

RF Exposure Testing of the

Occammd, LLC

LoRa Smart Gateway Card SG8001, SG8002

In accordance EN 62311 & AS/NZS 2772.2

Prepared for: Occammd, LLC
PO Box 172548
Tampa, FL 33672



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RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Authorized Signatory	Peter Walsh	2020 -February-14	
Testing	Thierry Jean-Charles	2020-February-14	

Signatures in this approval box have checked this document in line with the requirements of TÜV SÜD America, Inc. document control rules.

FCC Accreditation
Designation Number US1063 Tampa, FL Test Laboratory

Innovation, Science, and Economic Development Canada
Accreditation
Site Number 2087A-2 Tampa, FL Test Laboratory

EXECUTIVE SUMMARY

Samples of this product were tested and found to be in compliance with EN 62311 and AS/NZS 2772.2.

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TÜV SÜD America
5610 West Sligh Ave., Suite 100
Tampa, FL 33634

Phone: 813-284-2715
www.tuv-sud-america.com

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1 Report Summary

1.1 Report Modification Record

Alterations and additions to this report will be issued to the holders of each copy in the form of a complete document.

Issue	Description of Change	Date of Issue
1	First Issue	2020-February-14

1.2 Introduction

The information contained in this report is intended to show verification of the Occammd, LLC Model LoRa Smart Gateway Card SG8001, SG8002 to the requirements of EN 62311 and AS/NZS 2772.2.



Applicant	Occammd, LLC
Manufacturer	Occammd, LLC
Applicant's Email Address	mark.kelly@occamtechgroup.com
Model Number(s)	LoRa Smart Gateway Card SG8001, SG8002
Serial Number(s)	SG8461900001
Hardware Version(s)	0.6
Software Version(s)	2.06
Number of Samples Tested	1
Test Specification/Issue/Date	EN62311 January 2008. Assessment of electronic and electrical equipment related to human exposure restrictions for electromagnetic fields (0 Hz – 300 GHz) (IEC 62311:2007, modified) AS/NZS 2772.2:2011. Radiofrequency fields Part 2: Principles and methods of measurement and computation — 3 kHz to 300 GHz
Test Plan/Issue/Date	2019-June-11
Order Number	72151473
Date	2019-July-16
Date of Receipt of EUT	2019-November-18
Start of Test	2019-November-21
Finish of Test	2020-February-12
Name of Engineer(s)	Thierry Jean-Charles
Related Document(s)	ICNIRP Guidelines (Published in Health Physics 74 (4):494-522;1998) For Limiting Exposure To Time-Varying Electric, Magnetic And Electromagnetic Fields (Up To 300 Ghz) Council Recommendation of 12 July 1999 on the limitation of exposure of the general public to electromagnetic fields (0 Hz to 300 GHz)(1999/519/EC)



1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with EN 62311 is shown below. Principles and methods of measurement and computation used in this test report were also verified in accordance with AS/NZS 2772.2.

Table 1.3-1: Test Result Summary

Test Parameter	Test Plan (Yes/No)	Test Result	Comments/Base Standard	Test Report Page No
Generic Procedure for Assessment of Equipment	Yes	Pass		10
Exposure from Source with Multiple Frequencies	Yes	Pass	Council Recommendation of 12 July 1999 (1999/519/EC)	14



1.4 Product Information

1.4.1 Technical Description

The SG8001 and SG8002 are radio transceiver modules designed to operate in the 868 MHz European ISM band. The difference between the two models is just software for UART (SG8002) and USB (SG8001) host interface, respectively.

Radio Parameters:

Type of Radio Equipment:	668 MHz LoRa
Frequency Range:	863 MHz - 870 MHz
Antenna Type:	Dipole Antenna
Antenna Gain:	5 dBi
MIMO Type	1T1R
Input Power:	3.3 VDC
Maximum Conducted Output Power	11.04 dBm
Maximum Duty Cycle:	100%
Exposure Conditions:	General Public

A full description and detailed product specification details are available from the manufacturer.

Table 1.4.1-1 – Cable Descriptions

Cable/Port	Description
Power Leads	2m, Not Shielded, Power Supply to mPCIe adaptor
USB	1m, Not Shielded, mPCIe adaptor
Power Cord	2.2 m, Not Shielded, DC Power Supply to AC Mains

Table 1.4.1-2 – Support Equipment Descriptions

Make/Model	Description
Hewlett Packard / 6291A	DC Power Supply, SN: 1926A05628
	mPCIe Adaptor



Declaration of Build Status

EQUIPMENT DESCRIPTION			
Model Name/Number	LoRa Smart Gateway Card		
Part Number	SG8001; SG8002		
Hardware Version	0.6		
Software Version	2.06		
FCC ID (if applicable)	2ANX6-SG9001-2		
ISED ID (if applicable)	23319-SG90012		
Technical Description (Please provide a brief description of the intended use of the equipment)	The SG8001/8002 modules are radio transceiver modules designed to operate in the ISM band from 864 – 870 MHz.		
UN-INTENTIONAL RADIATOR			
Highest frequency generated or used in the device or on which the device operates or tunes	870 MHz		
Lowest frequency generated or used in the device or on which the device operates or tunes	863 MHz		
Class A Digital Device (Use in commercial, industrial or business environment) <input checked="" type="checkbox"/>			
Class B Digital Device (Use in residential environment only) <input type="checkbox"/>			
Power Source			
AC	Single Phase	Three Phase	Nominal Voltage
	<input type="checkbox"/>	<input type="checkbox"/>	
External DC	Nominal Voltage		Maximum Current
	3.3		200 mA
Battery	Nominal Voltage		Battery Operating End Point Voltage
EXTREME CONDITIONS			
Maximum temperature	+	°C	Minimum temperature - °C
Ancillaries			
Please list all ancillaries which will be used with the device.			
Antenna (Max gain 5 dBi)			

I hereby declare that the information supplied is correct and complete.

Name: Mark L Kelly *Mark L Kelly*

Position held: Senior Principal Engineer Date: February 13, 2020



1.4.2 Modes of Operation

The EUT supports the following modes of operation.
 LoRa 125 kHz, 250 kHz and 500 MHz as well as FSK (250 kbaud, 200 kHz deviation) modes.

The test power settings were the following:
 LoRa 125 kHz and 250 KHz: 13 dBm
 LoRa 500 kHz: 7 dBm
 FSK: 11 dBm

1.4.3 Monitoring of Performance

The EUT is evaluated for RX exposure using the maximum TX output power measured during the Effective Radiated Power (E.R.P.) measurements in accordance with EN 300 220-1.

1.4.4 Performance Criteria

The module is not co-located with any other radio equipment. The performance criteria is summarized below.

Table 1.4.4 -1: Performance Criteria

Parameter	Requirement
Generic Procedure for Assessment of Equipment	EN 62311 section 7.2
Exposure from Source with Multiple Frequencies	EN 62311 section 7.2

1.5 Deviations from the Standard

The measurements were performed without any deviation from the test standard.

1.6 EUT Modification Record

The table below details modifications made to the EUT during the test programme. The modifications incorporated during each test are recorded on the appropriate test pages.

Modification State	Description of Modification still fitted to EUT	Modification Fitted By	Date Modification Fitted

The equipment was tested as provided without any modifications.



1.7 Test Location

TÜV SÜD Product Service conducted the following tests at our Tampa FL Test Laboratory.

Test Name	Name of Engineer(s)	Accreditation
DC Powered Operating		
Generic Procedure for Assessment of Equipment	Thierry Jean-Charles	A2LA

Office Address:

TÜV SÜD America, Inc.
5610 W. Sligh Ave, Suite 100
Tampa, FL 33634
USA



2 Test Details

2.1 Generic Procedure for Assessment of Equipment

2.1.1 Specification Reference

EN 62311 Section 7.2

2.1.2 Equipment Under Test and Modification State

Model: SG8002, SN: SG8461900001

2.1.3 Date of Test

12/2/2019 to 2/12/2020

2.1.4 Test Method

EN 62311 Annex F

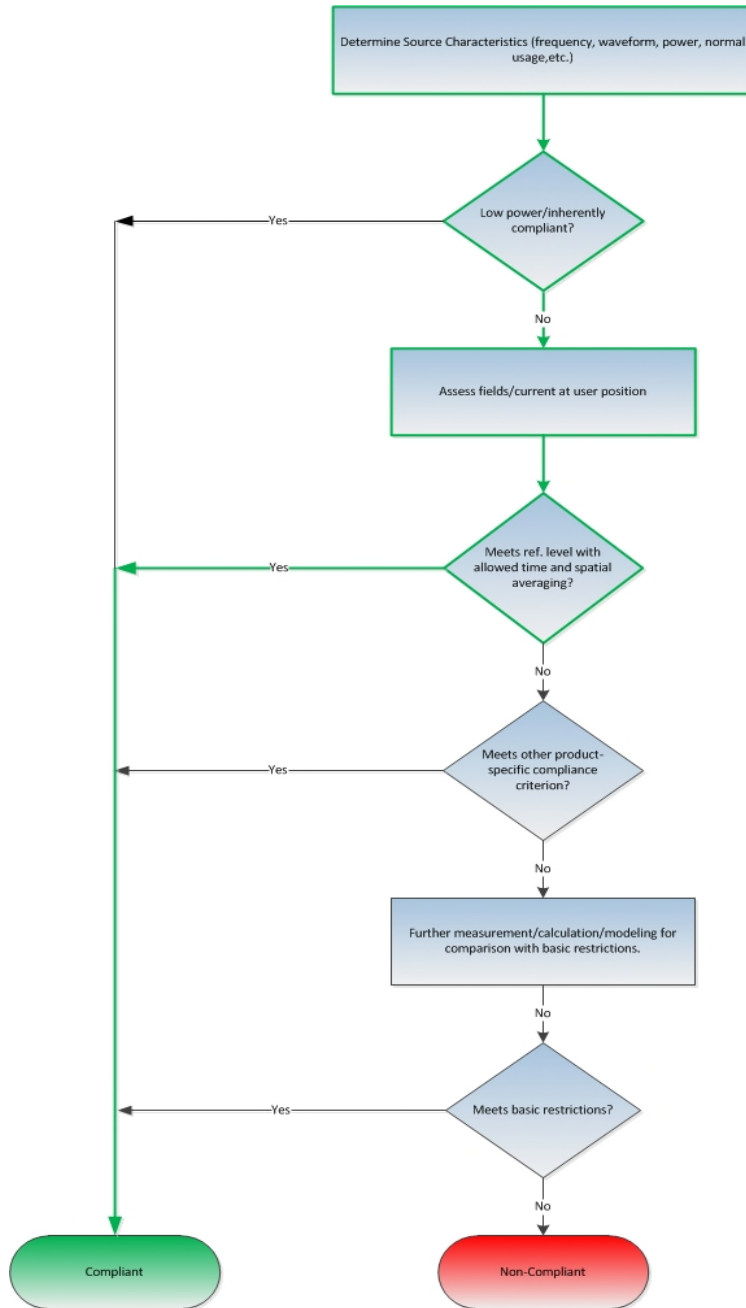
E and H measurement. Near of far field. Direct measurement for comparison with reference levels or as input for more detailed assessment.

2.1.5 Environmental Conditions

Ambient Temperature	25.7°C
Relative Humidity	42.5 %
Atmospheric Pressure	1013 mbar



2.1.6 Test Results





Compliance Assessment Method

The Far field calculation method was chosen for this device per EC Council Recommendation 1999/519/EC, Annex III Table 2

Table 2

Reference levels for electric, magnetic and electromagnetic fields
(0 Hz to 300 GHz, unperturbed rms values)

Frequency range	E-field strength (V/m)	H-field strength (A/m)	B-field (μT)	Equivalent plane wave power density S_{eq} (W/m ²)
0-1 Hz	—	$3,2 \times 10^4$	4×10^4	—
1-8 Hz	10 000	$3,2 \times 10^4/f^2$	$4 \times 10^4/f^2$	—
8-25 Hz	10 000	$4\,000/f$	$5\,000/f$	—
0,025-0,8 kHz	$250/f$	$4/f$	$5/f$	—
0,8-3 kHz	$250/f$	5	6,25	—
3-150 kHz	87	5	6,25	—
0,15-1 MHz	87	$0,73/f$	$0,92/f$	—
1-10 MHz	$87/f^{1/2}$	$0,73/f$	$0,92/f$	—
10-400 MHz	28	0,073	0,092	2
400-2 000 MHz	$1,375 f^{1/2}$	$0,0037 f^{1/2}$	$0,0046 f^{1/2}$	$f/200$
2-300 GHz	61	0,16	0,20	10

Notes:

1. f as indicated in the frequency range column.
2. For frequencies between 100 kHz and 10 GHz, S_{eq} , E^2 , H^2 , and B^2 are to be averaged over any six-minute period.
3. For frequencies exceeding 10 GHz, S_{eq} , E^2 , H^2 , and B^2 are to be averaged over any $68/f^{1.05}$ -minute period (f in GHz).
4. No E-field value is provided for frequencies < 1 Hz, which are effectively static electric fields. For most people the annoying perception of surface electric charges will not occur at field strengths less than 25 kV/m. Spark discharges causing stress or annoyance should be avoided.

Equation for predicting RF field is then used to determine the minimum distance that will comply with the requirements. The equation is from Section 8.3.2 of EN50383:2002. The model where the formula was derived is applicable in the far-field region and over-estimates in the radiating near-field region:



MPE Calculations

The Power Density (W/m²) is calculated as follows:

$$S = \frac{PG}{4\pi R^2}$$

Where:

S = power density (in appropriate units, e.g. W/m²)

P = power input to the antenna (in appropriate units, e.g., W)

G = power gain of the antenna in the direction of interest relative to an isotropic radiator

R = distance to the center of radiation of the antenna (appropriate units, e.g., m)

Radio Type: 868 MHz LoRa
 Antenna Gain: 5 dBi
 Number of TX Antennas: 1
 Maximum TX Output Power: 11.04 dBm
 Maximum EIRP: 16.04 dBm
 Minimum Distance: 20 centimeters

Note: The EUT is classified as multiple antennas, no beamforming per the equipment manufacturer.

Table 2.1.6-1: MPE Calculations

RF Exposure Calculations							
Transmit Frequency (MHz)	Radio Power (dBm)	Power Density Limit (W/m ²)	Radio Power (W)	Antenna Gain (dBi)	Antenna Gain (mW eq.)	Distance (m)	Power Density (W/m ²)
864	11.04	4.32	0.01	5	3.162	0.2	0.080

2.1.7 Test Location and Test Equipment Used

This test was carried out in TÜV SÜD America, Inc., 5610 W. Sligh Ave, Suite 100, Tampa, FL 33634, USA.

As this assessment consists solely of calculations, no test equipment was used.



2.2 Exposure from Sources with Multiple Frequencies

2.2.1 Specification Reference

EN 62311 Section 7.2
Council recommendation 1999/519/EC Annex IV

2.2.2 Equipment Under Test and Modification State

Model: SG8002, SN: SG8461900001

2.2.3 Date of Test

12/2/2019 to 2/12/2020

2.2.4 Test Method

EN 62311 Annex F

E and H measurement. Near of far field. Direct measurement for comparison with reference levels or as input for more detailed assessment.

When the evaluation has to account for simultaneous transmissions from co-located devices. Each individual transmitter is evaluated separately. The sum of the individual ratios of measured/calculated value to the basic restriction/reference level has to be < 1.

2.2.5 Environmental Conditions

Ambient Temperature	25.7°C
Relative Humidity	42.5 %
Atmospheric Pressure	1013 mbar

2.2.6 Test Results

Verification is based from power levels and declared antenna gains(for multi co-located transmitters type EUT) detailed in this test report

Equation for predicting RF field is then performed. The equation is from Section 8.3.2 of EN50383:2002. The model where the formula was derived is applicable in the far-field region and over-estimates in the radiating near-field region:

$$S = \frac{PG}{4\pi r^2}$$

Where: S=the power flux
P=input power of the antenna
G=antenna gain relative to an isotropic antenna
r=distance from the antenna to the point of investigation



Test Results: Not Applicable.

There are no conditions of simultaneous transmissions for the EUT. The Wi-Fi radio is the only operational radio in the new host configuration. The Bluetooth radio is disabled per the manufacturer.

2.2.7 Test Location and Test Equipment Used

Not Applicable

3 Photographs of Equipment

3.1 Equipment Under Test (EUT)



Figure 3.1-1: EUT Photo, Top View



Figure 3.1-2: EUT Photo, Bottom View



4 Accreditation, Disclaimers and Copyright

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