1. Launching a Laser Beam into a Singlemode Fiber with the 60SMS-... Laser Beam Coupler

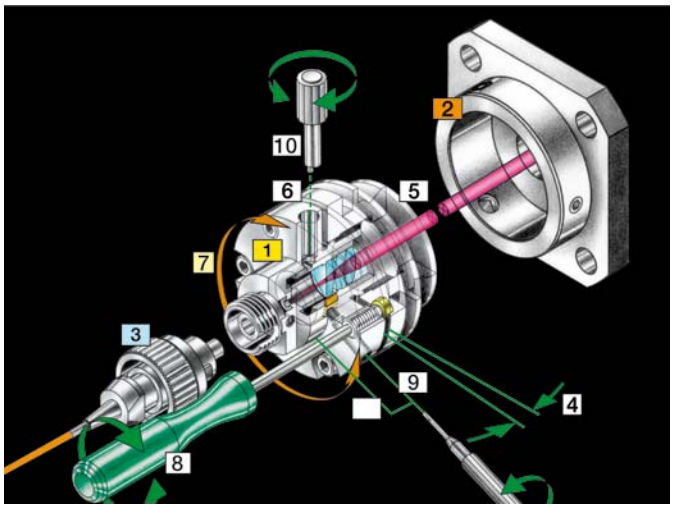

Figure 1:
1 Laser Beam Coupler 60SMS...
2 Adapter flange
3 Fiber connector
4 TILT adjustment
5 Circumferential V-groove and thigt fit cylinder
6 Lens focussing mechanism
7 Adjustment of fiber rotation
8 Hex Allen key 50 HD-15
9 Screwdriver 9D-12
10 Eccentric key 60EX-4

1.1 Connecting the Laser Beam Coupler to your System

The **Schäfter+Kirchhoff** laser beam coupler (Figure 1) launches a laser beam into, or from, a polarization-maintaining singlemode fiber using either an inclined FC-APC or coaxial FC-PC connector. It can be connected to your system or optical bench by using an adapter flange or it can be attached directly to a multicube from **Schäfter+Kirchhoff**.

It is very important for correct coupling that the laser beam reaching the laser beam coupler is centered and this can be tested attaching the 13BL1-13 aperture instead of the laser beam coupler (Figure 2: Left).

Especially for HeNe lasers, **Schäfter+Kirchhoff** offers adapter flanges which can be moved laterally in elongated holes in order to center the adapter flange with the laser beam (Figure 2: Right).

Only a coarse alignment is necessary, and this can be done by hand, as the positioning accuracy must only be a fraction (7 - 10 %) of the beam diameter.

Locate the three radially arranged tapered pin screws in the adapter flange/attentuator (Figure 3: Left) and loosen them using the hex screwdriver 50HD-15. For an adapter flange with integrated shutter or attenuator, ensure that the shutter or attenuator is completely open. Gently introduce the laser beam coupler into the vacant aperture.

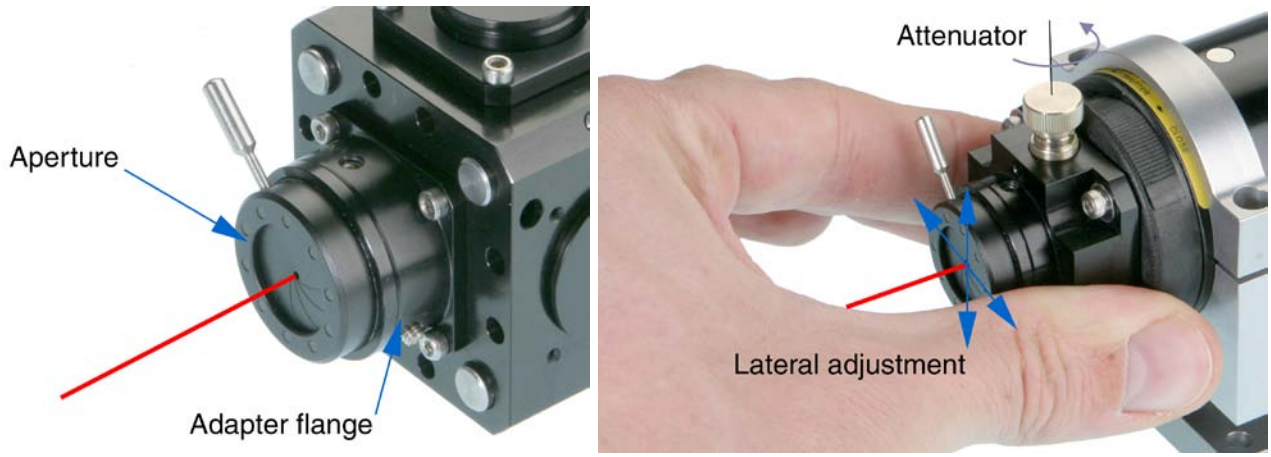

Figure 2: *Left: The laser beam and the adapter flange are centered using an aperture. Right: Adapter flange with elongated holes for a lateral adjustment. Completely open the attenuator for the adjustment.*

If a polarization-maintaining singlemode fiber is to be attached to the laser beam coupler, coarsely rotate the laser beam coupler so that the plane cut at the connector receptacle is perpendicular to the polarization axis (Figure 3: Right).

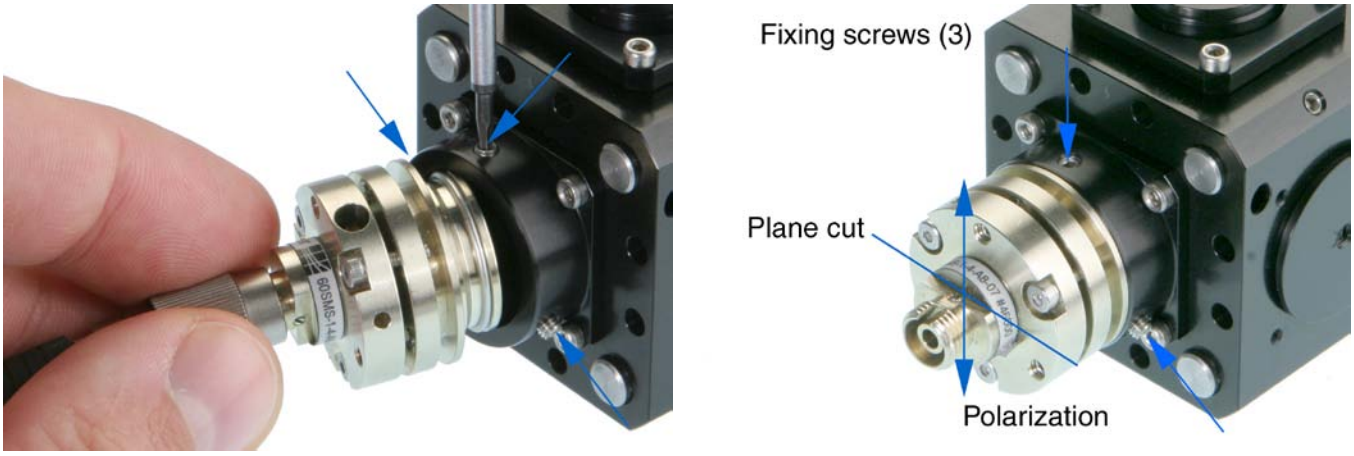

Figure 3: Left. Attach the laser beam coupler to the adapter flange with three radially arranged pin screws. Right. For use with a polarization-maintaining singlemode fiber, the plane cut of the laser beam coupler is aligned perpendicular to the laser polarization.

Warning! To prevent damage to the flat face of the fiber ends, the following adjustment steps 2, 3 and 4 must be performed under low optical power (P < 40 mW). After step 4, the power level can be restored to the level required.

1.2 Attaching a Singlemode Fiber Cable to the Laser Beam Coupler

Only attach fiber cables with connectors of the FC-APC type (polished at an 8° angle) to laser beam coupler with an inclined coupling axis (Order code 60SMS-1-**4**-...), or fiber cables with connectors of the FC-PC type (0° angle) to laser beam couplers with a coaxial coupling axis (Order code 60SMS-1-**0**-...).

Ensure that the pin screw for holding the fiber ferrule of the FC connector, is loosened using the screwdriver 9D-12, otherwise the optical fiber may be damaged, (Figure 4: Left.

Locate the orientation marker (key) on the connector by pulling back the threaded collar and align the marker with the orientation groove in the laser beam coupler (Figure 4: Left). To prevent damage to the polished end of the optical fiber, carefully introduce the connector ferrule into the aperture of the laser beam coupler at an oblique angle.

Gently screw the threaded collar of the connector onto the thread of the laser beam coupler, until finger tight.

Gently tighten the locking screw 1.5 onto the optical fiber ferrule, using screwdriver 9D-12, to lock the fiber into position. Do not overtighten or the state of polarization of the fiber will be affected.

The polarization axis of the fiber is coarsly aligned using the orientation marker but, for a reproducible connection, fully tighten the collar and the connector by hand to locate the key positively against the right-hand side of the oriientation groove in the laser beam coupler.

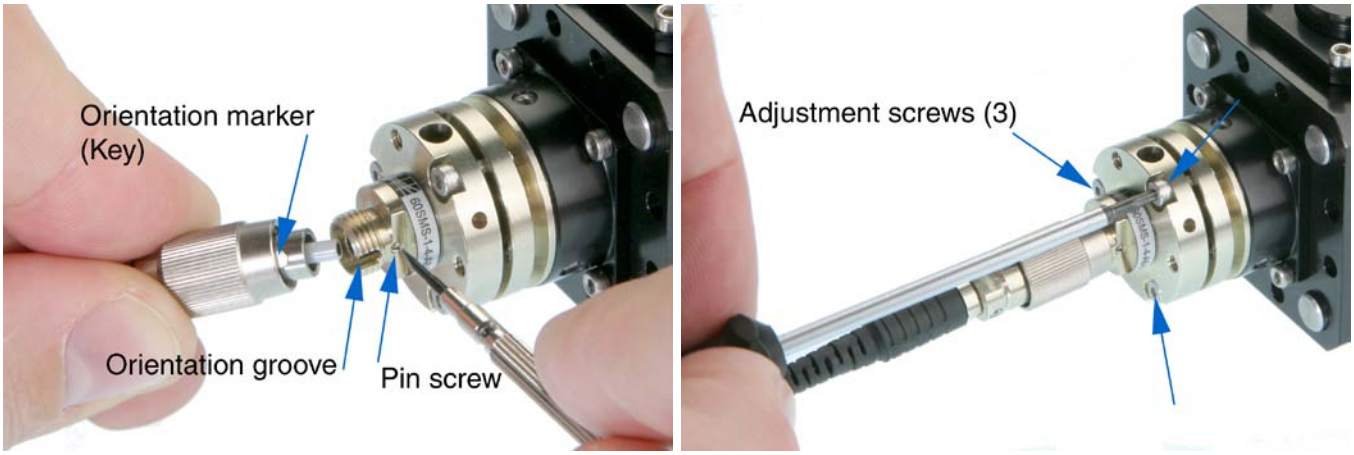

Figure 4: Left. Ensure that the pin screw is loosened before inserting the fiber connector. Right: Coarse tilt adjustment of the laser beam coupler with the three headed screws.

Kieler Straße 212, D-22525 Hamburg • Phone (+49) 40 85 39 97-0 • Fax (+49) 40 85 39 97-79 • eMail: info@SuKHamburg.de • Web: www.SuKHamburg.de

1.3 Tilt Adjustment: Finding a Signal

Coupling a laser beam into a singlemode fiber requires precise adjustment and needs some patience. Laser beam couplers are collimated for a particular wavelength to ensure that the focus is located in the plane of the polished end face of the connector ferrule. Thus, light is coupled into the fiber at only a very limited locality.

Warning! Do not look at the light emitted by the laser nor at the open fiber end. Follow all laser safety instructions recommended by the laser manufacturer! Adhere strictly to local laser safety requirements (e.g., BGI832, BGV B2) !

Measure the coupled light at the opposite end of the fibre cable using a light detector or power meter. The detector may have to be adjusted to maximum sensitivity in order to detect a low transmission level.

Loosen the locking screws (pin screws) by 2-3 turns. The adjustment screws (hex with head) see Figure 4, right, now are turned systematically (i.e. each possible adjustment point is met once), until the detector shows a reaction and the beam is found. Use hex screwdriver 50HD-15.

If no signal is found then the signal area can be increased by slightly loosening the threaded collar of the FC connector – this increases the diameter of the laser spot and making it easier to detect a signal. Once a signal is found then gently tighten the collar and the connector again, remembering to locate the alignment marker positively against the right-hand side of the groove in the laser beam coupler.

1.4 Tilt Adjustment: Adjustment Procedure, Coarse Adjustment

Tighten the headed screws (Figure 4: Right) one after the other (e.g. in a clockwise direction), so that the signal is maximized. The screw is tightened a little beyond the maximum until the signal decreases by a few percent. Adjust the detector sensitivity as required.

Move on to the next headed screw and proceed as described before. Always follow the initial direction (i.e. clockwise). After two or three cycles of adjustment the last screw is tightened and maximum power at fiber end is achieved. The adjustment should be now at optimum. The fine adjustment to provide the maximum coupling efficiency is done by the counter screws innthe next step (pin screws, Figure 5: Left).

1.5 Tilt Adjustment: Fine Adjustment and Locking

Now the three locking screws (pin screws, Figure 5: Left) are tightened roughly equal with very gentle force using screwdriver 9D-12. The detector at fiber end now shows a signal, but usually it differs from the maximum as seen before.

The three locking screws are now gently tightened using the same systematic procedure. Again, the screws are tightened a little beyond the maximum, repeating the procedure for each screw over two or three cycles of adjustment until all are fully tightened.

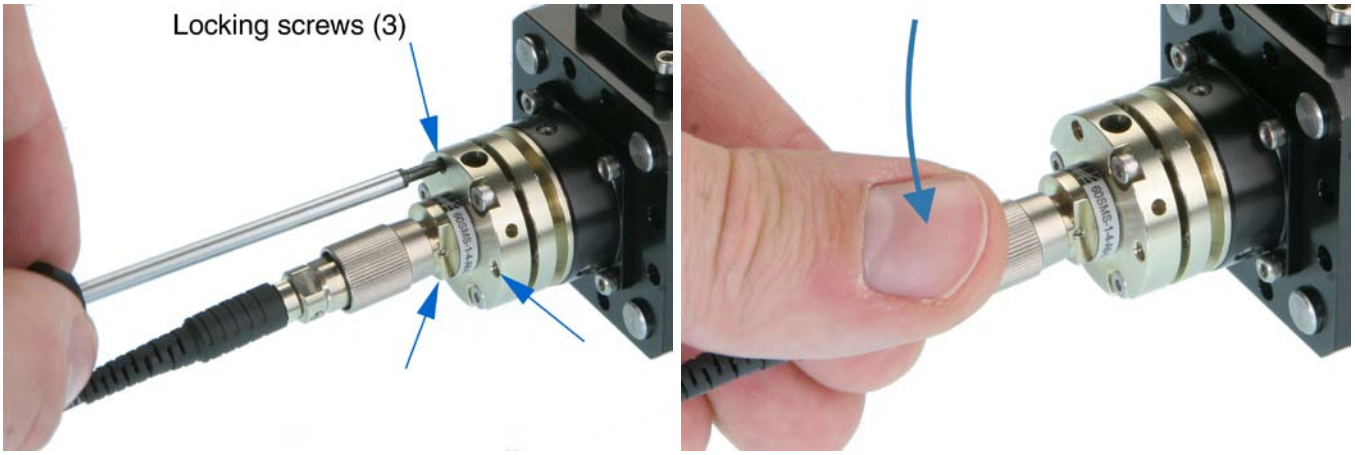

Figure 5: Left: Fine adjustment and locking of the TILT adjustment by three pin screws. Right: Checking the alignment by pushing the coupler in different directions. If the coupler is aligned correctly, the power emitted by the end of the fiber should always decrease.

Kieler Straße 212, D-22525 Hamburg • Phone (+49) 40 85 39 97-0 • Fax (+49) 40 85 39 97-79 • eMail: info@SuKHamburg.de • Web: www.SuKHamburg.de

Now subsequenly adjust the optical power to the power level required. Depending on your particular laser system, a minor readjustment of the counter screws may be necessary.

The last screw in the last adjustment round is tightened up to its maximum power at fiber end.

1.6 Checking the Alignment, 'Thumb Test'

As a useful check of the optimal alignment, the fiber can **gently** be displaced by hand in different directions (see Figure 5: Right). When optimally aligned, this slight displacement of the fiber should always reduce the signal. If the signal increases by displacing in one direction, the locking screw shifting the fiber position into the desired direction has to be tightened further. Please remember: The locking screws are pressing.

1.7 Focussing the Laser Beam Coupler

Focus adjustment (adjustment of the coupling lens in z-direction) is difficult and should be performed by use of a collimating telescope only. Normally, it is not necessary for the customer to readjust the coupling lens position, since they are shipped preadjusted for the given wavelength. If adjustment becomes necessary, please contact **Schäfter+Kirchhoff**.

A relatively simple procedure for checking the focus setting of the laser beam coupler can be performed using the laser beam coupler as a fiber collimator.

Couple some radiation of appropriate wavelength into the fiber and place the laser beam coupler to be adjusted to the open fiber end. Direct the beam to a target at about 3 m distance. **Follow laser safety precautions!** The laser spot diameter on the target has to be as large as the beam diameter directly behind the laser beam coupler.

Loosen the two radially arranged pin screws, that lock the coupling lens in place, using Screwdriver 9D-12, see Figure 5: Left. Adjust the focus using the eccentric key 60EX-4 by minimizing the laser spot on the target about 3 m away, see Figure 6:, Right. Minimize the laser spot on a target in about 3 m distance. Lock the coupling lens into position by retightening the two radially arranged pin screws.

Figure 6: Left: Loosen the two radially arranged pin screws for loosen the coupling optics. Right: Slightly rotate eccentric key 60EX-5 for collimating the coupling optics.

1.8 Alignment of the Fiber Polarization Axis

When coupling a laser beam into a polarization-maintaining singlemode fiber, the polarization axis of the fiber must be aligned to obtain a high polarization extinction ratio.

The polarization axis is adjusted by rotating the fiber and the laser beam coupler together. Loosen the three radially arranged pin screws locking the laser beam coupler to its adapter flange. Slightly rotate the laser beam coupler and finally lock the three pin screws again.

The polarization extinction of the laser radiation coupled into a fiber cable is measured using a polarization analyzer, such as the SK010PA Polarization Analyzer from **Schäfter+Kirchhoff** (see separate data sheet).

4 Schäfter + Kirchhoff GmbH
Kieler Straße 212, D-22525 Hamburg • Phone (+49) 40 85 39 97-0 • Fax (+49) 40 85 39 97-79 • eMail: info@SuKHamburg.de • Web: www.SuKHamburg.de