Venstar, Inc.

TEST REPORT FOR

Z-Wave Module
Model: ACCVZW1

Tested To The Following Standards:

FCC Part 15 Subpart C Section(s)

15.207 & 15.249

Report No.: 99183-5

Date of issue: October 26, 2016

ACCREDITED
Testing Certificates:
803.01, 803.02, 803.05, 803.06

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 EMC 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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Testing the Future
CKC LABORATORIES, INC.

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ADMINISTRATIVE INFORMATION

Test Report Information

REPORT PREPARED FOR:

Venstar, Inc.
9250 Owensmouth Avenue
Chatsworth, CA 91311

REPRESENTATIVE: Alex Garashin

REPORT PREPARED BY:

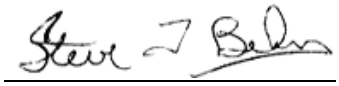
Terri Rayle
CKC Laboratories, Inc.
5046 Sierra Pines Drive
Mariposa, CA 95338

Project Number: 99183

DATE OF EQUIPMENT RECEIPT: October 19, 2016
DATE(S) OF TESTING: October 19-20, 2016

Report Authorization

The test data contained in this report documents the observed testing parameters pertaining to and are relevant for only the sample equipment 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	5.03.02

Site Registration & Accreditation Information

Location	CB #	TAIWAN	CANADA	FCC	JAPAN
Brea A	US0060	SL2-IN-E-1146R	3082D-1	US1025	A-0147

SUMMARY OF RESULTS

Standard / Specification: FCC Part 15 Subpart C - 15.249

Test Procedure	Description	Modifications	Results
15.215(c)	Occupied Bandwidth	NA	Pass
15.249(a)	Field Strength of Fundamental	NA	Pass
15.249(a)	Field Strength of Spurious Emissions	NA	Pass
15.207	AC Conducted Emissions	NA	Pass

NA = Not Applicable

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
Z-Wave module	Venstar, Inc.	ACCVZW1	NA

Support Equipment:

Device	Manufacturer	Model #	S/N
Power supply	Xantrex	XTS 30-2X	58738

General Product Information:

Product Information	Manufacturer-Provided Details
Equipment Type:	Radio Module
Modulation Type(s):	FSK
Maximum Duty Cycle:	1%
Antenna Type(s) and Gain:	Monopole/ +4 dBm
Antenna Connection Type:	Integral
Nominal Input Voltage:	3.3VDC
Firmware / Software used for Test:	Micro RF Link5 v1.1

FCC Part 15 Subpart C

15.215(c) Occupied Bandwidth (20dB BW)

Test Setup/Conditions			
Test Location:	Brea Lab A	Test Engineer:	Don Nguyen
Test Method:	ANSI C63.10 (2013)	Test Date(s):	10/19/2016
Configuration:	1		
Test Setup:	The EUT is placed on a Styrofoam platform at 0.8m in height. The EUT is programmed to continuously transmit modulated carrier with pseudo-random data. The EUT is powered from 3.3VDC support power supply. Firmware power is set at 10. Operating frequency: 908.42 MHz Frequency range of measurement = 908.42MHz RBW=1 kHz, VBW= 3 kHz		

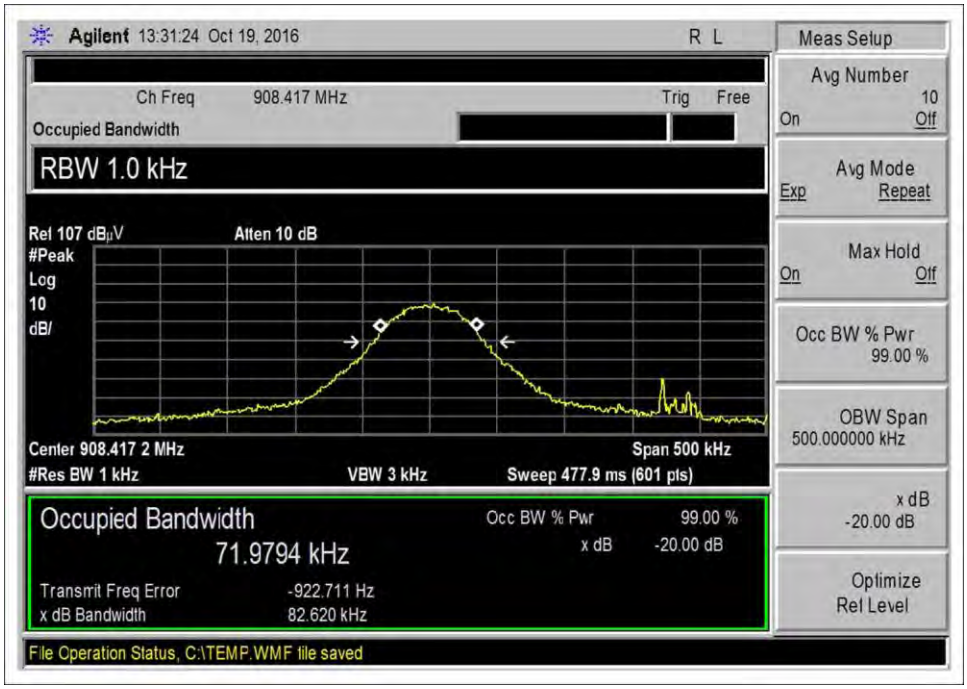
Environmental Conditions			
Temperature (ºC)	26	Relative Humidity (%):	37

Test Equipment					
Asset#	Description	Manufacturer	Model	Cal Date	Cal Due
AN00309	Preamp	HP	8447D	3/14/2016	3/14/2018
AN01995	Biconilog Antenna	Chase	CBL6111C	5/10/2016	5/10/2018
ANP05275	Attenuator	Weinschel	1W	5/5/2016	5/5/2018
ANP05050	Cable	Pasternack	RG223/U	1/15/2015	1/15/2017
ANP05198	Cable-Amplitude 15 to 45degC (dB)	Belden	8268	12/22/2014	12/22/2016
AN02672	Spectrum Analyzer	Agilent	E4446A	9/30/2015	9/30/2017

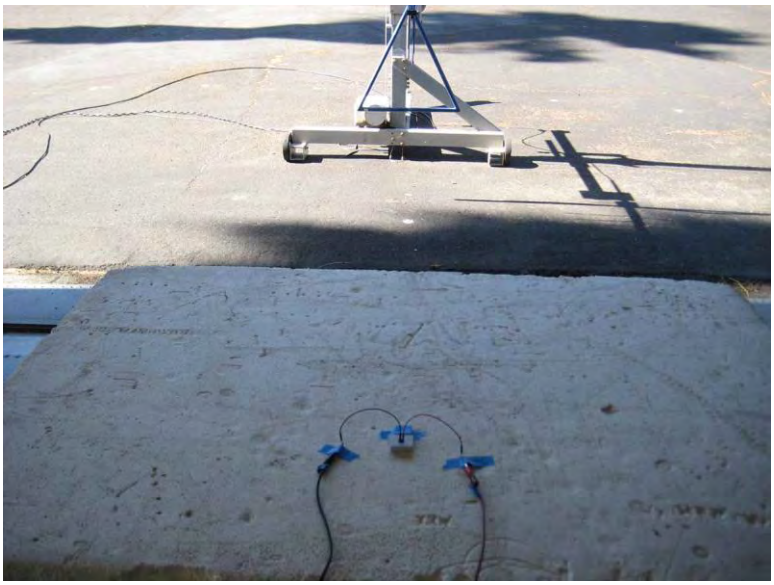
Test Data Summary					
Frequency (MHz)	Antenna Port	Modulation	Measured (kHz)	Limit (kHz)	Results
908.42	NA	FSK	82.62	None	NA

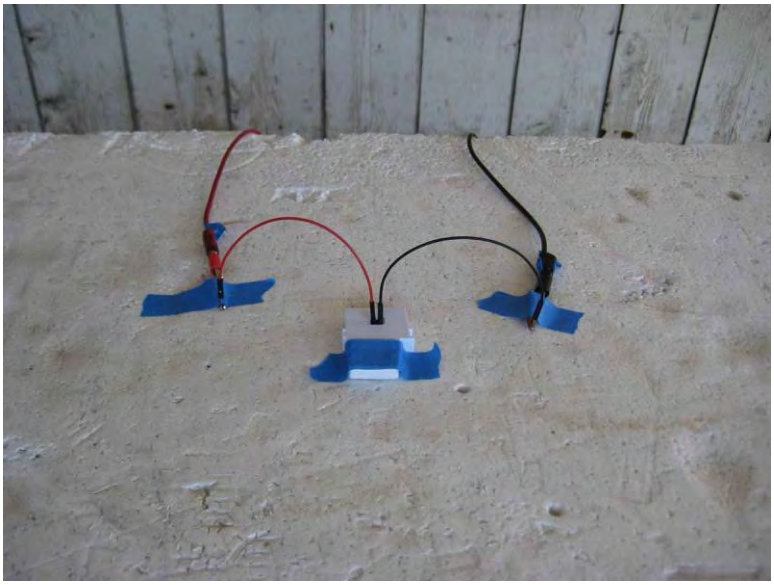
NA = Radiated emission measurement

Plot

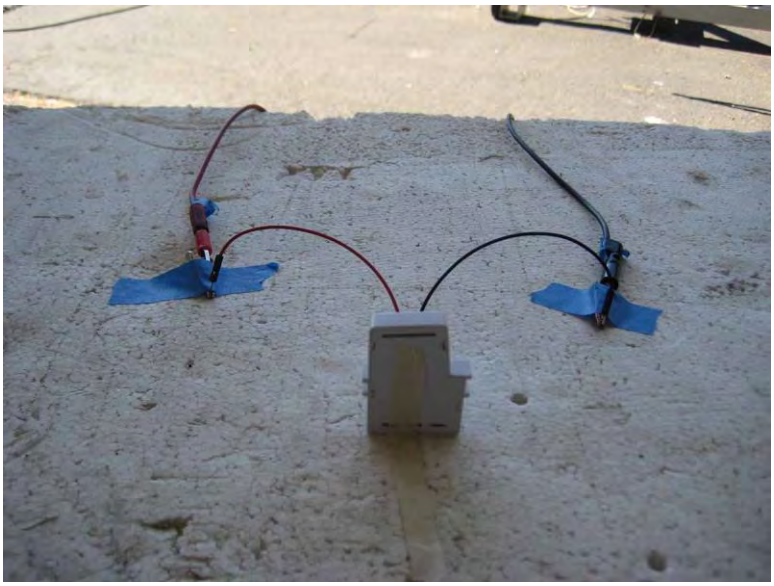

Agilent 13:31:24 Oct 19, 2016
R L
Meas Setup
Avg Number
10
On Off
Ch Freq 908.417 MHz
Trig Free
Occupied Bandwidth
RBW 1.0 kHz
Avg Mode
Exp Repeat
Ref 107 dBµV
Atten 10 dB
#Peak
Log
10
dB/
Max Hold
On Off
Occ BW % Pwr
99.00 %
OBW Span
500.000000 kHz
Center 908.417 2 MHz
Span 500 kHz
#Res BW 1 kHz
VBW 3 kHz
Sweep 477.9 ms (601 pts)
x dB
-20.00 dB
Occupied Bandwidth
71.9794 kHz
Occ BW % Pwr 99.00 %
x dB -20.00 dB
Transmit Freq Error -922.711 Hz
x dB Bandwidth 82.620 kHz
Optimize
Ref Level
File Operation Status, C:\TEMP.WMF file saved

Test Setup Photos

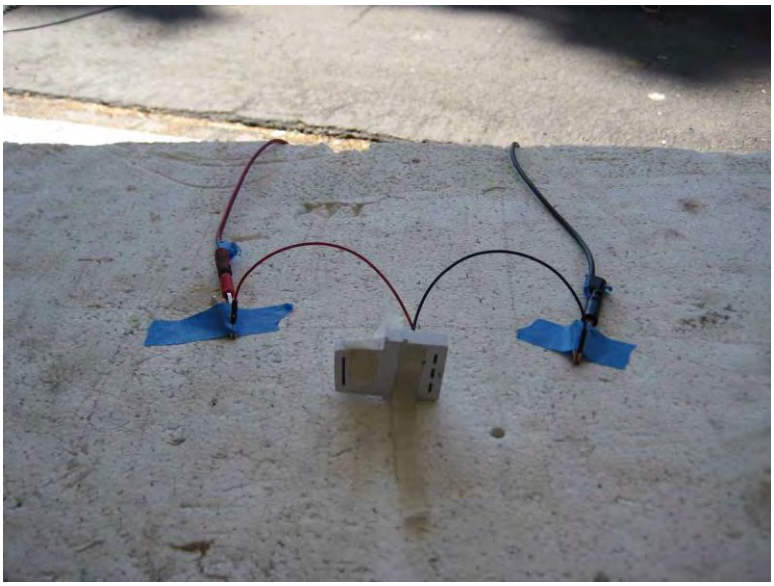




X Axis



Y Axis



Z Axis

15.249(a) Field Strength of Fundamental

Test Data Summary - Voltage Variations					
Frequency (MHz)	Modulation / Ant Port	$V_{Minimum}$ (dBuV/m)	$V_{Nominal}$ (dBuV/m)	$V_{Maximum}$ (dBuV/m)	Max Deviation from $V_{Nominal}$ (dB)
908.42	FSK/ NA	93.4	93.4	93.4	0

NA = Radiated emission measurement

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

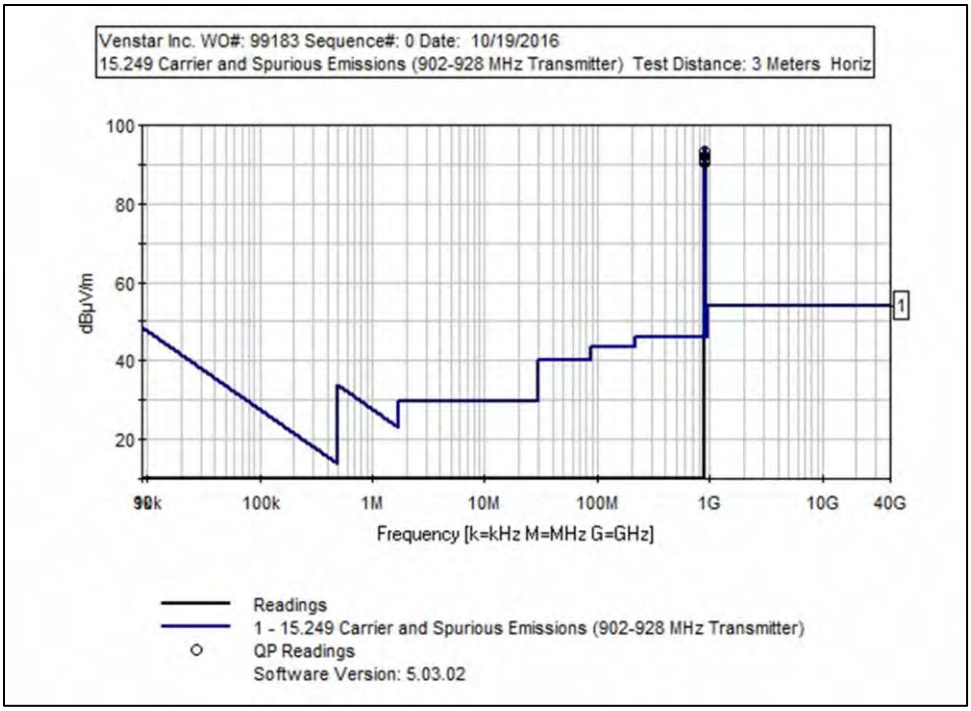
Parameter Definitions:

Measurements performed at input voltage Vnominal ± 15%.

Parameter	Value
$V_{Nominal}$:	3.3 VDC
$V_{Minimum}$:	3.795 VDC
$V_{Maximum}$:	2.805 VDC

Test Data Summary – Radiated Field Strength Measurement					
Frequency (MHz)	Modulation	Ant. Type	Measured (dBuV/m @ 3m)	Limit (dBuV/m @ 3m)	Results
908.42	FSK	Integral	93.4	≤94	Pass

Plot



Test Setup / Conditions / Data

Test Location:	CKC Laboratories, Inc. • 110 N. Olinda Place • Brea, CA 92823 • 714-993-6112		
Customer:	**Venstar Inc.**		
Specification:	**15.249 Carrier and Spurious Emissions (902-928 MHz Transmitter)**		
Work Order #:	**99183**	Date:	10/19/2016
Test Type:	**Maximized Emissions**	Time:	13:21:12
Tested By:	Don Nguyen	Sequence#:	0
Software:	EMITest 5.03.02		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

The EUT is placed on a Styrofoam platform at 0.8m in height. The EUT is programmed to continuously transmit modulated carrier with pseudo-random data. The EUT is powered from 3.3VDC support power supply.
Firmware power is set at 10.
The EUT is rotated in 3 orthogonal axes.
Operating frequency: 908.42 MHz

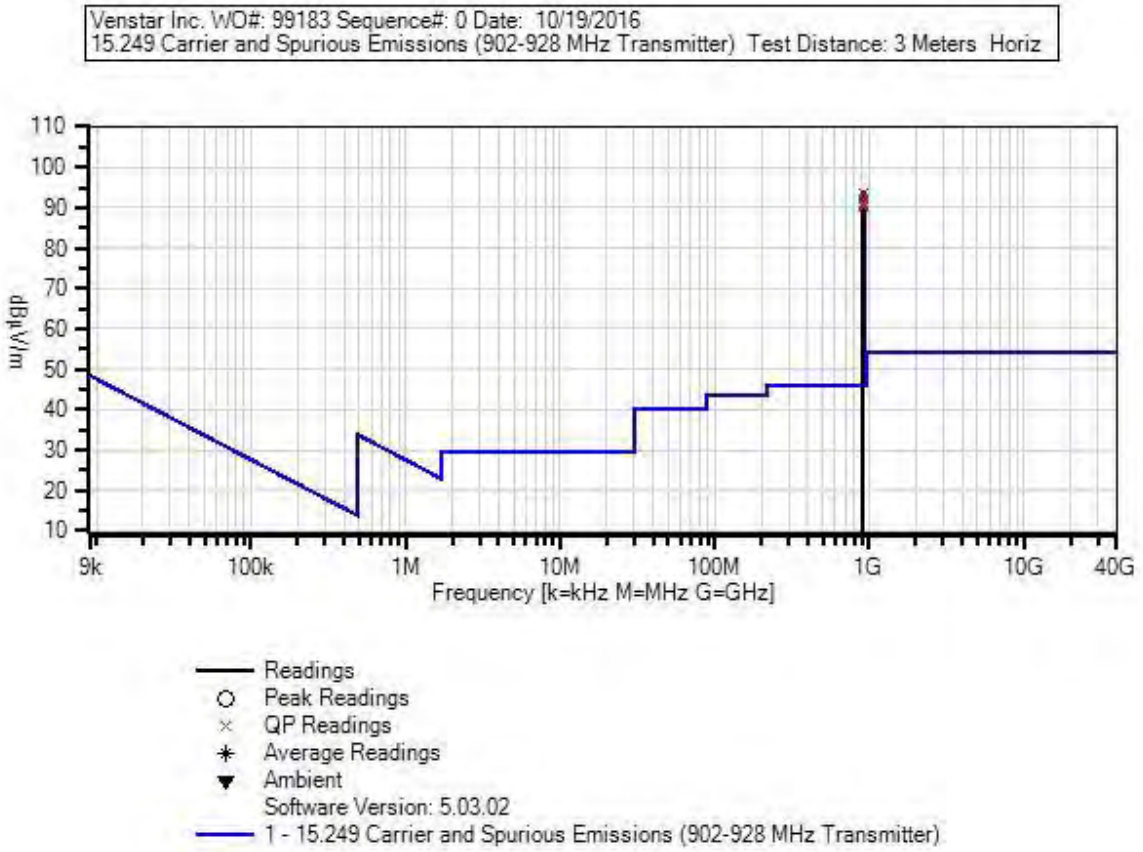
Frequency range of measurement = 908.42MHz

RBW=120 kHz, VBW=360 kHz

Test environment conditions:
Temperature: 26°C
Relative Humidity: 37%
Pressure: 100kPa

ANSI C63.10 (2013)

Site A


Venstar Inc. WO#: 99183 Sequence#: 0 Date: 10/19/2016
15.249 Carrier and Spurious Emissions (902-928 MHz Transmitter) Test Distance: 3 Meters Horiz
dBµV/m
110
100
90
80
70
60
50
40
30
20
10
9k
100k
1M
10M
100M
1G
10G
40G
Frequency [k=kHz M=MHz G=GHz]
Readings
Peak Readings
QP Readings
Average Readings
Ambient
Software Version: 5.03.02
1 - 15.249 Carrier and Spurious Emissions (902-928 MHz Transmitter)

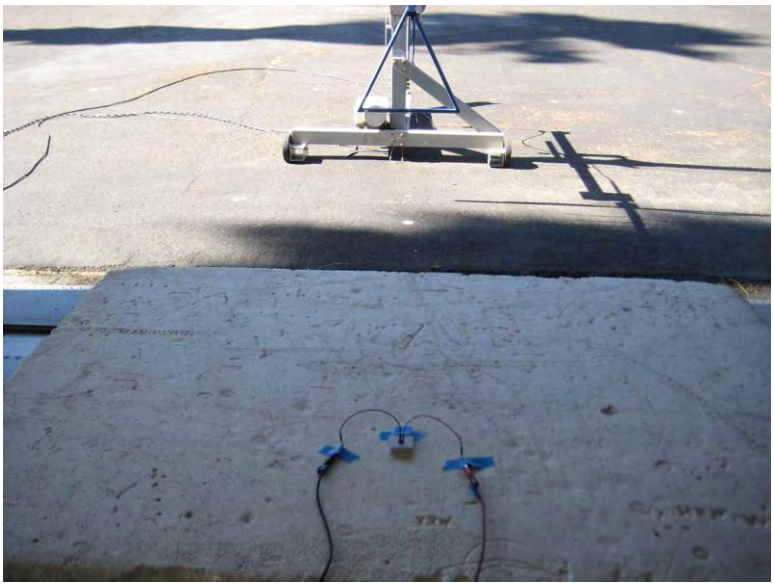
Test Equipment:

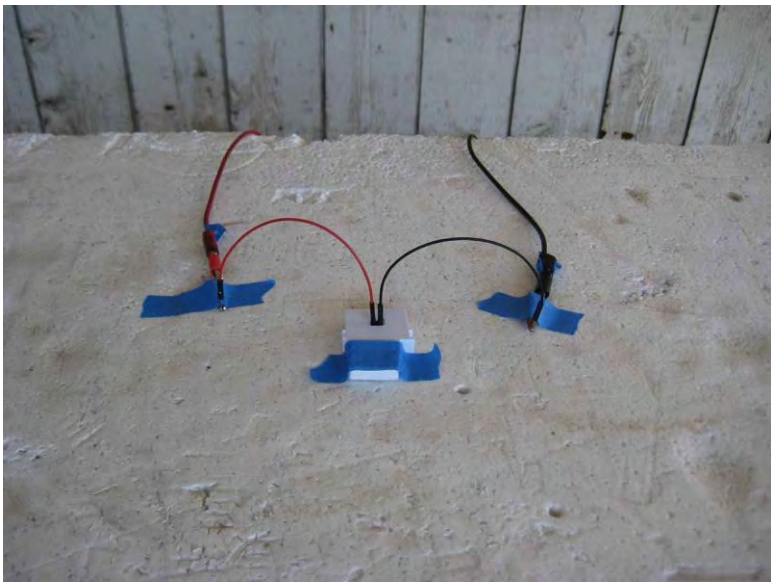
ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN00309	Preamp	8447D	3/14/2016	3/14/2018
T2	AN01995	Biconilog Antenna	CBL6111C	5/10/2016	5/10/2018
T3	ANP05275	Attenuator	1W	5/5/2016	5/5/2018
T4	ANP05050	Cable	RG223/U	1/15/2015	1/15/2017
T5	ANP05198	Cable-Amplitude 15 to 45degC (dB)	8268	12/22/2014	12/22/2016
	AN02672	Spectrum Analyzer	E4446A	9/30/2015	9/30/2017

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

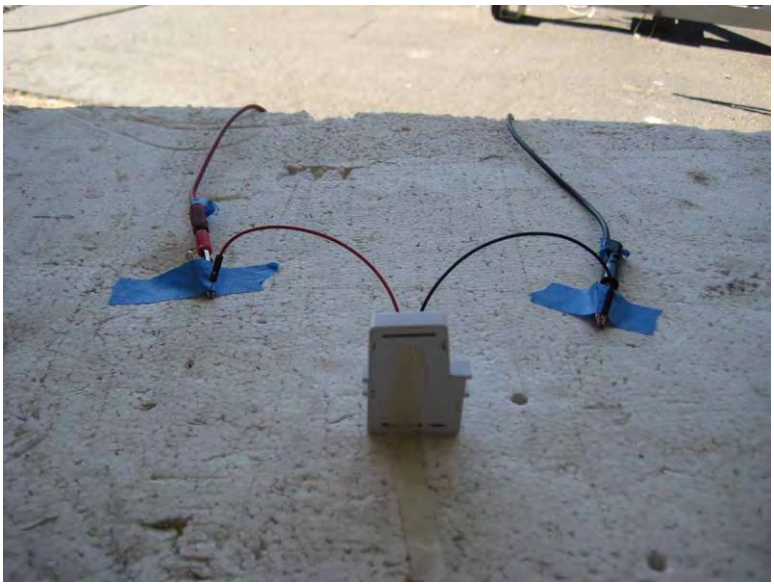
#	Freq	Rdng	T1 T5	T2	T3	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV/m	dBµV/m	dB	Ant
1	908.417M QP	85.4	-27.3 +5.5	+23.4	+6.0	+0.4	+0.0	93.4	94.0 Y axis	-0.6	Vert
2	908.417M QP	84.0	-27.3 +5.5	+23.4	+6.0	+0.4	+0.0	92.0	94.0 Z axis	-2.0	Vert
3	908.417M QP	83.1	-27.3 +5.5	+23.4	+6.0	+0.4	+0.0	91.1	94.0 X axis	-2.9	Vert
^	908.417M	85.4	-27.3 +5.5	+23.4	+6.0	+0.4	+0.0	93.4	94.0 Y axis	-0.6	Vert
^	908.417M	84.0	-27.3 +5.5	+23.4	+6.0	+0.4	+0.0	92.0	94.0 Z axis	-2.0	Vert
^	908.417M	83.1	-27.3 +5.5	+23.4	+6.0	+0.4	+0.0	91.1	94.0 X axis	-2.9	Vert
7	908.417M QP	82.9	-27.3 +5.5	+23.4	+6.0	+0.4	+0.0	90.9	94.0 X axis	-3.1	Horiz
8	908.417M QP	82.8	-27.3 +5.5	+23.4	+6.0	+0.4	+0.0	90.8	94.0 Y axis	-3.2	Horiz
9	908.417M QP	82.3	-27.3 +5.5	+23.4	+6.0	+0.4	+0.0	90.3	94.0 Z axis	-3.7	Horiz
^	908.417M	82.9	-27.3 +5.5	+23.4	+6.0	+0.4	+0.0	90.9	94.0 X axis	-3.1	Horiz
^	908.417M	82.8	-27.3 +5.5	+23.4	+6.0	+0.4	+0.0	90.8	94.0 Y axis	-3.2	Horiz
^	908.417M	82.3	-27.3 +5.5	+23.4	+6.0	+0.4	+0.0	90.3	94.0 Z axis	-3.7	Horiz

Test Setup Photos

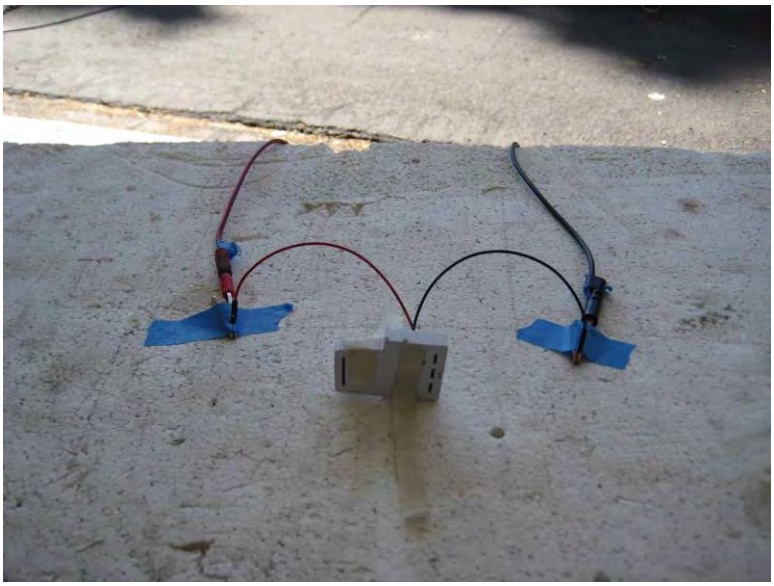




X Axis



Y Axis



Z Axis

15.249(a) Radiated Emissions

Test Setup / Conditions / Data

Test Location:	CKC Laboratories, Inc. • 110 N. Olinda Place • Brea, CA 92823 • 714-993-6112		
Customer:	**Venstar Inc.**		
Specification:	**15.249 Carrier and Spurious Emissions (902-928 MHz Transmitter)**		
Work Order #:	**99183**	Date:	10/19/2016
Test Type:	**Maximized Emissions**	Time:	15:37:51
Tested By:	Don Nguyen	Sequence#:	2
Software:	EMITest 5.03.02		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

The EUT is placed on a Styrofoam platform at 0.8m in height below 1GHz and 1.5m above 1GHz. The EUT is programmed to continuously transmit modulated carrier with pseudo-random data. The EUT is powered from 3.3VDC support power supply.
Firmware power is set at 10.
Operating frequency: 908.42 MHz
The EUT is rotated in 3 orthogonal axes.

Frequency range of measurement = 9kHz-9280MHz

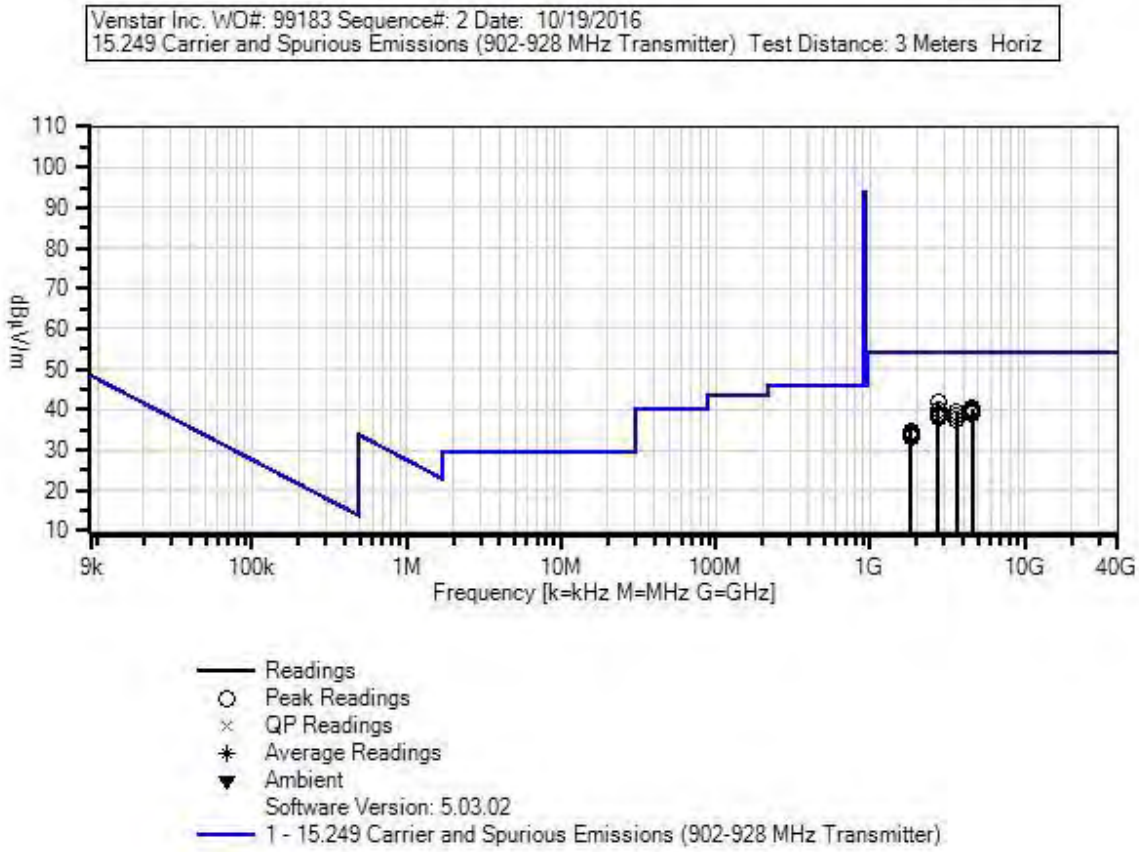
9 kHz - 150 kHz, RBW=200 Hz, VBW=600 Hz
150 kHz -30 MHz, RBW=9 kHz, VBW=27kHz
30 MHz - 1000MHz, RBW=120 kHz, VBW=360 kHz
1000 MHz - 9280MHz, RBW=1 MHz, VBW=3 MHz

Test environment conditions:
Temperature: 26°C
Relative Humidity: 37%
Pressure: 100kPa

ANSI C63.10 (2013)

Site A

No emission found below 1GHz.


Venstar Inc. WO#: 99183 Sequence#: 2 Date: 10/19/2016
15.249 Carrier and Spurious Emissions (902-928 MHz Transmitter) Test Distance: 3 Meters Horiz
dBµV/m
110
100
90
80
70
60
50
40
30
20
10
9k
100k
1M
10M
100M
1G
10G
40G
Frequency [k=kHz M=MHz G=GHz]
Readings
Peak Readings
QP Readings
Average Readings
Ambient
Software Version: 5.03.02
1 - 15.249 Carrier and Spurious Emissions (902-928 MHz Transmitter)

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN00314	Loop Antenna	6502	5/20/2016	5/20/2018
	AN00309	Preamp	8447D	3/14/2016	3/14/2018
	AN01995	Biconilog Antenna	CBL6111C	5/10/2016	5/10/2018
	ANP05275	Attenuator	1W	5/5/2016	5/5/2018
	ANP05050	Cable	RG223/U	1/15/2015	1/15/2017
	ANP05198	Cable-Amplitude 15 to 45degC (dB)	8268	12/22/2014	12/22/2016
	ANP05198	Cable-Amplitude - 15 to 15degC	8268	12/22/2014	12/22/2016
	AN02672	Spectrum Analyzer	E4446A	9/30/2015	9/30/2017
T1	AN00786	Preamp	83017A	5/9/2016	5/9/2018
T2	AN00849	Horn Antenna	3115	3/4/2016	3/4/2018
T3	ANP06554	Cable	32022-29094K-29094K-24TC	12/30/2015	12/30/2017
T4	ANP06661	Cable	LDF1-50	5/6/2016	5/6/2018
T5	AN03169	High Pass Filter	HM1155-11SS	6/24/2015	6/24/2017

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

#	Freq	Rdng	T1 T5	T2	T3	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV/m	dBµV/m	dB	Ant
1	2725.250M	49.2	-38.1 +0.2	+25.9	+0.6	+4.1	+0.0	41.9	54.0 Y axis	-12.1	Horiz
2	2725.250M	49.1	-38.1 +0.2	+25.9	+0.6	+4.1	+0.0	41.8	54.0 Z axis	-12.2	Vert
3	4542.090M	42.5	-37.6 +0.1	+29.0	+0.8	+5.5	+0.0	40.3	54.0 Y axis	-13.7	Horiz
4	2725.250M	47.3	-38.1 +0.2	+25.9	+0.6	+4.1	+0.0	40.0	54.0 X axis	-14.0	Horiz
5	4542.090M	42.2	-37.6 +0.1	+29.0	+0.8	+5.5	+0.0	40.0	54.0 Z axis	-14.0	Horiz
6	3633.670M	44.5	-37.9 +0.1	+27.6	+0.7	+4.6	+0.0	39.6	54.0 Y axis	-14.4	Horiz
7	3633.670M	44.5	-37.9 +0.1	+27.6	+0.7	+4.6	+0.0	39.6	54.0 Z axis	-14.4	Vert
8	4542.090M	41.7	-37.6 +0.1	+29.0	+0.8	+5.5	+0.0	39.5	54.0 X axis	-14.5	Horiz
9	4542.090M	41.5	-37.6 +0.1	+29.0	+0.8	+5.5	+0.0	39.3	54.0 Z axis	-14.7	Vert
10	3633.670M	44.1	-37.9 +0.1	+27.6	+0.7	+4.6	+0.0	39.2	54.0 X axis	-14.8	Vert
11	4542.090M	41.1	-37.6 +0.1	+29.0	+0.8	+5.5	+0.0	38.9	54.0 X axis	-15.1	Vert
12	2725.250M	46.2	-38.1 +0.2	+25.9	+0.6	+4.1	+0.0	38.9	54.0 Y axis	-15.1	Vert
13	2725.250M	46.0	-38.1 +0.2	+25.9	+0.6	+4.1	+0.0	38.7	54.0 X axis	-15.3	Vert
14	3633.670M	43.4	-37.9 +0.1	+27.6	+0.7	+4.6	+0.0	38.5	54.0 X axis	-15.5	Horiz

15	3633.670M	43.2	-37.9 +0.1	+27.6	+0.7	+4.6	+0.0	38.3	54.0 Z axis	-15.7	Horiz
16	2725.250M	45.2	-38.1 +0.2	+25.9	+0.6	+4.1	+0.0	37.9	54.0 Z axis	-16.1	Horiz
17	3633.670M	42.3	-37.9 +0.1	+27.6	+0.7	+4.6	+0.0	37.4	54.0 Y axis	-16.6	Vert
18	1816.830M	45.0	-38.5 +0.3	+23.9	+0.5	+3.6	+0.0	34.8	54.0 Y axis	-19.2	Vert
19	1816.830M	44.4	-38.5 +0.3	+23.9	+0.5	+3.6	+0.0	34.2	54.0 Z axis	-19.8	Vert
20	1816.830M	44.2	-38.5 +0.3	+23.9	+0.5	+3.6	+0.0	34.0	54.0 X axis	-20.0	Horiz
21	1816.830M	44.0	-38.5 +0.3	+23.9	+0.5	+3.6	+0.0	33.8	54.0 Y axis	-20.2	Horiz
22	1816.830M	43.5	-38.5 +0.3	+23.9	+0.5	+3.6	+0.0	33.3	54.0 X axis	-20.7	Vert
23	1816.830M	43.5	-38.5 +0.3	+23.9	+0.5	+3.6	+0.0	33.3	54.0 Z axis	-20.7	Horiz

Band Edge

Band Edge Summary					
Frequency (MHz)	Modulation	Ant. Type	Field Strength (dBuV/m @3m)	Limit (dBuV/m @3m)	Results
902	FSK	Integral	29.4	<46	Pass
928	FSK	Integral	30.8	<46	Pass

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

Test Setup / Conditions / Data

Test Location: CKC Laboratories, Inc. • 110 N. Olinda Place • Brea, CA 92823 • 714-993-6112
Customer: **Venstar Inc.**
Specification: **15.249 Carrier and Spurious Emissions (902-928 MHz Transmitter)**
Work Order #: **99183** Date: 10/19/2016
Test Type: **Maximized Emissions** Time: 13:41:56
Tested By: Don Nguyen Sequence#: 1
Software: EMITest 5.03.02

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

The EUT is placed on a Styrofoam platform at 0.8m in height. The EUT is programmed to continuously transmit modulated carrier with pseudo-random data. The EUT is powered from 3.3VDC support power supply.
Firmware power is set at 10.
Operating frequency: 908.42 MHz

Frequency range of measurement = 902-928MHz

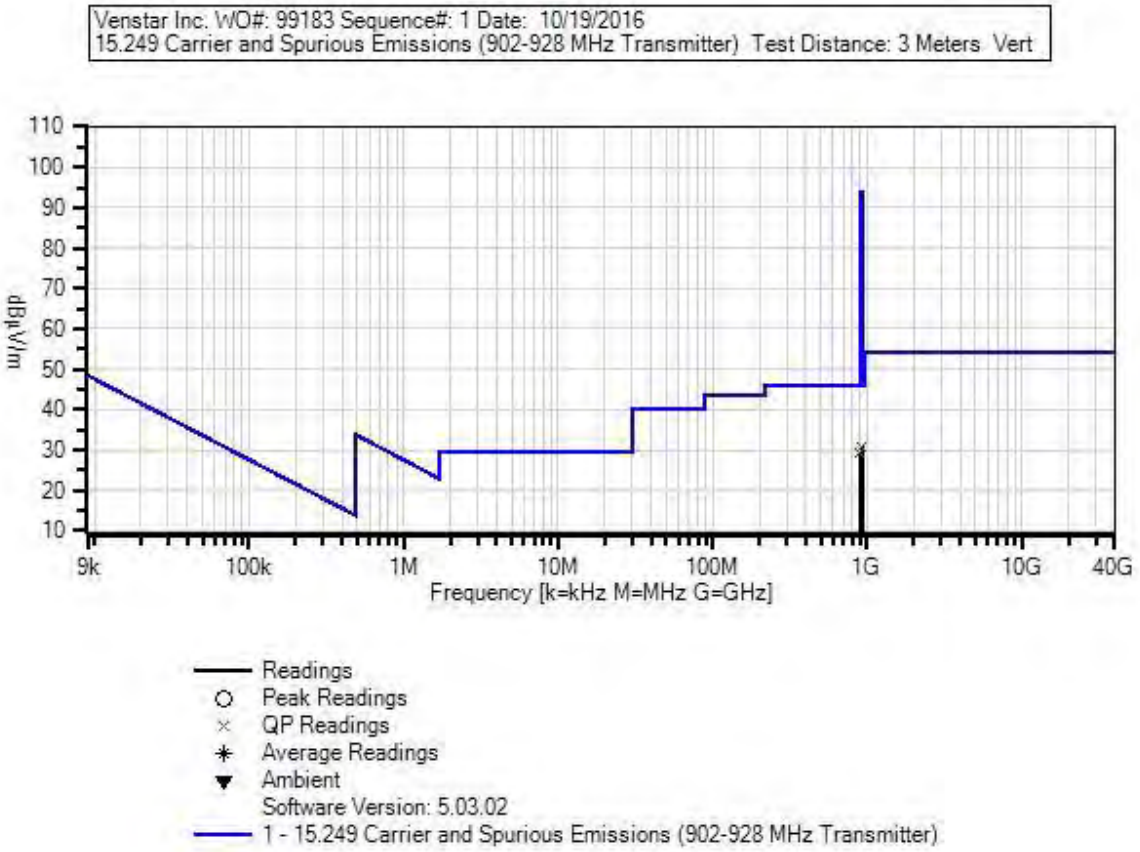
RBW=120 kHz, VBW=360 kHz

Test environment conditions:
Temperature: 26°C
Relative Humidity: 37 %
Pressure: 100kPa

ANSI C63.10 (2013)

Site A

Emission is recorded in the worst case scenario.


Venstar Inc. WO#: 99183 Sequence#: 1 Date: 10/19/2016
15.249 Carrier and Spurious Emissions (902-928 MHz Transmitter) Test Distance: 3 Meters Vert
110
100
90
80
70
60
50
40
30
20
10
dBµV/m
9k
100k
1M
10M
100M
1G
10G
40G
Frequency [k=kHz M=MHz G=GHz]
Readings
Peak Readings
QP Readings
Average Readings
Ambient
Software Version: 5.03.02
1 - 15.249 Carrier and Spurious Emissions (902-928 MHz Transmitter)

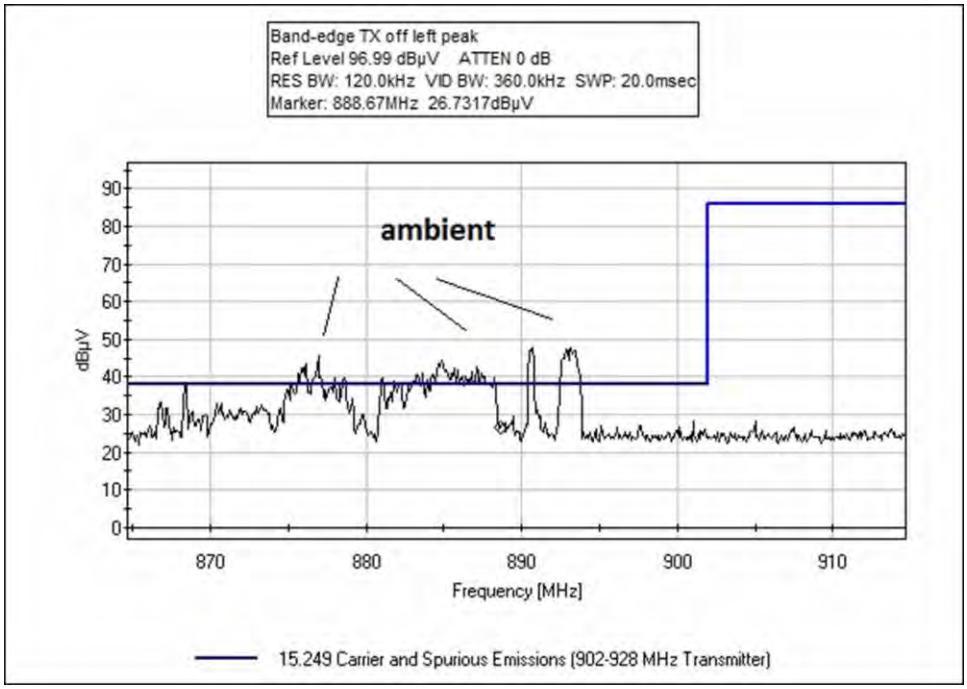
Test Equipment:

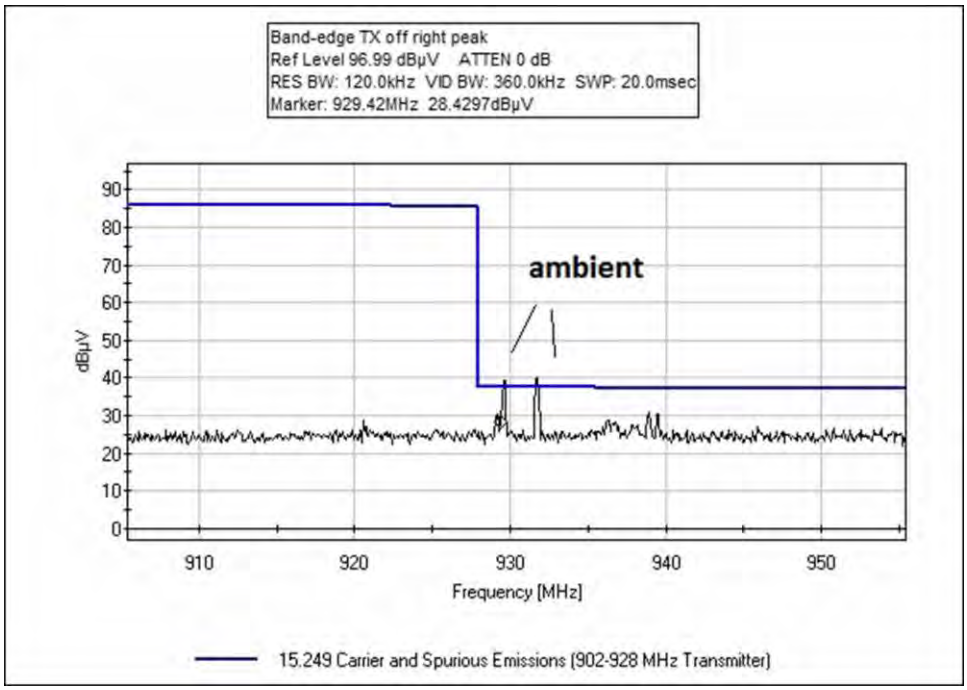
ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN00309	Preamp	8447D	3/14/2016	3/14/2018
T2	AN01995	Biconilog Antenna	CBL6111C	5/10/2016	5/10/2018
T3	ANP05275	Attenuator	1W	5/5/2016	5/5/2018
T4	ANP05050	Cable	RG223/U	1/15/2015	1/15/2017
T5	ANP05198	Cable-Amplitude 15 to 45degC (dB)	8268	12/22/2014	12/22/2016
	AN02672	Spectrum Analyzer	E4446A	9/30/2015	9/30/2017

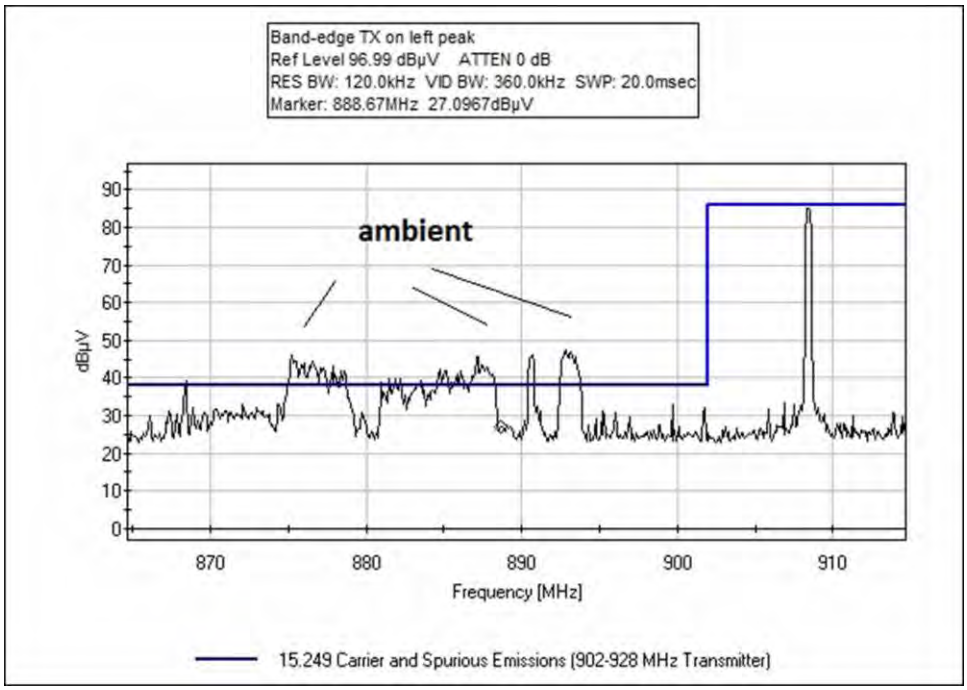
Measurement Data: Reading listed by margin. Test Distance: 3 Meters

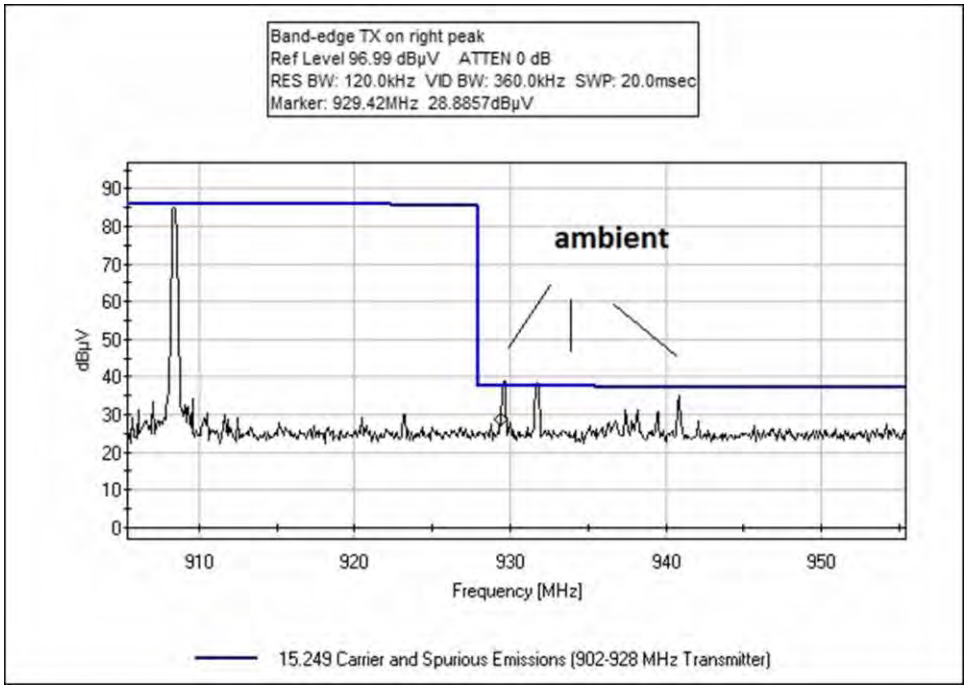
#	Freq	Rdng	T1 T5	T2	T3	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV/m	dBµV/m	dB	Ant
1	928.000M	22.4	-27.4	+23.7	+6.1	+0.4	+0.0	30.8	46.0	-15.2	Vert
	QP		+5.6						Y axis		
^	928.000M	26.3	-27.4	+23.7	+6.1	+0.4	+0.0	34.7	46.0	-11.3	Vert
			+5.6						Y axis		
3	902.000M	21.5	-27.3	+23.3	+6.0	+0.4	+0.0	29.4	46.0	-16.6	Vert
	QP		+5.5						Y axis		
^	902.000M	33.6	-27.3	+23.3	+6.0	+0.4	+0.0	41.5	46.0	-4.5	Vert
			+5.5						Y axis		

Band Edge Plots

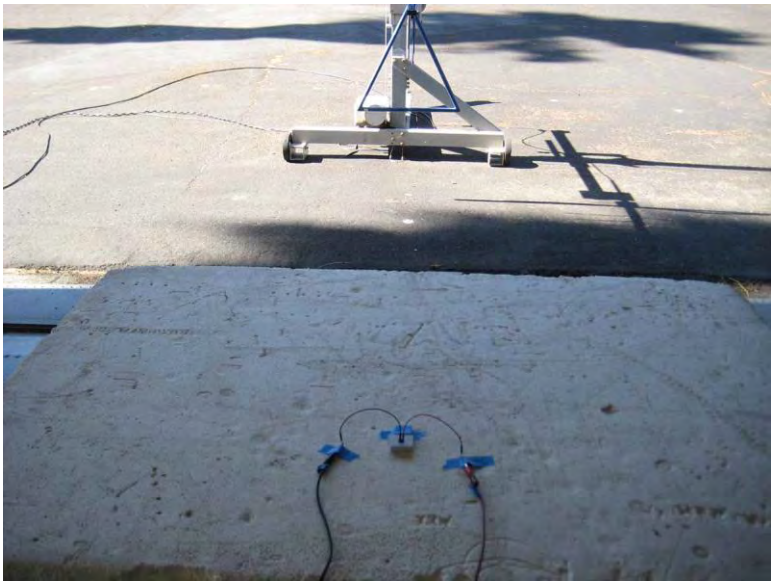


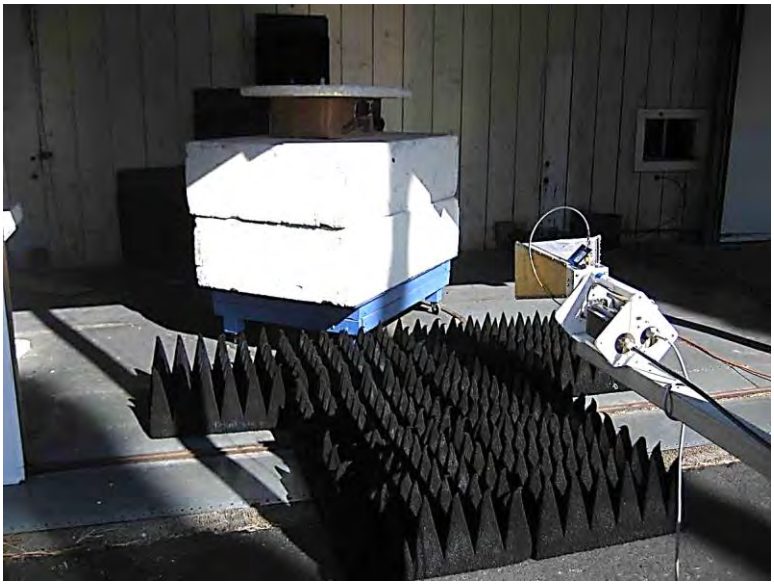


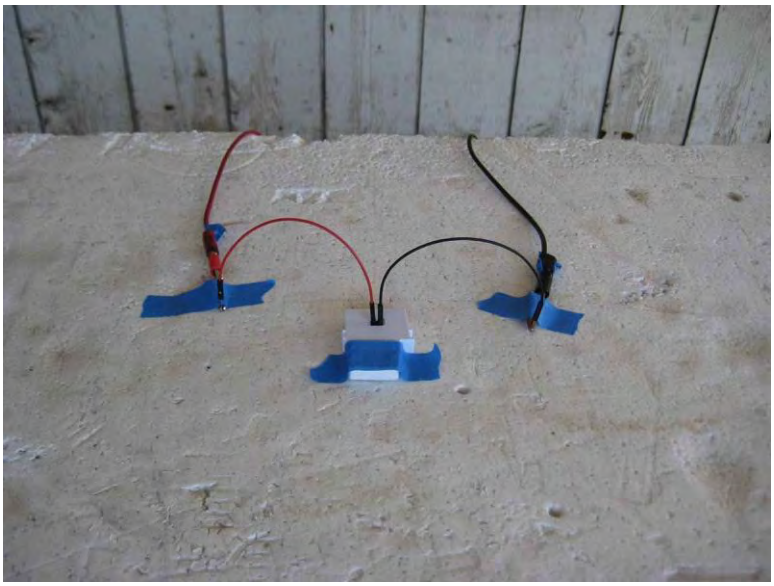

Band-edge TX on left peak
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 120.0kHz VID BW: 360.0kHz SWP: 20.0msec
Marker: 888.67MHz 27.0967dBµV
ambient
dBµV
90
80
70
60
50
40
30
20
10
0
870
880
890
900
910
Frequency [MHz]
15.249 Carrier and Spurious Emissions (902-928 MHz Transmitter)


Band-edge TX on right peak
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 120.0kHz VID BW: 360.0kHz SWP: 20.0msec
Marker: 929.42MHz 28.8857dBµV
ambient
dBµV
90
80
70
60
50
40
30
20
10
0
910
920
930
940
950
Frequency [MHz]
15.249 Carrier and Spurious Emissions (902-928 MHz Transmitter)

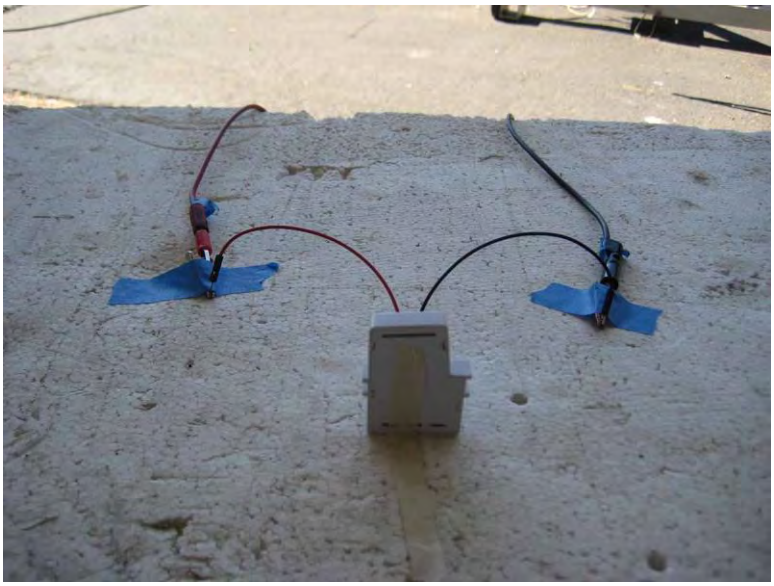
Test Setup Photos



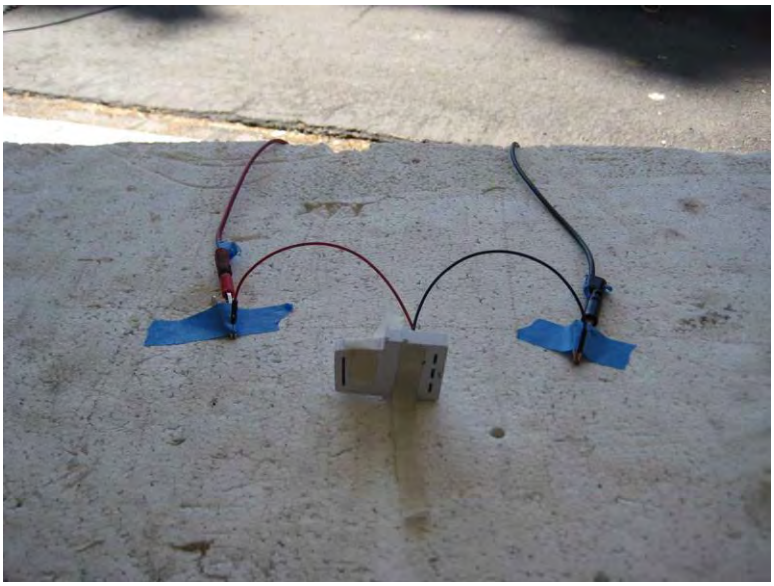




X Axis



Y Axis



Z Axis

15.207 AC Conducted Emissions

Test Setup / Conditions / Data

Test Location:	CKC Laboratories, Inc. • 110 N. Olinda Place • Brea, CA 92823 • 714-993-6112		
Customer:	**Venstar Inc.**		
Specification:	**15.207 AC Mains - Average**		
Work Order #:	**99183**	Date:	10/20/2016
Test Type:	**Conducted Emissions**	Time:	10:41:08 AM
Tested By:	Don Nguyen	Sequence#:	7
Software:	EMITest 5.03.02		120V 60Hz

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

The EUT is placed on table top at 0.8m in height. The EUT is programmed to continuously transmit modulated carrier with pseudo-random data. The EUT is powered from 3.3Vdc support power supply.
Firmware power is set at 10.
Operating frequency: 908.42 MHz

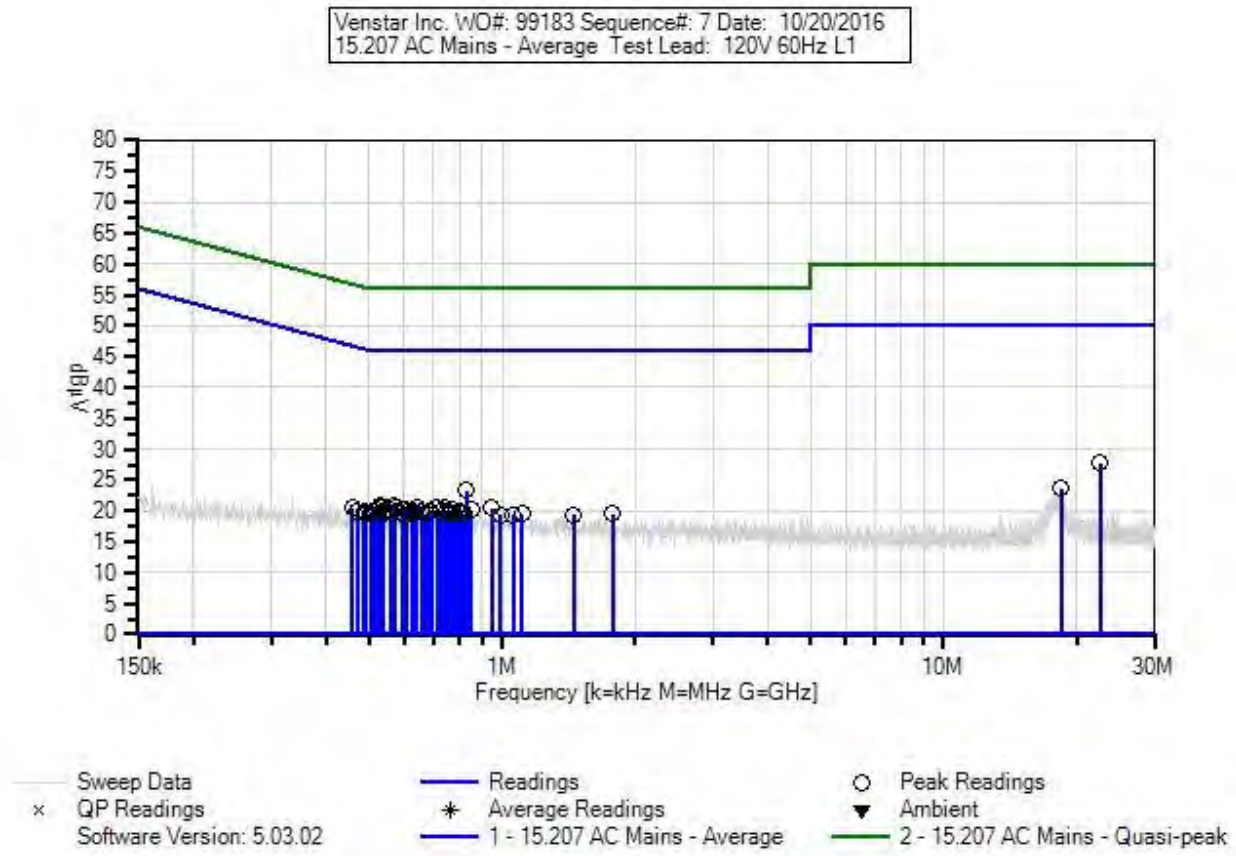
Frequency range of measurement = 150 kHz - 30 MHz

150 kHz - 30 MHz, RBW=9 kHz, VBW=27 kHz

Test environment conditions:
Temperature: 22°C
Relative Humidity: 21%
Pressure: 100kPa

ANSI C63.4 (2014)

Site A


Venstar Inc. WO#: 99183 Sequence#: 7 Date: 10/20/2016
15.207 AC Mains - Average Test Lead: 120V 60Hz L1
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
dBµV
150k
1M
10M
30M
Frequency [k=kHz M=MHz G=GHz]
Sweep Data
QP Readings
Software Version: 5.03.02
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	ANP06084	Attenuator	SA18N10W-06	12/17/2014	12/17/2016
T2	ANP04358	Cable	RG142	3/14/2016	3/14/2018
T3	AN00969A	50uH LISN-Line 1 (L1) (dB)	3816/2NM	3/12/2015	3/12/2017
	AN00969A	50uH LISN-Line 2 (L2) (dB)	3816/2NM	3/12/2015	3/12/2017
	AN02672	Spectrum Analyzer	E4446A	9/30/2015	9/30/2017
T4	AN02610	High Pass Filter	HE9615-150K-50-720B	10/22/2015	10/22/2017

Measurement Data: Reading listed by margin. Test Lead: L1

#	Freq MHz	Rdng dBµV	T1 dB	T2 dB	T3 dB	T4 dB	Dist Table	Corr dBµV	Spec dBµV	Margin dB	Polar Ant
1	22.580M	20.8	+5.7	+0.4	+0.7	+0.2	+0.0	27.8	50.0	-22.2	L1
2	829.937k	17.2	+5.7	+0.1	+0.1	+0.2	+0.0	23.3	46.0	-22.7	L1
3	528.874k	14.9	+5.7	+0.1	+0.1	+0.2	+0.0	21.0	46.0	-25.0	L1
4	565.961k	14.9	+5.7	+0.1	+0.1	+0.2	+0.0	21.0	46.0	-25.0	L1
5	641.591k	14.4	+5.7	+0.1	+0.1	+0.2	+0.0	20.5	46.0	-25.5	L1
6	526.692k	14.4	+5.7	+0.1	+0.1	+0.2	+0.0	20.5	46.0	-25.5	L1
7	739.036k	14.4	+5.7	+0.1	+0.1	+0.2	+0.0	20.5	46.0	-25.5	L1
8	712.130k	14.4	+5.7	+0.1	+0.1	+0.2	+0.0	20.5	46.0	-25.5	L1
9	572.506k	14.3	+5.7	+0.1	+0.1	+0.2	+0.0	20.4	46.0	-25.6	L1
10	949.501k	14.3	+5.7	+0.1	+0.1	+0.2	+0.0	20.4	46.0	-25.6	L1
11	596.504k	14.1	+5.7	+0.1	+0.1	+0.2	+0.0	20.2	46.0	-25.8	L1
12	518.693k	14.1	+5.7	+0.1	+0.1	+0.2	+0.0	20.2	46.0	-25.8	L1
13	605.958k	14.1	+5.7	+0.1	+0.1	+0.2	+0.0	20.2	46.0	-25.8	L1
14	849.572k	14.1	+5.7	+0.1	+0.1	+0.2	+0.0	20.2	46.0	-25.8	L1
15	771.033k	14.1	+5.7	+0.1	+0.1	+0.2	+0.0	20.2	46.0	-25.8	L1
16	557.235k	14.0	+5.7	+0.1	+0.1	+0.2	+0.0	20.1	46.0	-25.9	L1
17	609.594k	13.9	+5.7	+0.1	+0.1	+0.2	+0.0	20.0	46.0	-26.0	L1
18	514.330k	13.9	+5.7	+0.1	+0.1	+0.2	+0.0	20.0	46.0	-26.0	L1

19	746.308k	13.9	+5.7	+0.1	+0.1	+0.2	+0.0	20.0	46.0	-26.0	L1
20	691.041k	13.9	+5.7	+0.1	+0.1	+0.2	+0.0	20.0	46.0	-26.0	L1
21	631.410k	13.8	+5.7	+0.1	+0.1	+0.2	+0.0	19.9	46.0	-26.1	L1
22	507.058k	13.8	+5.7	+0.1	+0.1	+0.2	+0.0	19.9	46.0	-26.1	L1
23	680.860k	13.8	+5.7	+0.1	+0.1	+0.2	+0.0	19.9	46.0	-26.1	L1
24	656.862k	13.8	+5.7	+0.1	+0.1	+0.2	+0.0	19.9	46.0	-26.1	L1
25	800.849k	13.7	+5.7	+0.1	+0.1	+0.2	+0.0	19.8	46.0	-26.2	L1
26	724.492k	13.7	+5.7	+0.1	+0.1	+0.2	+0.0	19.8	46.0	-26.2	L1
27	563.053k	13.6	+5.7	+0.1	+0.1	+0.2	+0.0	19.7	46.0	-26.3	L1
28	456.880k	14.3	+5.7	+0.1	+0.1	+0.2	+0.0	20.4	46.7	-26.3	L1
29	592.141k	13.6	+5.7	+0.1	+0.1	+0.2	+0.0	19.7	46.0	-26.3	L1
30	18.427M	16.8	+5.7	+0.4	+0.6	+0.2	+0.0	23.7	50.0	-26.3	L1
31	762.307k	13.6	+5.7	+0.1	+0.1	+0.2	+0.0	19.7	46.0	-26.3	L1
32	672.861k	13.5	+5.7	+0.1	+0.1	+0.2	+0.0	19.6	46.0	-26.4	L1
33	777.578k	13.5	+5.7	+0.1	+0.1	+0.2	+0.0	19.6	46.0	-26.4	L1
34	489.605k	13.7	+5.7	+0.1	+0.1	+0.2	+0.0	19.8	46.2	-26.4	L1
35	504.149k	13.5	+5.7	+0.1	+0.1	+0.2	+0.0	19.6	46.0	-26.4	L1
36	781.214k	13.5	+5.7	+0.1	+0.1	+0.2	+0.0	19.6	46.0	-26.4	L1
37	821.211k	13.5	+5.7	+0.1	+0.1	+0.2	+0.0	19.6	46.0	-26.4	L1
38	1.783M	13.6	+5.7	+0.1	+0.1	+0.1	+0.0	19.6	46.0	-26.4	L1
39	810.303k	13.5	+5.7	+0.1	+0.1	+0.2	+0.0	19.6	46.0	-26.4	L1
40	813.939k	13.5	+5.7	+0.1	+0.1	+0.2	+0.0	19.6	46.0	-26.4	L1
41	539.782k	13.4	+5.7	+0.1	+0.1	+0.2	+0.0	19.5	46.0	-26.5	L1
42	485.969k	13.6	+5.7	+0.1	+0.1	+0.2	+0.0	19.7	46.2	-26.5	L1
43	469.970k	13.9	+5.7	+0.1	+0.1	+0.2	+0.0	20.0	46.5	-26.5	L1
44	1.107M	13.4	+5.7	+0.1	+0.1	+0.2	+0.0	19.5	46.0	-26.5	L1

45	754.308k	13.4	+5.7	+0.1	+0.1	+0.2	+0.0	19.5	46.0	-26.5	L1
46	628.501k	13.4	+5.7	+0.1	+0.1	+0.2	+0.0	19.5	46.0	-26.5	L1
47	603.776k	13.3	+5.7	+0.1	+0.1	+0.2	+0.0	19.4	46.0	-26.6	L1
48	992.028k	13.3	+5.7	+0.1	+0.1	+0.2	+0.0	19.4	46.0	-26.6	L1
49	1.060M	13.3	+5.7	+0.1	+0.1	+0.2	+0.0	19.4	46.0	-26.6	L1
50	1.451M	13.3	+5.7	+0.1	+0.1	+0.1	+0.0	19.3	46.0	-26.7	L1

Test Location:	CKC Laboratories, Inc. • 110 N. Olinda Place • Brea, CA 92823 • 714-993-6112		
Customer:	**Venstar Inc.**		
Specification:	**15.207 AC Mains - Average**		
Work Order #:	**99183**	Date:	10/20/2016
Test Type:	**Conducted Emissions**	Time:	10:38:12 AM
Tested By:	Don Nguyen	Sequence#:	6
Software:	EMITest 5.03.02		120V 60Hz

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

The EUT is placed on table top at 0.8m in height. The EUT is programmed to continuously transmit modulated carrier with pseudo-random data. The EUT is powered from 3.3VDC support power supply.
Firmware power is set at 10.
Operating frequency: 908.42 MHz

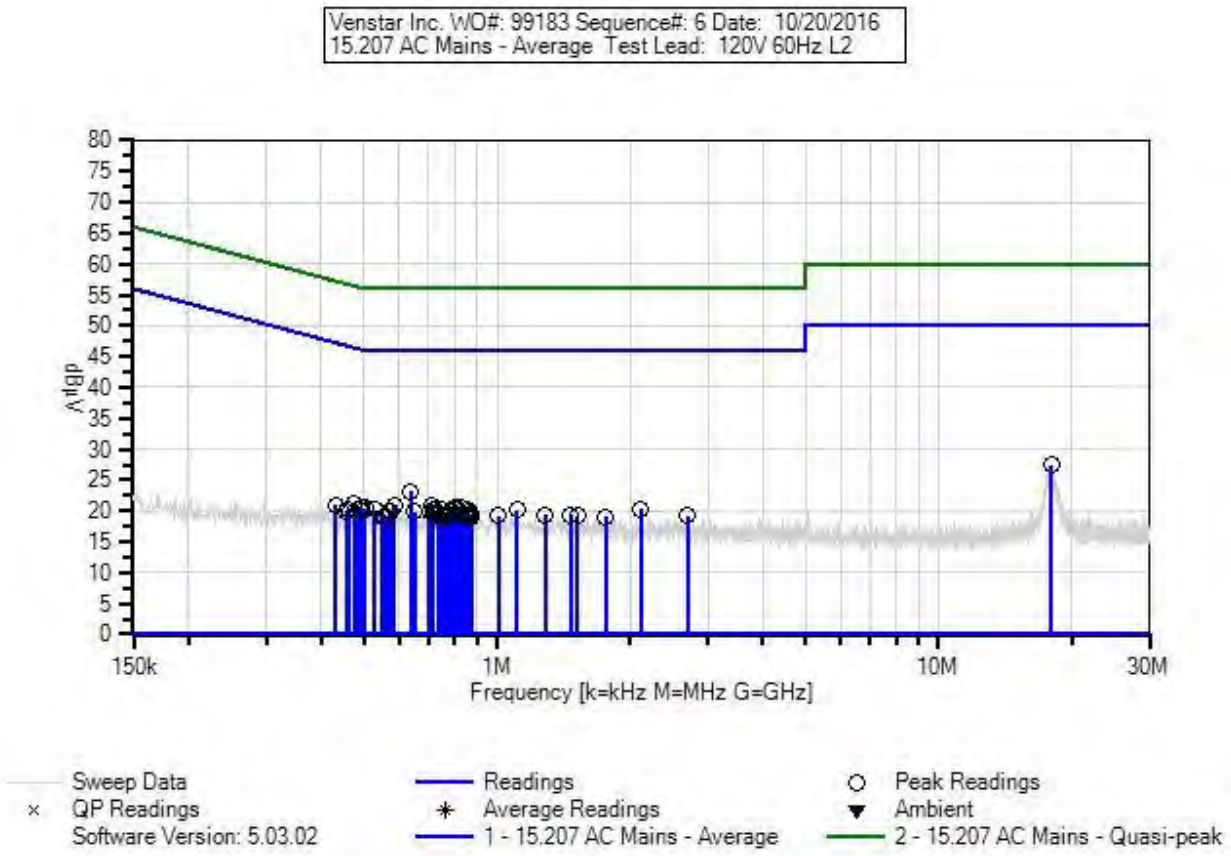
Frequency range of measurement = 150 kHz - 30 MHz

150 kHz - 30 MHz, RBW=9 kHz, VBW=27 kHz

Test environment conditions:
Temperature: 22°C
Relative Humidity: 21%
Pressure: 100kPa

ANSI C63.4 (2014)

Site A


Venstar Inc. WO#: 99183 Sequence#: 6 Date: 10/20/2016
15.207 AC Mains - Average Test Lead: 120V 60Hz L2
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
dBµV
150k
1M
10M
30M
Frequency [k=kHz M=MHz G=GHz]
Sweep Data
QP Readings
Software Version: 5.03.02
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	ANP06084	Attenuator	SA18N10W-06	12/17/2014	12/17/2016
T2	ANP04358	Cable	RG142	3/14/2016	3/14/2018
	AN00969A	50uH LISN-Line 1 (L1) (dB)	3816/2NM	3/12/2015	3/12/2017
T3	AN00969A	50uH LISN-Line 2 (L2) (dB)	3816/2NM	3/12/2015	3/12/2017
	AN02672	Spectrum Analyzer	E4446A	9/30/2015	9/30/2017
T4	AN02610	High Pass Filter	HE9615-150K-50-720B	10/22/2015	10/22/2017

Measurement Data: Reading listed by margin. Test Lead: L2

#	Freq MHz	Rdng dBµV	T1 dB	T2 dB	T3 dB	T4 dB	Dist Table	Corr dBµV	Spec dBµV	Margin dB	Polar Ant
1	17.977M	20.6	+5.7	+0.4	+0.6	+0.2	+0.0	27.5	50.0	-22.5	L2
2	637.228k	17.1	+5.7	+0.1	+0.1	+0.2	+0.0	23.2	46.0	-22.8	L2
3	475.061k	15.2	+5.7	+0.1	+0.1	+0.2	+0.0	21.3	46.4	-25.1	L2
4	709.221k	14.8	+5.7	+0.1	+0.1	+0.2	+0.0	20.9	46.0	-25.1	L2
5	585.596k	14.7	+5.7	+0.1	+0.1	+0.2	+0.0	20.8	46.0	-25.2	L2
6	826.301k	14.6	+5.7	+0.1	+0.1	+0.2	+0.0	20.7	46.0	-25.3	L2
7	491.786k	14.5	+5.7	+0.1	+0.1	+0.2	+0.0	20.6	46.1	-25.5	L2
8	501.240k	14.4	+5.7	+0.1	+0.1	+0.2	+0.0	20.5	46.0	-25.5	L2
9	803.030k	14.3	+5.7	+0.1	+0.1	+0.2	+0.0	20.4	46.0	-25.6	L2
10	751.399k	14.2	+5.7	+0.1	+0.1	+0.2	+0.0	20.3	46.0	-25.7	L2
11	855.389k	14.2	+5.7	+0.1	+0.1	+0.2	+0.0	20.3	46.0	-25.7	L2
12	2.115M	14.2	+5.7	+0.1	+0.2	+0.1	+0.0	20.3	46.0	-25.7	L2
13	527.419k	14.1	+5.7	+0.1	+0.1	+0.2	+0.0	20.2	46.0	-25.8	L2
14	804.485k	14.1	+5.7	+0.1	+0.1	+0.2	+0.0	20.2	46.0	-25.8	L2
15	715.039k	14.0	+5.7	+0.1	+0.1	+0.2	+0.0	20.1	46.0	-25.9	L2
16	1.107M	14.0	+5.7	+0.1	+0.1	+0.2	+0.0	20.1	46.0	-25.9	L2
17	702.676k	13.9	+5.7	+0.1	+0.1	+0.2	+0.0	20.0	46.0	-26.0	L2
18	576.869k	13.8	+5.7	+0.1	+0.1	+0.2	+0.0	19.9	46.0	-26.1	L2

19	487.423k	14.0	+5.7	+0.1	+0.1	+0.2	+0.0	20.1	46.2	-26.1	L2
20	858.298k	13.8	+5.7	+0.1	+0.1	+0.2	+0.0	19.9	46.0	-26.1	L2
21	651.044k	13.8	+5.7	+0.1	+0.1	+0.2	+0.0	19.9	46.0	-26.1	L2
22	493.968k	13.8	+5.7	+0.1	+0.1	+0.2	+0.0	19.9	46.1	-26.2	L2
23	431.428k	14.9	+5.7	+0.1	+0.1	+0.2	+0.0	21.0	47.2	-26.2	L2
24	783.396k	13.7	+5.7	+0.1	+0.1	+0.2	+0.0	19.8	46.0	-26.2	L2
25	570.325k	13.7	+5.7	+0.1	+0.1	+0.2	+0.0	19.8	46.0	-26.2	L2
26	717.947k	13.5	+5.7	+0.1	+0.1	+0.2	+0.0	19.6	46.0	-26.4	L2
27	736.855k	13.4	+5.7	+0.1	+0.1	+0.2	+0.0	19.5	46.0	-26.5	L2
28	872.842k	13.4	+5.7	+0.1	+0.1	+0.2	+0.0	19.5	46.0	-26.5	L2
29	796.486k	13.3	+5.7	+0.1	+0.1	+0.2	+0.0	19.4	46.0	-26.6	L2
30	843.754k	13.3	+5.7	+0.1	+0.1	+0.2	+0.0	19.4	46.0	-26.6	L2
31	460.516k	14.0	+5.7	+0.1	+0.1	+0.2	+0.0	20.1	46.7	-26.6	L2
32	765.943k	13.3	+5.7	+0.1	+0.1	+0.2	+0.0	19.4	46.0	-26.6	L2
33	1.285M	13.2	+5.7	+0.1	+0.2	+0.2	+0.0	19.4	46.0	-26.6	L2
34	1.468M	13.3	+5.7	+0.1	+0.2	+0.1	+0.0	19.4	46.0	-26.6	L2
35	848.117k	13.3	+5.7	+0.1	+0.1	+0.2	+0.0	19.4	46.0	-26.6	L2
36	871.388k	13.3	+5.7	+0.1	+0.1	+0.2	+0.0	19.4	46.0	-26.6	L2
37	733.219k	13.2	+5.7	+0.1	+0.1	+0.2	+0.0	19.3	46.0	-26.7	L2
38	776.851k	13.2	+5.7	+0.1	+0.1	+0.2	+0.0	19.3	46.0	-26.7	L2
39	851.753k	13.2	+5.7	+0.1	+0.1	+0.2	+0.0	19.3	46.0	-26.7	L2
40	863.389k	13.1	+5.7	+0.1	+0.1	+0.2	+0.0	19.2	46.0	-26.8	L2
41	773.215k	13.1	+5.7	+0.1	+0.1	+0.2	+0.0	19.2	46.0	-26.8	L2
42	455.426k	13.9	+5.7	+0.1	+0.1	+0.2	+0.0	20.0	46.8	-26.8	L2
43	2.697M	13.0	+5.7	+0.2	+0.2	+0.1	+0.0	19.2	46.0	-26.8	L2
44	1.524M	13.1	+5.7	+0.1	+0.2	+0.1	+0.0	19.2	46.0	-26.8	L2

45	1.009M	13.1	+5.7	+0.1	+0.1	+0.2	+0.0	19.2	46.0	-26.8	L2
46	557.235k	13.0	+5.7	+0.1	+0.1	+0.2	+0.0	19.1	46.0	-26.9	L2
47	549.236k	13.0	+5.7	+0.1	+0.1	+0.2	+0.0	19.1	46.0	-26.9	L2
48	757.944k	13.0	+5.7	+0.1	+0.1	+0.2	+0.0	19.1	46.0	-26.9	L2
49	1.766M	13.0	+5.7	+0.1	+0.2	+0.1	+0.0	19.1	46.0	-26.9	L2
50	867.752k	13.0	+5.7	+0.1	+0.1	+0.2	+0.0	19.1	46.0	-26.9	L2

Test Setup Photos

SUPPLEMENTAL INFORMATION

Measurement Uncertainty

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

Reported uncertainties 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.