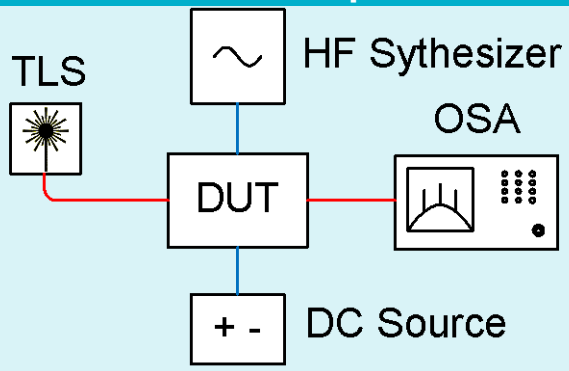
POLARITON TECHNOLOGIES

How to Measure V_π at High Frequencies

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 is by analyzing the optical spectrum of the modulated. This way, one can determine V_π from low to high frequencies characterizing a modulator's bandwidth and modulation speed.

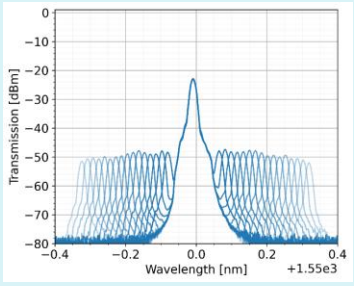
Schematic Setup



DUT:	Device Under Test
HF:	High Frequency
OSA:	Optical Spectrum Analyzer
TLS:	Tunable Laser Source

Working Principle

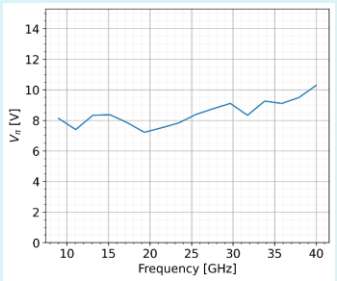
Modulation of the optical carrier leads to a transfer of energy from the carrier to sidebands. The modulation can be calculated as the power ratio between carrier and sideband.



From this, one can calculate the modulation index or phase modulation amplitude η. One can then calculate V_π for a PPM, respectively a MZM as follows:

$$V_\pi = \frac{V_D}{\eta}\pi, \qquad V_\pi = \frac{V_D}{2\eta}\pi$$

An ideal MZM in push-pull mode only needs half the voltage for a shift of π. Furthermore, MZM must be driven at its 3 dB point which is done by applying a constant bias voltage for a balanced MZM or by shifting the wavelength for an imbalanced MZM.



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.
H. Zwickel, "Optical Frequency Comb Generation with Silicon-Organic Hybrid Modulators", Karlsruhe Institute of Technology, 2015

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