



## ROGERS LABS, INC.

4405 West 259th Terrace Louisburg, KS 66053 Phone / Fax (913) 837-3214

## Test Report - Maximum Permissible Exposure, Radio Frequency (RF) Exposure Report 47CFR, PART 1.1310 / MPE and RSS-102 Issue 5

Model: AA4560

9300-9500 MHz Shipborne Radar

FCC ID: IPH-A4560

IC: 1792A-A4560

# Garmin International, Inc.

1200 East 151st Street Olathe, KS 66062

FCC Designation: US5305 ISED Registration: 3041A

Test Report Number: 221202

Test Date: December 2, 2022

Authorized Signatory: Sot DRogers

Scot D. Rogers

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Rogers Labs, Inc. 4405 West 259<sup>th</sup> Terrace Louisburg, KS 66053

Revision 1

Garmin International, Inc. Model: AA4560

Test: 221202 Phone/Fax: (913) 837-3214 Test to: 47CFR 1.1310, RSS-102

File: AA4560 Garmin MPE TstRpt 221202 Page 1 of 11

SN: 3433643766 FCC ID: IPH-A4560 IC: 1792A-A4560 Date: March 14, 2023



TABLE OF CONTENTS2
REVISIONS2
CUSTOMER INFORMATION
EQUIPMENT TESTED
Equipment Function
Equipment Configuration
TEST SITE LOCATIONS5
ENVIRONMENTAL CONDITIONS
APPLICABLE STANDARDS AND REGULATORY LIMITS6
FCC Limits for Maximum Permissible Exposure
ISED RSS-102 RF Field Strength Limits for Devices Used by the General Public (Uncontrolled Environment)
ISED RSS-102 RF Field Strength Limits for Controlled Use Devices (Controlled Environment)
APPLICABLE INFORMATION AND EQUATIONS
Power Density
Distance
RF EXPOSURE RESULTS
ANNEX11
Laboratory Certificate of Accreditation11

### **Revisions**

Revision 1

Revision 1 Issued March 14, 2023

Rogers Labs, Inc. 4405 West 259<sup>th</sup> Terrace Louisburg, KS 66053

Garmin International, Inc. Model: AA4560

Test: 221202

Phone/Fax: (913) 837-3214 Test to: 47CFR 1.1310, RSS-102

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File: AA4560 Garmin MPE TstRpt 221202 Page 2 of 11



### **Customer Information**

Applicant: Garmin International, Inc.
Address: 1200 East 151st Street
Olathe, KS 66062

M/N: AA4560 HVIN: AA4560

FCC ID: IPH-A4560 IC: 1792A-A4560 Operating Frequency Range: 9300-9500 MHz

### **Equipment Tested**

Model: AA4560

Garmin International, Inc. 1200 East 151st Street Olathe, KS 66062

Equipment	Model / PN	Serial Number
EUT (test sample, Power Load or antenna)	AA4560	3433643766
Radar Voltage Converter	011-01315-50	6SA000150
Power cable (0.8-meter)	Custom Cable (No P/N)	N/A
Power cable (2-meter)	Custom Cable (No P/N)	N/A
Power cable (15-meter)	320-00246-40	N/A
I/O cable (2-meter)	320-01038-00	N/A
I/O cable (15-meter)	011-05671-00	N/A
Chart Plotter (GPSMap 8208)	010-01016-01	3855826969
DC Power Supply	BK 1745	209C13
Marine Battery (12Volt)	Duracell	N/A

Test results in this report relate only to the items tested. Worst-case configuration data recorded in this report.

Software: 0.21, Antennas: 4-foot open array (pk-27, ave-3.99 dBi), 6-foot open array (pk-29, ave-3.85 dBi)

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 Date: March 14, 2023

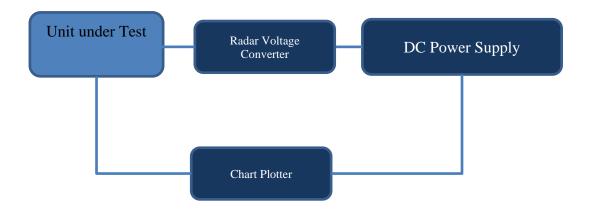
Revision 1 File: AA4560 Garmin MPE TstRpt 221202 Page 3 of 11



### **Equipment Function**

The EUT is ship borne marine radar designed to provide bearing and distance information of ship and land targets located within the field of view (near the ship). The radar unit must be integrated into a full Marine system installation for operation, including chart plotter for display and control purposes. As the radar sweeps through  $360^{\circ}$ , reflected signals are interpreted and displayed on the chart plotter as indication of potential above surface hazards. Test results in this report relate only to the products described in this report.

### **Equipment Configuration**



Rogers Labs, Inc. 4405 West 259<sup>th</sup> Terrace Louisburg, KS 66053

Phone/Fax: (913) 837-3214 Revision 1

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Garmin International, Inc.
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SN: 3433643766 FCC ID: IPH-A4560 IC: 1792A-A4560 Date: March 14, 2023

File: AA4560 Garmin MPE TstRpt 221202 Page 4 of 11



### **Test Site Locations**

Conducted EMI AC line conducted emissions testing performed in a shielded screen room

located at Rogers Labs, Inc., 4405 West 259th Terrace, Louisburg, KS

Antenna port Antenna port conducted emissions testing was performed in a shielded

screen room located at Rogers Labs, Inc., 4405 West 259th Terrace,

Louisburg, KS

Radiated EMI The radiated emissions tests were performed at the 3 meters, Open Area

Test Site (OATS) located at Rogers Labs, Inc., 4405 West 259th Terrace,

Louisburg, KS

Registered Site information: FCC Site: US5305, ISED: 3041A, CAB Identifier: US0096

NVLAP Accreditation Lab code 200087-0

### **Environmental Conditions**

Ambient Temperature 21.6° C

Relative Humidity 38 %

Atmospheric Pressure 1011.7 mb

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 Date: March 14, 2023

Revision 1 File: AA4560 Garmin MPE TstRpt 221202 Page 5 of 11



## **Applicable Standards and Regulatory Limits**

In accordance with Title 47 Code of Federal Regulations (47CFR), dated December 2, 2022, Parts 1 and 2 (2.1091 and 2.1093), and Innovation, Science and Economic Development, the following information is submitted. Test procedures used follow the guidance of FCC KDB 447498 D01 General RF Exposure Guidance v06 as per 47CFR 1.1310, and 2.1093, and Innovation, Science and Economic Development (ISED) RSS-102 Issue 5.

FCC Limits for Maximum Permissible Exposure

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm2)	Averaging time (minutes)						
(i) 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						
(ii) Lin	(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 <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.

Rogers Labs, Inc. 4405 West 259<sup>th</sup> Terrace Louisburg, KS 66053

Revision 1

Garmin International, Inc. Model: AA4560

Test: 221202 Phone/Fax: (913) 837-3214 Test to: 47CFR 1.1310, RSS-102 SN: 3433643766 FCC ID: IPH-A4560 IC: 1792A-A4560 Date: March 14, 2023

File: AA4560 Garmin MPE TstRpt 221202 Page 6 of 11



# ISED RSS-102 RF Field Strength Limits for Devices Used by the General Public (Uncontrolled Environment)

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m2)	Reference Period (minutes)
0.003-1021	83	90	-	Instantaneous*
0.1-10	-	0.73/ f	-	6**
1.1-10	87/ f 0.5	-	-	6**
10-20	27.46	0.0728	2	6
20-48	58.07/f 0.25	0.1540/f 0.25	$8.944/\ f$ 0.5	6
48-300	22.06	0.05852	1.291	6
300-6000	$3.142 f^{0.3417}$	$0.008335 f^{0.3417}$	$0.02619f^{0.6834}$	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	616000/ f <sup>1.2</sup>
150000-300000	0.158f 0.5	4.21 x 10-4 f 0.5	6.67 x 10 <sup>-5</sup> f	616000/ f <sup>1.2</sup>

**Note:** *f* is frequency in MHz.

# ISED RSS-102 RF Field Strength Limits for Controlled Use Devices (Controlled Environment)

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m <sub>2</sub> )	Reference Period (minutes)
0.003-1023	170	180	-	Instantaneous*
1-10	-	1.6/ f	-	6**
1.29-10	193/f 0.5	-	-	6**
10-20	61.4	0.163	10	6
20-48	129.8/f 0.25	0.3444/f 0.25	$44.72/f$ $^{0.5}$	6
48-100	49.33	0.1309	6.455	6
100-6000	15.60 f 0.25	0.04138f 0.25	0.6455f 0.5	6
6000-15000	137	0.364	50	6
15000-150000	137	0.364	50	616000/f 1.2
150000-300000	$0.354\ f$ $^{0.5}$	9.40 x 10 <sup>-4</sup> f <sup>0.5</sup>	3.33 x 10 <sup>-4</sup> f	616000/f 1.2

**Note:** *f* is frequency in MHz.

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 Test to: 47CFR 1.1310, RSS-102
 Date: March 14, 2023

Revision 1 File: AA4560 Garmin MPE TstRpt 221202 Page 7 of 11

<sup>\*</sup>Based on nerve stimulation (NS).

<sup>\*\*</sup> Based on specific absorption rate (SAR).

<sup>\*</sup>Based on nerve stimulation (NS).

<sup>\*\*</sup> Based on specific absorption rate (SAR).



### Applicable information and equations

f = Transmit Frequency (MHz)

PT = Power Input to Antenna (mW)

Duty cycle (percentage of operation)

PA = Adjusted Power due to Duty cycle or Cable Loss (mW)

GN = Numeric Gain of the Antenna

S20 = Power Density of device at 20cm (mW/m2) S20=(PAGN)/ $(4\pi R20)2$ 

RC = Minimum distance to the Radiating Element for Compliance (cm) FCC  $RC = \sqrt{(PAGN/4\pi SL)}$ 

SC = Power Density of the device at the Compliance Distance RC (W/m2) FCC SC=(PAGN)/ $(4\pi RC)$ 2

### **Power Density**

E(V/m) = SQRT (30\*P\*G)/D

 $Pd(W/m^2) = E^2 / 377$ 

 $S = EIRP / (4*PI*D^2)$ 

Where:

D = Separation Distance in cm

EIRP = Equivalent Isotropic Radiated Power, in mW

 $S = Power density in mW/cm^2$ 

Power density converted from units of  $mW/cm^2$  to units of  $W/m^2$  by multiplying by 10  $mW/cm^2$  by  $10 \Rightarrow W/cm^2$ 

#### Distance

D = SQRT [EIRP / (4\*PI\*S)]

Where:

D = Separation Distance in cm

EIRP = Equivalent Isotropic Radiated Power, in mW

 $S = Power density in mW/cm^2$ 

Source-based time-average EIRP = (DC/100) \*EIRP

Where:

DC = Duty Cycle in percent as applicable

EIRP = Equivalent Isotropic Radiated Power, in mW

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 Test to: 47CFR 1.1310, RSS-102
 Date: March 14, 2023

Revision 1 File: AA4560 Garmin MPE TstRpt 221202 Page 8 of 11



## **RF Exposure Results**

	HVIN.	A A 4560 (4 foot		Test Number:	221202				
MPE Calculator		AA4560 (4-foot a		TX power added to the antenna ga					
	dBi = dB gain compared to a			1A power added to the america ga	in in abi.				
	S = power density in mW/cn								
		nsmitter Output p	ower (mW)	12,000,000.0					
Output Power for % d		ransmitter Output							
	ity Cycle operation (mWatts)	•	0.099			Antenna Gain (dBi)	3.99		
	Output Power for	Duty Cycle operat	ion (Watts)	11.885	Ant	enna Gain (Numeric)	2.51		
Tx Frequency (MHz)	9400	Calculation pov	ver (Watts)	11.885	dBd + 2.17 = dB	i dBi to dBd	2.17		
						Antenna Gain (dBd)	1.82		
Cable Loss (dB)	0.0	Adjusted Po	wer (dBm)	40.75		nna minus cable (dBi)	3.99		
						enna Gain (Numeric)	2.51		
	Calculated ERP (mw)					Po(dBm) + Gain (dB)	11.510		
	Calculated EIRP (mw)	29,/84.60/			Radiated (EIRP) dB		44.740		
		EIRP				ERP = EIRP - 2.17 Radiated (ERP) dBm	42.570		
	Power density (S) mW/					radiaca (Era ) abiii	42.570		
		4 p r^2							
	r (cm) EIRP (mW)								
	Occupational Limit	F	CC radio f	requency radiation exposure limits p	per 1.1310				
5	mW/cm <sup>2</sup>	Frequency (	MHz)	Occupational Limit (mW/cm <sup>2</sup> )	Public Limit (mW/cm <sup>2</sup> )				
50.0	W/m <sup>2</sup>	30-300	)	1	0.2				
	General Public Limit	300-1,50		f/300	f/1500				
1	mW/cm <sup>2</sup>	1,500-10,		5	1				
10.0	W/m <sup>2</sup>	,							
10.0	**/111								
	Occupational Limit								
50	W/m <sup>2</sup>	I	C radio free	quency radiation exposure limits per	RSS-102				
50.0	W/m <sup>2</sup>	Frequency (	MHz)	Occupational Limit (W/m²)	Public Limit (W/m <sup>2</sup> )				
2 0.0	General Public Limit	100-6,0		0.6455 f <sup>0.5</sup>	T GOILE LITTLE (VV/III)				
10									
10	W/m <sup>2</sup>	6,000-15,000		50					
10	300-6,000			1.291					
				$0.02619f^{0.6834}$					
		6,000-15,	000	50	10				
						General Public	Occupational		
f = Transmit Frequency (MHz)					f (MHz) =			MHz	
P <sub>T</sub> = Power Input to Antenna (mW)					P <sub>T</sub> (mW) =				
Duty cycle (percentage of operation					% =		0.09904		
P <sub>A</sub> = Adjusted Power due to Duty cy	cle or Cable Loss (mW)				$P_{A}(mW) =$		11,884.80		
G <sub>N</sub> = Numeric Gain of the Antenna				2	GN (numeric) =			numeric	
$S_{20}$ = Power Density of device at 20c	em (mW/m <sup>2</sup> )			$S_{20} = (P_A G_N)/(4\pi R_{20})^2$	$S_{20} (mW/m^2) =$			mW/m <sup>2</sup>	
$S_{20}$ = Power Density of device at 20c	em (W/m <sup>2</sup> )			$S_{20} = (P_A G_N)/(4\pi R_{20})^2$	$S_{20} (W/m^2) =$	59.25	59.25	W/m <sup>2</sup>	
$S_L = Power Density Limit (W/m^2) FC$	nc				$S_L (W/m^2)=$	10.000	50.000	W/m <sup>2</sup>	
S <sub>L</sub> = Power Density Limit (W/m <sup>2</sup> ) Ca	nada				$S_L (W/m^2)=$		50.000	W/m <sup>2</sup>	
R <sub>C</sub> = Minimum distance to the Radia		FCC		$R_C = \sqrt{(P_A G_N / 4\pi S_L)}$	R <sub>C</sub> (cm) =		21.8		
R <sub>C</sub> = Minimum distance to the Radia				$R_C = \sqrt{(P_A G_N / 4\pi S_L)}$	R <sub>C</sub> (cm) =	48.7	21.8		
				$S_C = (P_A G_N)/(4\pi R_C)^2$	$S_C(W/m^2) =$			W/m <sup>2</sup>	-
S <sub>C</sub> = Power Density of the device at				2				-	
S <sub>C</sub> = Power Density of the device at	the Compliance Distance R <sub>C</sub> (W/i	n-) Canada		$S_C = (P_A G_N)/(4\pi R_C)^2$	$S_C(W/m^2) =$			W/m <sup>2</sup>	
$R_{20} = 20cm$					R20=	20	20	cm	
	For Compliance with Canada General Population Limits		User Menuel must indicate a minimum conception dictance of		48.7	om			
				ts, User Manual must indicate a minimum separation distance of da General Population Limits, a minimum separation distance of			Meters		
	Or in Mete	is ioi compliance	wiiii Canad	a ocuciai r opuiauon Limits, a minii	iniii separation distance of	0.49	IVICICIS		
Summary: Standalone MPE Cal	culations and Summers					Public Limit		Public	
Summary. Standarone Wit L Car	Tx Duty Cycle (%)	Tx Frequency	(MH <sub>2</sub> )	Power Total (mW)	Antenna Gain (numeric)	S <sub>L</sub> (W/m <sup>2</sup> )	S <sub>20</sub> (W/m <sup>2</sup> )	R <sub>C</sub> (cm)	S <sub>C</sub> (W/m <sup>2</sup>
FCC	0.09904	9400	(IVII IZ)	11,885	2.51	10.000	59.25	48.7	10.00
Canada	0.09904	9400		11,885	2.51	10.000	59.25	48.7	10.00
Cumuu	3.07704	2400		11,005	2.31	10.000	37.23	70.7	10.00
				Limit	Overall Minimum (cm)	Overall Minimum (in	ches)		
		Public		Occupational	(	(			
	FCC (cm)	48.7		21.8					
	FCC (inches)	20.0		9.0					
		48.7		21.8					
	Canada (cm)	40.7							
		20.0		9.0					
	Canada (cm) Canada (inches)			9.0					
Overall Minimur	Canada (cm) Canada (inches)			9.0 Overall Minumu Limit	Occuppational cm				

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SN: 3433643766 FCC ID: IPH-A4560 IC: 1792A-A4560 Date: March 14, 2023

Revision 1 File: AA4560 Garmin MPE TstRpt 221202 Page 9 of 11



NVLAP Lab Cod									
		AA4560 (6-foot		Test Number:					
MPE Calculator				TX power added to the antenna ga	in in dBi.				
	dBi = dB gain compared to a	•	r.						
	S = power density in mW/cn								
		ansmitter Output p							
		Fransmitter Output							
Output Power for % d	uty Cycle operation (mWatts)		0.099			Antenna Gain (dBi)		<u> </u>	
	Output Power for					tenna Gain (Numeric)			
Tx Frequency (MHz)	9400	Calculation po	wer (Watts)	11.885	dBd + 2.17 = dBi				
						Antenna Gain (dBd)		<u> </u>	
Cable Loss (dB)	0.0	Adjusted Po	ower (dBm)	40.75		nna minus cable (dBi)			
						tenna Gain (Numeric)			
	Calculated ERP (mw)					Po(dBm) + Gain (dB)			
	Calculated EIRP (mw)	28839.776			R	Radiated (EIRP) dBm			
		EIRP				ERP = EIRP - 2.17			
	Power density (S) mW,					Radiated (ERP) dBm			
	• • • • • • • • • • • • • • • • • • • •	4 p r^2			D	Outy Cycle Correction	0.04417176		
	r (cm) EIRP (mW)								
			100 11 (		1.1210	_			
	Occupational Limit			requency radiation exposure limits p		4			-
5		Frequency (		Occupational Limit (mW/cm <sup>2</sup> )	Public Limit (mW/cm <sup>2</sup> )				
50.0	W/m <sup>2</sup>	30-30	)	1	0.2				
	General Public Limit	300-1,5	00	f/300	f/1500				
1	mW/cm <sup>2</sup>	1,500-10	000	5	1				
10.0						9			
10.0	**/111								-
	Occupational Limit								
50		1	C radio fro	quency radiation exposure limits per	· RSS_102	1			
<b>-</b>				1					
50.0		Frequency (		Occupational Limit (W/m <sup>2</sup> )	Public Limit (W/m <sup>2</sup> )				
	General Public Limit	100-6,0	00	$0.6455 f^{0.5}$					
10	W/m <sup>2</sup>	6,000-15	000	50					
10		48-30	)		1.291	1			
10	300-6,000				$0.02619f^{0.6834}$	1			
				50					
		6,000-15	000	50	10	Communit Dorle Ex	01		
6 m 3 m 2 m 3					COMI	General Public	Occupational		-
f = Transmit Frequency (MHz)					f (MHz) =			MHz	
P <sub>T</sub> = Power Input to Antenna (mW)					$P_{T}$ (mW) =		11,884,800.0000		
Duty cycle (percentage of operation	1)				% =	0.09904	0.09904	%	
$P_A = Adjusted$ Power due to Duty c	ycle or Cable Loss (mW)				$P_{A}(mW) =$	11,884.80	11,884.80	mW	
G <sub>N</sub> = Numeric Gain of the Antenna					GN (numeric) =	2.43	2.43	numeric	
S <sub>20</sub> = Power Density of device at 20	cm (mW/m <sup>2</sup> )			$S_{20}=(P_AG_N)/(4\pi R_{20})^2$	$S_{20} (mW/m^2) =$	5.74	5.74	mW/m <sup>2</sup>	
S <sub>20</sub> = Power Density of device at 20				$S_{20} = (P_A G_N)/(4\pi R_{20})^2$	$S_{20} (W/m^2) =$			W/m <sup>2</sup>	
				520-(1 AGN)/(4/LIC20)					_
$S_L = Power Density Limit (W/m^2) FO$					$S_L (W/m^2) =$				-
$S_L = Power Density Limit (W/m^2) Ca$	anada				$S_L (W/m^2) =$				
R <sub>C</sub> = Minimum distance to the Radia	ating Element for Compliance (cm)	FCC		$R_C = \sqrt{(P_A G_N / 4\pi S_L)}$	$R_{C}$ (cm) =	47.9	21.4	cm	
R <sub>C</sub> = Minimum distance to the Radia	ating Element for Compliance (cm)	Canada		$R_C = \sqrt{(P_A G_N / 4\pi S_1)}$	R <sub>C</sub> (cm) =	47.9	21.4	cm	
$S_C$ = Power Density of the device at				$S_C = (P_A G_N)/(4\pi R_C)^2$	$S_C(W/m^2) =$			W/m <sup>2</sup>	
				2	2				
S <sub>C</sub> = Power Density of the device at	tne Compliance Distance R <sub>C</sub> (W/i	m ) Canada		$S_C = (P_A G_N)/(4\pi R_C)^2$	$S_C (W/m^2) =$			W/m <sup>2</sup>	-
$R_{20} = 20cm$					R20=	20	20	cm	-
				, User Manual must indicate a minir					-
	Or in Mete	rs for Compliance	with Canad	a General Population Limits, a minir	num separation distance of	0.48	Meters		
						n i r		n 1 "	
Summary: Standalone MPE Ca	· · · · · · · · · · · · · · · · · · ·	_				Public Limit	2	Public	<b>.</b>
	Tx Duty Cycle (%)	Tx Frequency		Power Total (mW)	Antenna Gain (numeric)	$S_L (W/m^2)$	$S_{20} (W/m^2)$	R <sub>C</sub> (cm)	$S_C (W/m^2)$
FCC	0.09904	9400		11,885	2.43	10.000	57.37	47.9	10.00
Canada	0.09904	9400		11,885	2.43	10.000	57.37	47.9	10.00
			Limit	Overall Minimum (cm)	Overall Minimum (in	ches)			
		Public		Occupational					
	FCC (cm)	47.9		21.4					
	r cc (ciii)	19.0		9.0					
	FCC (inches)	19.0			4				
		47.9		21.4					
	FCC (inches)			21.4 9.0					
	FCC (inches) Canada (cm)	47.9							
Overall Minimu	FCC (inches) Canada (cm) Canada (inches)	47.9			Occuppational				
	FCC (inches) Canada (cm) Canada (inches)	47.9		9.0 Overall Minumu Limit	Occuppational cm				

Rogers Labs, Inc. 4405 West 259<sup>th</sup> Terrace Louisburg, KS 66053

Revision 1

Phone/Fax: (913) 837-3214

Garmin International, Inc.

Model: AA4560 FCC ID: IPH-A4560
Test: 221202 IC: 1792A-A4560
Test to: 47CFR 1.1310, RSS-102 Date: March 14, 2023

SN: 3433643766

File: AA4560 Garmin MPE TstRpt 221202 Page 10 of 11



### Annex

### Laboratory Certificate of Accreditation

# United States Department of Commerce National Institute of Standards and Technology



## Certificate of Accreditation to ISO/IEC 17025:2017

**NVLAP LAB CODE: 200087-0** 

### Rogers Labs, Inc.

Louisburg, KS

is accredited by the National Voluntary Laboratory Accreditation Program for specific services, listed on the Scope of Accreditation, for:

### **Electromagnetic Compatibility & Telecommunications**

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017.

This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communique dated January 2009).

2022-03-22 through 2023-03-31

Effective Dates

OF COMPLETO OF AMERICA

or the National Voluntary Laboratory Approximation Program

Rogers Labs, Inc. 4405 West 259<sup>th</sup> Terrace Louisburg, KS 66053

Revision 1

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Model: AA4560

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File: AA4560 Garmin MPE TstRpt 221202 Page 11 of 11