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TEST REPORT #: 315364 C
LSR Job #: C-2368

Compliance Testing of:

IoT Gateway

Prepared For:

Attention:
Georgia-Pacific
1915 Marathon Avenue
Neenah, WI 54956

This Test Report is issued under the Authority of:
Michael Hintzke, EMC Engineer

Signature: 

Date: 8/12/16

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EXHIBIT 1 INTRODUCTION

1.1 Client Information

Manufacturer Name:	Georgia-Pacific
Address:	1915 Marathon Avenue, Neenah WI 54956
Contact Name:	Kim Cannon
E-mail:	kim.cannon@gapac.com

1.2 Equipment Under Test (EUT) Information

Product Name:	IoT Gateway
Model Number:	A-100278
Serial Number:	Engineering Sample

1.3 Product Description

The Georgia Pacific daughter card is a communication gateway for transporting data between a proprietary Bluetooth network and a WiFi network. It consists of a certified Bluetooth module, a certified WiFi module, and a voltage regulator. Data and power are supplied by a proprietary connection to a host product.

1.4 Summary of Calculations

The calculations provided within this report demonstrate that the EUT is primarily compliant to the FCC and ISED SAR exclusion thresholds for portable operation. Additional calculations have also been included in this report demonstrating that the EUT is compliant with FCC and ISED MPE limits for mobile operation.

EXHIBIT 2 SAR Minimum Separation Distance

2.1 802.11 Transmitter

The EUT was evaluated against the SAR test exclusion threshold listed in FCC KDB 447498 D01 General RF Exposure Guidance v05r02, Section 4.3 (1).

802.11 Standard	Data Rate (MBPS)	Channel	Max (Avg) Conducted Power (dBm)
b	1 (DBPSK)	1	17.8
		6	17.8
		11	16.9
b	11 (8QPSK)	1	18.0
		6	17.8
		11	17.0
g	6 (BPSK)	1	16.6
		6	16.6
		11	15.8
g	54 (64QAM)	1	14.3
		6	14.3
		11	13.6
n	MCS0 (BPSK)	1	14.7
		6	14.7
		11	14.1
n	MCS7 (64QAM)	1	13.3
		6	13.3
		11	12.4

Frequency = 2.412 GHz
Output Power = 17.8 dBm
Tune-up Tolerance = 1.4 dB
Pout including tune-up tolerance = 19.2 dBm = 83 mW

2.1.1 1-g Head/Body Minimum Separation Distance

$$\frac{P_{out}\sqrt{f(GHz)}}{3} = \frac{83\ mW\sqrt{2.412}}{3} = 43\ mm$$

2.1.2 10-g Extremity Minimum Separation Distance

$$\frac{P_{out}\sqrt{f(GHz)}}{7.5} = \frac{83\ mW\sqrt{2.412}}{7.5} = 17\ mm$$

2.2 Bluetooth Transmitter

The EUT was evaluated against the SAR test exclusion threshold listed in KDB 447498 D01 General RF Exposure Guidance v05r02, section 4.3 (1).

Frequency = 2.402 GHz
Output Power = -0.46 dBm
Tune-up Tolerance = 2.1 dB
Pout including tune-up tolerance = 1.64 dBm = 1.5 mW

2.1.1 1-g Head/Body Minimum Separation Distance

$$\frac{P_{out}\sqrt{f(GHz)}}{3} = \frac{1.5\ mW\sqrt{2.402}}{3} = 0.8\ mm$$

2.1.2 10-g Extremity Minimum Separation Distance

$$\frac{P_{out}\sqrt{f(GHz)}}{7.5} = \frac{1.5\ mW\sqrt{2.402}}{7.5} = 0.3\ mm$$

Note: Since the minimum test separation distance calculated for both 1-g and 10-g is less than 5 mm, the distance of 5mm will be applied for each, respectively.

EXHIBIT 3 Simultaneous Transmission SAR Test Exclusion

Per KDB 447498 D01 General RF Exposure Guidance v06, section 4.3.2 b), the standalone SAR value must be estimated to determine the simultaneous transmission SAR test exclusion criteria.

3.1 1-g SAR Estimation

Bluetooth Transmitter (d > 50 mm*):

= 0.4 W/kg

*Based on the worst case distance of 50 mm.

802.11 Transmitter (d > 50 mm):

= 0.4 W/kg

3.1.1 Sum of Estimated 1-g SAR Values:

0.4 W/kg + 0.4 W/kg = 0.8 W/kg

3.1.2 Evaluation for SAR test exclusion:

For portable devices, the SAR limit for general population/uncontrolled exposure is 1.6 W/kg for any 1-g of tissue per FCC 2.1093.

0.8 W/kg < 1.6 W/kg

3.2 10-g SAR Estimation

Bluetooth Transmitter (d ≤ 50 mm):

$$\frac{83\ mW}{20\ mm} * \frac{\sqrt{2.402\ (GHz)}}{18.75} = 0.34\ W/kg$$

802.11 Transmitter (d ≤ 50 mm)::

$$\frac{1.4\ mW}{20\ mm} * \frac{\sqrt{2.402\ (GHz)}}{18.75} = 0.006\ W/kg$$

3.2.1 Sum of Estimated 10-g SAR Values:

0.34 W/kg + 0.006 W/kg = 0.346 W/kg

3.2.2 Evaluation for SAR test exclusion:

For portable devices, the SAR limit for general population/uncontrolled exposure is 4 W/kg for any 10-g of tissue per FCC 2.1093.

0.346 W/kg < 4 W/kg

EXHIBIT 4 RSS 102 Compliance

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of ≤5 mm	At separation distance of 10 mm	At separation distance of 15 mm	At separation distance of 20 mm	At separation distance of 25 mm
≤300	71 mW	101 mW	132 mW	162 mW	193 mW
450	52 mW	70 mW	88 mW	106 mW	123 mW
835	17 mW	30 mW	42 mW	55 mW	67 mW
1900	7 mW	10 mW	18 mW	34 mW	60 mW
2450	4 mW	7 mW	15 mW	30 mW	52 mW
3500	2 mW	6 mW	16 mW	32 mW	55 mW
5800	1 mW	6 mW	15 mW	27 mW	41 mW

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of 30 mm	At separation distance of 35 mm	At separation distance of 40 mm	At separation distance of 45 mm	At separation distance of ≥50 mm
≤300	223 mW	254 mW	284 mW	315 mW	345 mW
450	141 mW	159 mW	177 mW	195 mW	213 mW
835	80 mW	92 mW	105 mW	117 mW	130 mW
1900	99 mW	153 mW	225 mW	316 mW	431 mW
2450	83 mW	123 mW	173 mW	235 mW	309 mW
3500	86 mW	124 mW	170 mW	225 mW	290 mW
5800	56 mW	71 mW	85 mW	97 mW	106 mW

Note: Table 1 from RSS 102. The exemption limits represented in this table apply to 1-gram tissue, head and body, evaluation (uncontrolled).

4.1 802.11 Transmitter

Frequency = 2412 MHz
Output Power = 17.8 dBm
Antenna Gain = 0.5 dBi
Highest output power of the device = 18.3 dBm = 68 mW

4.1.1 1-g SAR Exemption:

Interpolating between 1900 and 2450 MHz for 2412 MHz at a separation distance of **30 mm** yields the exemption limit of 84.1 mW

When evaluated against RSS 102 issue 5 section 2.5, table 1:

68 mW ≤ 84.1 mW

4.1.2 10-g SAR Exemption:

For limb-worn devices where the 10 gram value applies, the exemption limit from the above table is multiplied by 2.5. Interpolating between 1900 and 2450 MHz for 2412 MHz at a separation distance of **20 mm** yields the exemption limit of 75.7 mW with respect to the 10 gram SAR exemption limit.

When evaluated against RSS 102 issue 5 section 2.5, table 1:

68 mW ≤ 75.7 mW

4.2 Bluetooth Transmitter

Frequency = 2.402 GHz
Output Power = -0.46 dBm
Antenna Gain = 0.5 dBi
Highest output power of the device = 0.04 dBm = 1 mW

Note: The Bluetooth output power and frequency data represented within this report was obtained from the OET Exhibits List for FCC ID TFB-1001.

4.2.1 1-g SAR Exemption:

Interpolating between 1900 MHz and 2450 MHz for 2402 MHz at a separation distance of **5 mm** yields the exemption limit of 4.3 mW

When evaluated against RSS 102 issue 5 section 2.5, table 1:

1 mW ≤ 4.3 mW

4.2.2 10-g SAR Exemption:

For limb-worn devices where the 10 gram value applies, the exemption limit from the above table is multiplied by 2.5. Interpolating between 1900 and 2450 MHz for 2402 MHz at a separation distance of **20 mm** yields the exemption limit of 10.7 mW with respect to the 10 gram SAR exemption limit.

When evaluated against RSS 102 issue 5 section 2.5, table 1:

1 mW ≤ 10.7 mW

EXHIBIT 5 MPE Calculations

5.1 802.11 Transmitter

The following MPE calculations are based on a measured conducted RF power of +18.3 dBm as presented to the antenna. The peak gain of this antenna is 0.5 dBi.

Prediction of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$$S = \frac{PG}{4\pi R^2}$$

where: S = power density
P = power input to the antenna
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna

Maximum peak output power at antenna input terminal:	17.80	(dBm)
Maximum peak output power at antenna input terminal:	60.256	(mW)
Antenna gain(typical):	0.5	(dBi)
Maximum antenna gain:	1.122	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	2412	(MHz)
MPE limit for uncontrolled exposure at prediction frequency:	1	(mW/cm^2)
Power density at prediction frequency:	0.013450	(mW/cm^2)
Maximum allowable antenna gain:	19.2	(dBi)
Margin of Compliance at 20 cm =	18.7	dB

5.2 Bluetooth Transmitter

The following MPE calculations are based on a measured conducted RF power of +3.46 dBm as presented to the antenna. The peak gain of this antenna is 0.5 dBi.

Prediction of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$$S = \frac{PG}{4\pi R^2}$$

where: S = power density
P = power input to the antenna
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna

Maximum peak output power at antenna input terminal:	-0.46	(dBm)
Maximum peak output power at antenna input terminal:	0.899	(mW)
Antenna gain(typical):	0.5	(dBi)
Maximum antenna gain:	1.122	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	2402	(MHz)
MPE limit for uncontrolled exposure at prediction frequency:	1	(mW/cm^2)
Power density at prediction frequency:	0.000201	(mW/cm^2)
Maximum allowable antenna gain:	37.5	(dBi)
Margin of Compliance at 20 cm =	37.0	dB