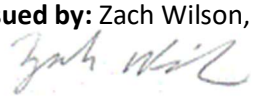
Test Report # 319379 C (RFx)

Equipment Under Test:	SmartCraft Connect
Test Date(s):	November 3rd – 5th, 2020
Prepared for:	Brunswick Corporation Attn: Andrew Sember W6250 Pioneer Road Fond du Lac, WI 54936

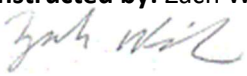
Report Issued by: Zach Wilson, EMC Engineer

Signature:  Date: 1/20/2021

Report Reviewed by: Adam Alger, Quality Manager

Signature:  Date: 01/12/2021

Report Constructed by: Zach Wilson, EMC Engineer

Signature:  Date: 12/16/2020

CONTENTS

Laird Connectivity Test Services in Review

The Laird Connectivity, Inc. laboratory located at W66 N220 Commerce Court Cedarburg, Wisconsin, 53012 USA is recognized through the following organizations:

A2LA – American Association for Laboratory Accreditation

Accreditation based on ISO/IEC 17025:2017 with Electrical (EMC) Scope

A2LA Certificate Number: 1255.01

Scope of accreditation includes all test methods listed herein unless otherwise noted

---

Federal Communications Commission (FCC) – USA

Accredited Test Firm Registration Number: 953492

Recognition of two 3 meter Semi-Anechoic Chambers

Government of Canada

Innovation, Science and Economic Development Canada

Accredited U.S. Identification Number: US0218

Recognition of two 3 meter Semi-Anechoic Chambers

1 TEST REPORT SUMMARY

During **November 3rd – 5th, 2020** the Equipment Under Test (EUT), **SmartCraft Connect**, as provided by **Brunswick Corporation** was tested to the following requirements of the **Federal Communications Commission** and **Innovation, Science and Economic Development Canada** :

Test Requirements	Description	Specification	Method	Compliant
RSS-102	Radio Frequency Exposure Compliance of Radiocommunication Apparatus	Reported	RSS-102 Section 2.5.2	Reported
FCC Part 1.1307, 2.1091, 2.1093	RF Exposure and equipment authorization requirements	Reported	FCC KDB 447498 D01	Reported

Notice:

The results relate only to the item tested as configured and described in this report. Any additional configurations, modes of operation, or modifications made to the equipment under test after the specified test date(s) are at the decision of the client and may not apply to the data seen in this test report.

The decision rule for Pass / Fail assessment to the specification or standard listed in this test report has been agreed upon by the client and laboratory to be as follows:

Measurement Type	Rule
Emissions – Amplitude	N/A
Emissions – Frequency	N/A
Immunity	N/A

2 CLIENT INFORMATION

Company Name	Brunswick Corporation
Contact Person	Andrew Sember
Address	W6250 Pioneer Road Fond du Lac, WI 54936

2.1 Equipment Under Test (EUT) Information

The following information has been supplied by the client

Product Name	SmartCraft Connect
Model Number	SCC-1
Serial Number	Engineering Sample
FCC ID	2APYL-GH19392020
IC ID	26775-HG19392020

2.2 Product Description

The primary purpose of this custom electronic device is to transmit wired CAN data wirelessly via integrated WLAN (SILabs WFM200S022XNN2) & Bluetooth (SILabs EFR32BG21A010F1024IM32-BR) radios. The secondary purpose is to translate proprietary CAN data (Mercury proprietary protocol) to a public NMEA 2000 protocol. Both of these functions provide local wired and wireless monitoring of vessel information. Vessel information includes engine and navigation data.

Both radios use the following chip antenna: Johanson Tech, PN: 2450AT18D0100E-AEC. The antenna has max peak gain of 2.0dBi at 2.44GHz. The module is powered by 12VDC boat battery.

The radios cannot transmit simultaneously.

2.3 Modifications Incorporated for Compliance

None noted at time of test

2.4 Deviations and Exclusions from Test Specifications

None noted at time of test

2.5 Radio Programming Information

EUT programmed using a Mercury proprietary application. The radio manufacturer provided the commands to put the radio into the correct test modes.

2.6 Distance to User and Use Environment

Per customer, the radio will be greater than 20cm from the user's body/head. The EUT is a mobile device used in an uncontrolled environment.

3 REFERENCES

Publication	Edition	Date
CFR Title 47	-	2020
RSS-102	5	2015
FCC KDB 447498 D01	v06	2015

4 UNCERTAINTY SUMMARY

Using the guidance of the following publications the calculated measurement uncertainty represents an expanded uncertainty expressed at approximately the 95 % confidence level, using a coverage factor of k = 2.

References	Version / Date
CISPR 16-4-1	Ed. 2 (2009-02)
CISPR 16-4-2	Ed. 2 (2011-06)
CISPR 32	Ed. 1 (2012-01)
ANSI C63.23	2012
A2LA P103	February 4, 2016
A2LA P103c	August 10, 2015
ETSI TR 100-028	V1.3.1 (2001-03)

Measurement Type	Configuration	Uncertainty ±
Radiated Emissions	Biconical Antenna	5.0 dB
Radiated Emissions	Log Periodic Antenna	5.3 dB
Radiated Emissions	Horn Antenna	4.7 dB
AC Line Conducted Emissions	Artificial Mains Network	3.4 dB
Telecom Conducted Emissions	Asymmetric Artificial Network	4.9 dB
Disturbance Power Emissions	Absorbing Clamp	4.1 dB
Radiated Immunity	3 Volts/meter	2.2 dB
Conducted Immunity	CDN/EM/BCI	2.4/3.5/3.4 dB
EFT Burst/Surge	Peak pulse voltage	164 volts
ESD Immunity	15 kV level	1377 Volts

Parameter	ETSI U.C. ±	U.C. ±
Radio Frequency, from F0	$1x10^{-7}$	$0.55x10^{-7}$
Occupied Channel Bandwidth	5 %	2 %
RF conducted Power (Power Meter)	1.5 dB	1.2 dB
RF conducted emissions (Spectrum Analyzer)	3.0 dB	1.7 dB
All emissions, radiated	6.0 dB	5.3 dB
Temperature	1° C	0.65° C
Humidity	5 %	2.9 %
Supply voltages	3 %	1 %

5 TEST DATA

5.1 WLAN Fundamental Emission

Operator	Zach Wilson	**QA**	Anthony Smith
Temperature	22.1°C	**R.H. %**	40.8
Test Date	11/5/2020	**Location**	Conducted Radio Bench
Requirement	FCC 15.247	**Method**	ANSI C63.10

Test Parameters

Frequency	2412-2462MHz
Device Used	Power Meter
Method	Peak
EUT Power	3.3VDC
EUT Mode	WLAN Transmit
Example Calculation	Conducted Power (e.i.r.p.) = Conducted Power (dBm) + Antenna Gain (dBi)

Instrumentation

Laird

Date: 29-Oct-2020 Test: Conducted Radio Job: C-3380

PE: Zach Wilson Customer: Mercury Maring Quote: 319379

No.	Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due Date	Equipment Status
1	EE 960087	Analyzer - Spectrum	Agilent	N9010A	MY53400296	7/14/2019	7/14/2021	Active Calibration
2	AA 960144	Cable	Gore	EKD01D010720	5800373	12/9/2019	12/9/2020	Active Verification

Data Table

Channel	Protocol	Data Rate	Conducted Output Power (dBm)	Output Power Limit (dBm)	Margin (dB)
1	802.11b	1Mbps	16.0	30.0	14.0
6	802.11b	1Mbps	15.9	30.0	14.1
11	802.11b	1Mbps	15.9	30.0	14.1
1	802.11b	11Mbps	14.1	30.0	15.9
6	802.11b	11Mbps	14.0	30.0	16.0
11	802.11b	11Mbps	14.0	30.0	16.0
1	802.11g	6Mbps	13.4	30.0	16.6
6	802.11g	6Mbps	13.0	30.0	17.0
11	802.11g	6Mbps	13.1	30.0	16.9
1	802.11g	54Mbps	17.5	30.0	12.5
6	802.11g	54Mbps	16.9	30.0	13.1
11	802.11g	54Mbps	17.1	30.0	12.9
1	802.11n	MCS0	12.8	30.0	17.2
6	802.11n	MCS0	12.9	30.0	17.1
11	802.11n	MCS0	12.8	30.0	17.2
1	802.11n	MCS7	16.3	30.0	13.8
6	802.11n	MCS7	15.8	30.0	14.2
11	802.11n	MCS7	16.0	30.0	14.0

5.2 BLE Fundamental Emission

Operator	Anthony Smith	**QA**	Shane Dock
Temperature	21.9°C	**R.H. %**	27.60%
Test Date	11/3/2019	**Location**	Conducted Radio Bench
Requirement	FCC 15.247	**Method**	ANSI C63.10

Test Parameters

Frequency	2402 MHz, 2440 MHz, 2480 MHz
RBW	3 MHz
VBW	50 MHz
EUT Power	3.3VDC
EUT Mode	BLE Single Channel, Max Power
Example Calculation	Conducted Power (e.i.r.p.) = Conducted Power (dBm) + Antenna Gain (dBi)

Instrumentation

Laird

Date: 29-Oct-2020 Test: Conducted Radio Job: C-3380

PE: Zach Wilson Customer: Mercury Maring Quote: 319379

No.	Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due Date	Equipment Status
1	EE 960087	Analyzer - Spectrum	Agilent	N9010A	MY53400296	7/14/2019	7/14/2021	Active Calibration
2	AA 960144	Cable	Gore	EKD01D010720	5800373	12/9/2019	12/9/2020	Active Verification

Data Table

Channel	Data Rate	Conducted Output Power (dBm)	Output Power Limit (dBm)	Margin (dB)
0	125 kbps	7.8	30.0	22.2
19	125 kbps	7.9	30.0	22.1
39	125 kbps	7.8	30.0	22.2
0	500 kbps	7.9	30.0	22.1
19	500 kbps	8.0	30.0	22.0
39	500 kbps	7.9	30.0	22.1
0	1 Mbps	7.8	30.0	22.2
19	1 Mbps	8.0	30.0	22.0
39	1 Mbps	7.8	30.0	22.2
0	2 Mbps	7.8	30.0	22.2
19	2 Mbps	8.0	30.0	22.0
39	2 Mbps	7.9	30.0	22.1

Plots

Worst Case Conducted Peak Output Power
BLE 500 kbps, 2440 MHz

6 EXCLUSION CALCULATION

6.1 Technical Brief

WLAN Worst Case: **17.5 dBm** (Pout) + **1 dB** (Tune-Up Tolerance) = **18.5 dBm = 70.8 mW**

BLE Worst Case: **8.0 dBm** (Pout) + **1 dB** (Tune-Up Tolerance) = **9.0 dBm = 7.9 mW**

Test Separation Distance: **Greater than 20cm**

6.2 FCC – WLAN MPE Calculation

Prediction of MPE limit at a given distance

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

where: S = power density
P = power input to the antenna
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna

Maximum peak output power at antenna input terminal:	18.50	(dBm)
Maximum peak output power at antenna input terminal:	70.795	(mW)
Antenna gain(typical):	2.0	(dBi)
Numeric Antenna Gain:	1.585	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	2440	(MHz)
MPE limit for uncontrolled exposure at prediction frequency:	1.0	(mW/cm^2)
Power density at prediction frequency:	0.022322	(mW/cm^2)

WLAN CONFORMANCE STATEMENT

Routine SAR testing is ***excluded*** as 0.022322 mW/cm^2 is less than 1.0000000 mW/cm^2.

6.3 FCC – BLE MPE Calculation

Prediction of MPE limit at a given distance

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

where: S = power density
P = power input to the antenna
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna

Maximum peak output power at antenna input terminal:	9.00	(dBm)
Maximum peak output power at antenna input terminal:	7.943	(mW)
Antenna gain(typical):	2.0	(dBi)
Numeric Antenna Gain:	1.585	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	2440	(MHz)
MPE limit for uncontrolled exposure at prediction frequency:	1.0	(mW/cm^2)
Power density at prediction frequency:	0.002505	(mW/cm^2)

BLE CONFORMANCE STATEMENT

Routine SAR testing is ***excluded*** as 0.002505 mW/cm^2 is less than 1.000000 mW/cm^2.

6.4 ISED

BLE

BLE EIRP CALCULATION = OP + ANTENNA GAIN

8.0 dBm + 2.0 dBi = 10.0 dBm (0.010 W)

BLE POWER DENSITY LIMIT

f= 2480 MHz

$0.02619 \times f^{0.6834} = 5.469\ W/m^2$

BLE CONFORMANCE STATEMENT

Routine SAR testing is ***excluded*** as 0.010 W/m^2 is less than 5.469 W/m^2.

WLAN

WLAN EIRP CALCULATION = OP + ANTENNA GAIN

17.5 dBm + 2.0 dBi = 19.5 dBm (0.089 W)

WLAN POWER DENSITY LIMIT

f= 2480 MHz

$0.02619 \times f^{0.6834} = 5.469\ W/m^2$

WLAN CONFORMANCE STATEMENT

Routine SAR testing is ***excluded*** as 0.089 W/m^2 is less than 5.469 W/m^2.

7 REVISION HISTORY

Version	Date	Notes	Person
2	1/20/2021	Revised per TCB review	Zach Wilson
3	2/3/2021	Revised per TCB review	Zach Wilson

END OF REPORT