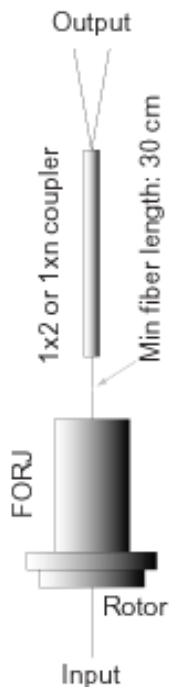


FAQ

Fiberoptic Rotary Joint

Part 1: For those who are not sure about fiber in their system



Q: Why should I use fiber?

A: *Bandwidth:* Optical fiber has been proven to have far wider bandwidth than any other media known to us such as wireless, copper wire, sonar, and even free-space-optics. Tera Hertz (10 to the 12th power) bit rate has been demonstrated in the lab by using the standard singlemode telecom fiber. A single strand of optical fiber can easily replace a large bundle of copper wires while boosting up system bandwidth.

A: *Loss:* Optical fiber poses far lower loss to signal than any other transmission media. The typical loss per kilometer in a singlemode fiber is around 0.4 dB making it possible to send signal over a much longer distance (>100 kilometer) without the need for repeaters.

A: *Security:* Unlike its counter parts an optical fiber is extremely difficult to be tapped into. Even when the fiber is tapped into successfully, it would have created enough disturbances in the system to be detected. Optical fiber has been the most preferred transmission medium in secure systems worldwide especially military applications.

A: *Safety:* Electrical current can be extremely harmful in the environment where flammable or explosive materials are used or stored. Optical fiber provides an ideal channel to collect useful information such as temperature, pressure, and humidity.

Q: I have 8 copper wires for signal now. Should I use 8 channels of fibers to replace them?

A: Generally the answer is no since one fiber can far outperform 8 copper wires in terms of bandwidth. However, multiple fibers may be desirable when either redundancy is necessary or signal multiplexing is not practical.

Q: Optical fibers are much more fragile. Can I use them in a challenging environment?

A: Yes, optical fibers can withstand extreme temperature, humidity, and pressure. With proper reinforcement optical cable can be handled just like its copper counter parts.

Q: Can you integrate fiber and electrical rotary joints?

A: Yes. Our FORJs are very small making them good candidates for integration with slip rings. Princetel work with leading slipping manufacturers to provide complete solutions to our customers.

Q: Can you combine fiber and fluid or gas rotary joints?

A: Yes, rotary unions can be made with center bores. Princetel's single-channel and dual-channel FORJs are ideal to combine with rotary unions. Our MJX series FORJs are so small that one can actually mount it in the middle of a fluid or gas pipe. All MJX series FORJs are sealed and can be pressure compensated for fluid immersion.

Q: What wavelength should I use in my system?

A: The three most commonly used bands of spectra are 850 nm, 1310 nm, and 1550 nm. 850 and 1310 nm used to be the choice for color because of lower cost. In recent years 1550 nm has become increasingly popular thanks to the availability of wide variety of DWDM (dense wavelength division multiplexing) components in not only the C band (1530-1570 nm) but also the two adjacent bands S (1490-1530 nm) and L (1570-1620 nm). Potentially, one can increase the system capacity more than 100 folds without adding any additional fibers.

Q: Can FORJ be pressure compensated?

A: Yes, our single channel (RPT), dual channel (RJ2), and multiple channel (MJn and RJn) FORJs are all designed with pressure compensation mechanism. Check with our technical staff for your specific application.

Part 2: For those who will incorporate fiber in their system

Q: Should I use singlemode or multimode?

A: It mostly depends on your current and most importantly your future need for bandwidth. If you can be confident that your need for bandwidth is not going to exceed a few hundred mega Hertz or even a giga Hertz in the life time of the system, then multimode should be your choice for lower cost. However, if any branching device such as a coupler were necessary in the system, we would recommend singlemode system for better stability. If future upgrade is in your mind, then singlemode system should be your choice. Keep in mind that singlemode systems have been growing much faster than multimode systems for a number of potential advantages.

Q: Can you mix single- and multiple-mode fibers in your FORJs?

A: Yes, it has been done routinely without any adverse effect on crosstalk.

Q: Should I consider pigtailed FORJ or receptacle type of FORJ?

A: We highly recommend pigtailed FORJs for their consistent optical performance and longevity. The optical performance of a receptacle type of FORJ depends heavily on the mating connector. Performance degradation is also common in receptacle type of devices. Dust particles and moisture introduced by repeated mating are the main cause of problem.

Q: What kind of connector should I use?

A: For historical reason, ST connectors have been the workhorses in FORJ applications even though ST connectors are known to have inferior optical performance. Furthermore, ST connectors cannot be polished at an angle for better return loss figure. All Princtel's singlemode FORJs come with unmatched return loss figures, which make ST connectors grossly inadequate. For example, the typical return loss value can be 65 dB in our singlemode FORJs and the typical return loss value of a ST connector is only 30-45 dB. In other words one would be getting 20-30 dB higher unwanted reflections because of ST connectors. Our recommendation is FC connector, which is the most popular connector type in telecom industry. The 8-degree angle polished FC/APC (angled physical contact) is also readily available. SC, SC/APC, LC, and LC/APC are a few other popular connector types that are growing in popularity.

Q: Are singlemode and multimode fibers interchangeable?

A: Generally no. However, multimode fiber can be used on the receiving leg if the bandwidth is not prohibitively high.

Q: What is the maximum number of fibers in a FORJ?

A: Currently 10 channels. Our goal is to achieve 40 channels in our multi-channel FORJ.

Q: What kind of fiber jacket should I consider?

A: The standard optical fiber has 125 um cladding diameter, which is protected by a variety of jacket types such as 250 um acrylic, 900 um Hytrel tight buffer, 1.8 mm, 2.2 mm, or 3 mm Kevlar reinforce cables. Our default choice is the 3 mm jacket. It allows the fiber to remain flexible while providing adequate protection. Thinner variations such as the 1.8 and 2.2 mm cables are becoming more popular these days in the telecom industry. There will be added lead-time for those non-standard cables.

Q: What should I consider when I compare FORJs from different vendors?

A: *Size:* The unit has to fit in your existing system. If you are in the design process, consider smaller packages for their lightweight, lower linear velocity, and lower torque.

Insertion loss: The lower the insertion loss, the less demand the FORJ has on your overall optical budget.

Insertion loss variation: The lower the figure, the better the signal fidelity is.

Return loss: A figure that is far more important than most people realize. The higher the return loss, the better the system stability is.

Part 3: For those who have used FORJs

Q: I have suffered from optical power fluctuation in my fiber system. What is likely the cause?

A: The most common cause of optical power or frequency jitter is high reflection or back scattering, which is often referred to as low return loss. A laser is essentially an optical oscillator with a fixed oscillation frequency (wavelength). Optical reflection or back scattering tend to push or pull the optical frequency around its natural position. In turn optical power would fluctuate according to the laser gain profile. The best solution is to replace your current FORJ with a high performance unit and replace all your current ST connectors with FC/APC connectors.

Q: How many mating can I expect from a typical fiber connector?

A: It highly depends on the cleanness of the environment and the care on the connectors during usage. Clean the connector face with a connector cleaner before each mating. Avoid dust and moisture. Do not touch the ferrule face with fingers. With good care a connector can be mated 50-100 times before any need of re-polishing. One can only re-polish a connector a few times until the ferrule becomes too short.

Q: How do I know if a fiber connector is defective?

A: To visually inspect a connector one can use a low-cost portable fiber inspector microscope. It should not cost more than \$300 per unit. And it comes with battery and carrying case. Look for defect such as pits or scratches on the fiber face especially around the core of the fiber. To verify the visual inspection one can add a small mount of index matching oil or gel in between both ferrule faces. If a measurable

improvement in insertion loss is observed, then one or both of the mating connectors need to be reconditioned or replaced. If you observe the same phenomenon when the connectors are new, it is a strong indication that the vendor did not polish the connector with a proper dome radius or fiber under cut. Demand a rework or switch to a more reputable vendor.

Q: Can I add more signal channels to my existing system without upgrading my FORJ?

A: Yes, it has been done routinely for systems based on singlemode fibers. For example, it is very cost effective to add passive CWDM components in your system to multiple the capacity by introducing the CWDM wavelengths. Call us to discuss the details. We may be able to help you save significantly. Multimode systems are usually limited to two-color WDM schemes.

Q: Is there an easy way to test the continuity of an optical fiber?

A: Yes. A visual fiber fault locator such as the Princetel FLA635 series fault locator is the best tool to test fiber continuity. A 250 um bare fiber or a 900-um buffered fiber would exhibit a red bleeding spot at the broken point. The red laser beam usually cannot transmit through heavier cable wall. Therefore, one has to rely on checking the amount of red beam at the other end of the cable or resort to more expensive equipment such as optical time domain reflectometer (OTDR).