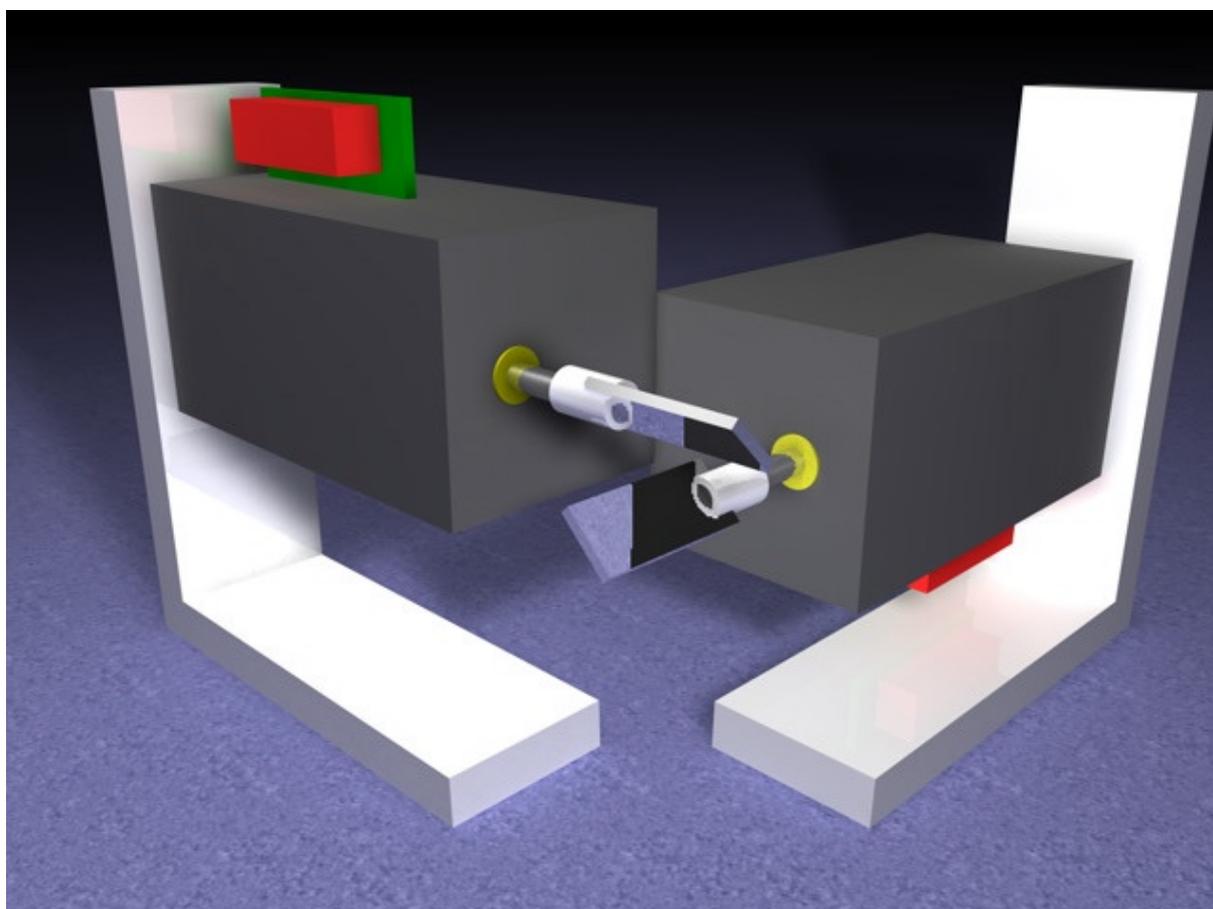


M9024 Galvanometer Scanner

Instruction Manual



Published by:
Mueller Elektronik, Hauptstrasse 86, D-78549 Spaichingen, Germany, www.jmlaser.com

Mueller Elektronik reserves the right not to be responsible for the correctness, completeness or quality of the information provided. Liability claims regarding damage caused by the use of any information provided, including any kind of information which is incomplete or incorrect, will therefore be rejected. Specifications are subject to change without notice.

Content on this manual, whether in part or full, may not be copied, reproduced or redistributed in any form without the authors agreement.

© 2003 Mueller Elektronik. All rights reserved.

Contents

Technical Data	Page 3
Operating Conditions	Page 4
Responsibility Lasersafety Delivery contents	Page 5
Handling instructions ESD-Precautions Mirrors Cleanliness	Page 6
Setting-up operation Installation Galvocable	Page 7
Mounting variants	Page 8
Mirror distance	Page 9
Replacing mirrors	Page 10
Basic position of the mirrors Effects of disturbance Overload Position drift	Page 12
Driverboard Setting-up operation	Page 13
Signal inputs Grounding Adjustment controls	Page 14
Factory settings Setting up drivers	Page 15
Driverlayout	Page 17

Technical Data

Electrical

Coil resistance	0.8 Ohm
Inductivity (1KHz)	250 μ H
Peak current	2.5 A
Power supply driver	115V/230V selectable 30W
Signal inputs	X and Y symmetrical inputs max. 20V pp
Position feedback	100mV/degree optical angle

Optical

Steptime <8 deg. opt.	250 μ s
Steptime 40 deg. opt.	1.0 ms
Steptime 90 deg. opt.	1.6 ms
Steptime 180 deg. opt.	2.5 ms
Scanspeed ILDA	26K with mirror 5 x 10 mm 24K with mirror 5 x 12 mm
Pointing stability	<1mrad
Noise	<0.5mrad 0-10KHz
Mirror size L x B	5 x 10 mm (5 x 12 mm on request)
Mirror type	Floatglass dielectrical broadband coating
Reflection	>95% 400-700nm
Laserpower tested	10W Argon Ion Laser

Mechanical Galvo

Dimensions L x H x W	40 x 21 x 22 mm
Total lenght	68 mm
Recommended shaft dist.	5.5 mm min. between X and Y
Cable length	50 cm
Connector type	10 pin DSUB

Mechanical Driver

Dimensions L x H x W	220 x 83 x 40 mm
Galvo connector	10 pin DSUB
Signal connector	10 pin in line
Mains connector	3 pin screws

All specifications at 20°C ambient temperature after 5 minutes warm-up time.

Operation conditions

It is recommended to read this instruction manual completely before starting working with the scanners.

Warranty can be void due to mishandling.

The scanner should only be used under dry condition and 10°C to 35°C roomtemperature.

Technical specifications were measured under a room temperature of 20°C after a warmup-time of 5 minutes.

Using the scanners outdoor only is allowed under dry condition and allowed ambient temperature.

Driverelectronics must be cooled using a fan (CPU-cooler) when mounting the driver into a closed unit or using it at higher ambient temperature.

The mirrors or shafts of the galvos should be free movable and not touch each other. It should be taken into account that the mirrors and shaft are not exposed to any mechanical stress or force.

Do not heat the shaft over 80°C long-term.

Heating the mirror-mount for mirror replacement should not take more than 10 seconds.

Cleaning mirrors should be done without strong forces affecting mirrors or shafts.

When shaft movement is blocked, overheating can occur, which can cause failure or irreparable damage.

The scanner should not be driven beyond specified limits.

The user has to make shure that the system or device, where this scanner is installed, meets the local standards of electromagnetic emission.

Responsibility

The manufacturer excludes liability in case of the following damages, unless it is verifiable that damage existed when the product left factory.

Also any liability claims regarding damage caused by the use of this product will be rejected.

- Damage as a result using the product beyond recommended operation conditions.
- Damaged mirrors or loose mirrors and mirror-mounts.
- Damage to scanners or drivers caused by overheating.
- Damage caused by dust and corrosion.
- Damage to shafts and magnetic components caused by overheating the shaft.
- Damage caused by faulty driver adjustment or input signals and power supply beyond specified limits.

Lasersafety

The user has to make shure that the system, where this product is installed, meets the local laser safety regulations.

The manufacturer recommends the use of additional safety circuits for monitoring the safety of the system.

NOTICE!

It should be taken into account, that the scanner mirrors have no default position when driver power is off. In this case, laser radiation can be deflected in any direction. The user has to make shure, that such deflection when changing between power off and power-on can not point to a person's eye by accident.

This is also an important point to keep in mind, when working on the laser system for maintenance or adjustments.

Delivery contents

The complete X/Y-set includes:

- Driver board for 2 scanners with integrated power supply for 115V or 230V line voltage.
- 2 Galvos with fixing bracket, screws and a galvocable 50cm long. Each galvo is supplied with 5 x 10 mm mirrors.
- Drivers are preadjusted but finetuning must be done by the user.
- This instruction manual

Handling instructions

Handle with care when unpacking components!

Surface mirrors are very sensitive. Do not touch mirrors when taking the galvos out of the package.

Before switching-on the scanners, the user has to make shure, that shaft or mirror can be moved free and is not blocked.

When driving the scanners with blocked shafts, maximum current flows and will cause overheating on galvos and drivers.

When using the scanner for the first time, check that shafts are not blocked by slightly turning the mirror.

Blocked shafts can be made moveable by slightly pushing and pulling the shaft in axial direction.

This check only is necessary when using the scanner for the first time or after manipulation at the scanner shaft or mirror (replacing mirror or mirror-cleaning).

During normal operation, also after power off and power-on, the shafts are automatically centered to initial position.

ESD-Precautions

Parts of scanners and drivers are very sensitive against electrostatic discharge ESD.

Mirrors

Do not touch the surface of the mirrors with fingers or tools.

Coatings of mirrors are very sensitive.

Mirror cleaning

The manufacturer does not recommend mirror cleaning and will not be obligated to replace scratched or broken mirrors free of charge.

If it is not avoidable to clean the surface of the mirrors, the user should proceed under the following instructions:

Dust particles can be blown away using compressed air.

Other dirt can be removed using acetone or alcohol and a cotton swab (Q-Tip) or lens cleaning paper.

Wet a cotton swab or piece of lens cleaning paper with a generous amount of reagent grade acetone and make a single swipe across the mirror surface, starting from the side of the mirror mount. Repeat using a clean swab each time until you achieve best result.

Do not soak mirror with acetone.

Do not put too much pressure on the mirror.

Caution: Make shure that no solvent or acetone wets the galvo bearings!

Cleanliness

These scanners are sensitive optical and mechanical devices.

When handling galvos and running the scanners, precaution should be taken, that no dirt, dust and other contaminants get into the shaft bearings.

Sand or metal chipping in the bearings can cause total failure of the scanner.

Bearings are oiled by the manufacturer and are normally maintenance-free.

Setting-up operation

Galvo assembly (Fig. 1)

1. Fixing bracker
2. PCB
3. Galvocable
4. Connector
5. Lasermirror
6. Mirrormount
7. Shaft
8. Bearing

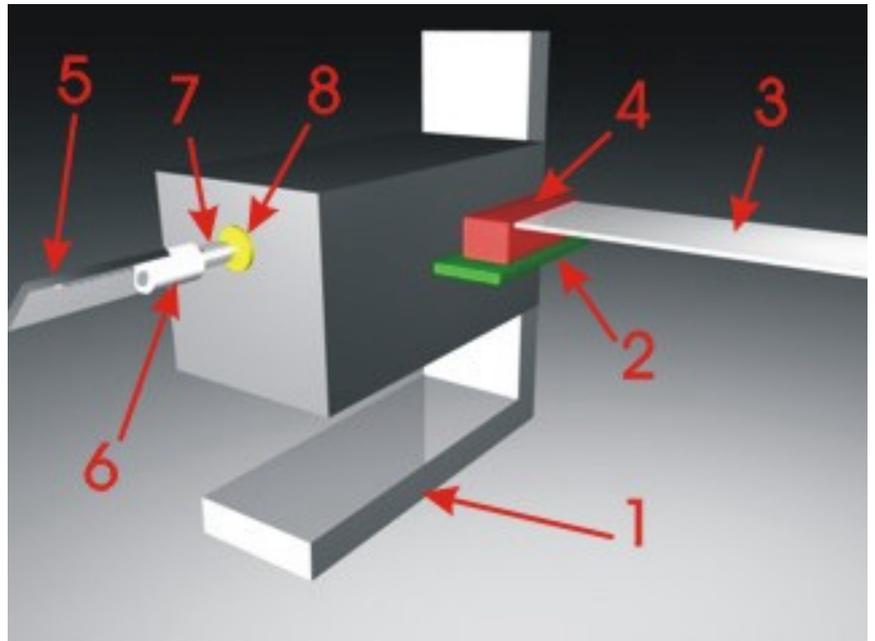


Fig. 1

Installation

Fixing brackets are provided with a slotted hole at the bottom side to use M5-screws on optical tables. Hexagon screws should be used to attach the bracket to the groundplate. The galvo will be attached to the bracket using the threaded bolt and the wingscrew. The fiber washer should be placed between bracket and wingscrew. The rotating axis of the bolt is equivalent to the rotating axis of the lasermirror.

Galvocable

The connector is inserted in that way, the cable is pointing away from the galvo. (Fig. 2)

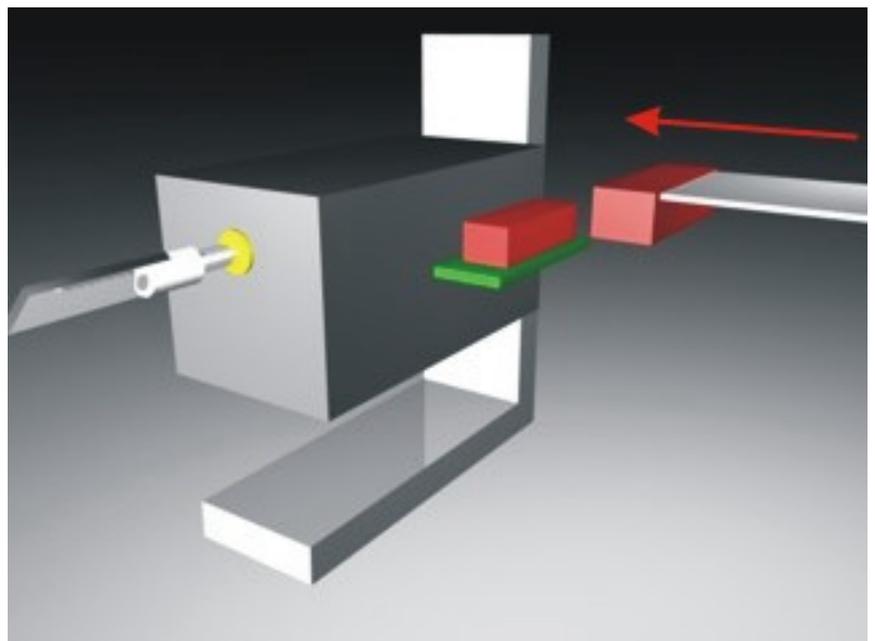


Fig. 2

When the mirror does not move to the center position after power-on, immediately switch off the scanner!

Mounting variants

There are several possible variants of arranging the scanners.

When the maximum scanangle should be used, there must be paid attention, that no parts of the galvo will block the outgoing laserbeam.

The best solution in that case is to deflect the beam first using the upper galvo (Fig. 4).

Fig. 3 shows a well-established arrangement where the beam first hits the lower mirror.

It is possible that parts of the upper galvo will cover the output beam at large scanangles.

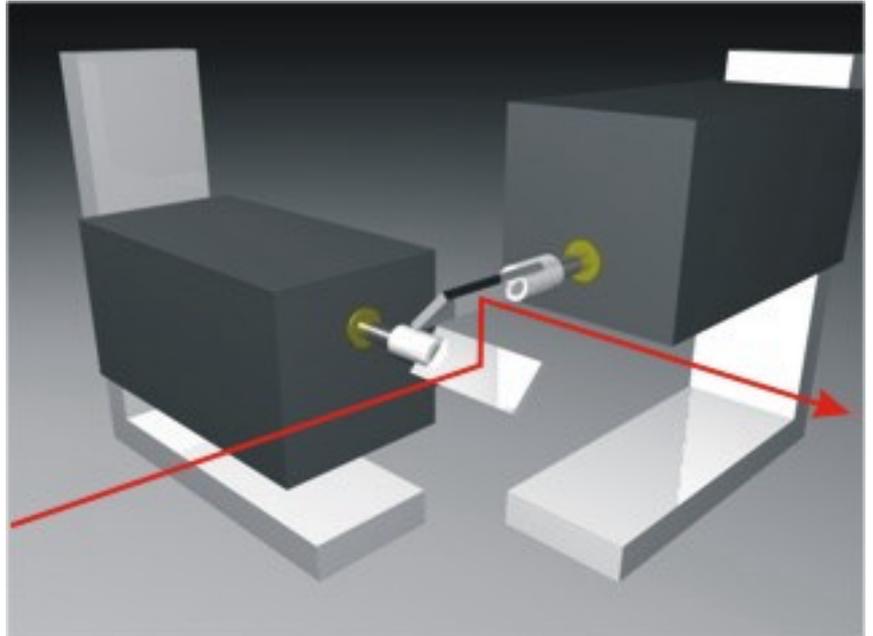


Fig. 3

Fig. 4 shows a better variant, where the beam first hits the upper mirror.

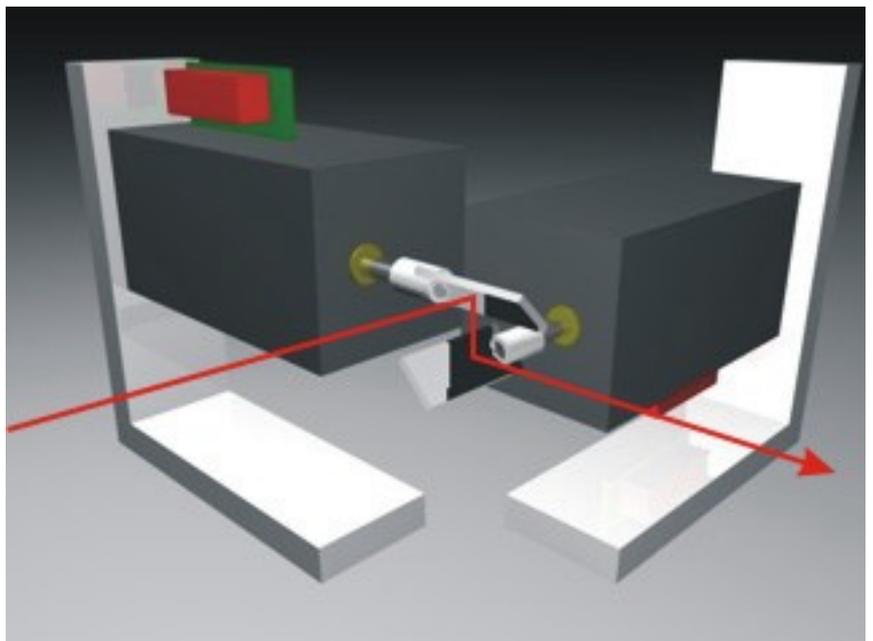


Fig. 4

Mirror distance

To achieve the maximum deflection angle, the 2 mirrors have to be arranged against each other as close as possible. Care should be taken, that the mirrors can not touch each other. Because mirrors can turn into positions beyond scan area at power-off, make sure, that there is enough distance between the mirrors when turned to perpendicular positions. (Fig. 5).

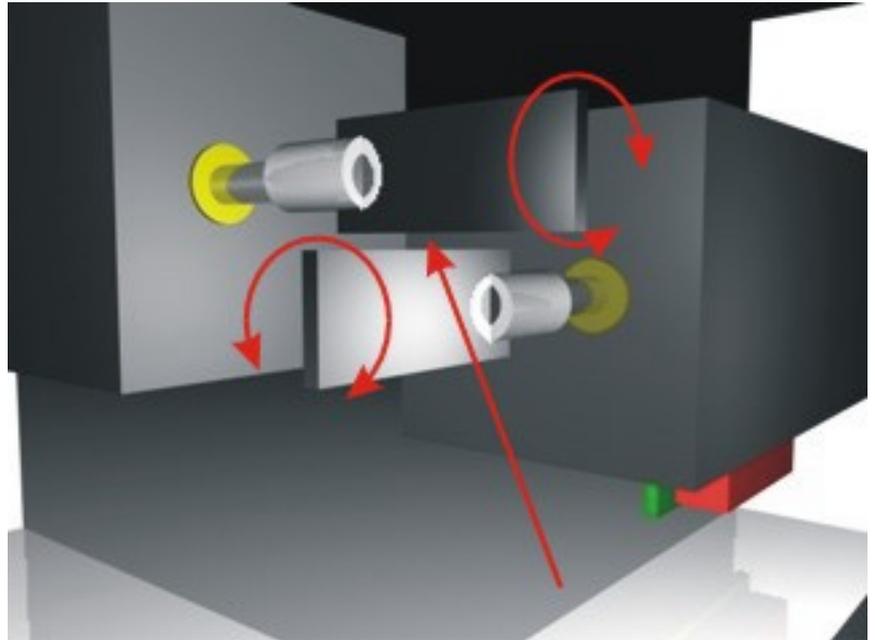


Fig. 5

When using standard mirrors, a gap of 0.5 millimeters minimum should be observed between the mirrors (Fig. 6).

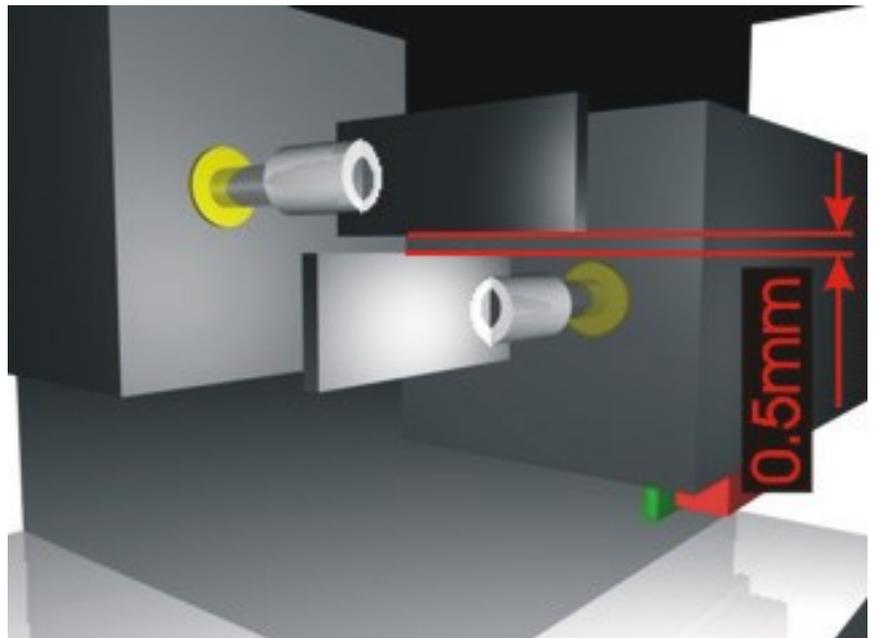


Fig. 6

Replacing mirrors

If it is necessary to replace a mirror, always the complete assembly of mirror and mirror mount should be replaced. The following work should only be done by qualified personnel.

Improper handling can cause irreparable damage on the galvo.

The manufacturer excludes liability in case of damage, caused by manipulations for mirror-replacement.

At first, the old mirror mount has to be removed. Therefore, the bonding surface at the rear side of the mirror mount must be heated. Use a soldering iron. Switch off the scanners!

The soldering tip at a temperature of around 200°C must be placed at the rear edge of the mirror mount in such a way, that it touches both mirror mount and shaft.

While heating, push the mirror holder with the soldering iron in front direction (Fig.7).

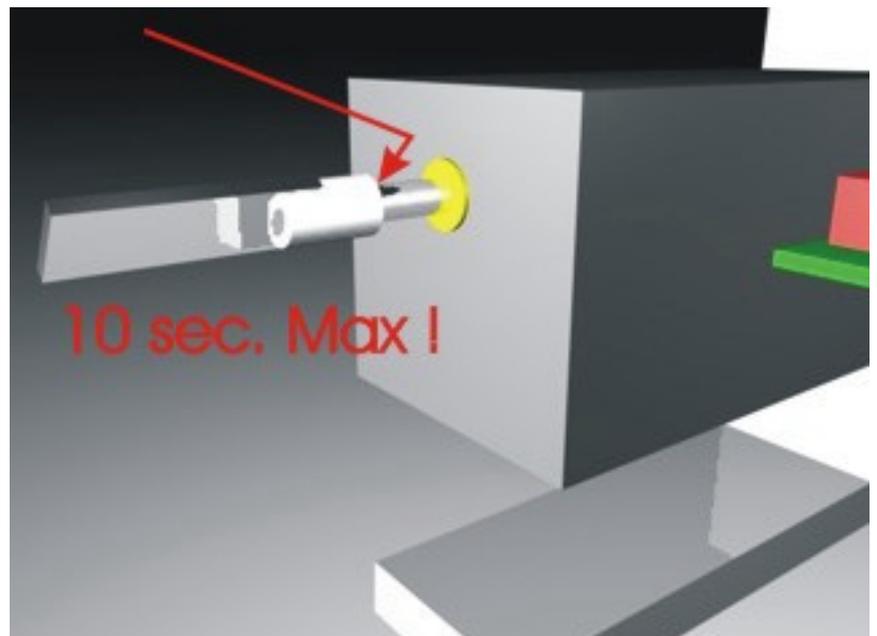


Fig. 7

Normally, the mirror mount can be stripped off the shaft after a few seconds (Fig 8).

Important: Do not heat the shaft more than 10 seconds, otherwise the galvo can be damaged.

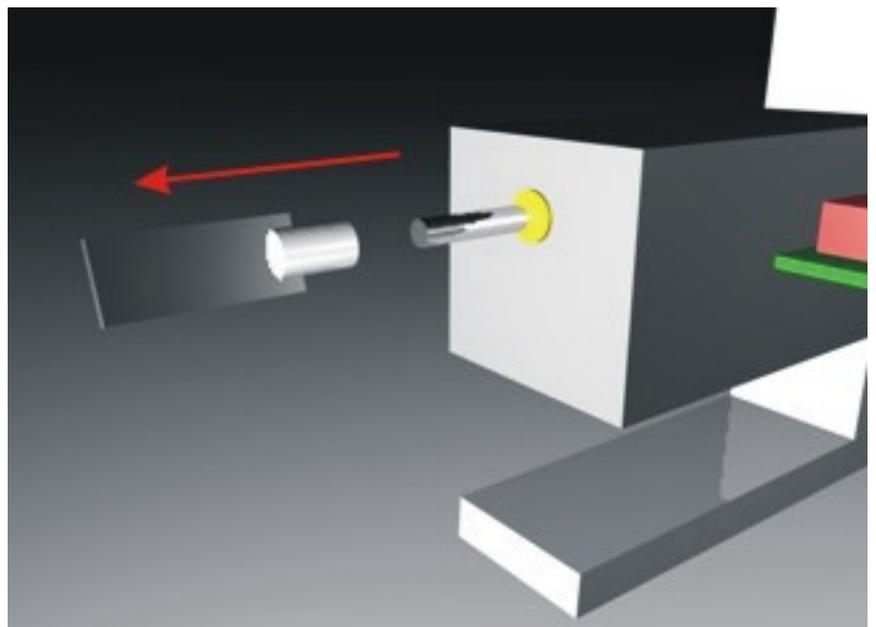


Fig. 8

Adhesive parts, remaining on the shaft, can be abraded using a knife or scalpel. Always rasp from the rear side to the front end of the shaft, so no dust contaminates the bearing.

Do not use any additional abrasives!

The shaft then must be cleaned using a tissue wetted with acetone or alcohol.

Do not soak the bearing with solvent!

Now the new mirrmount should be stuck to the shaft.

The mirrmount should be free movable on the shaft, otherwise old adhesive or dirt remains on the shaft. Also the shaft should be free movable in the bearing.

The scanner now has to be powered-on. Input a zero input signal to the driver.

The shaft will move to its center position.

The mirrmount now has to be turned on the shaft until the mirror surface points to the center position (normally 45° to the groundplane, Fig. 9).

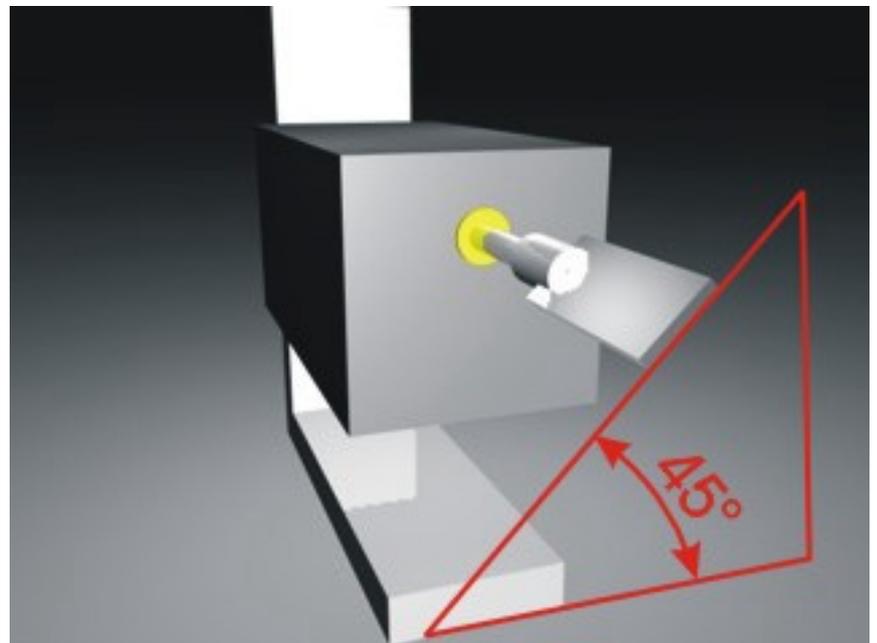


Fig. 9

Now put a small amount of adhesive (superglue) at the rear edge of the mirrmount using a piece of thin wire or a needle.

Make sure, that the adhesive covers the edge of the mirrmount all around the shaft.

Only use as much adhesive as necessary!

It must be strictly avoided to put any adhesive to the bearing.

In this case, the galvo would be irreparable damaged!

Wait at least 15 minutes before operating the galvo again.

Basic position of the mirrors

This galvanometer scanner is not supplied with mechanical stoppers at the rotor-shaft.

During power-on, the shaft automatically moves to the basic position.

When switching the power off, the shaft will take a position, which will ensure a correct initial position at later power-on.

In case of overdriving or misadjustment of the driver settings, or after manipulations at the mirror, the center position could be changed, so the mirror points to the wrong direction.

This problem should be eliminated after switching-off and power on the driver again.

When the mirror will not move to the initial position after power on, switch-off and try to find out the problem.

Effects of disturbance

The magnetic position sensing system must not be exposed to strong magnetic fields.

Do not install the galvos close to strong transformers or motors, otherwise interferences can cause waves or distortions of the scanned laser projection.

When there is not enough space between galvos and other magnetic sources, a shield made of iron (no stainless steel!) should be mounted between scanners and a source of disturbance.

The used material should be tested for magnetic conduction using a permanent magnet.

The shield does not need to be an electric conductor.

Overload

Normally, the galvos only produce less heat and don't need separate cooling.

When overdrive the scanners beyond specified limits, the coil temperature can rise rapidly.

The scanners should not be driven beyond limits over longer time.

Also the driver can overheat when overdrive the scanners.

The temperature of the coil should never exceed 80°C (= max. 50°C galvo housing) and the temperature of the driver-heatsink should never exceed 70°C.

Position drift

The position sensor of the galvos drifts slightly when temperature changes strongly.

To achieve maximum pointing stability, the scanner should only be used after a warm-up time.

When targetting at effect-mirrors with laser beams, the scanners should warm-up 10 minutes before scanning any beam position.

The scanners should be powered up using a zero input signal while the laser is blanked.

Also the warm-up procedure should be done before adjusting any driver settings or programming any beam positions for a show.

When using cold scanners for beam programming, scanned positions after warm-up may differ from the programmed positions.

Driverboard (Fig. 10)

Setting-up operation

Make sure that the line voltage selector is in the correct position (115/230V) before connecting the driver to mains voltage.

Make sure that the input signals are connected correctly.

Only inputs XIN+, XIN-, YIN+ and YIN- should be used!

Maximum signal amplitude per input is +10 Volts (20Vpp).

Never connect a signal to the outputs XBACK and YBACK. This can cause damage!

These outputs are feedback position signals and are only used for external safety circuits (scanner-safety).

Also the pins for +12V and -12V are only for special use and should not be used to power separate circuits.

Do not adjust the potentiometers at first!

Install the galvos correctly and make shure that the mirros cannot touch each other.

For power-up, first use a zero input signal (center position) or start with a frame with low scanspeed and small scanangle.

When the projection is side-inverted, the jumpers POLARITY can be changed by setting both jumpers in a 90 degree-positon across the two pins (Fig. 10).

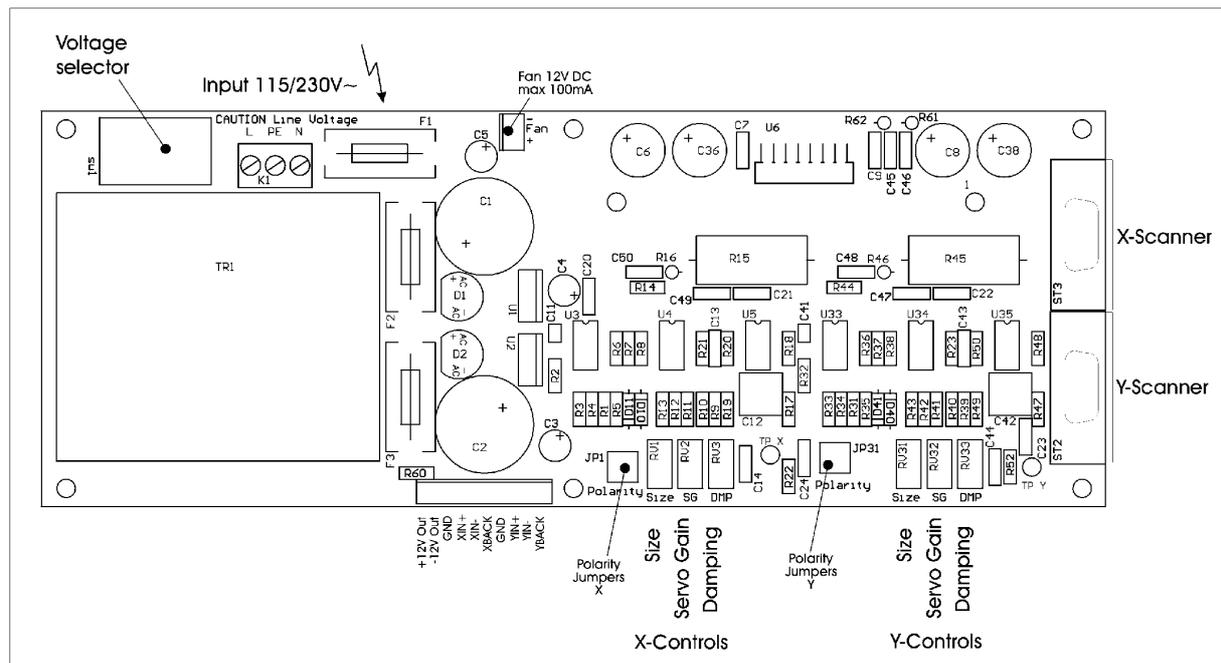


Fig.10

The driverboard develops considerable heat, when in operation.

When installed inside a closed housing, the driver has to be cooled by a fan (CPU-cooler). A cooler 40 x 40 or 50 x 50 millimeters and 12 Volts can be used.

There are 2 pins located at the driverboard, which can be used to connect a cooler.

Current may not exceed 100mA. A special filter circuit eliminates disturbances resulted from the motor commutation of the cooler. Make sure that the polarity is right!

Sufficient cooling will ensure reliable operation and increase performance of the scanners.

Symmetrical inputs

When the lasercontroller uses symmetrical or differential outputs as described in the ILDA standards, the signals X+, X-, Y+ und Y- can directly connected to the corresponding inputs XIN+, XIN-, YIN+ und YIN- located at the 10 pin connector.

A connection of ground GND is not necessary.

Single ended inputs

When the lasercontroller uses just one wire per axis and ground GND, the signals for X and Y must be wired to the inputs XIN+ and YIN+.

Inputs XIN- and YIN- must be connected to signal ground.

Also the ground pin GND has to be connected with the signal ground.

When using the negative inputs XIN- and YIN- instead of the positive ones, the image will be inverted.

Grounding

The driver must be grounded.

The ground wire of the line voltage (PE) must be connected to the driver.

Ground is internally connected to GND. Also the mounting holes of the driverboard are connected to ground.

The housings of the galvos are also connected to ground, using the galvocable.

Improper grounding of power and signals can result in distortion of the scanned projection.

Adjustment controls

All potentiometers act in that way, that turning clockwise will increase function:

Larger size, higher servogain and stronger damping.

Adjustments must be done by qualified personnel only by using suitable test patterns like the ILDA testframe.

The manufacturer assumes no liability for any damage or malfunction caused by bad adjustment.

P1 Size

This potentiometer is for adjusting the scan angle. The factory settings are approximately 45° optical angle at +-5V input signal.

The maximum scan angle of 180° optical should never be exceeded!

P2 Servo-Gain

Here, the accuracy of the scanner is adjusted. Adjusting this potentiometer clockwise will increase speed of the scanners and may produce overshoots in projection.

Servo gain should only be adjusted in combination with damping.

P3 Damping

Damping reduces overshoot of the galvos. Too much damping can result in ringing or oscillations of the galvo.

Factory settings

All scanners are preadjusted to allow starting-up running the scanners without previous adjustments. Fine adjustments can be necessary to create maximum performance of the scanners.

Setting up completely deadjusted drivers

When a driver is completely bad adjusted, the scanners can oscillate after power on.

Switch-off the driver immediately!

Adjust P1 size and P2 servo gain counterclockwise, until the endposition of the potentiometer is reached (hearable 'clicks').

Apply a zero input signal to the driver inputs.

Switch on the driver.

When a frequency or oscillation is hearable, turn P3 damping counterclockwise, until the frequency disappears.

Use a simple testframe as input, for example a square with slow speed (10Kpps).

Increase the size slightly by turning P1 size clockwise.

Do not adjust to maximum scan size!

Increase servo gain by turning P2 clockwise. Make sure that overshoots do not exceed maximum scan angle.

Reduce overshoots by truning P3 damping clockwise.

Repeat increasing servo gain and damping until the image looks best.

Adjust P1 size at maximum input signal to desired image size.

Use a standard test image (ILDA testframe) for fine adjustments.

Driver connections

- 1 +12V output (Do not use!)
- 2 -12V output (Do not use!)
- 3 GND signal ground (for single ended signal)
- 4 XIN+ input X-axis +
- 5 XIN- input X-axis -
- 6 XBACK output feedback positon X-axis for scanner –safety
- 7 GND signal ground (for single ended signal)
- 8 YIN+ input Y-axis +
- 9 YIN- input Y-axis -
- 10 YBACK output feedback positon Y-axis for scanner -safety

