RHEIN TECH LABORATORIES, INC.

Engineering Solutions & Electromagnetic Compatibility Services

RF Exposure Report
for
Uncontrolled Environments

FCC Part 1.1307, 1.1310, 2.1091, 2.1093; ISED RSS-102

Alula, LLC
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Model: Connect+Pro

FCC ID: U5X-HUBPLUS
IC: 8310A-HUBPLUS

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RF Exposure FCC Part 1.1307, 1.1310, 2.1091, 2.1093; ISED RSS-102

MPE Co-location Calculations

The maximum permissible RF exposure for an uncontrolled environment is specified in FCC 1.1310 Table 1B and RSS-102 Issue 6 Table 7.

From OET 65, $S = EIRP / 4\pi R^2$

where:
S = Power density (mw/cm^2)
EIRP = Equivalent Isotropic Radiated Power
R = 20 cm separation distance

Power Density for Alula 433 MHz TX

1. The MPE limit for the above device operating at 433.92 MHz for uncontrolled environments is 0.3 mW/cm^2 for FCC and 3 W/m^2 for ISED.
2. EUT fundamental field strength at 433.92 MHz = 100.6 dBuV/m at 3 meters* = 5.4 dBm.
3. EIRP + 1 dB tune-up tolerance = 6.4 dBm = 4.4 mW
4. S = 0.00088 mW/cm^2 = at 20 cm separation
   (*per Rhein Tech 15.231/RSS-210 test report)

Power Density for Alula Z-Wave 908.42 MHz LMA TX (FCC ID: U5X-RE934Z; IC: 8310A-RE934Z)

1. The MPE limit for the above device operating at 908.42 MHz for uncontrolled environments is 0.3 mW/cm^2 for FCC and 3 W/m^2 for ISED.
2. EUT fundamental field strength at 908.42 MHz = 89.1 dBuV/m at 3 meters* = -6.1 dBm.
3. EIRP + 1 dB tune-up tolerance = -5.1 dBm = 0.31 mW
4. S = 0.000062 mW/cm^2 = at 20 cm separation
   (*per certified test report)

Power Density for Espressif Wi-Fi (FCC ID: 2AC7Z-ESP32WROOM32E; IC: 21098-ESPWROOM32E)

1. The MPE limit for the above device operating at 2402-2480 MHz for uncontrolled environments is 1 mW/cm^2 for FCC and 10 W/m for ISED.
2. The worst-case conducted power for the low band is 10 mW (per FCC grant).
3. Maximum antenna gain for this frequency range of operation is 3.4 dBi /2.2 numeric
4. EIRP = Conducted Power + 1 dB tune-up tolerance + Antenna Gain = 13.4 dBm = 22 mW.
5. S = 0.0044 mW/cm^2 = at 20 cm separation.

Power Density for Telit Cellular Modem (FCC ID: RI7ME310G1WW; IC: 5131A-ME310G1WW)

Note: Most major U.S. carriers have shut down their 2G networks, which include GPRS and EDGE technologies, to repurpose the spectrum for more advanced technologies like 4G LTE and 5G. As a result, most GPRS/EDGE networks in the 824-849 MHz and 1850-1910 MHz bands have been phased out in the United States as of August 2023. Thus, LTE Band 4 1700 MHz with a conducted power of 0.316 W and a 5 dBi antenna were chosen as the worst-case LTE RF power for the MPE calculation.

Co-Location Calculations			
Frequency (MHz)	**Band**	**Power (Watt)**	**Antenna Gain (dBi) / Numeric**
1710 - 1780	4	0.316	5 / 3.2

The table above includes the conducted output power and the antenna gain of the Telit cellular modem collocated in the EUT.

Calculation of Co-Location MPE per Section 7.2 of KDB 447498 D01 General RF Exposure Guidance v06 and ISED Notice 2016-DRS001: Updated July 2020, Applicability of Latest FCC RF Exposure KDB 447898 D01 v06

1. The MPE limit for uncontrolled environments for the above device operating at 1710 - 1780 MHz, Band 4, is 1.0 mW/cm^2 for FCC and 10 W/m^2 for ISED.
2. The worst-case conducted power for the above frequency range is 0.316 W (per cellular grant).
3. The maximum antenna gain for this frequency range of operation is 5 dBi / 3.2 numeric (from Telit).
4. The EIRP = Conducted Power + 1 dB tune-up tolerance + Antenna Gain = 31 dBm = 1259.0 mW.
5. S = 0.25 mW/cm^2 = at 20 cm separation.

Co-Location - Summary of MPE: Alula TX + Alula Z-Wave + Espressif Wi-Fi + Telit Cellular Modem

Transmitter	Frequency (MHz)	FCC MPE Result (mW/cm^2)	ISED MPE Result (W/m^2)	FCC Limit (mW/cm^2)	ISED Limit (W/m^2)	Ratio FCC	Ratio ISED
Alula TX	433.92	0.00088	0.0088	**0.3**	**3**	0.003	0.003
Alula Z-Wave	908.24	0.000062	0.00062	**0.6**	**6**	0.00010	0.00010
Wi-Fi	2412 - 2462	0.0044	0.044	**1.0**	**10**	0.0044	0.0044
Cellular	1710 - 1780	0.251	2.51	**1.0**	**4.24**	0.251	0.6
					Sum of Ratios	**0.26**	**0.6**

Rounding up the sum of the ratios per FCC/ISED RF exposure policies, the sum of the ratios must be <1.

The sum of ratios for both FCC = 0.26<1 and the sum of ratios for ISED = 0.6<1

Thus, the EUT meets the uncontrolled exposure limit at 20 cm when all transmitters transmit simultaneously and does **NOT** require MPE measurement for both FCC and ISED.

The collocation test report is on file.