

## Manual for QP/NP Series 2D/3D Pre-Scanning System



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# Summary

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## Manual Description

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This manual describes the principle and operation of RAY- MOTION's QP series prefocused 2D/3D scanning systems.

Please read this manual carefully before using these devices. If you have any questions please contact us.

RAY-MOTION reserves the right to update this manual at any time without notice.

## Overview

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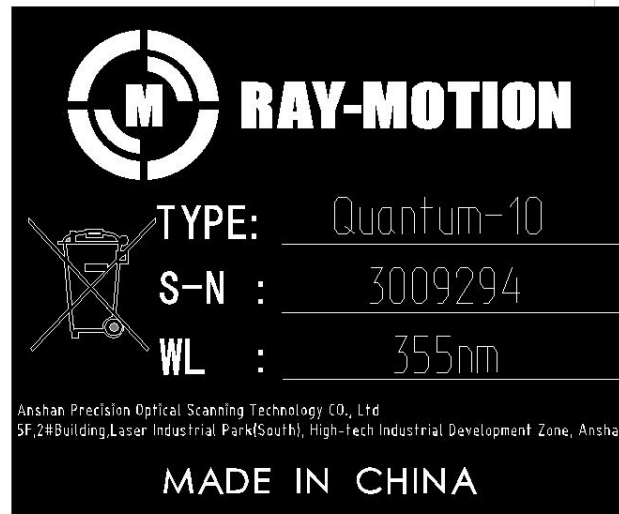
The QP/NP Series Pre-Scanning 2D/3D system is designed for scanning using 3D galvo. It includes input aperture models of 14mm, 20mm, 30mm, and 50mm. Cooling can be added to stabilize the system temperature.

## Product Configuration

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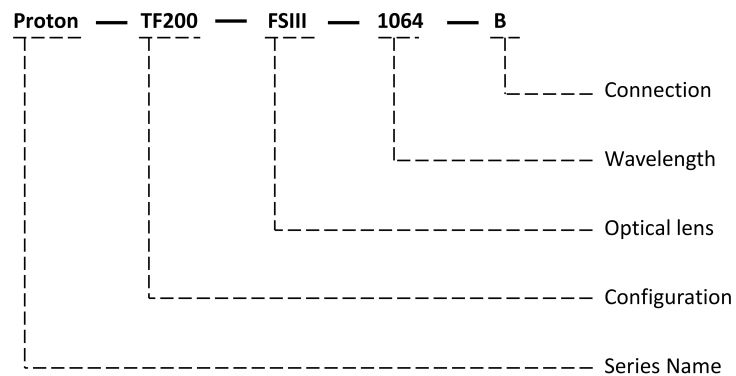
To determine the configuration of your product, refer to the product label located on the back of the galvo, which contains the model name of the product, the compatible laser wavelength ( $\lambda$ ) of the galvo, and the factory serial number (SN).

## Product Labels

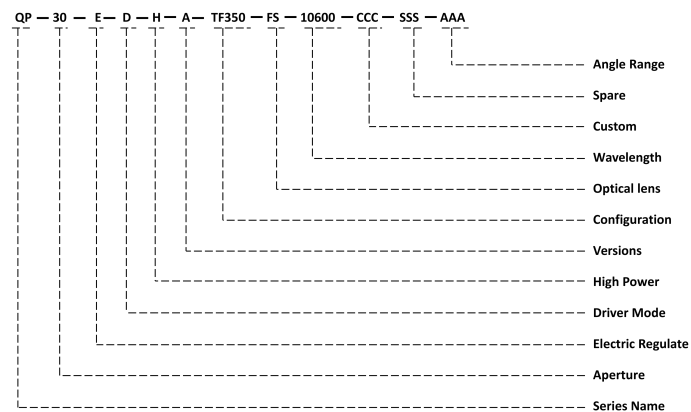


## Naming Rules

RAY-MOTION 3D Scanner naming rules:



RAY-MOTION 2D Scanner naming rules:



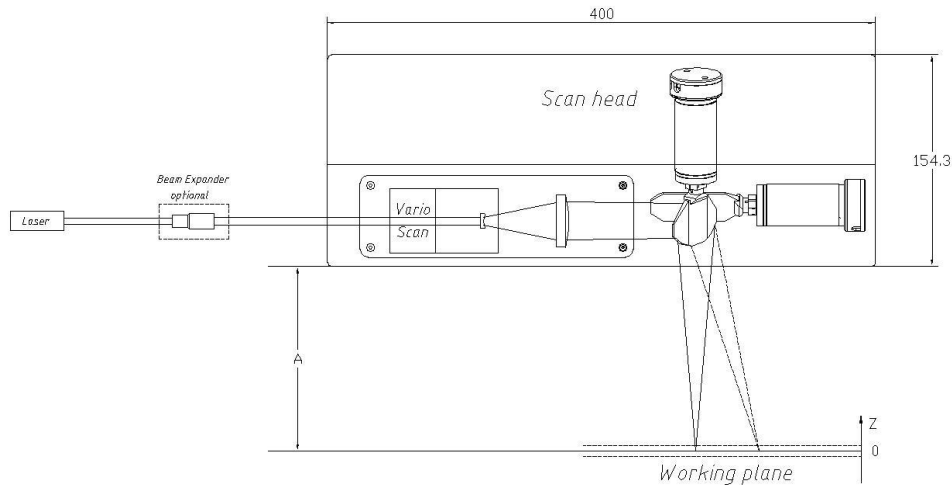
## List And Specifications Optional Of Systems

| System Type        | Equipment Model            |
|--------------------|----------------------------|
| 2D/3D Pre-Scanning | Proton-TF200 Series        |
|                    | Proton-TF200FSIII Series   |
|                    | Proton-TF300 Series        |
|                    | QP20 Series                |
|                    | NP20 Series                |
|                    | QP30 Series <sup>air</sup> |
|                    | NP30 Series <sup>air</sup> |
|                    | QP50 Series <sup>air</sup> |

# Instructions For Use

## System Structure

The optical configuration is shown in the figure below



The QP/NP series 3D Pre-Scanning system consist of three parts.

- 1) Voice coil motor(VCM) with diverging optic inside.
- 2) Focusing on optic.
- 3) 2D galvo subsystem.

The laser beam first enters the VCM, and is expanded by the diverging optical mirror. It is then focused by a focusing optics, which consists of a lens system with positive focal length. After focusing the optics, the 2D galvo system is responsible for scanning of the focused laser in the X-Y direction. VCM, on the other hand, focuses the beam at the desired location.

## Principles Of Operation

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Using the controller to programming the command for voice coil motor to move along the optical axis to maintain the laser focus in the desired plane or curved surface.

The working area and Z axis range depend on the position of the VCM position. You can tune them by shift the VCM initial position manually.

The entrance laser aperture must be tune carefully to match to system.



## System Component Requirements

You will need the following components to build a laser system for RAY-MOTION galvo.

| No.    | Parts  | Instruction  |
|--------|--|--|
| 1      | Power supply(AC220V)   | Used for power supply of lasers and computers                              |
| 2      | Power supply(DC $\pm 15v$ )  | For the power supply of the galvo  |
| 3      | Lasers   | Used to output lasers  |
| 4      | Beam adjustment device   | Such as beam expanders, collimators, etc                                   |
| 5      | Mounting plate   | For connecting fixed RAY-MOTION galvo                                      |
| 6      | Install hardware   | 4 $\times$ M5 Screws, 2 $\times$ 4mm dowel Pin                             |
| 7      | RAY-MOTION galvo   | Used to control laser deflection   |
| 8      | System Controller  | used to output the control signal of the galvo and laser with the computer |
| 9      | PC   | For controlling galvo and laser  |
| 10     | Power Cord/Data Cable  | Used to connect the system controller to the computer                      |
| 11     | Cooling Equipment*   | Air-cooled or liquid-cooled equipment for temperature control              |
| 12     | Work Protection*   | Air knife, inert gas environment, etc.                                     |
| Remark | * Marked parts are non-primary and are added selectively based on requirements and equipment capabilities. |  |

# Installation

## Installation Guide

### Note

*The scanning system must be mounted on a suitable support surface. The support surface should be flat and not affected by mechanical vibration.*

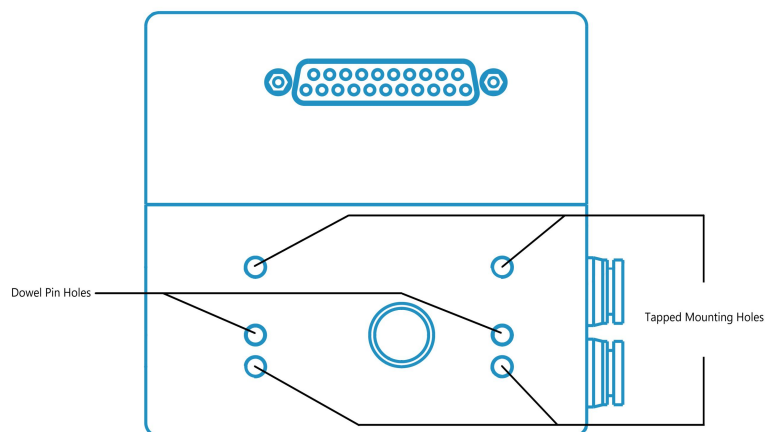
#### 1) Open the RAY-MOTION galvo package

After receiving this product, carefully unpack the contents of the box (check the contents according to the packaging list included with the equipment), carefully remove the galvo from the packaging, remove all the galvo dustproof items, and check whether all components are complete and available.

- ① Protects the galvo from dust and other contaminants.
- ② Save shipping containers and packaging material in case you need to return them for repairs, and the original packaging can better protect the product.

#### 2) Install the galvo

Mount the galvo to the mounting plate with mounting hardware, which has 2 Pin holes and 4 tapping mounting holes.

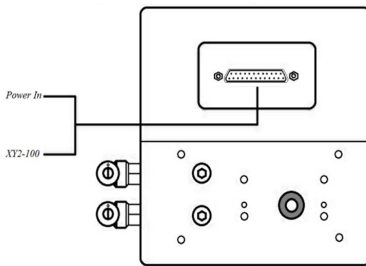


### 3) Connect the galvo

In the case of power off, use the power/data cable to connect the RAY-MOTION galvo to the system controller, the power supply and signal are set in a D-SUB25 female, the power supply specification is  $\pm 15V$ , the maximum peak current is 10A, and the digital signal protocol defaults to XY2-100.

It is recommended to verify the supply voltage before connecting the cable to the galvo, it is important to use the correct voltage, and using a voltage higher than the specified voltage may damage the machine.

The figure below depicts the distribution of the galvo power supply pins



| Pin      | Name            | Signal description                | In/Out |
|----------|-----------------|-----------------------------------|--------|
| 1/14     | Clock- / Clock+ | Clock: Continuously running clock | Input  |
| 2/15     | SYNC- / SYNC+   | SYNC: Synchronises data transfer  | Input  |
| 3/16     | CHAN1- / CHAN1+ | CHANNELX: Data to X axis          | Input  |
| 4/17     | CHAN2- / CHAN2+ | CHANNELY: Data to Y axis          | Input  |
| 5/18     | CHAN3- / CHAN3+ | CHANNELZ: Data to Z axis          | Input  |
| 6/19     | NC              | Not Connected                     | /      |
| 7/20     | NC              | Not Connected                     | /      |
| 8/21     | NC              | Not Connected                     | /      |
| 9/10/22  | POWER+          | +15V 5A                           | Input  |
| 11/23/24 | COM             | /                                 | Input  |
| 12/13/25 | POWER-          | -15V 5A                           | Input  |

### Note

- All related control devices must be turned off before connecting to scan the system.
- The scanning system does not support hot plug.
- The access power signal cable should be shielded.
- The pin GND must be grounded to avoid signal interference.

#### 4) Power on the galvo

Before plugging in the power, confirm that you have configured the system controller correctly to work with your laser, and after you have configured the controller and verified the controller's functionality, you can power on the galvo.

#### 5) Align the galvo with the laser

**To reduce the risk of injury, please follow the laser safety guidelines in this section.**



Never stare at the laser's beam, place any part of your body on the beam path, or expose yourself to the reflections of the beam, RAY-MOTION recommends that you completely enclose and lock the danger zone to prevent possible beam shifts when the laser is energized.

#### 6) Galvo correction

Each controller manufacturer has a specific correction procedure to eliminate any distortion caused by the position of the lens and galvo relative to the working area, distortion caused by the position of the lens and galvo relative to the working area. In the case of using the RMC2 controller, you will use RAY-MOTION CorrectionWizard software and follow the procedures in the CorrectionWizard manual and correction application notes.

At this point, the installation of the galvo is complete.

## Set Up For Initial Use

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The setting of the delay parameters is variable because the requirements and controllers used for each application fluctuate.

Use the delay settings listed in the following table as a starting point, then fine-tune the settings as needed.

RECOMMENDED DELAY SETTINGS FOR INITIAL USE

| Parameter Name | Parameter index |
|----------------|-----------------|
| Laser On       | Laser-dependent |
| Laser Off      | Laser-dependent |
| Mark Delay     | 130 $\mu$ s     |
| Jump Delay     | 260 $\mu$ s     |
| Poly Delay     | 65 $\mu$ s      |

This parameter is a universal recommended parameter, and should be adjusted according to the actual effect in order to achieve a better marking effect.

If you have any issues or questions while completing these steps, please contact RAY-MOTION.

## Cooling Fittings

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The QP/NP series scanning system can add liquid cooling to conduct the heat generated by the drive and laser injection. The user needs to install the appropriate liquid cooling equipment to ensure the supply cycle of the coolant.

Select the appropriate fittings and hoses to connect the QP/NP system to the liquid cooling equipment at a water temperature of not more than 30° C and a maximum pressure of 3 bar.

The coolant can be water with preservatives.

The coolant should not contain copper ions and other heavy metal ions, otherwise it will exacerbate the corrosion of the cooling pipe.

Some models are equipped with a lens air cooling device, and the air cooling interface and function are subject to the actual configuration (optional equipment equipped with air cooling has the "XXX<sup>air</sup>" logo in the "Optional System List and Specifications").

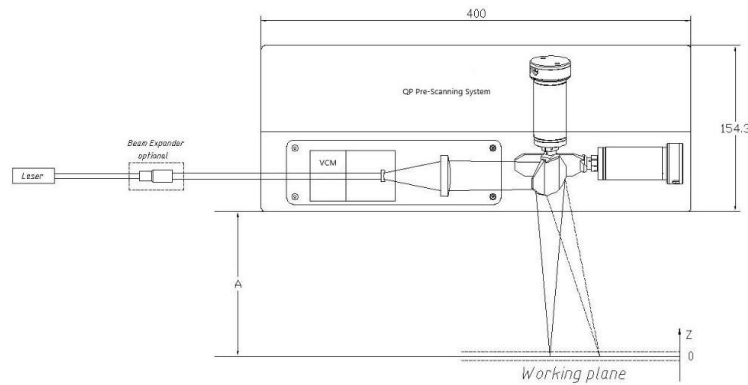
# Debugging

## Check The Installation

Before operating a QP/NP scanning system, double-check the following

- Verify that the laser wavelength is correct.
- Enter whether the beam diameter is correct.
- Whether the maximum laser power is appropriate.

The settings of the prefocus scanning system are as follows, and the following is an example of QP/NP30.



If the laser output beam is smaller than the inlet diameter of the QP/NP system, a beam expander must be added to the system.

If the diameter of the input beam is too small, the diameter of the focal point size on the focus plane will not be as small as it is theoretically. Moreover, the laser power density applied to the internal optics of the scanning system will be higher, which may lead to damage to the coating.

If the diameter of the input beam is too large, there will be a power loss at the entrance of the QP/NP scanning system. Therefore, the diameter of the laser beam must be carefully adjusted to meet the specifications of the QP/NP system.

The calculation of the diameter of the input beam depends on the exact system type of the QP/NP, Roughly its formula is as follows.

$$\Phi \approx \frac{A}{F}$$

$\Phi$  — Input diameter of the QP/NP series.

A — 2D aperture of the QP/NP series.

F — QP/NP beam expansion factor.

Take model QP/NP30-TF360-10600 as an example. The two-dimensional aperture is 30mm and the beam expansion coefficient is 3.6. The calculation method is as follows:

$$\Phi \approx \frac{A}{F} = \frac{30}{3.6} = 8.3mm$$

Considering the halo of the laser beam, we recommend 8 mm as the diameter of the input laser beam.

## Optical Path Correction

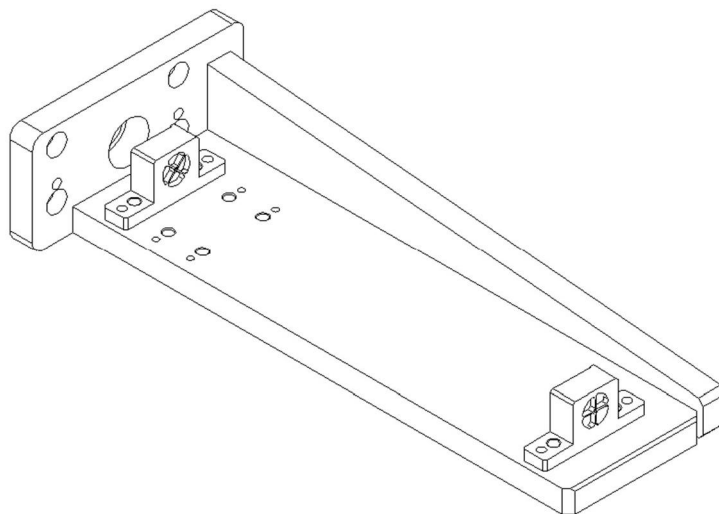
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Ensure that the laser coincides with the optical axis of the beam expander, which provides the correct beam expansion factor to guarantee the inlet beam diameter of the QP/NP system.

Make sure the beams behind the beam expander are parallel.

Make sure the beam matches the inlet hole of the QP/NP system.

RAY-MOTION offers the following beam alignment tools to check laser beams. The tool is installed on its mounting surface.





## Adjust The Focal Length - Manual Adjustment Version

First, adjust the appropriate working distance to guarantee scanning performance, which is determined by the size of the format you are using.

Following these steps to adjust the working distance.

- a. Open the QP/NP system side cover as shown below.

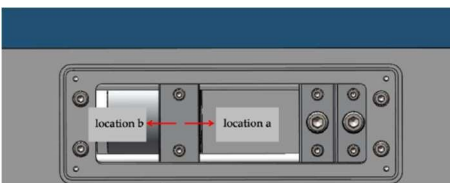


Loosen the fixing screws for the VCM.



- b. Manually adjust the VCM position. Move to the right to extend the working distance and expand the working range. Move to the left to shorten the working distance and reduce the working range.

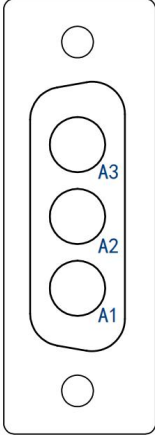
Slowly adjust and appropriately reduce the power of the input laser to prevent damage to the optical coating.



## Adjust The Focal Length - Electric Adjustment Version

### Wiring

Connect the D-SUB 3W3 socket to the +15V-48V DC power supply as follows.

| D-SUB 3W3 female connector foot map  | Index | Name | Explain                 |
|--|-------|------|-------------------------|
|  | A1    | V+   | +12V-48V DC Power Input |
|  | A2    | NC   | No Connection           |
|  | A3    | V-   | GND                     |

The RJ-45 connector of the galvo is a 100Base-TX(100Mbps) interface, which can be directly connected to the computer with a standard network cable of 568B.

| Network cable RJ-45 wiring diagram  | Index | Name           | Explain         |
|---|-------|----------------|-----------------|
|  | 1     | Orange & White | Transmit Data + |
|   | 2     | Orange         | Transmit Data - |
|   | 3     | Green & White  | Receive Data +  |
|   | 4     | Blue           | NC              |
|   | 5     | Blue & White   | NC              |
|   | 6     | Green          | Receive Data -  |
|   | 7     | Brown & White  | NC              |
|   | 8     | Brown          | NC              |

## Software Installation

Install the "STF Configurator Setup" software.

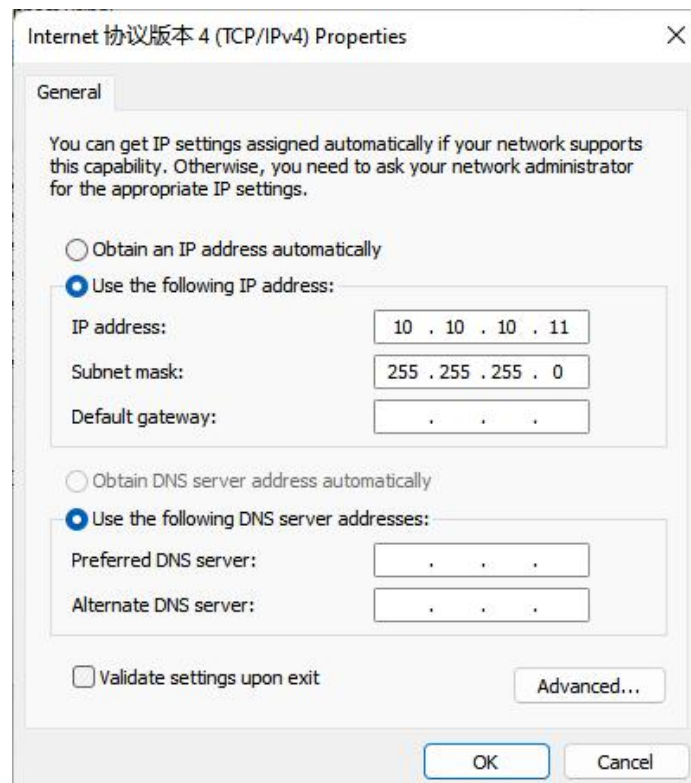


## Connect the PC

- 1) Open the "Control Panel", and select "Network and Internet" - "Network and Sharing Center" - "Change Adapter Settings".
- 2) Unplug the network cable and right-click the network cable where shown "Network cable unplugged", then click "Properties".



- 3) Double-click "Internet Protocol Version4(TCP/IPv4)", select "Use the following IP address" and set as shown in the figure.

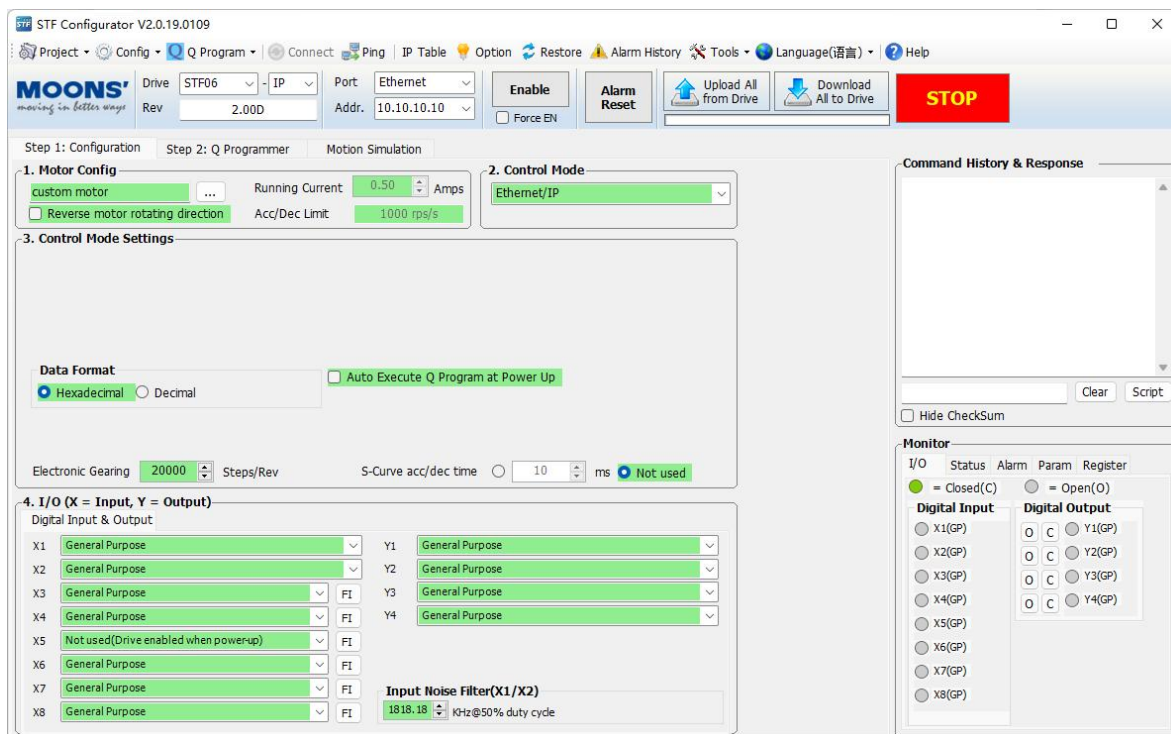
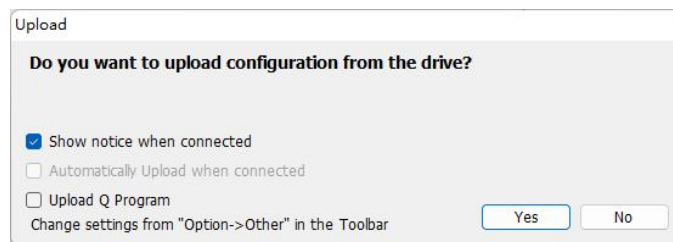


4) Confirm to exit. At this time, connect the network cable and power on the controller, and the network will be in the connected state.

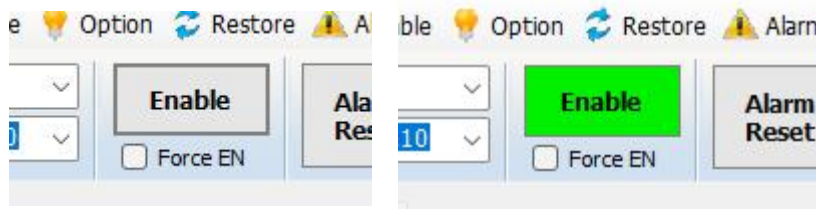


## Basic parameter setting and motion control

- 1) Open the "STF Configurator" software.
- 2) Set "Port" as "Ethemet", and set "Addr." as "10.10.10.10", and set "Drive" as "STF6 - IP".
- 3) Click the "Connect" button, if the device is correctly connected to the computer, a window of "Do you want to upload the configuration from the drive?" will be shown, click "Yes" and wait for the upload completed.



4) Click the “Enable” button to make the button green.



5) Select “Motion Simulation” tab, modify Velocity in “Initialize Parameters” and Jog Speed in “Jog” to “1”. At this time, the dynamic axis position adjustment can be realized by clicking or holding “CW Jog” or “CCW Jog”. “CW Jog” makes the focal length shorter, “CCW Jog” makes the focal length longer.

## Calibrate The Z Axis

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The QP/NP Series Front Focus Scanning System is compatible with most third-party 3D marking software and controllers on the market. Refer to calibration methods with third-party vendors.

# Trouble Shooting

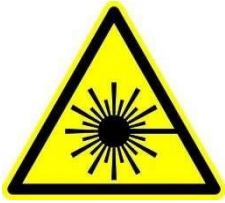
The following table outlines common problems that users encounter when using galvo, and completes the recommended actions to resolve them. If you need more help, please contact RAY-MOTION.

| Symptom  | Possible Cause                       | Recommended Action   |
|--|--------------------------------------|--|
| Head does not create any marks                           | Lens is out of focus                 | Verify that lens is set to the proper working distance   |
|  | Laser is disconnected                | Verify that all cables and wires are connected   |
|  | Beam path is blocked                 | Verify that the beam path is clear   |
| Head only marks a spot in the center of the field        | No command data is going to the head | 1)Verify that all cables and wires are connected<br>2)Check continuity and verify pinout of power/data cable   |
| Head only marks a spot in a random location of the field | No power is going to the head        | 1)Verify that all cables and wires are connected<br>2)Check voltage of cable providing power to the scan head.<br>3)Check continuity and verify pinout of power/data cable |
| Low laser power  | Optics are dirty or damaged          | Inspect all optical surfaces for dirt or damage  |
|  | Controller parameters have changed   | Verify the laser parameters in the software; correct parameters as needed.   |
|  | Laser is aging                       | Confirm that laser output corresponds with expectations according to the age of laser  |
|  | Optics have incorrect coating        | Verify transmission of optics with a laser power meter   |

# Laser Safety

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## Warning:



Laser beam can cause serious damage to the eyes and skin.

Ensure that the laser is turned off and that misoperation operation is available before operation.

Operators must pass laser safety-related training and wear protective equipment.

Before installing the system, it is important to understand all applicable rules and regulations for the safe operation of the laser. RAY - MOTION is not responsible for the customer's lasers and the entire system.

- a. Debug the laser path using a laser level not higher than 2.
- b. Enclose the entire laser path to block laser radiation.
- c. The laser warning symbol must be placed on the system. (Refer to IEC 60825-1 laser product safety requirements)
- d. During installation and operating system, do not look directly at the laser beam or its deflection radiation. Keep all parts of the body away from the laser beam and its deflection radiation range.
- e. Before daily maintenance, ensure that the laser, QP/NP series scanning system, and controller are turned off.
- f. Always wear appropriate goggles.

# Optical Safety

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- a. Do not touch the optics and lens with your hands.
- b. Optics may contain toxic substances. If the lens is damaged, do not touch or suck in dust with your hands.
- c. Optics should be cleaned using a mixture of 6:4 acetone and methanol in an appropriate manner.



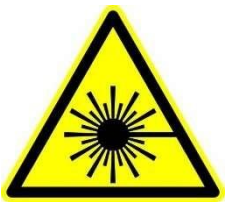
# Maintenance

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Due to the special method of equipment commissioning, the maintenance service of the equipment will be provided exclusively by RAY-MOTION.

For after-sales service, please contact us.

[www.ray-motion.com](http://www.ray-motion.com)



Warning:

Laser beam can cause serious damage to the eyes and skin.

Before cleaning, make sure that the laser is turned off and that the misoperation guard is available.

Relevant personnel must pass laser safety-related training and wear protective equipment.

Dirty optics increase the absorption of laser power by the optical surface.

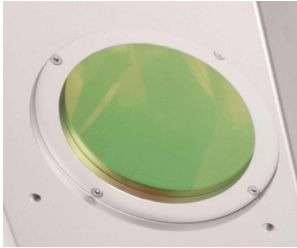
Dust, droplets and other contaminants in the air can distort the laser beam, causing damage to optical components or other indirect losses.

The company's promised warranty does not include any equipment damage caused by incorrect use methods, improper cleaning or handling methods, at which time the repair and maintenance costs will be borne by the customer.

All optics are sealed in a double-shell kit to protect the optics from dust contamination.

In principle, any form of contamination of the optical system should be avoided as much as possible, but it is difficult to completely avoid it in the actual use process, so it is necessary to clean the optical system with appropriate cycles. Regular inspection and cleaning of optical surfaces can effectively prevent permanent damage.

Optical cleaning instructions: If the optical component is contaminated by the marking process (such as being burned by splashed particles), some solvents (such as acetone, ethanol, propanol, hexane, etc.) can be prepared as follows:



- a. Wear clean gloves, loosen the fixing screws and remove the device.
- b. Blow the dust clearly with rubber skin.
- c. Use a cotton swabs to remove debris.
- d. Use mirror wipe paper to drag and drop to clean up.
- e. Clean again with a cotton swab stained with a small amount of the above solution, with a little force.
- f. Clean the edges of the lens.
- g. Clean up other parts.

# After-Sales Service

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All maintenance and repairs must be provided by RAY-MOTION.

Before the equipment is serviced and repaired, the customer need to contact RAY-MOTION to ensure that the process is carried out properly.

RAY-MOTION is responsible for the cost of mailing equipment for repairs and maintenance.

The customer is responsible for the cost of sending the equipment back to RAY-MOTION.

Contact details are as follows:

RAY-MOTION

Anshan Precision Optical Scanning Technology CO., Ltd

5F, 2#Building, Laser Industrial Park(South)

High-tech Industrial Development Zone

114000 Anshan, Liaoning China

Tel 86-412-5297375

Fax 86-412-5297370

[Info@RAY-MOTION.com](mailto:Info@RAY-MOTION.com)

[www.RAY-MOTION.com](http://www.RAY-MOTION.com)

## 3D Pre-Scanning Solution Specifications

### 前聚焦3D扫描系统 规格参数

二维扫描振镜请参照 Quantum14/20/30/50、Neutron14D/20D/30D规格书  
2D galvo reference to Quantum14/20/30/50、Neutron14D/20D/30D datasheet.

| 通用规格 General specifications |   | 动态聚焦轴 规格参数 Specifications for dynamic focus unit |          |
|-----------------------------|---|--|----------|
| 额定电源容量 Power requirements   | ±15V DC, Max peak current 10A<br>Max RMS current 5A | 镜头最大行程 Maximum lens travel                       | ±1.5mm   |
| 工作温度 Operating temperature  | 25±10℃  | 追踪时间 Tracking error time                         | 1ms      |
| 标准扫描角度 Typical scan angle   | 40 degrees  | 典型移动速度 Typical travel speed                      | ≤140mm/s |
| 接口协议 Interface              | XY2-100   | 可重复性 Repeatability                               | <1μm     |
| 重量 Weight                   | 4.5kg-21kg  | 长期漂移 Long-term drift                             | <6μm     |

#### CO2激光器(λ=10600nm):QP20/NP20D/QP30/NP30D/QP50配置实例

| 工作范围 Working dimension(mm)               | 200x200 | 400x400 | 600x600 | 800x800 | 1000x1000 | 1200x1200 | 1400x1400 |
|--|---------|---------|---------|---------|-----------|-----------|-----------|
| 光斑直径 Spot diameter(μm) <sup>(1)</sup>    |         |         |         |         |           |           |           |
| QP20/NP20                                | 336     | 603     | 869     | 1136    | —         | —         | —         |
| QP30/NP30                                | —       | 420     | 598     | 775     | 953       | —         | —         |
| QP50                                     | —       | —       | 372     | 478     | 585       | 691       | 798       |
| 工作距离 Working distance(mm) <sup>(2)</sup> |         |         |         |         |           |           |           |
| QP20/NP20                                | 228     | 502     | 777     | 1052    | —         | —         | —         |
| QP30/NP30                                | —       | 502     | 777     | 1052    | 1327      | —         | —         |
| QP50                                     | —       | —       | 737     | 1012    | 1287      | 1561      | 1836      |
| 分辨率 Resolution(μm)                       | 3       | 6       | 9       | 12      | 15        | 18        | 21        |

#### Nd:YAG激光器 (λ=1064nm) : QP20/NP20D/QP30/NP30D/QP50配置实例

| 工作范围 Working dimension(mm)               | 200x200 | 400x400 | 600x600 | 800x800 | 1000x1000 | 1200x1200 | 1400x1400 |
|--|---------|---------|---------|---------|-----------|-----------|-----------|
| 光斑直径 Spot diameter(μm) <sup>(1)</sup>    |         |         |         |         |           |           |           |
| QP20/NP20                                | 34      | 61      | 87      | —       | —         | —         | —         |
| QP30/NP30                                | —       | 42      | 60      | 78      | 96        | —         | —         |
| QP50                                     | —       | —       | 37      | 48      | 59        | 69        | 80        |
| 工作距离 Working distance(mm) <sup>(2)</sup> |         |         |         |         |           |           |           |
| QP20/NP20                                | 228     | 502     | 777     | —       | —         | —         | —         |
| QP30/NP30                                | —       | 502     | 777     | 1052    | —         | —         | —         |
| QP50                                     | —       | —       | 737     | 1012    | 1327      | 1561      | 1836      |
| 分辨率 Resolution(μm)                       | 3       | 6       | 9       | 12      | 15        | 18        | 21        |

#### QP14/NP14D配置实例: (λ=355/532/1064nm)

| 工作范围 Working dimension(mm)                | 200x200 | 300x300 | 400x400 | 500x500 | 600x600 |
|---|---------|---------|---------|---------|---------|
| 光斑直径 Spot diameter (μm) <sup>(1)</sup>    |         |         |         |         |         |
| λ=355nm                                   | 16      | 23      | 29      | 36      | 42      |
| λ=532nm                                   | 25      | 34      | 44      | 53      | 63      |
| λ=1064nm                                  | 50      | 68      | 88      | 106     | 126     |
| 工作距离 Working distance (mm) <sup>(2)</sup> | 247     | 385     | 522     | 660     | 797     |
| 分辨率 Resolution (μm)                       | 3       | 4.6     | 6       | 7.6     | 9       |

1、上述资料如有更改,将不做另行通知。The above information is subject to change without notice. 08/2022

2、以上参数均为理论值。All of the above parameters are theoretical values.

(1)实际光斑尺寸和写入速度取决于材料及应用,输入光束质量M<sup>2</sup>=1.

Actual spot size and writing speed are dependent on material and application, input beam quality M<sup>2</sup>=1.

(2)扫描振镜下沿到工作平面的距离。该距离取决于产品型号,并随着激光发散角和物镜公差而有所不同。

Distance between edge of deflection unit and working surface. This distance is dependent on the product model and will vary with laser divergence and objective tolerance.

## Revision History

Tip: The page numbers may appear differently for different versions, depending on the latest version.

| Versions | Date    | Attribute  |
|----------|---------|--|
| 1.0.a    | 2022.1  | <ul style="list-style-type: none"> <li>• Initial Version</li> </ul>  |
| 1.0.d    | 2022.6  | <ul style="list-style-type: none"> <li>• Add System component requirements</li> <li>• Add installation guide</li> <li>• Add initial use settings</li> <li>• Add trouble shooting</li> <li>• Add input aperture calculation method</li> </ul> |
| 1.0.e    | 2022.11 | <ul style="list-style-type: none"> <li>• Add Electric Adjustment Version</li> </ul>  |