

July 31, 2020


Enlighted, Inc  
930 Benecia Ave.  
Sunnyvale, CA 94085

Dear Hariharan Muthukrishnan,

Enclosed is the EMC Wireless test report for compliance testing of the Enlighted, Inc, SU-5i as tested to the requirements of the FCC Certification rules under Title 47 of the CFR Part 1.1310 RF Exposure.

Thank you for using the services of Eurofins E&E North America. If you have any questions regarding these results or if MET can be of further service to you, please contact me.

Sincerely yours,  
EUROFINS E&E NORTH AMERICA



Michelle Tawmging  
Documentation Department

Reference: (\\Enlighted, Inc\\WIRS107425-FCC-MPE Rev 1)



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**Electromagnetic Compatibility Criteria  
Test Report**

for the

**Enlighted, Inc  
SU-5i**

**Tested under  
FCC Certification Rules  
Title 47 of the CFR, Part 1 1.1310**

**Report: WIRS107425-FCC-MPE Rev. 1**

July 31, 2020

**Prepared For:**

**Enlighted, Inc  
930 Benecia Ave.  
Sunnyvale, CA 94085**

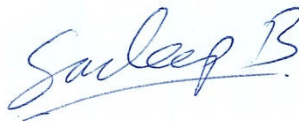
**Prepared By:  
Eurofins E&E North America  
3162 Belick St.  
Santa Clara, CA 95054**

**Electromagnetic Compatibility Criteria  
Test Report**

for the

**Enlighted, Inc  
SU-5i****Tested Under****FCC Certification Rules  
Title 47 of the CFR, Part 1 1.1310**Arsalan Hasan  
Project Engineer, Electromagnetic Compatibility Lab

**Engineering Statement:** The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of Part 1 of the FCC Rules under normal use and maintenance.

Sandeep Brar,  
Manager, Electromagnetic Compatibility Lab

## Report Status Sheet

Revision	Report Date	Reason for Revision
∅	July 26, 2020	Initial Issue.
1	July 31, 2020	TCB Updates.

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## List of Terms and Abbreviations

AC	Alternating Current
ACF	Antenna Correction Factor
Cal	Calibration
<i>d</i>	Measurement Distance
dB	Decibels
dB $\mu$ A	Decibels above one <b>microamp</b>
dB $\mu$ V	Decibels above one <b>microvolt</b>
dB $\mu$ A/m	Decibels above one <b>microamp per meter</b>
dB $\mu$ V/m	Decibels above one <b>microvolt per meter</b>
DC	Direct Current
E	Electric Field
DSL	Digital Subscriber Line
ESD	Electrostatic Discharge
EUT	Equipment Under Test
<i>f</i>	Frequency
FCC	Federal Communications Commission
GRP	Ground Reference Plane
H	Magnetic Field
HCP	Horizontal Coupling Plane
Hz	Hertz
IEC	International Electrotechnical Commission
kHz	kilohertz
kPa	kilopascal
kV	kilovolt
LISN	Line Impedance Stabilization Network
MHz	Megahertz
$\mu$ H	microhenry
$\mu$	microfarad
$\mu$ s	microseconds
NEBS	Network Equipment-Building System
PRF	Pulse Repetition Frequency
RF	Radio Frequency
RMS	Root-Mean-Square
TWT	Traveling Wave Tube
V/m	Volts <b>per meter</b>
VCP	Vertical Coupling Plane

# I. Executive Summary

**A. Purpose of Test**

An EMC evaluation was performed to determine compliance of the Enlighted, Inc SU-5i, with the requirements of Part 1. All references are to the most current version of Title 47 of the Code of Federal Regulations in effect. In accordance with §2.1033, the following data is presented in support of the Certification of the Enlighted, Inc SU-5i. Enlighted, Inc. should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the Enlighted, Inc SU-5i, has been **permanently** discontinued.

**B. Executive Summary**

The following tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 1, in accordance with Enlighted, Inc, purchase order number MOB2012-1.

Reference	Description	Compliance
§1.1310	RF Exposure	Compliant

**Table 1. Executive Summary of EMC Compliance Testing**



## II. Equipment Configuration

## A. Overview

Eurofins E&E North America was contracted by Enlighted, Inc. to perform testing on the Enlighted Inc SU-5i, under Enlighted, Inc. 's purchase order number MOB2012-1.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Enlighted, Inc. , Enlighted SU-5i.

The results obtained relate only to the item(s) tested.

Model(s) Tested:	<b>SU-5i</b>		
Model(s) Covered:	<b>SU-5i</b>		
EUT Specifications:	<b>Primary Power: 5 VDC</b>		
	<b>FCC ID: AQQ-SU5I</b>		
	Type of Modulations:	GFSK	
	Equipment Code:	DTS	
	Technology	Frequency Ranges	Peak RF Output Power
	BLE	2402 – 2480 MHz	4.038 dBm
	ZigBee	2405 – 2480 MHz	4.282 dBm
<b>Analysis:</b>	The results obtained relate only to the item(s) tested.		
<b>Environmental Test Conditions:</b>	Temperature: 15-35° C		
	Relative Humidity: 30-60%		
	Barometric Pressure: 860-1060 mbar		
<b>Evaluated by:</b>	Arsalan Hasan		
<b>Report Date(s):</b>	July 31, 2020		

**Table 1: EUT Summary Table**

## B. References

CFR 47, Part 15, Subpart C	Federal Communication Commission, Code of Federal Regulations, Title 47, Part 15: General Rules and Regulations, Allocation, Assignment, and Use of Radio Frequencies
ANSI C63.4:2014	Methods and Measurements of Radio-Noise Emissions from Low-Voltage Electrical And Electronic Equipment in the Range of 9 kHz to 40 GHz
ISO/IEC 17025:2005	General Requirements for the Competence of Testing and Calibration Laboratories
ANSI C63.10-2013	American National Standard for Testing Unlicensed Wireless Devices

**Table 3: References**

## C. Test Site

All testing was performed at Eurofins MET Labs, 3162 Belick St., Santa Clara, CA 95054. All equipment used in making physical determinations is accurate and bears recent traceability to the National Institute of Standards and Technology.

Eurofins MET Labs is a ISO/IEC 17025 accredited site by A2LA, California #0591.02.

## D. Measurement Uncertainty

Test Method	Typical Expanded Uncertainty	K	Confidence Level
RF Frequencies	±4.52 Hz	2	95%
RF Power Conducted Emissions	±2.32 dB	2	95%
RF Power Conducted Spurious Emissions	±2.25 dB	2	95%
RF Power Radiated Emissions	±3.01 dB	2	95%

**Table 4. Measurement Uncertainty**

### E. Description of Test Sample

The Enlighted, Inc SU-5i, Equipment Under Test (EUT), is a desk occupancy sensor placed under each open-office workspace detects when the desk is in use, providing real-time desk availability information. It has an embedded BLE radio that transmits and receives beacons. It has an 802.15.4 radio that works with secured Enlighted wireless network with AES-128 encryption delivering secure, reliable communication by sensing low-traffic channels and transmitting in bursts. It has a digital Passive Infrared (PIR) sensor that supports precise motion identification while minimizing false detection events

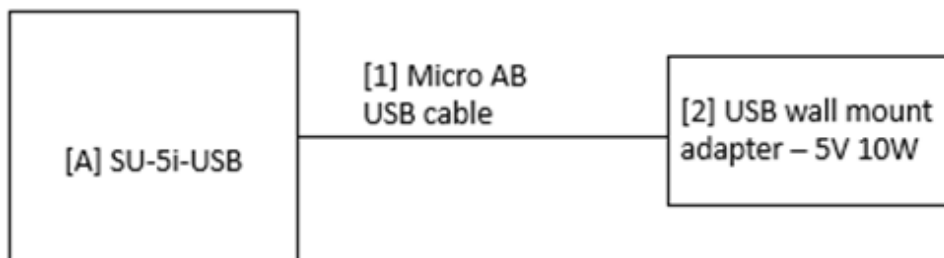


Figure 1: Block Diagram of Test Configuration

### F. Equipment Configuration

The EUT was set up as outlined in Figure , Block Diagram of Test Setup. All cards, racks, etc., incorporated as part of the EUT is included in the following list.

Ref. ID	Slot #	Name / Description	Model Number	Part Number	Serial Number	Rev. #
A		Desk sensor	SU-5i-USB			

Table 5: Equipment Configuration

### G. Support Equipment

Support equipment necessary for the operation and testing of the EUT is included in the following list.

Ref. ID	Name / Description	Manufacturer	Model Number	*Customer Supplied Calibration Data
	Laptop	Dell	Latitude 7480	NA

Table 6: Support Equipment

### H. Ports and Cabling Information

Ref. ID	Port name on EUT	Cable Description or reason for no cable	Qty	Length as tested (m)	Max Length (m)	Shielded? (Y/N)	Termination Box ID & Port Name
1	USB	Micro USB A B type	1				
2	supply	USB Wall mount adapter	1				

Table 7: Ports and Cabling Information

## **I. Mode of Operation During Testing**

Continuous transmit mode – Specific commands can be sent to the device using which we select the radio to transmit (BLE or 802.15.4), select the channel and power level at which the radio transmits. This will be the worst case condition.

Modulated signal mode – For specific test cases that involves to set the device to transmit in modulated signal, test commands have been provided that can be sent to put the radio (BLE or 15.4) in the respective modulated signal mode.

Normal operating mode – In normal circumstances the device will detect motion and transmit the information to other Enlighted sensors and Enlighted Gateway through 802.15.4. It will send BLE beaconing to other Enlighted sensors and Enlighted Room Control (wall switch) to listen for commands. The 15.4 and BLE beaconing transmissions lasts for not more than 50ms for every burst.

## **J. Method of Monitoring EUT Operation**

The only way to check if the device is functioning will be to see if the device is still connected to the test laptop that is used for sending commands to set the device in a specific test condition. The LEDs will not show any indication.

## **K. Modifications**

### **a) Modifications to EUT**

No modifications were made to the EUT.

### **b) Modifications to Test Standard**

No modifications were made to the test standard.

## **L. Disposition of EUT**

The test sample including all support equipment submitted to the Electro-Magnetic Compatibility Lab for testing was returned to Enlighted, Inc upon completion of testing.

### **III. Electromagnetic Compatibility Criteria for Intentional Radiators**

## Maximum Permissible Exposure

**RF Exposure Requirements:** §1.1307(b)(1) and §1.1307(b)(2): Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission’s guidelines.

**RF Radiation Exposure Limit:** §1.1310: As specified in this section, the Maximum Permissible Exposure (MPE) Limit shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in Sec. 1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of Sec. 2.1093 of this chapter.

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm <sup>2</sup> )	Averaging time (minutes)
<b>(i) Limits for Occupational/Controlled Exposure</b>				
0.3-3.0	614	1.63	*(100)	≤6
3.0-30	1842/f	4.89/f	*(900/f <sup>2</sup> )	<6
30-300	61.4	0.163	1.0	<6
300-1,500			f/300	<6
1,500-100,000			5	<6
<b>(ii) Limits for General Population/Uncontrolled Exposure</b>				
0.3-1.34	614	1.63	*(100)	<30
1.34-30	824/f	2.19/f	*(180/f <sup>2</sup> )	<30
30-300	27.5	0.073	0.2	<30
300-1,500			f/1500	<30
1,500-100,000			1.0	<30

**Table 7. RF Exposure Limits**

$$S = PG / 4\pi R^2 \quad \text{or} \quad R = \sqrt{PG / 4\pi S}$$

where, S = Power Density (mW/cm<sup>2</sup>)  
P = Power Input to antenna (mW)  
G = Antenna Gain (numeric value)  
R = Distance (cm)

For Antenna Gain → dBi = 10log(Numeric)

**Test Results - BLE:**

Band	Frequency (MHz)	Conducted Power (dBm)	Tune-Up Power (dBm)	Conducted Power (mW)	Antenna Gain (dBi)	Antenna Gain (Numeric)	Power Density (mW/cm2)	Limit (mW/cm2)	Margin	Distance (cm)	Result
BLE	2402	4.038	5.038	3.19	2.4	1.737	0.0011	1	-0.998	20	Pass

**Table 8. MPE Calculation for BLE under FCC Part 1**

Tune-up power: ±1dB

The safe distance where Power Density is less than the MPE limit listed above was found to be 20 cm.

**Test Results - ZigBee:**

Band	Frequency (MHz)	Conducted Power (dBm)	Tune-Up Power (dBm)	Conducted Power (mW)	Antenna Gain (dBi)	Antenna Gain (Numeric)	Power Density (mW/cm2)	Limit (mW/cm2)	Margin	Distance (cm)	Result
ZigBee	2405	4.282	5.282	3.37	4.5	2.818	0.0018	1	-0.998	20	Pass

**Table 9. MPE Calculation for BLE under FCC Part 1**

Tune-up power: ±1dB

The safe distance where Power Density is less than the MPE limit listed above was found to be 20 cm.

**Note: Results are based on KDB 447498 D01 (Section 7.2) Transmitters used in mobile devices exposure conditions for simultaneous transmission operations.**

Simultaneous transmission MPE test exclusion applies when the sum of the MPE ratios for all simultaneously transmitting antennas incorporated in a host device is ≤ 1.0, according to calculated/estimated, numerically modeled, or measured field strengths or power density. The MPE ratio of each antenna is determined at the minimum test separation distance required by the operating configurations and exposure conditions of the host device, according to the ratio of field strengths or power density to the MPE limit at the test frequency.

Both BLE and ZigBee can transmit simultaneously, the formula for calculating the simultaneous MPE is

$$CPD1/LPD1 + CPD2/LPD2 + \dots, CPDn/LPDn < 1$$

CPD: Calculated Power Density

LPD: Limit of Power Density

Therefore worst case scenario is as below:

$$\begin{aligned} \text{Simultaneous MPE} &= 0.0011/1 + 0.0018/1 \\ &= 0.0011 + 0.0018 \\ &= 0.0029 \end{aligned}$$

**Result:** 0.0029 < 1 (Pass)



## IV. Test Equipment

## Test Equipment

Calibrated test equipment utilized during testing was maintained in a current state of calibration per the requirements of ISO/IEC 17025:2017.

Asset #	Equipment	Manufacturer	Model	Last Cal Date	Cal Due Date
1S4075	RADIO COMMUNICATION TESTER	ROHDE & SCHWARZ	CMW500	09/18/2018	09/18/2020
1S2399	TURNTABLE/MAST CONTROLLER	SUNOL SCIENCES	SC99V	SEE NOTE 1	
1S2600	BILOG ANTENNA	TESEQ	CBL6112D	03/19/2019	03/19/2021
1S3826	DRG HORN ANTENNA	ETS-LINDGREN	3117	12/03/2018	12/03/2020
1S2000	SPECTRUM ANALYZER	AGILENT	E4448A	11/06/2019	11/06/2020
1S2587	PRE AMPLIFIER	AML COMMUNICATIONS	AML0126L3801	SEE NOTE 1	
1S2653	AMPLIFIER	SONOMA INSTRUMENT	310 N	SEE NOTE 1	
1S2486	5 METER CHAMBER	PANASHIELD - ETS	5M	SEE NOTE 2	
1S3824	SIGNAL GENERATOR	ROHDE & SCHWARZ	SMA100B	11/06/2019	05/06/2021

**Table 10. Test Equipment List**

Note 1: Functionally tested equipment is verified using calibrated instrumentation at the time of testing.

Note 2: Latest NSA and VSWR data available upon request.

**End of Report**