

RF Exposure Exemption Report

Renishaw Plc
RMP24-Micro, Model: RMP24MICQE

In accordance with FCC CFR 47 Pt 1.1307



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COMMERCIAL-IN-CONFIDENCE

FCC ID: KQGRMP24MICQE

Document 75960006-08 Issue: 02

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EXECUTIVE SUMMARY
The wireless devices described within this report are compliant with the exemption criteria related to human exposure to electromagnetic fields laid out in FCC CFR Title 47 Part 1.1307.

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1 Report Summary

1.1 Report Modification Record

Alterations and additions to this report will be issued to the holders of each copy in the form of a complete document.

Issue	Description of Change	Date of Issue
1	First Issue	16-April-2024
2	Adding second mode	02-May-2024

Table 1

1.2 Introduction

Applicant	Renishaw Plc
Manufacturer	Renishaw Plc
Model Number(s)	RMP24MICQE
Hardware Version(s)	Production
Software Version(s)	Production
Specification/Issue/Date	FCC 47 CFR Part 1.13072: 2022
Order Number	PU03663331
Date	06-December-2023
Related Document(s)	<ul style="list-style-type: none">• KDB 447498 D04 v01



1.3 Brief Summary of Results

The wireless devices described within this report are compliant with the exemption criteria related to human exposure to electromagnetic fields laid out in FCC CFR Title 47 Part 1.1307.

The calculations shown in this report were made in accordance with the procedures specified in the applied test specification(s).

1.4 Application Form

Equipment Description

Technical Description: <i>(Please provide a brief description of the intended use of the equipment)</i>	The RMP24-micro enables automated workpiece inspection and job set-up on small multi-tasking machines and machine centres. It uses 2.4GHz FHSS GFSK to communicate with an appropriate interface (RMI-QE).
Manufacturer:	Renishaw PLC
Model:	RMP24MICQE
Part Number:	As Tested

If more than one frequency band is supported, please confirm which combinations of bands are capable of Simultaneous Transmit.	
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Frequency Band 1: 2.4 GHz Renishaw Proprietary

Antenna Model:	PCB trace antenna	
Antenna length:	6.6	cm
Bottom frequency:	2403	MHz
Middle frequency:	2442	MHz
Top frequency:	2481	MHz

Maximum power (input to the antenna including a tolerance):	4	dBm
Antenna gain (or maximum gain allowed):	-14.43	dBi

Or

Field Strength Measurement:		dBµA/M
Measurement Distance:		cm

Separation distance from antenna to the user/bystander	20	cm
Transmitter Duty Cycle:	32	%



1.5 Product Information

1.5.1 Technical Description

The RMP24-micro enables automated workpiece inspection and job set-up on small multi-tasking machines and machine centres. It uses 2.4GHz FHSS GFSK to communicate with an appropriate interface (RMI-QE).

1.5.2 Transmitter Description

The following radio access technologies and frequency bands are supported by the equipment under test.

Radio Access Technology	Frequency Band (MHz)	Minimum Frequency (MHz)	Output Power (dBm)	Duty Cycle (%)
Renishaw Proprietary Mode 1 (FHSS)	2403 MHz to 2481 MHz	2403 MHz	0.00	32.0
Renishaw Proprietary Mode 2 (DTS)	2404 MHz to 2480 MHz	2404 MHz	4.00	32.0

Table 2 – Transmitter Description- FCC

Note: Transmitter power includes upper bounds of uncertainty therefore maximum values are used.



1.5.3 Antenna Description

The following antennas are supported by the equipment under test.

Radio Access Technology	Antenna Model	Gain (dBi)	Antenna length (cm)	Minimum Separation Distance (mm)
Renishaw Proprietary	PCB Slot	-14.43	6.6	200

Table 3 – Antenna description

In the case of more than one type of antenna being supported by the equipment, the calculation is based on the maximum of the antenna gains. If other antennas can be used that have greater gains, the minimum separation distances will need to be recalculated.

Note: Antenna gain includes upper bounds of uncertainty therefore maximum values are used.

1.5.4 Equipment Configuration

Single transmitter



2 Assessment Details

2.1 Single RF Source options for determination of exemption.

Option	Reference	RF Exposure Test Exemptions for Single Source												
A (1-mW Test Exemption)	FCC 1.1307(b)(3)(i)(A)	The available maximum time averaged power is no more than 1 mW, regardless of separation distance.												
B (SAR-Based Exemption)	FCC 1.1307(b)(3)(i)(B)	<p>The available maximum timeaveraged power or effective radiated power (ERP), whichever is greater, is less than or equal to the threshold P_{th} (mW) described in the following formula. This method shall only be used at separation distances (cm) from 0.5 centimeters to 40 centimeters and at frequencies from 0.3 GHz to 6 GHz (inclusive). P_{th} is given by:</p> $P_{th} \text{ (mW)} = \begin{cases} ERP_{20 \text{ cm}}(d/20 \text{ cm})^x & d \leq 20 \text{ cm} \\ ERP_{20 \text{ cm}} & 20 \text{ cm} < d \leq 40 \text{ cm} \end{cases}$ <p>Where</p> $x = -\log_{10} \left(\frac{60}{ERP_{20 \text{ cm}} \sqrt{f}} \right) \text{ and } f \text{ is in GHz;}$ <p>and</p> $ERP_{20 \text{ cm}} \text{ (mW)} = \begin{cases} 2040f & 0.3 \text{ GHz} \leq f < 1.5 \text{ GHz} \\ 3060 & 1.5 \text{ GHz} \leq f \leq 6 \text{ GHz} \end{cases}$ <p><i>d</i> = the separation distance (cm);</p>												
C (MPE-Based Exemption)	FCC 1.1307(b)(3)(i)(C)	<p>Or using Table 1 and the minimum separation distance (R in meters) from the body of a nearby person for the frequency (f in MHz) at which the source operates, the ERP (watts) is no more than the calculated value prescribed for that frequency. For the exemption in Table 1 to apply, R must be at least λ/2π, where λ is the free-space operating wavelength in meters. If the ERP of a single RF source is not easily obtained, then the available maximum time-averaged power may be used in lieu of ERP if the physical dimensions of the radiating structure(s) do not exceed the electrical length of λ/4 or if the antenna gain is less than that of a half-wave dipole (1.64 linear value).</p> <p>TABLE 1 TO § 1.1307(b)(3)(i)(C)—SINGLE RF SOURCES SUBJECT TO ROUTINE ENVIRONMENTAL EVALUATION</p> <table border="1"> <thead> <tr> <th>RF Source frequency (MHz)</th> <th>Threshold ERP (watts)</th> </tr> </thead> <tbody> <tr> <td>0.3–1.34</td> <td>1,920 R².</td> </tr> <tr> <td>1.34–30</td> <td>3,450 R²/f².</td> </tr> <tr> <td>30–300</td> <td>3.83 R².</td> </tr> <tr> <td>300–1,500</td> <td>0.0128 R²f.</td> </tr> <tr> <td>1,500–100,000</td> <td>19.2R².</td> </tr> </tbody> </table>	RF Source frequency (MHz)	Threshold ERP (watts)	0.3–1.34	1,920 R ² .	1.34–30	3,450 R ² /f ² .	30–300	3.83 R ² .	300–1,500	0.0128 R ² f.	1,500–100,000	19.2R ² .
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30–300	3.83 R ² .													
300–1,500	0.0128 R ² f.													
1,500–100,000	19.2R ² .													



2.2 Multiple RF Sources options for determination of exemption.

Option	Reference	
A 1-mW Test Exemption for Multiple Sources	FCC 1.1307(b)(3)(ii)(A)	The available maximum time averaged power of each source is no more than 1 mW and there is a separation distance of two centimeters between any portion of a radiating structure operating and the nearest portion of any other radiating structure in the same device, except if the sum of multiple sources is less than 1 mW during the time-averaging period, in which case they may be treated as a single source (separation is not required). This exemption may not be used in conjunction with other exemption criteria other than those is paragraph (b)(3)(i)(A) of this section. Medical implant devices may only use this exemption and that in paragraph (b)(3)(i)(A).
B Simultaneous Transmission with both SAR-based and MPE- Based Test Exemptions	FCC 1.1307(b)(3)(ii)(B)	in the case of fixed RF sources operating in the same time-averaging period, or of multiple mobile or portable RF sources within a device operating in the same time averaging period, if the sum of the fractional contributions to the applicable thresholds is less than or equal to 1 as indicated in the following equation. $\sum_{i=1}^a \frac{P_i}{P_{th,i}} + \sum_{j=1}^b \frac{ERP_j}{ERP_{th,j}} + \sum_{k=1}^c \frac{Evaluated_k}{Exposure\ Limit_k} \leq 1$



2.3 Individual Antenna Port Exposure Results

2.3.1 Single Source Calculation of Exposure at Specified Separation Distance FCC 1.1307 (b)(3)(i)(A) 'Option A'

RAT	Frequency (MHz)	Conducted Power Output mW	Duty Cycle %	Time Average Conducted Power Output mW	Separation Distance mm	1.1307(b)(3)(ii)(A) Exemption (Yes/No)
Renishaw Proprietary Mode 1 (FHSS)	2403	1.00	32.0	0.32	200	Yes
Renishaw Proprietary Mode 2 (DTS)	2404	2.51	32.0	0.8032	200	Yes

Table 4 –Transmitter Result

The calculations show that the individual transmitters comply with FCC 1.1307(b)(3)(i)(A) 1 mW based exception.