AMPT LLC
RF Exposure Exhibit

SCOPE OF WORK
EMC TESTING- String Optimizer, Models: 31570023-00

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RF Exposure Exhibit
(mobile devices)

Report Number: 104402894MPK-010B
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Report Issue Date: November 17, 2020

Product Designation: String Optimizer
Model Tested: 31570023-00

FCC ID: X3R-TKKR
IC: 8399A-TKKR
to

47CFR 2.1091
RSS-102 Issue 5

for

AMPT LLC

Tested by:
Intertek
1365 Adams Court
Menlo Park, CA 94025 USA

Client:
AMPT LLC
4850 Innovation Dr
Fort Collins, CO 80525-5576 USA

Report prepared by:

Hung Huynh / EMC Test Engineer

Report reviewed by:

Krishna Vemuri / EMC Manager

Report No. 104402894MPK-010B	
Equipment Under Test:	String Optimizer
Trade Name:	AMPT LLC
Model(s) Tested:	31570023-00
Applicant:	AMPT LLC
Contact:	Robin Richardson
Address:	AMPT LLC 4850 Innovation Dr Fort Collins, CO 80525-5576
Country:	USA
Tel. Number:	9703726960
Email:	robin.richardson@ampt.com
Applicable Regulation:	47CFR 2.1091 RSS-102 Issue 5

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1.0 RF Exposure Summary

Test	Reference FCC	Reference Industry Canada	Result
Radio frequency Radiation Exposure Evaluation	47 CFR§2.1091	RSS-102 Issue 5	Complies

2.0 RF Exposure Limits

In this document, we evaluate the RF Exposure to human body due the intentional transmission from the transmitter (EUT). The limits for Maximum Permissible Exposure (MPE) specified in FCC 1.1310 and RSS-102 are followed.

2.1 FCC Limits

According to FCC 1.1310 table 1: The criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in 1.1307(b)

LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Average Time (minutes)
(A)Limits For Occupational / Control Exposures				
0.3 – 3.0	614	1.63	*100	6
3.0 – 30	1842/f	4.89/f	$*900/f^2$	6
30-300	61.4	0.163	1.0	6
300 - 1500	…	…	F/300	6
1500 - 100,000	…	…	5	6
(B)Limits For General Population / Uncontrolled Exposure				
0.3 – 1.34	614	1.63	*100	30
1.34 – 30	824/f	2.19/f	$*180/f^2$	30
30 – 300	27.5	0.073	0.2	30
300 - 1500	…	…	F/1500	30
1500 - 100,000	…	…	1.0	30

F = Frequency in MHz

* = plane wave equivalent density

2.2 Industry Canada Limits

According to RSS-102, Industry Canada has adopted the SAR and RF field strength limits established in Health Canada's RF exposure guideline, Safety Code 6.

Table 4: 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/m^2)	Reference Period (minutes)
0.003-10	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	$58.07/f^{0.25}$	$0.1540/f^{0.25}$	$8.944/f0.5$	6
48-300	22.06	0.05852	1.291	6
300-6000	$3.142\ f^{0.3417}$	$0.008335\ f^{0.3417}$	$0.02619\ f^{0.6834}$	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	$616000/f^{1.2}$
150000-300000	$0.158\ f^{0.5}$	$4.21 \times 10\text{-}4\ f^{0.5}$	$6.67 \times 10^{-5}\ f$	$616000/f^{1.2}$

Note: f is frequency in MHz.
* Based on nerve stimulation (NS).
** Based on specific absorption rate (SAR).

3.0 Test Results (Mobile Configuration)

3.1 Classification

Radio is installed inside a mobile host device. The antenna of the product, under normal use condition, is at least 20 cm away from the body of the user and accessible to the end user. Warning statement to the user for keeping at least 20 cm or more separation distance with the antenna should be included in user's manual.

3.2 EIRP calculations

The String Optimizer, Model: 31570023-00 consists of one radio: 2.4 GHz Bluetooth FHSS.

3.3 Maximum RF Power

Frequency Range (MHz)	RF Output (dBm)	Antenna Gain[1] (dBi)	Note
2410-2474.5	-4.38	4	Power measurement was taken from Report # 104402894MPK-010

[1]As declared by the manufacturer.

3.4 RF Exposure Calculation

3.4.1 RF Exposure calculation for 2.4 GHz Bluetooth FHSS

Calculations for this report are based on highest power measured for each band.

Frequency Range (MHz)	EIRP (dBm)	EIRP (mW)	Power Density (mW/cm^2) @20 cm	FCC Limit (mW/cm^2)
2410-2474.5	-0.38	0.9162	0.00018	1

Note: Antenna gains below 0 are considered as 0dBi.

Frequency Range (MHz)	EIRP (dBm)	EIRP (mW)	Power Density (W/m^2) @20 cm	RSS Limit (W/m^2)
2410-2474.5	-0.38	0.9162	0.0018	5.36

Note: Antenna gains below 0 are considered as 0dBi.

Appendix A: Power Density Calculation

The Power Density can be calculated using the formula

$$S = EIRP/ 4\pi D^2$$

Where: S is Power Density in mW/cm^2
D is the distance from the antenna in cm.

4.0 Document History

Revision/ Job Number	Writer Initials	Reviewers Initials	Date	Change
1.0/ G104402894	HH	KV	November 17, 2020	Original document