

# SAR & RF Exposure Exemption Technical Brief

## Application Information

APPLICANT	Alula
DATE	4/7/2021
PROD DESC	LED Keypad
PMN	RE663 LED Keypad
HVIN	RE663
FVIN	75-00116
IC	8310A-RE663

## SAR Evaluation Exemption (RSS-102, Section 2.5.1)

From RSS-102, Section 2.5.1 Exemption Limits for Routine Evaluation – SAR Evaluation

*“SAR evaluation is required if the separation distance between the user and/or bystander and the antenna and/or radiating element of the device is less than or equal to 20 cm, except when the device operates at or below the applicable output power level (adjusted for tune-up tolerance) for the specified separation distance defined in Table 1.”*

This device is meant for user interaction which means the user will come within 20 cm of the device during operation. As such, the device needs to follow Table 1 in RSS-102, Section 2.5.1. The user’s fingertip can come within 5 mm of the antenna and, therefore, this device will follow the  $\leq 5$  mm power limits from Table 1 for the frequencies this device uses:

Frequency (MHz)	$\leq 5$ mm
1900	7 mW
2450	4 mW
3500	2 mW
5800+	1 mW

$$2402 \text{ MHz: } 7\text{mW} + (2402\text{MHz} - 1900\text{MHz}) \times \frac{(4\text{mW}-7\text{mW})}{(2450\text{MHz}-1900\text{MHz})} = 4.26 \text{ mW}$$

$$2442 \text{ MHz: } 7\text{mW} + (2442\text{MHz} - 1900\text{MHz}) \times \frac{(4\text{mW}-7\text{mW})}{(2450\text{MHz}-1900\text{MHz})} = 4.04 \text{ mW}$$

$$2480 \text{ MHz: } 4\text{mW} + (2480\text{MHz} - 2450\text{MHz}) \times \frac{(2\text{mW}-4\text{mW})}{(3500\text{MHz}-2450\text{MHz})} = 3.94 \text{ mW}$$

$$4804 \text{ MHz: } 2\text{mW} + (4804\text{MHz} - 3500\text{MHz}) \times \frac{(1\text{mW}-2\text{mW})}{(5800\text{MHz}-3500\text{MHz})} = 1.43 \text{ mW}$$

$$4884 \text{ MHz: } 2\text{mW} + (4884\text{MHz} - 3500\text{MHz}) \times \frac{(1\text{mW}-2\text{mW})}{(5800\text{MHz}-3500\text{MHz})} = 1.39 \text{ mW}$$

$$4960 \text{ MHz: } 2\text{mW} + (4804\text{MHz} - 3500\text{MHz}) \times \frac{(1\text{mW}-2\text{mW})}{(5800\text{MHz}-3500\text{MHz})} = 1.37 \text{ mW}$$

All other frequencies are above 5800 MHz so they are limited to 1 mW.

The 20dB duty cycle correction is allowed because of the low duty cycle of this device. A plot of the radio’s GPIO pin using the internal Peripheral Reflex System to signal when transmit occurs below shows the transmit time is about 298us per packet.



The radio has a capability of transmitting 3 advertisement packets at a minimum interval of 20ms or 1 connection packet every 7.5ms. The worst case being 3 packets in a 20ms window. Converting the timing over a 100ms window shows that the radio is well below the 10ms in a 100ms window for maximum duty cycle correction.

**On Time:**  $298\mu s \times 3 \times \frac{100\ ms}{20\ ms} = 4.47\text{ms}$  in 100ms window

Field strength measurements were taken at 3 meters. Using the standard conversion from field strength, EIRP is calculated as follows:

**EIRP (dBm) = (E – 20) + 20log(3) – 104.8**

The tables below show that the device is exempt from RF exposure evaluation.

Frequency (MHz)	Peak Level (dBuV/m)	EIRP (dBm)	Interpolated Power Limit (mW)	EIRP Limit (dBm)	Margin (dB)	Test Result
2402	112.0	-3.3	4.26	6.3	-9.6	PASS
4804	52.9	-62.4	1.43	1.6	-63.9	PASS
7206	71.9	-43.4	2.00	3.0	-46.4	PASS
9608	66.5	-48.8	2.00	3.0	-51.8	PASS
12010	59.4	-55.9	2.00	3.0	-58.9	PASS
14412	63.3	-52.0	2.00	3.0	-55.0	PASS
16814	55.1	-60.2	2.00	3.0	-63.2	PASS
19216	53.3	-62.0	2.00	3.0	-65.0	PASS
21618	53	-62.3	2.00	3.0	-65.3	PASS
24020	57.4	-57.9	2.00	3.0	-60.9	PASS

Frequency (MHz)	Peak Level (dBuV/m)	EIRP (dBm)	Interpolated Power Limit (mW)	EIRP Limit (dBm)	Margin (dB)	Test Result
2442	111.7	-3.6	4.04	6.1	-9.6	PASS
4884	55.1	-60.2	1.40	1.5	-61.6	PASS
7326	71.4	-43.9	2.00	3.0	-46.9	PASS
9768	67.5	-47.8	2.00	3.0	-50.8	PASS
12210	60.3	-55.0	2.00	3.0	-58.0	PASS
14652	64.1	-51.2	2.00	3.0	-54.2	PASS
17094	53.8	-61.5	2.00	3.0	-64.5	PASS
19536	53	-62.3	2.00	3.0	-65.3	PASS
21978	56.6	-58.7	2.00	3.0	-61.7	PASS
24420	56.4	-58.9	2.00	3.0	-61.9	PASS

Frequency (MHz)	Peak Level (dBuV/m)	EIRP (dBm)	Interpolated Power Limit (mW)	EIRP Limit (dBm)	Margin (dB)	Test Result
2480	113.0	-2.3	3.94	6.0	-8.2	PASS
4960	57.7	-57.6	1.37	1.4	-58.9	PASS
7440	67.6	-47.7	2.00	3.0	-50.7	PASS
9920	68.7	-46.6	2.00	3.0	-49.6	PASS
12400	64.6	-50.7	2.00	3.0	-53.7	PASS
14880	62.8	-52.5	2.00	3.0	-55.5	PASS
17360	52.9	-62.4	2.00	3.0	-65.4	PASS
19840	55.9	-59.4	2.00	3.0	-62.4	PASS
22320	60.5	-54.8	2.00	3.0	-57.8	PASS
24800	55.3	-60.0	2.00	3.0	-63.0	PASS

## RF Exposure Limits (FCC 1.1310)

From FCC §1.1310, the allowable field strength exposure limits for frequencies above 1500 MHz, the limit is 1mW/cm<sup>2</sup>.

$$\text{Power Density Limit (dBmW/m}^2\text{): } \frac{dBmW}{m^2} = 10 \log_{10} \left( 1 \frac{mW}{cm^2} * 10000 \right) = 40$$

$$\text{Peak Level to Power Conversion: } \frac{dBmW}{m^2} = \frac{dBuV}{m} - 115.8$$

The tables below show that the device is below RF exposure limits.

Frequency (MHz)	Peak Level (dBuV/m)	Peak Level (dBmW/m <sup>2</sup> )	Power Limit (dBmW/m <sup>2</sup> )	Margin (dB)	Test Result
2402	112.0	-3.8	40.0	-43.8	PASS
4804	52.9	-62.9	40.0	-102.9	PASS
7206	71.9	-43.9	40.0	-83.9	PASS
9608	66.5	-49.3	40.0	-89.3	PASS
12010	59.4	-56.4	40.0	-96.4	PASS
14412	63.3	-52.5	40.0	-92.5	PASS
16814	55.1	-60.7	40.0	-100.7	PASS
19216	53.3	-62.5	40.0	-102.5	PASS
21618	53.0	-62.8	40.0	-102.8	PASS
24020	57.4	-58.4	40.0	-98.4	PASS

Frequency (MHz)	Peak Level (dBuV/m)	Peak Level (dBmW/m <sup>2</sup> )	Power Limit (dBmW/m <sup>2</sup> )	Margin (dB)	Test Result
2442	111.7	-4.1	40.0	-44.1	PASS
4884	55.1	-60.7	40.0	-100.7	PASS
7326	71.4	-44.4	40.0	-84.4	PASS
9768	67.5	-48.3	40.0	-88.3	PASS
12210	60.3	-55.5	40.0	-95.5	PASS
14652	64.1	-51.7	40.0	-91.7	PASS
17094	53.8	-62.0	40.0	-102.0	PASS
19536	53.0	-62.8	40.0	-102.8	PASS
21978	56.6	-59.2	40.0	-99.2	PASS
24420	56.4	-59.4	40.0	-99.4	PASS

Frequency (MHz)	Peak Level (dBuV/m)	Peak Level (dBmW/m <sup>2</sup> )	Power Limit (dBmW/m <sup>2</sup> )	Margin (dB)	Test Result
2480	113.0	-2.8	40.0	-42.8	PASS
4960	57.7	-58.1	40.0	-98.1	PASS
7440	67.6	-48.2	40.0	-88.2	PASS
9920	68.7	-47.1	40.0	-87.1	PASS
12400	64.6	-51.2	40.0	-91.2	PASS
14880	62.8	-53.0	40.0	-93.0	PASS
17360	52.9	-62.9	40.0	-102.9	PASS
19840	55.9	-59.9	40.0	-99.9	PASS
22320	60.5	-55.3	40.0	-95.3	PASS
24800	55.3	-60.5	40.0	-100.5	PASS

Sincerely,

A handwritten signature in black ink, appearing to read "Paul Saldin". The signature is fluid and cursive, with a long horizontal stroke extending to the right.

Paul Saldin  
Vice President  
Alula