RF Exposure Report

Report No.:	SA170825E04G
FCC ID:	UXX-S5A741A
Test Model:	S5A844A
Series Model:	S5A741A
Received Date:	Nov. 14, 2018
Test Date:	Dec. 11, 2018
Issued Date:	Dec. 27, 2018
Applicant:	Cradlepoint, Inc
Address:	1111 W. Jefferson Street Suite 400 Boise, ID 83702 USA
Issued By:	Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch Hsin Chu Laboratory
Lab Address:	E-2, No.1, Li Hsin 1st Road, Hsinchu Science Park, Hsinchu City 300, Taiwan R.O.C.
Test Location:	E-2, No.1, Li Hsin 1st Road, Hsinchu Science Park, Hsinchu City 300, Taiwan R.O.C.
FCC Registration / Designation Number:	723255 / TW2022

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Table of Contents

Release Control Record

Issue No.	Description	Date Issued
SA170825E04G	Original release.	Dec. 27, 2018

1 Certificate of Conformity

Product:	Integrated Mobile Broadband Router
Brand:	cradlepoint
Test Model:	S5A844A
Series Model:	S5A741A
Sample Status:	ENGINEERING SAMPLE
Applicant:	Cradlepoint, Inc
Test Date:	Dec. 11, 2018
Standards:	FCC Part 2 (Section 2.1091) KDB 447498 D01 General RF Exposure Guidance v06 IEEE C95.1-1992

The above equipment has been tested by **Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's EMC characteristics under the conditions specified in this report.

Prepared by : Wendy Wu , **Date:** Dec. 27, 2018

Wendy Wu / Specialist

Approved by : , **Date:** Dec. 27, 2018

May Chen / Manager

2 RF Exposure

2.1 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)
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 power density

2.2 MPE Calculation Formula

$Pd = (Pout*G) / (4*pi*r^2)$

where

Pd = power density in mW/cm^2

Pout = output power to antenna in mW

G = gain of antenna in linear scale

Pi = 3.1416

R = distance between observation point and center of the radiator in cm

2.3 Classification

The antenna of this product, under normal use condition, is at least 40cm away from the body of the user. So, this device is classified as **Mobile Device**.

2.4 Antenna Gain

Model: S5A741A

WLAN

Ant Set.	Transmitter Circuit			Model	Frequency range (GHz)	Ant Type	Connector Type	Cable Length (mm)	Cable Loss(dB)	excluding cable loss Ant Gain(dBi)	Ant Net Gain (dBi)
	Radio 1		Radio 2								
	2.4G	5G	5G								
1	GPIO 0 Chain0	Chain1	-	RFA-25-F17M3-B70-25	2.4~2.4835 5.15~5.85	Dipole	R-SMA	230	0.8 1.4	2.5 3.5	1.7 2.1
	GPIO 0 Chain1	Chain0	-		2.4~2.4835 5.15~5.85	Dipole	R-SMA	230	0.8 1.4	2.5 3.5	1.7 2.1
	GPIO 1 Chain1	-	Chain2		2.4~2.4835 5.15~5.85	Dipole	R-SMA	230	0.8 1.4	2.5 3.5	1.7 2.1
	-	-	Chain3		2.4~2.4835 5.15~5.85	Dipole	R-SMA	230	0.8 1.4	2.5 3.5	1.7 2.1
	-	-	Chain0		2.4~2.4835 5.15~5.85	Dipole	R-SMA	230	0.8 1.4	2.5 3.5	1.7 2.1
	GPIO 1 Chain0	-	Chain1		2.4~2.4835 5.15~5.85	Dipole	R-SMA	230	0.8 1.4	2.5 3.5	1.7 2.1
2	GPIO 0 Chain0	Chain1	-	TWX-1513RSXX-711	2.4~2.4835 5.15~5.85	Dipole	R-SMA	230	0.8 1.4	5 5	4.2 3.6
	GPIO 0 Chain1	Chain0	-		2.4~2.4835 5.15~5.85	Dipole	R-SMA	230	0.8 1.4	5 5	4.2 3.6
	GPIO 1 Chain1	-	Chain2		2.4~2.4835 5.15~5.85	Dipole	R-SMA	230	0.8 1.4	5 5	4.2 3.6
	-	-	Chain3		2.4~2.4835 5.15~5.85	Dipole	R-SMA	230	0.8 1.4	5 5	4.2 3.6
	-	-	Chain0		2.4~2.4835 5.15~5.85	Dipole	R-SMA	230	0.8 1.4	5 5	4.2 3.6
	GPIO 1 Chain0	-	Chain1		2.4~2.4835 5.15~5.85	Dipole	R-SMA	230	0.8 1.4	5 5	4.2 3.6

3G/LTE

Ant Set.	Transmitter Circuit	Model	Antenna Gain with cable including cable loss	Frequency range	Antenna Type	Connector Type	Cable Length (mm)	Cable Loss (dB)
1	Main	YWX-6252SABX-711	1.0dBi@2300~2320MHz 2dBi@690~2300MHz 3dBi@2320~2700MHz	2300~2320MHz 690~2300MHz 2320~2700MHz	Dipole	SMA	230	0~1G 0.5dB 1~3G 0.9dB
	Aux	YWX-6252SABX-711	1.0dBi@2300~2320MHz 2dBi@690~2300MHz 3dBi@2320~2700MHz	2300~2320MHz 690~2300MHz 2320~2700MHz	Dipole	SMA	230	0~1G 0.5dB 1~3G 0.9dB
2	Main	YWX-6241SAXX-711D	1.0dBi@2300~2320MHz 2dBi@690~2300MHz 3dBi@2320~2700MHz	2300~2320MHz 690~2300MHz 2320~2700MHz	Dipole	SMA	230	0~1G 0.5dB 1~3G 0.9dB
	Aux	YWX-6241SAXX-711D	1.0dBi@2300~2320MHz 2dBi@690~2300MHz 3dBi@2320~2700MHz	2300~2320MHz 690~2300MHz 2320~2700MHz	Dipole	SMA	230	0~1G 0.5dB 1~3G 0.9dB

GPS

Antenna Gain with cable including cable loss	Frequency range	Antenna Type	Connector Type
GPS: 1.36dBi GLONASS: 0.09dBi	GPS: 1574.42MHz±3MHz GLONASS: 1602MHz±0.5MHz	Dipole	SMA

Model: S5A844A											
WLAN											
Ant Set.	Transmitter Circuit			Model	Frequency range (GHz)	Ant Type	Connector Type	Cable Length (mm)	Cable Loss(dB)	excluding cable loss Ant Gain(dBi)	Ant Net Gain (dBi)
	Radio 1		Radio 2								
	2.4G	5G	5G								
1	GPIO 0 Chain0	Chain1	-	RFA-25-F17M3-B70-25	2.4~2.4835 5.15~5.85	Dipole	R-SMA	230	0.8 1.4	2.5 3.5	1.7 2.1
	GPIO 0 Chain1	Chain0	-		2.4~2.4835 5.15~5.85	Dipole	R-SMA	230	0.8 1.4	2.5 3.5	1.7 2.1
	GPIO 1 Chain1	-	Chain2		2.4~2.4835 5.15~5.85	Dipole	R-SMA	230	0.8 1.4	2.5 3.5	1.7 2.1
	-	-	Chain3		2.4~2.4835 5.15~5.85	Dipole	R-SMA	230	0.8 1.4	2.5 3.5	1.7 2.1
	-	-	Chain0		2.4~2.4835 5.15~5.85	Dipole	R-SMA	230	0.8 1.4	2.5 3.5	1.7 2.1
	GPIO 1 Chain0	-	Chain1		2.4~2.4835 5.15~5.85	Dipole	R-SMA	230	0.8 1.4	2.5 3.5	1.7 2.1
2	GPIO 0 Chain0	Chain1	-	TWX-1513RSXX-711	2.4~2.4835 5.15~5.85	Dipole	R-SMA	230	0.8 1.4	5 5	4.2 3.6
	GPIO 0 Chain1	Chain0	-		2.4~2.4835 5.15~5.85	Dipole	R-SMA	230	0.8 1.4	5 5	4.2 3.6
	GPIO 1 Chain1	-	Chain2		2.4~2.4835 5.15~5.85	Dipole	R-SMA	230	0.8 1.4	5 5	4.2 3.6
	-	-	Chain3		2.4~2.4835 5.15~5.85	Dipole	R-SMA	230	0.8 1.4	5 5	4.2 3.6
	-	-	Chain0		2.4~2.4835 5.15~5.85	Dipole	R-SMA	230	0.8 1.4	5 5	4.2 3.6
	GPIO 1 Chain0	-	Chain1		2.4~2.4835 5.15~5.85	Dipole	R-SMA	230	0.8 1.4	5 5	4.2 3.6

3G/LTE								
Ant Set.	Transmitter Circuit	Model	Antenna Gain with cable including cable loss	Frequency range	Antenna Type	Connecter Type	Cable Length (mm)	Cable Loss (dB)
1	Main	YWX-UM03SAXX-711	1.42dBi@615~960MHz 0.88dBi@1445~1515MHz 2.69dBi@1700~2700MHz 4.13dBi@3400~3700MHz 4.29dBi@5150~5925MHz	615~960MHz 1445~1515MHz 1700~2700MHz 3400~3700MHz 5150~5925MHz	Dipole	SMA	230	0~1G 0.5dB 1~3G 1.1dB
	Aux-1	YWX-UM03SAXX-711	1.42dBi@615~960MHz 0.88dBi@1445~1515MHz 2.69dBi@1700~2700MHz 4.13dBi@3400~3700MHz 4.29dBi@5150~5925MHz	615~960MHz 1445~1515MHz 1700~2700MHz 3400~3700MHz 5150~5925MHz	Dipole	SMA	230	0~1G 0.5dB 1~3G 1.1dB
	Aux-2	YWX-UM03SAXX-711	1.42dBi@615~960MHz 0.88dBi@1445~1515MHz 2.69dBi@1700~2700MHz 4.13dBi@3400~3700MHz 4.29dBi@5150~5925MHz	615~960MHz 1445~1515MHz 1700~2700MHz 3400~3700MHz 5150~5925MHz	Dipole	SMA	230	0~1G 0.5dB 1~3G 1.1dB
	Aux-3	YWX-UM03SAXX-711	1.42dBi@615~960MHz 0.88dBi@1445~1515MHz 2.69dBi@1700~2700MHz 4.13dBi@3400~3700MHz 4.29dBi@5150~5925MHz	615~960MHz 1445~1515MHz 1700~2700MHz 3400~3700MHz 5150~5925MHz	Dipole	SMA	230	0~1G 0.5dB 1~3G 1.1dB

NOTE : LTE Band 30 for DL only.

GPS			
Antenna Gain with cable including cable loss	Frequency range	Antenna Type	Connecter Type
GPS: 1.36dBi GLONASS: 0.09dBi	GPS: 1574.42MHz±3MHz GLONASS: 1602MHz±0.5MHz	Dipole	SMA
Note: 1. For WLAN: Ant set 2 was selected for the final test.			

2.5 Calculation Result of Maximum Conducted Power

For 2.4GHz, 5GHz (U-NII-1 band and U-NII-3 band) and 3G/LTE Modem data was copied from the original test report (Report No.: SA170825E04)

For WLAN 5GHz: Radio 1 and Radio 2 can simultaneously transmit only in different bands.

For WLAN (Radio 1)

Frequency Band (MHz)	Max Power (mW)	Antenna Gain (dBi)	Distance (cm)	Power Density (mW/cm^2)	Limit (mW/cm^2)
2412-2462	833.916	7.21	40	0.21817	1
5180-5240	681.538	6.61	40	0.15530	1
5260-5320	242.817	6.61	40	0.05533	1
5500-5700	237.982	6.61	40	0.05423	1
5745-5825	873.145	6.61	40	0.19896	1

NOTE:
2.4GHz: Directional gain = 4.20dBi + 10log(2) = 7.21dBi
5GHz: Directional gain = 3.60dBi + 10log(2) = 6.61dBi

For WLAN (Radio 2)

Frequency Band (MHz)	Max Power (mW)	Antenna Gain (dBi)	Distance (cm)	Power Density (mW/cm^2)	Limit (mW/cm^2)
5180-5240	789.037	9.62	40	0.35956	1
5260-5320	206.889	9.62	40	0.09428	1
5500-5700	242.715	9.62	40	0.11060	1
5745-5825	996.851	9.62	40	0.45425	1

NOTE:
5GHz: Directional gain = 3.60dBi + 10log(4) = 9.62dBi

For 3G/LTE (Radio 3) (FCC ID: RI7LM960)

Frequency Band (MHz)	Max Power (mW)	Antenna Gain (dBi)	Distance (cm)	Power Density (mW/cm^2)	Limit (mW/cm^2)
2496-2690	472	2.69	40	0.04361	1

For 3G/LTE Modem (FCC ID: N7NMC7455)

Frequency Band (MHz)	Max Power (mW)	Antenna Gain (dBi)	Distance (cm)	Power Density (mW/cm^2)	Limit (mW/cm^2)
698-716	251.189	1.99	40	0.01975	0.4665*

Note: *Limit of Power Density = F/1500

Conclusion:

The formula of calculated the MPE is:

CPD1 / LPD1 + CPD2 / LPD2 + ……etc. < 1

CPD = Calculation power density

LPD = Limit of power density

WLAN 2.4GHz <Radio 1> + WLAN 5GHz <Radio 1> + WLAN 5GHz <Radio 2> + 3G/LTE <Radio 3> + 3G/LTE Modem = 0.21817 / 1 + 0.15530 / 1 + 0.45425 / 1 + 0.04361 / 1 + 0.01975 / 0.4665 = 0.91367

Therefore the maximum calculations of above situations are less than the "1" limit.

Appendix

3G/LTE module
MPE Evaluation for FCC ID: RI7LM960 Radio Module

Mode	Equipment Category	Transmitter Range (MHz)		Maximum		Antenna Gain (dBi)	Power Density (mW/cm^2)		Ratio
		Start	Stop	(dBm)	(W)		Vaule	Limit	
UMTS	Band II	1852.4	1907.6	22.53	0.179	2.69	0.01654	1	0.01654
	Band IV	1712.4	1752.6	22.81	0.191	2.69	0.01765	1	0.01765
	Band V	826.4	846.6	23.54	0.226	1.42	0.01559	0.55093	0.02830
LTE	Band 2	1850.7	1909.3	23.42	0.22	2.69	0.02033	1	0.02033
	Band 4	1710.7	1754.3	24.1	0.257	2.69	0.02375	1	0.02375
	Band 5	824.7	848.3	24.05	0.254	1.42	0.01752	0.5498	0.03187
	Band 7	2502.5	2567.5	24.05	0.254	2.69	0.02347	1	0.02347
	Band 12	699.7	715.3	23.44	0.221	1.42	0.01524	0.46646	0.03267
	Band 13	779.5	784.5	23.22	0.21	1.42	0.01448	0.51966	0.02786
	Band 14	790.5	795.5	23.24	0.211	1.42	0.01455	0.527	0.02761
	Band 17	706.5	713.5	23.44	0.221	1.42	0.01524	0.471	0.03236
	Band 19	832.5	842.5	23.84	0.242	1.42	0.01669	0.555	0.03007
	Band 25	1850.7	1914.3	23.69	0.234	2.69	0.02162	1	0.02162
	Band 26	814.7	848.3	23.14	0.206	1.42	0.01421	0.54313	0.02616
	Band 38	2572.5	2617.5	24.08	0.256	2.69	0.02365	1	0.02365
	Band 41	2498.5	2687.5	26.74	0.472	2.69	0.04361	1	**0.04361**
	Band 66	1710.7	1779.3	24	0.251	2.69	0.02319	1	0.02319
	Band 71	665.5	695.5	23.84	0.242	1.42	0.01669	0.44366	0.03762

3G/LTE Modem
MPE Evaluation for FCC ID: N7NMC7455 Radio Module

Operating Mode	TX Freq Range (MHz)		Max Time-Avg Cond Power		Antenna Gain (dBi)	Power Density (mW/cm^2)		Ratio
	Start	Stop	(dBm)	(W)		Vaule	Limit	
WCDMA Band II LTE Band 2	1850	1910	24	0.25	4	0.0312	1	0.03123
WCDMA Band IV LTE Band 4	1710	1755	24	0.25	4	0.0312	1	0.03123
WCDMA Band V LTE Band 5	824	849	24	0.25	1.99	0.0197	0.54933	0.03579
LTE Band 7	2500	2570	23	0.2	2.8	0.019	1	0.01895
LTE Band 12	699	716	24	0.25	1.99	0.0197	0.466	**0.04219**
LTE Band 13	777	787	24	0.25	1.99	0.0197	0.518	0.03795
LTE Band 25	1850	1915	24	0.25	4	0.0312	1	0.03123
LTE Band 26	814	849	24	0.25	1.99	0.0197	0.54266	0.03623
LTE Band 30	2305	2315	23	0.2	1	0.0125	1	0.01252
LTE Band 41	2496	2690	23	0.2	2.8	0.019	1	0.01895

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