

SynapSense a Panduit Company

TEST REPORT FOR

**Low Power Wireless Mesh Network Gateway
Model: 1156**

Tested To The Following Standard:

EN 300 328 V1.9.1

Report No.: 97514-11

Date of issue: December 14, 2015



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.

TABLE OF CONTENTS

Administrative Information 3

 Test Report Information3

 Report Authorization3

 Test Facility Information4

 Software Versions4

 Summary of Results5

 Modifications During Testing.....6

 Conditions During Testing.....6

 Equipment Under Test.....6

EN 300 328 V1.9.1 7

 General Product Information.....7

4.3.2 Technical Requirements..... 8

 4.3.2.2 RF Power Output8

 4.3.2.3 Power Spectral Density.....13

 4.3.2.7 Occupied Channel Bandwidth15

 4.3.2.8 Transmitter Unwanted Emissions in the OOB Domain.....18

 4.3.2.9 Transmitter Unwanted Emissions in the Spurious Domain21

 4.3.2.10 Receiver Spurious Emissions.....26

Supplemental Information..... 31

 Measurement Uncertainty31

ADMINISTRATIVE INFORMATION

Test Report Information

REPORT PREPARED FOR:

SynapSense a Panduit Company
340 Palladio Pkwy, Suite 530
Folsom, CA 95630

Representative: Abraham Fechter
Customer Reference Number: 100137

DATE OF EQUIPMENT RECEIPT:

DATE(S) OF TESTING:

REPORT PREPARED BY:

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

Project Number: 97514

October 21, 2013

October 21, 2013 - November 17, 2015

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

5046 Sierra Pines Dr.
Mariposa CA 95338

Software Versions

CKC Laboratories Proprietary Software	Version
EMITest Emissions	5.02.00

SUMMARY OF RESULTS

Standard / Specification: EN 300 328 V1.9.1

Test Procedure/Method	Description	Modifications	Results
Transmitter Requirements			
Sub clause 4.3.2.2	RF Power Output	NA	Pass
Sub clause 4.3.2.3	Power Spectral Density	NA	Pass
Sub clause 4.3.2.4	Duty Cycle, Tx Sequence, Tx-gap	NA	NA ²
Sub clause 4.3.2.5	Medium Utilisation (MU) Factor	NA	NA ²
Sub clause 4.3.2.6	Adaptivity	NA	NA ²
Sub clause 4.3.2.7	Occupied Channel Bandwidth	NA	Pass
Sub clause 4.3.2.8	Transmitter Unwanted Emissions in the OOB Domain	NA	Pass
Sub clause 4.3.2.9	Transmitter Unwanted Emissions in the Spurious Domain	NA	Pass
Receiver Requirements			
Sub clause 4.3.2.10	Receiver Spurious Emissions	NA	Pass
Sub clause 4.3.2.12	Receiver Blocking	NA	NA ¹

NA = Not Applicable

Notes:

NA1	Not applicable because device does not utilize adaptive modes
NA2	Not applicable because device has output power <10mW EIRP

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
The EUT is placed on the test bench. RF parameter is evaluated at the temporary antenna port. The EUT is placed on the Styrofoam block. The data port and config port of the EUT are connected to the support laptops via an Ethernet cable. The support laptop runs test software to ping the EUT. Both the config and USB ports are service ports, however the Ethernet service port is active to match original testing. Emission profile of the EUT rotated along three orthogonal axes was investigated. Recorded data represent worse case emission.

EQUIPMENT UNDER TEST

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
Power Supply	GlobTek, Inc.	GT-46200-2005-T3	NA
Low Power Wireless Mesh Network Gateway	SynapSense a Panduit Company	1156	PR15180020IG

Support Equipment:

Device	Manufacturer	Model #	S/N
Laptop	Lenovo	T60P	8744C9U

Configuration 4

Equipment Tested:

Device	Manufacturer	Model #	S/N
Power Supply	GlobTek, Inc.	GT-46200-2005-T3	NA
Low Power Wireless Mesh Network Gateway	SynapSense a Panduit Company	1156	PR15180021IG

Support Equipment:

Device	Manufacturer	Model #	S/N
Laptop	Lenovo	T60P	8744C9U
Laptop	Lenovo	R61i	76509LU

EN 300 328 V1.9.1

General Product Information:

Product Information	Manufacturer-Provided Details
Equipment Type:	Stand-Alone Equipment
Type of Wideband System:	802.15.4 (ZigBee)
Operating Frequency Range:	2405-2480MHz
Output Power:	9.5 dBm EIRP
Modulation Type(s):	Q-PSK
Nominal Channel Bandwidth(s):	5MHz
Number of TX Chains:	1
Number of RX Chains:	1
Antenna Gain (A):	3.3
Beamforming Gain (Y):	NA
Antenna Connection Type:	Integral
Nominal Input Voltage:	230VAc 50Hz
Operating Temperature Range:	0-60 DegC
Firmware / Software used for Test:	FCC radio CW & Mod
Geo-Location Capability:	Not Supported

Non Adaptive Mode(s)

Product Information	Manufacturer-Provided Details
Duty Cycle:	<1%

Adaptive Mode(s)

Product Information	Manufacturer-Provided Details
Adaptivity Type:	NA

4.3.2 TECHNICAL REQUIREMENTS

4.3.2.2 RF Power Output

Test Setup/Conditions

Test Location:	Brea Lab A	Test Engineer:	E. Wong
Test Method:	EN 300 328 v1.9.1 §5.3.2	Test Date(s):	11/16/2015
Configuration:	1		

Environmental Conditions

Temperature (°C)	23.9	Relative Humidity (%):	35
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Test Equipment

Asset# / Serial#	Description	Manufacturer	Model	Cal Date	Cal Due
03494	RF Powerhead	ETS Lindgren	7002-006	11/20/2014	11/20/2016
C00094	Attenuator	Weinschel	33-20-34	3/5/2015	3/5/2017
02869	Spectrum Analyzer	Agilent	E4440A	7/17/2015	7/17/2016
01878	Temperature Chamber	Thermotron Corp.	S 1.2 Mini-Max	5/15/2015	5/15/2017
05947	Thermometer	Fluke	51	3/18/2014	3/18/2016
06663	Cable	Gore	PHASEFLEX 0SQ01R01180.0	4/15/2014	4/15/2016
03430	Attenuator	Aeroflex/Weinschel	75A-10-12	11/2/2015	11/2/2017

Maximum Output Power (dBm EIRP) – Non Adaptive Mode

Declared Antenna Gain, G (dBi): 3.3dBi

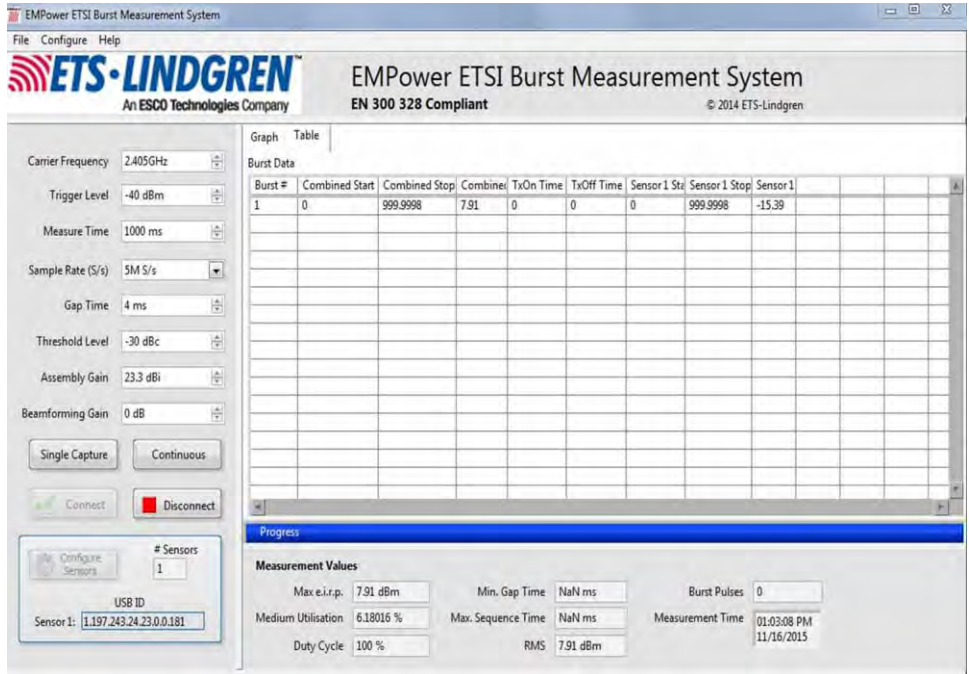
Declared Beam Forming Gain, Y (dB) : 0

Freq (MHz)	Operational Mode	T _{Low}	T _{Nominal}	T _{High}	Limit	Results
2405	Transmit	9.0	7.9	6.1	≤9.5	Pass
2445		8.3	7.5	5.3	≤9.5	Pass
2480		8.0	7.0	4.6	≤9.5	Pass
Max Deviation from Nominal:		-2.4dB				

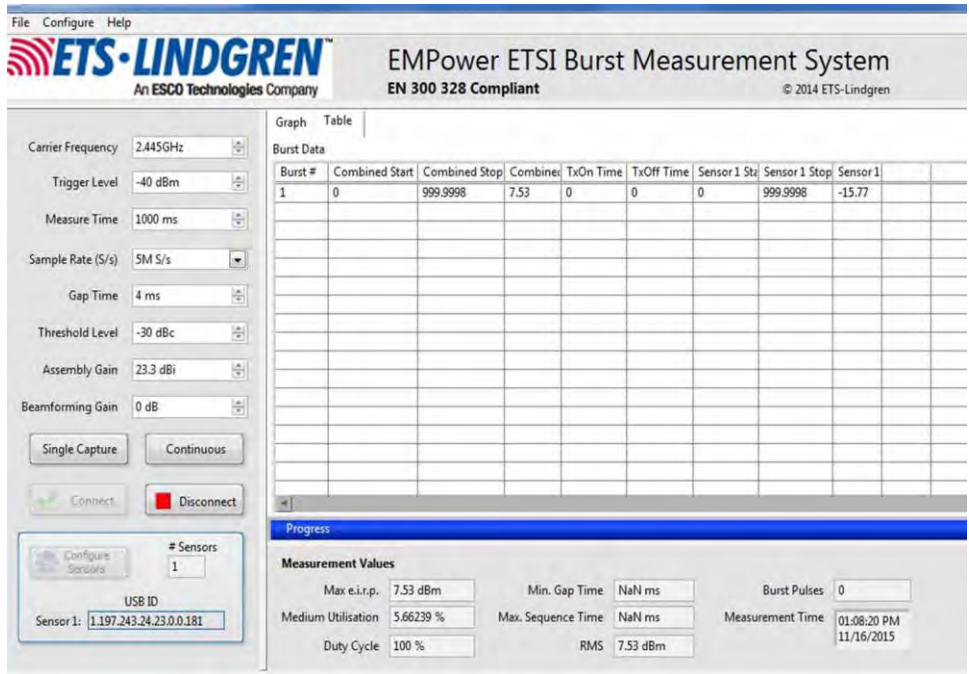
Parameter Definitions:

Parameter	Value
T _{Low}	0
T _{Nominal}	25
T _{High}	60
V _{Nominal}	230

Plot Data



Low

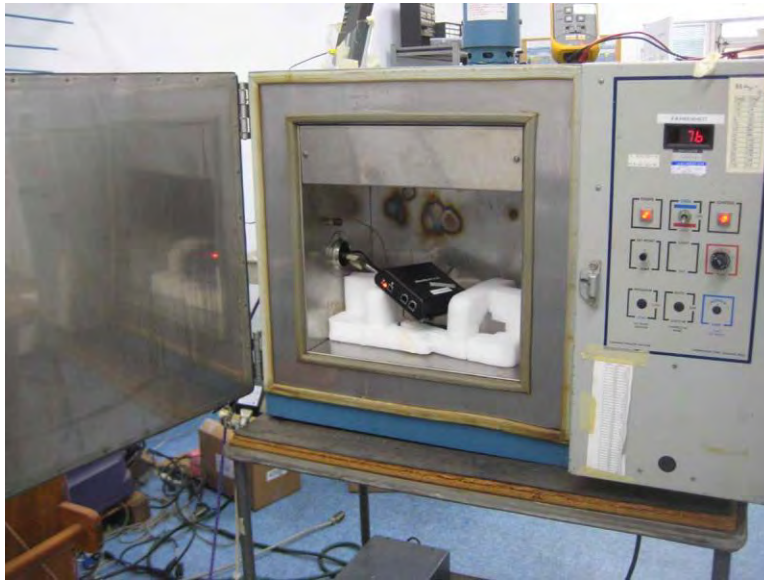


Middle

Test Setup Photos



Temperature Chamber



Temperature Chamber

4.3.2.3 Power Spectral Density

Test Setup/Conditions

Test Location:	Brea Lab A	Test Engineer:	E. Wong
Test Method:	EN 300 328 v1.9.1 §5.3.3	Test Date(s):	11/16/2015
Configuration:	1		

Environmental Conditions

Temperature (°C)	23.9	Relative Humidity (%):	35
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Test Equipment

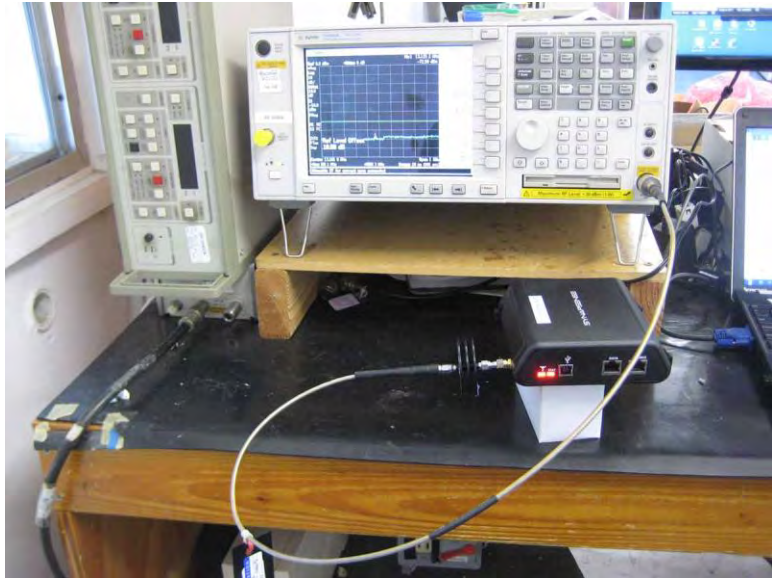
Asset# / Serial#	Description	Manufacturer	Model	Cal Date	Cal Due
02869	Spectrum Analyzer	Agilent	E4440A	7/17/2015	7/17/2016
02946	Cable	Astrolab Inc.	32022-2-2909K-36TC	11/2/2015	11/2/2017
03430	Attenuator	Aeroflex/Weinschel	75A-10-12	11/2/2015	11/2/2017

Power Spectral Density (EIRP dBm/MHz)

Freq (MHz)	Operational Mode	Measured PSD (dBm/MHz EIRP)	Limit (dBm/MHz EIRP)	Results
2405	Transmit	5.66	≤10	Pass
2445		5.18	≤10	Pass
2480		4.44	≤10	Pass

*Note: Antenna gain of 3.3dBi added to raw data.

Test Setup Photo



4.3.2.7 Occupied Channel Bandwidth

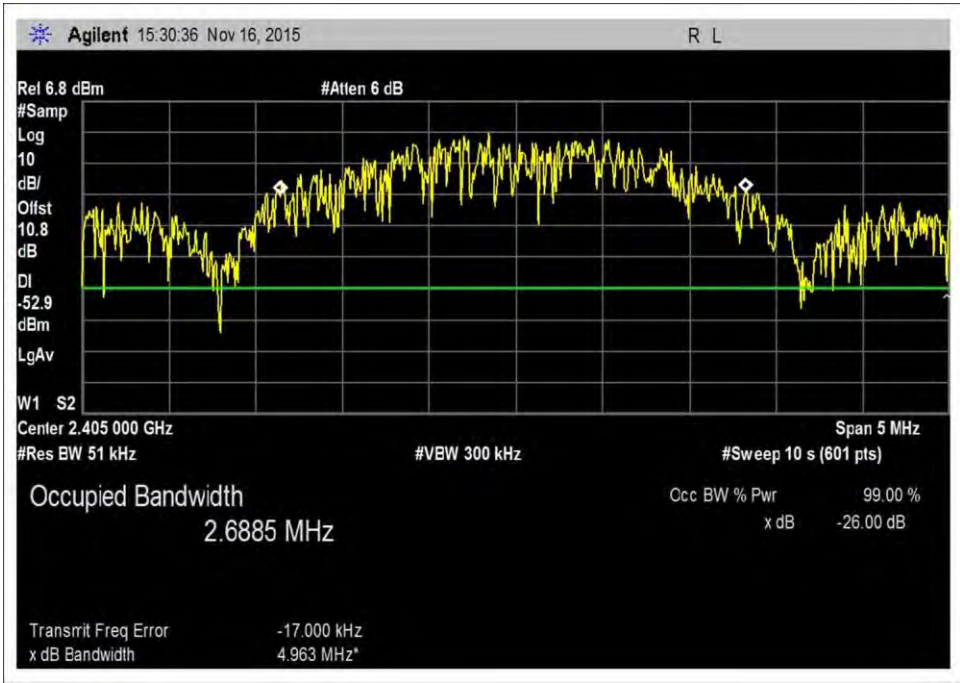
Test Setup/Conditions			
Test Location:	Brea Lab A	Test Engineer:	
Test Method:	EN 300 328 v1.9.1 §5.3.8	Test Date(s):	11/16/2015
Configuration:	1		

Environmental Conditions			
Temperature (°C)	23.9	Relative Humidity (%):	35

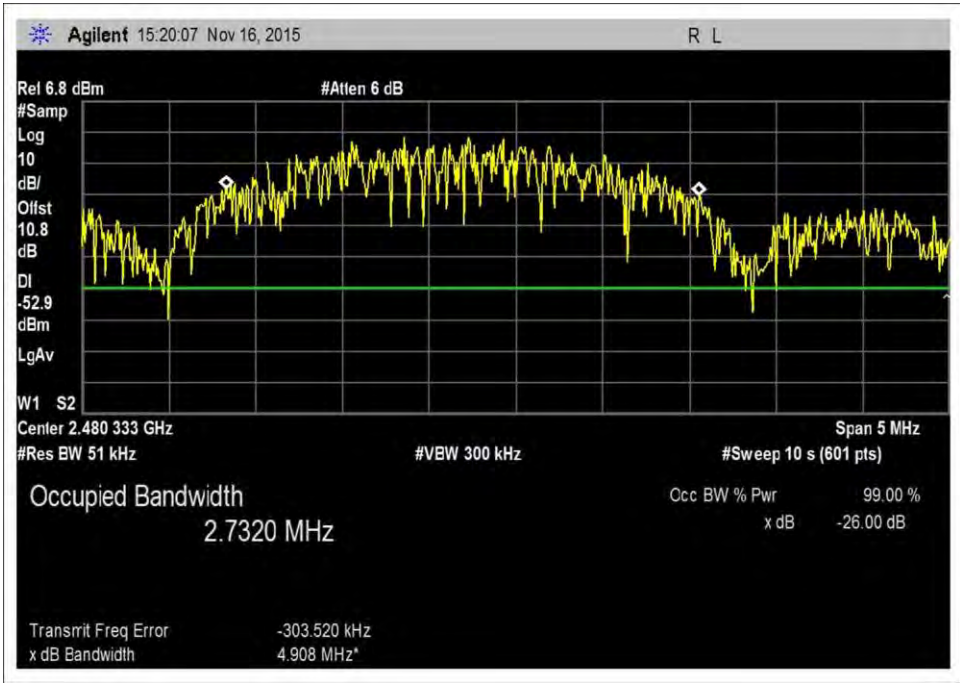
Test Equipment					
Asset# / Serial#	Description	Manufacturer	Model	Cal Date	Cal Due
02869	Spectrum Analyzer	Agilent	E4440A	7/17/2015	7/17/2016
02946	Cable	Astrolab Inc.	32022-2-2909K-36TC	11/2/2015	11/2/2017
03430	Attenuator	Aeroflex/Weinschel	75A-10-12	11/2/2015	11/2/2017

Occupied Channel Bandwidth – Non Adaptive Mode, Power ≤10 dBm EIRP				
Freq (MHz)	Operational Mode	Measured 99% BW _{Chan} (MHz)	Limit	Results
2405	Transmit	2.6885	Stay within band	Pass
2480	Transmit	2.7832	Stay within band	Pass

Plot Data

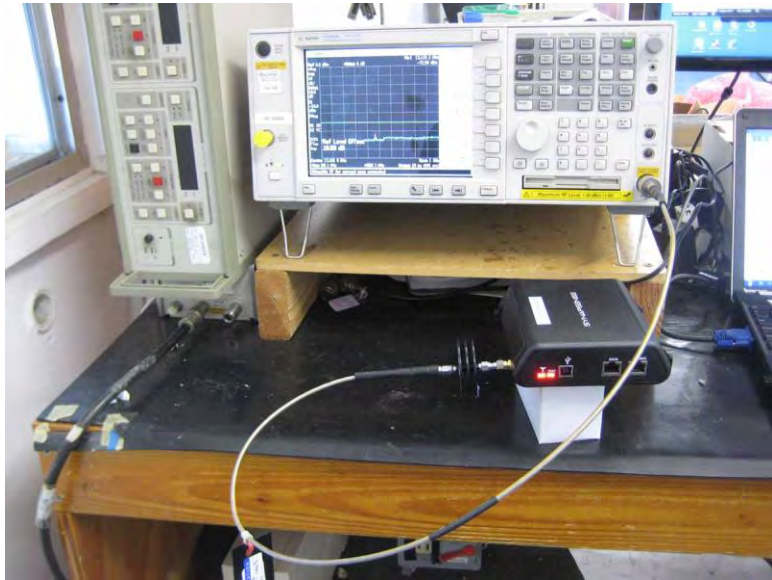


Low



High

Test Setup Photo



4.3.2.8 Transmitter Unwanted Emissions in the OOB Domain

Test Setup/Conditions			
Test Location:	Brea Lab A	Test Engineer:	E. Wong
Test Method:	EN 300 328 v1.9.1 §5.3.9	Test Date(s):	11/16/2015
Configuration:	1		

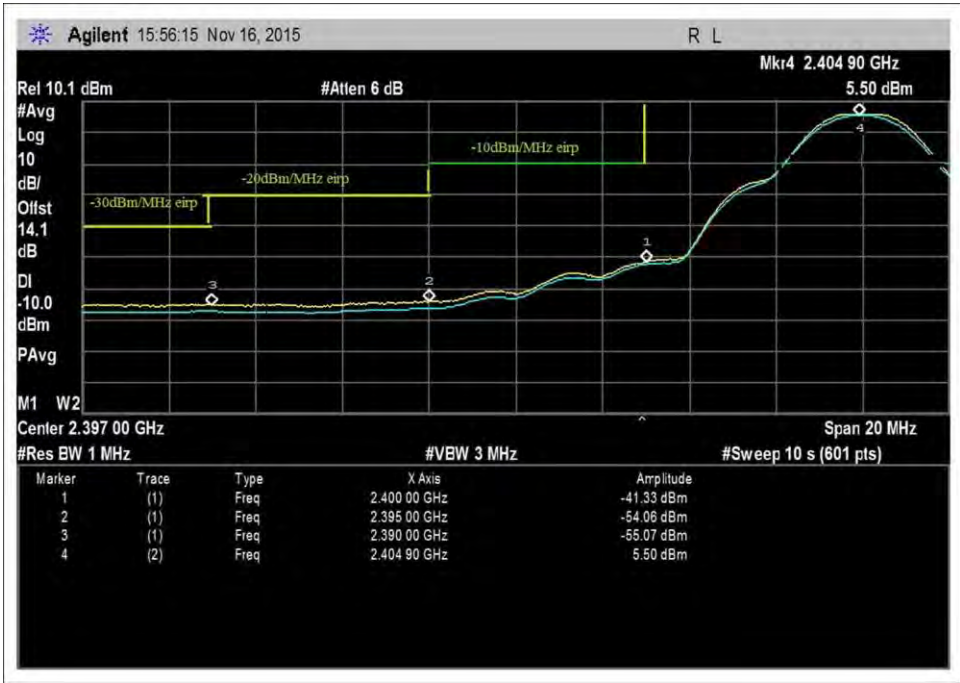
Environmental Conditions			
Temperature (°C)	23.9	Relative Humidity (%):	35

Test Equipment					
Asset# / Serial#	Description	Manufacturer	Model	Cal Date	Cal Due
02869	Spectrum Analyzer	Agilent	E4440A	7/17/2015	7/17/2016
02946	Cable	Astrolab Inc.	32022-2-2909K-36TC	11/2/2015	11/2/2017
03430	Attenuator	Aeroflex/Weinschel	75A-10-12	11/2/2015	11/2/2017

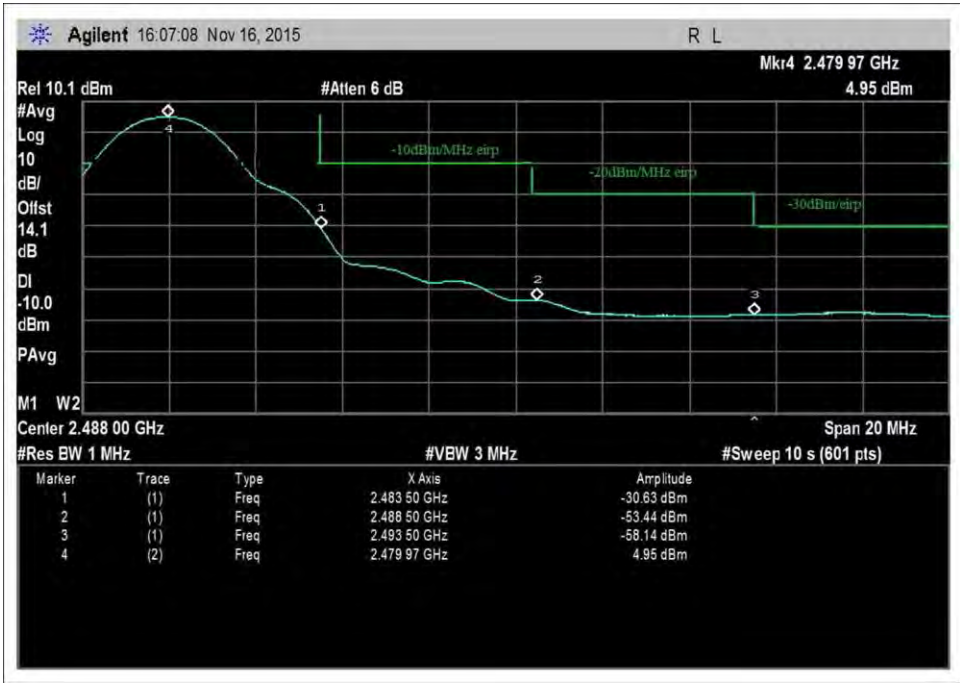
Unwanted Emissions in the Out-of-Band Domain				
Declared Antenna Gain, G (dBi): 3.3dBi				
Declared Beam Forming Gain, Y (dB) : 0				
Equipment operating frequencies (MHz): 2405MHz, 2480MHz				
$BW = \begin{cases} BW_{chan}(MHz) \\ 1 MHz \end{cases}; \text{ whichever is greater}$				
Freq (MHz)	Operational Mode	Measured EIRP (dBm/MHz)	Limit EIRP (dBm/MHz)	Results
2400-2BW	2405MHz	-56	≤ -20	Pass
2400-BW	2405MHz	-42	≤ -10	Pass
2483.5+BW	2480MHz	-30.6	≤ -10	Pass
2483.5+2BW	2480MHz	-53.2	≤ -20	Pass

Amplitude off set = 10.8 + 3.3 = 14.1dB
 The manufacturer declares the Occupied Channel Bandwidth = 5 MHz

Plot Data

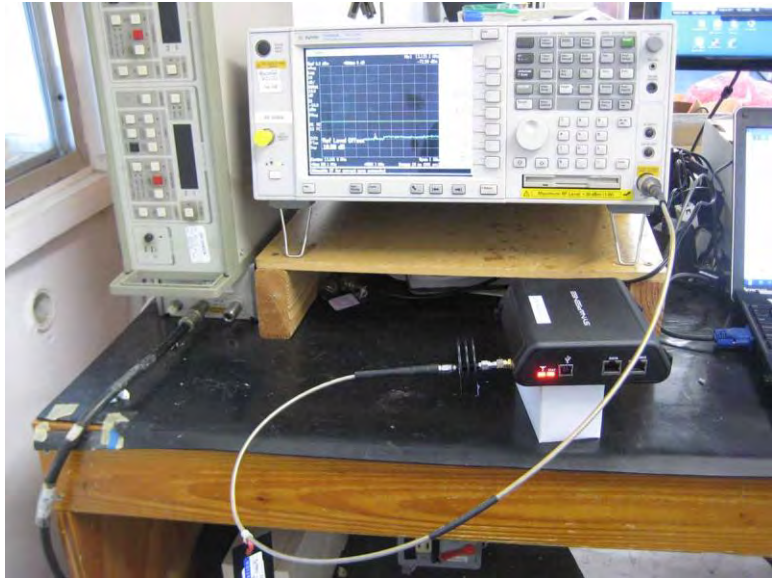


Low



High

Test Setup Photo



4.3.2.9 Transmitter Unwanted Emissions in the Spurious Domain

Test Setup/Conditions			
Test Location:	Brea Lab A	Test Engineer:	E. Wong
Test Method:	EN 300 328 v1.9.1 §5.3.10	Test Date(s):	11/16/2015
Configuration:	1 Antenna Conducted 4 Enclosure Radiated		

Environmental Conditions			
Temperature (°C)	23.9	Relative Humidity (%):	35

Conducted

Conducted - Test Equipment					
Asset# / Serial#	Description	Manufacturer	Model	Cal Date	Cal Due
02869	Spectrum Analyzer	Agilent	E4440A	7/17/2015	7/17/2016
02946	Cable	Astrolab Inc.	32022-2-2909K-36TC	11/2/2015	11/2/2017
03430	Attenuator	Aeroflex/Weinschel	75A-10-12	11/2/2015	11/2/2017

Unwanted Emissions in the Spurious Domain – Antenna Port Conducted

Equipment operating frequencies (MHz): 2405MHz 2480MHz				
Freq (MHz)	Operational Mode	Measured (dBm)	Limit (dBm)	Results
38	2405MHz	-91.3	-36	Pass
88	2405MHz	-87.3	-54	Pass
1797	2405MHz	-55.3	-30	Pass
2341	2405MHz	-38.6	-30	Pass
2500	2405MHz	-60.2	-30	Pass
4810	2405MHz	-56.0	-30	Pass
520	2480MHz	-83.3	-54	Pass
30	2480MHz	-86.8	-36	Pass
4954	2480MHz	-58.7	-30	Pass
1872.3	2480MHz	-54.6	-30	Pass
2384	2480MHz	-55.5	-30	Pass
2543.3	2480MHz	-45.8	-30	Pass

Reported measurement is Conducted power.

Radiated

Radiated - Test Equipment					
Asset# / Serial#	Description	Manufacturer	Model	Cal Date	Cal Due
AN02869	Spectrum Analyzer	Agilent	E4440A	7/17/2015	7/17/2016
AN01995	Biconilog Antenna	Chase	CBL6111C	4/30/2014	4/30/2016
AN00309	Preamp	HP	8447D	3/12/2014	3/12/2016
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
AN00786	Preamp	HP	83017A	4/25/2014	4/25/2016
AN00849	Horn Antenna	ETS	3115	3/18/2014	3/18/2016
ANP06543	Cable	AstroLab	32022-29094K- 29094K-24TC	11/20/2013	11/20/2015
ANP06661	Cable	Andrew	LDF1-50	4/15/2014	4/15/2016

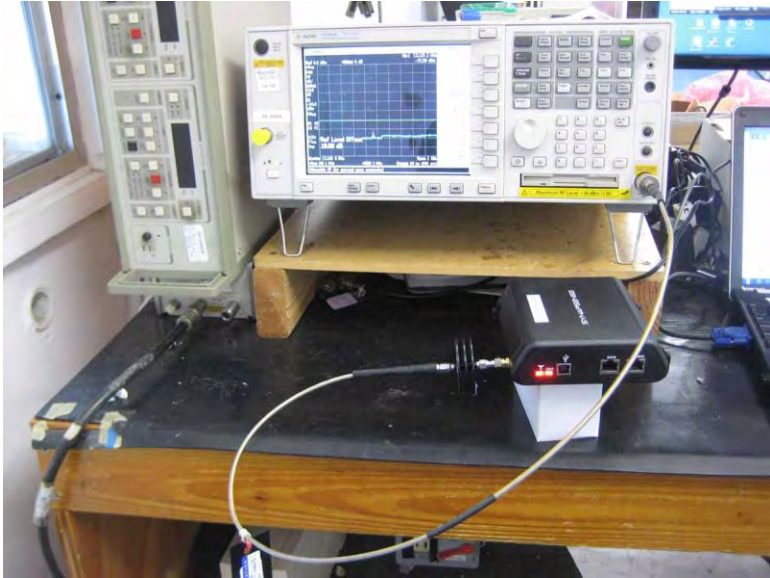
Unwanted Emissions in the Spurious Domain – Enclosure Radiated

Declared Antenna Gain, G (dBi): 3.3
 Declared Beam Forming Gain, Y (dB) : NA
 Equipment operating frequencies (MHz): 2405MHz, 2480MHz

Freq (MHz)	Operational Mode	Measured EIRP (dBm)	Limit EIRP (dBm)	Results
660.03	L_Y	-61.8	-54	Pass
2340.56	L_Y	-38.2	-30	Pass
999.97	L_Y	-45.5	-36	Pass
249.983	L_Y	-46.3	-36	Pass
2340.7	L-Z	-40.5	-30	Pass
2340.3	L_Y	-40.5	-30	Pass
2341	L_X	-41.6	-30	Pass
191.292	L_Y	-66.8	-54	Pass
2543.75	H_X	-43.5	-30	Pass
249.985	L_Y	-49.6	-36	Pass
60.96	L_Y	-67.7	-54	Pass
2544	H_Y	-44.2	-30	Pass
2340.7	L-Z	-45.4	-30	Pass
375.03	L_Y	-52.1	-36	Pass
51.17	H_Y	-70.3	-54	Pass
2341.3	L_X	-46.5	-30	Pass
2543.7	H_Z	-47.6	-30	Pass
249.92	H_Y	-53.7	-36	Pass
2544	H_X	-48.0	-30	Pass
374.98	L_Y	-54.2	-36	Pass

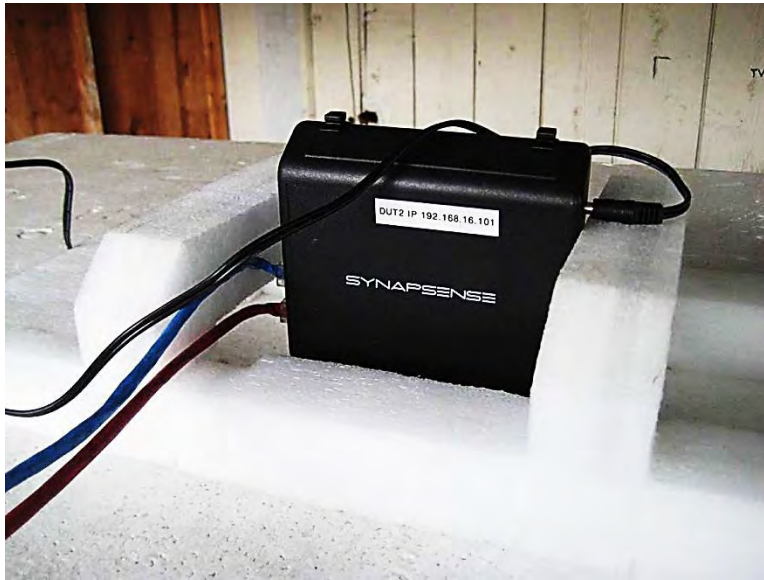
Note: Measured data within 20dB of the spurious emission limit.

Test Setup Photos

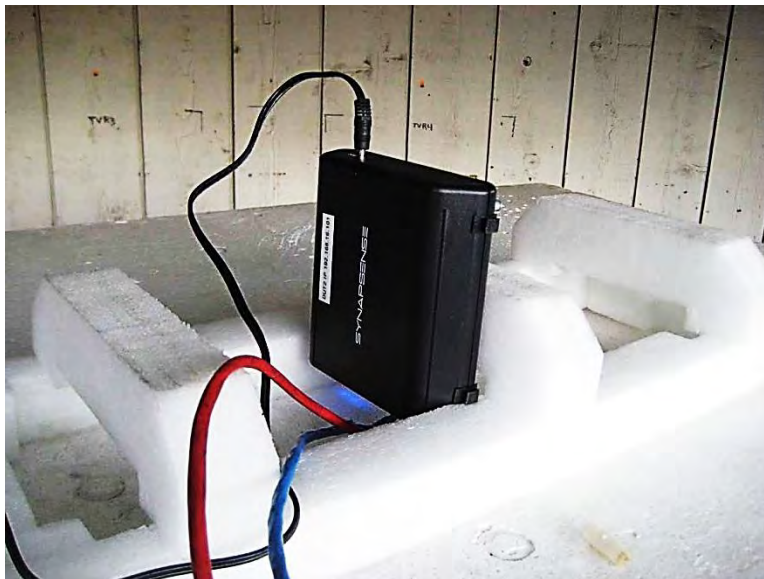




X Axis



Y Axis



Z Axis

4.3.2.10 Receiver Spurious Emissions

Conducted

Test Setup/Conditions

Test Location:	Brea Lab A	Test Engineer:	E. Wong
Test Method:	EN 300 328 v1.9.1 §5.3.11	Test Date(s):	11/17/2015
Configuration:	1		

Environmental Conditions			
Temperature (°C)	23.9	Relative Humidity (%):	35

Test Equipment

Asset# / Serial#	Description	Manufacturer	Model	Cal Date	Cal Due
02869	Spectrum Analyzer	Agilent	E4440A	7/17/2015	7/17/2016
02946	Cable	Astrolab Inc.	32022-2-2909K-36TC	11/2/2015	11/2/2017
03430	Attenuator	Aeroflex/Weinschel	75A-10-12	11/2/2015	11/2/2017

Conducted - Receiver Spurious Emissions

Declared Antenna Gain, G (dBi): 3.3
 Declared Beam Forming Gain, Y (dB) : 0
 Equipment operating frequencies (MHz): 2405MHz, 2480 MHz

Freq (MHz)	Operational Mode	Measured EIRP (dBm)	Limit EIRP (dBm)	Results
NA	NA	NED	-57	Pass

NA = Not Applicable
NED = No emissions detected.

Radiated

Test Setup/Conditions			
Test Location:	Mariposa Lab A	Test Engineer:	Chuck Kendall
Test Method:	EN 300 328 v1.9.1 §5.3.11	Test Date(s):	10/21/2013
Configuration:	1		
Declaration:	Data tested back in 2013 was recalculated against the most current requirements of this standard.		

Environmental Conditions			
Temperature (°C)	26.1	Relative Humidity (%):	40

Test Equipment					
Asset# / Serial#	Description	Manufacturer	Model	Cal Date	Cal Due
AN02660	Spectrum Analyzer	Agilent	E4446A	8/23/2012	8/23/2014
AN03155	Preamp	HP	83017A	6/26/2013	6/26/2015
AN03011	Cable	AstroSteel	32022-2-2909K-24TC	2/4/2013	2/4/2015
AN03355	Cable	AstroLab	32026-2-29094K-48TC	2/7/2013	2/7/2015
AN03356	Cable	AstroLab	32026-2-29094K-48TC	2/7/2013	2/7/2015
AN03358	Cable	AstroLab	32022-2-29094K-36TC	2/7/2013	2/7/2015
AN03360	Cable	AstroLab	32022-2-29094-36TC	2/4/2013	2/4/2015
AN00327	Horn Antenna	EMCO	3115	4/13/2012	4/13/2014
AN01991	Bilog Antenna	Chase	CBL6111C	3/14/2012	3/14/2014
AN00062	Pre-Amp	HP	8447D	6/6/2012	6/6/2014
AN05922	Cable	Pasternack	RG/214	8/15/2012	8/15/2014
ANP05686	Cable	Pasternack	RG/214	1/24/2012	1/24/2014

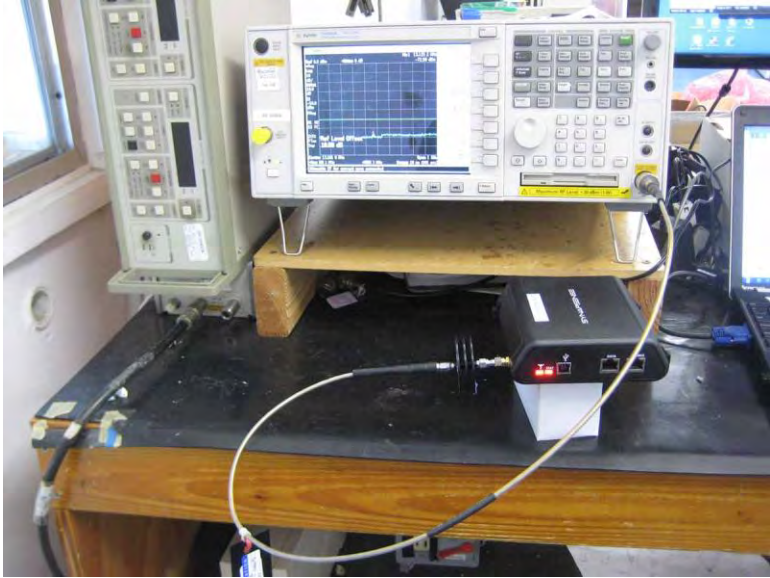
Unwanted Emissions in the Spurious Domain – Enclosure Radiated

Declared Antenna Gain, G (dBi): 3.3
 Declared Beam Forming Gain, Y (dB) : NA
 Equipment operating frequencies (MHz): Receive mode

Freq (MHz)	Operational Mode	Measured EIRP (dBm)	Limit EIRP (dBm)	Results
45.746V	Receive V	-74	-57	Pass
49.381H	Receive H	-76.6	-57	Pass
58.746V	Receive V	-74.9	-57	Pass
111.595V	Receive V	-70.4	-57	Pass
119.991V	Receive V	-74.2	-57	Pass
119.997H	Receive H	-72	-57	Pass
124.998V	Receive V	-73.9	-57	Pass
125.007H	Receive H	-76	-57	Pass
145.427V	Receive V	-76.5	-57	Pass
189.415V	Receive V	-73.8	-57	Pass
240.012H	Receive H	-82.5	-57	Pass
249.995V	Receive V	-65.4	-57	Pass
250.001H	Receive H	-62.4	-57	Pass
284.115V	Receive V	-84.5	-57	Pass
374.988V	Receive V	-67.7	-57	Pass
375H	Receive H	-69.5	-57	Pass
375.015V	Receive V	-77.7	-57	Pass
406.217H	Receive H	-80.5	-57	Pass
406.217V	Receive V	-71.9	-57	Pass
444.698V	Receive V	-83.9	-57	Pass
454.065V	Receive V	-71.4	-57	Pass
464.799V	Receive V	-66.7	-57	Pass
499.984H	Receive H	-66.8	-57	Pass
499.985V	Receive V	-69.5	-57	Pass
510.125H	Receive H	-71.6	-57	Pass
624.999V	Receive V	-73.5	-57	Pass
750.002V	Receive V	-72.3	-57	Pass
860.861H	Receive H	-73.8	-57	Pass
875.002V	Receive V	-80.3	-57	Pass
952.313V	Receive H	-75.4	-57	Pass
1000.003V	Receive V	-51.8	-57	Pass
1000.065H	Receive H	-52.2	-47	Pass

Freq (MHz)	Operational Mode	Measured EIRP (dBm)	Limit EIRP (dBm)	Results
1124.897V	Receive V	-49.9	-47	Pass
1176V	Receive V	-54.7	-47	Pass
1176.01H	Receive H	-59	-47	Pass
1249.925V	Receive V	-57.9	-47	Pass
1249.985H	Receive H	-59.6	-47	Pass
1732.525V	Receive V	-55.3	-47	Pass
1732.56H	Receive H	-51.7	-47	Pass
1796.47H	Receive H	-50.7	-47	Pass
1797.5V	Receive V	-58.2	-47	Pass
2146.555H	Receive H	-55.5	-47	Pass
2146.6V	Receive V	-52.2	-47	Pass
2340.61V	Receive V	-54.6	-47	Pass

Test Setup Photos



Radiated Spurious, Mariposa Lab

SUPPLEMENTAL INFORMATION

Measurement Uncertainty

Parameter Uncertainty	Actual	Limit	Unit of Measure
Occupied Channel Bandwidth	1	5	%
RF output power, conducted	0.67	1.5	dB
Power Spectral Density, conducted	0.67	3	dB
Unwanted Emissions, conducted	0.67	3	dB
All emissions, radiated	3.73	6	dB
Temperature	1	1	°C
Humidity	2.5	5	%
DC and low frequency voltages	2	3	%
Time	1.1	5	%
Duty Cycle	1.1	5	%

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.