



RF Exposure Evaluation Report

APPLICANT	NAVICO INC.
ADDRESS	4500 S. 129TH EAST AVENUE SUITE 200 TULSA OK 74134-5885 USA
FCC ID	RAYHALO20PLUS
IC	978B-HALO20PLUS
MODEL NUMBER	Halo20+
PRODUCT DESCRIPTION	RADAR
DATE SAMPLE RECEIVED	07/17/2019
FINAL TEST DATE	07/23/2019
PREPARED BY	Franklin Rose

Report Number	Report Version	Description	Issue Date
1833AUT19 MPE_TestReport_	Rev1	Initial Issue	07/23/2018

THE ATTACHED REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL WITHOUT THE WRITTEN APPROVAL OF TIMCO ENGINEERING, INC.



TABLE OF CONTENTS

GENERAL REMARKS	2
GENERAL INFORMATION	3
ANTENNA INFORMATION	4
MPE CALCULATION	5
FCC MPE LIMITS	5
MPE DATA	6
FCC MPE CALCULATION	6
<i>In-beam Field Strength</i>	<i>6</i>
<i>Outside-of-beam Field Strength</i>	<i>7</i>
IC MPE CALCULATION	8
<i>In-beam Field Strength</i>	<i>8</i>
<i>Outside-of-beam Field Strength</i>	<i>9</i>

GENERAL REMARKS

Summary

The device under test does:

- ☒ Fulfill the general approval requirements as identified in this test report and was selected by the customer.
- ☐ Not fulfill the general approval requirements as identified in this test report

Attestations

This equipment has been tested in accordance with the standards identified in this test report. To the best of my knowledge and belief, these tests were performed using the measurement procedures described in this report.

All instrumentation and accessories used to test products for compliance to the indicated standards are calibrated regularly in accordance with ISO 17025 requirements.

I attest that the necessary measurements were made at:

Timco Engineering Inc.
849 NW State Road 45
Newberry, FL 32669
Designation #: US1070

Prepared by:



Name and Title	Franklin Rose, EMC Project Manager / EMC Specialist
Date	07/23/2018

Applicant: NAVICO INC.
FCC ID: RAYHALO20PLUS
IC: 978B-HALO20PLUS
Report: 1833AUT19_MPE TestReport_Rev1

GENERAL INFORMATION

EUT Description	RADAR		
Model Number	Halo20+		
EUT Power Source	<input checked="" type="checkbox"/> 110–120 VAC	<input type="checkbox"/> DC Power (12 V)	<input type="checkbox"/> Battery Operated
Test Item	<input type="checkbox"/> Prototype	<input checked="" type="checkbox"/> Pre-Production	<input type="checkbox"/> Production
Type of Equipment	<input checked="" type="checkbox"/> Fixed	<input type="checkbox"/> Mobile	<input type="checkbox"/> Portable
Antenna Connector	WR-90 Waveguide		
Test Conditions	The temperature was 26°C Relative humidity of 50%.		
Modification to the EUT	No Modification to EUT.		
Applicable Standards	FCC CFR 47 Part 2.1091		
Test Facility	Timco Engineering Inc. at 849 NW State Road 45 Newberry, FL 32669 USA. Designation #: US1070		

NOTES:

In all cases, the radar equipment is intended for controlled/occupational use and access only. General population MPE distances have also been provided, for reference.

ANTENNA INFORMATION

This information was provided by the client:

Halo Antennas	Max. permissible antenna gain (dBi)	Impedance
Halo 20 Radar	22.5 dBi	Not applicable
Halo20+ Radar		
Halo24 Radar	23.5 dBi	

Antenna Type	Patch Array
Length	560 mm
Antenna Gain	22.5 dBi
Beamwidth	3.9 degrees
Sidelobe Supression	Better than -18dB inside +/-10deg Better than -24dB outside +/-10deg
Backlobe Supression	≥ -24dB

Manufacturer Provides Antenna	Type	Max Gain (dBi)
Yes	Patch Array	22.5

MPE CALCULATION

The minimum separation distance is calculated as follows:

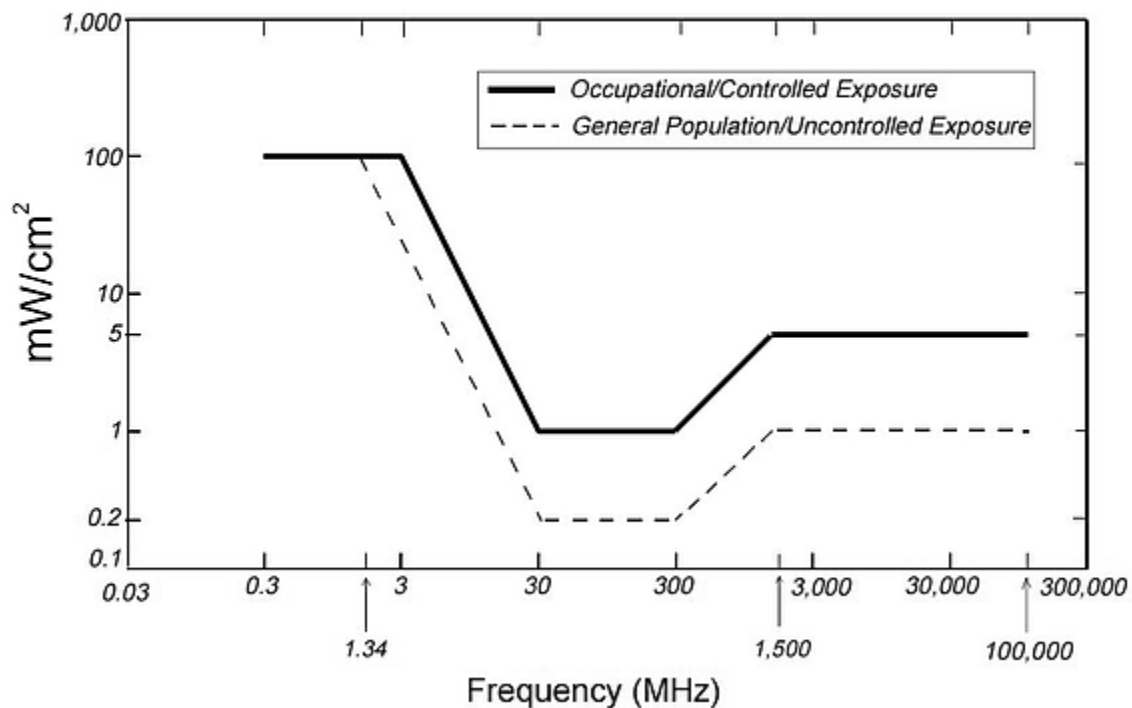
$$E(V/m) = \frac{\sqrt{30 \times P \times G}}{d}$$

$$\text{Power density: } P_d(mW/cm^2) = \frac{E^2}{3770}$$

FCC MPE LIMITS

Figure 1. FCC Limits for Maximum Permissible Exposure (MPE)

Plane-wave Equivalent Power Density



MPE DATA

FCC MPE Calculation

In-beam Field Strength

1. **General Uncontrolled Exposure Environment:** The limit for general uncontrolled exposure environment is shown in FCC rule Part 1.1310, Table 1B.

Variable	Value
Max Power (rated)	25 W
Duty Cycle	7.03%
Max Antenna Gain	22.5 dBi
Coax Loss	0.0
Transmit Frequency	9300 MHz
Power Density	1 mW/cm ²
Minimum Separation Distance	157.7 cm

2. **General Controlled Exposure Environment:** The limit for controlled exposure environment is shown in FCC rule Part 1.1310, Table 1A.

Variable	Value
Max Power (rated)	25 W
Duty Cycle	7.03%
Max Antenna Gain	22.5 dBi
Coax Loss	0.0
Maximum Transmit Frequency	9300 MHz
Power Density	5 mW/cm ²
Minimum Separation Distance	70.5 cm

Note: In-beam field strength calculation does not take into account reduction in exposure based on rotation of the transmit antenna.

Outside-of-beam Field Strength

3. **General Uncontrolled Exposure Environment:** The limit for general uncontrolled exposure environment is shown in FCC rule Part 1.1310, Table 1B.

Variable	Value
Max Power (rated)	25 W
Duty Cycle	7.03%
Max Antenna Gain	-1.5 dBi
Coax Loss	0.0
Transmit Frequency	9300 MHz
Power Density	0.25 mW/cm ²
Minimum Separation Distance	20.0 cm

4. **General Controlled Exposure Environment:** The limit for controlled exposure environment is shown in FCC rule Part 1.1310, Table 1A.

Variable	Value
Max Power (rated)	25 W
Duty Cycle	7.03%
Max Antenna Gain	-1.5 dBi
Coax Loss	0.0
Maximum Transmit Frequency	9300 MHz
Power Density	0.25 mW/cm ²
Minimum Separation Distance	20.0 cm

IC MPE Calculation

In-beam Field Strength

1. **General Uncontrolled Exposure Environment:** The limit for general uncontrolled exposure environment is shown in RSS-102, Issue 5, Table 4.

Variable	Value
Max Power (rated)	25 W
Duty Cycle	7.03%
Max Antenna Gain	-1.5 dBi
Coax Loss	0.0
Transmit Frequency	9300 MHz
Power Density	10 W/m ²
Minimum Separation Distance	157.7 cm

2. **General Controlled Exposure Environment:** The limit for controlled exposure environment is shown in RSS-102, Issue 5, Table 6.

Variable	Value
Max Power (rated)	25 W
Duty Cycle	7.03%
Max Antenna Gain	-1.5 dBi
Coax Loss	0.0
Maximum Transmit Frequency	9300 MHz
Power Density	50 W/m ²
Minimum Separation Distance	70.5 cm

Outside-of-beam Field Strength

3. **General Uncontrolled Exposure Environment:** The limit for general uncontrolled exposure environment is shown in RSS-102, Issue 5, Table 4.

Variable	Value
Max Power (rated)	25 W
Duty Cycle	7.03%
Max Antenna Gain	-1.5 dBi
Coax Loss	0.0
Transmit Frequency	9300 MHz
Power Density	2.5 W/m ²
Minimum Separation Distance	20 cm

4. **General Controlled Exposure Environment:** The limit for controlled exposure environment is shown in RSS-102, Issue 5, Table 6.

Variable	Value
Max Power (rated)	25 W
Duty Cycle	7.03%
Max Antenna Gain	-1.5 dBi
Coax Loss	0.0
Maximum Transmit Frequency	9300 MHz
Power Density	2.5 W/m ²
Minimum Separation Distance	20 cm