

INGERSOLL-RAND INDUSTRIAL U.S., INC. MPE REPORT

SCOPE OF WORK

MPE CALCULATION – MODEL QCXD21 (Zigbee – IEEE 802.15.4 USB Dongle)

REPORT NUMBER

105001833BOX-006MPE

ISSUE DATE

June 9, 2022

[REVISED DATE]

Original Issue

DOCUMENT CONTROL NUMBER

Non-Specific Radio Report Shell Rev. August 2020
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MPE REPORT
(FULL COMPLIANCE)

Report Number: 105001833BOX-006MPE

Project Number: G105001833

Report Issue Date: June 9, 2022

Model(s) Evaluated: QCXD21 (Zigbee – IEEE 802.15.4 USB Dongle)

Standards: FCC Part 1 Subpart I, October 2019

Procedures Implementing the National Environmental Policy Act of 1969
§1.1307 *Actions that may have a significant environmental effect, for which Environmental Assessments (EAs) must be prepared.*

ISED RSS-102 Issue 5, March 19, 2015

Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)

Tested by:
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Client:
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1 Introduction and Conclusion

This evaluation report covers for a mobile device subject to routine environmental evaluation for RF exposure. A mobile device is defined as a transmitting device designed to generally be used in such a way that a separation distance of at least 20 centimeters is normally maintained between the transmitter's radiating structure(s) and the body of the user or nearby persons.

The evaluation indicated in section 2.0 were performed on the product constructed as described in section 4.0. The remaining sections are the verbatim text from the actual evaluation during the investigation. These sections include the evaluation name, the specified Method, and Results. No additions, deviations, or exclusions have been made from the standard(s) unless specifically noted.

Based on the results of our investigation, we have concluded the product evaluated **complies** with the requirements of the standard(s) indicated. The results obtained in this report pertain only to the item(s) evaluated. Intertek does not make any claims of compliance for samples or variants which were not evaluated.

2 Evaluation Summary

Section	Test full name	Result
3	Client Information	-
4	Description of Equipment Under Evaluation and Variant Models	-
5	System Setup and Method	-
6	Power Density Calculation (FCC §1.1310; ISED RSS-102 Issue 5)	Compliant
7	Revision History	-

3 Client Information

This EUT was tested at the request of:

Client: Ingersoll-Rand Industrial U.S., Inc.
800-E Beaty Street
Davidson, NC 28036
USA

Contact: John Linehan
Telephone: Not provided
Fax: Not provided
Email: john_linehan@irco.com

4 Description of Equipment Under Test and Variant Models

Manufacturer: Ingersoll-Rand Industrial U.S., Inc.
800-E Beaty Street
Davidson, NC 28036
USA

Equipment Under Test			
Description	Manufacturer	Model Number	Serial Number
Zigbee (IEEE 802.15.4) USB Dongle	Ingersoll-Rand Company	QCXD21 (USB Dongle)	*BOX220506946-002

*Shipping track number issued by Intertek.

Description of Equipment Under Test (provided by client)
The equipment under test is Zigbee (IEEE 802.15.4) USB Dongle that use with the INSIGHTqcx Wireless Tool Controller

Equipment Under Test Power Configuration			
Rated Voltage	Rated Current	Rated Frequency	Number of Phases
USB Powered	N/A	DC	N/A

Variant Models:

The following variant models were not tested as part of this evaluation, but have been identified by the manufacturer as being electrically identical models, depopulated models, or with reasonable similarity to the model(s) tested. Intertek does not make any claims of compliance for samples or variants which were not tested.

None

5 Power Density Calculation

5.1 Requirement(s)

FCC §1.1310 Radiofrequency radiation exposure limits

Table 1 below sets forth limits for Maximum Permissible Exposure (MPE) to radiofrequency electromagnetic field.

Table 1 – Limits for Maximum Permissible Exposure (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power Density (mW/cm ²)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposure				
0.3-3.0	614	1.63	*100	6
3.0-30	1842/f	4.89/f	*900/f ²	6
30-300	61.4	0.163	1.0	6
300-1,500			f/300	6
1,500-100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*100	30
1.34-30	842/f	2.19/f	*180/f ²	30
30-300	27.5	0.073	0.2	30
300-1,500			f/1500	30
1,500-100,000			1.0	30

F = frequency in MHz

* = Plane-wave equivalent power density

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Table 2 below sets forth limits for the RF field strength.

Table 2 – RF Field Strength Limits for Devices Used by the General Public (Uncontrolled Environment)

Frequency range (MHz)	Electric field strength (V/m rms)	Magnetic field strength (A/m rms)	Power Density (W/m ²)	Reference Period (minutes)
0.003-10	83	90	-	Instantaneous*
0.1-10	-	0.73/ f	-	6**
1.1-10	87/ f ^{0.5}	-	-	6**
10-20	27.46	0.0728	-2	6
20-48	58.07/ f ^{0.25}	0.1540/ f ^{0.25}	8.944/ f ^{0.5}	6
48-300	22.06	0.05852	1.291	6
300-6000	3.142 f ^{0.3417}	0.008335 f ^{0.3417}	0.02619 f ^{0.6834}	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	616000/ f ^{1.2}
150000-300000	0.158 f ^{0.5}	4.21 x 10 ⁻⁴ f ^{0.5}	6.67 x 10 ⁻⁵ f	616000/f ^{1.2}

Note: f is frequency in MHz.
(SAR)

*Based on nerve stimulation (NS)

**Based on specific absorption rate

5.2 Method

An MPE evaluation was performed in order to show that the device was compliant with FCC §2.1091 and ISSED RSS-102. The maximum power density was calculated for each transmitter at a separation distance of 20 cm. The calculation was performed using the maximum gain from the internal and external antennas declared by the manufacturer.

The maximum permissible exposure (MPE) is predicted by using the following equation:

$$S = PG/4\pi R^2$$

where: S = power density (in appropriate units, e.g. mW/cm²)

P = power input to the antenna (in appropriate units, e.g., mW)

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 (appropriate units, e.g., cm)

5.3 Calculation:

Power Density Calculation @ 20 cm.

EIRP = 5.42 dBm (conducted) + 2 dBi = 7.42 dBm or 5.521 mW

For P = 7.42 mW, R = 20 cm,

$$S = (7.42)/(4*\pi*20^2) = \mathbf{0.00148 \text{ mW/cm}^2} = \mathbf{0.0148 \text{ W/m}^2}$$

Minimum Safe Distance Calculation:

Maximum Power Density, S = 1.0 mW/cm²

Minimum Safe Distance D_{cm} is D_{cm} = ([7.42] / [4π])^{1/2}

$$D_{cm} = 0.66 \text{ cm}$$

Notes: The maximum conducted power of 5.42 dBm was taken from Intertek Report # 105001833BOX-006.

5.4 Results:

The sample tested was found to Comply. The calculated maximum power density at 20 cm distance is less than the limits for general population / uncontrolled exposure of 1.0 mW/cm².

6 ISED RSS-102 Issue 5 §2.5.2 Exemption**6.1 Requirement(s)**

Exemption Limits: $1.31 \times 10^{-2} f^{-0.6834}$ W ($300 \text{ MHz} \leq f < 6 \text{ GHz}$), f is in MHz.

6.2 Calculation

Frequency (MHz)	Conducted Peak Power (dBm)	Antenna gain (dBi)	Peak EIRP (dBm)	Peak EIRP (mW)	RSS-102 Exemption Limit (W)	Results
2405	3.93	2	5.93	3.917	2.679	Compliant
2440	4.47	2	6.47	4.436	2.705	Compliant
2475	5.42	2	7.42	5.521	2.732	Compliant

Notes: The maximum conducted power was taken from Intertek Report # 105001833BOX-006.

6.3 Results:

The sample tested was found to Comply. The power (e.i.r.p.) is much lower than the exemption limit, RF exposure evaluation is exempted.

7 Revision History

Revision Level	Date	Report Number	Prepared By	Reviewed By	Notes
0	06/09/2020	105001833BOX-006MPE	KPS <i>KPS</i>	VFV <i>VFV</i>	Original Issue