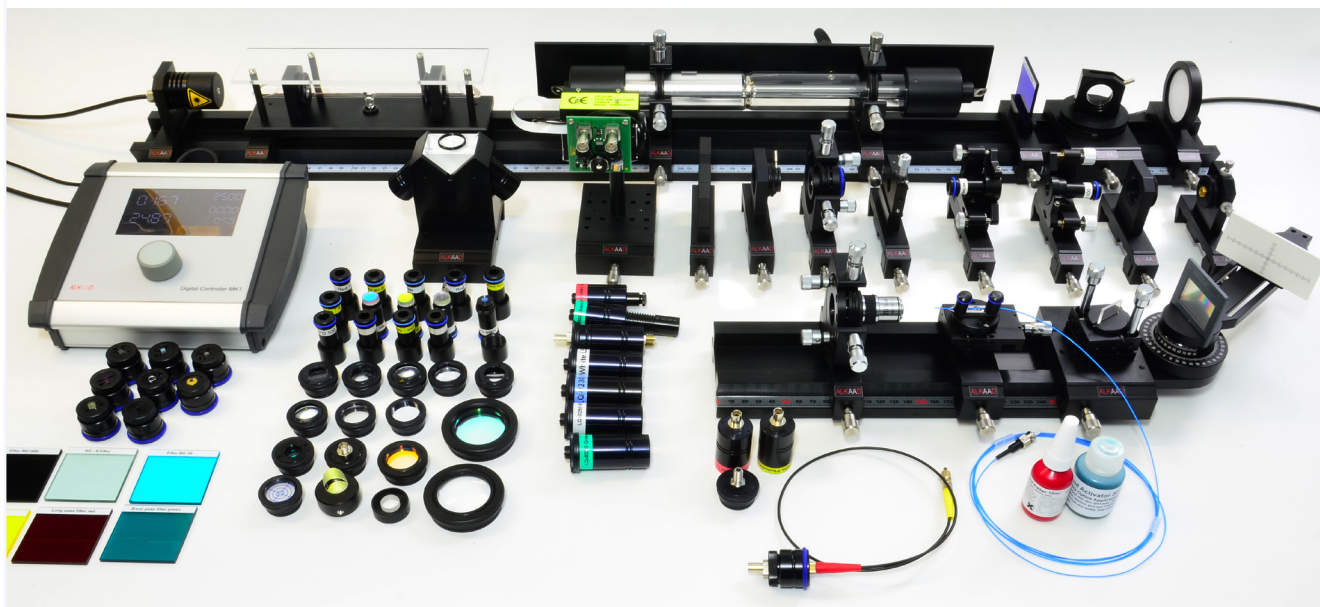


Modules and Components List



The experiments presented in this catalogue are based on the combination of a series of components and modules. Wherever applicable the same parts are used to minimize the costs. In fact, the most important part is the optical bench along with the carrier which accommodate the individual adjuster and mounts. A smart design of the optics mounts removes the ne-

cessity of using tools, maintaining a high precision and secure seat of the optical mounts in their respective holders. Each component or module is available separately allowing the customer inspired combination of new exciting experiments.

MP - Mechanical Parts

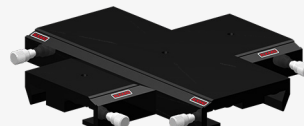
1 MP-0050 Cross-piece MG-65 with kinematic mount \varnothing 25mm

Four optical rails are combined and fixed to each other forming a 4 - way crossing. In the centre of the crossing an adjustable prism stage is provided. It has a clear hole with a diameter of 25 mm to accommodate various optical components like plates, prisms and beam splitting cubes. By means of two fine pitch screws the optical component can be tilted precisely around its perpendicular axis. Furthermore the prism stage provides the adjustment around the perpendicular axis of the optical component.



2 MP-0065 Carrier cross piece MG-65

Four optical rails are combined and fixed to each other forming a 4 - way crossing. In the centre of the crossing an M6 thread allows the attachment of the adjustable prism stage for instance.



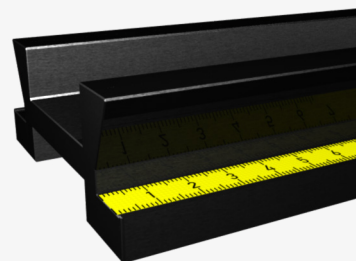
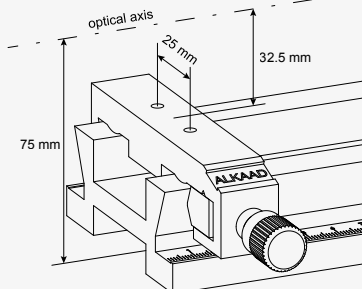
3 MP-0082 Bridge connector for two rails plus riser plate

This connector is used to connect two optical rails. By using two of them a rectangular or quadratic structure can be achieved.



4 MP-0100 Optical Bench MG-65, 1000 mm

The ALKAAD rail and carrier system provides a high degree of integral structural stiffness and accuracy. Due to this structure which is based on the reference meter of Paris is a further development optimised for daily laboratory use. The optical height of the optical axis is chosen to be 75 mm above the table surface. The optical height of 32.5 mm above the carrier surface is compatible with all other systems like from MEOS, LUHS, MICOS. OWIS and LD Didactic. Consequently a high degree of system compatibility is achieved.

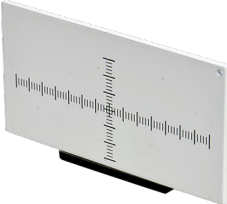


5 MP-0110 Optical Bench MG-65, 100 mm

The length of this bench is 100 mm

6 MP-0120 Optical bench MG-65, 200 mm

The length of this bench is 200 mm

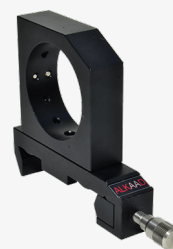
7	MP-0130 Optical Bench MG-65, 300 mm The length of this bench is 300 mm	
8	MP-0150 Optical Bench MG-65, 500 mm The length of this bench is 500 mm	
9	MP-0220 White screen with XY scale on block The screen is made from matt white powder coated aluminium with a size of 40 mm x 80 mm x 3 mm. It is attached to a block with two M4 threads so that the centre of the scale is in a height of 20 mm. The screen is mounted with 2 M4x10 screws to the rotary arm of MM-0300 (see 30)	

MM - Mechanical Modules

1	MM-0020 Mounting plate C25 on carrier MG20 This frequently used component is ideal to accommodate parts with a diameter of 25 mm where it is kept in position by three spring loaded steel balls. Especially C25 mounts having a click groove are firmly pulled into the mounting plate due to the smart chosen geometry. The mounting plate is mounted onto a 20 mm wide carrier.	
2	MM-0024 Mounting plate C25-S on carrier MG20 Components with 25 mm in diameter are placed into the mounting plate where it is kept in position by three spring loaded steel balls. This allows the precise rotating whereby an engraved scale serves as angle readout. This component is useful for polarisation sensitive components.	
3	MM-0028 Mounting plate C25-S with angle gradation This component is ideal to to accommodate parts with a diameter of 25 mm where it is kept in position by three spring loaded steel balls. Especially C25 mounts having a click groove are firmly pulled into the mounting plate due to the smart chosen geometry. The mounting plate is mounted with 2 M4x10 screws to the rotary arm of MM-0300 (see 30)	
4	MM-0030 Mounting plate C30 on carrier MG20 This frequently used component is ideal to accommodate parts with a diameter of 30 mm where it is kept in position by three spring loaded steel balls. Especially C30 mounts having a click groove are firmly pulled into the mounting plate due to the smart chosen geometry. The mounting plate is mounted to a 20 mm wide carrier.	
5	MM-0032 Mounting plate C30-V on carrier MG20 This component is ideal to accommodate parts with a diameter of 30 mm where it is kept in position by three spring loaded steel balls. Especially C30 mounts having a click groove are firmly pulled into the mounting plate due to the smart chosen geometry. The mounting plate is mounted onto a 20 mm wide carrier. Compared to the MM-0030 this mounting plate is manufactured as whole plate.	

6 MM-0050 Mounting plate C50 with carrier MG20

This component is ideal to accommodate parts with a diameter of 50 mm where it is kept in position by three spring loaded steel balls. Especially C50 mounts having a click groove are firmly pulled into the mounting plate due to the smart chosen geometry. The mounting plate is mounted onto a 20 mm wide carrier.

**7 MM-0060 Filter plate holder on MG20**

This filter plate holder is designed to accommodate standard optical filter plates with a thickness of 3 mm, a width of 50 mm and a height of 50 mm. The plate is held in position by two grub screws which have spring loaded balls at their tips.

**8 MM-0090 XY adjuster on MG20**

A precision XY adjuster with two fine pitch screws accepts all optics mounted in C25 mounts. The picture on the right shows the adjuster with an inserted optics, however, under this reference number the adjuster comes without such an optic.

**9 MM-0100 Target Cross in C25 Mount**

A crossed hair target screen is part of a 25 mm click holder C25 which can be inserted into the mounting plate (MP). The screen is kept in position by means of three precision spring loaded steel balls. It is used to visibly align a light beam with respect to the optical axis of the rail and carrier system.

**10 MM-0110 Translucent screen on carrier MG20**

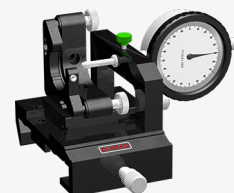
In a round holder a sheet of translucent paper is fixed with a retaining ring. This component is useful to image and visualize optical rays. Furthermore, the translucence allows the convenient photographic recording from the opposite side with digital cameras for a quick picture for the students measurement report.

**11 MM-0114 White screen with centre hole**

In a round holder a sheet of translucent paper is fixed with a retaining ring. This component is useful to image and visualize optical rays. Furthermore, the translucence allows the convenient photographic recording from the opposite side with digital cameras for a quick picture for the students measurement report. A hole in the centre allows a beam to be transmitted to a target which reflects or scatters the rays back to the screen.

**12 MM-0120 Dial gauge travel 5 mm resolution 1 μ m on MG20**

This module combines a translation stage which is moving a triple reflector and a dial gauge measuring this move. Furthermore, an kinematic adjustment holder is added which holds the required triple reflector ("OC-0520" on page 96).

**13 MM-0140 Triple reflector on motorised translation stage, travel 50 mm**

A triple reflector is mounted on top of the moveable part of a translation stage which is driven by a stepper motor. The motor with 200 steps per revolution is coupled to the mover with a fine pitch spindle with 1 mm per revolution. That means, each step corresponds to a movement of 5 μ m. Each step can be divided further into 64 micro steps which results in a smooth DC motor like behaviour.



14 MM-0160 Ring laser mirror mount M1 on MG65

A kinematic mirror adjustment holder is mounted to a turn table in such a way that the front surface of the attached laser mirror lies always within the centre of the rotation axis. The turn table is placed on top of a 65 mm wide carrier. Once the desired position has been set, the turntable is clamped by means of a M4 fixing screw. This version is assembled for the lower left mirror of a ring laser structure.

**15 MM-0162 Ring laser mirror mount M2 on MG65**

A kinematic mirror adjustment holder is mounted to a turn table in such a way that the front surface of the attached laser mirror lies always within the centre of the rotation axis. The turn table is placed on top of a 65 mm wide carrier. Once the desired position has been set, the turntable is clamped by means of a M4 fixing screw. This version is assembled for the upper left mirror of a ring laser structure.

**16 MM-0163 Ring laser mirror mount M3 on MG65**

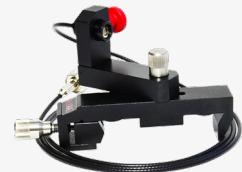
A kinematic mirror adjustment holder is mounted to a turn table in such a way that the front surface of the attached laser mirror lies always within the centre of the rotation axis. The turn table is placed on top of a 65 mm wide carrier. Once the desired position has been set, the turntable is clamped by means of a M4 fixing screw. This version is assembled for the upper right mirror of a ring laser structure.

**17 MM-0164 Ring laser mirror mount M4 on MG65**

A kinematic mirror adjustment holder is mounted to a turn table in such a way that the front surface of the attached laser mirror lies always within the centre of the rotation axis. The turn table is placed on top of a 65 mm wide carrier. Once the desired position has been set, the turntable is clamped by means of a M4 fixing screw. This version is assembled for the lower right mirror of a ring laser structure.

**18 MM-0230 Photodetector mount on rotary arm on MG20**

A Si PIN photodiode is integrated into a small housing and accommodated inside an mounting plate attached to the swivel arm to take in the light reflected from the Brewster window.

**19 MM-0240 Adjustable slit on carrier 20 mm**

The MM-0240 mechanical slit provides precise adjustment of two A2 tool steel blades centred equally about a through hole. Each blade is black to reduce unwanted reflections. The unique design of this mount provides a 1-to-1 correlation between the adjustment of the precision micrometer drive and the subsequent change in slit width to within 20 μm . The actual slit width ranges from fully closed to 6 mm wide with 0.5 mm of adjustment per revolution.

**20 MM-0300 Carrier with 360° rotary arm**

The MM-0300 provides goniometer operation for the optical bench. The carrier is attached to the bench and carries a rotary arm which can be rotated by 360 degrees. The centre of rotation provides a 35 mm mounting hole where probes can be accommodated. The rotary arm has two slots with a distance of 25 mm where mounting plates or other components with 2 M4 threads with 25 mm distance can be mounted.

**21 MM-0340 Scatter probe on rotary table**

The rotary table fits into the MM-0300 and carries a light grey plastic plate with 50x50x3 mm. It is used to measure the scattered light of a light source hitting the surface.



22 MM-0360 Fibre holder with articulated arm

The ferrule of the fibre is clamped in an adapter with a grub screw. Three 6 mm rods are interconnected with a fixed and a swivel joint. The fibre tip can be moved to virtually all coordinates and places and allows convenient hands-free measurements. The fibre holder comes without the fibre.

**23 MM-0380 MG65 carrier with rotary stage**

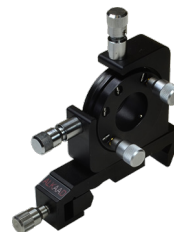
A 65 mm wide carrier is equipped with rotary stage with a central hole. Due to a sophisticated design the rotary table turns smoothly without slip stick effects and has a scale of 360 degrees with tick marks at each 2 degrees.

**24 MM-0410 Rotary Polarisation Analyser 40 mm**

The polarisation analyser or polarizer has a horizontal rotary stage with a 25 mm through hole bore and 360 degree scale with tick marks for each 5 degrees. It is attached to a 20 mm wide carrier. A film sheet polarizer is inserted into a C25 mount which is set into the rotary stage and is kept with three M3 grub screws in position. The module comes with aligned polarisation direction with 0 degree for vertical polarisation.

**25 MM-0420 Four axes kinematic mount on carrier MG20**

This frequently needed component is ideal for the fine adjustment of lenses, microscope objectives, diode laser, etc. with respect to the optical axis of the rail set-up. The displacement area is 5x5 mm and 10x10 degrees respectively. Different mounts can be attached to the adjustment holder. This model provides a holder for 25 mm cylindrical components. The component is inserted into the adjustment holder and is kept in position by a spring loaded steel ball in the same way as for the lens click mounts. Four precise fine pitch screws of repetitious accuracy allow the translational (X; Y) and azimuthal (ψ ; ϕ) adjustment.

**26 MM-0440 Kinematic mount \varnothing 25.4 mm on MG20**

The kinematic adjustment mount has a resting flange for the optics. One fixing screw secures the optics against 2 contact lines, which make 2 contact points. To prevent damage to the optics, the tip of the fixing screw is made of plastic. The movable platform is pre-loaded by two strong tension springs, ensuring tight kinematic fit. A thick base adds to stability which allows to cut away parts of the mount, keeping clear one edge of the optics. The kinematic mount is mounted onto a 20 mm wide carrier. The illustration shown on the right shows a "right" version which can be changed to the left version as well.

**27 MM-0442 Kinematic mount \varnothing 25.4 mm on MG20, right**

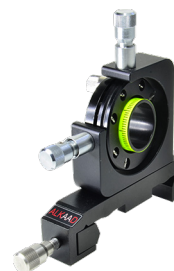
Same as MM-0040, however mounted as a right version

28 MM-0444 Kinematic mount 1", translation stage on MG65

This module utilises a combination of a kinematic mount and a translation stage to firstly adjust a mirror and secondly move it in the direction of the optical axis. Both components are mounted to 65 mm wide carrier MG65

**29 MM-0450 XY Adjustment holder with rotary insert on MG20**

This frequently needed component is ideal for the fine adjustment of lenses, microscope objectives, diode laser, etc. with respect to the optical axis of the rail set-up. The displacement area is 5x5 mm and 10x10 degrees respectively. Different mounts can be attached to the adjustment holder. This model provides a through hole for 25 mm cylindrical components. The component is inserted into the adjustment holder and is kept in position by a spring loaded steel ball in the same way as for the lens click mounts. Four precise fine pitch screws of repetitious accuracy allow the translational (X; Y) and azimuthal (ψ ; ϕ) adjustment. In addition the circumference of the 25 mm holding tube has a scale to determine the rotational position of the inserted component.



30 MM-0460 Kinematic mirror mount M16, left

The kinematic adjustment mount has a resting flange for the optics. One fixing screw secures the optics against 2 contact lines, which make 2 contact points. To prevent damage to the optics, the tip of the fixing screw is made of plastic. The movable platform is pre-loaded by two strong tension springs, ensuring tight kinematic fit. A thick base adds to stability which allows to cut away parts of the mount, keeping clear one edge of the optics. An adapter with a M16 threading is mounted to the movable platform to accommodate M16 mirror mounts. The kinematic mount is mounted onto a 20 mm wide carrier in the left position.

**31 MM-0462 Kinematic mirror mount M16, right**

The kinematic adjustment mount has a resting flange to stop the optics. One fixing screw secures the optics against 2 contact lines, which make 2 contact points. To prevent damage to the optics, the tip of the fixing screw is made of plastic. The movable platform is pre-loaded by two strong tension springs, ensuring tight kinematic fit. A thick base adds to stability which allows to eliminate part of the mount, keeping clear one edge of the optics. An adapter with a M16 threading is mounted to the movable platform to accommodate M16 mirror mounts. The kinematic mount is mounted onto a 20 mm wide carrier in the right position.

**32 MM-0470 XY mount, soft ring 30 mm, on MG20**

The XY adjustment holder provides a ring with an inner soft rubber ring which is used to accommodate round components with a diameter of 30 mm. The inner diameter of the soft rubber ring is slightly less than 30 mm and thus grips the inserted component firmly. This adjustment holder is commonly used in a pair to accommodate a longer cylindrical body. Since the holding forces are of an elastic kind, arbitrary aslant directions away from the centre axis can be aligned within the adjusting range of the precise fine pitch screws.

**33 MM-0480 Four axes kinematic plastic fibre mount**

This frequently needed component is ideal for the fine adjustment of lenses, microscope objectives, diode laser, etc. with respect to the optical axis of the rail set-up. The displacement area is 5x5 mm and 10x10 degrees respectively. Different mounts can be attached to the adjustment holder. The component is inserted into the adjustment holder and is kept in position by a spring loaded steel ball in the same way as for the lens click mounts. Four precise fine pitch screws of repetitious accuracy allow the translational (X; Y) and azimuthal (ψ ; ϕ) adjustment. This module comes with an insert with a ST POF fibre coupler.

**34 MM-0490 Translation stage with bare fibre holder**

A translation stage with fibre chuck is mounted onto a 30 mm wide carrier (MG30). The optical glass fibre is placed into a groove of the magnetic fibre chuck and held in position by two magnets. The translation range is 5 mm.

**35 MM-0494 Rotation stage with bare fibre mount**

The MM-00494 provides goniometer operation for the optical bench. The carrier is attached to the bench and carries a rotary arm which can be rotated by 360 degrees. The centre of rotation provides a 35 mm mounting hole where probes can be accommodated. The rotary arm has two slots with a distance of 25 mm where mounting plates or other components with 2 M4 threads with 25 mm distance can be mounted. This module comes with fibre chuck where the optical glass fibre is placed into a groove of the magnetic fibre chuck and held in position by two magnets. The length of the protruding fibre is chosen in such a way that the end face of it is located in the centre of rotation of the goniometer.

**36 MM-0500 Piezo transducer 10 μ /150V in kinematic mount**

The transducer consists of a pre-loaded stack of piezo disks with a centre hole. The piezo disks are connected electrically in parallel, resulting in a displacement of 10 μ m at 150 V. Typically 3 to 4 optical displacement orders require at a wavelength 500 nm a mechanical displacement of 1 μ m. This is achieved by applying 15 volts only! This module combines the MM-0504 piezo transducer with a kinematic mount onto a 20 mm wide carrier MG20.

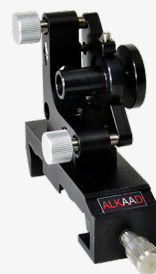
**37 MM-0504 Piezo transducer 10 μ /150V with 24 mm collar**

The transducer consists of a pre-loaded stack of piezo disks with a centre hole. The piezo disks are connected electrical in parallel, resulting in a displacement of 10 μ m at 150 V. Typically 3 to 4 optical displacement orders require at 500 nm a mechanical displacement of 1 μ m. This is achieved by applying 15 volts only! To mount the piezo to the kinematic mount like the MM-0440 (33) it is equipped with a suitable collar.



38 MM-0510 Kinematic mount with axial translation on MG30

The kinematic mount is fixed to a 30 mm wide carrier MG30. It is equipped with a axial translation unit. It consists of a fixed body and a rotary insert. By turning this precisely manufactured insert a translation of 250 μm per turn is achieved. The rotary insert has a mount to accommodate components with a diameter of 22 mm.

**39 MM-0560 Two mounting plates C25 on MG20**

Two C25 mounting plate are mounted side by side onto a 20 mm wide carrier MG20. The optical centres of the plates are 20 mm off axis.

**40 MM-0620 Lamp socket GU10 on MG65**

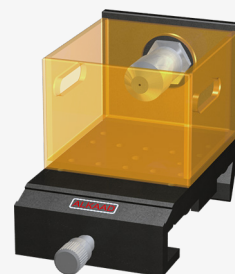
This module serves as base for lamps having a socket of GU10. The illustration on the right shows such a module with an inserted energy saving lamp. The lamp socket is connected to the mains with a two wire cable including an in line power switch. The lamp socket is mounted into 40 mm mounting plate on a 65 mm wide carrier MG65.

**41 MM-0700 Turntable drive unit**

A stepper motor driven turn table is mounted onto a heavy base made from black anodized aluminium. The rotation range is 360° with a resolution of 0.6 arc min in full step and 4.5 arc sec in 1/8 step operation mode. The maximum rotation speed is 50°/s and the maximum load 6 kg. The stepper motor is controlled by the DC-0100 controller (60).

**42 MM-0800 Adjustable fog nozzle on MG30**

This nozzle emits through a 1 mm hole a jet stream of water particles as required for the LDA experiment. The height of the nozzle is 32.5 mm and has the same height of the optical axis of the crossing beams. By turning the nozzle the horizontal position of the jet outlet is aligned. The entire nozzle is enclosed by a removable coloured Plexiglas housing which absorbs scattered laser light and collects the condensed water. The enclosure can easily be removed and emptied.



OC - Optical Components

1 OC-0005 Biconcave lens $f=-5$ mm, C25 mount

A biconcave lens with a diameter of 5 mm and a focal length of -5 mm is mounted into a C25 mount with a free opening of 4 mm.

**2 OC-0010 Biconcave lens $f=-10$ mm, C25 mount**

A biconcave lens with a diameter of 10 mm and a focal length of -10 mm is mounted into a C25 mount with a free opening of 8 mm.

**3 OC-0020 Biconcave lens $f=-20$ mm in C25 mount**

A biconcave lens with a diameter of 20 mm and a focal length of -20 mm is mounted into a C25 mount with a free opening of 16 mm.



4	OC-0040 Plano-convex lens f=40 mm in C25 mount A plano-convex lens with a diameter of 22 mm and a focal length of 40 mm is mounted into a C25 mount with a free opening of 20 mm.	
5	OC-0060 Biconvex lens f=60 mm in C25 mount A biconvex lens with a diameter of 22 mm and a focal length of 60 mm is mounted into a C25 mount with a free opening of 20 mm.	
6	OC-0068 Biconvex lens f=60 mm in C25 extended A biconvex lens with a diameter of 22 mm and a focal length of 60 mm is mounted at the end of a 25 mm housing. A C25 mount is attached to the housing to insert the component into a C25 mounting plate.	
7	OC-0100 Front face mirror in C25 mount A silver coated front face mirror with protective coating is mounted into a C25 mount with a free opening of 20 mm	
8	OC-0120 Achromat f=20 mm in C25 mount An achromatic lens with a focal length of 20 mm is mounted into a C25 mount with a free opening of 8 mm.	
9	OC-0140 Achromat f=40 mm in C30 mount An achromatic lens with a diameter of 25.4 mm and a focal length of 40 mm is mounted into a C30 mount with a free opening of 22 mm.	
10	OC-0150 Biconvex lens f=150 mm in C50 mount A biconvex lens with a diameter of 48 mm and a focal length of 150 mm is mounted into a C50 mount with a free opening of 45 mm.	
11	OC-0152 Biconvex lens f=150 mm in C25 mount A biconvex lens with a diameter of 22 mm and a focal length of 150 mm is mounted into a C25 mount with a free opening of 20 mm.	
12	OC-0160 Collimator 445 nm in C25 mount An aspheric glass lens with an anti reflex coating for 445 nm has a back focal length of 4 mm and is suited to collimate the divergent laser radiation of a laser diode into an almost parallel beam.	
13	OC-0170 Collimator 808 nm in C25 mount An aspheric glass lens with an anti reflex coating for 808 nm has a back focal length of 4 mm and is suited to collimate the divergent laser radiation of a laser diode into an almost parallel beam.	

14 OC-0220 Cylindrical lens f = 20 mm in C25 mount

A rounded cylindrical lens with a diameter of 20 mm and focal length of 20 mm is mounted into a C25 mount with a free opening of 16 mm.

**15 OC-0280 Cylindrical lens f=80 mm in C25 mount**

A rounded cylindrical lens with a diameter of 20 mm and focal length of 80 mm is mounted into a C25 mount with a free opening of 16 mm.

**16 OC-0320 Beam expander x2.7 in ø25 housing**

The beam expander is based on a Galilean telescope with one concave lens as entry lens and a plano-convex as exit lens. The expansion ratio is defined by the ratio of the focal length of the lenses. The entry lens is mounted into a C25 mount which screwed to the 25 mm housing at which end the exit lens is mounted. This beam expander has an expansion rate of 2.7. The telescope is aligned for far sight view and can be slightly changed by turning the C25 mount to change the parallel wave front into curved ones.

**17 OC-0360 Beam Expander x6 in ø25 housing**

The beam expander is based on a Galilean telescope with one concave lens as entry lens and a plano-convex as exit lens. The expansion ratio is defined by the ratio of the focal length of the lenses. The entry lens is mounted into a C25 mount which screwed to the 25 mm housing at which end the exit lens is mounted. This beam expander has an expansion rate of 6. The telescope is aligned for far sight view and can be slightly changed by turning the C25 mount to change the parallel wave front into curved ones.

**18 OC-0380 Beam expander x8 in ø 25 mm housing**

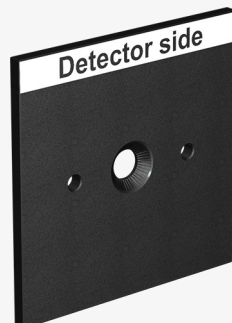
The beam expander is based on a Galilean telescope with one concave lens as entry lens and a plano-convex as exit lens. The expansion ratio is defined by the ratio of the focal length of the lenses. The entry lens is mounted into a C25 mount which screwed to the 25 mm housing at which end the exit lens is mounted. This beam expander has an expansion rate of 8. The telescope is aligned for far sight view and can be slightly changed by turning the C25 mount to change the parallel wave front into curved ones.

**19 OC-0400 Adjustable iris mounted in C25**

The adjustable iris is mounted into a C25 mount and has a minimum opening of 1 mm and the maximum opening is 14 mm.

**20 OC-0420 LDA alignment aid**

This alignment aid is used to check the parallel adjustment of both LDA beams before the focusing lens is inserted. When both beams are passing the plate in various distances they are parallel and they propagate in the same plane. During the LDA operation this plate is turned by 90 degrees to prevent the LDA laser beams reaching the photodetector.

**21 OC-0430 Fibre jacket in C25 mount**

A FSMA fibre coupler is mounted into a C25 mount to enable the use of optical fibre with C25 mounting plates.

**22 OC-0460 Transmission grating 600 l/mm**

A transmission grating with 600 lines per mm is mounted into a 50x50 mm frame. The thickness is 3 mm and fits into the filter plate holder MM-0060 (31).



23	OC-0470 Wire 0.05 mm in 50x50 frame A thin wire is placed between two glass plates and is mounted into a 50x50 mm frame. The thickness is 3 mm and fits into the filter plate holder MM-0060 (31).	
24	OC-0480 Circular apertures in 50x50 mm frame A mask with circular apertures 0.30, 0.60, 1.0 and 1.40 nominal diameter is mounted into a 50x50 mm frame. The thickness is 3 mm and fits into the filter plate holder MM-0060 (31) and can be traversed to select the required hole.	
25	OC-0482 Gauze 300 mesh in 50x50 mm frame A gauze with 300 mesh mounted into a 50x50 mm frame and serves as two dimensional coarse grating.	
26	OC-0484 Single slit 0.06 mm in 50x50 mm frame A mask with a 0.06 mm wide slit is mounted into a 50x50 mm frame. The thickness is 3 mm and fits into the filter plate holder MM-0060 (31) and can be traversed to select the best position.	
27	OC-0486 Double slit in 50x50 mm frame A mask with two 0.06 mm wide slits is mounted into a 50x50 mm frame. The thickness is 3 mm and fits into the filter plate holder MM-0060 (31) and can be traversed to select the best position.	
28	OC-0490 Sample transmission hologram (chess pieces) A professional transmission hologram is framed in a 50x50 mm frame. The sample shows what should be achievable with the holography experiment.	
29	OC-0500 Beam splitter plate ø 25 mount The beam splitter plate has a splitting ratio of 50/50 % at a wavelength of 632 nm. It is set into a slotted holder with a 25 mm mounting cylinder which can be inserted into the adjustment holder OM-0010 (47).	
30	OC-0510 Polarising beam splitter cube on 25 mm stage A polarizing beam splitter cube with a 20 mm side length and is set into a the collar of 25 mm stage. The arrangement separates an incoming beam into two orthogonal polarized beams. A prism is cemented to the cube in order to deviate an incoming beam from the opposite direction. This component is specifically used in a technical Michelson interferometer.	
31	OC-0520 Triple reflector in extended 1" mount A rounded triple reflector with a 1 " diameter is set into a 30 mm mount with a rear cylinder with a diameter of 1". This enables the component to be attached to a 1" kinematic mount.	

32 OC-0530 Ruby crystal in C25 mount

An industrial Ruby ball with a diameter of 6 mm is placed into a C25 mount with a free opening of 4 mm.

**33 OC-0550 Nd:YAG rod in CR25 mount**

A CR25 mount is designed to fit into the 4 axes adjustment holder MM-0420 (33). It consists out of the main body, a disk for holding a small optical component and a threaded retaining ring. In this CR25 a 3x3 and 5 mm long Nd:YAG crystal with anti reflex coating for 1064 nm on both sides is mounted.

**34 OC-0560 Ruby crystal in CR25 mount**

The efficient pumping of the blue band of the Ruby crystal requires an optimised Cr^{3+} dopant level as well a special orientation of the crystal's c-axis with respect to the mechanical axis of the Ruby rod. The Ruby rod is gently clamped by the mounting disk (1). The crystal is set into the housing (3) and fixed therein with the retaining ring (2).

**34 OC-0710 Polarizer in C25 mount**

A film sheet polarizer is set into a C25 mount with a tick mark as vertical polarisation indicator. The free opening is 20 mm.

**35 OC-0720 Fresnel zone plate in C25 mount**

A mask with a fresnel zone designed for 532 nm, 99 fringes and a focal length of 100 mm is mounted into a C25 mount. The Fresnel zone plate has been calculated and rendered by a computer and subsequently exposed to a high resolution black and white film as used in the professional printing machines.

**36 OC-0730 Fabry Perot plate in C25 mount**

Two precise glass plates with a reflectivity 50% are set into a C25 mount. A precise spacer of 3 mm separates the plates forming an air spaced Fabry Perot.

**37 OC-0740 Newton's rings optics in C25 mount**

A combination of a glass plate and a plano-convex lens are set into a C25 mount in such a way that the lens lightly touches the glass plate. To enhance the visibility of the effect, the glass plate has a coating with 50% reflectivity.

**38 OC-0750 Laser line filter 532 nm in C25 mount**

A laser line filter with a central wavelength (CWL) of 532 nm and a spectral width of 10 nm (FWHM) and a diameter of 12.7 mm is set into a C25 mount with a free opening of 11 mm.

**39 OC-0754 Laser line filter 810 nm in C25 mount**

A laser line filter with a central wavelength (CWL) of 510 nm and a spectral width of 10 nm (FWHM) and a diameter of 12.7 mm is set into a C25 mount with a free opening of 11 mm.

**40 OC-0756 Laser line filter 1064 nm in C25 mount**

A laser line filter with a central wavelength (CWL) of 1064 nm and a spectral width of 10 nm (FWHM) and a diameter of 12.7 mm is set into a C25 mount with a free opening of 11 mm.

**41 OC-0758 Laser line filter 980 nm in C25 mount**

A laser line filter with a central wavelength (CWL) of 980 nm and a spectral width of 10 nm (FWHM) and a diameter of 12.7 mm is set into a C25 mount with a free opening of 11 mm.



42 OC-0760 Laser line filter 1550 nm in C25 mount

A laser line filter with a central wavelength (CWL) of 1550 nm and a spectral width of 10 nm (FWHM) and a diameter of 12.7 mm is set into a C25 mount with a free opening of 11 mm.

**43 OC-0810 Mica plate in C25 mount**

A thin (0.1) Mica plate is mounted into a C25 mount and serves as optical retarder for multiple orders.

**44 OC-0820 Calcite crystal on rod and carrier**

A calcite crystal is shaped in such a way that a laser beam travels parallel to the crystal axis. By turning the crystal the laser beam travels perpendicular to the optical axis. The crystal is mounted to a rod which has a special shaped top to accommodate the crystal. The rod is screwed to the centre M6 thread of the 30 mm wide carrier MG30.

**45 OC-0830 Optical quartz plate in C25 mount**

A quartz plate made from natural quartz with a thickness of 3 mm has a diameter of 12.7 mm and is cut parallel to the optical axis of the crystal. The quartz plate is mounted into a C25 mount.

**46 OC-0840 Quarter-wave plate in C25 mount****47 OC-0850 Half-wave plate in C25 mount**

A quartz plate made from natural quartz with a thickness of multiples of $\lambda/2$ has a diameter of 12.7 mm and is cut parallel to the optical axis of the crystal. The quartz plate is mounted into a C25 mount.

**48 OC-0860 Nd:YAG rod 1.3 μ m coating, M16 mount**

Beside the well known emission wavelength of 1.064 μ m of a Nd:YAG Laser another wavelength centred at 1.3 μ m can be obtained when using optimized optical components. This component provides a Nd:YAG rod which is coated for high reflectivity at 1.3 μ m.

**49 OC-0870 "Red 660 nm" SHG crystal mounted KTP in mount**

A CR25 mount is designed to fit into the 4 axes adjustment holder MM-0420 (33). It consists out of the main body, a disk for holding a small optical component and a threaded retaining ring. Into this CR25 a 3x3 and 5 mm long KTP crystal is mounted for the second harmonic generation 1330 \rightarrow 665 nm with anti reflex coating for 1330 nm on both sides.

**50 OC-0880 GCL in CR25 mount**

A CR25 mount is designed to fit into the 4 axes adjustment holder MM-0420 (33). It consists out of the main body, a disk for holding a small optical component and a threaded retaining ring. Into this CR25 a green core laser (GLC) consisting of a combination of a Nd:YVO4 and KTP crystal is mounted. When pumped by an 808 nm laser diode the GLC emits green radiation at 532 nm but also residual 1064 nm and 808 nm.

**51 OC-0910 Filter KG5, 50 x 50 x 3 mm**

This coloured glass filter has a size of 50x50 mm and a thickness of 3 mm and is used to block the near infrared radiation above 700 nm and transmit the visible part of the spectrum.

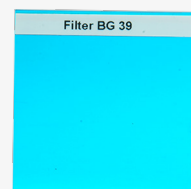


52 OC-0920 V(λ) filter in C50 mount

A V(λ) filter has the same spectral transmission curve as the spectral sensitivity curve of the human eye. This filter is used in conjunction with classical lamps to study and measure the optical power in radiometric and photometric units. The filter is mounted into a C50 mount.

**53 OC-0939 Filter BG39, 50 x 50 x 3 mm**

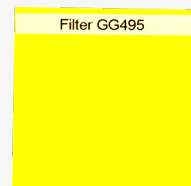
This coloured glass filter has a size of 50x50 mm and a thickness of 3 mm and is used to block the near infrared radiation above 700 nm and transmit the green 532 nm radiation created by second harmonic generation.

**54 OC-0950 Filter RG1000 50x50x3 mm**

This coloured glass filter has a size of 50x50 mm and a thickness of 3 mm and is used to block the radiation below 1000 nm and transmit the NIR part of the spectrum.

**55 OC-0970 Filter GG495, 50 x 50 x 3 mm**

This coloured glass filter has a size of 50x50 mm and a thickness of 3 mm and is used to block the blue radiation below 495 nm and transmit the visible part of the spectrum.

**56 OC-0980 Filter UG11 in C25 mount**

This coloured glass filter has a diameter of 20 mm and a thickness of 3 mm and is used to transmit the UV radiation around 320 nm and to block the visible radiation above 400 nm.

**57 OC-1000 Laser mirror M16, flat, T 3% @ 632 nm**

The M16 mirror mount is designed to accommodate 1/2" (12.7) mirror with a thickness of 1/4" (6.35 mm). The mirror is kept in position by a radially spring loaded flap. At the bottom of the mirror a soft rubber ring is placed to achieve an elastic contact to the surface of the mirror face to its adjustment holder. When the laser mirror is not in use a protective cap with M16 thread is screwed on top of it. This laser mirror has a flat surface and a transmission of 3% at a wavelength of 632 nm.

**58 OC-1005 Laser mirror M16, flat, HR @ 632 nm**

The M16 mirror mount is designed to accommodate 1/2" (12.7) mirror with a thickness of 1/4" (6.35 mm). The mirror is kept in position by a radially spring loaded flap. At the bottom of the mirror a soft rubber ring is placed to achieve an elastic contact to the surface of the mirror face to its adjustment holder. When the laser mirror is not in use a protective cap with M16 thread is screwed on top of it. This laser mirror has a flat surface and a high reflectivity (> 99.9 %) at a wavelength of 632 nm.

**59 OC-1010 Laser mirror M22, ROC 100 mm, T 4% @ 532 & 632 nm**

This laser mount has a short M22 thread at its rear side and is screwed into the "MM-0510 Kinematic mount with axial translation on MG30" (32). The 1/2" mirror is kept in position by a radial M4 grub screw with a plastic tip. This laser mirror has a transmission of 4% at 532 and 632 nm and a radius of curvature of 100 mm.

**60 OC-1012 Laser mirror M12, ROC 100 mm, T 4% @ 532 & 632 nm**

To attach the mirror to a piezo electric element it is mounted into a holder which fits to the M12 thread of the piezo element. By means of a threaded ring the mirror is pressed and centred against a soft rubber ring. This component contains a 1/2" mirror with a radius of curvature of 100 mm and transmission of 4% at 532 and 632 nm.



61 OC-1020 Laser mirror M16, ROC 700 mm, HR @ 632 nm

The M16 mirror mount is designed to accommodate 1/2" (12.7) mirror with a thickness of 1/4" (6.35 mm). The mirror is kept in position by a radially spring loaded flap. At the bottom of the mirror a soft rubber ring is placed to achieve an elastic contact to the surface of the mirror face to its adjustment holder. When the laser mirror is not in use a protective cap with M16 thread is screwed on top of it. This laser mirror has a radius of curvature of 700 mm and a high reflectivity (> 99.9 %) at a wavelength of 632 nm.

**62 OC-1030 Laser mirror M16, ROC 1000 mm, HR @ 632 nm**

The M16 mirror mount is designed to accommodate 1/2" (12.7) mirror with a thickness of 1/4" (6.35 mm). The mirror is kept in position by a radially spring loaded flap. At the bottom of the mirror a soft rubber ring is placed to achieve an elastic contact to the surface of the mirror face to its adjustment holder. When the laser mirror is not in use a protective cap with M16 thread is screwed on top of it. This laser mirror has a radius of curvature of 1000 mm and a high reflectivity (> 99.9 %) at a wavelength of 632 nm.

**63 OC-1040 Laser mirror M16, ROC 700 mm, HR @ 1180 nm**

The M16 mirror mount is designed to accommodate 1/2" (12.7) mirror with a thickness of 1/4" (6.35 mm). The mirror is kept in position by a radially spring loaded flap. At the bottom of the mirror a soft rubber ring is placed to achieve an elastic contact to the surface of the mirror face to its adjustment holder. When the laser mirror is not in use a protective cap with M16 thread is screwed on top of it. This laser mirror has a radius of curvature of 700 mm and a high reflectivity (> 99.9 %) at a wavelength of 1180 nm.

**64 OC-1060 Laser mirror M16, ROC 100 mm, T 2% @ 1064 nm**

The M16 mirror mount is designed to accommodate 1/2" (12.7) mirror with a thickness of 1/4" (6.35 mm). The mirror is kept in position by a radially spring loaded flap. At the bottom of the mirror a soft rubber ring is placed to achieve an elastic contact to the surface of the mirror face to its adjustment holder. When the laser mirror is not in use a protective cap with M16 thread is screwed on top of it. This laser mirror has a radius of curvature of 100 mm and a transmission of 2% at a wavelength of 1064 nm.

**65 OC-1070 Laser mirror M16, ROC 100 mm, HR @ 1064 nm**

The M16 mirror mount is designed to accommodate 1/2" (12.7) mirror with a thickness of 1/4" (6.35 mm). The mirror is kept in position by a radially spring loaded flap. At the bottom of the mirror a soft rubber ring is placed to achieve an elastic contact to the surface of the mirror face to its adjustment holder. When the laser mirror is not in use a protective cap with M16 thread is screwed on top of it. This laser mirror has a radius of curvature of 100 mm and a high reflectivity (> 99.9 %) at a wavelength of 1064 nm.

**66 OC-1074 Laser mirror 1/2" in 1" mount ROC 100 HR@1064 nm**

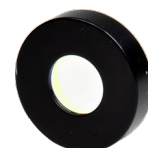
The 1/2" laser mirror is set into an adapter with an outer diameter of 1" which fits into the kinematic laser mirror adjustment mounts. The mirror is kept in position by a radial grub screw with a soft nylon tip. This laser mirror has a radius of curvature of 100 mm and a high reflectivity (>99.9%) at a wavelength of 1064 nm.

**67 OC-1080 Laser mirror M16, ROC 100 mm, HR @ 1300 nm**

The M16 mirror mount is designed to accommodate 1/2" (12.7) mirror with a thickness of 1/4" (6.35 mm). The mirror is kept in position by a radially spring loaded flap. At the bottom of the mirror a soft rubber ring is placed to achieve an elastic contact to the surface of the mirror face to its adjustment holder. When the laser mirror is not in use a protective cap with M16 thread is screwed on top of it. This laser mirror has a radius of curvature of 100 mm and a high reflectivity (> 99.9 %) at a wavelength of 1300 nm.

**68 OC-1090 Laser mirror M22, ROC flat, T 4% @ 532 and 632 nm**

This laser mount has a short M22 thread at his rear side and is screwed into the "MM-0510 Kinematic mount with axial translation on MG30" (32). The 1/2" mirror is kept in position by a radial M4 grub screw with a plastic tip. This laser mirror has a flat surface and a transmission of 4% at 532 and 632 nm



69 OC-1094 Laser mirror M12, ROC flat, T 4% @ 532 and 632 nm

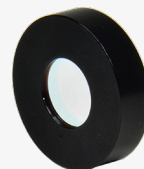
To attach the mirror to a piezo electric element it is mounted into a holder which fits to the M12 thread of the piezo element. By means of a threaded ring the mirror is pressed and centred against a soft rubber ring. This components contains a 1/2" flat mirror with a transmission of 4% at 532 and 632 nm.

**70 OC-1096 Laser mirror M12, ROC 75 mm, T 4% @ 532 and 632 nm**

To attach the mirror to a piezo electric element it is mounted into a holder which fits to the M12 thread of the piezo element. By means of a threaded ring the mirror is pressed and centred against a soft rubber ring. This components contains a 1/2" mirror with a radius of curvature of 75 mm and a transmission of 4% at 532 and 632 nm.

**71 OC-1098 Laser mirror M22, ROC 75 mm, T 4% @ 532 and 632 nm**

This laser mount has a short M22 thread at his rear side and is screwed into the "MM-0510 Kinematic mount with axial translation on MG30" (32). The 1/2" mirror is kept in position by a radial M4 grub screw with a plastic tip. This laser mirror has a radius of curvature of 75 mm and a transmission of 4% at 532 and 632 nm

**72 OC-1110 Laser mirror 1/2" in 1" mount, ROC flat, HR 550-800 nm**

The 1/2" laser mirror is set into an adapter with an outer diameter of 1" which fits into the kinematic laser mirror adjustment mounts. The mirror is kept in position by a radial grub screw with a soft nylon tip. This laser mirror has a flat surface and a high reflectivity (>99.9%) in a wavelength range of 550 to 800 nm.

**73 OC-1114 Laser mirror 1/2", ROC flat, HT 532, HR 540-700 nm**

The 1/2" laser mirror is set into an adapter with an outer diameter of 1" which fits into the kinematic laser mirror adjustment mounts. The mirror is kept in position by a radial grub screw with a soft nylon tip. This laser mirror has a flat surface and a high reflectivity (>99.9%) in a wavelength range of 540 to 700 nm and a high transmission for 532 nm.

**74 OC-1116 Laser mirror 1/2, ROC 250 nm, HR 520-700 nm**

The 1/2" laser mirror is set into an adapter with an outer diameter of 1" which fits into the kinematic laser mirror adjustment mounts. The mirror is kept in position by a radial grub screw with a soft nylon tip. This laser mirror has a radius of curvature of 250 mm and a high reflectivity (>99.9%) in a wavelength range of 540 to 700 nm and a high transmission for 532 nm.

**75 OC-1130 Laser mirror M16, ROC flat, HT 445, HR 580-725 nm**

The M16 mirror mount is designed to accommodate 1/2" (12.7) mirror with a thickness of 1/4" (6.35 mm). The mirror is kept in position by a radially spring loaded flap. At the bottom of the mirror a soft rubber ring is placed to achieve an elastic contact to the surface of the mirror face to its adjustment holder. When the laser mirror is not in use a protective cap with M16 thread is screwed on top of it. This laser mirror has a flat surface and a high reflectivity (> 99.9 %) at a wavelength of 1300 nm.

**76 OC-1134 Laser mirror M16, ROC 100, HT 445, HR 580-725 nm**

The M16 mirror mount is designed to accommodate 1/2" (12.7) mirror with a thickness of 1/4" (6.35 mm). The mirror is kept in position by a radially spring loaded flap. At the bottom of the mirror a soft rubber ring is placed to achieve an elastic contact to the surface of the mirror face to its adjustment holder. When the laser mirror is not in use a protective cap with M16 thread is screwed on top of it. This laser mirror has a radius of curvature of 100 mm and a high reflectivity (> 99.9 %) in a wavelength range of 580 to 725 nm and a high transmission at 445 nm.

**77 OC-1136 Laser mirror M16, ROC 150, HT445, HR 580-725 nm**

The M16 mirror mount is designed to accommodate 1/2" (12.7) mirror with a thickness of 1/4" (6.35 mm). The mirror is kept in position by a radially spring loaded flap. At the bottom of the mirror a soft rubber ring is placed to achieve an elastic contact to the surface of the mirror face to its adjustment holder. When the laser mirror is not in use a protective cap with M16 thread is screwed on top of it. This laser mirror has a radius of curvature of 150 mm and a high reflectivity (> 99.9 %) in a wavelength range of 580 to 725 nm and a high transmission at 445 nm.



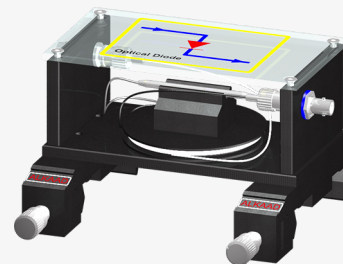
78	OC-1138	Laser mirror 1" mount, ROC 100, HT 445 nm, HR 580-725 nm The 1/2" laser mirror is set into an adapter with an outer diameter of 1" which fits into the kinematic laser mirror adjustment mounts. The mirror is kept in position by a radial grub screw with a soft nylon tip. This laser mirror has a radius of curvature of 100 mm and a high reflectivity (>99.9%) in a wavelength range of 580 to 725 nm and a high transmission at a wavelength of 445 nm.	
79	OC-1154	Laser mirror M16, ROC 150, HR640/HT320 The M16 mirror mount is designed to accommodate 1/2" (12.7) mirror with a thickness of 1/4" (6.35 mm). The mirror is kept in position by a radially spring loaded flap. At the bottom of the mirror a soft rubber ring is placed to achieve an elastic contact to the surface of the mirror face to its adjustment holder. When the laser mirror is not in use a protective cap with M16 thread is screwed on top of it. This laser mirror has a radius of curvature of 150 mm and a high reflectivity (> 99.9 %) at a wavelength of 640 nm and a high transmission at 320 nm.	
80	OC-1160	Laser mirror 1/2" in 1" mount, ROC flat, HT405-HR694 nm The 1/2" laser mirror is set into an adapter with an outer diameter of 1" which fits into the kinematic laser mirror adjustment mounts. The mirror is kept in position by a radial grub screw with a soft nylon tip. This laser mirror has a flat surface a high reflectivity (>99.9%) for a wavelength range of 694 nm and a high transmission at a wavelength of 405 nm.	
81	OC-1164	Laser mirror 1/2" in 1" mount, ROC 50, HT405-HR694 nm The 1/2" laser mirror is set into an adapter with an outer diameter of 1" which fits into the kinematic laser mirror adjustment mounts. The mirror is kept in position by a radial grub screw with a soft nylon tip. This laser mirror has a radius of curvature of 50 mm and a high reflectivity (>99.9%) for a wavelength range of 694 nm and a high transmission at a wavelength of 405 nm.	
82	OC-1168	Laser mirror 1/2" in 1" mount, OC 50, HR405 nm-HR 694 nm The 1/2" laser mirror is set into an adapter with an outer diameter of 1" which fits into the kinematic laser mirror adjustment mounts. The mirror is kept in position by a radial grub screw with a soft nylon tip. This laser mirror has a radius of curvature of 50 mm and a transmission of 2% for a wavelength range of 694 nm and a high reflectivity at a wavelength of 405 nm.	
83	OC-1200	Laser mirror C30, ROC flat, HR @ 632 nm A flat laser mirror with a diameter of 1" is set into a C30 mount. The mirror has a high reflectivity for 632 nm.	
84	OC-2010	ST/ST SM Fibre patch cable, length 0.25 m A single mode fibre with a 9 µm core and 125 µm cladding with a plastic buffer is terminated with two ST fibre connectors. The length of the fibre patch cable is 25 cm.	
85	OC-2020	ST/ST SM Fibre patch cable, length 1 m A single mode optical fibre with a 9 µm core and 125 µm cladding with a plastic buffer is terminated with two ST fibre connectors. The length of the fibre patch cable is 100 cm.	
86	OC-2030	ST/ST MM Fibre patch cable, length 1 m A multimode optical fibre with a 50 µm core and 125 µm cladding with a plastic buffer is terminated with two ST fibre connectors. The length of the fibre patch cable is 100 cm.	
87	OC-2040	Set of 10 ST pigtailed MM fibre A single mode optical fibre with a 9 µm core and 125 µm cladding with a plastic buffer is terminated with one ST fibre connector and the other side is left blank. The length of each fibre patch cable is 200 cm.	

88 OC-2100 SM Fibre collimator

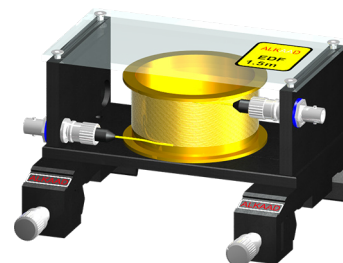
The collimator has a single mode ST connector and is set into a C25 mount. The aspheric collimator lens has a anti reflex coating and transforms the divergent beam coming from the connected fibre into an almost parallel beam.

**89 OC-2110 SM Fibre optical isolator, 980 nm, ST terminated**

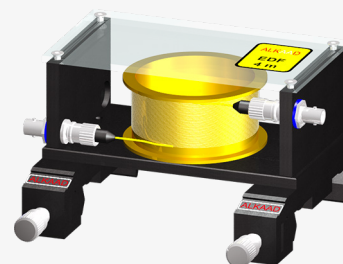
This module provides an fibre coupled optical diode based on the Faraday effect and is used to force the oscillation of a fibre ring laser into one direction. The connection to the diode is carried out with ST single mode panel jacks.

**90 OC-2200 Erbium doped fibre unit, ST terminated 1.5 m**

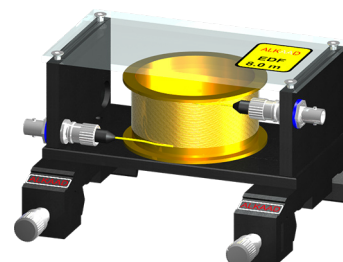
This module contains a spool with a 1.5 m long Erbium doped fibre. Both end are terminated with single mode connectors and are plugged into single mode fibre panel jacks.

**91 OC-2210 Erbium doped fibre unit, ST terminated 4.0 m**

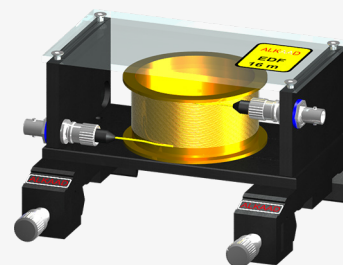
This module contains a spool with a 4 m long Erbium doped fibre. Both end are terminated with single mode connectors and are plugged into single mode fibre panel jacks.

**92 OC-2220 Erbium doped fibre unit, ST terminated, length 8 m**

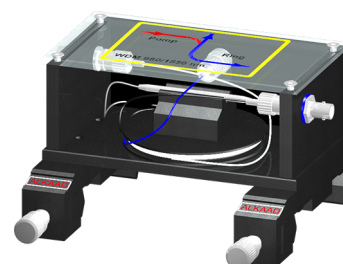
This module contains a spool with a 8 m long Erbium doped fibre. Both end are terminated with single mode connectors and are plugged into single mode fibre panel jacks.

**93 OC-2230 Erbium doped fibre unit, ST terminated, length 16 m**

This module contains a spool with a 16 m long Erbium doped fibre. Both end are terminated with single mode connectors and are plugged into single mode fibre panel jacks.

**94 OC-2300 SM-WDM coupler 980/1550 nm unit ST terminated**

This wavelength division multiplexer is designed to feed the radiation of a 980 nm Laser into a fibre loop for 1.550 nm. It is used as "pump gate" for Erbium doped fibres in a linear as well as ring configuration. The individual in- and outputs of the WDM are connected to ST connectors.



95	OC-2350	SM Four port fibre coupler unit A 2x2 wide band Fibre optic coupler is designed for a central wavelength of 1550 ± 100 nm. At the two output ports a fraction of 10 % of the primary intensity is available. The individual in- and outputs of the coupler are connected to ST connectors.	
96	OC-2360	Fibre SM beam splitter unit This component acts as fibre coupled beam splitter plate. It splits the incoming beam into two beams of equal intensity. The individual in- and outputs of the coupler are connected to ST connectors.	
97	OC-2410	Multimode fibre 1000 m 50/125 µm The multimode fibre has a core diameter of 50 µm and a cladding diameter of 125 µm. Along with the plastic coating the total diameter is 250 µm. 1000 m of such a fibre are coiled on a drum.	
98	OC-2440	Single mode fibre, 1000 m, 9/125 µm, ST panel jacks The single mode fibre has a core diameter of 9 µm and a cladding diameter of 125 µm. Along with the plastic coating the total diameter is 250 µm. 1000 m of such a fibre are coiled on a drum and both ends are terminated with ST single mode connectors which are plugged to single mode ST fibre panel jacks.	
99	OC-2450	Multimode fibre 1000 m, 50/125 µm, ST panel jacks The multimode fibre has a core diameter of 50 µm and a cladding diameter of 125 µm. Along with the plastic coating the total diameter is 250 µm. 1000 m of such a fibre are coiled on a drum and both ends are terminated with ST connectors which are plugged to ST fibre panel jacks.	
100	OC-2460	Multimode fibre, 2000 m 50/125 µm, ST panel jacks The multimode fibre has a core diameter of 50 µm and a cladding diameter of 125 µm. Along with the plastic coating the total diameter is 250 µm. 2000 m of such a fibre are coiled on a drum and both ends are terminated with ST connectors which are plugged to ST fibre panel jacks.	
101	OC-2500	Plastic optical fibre ST/FSMA, length 0.25 m This plastic optical fibre has a diameter of 1 mm and a length of 25 cm and is terminated on one side with a ST-POF connector and on the other side with a FSMA-POF connector	
102	OC-2502	Plastic optical fibre ST/ST, length 1 m This plastic optical fibre has a diameter of 1 mm and a length of 100 cm and is terminated on both sides with a ST-POF connector.	
103	OC-2510	Plastic optical fibre ST, length 10 m This plastic optical fibre has a diameter of 1 mm and a length of 10 m and is terminated on both sides with a ST-POF connector.	
104	OC-2520	Plastic optical fibre ST, length 20 m This plastic optical fibre has a diameter of 1 mm and a length of 20 m and is terminated on both sides with a ST-POF connector.	

105 OC-2530 Plastic optical fibre ST, length 30 m

This plastic optical fibre has a diameter of 1 mm and a length of 30 m and is terminated on both sides with a ST-POF connector.

**106 OC-2590 ST-POF coupler**

This coupler is used to interconnect two plastic optical fibres having ST connectors.

**107 OC-S010 Set of mirror (ROC flat and 100 mm) for 520 nm operation**

The coating of the mirrors is designed for high reflectivity (>99.98%) for 520 nm to achieve the laser oscillation for this wavelength. The set consists of two mirrors whereby one has a flat surface and the other a radius of curvature of 100 mm. The mirrors are kept in M16 holder and when not in use the provided plastic caps are screwed on top for protecting the mirror surface.

**108 OC-S020 Set of mirror (flat and ROC 100) for 604 nm operation**

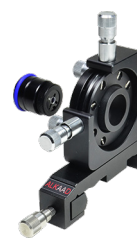
The coating of the mirrors is designed for high reflectivity (>99.98%) for 604 nm to achieve the laser oscillation for this wavelength. Furthermore the reflectivity is designed for high losses above 630 nm and below 550 nm to suppress undesired laser oscillation in this ranges. The set consists of two mirrors whereby one has a flat surface and the other a radius of curvature of 100 mm. The mirrors are kept in M16 holder and when not in use the provided plastic caps are screwed on top for protecting the mirror surface.



OM - Optical Modules

1 OM-0005 Beam expander lens f=-5mm, 4 axes kinematic mount

This frequently needed component is ideal for the fine adjustment of lenses, microscope objectives, diode laser, etc. with respect to the optical axis of the rail set-up. The displacement area is 5x5 mm and 10x10 degrees respectively. Different mounts can be attached to the adjustment holder. The component is inserted into the adjustment holder and is kept in position by a spring loaded steel ball in the same way as for the lens click mounts. Four precise fine pitch screws of repetitious accuracy allow the translational (X; Y) and azimuthal (ψ ; ϕ) adjustment. This module comes with an insert with a biconcave lens with a focal length of -5 mm.

**2 OM-0010 Adjustable beam splitter**

The adjustable prism mount has a clear hole with a diameter of 25 mm to accommodate various optical components like plates, prisms and beam splitting cubes. By means of two fine pitch screws the optical component can be tilted precisely around its perpendicular axis. Furthermore the prism stage can be rotated around the perpendicular axis of the optical component by means of a set screw at the side. The provided beam splitter plate has a splitting ratio of 1/1 for radiation at a wavelength of 635 nm.

**3 OM-0020 Adjustable beam splitter on tee-piece MG65**

This unit consists out of two carrier which are fixed in such a way that a T piece is formed. In the centre of the main axis the adjustable beam splitter is fixed with the M6 centre screw. A 10 mm polarising beam splitter cube is mounted to 25 mm mount and inserted into the clear hole of the adjustable prism mount. By means of two fine pitch screws the beam splitter cube can be tumbled precisely around its perpendicular axis. Furthermore the prism stage can be rotated around the perpendicular axis of the optical component by means of a set screw at the side.

**4 OM-0030 Lithium Niobate Pockels Cell C-1043**

The Pockels cell is provided with an rotatable Brewster window. By loosening the screw with the supplied tools the cap containing the window can be rotated. If a maximum of output power is reached, the screw is fastened again. The Brewster window is covered by an additional cap which prevents the damage to the window as well as shielding laser stray light coming from the window. The Pockels cell is connected to its driver with a special high voltage cable which forms an integral part of the assembly and should not be exchanged.



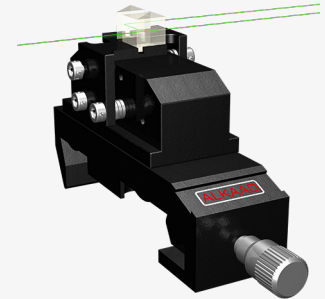
5 OM-0040 Beam displacer 5 mm on MG20

A 45° rhomboid glass prism is used to parallel offset the incoming beam by 5 mm with respect to the optical axis. It is placed on top of a rod which is mounted on a 20 mm wide carrier in such a way that the optical axis lies within the centre of the entrance face of the rhomboidal prism.



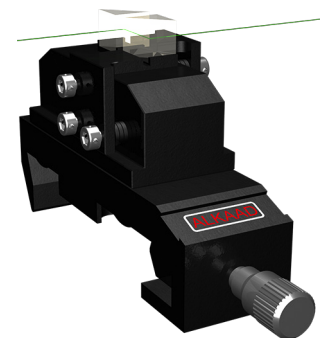
6 OM-0060 LDA Beam splitter unit

A Laser Doppler Anemometer (LDA) requires two laser beams coming from one coherent source. This unit splits the incoming beam into two parallel beams by means of a beam splitter cube and a 90° prism. To ensure that both beams are propagating in the same horizontal plane and desired direction the beam splitter cube and the 90° prism is mounted on separate precise adjustable kinematic stages. The capstan adjustment screws are spring loaded by a stack of cup springs for excellent long term stability. A special tool (CA-0012, 63) is provided for convenient alignment.



7 OM-0062 LDA Beam Displacer

This unit shifts the beam which is travelling in direction of the optical axis in such a way that both beams are travelling with the same offset from the centre optical axis. For this purpose two 90° prisms are used which are mounted on separate precise adjustable kinematic stages. The capstan adjustment screws are spring loaded by a stack of cup springs for excellent long term stability. A special tool (CA-0012, 63) is provided for convenient alignment.



8 OM-0066 LDA beam focussing unit

A plano-convex lens with a focal length of 60 mm and a diameter of 40 mm is mounted into a XY adjustment holder. The lens is used to deviate and focus the two beams of the LDA into one spot where the required interference pattern is created.



9 OM-0070 Dichroitic beam splitter unit on MG65

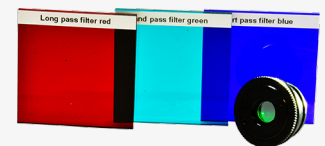
The transmitted light from the plastic fibre passes a microscope objective in order to be focused onto the photo detectors. Inside the cube an adjustable dichroic beam splitter separates the green and red radiation to the individual photo detector where the light signal is converted to electrical signals. The photo detectors are connected via BNC cables to the receiver section (DC-0030 Dual channel LED transmitter, 58). The mounting cube is screwed to a 65 mm wide carrier MG65.



10 OM-0200 Set of 4 optical filter

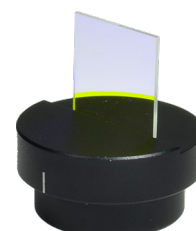
This set of filters consists of three coloured Plexiglas filter with a size of 50x50 mm with a thickness of 3 mm and one laser line in a C25 mount with a free opening of 11 mm. The coloured filter are as follows:

1. Long pass filter red
2. Band pass filter green
3. Short pass filter blue
4. Narrow band filter 532 nm



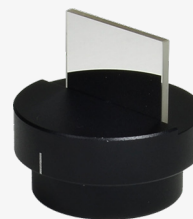
11 OM-0310 Dichroic mirror on rotary table

A dichroic mirror HR 530 nm and HT 630 nm is used as test mirror for the "Reflection and Transmission" experiment. It is cemented to a rotary stage with a 25 mm stud which fits into the goniometer "MM-0300 Carrier with 360° rotary arm" (32).

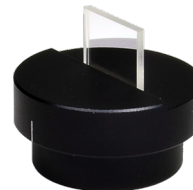


12 OM-0320 Front face mirror on rotary table

A silver coated front face mirror is used as test mirror for the “Reflection and Transmission” experiment. It is cemented to a rotary stage with a 25 mm stud which fits into the goniometer “MM-0300 Carrier with 360° rotary arm “ (32).

**13 OM-0330 Glass plate on rotary table**

An uncoated glass plate is used as test object for the “Reflection and Transmission” experiment. It is cemented to a rotary stage with a 25 mm stud which fits into the goniometer “MM-0300 Carrier with 360° rotary arm “ (32).

**14 OM-0340 Transmission grating on rotary table**

A transmission grating with 600 line per mm is used as spectral analyser for the “Reflection and Transmission” experiment. It is set into the slot of a rotary stage with a 25 mm stud which fits into the goniometer “MM-0300 Carrier with 360° rotary arm “ (32).

**15 OM-0400 Rotary Polariser / Analyser 360° on Carrier 20 mm**

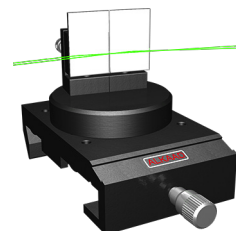
The polarisation analyser or polarizer has a horizontal rotary stage with a 25 mm through hole bore and 360 degree scale with tick marks for each 5 degrees. It is attached to a 20 mm wide carrier. A film sheet polarizer is inserted into a C25 mount which is set into the rotary stage and is kept with three M3 grub screws in position. The module comes with aligned polarisation direction with 0 degree for vertical polarisation.

**16 OM-0410 Rotary quarter wave plate on carrier**

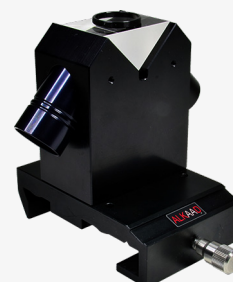
The polarisation analyser or polarizer has a horizontal rotary stage with a 25 mm through hole bore and 360 degree scale with tick marks for each 5 degrees. It is attached to a 20 mm wide carrier. A quarter wave plate is inserted into a C25 mount which is set into the rotary stage and is kept with three M3 grub screws in position. The module comes with aligned position of the optical axis at 0 degree.

**17 OM-0450 Fresnel mirror assembly**

Two silver coated front face mirrors are arranged side by side so that they can simultaneously illuminated by an expanded laser beam. Each mirrors is mounted to a kinematic adjustment holders allowing the horizontal and vertical tilt. The mirrors are aligned with a small inclination to each other creating a partial phase shift inside the illuminating beam.

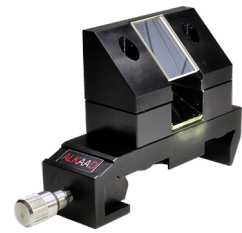
**18 OM-0460 Refraction prism assembly**

The central part of an Abbe refractometer is the refracting prism. In this module a 90° prism is attached on top of a base block. From left below the light enters the prism block. Inside the 25 mm housing a lens is located to focus the incoming light to the surface of the prism. The reflected part of the beam leaves right below the prism block and another lens collimates the beam to an almost parallel beam. The entire unit is attached to a 65 mm wide carrier MG65



19 OM-0462 Deflection mirror unit, left

A from left incoming beam is deflected by a silver coated mirror by 90 degrees down. Subsequently it hits another silver coated mirror which deflects the light under 45 degrees upwards. The entire unit is attached to a 30 mm wide carrier M65.

**20 OM-0464 Deflection mirror unit, right**

A from left incoming beam under 45 degrees is deflected by a silver coated mirror by 90 degrees up. Subsequently it hits another silver coated mirror which deflects the light horizontal. The entire unit is attached to a 30 mm wide carrier M65.

**21 OM-0510 Diode laser head in twofold rotary mount**

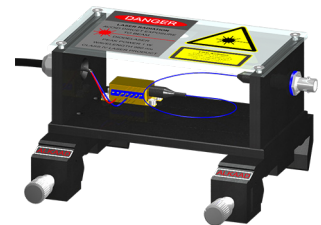
A diode laser is integrated into a 25 mm housing with cooling fins. A Peltier element and an NTC temperature sensor are used to measure and control the temperature of the laser diode with an accuracy of ± 0.1 °C. The diode laser is connected via a 15 pin SubD HD connector to the controller "DC-0040 Diode laser controller MK1" (58). Inside the connector an EPROM contains the data of the laser diode and when connected to the controller, these data are read and displayed by the controller. The laser head is inserted into a rotary stage which is attached to another rotary stage so that the laser head can be rotated around its horizontal and vertical axis.

**22 OM-0520 Pulsed diode laser head in twofold rotary mount**

A pulsed laser diode is integrated into a 25 mm housing with cooling fins. A NTC temperature sensor is used to measure the temperature of the laser diode. The diode laser is connected via a 15 pin SubD HD connector to the controller "DC-0050 Pulsed laser diode controller MK1" (59). Inside the connector an EPROM contains the data of the laser diode and when connected to the controller, these data are read and displayed by the controller. The controller provides the necessary voltage to load the ignition condenser inside the laser head and the discharge pulse to release the laser pulse. The emission wavelength is 905 nm with a repetition rate of 2 kHz and an adjustable pulse width of 50 to 150 ns and a output energy of 4 μ J. The laser head is inserted into a rotary stage which is attached to another rotary stage so that the laser head can be rotated around its horizontal and vertical axis.

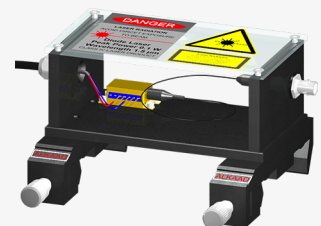
**23 OM-0540 Diode laser module 980 nm, ST fibre connector**

A laser diode is housed into a so called butterfly package. Inside the package the laser diode is connected to a single mode optical fibre which is terminated with a single mode ST fibre connector. Furthermore the laser diode is attached to a Peltier cooler and a NTC temperature sensor to measure and control the temperature of the laser diode. The fibre is plugged to an ST panel mount fibre jack of the module. The output power is 250 mW as single mode radiation at a wavelength of 980 nm. The diode laser is connected via a 15 pin SubD HD connector to the controller "DC-0040 Diode laser controller MK1" (58). Inside the connector an EPROM contains the data of the laser diode and when connected to the controller, these data are read and displayed by the controller.

**24 OM-0550 Diode laser module 1550 nm, ST fibre connector**

A laser diode is housed into a so called butterfly package. Inside the package the laser diode is connected to a single mode optical fibre which is terminated with a single mode ST fibre connector. The fibre is plugged to an ST panel mount fibre jack of the module. The output power is 250 mW as single mode radiation at a wavelength of 1550 nm.

The diode laser is connected via a 15 pin SubD HD connector to the controller "DC-0040 Diode laser controller MK1" (58). Inside the connector an EPROM contains the data of the laser diode and when connected to the controller, these data are read and displayed by the controller.

**25 OM-0560 HeNe laser tube with XY and wobble alignment**

The laser tube is mounted into two XY adjustment holders. The tube can be aligned parallel to the X and Y direction as well as slightly tumbled along its axis. This is necessary to align the capillary with respect to the optical axis of the laser cavity. A metal shield carries on its rear the required ballast resistor for a stable high voltage discharge. Both the anode and cathode are insulated so that no electrical hazard is possible. The Brewster windows are protected by soft silicon caps when the tube is not in operation.



26 OM-0570 Littrow Prism Tuner

A way to select different lines of a laser is to use a Littrow prism. The Littrow prism is made from fused silica which is the required substrate for IBS coating. The spectral range of the IBS coating covers 580..720 nm with a reflectivity >99.98 %. The prism is mounted into a precise adjustment holder where it can be smoothly tilted in vertical or horizontal direction.

**27 OM-0580 Birefringent Tuner**

The double refractive or birefringent plate is mounted in a dual rotational stage. For the intra-cavity operation the birefringent plate needs to be aligned in such a way that the laser beam hits the plate under the Brewster angle to minimize the reflection losses. This can be accomplished by turning the rotary plate. In addition the birefringent plate can be rotated around its optical axis by tilting the lever. By rotating the plate its optical retardation δ is changed. If the retardation δ of two passes is a multiple integer of the wavelength λ the polarisation remains unchanged. In all other cases the polarisation is changed and will cause losses at the Brewster window.

**28 OM-0590 Single Mode Etalon with kinematic mount**

To force the laser to operate in only one longitudinal mode a so called etalon is used. It consists of a quartz cylinder with its end faces precisely ground parallel within a few arc seconds. The length is designed so that the convolution of its free spectral range with the HeNe cavity favours only one mode. The etalon is mounted into a holder which is inserted into the adjustment holder. A provided hexagon key is used to fix the etalon mount. Two precise fine pitch screws allow the sensitive tilt of the etalon which is required to tune it inside the cavity to different orders of the etalon.

**29 OM-0596 Transverse Mode Enhancer**

This module uses a very thin wire ($< 50 \mu\text{m}$) which can be adjusted in 5 degrees of freedom. The translation XY, azimuthal tilting and rotation around its axis. Applied inside a cavity, it will force the electrical field of the laser radiation to zero due to its electrical conductivity. In this way the laser can be forced to oscillate on transverse modes.

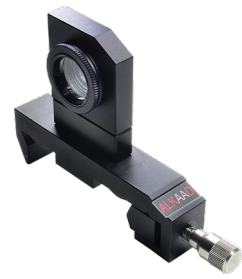
**30 OM-0620 Collimating optics on carrier MG20**

A high precision aspheric glass lens is mounted into a click holder (C25) which is inserted into the XY adjuster. By means of two fine pitch screws the collimator can be adjusted accordingly. The glass lens has a focal length of 4.6 mm, the numerical aperture is 0.53 and the clear opening is 4,9 mm. In addition the lens has a anti reflex coating in a range of 700 .. 900 nm with a residual reflection $< 0.5 \%$.



31 OM-0622 Focussing optics, f=60 mm on carrier MG20

To obtain a very high intensity of the incident light the beam is focused by using a biconvex lens with a focal length of 60 mm. The lens is mounted into a so called click mount (C25) with a mounting diameter of 25 mm. The mount is clicked into the mounting plate where three spring loaded steel balls keep the lens precisely in position.

**32 OM-0624 Nd:YAG rod in 2 axes kinematic mount**

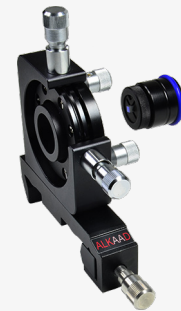
The adjustment holder comprises two high precision fine pitch screws. The upper screw is used to tilt the moveable plate vertically and the lower one to tilt it horizontally. The mounting plate provides a M16 mount into which the laser mirrors holder are screwed. The mirror is pressed against a mechanical reference plane inside the M16 mount in such a way that the mirror is always aligned perfectly when removed and screwed in again. The adjustment holder is mounted to the carrier that a "left" operating mode is achieved and thus forming the left mirror holder of the laser cavity including the Nd:YAG rod as active material. Due to the symmetry of the adjustment holder it can also be changed to the "right" mode if required. The Nd:YAG rod is coated on one side for HR 1064 nm, HT for 808 nm and has on the other side a anti reflex coating for 1064 nm.

**33 OM-0640 SiPIN photodetector on carrier MG20**

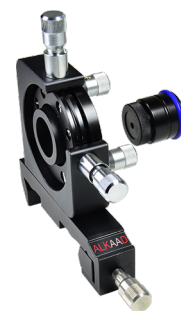
A Si PIN photodiode is integrated into a 25 mm housing (C25) with two click grooves (PD). A BNC cable and connector is attached to connect the module to the photodetector signal box ZB1. The photodetector is placed into the mounting plate where it is kept in position by three spring loaded steel balls.

**34 OM-0650 KTP crystal SHG 532 nm, 5 axes mount on carrier MG20**

For the frequency doubling or second harmonic generation a KTP crystal will be used. The KTP (Potassium titanyl phosphate KTiOPO_4) has a size of 3x3x6 mm and is mounted into a disk with 3 mm thickness and gently clamped. The disk holding the crystal is set into the mount where it is fixed by a threaded ring. The crystal mount is inserted into the adjustment holder. It is kept in position by a spring loaded steel ball in the same way as for the lens click mounts. Four precise fine pitch screws of repetitious accuracy allow the translational and azimuthal adjustment. The crystal mount can be rotated free of play around its axis. This is important to rotate the crystal with respect to the polarisation of the fundamental laser radiation. The end faces of the crystal are polished better $\lambda/10$ and are coated with a high bandwidth anti reflection coating of with a residual reflectivity R of 0.1%.

**35 OM-0660 Cr:YAG passive q-switch, 5 axis mount on MG20**

The Chromium YAG crystal has a diameter of 5 mm and a thickness of 1 mm. It is mounted with two disks into the crystal mount (CM) a threaded retaining ring (R) keeps the crystal and the two disks in position. The crystal mount (CM) is inserted into the five axes adjustment holder (AH). It is kept in position by a spring loaded steel ball in the same way as for the lens click mounts. Four precise fine pitch screws of repetitious accuracy allow the translational and azimuthal adjustment.

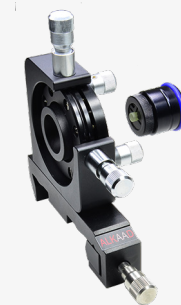
**36 OM-0670 Pr:YLF crystal in 5 axis mount on MG20**

A Praseodymium doped Yttrium Lithium Fluoride crystal with a diameter of 5 mm and a length of 6 mm is mounted into a disk with 3 mm thickness and gently clamped. The disk holding the crystal is set into the mount where it is fixed by using the threaded retaining ring. The crystal mount is inserted into the five axes adjustment holder. It is kept in position by a spring loaded steel ball in the same way as for the lens click mounts.

Four precise fine pitch screws of repetitious accuracy allowing the translative (X,Y) and azimuthal (φ) adjustment.

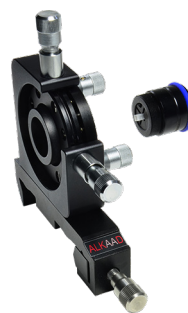
The crystal mount can be rotated free of play around its axis. This is important to rotate the crystal with respect to the polarisation of the pump laser radiation.

The Pr dopant level is 0.7% and the crystal is cut along its c axis termed also as c-cut orientation. The end faces of the crystal are polished better $\lambda/10$ and are coated with a high bandwidth anti reflection coating of 440 .. 740 nm with a residual reflectivity R of <0,1%.

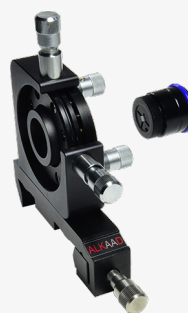


37 OM-0674 LBO crystal SHG 640 nm in 5 axis mount on MG20

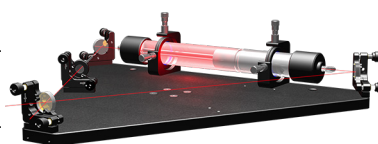
For the frequency doubling or second harmonic generation $640 \rightarrow 320$ nm a LBO crystal will be used. A 3x3 mm and 6 mm long LBO crystal is mounted into a disk with 3 mm thickness and gently clamped. The disk holding the crystal is set into the mount where it is fixed by using the threaded retaining ring. The crystal mount is inserted into the five axes adjustment holder. It is kept in position by a spring loaded steel ball in the same way as for the lens click mounts. Four precise fine pitch screws of repetitious accuracy allowing the translative (X,Y) and azimuthal (ψ, ϕ) adjustment. The crystal mount can be rotated free of play around its axis. This is important to rotate the crystal with respect to the polarisation of the fundamental laser radiation. The Pr dopant level is 0.7% and the crystal is cut along its c axis termed also as c-cut orientation. The end faces of the crystal are polished better $\lambda/10$ and are coated with a high bandwidth anti reflection coating of 440 .. 740 nm with a residual reflectivity R of $<0,1\%$.

**38 OM-0680 Nd:YAG rod in 5 axes mount on carrier 20**

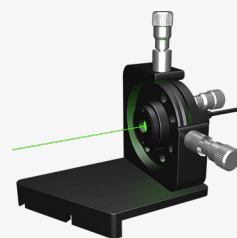
For the setup of a concentric Nd:YAG laser a Nd:YAG crystal has a size of 3x3x6 mm and is mounted into a disk with 3 mm thickness and gently clamped. The disk holding the crystal is set into the mount where it is fixed by a threaded ring. The crystal mount is inserted into the adjustment holder. It is kept in position by a spring loaded steel ball in the same way as for the lens click mounts. Four precise fine pitch screws allow the translational and azimuthal adjustment. The crystal mount can be rotated free of play around its axis. This is important to rotate the crystal with respect to the polarisation of the pump laser radiation. The end faces of the crystal are polished better $\lambda/10$ and are coated with a high bandwidth anti reflection coating of with a residual reflectivity R of 0.1% for 1064 nm.

**39 OM-0700 Gyroscope turntable**

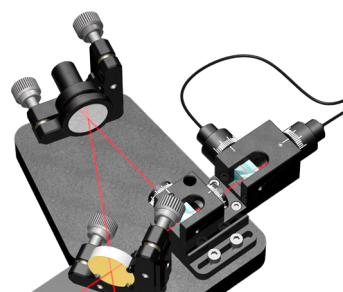
The HeNe ring laser formed by the three laser mirror and a single mode etalon is set-up on a rigid construction consisting of a solid base with a motor driven turn table. The HeNe-laser tube has a length of app. 400 mm with Brewster windows. The tube is mounted with soft rubber rings in two X-Y adjustment holder allowing the adjustment of the capillary with respect to the ring laser axis. The required alignment laser as well as the dual beat frequency detector module are attached by M4 screws to the turn table.

**40 OM-0720 Alignment laser 532 nm with power supply**

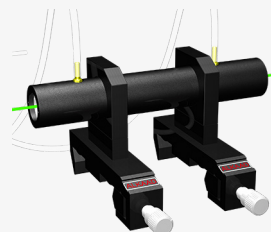
This module is designed as an attachment to OM-0700 Gyroscope turn table and provides a green emitting DPSSL which is mounted into a 4 axes kinematic mount. It is used for the initial alignment of the HeNe tube as well the three ring laser mirror of the laser gyroscope. Four precise fine pitch screws of repetitious accuracy allowing the translative (X,Y) and azimuthal (ψ, ϕ) adjustment. The alignment laser is powered by 5V USB wall plug power supply.

**41 OM-0780 Dual beat frequency detector**

To measure the beat frequency it is required that the clockwise (cw) and counter clockwise (ccw) modes are travelling collinear in one direction. For this purpose the ccw modes is deflected via a half-wave plate into a polarizing beam splitter cube where its is deflected by 90 degrees and travels from thereon in the same direction as the cw mode. The two modes are passing on its way to the photodetectors a quarter-wave plate which converts the polarisation state from linear into circular polarisation. Both modes are split by a neutral beam splitter cube into two channels. In front of each of the attached photodetectors a polarizer is placed, whereby one is turned by 45° to the other one to obtain a 90° phase shift. This enables to determine the rotation direction of the laser gyroscope by applying the electronic quadrature detection.

**42 OM-0820 Gas cuvette assembly**

A 25 mm housing with a length of 200 mm is vacuum proof sealed by two optical glass windows. The cuvette is held by two mounting plates on 20 mm wide carrier MG20. The cuvette has two hose connections which are connected to the "DC-0110 Vacuum Controller" (60).



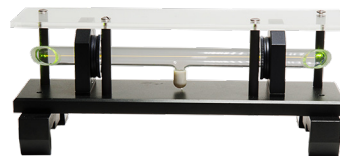
43	OM-0840 Fringe detection unit on MG100 <p>The interfering beams of an interferometer are passing a quarter wave plate to convert the orthogonally polarised light into circular polarisation and distributed on two channels at the neutral beam splitting cube . One polarising beam splitting cube generates a sine and a 180° phase shifted signal which are detected by the respective photo detectors. The other polarising beam splitter cube is rotated by 45° and generates the corresponding cosine signals to obtain a 90° phase to obtain a 90° phase shift. This enables to determine the travel direction of the moving triple reflector by applying the electronic quadrature detection. The unit is mounted onto a 65 mm wide carrier MG65 and a removable Plexiglas cover protects the optics against dust.</p>	
44	OM-0910 Single Mode HeNe laser with Zeeman magnet <p>Due to safety reasons with respect to the high voltage supply of the HeNe Laser tube, the anode section is enclosed by an acrylic box. The length of the tube is designed in such a way that the laser can only emit one longitudinal mode. To change the length of the resonator for stabilisation purposes a bifilar arranged heater coil is applied to the tube. Beneath the tube a linear array of strong magnets is located to create a longitudinal magnetic field. Under the influence of this field the atomic states are split according to the longitudinal Zeeman effect. The main laser intensity comes out of the mirror at the cathode side (right) whereby a laser power leakage on the mirror at the anode side (left) is used for the beat frequency detection.</p>	
45	OM-0920 POF Y coupler in C25 <p>A plastic optical Y coupler is housed inside a C25 housing. The coupler is used to merge the beams of two plastic fibre coupled LEDs into one fibre. The two input connectors are of FSMA type, whereby the output is of ST-POF type.</p>	
46	OM-0950 MO coupling optics, 4 axes kinematic mount <p>A 20x microscope objective is attached to the 4 axes kinematic mount. Four precise fine pitch screws of repetitious accuracy allowing the translative (X,Y) and azimuthal (ϕ,ϑ) adjustment.</p>	
47	OM-1000 Bar code scanner <p>A commercial bar code scanner as they are in use at the cash desks in super markets is modified to get the access to the relevant optical signals as the photodetector raw analogue signal and the binary signal built from the analogue signal. Both signals are available via two BNC panel jacks at the rear of the scanner. The data are transferred via a USB cable to a connected computer like a note pad for instance. Control and configuration commands are send to the controller of the scanner by reading special bar code symbol cards.</p>	
48	OM-1010 Configuration bar code symbol cards <p>A selection of necessary configuration barcode symbol cards is provided to enable desired code recognition or other initial settings.</p>	
49	OM-1020 Bar code sample cards <p>A set of bar code sample with simple coded words is used to compare and identify the related analogue scanner signal.</p>	
50	OM-1030 Set of beam blocker cards <p>The scanner emits a series of scan lines to enable the 3D reading of barcodes. Each scan line creates an optical signal which makes it difficult to identify and interpret the resulting electronic signal. There fore the number of scan lines is reduced to just on line by placing beam blocker cards in front of the scanner mirror except one.</p>	
51	OM-2100 Audio & Video upto fibre transmitter <p>The OM-2100 transmits composite video and two independent audio channels over one multimode or single mode fibre. The modulated laser signal is available at an ST fibre panel jack. Operating Wavelength is 1310 nm and the optical power is sufficient for a maximum transmission length of 5 km with a 50 µm multimode fibre. When using a single mode fibre the distance can be extended to 40 km.</p>	

52 OM-2200 Audio & Video from fibre receiver

The OM-2200 receives composite video and two independent audio channels over one multimode or single mode fibre. The optical fibre carrying the modulated laser signal is connected to an ST fibre panel jack. The video signal is available at the BNC panel jack and the audio stereo channel at attached cynch connectors.

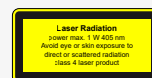
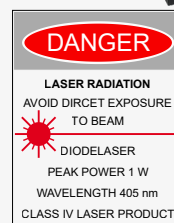
**53 OM-3010 Iodine cell on carrier**

The glass cell has a length of 200 mm and has a Brewster window at each side. It is baked out at a high temperature and natural Iodine is distilled into the evacuated cell and subsequently sealed. The cell is kept with soft rubber rings inside the two C25 mounts which are placed into two mounting plates. A Plexiglas cover protects the valuable cell against damage.

**54 OM-L405 Diode laser module 405 nm, 1 W**

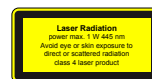
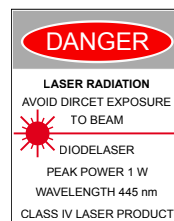
A laser diode which emits an optical power of 1 W at a wavelength of 405 nm is built into a round housing. A Peltier element removes the excess heat via the mounting plates and the carrier and finally by the optical rail. This device can emit highly concentrated visible light which can be hazardous to the human eye. The operators of the diode laser module have to follow the safety precautions found in IEC 60825-1 "Safety of laser products Part 1: Equipment classification, requirements and user's guide" when connected to the controller.

The diode laser is connected via a 15 pin SubD HD connector to the controller MK1. Inside the connector an EPROM contains the data of the laser diode and when connected to the controller, these data are read and displayed by the controller.

**55 OM-L445 Diode laser module 445 nm, 1 W**

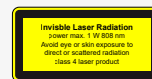
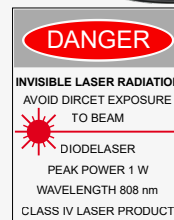
For the efficient optical excitation of the Praseodymium doped YLF crystal a pump wavelength of 444 nm at its full power is required. The pump laser diode is mounted onto a Peltier element to control the operating temperature in a range of 10 .. 50 °C. The output power is 1 Watt at a wavelength of 444 nm. A particularity of the blue diode lasers is that its wavelength strongly depends beside the temperature with 0.05 nm/°C also strongly on the injection current with 3.3 nm/A. This device can emit highly concentrated visible light which can be hazardous to the human eye. The operators of the diode laser module have to follow the safety precautions found in IEC 60825-1 "Safety of laser products Part 1: Equipment classification, requirements and user's guide" when connected to the controller.

The diode laser is connected via a 15 pin SubD HD connector to the controller MK1. Inside the connector an EPROM contains the data of the laser diode and when connected to the controller, these data are read and displayed by the controller.

**56 OM-L500 Diode laser module 808 nm on C20**

For the efficient optical excitation of the Nd doped YAF crystal a pump wavelength of 808 nm at its full power is required. The pump laser diode is mounted onto a Peltier element to control the operating temperature in a range of 10 .. 50 °C. The output power is 1 Watt at a wavelength of 808 nm. A particularity of the 808 nm diode lasers is that its wavelength strongly depends beside the temperature with 0.25 nm/°C also on the injection current with 0.05 nm/A. This device can emit highly concentrated invisible light which can be hazardous to the human eye. The operators of the diode laser module have to follow the safety precautions found in IEC 60825-1 "Safety of laser products Part 1: Equipment classification, requirements and user's guide" when connected to the controller.

The diode laser is connected via a 15 pin SubD HD connector to the controller MK1. Inside the connector an EPROM contains the data of the laser diode and when connected to the controller, these data are read and displayed by the controller.



LQ - Light Sources

1 LQ-0020 Green (532 nm) DPSSL in ø25 housing

A green (532 nm) emitting DPSSL is integrated into a C25 housing and is operated with the "DC-0020 LED and Photodiode Controller" (58). The output power is < 5 mW. The diode laser is connected via a 15 pin SubD HD connector to the controller MK1. Inside the connector an EEPROM contains the data of the laser diode and when connected to the controller, these data are read and displayed by the controller.



2 LQ-0030 Green (532 nm) pilot laser with USB power supply

A green (532 nm) emitting DPSSL is integrated into a C25 housing and is operated by a 5 V wall plug power supply which is connected via a USB and 1.3 mm connector. The output power is < 5 mW.



3 LQ-0040 Green (532 nm) stabilized Laser, 40 mW

In connection with the controller MK1-HP this laser module emits maximum 40 mW tunable 532 nm radiation in single mode with a frequency stability of ± 45 MHz. The green emitting DPSSL is mounted between two Peltier elements and the laser head is mounted into a 4 axes adjustment holder. Four precise fine pitch screws of repetitious accuracy allow the translational and azimuthal adjustment. The laser is connected to the controller with the 15 pin SubD HD connector which contains an EEPROM where the parameters of the laser are stored. The controller reads the data and sets the critical values accordingly.



4 LQ-0060 Red (635 nm) diode laser in ø 25 housing

A laser diode emitting 3 mW is mounted into a housing (C25) with 25 mm diameter. The two grooves are provided for a defined position inside a mounting plate (C25). The adjustable collimator can be removed if not required. The laser diode is powered by connecting it via the 1.3 mm jack at the rear to the provided 5 V power supply including the 1.3 mm to USB cable.



5 LQ-0100 Neon spectral lamp

This small but very effective module contains a Neon lamp which is operated at 230 VAC with a few Nanoamperes only. It is contained in a C25 housing with a SM fibre connector to allow the direct connection to a fibre coupled spectrometer. The Neon lamps emits the well known atomic lines and thus serves as a calibration source. An adapter is provided to connect the lamp to the mains line.



6 LQ-0200 White LED in ø 25 Housing

A high power white light LED with an emission surface of less 2 millimetre is contained into in a C25 housing. The LED is located closely to the front which has an opening of 2 mm. Furthermore a current stabilizer is integrated as well into the housing. At the rear of the housing a 1.3 mm jack is located for the power supply. For the operation a 5V power supply as well as a 1.3 mm to USB connection cable is provided. However the LED can be operated also from other sources from 3.5 V to 16 V DC.



7 LQ-0210 Red LED in ø 25 housing

A high power red (635 nm peak) light LED with an emission surface of less 2 millimetre is contained into in a C25 housing. The LED is located closely to the front which has an opening of 2 mm. Furthermore a current stabilizer is integrated as well into the housing. At the rear of the housing a 1.3 mm jack is located for the power supply. For the operation a 5V power supply as well as a 1.3 mm to USB connection cable is provided. However the LED can be operated also from other sources from 3.5 V to 16 V DC.



8 LQ-0212 Red LED in C25 with fibre jack

A high power red (635 nm peak) light LED with an emission surface of less 2 millimetre is contained into in a C25 housing. The LED is located closely to the front which has a fibre ST. For the operation the DC-0030 Dual channel LED transmitter is provided. However the LED can be operated also from other sources via the 2.1 mm connector, not exceeding the maximum current of 700 mA.



9 LQ-0214 Dark Red LED in ø 25 housing

A high power dark red (670 nm peak) light LED with an emission surface of less 2 millimetre is contained into in a C25 housing. The LED is located closely to the front which has an opening of 2 mm. Furthermore a current stabilizer is integrated as well into the housing. At the rear of the housing a 1.3 mm jack is located for the power supply. For the operation a 5V power supply as well as a 1.3 mm to USB connection cable is provided. However the LED can be operated also from other sources from 3.5 V to 16 V DC.

**10 LQ-0220 Green LED in ø C25 housing**

A high power green (525 nm peak) light LED with an emission surface of less 2 millimetre is contained into in a C25 housing. The LED is located closely to the front which has an opening of 2 mm. Furthermore a current stabilizer is integrated as well into the housing. At the rear of the housing a 1.3 mm jack is located for the power supply. For the operation a 5V power supply as well as a 1.3 mm to USB connection cable is provided. However the LED can be operated also from other sources from 3.5 V to 16 V DC.

**11 LQ-0222 Green LED in C25 with fibre jack**

A high power green (525 nm peak) light LED with an emission surface of less 2 millimetre is contained into in a C25 housing. The LED is located closely to the front which has a fibre ST. For the operation the DC-0030 Dual channel LED transmitter is provided. However the LED can be operated also from other sources via the 2.1 mm connector, not exceeding the maximum current of 700 mA.

**12 LQ-0230 Blue LED in ø 25 housing**

A high power blue (470 nm peak) light LED with an emission surface of less 2 millimetre is contained into in a C25 housing. The LED is located closely to the front which has an opening of 2 mm. Furthermore a current stabilizer is integrated as well into the housing. At the rear of the housing a 1.3 mm jack for the power supply is located. For the operation a 5V power supply as well as a 1.3 mm to USB connection cable is provided. However the LED can be operated also from other sources from 3.5 V to 16 V DC.

**13 LQ-0250 NIR LED in ø 25 housing**

A high power near infrared (850 nm peak) light LED with an emission surface of less 2 millimetre is contained into in a C25 housing. The LED is located closely to the front which has an opening of 2 mm. Furthermore a current stabilizer is integrated as well into the housing. At the rear of the housing a 1.3 mm jack for the power supply is located. For the operation a 5V power supply as well as a 1.3 mm to USB connection cable is provided. However the LED can be operated also from other sources from 3.5 V to 16 V DC.

**14 LQ-0300 Two mode HeNe laser Ø30 housing, 632 nm**

A helium Neon tube with a length of 18 cm is integrated into a black anodized aluminium housing with a diameter of mm. Click grooves are applied to accommodate the tube in a C30 mounting plate or in two XY adjustment mounts (MM-0470 34). The laser beam is precisely centred to the mechanical axis of the tube. The laser emits an output power of 1.5 mW at a wavelength of 632 nm and two orthogonal modes with a mode spacing of 900 MHz. For the operation of the tube the power supply DC-0062 (59) is required.

**15 LQ-0350 Pulsed diode laser in housing**

This diode laser emits pulsed radiation only when it is connected to the controller DC-0050 (59). The controller provides the necessary voltage to load the ignition condenser inside the laser head and the discharge pulse to release the laser pulse. The emission wavelength is 905 nm with a repetition rate of 2 kHz and an adjustable pulse width of 50 to 150 ns and a output energy of 4 µJ.

**16 LQ-0410 Energy saving lamp GU10, 9W/230V**

The energy saving lamp has a GU10 socket and fits into the socket which is attached to a MG65 carrier. The electrical power is 9W at 230 VAC. The lamp is connected to the mains via a cable with an in line switch. The lamp emits radiation with a colour temperature of 6500 K.



17 **LQ-0440 Tungsten filament white light source**

A tungsten filament lamp is mounted into a 25 mm housing. The bulb has a diameter of 2.5 mm and fits into on side of a FSMA fibre jack. The lamp is connected via 6 wires to the controller (DC-0270 Filament and LED lamp controller, 62). Two are used to power the lamp, two are used to measure the voltage at the lamp and two are used to measure the cold temperature of the lamp with a precise NTC resistor.



18 **LQ-0450 Tungsten lamp, GU10, 10 W/230V**

The tungsten lamp has a GU10 socket and fits into the socket which is attached to a MG65 carrier. The electrical power is 10W at 230 VAC. The lamp is connected to the mains via a cable with an in line switch.



DC - Devices and Controller

1 **DC-0010 Diode laser controller MK1-HP**

The diode laser module is connected via the 15 pin HD SubD jacket at the rear of the controller. The controller reads the EEPROM of the laser diode and sets the required parameter accordingly. The MK1 is powered by an external 12V/ 1.5 A wall plug supply. A USB bus allows the connection to a computer for remote control. Furthermore firmware updates can be applied simply by using the same USB bus. The central settings knob rotates a precision optical encoder to set the temperature, injection current and modulation frequency. Pushing the knob down shuts the laser immediately OFF. The MK1 provides an internal modulator which allows the periodic switch on and off of the diode laser. A buffered synchronisation signal is available via the BNC jacket (MOD). The controller is equipped with a touch panel display and industrial highly integrated circuits for the bipolar Peltier cooler as well as for the injection current and modulation control of the attached laser diode. The injection current is stabilized within ± 1 mA and the diode laser temperature within ± 0.01 °C.



2 **DC-0020 LED and Photodiode Controller**

This microprocessor operated device contains an LED current controller and a photodiode amplifier. A touch panel display allows in conjunction with the digital knob the selection and setting of the parameter for the attached LED or photodiode. The controller reads the parameter of the connected LED from the EEPROM located inside the LED connector. The device comes with a 230 VAC / 12 VDC wall plug power supply. Via the USB bus the device can be controlled and data read by an external computer.



3 **DC-0030 Dual channel LED transmitter and receiver**

This microprocessor operated device contains a dual LED current controller and a dual photodiode amplifier. A touch panel display allows in conjunction with the digital knob the selection and setting of the parameter for the attached LED or photodiode. Two internal modulators are used to modulate the current of each LED. The two channel photodiode amplifiers are converting the photocurrent of the connected photodiode into a voltage. The gain of the amplifier can be selected and the photo voltage is displayed on the touch panel display.



4 **DC-0040 Diode laser controller MK1**

The diode laser module is connected via the 15 pin HD SubD jacket at the rear of the controller. The controller reads the EEPROM of the laser diode and sets the required parameter accordingly. The MK1 is powered by an external 12V/ 1.5 A wall plug supply. A USB bus allows the connection to a computer for remote control. Furthermore firmware updates can be applied simply by using the same USB bus. The central settings knob rotates a precision optical encoder to set the temperature, injection current and modulation frequency. Pushing the knob down shuts the laser immediately OFF. The MK1 provides an internal modulator which allows the periodic switch on and off of the diode laser. A buffered synchronisation signal is available via the BNC jacket at the rear. The controller is equipped with a touch panel display and industrial highly integrated circuits for the bipolar Peltier cooler as well as for the injection current and modulation control of the attached laser diode. The injection current is stabilized within ± 1 mA and the diode laser temperature within ± 0.1 °C.



5 DC-0048 DC-0048 Diode laser controller MK2

The diode laser module is connected via the 15 pin HD SubD jacket at the rear of the controller. The controller reads the EEPROM of the laser diode and sets the required parameter accordingly. The MK1 is powered by an external 12V/ 1.5 A wall plug supply. A USB bus allows the connection to a computer for remote control. Furthermore firmware updates can be applied simply by using the same USB bus. The central settings knob rotates a precision optical encoder to set the temperature, injection current and modulation frequency. Pushing the knob down shuts the laser immediately OFF. The MK1 provides an internal modulator which allows the periodic switch on and off of the diode laser. A buffered synchronisation signal is available via the BNC jacket at the rear. The controller is equipped with a touch panel display and industrial highly integrated circuits for the bipolar Peltier cooler as well as for the injection current and modulation control of the attached laser diode. The injection current is stabilized within ± 1 mA and the diode laser temperature within ± 0.1 °C.



6 DC-0050 Pulsed laser diode controller MK1

The pulsed diode laser module is connected via the 15 pin HD SubD jacket at the rear of the controller. The controller reads the EEPROM of the laser diode and sets the required parameter accordingly. The MK1 is powered by an external 12V/ 1.5 A wall plug supply. A USB bus allows the connection to a computer for remote control. Furthermore firmware updates can be applied simply by using the same USB bus. The central settings knob rotates a precision optical encoder to set the temperature, injection current and modulation frequency. Pushing the knob down shuts the laser immediately OFF.

The MK1 provides an internal modulator which allows the periodic switch on and off of the diode laser. A buffered synchronisation signal is available via the BNC jacket at the rear. The controller is equipped with a touch panel display and in conjunction with the digital knob the parameter like load voltage, pulse width and repetition rate are selected and set.



7 DC-0060 High voltage supply 4.0 - 7 mA adjustable

A novel and safe combination of high voltage and micro processor control form the high voltage controller. The HeNe laser tube is connected via a special high voltage BNC connector to rear of the controller. The precision 5 turn potentiometer sets the discharge current in a range from 4.5 to 7 mA.

When the external 12 V is applied the controller starts while displaying the start screen. This will take approximately 3.5 seconds. After that the user is requested to authorize himself by entering the 4 digit pin code.



8 DC-0062 High voltage supply 5 mA

This device is used to operate a HeNe laser with a fixed discharge current of 5 mA. The HeNe laser is connected to the high voltage BNC jack. A safety key switch prevents the unauthorised operation. The device comes with a 230 VAC / 12 VDC wall plug power supply.



9 DC-0064 High voltage supply 6.5 mA

This device is used to operate a HeNe laser with a fixed discharge current of 6.5 mA. The HeNe laser is connected to the high voltage BNC jack. A safety key switch prevents the unauthorised operation. The device comes with a 230 VAC / 12 VDC wall plug power supply.



10 DC-0070 Piezo controller 0-150V

All voltages necessary for the supply of the Piezo-crystal and all monitor signals are generated by this controller. In addition it contains a photodiode amplifier. The output voltage can be adjusted from 10 to 150 V and the frequency of the integrated modulator for triangular signals up to 100 Hz. A monitor signal which is proportional to the selected Piezo-voltage is provided via a BNC panel jack at the rear. The amplification of the built-in photodiode amplifier can be selected from 1 to 100 in five steps and the amplifier out put is available at the BNC panel jack at the rear. The controller is equipped with a touch panel display and in conjunction with the digital knob the parameter are selected and set.



11 DC-0080 Quad counter & 2 channel photodiode amplifier

This device serves as 4 channel photodiode preamplifier and as quadrature counter. The gain, offset and coupling as AC or DC can independently be set each channel with the touch panel and digital knob. The output of each preamplifier is available via 4 BNC panel jacks at the rear of the device. From the four analogue signals the TTL quadrature signals are formed and counted by the quadrature counter. The counter signal is available as TTL signal at two BNC panel jacks at the rear of the device. The principle of quadrature counting allows to interpolate one count event into 2, 4, 8 or 16 fractions enhancing the interferometer resolution up to $\lambda/8$. The controller is equipped with a touch panel display and in conjunction with the digital knob the parameter like photodetector gain, pulse width and repetition rate are selected and set.

**12 DC-0090 Laser controller & exposure timer**

In addition to the functionality of the "DC-0040 Diode laser controller MK1" (58) an exposition timer is added to this device. It allows to switch the attached laser on for a limited time with a certain delay. Furthermore the display is darkened during the exposure time to avoid undesired light which may effect the intended illumination. The screen remains dark unless the panel screen is touched.

**13 DC-0100 Stepper motor controller**

This device controls two phase stepper motor with a maximum current of 1 A. The stepper motor is connected via a 15 pin SubD HD connector located at the rear of the device. The controller is operated by a microprocessor and a touch screen is used to select the parameter to be changed. A digital knob is used to set the value for the selected parameter. The controller is used for rotation as well as translation stages and the corresponding user interface is selected at the startup of the device. A USB bus is provided to control and collect data with external software.

**14 DC-0110 Vacuum Controller**

The controller contains a precise pressure sensor with an operating range of 300 - 1100 hPa with an accuracy of ± 0.1 hPa, a temperature sensor with an accuracy of ± 0.1 °C and a humidity sensor with an accuracy of $\pm 1\%$. The pressure cell is connected via two flexible hoses to the vacuum controller. One hose is connected to the integrated vacuum pump and the other one via a valve to the rear of the controller, where either the surrounding air or another provided gas streams into the cell. The pressure inside the cell is set by this valve and displayed on the controller. In addition, the temperature and humidity of the air or gas is displayed. The related index of refraction is calculated by the processor applying Edlen's formula.

**15 DC-0120 Si-PIN Photodetector, BPX61 with connection leads**

A Si PIN photodiode is integrated into a 25 mm housing with two click grooves. A BNC cable and connector is attached to connect the module to the photodetector signal box ZB1. The photodetector module is placed into the C25 mounting plate where it is kept in position by three spring loaded steel balls.

**16 DC-0124 Si-PIN Photodetector with ST jack and connection leads**

A Si PIN photodiode is integrated into a ST panel jack which is mounted into a 25 mm housing with two click grooves. A BNC cable and connector is attached to connect the module to the photodetector signal box ZB1. The photodetector module is placed into the C25 mounting plate where it is kept in position by three spring loaded steel balls.

**17 DC-0140 Mini SiPIN photodetector with connection lead**

A Si PIN photodiode is integrated into a 12 mm housing. A BNC cable and connector is attached to connect the module to the photodetector signal box ZB1.

**18 DC-0160 InGaAs Photodetector with connection leads**

An InGaAs photodiode is integrated into a 25 mm housing with two click grooves. A BNC cable and connector is attached to connect the module to the photodetector signal box ZB1. The photodetector module is placed into the C25 mounting plate where it is kept in position by three spring loaded steel balls.



19 DC-0164 InGaAs Photodetector ST with connection leads

An InGaAs photodiode is integrated into a ST panel jack which is mounted into a 25 mm housing with two click grooves. A BNC cable and connector is attached to connect the module to the photodetector signal box ZB1. The photodetector module is placed into the C25 mounting plate where it is kept in position by three spring loaded steel balls.

**20 DC-0170 UV Photodetector with connection leads**

A UV (peak 360 nm) photodiode is integrated into a 25 mm housing with two click grooves. A BNC cable and connector is attached to connect the module to the photodetector signal box ZB1. The photodetector module is placed into the C25 mounting plate where it is kept in position by three spring loaded steel balls

**21 DC-0200 High sensitivity power sensor, 0.3-11 μ m**

The detector is provided with a wavelength independent (0.3 to 11 μ m) thermoelectric element and is designed for a power range of 500 μ W to 2W with a resolution of 50 μ W. The round sensitive area has a diameter of 19 mm. The detector is attached to a 20 mm wide carrier MG20 and requires for the operation the “CA-0260 Laser power meter LabMax-TO “ (66).

**22 DC-0210 InGaAs Photodetector, ultrafast with amplifier 120 MHz**

A fast InGaAs photodiode is built into a ST fibre panel jack and set into a C25 housing. To achieve the high speed of 120 MHz the preamplifier is located close to the photodiode inside the C25 housing. For the power supply a junction box is provided which also has a BNC panel jack for the amplified signal.

**23 DC-0220 Si PIN Photodetector, ultrafast with amplifier**

A fast InGaAs photodiode is built into a ST fibre panel jack and set into a C25 housing. To achieve the high speed of 400 MHz the preamplifier is located close to the photodiode inside the C25 housing. For the power supply a junction box is provided which also has a BNC panel jack for the amplified signal.

**24 DC-0250 Active Si PIN Photodetector**

This Si PIN is connected via a 15 pin SubD HD connector to its control unit “DC-0020 LED and Photodiode Controller “ (58). The EEPROM inside the connector stores the sensitivity curve and other useful information of the detector which is read by the microprocessor when connected to it.

**25 DC-0260 Audio fringe detector**

This device is an audio amplifier with an input designed for a photodiode which is connected via a BNC panel jack. Changes of the light intensity falling onto the detector will be converted into an audible sound. Either the built-in speaker or an external earphone is used to listen to the light intensity changes. This detector is very useful for white light interferometer to detect the appearance of fringes.



26 DC-0270 Filament and LED lamp controller

The controller is designed for precise control of the voltage and current of the “LQ-0440 Tungsten filament white light source” (58). The microprocessor evaluates the temperature of the cold lamp to get the environmental temperature T_0 which is required for the calculation of the filament temperature. The touch screen displays the current and voltage and the calculate resistor as well as the temperature of the lamp body. The digital knob is used to set the current of the filament. The controller is also used to operate LED and sets the touch screen display automatically by reading the EEPROM information from the attached component.



27 DC-0310 Laser frequency stabilizer

The main part of the device is a digital PID controller. The controller is equipped with a touch screen display and in conjunction with the digital knob the PID parameter are selected and set. The input variable for the PID controller is the beat frequency of the Zeeman split HeNe laser modes. The goal is to keep this frequency to its minimum. Thus the input signal is amplified, digitized and the frequency determined by a counter. The output signal of the controller is designed to drive the heater coil of the HeNe laser. The amplified input signal (beat frequency) is available via a BNC panel jack at the rear of the device.



28 DC-0320 US particle generator

To provide particles which can be detected by an LDA an ultrasonic particle nebuliser using an ultrasonic crystal in conjunction with a blower is used. In a two step process a jet of “dry” water particles is generated. The speed of the jet is controlled by an adjustable air blower. The device is filled with distilled and abacterial water. The speed of the air blower is set via the touch screen and the digital knob. The display informs about the temperature of the US transducer as well as about the water reservoir level. A push button on the touch screen is used to switch the US transducer on and off.



29 DC-0356 Pockels Cell HV Driver DQ21, HV and Trigger Cable

This Pockels cell driver is used for q-switch operations. The driver DQ21 has the following properties:
Output voltage: 320..1940 V
Switching time: 11 ns @ 1.500 V and 30 pF cap. load
Delay: 54..1090 μS
Repetition rate: max. 20 kHz
Trigger input: TTL, a falling edge switches the high voltage off
An extra cable is provided. One end of the cable has a Lemosa connector for the connection to the driver DQ21 and the other one provides a BNC connector with a T-piece to monitor the trigger on an oscilloscope.



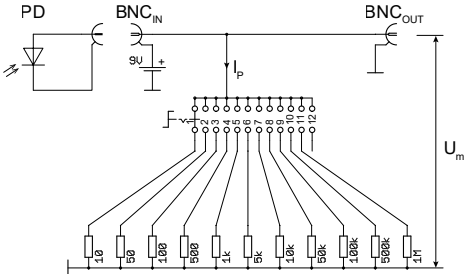
30 DC-0358 Pockels Cell Driver DQ21

This Pockels cell driver is used for polarisation experiments. The driver DQ21 has the following properties:
Output voltage: 320..1940 V
Switching time: 11 ns @ 1.500 V and 30 pF cap. load
Delay: 54..1090 μS
Repetition rate: max. 20 kHz
Trigger input: TTL, a falling edge switches the high voltage off



31 DC-0380 Photodetector Junction Box ZB1

The signal box contains a resistor network and a replaceable 9V battery and is prepared to accept all kinds of photodiodes provided they are connected to the BNC input (PD_{IN}) as shown in the schematic of the figure below.



$$I_P = \frac{U_m}{R_L}$$

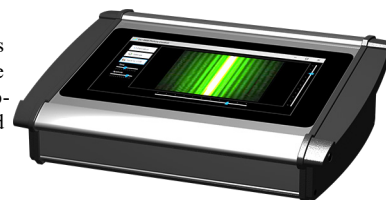
At the output BNC_{OUT} of the signal box a signal is present which is given by the equation shown on the right.

32 DC-0384 Photodetector junction box with amplifier

This junction box provides in addition to the DC-0380 (see above) an 10 x amplifier.

**33 DC-0800 CCD Camera Controller**

This microprocessor controlled device has a large 7 inch touch screen display. It is designed to control the attached CCD camera DC-0810 (see below) and to display the captured image. The control parameters for the camera like exposition time and aperture are set via the touch screen. The captured images can be stored on an attached USB pen drive.

**34 DC-0820 CCD Camera Module**

The color CCD camera module is mounted to a 30 mm wide carrier MG30 in such a way, that the centre of the CCD sensor matches the optical height of the optical bench. The focus is set manually while observing the result on the display of the DC-0800 camera controller.



CA - Cables and Accessories

1 CA-0005 Allan key SW 0.9

Fine hex screwdriver with a wrench size of 0.9 mm

**2 CA-0010 Set of test liquids**

A set of 3 test liquids filled into 15 ml dropping bottles with isopropyl alcohol (IPA), distilled water and a 60 °Bx (Degrees Brix) sugar solution is provided. Brix is a definition of the content of the dry matter in a solution. One degree Brix is 1 gram of sucrose in 100 grams of solution.

**3 CA-0012 Set of tools for LDA**

For convenient alignment of the capstan screws of the prism stages of the LDA Experiments. The tool comes with a removable 1 mm steel pin.

**4 CA-0030 Set of development equipment**

The set consists of a balance with an accuracy of 0.1 g, a 500 ml beaker with stirring staff. A scoop is used to collect the chemicals from the bottles. Three lab dishes and three film tongs are required for the development process. The ready mixed developer and bleacher are stored in three wide mouth bottles.



5	CA-0034 Set of developer chemicals The chemicals provided are good for 4 litres and are coming in sealed bottles. PART A solution for 4 litres: <table> <tr><td>Catechol</td><td>40</td><td>grams</td></tr> <tr><td>Ascorbic Acid</td><td>20</td><td>grams</td></tr> <tr><td>Sodium Sulfite (anhydrous)</td><td>20</td><td>grams</td></tr> <tr><td>Urea</td><td>200</td><td>grams</td></tr> </table> PART B for 4 litres: <table> <tr><td>Sodium Carbonate</td><td>120</td><td>grams</td></tr> </table> PBU-Amidol bleach for 4 litres: <table> <tr><td>Potassium Persulfate</td><td>40</td><td>grams</td></tr> <tr><td>Citric Acid</td><td>40</td><td>grams</td></tr> <tr><td>Potassium Bromide</td><td>80</td><td>grams</td></tr> <tr><td>Cupric Bromide</td><td>4</td><td>gram</td></tr> <tr><td>Amidol</td><td>4</td><td>gram</td></tr> </table>	Catechol	40	grams	Ascorbic Acid	20	grams	Sodium Sulfite (anhydrous)	20	grams	Urea	200	grams	Sodium Carbonate	120	grams	Potassium Persulfate	40	grams	Citric Acid	40	grams	Potassium Bromide	80	grams	Cupric Bromide	4	gram	Amidol	4	gram	
Catechol	40	grams																														
Ascorbic Acid	20	grams																														
Sodium Sulfite (anhydrous)	20	grams																														
Urea	200	grams																														
Sodium Carbonate	120	grams																														
Potassium Persulfate	40	grams																														
Citric Acid	40	grams																														
Potassium Bromide	80	grams																														
Cupric Bromide	4	gram																														
Amidol	4	gram																														
6	CA-0036 Sample object for holography A white coloured chess figure is set on a pedestal. The height matches the optical height of the holographic setup.																															
7	CA-0038 Photographic plate VRP-M, 532 nm, 63 x 63 mm The fine grain blue and green sensitive photo plates are designed for holograms recording with pulsed and CW laser. The plates have a size of 63 x 63 mm and shall be unseal and processed in indirect non-actinic light with use of a dark-red light filter (transmission > 600 nm) or a dark red LED “LQ-0214 Dark Red LED in ø 25 housing” (57).																															
8	CA-0040 Set of 5 transmission gratings This set comes with holographic transmission gratings with 1200, 600, 300, 100 and 80 lines per mm with a size of 50x50 mm.																															
9	CA-0050 Set of tools and connection cable This set is intended for the bar code reader. A torx screw driver of size T10 is used to open the scanner to apply the mirror blinds or just to have a look inside of it. A USB cable is added to the set.																															
10	CA-0060 Infrared display card 0.8 -1.4 µm To convert invisible radiation in a wavelength range of 0.8-1.2 µm into visible light this card is used. Depending on the incident power the visible spot ranges from orange to white. This card should only be used for non focussed optical beams with less than 500 mw.																															
11	CA-0070 NIR Laser viewing card 980 nm and 1.5µm The CA-0070 is a credit-card-sized detector card for viewing light in the 790 to 840 nm, 870 to 1070 nm, and 1500 to 1590 nm wavelength ranges. The lower front surface of this durable plastic card is photosensitive and enables the easy location of near-infrared (NIR) light beams and focal points. As it is not necessary to charge the active region of the card before use, either CW or pulsed incident light will generate emission, even when the card is used in a darkened room.																															

12 CA-0080 Optics cleaning set

Sensitive optics, especially used in connection with open frame lasers, the cleaning of the optics surfaces is a substantial must to remove contaminations of the mirror surfaces. For this purpose soft cleaning tissues wetted with pure acetone are commonly used. Clamp pliers are provided to hold the folded and wetted pad of the cleaning tissue. A 15 ml dropping bottle filled with "Optics cleaning Liquid" (acetone) is included as well.

**13 CA-0100 Flat panel TV**

To monitor video signal a state of the art flat panel TV of minimum 19 inch is used. The model shown on the right is just an example, it may differ due to the fast development in this area. The monitor comes with integrated speakers, a composite, S video and audio input.

**14 CA-0110 CCD day & night camera block module**

The CA-0110 incorporates the Super HAD CCD II sensor that offers highly improved sensitivity and colour reproduction. In addition, the camera can operate with a minimum illumination of 0.25 lx, resulting in a significant improvement in image quality under limited lighting conditions with a high horizontal resolution of 530 TV lines. The CA-0110 incorporates a 10x zoom lens. When used in combination with its 12x digital zoom, the camera achieves a zooming capability of up to 120x. The CA-0110 features a Day/Night capability, which provides optimum sensitivity in both day and night shooting applications. As the scene illumination darkens, the infrared filter is automatically removed. The camera then switches to B&W mode enabling it to operate under a minimum illumination of 0.0004 lx. A junction board provides a BNC jack for the composite video and a P/S2 jack for an S video signal. Another P/S jack is used to connect to the RS232 interface of the camera which fully controls the iris, focus and zoom and a lot more of specific features related to the exposition.

**15 CA-0120 Tablet PC Windows**

A tablet or notebook comes with a Windows based operating system with a minimum 11" display, a multicore processor 1.5 GHz and 4 GByte ram, a USB 2.0 bus. Due to the rapid changes in this field the specification can be even better.

**16 CA-0130 Colour CCD Camera on tripod**

The colour CCD camera is mounted onto a tripod for table top operation. The iris of the lens is controlled by the camera electronics, distance and focus can be set manually and independent from each other. The video signal is available at the rear of the camera via a BNC jack. The power supply is connected with a two pin connector.

**17 CA-0140 DVD player with music DVD**

A state of the art DVD player is used as an audio as well as a video source. At the front a USB connection is provided to accept USB sticks with video, audio and still picture files. At the rear the two audio output channel as well the video out is available. To use these, the provided BNC cable which is also used by the camera a cynch to BNC adapter is inserted into the video cynch output. For immediate startup a music DVD is added.



18 CA-0150 USB Video frame grabber

The audio and video signals of an external source like a camera or DVD player can be connected to this device and are streamed via the USB bus to a connected PC.

**19 CA-0200 Oscilloscope 100 MHz digital, two channel**

A frequently used and indispensable device for a variety of experiment is a two channel digital oscilloscope with a bandwidth of 100 MHz. The digital capabilities allow the storage of the displayed curves on a USB pen drive as a graphics or a CVS data file which can be opened with EXCEL or other sheet related software. The model shown on the right is an example and may vary due to technical progress with even better specifications.

**20 CA-0210 Spectrum Analyser 100 kHz - 500 MHz**

This spectrum analyser has a bandwidth of 100 kHz to 500 MHz and is used to detect and display optical beat frequencies. The analyser comes with a BNC to PL adapter to connect a SiPIN photodetector directly to the device. The input impedance is set to 50 Ohms and the AC amplifier to an appropriate gain and the beat frequencies up to 500 MHz can clearly be observed. The digital capabilities allow the storage of the displayed curves on a USB pen drive as a graphics or a CVS data file which can be opened with EXCEL or other sheet related software.

**21 CA-0220 Multimeter 3 1/2 digits**

For measurements with an accuracy of minimum 3 digits behind the comma, a 4 digit multimeter is required. Besides the measurement of voltage and current the multimeter offers also an Ohm meter. The model shown on the right is just an example and may vary due to technical progress. A must is a current range with 0.1 μ A resolution and 0.1 mV in the voltage range.

**22 CA-0260 Laser power meter LabMax-TO**

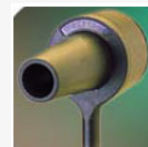
LabMax is appropriate for anyone who needs to analyse and monitor laser output. Data analysis can be achieved via statistical and trend analysis and stored in onboard flash memory for future retrieval with the File Manager tool. Data can also be analyzed directly on a PC through USB and RS-232 serial connections, or by logging data to a USB flash drive attached directly to the meter. The LabMax display and meter can be positioned at many different angles so customers can place it within the limited bench space typically available in a laser lab and still easily view the display. LabMax-TO is directly compatible with most Coherent thermal and semiconductor sensors and displays beam position for quick and accurate setup. These sensors offer wavelength coverage from 190 nm to 12 μ m and measure from nW to kW.

**23 CA-0262 Energy sensor head 300 nJ - 600 μ J**

An energy sensor head for a measuring range of 500 nJ - 600 μ J in a wavelength range from 0.19 - 12 μ m. The diameter of the active sensor is 10 mm. The detector is attached to a 20 mm wide carrier MG20 and requires for the operation the "CA-0260 Laser power meter LabMax-TO" (66).

**24 CA-0264 Power sensor LM2 VIS 50 mW / 1 nW**

These high-sensitivity semiconductor sensor is ideal for CW laser measurements in the nW to low mW level for a wavelength range of 0.4 to 1.06 μ m. The detector is mounted to a 20 mm wide carrier where it is kept in a post holder.



25 CA-0266 Power sensor PM3 0.5 mW to 2W

The detector is provided with a wavelength independent (0.3 to 11 μm) thermoelectric element and is designed for a power range of 500 μW to 2W with a resolution of 50 μW . The round sensitive area has a diameter of 19 mm. The detector is attached to a 20 mm wide carrier MG20 and requires for the operation the “CA-0260 Laser power meter LabMax-TO “ (66).

**26 CA-0270 Fibre coupled spectrometer 200 - 1200 nm, USB**

The spectral range of the spectrometer covers 200 to 1200 nm with a resolution of 1 nm. The entrance slit is 50 μm wide and the provided fibre has a core diameter of 600 μm . The spectrometer has a SMA fibre jack and the data are available via the USB bus. The spectrometer comes with the USB cable and a Windows software.

**27 CA-0410 BNC - banana adapter cable, 1m**

This adapter cable is used for the connection of coaxial BNC terminated components to the 19 mm banana receptacle of a digital multimeter.

**28 CA-0450 BNC connection cable 1 m**

This connection cable is made from high flexible RG174 coaxial cable and is terminated by a BNC Connector on each end. The length is 1 m and the flexible cable it is ideally suited for experimental purposes.

**29 CA-0510 Laser safety goggles 632 nm**

For working with the HeNe laser with higher output coupler the use of this safety goggle is recommended.

**30 CA-0600 Fibre inspection microscope**

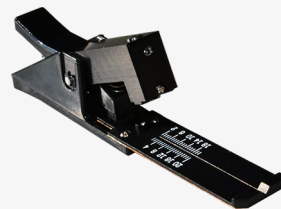
This hand-held microscope is designed for field use or lab inspection of optical fibre connectors. It has a 200 x precision optics and two interchangeable pre-centred universal adapter for 2.5 and 2 mm ferrules.



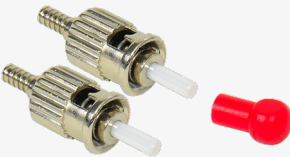


**31 CA-0610 Plastic fibre connector mounting set**

Before the plastic optical fibre can be terminated with a connector the protective cover has to be removed. This will be done with special stripping pliers. After that the fibre is inserted into the connector in such a way that the bare fibre stands out app. 2-5 mm from the ferrule. Subsequently the stand out bare fibre will be cut with the provided pliers and ground down with the polishing and grinding tool consisting of an acrylic base plate, fibre chuck and coarse and fine polishing films.

**32 CA-0620 Optical fibre scribe and breaker**

For professional cutting of optical fibre a cleaver is required to provide perpendicular cuts. Furthermore the surface quality of the cut fibre must be perfect especially when a high light coupling efficiency is of interest. The plastic cladding is removed by the Miller's pliers and the bare fibre is clamped into the holding mechanism of the cleaver. Bending the fibre and pushing down the lever with the ceramic blade scribes and breaks the fibre.



33	<p>CA-0625 Fibre scriber, tungsten carbide</p> <p>A sharp tungsten knife is fixed to a pen and is especially used to scribe the protruding part of the fibre in a connector. Pulling the scribed fibre makes it breaking and the polishing of the fibre can take place.</p>	
34	<p>CA-0630 Adjustable plastic cover stripper</p> <p>This tool is called Miller's pliers and is used to safely remove the plastic cover of an optical glass fibre.</p>	
35	<p>CA-0640 One step polishing film 2 µm, set of 50</p> <p>This polishing film allows the polishing in one step. That means no other films with other graininess are required. The round shape makes it more convenient to perform the polishing in a 8 shape.</p>	
36	<p>CA-0672 ST - connector multimode, Set of 60</p> <p>A set of 60 ST multimode connectors is used as training samples for connecting optical glass fibres to connectors.</p>	
37	<p>CA-0710 Two part anaerobic epoxy for 150 connectors</p> <p>There are many ways to bond the optical fibre to its connector. A fast method is to use this two part anaerobic epoxy. The ferrule is filled with the epoxy by using a syringe, before the fibre is inserted into the ferrule it is dipped into the bond activator. It hardens almost immediately and the fibre can be processed further.</p>	
38	<p>CA-0726 Acrylic plate 230 x 140 x 3 mm</p> <p>For the polishing process a flat surface is required. The polishing media is stuck to the plate by some drops of isopropyl alcohol.</p>	
39	<p>CA-0728 Fiber Optic Polishing Disc for ST, SC, FC</p> <p>To ensure a perfect perpendicular polishing the fibre ferrule is placed into the polishing disk.</p>	
40	<p>CA-0730 Cleaning wipes dry - 280 wipes per box</p> <p>After polishing the optical fibre, remaining particles needs to be removed with this cleaning wipe wetted with isopropyl alcohol.</p>	
41	<p>CA-0732 Dispenser bottle. Isopropyl alcohol</p> <p>After polishing the optical fibre, remaining particles needs to be removed with a cleaning wipe wetted with this alcohol.</p>	
42	<p>CA-0740 Epoxy Syringe</p> <p>The syringe is filled with the epoxy for the bond of the fibre to the ferrule. The hollow needle is attached and the epoxy is pressed into the ferrule.</p>	

43 CA-0742 Fibre splint tweezers

The processing of optical fibres always leaves broken fibre parts behind. The are of potential danger to accidentally intrude the human body. Therefore all those splints must be safely collected in a closable can. These tweezers help to collect the splints and put it into the trash can.

**44 CA-0744 Fibre optic scrap trash can**

The processing of optical fibres always leaves broken fibre parts behind. The are of potential danger to accidentally intrude the human body. Therefore all those splints must be safely collected in a closable can.

**XT - Extensions**

1

LE-0350 HeNe Fabry Perot Mode Analyser consisting of:

Item	Code	Qty.	Description	Details page
1	DC-0070	1	Piezo controller 0-150V	59 (10)
2	DC-0120	1	Si-PIN Photodetector, BPX61 with connection leads	60 (15)
3	DC-0380	1	Photodetector Junction Box ZB1	62 (31)
4	MM-0020	1	Mounting plate C25 on carrier MG20	30 (9)
5	MM-0460	1	Kinematic mirror mount M16, left	34 (30)
6	MM-0500	1	Piezo transducer 10 μ /150V in kinematic mount	34 (36)
7	OC-1010	1	Laser mirror M22, ROC 100 mm, T 4% @ 532 & 632 nm	41 (59)
8	OC-1012	1	Laser mirror M12, ROC 100 mm, T 4% @ 532 & 632 nm	41 (59)
9	UM-LM03	1	Manual Fabry Perot Resonator	

2

LE-0620 Concentric Cavity Extension consisting of:

Item	Code	Qty.	Description	Details page
1	OC-0068	1	Biconvex lens f=60 mm in C25 extended	36 (6)
2	OC-1074	1	Laser mirror 1/2" in 1" mount ROC100 HR@1064 nm	42 (66)
3	OM-0680	1	Nd:YAG rod in 5 axes mount on carrier 20	52 (35)

3

LE-0810 Passive Q-Switch Extension consisting of:

Item	Code	Qty.	Description	Details page
1	OM-0660	1	Cr:YAG passive q-switch, 5 axis mount on MG20	52 (35)

4

LE-0820 Active Q-switch Extension consisting of:

Item	Code	Qty.	Description	Details page
1	CA-0005	1	Allan key SW 0.9	63 (1)
2	DC-0356	1	Pockels Cell HV Driver DQ21, HV and Trigger Cable	62 (29)
3	OM-0030	1	Lithium Niobate Pockels Celle C-1043	47 (4)

5

LE-1020 SHG 640 to 320 nm (UV) extension consisting of:

Item	Code	Qty.	Description	Details page
1	DC-0170	1	UV Photodetector with connection leads	61 (20)
2	OC-0068	1	Biconvex lens f=60 mm in C25 extended	36 (6)
3	OC-0980	1	Filter UG11 in C25 mount	41 (56)
4	OC-1138	1	Laser mirror 1", ROC 100, HT 445 nm, HR 580-725 nm	44 (78)
5	OC-1154	1	Laser mirror M16, ROC 150, HR640/HT320	44 (79)
6	OM-0674	1	LBO crystal SHG 640 nm in 5 axis mount om MG20	53 (37)

6

LE-1030 Birefringent tuner extension consisting of:

Item	Code	Qty.	Description	Details page
1	OC-1136	1	Laser mirror M16, ROC 150, HT445, HR 580-725 nm	43 (77)
2	OM-0580	1	Birefringent Tuner	51 (27)

7

LE-1040 Littrow prism tuner extension consisting of:

Item	Code	Qty.	Description	Details page
1	MM-0020	1	Mounting plate C25 on carrier MG20	30 (1)
2	OC-0060	1	Biconvex lens f=60 mm in C25 mount	36 (5)
3	OM-0570	1	Littrow Prism Tuner	51 (26)

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