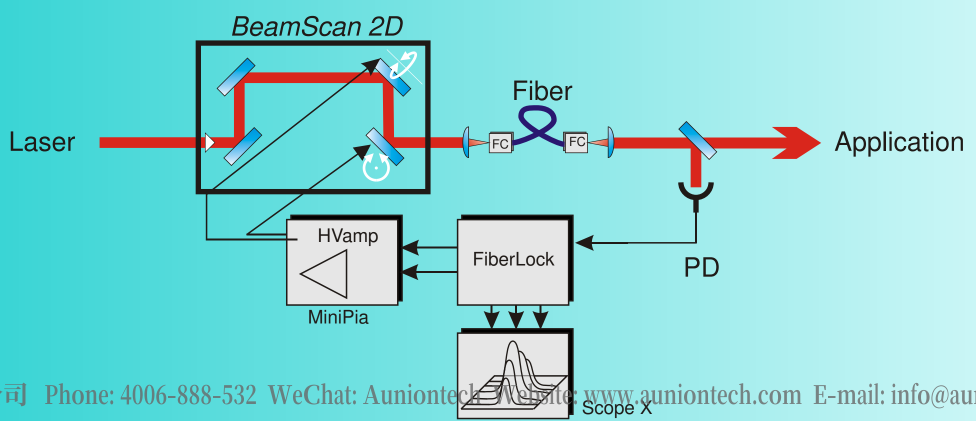
FiberLock

FiberLock®

Automatic single mode fiber coupling

- single-mode fiber coupling is set up within seconds
- automatic multidimensional tracking
- compensation of thermal and mechanical drifts
- easy optimization of coupling optics
- optimum coupling factors can be accomplished

Principle

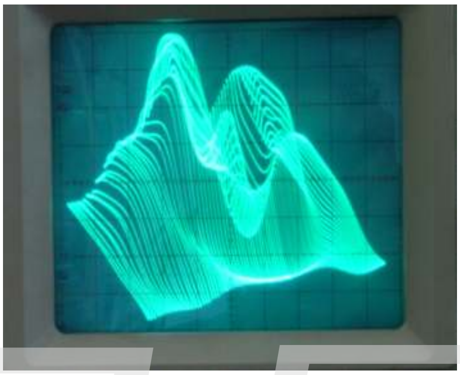


www.TEM-Messtechnik.de

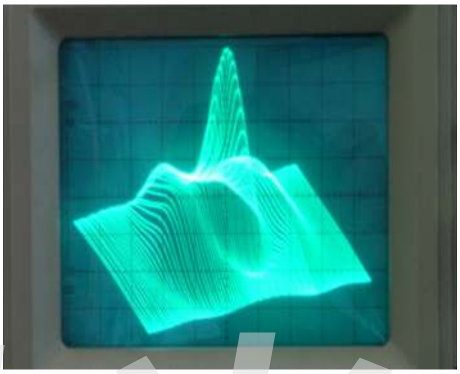
Principle of Operation

Usually, the coupling into single-mode fibers is a time-consuming task since mechanical positioning with sub-micrometer precision has to be performed. Expensive moving or tilting units with very good long-term stability have to be used.

With *FiberLock* the laser beam is scanned two-dimensionally by special piezo actuators with up to kHz frequency and by up to several hundreds of micrometers. The light transmitted through the fiber is detected by a photo detector and is then displayed 'real-time' as a 3D-view on an oscilloscope (in x/y-mode). Thus, the coupling can be monitored and optimized, e.g. by shifting or tilting of the focussing optics.

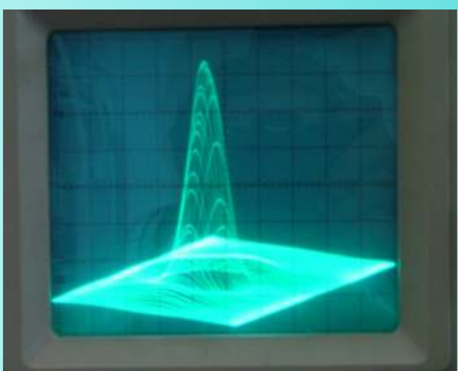


Focus not yet optimized

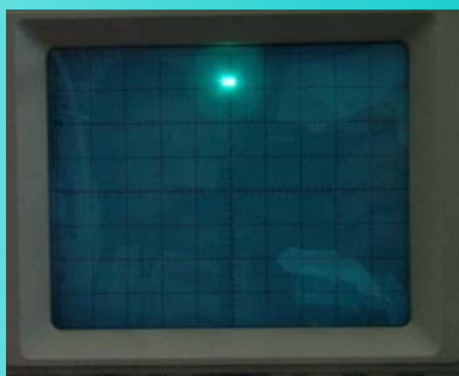


Improved focus

The three-dimensionally displayed coupling profile can be viewed from any direction. After successful mechanical optimization, the *FiberLock* is switched from 'scanning' to 'regulation' mode. In the regulation mode the x- and the y-directions are modulated by phase-shifted sine signals and then the measured photo detector signal is detected phase-sensitively ('dual-phase lock-in technique'). A deviation from the transmission maximum results in an error signal that is used to correct the beam direction with respect to the fiber by a 2D PID-regulator.



Perfectly optimized focus



Switched to 2D-stabilization

FiberLock

The very compact electronic devices are available in following variants:

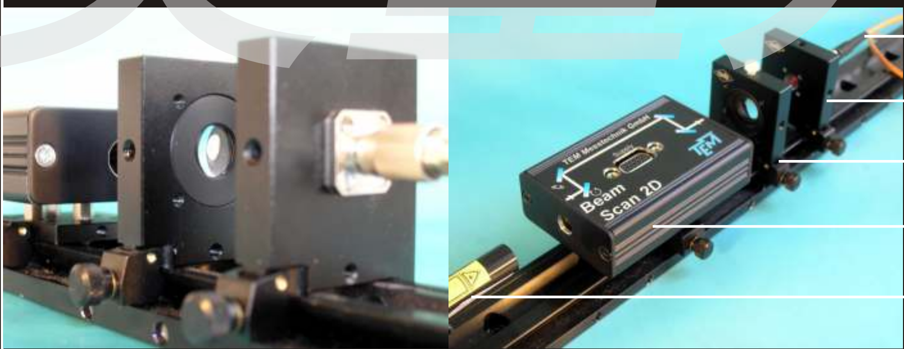
- FiberLock s, and
- FiberLock 3D

Both versions are identical regarding modulation, regulation, and stabilization functionality. In addition to this *FiberLock 3D* contains the xy-scan unit and the 3D-display unit for connecting an oscilloscope.

FiberLock 3D: Scan and Regulation Electronics

The control and regulator unit requires a supply unit with low voltage supply, high voltage supply and high voltage amplifiers for driving the piezo actuators.
We recommend to use *miniPiA FiberLock* of TEM Messtechnik for this purpose.
Third-party piezo amplifiers can be used as well.

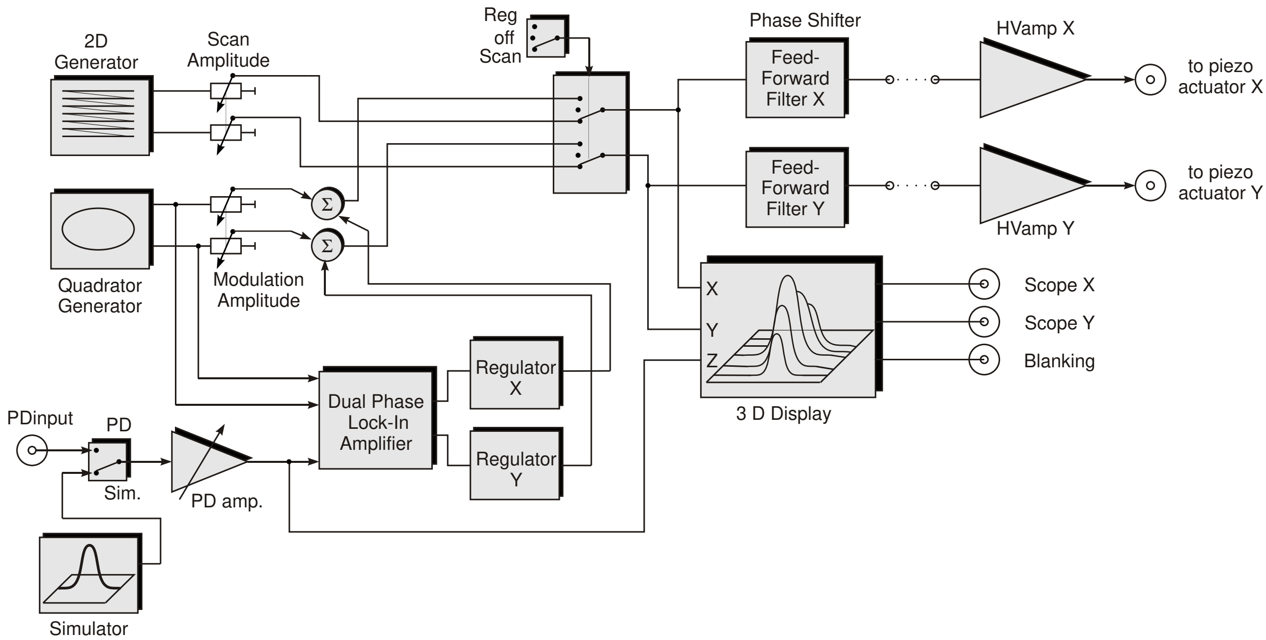
MiniPiA FiberLock: Supply and Piezo Amplifier



The *FiberLock* principle requires the laser focus and the fiber aperture to be moved relatively to each other. In general, we recommend the *BeamScan 2D* unit, which contains 2 piezo-tilted mirrors (see picture on the right). Customer specific solution can also be offered.

FiberLock

Block Diagram



Specifications of miniPiA FiberLock

Output voltage range for piezo: 150 V, >10 mA per channel (other values on request)

Low voltage supply output: ± 15 V, ± 200 mA

Electrical power supply: 100...120V AC or 200...250V AC, 40...70 Hz

Housing dimensions: 209 x 125 x 88 mm

Specifications of BeamScan 2D

Wavelength range: 380...1100 nm (other wavelengths on request)

Aperture: 6 x 6 mm (other dimensions on request)

Scan angle: ± 0,5°

Max. scanning frequency: 400...700 Hz (typ.)

Housing dimensions: 84 x 55 x 24 mm

Laser power through the fiber is not modulated

Due to the two-dimensional modulation, the coupled-in laser power is constant in the regulated case and is almost not modulated! In contrast to two independent x- and y-modulations, the focus is moving on a 'topographic' curve very close to the maximum coupling. Only in case of a mechanical drift, this topographic curve is tilted and an error signal results in the x- or y-regulator (or in both), which will lead to an immediate correction.

Automatic search for the transmission structure

If the stabilization has failed due to a greater disturbance (e.g., due to a loss of the complete laser power), *FiberLock* can switch to the search mode: the modulation amplitude will be varied continuously between maximum and minimum modulation. If during this 'spiral scan' the coupling structure is detected again, a reduction of the modulation amplitude to the predefined very small value is performed and the system returns automatically to the maximum coupling factor.
If now any optical element in the optical path is drifting in x- or y-direction, e.g. due to thermal expansion of mechanical components, drifting splices or similar, this will immediately be compensated for by the regulator.

The following major advantages are resulting:

- Very simple and low-cost adjustment mechanics can be used (with a position accuracy of 1/10 mm), since the fine adjustment is performed automatically. In many applications, even coarse adjustment can be omitted, because typical manufacturing tolerances of optical components are smaller than the activity radius of the piezos used.
- No attention needs to be paid to high thermal and mechanical stability of the fiber coupling mechanics (like usually required with single-mode couplers). It is even possible to use plastic parts and inaccurately manufactured mechanics due to the fact that drifts in the range of up to several 100 µm will be compensated for.
- An optimization of the coupling parameters, e.g. by the selection of the focussing length for the coupling optics (which normally is performed only roughly) can be performed in “real-time” due to the enormous speed advantage.
- Especially for laser systems where the coupling into a single-mode fiber has to be performed quite often (e.g. because the beam position is changed after each adjustment of the laser, or if the laser has to be exchanged), the automatic fiber coupling pays off.
- Especially for measurement or test systems where different laser beams have to be alternatingly coupled into one single-mode fiber, a big advantage will result from using the automatic fiber coupling.

FiberLock

Technical Data FiberLock 3D Electronics

Housing dimensions:	170 x 115 x 30 mm
Scan repetition frequency: (depends on beam scanner used)	1...1000 Hz
Sensitivity of detector input:	10 mV...2V
Electrical power consumption:	± 15 V, max. ± 150 mA
Wavelength and type of fiber:	depends on optical setup

Subject to change without notice

Development, Manufacturing and Distribution

TEM Messtechnik

06/2011

TEM Messtechnik GmbH
Grosser Hillen 38
30559 Hannover
Germany

tel. +49-511-51089630
fax +49-511-51089638
info@tem-messtechnik.de
www.tem-messtechnik.de