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Report No.: 2305RSU016-U4 Report Version: V02 Issue Date: 2023-11-10

# **RF Exposure Evaluation Declaration**

FCC ID: TK4WLE3000HX

**Applicant:** Compex Systems Pte Ltd

**Product:** WiFi 6 (802.11ax) 4×4 MU-MIMO Dual Band Module

Model No.: WLE3000HX, WLE3000HX-I

**Brand Name:** COMPEX

FCC Classification: Digital Transmission System (DTS)

Unlicensed National Information Infrastructure (NII)

FCC Rule Part(s): FCC Part 2.1091

**Received Date:** 2023-05-08

**Evaluation Date:** 2023-09-18

Result: Complies

Approved By:

Reviewed By:

Jame Yuan

Robin Wu

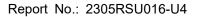
Robin Wu

The test results relate only to the samples tested.

The test results shown in the test report are traceable to the national/international standards through the calibration of the equipment and evaluated measurement uncertainty herein.

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Template Version:0.0 1 of 10





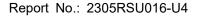
# **Revision History**

Report No.	Version	Description	Issue Date	Note
2305RSU016-U4	V01	Initial Report	2023-09-19	Invalid
2305RSU016-U4	V02	Updated calculated	2023-11-10	Valid



# **CONTENTS**

Des	cription	1	Page
1.	Gene	ral Information	4
	1.1.	Applicant	4
	1.2.	Manufacturer	4
	1.3.	Testing Facility	4
	1.4.	Product Information	5
	1.5.	Antenna Details	5
	1.6.	Device Classification	5
	1.7.	Applied Standards	6
2.	RF E	xposure Evaluation	7
	2.1.	Test Limits	7
	2.2.	MPE Exemptions	8
	2.3.	Calculated Result	11





### 1. General Information

### 1.1. Applicant

Compex Systems Pte Ltd

No:9 Harrison Road, Harrison Industrial Building, #05-01, Singapore 369651

### 1.2. Manufacturer

Compex Systems Pte Ltd

No:9 Harrison Road, Harrison Industrial Building, #05-01, Singapore 369651

# 1.3. Testing Facility

$\boxtimes$	Test Site – MRT Suzhou Laboratory								
	Laboratory Location (Suzhou - Wuzhong)								
	D8 Building, No.2 Tian'edang Rd., Wuzhong Economic Development Zone, Suzhou, China								
	Laboratory Location (Suzhou - SIP)								
	4b Building, Liando U Valley, No.200 Xingpu Rd., Shengpu Town, Suzhou Industrial Park, China								
	Laboratory Accre	editations							
	A2LA: 3628.01		CNAS	5: L10551					
	FCC: CN1166		ISED:	CN0001					
	\/OO!-	□R-20025	□G-20034	□C-20020	□T-20020				
	VCCI:	□R-20141	□G-20134	□C-20103	□T-20104				
	Test Site - MRT S	Shenzhen Laborat	ory						
	Laboratory Locat	tion (Shenzhen)							
	1G, Building A, Ju	nxiangda Building,	Zhongshanyuan Roa	ıd West, Nanshan Di	strict, Shenzhen,				
	China								
	Laboratory Accreditations								
	A2LA: 3628.02 CNAS: L10551								
	FCC: CN1284		ISED:	CN0105					
	Test Site – MRT Taiwan Laboratory								
	Laboratory Location (Taiwan)								
	No. 38, Fuxing 2nd Rd., Guishan Dist., Taoyuan City 333, Taiwan (R.O.C.)								
	Laboratory Accre	editations							
	TAF: 3261								
	FCC: 291082, TW	3261	ISED:	TW3261					



#### 1.4. Product Information

Product Name	WiFi 6 (802.11ax) 4×4 MU-MIMO Dual Band Module		
Model No.	WLE3000HX, WLE3000HX-I		
Wi-Fi Specification	802.11a/b/g/n/ac/ax		
Antenna Information	Refer to Section 1.5		
Operating Voltage	3.3Vdc		
Host Information			
	FCC ID: 2BA8GPCWL-0510		
1#	Applicant: PicoCELA Inc		
	Model No.: PCWL-0510		
	FCC ID: 2BBYQPCWL-0500		
2#	Applicant: PicoCELA Inc		
	Model No.: PCWL-0500		
1			

#### Note:

- 1. The information of EUT was provided by the manufacturer, and the accuracy of the information shall be the responsibility of the manufacturer.
- 2. Model Difference: Marketing purpose only.

#### 1.5. Antenna Details

Antenna	enna Model No. No.	Polarization	Frequency Band (GHz)	Max. Peak Gain	CDD Direct	
NO.				(dBi)	For Power	For PSD
1#	SAA04-222060	Directional	2.4 ~2.5	13.50	13.50	19.52
		Panel	5.15 ~5.85	15.50	15.50	21.52

#### Note:

The EUT supports Cyclic Delay Diversity (CDD) mode, and CDD signals are correlated.

For CDD transmissions, directional gain is calculated as follows,  $N_{ANT} = 4$ ,  $N_{SS} = 1$ . If all antennas have the same gain,  $G_{ANT}$ , Directional gain =  $G_{ANT}$  + Array Gain, where Array Gain is as follows.

- For power spectral density (PSD) measurements on all devices, Array Gain = 10 log (N<sub>ANT</sub>/ N<sub>SS</sub>) dB = 6.02;
- For power measurements on IEEE 802.11 devices, Array Gain = 0 dB for NANT ≤ 4;

#### 1.6. Device Classification

According to the user manual, this device is classified as a Mobile Device. So, the RF exposure evaluation requirements of § 2.1091 for mobile device exposure conditions subject to MPE limits.



# 1.7. Applied Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

• FCC Part 2.1091 & KDB 447498 D04 Interim General RF Exposure Guidance v01



# 2. RF Exposure Evaluation

### 2.1. Test Limits

According to FCC §1.1310: The criteria listed in the following table shall be used to evaluate the environment impact of human exposure to radio frequency (RF) radiation as specified in §1.1307(b)

Limits For Maximum Permissible Exposure (MPE)

Frequency Range	Electric Field	Magnetic Field	Power Density	Average Time				
(MHz)	Strength (V/m)	Strength (A/m)	(mW/cm²)	(Minutes)				
	(A) Limits for Occupational/ Control Exposures							
0.3-3.0	614	1.63	*(100)	≤6				
3.0-30	1842/f	4.89/f	*(900/f <sup>2</sup> )	<6				
30-300	61.4	0.163	1.0	<6				
300-1,500			f/300	<6				
1,500-100,000			5	<6				
	(B) Limits for Gen	eral Population/ Uncor	trolled Exposures					
0.3-1.34	614	1.63	*(100)	<30				
1.34-30	824/f	2.19/f	*(180/f <sup>2</sup> )	<30				
30-300	27.5	0.073	0.2	<30				
300-1,500			f/1500	<30				
1,500-100,000			1.0	<30				

f= frequency in MHz. \* = Plane-wave equivalent power density.



### 2.2. MPE Exemptions

**For single RF sources** (i.e., any single fixed RF source, mobile device, or portable device, as defined in paragraph §1.1307(b)(2) of this section): A single RF source is exempt if:

**(Option A)** The available maximum time-averaged power is no more than 1 mW, regardless of separation distance. This exemption may not be used in conjunction with other exemption criteria other than those in paragraph §1.1307(b)(3)(ii)(A) of this section.

Medical implant devices may only use this exemption and that in paragraph §1.1307(b)(3)(ii)(A);

**(Option B)** Or the available maximum time-averaged power or effective radiated power (ERP), whichever is greater, is less than or equal to the threshold P (mW) described in the following formula. This method shall only be used at separation distances (cm) from 0.5 centimeters to 40 centimeters and at frequencies from 0.3 GHz to 6 GHz (inclusive). P is given by:

$$P th(mW) = \{ERP_{20cm}(d / 20cm)^x d \le 20cm\}$$

$$Pth(mW) = \{ERP_{20cm} 20cm < d \le 40cm$$

Where

$$x = -\log_{10}\left(\frac{60}{ERP_{20cm}\sqrt{f}}\right)$$
 and f is in GHz;

and

$$ERP_{20cm}(mW) = \{2040f \ 0.3GHz \le f < 1.5GHz\}$$

$$ERP_{20cm}(mW) = \{3060 \ 1.5GHz \le f \le 6GHz\}$$

(**Option C**) Or using Table 1 and the minimum separation distance (R in meters) from the body of a nearby person for the frequency (f in MHz) at which the source operates, the ERP (watts) is no more than the calculated value prescribed for that frequency. For the exemption in Table 1 to apply, R must be at least  $\lambda/2\pi$ , where  $\lambda$  is the free-space operating wavelength in meters. If the ERP of a single RF source is not easily obtained, then the available maximum time-averaged power may be used in lieu of ERP if the physical dimensions of the radiating structure(s) do not exceed the electrical length of  $\lambda/4$  or if the antenna gain is less than that of a half-wave dipole (1.64 linear value).



RF Source Frequency (MHz)	Threshold ERP (watts)
0.3-1.34	1920R <sup>2</sup>
1.34-30	3450R <sup>2</sup> /f <sup>2</sup>
30-300	3.83R <sup>2</sup>
300-1,500	0.0128R <sup>2</sup> f
1,500-100,000	19.2R <sup>2</sup>

For multiple RF sources: Multiple RF sources are exempt if:

(A) The available maximum time-averaged power of each source is no more than 1 mW and there is a separation distance of two centimeters between any portion of a radiating structure operating and the nearest portion of any other radiating structure in the same device, except if the sum of multiple sources is less than 1 mW during the time-averaging period, in which case they may be treated as a single source (separation is not required). This exemption may not be used in conjunction with other exemption criteria other than those is paragraph §1.1307(b)(3)(i)(A) of this section. Medical implant devices may only use this exemption and that in paragraph §1.1307(b)(3)(i)(A).

(B) in the case of fixed RF sources operating in the same time-averaging period, or of multiple mobile or portable RF sources within a device operating in the same time averaging period, if the sum of the fractional contributions to the applicable thresholds is less than or equal to 1 as indicated in the following equation.

$$\sum_{i=1}^{a} \frac{P_i}{P_{th,i}} + \sum_{j=1}^{b} \frac{ERP_j}{ERP_{th,j}} + \sum_{k=1}^{c} \frac{Evaluated_k}{Exposure\ Limit_k} \le 1$$

### Where:

a = number of fixed, mobile, or portable RF sources claiming exemption using paragraph §1.1307(b)(3)(i)(B) of this section for  $P_{th}$ , including existing exempt transmitters and those being added.

b = number of fixed, mobile, or portable RF sources claiming exemption using paragraph 1.1307(b)(3)(i)(C) of this section for Threshold ERP, including existing exempt transmitters and those being added.

c = number of existing fixed, mobile, or portable RF sources with known evaluation for the specified minimum distance including existing evaluated transmitters.

 $P_i$  = the available maximum time-averaged power or the ERP, whichever is greater, for fixed, mobile, or portable RF source i at a distance between 0.5 cm and 40 cm (inclusive).

 $P_{th,i}$  = the exemption threshold power ( $P_{th}$ ) according to paragraph §1.1307(b)(3)(i)(B) of this section for fixed, mobile, or portable RF source i.

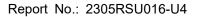
 $ERP_j$  = the ERP of fixed, mobile, or portable RF source j.



 $ERP_{th,j}$  = exemption threshold ERP for fixed, mobile, or portable RF source j, at a distance of at least  $\lambda/2\pi$  according to the applicable formula of paragraph §1.1307(b)(3)(i)(C) of this section.

**Evaluated**<sub>k</sub> = the maximum reported SAR or MPE of fixed, mobile, or portable RF source k either in the device or at the transmitter site from an existing evaluation at the location of exposure.

**Exposure Limit**<sub>k</sub> = either the general population/uncontrolled maximum permissible exposure (MPE) or specific absorption rate (SAR) limit for each fixed, mobile, or portable RF source k, as applicable from §1.1310 of this chapter.





### 2.3. Calculated Result

Product	WiFi 6 (802.11ax) 4×4 MU-MIMO Dual Band Module
Test Item	RF Exposure Evaluation

### Module

Test Mode	Frequency Band	Tune-up Conducted Power	Antenna Gain	Tune-up ERP
	(MHz)	(dBm)	(dBi)	(dBm)
802.11b/g/n/ax	2412 ~ 2462	23.0	13.5	34.35
802.11a/n/ac/ax	5180 ~ 5320, 5500 ~ 5720,	21.0	15.5	34.35
002.11a/11/ac/ax	5745 ~ 5825	21.0	15.5	34.33

Note: Tune-up power was declared by manufacturer.

# **Host 1# Transmitting Unit**

Test Mode	Frequency	Max.	Antenna Gain	Max EIRP	Max ERP	Max Tune-up		
	Band	Conducted	(dBi)	(dBm)	(dBm)	ERP		
	(MHz)	Power (dBm)				(dBm)		
Antenna 1#	Antenna 1#							
802.11b/g/n/ax	2412 ~ 2462	29.02	4.50	33.52	31.37	32		
802.11a/n/ac/ax	5180 ~ 5825	27.76	7.00	34.76	32.61	33		
Antenna 2#	Antenna 2#							
802.11b/g/n/ax	2412 ~ 2462	22.37	13.50	35.87	33.72	34		
802.11a/n/ac/ax	5180 ~ 5825	20.35	15.50	35.85	33.70	34		

Note: Tune-up power declared by manufacturer.

## **Host 2# Transmitting Unit**

Test Mode	Frequency Band	Tune-up Conducted Power	Antenna Gain	Tune-up ERP	
	(MHz)	(dBm)	(dBi)	(dBm)	
802.11b/g/n/ax	2412 ~ 2462	29.00	3	29.85	
000 44 - / - / - / - /	5180 ~ 5320, 5500 ~ 5720,	20.00	C	21.95	
802.11a/n/ac/ax	5745 ~ 5825	28.00	6	31.85	

Note: Tune-up power was declared by manufacturer.



Report No.: 2305RSU016-U4

### **Simultaneous Transmitting Condition**

Module Wi-Fi 5G + Host 1# / 2# Wi-Fi 2.4G + Host 1# / 2# Wi-Fi 5G

Note: Module Wi-Fi 5G and Host Wi-Fi 5G work on different NII bands.

### For multiple RF sources (With Host 1#), Option C

Test Mode	λ/2π	R	Tune-up ERP	Thresholds ERP		
	(m)	(m)	(Watts)	(Watts)		
Module						
Wi-Fi (NII)	0.0092	0.65	2.723	8.112		
Host 1#						
Wi-Fi (DTS)	0.0198	0.65	2.512	8.112		
Wi-Fi (NII)	0.0092	0.65	2.512	8.112		

Note: R is from user manual.

Max Simultaneous Transmission = 2.723 / 8.112 + 2.512 / 8.112 + 2.512 / 8.112 = 0.955 < 1.

Therefore, the device qualifies for RF exposure test exemption.

### For multiple RF sources (With Host 2#), Option C

Test Mode	λ/2π	R	Tune-up ERP	Thresholds ERP		
	(m)	(m)	(Watts)	(Watts)		
Module						
Wi-Fi (NII)	0.0092	0.55	2.723	5.808		
Host 2#						
Wi-Fi (DTS)	0.0198	0.55	0.966	5.808		
Wi-Fi (NII)	0.0092	0.55	1.531	5.808		

Note: R is from user manual.

Max Simultaneous Transmission = 2.723 / 5.808 + 0.966 / 5.808 + 1.531 / 5.808 = 0.899 < 1.

Therefore, the device qualifies for RF exposure test exemption.

 The End	