



# RF EXPOSURE REPORT

**REPORT NO.:** SA970312L14A

**MODEL NO.:** DIR-855

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

**APPLICANT:** D-Link Corporation

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**ISSUED BY:** Bureau Veritas Consumer Products Services  
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## RF EXPOSURE MEASUREMENT (MOBILE DEVICE)

### 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 ADT, 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	30
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

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  $r$ .

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

The maximum Gain measured in Fully Anechoic Chamber is 2dBi or 1.585(numeric).

### 6.2 OUTPUT POWER INTO ANTENNA & RF EXPOSURE VALUE AT DISTANCE 20cm:

**FOR 2.400 ~ 2.4385GHz BAND:**

#### 802.11b DSSS MODULATION:

CHANNEL	CHANNEL FREQUENCY (MHz)	PEAK POWER OUTPUT (mW)	PEAK POWER OUTPUT (dBm)	POWER DENSITY (mW/CM <sup>2</sup> )	LIMIT OF POWER DENSITY (mW/CM <sup>2</sup> )
1	2412	63.387	18.02	0.020	1.000
6	2437	64.269	18.08	0.020	1.000
11	2462	63.096	18.00	0.020	1.000

#### 802.11g OFDM MODULATION:

CHANNEL	CHANNEL FREQUENCY (MHz)	PEAK POWER OUTPUT (mW)	PEAK POWER OUTPUT (dBm)	POWER DENSITY (mW/CM <sup>2</sup> )	LIMIT OF POWER DENSITY (mW/CM <sup>2</sup> )
1	2412	50.466	17.03	0.016	1.000
6	2437	51.050	17.08	0.016	1.000
11	2462	50.699	17.05	0.016	1.000

#### DRAFT 802.11n (20MHz) OFDM MODULATION:

CHAN.	CHAN. FREQ. (MHz)	PEAK POWER OUTPUT (dBm)			TOTAL PEAK POWER (mW)	TOTAL PEAK POWER (dBm)	POWER DENSITY (mW/CM <sup>2</sup> )	LIMIT OF POWER DENSITY (mW/CM <sup>2</sup> )
		CHAIN 0	CHAIN 1	CHAIN 2				
1	2412	12.06	12.05	12.05	48.134	16.82	0.015	1.000
6	2437	12.02	12.01	12.00	47.656	16.78	0.015	1.000
11	2462	12.08	12.07	12.04	48.246	16.83	0.015	1.000

#### DRAFT 802.11n (40MHz) OFDM MODULATION:

CHAN.	CHAN. FREQ. (MHz)	PEAK POWER OUTPUT (dBm)			TOTAL PEAK POWER (mW)	TOTAL PEAK POWER (dBm)	POWER DENSITY (mW/CM <sup>2</sup> )	LIMIT OF POWER DENSITY (mW/CM <sup>2</sup> )
		CHAIN 0	CHAIN 1	CHAIN 2				
1	2422	10.11	10.06	10.11	30.652	14.86	0.010	1.000
4	2437	10.04	10.02	10.09	30.348	14.82	0.010	1.000
7	2452	10.04	10.07	10.08	30.441	14.83	0.010	1.000



### FOR 5.150 ~ 5.350GHz, 5.470 ~ 5.725GHz BAND:

#### 802.11a OFDM MODULATION:

CHANNEL	CHANNEL FREQUENCY (MHz)	PEAK POWER OUTPUT (mW)	PEAK POWER OUTPUT (dBm)	POWER DENSITY (mW/CM <sup>2</sup> )	LIMIT OF POWER DENSITY (mW/CM <sup>2</sup> )
36	5180	26.062	14.16	0.008	1.000
40	5200	27.990	14.47	0.009	1.000
48	5240	25.882	14.13	0.008	1.000
52	5260	22.751	13.57	0.005	1.000
60	5300	23.823	13.77	0.005	1.000
64	5320	23.496	13.71	0.005	1.000
100	5500	22.961	13.61	0.005	1.000
120	5600	23.388	13.69	0.005	1.000
140	5700	22.856	13.59	0.005	1.000

#### DRAFT 802.11n (20MHz) OFDM MODULATION:

CHAN.	CHAN. FREQ. (MHz)	PEAK POWER OUTPUT (dBm)			TOTAL PEAK POWER (mW)	TOTAL PEAK POWER (dBm)	POWER DENSITY (mW/CM <sup>2</sup> )	LIMIT OF POWER DENSITY (mW/CM <sup>2</sup> )
		CHAIN 0	CHAIN 1	CHAIN 2				
36	5180	10.79	10.82	10.02	34.119	15.33	0.011	1.000
40	5200	10.89	10.90	10.20	35.048	15.45	0.011	1.000
48	5240	10.43	10.23	10.13	31.889	15.04	0.010	1.000
52	5260	9.90	9.69	9.55	28.099	14.49	0.006	1.000
60	5300	10.07	9.78	9.68	28.958	14.62	0.006	1.000
64	5320	9.85	9.58	9.54	27.734	14.43	0.006	1.000
100	5500	10.01	9.64	9.51	28.161	14.50	0.006	1.000
120	5600	10.18	9.82	9.75	29.458	14.69	0.006	1.000
140	5700	9.88	9.80	9.67	28.546	14.56	0.006	1.000

#### DRAFT 802.11n (40MHz) OFDM MODULATION:

CHAN.	CHAN. FREQ. (MHz)	PEAK POWER OUTPUT (dBm)			TOTAL PEAK POWER (mW)	TOTAL PEAK POWER (dBm)	POWER DENSITY (mW/CM <sup>2</sup> )	LIMIT OF POWER DENSITY (mW/CM <sup>2</sup> )
		CHAIN 0	CHAIN 1	CHAIN 2				
38	5190	10.06	11.01	11.11	35.670	15.52	0.011	1.000
46	5230	10.13	11.18	11.14	36.428	15.61	0.011	1.000
54	5270	10.28	9.72	9.69	29.353	14.68	0.006	1.000
62	5310	10.13	9.62	9.66	28.713	14.58	0.006	1.000
102	5510	10.20	9.69	9.56	28.819	14.60	0.006	1.000
118	5590	10.11	9.74	9.66	28.922	14.61	0.006	1.000
134	5670	9.91	9.78	9.58	28.379	14.53	0.006	1.000

### FOR 5.725 ~ 5.850GHz BAND:

#### 802.11a OFDM MODULATION:

CHANNEL	CHANNEL FREQUENCY (MHz)	PEAK POWER OUTPUT (mW)	PEAK POWER OUTPUT (dBm)	POWER DENSITY (mW/CM <sup>2</sup> )	LIMIT OF POWER DENSITY (mW/CM <sup>2</sup> )
149	5745	51.168	17.09	0.016	1.000
157	5785	50.234	17.01	0.016	1.000
165	5825	50.933	17.07	0.016	1.000

#### DRAFT 802.11n (20MHz) OFDM MODULATION:

CHAN.	CHAN. FREQ. (MHz)	PEAK POWER OUTPUT (dBm)			TOTAL PEAK POWER (mW)	TOTAL PEAK POWER (dBm)	POWER DENSITY (mW/CM <sup>2</sup> )	LIMIT OF POWER DENSITY (mW/CM <sup>2</sup> )
		CHAIN 0	CHAIN 1	CHAIN 2				
149	5745	16.53	15.51	15.54	116.351	20.66	0.037	1.000
157	5785	16.61	15.65	15.62	119.018	20.76	0.038	1.000
165	5825	16.50	15.54	15.51	116.041	20.65	0.037	1.000

#### DRAFT 802.11n (40MHz) OFDM MODULATION:

CHAN.	CHAN. FREQ. (MHz)	PEAK POWER OUTPUT (dBm)			TOTAL PEAK POWER (mW)	TOTAL PEAK POWER (dBm)	POWER DENSITY (mW/CM <sup>2</sup> )	LIMIT OF POWER DENSITY (mW/CM <sup>2</sup> )
		CHAIN 0	CHAIN 1	CHAIN 2				
151	5755	13.50	13.58	13.53	67.733	18.31	0.021	1.000
159	5795	13.59	13.58	13.53	68.202	18.34	0.022	1.000

#### CONCLUSION:

The EUT can transmit 2.4GHz & 5.0GHz simultaneously, the formula of calculated the MPE is:

$$CPD1 / LPD1 + CPD2 / LPD2 + \dots \text{etc.} < 1$$

CPD = Calculation power density

LPD = Limit of power density

$$\text{Maximum MPE of WLAN 2.4G} + \text{Maximum MPE of WLAN 5.0G} = 0.020 + 0.038 = 0.058$$

Therefore, the maximum calculation of this situation is 0.058, which is less than the "1" limit.