



# RF EXPOSURE REPORT

**REPORT NO.:** SA970918H10

**MODEL NO.:** DAP-3520

**ACCORDING:** FCC Guidelines for Human Exposure  
IEEE C95.1

**APPLICANT:** D-Link Co.

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**ISSUED BY:** Bureau Veritas Consumer Products Services (H.K.)  
Ltd., Taoyuan Branch

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# RF Exposure Measurement

## 1. Introduction

In this document, we try to prove the safety of radiation harmfulness to the human body for our product. The limit for Maximum Permissible Exposure (MPE) specified in FCC 1.1310 is followed. The Gain of the antenna used in this product is measured in a Fully Anechoic Chamber (FAC) calibrated for antenna measurement in our lab, and also the maximum total power input to the antenna is measured. Through the Friis transmission formula and the maximum gain of the antenna, we can calculate the distance, away from the product, where the limit of MPE is reached.

Although the Friis transmission formula is a far field assumption, the calculated result of that is an over-prediction for near field power density. We will take that as the worst case to specify the safety range.

## 2. RF Exposure Limit

According to FCC 1.1310: 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)

### LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm <sup>2</sup> )	Average Time (minutes)
<b>(A)Limits For Occupational / Control Exposures</b>				
300-1500	...	...	F/300	6
1500-100,000	...	...	5	6
<b>(B)Limits For General Population / Uncontrolled Exposure</b>				
300-1500	...	...	F/1500	6
1500-100,000	...	...	1.0	30

F = Frequency in MHz

### 3. Friis Formula

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

where

$P_d$  = power density in  $mW/cm^2$

$P_{out}$  = output power to antenna in mW

$G$  = gain of antenna in linear scale

$\pi = 3.1416$

$R$  = distance between observation point and center of the radiator in cm

$P_d$  is the limit of MPE,  $1 mW/cm^2$ . If we know the maximum Gain of the antenna and the total power input to the antenna, through the calculation, we will know the MPE value at distance 20cm.

Ref. : David K. Cheng, *Field and Wave Electromagnetics*, Second Edition,  
Page 640, Eq. (11-133).

### 4. EUT Operating condition

The software provided by Manufacturer enabled the EUT to transmit and receive data at lowest, middle and highest channel individually.

### 5. Classification

The antenna of this product, under normal use condition, is at least 20cm away from the body of the user. Warning statement to the user for keeping at least 20cm or more separation distance with the antenna should be included in users manual. So, this device is classified as **Mobile Device**

## 6. Test Results

### 6.1 Antenna Gain

There are two set of antennas provided to this EUT, please refer to the following table:

Antenna Set 1 (Internal antenna):						
Transmitter Circuit	Manufacture	Antenna Model	For 2.4GHz Gain (dBi)	For 5GHz Gain (dBi)	Antenna Type	Connector
Chain(0)	SmartAnt Telecom Co., Ltd.	DWL08-220190	8	10	PCB	MMCX R/A plug
Chain (1)	SmartAnt Telecom Co., Ltd.	DWL08-220190	8	10	PCB	MMCX R/A plug
Antenna Set 2 (External antenna):						
Transmitter Circuit	Manufacture	Antenna Model	Antenna Gain	Only 2.4GHz	Antenna Type	Connector
Chain(0)	SmartAnt Telecom Co., Ltd.	ANT24-0800 (DWL07-050660)	Gain (dBi)	8	DIPOLE	N-jack
			Cable Loss (dB)	3		
			Net Gain (dBi)	5		
			Cable length (m)	6		
Chain(1)	SmartAnt Telecom Co., Ltd.	ANT24-0800 (DWL07-050660)	Gain (dBi)	8	DIPOLE	N-jack
			Cable Loss (dB)	3		
			Net Gain (dBi)	5		
			Cable length (m)	6		
Note: While EUT connect with antenna set 2, the function of antenna set 1 were lose.						

## 6.2 Output Power Into Antenna & RF Exposure value at distance 20cm:

**For 15.247(2.4GHz – with PCB antenna) :**

**For Part 802.11b:**

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm <sup>2</sup> )	Limit of Power Density (mW/cm <sup>2</sup> )
1	2412	226.509	0.284	1.0
6	2437	495.568	0.622	1.0
11	2462	231.001	0.290	1.0

**For Part 802.11g:**

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm <sup>2</sup> )	Limit of Power Density (mW/cm <sup>2</sup> )
1	2412	432.636	0.543	1.0
6	2437	384.362	0.482	1.0
11	2462	433.145	0.544	1.0

**DRAFT 802.11n (20MHz) OFDM**

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm <sup>2</sup> )	Limit of Power Density (mW/cm <sup>2</sup> )
1	2412	458.725	0.576	1.0
6	2437	369.536	0.464	1.0
11	2462	342.923	0.430	1.0

**DRAFT 802.11n (40MHz) OFDM**

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm <sup>2</sup> )	Limit of Power Density (mW/cm <sup>2</sup> )
1	2422	248.373	0.312	1.0
4	2437	447.888	0.562	1.0
7	2452	322.296	0.405	1.0

**For 15.247(2.4GHz – with Dipole antenna) :**

**For Part 802.11b:**

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm <sup>2</sup> )	Limit of Power Density (mW/cm <sup>2</sup> )
1	2412	181.898	0.114	1.0
6	2437	302.333	0.190	1.0
11	2462	129.528	0.081	1.0

**For Part 802.11g:**

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm <sup>2</sup> )	Limit of Power Density (mW/cm <sup>2</sup> )
1	2412	347.967	0.219	1.0
6	2437	508.200	0.320	1.0
11	2462	237.647	0.150	1.0

**DRAFT 802.11n (20MHz) OFDM**

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm <sup>2</sup> )	Limit of Power Density (mW/cm <sup>2</sup> )
1	2412	380.928	0.240	1.0
6	2437	510.650	0.321	1.0
11	2462	259.620	0.163	1.0

**DRAFT 802.11n (40MHz) OFDM**

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm <sup>2</sup> )	Limit of Power Density (mW/cm <sup>2</sup> )
1	2422	238.001	0.150	1.0
4	2437	399.180	0.251	1.0
7	2452	194.872	0.123	1.0

**For 15.247(5GHz – with PCB antenna) :**

**For Part 802.11a:**

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm <sup>2</sup> )	Limit of Power Density (mW/cm <sup>2</sup> )
1	5745	266.171	0.530	1.0
3	5785	284.382	0.566	1.0
5	5825	381.496	0.759	1.0

**For DRAFT 802.11n (20MHz) OFDM:**

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm <sup>2</sup> )	Limit of Power Density (mW/cm <sup>2</sup> )
1	5745	259.359	0.516	1.0
3	5785	274.383	0.546	1.0
5	5825	341.902	0.680	1.0

**DRAFT 802.11n (40MHz) OFDM**

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm <sup>2</sup> )	Limit of Power Density (mW/cm <sup>2</sup> )
1	5755	225.893	0.449	1.0
2	5795	284.382	0.566	1.0