Manual for QP/NP Series

3-axis galvo scanner system
Installation and operation

RAY-MOTION
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
www.ray-motion.com

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Contents

1 .Summary

This manual introduces the principle and operation method of Ray-motion QP20/NP20, QP/NP30 and QP/NP30H 3D Pre-Scanning systems.
Read this manual carefully before you operate with these systems. If you have any questions, please contact Ray-motion.
Ray-motion reserves the right to update this manual at any time without notification.

1.1 Overview

The QP/NP series 3D Pre-Scanning system is designed for 3D galvanometer scanning without scan lens. It includes 20 30 and 50mm input aperture style. It also has the water cooling function to stable the temperature of the system.

1.2 Unpacking and Caution

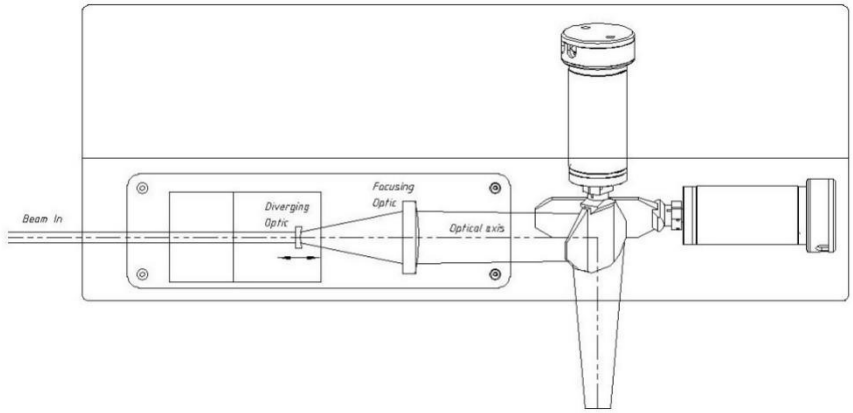
Carefully take out the QP/NP series from the packaging. Keep the packaging when you need to send it back to Ray-motion for repair or others reasons
Check all the components is available list in the shipping orders.

2.Principal description

2.1 System structure

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

a. Voice coil motor(VCM) with diverging optic inside it.
b. Focusing optic.
c. 2D galvanometers sub-system.



The laser beam first enters the VCM, and expanded by the diverging optic. Then focused by the focusing optic which consists a lens system with positive focal length.
After the focusing optic, the 2D galvanometer system is responsible for the scanning of the focused laser in the X-Y directions. And the VCM focuses the beam at the desired position.

2.2 Operation Principle

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

3.Installation

3.1 Laser Safety

Before installation of the system, all applicable rules and regulations for safe operation of lasers must be known. Ray-motion is not responsible for the laser and overall system in the customer location.

a. Adjust the laser path with a laser class not higher than 2
b. Cover the entire laser path to block laser radiation.
c. The laser warning symbol must be placed at the system. Reference to IEC 60825-1
d. During the installation, operation of the system, never stare directly in to the laser beam or its deflected radiation. Keep all parts of the body away from the laser beam and its deflected radiation.
e. Make sure that laser, QP/NP series scanner, PC controller are all turn off before routine maintenance.
f. Wear suitable eye protection glass at all times.

3.2 Optics Safety

a. Do not touch the optics by hand.
b. The optics may contain the toxic substance zinc selenide (ZnSe). If the ZnSe lens break, do not touch the glass or inhale any of the dust.
c. The optics should be cleaned by a mix of 60% acetone† and 40% methanol with appropriate method, and the ZnSe optics should not be cleaned with acids, since they may react to produce hydrogen selenide， which is a high toxic gas.

3.3 Mounting

a. The QP/NP series scanning system must be mounted onto a suitable support plate. The support plates should be planar and not subjected to mechanical vibration.
b. For the mounting details reference to the layout of the model.

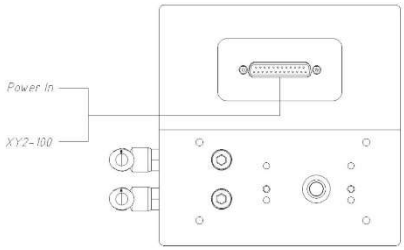
3.4 Cooling connection

The QP/NP series scanning system can be cooled during operation to transfer the heat produced by the driver and absorbed laser power from the entrance aperture. The user must install appropriate water inputs and outputs to ensure adequate supply and circulation of cooling water.
Select appropriate connectors and hoses to connect the QP/NP system and the

water supply device. The water temperature do not exceed 30℃. The maximum pressure of the cooling water is 3 bar.
Water with anticorrosive agent can be used as cooling liquid. The cooling liquid should be free of copper ions and other heavy metal ions. Otherwise enhanced corrosion of the cooling channels can occur.

3.5 Electrical connection

The power and signal are taken together in one 25-pin female D-SUB connector.



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+	CHANNELY :Data to Z axis	Input
6/19			
7/20			
8/21			
9/10/22	POWER+	+15V	Input
11/23/24	GND		Input
12/13/25	POWER-	-15V	Input

The power supply specification is ±15V, max 10 A.
The digital signal protocol is XY2-100
Caution!

a. When wiring the system, all control devices must be turned off.
b. The QP/NP system does not support hot-plugging.
c. The power cable should be shielded
d. The pin GND must reliable connection to the earth to avoid noise interference

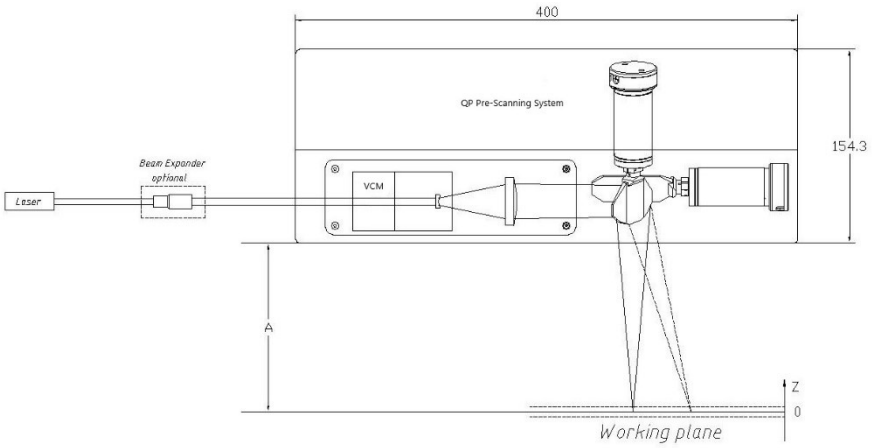
4.Tuning

4.1 Checking the Installation

Before operating the QP/NP scanning system, carefully check the following

a. Verify the laser wavelength is correct.
b. The input beam diameter is correct.
c. The maximum laser power is suitable.

The pre-scanning system setup is like below, Take QP/NP30 for an example below.



If the laser output beam is smaller than the entrance 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 focus spot size on the focus plane will not as small as theoretically possible. And the laser power density applied to the optics inside the scan system will be higher and might lead to coating damage.

If the diameter of the input beam is too large, there will be a loss of power at the entrance of the QP/NP scan system. So the laser beam diameter must be tuned carefully to match the QP/NP system specification.

The diameter of the input beam is calculated depend on the exact type of the QP/NP system. Roughly, the formula is below.

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

Φ - Input diameter of the QP/NP series.

A - 2D aperture of the QP/NP series.

F -QP/NP beam expand factor.

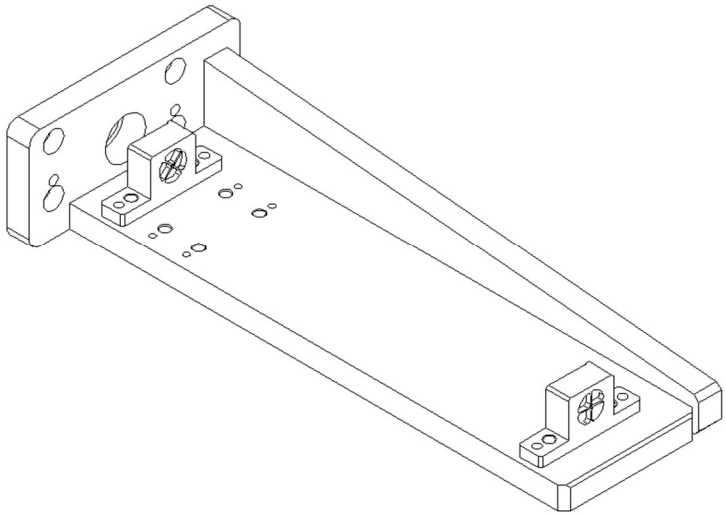
For example, the type is QP/NP30-TF360-10600. The 2D aperture is 30mm, beam expand factor is 3.6. Calculate it like below.

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

Consider the laser beam halo, we suggest 8mm as the input laser beam diameter.

4.2 Alignment

Make sure the laser coincides with the optical axis of the beam expander and the beam expander provide the correct expansion factor to guarantee the entrance beam diameter of the QP/NP system.
Make sure the beam after expander is parallel.
Make sure the beam is coincided with the entrance hole of the QP/NP system.
Ray-motion supply the Beam Alignment Tool below to check the laser beam. The tool is mounted to its installation surface



4.3 Find working distance

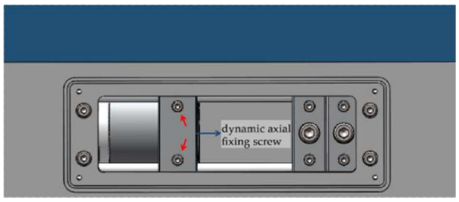
First of all, adjust suitable working distance to guarantee the scanning performance. The relationship of working distance and marking field dimension is illustrated below:

Model	Input (mm)	Wavelength (nm)	Feild	Focal length (mm)	Spot size in the center (um)
QP30-TF360-10600	7.2	10600	300×300mm	365	203.9
			400×400mm	502	270.2
			500×500mm	640	336.9
			600×600mm	777	403
			700×700mm	915	469.5
			800×800mm	1052	535.3
			900×900mm	1189	600.9
			1000×1000mm	1327	666.9
			1100×1100mm	1464	732.3
			1200×1200mm	1601	797.5

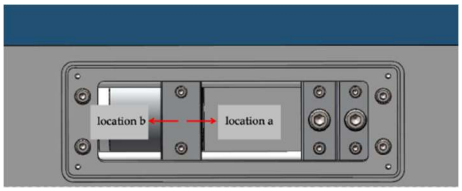
Following these steps to adjust the working distance.

a. Open the tuning window cover on the side of the QP/NP system like below.

Loosen the fixed screw of VCM.



b. Tune the VCM position manually. Move right to extend the working distance to enlarge the working field. Move left to shorten the working distance to reduce the working field.
Tuning slowly and lower down the input laser power to avoid optics coating damage.

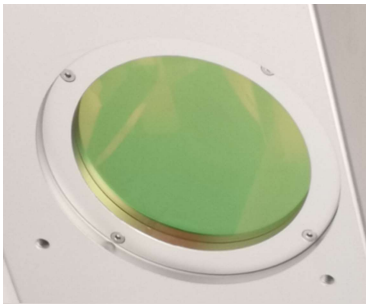


4.4 Calibrate the Z axis

QP/NP series Pre-Scanning system compatible with the majority third party 3D marking software and controller in the market. Reference to the calibration method with third-party supplier.

5. Maintenance

A dirty optic increases the absorption of laser power at the optical surface. Dirt, dust and other contaminants can distort the laser beam, burn into the surface and damage the optic. Consequential damage can also occur. The warranty does not cover any damage due to improper use, cleaning or handling.
All the optics are sealed in the twin shell kit, so it can avoid optics contaminated with dust.
Pay attention to cover the entrance hole of the QP/NP system.
If the window is contaminated from the laser process, i.e. burned-in particles of back-spatter, clean it with following steps.



a. Prepare some solvents like acetone, alcohol (e.g. propanol), hexane.
b. Take it down carefully with powder-free gloves by loosen the fixe screw.
c. Remove dust with the rubber blower.
d. Using Q-tips to remove contamination.
e. Using lens tissues with drag method.
f. Using Q-tips with polishing compound with slight pressure.
g. Clean the lens edge.
h. Clean the mount ring.

6. Service and Repairs

All service and repairs must be performed by RAY-MOTION.
Before the service and repairs the customer must contact RAY-MOTION to start the process.
RAY-MOTION is responsible for the return delivery of the products under warranty; then customer is responsible for delivery to RAY-MOTION.
The contact details are blow.

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
www.ray-motion.com

7. 3D Pre-Scanning Solution Specification

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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规格书（2D galvo reference to Quantum14/20/30/50 datasheet）

CO2激光器(λ=10600nm):QP20/QP30和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(um)[1]							
QP20	214	402	589	683	—	—	—
QP30	—	247	367	428	607	—	—
QP50	—	—	225	295	367	431	498
工作距离 Working distance(mm)							
QP20	228	502	777	915	—	—	—
Qp30	—	502	777	915	1327	—	—
QP50	—	—	737	1012	1287	1561	1836
分辨率(um)	3	6	9	12	15	18	21

Nd:YAG激光器（λ=1064nm）：QP20/QP30和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(um)[1]							
QP20	20	39	59	—	—	—	—
Qp30	—	26	38	45	—	—	—
QP50	—	—	23	30	38	45	53
工作距离 Working distance(mm)							
QP20	228	502	777	—	—	—	—
QP30	—	502	777	915	—	—	—
QP50	—	—	737	1012	1287	1561	1836
分辨率(um)	3	6	9	12	15	18	21

紫外激光器(λ=355nm)配置实例：Quantum-14-355+Proton-TF200FSⅢ-355

工作范围 Working dimension(mm)	200x200	300x300	400x400	500x500	600x600
光斑直径 Spot diameter (um)[1]	10	14	19	23	27
工作距离 Working distance (mm)	246	384	521	658	796
分辨率 Resolution (um)	3	4.6	6	7.6	9

绿光激光器(λ=532nm)配置实例：Quantum-14-532+Proton-TF200FSⅢ-532

工作范围 Working dimension (mm)	200x200	300x300	400x400	500x500	600x600
光斑直径 Spot diameter (um)[1]	15	21	28	35	41
工作距离 Working distance(mm)	246	384	521	658	796
分辨率 Resolution(um)	3	4.6	6	7.6	9

动态聚焦轴 规格参数 Specifications for dynamic focus unit	
镜头最大行程 Maximum lens travel	±1.5mm
追踪时间 Tracking error	1ms
典型移动速度 Typical travel speed	≤140mm/s
可重复性 Repeatability	<1um
长期漂移 Long-term drift	<6um

注:
(1)输入光束质量$M^2=1$,焦斑大小为理论值.
Input beam quality: $M^2=1.0$,The spot size is airy radius.

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. 12/2019
2、以上参数均为理论值。All of the above parameters are theoretical values.
3、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.
4、实际光斑尺寸和写入速度取决于材料及应用。
Actual spot size and writting speed are dependent on material and application.

鞍山精准光学扫描技术有限公司
Anshan Precision Optical Scanning Technology CO.,Ltd
辽宁省鞍山市高新区激光产业园南园2#楼
2#Building,Laser Industrial Park(South), High-tech Industrial Development Zone,AnShan
TEL:86-412-5297375
FAX:86-412-5297370
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info@ray-motion.com

Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

1.0.a (Mar 2020)
Initial
1.0.b (Mar 2020)
Add input aperture calculation method in 4.1
1.0.c (Dec 2021)
Add NP series, Beam Alignment Tool in 4.2