



# element

**TSI, Incorporated**

**TSI OmniTrak Modules**

**FCC 15.207:2023, FCC 15.247:2023**

**RSS-247 Issue 2:2017, RSS-Gen Issue 5:2018+A1:2019+A2:2021**

**Bluetooth Radio**

**Report: TSIN0196.5 Rev. 3, Issue Date: July 12, 2023**



# TABLE OF CONTENTS

Section	Page Number
Certificate of Test .....	3
Revision History .....	4
Accreditations.....	5
Facilities .....	6
Measurement Uncertainty .....	7
Test Setup Block Diagrams.....	8
Product Description .....	11
Power Settings and Antenna Information.....	12
Configurations .....	13
Modifications .....	15
Powerline Conducted Emissions.....	16
Duty Cycle.....	21
DTS Bandwidth (6 dB) .....	35
Occupied Bandwidth (99%).....	43
Output Power .....	51
Equivalent Isotropic Radiated Power .....	59
Power Spectral Density .....	67
Band Edge Compliance .....	75
Spurious Conducted Emissions .....	81
Spurious Radiated Emissions .....	101
End of Report.....	118

# CERTIFICATE OF TEST



Last Date of Test: March 30, 2023  
TSI, Incorporated  
EUT: TSI OmniTrak Modules

## Radio Equipment Testing Standards

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

## Results

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

## Deviations From Test Standards

None

## Approved By:

James Morris, Operations Manager

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

# REVISION HISTORY



Revision Number	Description	Date (yyyy-mm-dd)	Page Number
00	None		
01	Corrected antenna gain, clarified models	2023-06-19	All
02	Added model variants	2023-06-26	All
03	Corrected Duty Cycles and DCCF in SRE	2023-07-11	101-117

# ACCREDITATIONS AND AUTHORIZATIONS

## United States

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

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

## Canada

**ISED** - Recognized by Innovation, Science and Economic Development Canada as a Certification Body (CB) and as a CAB for the acceptance of test data.

## European Union

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

## United Kingdom

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

## Australia/New Zealand

**ACMA** - Recognized by ACMA as a CAB for the acceptance of test data.

## Korea

**MSIT / RRA** - Recognized by KCC's RRA as a CAB for the acceptance of test data.

## Japan

**VCCI** - Associate Member of the VCCI. Conducted and radiated measurement facilities are registered.

## Taiwan

**BSMI** – Recognized by BSMI as a CAB for the acceptance of test data.

**NCC** - Recognized by NCC as a CAB for the acceptance of test data.

## Singapore

**IDA** – Recognized by IDA as a CAB for the acceptance of test data.

## Israel

**MOC** – Recognized by MOC as a CAB for the acceptance of test data.

## Hong Kong

**OFCA** – Recognized by OFCA as a CAB for the acceptance of test data.

## Vietnam

**MIC** – Recognized by MIC as a CAB for the acceptance of test data.

## SCOPE

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

[California](#)

[Minnesota](#)

[Oregon](#)

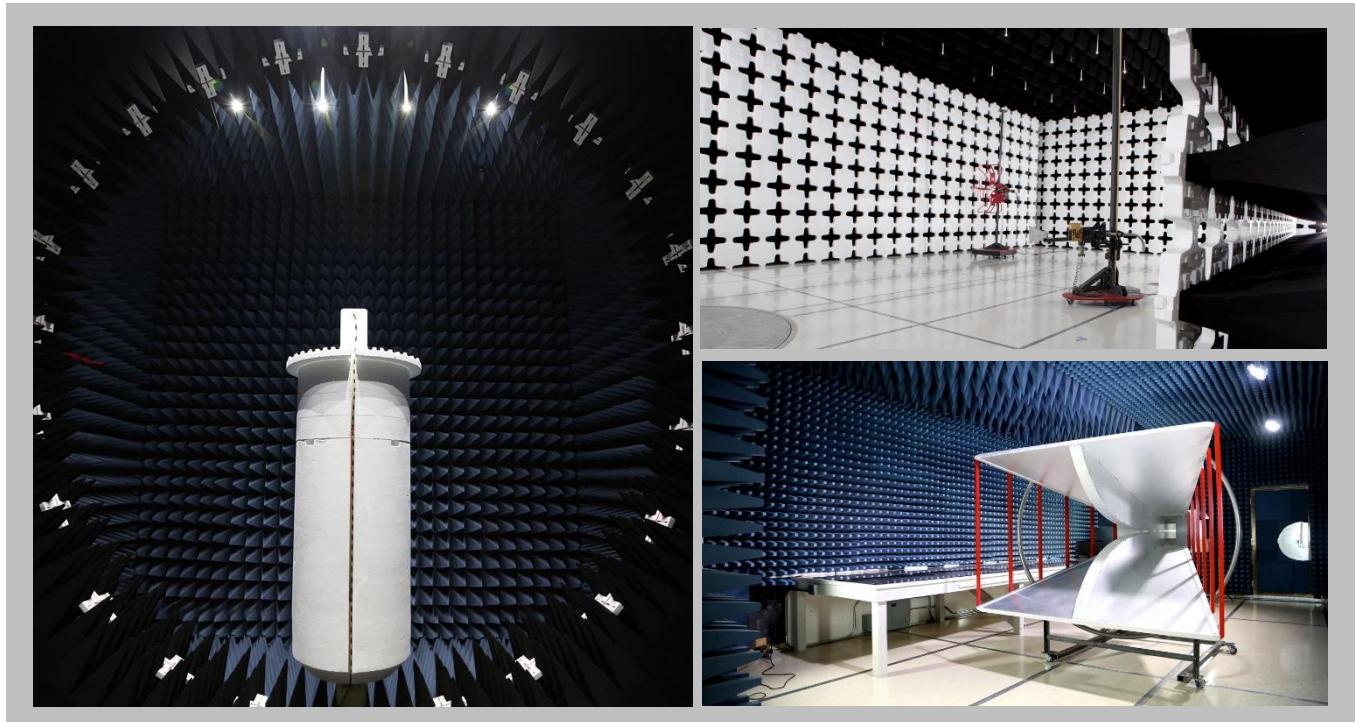
[Texas](#)

[Washington](#)

# FACILITIES



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



# MEASUREMENT UNCERTAINTY



## Measurement Uncertainty

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

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

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

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

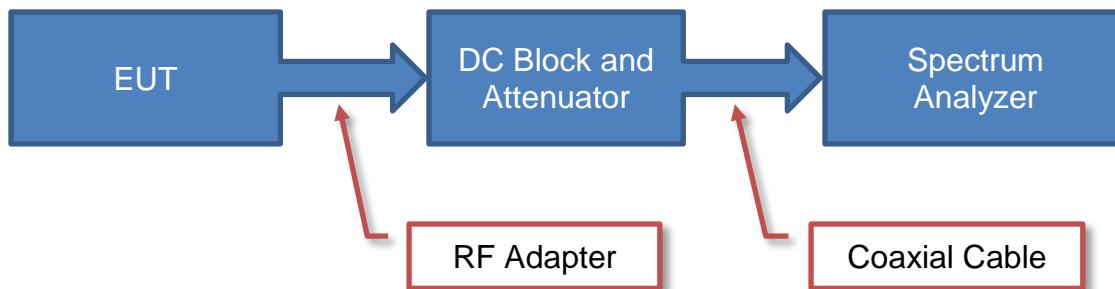
# TEST SETUP BLOCK DIAGRAMS

## Measurement Bandwidths

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

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

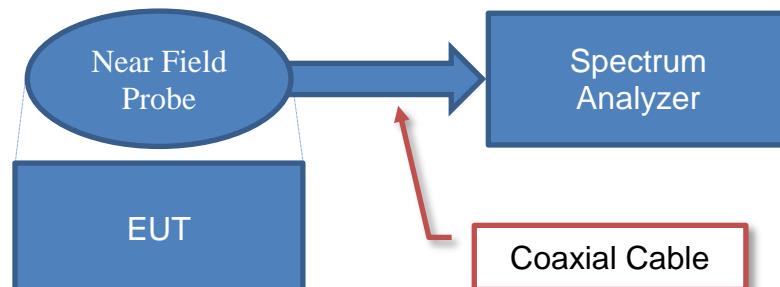
## Antenna Port Conducted Measurements



## Sample Calculation (logarithmic units)

$$\begin{array}{ccc} \text{Measured} & \text{Measured} & \text{Reference} \\ \text{Value} & = & \text{Level} \\ 71.2 & = & 42.6 \\ & & + \\ & & \text{Level} \\ & & \text{Offset} \\ & & 28.6 \end{array}$$

## Near Field Test Fixture Measurements

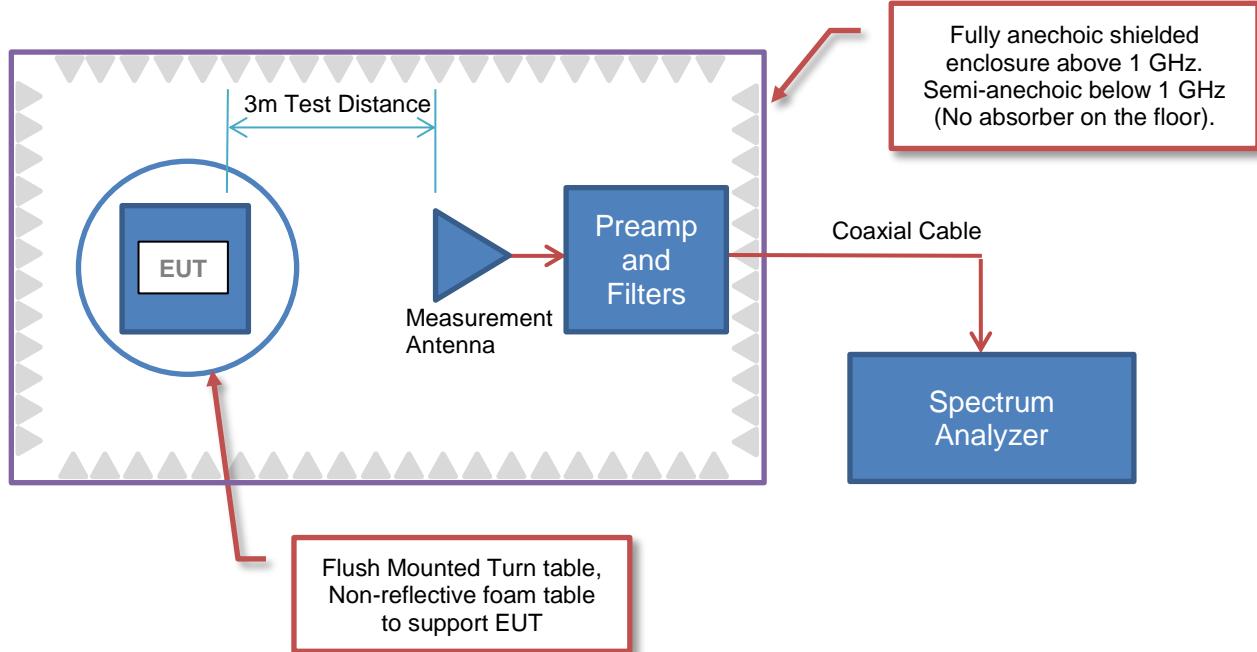


## Sample Calculation (logarithmic units)

$$\begin{array}{ccc} \text{Measured} & \text{Measured} & \text{Reference} \\ \text{Value} & = & \text{Level} \\ 71.2 & = & 42.6 \\ & & + \\ & & \text{Level} \\ & & \text{Offset} \\ & & 28.6 \end{array}$$

# TEST SETUP BLOCK DIAGRAMS

## Emissions Measurements



## Sample Calculation (logarithmic units)

### Radiated Emissions:

Factor						
Measured Level (Amplitude)	Antenna Factor	Cable 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:

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

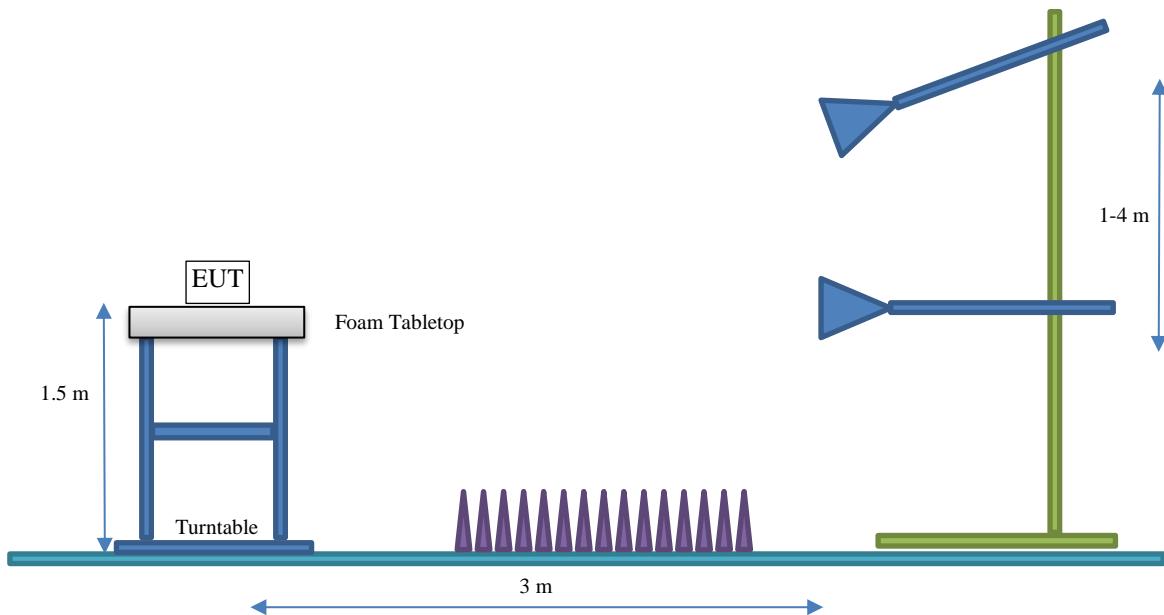
### Radiated Power (ERP/EIRP) – Substitution Method:

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

<b>Company Name:</b>	TSI, Incorporated
<b>Address:</b>	500 Cardigan Road
<b>City, State, Zip:</b>	Shoreview, MN 55126
<b>Test Requested By:</b>	Jessica Pedersen
<b>EUT:</b>	TSI OmniTrak Modules
<b>First Date of Test:</b>	February 22, 2023
<b>Last Date of Test:</b>	March 30, 2023
<b>Receipt Date of Samples:</b>	February 17, 2023
<b>Equipment Design Stage:</b>	Production
<b>Equipment Condition:</b>	No Damage
<b>Purchase Authorization:</b>	Verified

## Information Provided by the Party Requesting the Test

### Functional Description of the EUT:

Three sensor nodes available: tVOC (total Volatile Organic Compounds), PM (particulate matter), and tVOC+PM. The sensor node may be used as a desktop unit or it may be placed in the cradle for a handheld option. Bluetooth radio with 1 antenna type and 1 antenna port

### Testing Objective:

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

# POWER SETTINGS AND ANTENNAS



The power settings, antenna gain value(s) and cable loss (if applicable) used for the testing contained in this report were provided by the customer and will affect the validity of the results. Element assumes no responsibility for the accuracy of this information. The power settings below reflect the maximum power that the EUT is allowed to transmit at during normal operation.

## ANTENNA GAIN (dBi)

Type	Provided by:	Frequency Range (MHz)	Gain (dBi)
PCB Trace on module	ProAnt	2400-2483.5	2.0

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: sdk\_nr5\_v17.1.0/ble\_sdk\_app\_dtm\_serial (com port)
- Rated power settings

## SETTINGS FOR ALL TESTS IN THIS REPORT

Modulation Types	Channel Position	Frequency Range (MHz)	Power Setting
1 Mbps, 2 Mbps, 125kbps, 500 kbps	Low, Mid, High	2400-2483.5	0 dBm

# CONFIGURATIONS



## Configuration TSIN0196-2

EUT					
Description		Manufacturer		Model/Part Number	Serial Number
TSI OmniTrak Module PM (particulate matter)		TSI, Incorporated		PM (7591-01)	LCOPC_061

Remote Equipment Outside of Test Setup Boundary					
Description		Manufacturer		Model/Part Number	Serial Number
Laptop		Lenovo			

Cables					
Cable Type		Shield	Length (m)	Ferrite	Connection 1
USB Programming Cable		No	1.8m	No	Laptop
					Cradle

## Configuration TSIN0196-4

Software/Firmware Running During Test					
Description		Version			
Firmware		Direct Test Mode			

EUT					
Description		Manufacturer		Model/Part Number	Serial Number
TSI OmniTrak Module PM (particulate matter)		TSI, Incorporated		PM (7591-01)	LCOPC_060

## Configuration TSIN0196-5

Software/Firmware Running During Test					
Description		Version			
Firmware		Direct Test Mode			

EUT					
Description		Manufacturer		Model/Part Number	Serial Number
TSI OmniTrak Module PM/tVOC (total Volatile Organic Compounds + particulate matter)		TSI, Incorporated		PM/tVOC (7591-04)	LCOPC_056

# CONFIGURATIONS



## Configuration TSIN0196-6

Software/Firmware Running During Test	
Description	Version
Firmware	Direct Test Mode

EUT			
Description	Manufacturer	Model/Part Number	Serial Number
TSI OmniTrak Module tVOC (total Volatile Organic Compounds)	TSI, Incorporated	tVOC (7591-02)	LCOPC_055

## Configuration TSIN0196-11

Software/Firmware Running During Test	
Description	Version
Firmware	1.0.1 BLE Off

EUT			
Description	Manufacturer	Model/Part Number	Serial Number
TSI OmniTrak Module PM/tVOC (total Volatile Organic Compounds + particulate matter)	TSI, Incorporated	PM/tVOC (7591-04)	LCOPC_056

Peripherals in Test Setup Boundary			
Description	Manufacturer	Model/Part Number	Serial Number
USB Power Adapter	GlobTrek	WR9QA2000USBN23MDR6P	None

Cables					
Cable Type	Shield	Length (m)	Ferrite	Connection 1	Connection 2
USB Cable	No	1.8m	No	7591-04	USB Power Adapter

# MODIFICATIONS



## Equipment Modifications

Item	Date	Test	Modification	Note	Disposition of EUT
1	2023-02-22	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	2023-02-22	DTS Bandwidth	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
3	2023-02-22	Occupied Bandwidth	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
4	2023-02-22	Output Power	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
5	2023-02-22	Equivalent Isotropic Radiated Power (EIRP)	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	2023-02-22	Power Spectral Density	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
7	2023-02-22	Band Edge Compliance	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
8	2023-02-22	Spurious Conducted Emissions	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
9	2023-03-09	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.
10	2023-03-30	Powerline Conducted Emissions	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	Scheduled testing was completed.

# POWERLINE CONDUCTED EMISSIONS



## TEST DESCRIPTION

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

## TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Receiver	Gauss Instruments	TDEMI 30M	ARS	2022-04-20	2023-04-20
LISN	Solar Electronics	9252-50-R-24-BNC	LIY	2022-04-04	2023-04-04
Cable - Conducted Cable Assembly	Northwest EMC	MNC, HGN, TYK	MNCA	2023-03-09	2024-03-09
Filter - High Pass	TTE	H97-100K-50-720B	HGN	NCR	NCR

## MEASUREMENT UNCERTAINTY

Description			
Expanded k=2	1.2 dB		-1.2 dB

## CONFIGURATIONS INVESTIGATED

TSIN0196-11

## MODES INVESTIGATED

Transmitting Bluetooth Low Energy 1 Mbps, Mid Channel 18, 2442 MHz

# POWERLINE CONDUCTED EMISSIONS



EUT:	TSI OmniTrak Module PM/tVOC (7591-04)	Work Order:	TSIN0196
Serial Number:	LCOPC_056	Date:	2023-03-30
Customer:	TSI, Incorporated	Temperature:	21.3°C
Attendees:	Micah Larson	Relative Humidity:	18.5%
Customer Project:	None	Bar. Pressure (PMSL):	1021 mb
Tested By:	Ko Vorasarn	Job Site:	MN03
Power:	110VAC/60Hz	Configuration:	TSIN0196-11

## TEST SPECIFICATIONS

Specification:	Method:
FCC 15.207:2023	ANSI C63.10:2013
RSS-Gen Issue 5:2018+A1:2019+A2:2021	ANSI C63.10:2013

## TEST PARAMETERS

Run #:	11	Line:	High Line	Add. Ext. Attenuation (dB):	0
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## COMMENTS

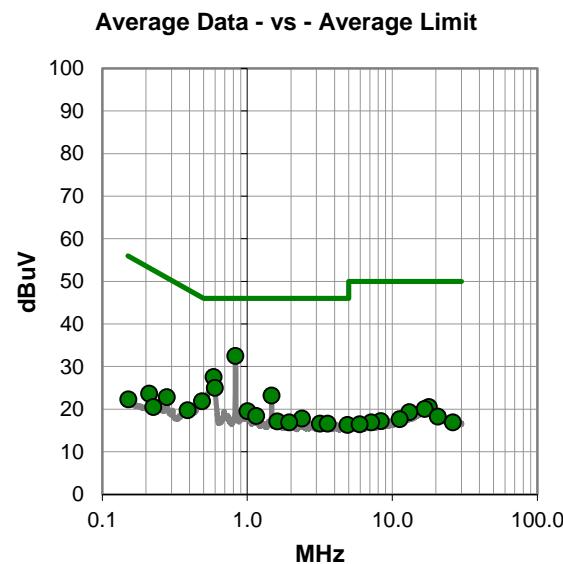
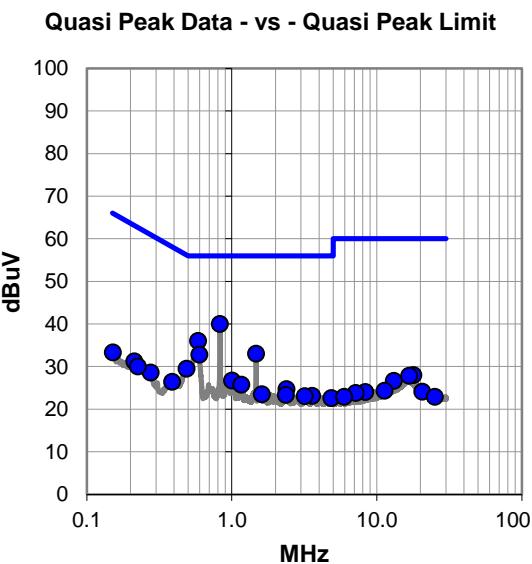
Node AC tested

## EUT OPERATING MODES

Transmitting Bluetooth Low Energy 1 Mbps, Mid Channel 18, 2442 MHz

## DEVIATIONS FROM TEST STANDARD

None



# POWERLINE CONDUCTED EMISSIONS



## RESULTS - Run #11

Quasi Peak Data - vs - Quasi Peak Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
0.829	19.9	20.1	40.0	56.0	-16.0
0.586	15.9	20.1	36.0	56.0	-20.0
1.470	12.9	20.1	33.0	56.0	-23.0
0.597	12.7	20.1	32.8	56.0	-23.2
0.489	9.4	20.1	29.5	56.2	-26.7
1.008	6.6	20.1	26.7	56.0	-29.3
1.165	5.6	20.1	25.7	56.0	-30.3
2.388	4.5	20.2	24.7	56.0	-31.3
0.388	6.3	20.1	26.4	58.1	-31.7
0.213	10.9	20.3	31.2	63.1	-31.9
17.918	6.6	21.4	28.0	60.0	-32.0
16.722	6.4	21.4	27.8	60.0	-32.2
0.277	8.5	20.1	28.6	60.9	-32.3
1.615	3.4	20.1	23.5	56.0	-32.5
0.225	9.7	20.3	30.0	62.6	-32.6
0.152	12.7	20.6	33.3	65.9	-32.6
2.358	3.1	20.2	23.3	56.0	-32.7
3.583	2.8	20.3	23.1	56.0	-32.9
3.186	2.7	20.3	23.0	56.0	-33.0
4.866	2.2	20.4	22.6	56.0	-33.4
13.141	5.4	21.2	26.6	60.0	-33.4
11.349	3.1	21.2	24.3	60.0	-35.7
20.690	2.4	21.7	24.1	60.0	-35.9
8.362	3.3	20.7	24.0	60.0	-36.0
7.167	3.2	20.6	23.8	60.0	-36.2

Average Data - vs - Average Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
0.829	12.4	20.1	32.5	46.0	-13.5
0.586	7.4	20.1	27.5	46.0	-18.5
0.597	4.9	20.1	25.0	46.0	-21.0
1.470	3.1	20.1	23.2	46.0	-22.8
0.489	1.7	20.1	21.8	46.2	-24.4
1.003	-0.6	20.1	19.5	46.0	-26.5
1.156	-1.7	20.1	18.4	46.0	-27.6
0.278	2.7	20.1	22.8	50.9	-28.1
2.388	-2.4	20.2	17.8	46.0	-28.2
0.388	-0.4	20.1	19.7	48.1	-28.4
1.615	-3.0	20.1	17.1	46.0	-28.9
1.950	-3.2	20.1	16.9	46.0	-29.1
3.177	-3.7	20.3	16.6	46.0	-29.4
3.585	-3.7	20.3	16.6	46.0	-29.4
17.918	-0.9	21.4	20.5	50.0	-29.5
0.211	3.3	20.3	23.6	53.2	-29.6
4.927	-4.1	20.4	16.3	46.0	-29.7
16.722	-1.4	21.4	20.0	50.0	-30.0
13.139	-1.9	21.2	19.3	50.0	-30.7
20.672	-3.5	21.7	18.2	50.0	-31.8
0.225	0.2	20.3	20.5	52.6	-32.1
11.261	-3.6	21.2	17.6	50.0	-32.4
8.360	-3.5	20.7	17.2	50.0	-32.8
7.167	-3.7	20.6	16.9	50.0	-33.1
26.279	-5.2	22.1	16.9	50.0	-33.1

## CONCLUSION

Pass

Tested By

# POWERLINE CONDUCTED EMISSIONS



EUT:	TSI OmniTrak Module PM/tVOC (7591-04)	Work Order:	TSIN0196
Serial Number:	LCOPC_056	Date:	2023-03-30
Customer:	TSI, Incorporated	Temperature:	21.3°C
Attendees:	Micah Larson	Relative Humidity:	18.5%
Customer Project:	None	Bar. Pressure (PMSL):	1021 mb
Tested By:	Ko Vorasarn	Job Site:	MN03
Power:	110VAC/60Hz	Configuration:	TSIN0196-11

## TEST SPECIFICATIONS

Specification:	Method:
FCC 15.207:2023	ANSI C63.10:2013
RSS-Gen Issue 5:2018+A1:2019+A2:2021	ANSI C63.10:2013

## TEST PARAMETERS

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

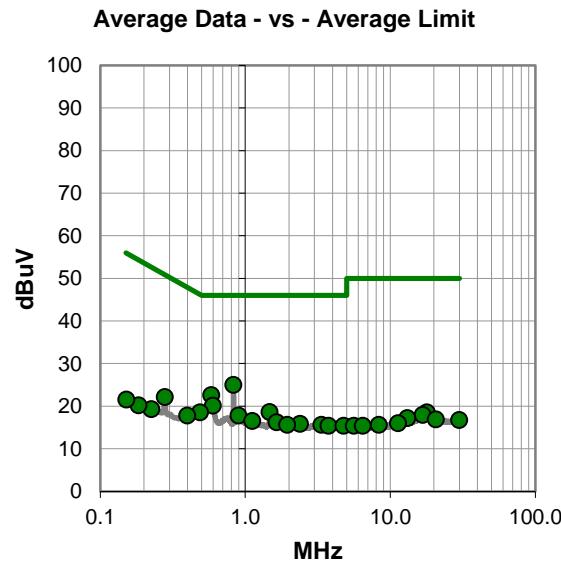
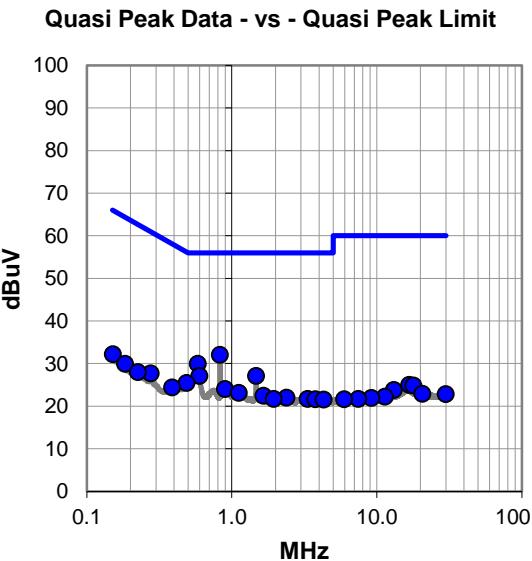
Node AC tested

## EUT OPERATING MODES

Transmitting Bluetooth Low Energy 1 Mbps, Mid Channel 18, 2442 MHz

## DEVIATIONS FROM TEST STANDARD

None



# POWERLINE CONDUCTED EMISSIONS



## RESULTS - Run #12

Quasi Peak Data - vs - Quasi Peak Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
0.829	11.9	20.1	32.0	56.0	-24.0
0.583	9.8	20.1	29.9	56.0	-26.1
0.597	7.0	20.1	27.1	56.0	-28.9
1.470	7.0	20.1	27.1	56.0	-28.9
0.487	5.3	20.1	25.4	56.2	-30.8
0.898	3.9	20.1	24.0	56.0	-32.0
1.120	3.0	20.1	23.1	56.0	-32.9
0.277	7.6	20.1	27.7	60.9	-33.2
1.651	2.3	20.1	22.4	56.0	-33.6
0.152	11.6	20.6	32.2	65.9	-33.7
0.388	4.3	20.1	24.4	58.1	-33.7
2.390	1.8	20.2	22.0	56.0	-34.0
1.947	1.6	20.1	21.7	56.0	-34.3
3.337	1.4	20.3	21.7	56.0	-34.3
0.184	9.5	20.4	29.9	64.3	-34.4
3.777	1.3	20.3	21.6	56.0	-34.4
4.309	1.2	20.3	21.5	56.0	-34.5
0.225	7.7	20.3	28.0	62.6	-34.6
16.728	3.6	21.4	25.0	60.0	-35.0
17.921	3.4	21.4	24.8	60.0	-35.2
13.142	2.6	21.2	23.8	60.0	-36.2
20.681	1.2	21.7	22.9	60.0	-37.1
29.876	0.5	22.3	22.8	60.0	-37.2
11.357	1.0	21.2	22.2	60.0	-37.8
9.203	1.1	20.8	21.9	60.0	-38.1

Average Data - vs - Average Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
0.829	4.9	20.1	25.0	46.0	-21.0
0.583	2.5	20.1	22.6	46.0	-23.4
0.597	0.0	20.1	20.1	46.0	-25.9
1.470	-1.5	20.1	18.6	46.0	-27.4
0.489	-1.6	20.1	18.5	46.2	-27.7
0.898	-2.3	20.1	17.8	46.0	-28.2
0.278	2.0	20.1	22.1	50.9	-28.8
1.117	-3.6	20.1	16.5	46.0	-29.5
1.645	-3.9	20.1	16.2	46.0	-29.8
0.399	-2.3	20.1	17.8	47.9	-30.1
2.390	-4.4	20.2	15.8	46.0	-30.2
1.943	-4.5	20.1	15.6	46.0	-30.4
3.351	-4.7	20.3	15.6	46.0	-30.4
3.763	-4.9	20.3	15.4	46.0	-30.6
4.781	-5.0	20.4	15.4	46.0	-30.6
17.920	-2.9	21.4	18.5	50.0	-31.5
16.726	-3.5	21.4	17.9	50.0	-32.1
13.142	-4.0	21.2	17.2	50.0	-32.8
20.655	-4.8	21.7	16.9	50.0	-33.1
0.225	-1.0	20.3	19.3	52.6	-33.3
29.867	-5.6	22.3	16.7	50.0	-33.3
11.334	-5.2	21.2	16.0	50.0	-34.0
0.184	-0.2	20.4	20.2	54.3	-34.1
0.152	0.9	20.6	21.5	55.9	-34.4
8.362	-5.1	20.7	15.6	50.0	-34.4

## CONCLUSION

Pass

Tested By

# DUTY CYCLE



XMit 2022.12.28.0

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	SA26B-20	RFW	2023-02-07	2024-02-07
Block - DC	Fairview Microwave	SD3379	AMZ	2022-11-06	2023-11-06
Cable	Micro-Coax	UFD150A-1-0720-200200	MNL	2022-09-10	2023-09-10
Generator - Signal	Keysight	N5171B (EXG)	TEY	2023-01-23	2026-01-23
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFM	2022-04-25	2023-04-25

## 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



TbTx 2022.06.03.0 XMII 2022.12.28.0

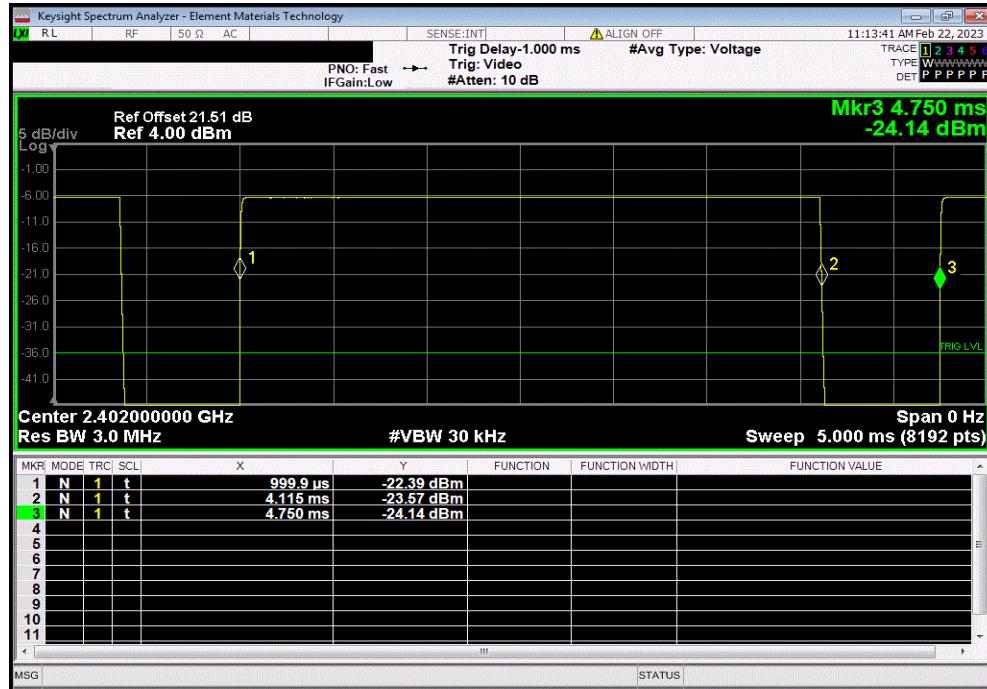
EUT:	TSI OmniTrak Module PM (7591-01)	Work Order:	TSIN0196				
Serial Number:	LCOPC_061	Date:	02/22/2023				
Customer:	TSI, Incorporated	Temperature:	22.8°C				
Attendees:	Andrew Bentley	Humidity:	18.4%				
Project:	None	Barometric Pres.:	1012 mbar				
Tested by:	Christopher Heintzelman	Power:	5VDC Battery				
TEST SPECIFICATIONS		Test Method	Job Site: MN11				
FCC 15.247:2023		ANSI C63.10:2013					
RSS-Gen Issue 5:2018+A1:2019+A2:2021		ANSI C63.10:2013					
COMMENTS							
Reference level offset includes measurement cable, DC block, and attenuator.							
DEVIATIONS FROM TEST STANDARD							
None							
Configuration #	TSIN0196-2	Signature	<i>CleAnne Heintzelman</i>				
		Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
BLE/GFSK 125 kbps							
Low Channel, 2402 MHz		3.115 ms	3.75 ms	1	83.1	N/A	N/A
Low Channel, 2402 MHz		N/A	N/A	5	N/A	N/A	N/A
Mid Channel, 2442 MHz		3.115 ms	3.75 ms	1	83.1	N/A	N/A
Mid Channel, 2442 MHz		N/A	N/A	5	N/A	N/A	N/A
High Channel, 2480 MHz		3.115 ms	3.75 ms	1	83.1	N/A	N/A
High Channel, 2480 MHz		N/A	N/A	5	N/A	N/A	N/A
BLE/GFSK 500 kbps							
Low Channel, 2402 MHz		1.087 ms	1.875 ms	1	58	N/A	N/A
Low Channel, 2402 MHz		N/A	N/A	5	N/A	N/A	N/A
Mid Channel, 2442 MHz		1.087 ms	1.875 ms	1	58	N/A	N/A
Mid Channel, 2442 MHz		N/A	N/A	5	N/A	N/A	N/A
High Channel, 2480 MHz		1.087 ms	1.875 ms	1	58	N/A	N/A
High Channel, 2480 MHz		N/A	N/A	5	N/A	N/A	N/A
BLE/GFSK 1 Mbps							
Low Channel, 2402 MHz		411.3 us	625.1 us	1	65.8	N/A	N/A
Low Channel, 2402 MHz		N/A	N/A	5	N/A	N/A	N/A
Mid Channel, 2442 MHz		410.4 us	625.1 us	1	65.7	N/A	N/A
Mid Channel, 2442 MHz		N/A	N/A	5	N/A	N/A	N/A
High Channel, 2480 MHz		410 us	625.1 us	1	65.6	N/A	N/A
High Channel, 2480 MHz		N/A	N/A	5	N/A	N/A	N/A
BLE/GFSK 2 Mbps							
Low Channel, 2402 MHz		225.4 us	625.1 us	1	36.1	N/A	N/A
Low Channel, 2402 MHz		N/A	N/A	5	N/A	N/A	N/A
Mid Channel, 2442 MHz		224.5 us	625.1 us	1	35.9	N/A	N/A
Mid Channel, 2442 MHz		N/A	N/A	5	N/A	N/A	N/A
High Channel, 2480 MHz		224.3 us	625.1 us	1	35.9	N/A	N/A
High Channel, 2480 MHz		N/A	N/A	5	N/A	N/A	N/A

# DUTY CYCLE

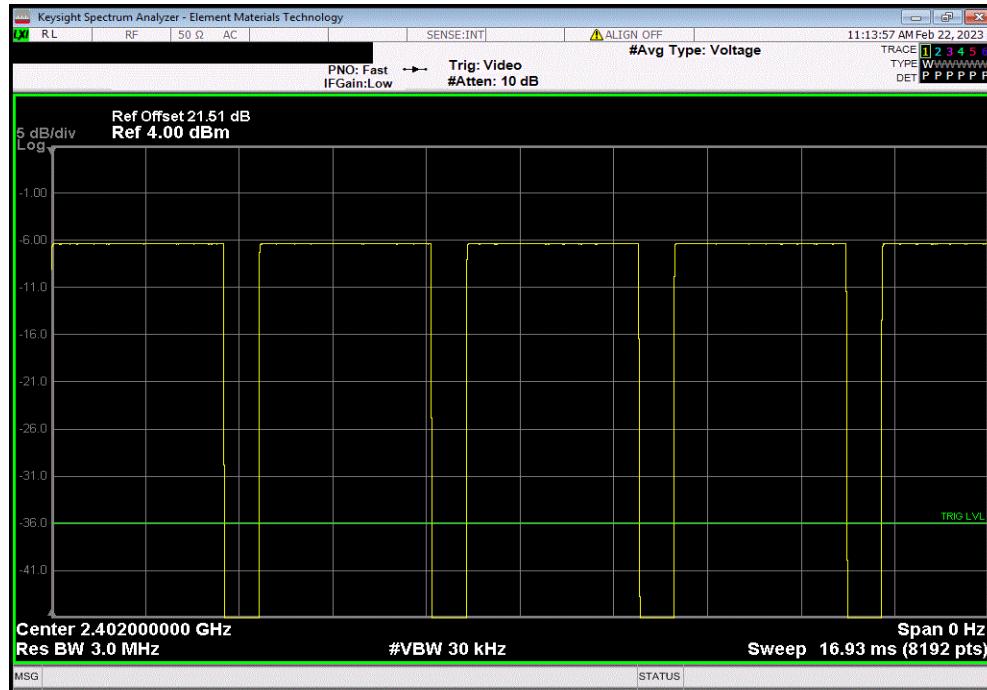


TbtTx 2022.06.03.0 XMit 2022.12.28.0

BLE/GFSK 125 kbps, Low Channel, 2402 MHz					
Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
3.115 ms	3.75 ms	1	83.1	N/A	N/A



BLE/GFSK 125 kbps, Low Channel, 2402 MHz					
Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
N/A	N/A	5	N/A	N/A	N/A

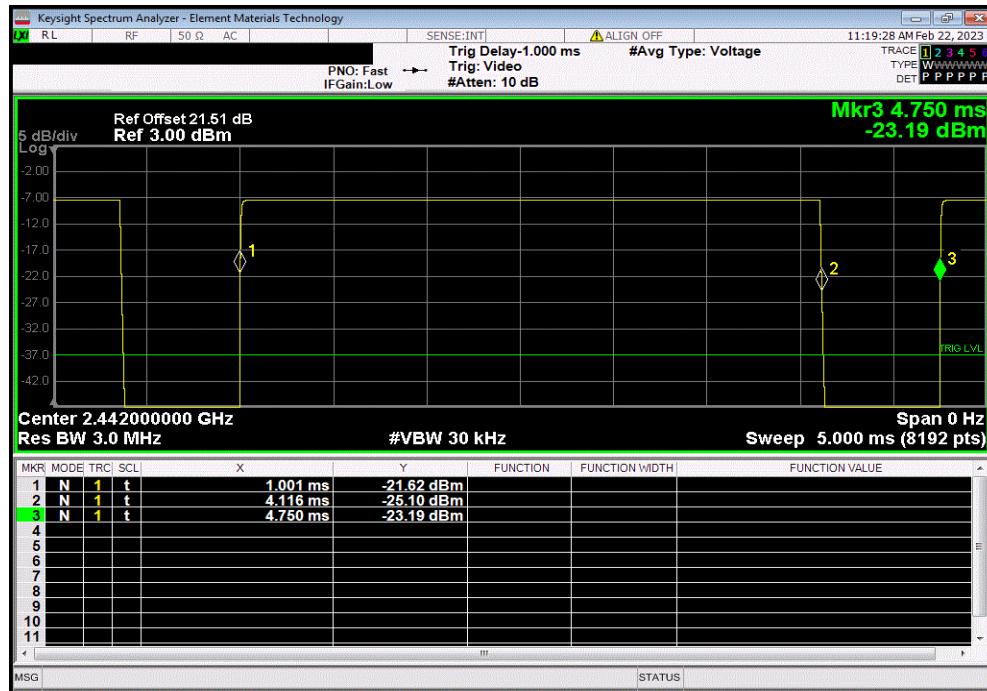


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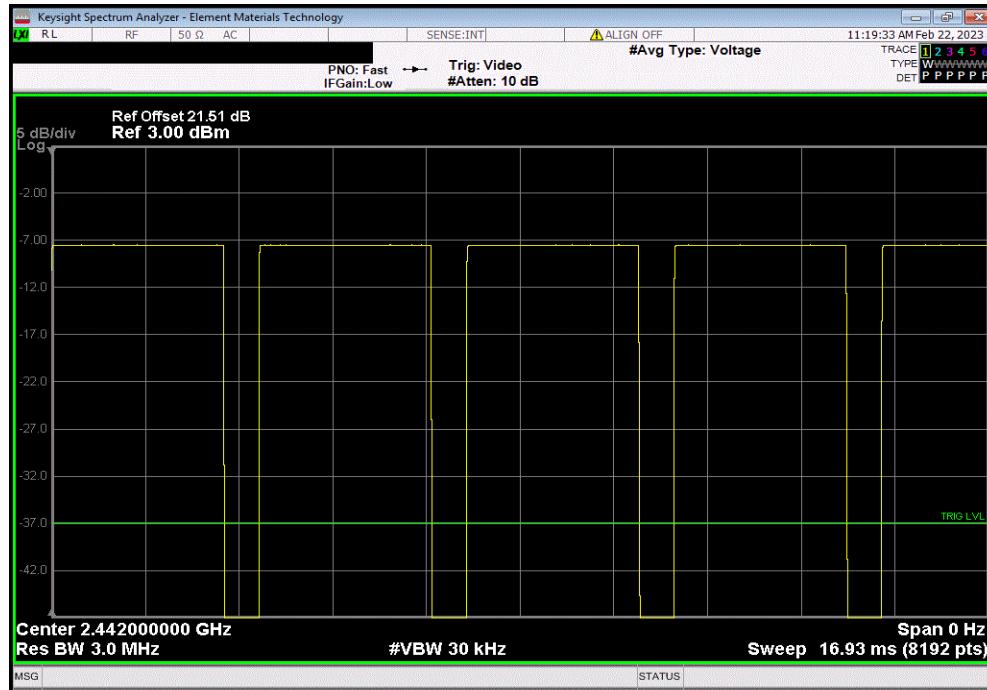


TbITx 2022.06.03.0 XMit 2022.12.28.0

BLE/GFSK 125 kbps, Mid Channel, 2442 MHz						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	3.115 ms	3.75 ms	1	83.1	N/A	N/A



BLE/GFSK 125 kbps, Mid Channel, 2442 MHz						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	N/A	N/A	5	N/A	N/A	N/A

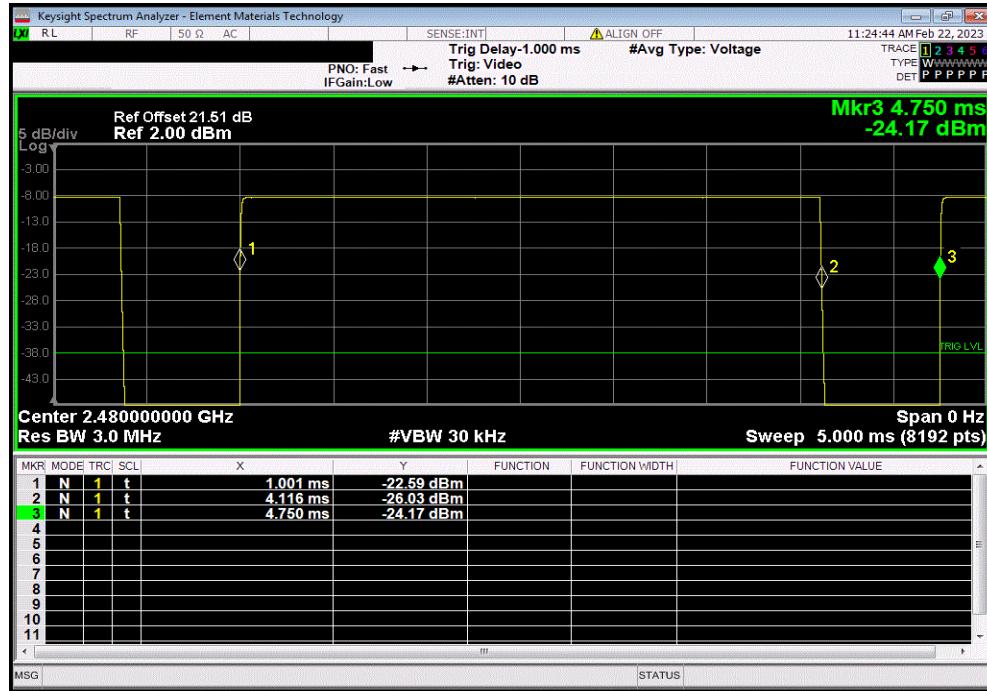


# DUTY CYCLE

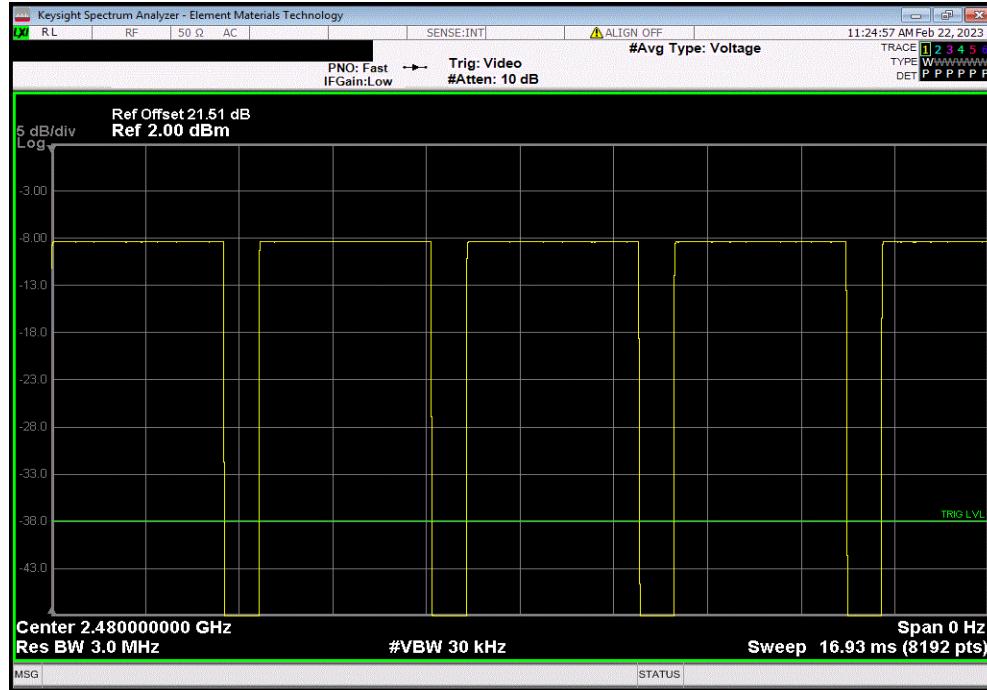


TbITx 2022.06.03.0 XMit 2022.12.28.0

BLE/GFSK 125 kbps, High Channel, 2480 MHz						
Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results	
3.115 ms	3.75 ms	1	83.1	N/A	N/A	N/A



BLE/GFSK 125 kbps, High Channel, 2480 MHz						
Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results	
N/A	N/A	5	N/A	N/A	N/A	N/A

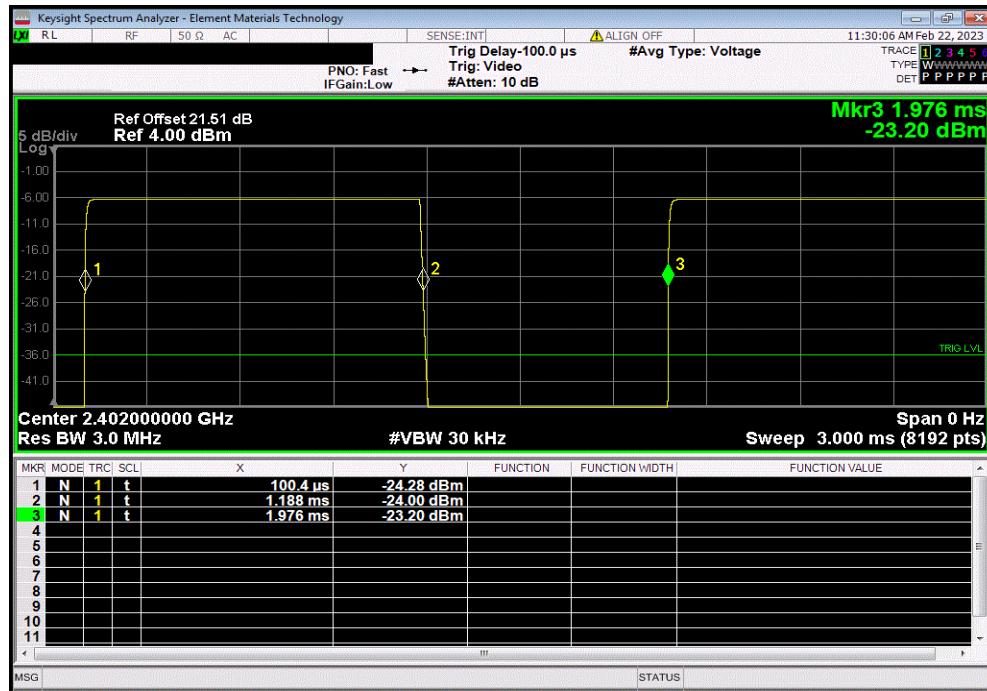


# DUTY CYCLE

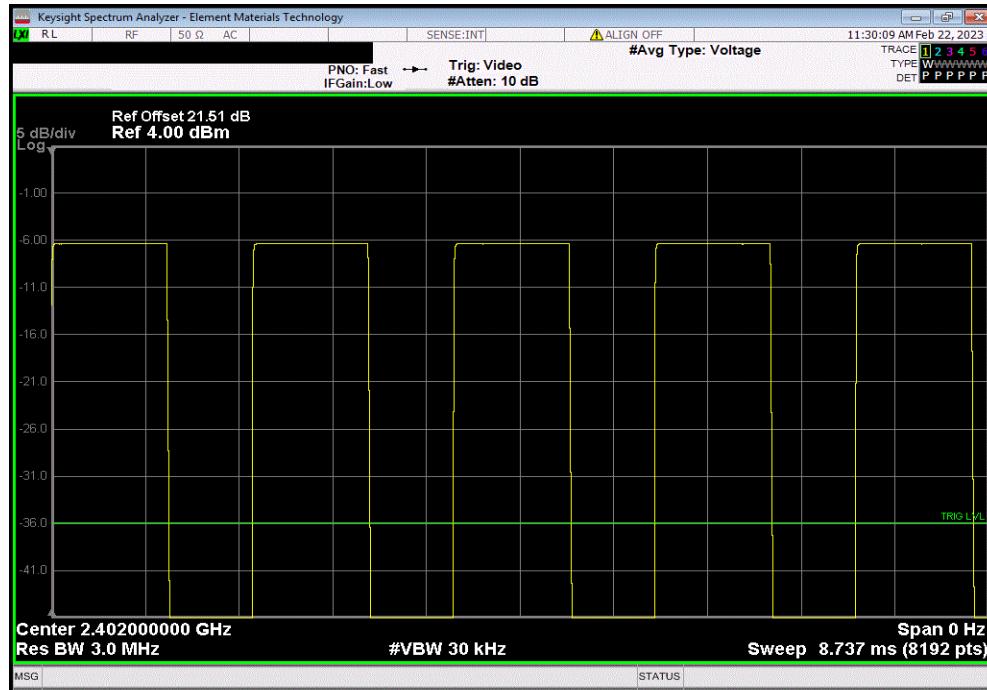


TbITx 2022.06.03.0 XMit 2022.12.28.0

BLE/GFSK 500 kbps, Low Channel, 2402 MHz						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	1.087 ms	1.875 ms	1	58	N/A	N/A



BLE/GFSK 500 kbps, Low Channel, 2402 MHz						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	N/A	N/A	5	N/A	N/A	N/A

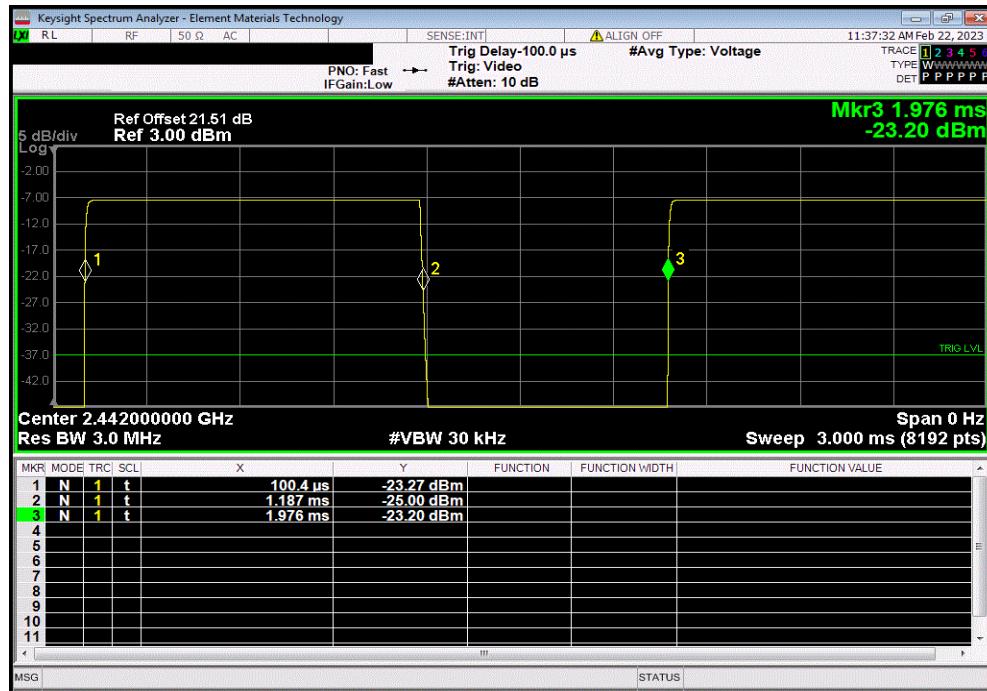


# DUTY CYCLE

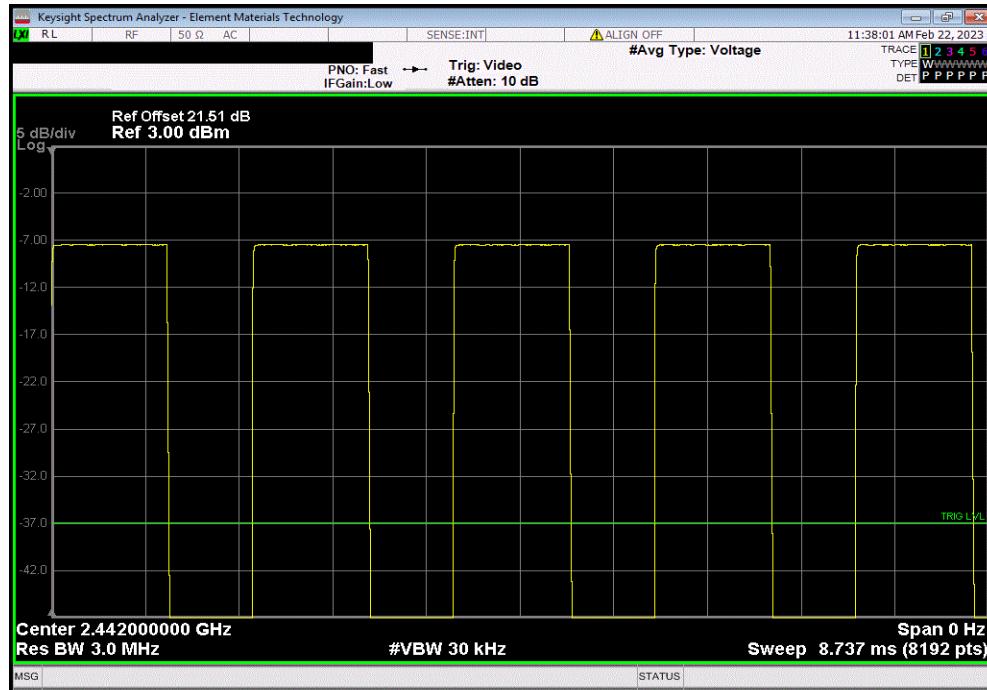


TbtTx 2022.06.03.0 XMit 2022.12.28.0

BLE/GFSK 500 kbps, Mid Channel, 2442 MHz						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	1.087 ms	1.875 ms	1	58	N/A	N/A



BLE/GFSK 500 kbps, Mid Channel, 2442 MHz						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	N/A	N/A	5	N/A	N/A	N/A



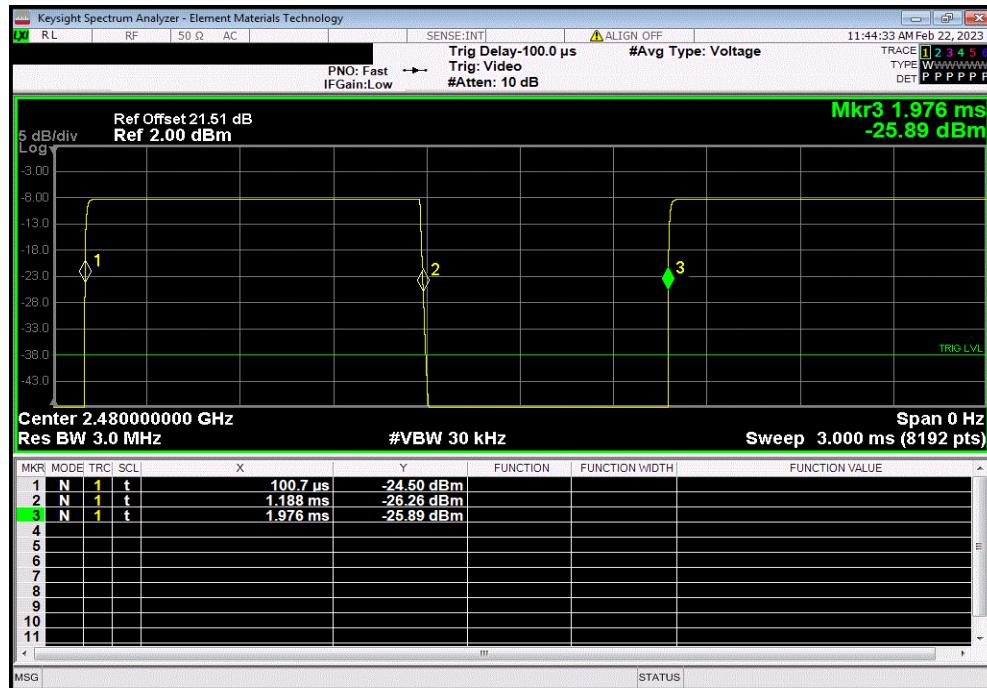
## DUTY CYCLE



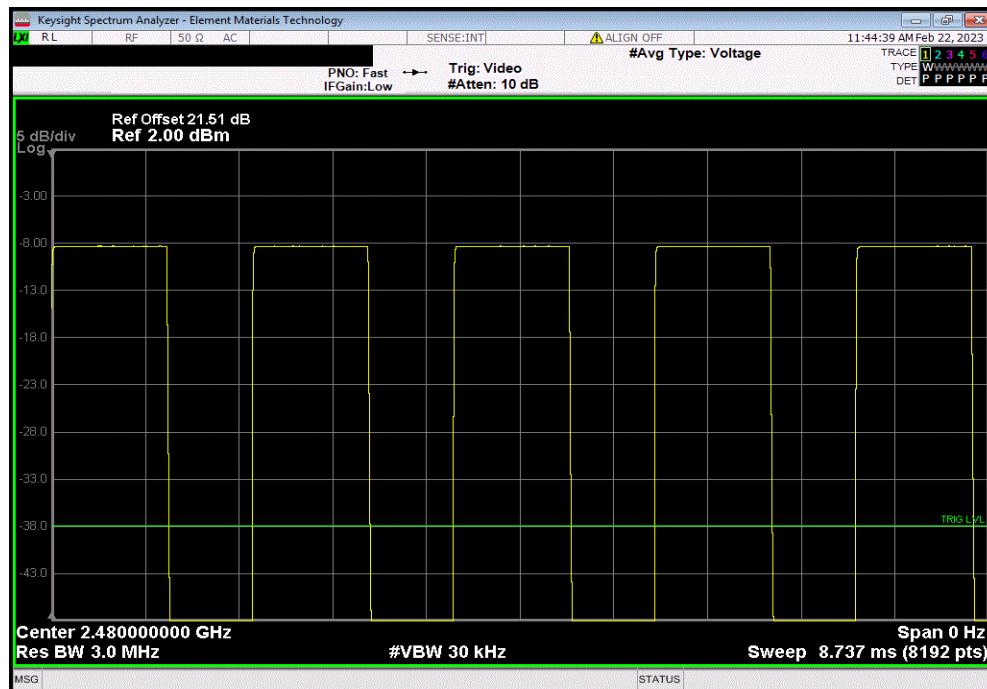
TbtTx 2022.06.03.0

XMit 2022.12.28.0

BLE/GFSK 500 kbps, High Channel, 2480 MHz						
Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results	
1.087 ms	1.875 ms	1	58	N/A	N/A	



BLE/GFSK 500 kbps, High Channel, 2480 MHz						
Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results	
	N/A	N/A	5	N/A	N/A	N/A

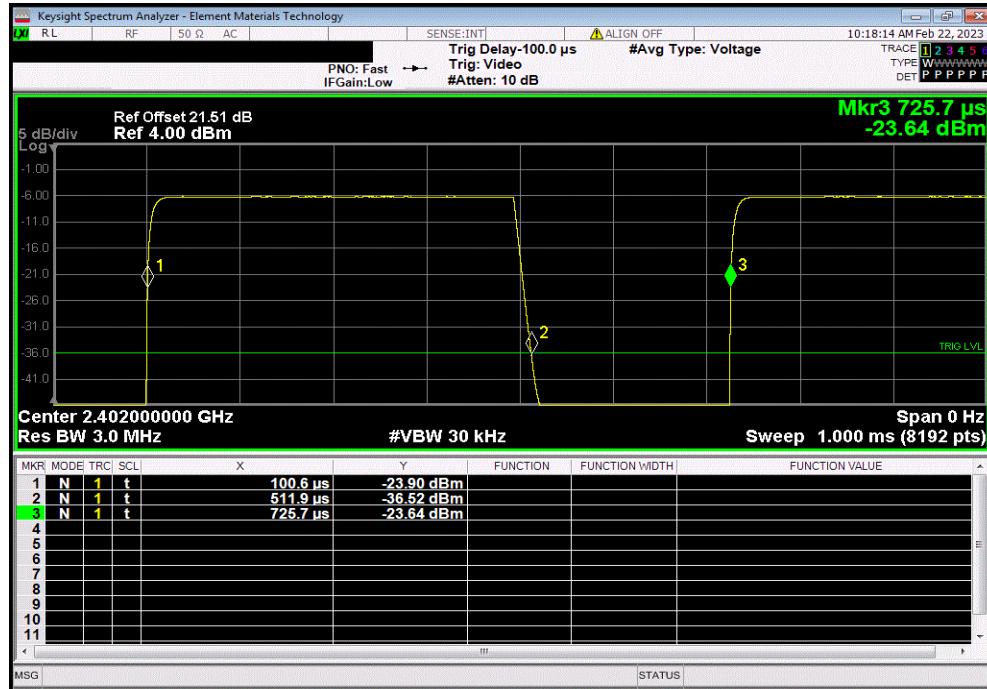


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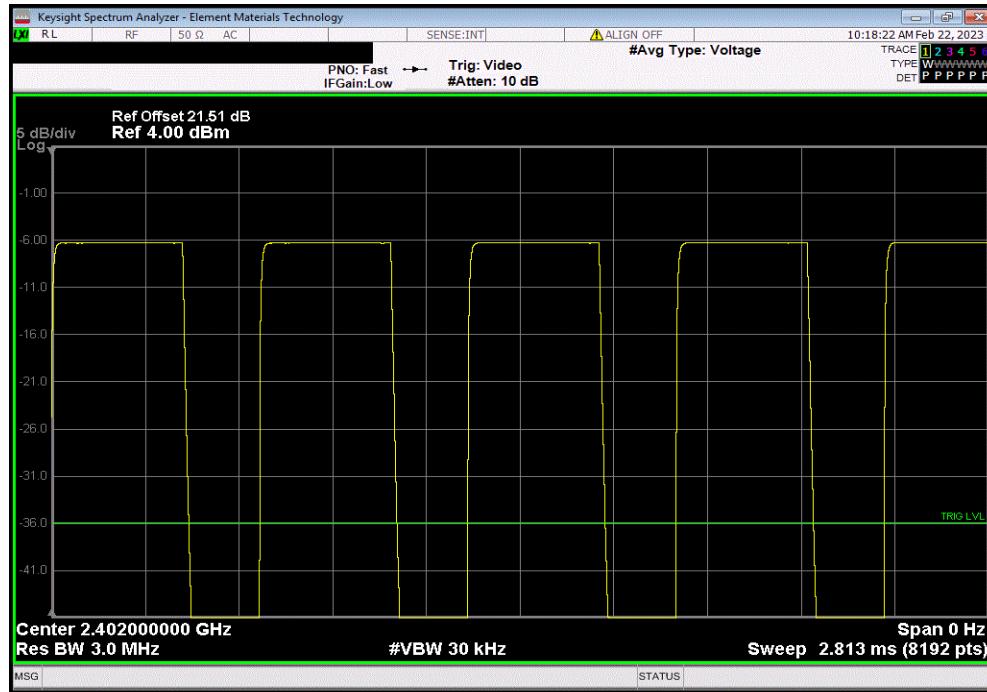


TbtTx 2022.06.03.0 XMit 2022.12.28.0

BLE/GFSK 1 Mbps, Low Channel, 2402 MHz					
Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
411.3 us	625.1 us	1	65.8	N/A	N/A



BLE/GFSK 1 Mbps, Low Channel, 2402 MHz					
Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
N/A	N/A	5	N/A	N/A	N/A

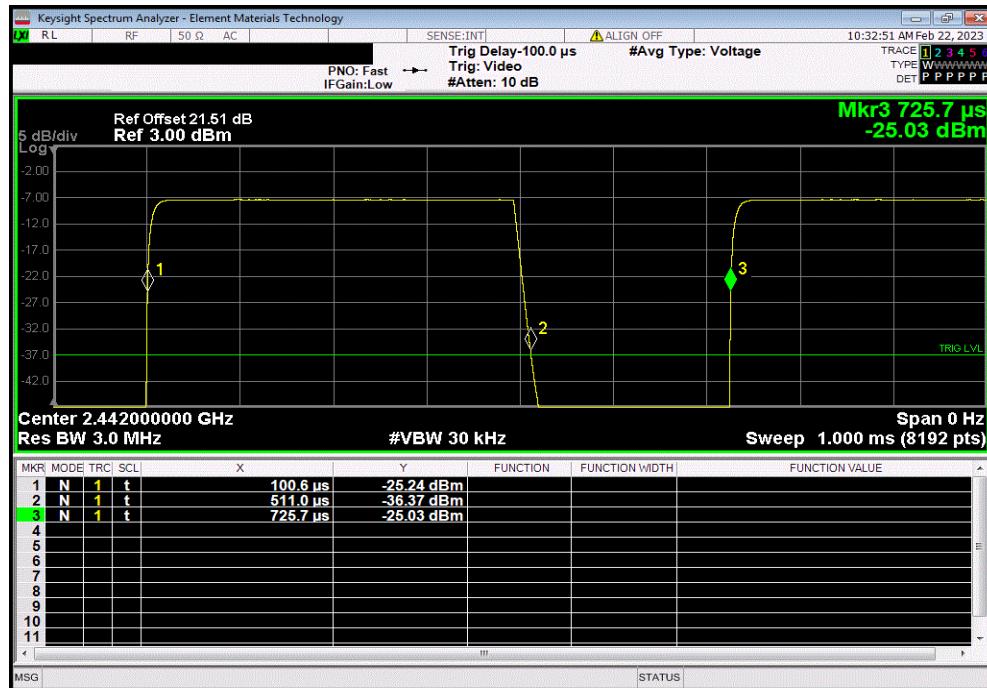


# DUTY CYCLE

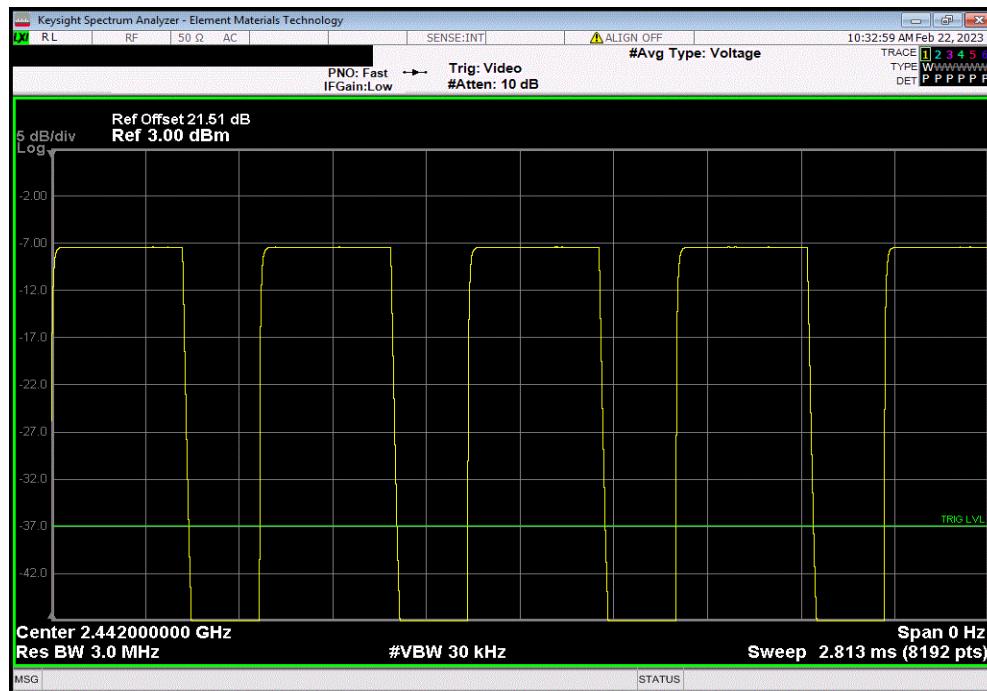


TbtTx 2022.06.03.0 XMit 2022.12.28.0

BLE/GFSK 1 Mbps, Mid Channel, 2442 MHz					
Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
410.4 us	625.1 us	1	65.7	N/A	N/A



BLE/GFSK 1 Mbps, Mid Channel, 2442 MHz					
Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
N/A	N/A	5	N/A	N/A	N/A

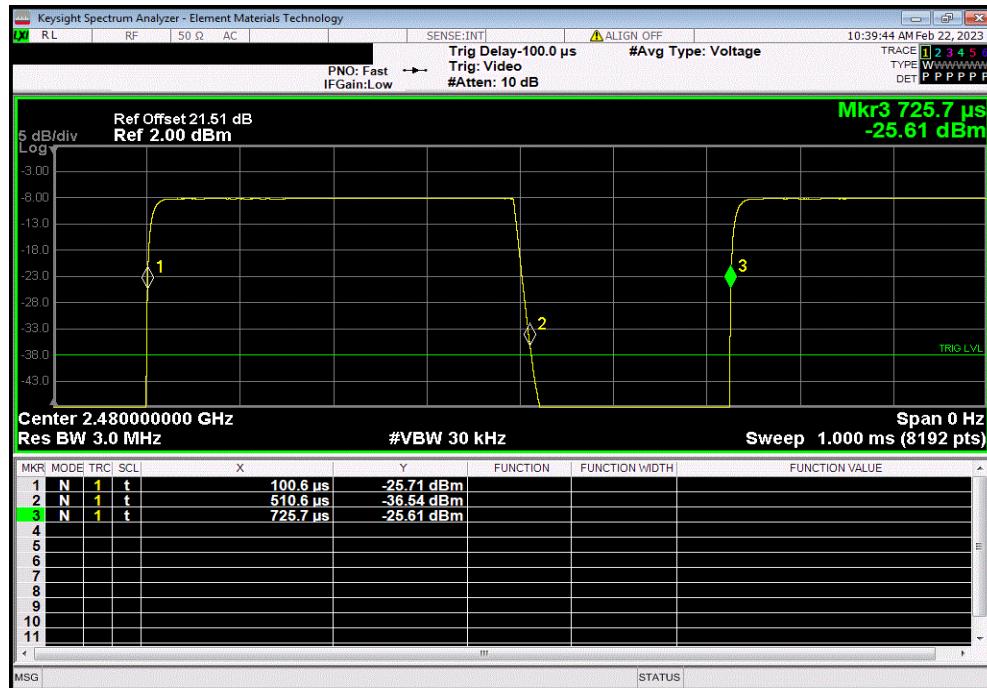


# DUTY CYCLE

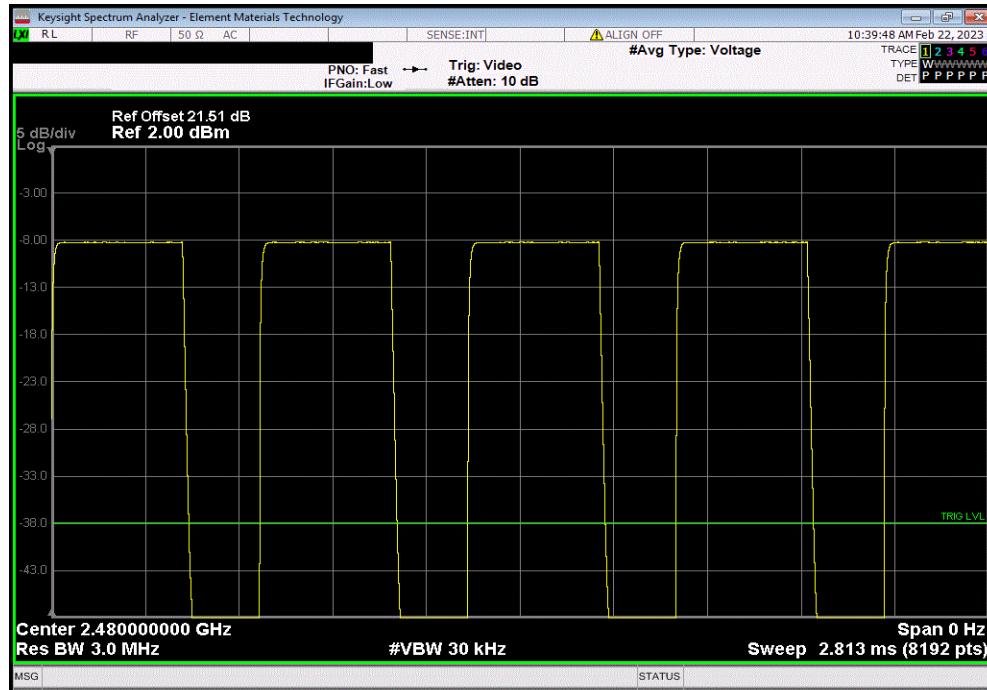


TbtTx 2022.06.03.0 XMit 2022.12.28.0

BLE/GFSK 1 Mbps, High Channel, 2480 MHz					
Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
410 us	625.1 us	1	65.6	N/A	N/A



BLE/GFSK 1 Mbps, High Channel, 2480 MHz					
Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
N/A	N/A	5	N/A	N/A	N/A

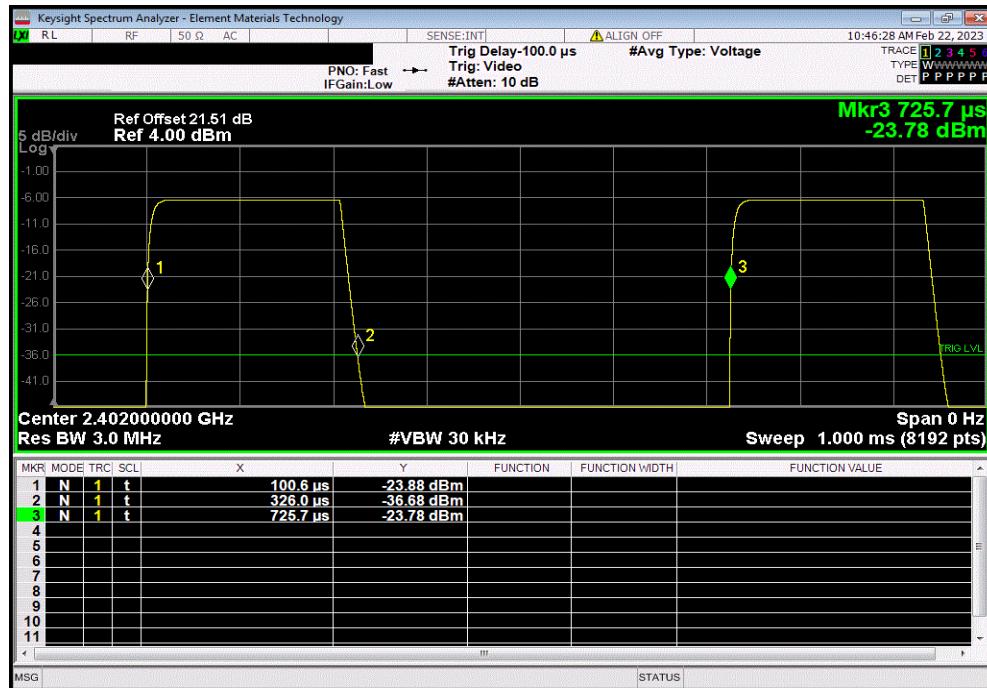


# DUTY CYCLE

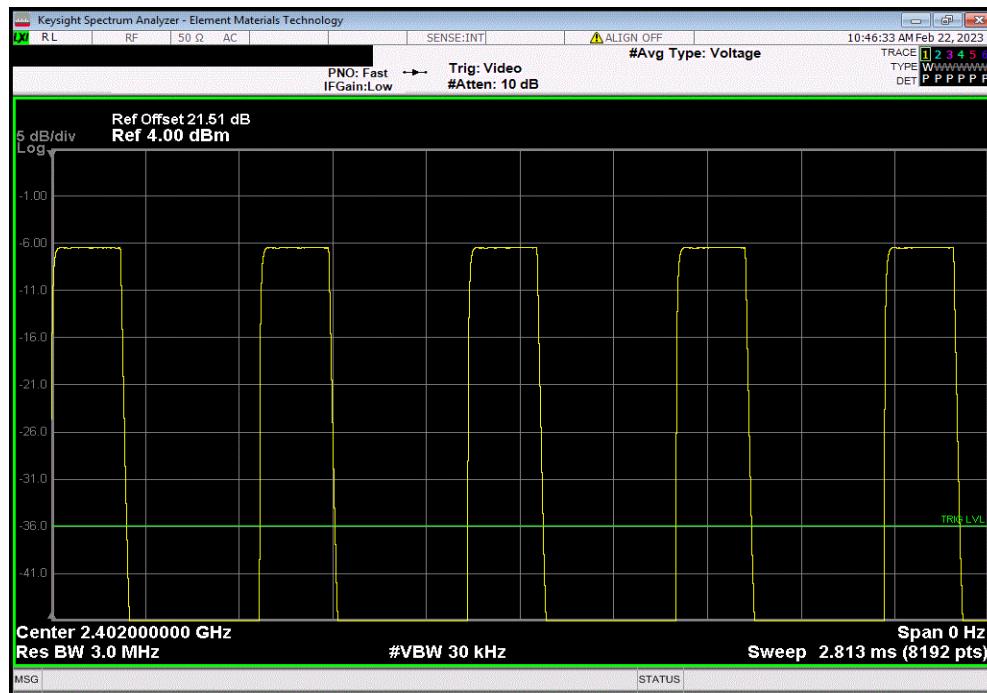


TbITx 2022.06.03.0 XMit 2022.12.28.0

BLE/GFSK 2 Mbps, Low Channel, 2402 MHz					
Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
225.4 us	625.1 us	1	36.1	N/A	N/A



BLE/GFSK 2 Mbps, Low Channel, 2402 MHz					
Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
N/A	N/A	5	N/A	N/A	N/A

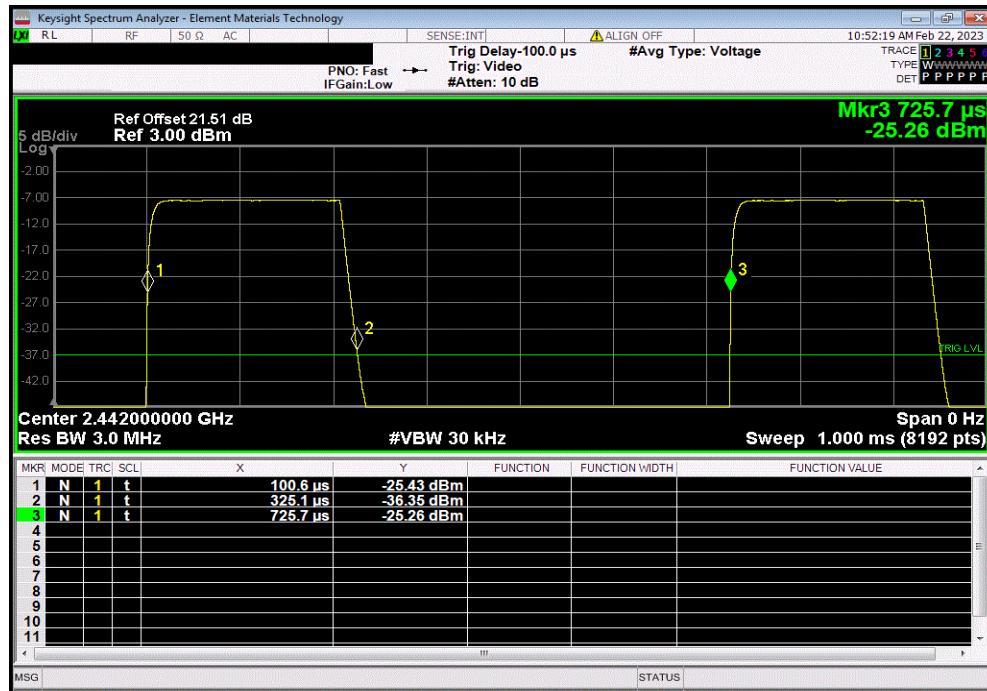


# DUTY CYCLE

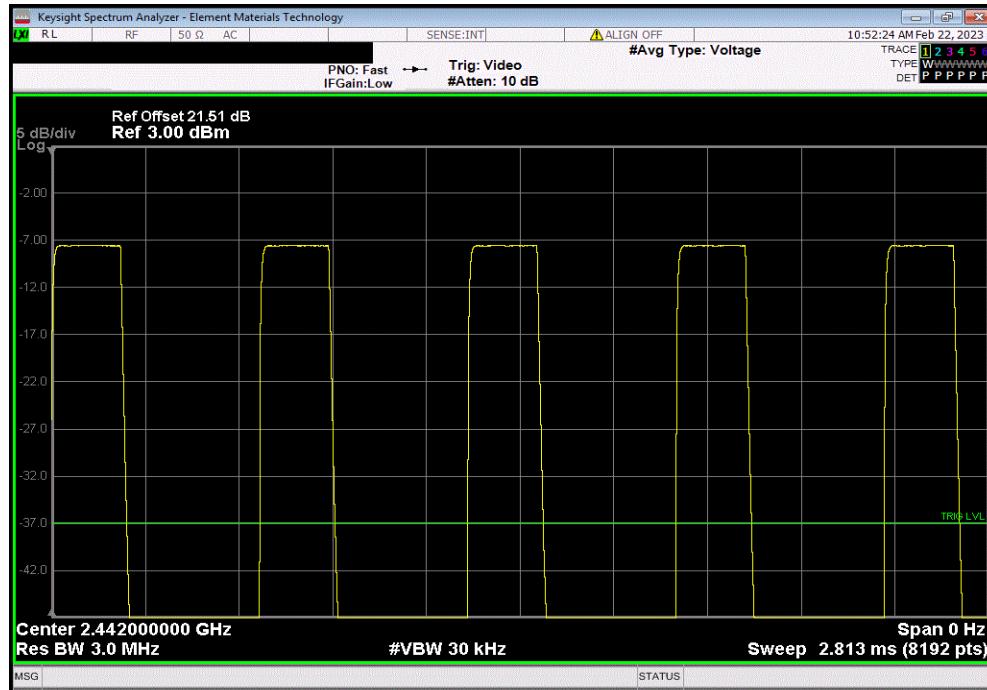


TbITx 2022.06.03.0 XMit 2022.12.28.0

BLE/GFSK 2 Mbps, Mid Channel, 2442 MHz					
Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
224.5 us	625.1 us	1	35.9	N/A	N/A



BLE/GFSK 2 Mbps, Mid Channel, 2442 MHz					
Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
N/A	N/A	5	N/A	N/A	N/A

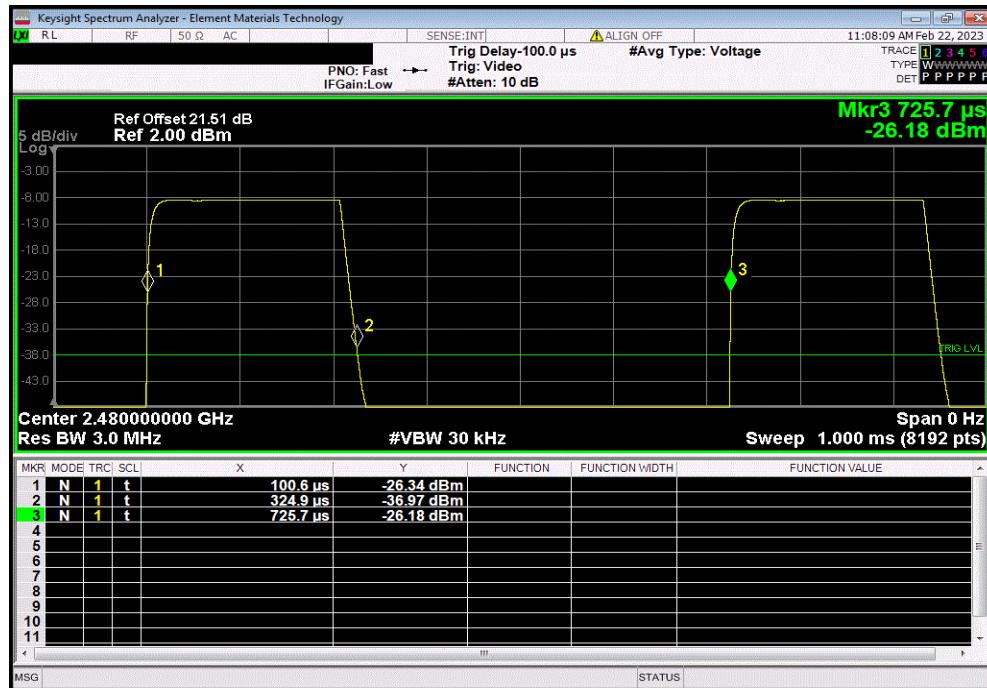


# DUTY CYCLE

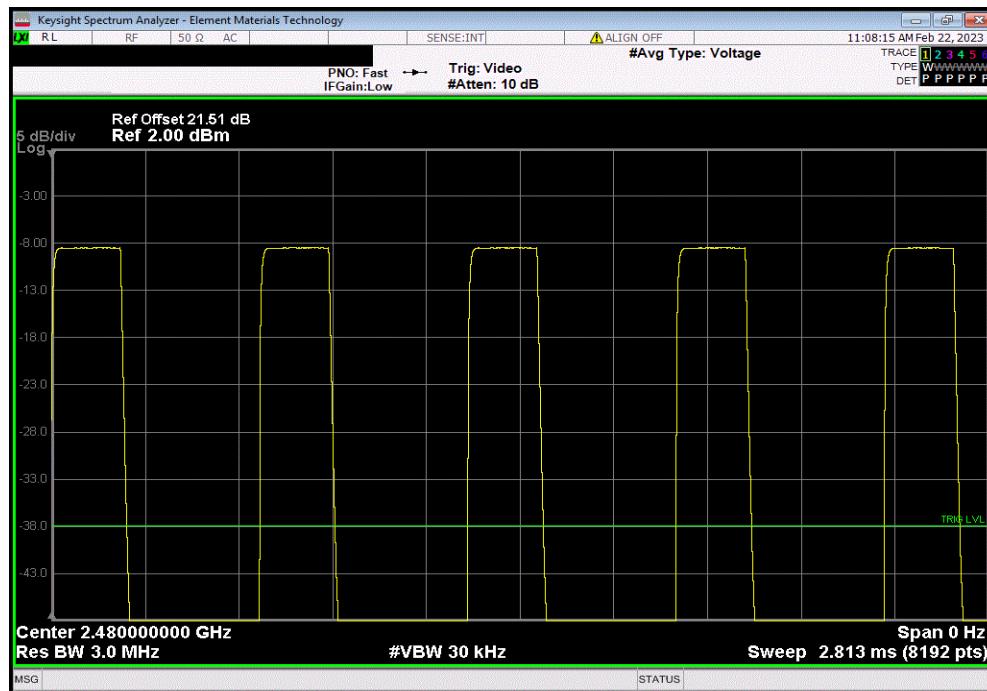


TbITx 2022.06.03.0 XMit 2022.12.28.0

BLE/GFSK 2 Mbps, High Channel, 2480 MHz					
Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
224.3 us	625.1 us	1	35.9	N/A	N/A



BLE/GFSK 2 Mbps, High Channel, 2480 MHz					
Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
N/A	N/A	5	N/A	N/A	N/A



# DTS BANDWIDTH



XMit 2022.12.28.0

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	SA26B-20	RFW	2023-02-07	2024-02-07
Block - DC	Fairview Microwave	SD3379	AMZ	2022-11-06	2023-11-06
Generator - Signal	Keysight	N5171B (EXG)	TEY	2023-01-23	2026-01-23
Cable	Micro-Coax	UFD150A-1-0720-200200	MNL	2022-09-10	2023-09-10
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFM	2022-04-25	2023-04-25

## TEST DESCRIPTION

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

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

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

# DTS BANDWIDTH



TbTx 2022.06.03.0 XMII 2022.12.28.0

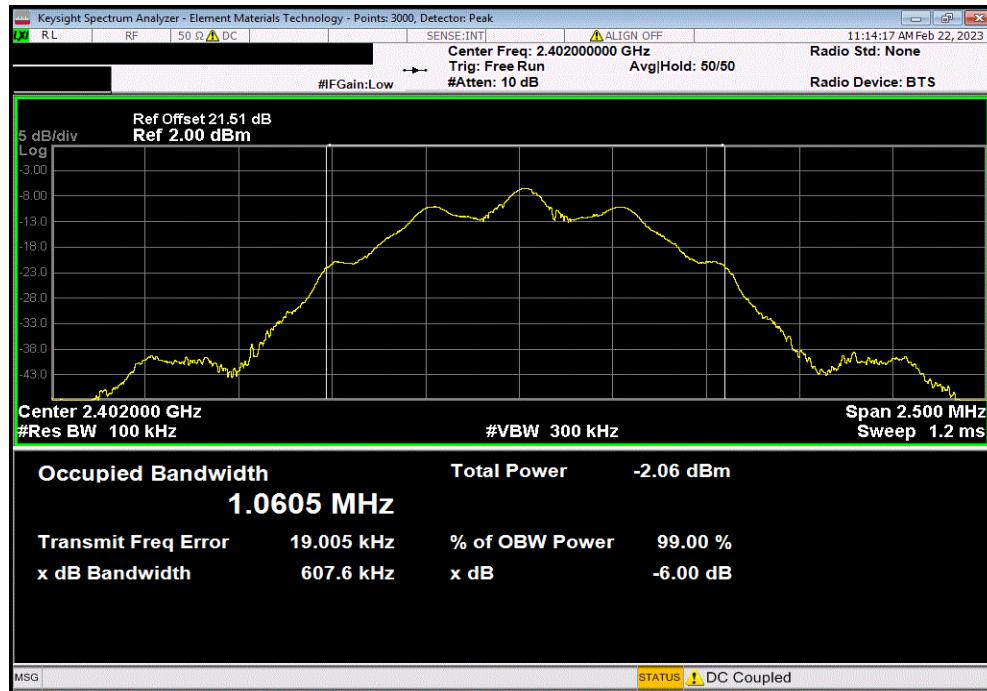
EUT:	TSI OmniTrak Module PM (7591-01)	Work Order:	TSIN0196	
Serial Number:	LCOPC_061	Date:	02/22/2023	
Customer:	TSI, Incorporated	Temperature:	22.8°C	
Attendees:	Andrew Bentley	Humidity:	18.4%	
Project:	None	Barometric Pres.:	1012 mbar	
Tested by:	Christopher Heintzelman	Power:	5VDC Battery	
TEST SPECIFICATIONS		Test Method	Job Site: MN11	
FCC 15.247:2023		ANSI C63.10:2013		
RSS-247 Issue 2:2017		ANSI C63.10:2013		
COMMENTS	Reference level offset includes measurement cable, DC block, and attenuator.			
DEVIATIONS FROM TEST STANDARD				
None				
Configuration #	TSIN0196-2	Signature	<i>Christopher Heintzelman</i>	
		Value	Limit (±)	Result
BLE/GFSK 125 kbps	Low Channel, 2402 MHz	607.558 kHz	500 kHz	Pass
	Mid Channel, 2442 MHz	609.007 kHz	500 kHz	Pass
	High Channel, 2480 MHz	609.226 kHz	500 kHz	Pass
BLE/GFSK 500 kbps	Low Channel, 2402 MHz	685.059 kHz	500 kHz	Pass
	Mid Channel, 2442 MHz	708.326 kHz	500 kHz	Pass
	High Channel, 2480 MHz	706.302 kHz	500 kHz	Pass
BLE/GFSK 1 Mbps	Low Channel, 2402 MHz	686.967 kHz	500 kHz	Pass
	Mid Channel, 2442 MHz	692.617 kHz	500 kHz	Pass
	High Channel, 2480 MHz	694.948 kHz	500 kHz	Pass
BLE/GFSK 2 Mbps	Low Channel, 2402 MHz	1.134 MHz	500 kHz	Pass
	Mid Channel, 2442 MHz	1.135 MHz	500 kHz	Pass
	High Channel, 2480 MHz	1.139 MHz	500 kHz	Pass

# DTS BANDWIDTH

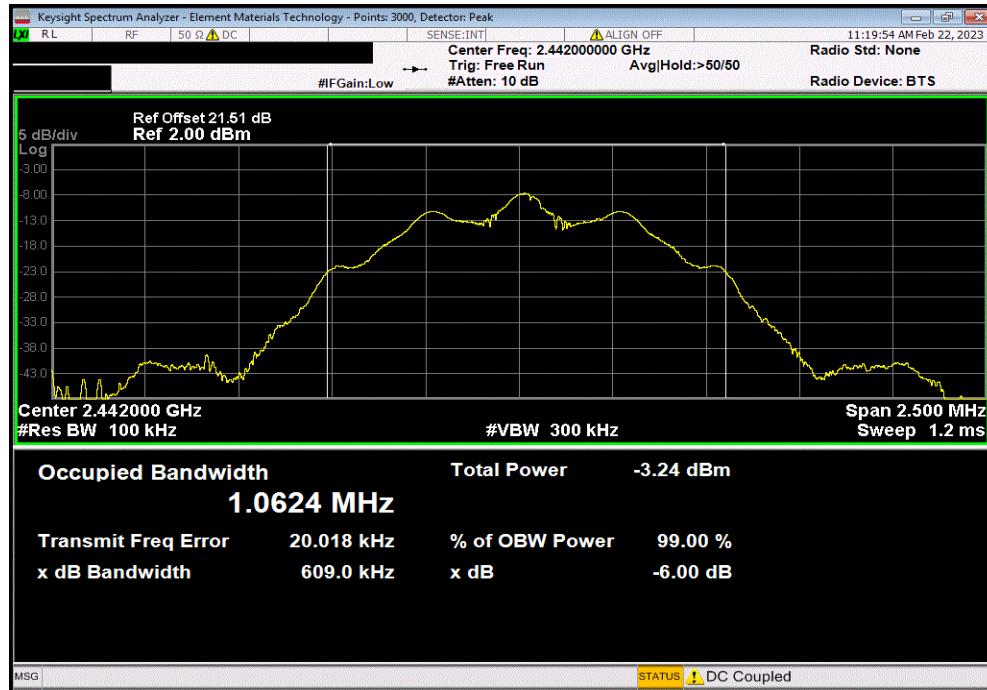


TbtTx 2022.06.03.0 XMit 2022.12.28.0

BLE/GFSK 125 kbps, Low Channel, 2402 MHz			Limit
Value	(≥)	Result	
607.558 kHz	500 kHz	Pass	



BLE/GFSK 125 kbps, Mid Channel, 2442 MHz			Limit
Value	(≥)	Result	
609.007 kHz	500 kHz	Pass	

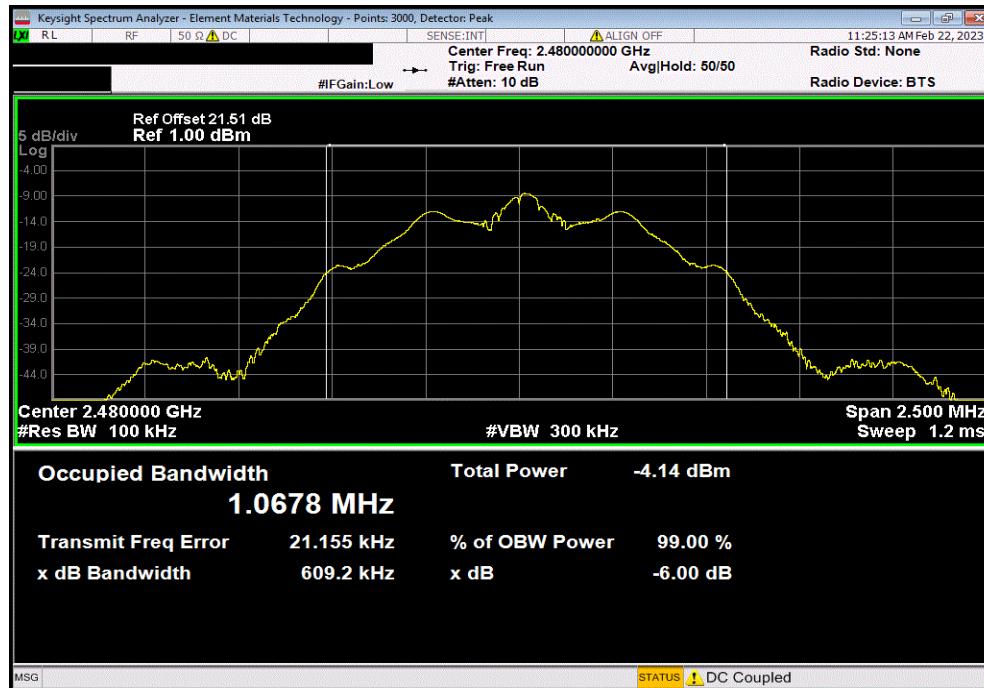


# DTS BANDWIDTH

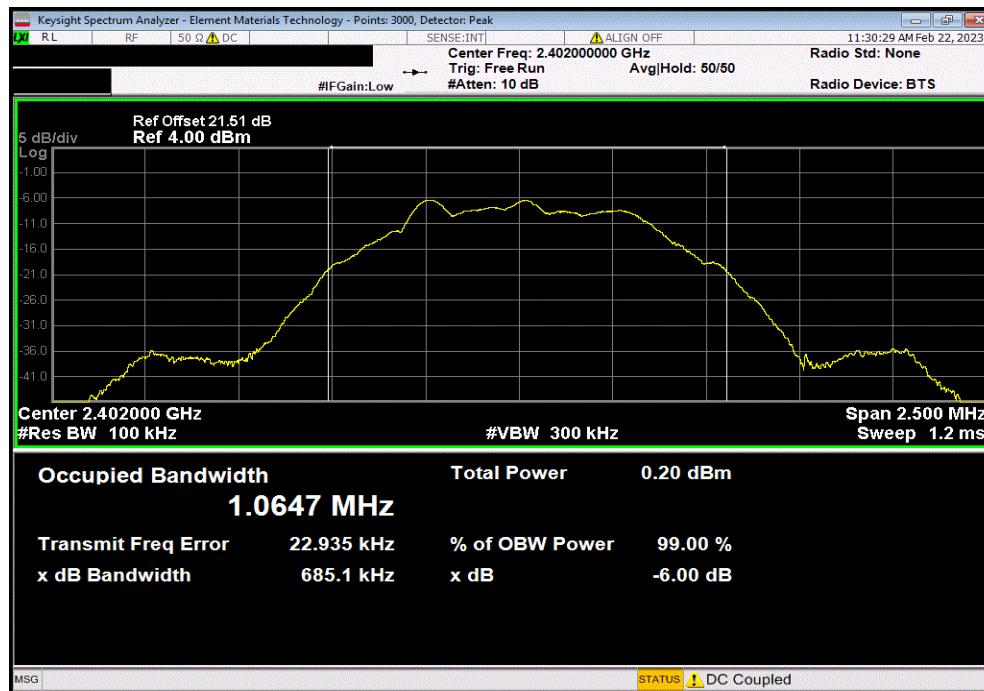


TbTx 2022.06.03.0 XMit 2022.12.28.0

			Limit
	Value	( $\geq$ )	Result
	609.226 kHz	500 kHz	Pass



			Limit
	Value	( $\geq$ )	Result
	685.059 kHz	500 kHz	Pass

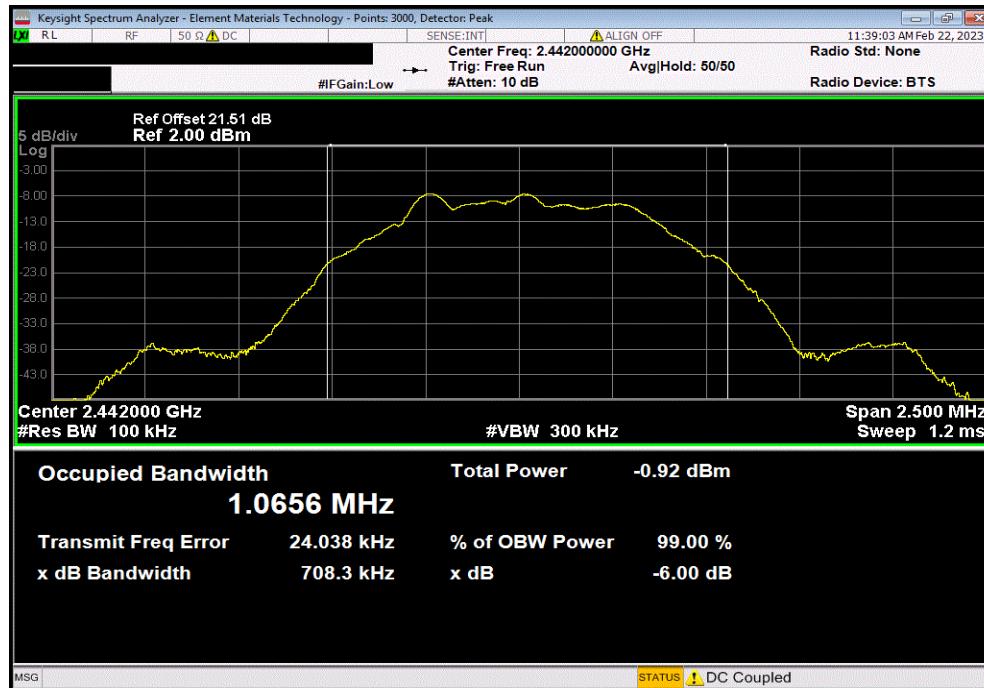


# DTS BANDWIDTH

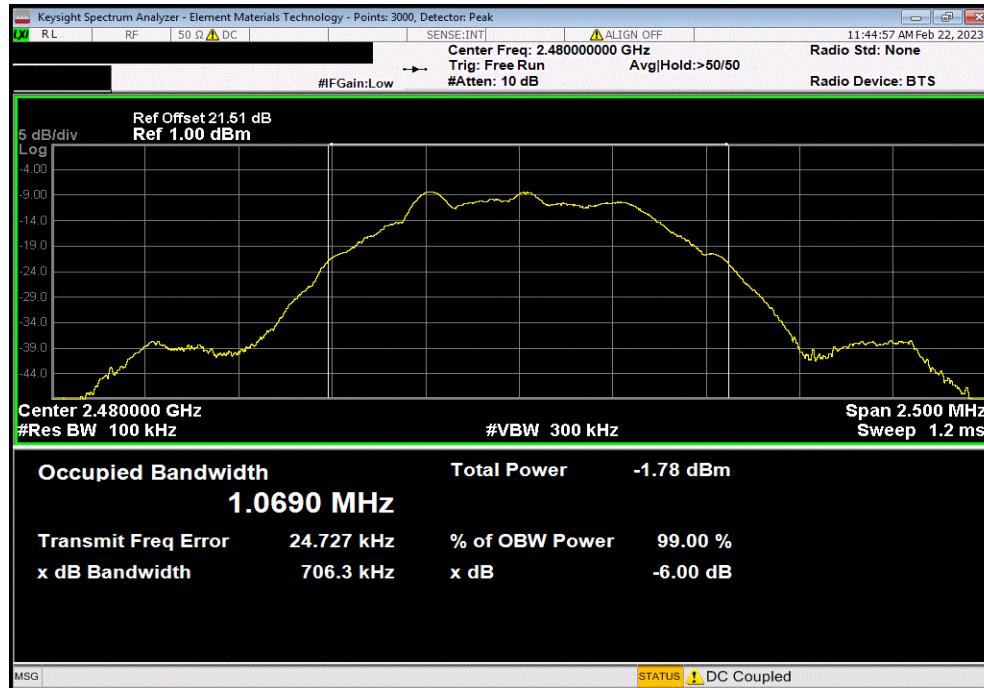


TbITx 2022.06.03.0 XMit 2022.12.28.0

BLE/GFSK 500 kbps, Mid Channel, 2442 MHz			Limit
Value	(≥)	Result	
708.326 kHz	500 kHz	Pass	



BLE/GFSK 500 kbps, High Channel, 2480 MHz			Limit
Value	(≥)	Result	
706.302 kHz	500 kHz	Pass	

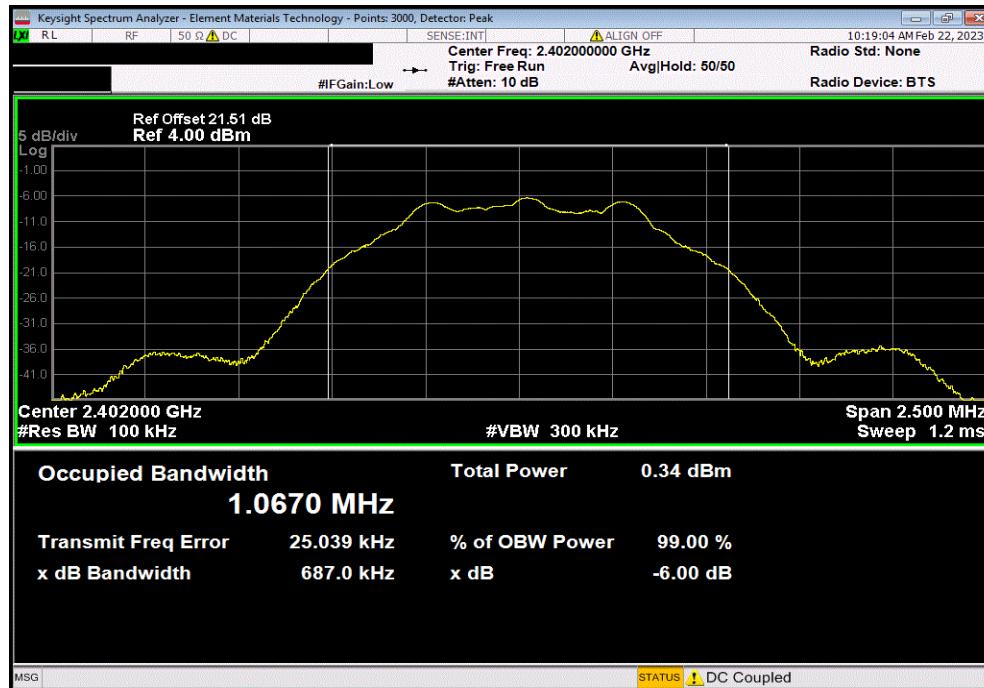


# DTS BANDWIDTH

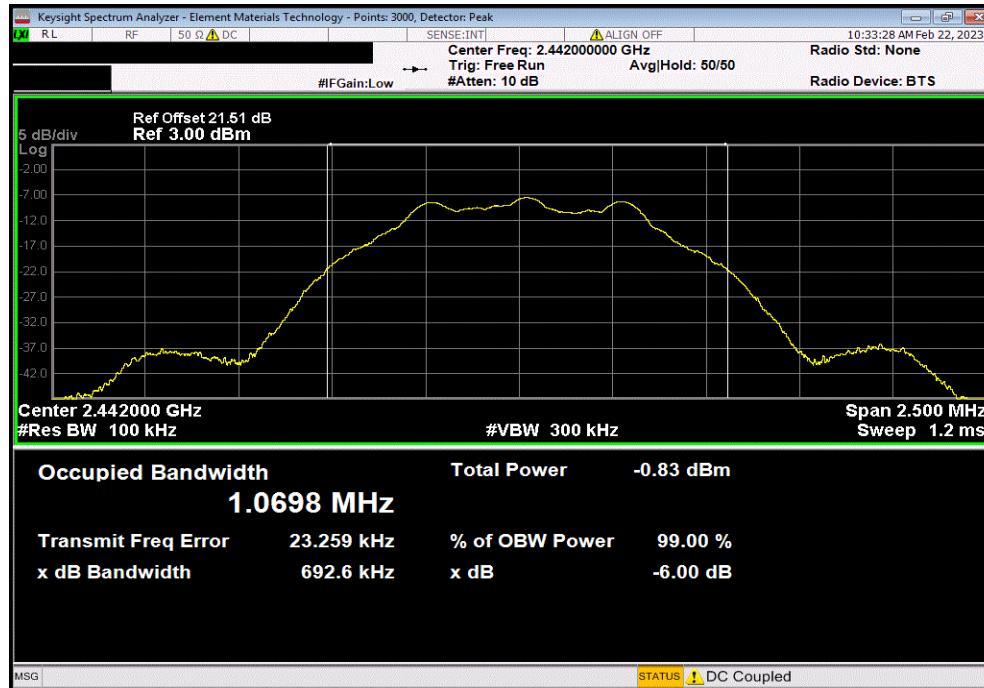


TbtTx 2022.06.03.0 XMit 2022.12.28.0

BLE/GFSK 1 Mbps, Low Channel, 2402 MHz			Value	Limit (≥)	Result
			686.967 kHz	500 kHz	Pass



BLE/GFSK 1 Mbps, Mid Channel, 2442 MHz			Value	Limit (≥)	Result
			692.617 kHz	500 kHz	Pass

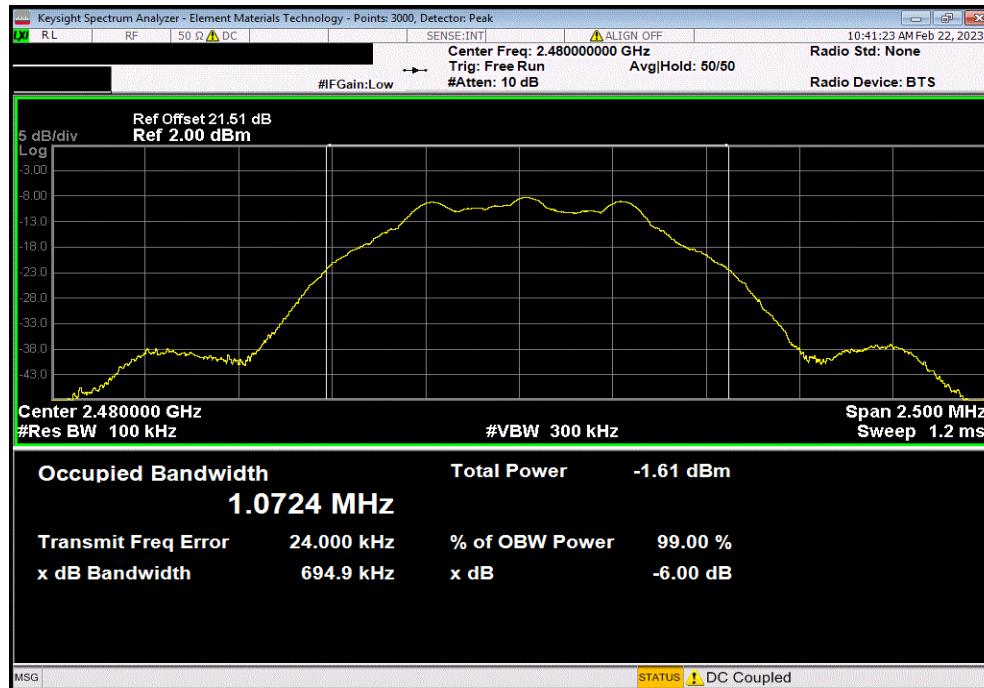


# DTS BANDWIDTH

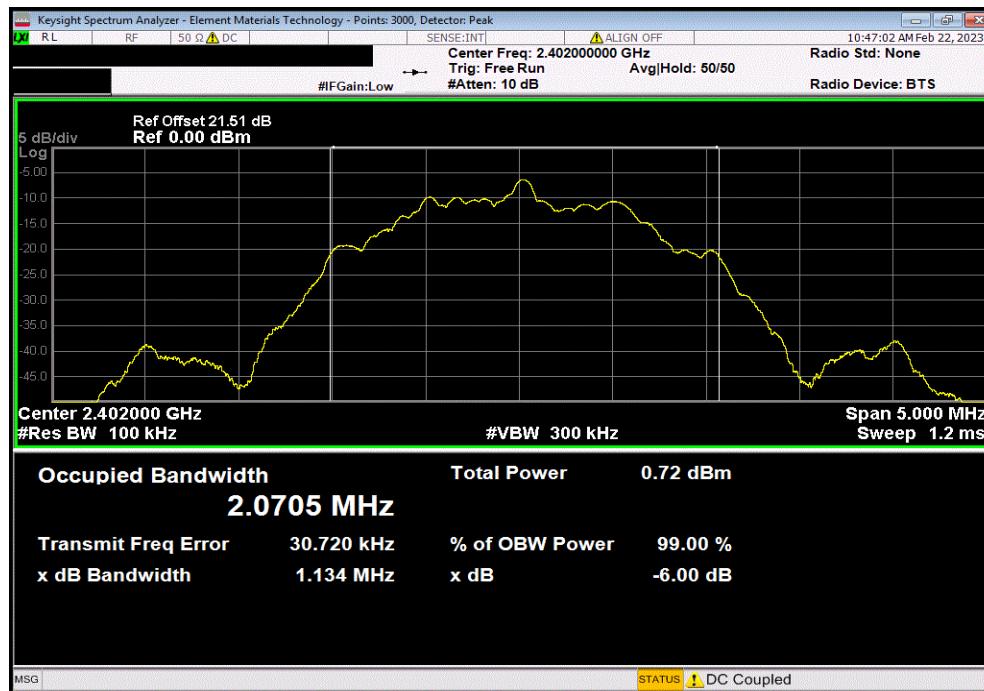


TbTx 2022.06.03.0 XMit 2022.12.28.0

BLE/GFSK 1 Mbps, High Channel, 2480 MHz			Value	Limit (≥)	Result
			694.948 kHz	500 kHz	Pass



BLE/GFSK 2 Mbps, Low Channel, 2402 MHz			Value	Limit (≥)	Result
			1.134 MHz	500 kHz	Pass

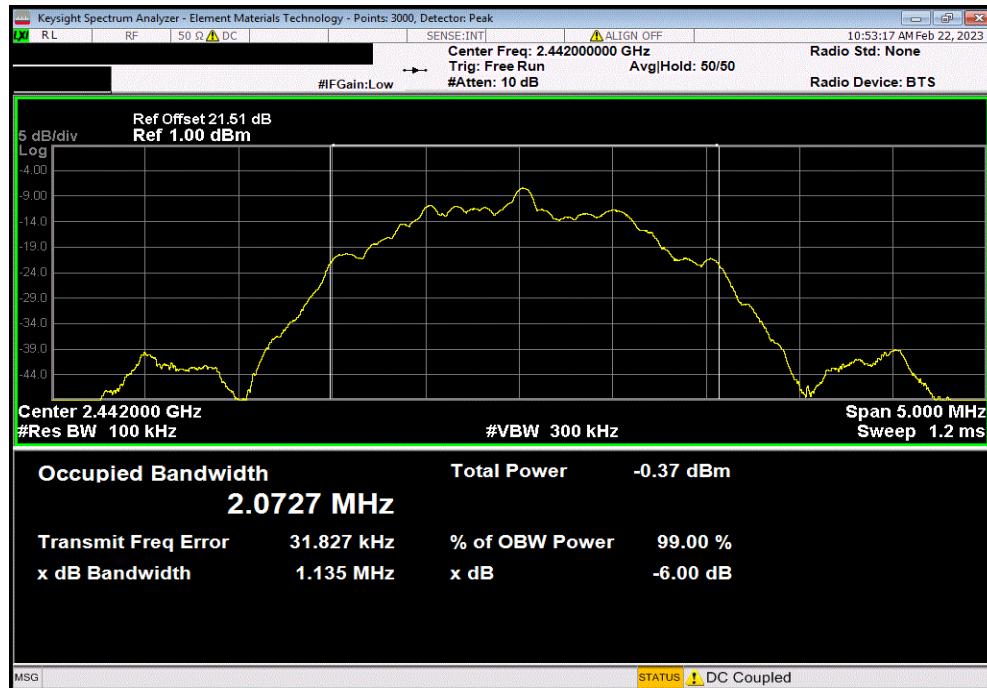


# DTS BANDWIDTH

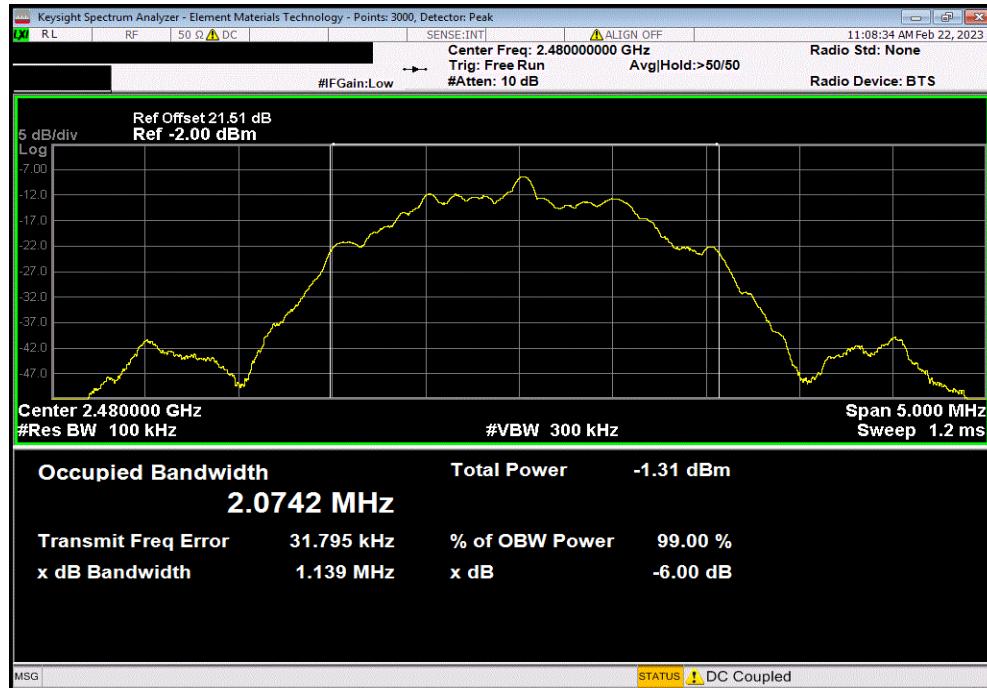


TbITx 2022.06.03.0 XMit 2022.12.28.0

BLE/GFSK 2 Mbps, Mid Channel, 2442 MHz			Limit
Value	(≥)	Result	
1.135 MHz	500 kHz	Pass	



BLE/GFSK 2 Mbps, High Channel, 2480 MHz			Limit
Value	(≥)	Result	
1.139 MHz	500 kHz	Pass	



# OCCUPIED BANDWIDTH



XMit 2022.12.28.0

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

## TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Keysight	N5171B (EXG)	TEY	2023-01-23	2026-01-23
Cable	Micro-Coax	UFD150A-1-0720-200200	MNL	2022-09-10	2023-09-10
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFM	2022-04-25	2023-04-25
Attenuator	S.M. Electronics	SA26B-20	RFW	2023-02-07	2024-02-07
Block - DC	Fairview Microwave	SD3379	AMZ	2022-11-06	2023-11-06

## TEST DESCRIPTION

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

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

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

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

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

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

# OCCUPIED BANDWIDTH



TbTx 2022.06.03.0 XMII 2022.12.28.0

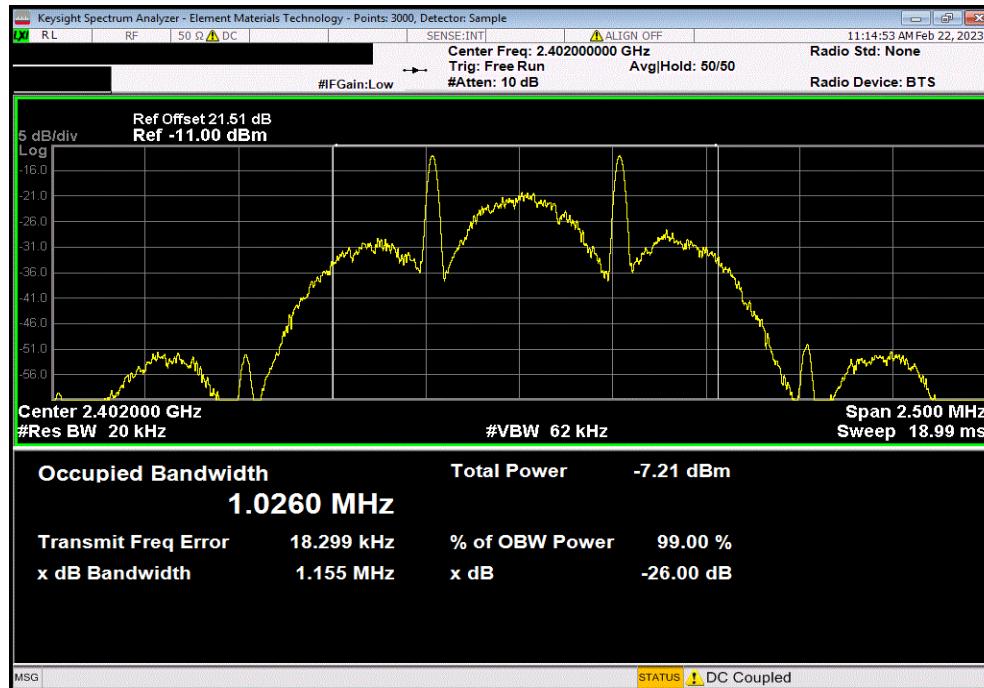
EUT:	TSI OmniTrak Module PM (7591-01)	Work Order:	TSIN0196
Serial Number:	LCOPC_061	Date:	02/22/2023
Customer:	TSI, Incorporated	Temperature:	22.8°C
Attendees:	Andrew Bentley	Humidity:	18.4%
Project:	None	Barometric Pres.:	1012 mbar
Tested by:	Christopher Heintzelman	Power:	5VDC Battery
TEST SPECIFICATIONS		Test Method	ANSI C63.10:2013
FCC 15.247:2023			ANSI C63.10:2013
RSS-Gen Issue 5:2018+A1:2019+A2:2021			ANSI C63.10:2013
COMMENTS	Reference level offset includes measurement cable, DC block, and attenuator.		
DEVIATIONS FROM TEST STANDARD			
None			
Configuration #	TSIN0196-2	Signature	<i>Christopher Bentley</i>
BLE/GFSK 125 kbps		Value	Limit
Low Channel, 2402 MHz	1.026 MHz	N/A	N/A
Mid Channel, 2442 MHz	1.052 MHz	N/A	N/A
High Channel, 2480 MHz	1.056 MHz	N/A	N/A
BLE/GFSK 500 kbps		Value	Limit
Low Channel, 2402 MHz	1.034 MHz	N/A	N/A
Mid Channel, 2442 MHz	1.03 MHz	N/A	N/A
High Channel, 2480 MHz	1.039 MHz	N/A	N/A
BLE/GFSK 1 Mbps		Value	Limit
Low Channel, 2402 MHz	1.048 MHz	N/A	N/A
Mid Channel, 2442 MHz	1.049 MHz	N/A	N/A
High Channel, 2480 MHz	1.051 MHz	N/A	N/A
BLE/GFSK 2 Mbps		Value	Limit
Low Channel, 2402 MHz	2.05 MHz	N/A	N/A
Mid Channel, 2442 MHz	2.064 MHz	N/A	N/A
High Channel, 2480 MHz	2.052 MHz	N/A	N/A

# OCCUPIED BANDWIDTH

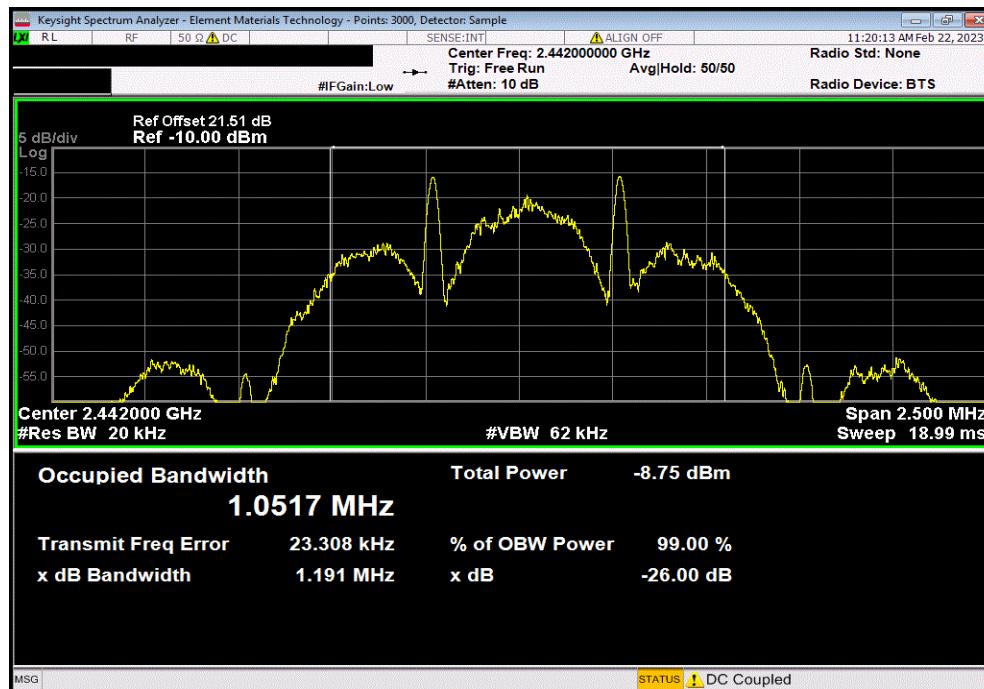


TbITx 2022.06.03.0 XMit 2022.12.28.0

BLE/GFSK 125 kbps, Low Channel, 2402 MHz			Value	Limit	Result
			1.026 MHz	N/A	N/A



BLE/GFSK 125 kbps, Mid Channel, 2442 MHz			Value	Limit	Result
			1.052 MHz	N/A	N/A

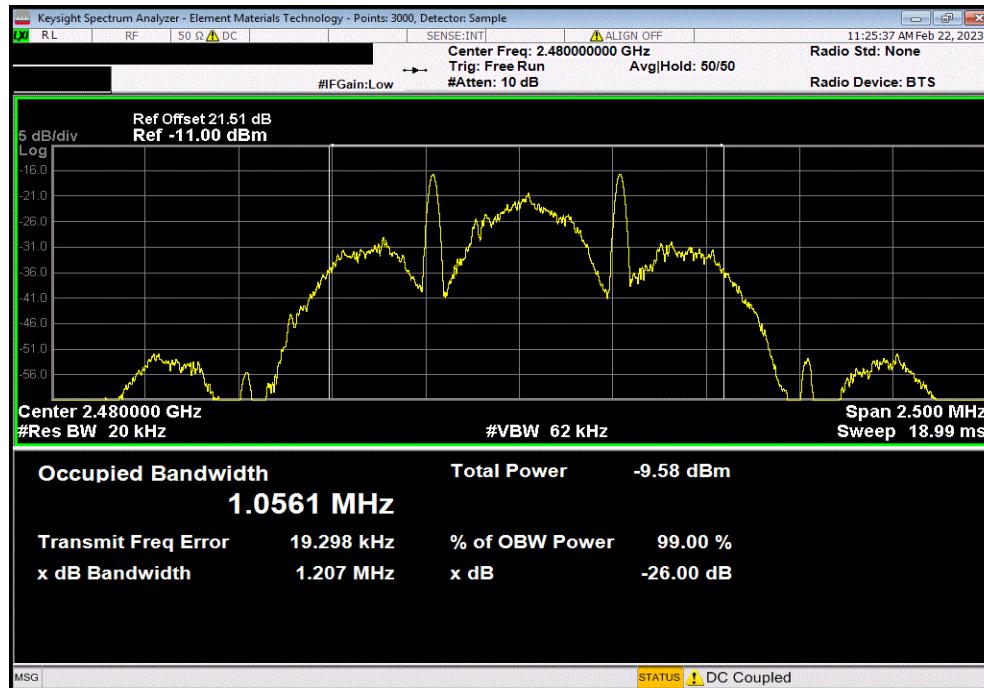


# OCCUPIED BANDWIDTH

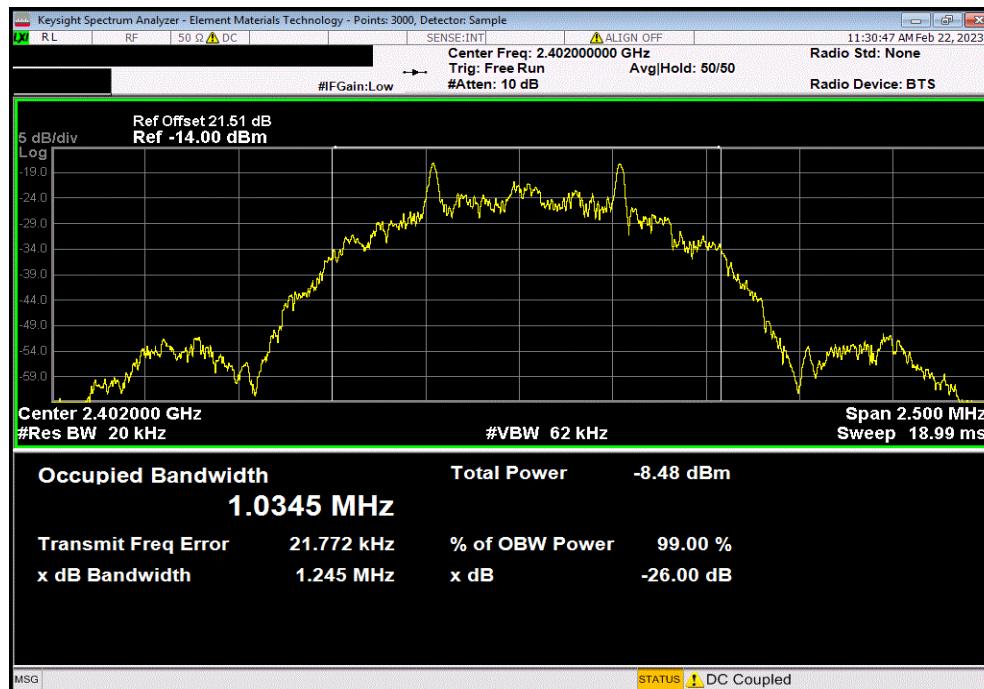


TbTx 2022.06.03.0 XMit 2022.12.28.0

BLE/GFSK 125 kbps, High Channel, 2480 MHz			Value	Limit	Result
			1.056 MHz	N/A	N/A



BLE/GFSK 500 kbps, Low Channel, 2402 MHz			Value	Limit	Result
			1.034 MHz	N/A	N/A

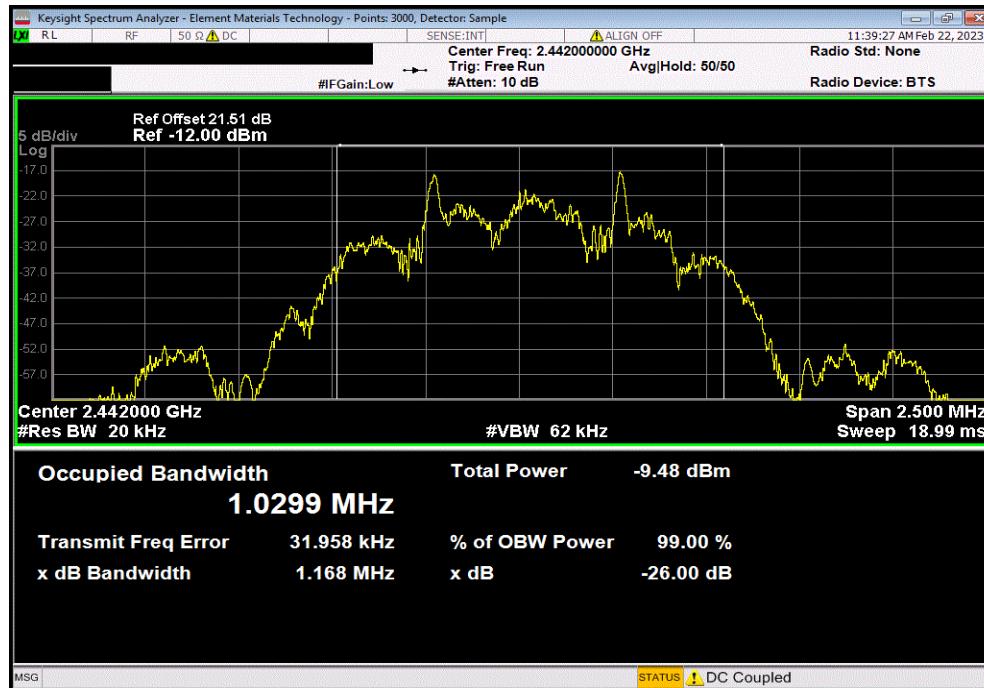


# OCCUPIED BANDWIDTH

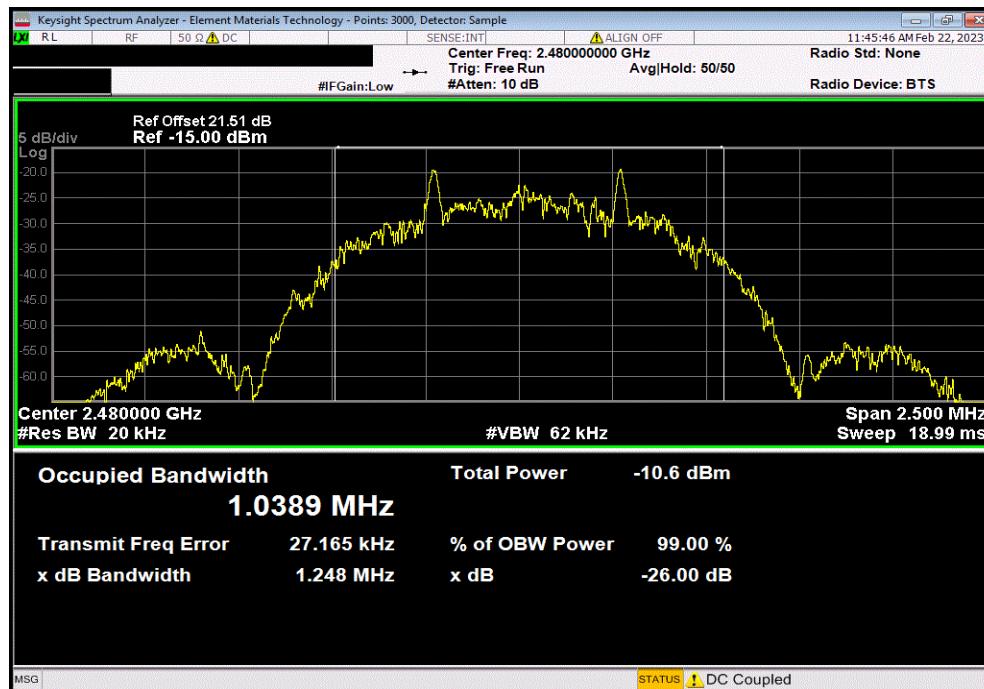


TbtTx 2022.06.03.0 XMit 2022.12.28.0

BLE/GFSK 500 kbps, Mid Channel, 2442 MHz		
	Value	Limit
	1.03 MHz	N/A



BLE/GFSK 500 kbps, High Channel, 2480 MHz		
	Value	Limit
	1.039 MHz	N/A

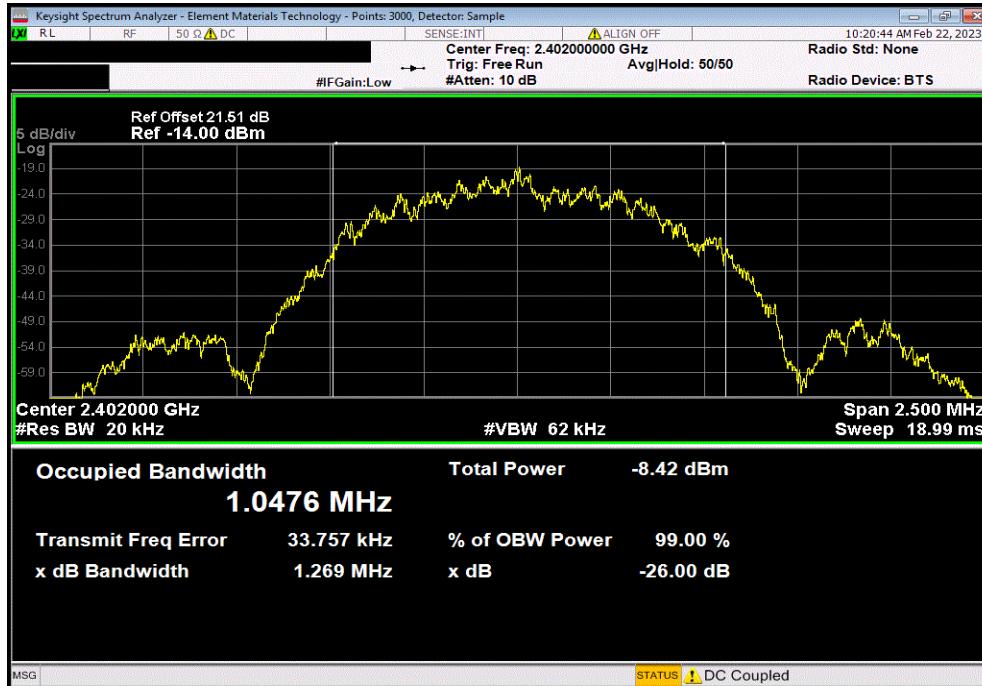


# OCCUPIED BANDWIDTH

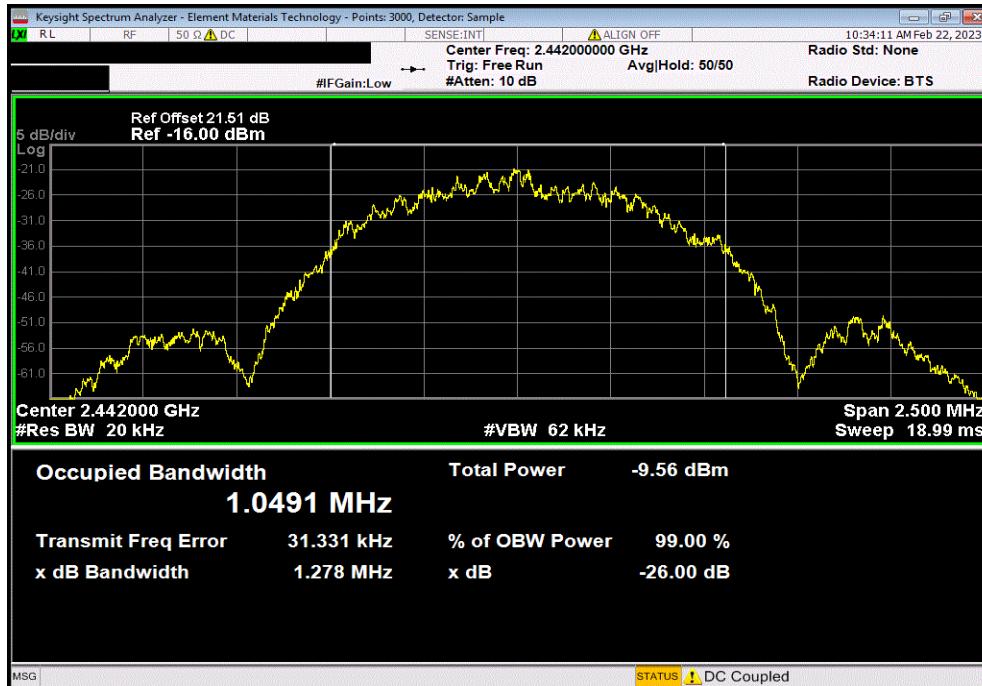


TbITx 2022.06.03.0 XMit 2022.12.28.0

BLE/GFSK 1 Mbps, Low Channel, 2402 MHz		
	Value	Limit
	1.048 MHz	N/A



BLE/GFSK 1 Mbps, Mid Channel, 2442 MHz		
	Value	Limit
	1.049 MHz	N/A

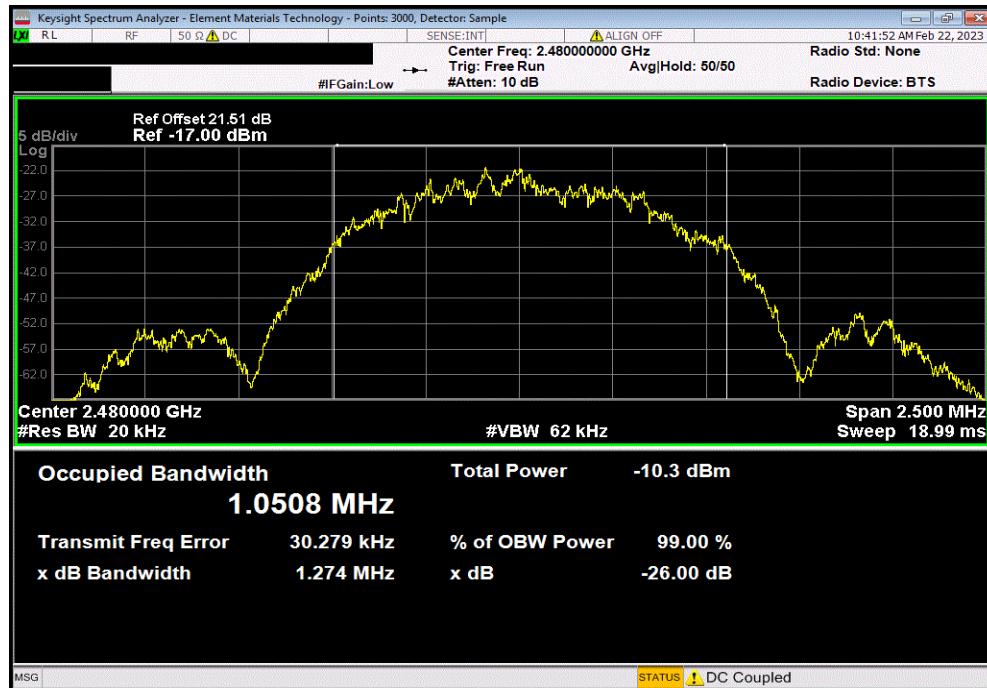


# OCCUPIED BANDWIDTH

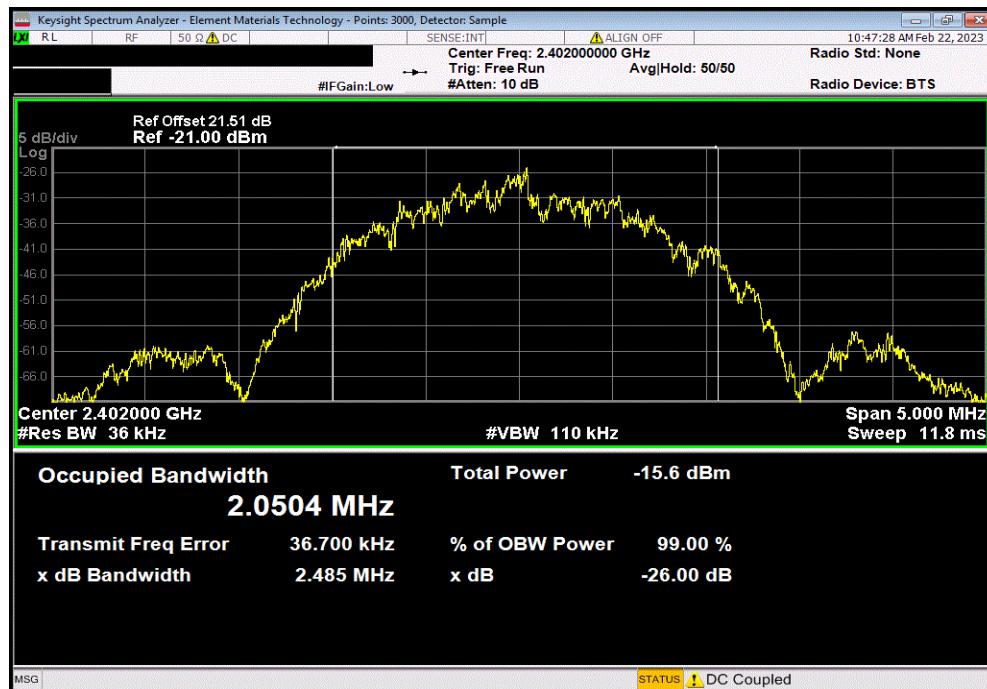


TbTx 2022.06.03.0 XMit 2022.12.28.0

BLE/GFSK 1 Mbps, High Channel, 2480 MHz		
	Value	Limit
	1.051 MHz	N/A



BLE/GFSK 2 Mbps, Low Channel, 2402 MHz		
	Value	Limit
	2.05 MHz	N/A

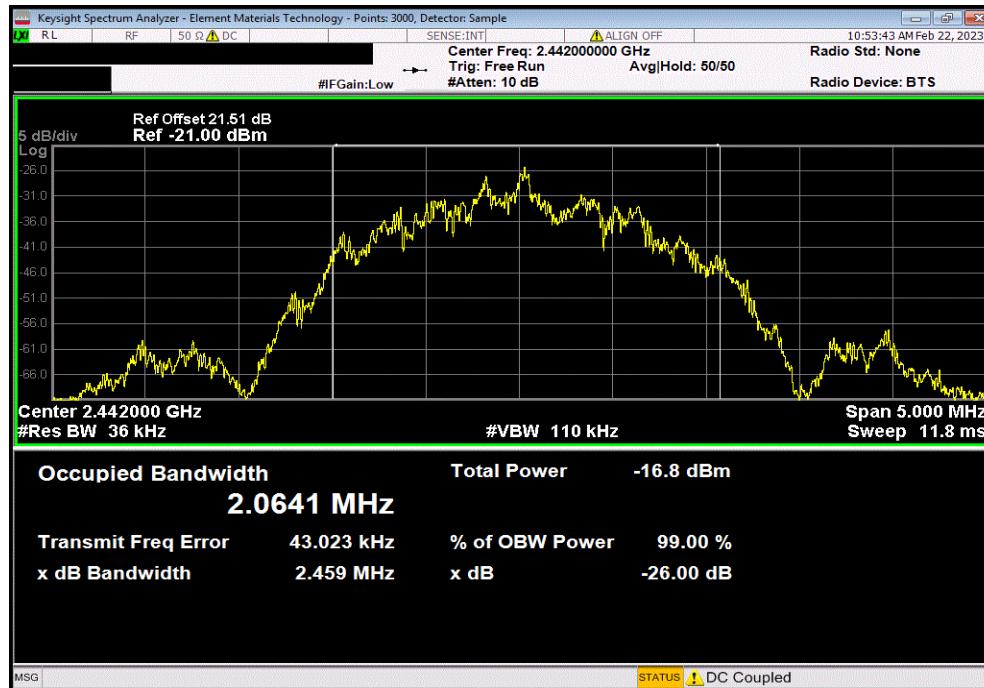


# OCCUPIED BANDWIDTH

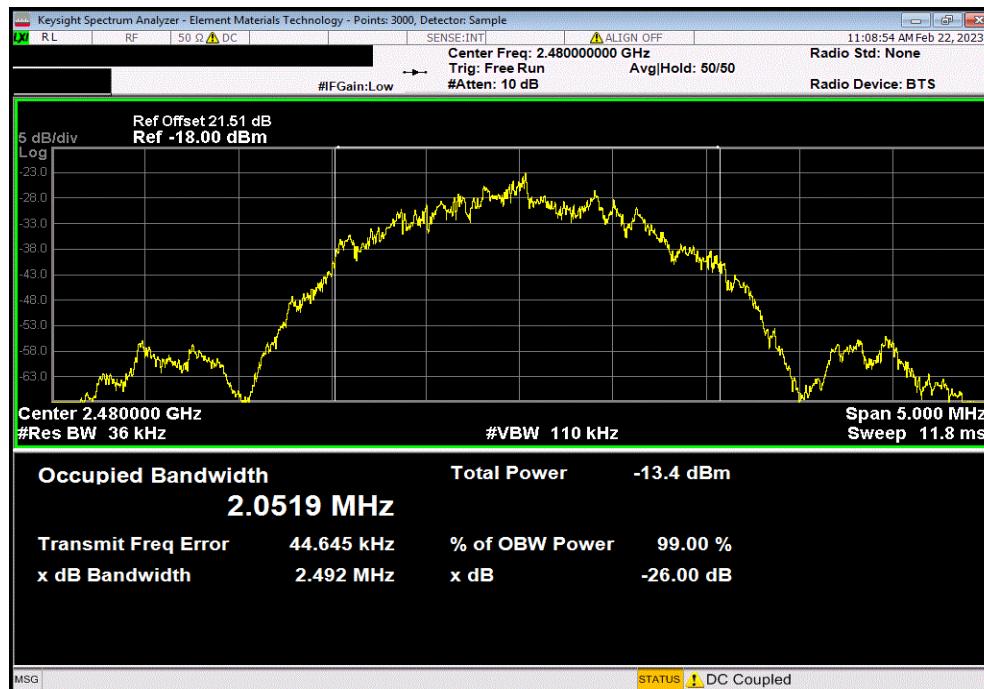


TbTx 2022.06.03.0 XMit 2022.12.28.0

BLE/GFSK 2 Mbps, Mid Channel, 2442 MHz			Value	Limit	Result
			2.064 MHz	N/A	N/A



BLE/GFSK 2 Mbps, High Channel, 2480 MHz			Value	Limit	Result
			2.052 MHz	N/A	N/A



# OUTPUT POWER



XMit 2022.12.28.0

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	SA26B-20	RFW	2023-02-07	2024-02-07
Block - DC	Fairview Microwave	SD3379	AMZ	2022-11-06	2023-11-06
Cable	Micro-Coax	UFD150A-1-0720-200200	MNL	2022-09-10	2023-09-10
Generator - Signal	Keysight	N5171B (EXG)	TEY	2023-01-23	2026-01-23
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFM	2022-04-25	2023-04-25

## TEST DESCRIPTION

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

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

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

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

# OUTPUT POWER



TbTx 2022.06.03.0 XMII 2022.12.28.0

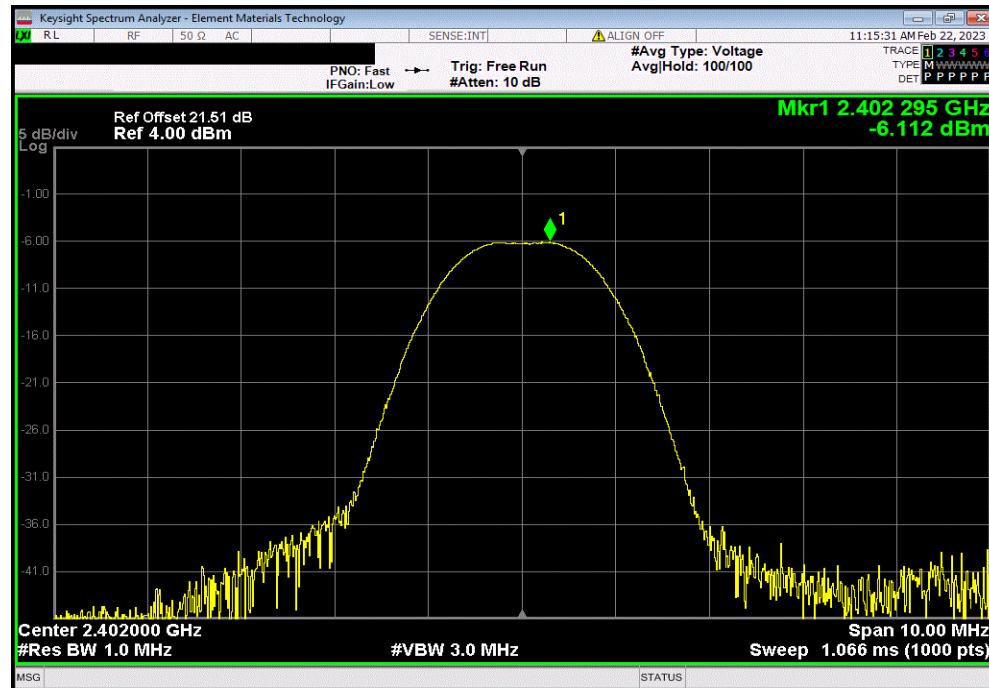
EUT:	TSI OmniTrak Module PM (7591-01)	Work Order:	TSIN0196			
Serial Number:	LCOPC_061	Date:	02/22/2023			
Customer:	TSI, Incorporated	Temperature:	22.7°C			
Attendees:	Andrew Bentley	Humidity:	18.5%			
Project:	None	Barometric Pres.:	1012 mbar			
Tested by:	Christopher Heintzelman	Power:	5VDC Battery			
TEST SPECIFICATIONS		Test Method	Job Site: MN11			
FCC 15.247:2023		ANSI C63.10:2013				
RSS-Gen Issue 5:2018+A1:2019+A2:2021		ANSI C63.10:2013				
RSS-247 Issue 2:2017		ANSI C63.10:2013				
COMMENTS	Reference level offset includes measurement cable, DC block, and attenuator.					
DEVIATIONS FROM TEST STANDARD						
None						
Configuration #	TSIN0196-2	 Signature				
		Out Pwr (dBm)	Limit (dBm)	Result		
BLE/GFSK 125 kbps	Low Channel, 2402 MHz	-6.112	30	Pass		
	Mid Channel, 2442 MHz	-7.356	30	Pass		
	High Channel, 2480 MHz	-8.113	30	Pass		
BLE/GFSK 500 kbps	Low Channel, 2402 MHz	-6.063	30	Pass		
	Mid Channel, 2442 MHz	-7.291	30	Pass		
	High Channel, 2480 MHz	-8.12	30	Pass		
BLE/GFSK 1 Mbps	Low Channel, 2402 MHz	-6.006	30	Pass		
	Mid Channel, 2442 MHz	-7.011	30	Pass		
	High Channel, 2480 MHz	-7.941	30	Pass		
BLE/GFSK 2 Mbps	Low Channel, 2402 MHz	-5.959	30	Pass		
	Mid Channel, 2442 MHz	-7.181	30	Pass		
	High Channel, 2480 MHz	-8.062	30	Pass		

# OUTPUT POWER

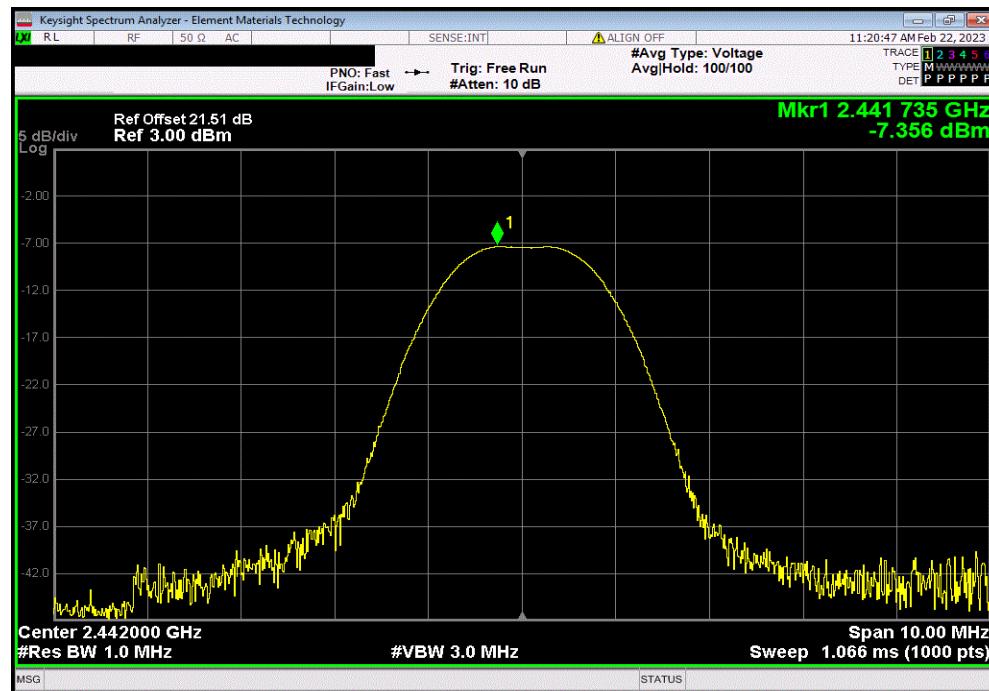


TbITx 2022.06.03.0 XMit 2022.12.28.0

BLE/GFSK 125 kbps, Low Channel, 2402 MHz			
	Out Pwr (dBm)	Limit (dBm)	Result
	-6.112	30	Pass



BLE/GFSK 125 kbps, Mid Channel, 2442 MHz			
	Out Pwr (dBm)	Limit (dBm)	Result
	-7.356	30	Pass

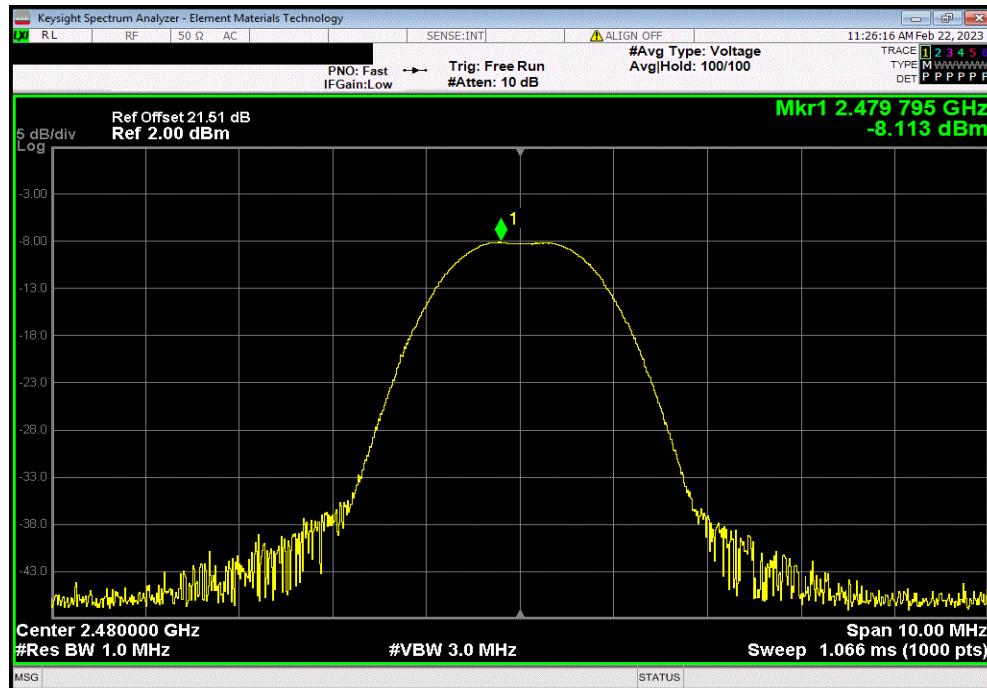


# OUTPUT POWER

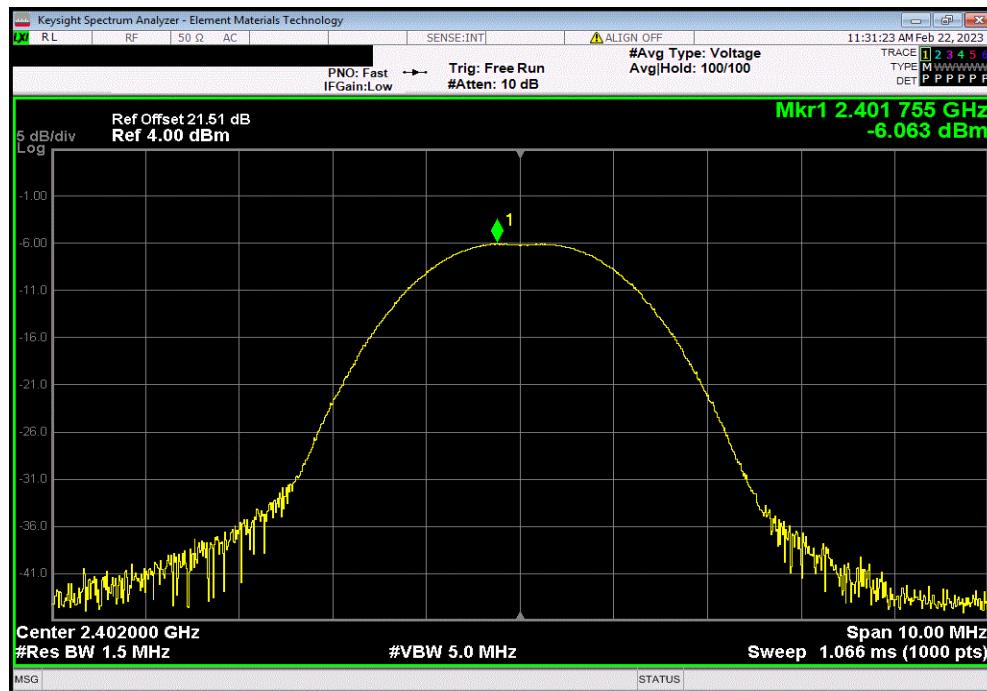


TbITx 2022.06.03.0 XMit 2022.12.28.0

BLE/GFSK 125 kbps, High Channel, 2480 MHz			
	Out Pwr (dBm)	Limit (dBm)	Result
	-8.113	30	Pass



BLE/GFSK 500 kbps, Low Channel, 2402 MHz			
	Out Pwr (dBm)	Limit (dBm)	Result
	-6.063	30	Pass

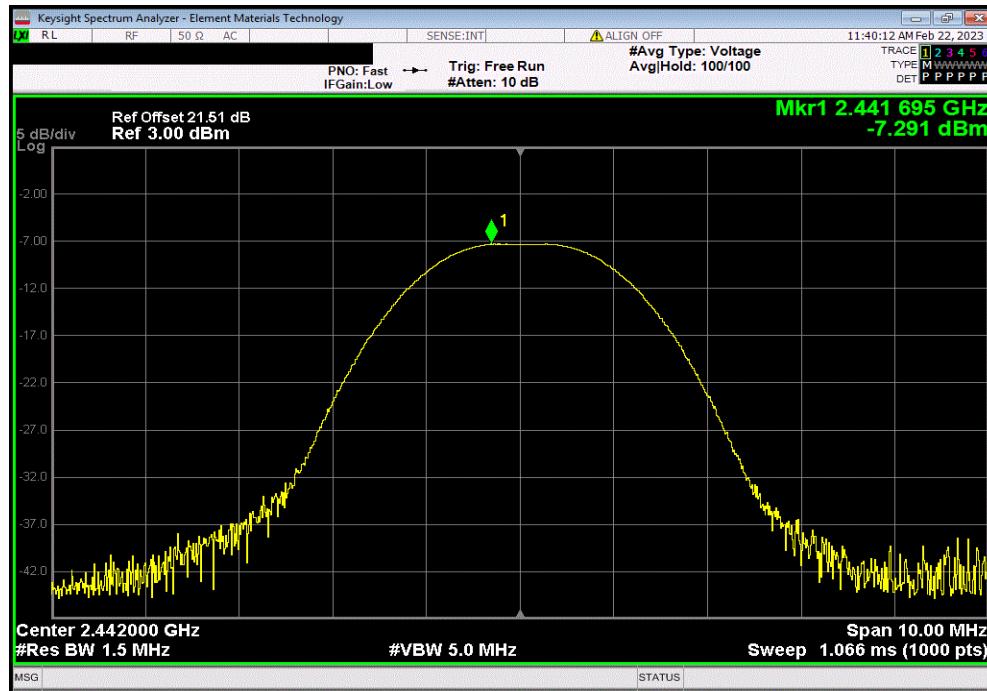


# OUTPUT POWER

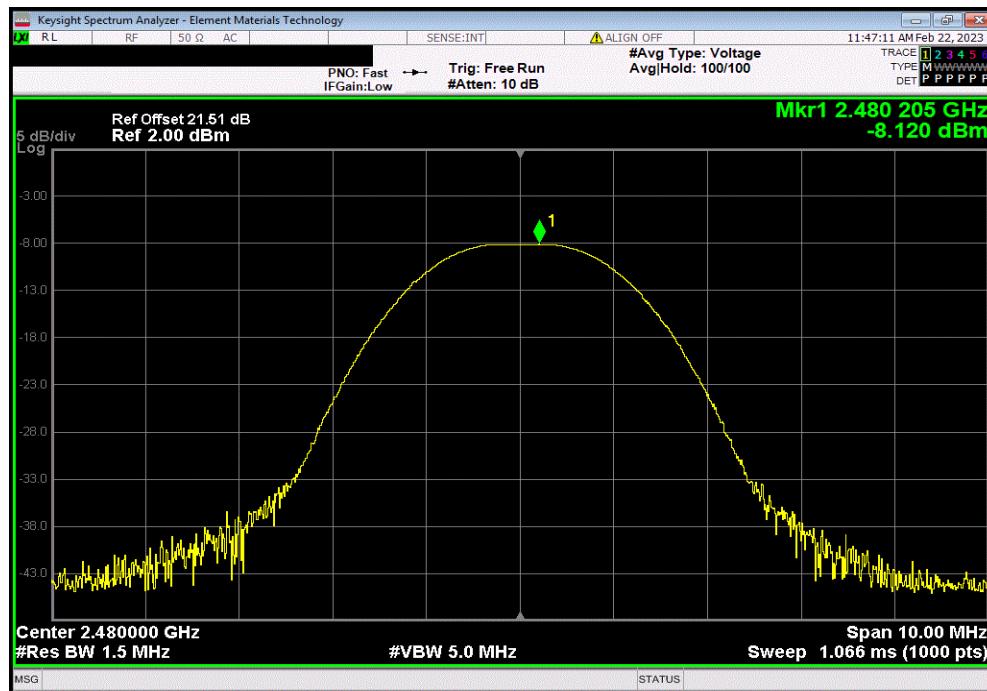


TbTx 2022.06.03.0 XMit 2022.12.28.0

BLE/GFSK 500 kbps, Mid Channel, 2442 MHz				Out Pwr (dBm)	Limit (dBm)	Result
				-7.291	30	Pass



BLE/GFSK 500 kbps, High Channel, 2480 MHz				Out Pwr (dBm)	Limit (dBm)	Result
				-8.12	30	Pass

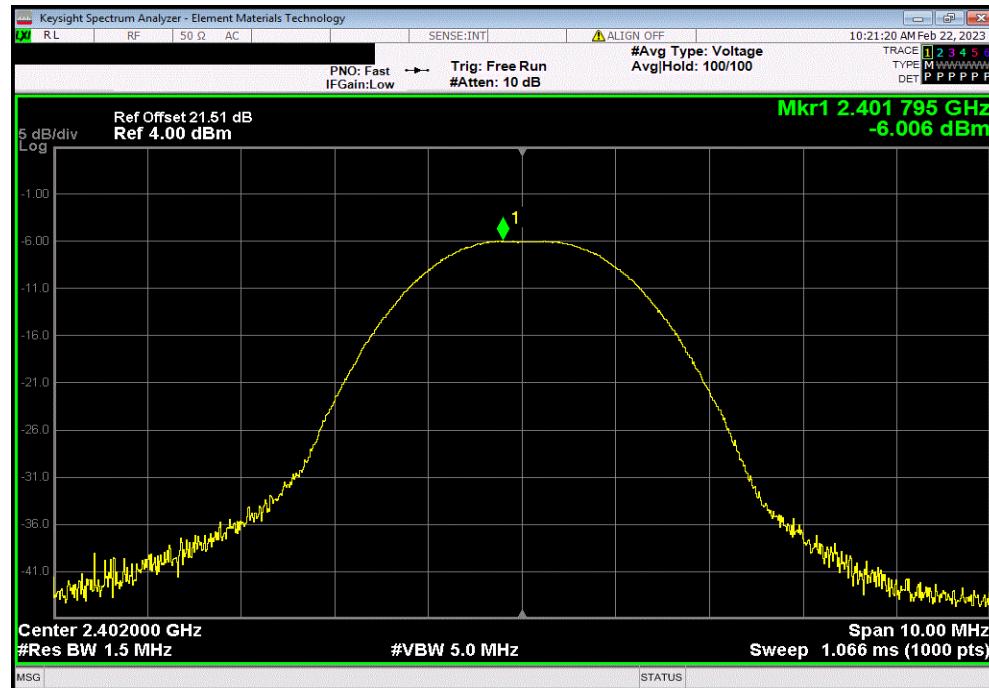


# OUTPUT POWER

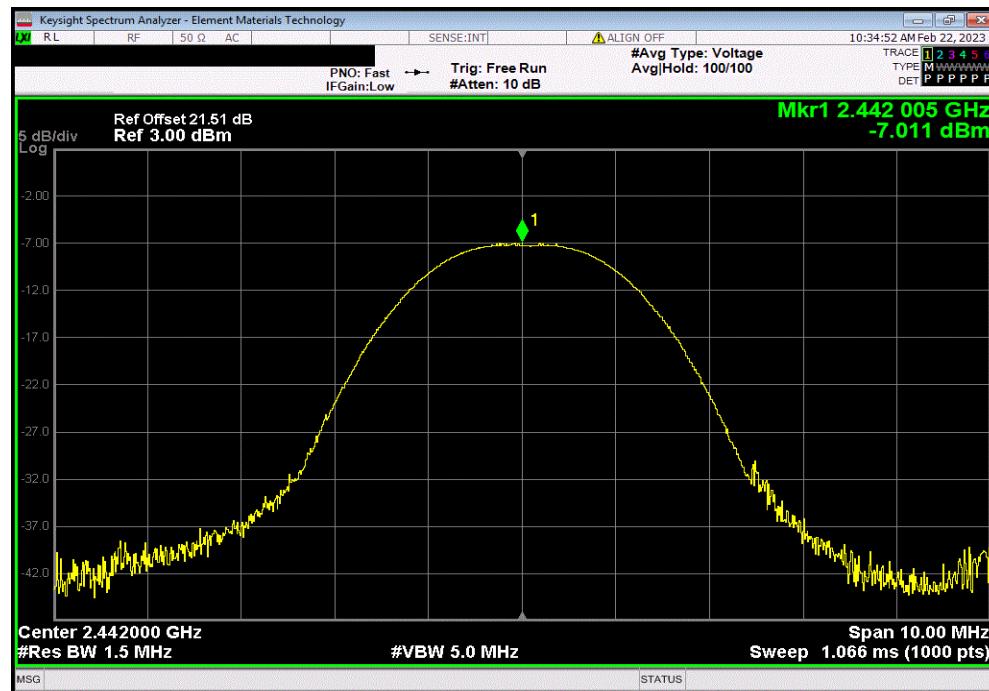


TbITx 2022.06.03.0 XMit 2022.12.28.0

BLE/GFSK 1 Mbps, Low Channel, 2402 MHz			
	Out Pwr (dBm)	Limit (dBm)	Result
	-6.006	30	Pass



BLE/GFSK 1 Mbps, Mid Channel, 2442 MHz			
	Out Pwr (dBm)	Limit (dBm)	Result
	-7.011	30	Pass

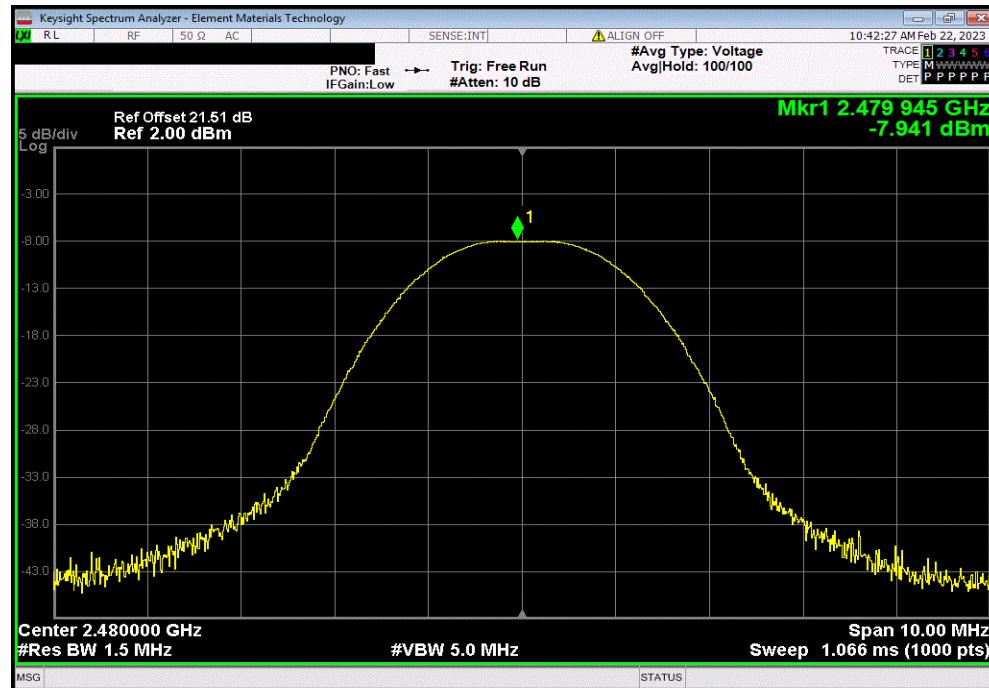


# OUTPUT POWER

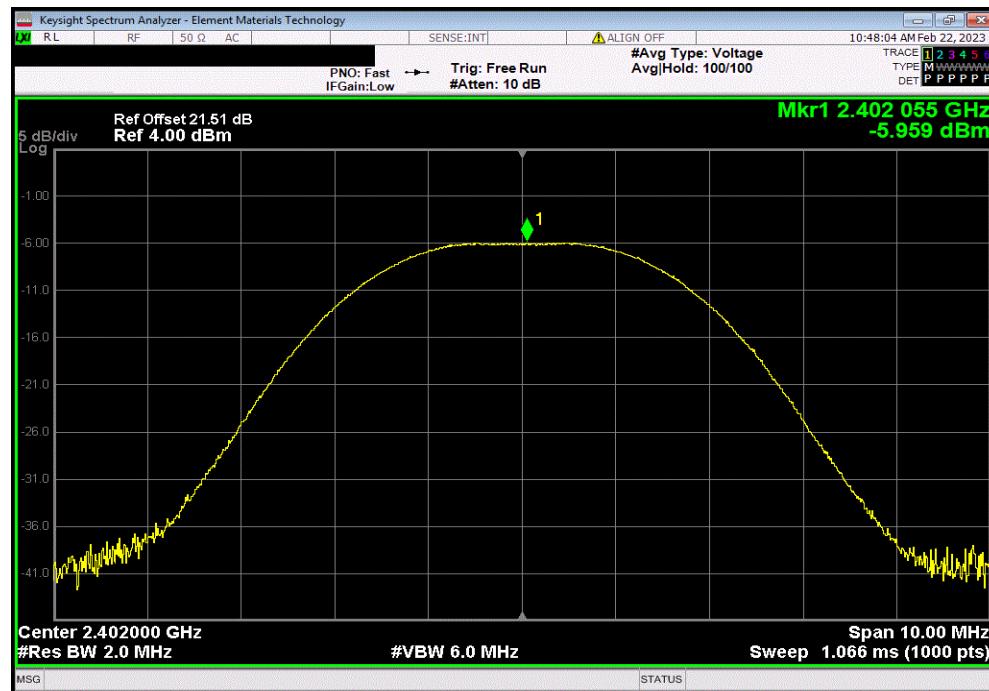


TbITx 2022.06.03.0 XMit 2022.12.28.0

BLE/GFSK 1 Mbps, High Channel, 2480 MHz				Out Pwr (dBm)	Limit (dBm)	Result
				-7.941	30	Pass



BLE/GFSK 2 Mbps, Low Channel, 2402 MHz				Out Pwr (dBm)	Limit (dBm)	Result
				-5.959	30	Pass

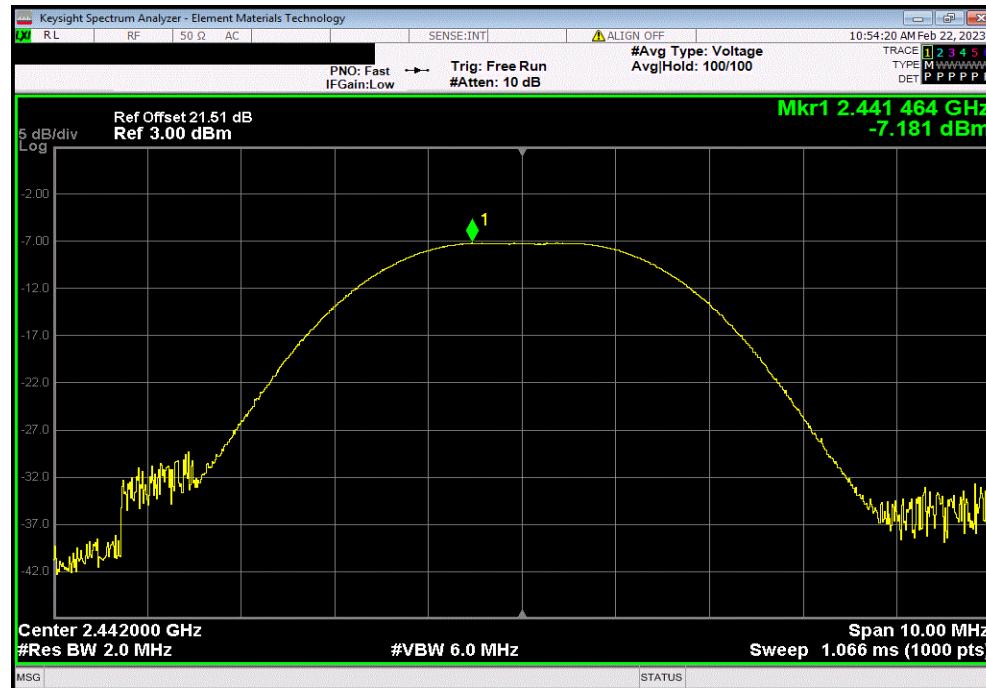


# OUTPUT POWER



TbITx 2022.06.03.0 XMit 2022.12.28.0

BLE/GFSK 2 Mbps, Mid Channel, 2442 MHz			
	Out Pwr (dBm)	Limit (dBm)	Result
	-7.181	30	Pass



BLE/GFSK 2 Mbps, High Channel, 2480 MHz			
	Out Pwr (dBm)	Limit (dBm)	Result
	-8.062	30	Pass

