

RF Exposure Evaluation Report

Application No.: SZEM2007006018CR
Applicant: Navico Inc.
Address of Applicant: 4500 S. 129th East Avenue, Ste. 200, Tulsa, Oklahoma, 74134 United States
Manufacturer: Navico Auckland Limited
Address of Manufacturer: Arrenway Drive, Rosedale, Auckland, 0632 New Zealand
Factory: Shenzhen Fastrain Technology Co., Ltd.
Address of Factory: No.3 Baolong 4th Rd., Baolong Industrial Area, Longgang District, Shenzhen, China

Equipment Under Test (EUT):

Product Name: MARINE BLACK BOX DSC/AIS VHF RADIO SYSTEM
Model No.: NRS-1
Trade Mark: NAVICO
FCC ID: RAYVHFNRS1
Standards: 47 CFR Part 1.1307 (2016)
47 CFR Part 1.1310 (2016)
Date of Receipt: 2020-07-03
Date of Test: 2020-10-26 to 2020-11-04
Date of Issue: 2020-11-06

Test Result :	PASS*
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* In the configuration tested, the EUT complied with the standards specified above.


Keny Xu
EMC Laboratory Manager



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2 Version

Revision Record				
Version	Chapter	Date	Modifier	Remark
01		2020-11-06		Original

Authorized for issue by:			
			
		<hr/> Edison Li /Project Engineer	
			
		<hr/> Eric Fu /Reviewer	



3 Contents

	Page
1 COVER PAGE	1
2 VERSION.....	2
3 CONTENTS.....	3
4 GENERAL INFORMATION	4
4.1 GENERAL DESCRIPTION OF EUT.....	4
4.2 TEST SUMMARY OF SPOT-CHECK TEST DATA	6
4.3 TEST LOCATION	7
4.4 TEST FACILITY	7
4.5 DEVIATION FROM STANDARDS	7
4.6 ABNORMALITIES FROM STANDARD CONDITIONS	7
4.7 OTHER INFORMATION REQUESTED BY THE CUSTOMER	7
5 RF EXPOSURE EVALUATION.....	8
5.1 RF EXPOSURE COMPLIANCE REQUIREMENT.....	8
5.1.1 Limits.....	8
5.1.2 Test Procedure.....	8
4.1.3 EUT RF EXPOSURE EVALUATION.....	9



4 General Information

4.1 General Description of EUT

Power supply:	12 VDC battery system
Cable:	DC cable: longer than 300cm unshielded
Sample Type:	Mobile device
Classification:	Uncontrolled Environment
Internal Source:	More than 108MHz
Transmitter Frequency Range:	VHF:156.025MHz-157.425MHz 802.11b/g/n HT20: 2412MHz-2462MHz
DSC Transmitter Frequency Range:	156.525MHz(CH70), Meets Global DSC Class D standards.
GNSS Receiver Frequency Range:	1559MHz-1610MHz(GLONASS:G1, GPS:L1)
Modulation Type:	VHF:FM for Analog; DSC:FSK; GNSS: BPSK; 802.11b: DSSS (CCK, DQPSK, DBPSK) 802.11g: OFDM (64QAM, 16QAM, QPSK, BPSK) 802.11n(HT20): OFDM (BPSK, QPSK, 16QAM, 64QAM)
Frequency Spacing:	VHF: 25KHz 802.11b/g/n HT20: 5MHz
Channel Numbers:	802.11b/g/n HT20: 11 Channels
Emission Type:	16K0G3E for VHF 16K0G2B for DSC
Rated Output Power:	25W/1W for VHF/DSC
VHF/DSC Antenna Connectors:	SO-239(50 ohm, External Antenna)
VHF/DSC Antenna Gain:	6dBi
GNSS Antenna Connector:	SMA for External antenna
GNSS Antenna Gain:	1.5dBi
WiFi Antenna Type:	Integral
WiFi Antenna Gain:	5.3dBi



Remark:

Model No.: NRS-1

This device has two different models NRS1 and NRS2. since according to the declaration from the applicant, the electrical circuit design, layout, components used, internal wiring and functions were identical for all the above models, with only differences are the model no. and AIS board(NRS2 has AIS board inside the main unit and while NRS-1 not).

This report SZEM200700601809 is only for model NRS1(FCC ID: RAYVHFNRS1).

This report SZEM200700601809 is prepared for FCC Spot Check Verification report. the format, test items and amount of spot-check test data are decided by applicant's engineering judgment; for more details please refer to declaration letter. the original report please refer to report no.: SZEM200700601805.

Determining compliance based on the results of the compliance measurement not taking into account measurement instrumentation uncertainty.



4.2 Test Summary of spot-check test data

Item	Worst test result for original report(FCC ID:RAYVHFNR2)	Worst test result for this report(FCC ID:RAYVHFNR1)
MPE ratio	0.5925	0.4915



4.3 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.

4.4 Test Facility

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

- **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.

4.5 Deviation from Standards

None.

4.6 Abnormalities from Standard Conditions

None.

4.7 Other Information Requested by the Customer

None.



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/cm ²)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0	614	1.63	*(100)	6
3.0–30	1842/f	4.89/f	*(900/f ²)	6
30–300	61.4	0.163	1.0	6
300–1500 .....	.....	.....	f/300	6
1500–100,000 .....	.....	.....	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 ²)	30
30–300	27.5	0.073	0.2	30
300–1500 .....	.....	.....	f/1500	30
1500–100,000 .....	.....	.....	1.0	30

F= Frequency in MHz

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

For Uncontrolled Environment, the MPE limit of VHF is 0.2 mW/cm², the MPE limit of 802.11b/g/n is 1.0 mW/cm². 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.



4.1.3 EUT RF Exposure Evaluation

The best case gain of the antenna is 6dBi. 6dB logarithmic terms convert to numeric result is nearly 3.98.

Test Frequency (MHz)	Maximum Antenna Gain (dBi)	Maximum Antenna Gain (Numeric)	Output Power (dBm)	Max Tune-up tolerance power (dBm)	Max Tune-up tolerance power*50% ^a (mW)	Power density (mW/cm ²)	Minimum Distance to Human body (cm)
156.025	6	3.98	43.92	43.98	12501.73	0.20	140.72
156.025	6	3.98	29.54	30	500.00	0.20	28.14
156.300	6	3.98	43.95	43.98	12501.73	0.20	140.72
156.300	6	3.98	28.94	30	500.00	0.20	28.14
156.650	6	3.98	43.83	43.98	12501.73	0.20	140.72
156.650	6	3.98	28.97	30	500.00	0.20	28.14
156.800	6	3.98	43.9	43.98	12501.73	0.20	140.72
156.800	6	3.98	29.23	30	500.00	0.20	28.14
157.425	6	3.98	43.96	43.98	12501.73	0.20	140.72
157.425	6	3.98	29.29	30	500.00	0.20	28.14
156.525	6	3.98	43.86	43.98	12501.73	0.20	140.72
156.525	6	3.98	29.08	30	500.00	0.20	28.14

Note ^a: These channels may be operated as half-duplex frequency channels.

For VHF Transmitter:

The maximum rated power of duplex is 25W, the low rated power of duplex is 1W which declared by manufacturer.

Then the maximum rated power of half-duplex is 12.5W, the low rated power of half-duplex is 0.5W.

To satisfy RF exposure requirements, a separation distance of 140.72cm or more should be maintained between this device and persons during device operation. To ensure compliance, operations at closer than this distance is not recommended.

The minimum distance between this device and persons during device operation is 210 cm which declared by manufacturer. Through the calculation, the maximum power density at 210cm is:

$$P_d = (P_{out} * G) / (4 * \pi * R^2) = (12501.73 * 3.98) / (4 * 3.1416 * 210 * 210) = 0.0898 \text{ mW/cm}^2$$



For 802.11b/g/n HT20:

The best case gain of the antenna is 5.3dBi. 5.3dB logarithmic terms convert to numeric result is nearly 3.39

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

Channel	Frequency (MHz)	Max tune-up tolerance power(dBm)	Max tune-up Tolerance power to Antenna (mW)	Power Density at R = 20 cm (mW/cm ²)	Limit	MPE Ratio	Result
Low	2412MHz	18	63.10	0.0425	1.0	0.0425	PASS

The simultaneous transmission result between of 2.4G WiFi and VHF:

The SAR Exclusion Threshold Level:

=CPD1/LPD1 + CPD2/LPD2 (CPD = Calculation power density, LPD = Limit of power density)

= (0.0898/0.2) +(0.0425/1) = 0.4915 < 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 the Report -

