Certifier40G Fiber Reference Methods and Their Impact on Loss Limits

This application note explains various reference methods available on the Certifier40G and how they affect limit and margin results. Always refer to local standards and vendor requirements to determine which reference method to use.

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Overview

When performing Tier 1 fiber certification (loss and length), the loss of the fiber system under test must be measured and compared to a loss limit to provide a loss margin. The loss limit is the maximum allowable loss of the overall system and is based on the following factors:

- Length of the fiber
- Number of connections
- Number of splices

Each of the above factors has a loss associated with it. Remembering that standards and requirements vary, here are generic Telecommunications Industry Association (TIA) maximums:

- 3.5 dB/km at 850 nm
- 1.5 dB/km at 1300 nm
- 1.0 dB/km at 1310 nm
- 1.0 dB/km at 1550 nm
- Loss per connection: 0.75 dB
- Loss per splice: 0.3 dB

For loss associated with length, the Certifier40G measures the length of the fiber system and then applies the slope (loss per km). For loss per connection and splice, the technician must indicate how many connections and splices are present in the fiber system under test.

There are four additional connections required to perform a test:

- A connection at the local device to the local reference jumper
- A connection from the local reference jumper to the fiber system under test
- A connection from the fiber system under test to the remote reference jumper
- A connection from the remote reference jumper to the remote device

The reference method chosen will determine how many of these connections are included in the loss measurement and in the loss limit.

$$\Delta_{conn1} + \Delta_{conn2} + \text{fiber system under test} + \Delta_{conn3} + \Delta_{conn4}$$

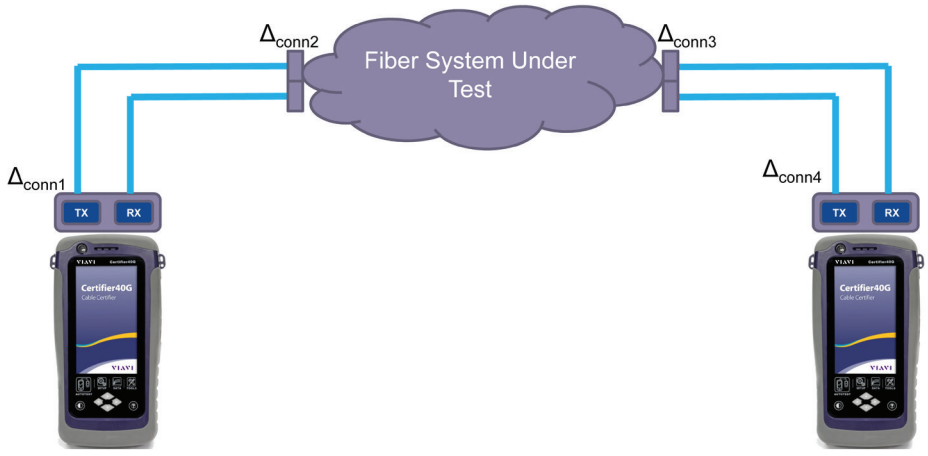

Figure 1. Measured loss without performing a reference

Note: In the following procedures, test-reference jumpers are assumed to:

- Be high-quality and in good condition
- Be equal in length and relatively short
- Have no end-face damage or debris

Disconnecting the connection at the transmitter of the Certifier40G after a reference is performed invalidates the reference. Since the connection at the receiver is not glass-to-glass, it can be removed without affecting the reference. Any loss associated with the test-reference jumpers is negligible.

One-Jumper Reference

This reference removes the losses at Δ_{conn1} and Δ_{conn4} from the measurement.

This reference removes any loss at the connection between the local unit's transmitter and the reference test jumper as well as the loss at the connection between the remote unit's transmitter and the reference test jumper. However, the loss at the connection from the local reference jumper to the fiber system under test and the connection from the fiber system under test to the remote reference jumper will not be referenced out.

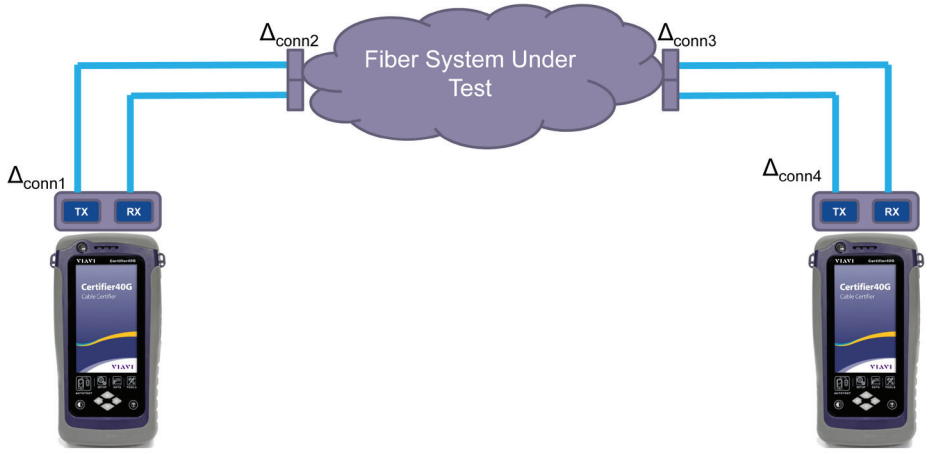

Figure 1. Measured loss without performing a reference

Setting a one-jumper reference, the loss at these two connections is automatically added to the loss limit and will be included in the measured loss. For an accurate limit, enter any connections and splices within the fiber system under test.

Performing the Measurement

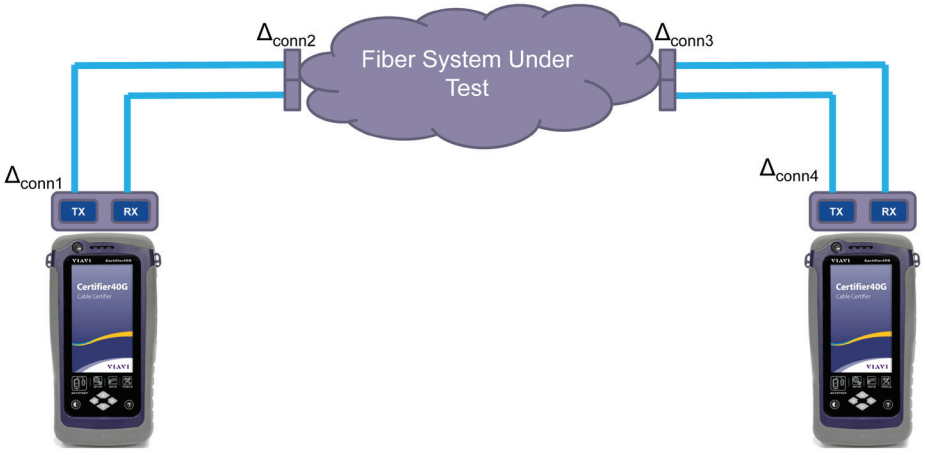

Figure 3. Connection locations

The losses at Δ_{conn1} and Δ_{conn4} are referenced out, so the loss measurement is:

$$\Delta_{conn2} + \text{fiber system under test} + \Delta_{conn3}$$

The limit will be based on the limit settings for connections and splices plus the slope. Loss will be measured and a margin will be calculated. Margin is the amount of "headroom" in dB between the limit and the measured loss.

850 nm Example

The fiber system under test is known to have 4 connections. The user enters 4 connections and 0 splices:

- Limit = 1.5 dB (Δ_{conn2}+ Δ_{conn3})
- 4 connections at 0.75 dB per connection = 3.0 dB
- Limit due to connections and splices = 4.5 dB

When performing a test, the length is measured and the slope is applied. If the fiber is 25 m, then at 3.5 dB per 1000 m, the maximum loss (limit) due to fiber length is 0.08 dB. This is then added to the limit due to connections.

The total limit is 1.5 dB + 3.0 dB + 0.08 dB = 4.58 dB. Loss is measured and margin is calculated.

Two-Jumper Reference

This reference removes the losses at Δ_{conn1} + Δ_{conn2} + Δconn4 from the measurement.

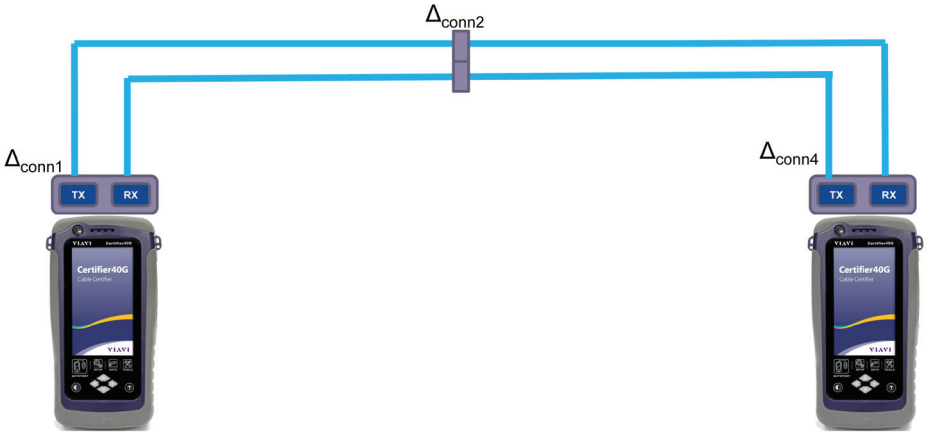

Figure 4. Loss measurement = fiber system under test + Δ_{conn3}.
Limit = Δ_{conn}3 @ 0.75 dB + connection/splice/length loss for fiber system under test

This reference removes any loss at the connection between the local unit's transmitter and a reference test jumper plus the loss at one connection plus a second reference test jumper, as well as the loss at the connection between the remote unit's transmitter and the reference test jumper. The loss at the second connection that must be present to measure the fiber system under test will not be referenced out.

By setting a two-jumper reference, the loss at this one connection is automatically added to the loss limit and will be included in the measured loss. For an accurate limit, enter any connections and splices within the fiber system under test.

Performing the Measurement

The losses at $\Delta_{conn1} + \Delta_{conn2} + \Delta_{conn4}$ are referenced out, so the loss measurement is:

fiber system under test + Δ_{conn3}

For connection locations, see Figure 3.

The limit will be based on the limit settings for connections and splices plus the slope. Loss will be measured and a margin will be calculated. Margin is the amount of "headroom" in dB between the limit and the measured loss.

850 nm Limit Example

The fiber system under test is known to have 4 connections. The user enters 4 connections and 0 splices:

- Limit due to two-jumper reference = 0.75 dB (Δ_{conn3})
- 4 connections at 0.75 dB per connection = 3.0 dB
- Limit due to connections and splices = 3.75 dB

When performing a test, the length is measured and the slope is applied. If the fiber is 25 m, then at 3.5 dB per 1000 m, the maximum loss (limit) due to fiber length is 0.08 dB. This is then added to the limit due to connections.

The total limit = 0.75 dB + 3.0 dB + 0.08 dB = 3.83 dB. Loss is measured and margin in calculated.

Three-Jumper Reference

This reference removes the loss at $\Delta_{conn1} + \Delta_{conn2} + \Delta_{conn3} + \Delta_{conn4}$ from the measurement.

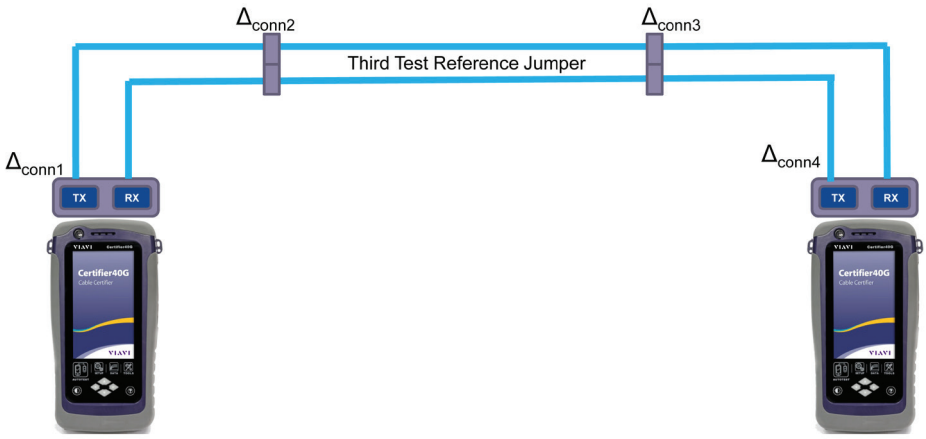

Figure 5. Loss measurement = fiber system under test. Limit = connection/splice/length loss for fiber system under test

This reference removes any loss at all the connections. A third reference jumper is used. Just as with the other test jumpers, the loss of this short reference jumper will not affect the loss measurement.

By using a three-jumper reference, no connection loss is added to the limit. Enter any connections and splices within the fiber system under test.

Performing the Measurement

The losses at $\Delta_{conn1} + \Delta_{conn2} + \Delta_{conn3} + \Delta_{conn4}$ are referenced out, so the measurement is the fiber system under test only.

The limit will be based on the limit settings for connections and splices plus the slope. Loss will be measured and a margin will be calculated. Margin is the amount of "headroom" in dB between the limit and the measured loss.

850 nm Limit Example

The fiber system under test is known to have 4 connections. The user enters 4 connections and 0 splices:

- Limit due to three-jumper reference = 0.0 dB
- 4 connections at 0.75 dB per connection = 3.0 dB
- Limit due to connections and splices = 3.0 dB

When performing a test, the length is measured and the slope is applied. If the fiber is 25 m, then at 3.5 dB per 1000 m, the maximum loss (limit) due to fiber length is 0.08 dB. This is then added to the limit due to connections.

The total limit = 0.0 dB + 3.0 dB + 0.08 dB = 3.08 dB. Loss is measured and margin in calculated.

Conclusion

Certifier40G can be used to perform Tier 1 fiber certification. In Tier 1 fiber certification, loss and length are measured and compared to a limit to determine pass or fail. The loss limit is partially determined by the chosen reference method.

When using the Viavi Certifier40G for Tier 1 fiber certification, local standards and vendor recommendations dictate which of three different reference methods is most appropriate. Depending on the reference method chosen, additional connections may need to be added to connect to the fiber system under test. The maximum allowed loss for these connections is automatically added to the loss limit. The user needs to enter any additional connections or splices when setting up the limit.

The final factor for determining the overall loss limit is the maximum loss permitted for the length of the fiber. The Certifier40G measures the length of the fiber and then applies the standard slope to the loss limit. The overall loss limit = <losses defined for the connections required due to the reference method> + <connections and splices set in limit> + <slope loss>.

The Certifier40G measures the loss each fiber of the overall fiber system under test, applies the loss limit, shows the margin, and indicates if the fiber system under test passed or failed the limit.

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