

Report No.: SZEM210100002804

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## RF Exposure Evaluation Report

Application No.:SZEM2101000028CRApplicant:Flir Belgium BVBA

Address of Applicant: Luxemburgstraat 2, Meer 2321, Belgium Manufacturer: Shenzhen Fastrain Technology Co., Ltd.

Address of Manufacturer: No.3 Baolong 4th Rd., Baolong Industrial Area, Longgang District,

Shenzhen, China

Factory: Shenzhen Fastrain Technology Co., Ltd.

Address of Factory: No.3 Baolong 4th Rd., Baolong Industrial Area, Longgang District,

Shenzhen, China

**Product Name:** YachtSense Link – Marine Cloud Router

Model No.: E70640

Trade Mark: Raymarine

FCC ID: PJ5-RAY4GHUB

47 CFR Part 1.1307

Standards: 47 CFR Part 1.1310

47 CFR Part 2.1091

**Date of Receipt:** 2021-01-04

**Date of Test:** 2021-01-07 to 2021-02-24

**Date of Issue:** 2021-02-24

Test Result : PASS\*

Keny Xu EMC Laboratory Manager

Ceny. Ku



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<sup>\*</sup> In the configuration tested, the EUT complied with the standards specified above.



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## 2 Version

Revision Record							
Version	Chapter	Date	Modifier	Remark			
01		2021-02-24		Original			

Authorized for issue by:		
	Robsonti	
	Edison Li /Project Engineer	-
	EvicFu	
	Eric Fu /Reviewer	-



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## 4 General Information

## 4.1 General Description of EUT

Power supply:	Nominal Supply Voltage:12/24V dc
	Operating Voltage Range:8V dc to 32V dc
Cable(s):	DC cable:150cm unshielded
Gabic(3).	Network cable:110cm unshielded
	5 in 1 SANAV antenna length:500cm unshielded
	5 in 1 Sinclair antenna length:500cm unshielded
Internal Source:	More than 108MHz

### **Details of Boat WLAN(AP mode)**

Operation Frequency:	802.11b/g/n(HT20): 2412MHz to 2462MHz	
	802.11n(HT40): 2422MHz to 2452MHz	
Modulation Type:	802.11b: DSSS(CCK, DQPSK, DBPSK)	
	802.11g: OFDM(64QAM, 16QAM, QPSK, BPSK)	
	802.11n(HT20 and HT40): OFDM (BPSK, QPSK, 16QAM, 64QAM)	
Channel Numbers:	802.11b/g, 802.11n HT20: 11 Channels	
	802.11n HT40: 7 Channels	
Sample Type:	Fixed device	
Antenna Type:	Dipole antenna	
Antenna Gain:	Antenna1/ Antenna2:5.3dBi	
	Note: MIMO for 802.11n	

### **Details of Dock WLAN(Station mode)**

Operation Frequency:	802.11b/g/n(HT20): 2412MHz to 2462MHz		
	802.11n(HT40): 2422MHz to 2452MHz		
Modulation Type:	802.11b: DSSS(CCK, DQPSK, DBPSK)		
	802.11g: OFDM(64QAM, 16QAM, QPSK, BPSK)		
	802.11n(HT20 and HT40): OFDM (BPSK, QPSK, 16QAM, 64QAM)		
Channel Numbers:	802.11b/g, 802.11n HT20: 11 Channels		
	802.11n HT40: 7 Channels		
Sample Type:	Fixed device		



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Antenna Type:	Smart antenna
Antenna Gain:	Sinclair LM715(E6685) Rugged mobile antenna, 5 in 1, LTE&WiFi MIMO
	with GNSS, Sinclair1 Antenna/ Sinclair2 Antenna:1.9dBi
	SANAV 5-in-1 5G NR/ 4G LTE/ WiFi/ GNSS Combination Antenna
	SANAV1 Antenna:4.55dBi, SANAV2 Antenna:4.45dBi(Note: MIMO for
	802.11n)
	Note: MIMO for 802.11n

#### Details of Dock WLAN(Station mode)

Operation Frequency	Band	Mode	Frequency Range(MHz)	Number of channels			
	UNII Band I	802.11a/n(HT20)/ac(HT20)	5180-5240	4			
		802.11n(HT40)/ac(HT40)	5190-5230	2			
		802.11ac(HT80) 5210		1			
	UNII Band II-A	802.11a/n(HT20)/ac(HT20)	1a/n(HT20)/ac(HT20) 5260-5320				
		802.11n(HT40)/ac(HT40)	5270-5310	2			
		802.11ac(HT80)	5290	1			
	UNII Band II-C	802.11a/n(HT20)/ac(HT20)	5500-5700	11			
		802.11n(HT40)/ac(HT40)	5510-5670	5			
		802.11ac(HT80)	5530,5610	2			
	UNII Band III	802.11a/n(HT20)/ac(HT20)	5745-5825	5			
		802.11n(HT40)/ac(HT40)	5755-5795	2			
		802.11ac(HT80)	5775	1			
Modulation Type:	802.11a: OFDM(64QAM, 16QAM, QPSK, BPSK) 802.11n: OFDM (BPSK, QPSK, 16QAM, 64QAM)						
	802.11ac: OFDN	802.11ac: OFDM (BPSK, QPSK, 16QAM, 64QAM, 256QAM)					
DFS Function:	Slave without rac	dar detection					
TPC Function:	Not support						
Sample Type:	Fixed device						
Antenna Type:	Smart antenna						
Antenna Gain:	Sinclair LM715(E6685) Rugged mobile antenna, 5 in 1, LTE&WiFi MIMO with GNSS Sinclair1 Antenna/ Sinclair2 Antenna:3.9dBi						



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SANAV 5-in-1 5G NR/ 4G LTE/ WiFi/ GNSS Combination Antenna
SANAV1 Antenna:5.84dBi, SANAV2 Antenna:4.02dBi
Note: MIMO for 802.11n

Details of GSM/WCDMA/LTE module*:					
Operation Frequency Band:	GSM850/GSM1900, WCDMA Band II,IV,V; LTE FDD Band 2,4,5,7,12,13,25,26,38,41				
Modulation Type:	WCDMA: QPSK LTE: QPSK, 16QAM				
HSDPA UE Category:	24				
HSUPA UE Category:	6				
LTE Category:	4				
Antenna Type:	Smart antenna				
	Tx & Rx Port	1			
Antenna Ports:	Rx-only Port	1			
Antenna Gain:	SANAV 5-in-1 5G GSM850: Mobile GSM1900: Mobile WCDMA Band II: WCDMA Band IV WCDMA Band V: LTE Band 2: Mob LTE Band 4: Mob LTE Band 5: Mob LTE Band 12: Mo LTE Band 13: Mo LTE Band 25: Mo LTE Band 26: Mo LTE Band 38: Mo	nna:1.9dBi, Mobile Aux Antenna:3.9dBi  NR/ 4G LTE/ WiFi/ GNSS Combination Antenna Main Antenna:1.49dBi, Mobile Aux Antenna:4.66dBi Main Antenna:3.95dBi, Mobile Aux Antenna:4.92dBi Mobile Main Antenna:3.95dBi, Mobile Aux Antenna:4.92dBi Mobile Main Antenna:3.95dBi, Mobile Aux Antenna:4.66dBi Mobile Main Antenna:1.49dBi, Mobile Aux Antenna:4.66dBi ile Main Antenna:3.95dBi, Mobile Aux Antenna:4.92dBi ile Main Antenna:3.95dBi, Mobile Aux Antenna:4.66dBi ile Main Antenna:1.49dBi, Mobile Aux Antenna:4.66dBi ile Main Antenna:4.29dBi, Mobile Aux Antenna:4.29dBi bile Main Antenna:2.42dBi, Mobile Aux Antenna:5.32dBi bile Main Antenna:3.95dBi, Mobile Aux Antenna:4.29dBi bile Main Antenna:4.29dBi, Mobile Aux Antenna:4.92dBi bile Main Antenna:1.49dBi, Mobile Aux Antenna:4.92dBi bile Main Antenna:1.49dBi, Mobile Aux Antenna:4.29dBi bile Main Antenna:4.29dBi, Mobile Aux Antenna:4.29dBi bile Main Antenna:4.29dBi, Mobile Aux Antenna:4.29dBi bile Main Antenna:4.29dBi, Mobile Aux Antenna:4.29dBi			

<sup>\*:</sup> The GSM/WCDMA/LTE single module approval by TCB(FCC ID:XMR201903EG25G), Grant at 03/29/2019.



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## 4.2 Test Location

All tests were performed at:

SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch

No. 1 Workshop, M-10, Middle section, Science & Technology Park, Shenzhen, Guangdong, China 518057

Telephone: +86 (0) 755 2601 2053 Fax: +86 (0) 755 2671 0594

No tests were sub-contracted.

### 4.3 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

#### CNAS (No. CNAS L2929)

CNAS has accredited SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch EMC Lab to ISO/IEC 17025:2005 General Requirements for the Competence of Testing and Calibration Laboratories (CNAS-CL01 Accreditation Criteria for the Competence of Testing and Calibration Laboratories) for the competence in the field of testing.

### A2LA (Certificate No. 3816.01)

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory is accredited by the American Association for Laboratory Accreditation(A2LA). Certificate No. 3816.01.

#### • VCCI

The 3m Fully-anechoic chamber for above 1GHz, 10m Semi-anechoic chamber for below 1GHz, Shielded Room for Mains Port Conducted Interference Measurement and Telecommunication Port Conducted Interference Measurement of SGS-CSTC Standards Technical Services Co., Ltd. have been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: G-20026, R-14188, C-12383 and T-11153 respectively.

#### FCC –Designation Number: CN1178

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory has been recognized as an accredited testing laboratory.

Designation Number: CN1178. Test Firm Registration Number: 406779.

#### Innovation, Science and Economic Development Canada

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory has been recognized by ISED as an accredited testing laboratory.

CAB identifier: CN0006.

IC#: 4620C.

### 4.4 Deviation from Standards

None.

### 4.5 Abnormalities from Standard Conditions

None

## 4.6 Other Information Requested by the Customer

None.



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## 5 RF Exposure Evaluation

## 5.1 RF Exposure Compliance Requirement

#### **5.1.1 Limits**

According to FCC Part1.1310: 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 part1.1307(b)

Table 1—Limits for Maximum Permissible Exposure (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm²)	Averaging time (minutes)				
(A) Limits for Occupational/Controlled Exposures								
0.3–3.0	614 1842/f 61.4	1.63 4.89/f 0.163	*(100) *(900/f²) 1.0 f/300	6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6				
(B) Limits	for General Populati	on/Uncontrolled Exp	oosure					
0.3–1.34	614 824/f 27.5	1.63 2.19/f 0.073	*(100) *(180/f²) 0.2 f/1500 1.0	30 30 30 30 30				

F= Frequency in MHz

Friis Formula

Friis transmission formula:  $Pd = (Pout*G)/(4*Pi*R^2)$ 

Where

Pd = power density in mW/cm<sup>2</sup>

Pout = output power to antenna in mW

G = gain of antenna in linear scale

Pi = 3.1416

For Uncontrolled Environment, the MPE limit of 300 MHz to 1500 MHz is  $f/1500 \ mW/cm^2$ , the MPE limit of 1500 MHz to 100000 MHz is  $1.0 \ mW/cm^2$ . If we know the maximum gain of the antenna and the total power input to the antenna, through the calculation, we will know the distance r where the MPE limit is reached.

### 5.1.2 Test Procedure

Software provided by client enabled the EUT to transmit and receive data at lowest, middle and highest channel individually.



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### 5.1.3 EUT RF Exposure Evaluation

### 1) Test Results

Note: The Boat WLAN antenna, Dock WLAN antenna and GSM/WCDMA/LTE antenna can synchronous transmission at the same time.

### For 2.4G WiFi(Boat WLAN):

The max tune-up tolerance power Into Antenna & RF Exposure Evaluation Distance:

Antenna	Max Antenna Gain (dBi)	Max Antenna Gain (Numeric)	Max tune-up tolerance power (dBm)	Max tune-up Tolerance power to Antenna (mW)	Power Density at R = 50 cm (mW/cm²)	Limit (mW/cm²)	MPE Ratios	Result
MIMO	5.3	3.39	17.02	50.35	0.0054	1	0.0054	PASS

Note: Refer to report No. SZEM210100002802 or EUT test Max Conducted Peak Output Power value.

The distancer (4th column) calculated from the Fries transmission formula is far greater than 50 cm separation requirement, the MPE limit of 1500MHz to 100000MHz is 1.0 mW/cm<sup>2</sup>.

#### For 2.4G WiFi(Dock WLAN, Sinclair antenna):

The max tune-up tolerance power Into Antenna & RF Exposure Evaluation Distance:

Antenna	Max Antenna Gain (dBi)	Max Antenna Gain (Numeric)	Max tune-up tolerance power (dBm)	Max tune-up Tolerance Power to Antenna(mW)	Power Density at R = 50 cm (mW/cm²)	Limit (mW/cm²)	MPE Ratios	Result
MIMO	1.9	1.55	17.96	62.52	0.0031	1	0.0031	PASS

Note: Refer to report No. SZEM210100002802 or EUT test Max Conducted Peak Output Power value.

The distancer (4th column) calculated from the Fries transmission formula is far greater than 50 cm separation requirement, the MPE limit of 1500MHz to 100000MHz is 1.0 mW/cm<sup>2</sup>.

#### For 2.4G WiFi(Dock WLAN, SANAV antenna):

The max tune-up tolerance power Into Antenna & RF Exposure Evaluation Distance:

Antenna	Max Antenna Gain (dBi)	Max Antenna Gain (Numeric)	Max tune-up tolerance power (dBm)	Max tune-up Tolerance Power to Antenna(mW)	Power Density at R = 50 cm (mW/cm²)	Limit (mW/cm²)	MPE Ratios	Result
MIMO	4.55	2.85	17.96	62.52	0.0057	1	0.0057	PASS

Note: Refer to report No. SZEM210100002802 or EUT test Max Conducted Peak Output Power value.

The distancer (4th column) calculated from the Fries transmission formula is far greater than 50 cm separation requirement, the MPE limit of 1500MHz to 100000MHz is 1.0 mW/cm<sup>2</sup>.



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#### For 5G WiFi(Dock WLAN, Sinclair antenna):

The max tune-up tolerance power Into Antenna & RF Exposure Evaluation Distance:

Antenna	Max Antenna Gain (dBi)	Max Antenna Gain (Numeric)	Max tune-up tolerance power (dBm)	Max tune-up Tolerance power to Antenna (mW)	Power Density at R = 50 cm (mW/cm²)	Limit (mW/cm²)	MPE Ratios	Result	
MIMO	3.9	2.45	17.59	57.41	0.0045	1	0.0045	PASS	

Note: Refer to report No. SZEM210100002803 or EUT test Max Conducted Peak Output Power value. The distancer (4th column) calculated from the Fries transmission formula is far greater than 50 cm separation requirement, the MPE limit of 1500MHz to 100000MHz is 1.0 mW/cm<sup>2</sup>.

### For 5G WiFi(Dock WLAN, SANAV antenna):

The max tune-up tolerance power Into Antenna & RF Exposure Evaluation Distance:

Antenna	Max Antenna Gain (dBi)	Max Antenna Gain (Numeric)	Max tune-up tolerance power (dBm)	Max tune-up Tolerance power to Antenna (mW)	Power Density at R = 50 cm (mW/cm²)	Limit (mW/cm²)	MPE Ratios	Result
MIMO	5.84	3.84	17.59	57.41	0.0070	1	0.0070	PASS

Note: Refer to report No. SZEM210100002803 or EUT test Max Conducted Peak Output Power value. The distancer (4th column) calculated from the Fries transmission formula is far greater than 50 cm separation requirement, the MPE limit of 1500MHz to 100000MHz is 1.0 mW/cm².



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#### For GSM/WCDMA/LTE module(Sinclair antenna):

The max tune-up tolerance power Into Antenna & RF Exposure Evaluation Distance:

Туре	Test Freq. (MHz)	Max Antenna Gain (dBi)	Max Antenna Gain (Numeric)	Max tune-up tolerance power (dBm)	Max tune-up Tolerance power to Antenna (mW)	Power Density at R=50cm (mW/cm²)	Limit (mW/cm²)	MPE Ratios	Result
GSM850	824.2	3.9	2.45	33	1995.26	0.1559	0.5495	0.2837	PASS
PCS1900	1850.2	3.9	2.45	30	1000.00	0.0781	1	0.0781	PASS
WCDMA Band II	1852.4	3.9	2.45	24	251.19	0.0196	1	0.0196	PASS
WCDMA Band IV	1712.4	3.9	2.45	24	251.19	0.0196	1	0.0196	PASS
WCDMA Band V	826.4	3.9	2.45	24	251.19	0.0196	0.5509	0.0356	PASS
LTE Band2	1850.7	3.9	2.45	23	199.53	0.0156	1	0.0156	PASS
LTE Band4	1710.7	3.9	2.45	23	199.53	0.0156	1	0.0156	PASS
LTE Band5	824.7	3.9	2.45	23	199.53	0.0156	0.5498	0.0284	PASS
LTE Band7	2502.5	3.9	2.45	23	199.53	0.0156	1	0.0156	PASS
LTE Band12	699.7	3.9	2.45	23	199.53	0.0156	0.4665	0.0334	PASS
LTE Band13	779.5	3.9	2.45	23	199.53	0.0156	0.5197	0.0300	PASS
LTE Band25	1850.7	3.9	2.45	23	199.53	0.0156	1	0.0156	PASS
LTE Band26	814.7	3.9	2.45	23	199.53	0.0156	0.5431	0.0287	PASS
LTE Band38	2572.5	3.9	2.45	23	199.53	0.0156	1	0.0156	PASS
LTE Band41	2498.5	3.9	2.45	23	199.53	0.0156	1	0.0156	PASS

Note: Refer to report No. HR/2019/1001601 or EUT test Max Conducted Peak Output Power value.

The distancer (4th column) calculated from the Fries transmission formula is far greater than 50 cm separation requirement.

the MPE limit of 300MHz to 1500MHz is  $f/1500 \text{ mW/cm}^2$ , the MPE limit of 1500MHz to 100000MHz is 1.0  $\text{mW/cm}^2$ .



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### For GSM/WCDMA/LTE module(SANAV antenna):

The max tune-up tolerance power Into Antenna & RF Exposure Evaluation Distance:

		. '			. '				
Туре	Test Freq. (MHz)	Max Antenna Gain (dBi)	Max Antenna Gain (Numeric)	Max tune-up tolerance power (dBm)	Max tune-up Tolerance power to Antenna (mW)	Power Density at R=50cm (mW/cm²)	Limit (mW/cm²)	MPE Ratios	Result
GSM850	824.2	4.66	2.92	33	1995.26	0.1857	0.5495	0.3380	PASS
PCS1900	1850.2	4.92	3.10	30	1000.00	0.0988	1	0.0988	PASS
WCDMA Band II	1852.4	4.92	3.10	24	251.19	0.0248	1	0.0248	PASS
WCDMA Band IV	1712.4	5.82	3.82	24	251.19	0.0305	1	0.0305	PASS
WCDMA Band V	826.4	4.66	2.92	24	251.19	0.0234	0.5509	0.0424	PASS
LTE Band2	1850.7	4.92	3.10	23	199.53	0.0197	1	0.0197	PASS
LTE Band4	1710.7	5.82	3.82	23	199.53	0.0243	1	0.0243	PASS
LTE Band5	824.7	4.66	2.92	23	199.53	0.0186	0.5498	0.0338	PASS
LTE Band7	2502.5	4.29	2.69	23	199.53	0.0171	1	0.0171	PASS
LTE Band12	699.7	5.32	3.40	23	199.53	0.0216	0.4665	0.0463	PASS
LTE Band13	779.5	5.32	3.40	23	199.53	0.0216	0.5197	0.0416	PASS
LTE Band25	1850.7	4.92	3.10	23	199.53	0.0197	1	0.0197	PASS
LTE Band26	814.7	4.66	2.92	23	199.53	0.0186	0.5431	0.0342	PASS
LTE Band38	2572.5	4.29	2.69	23	199.53	0.0171	1	0.0171	PASS
LTE Band41	2498.5	4.29	2.69	23	199.53	0.0171	1	0.0171	PASS

Note: Refer to report No. HR/2019/1001601 or EUT test Max Conducted Peak Output Power value.

The distancer (4th column) calculated from the Fries transmission formula is far greater than 50 cm separation requirement.

the MPE limit of 300MHz to 1500MHz is  $f/1500 \text{ mW/cm}^2$ , the MPE limit of 1500MHz to 100000MHz is 1.0  $\text{mW/cm}^2$ .



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The simultaneous transmission result between of Boat WLAN, Dock WLAN and GSM/WCDMA/LTE module:

The SAR Exclusion Threshold Level:

=CPD1 / LPD1 + CPD2 / LPD2 + CPD3 / LPD3

(CPD = Calculation power density, LPD = Limit of power density)

= (0.0054/1) + (0.0070/1) + (0.1857/0.5495) = 0.3504 < 1

Since the SAR Exclusion Threshold Level is well below the SAR low threshold level, so the EUT is considered to comply with SAR requirement without testing.

End of Report



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