Using Siemon's SFP+ interconnect assemblies proven by UNH IOL to be interoperable with Brocade, Cisco, Dell, and other leading equipment

A cost-effective and lower-power alternative to optical fiber cables for short reach links in high-speed interconnect applications such as high performance computing (HPC), enterprise networking and network storage

Introduction

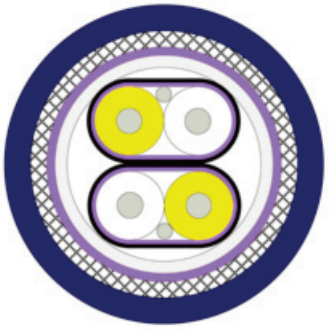
SFP+ passive copper cable assemblies from Siemon Interconnect Solutions (SIS) were developed specifically as a cost-effective and lower-power alternative to optical fiber cables for short reach links in high-speed interconnect applications such as high performance computing (HPC), data center networking and network storage markets. The assemblies support data transfer rates up to 10 Gb/s per lane, meeting or exceeding current Industry Standard Specifications.

These SFP+ fully-shielded assemblies combine twin-axial shielded cable with robust die cast connector interfaces for enhanced support of high frequency data rates. Siemon's SFP+ assemblies are impedance matched to ensure interoperability and minimize electromagnetic interference (EMI) through their fully-shielded design.

Description

SFP+ passive copper cable assemblies use twin-axial (twinax) shielded cable, which means that the signals travel over parallel pairs of conductors that have foil shields over each pair with a drain wire interstitial to the conductors. The cable contains 2 pairs, one for transmit (Tx) and one for receive (Rx) and each shielded pair is surrounded by an overall shield.

Twinax cable has all of the noise cancelling characteristics of twisted-pair cable with the added benefits of homogeneous geometry, which means that the cable's 100 ohm impedance is much better controlled resulting in less signal loss.



Cross-section of SFP+ cable

These assemblies are called "passive" copper cables because there isn't any signal conditioning circuitry (e.g. crosstalk or echo cancellation) contained within the SFP+ connector. Sometimes these assemblies are referred to as "DAC" or "Direct Attached Copper" cables or Cu cables. Inside the SFP+ MSA footprint optical cables can be used that require optical tranceivers or Active Optical Cables (AOC) that contain the transceiver as part of the cable.

Siemon offers four wire gauges to support our SFP+ passive copper cable assemblies: 30, 28, 26 and 24 AWG. These gauge offerings are based on the attenuation limits within the governing standards; longer cables require larger gauge copper wire.

SFP+ connectors feature robust die cast housings and cable strain reliefs as well as gold plated contacts. They are SFF-8083[1], SFF-8431[2] and SFF-8432[3] compliant, which are the industry standards for this particular connector form factor. SFF-8083 covers the original SFP connector mechanical form factor and electrical requirements, SFF-8431 covers the electrical specifications for SFP+ and SFF-8432 covers the SFP+ mechanical enhancements.

SFP+ connectors contain EEPROMs within the connector's diecast metal backshell. An EEPROM is an "Electrically Erasable Programmable Read-Only Memory" chip that is programmed at the factory with specific information about the cable assembly. This information is used by the network equipment that the cable is plugged into to get information that is used for signal transmission as well as information about the cable assembly such as vendor, serial number, part number, etc. All of the EEPROMs in Siemon's SFP+ cable assemblies comply with the SFF-8472[4] standard, which allocates specific memory locations to certain information.

Applications and Compatibility

The initial interface option for 10 Gigabit Ethernet (10GbE) switches and servers were SFP+ ports because the 10GBASE-T standard and products were still being developed. As a result, there are many existing 10GbE switches and servers on the market that support SFP+ cabling. The SFP+ ports allow SFP+ direct attach (DAC) passive copper cable assemblies or SFP+ optical fiber modules to be used within the same port. The choices between SFP+ passive copper or active optical fiber are based on reach or the distance between the ports that are being connected as well as user preference. The passive SFP+ DAC has a maximum reach of 5 meters which allows for Top of Rack (ToR) configurations and may also support Middle of Row (MoR) deployments as explained below.

The SFP+ DAC performance advantages over 10GBASE-T include lower latency and slightly lower power.

SFP+ interfaces take approximately the same space on a switch front panel as the RJ45 connector and, with SFP+ interfaces, switches can be built with 32 or 48 ports of 10 GbE in a single rack-unit height.

Most active equipment OEM's offer ToR switch to server topologies. The ToR architecture allows servers to be connected to switches that are located within the same or adjacent racks. These switches are then connected to aggregation and/or core switches via horizontal optical fiber cabling.

The SFP+ direct-attach solution draws less than 1.5 milliwatts (mW) of power per port and has a latency of 0.1 microsecond at the switch. SFP+ server NICs have various power requirements depending on the manufacturer.

For those end users who have implemented ToR switching in their data centers, DAC cables are typically restricted to a single cabinet. For customers with power, heat or weight restrictions that could result in several unused ports per cabinet. Siemon AOC or 5m direct attached copper cables can be used allowing adjacent cabinets to occupy some of the unused ports while still supporting industry standard best practices of routing the cable assembly through proper pathways and spaces.

AOC or 5 meter direct attached copper cable assemblies may also be used in a Middle of Row Switch configuration or a switch in every other cabinet. These scenarios can eliminate the need for costly switches in the top of each rack while minimizing unused ports.

Some equipment vendors discourage the use of 3rd party cable assemblies by issuing a warning message if a non-vendor approved cable is plugged into a port. Most vendors, however, will provide a "work around." Some errors are simple to clear just by acknowledging brand messaging. Siemon's SFP+ direct attached passive copper cables have been tested by the University of New Hampshire's Interoperability Lab (UNH IOL) and passed their 10Gigabit Ethernet interoperability testing with several vendors' devices including: Brocade, Dell, Cisco, Mellanox, Arista, Arastra and F5.

Siemon SFP+ passive copper cable assemblies can be used in the following applications:

- InfiniBand SDR, DDR and QDR
- Ethernet
- Fiber Channel - 1, 2, 4, 8 and 16Gbps
- FCoE 1G, 10G
- Storage
- Server NICs

Typical Applications showing maximum distance versus wire gauge

Standard	Gauge (AWG)	Length (m)
Ethernet (10GbE) [5]	24	7
Ethernet (10GbE)	26	6
Ethernet (10GbE)	28	5
Ethernet (10GbE)	30	4
Fibre Channel [6]	24	7
Fibre Channel	26	6
Fibre Channel	28	5
Fibre Channel	30	4
QDR [7]	24	6
QDR	26	5
QDR	28	4
QDR	30	3

Notes: Lengths are approximate based on current specifications. Because not all SFP+ ports conform to the 10GbE cable loss specifications, maximum lengths can be shorter or longer based on the transmitters and receivers that are being used. The SFP+ connector is not recognized by the InfiniBand Trade Association but can be used in InfiniBand applications.

Bibliography

[1] SFF-8083 SFF Committee, Specification for 0.8mm Card Edge Connector for 8/10 Gb/s Applications, Rev 2.5, January 19, 2010

[2] SFF-8431 SFF Committee, Specification for Enhanced Small Form Factor Pluggable Module SFP+, Rev 4.1, July 6, 2009

[3] SFF-8432 SFF Committee, Specification for Improved Pluggable Form Factor, Rev 5.0, July 16, 2007

[4]] SFF-8472 SFF Committee, Specification for Diagnostic Monitoring Interface for Optical Transceivers, Rev 11.0, September 14, 2010

[5] IEEE Std 802.3™-2008, Part 3: Carrier sense multiple access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications

[6] Fibre Channel, Physical Interface-5, (FC-PI-5), Rev 2.00, March 15, 2010

[7] InfiniBand TM Architecture, Volume 2 - Physical Specifications, Release 1.3, November 2012

Installation

Caution: Follow accepted ESD practices when handling SFP+ connectors to prevent damage to the internal components within the connector. ESD (electrostatic discharge) is the sudden flow of electricity between two objects at different voltage potentials caused by contact. The basis of any ESD protection strategy is to ground or bring all elements in the ESD protected area to the same potential. An ESD wrist strap should be used for everything in the ESD protected area including personnel, tools, cabinets and components.

Installing SFP+ Modules

Follow these steps to install a Siemon SFP+ cable assembly:

Step 1. Remove the protective ESD cap from the connector

Step 2. Slide the SFP+ cable end into the slot until it locks into position (see figure 1).

There is an audible click when the connector is properly seated.

Figure 1. Installing an SFP+ Module

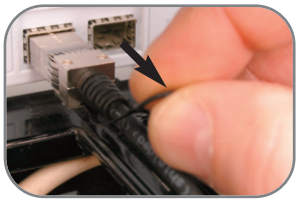


Figure 2. Disconnecting Latch Mechanism

Caution The latching mechanism locks the SFP+ connector into place when cables are connected. Do not pull on the cable in an attempt to remove the SFP+ connector.

Figure 3. Removing Modules

Removing SFP+ Modules

Follow these steps to remove a Siemon SFP+ cable assembly:

Step 1. Pull on the SFP+ latch pull lanyard. *See figure 2.*

Step 2. Grasp the SFP+ connector on both sides and remove it from the system. *See figure 3.*

Step 3. If possible, replace the ESD protective cap or put the SFP+ into an ESD protected bag

When installing the cables, be sure to maintain proper bend radius per the table below:

Guage (awg)	Cable Weight per meter (grams)	Cable Weight per meter (ounces)	OD (mm)	Bend Radius (mm)		OD (mm)	Bend Radius (in.)	
				repeated	single		repeated	single
30	23	0.8	4.5	45.0	22.5	0.18	1.77	0.89
28	32	1.1	4.7	47.0	23.5	0.19	1.85	0.93
26	35	1.2	5.21	52.1	26.1	0.21	2.05	1.03
24	42	1.5	6.2	6.2	31.0	0.24	2.44	1.22

Links

Siemon web site: http://www.siemon.com/sis/
Specification data sheet: http://files.siemon.com/sis/ss/cca_sfp%2B-copper-cable-assemblies_ss.pdf

SFP+ Drawing: http://files.siemon.com/sis/cud/cca_sfp%2B-copper-cable-assemblies_cud.pdf

EEPROM information: http://files.siemon.com/sis/application-guide/sfp-plus-to-sfp-plus_eeprom_summary.pdf

Test report: http://www.siemon.com/sis/application-guide/2010-05-05-Test-Report-Siemon-SFP-plus-Cable-Assemblies.asp

www.siemon.com/sis/interoperability

Link to Siemon high speed white paper: http://www.siemon.com/us/white_papers/11-02-15-higher-speed-cabling-solutions.asp

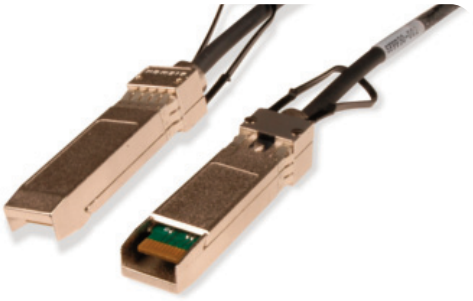
SFF Committee Standards: ftp://ftp.seagate.com/sff

UNH IOL Report: www.siemon.com/sis/interoperability

Siemon Interconnect Solutions

Siemon has one of the industry's most comprehensive SFP+ passive copper cable assembly length offerings: Visit: http://www.siemon.com/sis/

Part Number	Length (Meters)	Gauge
SFPP30-00.5	*0.5*	*30*
SFPP30-01	*1*	*30*
SFPP30-01.5	*1.5*	*30*
SFPP30-02	*2*	*30*
SFPP30-02.5	*2.5*	*30*
SFPP30-03	*3*	*30*
SFPP30-04	*4*	*30*
SFPP28-05	*5*	*28*
SFPP24-07	*7*	*24*



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Siemon SFP+ passive copper cable assemblies have been tested by UNH IOL to ensure interoperability with network equipment manufactured by Cisco, Dell, and other leading equipment manufacturers. A third party test report is available at www.siemon.com/sis/interoperability.

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Visit our website at or contact SIS customer service at the address and phone number below.

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