



RF EXPOSURE REPORT

REPORT NO.: SA980504L06

MODEL NO.: ZF7762

ACCORDING: FCC Guidelines for Human Exposure
IEEE C95.1

Applicant's Company	Senao Networks, Inc.
Applicant Address	3F, No. 529, Chung Cheng Rd., Hsintien, Taipei, Taiwan
FCC ID	U2M-ZF7762
Manufacturer's Company	Senao Networks, Inc.
Manufacturer Address	3F, No. 529, Chung Cheng Rd., Hsintien, Taipei, Taiwan

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

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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 ²)	AVERAGE TIME (minutes)
(A)LIMITS FOR OCCUPATIONAL / CONTROL EXPOSURES				
300-1500	F/300	6
1500-100,000	5	6
(B)LIMITS FOR GENERAL POPULATION / UNCONTROLLED EXPOSURE				
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/cm²

P_{out} = output power to antenna in mW

G = gain of antenna in linear scale

π = 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 are 3dBi or 1.99526(numeric) and 14dBi or 25.1189(numeric).

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

Internal antenna with 3dBi gain:

For 2.4GHz band:

802.11b DSSS MODULATION:

CHAN.	CHAN. FREQ. (MHz)	PEAK POWER OUTPUT (dBm)			TOTAL PEAK POWER (mW)	TOTAL PEAK POWER (dBm)	POWER DENSITY (mW/cm ²)	LIMIT OF POWER DENSITY (mW/cm ²)
		CHAIN 0	CHAIN 1	CHAIN 2				
1	2412	23.01	23.06	23.04	603.66	27.81	0.240	1.000
6	2437	23.03	23.07	23.03	604.59	27.81	0.240	1.000
11	2462	23.03	23.06	23.07	605.98	27.82	0.241	1.000

802.11g OFDM MODULATION:

CHAN.	CHAN. FREQ. (MHz)	PEAK POWER OUTPUT (dBm)			TOTAL PEAK POWER (mW)	TOTAL PEAK POWER (dBm)	POWER DENSITY (mW/cm ²)	LIMIT OF POWER DENSITY (mW/cm ²)
		CHAIN 0	CHAIN 1	CHAIN 2				
1	2412	22.06	22.12	22.09	485.43	26.86	0.193	1.000
6	2437	22.13	22.11	22.01	484.72	26.85	0.192	1.000
11	2462	22.04	22.13	22.02	482.48	26.83	0.192	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 ²)	LIMIT OF POWER DENSITY (mW/cm ²)
		CHAIN 0	CHAIN 1	CHAIN 2				
1	2412	22.01	22.04	22.14	482.49	26.83	0.192	1.000
6	2437	22.08	22.13	22.14	488.42	26.89	0.194	1.000
11	2462	22.11	22.09	22.01	483.22	26.84	0.192	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 ²)	LIMIT OF POWER DENSITY (mW/cm ²)
		CHAIN 0	CHAIN 1	CHAIN 2				
1	2422	22.11	22.11	22.12	488.04	26.88	0.194	1.000
4	2437	22.04	22.08	22.11	483.95	26.85	0.192	1.000
7	2452	22.09	22.03	22.13	484.70	26.85	0.192	1.000

Internal antenna with 3dBi gain:**For 5.0GHz band:****802.11a OFDM MODULATION:**

CHAN.	CHAN. FREQ. (MHz)	POWER OUTPUT (dBm)			TOTAL POWER (mW)	TOTAL POWER (dBm)	POWER DENSITY (mW/cm ²)	LIMIT OF POWER DENSITY (mW/cm ²)
		CHAIN 0	CHAIN 1	CHAIN 2				
36	5180	11.06	11.07	11.01	38.18	15.82	0.015	1.000
40	5200	11.06	11.05	11.07	38.29	15.83	0.015	1.000
48	5240	11.11	11.03	11.10	38.47	15.85	0.015	1.000
149	5745	19.01	19.11	19.10	242.37	23.84	0.096	1.000
157	5785	19.12	19.05	19.10	243.29	23.86	0.097	1.000
165	5825	19.09	19.08	19.07	242.73	23.85	0.096	1.000

DRAFT 802.11n (20MHz) OFDM MODULATION:

CHAN.	CHAN. FREQ. (MHz)	POWER OUTPUT (dBm)			TOTAL POWER (mW)	TOTAL POWER (dBm)	POWER DENSITY (mW/cm ²)	LIMIT OF POWER DENSITY (mW/cm ²)
		CHAIN 0	CHAIN 1	CHAIN 2				
36	5180	11.12	11.14	11.05	38.68	15.87	0.015	1.000
40	5200	11.04	11.07	11.04	38.21	15.82	0.015	1.000
48	5240	11.02	11.02	11.06	38.06	15.80	0.015	1.000
149	5745	19.09	19.08	19.08	242.92	23.85	0.096	1.000
157	5785	19.09	19.03	19.10	242.36	23.84	0.096	1.000
165	5825	19.13	19.08	19.04	242.92	23.85	0.096	1.000

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

CHAN.	CHAN. FREQ. (MHz)	POWER OUTPUT (dBm)			TOTAL POWER (mW)	TOTAL POWER (dBm)	POWER DENSITY (mW/cm ²)	LIMIT OF POWER DENSITY (mW/cm ²)
		CHAIN 0	CHAIN 1	CHAIN 2				
38	5190	11.09	11.10	11.11	38.65	15.87	0.015	1.000
46	5230	11.10	11.13	11.11	38.77	15.88	0.015	1.000
151	5755	19.11	19.11	19.05	243.29	23.86	0.097	1.000
159	5795	19.14	19.01	19.02	241.45	23.83	0.096	1.000

External antenna with 14dBi gain:**For 5.0GHz band:****802.11a OFDM MODULATION:**

CHANNEL	CHANNEL FREQUENCY (MHz)	POWER OUTPUT (dBm)		TOTAL POWER (mW)	TOTAL POWER (dBm)	POWER DENSITY (mW/cm ²)	LIMIT OF POWER DENSITY (mW/cm ²)
		CHAIN 0	CHAIN 1				
36	5180	2.11	2.03	3.22	5.08	0.016	1.0
40	5200	2.10	2.08	3.24	5.10	0.016	1.0
48	5240	2.14	2.04	3.24	5.10	0.016	1.0
149	5745	10.02	10.13	20.35	13.09	0.102	1.0
157	5785	10.05	10.06	20.26	13.07	0.101	1.0
165	5825	10.07	10.04	20.26	13.07	0.101	1.0

DRAFT 802.11n (20MHz) OFDM MODULATION:

CHANNEL	CHANNEL FREQUENCY (MHz)	POWER OUTPUT (dBm)		TOTAL POWER (mW)	TOTAL POWER (dBm)	POWER DENSITY (mW/cm ²)	LIMIT OF POWER DENSITY (mW/cm ²)
		CHAIN 0	CHAIN 1				
36	5180	2.06	2.15	3.25	5.12	0.016	1.0
40	5200	2.08	2.05	3.22	5.08	0.016	1.0
48	5240	2.11	2.10	3.25	5.12	0.016	1.0
149	5745	10.13	10.14	20.63	13.15	0.103	1.0
157	5785	10.08	10.08	20.37	13.09	0.102	1.0
165	5825	10.13	10.08	20.49	13.12	0.102	1.0

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

CHANNEL	CHANNEL FREQUENCY (MHz)	PEAK POWER OUTPUT (dBm)		TOTAL PEAK POWER (mW)	TOTAL PEAK POWER (dBm)	POWER DENSITY (mW/cm ²)	LIMIT OF POWER DENSITY (mW/cm ²)
		CHAIN 0	CHAIN 1				
38	5190	2.04	2.08	3.21	5.07	0.016	1.0
46	5230	2.14	2.10	3.26	5.13	0.016	1.0
151	5755	10.07	10.03	20.23	13.06	0.101	1.0
159	5795	10.07	10.12	20.44	13.11	0.102	1.0

CONCLUSION:

Both of the WLAN 2.4G & 5.0G can transmit 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

1. WLAN 2.4G + WLAN 5.0G = 0.344

Therefore, the maximum calculation of this situation is 0.344, which is less than the "1" limit.