Tonal

TEST REPORT FOR

Trainer
Model: T1522

Tested to The Following Standards:

FCC Part 15 Subpart C Section(s)

15.207 & 15.247
(FHSS 2400-2483.5MHz)
Bluetooth FHSS for Hydra Board for Main System

Report No.: 105488-36

Date of issue: February 15, 2022

This test report bears the accreditation symbol indicating that the testing performed herein meets the test and reporting requirements of ISO/IEC 17025 under the applicable scope of testing for CKC Laboratories, Inc.

We strive to create long-term, trust based relationships by providing sound, adaptive, customer first testing services. We embrace each of our customers' unique EMC challenges, not as an interruption to set processes, but rather as the reason we are in business.

Test Certificate # 803.01

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ADMINISTRATIVE INFORMATION

Test Report Information

REPORT PREPARED FOR:

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Representative: Lars Gilstrom
Customer Reference Number: PO1203

REPORT PREPARED BY:

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Project Number: 105488

DATE OF EQUIPMENT RECEIPT: December 8, 2021
DATE(S) OF TESTING: December 8, 2021 – January 25, 2022

Report Authorization

The test data contained in this report documents the observed testing parameters pertaining to and are relevant for only the equipment provided by the client, tested in the agreed upon operational mode(s) and configuration(s) as identified herein. Compliance assessment remains the client's responsibility. This report may not be used to claim product endorsement by A2LA or any government agencies. This test report has been authorized for release under quality control from CKC Laboratories, Inc.

Steve Behm
Director of Quality Assurance & Engineering Services
CKC Laboratories, Inc.

Test Facility Information

Our laboratories are configured to effectively test a wide variety of product types. CKC utilizes first class test equipment, anechoic chambers, data acquisition and information services to create accurate, repeatable and affordable test results.

TEST LOCATION(S):
CKC Laboratories, Inc.
1120 Fulton Place
Fremont, CA 94539

Software Versions

CKC Laboratories Proprietary Software	Version
EMITest Emissions	5.03.20

Site Registration & Accreditation Information

Location	*NIST CB #	FCC	Canada	Japan
Canyon Park, Bothell, WA	US0103	US1024	3082C	A-0136
Brea, CA	US0103	US1024	3082D	A-0136
Fremont, CA	US0103	US1024	3082B	A-0136
Mariposa, CA	US0103	US1024	3082A	A-0136

*CKC's list of NIST designated countries can be found at: https://standards.gov/cabs/designations.html

SUMMARY OF RESULTS

Standard / Specification: FCC Part 15 Subpart C - 15.247 (FHSS 2.4GHz)

Test Procedure	Description	Modifications	Results
15.247(a)(1)	Occupied Bandwidth	NA	PASS
15.247(a)(1)	Carrier Separation	NA	PASS
15.247(a)(1)(iii)	Number of Hopping Channels	NA	PASS
15.247(a)(1)(iii)	Average Time of Occupancy	NA	PASS
15.247(b)(1)	Output Power	NA	PASS
15.247(d)	RF Conducted Emissions & Band Edge	NA	PASS
15.247(d)	Radiated Emissions & Band Edge	Mods. #1, #2, #3 #4, #5, #6	PASS
15.207	AC Conducted Emissions	NA	PASS

NA = Not Applicable

ISO/IEC 17025 Decision Rule
The declaration of pass or fail herein is based upon assessment to the specification(s) listed above, including where applicable, assessment of measurement uncertainties. For performance related tests, equipment was monitored for specified criteria identified in that section of testing.

Modifications During Testing

This list is a summary of the modifications made to the equipment during testing.

Summary of Conditions
Radiated Emissions only; Configurations: 1 & 3 Mod. #1 = Copper tape between microphone PCBA gold-plated pads and chassis. Mod. #2 = Screws on hydra backplane mounting bracket. Mod. #3 = Copper tape on hydra backplane to display backplane. Mod. #4 = Ferrite (1 each) 742-712-21 on upper lead to shunt. Mod. #5 = Door bonding replaced with three (3) lug-to-lug wire strap. Mod. #6 = Set display mode into spread spectrum.

Modifications listed above must be incorporated into all production units.

Conditions During Testing

This list is a summary of the conditions noted to the equipment during testing.

Summary of Conditions
The Test Setup Photos are incorporated by reference 105488-36_Test Setup_Photos

EQUIPMENT UNDER TEST (EUT)

During testing, numerous configurations may have been utilized. The configurations listed below support compliance to the standard(s) listed in the Summary of Results section.

Configuration 1

***Equipment Under Test* (* = EUT):**

Device Name	Manufacturer	Model #	S/N
Trainer	Tonal System	T1522	02016558
Hydra Board	Tonal System	500-0801 Rev 008	080100702000476
Internal Power Supply	Artesyn Embedded Tech.	LCM1500W-T	K510UN001BBVC-8-416 Revision: BV Firmware 6/2/2021
Direct Bond 2312 Touch screen display	BOE	380-0015 Rev. 1-1 CJ238FSB-TG21	00000015

Support Equipment:

Device Name	Manufacturer	Model #	S/N
None			

Configuration 2

***Equipment Under Test* (* = EUT):**

Device Name	Manufacturer	Model #	S/N
Trainer	Tonal System	T1522	02016558
Hydra Board	Tonal System	500-0801 Rev 008	080100702000476
Internal Power Supply	Artesyn Embedded Tech.	LCM1500W-T	K510UN001BBVC-8-416 Revision: BV Firmware 6/2/2021
Direct Bond 2312 Touch screen display	BOE	380-0015 Rev. 1-1 CJ238FSB-TG21	00000015

Support Equipment:

Device Name	Manufacturer	Model #	S/N
Laptop	Lenovo	X1 Carbon Gen 9	PF-37KBYM

Configuration 3

***Equipment Under Test* (* = EUT):**

Device Name	Manufacturer	Model #	S/N
Trainer	Tonal System	T1522	02016558
Hydra Board	Tonal System	500-0801 Rev 008	080100702000476
Internal Power Supply	Artesyn Embedded Tech.	LCM1500W-T	K510UN001BBVC-8-416 Revision: BV Firmware 6/2/2021
Direct Bond 2312 Touch screen display	BOE	380-0015 Rev. 1-1 CJ238FSB-TG21	00000015

Support Equipment:

Device Name	Manufacturer	Model #	S/N
Laptop	Lenovo	X1 Carbon Gen 9	PF-37KBYM
Laptop Power Supply	Lenovo	SA10R16922	8SSA10R16922C2TJ-19M0G0G

Configuration 9

***Equipment Under Test* (* = EUT):**

Device Name	Manufacturer	Model #	S/N
Hydra Board	Tonal System	500-0801 Rev 008	080100702000476

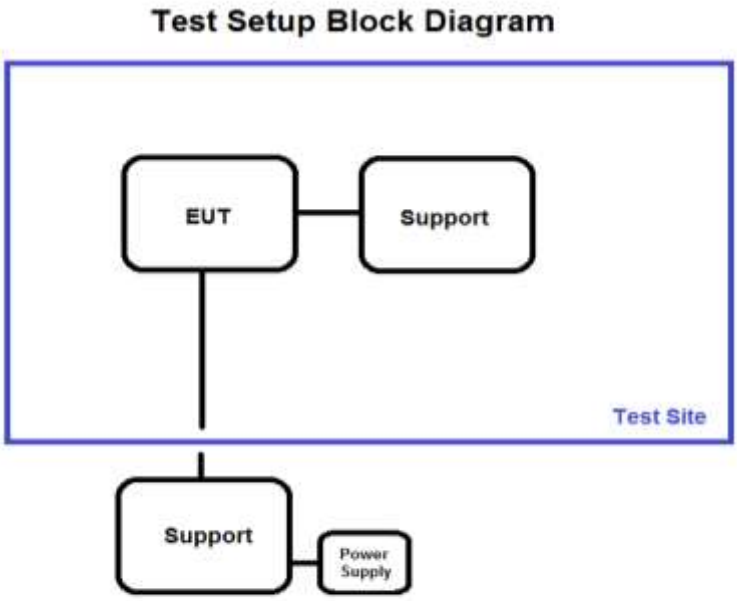
Support Equipment:

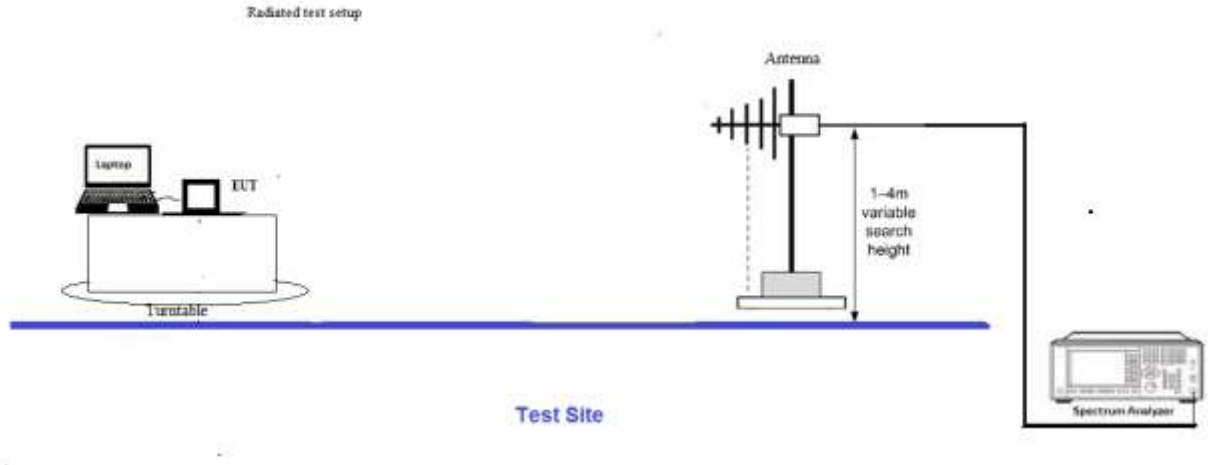
Device Name	Manufacturer	Model #	S/N
Laptop	Lenovo	X1 Carbon Gen 9	PF-37KBYM
Laptop Power Supply	Lenovo	SA10R16922	8SSA10R16922C2TJ-19M0G0G

General Product Information:

Product Information	Manufacturer-Provided Details
Equipment Type:	Stand-Alone Equipment
Type of Wideband System:	Bluetooth FHSS for Hydra Board for Main System
Operating Frequency Range:	2402-2480MHz
Number of Hopping Channels:	79
Receiver Bandwidth and Synchronization:	The manufacturer declares the receiver input bandwidth matches the transmit channel bandwidth and shifts frequencies in synchronization with the transmitter.
Modulation Type(s):	GFSK, π/4-DQPSK and 8-DQPSK
Maximum Duty Cycle:	100%
Number of TX Chains:	1
Antenna Type(s) and Gain:	External/ 3.42dBi
Beamforming Type:	NA
Antenna Connection Type:	External Connector
Nominal Input Voltage:	15VDC
Firmware / Software used for Test:	QRCT (Qualcomm Radio Control Toolkit) Version 4
The validity of results is dependent on the stated product details, the accuracy of which the manufacturer assumes full responsibility.	

Block Diagram of Test Setup(s)





Rev. C

FCC Part 15 Subpart C

15.247(a) Transmitter Characteristics

Test Setup/Conditions			
Test Location:	Fremont Lab C3	Test Engineer:	Hoang Cao
Test Method:	ANSI C63.10 (2013), KDB 558074 D01 15.247 Meas Guidance v05r02	Test Date(s):	12/8/2021
Configuration:	9		
Test Setup:	The EUT is placed non-conducted table. It is operated as intended. It is connected straight to a Spectrum Analyzer.		

Environmental Conditions			
Temperature (ºC)	22.5	Relative Humidity (%):	45

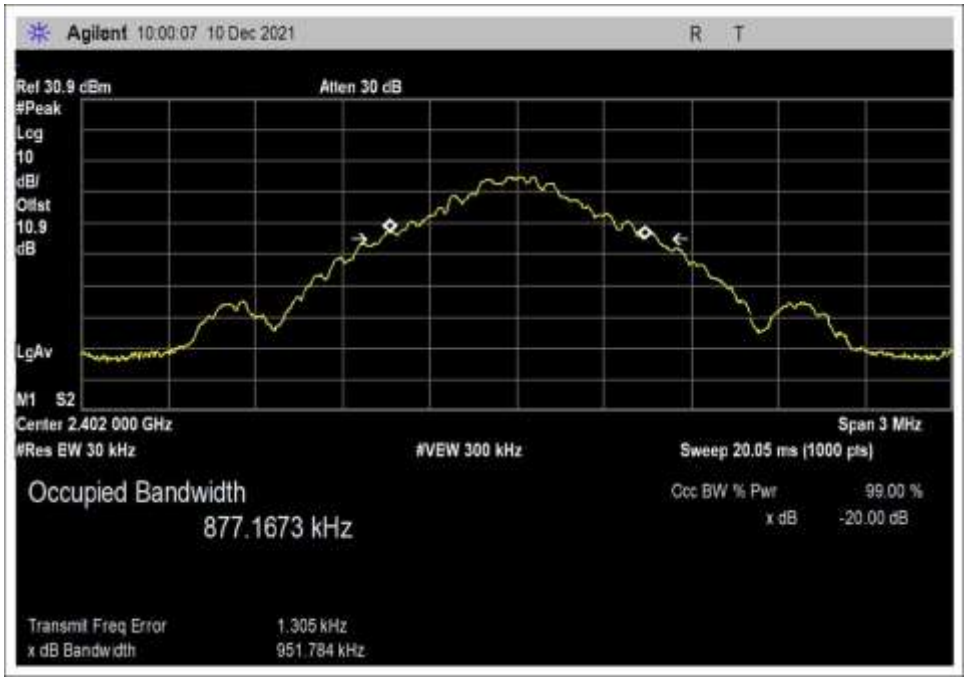
Test Equipment					
Asset#	**Description**	**Manufacturer**	**Model**	**Cal Date**	**Cal Due**
03360	Cable	Astrolab	32022-2-29094-36TC	4/9/2020	4/9/2022
P06239	Attenuator	Weinschel	54A-10	6/17/2020	6/17/2022
03471	Spectrum Analyzer	Agilent	E4440A	2/11/2020	2/11/2022

15.247(a)(1) 20 dB Bandwidth

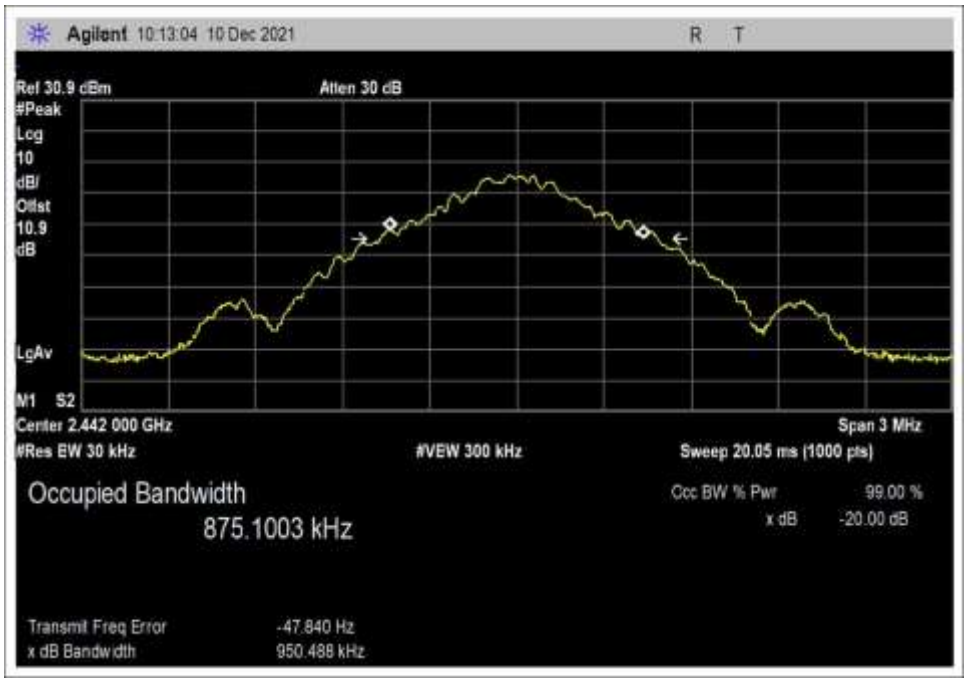
Test Data Summary					
Frequency (MHz)	**Antenna Port**	**Modulation**	**Measured (kHz)**	**Limit (kHz)**	**Results**
2402	1	GFSK	951.784	None	NA
2442	1	GFSK	950.488		
2480	1	GFSK	951.131		
2402	1	π/4-DQPSK	1281		
2442	1	π/4-DQPSK	1280		
2480	1	π/4-DQPSK	1280		
2402	1	8-DQPSK	1288		
2442	1	8-DQPSK	1287		
2480	1	8-DQPSK	1286		

Plot(s)

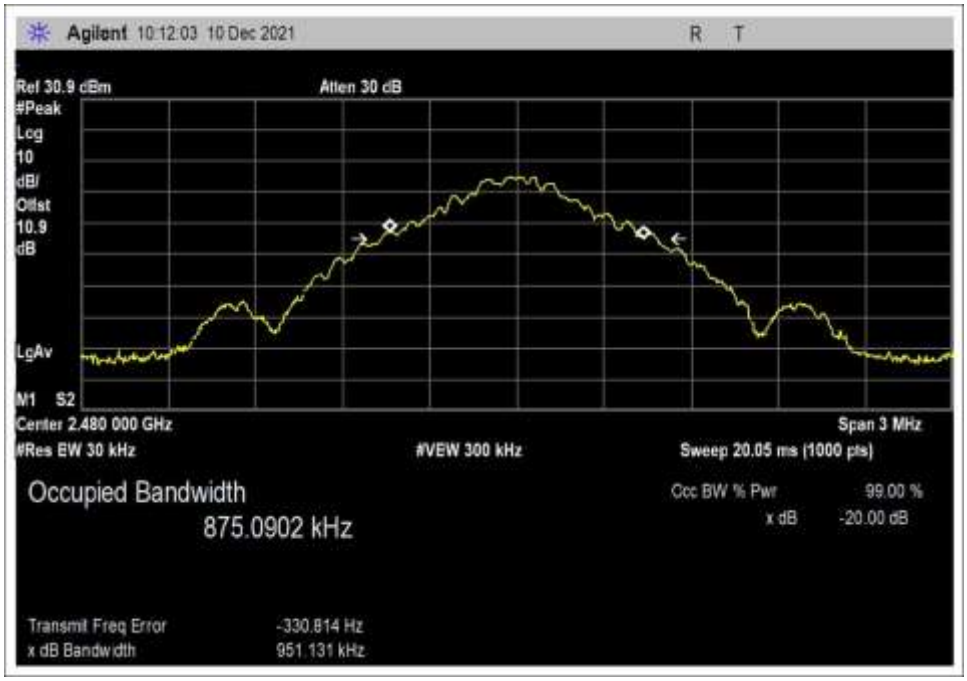
20dB and 99% Occupied Bandwidth GFSK



Low Channel

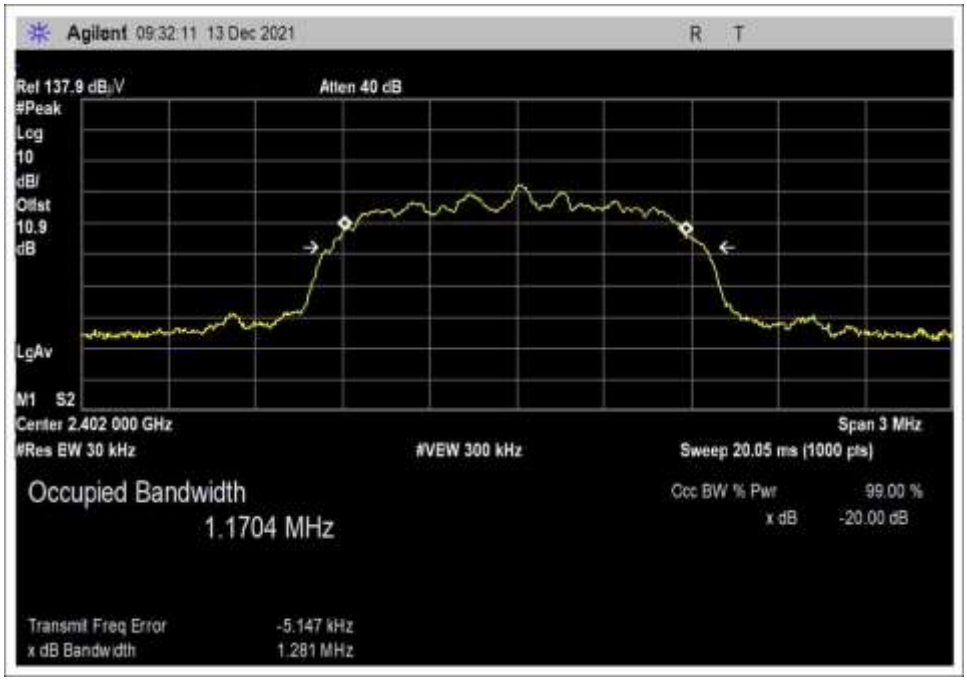


Middle Channel



High Channel

20dB and 99% Occupied Bandwidth π/4-DQPSK



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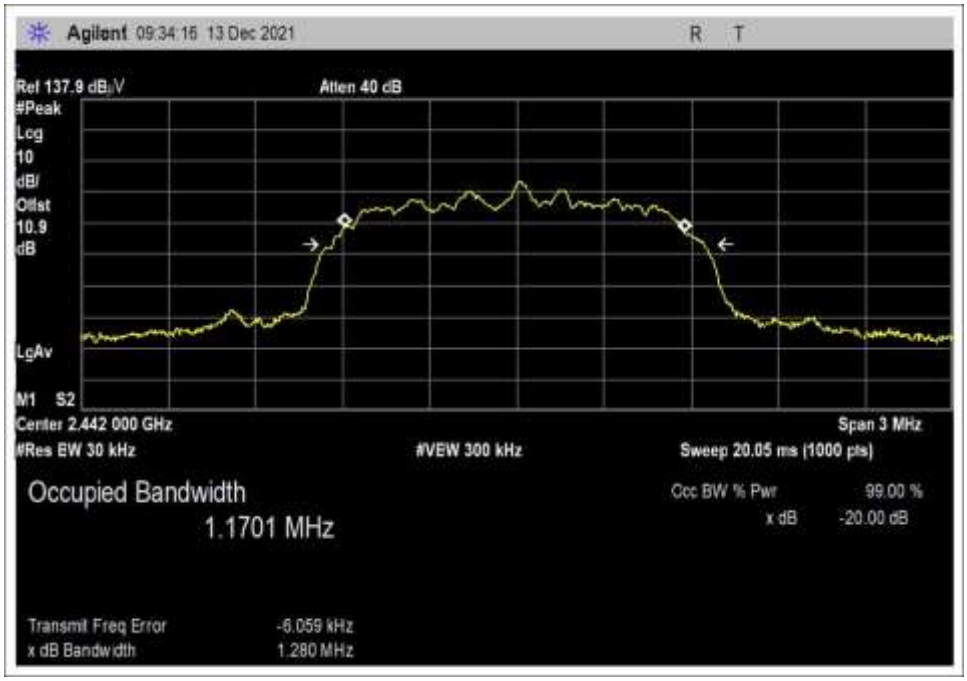
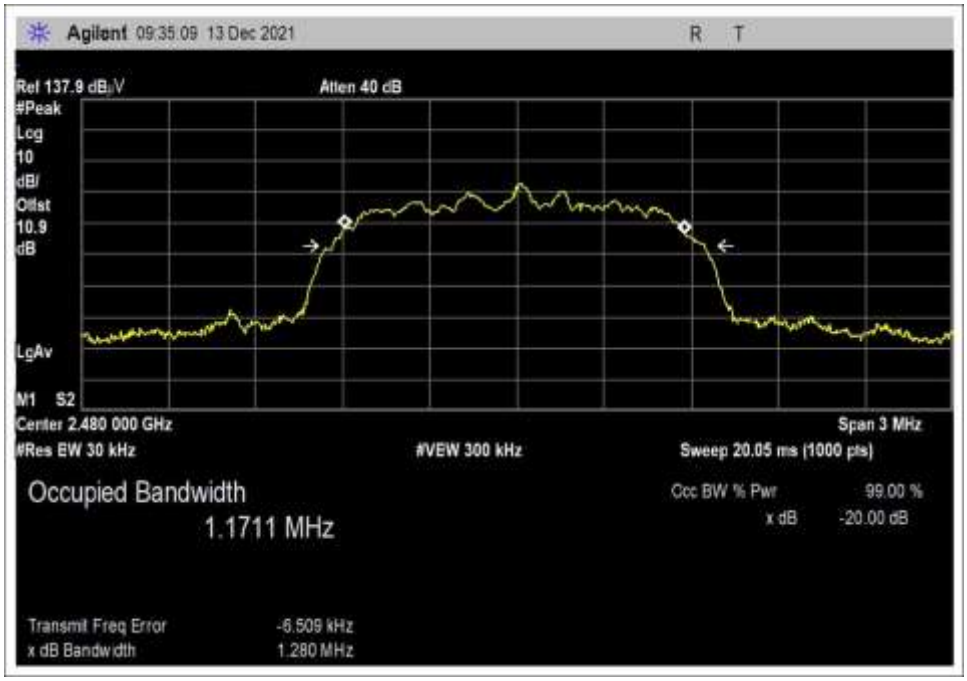
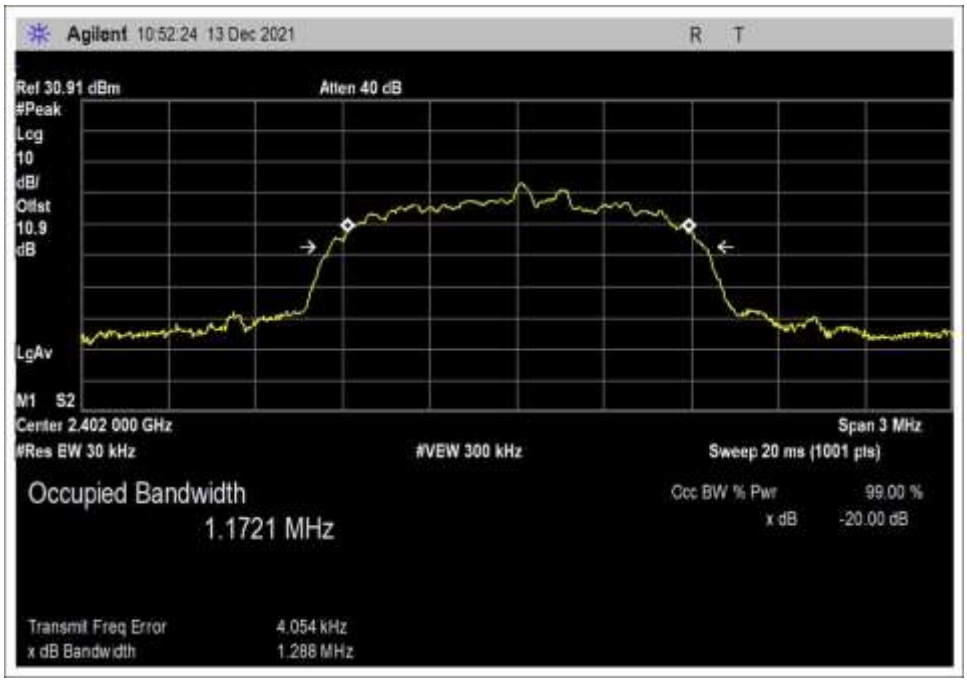


Middle Channel

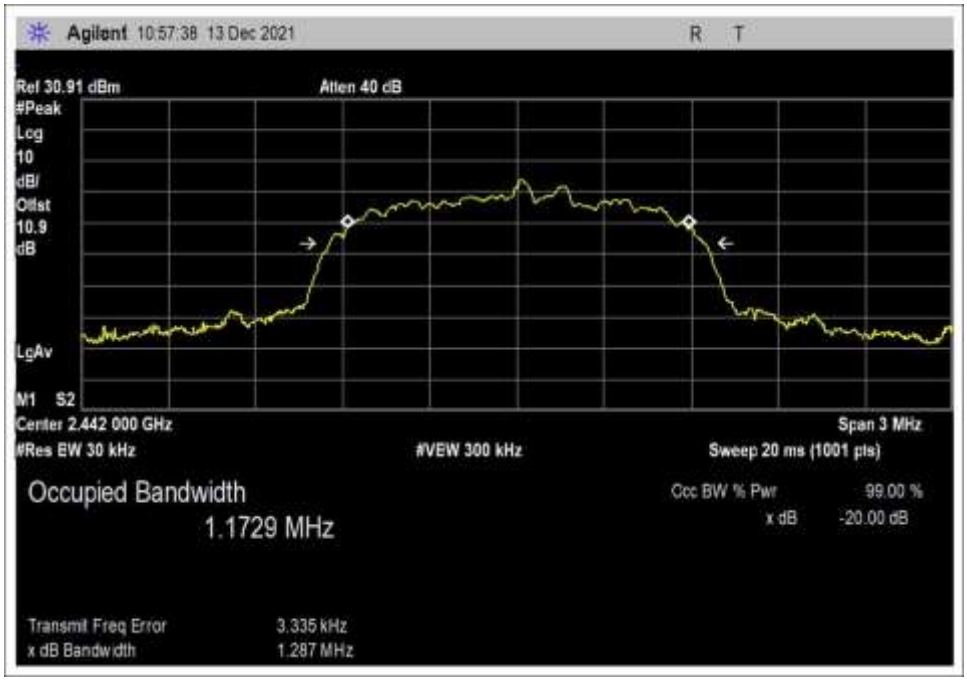


High Channel

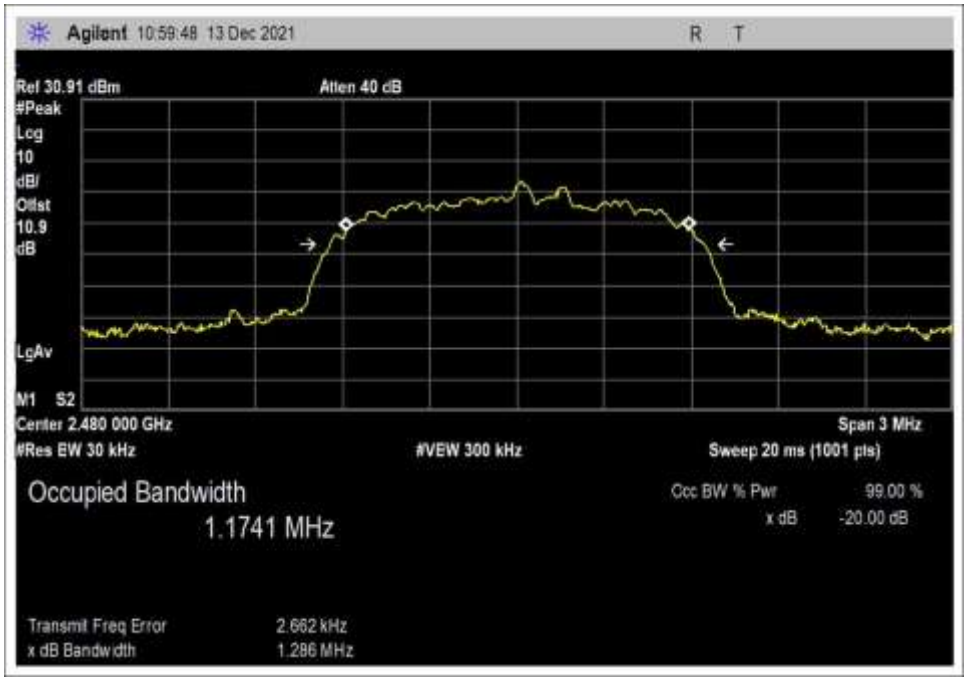
20dB and 99% Occupied Bandwidth 8-DQPSK



Low Channel



Middle Channel



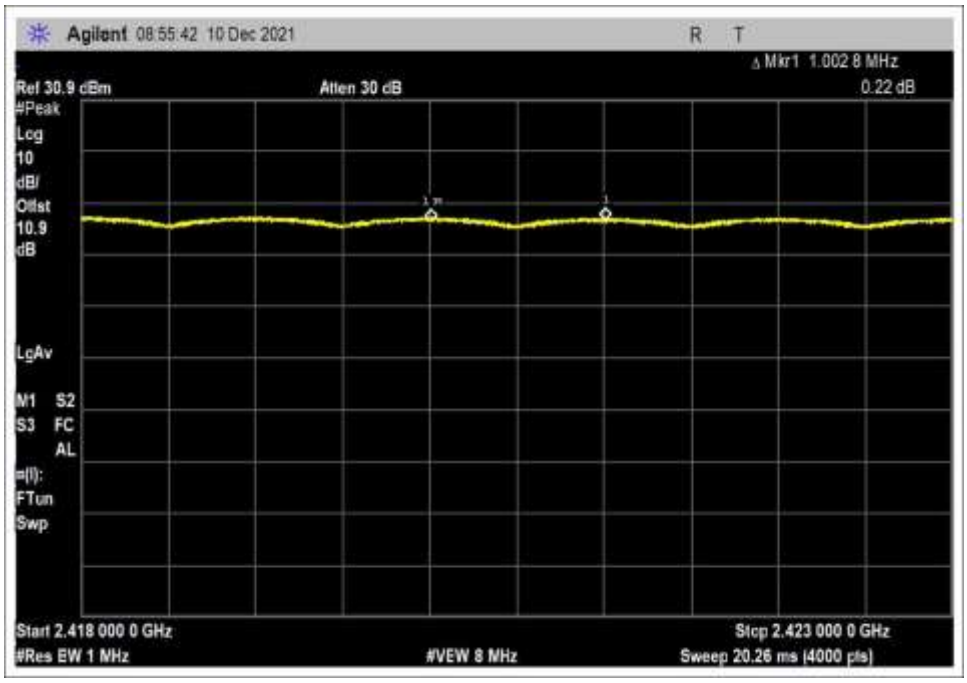
High Channel

15.247(a)(1) Carrier Separation

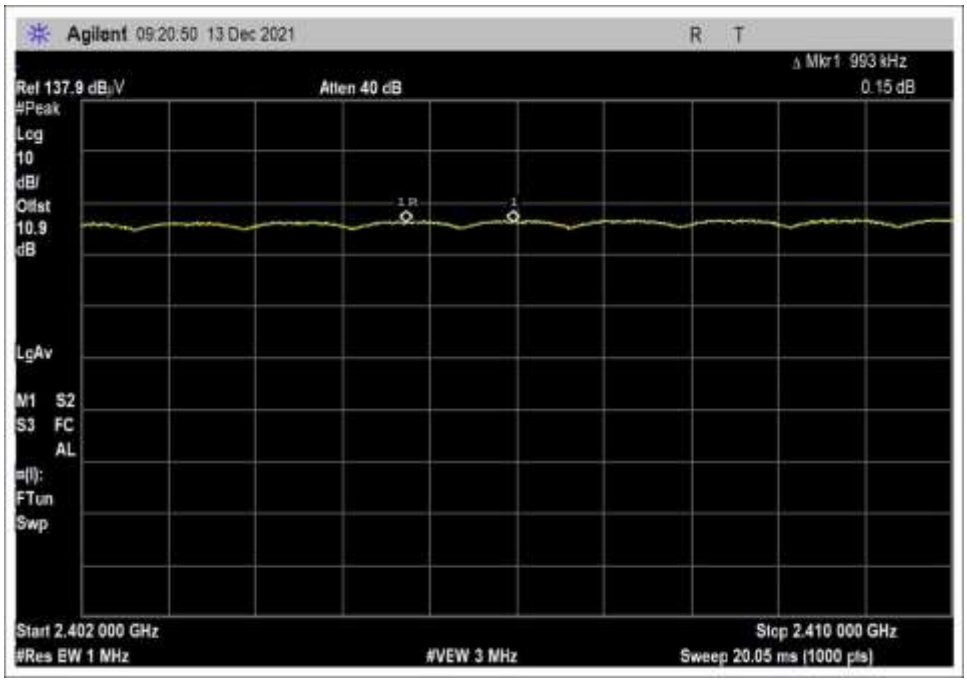
Test Data Summary				
Limit applied: minimum 25kHz.				
Antenna Port	**Operational Mode**	**Measured (kHz)**	**Limit (kHz)**	**Results**
1	Normal	GFSK	1002.8	≥25
1	Normal	π/4-DQPSK	993.0	≥25
1	Normal	8-DQPSK	984.0	≥25

Plot(s)

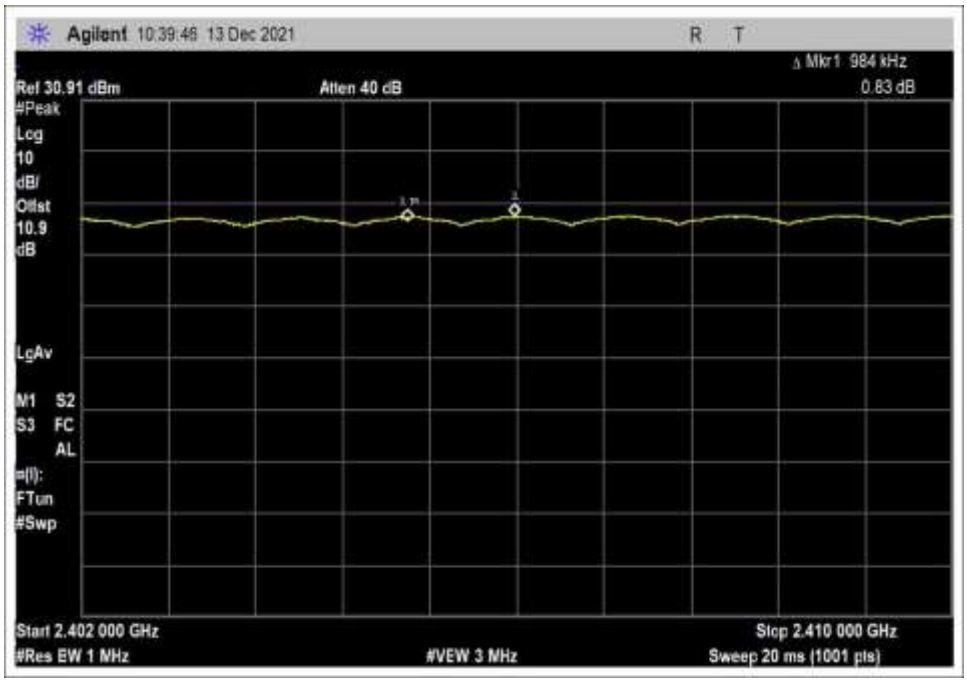
GFSK



π/4-DQPSK



8-DQPSK

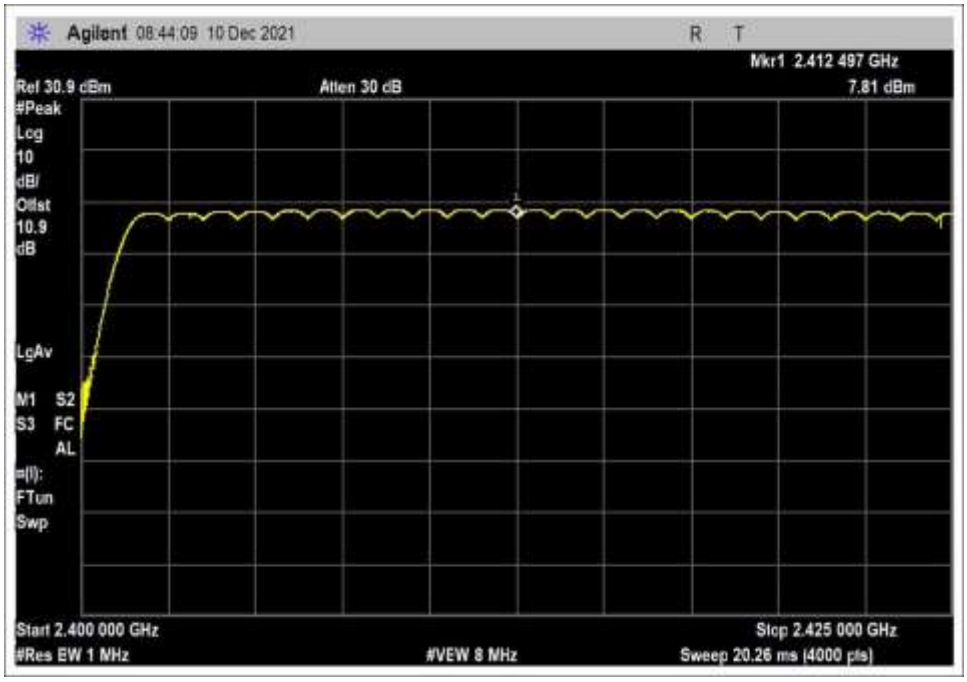


15.247(a)(1)(iii) Number of Channels

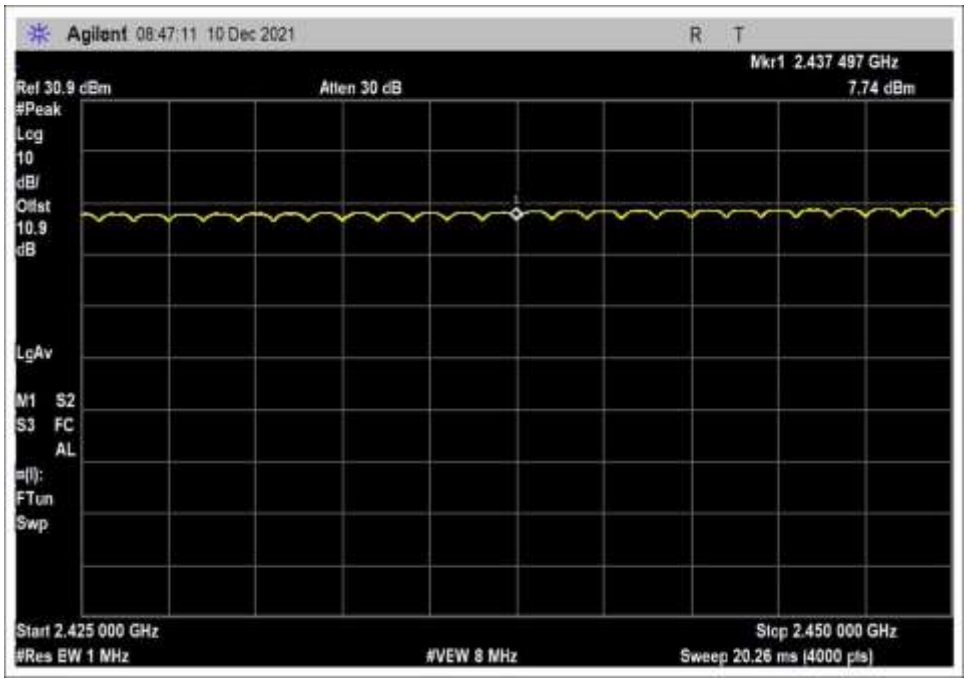
Test Data Summary				
Limit applied: 75; for equipment with power output >125 mW..				
Antenna Port	**Operational Mode**	**Measured (Channels)**	**Limit (Channels)**	**Results**
1	Normal	GFSK	79	≥75
1	Normal	π/4-DQPSK	79	≥75
1	Normal	8-DQPSK	79	≥75

Plot(s)

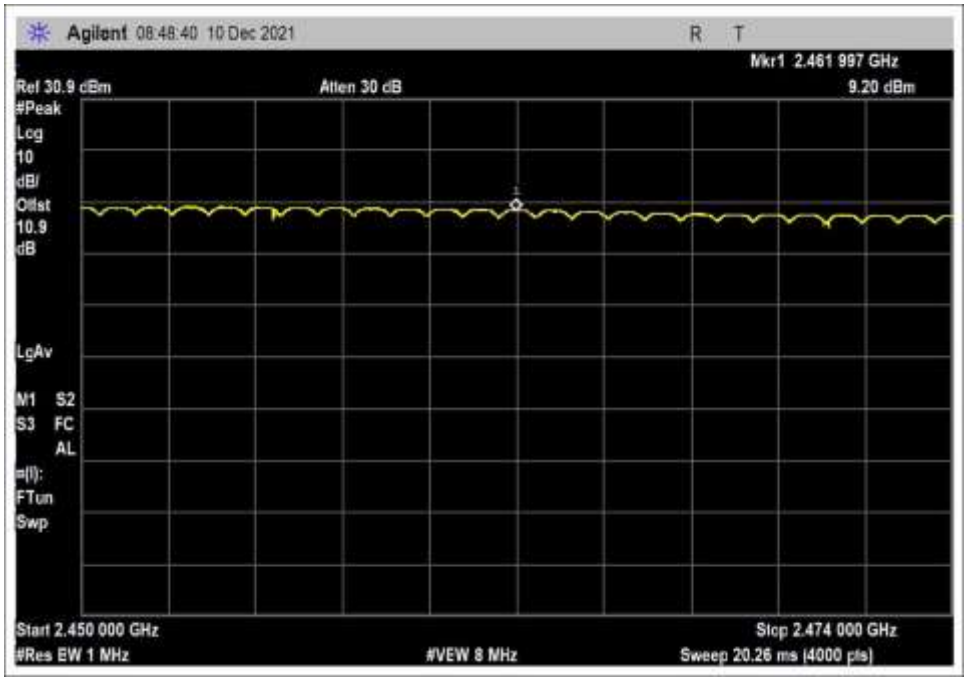
GFSK



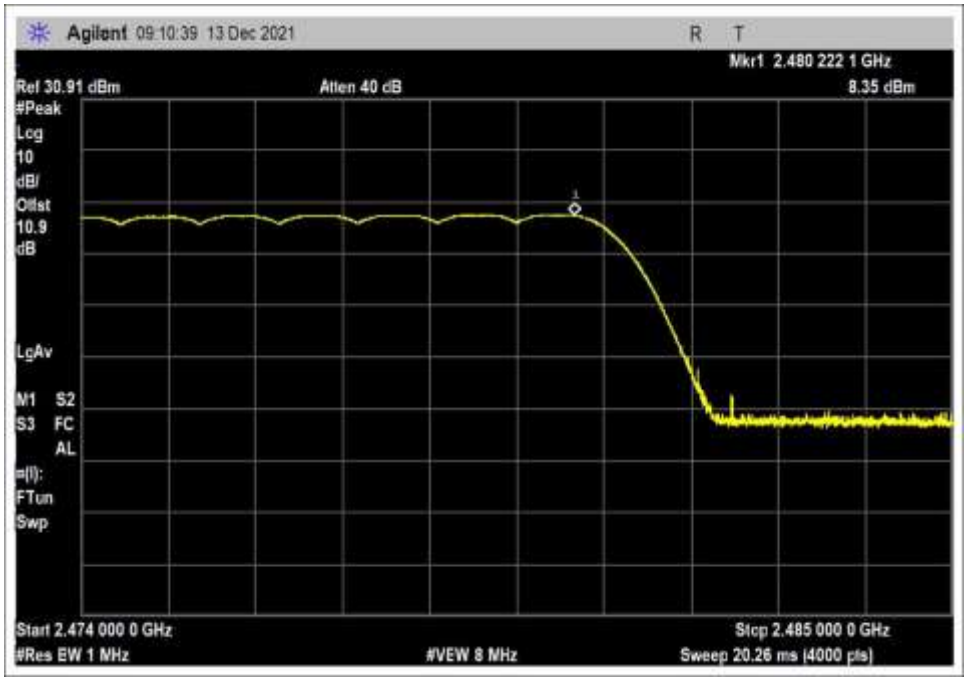
Number channel 1-24



Number channel 24-49

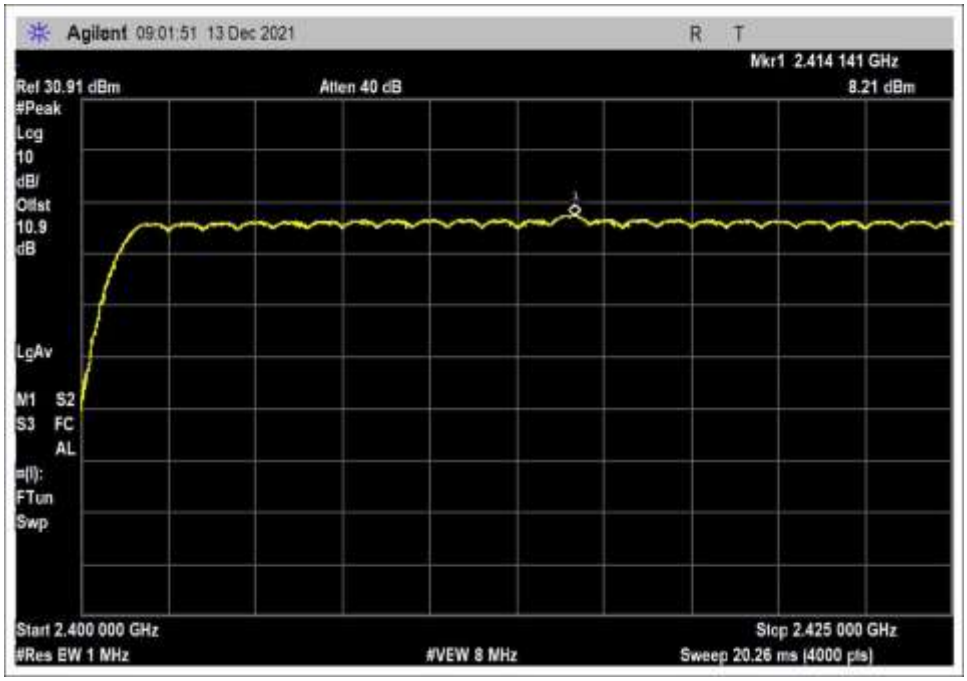


Number channel 49-73

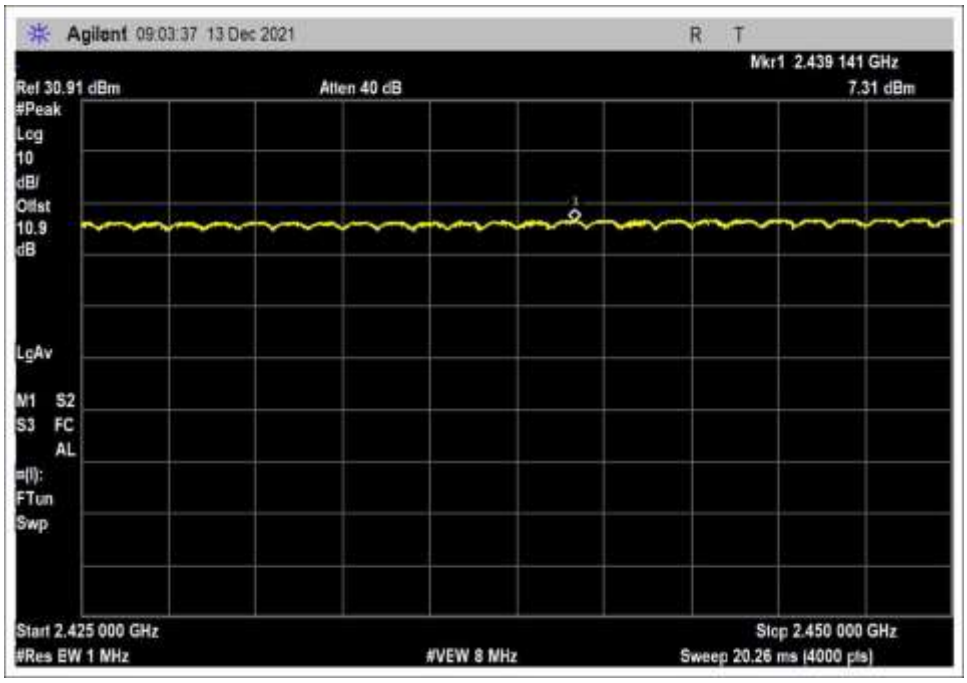


Number channel 73-79

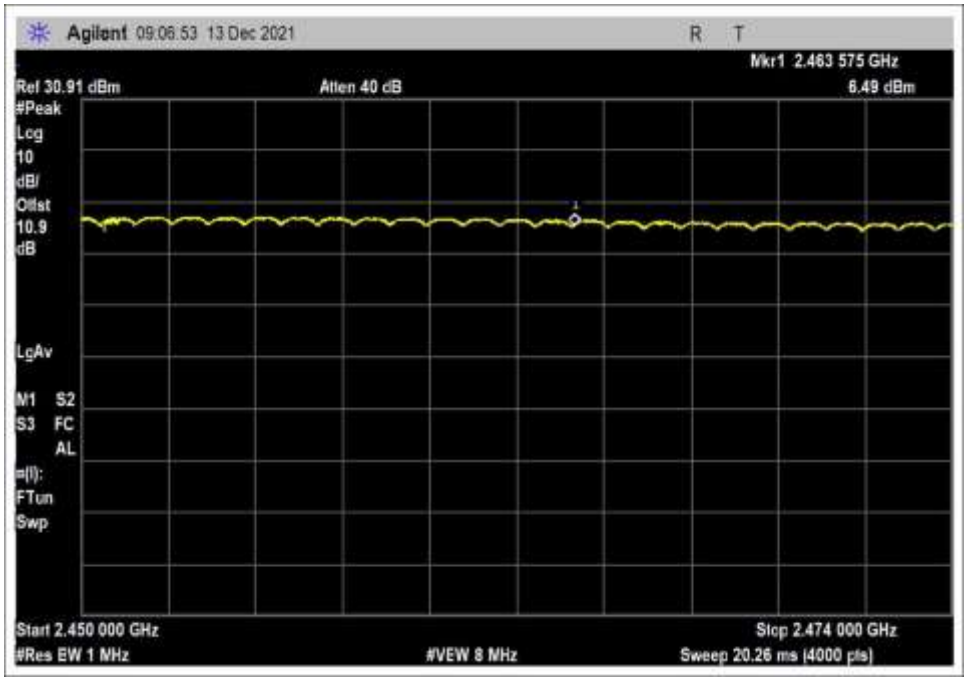
π/4-DQPSK



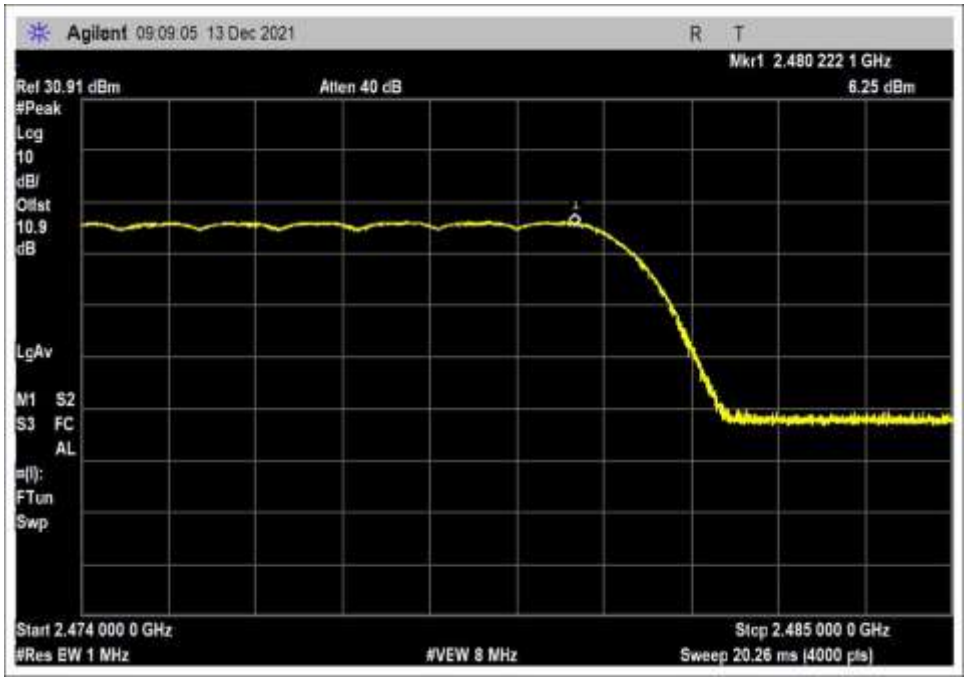
Number channel 1-24



Number channel 24-49

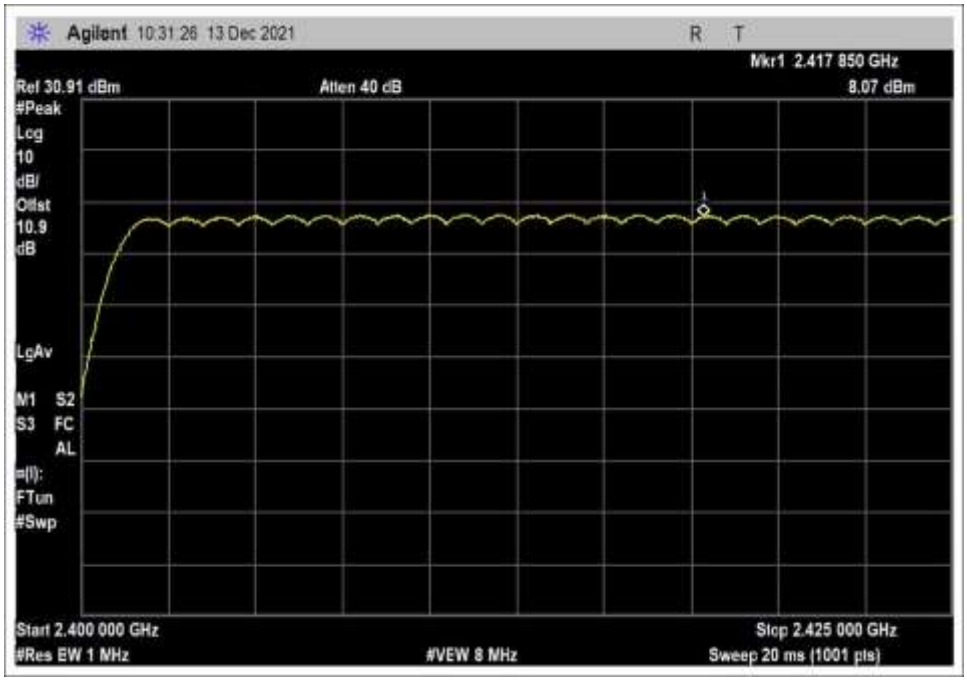


Number channel 49-73

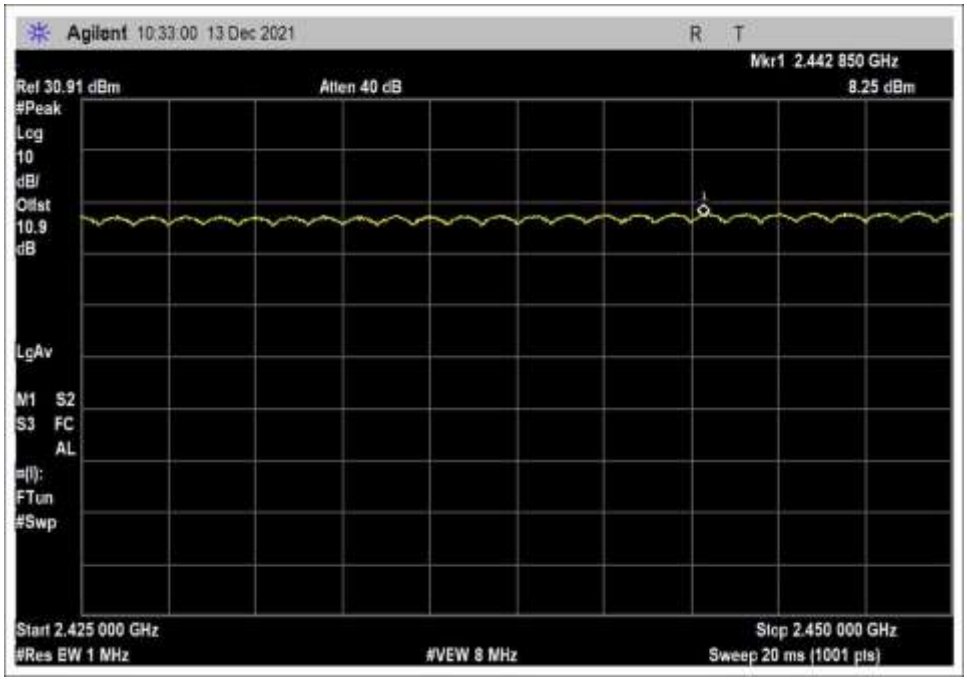


Number channel 73-79

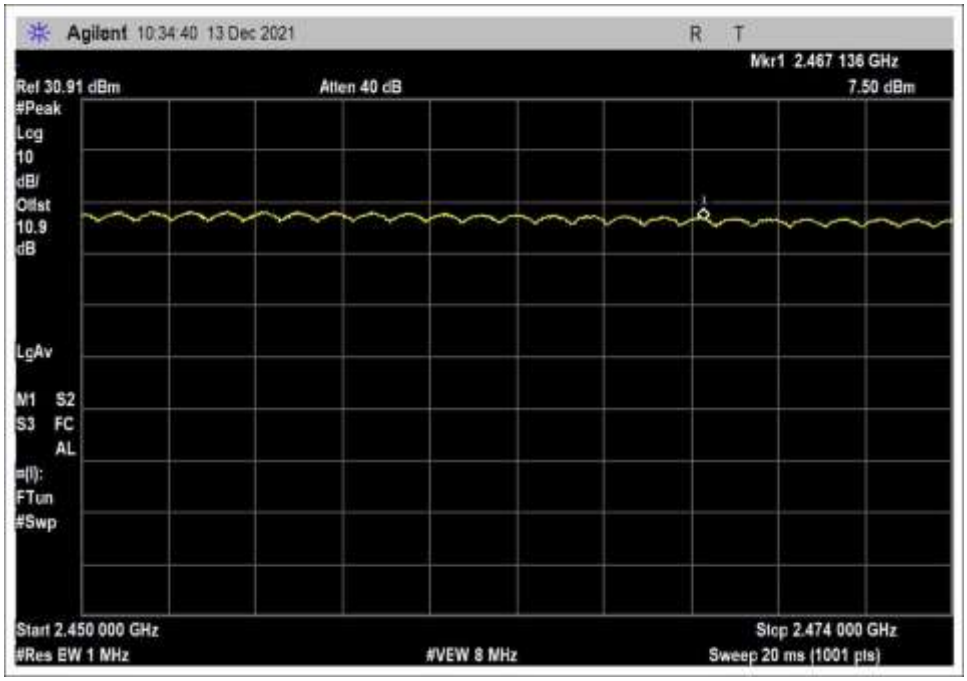
8-DQPSK



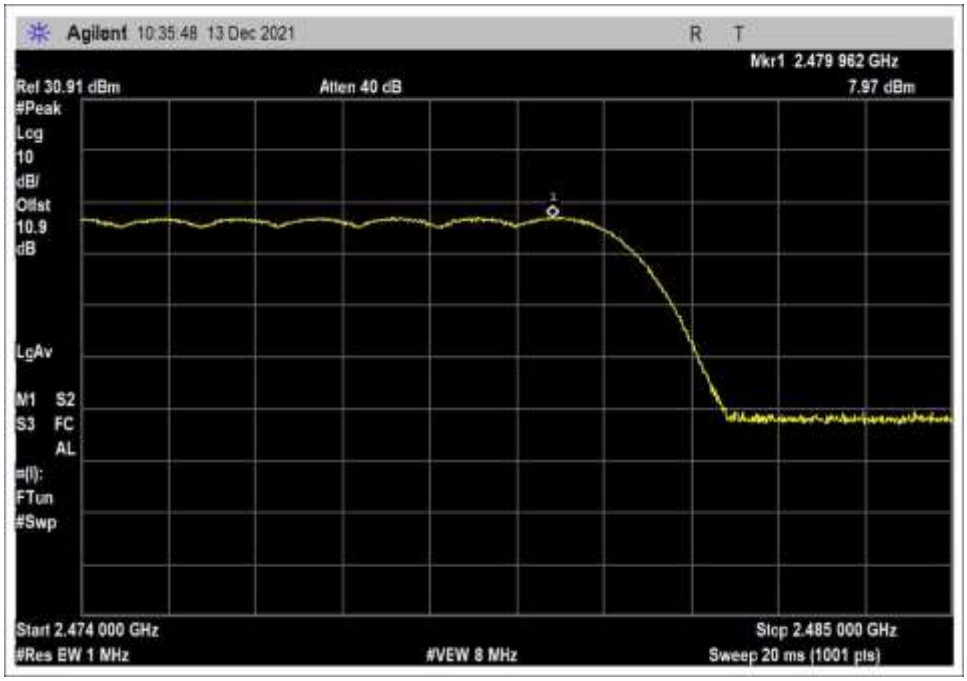
Number channel 1-24



Number channel 24-49



Number channel 49-73



Number channel 73-79

15.247(a)(1)(iii) Time of Occupancy

Test Data Summary					
Observation Period, P_{obs} is derived from the following: $P_{Obs} = 0.4\ x \max number\ of\ hopping\ channels$					
Antenna Port	**Operational Mode**	**Modulation**	**Measured (ms)**	**Limit (ms/P_{obs})**	**Results**
1	Normal	GFSK	360.1	≤400	Pass
1	Normal	/4-DQPSK	266.3	≤400	Pass
1	Normal	8-DQPSK	267.3	≤400	Pass

Measured results are calculated as follows:

$$Dwell\ time = \left(\sum_{Bursts} RF\ Burst\ On\ Time + \sum_{Control} Control\ Signal\ On\ time \right) \Big|_{P_{obs}}$$

Actual Calculated Values: GFSK

Parameter	Value
Observation Period (P_{obs}):	31.6s
Number of RF Bursts / P_{obs}:	126.4
On time of RF Burst:	0.002849
Number of Control or other signals / P_{obs}:	0
On time of Control or other Signals:	0
Total Measured On Time:	0.3601s

Actual Calculated Values: π/4-DQPSK

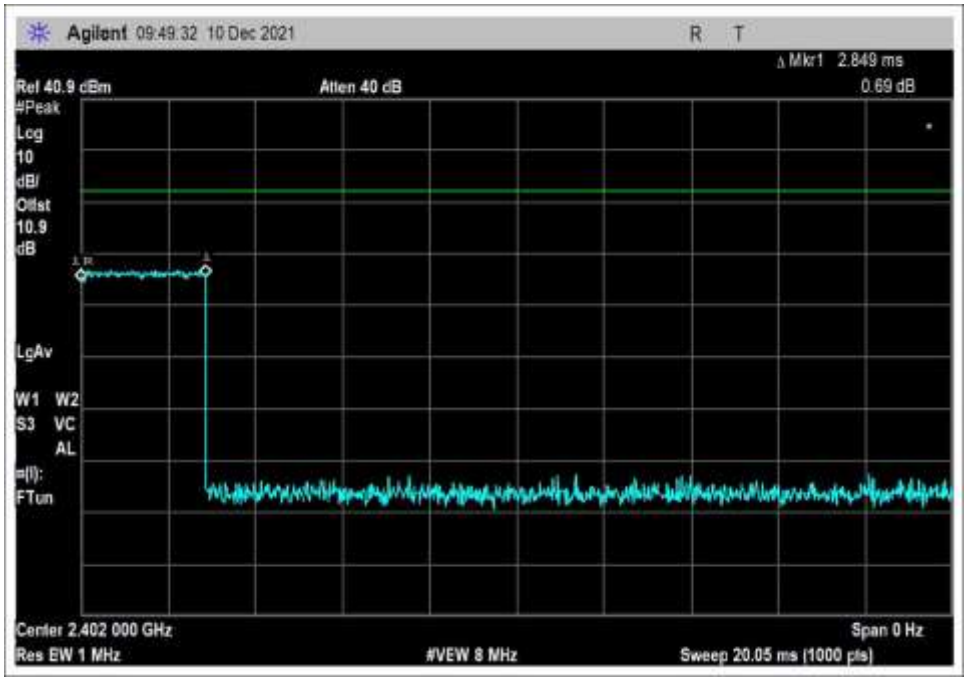
Parameter	Value
Observation Period (P_{obs}):	31.6s
Number of RF Bursts / P_{obs}:	94.8
On time of RF Burst:	0.002809
Number of Control or other signals / P_{obs}:	0
On time of Control or other Signals:	0
Total Measured On Time:	0.2663s

Actual Calculated Values: 8-DQPSK

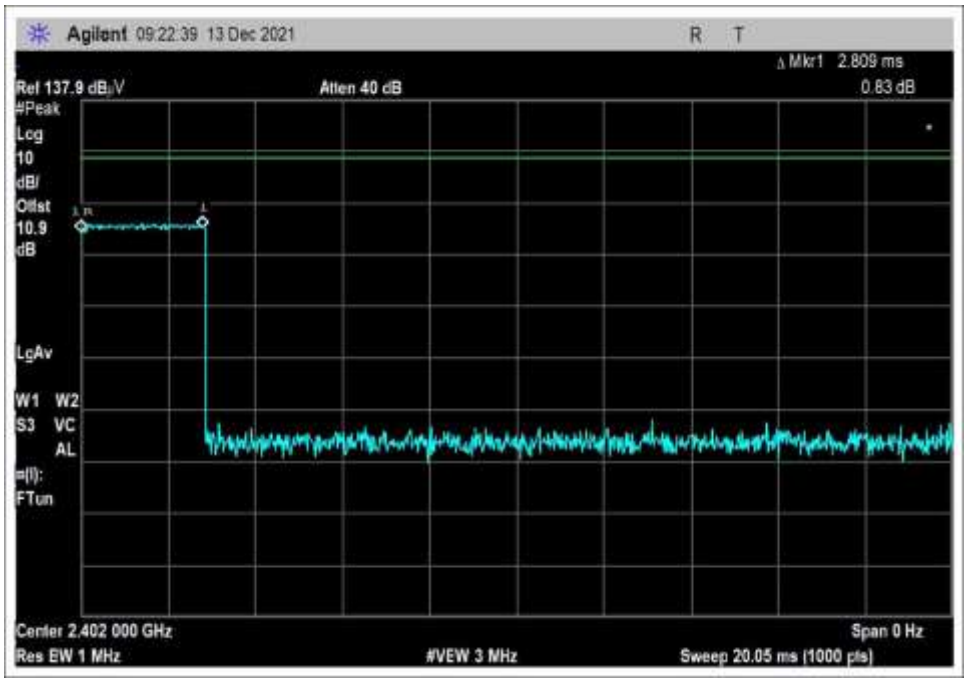
Parameter	Value
Observation Period (P_{obs}):	31.6s
Number of RF Bursts / P_{obs}:	94.8
On time of RF Burst:	0.002820
Number of Control or other signals / P_{obs}:	0
On time of Control or other Signals:	0
Total Measured On Time:	0.2673s

Plot(s)

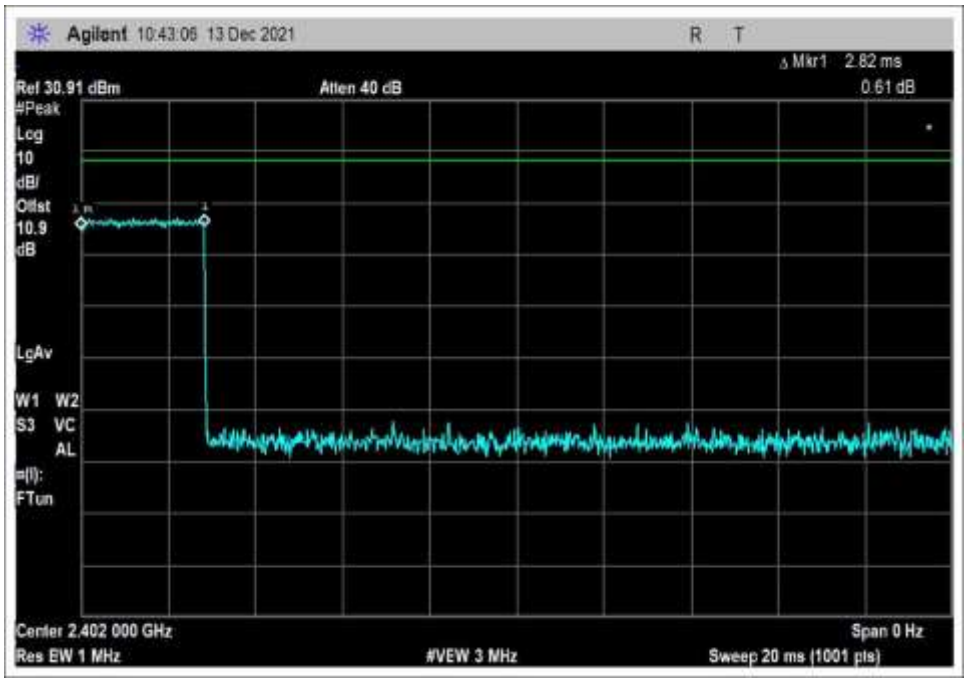
GFSK



π/4-DQPSK



8-DQPSK


Agilent 10:43:06 13 Dec 2021
R T
Mkr1 2.82 ms
0.61 dB
Ref 30.91 dBm
Atten 40 dB
#Peak
Log
10
dB/
Offst
10.9
dB
LgAv
W1 W2
S3 VC
AL
#(!):
FTun
Center 2.402 000 GHz
Res BW 1 MHz
#VBW 3 MHz
Span 0 Hz
Sweep 20 ms (1001 pts)

15.247(b)(1) Output Power

Test Setup/Conditions			
Test Location:	Fremont Lab C3	Test Engineer:	Hoang Cao
Test Method:	ANSI C63.10 (2013), KDB 558074 D01 15.247 Meas Guidance v05r02	Test Date(s):	12/8/2021
Configuration:	9		
Test Setup:	The EUT is placed non-conducted table. It is operated as intended. It is connected straight to a Spectrum Analyzer.		

Environmental Conditions			
Temperature (ºC)	22.7	Relative Humidity (%):	46

Test Equipment					
Asset# / Serial#	**Description**	**Manufacturer**	**Model**	**Cal Date**	**Cal Due**
03360	Cable	Astrolab	32022-2-29094-36TC	4/9/2020	4/9/2022
P06239	Attenuator	Weinschel	54A-10	6/17/2020	6/17/2022
03471	Spectrum Analyzer	Agilent	E4440A	2/11/2020	2/11/2022

Test Data Summary - Voltage Variations					
Frequency (MHz)	**Modulation / Ant Port**	**$V_{Minimum}$ (dBm)**	**$V_{Nominal}$ (dBm)**	**$V_{Maximum}$ (dBm)**	**Max Deviation from $V_{Nominal}$ (dB)**
2402	8-DQPSK	8.50	8.58	8.59	0.09
2442	8-DQPSK	9.31	9.32	9.28	0.04
2480	8-DQPSK	8.69	8.68	8.65	0.04

Test performed using operational mode with the highest output power, representing worst case.

Parameter Definitions:

Measurements performed at input voltage Vnominal ± 15%.

Parameter	Value
$V_{Nominal}$:	15 VDC
$V_{Minimum}$:	12.75 VDC
$V_{Maximum}$:	17.25 VDC

Test Data Summary - RF Conducted Measurement					
$Limit = \begin{cases} 30dBm\ Conducted/36dBm\ EIRP \mid \geq 75\ Channels \\ 21dBm\ Conducted/27dBm\ EIRP \mid < 75\ Channels\ (\min 15) \end{cases}$					
Frequency (MHz)	**Modulation**	**Ant. Type / Gain (dBi)**	**Measured (dBm)**	**Limit (dBm)**	**Results**
2402	GFSK	External Connector /3.42	8.76	≤30	Pass
2442	GFSK	External Connector /3.42	9.47	≤30	Pass
2480	GFSK	External Connector /3.42	8.78	≤30	Pass
2402	□/4-DQPSK	External Connector /3.42	7.88	≤30	Pass
2442	□/4-DQPSK	External Connector /3.42	8.43	≤30	Pass
2480	□/4-DQPSK	External Connector /3.42	8.00	≤30	Pass
2402	8-DQPSK	External Connector /3.42	8.57	≤30	Pass
2442	8-DQPSK	External Connector /3.42	9.33	≤30	Pass
2480	8-DQPSK	External Connector /3.42	8.64	≤30	Pass

For fixed point-to-point antennas, the limit is calculated in accordance with 15.247(c)(1):

$Limit = 30 - Roundup\left(\frac{G-6}{3}\right)$

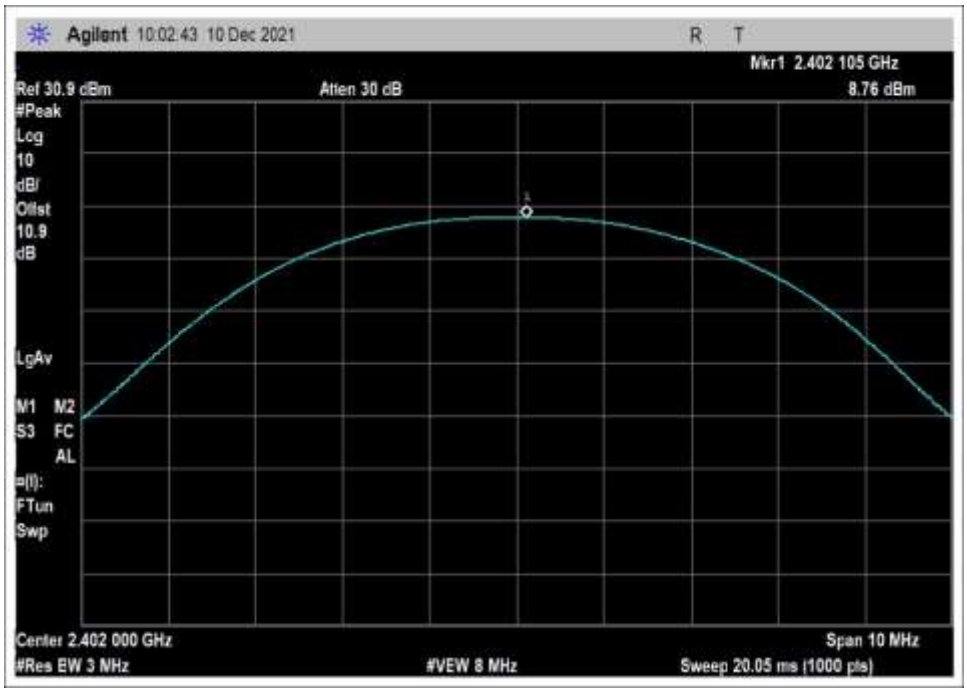
For all other antennas, the limit is calculated according to a maximum of 1W (30 dBm) or 0.25W (21 dBm) conducted power with a maximum of 6dBi gain antenna in accordance with 15.247(b)

$Limit = 30\ [or\ 21] - Roundup(G - 6)$

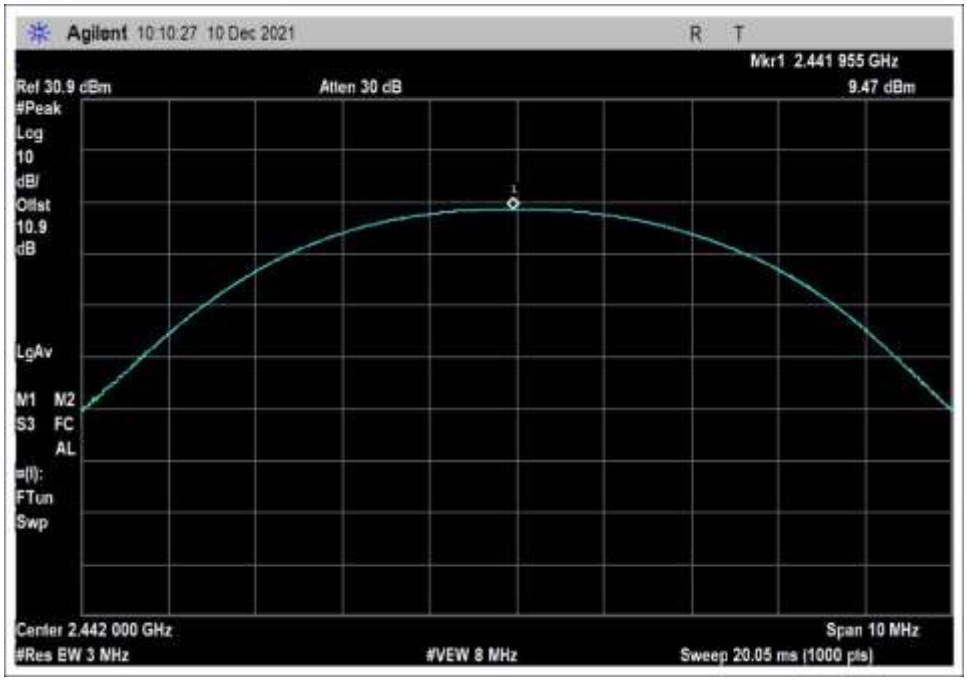
For directional beamforming antennas, the limit is calculated in accordance with 15.247(c)(2) and KDB 662911.

Plot(s)

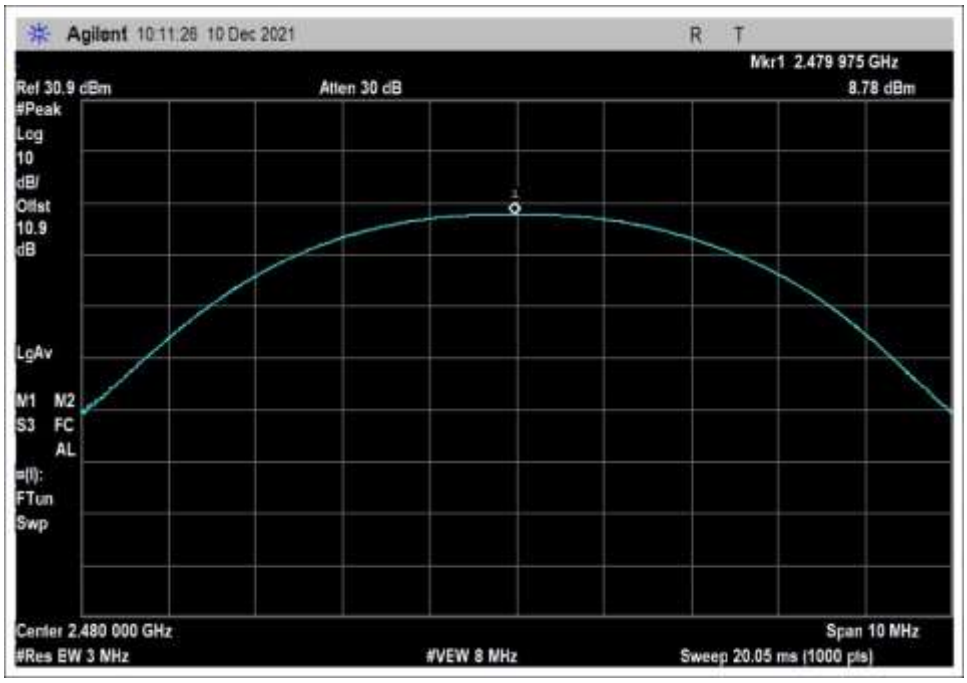
GFSK



Low Channel

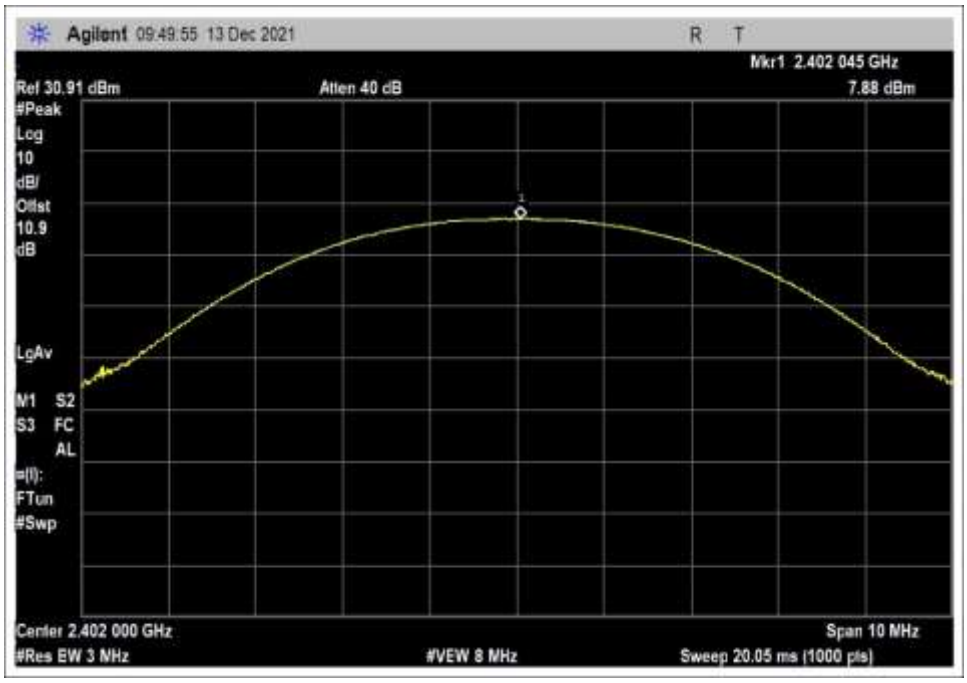


Middle Channel

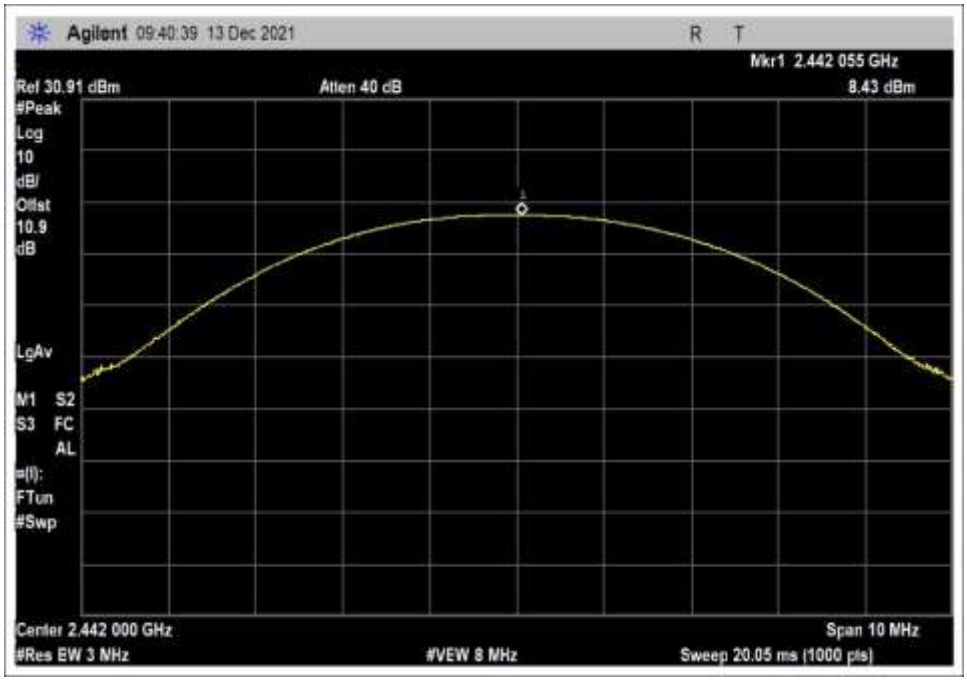


High Channel

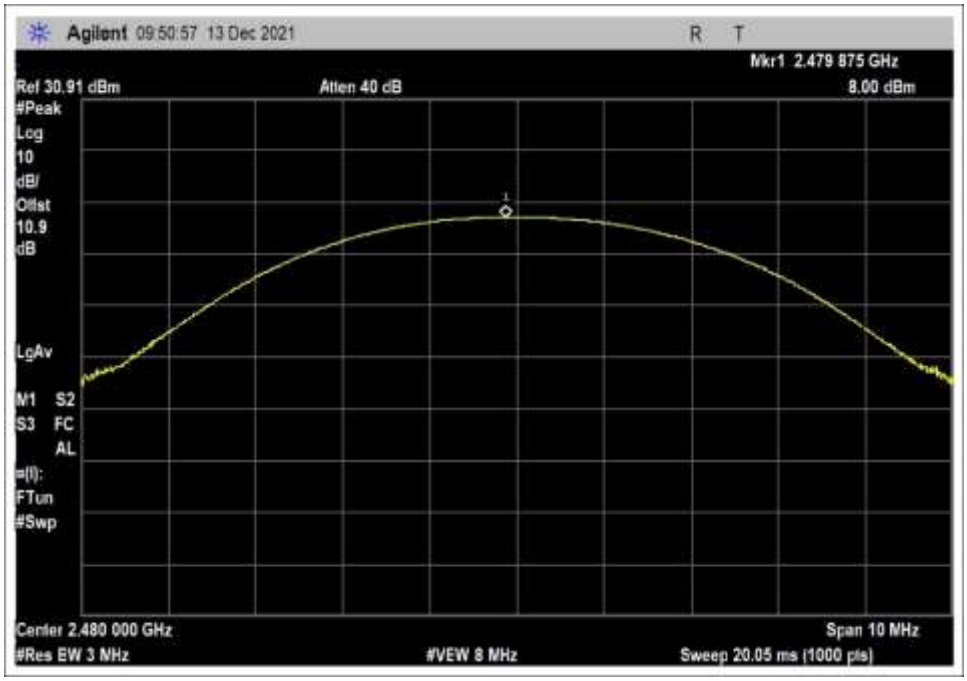
π/4-DQPSK



Low Channel

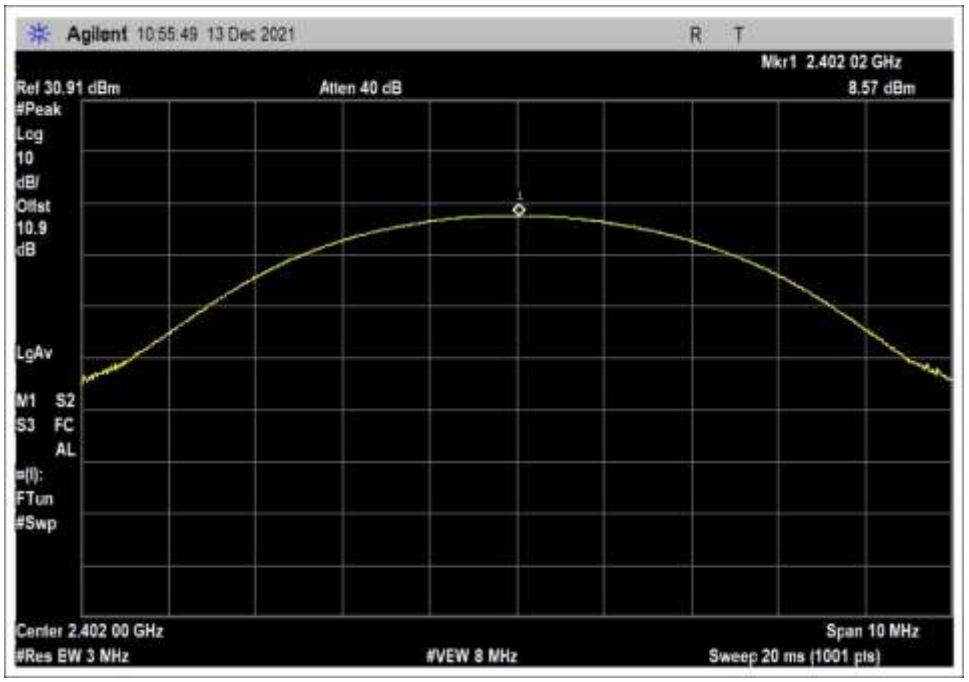


Middle Channel

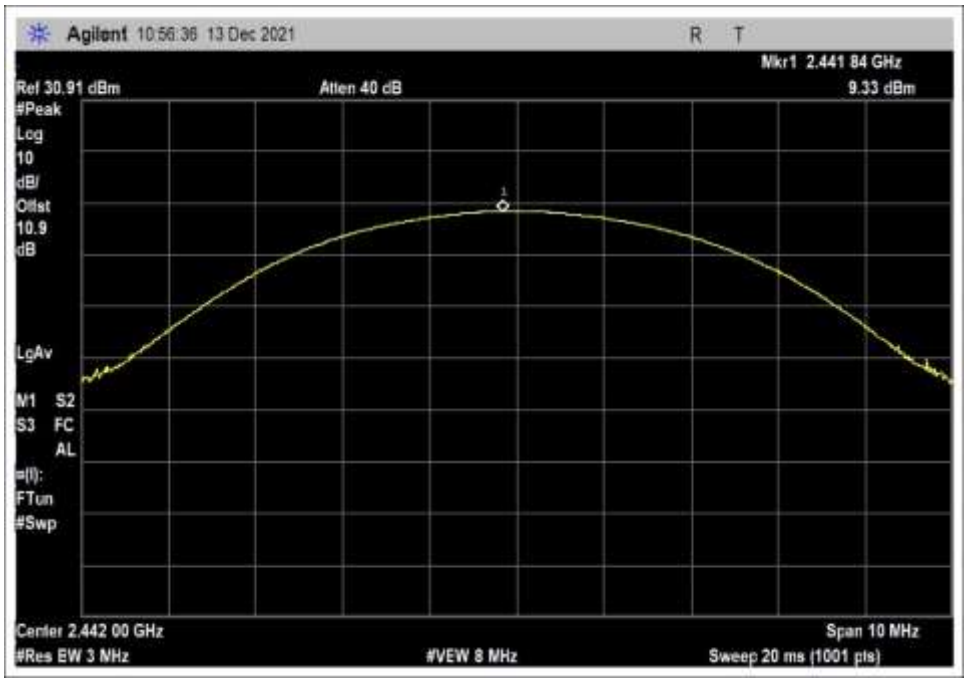


High Channel

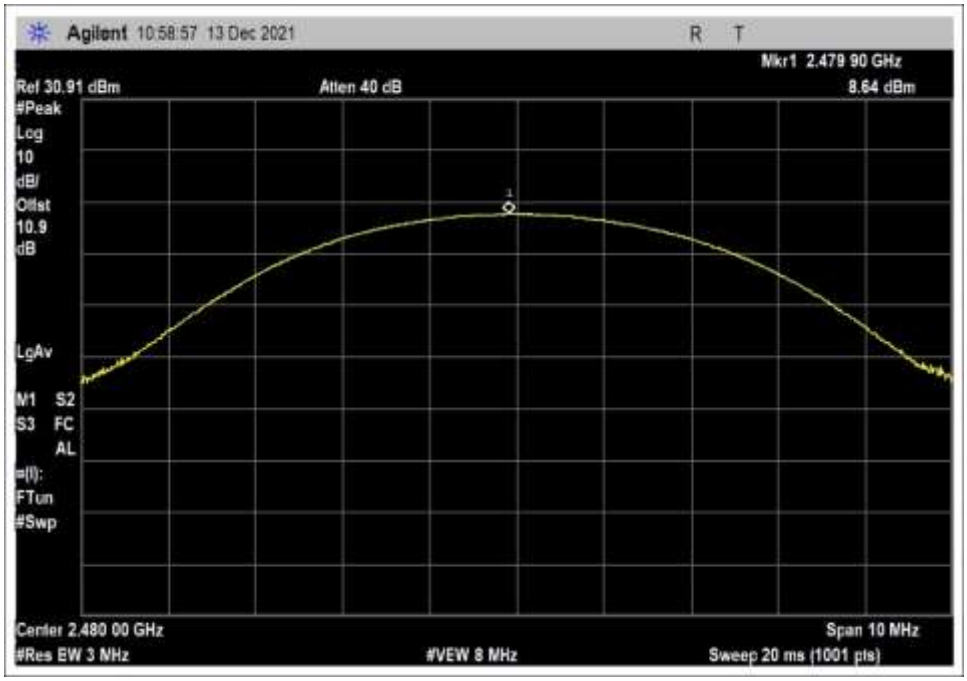
8-DQPSK



Low Channel



Middle Channel



High Channel

15.247(d) RF Conducted Emissions & Band Edge

Test Setup / Conditions / Data

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont CA 94539 • 510-249-1170		
Customer:	**Tonal**		
Specification:	**15.247(d) Conducted Spurious Emissions**		
Work Order #:	**105488**	Date:	12/10/2021
Test Type:	**Conducted Scan**	Time:	10:45:49 AM
Tested By:	Hoang Cao	Sequence#:	31
Software:	EMITest 5.03.20		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 9			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 9			

Test Conditions / Notes:

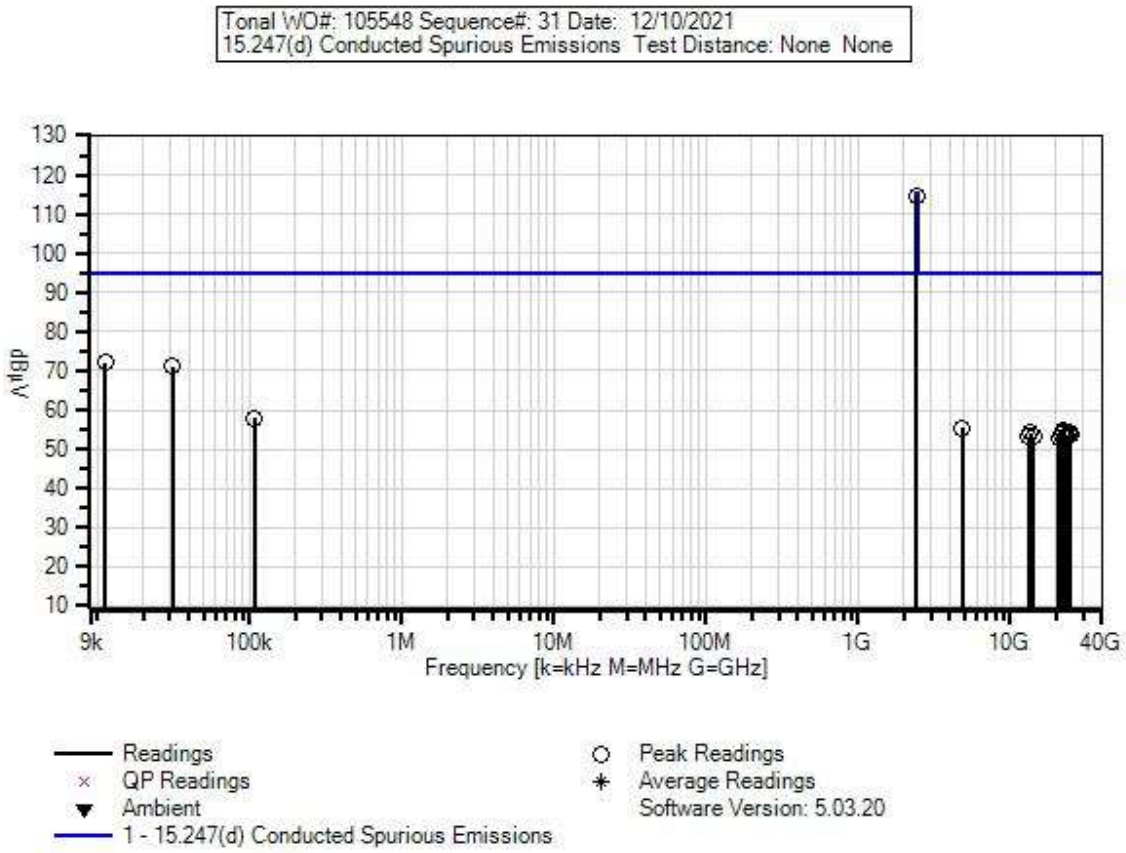
Conducted Spurious Emission
Frequency Range: 9kHz to 25GHz

Environmental Conditions:
Temperature: 21.8ºC
Humidity: 47%
Atmospheric Pressure: 101.5kPa
Highest Generated Frequency: 2.48GHz
Method: ANSI C63.10 2013

The EUT is placed non-conducted table. It is operated as intended. It is connected straight to a Spectrum Analyzer. A laptop is used to send the command to the EUT.

RF output power: PL9

Note:
Low Channel
GFSK



Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	ANP07365	Attenuator	54A-10	5/26/2021	5/26/2023
T2	ANP06904	Cable	32022-29094K-29094K-36TC	1/7/2020	1/7/2022
	AN03471	Spectrum Analyzer	E4440A	2/11/2020	2/11/2022

Measurement Data: Reading listed by margin. Test Distance: None

#	Freq MHz	Rdng dBµV	T1 dB	T2 dB	dB	dB	Dist Table	Corr dBµV	Spec dBµV	Margin dB	Polar Ant
1	2400.765M	104.0	+9.9	+0.8			+0.0	114.7	115.1	-0.4	None
2	11.264k	62.3	+9.7	+0.0			+0.0	72.0	95.1	-23.1	None
3	31.444k	61.3	+9.7	+0.0			+0.0	71.0	95.1	-24.1	None
4	107.228k	48.3	+9.7	+0.0			+0.0	58.0	95.1	-37.1	None
5	4804.480M	44.6	+9.9	+1.0			+0.0	55.5	95.1	-39.6	None
6	22160.179 M	42.4	+10.1	+2.4			+0.0	54.9	95.1	-40.2	None
7	22390.718 M	42.0	+10.1	+2.4			+0.0	54.5	95.1	-40.6	None
8	24402.694 M	41.6	+10.1	+2.5			+0.0	54.2	95.1	-40.9	None
9	13603.919 M	42.2	+10.0	+1.9			+0.0	54.1	95.1	-41.0	None
10	21479.041 M	41.6	+10.0	+2.4			+0.0	54.0	95.1	-41.1	None
11	21678.143 M	41.5	+10.0	+2.4			+0.0	53.9	95.1	-41.2	None
12	24193.114 M	41.2	+10.1	+2.5			+0.0	53.8	95.1	-41.3	None
13	24790.419 M	41.1	+10.1	+2.6			+0.0	53.8	95.1	-41.3	None
14	23889.221 M	41.0	+10.1	+2.5			+0.0	53.6	95.1	-41.5	None
15	23354.790 M	40.8	+10.1	+2.5			+0.0	53.4	95.1	-41.7	None
16	23564.371 M	40.8	+10.1	+2.5			+0.0	53.4	95.1	-41.7	None
17	14119.108 M	41.3	+10.0	+1.9			+0.0	53.2	95.1	-41.9	None

18	23040.419 M	40.7	+10.0	+2.5		+0.0	53.2	95.1	-41.9	None
19	13202.071 M	41.3	+10.0	+1.8		+0.0	53.1	95.1	-42.0	None
20	20860.778 M	40.5	+10.0	+2.4		+0.0	52.9	95.1	-42.2	None

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont CA 94539 • 510-249-1170		
Customer:	**Tonal**		
Specification:	**15.247(d) Conducted Spurious Emissions**		
Work Order #:	**105488**	Date:	12/10/2021
Test Type:	**Conducted Scan**	Time:	10:52:52 AM
Tested By:	Hoang Cao	Sequence#:	32
Software:	EMITest 5.03.20		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 9			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 9			

Test Conditions / Notes:

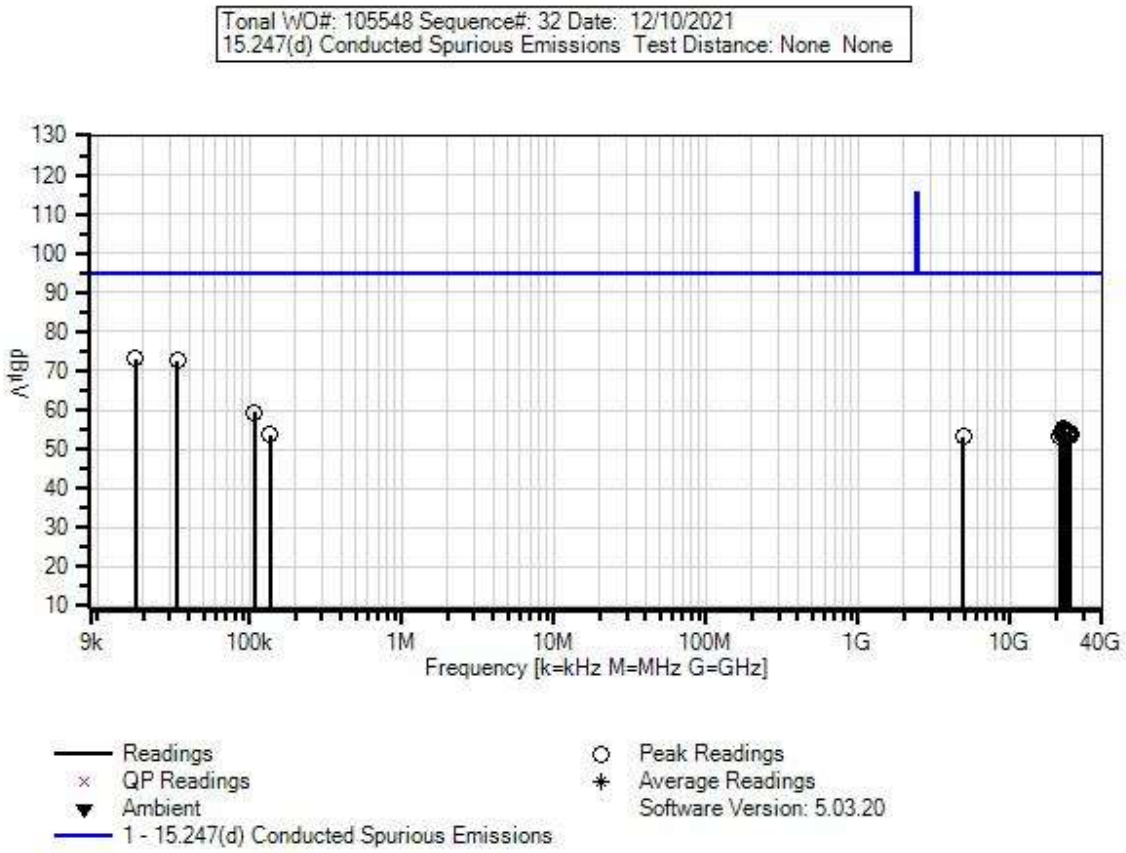
Conducted Spurious Emission
Frequency Range: 9kHz to 25GHz

Environmental Conditions:
Temperature: 21.8ºC
Humidity: 47%
Atmospheric Pressure: 101.5kPa
Highest Generated Frequency: 2.48GHz
Method: ANSI C63.10 2013

The EUT is placed non-conducted table. It is operated as intended. It is connected straight to a Spectrum Analyzer. A laptop is used to send the command to the EUT.

RF output power: PL9

Note:
Middle Channel
GFSK



Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	ANP07365	Attenuator	54A-10	5/26/2021	5/26/2023
T2	ANP06904	Cable	32022-29094K-29094K-36TC	1/7/2020	1/7/2022
	AN03471	Spectrum Analyzer	E4440A	2/11/2020	2/11/2022

Measurement Data: Reading listed by margin. Test Distance: None

#	Freq MHz	Rdng dBµV	T1 dB	T2 dB	dB	dB	Dist Table	Corr dBµV	Spec dBµV	Margin dB	Polar Ant
1	17.817k	63.5	+9.7	+0.0			+0.0	73.2	95.1	-21.9	None
2	33.564k	62.8	+9.7	+0.0			+0.0	72.5	95.1	-22.6	None
3	107.489k	49.6	+9.7	+0.0			+0.0	59.3	95.1	-35.8	None
4	22086.826 M	42.8	+10.1	+2.4			+0.0	55.3	95.1	-39.8	None
5	21856.287 M	42.4	+10.0	+2.4			+0.0	54.8	95.1	-40.3	None
6	22128.742 M	42.1	+10.1	+2.4			+0.0	54.6	95.1	-40.5	None
7	22202.095 M	42.0	+10.1	+2.4			+0.0	54.5	95.1	-40.6	None
8	23669.161 M	41.8	+10.1	+2.5			+0.0	54.4	95.1	-40.7	None
9	24098.802 M	41.8	+10.1	+2.5			+0.0	54.4	95.1	-40.7	None
10	23711.078 M	41.6	+10.1	+2.5			+0.0	54.2	95.1	-40.9	None
11	21520.957 M	41.7	+10.0	+2.4			+0.0	54.1	95.1	-41.0	None
12	136.167k	44.1	+9.7	+0.0			+0.0	53.8	95.1	-41.3	None
13	22264.970 M	41.3	+10.1	+2.4			+0.0	53.8	95.1	-41.3	None
14	24769.461 M	40.9	+10.1	+2.6			+0.0	53.6	95.1	-41.5	None
15	21185.628 M	41.1	+10.0	+2.4			+0.0	53.5	95.1	-41.6	None
16	24423.653 M	40.9	+10.1	+2.5			+0.0	53.5	95.1	-41.6	None
17	24276.946 M	40.8	+10.1	+2.5			+0.0	53.4	95.1	-41.7	None

18	4886.910M	42.3	+9.9	+1.1		+0.0	53.3	95.1	-41.8	None
19	23742.515 M	40.7	+10.1	+2.5		+0.0	53.3	95.1	-41.8	None

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont CA 94539 • 510-249-1170		
Customer:	**Tonal**		
Specification:	**15.247(d) Conducted Spurious Emissions**		
Work Order #:	**105488**	Date:	12/10/2021
Test Type:	**Conducted Scan**	Time:	11:01:46 AM
Tested By:	Hoang Cao	Sequence#:	33
Software:	EMITest 5.03.20		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 9			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 9			

Test Conditions / Notes:

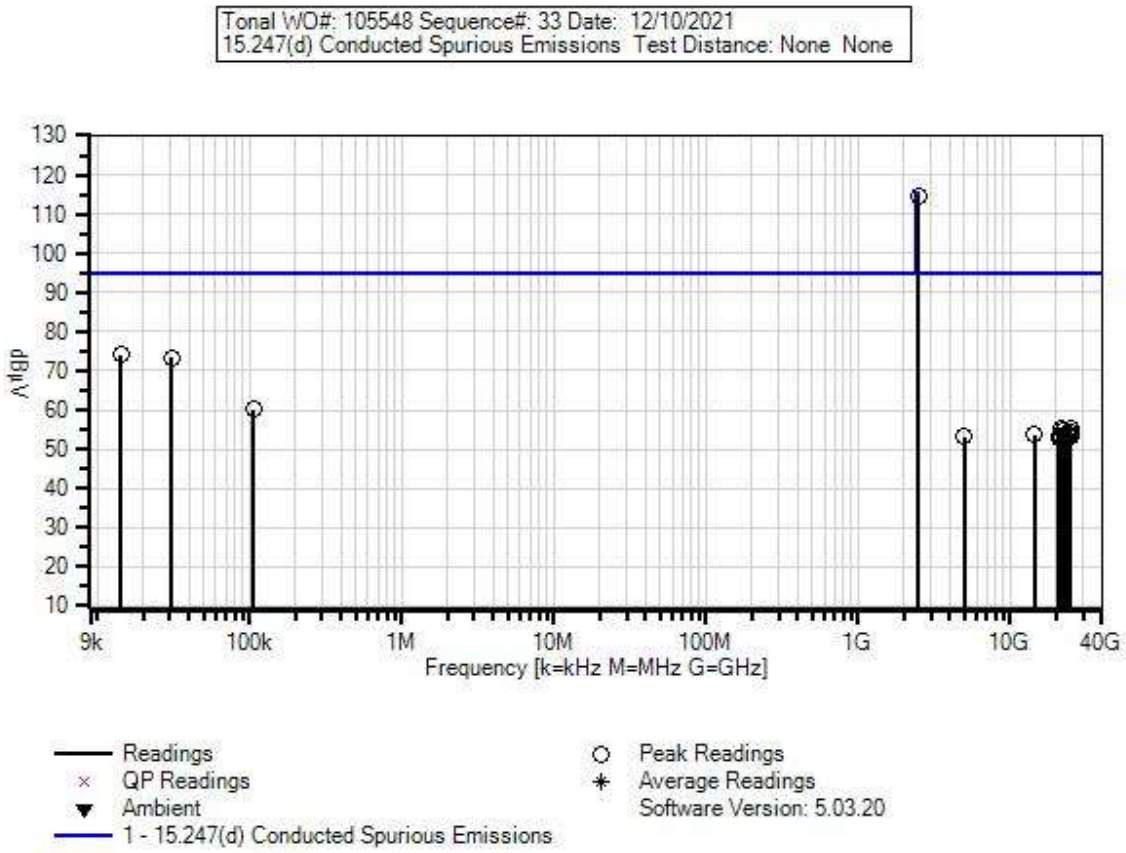
Conducted Spurious Emission
Frequency Range: 9kHz to 25GHz

Environmental Conditions:
Temperature: 21.8ºC
Humidity: 47%
Atmospheric Pressure: 101.5kPa
Highest Generated Frequency: 2.48GHz
Method: ANSI C63.10 2013

The EUT is placed non-conducted table. It is operated as intended. It is connected straight to a Spectrum Analyzer. A laptop is used to send the command to the EUT.

RF output power: PL9

Note:
High Channel
GFSK



Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	ANP07365	Attenuator	54A-10	5/26/2021	5/26/2023
T2	ANP06904	Cable	32022-29094K-29094K-36TC	1/7/2020	1/7/2022
	AN03471	Spectrum Analyzer	E4440A	2/11/2020	2/11/2022

Measurement Data: Reading listed by margin. Test Distance: None

#	Freq MHz	Rdng dBµV	T1 dB	T2 dB	dB	dB	Dist Table	Corr dBµV	Spec dBµV	Margin dB	Polar Ant
1	2478.568M	103.9	+9.9	+0.8			+0.0	114.6	115.1	-0.5	None
2	14.299k	64.5	+9.7	+0.0			+0.0	74.2	95.1	-20.9	None
3	30.990k	63.6	+9.7	+0.0			+0.0	73.3	95.1	-21.8	None
4	106.707k	50.4	+9.7	+0.0			+0.0	60.1	95.1	-35.0	None
5	21803.892 M	43.1	+10.0	+2.4			+0.0	55.5	95.1	-39.6	None
6	24832.335 M	42.4	+10.1	+2.6			+0.0	55.1	95.1	-40.0	None
7	21929.640 M	42.3	+10.1	+2.4			+0.0	54.8	95.1	-40.3	None
8	24884.731 M	41.7	+10.1	+2.6			+0.0	54.4	95.1	-40.7	None
9	24255.988 M	41.4	+10.1	+2.5			+0.0	54.0	95.1	-41.1	None
10	23553.892 M	41.1	+10.1	+2.5			+0.0	53.7	95.1	-41.4	None
11	14294.273 M	41.7	+10.0	+1.9			+0.0	53.6	95.1	-41.5	None
12	23050.898 M	40.8	+10.0	+2.5			+0.0	53.3	95.1	-41.8	None
13	24392.215 M	40.7	+10.1	+2.5			+0.0	53.3	95.1	-41.8	None
14	20630.239 M	40.7	+10.1	+2.4			+0.0	53.2	95.1	-41.9	None
15	21468.562 M	40.8	+10.0	+2.4			+0.0	53.2	95.1	-41.9	None
16	23134.730 M	40.6	+10.1	+2.5			+0.0	53.2	95.1	-41.9	None
17	4959.036M	42.0	+10.0	+1.1			+0.0	53.1	95.1	-42.0	None

18	24664.671 M	40.5	+10.1	+2.5		+0.0	53.1	95.1	-42.0	None
19	21279.939 M	40.6	+10.0	+2.4		+0.0	53.0	95.1	-42.1	None
20	20672.155 M	40.4	+10.1	+2.4		+0.0	52.9	95.1	-42.2	None

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont CA 94539 • 510-249-1170		
Customer:	**Tonal**		
Specification:	**15.247(d) Conducted Spurious Emissions**	Date:	12/13/2021
Test Type:	**Conducted Scan**	Time:	10:07:36 AM
Tested By:	Hoang Cao	Sequence#:	34
Software:	EMITest 5.03.20		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 9			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 9			

Test Conditions / Notes:

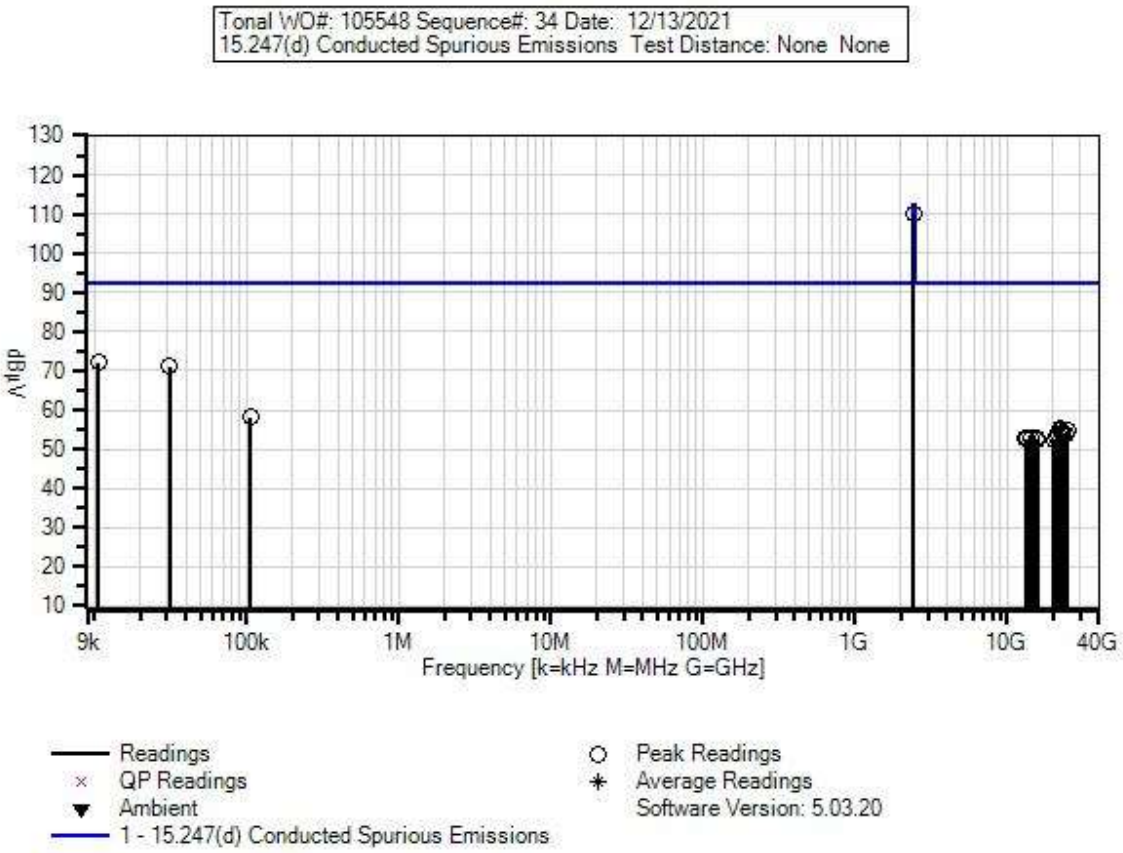
Conducted Spurious Emission
Frequency Range: 9kHz to 25GHz

Environmental Conditions:
Temperature: 21.8ºC
Humidity: 47%
Atmospheric Pressure: 101.5kPa
Highest Generated Frequency: 2.48GHz
Method: ANSI C63.10 2013

The EUT is placed non-conducted table. It is operated as intended. It is connected straight to a Spectrum Analyzer. A laptop is used to send the command to the EUT.

RF output power: PL9

Note:
Low Channel
4DQPSK



Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	ANP07365	Attenuator	54A-10	5/26/2021	5/26/2023
T2	ANP06904	Cable	32022-29094K-29094K-36TC	1/7/2020	1/7/2022
	AN03471	Spectrum Analyzer	E4440A	2/11/2020	2/11/2022

Measurement Data: Reading listed by margin. Test Distance: None

#	Freq MHz	Rdng dBµV	T1 dB	T2 dB	dB	dB	Dist Table	Corr dBµV	Spec dBµV	Margin dB	Polar Ant
1	2400.765M	99.2	+9.9	+0.8			+0.0	109.9	112.4	-2.5	None
2	10.737k	62.5	+9.7	+0.0			+0.0	72.2	92.4	-20.2	None
3	31.217k	61.3	+9.7	+0.0			+0.0	71.0	92.4	-21.4	None
4	106.707k	48.4	+9.7	+0.0			+0.0	58.1	92.4	-34.3	None
5	22013.472 M	42.9	+10.1	+2.4			+0.0	55.4	92.4	-37.0	None
6	21898.203 M	42.3	+10.1	+2.4			+0.0	54.8	92.4	-37.6	None
7	24800.898 M	41.9	+10.1	+2.6			+0.0	54.6	92.4	-37.8	None
8	22726.047 M	41.8	+10.0	+2.4			+0.0	54.2	92.4	-38.2	None
9	22558.383 M	41.4	+10.0	+2.4			+0.0	53.8	92.4	-38.6	None
10	23878.742 M	41.1	+10.1	+2.5			+0.0	53.7	92.4	-38.7	None
11	21573.353 M	41.3	+10.0	+2.4			+0.0	53.7	92.4	-38.7	None
12	20976.047 M	40.7	+10.0	+2.4			+0.0	53.1	92.4	-39.3	None
13	14438.526 M	41.0	+10.0	+1.9			+0.0	52.9	92.4	-39.5	None
14	13222.678 M	40.8	+10.0	+1.8			+0.0	52.6	92.4	-39.8	None
15	13583.311 M	40.8	+10.0	+1.8			+0.0	52.6	92.4	-39.8	None
16	15547.902 M	40.6	+10.0	+2.0			+0.0	52.6	92.4	-39.8	None
17	15778.441 M	40.4	+10.0	+2.0			+0.0	52.4	92.4	-40.0	None

18	20588.323 M	39.9	+10.1	+2.4		+0.0	52.4	92.4	-40.0	None
19	20011.975 M	39.7	+10.1	+2.4		+0.0	52.2	92.4	-40.2	None
20	20567.364 M	39.7	+10.1	+2.4		+0.0	52.2	92.4	-40.2	None

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont CA 94539 • 510-249-1170		
Customer:	**Tonal**		
Specification:	**15.247(d) Conducted Spurious Emissions**		
Work Order #:	**105488**	Date:	12/13/2021
Test Type:	**Conducted Scan**	Time:	10:15:26 AM
Tested By:	Hoang Cao	Sequence#:	35
Software:	EMITest 5.03.20		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 9			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 9			

Test Conditions / Notes:

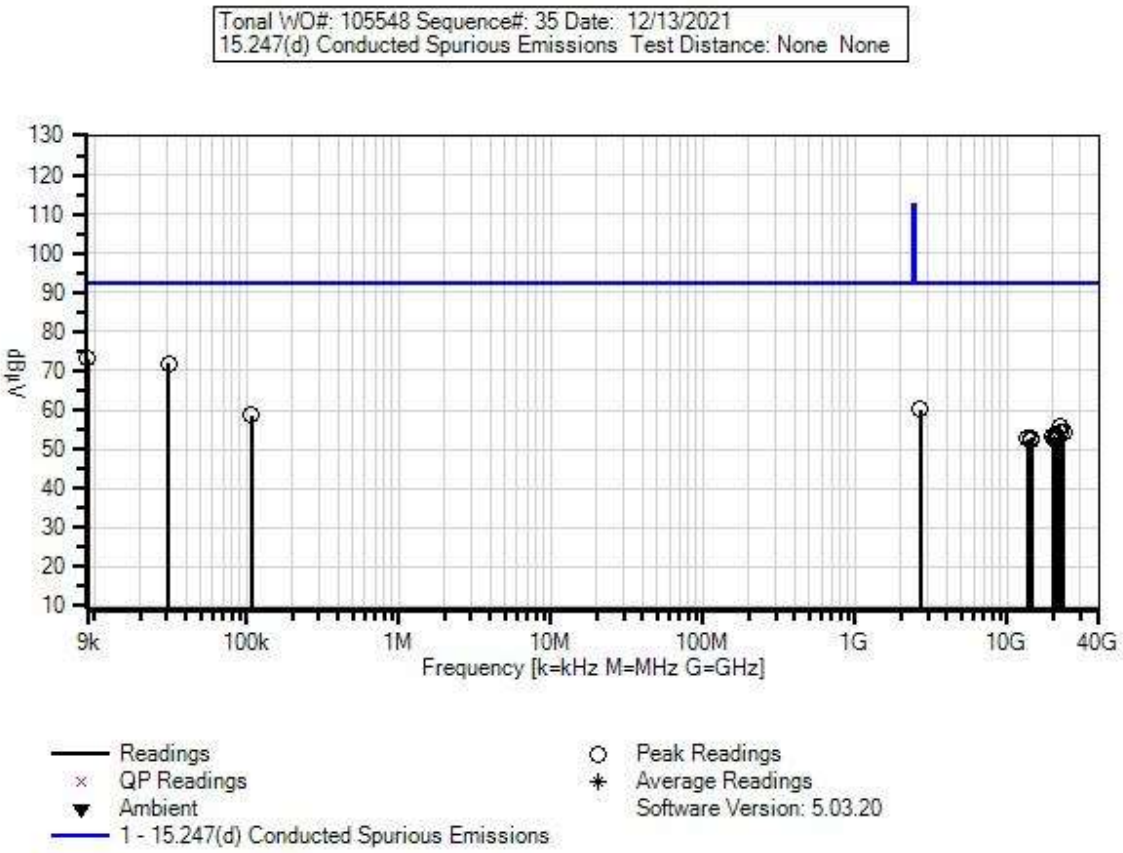
Conducted Spurious Emission
Frequency Range: 9kHz to 25GHz

Environmental Conditions:
Temperature: 21.8ºC
Humidity: 47%
Atmospheric Pressure: 101.5kPa
Highest Generated Frequency: 2.48GHz
Method: ANSI C63.10 2013

The EUT is placed non-conducted table. It is operated as intended. It is connected straight to a Spectrum Analyzer. A laptop is used to send the command to the EUT.

RF output power: PL9

Note:
Middle Channel
4DQPSK



Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	ANP07365	Attenuator	54A-10	5/26/2021	5/26/2023
T2	ANP06904	Cable	32022-29094K-29094K-36TC	1/7/2020	1/7/2022
	AN03471	Spectrum Analyzer	E4440A	2/11/2020	2/11/2022

Measurement Data: Reading listed by margin. Test Distance: None

#	Freq MHz	Rdng dBµV	T1 dB	T2 dB	dB	dB	Dist Table	Corr dBµV	Spec dBµV	Margin dB	Polar Ant
1	9.131k	63.3	+9.7	+0.0			+0.0	73.0	92.4	-19.4	None
2	30.990k	62.1	+9.7	+0.0			+0.0	71.8	92.4	-20.6	None
3	2661.106M	49.4	+9.9	+0.8			+0.0	60.1	92.4	-32.3	None
4	108.010k	49.0	+9.7	+0.0			+0.0	58.7	92.4	-33.7	None
5	22002.993 M	43.3	+10.1	+2.4			+0.0	55.8	92.4	-36.6	None
6	22244.011 M	41.7	+10.1	+2.4			+0.0	54.2	92.4	-38.2	None
7	23187.125 M	41.6	+10.1	+2.5			+0.0	54.2	92.4	-38.2	None
8	23229.042 M	41.6	+10.1	+2.5			+0.0	54.2	92.4	-38.2	None
9	19907.185 M	40.8	+10.0	+2.4			+0.0	53.2	92.4	-39.2	None
10	20808.382 M	40.7	+10.0	+2.4			+0.0	53.1	92.4	-39.3	None
11	14325.184 M	41.1	+10.0	+1.9			+0.0	53.0	92.4	-39.4	None
12	20976.047 M	40.5	+10.0	+2.4			+0.0	52.9	92.4	-39.5	None
13	20504.490 M	40.3	+10.1	+2.4			+0.0	52.8	92.4	-39.6	None
14	13614.222 M	40.8	+10.0	+1.9			+0.0	52.7	92.4	-39.7	None
15	21311.377 M	40.3	+10.0	+2.4			+0.0	52.7	92.4	-39.7	None
16	14397.311 M	40.7	+10.0	+1.9			+0.0	52.6	92.4	-39.8	None
17	14098.501 M	40.6	+10.0	+1.9			+0.0	52.5	92.4	-39.9	None

18	14253.057 M	40.5	+10.0	+1.9		+0.0	52.4	92.4	-40.0	None
19	21154.191 M	40.0	+10.0	+2.4		+0.0	52.4	92.4	-40.0	None

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont CA 94539 • 510-249-1170		
Customer:	**Tonal**		
Specification:	**15.247(d) Conducted Spurious Emissions**		
Work Order #:	**105488**	Date:	12/13/2021
Test Type:	**Conducted Scan**	Time:	10:22:13 AM
Tested By:	Hoang Cao	Sequence#:	36
Software:	EMITest 5.03.20		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 9			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 9			

Test Conditions / Notes:

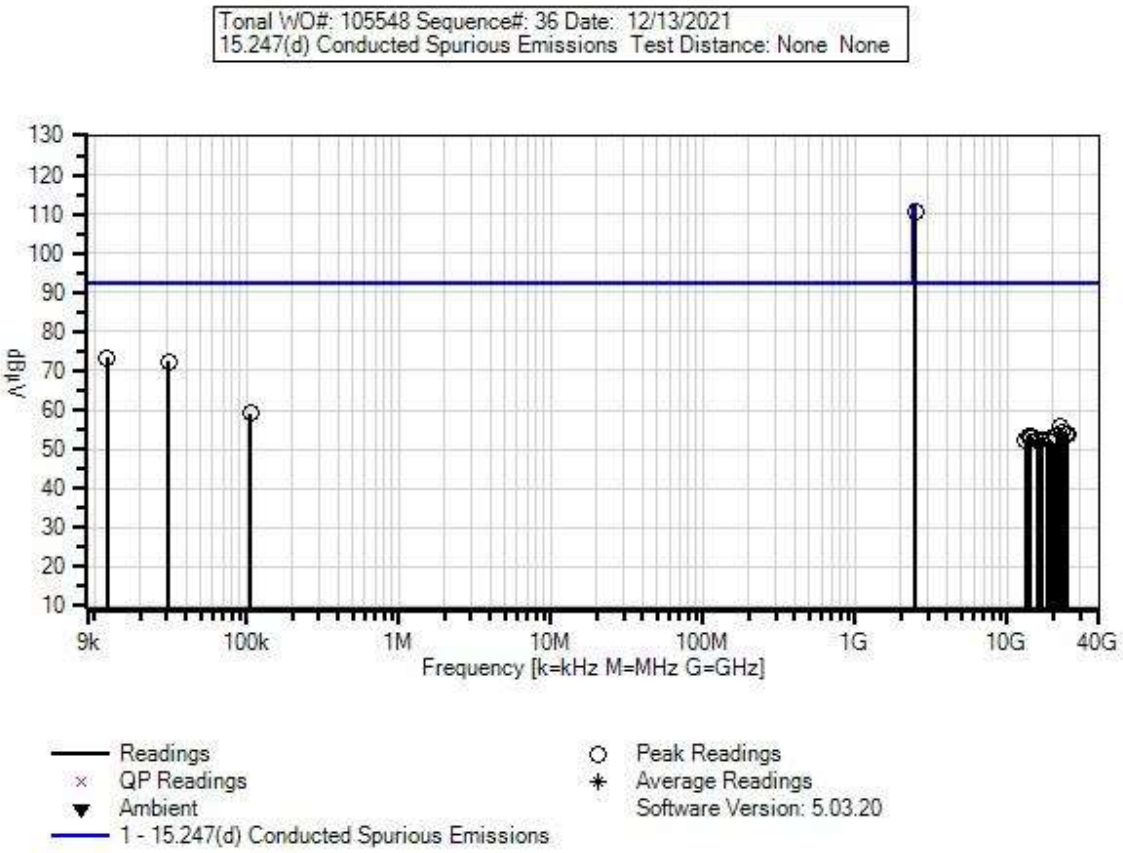
Conducted Spurious Emission
Frequency Range: 9kHz to 25GHz

Environmental Conditions:
Temperature: 21.8ºC
Humidity: 47%
Atmospheric Pressure: 101.5kPa
Highest Generated Frequency: 2.48GHz
Method: ANSI C63.10 2013

The EUT is placed non-conducted table. It is operated as intended. It is connected straight to a Spectrum Analyzer. A laptop is used to send the command to the EUT.

RF output power: PL9

Note:
High Channel
4DQPSK



Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	ANP07365	Attenuator	54A-10	5/26/2021	5/26/2023
T2	ANP06904	Cable	32022-29094K-29094K-36TC	1/7/2020	1/7/2022
	AN03471	Spectrum Analyzer	E4440A	2/11/2020	2/11/2022

Measurement Data: Reading listed by margin. Test Distance: None

#	Freq MHz	Rdng dBµV	T1 dB	T2 dB	dB	dB	Dist Table	Corr dBµV	Spec dBµV	Margin dB	Polar Ant
1	2478.568M	99.7	+9.9	+0.8			+0.0	110.4	112.4	-2.0	None
2	12.253k	63.7	+9.7	+0.0			+0.0	73.4	92.4	-19.0	None
3	30.990k	62.6	+9.7	+0.0			+0.0	72.3	92.4	-20.1	None
4	106.707k	49.5	+9.7	+0.0			+0.0	59.2	92.4	-33.2	None
5	22002.993 M	43.2	+10.1	+2.4			+0.0	55.7	92.4	-36.7	None
6	22830.838 M	41.9	+10.0	+2.5			+0.0	54.4	92.4	-38.0	None
7	24874.251 M	41.2	+10.1	+2.6			+0.0	53.9	92.4	-38.5	None
8	24130.239 M	41.1	+10.1	+2.5			+0.0	53.7	92.4	-38.7	None
9	13830.602 M	41.6	+10.0	+1.9			+0.0	53.5	92.4	-38.9	None
10	20923.652 M	41.1	+10.0	+2.4			+0.0	53.5	92.4	-38.9	None
11	13809.994 M	41.6	+10.0	+1.9			+0.0	53.5	92.4	-38.9	None
12	14222.146 M	41.3	+10.0	+1.9			+0.0	53.2	92.4	-39.2	None
13	21143.712 M	40.7	+10.0	+2.4			+0.0	53.1	92.4	-39.3	None
14	14191.235 M	40.8	+10.0	+1.9			+0.0	52.7	92.4	-39.7	None
15	19068.861 M	40.4	+10.0	+2.3			+0.0	52.7	92.4	-39.7	None
16	15757.483 M	40.3	+10.0	+2.0			+0.0	52.3	92.4	-40.1	None
17	18544.909 M	40.1	+10.0	+2.2			+0.0	52.3	92.4	-40.1	None

18	13222.678 M	40.4	+10.0	+1.8		+0.0	52.2	92.4	-40.2	None
19	16637.723 M	40.0	+10.0	+2.2		+0.0	52.2	92.4	-40.2	None
20	19959.580 M	39.3	+10.1	+2.4		+0.0	51.8	92.4	-40.6	None

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont CA 94539 • 510-249-1170		
Customer:	**Tonal**		
Specification:	**15.247(d) Conducted Spurious Emissions**		
Work Order #:	**105488**	Date:	12/13/2021
Test Type:	**Conducted Scan**	Time:	11:13:18 AM
Tested By:	Hoang Cao	Sequence#:	37
Software:	EMITest 5.03.20		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 9			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 9			

Test Conditions / Notes:

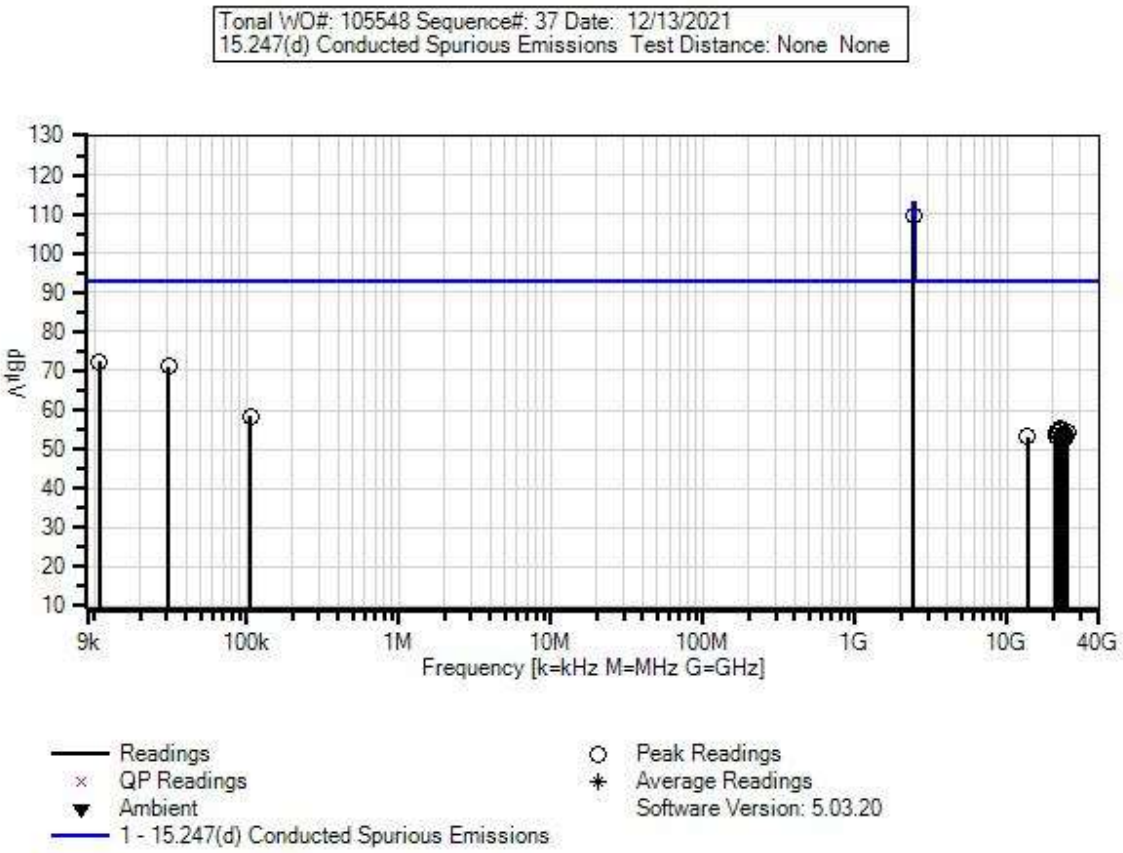
Conducted Spurious Emission
Frequency Range: 9kHz to 25GHz

Environmental Conditions:
Temperature: 21.8ºC
Humidity: 47%
Atmospheric Pressure: 101.5kPa
Highest Generated Frequency: 2.48GHz
Method: ANSI C63.10 2013

The EUT is placed non-conducted table. It is operated as intended. It is connected straight to a Spectrum Analyzer. A laptop is used to send the command to the EUT.

RF output power: PL9

Note:
Low Channel
8DQPSK



Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	ANP07365	Attenuator	54A-10	5/26/2021	5/26/2023
T2	ANP06904	Cable	32022-29094K-29094K-36TC	1/7/2020	1/7/2022
	AN03471	Spectrum Analyzer	E4440A	2/11/2020	2/11/2022

Measurement Data: Reading listed by margin. Test Distance: None

#	Freq MHz	Rdng dBµV	T1 dB	T2 dB	dB	dB	Dist Table	Corr dBµV	Spec dBµV	Margin dB	Polar Ant
1	2400.765M	98.7	+9.9	+0.8			+0.0	109.4	112.7	-3.3	None
2	10.759k	62.6	+9.7	+0.0			+0.0	72.3	92.7	-20.4	None
3	30.990k	61.4	+9.7	+0.0			+0.0	71.1	92.7	-21.6	None
4	106.967k	48.7	+9.7	+0.0			+0.0	58.4	92.7	-34.3	None
5	21992.514 M	42.9	+10.1	+2.4			+0.0	55.4	92.7	-37.3	None
6	22170.658 M	42.9	+10.1	+2.4			+0.0	55.4	92.7	-37.3	None
7	22097.305 M	42.8	+10.1	+2.4			+0.0	55.3	92.7	-37.4	None
8	21887.724 M	42.5	+10.1	+2.4			+0.0	55.0	92.7	-37.7	None
9	21709.580 M	42.0	+10.0	+2.4			+0.0	54.4	92.7	-38.3	None
10	24821.856 M	41.7	+10.1	+2.6			+0.0	54.4	92.7	-38.3	None
11	21133.233 M	42.0	+10.0	+2.4			+0.0	54.4	92.7	-38.3	None
12	22684.131 M	41.5	+10.0	+2.4			+0.0	53.9	92.7	-38.8	None
13	23585.329 M	41.1	+10.1	+2.5			+0.0	53.7	92.7	-39.0	None
14	22747.006 M	41.0	+10.0	+2.4			+0.0	53.4	92.7	-39.3	None
15	13603.919 M	41.4	+10.0	+1.9			+0.0	53.3	92.7	-39.4	None
16	20766.466 M	40.8	+10.0	+2.4			+0.0	53.2	92.7	-39.5	None
17	24444.611 M	40.6	+10.1	+2.5			+0.0	53.2	92.7	-39.5	None

18	23700.599 M	40.5	+10.1	+2.5		+0.0	53.1	92.7	-39.6	None
19	23920.658 M	40.5	+10.1	+2.5		+0.0	53.1	92.7	-39.6	None
20	23616.766 M	40.4	+10.1	+2.5		+0.0	53.0	92.7	-39.7	None

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont CA 94539 • 510-249-1170		
Customer:	**Tonal**		
Specification:	**15.247(d) Conducted Spurious Emissions**		
Work Order #:	**105488**	Date:	12/13/2021
Test Type:	**Conducted Scan**	Time:	11:21:41 AM
Tested By:	Hoang Cao	Sequence#:	38
Software:	EMITest 5.03.20		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 9			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 9			

Test Conditions / Notes:

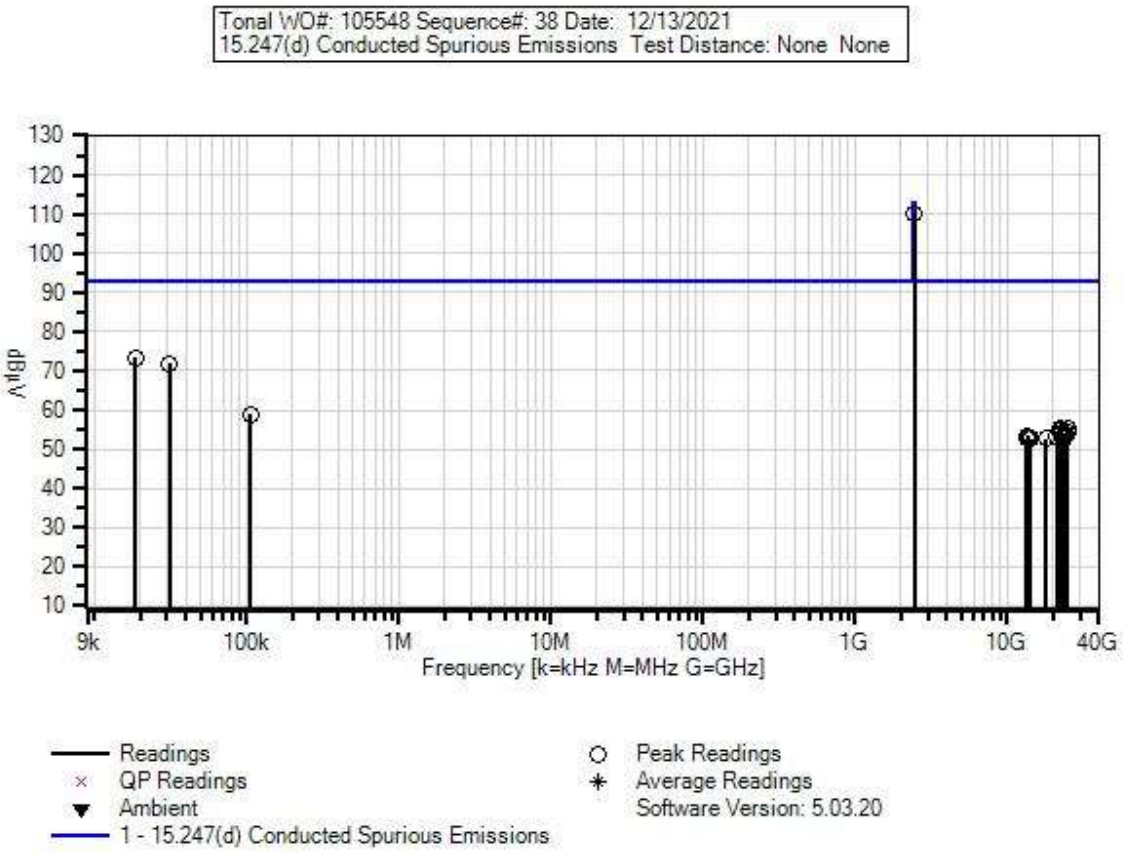
Conducted Spurious Emission
Frequency Range: 9kHz to 25GHz

Environmental Conditions:
Temperature: 21.8ºC
Humidity: 47%
Atmospheric Pressure: 101.5kPa
Highest Generated Frequency: 2.48GHz
Method: ANSI C63.10 2013

The EUT is placed non-conducted table. It is operated as intended. It is connected straight to a Spectrum Analyzer. A laptop is used to send the command to the EUT.

RF output power: PL9

Note:
Middle Channel
8DQPSK



Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	ANP07365	Attenuator	54A-10	5/26/2021	5/26/2023
T2	ANP06904	Cable	32022-29094K-29094K-36TC	1/7/2020	1/7/2022
	AN03471	Spectrum Analyzer	E4440A	2/11/2020	2/11/2022

Measurement Data: Reading listed by margin. Test Distance: None

#	Freq MHz	Rdng dBµV	T1 dB	T2 dB	dB	dB	Dist Table	Corr dBµV	Spec dBµV	Margin dB	Polar Ant
1	2442.659M	99.5	+9.9	+0.8			+0.0	110.2	112.7	-2.5	None
2	18.587k	63.6	+9.7	+0.0			+0.0	73.3	92.7	-19.4	None
3	31.368k	62.2	+9.7	+0.0			+0.0	71.9	92.7	-20.8	None
4	106.967k	49.3	+9.7	+0.0			+0.0	59.0	92.7	-33.7	None
5	21961.077 M	43.0	+10.1	+2.4			+0.0	55.5	92.7	-37.2	None
6	24853.293 M	42.6	+10.1	+2.6			+0.0	55.3	92.7	-37.4	None
7	22223.053 M	42.1	+10.1	+2.4			+0.0	54.6	92.7	-38.1	None
8	24706.587 M	41.8	+10.1	+2.6			+0.0	54.5	92.7	-38.2	None
9	22788.922 M	41.9	+10.0	+2.4			+0.0	54.3	92.7	-38.4	None
10	23878.742 M	41.4	+10.1	+2.5			+0.0	54.0	92.7	-38.7	None
11	23794.910 M	41.2	+10.1	+2.5			+0.0	53.8	92.7	-38.9	None
12	24497.006 M	41.2	+10.1	+2.5			+0.0	53.8	92.7	-38.9	None
13	13624.526 M	41.6	+10.0	+1.9			+0.0	53.5	92.7	-39.2	None
14	20923.652 M	40.9	+10.0	+2.4			+0.0	53.3	92.7	-39.4	None
15	23564.371 M	40.6	+10.1	+2.5			+0.0	53.2	92.7	-39.5	None
16	23417.664 M	40.3	+10.1	+2.5			+0.0	52.9	92.7	-39.8	None
17	13325.716 M	41.0	+10.0	+1.8			+0.0	52.8	92.7	-39.9	None

18	14232.450 M	40.9	+10.0	+1.9		+0.0	52.8	92.7	-39.9	None
19	13923.336 M	40.8	+10.0	+1.9		+0.0	52.7	92.7	-40.0	None
20	17853.292 M	40.5	+10.0	+2.1		+0.0	52.6	92.7	-40.1	None

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont CA 94539 • 510-249-1170		
Customer:	**Tonal**		
Specification:	**15.247(d) Conducted Spurious Emissions**		
Work Order #:	**105488**	Date:	12/13/2021
Test Type:	**Conducted Scan**	Time:	11:28:50 AM
Tested By:	Hoang Cao	Sequence#:	39
Software:	EMITest 5.03.20		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 9			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 9			

Test Conditions / Notes:

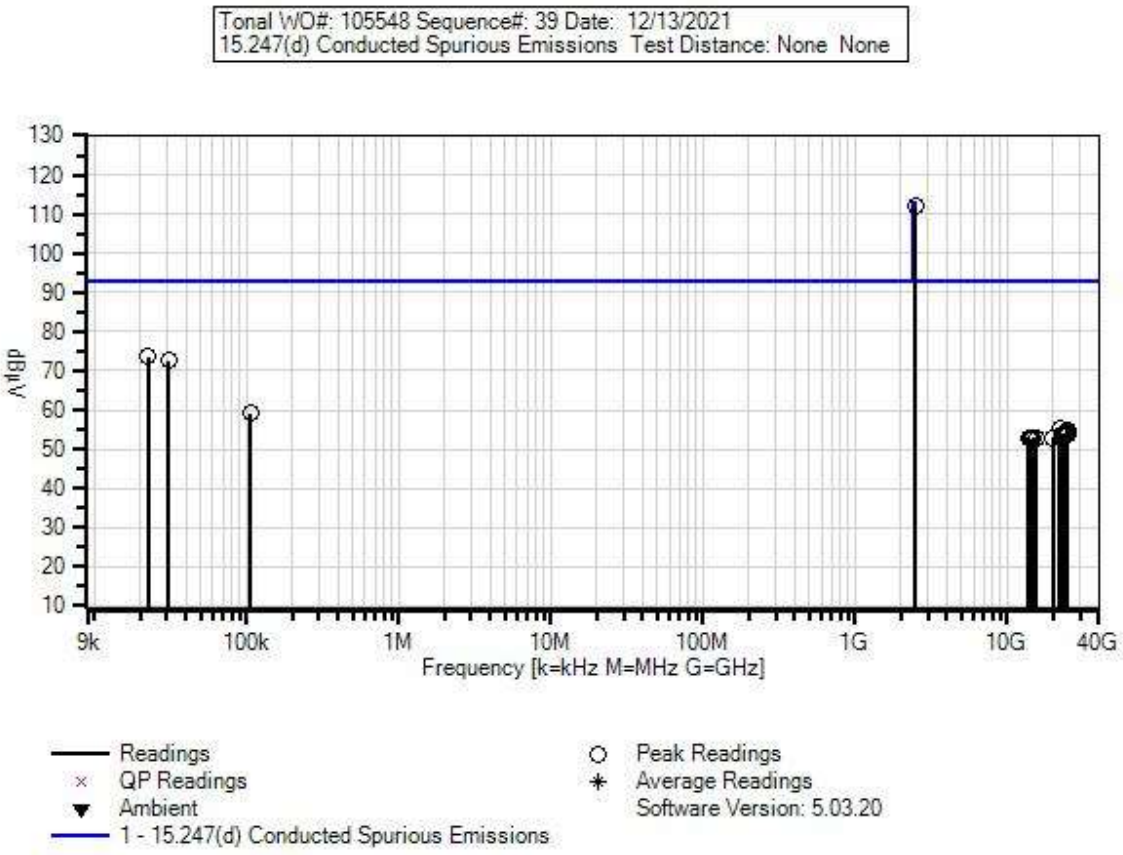
Conducted Spurious Emission
Frequency Range: 9kHz to 25GHz

Environmental Conditions:
Temperature: 21.8ºC
Humidity: 47%
Atmospheric Pressure: 101.5kPa
Highest Generated Frequency: 2.48GHz
Method: ANSI C63.10 2013

The EUT is placed non-conducted table. It is operated as intended. It is connected straight to a Spectrum Analyzer. A laptop is used to send the command to the EUT.

RF output power: PL9

Note:
High Channel
8DQPSK



Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	ANP07365	Attenuator	54A-10	5/26/2021	5/26/2023
T2	ANP06904	Cable	32022-29094K-29094K-36TC	1/7/2020	1/7/2022
	AN03471	Spectrum Analyzer	E4440A	2/11/2020	2/11/2022

Measurement Data: Reading listed by margin. Test Distance: None

#	Freq MHz	Rdng dBµV	T1 dB	T2 dB	dB	dB	Dist Table	Corr dBµV	Spec dBµV	Margin dB	Polar Ant
1	2478.568M	101.3	+9.9	+0.8			+0.0	112.0	112.7	-0.7	None
2	22.568k	63.8	+9.7	+0.0			+0.0	73.5	92.7	-19.2	None
3	30.990k	62.9	+9.7	+0.0			+0.0	72.6	92.7	-20.1	None
4	106.707k	49.4	+9.7	+0.0			+0.0	59.1	92.7	-33.6	None

5	22044.910 M	42.8	+10.1	+2.4		+0.0	55.3	92.7	-37.4	None
6	24717.066 M	42.2	+10.1	+2.6		+0.0	54.9	92.7	-37.8	None
7	24832.335 M	41.7	+10.1	+2.6		+0.0	54.4	92.7	-38.3	None
8	24895.210 M	41.4	+10.1	+2.6		+0.0	54.1	92.7	-38.6	None
9	24947.605 M	41.1	+10.1	+2.6		+0.0	53.8	92.7	-38.9	None
10	23459.581 M	41.1	+10.1	+2.5		+0.0	53.7	92.7	-39.0	None
11	23071.856 M	41.2	+10.0	+2.5		+0.0	53.7	92.7	-39.0	None
12	23281.437 M	41.1	+10.1	+2.5		+0.0	53.7	92.7	-39.0	None
13	24538.922 M	41.0	+10.1	+2.5		+0.0	53.6	92.7	-39.1	None
14	23092.814 M	40.7	+10.0	+2.5		+0.0	53.2	92.7	-39.5	None
15	13686.349 M	41.1	+10.0	+1.9		+0.0	53.0	92.7	-39.7	None
16	19854.789 M	40.6	+10.0	+2.4		+0.0	53.0	92.7	-39.7	None
17	14845.806 M	41.0	+10.0	+1.9		+0.0	52.9	92.7	-39.8	None
18	15558.381 M	40.9	+10.0	+2.0		+0.0	52.9	92.7	-39.8	None
19	13995.463 M	40.9	+10.0	+1.9		+0.0	52.8	92.7	-39.9	None
20	14170.627 M	40.9	+10.0	+1.9		+0.0	52.8	92.7	-39.9	None

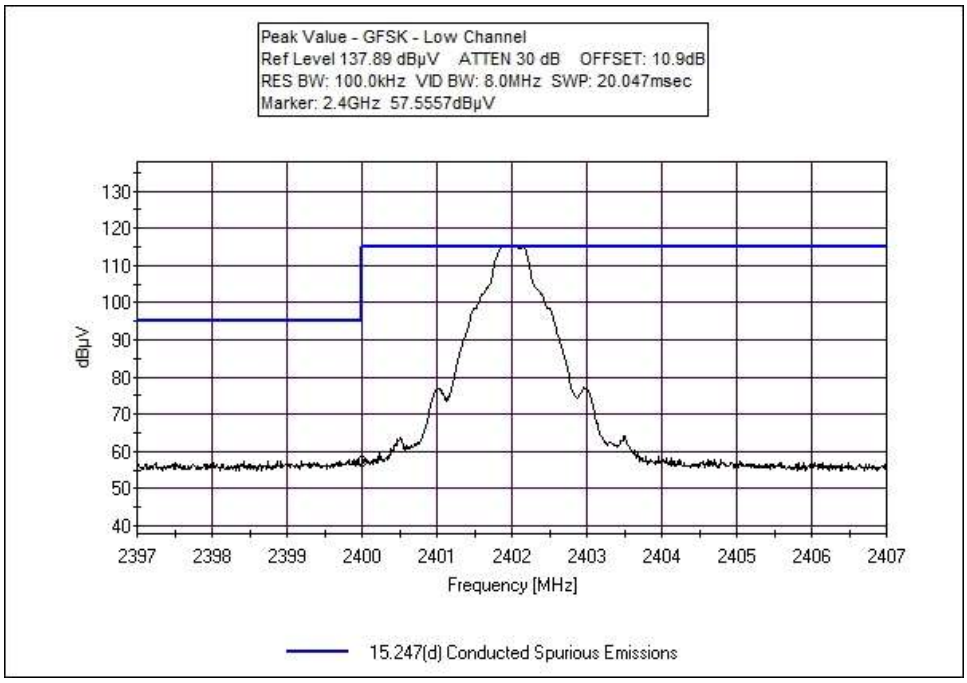
Band Edge

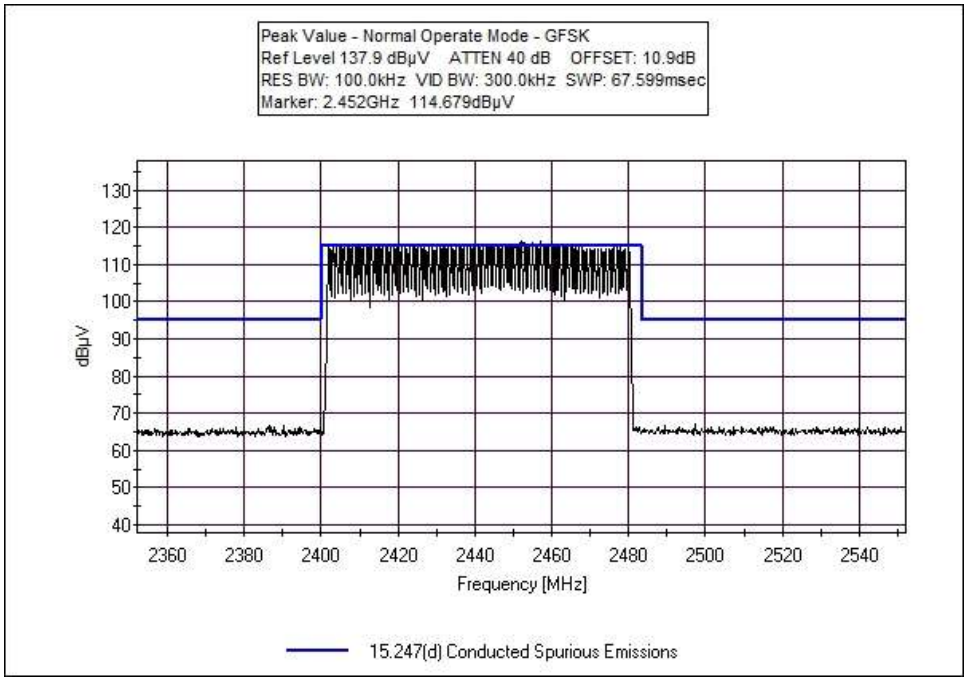
Band Edge Summary, GFSK				
Limit applied: Max Power/100kHz - 20dB. Operating Mode: Hopping				
Frequency (MHz)	**Modulation**	**Measured (dBm)**	**Limit (dBm)**	**Results**
2400	GFSK	57.5557	<95.10	Pass
2483.5	GFSK	54.7847	<95.10	Pass

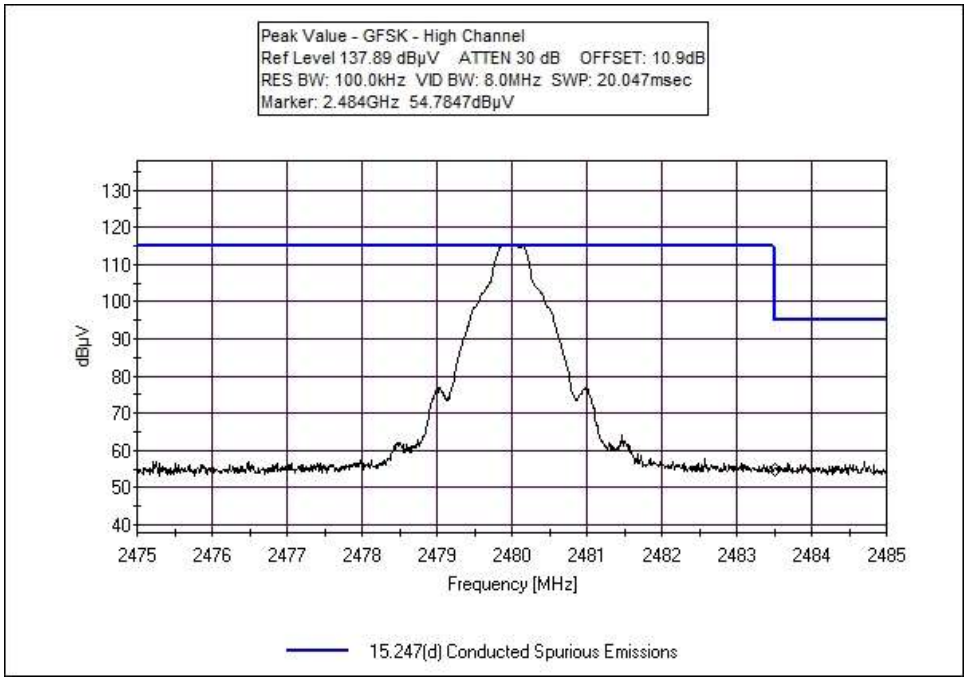
Band Edge Summary, 4-DQPSK				
Limit applied: Max Power/100kHz - 20dB. Operating Mode: Hopping				
Frequency (MHz)	**Modulation**	**Measured (dBm)**	**Limit (dBm)**	**Results**
2400	π/4-DQPSK	64.9537	<92.38	Pass
2483.5	π/4-DQPSK	64.3317	<92.38	Pass

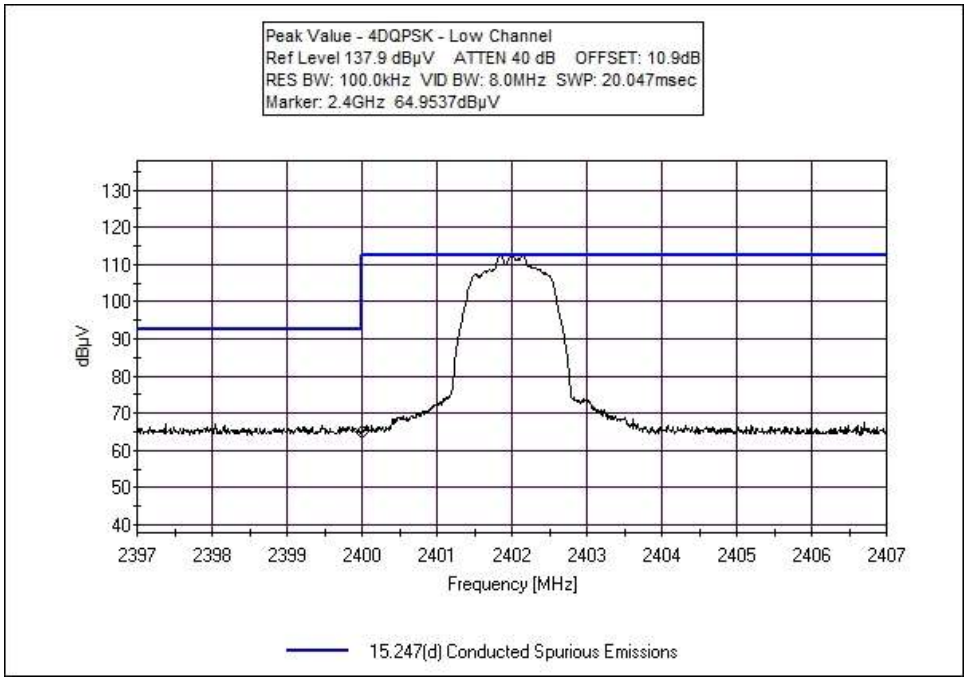
Band Edge Summary, 8-DQPSK				
Limit applied: Max Power/100kHz - 20dB. Operating Mode: Hopping				
Frequency (MHz)	**Modulation**	**Measured (dBm)**	**Limit (dBm)**	**Results**
2400	8-DQPSK	65.6137	<92.70	Pass
2483.5	8-DQPSK	64.0377	<92.70	Pass

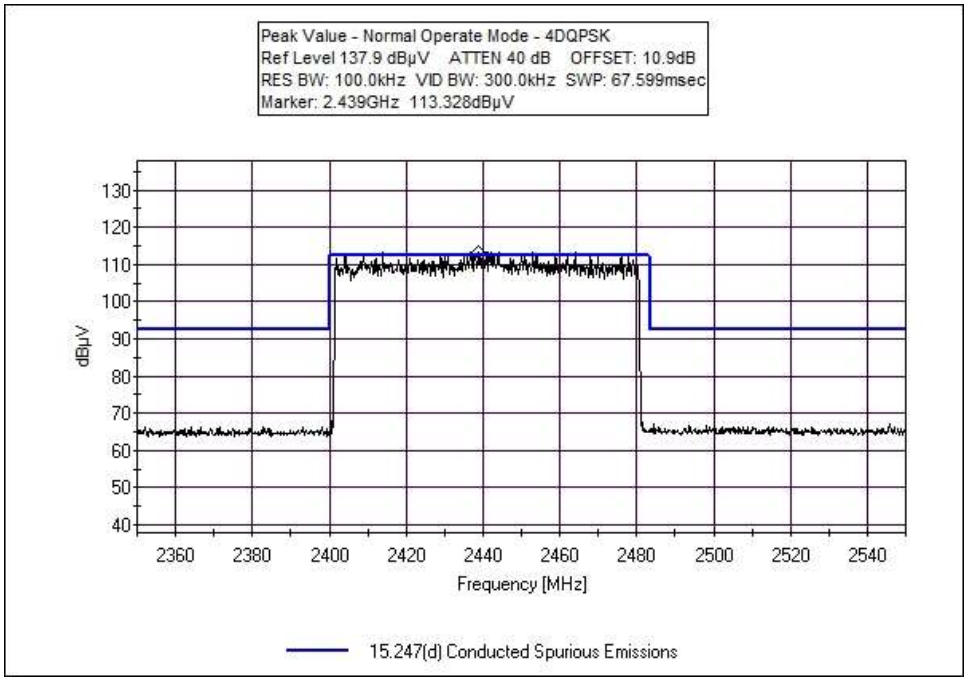
Band Edge Plots

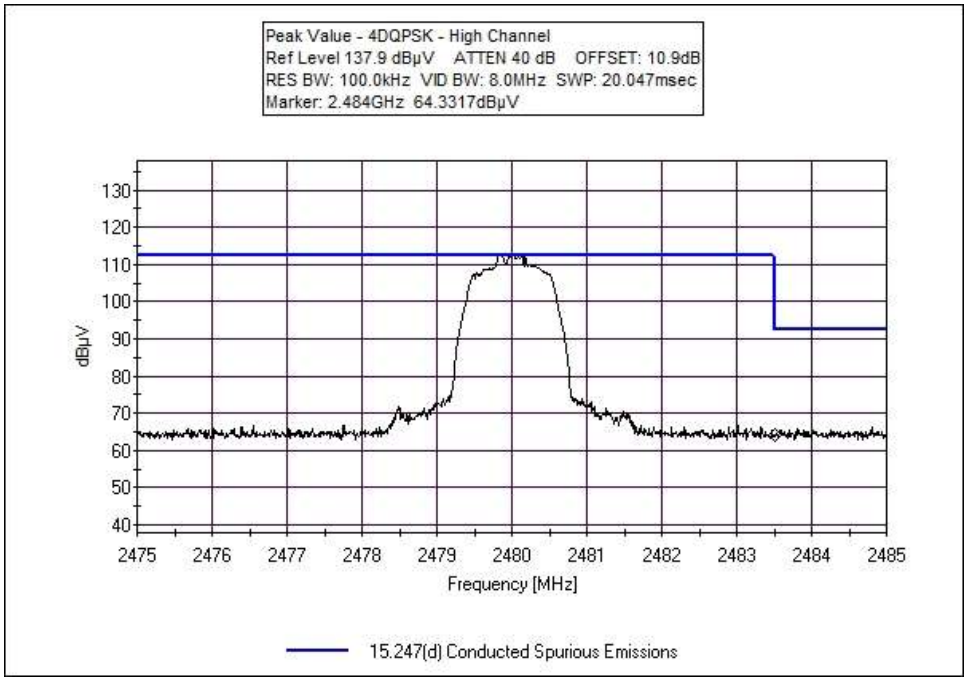


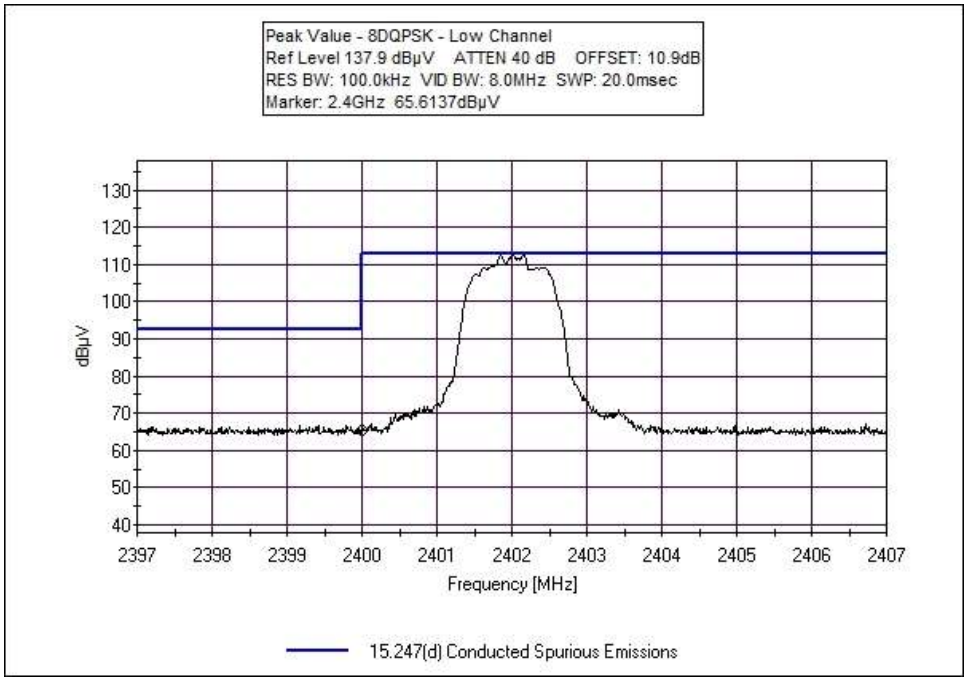


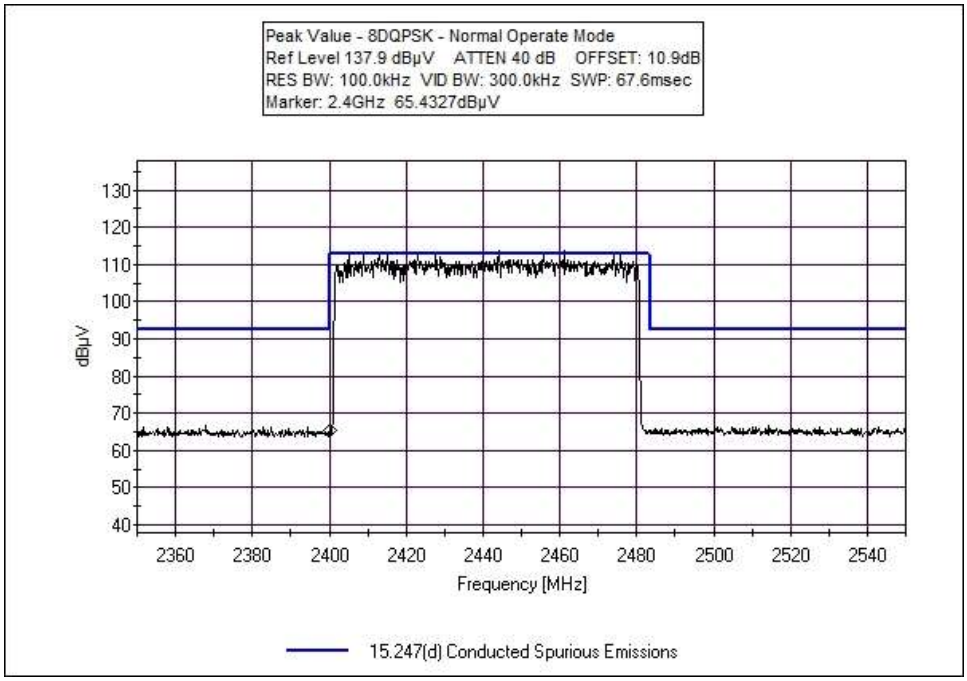

Peak Value - GFSK - High Channel
Ref Level 137.89 dBµV ATTEN 30 dB OFFSET: 10.9dB
RES BW: 100.0kHz VID BW: 8.0MHz SWP: 20.047msec
Marker: 2.484GHz 54.7847dBµV
dBµV
130
120
110
100
90
80
70
60
50
40
2475 2476 2477 2478 2479 2480 2481 2482 2483 2484 2485
Frequency [MHz]
15.247(d) Conducted Spurious Emissions

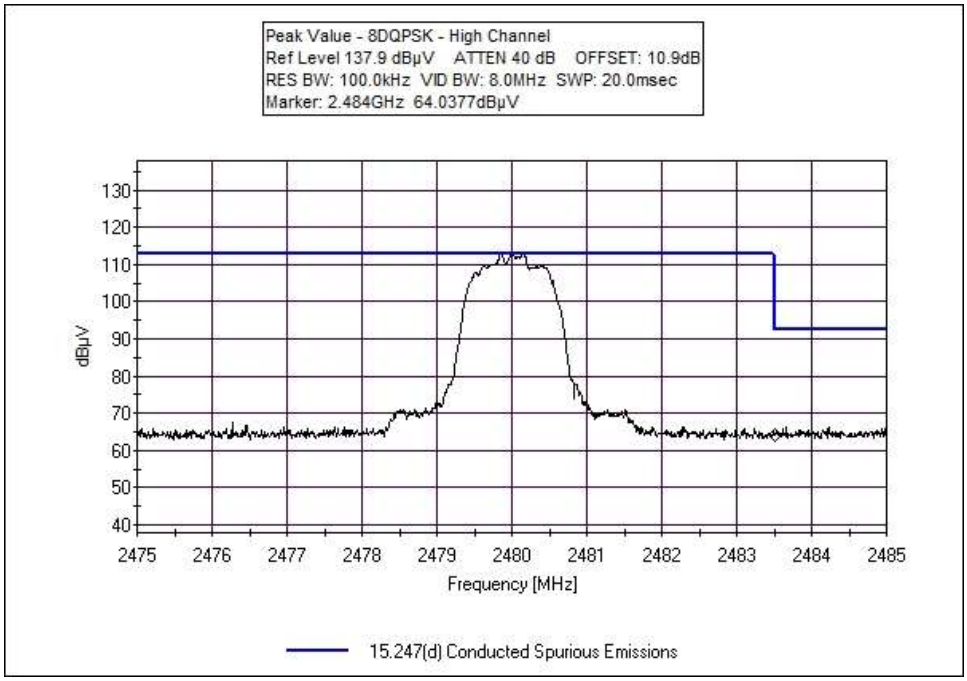

Peak Value - 4DQPSK - Low Channel
Ref Level 137.9 dBµV ATTEN 40 dB OFFSET: 10.9dB
RES BW: 100.0kHz VID BW: 8.0MHz SWP: 20.047msec
Marker: 2.4GHz 64.9537dBµV
dBµV
130
120
110
100
90
80
70
60
50
40
2397 2398 2399 2400 2401 2402 2403 2404 2405 2406 2407
Frequency [MHz]
15.247(d) Conducted Spurious Emissions


Peak Value - Normal Operate Mode - 4DQPSK
Ref Level 137.9 dBµV ATTEN 40 dB OFFSET: 10.9dB
RES BW: 100.0kHz VID BW: 300.0kHz SWP: 67.599msec
Marker: 2.439GHz 113.328dBµV
dBµV
130
120
110
100
90
80
70
60
50
40
2360
2380
2400
2420
2440
2460
2480
2500
2520
2540
Frequency [MHz]
15.247(d) Conducted Spurious Emissions


Peak Value - 4DQPSK - High Channel
Ref Level 137.9 dBµV ATTEN 40 dB OFFSET: 10.9dB
RES BW: 100.0kHz VID BW: 8.0MHz SWP: 20.047msec
Marker: 2.484GHz 64.3317dBµV
dBµV
130
120
110
100
90
80
70
60
50
40
2475
2476
2477
2478
2479
2480
2481
2482
2483
2484
2485
Frequency [MHz]
15.247(d) Conducted Spurious Emissions


Peak Value - 8DQPSK - Low Channel
Ref Level 137.9 dBµV ATTEN 40 dB OFFSET: 10.9dB
RES BW: 100.0kHz VID BW: 8.0MHz SWP: 20.0msec
Marker: 2.4GHz 65.6137dBµV
dBµV
130
120
110
100
90
80
70
60
50
40
2397
2398
2399
2400
2401
2402
2403
2404
2405
2406
2407
Frequency [MHz]
15.247(d) Conducted Spurious Emissions


Peak Value - 8DQPSK - Normal Operate Mode
Ref Level 137.9 dBµV ATTEN 40 dB OFFSET: 10.9dB
RES BW: 100.0kHz VID BW: 300.0kHz SWP: 67.6msec
Marker: 2.4GHz 65.4327dBµV
dBµV
130
120
110
100
90
80
70
60
50
40
2360
2380
2400
2420
2440
2460
2480
2500
2520
2540
Frequency [MHz]
15.247(d) Conducted Spurious Emissions


Peak Value - 8DQPSK - High Channel
Ref Level 137.9 dBµV ATTEN 40 dB OFFSET: 10.9dB
RES BW: 100.0kHz VID BW: 8.0MHz SWP: 20.0msec
Marker: 2.484GHz 64.0377dBµV
dBµV
130
120
110
100
90
80
70
60
50
40
2475
2476
2477
2478
2479
2480
2481
2482
2483
2484
2485
Frequency [MHz]
15.247(d) Conducted Spurious Emissions

15.247(d) Radiated Emissions & Band Edge

Test Setup / Conditions / Data

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont CA 94539 • 510-249-1170		
Customer:	**Tonal**		
Specification:	**15.209 Radiated Emissions**		
Work Order #:	**105488**	Date:	12/19/2021
Test Type:	**Radiated Scan**	Time:	11:54:28 AM
Tested By:	Randy Clark	Sequence#:	74
Software:	EMITest 5.03.20		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 2			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 2			

Test Conditions / Notes:

Radiated Emission
Frequency Range: 9kHz to 1GHz

Environmental Conditions:
Temperature: 18.7ºC
Humidity: 36%
Atmospheric Pressure: 101.9kPa

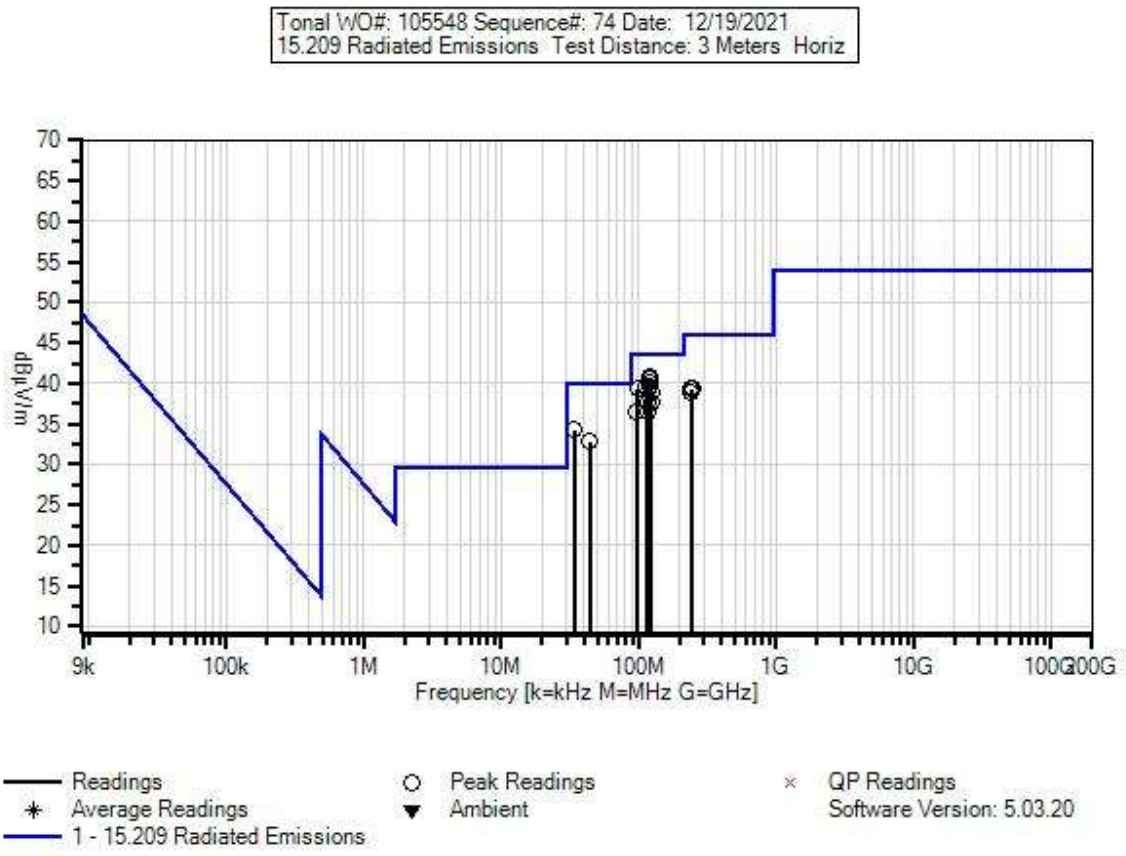
Method: ANSI C63.10 2013

The unit is mounted to a floor standing rack as to simulate typical wall mounted setup. One weight line is extended to the floor.
BT is set to 2442 MHz with 8DQPSK modulation type, at power level 9 (+9dBm) with repeating 0s and 1s with 100% duty cycle.
Operational mode is representative of worst case.

Notes:
Touch screen display: Direct bond 2312
Power Supply: Artesyn
Display is showing home screen

Modifications #1, #2, #3 #4, #5 and #6 were in place during testing

Support laptop included in this setup to control Bluetooth operating mode; port is internal to the equipment for configuration only.
Unintentional emissions related to display and display controller increased due to external cable to laptop.
No emissions from EUT has been found in 20dB tolerance in the frequency range 9kHz to 30MHz.



Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	ANP07508	Preamp	310N	7/9/2020	7/9/2022
T2	AN00852	Biconilog Antenna	CBL 6111C	4/14/2020	4/14/2022
T3	ANP06049	Attenuator	PE7002-6	5/11/2020	5/11/2022
T4	ANP01187	Cable	CNT-195	7/6/2020	7/6/2022
T5	ANP06691	Cable	PE3062-180	3/25/2020	3/25/2022
T6	ANP06694	Cable	PE3062-480	3/25/2020	3/25/2022
	AN02660	Spectrum Analyzer	E4446A	12/4/2020	12/4/2022
	AN00432	Loop Antenna	6502	7/19/2021	7/19/2023

Measurement Data: Reading listed by margin. Test Distance: 3 Meters

#	Freq	Rdng	T1 T5	T2 T6	T3	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV/m	dBµV/m	dB	Ant
1	119.612M	53.6	-32.0 +0.3	+11.9 +1.0	+5.9	+0.1	+0.0	40.8	43.5	-2.7	Horiz
2	119.972M	53.5	-32.0 +0.3	+11.9 +1.0	+5.9	+0.1	+0.0	40.7	43.5	-2.8	Horiz
3	122.134M	52.9	-32.0 +0.3	+11.9 +1.0	+5.9	+0.1	+0.0	40.1	43.5	-3.4	Horiz
4	114.086M	53.0	-32.0 +0.3	+11.5 +0.9	+5.9	+0.1	+0.0	39.7	43.5	-3.8	Horiz
5	120.693M	52.5	-32.0 +0.3	+11.9 +1.0	+5.9	+0.1	+0.0	39.7	43.5	-3.8	Horiz
6	121.534M	52.3	-32.0 +0.3	+11.9 +1.0	+5.9	+0.1	+0.0	39.5	43.5	-4.0	Horiz
7	98.110M	54.0	-32.0 +0.3	+10.2 +0.8	+5.9	+0.1	+0.0	39.3	43.5	-4.2	Horiz
8	122.735M	51.7	-32.0 +0.3	+11.9 +1.0	+5.9	+0.1	+0.0	38.9	43.5	-4.6	Horiz
9	34.059M	42.9	-32.1 +0.2	+17.0 +0.4	+5.9	+0.0	+0.0	34.3	40.0	-5.7	Horiz
10	123.696M	50.5	-32.0 +0.3	+11.9 +1.0	+5.9	+0.1	+0.0	37.7	43.5	-5.8	Horiz
11	118.411M	50.6	-32.0 +0.3	+11.8 +1.0	+5.9	+0.1	+0.0	37.7	43.5	-5.8	Horiz
12	124.297M	50.3	-32.0 +0.4	+11.9 +1.0	+5.9	+0.1	+0.0	37.6	43.5	-5.9	Horiz
13	240.092M	50.9	-31.9 +0.6	+12.0 +1.4	+6.0	+0.3	+0.0	39.3	46.0	-6.7	Horiz
14	242.735M	50.7	-31.9 +0.6	+12.2 +1.4	+6.0	+0.3	+0.0	39.3	46.0	-6.7	Horiz
15	243.696M	50.7	-31.9 +0.6	+12.2 +1.4	+6.0	+0.3	+0.0	39.3	46.0	-6.7	Horiz
16	96.416M	51.4	-32.0 +0.3	+10.0 +0.8	+5.9	+0.1	+0.0	36.5	43.5	-7.0	Horiz
17	117.810M	49.5	-32.0 +0.3	+11.7 +1.0	+5.9	+0.1	+0.0	36.5	43.5	-7.0	Horiz
18	242.134M	50.4	-31.9 +0.6	+12.1 +1.4	+6.0	+0.3	+0.0	38.9	46.0	-7.1	Horiz
19	43.842M	46.7	-32.1 +0.2	+11.6 +0.5	+5.9	+0.0	+0.0	32.8	40.0	-7.2	Horiz

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont CA 94539 • 510-249-1170		
Customer:	**Tonal**		
Specification:	**15.209 Radiated Emissions**		
Work Order #:	**105488**	Date:	12/19/2021
Test Type:	**Radiated Scan**	Time:	12:12:08 PM
Tested By:	Randy Clark	Sequence#:	75
Software:	EMITest 5.03.20		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 2			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 2			

Test Conditions / Notes:

Radiated Emission
Frequency Range: 9kHz to 1GHz

Environmental Conditions:
Temperature: 18.7ºC
Humidity: 36%
Atmospheric Pressure: 101.9kPa

Method: ANSI C63.10 2013

The unit is mounted to a floor standing rack as to simulate typical wall mounted setup. One weight line is extended to the floor.
BT is set to 2442 MHz with 8DQPSK modulation type, at power level 9 (+9dBm) with repeating 0s and 1s with 100% duty cycle.
Operational mode is representative of worst case.

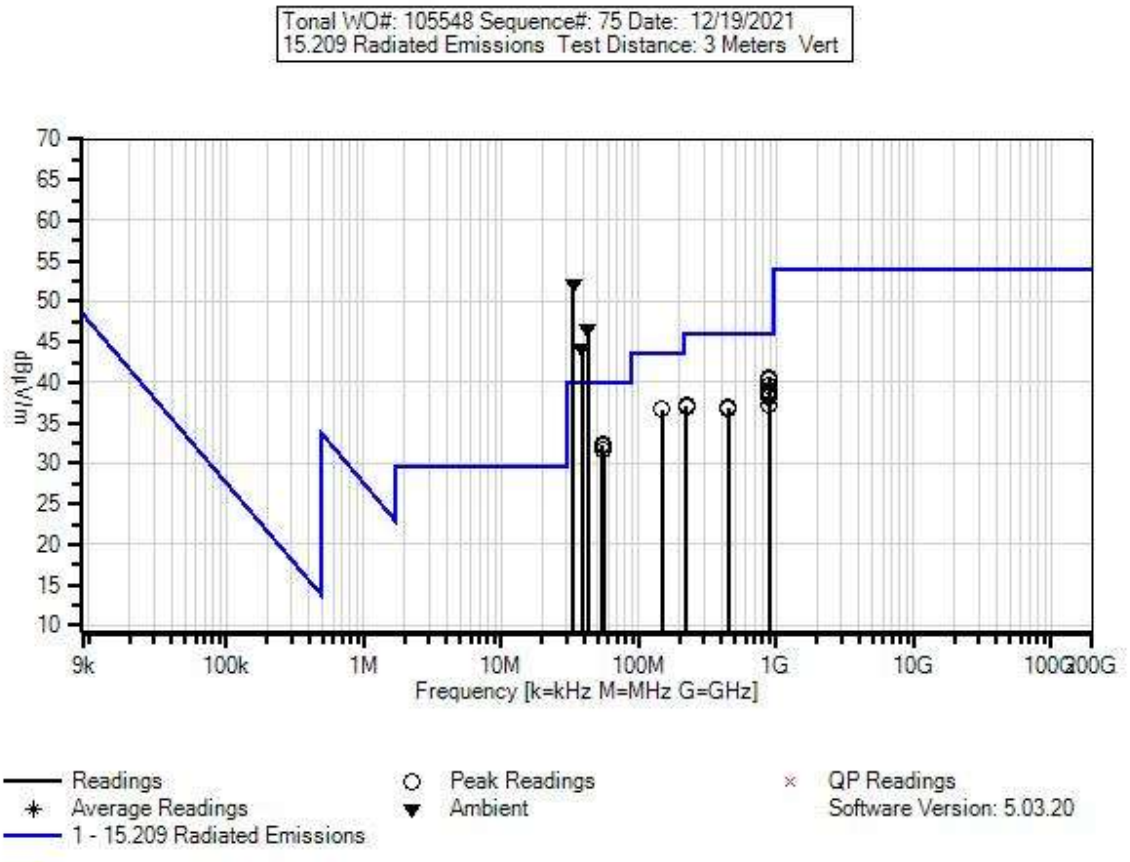
Measurements marked as Support equipment have been evaluated with radios turned off and determined not to be radio emissions. Indicated emissions are ignored for the purposes of this report.

Notes:
Touch screen display: Direct bond 2312
Power Supply: Artesyn
Display is showing home screen

Modifications #1, #2, #3 #4, #5 and #6 were in place during testing

Support laptop included in this setup to control Bluetooth operating mode; port is internal to the equipment for configuration only.
Unintentional emissions related to display and display controller increased due to external cable to laptop.

No emissions from EUT has been found in 20dB tolerance in the frequency range 9kHz to 30MHz.



Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	ANP07508	Preamp	310N	7/9/2020	7/9/2022
T2	AN00852	Biconilog Antenna	CBL 6111C	4/14/2020	4/14/2022
T3	ANP06049	Attenuator	PE7002-6	5/11/2020	5/11/2022
T4	ANP01187	Cable	CNT-195	7/6/2020	7/6/2022
T5	ANP06691	Cable	PE3062-180	3/25/2020	3/25/2022
T6	ANP06694	Cable	PE3062-480	3/25/2020	3/25/2022
	AN02660	Spectrum Analyzer	E4446A	12/4/2020	12/4/2022
	AN00432	Loop Antenna	6502	7/19/2021	7/19/2023

Measurement Data: Reading listed by margin. Test Distance: 3 Meters

#	Freq	Rdng	T1 T5	T2 T6	T3	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV/m	dBµV/m	dB	Ant
1	33.327M	60.5	-32.1	+17.3	+5.9	+0.0	+0.0	52.2	40.0	+12.2	Vert
	Ambient		+0.2	+0.4					Support Laptop Related		
2	42.910M	59.9	-32.1	+12.1	+5.9	+0.0	+0.0	46.5	40.0	+6.5	Vert
	Ambient		+0.2	+0.5					Support Laptop Related		
3	38.918M	55.5	-32.1	+14.1	+5.9	+0.0	+0.0	44.1	40.0	+4.1	Vert
	Ambient		+0.2	+0.5					Support Laptop Related		
4	896.668M	37.8	-31.4	+23.2	+5.9	+0.7	+0.0	40.6	46.0	-5.4	Vert
			+1.2	+3.2							
5	893.305M	37.7	-31.4	+23.2	+5.9	+0.7	+0.0	40.5	46.0	-5.5	Vert
			+1.2	+3.2							
6	888.860M	37.7	-31.4	+23.1	+5.9	+0.7	+0.0	40.4	46.0	-5.6	Vert
			+1.2	+3.2							
7	885.017M	37.0	-31.4	+23.1	+5.9	+0.7	+0.0	39.7	46.0	-6.3	Vert
			+1.2	+3.2							
8	147.600M	49.6	-32.0	+11.5	+5.9	+0.2	+0.0	36.7	43.5	-6.8	Vert
			+0.4	+1.1							
9	896.188M	36.0	-31.4	+23.2	+5.9	+0.7	+0.0	38.8	46.0	-7.2	Vert
			+1.2	+3.2							
10	892.584M	35.8	-31.4	+23.2	+5.9	+0.7	+0.0	38.6	46.0	-7.4	Vert
			+1.2	+3.2							
11	887.899M	35.8	-31.4	+23.1	+5.9	+0.7	+0.0	38.5	46.0	-7.5	Vert
			+1.2	+3.2							
12	54.956M	49.9	-32.1	+7.7	+5.9	+0.1	+0.0	32.3	40.0	-7.7	Vert
			+0.2	+0.6							
13	888.260M	35.5	-31.4	+23.1	+5.9	+0.7	+0.0	38.2	46.0	-7.8	Vert
			+1.2	+3.2							
14	54.224M	49.5	-32.1	+7.9	+5.9	+0.1	+0.0	32.1	40.0	-7.9	Vert
			+0.2	+0.6							
15	55.555M	49.3	-32.1	+7.6	+5.9	+0.1	+0.0	31.6	40.0	-8.4	Vert
			+0.2	+0.6							
16	224.236M	50.1	-31.9	+10.9	+5.9	+0.3	+0.0	37.2	46.0	-8.8	Vert
			+0.5	+1.4							
17	889.821M	34.4	-31.4	+23.1	+5.9	+0.7	+0.0	37.1	46.0	-8.9	Vert
			+1.2	+3.2							
18	222.194M	49.9	-31.9	+10.8	+5.9	+0.3	+0.0	36.9	46.0	-9.1	Vert
			+0.5	+1.4							
19	446.579M	42.6	-31.9	+16.9	+5.9	+0.5	+0.0	36.9	46.0	-9.1	Vert
			+0.8	+2.1							
20	448.621M	42.4	-31.9	+17.0	+5.9	+0.5	+0.0	36.8	46.0	-9.2	Vert
			+0.8	+2.1							

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont CA 94539 • 510-249-1170		
Customer:	**Tonal**		
Specification:	**15.247(d) / 15.209 Radiated Spurious Emissions**		
Work Order #:	**105488**	Date:	1/25/2022
Test Type:	**Radiated Scan**	Time:	14:09:29
Tested By:	Hoang Cao	Sequence#:	352
Software:	EMITest 5.03.20		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 3			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 3			

Test Conditions / Notes:

Radiated Emission
Frequency Range: 1 to 26GHz

Environmental Conditions:
Temperature: 22.5ºC
Humidity: 33%
Atmospheric Pressure: 101.7kPa

Method: ANSI C63.10 2013

The unit is mounted to a floor standing rack as to simulate typical wall mounted setup. One weight line is extended to the floor.
BT transmitting continuously with 8-DQPSK modulation type, with pattern of 0s and 1s at power level 9 (+9dBm).
Operational mode is representative of worst case.

Notes:
Touch screen display: Direct bond 2312
Power Supply: Artesyn
Display is showing home screen

Modifications #1, #2, #3 #4, #5 and #6 were in place during testing

Support laptop included in this setup to control Bluetooth operating mode; port is internal to the equipment for configuration only.
Unintentional emissions related to display and display controller increased due to external cable to laptop.

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN02113	Horn Antenna-ANSI C63.5	3115	3/11/2021	3/11/2023
T2	AN03302	Cable	32026-29094K-29094K-72TC	1/10/2022	1/10/2024
T3	ANP01210	Cable	FSJ1P-50A-4A	11/2/2020	11/2/2022
T4	ANP06902	Cable	32022-29094K-29094K-36TC	8/13/2020	8/13/2022
	AN02660	Spectrum Analyzer	E4446A	12/4/2020	12/4/2022
T5	AN03386	High Pass Filter	11SH10-3000/T10000-O/O	4/6/2020	4/6/2022
T6	AN03713	Preamp	01001800-221055-202525	5/24/2021	5/24/2023
	AN02693	Active Horn Antenna	AMFW-5F-12001800-20-10P	10/26/2021	10/26/2023
	AN02694	Horn Antenna	AMFW-5F-18002650-20-10P	10/26/2021	10/26/2023
	ANP00928	Cable	various	1/12/2022	1/12/2024
	ANP00929	Cable	various	1/12/2022	1/12/2024

Measurement Data: Reading listed by margin. Test Distance: 3 Meters

#	Freq	Rdng	T1 T5	T2 T6	T3	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV/m	dBµV/m	dB	Ant
1	4883.680M	64.2	+32.4 +0.4	+2.0 -56.1	+3.7	+1.2	+0.0	47.8	54.0 Middle Channel	-6.2	Vert
2	4959.700M	63.7	+32.6 +0.4	+2.0 -56.1	+3.8	+1.2	+0.0	47.6	54.0 High Channel	-6.4	Vert
3	9916.360M	55.4	+36.7 +0.5	+2.9 -56.7	+5.4	+1.7	+0.0	45.9	54.0 High Channel	-8.1	Vert
4	4803.940M	62.0	+32.2 +0.4	+2.0 -56.1	+3.7	+1.2	+0.0	45.4	54.0 Low Channel	-8.6	Vert
5	9768.000M	54.6	+36.6 +0.4	+2.9 -57.0	+5.3	+1.7	+0.0	44.5	54.0 Middle Channel	-9.5	Vert
6	9604.460M	54.5	+36.5 +0.4	+2.9 -57.0	+5.3	+1.7	+0.0	44.3	54.0 Low Channel	-9.7	Vert
7	7443.200M	56.9	+35.3 +0.5	+2.5 -57.3	+4.6	+1.5	+0.0	44.0	54.0 High Channel	-10.0	Vert
8	7205.740M	57.0	+34.6 +0.4	+2.5 -57.1	+4.5	+1.5	+0.0	43.4	54.0 Low Channel	-10.6	Vert
9	7326.000M	56.1	+35.0 +0.4	+2.5 -57.2	+4.6	+1.5	+0.0	42.9	54.0 Middle Channel	-11.1	Vert

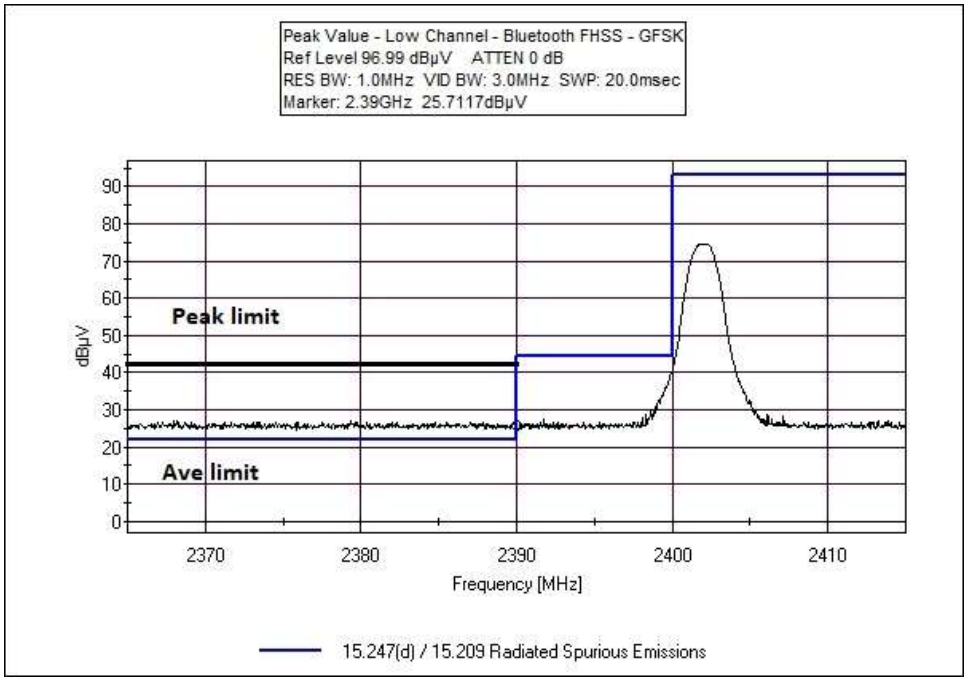
Band Edge

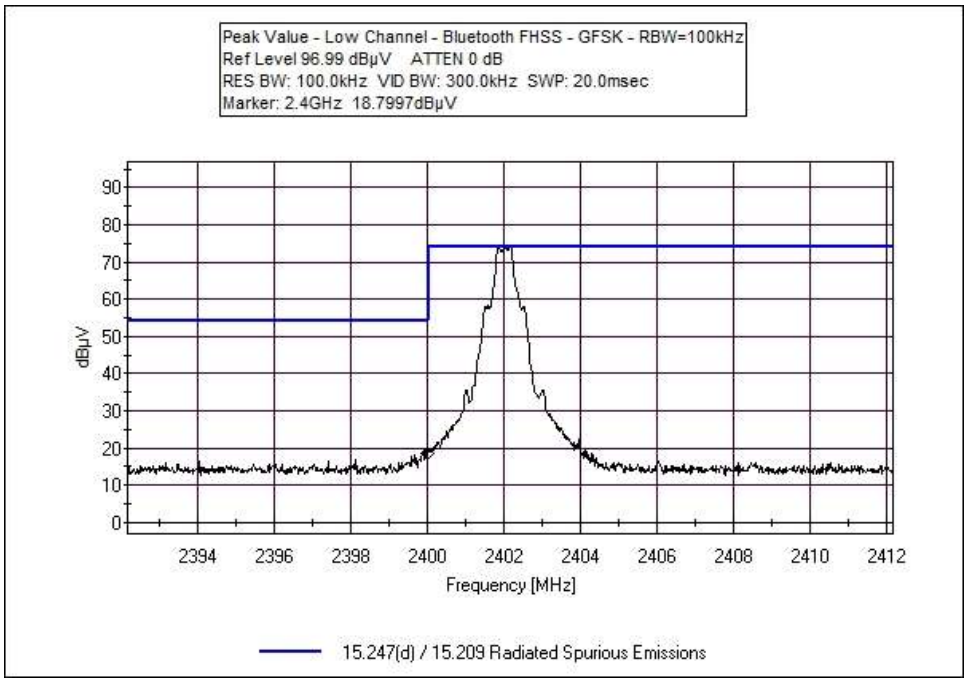
Band Edge Summary, GFSK					
Frequency (MHz)	**Modulation**	**Ant. Type**	**Field Strength (dBuV/m @3m)**	**Limit (dBuV/m @3m)**	**Results**
2390.0	GFSK	External Connector	44.3467	<54	Pass
2400	GFSK	External Connector	50.7997	<78	Pass
2483.5	GFSK	External Connector	45.1717	<54	Pass

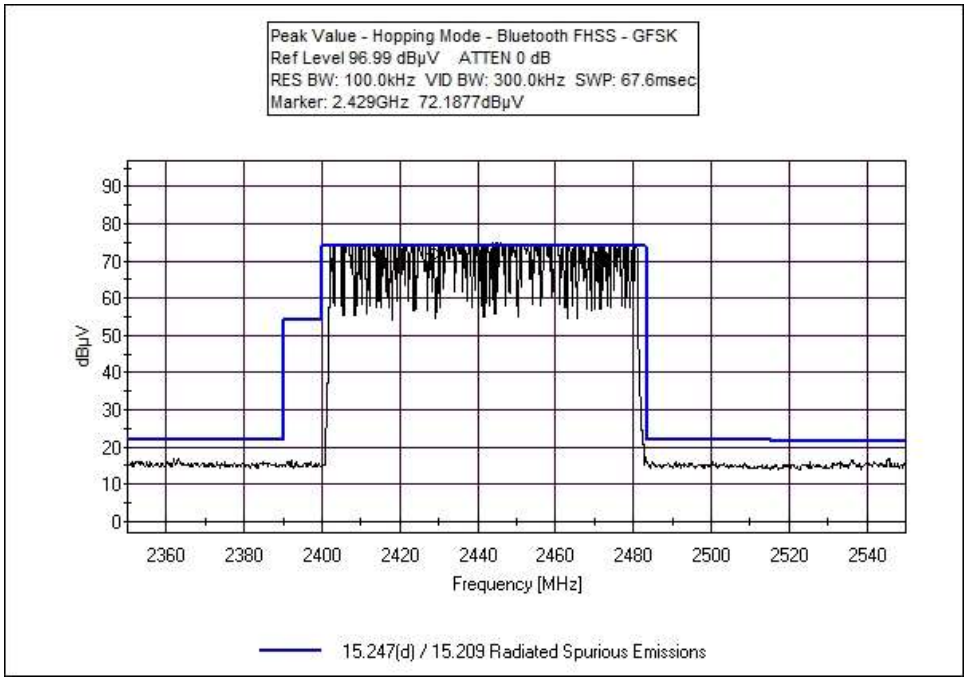
Band Edge Summary, 4 DQPSK					
Frequency (MHz)	**Modulation**	**Ant. Type**	**Field Strength (dBuV/m @3m)**	**Limit (dBuV/m @3m)**	**Results**
2390.0	π/4-DQPSK	External Connector	44.3527	<54	Pass
2400	π/4-DQPSK	External Connector	48.4207	<78	Pass
2483.5	π/4-DQPSK	External Connector	45.0487	<54	Pass

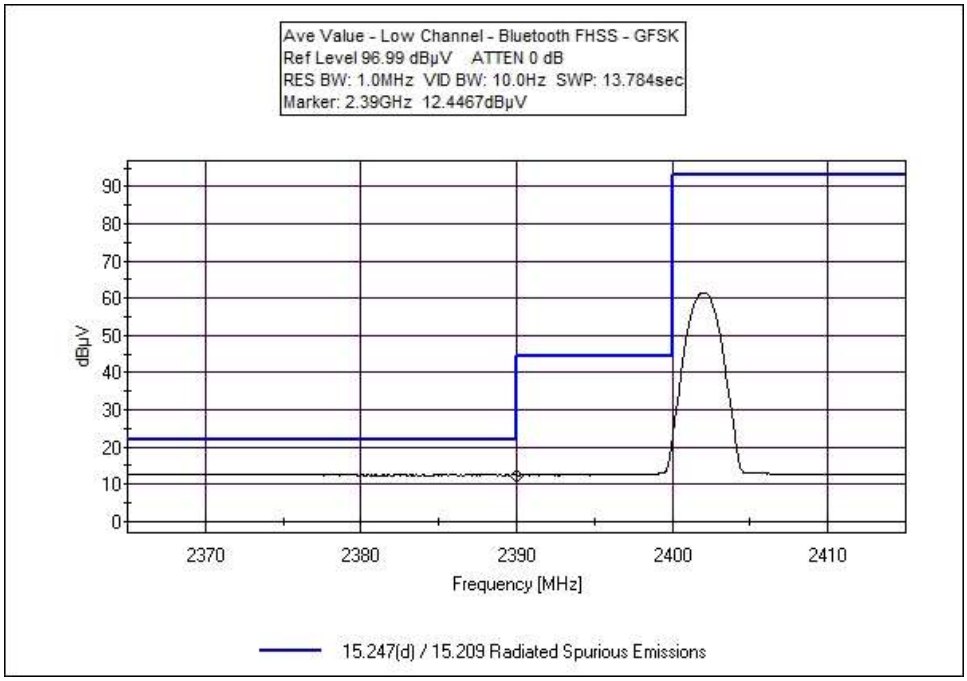
Band Edge Summary, 8 DQPSK					
Frequency (MHz)	**Modulation**	**Ant. Type**	**Field Strength (dBuV/m @3m)**	**Limit (dBuV/m @3m)**	**Results**
2390.0	8-DQPSK	External Connector	44.3097	<54	Pass
2400	8-DQPSK	External Connector	49.5397	<78	Pass
2483.5	8-DQPSK	External Connector	44.9717	<54	Pass

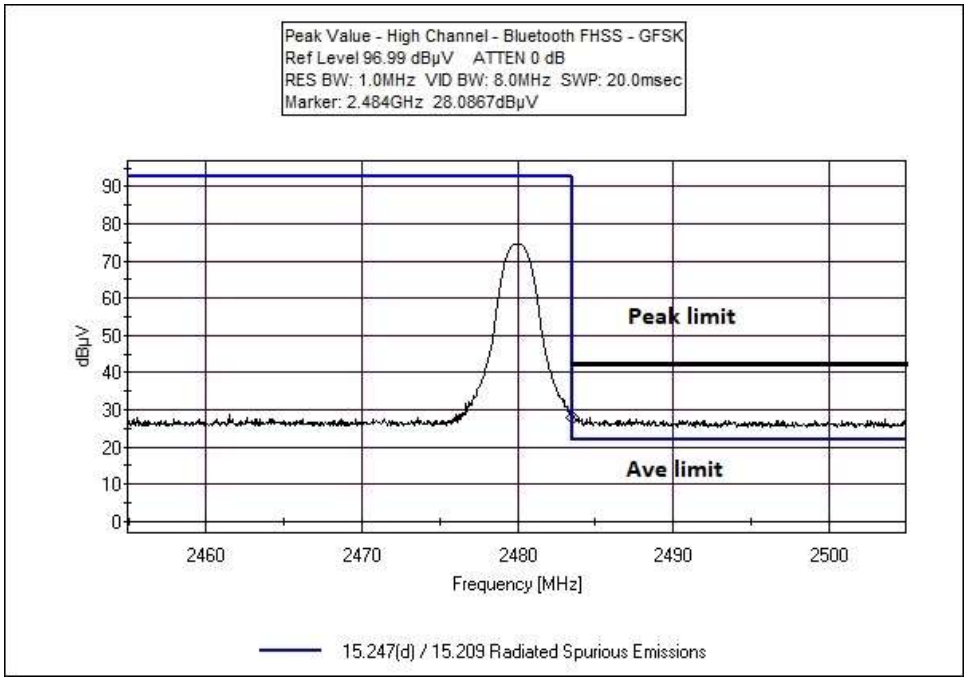
Band Edge Plots

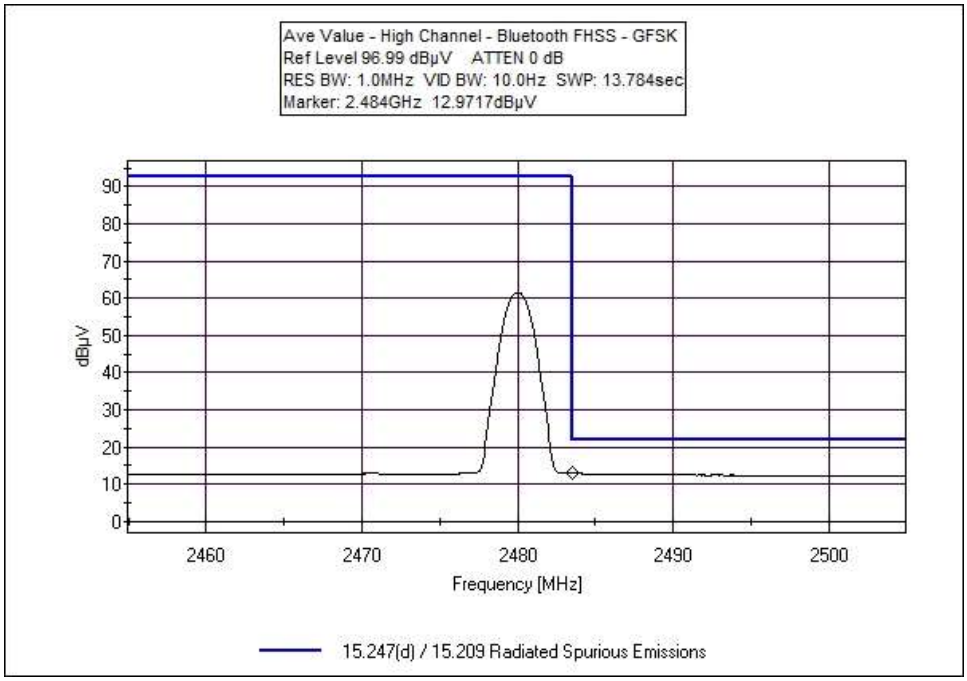


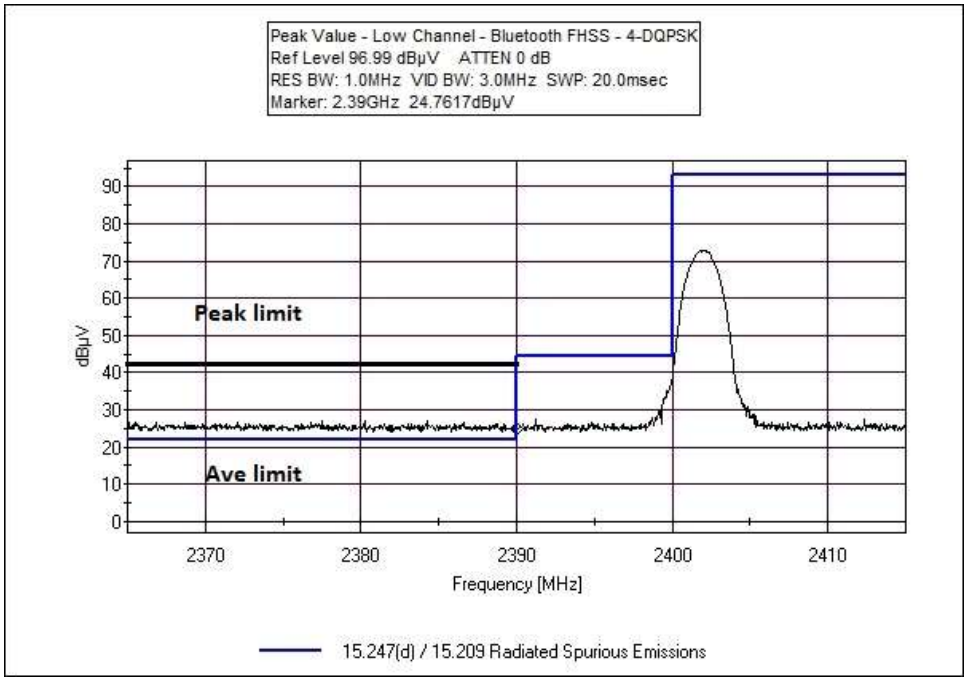


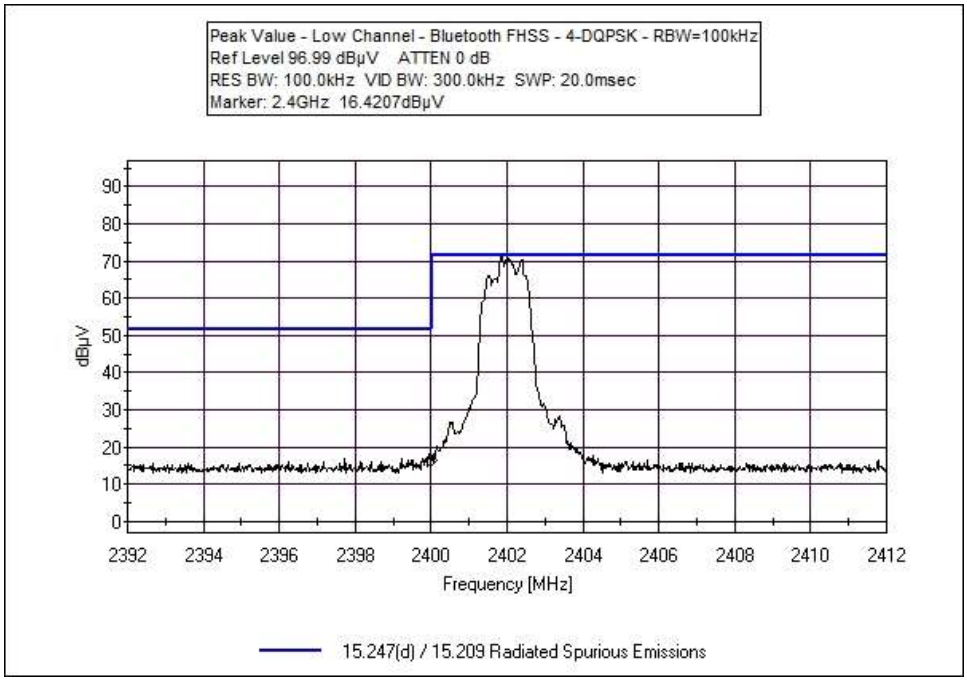

Peak Value - Hopping Mode - Bluetooth FHSS - GFSK
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 100.0kHz VID BW: 300.0kHz SWP: 67.6msec
Marker: 2.429GHz 72.1877dBµV
dBµV
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions

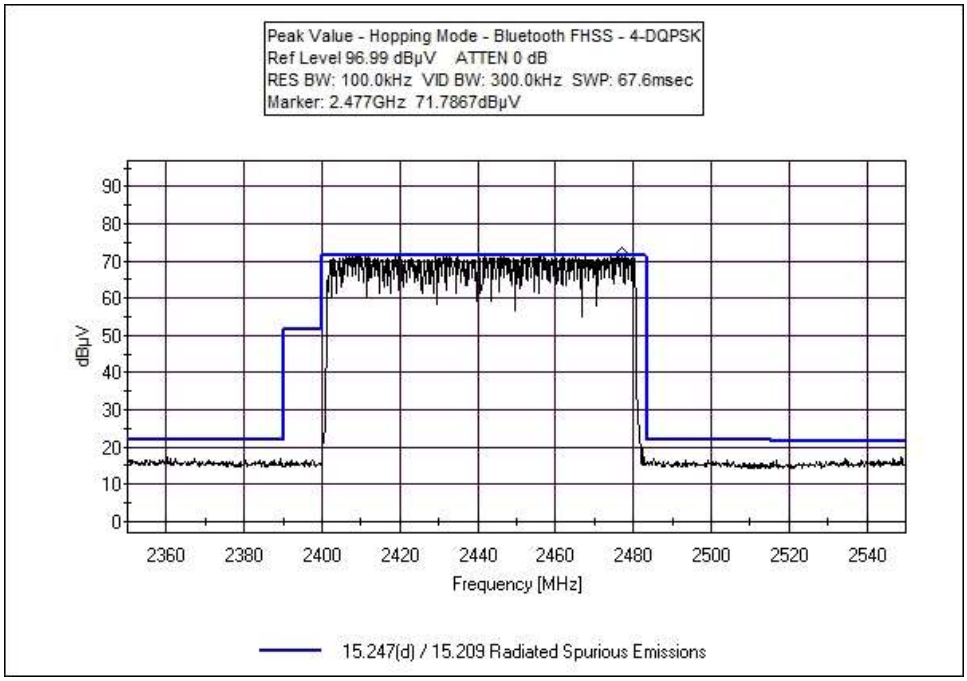

Ave Value - Low Channel - Bluetooth FHSS - GFSK
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 1.0MHz VID BW: 10.0Hz SWP: 13.784sec
Marker: 2.39GHz 12.4467dBµV
dBµV
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions

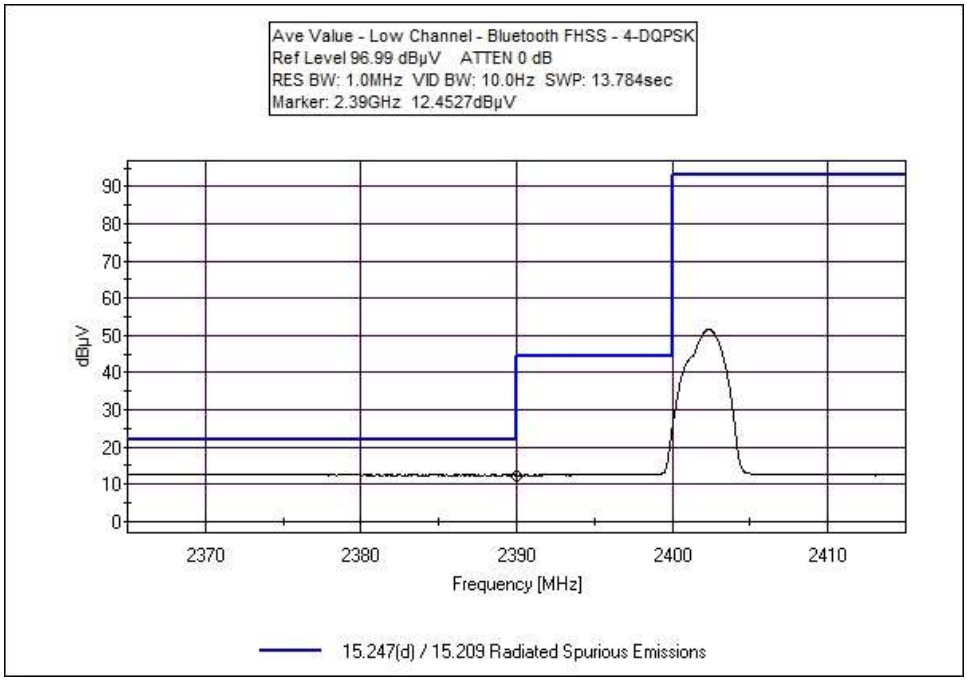

Peak Value - High Channel - Bluetooth FHSS - GFSK
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 1.0MHz VID BW: 8.0MHz SWP: 20.0msec
Marker: 2.484GHz 28.0867dBµV
Peak limit
Ave limit
dBµV
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions

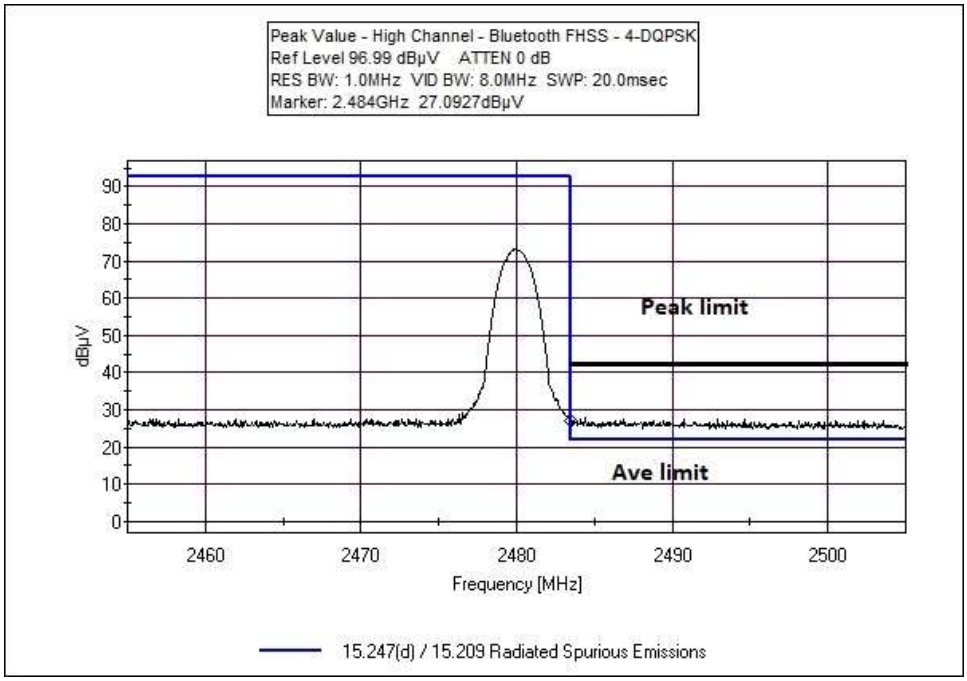

Ave Value - High Channel - Bluetooth FHSS - GFSK
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 1.0MHz VID BW: 10.0Hz SWP: 13.784sec
Marker: 2.484GHz 12.9717dBµV
dBµV
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions

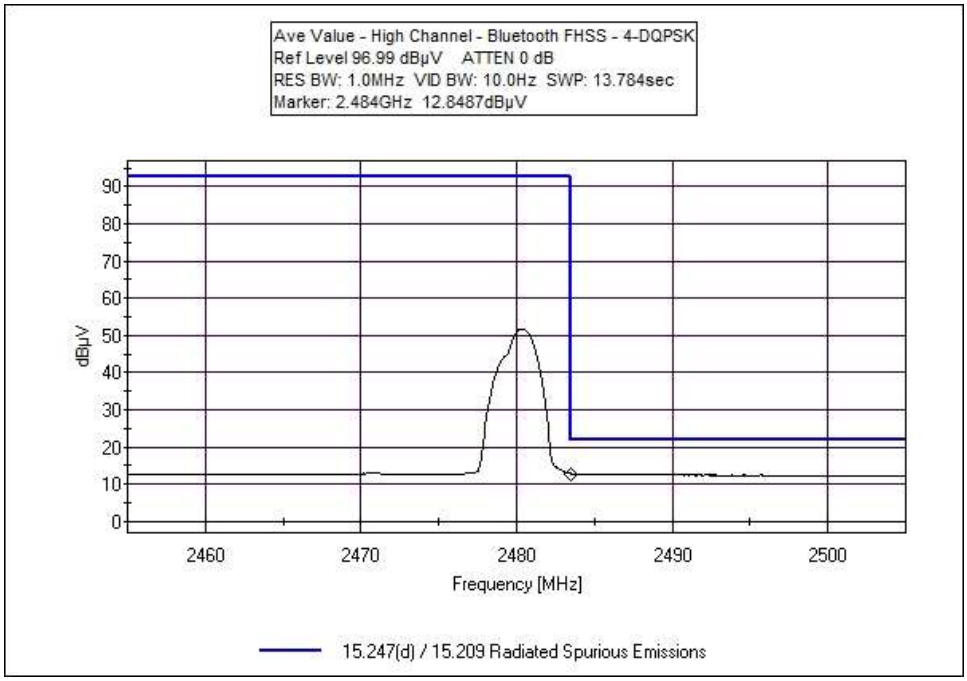

Peak Value - Low Channel - Bluetooth FHSS - 4-DQPSK
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 1.0MHz VID BW: 3.0MHz SWP: 20.0msec
Marker: 2.39GHz 24.7617dBµV
Peak limit
Ave limit
dBµV
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions

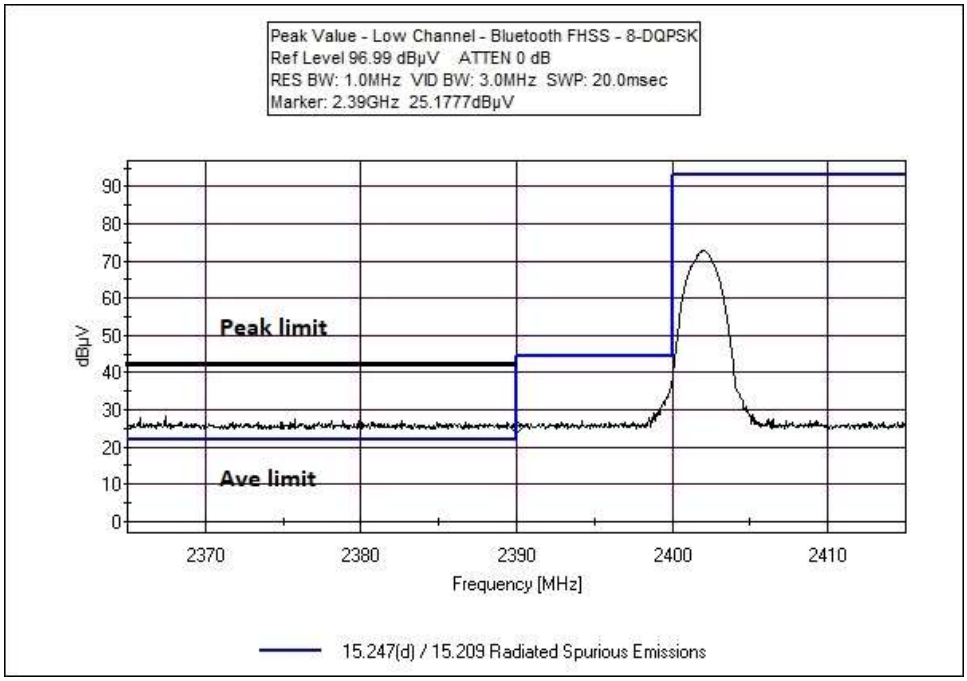

Peak Value - Low Channel - Bluetooth FHSS - 4-DQPSK - RBW=100kHz
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 100.0kHz VID BW: 300.0kHz SWP: 20.0msec
Marker: 2.4GHz 16.4207dBµV
dBµV
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions

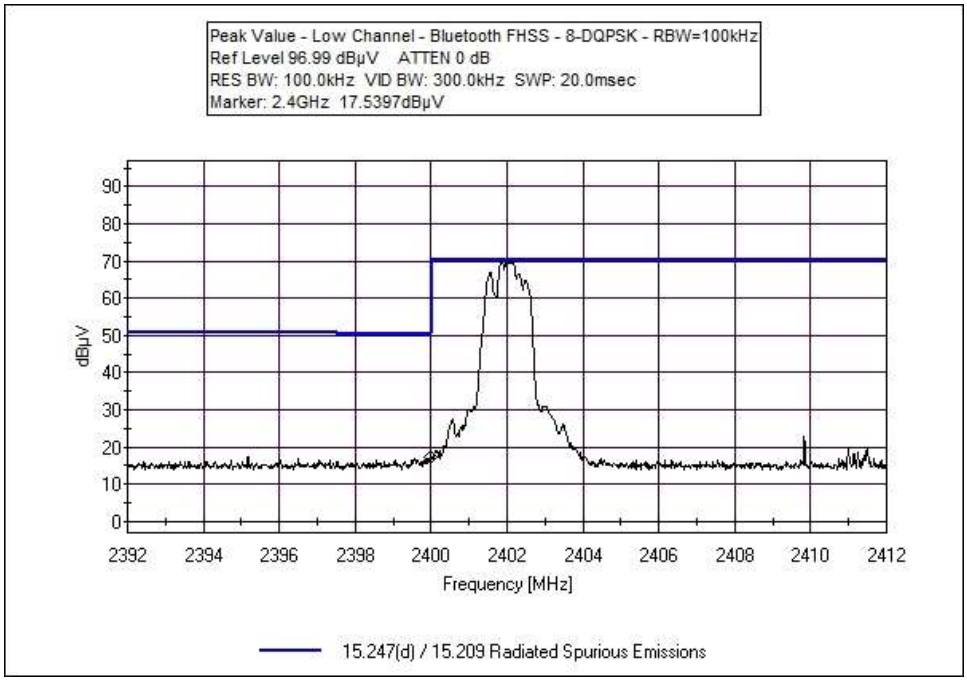

Peak Value - Hopping Mode - Bluetooth FHSS - 4-DQPSK
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 100.0kHz VID BW: 300.0kHz SWP: 67.6msec
Marker: 2.477GHz 71.7867dBµV
dBµV
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions

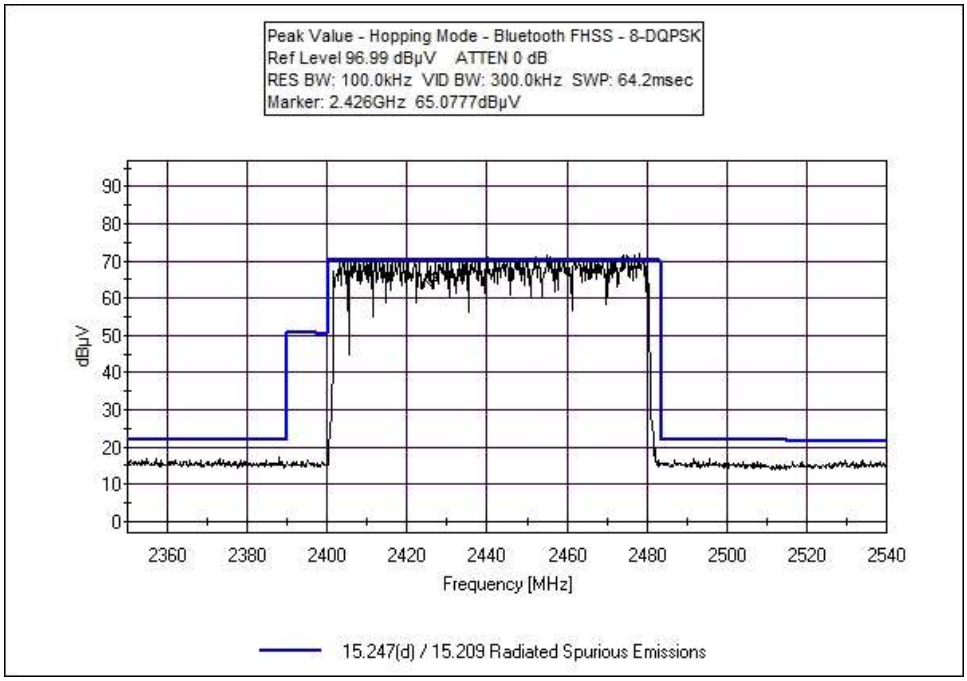

Ave Value - Low Channel - Bluetooth FHSS - 4-DQPSK
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 1.0MHz VID BW: 10.0Hz SWP: 13.784sec
Marker: 2.39GHz 12.4527dBµV
dBµV
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions

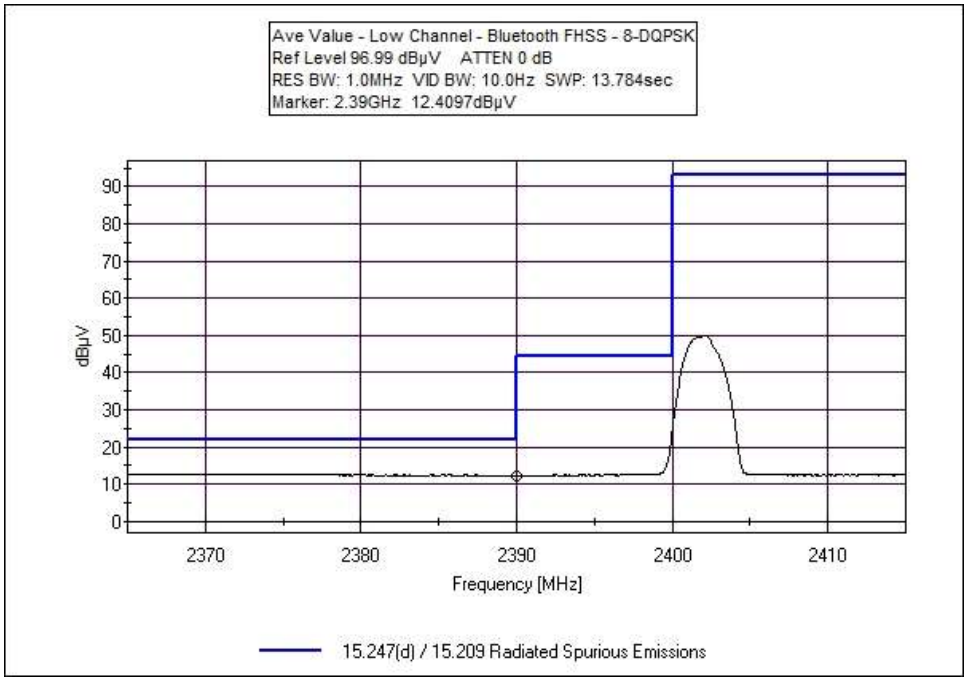

Peak Value - High Channel - Bluetooth FHSS - 4-DQPSK
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 1.0MHz VID BW: 8.0MHz SWP: 20.0msec
Marker: 2.484GHz 27.0927dBµV
Peak limit
Ave limit
dBµV
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions

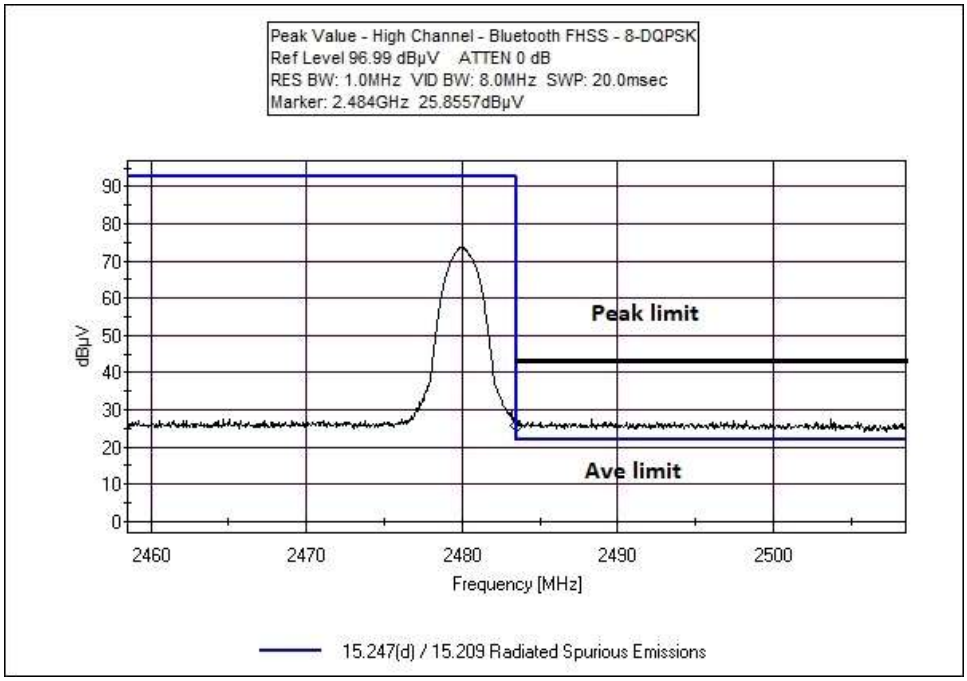

Ave Value - High Channel - Bluetooth FHSS - 4-DQPSK
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 1.0MHz VID BW: 10.0Hz SWP: 13.784sec
Marker: 2.484GHz 12.8487dBµV
dBµV
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions

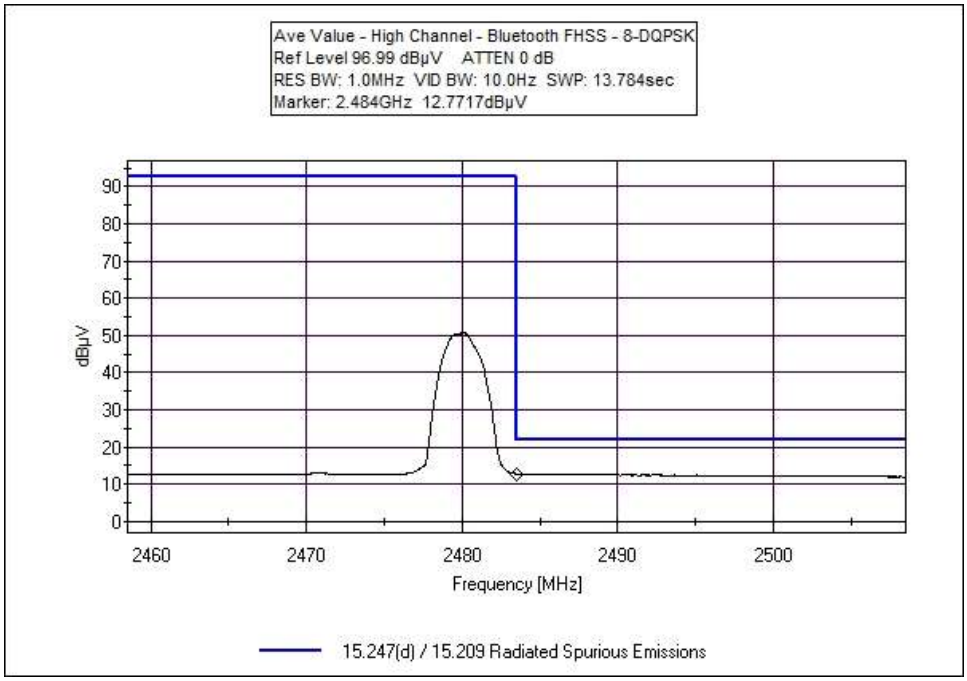

Peak Value - Low Channel - Bluetooth FHSS - 8-DQPSK
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 1.0MHz VID BW: 3.0MHz SWP: 20.0msec
Marker: 2.39GHz 25.1777dBµV
Peak limit
Ave limit
dBµV
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions


Peak Value - Low Channel - Bluetooth FHSS - 8-DQPSK - RBW=100kHz
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 100.0kHz VID BW: 300.0kHz SWP: 20.0msec
Marker: 2.4GHz 17.5397dBµV
dBµV
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions


Peak Value - Hopping Mode - Bluetooth FHSS - 8-DQPSK
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 100.0kHz VID BW: 300.0kHz SWP: 64.2msec
Marker: 2.426GHz 65.0777dBµV
dBµV
90
80
70
60
50
40
30
20
10
0
2360
2380
2400
2420
2440
2460
2480
2500
2520
2540
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions


Ave Value - Low Channel - Bluetooth FHSS - 8-DQPSK
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 1.0MHz VID BW: 10.0Hz SWP: 13.784sec
Marker: 2.39GHz 12.4097dBµV
dBµV
90
80
70
60
50
40
30
20
10
0
2370
2380
2390
2400
2410
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions


Peak Value - High Channel - Bluetooth FHSS - 8-DQPSK
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 1.0MHz VID BW: 8.0MHz SWP: 20.0msec
Marker: 2.484GHz 25.8557dBµV
Peak limit
Ave limit
dBµV
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions


Ave Value - High Channel - Bluetooth FHSS - 8-DQPSK
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 1.0MHz VID BW: 10.0Hz SWP: 13.784sec
Marker: 2.484GHz 12.7717dBµV
dBµV
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions

Test Setup / Conditions / Data

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont CA 94539 • 510-249-1170		
Customer:	**Tonal**		
Specification:	**Band Edge**		
Work Order #:	**105488**	Date:	1/25/2022
Test Type:	**Radiated Scan**	Time:	
Tested By:	Hoang Cao	Sequence#:	
Software:	EMITest 5.03.20		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 3			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 3			

Test Conditions / Notes:

Band edge

BT-FHSS

Environmental Conditions:
Temperature: 22.9ºC
Humidity: 43%
Atmospheric Pressure: 101.3kPa

Software: Putty version 0.74

Highest Generated Frequency: 2.48GHz

Method: ANSI C63.10 2013

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02113	Horn Antenna-ANSI C63.5	3115	3/11/2021	3/11/2023
	AN03302	Cable	32026-29094K-29094K-72TC	1/10/2022	1/10/2024
	ANP01210	Cable	FSJ1P-50A-4A	11/2/2020	11/2/2022
	AN02660	Spectrum Analyzer	E4446A	12/4/2020	12/4/2022

15.207 AC Conducted Emissions

Test Setup / Conditions / Data

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont CA 94539 • 510-249-1170		
Customer:	**Tonal**		
Specification:	**15.207 AC Mains - Average**		
Work Order #:	**105488**	Date:	12/17/2021
Test Type:	**Conducted Emissions**	Time:	10:10:04
Tested By:	Hoang Cao	Sequence#:	46
Software:	EMITest 5.03.20		120V 60Hz

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

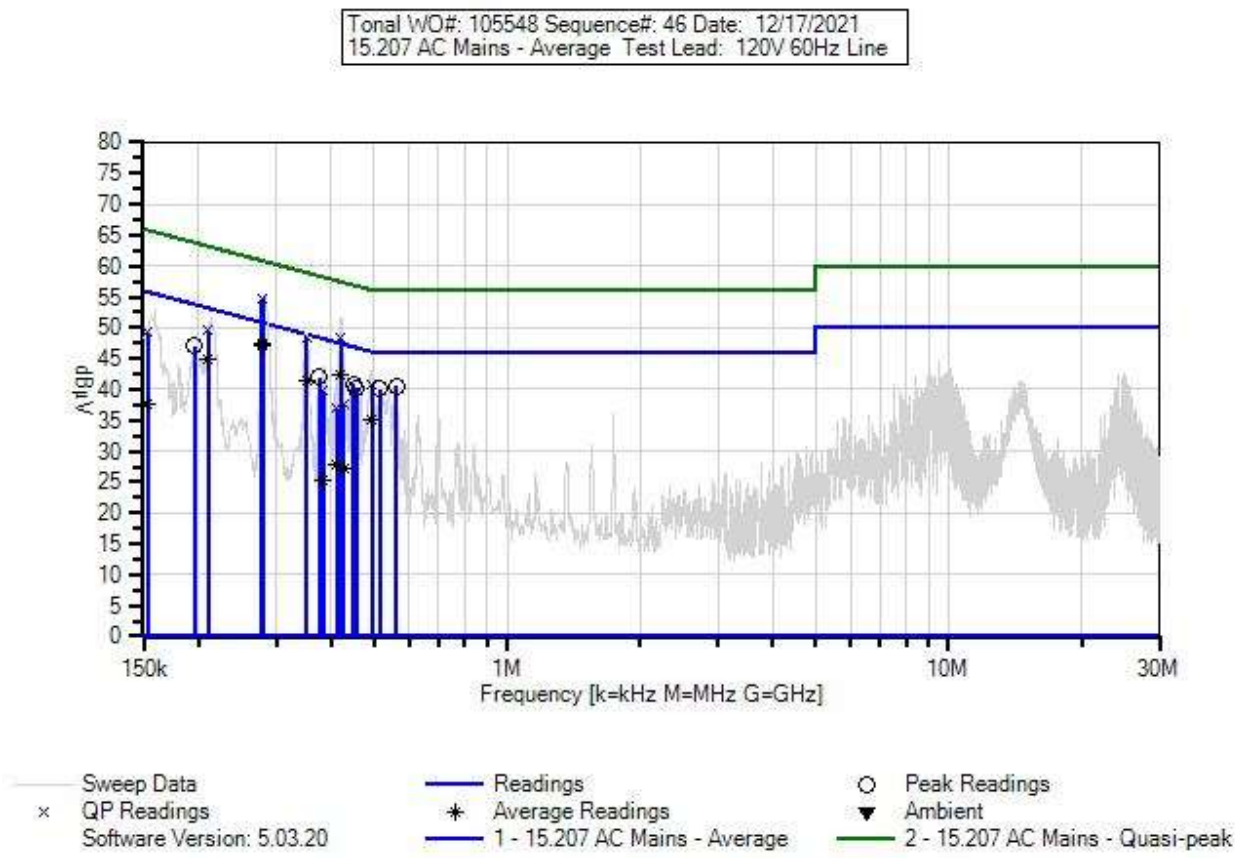
Conducted Emission
Frequency Range: 150kHz to 30MHz

Environmental Conditions:
Temperature: 21.8ºC
Humidity: 47%
Atmospheric Pressure: 101.5kPa

Highest Generation Frequency: 5.8GHz
Method: ANSI C63.10 2013

The unit is mounted to a floor standing rack as to simulate typical wall mounted setup. It is set in a testing mode, lifting a weight on a loop.
All WIFI and Bluetooth modules are on.

Notes:
Touch screen display: Direct bond 2312
Power Supply: Artesyn



Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	ANP01211	Attenuator	23-10-34	2/25/2021	2/25/2023
T2	ANP06691	Cable	PE3062-180	3/25/2020	3/25/2022
T3	ANP06694	Cable	PE3062-480	3/25/2020	3/25/2022
T4	AN00494	50uH LISN-Line Loss (dB)	3816/NM	3/11/2021	3/11/2023
	AN00494	50uH LISN-Return Loss (dB)	3816/NM	3/11/2021	3/11/2023
	AN02660	Spectrum Analyzer	E4446A	12/4/2020	12/4/2022
T5	ANP05258	High Pass Filter	HE9615-150K-50-720B	7/6/2020	7/6/2022

Measurement Data: Reading listed by margin. Test Lead: Line

#	Freq	Rdng	T1	T2	T3	T4	Dist	Corr	Spec	Margin	Polar
			T5								
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV	dBµV	dB	Ant
1	280.316k	37.3	+9.9	+0.0	+0.0	+0.1	+0.0	47.4	50.8	-3.4	Line
	Ave		+0.1								
2	278.856k	37.1	+9.9	+0.0	+0.0	+0.1	+0.0	47.2	50.8	-3.6	Line
	Ave		+0.1								
3	420.747k	32.4	+9.9	+0.0	+0.0	+0.0	+0.0	42.4	47.4	-5.0	Line
	Ave		+0.1								
4	562.324k	30.3	+9.9	+0.0	+0.1	+0.1	+0.0	40.6	46.0	-5.4	Line
			+0.2								
5	515.783k	29.7	+9.9	+0.0	+0.1	+0.1	+0.0	40.0	46.0	-6.0	Line
			+0.2								
6	280.316k	44.6	+9.9	+0.0	+0.0	+0.1	+0.0	54.7	60.8	-6.1	Line
	QP		+0.1								
7	448.880k	30.7	+9.9	+0.0	+0.1	+0.0	+0.0	40.8	46.9	-6.1	Line
			+0.1								
8	278.856k	44.5	+9.9	+0.0	+0.0	+0.1	+0.0	54.6	60.8	-6.2	Line
	QP		+0.1								
^	280.316k	46.6	+9.9	+0.0	+0.0	+0.1	+0.0	56.7	50.8	+5.9	Line
			+0.1								
^	278.856k	46.5	+9.9	+0.0	+0.0	+0.1	+0.0	56.6	50.8	+5.8	Line
			+0.1								
11	375.432k	31.8	+9.9	+0.0	+0.0	+0.1	+0.0	41.9	48.4	-6.5	Line
			+0.1								
12	454.698k	30.1	+9.9	+0.0	+0.1	+0.0	+0.0	40.2	46.8	-6.6	Line
			+0.1								
13	195.812k	36.8	+9.9	+0.0	+0.0	+0.1	+0.0	47.0	53.8	-6.8	Line
			+0.2								
14	351.428k	31.4	+9.9	+0.0	+0.0	+0.0	+0.0	41.4	48.9	-7.5	Line
	Ave		+0.1								
15	209.905k	34.9	+9.9	+0.0	+0.0	+0.1	+0.0	45.0	53.2	-8.2	Line
	Ave		+0.1								
16	420.747k	38.3	+9.9	+0.0	+0.0	+0.0	+0.0	48.3	57.4	-9.1	Line
	QP		+0.1								
^	420.747k	43.2	+9.9	+0.0	+0.0	+0.0	+0.0	53.2	47.4	+5.8	Line
			+0.1								
18	351.428k	38.5	+9.9	+0.0	+0.0	+0.0	+0.0	48.5	58.9	-10.4	Line
	QP		+0.1								
^	351.428k	42.2	+9.9	+0.0	+0.0	+0.0	+0.0	52.2	48.9	+3.3	Line
			+0.1								
20	493.040k	24.9	+9.9	+0.0	+0.1	+0.1	+0.0	35.1	46.1	-11.0	Line
	Ave		+0.1								
21	209.905k	39.5	+9.9	+0.0	+0.0	+0.1	+0.0	49.6	63.2	-13.6	Line
	QP		+0.1								
^	209.905k	43.1	+9.9	+0.0	+0.0	+0.1	+0.0	53.2	53.2	+0.0	Line
			+0.1								
23	493.040k	30.7	+9.9	+0.0	+0.1	+0.1	+0.0	40.9	56.1	-15.2	Line
	QP		+0.1								

^	493.040k	35.1	+9.9 +0.1	+0.0	+0.1	+0.1	+0.0	45.3	46.1	-0.8	Line
25	153.270k QP	37.7	+9.9 +1.6	+0.0	+0.0	+0.1	+0.0	49.3	65.8	-16.5	Line
26	153.270k Ave	25.9	+9.9 +1.6	+0.0	+0.0	+0.1	+0.0	37.5	55.8	-18.3	Line
^	153.270k	44.2	+9.9 +1.6	+0.0	+0.0	+0.1	+0.0	55.8	55.8	+0.0	Line
28	383.373k QP	29.6	+9.9 +0.1	+0.0	+0.0	+0.1	+0.0	39.7	58.2	-18.5	Line
29	427.092k QP	27.5	+9.9 +0.1	+0.0	+0.0	+0.0	+0.0	37.5	57.3	-19.8	Line
30	411.207k Ave	17.7	+9.9 +0.1	+0.0	+0.0	+0.0	+0.0	27.7	47.6	-19.9	Line
31	427.092k Ave	17.3	+9.9 +0.1	+0.0	+0.0	+0.0	+0.0	27.3	47.3	-20.0	Line
^	427.092k	37.0	+9.9 +0.1	+0.0	+0.0	+0.0	+0.0	47.0	47.3	-0.3	Line
33	411.207k QP	26.9	+9.9 +0.1	+0.0	+0.0	+0.0	+0.0	36.9	57.6	-20.7	Line
^	411.207k	35.2	+9.9 +0.1	+0.0	+0.0	+0.0	+0.0	45.2	47.6	-2.4	Line
^	409.611k	32.4	+9.9 +0.1	+0.0	+0.0	+0.0	+0.0	42.4	47.7	-5.3	Line
36	383.373k Ave	15.2	+9.9 +0.1	+0.0	+0.0	+0.1	+0.0	25.3	48.2	-22.9	Line
^	383.373k	35.4	+9.9 +0.1	+0.0	+0.0	+0.1	+0.0	45.5	48.2	-2.7	Line
^	385.613k	32.5	+9.9 +0.1	+0.0	+0.0	+0.1	+0.0	42.6	48.2	-5.6	Line

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont CA 94539 • 510-249-1170		
Customer:	**Tonal**		
Specification:	**15.207 AC Mains - Average**		
Work Order #:	**105488**	Date:	12/17/2021
Test Type:	**Conducted Emissions**	Time:	10:28:13
Tested By:	Hoang Cao	Sequence#:	47
Software:	EMITest 5.03.20		120V 60Hz

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

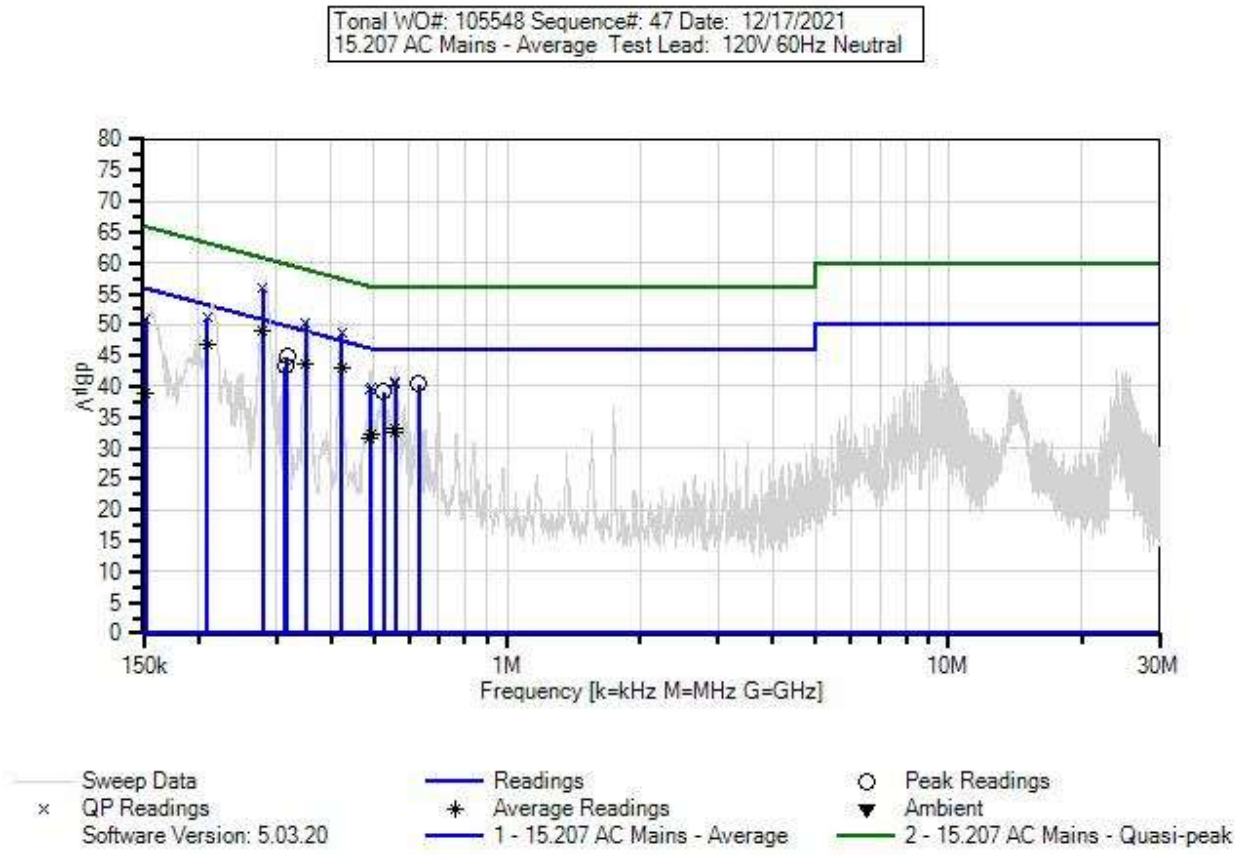
Conducted Emission
Frequency Range: 150kHz to 30MHz

Environmental Conditions:
Temperature: 21.8ºC
Humidity: 47%
Atmospheric Pressure: 101.5kPa

Highest Generation Frequency: 5.8GHz
Method: ANSI C63.10 2013

The unit is mounted to a floor standing rack as to simulate typical wall mounted setup. It is set in a testing mode, lifting a weight on a loop.
All WIFI and Bluetooth modules are on.

Notes:
Touch screen display: Direct bond 2312
Power Supply: Artesyn



Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	ANP01211	Attenuator	23-10-34	2/25/2021	2/25/2023
T2	ANP06691	Cable	PE3062-180	3/25/2020	3/25/2022
T3	ANP06694	Cable	PE3062-480	3/25/2020	3/25/2022
	AN00494	50uH LISN-Line Loss (dB)	3816/NM	3/11/2021	3/11/2023
T4	AN00494	50uH LISN-Return Loss (dB)	3816/NM	3/11/2021	3/11/2023
	AN02660	Spectrum Analyzer	E4446A	12/4/2020	12/4/2022
T5	ANP05258	High Pass Filter	HE9615-150K-50-720B	7/6/2020	7/6/2022

Measurement Data: Reading listed by margin. Test Lead: Neutral

#	Freq	Rdng	T1	T2	T3	T4	Dist	Corr	Spec	Margin	Polar
			T5								
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV	dBµV	dB	Ant
1	280.264k	38.9	+9.9	+0.0	+0.0	+0.0	+0.0	48.9	50.8	-1.9	Neutr
	Ave		+0.1								
2	421.660k	33.0	+9.9	+0.0	+0.0	+0.0	+0.0	43.0	47.4	-4.4	Neutr
	Ave		+0.1								
3	280.264k	45.9	+9.9	+0.0	+0.0	+0.0	+0.0	55.9	60.8	-4.9	Neutr
	QP		+0.1								
^	280.264k	47.7	+9.9	+0.0	+0.0	+0.0	+0.0	57.7	50.8	+6.9	Neutr
			+0.1								
5	317.256k	34.8	+9.9	+0.0	+0.0	+0.0	+0.0	44.8	49.8	-5.0	Neutr
			+0.1								
6	350.035k	33.5	+9.9	+0.0	+0.0	+0.0	+0.0	43.5	49.0	-5.5	Neutr
	Ave		+0.1								
7	630.682k	30.2	+9.9	+0.0	+0.1	+0.0	+0.0	40.4	46.0	-5.6	Neutr
			+0.2								
8	209.412k	36.7	+9.9	+0.0	+0.0	+0.0	+0.0	46.7	53.2	-6.5	Neutr
	Ave		+0.1								
9	315.074k	33.3	+9.9	+0.0	+0.0	+0.0	+0.0	43.3	49.8	-6.5	Neutr
			+0.1								
10	525.237k	29.0	+9.9	+0.0	+0.1	+0.0	+0.0	39.2	46.0	-6.8	Neutr
			+0.2								
11	350.035k	40.4	+9.9	+0.0	+0.0	+0.0	+0.0	50.4	59.0	-8.6	Neutr
	QP		+0.1								
^	350.035k	43.5	+9.9	+0.0	+0.0	+0.0	+0.0	53.5	49.0	+4.5	Neutr
			+0.1								
13	421.660k	38.6	+9.9	+0.0	+0.0	+0.0	+0.0	48.6	57.4	-8.8	Neutr
	QP		+0.1								
^	421.660k	43.9	+9.9	+0.0	+0.0	+0.0	+0.0	53.9	47.4	+6.5	Neutr
			+0.1								
15	209.412k	41.1	+9.9	+0.0	+0.0	+0.0	+0.0	51.1	63.2	-12.1	Neutr
	QP		+0.1								
^	209.412k	44.4	+9.9	+0.0	+0.0	+0.0	+0.0	54.4	53.2	+1.2	Neutr
			+0.1								
17	558.862k	23.0	+9.9	+0.0	+0.1	+0.0	+0.0	33.2	46.0	-12.8	Neutr
	Ave		+0.2								
18	558.003k	22.4	+9.9	+0.0	+0.1	+0.0	+0.0	32.6	46.0	-13.4	Neutr
	Ave		+0.2								
19	492.486k	22.0	+9.9	+0.0	+0.1	+0.0	+0.0	32.1	46.1	-14.0	Neutr
	Ave		+0.1								
20	488.923k	21.6	+9.9	+0.0	+0.1	+0.0	+0.0	31.7	46.2	-14.5	Neutr
	Ave		+0.1								
21	152.236k	38.8	+9.9	+0.0	+0.0	+0.1	+0.0	50.9	65.9	-15.0	Neutr
	QP		+2.1								
22	558.862k	30.4	+9.9	+0.0	+0.1	+0.0	+0.0	40.6	56.0	-15.4	Neutr
	QP		+0.2								
23	558.003k	30.3	+9.9	+0.0	+0.1	+0.0	+0.0	40.5	56.0	-15.5	Neutr
	QP		+0.2								

^	558.003k	33.6	+9.9 +0.2	+0.0	+0.1	+0.0	+0.0	43.8	46.0	-2.2	Neutr
^	558.862k	33.4	+9.9 +0.2	+0.0	+0.1	+0.0	+0.0	43.6	46.0	-2.4	Neutr
26	492.486k QP	29.9	+9.9 +0.1	+0.0	+0.1	+0.0	+0.0	40.0	56.1	-16.1	Neutr
27	488.923k QP	29.5	+9.9 +0.1	+0.0	+0.1	+0.0	+0.0	39.6	56.2	-16.6	Neutr
^	488.923k	33.9	+9.9 +0.1	+0.0	+0.1	+0.0	+0.0	44.0	46.2	-2.2	Neutr
^	492.486k	33.6	+9.9 +0.1	+0.0	+0.1	+0.0	+0.0	43.7	46.1	-2.4	Neutr
^	485.968k	30.0	+9.9 +0.1	+0.0	+0.1	+0.0	+0.0	40.1	46.2	-6.1	Neutr
31	152.236k Ave	26.9	+9.9 +2.1	+0.0	+0.0	+0.1	+0.0	39.0	55.9	-16.9	Neutr
^	152.236k	44.8	+9.9 +2.1	+0.0	+0.0	+0.1	+0.0	56.9	55.9	+1.0	Neutr

SUPPLEMENTAL INFORMATION

Measurement Uncertainty

Uncertainty Value	Parameter
4.73 dB	Radiated Emissions
3.34 dB	Mains Conducted Emissions
3.30 dB	Disturbance Power

Uncertainties reported are worst case for all CKC Laboratories' sites and represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k=2. Compliance is deemed to occur provided measurements are below the specified limits.

Emissions Test Details

TESTING PARAMETERS

Unless otherwise indicated, the following configuration parameters are used for equipment setup: The cables were routed consistent with the typical application by varying the configuration of the test sample. Interface cables were connected to the available ports of the test unit. The effect of varying the position of the cables was investigated to find the configuration that produced maximum emissions. Cables were of the type and length specified in the individual requirements. The length of cable that produced maximum emissions was selected.

The equipment under test (EUT) was set up in a manner that represented its normal use, as shown in the setup photographs. Any special conditions required for the EUT to operate normally are identified in the comments that accompany the emissions tables.

The emissions data was taken with a spectrum analyzer or receiver. Incorporating the applicable correction factors for distance, antenna, cable loss and amplifier gain, the data was reduced as shown in the table below. The corrected data was then compared to the applicable emission limits. Preliminary and final measurements were taken in order to ensure that all emissions from the EUT were found and maximized.

CORRECTION FACTORS

The basic spectrum analyzer reading was converted using correction factors as shown in the highest emissions readings in the tables. For radiated emissions in dBµV/m, the spectrum analyzer reading in dBµV was corrected by using the following formula. This reading was then compared to the applicable specification limit. Individual measurements were compared with the displayed limit value in the margin column. The margin was calculated based on subtracting the limit value from the corrected measurement value; a positive margin represents a measurement exceeding the limit, while a negative margin represents a measurement less than the limit.

SAMPLE CALCULATIONS		
	Meter reading	(dBµV)
+	Antenna Factor	(dB/m)
+	Cable Loss	(dB)
-	Distance Correction	(dB)
-	Preamplifier Gain	(dB)
=	Corrected Reading	(dBµV/m)

TEST INSTRUMENTATION AND ANALYZER SETTINGS

The test instrumentation and equipment listed were used to collect the emissions data. A spectrum analyzer or receiver was used for all measurements. Unless otherwise specified, the following table shows the measuring equipment bandwidth settings that were used in designated frequency bands. For testing emissions, an appropriate reference level and a vertical scale size of 10 dB per division were used.

MEASURING EQUIPMENT BANDWIDTH SETTINGS PER FREQUENCY RANGE			
TEST	BEGINNING FREQUENCY	ENDING FREQUENCY	BANDWIDTH SETTING
CONDUCTED EMISSIONS	150 kHz	30 MHz	9 kHz
RADIATED EMISSIONS	9 kHz	150 kHz	200 Hz
RADIATED EMISSIONS	150 kHz	30 MHz	9 kHz
RADIATED EMISSIONS	30 MHz	1000 MHz	120 kHz
RADIATED EMISSIONS	1000 MHz	>1 GHz	1 MHz

SPECTRUM ANALYZER/RECEIVER DETECTOR FUNCTIONS

The notes that accompany the measurements contained in the emissions tables indicate the type of detector function used to obtain the given readings. Unless otherwise noted, all readings were made in the "positive peak" detector mode. Whenever a "quasi-peak" or "average" reading was recorded, the measurement was annotated with a "QP" or an "Ave" on the appropriate rows of the data sheets. In cases where quasi-peak or average limits were employed and data exists for multiple measurement types for the same frequency then the peak measurement was retained in the report for reference, however the numbering for the affected row was removed and an arrow or caret ("^") was placed in the far left-hand column indicating that the row above takes precedence for comparison to the limit. The following paragraphs describe in more detail the detector functions and when they were used to obtain the emissions data.

Peak

In this mode, the spectrum analyzer or receiver recorded all emissions at their peak value as the frequency band selected was scanned. By combining this function with another feature called "peak hold," the measurement device had the ability to measure intermittent or low duty cycle transient emission peak levels. In this mode the measuring device made a slow scan across the frequency band selected and measured the peak emission value found at each frequency across the band.

Quasi-Peak

Quasi-peak measurements were taken using the quasi-peak detector when the true peak values exceeded or were within 2 dB of a quasi-peak specification limit. Additional QP measurements may have been taken at the discretion of the operator.

Average

Average measurements were taken using the average detector when the true peak values exceeded or were within 2 dB of an average specification limit. Additional average measurements may have been taken at the discretion of the operator. If the specification or test procedure requires trace averaging, then the averaging was performed using 100 samples or as required by the specification. All other average measurements are performed using video bandwidth averaging. To make these measurements, the test engineer reduces the video bandwidth on the measuring device until the modulation of the signal is filtered out. At this point the measuring device is set into the linear mode and the scan time is reduced.