Glowforge Incorporated

GFD200

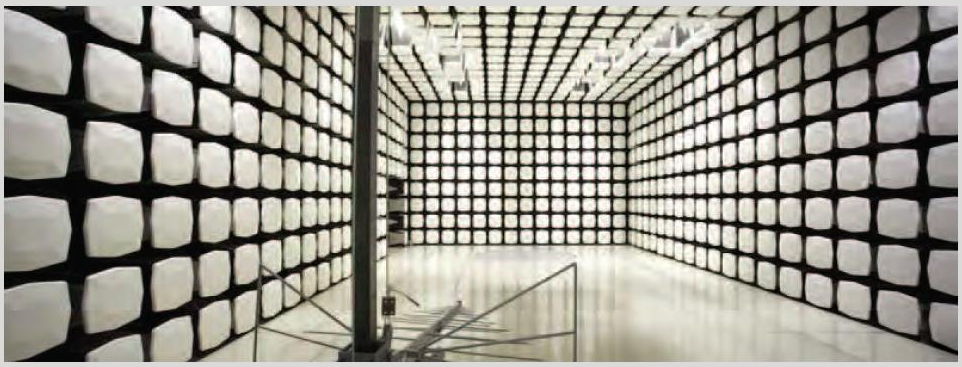
FCC 15.247:2023

RSS-247 Issue 2:2017

RSS-Gen Issue 5:2018+A1:2019+A2:2021

Bluetooth radio with 1 antenna type(s) and 1 antenna port(s)

Report: GLOW0038.1 Rev. 2, Issue Date: May 1, 2023



ACCREDITED
CERT #3310.06

CERTIFICATE OF TEST

Last Date of Test: April 18, 2023
Glowforge Incorporated
EUT: GFD200

Radio Equipment Testing

Standards

Specification	Method
FCC 15.207:2023	ANSI C63.10:2013, FCC KDB 558074 v05r02:2019
FCC 15.247:2023	ANSI C63.10:2013, FCC KDB 558074 v05r02:2019
RSS-247 Issue 2:2017	ANSI C63.10:2013
RSS-Gen Issue 5:2018+A1:2019+A2:2021	ANSI C63.10:2013

Results

Test Description	Result	Specification Section(s)	Method Section(s)	Comments
Powerline Conducted Emissions	Pass	15.207, RSS-Gen 8.8	6.2	
Spurious Radiated Emissions	Pass	15.247(d), RSS-247 5.5	6.5, 6.6	
Duty Cycle	Pass	15.247, RSS-Gen 3.2	7.5	
Carrier Frequency Separation	Pass	15.247(a)(1), RSS-247 5.1(b)	7.8.2	
Number of Hopping Frequencies	Pass	15.247(a)(1)(iii), RSS-247 5.1(d)	7.8.3	
Dwell Time	Pass	15.247(a)(1)(iii), RSS-247 5.1(d)	7.8.4	
Output Power	Pass	15.247(b)(1), RSS-247 5.4(b)	7.8.5	
Equivalent Isotropic Radiated Power	Pass	15.247(b)(1) , RSS-247 5.4(b)	7.8.5	
Band Edge Compliance	Pass	15.247(d), RSS-247 5.5	7.8.6	
Band Edge Compliance – Hopping Mode	Pass	15.247(d), RSS-247 5.5	7.8.6	
Spurious Conducted Emissions	Pass	15.247(d), RSS-247 5.5	7.8.8	
Occupied Bandwidth (99%)	Pass	RSS-Gen 6.7	6.9.3	

Deviations From Test Standards

None

Approved By:

Chuck Heller, Department Manager

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

REVISION HISTORY

Revision Number	Description	Date (yyyy-mm-dd)	Page Number
01	Added Band Edge Compliance (Single Channel)	2023-04-19	68-72
02	Updated last testing date	2023-05-03	10
02	Added the test setup method	2023-05-03	101

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

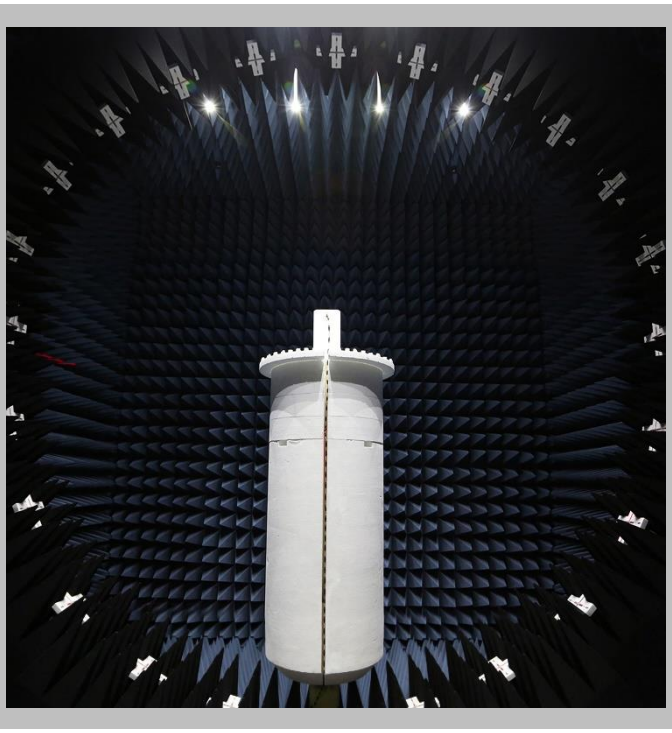
For details on the Scopes of our Accreditations, please visit:

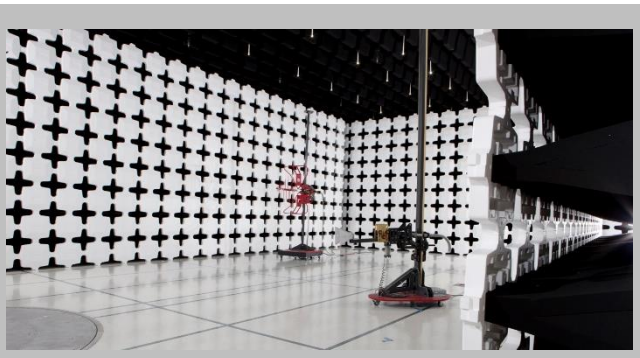
California Minnesota Oregon Texas Washington

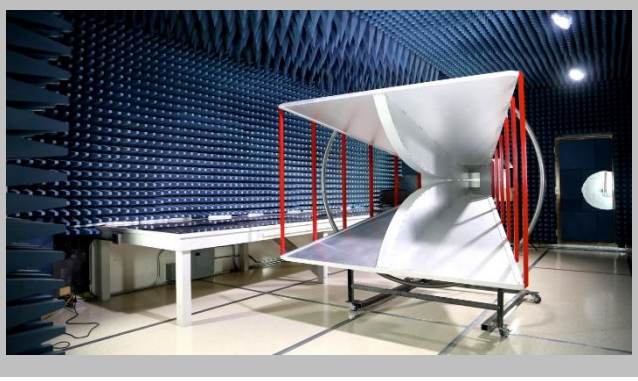
FACILITIES

element
2020.12.15

California	Minnesota	Oregon	Texas	Washington
Labs OC01-17 41 Tesla Irvine, CA 92618 (949) 861-8918	Labs MN01-11 9349 W Broadway Ave. Brooklyn Park, MN 55445 (612)-638-5136	Labs EV01-12 6775 NE Evergreen Pkwy #400 Hillsboro, OR 97124 (503) 844-4066	Labs TX01-09 3801 E Plano Pkwy Plano, TX 75074 (469) 304-5255	Labs NC01-05 19201 120th Ave NE Bothell, WA 98011 (425)984-6600
A2LA				
Lab Code: 3310.04	Lab Code: 3310.05	Lab Code: 3310.02	Lab Code: 3310.03	Lab Code: 3310.06
Innovation, Science and Economic Development Canada				
2834B-1, 2834B-3	2834E-1, 2834E-3	2834D-1	2834G-1	2834F-1
BSMI				
SL2-IN-E-1154R	SL2-IN-E-1152R	SL2-IN-E-1017	SL2-IN-E-1158R	SL2-IN-E-1153R
VCCI				
A-0029	A-0109	A-0108	A-0201	A-0110
Recognized Phase I CAB for ISED, ACMA, BSMI, IDA, KCC/RRA, MIC, MOC, NCC, OFCA				
US0158	US0175	US0017	US0191	US0157







MEASUREMENT UNCERTAINTY

element
TMU.2015.07.10

Measurement Uncertainty

When a measurement is made, the result will be different from the true or theoretically correct value. The difference is the result of tolerances in the measurement system that cannot be completely eliminated. To the extent that technology allows us, it has been our aim to minimize this error. Measurement uncertainty is a statistical expression of measurement error qualified by a probability distribution.

A measurement uncertainty estimation has been performed for each test per our internal quality document QM205.4.6. The estimation is used to compare the measured result with its "true" or theoretically correct value. The expanded measurement uncertainty (K=2) can be found in the table below. A lab specific value may also be found in the applicable test description section. Our measurement data meets or exceeds the measurement uncertainty requirements of the applicable specification; therefore, the test data can be compared directly to the specification limit to determine compliance. The calculations for estimating measurement uncertainty are based upon ETSI TR 100 028 (or CISPR 16-4-2 as applicable), and are available upon request.

The following table represents the Measurement Uncertainty (MU) budgets for each of the tests that may be contained in this report.

Test	+ MU	- MU
Frequency Accuracy	0.0007%	-0.0007%
Amplitude Accuracy (dB)	1.2 dB	-1.2 dB
Conducted Power (dB)	1.2 dB	-1.2 dB
Radiated Power via Substitution (dB)	0.7 dB	-0.7 dB
Temperature (degrees C)	0.7°C	-0.7°C
Humidity (% RH)	2.5% RH	-2.5% RH
Voltage (AC)	1.0%	-1.0%
Voltage (DC)	0.7%	-0.7%
Field Strength (dB)	5.2 dB	-5.2 dB
AC Powerline Conducted Emissions (dB)	3.1 dB	-3.1 dB

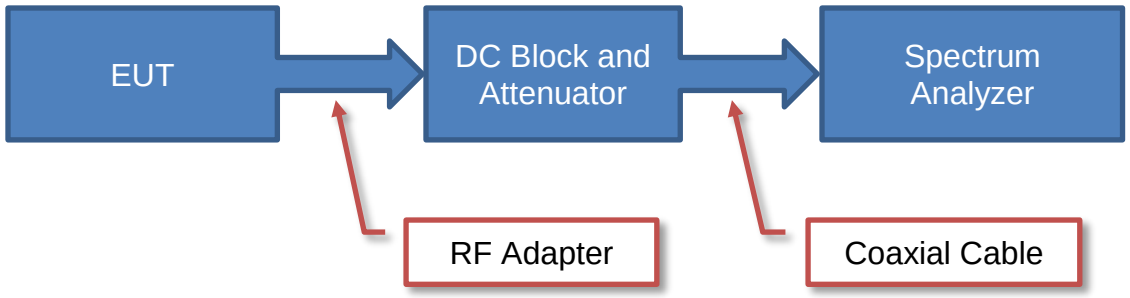
TEST SETUP BLOCK DIAGRAMS

Measurement Bandwidths

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

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

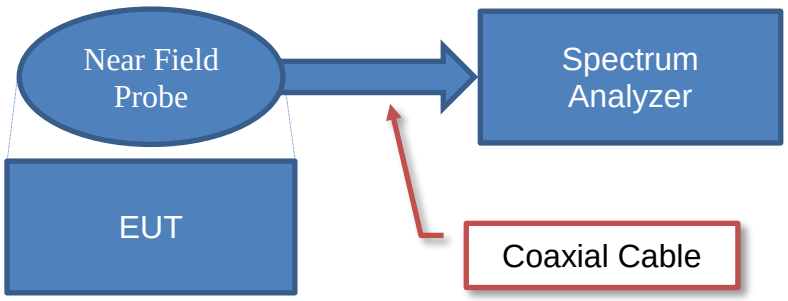
Antenna Port Conducted Measurements



Sample Calculation (logarithmic units)

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

Near Field Test Fixture Measurements

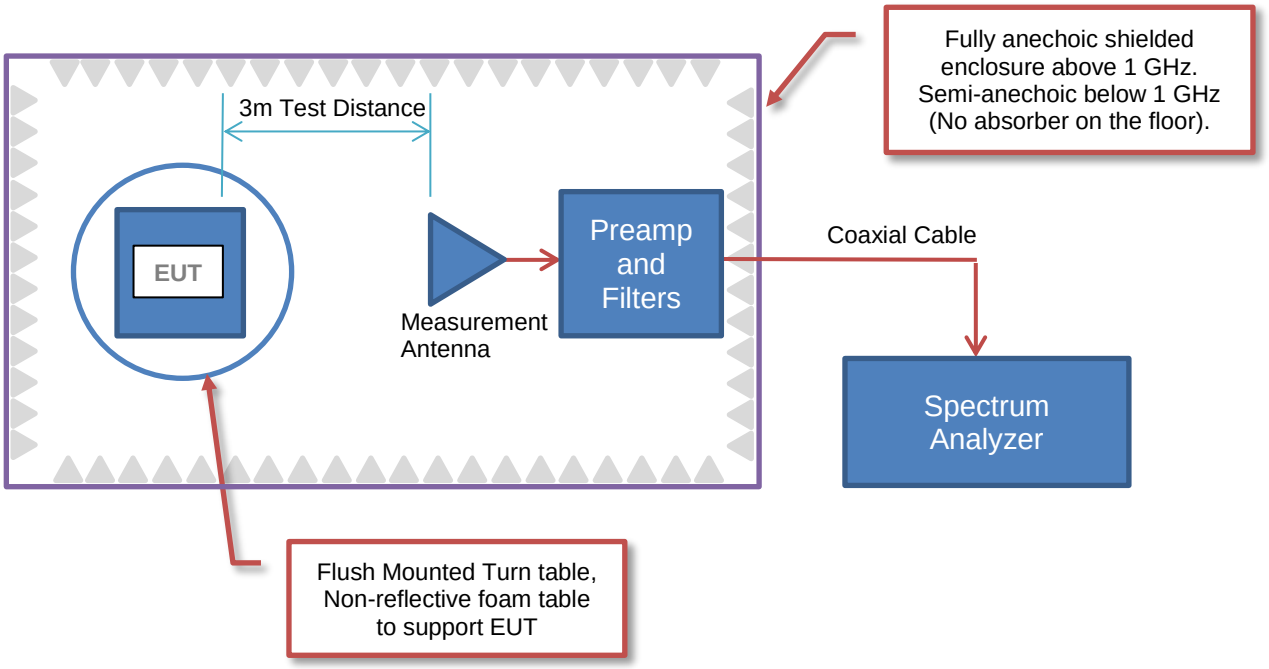


Sample Calculation (logarithmic units)

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

TEST SETUP BLOCK DIAGRAMS

Emissions Measurements



Sample Calculation (logarithmic units)

Radiated Emissions:

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

Conducted Emissions:

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

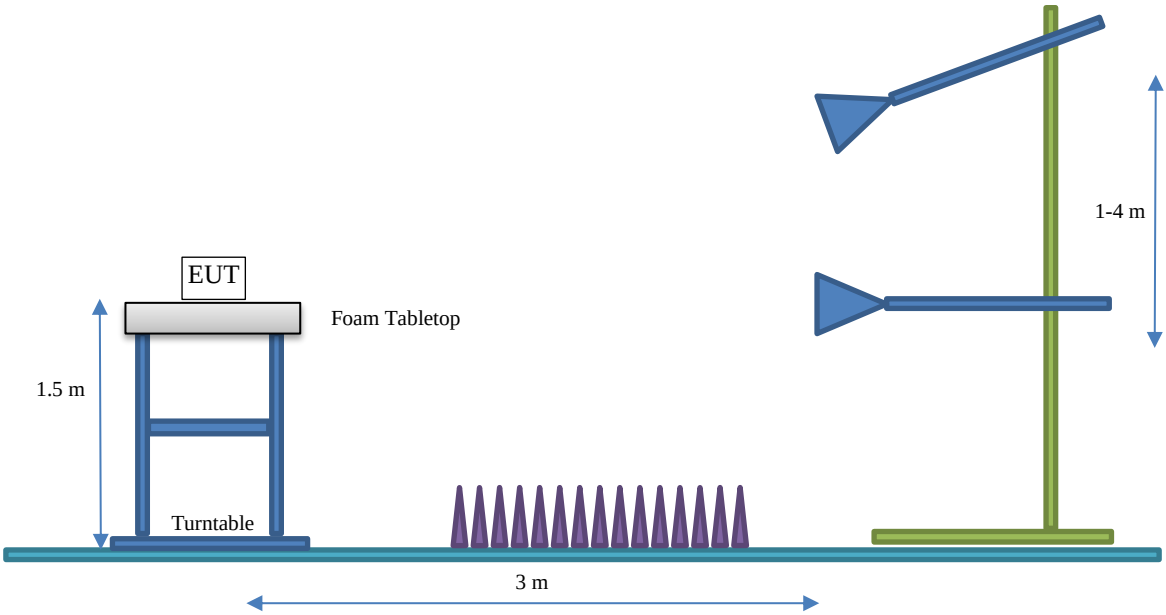
Radiated Power (ERP/EIRP) – Substitution Method:

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:	Glowforge Incorporated
Address:	1938 Occidental Avenue S Suite C
City, State, Zip:	Seattle, WA 98134
Test Requested By:	Nick Woolger
EUT:	GFD200
First Date of Test:	January 27, 2023
Last Date of Test:	April 18, 2023
Receipt Date of Samples:	January 27, 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:
3D Laser Printer with Bluetooth and Wi-Fi radios.

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)
PIFA	ProAnt	2400 – 2500	4.9

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:_____emitest-v0.9.4a_____
☐ Rated power settings

SETTINGS FOR ALL TESTS IN THIS REPORT

Modulation Types	Type	Channel	Position	Frequency (MHz)	Power Setting
DH5 GFSK	FHSS	0 or 1	Low Channel	2402	34
		39	Mid Channel	2440 or 2441	34
		78 or 79	High Channel	2480	34
2DH5 pi/4-DQPSK	FHSS	0 or 1	Low Channel	2402	34
		39	Mid Channel	2440 or 2441	34
		78 or 79	High Channel	2480	34
3DH5 8-DPSK	FHSS	0 or 1	Low Channel	2402	34
		39	Mid Channel	2440 or 2441	34
		78 or 79	High Channel	2480	34

CONFIGURATIONS

Configuration GLOW0038-1

Software/Firmware Running During Test	
Description	**Version**
Firmware provided by manufacturer	emitest-v0.9.4a

EUT			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
Laser Printer	Glowforge	GFD200	MB2-398

Remote Equipment Outside of Test Setup Boundary			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
Laptop	Dell	XPS	N/A
Manufactured interface board	Glowforge	GF-ECA-01595	N/A

Cables					
Cable Type	**Shield**	**Length (m)**	**Ferrite**	**Connection 1**	**Connection 2**
AC cable	None	3 m	None	EUT	AC power
USB-C-to-USB-C	None	1 m	None	Manufactured interface board	Laptop
White FFC cable	None	1 m	None	EUT	Manufactured interface board

Configuration GLOW0038-2

Software/Firmware Running During Test	
Description	**Version**
Firmware provided by manufacturer	emitest-v0.9.4a

EUT			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
Laser Printer	Glowforge	GFD200	XB2-839

Peripherals in Test Setup Boundary			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
Laptop	Dell	XPS	N/A
Manufactured interface board	Glowforge	GF-ECA-01595	N/A

Cables					
Cable Type	**Shield**	**Length (m)**	**Ferrite**	**Connection 1**	**Connection 2**
AC cable	None	3 m	None	EUT	AC power
USB-C-to-USB-C	None	1 m	None	Manufactured interface board	Laptop
White FFC cable	None	1 m	None	EUT	Manufactured interface board

MODIFICATIONS

Equipment Modifications

Item	Date	Test	Modification	Note	Disposition of EUT
1	2023-01-27	Duty Cycle	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	2023-01-27	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.
3	2023-01-27	Emissions Bandwidth (20 dB)	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	2023-01-27	Equivalent Isotropic Radiated Power	Tested as delivered to test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
5	2023-01-27	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.
6	2023-01-27	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	2023-01-27	Spurious Conducted Emissions	Tested as delivered to test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
8	2023-02-01	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.
9	2023-02-01	Dwell Time	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	2023-02-03	Powerline Conducted Emissions	Tested as delivered to test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
11	2023-02-08	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.
12	2023-02-08	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.
13	2023-04-18	Band Edge Compliance	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.2022.07.28.0
EmiR5 2022.07.06.0
PSA-ESCI 2022.08.23.0

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	Rohde & Schwarz	ESCI	ARE	2022-11-02	2023-11-02
LISN	Solar Electronics	9252-50-R-24-BNC	LIM	2022-07-05	2023-07-05
Cable - Conducted Cable Assembly	Northwest EMC	NC4, HHF, TYL	NC4A	2022-02-16	2023-02-16

MEASUREMENT UNCERTAINTY

Description		
Expanded k=2	3.1 dB	-3.1 dB

CONFIGURATIONS INVESTIGATED

GLOW0038-1

MODES INVESTIGATED

Transmitting Bluetooth classic. Channel 39 = 2441 MHz, DH5, power setting = 34

POWERLINE CONDUCTED EMISSIONS

element
WTD.2022.07.28.0
EmiR5 2022.07.06.0
PSA-ESCI 2022.08.23.0

EUT:	GFD200	Work Order:	GLOW0038
Serial Number:	MB2-398	Date:	2023-02-03
Customer:	Glowforge Incorporated	Temperature:	20.5°C
Attendees:	Jason Bluhm	Relative Humidity:	28.6%
Customer Project:	None	Bar. Pressure (PMSL):	1012 mb
Tested By:	Harry Zhao	Job Site:	NC05
Power:	120VAC/60Hz	Configuration:	GLOW0038-1

TEST SPECIFICATIONS

Specification: Equipment Class B	Method:
FCC 15.207:2023	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 #:	12	Line:	High Line	Add. Ext. Attenuation (dB):	0

COMMENTS

None

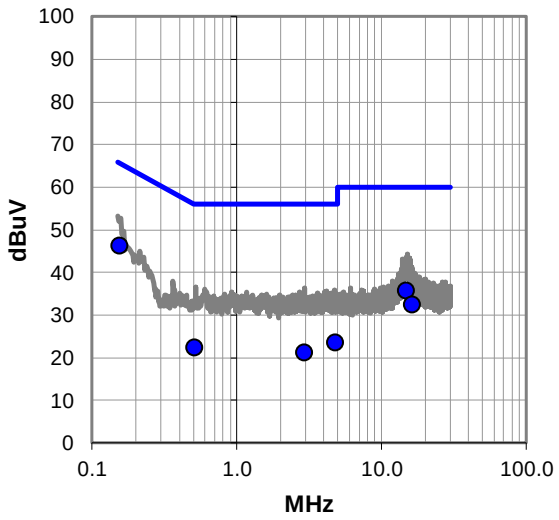
EUT OPERATING MODES

Transmitting Bluetooth classic. Channel 39 = 2441 MHz, DH5, power setting = 34

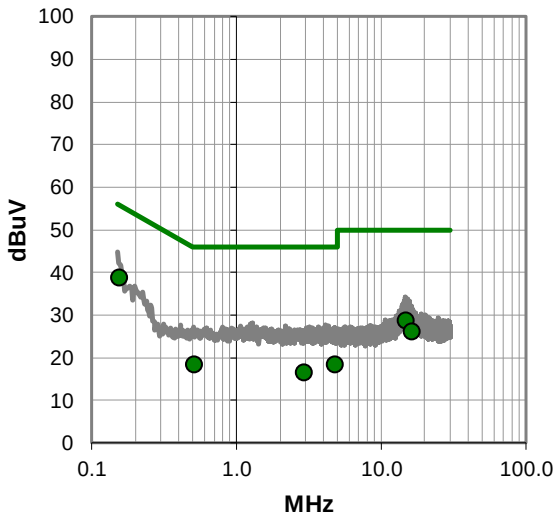
DEVIATIONS FROM TEST STANDARD

None

Quasi Peak Data - vs - Quasi Peak Limit



Average Data - vs - Average Limit



POWERLINE CONDUCTED EMISSIONS

element
WTD.2022.07.28.0
EmiR5 2022.07.06.0
PSA-ESCI 2022.08.23.0

RESULTS - Run #12

Quasi Peak Data - vs - Quasi Peak Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
0.155	25.5	20.8	46.3	65.7	-19.4
14.765	14.4	21.3	35.7	60.0	-24.3
16.225	11.2	21.4	32.6	60.0	-27.4
4.750	2.9	20.8	23.7	56.0	-32.3
0.511	2.0	20.5	22.5	56.0	-33.5
2.925	0.6	20.7	21.3	56.0	-34.7

Average Data - vs - Average Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
0.155	18.1	20.8	38.9	55.7	-16.8
14.765	7.5	21.3	28.8	50.0	-21.2
16.225	4.8	21.4	26.2	50.0	-23.8
0.511	-2.0	20.5	18.5	46.0	-27.5
4.750	-2.4	20.8	18.4	46.0	-27.6
2.925	-4.2	20.7	16.5	46.0	-29.5

CONCLUSION

Pass

Tested By

POWERLINE CONDUCTED EMISSIONS

element
WTD.2022.07.28.0
EmiR5 2022.07.06.0
PSA-ESCI 2022.08.23.0

EUT:	GFD200	Work Order:	GLOW0038
Serial Number:	MB2-398	Date:	2023-02-03
Customer:	Glowforge Incorporated	Temperature:	20.5°C
Attendees:	Jason Bluhm	Relative Humidity:	28.6%
Customer Project:	None	Bar. Pressure (PMSL):	1012 mb
Tested By:	Harry Zhao	Job Site:	NC05
Power:	120VAC/60Hz	Configuration:	GLOW0038-1

TEST SPECIFICATIONS

Specification: Equipment Class B	Method:
FCC 15.207:2023	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 #:	13	Line:	Neutral	Add. Ext. Attenuation (dB):	0

COMMENTS

None

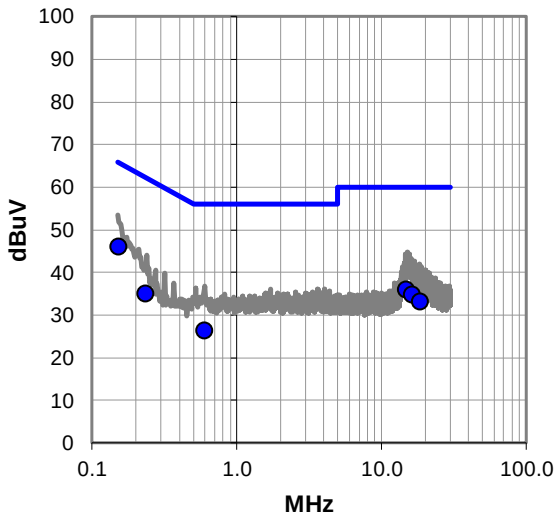
EUT OPERATING MODES

Transmitting Bluetooth classic. Channel 39 = 2441 MHz, DH5, power setting = 34

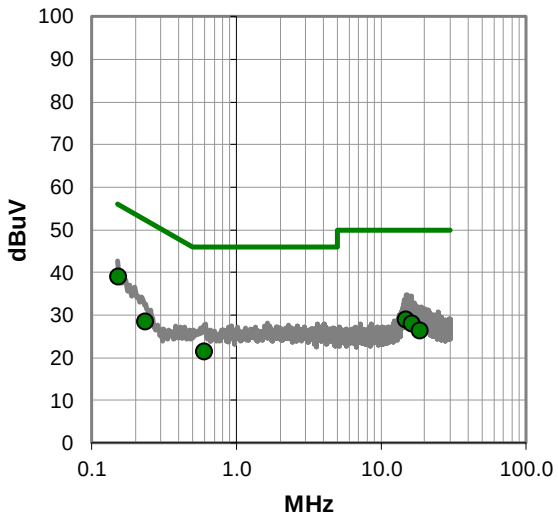
DEVIATIONS FROM TEST STANDARD

None

Quasi Peak Data - vs - Quasi Peak Limit



Average Data - vs - Average Limit



POWERLINE CONDUCTED EMISSIONS

element
WTD.2022.07.28.0
EmiR5 2022.07.06.0
PSA-ESCI 2022.08.23.0

RESULTS - Run #13

Quasi Peak Data - vs - Quasi Peak Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
0.153	25.3	20.8	46.1	65.9	-19.8
14.817	14.6	21.3	35.9	60.0	-24.1
16.214	13.5	21.4	34.9	60.0	-25.1
18.329	11.7	21.4	33.1	60.0	-26.9
0.232	14.5	20.5	35.0	62.4	-27.4
0.599	5.8	20.5	26.3	56.0	-29.7

Average Data - vs - Average Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
0.153	18.3	20.8	39.1	55.9	-16.8
14.817	7.7	21.3	29.0	50.0	-21.0
16.214	6.7	21.4	28.1	50.0	-21.9
18.329	5.0	21.4	26.4	50.0	-23.6
0.232	8.0	20.5	28.5	52.4	-23.9
0.599	0.9	20.5	21.4	46.0	-24.6

CONCLUSION

Pass

Tested By

SPURIOUS RADIATED EMISSIONS

element
WTD.2022.07.28.0
EmiR5 2022.07.06.0
PSA-ESCI 2022.08.23.0

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 (in no-hop, single channel mode) 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).

RMS measurements taken for a FHSS radio also may have a duty cycle correction subtracted using the formula 10*log(DC), where DC is the worst-case dwell time of the radio while in a hopping mode in a 100 ms period.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Antenna - Double Ridge	EMCO	3115	AHM	2022-07-13	2024-07-13
Cable	Northwest EMC	3115 Horn Cable	NC2	2022-04-14	2023-04-14
Amplifier - Pre-Amplifier	Miteq	AMF-3D-00100800-32-13P	AVZ	2022-04-14	2023-04-14
Analyzer - Spectrum Analyzer	Agilent	E4446A	AAT	2022-11-03	2023-11-03
Antenna - Standard Gain	EMCO	3160-07	AHP	NCR	NCR
Cable	High Speed Interconnects	EW292A-NGNG-300	NC3	2022-08-30	2023-08-30
Amplifier - Pre-Amplifier	Miteq	AMF-6F-08001200-30-10P	AOK	2022-08-04	2023-08-04
Antenna - Standard Gain	EMCO	3160-08	AHO	NCR	NCR
Amplifier - Pre-Amplifier	Miteq	AMF-6F-12001800-30-10P	AOJ	2022-08-04	2023-08-04
Antenna - Standard Gain	ETS Lindgren	3160-09	AIY	NCR	NCR
Cable	Northwest EMC	N/A	NC8	2022-03-21	2023-03-21
Amplifier - Pre-Amplifier	Miteq	AMF-6F-18002650-25-10P	AOD	2022-03-21	2023-03-21
Filter - Low Pass	Micro-Tronics	LPM50004	LFF	2022-11-01	2023-11-01
Antenna - Biconilog	Teseq	CBL 6141B	AYL	2021-10-05	2023-10-05
Cable	Northwest EMC	Bilog Cables	NC1	2023-01-29	2024-01-29
Amplifier - Pre-Amplifier	Miteq	AM-1616-1000	PAB	2023-01-29	2024-01-29
Filter - High Pass	Micro-Tronics	HPM50111	HHI	2022-10-03	2023-10-03
Attenuator	Fairview Microwave	SA18E-20	AQV	2022-07-28	2023-07-28

SPURIOUS RADIATED EMISSIONS

element
WTD.2022.07.28.0
EmiR5 2022.07.06.0
PSA-ESCI 2022.08.23.0

MEASUREMENT UNCERTAINTY

Description		
Expanded k=2	5.2 dB	-5.2 dB

FREQUENCY RANGE INVESTIGATED

30 MHz TO 26.5 GHz

POWER INVESTIGATED

120VAC/60Hz

CONFIGURATIONS INVESTIGATED

GLOW0038-1

MODES INVESTIGATED

Transmitting BT classic. Channel 0 = 2402 MHz, Channel 39 = 2441 MHz, Channel 78 = 2480 MHz, power setting (34)

SPURIOUS RADIATED EMISSIONS

element
WTD.2022.07.28.0
EmiR5 2022.07.06.0
PSA-ESCI 2022.08.23.0

EUT:	GFD200	Work Order:	GLOW0038
Serial Number:	MB2-398	Date:	2023-01-26
Customer:	Glowforge Incorporated	Temperature:	20.7°C
Attendees:	Jason Bluhm	Relative Humidity:	37.7%
Customer Project:	None	Bar. Pressure (PMSL):	1037 mb
Tested By:	Harry Zhao	Job Site:	NC01
Power:	120VAC/60Hz	Configuration:	GLOW0038-1

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

COMMENTS

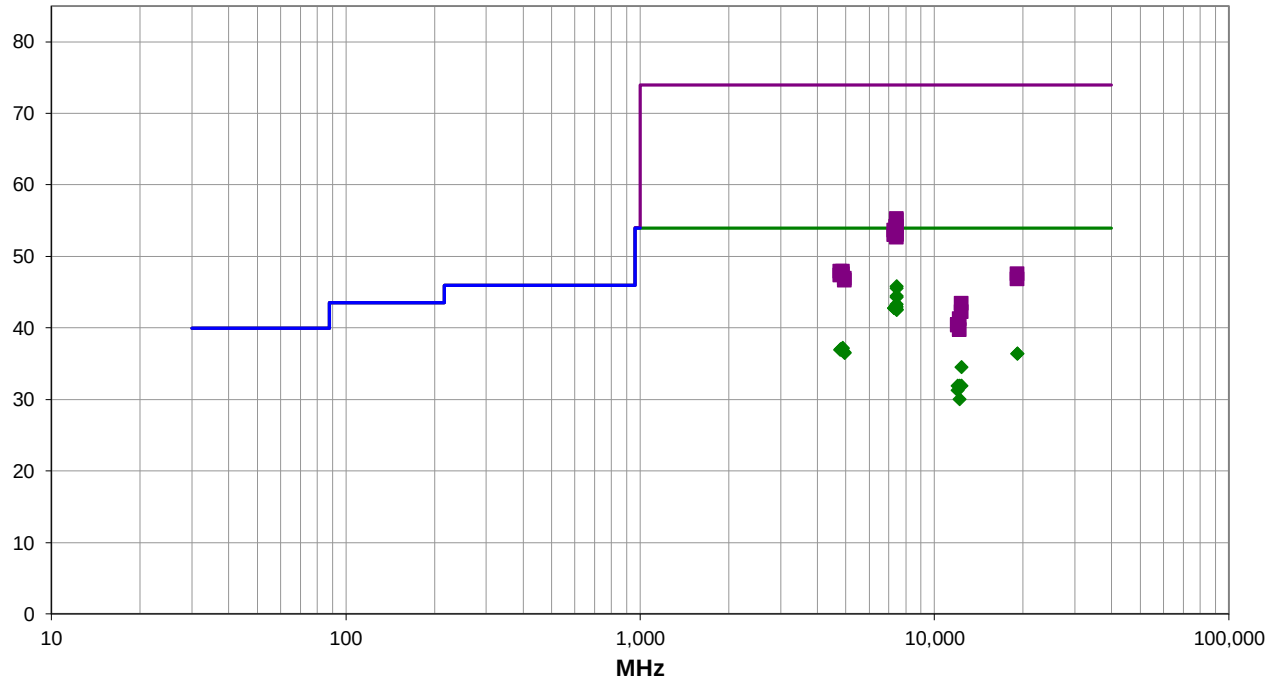
The test mode operates at 93.7% duty cycle (DC), an upward duty cycle correction factor(DCCF) of 10*log(1/0.937) = 0.2826 dB was applied to average measurements. See data comments for EUT orientations, channel and data rate

EUT OPERATING MODES

Transmitting BT classic. Channel 0 = 2402 MHz, Channel 39 = 2441 MHz, Channel 78 = 2480 MHz, power setting (34)

DEVIATIONS FROM TEST STANDARD

None



Run #: 31 PK AV QP

SPURIOUS RADIATED EMISSIONS

element
WTD.2022.07.28.0
EmiR5 2022.07.06.0
PSA-ESCI 2022.08.23.0

RESULTS - Run #31

Freq (MHz)	Amplitude (dBuV)	Factor (dB/m)	Antenna Height (meters)	Azimuth (degrees)	Duty Cycle Correction Factor	External Attenuation (dB)	Polarity/ Transducer	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)	Comments
7440.017	30.4	15.1	1.3	125.0	0.3	0.0	Vert	AV	0.0	45.8	54.0	-8.2	Ch. 78, EUT Horizontal, DH5
7440.050	30.1	15.1	3.8	121.0	0.3	0.0	Horz	AV	0.0	45.5	54.0	-8.5	Ch. 78, EUT lying on side, DH5
7440.133	29.1	15.1	3.8	121.0	0.3	0.0	Horz	AV	0.0	44.5	54.0	-9.5	Ch. 78, EUT lying on side, 2DH5
7440.092	28.9	15.1	3.8	121.0	0.3	0.0	Horz	AV	0.0	44.3	54.0	-9.7	Ch. 78, EUT lying on side, 3DH5
7439.992	27.9	15.1	2.0	360.0	0.3	0.0	Vert	AV	0.0	43.3	54.0	-10.7	Ch. 78, EUT front facing down, DH5
7439.600	27.7	15.1	1.3	98.0	0.3	0.0	Horz	AV	0.0	43.1	54.0	-10.9	Ch. 78, EUT Horizontal, DH5
7440.008	27.5	15.1	1.3	179.0	0.3	0.0	Vert	AV	0.0	42.9	54.0	-11.1	Ch. 78, EUT lying on side, DH5
7323.092	28.0	14.5	1.5	359.0	0.3	0.0	Vert	AV	0.0	42.8	54.0	-11.2	Ch. 39, EUT front facing down, DH5
7322.567	28.0	14.5	1.6	234.0	0.3	0.0	Horz	AV	0.0	42.8	54.0	-11.2	Ch. 39, EUT lying on side, DH5
7440.200	27.2	15.1	1.7	236.0	0.3	0.0	Horz	AV	0.0	42.6	54.0	-11.4	Ch. 78, EUT Horizontal, DH5
7440.283	27.2	15.1	1.5	295.0	0.3	0.0	Vert	AV	0.0	42.6	54.0	-11.4	Ch. 78, EUT Horizontal, DH5
7441.792	27.1	15.1	1.5	21.0	0.3	0.0	Horz	AV	0.0	42.5	54.0	-11.5	Ch. 78, EUT front facing down, DH5
4880.792	26.8	10.1	1.5	42.0	0.3	0.0	Horz	AV	0.0	37.2	54.0	-16.8	Ch. 39, EUT lying on side, DH5
4881.092	26.7	10.1	1.5	163.0	0.3	0.0	Vert	AV	0.0	37.1	54.0	-16.9	Ch. 39, EUT front facing down, DH5
4806.367	27.0	9.7	1.4	195.0	0.3	0.0	Horz	AV	0.0	37.0	54.0	-17.0	Ch. 0, EUT lying on side, DH5
4801.842	26.9	9.7	3.9	246.0	0.3	0.0	Vert	AV	0.0	36.9	54.0	-17.1	Ch. 0, EUT front facing down, DH5
4957.633	26.3	10.0	2.2	14.0	0.3	0.0	Horz	AV	0.0	36.6	54.0	-17.4	Ch. 78, EUT lying on side, DH5
4959.700	26.2	10.0	1.5	153.0	0.3	0.0	Vert	AV	0.0	36.5	54.0	-17.5	Ch. 78, EUT front facing down, DH5
19215.620	35.8	0.3	1.5	93.0	0.3	0.0	Horz	AV	0.0	36.4	54.0	-17.6	Ch. 0, EUT lying on side, DH5
19215.090	35.8	0.3	1.5	48.0	0.3	0.0	Vert	AV	0.0	36.4	54.0	-17.6	Ch. 0, EUT front facing down, DH5
7440.033	40.1	15.1	1.3	125.0	0.0	0.0	Vert	PK	0.0	55.2	74.0	-18.8	Ch. 78, EUT Horizontal, DH5
7440.333	39.9	15.1	3.8	121.0	0.0	0.0	Horz	PK	0.0	55.0	74.0	-19.0	Ch. 78, EUT lying on side, DH5
12399.400	36.6	-2.4	4.0	140.0	0.3	0.0	Vert	AV	0.0	34.5	54.0	-19.5	Ch. 78, EUT front facing down, DH5
7439.742	39.0	15.1	3.8	121.0	0.0	0.0	Horz	PK	0.0	54.1	74.0	-19.9	Ch. 78, EUT lying on side, 2DH5
7440.350	39.0	15.1	3.8	121.0	0.0	0.0	Horz	PK	0.0	54.1	74.0	-19.9	Ch. 78, EUT lying on side, 3DH5
7324.508	39.1	14.5	1.6	234.0	0.0	0.0	Horz	PK	0.0	53.6	74.0	-20.4	Ch. 39, EUT lying on side, DH5
7439.600	38.2	15.1	1.3	98.0	0.0	0.0	Horz	PK	0.0	53.3	74.0	-20.7	Ch. 78, EUT Horizontal, DH5
7439.025	38.2	15.1	1.5	295.0	0.0	0.0	Vert	PK	0.0	53.3	74.0	-20.7	Ch. 78, EUT Horizontal, DH5
7442.483	38.0	15.1	2.0	360.0	0.0	0.0	Vert	PK	0.0	53.1	74.0	-20.9	Ch. 78, EUT front facing down, DH5
7438.158	37.9	15.1	1.5	21.0	0.0	0.0	Horz	PK	0.0	53.0	74.0	-21.0	Ch. 78, EUT front facing down, DH5
7441.192	37.9	15.1	1.3	179.0	0.0	0.0	Vert	PK	0.0	53.0	74.0	-21.0	Ch. 78, EUT lying on side, DH5
7324.125	38.5	14.5	1.5	359.0	0.0	0.0	Vert	PK	0.0	53.0	74.0	-21.0	Ch. 39, EUT front facing down, DH5
7440.992	37.5	15.1	1.7	236.0	0.0	0.0	Horz	PK	0.0	52.6	74.0	-21.4	Ch. 78, EUT Horizontal, DH5
12010.780	34.3	-2.7	3.8	157.0	0.3	0.0	Vert	AV	0.0	31.9	54.0	-22.1	Ch. 0, EUT front facing down, DH5
12399.480	34.0	-2.4	1.5	227.0	0.3	0.0	Horz	AV	0.0	31.9	54.0	-22.1	Ch. 78, EUT lying on side, DH5
12205.890	33.7	-2.1	1.0	222.0	0.3	0.0	Horz	AV	0.0	31.9	54.0	-22.1	Ch. 39, EUT lying on side, DH5
12010.740	33.7	-2.7	1.5	318.0	0.3	0.0	Horz	AV	0.0	31.3	54.0	-22.7	Ch. 0, EUT lying on side, DH5
12204.530	31.8	-2.1	1.5	204.0	0.3	0.0	Vert	AV	0.0	30.0	54.0	-24.0	Ch. 39, EUT front facing down, DH5
4883.967	37.8	10.1	1.5	163.0	0.0	0.0	Vert	PK	0.0	47.9	74.0	-26.1	Ch. 39, EUT front facing down, DH5
4803.850	38.2	9.7	1.4	195.0	0.0	0.0	Horz	PK	0.0	47.9	74.0	-26.1	Ch. 0, EUT lying on side, DH5
4882.117	37.4	10.1	1.5	42.0	0.0	0.0	Horz	PK	0.0	47.5	74.0	-26.5	Ch. 39, EUT lying on side, DH5
19215.860	47.2	0.3	1.5	93.0	0.0	0.0	Horz	PK	0.0	47.5	74.0	-26.5	Ch. 0, EUT lying on side, DH5

SPURIOUS RADIATED EMISSIONS

element
WTD.2022.07.28.0
EmiR5 2022.07.06.0
PSA-ESCI 2022.08.23.0

Freq (MHz)	Amplitude (dBuV)	Factor (dB/m)	Antenna Height (meters)	Azimuth (degrees)	Duty Cycle Correction Factor	External Attenuation (dB)	Polarity/ Transducer	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)	Comments
4801.867	37.6	9.7	3.9	246.0	0.0	0.0	Vert	PK	0.0	47.3	74.0	-26.7	Ch. 0, EUT front facing down, DH5
4960.608	36.9	10.0	2.2	14.0	0.0	0.0	Horz	PK	0.0	46.9	74.0	-27.1	Ch. 78, EUT lying on side, DH5
19216.620	46.5	0.3	1.5	48.0	0.0	0.0	Vert	PK	0.0	46.8	74.0	-27.2	Ch. 0, EUT front facing down, DH5
4957.583	36.6	10.0	1.5	153.0	0.0	0.0	Vert	PK	0.0	46.6	74.0	-27.4	Ch. 78, EUT front facing down, DH5
12399.330	45.8	-2.4	4.0	140.0	0.0	0.0	Vert	PK	0.0	43.4	74.0	-30.6	Ch. 78, EUT front facing down, DH5
12399.630	44.6	-2.4	1.5	227.0	0.0	0.0	Horz	PK	0.0	42.2	74.0	-31.8	Ch. 78, EUT lying on side, DH5
12206.160	43.3	-2.1	1.0	222.0	0.0	0.0	Horz	PK	0.0	41.2	74.0	-32.8	Ch. 39, EUT lying on side, DH5
12010.730	43.1	-2.7	1.5	318.0	0.0	0.0	Horz	PK	0.0	40.4	74.0	-33.6	Ch. 0, EUT lying on side, DH5
12009.380	43.0	-2.7	3.8	157.0	0.0	0.0	Vert	PK	0.0	40.3	74.0	-33.7	Ch. 0, EUT front facing down, DH5
12205.770	41.8	-2.1	1.5	204.0	0.0	0.0	Vert	PK	0.0	39.7	74.0	-34.3	Ch. 39, EUT front facing down, DH5

CONCLUSION

Pass

Tested By

SPURIOUS RADIATED EMISSIONS

element
WTD.2022.07.28.0
EmiR5 2022.07.06.0
PSA-ESCI 2022.08.23.0

EUT:	GFD200	Work Order:	GLOW0038
Serial Number:	MB2-398	Date:	2023-01-27
Customer:	Glowforge Incorporated	Temperature:	20.5°C
Attendees:	Jason Bluhm	Relative Humidity:	41.3%
Customer Project:	None	Bar. Pressure (PMSL):	1024 mb
Tested By:	Harry Zhao	Job Site:	NC01
Power:	120VAC/60Hz	Configuration:	GLOW0038-1

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

COMMENTS

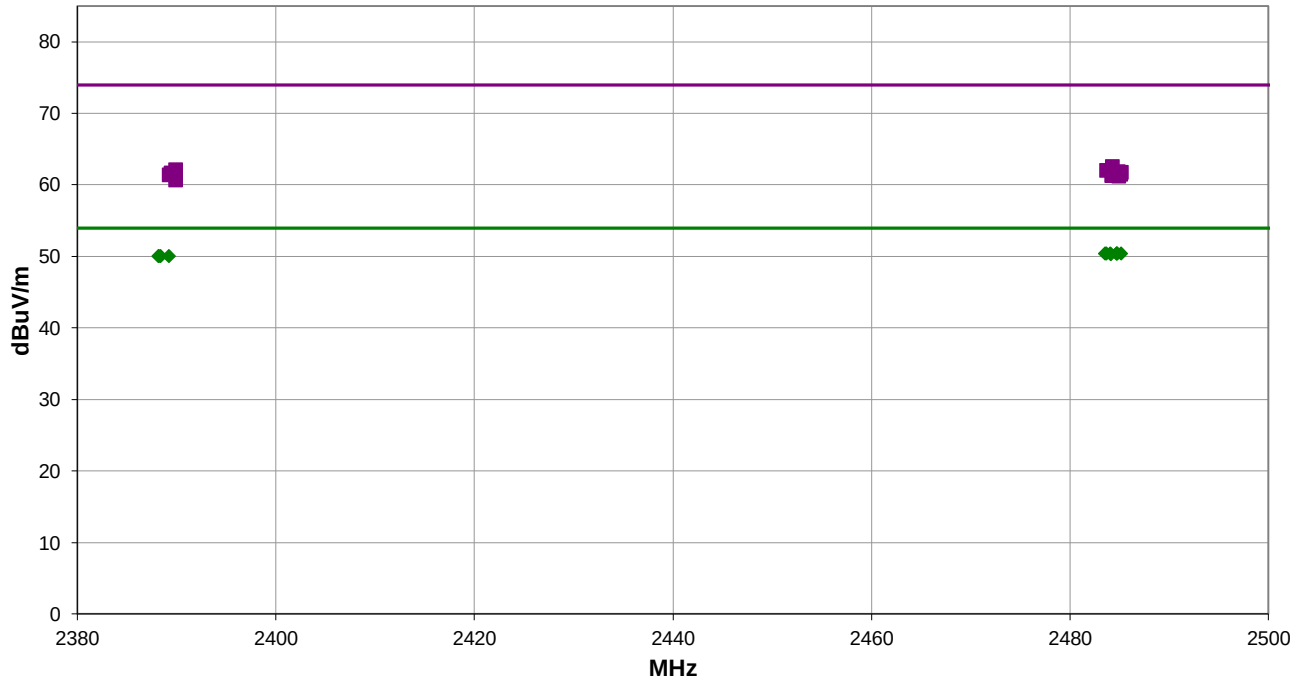
All measurements are noise floor; no duty cycle correction factor applied to the average measurement.See data comments for EUT orientations, channel and data rate

EUT OPERATING MODES

Transmitting BT classic. Channel 0 = 2402 MHz, Channel 39 = 2441 MHz, Channel 78 = 2480 MHz, power setting (34)

DEVIATIONS FROM TEST STANDARD

None



Run #: 37 ■ PK ◆ AV ● QP

SPURIOUS RADIATED EMISSIONS

element
WTD.2022.07.28.0
EmiR5 2022.07.06.0
PSA-ESCI 2022.08.23.0

RESULTS - Run #37

Freq (MHz)	Amplitude (dBuV)	Factor (dB/m)	Antenna Height (meters)	Azimuth (degrees)	Test Distance (meters)	External Attenuation (dB)	Polarity/ Transducer	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)	Comments
2484.743	29.2	1.2	1.5	36.0	3.0	20.0	Horz	AV	0.0	50.4	54.0	-3.6	Ch. 78, EUT lying on side, DH5
2483.717	29.2	1.2	1.5	286.0	3.0	20.0	Horz	AV	0.0	50.4	54.0	-3.6	Ch. 78, EUT front facing down, DH5
2483.553	29.2	1.2	1.5	306.0	3.0	20.0	Vert	AV	0.0	50.4	54.0	-3.6	Ch. 78, EUT front facing down, DH5
2484.050	29.2	1.2	1.5	328.0	3.0	20.0	Horz	AV	0.0	50.4	54.0	-3.6	Ch. 78, EUT Horizontal, DH5
2485.173	29.2	1.2	1.5	151.0	3.0	20.0	Vert	AV	0.0	50.4	54.0	-3.6	Ch. 78, EUT Horizontal, DH5
2484.733	29.2	1.2	1.5	36.0	3.0	20.0	Horz	AV	0.0	50.4	54.0	-3.6	Ch. 78, EUT lying on side, 2DH5
2484.803	29.2	1.2	1.5	36.0	3.0	20.0	Horz	AV	0.0	50.4	54.0	-3.6	Ch. 78, EUT lying on side, 3DH5
2484.153	29.1	1.2	1.5	231.0	3.0	20.0	Vert	AV	0.0	50.3	54.0	-3.7	Ch. 78, EUT lying on side, DH5
2389.223	29.0	1.0	1.5	49.0	3.0	20.0	Horz	AV	0.0	50.0	54.0	-4.0	Ch. 0, EUT lying on side, DH5
2388.407	29.0	1.0	1.5	256.0	3.0	20.0	Vert	AV	0.0	50.0	54.0	-4.0	Ch. 0, EUT lying on side, DH5
2388.183	29.0	1.0	1.5	256.0	3.0	20.0	Vert	AV	0.0	50.0	54.0	-4.0	Ch. 0, EUT lying on side, 2DH5
2388.173	29.0	1.0	1.5	256.0	3.0	20.0	Vert	AV	0.0	50.0	54.0	-4.0	Ch. 0, EUT lying on side, 3DH5
2484.363	41.3	1.2	1.5	286.0	3.0	20.0	Horz	PK	0.0	62.5	74.0	-11.5	Ch. 78, EUT front facing down, DH5
2389.960	41.0	1.0	1.5	256.0	3.0	20.0	Vert	PK	0.0	62.0	74.0	-12.0	Ch. 0, EUT lying on side, 3DH5
2483.740	40.7	1.2	1.5	36.0	3.0	20.0	Horz	PK	0.0	61.9	74.0	-12.1	Ch. 78, EUT lying on side, 2DH5
2484.953	40.6	1.2	1.5	36.0	3.0	20.0	Horz	PK	0.0	61.8	74.0	-12.2	Ch. 78, EUT lying on side, DH5
2485.273	40.5	1.2	1.5	328.0	3.0	20.0	Horz	PK	0.0	61.7	74.0	-12.3	Ch. 78, EUT Horizontal, DH5
2389.467	40.6	1.0	1.5	256.0	3.0	20.0	Vert	PK	0.0	61.6	74.0	-12.4	Ch. 0, EUT lying on side, DH5
2485.160	40.2	1.2	1.5	231.0	3.0	20.0	Vert	PK	0.0	61.4	74.0	-12.6	Ch. 78, EUT lying on side, DH5
2484.767	40.2	1.2	1.5	36.0	3.0	20.0	Horz	PK	0.0	61.4	74.0	-12.6	Ch. 78, EUT lying on side, 3DH5
2389.273	40.3	1.0	1.5	256.0	3.0	20.0	Vert	PK	0.0	61.3	74.0	-12.7	Ch. 0, EUT lying on side, 2DH5
2484.270	40.0	1.2	1.5	151.0	3.0	20.0	Vert	PK	0.0	61.2	74.0	-12.8	Ch. 78, EUT Horizontal, DH5
2485.013	39.9	1.2	1.5	306.0	3.0	20.0	Vert	PK	0.0	61.1	74.0	-12.9	Ch. 78, EUT front facing down, DH5
2389.967	39.6	1.0	1.5	49.0	3.0	20.0	Horz	PK	0.0	60.6	74.0	-13.4	Ch. 0, EUT lying on side, DH5

CONCLUSION

Pass

Tested By

DUTY CYCLE

XMit 2022.02.07.0

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

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Attenuator	S.M. Electronics	SA18H-20	REK	2022-02-15	2023-02-15
Analyzer - Spectrum Analyzer	Agilent	E4440A	AAX	2023-01-19	2024-01-19
Cable	Micro-Coax	UFD150A-1-0720-200200	NCW	2023-01-18	2024-01-18
Block - DC	Weinschel Corp.	7006	AMS	2023-01-18	2024-01-18
Generator - Signal	Agilent	N5183A	TIA	2022-06-25	2024-06-25

TEST DESCRIPTION

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

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

If the transmit duty cycle < 98 percent, burst gating may have been used during some of the other tests in this report to only take the measurement during the burst duration.

DUTY CYCLE

element

TbtTx 2022.06.03.0 XMit 2022.02.07.0

EUT:	**GFD200**			**Work Order:**	**GLOW0038**
Serial Number:	**XB2-839**			**Date:**	**27-Jan-23**
Customer:	**Glowforge Incorporated**			**Temperature:**	**20.9 °C**
Attendees:	**Jason Bluhm**			**Humidity:**	**38.8% RH**
Project:	**None**			**Barometric Pres.:**	**1029 mbar**
Tested by:	**Harry Zhao**	**Power:**	**120VAC/60Hz**	**Job Site:**	**NC06**

TEST SPECIFICATIONS	**Test 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 offset connection between EUT and Spectrum analyzer: DC Block + 20 dB attenuator + measurement cable + patched coax cable = 22.63 dB.

DEVIATIONS FROM TEST STANDARD

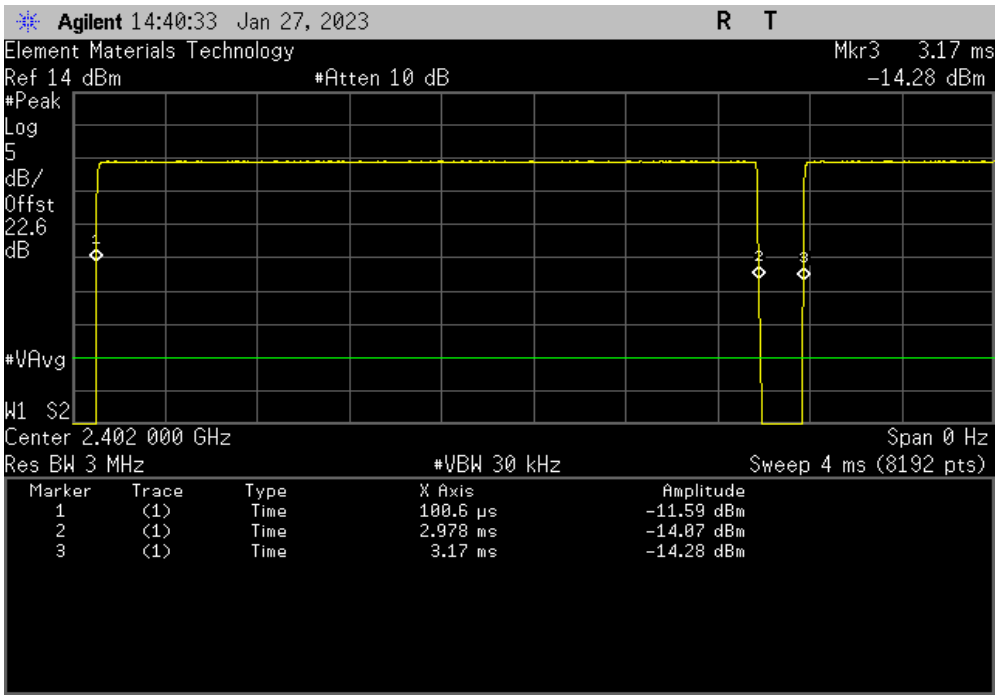
None

Configuration #	**2**	*Signature*

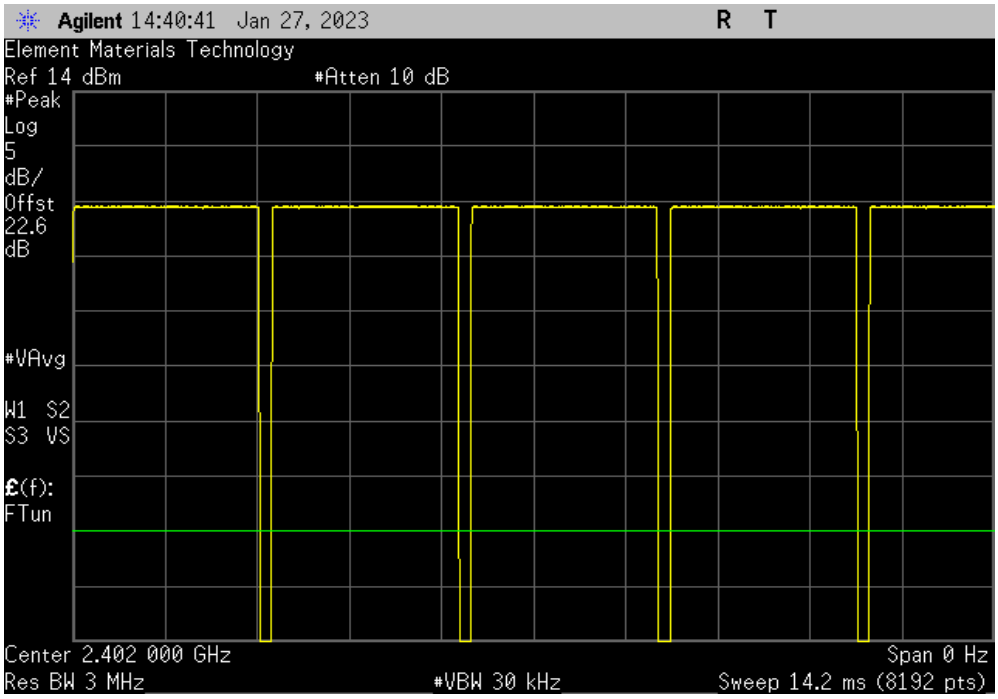
		Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
DH5, GFSK							
	Low Channel	2.878 ms	3.07 ms	1	93.7	N/A	N/A
	Low Channel	N/A	N/A	5	N/A	N/A	N/A
	Mid Channel	2.878 ms	3.07 ms	1	93.7	N/A	N/A
	Mid Channel	N/A	N/A	5	N/A	N/A	N/A
	High Channel	2.878 ms	3.07 ms	1	93.7	N/A	N/A
	High Channel	N/A	N/A	5	N/A	N/A	N/A
2DH5, pi/4-DQPSK							
	Low Channel	2.889 ms	3.083 ms	1	93.7	N/A	N/A
	Low Channel	N/A	N/A	5	N/A	N/A	N/A
	Mid Channel	2.889 ms	3.083 ms	1	93.7	N/A	N/A
	Mid Channel	N/A	N/A	5	N/A	N/A	N/A
	High Channel	2.889 ms	3.083 ms	1	93.7	N/A	N/A
	High Channel	N/A	N/A	5	N/A	N/A	N/A
3DH5, 8-DPSK							
	Low Channel	2.892 ms	3.087 ms	1	93.7	N/A	N/A
	Low Channel	N/A	N/A	5	N/A	N/A	N/A
	Mid Channel	2.892 ms	3.087 ms	1	93.7	N/A	N/A
	Mid Channel	N/A	N/A	5	N/A	N/A	N/A
	High Channel	2.892 ms	3.087 ms	1	93.7	N/A	N/A
	High Channel	N/A	N/A	5	N/A	N/A	N/A

DUTY CYCLE

DH5, GFSK, Low Channel						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	2.878 ms	3.07 ms	1	93.7	N/A	N/A

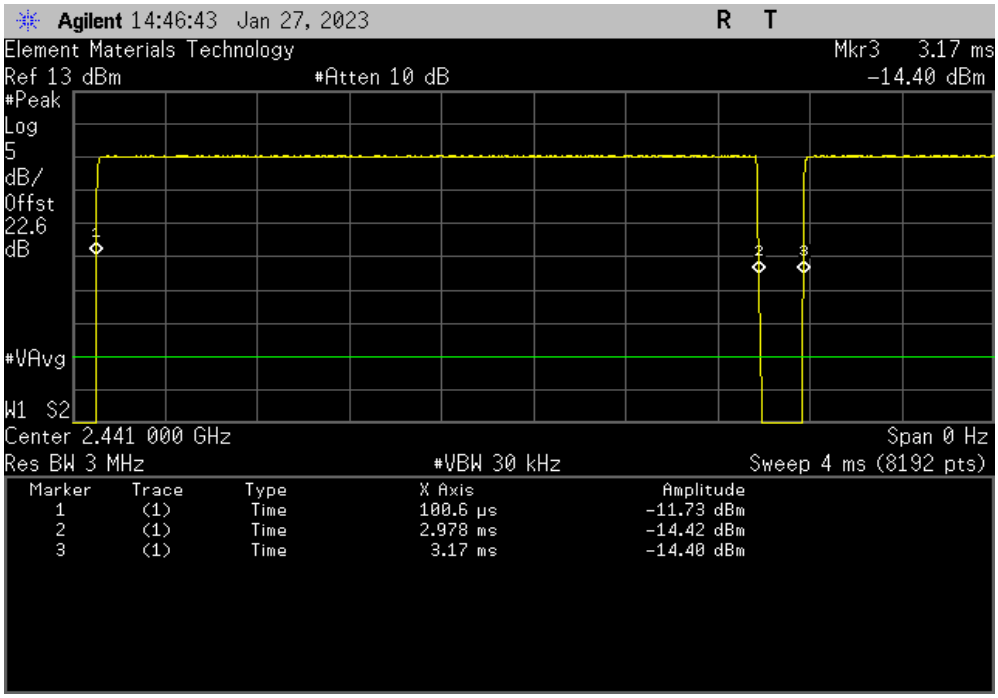


DH5, GFSK, Low Channel						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	N/A	N/A	5	N/A	N/A	N/A

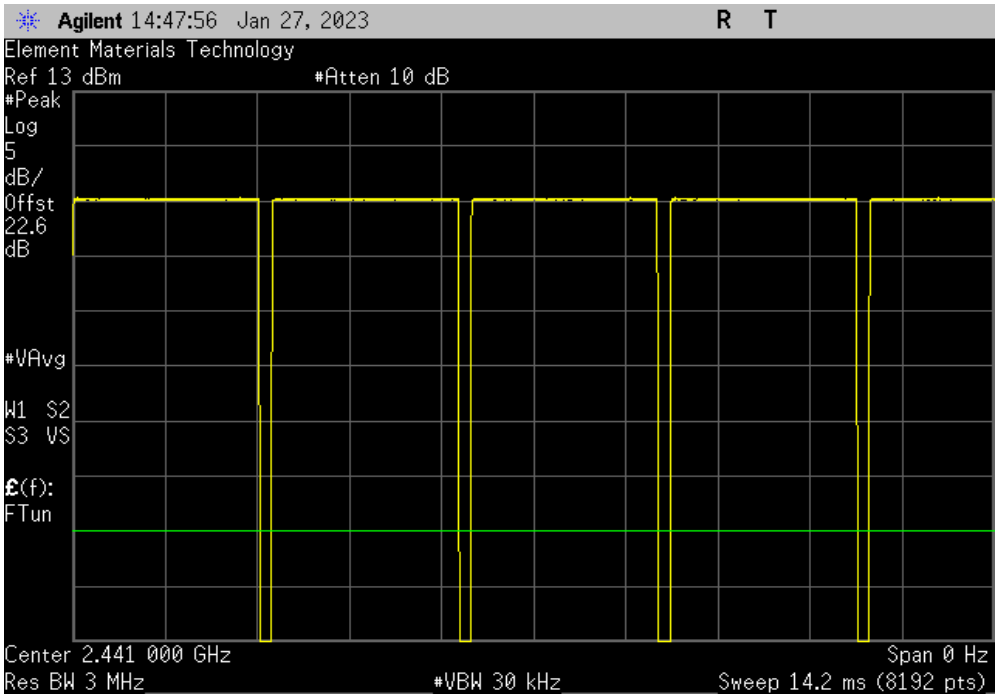


DUTY CYCLE

DH5, GFSK, Mid Channel						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	2.878 ms	3.07 ms	1	93.7	N/A	N/A

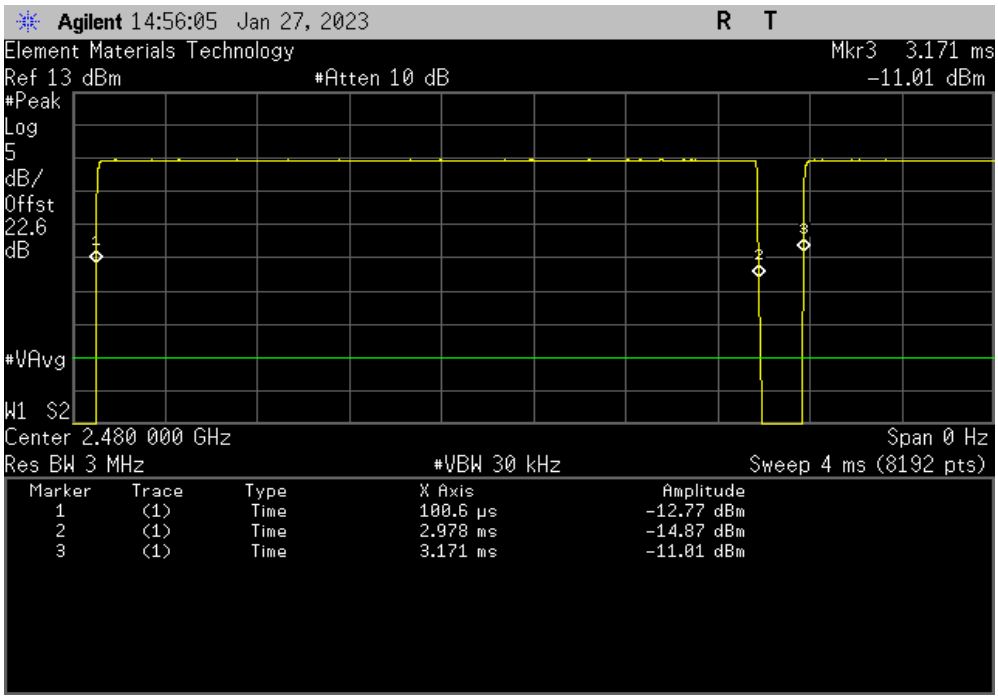


DH5, GFSK, Mid Channel						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	N/A	N/A	5	N/A	N/A	N/A

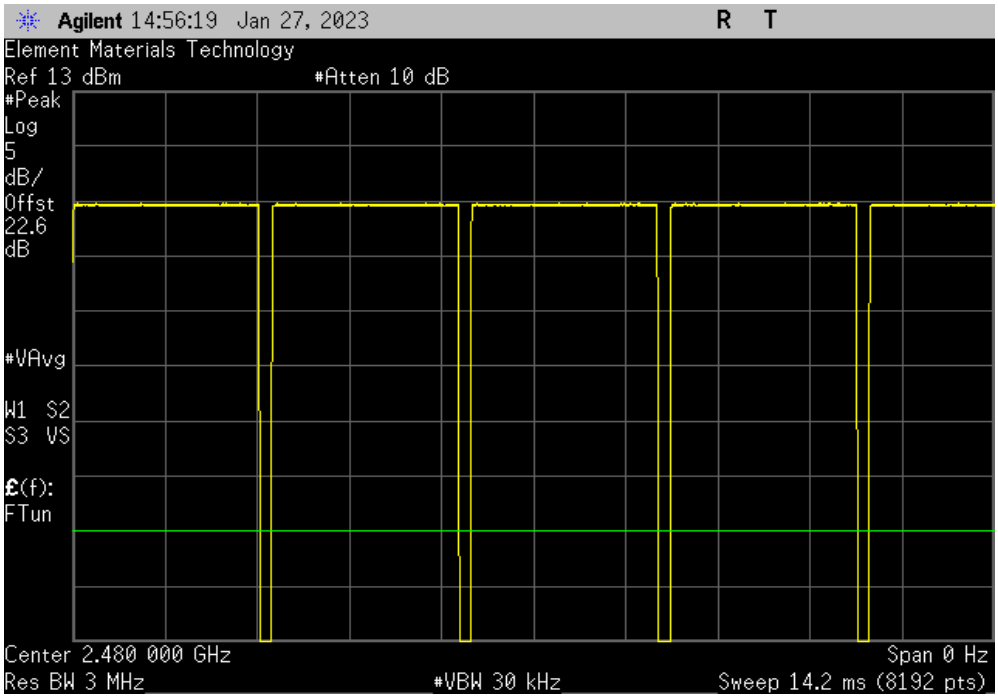


DUTY CYCLE

DH5, GFSK, High Channel						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	2.878 ms	3.07 ms	1	93.7	N/A	N/A

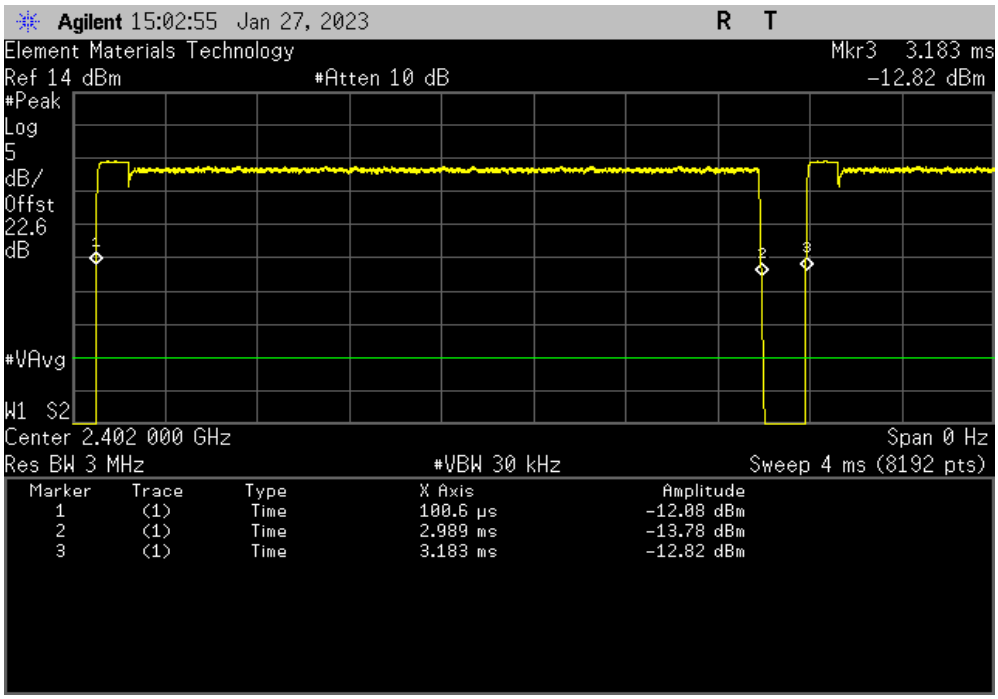


DH5, GFSK, High Channel						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	N/A	N/A	5	N/A	N/A	N/A

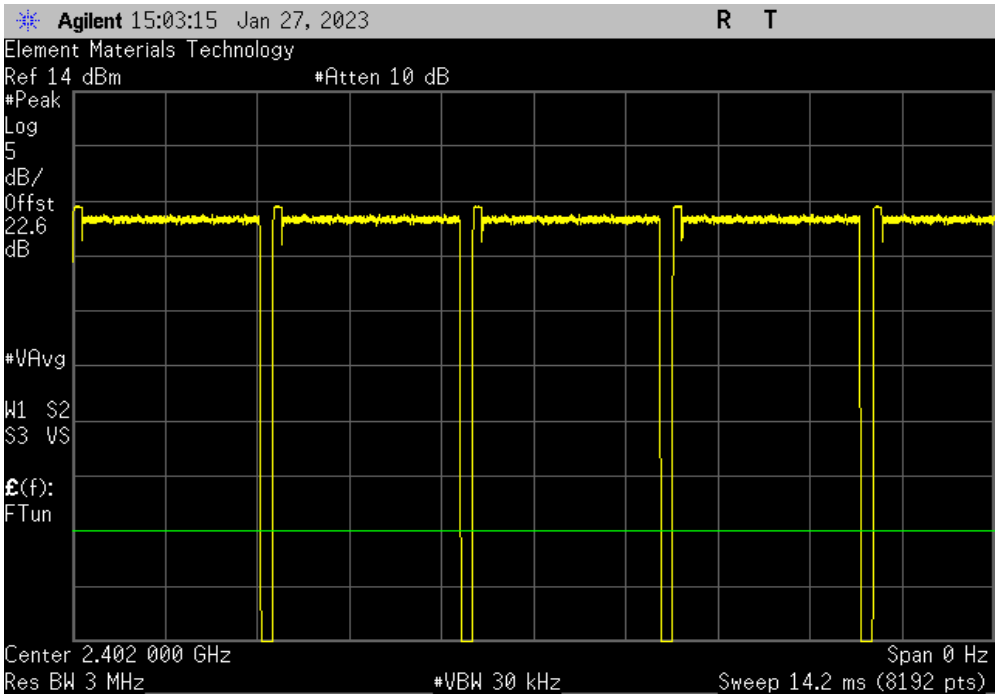


DUTY CYCLE

2DH5, pi/4-DQPSK, Low Channel						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	2.889 ms	3.083 ms	1	93.7	N/A	N/A

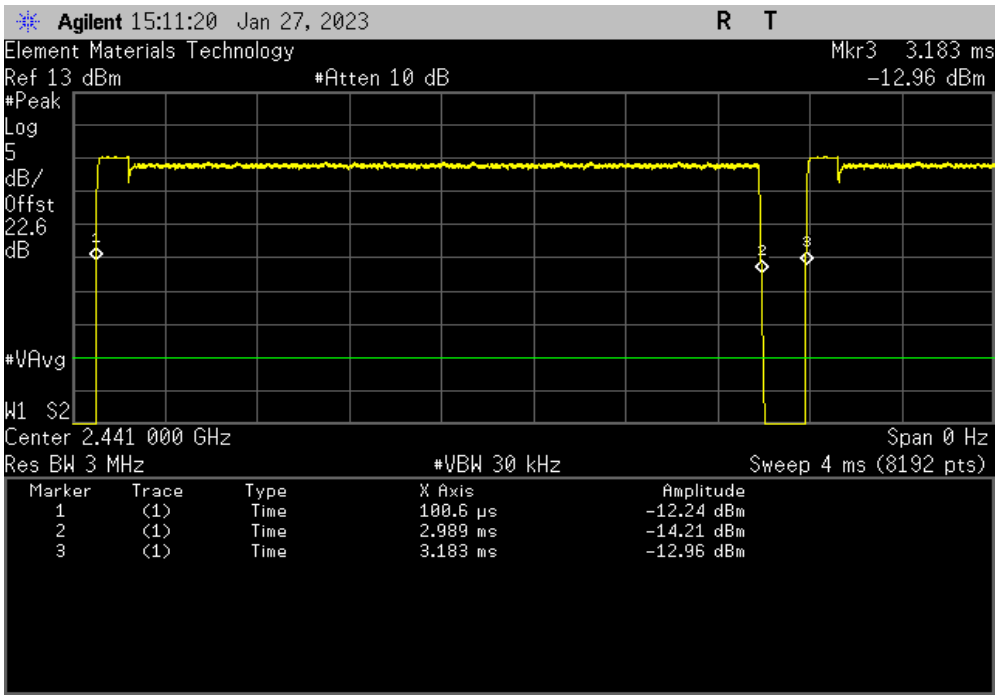


2DH5, pi/4-DQPSK, Low Channel						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	N/A	N/A	5	N/A	N/A	N/A

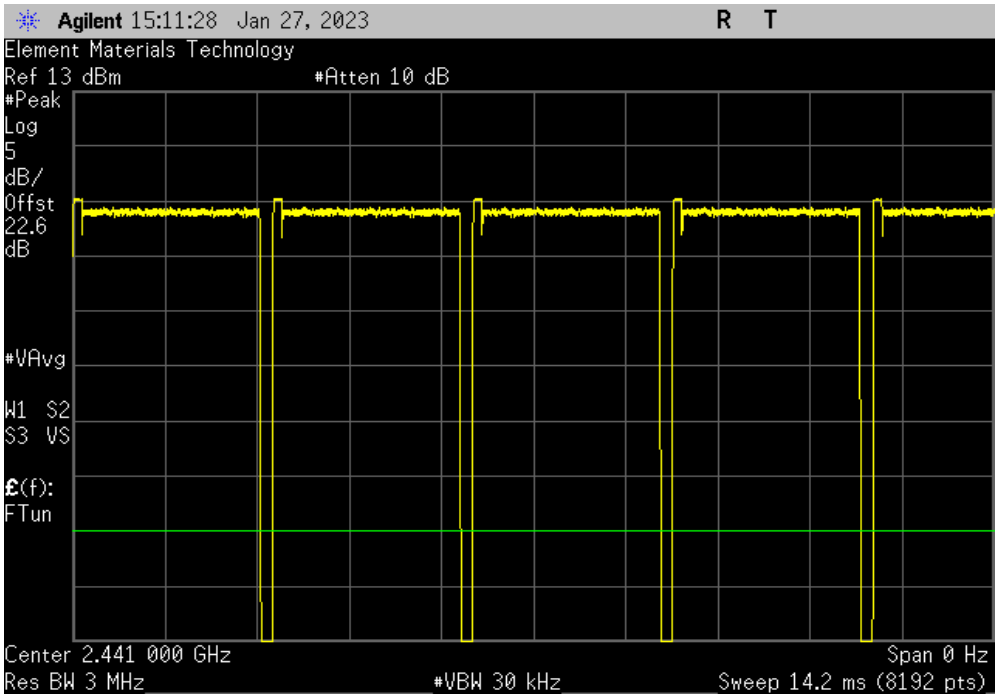


DUTY CYCLE

2DH5, pi/4-DQPSK, Mid Channel						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	2.889 ms	3.083 ms	1	93.7	N/A	N/A

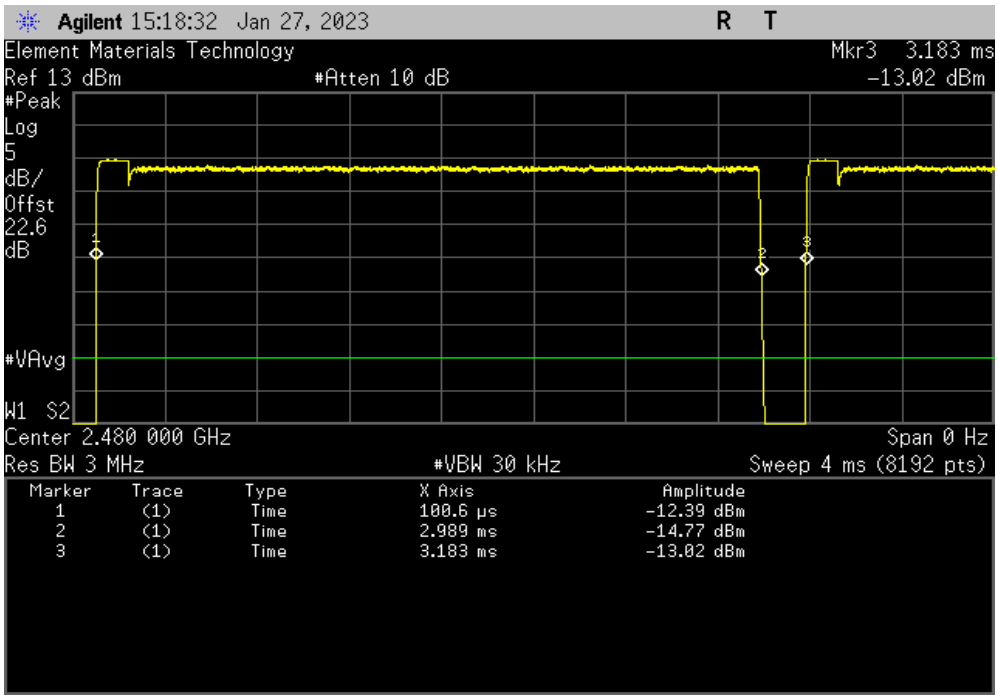


2DH5, pi/4-DQPSK, Mid Channel						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	N/A	N/A	5	N/A	N/A	N/A

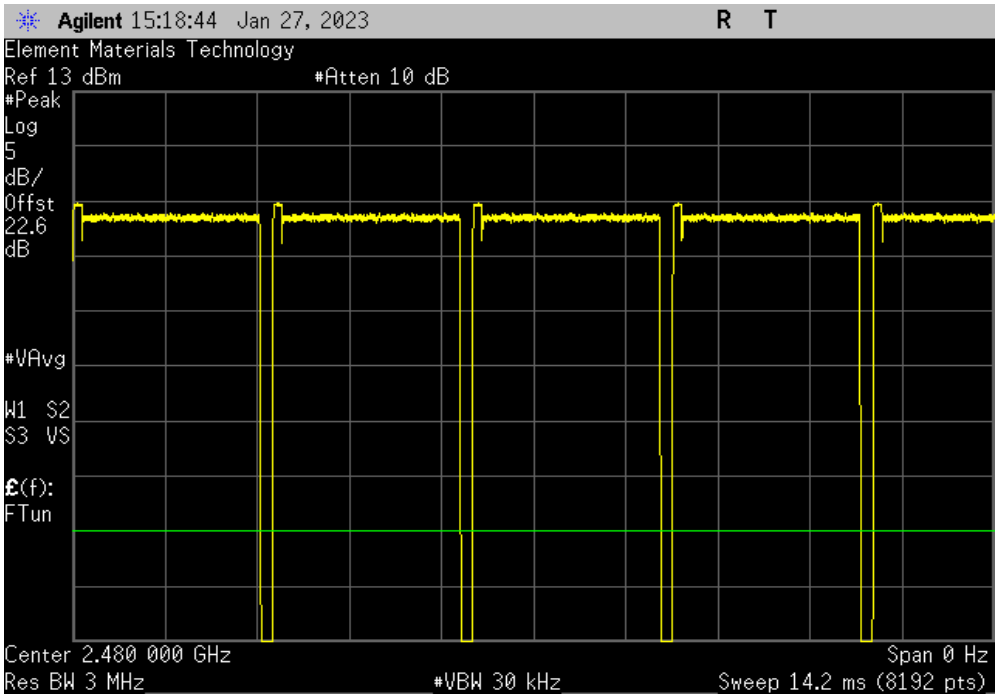


DUTY CYCLE

2DH5, pi/4-DQPSK, High Channel						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	2.889 ms	3.083 ms	1	93.7	N/A	N/A

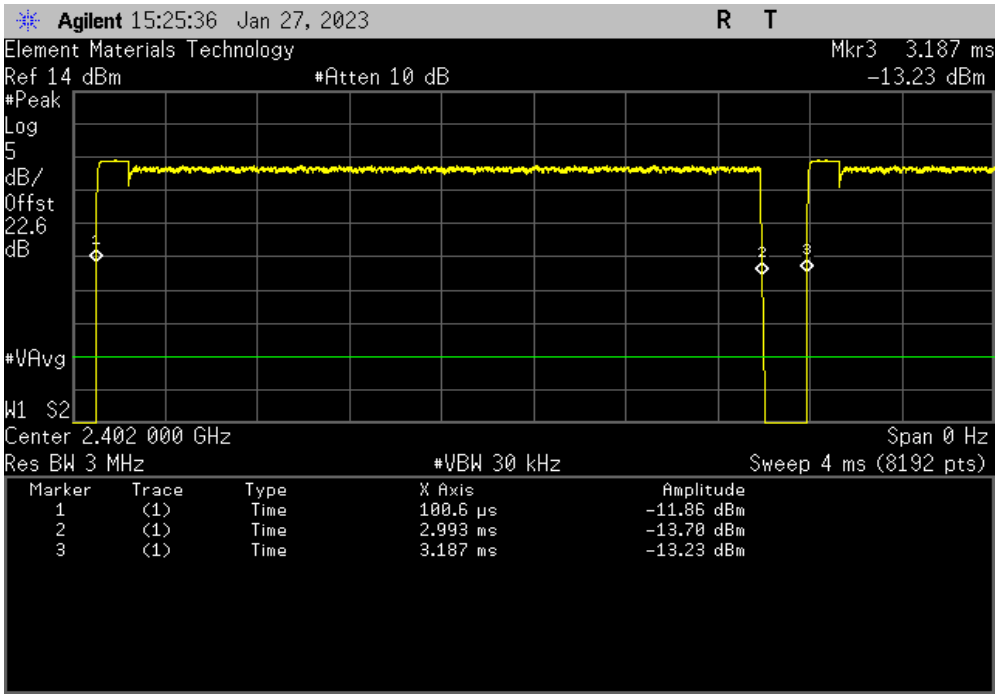


2DH5, pi/4-DQPSK, High Channel						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	N/A	N/A	5	N/A	N/A	N/A

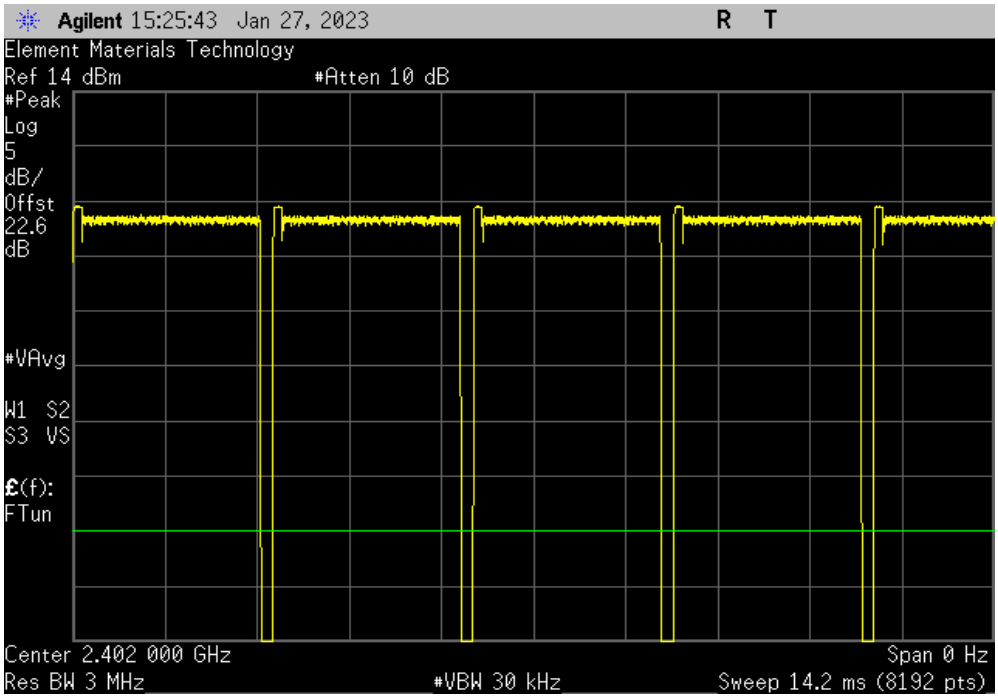


DUTY CYCLE

3DH5, 8-DPSK, Low Channel						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	2.892 ms	3.087 ms	1	93.7	N/A	N/A

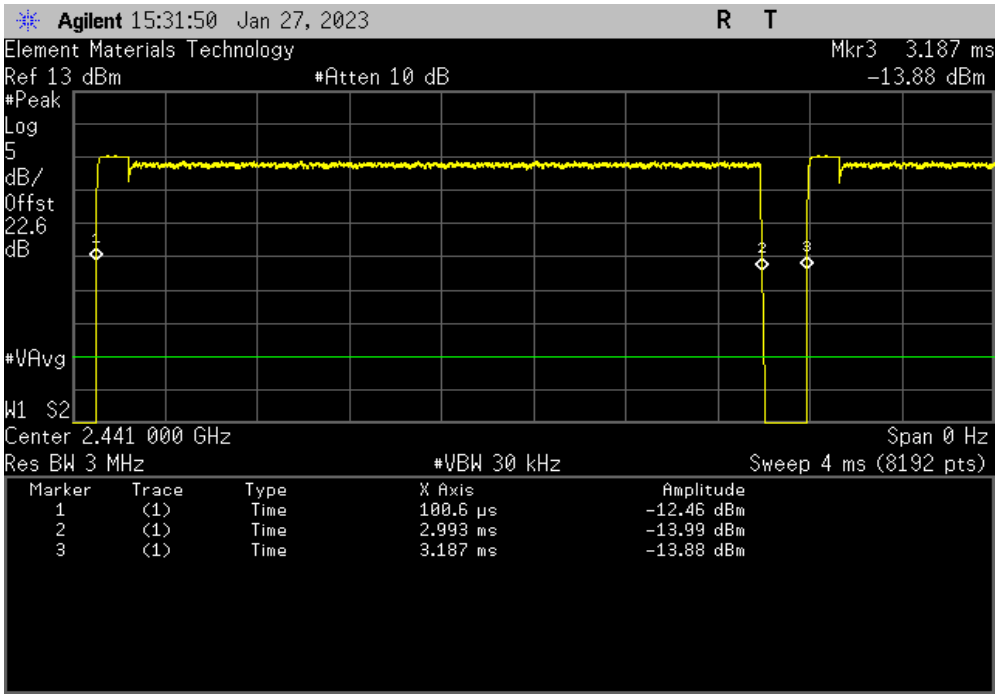


3DH5, 8-DPSK, Low Channel						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	N/A	N/A	5	N/A	N/A	N/A

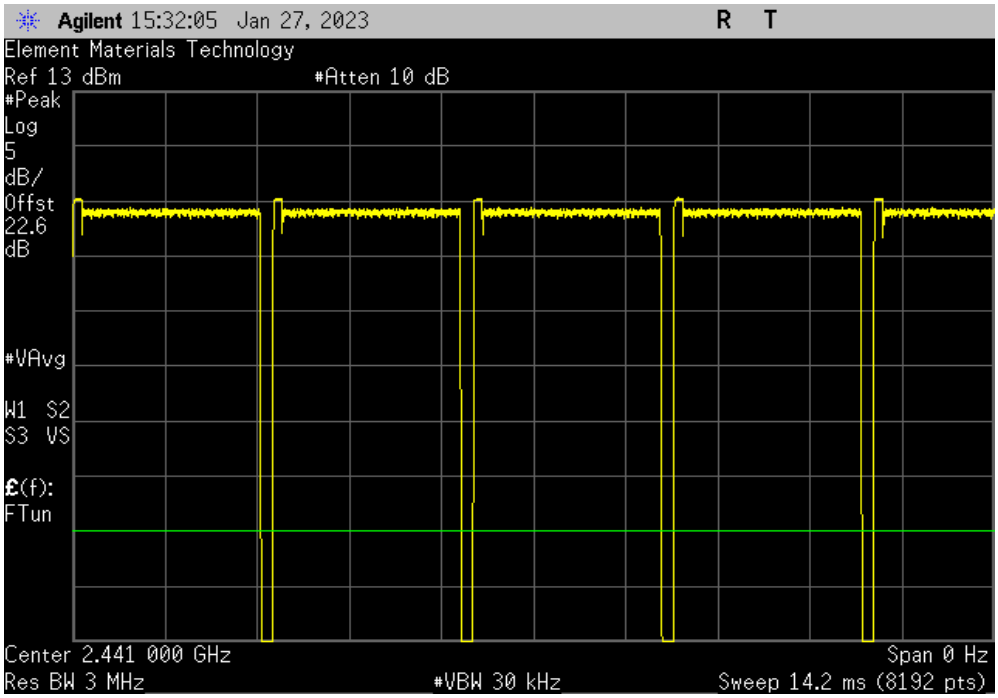


DUTY CYCLE

3DH5, 8-DPSK, Mid Channel						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	2.892 ms	3.087 ms	1	93.7	N/A	N/A



3DH5, 8-DPSK, Mid Channel						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	N/A	N/A	5	N/A	N/A	N/A

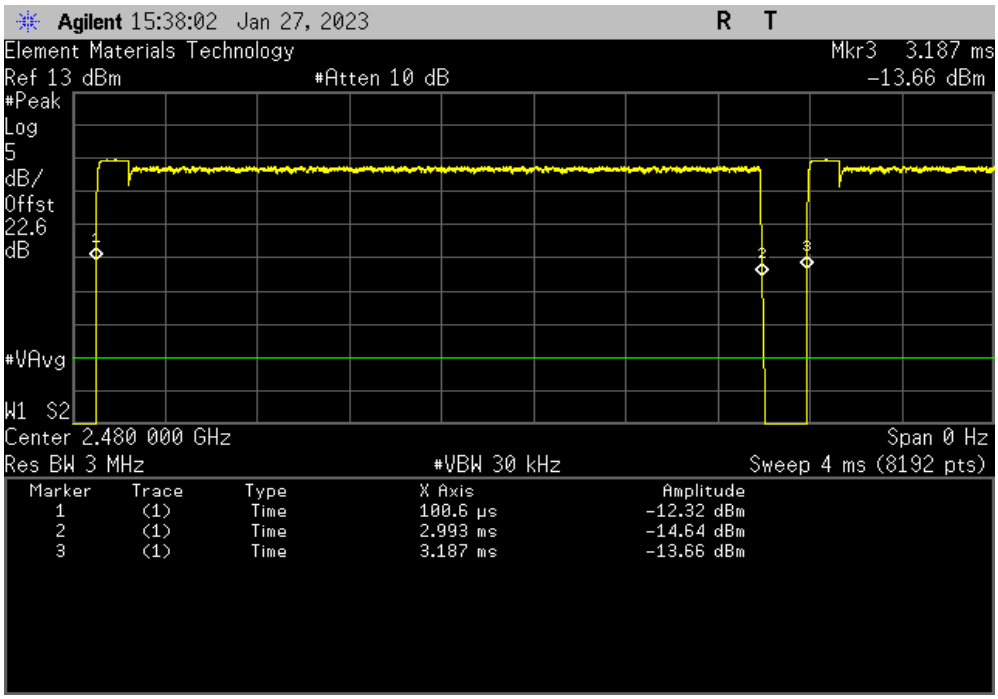


DUTY CYCLE

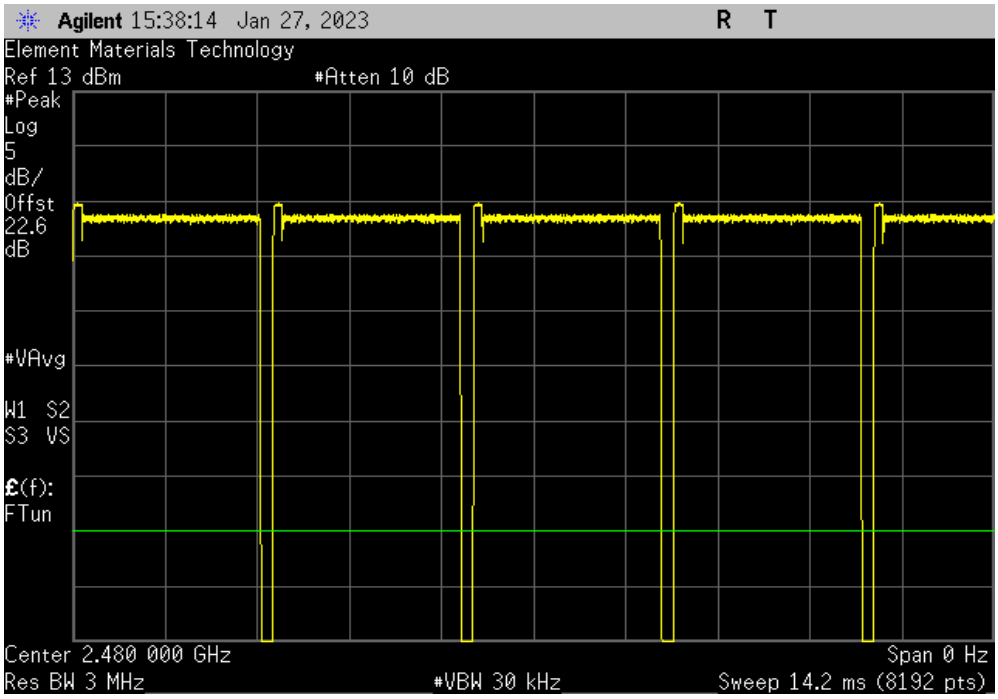
element

TbtTx 2022.06.03.0 XMit 2022.02.07.0

3DH5, 8-DPSK, High Channel						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	2.892 ms	3.087 ms	1	93.7	N/A	N/A



3DH5, 8-DPSK, High Channel						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	N/A	N/A	5	N/A	N/A	N/A



CARRIER FREQUENCY SEPARATION

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	N5183A	TIA	2022-06-25	2024-06-25
Analyzer - Spectrum Analyzer	Agilent	E4440A	AAX	2023-01-19	2024-01-19
Block - DC	Weinschel Corp.	7006	AMS	2023-01-18	2024-01-18
Attenuator	S.M. Electronics	SA18H-20	REK	2022-02-15	2023-02-15
Cable	Micro-Coax	UFD150A-1-0720-200200	NCW	2023-01-18	2024-01-18

TEST DESCRIPTION

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

The channel carrier frequencies in the 2400-2483.5MHz band must be separated by 25 kHz or the 20dB bandwidth of the hopping channel, whichever is greater. Or, if the output power is less than 125 mW, the channel separation can be 25 kHz or 2/3 of the 20dB bandwidth. 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

element

TbtTx 2022.06.03.0 XMit 2022.02.07.0

EUT:	**GFD200**			**Work Order:**	**GLOW0038**
Serial Number:	**XB2-839**			**Date:**	**8-Feb-23**
Customer:	**Glowforge Incorporated**			**Temperature:**	**21 °C**
Attendees:	**Jason Bluhm**			**Humidity:**	**34.2% RH**
Project:	**None**			**Barometric Pres.:**	**1034 mbar**
Tested by:	**Harry Zhao**	**Power:**	**120VAC/60Hz**	**Job Site:**	**NC06**

TEST SPECIFICATIONS	**Test 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 offset connection between EUT and Spectrum analyzer: DC Block + 20 dB attenuator + measurement cable + patched coax cable = 22.63 dB. The largest measured 20 dB occupied bandwidth for data rate is as followed:
DH5 = 925 kHz, 2/3*925 kHz = 617 kHz

DEVIATIONS FROM TEST STANDARD

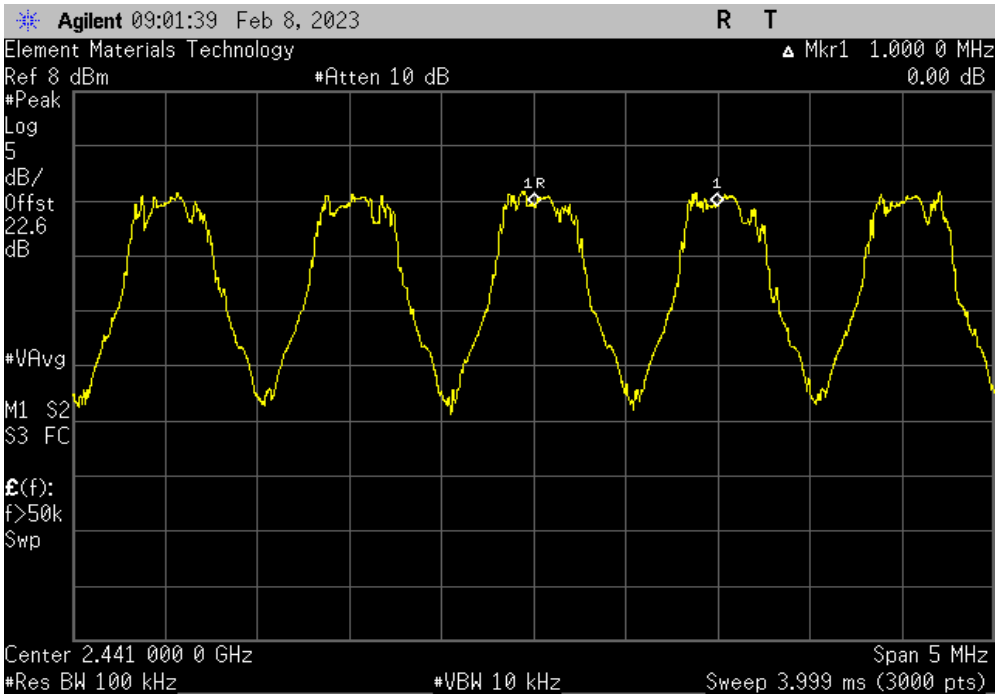
None

Configuration #	**2**	*Signature*

		Value	**Limit (≥)**	**Results**
DH5, GFSK				
	Mid Channel	1 MHz	617 kHz	Pass

CARRIER FREQUENCY SEPARATION

DH5, GFSK, Mid Channel						
				Value	Limit (≥)	Results
				1 MHz	617 kHz	Pass



NUMBER OF HOPPING FREQUENCIES

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
Cable	Micro-Coax	UFD150A-1-0720-200200	NCW	2023-01-18	2024-01-18
Attenuator	S.M. Electronics	SA18H-20	REK	2022-02-15	2023-02-15
Analyzer - Spectrum Analyzer	Agilent	E4440A	AAX	2023-01-19	2024-01-19
Block - DC	Weinschel Corp.	7006	AMS	2023-01-18	2024-01-18
Generator - Signal	Agilent	N5183A	TIA	2022-06-25	2024-06-25

TEST DESCRIPTION

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

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

NUMBER OF HOPPING FREQUENCIES

TbtTx 2022.06.03.0 XMit 2022.02.07.0

EUT:	**GFD200**			**Work Order:**	**GLOW0038**
Serial Number:	**GF-225000037**			**Date:**	**8-Feb-23**
Customer:	**Glowforge Incorporated**			**Temperature:**	**21.1 °C**
Attendees:	**Jason Bluhm**			**Humidity:**	**34.6% RH**
Project:	**None**			**Barometric Pres.:**	**1035 mbar**
Tested by:	**Harry Zhao**	**Power:**	**120VAC/60Hz**	**Job Site:**	**NC0A**

TEST SPECIFICATIONS	**Test 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 offset connection between EUT and Spectrum analyzer: DC Block + 20 dB attenuator + measurement cable + patched coax cable = 22.63 dB.

DEVIATIONS FROM TEST STANDARD

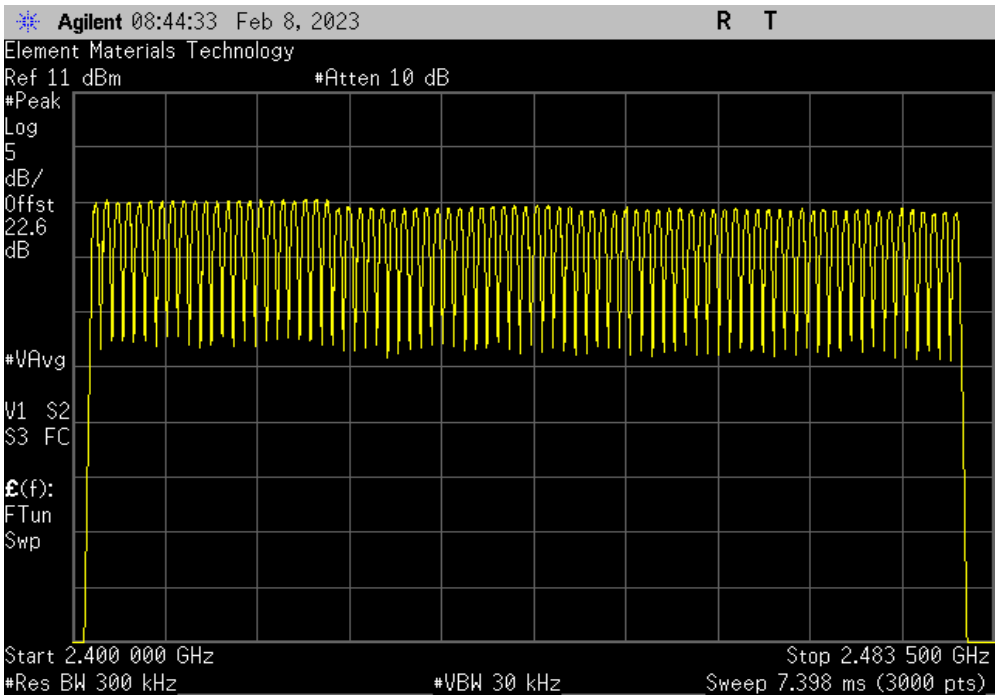
None

Configuration #	**2**	*Signature*

	Number of Channels	**Limit (≥)**	**Results**
DH5, GFSK			
Mid Channel	79	15	Pass

NUMBER OF HOPPING FREQUENCIES

DH5, GFSK, Mid Channel						
				Number of Channels	Limit (≥)	Results
				79	15	Pass



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	N5183A	TIA	2022-06-25	2024-06-25
Analyzer - Spectrum Analyzer	Agilent	E4440A	AAX	2023-01-19	2024-01-19
Block - DC	Weinschel Corp.	7006	AMS	2023-01-18	2024-01-18
Attenuator	S.M. Electronics	SA18H-20	REK	2022-02-15	2023-02-15
Cable	Micro-Coax	UFD150A-1-0720-200200	NCW	2023-01-18	2024-01-18

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 Bluetooth this would be 79 Channels * 400mS = 31.6 Sec.
- On Time During 31.6 Sec = Pulse Width * Average Number of Pulses * Scale Factor
- Average Number of Pulses is based on 4 samples.
- Scale Factor = 31.6 Sec / Screen Capture Sweep Time = 31.6 Sec / 6.32 Sec = 5

DWELL TIME

TbtTx 2022.06.03.0 XMit 2022.02.07.0

EUT:	**GFD200**			**Work Order:**	**GLOW0038**
Serial Number:	**XB2-839**			**Date:**	**1-Feb-23**
Customer:	**Glowforge Incorporated**			**Temperature:**	**21.5 °C**
Attendees:	**Jason Bluhm**			**Humidity:**	**38.1% RH**
Project:	**None**			**Barometric Pres.:**	**1029 mbar**
Tested by:	**Harry Zhao**	**Power:**	**120VAC/60Hz**	**Job Site:**	**NC06**

TEST SPECIFICATIONS	**Test 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 offset connection between EUT and Spectrum analyzer: DC Block + 20 dB attenuator + measurement cable + patched coax cable = 22.63 dB.

DEVIATIONS FROM TEST STANDARD

None

Configuration #	**2**	*Signature*

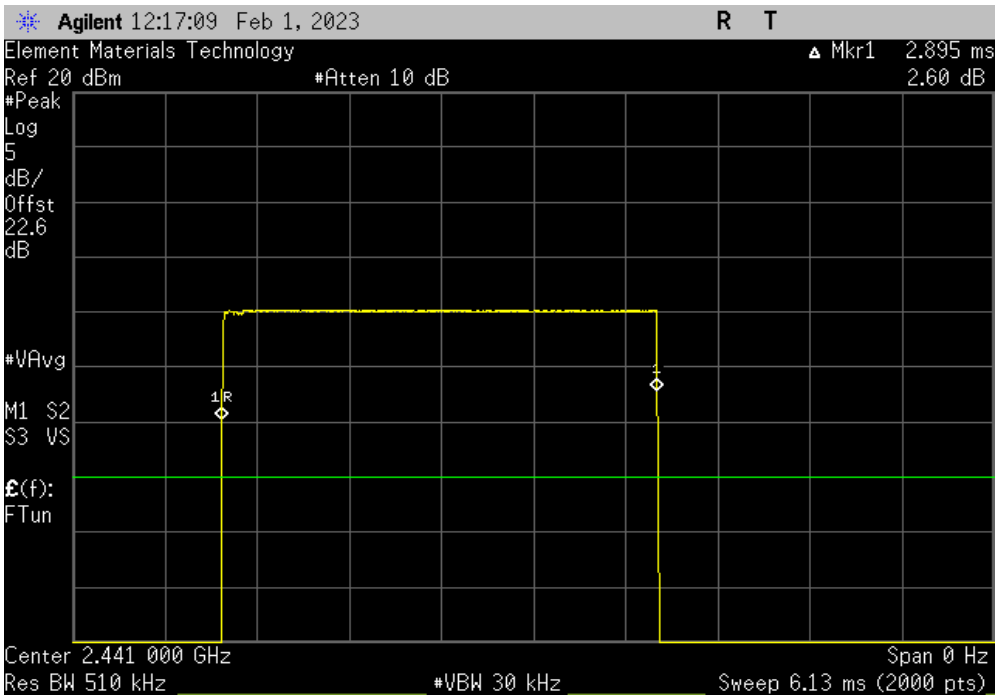
		Pulse Width (ms)	Number of Pulses	Average No. of Pulses	Scale Factor	On Time (ms) During 31.6 s	Limit (ms)	Results
DH5, GFSK								
	Mid Channel	2.895	N/A	N/A	N/A	N/A	N/A	N/A
	Mid Channel	N/A	23	N/A	N/A	N/A	N/A	N/A
	Mid Channel	N/A	24	N/A	N/A	N/A	N/A	N/A
	Mid Channel	N/A	33	N/A	N/A	N/A	N/A	N/A
	Mid Channel	N/A	25	N/A	N/A	N/A	N/A	N/A
	Mid Channel	2.895	N/A	26.25	5	379.97	400	Pass
2DH5, pi/4-DQPSK								
	Mid Channel	2.898	N/A	N/A	N/A	N/A	N/A	N/A
	Mid Channel	N/A	24	N/A	N/A	N/A	N/A	N/A
	Mid Channel	N/A	20	N/A	N/A	N/A	N/A	N/A
	Mid Channel	N/A	17	N/A	N/A	N/A	N/A	N/A
	Mid Channel	N/A	16	N/A	N/A	N/A	N/A	N/A
	Mid Channel	2.898	N/A	19.25	5	278.93	400	Pass
3DH5, 8-DPSK								
	Mid Channel	2.901	N/A	N/A	N/A	N/A	N/A	N/A
	Mid Channel	N/A	12	N/A	N/A	N/A	N/A	N/A
	Mid Channel	N/A	14	N/A	N/A	N/A	N/A	N/A
	Mid Channel	N/A	12	N/A	N/A	N/A	N/A	N/A
	Mid Channel	N/A	13	N/A	N/A	N/A	N/A	N/A
	Mid Channel	2.901	N/A	12.75	5	184.94	400	Pass

DWELL TIME

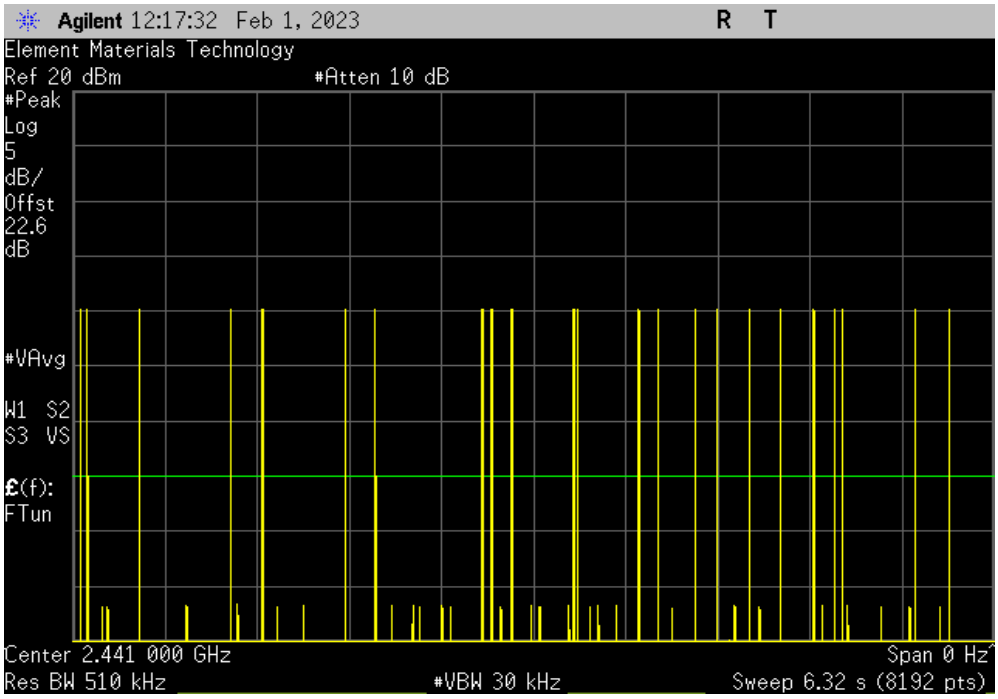
element

TbtTx 2022.06.03.0 XMit 2022.02.07.0

DH5, GFSK, Mid Channel						
Pulse Width (ms)	Number of Pulses	Average No. of Pulses	Scale Factor	On Time (ms) During 31.6 s	Limit (ms)	Results
2.895	N/A	N/A	N/A	N/A	N/A	N/A

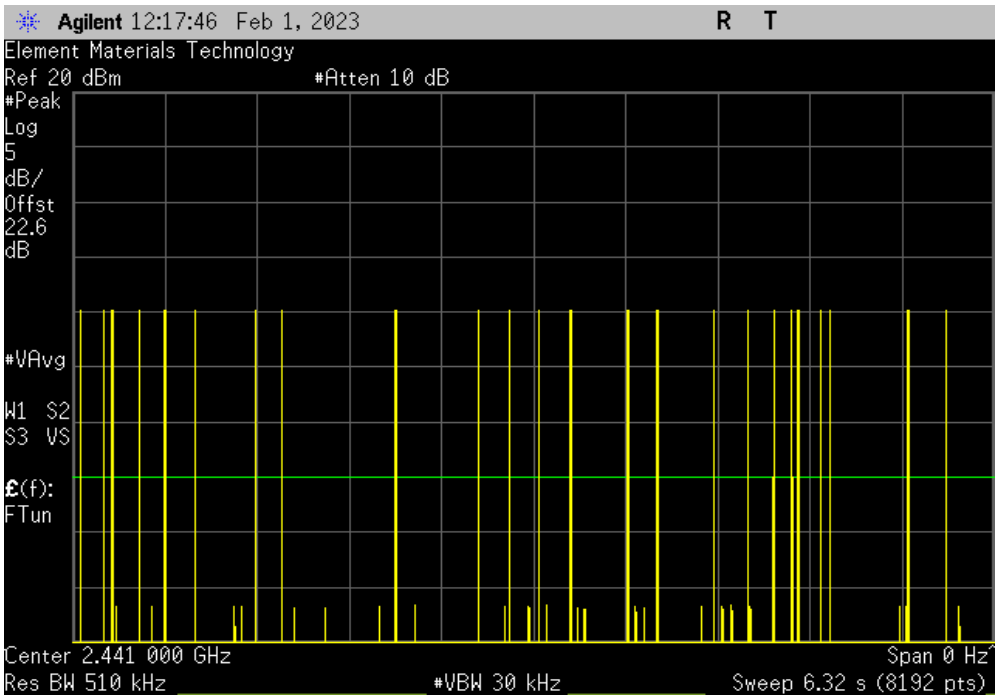


DH5, GFSK, Mid Channel						
Pulse Width (ms)	Number of Pulses	Average No. of Pulses	Scale Factor	On Time (ms) During 31.6 s	Limit (ms)	Results
N/A	23	N/A	N/A	N/A	N/A	N/A

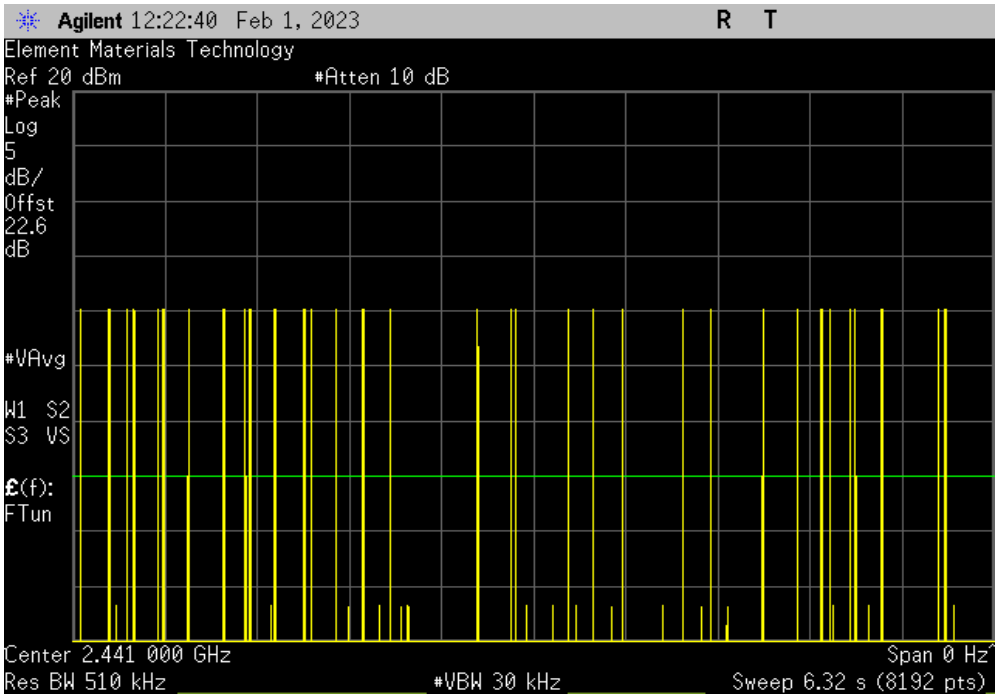


DWELL TIME

DH5, GFSK, Mid Channel						
Pulse Width (ms)	Number of Pulses	Average No. of Pulses	Scale Factor	On Time (ms) During 31.6 s	Limit (ms)	Results
N/A	24	N/A	N/A	N/A	N/A	N/A

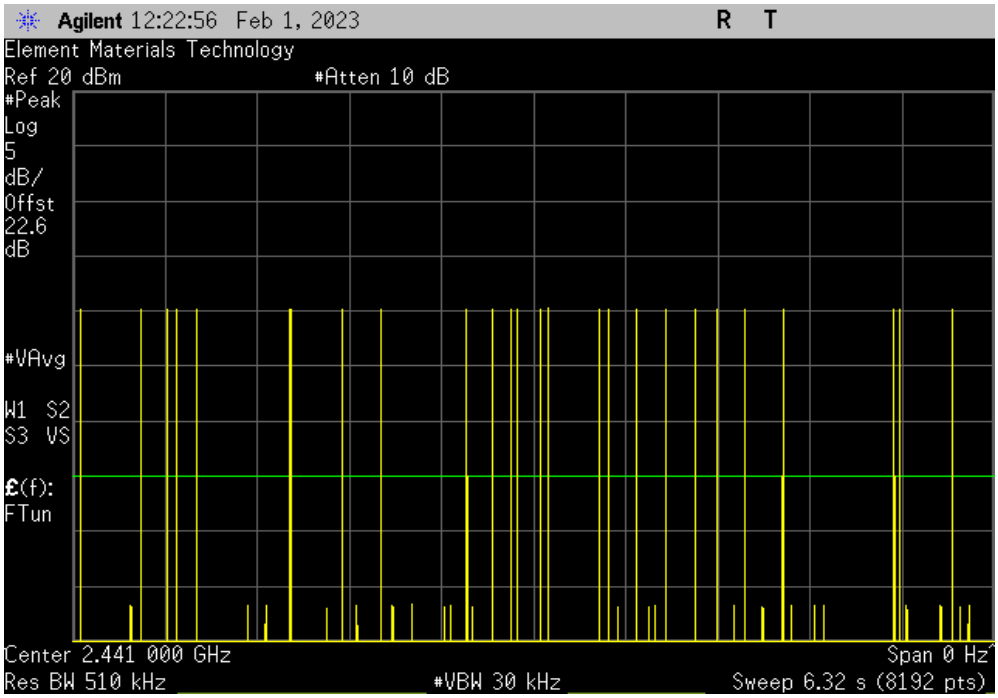


DH5, GFSK, Mid Channel						
Pulse Width (ms)	Number of Pulses	Average No. of Pulses	Scale Factor	On Time (ms) During 31.6 s	Limit (ms)	Results
N/A	33	N/A	N/A	N/A	N/A	N/A



DWELL TIME

DH5, GFSK, Mid Channel						
Pulse Width (ms)	Number of Pulses	Average No. of Pulses	Scale Factor	On Time (ms) During 31.6 s	Limit (ms)	Results
N/A	25	N/A	N/A	N/A	N/A	N/A



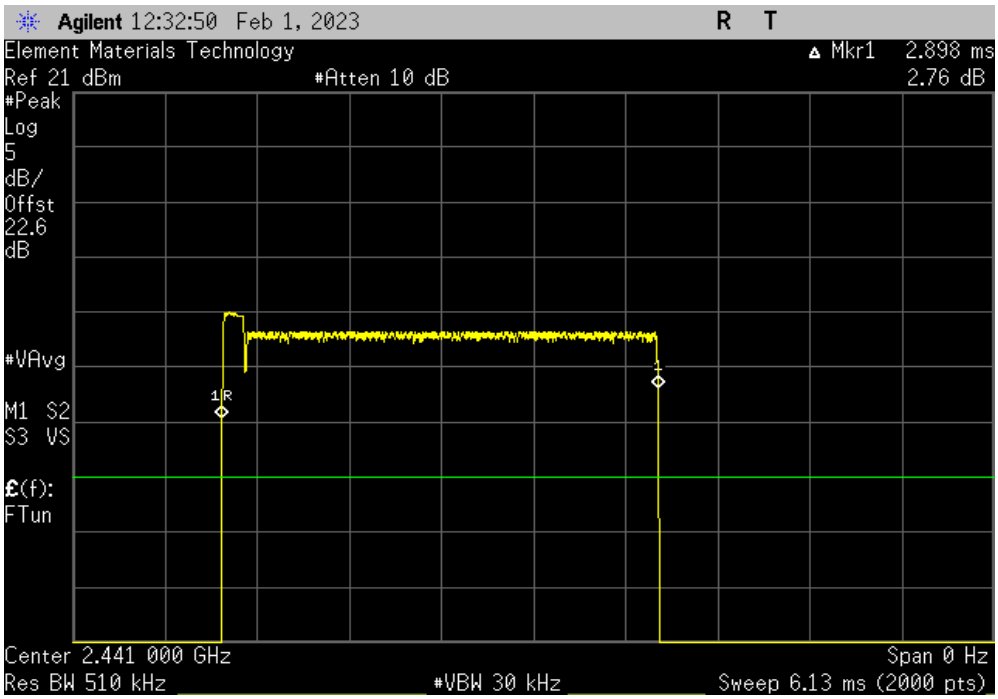
DH5, GFSK, Mid Channel						
Pulse Width (ms)	Number of Pulses	Average No. of Pulses	Scale Factor	On Time (ms) During 31.6 s	Limit (ms)	Results
2.895	N/A	26.25	5	379.97	400	Pass

Calculation Only

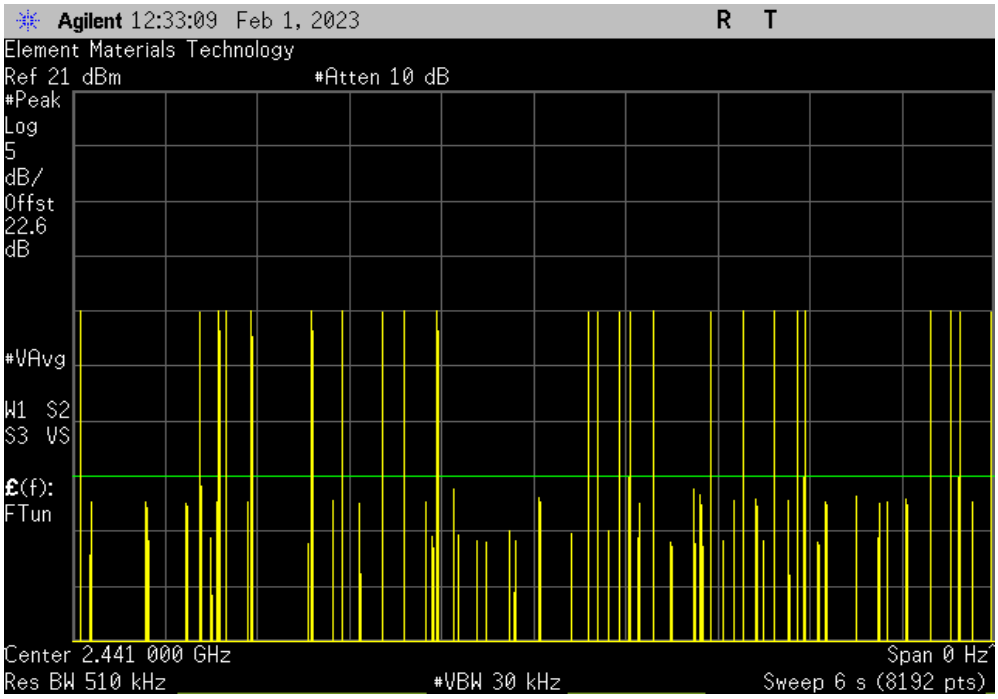
No Screen Capture Required

DWELL TIME

2DH5, pi/4-DQPSK, Mid Channel						
Pulse Width (ms)	Number of Pulses	Average No. of Pulses	Scale Factor	On Time (ms) During 31.6 s	Limit (ms)	Results
2.898	N/A	N/A	N/A	N/A	N/A	N/A

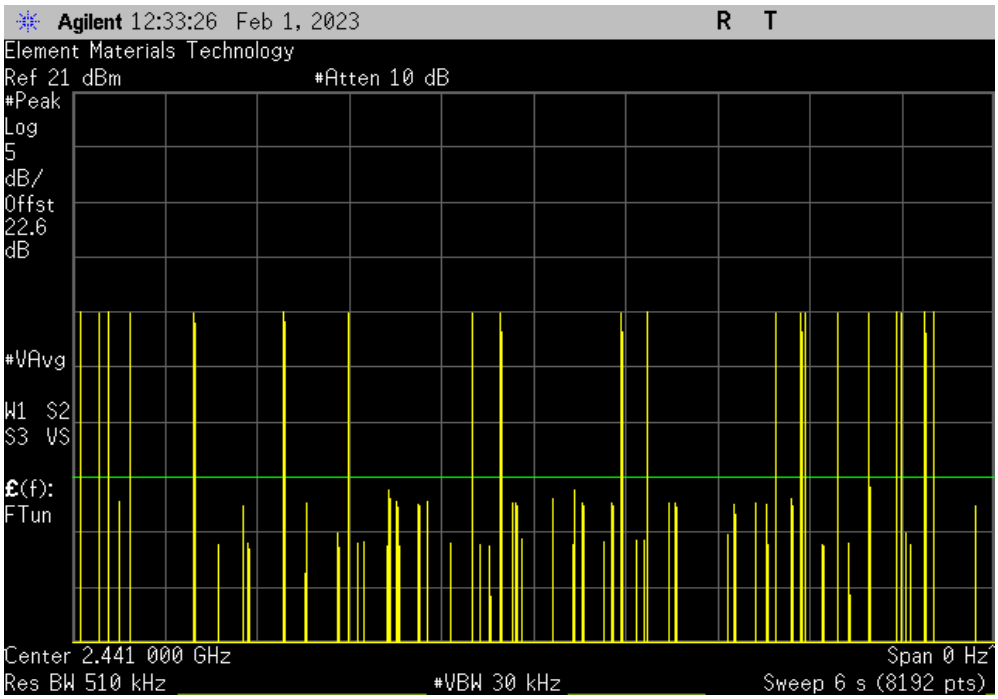


2DH5, pi/4-DQPSK, Mid Channel						
Pulse Width (ms)	Number of Pulses	Average No. of Pulses	Scale Factor	On Time (ms) During 31.6 s	Limit (ms)	Results
N/A	24	N/A	N/A	N/A	N/A	N/A

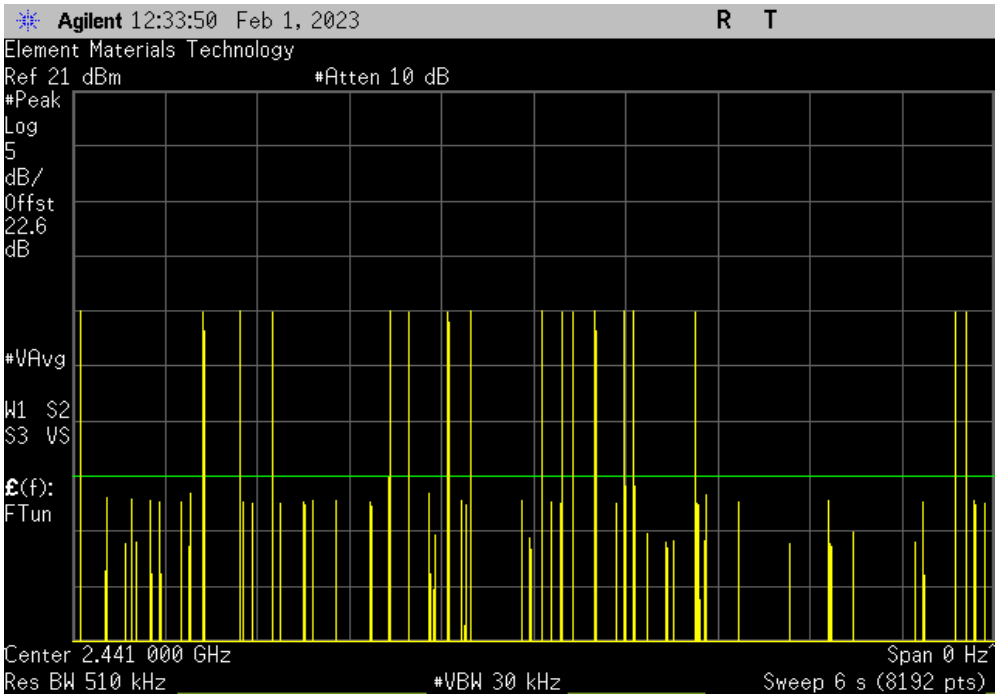


DWELL TIME

2DH5, pi/4-DQPSK, Mid Channel						
Pulse Width (ms)	Number of Pulses	Average No. of Pulses	Scale Factor	On Time (ms) During 31.6 s	Limit (ms)	Results
N/A	20	N/A	N/A	N/A	N/A	N/A



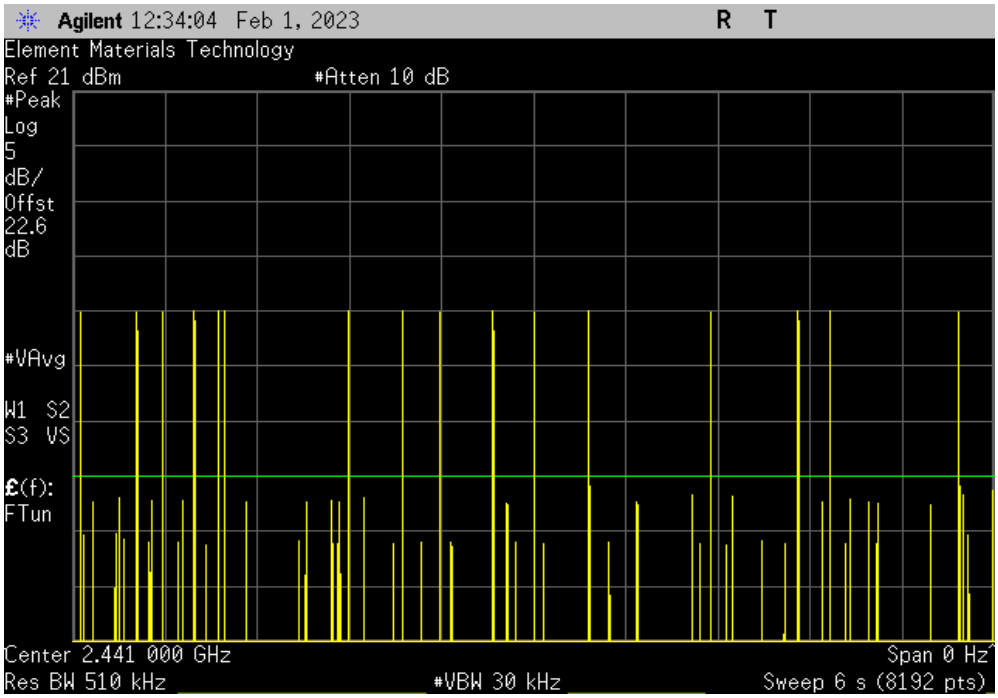
2DH5, pi/4-DQPSK, Mid Channel						
Pulse Width (ms)	Number of Pulses	Average No. of Pulses	Scale Factor	On Time (ms) During 31.6 s	Limit (ms)	Results
N/A	17	N/A	N/A	N/A	N/A	N/A



DWELL TIME

TbtTx 2022.06.03.0 XMit 2022.02.07.0

2DH5, pi/4-DQPSK, Mid Channel						
Pulse Width (ms)	Number of Pulses	Average No. of Pulses	Scale Factor	On Time (ms) During 31.6 s	Limit (ms)	Results
N/A	16	N/A	N/A	N/A	N/A	N/A



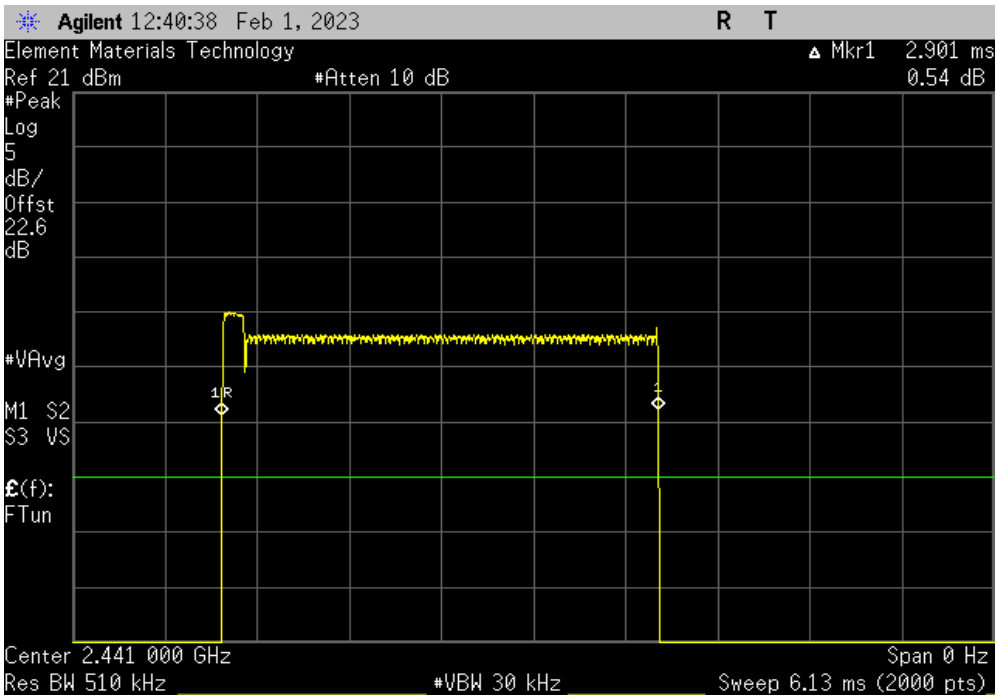
2DH5, pi/4-DQPSK, Mid Channel						
Pulse Width (ms)	Number of Pulses	Average No. of Pulses	Scale Factor	On Time (ms) During 31.6 s	Limit (ms)	Results
2.898	N/A	19.25	5	278.93	400	Pass

Calculation Only

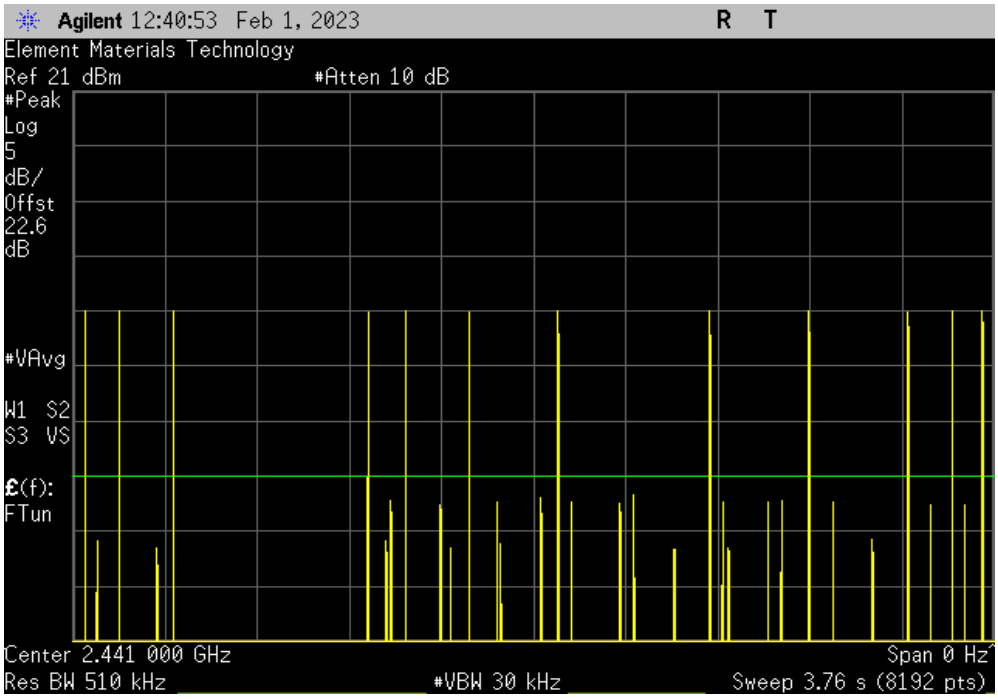
No Screen Capture Required

DWELL TIME

3DH5, 8-DPSK, Mid Channel						
Pulse Width (ms)	Number of Pulses	Average No. of Pulses	Scale Factor	On Time (ms) During 31.6 s	Limit (ms)	Results
2.901	N/A	N/A	N/A	N/A	N/A	N/A

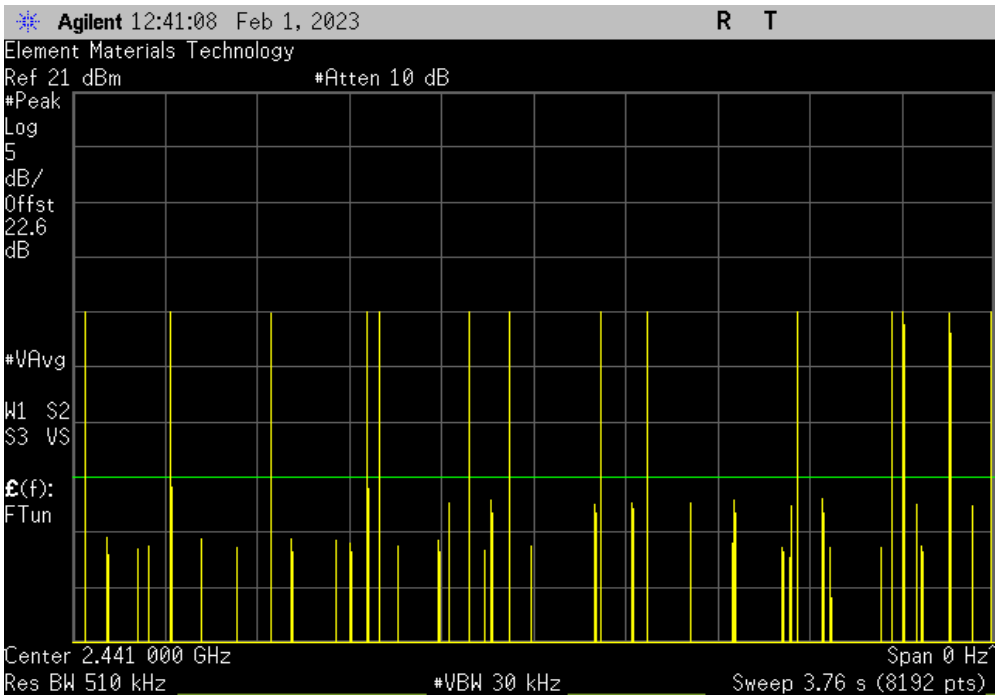


3DH5, 8-DPSK, Mid Channel						
Pulse Width (ms)	Number of Pulses	Average No. of Pulses	Scale Factor	On Time (ms) During 31.6 s	Limit (ms)	Results
N/A	12	N/A	N/A	N/A	N/A	N/A

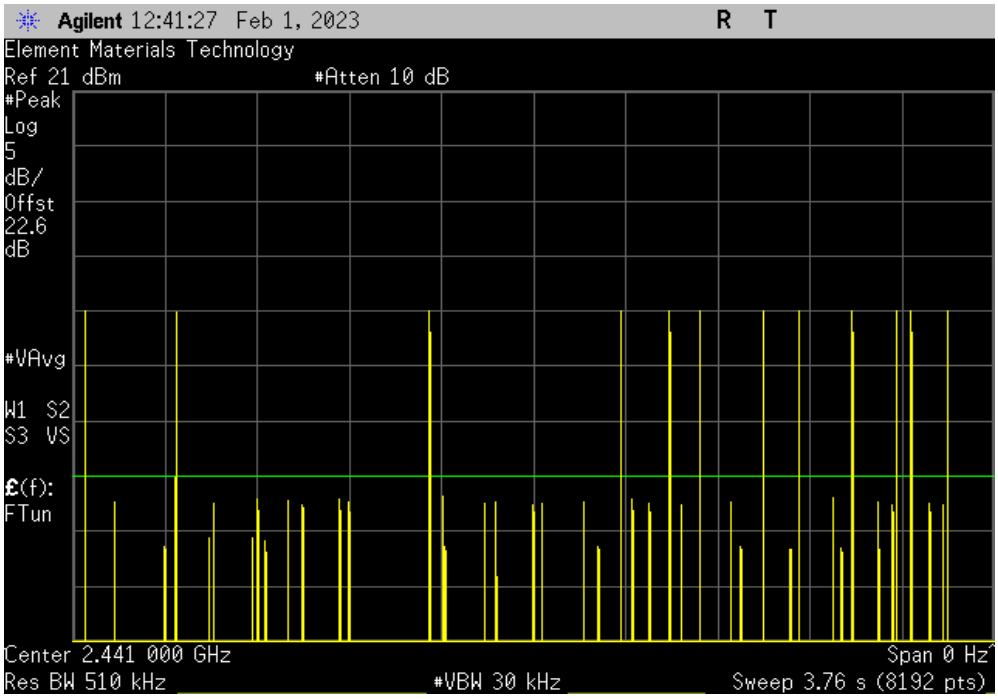


DWELL TIME

3DH5, 8-DPSK, Mid Channel						
Pulse Width (ms)	Number of Pulses	Average No. of Pulses	Scale Factor	On Time (ms) During 31.6 s	Limit (ms)	Results
N/A	14	N/A	N/A	N/A	N/A	N/A



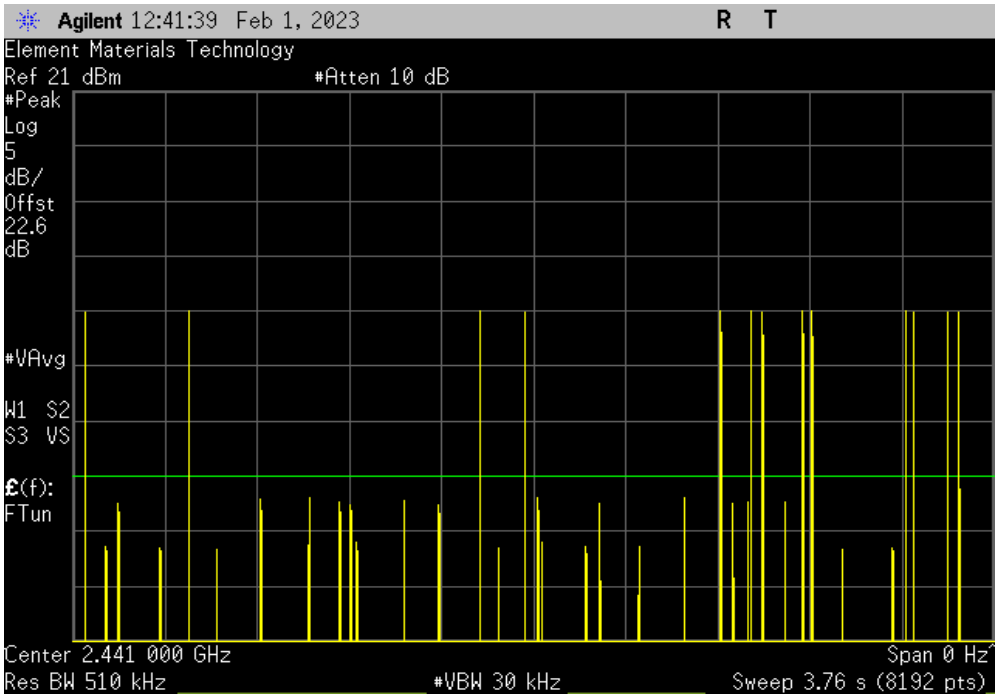
3DH5, 8-DPSK, Mid Channel						
Pulse Width (ms)	Number of Pulses	Average No. of Pulses	Scale Factor	On Time (ms) During 31.6 s	Limit (ms)	Results
N/A	12	N/A	N/A	N/A	N/A	N/A



DWELL TIME

TbtTx 2022.06.03.0 XMit 2022.02.07.0

3DH5, 8-DPSK, Mid Channel						
Pulse Width (ms)	Number of Pulses	Average No. of Pulses	Scale Factor	On Time (ms) During 31.6 s	Limit (ms)	Results
N/A	13	N/A	N/A	N/A	N/A	N/A



3DH5, 8-DPSK, Mid Channel						
Pulse Width (ms)	Number of Pulses	Average No. of Pulses	Scale Factor	On Time (ms) During 31.6 s	Limit (ms)	Results
2.901	N/A	12.75	5	184.94	400	Pass

Calculation Only

No Screen Capture Required

OUTPUT POWER

XMit 2022.02.07.0

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

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Attenuator	S.M. Electronics	SA18H-20	REK	2022-02-15	2023-02-15
Block - DC	Weinschel Corp.	7006	AMS	2023-01-18	2024-01-18
Cable	Micro-Coax	UFD150A-1-0720-200200	NCW	2023-01-18	2024-01-18
Analyzer - Spectrum Analyzer	Agilent	E4440A	AAX	2023-01-19	2024-01-19
Generator - Signal	Agilent	N5183A	TIA	2022-06-25	2024-06-25

TEST DESCRIPTION

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

The peak output power was measured with the EUT set to low, medium and high transmit frequencies. The EUT was transmitting in a no hop mode at the data rate(s) listed in the datasheet.

The method found in ANSI C63.10:2013 Section 7.8.5 was used for a FHSS radio.

OUTPUT POWER

TbtTx 2022.06.03.0 XMit 2022.02.07.0

EUT:	**GFD200**			**Work Order:**	**GLOW0038**
Serial Number:	**XB2-839**			**Date:**	**27-Jan-23**
Customer:	**Glowforge Incorporated**			**Temperature:**	**21.1 °C**
Attendees:	**Jason Bluhm**			**Humidity:**	**38.4% RH**
Project:	**None**			**Barometric Pres.:**	**1029 mbar**
Tested by:	**Harry Zhao**	**Power:**	**120VAC/60Hz**	**Job Site:**	**NC06**

TEST SPECIFICATIONS	**Test 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 offset connection between EUT and Spectrum analyzer: DC Block + 20 dB attenuator + measurement cable + patched coax cable = 22.63 dB.

DEVIATIONS FROM TEST STANDARD

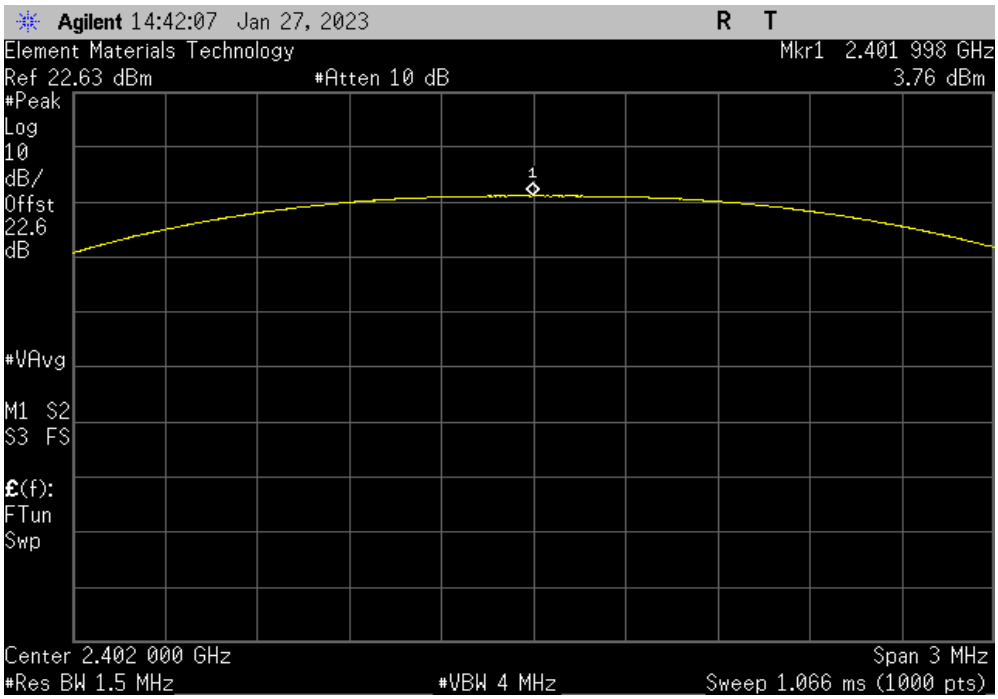
None

Configuration #	**2**	*Signature*

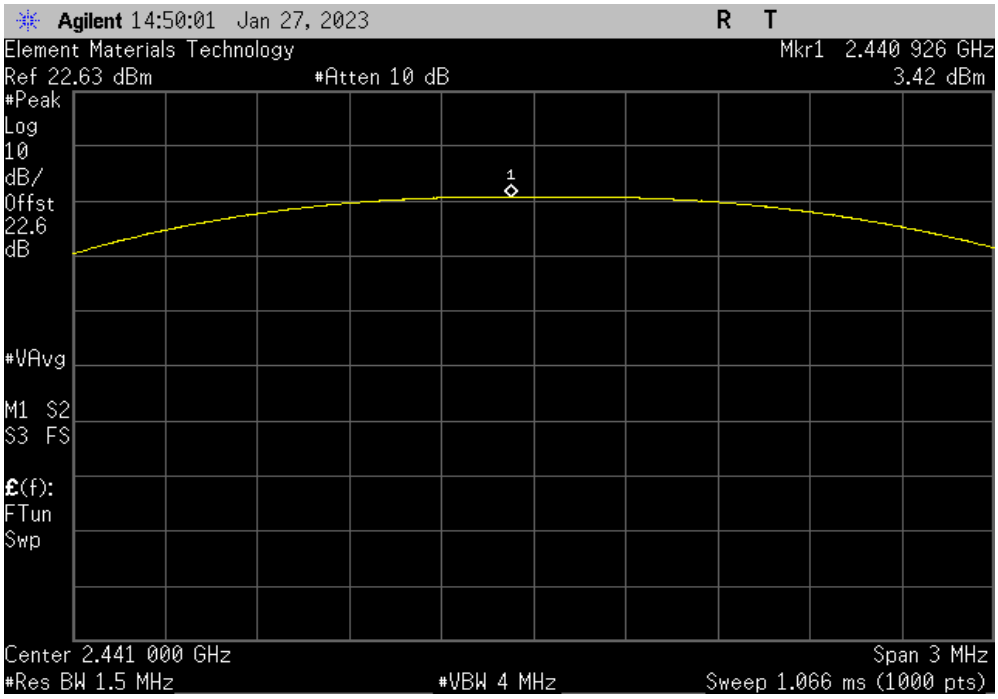
		Out Pwr (dBm)	**Limit (dBm)**	**Result**
DH5, GFSK				
	Low Channel	3.764	21	Pass
	Mid Channel	3.423	21	Pass
	High Channel	2.895	21	Pass
2DH5, pi/4-DQPSK				
	Low Channel	4.773	21	Pass
	Mid Channel	4.585	21	Pass
	High Channel	4.118	21	Pass
3DH5, 8-DPSK				
	Low Channel	5.35	21	Pass
	Mid Channel	5.08	21	Pass
	High Channel	4.653	21	Pass

OUTPUT POWER

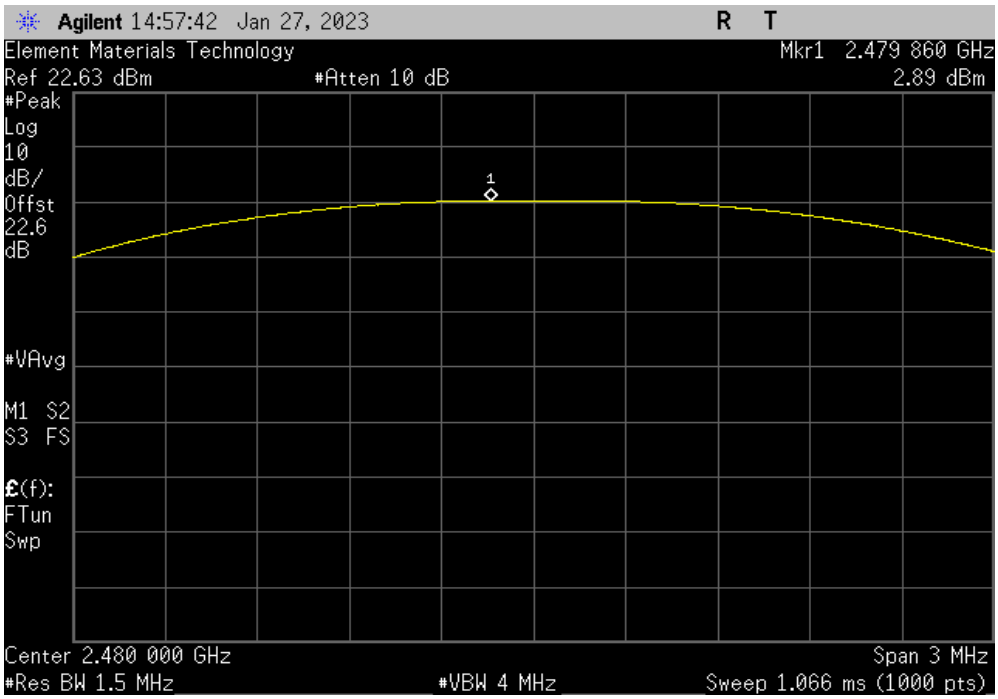
DH5, GFSK, Low Channel						
				Out Pwr (dBm)	Limit (dBm)	Result
				3.764	21	Pass



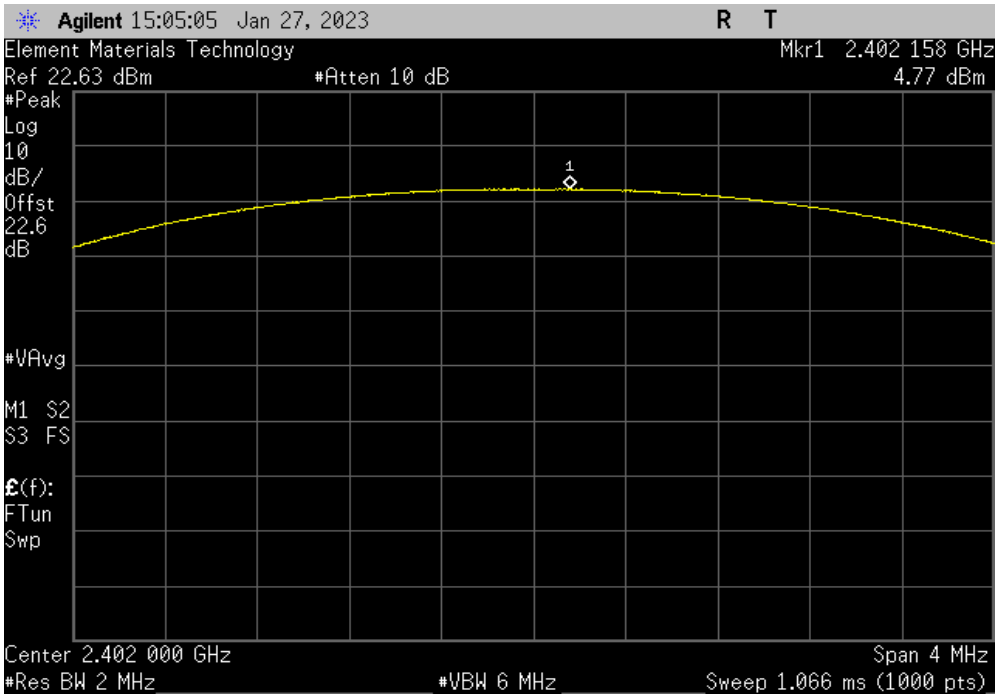
DH5, GFSK, Mid Channel						
				Out Pwr (dBm)	Limit (dBm)	Result
				3.423	21	Pass



DH5, GFSK, High Channel						
				Out Pwr (dBm)	Limit (dBm)	Result
				2.895	21	Pass

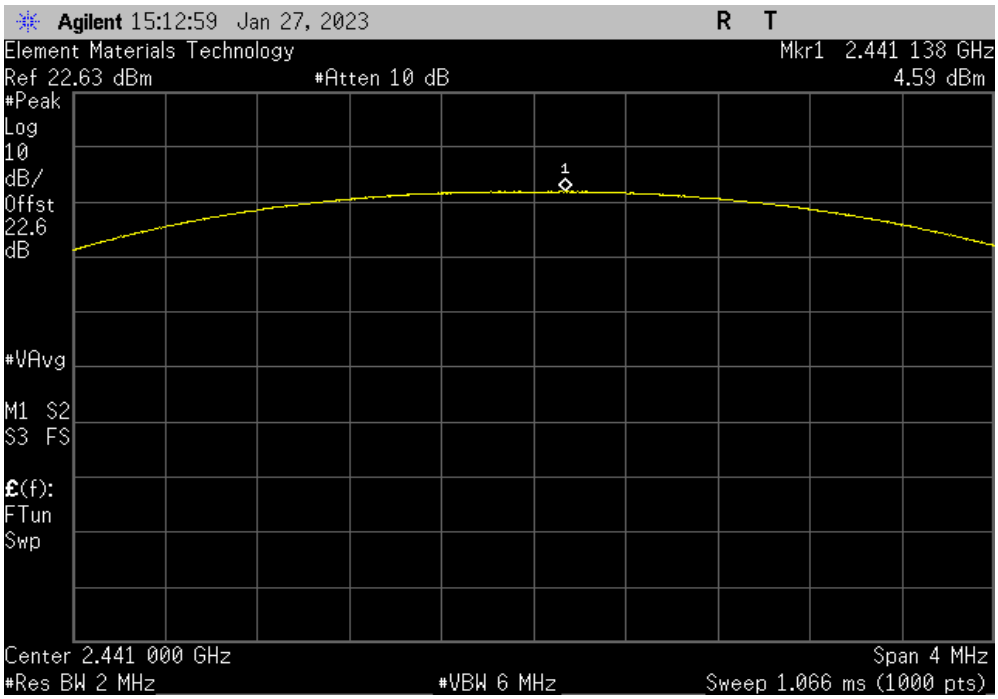


2DH5, pi/4-DQPSK, Low Channel						
				Out Pwr (dBm)	Limit (dBm)	Result
				4.773	21	Pass

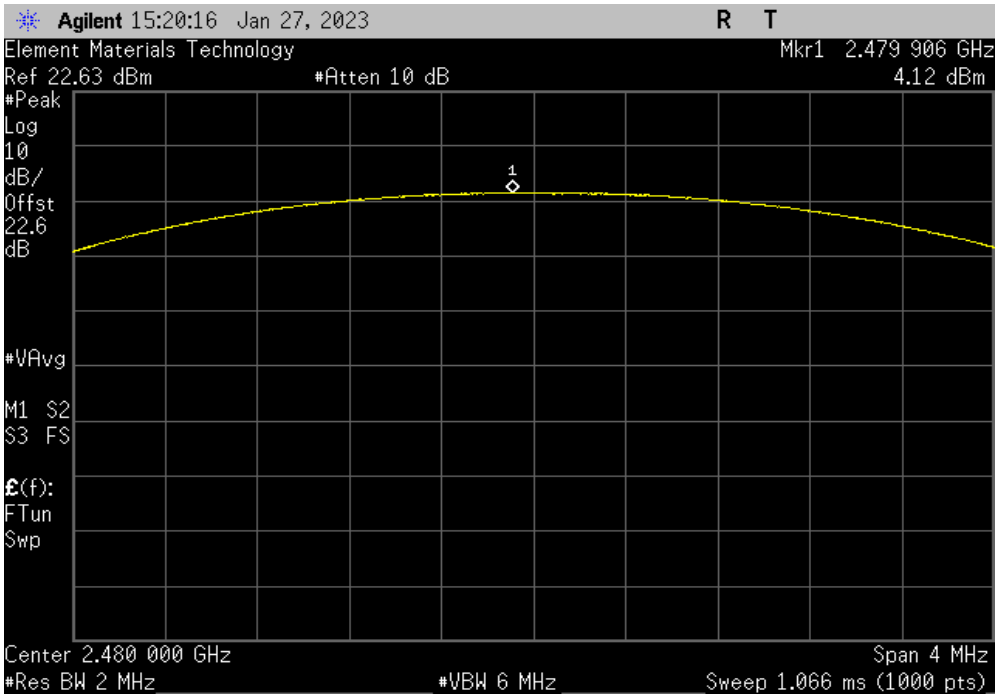


OUTPUT POWER

2DH5, pi/4-DQPSK, Mid Channel						
				Out Pwr (dBm)	Limit (dBm)	Result
				4.585	21	Pass

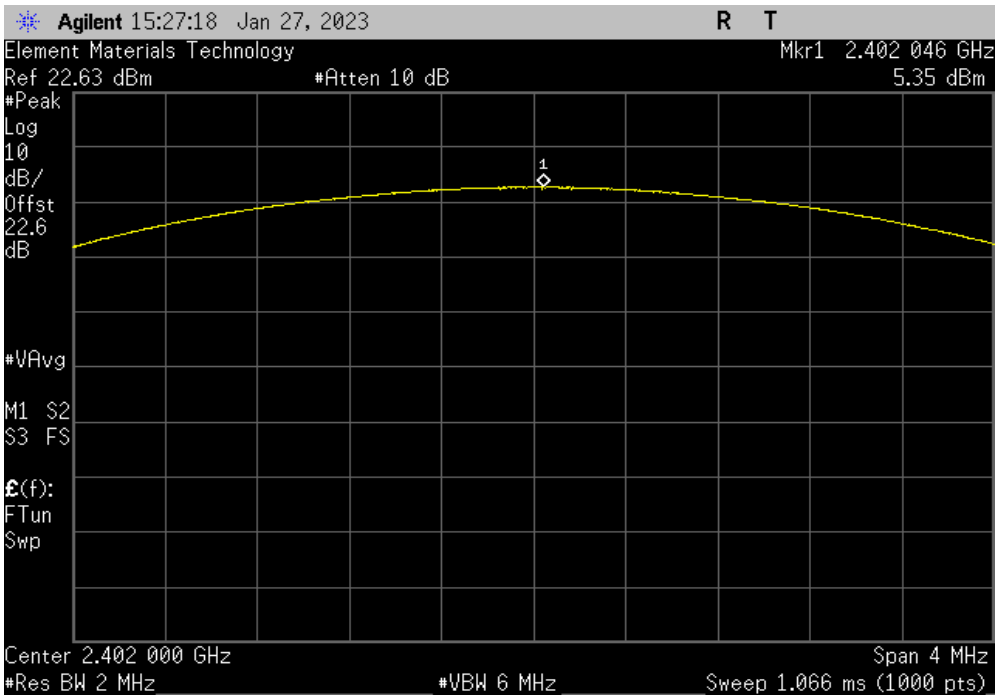


2DH5, pi/4-DQPSK, High Channel						
				Out Pwr (dBm)	Limit (dBm)	Result
				4.118	21	Pass

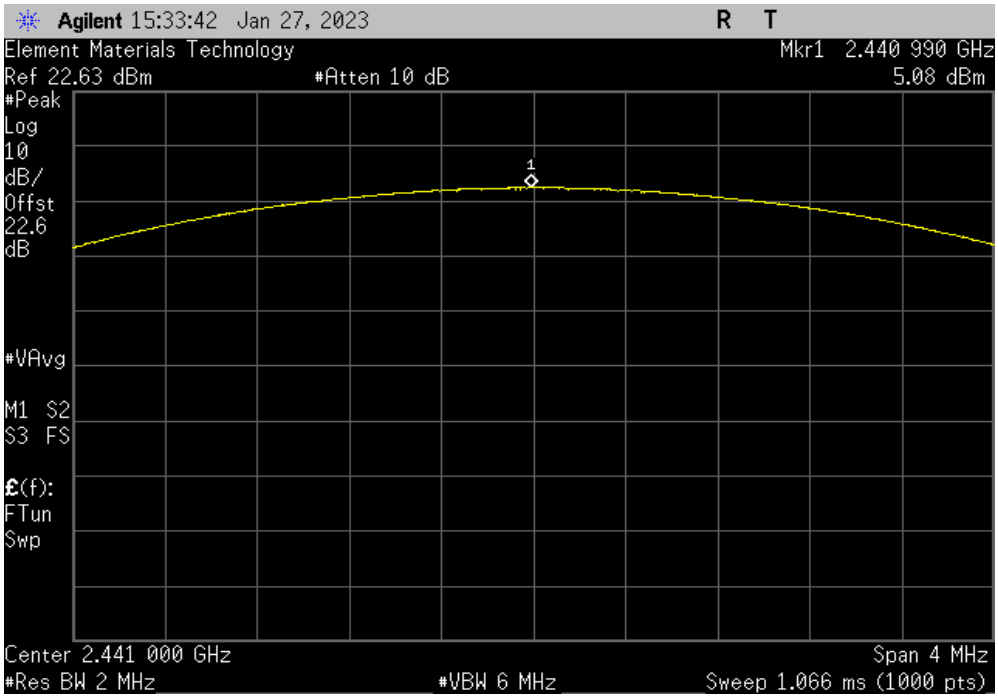


OUTPUT POWER

3DH5, 8-DPSK, Low Channel						
				Out Pwr (dBm)	Limit (dBm)	Result
				5.35	21	Pass

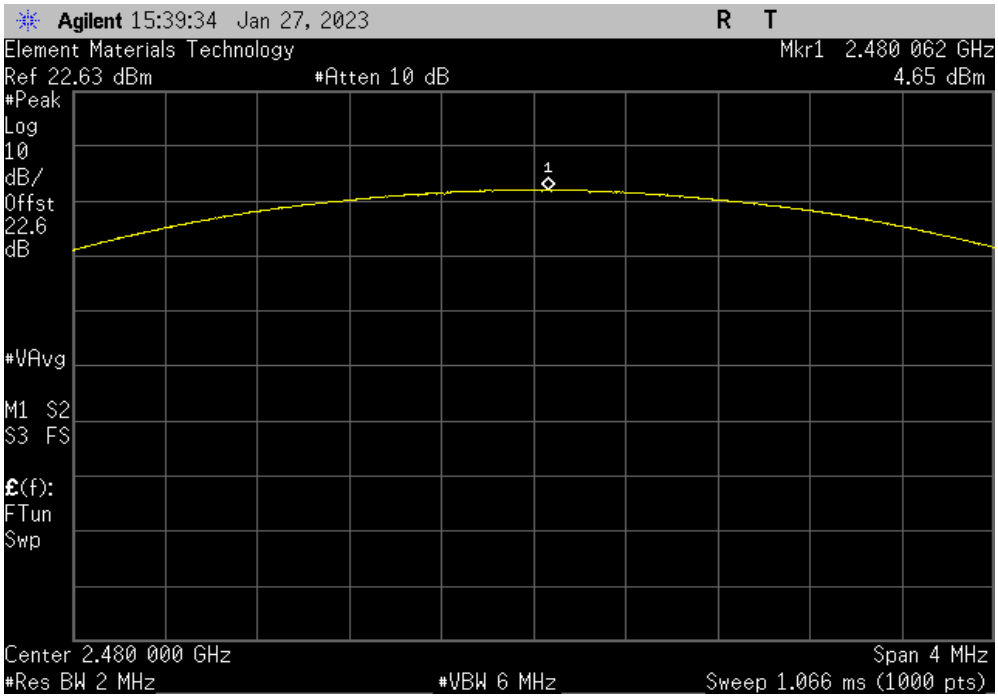


3DH5, 8-DPSK, Mid Channel						
				Out Pwr (dBm)	Limit (dBm)	Result
				5.08	21	Pass



OUTPUT POWER

3DH5, 8-DPSK, High Channel						
				Out Pwr (dBm)	Limit (dBm)	Result
				4.653	21	Pass



EQUIVALENT ISOTROPIC RADIATED POWER (EIRP)

XMit 2022.02.07.0

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

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Attenuator	S.M. Electronics	SA18H-20	REK	2022-02-15	2023-02-15
Block - DC	Weinschel Corp.	7006	AMS	2023-01-18	2024-01-18
Generator - Signal	Agilent	N5183A	TIA	2022-06-25	2024-06-25
Cable	Micro-Coax	UFD150A-1-0720-200200	NCW	2023-01-18	2024-01-18
Analyzer - Spectrum Analyzer	Agilent	E4440A	AAX	2023-01-19	2024-01-19

TEST DESCRIPTION

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

The peak output power was measured with the EUT set to low, medium and high transmit frequencies. The EUT was transmitting in a no hop mode at the data rate(s) listed in the datasheet.

The method found in ANSI C63.10:2013 Section 7.8.5 was used for a FHSS radio.

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

EQUIVALENT ISOTROPIC RADIATED POWER (EIRP)

TbtTx 2022.06.03.0 XMit 2022.02.07.0

EUT:	GFD200			**Work Order:**	GLOW0038
Serial Number:	XB2-839			**Date:**	27-Jan-23
Customer:	Glowforge Incorporated			**Temperature:**	21.7 °C
Attendees:	Jason Bluhm			**Humidity:**	37.5% RH
Project:	None			**Barometric Pres.:**	1029 mbar
Tested by:	Harry Zhao	**Power:**	120VAC/60Hz	**Job Site:**	NC06

TEST SPECIFICATIONS	**Test 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 offset connection between EUT and Spectrum analyzer: DC Block + 20 dB attenuator + measurement cable + patched coax cable = 22.63 dB.

DEVIATIONS FROM TEST STANDARD

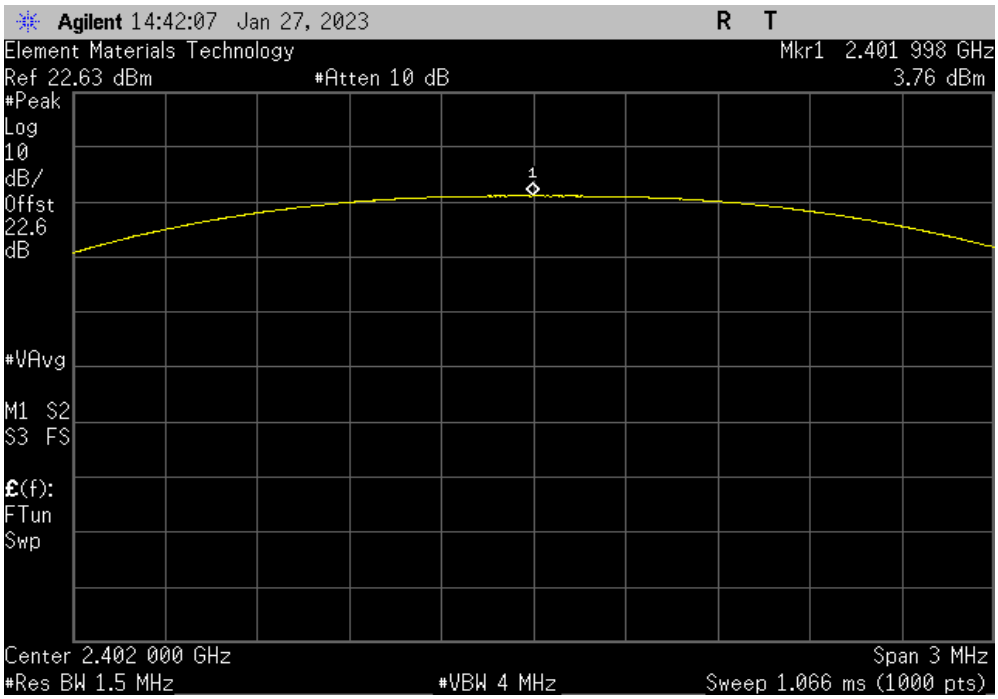
None

Configuration #	**2**	*Signature*

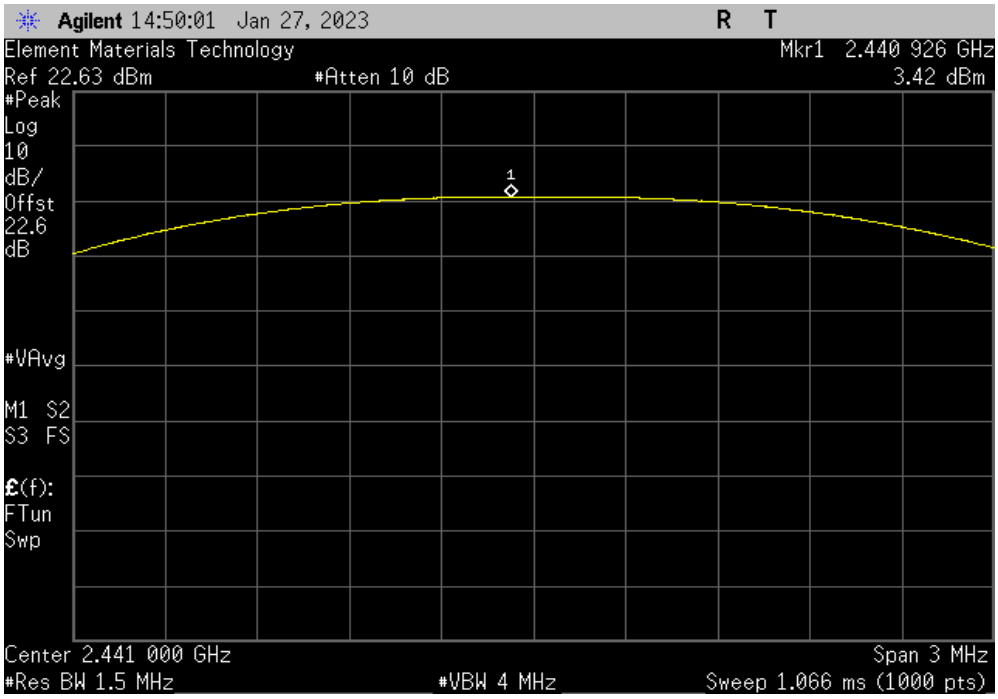
		Out Pwr (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Result
DH5, GFSK						
	Low Channel	3.764	4.9	8.664	27	Pass
	Mid Channel	3.423	4.9	8.323	27	Pass
	High Channel	2.895	4.9	7.795	27	Pass
2DH5, pi/4-DQPSK						
	Low Channel	4.773	4.9	9.673	27	Pass
	Mid Channel	4.585	4.9	9.485	27	Pass
	High Channel	4.118	4.9	9.018	27	Pass
3DH5, 8-DPSK						
	Low Channel	5.35	4.9	10.25	27	Pass
	Mid Channel	5.08	4.9	9.98	27	Pass
	High Channel	4.653	4.9	9.553	27	Pass

EQUIVALENT ISOTROPIC RADIATED POWER (EIRP)

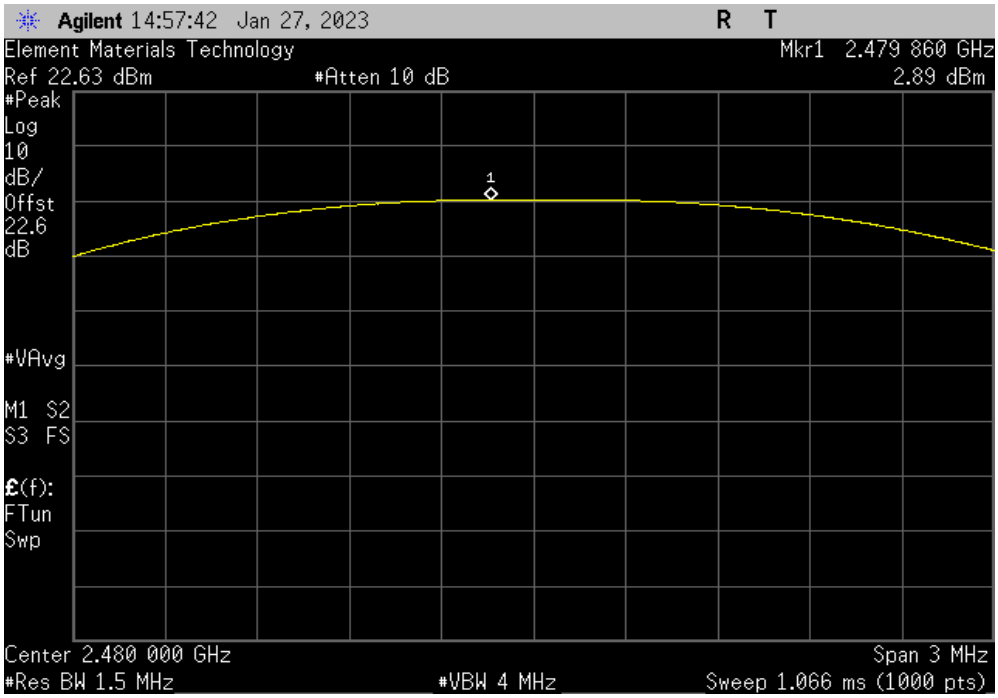
DH5, GFSK, Low Channel						
		Out Pwr (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Result
		3.764	4.9	8.664	27	Pass



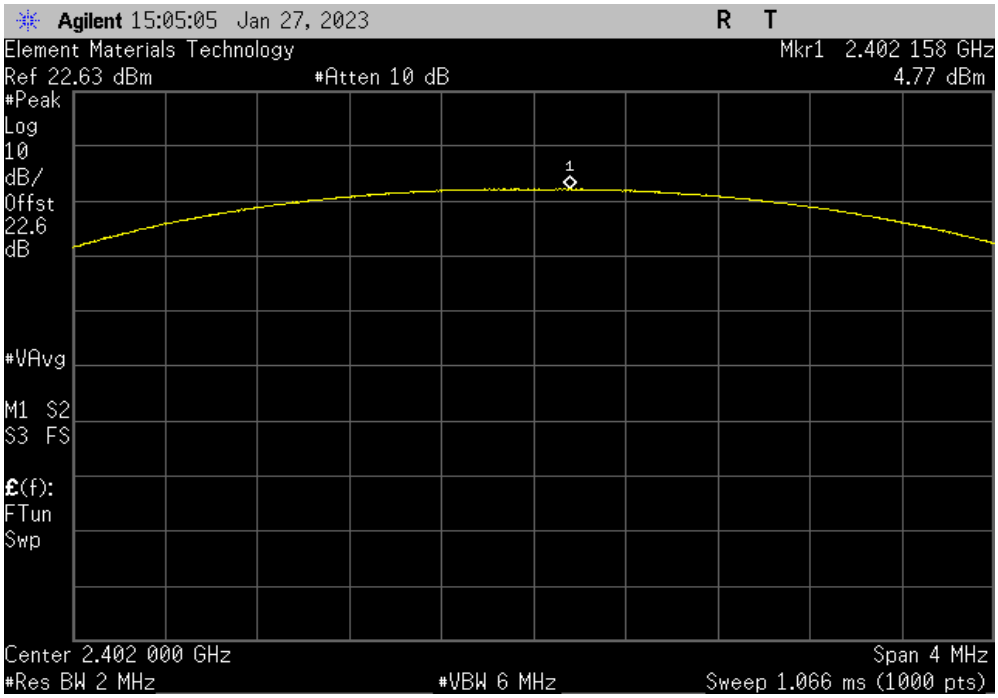
DH5, GFSK, Mid Channel						
		Out Pwr (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Result
		3.423	4.9	8.323	27	Pass



DH5, GFSK, High Channel						
		Out Pwr (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Result
		2.895	4.9	7.795	27	Pass

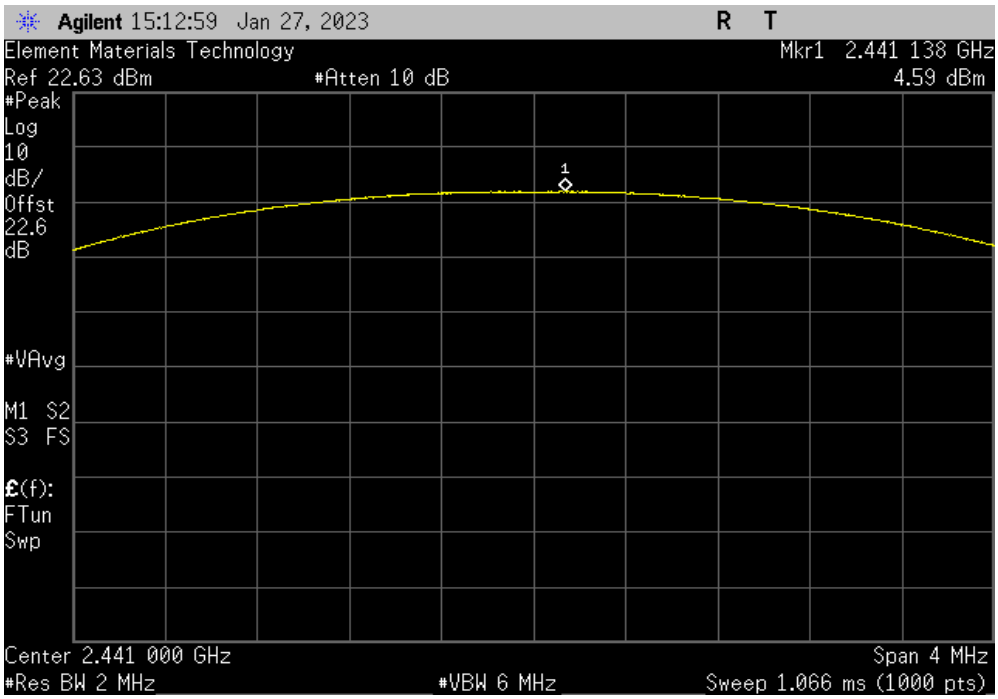


2DH5, pi/4-DQPSK, Low Channel						
		Out Pwr (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Result
		4.773	4.9	9.673	27	Pass

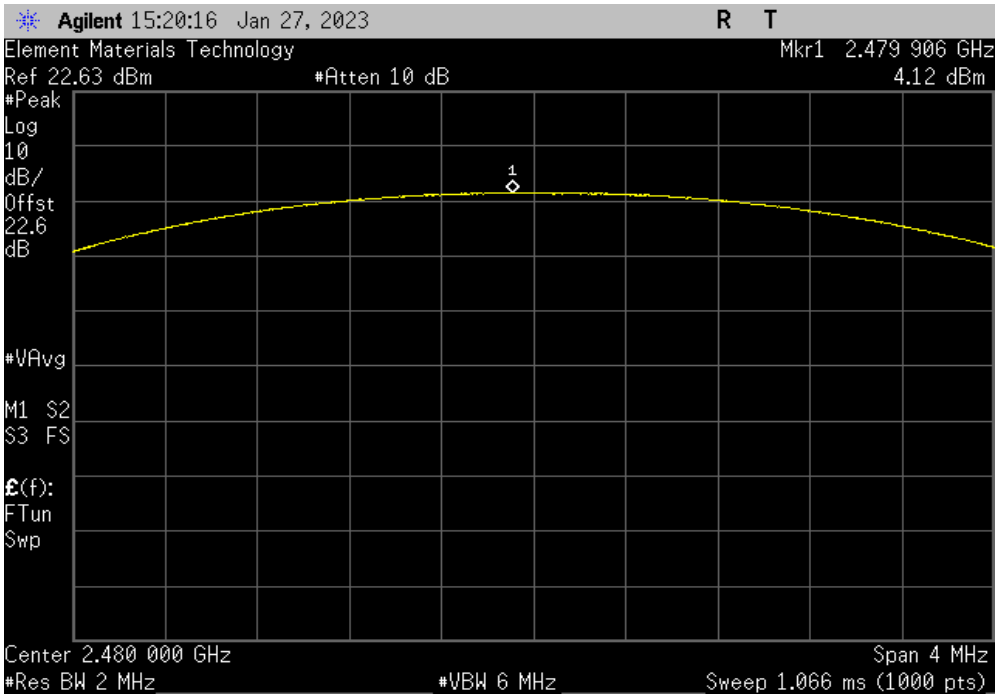


EQUIVALENT ISOTROPIC RADIATED POWER (EIRP)

2DH5, pi/4-DQPSK, Mid Channel						
		Out Pwr (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Result
		4.585	4.9	9.485	27	Pass

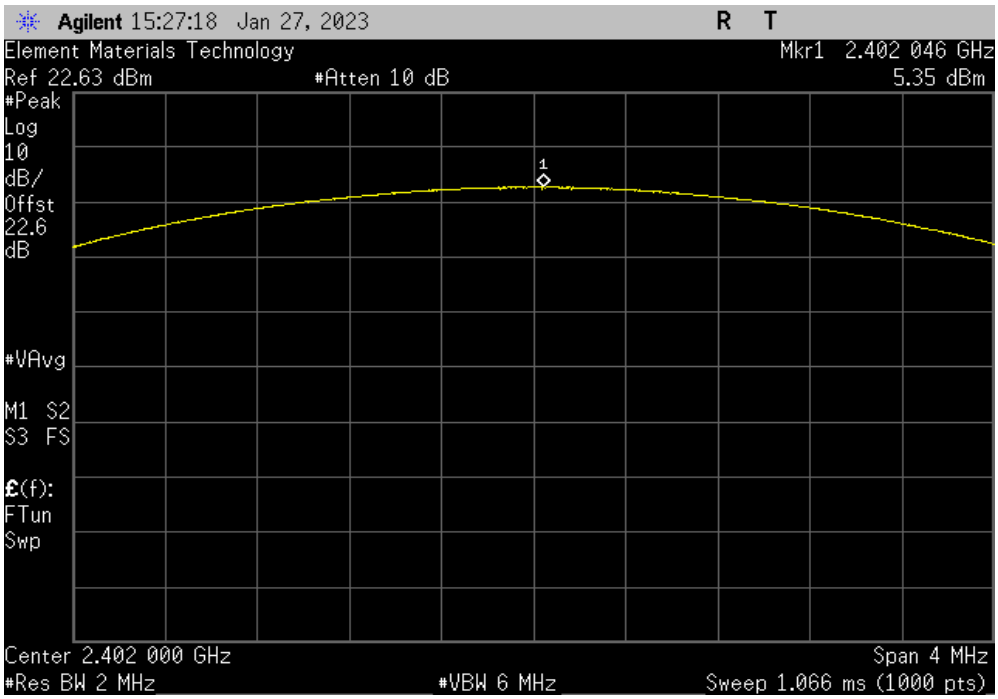


2DH5, pi/4-DQPSK, High Channel						
		Out Pwr (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Result
		4.118	4.9	9.018	27	Pass

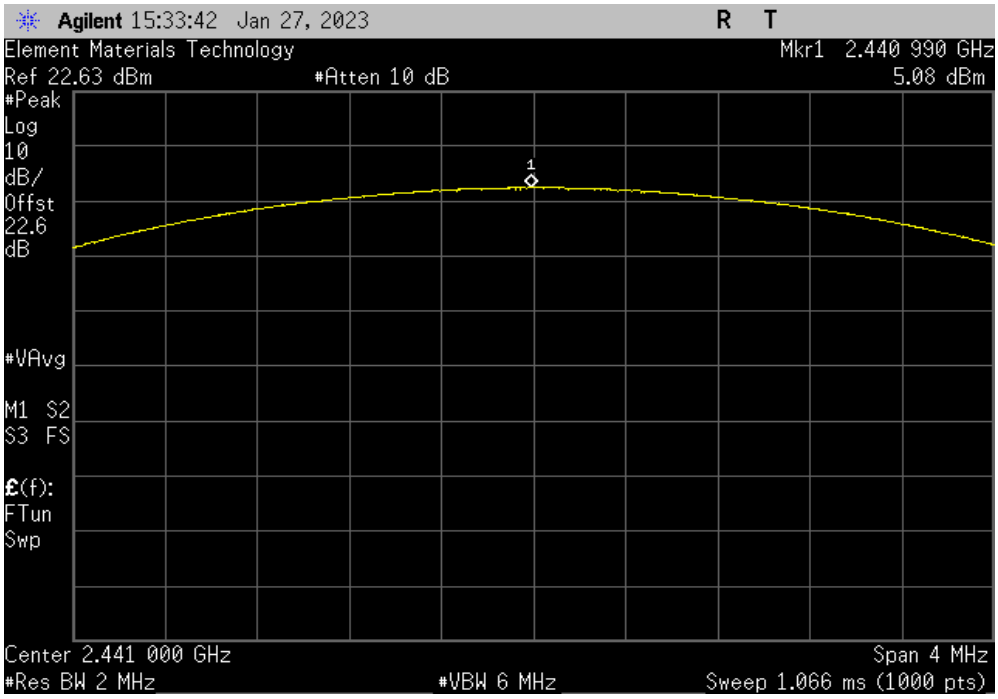


EQUIVALENT ISOTROPIC RADIATED POWER (EIRP)

3DH5, 8-DPSK, Low Channel						
		Out Pwr (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Result
		5.35	4.9	10.25	27	Pass



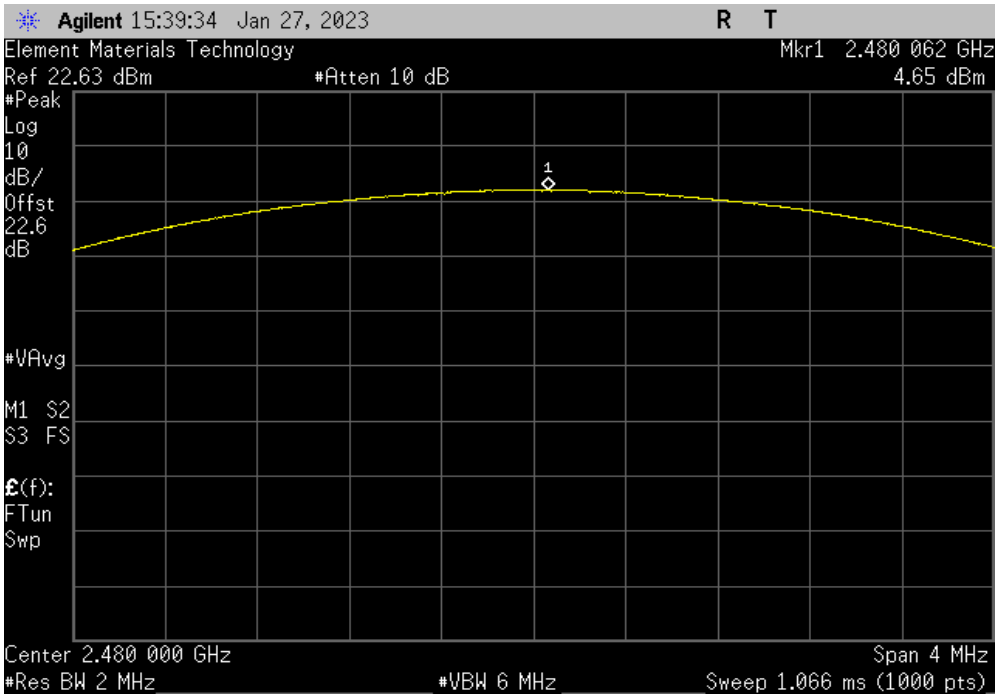
3DH5, 8-DPSK, Mid Channel						
		Out Pwr (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Result
		5.08	4.9	9.98	27	Pass



EQUIVALENT ISOTROPIC RADIATED POWER (EIRP)

TbtTx 2022.06.03.0 XMit 2022.02.07.0

3DH5, 8-DPSK, High Channel						
		Out Pwr (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Result
		4.653	4.9	9.553	27	Pass



BAND EDGE COMPLIANCE

XMit 2023.02.14.0

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
Cable	Micro-Coax	UFD150A-1-0720-200200	NCW	2023-01-18	2024-01-18
Attenuator	S.M. Electronics	SA18H-20	REK	2023-03-08	2024-03-08
Block - DC	Weinschel Corp.	7006	AMS	2023-01-18	2024-01-18
Analyzer - Spectrum Analyzer	Agilent	E4446A	AAT	2022-11-03	2023-11-03
Generator - Signal	Agilent	N5183A	TIA	2022-06-25	2024-06-25

TEST DESCRIPTION

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

The spurious RF conducted emissions at the edges of the authorized 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

TbtTx 2022.06.03.0 XMit 2023.02.14.0

EUT:	**GFD200**			**Work Order:**	**GLOW0038**
Serial Number:	**XB2-839**			**Date:**	**04/18/23**
Customer:	**Glowforge Incorporated**			**Temperature:**	**20.9°C**
Attendees:	**Jason Bluhm**			**Humidity:**	**34.7%**
Project:	**None**			**Barometric Pres.:**	**1012 mbar**
Tested by:	**Harry Zhao**	**Power:**	**120VAC/60Hz**	**Job Site:**	**NC06**

TEST SPECIFICATIONS	**Test 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 offset connection between EUT and Spectrum analyzer: DC Block + 20 dB attenuator + measurement cable + patched coax cable = 22.89 dB.

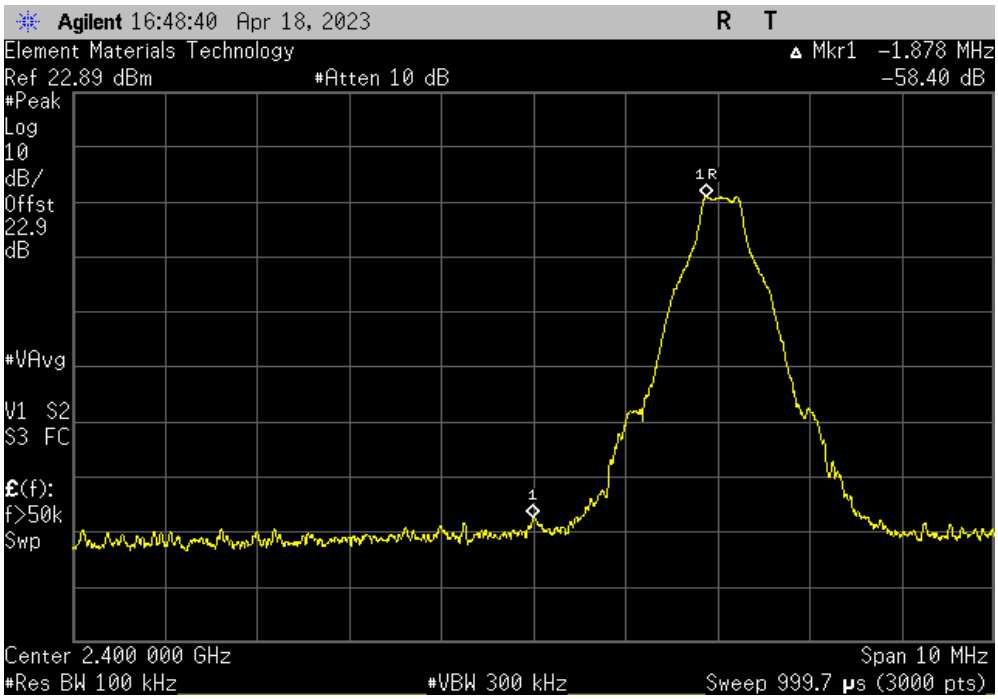
DEVIATIONS FROM TEST STANDARD

None

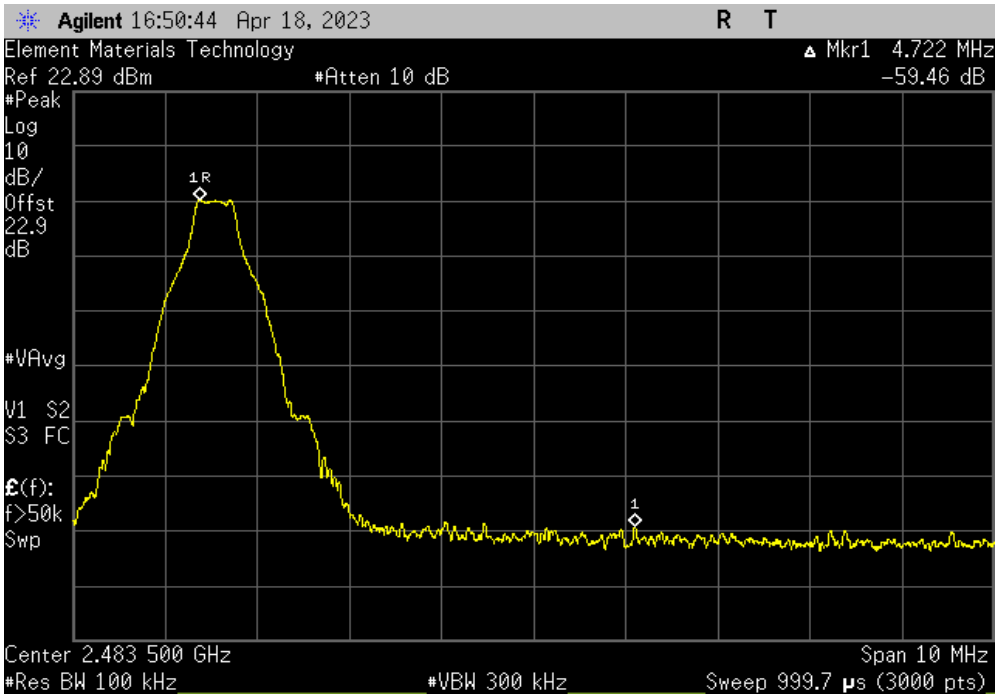
Configuration #	**2**	*Signature*

		Value (dBc)	**Limit ≤ (dBc)**	**Result**
DH5, GFSK				
	Low Channel, 2402 MHz	-58.4	-20	Pass
	High Channel, 2480 MHz	-59.46	-20	Pass
2DH5, pi/4-DQPSK				
	Low Channel, 2402 MHz	-53.38	-20	Pass
	High Channel, 2480 MHz	-60.03	-20	Pass
3DH5, 8-DPSK				
	Low Channel, 2402 MHz	-53.86	-20	Pass
	High Channel, 2480 MHz	-59.47	-20	Pass

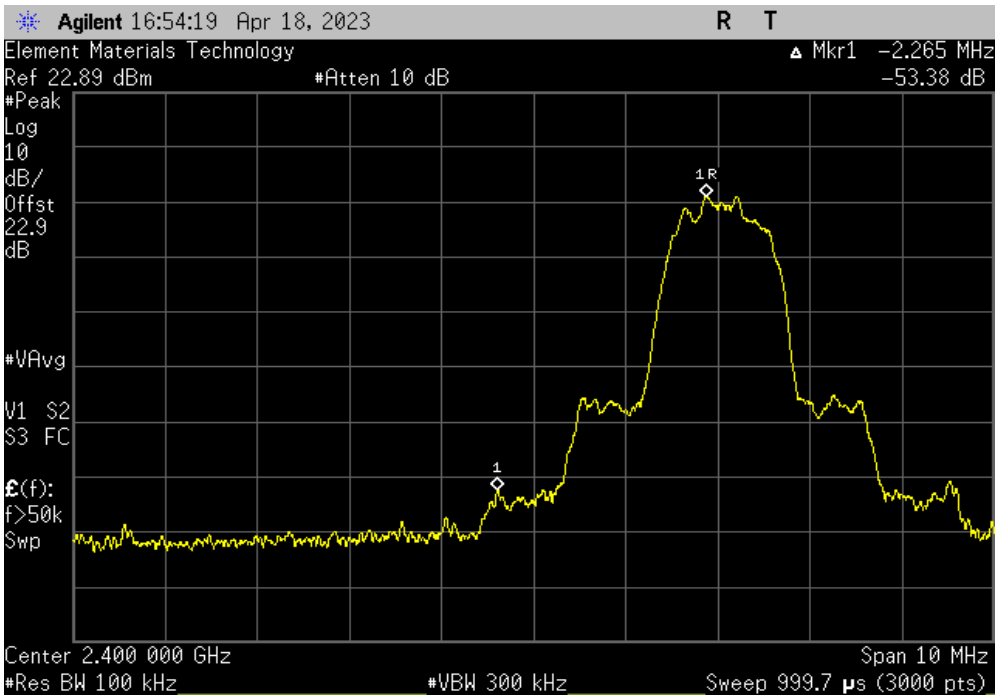
DH5, GFSK, Low Channel, 2402 MHz						
				Value (dBc)	Limit ≤ (dBc)	Result
				-58.4	-20	Pass



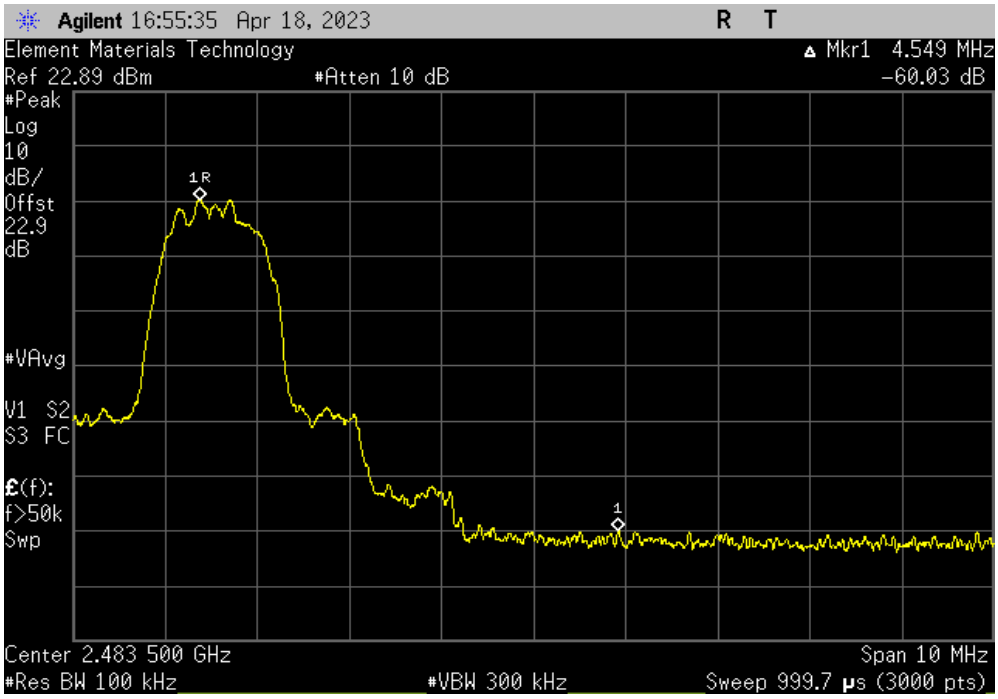
DH5, GFSK, High Channel, 2480 MHz						
				Value (dBc)	Limit ≤ (dBc)	Result
				-59.46	-20	Pass



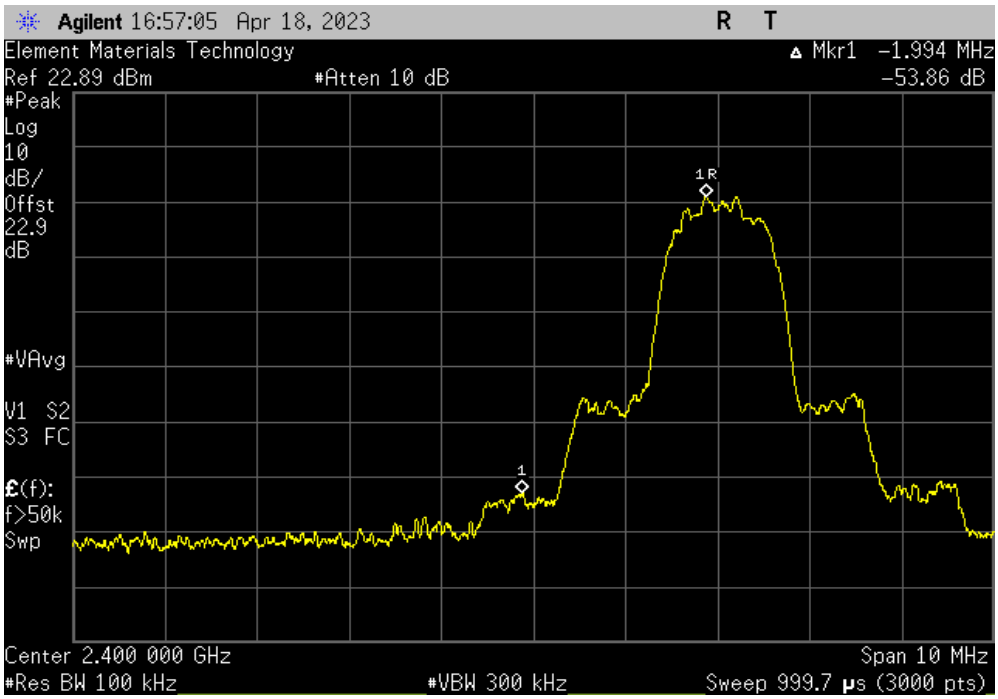
2DH5, pi/4-DQPSK, Low Channel, 2402 MHz						
				Value (dBc)	Limit ≤ (dBc)	Result
				-53.38	-20	Pass



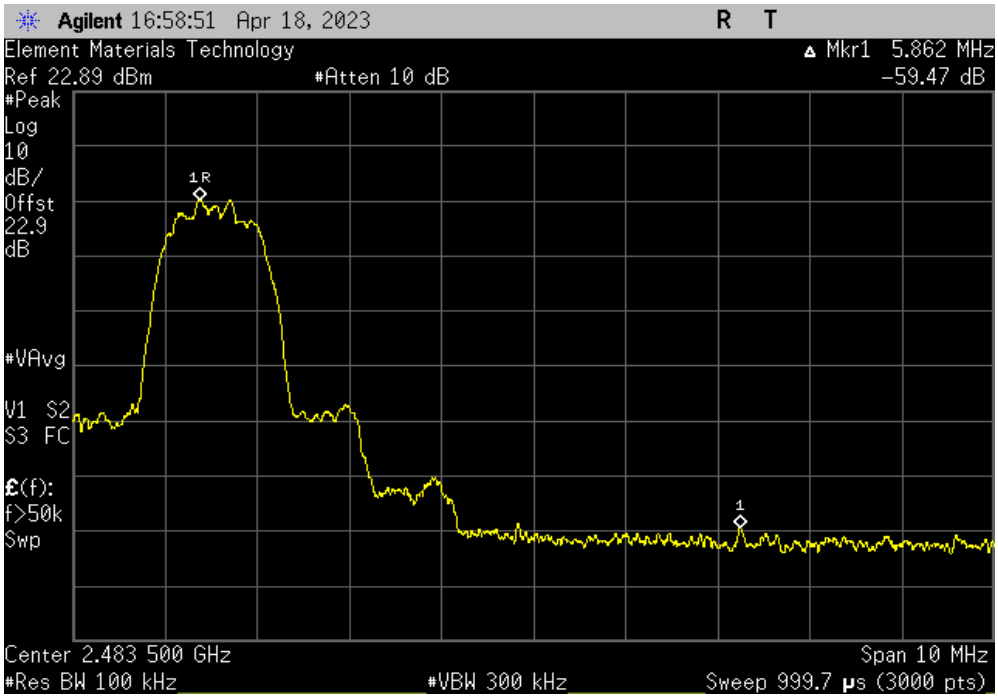
2DH5, pi/4-DQPSK, High Channel, 2480 MHz						
				Value (dBc)	Limit ≤ (dBc)	Result
				-60.03	-20	Pass



3DH5, 8-DPSK, Low Channel, 2402 MHz						
				Value (dBc)	Limit ≤ (dBc)	Result
				-53.86	-20	Pass



3DH5, 8-DPSK, High Channel, 2480 MHz						
				Value (dBc)	Limit ≤ (dBc)	Result
				-59.47	-20	Pass



BAND EDGE COMPLIANCE - HOPPING MODE

XMit 2022.02.07.0

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

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Attenuator	S.M. Electronics	SA18H-20	REK	2022-02-15	2023-02-15
Generator - Signal	Agilent	N5183A	TIA	2022-06-25	2024-06-25
Analyzer - Spectrum Analyzer	Agilent	E4440A	AAX	2023-01-19	2024-01-19
Block - DC	Weinschel Corp.	7006	AMS	2023-01-18	2024-01-18
Cable	Micro-Coax	UFD150A-1-0720-200200	NCW	2023-01-18	2024-01-18

TEST DESCRIPTION

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

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

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

BAND EDGE COMPLIANCE - HOPPING MODE

TbtTx 2022.06.03.0 XMit 2022.02.07.0

EUT:	**GFD200**			**Work Order:**	**GLOW0038**
Serial Number:	**XB2-839**			**Date:**	**1-Feb-23**
Customer:	**Glowforge Incorporated**			**Temperature:**	**20.7 °C**
Attendees:	**Jason Bluhm**			**Humidity:**	**39.1% RH**
Project:	**None**			**Barometric Pres.:**	**1030 mbar**
Tested by:	**Harry Zhao**	**Power:**	**120VAC/60Hz**	**Job Site:**	**NC06**

TEST SPECIFICATIONS	**Test 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 offset connection between EUT and Spectrum analyzer: DC Block + 20 dB attenuator + measurement cable + patched coax cable = 22.63 dB.

DEVIATIONS FROM TEST STANDARD

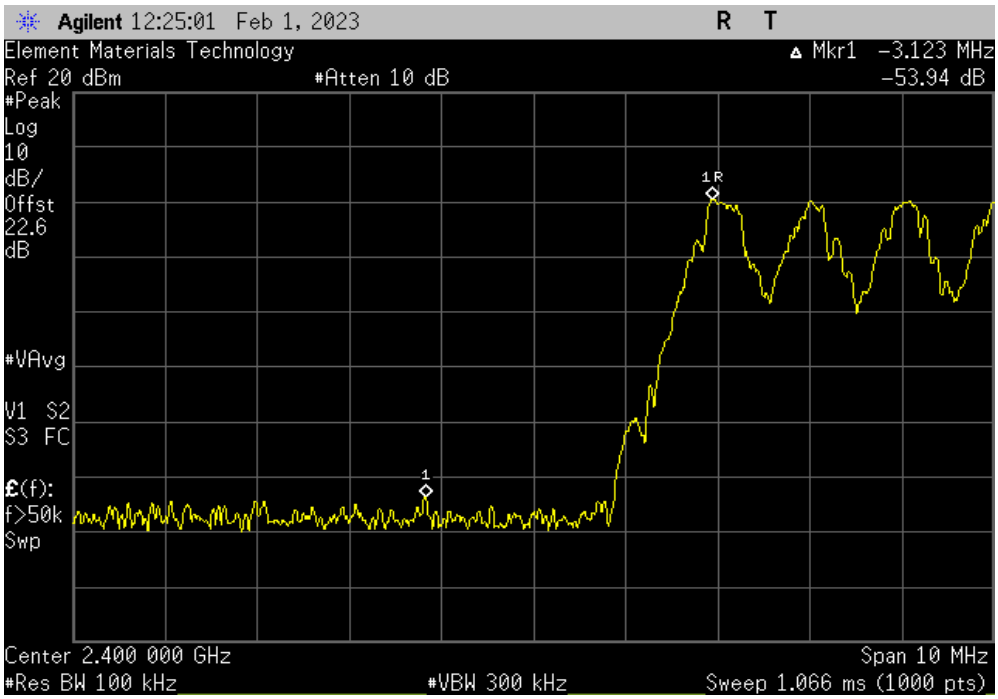
None

Configuration #	**2**	*Signature*

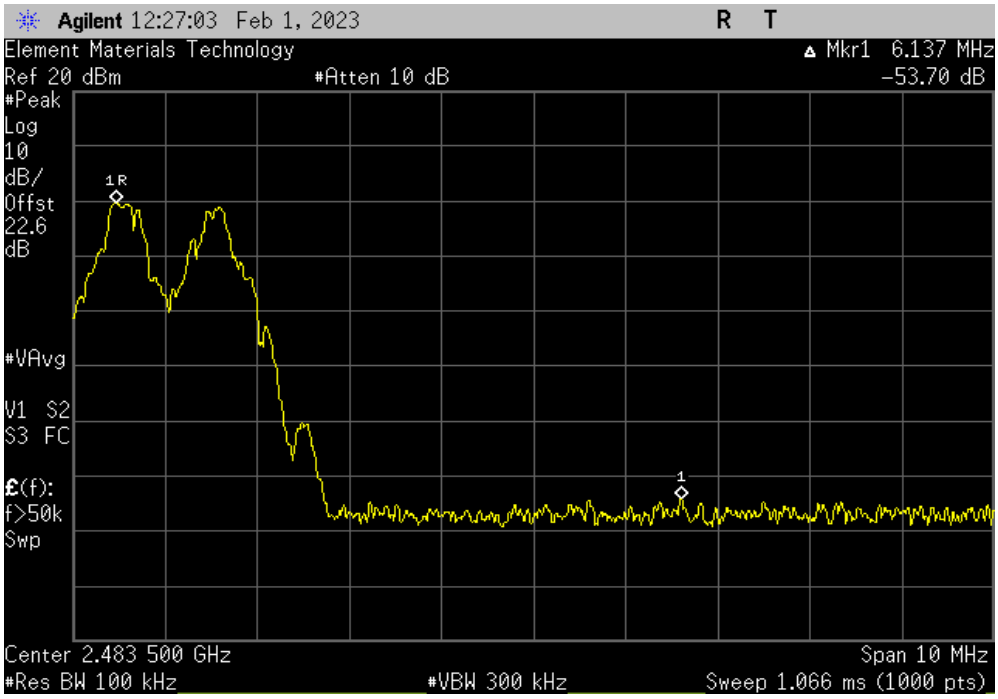
		Value (dBc)	**Limit ≤ (dBc)**	**Result**
DH5, GFSK				
	Low Channel	-53.94	-20	Pass
	High Channel	-53.7	-20	Pass
2DH5, pi/4-DQPSK				
	Low Channel	-53.52	-20	Pass
	High Channel	-54.49	-20	Pass
3DH5, 8-DPSK				
	Low Channel	-55.92	-20	Pass
	High Channel	-54.17	-20	Pass

BAND EDGE COMPLIANCE - HOPPING MODE

DH5, GFSK, Low Channel						
				Value (dBc)	Limit ≤ (dBc)	Result
				-53.94	-20	Pass

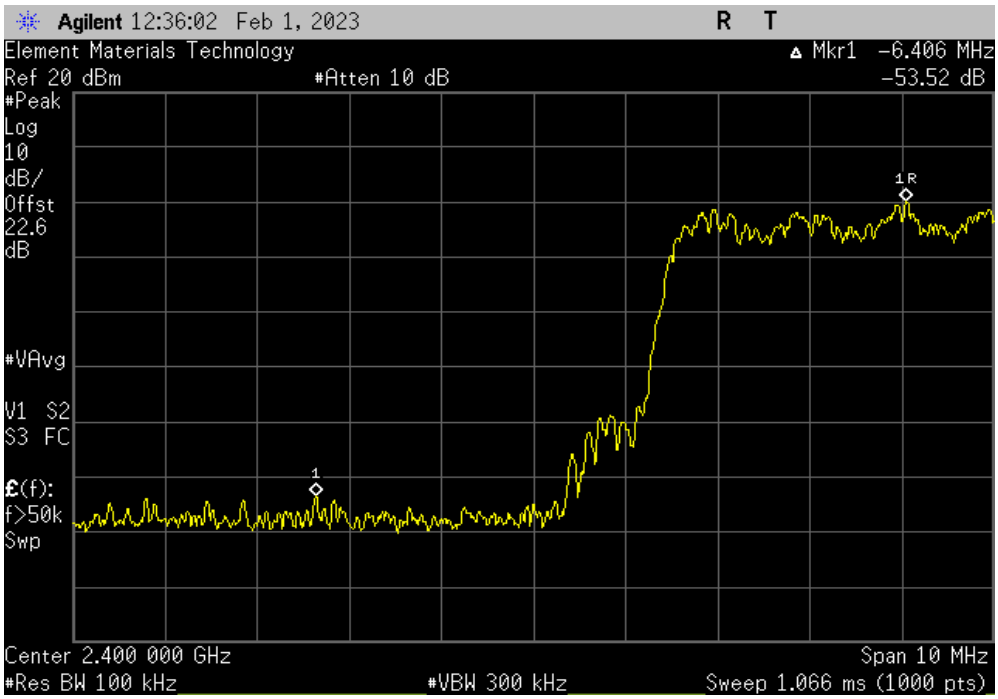


DH5, GFSK, High Channel						
				Value (dBc)	Limit ≤ (dBc)	Result
				-53.7	-20	Pass

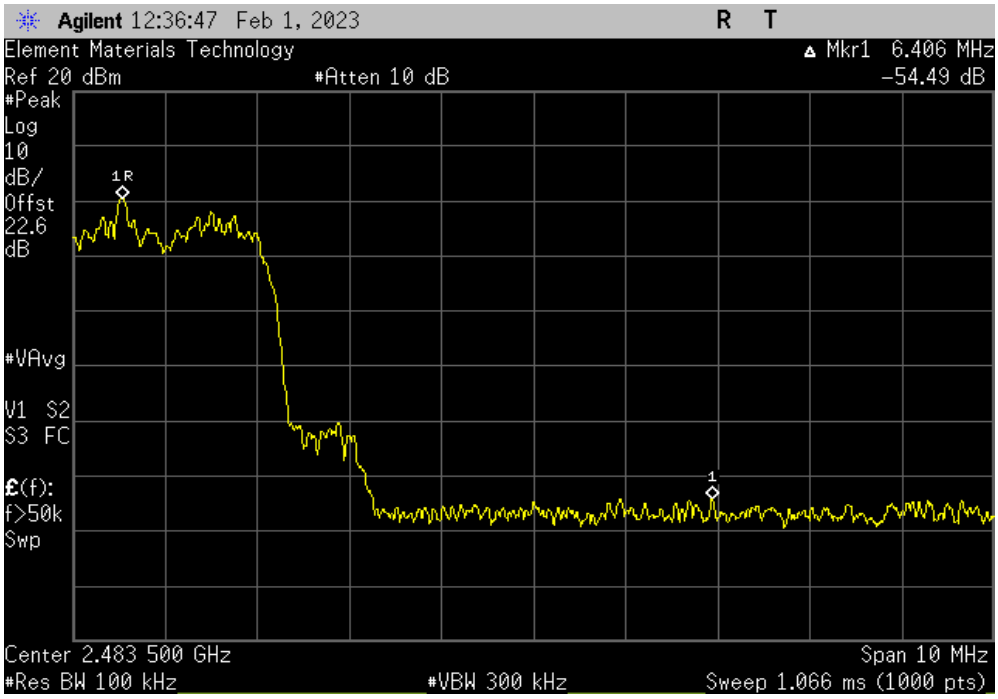


BAND EDGE COMPLIANCE - HOPPING MODE

2DH5, pi/4-DQPSK, Low Channel						
				Value (dBc)	Limit ≤ (dBc)	Result
				-53.52	-20	Pass

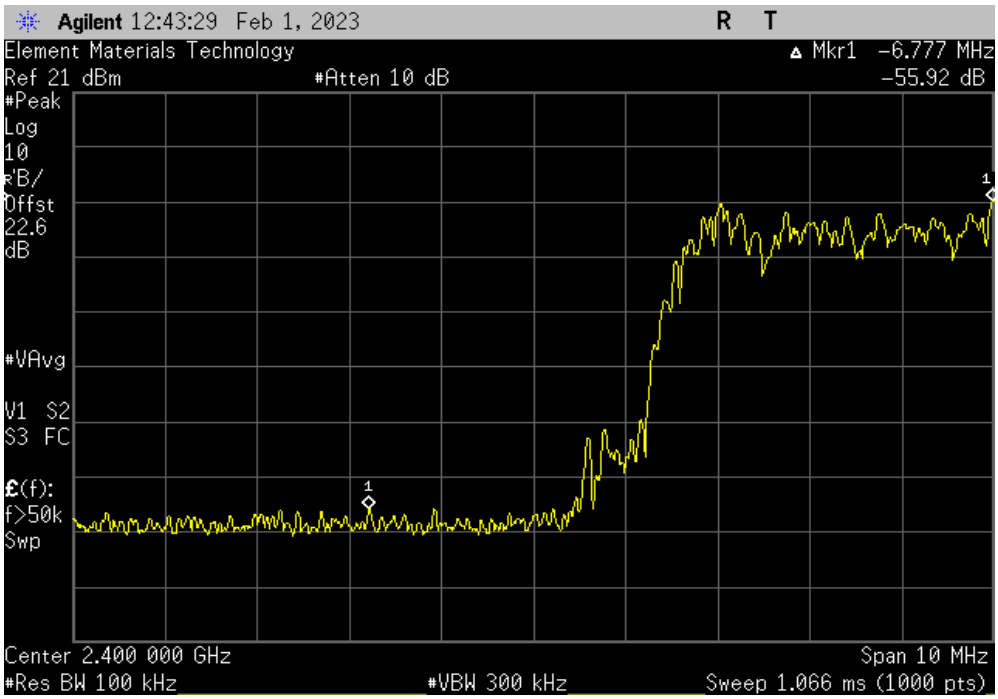


2DH5, pi/4-DQPSK, High Channel						
				Value (dBc)	Limit ≤ (dBc)	Result
				-54.49	-20	Pass

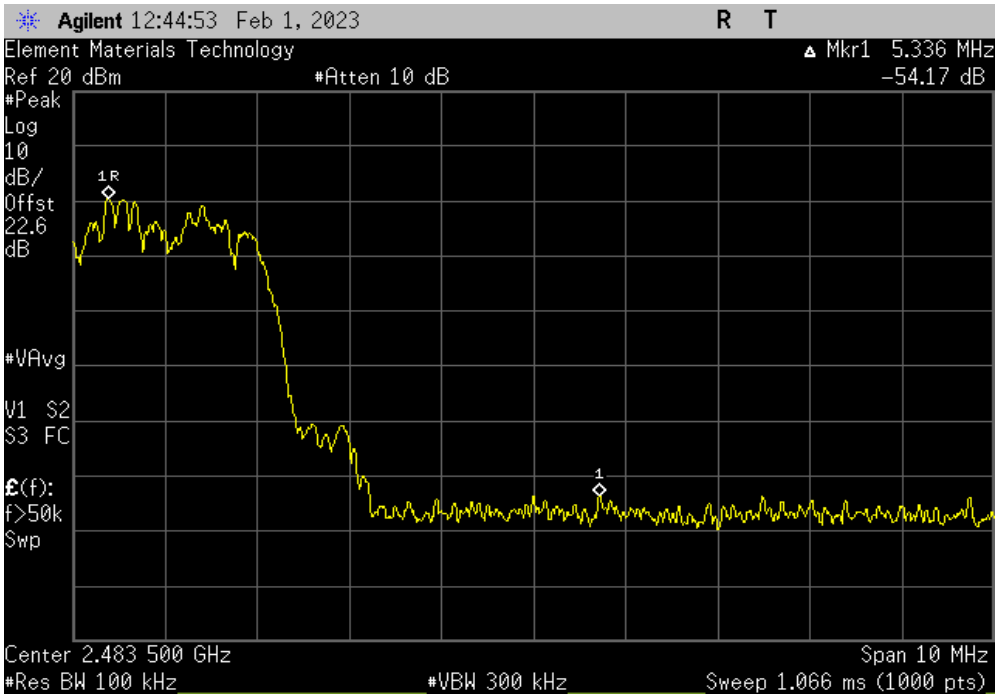


BAND EDGE COMPLIANCE - HOPPING MODE

3DH5, 8-DPSK, Low Channel						
				Value (dBc)	Limit ≤ (dBc)	Result
				-55.92	-20	Pass



3DH5, 8-DPSK, High Channel						
				Value (dBc)	Limit ≤ (dBc)	Result
				-54.17	-20	Pass



SPURIOUS CONDUCTED EMISSIONS

XMit 2022.02.07.0

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

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Attenuator	S.M. Electronics	SA18H-20	REK	2022-02-15	2023-02-15
Cable	Micro-Coax	UFD150A-1-0720-200200	NCW	2023-01-18	2024-01-18
Analyzer - Spectrum Analyzer	Agilent	E4440A	AAX	2023-01-19	2024-01-19
Block - DC	Weinschel Corp.	7006	AMS	2023-01-18	2024-01-18
Generator - Signal	Agilent	N5183A	TIA	2022-06-25	2024-06-25

TEST DESCRIPTION

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

The spurious RF conducted emissions 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 in a no-hop mode. For each transmit frequency, the fundamental was measured with a 100 kHz resolution bandwidth and the highest value was recorded. The rest of the spectrum was then measured with a 100 kHz resolution bandwidth and the highest value was found. The difference between the value found on the fundamental and the rest of the spectrum was compared against the limit to determine compliance.

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

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

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

SPURIOUS CONDUCTED EMISSIONS

TbtTx 2022.06.03.0 XMit 2022.02.07.0

EUT:	**GFD200**			**Work Order:**	**GLOW0038**
Serial Number:	**XB2-839**			**Date:**	**27-Jan-23**
Customer:	**Glowforge Incorporated**			**Temperature:**	**21 °C**
Attendees:	**Jason Bluhm**			**Humidity:**	**38.7% RH**
Project:	**None**			**Barometric Pres.:**	**1029 mbar**
Tested by:	**Harry Zhao**	**Power:**	**120VAC/60Hz**	**Job Site:**	**NC06**

TEST SPECIFICATIONS	**Test 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 offset connection between EUT and Spectrum analyzer: DC Block + 20 dB attenuator + measurement cable + patched coax cable = 22.63 dB.

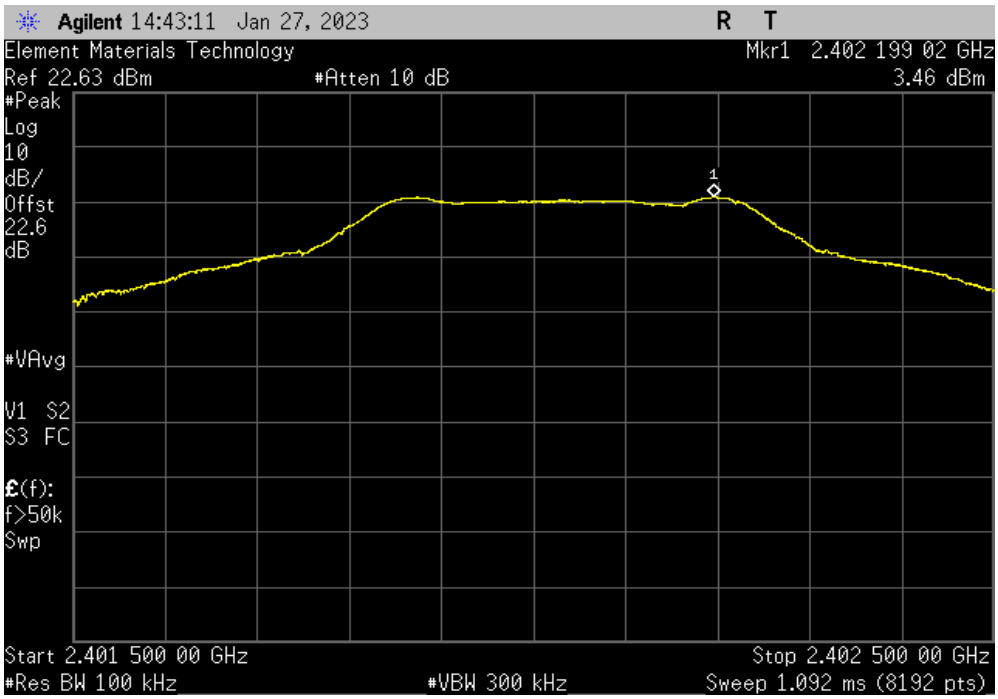
DEVIATIONS FROM TEST STANDARD

None

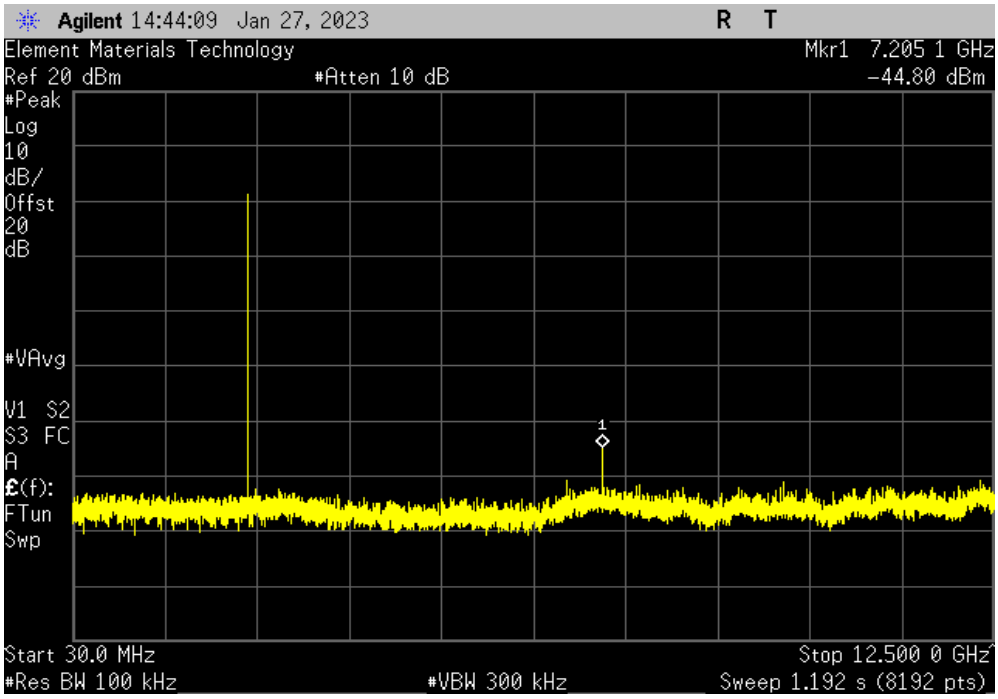
Configuration #	**2**	*Signature*

		Frequency Range	Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
DH5, GFSK						
	Low Channel	Fundamental	2402.2	N/A	N/A	N/A
	Low Channel	30 MHz - 12.5 GHz	7205.1	-48.26	-20	Pass
	Low Channel	12.5 GHz - 25 GHz	24246.1	-50.59	-20	Pass
	Mid Channel	Fundamental	2440.87	N/A	N/A	N/A
	Mid Channel	30 MHz - 12.5 GHz	7322.3	-48.65	-20	Pass
	Mid Channel	12.5 GHz - 25 GHz	24955.7	-49.09	-20	Pass
	High Channel	Fundamental	2480.2	N/A	N/A	N/A
	High Channel	30 MHz - 12.5 GHz	7439.5	-47.76	-20	Pass
	High Channel	12.5 GHz - 25 GHz	24501	-48.48	-20	Pass
2DH5, pi/4-DQPSK						
	Low Channel	Fundamental	2402.2	N/A	N/A	N/A
	Low Channel	30 MHz - 12.5 GHz	7205.1	-48.24	-20	Pass
	Low Channel	12.5 GHz - 25 GHz	22799.4	-50.14	-20	Pass
	Mid Channel	Fundamental	2440.87	N/A	N/A	N/A
	Mid Channel	30 MHz - 12.5 GHz	7323.8	-51.09	-20	Pass
	Mid Channel	12.5 GHz - 25 GHz	23341.2	-49.82	-20	Pass
	High Channel	Fundamental	2479.87	N/A	N/A	N/A
	High Channel	30 MHz - 12.5 GHz	7441.1	-48.6	-20	Pass
	High Channel	12.5 GHz - 25 GHz	13966.5	-49.51	-20	Pass
3DH5, 8-DPSK						
	Low Channel	Fundamental	2401.87	N/A	N/A	N/A
	Low Channel	30 MHz - 12.5 GHz	7206.6	-49.64	-20	Pass
	Low Channel	12.5 GHz - 25 GHz	24189.7	-50.12	-20	Pass
	Mid Channel	Fundamental	2440.87	N/A	N/A	N/A
	Mid Channel	30 MHz - 12.5 GHz	7322.3	-49.13	-20	Pass
	Mid Channel	12.5 GHz - 25 GHz	24034	-49.39	-20	Pass
	High Channel	Fundamental	2479.87	N/A	N/A	N/A
	High Channel	30 MHz - 12.5 GHz	7439.5	-47.16	-20	Pass
	High Channel	12.5 GHz - 25 GHz	23863.1	-48.5	-20	Pass

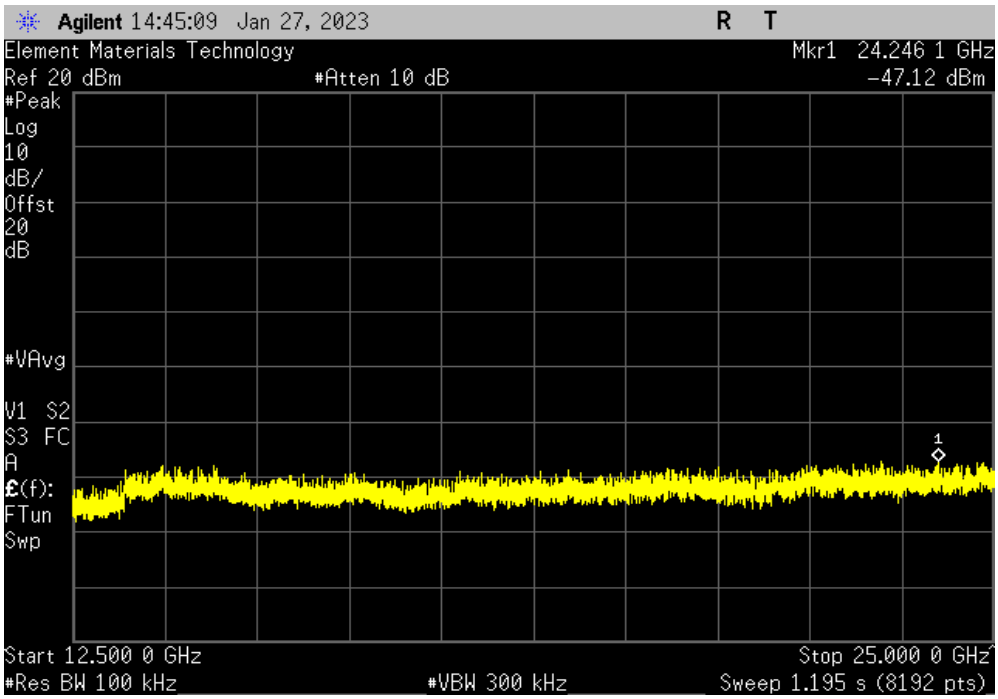
DH5, GFSK, Low Channel						
	Frequency Range		Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
	Fundamental		2402.2	N/A	N/A	N/A



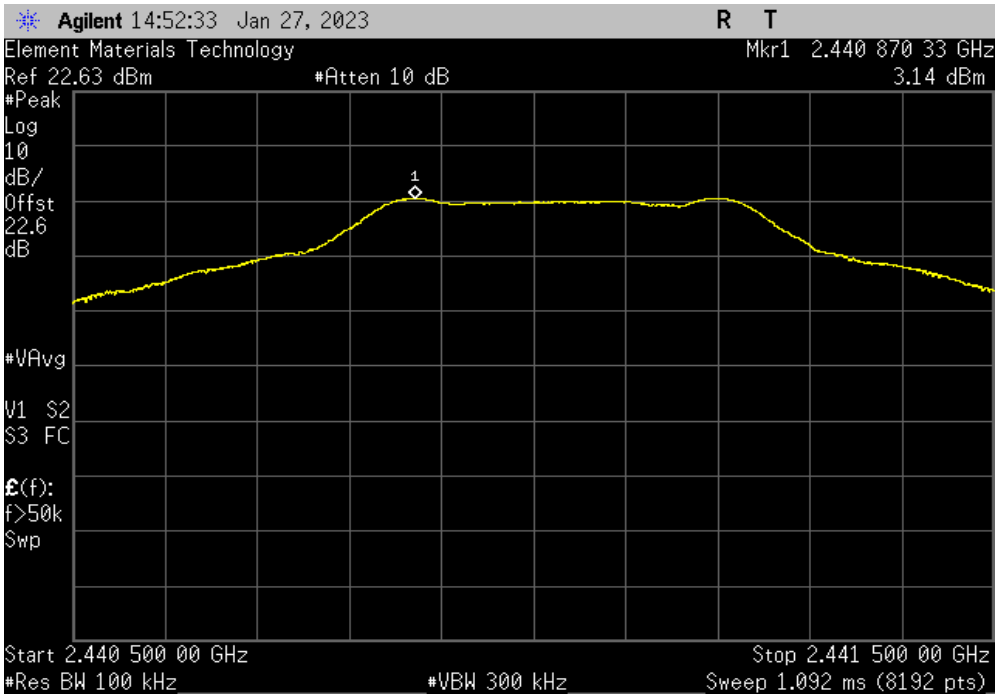
DH5, GFSK, Low Channel					
Frequency Range	Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
30 MHz - 12.5 GHz	7205.1	-48.26	-20	Pass



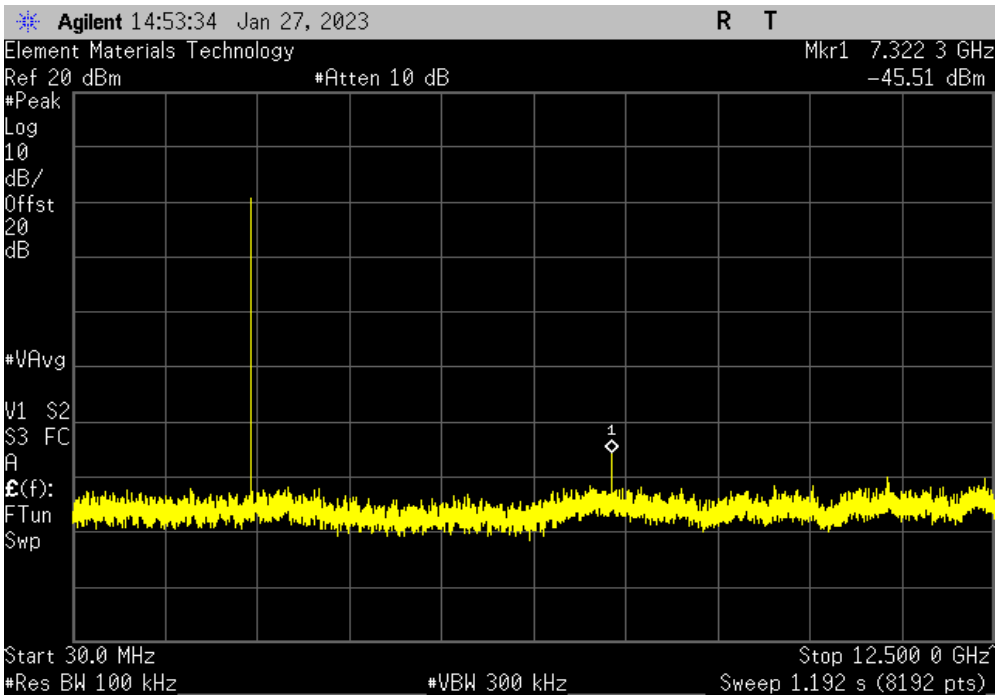
DH5, GFSK, Low Channel				
Frequency Range	Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
12.5 GHz - 25 GHz	24246.1	-50.59	-20	Pass



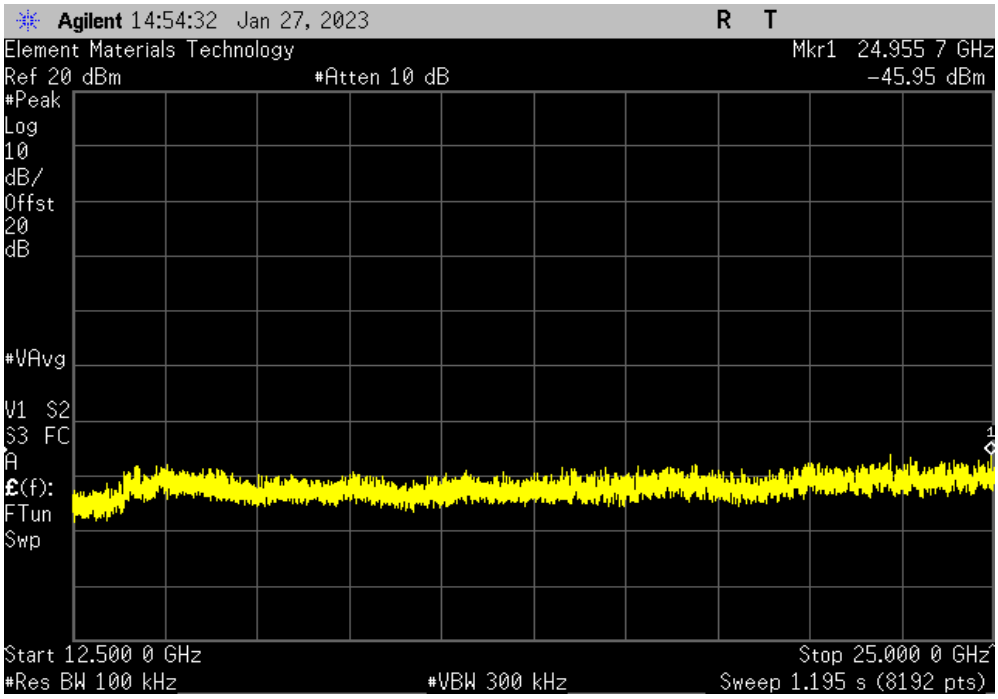
DH5, GFSK, Mid Channel					
Frequency Range		Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
	Fundamental	2440.87	N/A	N/A	N/A



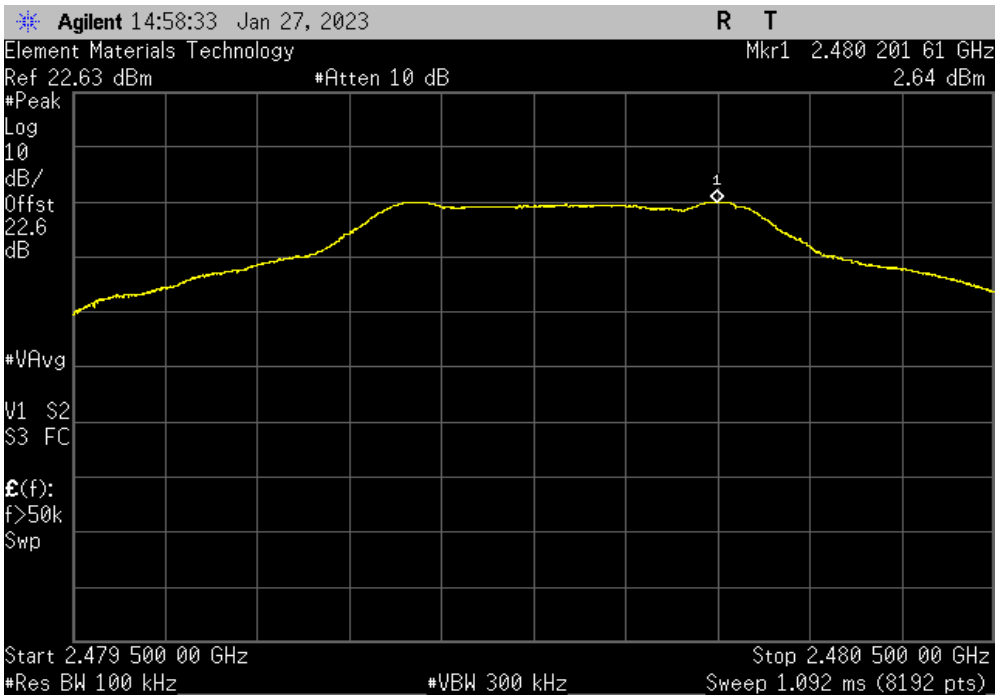
DH5, GFSK, Mid Channel				
Frequency Range	**Measured Freq (MHz)**	**Max Value (dBc)**	**Limit ≤ (dBc)**	**Result**
30 MHz - 12.5 GHz	7322.3	-48.65	-20	Pass



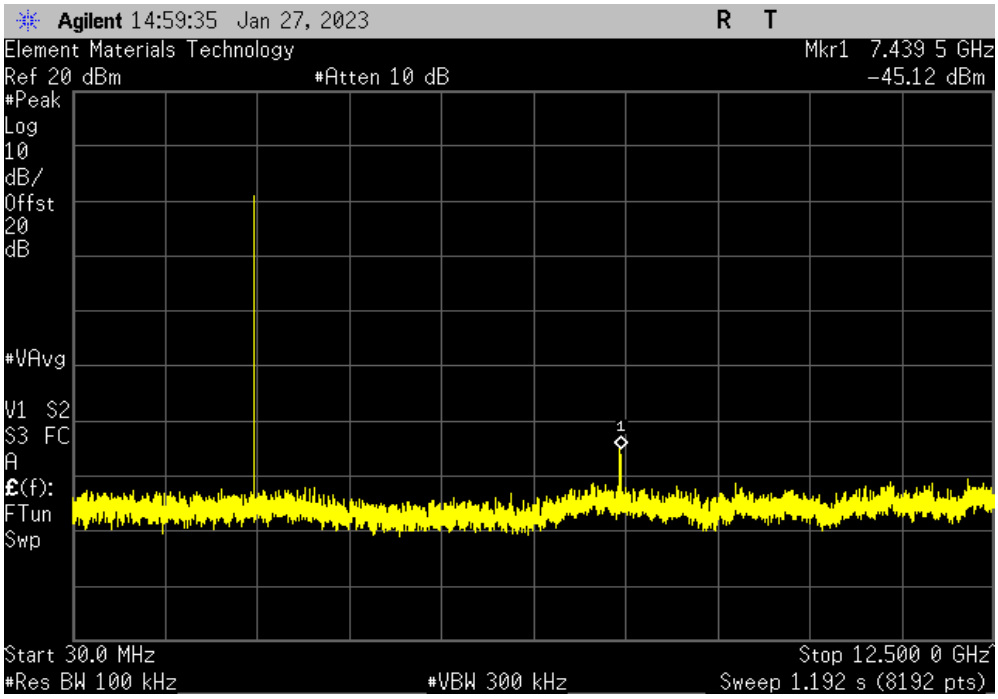
DH5, GFSK, Mid Channel				
Frequency Range	**Measured Freq (MHz)**	**Max Value (dBc)**	**Limit ≤ (dBc)**	**Result**
12.5 GHz - 25 GHz	24955.7	-49.09	-20	Pass



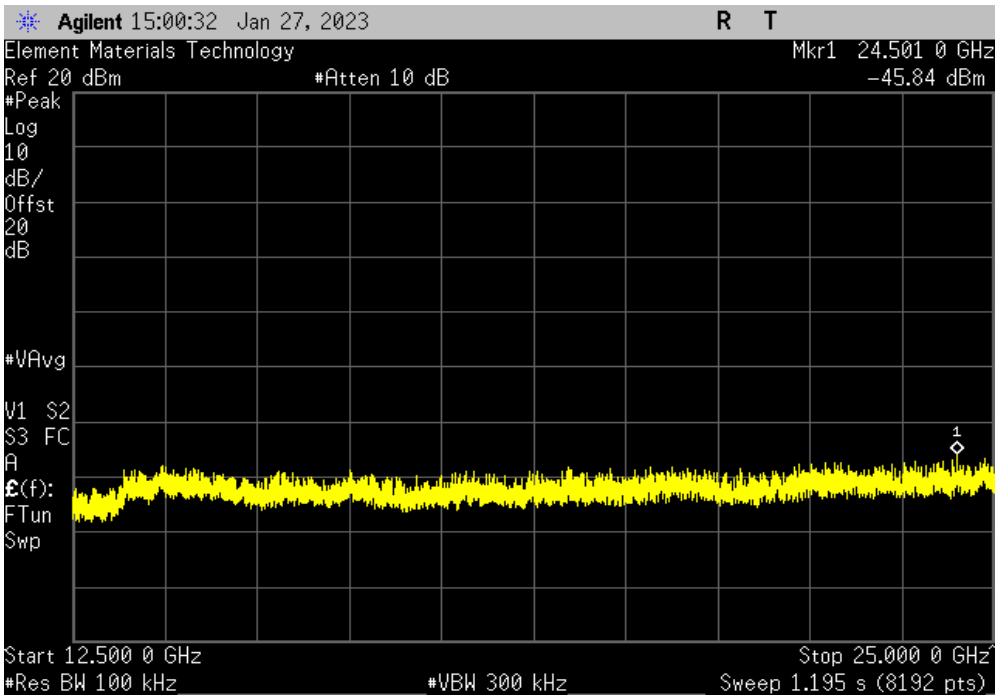
DH5, GFSK, High Channel					
Frequency Range		Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
	Fundamental	2480.2	N/A	N/A	N/A



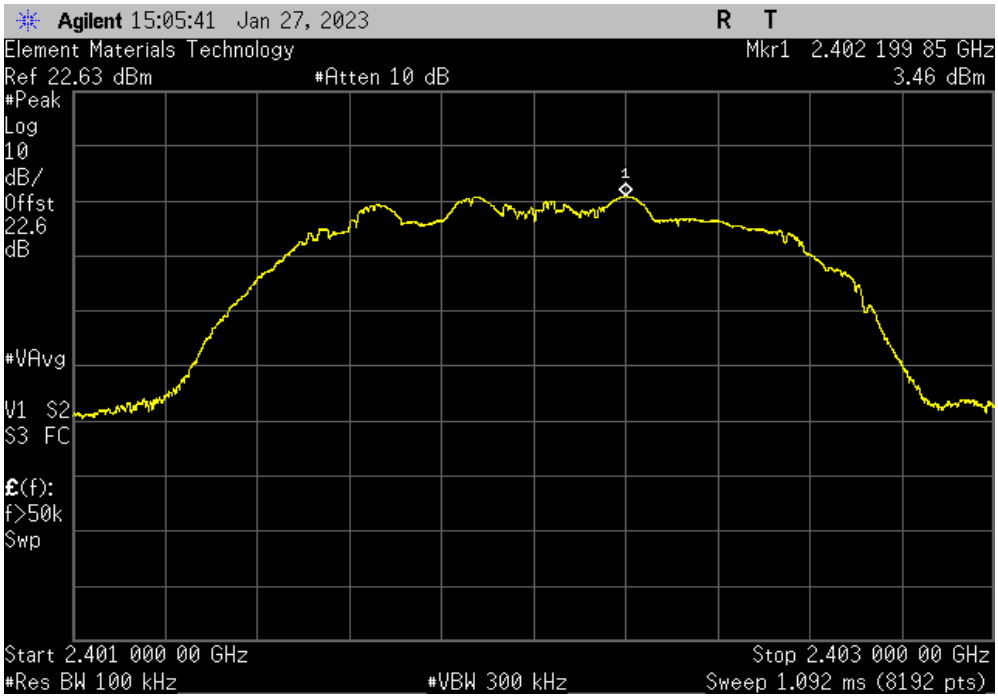
DH5, GFSK, High Channel				
Frequency Range	Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
30 MHz - 12.5 GHz	7439.5	-47.76	-20	Pass



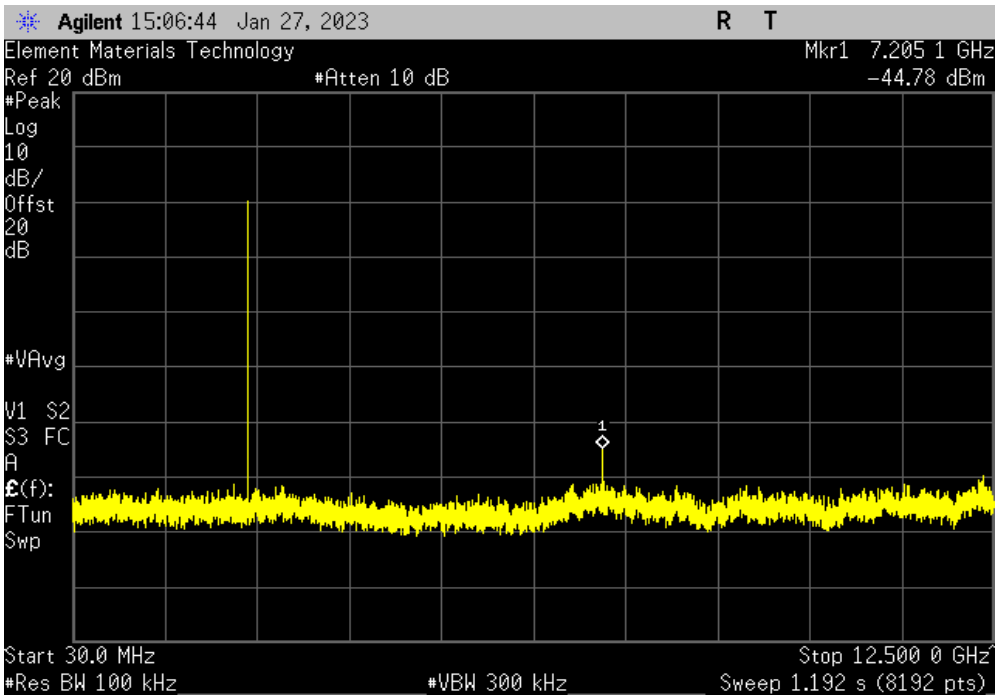
DH5, GFSK, High Channel				
Frequency Range	**Measured Freq (MHz)**	**Max Value (dBc)**	**Limit ≤ (dBc)**	**Result**
12.5 GHz - 25 GHz	24501	-48.48	-20	Pass



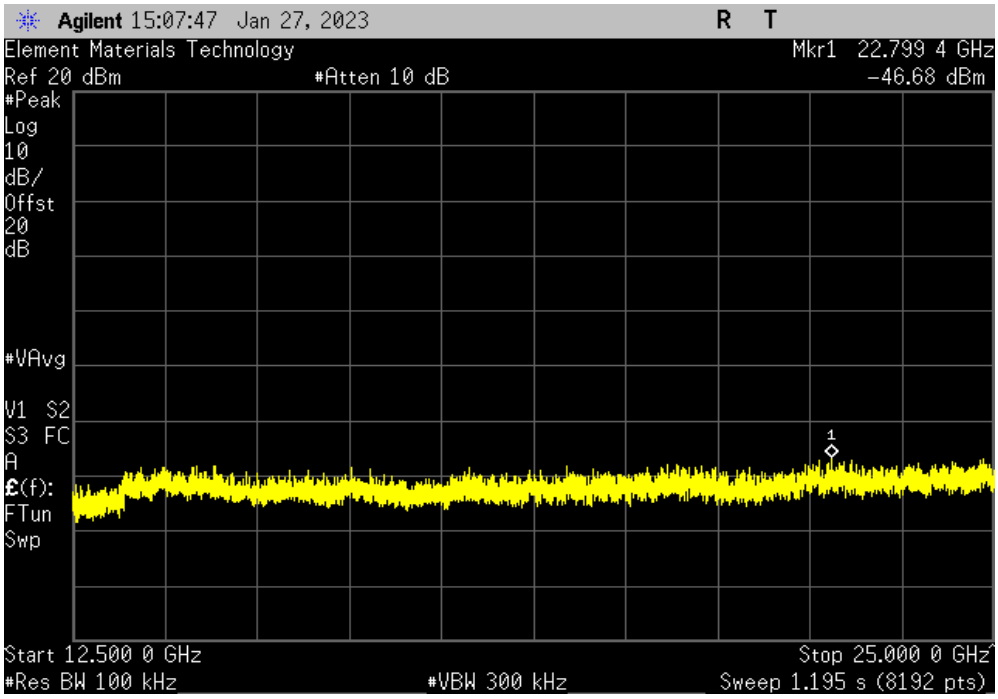
2DH5, pi/4-DQPSK, Low Channel					
Frequency Range		**Measured Freq (MHz)**	**Max Value (dBc)**	**Limit ≤ (dBc)**	**Result**
	Fundamental	2402.2	N/A	N/A	N/A



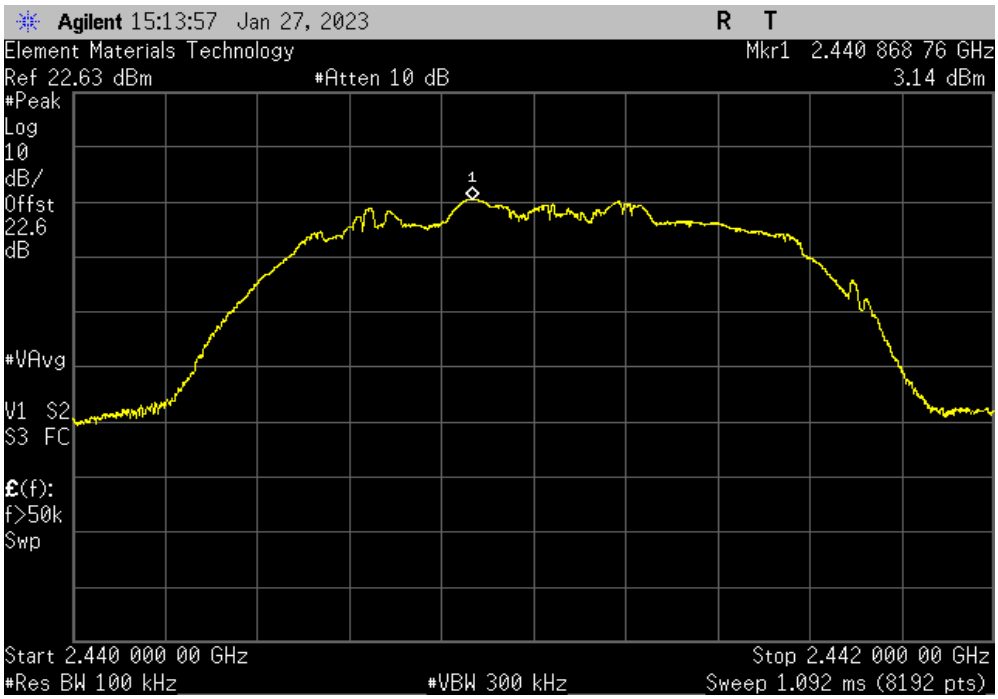
2DH5, pi/4-DQPSK, Low Channel				
Frequency Range	**Measured Freq (MHz)**	**Max Value (dBc)**	**Limit ≤ (dBc)**	**Result**
30 MHz - 12.5 GHz	7205.1	-48.24	-20	Pass



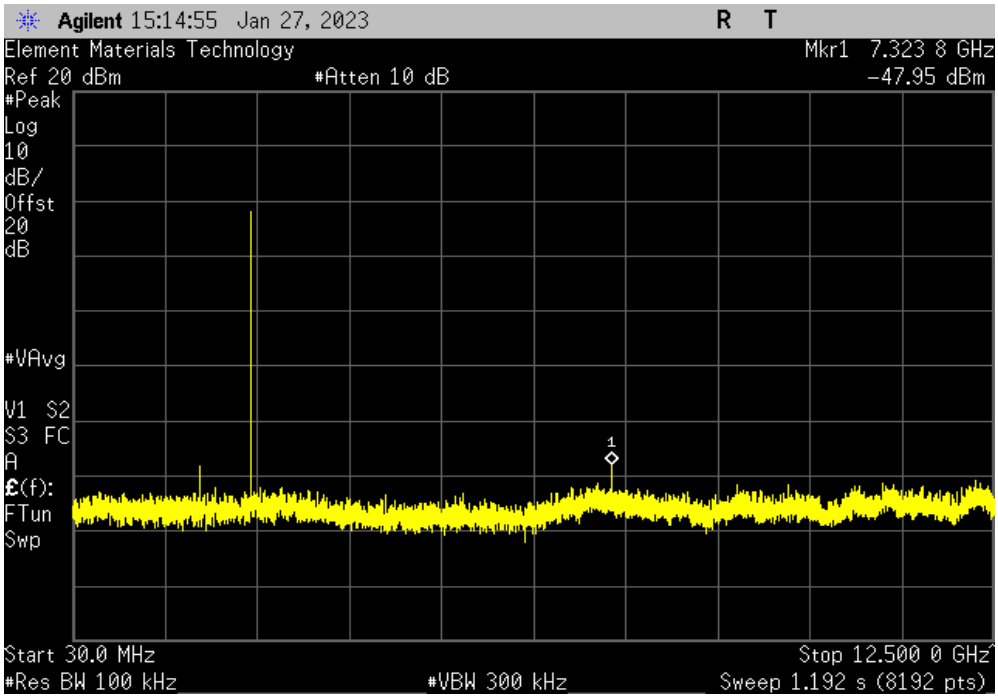
2DH5, pi/4-DQPSK, Low Channel				
Frequency Range	**Measured Freq (MHz)**	**Max Value (dBc)**	**Limit ≤ (dBc)**	**Result**
12.5 GHz - 25 GHz	22799.4	-50.14	-20	Pass



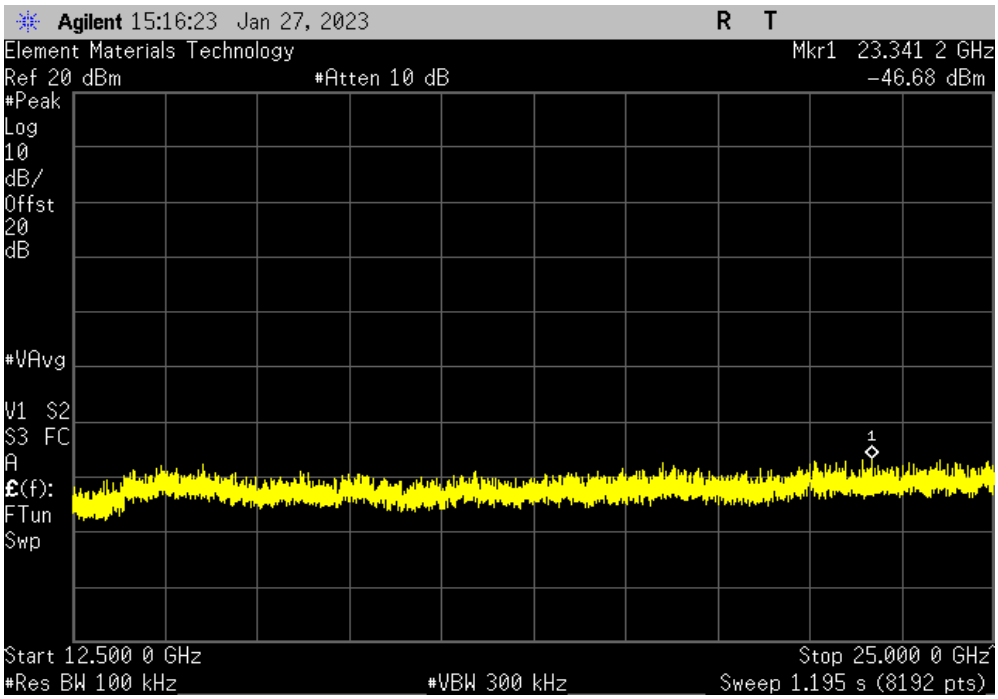
2DH5, pi/4-DQPSK, Mid Channel					
Frequency Range		Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
	Fundamental	2440.87	N/A	N/A	N/A



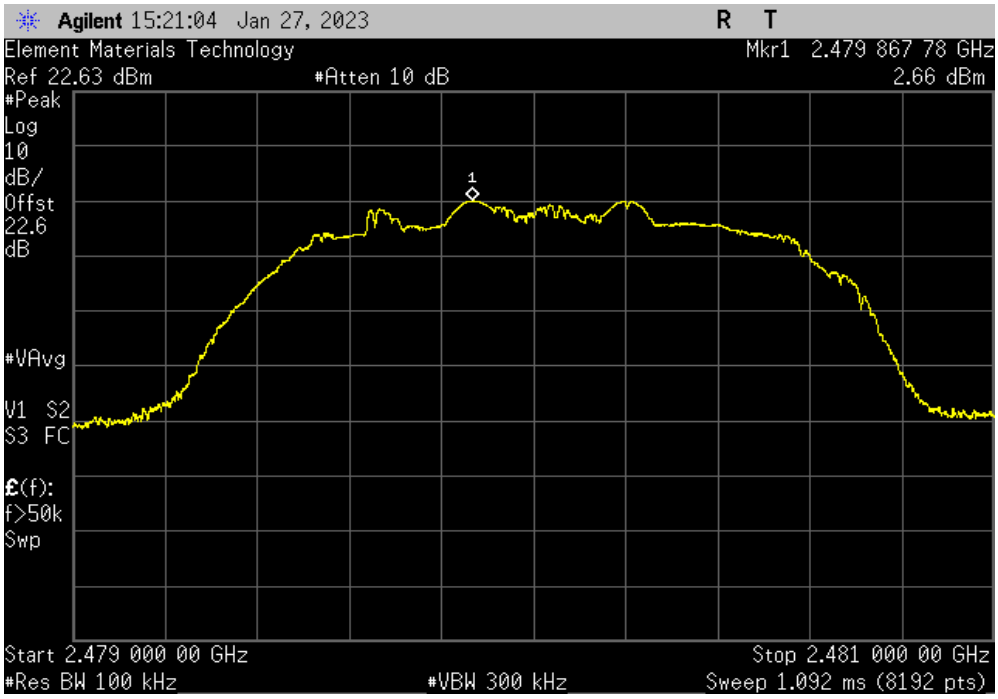
2DH5, pi/4-DQPSK, Mid Channel				
Frequency Range	Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
30 MHz - 12.5 GHz	7323.8	-51.09	-20	Pass



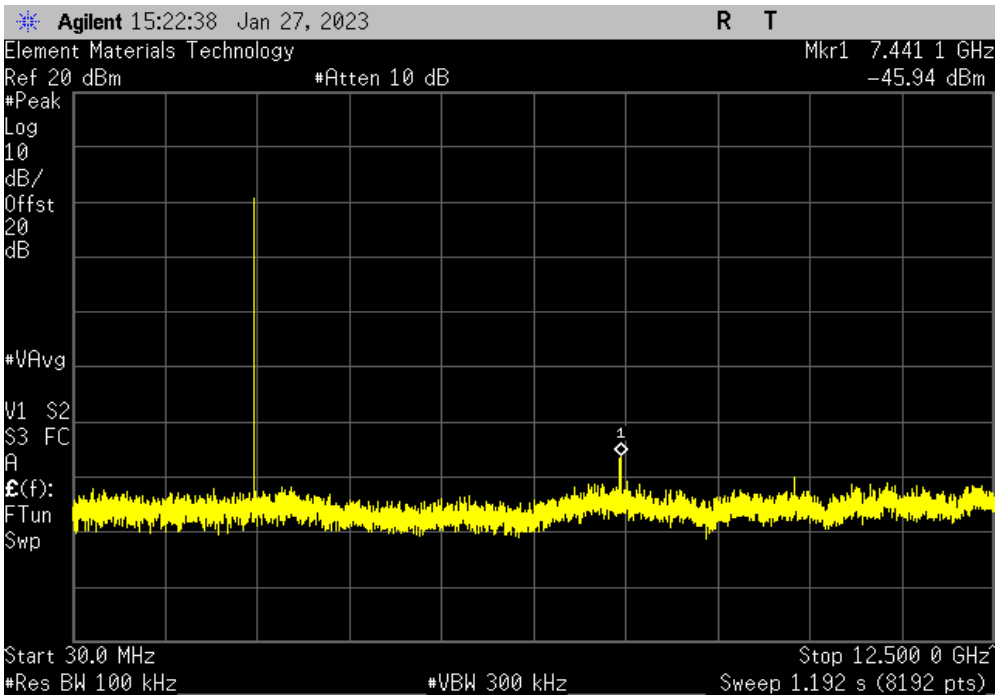
2DH5, pi/4-DQPSK, Mid Channel				
Frequency Range	**Measured Freq (MHz)**	**Max Value (dBc)**	**Limit ≤ (dBc)**	**Result**
12.5 GHz - 25 GHz	23341.2	-49.82	-20	Pass



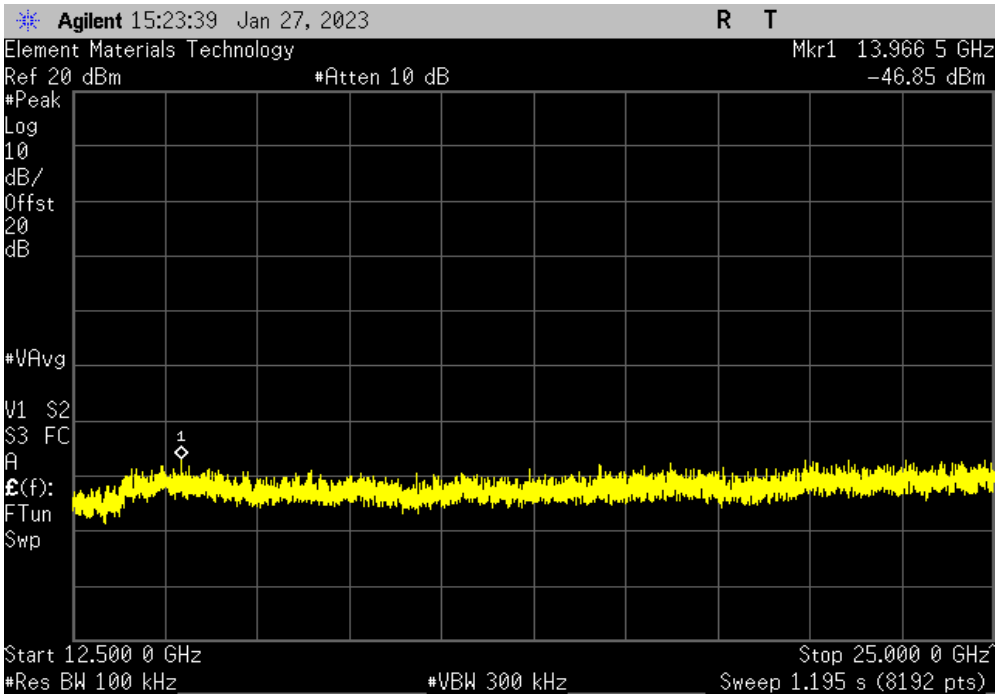
2DH5, pi/4-DQPSK, High Channel					
Frequency Range		**Measured Freq (MHz)**	**Max Value (dBc)**	**Limit ≤ (dBc)**	**Result**
	Fundamental	2479.87	N/A	N/A	N/A



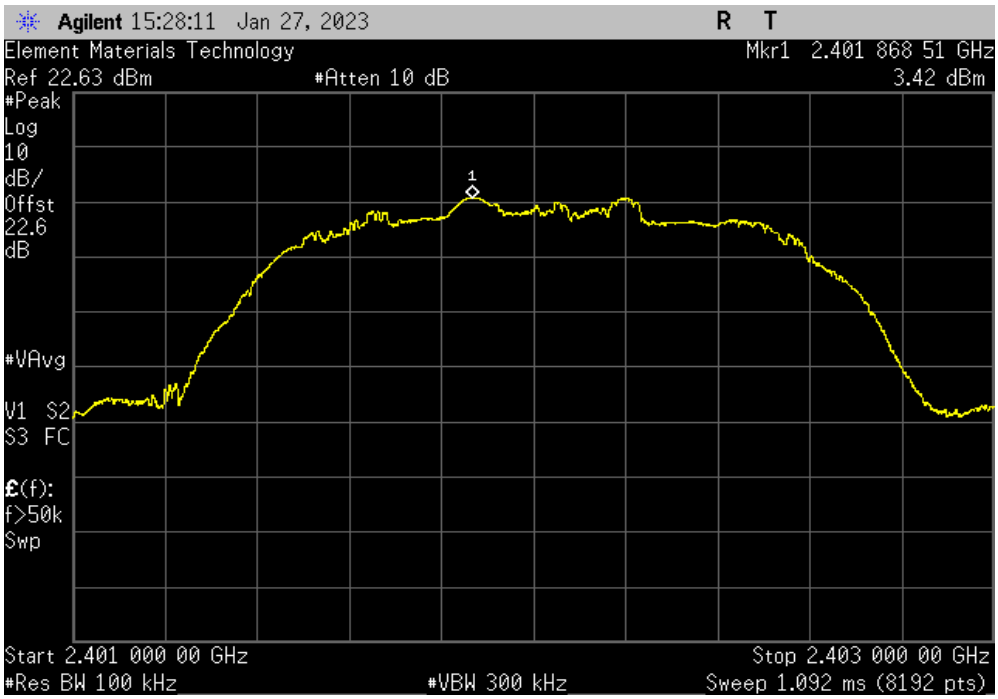
2DH5, pi/4-DQPSK, High Channel				
Frequency Range	**Measured Freq (MHz)**	**Max Value (dBc)**	**Limit ≤ (dBc)**	**Result**
30 MHz - 12.5 GHz	7441.1	-48.6	-20	Pass



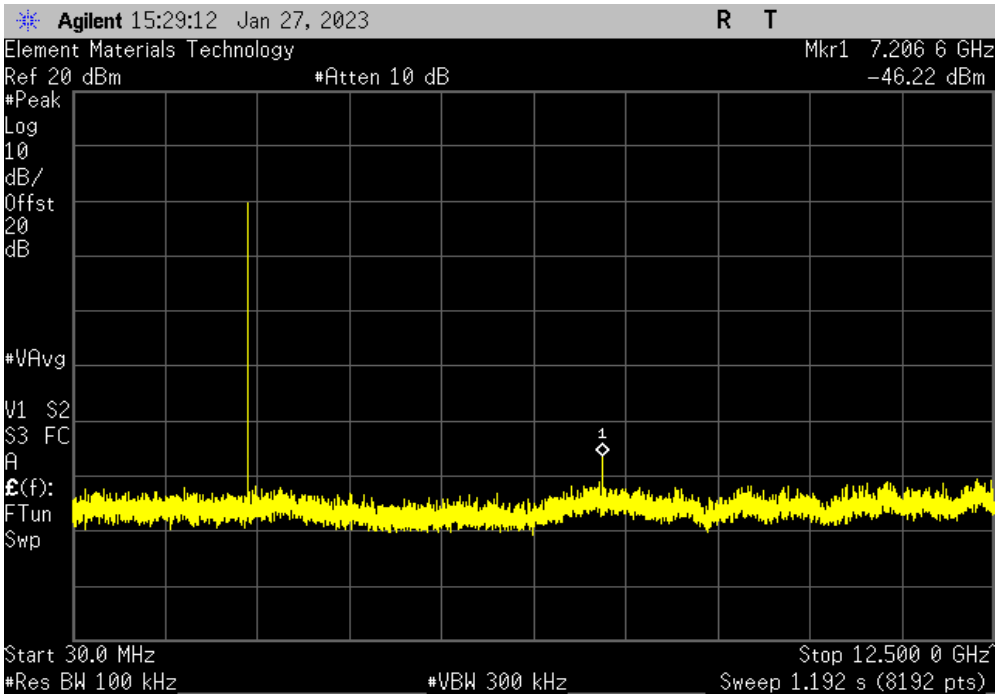
2DH5, pi/4-DQPSK, High Channel				
Frequency Range	**Measured Freq (MHz)**	**Max Value (dBc)**	**Limit ≤ (dBc)**	**Result**
12.5 GHz - 25 GHz	13966.5	-49.51	-20	Pass



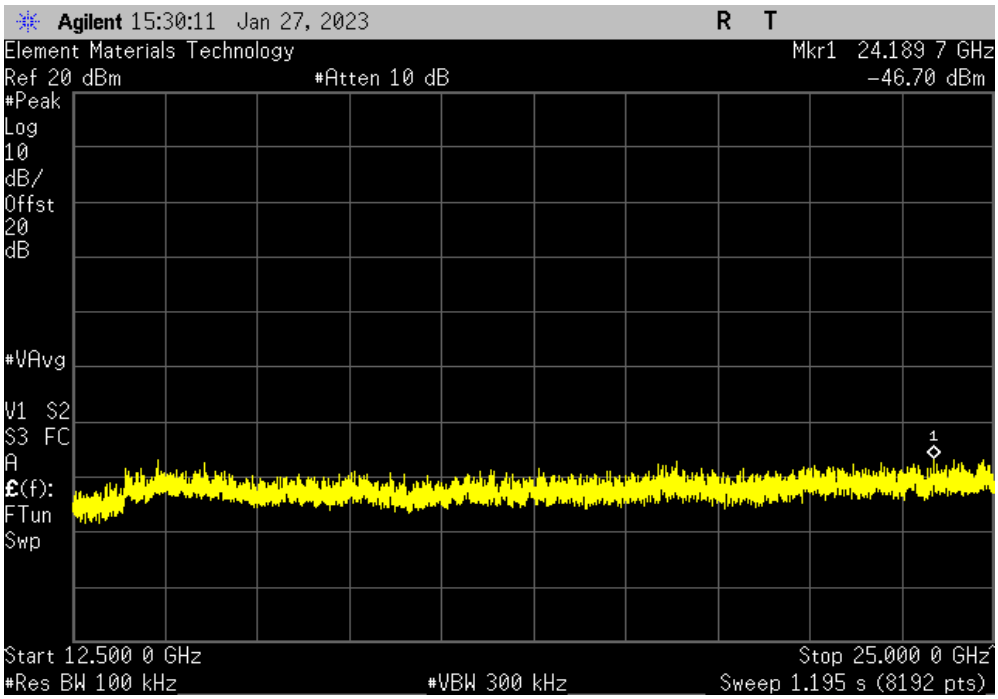
3DH5, 8-DPSK, Low Channel					
Frequency Range		Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
	Fundamental	2401.87	N/A	N/A	N/A



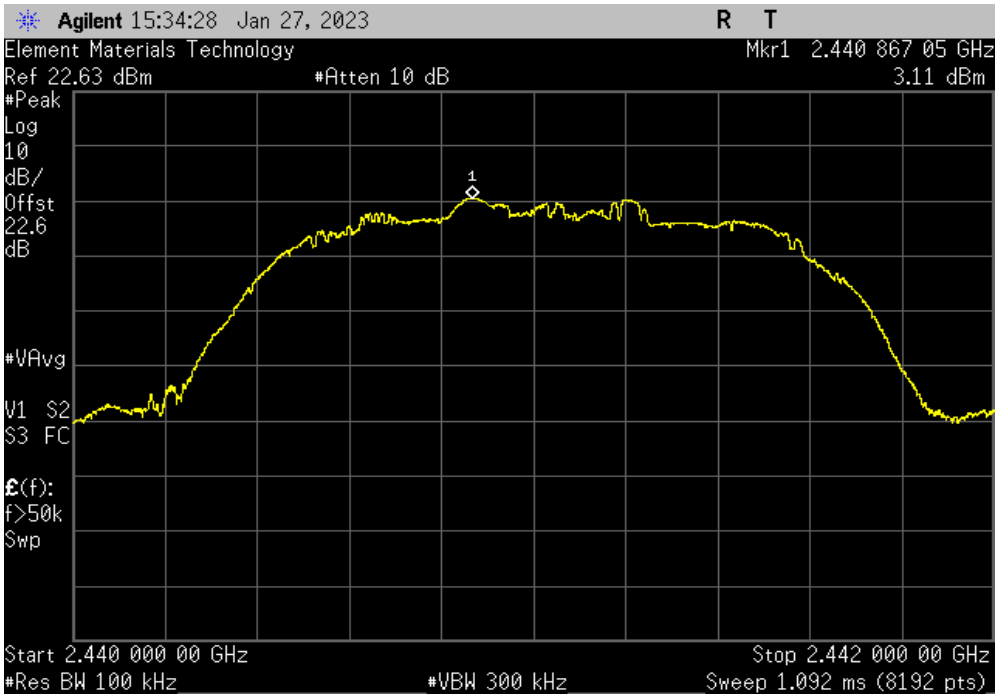
3DH5, 8-DPSK, Low Channel				
Frequency Range	Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
30 MHz - 12.5 GHz	7206.6	-49.64	-20	Pass



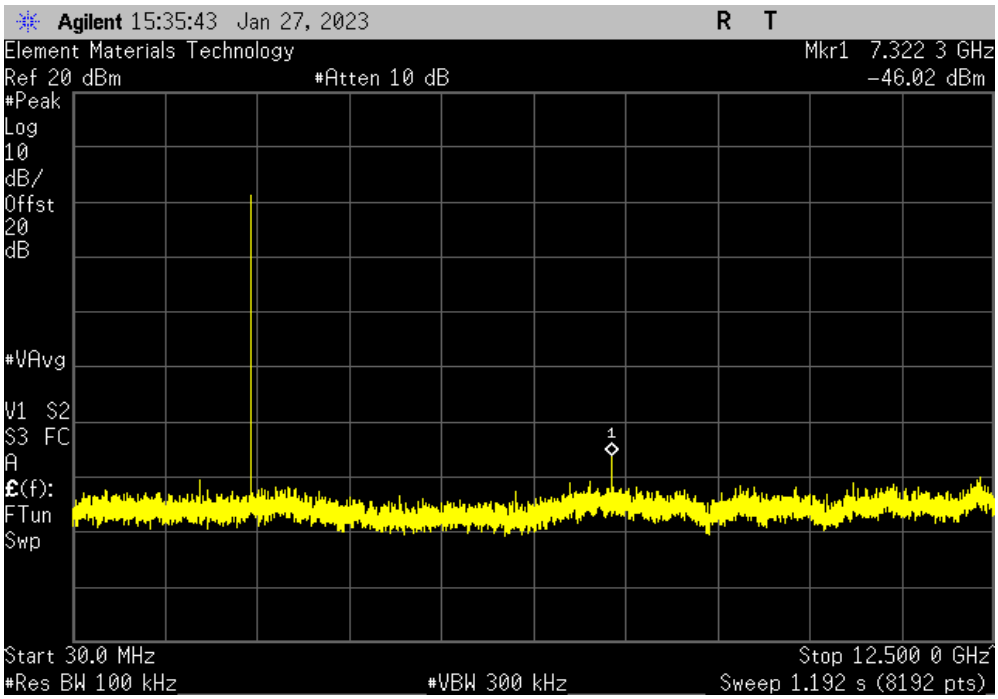
3DH5, 8-DPSK, Low Channel				
Frequency Range	Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
12.5 GHz - 25 GHz	24189.7	-50.12	-20	Pass



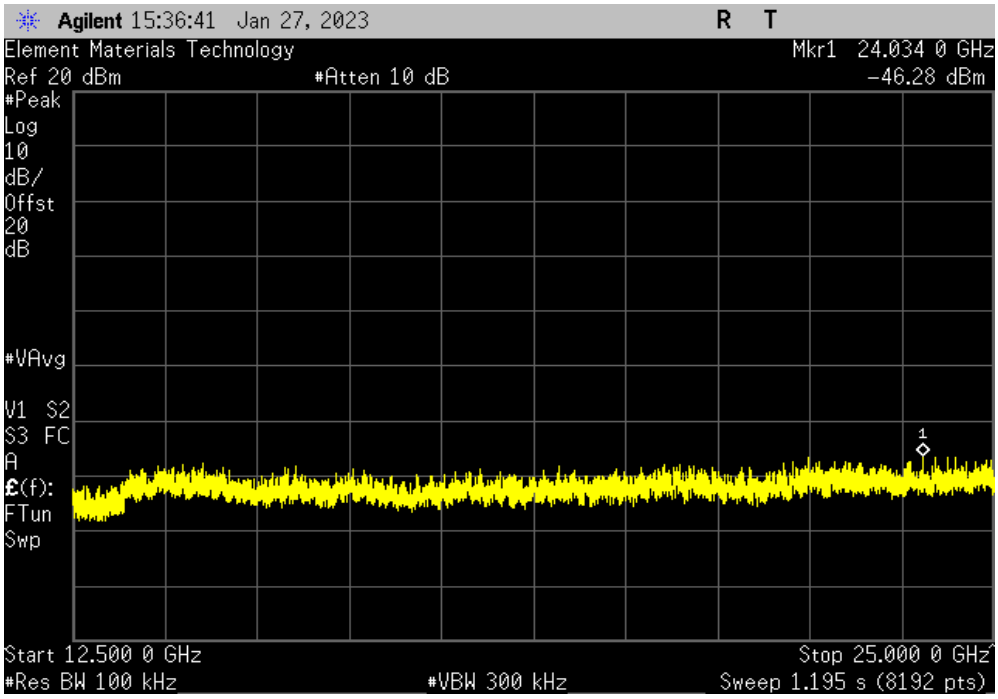
3DH5, 8-DPSK, Mid Channel				
Frequency Range	Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
Fundamental	2440.87	N/A	N/A	N/A



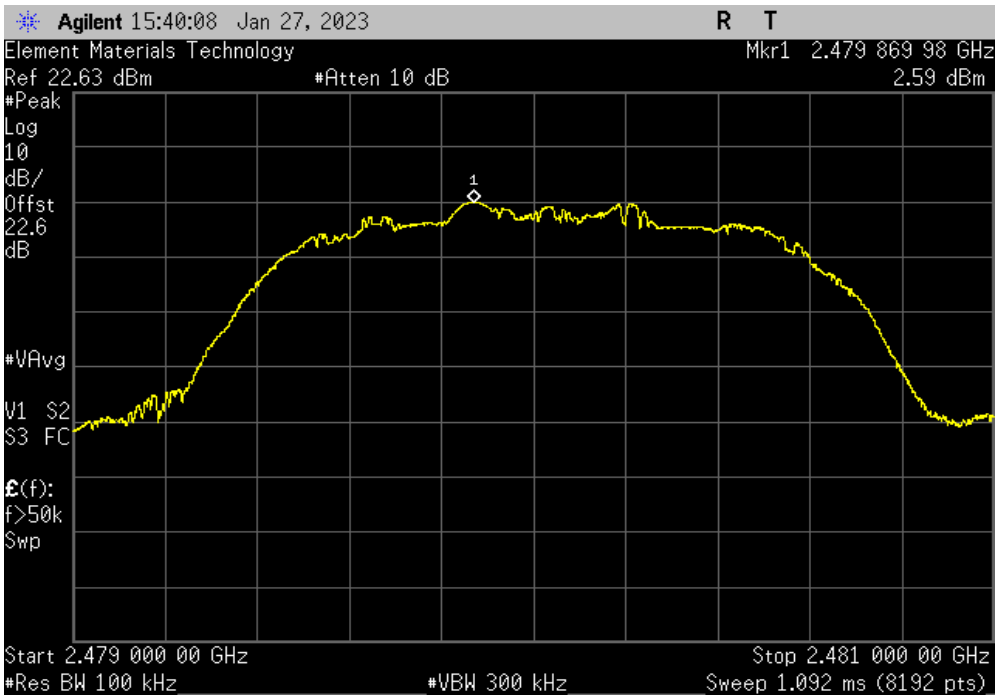
3DH5, 8-DPSK, Mid Channel				
Frequency Range	**Measured Freq (MHz)**	**Max Value (dBc)**	**Limit ≤ (dBc)**	**Result**
30 MHz - 12.5 GHz	7322.3	-49.13	-20	Pass



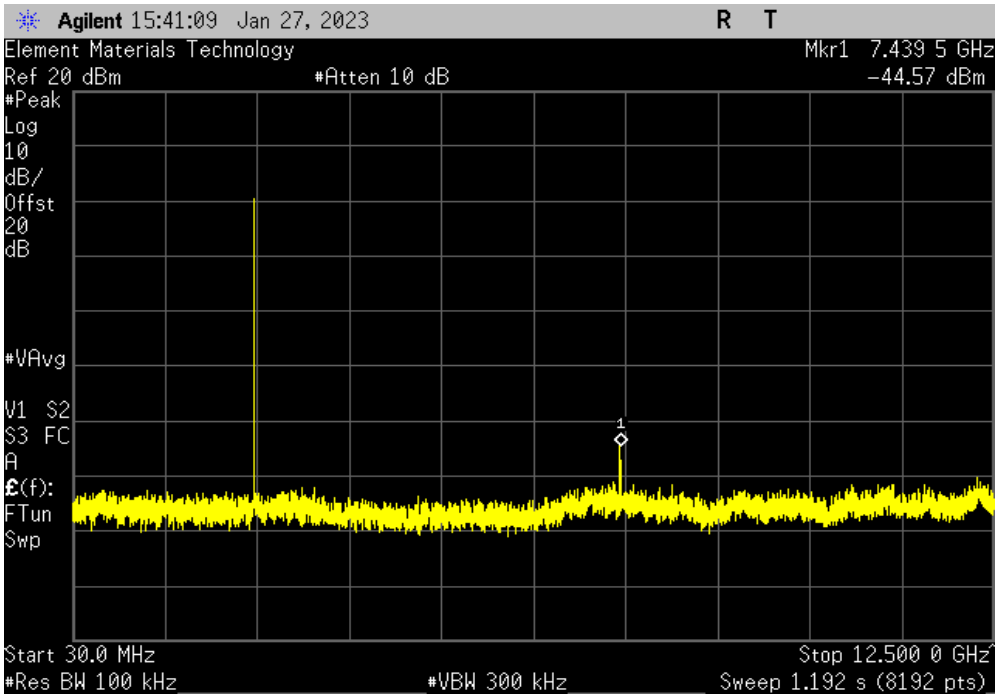
3DH5, 8-DPSK, Mid Channel				
Frequency Range	**Measured Freq (MHz)**	**Max Value (dBc)**	**Limit ≤ (dBc)**	**Result**
12.5 GHz - 25 GHz	24034	-49.39	-20	Pass



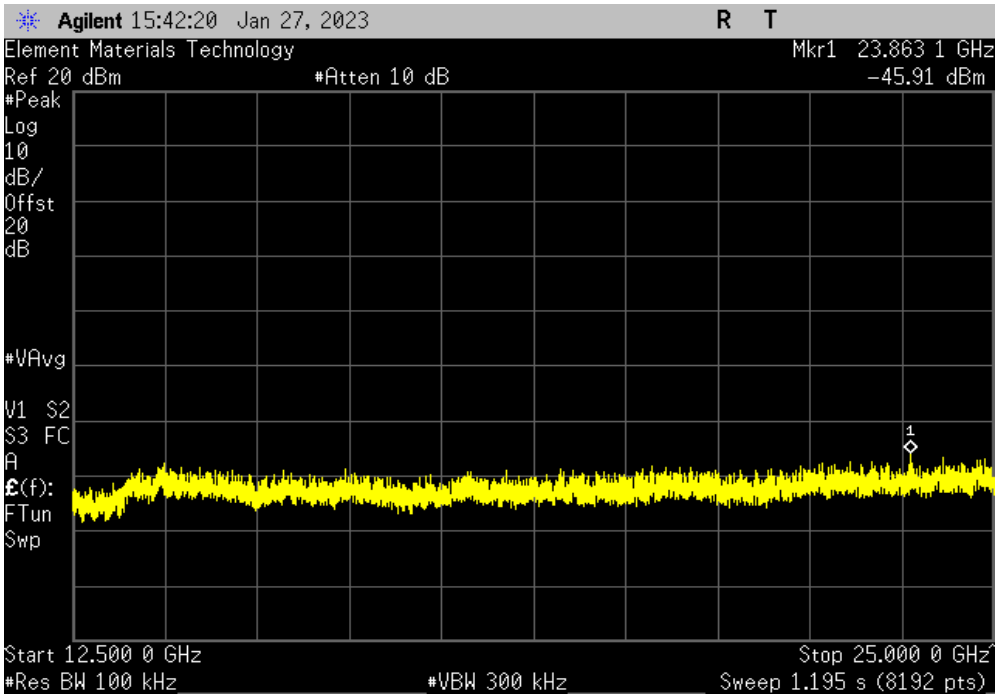
3DH5, 8-DPSK, High Channel					
Frequency Range		Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
	Fundamental	2479.87	N/A	N/A	N/A



3DH5, 8-DPSK, High Channel				
Frequency Range	Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
30 MHz - 12.5 GHz	7439.5	-47.16	-20	Pass



3DH5, 8-DPSK, High Channel				
Frequency Range	**Measured Freq (MHz)**	**Max Value (dBc)**	**Limit ≤ (dBc)**	**Result**
12.5 GHz - 25 GHz	23863.1	-48.5	-20	Pass



EMISSIONS BANDWIDTH

XMit 2022.02.07.0

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

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	N5183A	TIA	2022-06-25	2024-06-25
Analyzer - Spectrum Analyzer	Agilent	E4440A	AAX	2023-01-19	2024-01-19
Block - DC	Weinschel Corp.	7006	AMS	2023-01-18	2024-01-18
Attenuator	S.M. Electronics	SA18H-20	REK	2022-02-15	2023-02-15
Cable	Micro-Coax	UFD150A-1-0720-200200	NCW	2023-01-18	2024-01-18

TEST DESCRIPTION

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

The 20 dB emissions 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.

EMISSIONS BANDWIDTH

TbtTx 2022.06.03.0 XMit 2022.02.07.0

EUT:	**GFD200**			**Work Order:**	**GLOW0038**
Serial Number:	**XB2-839**			**Date:**	**27-Jan-23**
Customer:	**Glowforge Incorporated**			**Temperature:**	**21.8 °C**
Attendees:	**Jason Bluhm**			**Humidity:**	**37.4% RH**
Project:	**None**			**Barometric Pres.:**	**1029 mbar**
Tested by:	**Harry Zhao**	**Power:**	**120VAC/60Hz**	**Job Site:**	**NC06**

TEST SPECIFICATIONS	**Test 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 offset connection between EUT and Spectrum analyzer: DC Block + 20 dB attenuator + measurement cable + patched coax cable = 22.63 dB.

DEVIATIONS FROM TEST STANDARD

None

Configuration #	**2**	*Signature*

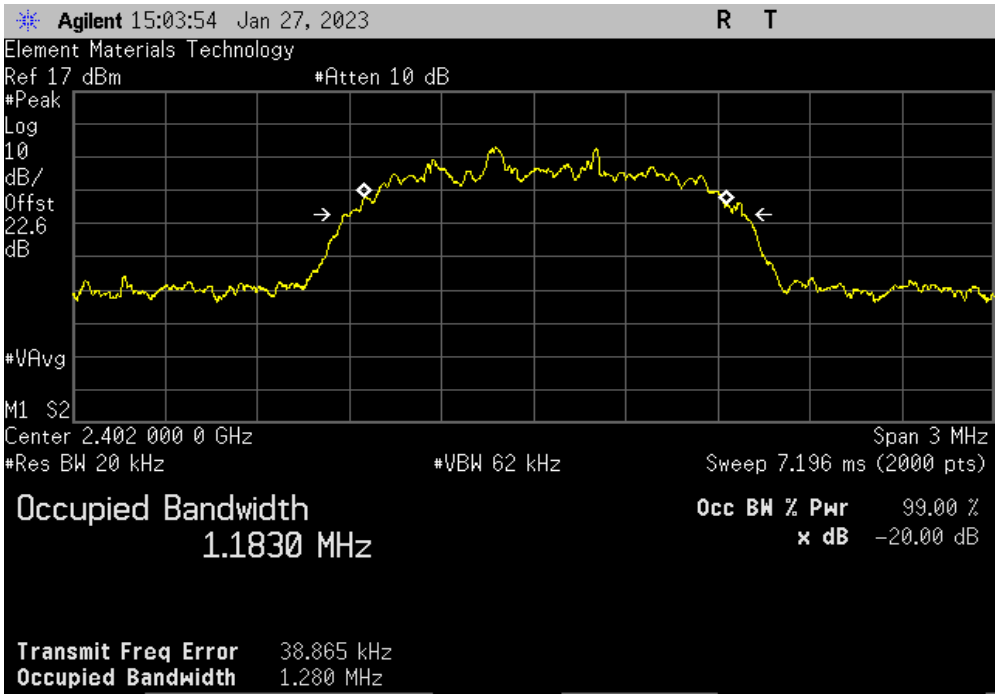
		Value	Limit (<)	Result
DH5, GFSK				
	Low Channel	924.514 kHz	1.5 MHz	Pass
	Mid Channel	925 kHz	1.5 MHz	Pass
	High Channel	923.087 kHz	1.5 MHz	Pass
2DH5, pi/4-DQPSK				
	Low Channel	1.28 MHz	1.5 MHz	Pass
	Mid Channel	1.274 MHz	1.5 MHz	Pass
	High Channel	1.303 MHz	1.5 MHz	Pass
3DH5, 8-DPSK				
	Low Channel	1.265 MHz	1.5 MHz	Pass
	Mid Channel	1.272 MHz	1.5 MHz	Pass
	High Channel	1.275 MHz	1.5 MHz	Pass

DH5, GFSK, Low Channel						
				Value	Limit (<)	Result
				924.514 kHz	1.5 MHz	Pass

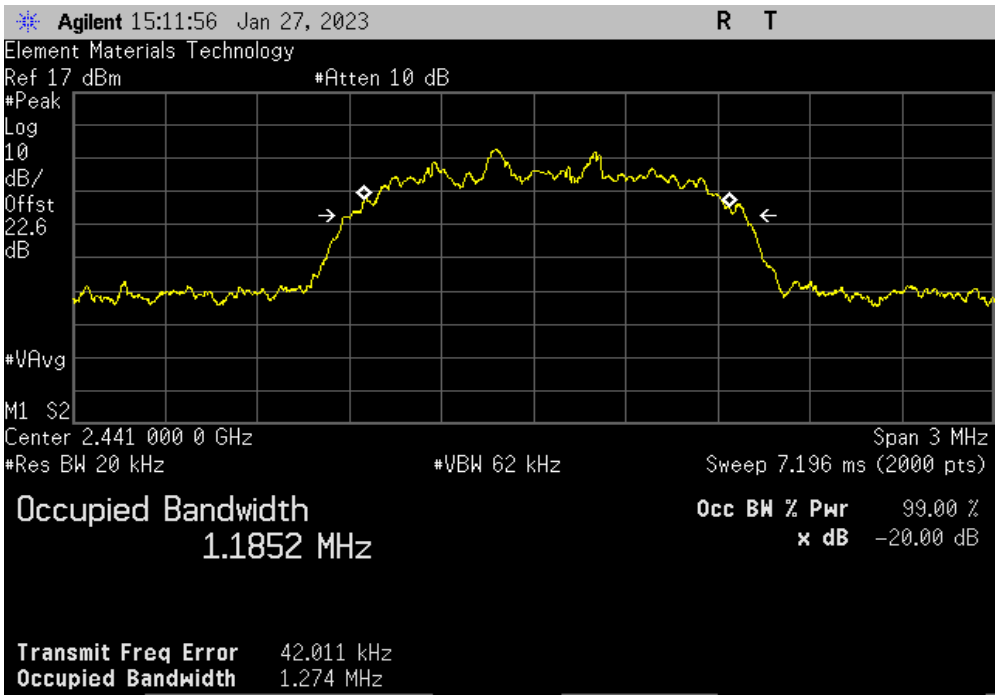
DH5, GFSK, Mid Channel						
				Value	Limit (<)	Result
				925 kHz	1.5 MHz	Pass

DH5, GFSK, High Channel						
				Value	Limit (<)	Result
				923.087 kHz	1.5 MHz	Pass

2DH5, pi/4-DQPSK, Low Channel						
				Value	Limit (<)	Result
				1.28 MHz	1.5 MHz	Pass

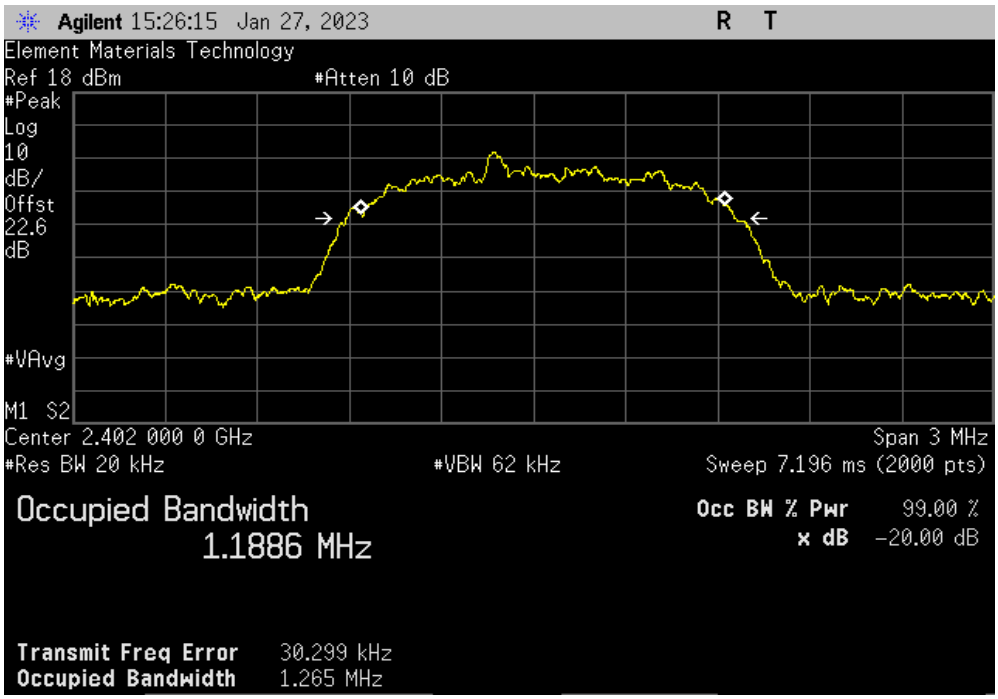


2DH5, pi/4-DQPSK, Mid Channel						
				Value	Limit (<)	Result
				1.274 MHz	1.5 MHz	Pass

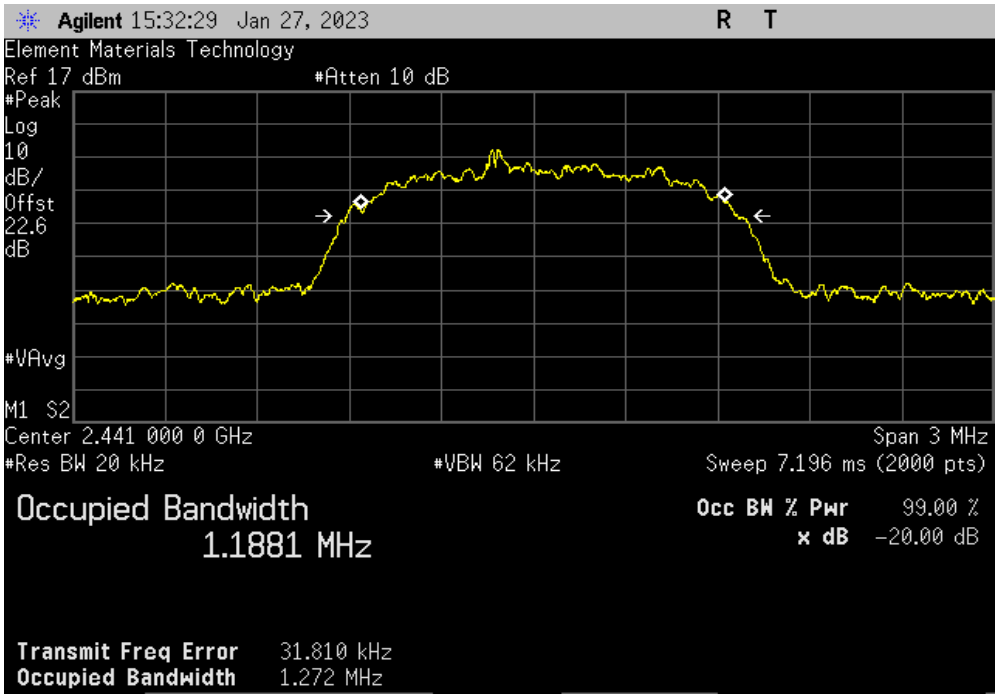


2DH5, pi/4-DQPSK, High Channel						
				Value	Limit (<)	Result
				1.303 MHz	1.5 MHz	Pass

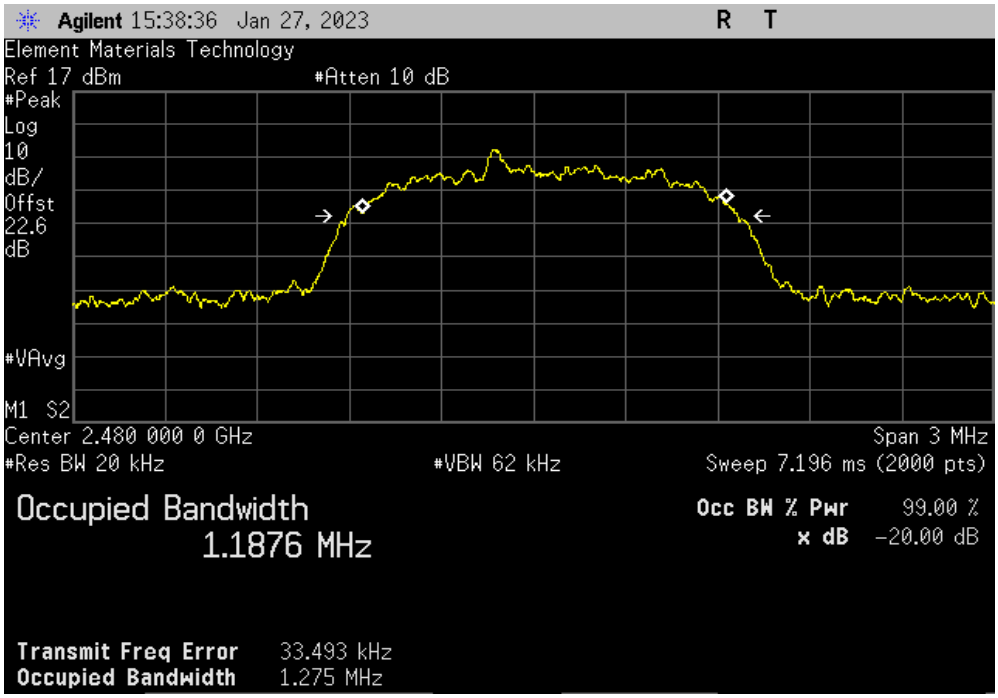
3DH5, 8-DPSK, Low Channel						
				Value	Limit (<)	Result
				1.265 MHz	1.5 MHz	Pass



3DH5, 8-DPSK, Mid Channel						
				Value	Limit (<)	Result
				1.272 MHz	1.5 MHz	Pass



3DH5, 8-DPSK, High Channel						
				Value	Limit (<)	Result
				1.275 MHz	1.5 MHz	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
Attenuator	S.M. Electronics	SA18H-20	REK	2022-02-15	2023-02-15
Block - DC	Weinschel Corp.	7006	AMS	2023-01-18	2024-01-18
Cable	Micro-Coax	UFD150A-1-0720-200200	NCW	2023-01-18	2024-01-18
Analyzer - Spectrum Analyzer	Agilent	E4440A	AAX	2023-01-19	2024-01-19
Generator - Signal	Agilent	N5183A	TIA	2022-06-25	2024-06-25

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer." at the beginning of the test description.

When the occupied bandwidth limit is not stated in the applicable RSS or reference measurement method, the transmitted signal bandwidth shall be reported as the 99% emission bandwidth as defined in RSS-Gen.

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

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.

OCCUPIED BANDWIDTH

TbtTx 2022.06.03.0 XMit 2022.02.07.0

EUT:	**GFD200**			**Work Order:**	**GLOW0038**
Serial Number:	**XB2-839**			**Date:**	**27-Jan-23**
Customer:	**Glowforge Incorporated**			**Temperature:**	**21.2 °C**
Attendees:	**Jason Bluhm**			**Humidity:**	**38.8% RH**
Project:	**None**			**Barometric Pres.:**	**1029 mbar**
Tested by:	**Harry Zhao**	**Power:**	**120VAC/60Hz**	**Job Site:**	**NC06**

TEST SPECIFICATIONS	**Test 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 offset connection between EUT and Spectrum analyzer: DC Block + 20 dB attenuator + measurement cable + patched coax cable = 22.63 dB.

DEVIATIONS FROM TEST STANDARD

None

Configuration #	**2**	*Signature*

		Value	**Limit**	**Result**
DH5, GFSK				
	Low Channel	831.955 kHz	N/A	N/A
	Mid Channel	832.11 kHz	N/A	N/A
	High Channel	827.865 kHz	N/A	N/A
2DH5, pi/4-DQPSK				
	Low Channel	1.183 MHz	N/A	N/A
	Mid Channel	1.188 MHz	N/A	N/A
	High Channel	1.187 MHz	N/A	N/A
3DH5, 8-DPSK				
	Low Channel	1.189 MHz	N/A	N/A
	Mid Channel	1.191 MHz	N/A	N/A
	High Channel	1.182 MHz	N/A	N/A

DH5, GFSK, Low Channel

				Value	Limit	Result
				831.955 kHz	N/A	N/A

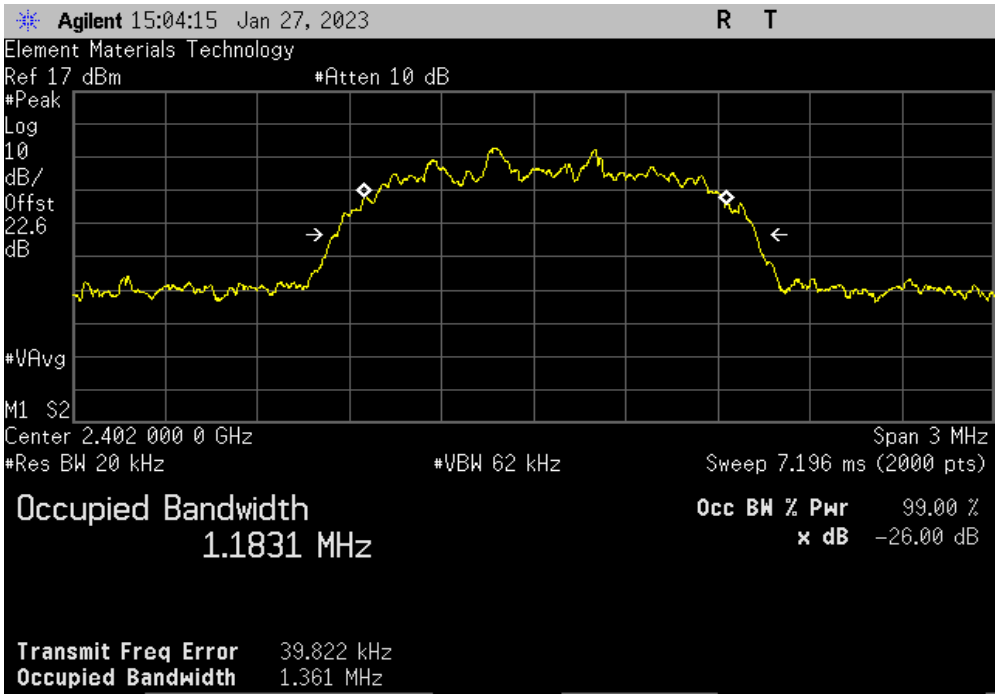
DH5, GFSK, Mid Channel

				Value	Limit	Result
				832.11 kHz	N/A	N/A

OCCUPIED BANDWIDTH

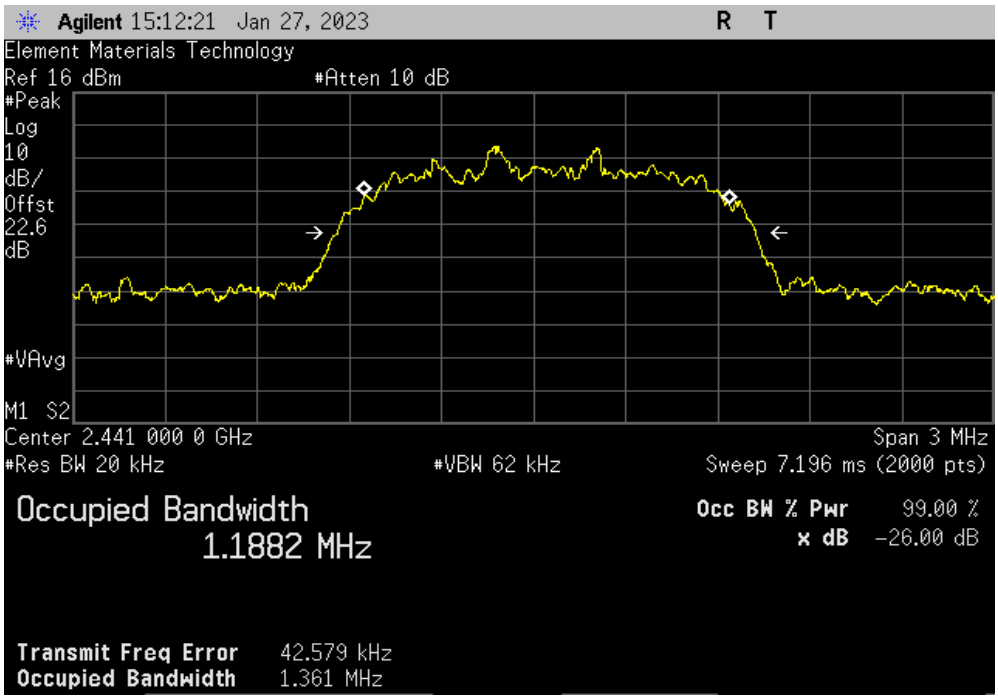
DH5, GFSK, High Channel						
				Value	Limit	Result
				827.865 kHz	N/A	N/A

2DH5, pi/4-DQPSK, Low Channel						
				Value	Limit	Result
				1.183 MHz	N/A	N/A

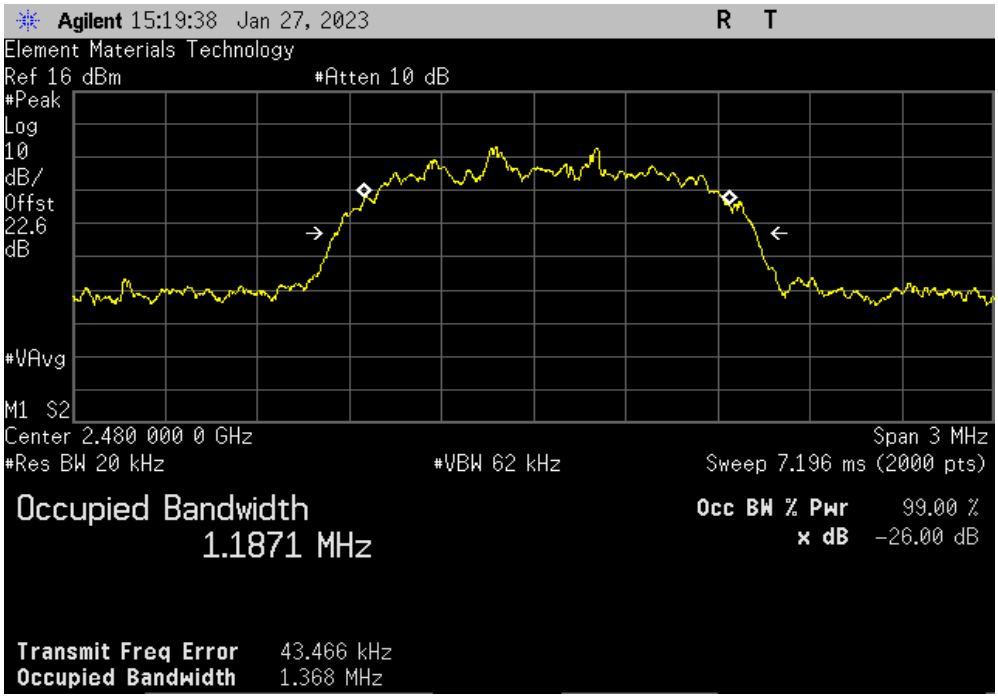


OCCUPIED BANDWIDTH

2DH5, pi/4-DQPSK, Mid Channel						
				Value	Limit	Result
				1.188 MHz	N/A	N/A



2DH5, pi/4-DQPSK, High Channel						
				Value	Limit	Result
				1.187 MHz	N/A	N/A

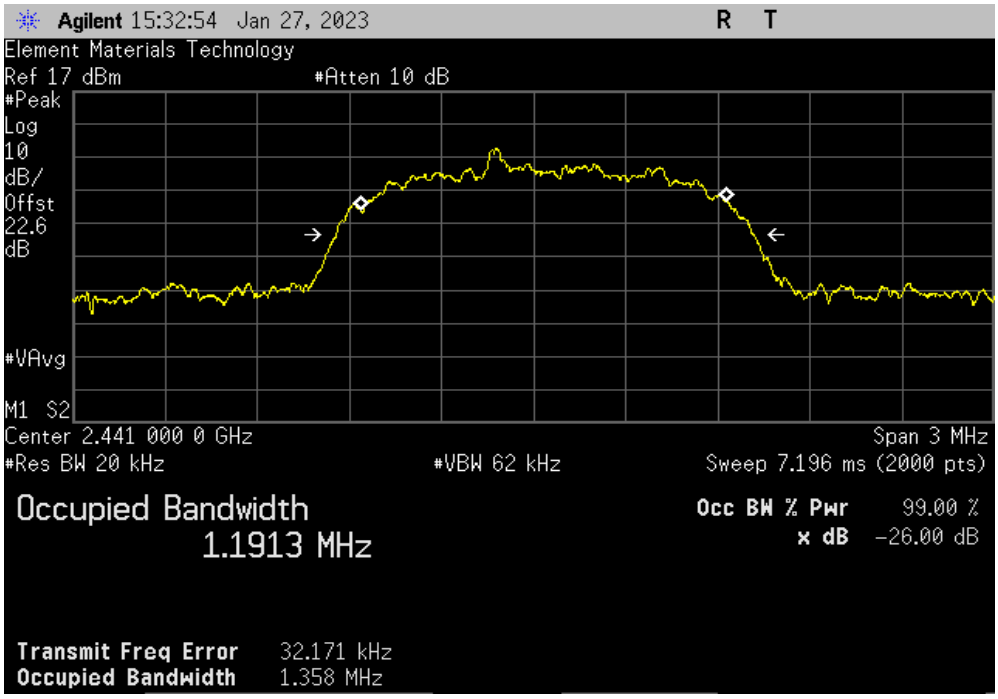


3DH5, 8-DPSK, Low Channel

				Value	Limit	Result
				1.189 MHz	N/A	N/A

3DH5, 8-DPSK, Mid Channel

				Value	Limit	Result
				1.191 MHz	N/A	N/A



3DH5, 8-DPSK, High Channel

				Value	Limit	Result
				1.182 MHz	N/A	N/A

End of Test Report