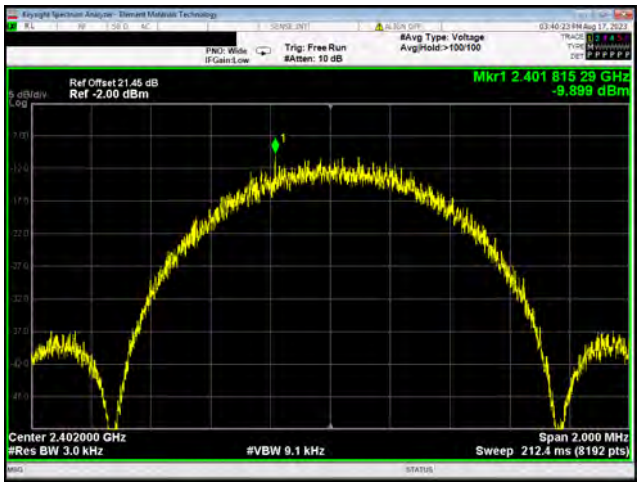
BLE/GFSK 125 kbps; Low Channel, 2402 MHz



BLE/GFSK 125 kbps; Mid Channel, 2442 MHz



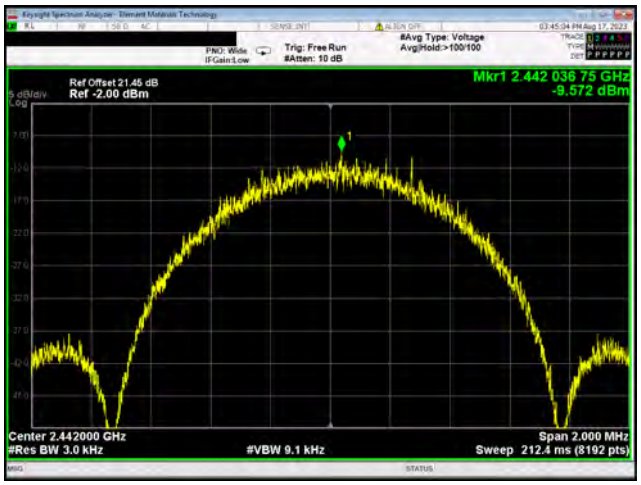
BLE/GFSK 125 kbps; High Channel, 2480 MHz



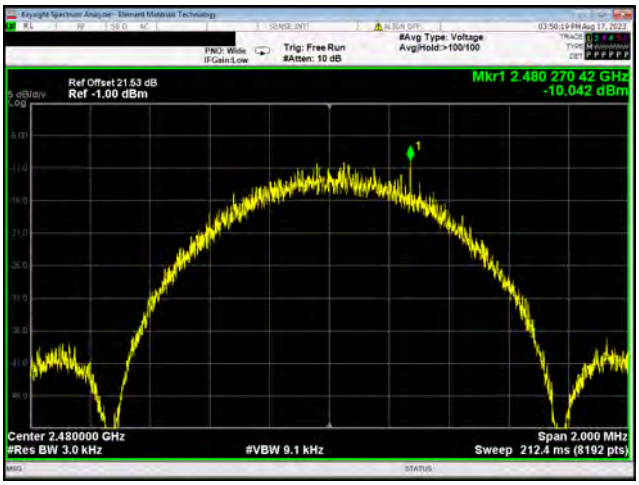
BLE/GFSK 500 kbps; Low Channel, 2402 MHz

POWER SPECTRAL DENSITY

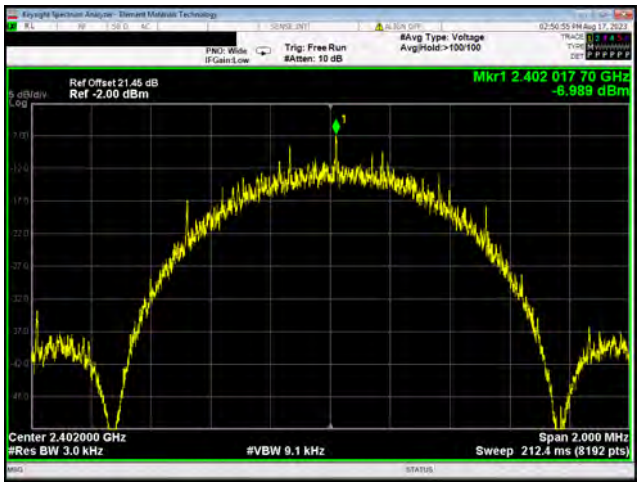
element
TbtTx 2023.07.28.0 BETA
WTD.2023.08.03.0



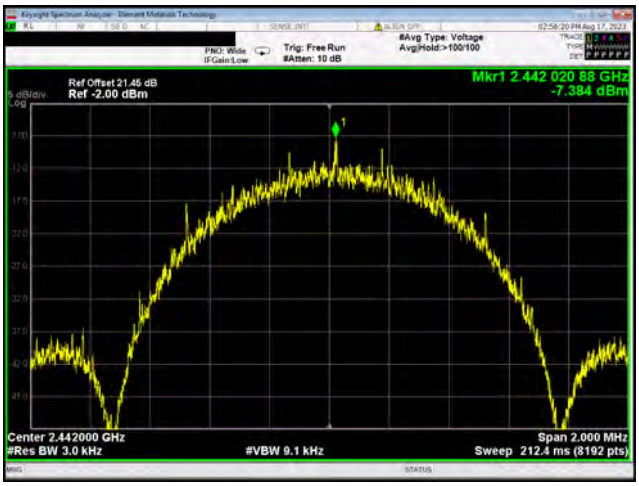
BLE/GFSK 500 kbps; Mid Channel, 2442 MHz



BLE/GFSK 500 kbps; High Channel, 2480 MHz



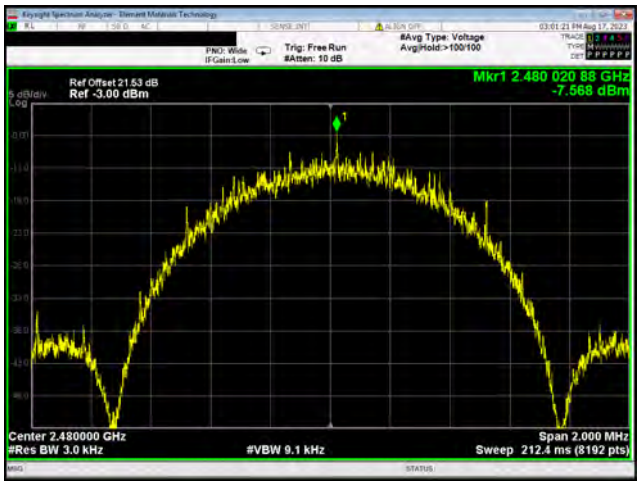
BLE/GFSK 1 Mbps; Low Channel, 2402 MHz



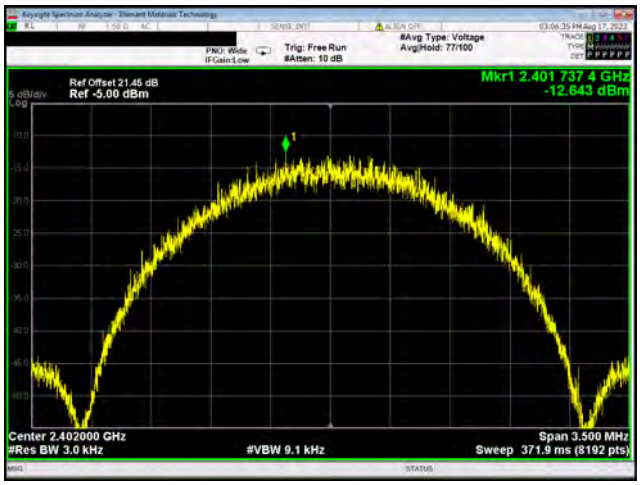
BLE/GFSK 1 Mbps; Mid Channel, 2442 MHz

POWER SPECTRAL DENSITY

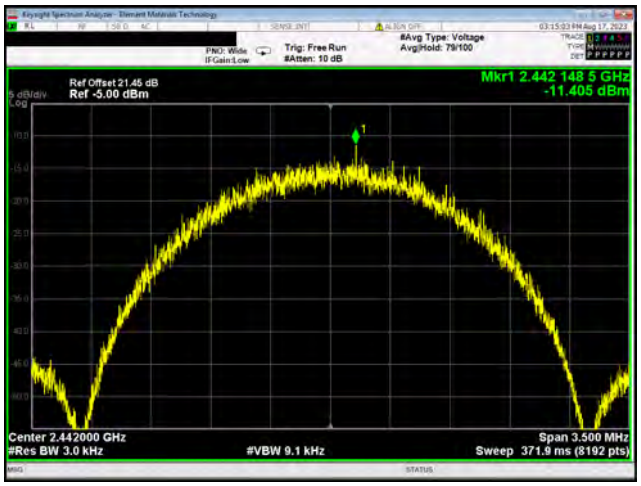
element
TbtTx 2023.07.28.0 BETA
WTD.2023.08.03.0



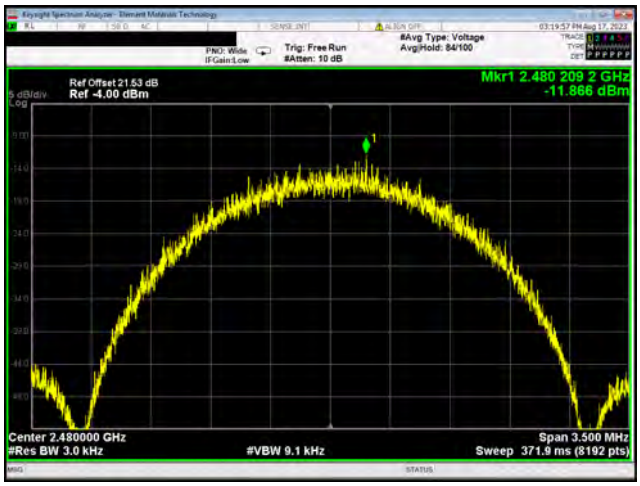
BLE/GFSK 1 Mbps; High Channel, 2480 MHz



BLE/GFSK 2 Mbps; Low Channel, 2402 MHz



BLE/GFSK 2 Mbps; Mid Channel, 2442 MHz



BLE/GFSK 2 Mbps; High Channel, 2480 MHz

BAND EDGE COMPLIANCE

element
TbtTx 2023.07.28.0 BETA
WTD.2023.08.03.0

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.

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

The spurious RF conducted emissions at the edges of the authorized bands were measured with the EUT set to low and high transmit frequencies in each available band. The channels closest to the band edges were selected. The EUT was transmitting at the data rate(s) listed in the datasheet.

The spectrum was scanned below the lower band edge and above the higher band edge. The analyzer screen captures for this test show an example of the emission mask for the test mode also used during the radiated spurious emissions at the restricted band edges test.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	N5183A	TIK	2022-01-24	2025-01-24
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFM	2023-05-01	2024-05-01
Cable	Micro-Coax	UFD150A-1-0720-200200	MNL	2022-09-10	2023-09-10
Block - DC	Fairview Microwave	SD3379	AMZ	2022-11-06	2023-11-06
Attenuator	Fairview Microwave	SA4014-20	AQI	2022-09-10	2023-09-10

BAND EDGE COMPLIANCE

element
TbtTx 2023.07.28.0 BETA
WTD.2023.08.03.0

EUT:	Sprinkler	Work Order:	IRRI0015
Serial Number:	1000824	Date:	2023-08-17
Customer:	IrriGreen, Inc.	Temperature:	22.1°C
Attendees:	Gary Klinefelter	Relative Humidity:	48.2%
Customer Project:	None	Bar. Pressure (PMSL):	1011 mbar
Tested By:	Christopher Heintzelman	Job Site:	MN11
Power:	5VDC VIA LAPTOP	Configuration:	IRRI0015-3

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.247:2023	ANSI C63.10:2013
RSS-Gen Issue 5:2018+A1:2019+A2:2021	ANSI C63.10:2013

COMMENTS

Reference level offset includes measurement cable, attenuator, and DC block.

DEVIATIONS FROM TEST STANDARD

None

TESTED BY

Christopher Heintzelman

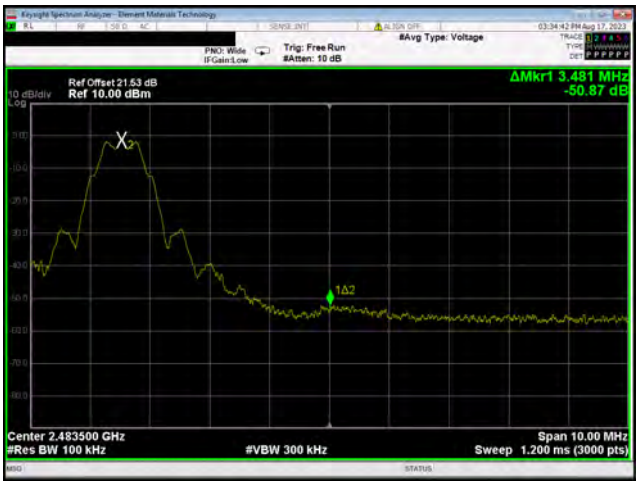
TEST RESULTS

	Value (dBc)	Limit ≤ (dBc)	Result
BLE/GFSK 125 kbps			
Low Channel, 2402 MHz	-44.9	-20	Pass
High Channel, 2480 MHz	-50.87	-20	Pass
BLE/GFSK 500 kbps			
Low Channel, 2402 MHz	-47.44	-20	Pass
High Channel, 2480 MHz	-53.44	-20	Pass
BLE/GFSK 1 Mbps			
Low Channel, 2402 MHz	-47.2	-20	Pass
High Channel, 2480 MHz	-52.54	-20	Pass
BLE/GFSK 2 Mbps			
Low Channel, 2402 MHz	-32.1	-20	Pass
High Channel, 2480 MHz	-51.38	-20	Pass

BAND EDGE COMPLIANCE

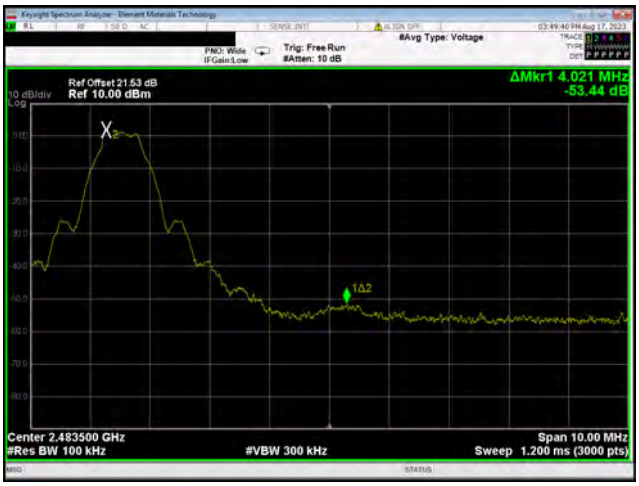
element
TbtTx 2023.07.28.0 BETA
WTD.2023.08.03.0

BLE/GFSK 125 kbps; Low Channel, 2402 MHz



BLE/GFSK 125 kbps; High Channel, 2480 MHz

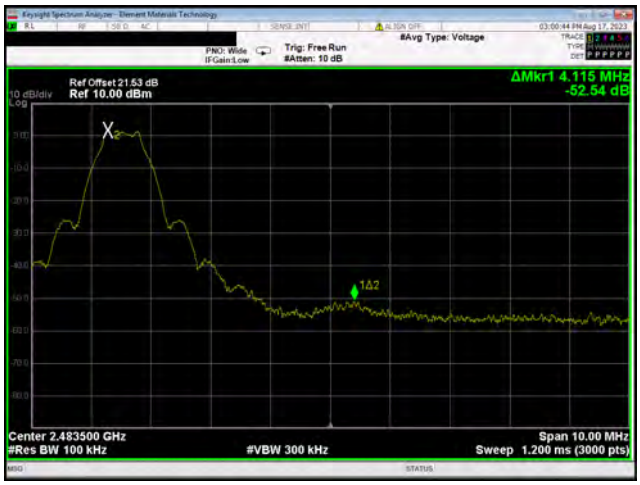
BLE/GFSK 500 kbps; Low Channel, 2402 MHz



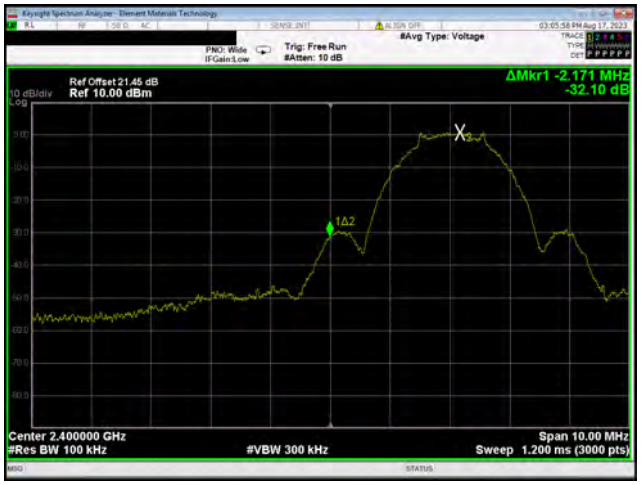
BLE/GFSK 500 kbps; High Channel, 2480 MHz

BAND EDGE COMPLIANCE

BLE/GFSK 1 Mbps; Low Channel, 2402 MHz



BLE/GFSK 1 Mbps; High Channel, 2480 MHz



BLE/GFSK 2 Mbps; Low Channel, 2402 MHz

BLE/GFSK 2 Mbps; High Channel, 2480 MHz

SPURIOUS CONDUCTED EMISSIONS

element
TbtTx 2023.07.28.0 BETA
WTD.2023.08.03.0

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.

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

The spurious RF conducted emissions were measured with the EUT set to low, medium and high transmit frequencies. The EUT was transmitting at the data rate(s) listed in the datasheet. For each transmit frequency, the fundamental was measured with a 100 kHz resolution bandwidth and the highest value was recorded. The rest of the spectrum was then measured with a 100 kHz resolution bandwidth and the highest value was found. The difference between the value found on the fundamental and the rest of the spectrum was compared against the limit to determine compliance.

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

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

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

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	N5183A	TIK	2022-01-24	2025-01-24
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFM	2023-05-01	2024-05-01
Cable	Micro-Coax	UFD150A-1-0720-200200	MNL	2022-09-10	2023-09-10
Block - DC	Fairview Microwave	SD3379	AMZ	2022-11-06	2023-11-06
Attenuator	Fairview Microwave	SA4014-20	AQI	2022-09-10	2023-09-10

SPURIOUS CONDUCTED EMISSIONS

element
TbtTx 2023.07.28.0 BETA
WTD.2023.08.03.0

EUT:	Sprinkler	Work Order:	IRRI0015
Serial Number:	1000824	Date:	2023-08-17
Customer:	IrriGreen, Inc.	Temperature:	22°C
Attendees:	Gary Klinefelter	Relative Humidity:	48.8%
Customer Project:	None	Bar. Pressure (PMSL):	1011 mbar
Tested By:	Christopher Heintzelman	Job Site:	MN11
Power:	5VDC VIA LAPTOP	Configuration:	IRRI0015-3

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.247:2023	ANSI C63.10:2013
RSS-247 Issue 2:2017	ANSI C63.10:2013

COMMENTS

None

DEVIATIONS FROM TEST STANDARD

None

TESTED BY

Christopher Heintzelman

TEST RESULTS

	Frequency Range	Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
BLE/GFSK 125 kbps					
Low Channel, 2402 MHz	Fundamental	2402.02	N/A	N/A	N/A
	30 MHz - 12.5 GHz	12085.91	-48.43	-20	Pass
	12.5 GHz - 25 GHz	24885.55	-36.14	-20	Pass
Mid Channel, 2442 MHz	Fundamental	2442.02	N/A	N/A	N/A
	30 MHz - 12.5 GHz	11324.71	-47.77	-20	Pass
	12.5 GHz - 25 GHz	24568.12	-36.08	-20	Pass
High Channel, 2480 MHz	Fundamental	2480.02	N/A	N/A	N/A
	30 MHz - 12.5 GHz	5449.75	-47.83	-20	Pass
	12.5 GHz - 25 GHz	24932.85	-35.65	-20	Pass
BLE/GFSK 500 kbps					
Low Channel, 2402 MHz	Fundamental	2401.77	N/A	N/A	N/A
	30 MHz - 12.5 GHz	12102.65	-51.67	-20	Pass
	12.5 GHz - 25 GHz	24984.74	-39.17	-20	Pass
Mid Channel, 2442 MHz	Fundamental	2441.77	N/A	N/A	N/A
	30 MHz - 12.5 GHz	5926.27	-51.48	-20	Pass
	12.5 GHz - 25 GHz	24613.91	-38.69	-20	Pass
High Channel, 2480 MHz	Fundamental	2479.77	N/A	N/A	N/A
	30 MHz - 12.5 GHz	12110.26	-50.88	-20	Pass
	12.5 GHz - 25 GHz	24858.08	-38.42	-20	Pass

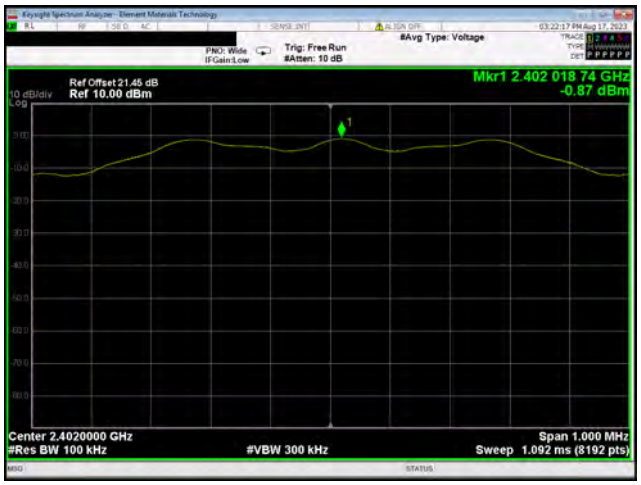
SPURIOUS CONDUCTED EMISSIONS

element
TbtTx 2023.07.28.0 BETA
WTD.2023.08.03.0

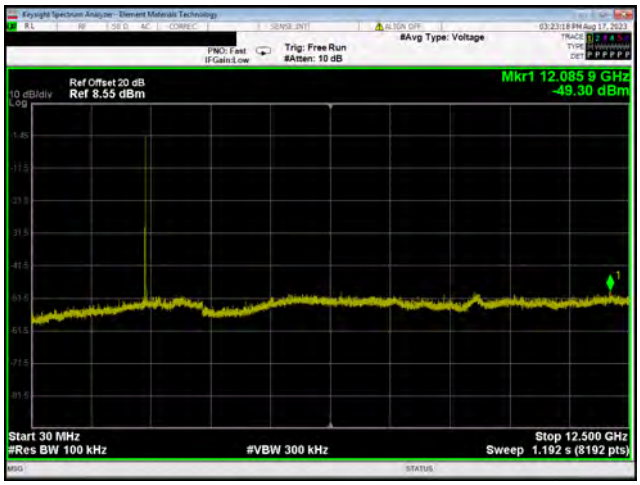
	Frequency Range	Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
BLE/GFSK 1 Mbps					
Low Channel, 2402 MHz	Fundamental	2401.77	N/A	N/A	N/A
	30 MHz - 12.5 GHz	9884.51	-51.88	-20	Pass
	12.5 GHz - 25 GHz	24862.65	-39.53	-20	Pass
Mid Channel, 2442 MHz	Fundamental	2442.26	N/A	N/A	N/A
	30 MHz - 12.5 GHz	12155.94	-51.55	-20	Pass
	12.5 GHz - 25 GHz	24993.9	-38.52	-20	Pass
High Channel, 2480 MHz	Fundamental	2480.26	N/A	N/A	N/A
	30 MHz - 12.5 GHz	12008.26	-50.57	-20	Pass
	12.5 GHz - 25 GHz	24905.38	-38.96	-20	Pass
BLE/GFSK 2 Mbps					
Low Channel, 2402 MHz	Fundamental	2401.52	N/A	N/A	N/A
	30 MHz - 12.5 GHz	9298.39	-50.8	-20	Pass
	12.5 GHz - 25 GHz	24923.7	-39.11	-20	Pass
Mid Channel, 2442 MHz	Fundamental	2442.53	N/A	N/A	N/A
	30 MHz - 12.5 GHz	12296	-50.25	-20	Pass
	12.5 GHz - 25 GHz	24821.45	-38.17	-20	Pass
High Channel, 2480 MHz	Fundamental	2479.54	N/A	N/A	N/A
	30 MHz - 12.5 GHz	9354.72	-50.07	-20	Pass
	12.5 GHz - 25 GHz	24879.44	-37.77	-20	Pass

SPURIOUS CONDUCTED EMISSIONS

element
TbtTx 2023.07.28.0 BETA
WTD.2023.08.03.0

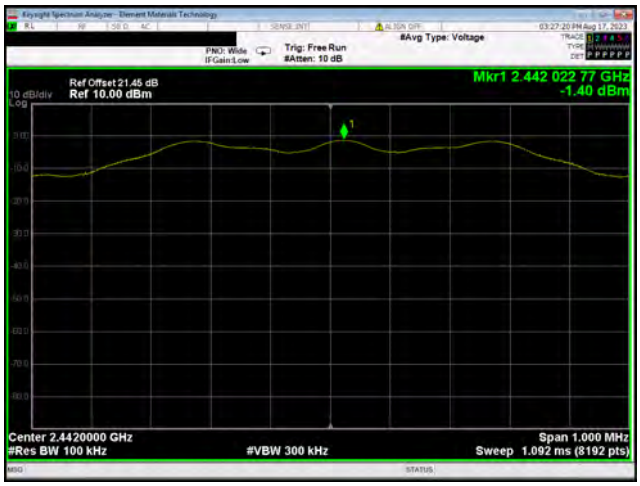


BLE/GFSK 125 kbps; Low Channel, 2402 MHz



BLE/GFSK 125 kbps; Low Channel, 2402 MHz

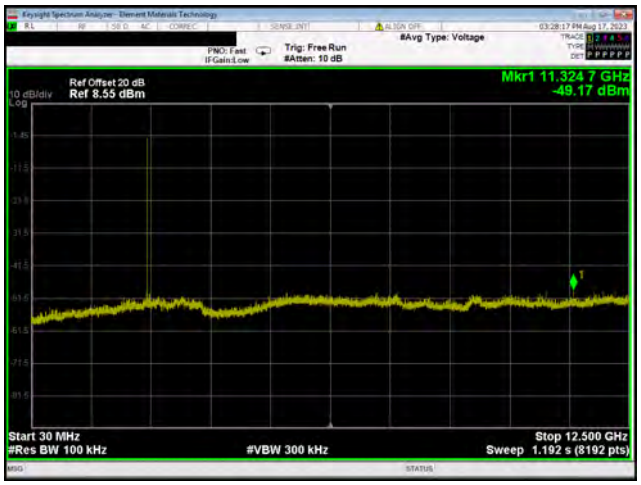
BLE/GFSK 125 kbps; Low Channel, 2402 MHz



BLE/GFSK 125 kbps; Mid Channel, 2442 MHz

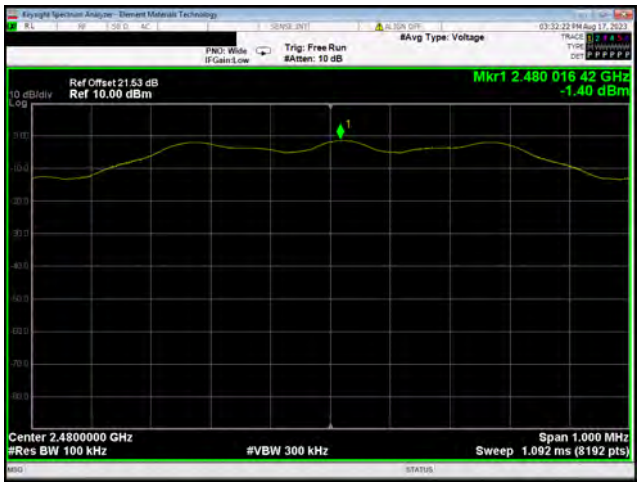
SPURIOUS CONDUCTED EMISSIONS

element
TbtTx 2023.07.28.0 BETA
WTD.2023.08.03.0

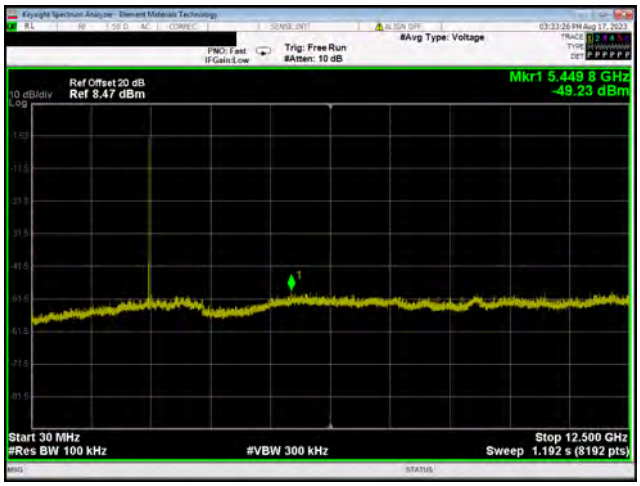


BLE/GFSK 125 kbps; Mid Channel, 2442 MHz

BLE/GFSK 125 kbps; Mid Channel, 2442 MHz



BLE/GFSK 125 kbps; High Channel, 2480 MHz

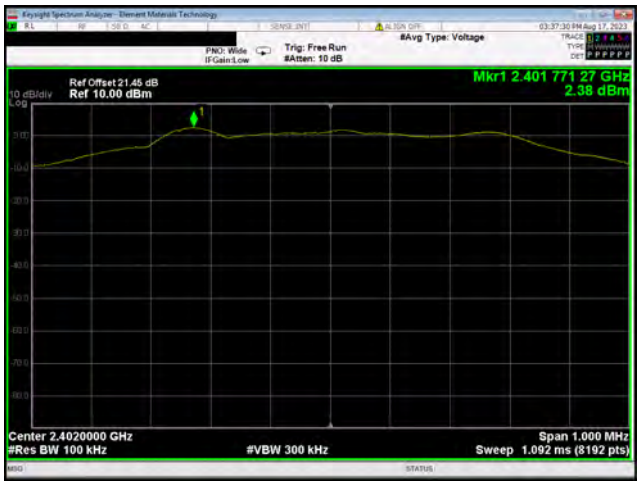


BLE/GFSK 125 kbps; High Channel, 2480 MHz

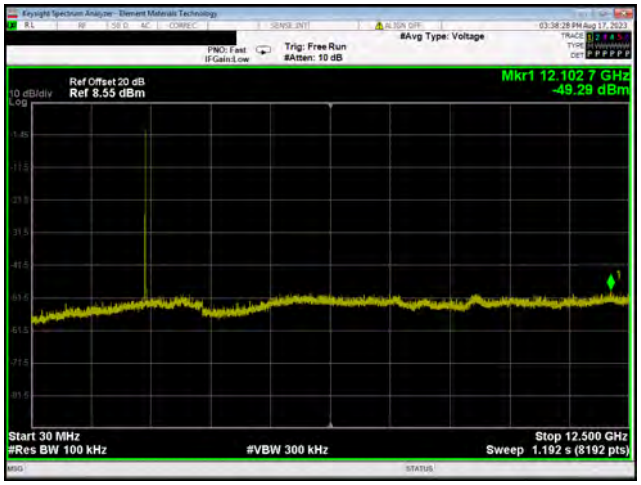
SPURIOUS CONDUCTED EMISSIONS

element
TbtTx 2023.07.28.0 BETA
WTD.2023.08.03.0

BLE/GFSK 125 kbps; High Channel, 2480 MHz



BLE/GFSK 500 kbps; Low Channel, 2402 MHz

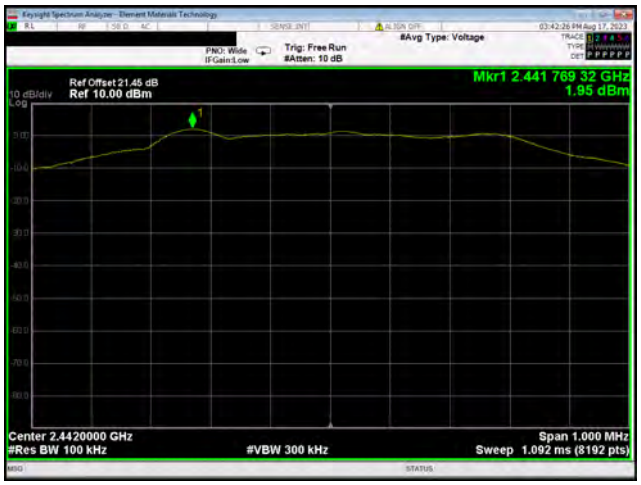


BLE/GFSK 500 kbps; Low Channel, 2402 MHz

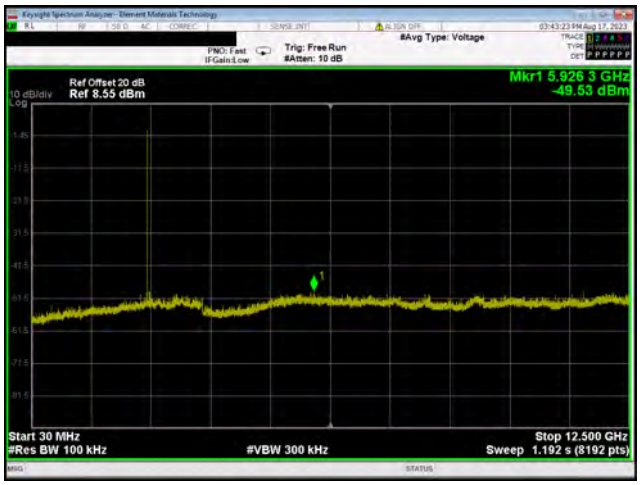
BLE/GFSK 500 kbps; Low Channel, 2402 MHz

SPURIOUS CONDUCTED EMISSIONS

element
TbtTx 2023.07.28.0 BETA
WTD.2023.08.03.0

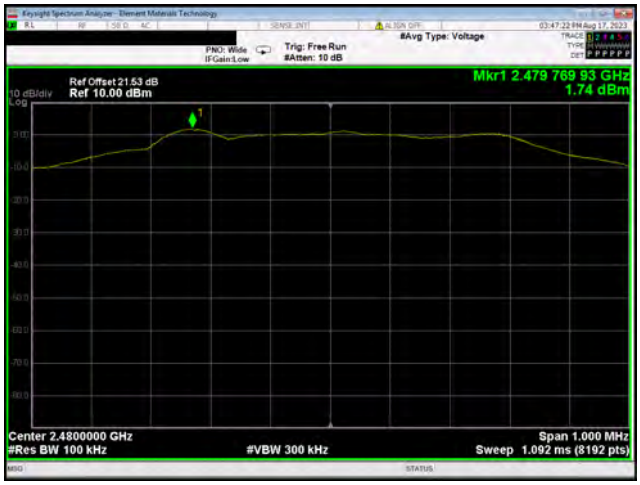


BLE/GFSK 500 kbps; Mid Channel, 2442 MHz



BLE/GFSK 500 kbps; Mid Channel, 2442 MHz

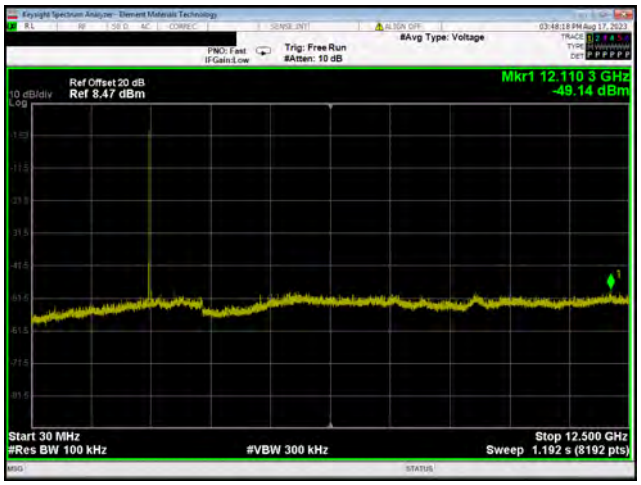
BLE/GFSK 500 kbps; Mid Channel, 2442 MHz



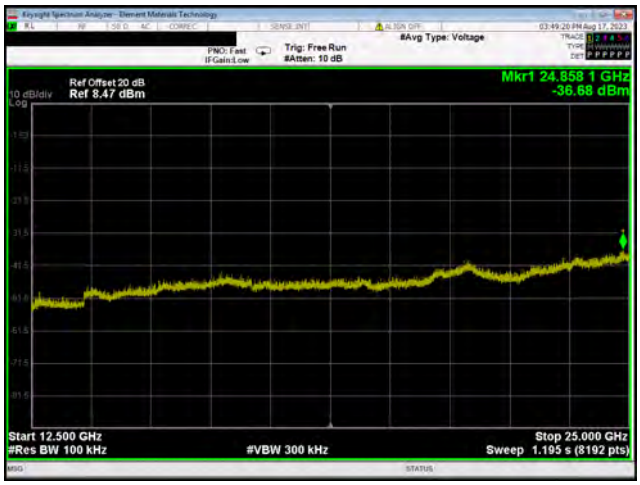
BLE/GFSK 500 kbps; High Channel, 2480 MHz

SPURIOUS CONDUCTED EMISSIONS

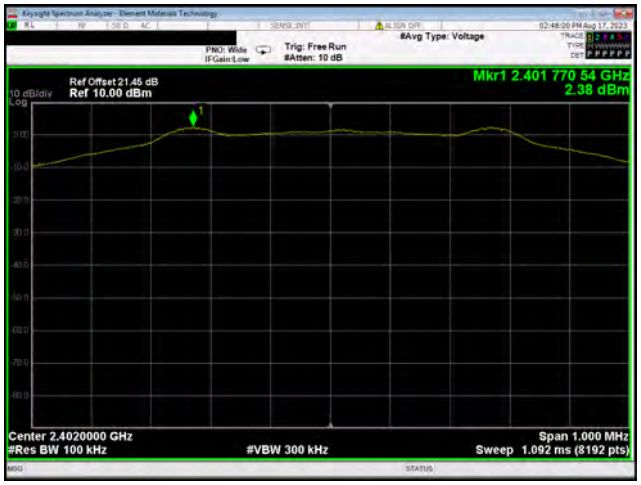
element
TbtTx 2023.07.28.0 BETA
WTD.2023.08.03.0



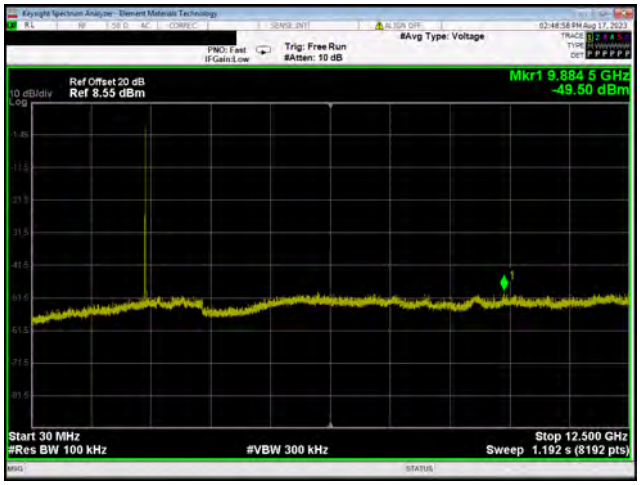
BLE/GFSK 500 kbps; High Channel, 2480 MHz



BLE/GFSK 500 kbps; High Channel, 2480 MHz



BLE/GFSK 1 Mbps; Low Channel, 2402 MHz

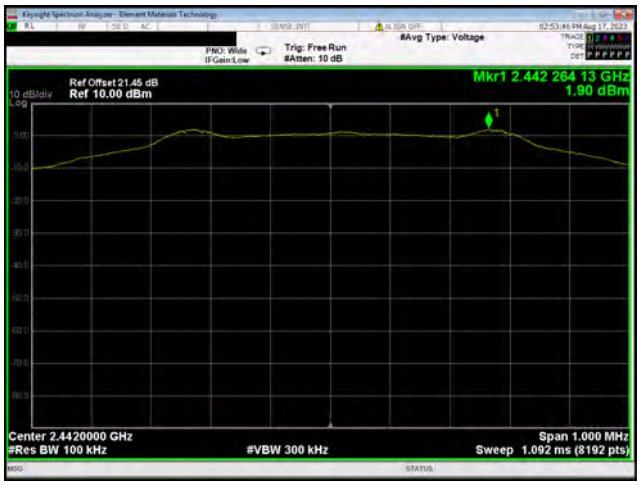


BLE/GFSK 1 Mbps; Low Channel, 2402 MHz

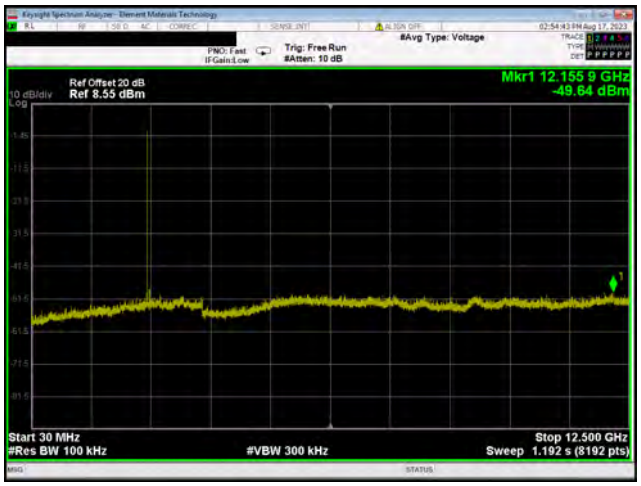
SPURIOUS CONDUCTED EMISSIONS

element
TbtTx 2023.07.28.0 BETA
WTD.2023.08.03.0

BLE/GFSK 1 Mbps; Low Channel, 2402 MHz



BLE/GFSK 1 Mbps; Mid Channel, 2442 MHz

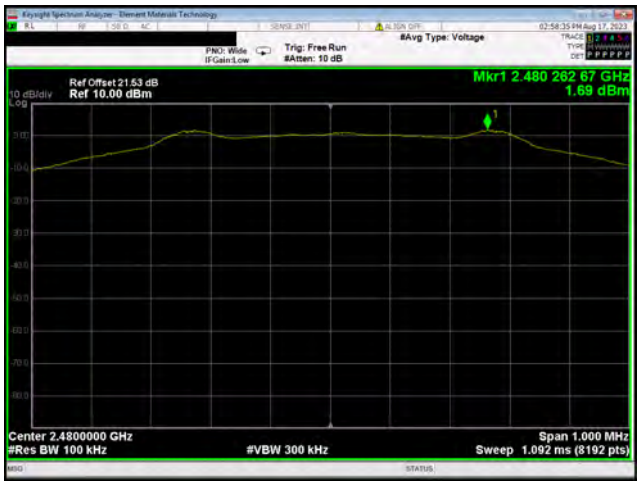


BLE/GFSK 1 Mbps; Mid Channel, 2442 MHz

BLE/GFSK 1 Mbps; Mid Channel, 2442 MHz

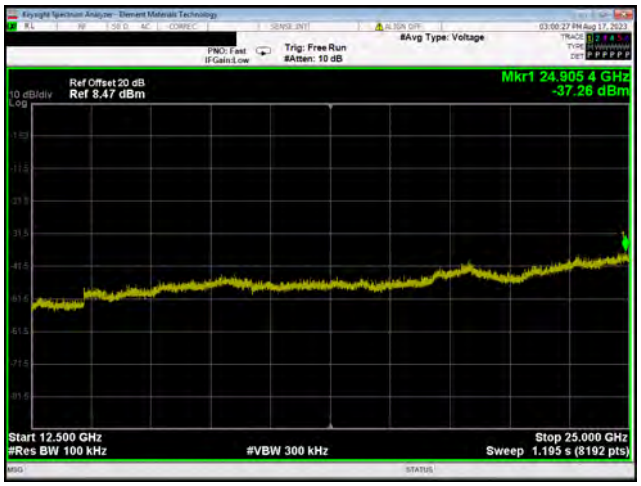
SPURIOUS CONDUCTED EMISSIONS

element
TbtTx 2023.07.28.0 BETA
WTD.2023.08.03.0

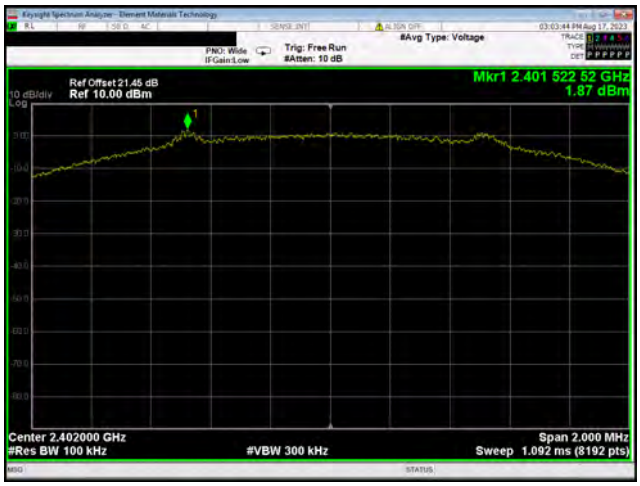


BLE/GFSK 1 Mbps; High Channel, 2480 MHz

BLE/GFSK 1 Mbps; High Channel, 2480 MHz



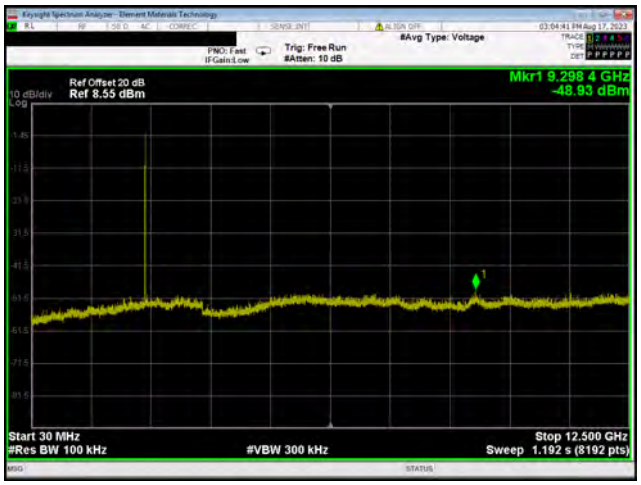
BLE/GFSK 1 Mbps; High Channel, 2480 MHz



BLE/GFSK 2 Mbps; Low Channel, 2402 MHz

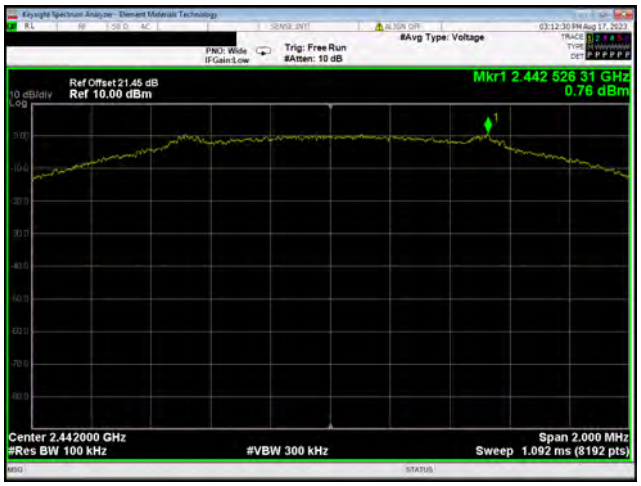
SPURIOUS CONDUCTED EMISSIONS

element
TbtTx 2023.07.28.0 BETA
WTD.2023.08.03.0

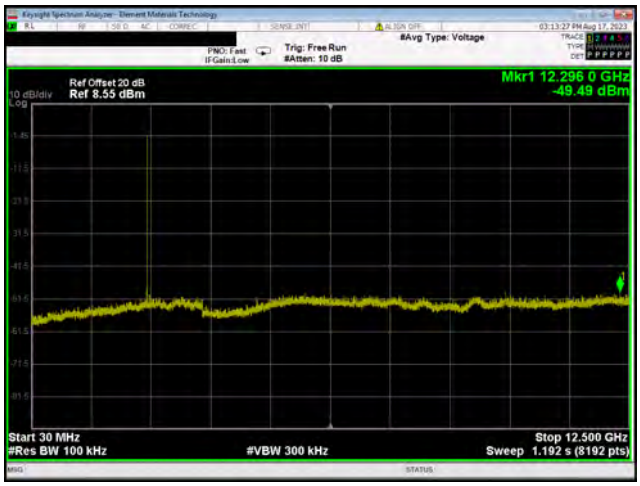


BLE/GFSK 2 Mbps; Low Channel, 2402 MHz

BLE/GFSK 2 Mbps; Low Channel, 2402 MHz



BLE/GFSK 2 Mbps; Mid Channel, 2442 MHz

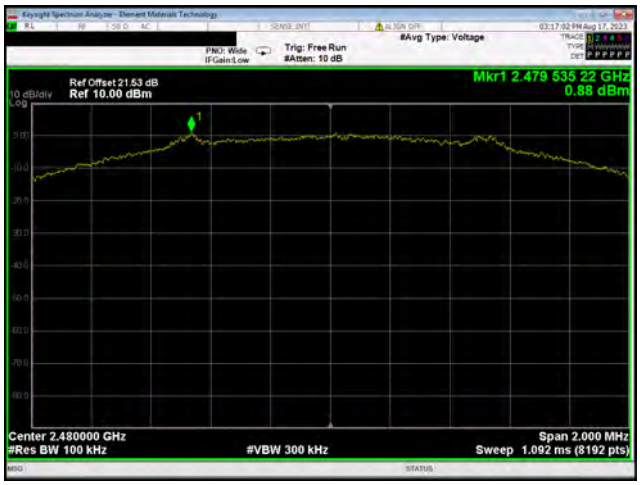


BLE/GFSK 2 Mbps; Mid Channel, 2442 MHz

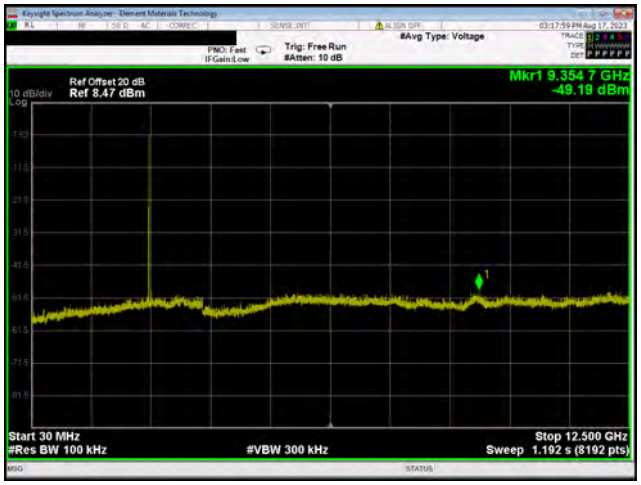
SPURIOUS CONDUCTED EMISSIONS

element
TbtTx 2023.07.28.0 BETA
WTD.2023.08.03.0

BLE/GFSK 2 Mbps; Mid Channel, 2442 MHz



BLE/GFSK 2 Mbps; High Channel, 2480 MHz



BLE/GFSK 2 Mbps; High Channel, 2480 MHz

BLE/GFSK 2 Mbps; High Channel, 2480 MHz

SPURIOUS RADIATED EMISSIONS

element
WTD.2023.04.25.0
EmiR5 2022.07.06.0
PSA-ESCI 2023.04.25.0

TEST DESCRIPTION

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

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

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

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

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

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

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

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

Where the radio test software does not provide for a duty cycle at continuous transmit conditions (> 98%) and the RMS (power average) measurements were made across the on and off times of the EUT transmissions, a duty cycle correction is added to the measurements using the formula of 10*log(1/dc).

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Analyzer - Spectrum Analyzer	Agilent	E4446A	AAQ	2023-02-06	2024-02-06
Antenna - Biconilog	Ametek	CBL 6141B	AYS	2023-03-28	2025-03-28
Cable	ESM Cable Corp.	Bilog Cables	MNH	2022-10-08	2023-10-08
Amplifier - Pre-Amplifier	Miteq	AM-1616-1000	AVO	2022-10-08	2023-10-08
Filter - Low Pass	Micro-Tronics	LPM50004	LFK	2022-08-27	2023-08-27
Antenna - Double Ridge	ETS Lindgren	3115	AIP	2022-07-20	2024-07-20
Cable	ESM Cable Corp.	Double Ridge Guide Horn Cables	MNI	2023-01-14	2024-01-14
Amplifier - Pre-Amplifier	Miteq	AMF-3D-00100800-32-13P	AVT	2023-01-14	2024-01-14
Attenuator	Fairview Microwave	SA18E-20	TWZ	2022-08-27	2023-08-27
Filter - High Pass	Micro-Tronics	HPM50111	LFN	2022-08-27	2023-08-27
Antenna - Standard Gain	ETS Lindgren	3160-07	AXP	NCR	NCR
Cable	ESM Cable Corp.	Standard Gain Horn Cables	MNJ	2023-01-14	2024-01-14
Amplifier - Pre-Amplifier	Miteq	AMF-6F-08001200-30-10P	AVV	2023-01-14	2024-01-14
Antenna - Standard Gain	ETS Lindgren	3160-08	AIQ	NCR	NCR
Amplifier - Pre-Amplifier	Miteq	AMF-6F-12001800-30-10P	AVW	2023-01-14	2024-01-14
Antenna - Standard Gain	ETS Lindgren	3160-09	AHG	NCR	NCR
Cable	ESM Cable Corp.	TTBJ141 KMKM-72	MNP	2022-09-10	2023-09-10
Amplifier - Pre-Amplifier	Miteq	JSD4-18002600-26-8P	APU	2022-09-10	2023-09-10

SPURIOUS RADIATED EMISSIONS

element
WTD.2023.04.25.0
EmiR5 2022.07.06.0
PSA-ESCI 2023.04.25.0

MEASUREMENT UNCERTAINTY

Description		
Expanded k=2	5.2 dB	-5.2 dB

FREQUENCY RANGE INVESTIGATED

30 MHz TO 26400 MHz

POWER INVESTIGATED

5VDC VIA LAPTOP

CONFIGURATIONS INVESTIGATED

IRRI0015-8

MODES INVESTIGATED

Transmitting BLE High Ch, 2480 MHz, 1 Mbps, GFSK Modulated, Power 5
Transmitting BLE Low Ch, 2402 MHz, 1 Mbps, GFSK Modulated, Power 5
Transmitting BLE Mid Ch, 2442 MHz, 1 Mbps, GFSK Modulated, Power 5
Transmitting BLE, Power=5. See comments for EUT orientation, frequency

SPURIOUS RADIATED EMISSIONS

element
WTD.2023.04.25.0
EmiR5 2022.07.06.0
PSA-ESCI 2023.04.25.0

EUT:	Sprinkler	Work Order:	IRRI0015
Serial Number:	2308	Date:	2023-08-15
Customer:	IrriGreen, Inc.	Temperature:	22.3°C
Attendees:	Gary Klinefelter	Relative Humidity:	53.6%
Customer Project:	None	Bar. Pressure (PMSL):	1019 mb
Tested By:	Dan Haas	Job Site:	MN05
Power:	5VDC VIA LAPTOP	Configuration:	IRRI0015-8

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.247:2023	ANSI C63.10:2013
RSS-247 Issue 2:2017	ANSI C63.10:2013
RSS-Gen Issue 5:2018+A1:2019+A2:2021	ANSI C63.10:2013

TEST PARAMETERS

Run #:	55	Test Distance (m):	3	Ant. Height(s) (m):	1 to 4(m)

COMMENTS

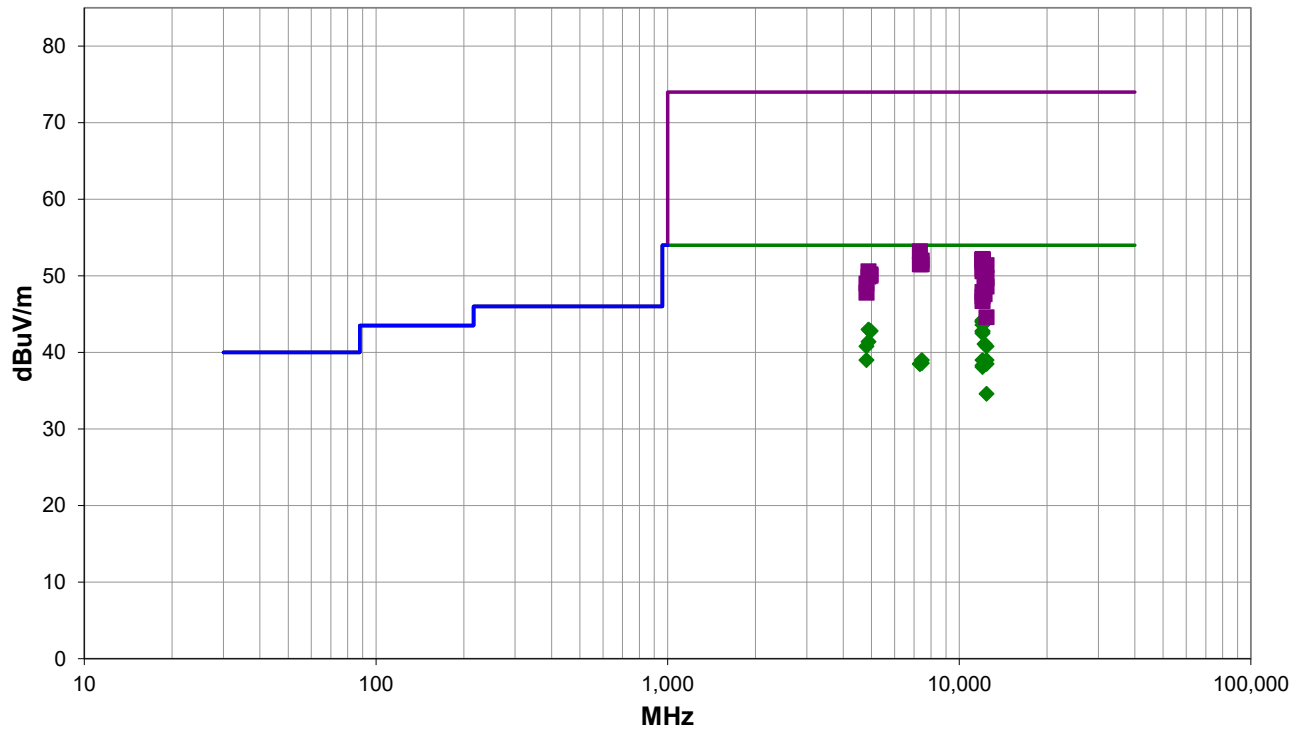
c105 is 1.2pF. Board is in the case. Duty cycle = 100%

EUT OPERATING MODES

Transmitting BLE, Power=5. See comments for EUT orientation, frequency, modulation

DEVIATIONS FROM TEST STANDARD

None



Run #: 55 ■ PK ◆ AV ● QP

SPURIOUS RADIATED EMISSIONS

element
WTD.2023.04.25.0
EmiR5 2022.07.06.0
PSA-ESCI 2023.04.25.0

RESULTS - Run #55

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
12011.220	43.7	0.5	1.9	240.9	3.0	0.0	Horz	AV	0.0	44.2	54.0	-9.8	EUT on side, Low ch. 2402, 1Mbps
12011.180	43.5	0.5	1.9	240.9	3.0	0.0	Horz	AV	0.0	44.0	54.0	-10.0	EUT on side, Low ch. 2402, 500kbps
12011.270	43.5	0.5	1.9	240.9	3.0	0.0	Horz	AV	0.0	44.0	54.0	-10.0	EUT on side, Low ch. 2402, 125kbps
12011.250	43.1	0.5	1.9	239.9	3.0	0.0	Horz	AV	0.0	43.6	54.0	-10.4	EUT on side, Low ch. 2402, 1Mbps
4884.100	39.6	3.4	1.2	167.9	3.0	0.0	Vert	AV	0.0	43.0	54.0	-11.0	EUT on side, Mid ch. 2442, 1Mbps
12011.220	42.3	0.5	1.6	304.9	3.0	0.0	Vert	AV	0.0	42.8	54.0	-11.2	EUT Vert, Low ch. 2402, 1Mbps
4960.067	39.2	3.6	2.3	225.9	3.0	0.0	Horz	AV	0.0	42.8	54.0	-11.2	EUT on side, High ch. 2480, 1Mbps
4960.033	39.2	3.6	1.3	167.9	3.0	0.0	Vert	AV	0.0	42.8	54.0	-11.2	EUT on side, High ch. 2480, 1Mbps
12012.370	42.2	0.5	1.9	240.9	3.0	0.0	Horz	AV	0.0	42.7	54.0	-11.3	EUT on side, Low ch. 2402, 2Mbps
12011.220	42.0	0.5	1.9	146.9	3.0	0.0	Horz	AV	0.0	42.5	54.0	-11.5	EUT Horz, Low ch. 2402, 1Mbps
4884.033	38.0	3.4	3.1	189.0	3.0	0.0	Horz	AV	0.0	41.4	54.0	-12.6	EUT on side, Mid ch. 2442, 1Mbps
12208.950	39.3	1.8	1.8	192.9	3.0	0.0	Horz	AV	0.0	41.1	54.0	-12.9	EUT on side, Mid ch. 2442, 1Mbps
12401.230	32.7	8.1	1.7	256.0	3.0	0.0	Horz	AV	0.0	40.8	54.0	-13.2	EUT on side, High ch. 2480, 1Mbps
4804.050	37.5	3.3	1.1	168.9	3.0	0.0	Vert	AV	0.0	40.8	54.0	-13.2	EUT on side, Low ch. 2402, 1Mbps
12011.220	38.5	0.5	1.6	90.0	3.0	0.0	Vert	AV	0.0	39.0	54.0	-15.0	EUT Horz, Low ch. 2402, 1Mbps
12398.970	37.1	1.9	1.6	257.9	3.0	0.0	Horz	AV	0.0	39.0	54.0	-15.0	EUT on side, High ch. 2480, 1Mbps
7439.400	27.1	11.9	3.9	148.0	3.0	0.0	Horz	AV	0.0	39.0	54.0	-15.0	EUT on side, High ch. 2480, 1Mbps
4804.150	35.7	3.3	2.3	224.0	3.0	0.0	Horz	AV	0.0	39.0	54.0	-15.0	EUT on side, Low ch. 2402, 1Mbps
12211.280	37.0	1.8	3.1	193.9	3.0	0.0	Vert	AV	0.0	38.8	54.0	-15.2	EUT on side, Mid ch. 2442, 1Mbps
7438.350	26.7	11.9	2.3	250.9	3.0	0.0	Vert	AV	0.0	38.6	54.0	-15.4	EUT on side, High ch. 2480, 1Mbps
12401.240	30.4	8.1	3.9	153.9	3.0	0.0	Vert	AV	0.0	38.5	54.0	-15.5	EUT on side, High ch. 2480, 1Mbps
7322.083	26.8	11.7	1.5	34.9	3.0	0.0	Horz	AV	0.0	38.5	54.0	-15.5	EUT on side, Mid ch. 2442, 1Mbps
7325.300	26.8	11.7	1.5	62.0	3.0	0.0	Vert	AV	0.0	38.5	54.0	-15.5	EUT on side, Mid ch. 2442, 1Mbps
12011.250	37.8	0.5	1.0	109.9	3.0	0.0	Vert	AV	0.0	38.3	54.0	-15.7	EUT on side, Low ch. 2402, 1Mbps
12011.250	37.6	0.5	1.4	81.0	3.0	0.0	Horz	AV	0.0	38.1	54.0	-15.9	EUT Vert, Low ch. 2402, 1Mbps
12398.980	32.7	1.9	1.9	193.9	3.0	0.0	Vert	AV	0.0	34.6	54.0	-19.4	EUT on side, High ch. 2480, 1Mbps
7326.617	41.5	11.7	1.5	62.0	3.0	0.0	Vert	PK	0.0	53.2	74.0	-20.8	EUT on side, Mid ch. 2442, 1Mbps
12011.370	51.7	0.5	1.9	240.9	3.0	0.0	Horz	PK	0.0	52.2	74.0	-21.8	EUT on side, Low ch. 2402, 1Mbps
12012.520	51.6	0.5	1.9	240.9	3.0	0.0	Horz	PK	0.0	52.1	74.0	-21.9	EUT on side, Low ch. 2402, 2Mbps
12011.180	51.6	0.5	1.9	240.9	3.0	0.0	Horz	PK	0.0	52.1	74.0	-21.9	EUT on side, Low ch. 2402, 500kbps
12011.320	51.6	0.5	1.9	240.9	3.0	0.0	Horz	PK	0.0	52.1	74.0	-21.9	EUT on side, Low ch. 2402, 125kbps
7435.033	40.2	11.8	3.9	148.0	3.0	0.0	Horz	PK	0.0	52.0	74.0	-22.0	EUT on side, High ch. 2480, 1Mbps
12011.400	51.3	0.5	1.9	239.9	3.0	0.0	Horz	PK	0.0	51.8	74.0	-22.2	EUT on side, Low ch. 2402, 1Mbps
7435.000	39.7	11.8	2.3	250.9	3.0	0.0	Vert	PK	0.0	51.5	74.0	-22.5	EUT on side, High ch. 2480, 1Mbps
7327.767	39.7	11.8	1.5	34.9	3.0	0.0	Horz	PK	0.0	51.5	74.0	-22.5	EUT on side, Mid ch. 2442, 1Mbps
12401.600	43.3	8.1	1.7	256.0	3.0	0.0	Horz	PK	0.0	51.4	74.0	-22.6	EUT on side, High ch. 2480, 1Mbps
12008.880	50.5	0.4	1.6	304.9	3.0	0.0	Vert	PK	0.0	50.9	74.0	-23.1	EUT Vert, Low ch. 2402, 1Mbps
12011.470	50.1	0.5	1.9	146.9	3.0	0.0	Horz	PK	0.0	50.6	74.0	-23.4	EUT Horz, Low ch. 2402, 1Mbps
4883.600	47.2	3.4	1.2	167.9	3.0	0.0	Vert	PK	0.0	50.6	74.0	-23.4	EUT on side, Mid ch. 2442, 1Mbps
4960.817	46.6	3.6	2.3	225.9	3.0	0.0	Horz	PK	0.0	50.2	74.0	-23.8	EUT on side, High ch. 2480, 1Mbps

SPURIOUS RADIATED EMISSIONS

element
WTD.2023.04.25.0
EmiR5 2022.07.06.0
PSA-ESCI 2023.04.25.0

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
4960.150	46.4	3.6	1.3	167.9	3.0	0.0	Vert	PK	0.0	50.0	74.0	-24.0	EUT on side, High ch. 2480, 1Mbps
4883.900	46.5	3.4	3.1	189.0	3.0	0.0	Horz	PK	0.0	49.9	74.0	-24.1	EUT on side, Mid ch. 2442, 1Mbps
12401.520	41.6	8.1	3.9	153.9	3.0	0.0	Vert	PK	0.0	49.7	74.0	-24.3	EUT on side, High ch. 2480, 1Mbps
12209.130	47.7	1.8	1.8	192.9	3.0	0.0	Horz	PK	0.0	49.5	74.0	-24.5	EUT on side, Mid ch. 2442, 1Mbps
4804.133	45.7	3.3	1.1	168.9	3.0	0.0	Vert	PK	0.0	49.0	74.0	-25.0	EUT on side, Low ch. 2402, 1Mbps
12398.960	46.7	1.9	1.6	257.9	3.0	0.0	Horz	PK	0.0	48.6	74.0	-25.4	EUT on side, High ch. 2480, 1Mbps
12008.800	47.5	0.4	1.6	90.0	3.0	0.0	Vert	PK	0.0	47.9	74.0	-26.1	EUT Horz, Low ch. 2402, 1Mbps
4804.400	44.5	3.3	2.3	224.0	3.0	0.0	Horz	PK	0.0	47.8	74.0	-26.2	EUT on side, Low ch. 2402, 1Mbps
12211.420	45.8	1.8	3.1	193.9	3.0	0.0	Vert	PK	0.0	47.6	74.0	-26.4	EUT on side, Mid ch. 2442, 1Mbps
12011.380	46.8	0.5	1.0	109.9	3.0	0.0	Vert	PK	0.0	47.3	74.0	-26.7	EUT on side, Low ch. 2402, 1Mbps
12008.820	46.3	0.4	1.4	81.0	3.0	0.0	Horz	PK	0.0	46.7	74.0	-27.3	EUT Vert, Low ch. 2402, 1Mbps
12398.970	42.7	1.9	1.9	193.9	3.0	0.0	Vert	PK	0.0	44.6	74.0	-29.4	EUT on side, High ch. 2480, 1Mbps

CONCLUSION

Pass

Tested By

SPURIOUS RADIATED EMISSIONS

element
WTD.2023.04.25.0
EmiR5 2022.07.06.0
PSA-ESCI 2023.04.25.0

EUT:	Sprinkler	Work Order:	IRRI0015
Serial Number:	2308	Date:	2023-08-15
Customer:	IrriGreen, Inc.	Temperature:	22.3°C
Attendees:	Gary Klinefelter	Relative Humidity:	50.5%
Customer Project:	None	Bar. Pressure (PMSL):	1018 mb
Tested By:	Dan Haas	Job Site:	MN05
Power:	5VDC VIA LAPTOP	Configuration:	IRRI0015-8

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.247:2023	ANSI C63.10:2013
RSS-247 Issue 2:2017	ANSI C63.10:2013
RSS-Gen Issue 5:2018+A1:2019+A2:2021	ANSI C63.10:2013

TEST PARAMETERS

Run #:	59	Test Distance (m):	3	Ant. Height(s) (m):	1 to 4(m)

COMMENTS

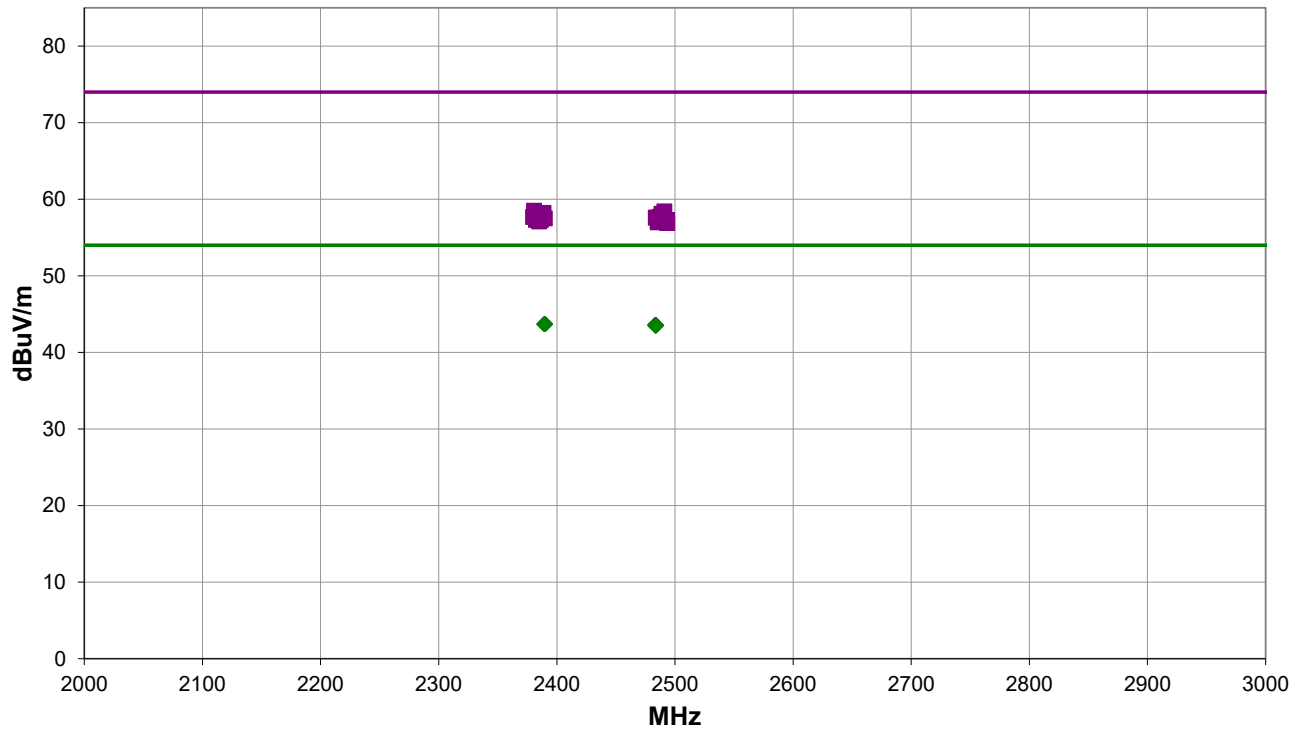
c105 is 1.2pF. Board is in the case.

EUT OPERATING MODES

Transmitting BLE, Power=5. See comments for EUT orientation, frequency, modulation

DEVIATIONS FROM TEST STANDARD

None



Run #: 59 PK AV QP

SPURIOUS RADIATED EMISSIONS

element
WTD.2023.04.25.0
EmiR5 2022.07.06.0
PSA-ESCI 2023.04.25.0

RESULTS - Run #59

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
2389.967	28.0	-4.3	1.5	55.0	3.0	20.0	Horz	AV	0.0	43.7	54.0	-10.3	EUT on side, Low ch. 2402, 1Mbps
2390.000	28.0	-4.3	1.5	40.0	3.0	20.0	Vert	AV	0.0	43.7	54.0	-10.3	EUT on side, Low ch. 2402, 1Mbps
2389.850	28.0	-4.3	1.5	66.9	3.0	20.0	Horz	AV	0.0	43.7	54.0	-10.3	EUT Horz, Low ch. 2402, 1Mbps
2389.700	28.0	-4.3	1.5	315.0	3.0	20.0	Vert	AV	0.0	43.7	54.0	-10.3	EUT Horz, Low ch. 2402, 1Mbps
2389.833	28.0	-4.3	1.5	286.9	3.0	20.0	Horz	AV	0.0	43.7	54.0	-10.3	EUT Vert, Low ch. 2402, 1Mbps
2389.683	28.0	-4.3	1.5	217.9	3.0	20.0	Vert	AV	0.0	43.7	54.0	-10.3	EUT Vert, Low ch. 2402, 1Mbps
2389.800	28.0	-4.3	1.5	27.0	3.0	20.0	Horz	AV	0.0	43.7	54.0	-10.3	EUT Vert, Low ch. 2402, 2Mbps
2389.667	28.0	-4.3	1.5	175.9	3.0	20.0	Vert	AV	0.0	43.7	54.0	-10.3	EUT Vert, Low ch. 2402, 2Mbps
2389.300	28.0	-4.3	1.5	56.0	3.0	20.0	Horz	AV	0.0	43.7	54.0	-10.3	EUT on side, Low ch. 2402, 2Mbps
2389.900	28.0	-4.3	1.5	56.0	3.0	20.0	Horz	AV	0.0	43.7	54.0	-10.3	EUT on side, Low ch. 2402, 500kbps
2389.833	28.0	-4.3	1.5	56.0	3.0	20.0	Horz	AV	0.0	43.7	54.0	-10.3	EUT on side, Low ch. 2402, 125kbps
2483.500	27.8	-4.2	1.5	189.0	3.0	20.0	Vert	AV	0.0	43.6	54.0	-10.4	EUT Vert, High ch. 2480, 1Mbps
2483.567	27.8	-4.2	1.5	16.9	3.0	20.0	Horz	AV	0.0	43.6	54.0	-10.4	EUT Horz, High ch. 2480, 1Mbps
2483.500	27.8	-4.2	3.16	311.9	3.0	20.0	Vert	AV	0.0	43.6	54.0	-10.4	EUT Vert, High ch. 2480, 2Mbps
2483.517	27.8	-4.2	3.16	311.9	3.0	20.0	Vert	AV	0.0	43.6	54.0	-10.4	EUT Vert, High ch. 2480, 500kbps
2483.517	27.8	-4.2	3.16	311.9	3.0	20.0	Vert	AV	0.0	43.6	54.0	-10.4	EUT Vert, High ch. 2480, 125kbps
2484.000	27.7	-4.2	1.5	1.0	3.0	20.0	Horz	AV	0.0	43.5	54.0	-10.5	EUT Vert, High ch. 2480, 1Mbps
2483.550	27.7	-4.2	1.5	5.0	3.0	20.0	Vert	AV	0.0	43.5	54.0	-10.5	EUT Horz, High ch. 2480, 1Mbps
2483.517	27.7	-4.2	1.5	225.9	3.0	20.0	Horz	AV	0.0	43.5	54.0	-10.5	EUT on side, High ch. 2480, 1Mbps
2483.517	27.7	-4.2	1.5	106.0	3.0	20.0	Vert	AV	0.0	43.5	54.0	-10.5	EUT on side, High ch. 2480, 1Mbps
2380.683	42.8	-4.3	1.5	66.9	3.0	20.0	Horz	PK	0.0	58.5	74.0	-15.5	EUT Horz, Low ch. 2402, 1Mbps
2491.033	42.5	-4.1	3.16	311.9	3.0	20.0	Vert	PK	0.0	58.4	74.0	-15.6	EUT Vert, High ch. 2480, 125kbps
2388.567	42.5	-4.3	1.5	56.0	3.0	20.0	Horz	PK	0.0	58.2	74.0	-15.8	EUT on side, Low ch. 2402, 500kbps
2489.200	42.1	-4.0	1.5	5.0	3.0	20.0	Vert	PK	0.0	58.1	74.0	-15.9	EUT Horz, High ch. 2480, 1Mbps
2488.550	42.1	-4.0	3.16	311.9	3.0	20.0	Vert	PK	0.0	58.1	74.0	-15.9	EUT Vert, High ch. 2480, 2Mbps
2387.300	42.4	-4.3	1.5	56.0	3.0	20.0	Horz	PK	0.0	58.1	74.0	-15.9	EUT on side, Low ch. 2402, 125kbps
2380.050	42.0	-4.3	1.5	40.0	3.0	20.0	Vert	PK	0.0	57.7	74.0	-16.3	EUT on side, Low ch. 2402, 1Mbps
2380.267	42.0	-4.3	1.5	286.9	3.0	20.0	Horz	PK	0.0	57.7	74.0	-16.3	EUT Vert, Low ch. 2402, 1Mbps
2487.267	41.9	-4.2	3.16	311.9	3.0	20.0	Vert	PK	0.0	57.7	74.0	-16.3	EUT Vert, High ch. 2480, 500kbps
2483.733	41.8	-4.2	1.5	189.0	3.0	20.0	Vert	PK	0.0	57.6	74.0	-16.4	EUT Vert, High ch. 2480, 1Mbps
2389.817	41.8	-4.3	1.5	55.0	3.0	20.0	Horz	PK	0.0	57.5	74.0	-16.5	EUT on side, Low ch. 2402, 1Mbps
2384.533	41.8	-4.3	1.5	27.0	3.0	20.0	Horz	PK	0.0	57.5	74.0	-16.5	EUT Vert, Low ch. 2402, 2Mbps
2382.600	41.7	-4.3	1.5	315.0	3.0	20.0	Vert	PK	0.0	57.4	74.0	-16.6	EUT Horz, Low ch. 2402, 1Mbps
2382.383	41.6	-4.3	1.5	217.9	3.0	20.0	Vert	PK	0.0	57.3	74.0	-16.7	EUT Vert, Low ch. 2402, 1Mbps
2493.233	41.4	-4.1	1.5	1.0	3.0	20.0	Horz	PK	0.0	57.3	74.0	-16.7	EUT Vert, High ch. 2480, 1Mbps
2386.367	41.6	-4.3	1.5	56.0	3.0	20.0	Horz	PK	0.0	57.3	74.0	-16.7	EUT on side, Low ch. 2402, 2Mbps
2485.383	41.4	-4.2	1.5	106.0	3.0	20.0	Vert	PK	0.0	57.2	74.0	-16.8	EUT on side, High ch. 2480, 1Mbps
2384.917	41.4	-4.3	1.5	175.9	3.0	20.0	Vert	PK	0.0	57.1	74.0	-16.9	EUT Vert, Low ch. 2402, 2Mbps
2485.417	41.2	-4.2	1.5	16.9	3.0	20.0	Horz	PK	0.0	57.0	74.0	-17.0	EUT Horz, High ch. 2480, 1Mbps
2493.283	41.0	-4.1	1.5	225.9	3.0	20.0	Horz	PK	0.0	56.9	74.0	-17.1	EUT on side, High ch. 2480, 1Mbps

SPURIOUS RADIATED EMISSIONS

element
WTD.2023.04.25.0
EmiR5 2022.07.06.0
PSA-ESCI 2023.04.25.0

CONCLUSION
Pass

Tested By

End of Test Report