

# FCC Maximum Permissible RF Exposure (MPE) Estimation Report

In accordance with the requirements of  
FCC 47 CFR Part 2(2.1091), ANSI/IEEE C95.1-1992 and  
KDB 447498 D01

**Product Name:** ScreenBeam OPS Wireless Display Module

**Trademark:** ScreenBeam

**Model Name:** SBWD3100

**Family Model:** N/A

**Report No.:** S19052104007004

**FCC ID:** LNQSBWD3100

## Prepared for

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### TEST RESULT CERTIFICATION

**Applicant's name** ..... : Actiontec Electronics Inc  
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**Manufacturer's Name** ..... : Actiontec Electronics Inc  
Address ..... : 3301 Olcott St Santa Clara, CA 95054 United States

**Product description**

Product name ..... : ScreenBeam OPS Wireless Display Module  
Trademark ..... : ScreenBeam  
Model and/or type reference : SBWD3100  
Family Model ..... : N/A

**Standards**..... : FCC 47 CFR Part 1(1.1310)  
FCC 47 CFR Part 2(2.1091)  
ANSI/IEEE C95.1-1992  
KDB 447498 D01

This device described above has been tested by Shenzhen NTEK. Testing has shown that this device is capable of compliance with MPE specified in FCC 47 CFR Part 2(2.1091) and ANSI/IEEE C95.1-1992. The test results in this report apply only to the tested sample of the stated device/equipment. Other similar device/equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties.

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**Date of Test**

Date (s) of performance of tests ..... : 27 Dec. 2018 ~ 19 Jul. 2019  
Date of Issue ..... : 29 Jul. 2019  
Test Result..... : **Pass**

Prepared By : Cheng Jiawen  
(Test Engineer) :  
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(Sam Chen)

※ ※ **Revision History** ※ ※

REV.	DESCRIPTION	ISSUED DATE	REMARK
Rev.1.0	Initial Test Report Release	Jul. 12, 2019	Cheng Jiawen

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# 1 General Information

## 1.1 RF Exposure Requirements

### 1.1.1 RF Exposure Limits

**Table - 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> )	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposure				
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 General Population/Uncontrolled Exposure				
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

A rough estimation of the expected exposure in power flux density on a given point can be made with the following equation:

$$S = \frac{P_t * G_t}{4 * \pi * R^2}$$

Where:

S = Power density (mW/cm<sup>2</sup>)

P<sub>t</sub> = Conducted output power (dBm)

G<sub>t</sub> = numeric gain of the antenna in the direction of interest relative to an isotropic radiator (dBi)

R = distance to the centre of radiation of the antenna (cm)

EIRP = P<sub>t</sub> \* G<sub>t</sub>

The antenna of the product, under normal use condition is at least 20 cm away from the body of the user. Warning statement to the user for keeping at least 20cm separation distance and the prohibition of operating to a person has been printed on the user's manual. Therefore, the S of the device is calculated with R=20cm, and if it is below the limit S, then we can conclude the device complies with the rules.

### 1.1.2 Additional Description

An estimation of MPE in this application for product is used to ensure if it complies to the rules of the standard in the regulation list above.

Maximum permissible exposure (MPE) refers to the RF energy that is acceptable for human exposure. It is broken down into two categories, Occupational/controlled and General population/uncontrolled.

Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or cannot exercise control over their exposure.

We analysis if it comply with the limits for General population/uncontrolled exposure. The FCC's MPE limits for field strength and power density are given in 47CFR 1.1310(Table below).These limits are generally based on recommended exposure guidelines published by the National Council on Radiation Protection and Measurements (NCRP), and also partly based on guidelines recommended by the American National Standards Institute (ANSI) in Section 4.1 of ANSI/IEEE C95.1.

## 1.2 EUT Description

Device Information			
Product Name	ScreenBeam OPS Wireless Display Module		
Trade Name	Actiontec		
Model Name	SBWD3100		
Family Model	N/A		
FCC ID	LNQSBWD3100		
Device Phase	Identical Prototype		
Exposure Category	General population / Uncontrolled environment		
Antenna Type	2.4G/5Gwifi Ant 0: PIFA Antenna Ant 1: PIFA Antenna Ant 2: PIFA Antenna BLE: PCB Antenna		
Antenna Gain	2.4G/5Gwifi Ant 0: -1.06dBi for WLAN2.4G and 3.37dBi for WLAN5G Ant 1: -0.78Bi for WLAN2.4G and 4.28dBi for WLAN5G Ant 2: 0.13dBi for WLAN2.4G and 3.67dBi for WLAN5G BLE: -2.38dBi		
Device Operating Configurations			
Supporting Mode(s)	WLAN 2.4G/5.2G/5.8G		
Test Modulation	WLAN(DSSS/OFDM)		
Operating Frequency Range(s)	Band	Tx (MHz)	Rx (MHz)
	WLAN 2.4G	2412-2462	
	WLAN 5.2G	5180-5240	
	WLAN 5.8G	5745-5825	

## 1.3 Test specification(s)

FCC 47 CFR Part 1(1.1310)
FCC 47 CFR Part 2(2.1091)
ANSI/IEEE C95.1-1992
KDB 447498 D01 General RF Exposure Guidance

## 1.4 Ambient Condition

Ambient temperature	20°C – 24°C
Relative Humidity	30% – 70%

## 2 RF Output Power

### BLE

Test Channel	Frequency (MHz)	Power Setting	Peak Output Power (dBm)- 1Mbps	Peak Output Power (dBm)- 2Mbps	LIMIT (dBm)	Verdict
00	2402	Default	-1.98	-1.81	30	PASS
19	2440	Default	-2.71	-2.31	30	PASS
39	2480	Default	-3.59	-3.50	30	PASS

### 2.4Gwifi

Test Channel	Frequency (MHz)	Power Setting	Duty Cycle Factor (dB)	Peak Output Power(dBm)			Total (dBm)	LIMIT (dBm)	Verdict
				ANT 0	ANT 1	ANT 2			
<b>TX 802.11b Mode</b>									
1	2412	Default	0	23.3	23.2	23.3	-	30	PASS
6	2437	Default	0	23.4	23.3	23.3	-	30	PASS
11	2462	Default	0	23.5	23.4	23.4	-	30	PASS
<b>TX 802.11 g Mode</b>									
1	2412	Default	0	18.2	18.5	18.7	-	30	PASS
6	2437	Default	0	21.1	21.2	21.0	-	30	PASS
11	2462	Default	0	18.5	18.0	17.9	-	30	PASS
<b>TX 802.11 n20M Mode(Single TX)</b>									
1	2412	Default	0	16.9	16.8	17.1	-	30	PASS
6	2437	Default	0	20.8	20.7	20.6	-	30	PASS
11	2462	Default	0	16.7	16.9	16.9	-	30	PASS
<b>TX 802.11 n20M Mode(MIMO TX)</b>									
1	2412	Default	0	13.6	13.5	14.4	18.62	30	PASS
6	2437	Default	0	19.8	20.1	20.2	24.81	30	PASS
11	2462	Default	0	11.4	11.5	12.1	16.45	30	PASS
<b>TX 802.11 n40M Mode(Single TX)</b>									
3	2422	Default	0	18.9	19.0	19.1	-	30	PASS
6	2437	Default	0	20.6	20.6	20.5	-	30	PASS
9	2452	Default	0	15.0	15.3	15.2	-	30	PASS
<b>TX 802.11 n40M Mode(MIMO TX)</b>									
3	2422	Default	0	15.4	14.9	15.7	20.12	30	PASS
6	2437	Default	0	19.4	19.4	19.8	24.31	30	PASS
9	2452	Default	0	10.2	10.2	10.9	15.22	30	PASS

### 5Gwifi

Test Channel	Frequency (MHz)	Maximum output power. Antenna port (AV) (dBm)			Total Power (AV) (dBm)	LIMIT (dBm)	Result
		ANT 0	ANT 1	ANT 2	dBm		
	<b>TX 802.11a Mode</b>						
CH36	5180	17.4	17.6	18.3	-	30	Pass
CH40	5200	18.6	17.9	18.8	-	30	Pass



CH48	5240	18.4	18.2	18.7	-	30	Pass
<b>TX 802.11 n20M Mode(Single TX)</b>							
CH36	5180	16.6	17.1	18.4	-	30	Pass
CH40	5200	18.4	17.3	18.4	-	30	Pass
CH48	5240	18.4	18.0	18.5	-	30	Pass
<b>TX 802.11 n40M Mode(Single TX)</b>							
CH38	5190	15.6	15.3	15.1	-	30	Pass
CH46	5230	17.0	16.9	17.1	-	30	Pass
<b>TX 802.11 AC20M Mode(Single TX)</b>							
CH36	5180	16.5	17.5	18.3	-	30	Pass
CH40	5200	18.2	17.5	18.2	-	30	Pass
CH48	5240	18.3	17.7	18.2	-	30	Pass
<b>TX 802.11 AC40M Mode(Single TX)</b>							
CH38	5190	15.7	15.3	15.1	-	30	Pass
CH46	5230	16.5	17.1	17.1	-	30	Pass
<b>TX 802.11 AC80M Mode(Single TX)</b>							
CH42	5210	14.2	13.8	14.3	-	30	Pass

Test Channel	Frequency	Maximum output power. Antenna port			Total Power	LIMIT	Result
		(AV) (dBm)			(AV)		
	(MHz)	ANT 0	ANT 1	ANT 2	dBm	dBm	
<b>TX 802.11 n20M Mode(MIMO TX)</b>							
CH36	5180	15.9	16.0	15.1	20.46	27.44	Pass
CH40	5200	15.3	15.3	14.6	19.85	27.44	Pass
CH48	5240	15.3	16.0	14.8	20.17	27.44	Pass
<b>TX 802.11 n40M Mode(MIMO TX)</b>							
CH38	5190	15.8	15.1	15.2	20.15	27.44	Pass
CH46	5230	16.9	17.1	16.7	21.67	27.44	Pass
<b>TX 802.11 AC20M Mode(MIMO TX)</b>							
CH36	5180	14.9	14.9	14.2	19.45	27.44	Pass
CH40	5200	15.6	15.9	15.2	20.35	27.44	Pass
CH48	5240	15.5	15.6	14.7	20.06	27.44	Pass
<b>TX 802.11 AC40M Mode(MIMO TX)</b>							
CH38	5190	15.0	14.9	15.5	19.91	27.44	Pass
CH46	5230	16.7	17.0	16.6	21.54	27.44	Pass
<b>TX 802.11 AC80M Mode(MIMO TX)</b>							
CH42	5210	13.8	13.9	13.3	18.45	27.44	Pass

Test Channel	Frequency	Maximum output power. Antenna port			Total Power	LIMIT	Result
		(AV) (dBm)			(AV)		
	(MHz)	ANT 0	ANT 1	ANT 2	dBm	dBm	
<b>TX 802.11a Mode</b>							
CH149	5745	17.8	18.4	18.6	-	30	Pass
CH157	5785	17.9	18.1	18.5	-	30	Pass

CH165	5825	17.9	19.8	19.0	-	30	Pass
<b>TX 802.11 n20M Mode(Single TX)</b>							
CH149	5745	18.2	18.5	18.3	-	30	Pass
CH157	5785	17.6	18.7	18.6	-	30	Pass
CH165	5825	17.9	19.0	19.1	-	30	Pass
<b>TX 802.11 n40M Mode(Single TX)</b>							
CH151	5755	17.0	17.9	17.8	-	30	Pass
CH159	5795	18.0	18.2	17.5	-	30	Pass
<b>TX 802.11 AC20M Mode(Single TX)</b>							
CH149	5745	18.1	17.9	18.9	-	30	Pass
CH157	5785	18.0	18.0	18.6	-	30	Pass
CH165	5825	17.8	19.0	19.3	-	30	Pass
<b>TX 802.11 AC40M Mode(Single TX)</b>							
CH151	5755	17.3	17.5	17.9	-	30	Pass
CH159	5795	17.5	18.1	18.5	-	30	Pass
<b>TX 802.11 AC80M Mode(Single TX)</b>							
CH155	5775	16.7	17.4	17.7	-	30	Pass

Test Channel	Frequency	Maximum output power. Antenna port			Total Power	LIMIT	Result
		(AV) (dBm)			(AV)		
	(MHz)	ANT 0	ANT 1	ANT 2	dBm	dBm	
<b>TX 802.11 n20M Mode(MIMO TX)</b>							
CH149	5745	17.8	17.9	17.9	22.64	27.44	Pass
CH157	5785	18.5	18.9	19.1	23.61	27.44	Pass
CH165	5825	18.4	18.9	18.5	23.38	27.44	Pass
<b>TX 802.11 n40M Mode(MIMO TX)</b>							
CH151	5755	17.2	18.1	17.3	22.32	27.44	Pass
CH159	5795	17.4	17.5	17.2	22.14	27.44	Pass
<b>TX 802.11 AC20M Mode(MIMO TX)</b>							
CH149	5745	18.6	19.3	19.0	23.75	27.44	Pass
CH157	5785	18.4	19.0	18.9	23.55	27.44	Pass
CH165	5825	17.9	18.4	18.5	23.05	27.44	Pass
<b>TX 802.11 AC40M Mode(MIMO TX)</b>							
CH151	5755	17.7	17.2	18.0	22.42	27.44	Pass
CH159	5795	17.6	18.2	17.0	22.40	27.44	Pass
<b>TX 802.11 AC80M Mode(MIMO TX)</b>							
CH155	5775	16.5	17.2	16.9	21.65	27.44	Pass

### 3 RF Exposure Evaluation

#### 3.1 Operation in WLAN 2.4G

##### SISO

Antenna	Maximum output power (dBm)	Gain (dBi)	EIRP (dBm)	EIRP (mW)	R(cm)	S (mW/cm <sup>2</sup> )	MPE Limit (mW/cm <sup>2</sup> )	Conclusion
Ant 0	23.5	-1.06	22.44	175.39	20	0.0349	1	Pass
Ant 1	23.4	-0.78	22.62	182.81	20	0.0257	1	Pass
Ant 2	23.4	0.13	23.53	225.42	20	0.0448	1	Pass

##### BLE

Antenna	Maximum output power (dBm)	Gain (dBi)	EIRP (dBm)	EIRP (mW)	R(cm)	S (mW/cm <sup>2</sup> )	MPE Limit (mW/cm <sup>2</sup> )	Conclusion
Ant 0	-1.98	-2.38	-4.36	0.37	20	0.0001	1	Pass

#### 3.2 Operation in WLAN 5G

##### SISO

Antenna	Maximum output power (dBm)	Gain (dBi)	EIRP (dBm)	EIRP (mW)	R(cm)	S (mW/cm <sup>2</sup> )	MPE Limit (mW/cm <sup>2</sup> )	Conclusion
Ant 0	18.6	3.37	21.97	157.40	20	0.0313	1	Pass
Ant 1	19.8	4.28	24.08	255.86	20	0.0360	1	Pass
Ant 2	19.3	3.67	22.97	198.15	20	0.0394	1	Pass

#### 4 Exposure calculations for multiple sources

When a number of sources at different frequencies, and/or broadband sources, contribute to the total exposure, it becomes necessary to weigh each contribution relative to the MPE in accordance with the provisions of Table (A) and Table (B). To comply with the MPE, the fraction of the MPE in terms of  $E^2$ ,  $H^2$  (or power density) incurred within each frequency interval should be determined and the sum of all such fractions should not exceed unity.

In order to ensure compliance with the MPE for a controlled environment, the sum of the ratios of the power density to the corresponding MPE should not exceed unity. That is

$$\sum_{i=1}^n \frac{S_i}{MPE_i}$$

The product also has multiple transmitters The Simultaneous Transmission Possibilities are as below:

Simultaneous Tx Combination	Configuration
1	WLAN 2.4G MIMO
2	WLAN 5.2G MIMO
3	WLAN 5.8G MIMO

**4.1 Estimation for WLAN2.4G MIMO**

Antenna	Tune-up limit (dBm)	Gain (dBi)	EIRP (dBm)	EIRP (mW)	R(cm)	S (mW/cm <sup>2</sup> )	MPE Limit (mW/cm <sup>2</sup> )	Calculation result	Conclusion
Ant 0	19.8	-1.06	18.74	74.82	20	0.0149	1	0.0484	Pass
Ant 1	20.1	-0.78	19.32	85.51	20	0.0120	1		
Ant 2	20.2	0.13	20.33	107.89	20	0.0215	1		

**4.2 Estimation for WLAN5G MIMO**

Antenna	Tune-up limit (dBm)	Gain (dBi)	EIRP (dBm)	EIRP (mW)	R(cm)	S (mW/cm <sup>2</sup> )	MPE Limit (mW/cm <sup>2</sup> )	Calculation result	Conclusion
Ant 0	18.6	3.37	21.97	157.40	20	0.0313	1	0.1002	Pass
Ant 1	19.3	4.28	23.58	228.03	20	0.0321	1		
Ant 2	19.0	3.67	22.67	184.93	20	0.0368	1		

Measurement Result For multiple Transmitting:

Because:

The wifi module 802R8822(FCC ID: LNQ802R8822) has the maximum Power Density value 0.1002 mW/cm<sup>2</sup> in 5G MIMO transmitting mode;

The wifi module 802C2447(FCC ID: LNQ802C2447) has the maximum Power Density value 0.169 mW/cm<sup>2</sup> in 5G MIMO transmitting mode;

So:

When BT & 802R8822 WIFI 5G MIMO mode& 802C2447 WIFI 5G MIMO mode transmitting simultaneously is the worst mode. The worst result as below:

Transmitting Mode	R(cm)	S (mW/cm <sup>2</sup> )	Total S (mW/cm <sup>2</sup> )	MPE Limit (mW/cm <sup>2</sup> )	Conclusion
BT	20	0.0001	0.2693	1.000	Pass
802R8822 Wifi 5G MIMO Mode		0.1002			
802C2447 Wifi 5G MIMO Mode		0.1690			

According to the Table above, we can conclude that the calculation results of all simultaneous transmission possibilities are less than 1, so it is into compliance.

Therefore the product also meets the requirements under multiple sources condition.

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