

Radio Exposure Evaluation Report

FCC ID : UXX-S5A237A

Contains FCC ID : N7NEM91

Equipment : R2105 5G Ruggedized Router

Brand Name : Cradlepoint

Model Name : S5A237A

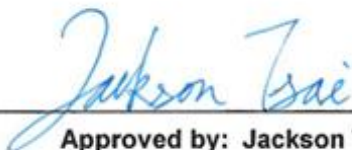
Applicant : Cradlepoint, Inc.
1111 West Jefferson Street ,Boise ,Idaho,United States 83702

Manufacturer : Cradlepoint, Inc.
1111 West Jefferson Street ,Boise ,Idaho,United States 83702

Standard : 47 CFR FCC Part 2 Subpart J, section 2.1091

The product was received on May 13, 2022, and testing was started from Jun. 06, 2022 and completed on Jul. 26, 2022. We, SPORTON INTERNATIONAL INC. Hsinhua Laboratory, would like to declare that the tested sample has been evaluated in accordance with the procedures given in 47 CFR FCC Part 2 Subpart J, section 2.1091 and shown compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC. Hsinhua Laboratory, the test report shall not be reproduced except in full.



Approved by: Jackson Tsai

SPORTON INTERNATIONAL INC. Hsinhua Laboratory
No.52, Huaya 1st Rd., Guishan Dist., Taoyuan City 333411, Taiwan (R.O.C.)



Table of Contents

HISTORY OF THIS TEST REPORT3

1 GENERAL DESCRIPTION5

1.1 Information.....5

1.2 Applicable Standards8

1.3 Testing Location8

2 MAXIMUM PERMISSIBLE EXPOSURE9

2.1 Limit of Maximum Permissible Exposure9

2.2 RF Exposure Exempt Measurement10

2.3 Multiple RF Sources Exposure11

2.4 MPE Calculation Method12

2.5 Calculated Result and Limit.....13

Photographs of EUT V01



History of this test report

Report No.	Version	Description	Issued Date
FA250405-01	01	Initial issue of report	Nov. 14, 2022



Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
2	-	Exposure evaluation	PASS	-

Declaration of Conformity:
The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.
Comments and Explanations:
None

Reviewed by: Ryan Hsiao

Report Producer: Amber Chiu



1 General Description

1.1 Information

1.1.1 EUT General Information

RF General Information			
Evaluation Mode	Frequency Range (MHz)	Operating Frequency (MHz)	Modulation Type
2.4GHz WLAN	2400-2483.5	2412-2462	802.11b: DSSS (DBPSK, DQPSK, CCK) 802.11g/n: OFDM (BPSK, QPSK, 16QAM, 64QAM) VHT: OFDM (BPSK, QPSK, 16QAM, 64QAM, 256QAM) 802.11ax: OFDMA (BPSK, QPSK, 16QAM, 64QAM, 256QAM)
5GHz WLAN	5250-5350 5470-5725 5725-5850	5260-5320 5500-5700 5745-5825	802.11a/n: OFDM (BPSK, QPSK, 16QAM, 64QAM) 802.11ac: OFDM (BPSK, QPSK, 16QAM, 64QAM, 256QAM) 802.11ax: OFDMA (BPSK, QPSK, 16QAM, 64QAM, 256QAM)

RF General Information		
Evaluation Mode	Frequency Range (MHz)	Modulation Type
WCDMA Band II	1850 ~ 1910	RMC 12.2 kbps HSDPA HSUPA DC-HSDPA HSPA+(16QAM uplink is not supported)
WCDMA Band IV	1710 ~ 1755	
WCDMA Band V	824 ~ 849	
LTE Band 2	1850~1910	LTE: QPSK / 16QAM / 64QAM/ 256QAM
LTE Band 4	1710~1755	
LTE Band 5	824~849	
LTE Band 7	2500~2570	
LTE Band 12	699~716	
LTE Band 13	777~787	
LTE Band 14	788~798	
LTE Band 17	704~716	
LTE Band 25	1850~1915	
LTE Band 26	814~849	
LTE Band 30	2305~2315	
LTE Band 41	2496~2690	
LTE Band 41-HPUE		



RF General Information		
Evaluation Mode	Frequency Range (MHz)	Modulation Type
LTE Band 42	3400~3600	LTE: QPSK / 16QAM / 64QAM/ 256QAM
LTE Band 48	3550~3700	
LTE Band 66	1710~1780	
LTE Band 71	663~698	
LTE Band 71-ENDC		
5G NR n2	1850~1910	DFT-s-OFDM / P1/2 BPSK/ QPSK / 16QAM / 64QAM/ 256QAM) CP-OFDM / QPSK/ 16QAM/ 64QAM/ 256QAM)
5G NR n5	824~849	
5G NR n7	2500~2570	
5G NR n12	699~716	
5G NR n25	1850~1915	
5G NR n41	2496~2690	
5G NR n66	1710~1780	
5G NR n71	663~698	
5G NR n71-ENDC		
5G NR n77	3300~4200	
5G NR n78	3300~3800	

1.1.2 Antenna Information

Ant.	Brand	Model Name	Antenna Type	Connector	Support	Remark
0	WNC	XEAK-CP1	PIFA antenna	I-PEX	2.4G+5G	-
1	WNC	XEAK-CP1	PIFA antenna	I-PEX	2.4G+5G	-
2	WNC	XEAK-CP1	PIFA antenna	I-PEX	WWAN	Cellular Main
3	WNC	XEAK-CP1	PIFA antenna	I-PEX	WWAN	Cellular AUX
4	WNC	XEAK-CP1	PIFA antenna	I-PEX	WWAN	MIMO1(GNSS L1)
5	WNC	XEAK-CP1	PIFA antenna	I-PEX	WWAN	MIMO2(GNSS L5)

Ant.	Port	Gain (dBi)			
		2.4G	5G		
			U-NII-2A	U-NII-2C	U-NII-3
0	1	2.2	3.4	5.0	3.3
1	2	4.3	5.0	4.9	5.4

Note 1: The EUT has six antennas.

For 2.4GHz function:

For IEEE 802.11 b/g/n/VHT/ax mode (2TX/2RX)

Ant. 0 (port 1) and Ant. 1(port 2) could transmit/receive simultaneously.



For 5GHz function:

For IEEE 802.11 a/n/ac/ax mode (2TX/2RX)

Ant. 0 (port 1) and Ant. 1(port 2) could transmit/receive simultaneously.

Gain (dBi)			
Evaluation Mode	Frequency Range (MHz)	DG(dBi)	Antenna
WCDMA Band II	1850 ~ 1910	3.2	Main
WCDMA Band IV	1710 ~ 1755	4.2	Main
WCDMA Band V	824 ~ 849	2.8	Main
LTE Band 2	1850~1910	3.2	Main
LTE Band 4	1710~1755	4.2	Main
LTE Band 5	824~849	2.8	Main
LTE Band 7	2500~2570	3.6	Main
LTE Band 12	699~716	2.2	Main
LTE Band 13	777~787	3.8	Main
LTE Band 14	788~798	3.9	Main
LTE Band 17	704~716	2.2	Main
LTE Band 25	1850~1915	3.2	Main
LTE Band 26	814~849	2.8	Main
LTE Band 30	2305~2315	2.6	Main
LTE Band 41	2496~2690	5.4	AUX
LTE Band 41-HPUE		5.4	AUX
LTE Band 42	3400~3600	4.8	Main
LTE Band 48	3550~3700	4.6	Main
LTE Band 66	1710~1780	3.8	Main
LTE Band 71	663~698	1	Main
LTE Band 71-ENDC		1	Main
5G NR n2	1850~1910	3.2	Main
5G NR n5	824~849	2.8	Main
5G NR n7	2500~2570	3.6	Main
5G NR n12	699~716	2.2	Main
5G NR n25	1850~1915	3.2	Main
5G NR n41	2496~2690	5.4	AUX
5G NR n66	1710~1780	4.2	Main
5G NR n71	663~698	1	Main
5G NR n71-ENDC		1	Main
5G NR n77	3300~4200	6	Main
5G NR n78	3300~3800	5.1	Main



1.1.3 Accessories

Accessories				
DC Cable	Brand Name	Cradlepoint	Model Name	170864-000
	Signal Line	3 meter (Nien-Yi NYS4862)		

Reminder: Regarding to more detail and other information, please refer to user manual.

1.2 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- ♦ 47 CFR FCC Part 2 Subpart J, section 2.1091
- ♦ KDB 447498 D04 Interim General RF Exposure Guidance v01

The following reference test guidance is not within the scope of accreditation of TAF.

- ♦ 47 CFR Part 1.1307
- ♦ 47 CFR Part 1.1310

1.3 Testing Location

Test Lab. : Sporton International Inc. Hsinhua Laboratory		
<input checked="" type="checkbox"/>	Hsinhua (TAF: 3785)	ADD: No.52, Huaya 1st Rd., Guishan Dist., Taoyuan City 333411, Taiwan (R.O.C.) TEL: 886-3-327-3456 FAX: 886-3-327-0973
Test site Designation No. TW3785 with FCC.		
<input type="checkbox"/>	Wen 33rd.St. (TAF: 3785)	ADD: No.14-1, Ln. 19, Wen 33rd St., Guishan Dist., Taoyuan City 333010, Taiwan (R.O.C.) TEL: 886-3-318-0787 FAX: 886-3-318-0287
Test site Designation No. TW0008 with FCC.		

2 Maximum Permissible Exposure

2.1 Limit of Maximum Permissible Exposure

(A) Limits for Occupational / Controlled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/ cm ²)	Averaging Time E ² , H ² or S (minutes)
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

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/ cm ²)	Averaging Time E ² , H ² or S (minutes)
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

Note: f = frequency in MHz ; *Plane-wave equivalent power density

Multiple Transmitters Condition

Co-location as simultaneously transmitting (co-transmitting) and the evaluation shall be consider that simultaneous transmissions from co-located devices the individual transmitters are evaluated separately. After sum of the individual value (basic restriction / reference level) are measured/calculated also have to under basic restriction / reference level.

Co-transmitting mode: WLAN 2.4GHz+WLAN 5GHz+WWAN

2.2 RF Exposure Exempt Measurement

Option	Refer Std.	Exemption Exposure Thresholds (TL)
A	§1.1307(b)(3)(i)(A)	Available maximum time-averaged power is no more than 1 mW
B	§1.1307(b)(3)(i)(B)	$P_{th}(mW) = \begin{cases} ERP_{20cm} (d / 20cm)^x & \rightarrow d \leq 20cm \\ ERP_{20cm} & \rightarrow 20cm < d \leq 40cm \end{cases}$ $x = -\log_{10} \left(\frac{60}{ERP_{20cm} \sqrt{f}} \right) \text{ and } f \text{ is in GHz}$ $\begin{cases} ERP_{20cm} : 0.3GHz \leq f < 1.5GHz \rightarrow 2040 f (mW) \\ ERP_{20cm} : 1.5GHz \leq f \leq 6GHz \rightarrow 3060 (mW) \end{cases}$
C	§1.1307(b)(3)(i)(C)	$\begin{cases} 0.3 \sim 1.34MHz \rightarrow ERP(W) = 1920 R^2 \\ 1.34 \sim 30MHz \rightarrow ERP(W) = 3450 R^2 / f^2 \\ 30 \sim 300MHz \rightarrow ERP(W) = 3.83R^2 \\ 300 \sim 1500MHz \rightarrow ERP(W) = 0.0128 R^2 f \\ 1500 \sim 100000MHz \rightarrow ERP(W) = 19.2R^2 \end{cases}$ <p>f is in MHz; R is in m; $R > \lambda / 2\pi$</p>

2.3 Multiple RF Sources Exposure

Refer Std.	Exemption Exposure Thresholds (TL)
§1.1307(b)(3)(ii)(A)	<p>The available maximum time-averaged power of each source is no more than 1 mW and there is a separation distance of two centimeters between any portion of a radiating structure operating and the nearest portion of any other radiating structure in the same device, except if the sum of multiple sources is less than 1 mW during the time-averaging period, in which case they may be treated as a single source (separation is not required)</p>
§1.1307(b)(3)(ii)(B)	$\sum_{i=1}^a \frac{P_i}{P_{th,i}} + \sum_{j=1}^b \frac{ERP_j}{ERP_{th,j}} + \sum_{k=1}^c \frac{Evaluated_k}{ExposureLimit_k} \leq 1$ <p>a = number of fixed, mobile, or portable RF sources claiming exemption using paragraph §1.1307(b)(3)(i)(B) of this section for P , including existing exempt transmitters and those being added.</p> <p>b = number of fixed, mobile, or portable RF sources claiming exemption using paragraph §1.1307(b)(3)(i)(C) of this section for Threshold ERP, including existing exempt transmitters and those being added.</p> <p>c = number of existing fixed, mobile, or portable RF sources with known evaluation for the specified minimum distance including existing evaluated transmitters.</p> <p>P_i = the available maximum time-averaged power or the ERP, whichever is greater, for fixed, mobile, or portable RF source i at a distance between 0.5 cm and 40 cm (inclusive).</p> <p>P_{th,i} = the exemption threshold power (P_{th}) according to paragraph §1.1307(b)(3)(i)(B) of this section for fixed, mobile, or portable RF source i.</p> <p>ERP_j = the ERP of fixed, mobile, or portable RF source j.</p> <p>ERP_{th,j} = exemption threshold ERP for fixed, mobile, or portable RF source j, at a distance of at least λ/2π according to the applicable formula of paragraph §1.1307(b)(3)(i)(C) of this section.</p> <p>Evaluated_k = the maximum reported SAR or MPE of fixed, mobile, or portable RF source k either in the device or at the transmitter site from an existing evaluation at the location of exposure.</p> <p>Evaluated Limit_k = either the general population/uncontrolled maximum permissible exposure (MPE) or specific absorption rate (SAR) limit for each fixed, mobile, or portable RF source k, as applicable from § 1.1310 of this chapter.</p>



2.4 MPE Calculation Method

The MPE was calculated at 44 cm to show compliance with the power density limit.
The following formula was used to calculate the Power Density:

$$E \text{ (V/m)} = \frac{\sqrt{30 \times P \times G}}{d} \qquad \text{Power Density: } Pd \text{ (W/m}^2\text{)} = \frac{E^2}{377}$$

E = Electric field (V/m)

P = RF output power (W)

G = EUT Antenna numeric gain (numeric)

d = Separation distance between radiator and human body (m)

The formula can be changed to

$$Pd = \frac{30 \times P \times G}{377 \times d^2}$$

2.5 Calculated Result and Limit

Exposure Environment: General Population / Uncontrolled Exposure

WLAN 2.4GHz Non-Beamforming

Mode	DG (dBi)	Power (dBm)	ERP (dBm)	Tolerance (dB)	Tune-up ERP (dBm)	Distance (cm)	S (mW/cm ²)	S Limit (mW/cm ²)	Option	TL ERP (dBm)	TL Ratio
2.4G;G1D	4.30	24.83	29.13	0.50	559.90	44.00	0.03775	1.00000	C	3717.120	0.15063
2.4G;D1D	4.30	24.07	28.37	0.50	470.01	44.00	0.03169	1.00000	C	3717.120	0.12645

Beamforming

Mode	DG (dBi)	Power (dBm)	ERP (dBm)	Tolerance (dB)	Tune-up ERP (dBm)	Distance (cm)	S (mW/cm ²)	S Limit (mW/cm ²)	Option	TL ERP (dBm)	TL Ratio
2.4G;D1D	7.31	23.61	30.92	0.50	845.49	44.00	0.05700	1.00000	C	3717.120	0.0988

WLAN 5GHz Non-Beamforming

Mode	DG (dBi)	Power (dBm)	ERP (dBm)	Tolerance (dB)	Tune-up ERP (dBm)	Distance (cm)	S (mW/cm ²)	S Limit (mW/cm ²)	Option	TL ERP (dBm)	TL Ratio
5.3G;D1D	5.00	23.11	28.11	0.50	442.70	44.00	0.02985	1.00000	C	3717.120	0.11910
5.6G;D1D	5.00	23.74	28.74	0.50	511.81	44.00	0.03451	1.00000	C	3717.120	0.13769
5.8G;D1D	5.40	26.41	31.81	0.50	1,037.79	44.00	0.06997	1.00000	C	3717.120	0.27919

Beamforming

Mode	DG (dBi)	Power (dBm)	ERP (dBm)	Tolerance (dB)	Tune-up ERP (dBm)	Distance (cm)	S (mW/cm ²)	S Limit (mW/cm ²)	Option	TL ERP (dBm)	TL Ratio
5.3G;D1D	8.01	21.43	29.44	0.50	601.33	44.00	0.04054	1.00000	C	3717.120	0.16177
5.6G;D1D	8.01	21.48	29.49	0.50	608.29	44.00	0.04101	1.00000	C	3717.120	0.16365
5.8G;D1D	8.41	25.87	34.28	0.50	1,832.78	44.00	0.12356	1.00000	C	3717.120	0.49306



WWAN

Mode	DG (dBi)	Power (dBm)	EIRP (dBm)	Tolerance (dB)	Tune-up ERP (mW)	Distance (cm)	S (mW/cm ²)	S Limit (mW/cm ²)	Option	TL ERP (mW)	TL Ratio
WCDMA Band 2	3.20	24.50	27.70	0.50	402.82	44.00	0.02716	1.00000	C	3717.120	0.10837
WCDMA Band 4	4.20	24.50	28.70	0.50	507.12	44.00	0.03419	1.00000	C	3717.120	0.13643
WCDMA Band 5	2.80	24.50	27.30	0.50	367.3753	44.00	0.02477	0.55093	C	2047.885	0.17939
LTE Band 2	3.20	24.00	27.20	0.50	359.01	44.00	0.02420	1.00000	C	3717.120	0.09658
LTE Band 4	4.20	24.00	28.20	0.50	451.97	44.00	0.03047	1.00000	C	3717.120	0.12159
LTE Band 5	2.80	24.00	26.80	0.50	327.42	44.00	0.02207	0.56600	C	2103.890	0.15563
LTE Band 7	3.60	24.80	28.40	0.50	473.27	44.00	0.03191	1.00000	C	3717.120	0.12732
LTE Band 12	2.20	24.00	26.20	0.50	285.17	44.00	0.01923	0.47733	C	1774.305	0.16072
LTE Band 13	3.80	24.00	27.80	0.50	412.20	44.00	0.02779	0.52467	C	1950.249	0.21136
LTE Band 14	3.90	24.00	27.90	0.50	421.80	44.00	0.02844	0.53200	C	1977.508	0.21330
LTE Band 17	2.20	24.00	26.20	0.50	285.17	44.00	0.01923	0.47733	C	1774.305	0.16072
LTE Band 25	3.20	24.00	27.20	0.50	359.01	44.00	0.02420	1.00000	C	3717.120	0.09658
LTE Band 26	3.80	24.00	27.80	0.50	412.20	44.00	0.02779	0.56600	C	2103.890	0.19592
LTE Band 30	2.60	24.00	26.60	0.50	312.69	44.00	0.02108	1.00000	C	3717.120	0.08412
LTE Band 41	5.40	24.80	30.20	0.50	716.32	44.00	0.04829	1.00000	C	3717.120	0.19271
LTE Band 41-HPUE	5.40	26.00	31.40	0.50	944.30	44.00	0.06366	1.00000	C	3717.120	0.25404
LTE Band 42	4.80	24.80	29.60	0.50	623.89	44.00	0.04206	1.00000	C	3717.120	0.16784
LTE Band 48	4.60	24.80	29.40	0.50	595.81	44.00	0.04017	1.00000	C	3717.120	0.16029
LTE Band 66	3.80	24.00	27.80	0.50	412.20	44.00	0.02779	1.00000	C	3717.120	0.11089
LTE Band 71	1.00	24.00	25.00	0.50	216.33	44.00	0.01458	0.46533	C	1729.700	0.12507
LTE Band 71-ENDC	1.00	21.00	22.00	0.50	108.42	44.00	0.00731	0.46533	C	1729.700	0.06268
5G NR n2	3.20	24.50	27.70	0.50	402.82	44.00	0.02716	1.00000	C	3717.120	0.10837
5G NR n5	2.80	24.50	27.30	0.50	367.38	44.00	0.02477	0.56600	C	2103.890	0.17462
5G NR n7	3.60	24.50	28.10	0.50	441.68	44.00	0.02978	1.00000	C	3717.120	0.11882
5G NR n12	2.20	24.50	26.70	0.50	319.97	44.00	0.02157	0.47733	C	1774.305	0.18034
5G NR n25	3.20	24.50	27.70	0.50	402.82	44.00	0.02716	1.00000	C	3717.120	0.10837
5G NR n41	5.40	24.50	29.90	0.50	668.51	44.00	0.04507	1.00000	C	3717.120	0.17985
5G NR n66	4.20	24.50	28.70	0.50	507.12	44.00	0.03419	1.00000	C	3717.120	0.13643
5G NR n71	1.00	24.50	25.50	0.50	242.72	44.00	0.01636	0.46533	C	1729.700	0.14033
5G NR n71-ENDC	1.00	21.50	22.50	0.50	121.65	44.00	0.00820	0.46533	C	1729.700	0.07033
5G NR n77	6.00	24.50	30.50	0.50	767.56	44.00	0.05175	1.00000	C	3717.120	0.20649
5G NR n78	5.10	24.50	29.60	0.50	623.89	44.00	0.04206	1.00000	C	3717.120	0.16784

Note 1: Option A, B and C refer as clause 2.2

Note 2: For option B, Pth(mW) convert to TL ERP(dBm); For option C, ERP(W) convert to TL ERP(dBm)

Note 3: TL Ratio=Tune-up ERP(mW)/TL ERP(mW)



Simultaneous Transmission Analysis Mode: WLAN 2.4GHz+WLAN 5GHz+WWAN

Mode	DG (dBi)	Power (dBm)	EIRP (dBm)	Tolerance (dB)	Tune-up ERP (mW)	Distance (cm)	S (mW/cm ²)	S Limit (mW/cm ²)	Option	TL ERP (mW)	TL Ratio
2.4G;D1D	7.31	23.61	30.92	0.50	845.49	44.00	0.05700	1.00000	C	3717.120	0.22746
5.8G;D1D	8.41	25.87	34.28	0.50	1,832.78	44.00	0.12356	1.00000	C	3717.120	0.49306
LTE Band 41-HPUE	5.40	26.00	31.40	0.50	944.30	44.00	0.06366	1.00000	C	3717.120	0.25404
										Sum Ratio	0.97456
										Ratio Limit	1

Note 1: Option A, B and C refer as clause 2.2

Note 2: For option B, Pth(mW) convert to TL ERP(dBm); For option C, ERP(W) convert to TL ERP(dBm)

Note 3: TL Ratio=Tune-up ERP(mW)/TL ERP(mW)

Note 4: Refer as clause 2.3 Multiple RF Sources Exposure. Please follow below option and sum TL ration table.

Option	Sum TL Ratio_B	Option	Sum TL Ratio_C	Option	Sum TL Ratio_E
B	$\sum_{i=1}^a \frac{P_i}{P_{th,i}}$	C	$\sum_{j=1}^b \frac{ERP_j}{ERP_{th,j}}$	E	$\sum_{k=1}^c \frac{Evaluated_k}{ExposureLimit_k}$

Note: The above antenna gain was declared by manufacturer.

—————THE END—————