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RF EXPOSURE EVALUATION
Maximum Permissible Exposure (MPE)

Applicant Name:
H&D Wireless AB
Färögatan 33,
SE-164 51 Kista,
Sweden

Date of Testing:
12/14/16 - 1/24/2017
Test Site/Location:
PCTEST Lab, Columbia, MD, USA
Test Report Serial No.:
0Y1612302093-MPE.XO2

FCC ID:	**XO2SPB209A**
APPLICANT:	**H&D Wireless AB**

EUT Type:	Wifi/BT/NFC Module
FCC Rule Part(s):	FCC Part 1 (§1.1310) and Part 2 (§2.1091)
FCC Classification:	Digital Transmission System (DTS), Unlicensed National Information Infrastructure (UNII)
Test Procedure:	KDB 447498 D01 v05r02

The device bearing the FCC Identifier specified above has been shown to comply with the applicable technical standards as indicated in the measurement report and has been tested in accordance with the measurement procedures specified in FCC KDB 447498 D01 v05r02. These measurements were performed with no deviation from the standards. Test results reported herein relate only to the item(s) tested.

I authorize and attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

Randy Ortanez
President

ACCREDITED
TESTING LABORATORY
CERTIFICATE #2041.01

REV 3.2MPE
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1.0 RF EXPOSURE EVALUATION – MAXIMUM PERMISSIBLE EXPOSURE (MPE)

1.1 Introduction

This document is prepared on behalf of H&D Wireless AB to show compliance with the RF Exposure requirements as required in §1.1310 of the FCC Rules and Regulations and RSS-102 of Industry Canada.

The limit for Maximum Permissible Exposure (MPE), specified in FCC §1.1310, is listed in Table 1-1. According to FCC §1.1310 and RSS-102: the criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in §1.1307(b).

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Average Time (Minutes)
(A) Limits For Occupational / Control Exposures (f = frequency)				
30-300	61.4	0.163	1.0	6
300-1500	…	…	f/300	6
1500-100,000	…	…	5.0	6
(B) Limits For General Population / Uncontrolled Exposure (f = frequency)				
30-300	27.5	0.073	0.2	30
300-1500	…	…	f/1500	30
1500-100,000	…	…	1.0	30

Table 1-1. Limits for Maximum Permissible Exposure (MPE)

1.2 EUT Description

The H&D Wireless AB Model: SPB209A is a Wifi/BT/NFC module. For this MPE evaluation, the device is set to transmit from the antenna of each transmitter and the RF exposure of each transmitter is evaluated individually.

EUT:

Model:	SPB209A
Grantee:	H&D Wireless AB
FCC ID:	XO2SPB209A
Antenna(s):	Please see technical description for list of available antenna options

1.3 MPE Requirements Overview

Three different categories of transmitters are defined by the FCC KDB 447498 D01 v05r02. These categories are fixed installation, mobile, and portable and are defined as follows:

- **Fixed Installations:** fixed location means that the device, including its antenna, is physically secured at a permanent location and is not able to be easily moved to another location. Additionally, distance to humans from the antenna is maintained to at least 2 meters.

- **Mobile Devices:** a mobile device is defined as a transmitting device designed to be used in other than fixed locations and to be generally used in such a way that a separation distance of at least 20 centimeters is normally maintained between the transmitter's radiating structures and the body of the user or nearby persons. Transmitters designed to be used by consumers or workers that can be easily re-located, such as a wireless modem operating in a laptop computer, are considered mobile devices if they meet the 20 centimeter separation requirement. The FCC rules for evaluating mobile devices for RF compliance are found in 47 CFR §2.1091.

- **Portable Devices:** a portable device is defined as a transmitting device designed to be used so that the radiating structure(s) of the device is/are within 20 centimeters of the body of the user. Portable device requirements are found in Section 2.1093 of the FCC's Rules (47 CFR§2.1093).

The FCC also categorizes the use of the device as based upon the user's awareness and ability to exercise control over his or her exposure. The two categories defined are Occupational/ Controlled Exposure and General Population/Uncontrolled Exposure. These two categories are defined as follows:

- **Occupational/Controlled Exposure:** In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. This exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means. Awareness of the potential for RF exposure in a workplace or similar environment can be provided through specific training as part of a RF safety program. If appropriate, warning signs and labels can also be used to establish such awareness by providing prominent information on the risk of potential exposure and instructions on methods to minimize such exposure risks.

- **General Population/Uncontrolled Exposure:** The general population / uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity. Warning labels placed on low-power consumer devices such as cellular telephones are not considered sufficient to allow the device to be considered under the occupational/controlled category, and the general population/uncontrolled exposure limits apply to these devices.

The H&D Wireless AB Wifi/BT/NFC Module FCC ID: XO2SPB209A is evaluated to the Mobile Device requirements and is considered a device to be used by the General Population/Uncontrolled Exposure.

1.4 Procedure

The procedure used to determine the RF power density was based upon a calculation for determining compliance with the MPE requirements.

The power generated by each transmitter used in this product was initially measured by a power meter and the powers were recorded. Through use of the Friis transmission formula and knowledge of the maximum antenna gain to be used, the power density level is calculated at a distance of 20cm.

The antenna gains of each antenna to be used with the different available transmitters were used to calculate the MPE in all relevant bands of operation.

Friis Transmission Formula

Friis transmission formula: $P_d = (P_{out}*G) / (4\pi r^2)$

Where,

P_d = Power Density (mW/cm^2) π = 3.1416
P_{out} = output power to antenna (mW) r = distance between observation point and center of the radiator (cm)
G = gain of antenna in linear scale

Calculated MPE

The power density limit for General Population/Uncontrolled Exposure at each frequency is determined based on the information in Table 1-1.

There is no co-location between the electric fields of any two transmitters therefore following power densities are calculated for each individual transmitter by frequency at 20cm spacing:

Test Configuration

The UUT is powered by an external DC Power Supply and inserted in SD card slot of a laptop to be configured into test mode. There are four test cases with different antenna types:

Test Case 1: UUT S/N: 164701 with Fractus FR05-S1-NO-1-004 Antenna mounted directly on the module.
Test Case 2: UUT S/N: 164602 with Taoglas FXP832.03.0458D Antenna connected to a RP-SMA connector on the module.
Test Case 3: UUT S/N: 164602 with Taoglas GW.40.2153 Antenna connected to a RP-SMA connector on the module.
Test Case 4: UUT S/N: 164602 with Walsin RFDPA870900SBLB8G1 Antenna connected to a RP-SMA connector on the module.

Frequency	2412	MHz		
Limit	1.000	mW/cm^2		
Distance (cm), R =	20	cm		
Power (dBm), P =	16.01	dBm	39.90	mW
TX Ant Gain (dB), G =	1.8	dBi		
Power Density (S) =	**0.012**	mW/cm^2	(at 20cm)	
Minimum Distance =	**2.2**	cm		

Table 1-2. Calculated MPE Data for 2.4GHz Band (Fractus Antenna)

Frequency	2412	MHz		
Limit	1.000	mW/cm^2		
Distance (cm), R =	20	cm		
Power (dBm), P =	16.01	dBm	39.90	mW
TX Ant Gain (dB), G =	3.7	dBi		
Power Density (S) =	**0.019**	mW/cm^2	(at 20cm)	
Minimum Distance =	**2.7**	cm		

Table 1-3. Calculated MPE Data for 2.4GHz Band (Taoglas GW Antenna)

Frequency	2412	MHz		
Limit	1.000	mW/cm^2		
Distance (cm), R =	20	cm		
Power (dBm), P =	16.01	dBm	39.90	mW
TX Ant Gain (dB), G =	3.7	dBi		
Power Density (S) =	**0.019**	mW/cm^2	(at 20cm)	
Minimum Distance =	**2.7**	cm		

Table 1-4. Calculated MPE Data for 2.4GHz Band (Taoglas FX Antenna)

Frequency	2412	MHz		
Limit	1.000	mW/cm^2		
Distance (cm), R =	20	cm		
Power (dBm), P =	16.01	dBm	39.90	mW
TX Ant Gain (dB), G =	2	dBi		
Power Density (S) =	**0.013**	mW/cm^2	(at 20cm)	
Minimum Distance =	**2.2**	cm		

Table 1-5. Calculated MPE Data for 2.4GHz Band (Walsin Antenna)

Frequency	5240	MHz		
Limit	1.000	mW/cm^2		
Distance (cm), R =	20	cm		
Power (dBm), P =	14.55	dBm	28.51	mW
TX Ant Gain (dB), G =	4.9	dBi		
Power Density (S) =	**0.018**	mW/cm^2	(at 20cm)	
Minimum Distance =	**2.6**	cm		

Table 1-6. Calculated MPE Data for 5GHz Band (Fractus Antenna)

Frequency	5240	MHz		
Limit	1.000	mW/cm^2		
Distance (cm), R =	20	cm		
Power (dBm), P =	14.55	dBm	28.51	mW
TX Ant Gain (dB), G =	2.5	dBi		
Power Density (S) =	**0.010**	mW/cm^2	(at 20cm)	
Minimum Distance =	**2.0**	cm		

Table 1-7. Calculated MPE Data for 5GHz Band (Taoglas GW Antenna)

Frequency	5240	MHz		
Limit	1.000	mW/cm^2		
Distance (cm), R =	20	cm		
Power (dBm), P =	14.55	dBm	28.51	mW
TX Ant Gain (dB), G =	5.3	dBi		
Power Density (S) =	**0.019**	mW/cm^2	(at 20cm)	
Minimum Distance =	**2.8**	cm		

Table 1-8. Calculated MPE Data for 5GHz Band (Taoglas FX Antenna)

Frequency	5240	MHz		
Limit	1.000	mW/cm^2		
Distance (cm), R =	20	cm		
Power (dBm), P =	14.55	dBm	28.51	mW
TX Ant Gain (dB), G =	3	dBi		
Power Density (S) =	**0.011**	mW/cm^2	(at 20cm)	
Minimum Distance =	**2.1**	cm		

Table 1-9. Calculated MPE Data for 5GHz Band (Walsin Antenna)

1.5 Summary of Results

Frequency Band	Maximum Antenna Gain [dBi]	MPE @ 20cm (mW/cm^2)	Test Result
2.4 GHz	3.7	0.019	PASS
5 GHz	5.3	0.019	PASS

Table 1-10. Maximum Permissible Exposure Summary Table

2.0 CONCLUSION

The device meets the mobile RF exposure limit at a 20cm separation distance as specified in §2.1091 of the FCC Rules and Regulations and Health Canada Safety Code 6. An appropriate RF exposure compliance statement will be placed in the user's manual.