HIGH POWER PHENOMENA

There are basically two factors that limit the maximum power that can be transmitted with a single-mode or polarization-maintaning fiber.

- Bulk effect: Stimulated Brillouin Scattering
- Fiber end-face effect: Scorching of the fiber end-face or Photocontamination (this effect can be limited by fiber end caps)

STIMULATED BRILLOUIN SCATTERING/BRILLOUIN THRESHOLD

Stimulated Brillouin Scattering (SBS) is an effect that limits the maximum power that can be transmitted by the fiber. Unlike photo-contamination and direct scorching of the fiber end-face, which limit the power that can be transmitted at the fiber end-face, stimulated Brillouin scattering is a bulk medium effect.
The electro-magnetic wave propagating within the optical fiber is scattered by acoustical phonons that are caused by electrostriction. The acoustical phonons induce periodic changes in refractive index (elasto-optical effect) that serve as a Bragg grating, reflecting the incoming radiation. The wavelength of the reflected radiation (Stokes photon) is shifted towards higher wavelengths.
If the input power exceeds the Brillouin threshold P_{cr} , almost the entire radiation is reflected. The threshold is defined as:

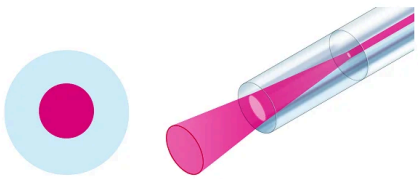
$$P_{cr} = \frac{21 \cdot A_{eff}}{g_B \cdot L_{eff}}$$

A_{eff} ~ (MFD)2 = effective core diameter

L_{eff} = effective cable length, dependent on fiber losses

g_B = gain coefficient of the Brillouin spectrum

The critical power is wavelength-dependent and influenced by other fiber parameters. The amount of power that can be transmitted by a particular fiber needs to be determined for each fiber individually.



PREVENTING DETRIMENTAL EFFECTS ON THE FIBER END- FACE: END CAPS

The described detrimental effects can be obviated using a fiber end cap, in which a short length of fiber (<300 µm) without a core is spliced onto the polarization-maintaining fiber .
Without a fiber core to confine the beam, the mode field diameter of the beam already starts to diverge within the fiber end cap and the resulting beam area at the end-face is significantly larger. More details are found here.

This is a printout of the page https://sukhamburg.com/support/technotes/fiberoptics/cablebasics/highpower.html from 5/31/2026

CONTACT

For more information please contact:
Schäfter + Kirchhoff GmbH
Kieler Str. 212
22525 Hamburg
Germany
Tel: +49 40 85 39 97-0
Fax: +49 40 85 39 97-79

info@sukhamburg.com
www.sukhamburg.com

LEGAL NOTICE