Calculating chromatic dispersion (CD) for fiber measurements using the OVA

The OVA is designed to "zero out" the contribution to chromatic dispersion (CD) of the fiber leads connected to the device under test (DUT). (This assumes the leads are SMF 28.) An example of data taken from 30 m of SMF 28 is shown in the figure below. Note that the CD is measured to be zero when it should be about 0.54 ps/nm [(18ps/nm*km)*(0.03km) = 0.54 ps/nm].

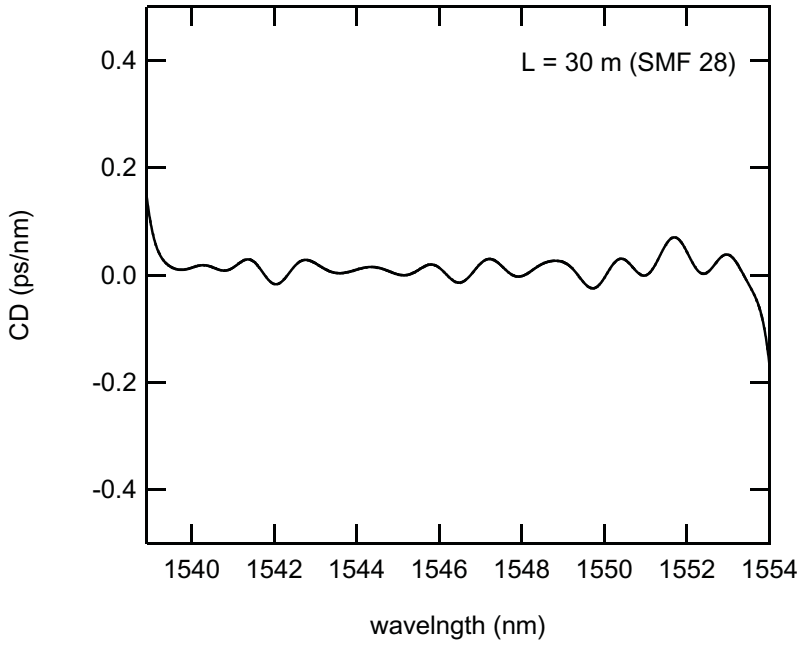

Figure 1. OVA measurement of the CD of 30 m SMF 28.

If one wishes to use the OVA to measure the CD of fiber, one must account for this zeroing effect and manipulate the data a bit in order to get meaningful answers. The prescription is as follows. The measured CD, CD_m, is the actual CD, CD_a, minus the CD of the device length's worth of SMF 28 (= L_{dut} x 0.18 ps/nm km).

$$CD_m = CD_a - CD_{smf\,28}(L_{dut}),$$

where L_{dut} is the total device length.

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So the actual CD is

$$CD_a = CD_m + CD_{smf\,28}(L_{dut}).$$

Note that if you are measuring SMF 28, then you should use $CD_m = 0$.

Example – 2m EDF

The graph below is a measurement of 2m of EDF spliced into 7m SMF28.

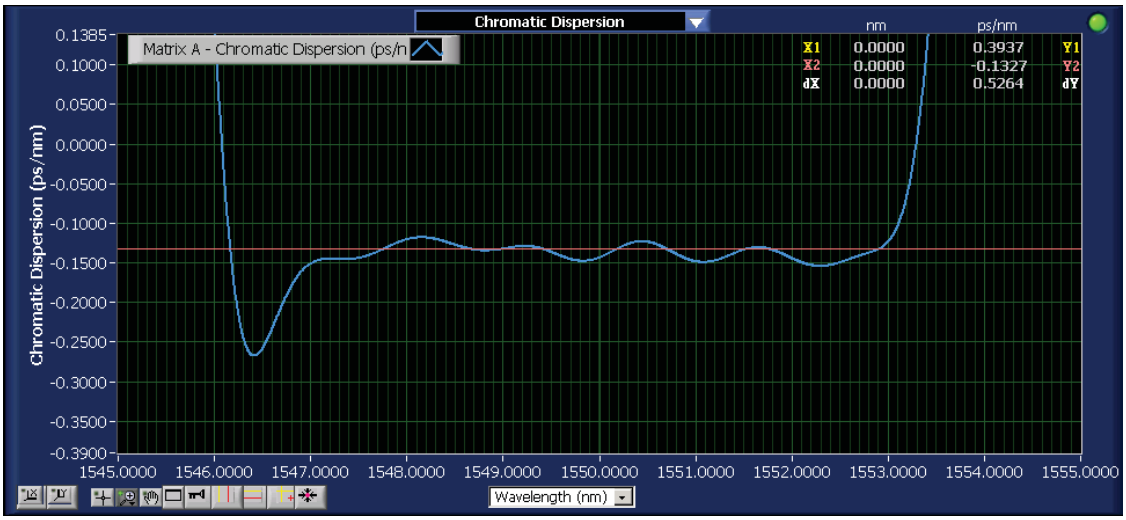

Figure 2: CD measurement of 2 m of EDF spliced into 7 m SMF 28

The CD is measured to be -0.13 ps/nm. So according to the equation above, the actual CD of the combination of the 7 m of SMF 28 and the 2 m of EDF is

$$\begin{aligned} CD_a &= -0.13\frac{ps}{nm} + 18\frac{ps}{nm \cdot km}(0.009km) \\ &= (-0.13 + 0.16)\frac{ps}{nm} \\ &= 0.03\frac{ps}{nm}. \end{aligned}$$

So, to get the contribution to the CD from the EDF, we have to subtract off the CD from the 7 m of SMF 28.

$$CD_{EDF,2m} = 0.03\frac{ps}{nm} - 18\frac{ps}{nm}(0.007km)$$

$$= (0.03 - 0.13)\frac{ps}{nm}$$

$$= -0.10\frac{ps}{nm}$$

This calculation can be done in one step using the following equation, remembering that L_{dut} is the *total* DUT length shown on the OVA software GUI.

$$CD_{EDF,2m} = CD_m + CD_{smf\,28}(L_{dut} - L_{smf\,28}).$$

Example – 10m EDF

The graph below is a measurement of 10 m of EDF spliced into 7 m SMF 28.

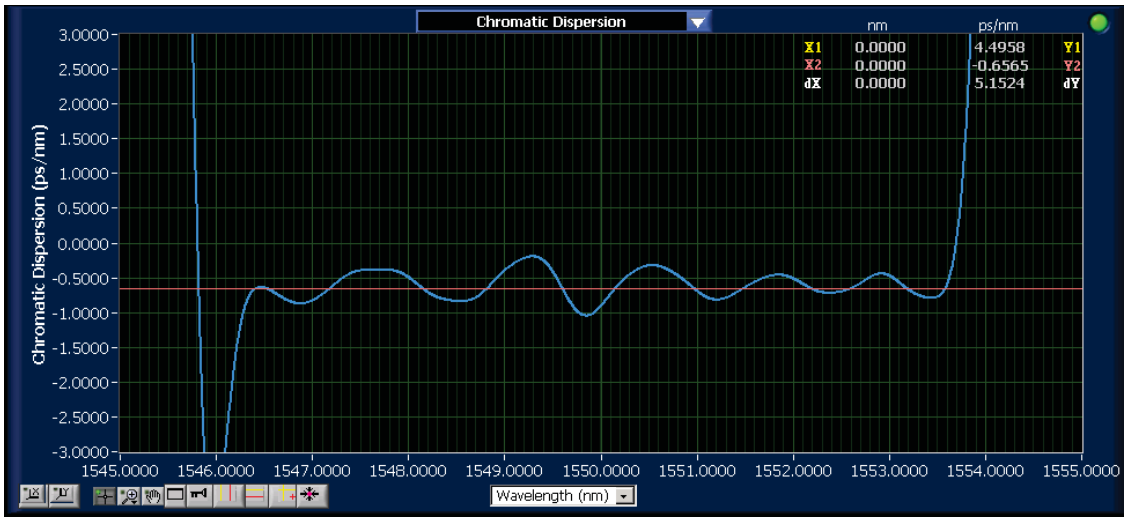

Figure 3: CD measurement of 10 m of EDF spliced 7 m SMF 28

The CD is measured to be -0.66 ps/nm. Using the boxed equation above to get the contribution to the CD from the EDF,

$$CD_{edf,10m} = -0.66\frac{ps}{nm} + 18\frac{ps}{nm \cdot km}(0.017km - 0.007km)$$

$$= (-0.66 + 0.18)\frac{ps}{nm}$$

$$= -0.48\frac{ps}{nm}.$$

Summary

Length (m)	CD (ps/nm)
2	-0.10
10	-0.48

The CD from the EDF is approximately -50 ps/nm*km. The accuracy of this depends mostly on the accuracy with which the lengths are known. If they are known to a high level of precision, then the accuracy of this measurement is approximately ±5ps/nm*km. 18 ps/nm*km was used for the CD of SMF 28 for simplicity; however, when performing the calculations, the actual, wavelength dependent value can be used.

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