



# RF EXPOSURE REPORT

**REPORT NO.:** SA970630L13

**MODEL NO.:** DIR-825

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

**APPLICANT:** D-Link Corporation

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**ISSUED BY:** Advance Data Technology Corporation

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R.O.C.



## 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<sup>2</sup>

$P_{out}$  = 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	89.536	19.52	0.028	1.000
6	2437	89.536	19.52	0.028	1.000
11	2462	90.782	19.58	0.029	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	90.991	19.59	0.029	1.000
6	2437	102.094	20.09	0.032	1.000
11	2462	89.743	19.53	0.028	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				
1	2412	15.52	15.53	71.372	18.54	0.023	1.000
6	2437	17.60	17.50	113.778	20.56	0.036	1.000
11	2462	14.56	14.56	57.152	17.57	0.018	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				
1	2422	12.51	11.59	32.245	15.08	0.010	1.000
4	2437	16.04	15.56	76.154	18.82	0.024	1.000
7	2452	12.08	11.53	30.367	14.82	0.010	1.000

### For 5.150 ~ 5.250GHz 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	16.032	12.05	0.005	1.000
40	5200	16.181	12.09	0.005	1.000
48	5240	15.996	12.04	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				
36	5180	9.56	8.53	16.165	12.09	0.005	1.000
40	5200	12.09	12.10	32.399	15.11	0.010	1.000
48	5240	12.04	12.02	31.918	15.04	0.010	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				
38	5190	9.57	9.64	18.262	12.62	0.006	1.000
46	5230	11.55	11.61	28.777	14.59	0.009	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	50.816	17.06	0.016	1.000
157	5785	51.050	17.08	0.016	1.000
165	5825	56.754	17.54	0.018	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				
149	5745	16.60	16.07	86.166	19.35	0.027	1.000
157	5785	16.63	16.13	87.046	19.40	0.027	1.000
165	5825	12.52	12.07	33.971	15.31	0.011	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				
151	5755	15.56	15.05	67.964	18.32	0.021	1.000
159	5795	15.50	15.02	67.250	18.28	0.021	1.000

#### CONCLUSION:

Both of the modules can transmit simultaneously, the formula of calculated the MPE is:

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

CPD = Calculation power density

LPD = Limit of power density

WLAN 2.4G + WLAN 5.0G = 0.036 + 0.027 = 0.063

Therefore, the maximum calculation of this situation is 0.063, which is less than the "1" limit.