POLARITON TECHNOLOGIES

How to Characterize Extinction Ratio and Operating Points

Description

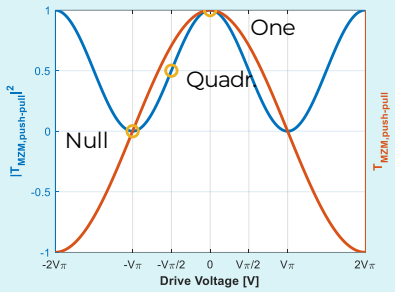
Extinction ratio (ER) describes the difference between the on- and off-state of the MZM. The right plot shows the intensity and amplitude transfer function of a MZM in push-pull mode. Three operation points for the intensity modulation, the Null point, the Quadrature point and the One point, are marked. The ER is the difference between the Null and the One-point. For the push-pull operation mode the transfer function is described by:

$$T_{MZM,push-pull} = \exp\left(j\frac{\varphi_{DC}}{2}\right)\cos\left(\frac{\varphi_{MZM}(t)}{2}+\frac{\varphi_{DC}}{2}\right).$$

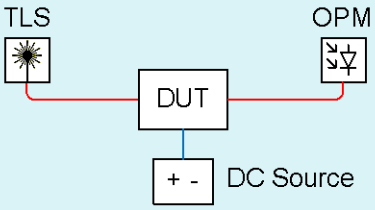
The intensity transfer function is achieved by the square of it:

$$\left|T_{MZM,push-pull}\right|^2 = \frac{1}{2}(1+\cos(\varphi_{MZM}(t)+\varphi_{DC})).$$

The operation point can be shifted via the DC voltage, changing the phase of one arm. By neglecting the DC part, one sees that the drive voltage can shift from on- to off-state.



Schematic Setup

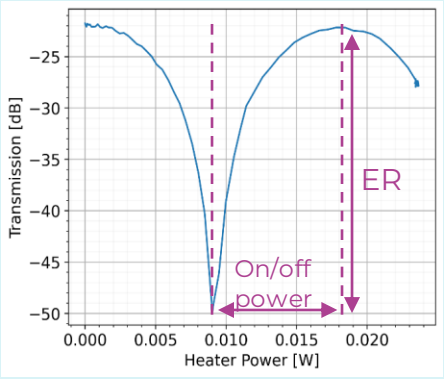


DUT: Device Under Test
OPM: Power Meter
TLS: Tunable Laser Source

Working Principle

A voltage source is connected to the DC bias of the device and the laser is set to a specific wavelength. For a range of voltage, the current and the optical transmission of the device is measured. Ideally the device shows maximum transmission when no voltage is applied, indicating that the two arms of the MZM are perfectly balanced. The transmission will show periodic on-off behavior caused by destructive and constructive interference. From this, the MZM transfer function is obtained with the transmission vs electrical power. Now, one can determine where the device shows maximum transmission and minimum transmission.

In addition, its 3 dB operation point., the ER and the on-off power applied on the heater is read from the data.



References

B. Baeuerle, "Real-time digital signal processing for coherent reception and its application to optical communications", ETH Zurich, 2019, doi: https://doi.org/10.3929/ethz-b-000382187

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