RF Exposure Evaluation Report

APPLICANT	:	Senao Networks, Inc.
EQUIPMENT	:	802.11 a/n/ac Module
BRAND NAME	:	Senao
MODEL NAME	:	PCE4550AH
FCC ID	:	U2M-PCE4550AH
FILING TYPE	:	Certification
STANDARD	:	OET Bulletin 65 Supplement C (Edition 01-01)

We, SPORTON INTERNATIONAL INC., would like to declare that the device has been evaluated in accordance with FCC OET Bulletin 65 Supplement C (Edition 01-01), and pass the limit. Without written approval of SPORTON INTERNATIONAL INC., the test report shall not be reproduced except in full.

Reviewed by: Eric Huang / Deputy Manager

Approved by: Jones Tsai / Manager

Testing Laboratory
1190

SPORTON INTERNATIONAL INC.
No. 52, Hwa Ya 1st Rd., Hwa Ya Technology Park, Kwei-Shan Hsiang, Tao Yuan Hsien, Taiwan, R.O.C.

Table of Contents

Revision History

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FA341809	Rev. 01	Initial issue of report	Apr. 29, 2013

1. Administration Data

1.1. Testing Laboratory

Test Site	SPORTON INTERNATIONAL INC.
Test Site Location	No. 52, Hwa Ya 1st Rd., Hwa Ya Technology Park, Kwei-Shan Hsiang, Tao Yuan Hsien, Taiwan, R.O.C. TEL: +886-3-327-3456 FAX: +886-3-328-4978

1.2. Applicant

Company Name	Senao NETWORKS, INC.
Address	3F, No. 529, Chung Cheng Rd., Hsintien,Taipei,Taiwan

1.3. Manufacturer

Company Name	Senao Networks, Inc.
Address	3F, No. 529, Chung Cheng Rd., Hsintien,Taipei,Taiwan

2. Description of Equipment Under Test (EUT)

Product Feature & Specification	
EUT Type	802.11 a/n/ac Module
Brand Name	Senao
Model Name	PCE4550AH
FCC ID	U2M-PCE4550AH
Tx Frequency	5.2GHz Band: 5180 MHz ~ 5240 MHz 5.8GHz Band: 5745 MHz ~ 5825 MHz
Antenna Type	Dipole Antenna / PIFA Antenna
Uplink Modulation	802.11a/g/n/ac: OFDM (BPSK / QPSK / 16QAM / 64QAM / 256QAM)
EUT Stage	Identical Prototype

Remark: The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.

3. RF Exposure Limit Introduction

The FCC categorizes the RF exposure limit based on the intended usage of the device and the user's awareness and ability to exercise control over his or her exposure. This is a consumer product to be used in the home, hence this device was evaluated by mobile device with general population/uncontrolled exposure condition. The definition of these category are shown as follows:

- **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 transmitters' 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 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.

- **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.

4. Maximum Permissible Exposure

4.1. Limit of Maximum Permissible Exposure

Limits for Occupational / Controlled Exposure				
Frequency Range (MHz)	**Electric Field Strength (E) (V/m)**	**Magnetic Field Strength (H) (A/m)**	**Power Density (S) (mW/ cm²)**	**Averaging Time |E|²,|H|² or S (minutes)**
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842 / f	4.89 / f	(900 / f)*	6
30-300	61.4	0.163	1.0	6
300-1500	-	-	F/300	6
1500-100,000	-	-	5	6
Limits for General Population / Uncontrolled Exposure				
Frequency Range (MHz)	**Electric Field Strength (E) (V/m)**	**Magnetic Field Strength (H) (A/m)**	**Power Density (S) (mW/ cm²)**	**Averaging Time |E|²,|H|² or S (minutes)**
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	(180/f)*	30
30-300	27.5	0.073	0.2	30
300-1500	-	-	F/1500	30
1500-100,000	-	-	1.0	30
Note 1: f = frequency in MHz ; *Plane-wave equivalent power density Note 2: For the applicable limit, see FCC 1.1310				

RF Field Strength Limits for Controlled Use Devices (Controlled Environment)				
Frequency Range (MHz)	**Electric Field (V/m rms)**	**Magnetic Field (A/m rms)**	**Power Density (W/m2)**	**Averaging Time (minutes)**
0.003-1	600	4.9	-	6
1-10	600/f	4.9/f	-	6
10-30	60	4.9/f	-	6
30-300	60	0.163	10*	6
300-1500	3.54 f 0.5	0.0094 f 0.5	f/30	6
1500-15000	137	0.364	50	6
15000-150000	137	0.364	50	616000/f 1.2
150000-300000	0.354 f 0.5	9.4 x 10-4 f 0.5	3.33 x 10-4 f	616000/f 1.2
RF Field Strength Limits for Devices Used by the General Public (Uncontrolled Environment)				
Frequency Range (MHz)	**Electric Field (V/m rms)**	**Magnetic Field (A/m rms)**	**Power Density (W/m2)**	**Averaging Time (minutes)**
0.003-1	280	2.19	-	6
1-10	280/f	2.19/f	-	6
10-30	28	2.19/f	-	6
30-300	28	0.073	2*	6
300-1500	1.585 $f^{0.5}$	0.0042 $f^{0.5}$	f/150	6
1500-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	616000/$f^{1.2}$
150000-300000	0.158 $f^{0.5}$	4.21 x 10^{-4} $f^{0.5}$	6.67 x 10^{-5} f	616000/$f^{1.2}$
Note 1: f is frequency in MHz. Note 2: For the applicable limit, see IC RSS-102				

4.1.1 MPE Calculation Method

E (V/m) = $\frac{\sqrt{30 \times P \times G}}{d}$ Power Density: Pd (W/m^2) = $\frac{E^2}{377}$

E = Electric field (V/m) **P** = RF output power (W)

G = EUT Antenna numeric gain (numeric) **d** = Separation distance between radiator and human body (m)

The formula can be changed to

Pd = $\frac{30 \times P \times G}{377 \times d^2}$

4.2. Tune up information

Frequency Range (MHz)	Operating Mode	Max Declaration Conducted average power (dBm)
5150~5250	1	17.0
	2	16.0
	3	16.0
5725~5850	1	27.5
	3	24.5

Note: Max declaration conducted average power is used for " Sum chain " of below sections

4.3. Result of Maximum Permissible Exposure-(5.8G)

Operating Mode	1					
RF General Information						
Frequency Range (MHz)	IEEE Std. 802.11	Ch. Freq. (MHz)	Channel Number	Transmit Chains (N_{TX})	RF Output Power (dBm)	Co-location
5725-5850	a	5745-5825	149-165 [5]	3	27.22	N/A
5725-5850	n(HT20)	5745-5825	149-165 [5]	3	27.25	N/A
5725-5850	n(HT40)	5755-5795	151-159 [2]	3	26.86	N/A
5725-5850	ac(VHT20)	5745-5825	149-165 [5]	3	27.19	N/A
5725-5850	ac(VHT40)	5755-5795	151-159 [2]	3	26.83	N/A
5725-5850	ac(VHT80)	5775	155 [1]	3	20.82	N/A
Note 1: RF output power specifies that Maximum Peak Conducted Output Power. Note 2: Co-location, Co-location is generally defined as simultaneously transmitting (co-transmitting) antennas within 20 cm of each other. (i.e., EUT has simultaneously co-transmitting that operating 2.4GHz and 5GHz.)						

Operating Mode	1							
Worst Maximum RF Output Power Result								
Exposure Environment	General Population / Uncontrolled Exposure							
Separation Distance (cm)	20							
Condition	RF Output Power (dBm)							
Modulation Mode	Chain-Port 1	Chain-Port 2	Chain-Port 3	Chain-Port 4	Sum Chain	DG (dBi)	EIRP Power	PD (S) (mW/cm²)
a	22.71	22.06	22.56	-	27.5	3	30.5	0.223
n(HT20)	22.85	22.12	22.43	-	27.5	3	30.5	0.223
n(HT40)	22.37	21.84	22.04	-	27.5	3	30.5	0.223
ac(VHT20)	22.82	22.03	22.36	-	27.5	3	30.5	0.223
ac(VHT40)	22.33	21.81	22.01	-	27.5	3	30.5	0.223
ac(VHT80)	16.18	16.1	15.87	-	27.5	3	30.5	0.223
Maximum Permissible Exposure Limit (mW/cm²)								1

Operating Mode	3					
RF General Information						
Frequency Range (MHz)	**IEEE Std. 802.11**	**Ch. Freq. (MHz)**	**Channel Number**	**Transmit Chains (N_{TX})**	**RF Output Power (dBm)**	**Co-location**
5725-5850	a	5745-5825	149-165 [5]	3	24.16	N/A
5725-5850	n(HT20)	5745-5825	149-165 [5]	3	24.06	N/A
5725-5850	n(HT40)	5755-5795	151-159 [2]	3	24.29	N/A
5725-5850	ac(VHT20)	5745-5825	149-165 [5]	3	24.03	N/A
5725-5850	ac(VHT40)	5755-5795	151-159 [2]	3	24.27	N/A
5725-5850	ac(VHT80)	5775	155 [1]	3	20.82	N/A

Note 1: RF output power specifies that Maximum Peak Conducted Output Power.
Note 2: Co-location, Co-location is generally defined as simultaneously transmitting (co-transmitting) antennas within 20 cm of each other. (i.e., EUT has simultaneously co-transmitting that operating 2.4GHz and 5GHz.)

Operating Mode	3							
Worst Maximum RF Output Power Result								
Exposure Environment	General Population / Uncontrolled Exposure							
Separation Distance (cm)	20							
Condition	**RF Output Power (dBm)**							
Modulation Mode	**Chain-Port 1**	**Chain-Port 2**	**Chain-Port 3**	**Chain-Port 4**	**Sum Chain**	**DG (dBi)**	**EIRP Power**	**PD (S) (mW/cm²)**
a	19.55	19.16	19.45	-	24.5	6.00	30.5	0.223
n(HT20)	19.49	19.31	19.06	-	24.5	6.00	30.5	0.223
n(HT40)	19.64	19.31	19.6	-	24.5	6.00	30.5	0.223
ac(VHT20)	19.41	19.26	19.1	-	24.5	6.00	30.5	0.223
ac(VHT40)	19.63	19.28	19.58	-	24.5	6.00	30.5	0.223
ac(VHT80)	16.18	16.1	15.87	-	24.5	6.00	30.5	0.223
Maximum Permissible Exposure Limit (mW/cm²)								1

4.4. Result of Maximum Permissible Exposure-(5.2G)

Operating Mode	1					
RF General Information						
Frequency Range (MHz)	IEEE Std. 802.11	Ch. Freq. (MHz)	Channel Number	Transmit Chains (N_{TX})	RF Output Power (dBm)	Co-location
5150-5250	a	5180-5240	36-48 [4]	3	14.93	N/A
5150-5250	n(HT20)	5180-5240	36-48 [4]	3	14.89	N/A
5150-5250	n(HT40)	5190-5230	38-46 [2]	3	16.66	N/A
5150-5250	ac(VHT20)	5180-5240	36-48 [4]	3	14.86	N/A
5150-5250	ac(VHT40)	5190-5230	38-46 [2]	3	16.73	N/A
5150-5250	ac(VHT80)	5210	42 [1]	3	12.96	N/A

Note 1: RF output power specifies that Maximum Conducted Output Power.
Note 2: RF output power specifies that Maximum Peak Conducted Output Power for ac(VHT80) only.
Note 3: Co-location, Co-location is generally defined as simultaneously transmitting (co-transmitting) antennas within 20 cm of each other. (i.e., EUT has simultaneously co-transmitting that operating 2.4GHz and 5GHz.)

Operating Mode	1							
Worst Maximum RF Output Power Result								
Exposure Environment	General Population / Uncontrolled Exposure							
Separation Distance (cm)	20							
Condition	RF Output Power (dBm)							
Modulation Mode	Chain-Port 1	Chain-Port 2	Chain-Port 3	Chain-Port 4	Sum Chain	DG (dBi)	EIRP Power	PD (S) (mW/cm²)
a	10.38	10.26	9.82	-	17.0	3.00	20	0.020
n(HT20)	10.31	10.26	9.76	-	17.0	3.00	20	0.020
n(HT40)	12.11	11.91	11.63	-	17.0	3.00	20	0.020
ac(VHT20)	10.19	10.26	9.81	-	17.0	3.00	20	0.020
ac(VHT40)	12.11	11.93	11.84	-	17.0	3.00	20	0.020
ac(VHT80)	8.33	8.35	7.87	-	17.0	3.00	20	0.020
Maximum Permissible Exposure Limit (mW/cm²)								1

Operating Mode	2					
RF General Information						
Frequency Range (MHz)	**IEEE Std. 802.11**	**Ch. Freq. (MHz)**	**Channel Number**	**Transmit Chains (N_{TX})**	**RF Output Power (dBm)**	**Co-location**
5150-5250	a	5180-5240	36-48 [4]	3	11.76	N/A
5150-5250	n(HT20)	5180-5240	36-48 [4]	3	11.69	N/A
5150-5250	n(HT40)	5190-5230	38-46 [2]	3	15.49	N/A
5150-5250	ac(VHT20)	5180-5240	36-48 [4]	3	11.63	N/A
5150-5250	ac(VHT40)	5190-5230	38-46 [2]	3	15.48	N/A
5150-5250	ac(VHT80)	5210	42 [1]	3	10.72	N/A

Note 1: RF output power specifies that Maximum Conducted Output Power.
Note 2: RF output power specifies that Maximum Peak Conducted Output Power for ac(VHT80) only.
Note 3: Co-location, Co-location is generally defined as simultaneously transmitting (co-transmitting) antennas within 20 cm of each other. (i.e., EUT has simultaneously co-transmitting that operating 2.4GHz and 5GHz.)

Operating Mode	2							
Worst Maximum RF Output Power Result								
Exposure Environment	General Population / Uncontrolled Exposure							
Separation Distance (cm)	20							
Condition	**RF Output Power (dBm)**							
Modulation Mode	**Chain-Port 1**	**Chain-Port 2**	**Chain-Port 3**	**Chain-Port 4**	**Sum Chain**	**DG (dBi)**	**EIRP Power**	**PD (S) (mW/cm²)**
a	6.83	6.88	7.24	-	16.0	5.50	21.50	0.032
n(HT20)	6.82	6.89	7.03	-	16.0	5.50	21.50	0.032
n(HT40)	10.61	10.71	10.82	-	16.0	5.50	21.50	0.032
ac(VHT20)	6.78	6.72	7.06	-	16.0	5.50	21.50	0.032
ac(VHT40)	10.41	10.94	10.76	-	16.0	5.50	21.50	0.032
ac(VHT80)	5.90	5.78	6.17	-	16.0	5.50	21.50	0.032
Maximum Permissible Exposure Limit (mW/cm²)								1

Operating Mode	3					
RF General Information						
Frequency Range (MHz)	**IEEE Std. 802.11**	**Ch. Freq. (MHz)**	**Channel Number**	**Transmit Chains (N_{TX})**	**RF Output Power (dBm)**	**Co-location**
5150-5250	a	5180-5240	36-48 [4]	3	11.76	N/A
5150-5250	n(HT20)	5180-5240	36-48 [4]	3	11.75	N/A
5150-5250	n(HT40)	5190-5230	38-46 [2]	3	15.53	N/A
5150-5250	ac(VHT20)	5180-5240	36-48 [4]	3	11.63	N/A
5150-5250	ac(VHT40)	5190-5230	38-46 [2]	3	15.48	N/A
5150-5250	ac(VHT80)	5210	42 [1]	3	12.03	N/A

Note 1: RF output power specifies that Maximum Conducted Output Power.
Note 2: RF output power specifies that Maximum Peak Conducted Output Power for ac(VHT80) only.
Note 3: Co-location, Co-location is generally defined as simultaneously transmitting (co-transmitting) antennas within 20 cm of each other. (i.e., EUT has simultaneously co-transmitting that operating 2.4GHz and 5GHz.)

Operating Mode	3							
Worst Maximum RF Output Power Result								
Exposure Environment	General Population / Uncontrolled Exposure							
Separation Distance (cm)	20							
Condition	**RF Output Power (dBm)**							
Modulation Mode	**Chain-Port 1**	**Chain-Port 2**	**Chain-Port 3**	**Chain-Port 4**	**Sum Chain**	**DG (dBi)**	**EIRP Power**	**PD (S) (mW/cm²)**
a	6.83	6.88	7.24	-	16.0	6.00	22	0.032
n(HT20)	6.82	6.89	7.23	-	16.0	6.00	22	0.032
n(HT40)	10.61	10.71	10.96	-	16.0	6.00	22	0.032
ac(VHT20)	6.78	6.72	7.06	-	16.0	6.00	22	0.032
ac(VHT40)	10.41	10.94	10.76	-	16.0	6.00	22	0.032
ac(VHT80)	7.40	7.44	6.92	-	16.0	6.00	22	0.032
Maximum Permissible Exposure Limit (mW/cm²)								1