

RF Exposure Report

Application No.: FYCR2206000234AT
Applicant: Navico Inc.
Address of Applicant: 4500 S. 129th East Avenue, Ste. 200 Tulsa Oklahoma United States 74134
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):
EUT Name: Marin VHF Radio
Model No.: V60-B, RS40-B ♣
 ♣ Please refer to section 2 of this report which indicates which model was actually tested and which were electrically identical.
Trade mark: B&G, SIMRAD
FCC ID: RAYVHFERS40BA
 47 CFR Part 2.1091
Standard(s) : 47 CFR Part 1.1310
 47 CFR Part 1.1307
Date of Receipt: 2022-06-14
Date of Test: 2022-07-13 to 2022-07-22
Date of Issue: 2022-07-28

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





Winkey Wang
EMC Technical Manager



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Revision Record				
Version	Chapter	Date	Modifier	Remark
01		2022-07-28		Original

Authorized for issue by:			
			
	Tree Zhan/Project Engineer		
			
	Winkey Wang/Reviewer		



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3 General Information

3.1 Details of E.U.T.

Power supply:	12 VDC battery system
Cable:	DC cable: longer than 300cm unshielded
Sample Type:	Mobile device
Internal Source:	More than 108MHz
Transmitter Frequency Range:	VHF:156.025MHz-157.425MHz 802.11b/g/n HT20: 2412MHz-2462MHz
AIS Transmitter Frequency Range:	161.975MHz(CH87), 162.025MHz(CH88)
DSC Transmitter Frequency Range:	156.525MHz(CH70)
GNSS Receiver Frequency Range:	1559MHz-1610MHz(GLONASS:G1, GPS:L1)
Modulation Type:	VHF:FM for Analog; DSC:FSK; AIS:GMSK; 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; 2W for AIS;
VHF/DSC Antenna Connectors:	SO-239(50 ohm, External Antenna)
AIS Antenna Connectors:	SO-239(50 ohm, External Antenna)
VHF/DSC Antenna Gain:	6dBi
AIS Antenna Gain:	6dBi
GPS Antenna Connector:	SMA for External antenna; Integral for Internal antenna
GPS Antenna Gain:	1.5dBi
WiFi Antenna Type:	Integral
WiFi Antenna Gain:	2.64dBi



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Remark:

Model No.: V60-B, RS40-B

Only the model V60-B was tested, since the electrical circuit design, layout, components used, internal wiring and functions were identical for all the above models, with only differences are the trade name and model no. for trading purpose.



3.2 Test Location

All tests were performed at:

Compliance Certification Services (Kunshan) Inc. Shenzhen branch.

Fuyong lab. Xinlong TechnoPark, Fengtang Road, Fuyong Subdistrict, Bao'an, Shenzhen, China

Tel: +86 755 8866 3988 Fax: +86 755 2671 0594

No tests were sub-contracted.

3.3 Test Facility

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

- **A2LA (Certificate No. 6606.01)**

Compliance Certification Services (Kunshan) Inc. Shenzhen branch is accredited by the American Association for Laboratory Accreditation(A2LA). Certificate No. 6606.01.

- **FCC –Designation Number: CN1322**

Compliance Certification Services (Kunshan) Inc. Shenzhen branch has been recognized as an accredited testing laboratory.

Designation Number: CN1322. Test Firm Registration Number: 718073

- **Innovation, Science and Economic Development Canada**

Compliance Certification Services (Kunshan) Inc. Shenzhen branch has been recognized by ISED as an accredited testing laboratory.

CAB identifier: CN0129.

IC#: 28189.



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4 Radio Spectrum Technical Requirement

4.1 RF Exposure

4.1.1 Requirement

In accordance with 47 CFR FCC Part 2.1091, this device has been defined as a mobile device whereby a distance of 0.2m normally can be maintained between the user and the device.

According to 47 CFR FCC Part 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 TO §1.1310(E)(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)
(i) Limits for Occupational/Controlled Exposure				
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
300-1,500			f/300	<6
1,500-100,000			5	<6
(ii) 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
300-1,500			f/1500	<30
1,500-100,000			1.0	<30

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



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4.1.2 Method

According to IEEE C95.3:2002 section 5.5.1.1, the power density S at a point on the axis at a distance d from a transmitting antenna is given by the Friis free-space transmission formula:

$$S = \frac{PG}{4\pi d^2}$$

S = power density (mW/cm²)

P = the net power delivered to the antenna (mW)

G = gain of the antenna in linear scale

d = distance between observation point and center of the radiator (cm)

From the maximum EUT RF output power, as well as the gain of the used antenna, according to the RF power density limit stated in above table, the minimum distance between the antenna and human body will be calculated.

4.1.3 Conclusion

1) Test Results

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	43.84	43.98	12501.73	0.2	140.72
156.025	6	3.98	29.33	30.00	500.00	0.2	28.14
156.300	6	3.98	43.82	43.98	12501.73	0.2	140.72
156.300	6	3.98	29.16	30.00	500.00	0.2	28.14
156.650	6	3.98	43.79	43.98	12501.73	0.2	140.72
156.650	6	3.98	29.07	30.00	500.00	0.2	28.14
156.800	6	3.98	43.73	43.98	12501.73	0.2	140.72
156.800	6	3.98	29.24	30.00	500.00	0.2	28.14
157.425	6	3.98	43.83	43.98	12501.73	0.2	140.72
157.425	6	3.98	29.25	30.00	500.00	0.2	28.14
156.525	6	3.98	43.86	43.98	12501.73	0.2	140.72
162.025	6	3.98	32.37	34.50	1409.19	0.2	47.25

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



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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:

$$Pd = (Pout \cdot G) / (4 \cdot \pi \cdot R^2) = (12501.73 \cdot 3.98) / (4 \cdot 3.1416 \cdot 210^2) = 0.0898 \text{ mW/cm}^2$$

For AIS Transmitter:

The rated power is 2W, which declared by manufacturer. Then the rated power of half-duplex is 1W. To satisfy RF exposure requirements, a separation distance of 47.25cm 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:

$$Pd = (Pout \cdot G) / (4 \cdot \pi \cdot R^2) = (1409.19 \cdot 3.98) / (4 \cdot 3.1416 \cdot 210^2) = 0.0101 \text{ mW/cm}^2$$

For 802.11b/g/n HT20:

The best case gain of the antenna is 2.64dBi. 2.64dBi logarithmic terms convert to numeric result is nearly 1.84dB

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
High	2462MHz	11	12.59	0.0046	1.0	0.0046	PASS



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

The SAR Exclusion Threshold Level:

=CPD1 / LPD1 + CPD2 / LPD2 + CPD3 / LPD3 (CPD = Calculation power density, LPD = Limit of power density)

= (0.0898/0.2) +(0.0101/0.2) +(0.0046/1)= 0.5041 < 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.

4.2 EUT Constructional Details

Refer to Appendix - external and internal photos for FYCR2206000234AT.

--End of the Report--



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