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Small Form Factor Connector Basics

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Using small form factor connectors in your fiber network can save you space and money. However, choosing which type to use can be challenging. What's half the size of a standard SC connector, is roughly the same size as an RJ-45 jack used in most copper datacom applications, and takes up minimal space in a patch panel? Developed for today's demanding fiber optic applications, the answer is a small

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What's half the size of a standard SC connector, is roughly the same size as an RJ-45 jack used in most copper datacom applications, and takes up minimal space in a patch panel? Developed for today's demanding fiber optic applications, the answer is a small form factor (SFF) connector.

Why go the SFF route? Because fiber networks configured with SFF connectors require less rack and closet space, and they are significantly cheaper. SFF connectors also increase the port density on electronic devices (such as network interface cards, switches, and hubs), making them less expensive and increasing the likelihood that manufacturers will use them. SFF connectors are also carefully designed for fast field termination. However, most require special tool sets for installation and specially designed transceivers.

Some new SFF connectors use 1.25-mm ceramic or glass ferrules (rather than the standard 2.5 mm), which reduces cost and installation polishing time. In other designs, open plastic V-grooves hold the two fiber ends in place either by a bend in one of the fibers in the groove or by closely spaced metal ferrule alignment pins. Some people doubt the long-term reliability of SFF connectors, but so far their skepticism has proved to be unfounded.

Connector battles.

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What's Wrong Here?

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The Telecommunications Industry Association (TIA) standards groups have not yet embraced SFF connectors, leaving the industry in the midst of a connector war. With no standard type of SFF connector, the big market players continue to fight for dominance. What will the marketplace decide? Eventually, one type may become the de facto standard. But perhaps the continued existence of several SFF connectors is the most likely scenario for now. After all, traditional FC, ST, and SC connectors are still in use, so it's possible no one connector will dominate for some time. With so many connectors on the market to choose from, it's not surprising many users have not yet developed an SFF preference.

Common types of SFF connectors.

Here is a brief overview of five SFF connector designs.

MT-RJ: The MT-RJ is the product of a coalition that includes Corning Cable Systems (formerly Siecor), AMP, Hewlett-Packard, USConect, and Fujikura. The MT-RJ is a very small duplex connector with a molded body with two fibers. Although you could use it for epoxy-polish termination in the field, the current design uses a no-polish technology with a prepolished fiber stub.

3M Volition (VF-45): Featuring the most radical design, the Volition VF-45 connector abandons alignment ferrules for grooves, which still require you to polish the bare fiber in a special fixture. Its unique jack-and-plug design limits field terminations to jacks, but patch cords and single-mode versions will soon be available. Manufacturers such as Honeywell, Siemens, and Sumitomo are using the VF-45, and 14 Taiwanese networking product manufacturers recently adopted it. With a simple design, inexpensive parts, and easy termination, this connector is becoming an increasingly viable SFF option.

Avaya LC: Based on proven single-fiber ferrule technology, this LC connector looks like a half-size SC connector. Both the multimode and single-mode LC perform very well, and their packing density is equivalent to other SFF connectors. Both standard epoxy and prepolished quick-mountable versions of the LC are available for addressing installation needs. Because of Avaya's (formerly Lucent Technologies) experience in high-speed products for high-bandwidth applications, many people believe the LC connector holds an advantage in telecommunications applications.

Panduit Opti-Jack: The Opti-Jack is a duplex design based on the ST/SC 2.5-mm ferrule, with a jack-and-plug configuration. The manufacturer is developing active device mounts and a plastic optical fiber (POF) version. The duplex connector contains two 2.5-mm outer-diameter ferrules in a housing similar to the RJ-45 8-pin modular jack for copper telecommunications equipment. You can field-terminate the Opti-Jack with common fiber optic tools, and it's designed around zipcord cable.

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Siecor/IBM SC-DC or SC-QC: This option resembles an SC connector with two or four fibers in a line across the end of a standard 2.5-mm ceramic ferrule. You can terminate both at once, although the Siecor version is a “cleave and leave” type.

Testing duplex SFF connectors.

Because MT-RJ and Volition Duplex SFF connectors come as “plugs and jacks,” using standard test procedures to gauge their loss performance can be a challenge. SFF connectors, with the exception of the LC, are male and female. The traditional cable plant runs from socket to socket, while ST, SC, FC, and LC connectors go from plug to plug. Mating adapters allow connections at each end.

A miniature version of the SC or ST concept, the LC connector easily adapts to test equipment and reference cables. You can connect the plug ends of the MT-RJ and Volition directly to a meter with adapters, measure optical power, and calibrate launch cables for testing. Because you can't measure power directly, you'll need a patch cord to measure power out of the sockets. This adds an unknown loss to every measurement and an additional uncertainty in every loss measured.

Before testing individual patch cords (FOTP-171) and installing multimode cable (OFSTP-14), you must begin by setting a zero-loss reference from a launch reference cable. For any cable test, it is imperative you have good reference cables and use them properly. All current test procedures were developed on the assumption that connectors are male-type and are adaptable to plug directly into a meter. You can use these procedures with the LC connector, but many of the other new SFF connectors are not tested so easily.

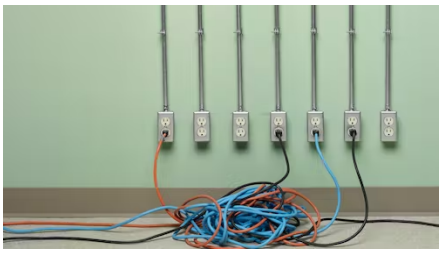
You should use two patch cords you know are good, set a reference with the launch reference cable attached to the source, plug them into sockets on the installed cable plant, and measure the loss. Because most test equipment — especially sources — have ST connector interfaces, you can do this by using patch cords with ST-to-SFF (plug) connectors.

How do you test those patch cords and any other SFF patch cords? Once you have instrument adapters for the connectors, you can set up a test for patch cords that closely follows FOTP-171. First, set your reference levels for loss with an ST-to-plug cable and a matching adapter on the meter. Plug an SFF cable equipped with a socket or socket-to-ST connection into the meter. Remember, you are testing a mated plug and jack — the loss you measure is for the pair. Using the output of the plug as your reference point allows you to use this same source setup to test the cable plant. You also need to test a patch cord for use on the receive reference cable (the one attached to the meter). However, testing in this way requires you to set up a reference value and retest each cable, which can be time-consuming.

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As small form factor connectors continue to drop in price and increase in capability, their popularity will inevitably grow. However, as they gain a larger portion of the market, it will become important for system installers to understand new connector technology and learn the most effective methods of testing them.

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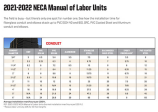
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