

December 23, 2020

Bluecats US LLC  
6767 Old Madison Pike Suite 300  
Huntsville, Alabama 35806  
USA

Dear Kurt Nehrenz,

Enclosed is the EMC Wireless test report for compliance testing of the Bluecats US LLC, BC4520 ProxPoint as tested to the requirements of the FCC Certification rules under Title 47 of the CFR Part 1 1.1310 RF Exposure.

Thank you for using the services of Eurofins E&E North America. If you have any questions regarding these results or if MET can be of further service to you, please contact me.

Sincerely yours,  
EUROFINS E&E NORTH AMERICA



Arsalan Hasan  
Wireless Laboratory

Reference: (\Bluecats US LLC\WIRS109093-FCC-MPE Rev 0)



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Eurofins MET Laboratories Inc. (Eurofins E&E North America) is part of the Eurofins Electrical & Electronics (E&E) global compliance network.

**Electromagnetic Compatibility Criteria  
Test Report**

for the

**Bluecats US LLC  
BC4520 ProxPoint**

**Tested under  
FCC Certification Rules  
Title 47 of the CFR, Part 1 1.1310**

**Report: WIRS109093-FCC-MPE Rev 0**

December 23, 2020

**Prepared For:**

**Bluecats US LLC  
6767 Old Madison Pike Suite 300  
Huntsville, Alabama 35806  
USA**

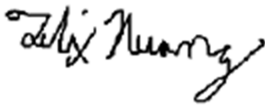
**Prepared By:  
Eurofins E&E North America  
3162 Belick Street  
Santa Clara, CA 95054**

**Electromagnetic Compatibility Criteria  
Test Report**

for the

**Bluecats US LLC  
BC4520 ProxPoint**

Tested Under

**FCC Certification Rules  
Title 47 of the CFR, Part 1 1.1310**Felix Huang  
Engineer, Wireless LaboratoryArsalan Hasan  
Manager, Wireless Laboratory

**Engineering Statement:** The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of Part 1 of the FCC Rules under normal use and maintenance.

Eleazar Zuniga, PhD.  
Director, Wireless Technologies

## Report Status Sheet

Revision	Report Date	Reason for Revision
∅	December 23, 2020	Initial Issue.

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## List of Terms and Abbreviations

AC	Alternating Current
ACF	Antenna Correction Factor
Cal	Calibration
<i>d</i>	Measurement Distance
dB	Decibels
dB $\mu$ A	Decibels above one <b>microamp</b>
dB $\mu$ V	Decibels above one <b>microvolt</b>
dB $\mu$ A/m	Decibels above one <b>microamp per meter</b>
dB $\mu$ V/m	Decibels above one <b>microvolt per meter</b>
DC	Direct Current
E	Electric Field
DSL	Digital Subscriber Line
ESD	Electrostatic Discharge
EUT	Equipment Under Test
<i>f</i>	Frequency
FCC	Federal Communications Commission
GRP	Ground Reference Plane
H	Magnetic Field
HCP	Horizontal Coupling Plane
Hz	Hertz
IEC	International Electrotechnical Commission
kHz	kilohertz
kPa	kilopascal
kV	kilovolt
LISN	Line Impedance Stabilization Network
MHz	Megahertz
$\mu$ H	microhenry
$\mu$	microfarad
$\mu$ s	microseconds
NEBS	Network Equipment-Building System
PRF	Pulse Repetition Frequency
RF	Radio Frequency
RMS	Root-Mean-Square
TWT	Traveling Wave Tube
V/m	Volts <b>per meter</b>
VCP	Vertical Coupling Plane

# I. Executive Summary

## 1.1 Purpose of Test

An EMC evaluation was performed to determine compliance of the Bluecats US LLC BC4520 ProxPoint, with the requirements of Part 1. All references are to the most current version of Title 47 of the Code of Federal Regulations in effect. In accordance with §2.1033, the following data is presented in support of the Certification of the BC4520 ProxPoint. Bluecats US LLC should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the BC4520 ProxPoint, has been **permanently** discontinued.

## 1.2 Executive Summary

The following tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 1, in accordance with Bluecats US LLC, purchase order number PO-BCUS-00608.

Reference	Description	Compliance
§1.1310	RF Exposure	Compliant

**Table 1. Executive Summary of EMC Compliance Testing**



## **II. Equipment Configuration**

## 2.1 Overview

Eurofins E&E North America was contracted by Bluecats US LLC to perform testing on the BC4520 ProxPoint, under Bluecats US LLC’s purchase order number PO-BCUS-00608

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Bluecats US LLC, BC4520 ProxPoint.

<b>Model(s) Tested:</b>	BC4520 ProxPoint	
<b>Filing Status:</b>	Original	
<b>EUT Specifications:</b>	Primary Power: 120V (AC/DC Adaptor)	
	FCC ID: 2AHXCBC4520	
	Module Original Report Number(s): Report: R2007A0435-M1: Report: 1901FS12	
	Type of Modulations:	GFSK, GMSK, 8PSK, QPSK, 16QAM
	Equipment Code:	DTS, PCB
	Technology	TX Frequency Range
	GSM 850	824 – 849 MHz
	GSM 1900	1850 – 1910 MHz
	LTE CAT-M1 Band 2	1850 – 1910 MHz
	LTE CAT-M1 Band 4	1710 – 1755 MHz
	LTE CAT-M1 Band 5	824 – 849 MHz
	LTE CAT-M1 Band 12	699 – 716 MHz
	LTE CAT-M1 Band 13	777 – 787 MHz
	LTE CAT-M1 Band 25	1850 – 1915 MHz
	BLE	2402 – 2480 MHz
WLAN (2.4GHz)	2412 – 2462 MHz	
WLAN (5.0GHz)	5180 – 5825 MHz	
<b>Analysis:</b>	The results obtained relate only to the item(s) tested.	
<b>Environmental Test Conditions:</b>	Temperature: 15-35° C	
	Relative Humidity: 30-60%	
	Barometric Pressure: 860-1060 mbar	
<b>Evaluated by:</b>	Arsalan Hasan	
<b>Date(s):</b>	December 23, 2020	

Table 2. EUT Summary Table

## 2.2 References

<b>CFR 47, Part 22, Subpart H</b>	Federal Communication Commission, Code of Federal Regulations, Title 47, Part 22: Rules and Regulations for Cellular Devices.
<b>CFR 47, Part 24, Subpart E</b>	Federal Communication Commission, Code of Federal Regulations, Title 47, Part 24: Rules and Regulations for Personal Communications Services
<b>CFR 47, Part 27</b>	Federal Communication Commission, Code of Federal Regulations, Title 47, Part 27: Rules and Regulations for Advanced Wireless Services
<b>KDB 996369 D04</b>	Modular Transmitter Integration Guide – Guidance For Host Product Manufacturers
<b>ANSI C63.4:2014</b>	Methods and Measurements of Radio-Noise Emissions from Low-Voltage Electrical And Electronic Equipment in the Range of 9 kHz to 40 GHz
<b>ANSI C63.26: 2015</b>	Compliance Testing of Transmitters Used in Licensed Radio Services
<b>ISO/IEC 17025:2017</b>	General Requirements for the Competence of Testing and Calibration Laboratories
<b>EIA/TIA-603-A-2001</b>	Land Mobile FM or PM Communication Equipment Measurement and Performance Standards
<b>KDB 971168 v02r02</b>	Measurement Guidance For Certification Of Licensed Digital Transmitters

**Table 3. Standard References**

## 2.3 Test Site

All testing was performed at Eurofins MET Labs, 3162 Belick St., Santa Clara, CA 95054. All equipment used in making physical determinations is accurate and bears recent traceability to the National Institute of Standards and Technology.

Eurofins MET Labs is a ISO/IEC 17025 accredited site by A2LA, California #0591.02.

## 2.4 Measurement Uncertainty

Test Method	Typical Expanded Uncertainty	K	Confidence Level
<b>RF Frequencies</b>	±4.52 Hz	2	95%
<b>RF Power Conducted Emissions</b>	±2.32 dB	2	95%
<b>RF Power Conducted Spurious Emissions</b>	±2.25 dB	2	95%
<b>RF Power Radiated Emissions</b>	±3.01 dB	2	95%

**Table 4. Measurement Uncertainty**

## 2.5 Description of Test Sample

The Bluecats US LLC BC4520 ProxPoint is an RTLS gateway that receives Bluetooth transmissions from beacons and tags, filters and processes location and sensor information, and forwards to a server via Ethernet, Wi-Fi, or LTE.

## 2.6 Equipment Configuration

The EUT was set up as outlined in **Error! Reference source not found.**, Block Diagram of Test Setup. All cards, racks, etc., incorporated as part of the EUT is included in the following list.

Ref. ID	Slot #	Name / Description	Model Number	Part Number	Serial Number	Revision
	NA	BC4520 ProxPoint	BC4520	NA	NA	NA
	BT1, BT4	Bluetooth Stick Antenna, Right Angle	W5029	NA	NA	NA
	BT2, BT3	Bluetooth Stick Antenna, Straight	W5029RPGT	NA	NA	NA
	LTE	LTE Flat Bar Antenna, 2m cable	ANT-LTE-VDP-2000-SMA	NA	NA	NA
	GNSS	GPS GLONASS SMA, 3m cable	ANT-GPS-SH2-SMA	NA	NA	NA
	PWR	Power Adapter	GST25A12-P1J	NA	NA	NA
	ETH	M12 X-Coded to RJ45 10m cable	ETH	NA	NA	NA

Table 5: Equipment Configuration

## 2.7 Support Equipment

Support equipment necessary for the operation and testing of the EUT is included in the following list.

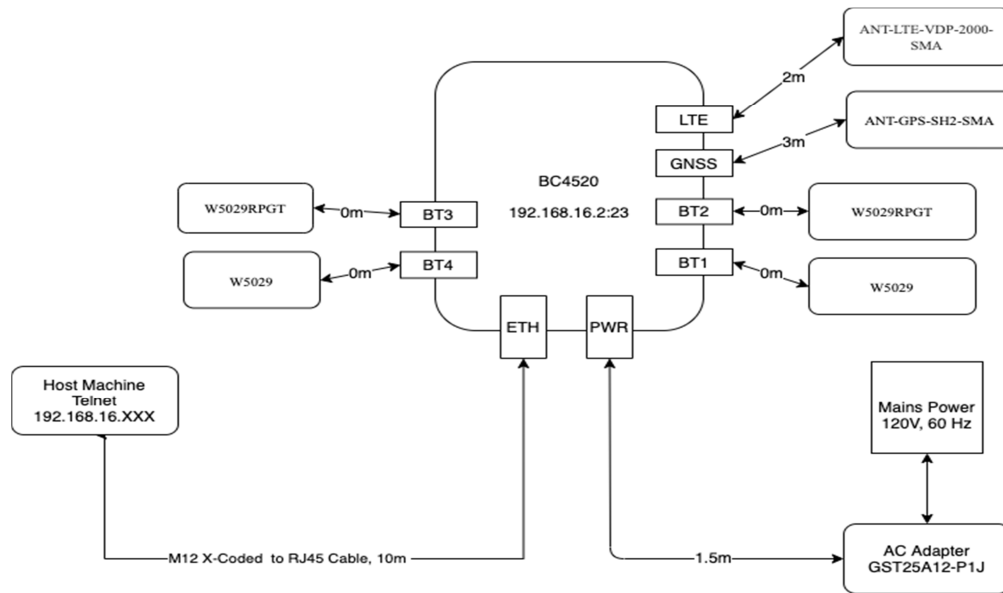
Ref. ID	Name / Description	Manufacturer	Model Number	*Customer Supplied Calibration Data
	Laptop with Windows 10	HP	NA	N/A

Table 6: Support Equipment

## 2.8 Ports and Cabling Information

Ref. ID	Port name on EUT	Cable Description or reason for no cable	Qty	Length as tested (m)	Max Length (m)	Shielded? (Y/N)	Termination Box ID & Port Name
	BT1	W5029 Antenna	1	NA	NA	NA	NA
	BT2	W5029RPGT Antenna	1	NA	NA	NA	NA
	BT3	W5029RPGT Antenna	1	NA	NA	NA	NA
	BT4	W5029 Antenna	1	NA	NA	NA	NA
	LTE	ANT-LTE-VDP-2000-SMA Antenna	1	2m	NA	Yes	NA
	GNSS	ANT-GPS-SH2-SMA Antenna	1	3m	NA	Yes	NA
	ETH	M12 X-Coded connector to RJ45	1	10m	NA	Yes	NA
	PWR	M12 A-Coded terminated GST25A12-P1J Power Adapter	1	NA	NA	NA	(120v/60hz)

Table 7: Ports and Cabling Information



**Figure 1: EUT configuration**

## 2.9 Mode of Operation During Testing

Standard test mode was used. Allows independent activation of all radios in their various test modes, as well as methods to generate traffic similar to normal operation on all digital busses.

## 2.10 Method of Monitoring EUT Operation

The signal will be displayed on a spectrum analyzer.

## 2.11 Modifications

### 2.11.1 Modifications to EUT

No modifications were made to the EUT.

### 2.11.2 Modifications to Test Standard

No modifications were made to the test standard.

## 2.12 Disposition of EUT

The test sample including all support equipment submitted to the Electro-Magnetic Compatibility Lab for testing was returned to Bluecats US LLC upon completion of testing.

### **III. Electromagnetic Compatibility Criteria for Intentional Radiators**

**Maximum Permissible Exposure**

**RF Exposure Requirements:** §1.1307(b)(1) and §1.1307(b)(2): Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission’s guidelines.

**RF Radiation Exposure Limit:** §1.1310: As specified in this section, the Maximum Permissible Exposure (MPE) Limit shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in Sec. 1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of Sec. 2.1093 of this chapter.

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm <sup>2</sup> )	Averaging time (minutes)
<b>(i) Limits for Occupational/Controlled Exposure</b>				
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
<b>(ii) Limits for General Population/Uncontrolled Exposure</b>				
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

**Table 8. RF Exposure Limits**

$$S = PG / 4\pi R^2 \quad \text{or} \quad R = \sqrt{PG / 4\pi S}$$

where, S = Power Density (mW/cm<sup>2</sup>)  
 P = Power Input to antenna (mW)  
 G = Antenna Gain (numeric value)  
 R = Distance (cm)

For Antenna Gain → dBi = 10log(Numeric)

Technology	TX Frequency Range (MHz)	Peak Gain (dBi)	Type
GSM 850	824 – 849	4.5	External Flat Antenna
GSM 1900	1850 – 1910	3.5	External Flat Antenna
LTE CAT-M1 Band 2	1850 – 1910	3.5	External Flat Antenna
LTE CAT-M1 Band 4	1710 – 1755	3.5	External Flat Antenna
LTE CAT-M1 Band 5	824 – 849	4.5	External Flat Antenna
LTE CAT-M1 Band 12	699 – 716	4.5	External Flat Antenna
LTE CAT-M1 Band 13	777 – 787	4.5	External Flat Antenna
LTE CAT-M1 Band 25	1850 – 1915	3.5	External Flat Antenna
BLE *	2402 – 2480	2.3	External Stick Antenna
WLAN (2.4GHz) **	2412 – 2462	0.712	PCB Trace***
WLAN (5.0GHz) **	5180 – 5825	1.250	PCB Trace***

**Table 9. EUT Antenna Gain Specification**

\* This BLE transmission is from the TI Chip, CC2640.

\*\* Only WLAN (2.4GHz/5GHz) is supported by the RedPine module. BT, BLE, ZigBee for RedPine module have been disabled. Transmission only occurs through a single PCB trace antenna. 2.4GHz & 5GHz do not transmit simultaneously.

\*\*\* RedPine module is only using the original integrated PCB trace antenna without any modifications. The alternate RF port is not activated in the final host product.



Technology	TX Frequency Range (MHz)	Time-average maximum tune-up procedure (dBm)	Division Factor (dB)	Frame-Average Power (dBm)
GSM 850	824 – 849	32 (-3 ~ +1dB)	-9.03	23.97
GSM 1900	1850 – 1910	29 (-3 ~ +1dB)	-9.03	20.97

**Table 10. Tune up Power**

Technology	TX Frequency Range (MHz)	Maximum Conducted Output Power (dBm)
GSM 850	824 – 849	23.97
GSM 1900	1850 – 1910	20.97
LTE CAT-M1 Band 2	1850 – 1910	23 (-3 ~ +1dB) = 24
LTE CAT-M1 Band 4	1710 – 1755	22 (-3 ~ +1dB) = 23
LTE CAT-M1 Band 5	824 – 849	23 (-3 ~ +1dB) = 24
LTE CAT-M1 Band 12	699 – 716	23 (-3 ~ +1dB) = 24
LTE CAT-M1 Band 13	777 – 787	23 (-3 ~ +1dB) = 24
LTE CAT-M1 Band 25	1850 – 1915	24 (-3 ~ +1dB) = 25
BLE	2402 – 2480	4 (-1 ~ +1dB) = 5
WLAN (2.4GHz)	2412 – 2462	17 (-1 ~ +1dB) = 18
WLAN (5.0GHz)	5180 – 5825	14 (-1 ~ +1dB) = 15

**Table 11. Tune up Power**

### Bands covered under FCC Part 22 / FCC Part 24

**Test Results:**

Band	Frequency (MHz)	Maximum Conducted Power (dBm)	Conducted Power (mW)	Antenna Gain (dBi)	Antenna Gain (Numeric)	Power Density (mW/cm <sup>2</sup> )	Limit (mW/cm <sup>2</sup> )	Margin	Distance (cm)	Result
GSM 850	848.8	23.97	249.45	4.5	2.818	0.1399	0.565	-0.425	20	Pass
GSM 1900	1850.2	20.97	125.02	3.5	2.238	0.0556	1	-0.944	20	Pass
LTE Band 2	1905.0	24	251.18	3.5	2.238	0.1118	1	-0.888	20	Pass
LTE Band 5	829.0	24	251.18	4.5	2.818	0.1408	0.552	-0.411	20	Pass
LTE Band 25	1910.0	25	316.22	3.5	2.238	0.1408	1	-0.859	20	Pass

**Table 12. MPE Calculation for Bands under Part 22 and Part 24**

The safe distance where Power Density is less than the MPE limit listed above was found to be 20 cm.

### Bands covered under FCC Part 27

**Test Results:**

Band	Frequency (MHz)	Maximum Conducted Power (dBm)	Conducted Power (mW)	Antenna Gain (dBi)	Antenna Gain (Numeric)	Power Density (mW/cm <sup>2</sup> )	Limit (mW/cm <sup>2</sup> )	Margin	Distance (cm)	Result
LTE Band 4	1750	23	199.52	3.5	2.238	0.0888	1	-0.911	20	Pass
LTE Band 12	711.0	24	251.18	4.5	2.818	0.1408	0.474	-0.333	20	Pass
LTE Band 13	782.0	24	251.18	4.5	2.818	0.1408	0.521	-0.380	20	Pass

**Table 13 MPE Calculation for Bands under Part 27**

The safe distance where Power Density is less than the MPE limit listed above was found to be 20 cm.

### Bands covered under FCC Part 15.247 / 15.407

**Test Results:**

Band	Frequency (MHz)	Maximum Conducted Power (dBm)	Conducted Power (mW)	Antenna Gain (dBi)	Antenna Gain (Numeric)	Power Density (mW/cm <sup>2</sup> )	Limit (mW/cm <sup>2</sup> )	Margin	Distance (cm)	Result
BLE	2402	5	3.16	2.3	1.698	0.0010	1	-0.998	20	Pass
WLAN 2.4G	2412	18	63.09	0.712	1.178	0.0147	1	-0.985	20	Pass
WLAN 5G	5500	15	31.62	1.250	1.333	0.0083	1	-0.991	20	Pass

**Table 14. MPE Calculation for Bands under Part 15.247 / 15.407**

The safe distance where Power Density is less than the MPE limit listed above was found to be 20 cm.

**Note: Results are based on KDB 447498 D01 (Section 7.2) Transmitters used in mobile devices exposure conditions for simultaneous transmission operations.**

Simultaneous transmission MPE test exclusion applies when the sum of the MPE ratios for all simultaneously transmitting antennas incorporated in a host device is  $\leq 1.0$ , according to calculated/estimated, numerically modeled, or measured field strengths or power density. The MPE ratio of each antenna is determined at the minimum test separation distance required by the operating configurations and exposure conditions of the host device, according to the ratio of field strengths or power density to the MPE limit at the test frequency.

BLE, WLAN (2.4G or 5G) and Cellular can transmit simultaneously, the formula for calculating the simultaneous MPE is

$$CPD1/LPD1 + CPD2/LPD2 + \dots, CPDn/LPDn < 1$$

CPD: Calculated Power Density

LPD: Limit of Power Density

Therefore worst case scenario is as below when 4 BLE antennas transmit simultaneously with WLAN/Cellular:

$$\begin{aligned}
 \text{Simultaneous MPE} &= \text{Cellular} & + & \text{BLE 1} & + & \text{BLE 2} & + & \text{BLE 3} & + & \text{BLE 4} & + & \text{WLAN} \\
 &= 0.1408/0.474 & + & 0.0010/1 & + & 0.0010/1 & + & 0.0010/1 & + & 0.0010/1 & + & 0.0147/1 \\
 &= 0.2970 & + & 0.0010 & + & 0.0010 & + & 0.0010 & + & 0.0010 & + & 0.0147 \\
 &= 0.3157
 \end{aligned}$$

**Result:** 0.3157 < 1 (Pass)

## IV. Test Equipment

## Test Equipment

Calibrated test equipment utilized during testing was maintained in a current state of calibration per the requirements of ISO/IEC 17025:2017.

Asset #	Equipment	Manufacturer	Model	Last Cal Date	Cal Due Date
1S4075	RADIO COMMUNICATION TESTER	ROHDE & SCHWARZ	CMW500	09/20/2020	09/20/2022
1S2399	TURNTABLE/MAST CONTROLLER	SUNOL SCIENCES	SC99V	SEE NOTE 1	
1S2600	BILOG ANTENNA	TESEQ	CBL6112D	03/19/2019	03/19/2021
1S2733	BILOG ANTENNA	TESEQ	CBL6112D	06/05/2019	06/05/2021
1S3826	DRG HORN ANTENNA	ETS-LINDGREN	3117	12/03/2018	12/03/2020
1S2198	DRG HORN ANTENNA	ETS-LINDGREN	3117	10/07/2019	10/07/2021
1S2000	SPECTRUM ANALYZER	AGILENT	E4448A	11/06/2020	11/06/2022
1S2587	PRE AMPLIFIER	AML COMMUNICATIONS	AML0126L3801	SEE NOTE 1	
1S2653	AMPLIFIER	SONOMA INSTRUMENT	310 N	SEE NOTE 1	
1S2486	5 METER CHAMBER	PANASHIELD - ETS	5M	SEE NOTE 2	
1S3824	SIGNAL GENERATOR	ROHDE & SCHWARZ	SMA100B	11/06/2019	05/06/2021

**Table 15. Test Equipment List**

Note 1: Functionally tested equipment is verified using calibrated instrumentation at the time of testing.

Note 2: Latest NSA and VSWR data available upon request.

**End of Report**