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# **FCC/ISED** Test Report

Prepared for:

Garmin International Inc.

Address:

1200 E. 151<sup>st</sup> Street Olathe, Kansas, 66062, USA

Product:

A03690

**Test Report No:** 

Approved by:

R20191028-24-E1D

Nic S. Johnson, NCE Technical Manager iNARTE Certified EMC Engineer #EMC-003337-NE

DATE:

16 June 2020

Total Pages:

70

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## **REVISION PAGE**

Rev. No.	Date	Description
0	28 January 2020	Original – NJohnson
		Prepared by CFarrington
A	8 June 2020	Updated calibration Table
		Includes NCEE Labs test report R20191028-24-E1 and its amendment in fullNJ
В	15 June 2020	Includes NCEE Labs test report R20191028-24-E1A and its amendment in fullNJ
С	16 June 2020	Updated calibration table.
		Includes NCEE Labs test report R20191028-24-E1B and its amendment in fullNJ
D	23 June 2020	Updated cover page
		Includes NCEE Labs test report R20191028-24-E1C and its amendment in fullNJ

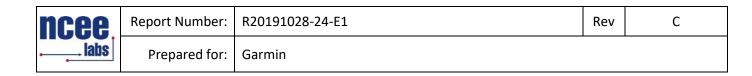


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#### 1.0 SUMMARY OF TEST RESULTS

The worst-case measurements were reported in this report. The EUT has been tested according to the following specifications:

APPLIED STANDARDS AND REGULATIONS						
Standard Section	Test Type	Result				
FCC Part 15.35 RSS Gen, Issue 4, Section 6.10	Duty Cycle	Pass				
FCC Part 15.247(a)(1) RSS-247 Issue 2 Section 5.2	Peak output power	Pass				
FCC Part 15.247(a)(1) RSS-247 Issue 2 Section 5.2	Bandwidth	Pass				
FCC Part 15.209 RSS-Gen Issue 4, Section 7.1	Receiver Radiated Emissions	Pass				
FCC Part 15.209 (restricted bands), 15.247 (unrestricted) RSS-247 Issue 2 Section 5.5, RSS-Gen Issue 4, Section 8.9	Transmitter Radiated Emissions	Pass				
FCC Part 15.247(a)(1) RSS-247 Issue 2 Section 5.2	Power Spectral Density	Pass				
FCC Part 15.209, 15.247(d) RSS-247 Issue 2 Section 11.13	Band Edge Measurement	Pass				
FCC Part 15.207 RSS-Gen Issue 4, Section 7.1	Conducted Emissions	Pass				

See Section 4 for details on the test methods used for each test.



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#### 2.0 EUT DESCRIPTION

#### 2.1 EQUIPMENT UNDER TEST

### Summary

EUT	A03690				
EUT Received	19 December 2019				
EUT Tested	ested 6 January 2020- 27 February 2020				
Serial No.3319367796 (conducted antenna port measurements); 3319367789 (radiated measurements)					
Operating Band 2400 – 2483.5 MHz					
Device Type	GMSK				
Power SupplyInternal Battery/ Charger: Garmin (Phi Hong) MN: PSAF10R-050Q (Representative Power Supply)					

NOTE: For more detailed features description, please refer to the manufacturer's specifications or user's manual.



#### 2.2 DESCRIPTION OF TEST MODES

The EUT operates on, and was tested at the frequencies below:

Channel	Frequency
Low	2402 MHz
Mid	2440 MHz
High	2480 MHz

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These are the only three representative channels tested in the frequency range according to FCC Part 15.31 and RSS-Gen Table A1. See the operational description for a list of all channel frequency and designations.

This EUT was set to transmit in a worse-case scenario with modulation on. The manufacturer modified the unit to transmit continuously on the lowest, middle and highest frequency channels.

The EUT was tested for spurious emissions while running off of battery power.

#### 2.3 DESCRIPTION OF SUPPORT UNITS

None



#### 3.1 LABORATORY DESCRIPTION

All testing was performed at the following Facility:

The Nebraska Center for Excellence in Electronics (NCEE Labs) 4740 Discovery Drive Lincoln, NE 68521 С

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A2LA Certificate Number:	1953.01
FCC Accredited Test Site Designation No:	US1060
Industry Canada Test Site Registration No:	4294A-1
NCC CAB Identification No:	US0177

Environmental conditions varied slightly throughout the tests:

Relative humidity of  $35 \pm 4\%$ Temperature of  $22 \pm 3^{\circ}$  Celsius



#### 3.2 TEST PERSONNEL

No.	PERSONNEL	TITLE	ROLE
1	Nic Johnson	Technical Manager	Review/editing
2	Karthik Vepuri	Test Engineer	Testing and report
3	Caleb Farrington	Test Technician	Testing and report

#### Notes:

All personnel are permanent staff members of NCEE Labs. No testing or review was sub-contracted or performed by sub-contracted personnel.



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#### 3.3 TEST EQUIPMENT

DESCRIPTION AND MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CALIBRATION DATE	CALIBRATION DUE DATE
Rohde & Schwarz Test Receiver	ES126	100037	30 Jan 2018	30 Jan 2020
Keysight MXE Signal Analyzer	N9038A	MY59050109	23 Apr 2019	23 Apr 2021
SunAR RF Motion Hybrid Ant.	JB1	A082918-1	15 Oct 2018	15 Oct 2020
EMCO Horn Antenna	3115	6416	26 Jan 2018	26 Jan 2021
EMCO Horn Antenna	3116	2576	31 Jan 2018	31 Jan 2021
EMCO Horn Antenna	3115	6416	10 Mar 2020	10 Mar 2022
EMCO Horn Antenna	3116	2576	10 Mar 2020	10 Mar 2022
Rohde & Schwarz Preamplifier	TS-PR18	3545700803	09 Mar 2018*	09 Mar 2021*
Trilithic High Pass Filter	6HC330	23042	09 Mar 2018*	09 Mar 2021*
Rohde & Schwarz LISN	ESH3-Z5	836679/010	25 Jul 2019	25 Jul 2020
Rohde & Schwarz Test Software	ES-K1	12575	NA	NA
TDK Emissions Lab Software	V11.25	700307	NA	NA
RF Cable (preamplifier to antenna)	MFR-57500	01-07-002	09 Mar 2018*	09 Mar 2021*
RF Cable (antenna to 10m chamber bulkhead)	FSCM 64639	01E3872	09 Mar 2018*	09 Mar 2021*
RF Cable (10m chamber bulkhead to control room bulkhead)	FSCM 64639	01E3874	09 Mar 2018*	09 Mar 2021*
RF Cable (Control room bulkhead to RF switch)	FSCM 64639	01E3871	09 Mar 2018*	09 Mar 2021*
RF Cable (RF switch to test receiver)	FSCM 64639	01F1206	09 Mar 2018*	09 Mar 2021*
RF switch – Rohde and Schwarz	TS-RSP	1113.5503.14	09 Mar 2018*	09 Mar 2021*
N connector bulkhead (10m chamber)	PE9128	NCEEBH1	09 Mar 2018*	09 Mar 2021*
N connector bulkhead (control room)	PE9128	NCEEBH2	09 Mar 2018*	09 Mar 2021*

\*Internal Characterization

#### Notes:

All equipment is owned by NCEE Labs and stored permanently at NCEE Labs facilities.

### 4.0 DETAILED RESULTS

#### 4.1 DUTY CYCLE

Test Method: NA



#### Test Method: ANSI C63.10:

1. Section(s) 11.9.1.1 "RBW ≥ DTS Bandwidth"

#### Limits of power measurements:

The maximum allowed peak output power is 30 dBm.

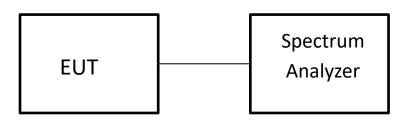
#### Test procedures:

The EUT was connected to ab RF power meter directly with a low-loss shielded coaxial cable with 10 MHz RBW and 10 MHz VBW.

#### Deviations from test standard:

No deviation.

#### Test setup:



#### Figure 1 – Peak Output Power Measurements Test Setup

#### EUT operating conditions:

The EUT was powered by internal battery power unless specified and set to transmit continuously on the lowest frequency channel, highest frequency channel and one in the middle of its operating range. EUT was set to transmit in indicated modulation.

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#### Test results:

Peak Output Power							
CHANNEL	CHANNEL FREQUENCY (MHz)	PEAK OUTPUT POWER (dBm)	PEAK OUTPUT POWER (mW)	Method	RESULT	Transmitter	
Low	2402	0.821	1.208	Conducted	PASS	BT EDR 2MB	
Mid	2440	0.554	1.136	Conducted	PASS	BT EDR 2MB	
High	2480	1.033	1.269	Conducted	PASS	BT EDR 2MB	
Low	2402	0.909	1.233	Conducted	PASS	BT EDR 3MB	
Mid	2440	0.712	1.178	Conducted	PASS	BT EDR 3MB	
High	2480	1.164	1.307	Conducted	PASS	BT EDR 3MB	

CHANNEL	CHANNEL FREQUENCY (MHz)	AVERAGE OUTPUT POWER (dBm)	AVERAGE OUTPUT POWER (mW)	Method	RESULT	Transmitter
Low	2402	-6.470	0.225	Conducted	PASS	BT EDR 2MB
Mid	2440	-6.349	0.232	Conducted	PASS	BT EDR 2MB
High	2480	-6.073	0.247	Conducted	PASS	BT EDR 2MB
Low	2402	-6.165	0.242	Conducted	PASS	BT EDR 3MB
Mid	2440	-6.950	0.202	Conducted	PASS	BT EDR 3MB
High	2480	-5.853	0.260	Conducted	PASS	BT EDR 3MB

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Keysight	Spectrum Ana RF	Iyzer - Peak Out 50 Ω DO	•	C63.10 Sec. 11.9.1.1	CENCE-INT			10,20,2		
arkor					SENSE:INT		e: Voltage		4 AM Jan 08, 20	
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1	(-VUD)			VI.	994 JU 191112		04466	P 1.000 III	5 (1001 )	
						STATUS				

Figure 2 - Output Power, Low Channel, BT EDR 2MB

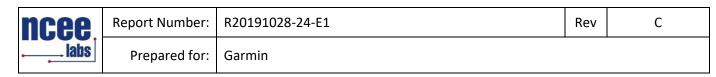
Output power = 0.821 dBm

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		It Power BT C63.10 Sec. 11.9.1.1			
	RF 50 Ω DC		SENSE:INT	A	10:02:22 AM Jan 08, 20
arker 1	1 2.44086000000	PNO: Fast IFGain:Low	Trig: Free Run #Atten: 20 dB	Avg Type: Voltage Avg Hold:>100/100	TRACE 1 2 3 4 5 TYPE MWWW DET P NNN
dB/div	Ref 10.00 dBm				Mkr1 2.440 86 GH 0.554 dB
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	.44100 GHz				Span 20.00 M
es BW	(-6dB) 10 MHz	VI	BW 50 MHz	Swe	ep 1.000 ms (1001 p

Figure 3 - Output Power, Mid Channel, BT EDR 2MB

Output power = 0.554 dBm



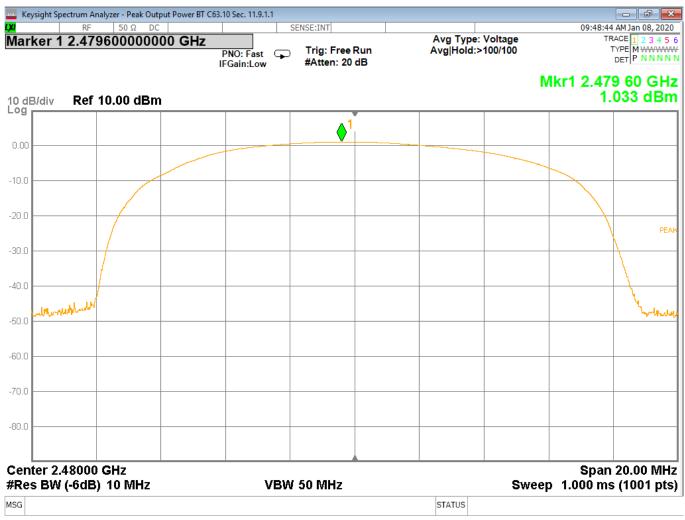


Figure 4 - Output Power, High Channel, BT EDR 2MB

Output power = 1.033 dBm

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Marker 1 2.40192000000 GHz     PNO: Fast     Trig: Free Run     Avg Type: Voltage     Trace [] 3.4 5 6       00 dB/div     Ref 10.00 dBm     Mkr1 2.401 92 GHz     0.909 dBm       00 dB/div     Ref 10.00 dBm     0.909 dBm     0.909 dBm       00 dB/div     Ref 10.00 dBm     0.909 dBm     0.909 dBm       00 dB/div     Ref 10.00 dBm     0.909 dBm     0.909 dBm       00 dB/div     Ref 10.00 dBm     0.909 dBm     0.909 dBm       00 dB/div     Ref 10.00 dBm     0.909 dBm     0.909 dBm       00 dB/div     Ref 10.00 dBm     0.909 dBm     0.909 dBm       00 dB/div     Ref 10.00 dBm     0.909 dBm     0.909 dBm       00 dB/div     Image: Ref 10.00 dBm     Image: Ref 10.00 dBm     0.909 dBm       00 dB/div     Image: Ref 10.00 dBm		Spectrum Analyzer - Peak							
PNO: Feet IFGeintLow     Trig: Free Run #Atten: 20 dB     Avg Hold:>100/100     Trig: Free Run EF[BinxLow       0 dB/div     Ref 10.00 dBm     0.909 dBm     0.909 dBm       0 00     1     1     1     1       0 00     1     1     1     1     1       0.00     1     1     1     1     1     1       0.00     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1	<mark>IXI</mark> Markor				SENSE:INT	Ava Type:	Voltage		
100 dB/d/v   Ref 10.00 dBm   0.909 dBm     000   1   1   1     100   1   1   1     100   1   1   1     100   1   1   1     100   1   1   1     100   1   1   1     100   1   1   1     100   1   1   1     100   1   1   1     100   1   1   1     100   1   1   1     100   1   1   1     100   1   1   1     100   1   1   1     100   1   1   1   1     100   1   1   1   1     100   1   1   1   1   1     100   1   1   1   1   1     100   1   1   1   1   1     100   1   1   1   1   1<	Marker	1 2.40 192000	PNO: Fast Trig: Free Run Avg Hold:>100/100		100/100	T			
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	-10.0								
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-80.0 -80.0 Center 2.40200 GHz #Res BW (-6dB) 10 MHz VBW 50 MHz Sweep 1.000 ms (1001 pts)	00.0								
Center 2.40200 GHz     Span 20.00 MHz       #Res BW (-6dB) 10 MHz     VBW 50 MHz     Sweep 1.000 ms (1001 pts)	-70.0								
#Res BW (-6dB) 10 MHz VBW 50 MHz Sweep 1.000 ms (1001 pts)	-80.0								
#Res BW (-6dB) 10 MHz VBW 50 MHz Sweep 1.000 ms (1001 pts)									
			-	)/D\4	50 MU-		Gwoon		
ISG	HRES BI		۷	VBM	JU MINZ	STATUS	Sweep	1.000 MS	(TOUT Pts)

Figure 5 - Output Power, Low Channel, BT EDR 3MB

Output power = 0.909 dBm

ncee.	Report Number:	R20191028-24-E1	Rev	С
	Prepared for:	Garmin		

Keysight Spectrum Analyzer - Peak C				
RF 50 Ω larker 1 2.440900000		Trig: Free Run #Atten: 20 dB	Avg Type: Voltage Avg Hold:>100/100	11:00:38 AM Jan 08, 202 TRACE 1 2 3 4 5 TYPE M WWWW DET P N N N
o dB/div Ref 10.00 dB	m			Mkr1 2.440 90 GH 0.712 dBi
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0.0				PE
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				- Price Par
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0.0				
30.0				
enter 2.44100 GHz Res BW (-6dB) 10 MHz	ver	50 MHz	Swe	Span 20.00 MH ep 1.000 ms (1001 pt
SG			STATUS	

Figure 6 - Output Power, Mid Channel, BT EDR 3MB

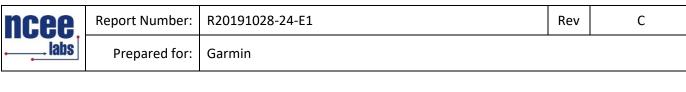
Output power = 0.712 dBm

ncee.	Report Number:	R20191028-24-E1	Rev	С
labs	Prepared for:	Garmin		

	pectrum Analyzer - Peak Output Po	wer BT C63.10 Sec. 11.9.1.1				
<mark>XI</mark>	RF 50 Ω DC		ENSE:INT			0 AM Jan 08, 2020
Marker '	1 2.479800000000	PNO: Fast	Trig: Free Run #Atten: 20 dB	Avg Type: Volt Avg Hold:>100/	age T 100	RACE 1 2 3 4 5 ( TYPE M WWWWW DET P N N N N
		IFGain:Low	#Atten: 20 dB		Mind 0.47	-
					Mkr1 2.47	.164 dBm
10 dB/div Log	Ref 10.00 dBm					. 104 0.511
Ĭ			<b>A</b> 1			
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0.00				and the second second	and the second s	
-10.0						
10.0						
-20.0					\	
-20.0					1	PEA
-30.0						
-30.0						
-40.0						
-50.0	dations					Mountain
-50.0						
-60.0						
-70.0						
-80.0						
Center 2	.48000 GHz	I		· · · · · ·	Spar	20.00 MHz
#Res BW	/ (-6dB) 10 MHz	VBW	50 MHz		Sweep 1.000 m	
ASG				STATUS		

Figure 7 - Output Power, High Channel, BT EDR 3MB

Output power = 1.164 dBm



	trum Analyzer - Average Output Po					
Marker 1 2	RF 50 Ω DC 2.401600000000 G		Trig: Free Run #Atten: 20 dB	Avg Type: RMS Avg Hold: 100/1	S 100	04 AM Jan 08, 2020 TRACE 1 2 3 4 5 6 TYPE A WWWW DET A NNNN
10 dB/div Log	Ref 10.00 dBm				Mkr1 2.4	01 60 GHz 3.470 dBm
0.00			Ĭ			
-10.0					<b></b>	
-20.0						
-30.0						
-40.0						RM
-50.0						
.60.0						
70.0						
.80.0						
Center 2.40 #Res BW (-I	0200 GHz 6dB) 10 MHz	#VBV	√ 50 MHz*		Spa Sweep 1.000 n	n 20.00 MHz ns (1001 pts
MSG				STATUS	•	

Figure 8 - Average Output Power, Low Channel, BT EDR 2MB

Average Output power = -6.470 dBm

ncee.	Report Number:	R20191028-24-E1	Rev	С
	Prepared for:	Garmin		

	pectrum Analyzer - Average Output Po				
Marker 1	RF 50 Ω DC 1 2.441380000000 G		Trig: Free Run #Atten: 20 dB	Avg Type: RMS Avg Hold: 100/100	10:37:36 AM Jan 08, 2020 TRACE 1 2 3 4 5 6 TYPE A WWWWW DET A N N N N
10 dB/div	Ref 10.00 dBm				Mkr1 2.441 38 GHz -6.349 dBm
0.00			1		
-10.0					~~~
-20.0					
-30.0					RMS
-40.0					
-50.0					
-70.0					
-80.0					
Center 2.	.44100 GHz				Span 20.00 MHz
	(-6dB) 10 MHz	#VBV	√ 50 MHz*	STATUS	veep 1.000 ms (1001 pts)

Figure 9 - Average Output Power, Mid Channel, BT EDR 2MB

Average Output power = -6.349 dBm

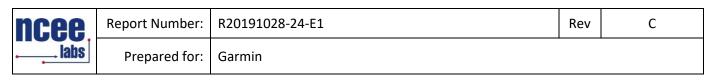




Figure 10 - Average Output Power, High Channel, BT EDR 2MB

Average Output power = -6.073 dBm

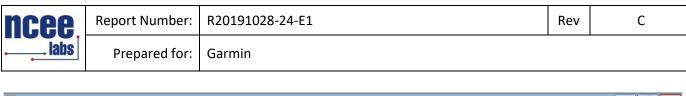




Figure 11 - Average Output Power, Low Channel, BT EDR 3MB

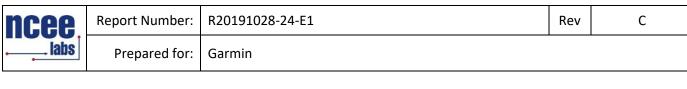
Average Output power = -6.165 dBm

ncee.	Report Number:	R20191028-24-E1	Rev	С
labs	Prepared for:	Garmin		

	RF	50 Ω DC			SENSE:INT				AM Jan 08, 2020
larker 1	1 2.4397	60000000	F	PNO: Fast 🛏 Gain:Low	. Trig: Free Run #Atten: 20 dB	Avg Type Avg Hold:		Т	ACE 1 2 3 4 5 TYPE A WWWW DET A N N N N
) dB/div	Ref 1(	).00 dBm		Gam.Low				Mkr1 2.43 -6.	9 76 GH 950 dBi
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0.0									
0.0									
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									R
).0									
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).0									
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D.0									
optor 2	44400 0	•⊔->							20.00 844
	.44100 G / (-6dB) <i>'</i>			#VE	W 50 MHz*		Swe	span ep 1.000 ms	20.00 MH a (1001 pt
G						STATUS			

Figure 12 - Average Output Power, Mid Channel, BT EDR 3MB

Average Output power = -6.950 dBm



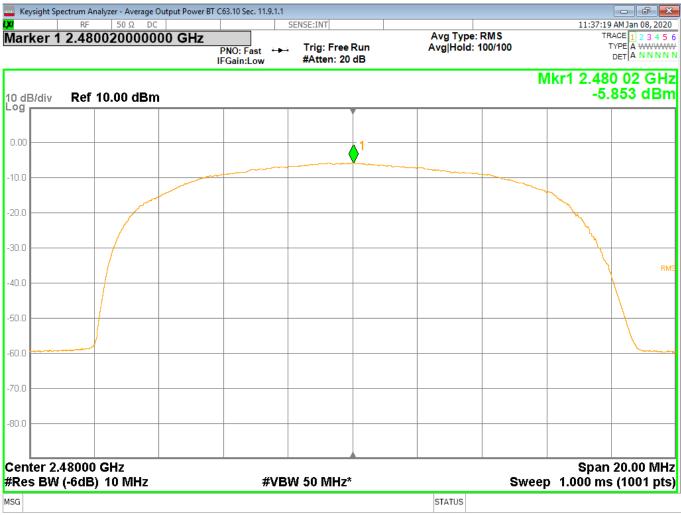


Figure 13 - Average Output Power, High Channel, BT EDR 3MB

Average Output power = -5.853 dBm



#### Test Method: ANSI C63.10,

1. Section(s) 11.8.1 "DTS Bandwidth, Option 1"

#### Limits of bandwidth measurements:

The 99% occupied bandwidth is displayed.

The 6dB bandwidth of the signal must be greater than 500 kHz.

#### **Test procedures:**

The EUT was connected to the spectrum analyzer directly with a low-loss shielded coaxial cable. The bandwidth of the fundamental frequency was measured by spectrum analyzer with 100 kHz RBW and 300 kHz VBW.

The 99% occupied is defined as the bandwidth at which 99% of the signal power is found. This corresponds to 20dB down from the maximum power level. The maximum power was measured with the largest resolution bandwidth possible (10MHz) and this value was recorded. The signal was then captured with a 1 MHz resolution bandwidth and the frequencies where the measurements were 20dB below the maximum power were marked. The bandwidth between these frequencies was recorded as the 99% occupied bandwidth.

The 6 dB bandwidth is defined as the bandwidth of which is higher than peak power minus 6dB.

For peak output power measurements, the EUT was connected to the spectrum analyzer directly with a low-loss shielded coaxial cable with 3 MHz RBW and 10 MHz VBW.

#### Deviations from test standard:

No deviation

Test setup:

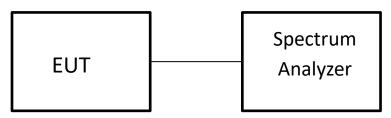


Figure 14 – Peak Output Power Measurements Test Setup

#### EUT operating conditions:

The EUT was powered by internal battery power unless specified and set to transmit continuously on the lowest frequency channel, highest frequency channel and one in the middle of its operating range. EUT was set to transmit in indicated modulation.

Rev



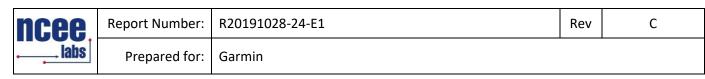
С

Prepared for: Garmin

#### **Test results:**

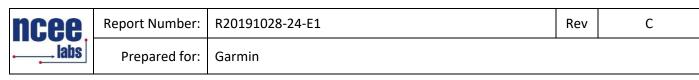
Occupied Bandwidth								
CHANNEL	Mode	CHANNEL FREQUENCY (MHz)	OBW (KHz)	RESULT				
Low	BT EDR 2MB	2402	1204.3	PASS				
Mid	BT EDR 2MB	2440	1205.4	PASS				
High	BT EDR 2MB	2480	1205.5	PASS				
Low	BT EDR 3MB	2402	1228.1	PASS				
Mid	BT EDR 3MB	2440	1229.6	PASS				
High	BT EDR 3MB	2480	1227.9	PASS				

#### 6dB Bandwidth CHANNEL 6dB FREQUENCY **CHANNEL** Mode Bandwidth RESULT (MHz) (KHz) BT EDR 2MB 2402 PASS Low 677.5 BT EDR 2MB Mid 2440 PASS 677.9 BT EDR 2MB 2480 PASS High 676.5 BT EDR 3MB Low 2402 PASS 857.1 BT EDR 3MB Mid PASS 2440 862.3 BT EDR 3MB High 2480 PASS 858.8



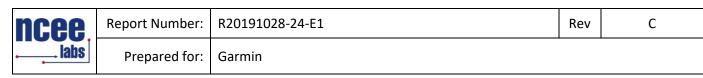
Keysight Spectrum Analyzer - Occupied Ban	dwidth BT C63.10 2013 Sec. 11.8	.1		
RF 50 Ω AC		SENSE:INT		08:59:56 AM Jan 08, 20
ef Value 12.00 dBm		Center Freq: 2.402000000 Trig: Free Run		Radio Std: None
	IFGain:Low	#Atten: 40 dB	Avg Hold:>10/10	Radio Device: BTS
dB/div Ref 12.00 dBm				
.0				
.0				
3.0				
.0 0.	~~		\	
.0				
.0				
3.0				
enter 2.402 GHz				Span 5 Mł
Res BW 100 kHz		#VBW 300 kHz		Sweep 1 n
Occupied Bandwidth	ı	Total Power	6.48 dBm	
95	51.21 kHz			
Transmit Freq Error	-755 Hz	% of OBW Power	99.00 %	
x dB Bandwidth	477.8 kHz	x dB	-6.00 dB	
	1.8.1.state> saved			

Figure 15 –Bandwidth, Low Channel, BT BR (GFSK)



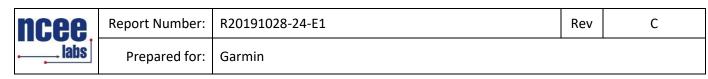
RF 50 Ω AC	width BT C63.10 2013 Sec. 11.8	SENSE:INT		09:27:25 AM Jan 08,
ter Freq 2.441000000	GHz	Center Freq: 2.44100000		Radio Std: None
·	IFGain:Low	⊃ Trig: Free Run #Atten: 40 dB	Avg Hold:>10/10	Radio Device: BTS
B/div Ref 12.00 dBm				
Bidly Rel 12.00 dBill				
			we have	
www.www.www.com.				a consister a construction of the
iter 2.441 GHz s BW 100 kHz		#VBW 300 kH	7	Span 5 I Sweep 1
3 DW 100 KHZ				Sweep 1
		Tatal Davis	6.25 dBm	
ccupied Bandwidth	l	Total Power	0.25 aBm	
	9.29 kHz	Total Power	0.25 dBm	
		% of OBW Power		
94 ransmit Freq Error	9.29 kHz			
94	9.29 kHz -1.367 kHz	% of OBW Power	r 99.00 %	

Figure 16 - Bandwidth, Mid Channel, BT BR (GFSK)



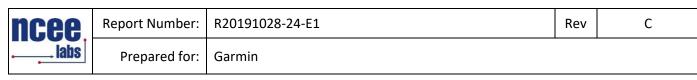
Keysight Spectrum Analyzer - Occupied E	Bandwidth BT C63.10 2013 Sec. 11.8	.1		- P
RF 50 Ω AC		SENSE:INT		09:46:14 AM Jan 08, 20
enter Freq 2.4800000		Center Freq: 2.48000000	0 GHz Avg Hold:>10/10	Radio Std: None
	IFGain:Low	Trig: Free Run #Atten: 40 dB	Avg Hold:>10/10	Radio Device: BTS
dB/div Ref 12.00 dB	m	ı <del>.</del>		
.0				
.0				
.0				
0	man			mun war
.0				
.0				
.0				
enter 2.48 GHz Res BW 100 kHz		#VBW_300 kH:	Z	Span 5 M Sweep 1 r
Occupied Bandwid	th	Total Power	6.68 dBm	
	950.51 kHz			
	-775 Hz	% of OBW Power	99.00 %	
Transmit Freq Error	-//3 HZ			
-	477.6 kHz	x dB	-6.00 dB	
Transmit Freq Error x dB Bandwidth		x dB	-6.00 dB	

Figure 17 - Bandwidth, High Channel, BT BR (GFSK)



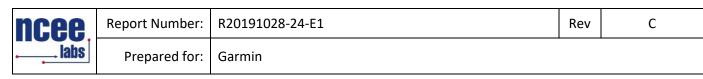
Keysight Spectrum Analyzer - Occupied Bar	idwidth BT C63.10 2013 Sec. 1						- F
RF 50 Ω AC		S	ENSE:INT	20-		10:40 Radio Std	):11 AM Jan 08, 20
nter Freq 2.40200000		G	Center Freq: 2.402000000 Trig: Free Run		d:>10/10	Radio Std	. None
	IFGain:Low	÷	#Atten: 40 dB			Radio Dev	vice: BTS
dB/div Ref 12.00 dBm	<b>I</b>			-			
		Τ		5			
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.0		++					
.0							
.0							
enter 2.402 GHz							Span 5 MI
tes BW 100 kHz			#VBW 300 kHz				Sweep 1 n
Occupied Bandwidt	h		Total Power	6.36	dBm		
1 :	2043 MHz						
					00 M		
Transmit Freq Error	34.833 kHz		% of OBW Power	99.	.00 %		
x dB Bandwidth	677.5 kHz		x dB	-6.0	)0 dB		

Figure 18 – Bandwidth, Low Channel, BT EDR 2MB



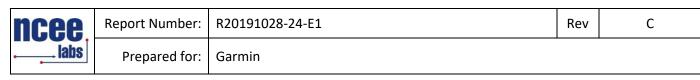
RF 50 Ω AC		SENSE:INT		10:00:51 AM Jan 08,
nter Freq 2.441000000	GHz	Center Freq: 2.441000000		Radio Std: None
	IFGain:Low	⊃ Trig: Free Run #Atten: 40 dB	Avg Hold:>10/10	Radio Device: BTS
B/div Ref 12.00 dBm				
	/			
~~~~	month		and man	m .
montaper				
ter 2.441 GHz				Span 5 I
		#\/D\\/ 200 LU-		Sweep 1
s BW 100 kHz		#VBW 300 kHz		
sBW 100 kHz		Total Power	6.21 dBm	
s BW 100 kHz Occupied Bandwidth	2054 MHz		6.21 dBm	
s BW 100 kHz Occupied Bandwidth 1.2			6.21 dBm 99.00 %	
s BW 100 kHz Occupied Bandwidth 1.2 ransmit Freq Error	054 MHz	Total Power		
s BW 100 kHz Occupied Bandwidth 1.2 ransmit Freq Error	2 <b>054 MHz</b> 35.021 kHz	Total Power % of OBW Power	99.00 %	
s BW 100 kHz Occupied Bandwidth	2 <b>054 MHz</b> 35.021 kHz	Total Power % of OBW Power	99.00 %	

Figure 19 - Bandwidth, Mid Channel, BT EDR 2MB



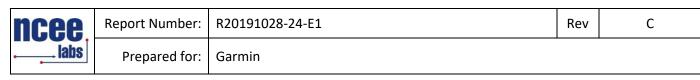
Keysight Spectrum Analyzer - Occupied Bar	ndwidth BT C63.10 2013 Sec. 11.8	.1		- 6
RF 50 Ω AC		SENSE:INT		09:47:08 AM Jan 08, 20
nter Freq 2.48000000	GHz	Center Freq: 2.48000000		Radio Std: None
	IFGain:Low	─ Trig: Free Run #Atten: 40 dB	Avg Hold:>10/10	Radio Device: BTS
dB/div Ref 12.00 dBm	<u> </u>			
0				
			$\mathbf{V}_{\mathbf{v}}$	
0				
0				
.0				
0 minute and 0	- Mart		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	manner
.0				
.0				
.0				
enter 2.48 GHz tes BW 100 kHz		#VBW 300 kHz		Span 5 M Sweep 1 r
		#VOVV JUO KHZ		Sweep 11
Occupied Bandwidt	h	Total Power	6.62 dBm	
	<sup>h</sup> 2055 MHz	Total Power	6.62 dBm	
		Total Power % of OBW Power	6.62 dBm 99.00 %	
1.:	2055 MHz			
1.2 Transmit Freq Error	2055 MHz 34.881 kHz	% of OBW Power	99.00 %	
1.2 Transmit Freq Error	2055 MHz 34.881 kHz	% of OBW Power	99.00 %	

Figure 20 - Bandwidth, High Channel, BT EDR 2MB



ysight Spectrum Analyzer - Occupied Band RF 50 Ω AC		SENSE:INT		10:41:28 AM Jan 08
ter Freq 2.40200000	GHz	Center Freq: 2.40200000		Radio Std: None
		Trig: Free Run #Atten: 40 dB	Avg Hold:>10/10	Radio Device: BTS
B/div Ref 12.00 dBm	<b>^</b>			
	A			
	/			
man man and and and and and and and and and a	~~~~			mon man
ter 2.402 GHz				Chan El
s BW 100 kHz		#VBW_300 kH	z	Span 5 I Sweep 1
occupied Bandwidth	 ו	Total Power	6.47 dBm	
1.2	279 MHz			
	21.743 kHz	% of OBW Power	99.00 %	
ransmit Freq Error			-6.00 dB	
-	857.1 kHz	x dB	-0.00 ub	
-	857.1 kHz	X aB	-0.00 01	
ransmit Freq Error dB Bandwidth	857.1 kHz	хав	-0.00 48	

Figure 21 –Bandwidth, Low Channel, BT EDR 3MB



eysight Spectrum Analyzer - Occupied Band	width BT C63.10 2013 Sec. 11.			
RF 50 Ω AC 1000000 0	GHz	SENSE:INT Center Freq: 2.44100000	0 GHz	10:58:50 AM Jan 08, 2 Radio Std: None
2.441000000	IFGain:Low	Talas Francis Barrow	Avg Hold:>10/10	Radio Device: BTS
Def 40.00 dBre				
B/div Ref 12.00 dBm	<b>_</b>			
	- and - we		har	
server and and				man man
nter 2.441 GHz es BW 100 kHz		#VBW 300 kH	7	Span 5 M Sweep 1
5 DW 100 KHZ				Sweep 1
Occupied Bandwidth	1	Total Power	6.24 dBm	
1.2	296 MHz			
	22.076 kHz	% of OBW Power	r 99.00 %	
ransmit Freq Error				
-	862.3 kHz	x dB	-6.00 dB	
-	862.3 kHz	x dB	-6.00 dB	
ransmit Freq Error dB Bandwidth	862.3 kHz	x dB	-6.00 dB	
-	862.3 kHz	x dB	-6.00 dB	

Figure 22 - Bandwidth, Mid Channel, BT EDR 3MB

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Keysight Spectrum Analyzer - Occupied Bar RF 50 Ω AC	dwidth BT C63.10 2013 Sec. 1				
RF 50 Ω AC		SENSE:INT	00.011-	11:36:17 AM Jan 08, 20	
nter Freq 2.480000000 GHz		Center Freq: 2.48000000 GHz Trig: Free Run Avg Hold:>10/10		Radio Std: None	
	IFGain:Low	#Atten: 40 dB		Radio Device: BTS	
dB/div Ref 12.00 dBm	1	·			
.0					
3.0					
3.0	- mot		- horn		
8.0 mmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmm	har		- mr	man man	
8.0					
8.0					
8.0					
enter 2.48 GHz Res BW 100 kHz		#VBW_300 ki	47	Span 5 Ml Sweep 1 n	
		#VDVV 300 Ki	112	Sweep 11	
Occupied Bandwidth		Total Power	6.66 dBm		
	2281 MHz				
1.2					
		% of OBW Powe	er 99.00 %		
Transmit Freq Error	22.508 kHz				
		% of OBW Powe x dB	er 99.00 % -6.00 dB		
Transmit Freq Error	22.508 kHz				
Transmit Freq Error	22.508 kHz				
Transmit Freq Error	22.508 kHz				

Figure 23 - Bandwidth, High Channel, BT EDR 3MB



#### Test Method: ANSI C63.10:2013:

- 1. Section 6.5, "Radiated emissions from unlicensed wireless devices in the frequency range of 30 MHz to 1000 MHz"
- Section 6.6, "Radiated emissions from unlicensed wireless devices above 1 GHz"
- 3. Section 11.11, "Measurement in nonrestricted frequency bands"
- 4. Section 11.12, "Emissions in restricted bands"

#### Limits for radiated emissions measurements:

Emissions radiated outside of the specified bands shall be applied to the limits in 15.209 as followed:

FREQUENCIES (MHz)	FIELD STRENGTH (μV/m)	MEASUREMENT DISTANCE (m)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	3
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

#### Note about requirement from FCC Part 15.247(d) and RSS-247, Section 5.5:

In addition to the limits shown above, all emissions were also required to be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power. All measurements were performed with a 1 MHz bandwidth, but the bandwidth conversion from 1 MHz to 100 kHz would be equally applied to the highest emission and the spurious emissions, so it would not effect the delta measurement.

Since the fundamental emissions was at least 20 dB over the spurious emissions limits from 15.209 and all spurious emissions were below the 15.209 limit, this requirement was met.

#### NOTE:

- 1. The lower limit shall apply at the transition frequencies.
- 2. Emission level (dBuV/m) = 20 \* log \* Emission level ( $\mu$ V/m).

3. As shown in 15.35(b), for frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits by more than 20dB under any condition of modulation.

Rev



a. The EUT was placed on the top of a rotating table above the ground plane in a 10 meter semianechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation. The table was 0.8m high for measurements form 30MHz-1Ghz and 1.5m for measurements from 1GHz and higher.

b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

c. The antenna was a broadband antenna, and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are used to make the measurement.

d. For each suspected emission, the EUT was arranged to maximize its emissions and then the antenna height was varied from 1 meter to 4 meters and the rotating table was turned from 0 degrees to 360 degrees to find the maximum emission reading.

e. The test-receiver system was set to use a peak detector with a specified resolution bandwidth. For spectrum analyzer measurements, the composite maximum of several analyzer sweeps was used for final measurements.

f. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10 dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

g. The EUT was maximized in all 3 orthogonal positions. The results are presented for the axis that had the highest emissions.

h. Intermodulation products were investigated by measuring spurious emissions with each of the two 2.4 GHz radios running in parallel with the NFC radio. No intermodulation products were found above the labs system sensitivity.

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1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Peak detection (PK) and Quasi-peak detection (QP) at frequencies below 1GHz.

2. The resolution bandwidth 1 MHz for all measurements and at frequencies above 1GHz, A peak detector was used for all measurements above 1GHz. Measurements were made with an EMI Receiver.

### Deviations from test standard:

No deviation.

## Test setup:

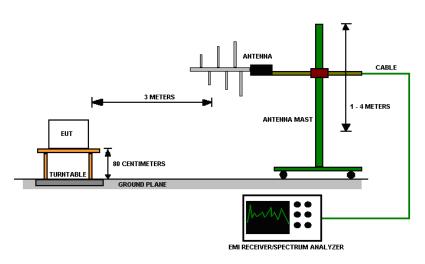
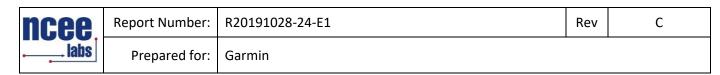


Figure 24 - Radiated Emissions Test Setup

# EUT operating conditions

The EUT was powered by internal battery power unless specified and set to transmit continuously on the lowest frequency channel, highest frequency channel and one in the middle of its operating range. EUT was set to transmit in indicated modulation.



Test results:

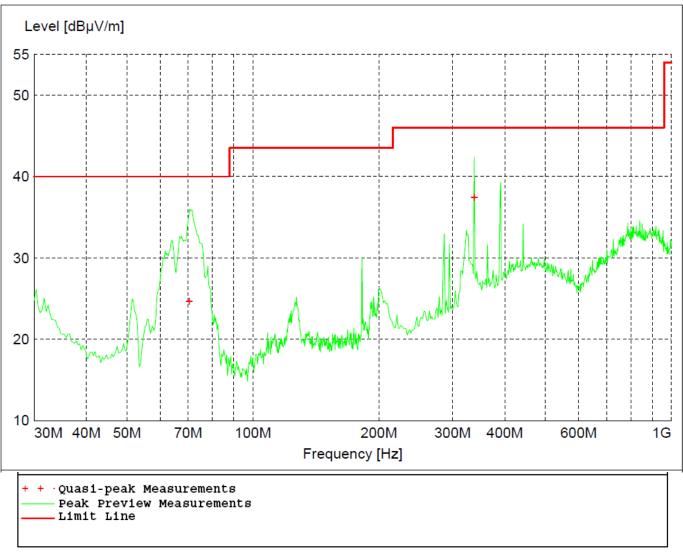


Figure 25 - Radiated Emissions Plot, Receive

#### REMARKS:

- 1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB)
- 2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB)
- 3. The other emission levels were very low against the limit.
- 4. Margin value = Emission level Limit value

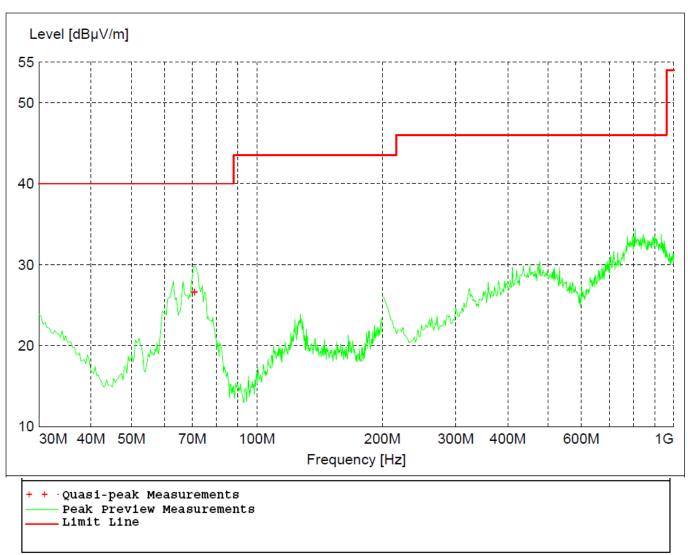
	Lawal		Marain	Halasha	America	Del	-
Table 1 -	Radiated E	Emissions (	Quasi-peak	k Measurer	nents, Red	ceive	

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
70.440000	24.70	40.00	15.30	100.00	295.00	VERT
338.040000	37.41	46.00	8.60	100.00	167.00	HORI



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#### Figure 26 - Radiated Emissions Plot, 2EDR

#### REMARKS:

- 1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB)
- 2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB)
- 3. The other emission levels were very low against the limit.
- 4. Margin value = Emission level Limit value

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
70.800000	26.65	40.00	13.40	99	250	VERT

The EUT was maximized in all 3 orthogonal axis. The worst-case is shown in the table above.



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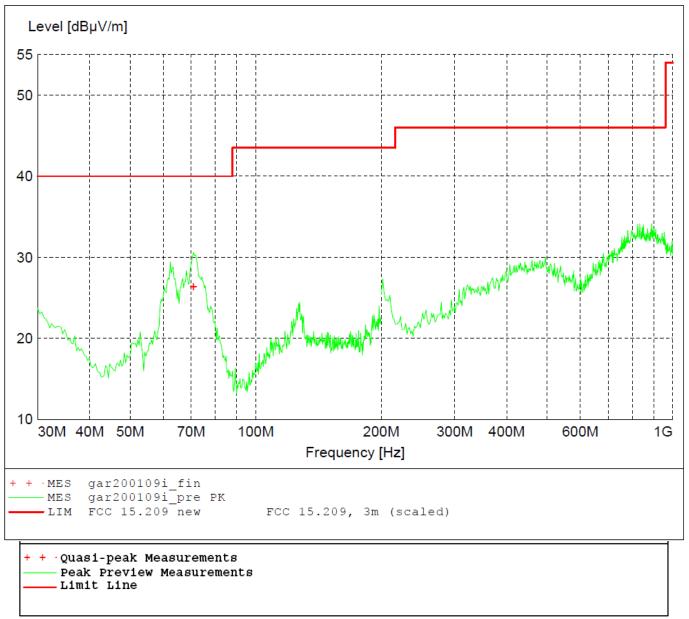


Figure 27 - Radiated Emissions Plot, 3EDR

# REMARKS:

- 1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB)
- 2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB)
- 3. The other emission levels were very low against the limit.
- 4. Margin value = Emission level Limit value

#### Table 3 - Radiated Emissions Quasi-peak Measurements

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
70.920000	26.39	40.00	13.60	106	138	VERT

The EUT was maximized in all 3 orthogonal axis. The worst-case is shown in the table above.

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# Table 4 - Radiated Emissions Peak Measurements

Frequency	Level	Limit	Margin	Height	Angle	Pol	Radio	Channel
MHz	dBµV/m	dBµV/m	dB	cm.	deg.			
2402.000000	90.40	N/A	N/A	180	322	HORI	2EDR	Low
2441.000000	94.32	N/A	N/A	180	322	HORI	2EDR	Mid
2480.000000	97.93	N/A	N/A	180	322	HORI	2EDR	High
2402.000000	90.38	N/A	N/A	180	322	HORI	3EDR	Low
2441.000000	94.34	N/A	N/A	180	322	HORI	3EDR	Mid
2480.000000	97.97	N/A	N/A	180	322	HORI	3EDR	High

The EUT was maximized in all 3 orthogonal axis. The worst-case is shown in the table above.



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#### Test Method: ANSI C63.10:

- 1. Section 6.10.5 (used for restricted bands)
- 2. Section 11.13.2 "Marker-delta method" (for unrestricted bands)
- 3. Section 11.11, "Measurement in unrestricted frequency bands"

#### Limits of bandedge measurements:

For emissions outside of the allowed band of operation (2400.0MHz – 2480.0MHz), the emission level needs to be 20dB under the maximum fundamental field strength. However, if the emissions fall within one of the restricted bands from 15.205 the field strength levels need to be under that of the limits in 15.209. Emissions were evaluated at the low and higher band edge frequencies.

#### Test procedures:

The EUT was tested in the same method as described in section *4.4 - Bandwidth*. The resolution bandwidth was set to 100kHz and video bandwidth to 300 kHz the EMI receiver was used to scan from the bandedge to the fundamental frequency with a quasi-peak detector. The highest emissions level beyond the bandedge was measured and recorded. All band edge measurements were evaluated to the general limits in Part 15.209.

#### **Deviations from test standard:**

No deviation.

Test setup: See Section 4.3

#### EUT operating conditions:

The EUT was powered by internal battery power unless specified and set to transmit continuously on the lowest frequency channel, highest frequency channel and one in the middle of its operating range. EUT was set to transmit in indicated modulation.

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labs	Prepared for:	Garmin		

### **Test results:**

CHANNEL	Mode	Band edge /Measurement Frequency (MHz)	Relative Highest out of band level dBm	Relative Fundamental dBm	Delta (dB)	Min Delta (dB)	Result
Low, Continuous (restricted)	BT EDR 2MB	2390	-74.00	-0.473	74.473	36.51	PASS
High, Continuous (restricted)	BT EDR 2MB	2483.5	-66.54	-0.207	66.747	44.04	PASS
Low, Continuous (unrestricted)	BT EDR 2MB	2400	-57.49	-0.473	57.02	20.00	PASS
High, Continuous (unrestricted)	BT EDR 2MB	2483.5	-59.88	-0.207	59.67	20.00	PASS

\*Minimum delta = [highest fundamental peak field strength from Section 4.2] – [Part 15.209 radiated emissions limit.]

# From Section 4.4

CHANNEL	Mode	Field Strength (dBuV/m)	Field Strength Limit (dBuV/m)	Min Delta (dBc)	Result
Low, Continuous (restricted)	BT EDR 2MB	15.93	53.98	37.99	PASS
High, Continuous (restricted)	BT EDR 2MB	31.18	22.80	43.95	PASS

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RF	er - Lower Band Edge Peak Rest 50 Ω AC		SENSE:INT			09:54:31 AM Jan 08,3
	80000000 GHz		DEINDERINT	Aval	ype: Log-Pwr	TRACE 1 2 3
INCI I 2.3031		PNO: Wide	Trig: Free Ru	n Avg H	old:>100/100	TYPE M WW
		FGain:High	#Atten: 0 dB			DET P N N
						Mkr1 2.389 18 G
	).00 dBm					-73.996 dI
B/div Ref -20						10.000 ui
)						
)						
)						<b>≬</b> 1
				~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		- mannan
more war	and a second of the second	Marcan	Monthand - W- Calif			
)						
,						
rt 2.380000 GH	17			I		Stop 2.390000 C
es BW 100 kHz		#VB	N 300 kHz		Swee	p 1.000 ms (1001
MODE TRC SCL	× 2.389 18 GHz	-73.996	FUNCTIO	DN FUNCTION WIDTH		FUNCTION VALUE
N	2.303 10 012	-75.550	ubili			

Figure 28 - Band-edge Measurement, Low Channel, Restricted Frequency, Peak

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	RF	50 Ω	AC		SENSE:II	T				09;58:1	0 AM Jan 08, 2
ırker 1			0000 GHz	PNO: Fast Gain:Low	🕞 Trig	g: Free Run ten: 30 dB		Avg Type Avg Hold:	: Log-Pwr >100/100		RACE 1 2 3 4 TYPE MWWW DET PNNN
dB/div	Ref	20.00 d	Bm						М	(r1 2.401 -0.	843 G 473 dE
g											
.0											▲1 43
											X-
.0 0.										<i>ل</i> م	$\downarrow \sim$
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.0											
art 2.39 es BW					VBW 30	▲ ∩ ⊬⊔z			Swee	Stop 2.4 5 1.000 m	03000 G
				7					-		s (1001 p
R MODE T N Δ3 F	1 f	(Δ)	X 2.401 843 GHz 1.843 MHz 2.400 000 GHz	(Δ) ξ	473 dBm 57.019 dB 492 dBm	FUNCTION	FUNC	TION WIDTH	F	UNCTION VALUE	

Figure 29 - Band-edge Measurement, Low Channel, Fundamental, Peak

ncee.	Report Number:	R20191028-24-E1		Rev	С
labs	Prepared for:	Garmin			
🚥 Keysight Spectrum	) Analyzer - High Band Edge Peal	Restricted BT C63.10 Sec. 6.10.4 and 6.10.5			
Marker 1 2.4	F 50 Ω AC 83929000000 GH	SENSE:INT PNO: Fast IFGain:High #Atten: 0 dB	Avg Type: Log-Pwr Avg Hold:>100/100	09	51:00 AM Jan 08, 2020 TRACE 1 2 3 4 5 6 TYPE MWWWW DET P N N N N N

					Mkr1	2.483 9	29 0 G 539 dE
dB/div <b>Ref</b>	-20.00 dBm					-00	.555 UE
.0							
.0							
0							
o <b> ∆</b> 1							
	when the work when the second	m m m	m	mmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmm	man ma	~ man	Mar Mar
)							
0							
rt 2.483500		#VBW 300	) kHz		Sweep	Stop 2.5 1.000 m	500000 G s (1001 p
art 2.483500 es BW 100 k		#VBW 300		FUNCTION WIDTH	-	Stop 2.5 1.000 m NCTION VALUE	i00000 G s (1001 p
nrt 2.483500 es BW 100 k MODE TRC SCL	Hz	Y		FUNCTION WIDTH	-	1.000 m	500000 G s (1001 p
rt 2.483500 es BW 100 k MODE TRC SCL	Hz	Y		FUNCTION WIDTH	-	1.000 m	500000 G s (1001 p
rt 2.483500 es BW 100 k MODE TRC SCL	Hz	Y		FUNCTION WIDTH	-	1.000 m	500000 G s (1001 p
nrt 2.483500 es BW 100 k MODE TRC SCL	Hz	Y		FUNCTION WIDTH	-	1.000 m	500000 G s (1001 p
nrt 2.483500 es BW 100 k Mode TRC SCL	Hz	Y		FUNCTION WIDTH	-	1.000 m	500000 G s (1001 p
nrt 2.483500 es BW 100 k Mode TRC SCL	Hz	Y		FUNCTION WIDTH	-	1.000 m	500000 G s (1001 p
art 2.483500 es BW 100 k MODE TRC SCL	Hz	Y			-	1.000 m	600000 G s (1001 p
nrt 2.483500 es BW 100 k Mode TRC SCL	Hz	Y		FUNCTION WIDTH	-	1.000 m	000000 G s (1001 p
art 2.483500 es BW 100 k MODE TRC SCL	Hz	Y			-	1.000 m	600000 G s (1001 p

Figure 30 - Band-edge Measurement, High Channel, Restricted Frequency, Peak



				) GHz kHz			#VBW 30	0 kHz			Sweep	Stop 2.43 1.000 ms	83500 GH: (1001 pts
MKR	MODE	TRC	SCL		Х		Y	FUNCTION	FUNC	TION WIDTH	FL	INCTION VALUE	,
1	Ν	1	f		2.479 842 5 GHz		-0.207 dBm						
2	Δ3	1	f	(Δ)	-3.657 5 MHz	(Δ)	59.670 dB						
3	F	1	f		2.483 500 0 GHz		-59.877 dBm						
4													
5													
6													
7													
8													
9													
10													
11													
< 1													>

Figure 31 - Band-edge Measurement, High Channel, Fundamental, Peak

-40.0 -50.0 -60.0 -70.0

ncee.	Report Number:	R20191028-24-E1	Rev	С
	Prepared for:	Garmin		

CHANNEL	Mode	Band edge /Measurement Frequency (MHz)	Relative Highest out of band level dBm	Relative Fundamental dBm	Delta (dB)	Min Delta (dB)	Result
Low, Continuous (unrestricted)	BT EDR 3MB	2400.0	-54.52	-0.468	54.05	20.00	PASS
High, Continuous (unrestricted)	BT EDR 3MB	2483.5	-60.52	-0.208	60.31	20.00	PASS

\*Minimum delta = [highest fundamental peak field strength from Section 4.2] – [Part 15.209 radiated emissions limit.]

From Section 4.4

CHANNEL	Mode	Field Strength (dBuV/m)	Field Strength Limit (dBuV/m)	Margin (dB)	Result
Low, Continuous (restricted)	BT EDR 3MB	15.52	53.98	38.46	PASS
High, Continuous (restricted)	BT EDR 3MB	29.94	53.98	24.04	PASS

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labs	Prepared for:	Garmin		

Keysight Spectrum Analyzer - Lov	-				-	_ f
RF 50 Ω arker 1 2.3899900		SENS	I	Avg Type	e: Log-Pwr	10:44:14 AM Jan 08, 2 TRACE 1 2 3 4
	PNO:		rig: Free Run Atten: 0 dB	Avg Hold	:>100/100	TYPE MWW DET PNN
	-10				N	lkr1 2.389 99 G -74.390 dE
0 dB/div Ref -20.00	abm					-14.000 dL
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10.0						
0.0						
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0.0						
00						
10						
art 2.380000 GHz			<b>i</b>			Otom 2 200000 0
Res BW 100 kHz		#VBW 3	00 kHz		Sweep	Stop 2.390000 G 1.000 ms (1001 p
R MODE TRC SCL	X 2.389 99 GHz	Y -74.390 dBr		FUNCTION WIDTH	FL	JNCTION VALUE
2	2.363 33 612	-74.550 001				
3						
5 6						
7						
9						
0						
•						
3				STATUS		

Figure 32 - Band-edge Measurement, Low Channel, Restricted Frequency, Peak

ncee.	Report Number:	R20191028-24-E1	Rev	С
labs	Prepared for:	Garmin		

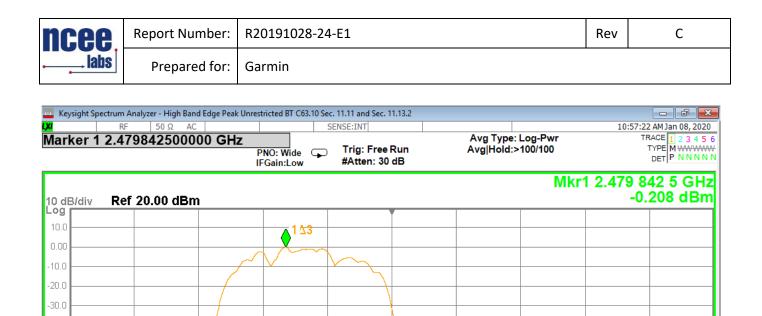
			ver Band Edge Peak Un	restricted							1		
	RF	50 Ω			-	SENSE:II	NT			A T	 	10	45:56 AM Jan 0
ker 1	1 2.40	0184300	00000 GHz			Tria				Avgiyp	e: Log-Pwr		TRACE 1 2
					ast 🖵		: Free F			Avginoid	:>100/100		DET P N
				IFGain:	Low	#At	ten: 30 d	аB					BEIJ.
											N	lkr1 2 4	01 843 (
													-0.468 d
B/div	Ref	f 20.00 c	1Bm										-0.408 0
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	90000										_	Stop	2.403000
s BN	/ 100	kHz			#VB	W 30	) KHZ				Swee	ep 1.000	ms (1001
MODELT	FRC SCL		X		Y		FUNC	TION	EUNCT	ON WIDTH		FUNCTION VA	
N	1 f		2.401 843 GH	7	-0.468	dBm	Tone	inen	- onen	on morn		TONCHON VA	
Δ3	1 f	(Δ)	1.843 MH		54.05								
F	1 f	(4)	2.400 000 GH		-54.519								
	· ·			-	•• .•								

Figure 33 - Band-edge Measurement, Low Channel, Fundamental, Peak

ncee	Report Number:	R20191028-24-E1		Rev	С
labs	Prepared for:	Garmin			
Keysight Spectrum	ı Analyzer - High Band Edge Peal	c Restricted BT C63.10 Sec. 6.10.4 and 6.10.5			
	F 50 Ω AC	SENSE:INT		10	:56:38 AM Jan 08, 2020
Marker 1 2.4	84127000000 GH	Z	Avg Type: Log-Pwr		TRACE 1 2 3 4 5 6

larker 1	2.484		IO: Fast 🖵 Trig: Fre ain:High #Atten: (	eRun Av	/g Type: Log-Pwr g Hold:>100/100	TRACE 1 2 3 4 5 TYPE M WWW DET P N N N N
0 dB/div	Ref -	20.00 dBm			Mkr1	2.484 127 0 GH -67.817 dBr
<b>og</b> 30.0						
10.0						
0.0						
0.0	1					
0.0 <mark>~~</mark>	m	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~				
0.0			and a constrained and a constr	a for	" barrow warrante	harmon part
0.0						
00						
10						
tart 2.48 Res BW			#VBW 300 kH	z	Sweep	Stop 2.500000 GH 1.000 ms (1001 pt
R MODE T		Х		INCTION FUNCTION W	IDTH FU	NCTION VALUE
1 N 1 2	f	2.484 127 0 GHz	-67.817 dBm			
3						
4 5						
6						
7 B						
9						
0 1						
• • •						>
					TATUS	

Figure 34 - Band-edge Measurement, High Channel, Restricted Frequency, Peak



Start 2.478000 GHz #Res BW 100 kHz					#VBW 300 kHz			Stop 2.483500 GHz Sweep   1.000 ms (1001 pts)			
MKR	MODE	TRC	SCL		Х			Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	N	1	f		2.479 842	5 GHz		-0.208 dBm			
2	Δ3	1	f	(Δ)	-3.657	5 MHz	<b>(Δ)</b>	60.309 dB			
3	F	1	f		2.483 500	0 GHz		-60.516 dBm			
4											
5											
6											
7											
8 9											
9											
10											
11											
<											>

Figure 35 - Band-edge Measurement, High Channel, Fundamental, Peak

-40.0 -50.0 -60.0 -70.0



Prepared for: Garmin

# 4.6 POWER SPECTRAL DENSITY

# Test Method: ANSI C63.10,

1. Section 11.10.2 "Method PKPSD (peak PSD)"

# Limits of power measurements:

The maximum PSD allowed is 8 dBm.

# Test procedures:

1. The EUT was connected to the spectrum analyzer directly with a low-loss shielded coaxial cable.

2. The resolution bandwidth was set to 3 kHz and the video bandwidth was set to 10 kHz to capture the signal. The analyzer used a peak detector in max hold mode.

## Test setup:

The EUT was connected to the spectrum analyzer directly with a low-loss shielded coaxial cable on a bench top.

## EUT operating conditions:

The EUT was powered by internal battery power unless specified and set to transmit continuously on the lowest frequency channel, highest frequency channel and one in the middle of its operating range. EUT was set to transmit in indicated modulation.

## Test results:



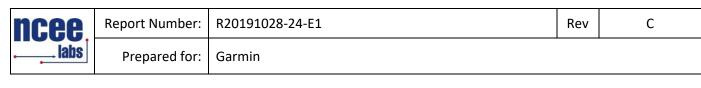
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CHANNEL	MODE	CHANNEL FREQUENCY (MHz)	PEAK PSD(dBm)	Method	Limit (dBm)	RESULT		
Low	BT BR (GFSK)	2402	-1.398	Conducted	8.00	PASS		
Middle	BT BR (GFSK)	2440	-1.602	Conducted	8.00	PASS		
High	BT BR (GFSK)	2480	-1.194	Conducted	8.00	PASS		
Low	BT EDR 2MB	2402	-4.715	Conducted	8.00	PASS		
Middle	BT EDR 2MB	2440	-4.879	Conducted	8.00	PASS		
High	BT EDR 2MB	2480	-4.469	Conducted	8.00	PASS		
Low	BT EDR 3MB	2402	-4.601	Conducted	8.00	PASS		
Middle	BT EDR 3MB	2440	-4.770	Conducted	8.00	PASS		
High	BT EDR 3MB	2480	-4.380	Conducted	8.00	PASS		

# **Power Spectral Density**

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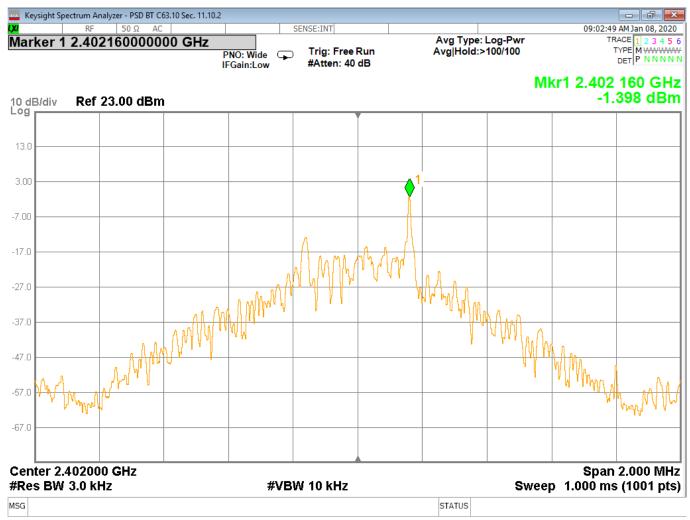
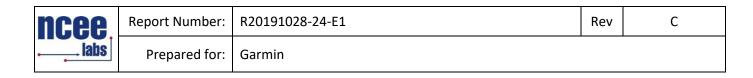


Figure 36 - Power Spectral Density, Low Channel, BT BR (GFSK)



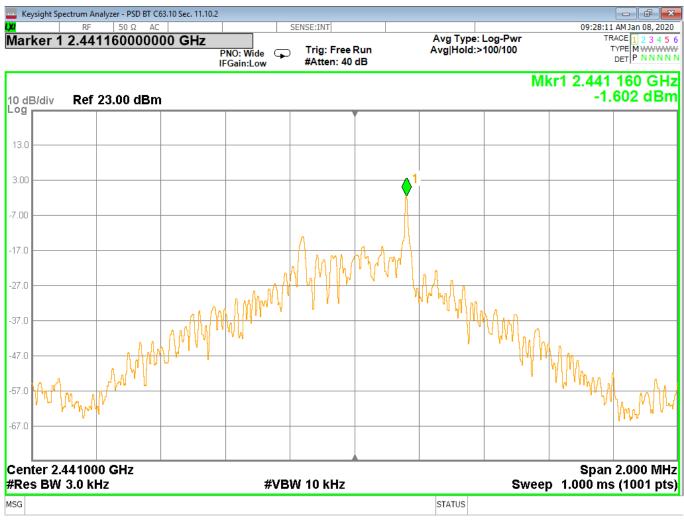
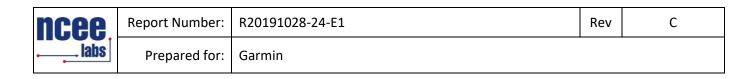


Figure 37 - Power Spectral Density, Mid Channel, BT BR (GFSK)



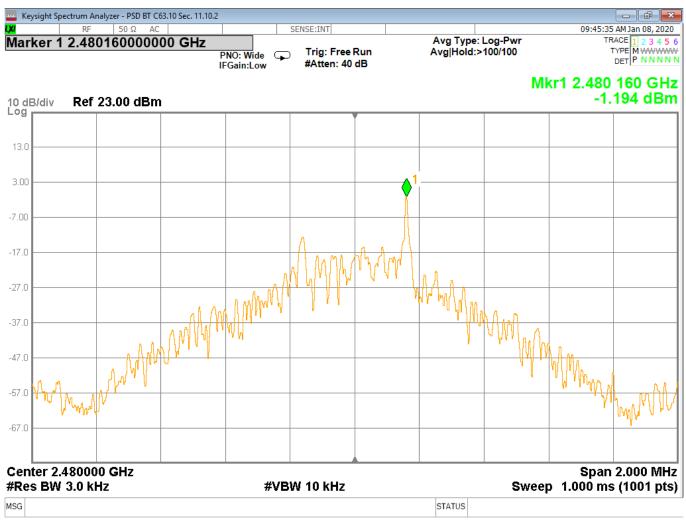


Figure 38 - Power Spectral Density, High Channel, BT BR (GFSK)

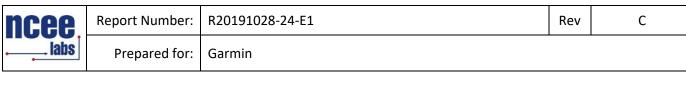




Figure 39 - Power Spectral Density, Low Channel, BT EDR 2MB

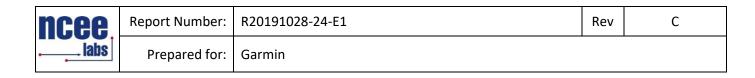




Figure 40 - Power Spectral Density, Mid Channel, BT EDR 2MB

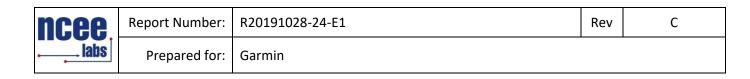




Figure 41 - Power Spectral Density, High Channel, BT EDR 2MB

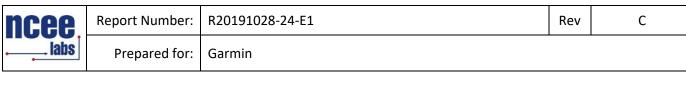




Figure 42 - Power Spectral Density, Low Channel, BT EDR 3MB

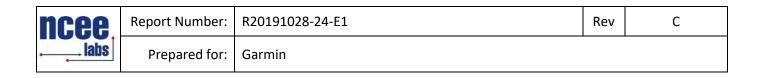




Figure 43 - Power Spectral Density, Mid Channel, BT EDR 3MB

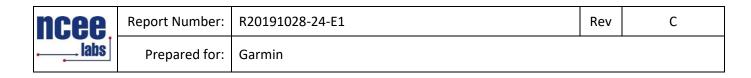




Figure 44 - Power Spectral Density, High Channel, BT EDR 3MB



# 4.6 CONDUCTED AC MAINS EMISSIONS

Test Method: ANSI C63.10-2013, Section(s) 6.2

### Limits for conducted emissions measurements:

FREQUENCY OF EMISSION (MHz)	CONDUCTED LIMIT (dBμV)		
	Quasi-peak	Average	
0.15-0.5	66 to 56	56 to 46	
0.5-5	56	46	
5-30	60	50	

#### Notes:

1. The lower limit shall apply at the transition frequencies.

The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50 MHz
All emanations from a class A/B digital device or system, including any network of conductors and apparatus connected thereto, shall not exceed the level of field strengths specified above.

#### **Test Procedures:**

- a. The EUT was placed 0.8m above a ground reference plane and 0.4 meters from the conducting wall of a shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). The LISN provides 50 ohm/ 50uH of coupling impedance for the measuring instrument.
- b. Both lines of the power mains connected to the EUT were checked for maximum conducted interference as well as the ground.
- c. The frequency range from 150 kHz to 30 MHz was searched. Emission levels over 10dB under the prescribed limits are not reported.
- d. Results were compared to the 15.207 limits.

#### Deviation from the test standard:

No deviation

#### EUT operating conditions:

The EUT was powered by 5 VDC unless specified and set to transmit continuously on the middle channel.

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#### **Test Results:**

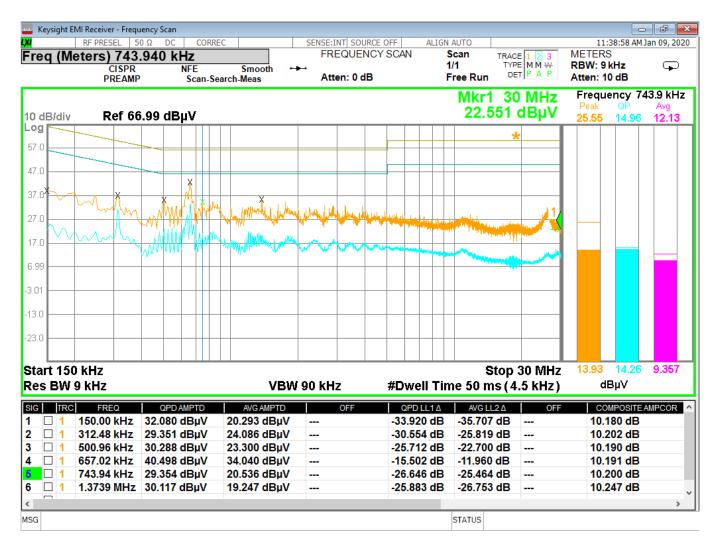
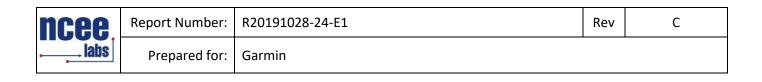


Figure 45 - Conducted Emissions, Line



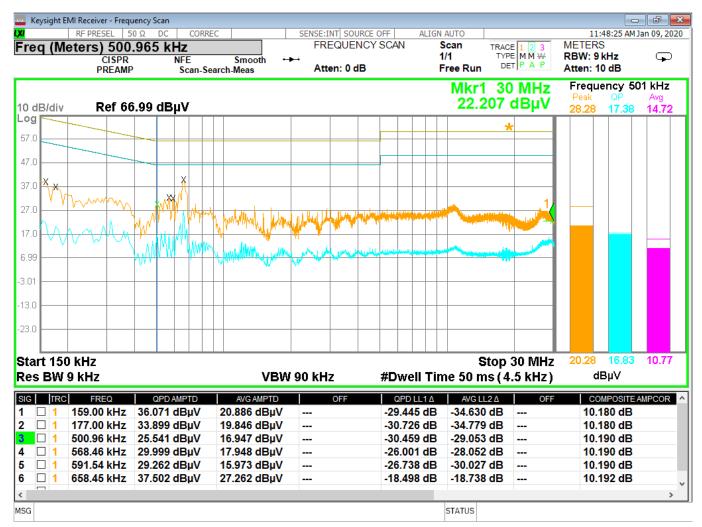


Figure 46 - Conducted Emissions, Neutral



# APPENDIX A: SAMPLE CALCULATION

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# **Field Strength Calculation**

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows: FS = RA + AF - (-CF + AG) + AV

where FS = Field Strength

RA = Receiver Amplitude AF = Antenna Factor CF = Cable Attenuation Factor AG = Amplifier Gain AV = Averaging Factor (if applicable)

Assume a receiver reading of 55 dB $\mu$ V is obtained. The Antenna Factor of 12 and a Cable Factor of 1.1 is added. The Amplifier Gain of 20 dB is subtracted, giving a field strength of 48.1 dB $\mu$ V/m.

 $FS = 55 + 12 - (-1.1 + 20) + 0 = 48.1 \text{ dB}\mu\text{V/m}$ 

The 48.1 dB $\mu$ V/m value can be mathematically converted to its corresponding level in  $\mu$ V/m.

Level in  $\mu$ V/m = Common Antilogarithm [(48.1 dB $\mu$ V/m)/20]= 254.1  $\mu$ V/m

AV is calculated by the taking the  $20^{100}(T_{on}/100)$  where  $T_{on}$  is the maximum transmission time in any 100ms window.

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# **EIRP Calculations**

In cases where direct antenna port measurement is not possible or would be inaccurate, output power is measured in EIRP. The maximum field strength is measured at a specified distance and the EIRP is calculated using the following equation;

EIRP (Watts) = [Field Strength (V/m) x antenna distance (m)]<sup>2</sup> / 30

Power (watts) = 10^[Power (dBm)/10] / 1000

Voltage ( $dB\mu V$ ) = Power (dBm) + 107 (for 50 $\Omega$  measurement systems)

Field Strength (V/m) =  $10^{Field}$  Strength (dB $\mu$ V/m) / 20] /  $10^{6}$ 

Gain = 1 (numeric gain for isotropic radiator)

Conversion from 3m field strength to EIRP (d=3):

 $EIRP = [FS(V/m) \times d^2]/30 = FS[0.3]$  for d = 3

 $EIRP(dBm) = FS(dB\mu V/m) - 10(log 10^9) + 10log[0.3] = FS(dB\mu V/m) - 95.23$ 

10log( 10^9) is the conversion from micro to milli



# APPENDIX B - MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been for tests performed in this test report:

Test	Frequency Range	Uncertainty Value (dB)
Radiated Emissions, 3m	30MHz - 1GHz	3.82
Radiated Emissions, 3m	1GHz - 18GHz	4.44
Emissions limits, conducted	30MHz – 18GHz	±3.30 dB

Expanded uncertainty values are calculated to a confidence level of 95%.

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REPORT END