

## RADIO FREQUENCY EXPOSURE

### LIMIT

According to §15.247(i), systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines. See § 1.1307(b)(1) of this chapter.

### EUT Specification

<b>EUT</b>	IoT Gateway System
<b>Model</b>	SYS-E100-8QE-AWE3
<b>Data Applies To</b>	SYS-E100-8Q-AWE3 ; SYS-E100-8Q-E3 ; SYS-E100-8QE-E3 ; SYS-E100-8Q-AW ; SYS-E100-8QE-AW
<b>Frequency band (Operating)</b>	<input checked="" type="checkbox"/> 802.11b/g/n HT20: 2.412GHz ~ 2.462GHz <input checked="" type="checkbox"/> 802.11gn HT40: 2.422GHz ~ 2.452GHz <input checked="" type="checkbox"/> Bluetooth 3.0: 2.402GHz ~ 2.480GHz <input checked="" type="checkbox"/> Bluetooth 4.0: 2.402GHz ~ 2.480GHz <input checked="" type="checkbox"/> Zigbee: 2.405GHz ~ 2.475GHz <input type="checkbox"/> Others
<b>Device category</b>	<input type="checkbox"/> Portable (<20cm separation) <input checked="" type="checkbox"/> Mobile (>20cm separation) <input type="checkbox"/> Others
<b>Exposure classification</b>	<input type="checkbox"/> Occupational/Controlled exposure (S = 5mW/cm <sup>2</sup> ) <input checked="" type="checkbox"/> General Population/Uncontrolled exposure (S=1mW/cm <sup>2</sup> )
<b>Antenna Specification</b>	Diploe Antenna x 2 (Wifi & Bluetooth) , 2.4GHz: Antenna 1 (Main) Gain : 2.60 dBi (Numeric gain 1.82) 2.4GHz: Antenna 2 (Aux) Gain : 2.60 dBi (Numeric gain 1.82) Diploe Antenna x 1 , Zigbee 1: Antenna Gain : 3.10 dBi (Numeric gain 2.04) Diploe Antenna x 1 , Zigbee 2: Antenna Gain : 3.10 dBi (Numeric gain 2.04)
<b>Maximum output power</b>	IEEE 802.11b Mode: 20.75 dBm (118.850 mW) IEEE 802.11g Mode: 23.67 dBm (232.809 mW) IEEE 802.11gn HT 20 Mode: 23.38 dBm (217.771 mW) IEEE 802.11gn HT 40 Mode: 22.65 dBm (184.077 mW) Bluetooth 3.0: 5.97 dBm (3.954 mW) Bluetooth 4.0: 5.96 dBm (3.945 mW) Zigbee 1: 18.39 dBm (69.024 mW) Zigbee 2: 19.26 dBm (84.333 mW)
<b>Evaluation applied</b>	<input checked="" type="checkbox"/> MPE Evaluation* <input type="checkbox"/> SAR Evaluation <input type="checkbox"/> N/A

**Remark :** The model SYS-E100-8QE-AWE3 was considered the main model for testing.

**Revision History**

Rev.	Issue Date	Revisions	Effect Page	Revised By
00	2015/06/30	Initial Issue	ALL	Gloria Chang

**TEST RESULTS****No non-compliance noted.****Calculation**

Given  $E = \frac{\sqrt{30 \times P \times G}}{d}$  &  $S = \frac{E^2}{3770}$

Where  $E$  = Field strength in Volts / meter

$P$  = Power in Watts

$G$  = Numeric antenna gain

$d$  = Distance in meters

$S$  = Power density in milliwatts / square centimeter

Combining equations and re-arranging the terms to express the distance as a function of the remaining variables yields:

$$S = \frac{30 \times P \times G}{3770 d^2}$$

Changing to units of mW and cm, using:

$$P \text{ (mW)} = P \text{ (W)} / 1000 \text{ and}$$

$$d \text{ (cm)} = d \text{ (m)} / 100$$

Yields

$$S = \frac{30 \times (P/1000) \times G}{3770 \times (d/100)^2} = 0.0796 \times \frac{P \times G}{d^2} \quad \textbf{Equation 1}$$

Where  $d$  = Distance in cm

$P$  = Power in mW

$G$  = Numeric antenna gain

$S$  = Power density in mW / cm<sup>2</sup>

**Maximum Permissible Exposure**

Substituting the MPE safe distance using  $d = 20$  cm into Equation 1:

$$S = 0.000199 \times P \times G$$

Where  $P$  = Power in mW

$G$  = Numeric antenna gain

$S$  = Power density in mW / cm<sup>2</sup>

**IEEE 802.11b mode:**

Frq.(MHz)	P (mW)	Gain (num.)	D (cm)	Power density in mW / cm <sup>2</sup>	Limit (mW/cm <sup>2</sup> )
2412 ~ 2462	118.850	1.82	20	0.0430	1

**IEEE 802.11g mode:**

Frq.(MHz)	P (mW)	Gain (num.)	D (cm)	Power density in mW / cm <sup>2</sup>	Limit (mW/cm <sup>2</sup> )
2412 ~ 2462	232.809	1.82	20	0.0843	1

**IEEE 802.11gn HT20 mode:**

Frq.(MHz)	P (mW)	Gain (num.)	D (cm)	Power density in mW / cm <sup>2</sup>	Limit (mW/cm <sup>2</sup> )
2412 ~ 2462	217.771	1.82	20	0.0789	1

**IEEE 802.11gn HT40 mode:**

Frq.(MHz)	P (mW)	Gain (num.)	D (cm)	Power density in mW / cm <sup>2</sup>	Limit (mW/cm <sup>2</sup> )
2422 ~ 2452	184.077	1.82	20	0.0667	1

**Bluetooth 3.0:**

Frq.(MHz)	P (mW)	Gain (num.)	D (cm)	Power density in mW / cm <sup>2</sup>	Limit (mW/cm <sup>2</sup> )
2402 ~ 2480	3.954	1.82	20	0.0014	1

**Bluetooth 4.0:**

Frq.(MHz)	P (mW)	Gain (num.)	D (cm)	Power density in mW / cm <sup>2</sup>	Limit (mW/cm <sup>2</sup> )
2402 ~ 2480	3.945	1.82	20	0.0014	1

**Zigbee 1:**

Frq.(MHz)	P (mW)	Gain (num.)	D (cm)	Power density in mW / cm <sup>2</sup>	Limit (mW/cm <sup>2</sup> )
2405 ~ 2475	69.024	2.04	20	0.0280	1

**Zigbee 2:**

Frq.(MHz)	P (mW)	Gain (num.)	D (cm)	Power density in mW / cm <sup>2</sup>	Limit (mW/cm <sup>2</sup> )
2405 ~ 2475	84.333	2.04	20	0.0342	1