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To Whom It May Concern:

To investigate the RF exposure of the Tantalus Systems Corp. RT-4200 TRUEdge Intelligent endpoint (FCC ID: OZFTXG000, IC ID: 3669A-TXG000) incorporated inside the TRUSense Gateway Series and co-located with two other transmitters (FCC ID: N7NRC76B, R68XPICO200, 2417C-RC76B, 3867A-XPICO200) the FCC KDB publication 447498 and the Health Canada Safety Code 6 (as specified in RSS-102) have been used as guidelines to determine compliance with the FCC and IC RF exposure limit.

The EUT contains 3 different transmitters:

- Part 15 transmitter operating in the 902-928MHz band,
- A WiFi operating in **either** the 2.4GHzband **OR** the 5GHz band. It is impossible to operate in both bands at the same time.
- An LTE transmitter that has the ability to operate in many different bands from 663MHz to 1915MHz. It can only operate in one band at a time.

The following analysis uses the following worst case operating conditions:

- Transmitter 1 operating at 902-928MHz has a maximum duty cycle of 34.6%
- Transmitter 2 operating at 2.4GHz/5.8GHz operates in half duplex and the maximum duty cycle is 50%
- Transmitter 3 operating in full-duplex operation of 100%

For this product:

Transmitter 1 has 3 possible antenna configurations:

- Integrated Antenna (default configuration)
- External antenna: 10dBi (At highest frequency of operation).
- External antenna: 15dBi (At highest frequency of operation).

Transmitter 3 has 3 possible antenna configurations:

- Integrated Antenna (default configuration)
- External antenna: 6dBi.
- External antenna: 8dBi.

The RF exposure analysis will be given for the worst case antenna configurations, **however** when analyzing the RF exposure of the external antenna's the RF power from the internal transmitter will be ignored since the distance from the internal transmitter and the external antennas connected to the first and third transmitters will be several meters apart.

Analysis per Health Canada Safety Code 6 guidelines:

As per Health Canada Safety Code 6 guidelines:

The EUT is classed to meet the RF exposure that it subjects to the "General Population/Uncontrolled Environment". Under this class the limit is calculated by:

$$S = f/150$$

Where S is the Power Density in W/m^2 .
F is the frequency of operation in MHz.

The power density for each transmitter (calculated at a distance of 20cm) and MPE ratio are shown in table 1. Time averaging and cable loss has also been accounted for where appropriate.

The worst case configuration is when the external directional LTE antenna is used in Band 71 in conjunction with the external patch antenna for the Part 15 transmitter which gives a combined MPE ratio of 0.98. In most scenarios, the host device, with no external antennas attached will have a maximum combined ratio of $0.11 + 0.06 + 0.01$ for a total of 0.18.

Antenna	Transmitter	Lowest Frequency Of Operation (MHz)	Exposure Limit (mW/cm ²)	Output Power (dBm)	Average Output Power (dBm)	Antenna Gain (dBi)	ERP (dBm)	Power Density at 20cm (mW/cm ²)	MPE Ratio
Internal	LTE Band 2	1850	1.233	20.0	20.0	0	20.0	0.020	0.02
Internal	LTE Band 4	1710	1.140	20.0	20.0	0	20.0	0.020	0.02
Internal	LTE Band 5	824	0.549	22.6	22.6	0	22.6	0.036	0.07
Internal	LTE Band 12	699	0.466	23.6	23.6	0	23.6	0.045	0.10
Internal	LTE Band 13	777	0.518	23.0	23.0	0	23.0	0.040	0.08
Internal	LTE Band 14	788	0.525	23.0	23.0	0	23.0	0.040	0.08
Internal	LTE Band 25	1850	1.233	20.0	20.0	0	20.0	0.020	0.02
Internal	LTE Band 26	814	0.543	22.7	22.7	0	22.7	0.037	0.07
Internal	LTE Band 66	1710	1.140	20.2	20.2	0	20.2	0.021	0.02
Internal	LTE Band 71	663	0.442	24.0	24.0	0	24.0	0.050	0.11
External	LTE Band 2	1850	1.233	20.0	20.0	10.70	30.7	0.234	0.19
External	LTE Band 4	1710	1.140	20.0	20.0	10.84	30.8	0.239	0.21
External	LTE Band 5	824	0.549	22.6	22.6	8.10	30.7	0.234	0.43
External	LTE Band 12	699	0.466	23.6	23.6	8.37	32.0	0.315	0.68
External	LTE Band 13	777	0.518	23.0	23.0	8.22	31.2	0.262	0.51
External	LTE Band 14	788	0.525	23.0	23.0	8.19	31.2	0.262	0.50
External	LTE Band 25	1850	1.233	20.0	20.0	10.70	30.7	0.234	0.19
External	LTE Band 26	814	0.543	22.7	22.7	8.11	30.8	0.239	0.44
External	LTE Band 66	1710	1.140	20.2	20.2	10.83	31.0	0.250	0.22
External	LTE Band 71	663	0.442	24.0	24.0	8.43	32.4	0.347	0.79
External	LTE Band 2	1850	1.233	20.0	20.0	4.70	24.7	0.059	0.05
External	LTE Band 4	1710	1.140	20.0	20.0	4.84	24.8	0.060	0.05
External	LTE Band 5	824	0.549	22.6	22.6	3.10	25.7	0.074	0.13
External	LTE Band 12	699	0.466	23.6	23.6	3.37	27.0	0.100	0.21
External	LTE Band 13	777	0.518	23.0	23.0	3.22	26.2	0.083	0.16
External	LTE Band 14	788	0.525	23.0	23.0	3.19	26.2	0.083	0.16
External	LTE Band 25	1850	1.233	20.0	20.0	4.70	24.7	0.059	0.05
External	LTE Band 26	814	0.543	22.7	22.7	3.11	25.8	0.076	0.14
External	LTE Band 66	1710	1.140	20.2	20.2	4.83	25.0	0.063	0.06
External	LTE Band 71	663	0.442	24.0	24.0	3.43	27.4	0.109	0.25
Internal	Part 15	902	0.601	27.4	22.6	0	22.6	0.036	0.06
External	Part 15	902	0.601	27.4	22.6	1.96	24.6	0.057	0.09
External	Part 15	902	0.601	27.4	22.6	4.96	27.6	0.114	0.19
Internal	WiFi-2.4GHz	2400	1.600	19.0	16.0	0.00	16.0	0.008	0.01
Internal	WiFi - 5GHz	5850	3.900	15.0	12.0	4.00	16.0	0.008	0.01

* The external antenna gain has been adjusted to account for the loss of 12' LMR-100 cable

Table 1. Power density at 20cm and associated MPE ratio for all possible transmitter configurations

Analysis as per the FCC KDB publication 447498:

As per the FCC KDB publication 447498 D06 General RF Exposure Guidance, 4.3.1(b) states that SAR tests are not required if the conducted RF power does not exceed the following formula:-

The maximum time averaged power (mW) must not exceed:-

$$\text{Max. Power (mW) Allowed at 50mm}^* + (\text{test separation distance} - 50 \text{ mm}) \times F_{(\text{MHz})}/150$$

$$*\text{Where Max. Power (mW) Allowed at 50mm} = 3 \times 50 / \sqrt{F_{(\text{GHz})}}$$

Based on the previous analysis we know that the LTE transmitter operating in Band 71 will have the strictest requirement for the SAR test. Table 2 outlines the results of the SAR test for the 3 transmitters.

Transmitter	Frequency (MHz)	Output Power (mW)	Average Output Power (mW)	Exposure Limit for SAR exclusion (mW)
LTE Band 71	663	252	252	822
Part 15	902	955	330.4	1058
WiFi	2400	79	39.5	1597

Table 2. Average Output Power compared to Exposure limits for SAR exclusion

FCC KDB publication 447498 D06 General RF Exposure Guidance, 4.3.2 states that in the case of co-located transmitters the SAR test exclusion is allowed if the sum of all transmissions meets the requirement. Using the ratio of the output power to exposure limit it can be seen that the sum is less than 1.

Result:

SAR tests are not required for this product. The RF power emitted by the module is considered not to be dangerous for the general public as long as a distance of at least 20cm from the general public is observed during normal operation.



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