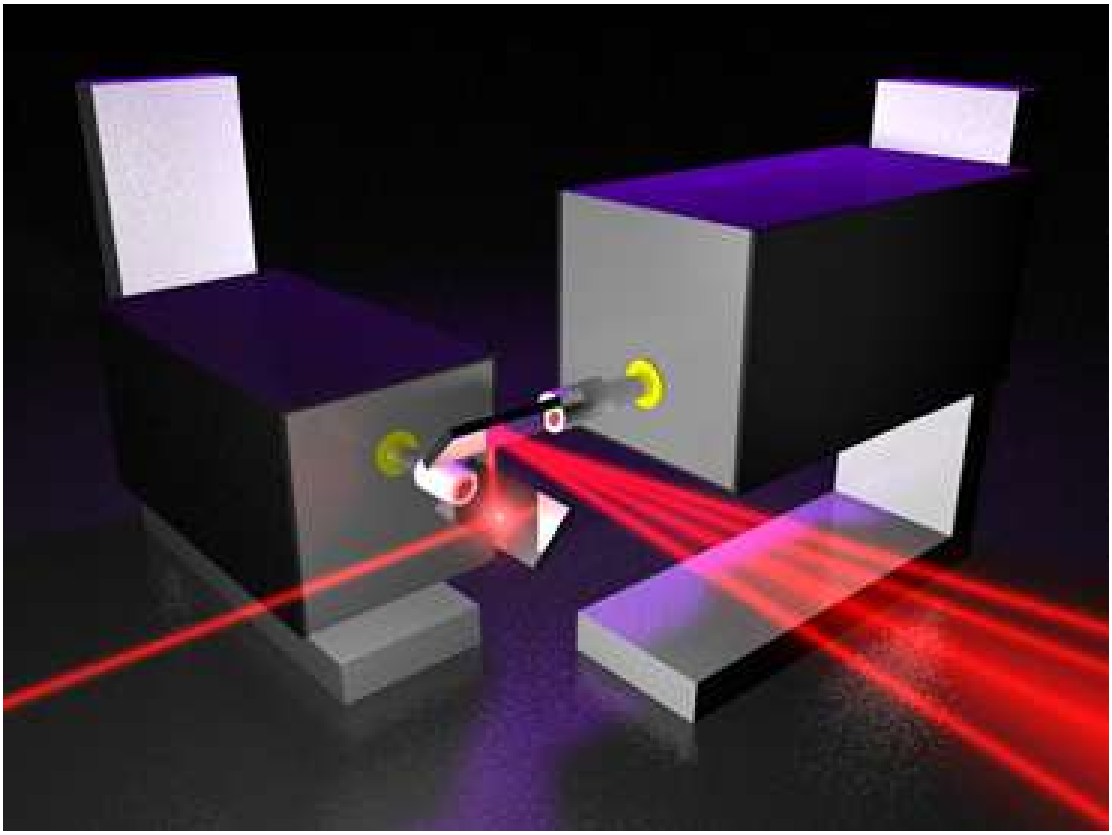
M6008 Low Cost Scanner

Users Manual



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Contents

Technical Data	Page 3
Operating Conditions Responsibility	Page 4
Lasersafety Delivery contents	Page 5
Handling instructions ESD-Precautions Mirrors Cleanliness	Page 6
Setting-up operation Installation Galvocable	Page 7
Scanner arrangement	Page 8
Mirror distance	Page 9
Replacing mirrors	Page 10
Auto Zero Position Scan Failure Protection SFP	Page 12
Connecting SFP Setting up SFP Deactivating SFP	Page 13
Effects of disturbance Overload Position drift Hysteresis	Page 14
Driver Board Layout	Page 15
Driverboard Setting-up operation Symmetrical inputs Single ended inputs Grounding	Page 16
Adjustment controls Size Gain Damping Factory settings Setting up deadjusted drivers	Page 17

Technical Data

Electrical

Max. current / scanner	0.15 A
Powersupply	+-12V DC (+-5%)
Max. current	+-300mA
Signal inputs driver	symmetrical 10Vpp, single ended +-10V

Optical

Max. scan angle opt.	60 degrees
Steptime <8 Grad opt.	<1.0 ms
Steptime 60 Grad opt.	<4.0 ms
Mirror dimensions L x W	5 x 10 mm
Mirror material	Floatglass Aluminium coated
Reflection	>85% 400-700nm

Mechanical Scanner

Dimensions L x H x W	45 x 26 x 27 mm
Total length w. mirrors	70 mm
Recomm. shaft distance	5.5 mm min. between X and Y
Scannercable length	50 cm
Connector type	10 pin

Mechanical driver

Dimensions L x W x H	92 x 78 x 20 mm
Connector type scanners	10 pin IDC
Connector type inputs	10 pin single row header

Scan Failure Protection

Samplingrate	>3 KHz
Response time	25 ms
Switching delay	<100 µs
Turn-off time min.	250 ms
Treshold range	0 – 20 degrees opt. movement during 25 ms
Output	Optocoupler (max. 100mA)

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 alllowed 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.

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 for dual +/-12V regulated powersupply
- 2 Galvos with fixing bracket, screws and a galvocable 50cm long.
  Each galvo is supplied with 5 x 10 mm mirrors.
- Drivers are preadjusted
- This instruction manual

Handling instuctions

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.

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 assemby (Fig. 1)

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

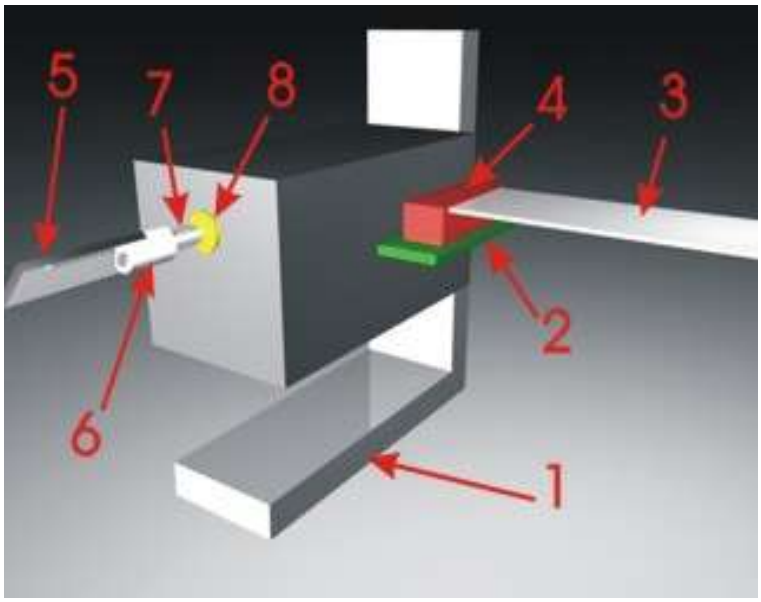


Fig. 1

Installation

Fixing brackets are provided with a slotted hole at the bottom side to use M5-screws on optical tables. Hexagon srews 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)

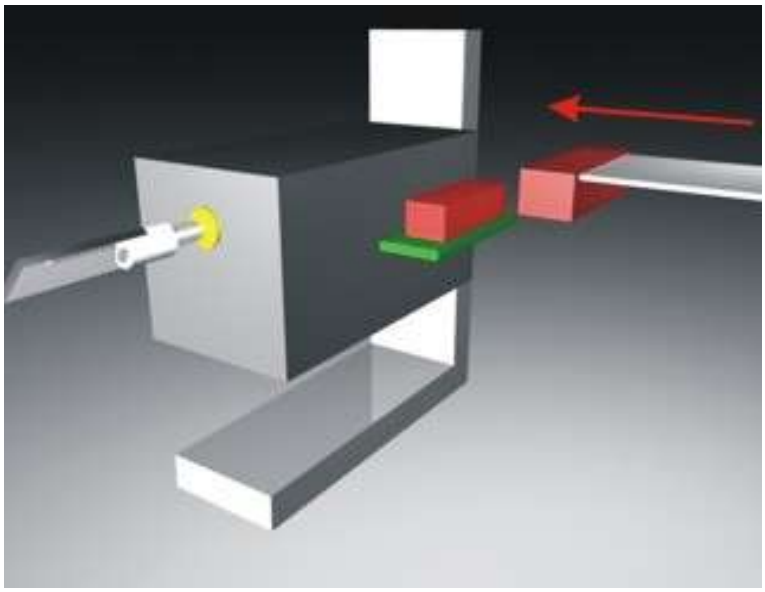


Fig. 2

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

Scanner arrangement

The 2 scanners should be arranged in such way, that the laserbeam first hits the lower mirror (X) and then is deflected to the upper mirror (Y).
Other arrangements are possible, but can be difficult because of the size of the scanners.

Figure 3 shows the arrangement of the scanners.

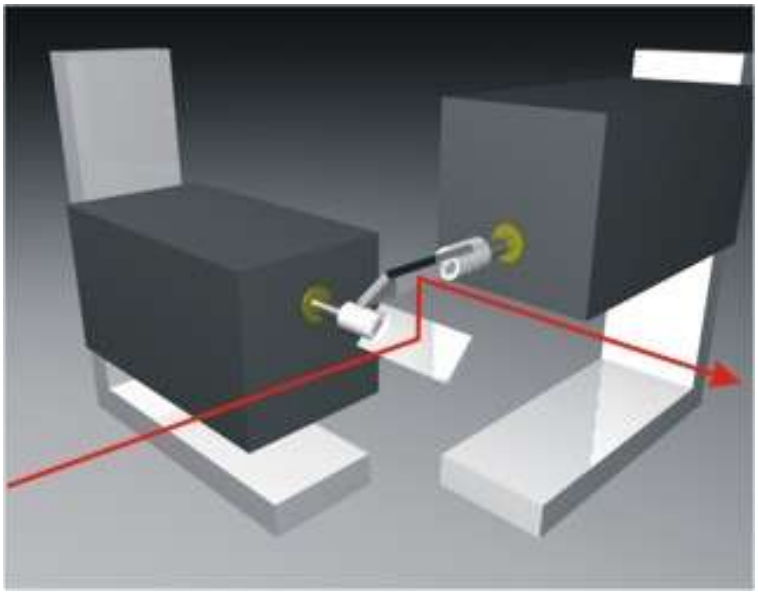


Fig. 3

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).

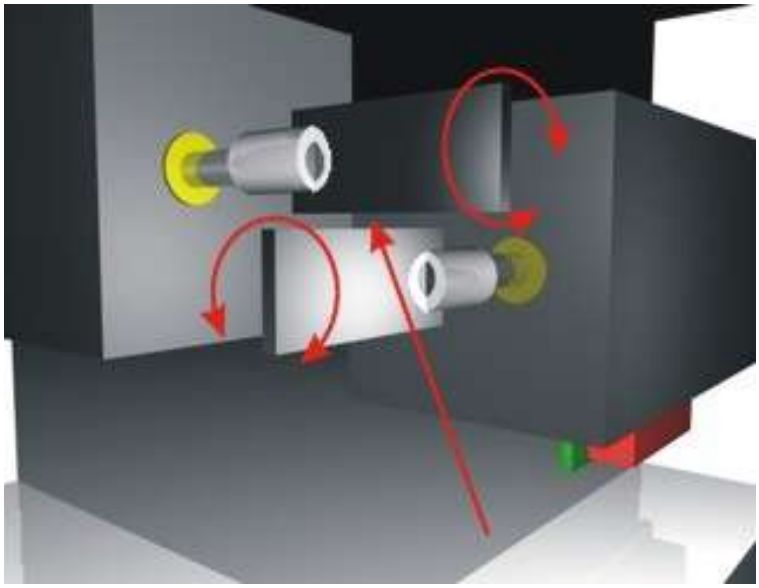


Fig. 5

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

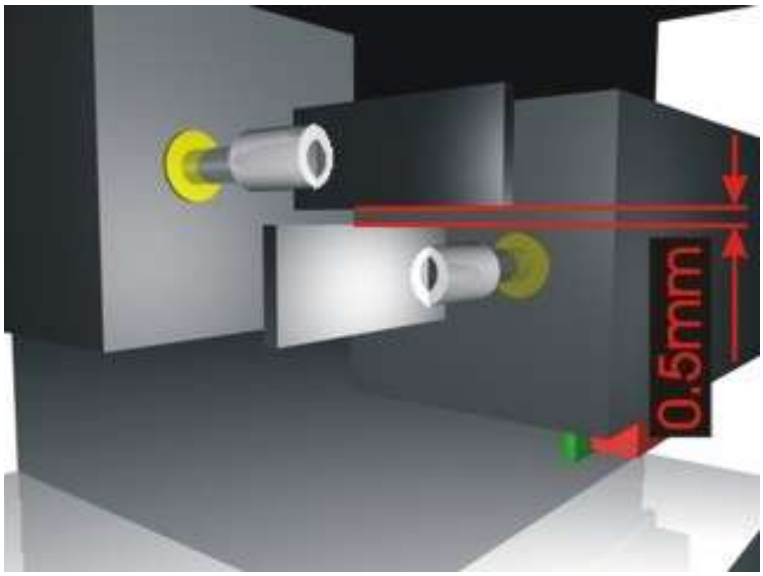


Fig. 6

Replacing mirrors

If it is necessary to replace a mirror, always the complete assembly of mirror and mirrormount 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 mirrormount has to be removed. Therefor, the bonding surface at the rear side of the mirrormount 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 mirrormount in such a way, that it touches both mirrormount and shaft.
While heating, push the mirrorholder with the soldering iron in front direction (Fig.7).

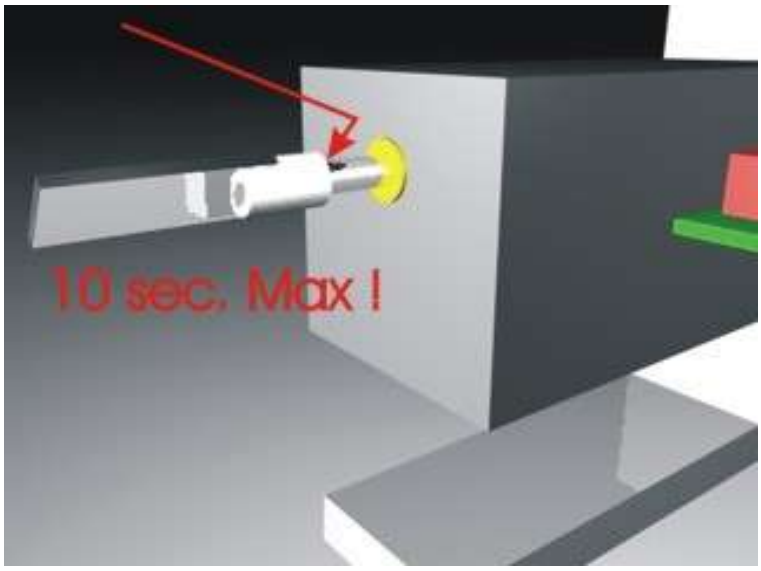


Fig. 7

Normally, the mirrormount 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.

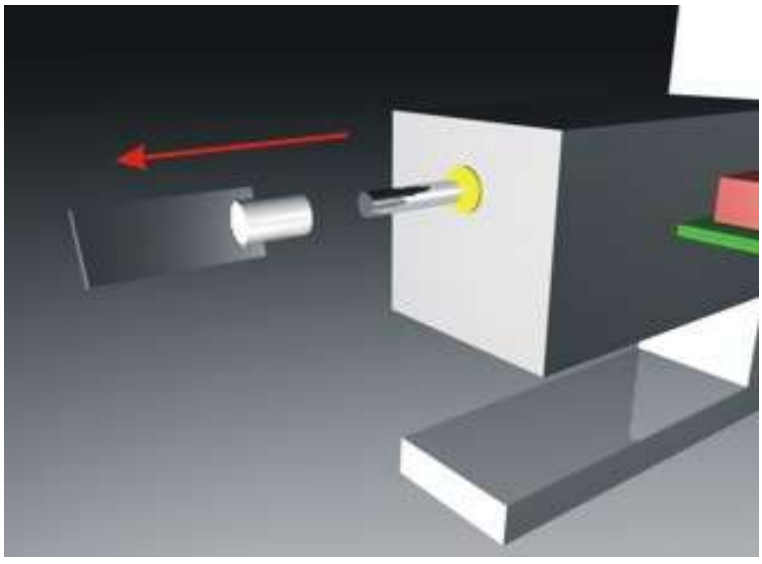


Fig. 8

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

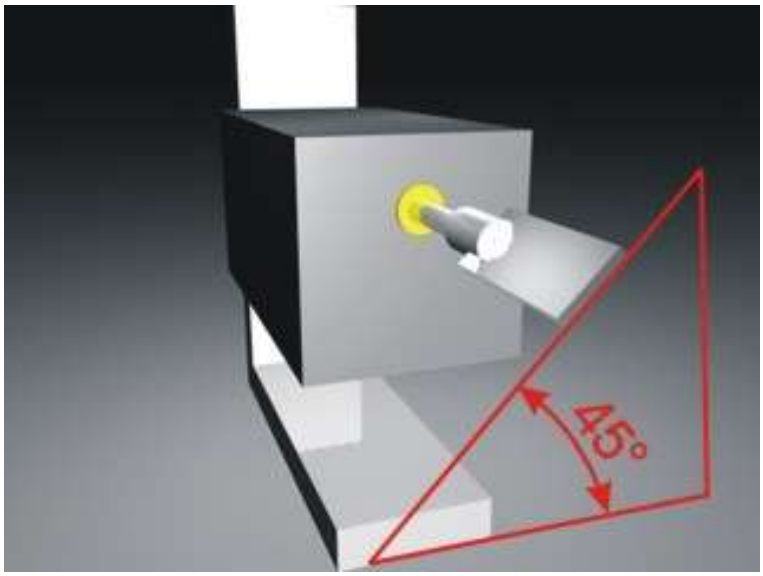


Fig. 9

Now put a small amount of adhesive (superglue) at the rear edge of the mirrormount using a piece of thin wire or a needle.
Make sure, that the adhesive covers the edge of the mirrormount 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.

Auto Zero Position

The Scanners are not supplied with a mechanical stopper for the rotor shafts.
The shaft moves to initial position automatically at power-on.
When moving to initial position (Auto Zero Position), the rotor can turn around 360 degrees, until it reaches center position.
Both scanners will move to initial shaft position **one after the other**, if necessary.
So, shaft position before power on is not important.
During AZP, input signals don't take effect.
Output of the safety circuit (Scan Failure Protection) is switched off during AZP-procedure to avoid emission of a laser, connected to the board.

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

Monitoring the scanangle during operation

During scanning operation, AZP-circuit controls the positions of the shafts being inside the allowed scanangle. If the rotor is outside the maximum scanangle, initialization starts automatically.

Make sure, that the maximum scanning movement of the mirrors is inside the maximum allowed scanangle of 60 degrees optical. Overshoots and positions outside this limit will cause initialization of the scanners. During AZP, the output of the Scan Failure Protection will be shut down, resulting in blackouts of the laserprojection.

Scan Failure Protection (SFP)

A complete saftey circuit is integrated on-board.
This Scan Failure Protection system monitors the movement of both scanners.
When movement is too slow or scanangle is too small (adjustable), an output (Blank Out) is disabled.

Function of SFP:
During a time window of 25 milliseconds, the rotors of the scanners have to move a defined angle. This ensures, that the exposure by the laser will not reach critical values in case of a standing beam.
The sensitivity of the SFP can be adjusted.

If there is not enough movement during the timeinterval of 25ms, the SFP shuts down the output for a time of 250ms minimum.

SFP will be triggered (output shut down) if

1. The scanned angle of **both** scanners is too small
2. The scanspeed of **both** scanners is too slow

Additional, signal inputs of the driver will be monitored to ensure safety in case of a defective position sensor of a scanner.

Connecting SFP

The signals 'Blank In' and 'Blank out' (see Fig. 10) of the driver have to be connected to the blanking signal, which comes from the lasercontroller and goes to the laser.
The blankingsignal of the lasercontroller (showcontroller) is connected to 'Blank In'.
The output 'Blank Out' has to be connected with the modulation input of the laser or AOM.
The maximum voltage if the blanking signal should be 12V, normally 5V.
No negative voltage is allowed!
Maximum current is 100mA.

When the lasercontroller or showcontroller does not have any blankingoutput, the input 'Blank In' of the driverboard has to be connected to 5V or 12V.
Otherwise, there will be no output signal at the output 'Blank Out'.

When connecting mechanical shutters to the board, the maximum current must not be higher than 100mA.

Setting up SFP

Sensitivity of the SFP is adjusted with the poti 'Safety Level' (Fig. 10).
The range (treshold level) of sensitivity is around 0-20 degrees optical scanangle.
This minimum angle has to be moved by the scanner during 25 milliseconds to avoid triggering the SFP and shut down the blanking line.
For adjusting the SFP, all signals including blanking must be connected.
The jumper 'Safety Off' must not be set in closed position!
Sensitivity of the SFP is decreased by turning Safety Level counterclockwise.
Turn Safety Level to the limit counterclockwise.
A testframe, for example a square or circle should be scanned.
Size should be set to the minimum allowed (safe) value and speed should be set to slowest allowed value, so the laser exposure will be safe.
Increase sensitivity by turning Safety Level clockwise, until laseremission is blanked.
There may be some pulsing laser emission at treshold position, but the minimum time for shutdown will be 250ms.
All frames or shows, scanned smaller or slower than the current settings used with the testframe, will be 'unsafe' and the laser will be blanked.

Deactivating SFP

SFP can be deactivated by setting a jumper 'Safety Off' (Fig.10) on the driverboard.
When this jumper is set to closed position **before switching-on the powersupply** for the driverboard, the SFP is deactivated.
Removing the jumper or set jumper to open position **before switching-on the powersupply** for the driverboard will activate SFP.
This function is only for tests done by qualified persons. Complete setup of the system can be tested and errors can be located without SFP interrupting the laser emission.

Warning: Deactivating SFP can cause serious danger! During normal operation, SFP should be activated all time. Unqualified personnel should not have any access to this function. Do NOT wire the jumper signals to an external switch!

Effects of disturbance

The magnetic position sensing system must not 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 an source of disturbance.
The used material should be testet 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 should never exceed 70°C.

Position drift

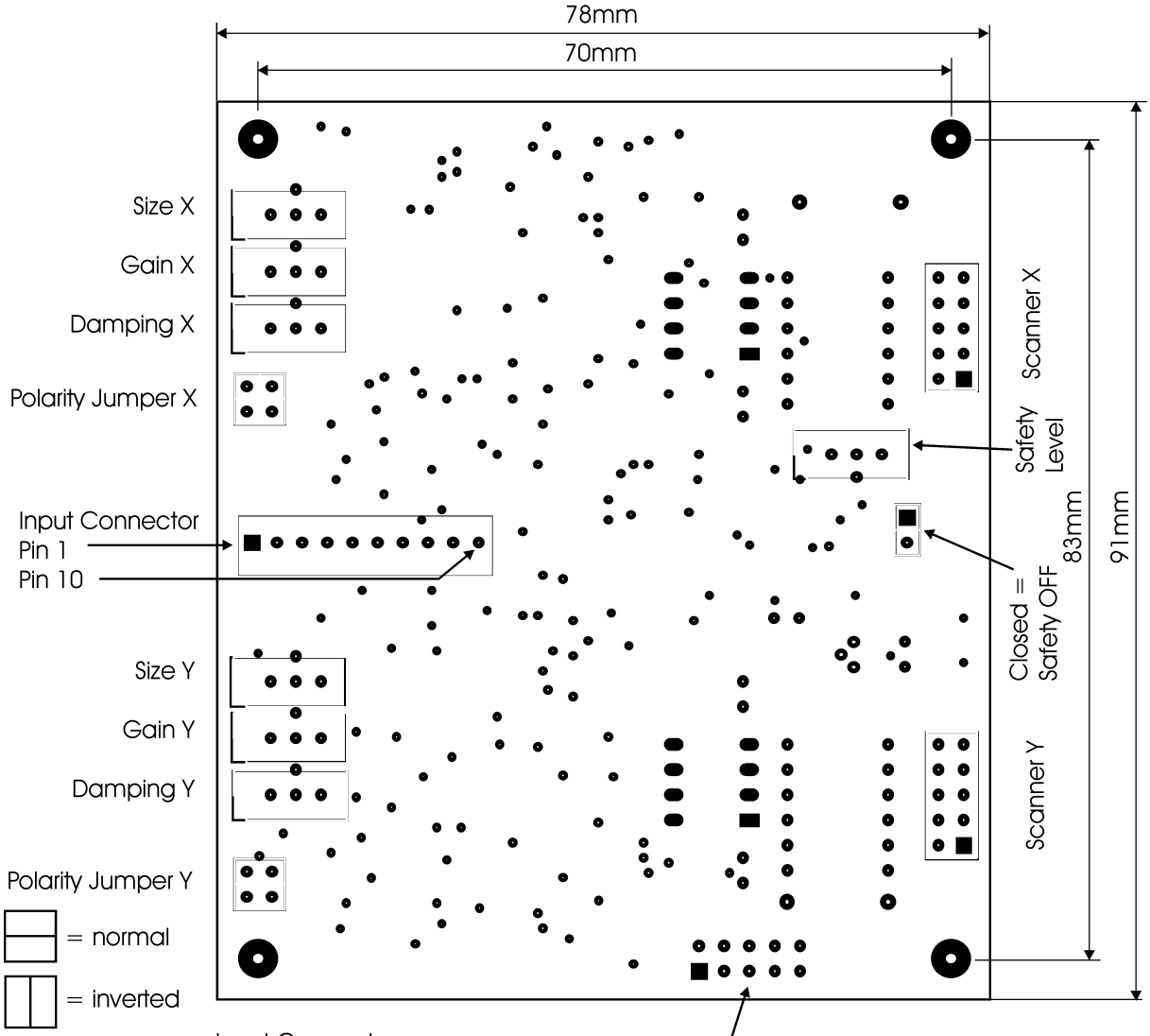
The position sensor of the galvos drifts slightly when temperature changes strong.
To achieve maximum pointing stability, the scanner should only be used after a warm-up time.
The scanners should be powered up using a zero input signal while the laser is blanked.
Also the warm-up procedure should be done before adjusting any driver settings or programming any positions for a show.

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

Hysteresis

The scanners have a high mechanical hysteresis.
When moving to the same position from 2 different startpoints, different endposition can be the result. The reason for this effect is a relatively high friciton of the bearings and the low torque of the scanners.
When keeping this effect in mind during show-programming, quality of show can be enhanced.
Friciton will cause small details and small scanangles not to be scanned correctly.
It is recommended to use a large scanangle. A range for good-quality scanning is between 20 and 40 degrees (optical).

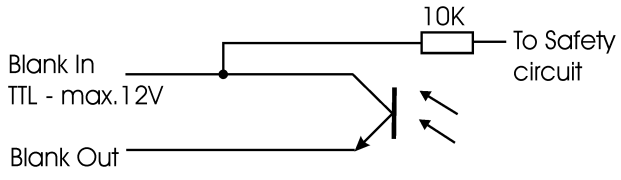
Driver Board Layout



Input Connector:

1	+12V In
2	-12V In
3	GND
4	Input X+
5	Input X-
6	Blank In
7	Blank Out
8	GND
9	Input Y+
10	Input Y-

Internal Blanking circuit



Power supply: Use regulated Power +-12V DC only!
Signal Input: +-10V maximum

Fig.10

Driverboard (Fig. 10)

Setting-up operation

Make sure that the powersupply of +/-12V is connected correctly.
The driverboard is protected against wrong polarization of the input voltage
by the use of diodes. Powersupply should be secured by fuses (500mA).
Make sure that the input signals are connected correctly.
Maximum signal amplitude per input is +-10 Volts (20Vpp).
Do not change any settings of the potentiometers.
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).

Symmetrical inputs

When the lasercontroller uses symmetrical or differencial outputs as described in the ILDA standards, the signals X+, X-, Y+ und Y- can directly connected to the corresponding inputs Input X+, Input X-, Input Y+ and Input Y- 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 Input X+ and Input Y+.
Inputs X- and Y- must be connected to signal ground.
Also the ground pin GND has to be connected with the signal ground.
When using the negative inputs X- and Y- instead of the positive ones, the image will be inverted.

Grounding

The mounting holes of the driverboard are grounded to GND.
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.
The manufacturer assumes no liability for any damage or malfunction caused by bad adjustment.

Size
This potentiometer is for adjusting the scan angle. The factory settings are approximately 30° optical angle at +-5V input signal.
The maximum scan angle of 60° optical should never be exceeded!
When exceeding the maximum allowed scanangle, the Auto Zero Position will be initiated.

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.

Damping
Damping reduces overshoot of the galvos. Too much damping can result in ringing or oscillations of the galvo.
Too much overshooting will initiate the Auto Zero Position sequence.

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 scanner, but is normally not necessary.

Setting up completely deadjusted drivers

When a driver is completely deadjusted, the scanners can oscillate after power on.
Switch-off the driver immediately!
Adjust Size and Gain counterclockwise, until the endpositon 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 Damping counterclockwise, until the frequency disappears.
Use a simple testframe as input, for example a square with slow speed (2Kpps).
Increase the size slightly by turning Size clockwise.
Do not adjust to maximum scan size!
Increase gain by turning Gain clockwise. Make sure that overshoots do not exceed maximum scan angle.
Reduce overshoots by truning Damping clockwise.
Repeat increasing Gain and Damping until the image looks best.
Adjust Size at maximum input signal to desired image size.