

RRA-EMIESS23H879SER-01Av0

Radio test report

According to the standard:

CFR 47 FCC PART 15

RSS 247 – Issue 2

Equipment under test:

S-LYNKS NODE

FCC ID: *KQ9-0A00A*

IC NUMBER: *1317A-0A00A*

Company:

SERCEL Inc

Distribution: Mr TIJOU

(Company: SERCEL NANTES)

Number of pages: 17 with 1 appendix

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			Name and Function	Visa
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This document is the result of testing a specimen or a sample of the product submitted. It does not imply an assessment of the conformity of the whole manufactured products of the tested sample.

Information in italics are declared by the manufacturer/customer and are under his responsibility

DESIGNATION OF PRODUCT: *S-LYNKS NODE*

Serial number (S/N): *EDE567C20251E0001*

Reference / model (P/N): *NODE*

Software version: *SLBB_ F V4 S36/20*

MANUFACTURER: *SERCEL Inc*

COMPANY SUBMITTING THE PRODUCT:

Company: SERCEL NANTES

Address: 16, RUE DU BEL AIR
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Responsible: Mr TIJOU

Person present during the tests: Mr PORCHEL

DATES OF TEST: 19-Dec-23

TESTING LOCATION: EMITECH ANGERS laboratory at JUIGNE SUR LOIRE (49) FRANCE

FCC Accredited under US-EU MRA Designation Number: FR0009
Test Firm Registration Number: 873677

TESTED BY: S. LOUIS

VISA:

A handwritten signature in black ink, appearing to read "S. Louis", with a stylized flourish at the end.

WRITTEN BY: S. LOUIS

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REVISIONS HISTORY

Revision	Date	Modified pages	Modifications
0	22-Dec-23	/	Creation

1. INTRODUCTION

This report presents the results of radio test carried out on the following radio equipment **S-LYNKS NODE**, in accordance with normative reference.

The equipment under test integrates the followings radio functions:

- LoRa radio part not already certified,
- WiFi radio part not already certified,
- GNSS receiver.

This report is a justification statement for antenna as stated in 'Timco' newsletter for Part 15 applications with equipment classes DTS, DSS, NII, 6ID, etc. which require the antenna gain for compliance with EIRP limits.

2. PRODUCT DESCRIPTION

Category of equipment (ISED): I

Class: A

Utilization: Industrial

LoRa radio part:

Antenna type and gain: Integral antenna
Gain at 903MHz => -0.01dBi
Gain at 915MHz => +1.01dBi
Gain at 927MHz => +2.93dBi

Operating frequency range: From 902 MHz to 928 MHz

Number of channels: 41

Channel spacing: 600kHz

Modulation: LoRa 500kHz

Power source: 7.2Vdc Li-ion battery

Power level adjusted to +18dBm by software

WiFi radio part:

Antenna type and gain:	integral antenna Antenna 1 Gain at 2412MHz => +1.53dBi Antenna 1 Gain at 2437MHz => +2.07dBi Antenna 1 Gain at 2462MHz => +2.20dBi Antenna 2 Gain at 2412MHz => +2.78dBi Antenna 2 Gain at 2437MHz => +2.28dBi Antenna 2 Gain at 2462MHz => +2.29dBi
Operating frequency range:	From 2400 MHz to 2483.5 MHz
Number of channels:	11
Channel spacing:	5MHz
Channel bandwidth:	20 MHz
Power setting	16 dBm
Modulation:	DBPSK OFDM: BPSK OFDM: 64-QAM
Mode tested:	802.11 b 802.11 g 802.11 n
Data rate:	For 802.11b: 1Mbit/s For 802.11g: 6Mbit/s For 802.11n: MCS0
Channel tested:	Channel 1: 2412 MHz Channel 6: 2437 MHz Channel 11: 2462 MHz
Correlated signal:	For mode n the signals are considered as correlated, the mode cyclic delay diversity (CDD) is used. (IEEE 802.11) The product is not using spatial multiplexing or intentional beamforming.
Power source:	7.2Vdc Li-ion battery

Power level, frequency range and channels characteristics are not user adjustable.
The details pictures of the product and the circuit boards are joined with this file.

3. NORMATIVE REFERENCE

The standards and testing methods related throughout this report are those listed below.

They are applied on the whole test report even though the extensions (version, date and amendment) are not repeated.

CFR 47 FCC Part 15 (2023) Radio Frequency Devices

ANSI C63.10 2013
Procedures for Compliance Testing of Unlicensed Wireless Devices.

558074 D01 DTS v05 r02 Guidance for compliance measurements on digital transmission system, frequency hopping spread spectrum system, and hybrid system devices operating under section 15.247 of the FCC rules.

RSS-247 Issue 2, February 2017
Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

4. TEST METHODOLOGY

Justification statement:

For antenna as stated in '[Timco](#)' newsletter for Part 15 applications with equipment classes DTS, which require the antenna gain for compliance with EIRP limits.

Radio performance tests procedures given in CFR 47 part 15:

Subpart C – Intentional Radiators

Paragraph 247: Operation within the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz

Radio performance tests procedures given in RSS-247:

Paragraph 5 - Standard specifications for frequency hopping systems and digital transmission systems operating in the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz

5. TEST EQUIPMENT CALIBRATION DATES

Emitech Number	Model	Type	Last calibration	Calibration interval (years)	Next calibration due
3544	SMA 0.5m - 17GHz	Cable	16/05/2022	2	15/05/2024
7566	Testo 608-H1	Meteo station	12/12/2022	2	11/12/2024
8548	Midwest Microwave 10dB	Attenuator	08/02/2023	3	07/02/2026
8593	SIDT Cage 2	Anechoic chamber	31/03/2022	3	30/03/2025
8896	ACQUISYS GPS8	Satellite synchronized frequency standard	/	/	/
11592	R&S NRV-Z86	Power Sensor	19/07/2023	2	18/07/2025
14736	MATURO	Turntable and mat controller MCU	/	/	/
14831	Fluke 177	Multimeter	01/02/2022	2	01/02/2024
15666	R&S FSV40	Spectrum Analyzer	27/09/2022	2	26/09/2024
///	R&S Power Viewer Plus V13.1	Software	/	/	/

6. TESTS RESULTS SUMMARY

6.1 CFR 47 part 15 requirements

Test procedure	Description of test	Respected criteria?				Comment
		Yes	No	NAp	NAs	
FCC Part 15.247	OPERATION WITHIN THE BANDS 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz					
	(b) Maximum peak output power	X				Note 1
	(c) Operation with directional antenna gains > 6 dBi			X		

NAp: Not Applicable

NAs: Not Asked

Note 1: First, a measurement was performed using the radiated method and the results found in radio test report referenced **RR051-20-104233-5-A Ed. 0** & **RR051-20-104233-6-A Ed. 0**, then a conducted measurement was performed with the same sample replacing the integral antenna by a SMA connector.

Gain antenna is calculated by subtracting conducted power measurement from radiated power measurement.

6.2 RSS-247 requirements

Test Procedure RSS-247	Description of test	Criteria respected ?				Comment
		Yes	No	NAp	NAs	
Paragraph 5	Standard specifications for frequency hopping system and digital transmission systems operating in the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz					
5.4	Transmitter output power and equivalent isotropically radiated power (e.i.r.p.) requirements	X				Note 1

NAp: Not Applicable

NAs: Not Asked

Note 1: First, a measurement was performed using the radiated method and the results found in radio test report referenced **RR051-20-104233-5-A Ed. 0** & **RR051-20-104233-6-A Ed. 0**, then a conducted measurement was performed with the same sample replacing the integral antenna by a SMA connector.

Gain antenna is calculated by subtracting conducted power measurement from radiated power measurement.

7. MEASUREMENT UNCERTAINTY

To declare, or not, the compliance with the specifications, it was not explicitly taken into account of uncertainty associated with the result(s)

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor $k=2$, which for normal distribution corresponds to a coverage probability of approximately 95%.

Parameter	Emitech Uncertainty
RF power, conducted	$\pm 0.8\text{dB}$
Radiated emission valid to 26 GHz	
9kHz – 30MHz	$\pm 2.7. \text{ dB}$
30MHz – 1GHz	$\pm 5.0 \text{ dB}$
1GHz – 18GHz	$\pm 5.3 \text{ dB}$
18GHz – 40GHz	$\pm 6.1 \text{ dB}$
AC Power Lines conducted emissions	$\pm 3.4 \text{ dB}$
Temperature	$\pm 1 \text{ }^{\circ}\text{C}$
Humidity	$\pm 5 \%$

8. ANTENNA GAIN CALCULATION – LoRa RADIO PART**Temperature (°C) :** 22**Humidity (%HR):** 39**Date :** December 19, 2023**Technician :** S. LOUIS**Standard:** FCC Part 15
RSS-247**Test procedure:**

For FCC Part 15: paragraph 15.247 (b)

For RSS-247: paragraph 5.4

Radiated Method Measurement: (Refer RR051-20-104233-5-A Ed. 0)
AVGSA-1 of paragraph 11.9.2.2.2 of ANSI C63.10

First an exploratory radiated measurement was performed.

During this phase the product is oriented in these two normal positions.

Then the final measurement is realized with the product on the most critical orientation.

The system is tested in an open area test site (OATS), the EUT is placed on a rotating table, 0.8m from a ground plane.

Zero degree azimuths correspond to the front of the device under test.

Distance of antenna: 10 meters (in open area test site)**Antenna height:** 1 to 4 meters (in open area test site)**Antenna polarization:** vertical and horizontal (only the highest level is recorded)

The measure of average output power is measured with a spectrum analyzer:

Resolution bandwidth: 1% to 5% of the OBW, not to exceed 1 MHz.

Video bandwidth: 3 x RBW

Span: At least 1.5 x OBW

Detector: RMS

Sweep points: At least 2 x SPAN/RBW

Sweep time: Auto

Trace: Average detector RMS

Trace Number: At least 100 traces

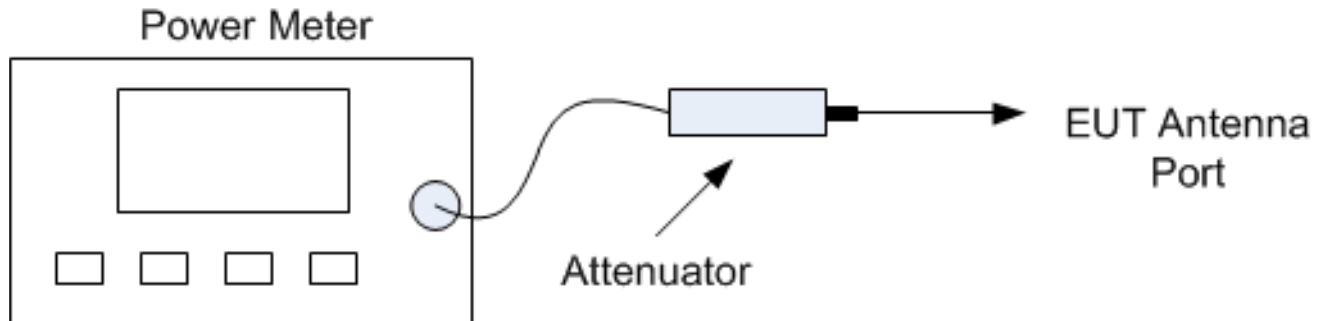
Then channel power function is used to compute power on OBW band.

Finally the radiated electro-magnetic field is converted in dBm with the following formula:

$$EIRP(dBm) = E (dB\mu V/m) + 20\log(D) - 104.8;$$
where D is the measurement distance in meters and antenna with a Gain (unit in dBi) different following the frequencies used.

Conducted Method Measurement:

AVGPM method (using an RF average-reading power meter) of paragraph 11.9.2.3.1 of ANSI C63.10

Conducted test

The measure is realized in conducted mode with a calibrated average reading power meter.

Then, if necessary, the measure is adjusted with the duty cycle correction factor ($10\log(1/x)$ with x is the duty cycle).

Equipment under test operating condition:

The equipment is blocked in continuous modulated transmission mode by an internal data signal at the highest power level at which the transmitter is intended to operate.

P Software adjusted to +18dBm

We used for power source the internal 7.2Vdc Li-ion battery fully charged of the equipment.

Results:

Sample N° 1 Low Channel (F = 903 MHz)

	Radiated Output power measured at 10 meters (dBμV/m):	Conducted Output Power computed (1) (dBm)	Conducted Output Power measured (dBm)	Antenna Gain calculation (dBi)
Nominal supply voltage: 7.2Vdc	101.1	16.33	16.34	-0.01

Polarization of test antenna: Vertical (height: 100 cm)

Position of equipment: Position 1 - (azimuth: 130 degrees)

(1) Conducted output power:

EIRP(dBm) = E (dBμV/m) + 20log(D) - 104.8; where D is the measurement distance in meters and antenna Gain = 0dBi (considered)

Sample N° 1 Central Channel (F = 915 MHz)

	Radiated Output power measured at 10 meters (dBμV/m):	Conducted Output Power computed (1) (dBm)	Conducted Output Power measured (dBm)	Antenna Gain calculation (dBi)
Nominal supply voltage: 7.2Vdc	102.0	17.23	16.22	1.01

Polarization of test antenna: Vertical (height: 100 cm)

Position of equipment: Position 1 - (azimuth: 130 degrees)

(1) Conducted output power:

EIRP(dBm) = E (dBμV/m) + 20log(D) - 104.8; where D is the measurement distance in meters and antenna Gain = 0dBi (considered)

Sample N° 1 High Channel (F = 927 MHz)

	Radiated Output power measured at 10 meters (dBμV/m):	Conducted Output Power computed (1) (dBm)	Conducted Output Power measured (dBm)	Antenna Gain calculation (dBi)
Nominal supply voltage: 7.2Vdc	103.8	19.03	16.10	2.93

Polarization of test antenna: Vertical (height: 100 cm)

Position of equipment: Position 1 - (azimuth: 130 degrees)

(1) Conducted output power:

EIRP(dBm) = E (dBμV/m) + 20log(D) - 104.8; where D is the measurement distance in meters and antenna Gain = 0dBi (considered)

9. ANTENNA GAIN CALCULATION – WiFi RADIO PART**Temperature (°C) :** 22**Humidity (%HR):** 39**Date :** December 19, 2023**Technician :** S. LOUIS**Standard:** FCC Part 15
RSS-247**Test procedure:**

For FCC Part 15: paragraph 15.247 (b)

For RSS-247: paragraph 5.4

Radiated Method Measurement: (Refer RR051-20-104233-6-A Ed. 0)
PKPM1 Peak power meter method of paragraph 11.9.1.3 of ANSI C63.10

First an exploratory radiated measurement was performed.

During this phase the product is oriented in these two normal positions.

Then the final measurement is realized with the product on the most critical orientation.

The system is tested in anechoic chamber, the EUT is placed on a rotating table, 1.5 m from a ground plane.

Zero degree azimuths correspond to the front of the device under test.

Distance of antenna: 3 meters**Antenna height:** 1.5 meter**Antenna polarization:** vertical and horizontal (only the highest level is recorded)

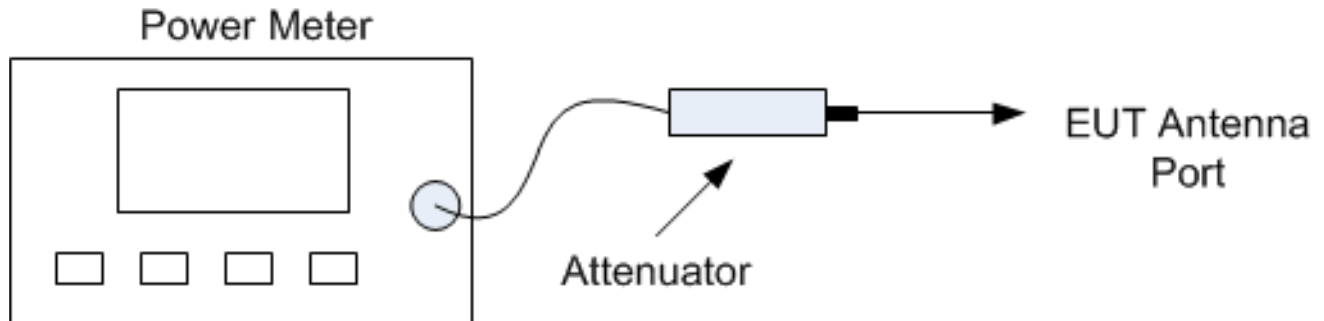
The measurement of the radiated electro-magnetic field is realized in radiated mode with a calibrated peak power reading power meter. (11.9.1.3 of ANSI C63.10).

Finally the radiated electro-magnetic field is converted in dBm with the following formula:

$$EIRP(dBm) = E (dB\mu V/m) + 20\log(D) - 104.8;$$
where D is the measurement distance in meters and antenna with a Gain (unit in dBi) different following the frequencies used.

Conducted Method Measurement:

PKPM1 Peak power meter method of paragraph 11.9.1.3 of ANSI C63.10

Conducted test

The measure is realized in conducted mode with a calibrated peak power reading power meter.

The power sensor was used on each output port of the EUT. A power meter was used to read the response of the power sensor.

Equipment under test operating condition:

The equipment is blocked in continuous modulated transmission mode by an internal data signal at the highest power level at which the transmitter is intended to operate.

P Software adjusted to +16dBm

We used for power source the internal 7.2Vdc Li-ion battery fully charged of the equipment.

Results: RF1

Sample N° 1 RF1 - Low Channel (F = 2412 MHz) - MIMO

	Radiated Output power measured at 3 meters (dBμV/m):	Conducted Output Power computed (1) (dBm)	Conducted Output Power measured (dBm)	Antenna Gain calculation (dBi)
Nominal supply voltage: 7.2Vdc	115.62	20.39	18.86	1.53

Polarization of test antenna: Vertical (height: 150 cm)

Position of equipment: Position 2 (azimuth: 320 degrees for antenna 1 / 165 degrees for antenna 2)

(1) Conducted output power:

EIRP(dBm) = E (dBμV/m) + 20log(D) - 104.8; where D is the measurement distance in meters and antenna Gain = 0dBi (considered)

Sample N° 1 RF1 - Central Channel (F = 2437 MHz) - MIMO

	Radiated Output power measured at 3 meters (dBμV/m):	Conducted Output Power computed (1) (dBm)	Conducted Output Power measured (dBm)	Antenna Gain calculation (dBi)
Nominal supply voltage: 7.2Vdc	116.70	21.47	19.40	2.07

Polarization of test antenna: Vertical (height: 150 cm)

Position of equipment: Position 2 (azimuth: 320 degrees for antenna 1 / 165 degrees for antenna 2)

(1) Conducted output power:

EIRP(dBm) = E (dBμV/m) + 20log(D) - 104.8; where D is the measurement distance in meters and antenna Gain = 0dBi (considered)

Sample N° 1 RF1 - High Channel (F = 2462 MHz) - MIMO

	Radiated Output power measured at 3 meters (dBμV/m):	Conducted Output Power computed (1) (dBm)	Conducted Output Power measured (dBm)	Antenna Gain calculation (dBi)
Nominal supply voltage: 7.2Vdc	115.53	20.30	18.10	2.20

Polarization of test antenna: Vertical (height: 100 cm)

Position of equipment: Position 1 - (azimuth: 130 degrees)

(1) Conducted output power:

EIRP(dBm) = E (dBμV/m) + 20log(D) - 104.8; where D is the measurement distance in meters and antenna Gain = 0dBi (considered)

Results: RF2

Sample N° 1 RF2 - Low Channel (F = 2412 MHz) - MIMO

	Radiated Output power measured at 3 meters (dBμV/m):	Conducted Output Power computed (1) (dBm)	Conducted Output Power measured (dBm)	Antenna Gain calculation (dBi)
Nominal supply voltage: 7.2Vdc	119.78	24.55	21.77	2.78

Polarization of test antenna: Vertical (height: 150 cm)

Position of equipment: Position 2 (azimuth: 320 degrees for antenna 1 / 165 degrees for antenna 2)

(1) Conducted output power:

EIRP(dBm) = E (dBμV/m) + 20log(D) - 104.8; where D is the measurement distance in meters and antenna Gain = 0dBi (considered)

Sample N° 1 RF2 - Central Channel (F = 2437 MHz) - MIMO

	Radiated Output power measured at 3 meters (dBμV/m):	Conducted Output Power computed (1) (dBm)	Conducted Output Power measured (dBm)	Antenna Gain calculation (dBi)
Nominal supply voltage: 7.2Vdc	119.69	24.46	22.18	2.28

Polarization of test antenna: Vertical (height: 150 cm)

Position of equipment: Position 2 (azimuth: 320 degrees for antenna 1 / 165 degrees for antenna 2)

(1) Conducted output power:

EIRP(dBm) = E (dBμV/m) + 20log(D) - 104.8; where D is the measurement distance in meters and antenna Gain = 0dBi (considered)

Sample N° 1 RF2 - High Channel (F = 2462 MHz) - MIMO

	Radiated Output power measured at 3 meters (dBμV/m):	Conducted Output Power computed (1) (dBm)	Conducted Output Power measured (dBm)	Antenna Gain calculation (dBi)
Nominal supply voltage: 7.2Vdc	118.25	23.02	20.73	2.29

Polarization of test antenna: Vertical (height: 100 cm)

Position of equipment: Position 1 - (azimuth: 130 degrees)

(1) Conducted output power:

EIRP(dBm) = E (dBμV/m) + 20log(D) - 104.8; where D is the measurement distance in meters and antenna Gain = 0dBi (considered)

APPENDIX 1: Test equipment list**Antenna Gain Calculation**

TYPE	MANUFACTURER	EMITECH NUMBER
Anechoic Chamber	EMITECH	8593
Turntable controller 1060C	MATURO	14736
Satellite synchronized frequency standard GPS8	ACQUISYS	8896
Power sensor NRV-Z86	Rohde & Schwarz	11592
Spectrum Analyzer FSV40	Rohde & Schwarz	15666
		3544
Attenuator 10dB	Midwest Microwave	8548
Multimeter 177	Fluke	14831
Meteo station 608-H1	Testo	7566
Software	R&S Power Viewer Plus V13.1	///