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A blue-ribbon approach

Field link-loss measurement methods for MTP connectorized ribbon cable in the data centre

By Doug Coleman and Mike Fuller

Data centre backbones are moving to higher cabled fiber counts to meet increased system bandwidth needs. Many data centres are now deploying ribbon cables with laser-optimized 50 µm multimode fiber (OM3) to meet this need, as well as to provide a migration path to higher data rates such as 100G parallel optics. In addition, data centres are turning to ribbon cable designs because of their ability to meet the design criteria of high connectivity density relative to cable diameter so that they can obtain maximum usage of pathways and spaces. For example, a 144-fiber unitized tight-buffered cable consumes three and a half times the effective area compared to a ribbon plenum cable of the same fiber count. Relative to copper cable, a 216-fiber ribbon plenum cable consumes the same effective area as two to three CAT 6a UTP copper cables.

Field link-loss attenuation tests provide quantitative measures of the installed performance of the ribbon cable system. It is the single most important test of an installed link as it provides a measure of the end-to-end, point-to-point or patch panel to patch panel optical power loss.

Ribbon optical cable design

Ribbon optical cable is now the primary cable design choice to deploy in data centre backbone applications where you require fiber counts of more than 24. The cable design characteristically consists of 12 to 216 fibers organized inside a central tube. The 12-fiber ribbons are readily accessible and identifiable with ribbon identification numbers

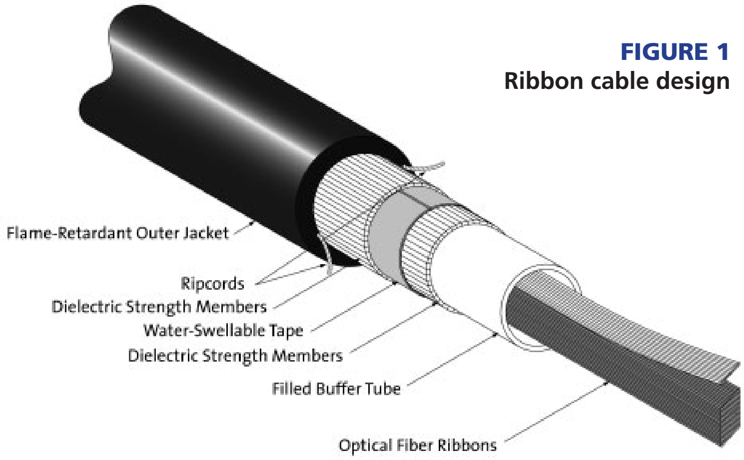


FIGURE 1
Ribbon cable design

and TIA-598-compliant fiber colour coding. In indoor data center applications, use specially formulated flame-retardant outer jackets which allow the cable design to meet the requirements of the NFPA-262 flame test for ribbon plenum cables and the requirements of the UL-1666 flame test for ribbon riser cables. Figure 1 demonstrates the design of this ribbon optical cable.

Ribbon optical cable termination

For many years, designers and installers have been reluctant to specify ribbon optical cable in the data centre because 12-fiber ribbon field terminations were limited.

But with innovations such as ribbon splitting tools, ribbon furcation kits and field-installable 12-fiber array connectors, we can now easily terminate 12-fiber ribbons with simplex and duplex connectors such as LC or SC connectors or with the MTP connector. The MTP connector is a 12-fiber push/pull optical connector with a footprint similar to the SC simplex connector. An MTP pinless connector is typically for the backbone cable, while an MTP pinned connector is for the interfacing jumper, harness or MTP connector module. We can use these high-density connectors to significantly accelerate the network cabling process, minimize errors and reduce congestion in patch panels. Today, the MTP connector is commonly available in pre-terminated form; either in pigtail form for splicing onto a 12-fiber ribbon or as an MTP connector backbone assembly terminated on each end. Field-installable MTP connectors are also available with the no-epoxy, no-polish design feature that allows termination of 12 fibers in less than five minutes. The MTP connector is specified to conform to the TIA/EIA-604-5 intermatability standard.

Ribbon optical cable deployment

We can deploy MTP connectorized ribbon cables in one of two methods. The first method involves using an MTP connector module or cassette. An MTP connector module is a small metal or plastic housing that encloses a harness which has an MTP connector on one end and single-fiber connectors (typically SC or LC) on the other end.

These connectors are plugged into adapters loaded on the front and back of the module. The module is then inserted into a 1U or 4U rack-mountable housing. This module provides a convenient and protective means of providing a break-out of the 12 fibers. Use this method of deployment for applications using serial transmissions over pairs of fibers. The single-fiber connectors on the front of the module allow for patching optical circuits using single-fiber duplexed patch cords on the front side of the rack or cabinet. When using this MTP connectorized ribbon cable deployment method, testing the system to verify the optical performance is just as simple and straight forward as any traditionally installed system. A simple link-loss test using a one-jumper reference is all you'll require. We outline the link-loss test method for MTP connectorized ribbon cables with MTP connector modules below.

The second method to deploy MTP connectorized ribbon cable involves using an MTP inter-connect. In this method, a 1U or 4U rack-mountable housing is populated with MTP connector panels loaded with MTP connector adapters. The MTP connectorized ribbon cable is strain-relieved to the housing and the MTP connectors are plugged into the back of the MTP connector panels. An MTP connectorized harness cable is plugged into the front of the panel. This MTP connectorized harness is a ribbon interconnect cable terminated with MTP connectors on both ends, or can be terminated with single-fiber connectors on one end. The other end of the harness is typically run to a network device or to a patch panel. Use this method of deployment for applications using parallel transmissions, such as Infiniband. Because there is no module with single-fiber connectors to plug into for testing, there is a method to test the MTP connectorized ribbon cable link. This link-loss test method uses a 3-jumper reference. We've outlined the link-loss test method for MTP connectorized ribbon cables without modules below.

Field link-loss measurement methods

You will require the following equipment for MTP connectorized ribbon cable with modules:
- Optical source with SC optical port
- Optical meter with SC optical port
- SC-SC jumper – three
- SC adapters – two

(Note: This example uses a light source and power meter that each have an SC connector interface; other single-fiber interface types work in a similar fashion.)

You will require the following equipment for MTP connectorized ribbon cable without modules:
- Optical source with SC optical port
- Optical meter with SC optical port
- 12-fiber SC to MTP pinned connector hybrid jumpers – two
- 12-fiber MTP connector to MTP pinless connector jumper – one
- SC-SC jumper – three
- MTP connector adapters – two
- SC adapters – two

(Note: This example uses a light source and power meter that each have an SC connector interface; other single-fiber interface types work in a similar fashion.)

TIA/EIA strongly recommends mandrel wrapping the test jumper at the transmitter to reduce measurement variability and increase accuracy during multimode system testing.

STEP 1: Setting the reference for 1- and 3-jumper reference methods. Connect the SC jumper to the optical source and meter as shown in Figure 2. Record this number for comparison to the values found in later steps. Once you've recorded this number, disconnect jumper #1 from the meter.

FIGURE 2
Determining output power of the source using one jumper

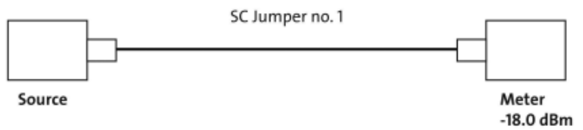
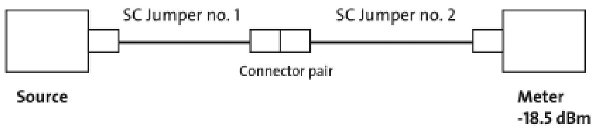


FIGURE 3
Checking the test connectors



Insert a second SC jumper into the setup as shown in Figure 3, connecting to test jumper #1 on one end and to the meter on the other. The change in the loss reading should not be higher than the value specified for the test jumper connectors.

If testing serial transmission through modules using the 1-jumper reference method, disconnect the two test jumpers at the junction formed in the connector adapter. Keep the other ends of the test jumpers connected to the source and receiver respectively. Connect the source and meter to the fibers under test in the modules, test and record the loss results.

If testing without modules, please continue with the test setup using the 3-jumper test method detailed below.

De-couple the connector pair made in the previous step. Insert test jumper #3 between jumpers #1 and #2, as shown in Figure 4. This change between the first step and this last step represents the loss of the two connector pairs formed by the three test jumpers. The loss reading should not be higher than the specification for the factory-terminated assemblies (two connector pairs). A typical maximum change in the measured value would be on the order of -1.0 dB (-19.0 dBm minus 18.0 dBm = -1.0 dBm) for two connector pairs (0.5 dB per mated pair). If you measure higher than expected losses, clean the connectors and retest. If the jumpers continue to test high, replace each jumper with a new one until the measurement reading is in the appropriate range.

FIGURE 4
Setting up the reference step with three jumpers

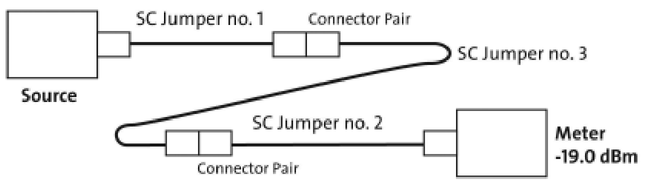
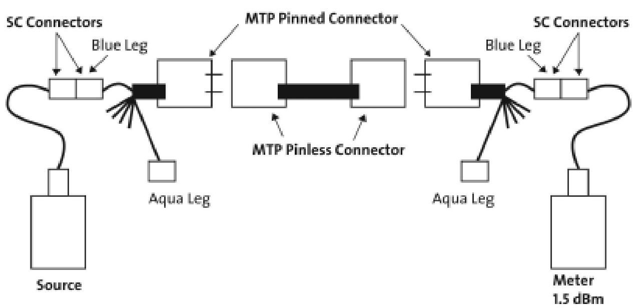
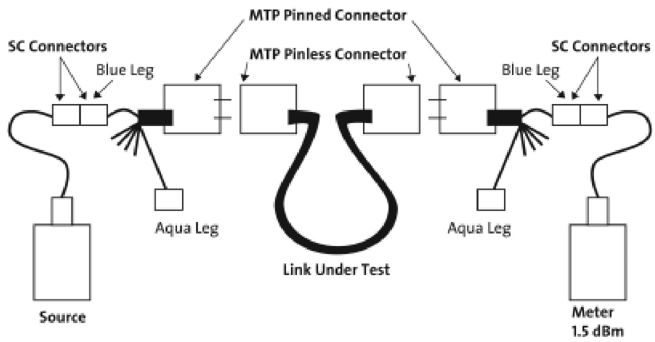


FIGURE 5
Set-up and verification of the test jumpers



Press the reference button (if available) on the meter. The meter should now display 0.0 dB. If a reference button is not available, this value must be recorded and subtracted from future readings.

FIGURE 6
Testing the MTP connector link



STEP 2: Checking MTP connector test jumpers. Remove jumper # 3 from the test set-up. Connect the blue leg of a 12-fiber SC to MTP pinned connector hybrid jumper to the SC jumper at the source and the blue leg of a second 12-fiber SC to MTP pinned hybrid connector jumper to the SC jumper at the meter, as shown in Figure 5. Connect the test sets and test jumpers together with an MTP connector to MTP connector (both without pins) jumper. For proper polarity testing with standard jumpers, you must connect the same jumper leg (same number or color) to the setup for each measurement.

The meter should now display a negative value of ≤ 1.5 dB. Do not press the reference button on the meter. Obtain these values using the maximum loss of 0.75 dB for a single-mated MTP connector pair. Take this value from the manufacturer's specification for maximum connector pair loss. The maximum resultant sum of two mated pairs would be a 1.5 dB loss. Disconnect the blue leg of each SC to MTP pinned hybrid connector jumper and connect with the orange legs. Test through all 12 SC connectors in sequence, ensuring that all connectors involved in the testing process are sound; each reading should be below the acceptable level. After verifying all 12 SC legs, remove the pinless MTP connector to MTP connector jumper from the set up. You're now ready to test the installed system.

STEP 3: Test. Without disconnecting the single-fiber jumpers from the units, take source and meter to the distant ends of the system, as shown in Figure 6. Each test value represents the system loss along one run of fiber.

Reconnect the first SC connector (blue leg) of each MTP connector to SC cable assembly to the source and meter SC jumpers. Connect the MTP pinned connectors of each SC to MTP connector jumper to the system MTP pinless connectors through the patch panel. Record the measurement for fiber one. Disconnect the first SC connectors (blue leg) of each MTP connector to SC cable assembly and reconnect with the second SC connectors (orange legs). Record the measurement for fiber two then repeat for all remaining fibers.

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