

Venstar, Inc.

TEST REPORT FOR

Thermostat with WiFi, Subgig, and BLE Model: Explorer 2

Tested to The Following Standards:

FCC Part 15 Subpart C Section(s)

15.207 & 15.247
(DTS 2400-2483.5 MHz)

Report No.: 104728-11

Date of issue: January 15, 2021



Test Certificate # 803.01

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.

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ADMINISTRATIVE INFORMATION

Test Report Information

REPORT PREPARED FOR:

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REPORT PREPARED BY:

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Project Number: 104728

DATE OF EQUIPMENT RECEIPT:

November 11, 2020

DATE(S) OF TESTING:

November 11, 13, 18, and 24, 2020

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.
110 Olinda Place
Brea, CA 92823

Software Versions

CKC Laboratories Proprietary Software	Version
EMITest Emissions	5.03.19

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 (DTS)

Test Procedure	Description	Modifications	Results
15.247(a)(2)	6dB Bandwidth	NA	Pass
15.247(b)(3)	Output Power	NA	Pass
15.247(e)	Power Spectral Density	NA	Pass
15.247(d)	RF Conducted Emissions & Band Edge	NA	Pass
15.247(d)	Radiated Emissions & Band Edge	NA	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
No modifications were made during testing.

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
None

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 Tested:

Device	Manufacturer	Model #	S/N
Thermostat with WiFi, Subgig, and BLE	Venstar, Inc.	Explorer 2	NA

Support Equipment:

Device	Manufacturer	Model #	S/N
Interface board	Texas Instruments	CC1352R1	NA
24Vac Adapter	Unbranded	MKA-412400200	NA
Laptop	Lenovo	T500	NA
Laptop ACDC Adapter	Lenovo	92P1156	NA

Configuration 2

Equipment Tested:

Device	Manufacturer	Model #	S/N
Thermostat with WiFi, Subgig, and BLE	Venstar, Inc.	Explorer 2	NA

Support Equipment:

Device	Manufacturer	Model #	S/N
24Vac Adapter	Unbranded	MKA-412400200	NA

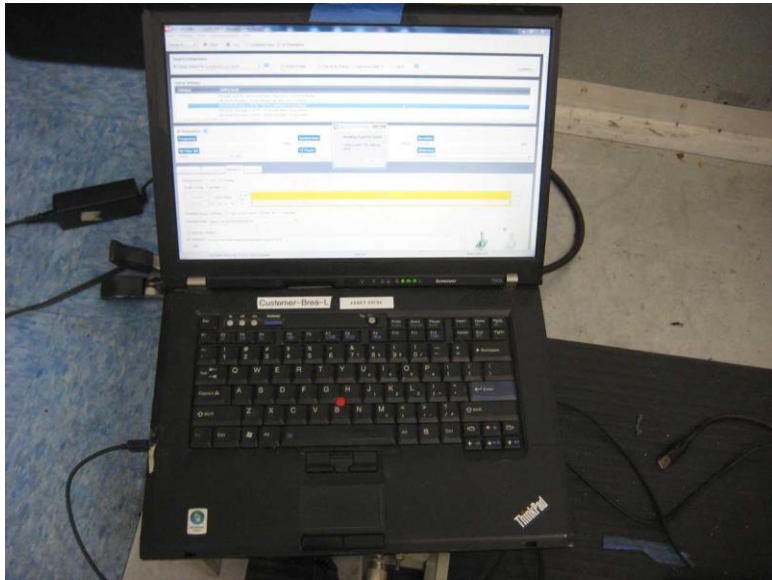
General Product Information:

Product Information	Manufacturer-Provided Details
Equipment Type:	Stand-Alone Equipment
Type of Wideband System:	BLE
Operating Frequency Range:	2404-2480MHz
Modulation Type(s):	GFSK
Maximum Duty Cycle:	100
Number of TX Chains:	1
Antenna Type(s) and Gain:	Chip Antenna/2.5dBi
Beamforming Type:	NA
Antenna Connection Type:	Integral (External connector provided to facilitate testing)
Nominal Input Voltage:	24Vac
Firmware / Software used for Test:	04-38-00

EUT Photo(s)



Support Equipment Photo(s)



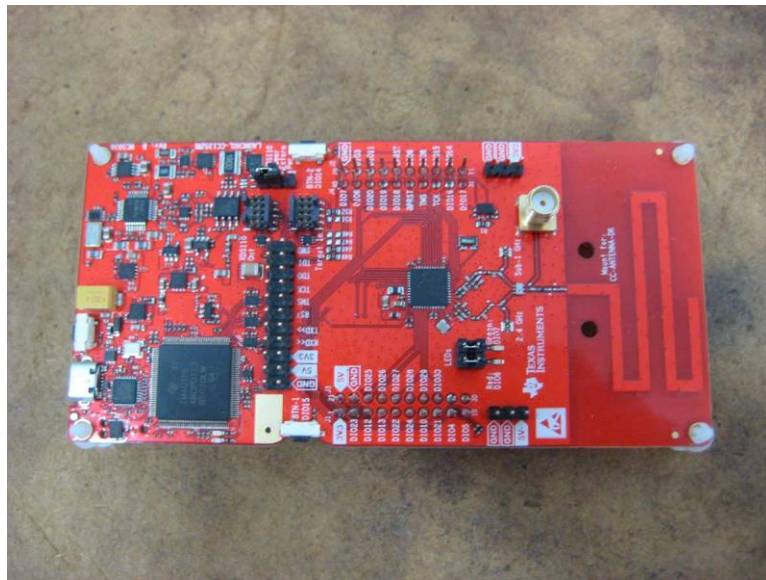
Laptop



AC/DC adapter



24Vac Adapter



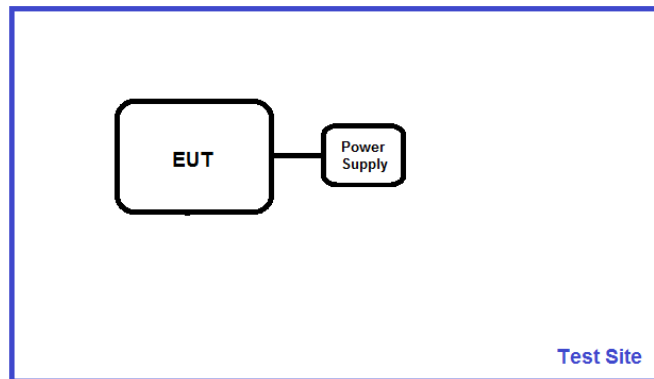
Interface Board



Wifi Prog Board

Block Diagram of Test Setup(s)

Test Setup Block Diagram



FCC Part 15 Subpart C

15.247(a)(2) 6dB Bandwidth

Test Setup/Conditions			
Test Location:	Brea Lab D	Test Engineer:	Don Nguyen
Test Method:	ANSI C63.10 (2013) KDB 558074 D01 15.247 Meas Guidance v05r02 04/02/2019	Test Date(s):	11/11/2020
Configuration:	1		
Test Setup:	<p>EUT is powered from 24Vac AC Adapter and connected to a laptop via USB cable and test board. The laptop is running software SmartRF Studio 7 to activate transmitter.</p> <p>Software setting: RF Designed Based On: LAUNCHXL-CC1352R1-2_4GHZ Frequency: 2404, 2442, 2480MHz Data Rate: 1Mbps, 2Mbps Modulation: GFSK Cap Array Delta: 20 (0x14) Mode: Continuous TX/ Modulated TX Power: 5dBm</p> <p>Frequency of measurement: 2404, 2442, 2480MHz RBW=100kHz, VBW=300kHz</p>		

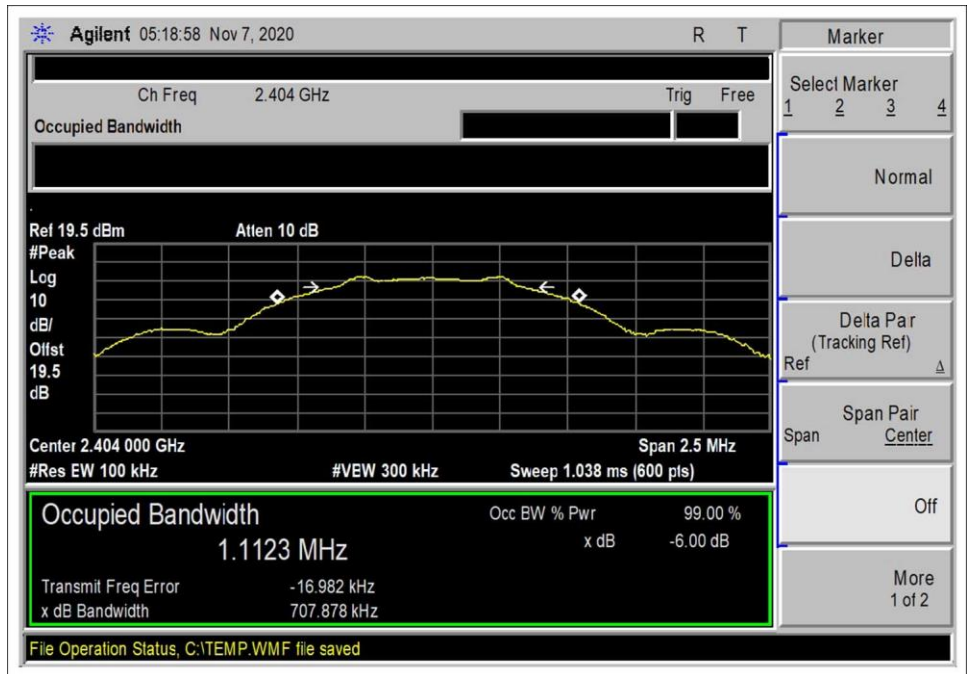
Environmental Conditions			
Temperature (°C)	23.3	Relative Humidity (%):	32

Test Equipment					
Asset #	Description	Manufacturer	Model	Cal Date	Cal Due
02869	Spectrum Analyzer	Agilent	E4440	8/3/2020	8/3/2021
03431	Attenuator	Aeroflex/Weinschel	89-20-21	12/20/2019	12/20/2021
P07246	Cable	H&S	32022-29094K-29094K-24TC	5/29/2020	5/29/2022

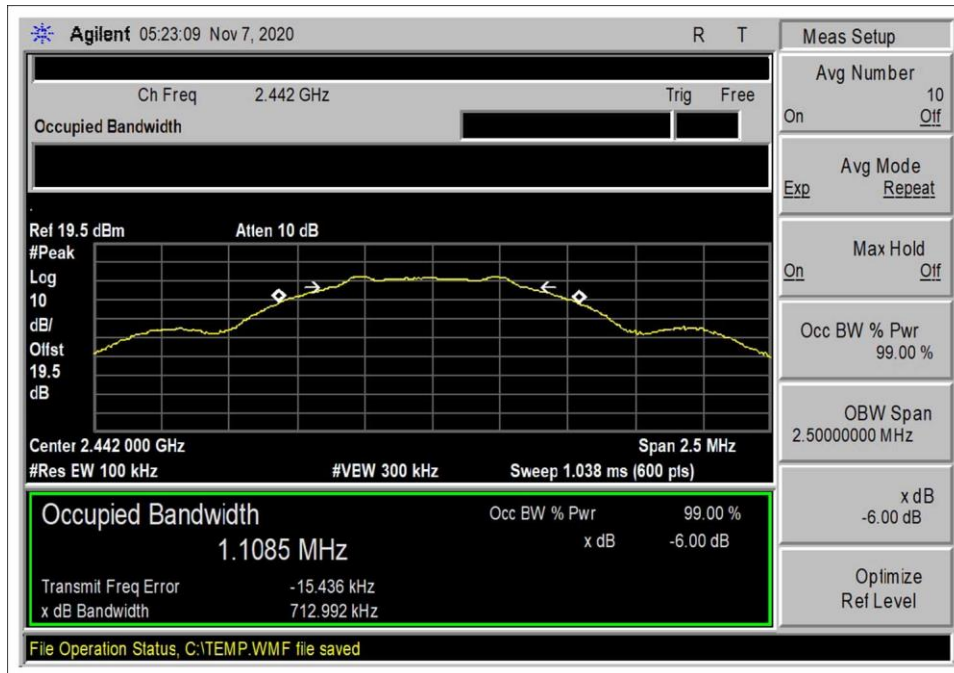
Test Data Summary-Data Rate 1Mbps					
Frequency (MHz)	Antenna Port	Modulation	Measured (kHz)	Limit (kHz)	Results
2404	BLE	GFSK	707.878	≥500	Pass
2442	BLE	GFSK	712.992	≥500	Pass
2480	BLE	GFSK	707.971	≥500	Pass

Test Data Summary-Data Rate 2Mbps					
Frequency (MHz)	Antenna Port	Modulation	Measured (kHz)	Limit (kHz)	Results
2404	BLE	GFSK	1324	≥500	Pass
2442	BLE	GFSK	1327	≥500	Pass
2480	BLE	GFSK	1344	≥500	Pass

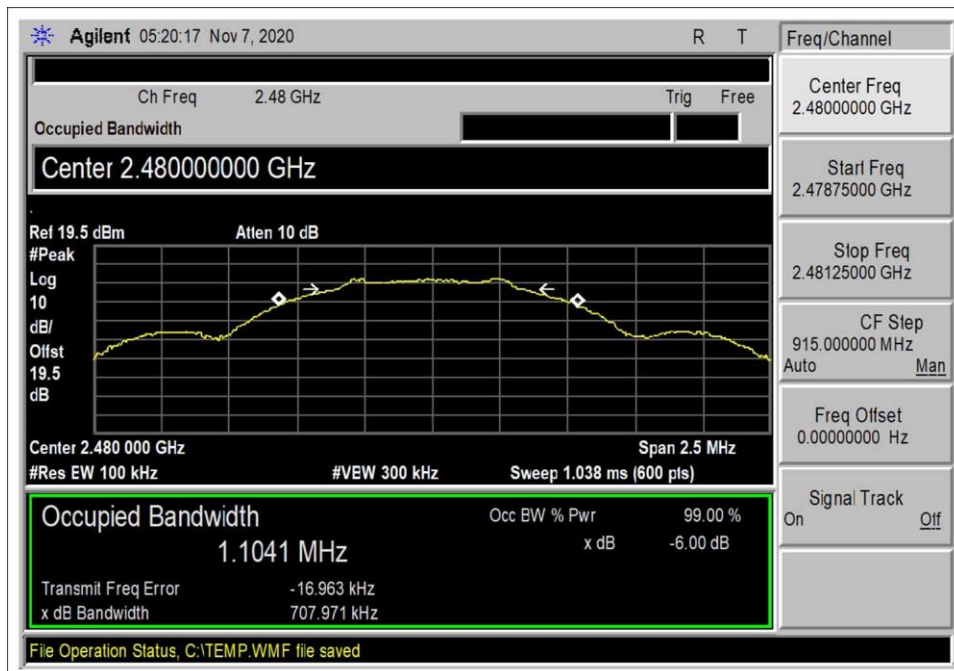
Plot(s)



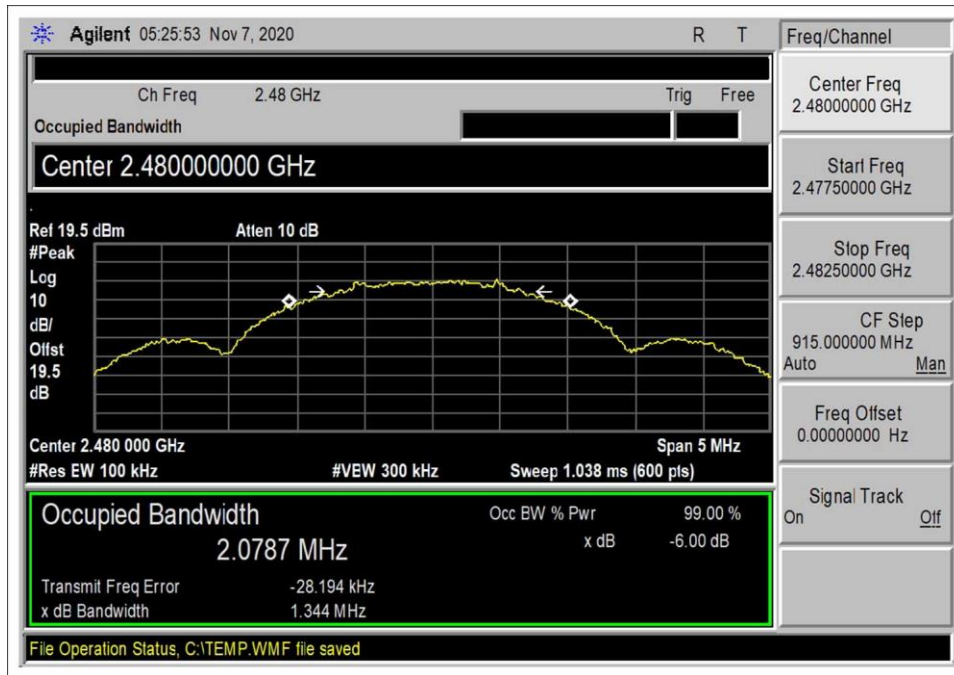
1Mbps, Low Channel



1Mbps, Middle Channel

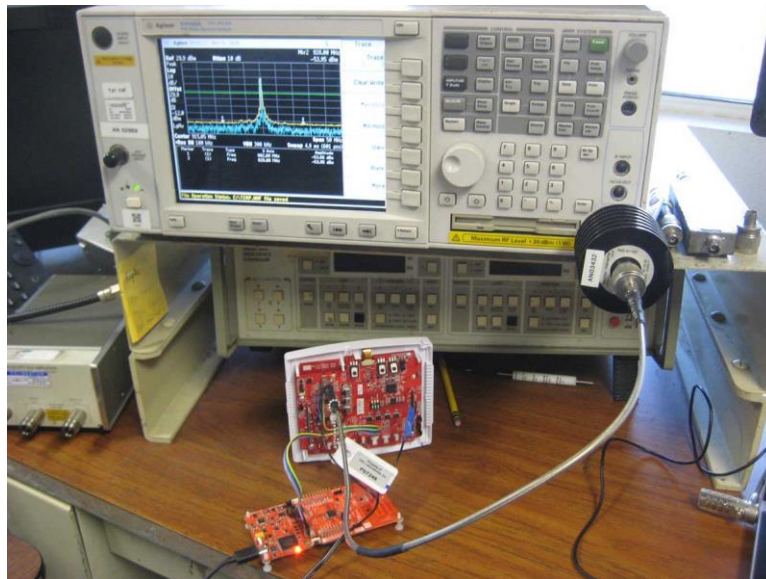


1Mbps, High Channel



2Mbps, High Channel

Test Setup Photo(s)



15.247(b)(3) Output Power

Test Setup/Conditions			
Test Location:	Brea Lab D	Test Engineer:	Don Nguyen
Test Method:	ANSI C63.10 (2013) KDB 558074 D01 15.247 Meas Guidance v05r02 04/02/2019	Test Date(s):	11/11/2020
Configuration:	1		
Test Setup:	EUT is powered from 24Vac AC Adapter and connected to a laptop via USB cable and test board. The laptop is running software SmartRF Studio 7 to activate transmitter. Software setting: RF Designed Based On: LAUNCHXL-CC1352R1-2_4GHZ Frequency: 2404, 2442, 2480MHz Data Rate: 1Mbps, 2Mbps Modulation: GFSK Cap Array Delta: 20 (0x14) Mode: Continuous TX/ Modulated TX Power: 5dBm Frequency of measurement: 2404, 2442, 2480MHz RBW=2MHz, VBW=6MHz		

Environmental Conditions			
Temperature (°C)	23.3	Relative Humidity (%):	32

Test Equipment					
Asset #	Description	Manufacturer	Model	Cal Date	Cal Due
02869	Spectrum Analyzer	Agilent	E4440	8/3/2020	8/3/2021
03431	Attenuator	Aeroflex/Weinschel	89-20-21	12/20/2019	12/20/2021
P07246	Cable	H&S	32022-29094K-29094K-24TC	5/29/2020	5/29/2022

Test Data Summary - Voltage Variations					
Frequency (MHz)	Modulation	V _{Minimum} (dBm)	V _{Nominal} (dBm)	V _{Maximum} (dBm)	Max Deviation from V _{Nominal} (dB)
2404	GFSK	1.60	1.61	1.61	0.01
2442	GFSK	1.61	1.62	1.62	0.01
2480	GFSK	1.60	1.58	1.58	0.02

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

Parameter Definitions:

Measurements performed at input voltage $V_{nominal} \pm 15\%$.

Parameter	Value
$V_{Nominal}$:	24.0Vac
$V_{Minimum}$:	20.4Vac
$V_{Maximum}$:	27.6Vac

Test Data Summary - RF Conducted Measurement – Data Rate 1Mbps

Measurement Option: RBW > DTS Bandwidth

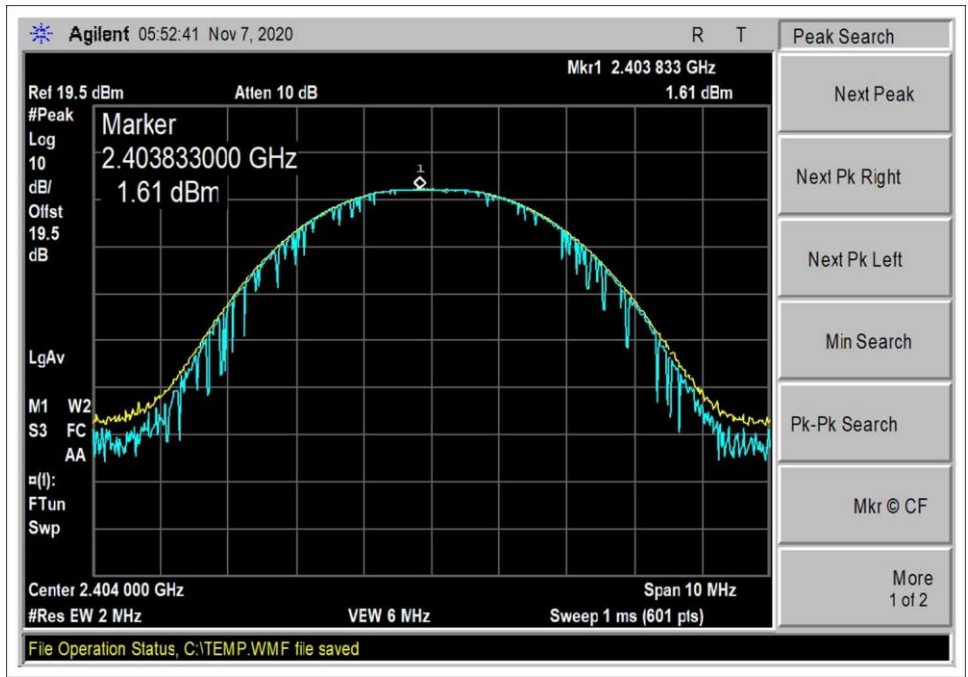
Frequency (MHz)	Modulation	Ant. Type / Gain (dBi)	Measured (dBm)	Limit (dBm)	Results
2404	GFSK	Chip/2.5	1.61	≤ 30	Pass
2442	GFSK	Chip/2.5	1.60	≤ 30	Pass
2480	GFSK	Chip/2.5	1.57	≤ 30	Pass

Test Data Summary - RF Conducted Measurement – Data Rate 2Mbps

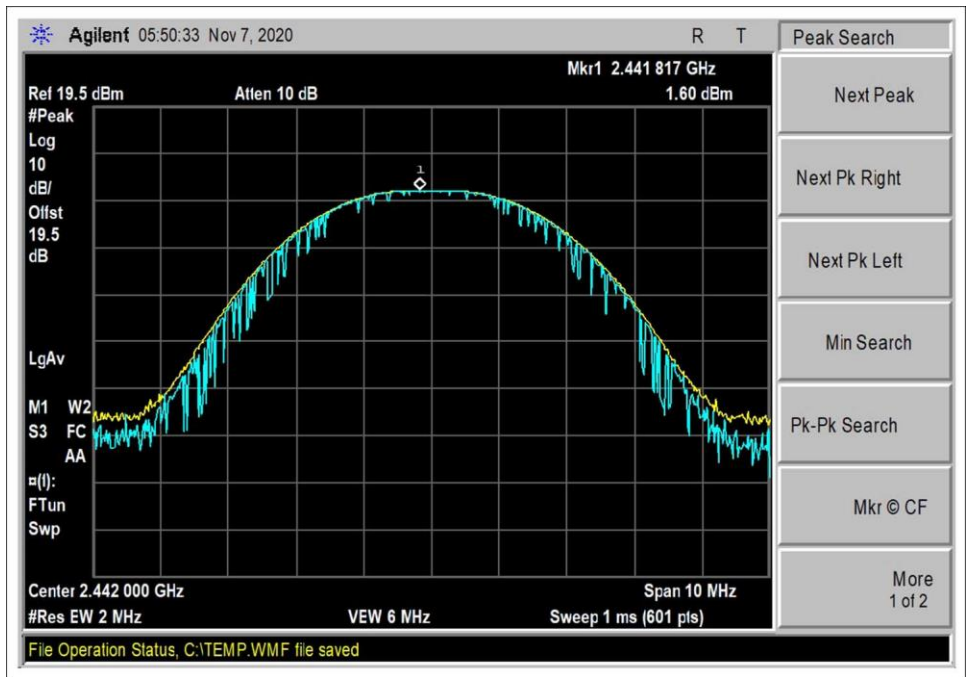
Measurement Option: RBW > DTS Bandwidth

Frequency (MHz)	Modulation	Ant. Type / Gain (dBi)	Measured (dBm)	Limit (dBm)	Results
2404	GFSK	Chip/2.5	1.60	≤ 30	Pass
2442	GFSK	Chip/2.5	1.62	≤ 30	Pass
2480	GFSK	Chip/2.5	1.58	≤ 30	Pass

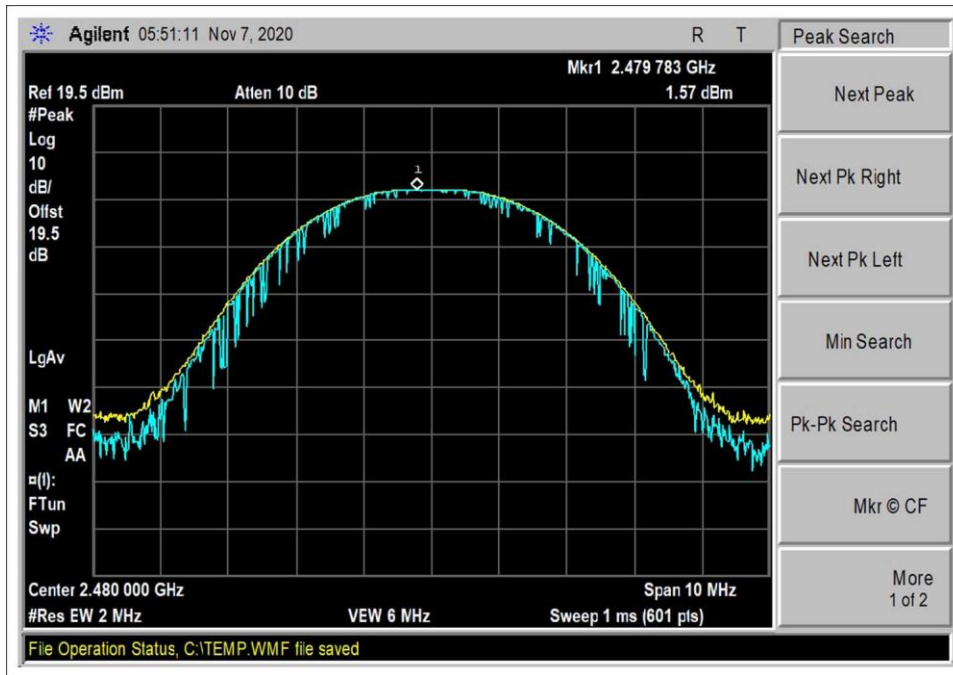
Plots



1Mbps, Low Channel



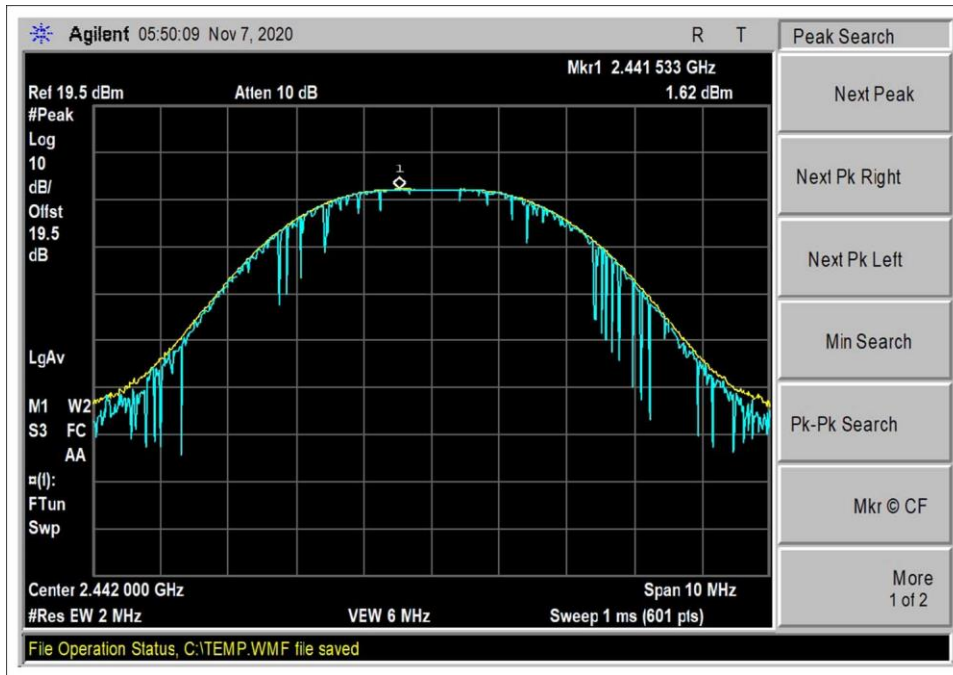
1Mbps, Middle Channel



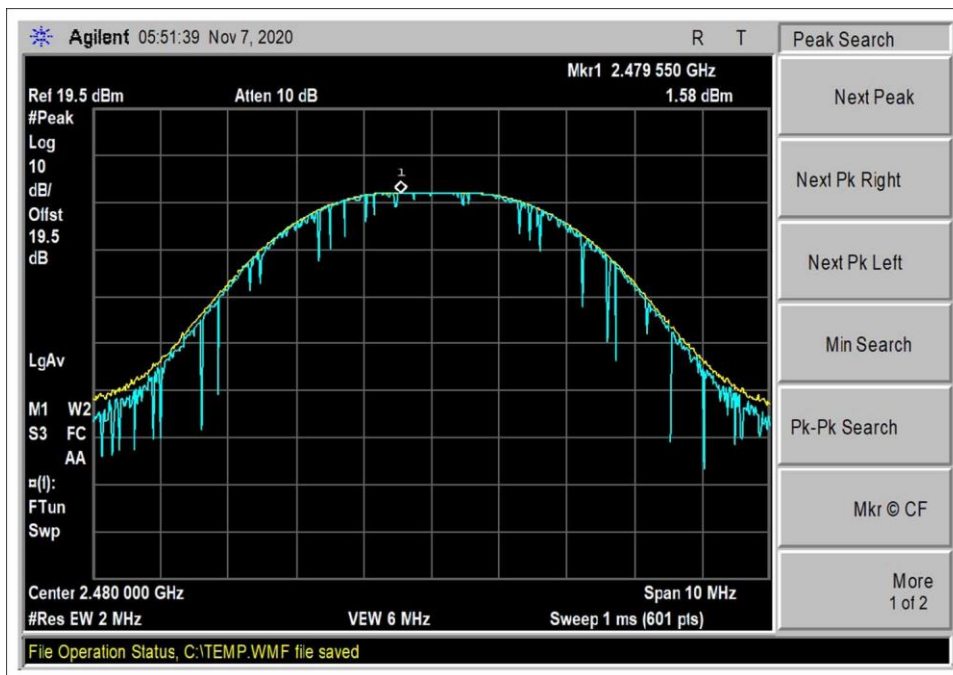
1Mbps, High Channel



2Mbps, Low Channel

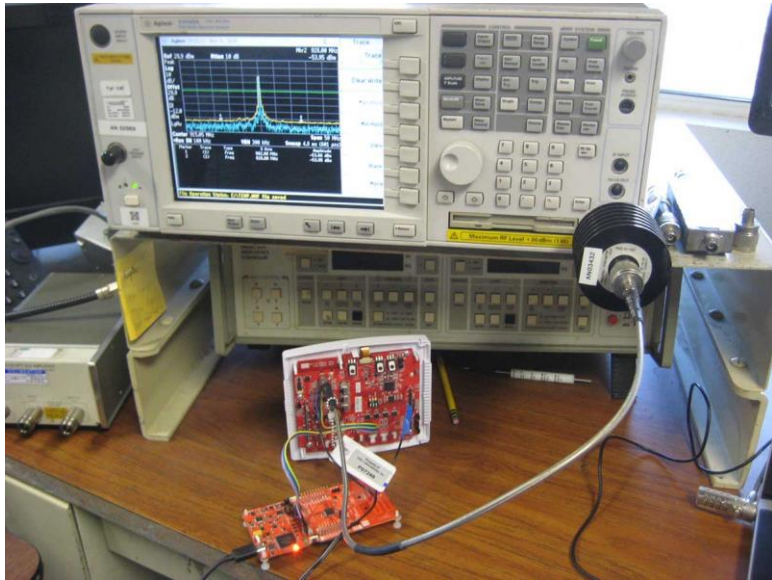


2Mbps, Middle Channel



2Mbps, High Channel

Test Setup Photo(s)



15.247(e) Power Spectral Density

Test Setup/Conditions			
Test Location:	Brea Lab D	Test Engineer:	Don Nguyen
Test Method:	ANSI C63.10 (2013) KDB 558074 D01 15.247 Meas Guidance v05r02 04/02/2019	Test Date(s):	11/11/2020
Configuration:	1		
Test Setup:	EUT is powered from 24Vac AC Adapter and connected to a laptop via USB cable and test board. The laptop is running software SmartRF Studio 7 to activate transmitter. Software setting: RF Designed Based On: LAUNCHXL-CC1352R1-2_4GHZ Frequency: 2404, 2442, 2480MHz Data Rate: 1Mbps, 2Mbps Modulation: GFSK Cap Array Delta: 20 (0x14) Mode: Continuous TX/ Modulated TX Power: 5dBm Frequency of measurement: 2404, 2442, 2480MHz RBW=3kHz, VBW=9.1kHz		

Environmental Conditions			
Temperature (°C)	23.3	Relative Humidity (%):	32

Test Equipment					
Asset #	Description	Manufacturer	Model	Cal Date	Cal Due
02869	Spectrum Analyzer	Agilent	E4440	8/3/2020	8/3/2021
03431	Attenuator	Aeroflex/Weinschel	89-20-21	12/20/2019	12/20/2021
P07246	Cable	H&S	32022-29094K-29094K-24TC	5/29/2020	5/29/2022

Test Data Summary - RF Conducted Measurement - Data Rate 1Mbps

Measurement Method: PKPSD

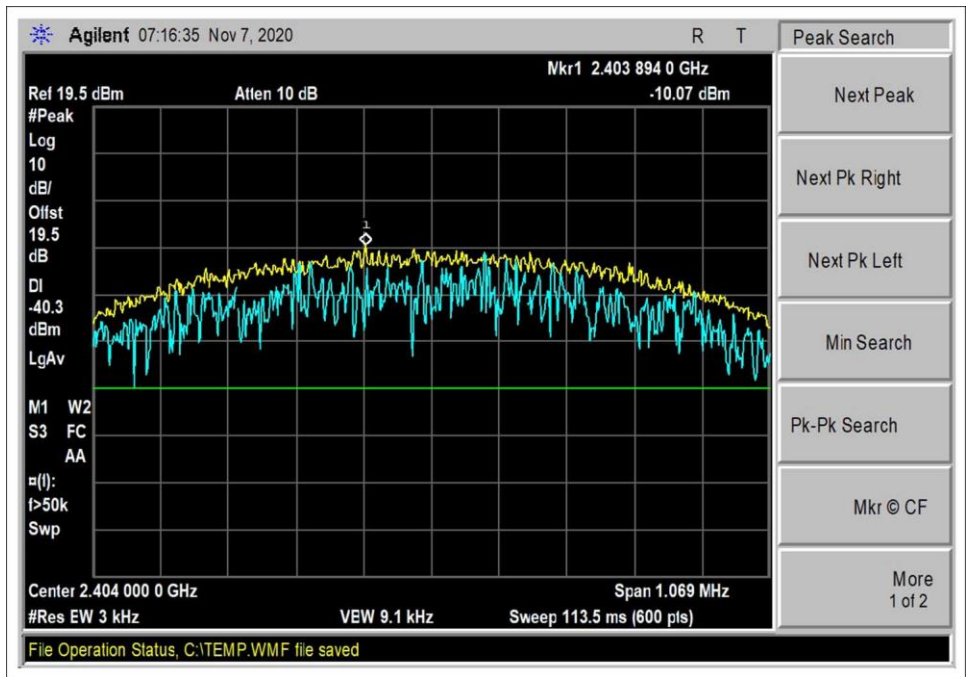
Frequency (MHz)	Modulation	Measured (dBm/3kHz)	Limit (dBm/3kHz)	Results
2404	GFSK	-10.07	≤8	Pass
2442	GFSK	-10.37	≤8	Pass
2480	GFSK	-10.34	≤8	Pass

Test Data Summary - RF Conducted Measurement - Data Rate 2Mbps

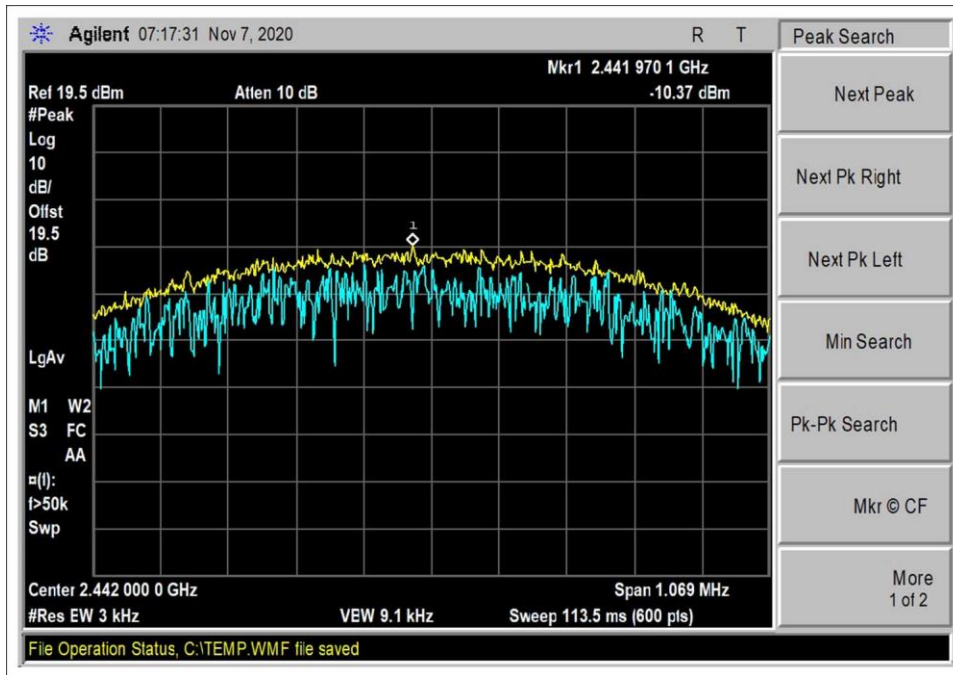
Measurement Method: PKPSD

Frequency (MHz)	Modulation	Measured (dBm/3kHz)	Limit (dBm/3kHz)	Results
2404	GFSK	-13.92	≤8	Pass
2442	GFSK	-13.11	≤8	Pass
2480	GFSK	-12.95	≤8	Pass

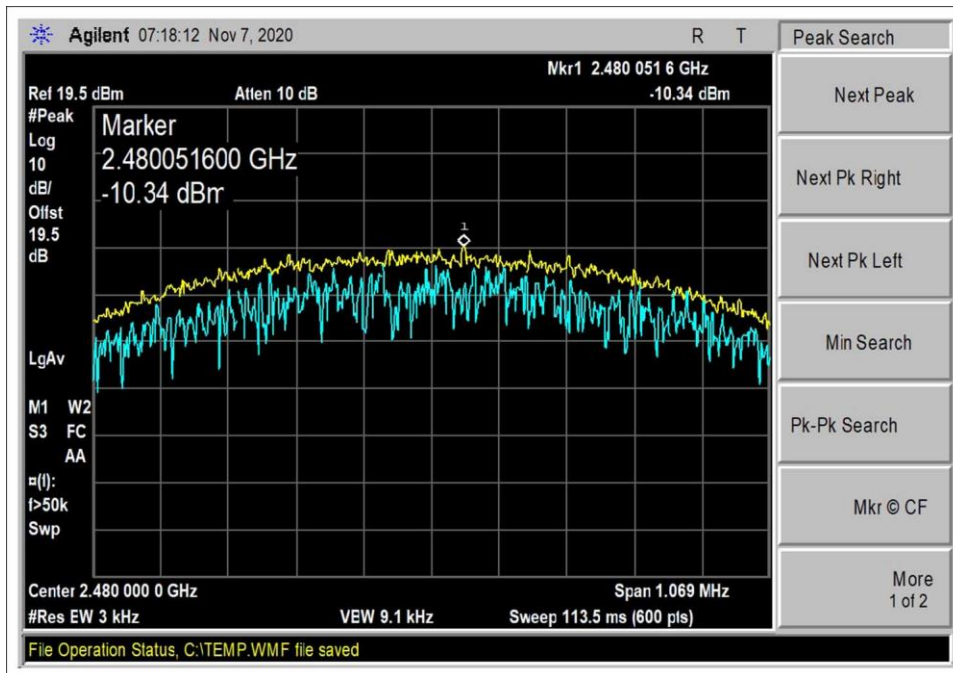
Plots



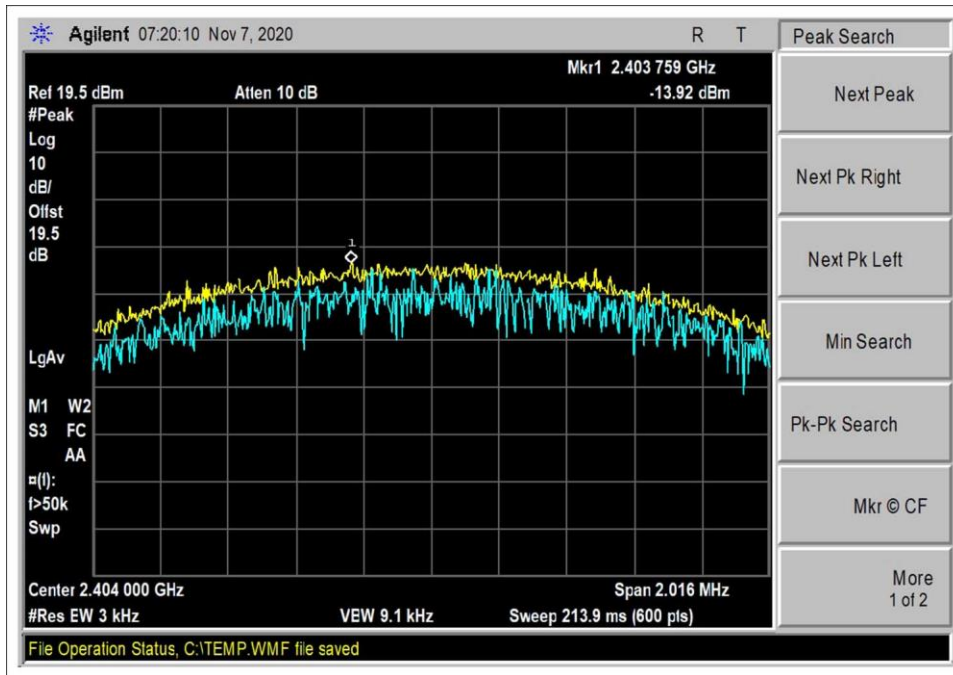
1Mbps; Low Channel



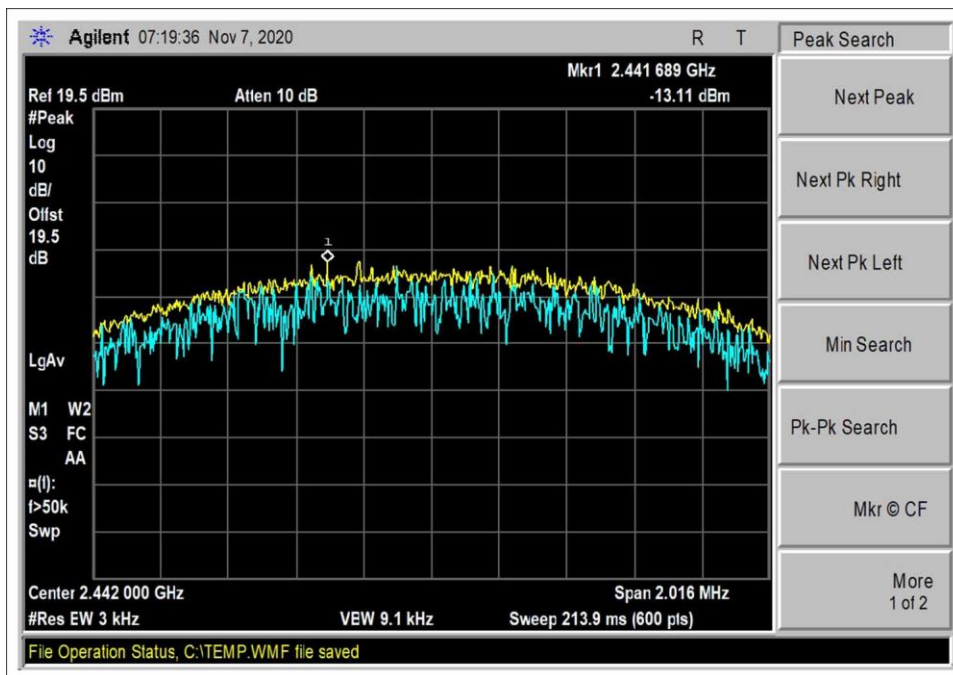
1Mbps; Middle Channel



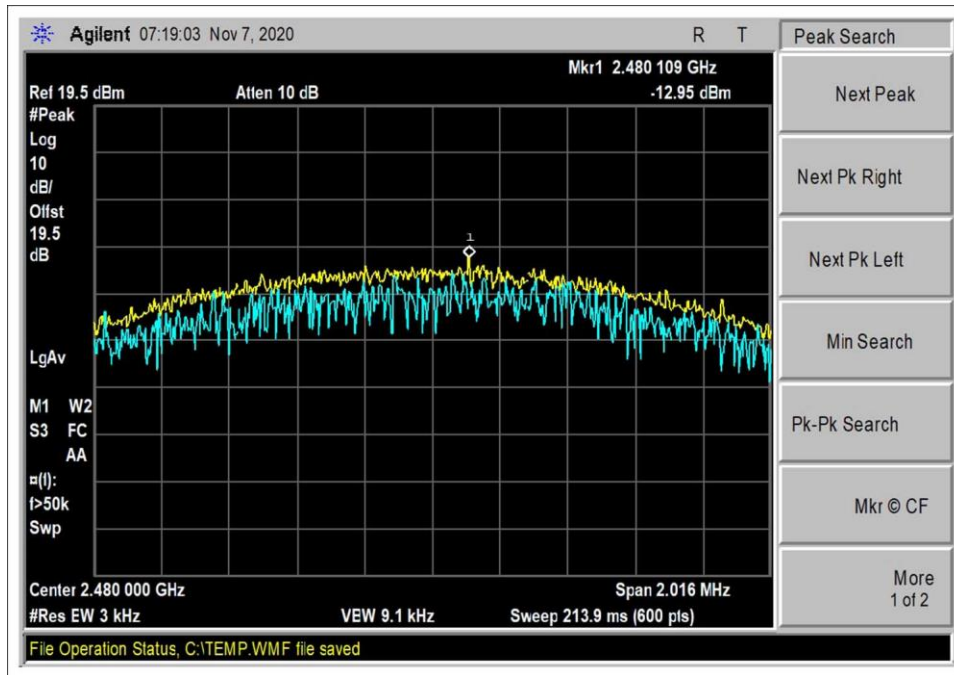
1Mbps; High Channel



2Mbps; Low Channel

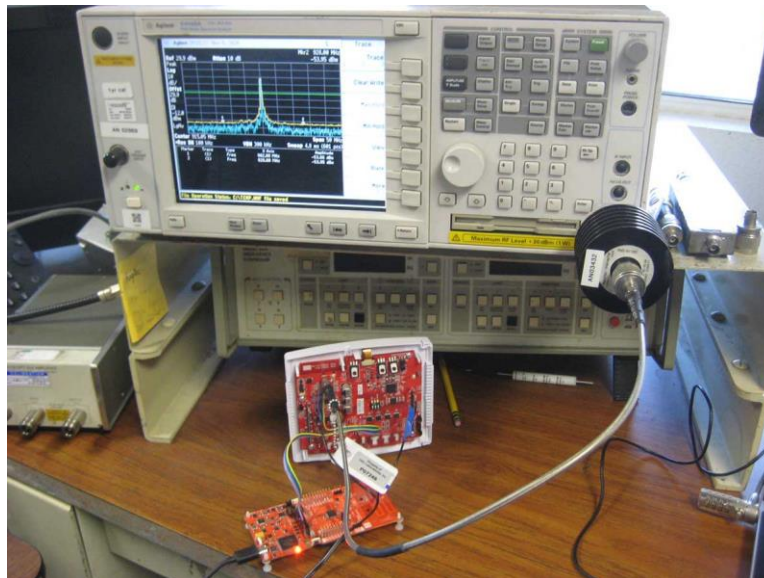


2Mbps; Middle Channel



2Mbps; High Channel

Test Setup Photo(s)



15.247(d) RF Conducted Emissions & Band Edge

Test Setup / Conditions / Data

Test Location: CKC Laboratories Inc. • 110 N. Olinda Pl. • Brea, CA 92823 • 714-993-6112
 Customer: **Venstar, Inc.**
 Specification: **15.247(d) Conducted Spurious Emissions**
 Work Order #: **104728** Date: 11/13/2020
 Test Type: **Conducted Emissions** Time: 08:45:53
 Tested By: Don Nguyen Sequence#: 1
 Software: EMITest 5.03.19 24Vac

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

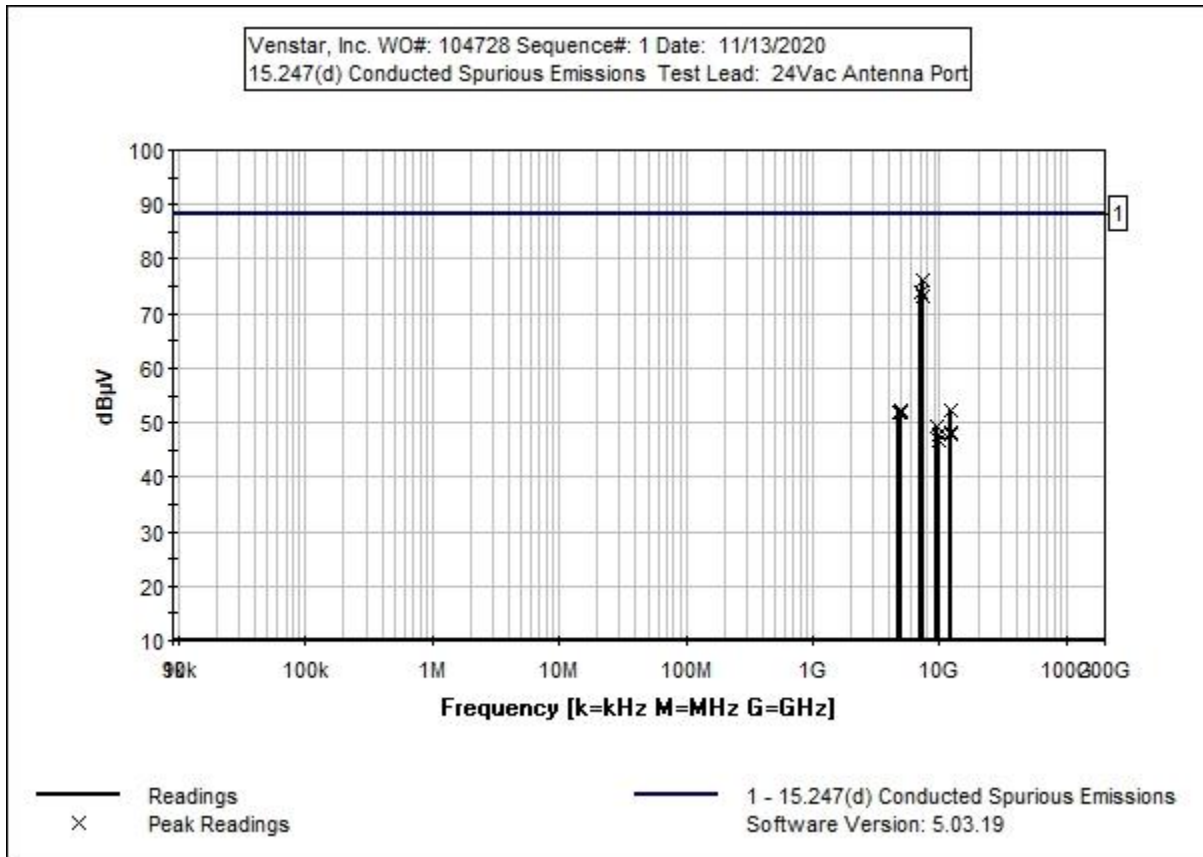
EUT is powered from 24Vac AC Adapter and connected to a laptop via USB cable and test board. The laptop is running software SmartRF Studio 7 to activate transmitter.

Software setting:
 RF Designed Based On: LAUNCHXL-CC1352R1-2_4GHZ
 Frequency: 2404, 2442, 2480MHz
 Data Rate: 1Mbps
 Modulation: GFSK
 Cap Array Delta: 20 (0x14)
 Mode: Continuous TX/ Modulated
 TX Power: 5dBm

Frequency of Measurement: 9kHz-25GHz
 RBW=100kHz, VBW=300kHz

Test Environment Conditions:
 Temperature: 23.3°C
 Relative Humidity: 32%

Test Methods: ANSI C63.10 (2013), KDB 558074 D01 15.247 Meas Guidance v05r02 04/02/2019



Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	ANP07246	Cable	32022-29094K-29094K-24TC	5/29/2020	5/29/2022
	AN02869	Spectrum Analyzer	E4440A	8/3/2020	8/3/2021
T2	AN03431	Attenuator	89-20-21	12/20/2019	12/20/2021

Measurement Data:

Reading listed by margin.

Test Lead: Antenna Port

#	Freq MHz	Rdng dB μ V	T1 dB	T2 dB		Dist Table	Corr dB μ V	Spec dB μ V	Margin dB	Polar Ant
1	7326.720M	56.0	+0.8	+19.2		+0.0	76.0	88.4	-12.4	Anten
2	7211.180M	54.0	+0.8	+19.2		+0.0	74.0	88.4	-14.4	Anten
3	7439.180M	52.9	+0.9	+19.3		+0.0	73.1	88.4	-15.3	Anten
4	4960.480M	32.5	+0.6	+19.3		+0.0	52.4	88.4	-36.0	Anten
5	12018.680 M	31.8	+1.2	+19.1		+0.0	52.1	88.4	-36.3	Anten
6	4808.480M	31.9	+0.7	+19.4		+0.0	52.0	88.4	-36.4	Anten
7	4884.480M	31.8	+0.6	+19.3		+0.0	51.7	88.4	-36.7	Anten
8	9614.980M	29.1	+1.1	+19.0		+0.0	49.2	88.4	-39.2	Anten
9	12401.320 M	27.7	+1.2	+19.3		+0.0	48.2	88.4	-40.2	Anten
10	12208.580 M	27.7	+1.1	+19.2		+0.0	48.0	88.4	-40.4	Anten
11	9768.950M	27.7	+1.0	+19.1		+0.0	47.8	88.4	-40.6	Anten
12	9918.980M	26.5	+1.1	+19.2		+0.0	46.8	88.4	-41.6	Anten

Test Location: CKC Laboratories Inc. • 110 N. Olinda Pl. • Brea, CA 92823 • 714-993-6112
 Customer: **Venstar, Inc.**
 Specification: **15.247(d) Conducted Spurious Emissions**
 Work Order #: **104728** Date: 11/13/2020
 Test Type: **Conducted Emissions** Time: 08:51:28
 Tested By: Don Nguyen Sequence#: 2
 Software: EMITest 5.03.19 24Vac

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

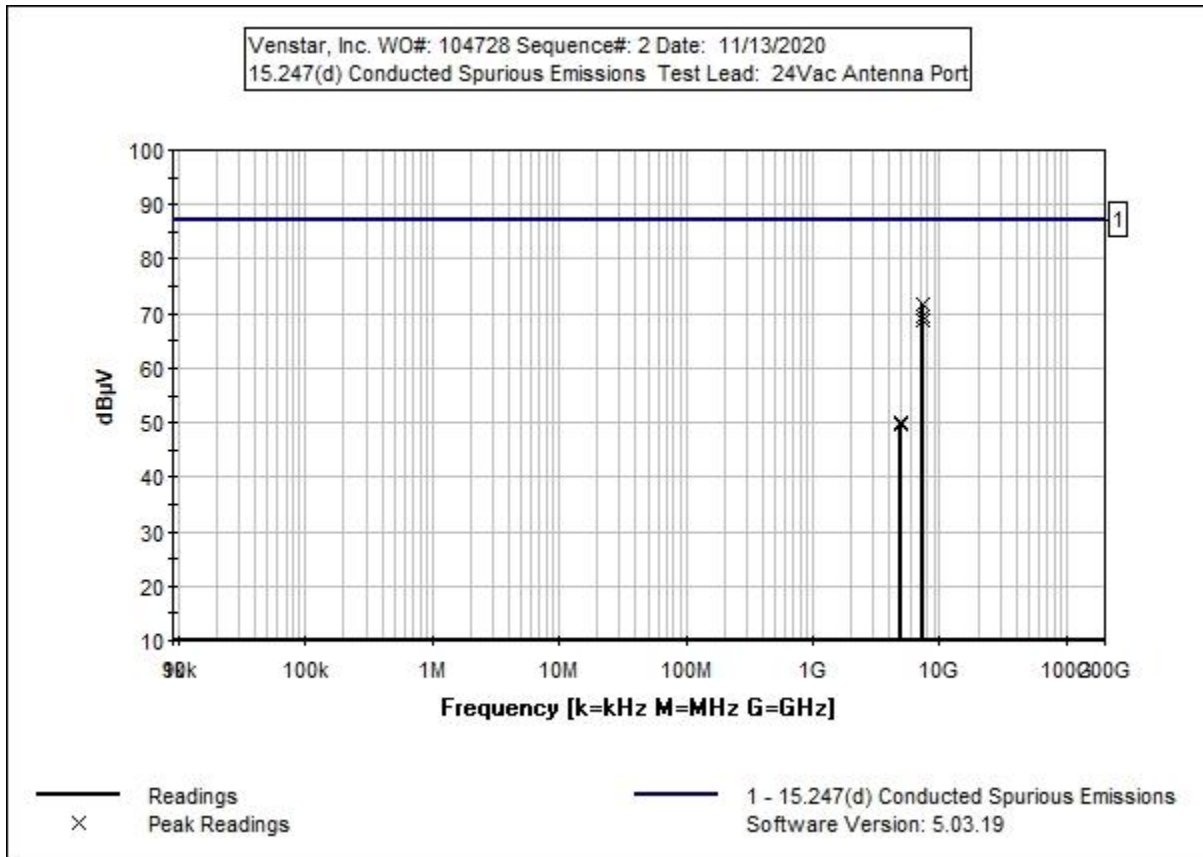
Test Conditions / Notes:

EUT is powered from 24Vac AC Adapter and connected to a laptop via USB cable and test board. The laptop is running software SmartRF Studio 7 to activate transmitter.
 Software setting:
 RF Designed Based On: LAUNCHXL-CC1352R1-2_4GHZ
 Frequency: 2404, 2442, 2480MHz
 Data Rate: 2Mbps
 Modulation: GFSK
 Cap Array Delta: 20 (0x14)
 Mode: Continuous TX/ Modulated
 TX Power: 5dBm

Frequency of Measurement: 9kHz-25GHz
 RBW=100kHz, VBW=300kHz

Test Environment Conditions:
 Temperature 23.3°C
 Relative Humidity: 32%

Test Methods: ANSI C63.10 (2013), KDB 558074 D01 15.247 Meas Guidance v05r02 04/02/2019



Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	ANP07246	Cable	32022-29094K-29094K-24TC	5/29/2020	5/29/2022
	AN02869	Spectrum Analyzer	E4440A	8/3/2020	8/3/2021
T2	AN03431	Attenuator	89-20-21	12/20/2019	12/20/2021

Measurement Data:

Reading listed by margin.

Test Lead: Antenna Port

#	Freq MHz	Rdng dB μ V	T1 dB	T2 dB		Dist Table	Corr dB μ V	Spec dB μ V	Margin dB	Polar Ant
1	7324.480M	51.7	+0.8	+19.2		+0.0	71.7	87.2	-15.5	Anten
2	7441.420M	49.2	+0.9	+19.3		+0.0	69.4	87.2	-17.8	Anten
3	7441.350M	48.7	+0.9	+19.3		+0.0	68.9	87.2	-18.3	Anten
4	4958.950M	30.1	+0.6	+19.3		+0.0	50.0	87.2	-37.2	Anten
5	4960.950M	29.7	+0.6	+19.3		+0.0	49.6	87.2	-37.6	Anten
6	4885.020M	29.7	+0.6	+19.3		+0.0	49.6	87.2	-37.6	Anten

Band Edge

Band Edge Summary – Data Rate 1Mbps

Limit applied: Max Power/100kHz - 20dB.

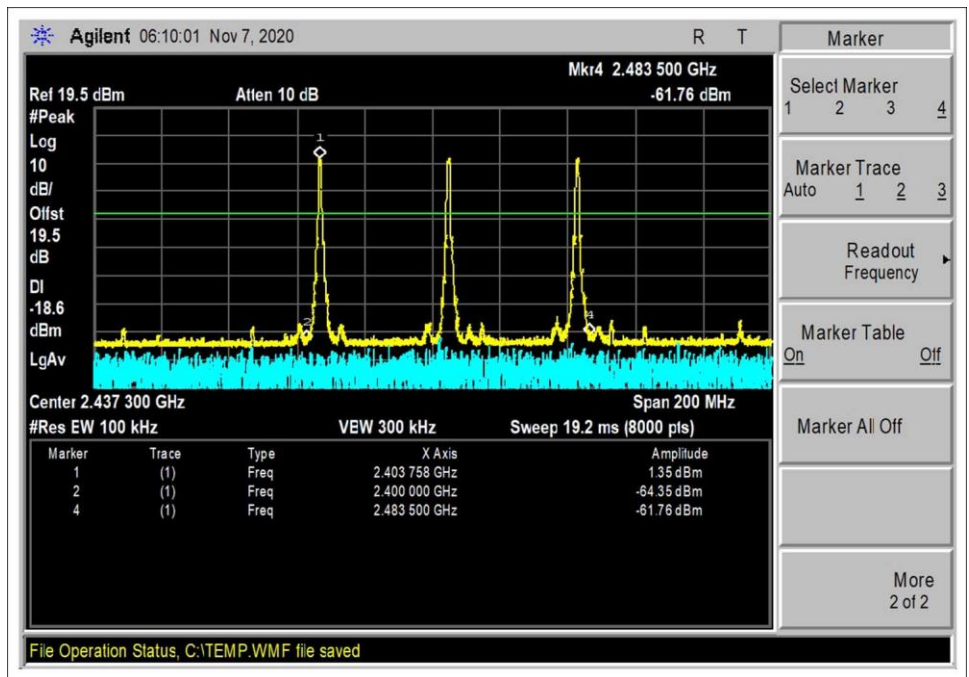
Frequency (MHz)	Modulation	Measured (dBm)	Limit (dBm)	Results
2400.0	GFSK	-64.35	<-18.6	Pass
2483.5	GFSK	-61.76	<-18.6	Pass

Band Edge Summary – Data Rate 2Mbps

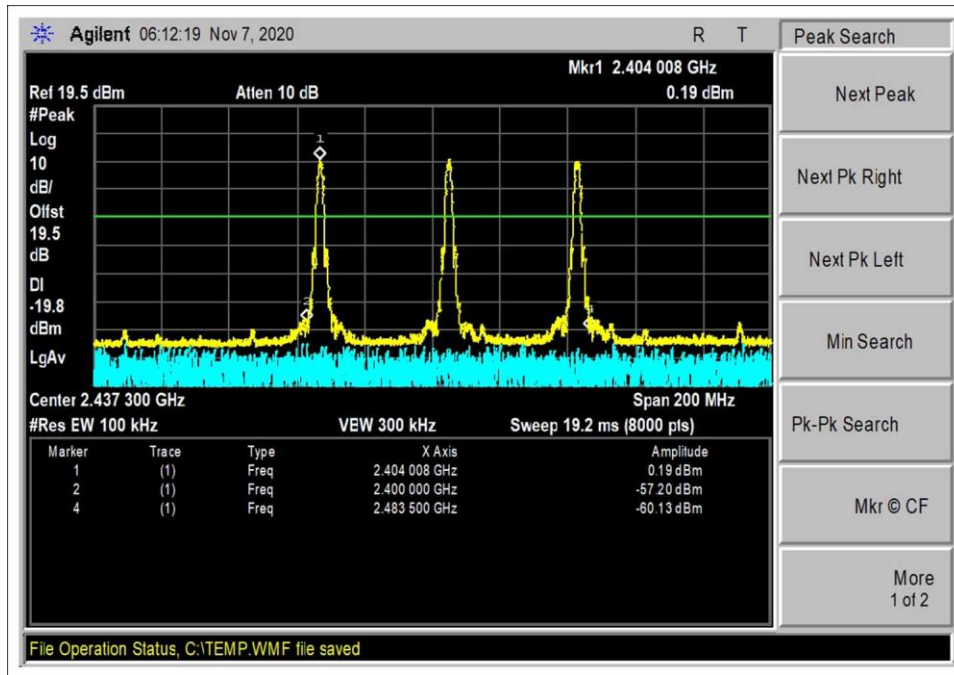
Limit applied: Max Power/100kHz - 20dB.

Frequency (MHz)	Modulation	Measured (dBm)	Limit (dBm)	Results
2400.0	GFSK	-57.20	<-19.8	Pass
2483.5	GFSK	-60.13	<-19.8	Pass

Band Edge Plots

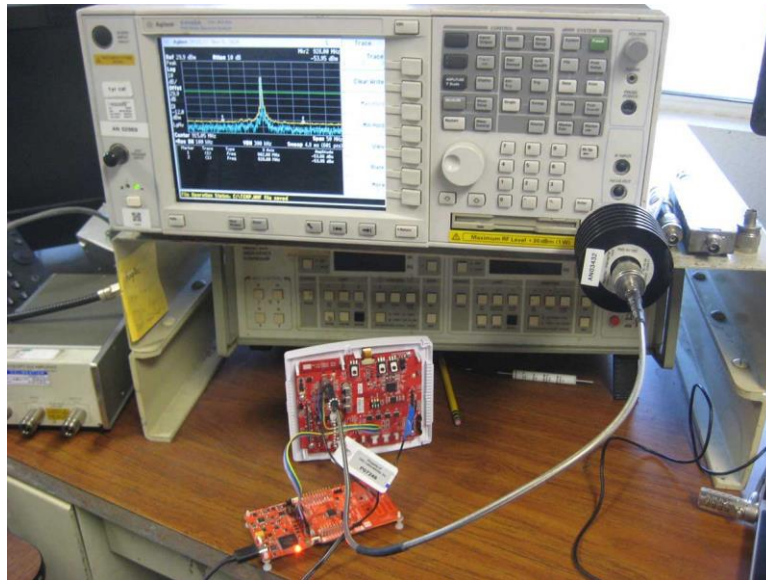


1Mbps



2Mbps

Test Setup Photo(s)



15.247(d) Radiated Emissions & Band Edge

Test Setup / Conditions / Data

Test Location: CKC Laboratories Inc. • 110 N. Olinda Pl. • Brea, CA 92823 • 714-993-6112
 Customer: **Venstar, Inc.**
 Specification: **15.247(d) / 15.209 Radiated Spurious Emissions**
 Work Order #: **104728** Date: 11/18/2020
 Test Type: **Maximized Emissions** Time: 10:01:47
 Tested By: Don Nguyen Sequence#: 6
 Software: EMITest 5.03.19

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 2			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 2			

Test Conditions / Notes:

EUT is powered from 24Vac AC Adapter and set to transmit continuously. All IO ports are populated with unterminated cables.
 Software setting:
 RF Designed Based On: LAUNCHXL-CC1352R1-2_4GHZ
 Frequency: 2404, 2442, 2480MHz
 Data Rate: 1Mbps and 2Mbps (data represent the worst case mode)
 Modulation: GFSK
 Cap Array Delta: 20 (0x14)
 Mode: Continuous TX/ Modulated
 TX Power: 5dBm

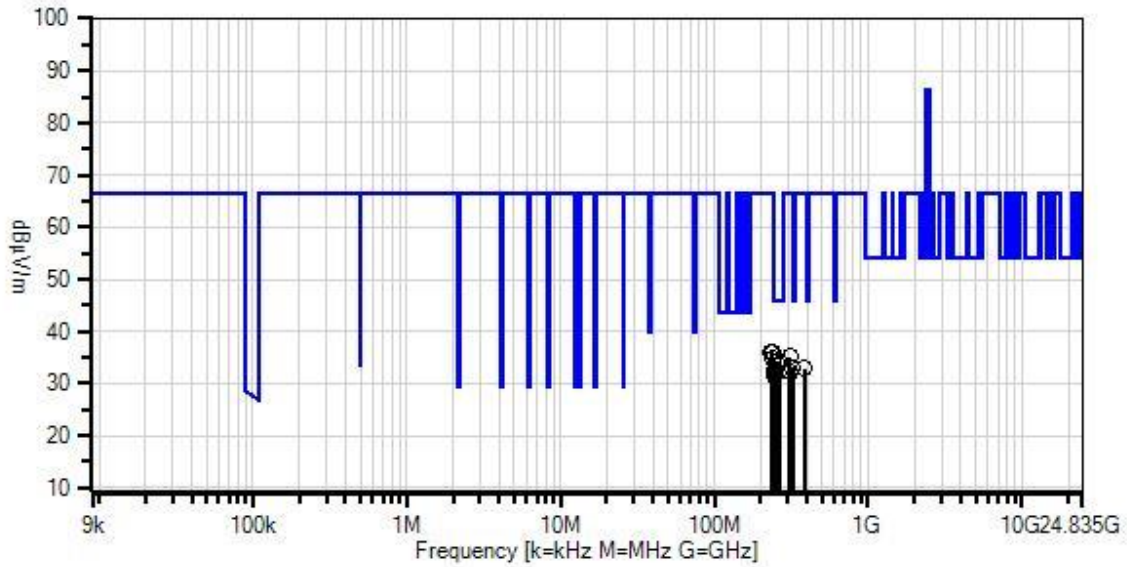
Frequency of Measurement: 9kHz-1000MHz
 9kHz to 150kHz RBW=0.2kHz, VBW=0.6kHz.
 150kHz to 30MHz RBW=9kHz, VBW=27kHz.
 30-1000MHz, RBW=120kHz, VBW=360kHz
 -20dBc limit, RBW=100kHz, VBW=300kHz

Test Environment Conditions:
 Temperature: 22.5°C
 Relative Humidity: 41%

Site A

Test Methods: ANSI C63.10 (2013), KDB 558074 D01 15.247 Meas Guidance v05r02 04/02/2019

Venstar, Inc. WO#: 104728 Sequence#: 6 Date: 11/18/2020
 15.247(d) / 15.209 Radiated Spurious Emissions Test Distance: 3 Meters Horiz



— Readings
 × QP Readings
 ▼ Ambient
 ○ Peak Readings
 * Average Readings
 Software Version: 5.03.19

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN00309	Preamp	8447D	12/24/2019	12/24/2021
T2	ANP05281	Attenuator	1B	4/7/2020	4/7/2022
T3	ANP05050	Cable	RG223/U	12/24/2018	12/24/2020
T4	ANP05198	Cable-Amplitude +15C to +45C (dB)	8268	12/4/2018	12/4/2020
	AN03643	Spectrum Analyzer	E4440A	5/20/2020	5/20/2022
T5	AN01993	Biconilog Antenna	CBL6111C	6/11/2019	6/11/2021
	AN00314	Loop Antenna	6502	4/13/2020	4/13/2022

Measurement Data:

Reading listed by margin.

Test Distance: 3 Meters

#	Freq MHz	Rdng dB μ V	T1 T5 dB	T2 dB	T3 dB	T4 dB	Dist Table	Corr dB μ V/m	Spec dB μ V/m	Margin dB	Polar Ant
1	241.550M	42.0	-27.9 +11.8	+5.9	+0.2	+2.9	+0.0	34.9	46.0	-11.1	Vert
2	264.150M	40.5	-27.9 +12.6	+5.9	+0.2	+3.0	+0.0	34.3	46.0	-11.7	Vert
3	253.100M	40.7	-27.9 +12.4	+5.9	+0.2	+2.9	+0.0	34.2	46.0	-11.8	Horiz
4	322.200M	37.5	-27.9 +14.0	+5.9	+0.3	+3.3	+0.0	33.1	46.0	-12.9	Horiz
5	247.550M	39.4	-27.9 +12.1	+5.9	+0.2	+2.9	+0.0	32.6	46.0	-13.4	Vert
6	244.450M	39.2	-27.9 +12.0	+5.9	+0.2	+2.9	+0.0	32.3	46.0	-13.7	Vert
7	245.950M	38.4	-27.9 +12.1	+5.9	+0.2	+2.9	+0.0	31.6	46.0	-14.4	Horiz
8	236.850M	43.6	-27.9 +11.5	+5.9	+0.2	+2.8	+0.0	36.1	66.3	-30.2	Vert
9	234.050M	43.5	-27.9 +11.3	+5.9	+0.2	+2.8	+0.0	35.8	66.3	-30.5	Vert
10	310.450M	39.9	-27.9 +13.6	+5.9	+0.3	+3.3	+0.0	35.1	66.3	-31.2	Horiz
11	382.150M	35.3	-27.9 +15.7	+5.9	+0.3	+3.6	+0.0	32.9	66.3	-33.4	Vert
12	308.150M	37.0	-27.9 +13.6	+5.9	+0.3	+3.3	+0.0	32.2	66.3	-34.1	Vert

Test Location: CKC Laboratories Inc. • 110 N. Olinda Pl. • Brea, CA 92823 • 714-993-6112
 Customer: **Venstar, Inc.**
 Specification: **15.247(d) / 15.209 Radiated Spurious Emissions**
 Work Order #: **104728** Date: 11/13/2020
 Test Type: **Maximized Emissions** Time: 14:08:31
 Tested By: Don Nguyen Sequence#: 5
 Software: EMITest 5.03.19

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 2			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 2			

Test Conditions / Notes:

EUT is powered from 24Vac AC Adapter and set to transmit continuously. All IO ports are populated with unterminated cables.
 Software setting:
 RF Designed Based On: LAUNCHXL-CC1352R1-2_4GHZ
 Frequency: 2404, 2442, 2480MHz
 Data Rate: 1Mbps and 2Mbps (data represent the worst case mode)
 Modulation: GFSK
 Cap Array Delta: 20 (0x14)
 Mode: Continuous TX/ Modulated
 TX Power: 5dBm

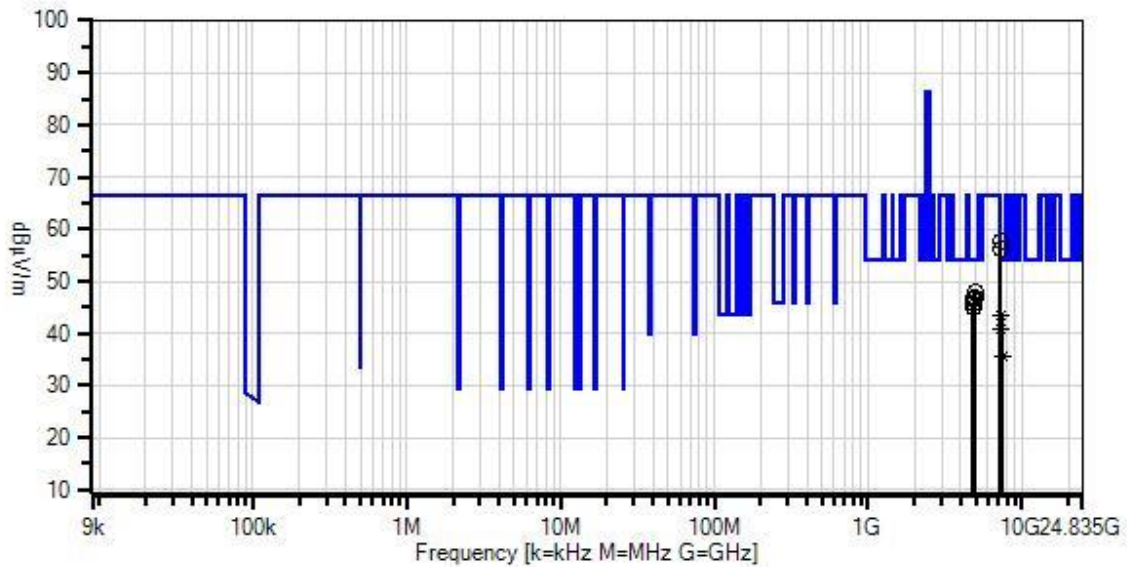
Frequency of Measurement: 1000MHz-25000MHz
 1000-25000MHz, RBW=1MHz, VBW=3MHz
 -20dBc limit, RBW=100kHz, VBW=300kHz

Test Environment Conditions:
 Temperature: 21.9°C
 Relative Humidity: 34%

Site D

Test Methods: ANSI C63.10 (2013), KDB 558074 D01 15.247 Meas Guidance v05r02 04/02/2019

Venstar, Inc. WO#: 104728 Sequence#: 5 Date: 11/13/2020
 15.247(d) / 15.209 Radiated Spurious Emissions Test Distance: 3 Meters Vert



— Readings
 × QP Readings
 ▼ Ambient
 — 1 - 15.247(d) / 15.209 Radiated Spurious Emissions

○ Peak Readings
 * Average Readings
 Software Version: 5.03.19

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN00787	Preamp	83017A	5/31/2019	5/31/2021
T2	AN01646	Horn Antenna	3115	3/17/2020	3/17/2022
T3	ANP07138	Cable	ANDL1- PNMNM-60	3/4/2019	3/4/2021
T4	ANP07246	Cable	32022-29094K- 29094K-24TC	5/29/2020	5/29/2022
T5	ANP04382	Cable	LDF-50	5/15/2020	5/15/2022
T6	AN02869	Spectrum Analyzer	E4440A	8/3/2020	8/3/2021
	AN03367	Horn Antenna	62-GH-62-25.	8/1/2019	8/1/2021
	AN01413	Horn Antenna	84125-80008	10/19/2020	10/19/2022

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

#	Freq MHz	Rdng dB μ V	T1 T5 dB	T2 T6 dB	T3 dB	T4 dB	Dist Table	Corr dB μ V/m	Spec dB μ V/m	Margin dB	Polar Ant
1	4960.000M	38.9	-39.9 +8.6	+33.8 +0.0	+5.9	+0.6	+0.0	47.9	54.0	-6.1	Horiz
2	4959.987M	37.9	-39.9 +8.6	+33.8 +0.0	+5.9	+0.6	+0.0	46.9	54.0	-7.1	Vert
3	4884.618M	38.0	-39.9 +8.6	+33.7 +0.0	+5.9	+0.6	+0.0	46.9	54.0	-7.1	Vert
4	4883.199M	37.4	-39.9 +8.6	+33.7 +0.0	+5.9	+0.6	+0.0	46.3	54.0	-7.7	Horiz
5	4807.641M	37.3	-40.0 +8.5	+33.5 +0.0	+5.8	+0.7	+0.0	45.8	54.0	-8.2	Horiz
6	7211.875M	42.1	-40.3 +11.0	+36.6 +0.0	+7.5	+0.8	+0.0	57.7	66.3	-8.6	Vert
7	4808.025M	36.6	-40.0 +8.5	+33.5 +0.0	+5.8	+0.7	+0.0	45.1	54.0	-8.9	Vert
8	7212.826M	40.6	-40.3 +11.0	+36.6 +0.0	+7.5	+0.8	+0.0	56.2	66.3	-10.1	Horiz
9	7325.216M	27.3	-40.3 +11.1	+37.0 +0.0	+7.5	+0.8	+0.0	43.4	54.0	-10.6	Horiz
^	7325.216M	41.6	-40.3 +11.1	+37.0 +0.0	+7.5	+0.8	+0.0	57.7	54.0	+3.7	Horiz
11	7326.484M	24.6	-40.3 +11.1	+37.0 +0.0	+7.5	+0.8	+0.0	40.7	54.0	-13.3	Vert
^	7326.484M	39.6	-40.3 +11.1	+37.0 +0.0	+7.5	+0.8	+0.0	55.7	54.0	+1.7	Vert
13	7440.069M	18.9	-40.4 +11.2	+37.3 +0.0	+7.6	+0.9	+0.0	35.5	54.0	-18.5	Vert
^	7440.069M	35.5	-40.4 +11.2	+37.3 +0.0	+7.6	+0.9	+0.0	52.1	54.0	-1.9	Vert
15	7440.000M	18.9	-40.4 +11.2	+37.3 +0.0	+7.6	+0.9	+0.0	35.5	54.0	-18.5	Horiz
^	7440.000M	34.1	-40.4 +11.2	+37.3 +0.0	+7.6	+0.9	+0.0	50.7	54.0	-3.3	Horiz

Band Edge

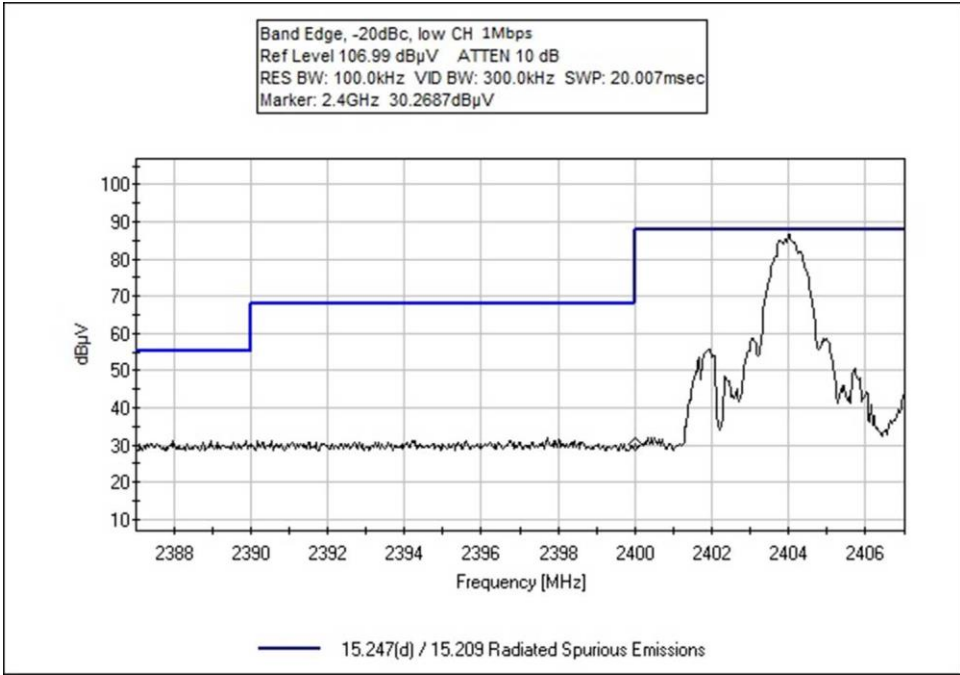
Band Edge Summary - Data Rate 1Mbps

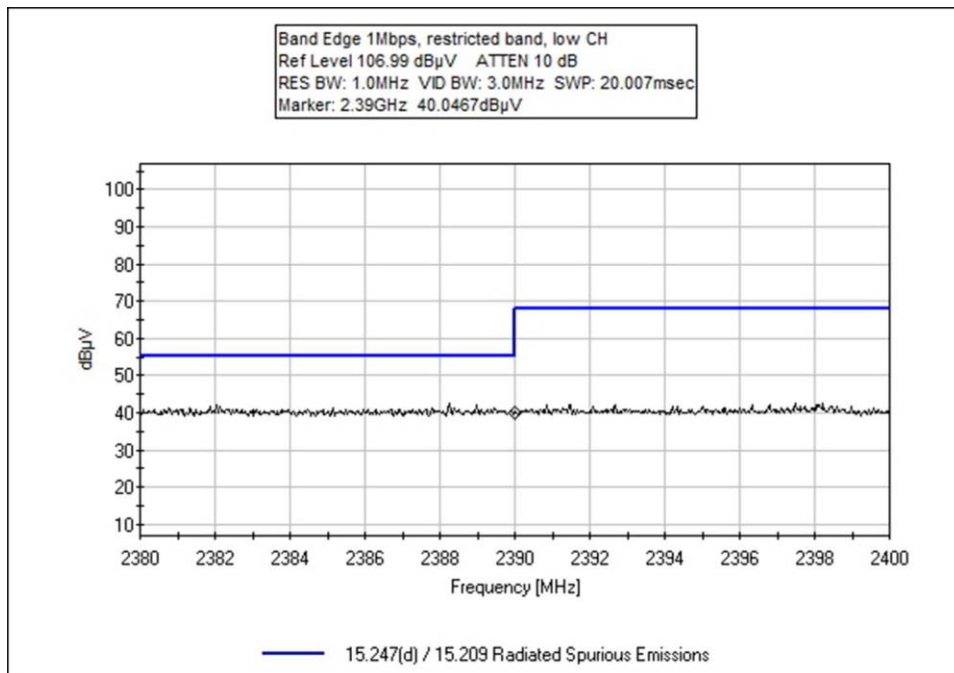
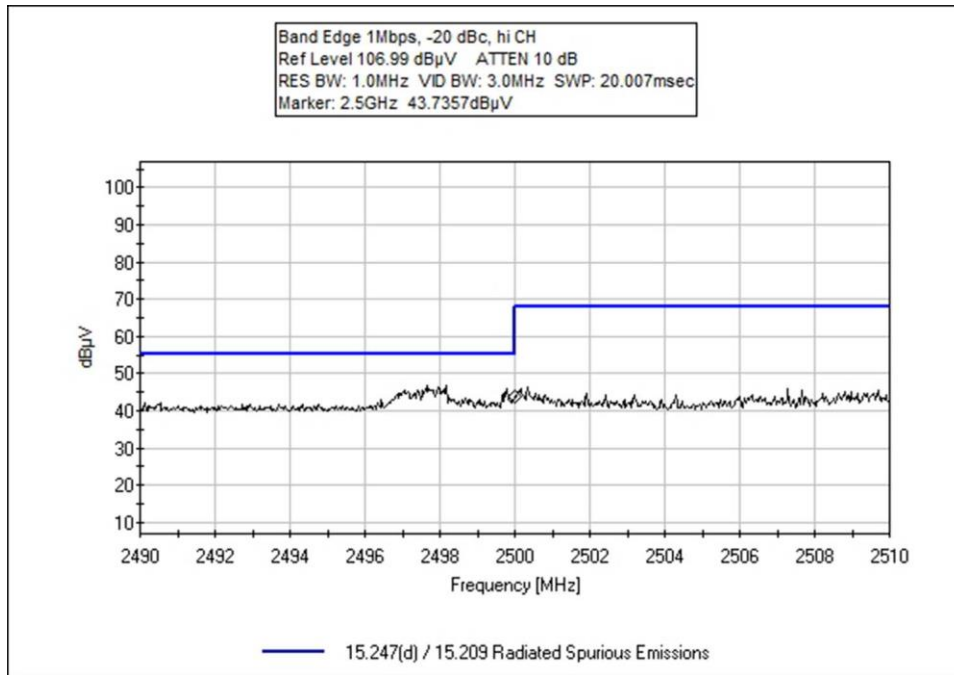
Frequency (MHz)	Modulation	Ant. Type	Field Strength (dBuV/m @3m)	Limit (dBuV/m @3m)	Results
2390.0	GFSK	Chip	38.6	<54	Pass
2400.0	GFSK	Chip	28.8	<66.3	Pass
2483.5	GFSK	Chip	37.8	<54	Pass

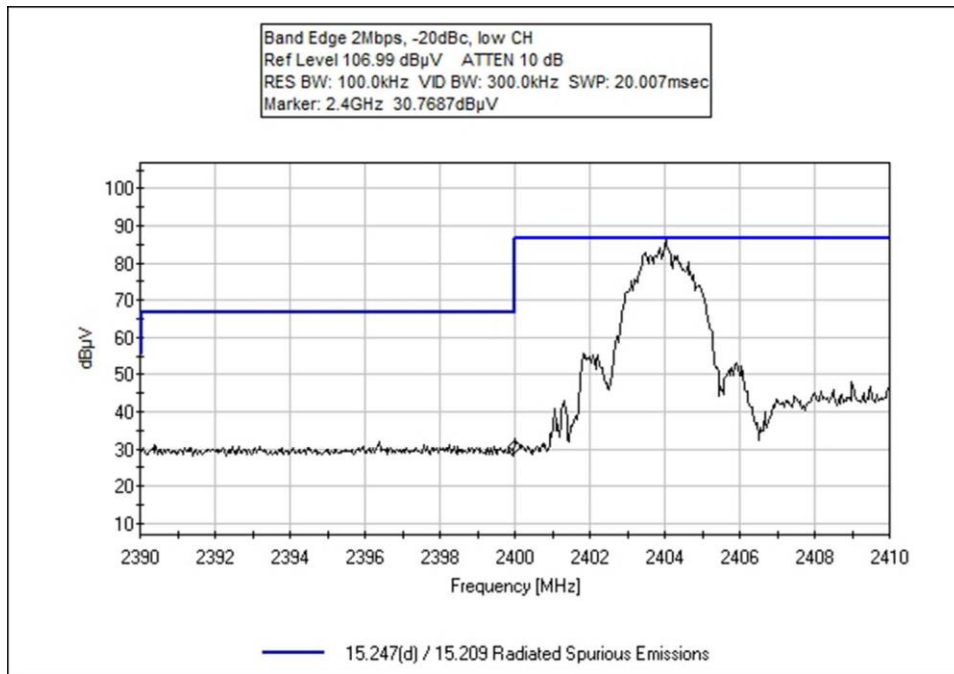
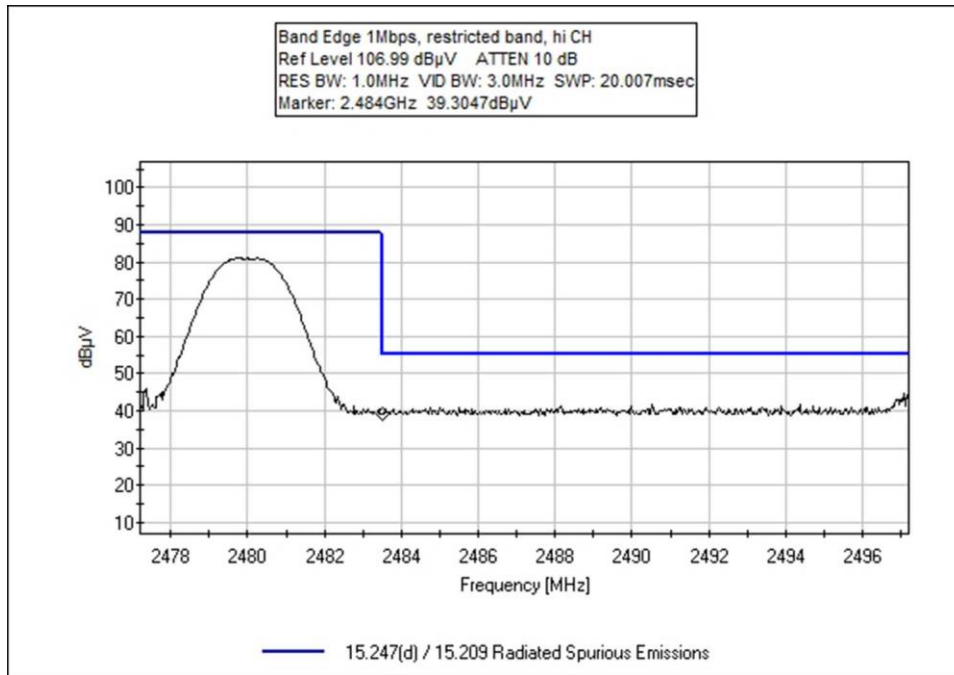
Band Edge Summary - Data Rate 2Mbps

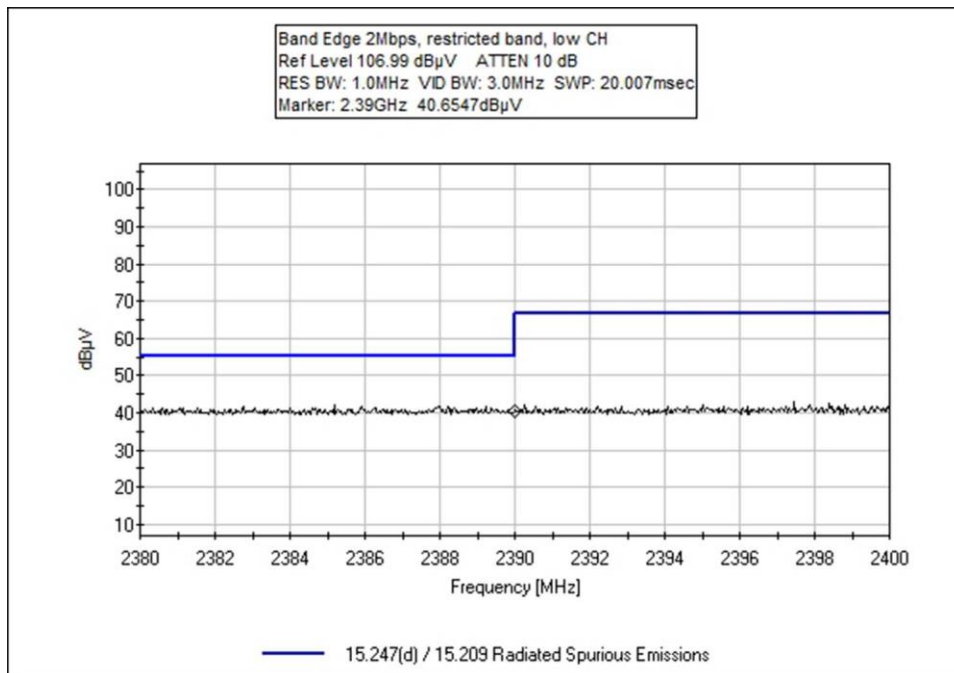
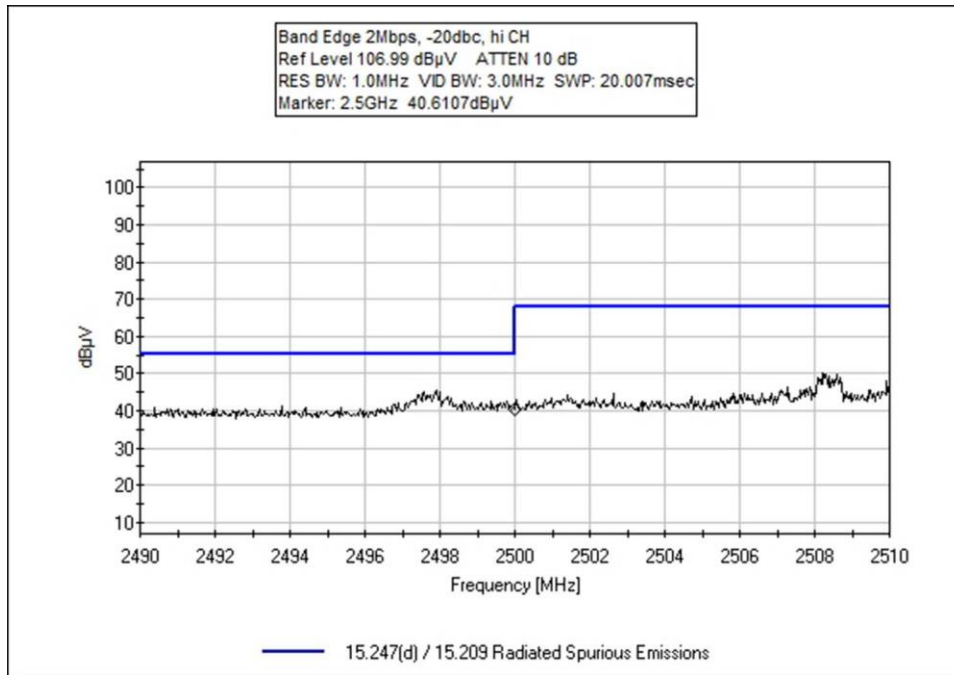
Frequency (MHz)	Modulation	Ant. Type	Field Strength (dBuV/m @3m)	Limit (dBuV/m @3m)	Results
2390.0	GFSK	Chip	39.2	<54	Pass
2400.0	GFSK	Chip	29.3	<65.1	Pass
2483.5	GFSK	Chip	39.7	<54	Pass

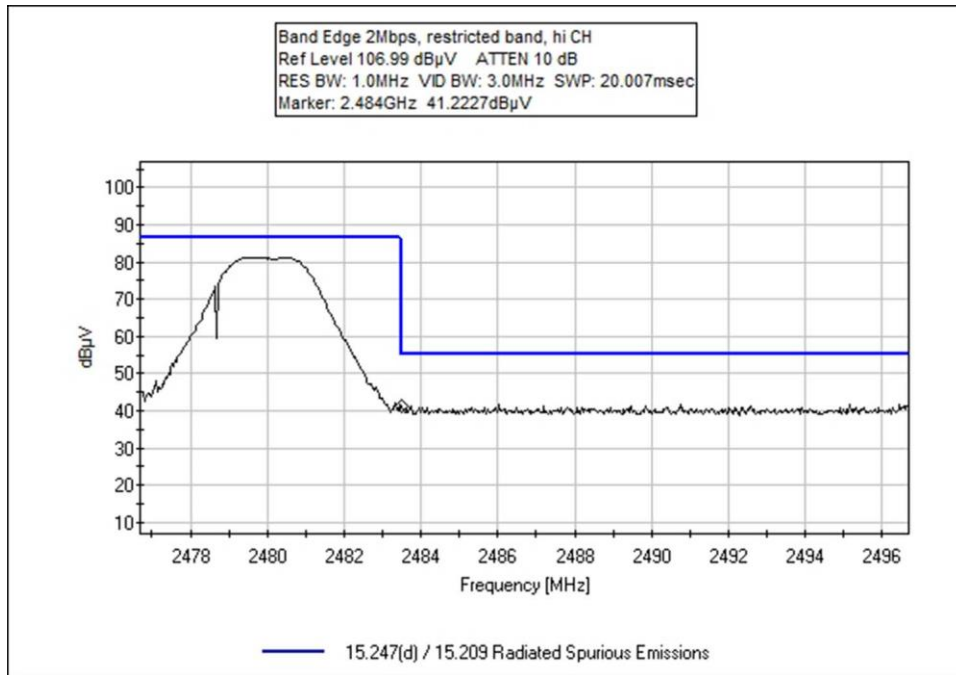
Band Edge Plots











Test Setup / Conditions / Data

Test Location: CKC Laboratories Inc. • 110 N. Olinda Pl. • Brea, CA 92823 • 714-993-6112
 Customer: **Venstar, Inc.**
 Specification: **15.247(d) / 15.209 Radiated Spurious Emissions**
 Work Order #: **104728** Date: 11/13/2020
 Test Type: **Maximized Emissions** Time: 13:34:40
 Tested By: Don Nguyen Sequence#: 4
 Software: EMITest 5.03.19

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 2			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 2			

Test Conditions / Notes:

EUT is powered from 24Vac AC Adapter and set to transmit continuously. All IO ports are populated with unterminated cables.
 Software setting:
 RF Designed Based On: LAUNCHXL-CC1352R1-2_4GHZ
 Frequency: 2404, 2442, 2480MHz
 Data Rate: 1Mbps
 Modulation: GFSK
 Cap Array Delta: 20 (0x14)
 Mode: Continuous TX/ Modulated
 TX Power: 5dBm

Frequency of Measurement: 2390.0-2483.5MHz
 RBW=100kHz, VBW=300kHz (-20dBc)
 RBW=1MHz, VBW=3MHz (restricted band)

Test Environment Conditions:
 Temperature: 21.9°C
 Relative Humidity: 34%

Test Methods: ANSI C63.10 (2013), KDB 558074 D01 15.247 Meas Guidance v05r02 04/02/2019

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN00787	Preamp	83017A	5/31/2019	5/31/2021
T2	AN01646	Horn Antenna	3115	3/17/2020	3/17/2022
T3	ANP07138	Cable	ANDL1- PNMNM-60	3/4/2019	3/4/2021
T4	ANP07246	Cable	32022-29094K- 29094K-24TC	5/29/2020	5/29/2022
T5	ANP04382	Cable	LDF-50	5/15/2020	5/15/2022
T6	AN02869	Spectrum Analyzer	E4440A	8/3/2020	8/3/2021

Measurement Data:

Reading listed by margin.

Test Distance: 3 Meters

#	Freq MHz	Rdng dB μ V	T1 T5 dB	T2 T6 dB	T3 dB	T4 dB	Dist Table	Corr dB μ V/m	Spec dB μ V/m	Margin dB	Polar Ant
1	2500.000M	43.7	-39.9 +5.7	+28.2 +0.0	+4.1	+0.4	+0.0	42.2	54.0	-11.8	Horiz
2	2390.000M	40.1	-39.8 +5.6	+28.3 +0.0	+4.0	+0.4	+0.0	38.6	54.0	-15.4	Horiz
3	2483.500M	39.3	-39.9 +5.7	+28.2 +0.0	+4.1	+0.4	+0.0	37.8	54.0	-16.2	Horiz
4	2400.000M	30.3	-39.8 +5.6	+28.3 +0.0	+4.0	+0.4	+0.0	28.8	66.3	-37.5	Horiz

Test Location: CKC Laboratories Inc. • 110 N. Olinda Pl. • Brea, CA 92823 • 714-993-6112
 Customer: **Venstar, Inc.**
 Specification: **15.247(d) / 15.209 Radiated Spurious Emissions**
 Work Order #: **104728** Date: 11/13/2020
 Test Type: **Maximized Emissions** Time: 13:20:29
 Tested By: Don Nguyen Sequence#: 5
 Software: EMITest 5.03.19

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 2			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 2			

Test Conditions / Notes:

EUT is powered from 24Vac AC Adapter and set to transmit continuously. All IO ports are populated with unterminated cables.
 Software setting:
 RF Designed Based On: LAUNCHXL-CC1352R1-2_4GHZ
 Frequency: 2404, 2442, 2480MHz
 Data Rate: 2Mbps
 Modulation: GFSK
 Cap Array Delta: 20 (0x14)
 Mode: Continuous TX/ Modulated
 TX Power: 5dBm

Frequency of Measurement: 2390.0-2483.5MHz
 RBW=100kHz, VBW=300kHz (-20dBc)
 RBW=1MHz, VBW=3MHz (restricted band)

Test Environment Conditions:
 Temperature: 21.9°C
 Relative Humidity: 34%

Test Methods: ANSI C63.10 (2013), KDB 558074 D01 15.247 Meas Guidance v05r02 04/02/2019

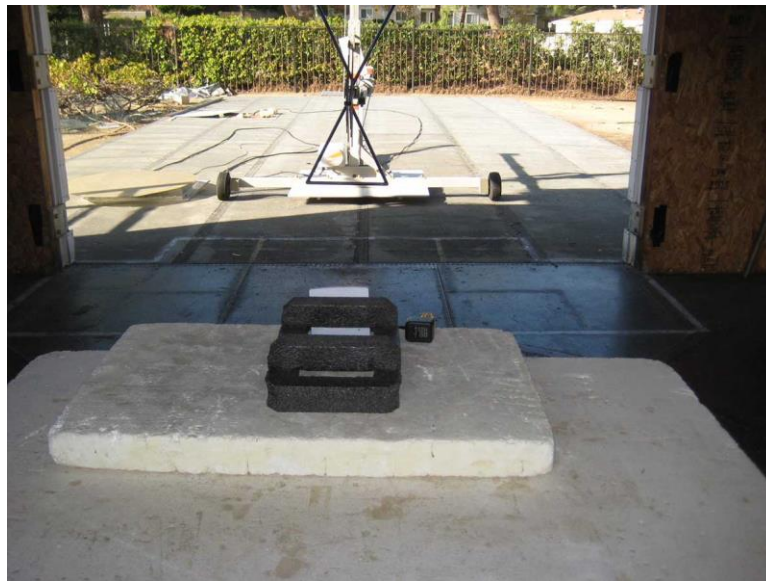
Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN00787	Preamp	83017A	5/31/2019	5/31/2021
T2	AN01646	Horn Antenna	3115	3/17/2020	3/17/2022
T3	ANP07138	Cable	ANDL1- PNMNM-60	3/4/2019	3/4/2021
T4	ANP07246	Cable	32022-29094K- 29094K-24TC	5/29/2020	5/29/2022
T5	ANP04382	Cable	LDF-50	5/15/2020	5/15/2022
T6	AN02869	Spectrum Analyzer	E4440A	8/3/2020	8/3/2021

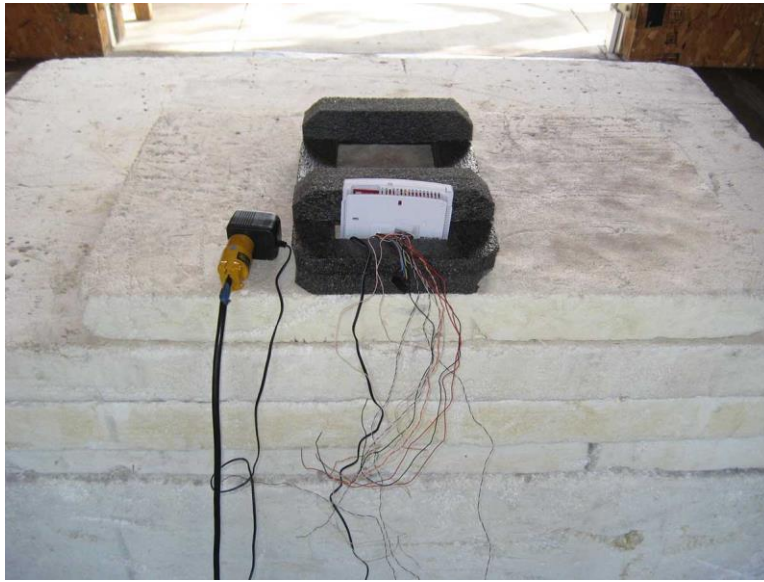
Measurement Data: Reading listed by margin. Test Distance: 3 Meters

#	Freq MHz	Rdng dB μ V	T1 T5 dB	T2 T6 dB	T3 dB	T4 dB	Dist Table	Corr dB μ V/m	Spec dB μ V/m	Margin dB	Polar Ant
1	2483.500M	41.2	-39.9 +5.7	+28.2 +0.0	+4.1	+0.4	+0.0	39.7	54.0	-14.3	Horiz
2	2390.000M	40.7	-39.8 +5.6	+28.3 +0.0	+4.0	+0.4	+0.0	39.2	54.0	-14.8	Horiz
3	2500.000M	31.2	-39.9 +5.7	+28.2 +0.0	+4.1	+0.4	+0.0	29.7	54.0	-24.3	Horiz
4	2400.000M	30.8	-39.8 +5.6	+28.3 +0.0	+4.0	+0.4	+0.0	29.3	65.1	-35.8	Horiz

Test Setup Photo(s)



Below 1GHz



Below 1GHz



Above 1GHz



Above 1GHz

15.207 AC Conducted Emissions

Test Setup / Conditions / Data

Test Location: CKC Laboratories Inc. • 110 N. Olinda Pl. • Brea, CA 92823 • 714-993-6112
 Customer: **Venstar, Inc.**
 Specification: **15.207 AC Mains - Average**
 Work Order #: **104728** Date: 11/24/2020
 Test Type: **Conducted Emissions** Time: 11:26:20 AM
 Tested By: Don Nguyen Sequence#: 9
 Software: EMITest 5.03.19 120V 60Hz

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 2			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 2			

Test Conditions / Notes:

EUT is powered from 24Vac AC Adapter and set to transmitting mode. Only the worst case (highest output power) mode is investigated.
 Software setting:
 RF Designed Based On: LAUNCHXL-CC1352R1-2_4GHZ
 Frequency: 2442MHz
 Data Rate: 2Mbps
 Modulation: GFSK
 Cap Array Delta: 20 (0x14)
 Mode: Continuous TX/ Modulated
 TX Power: 5dBm

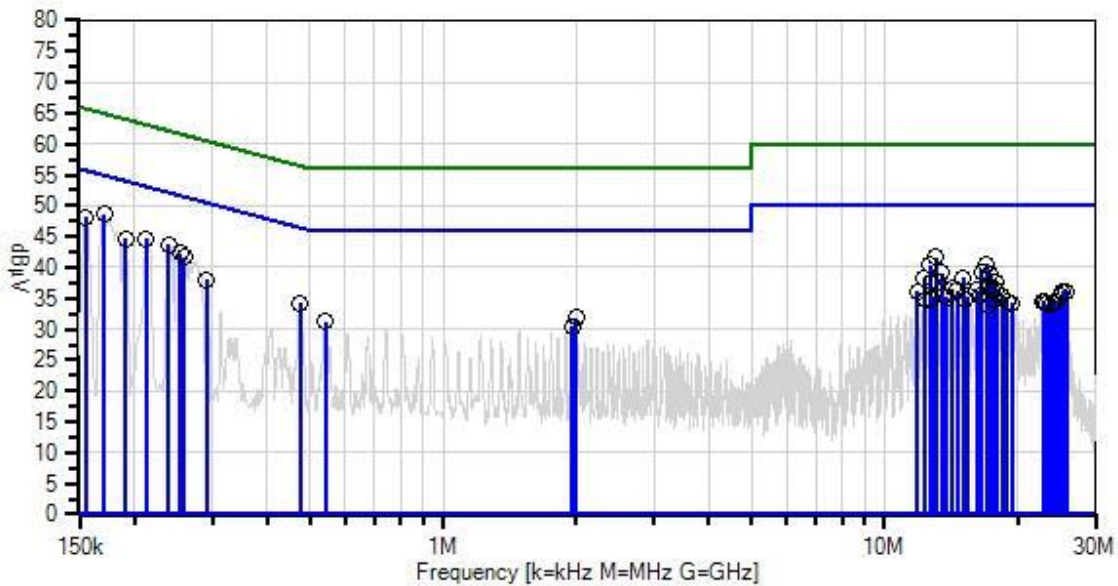
 Frequency of Measurement: 150kHz-30MHz
 RBW=9kHz, VBW=30kHz

 Test Environment Conditions:
 Temperature: 23°C
 Relative Humidity: 43%
 Pressure: 99.3kPa

 Site A

 Test Method: ANSI C63.10 (2013)

Venstar, Inc. WO#: 104728 Sequence#: 9 Date: 11/24/2020
 15.207 AC Mains - Average Test Lead: 120V 60Hz L1-Line



— Sweep Data
 × QP Readings
 Software Version: 5.03.19
 — Readings
 * Average Readings
 — 1 - 15.207 AC Mains - Average
 ○ Peak Readings
 ▼ Ambient
 — 2 - 15.207 AC Mains - Quasi-peak

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	ANP07545	Attenuator	SA18N10W-06	1/18/2019	1/18/2021
T2	ANP07338	Cable	2249-Y-240	12/24/2019	12/24/2021
T3	AN00847.1	50uH LISN-(L) Line 1	3816/2NM	3/10/2020	3/10/2021
	AN00847.1	50uH LISN-(N) Line 2	3816/2NM	3/10/2020	3/10/2021
T4	AN02610	High Pass Filter	HE9615-150K-50-720B	10/22/2019	10/22/2021
	AN03643	Spectrum Analyzer	E4440A	5/20/2020	5/20/2022
T5	ANP07738	Cable-Line L1(dB)	90cm-extcord	11/18/2020	11/18/2022
	ANP07738	Cable-Neutral L2(dB)	90cm-extcord	11/18/2020	11/18/2022

Measurement Data:

Reading listed by margin.

Test Lead: L1-Line

#	Freq MHz	Rdng dB μ V	T1 T5 dB	T2 dB	T3 dB	T4 dB	Dist Table	Corr dB μ V	Spec dB μ V	Margin dB	Polar Ant
1	171.088k	42.5	+5.8 +0.0	+0.0	+0.0	+0.3	+0.0	48.6	54.9	-6.3	L1-Li
2	155.090k	41.7	+5.8 +0.0	+0.0	+0.0	+0.7	+0.0	48.2	55.7	-7.5	L1-Li
3	212.539k	38.7	+5.8 +0.0	+0.0	+0.0	+0.2	+0.0	44.7	53.1	-8.4	L1-Li
4	238.719k	37.7	+5.8 +0.0	+0.0	+0.0	+0.2	+0.0	43.7	52.1	-8.4	L1-Li
5	13.049M	34.3	+5.8 +0.9	+0.3	+0.1	+0.2	+0.0	41.6	50.0	-8.4	L1-Li
6	190.723k	38.7	+5.8 +0.0	+0.0	+0.0	+0.2	+0.0	44.7	54.0	-9.3	L1-Li
7	253.263k	36.4	+5.8 +0.0	+0.0	+0.0	+0.1	+0.0	42.3	51.6	-9.3	L1-Li
8	17.004M	33.0	+5.8 +1.1	+0.3	+0.2	+0.2	+0.0	40.6	50.0	-9.4	L1-Li
9	12.652M	33.1	+5.8 +0.9	+0.3	+0.1	+0.2	+0.0	40.4	50.0	-9.6	L1-Li
10	259.080k	35.8	+5.8 +0.0	+0.0	+0.0	+0.1	+0.0	41.7	51.5	-9.8	L1-Li
11	16.625M	31.7	+5.8 +1.1	+0.3	+0.2	+0.2	+0.0	39.3	50.0	-10.7	L1-Li
12	13.463M	31.8	+5.8 +0.9	+0.3	+0.1	+0.2	+0.0	39.1	50.0	-10.9	L1-Li
13	17.409M	31.3	+5.8 +1.1	+0.4	+0.2	+0.2	+0.0	39.0	50.0	-11.0	L1-Li
14	12.274M	31.2	+5.8 +0.8	+0.3	+0.1	+0.2	+0.0	38.4	50.0	-11.6	L1-Li
15	15.067M	30.8	+5.8 +1.1	+0.3	+0.1	+0.2	+0.0	38.3	50.0	-11.7	L1-Li
16	474.333k	28.2	+5.8 +0.0	+0.0	+0.0	+0.3	+0.0	34.3	46.4	-12.1	L1-Li
17	13.139M	30.4	+5.8 +0.9	+0.3	+0.1	+0.2	+0.0	37.7	50.0	-12.3	L1-Li
18	17.815M	30.0	+5.8 +1.1	+0.4	+0.2	+0.2	+0.0	37.7	50.0	-12.3	L1-Li
19	12.734M	30.3	+5.8 +0.9	+0.3	+0.1	+0.2	+0.0	37.6	50.0	-12.4	L1-Li
20	291.805k	32.1	+5.8 +0.0	+0.0	+0.0	+0.1	+0.0	38.0	50.5	-12.5	L1-Li
21	17.184M	29.2	+5.8 +1.1	+0.3	+0.2	+0.2	+0.0	36.8	50.0	-13.2	L1-Li
22	14.238M	29.2	+5.8 +1.0	+0.3	+0.1	+0.2	+0.0	36.6	50.0	-13.4	L1-Li
23	17.923M	28.8	+5.8 +1.1	+0.4	+0.2	+0.2	+0.0	36.5	50.0	-13.5	L1-Li
24	17.517M	28.7	+5.8 +1.1	+0.4	+0.2	+0.2	+0.0	36.4	50.0	-13.6	L1-Li

25	16.202M	28.7	+5.8 +1.1	+0.3	+0.2	+0.2	+0.0	36.3	50.0	-13.7	L1-Li
26	14.643M	28.9	+5.8 +1.0	+0.3	+0.1	+0.2	+0.0	36.3	50.0	-13.7	L1-Li
27	25.875M	28.6	+5.8 +1.0	+0.4	+0.2	+0.2	+0.0	36.2	50.0	-13.8	L1-Li
28	11.878M	28.9	+5.8 +0.8	+0.3	+0.1	+0.2	+0.0	36.1	50.0	-13.9	L1-Li
29	25.306M	28.5	+5.8 +1.0	+0.4	+0.2	+0.2	+0.0	36.1	50.0	-13.9	L1-Li
30	2.000M	25.7	+5.8 +0.0	+0.1	+0.0	+0.2	+0.0	31.8	46.0	-14.2	L1-Li
31	13.553M	28.0	+5.8 +1.0	+0.3	+0.1	+0.2	+0.0	35.4	50.0	-14.6	L1-Li
32	18.490M	27.7	+5.8 +1.1	+0.4	+0.2	+0.2	+0.0	35.4	50.0	-14.6	L1-Li
33	15.427M	27.7	+5.8 +1.1	+0.3	+0.2	+0.2	+0.0	35.3	50.0	-14.7	L1-Li
34	540.509k	25.2	+5.8 +0.0	+0.0	+0.0	+0.3	+0.0	31.3	46.0	-14.7	L1-Li
35	24.888M	27.6	+5.8 +1.1	+0.4	+0.2	+0.2	+0.0	35.3	50.0	-14.7	L1-Li
36	16.526M	27.7	+5.8 +1.1	+0.3	+0.2	+0.2	+0.0	35.3	50.0	-14.7	L1-Li
37	13.851M	27.7	+5.8 +1.0	+0.3	+0.1	+0.2	+0.0	35.1	50.0	-14.9	L1-Li
38	12.788M	27.6	+5.8 +0.9	+0.3	+0.1	+0.2	+0.0	34.9	50.0	-15.1	L1-Li
39	15.139M	27.3	+5.8 +1.1	+0.3	+0.2	+0.2	+0.0	34.9	50.0	-15.1	L1-Li
40	12.337M	27.6	+5.8 +0.8	+0.3	+0.1	+0.2	+0.0	34.8	50.0	-15.2	L1-Li
41	17.661M	27.0	+5.8 +1.1	+0.4	+0.2	+0.2	+0.0	34.7	50.0	-15.3	L1-Li
42	18.941M	26.8	+5.8 +1.1	+0.4	+0.2	+0.2	+0.0	34.5	50.0	-15.5	L1-Li
43	22.968M	26.8	+5.8 +1.1	+0.4	+0.2	+0.2	+0.0	34.5	50.0	-15.5	L1-Li
44	1.962M	24.3	+5.8 +0.0	+0.1	+0.0	+0.2	+0.0	30.4	46.0	-15.6	L1-Li
45	22.896M	26.7	+5.8 +1.1	+0.4	+0.2	+0.2	+0.0	34.4	50.0	-15.6	L1-Li
46	24.464M	26.7	+5.8 +1.1	+0.4	+0.2	+0.2	+0.0	34.4	50.0	-15.6	L1-Li
47	19.382M	26.6	+5.8 +1.1	+0.4	+0.2	+0.2	+0.0	34.3	50.0	-15.7	L1-Li
48	23.312M	26.4	+5.8 +1.1	+0.4	+0.2	+0.2	+0.0	34.1	50.0	-15.9	L1-Li
49	23.881M	26.3	+5.8 +1.1	+0.4	+0.2	+0.2	+0.0	34.0	50.0	-16.0	L1-Li
50	17.157M	26.3	+5.8 +1.1	+0.3	+0.2	+0.2	+0.0	33.9	50.0	-16.1	L1-Li

Test Location: CKC Laboratories Inc. • 110 N. Olinda Pl. • Brea, CA 92823 • 714-993-6112
 Customer: **Venstar, Inc.**
 Specification: **15.207 AC Mains - Average**
 Work Order #: **104728** Date: 11/24/2020
 Test Type: **Conducted Emissions** Time: 11:27:42 AM
 Tested By: Don Nguyen Sequence#: 10
 Software: EMITest 5.03.19 120V 60Hz

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 2			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 2			

Test Conditions / Notes:

EUT is powered from 24Vac AC Adapter and set to transmitting mode. Only the worst case (highest output power) mode is investigated.
 Software setting:
 RF Designed Based On: LAUNCHXL-CC1352R1-2_4GHZ
 Frequency: 2442MHz
 Data Rate: 2Mbps
 Modulation: GFSK
 Cap Array Delta: 20 (0x14)
 Mode: Continuous TX/ Modulated
 TX Power: 5dBm

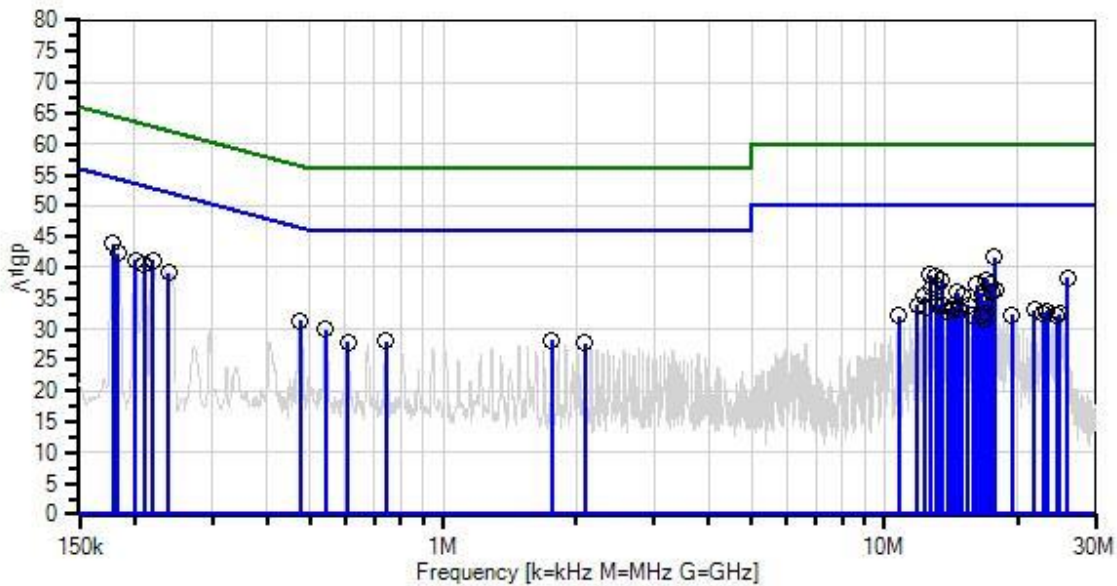
Frequency of Measurement: 150kHz-30MHz
 RBW=9kHz, VBW=30kHz

Test Environment Conditions:
 Temperature: 23°C
 Relative Humidity: 43%
 Pressure: 99.3kPa

Site A

Test Method: ANSI C63.10 (2013)

Venstar, Inc. WD#: 104728 Sequence#: 10 Date: 11/24/2020
 15.207 AC Mains - Average Test Lead: 120V 60Hz L2-Neutral



— Sweep Data
 × QP Readings
 Software Version: 5.03.19
 — Readings
 * Average Readings
 — 1 - 15.207 AC Mains - Average
 ○ Peak Readings
 ▼ Ambient
 — 2 - 15.207 AC Mains - Quasi-peak

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	ANP07545	Attenuator	SA18N10W-06	1/18/2019	1/18/2021
T2	ANP07338	Cable	2249-Y-240	12/24/2019	12/24/2021
	AN00847.1	50uH LISN-(L) Line 1	3816/2NM	3/10/2020	3/10/2021
T3	AN00847.1	50uH LISN-(N) Line 2	3816/2NM	3/10/2020	3/10/2021
T4	AN02610	High Pass Filter	HE9615-150K-50-720B	10/22/2019	10/22/2021
	AN03643	Spectrum Analyzer	E4440A	5/20/2020	5/20/2022
	ANP07738	Cable-Line L1(dB)	90cm-extcord	11/18/2020	11/18/2022
T5	ANP07738	Cable-Neutral L2(dB)	90cm-extcord	11/18/2020	11/18/2022

Measurement Data:

Reading listed by margin.

Test Lead: L2-Neutral

#	Freq MHz	Rdng dB μ V	T1 T5 dB	T2 dB	T3 dB	T4 dB	Dist Table	Corr dB μ V	Spec dB μ V	Margin dB	Polar Ant
1	17.706M	34.1	+5.8 +1.0	+0.4	+0.2	+0.2	+0.0	41.7	50.0	-8.3	L2-Ne
2	179.088k	37.8	+5.8 +0.0	+0.0	+0.0	+0.3	+0.0	43.9	54.5	-10.6	L2-Ne
3	12.661M	31.6	+5.8 +0.7	+0.3	+0.2	+0.2	+0.0	38.8	50.0	-11.2	L2-Ne
4	13.049M	31.3	+5.8 +0.8	+0.3	+0.2	+0.2	+0.0	38.6	50.0	-11.4	L2-Ne
5	219.811k	35.2	+5.8 +0.0	+0.0	+0.0	+0.2	+0.0	41.2	52.8	-11.6	L2-Ne
6	25.916M	30.7	+5.8 +0.9	+0.4	+0.3	+0.2	+0.0	38.3	50.0	-11.7	L2-Ne
7	13.454M	30.8	+5.8 +0.8	+0.3	+0.2	+0.2	+0.0	38.1	50.0	-11.9	L2-Ne
8	17.013M	30.6	+5.8 +1.0	+0.3	+0.2	+0.2	+0.0	38.1	50.0	-11.9	L2-Ne
9	183.451k	36.2	+5.8 +0.0	+0.0	+0.0	+0.3	+0.0	42.3	54.3	-12.0	L2-Ne
10	200.904k	35.2	+5.8 +0.0	+0.0	+0.0	+0.2	+0.0	41.2	53.6	-12.4	L2-Ne
11	210.358k	34.5	+5.8 +0.0	+0.0	+0.0	+0.2	+0.0	40.5	53.2	-12.7	L2-Ne
12	16.202M	29.9	+5.8 +0.9	+0.3	+0.2	+0.2	+0.0	37.3	50.0	-12.7	L2-Ne
13	17.382M	29.6	+5.8 +1.0	+0.4	+0.2	+0.2	+0.0	37.2	50.0	-12.8	L2-Ne
14	13.139M	29.8	+5.8 +0.8	+0.3	+0.2	+0.2	+0.0	37.1	50.0	-12.9	L2-Ne
15	239.446k	33.1	+5.8 +0.0	+0.0	+0.0	+0.2	+0.0	39.1	52.1	-13.0	L2-Ne
16	12.734M	29.4	+5.8 +0.7	+0.3	+0.2	+0.2	+0.0	36.6	50.0	-13.4	L2-Ne
17	17.788M	28.9	+5.8 +1.0	+0.4	+0.2	+0.2	+0.0	36.5	50.0	-13.5	L2-Ne
18	17.517M	28.5	+5.8 +1.0	+0.4	+0.2	+0.2	+0.0	36.1	50.0	-13.9	L2-Ne
19	14.643M	28.6	+5.8 +0.8	+0.3	+0.2	+0.2	+0.0	35.9	50.0	-14.1	L2-Ne
20	16.607M	28.4	+5.8 +0.9	+0.3	+0.2	+0.2	+0.0	35.8	50.0	-14.2	L2-Ne
21	12.265M	28.2	+5.8 +0.7	+0.3	+0.2	+0.2	+0.0	35.4	50.0	-14.6	L2-Ne
22	15.022M	27.9	+5.8 +0.9	+0.3	+0.2	+0.2	+0.0	35.3	50.0	-14.7	L2-Ne
23	474.333k	25.3	+5.8 +0.0	+0.0	+0.0	+0.3	+0.0	31.4	46.4	-15.0	L2-Ne
24	16.869M	26.8	+5.8 +0.9	+0.3	+0.2	+0.2	+0.0	34.2	50.0	-15.8	L2-Ne

25	15.436M	26.5	+5.8 +0.9	+0.3	+0.2	+0.2	+0.0	33.9	50.0	-16.1	L2-Ne
26	11.860M	26.7	+5.8 +0.7	+0.3	+0.2	+0.2	+0.0	33.9	50.0	-16.1	L2-Ne
27	540.509k	23.8	+5.8 +0.0	+0.0	+0.0	+0.3	+0.0	29.9	46.0	-16.1	L2-Ne
28	13.193M	26.6	+5.8 +0.8	+0.3	+0.2	+0.2	+0.0	33.9	50.0	-16.1	L2-Ne
29	14.247M	26.6	+5.8 +0.8	+0.3	+0.2	+0.2	+0.0	33.9	50.0	-16.1	L2-Ne
30	13.535M	26.6	+5.8 +0.8	+0.3	+0.2	+0.2	+0.0	33.9	50.0	-16.1	L2-Ne
31	14.328M	26.5	+5.8 +0.8	+0.3	+0.2	+0.2	+0.0	33.8	50.0	-16.2	L2-Ne
32	12.328M	26.2	+5.8 +0.7	+0.3	+0.2	+0.2	+0.0	33.4	50.0	-16.6	L2-Ne
33	14.716M	26.0	+5.8 +0.8	+0.3	+0.2	+0.2	+0.0	33.3	50.0	-16.7	L2-Ne
34	14.301M	25.9	+5.8 +0.8	+0.3	+0.2	+0.2	+0.0	33.2	50.0	-16.8	L2-Ne
35	21.806M	25.4	+5.8 +1.0	+0.4	+0.3	+0.2	+0.0	33.1	50.0	-16.9	L2-Ne
36	13.869M	25.7	+5.8 +0.8	+0.3	+0.2	+0.2	+0.0	33.0	50.0	-17.0	L2-Ne
37	23.340M	25.2	+5.8 +1.0	+0.4	+0.3	+0.2	+0.0	32.9	50.0	-17.1	L2-Ne
38	22.905M	24.9	+5.8 +1.0	+0.4	+0.3	+0.2	+0.0	32.6	50.0	-17.4	L2-Ne
39	16.932M	25.1	+5.8 +0.9	+0.3	+0.2	+0.2	+0.0	32.5	50.0	-17.5	L2-Ne
40	24.950M	24.8	+5.8 +1.0	+0.4	+0.3	+0.2	+0.0	32.5	50.0	-17.5	L2-Ne
41	1.762M	22.1	+5.8 +0.1	+0.1	+0.0	+0.2	+0.0	28.3	46.0	-17.7	L2-Ne
42	15.824M	24.9	+5.8 +0.9	+0.3	+0.2	+0.2	+0.0	32.3	50.0	-17.7	L2-Ne
43	19.382M	24.7	+5.8 +1.0	+0.4	+0.2	+0.2	+0.0	32.3	50.0	-17.7	L2-Ne
44	16.716M	24.8	+5.8 +0.9	+0.3	+0.2	+0.2	+0.0	32.2	50.0	-17.8	L2-Ne
45	744.127k	21.9	+5.8 +0.0	+0.1	+0.0	+0.3	+0.0	28.1	46.0	-17.9	L2-Ne
46	10.761M	25.0	+5.8 +0.6	+0.3	+0.2	+0.2	+0.0	32.1	50.0	-17.9	L2-Ne
47	24.511M	24.4	+5.8 +1.0	+0.4	+0.3	+0.2	+0.0	32.1	50.0	-17.9	L2-Ne
48	608.866k	21.7	+5.8 +0.0	+0.1	+0.0	+0.3	+0.0	27.9	46.0	-18.1	L2-Ne
49	2.098M	21.6	+5.8 +0.1	+0.1	+0.0	+0.2	+0.0	27.8	46.0	-18.2	L2-Ne
50	16.815M	24.3	+5.8 +0.9	+0.3	+0.2	+0.2	+0.0	31.7	50.0	-18.3	L2-Ne

Test Setup Photo(s)



Front View



Back View

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.