EMT **ELECTRO MAGNETIC TEST, INC.**
1547 Plymouth Street, Mountain View, CA 94043 Tel: (650) 965-4000 Fax: (650) 965-3000

FCC PART 15.247, SUBPART C
IC RSS-247
TEST REPORT

for

the

Sensor

Model: SU-5F-2W

Prepared for

Enlighted Inc.
930 Benecia Avenue
Sunnyvale, CA 94085

Prepared by: _____
Andreas Davidsson

Approved by: _____
Kevin Bothmann

Electro Magnetic Test, Inc.
1547 Plymouth Street
Mountain View, California 94043
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Date: November 1, 2019

	REPORT BODY	APPENDICES				TOTAL
		A	*B*	*C*	*D*	
PAGES	26	37	3	2	3	**71**

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REVISION HISTORY

REVISION	DATE	COMMENTS	MODIFIED BY
1.0	November 1, 2019	Original Document	-
2.0	January 8, 2019	Updated document following comments from TCB	AD
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TABLE OF CONTENTS

SECTION	TITLE	PAGE
REVISION HISTORY		2
GENERAL REPORT SUMMARY		5
SUMMARY OF TEST RESULTS		6
TECHNICAL DESCRIPTION OF THE EUT		7
1.	PURPOSE	8
2.	ADMINISTRATIVE DATA	9
2.1	Location of Testing	9
2.2	Traceability Statement	9
2.3	Cognizant Personnel	9
2.4	Date Test Sample was Received	9
2.5	Disposition of the Test Sample	9
3.	APPLICABLE DOCUMENTS	10
4.	DESCRIPTION OF TEST CONFIGURATION	11
4.1	Description of Test Configuration - EMI	11
4.1.1	Cable Construction and Termination	12
5.	LISTS OF EUT, ACCESSORIES AND TEST EQUIPMENT	13
5.1	EUT and Accessory List	13
5.2	EMI Test Equipment	14
6.	TEST SITE DESCRIPTION	16
6.1	Test Facility Description	16
6.2	EUT Mounting, Bonding and Grounding	16
6.3	Facility Environmental Characteristics	16
7.	TEST PROCEDURES	17
7.1	Emissions in Restricted and Non-Restricted Bands	17
7.1.3	Test Procedure (Radiated)	19
7.1.4	Test Procedure (Conducted)	20
7.2	Conducted Emissions Test – Mains Ports	21
7.2.1	Limit (FCC PART 15 Section 15.207(a), IC RSS-GEN Issue 5 [8.8])	21
7.2.2	Test Procedure	21
7.3	Occupied Bandwidth	22
7.3.1	Limit (FCC PART 15 Section 15.247(a)(2), IC-RSS 247 Issue 2, [5.2.1])	22
7.3.2	Test Procedure	22
7.3.3	Test Result	22
7.4	Maximum Peak Output Power	23
7.4.1	Limit (FCC PART 15 Section 15.247(b)(3), IC-RSS 247 Issue 2, [5.4.4])	23
7.4.2	Test Procedure	23
7.4.3	Test Result	23
7.5	Maximum Peak Power Spectral Density	24
7.5.1	Limit (FCC PART 15 Section 15.247(e), IC-RSS 247 Issue 2, [5.2.2])	24
7.5.2	Test Procedure	24
7.5.3	Test Result	24
7.6	Antenna Requirement	25
7.6.1	Requirement (FCC PART 15 SECTION 15.203,15.247(b)(4))	25
7.6.2	Test Result	25
8.	CONCLUSIONS / COMPLIANCE STATEMENT	26
APPENDIX A		1
APPENDIX B		1
APPENDIX C		1
APPENDIX D		1

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LIST OF APPENDICES

APPENDIX	TITLE
A	Radiated and Conducted Data Sheets • Radiated Emissions Test Data (General Requirements, and Restricted Bands) • Emissions in Non-Restricted Frequency Bands Test Data • Occupied Bandwidth Test Data • Maximum Peak Output Power Test Data • Maximum Peak Power Spectral Density Test Data
B	Test Setup Diagrams
C	Modifications To The EUT
D	Additional Models Covered Under This Report

LIST OF FIGURES

FIGURE	TITLE
1	Conducted Emissions Test Setup
2	Plot Map And Layout of Test Site
3	Layout of 5 Meter Semi-Anechoic Chamber

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GENERAL REPORT SUMMARY

This electromagnetic emission test report is generated by Electro Magnetic Test, Inc., which is an independent testing and consulting firm. The test report is based on testing performed Electro Magnetic Test, Inc. personnel according to the measurement procedure described in the test specification given below and in the "Test Procedures" section of this report.

The measurement data and conclusions appearing herein relate only to the sample tested and this report may not be reproduced in any form unless done so in full.

This report must not be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the U.S. Federal Government.

The measurement data and conclusions contained in this test report are deemed satisfactory evidence of compliance with Industry Canada Interference-Causing Equipment Standard ICES-003, Issue 6, January 2016.

Electro Magnetic Test, Inc. is recognized by the following agencies for performing EMI/EMC testing:

COUNTRY	AGENCY	IDENTIFYING #
USA	Federal Communications Commission (FCC) (EMT's test site is recognized by the FCC)	Registration Number: 90576
USA, Canada, Taiwan, Australia/New Zealand, European Community	National Voluntary Lab Accreditation Program (NVLAP) (EMT is accredited by NVLAP. A copy of the NVLAP Scope Of Accreditation is available upon request.)	Lab Code: 200147-0
Canada	Industry Canada	File No.: IC 2804
Japan	Voluntary Control Council For Interference (VCCI)	A-0118
	Open Field Test Site "A"	-
	Mains Conducted Emissions Test Site "D"	-
	Telecom Conducted Emissions Test Site "D"	-
	3 Meter Semi-Anechoic Chamber Site "E"	-
	3 Meter Semi-Anechoic Chamber Site "E" (1GHz – 6GHz)	-
	Mains Conducted Emissions Test Site "E"	-
	Telecom Conducted Emissions Test Site "E"	-
Korea	Ministry of Information and Communication's Radio Research Laboratory (RRL) under the Asia Pacific Economic Cooperation (APEC) Mutual Recognition Arrangement (A copy of the Scope Of Accreditation is available upon request)	US0036
Taiwan	Bureau Of Standards, Metrology and Inspection (BSMI)	Reference Number: SL2-IN-E-1024
Australia / New Zealand	Australian Communications Authority (AUSTEL)	*

*These agencies do not issue an identifying number to test labs.

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GENERAL REPORT SUMMARY (CONTINUED)

Device Tested:	Sensor Model: SU-5F-2W S/N: N/A
Product Description:	The Smart Sensor, is a ceiling-installed sensor that simultaneously monitors temperature, light, IR and power.
Modifications:	The EUT was not modified during the testing.
Manufacturer:	Enlighted Inc. 930 Benecia Avenue Sunnyvale, CA 94085
Test Date(s):	October 7, 10, 2019
Test Specifications:	EMI requirements Limits: CISPR 22: 1997 plus A1:2000 & A2:2002 Class A FCC Title 47, Part 15 Subpart B, Class A Test Procedure: ANSI C63.10-2013
Test Deviations:	The test procedure was not deviated from during the testing.

SUMMARY OF TEST RESULTS

TEST	DESCRIPTION	FCC STANDARD	IC STANDARD	RESULTS
7.1	Emissions in Restricted and Non-Restricted Bands	15.209, 15.247, 15.247(d)	RSS-GEN Issue 5, [8.9] RSS 247 Issue 2, [5.5]:	**PASS**
7.2	Conducted Emissions	15.207(a)	RSS-GEN Issue 5 [8.8]	**PASS**
7.3	Occupied Bandwidth	15.247(a)(2)	RSS 247 Issue 2, [5.2.1, 6.2.4.1]	**PASS**
7.4	Maximum Peak Output Power	15.247 (b)	RSS 247 Issue 2, [5.4.4]	**PASS**
7.5	Maximum Peak Power Spectral Density	15.247(e)	RSS 247 Issue 2, [5.2.2]	**PASS**
7.6	Antenna Requirement	15.203,15.247(b)(4))	N/A	**PASS**

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TECHNICAL DESCRIPTION OF THE EUT

Manufacturer:	Enlighted Inc.
Manufacturer Address:	930 Benecia Avenue
EUT Name:	Sensor
Model No:	Model: SU-5F-2W
Operation frequency:	2400MHz to 2483.5MHz
Channel Number:	40 / 16
Modulation Technology:	DTS
Antenna Type:	Whisker (For Zigbee) / PCB Trace (For BLE)
Antenna Gain:	2 dBi (For Zigbee) / 3.2 dBi (For BLE)
Maximum Output Power:	1.38 dBm (Radiated Measurement)

Description of Channel:

Bluetooth LE

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	10	2422	20	2442	30	2462
1	2404	11	2424	21	2444	31	2464
2	2406	12	2426	22	2446	32	2466
3	2408	13	2428	23	2448	33	2468
4	2410	14	2430	24	2450	34	2470
5	2412	15	2432	25	2452	35	2472
6	2414	16	2434	26	2454	36	2474
7	2416	17	2436	27	2456	37	2476
8	2418	18	2438	28	2458	38	2478
9	2420	19	2440	29	2460	39	2480

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Zigbee (IEEE 802.15.4)							
Channel	**Frequency (MHz)**	**Channel**	**Frequency (MHz)**	**Channel**	**Frequency (MHz)**	**Channel**	**Frequency (MHz)**
11	2405	15	2425	19	2445	23	2465
12	2410	16	2430	20	2450	24	2470
13	2415	17	2435	21	2455	25	2475
14	2420	18	2440	22	2460	26	2480

1. PURPOSE

This document is a qualification test report based on the Electromagnetic Interference (EMI) tests performed on the Sensor Model: SU-5F-2W. The EMI measurements were performed according to the measurement procedure described in ANSI C63.10-2013. The tests were performed in order to determine whether the electromagnetic emissions from the equipment under test, referred to as EUT hereafter, are within the specification limits defined in FCC Title 47, Part 15, Subpart C and IC RSS 247, Issue 2.

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2. ADMINISTRATIVE DATA

2.1 Location of Testing

The EMI tests described herein were performed at the test facility of Electro Magnetic Test, Inc., 1547 Plymouth Street, Mountain View, California, 94043.

2.2 Traceability Statement

The calibration certificates of all test equipment used during the test are on file at the location of the test. The measurement results in this report and the calibration of the test equipment are traceable to the National Institute of Standards and Technology (NIST).

2.3 Cognizant Personnel

Enlighted Inc.

Hariharan Muthukrishnan	RF Antenna Systems Engineer

Electro Magnetic Test, Inc.

Andreas Davidsson	Test Technician
Chinmay Shendurnikar	Test Technician
David Vivanco	Test Technician
Simeet Gandhi	Test Technician
Manan Modi	Test Technician
Kevin Bothmann	Lab Manager

2.4 Date Test Sample was Received

The test sample was received on October 7, 2019.

2.5 Disposition of the Test Sample

The test sample has not yet been returned to Enlighted Inc.

.2.6 Abbreviations and Acronyms

The following abbreviations and acronyms may be used in this document.

RF	Radio Frequency
EMI	Electromagnetic Interference
EUT	Equipment Under Test
P/N	Part Number
S/N	Serial Number
HP	Hewlett Packard
ITE	Information Technology Equipment
CML	Corrected Meter Limit
LISN	Line Impedance Stabilization Network
CISPR	International Special Committee On Radio Interference
FCC	Federal Communications Commission

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3. APPLICABLE DOCUMENTS

The following documents are referenced or used in the preparation of this EMI Test Report.

SPEC	TITLE
RSS-Gen Issue 5, March 2019	General Requirements for Compliance of Radio Apparatus
RSS 247, Issue 2, February 2017	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
FCC Title 47, Part 15, Subpart C	FCC Rules - Radio frequency devices (including digital devices).
FCC Publication KDB558074	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, August 24, 2018
ANSI C63.10-2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

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4. DESCRIPTION OF TEST CONFIGURATION

4.1 Description of Test Configuration - EMI

The Sensor Unit was connected to the power supply through its DC power lines. During testing the Bluetooth and the Zigbee radio were continuously transmitting. The unit was tested in three configurations, flat, horizontally aligned, and vertically aligned, it was found that the worst case configuration for spurious and intentional emissions was when it was placed flat.

It was determined that the emissions were at their highest level when the EUT was operating in the above configuration. The cables were moved to maximize the emissions. The final conducted as well as radiated data was taken in this mode of operation. All initial investigations were performed with the EMI receiver in manual mode scanning the frequency range continuously.

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4.1.1 Cable Construction and Termination

Cable #1

This is a 5 foot, 5 inch unshielded power cable connecting the EUT to the power supply. It is hardwired into the EUT and the power supply.

Cable #2

This is a 6 foot unshielded power cable connecting the power supply to the AC outlet. It is hardwired into the power supply and has a 5-15p connector on the AC outlet end.

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5. LISTS OF EUT, ACCESSORIES AND TEST EQUIPMENT

5.1 EUT and Accessory List

EQUIPMENT TYPE	MANUFACTURER	MODEL	SERIAL NUMBER	FCC ID
Sensor (EUT)	Enlighted Inc.	SU-5F-2W	N/A	AQQ-SU5F
Power Adapter	Recom	RELV4-16	N/A	DOC
THE FOLLOWING WERE LOCATED OUTSIDE THE TEST SITE:				
Remote Laptop	DELL	Latitude E5450	JWMC252	DOC
Remote Laptop Adapter	DELL	LA65NM130	4A9-4402-A01	DOC

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5.2 EMI Test Equipment

EQUIPMENT TYPE	MANU-FACTURER	MODEL NUMBER	SERIAL NUMBER	CAL. DATE	CAL. CYCLE
EMI Receiver	Rohde & Schwarz	ESU40	100295	February 15, 2019	1 Year
Radiated EMI Software	Sector Design	N/A	Ver.1.4.6	N/A	N/A
EMI Receiver (Conducted EMI)	Rohde & Schwarz	ESU40	100295	February 15, 2019	1 Year
Conducted EMI Software	ETS-Lindgren	Tile!	Rev. 7.2.10.12	N/A	N/A
RF Attenuator	Com-Power	LIT-153A	531175	December 15, 2018	1 Year
LISN	Solar Electronics	Type 21107-50-TS-50-N	21107150701	January 2, 2019	1 Year
LISN	Solar Electronics	Type 21107-50-TS-50-N	21107150702	January 2, 2019	1 Year
LISN	Solar Electronics	Type 21107-50-TS-50-N	21107150703	January 2, 2019	1 Year
LISN	Solar Electronics	Type 21107-50-TS-50-N	21107150704	January 2, 2019	1 Year
TLISN (CAT5)	Fischer	F-071115-1057-1-09	091407	October 31 2019	1 Year
LCL Adaptor	Fischer	T8ALCL-1	091407.02	October 31 2019	1 Year
Biconical Antenna	Com Power	AB-100	01557	July 20, 2019	1 Year
Log Periodic Antenna	Com Power	AL-100	16001	August 9, 2019	1 Year
Antenna Mast	Com Power	AM-400	N/A	N/A	N/A
Turntable	Com Power	TT-100	N/A	N/A	N/A
Preamplifier	Hewlett Packard	8447D	1937A02579	March 5, 2019	1 Year
Computer	Dell, Inc.	DHS	DNSV641	N/A	N/A
Printer	Hewlett Packard	C8124A	CN39A220ZD	N/A	N/A

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5.2 EMI Test Equipment (Continued)

EQUIPMENT TYPE	MANU-FACTURER	MODEL NUMBER	SERIAL NUMBER	CAL. DATE	CAL. CYCLE
EMI Receiver	Rohde & Schwarz	ESU40	100127	February 2, 2019	1 Year
EMI Test Software	Rohde & Schwarz	EMC32	V8.54.0	N/A	N/A
BiConiLog Antenna	ETS-Lindgren	3143B	00206757	August 28, 2019	1 Year
Horn Antenna	ETS-Lindgren	3117	00109294	September 18, 2019	1 Year
Preamplifier	Rohde & Schwarz	TS-PR18	100056	December 12, 2018	1 Year
Antenna Mast	ETS-Lindgren	2171B	00150364	N/A	N/A
Turntable	ETS-Lindgren	2187-3.0	00118231	N/A	N/A
Computer	Dell, Inc.	Optiplex 745	4T50WC1	N/A	N/A
Multi-Function Controller	ETS-Lindgren	2090	00102270	N/A	N/A

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6. TEST SITE DESCRIPTION

6.1 Test Facility Description

Please refer to the table below and section 7.1 of this report for the details of which sites were used for testing. All sites are located at 1547 Plymouth Street, Mountain View, California 94043.

Site Used For Test	Site Description
	Open Field Test Site "A"
	Mains Conducted Emissions Test Site "D"
	Telecom Conducted Emissions Test Site "D"
X	3 Meter Semi-Anechoic Chamber Site "E"
X	Mains Conducted Emissions Test Site "E"
	Telecom Conducted Emissions Test Site "E"

6.2 EUT Mounting, Bonding and Grounding

The EUT was mounted on a 1.0 by 1.5 meter non-conductive table 0.8 meters above the ground plane for all tests.

The EUT was grounded only through the safety ground in the power supply's power cable.

6.3 Facility Environmental Characteristics

All tests were performed in a climate controlled building. The temperature was 22° C, humidity 45%, and barometric pressure 101.6 kPa.

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7. TEST PROCEDURES

The following sections describe the test methods and the specifications for the tests.

7.1 Emissions in Restricted and Non-Restricted Bands

7.1.1 General Requirements Limit (FCC PART 15 Section 15.209(a)(1), IC-RSS-GEN Issue 5, [8.9])

Frequency of Emission (MHz)	Field Strength			Measurement Distance (Meters)
	µV/m	dBµV/m	(µA/m)	
0.009-0.49	2400/F(kHz)		6.37/F(kHz)	300
0.49-1.705	24000/F(kHz)		63.7/F(kHz)	30
1.705-30	30		0.08	30
30-88	100	40		3
88-216	150	43.5		3
216-960	200	46		3
Above 960	500	54		3

7.1.2 Emissions in Restricted and Non-Restricted Bands Limit (FCC PART 15 Section 15.247(d), IC RSS-GEN Issue 5, [8.10], IC-RSS 247 Issue 2, [5.5])

Emissions in Restricted and Non-Restricted Bands FCC PART 15 Section 15.247(d):

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

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7.1.2 Emissions in Restricted and Non-Restricted Bands Limit (FCC PART 15 Section 15.247(d), IC-RSS-GEN Issue 5, [8.10], IC-RSS 247 Issue 2, [5.5]) (Continued

Emissions in Restricted Bands IC-RSS-GEN Issue 5, [8.10]:

Restricted bands, identified in Table 6, are designated primarily for safety-of-life services (distress calling and certain aeronautical bands), certain satellite downlinks, radio astronomy and some government uses. Except where otherwise indicated, the following restrictions apply:

(a) Fundamental components of modulation of licence-exempt radio apparatus shall not fall within the resctricted bands of Table 6 except for apparatus complying under RSS-287
(b) Unwanted emissions that fall into restricted bands of Table 6 shall comply with the limits specified in RSS-Gen; and
(c) Unwanted emissions that do not fall within the restricted frequency bands of Table 6 shall comply either with the limits specified in the applicable RSS or with those specified in this RSS-Gen.

Limit (For Restricted Bands)
See General Limits Requirement In Above Chart (Section 7.1.1)

Emissions in Non-Restricted Bands IC-RSS 247 Issue 2, [5.5]:

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

Limit (For Non Restricted Bands)
20db Below Peak Power Spectral Density
30db Below Average Power Spectral Density

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7.1.3 Test Procedure (Radiated)

The Rohde & Schwarz ESU40 EMI receiver was used as a measuring meter while under software control by the Rohde & Schwarz EMC32 software. To increase the sensitivity of the instrument, the built in preamplifier was used from 9 KHz to 1 GHz and an external preamplifier was used from 1 GHz to 26.5 GHz. The EMI receiver was used in the peak detect mode with the "Max Hold" feature activated. In this mode, the EMI receiver records the highest measured reading over all the sweeps. The built in quasi-peak or average detector was used only for those readings which are marked accordingly on the data sheets. The effective measurement bandwidth used for the radiated emissions test was 100 kHz from 9 kHz to to 26.5 GHz.

The Loop Antenna, Broadband BiConiLog and horn antennas were used as transducers during the measurement. The Loop antenna was used from 9 KHz to 30 MHz, the BiConiLog antenna was used from 30 MHz to 1000 MHz and horn antennas were used from 1GHz – 26.5 GHz. The frequency spans were wide (9 kHz to 150 kHz, 150 kHz to 30 MHz, 30 MHz to 88 MHz, 88 MHz to 216 MHz, 216 to 300 MHz, 300 MHz to 1 GHz, 1 GHz to 18 GHz and 18 GHz to 26.5 GHz) during preliminary investigations. The final data was taken with a frequency span of 1 MHz. Furthermore, the frequency span was reduced during the preliminary investigations as deemed necessary.

The 5 meter semi-anechoic chamber of Electro Magnetic Test, Inc. was used for radiated emission testing. This test site is set up according to ANSI C63.10-2013. Please see section 6.2 of this report for mounting, bonding and grounding of the EUT. The turntable supporting the EUT is remote controlled using a motor. The turntable permits EUT rotation of 360 degrees in order to maximize emissions. Also, the antenna mast allows height variation of the antenna from 1 meter to 4 meters. Data was collected in the worst case (highest emission) configuration of the EUT. The EUT was rotated 360 degrees and the antenna height was varied from 1 to 4 meters (for E field radiated field strength).

The presence of non EUT signals was verified by turning the EUT off. In case a non EUT signal was detected, the measurement bandwidth was reduced temporarily and verification was made that an additional adjacent peak did not exist. This ensures that the other signal does not hide any emissions from the EUT. The EUT was tested at a 3 meter test distance from 9 kHz to 26.5 GHz. to obtain final test data.

Calculation Of Radiated Emission Test Data:

Amplitude - Gain + Antenna Factor + Cable Loss = Corrected Amplitude

Corrected Amplitude - Limit = Margin

Associated with the radiated emission test data in this report is a ±5.1dB measurement uncertainty.

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7.1.4 Test Procedure (Conducted)

The Rohde & Schwarz ESU40 EMI receiver was used as a measuring meter. The data was collected with the EMI receiver in the peak detect mode with the "Max Hold" feature activated. The quasi-peak and average detectors were used only where indicated in the data sheets. A 10 dB attenuation pad was used for the protection of the EMI receiver input stage, and the EMI receiver offset was adjusted accordingly to read the actual data measured. The LISN output was read by the Rohde & Schwarz ESU40 EMI receiver. The output of the second LISN was terminated by a 50 ohm termination. The effective measurement bandwidth used for the conducted emissions test was 9 kHz.

Please see section 6.2 of this report for mounting, bonding and grounding of the EUT. The EUT was powered through the LISN, which was bonded to the ground plane. The LISN power was filtered and the filter was bonded to the ground plane. The EUT was set up with the minimum distances from any conductive surfaces as specified in ANSI C63.4: 2014. The excess power cord was wrapped in a figure eight pattern to form a bundle not exceeding 0.4 meters in length.

The initial test data was taken in manual mode while scanning the frequency ranges of 0.15 MHz to 1.6 MHz, 1.6 MHz to 5 MHz and 5 MHz to 30 MHz. The conducted emissions from the EUT were maximized for operating mode as well as cable and peripheral placement. Once a predominant frequency (within 12 dB of the limit) was found, it was more closely examined with the spectrum analyzer span adjusted to 1 MHz.

The final data was collected under program control by the ETS-Lindgren Tile! software in several overlapping sweeps by running the spectrum analyzer at a minimum scan rate of 10 seconds per octave.

Calculation Of Conducted Emission Test Data:

Amplitudes shown on the test data are already corrected and include the following equation:

Raw Amplitude + LISN Insertion Loss + Attenuator + Cable Loss = Corrected Amplitude

Corrected Amplitude - Limit = Margin

Associated with the conducted emission test data in this report is a ±3.4dB measurement uncertainty.

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7.2 Conducted Emissions Test – Mains Ports

7.2.1 Limit (FCC PART 15 Section 15.207(a), IC RSS-GEN Issue 5 [8.8])

Frequency of Emission (MHz)	Conducted Limit (dBµV)	
	Quasi-peak	Average
0.15-0.5	66 to 56 *	56 to 46 *
0.5-5	56	46
5-30	60	50

*Note: Decreases with the logarithm of the frequency

7.2.2 Test Procedure

See Procedures for Conducted Emissions in section 7.1.4.

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7.3 Occupied Bandwidth

7.3.1 Limit (FCC PART 15 Section 15.247(a)(2), IC-RSS 247 Issue 2, [5.2.1])

FCC PART 15 Section 15.247(a)(2)

Systems using digital modulation techniques may operate in the 902 - 928 MHz, 2400 - 2483.5 MHz, and 5725 - 5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz

IC-RSS 247 Issue 2 [5.2.1]

DTSs include systems that employ digital modulation techniques resulting in spectral characteristics similar to direct sequence systems. The following applies to the bands 902-928 MHz and 2400-2483.5 MHz

Limit
6 dB Bandwidth ≥ 500 kHz

7.3.2 Test Procedure

Follow the radiated test procedure but set the Spectrum Analyzer as below:

RBW: 100 kHz
VBW: ≥ 3 X RBW
Detector: Peak
Trace Mode: Max Hold

(1) Set analyzer center frequency to center of signal

(2) Turn on occupied bandwidth measurement mode

(3) Set measurement to 6db bandwidth

Associated with the Occupied Bandwidth test data in this report is a ±2.5% measurement uncertainty.

7.3.3 Test Result

The EUT meets the requirements. Please see the datasheets in Appendix A for the measurement results.

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7.4 Maximum Peak Output Power

7.4.1 Limit (FCC PART 15 Section 15.247(b)(3), IC-RSS 247 Issue 2, [5.4.4])

FCC PART 15 Section 15.247(b)(3)
For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt.
IC-RSS 247 Issue 2, [5.4.4]
For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1W. Except provided in Section 5.4(5), the e.i.r.p. shall not exceed 4 W.

Limit
Maximum Peak Output Power (Digital Modulation) ≤ 1Watt or 30 dBm

7.4.2 Test Procedure

Follow the radiated test procedure but set the Spectrum Analyzer as below:

RBW > DTS Bandwidth
VBW ≥ 3 x RBW
Span ≥ 3 * RBW
Detector: Peak
Trace Mode: Max Hold

(1) When the trace is completed, mark the peak value
(2) Calculate the Field strength at 3Meters.
    a. E3 = Results - GP + AF + CL + 107
       Where:
    b. Results = Specific uncorrected results from test (dBm)
    c. GP = Pre-Amp Gain (dB)
    d. AF = Antenna Factor (dB/m)
    e. CL = Cable Loss (dB)
(3) Calculate the EIRP by using the following equation:
    a. EIRP = E3 - 95.2
       Where:
    b. E3 = See Step 2 (dBuV/m @ 3m)
(4) Calculate the Peak Output Power by using the following equation:
    a. Peak Power = EIRP - GA
       Where:
    b. EIRP = See step 3 (dBm)
    c. G_A = Antenna Gain (dBi)

Associated with the Maximum Peak Output Power test data in this report is a ±5.1dB measurement uncertainty.

7.4.3 Test Result

The EUT meets the requirements. Please see the datasheets in Appendix A for the measurement results.

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7.5 Maximum Peak Power Spectral Density

7.5.1 Limit (FCC PART 15 Section 15.247(e), IC-RSS 247 Issue 2, [5.2.2])

FCC PART 15 Section 15.247(e)

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density

Limit
8 dBm/3 KHz

7.5.2 Test Procedure

Follow the radiated test procedure but set the Spectrum Analyzer as below:

3 kHz ≤ RBW ≤ 100 kHz
VBW ≥ 3 x RBW
Span ≥ 1.5 * DTS Bandwidth
Detector: Peak
Sweep Time auto

1) Use Peak Marker Function
2) If value Exceeds limit, reduce RBW (no less than 3 kHz)
3) Calculate the Field strength at 3Meters.
   a) E_3 = Results - G_P + AF + CL + 107
      Where:
   b) Results = Specific uncorrected results from test (dBm)
   c) G_P = Pre-Amp Gain (dB)
   d) AF = Antenna Factor (dB/m)
   e) CL = Cable Loss (dB)
4) Calculate the EIRP by using the following equation:
   a) EIRP = E3 - 95.2
      Where:
   b) E_3 = See Step 3 (dBuV/m @ 3m)
5) Calculate the Peak Output Power by using the following equation:
   a) Peak Power = EIRP - G_A
      Where:
   b) EIRP = See step 4 (dBm)
   c) G_A = Antenna Gain (dBi)

Associated with the Maximum Peak Power Spectral Density test data in this report is a ±5.1dB measurement uncertainty.

7.5.3 Test Result

The EUT meets the requirements. Please see the datasheets in Appendix A for the measurement results.

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7.6 Antenna Requirement

7.6.1 Requirement (FCC PART 15 SECTION 15.203,15.247(b)(4))

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section.

(4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

7.6.2 Test Result

The antenna's are integrated on the main PCB with no consideration for replacement on the Sensor.

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8. CONCLUSIONS / COMPLIANCE STATEMENT

Based upon the results contained in this report, Electro Magnetic Test, Inc. has determined that the Sensor, Model: SU-5F-2W meets all of the specification limits defined in FCC Title 47, Part 15, Subpart C and IC RSS 247, Issue 2.

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APPENDIX A

RADIATED AND CONDUCTED EMISSIONS DATA SHEETS

Radiated Emission Test Report

Tested At:
Electro Magnetic Test, Inc.
1547 Plymouth Street
Mountain View, CA 94043
Tel. 650-965-4000
Fax. 650-965-3000

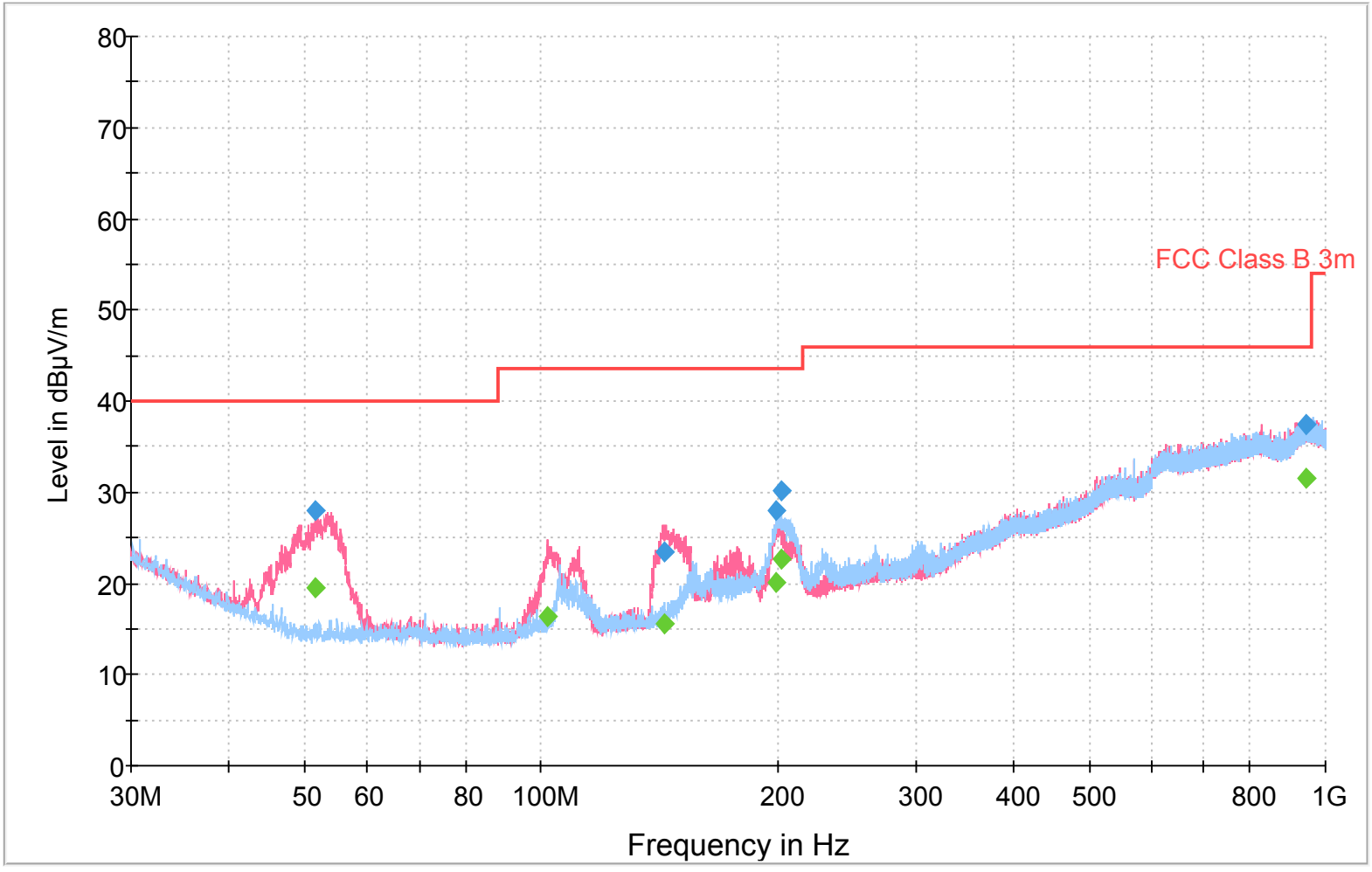
Common Information

Test Description:	Class B Radiated Emissions
Operating Conditions:	Normal
Test Engineer:	Chinmay Shendurnikar

EUT Information

Company Name:	Enlighted Inc.
EUT Name	Smart Sensor
Model Number:	SU-5F-2W
Serial Number:	N/A
Comment:	BLE - Channel 0, power 4dB(max), And Zigbee Channel 0, power 4dB(max)

FCC Class B Radiated Scan 3m PK QP



FCC 3m
Final Result 1-PK+
Preview Result 1V-PK+
Final Result 2-QPK
Preview Result 1H-PK+

Final Result 1

Frequency (MHz)	MaxPeak (dBµV/m)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
51.480000	28.1	100.0	V	261.0	12.1	11.94	49.50	
143.460000	23.4	100.0	V	276.0	14.0	20.12	54.00	
199.770000	28.1	100.0	V	196.0	15.6	15.43	54.00	
202.020000	30.2	165.0	H	107.0	15.7	13.26	54.00	
945.360000	37.5	354.0	H	359.0	31.9	8.48	56.90	

Final Result 2

Frequency (MHz)	QuasiPeak (dBµV/m)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
51.480000	19.5	100.0	V	261.0	12.1	20.50	40.00	
102.030000	16.4	100.0	V	161.0	13.4	27.10	43.50	
143.460000	15.5	100.0	V	276.0	14.0	27.98	43.50	
199.770000	20.0	100.0	V	196.0	15.6	23.47	43.50	
202.020000	22.6	165.0	H	107.0	15.7	20.89	43.50	
945.360000	31.5	354.0	H	359.0	31.9	14.51	46.00	

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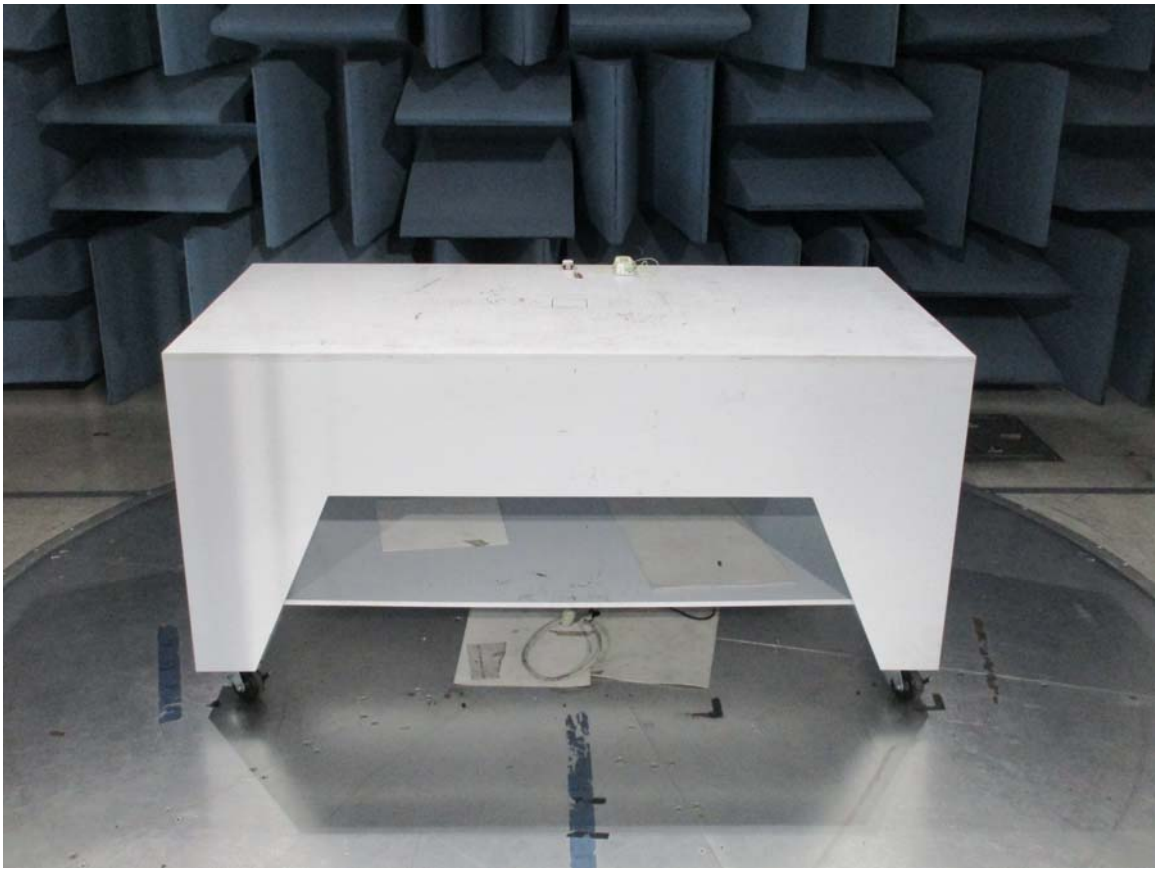

FRONT VIEW

Enlighted Inc.
Sensor
Model: SU-5F-2W
CISPR 22/FCC– Radiated/Conducted Emissions

PHOTOGRAPH SHOWING THE EUT CONFIGURATION FOR MAXIMUM EMISSIONS

EMT ELECTRO MAGNETIC TEST, INC.
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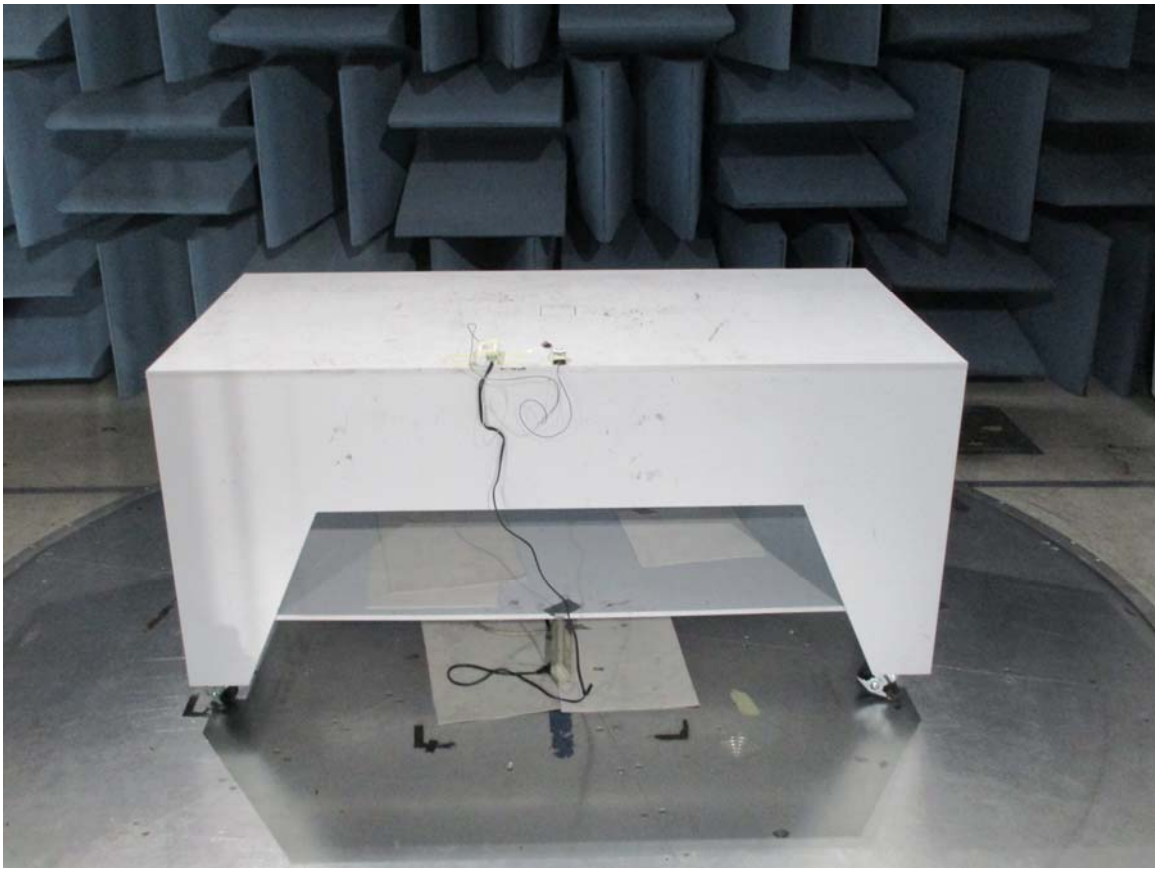


REAR VIEW

Enlighted Inc.
Sensor
Model: SU-5F-2W
CISPR 22/FCC– Radiated/Conducted Emissions

PHOTOGRAPH SHOWING THE EUT CONFIGURATION FOR MAXIMUM EMISSIONS

Radiated Emission Test Report

Tested At:
Electro Magnetic Test, Inc.
1547 Plymouth Street
Mountain View, CA 94043
Tel. 650-965-4000
Fax. 650-965-3000

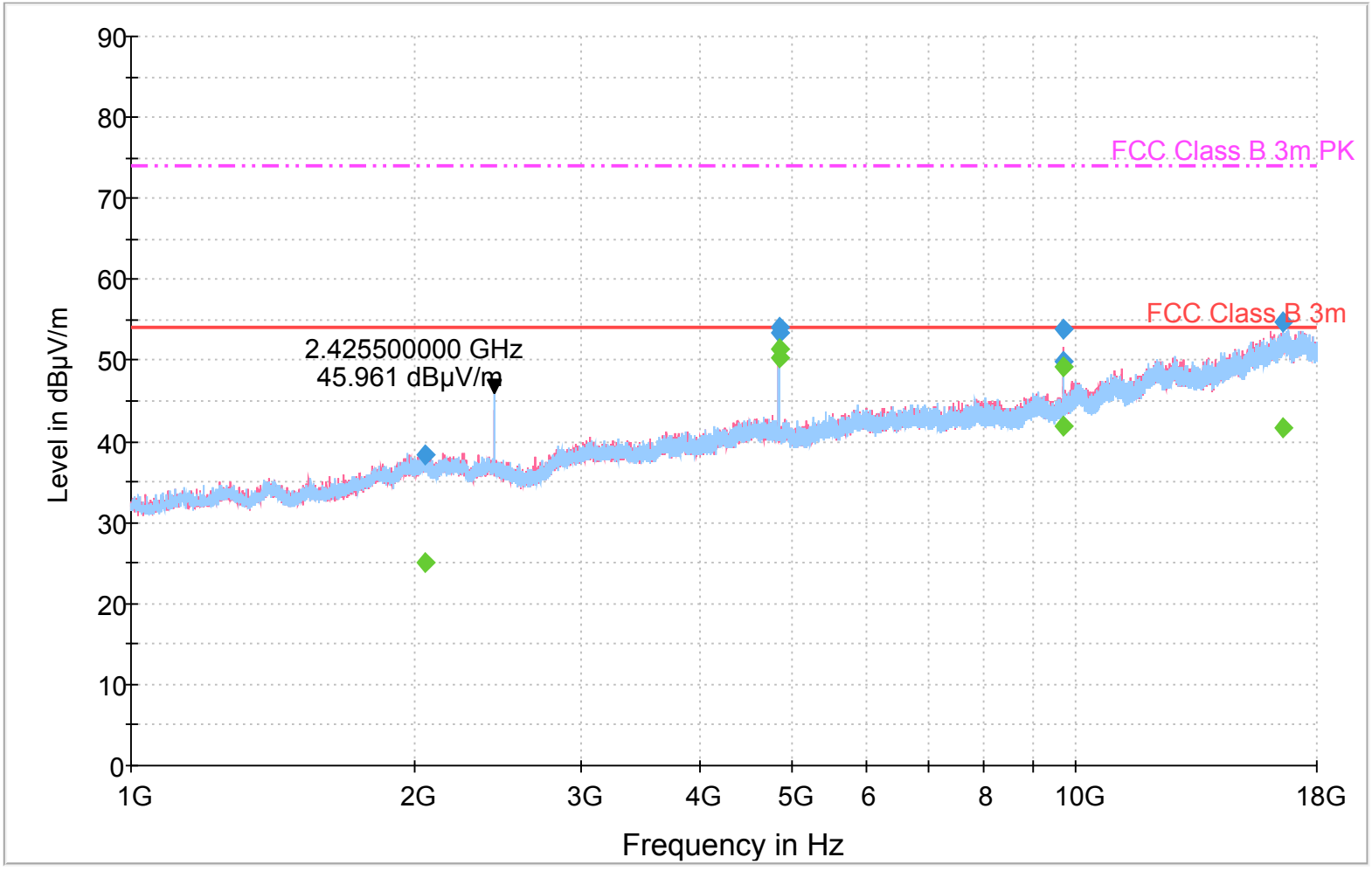
Common Information

Test Description:	FCC Class B Radiated Emissions
Operating Conditions:	Normal
Test Engineer:	Chinmay Shendurnikar

EUT Information

Company Name:	Enlighted Inc.
EUT Name	Smart Sensor
Model Number:	SU-5F-2W
Serial Number:	N/A
Comment:	BLE - Channel 0, power 4dB(max), And Zigbee Channel 0, power 4dB(max)

FCC Class B Radiated Scan 1GHz-18GHz 3m PK AVG



FCC 3m
FCC 3m PK
Preview Result 1V-PK+
Preview Result 1H-PK+
Final Result 1-PK+
Final Result 2-AVG

Final Result 1

Frequency (MHz)	MaxPeak (dBµV/m)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
2046.000000	38.2	171.0	H	197.0	0.6	35.75	74.00	
4851.000000	53.3	100.0	V	344.0	5.7	20.66	74.00	
4851.000000	54.0	133.0	H	336.0	5.7	20.01	74.00	
9702.000000	53.9	262.0	V	285.0	13.0	20.15	74.00	
9702.000000	50.0	188.0	H	359.0	13.0	24.02	74.00	
16587.750000	54.7	366.0	V	9.0	22.4	19.30	74.00	

Final Result 2

Frequency (MHz)	Average (dBµV/m)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
2046.000000	25.1	171.0	H	197.0	0.6	28.92	54.00	
4851.000000	50.4	100.0	V	344.0	5.7	3.58	54.00	
4851.000000	51.4	133.0	H	336.0	5.7	2.64	54.00	
9702.000000	49.3	262.0	V	285.0	13.0	4.72	54.00	
9702.000000	41.9	188.0	H	359.0	13.0	12.12	54.00	
16587.750000	41.7	366.0	V	9.0	22.4	12.29	54.00	

Radiated Emission Test Report

Tested At:
Electro Magnetic Test, Inc.
1547 Plymouth Street
Mountain View, CA 94043
Tel. 650-965-4000
Fax. 650-965-3000

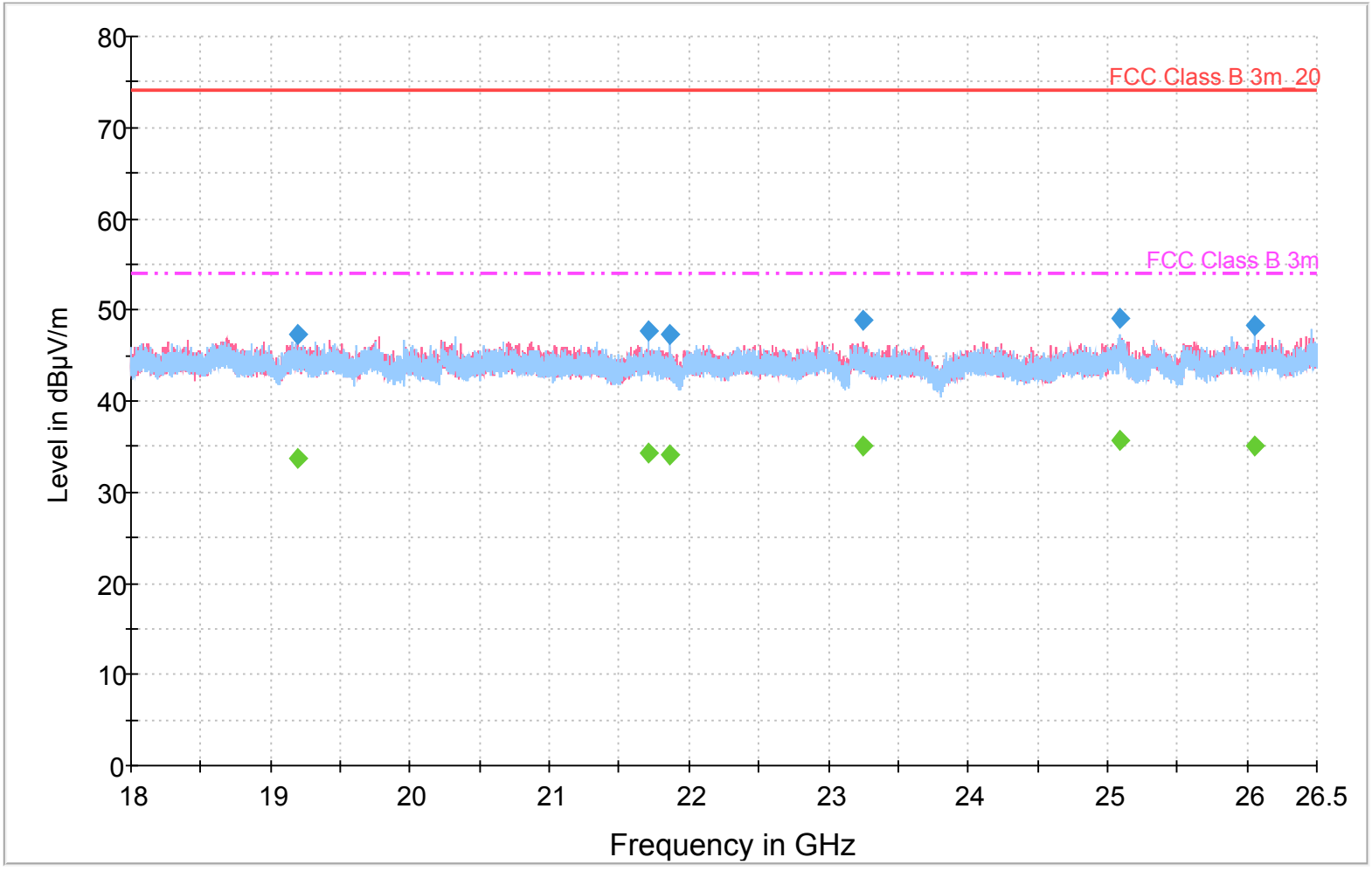
Common Information

Test Description:	FCC Class B Radiated Emissions
Operating Conditions:	Normal
Test Engineer:	Chinmay Shendurnikar

EUT Information

Company Name:	Enlighted Inc.
EUT Name	Smart Sensor
Model Number:	SU-5F-2W
Serial Number:	N/A
Comment:	BLE - Channel 0, power 4dB(max), And Zigbee Channel 0, power 4dB(max)

FCC Class B Radiated Sweep 18GHz-26.5GHz 3m PK AVG



FCC Class B 3m_20
Preview Result 1H-PK+
FCC Class B 3m
Final Result 1-PK+
Preview Result 1V-PK+
Final Result 2-AVG

Final Result 1

Frequency (MHz)	MaxPeak (dBµV/m)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
19195.525000	47.4	297.0	V	243.0	10.5	26.60	74.00	
21712.800000	47.7	176.0	H	56.0	11.1	26.30	74.00	
21859.425000	47.3	144.0	H	104.0	11.2	26.70	74.00	
23242.800000	48.8	184.0	V	198.0	11.8	25.20	74.00	
25083.900000	49.0	184.0	H	168.0	11.8	25.00	74.00	
26050.775000	48.3	254.0	H	311.0	11.7	25.70	74.00	

Final Result 2

Frequency (MHz)	Average (dBµV/m)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
19195.525000	33.8	297.0	V	243.0	10.5	20.20	54.00	
21712.800000	34.4	176.0	H	56.0	11.1	19.60	54.00	
21859.425000	34.2	144.0	H	104.0	11.2	19.80	54.00	
23242.800000	35.0	184.0	V	198.0	11.8	19.00	54.00	
25083.900000	35.7	184.0	H	168.0	11.8	18.30	54.00	
26050.775000	35.0	254.0	H	311.0	11.7	19.00	54.00	

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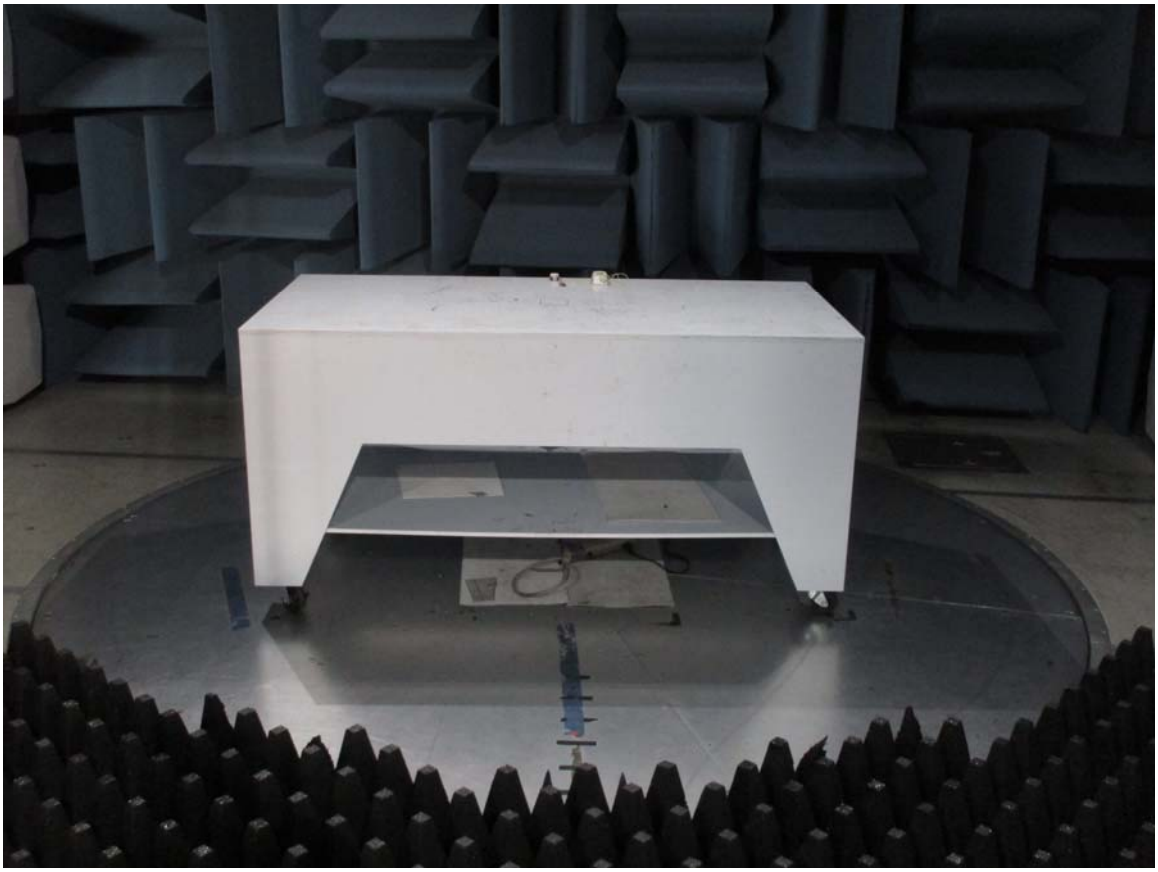

FRONT VIEW

Enlighted Inc.
Sensor
Model: SU-5F-2W
CISPR 22/FCC– Radiated Emissions (>1GHz)

PHOTOGRAPH SHOWING THE EUT CONFIGURATION FOR MAXIMUM EMISSIONS

EMT ELECTRO MAGNETIC TEST, INC.
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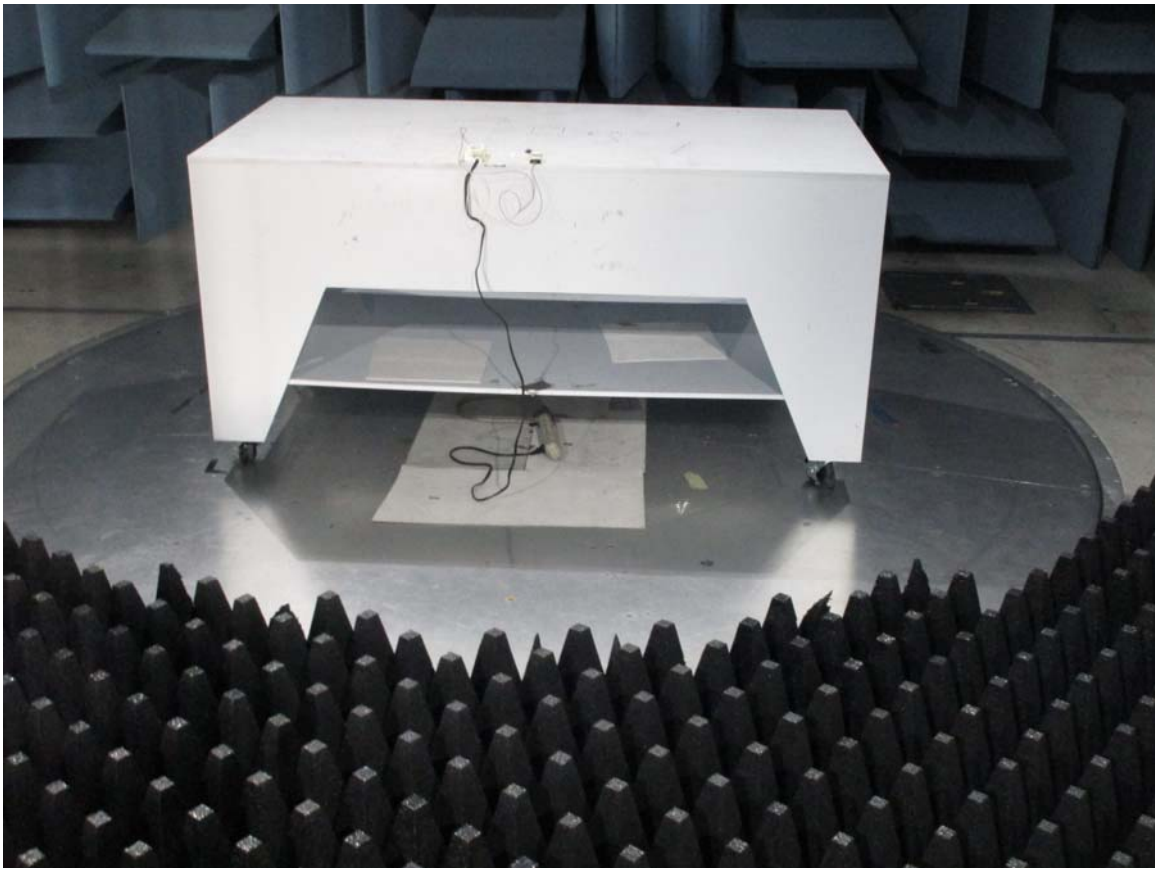

REAR VIEW

Enlighted Inc.
Sensor
Model: SU-5F-2W
CISPR 22/FCC– Radiated Emissions (>1GHz)

PHOTOGRAPH SHOWING THE EUT CONFIGURATION FOR MAXIMUM EMISSIONS

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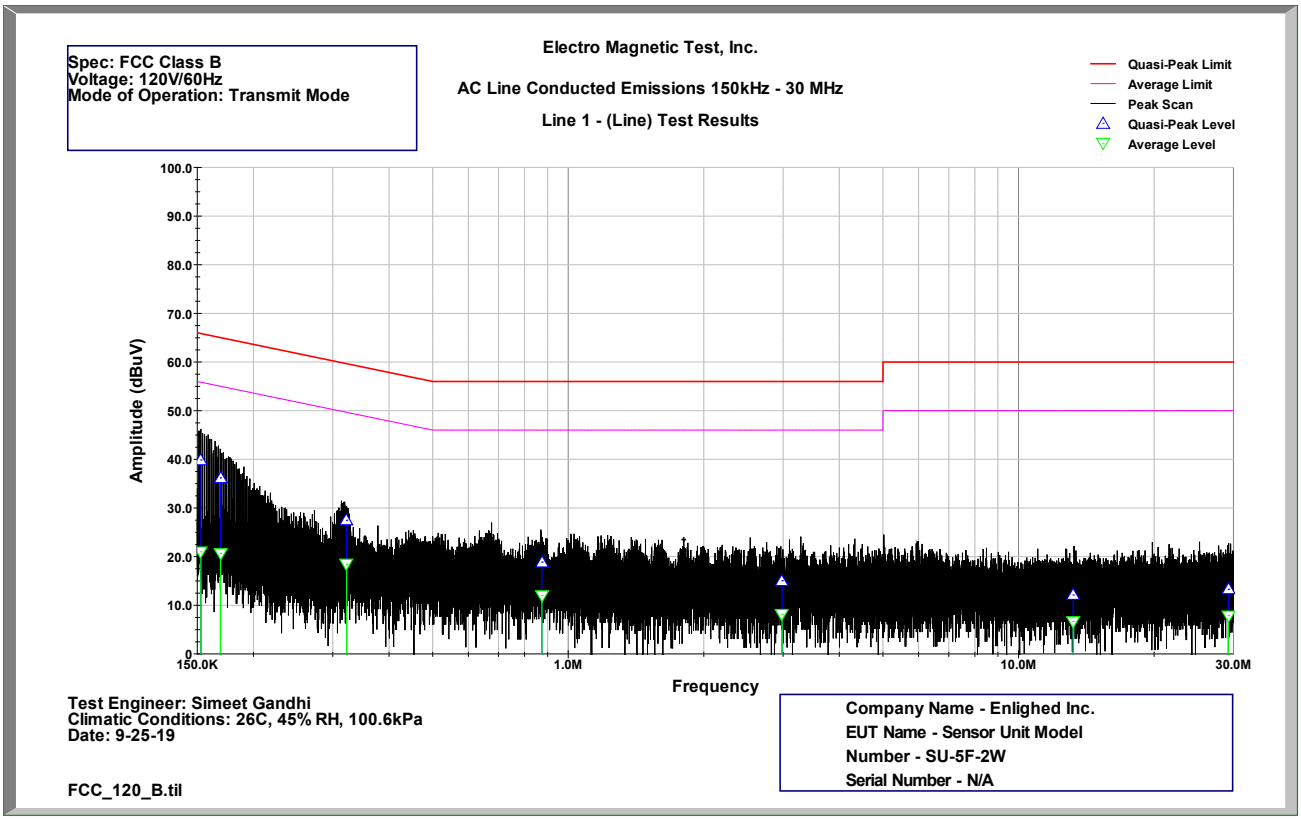
AC Line Conducted Emissions Test Data



Line 1 - (Line) Test Results

Frequency (MHz)	Peak (dBuV)	Quasi-Peak (dBuV)	Average (dBuV)	Corr. Factor (dB)	Quasi-Peak Limit	QP Margin	Average Limit	Average Margin
0.153	46.683	39.861	20.972	10.529	65.920	-39.139	55.920	-45.028
0.169	42.793	36.180	20.675	10.443	65.459	-42.820	55.459	-45.325
0.322	30.839	27.452	18.408	10.154	61.085	-51.548	51.085	-47.592
0.874	23.391	18.852	12.013	9.995	56.000	-54.148	46.000	-47.987
2.985	21.209	15.047	8.144	10.110	56.000	-57.953	46.000	-51.856
13.218	16.783	12.098	6.674	10.989	60.000	-60.902	50.000	-53.326
29.231	17.223	13.261	7.866	12.243	60.000	-59.739	50.000	-52.134

EMT
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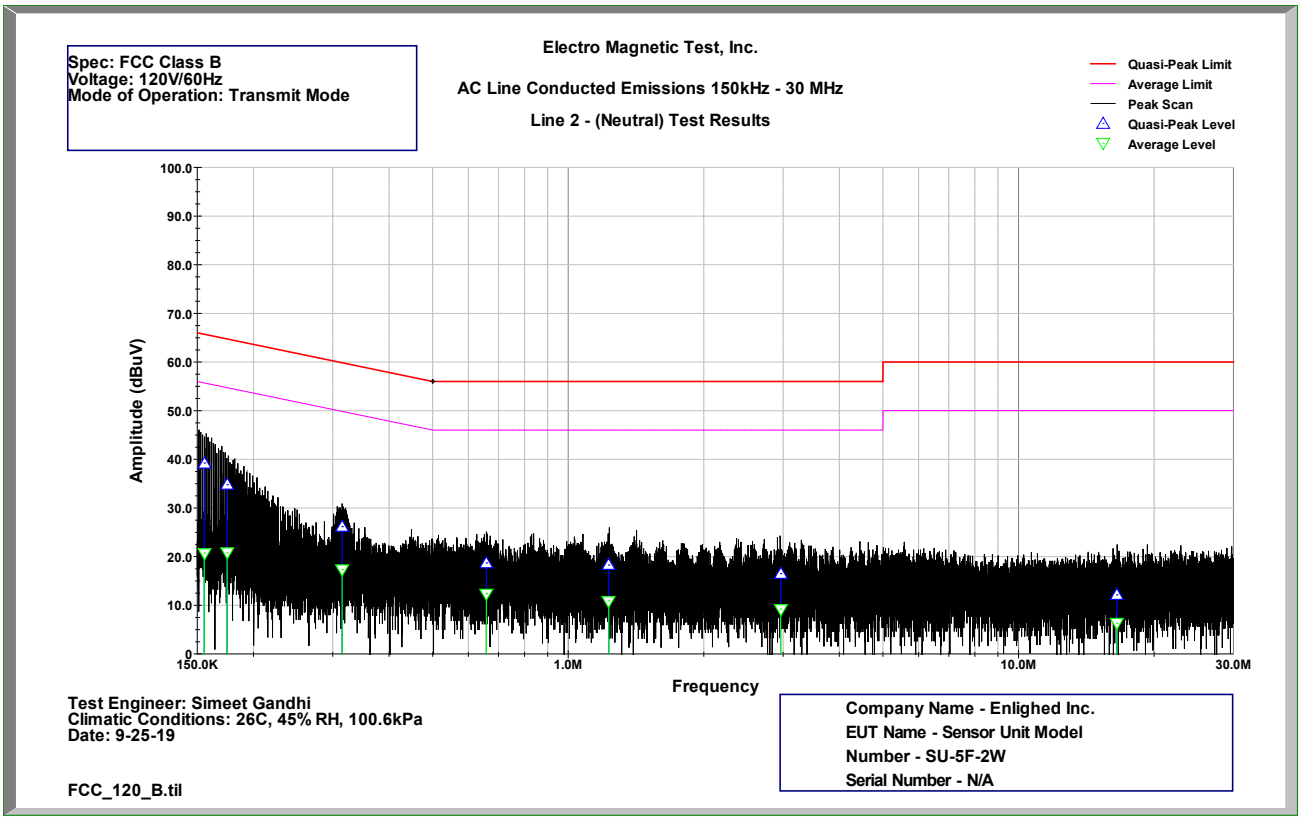
AC Line Conducted Emissions Test Data



Line 2 - (Neutral) Test Results

Frequency (MHz)	Peak (dBuV)	Quasi-Peak (dBuV)	Average (dBuV)	Corr. Factor (dB)	Quasi-Peak Limit	QP Margin	Average Limit	Average Margin
0.156	45.693	39.233	20.699	10.480	65.843	-39.767	55.843	-45.301
0.175	41.919	34.757	20.776	10.418	65.294	-44.243	55.294	-45.224
0.315	30.181	26.164	17.294	10.178	61.296	-52.836	51.296	-48.706
0.658	24.363	18.691	12.373	9.966	56.000	-54.309	46.000	-47.627
1.230	25.000	18.273	10.903	10.218	56.000	-54.727	46.000	-49.097
2.962	21.962	16.485	9.191	10.289	56.000	-56.515	46.000	-50.809
16.527	16.335	12.130	6.300	11.073	60.000	-60.870	50.000	-53.700

EMT ELECTRO MAGNETIC TEST, INC.
1547 Plymouth Street, Mountain View, CA 94043 Tel: (650) 965-4000 Fax: (650) 965-3000

6dB Bandwidth and Occupied Bandwidth Test

Company:	Enlighted Inc.	**Test Date:**	10/10/19
EUT Name:	Sensor	**Test Engineer:**	Andreas Davidsson
Model:	SU-5F-2W	**Test Result:**	PASS
Operating Mode:	TX Mode		

Mode	Test CH	Frequency (MHz)	6 dB Bandwidth (kHz)	99% Occupied Bandwidth (MHz)	6 dB Bandwidth Limit (kHz)	Conclusion
Bluetooth LE	0	2402	648.5	1.0791	≥ 500	PASS
	19	2440	626.2	1.0771	≥ 500	PASS
	39	2480	641	1.0787	≥ 500	PASS
Zigbee (IEEE 802.15.4)	11	2405	1166	2.2847	≥ 500	PASS
	18	2440	1169	2.2998	≥ 500	PASS
	26	2480	1414	2.3452	≥ 500	PASS

Test Equipment: Please refer to section 5.2

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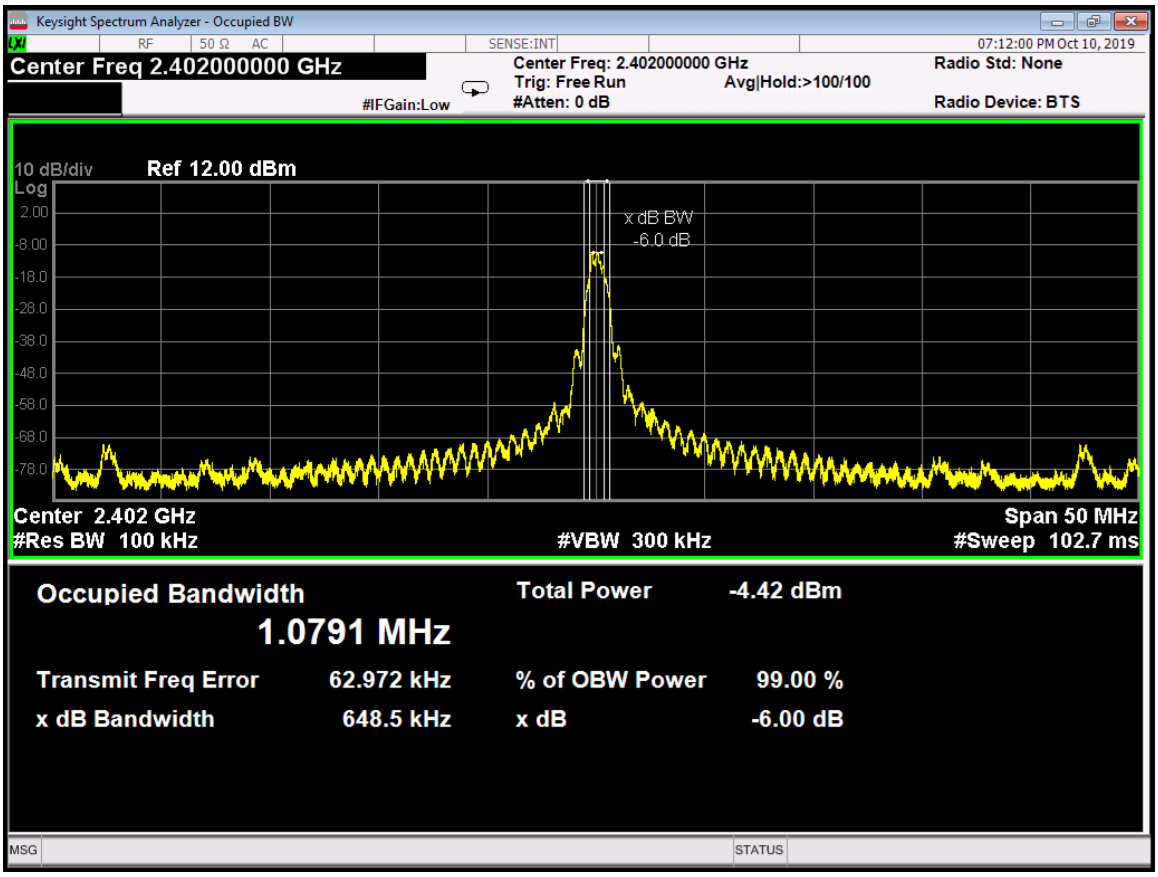
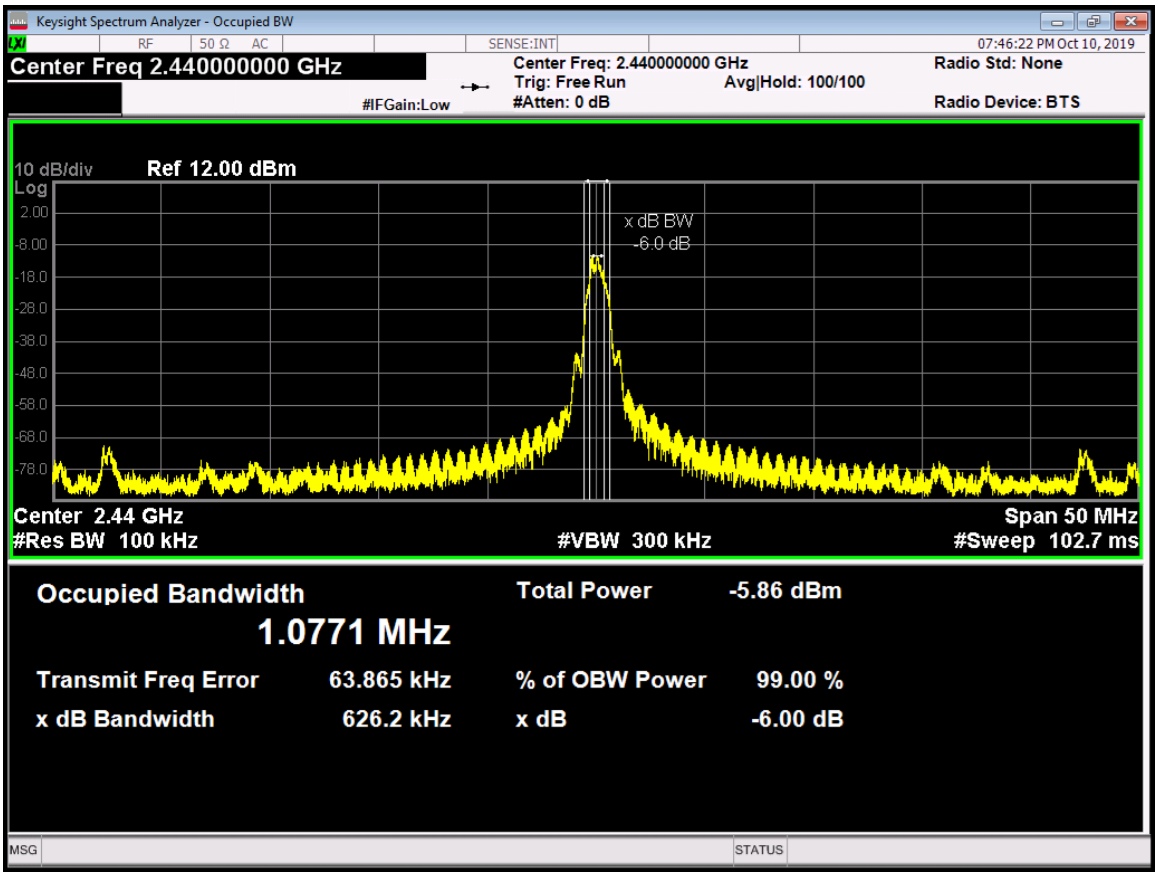


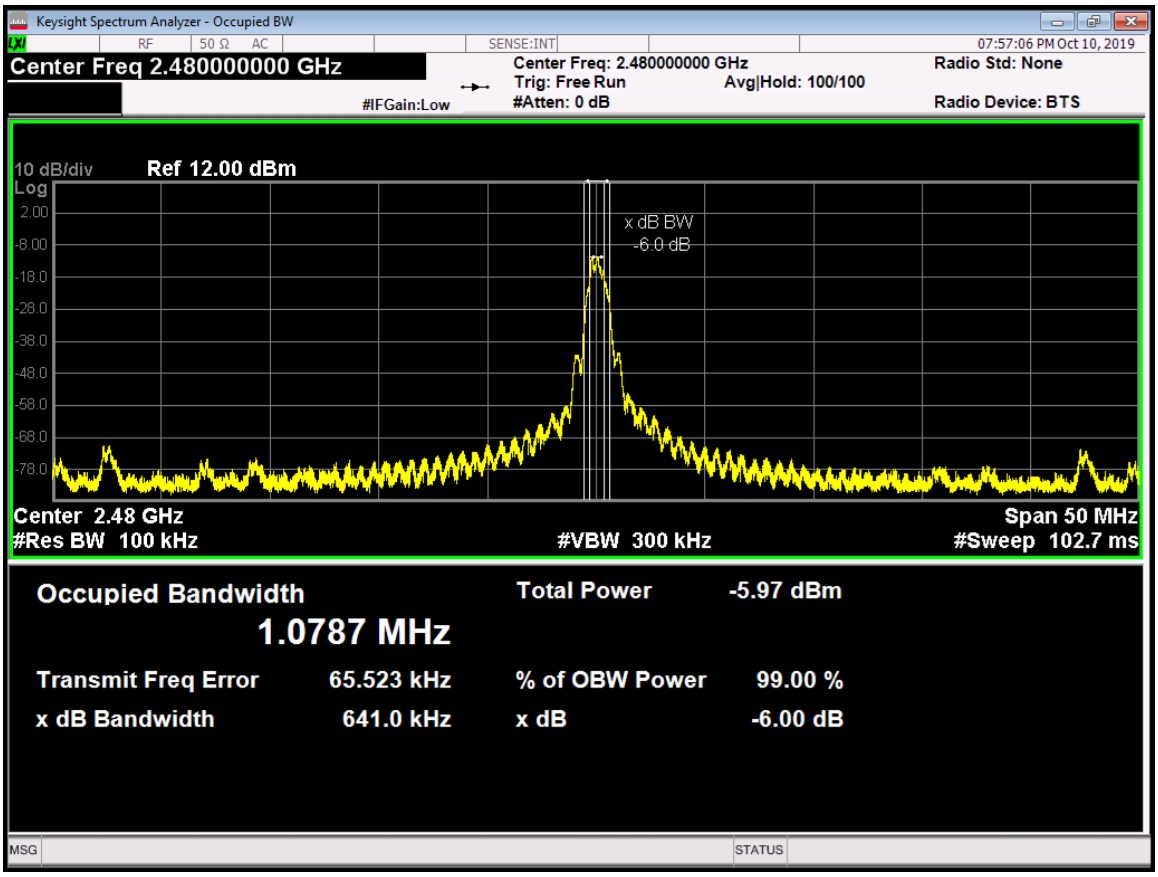
Bluetooth LE
Channel 0

EMT
ELECTRO MAGNETIC TEST, INC.
1547 Plymouth Street, Mountain View, CA 94043 Tel: (650) 965-4000 Fax: (650) 965-3000



Bluetooth LE
Channel 19

EMT
ELECTRO MAGNETIC TEST, INC.
1547 Plymouth Street, Mountain View, CA 94043 Tel: (650) 965-4000 Fax: (650) 965-3000



Bluetooth LE
Channel 39

EMT
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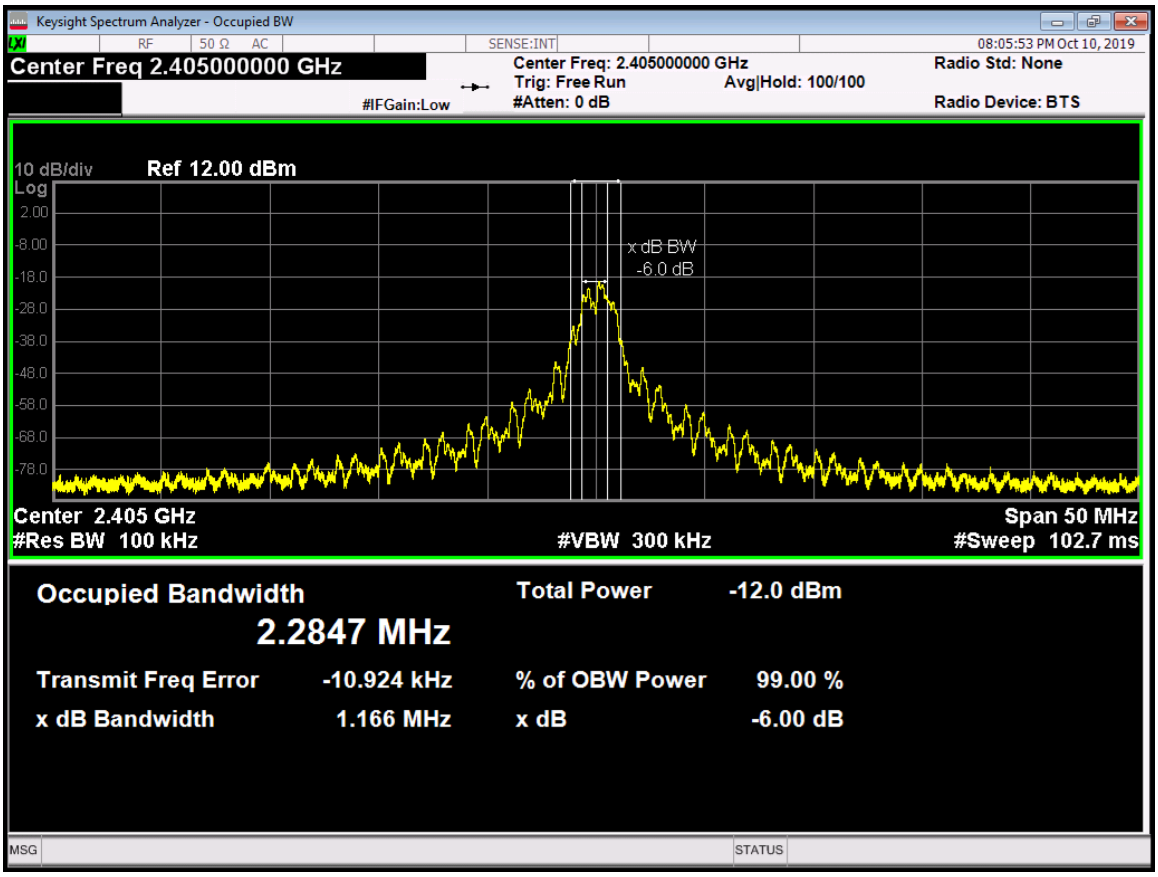
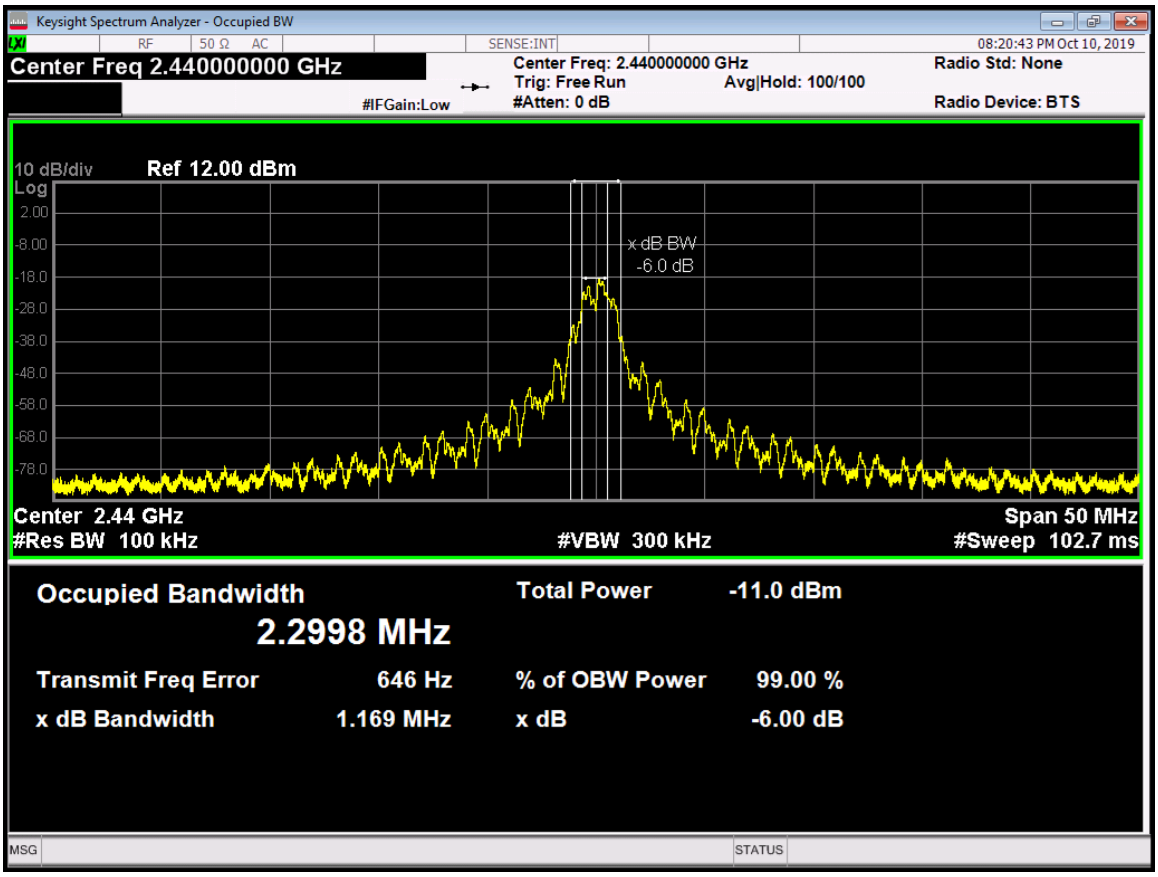
1547 Plymouth Street, Mountain View, CA 94043 Tel: (650) 965-4000 Fax: (650) 965-3000



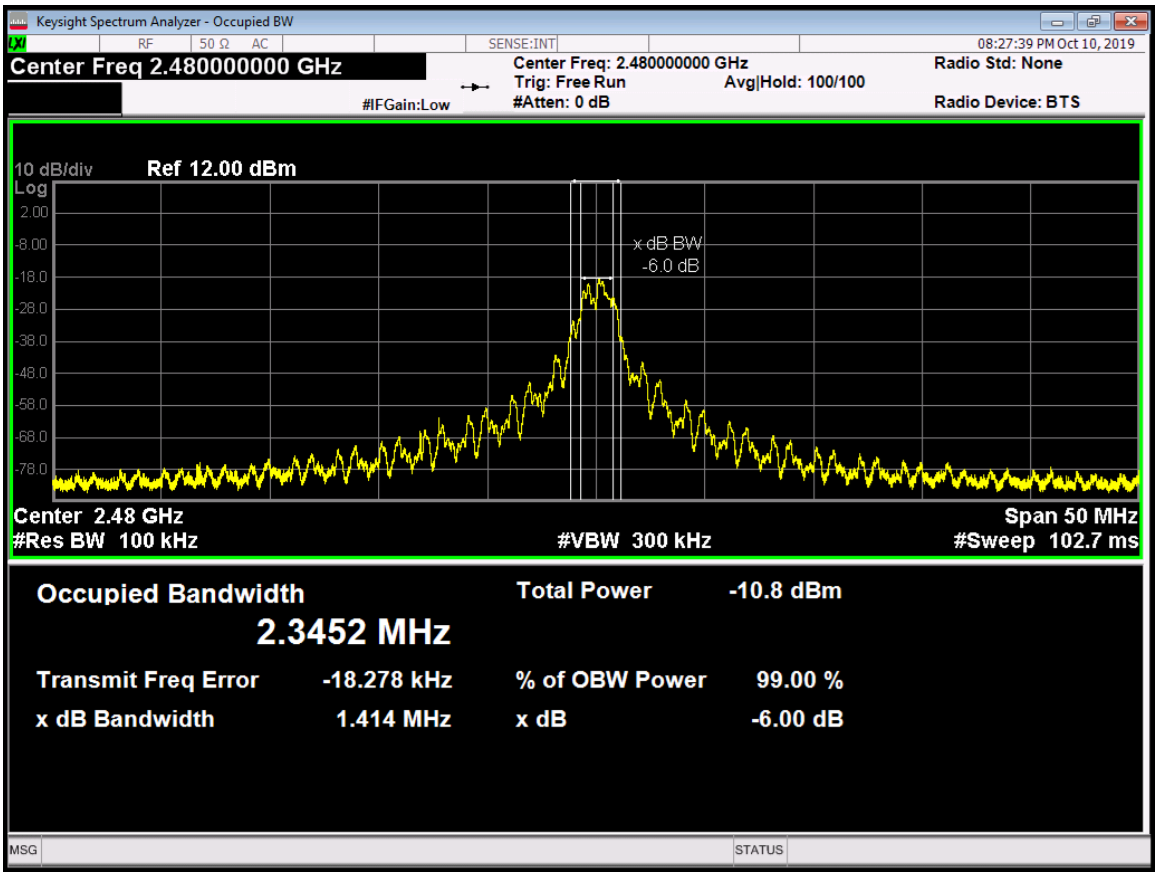
Zigbee (IEEE 802.15.4)
Channel 11

EMT
ELECTRO MAGNETIC TEST, INC.
1547 Plymouth Street, Mountain View, CA 94043 Tel: (650) 965-4000 Fax: (650) 965-3000



Zigbee (IEEE 802.15.4)
Channel 18

EMT
ELECTRO MAGNETIC TEST, INC.
1547 Plymouth Street, Mountain View, CA 94043 Tel: (650) 965-4000 Fax: (650) 965-3000



Zigbee (IEEE 802.15.4)
Channel 26

EMT ELECTRO MAGNETIC TEST, INC.
1547 Plymouth Street, Mountain View, CA 94043 Tel: (650) 965-4000 Fax: (650) 965-3000

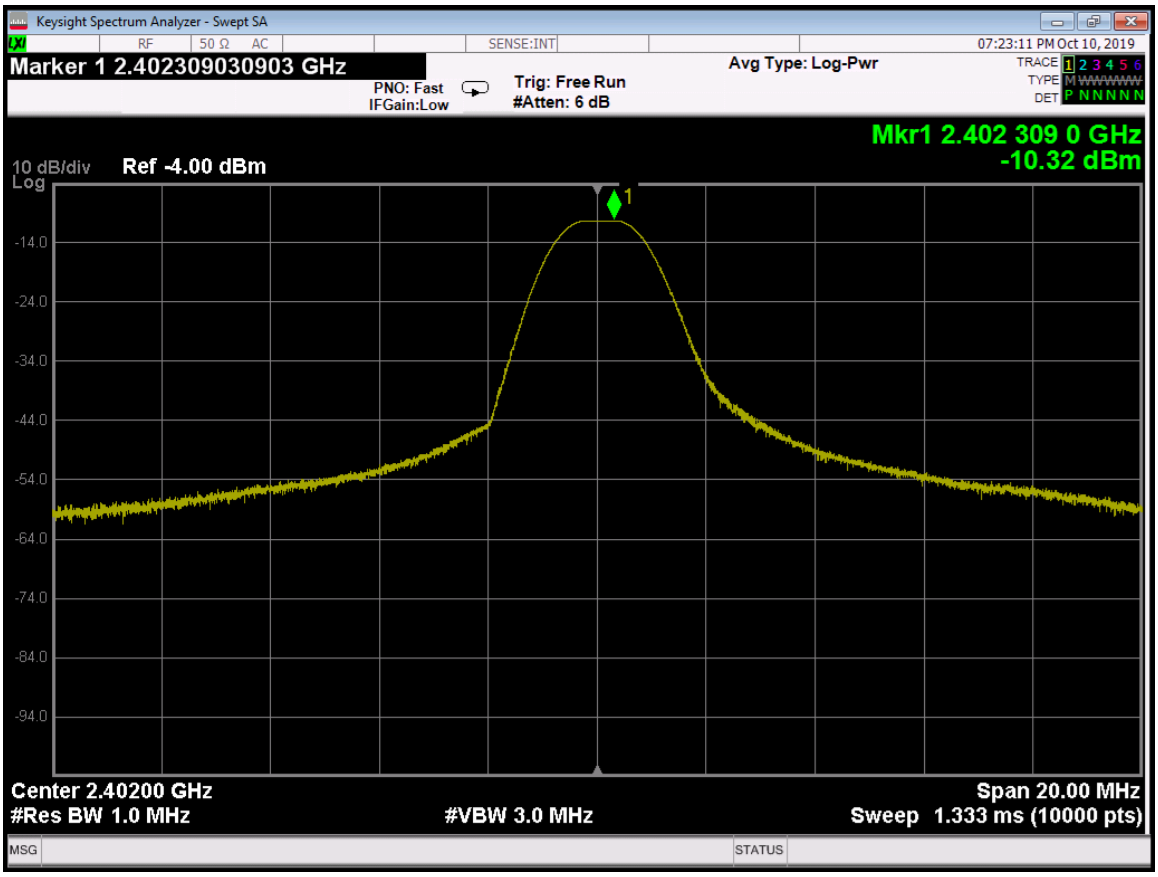
Maximum Peak Output Power Test Data

Company:	Enlighted Inc.	Test Date	10/10/19
EUT Name	Sensor	Test Engineer	Andreas Davidsson
Model:	SU-5F-2W	Test Result	PASS
Operating Mode	TX Mode		

Mode	Test CH	Frequency (MHz)	Raw Output Power (dBm)	Peak Output Power (dBm)	Limit (dBm)	Conclusion
Bluetooth LE	0	2402	-10.32	1.38	≤ 30	Pass
	19	2440	-11.49	0.21	≤ 30	Pass
	39	2480	-11.86	-0.16	≤ 30	Pass
Zigbee (IEEE 802.15.4)	11	2405	-15.69	-5.19	≤ 30	Pass
	18	2440	-14.69	-4.19	≤ 30	Pass
	26	2480	-14.51	-4.01	≤ 30	Pass

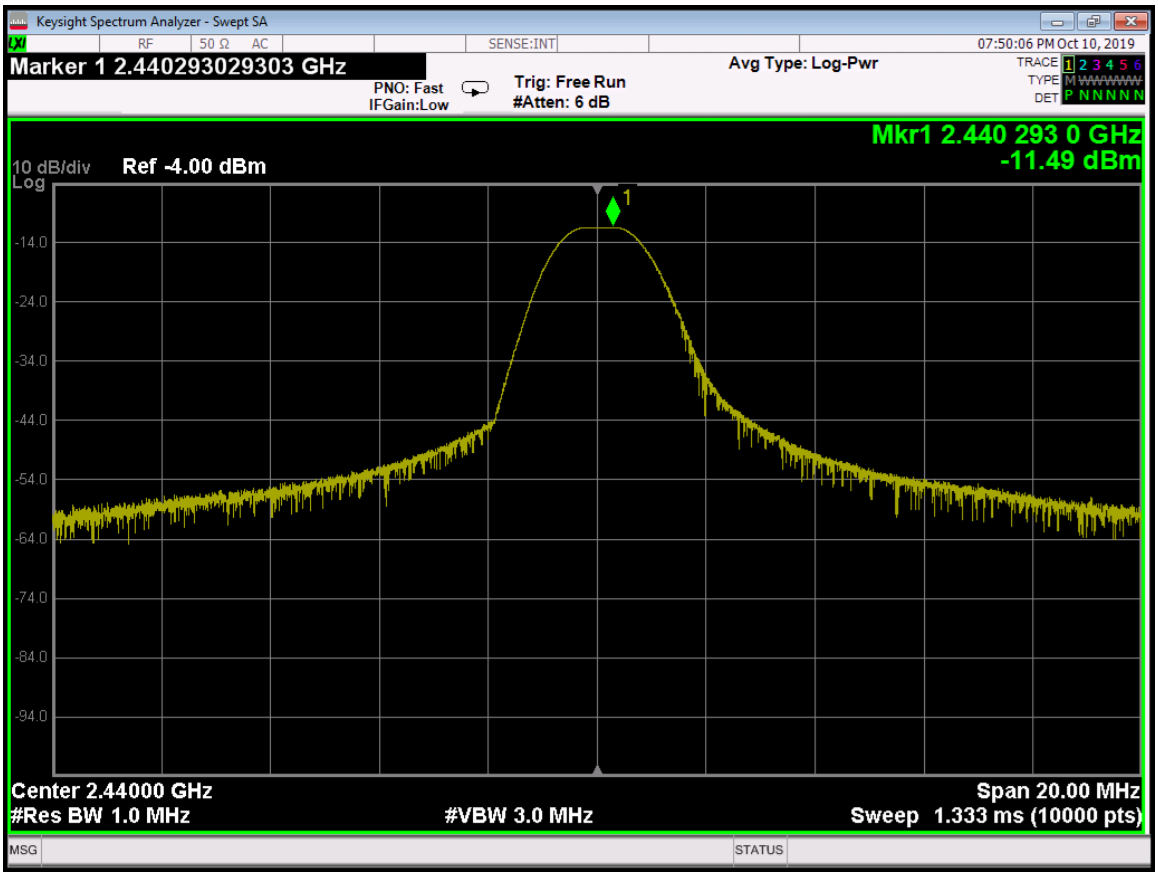
	Test Equipment: Please refer to section 5.2
	Peak Output Power Calculation (See Section 7.4.2 for calculation explanation)
	Channel 0: ((-10.32-34.4+32.1+4.2+107)-95.2)-2= 1.38
	Channel 19: ((-11.49-34.4+32.1+4.2+107)-95.2)-2= 0.21
	Channel 39: ((-11.86-34.4+32.1+4.2+107)-95.2)-2= -0.16
	Channel 11: ((-15.69-34.4+32.1+4.2+107)-95.2)-3.2= -5.19
	Channel 18: ((-14.69-34.4+32.1+4.2+107)-95.2)-3.2= -4.19
	Channel 26: ((-14.51-34.4+32.1+4.2+107)-95.2)-3.2= -4.01

EMT
ELECTRO MAGNETIC TEST, INC.
1547 Plymouth Street, Mountain View, CA 94043 Tel: (650) 965-4000 Fax: (650) 965-3000



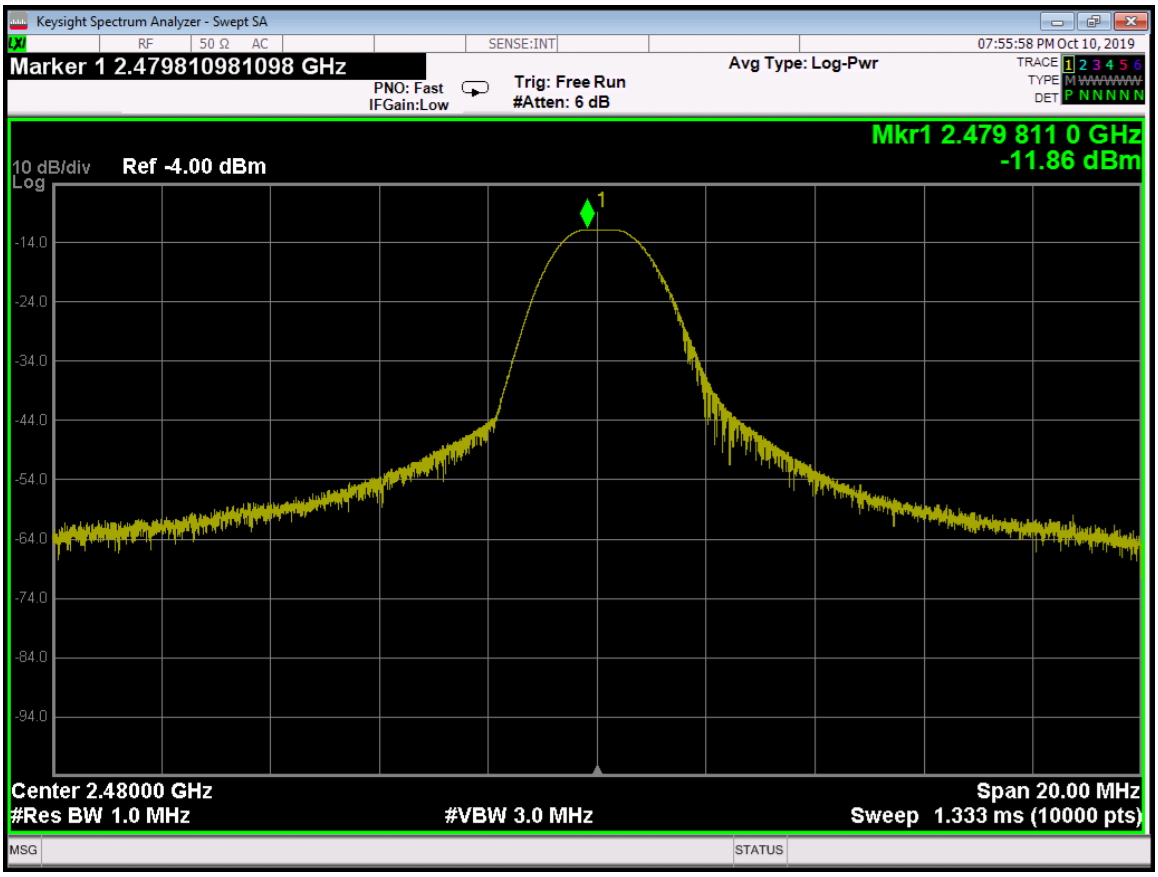
Bluetooth LE
Channel 0

EMT
ELECTRO MAGNETIC TEST, INC.
1547 Plymouth Street, Mountain View, CA 94043 Tel: (650) 965-4000 Fax: (650) 965-3000



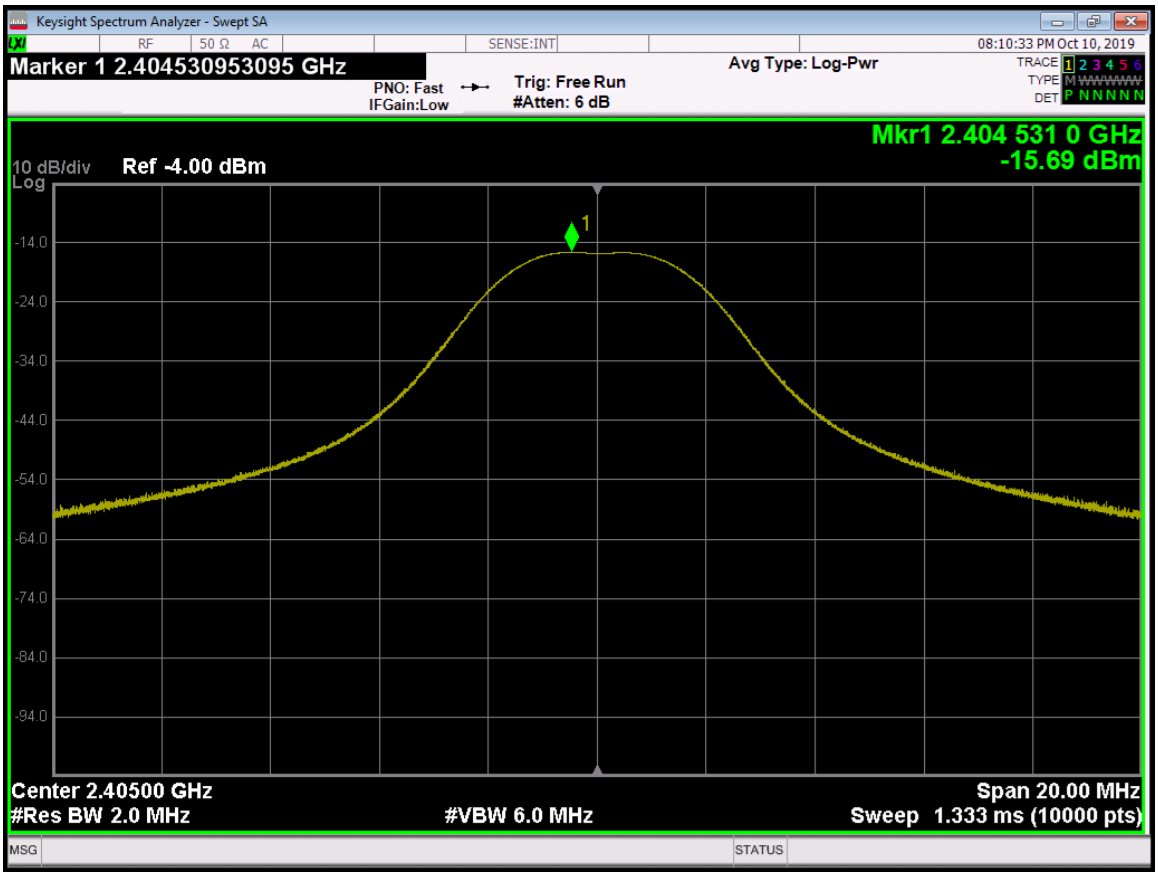
Bluetooth LE
Channel 19

EMT
ELECTRO MAGNETIC TEST, INC.
1547 Plymouth Street, Mountain View, CA 94043 Tel: (650) 965-4000 Fax: (650) 965-3000



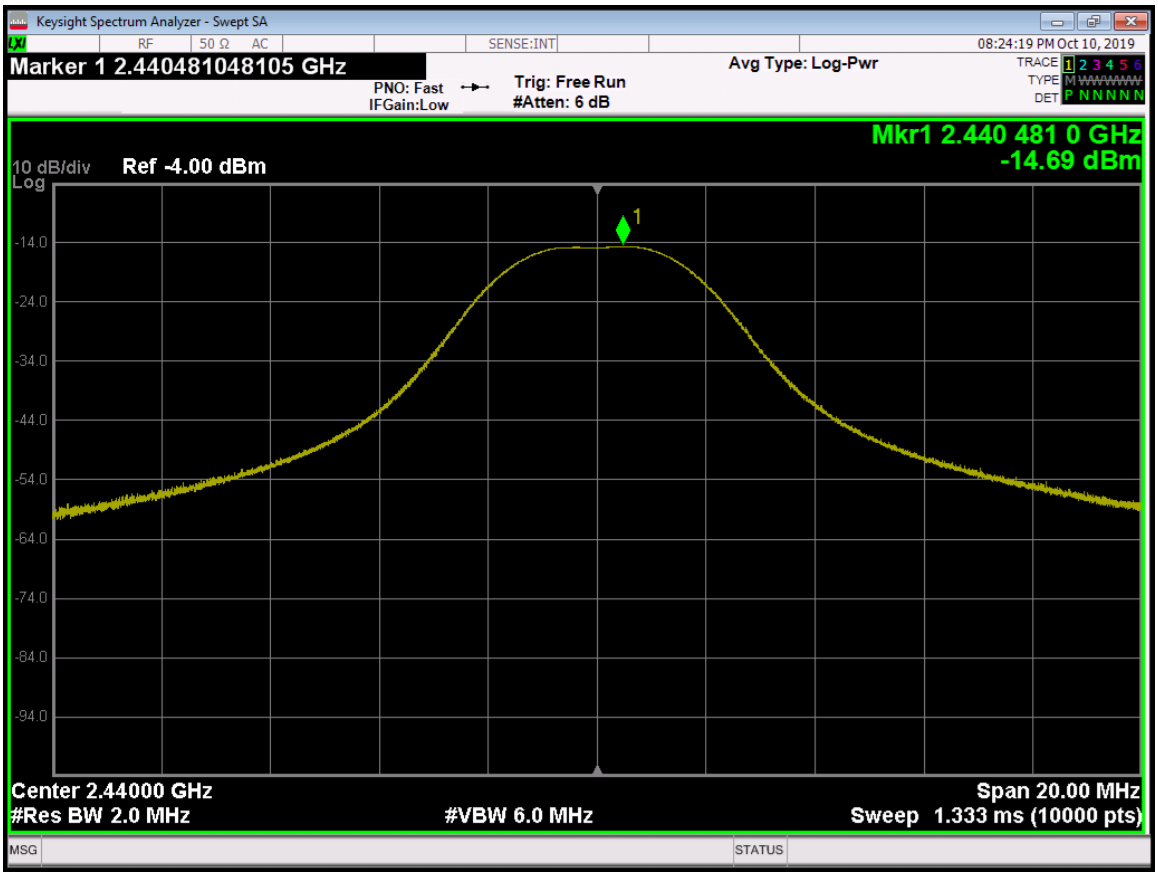
Bluetooth LE
Channel 39

EMT
ELECTRO MAGNETIC TEST, INC.
1547 Plymouth Street, Mountain View, CA 94043 Tel: (650) 965-4000 Fax: (650) 965-3000



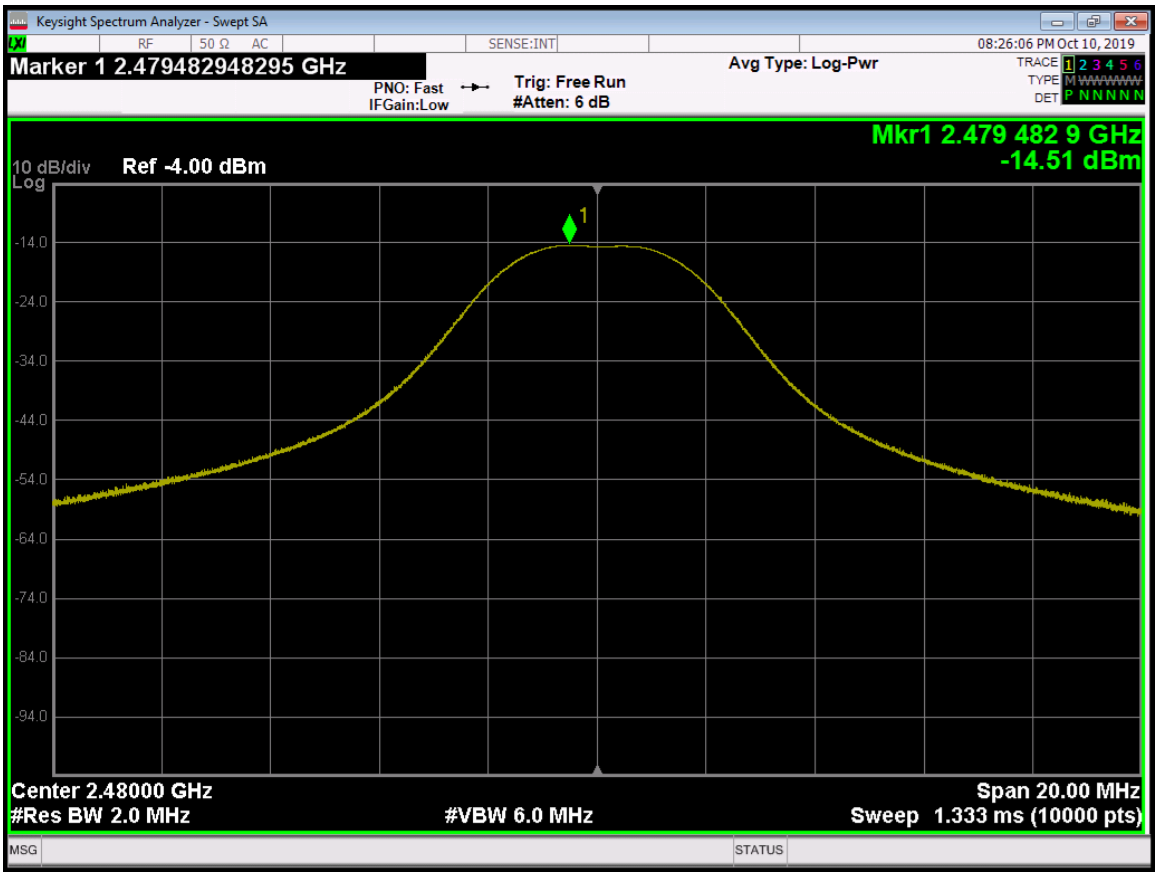
Zigbee (IEEE 802.15.4)
Channel 11

EMT
ELECTRO MAGNETIC TEST, INC.
1547 Plymouth Street, Mountain View, CA 94043 Tel: (650) 965-4000 Fax: (650) 965-3000



Zigbee (IEEE 802.15.4)
Channel 18

EMT
ELECTRO MAGNETIC TEST, INC.
1547 Plymouth Street, Mountain View, CA 94043 Tel: (650) 965-4000 Fax: (650) 965-3000



Zigbee (IEEE 802.15.4)
Channel 26

EMT ELECTRO MAGNETIC TEST, INC.
1547 Plymouth Street, Mountain View, CA 94043 Tel: (650) 965-4000 Fax: (650) 965-3000

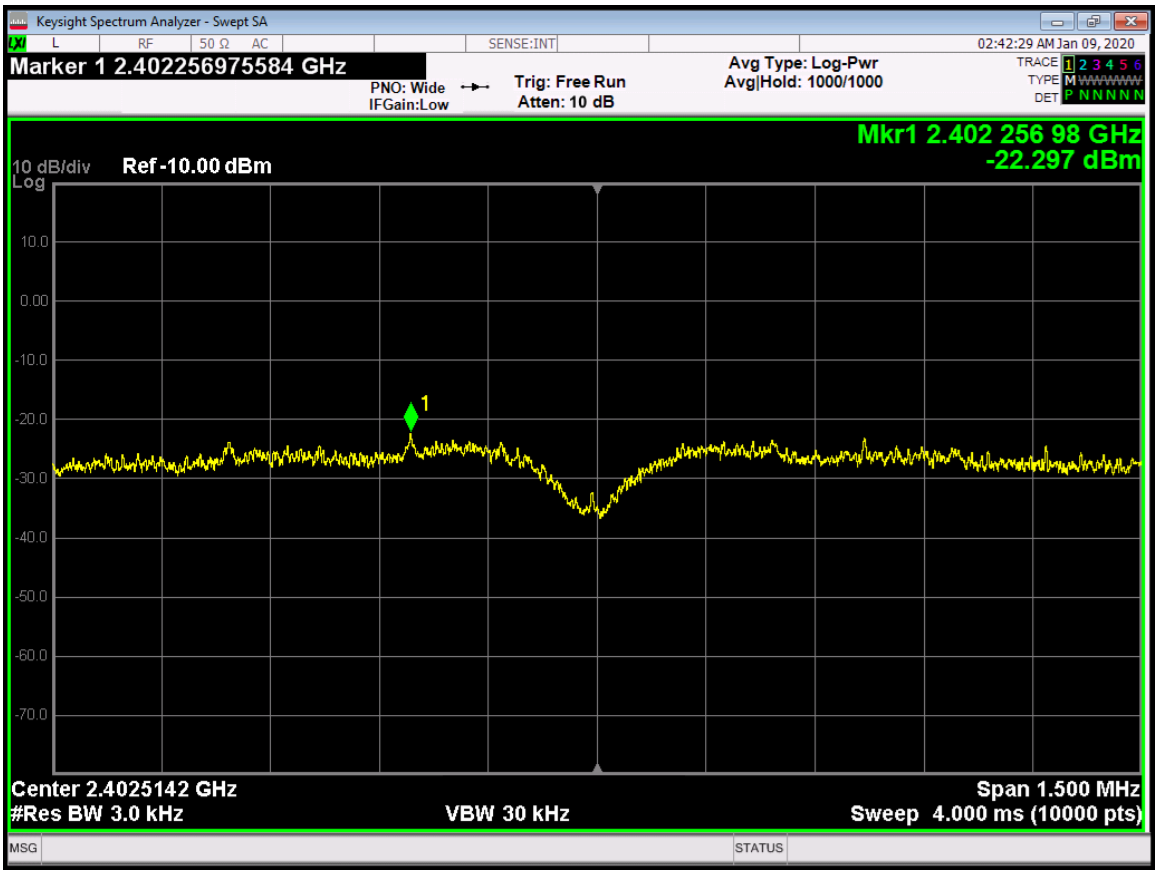
Maximum Power Spectral Density Test Data

Company:	Enlighted Inc.	Test Date	10/07/19
EUT Name	Sensor	Test Engineer	Andreas Davidsson
Model:	SU-5F-2W	Test Result	PASS
Operating Mode	TX Mode		

Mode	Test CH	Frequency (MHz)	Raw Peak (dBm)	Maximum PSD (dBm)	Limit (dBm)	Conclusion
Bluetooth LE	0	2402	-22.297	-10.597	≤ 8	Pass
	19	2440	-31.572	-19.872	≤ 8	Pass
	39	2480	-24.857	-13.157	≤ 8	Pass
Zigbee (IEEE 802.15.4)	11	2405	-18.709	-8.209	≤ 8	Pass
	18	2440	-18.751	-8.251	≤ 8	Pass
	26	2480	-20.943	-10.443	≤ 8	Pass

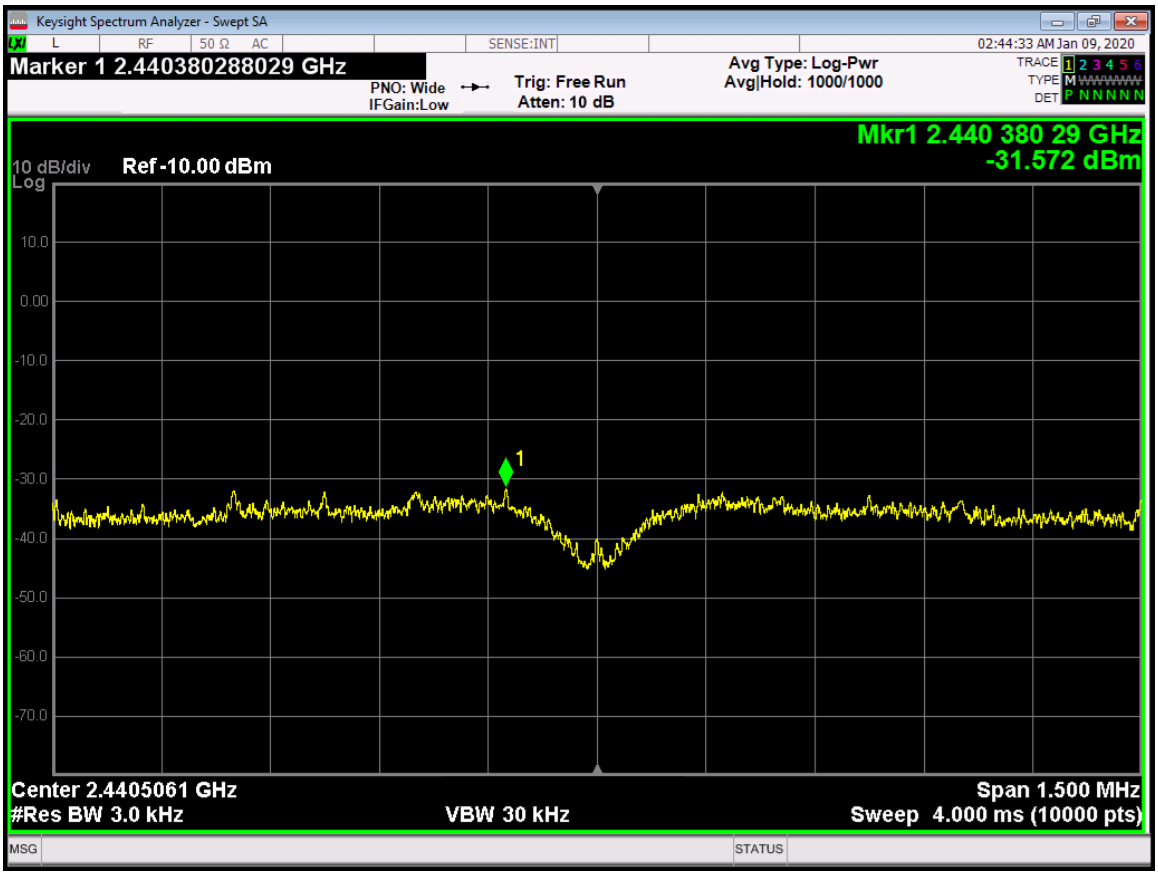
	Test Equipment: Please refer to 5.2
	Peak Calculation (See Section 7.5.2 for calculation explanation)
	Channel 0: ((-22.297-34.4+32.1+4.2)-95.2)-2= -10.597
	Channel 19: ((-31.572-34.4+32.1+4.2)-95.2)-2= -19.872
	Channel 39: ((-24.857-34.4+32.1+4.2)-95.2)-2= -13.157
	Channel 11: ((-18.709-34.4+32.1+4.2)-95.2)-3.2= -8.209
	Channel 18: ((-18.751-34.4+32.1+4.2)-95.2)-3.2= -8.251
	Channel 26: ((-20.943-34.4+32.1+4.2)-95.2)-3.2= -10.443

EMT
ELECTRO MAGNETIC TEST, INC.
1547 Plymouth Street, Mountain View, CA 94043 Tel: (650) 965-4000 Fax: (650) 965-3000



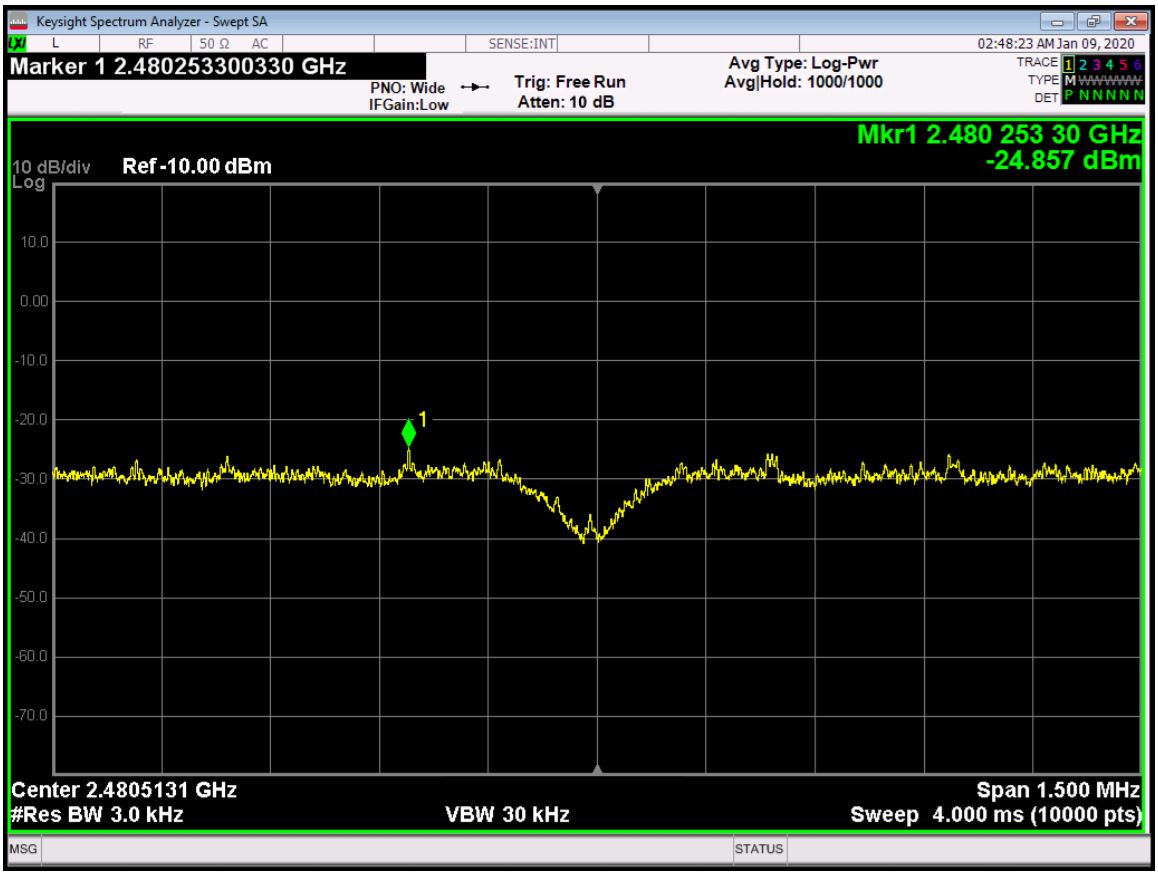
Bluetooth LE
Channel 0

EMT
ELECTRO MAGNETIC TEST, INC.
1547 Plymouth Street, Mountain View, CA 94043 Tel: (650) 965-4000 Fax: (650) 965-3000



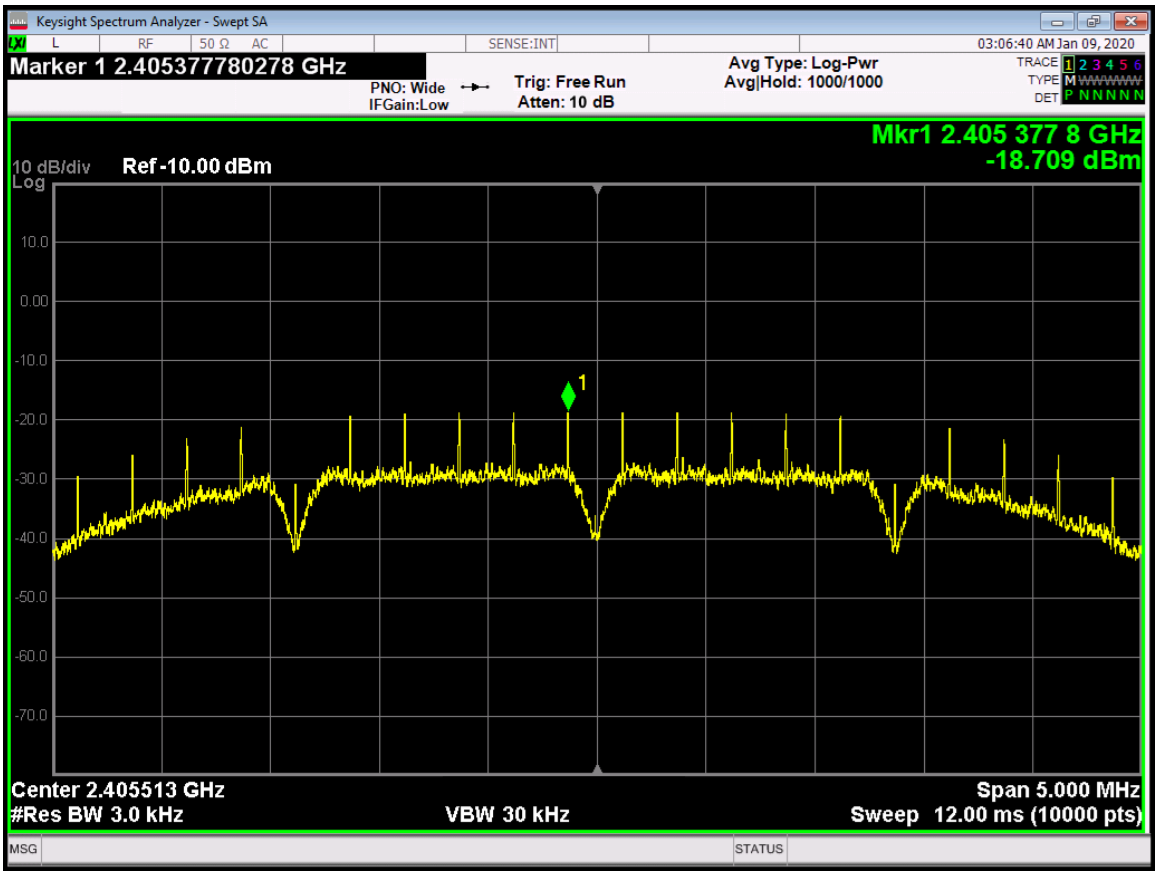
Bluetooth LE
Channel 19

EMT
ELECTRO MAGNETIC TEST, INC.
1547 Plymouth Street, Mountain View, CA 94043 Tel: (650) 965-4000 Fax: (650) 965-3000



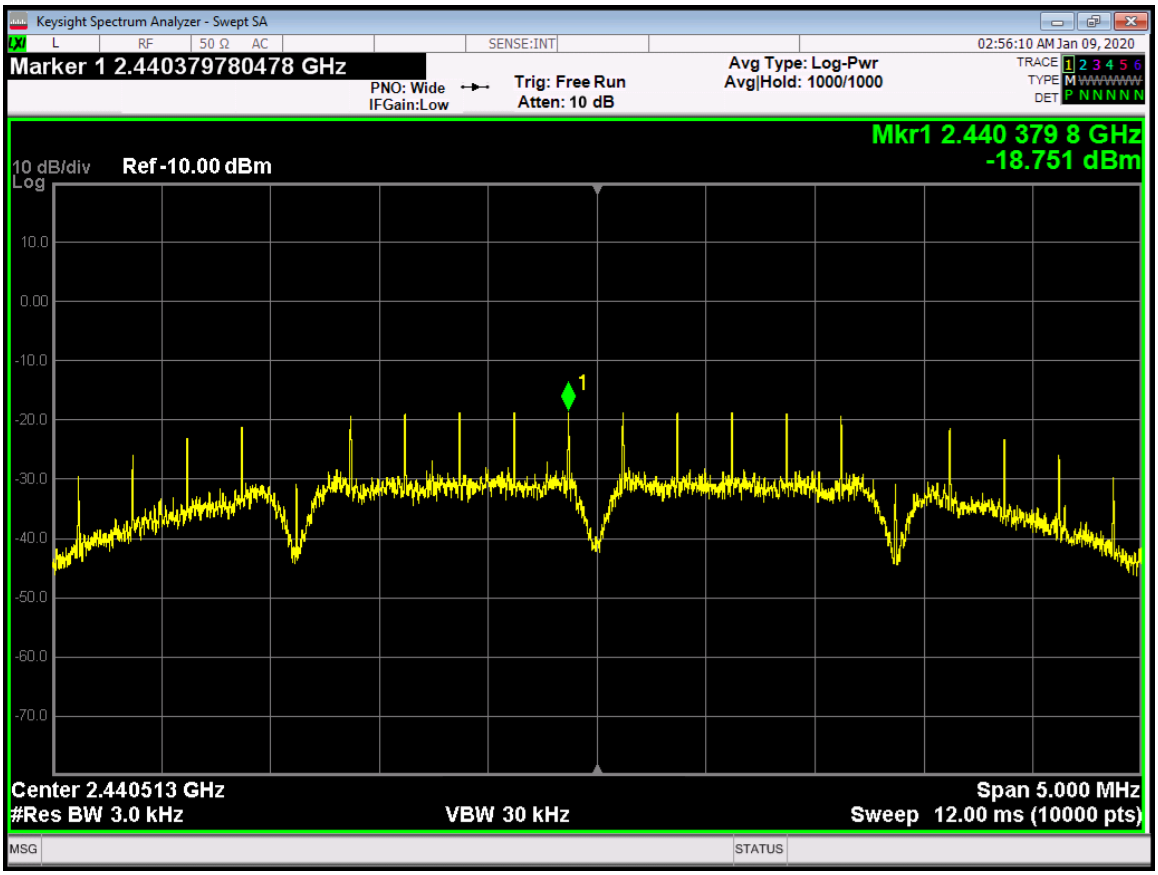
Bluetooth LE
Channel 39

EMT
ELECTRO MAGNETIC TEST, INC.
1547 Plymouth Street, Mountain View, CA 94043 Tel: (650) 965-4000 Fax: (650) 965-3000



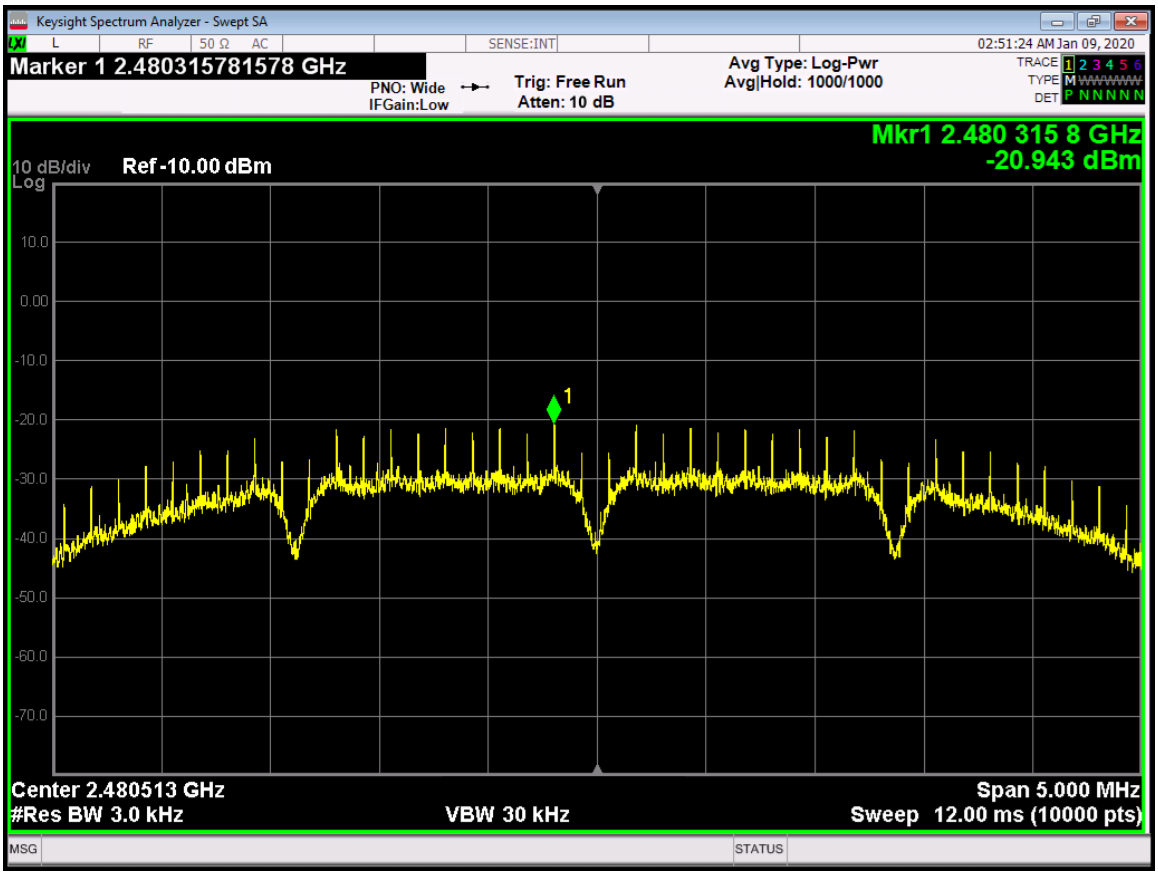
Zigbee (IEEE 802.15.4)
Channel 11

EMT
ELECTRO MAGNETIC TEST, INC.
1547 Plymouth Street, Mountain View, CA 94043 Tel: (650) 965-4000 Fax: (650) 965-3000



Zigbee (IEEE 802.15.4)
Channel 18

EMT
ELECTRO MAGNETIC TEST, INC.
1547 Plymouth Street, Mountain View, CA 94043 Tel: (650) 965-4000 Fax: (650) 965-3000



Zigbee (IEEE 802.15.4)
Channel 26

EMT ELECTRO MAGNETIC TEST, INC.
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APPENDIX B

TEST SETUP DIAGRAMS

EMT ELECTRO MAGNETIC TEST, INC.
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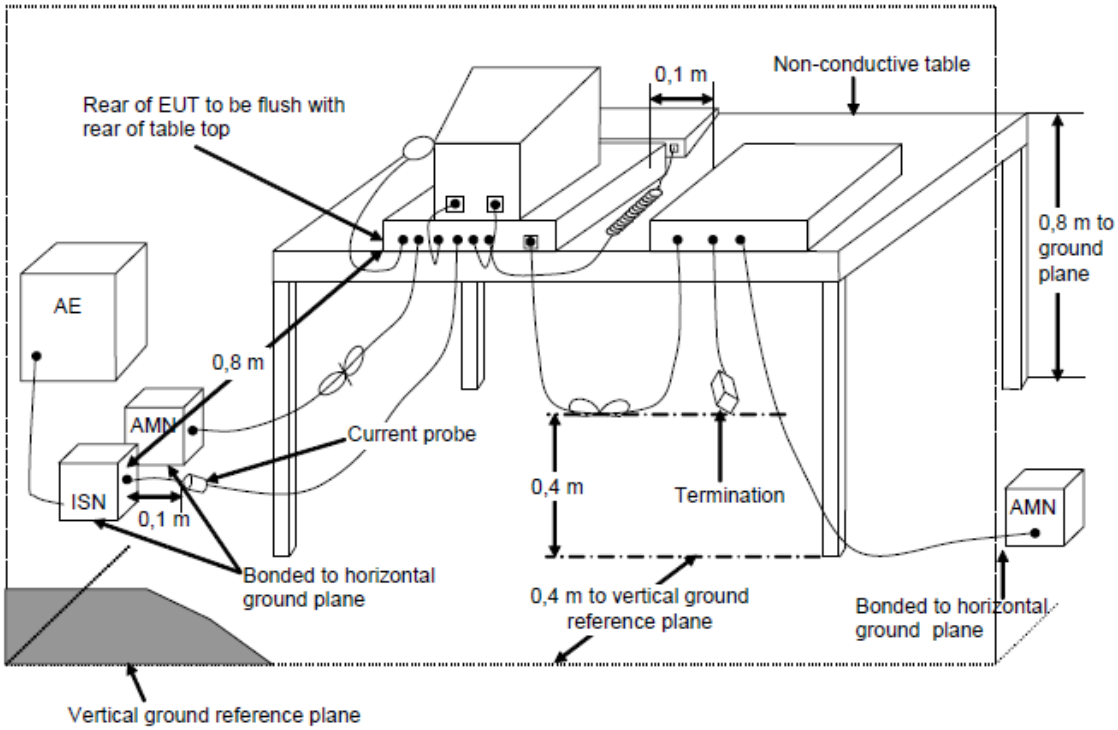

FIGURE 1 – TABLETOP CONDUCTED EMISSIONS TEST SETUP – SITE "D"

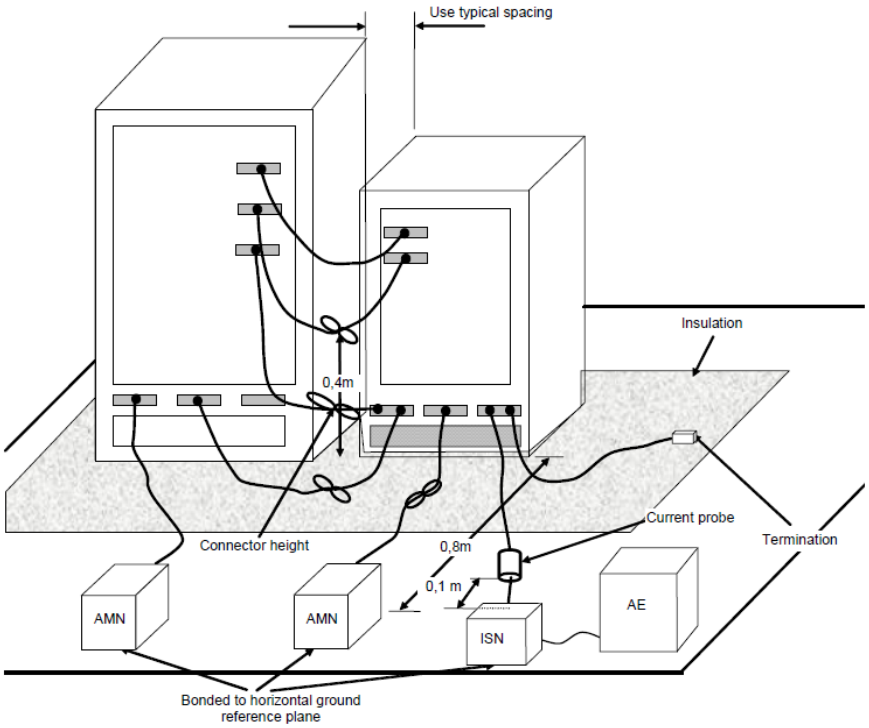

FIGURE 1a – FLOORSTANDING CONDUCTED EMISSIONS TEST SETUP – SITE "D"

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ELECTRO MAGNETIC TEST, INC.
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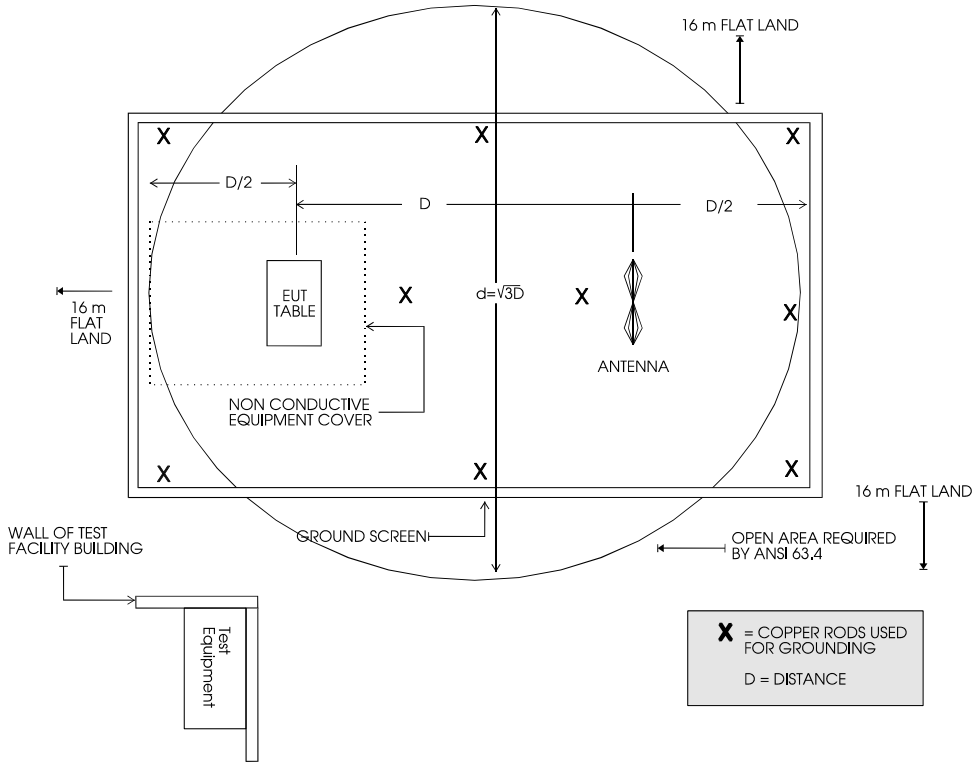

FIGURE 2 - PLOT MAP AND LAYOUT OF TEST SITE "A"

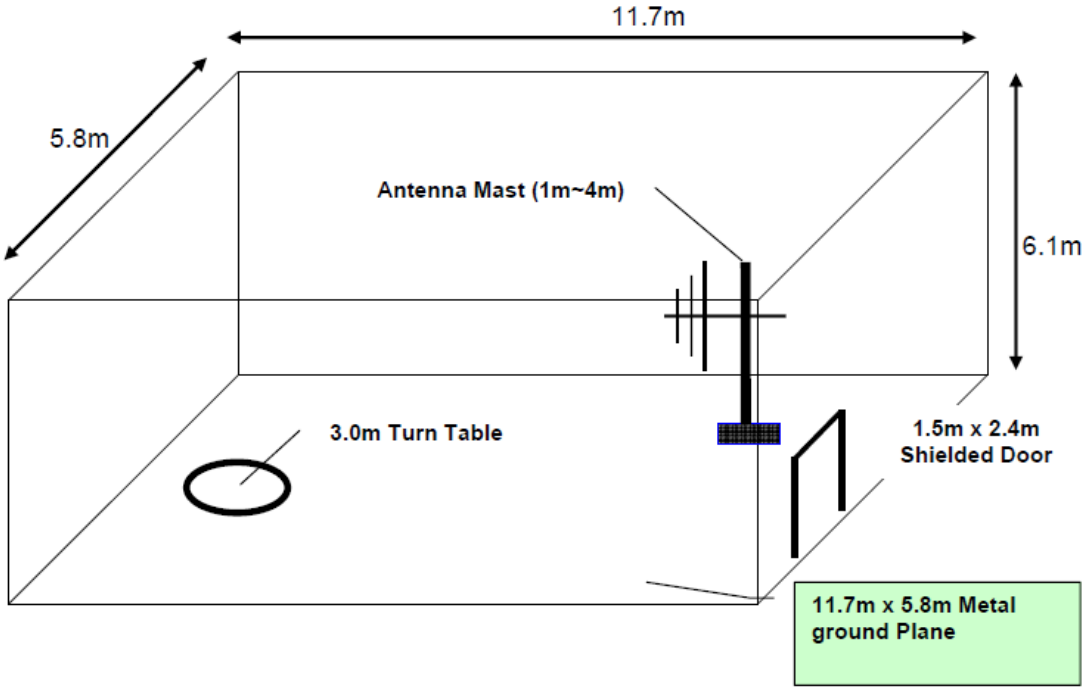

FIGURE 3 - LAYOUT OF 5 METER SEMI-ANECHOIC CHAMBER

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APPENDIX C

MODIFICATIONS TO THE EUT

EMT ELECTRO MAGNETIC TEST, INC.
1547 Plymouth Street, Mountain View, CA 94043 Tel: (650) 965-4000 Fax: (650) 965-3000

MODIFICATIONS TO THE EUT

No modifications were made to the EUT by Electro Magnetic Test, Inc. personnel during the testing.

EMT ELECTRO MAGNETIC TEST, INC.
1547 Plymouth Street, Mountain View, CA 94043 Tel: (650) 965-4000 Fax: (650) 965-3000

APPENDIX D

ADDITIONAL MODELS COVERED UNDER THIS REPORT

EMT ELECTRO MAGNETIC TEST, INC.
1547 Plymouth Street, Mountain View, CA 94043 Tel: (650) 965-4000 Fax: (650) 965-3000

ADDITIONAL MODELS COVERED UNDER THIS REPORT

There are no additional models to be covered under this report.

EMT ELECTRO MAGNETIC TEST, INC.
1547 Plymouth Street, Mountain View, CA 94043 Tel: (650) 965-4000 Fax: (650) 965-3000

End of Report

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