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 902-928 MHz)

Report No.: 104728-12

Date of issue: January 15, 2021

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

Testing the Future
CKC LABORATORIES, INC.

TABLE OF CONTENTS

ADMINISTRATIVE INFORMATION

Test Report Information

REPORT PREPARED FOR:

Venstar, Inc.
9250 Owensmouth Avenue
Chatsworth, CA 91311

Representative: Alex Garashin

REPORT PREPARED BY:

Kim Romero
CKC Laboratories, Inc.
5046 Sierra Pines Drive
Mariposa, CA 95338

Project Number: 104728

DATE OF EQUIPMENT RECEIPT: November 17, 2020
DATE(S) OF TESTING: November 17, 18, 20, 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 902-928MHz)

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:

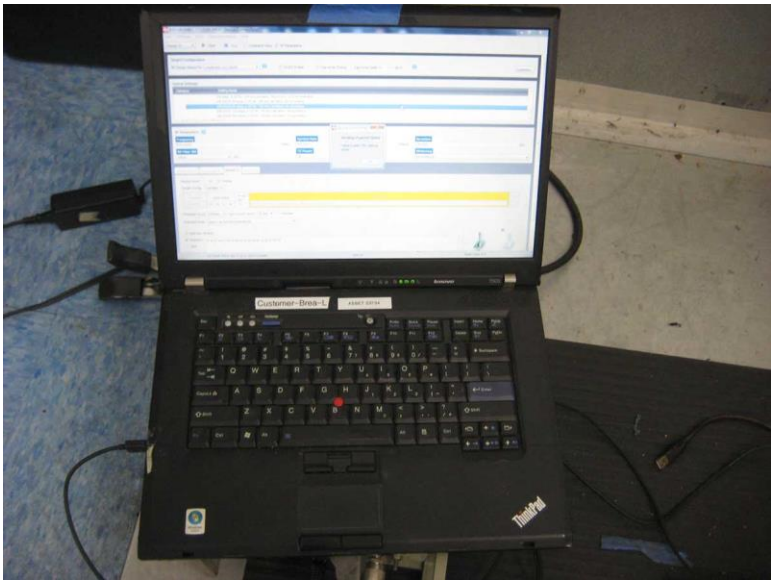
Device	Manufacturer	Model #	S/N
24Vac Adapter	Unbranded	MKA-412400200	NA

General Product Information:

Product Information	Manufacturer-Provided Details
Equipment Type:	Stand-Alone Equipment
Type of Wideband System:	802.15.4g/ Proprietary
Operating Frequency Range:	915MHz
Modulation Type(s):	2-GFSK
Maximum Duty Cycle:	100%
Number of TX Chains:	1
Antenna Type(s) and Gain:	Chip Antenna/ -1dBi
Beamforming Type:	NA
Antenna Connection Type:	Integral (External connector provided to facilitate testing)
Nominal Input Voltage:	24Vac
Firmware used for Test:	04-38-00

EUT Photo(s)

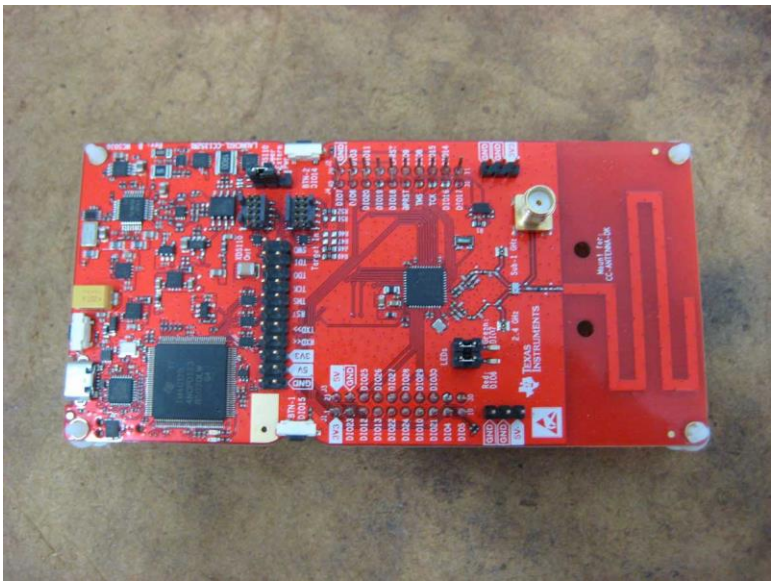
Support Equipment Photo(s)



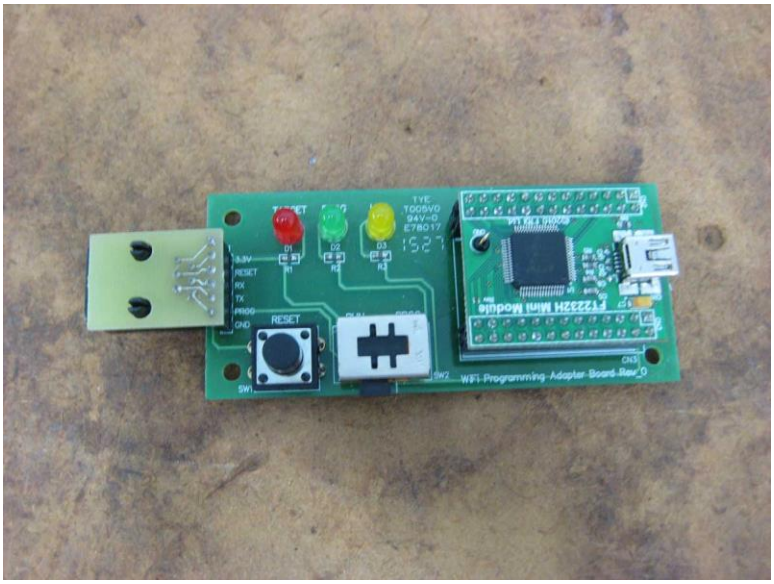
Laptop

AC/DC adapter

24Vac Adapter



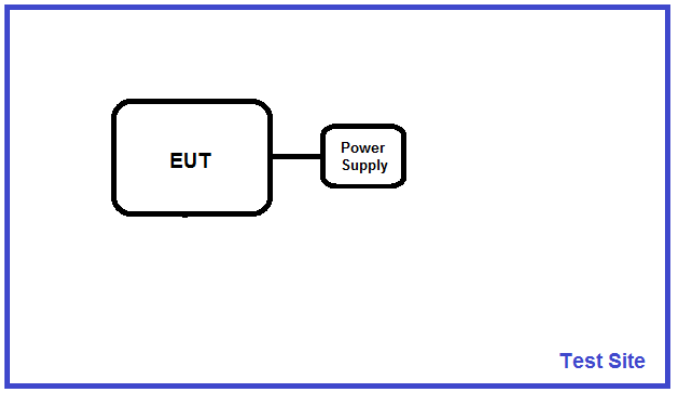
Interface Board



Wifi Prog Board

Block Diagram of Test Setup(s)

Test Setup Block Diagram



FCC Part 15 Subpart C

15.247(a)(2) 6dB Bandwidth

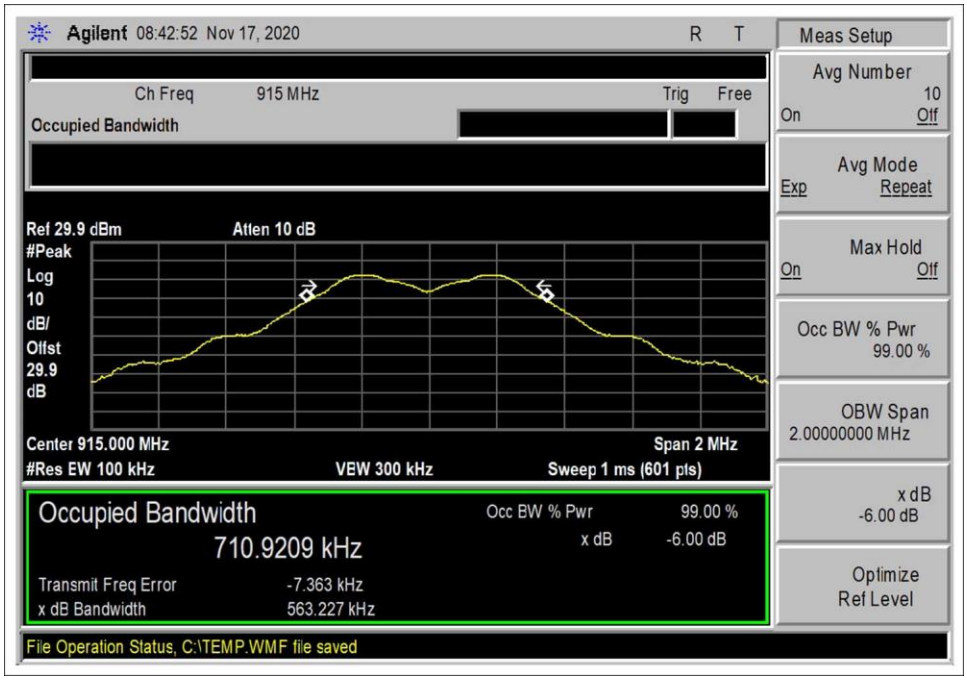
Test Setup/Conditions			
Test Location:	Brea Lab A	Test Engineer:	Don Nguyen
Test Method:	ANSI C63.10 (2013) KDB 558074 D01 15.247 Meas Guidance v05r02	Test Date(s):	11/17/2020
Configuration:	1		
Test Setup:	EUT is powered from 24Vac AC Adapter and connected to a laptop via USB cable and test board. The laptop is running software SmartRF Studio 7 to activate transmitter. Software profile: "WB-DSSS 60 kbps, 2-GFSK, 195 kHz deviation, 4x spreading" RF Designed Based On: LAUNCHXL-CC1352R1 Frequency: 915MHz Symbol Rate: 480kBaud Modulation: 2-GFSK Deviation: 195kHz Cap Array Delta: 20 (0x14) Mode: Continuous TX/ Modulated TX Power: 14dBm Frequency of measurement: 915MHz RBW=100kHz, VBW=300kHz		

Environmental Conditions			
Temperature (ºC)	21.1	Relative Humidity (%):	32

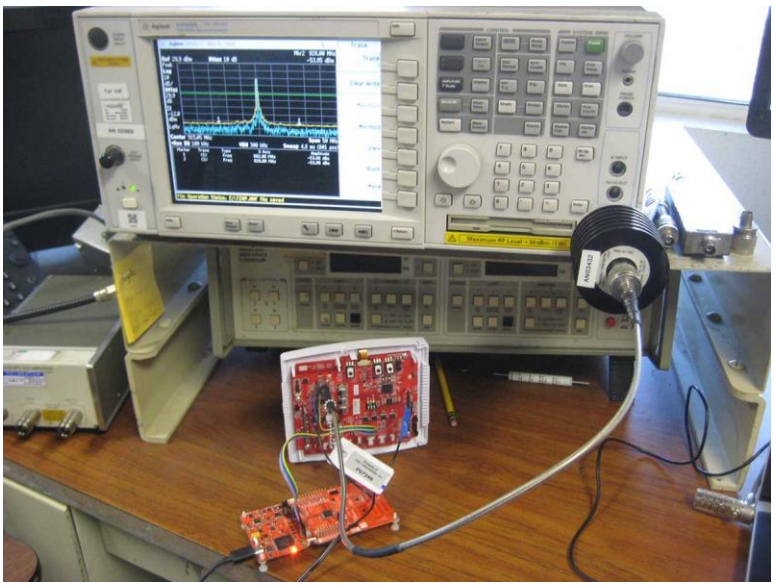
Test Equipment					
Asset#	Description	Manufacturer	Model	Cal Date	Cal Due
02869	Spectrum Analyzer	Agilent	E4440	8/3/2020	8/3/2021
03432	Attenuator	Aeroflex/Weinschel	90-30-34	10/22/2019	10/22/2021
P07246	Cable	H&S	32022-29094K-29094K-24TC	5/29/2020	5/29/2022

Test Data Summary					
Frequency (MHz)	Antenna Port	Modulation	Measured (kHz)	Limit (kHz)	Results
915	1	2-GFSK	563.227	≥500	Pass

Plot(s)


Agilent 08:42:52 Nov 17, 2020
R T
Meas Setup
Avg Number
10
On Off
Ch Freq 915 MHz
Trig Free
Occupied Bandwidth
Avg Mode
Exp Repeat
Ref 29.9 dBm
Atten 10 dB
Max Hold
On Off
#Peak
Log
10
dB/
Offst
29.9
dB
Occ BW % Pwr
99.00 %
OBW Span
2.00000000 MHz
Center 915.000 MHz
Span 2 MHz
#Res EW 100 kHz
VBW 300 kHz
Sweep 1 ms (601 pts)
x dB
-6.00 dB
Occupied Bandwidth
710.9209 kHz
Occ BW % Pwr 99.00 %
x dB -6.00 dB
Transmit Freq Error -7.363 kHz
x dB Bandwidth 563.227 kHz
Optimize
Ref Level
File Operation Status, C:\TEMP.WMF file saved

Test Setup Photo(s)



15.247(b)(3) Output Power

Test Setup/Conditions			
Test Location:	Brea Lab A	Test Engineer:	Don Nguyen
Test Method:	ANSI C63.10 (2013) KDB 558074 D01 15.247 Meas Guidance v05r02	Test Date(s):	11/17/2020
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 profile: "WB-DSSS 60 kbps, 2-GFSK, 195 kHz deviation, 4x spreading" RF Designed Based On: LAUNCHXL-CC1352R1 Frequency: 915MHz Symbol Rate: 480kBaud Modulation: 2-GFSK Deviation: 195kHz Cap Array Delta: 20 (0x14) Mode: Continuous TX/ Modulated TX Power: 14dBm Frequency of measurement: 915MHz RBW=1MHz, VBW=3MHz		

Environmental Conditions			
Temperature (ºC)	21.1	Relative Humidity (%):	32

Test Equipment					
Asset#	Description	Manufacturer	Model	Cal Date	Cal Due
02869	Spectrum Analyzer	Agilent	E4440	8/3/2020	8/3/2021
03432	Attenuator	Aeroflex/Weinschel	90-30-34	10/22/2019	10/22/2021
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)
915	GFSK	13.30	13.29	13.30	0.01

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

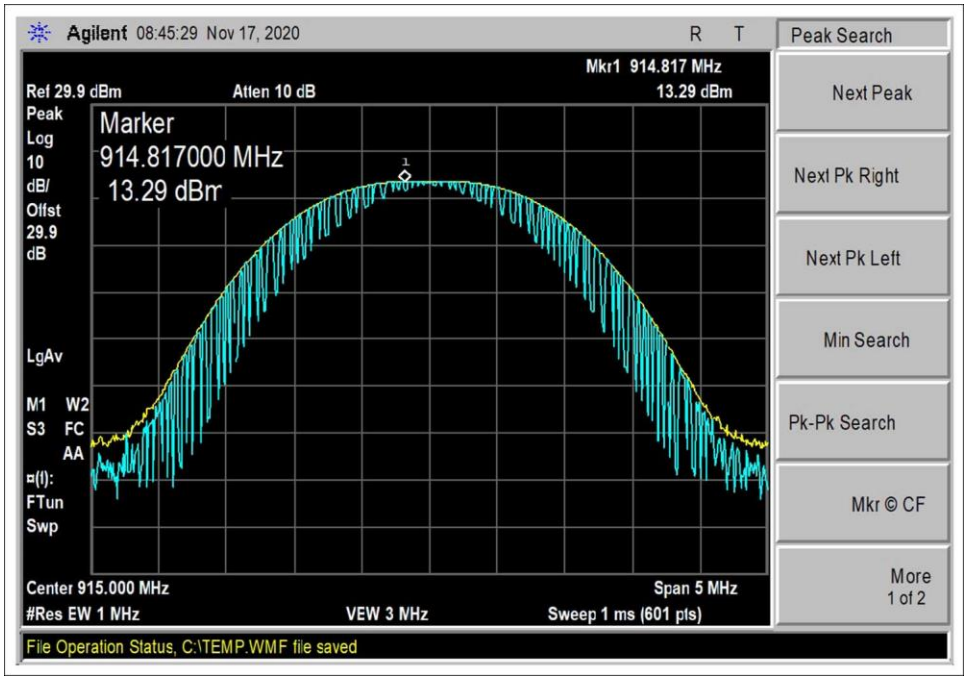
Parameter Definitions:

Measurements performed at input voltage Vnominal ± 15%.

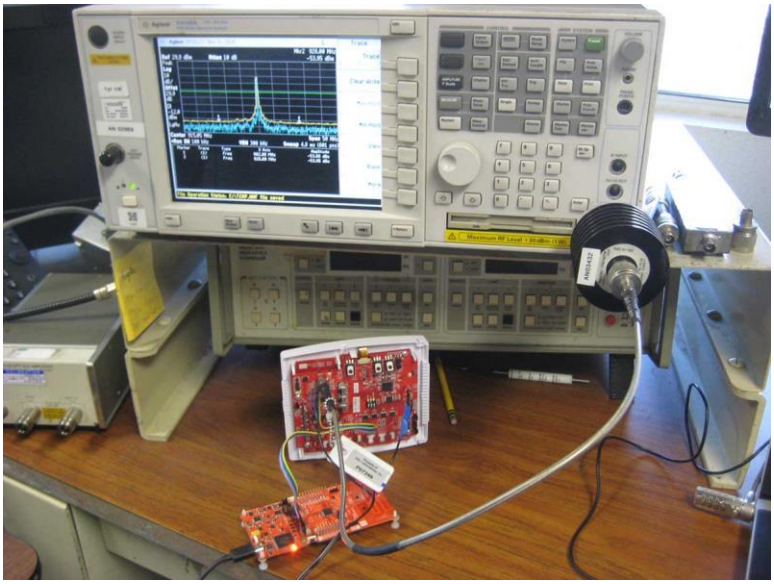
Parameter	Value
$V_{Nominal}$:	24.0Vac
$V_{Minimum}$:	20.4Vac
$V_{Maximum}$:	27.6Vac

Test Data Summary - RF Conducted Measurement					
Measurement Option: RBW > DTS Bandwidth					
Frequency (MHz)	**Modulation**	**Ant. Type / Gain (dBi)**	**Measured (dBm)**	**Limit (dBm)**	**Results**
915	GFSK	-1	13.29	≤30	Pass

Plot(s)



Test Setup Photo(s)



15.247(e) Power Spectral Density

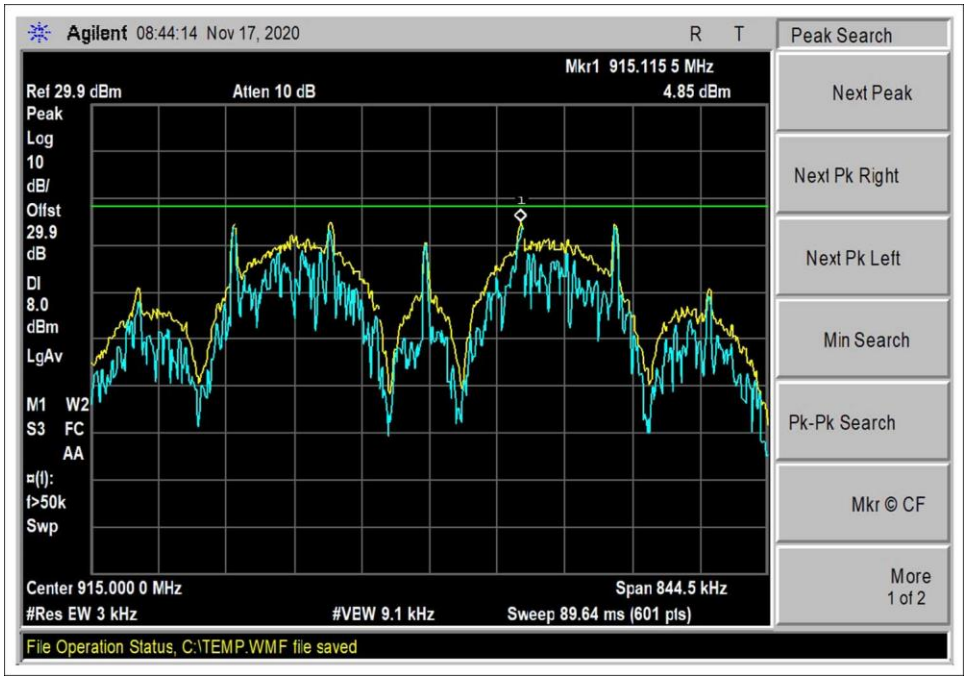
Test Setup/Conditions			
Test Location:	Brea Lab A	Test Engineer:	Don Nguyen
Test Method:	ANSI C63.10 (2013) KDB 558074 D01 15.247 Meas Guidance v05r02	Test Date(s):	11/17/2020
Configuration:	1		
Test Setup:	EUT is powered from 24Vac AC Adapter and connected to a laptop via USB cable and test board. The laptop is running software SmartRF Studio 7 to activate transmitter. Software profile: "WB-DSSS 60 kbps, 2-GFSK, 195 kHz deviation, 4x spreading" RF Designed Based On: LAUNCHXL-CC1352R1 Frequency: 915MHz Symbol Rate: 480kBaud Modulation: 2-GFSK Deviation: 195kHz Cap Array Delta: 20 (0x14) Mode: Continuous TX/ Modulated TX Power: 14dBm Frequency of measurement: 915MHz RBW=3kHz, VBW=9kHz		

Environmental Conditions			
Temperature (ºC)	21.1	Relative Humidity (%):	32

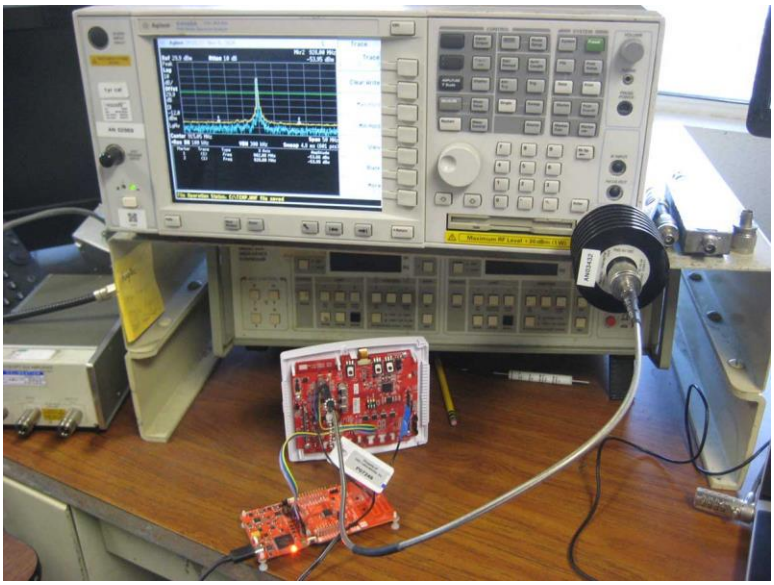
Test Equipment					
Asset#	Description	Manufacturer	Model	Cal Date	Cal Due
02869	Spectrum Analyzer	Agilent	E4440	8/3/2020	8/3/2021
03432	Attenuator	Aeroflex/Weinschel	90-30-34	10/22/2019	10/22/2021
P07246	Cable	H&S	32022-29094K-29094K-24TC	5/29/2020	5/29/2022

Test Data Summary - Conducted Measurement					
Measurement Method: PKPSD					
Frequency (MHz)	Modulation	Ant. Type / Gain (dBi)	Measured (dBm/3kHz)	Limit (dBm/3kHz)	Results
915	GFSK	-1	4.85	≤8	Pass

Plot(s)



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:	11/17/2020
Test Type:	**Conducted Emissions**	Time:	08:56:51
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			

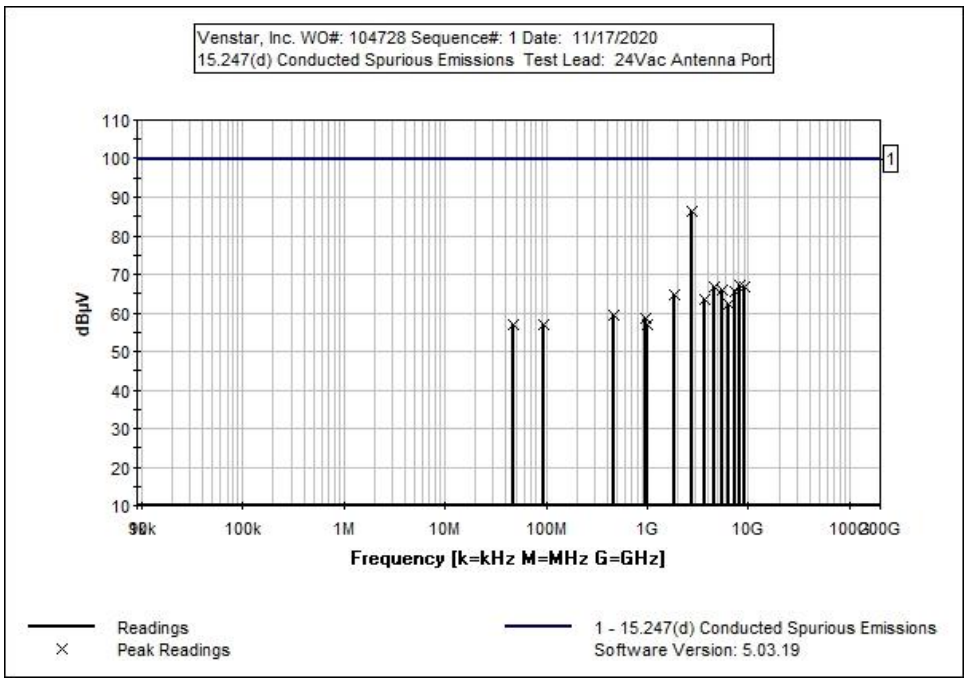
Test Conditions / Notes:

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
Frequency: 915MHz
Symbol Rate: 480kBaud
Modulation: 2-GFSK
Deviation: 195kHz
Cap Array Delta: 20 (0x14)
Mode: Continuous TX/ Modulated
TX Power: 14dBm

Frequency of Measurement: 9kHz-10GHz
RBW=100kHz, VBW=300kHz

Test Environment Conditions:
Temperature: 25.4°C
Relative Humidity: 24%

Test Method: ANSI C63.10 (2013)
KDB 558074 D01 15.247 Meas Guidance v05r02



Test Equipment:

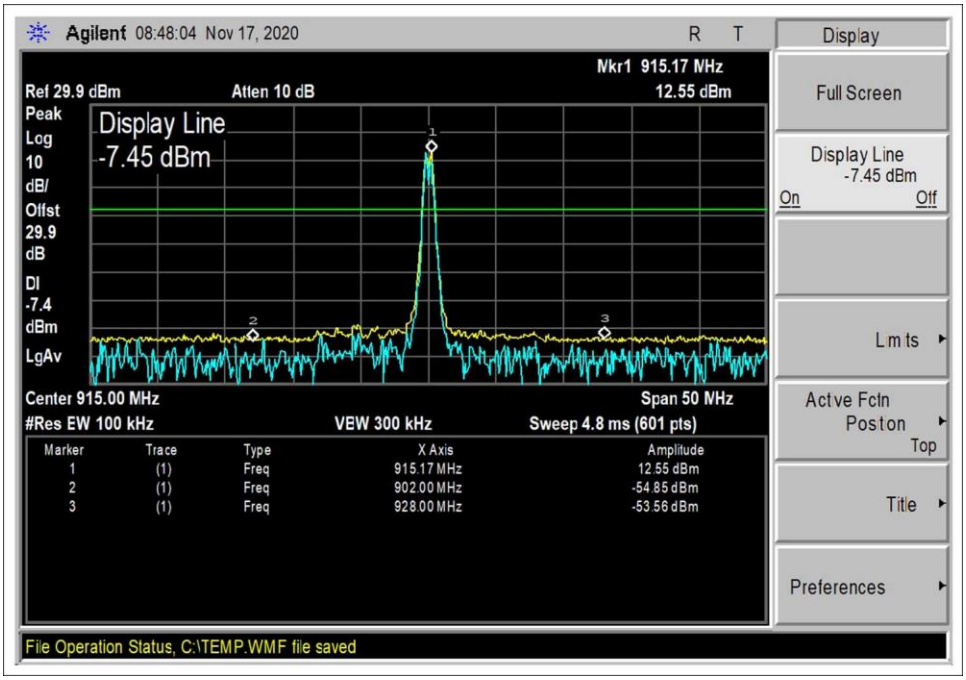
ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	ANP07246	Cable	32022-29094K-29094K-24TC	5/29/2020	5/29/2022
T2	AN03432	Attenuator	90-30-34	10/22/2019	10/22/2021
	AN03643	Spectrum Analyzer	E4440A	5/20/2020	5/20/2022

Measurement Data: Reading listed by margin. Test Lead: Antenna Port

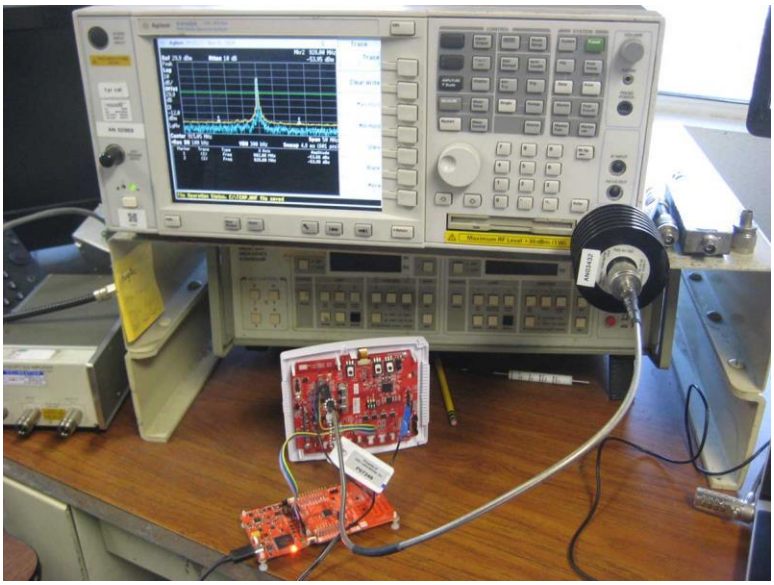
#	Freq MHz	Rdng dBµV	T1 dB	T2 dB	dB	dB	Dist Table	Corr dBµV	Spec dBµV	Margin dB	Polar Ant
1	2744.417M	56.3	+0.4	+29.7			+0.0	86.4	99.6	-13.2	Anten
2	8233.242M	36.9	+0.9	+29.3			+0.0	67.1	99.6	-32.5	Anten
3	9151.808M	36.4	+1.0	+29.3			+0.0	66.7	99.6	-32.9	Anten
4	4575.900M	36.3	+0.6	+29.7			+0.0	66.6	99.6	-33.0	Anten
5	5488.875M	35.4	+0.7	+29.9			+0.0	66.0	99.6	-33.6	Anten
6	7321.467M	35.3	+0.8	+29.4			+0.0	65.5	99.6	-34.1	Anten
7	1829.617M	34.7	+0.4	+29.6			+0.0	64.7	99.6	-34.9	Anten
8	3660.750M	32.9	+0.7	+29.8			+0.0	63.4	99.6	-36.2	Anten
9	6406.275M	32.2	+0.7	+29.5			+0.0	62.4	99.6	-37.2	Anten
10	457.500M	29.5	+0.1	+29.6			+0.0	59.2	99.6	-40.4	Anten
11	963.170M	28.5	+0.3	+29.6			+0.0	58.4	99.6	-41.2	Anten
12	48.000M	27.6	+0.0	+29.5			+0.0	57.1	99.6	-42.5	Anten
13	96.000M	27.4	+0.0	+29.5			+0.0	56.9	99.6	-42.7	Anten
14	1011.170M	26.9	+0.3	+29.6			+0.0	56.8	99.6	-42.8	Anten

Band Edge

Band Edge Plots



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:	11/20/2020
Test Type:	**Maximized Emissions**	Time:	09:06:15
Tested By:	Don Nguyen	Sequence#:	2
Software:	EMITest 5.03.19		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 2			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 2			

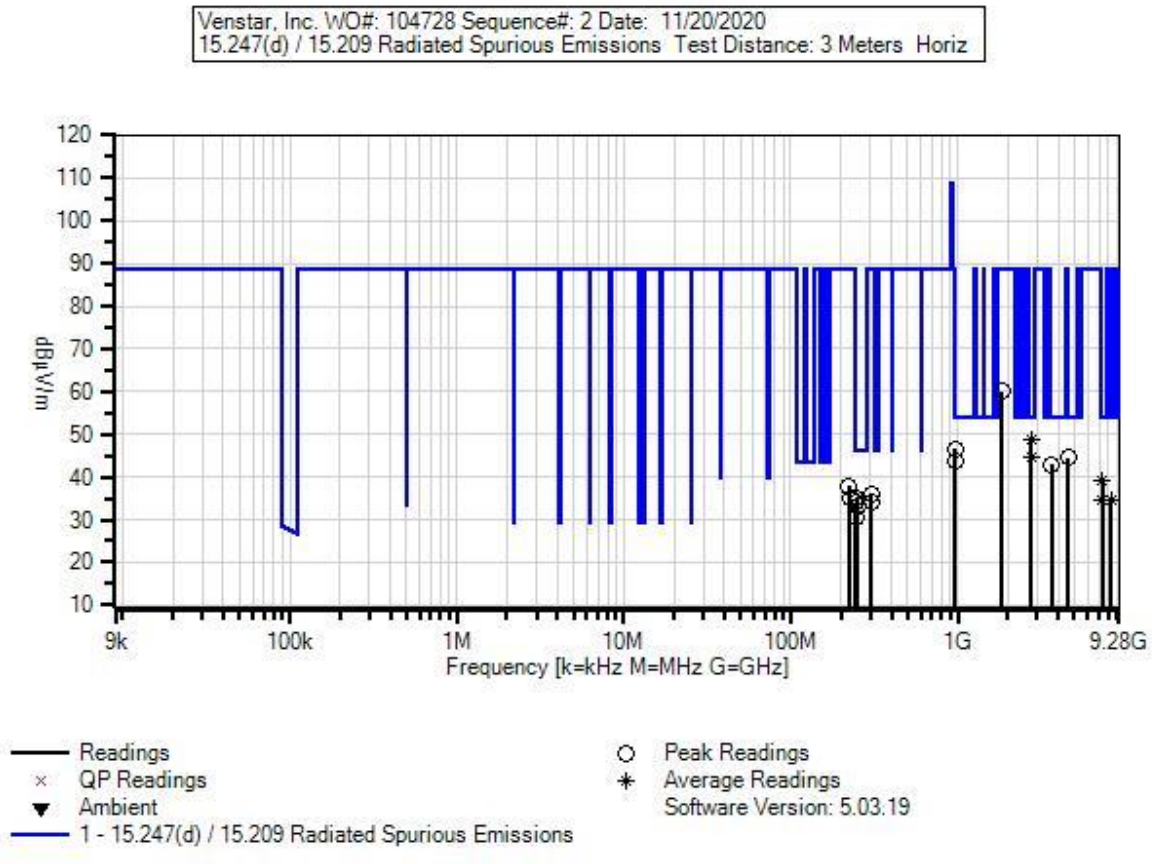
Test Conditions / Notes:

EUT is powered from 24Vac AC Adapter and set to transmit continuously. All IO ports are populated with unterminated cables.
Software profile: "WB-DSSS 60 kbps, 2-GFSK, 195 kHz deviation, 4x spreading"
RF Designed Based On: LAUNCHXL-CC1352R1
Frequency: 915MHz
Symbol Rate: 480kBaud
Modulation: 2-GFSK
Deviation: 195kHz
Cap Array Delta: 20 (0x14)
Mode: Continuous TX/ Modulated
TX Power: 14dBm

Frequency of Measurement: 9kHz-9280MHz
9kHz to 150kHz RBW=0.2kHz, VBW=0.6kHz.
150kHz to 30MHz RBW=9kHz, VBW=27kHz.
30-1000MHz, RBW=120kHz, VBW=360kHz
1000-9280MHz, RBW=1MHz, VBW=3MHz

Test Environment Conditions:
Temperature: 21.6°C
Relative Humidity: 42%

Test Method: ANSI C63.10 (2013)
KDB 558074 D01 15.247 Meas Guidance v05r02



Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN00314	Loop Antenna	6502	4/13/2020	4/13/2022
	AN03367	Horn Antenna	62-GH-62-25.	8/1/2019	8/1/2021
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
T5	AN01993	Biconilog Antenna	CBL6111C	6/11/2019	6/11/2021
T6	AN03643	Spectrum Analyzer	E4440A	5/20/2020	5/20/2022
T7	AN00786	Preamp	83017A	5/20/2020	5/20/2022
T8	AN00849	Horn Antenna	3115	3/17/2020	3/17/2022
T9	ANP06360	Cable	L1-PNMNM-48	8/8/2019	8/8/2021
T10	ANP07246	Cable	32022-29094K-29094K-24TC	5/29/2020	5/29/2022
T11	AN03169	High Pass Filter	HM1155-11SS	5/8/2019	5/8/2021

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

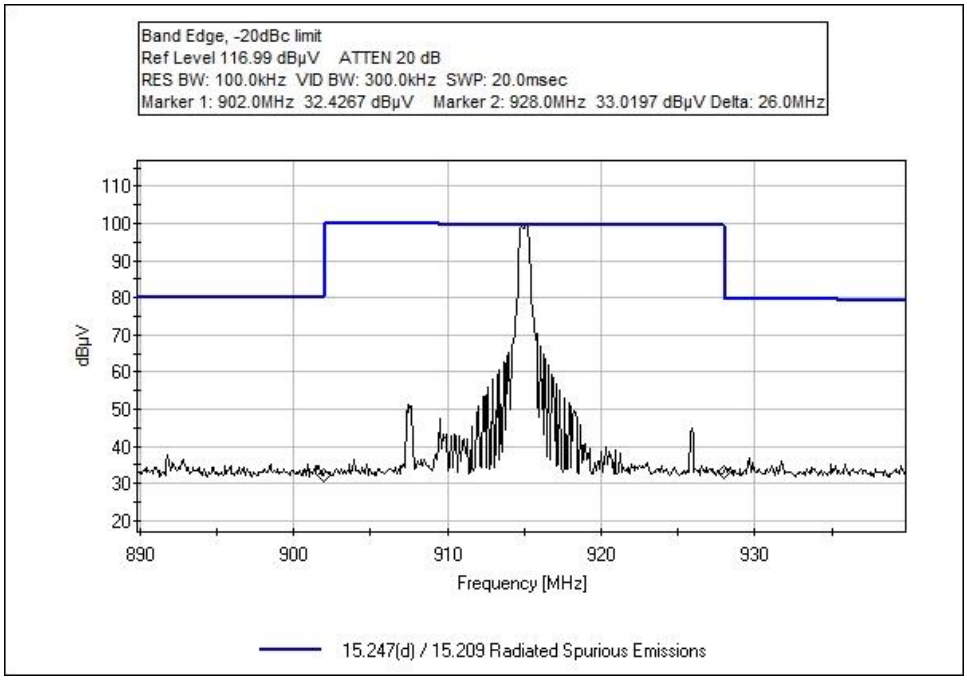
#	Freq	Rdng	T1 T5 T9	T2 T6 T10	T3 T7 T11	T4 T8	Dist	Corr	Spec	Margin	Polar
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV/m	dBµV/m	dB	Ant
1	2744.350M	53.5	+0.0	+0.0	+0.0	+0.0	+0.0	48.7	54.0	-5.3	Vert
	Ave		+0.0	+0.0	-38.5	+29.7					
			+3.4	+0.4	+0.2						
^	2744.350M	70.8	+0.0	+0.0	+0.0	+0.0	+0.0	66.0	54.0	+12.0	Vert
			+0.0	+0.0	-38.5	+29.7					
			+3.4	+0.4	+0.2						
3	962.825M	36.7	-27.2	+6.0	+0.4	+6.1	+0.0	46.5	54.0	-7.5	Vert
			+24.5	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0						
4	2744.383M	49.5	+0.0	+0.0	+0.0	+0.0	+0.0	44.7	54.0	-9.3	Horiz
	Ave		+0.0	+0.0	-38.5	+29.7					
			+3.4	+0.4	+0.2						
^	2744.383M	67.0	+0.0	+0.0	+0.0	+0.0	+0.0	62.2	54.0	+8.2	Horiz
			+0.0	+0.0	-38.5	+29.7					
			+3.4	+0.4	+0.2						
6	4574.080M	44.1	+0.0	+0.0	+0.0	+0.0	+0.0	44.6	54.0	-9.4	Horiz
			+0.0	+0.0	-37.4	+32.6					
			+4.5	+0.6	+0.2						
7	962.850M	33.7	-27.2	+6.0	+0.4	+6.1	+0.0	43.5	54.0	-10.5	Vert
			+24.5	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0						
8	248.200M	41.9	-27.9	+5.9	+0.2	+2.9	+0.0	35.2	46.0	-10.8	Horiz
			+12.2	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0						
9	3659.480M	44.1	+0.0	+0.0	+0.0	+0.0	+0.0	42.9	54.0	-11.1	Vert
			+0.0	+0.0	-38.1	+32.0					
			+4.0	+0.7	+0.2						
10	245.800M	40.8	-27.9	+5.9	+0.2	+2.9	+0.0	33.9	46.0	-12.1	Horiz
			+12.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0						
11	250.700M	40.0	-27.9	+5.9	+0.2	+2.9	+0.0	33.4	46.0	-12.6	Horiz
			+12.3	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0						
12	7318.450M	33.1	+0.0	+0.0	+0.0	+0.0	+0.0	39.1	54.0	-14.9	Horiz
	Ave		+0.0	+0.0	-37.3	+36.2					
			+6.1	+0.8	+0.2						
^	7318.450M	49.2	+0.0	+0.0	+0.0	+0.0	+0.0	55.2	54.0	+1.2	Horiz
			+0.0	+0.0	-37.3	+36.2					
			+6.1	+0.8	+0.2						
14	243.500M	37.5	-27.9	+5.9	+0.2	+2.9	+0.0	30.5	46.0	-15.5	Horiz
			+11.9	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0						

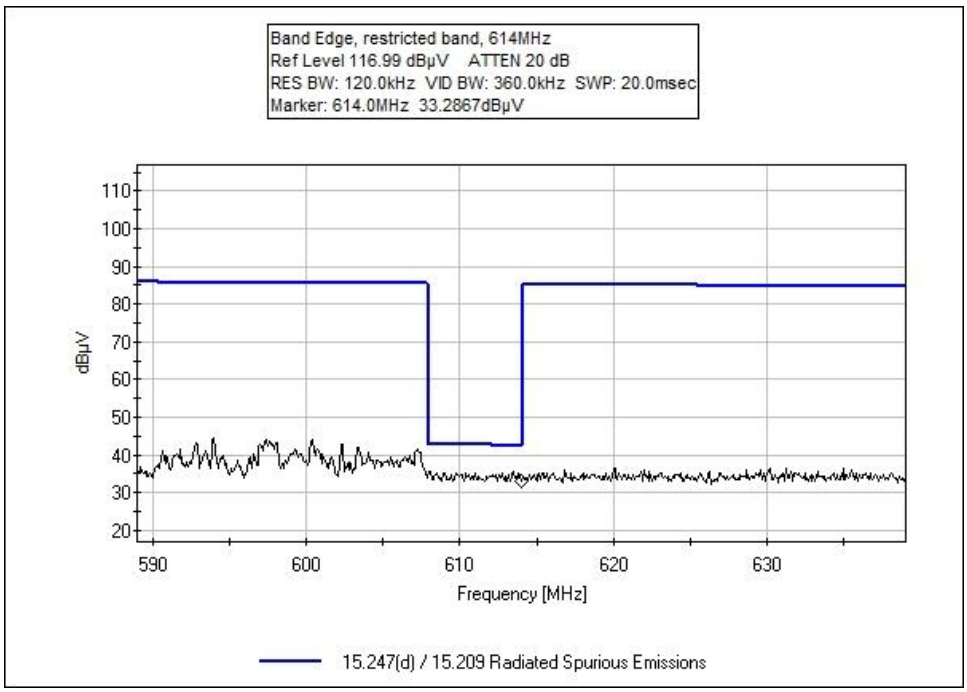
15	8233.450M	27.3	+0.0	+0.0	+0.0	+0.0	+0.0	34.7	54.0	-19.3	Horiz
	Ave		+0.0	+0.0	-37.2	+36.9					
			+6.5	+0.9	+0.3						
^	8233.450M	43.0	+0.0	+0.0	+0.0	+0.0	+0.0	50.4	54.0	-3.6	Horiz
			+0.0	+0.0	-37.2	+36.9					
			+6.5	+0.9	+0.3						
17	7321.380M	28.6	+0.0	+0.0	+0.0	+0.0	+0.0	34.6	54.0	-19.4	Vert
	Ave		+0.0	+0.0	-37.3	+36.2					
			+6.1	+0.8	+0.2						
^	7321.380M	44.9	+0.0	+0.0	+0.0	+0.0	+0.0	50.9	54.0	-3.1	Vert
			+0.0	+0.0	-37.3	+36.2					
			+6.1	+0.8	+0.2						
19	1830.017M	68.6	+0.0	+0.0	+0.0	+0.0	+0.0	60.1	88.7	-28.6	Vert
			+0.0	+0.0	-38.8	+26.9					
			+2.8	+0.4	+0.2						
20	221.950M	46.6	-27.9	+5.9	+0.2	+2.7	+0.0	38.0	88.7	-50.7	Horiz
			+10.5	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0						
21	303.100M	41.0	-27.9	+5.9	+0.3	+3.2	+0.0	35.9	88.7	-52.8	Horiz
			+13.4	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0						
22	224.900M	43.2	-27.9	+5.9	+0.2	+2.8	+0.0	34.9	88.7	-53.8	Vert
			+10.7	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0						
23	303.200M	39.2	-27.9	+5.9	+0.3	+3.2	+0.0	34.1	88.7	-54.6	Vert
			+13.4	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0						

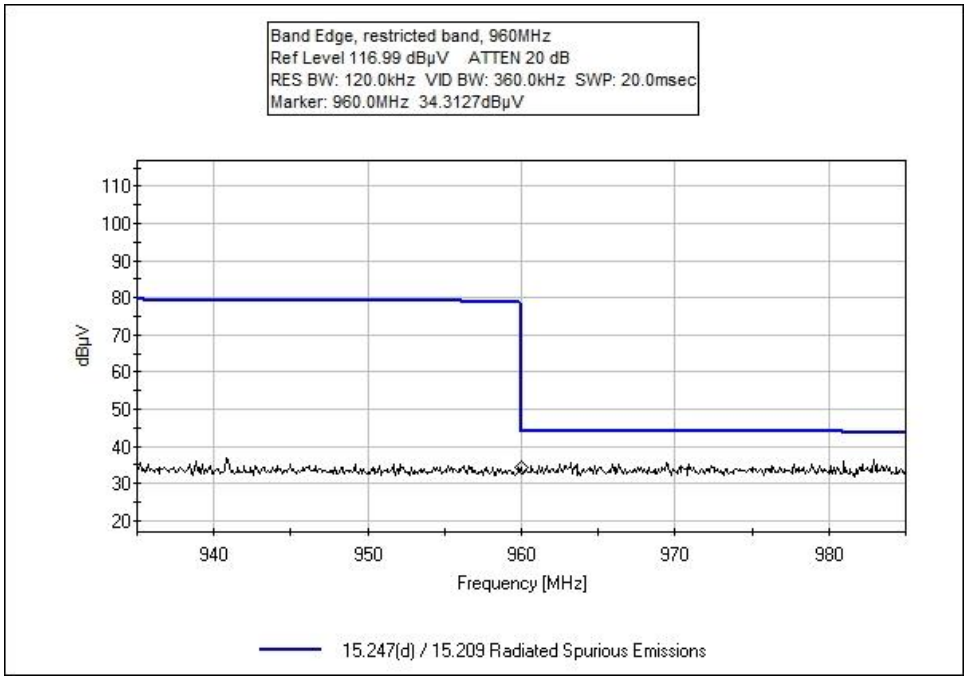
Band Edge

Band Edge Summary					
Limit applied: Max Power/100kHz - 20dB.					
Frequency (MHz)	**Modulation**	**Ant. Type**	**Field Strength (dBuV/m @3m)**	**Limit (dBuV/m @3m)**	**Results**
614	GFSK	Chip Antenna	36.7	< 46	Pass
902	GFSK	Chip Antenna	41.1	< 88.7	Pass
928	GFSK	Chip Antenna	42.1	< 88.7	Pass
960	GFSK	Chip Antenna	44.0	< 54	Pass

Band Edge Plots




Band Edge, restricted band, 614MHz
Ref Level 116.99 dBµV ATTEN 20 dB
RES BW: 120.0kHz VID BW: 360.0kHz SWP: 20.0msec
Marker: 614.0MHz 33.2867dBµV
dBµV
110
100
90
80
70
60
50
40
30
20
590
600
610
620
630
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions


Band Edge, restricted band, 960MHz
Ref Level 116.99 dBµV ATTEN 20 dB
RES BW: 120.0kHz VID BW: 360.0kHz SWP: 20.0msec
Marker: 960.0MHz 34.3127dBµV
dBµV
110
100
90
80
70
60
50
40
30
20
940
950
960
970
980
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions

Test Setup / Conditions / Data

Test Location:	CKC Laboratories Inc. • 110 N. Olinda Pl. • Brea, CA 92823 • 714-993-6112		
Customer:	**Venstar, Inc.**		
Specification:	**15.247(d) / 15.209 Radiated Spurious Emissions**		
Work Order #:	**104728**	Date:	11/18/2020
Test Type:	**Maximized Emissions**	Time:	09:23:51
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 profile: "WB-DSSS 60 kbps, 2-GFSK, 195 kHz deviation, 4x spreading"
RF Designed Based On: LAUNCHXL-CC1352R1
Frequency: 915MHz
Symbol Rate: 480kBaud
Modulation: 2-GFSK
Deviation: 195kHz
Cap Array Delta: 20 (0x14)
Mode: Continuous TX/ Modulated
TX Power: 14dBm

Frequency of Measurement:614-960MHz
RBW=120kHz, VBW=360kHz (restricted band)
RBW=100kHz, VBW=300kHz (-20dBc limit)

Test Environment Conditions:
Temperature: 21.6°C
Relative Humidity: 42%

Test Method: ANSI C63.10 (2013)
KDB 558074 D01 15.247 Meas Guidance v05r02

Test Equipment:

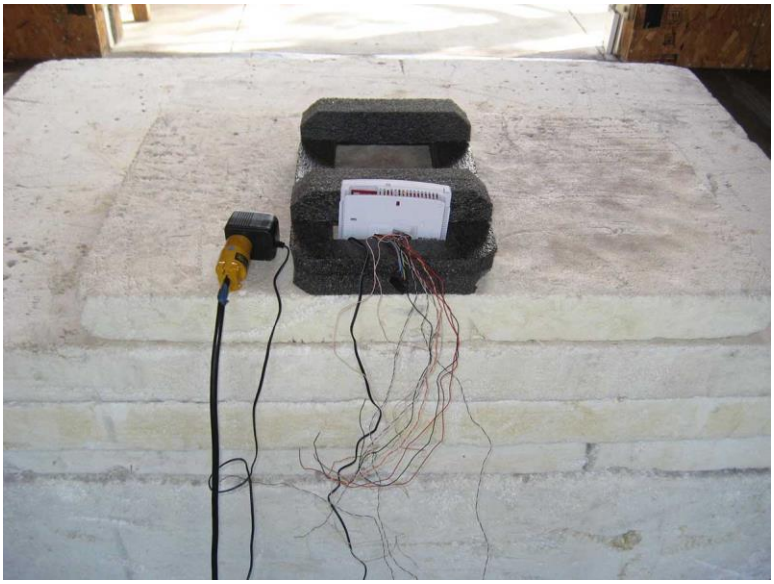
ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN00309	Preamp	8447D	12/24/2019	12/24/2021
T2	ANP05281	Attenuator	1B	4/7/2020	4/7/2022
T3	ANP05050	Cable	RG223/U	12/24/2018	12/24/2020
T4	ANP05198	Cable-Amplitude +15C to +45C (dB)	8268	12/4/2018	12/4/2020
T5	AN03643	Spectrum Analyzer	E4440A	5/20/2020	5/20/2022
T6	AN01993	Biconilog Antenna	CBL6111C	6/11/2019	6/11/2021

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	614.000M	33.3	-27.4 +0.0	+5.9 +19.8	+0.4	+4.7	+0.0	36.7	46.0	-9.3	Horiz
2	960.000M	34.3	-27.2 +0.0	+6.0 +24.4	+0.4	+6.1	+0.0	44.0	54.0	-10.0	Horiz
3	928.000M	33.0	-27.2 +0.0	+6.0 +23.9	+0.4	+6.0	+0.0	42.1	88.7	-46.6	Horiz
4	902.000M	32.4	-27.1 +0.0	+6.0 +23.5	+0.4	+5.9	+0.0	41.1	88.7	-47.6	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:	11:33:44 AM
Tested By:	Don Nguyen	Sequence#:	12
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			

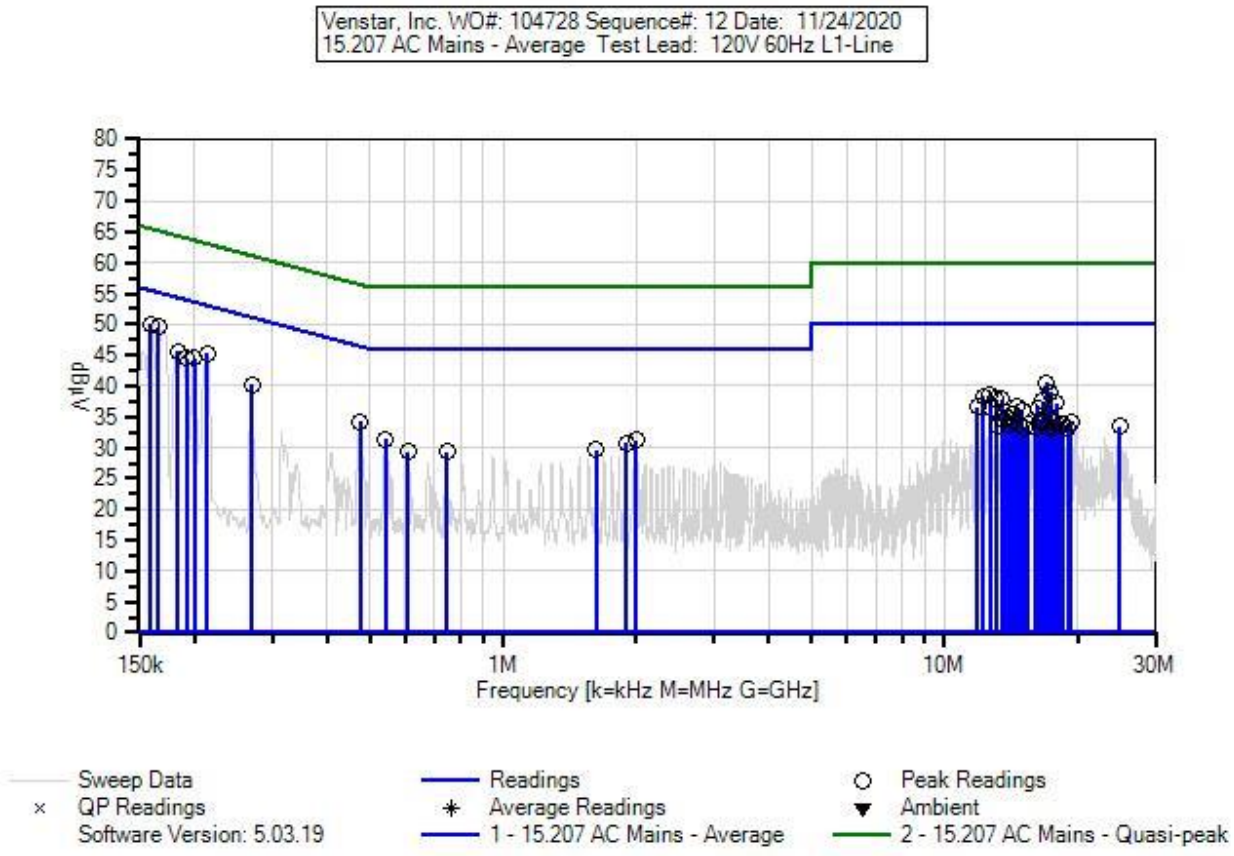
Test Conditions / Notes:

EUT is powered from 24Vac AC Adapter and set to transmitting mode.
Software profile: "WB-DSSS 60 kbps, 2-GFSK, 195 kHz deviation, 4x spreading"
RF Designed Based On: LAUNCHXL-CC1352R1
Frequency: 915MHz
Symbol Rate: 480kBaud
Modulation: 2-GFSK
Deviation: 195kHz
Cap Array Delta: 20 (0x14)
Mode: Continuous TX/ Modulated
TX Power: 14dBm

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)



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	Rdng	T1 T5	T2	T3	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV	dBµV	dB	Ant
1	158.726k	43.6	+5.8 +0.0	+0.0	+0.0	+0.6	+0.0	50.0	55.5	-5.5	L1-Li
2	165.271k	43.4	+5.8 +0.0	+0.0	+0.0	+0.4	+0.0	49.6	55.2	-5.6	L1-Li
3	213.994k	39.3	+5.8 +0.0	+0.0	+0.0	+0.2	+0.0	45.3	53.0	-7.7	L1-Li
4	183.451k	39.5	+5.8 +0.0	+0.0	+0.0	+0.3	+0.0	45.6	54.3	-8.7	L1-Li
5	199.450k	38.5	+5.8 +0.0	+0.0	+0.0	+0.2	+0.0	44.5	53.6	-9.1	L1-Li
6	192.177k	38.5	+5.8 +0.0	+0.0	+0.0	+0.2	+0.0	44.5	53.9	-9.4	L1-Li
7	17.004M	33.0	+5.8 +1.1	+0.3	+0.2	+0.2	+0.0	40.6	50.0	-9.4	L1-Li
8	269.261k	34.3	+5.8 +0.0	+0.0	+0.0	+0.1	+0.0	40.2	51.1	-10.9	L1-Li
9	17.400M	31.2	+5.8 +1.1	+0.4	+0.2	+0.2	+0.0	38.9	50.0	-11.1	L1-Li
10	12.652M	31.3	+5.8 +0.9	+0.3	+0.1	+0.2	+0.0	38.6	50.0	-11.4	L1-Li
11	12.256M	31.2	+5.8 +0.8	+0.3	+0.1	+0.2	+0.0	38.4	50.0	-11.6	L1-Li
12	474.333k	28.2	+5.8 +0.0	+0.0	+0.0	+0.3	+0.0	34.3	46.4	-12.1	L1-Li
13	13.040M	30.6	+5.8 +0.9	+0.3	+0.1	+0.2	+0.0	37.9	50.0	-12.1	L1-Li
14	13.454M	30.5	+5.8 +0.9	+0.3	+0.1	+0.2	+0.0	37.8	50.0	-12.2	L1-Li
15	16.634M	30.0	+5.8 +1.1	+0.3	+0.2	+0.2	+0.0	37.6	50.0	-12.4	L1-Li
16	17.914M	29.5	+5.8 +1.1	+0.4	+0.2	+0.2	+0.0	37.2	50.0	-12.8	L1-Li
17	11.860M	29.4	+5.8 +0.8	+0.3	+0.1	+0.2	+0.0	36.6	50.0	-13.4	L1-Li
18	14.625M	29.2	+5.8 +1.0	+0.3	+0.1	+0.2	+0.0	36.6	50.0	-13.4	L1-Li
19	16.238M	28.8	+5.8 +1.1	+0.3	+0.2	+0.2	+0.0	36.4	50.0	-13.6	L1-Li
20	12.734M	29.0	+5.8 +0.9	+0.3	+0.1	+0.2	+0.0	36.3	50.0	-13.7	L1-Li
21	15.022M	28.7	+5.8 +1.1	+0.3	+0.1	+0.2	+0.0	36.2	50.0	-13.8	L1-Li
22	541.964k	25.3	+5.8 +0.0	+0.0	+0.0	+0.3	+0.0	31.4	46.0	-14.6	L1-Li
23	14.256M	28.0	+5.8 +1.0	+0.3	+0.1	+0.2	+0.0	35.4	50.0	-14.6	L1-Li
24	2.000M	25.2	+5.8 +0.0	+0.1	+0.0	+0.2	+0.0	31.3	46.0	-14.7	L1-Li

25	13.842M	27.4	+5.8 +1.0	+0.3	+0.1	+0.2	+0.0	34.8	50.0	-15.2	L1-Li
26	1.898M	24.7	+5.8 +0.0	+0.1	+0.0	+0.2	+0.0	30.8	46.0	-15.2	L1-Li
27	13.481M	27.3	+5.8 +1.0	+0.3	+0.1	+0.2	+0.0	34.7	50.0	-15.3	L1-Li
28	16.526M	27.0	+5.8 +1.1	+0.3	+0.2	+0.2	+0.0	34.6	50.0	-15.4	L1-Li
29	13.526M	27.0	+5.8 +1.0	+0.3	+0.1	+0.2	+0.0	34.4	50.0	-15.6	L1-Li
30	14.319M	27.0	+5.8 +1.0	+0.3	+0.1	+0.2	+0.0	34.4	50.0	-15.6	L1-Li
31	17.526M	26.7	+5.8 +1.1	+0.4	+0.2	+0.2	+0.0	34.4	50.0	-15.6	L1-Li
32	16.716M	26.7	+5.8 +1.1	+0.3	+0.2	+0.2	+0.0	34.3	50.0	-15.7	L1-Li
33	17.779M	26.6	+5.8 +1.1	+0.4	+0.2	+0.2	+0.0	34.3	50.0	-15.7	L1-Li
34	16.508M	26.5	+5.8 +1.1	+0.3	+0.2	+0.2	+0.0	34.1	50.0	-15.9	L1-Li
35	19.373M	26.3	+5.8 +1.1	+0.4	+0.2	+0.2	+0.0	34.0	50.0	-16.0	L1-Li
36	14.743M	26.5	+5.8 +1.0	+0.3	+0.1	+0.2	+0.0	33.9	50.0	-16.1	L1-Li
37	18.490M	26.2	+5.8 +1.1	+0.4	+0.2	+0.2	+0.0	33.9	50.0	-16.1	L1-Li
38	13.932M	26.4	+5.8 +1.0	+0.3	+0.1	+0.2	+0.0	33.8	50.0	-16.2	L1-Li
39	1.626M	23.6	+5.8 +0.0	+0.1	+0.0	+0.2	+0.0	29.7	46.0	-16.3	L1-Li
40	15.445M	26.1	+5.8 +1.1	+0.3	+0.2	+0.2	+0.0	33.7	50.0	-16.3	L1-Li
41	13.148M	26.3	+5.8 +0.9	+0.3	+0.1	+0.2	+0.0	33.6	50.0	-16.4	L1-Li
42	18.184M	25.9	+5.8 +1.1	+0.4	+0.2	+0.2	+0.0	33.6	50.0	-16.4	L1-Li
43	24.902M	25.8	+5.8 +1.1	+0.4	+0.2	+0.2	+0.0	33.5	50.0	-16.5	L1-Li
44	608.866k	23.1	+5.8 +0.0	+0.1	+0.0	+0.3	+0.0	29.3	46.0	-16.7	L1-Li
45	744.854k	23.1	+5.8 +0.0	+0.1	+0.0	+0.3	+0.0	29.3	46.0	-16.7	L1-Li
46	15.112M	25.8	+5.8 +1.1	+0.3	+0.1	+0.2	+0.0	33.3	50.0	-16.7	L1-Li
47	19.004M	25.5	+5.8 +1.1	+0.4	+0.2	+0.2	+0.0	33.2	50.0	-16.8	L1-Li
48	16.112M	25.5	+5.8 +1.1	+0.3	+0.2	+0.2	+0.0	33.1	50.0	-16.9	L1-Li
49	17.166M	25.5	+5.8 +1.1	+0.3	+0.2	+0.2	+0.0	33.1	50.0	-16.9	L1-Li
50	17.607M	25.4	+5.8 +1.1	+0.4	+0.2	+0.2	+0.0	33.1	50.0	-16.9	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:	11:32:15 AM
Tested By:	Don Nguyen	Sequence#:	11
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:

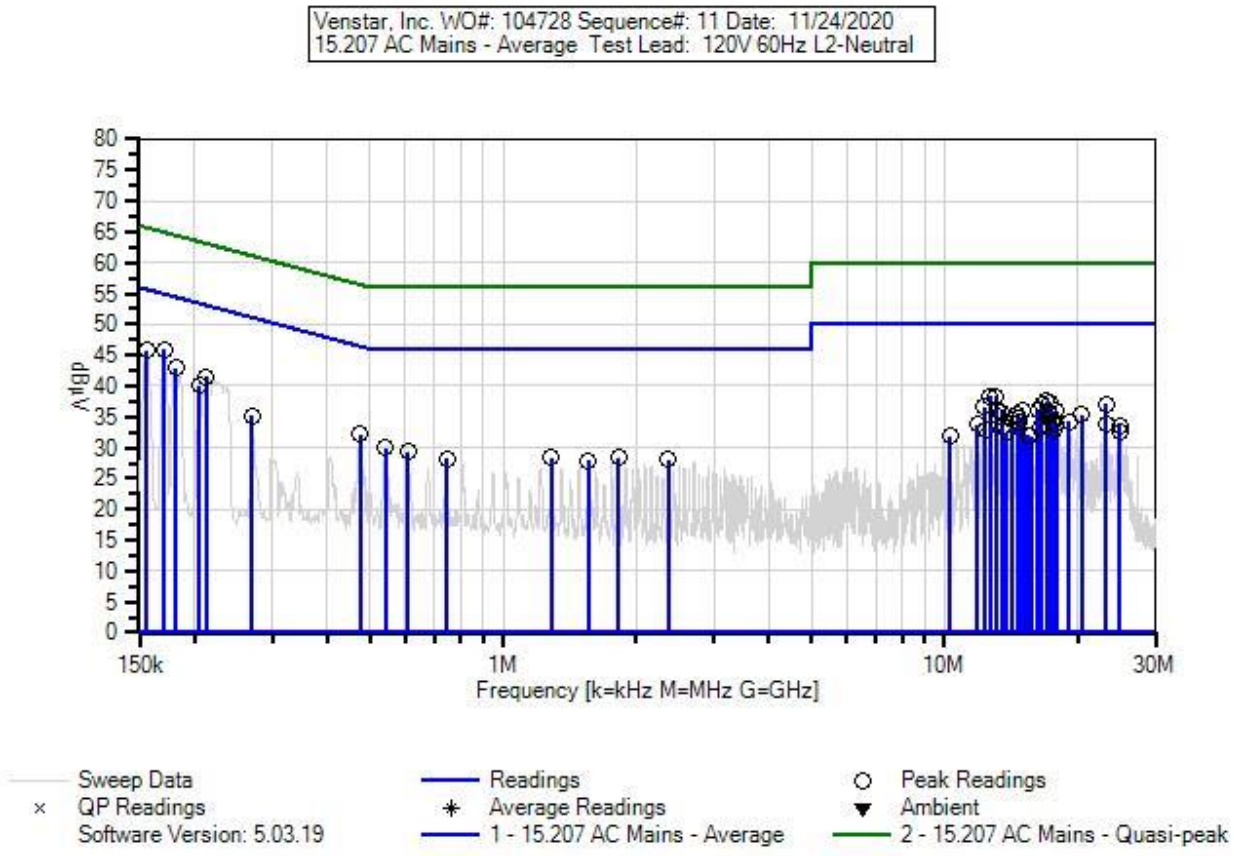
EUT is powered from 24Vac AC Adapter and set to transmitting mode.
Software profile: "WB-DSSS 60 kbps, 2-GFSK, 195 kHz deviation, 4x spreading"
RF Designed Based On: LAUNCHXL-CC1352R1
Frequency: 915MHz
Symbol Rate: 480kBaud
Modulation: 2-GFSK
Deviation: 195kHz
Cap Array Delta: 20 (0x14)
Mode: Continuous TX/ Modulated
TX Power: 14dBm

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)



Test Equipment:

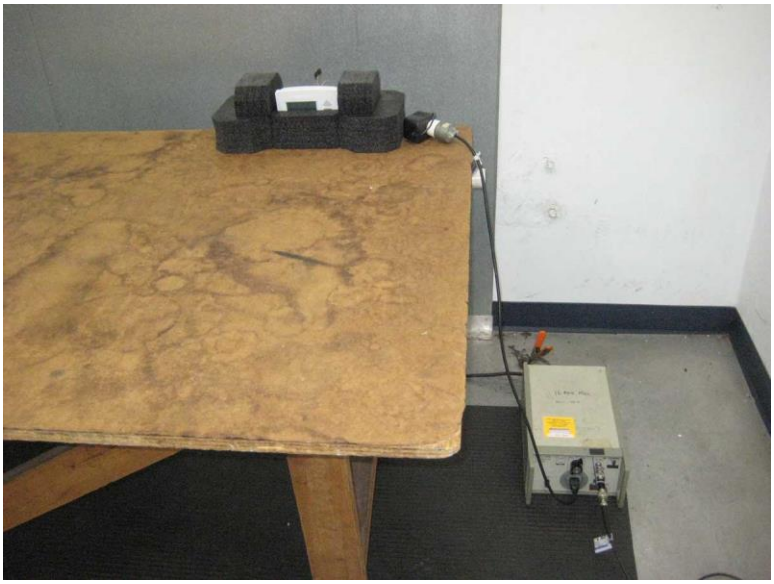
ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	ANP07545	Attenuator	SA18N10W-06	1/18/2019	1/18/2021
T2	ANP07338	Cable	2249-Y-240	12/24/2019	12/24/2021
	AN00847.1	50uH LISN-(L) Line 1	3816/2NM	3/10/2020	3/10/2021
T3	AN00847.1	50uH LISN-(N) Line 2	3816/2NM	3/10/2020	3/10/2021
T4	AN02610	High 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	Rdng	T1 T5	T2	T3	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV	dBµV	dB	Ant
1	170.361k	39.8	+5.8 +0.0	+0.0	+0.0	+0.3	+0.0	45.9	54.9	-9.0	L2-Ne
2	155.817k	39.3	+5.8 +0.0	+0.0	+0.0	+0.7	+0.0	45.8	55.7	-9.9	L2-Ne
3	181.269k	36.8	+5.8 +0.0	+0.0	+0.0	+0.3	+0.0	42.9	54.4	-11.5	L2-Ne
4	212.539k	35.5	+5.8 +0.0	+0.0	+0.0	+0.2	+0.0	41.5	53.1	-11.6	L2-Ne
5	13.058M	31.1	+5.8 +0.8	+0.3	+0.2	+0.2	+0.0	38.4	50.0	-11.6	L2-Ne
6	12.643M	31.1	+5.8 +0.7	+0.3	+0.2	+0.2	+0.0	38.3	50.0	-11.7	L2-Ne
7	16.995M	30.1	+5.8 +1.0	+0.3	+0.2	+0.2	+0.0	37.6	50.0	-12.4	L2-Ne
8	17.391M	29.7	+5.8 +1.0	+0.4	+0.2	+0.2	+0.0	37.3	50.0	-12.7	L2-Ne
9	23.162M	29.4	+5.8 +1.0	+0.4	+0.3	+0.2	+0.0	37.1	50.0	-12.9	L2-Ne
10	16.598M	29.5	+5.8 +0.9	+0.3	+0.2	+0.2	+0.0	36.9	50.0	-13.1	L2-Ne
11	205.267k	34.1	+5.8 +0.0	+0.0	+0.0	+0.2	+0.0	40.1	53.4	-13.3	L2-Ne
12	12.274M	29.4	+5.8 +0.7	+0.3	+0.2	+0.2	+0.0	36.6	50.0	-13.4	L2-Ne
13	16.238M	28.6	+5.8 +0.9	+0.3	+0.2	+0.2	+0.0	36.0	50.0	-14.0	L2-Ne
14	13.157M	28.6	+5.8 +0.8	+0.3	+0.2	+0.2	+0.0	35.9	50.0	-14.1	L2-Ne
15	15.031M	28.5	+5.8 +0.9	+0.3	+0.2	+0.2	+0.0	35.9	50.0	-14.1	L2-Ne
16	17.806M	28.3	+5.8 +1.0	+0.4	+0.2	+0.2	+0.0	35.9	50.0	-14.1	L2-Ne
17	13.454M	28.5	+5.8 +0.8	+0.3	+0.2	+0.2	+0.0	35.8	50.0	-14.2	L2-Ne
18	474.333k	26.0	+5.8 +0.0	+0.0	+0.0	+0.3	+0.0	32.1	46.4	-14.3	L2-Ne
19	17.121M	28.2	+5.8 +1.0	+0.3	+0.2	+0.2	+0.0	35.7	50.0	-14.3	L2-Ne
20	14.643M	28.2	+5.8 +0.8	+0.3	+0.2	+0.2	+0.0	35.5	50.0	-14.5	L2-Ne
21	17.337M	27.8	+5.8 +1.0	+0.4	+0.2	+0.2	+0.0	35.4	50.0	-14.6	L2-Ne
22	20.454M	27.8	+5.8 +1.0	+0.4	+0.2	+0.2	+0.0	35.4	50.0	-14.6	L2-Ne
23	13.130M	27.9	+5.8 +0.8	+0.3	+0.2	+0.2	+0.0	35.2	50.0	-14.8	L2-Ne
24	14.697M	27.5	+5.8 +0.8	+0.3	+0.2	+0.2	+0.0	34.8	50.0	-15.2	L2-Ne

25	14.238M	27.1	+5.8 +0.8	+0.3	+0.2	+0.2	+0.0	34.4	50.0	-15.6	L2-Ne
26	14.725M	27.0	+5.8 +0.8	+0.3	+0.2	+0.2	+0.0	34.3	50.0	-15.7	L2-Ne
27	19.085M	26.7	+5.8 +1.0	+0.4	+0.2	+0.2	+0.0	34.3	50.0	-15.7	L2-Ne
28	17.508M	26.6	+5.8 +1.0	+0.4	+0.2	+0.2	+0.0	34.2	50.0	-15.8	L2-Ne
29	269.988k	29.3	+5.8 +0.0	+0.0	+0.0	+0.1	+0.0	35.2	51.1	-15.9	L2-Ne
30	541.964k	23.9	+5.8 +0.0	+0.0	+0.0	+0.3	+0.0	30.0	46.0	-16.0	L2-Ne
31	11.860M	26.5	+5.8 +0.7	+0.3	+0.2	+0.2	+0.0	33.7	50.0	-16.3	L2-Ne
32	17.905M	26.1	+5.8 +1.0	+0.4	+0.2	+0.2	+0.0	33.7	50.0	-16.3	L2-Ne
33	23.196M	26.0	+5.8 +1.0	+0.4	+0.3	+0.2	+0.0	33.7	50.0	-16.3	L2-Ne
34	17.148M	26.1	+5.8 +1.0	+0.3	+0.2	+0.2	+0.0	33.6	50.0	-16.4	L2-Ne
35	24.923M	25.9	+5.8 +1.0	+0.4	+0.3	+0.2	+0.0	33.6	50.0	-16.4	L2-Ne
36	608.139k	23.2	+5.8 +0.0	+0.1	+0.0	+0.3	+0.0	29.4	46.0	-16.6	L2-Ne
37	13.544M	26.1	+5.8 +0.8	+0.3	+0.2	+0.2	+0.0	33.4	50.0	-16.6	L2-Ne
38	16.427M	25.8	+5.8 +0.9	+0.3	+0.2	+0.2	+0.0	33.2	50.0	-16.8	L2-Ne
39	12.355M	25.7	+5.8 +0.7	+0.3	+0.2	+0.2	+0.0	32.9	50.0	-17.1	L2-Ne
40	17.752M	25.3	+5.8 +1.0	+0.4	+0.2	+0.2	+0.0	32.9	50.0	-17.1	L2-Ne
41	24.868M	24.9	+5.8 +1.0	+0.4	+0.3	+0.2	+0.0	32.6	50.0	-17.4	L2-Ne
42	13.842M	25.2	+5.8 +0.8	+0.3	+0.2	+0.2	+0.0	32.5	50.0	-17.5	L2-Ne
43	1.285M	22.2	+5.8 +0.1	+0.1	+0.0	+0.2	+0.0	28.4	46.0	-17.6	L2-Ne
44	1.826M	22.2	+5.8 +0.1	+0.1	+0.0	+0.2	+0.0	28.4	46.0	-17.6	L2-Ne
45	744.854k	22.0	+5.8 +0.0	+0.1	+0.0	+0.3	+0.0	28.2	46.0	-17.8	L2-Ne
46	2.370M	21.9	+5.8 +0.1	+0.1	+0.0	+0.2	+0.0	28.1	46.0	-17.9	L2-Ne
47	15.418M	24.6	+5.8 +0.9	+0.3	+0.2	+0.2	+0.0	32.0	50.0	-18.0	L2-Ne
48	1.558M	21.7	+5.8 +0.1	+0.1	+0.0	+0.2	+0.0	27.9	46.0	-18.1	L2-Ne
49	10.292M	24.8	+5.8 +0.6	+0.3	+0.2	+0.2	+0.0	31.9	50.0	-18.1	L2-Ne
50	15.688M	24.5	+5.8 +0.9	+0.3	+0.2	+0.2	+0.0	31.9	50.0	-18.1	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.