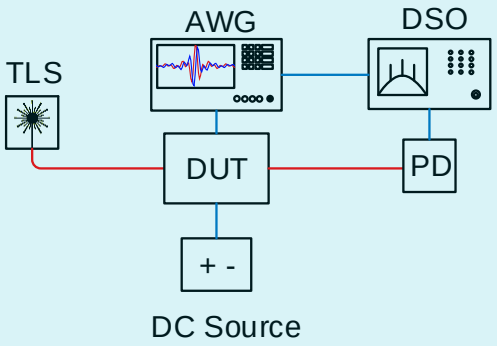
POLARITON TECHNOLOGIES

How to Measure V_π Employing Overmodulation

Description

The voltage V_π needed for a phase shift of π is an important figure of merit for the performance of an optical modulator. One method to measure V_π for a Mach-Zehnder modulator is through low radio frequencies giving a close approximation for the value at DC.

Schematic Setup



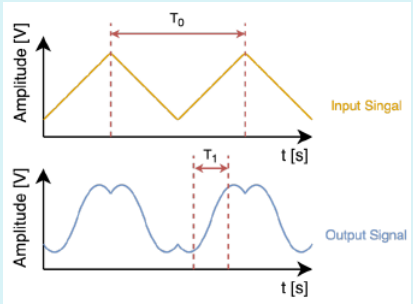
AWG:	Arbitrary Waveform Generator
DSO:	Digital Storage Oscilloscope
DTU:	Device Under Test
PD:	Photodiode
TLS:	Tunable Laser Source

Performance Data

A triangular low-frequency drive signal is applied to the modulator at the 3-dB working point. It is crucial that the peak-to-peak drive voltage V_D of the applied signal is greater than V_π such that an overmodulation is provoked. V_π can then be easily calculated from the input period T_0, on-off time T_1, which is the time between the maximum and minimum of the optical signal. The output signal of the modulator has its extrema not simultaneously to the input signal, but before and after. This can be interpreted as a shortening of the output signal period.

$$\frac{T_1}{T_0/2} = \frac{V_\pi}{V_D}, \text{with } \frac{1}{f_0} = T_0 \quad \rightarrow \quad V_\pi = \frac{T_1}{T_0/2} V_D$$

The ratio of the input period T_0 to the output period T_1 is used to calculate V_π with the expression shown left. If several periods of the output signal are captured during the measurement, V_π can be determined more precisely for the average of all T_1 is used to avoid errors from insufficient data resolution.



References

W. Heni et al., "Nonlinearities of organic electro-optic materials in nanoscale slots and implications for the optimum modulator design," Opt. Express, 2017, doi: 10.1364/OE.25.002627.

To cite: Polariton Technologies AG, MZM Parameter Testing: How to Measure V_π Employing Overmodulation [leaflet], Version POL-000147TSTPRC_revA_One-slide-Vpi-OM