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Assisted 24 Channel Rotary Joint

User Manual

Version 1.0.0

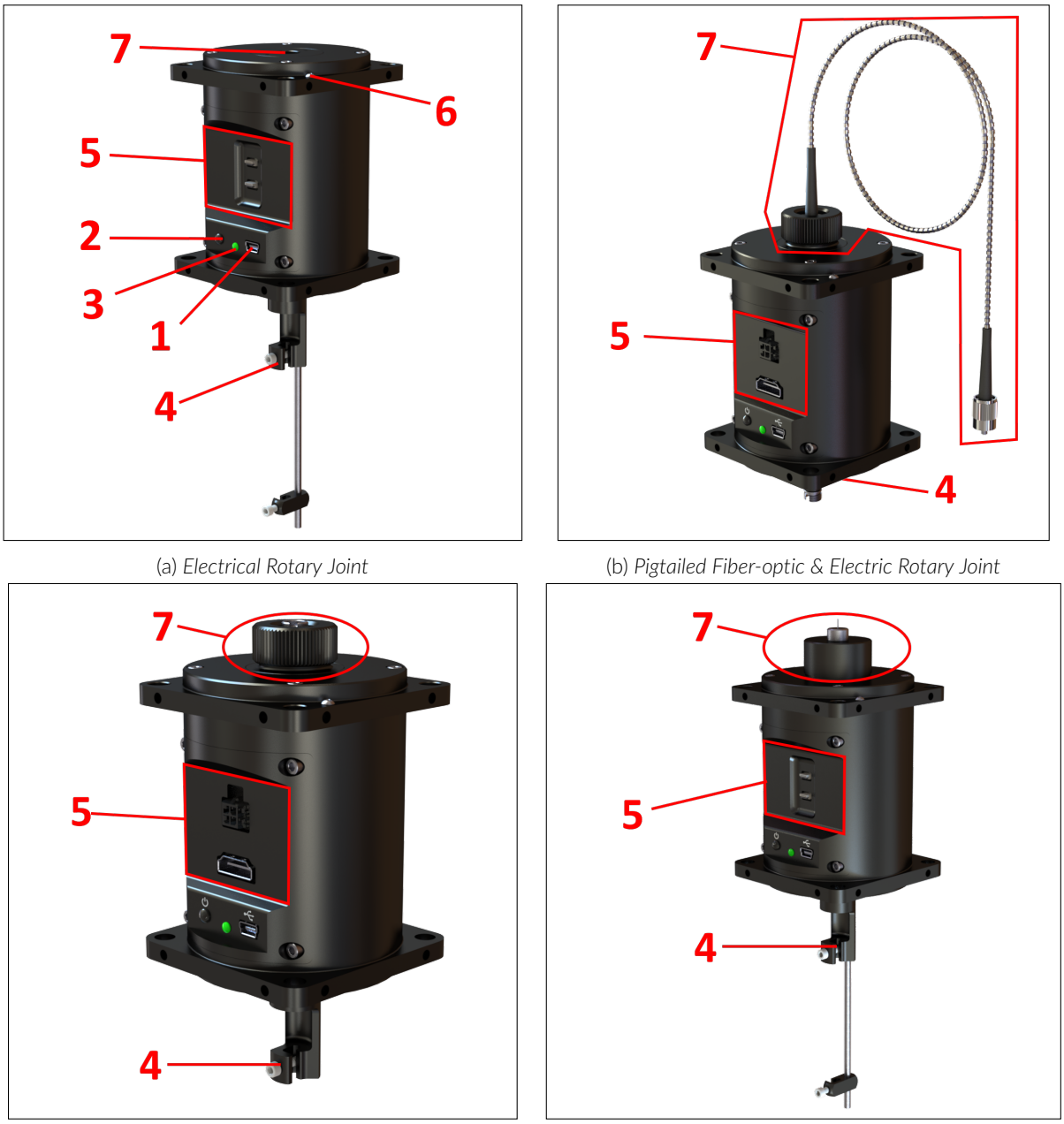
Contents

1

Quick Start

Assisted rotary joints contain the following features (see Fig 1.1):

1. **Power supply connector :** USB Mini-B 5V Port used to connect the rotary joint power supply. Must be connected to a 2A USB port.
2. **ON/OFF button :** Enables or disables the rotation function (Do not block the recording even if the rotary joint is OFF).
3. **Status light :** The light is red when the assistance is OFF but the power supply is connected. The light is green when the assistance is ON.
4. **Torque sensor :** The torque sensor detects when the electric cables or the optical fibers are turning to follow animal movements.
5. **Electrical connectors :** The electrical signal is transmitted through a variety of connectors located on the rotor and stator.
6. **Ground :** #2-56 screw connects to the ground hole. Bend an electrical wire around the screw, and connect the cable to an outside ground. This can reduce electrical noise when used in high-sensitivity applications.
7. **Optical or liquid connector :**
    a) Clearance hole: The central clearance hole is used in cases where an optical signal is required. It allows for the passage of one optical fiber with ferrule/sleeve connectors or a tube up to 12.7 mm in diameter (Fig. 1.1a).
    b) Optical connector: Fig. 1.1b and Fig. 1.1c
    c) Liquid connector: Fig. 1.1d



(a) *Electrical Rotary Joint*

(b) *Pigtailed Fiber-optic & Electric Rotary Joint*

(c) *Fiber-optic & Electric Rotary Joint*

(d) *Electric-Liquid Rotary Joint*

Figure 1.1: *Overview of the different rotary joints*

2

Mobility and Fixation

2.1 Torque Assistance

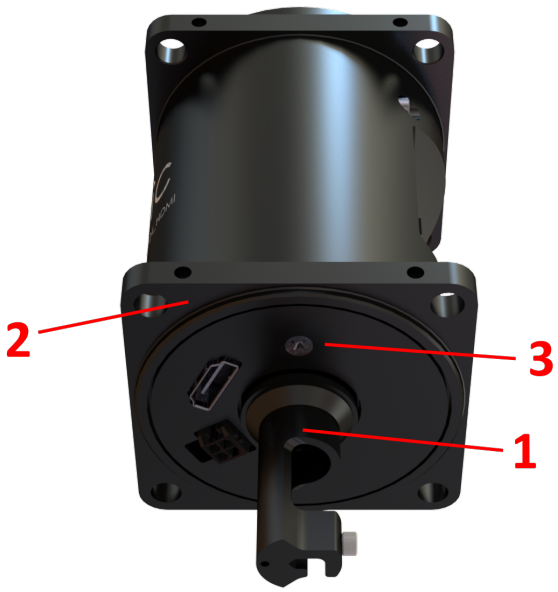
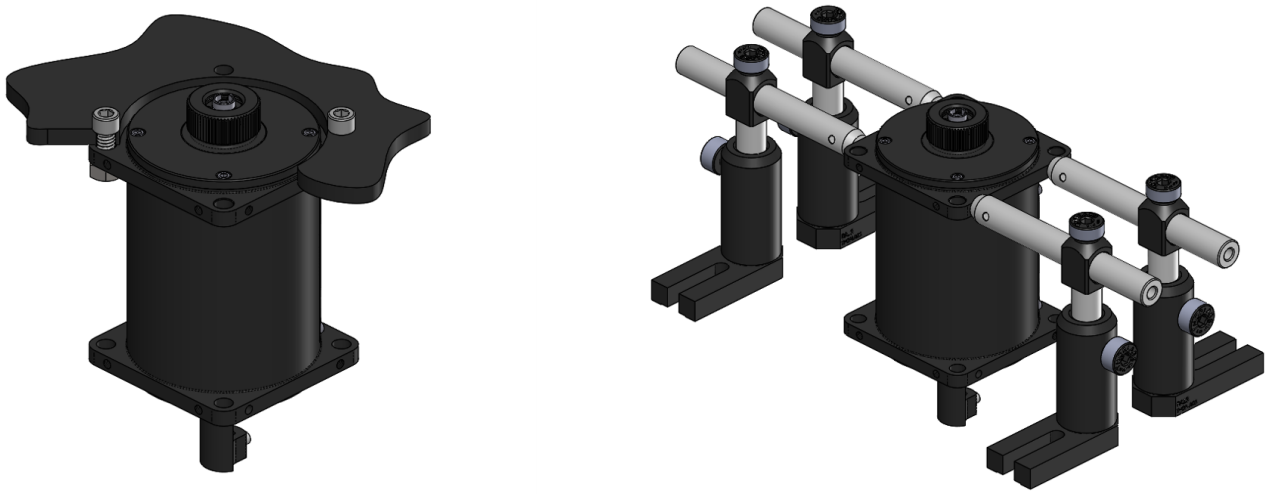


Figure 2.1: *View of the bottom of rotary joint*

1. The **Torque Sensor** is used by the rotary joint to detect when cables are turning.
2. The **Stator** contains all the fixed input ports, as well as the power supply port.
3. The **Rotor** contains all the rotary output ports.

2.2 Mounting Points

Several configurations are possible to secure the *Assisted 24-channel rotary joint*. To help immobilize the rotary joint, the frame contains 8 holes, 4 on the top and 4 on the bottom, with a diameter of 6.8 mm (example in Fig. 2.2a) and 16 internal threads 8-32, 2 on each corner (example Fig. 2.2b).



(a) *Example of fixation with 6.8 mm holes*

(b) *Example of fixation with 8-32 thread*

Figure 2.2: *Example of fixing rotary joints*

2.3 Electrical Rotary Joint Installation

Please be careful when connecting/disconnecting cables to avoid giving too much pressure on the torque sensor limiter as it is a relatively fragile sensor.

To make the torque sensor work properly, adding a loop or a deported cable is needed in some cases (see Table 2.1). The Assisted Electrical Rotary Joint uses the loop solution detailed in the section 2.3.1 if they are used without optical fiber, while the Rotary Bundle-imaging Fluorescence Mini Cube (RBFMC) Rotary Joint version uses a deported cable solution detailed in the section 2.3.2.

Note: The Assisted Electrical Rotary Joint For RFMC can be set with both solutions to perform.

	No Loop Required	Loop on Torque Sensor	Loop with Extension Rod	Deported Cable
AERJ		X	For rigid cables	
AHRJ 1x1-OE	X	If optical fiber not used		
AHRJ 1x2-OE	X	If optical fibers not used		
AHRJ 1x1-OE-PT	X			
RBFMC				X
RFMC			X	X
AHRJ-EL		With both cables		

Table 2.1: *Use of loop, rod, or deported cable*

2.3.1 Loop for Torque Sensor Installation

The **Torque Sensor loop** is necessary for the effective operation of the *Assisted Electrical Rotary Joint* when the rotary joint is used for electrophysiology only or with the integrated fluorescence mini cube. It acts as a cable holder to allow a good rotation with the weight of the electrical cable or the optical fiber. To install the loop and the electrical cable/fiber, follow this procedure before connecting the rotary joint to an experimental subject.

Notes:

- To simplify the text, an electrical cable will be used in the rest of the section to designate an electrical cable or an optical fiber.
- Steps 1 and 2 are not necessary if the extension rod is not necessary (see Table 2.1). The torque sensor's clamp for optical fiber can be used in replacement to minimize the system in this case.

(a) (b) (c)

Figure 2.3: *Rotary Joint Torque Rod and Loop Fixation*

1. Add the black cable clamp to the end of the **Torque Rod**. Secure the clamp to the rod with a # 4-40 screw (Fig. 2.3a).
2. Connect the **Torque Rod** with a # 0-80 set-screw into the small screw-hole on the **Torque Sensor** (Fig. 2.3a).
3. Install the rotary joint on the experimental setup. For proper function of the rotary joint, it **MUST BE LEVEL**.
4. Ensure approximately 10 cm of clearance around the **Torque Sensor**.
5. Delicately move the **Torque Sensor** left and right. The **Torque Sensor** will hit two **Sensors** (inside the rotary joint) that activate the rotary joint's assist function while powered. If you move the **Torque Sensor** less delicately or if the rotary joint is not activated, the rotor can be rotated.
6. Move the **Torque Sensor** to be between the two **Sensors**, a position called **Center** (Fig. 2.4).
7. Connect the **Electrical Connector** to the rotary joint.
8. Loop the cable into the clamp (Fig. 2.3b), and secure it in place using the *# 4-40 nylon socket screw* (Fig. 2.3c). The Loop needs to have a diameter greater than 5 cm, 10 cm is recommended.
9. Because of its weight, the **Cable Loop** will move the **Torque Sensor** off-center. The loop's orientation must be adjusted so the **Torque Sensor** is centered on its own.
    a) Adjust the **Cable Loop** orientation by slightly unscrewing the *nylon socket screw*, rotating the **Hanging Cable** (Fig. 2.3c) using the thumb and forefinger, then tightening the screw when in position.
    b) Identify the **Extremes** of the **Cable Loop** orientation. Adjust the loop so the **Torque Sensor** rests on one sensor, then the other.
    c) Adjust the orientation of the **Cable Loop** to be between the **Extremes**.

10. Check the distance between this new **Center** and the two sensors.
    a) If the distance from **Center** to **Sensor** appears equal on both sides, go to step **11**.
    b) If the distance from **Center** to **Sensor** appears unequal, redo step **9**.
11. Connect the power supply to the rotary joint and activate the rotation function with the **ON/OFF button**.
    a) If the rotary joint starts spinning uncontrollably, deactivate the rotation function.
        i. Check if the holder is level. If not, return to step **3**.
        ii. Check the **Center**. If the **Torque Sensor** is not properly centered, return to step **9**. If the *nylon socket screw* is not well secured, the **Cable Loop** can easily move and de-center the **Torque Sensor**.
    b) If the rotary joint stays motionless, gently grasp the **Hanging Cable** with the thumb and forefinger, rotating the **Hanging Cable** clockwise and counter-clockwise.
        i. If the assist function activates as the **Hanging Cable** is turned, doing small, slow movements, go to step **12**.
        ii. If the rotary joint starts spinning uncontrollably, go to step **11a**.
        iii. If the rotary joint spins rapidly, making large movements for small movements of the **Hanging Cable**, the **Torque Sensor** is almost centered. Return to step **9**.
        iv. If the rotary joint moves correctly in one direction but does not move in the other, check the clearance of the rotary joint. If the *1/8 hex set-screw* is still in place, it can easily hit the **Electrical Connector**, stopping movement in one direction. Objects that block the **Cable Loop** can cause similar problems. Once the blocking object is cleared, redo step **11**.
12. Once the rotary joint moves properly for small **Hanging Cable** rotations, ensure all screws are well secured.
13. Test the rotary joint using large, quick rotations of the **Hanging Cable**.
    a) If the rotary joint starts spinning uncontrollably, return to step **11a**.
    b) If the rotary joint now only spins in large, fast movements, even when the rotation of the **Hanging Cable** is minimal, return to step **10**.
14. Once the movement correspondence is adequate, the rotary joint is well aligned. This process must be repeated if the rotary joint is uninstalled, or if the movements no longer correspond.

Figure 2.4: *Torque Sensor position relative to the **Center** position (in blue), for **Left**, and **Right** (in red). In the **Center** position, the rotary joint doesn't move.*

2.3.2 Deported Cable Installation for Torque Sensor

The deported cable is necessary for the effective operation of the Rotary Bundle-imaging Fluorescence Mini Cube (RBFMC). The cable is included with the system but needs to be set before the first use of the system. To install it, follow this procedure:

1. Install the rotary joint. For proper function of the rotary joint, it **MUST BE LEVEL**.
2. Connect the patch cord to the SMA port of the rotary joint.
3. Turn on the rotary joint.
4. Delicately move the Torque Sensor left and right. The Torque Sensor will hit two Sensors (inside the rotary joint) that activate the rotary joint's assist function while powered. If you move the Torque Sensor less delicately or if the rotary joint is not activated, the rotor can be rotated.
5. Move the Torque Sensor to be between the two Sensors, the position called Center.
6. Clip the deported cable to the holder.
7. Bring the other extremity of the deported cable close to the fiber-optic patch cord and tape both cables together.
8. The fiber-optic patch cord needs to be straight and the rotary joint must not rotate when no effort is applied (see Fig. 2.5). (If this is not the case, please remove the tape and start this step again)
9. If the rotary joint didn't move, try to move the cable to see if the rotary joint follow the movement. If this is not the case, remove the tape and start again with the previous step. Otherwise, the system is ready to be used.

Figure 2.5: *RBFMC with deported cable*

2.3.3 Optical Fiber Patch Cord Use

Please be careful when connecting/disconnecting cables to avoid giving too much pressure on the torque sensor limiter as it is a relatively fragile sensor.

1. Clean the optical fiber connector before insertion. Use isopropanol and a lint-free wipe.
2. With an FC connector, the connector key must be oriented to enter within the receptacle slot to ensure proper connection (Fig. 2.6).

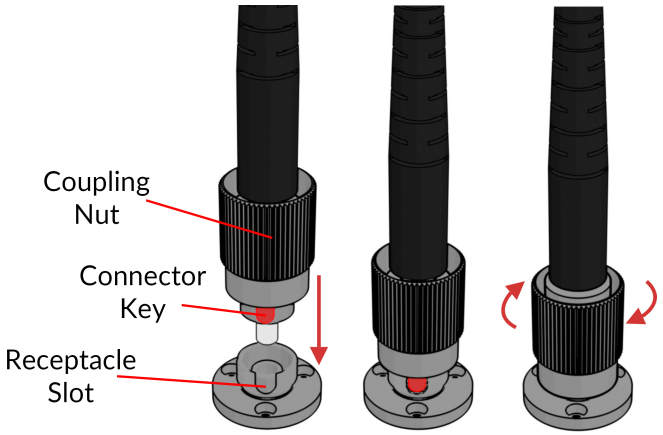


Figure 2.6: *FC connector, Fiber Installation*

WARNING!

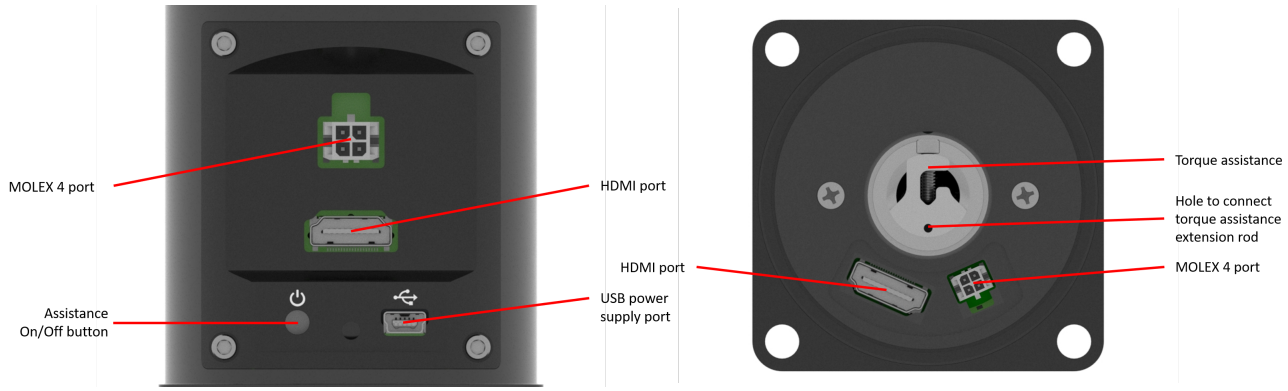
To reduce the risk of eye injury, **it is sound practice to NOT CONNECT/DISCONNECT OPTICAL FIBERS** when the light source is turned on.

3

Assisted Electrical Rotary Joint

This section will present different configurations for the **Assisted Electric 24-Channel Rotary Joint**. The **HDMI+4**, **HARWIN** and **PZN12** connectors configurations are also used with the Assisted Hybrid Rotary Joints.

3.1 HDMI+4 Connectors

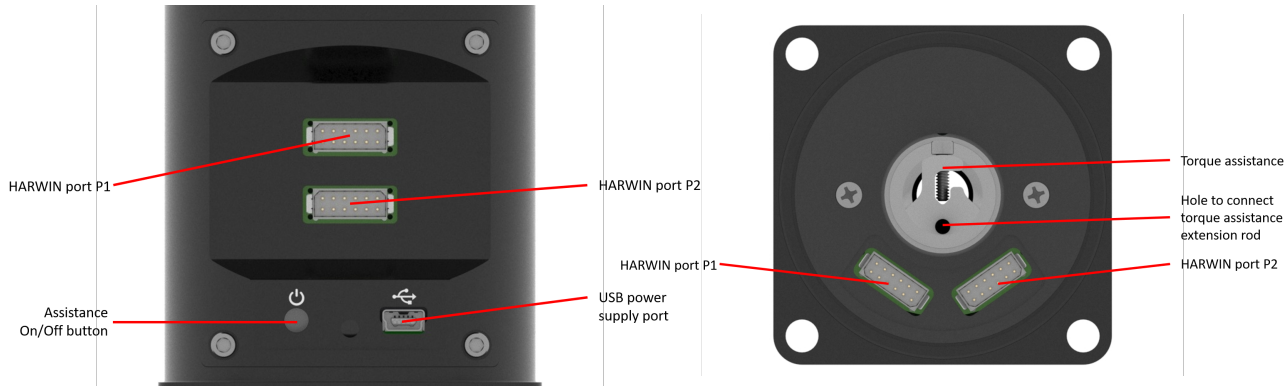


(a) *Front* (b) *Bottom*

Figure 3.1: *HDMI+4 presentation*

The configuration comprising an **HDMI** port and a **Molex 4** port (Molex Micro-fit 3.0 Dual Row 4 Contacts Connector) which allow to use 4 electrical contacts for custom use. This configuration is mainly used in the microscopy system, except for the 2-color microscopy system, and in Tethered Optoelectrophysiology. Both ports are present in the front and at the bottom of the rotary joint.

3.2 HARWIN Connectors

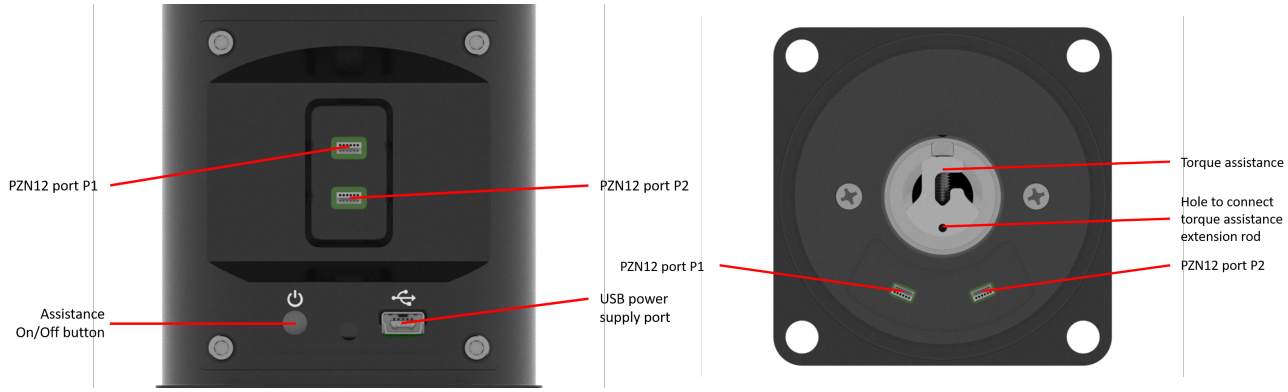


(a) *Front* (b) *Bottom*

Figure 3.2: *HARWINx2 presentation*

The configuration includes two **HARWIN** (Harwin Datamate L-Tek 12 pos 2-row male header) male ports in the front and at the bottom part of the rotary joint. This configuration is mainly used with self-developed devices as it's easy to connect and personalize.

3.3 PZN12 Connectors



(a) *Front* (b) *Bottom*

Figure 3.3: *PZN12x2 presentation*

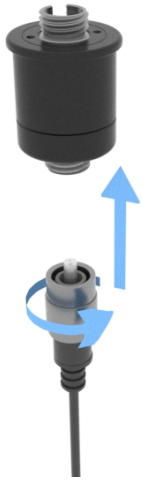
The configuration includes two **PZN12** (Omnetics Polarized Nano connector PZN-12) ports in the front and at the bottom part of the rotary joint. This configuration is mainly used with Intan systems and more generally in electro-physiology acquisition.

4

Assisted Hybrid Rotary Joint

4.1 1x1 Fiber-optic & Electric Rotary Joint

(a) *Unscrew the protection*



(b) *Plug the optical fiber into the FRJ-1x1*

(c) *Pass the optical fiber through the rotary joint*

(d) *Screw the protection on the FRJ 1x1*

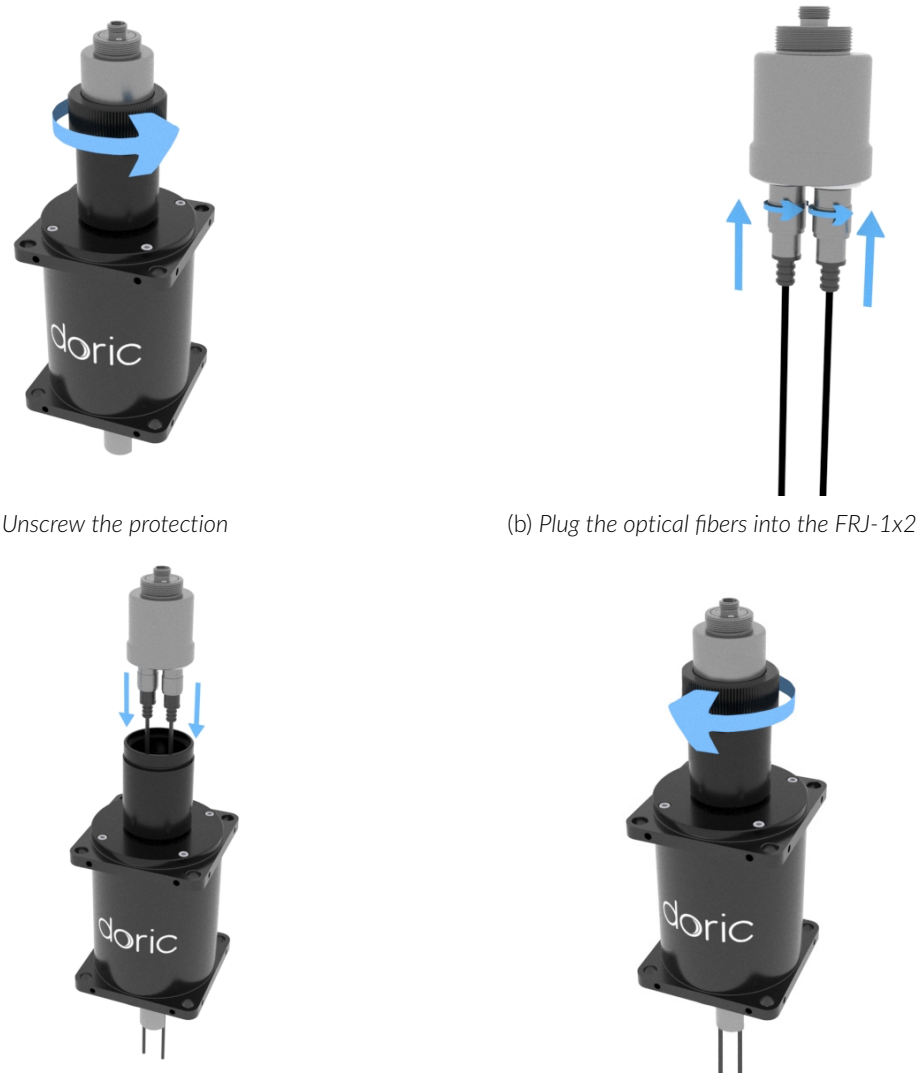
Figure 4.1: *Assisted rotary joint 1x1 installation*

This configuration is more versatile and allows to change the top fiber to switch between 200 µm and 400 µm optical fiber. Optical transmission is less uniform than the 1x1 pigtail version and is mainly used for optogenetics.

To install the optical rotary joint in the assisted electric rotary joint:

1. Unscrew the protection and take out the optical rotary joint (Fig. 4.1a).
2. Plug the optical fiber patch cord to the rotary joint (Fig. 4.1b). For the procedure showing how to connect an FC patch cord, please see section 2.3.3.
3. Pass the optical fiber through the assisted Electric Rotary joint until the optical rotary joint fits in the hole (Fig. 4.1c).
4. Screw the protection on the rotary joint (Fig. 4.1d). The rubber ring will immobilize the top part of the optical rotary joint.
5. Screw the screw on the torque sensor to pinch the optic fiber (take care to not break the optical fiber but put enough pressure to ensure that the optical fiber and the torque sensor are moving together).

4.2 1x2 Fiber-optic & Electric Rotary Joint



(a) *Unscrew the protection*

(b) *Plug the optical fibers into the FRJ-1x2*

(c) *Pass the optical fibers through the rotary joint*

(d) *Screw the protection on the FRJ 1x2*

Figure 4.2: *Assisted rotary joint 1x2 installation*

This configuration is the best configuration to preserve the maximum intensity for experiments that require one light source for two implants in freely moving animals.

To install the 1x2 optical rotary joint in the assisted electrical rotary joint:

1. Unscrew the protection and take out the optical rotary joint (Fig 4.2a).
2. Plug the optical fiber patch cords to the rotary joint (Fig. 4.2b). For the procedure showing how to connect an FC patch cord please, see section 2.3.3.
3. Pass the optical fibers through the Assisted Electric Rotary joint until the optical rotary joint fits in the hole (Fig. 4.2c).
4. Screw the protection on the rotary joint (Fig. 4.2d). The rubber ring will immobilize the top part of the optical rotary joint.
5. Screw the screw on the torque sensor to pinch one of the optical fiber (take care to not break the optical fiber but put enough pressure to ensure that the optical fiber and the torque sensor are moving together).

4.3 1x1 Pigtail Fiber-optic & Electric Rotary Joint

Figure 4.3: *1x1 Pigtail-assisted rotary joint presentation*

The **1x1 Pigtail Fiber-optic & electric assisted rotary joint** can't be dismantled like the other version presented previously. It's assembled and optimized in facility to maximize the performance and the light transmission to obtain a more stable illumination, mainly preferred in photometry applications. Due to this optimization, it's impossible to change the optical fiber at the top of the rotary joint.

4.4 Rotary Bundle-imaging Fluorescence Mini Cube (RBFMC) Rotary Joint

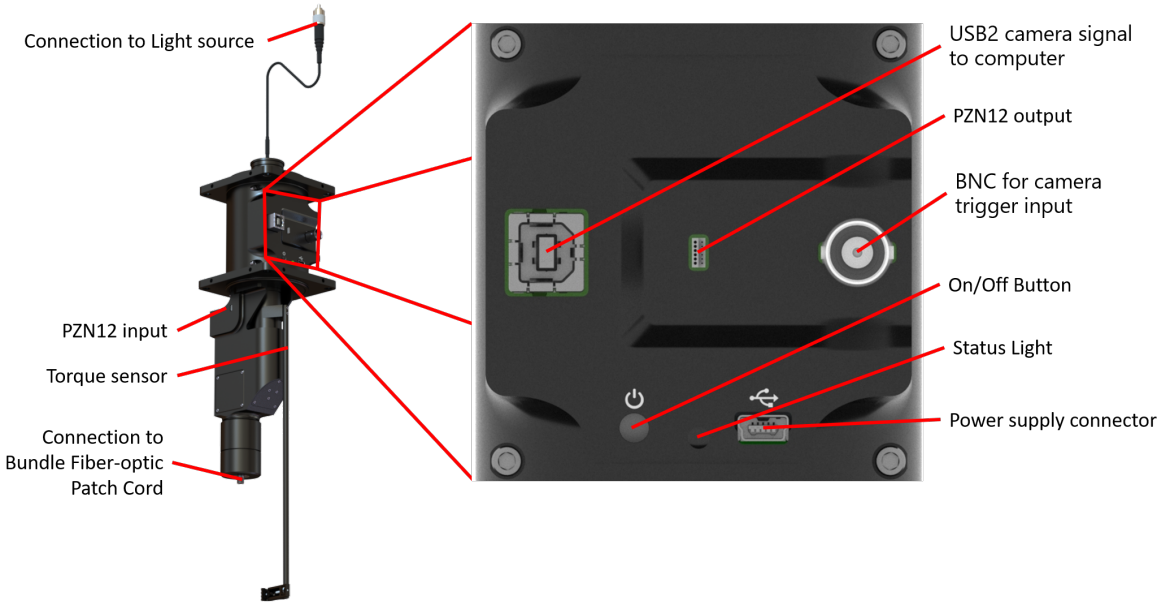
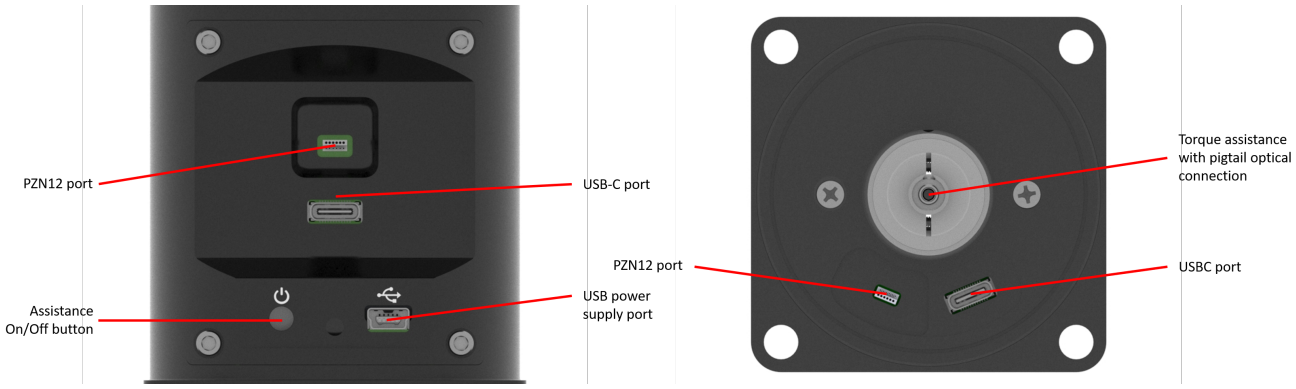


Figure 4.4: *RBFMC assisted rotary joint front presentation*

The RBFMC Rotary Joint is a rotary joint with a bundle fluorescence mini cube attached to the rotary part. Compared to a BFMC system, the rotary joint facilitates experiments with freely moving animals with several implanted brain sites.

4.5 Rotary Joint for 2-color Miniature Fluorescence Microscope

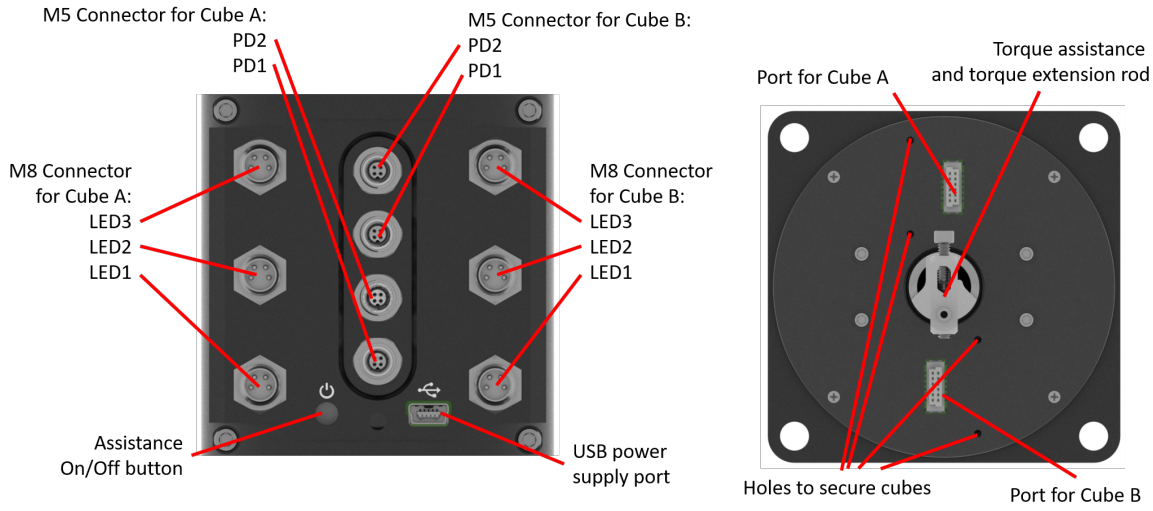


(a) *Front* (b) *Bottom*

Figure 4.5: *USB-C assisted rotary joint presentation*

The Assisted rotary joint with a USB-C port is dedicated to being used only with the Doric **2-color Fluorescence Microscope**. It facilitates experiments with freely moving animals. The rotary joint is also provided with a PZN12 port for electrophysiology or other applications.

4.6 Assisted Electrical Rotary Joint for RFMC



(a) *Front* (b) *Bottom*

Figure 4.6: *RFMC-assisted rotary joint presentation*

The **Rotary Joint for RFMC** configuration is specific to photometry. With this rotary joint, the Doric Fluorescence Mini Cube is connected directly to the rotary joint, with the integrated LEDs and detectors controlled via the M8 (LEDX ports) and M5 (PDX ports) connectors respectively. Two cubes can be connected at the same time to the Rotary Joint to maximize the experimental flexibility.

4.7 Assisted Electric-liquid Rotary Joint

(a) *Screw the protection*

(b) *Plug the tubing*

(c) *Pass the tubing through the rotary joint*

(d) *Screw the protection with the swivel*

Figure 4.7: *AHRJ-EL assisted rotary joint tubing installation*

This configuration is used to allow the injection of a liquid at the same time as electrophysiology acquisitions.

To install the tubing in the rotary joint:

1. Screw the support for the swivel if it's not already there (Fig 4.7a).
2. Plug the tubing to the swivel (Fig 4.7b).
3. Pass the tubing through the Assisted Electric Rotary joint until the swivel fits in the support's hole (Fig 4.7c).
4. Screw the nylon socket screw on the support (Fig 4.7d) to immobilize the top part of the swivel.
5. Make a loop and screw the screw on the torque sensor to pinch the tube (take care to not pinch the tubing but put enough pressure to ensure that the tube and the torque sensor are moving together) (see the section 2.3.1 for an equivalent procedure for electric cable).

5

Specifications

Table 5.1: *Physical dimensions*

SPECIFICATIONS	VALUE	NOTES
Size	70x70x134.5 mm	Size depends on the rotary joint configuration. Refer to the drawings for the exact size of each version.
Mass	1.8 kg	Mass depends on the rotary joint configuration.
Electrical Connector (one of the 3 configurations)	HDMI + 4 2x PZN-12 2x HARWIN	(Molex Micro-fit 3.0 Dual Row 4 Contacts Connector) (Omnetics Polarized Nano 12 Contacts) (Datamate L-Tek 12 pos 2 row)

Table 5.2: *Electrical specifications*

SPECIFICATIONS	VALUE
Number of contacts	24
Simple resistance	< 0.5 Ω
Resistance variation during rotation (constant rotation)	< 0.025 Ω @ 5 V DC
Start up torque	< 20 µN.m
Rotation speed	up to 40 rpm
Through-hole diameter	12.7 mm
Power Supply	10 W mini USB (included)

Table 5.3: *Recommended Environmental Specifications*

DESCRIPTION	OPERATION	STORAGE
Use	Indoor	Indoor
Temperature	0-40 ° C	0-40 ° C
Humidity	40-60% RH, non condensing	40-60% RH, non condensing

6

Support

6.1 Maintenance

The product does not require any maintenance. Do not open the enclosure. Contact Doric Lenses for return instructions if the unit does not work properly and needs to be repaired.

6.2 Warranty

This product is under warranty for a period of 12 months. Contact Doric Lenses for return instructions. This warranty will not be applicable if the unit is damaged or needs to be repaired as a result of improper use or operation outside the conditions stated in this manual. For more information, see our Website.

6.3 Disposition

Figure 6.1: *WEEE directive logo*

According with the directive 2012/19/EU of the European Parliament and the Council of the European Union regarding Waste Electrical and Electronic Equipment (WEEE), when the product will reach its end-of-life phase, it must not be disposed with regular waste. Make sure to dispose of it with regards of your local regulations. For more information about how and where to dispose of the product, please contact Doric Lenses.

6.4 Contact us

For any questions or comments, do not hesitate to contact us by:

Phone 1-418-877-5600

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