Compliance Testing, LLC
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Test Report

Prepared for: Sensys Networks, Inc.

Model: FLEX-RPT3-SLR-E

Description: Solar Repeater

Serial Number: N/A

FCC ID: TDB-FLEXRPS
IC: 9498A-FLEXRPS

To

FCC Part 15.249

And

IC RSS-210

Date of Issue: December 1, 2017

On the behalf of the applicant:

Sensys Networks, Inc.
1608 4th Street
Suite 200
Berkeley, CA 94710

Attention of:

Sebastian Lodahl, Hardware Engineer
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Project No: p1790010

Poona Saber
Project Test Engineer

Test Report Revision History

Revision	Date	Revised By	Reason for Revision
1.0	October 2, 2017	Poona Saber	Original Document
2.0	November 14, 2017	Amanda Reed	Updated company address
3.0	November 22, 2017	Poona Saber	Fixed the Ansi C63.10 version on page 6 Changed IC RSS standard version Changed bandwidth title Revised Annex A Revised Annex B
4.0	November 30, 2017	Poona Saber	Changed the test procedure for output measurement to radiated.
5.0	December 1, 2017	Poona Saber	Changed header on page 3 from conducted to radiated output power
6.0	December 1, 2017	Poona Saber	Changed table summary again for conducted spurious

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ILAC / A2LA

Compliance Testing, LLC, has been accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to the joint ISO-ILAC-IAF Communiqué dated January 2009).

The tests results contained within this test report all fall within our scope of accreditation, unless noted below.

Please refer to http://www.compliancetesting.com/labscope.html for current scope of accreditation.

Testing Certificate Number: **2152.01**

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TESTING CERT
#2152.01

FCC Site Reg. #349717

IC Site Reg. #2044A-2

Non-accredited tests contained in this report:

N/A

The applicant has been cautioned as to the following

15.21 - Information to User

The user's manual or instruction manual for an intentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

15.27(a) - Special Accessories

Equipment marked to a consumer must be capable of complying with the necessary regulations in the configuration in which the equipment is marketed. Where special accessories, such as shielded cables and/or special connectors are required to enable an unintentional or intentional radiator to comply with the emission limits in this part, the equipment must be marketed with, i.e. shipped and sold with, those special accessories. However, in lieu of shipping or packaging the special accessories with the unintentional or intentional radiator, the responsible party may employ other methods of ensuring that the special accessories are provided to the consumer without an additional charge.

Information detailing any alternative method used to supply the special accessories for a grant of equipment authorization or retained in the verification records, as appropriate. The party responsible for the equipment, as detailed in § 2.909 of this chapter, shall ensure that these special accessories are provided with the equipment. The instruction manual for such devices shall include appropriate instructions on the first page of text concerned with the installation of the device that these special accessories must be used with the device. It is the responsibility of the user to use the needed special accessories supplied with the equipment.

Standard Test Conditions Engineering Practices

Except as noted herein, the following conditions and procedures were observed during the testing:

In accordance with ANSI C63.10-2013 and unless otherwise indicated in the specific measurement results, the ambient temperature of the actual EUT was maintained within the range of 10° to 40°C (50° to 104°F) unless the particular equipment requirements specified testing over a different temperature range. Also, unless otherwise indicated, the humidity levels were in the range of 10% to 90% relative humidity.

Measurement results, unless otherwise noted, are worst-case measurements.

Environmental Conditions		
Temperature (ºC)	**Humidity (%)**	**Pressure (mbar)**
23.3	28.9	967

EUT Description
Model: FLEX-RPT3-SLR-E
Description: Solar Repeater
Firmware: N/A
Software: N/A
Serial Number: N/A
Additional Information:
The repeater is uses pulsed transmission under IEEE 802.15.2 Standard sending data in packets. When no packet is being sent the transmitter is turned off completely. The transmitter is designed to ramp up and ramp down pulse transmission edges to eliminate splatter.
For testing purposes device is put on continuous transmission and dusty cycle correction factor is applied to measure Average Power from peak measurements as below.

DCCF =20*Log(2.833*6/100) = -15.39 dB

The EUT incorporates a 5.5 dBi internal antenna and can go up to 14 dBi external Antenna.

EUT Operation during Tests
The manufacturer supplied software which enabled the EUT to be placed in to a test mode which transmitted high, mid and low channels with a continuous CW tone or a modulated signal.

Accessories:

Qty	Description	Manufacturer	Model	S/N
1	Laptop	Lenovo	T420	N/A
1	Sensys Access point	Sensys	Ap240-E	N/A
1	Ethernet to mini USB adapter	N/A	N/A	N/A

Cables

Qty	Description	Length (M)	Shielding Y/N	Shielded Hood Y/N	Termination
1	Mini USB to USB	<3	N	N	N/A

Modifications: None

15.203: Antenna Requirement:

	The antenna is permanently attached to the EUT
X	The antenna uses a unique coupling
	The EUT must be professionally installed
	The antenna requirement does not apply

Test Results Summary

FCC 15.247 Specification	Test Name	Pass, Fail, N/A	Comments
15.247(b)	Peak Output Power	Pass	
15.247(d)	Conducted Spurious Emissions	Pass	
15.247(d), 15.209(a), 15.205	Radiated Spurious Emissions	Pass	
15.247(d), 15.209(a), 15.205	Emissions At Band Edges	Pass	
15.247(a)(2)	Occupied Bandwidth	Pass	
15.247(e)	Transmitter Power Spectral Density	Pass	
15.207	A/C Powerline Conducted Emissions	N/A	DC Powered

References	Description
CFR47, Part 15, Subpart B	Unintentional Radiators
CFR47, Part 15, Subpart C	Intentional Radiators
ANSI C63.10-2013	American National standard for testing Unlicensed Wireless Devices
ANSI C63.4-2014	Method and Measurements of Radio-Noise Emissions from low-Voltage Electrical and Electronic Equipment in the range 9kHz to 40GHz.
ISO/IEC 17025:2005	General requirements for the Competence of Testing and Calibrations Laboratories
KDB 558074 D01 v04	Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating under §15.247

Radiated Output Power
Engineer: Poona Saber
Test Date: 10/20/2017

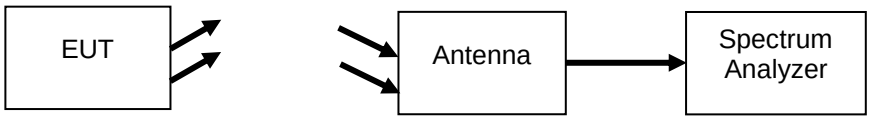
Test Procedure

EUT was placed on a turn table at 1.5 meter above the ground and 3 meters away from the receive antenna. The receive antenna was adjusted from 1-4 meter and turn table was positioned from 0 to 360 degrees to capture the highest emission coming from the EUT.
The Spectrum Analyzer was set to the following:

RBW = ≥ DTS bandwidth
VBW ≥ 3 x RBW
Peak Detector
Trace mode = max hold
Sweep = auto
Span ≥ 3 x RBW

The EUT was set to continuous transmit on the lowest, middle and highest frequencies at the maximum power level. The RF output power was measured using the spectrum analyzer's channel power function

Test Setup



Transmitter Output Power

With 5.5 dBi antenna

Tuned Frequency (MHz)	Peak Measured Level (dBuV/m)	Peak Limit	Result
2405	101.6	113.97	Pass
2440	103.1	113.97	Pass
2480	103.2	113.97	Pass

Tuned Frequency (MHz)	Average Measured Level (dBuV/m)	Average Limit (dBuV/m)	Result
2405	86.21	93.97	Pass
2440	87.71	93.97	Pass
2480	87.81	93.97	Pass

With 14 dBi antenna

Tuned Frequency (MHz)	Peak Measured Level (dBuV/m)	Peak Limit	Result
2405	107	113.97	Pass
2440	106.9	113.97	Pass
2480	106.4	113.97	Pass

Tuned Frequency (MHz)	Average Measured Level (dBuV/m)	Average Limit (dBuV/m)	Result
2405	91.61	93.97	Pass
2440	91.51	93.97	Pass
2480	91.01	93.97	Pass

Conducted Spurious Measurements

Engineer: Poona Saber

Test Date: 9/28/2017

Test Procedure

Antenna-port conducted measurements were performed as an alternative to radiated measurements for demonstrating compliance to spurious harmonic emissions and for other spurious Emissions, except for harmonics, that shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

The following offsets were added to the measurements:
The maximum transmit antenna gain (14 dBi) to the measured output power level to determine the EIRP level
A maximum ground reflection factor to the EIRP level, 6 dB for frequencies ≤ 30 MHz, 4.7 dB for frequencies between 30 MHz and 1000 MHz, inclusive and 0 dB for frequencies > 1000MHz.

The following equations were used to determine the field strength from the conducted values.
E[dBµV/m] = EIRP[dBm] - 20 log(d[meters]) + 104.77, where E = field strength and d = 3m
E[dBµV/m] = EIRP[dBm] + 95.2, for d = 3 meters.

The Spectrum Analyzer was set to the following:

The Spectrum Analyzer was set to the following for emissions > 1000MHz:

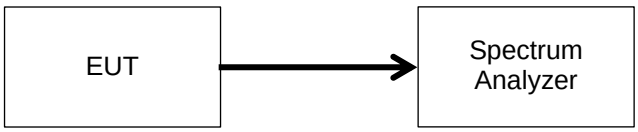
a. RBW = 1 MHz
b. VBW ≥ 3 MHz
c. Detector = Peak.
d. Sweep time = auto
e. Trace mode = max hold
    1. Note: For emissions where the peak exceeded that of the average 15.209 emission limit the following was performed.
f. RBW = 1 MHz
g. VBW ≤ RBW/100 (i.e., 10 kHz) but not less than 10 Hz

For emissions below 1000MHz the Spectrum Analyzer settings were as follows:

a. RBW = 100 kHz
b. VBW ≥ 300 kHz
c. Detector = Peak
d. Sweep time = auto
e. Trace mode = max hold

The EUT was connected to a spectrum analyzer to verify that the EUT met the requirements for spurious emissions. The EUT was set to transmit on the lowest, middle and highest frequencies at the maximum power level. The frequency range from 30 MHz to the 10th harmonic of the fundamental transmitter was investigated.

Test Setup



See Annex A for test data

Radiated Spurious Emissions
Engineer: Poona Saber
Test Date:10/20/2017

Test Procedure
Radiated Spurious Emissions: 30 – 1000 MHz

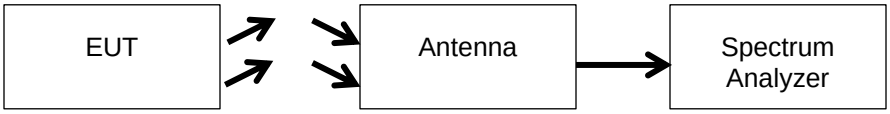
The EUT was setup in a semi-anechoic test chamber set 3m from the receiving antenna. The output of the transmitter was connected to a non-radiating balance load. The EUT was set to transmit on the lowest, middle and highest frequencies at the maximum power level. A spectrum analyzer was used to verify that the EUT met the requirements for Radiated Emissions. The EUT was tested by rotating it 360° with the antennas in both the vertical and horizontal orientation and was raised from 1 to 4 meters to ensure the TX signal levels were maximized.

The EUT was also exercised for radiated spurious coming out of the Unit with external antenna port (14 dBi) terminated.

All emissions from 30 MHz to 1 GHz were examined.
Measured Level includes antenna and receiver cable correction factors.
Correction factors were input into the spectrum analyzer before recording “Measured Level”.

RBW = 100 KHz
VBW = 300 KHz
Detector – Quasi Peak

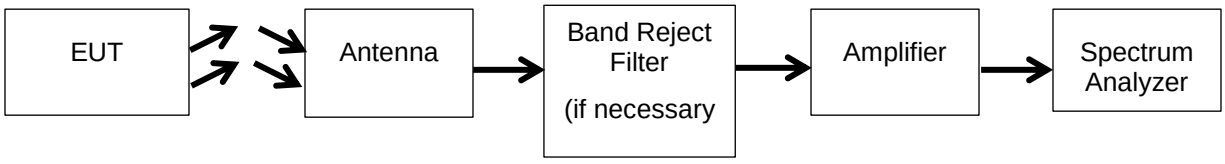
Test Setup



Test Procedure for
Radiated Spurious Emissions above 1 GHz

The EUT was setup in a semi-anechoic test chamber set 3m from the receiving antenna. The output of the transmitter was connected to a non-radiating balance load. The EUT was set to transmit on the lowest, middle and highest frequencies at the maximum power level. A spectrum analyzer was used to verify that the EUT met the requirements for Radiated Emissions. The EUT was tested by rotating it 360° with the antennas in both the vertical and horizontal orientation and was raised from 1 to 4 meters to ensure the TX signal levels were maximized.

Test Setup



See Annex B for Test Data

Occupied Bandwidth
Engineer: Poona Saber
Test Date: 10/20/2017

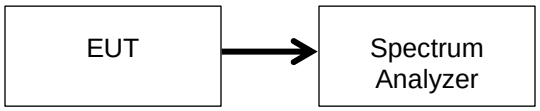
Test Procedure

The EUT was connected directly to a spectrum analyzer. The Spectrum Analyzer was set to the following:

RBW = 100 kHz
VBW ≥ 3 x RBW
Peak Detector
Trace mode = max hold
Sweep = auto couple
Span = 1.5 x EBW

The EUT was set to transmit at the lowest, middle and highest channels of the band at the maximum power levels. The maximum width of the emission that was determined by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that were attenuated by 20db and this value was used to determine the width of the carrier. Alternatively, the spectrum analyzer's automatic bandwidth capability was used.

Test Setup



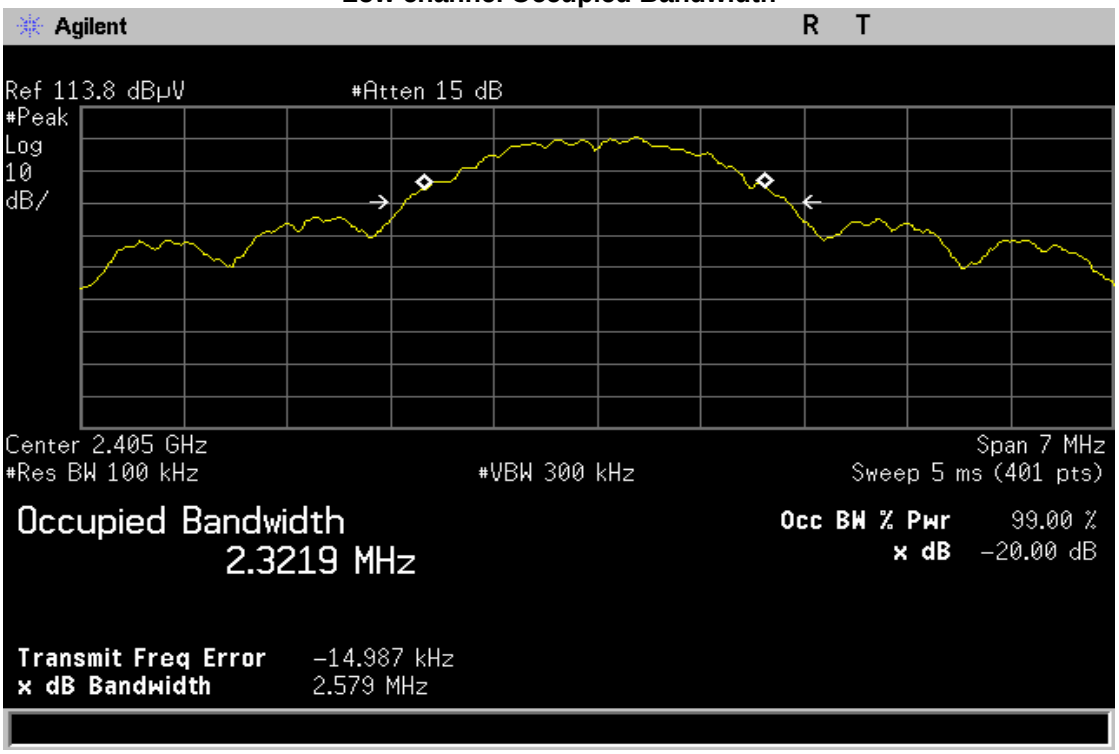
20 dB Occupied Bandwidth Summary

Frequency (MHz)	Measured Bandwidth (MHz)
2405	2.57
2440	2.57
2480	2.6

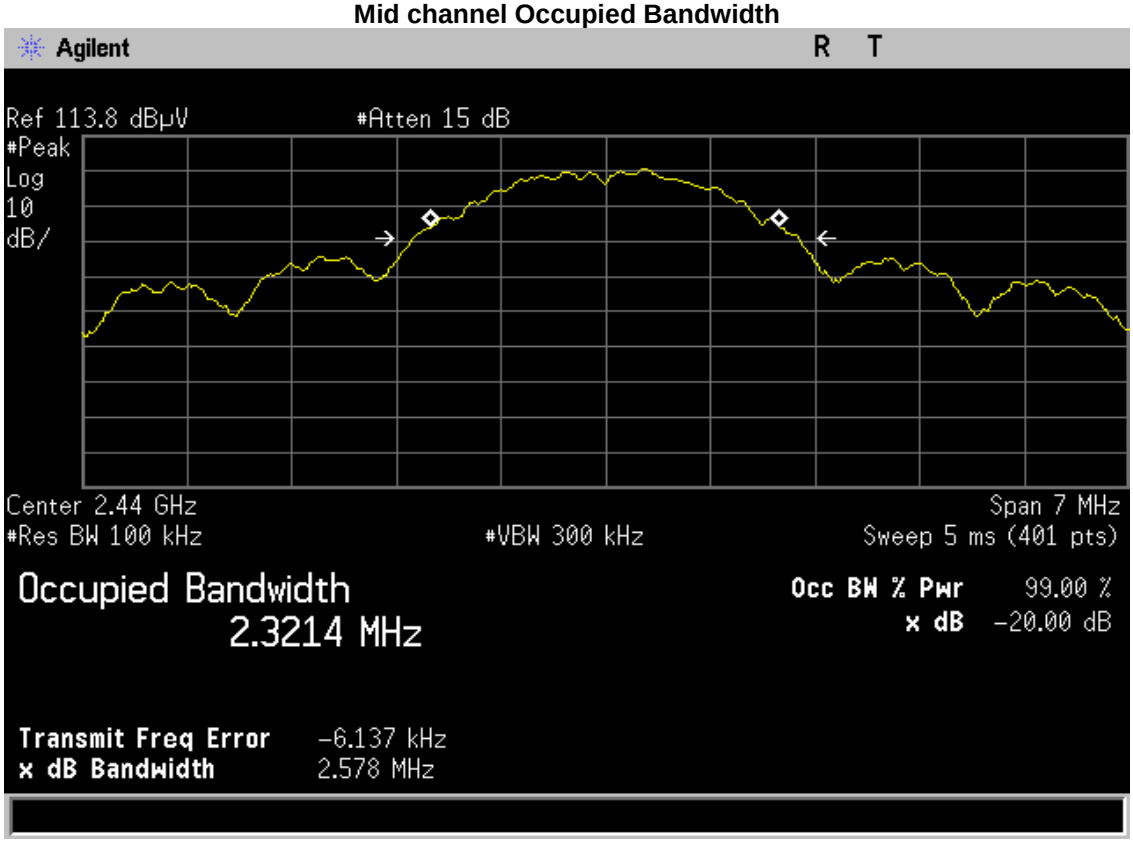
99% Bandwidth Summary

Frequency (MHz)	Measured Bandwidth (MHz)
2405	2.32
2440	2.32
2480	2.42

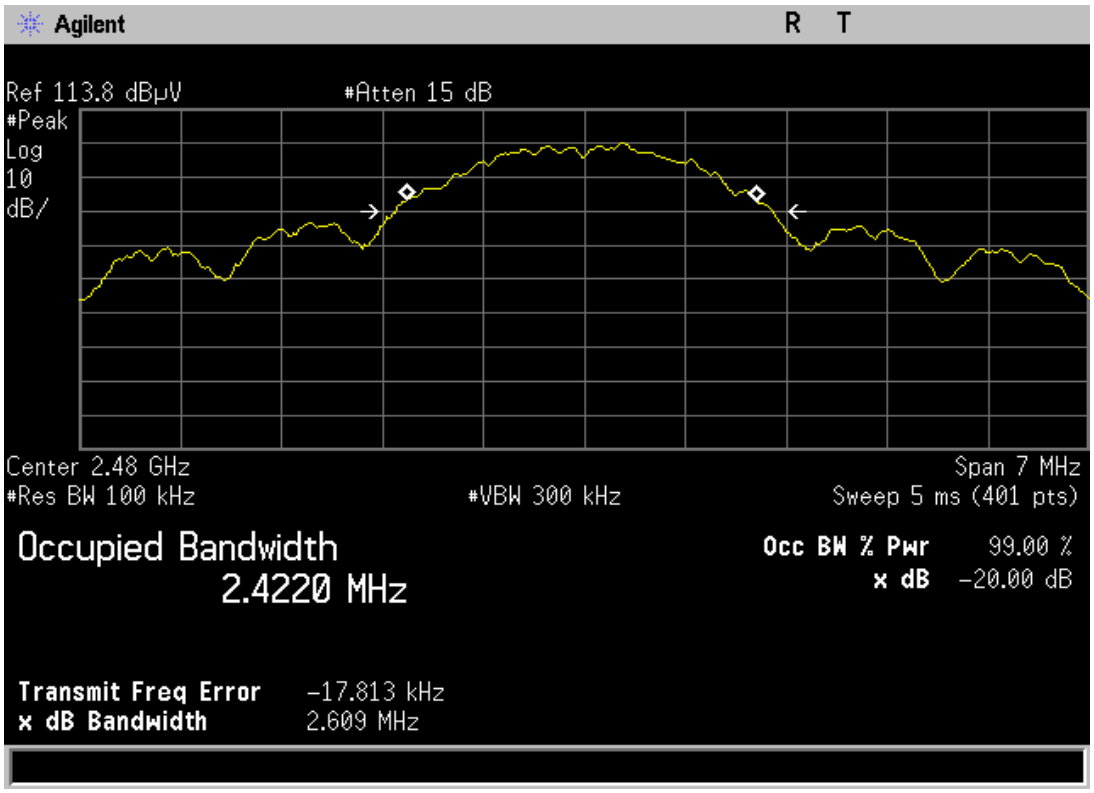
Low channel Occupied Bandwidth



Mid channel Occupied Bandwidth



High channel Occupied Bandwidth



Test Equipment Utilized

Description	Manufacturer	Model #	CT Asset #	Last Cal Date	Cal Due Date
Horn Antenna	ARA	DRG-118/A	i00271	6/16/16	6/16/18
Horn Antenna, Amplified	ARA	MWH-1826/B	i00273	4/22/15	4/22/18
Humidity / Temp Meter	Newport	IBTHX-W-5	i00282	6/9/17	6/9/18
Spectrum Analyzer	Agilent	E4407B	i00331	10/19/16	10/19/17
Bi-Log Antenna	Schaffner	CBL 6111D	i00349	8/3/16	8/3/18
EMI Analyzer	Agilent	E7405A	i00379	2/22/17	2/22/18
3 Meter Semi-Anechoic Chamber	Panashield	3 Meter Semi-Anechoic Chamber	i00428	8/15/16	8/15/19
Preamplifier	Miteq	AFS44 00101 400 23-10P-44	i00509	N/A	N/A

In addition to the above listed equipment standard RF connectors and cables were utilized in the testing of the described equipment. Prior to testing these components were tested to verify proper operation.

END OF TEST REPORT