EOSPACE

High-Speed (<1μsec) Integrated Multi-stage Polarization Controller Module

Polarization Controller Package (accommodate up to 8-stages)

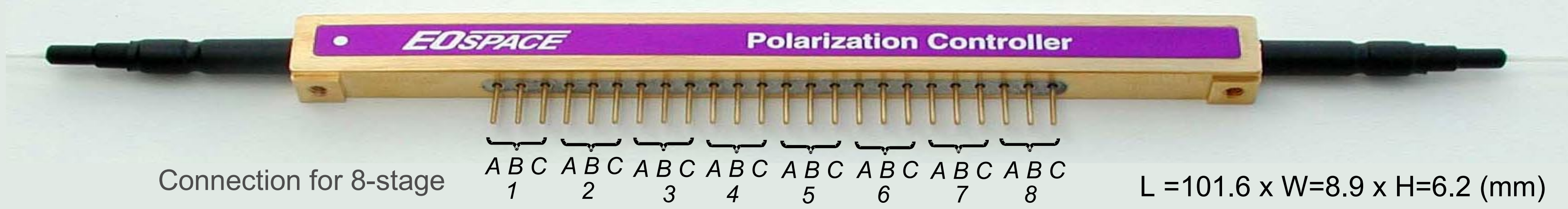
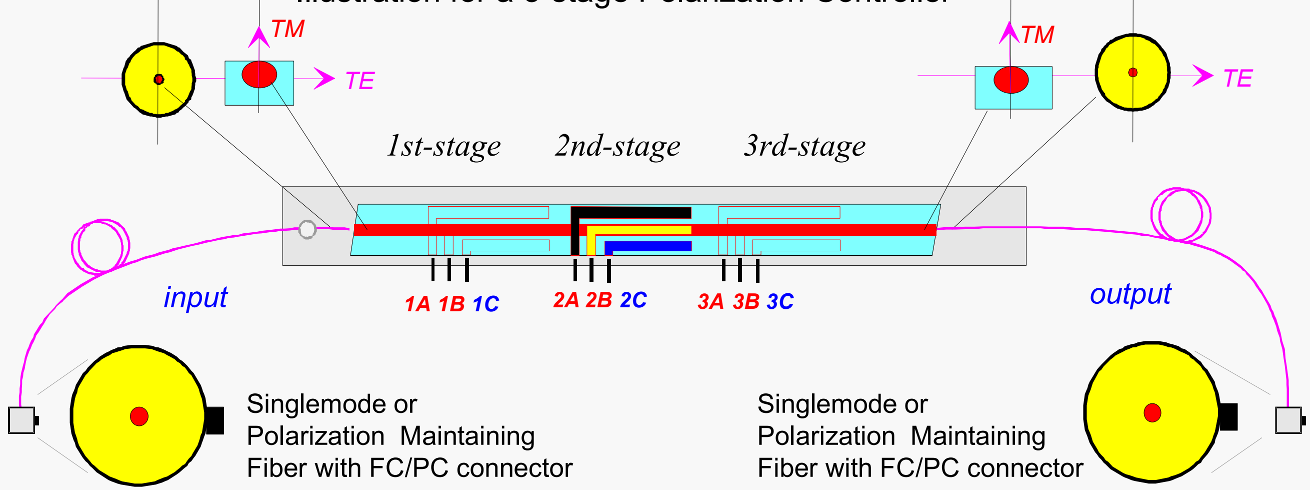
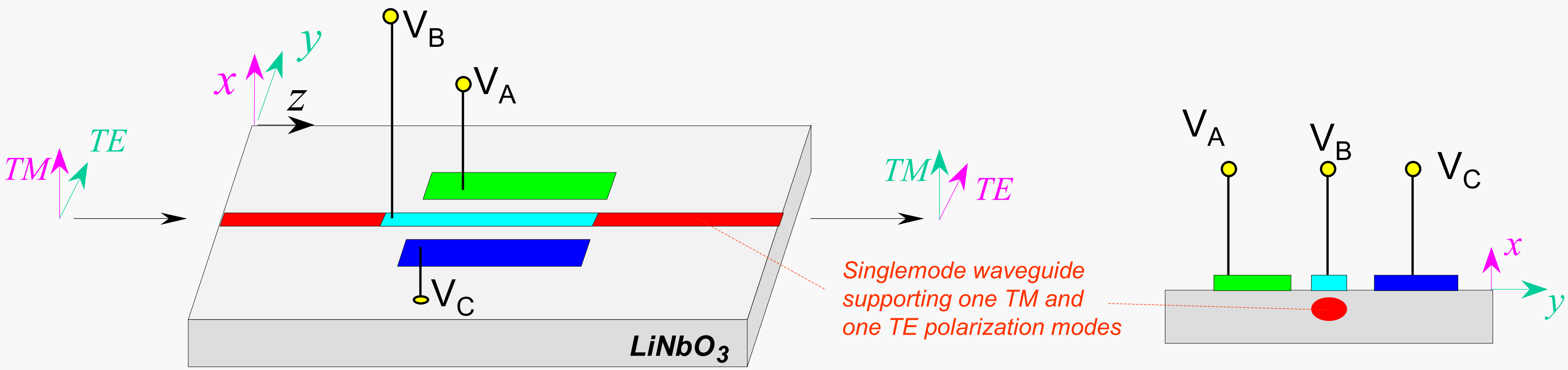


Illustration for a 3-stage Polarization Controller



- EOSPACE - Polarization Controller Module consists of multiple stages of Polarization converter devices cascaded in series
- Each polarization converter stage has three electrodes A, B and C respectively.
- The principle of operation is based on high-speed electro-optic lithium niobate waveguide polarization conversion concept, invented and patented by Dr. Suwat Thaniyavarn *(U.S. Patent # 4,691,984)*
- The basic device operation is described in Optics Letters, Vol. 11, No. 1, Jan 1986, PP. 39-41
- The use of multiple (1-8) stages of polarization converter devices allows each user to operate the device with their own electronic feedback controller, for a reset-free polarization tracking operation

The Basic Layout of each Polarization Converter Stage



Side view

Cross-section view

- Ref: Wavelength-independent $LiNbO_3$ TE-TM mode Converter, Optics Letters, Vol. 11, No. 1, Jan 1986, pages 29-41

- There are three electrodes per each polarization converter. One can be connected to ground.
- The operation of this singlemode waveguide device is via the high-speed electro-optic effect (sub µsec - nsec.)
- Applying voltages to the electrode generates horizontal (E_y) and vertical electric (E_x) field inside the waveguide region.
- Horizontal (E_y) field induces a relative optical phase shift between the TM and the TE polarization modes via the r_{22} and $r_{12} = (-r_{22})$ linear electro-optic coefficients: $\Delta n_{TM} \propto + n_o^3 r_{22} E_y/2$, $\Delta n_{TE} \propto - n_o^3 r_{22} E_y/2$. (where n_o - ordinary index)
- Vertical (E_x) field induces TE-TM mode coupling (κ) via the r_{61} ($=-r_{22}$) electro-optic coefficient: $\kappa \propto (\pi/2\lambda)\, n_o^3 r_{61} E_x$.
- A proper bias voltage is applied to generate the horizontal (E_y) field so that the TE and TM modes are phase-matched.
- The vertical (E_x) field is then used to essentially "rotate" the polarization states.
- The output state of polarization can be controlled by adjusting both the differential phase shift and the rotation angle of the two principal polarization states to achieve any arbitrary polarization state output.