RAYLASE
focus on laser

3-Axis Subsystems for Laser Beam Deflection

AXIALSCAN, FOCUSSHIFTER

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CONTENTS

1 BASIC SAFETY INSTRUCTIONS

1.1 Laser safety

The user is responsible for safe operation and for safeguarding the surrounding area against hazards that can be caused by laser radiation. OEM customers must ensure compliance with all local and national regulations.

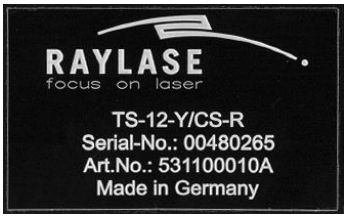
1.2 Laser shutter

The subsystem - consisting of a linear translator module and a deflection unit - is designed to focus and deflect an input laser beam and output it again. The subsystem cannot block or weaken the laser beam. To prevent unwanted emission of the laser beam, above a particular danger class the laser device must be fitted with a shutter (⇨ page 7, Classification of laser devices).

The laser device must be of sufficient quality that the laser beam can only be emitted at the beam output on the deflection unit.

1.3 Signs

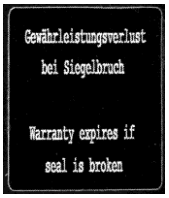
The following signs must be attached to the subsystem. These signs may not be removed. Signs that have become illegible must be replaced.



The **rating plates** and the identification codes printed on them can be used to determine the type of the linear translator module and the deflection unit (⇨ page 15, Rating plate code). The serial number and the item number are also used to identify the subsystem.

The **ground symbol** identifies the ground connection on the subsystem. This connection can be connected to the laser housing via a plug connection to increase the interference resistance.

The **CE symbol** confirms the subsystem's compliance with European directives. It indicates that the subsystem is approved for free trade within the EU.



The **seal labels** warn against unauthorized opening of the subsystem. If a seal is broken, all warranty claims against RAYLASE are void.

A **laser warning sign** must be attached at the point where laser radiation is emitted. This provides information about the type of radiation, specific hazards and the degree of protection. The laser warning sign is attached by the OEM customer in accordance with the laser device's classification (⇨ page 7, Classification of laser devices).

In the high-speed versions of the subsystem the mirrors are made from beryllium.
To indicate this, these subsystems are labeled with the adjacent sign.
Also note ⇨ page 9, Special hazards caused by mirrors made of beryllium.

Lenses for CO2 laser deflection units with linear translator modules are made of zinc selenide.
To indicate this, these subsystems are labeled with the adjacent sign.
Also note ⇨ page 9, Special hazards caused by lenses made of zinc selenide.

1.4 Classification of laser devices

The subsystem can be fitted on various laser devices. Every laser device is assigned to a particular danger class, which must be specified at the point where laser radiation is emitted, e.g. using a warning sign. The following classifications are defined in DIN EN 60825-1:

Class	Description
1	The accessible laser radiation is not dangerous under reasonable foreseeable conditions.
1M	The accessible laser radiation is in the wavelength range of 302.5nm to 4,000nm. The accessible laser radiation is not dangerous to the eyes, as long as the cross-section is not reduced by optical instruments (magnifying glasses, lenses, telescopes).
2	The accessible laser radiation is in the visible spectrum (400nm to 700nm). Short-term exposure (up to 0.25s) is not dangerous to the eyes. Additional radiation components outside the wavelength range from 400nm-700nm meet the requirements for class 1.
2M	The accessible laser radiation is in the visible spectrum from 400nm to 700nm. Short-term exposure (up to 0.25s) is not dangerous to the eyes, as long as the cross-section is not reduced by optical instruments (magnifying glasses, lenses, telescopes). Additional radiation components outside the wavelength range from 400nm-700nm meet the requirements for class 1M.
3R	The accessible laser radiation is in a wavelength range of 302.5nm to 10,600nm and is dangerous to the eyes. The power or energy is a maximum of five times the limit for permissible class 2 radiation in the wavelength range from 400nm to 700nm.
3B	The accessible laser radiation is dangerous to the eyes and frequently to the skin.
4	The accessible laser radiation is extremely dangerous to the eyes and dangerous to the skin. Even diffuse scattered radiation can be dangerous. The laser radiation can cause fires or a risk of explosion.

Note: Bear in mind that the subsystem changes the position at which the beam is emitted and the new beam output must be marked with a warning sign showing the appropriate classification.

Note: The subsystem can change the classification of the laser device, particularly if it is fitted with a focusing lens. The laser device may require additional protective equipment as a result.

1.5 Laser area

For the purposes of accident prevention, the laser area is defined as the area in which the maximum permitted radiation value can be exceeded. This is generally applicable for class 3B, 3R and 4 lasers. For class 1 to 2M laser devices, a laser area can be produced by focusing the laser beam.

A sufficient beam intensity produces a laser area that covers the entire radiation angle of the subsystem and includes the reflection from all objects that can be exposed to the radiation as a result. Note that even apparently diffuse surfaces can reflect laser radiation and a laser beam that has been reflected several times can still be dangerous.

The laser area must be indicated by corresponding warning signs or lamps and protected by appropriate shading and interlock switches.

No flammable or explosive objects or liquids should be located in the laser area.

This operating manual interprets a selection of accident prevention regulations from the point of view of using laser subsystems in industrial plants. However, the applicable local and national standards, rules and regulations are binding.

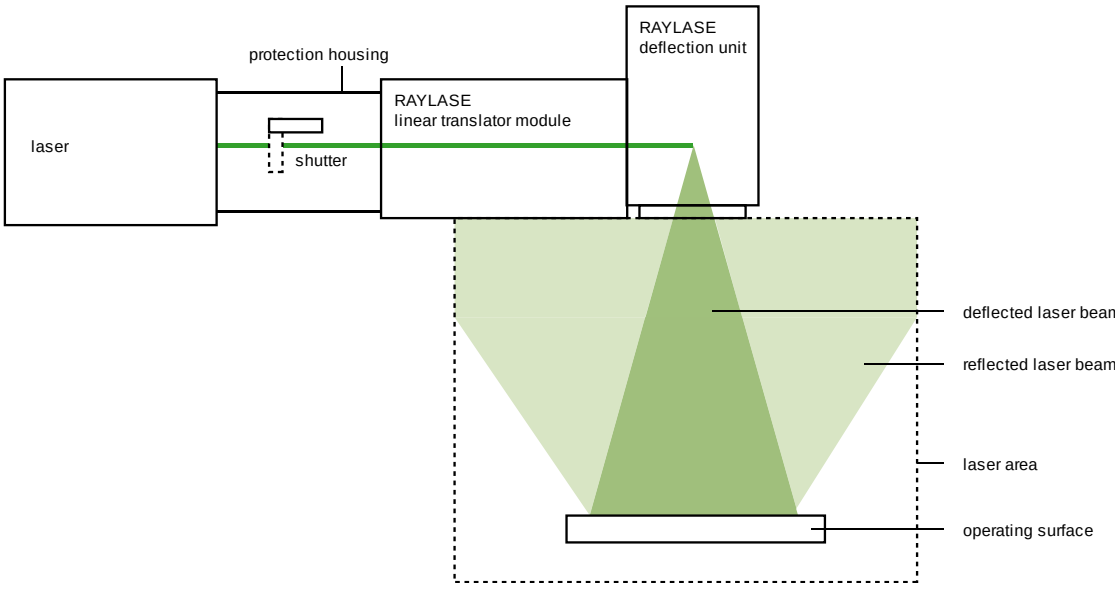


Fig. 1
Laser area

1.6 Special hazards caused by mirrors made of beryllium

Beryllium mirrors can be destroyed by improper loading. This can lead to a release of beryllium dusts. These dusts can cause cancer, are toxic if swallowed and very toxic by inhalation.

Please observe the specified maximum applicable laser power in the data sheet.
Please note also, that soiled mirrors strengthen the absorption of laser power and thereby increase the risk of destruction of the mirror.

⇨ page 50, Special notes for mirrors made of beryllium and lenses made of zinc selenide

1.7 Special hazards caused by lenses made of zinc selenide

Zinc selenide lenses can be destroyed by improper loading.This can lead to release of dust with hydrogen selenide and selenium dioxide. These dusts can cause cancer, are toxic if swallowed and very toxic by inhalation.

Please observe the specified maximum applicable laser power in the data sheet.
Please note also, that soiled lenses strengthen the absorption of laser power and thereby increase the risk of destruction of the lens.

Therefore it is essential to ensure suitable suction in the production environment. In addition, the outer protective glass of the F-Theta lens must be checked for dirt regularly and cleaned if necessary. For non-removable deposits and after wear, which is caused by frequent cleaning, the protective glass of the F-theta lens should be replaced.

⇨ page 50, Special notes for mirrors made of beryllium and lenses made of zinc selenide

2 BASIC INFORMATION

2.1 Introduction

Chapters 1 to 8 of this operating manual describe the general handling of subsystems the following series: AXIALSCAN and FOCUSSHIFTER. See the data sheet in the appendix for the different features. For details of the type you are using, refer to the rating plate.

This operating manual contains important information on qualified and safe handling of the subsystem. You should therefore familiarize yourself with the content of this manual before using the subsystem for the first time. In case of any queries, please contact RAYLASE.

The operating manual must be accessible to anyone who will be involved in developing, installing or using a laser device featuring the RAYLASE subsystem. If the subsystem is sold on, this operating manual or an authorized copy must be passed on with it.

2.2 Intended use

The deflection unit is developed for two-dimensional deflection and focus laser radiation in a suitable working range. If the materials to be processed generate toxic fumes, a secure suction must be ensured.

The deflection unit is designed for use in industrial environment and for use by trained professionals exclusively. It is made as a subassembly for laser devices. The deflection unit should be operated only with the specified wavelengths, laser power and beam diameters listed in the corresponding data sheet.

2.3 Package contents

Standard:

- Subsystem consisting of linear translator module and deflection unit
- Connecting cable between linear translator module and deflection unit (only digital subsystems)

Optional:

- Protection window
- Control card (only digital subsystems)
- Connecting cable between control card and deflection unit (only digital subsystems)
- Software package (only digital subsystems)

2.4 Module overview

The illustration below shows three typical digital laser devices that are equipped with RAYLASE and customer-specific (indicated by dotted lines) modules.

Analog subsystems are controlled by using an analog current or voltage interface provided by the customer.

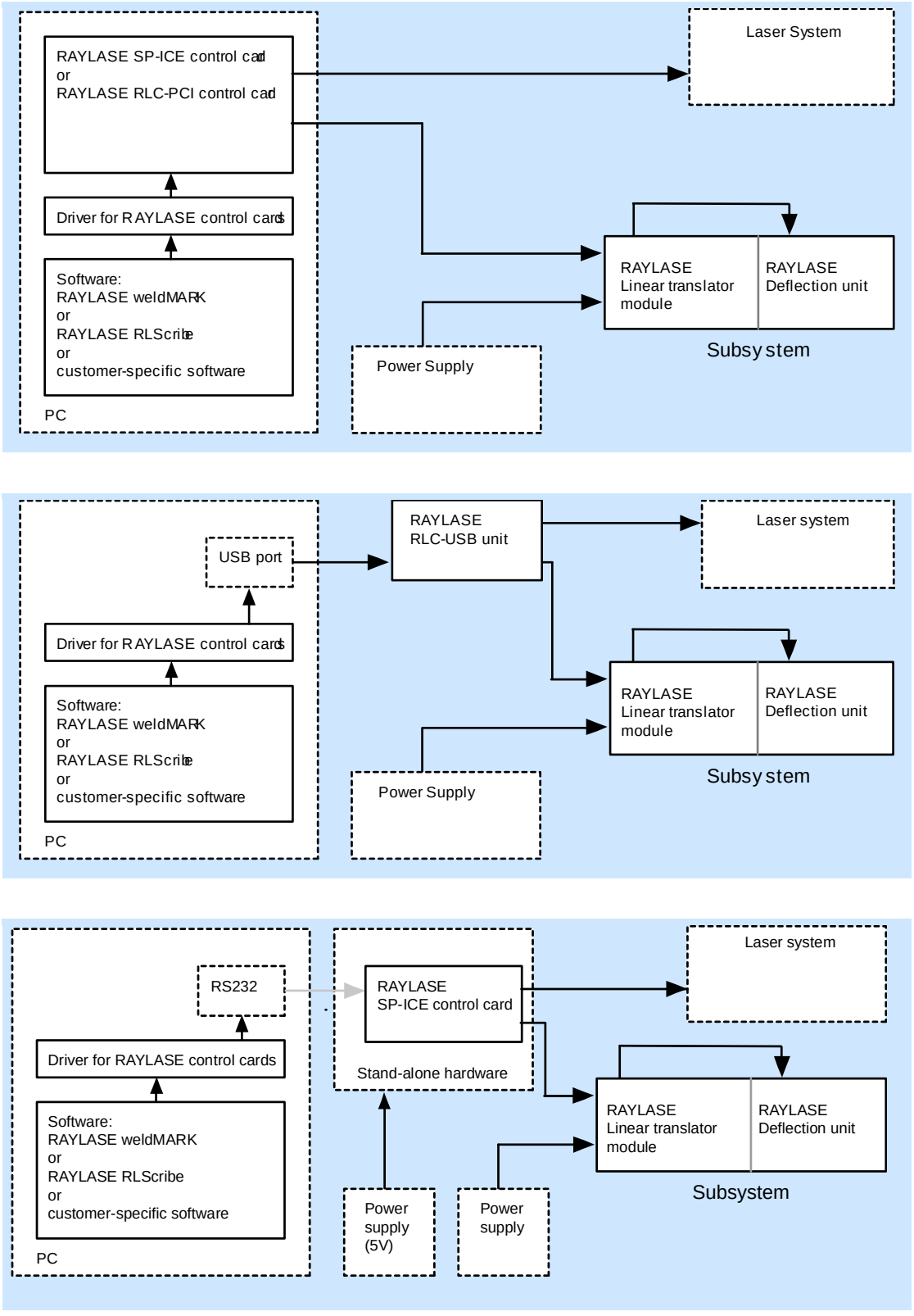


Fig. 2
Module overview

2.5 Warranty

The rights of the customer in respect of any defects in quality or deficiencies in title are governed by the general conditions of business of RAYLASE AG. These conditions are available for review on our website.

Pack the product in the original packaging or in packaging that provides equivalent protection for shipping.

RAYLASE shall not be obliged to repair defects under the following circumstances:

- If persons not authorized by RAYLASE have attempted to repair the product.
- If persons not authorized by RAYLASE have modified the product.
- If the product has been used improperly.
- If the product has been connected to incompatible devices.
- If the product has been damaged because of inadmissible high laser power or focusing the laser on optical areas.
- If the product has been damaged because of unqualified cleaning of the optical areas.
- If the warranty period is expired.

Note: No implicit guarantee or warranty of suitability for specific purposes has been made. RAYLASE is not responsible for damages arising from use of the product. Individual assemblies or other assemblies manufactured by RAYLASE may be subject to separate warranty conditions. Refer to the corresponding manuals for further information.

2.6 Manufacturer

RAYLASE AG
Argelsrieder Feld 2+4
82234 Wessling
Germany
Tel.: +49 (0) 81 53 - 88 98 - 0
Fax: +49 (0) 81 53 - 88 98 - 10
http://www.raylase.de
E-mail: info@raylase.de

2.7 Customer Service

The RAYLASE support services are available for your problems either in respect to the deflection unit or this manual. Before calling for support, please make sure you refer to any appropriate sections in the manuals on the supplied CD that may answer your questions.

If you need further assistance call RAYLASE customer service department, Monday through Friday between 8 A.M. and 5 P.M. (Middle European Time).

The customer service personnel will be able to give you direct assistance and answers to your questions.

Germany (Wessling)
+49 (0) 81 53 - 88 98 – 0
E-Mail: support@raylase.de

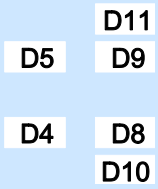
... ask for the customer service department

2.8 Status LED of the linear translator module

The status LEDs allow you to check important functions and statuses on the linear translator module. The LEDs are located behind a protection window on the top of the module.

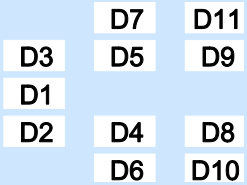
For subsystems with analog interface only

2.8.1 Analog linear translator modules

LED arrangement	Name	Color	Meaning	
	D4	green	Position acknowledge-Z	Data transfer when LEDs are flickering. (not analyzable)
	D5	green	not used	
	D8	red	Error Z	Galvanometer scanner or driver electronics defective. Power supply defective if LEDs are flickering.
	D9	red	not used	
	D10	green	+VCC	Power supplies ready for being used if LEDs are lit.
	D11	green	-VCC	

For subsystems with digital interface only

2.8.2 Digital linear translator modules

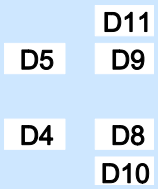
LED arrangement	Name	Color	Meaning	
	D1	red	CLK error	Data transmission faulty. Cable defective.
	D2	red	Parity error Z	
	D3	---	not used	
	D4	green	Temp. status Z	Temperature status available if LEDs are lit.
	D5	---	not used	
	D6	orange	New data Z	New data is being transferred if status LEDs are lit.
	D7	---	not used	
	D8	red	Error Z	Galvanometer scanner or driver electronics defective. Power supply defective if LEDs are flickering.
	D9	---	not used	
	D10	green	+VCC	Power supplies ready for being used if LEDs are lit.
	D11	green	-VCC	

2.9 Status LEDs of the deflection unit

The status LEDs allow you to check important functions and statuses on the deflection unit. If the deflection unit has status LEDs (depends on the type), they are located behind a protection window on the rear of the deflection unit.

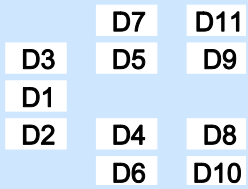
For subsystems with analog interface only

2.9.1 Analog deflection units

LED arrangement	Name	Color	Meaning	
	D4	green	Position acknowledge-X	Data transfer when LEDs are flickering. (not analyzable)
	D5	green	Position acknowledge-Y	
	D8	red	Error X	Galvanometer scanner or driver electronics defective. Power supply defective if LEDs are flickering.
	D9	red	Error Y	
	D10	green	+VCC	Power supplies ready for being used if LEDs are lit.
	D11	green	-VCC	

For subsystems with digital interface only

2.9.2 Digital deflection units

LED arrangement	Name	Color	Meaning	
	D1	red	CLK error	Data transmission faulty. Cable defective.
	D2	red	Parity error X	
	D3	red	Parity error Y	
	D4	green	Temp. status X	Temperature status available if LEDs are lit.
	D5	green	Temp. status Y	
	D6	orange	New data X	New data is being transferred if status LEDs are lit.
	D7	orange	New data Y	
	D8	red	Error X	Galvanometer scanner or driver electronics defective. Power supply defective if LEDs are flickering.
	D9	red	Error Y	
	D10	green	+VCC	Power supplies ready for being used if LEDs are lit.
	D11	green	-VCC	

3 TECHNICAL DATA

This section outlines the common features of all subsystems. For type-specific features, refer to the data sheets in the appendix. The individual data can be assigned using the rating plates on the linear translator module and the deflection unit in conjunction with the identification code (⇨ below, Rating plate code).

3.1 Rating plate code

The following type designation is used in the data sheets in the appendix:

```
Type designation
| AS   AXIALSCAN (subsystem consisting of LTM and deflection unit)
|
|  Beam input aperture of deflection unit (mm)
|  |
|  |  Coating
|  |  |
|  |  |  Min. field size (mm x mm)
|  |  |  | BO = beam optimized
|  |  |  | HP = high power
|  |  |  | HS = high speed
L  L  L  L
XX-XX XX [XXX]
```

```
Type designation
| FS   FOCUSSHIFTER (subsystem consisting of LTM-FS and deflection unit)
|
|  Beam input aperture of deflection unit (mm)
|  |
|  |  Coating
L  L  L
XX-XX [XX]
```

Both modules − linear translator module and deflection unit − have separate rating plates. Refer to the following sections to identify the modules.

3.1.1 Deflection Unit

type designation

RL	RL
RL-II	RL-II
RLA	RLA
MS	MINISCAN
SS-II	SUBERSCAN II
SS-II-LD	SUPERSCAN II -LOW DRIFT
SS-II-HS	SUPERSCAN II -HIGH SPEED
SS-II-HS-LD	SUPERSCAN II -HIGH SPEED -LOW DRIFT
SS-II-UHS	SUPERSCAN II -ULTRA HIGH SPEED
SS-II-UHS-LD	SUPERSCAN II -ULTRA HIGH SPEED –LOW DRIFT
SS	SUPERSCAN
SS-SC	SUPERSCAN -SC (special version)
SS-LD	SUPERSCAN -LOW DRIFT
TS	TURBOSCAN
RS-AC	RAZORSCAN -AUTO CALIBRATION
RL-KIT	RL-KIT
RL-II-KIT	RL-II –KIT
RLA-KIT	RLA –KIT
SS-KIT	SUPERSCAN –KIT
TS-KIT	TURBOSCAN –KIT

aperture(mm)

wavelength

C	9000nm to 11000nm
AU	10600nm
Y	1064nm
DY	532nm
TY	355nm
AG	400nm to 1064nm
405	405nm
DY+Y	532nm and 1064nm
780-980	780nm to 980nm
780-980+AL	780nm to 980nm and AL
850-870+1064	850nm to 870nm and 1064nm
900-1030+AL	900nm to 1030nm and AL
900-1100+AL	900nm to 1100nm and AL
915-975	915nm to 975nm
975	975nm
975-985+AL	975nm to 985nm and AL
AL	180nm to 700nm
AR	488nm to 514nm

version (optionally)

interface

D1	25pol Data/Power
D2	25pol Data/9pol Power
A	Analog

additional or customer no. (optionally)

XX-XX [XX] Vx XX /X

Note: The linear translator is provided with its own nameplate.

3.1.2 Linear Translator Module

TYPE DESIGNATION
LTM LINEAR TRANSLATOR MODULE

aperture (mm)

wavelength
C 10600nm
C* 9000-11000nm
Y 1064nm
DY 532nm
TY 355nm

default field size
100BO 100mm × 100mm
250BO 250mm × 250mm
100 100mm × 100mm
250 250mm × 250mm
200HP 200mm × 200mm, MP5-Coating
600 600mm × 600mm
300HP 300mm × 300mm, MP5-Coating
600HP 600mm × 600mm, MP5-Coating

extra (optionally)
-SR anti reflex coating
-HP MP5-Coating
-HS HIGH SPEED

version (optionally
V2 mono block version

interface
D2 25pol Date / 9pol Power / 25pol Data/Power
A Analog

additional or customer no. (optionally)

LTM-XX X [XXX] Vx X /X

Note: The defection unit is provided with its own nameplate.

3.1.3 Linear Translator Module (FOCUSSHIFTER)

TYPE DESIGNATION
LTM-FS LINEAR TRANSLATOR MODULE FOR FOCUSSHIFER

amplification factor
Lx Beam Expansion Factor x

aperture

wavelength
Y 1064nm
DY 532nm
TY 355nm
C 10600nm

tuning (optionally)
S step tuning
V vector tuning

version (optionally
V2 mono block version

interface
D2 25pol Date / 9pol Power / 25pol Data/Power

additional or customer no. (optionally)

LTM-FS Lx XX [X] X Vx X /X

Note: The defection unit is provided with its own nameplate.

3.2 Conformity with directives

The subsystem conforms to the requirements of the following directives:

- EU Directive 2004/108/EC (EMC)
- WEEE Directive 2012/19/EC
- RoHS II 2011/65/EU
- Directive 2006/42/EC on machinery

For details of conformity with other directives, contact RAYLASE.

4 FUNCTIONAL DESCRIPTION

4.1 Laser beam subsystem

The laser beam subsystem consists of the deflection unit and the linear translator module. The deflection unit can be used to deflect a laser beam in X and Y directions. This results in a two-dimensional plane, within which a laser can be directed at any position. This area is known as the "operating field" and is shown in Fig. 3 and Fig. 4. Deflection is performed by two mirrors, each of which is moved by a galvanometer scanner. RAYLASE provides the appropriate deflection unit for the deflection properties required. The laser beam subsystem can therefore be fitted with different deflection units. Refer to the rating plate to identify the deflection unit used (⇨ page 15, Rating plate code).

The focusing properties of the laser beam subsystem are determined by the linear translator module and, on some versions, also by an F-Theta lens on the deflection unit. The linear translator module is fitted with one or two focusing lenses. An additional lens with linear movement allows the focusing length to be adjusted.

Because of their different focusing properties, the subsystems are divided into four groups:

AXIALSCAN (standard)
In these systems, the lens with linear movement is moved within a small range by a galvanometer unit. This so-called linear translator allows the focusing length to be adjusted to the relevant deflection angle of the deflection unit. Compared to an F-Theta lens, this provides a relatively large operating field, in which the laser beam can be optimally focused at every point. The size of the operating field is set manually during installation (⇨ page 44, Manually adjusting the field size). The optical system and the electronic components of the deflection unit can be protected against contamination by installing a protection window over the beam output (⇨ page 26, Protection window).

AXIALSCAN (water cooled)
Like the standard AXIALSCAN, the water cooled version is also fitted with a motorized adjustable lens. Unlike the standard version, the lens is moved using two galvanometer units to increase the speed.
As well as this version designed for high speed, a version designed for a high laser power is available.

AXIALSCAN (motorized)
On this version of the AXIALSCAN, the entire linear translator can be moved by a motor. This enables motorized adjustment of the size of the operating field (⇨ page 5, Motorized field size adjustment).

FOCUSSHIFTER (standard)
On the FOCUSSHIFTER, an F-Theta lens on the deflection unit is used for focusing and to set the size of the operating field. With this configuration, the linear translator module can be used to change the focusing plane. This allows almost three-dimensional operations to be performed. For example, this is useful when creating a 3D image in a glass block or for deep processing of materials.

Subsystems are available as analog or digital versions. Refer to the following functional principles.

For subsystems with analog interface only

4.2 Functional principle of analog subsystems

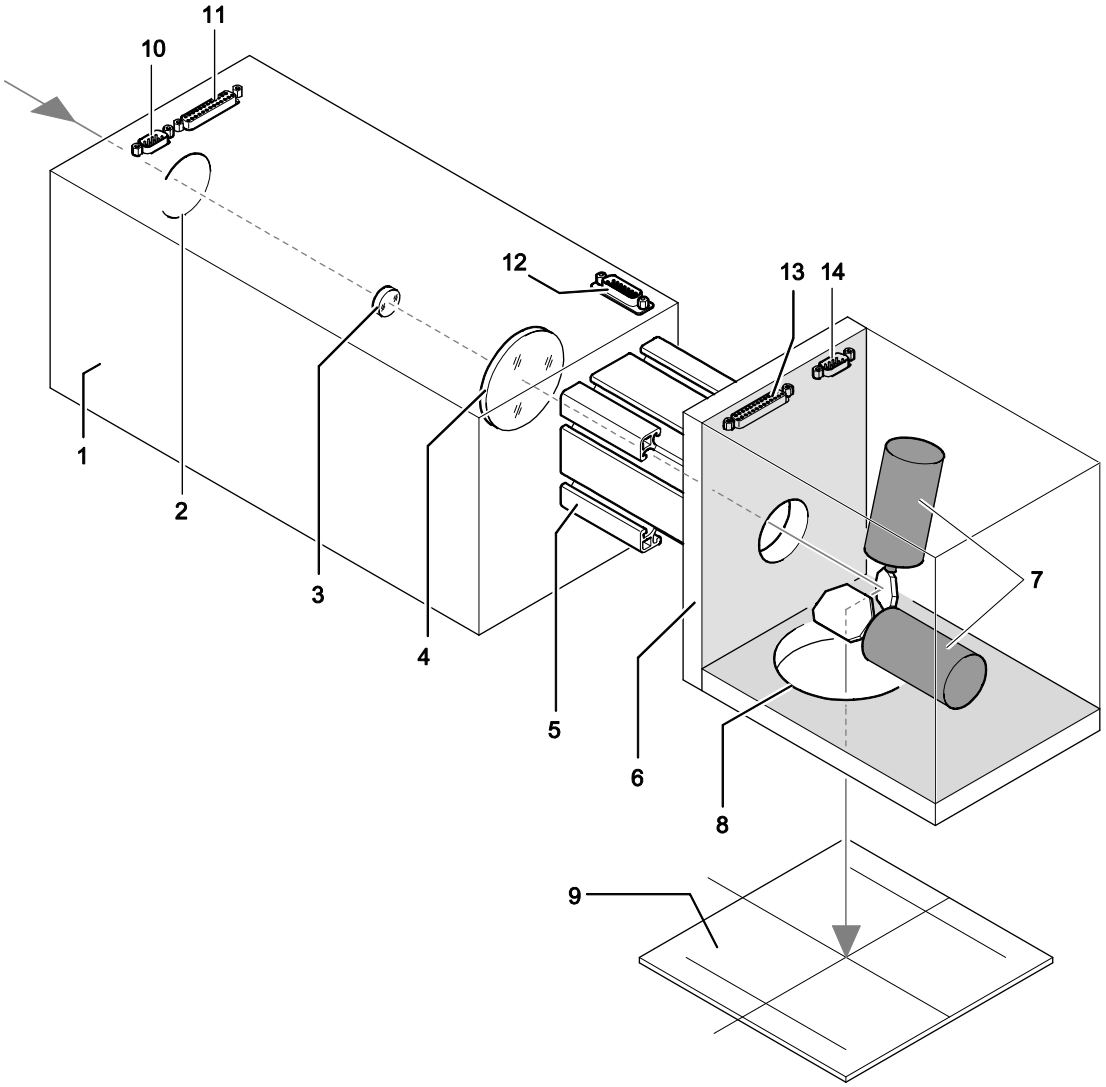


Fig. 3
Functional principle of analog subsystems

1 Linear translator module
2 Beam input
3 Lens with linear movement
4 Focusing lens (or 2x, depending on model)
5 Spacer (depends on model) with mounting plate for deflection unit
6 Deflection unit
7 Galvanometer scanner with mirror
8 Beam output
9 Operating field
10 Power supply of linear translator module
11 Analog input of linear translator module
12 Stepper motor interface (depends on model)
13 Analog input of deflection unit
14 Power supply of deflection unit

For subsystems with digital interface only

4.3 Functional principle of digital subsystems

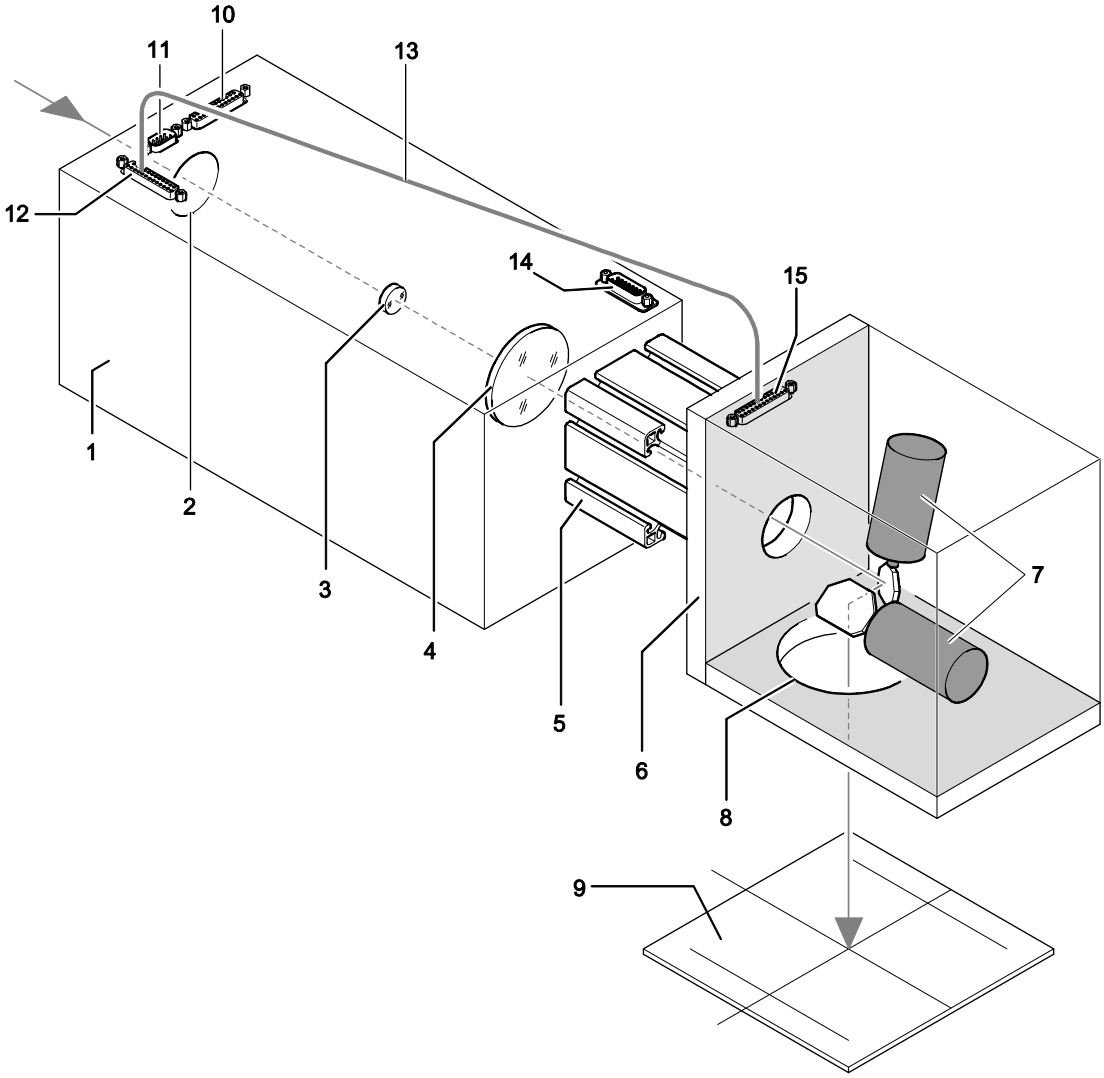


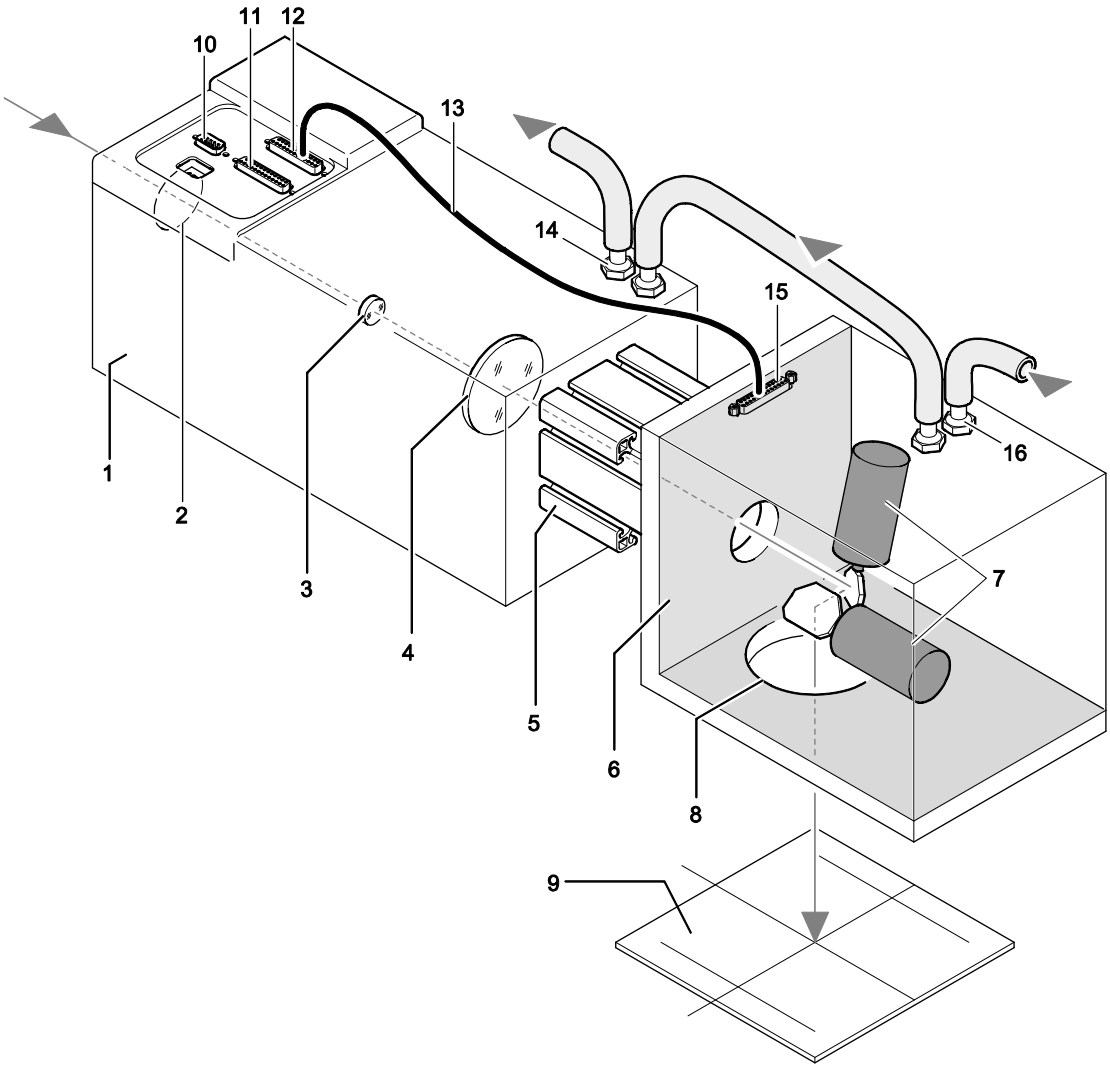
Fig. 4
AXIALSCAN (standard)

AXIALSCAN (motorized)

FOCUSSHIFTER (standard)

1 Linear translator module
2 Beam input
3 Lens with linear movement
4 Focusing lens (or 2x, depending on model)
5 Spacer (depends on model) with mounting plate for deflection unit
6 Deflection unit
7 Galvanometer scanner with mirror
8 Beam output
9 Operating field
10 Digital input
11 Power supply
12 Digital output
13 Connecting cable
14 Stepper motor interface (depends on model)
15 Digital interface of deflection unit

Fig. 5
AXIALSCAN
(water-cooled)



1 Linear translator module
2 Beam input
3 Lens with linear movement
4 Focusing lens (or 2x, depending on model)
5 Spacer (depends on model) with mounting plate for deflection unit
6 Deflection unit
7 Galvanometer scanner with mirror
8 Beam output
9 Operating field
10 Power supply of linear translator module
11 Digital Input
12 Digital Output
13 Connecting cable
14 Output coolant
15 Digital interface of deflection unit
16 Input coolant

Important information:
When connecting the water cooling, make sure that no coolant gets into the subsystem. The units are not waterproof and liquids can damage both the optical system and the electronics.

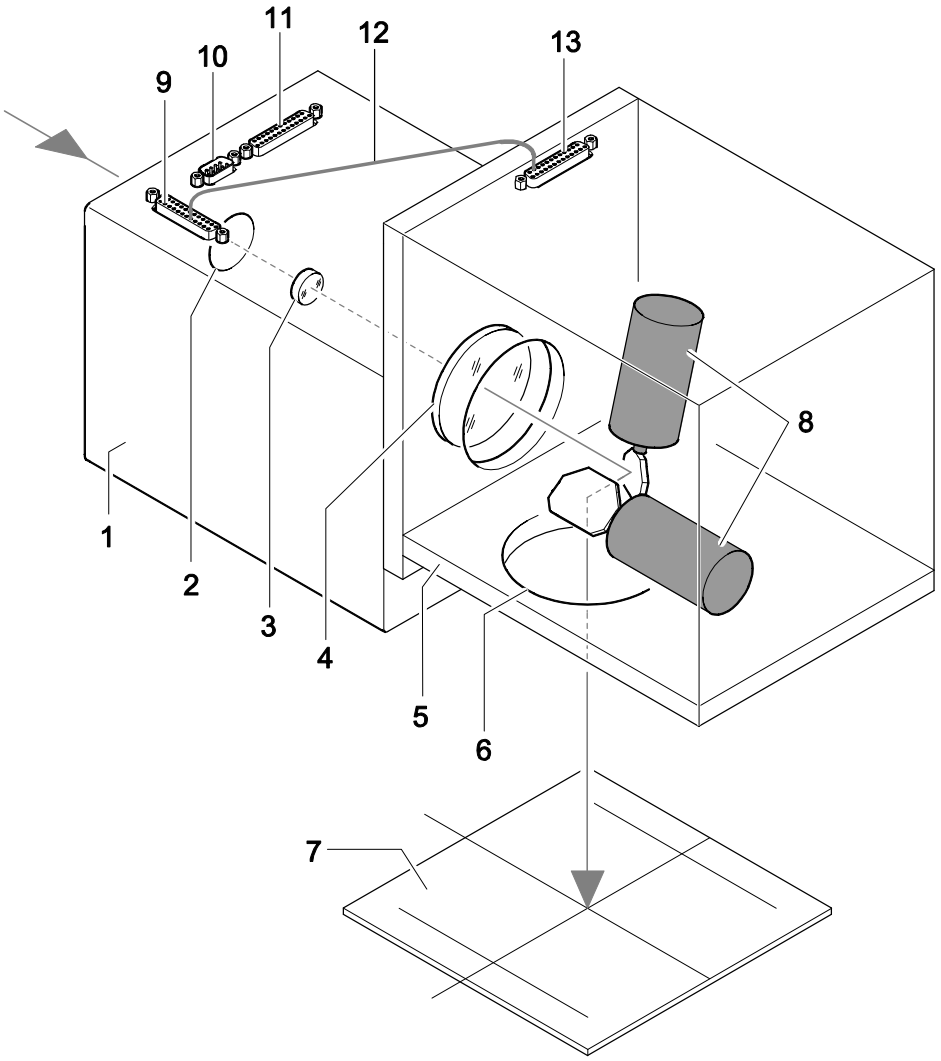
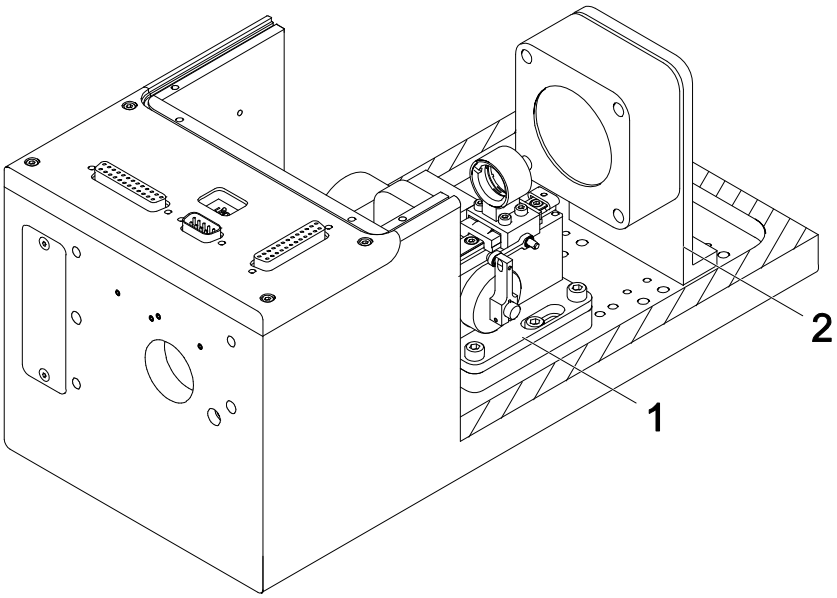


Fig. 6
FOCUSSHIFTER
(standard)

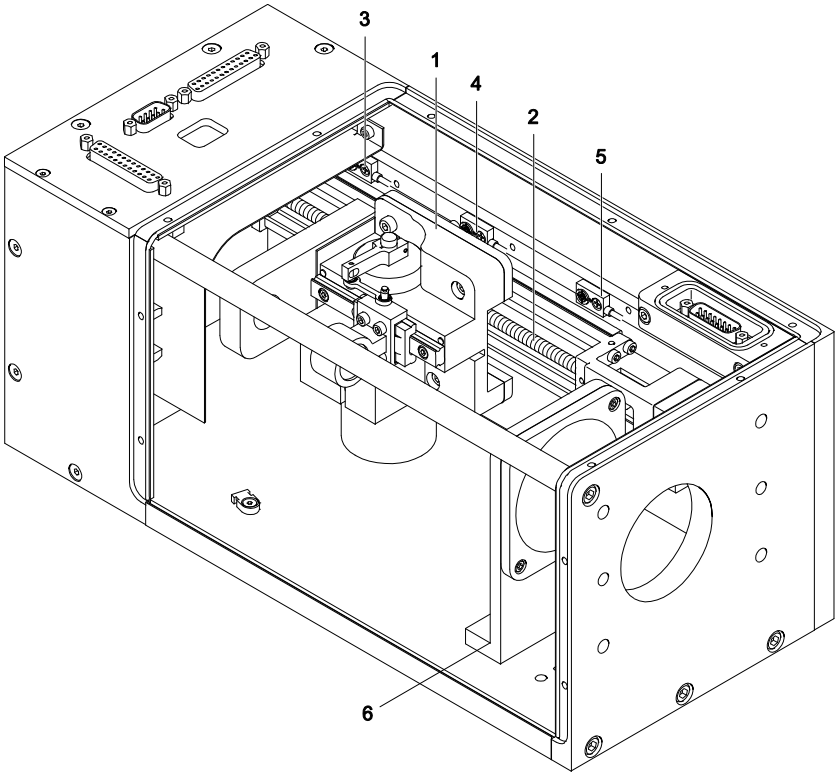
1 Linear translator module
2 Beam input
3 Lens with linear movement
4 Focusing lens (or 2x, depending on model)
5 Deflection unit
6 Beam output with F-Theta lens
7 Operating field
8 Galvanometer scanner with mirror
9 Digital output
10 Power supply
11 Digital input
12 Connecting cable
13 Digital interface of deflection unit

Fig. 7
Linear translator module from AXIALSCAN (standard) subsystem



1 Linear translator
2 Focusing lens

Fig. 8
Linear translator module from AXIALSCAN (motorized) subsystem



1 Linear translator
2 Motorized field size adjustment
3 SENSOR LEFT
4 SENSOR CENTER
5 SENSOR RIGHT
6 Focusing lens

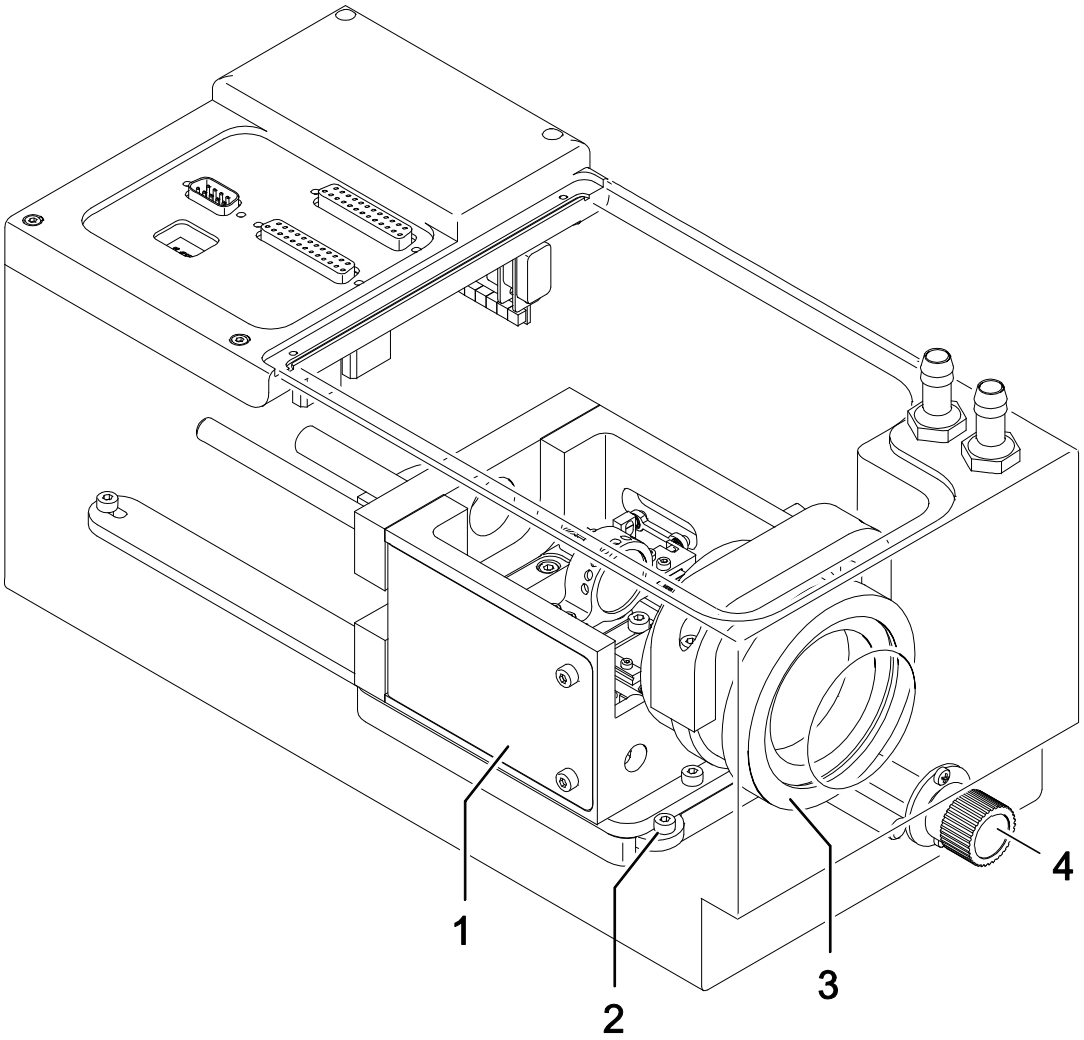


Fig. 9
Linear translator module of sub-system:

AXIALSCAN (water-cooled)

1 Linear translator
2 Clamping screw (field size adjustment)
3 Focusing lens
4 Adjusting screw (field size adjustment)

For subsystems fitted with a protection window only

4.4 Protection window

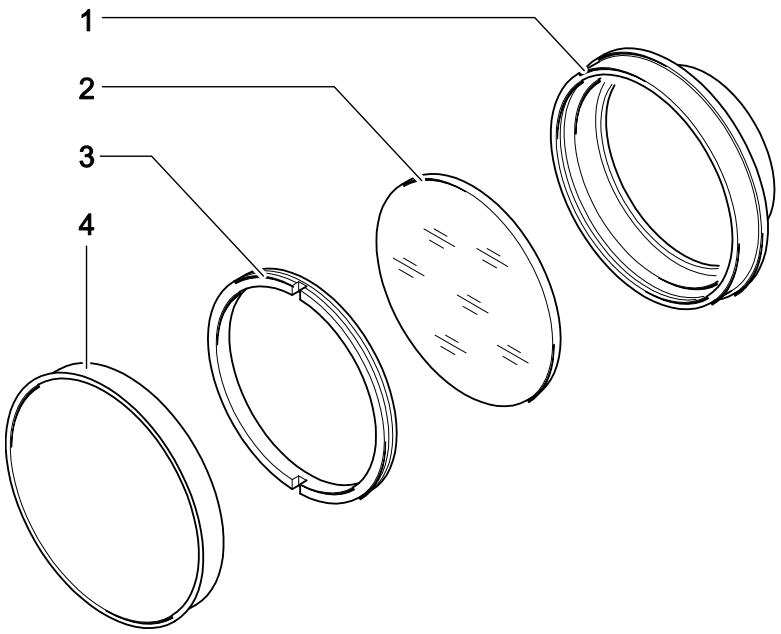


Fig. 10
Protection window

1 Mount
2 Protection window
3 Clamp ring
4 Protective cap

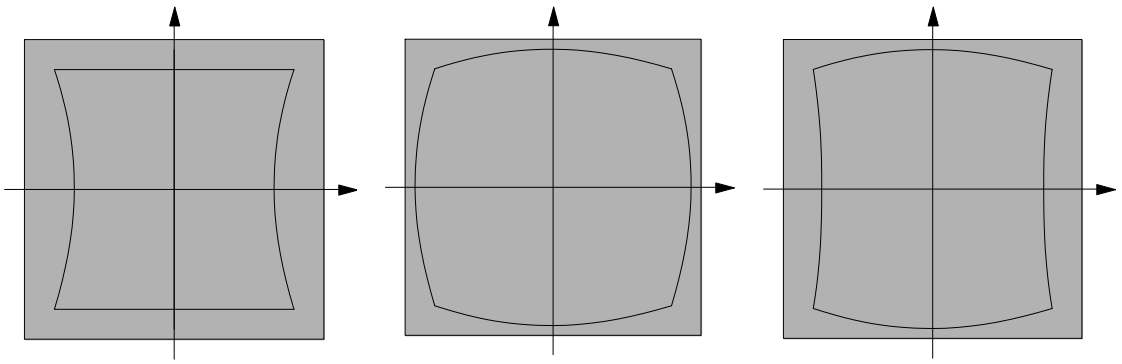
Installation instructions

- Before installation, check the protection window for dirt, scratches or cracks.
  - If the protection window is dirty, it must be cleaned (⇨ page 49, Instructions for cleaning lenses and protective glasses).
  - If the protection window is scratched or cracked, it must be replaced.
- Screw the protection window and mount into the beam output on the deflection unit until it is positioned securely.

For subsystems fitted with an F-Theta lens only

4.5 F-Theta lens

The F-Theta lens is specially designed for use with 2-axis deflection units or in FOCUSSHIFTER 3-axis subsystems. It focuses the laser beam at optimum quality on any position in the operating field. At the same time, it provides partial optical compensation for the barrel-shaped distortion that is unavoidable when using a 2-axis deflection unit. The remaining distortion (see below) must be compensated by the deflection unit drive.

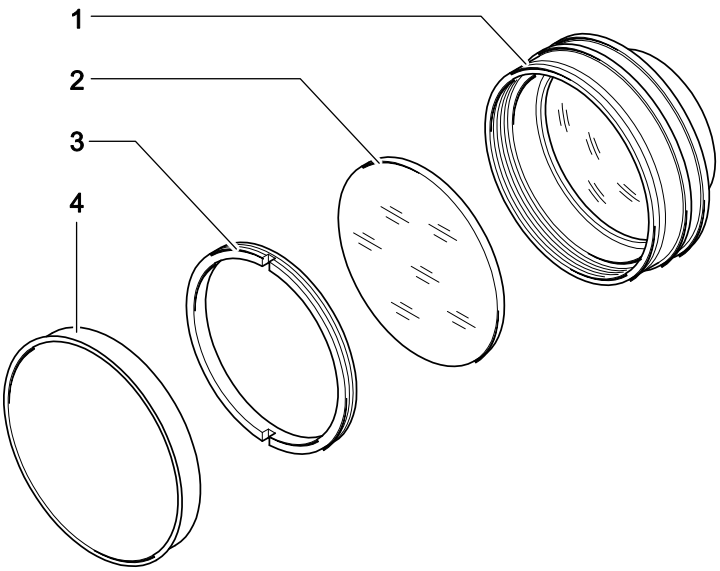


Distortion caused by two-mirror deflection.

Distortion caused by F-Theta lens.

Distortion caused by two-mirror deflection and F-Theta lens.

Fig. 11
Field distortion with and without F-Theta lens



1 Lens element inc. lens
2 Protection window
3 Clamp ring
4 Protective cap

Fig. 12
Example: F-Theta lens for Nd:YAG

Installation instructions

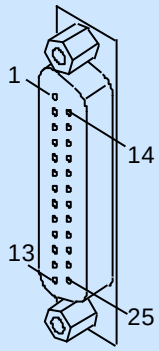
- Before installation, check the lens and the protection window for dirt, scratches or cracks.
  - If the optical system is dirty, it must be cleaned (⇨ page 49, Instructions for cleaning lenses and protective glasses).
  - A scratched or cracked lens and/or protection window must be replaced. If necessary, the protection window can be replaced separately.
- Screw the lens into the beam output on the deflection unit until it is positioned securely.

4.6 Interfaces of the linear translator module

For subsystems with analog interface only

4.6.1 Analog input

The terminal assignment of the analog interface is outlined below. To determine whether the deflection unit is fitted with an analog or a digital interface, refer to the code on the rating plate (⇨ page 15, Rating plate code).



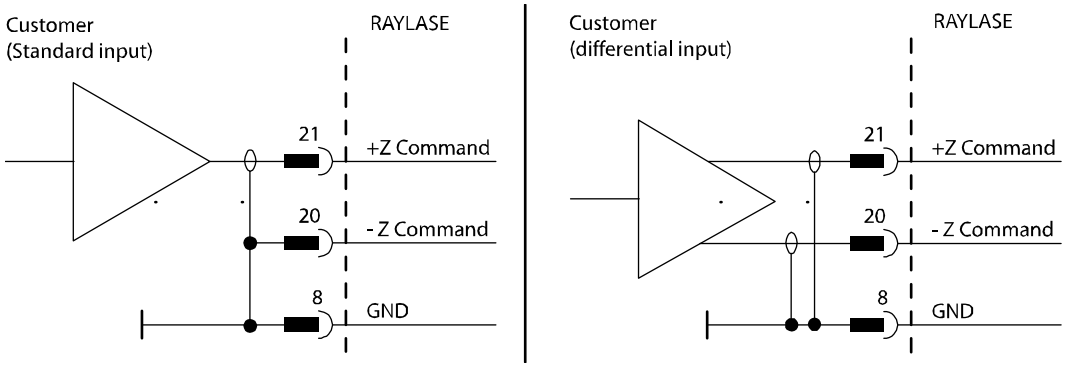
25 PIN D-SUB

PIN	Signal	PIN	Signal
1	GND	14	nu
2	GND	15	nu
3	GND	16	nu
4	GND	17	nu
5	nu	18	nu
6	GND	19	nu
7	GND	20	-Z Command
8	GND	21	+Z Command
9	GND	22	Z Position
10	GND	23	/Z Temp-ok
11	/Z Ready	24	/Z Pos-Error
12	GND	25	Z Velocity
13	GND	---	---

nu = not used

Fig. 13
Signal input

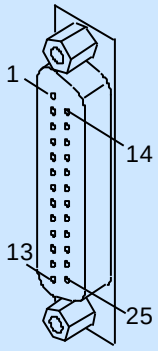
To prevent errors, shielded cables should be used and signals must be input as shown below.



For subsystems with digital interface only

4.6.2 Digital input

The linear translator module is connected to a RAYLASE control card using the 25-pin D-SUB connector. All signals are compatible with RAYLASE's extended function XY2-100 standard.



25 PIN D-SUB

PIN	Signal	PIN	Signal
1	I -SENDCLOCK	14	I +SENDCLOCK
2	I -SYNC	15	I +SYNC
3	I -X-DAC CHANNEL	16	I +X-DAC CHANNEL
4	I -Y-DAC CHANNEL	17	I +Y-DAC CHANNEL
5	I -Z-DAC CHANNEL	18	I +Z-DAC CHANNEL
6	O -HEAD-STATUS	19	O +HEAD-STATUS
7	nc	20	nc
8	nc	21	nc
9	nc	22	nc
10	nc	23	GND
11	GND	24	GND
12	nc	25	nc
13	nc	---	---

I = Diff. Input, nc = not connected, O = Diff. Output

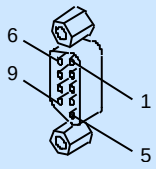
Specifications

Diff. Input-, Diff. Input+	
Input voltage	5V
Input threshold	200mV
Hysteresis	typ. 45mV
Input impedance	120Ω
ESD protection	±15kV

Diff. Output-, Diff. Output+		
Output low	max. 0.6V	max. 40mA
Output high	min. 2V @ 50Ω	max. 40mA
ESD protection	±10kV	

4.6.3 Power supply

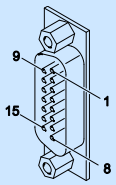
The 9-pin D-SUB connector provides the linear translator module with power. The power supply must be provided by the OEM customer. Refer to the following connection and parameter table:

	PIN	Designation	PIN	Designation
 9 PIN D-SUB	1	-VSS	6	-VSS
	2	-VSS	7	GND
	3	GND	8	GND
	4	+VSS	9	+VSS
	5	+VSS	---	---

For subsystems fitted with motorized field size adjustment only

4.6.4 Stepper motor interface

The 15-pin D-SUB male connector is used to operate the stepper motor for motorized field size adjustment.

	PIN	Signal		PIN	Signal	
 15 PIN D-SUB	1	I -Motor W3	(yellow)	9	I +Motor W3	(black)
	2	I -Motor W1	(brown)	10	I +Motor W1	(red)
	3	I -Motor W4	(purple)	11	I +Motor W4	(blue)
	4	I -Motor W2	(green)	12	I +Motor W2	(white)
	5	nc		13	nc	
	6	O SENSOR CENTER		14	O SENSOR LEFT	
	7	O SENSOR RIGHT		15	I GND	
	8	I VSS (+24V)		---		

I = Input, nc = not connected, O = Output

Specifications

Sensor Output	
Output high	VSS - (≤ 3V)
Current low	max. 50mA
Current high	max. 100mA

Stepper motor and sensors

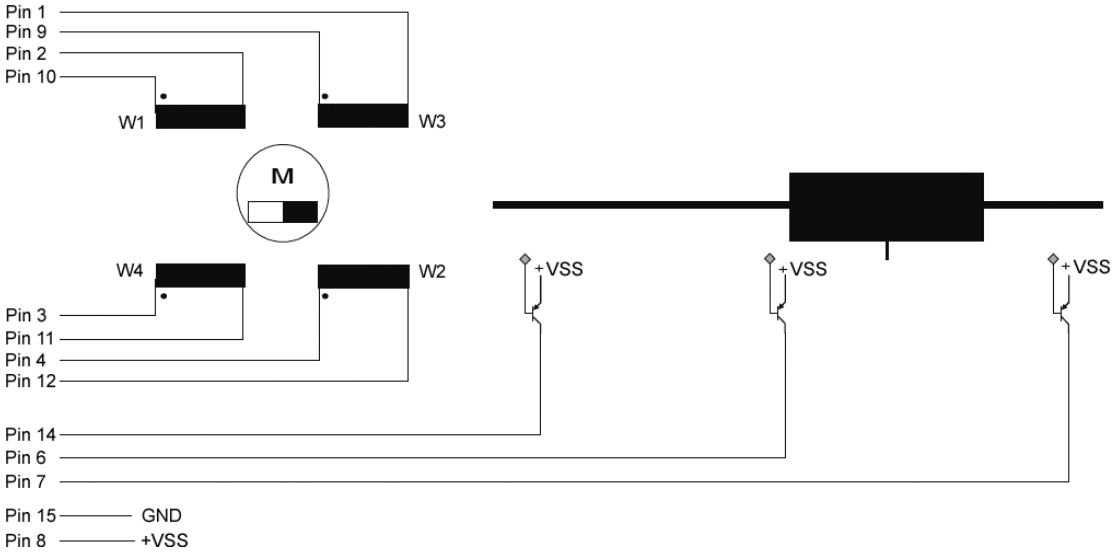


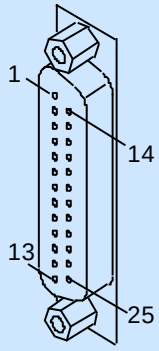
Fig. 14
Stepper motor and sensors, schematic view

Manufacturer: Phytron

For subsystems with digital interface only

4.6.5 Digital output

The linear translator module uses the 25-pin D-SUB female connector to transmit data to the deflection unit and supply it with power. All signals are compatible with RAYLASE's extended function XY2-100 standard.



25 PIN D-SUB

PIN	Signal		PIN	Signal	
1	O	-SENDCLOCK	14	O	+SENDCLOCK
2	O	-SYNC	15	O	+SYNC
3	O	-X-DAC CHANNEL	16	O	+X-DAC CHANNEL
4	O	-Y-DAC CHANNEL	17	O	+Y-DAC CHANNEL
5		nc	18		nc
6	I	-HEAD-STATUS	19	I	+HEAD-STATUS
7		nc	20		nc
8		nc	21		nc
9		+VSS	22		+VSS
10		+VSS	23		GND
11		GND	24		GND
12		-VSS	25		-VSS
13		-VSS	---		---

I = Diff. Input, nc = not connected, O = Diff. Output

Specifications

Diff. Input-, Diff. Input+	
Input voltage	5V
Input threshold	200mV
Hysteresis	typ. 45mV
Input impedance	120Ω
ESD protection	±15kV

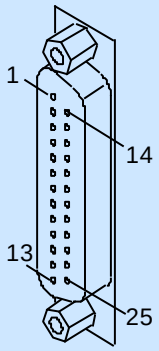
Diff. Output-, Diff. Output+		
Output low	max. 0.6V	max. 40mA
Output high	min. 2V @ 50Ω	max. 40mA
ESD protection	±10kV	

4.7 Interfaces of the deflection unit

For subsystems with analog interface only

4.7.1 Analog input

The terminal assignment of the analog interface is outlined below. To determine whether the deflection unit is fitted with an analog or a digital interface, refer to the code on the rating plate (⇨ page 15, Rating plate code).



25 PIN D-SUB

PIN	Signal	PIN	Signal
1	GND	14	-Y Command
2	GND	15	+Y Command
3	GND	16	Y Position
4	GND	17	/Y Temp ok
5	/Y Ready	18	Y Pos Error
6	GND	19	Y Velocity
7	GND	20	-X Command
8	GND	21	+X Command
9	GND	22	X Position
10	GND	23	/X Temp ok
11	/X Ready	24	/X Pos Error
12	GND	25	X Velocity
13	GND	---	---

To prevent errors, shielded cables should be used and signals must be input as shown below.

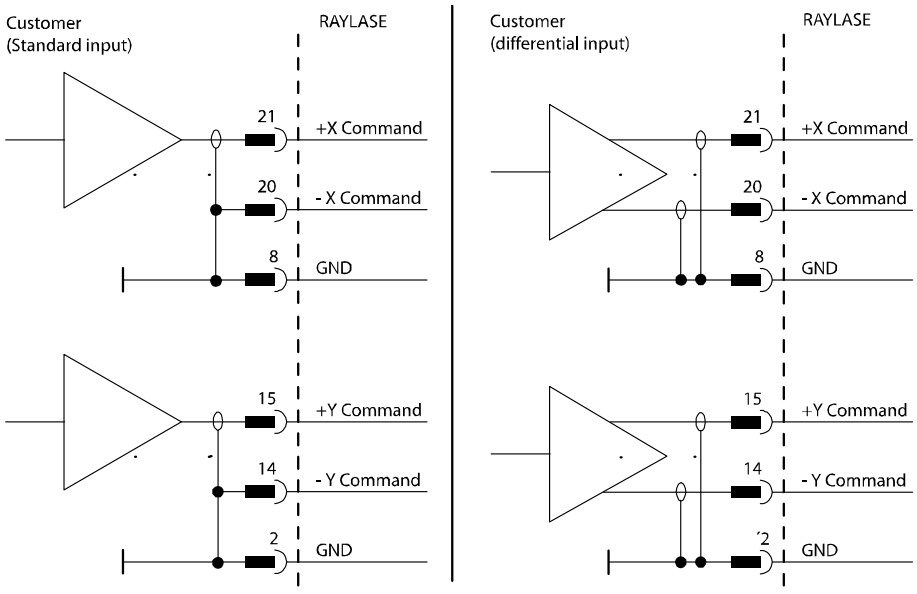
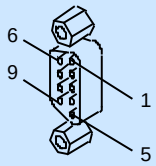


Fig. 15
Signal input

For subsystems with analog interface only

4.7.2 Power supply

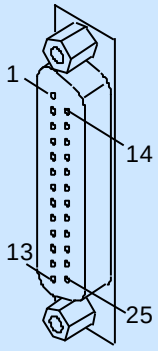
The 9-pin D-SUB connector provides the deflection unit with power. The power supply must be provided by the OEM customer. Refer to the following connection and parameter table:

	PIN	Designation	PIN	Designation
 9 PIN D-SUB	1	-VSS	6	-VSS
	2	-VSS	7	GND
	3	GND	8	GND
	4	+VSS	9	+VSS
	5	+VSS	---	---

For subsystems with digital interface only

4.7.3 Digital interface

The deflection unit uses the 25-pin D-SUB female connector to receive signals and its power supply from the linear translator module. All signals are compatible with RAYLASE's extended function XY2-100 standard. Refer to the following connection table:



25 PIN D-SUB

PIN	Signal		PIN	Signal	
1	I	-SENDCLOCK	14	I	+SENDCLOCK
2	I	-SYNC	15	I	+SYNC
3	I	-X-DAC CHANNEL	16	I	+X-DAC CHANNEL
4	I	-Y-DAC CHANNEL	17	I	+Y-DAC CHANNEL
5		nc	18		nc
6	O	-HEAD-STATUS	19	O	+HEAD-STATUS
7	I	-P-DAC CHANNEL	20	I	+P-DAC CHANNEL
8		nc	21		nc
9		+VSS	22		+VSS
10		+VSS	23		GND
11		GND	24		GND
12		-VSS	25		-VSS
13		-VSS	---		---

I= Diff. Input, nc = not connected, O = Diff. Output

Specifications

Diff. input-, Diff. input+	
Input voltage	5V
Input threshold	200mV
Hysteresis	typ. 45mV
Input impedance	120Ω
ESD protection	±15kV

Diff. output-, Diff. output+		
Output low	max. 0.6V	max. 40mA
Output high	min. 2V @ 50Ω	max. 40mA
ESD protection	±10kV	

5 INSTALLATION

The following sections describe installation of the subsystem in a laser device. When doing this, it is essential to check that the laser beam is input into the linear translator module and output from the module centrally. Otherwise, misalignment of the laser beam will occur each time the focus is changed. The linear translator module and the deflection unit are calibrated to one another prior to delivery and do not need to be adjusted.

Warning:

- The laser beam can cause severe injury to the eyes and the skin. Note that even apparently matt objects can reflect the wavelength of laser beams. All personnel in the room must wear appropriate laser protection goggles and, if necessary, protective clothing.
- Never look directly at the laser beam, even when wearing protective goggles.
- The subsystem may require the laser device to be assigned to a different danger class (⇨ page 7, Classification of laser devices).
- The laser must be switched off during installation.
- We recommend that the laser area is completely protected by an appropriate working chamber. If this is not possible, appropriate protective measures for the laser class must be implemented.
- The mirrors in the deflection unit must move freely after installation of the deflection unit. No components of the laser device may protrude into the deflection unit.
- The laser device must be of sufficient quality that the laser beam can only be emitted at the beam output on the deflection unit.
- The "Laser radiation" accident prevention regulations (BGV B2) must be observed.
- Connecting cables may not be subjected to mechanical strain.
- The subsystem must be protected against moisture, dust and corrosive vapors.
- The optical components may only be touched when wearing unpowdered latex gloves.
- The subsystem must be protected against static discharge and strong electromagnetic fields.
- The power density of the input laser radiation may not exceed the maximum permissible power density of the optical components in the subsystem.
- The beam path and the function of the subsystem must be tested after installation.
  We recommend performing all tests with a danger class 1 or 2 laser to minimize the risk of injury. If this is not possible, the laser used must be set to the lowest possible power. This setting must be secured against accidental adjustment.

5.1 Installing the linear translator module

- Carefully remove the protective cover over the beam input with a small screwdriver.
- To install the subsystem, insert locating pins into the corresponding holes and attach the subsystem to the prepared installation surface using screws.
  Note: The subsystem may only be installed using the pins and screws specified by RAYLASE. Follow the installation drawing supplied.

Only for water cooled deflection units

5.2 Requirements to the cooling water

To avoid destruction of the aluminum housing by pitting, the cooling water must meet the requirements listed in the following table.

Note regarding cooling circuit: Avoid pure copper components in the cooling circuit (not refrigerant cycle) of the cooler used. These lead without suitable additive to pitting in aluminum cooling channels.

Note: Damage caused by pitting is excluded from the warranty.

Cooling water alternatives	Clean tap water
	Deionized water mixed with 50% clean tap water
	Deionized water with additives
Recommended additives*	Industrial application: CCL105 (NALCO)
	Food industry: Dowcal N (Dow Chemicals)
Recommended cooling temperature	22°C – 28°C Avoid condensation
Temperature stability	+/- 1°C
Water pressure at the deflection unit	2 to 3 bar
Water flow	2-6 l/min (depending on the type of deflection unit)
Water hardness	< 10 ppm
Recommended pH	7-8.6
Bacterial content	< 1000 cfu/ml

* Follow the dosage and application instructions of the manufacturer.

Only for deflection units with option "Air Flush"

5.3 Requirements to the cooling air

To avoid contamination of the mirror and the resulting destruction by the laser beam, the cooling air must meet the following requirements:

Pore filter	Pore filter ≤ 0,05 mm
Required air pressure on the deflection unit	1-1,5 bar
Air flow	ca 50 l/min
Max. oil shares	≤ 0,005 mg/m^3
Max. water shares	≤ 0,05 g/m^3

5.4 Checking the beam coupling: AXIALSCAN (Standard), AXIALSCAN (motorized), FOCUSSHIFTER (Standard)

5.4.1 Preparation

In order to be able to check the beam coupling, all components located in the beam path must be removed and the deflection unit dismantled. The process for doing this is as follows:

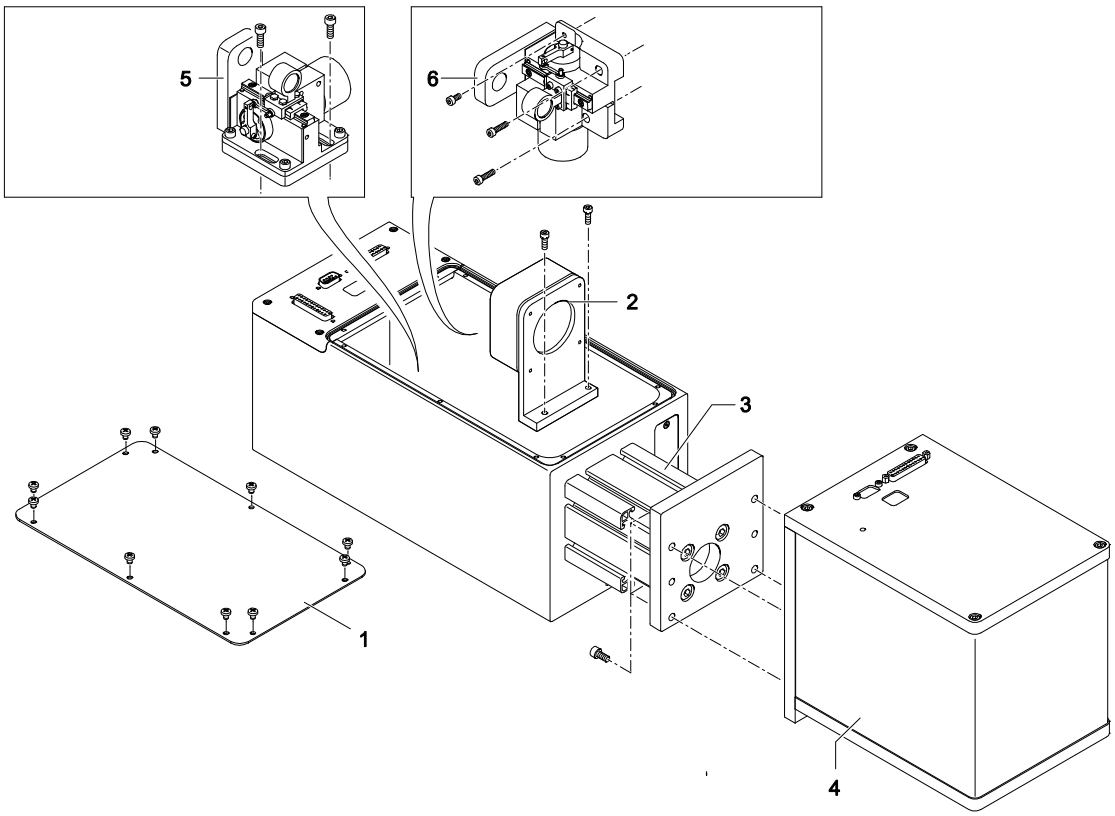


Fig. 16
Preparing the beam coupling

AXIALSCAN (standard)

AXIALSCAN (motorized)

FOCUSSHIFTER (standard)

- Remove the following components in turn:
  - Connecting cable between linear translator module and deflection unit
  - Linear translator module cover (1).
- Mark the installation position of the focusing lens (2) or the two focusing lenses for re-installation.
- Remove the following components in turn:
  - Focusing lens and second focusing lens if fitted.
  - Deflection unit (4); in subsystems with spacer: Only dismantle the deflection unit, not the spacer (3) and the mounting plate for the deflection unit.
  - Linear translator, (5) or (6) depending on model.
- Protect the focusing lens, deflection unit and linear translator against dust.

5.4.2 Checking procedure

The following steps are used to check that the laser beam is input into the linear translator module and output from the module centrally. If this is not the case, the input point and, if necessary, the input angle of the laser beam must be adjusted as described below.

Warning:
The laser beam can cause severe injury to the eyes and the skin. Make sure that all personnel in the laser area are wearing appropriate protective goggles and, if necessary, protective clothing.

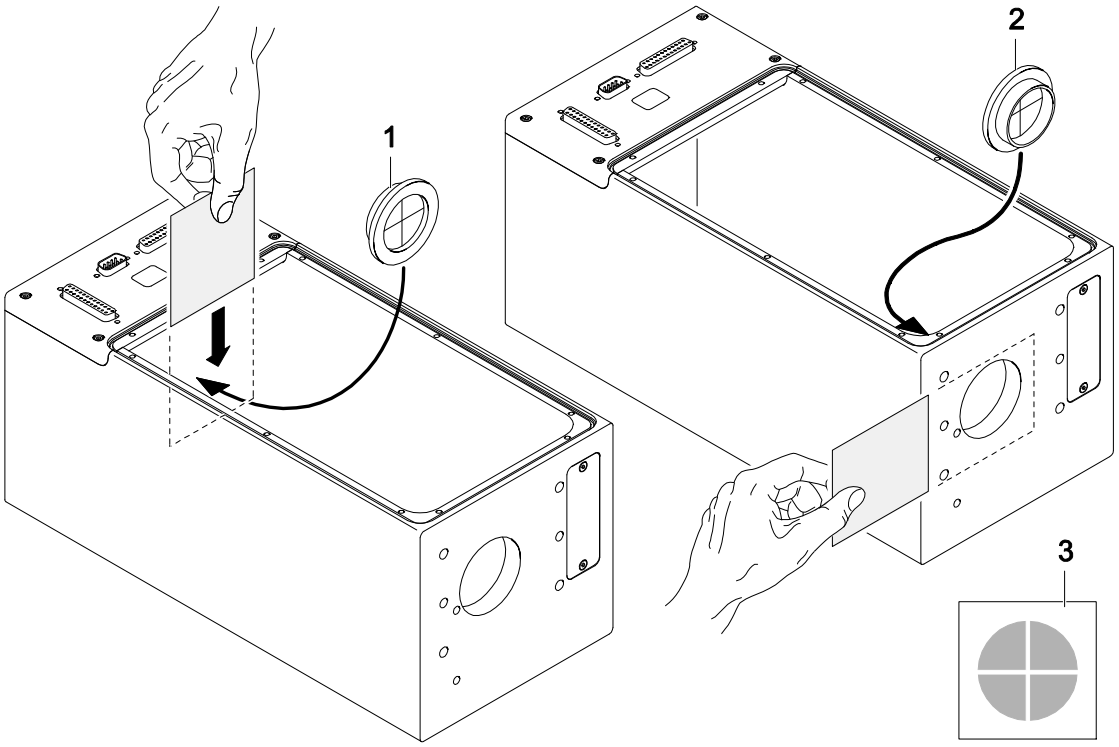


Fig. 17
Checking the beam coupling

AXIALSCAN (standard)

AXIALSCAN (motorized)

FOCUSSHIFTER (standard)

Checking the input point

- Insert the cross hair device into the beam input (1).
- Hold a piece of thermo transfer paper behind the cross hair device.
- Turn on the laser at low power for just long enough for a clearly visible effect to appear on the thermo transfer paper (3).
- Check the beam diameter. It must be smaller than the input aperture specified in the data sheet.
- Check that the laser beam appears in the center of the cross hairs. If not, the input point of the laser beam needs to be adjusted.

Checking the input angle

- Insert the cross hair device into the beam output (2). In subsystems with spacer: Insert the cross hair device into the opening in the mounting plate.
- Hold a piece of thermo transfer paper behind the cross hair device.
- Turn on the laser at low power for just long enough for a clearly visible effect to appear on the thermo transfer paper.
- Check the beam diameter. It must be smaller than the input aperture specified in the data sheet. If the beam diameter at the beam output is greater than that measured at the beam input, this indicates excessive divergence of the laser beam. In this case, reduce the beam diameter, e. g. by using beam expander with lower amplification.
- Check that the laser beam appears in the center of the cross hairs. If not, the input angle of the laser beam needs to be adjusted.

Optimizing settings

- Repeat the entire adjustment process until optimum laser beam input point and input angle settings are achieved.

5.4.3 Assembly

The process for assembling all of the components is as follows:

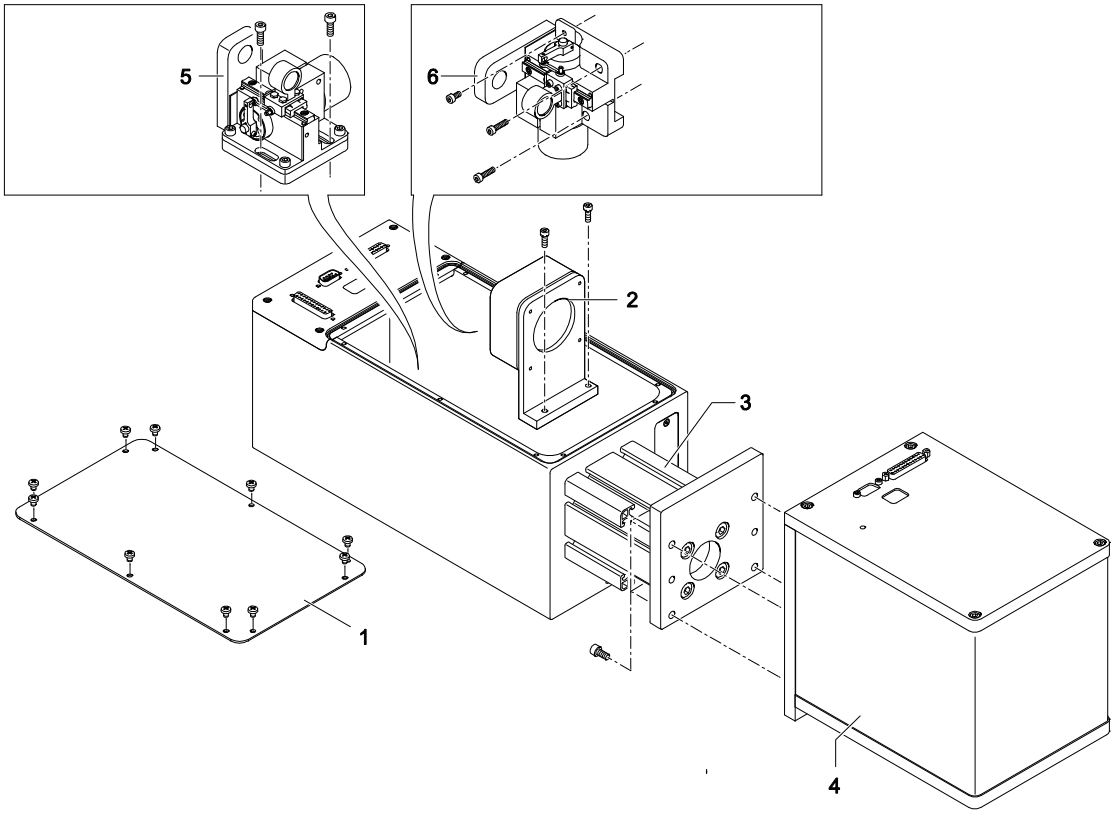


Fig. 18
Finalize the checking procedure

AXIALSCAN (standard)

AXIALSCAN (motorized)

FOCUSSHIFTER (standard)

- Install the deflection unit (4).
- Install the focusing lens(es) (2). Pay attention to the corresponding markings.
- Install the linear translator, (5) or (6) depending on the model.
- If you are using a subsystem with manual field size adjustment, you now have to adjust the field size (⇨ page 44, Manually adjusting the field size). In subsystems with motorized field size adjustment, this is done by the software.
- Fit the cover (1).

5.5 Checking the beam coupling: AXIALSCAN (water cooled)

5.5.1 Preparation

In order to be able to check the beam coupling, all components located in the beam path must be removed and the deflection unit dismantled. The process for doing this is as follows:

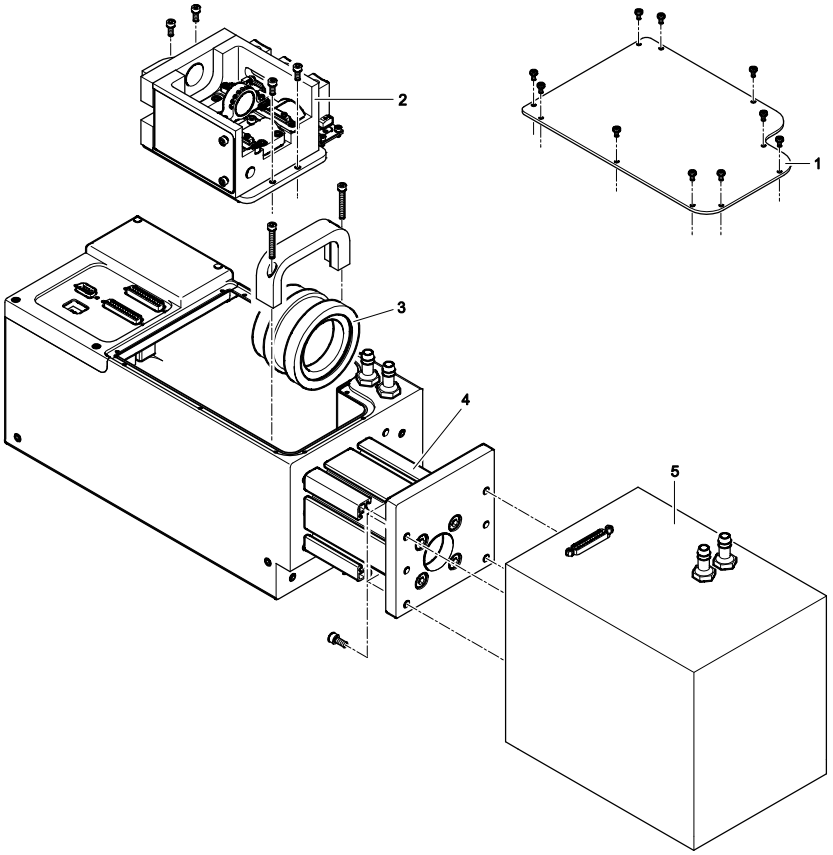


Fig. 19
Preparing the beam coupling

AXIALSCAN (water cooled)

- Remove the following components in turn:
  - Connection cable between linear translator module and deflection unit.
  - Hose connections for water cooling.
    Important information:
    Make sure that no coolant gets into the subsystem. The units are not waterproof and liquids can damage both the optical system and the electronics.
  - Linear translator module cover (1).
- Remove the following components in turn:
  - Focusing lens (3).
  - Deflection unit (5);
    in sub systems with spacer: Only dismantle the deflection unit, not the spacer (4) and the mounting plate for the deflection unit.
  - Linear translator (2).
- Protect the focusing lens, deflection unit and linear translator against dust.

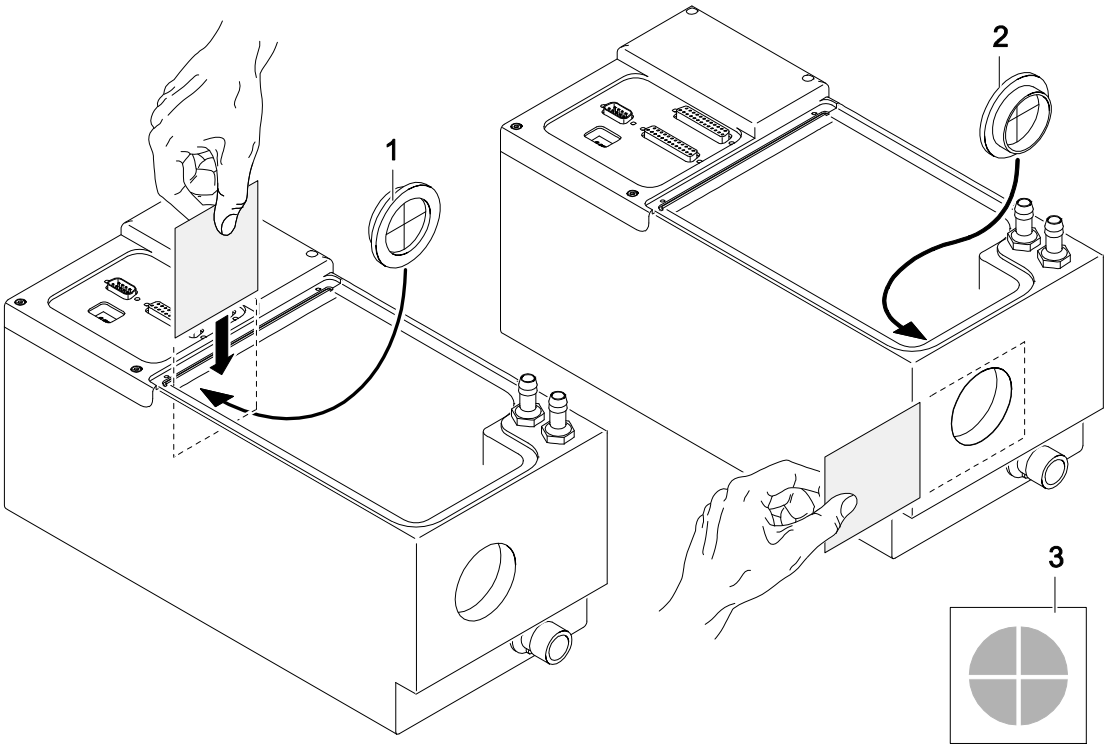
5.5.2 Checking procedure

The following steps are used to check that the laser beam is input into the linear translator module and output from the module centrally. If this is not the case, the input point and, if necessary, the input angle of the laser beam must be adjusted as described below.

Warning:
The laser beam can cause severe injury to the eyes and the skin. Make sure that all personnel in the laser area are wearing appropriate protective goggles and, if necessary, protective clothing.

Fig. 20
Checking the beam coupling

AXIALSCAN (water cooled)



Checking the input point

- Insert the cross hair device into the beam input (1).
- Hold a piece of thermo transfer paper behind the cross hair device.
- Turn on the laser at low power for just long enough for a clearly visible effect (3) to appear on the thermo transfer paper.
- Check the beam diameter. It must be smaller than the input aperture specified in the data sheet.
- Check that the laser beam appears in the center of the cross hairs. If not, the input point of the laser beam needs to be adjusted.

Checking the input angle

- Insert the cross hair device (2) into the beam output and repeat the above steps in this position.
  In subsystems with a spacer, insert the cross hair device in the mounting plate.
- Hold a piece of thermo transfer paper behind the cross hair device.
- Turn on the laser at low power for just long enough for a clearly visible effect to appear on the thermo transfer paper.
- Check the beam diameter. It must be smaller than the input aperture specified in the data sheet. If the beam diameter at the beam output is greater than that measured at the beam

input, this indicates excessive divergence of the laser beam. In this case, reduce the beam diameter, e.g. by using beam divergence with lower amplification.

- Check that the laser beam appears in the center of the cross hairs. If not, the input angle of the laser beam needs to be adjusted on the laser.

Optimizing settings

- Repeat the entire adjustment process until optimum laser beam input point and input angle settings are achieved.

5.5.3 Assembly

The process for assembling all of the components is as follows:

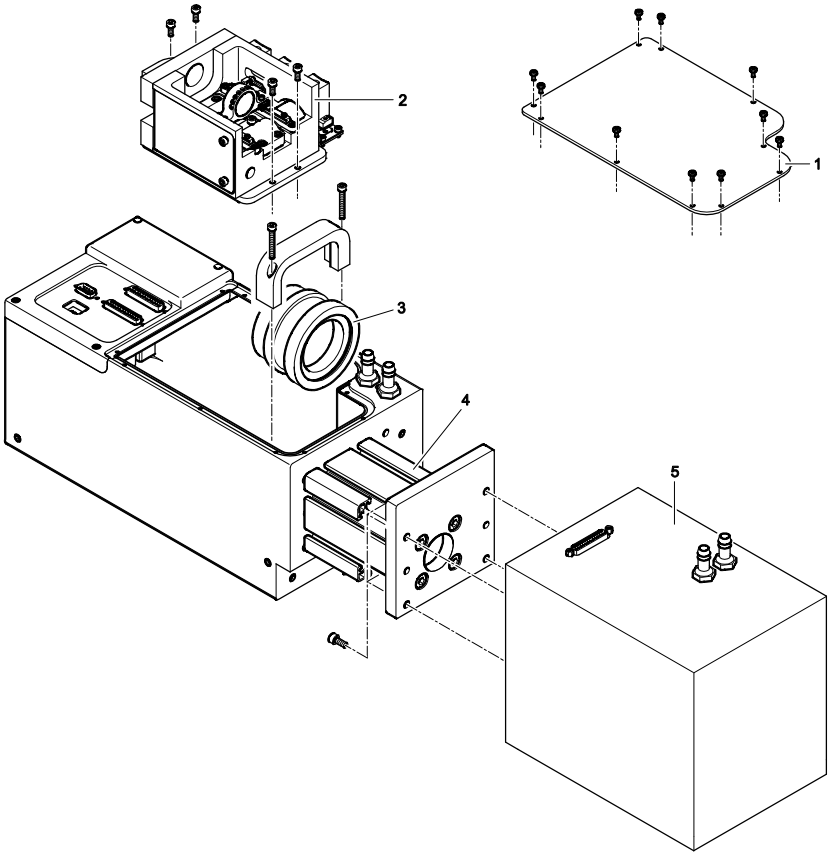


Fig. 21
Ending the checking procedure

AXIALSCAN
(water cooled)

- Install the deflection unit (5).
- Install the focusing lens (3). Pay attention to the corresponding markings.
- Install the linear translator (2).
- Adjust the field size (⇨ page 44, Manually adjusting the field size).
- Fit the cover (1).

For subsystems with manual field size adjustment only

5.6 Manually adjusting the field size

The 3-axis laser beam subsystem can be adjusted to different field sizes as follows. The field sizes that can be set are listed in the data sheet. If you want to set a different field size, you must consult RAYLASE for assistance.

5.6.1 Preparation

- Load the correction file corresponding to the desired operating field size. Make sure that you use the following identification code:

AXIALSCAN

The following identification code is used for AXIALSCAN type subsystems:

```
Type
AS  AXIALSCAN
|  Aperture of associated deflection unit [mm]
|  |  Coating code         Wavelength [nm] ..... Laser
|  |  DY                   532 ..... ..... Nd:YAG
|  |  TY                   355  ..... Nd:YAG
|  |  Y                    1064 ..... Nd:YAG
|  |  C                    10600 ..... CO2
|  |  |  Field size range (min.-max.)
|  |  |  |         Type
|  |  |  |         st  standard
|  |  |  |         bo  beam optimized
|  |  |  |         hp  high power
|  |  |  |         |
|  |  |  |         |  Operating field size
└─ └─ └─ └─────────└─ └
XX-XX-XX_XXXX-XXXXxxx_XXXX.gcd
```

FOCUSSHIFTER[1]

The following identification code is used for FOCUSSHIFTER type subsystems:

```
Type
FS  FOCUSSHIFTER
|  Aperture of associated deflection unit [mm]
|  |  Coating code         Wavelength [nm] ..... Laser
|  |  DY                   532 ..... ..... Nd:YAG
|  |  TY                   355  ..... Nd:YAG
|  |  Y                    1064 ..... Nd:YAG
|  |  C                    10600 ..... CO2
|  |  |  Focal distance
|  |  |  |
└─ └─ └─ └─
XX-XX-XX_XXX.gcd
```

- Create all electrical connections for the power supply and for control of the 3-axis subsystem (⇨ page 9, Special hazards caused by mirrors made of beryllium).
- For details of connecting the deflection unit to a RAYLASE control card and operation with RAYLASE software, refer to the corresponding manuals.

[1] In general there are no special correction files for Focusshifter. The standard 2-axis correction files are used. For using weldMARK in combination with FOCUSSHIFTER a special configuration file has to be generated in order to compensate for different object sizes at different z-position.

5.6.2 Adjustment procedure:: AXIALSCAN (standard)

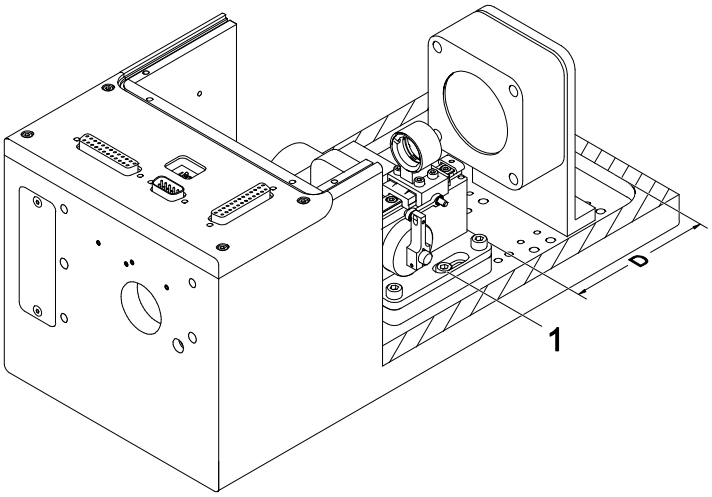


Fig. 22
Manual field size adjustment

AXIALSCAN (standard)

- Loosen the two retaining screws (1).
- Move the linear translator to the distance (D) specified in the reference table in the appendix. As shown above, the distance (D) is measured from the front edge of the linear translator to the inner side of the housing plate.
- Lightly screw in the linear translator at the set position.

Fine adjustment

Fine adjustment is used to adjust the linear translator to the laser-specific divergence.

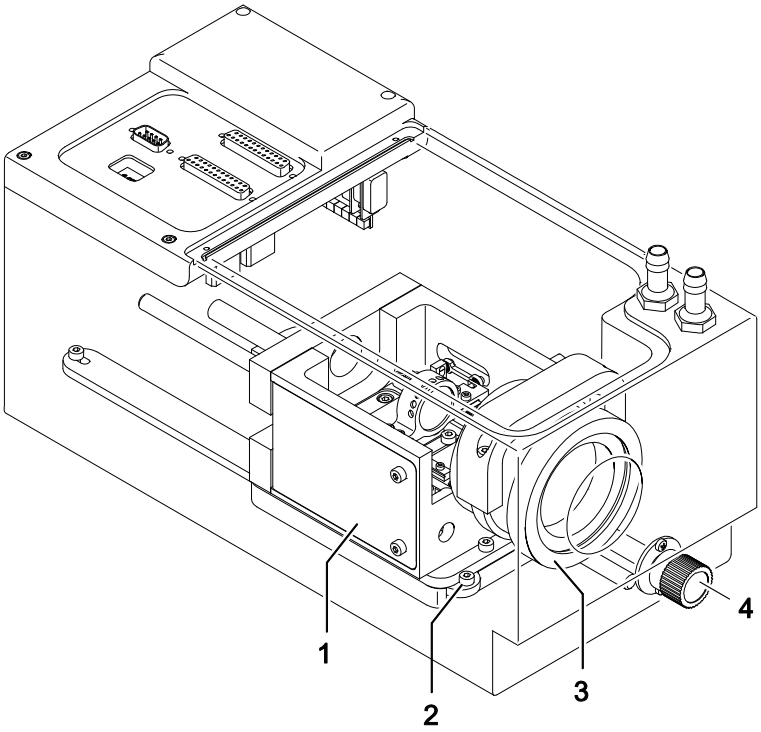
Warning:
The laser beam can cause severe injury to the eyes and the skin. Make sure that all personnel in the laser area are wearing appropriate protective goggles and, if necessary, protective clothing.

- Place a target of the same size as the operating field at the specified working distance from the deflection unit.
- In turn, use the laser to mark a square in the center of the field and at one corner.
- Check that the spot diameter is the same in the center of the field and at the corner.
- If necessary, move the linear translator within the range provided by the slots and repeat the fine adjustment until a satisfactory result is obtained in the center of the field and at the corner.
- Fix the linear translator in place with the two fastening screws (1).

5.6.3 Adjustment procedure: AXIALSCAN (water cooled)

Fig. 23
Manual field size adjustment

AXIALSCAN (water cooled)



1 Linear translator
2 Clamping screw
3 Focusing lens
4 Adjusting screw

- Release the clamping screw (2).
- Move the linear translator (1) using the adjusting screw (4) until the required setting is approximately reached. The positions for the approximate setting are indicated by a sticker attached on the inside, which can be seen when the cover is open.

Fine adjustment

Fine adjustment is used to adjust the linear translator to the laser-specific divergence.

Warning:
The laser beam can cause severe injury to the eyes and the skin. Make sure that all personnel in the laser area are wearing appropriate protective goggles and, if necessary, protective clothing.

- Place a marker the same size as the operating field at the specified working distance from the deflection unit.
- In turn, use the laser to mark a square in the center of the field and at one corner.
- Check that the spot diameter is the same in the center of the field and at the corner.
- If necessary, move the linear translator using the adjusting screw (4) and repeat the fine adjustment until a satisfactory result is obtained in the center of the field and at the corner.
- Fix the linear translator in place with the clamping screw (2).

For subsystems with motorized field size adjustment only

5.7 Motorized field size adjustment

The 3-axis laser beam subsystem can be adjusted to different field sizes using the motor: With motorized field size adjustment, the software adjusts the optical components.

6 MAINTENANCE AND CLEANING

The subsystem doesn‘t contain any components that require regular maintenance.

Repairs may only be carried out by RAYLASE or RAYLASE certified service centers because special know-how and comprehensive testing methods are required.

RAYLASE offers worldwide certified service and repair centers.
For a service and repair center in your area, see www.raylase.com.

6.1 Cleaning the housing

Warning:
The laser beam can cause severe injury to the eyes and the skin. Before cleaning, make sure that the laser device is switched off and secured against accidentally being switched on.

The deflection unit housing is dust proof. It can be cleaned with a duster. If it is very dirty, the duster can be moistened with a light and non-aggressive cleaning solution (e.g. soap solution).

6.2 Cleaning the optical system

Warning:
The laser beam can cause severe injury to the eyes and the skin. Before cleaning, make sure that the laser device is switched off and secured against accidentally being switched on.

Dirty optical surfaces result in increased absorption of the laser radiation. This can cause the dirt to heat up sufficiently, so that it burns into the optical surfaces and damage them permanently.

The following circumstances can cause increased accumulation of dirt:

- The ambient atmosphere is contaminated with dirt, grease or other particles.
- Vapors and particles are produced while working.
- Talking, coughing or sneezing close to optical surfaces.

In general, all contamination of the optical system should be avoided wherever possible. However, as contamination cannot be avoided completely, the optical system must be cleaned at appropriate intervals. Regular checking and cleaning of the optical surfaces can prevent permanent damage.

Note: RAYLASE accepts no liability for damaged optical components!

Note: Damage caused during the laser process, e.g. when processing metals, is irreversible and cannot be resolved by cleaning.

For deflection units with lens and protective glasses only

6.2.1 Instructions for cleaning lenses and protective glasses

Warning:
The laser beam can cause severe injury to the eyes and the skin. Before cleaning, make sure that the laser device is switched off and secured against accidentally being switched on.

Fingerprints contain aggressive substances that can damage the optical surfaces. Optical surfaces should therefore only be touched when wearing suitable gloves or with a lens cleaning cloth.

- Only touch the optical elements when wearing suitable cotton gloves and only touch the edges.
- Blow loose particles from the surface with clean and oil-free compressed air. Note that the compressed air in workshops can contain oil particles and is therefore unsuitable for cleaning the optical system.
- Moisten a suitable lens cleaning cloth with ethanol suitable for cleaning optical components.
- Place one end of the moistened cloth on the optical system and slowly move it over the optical components. Do not exert any pressure and do not rub the optical components.
- Remove any remaining ethanol residue with a dry optical cloth.
- Repeat the procedure until the surface is completely clean. Use a new cleaning cloth for each repetition.

6.2.2 Instructions for cleaning mirrors

Warning:
The laser beam can cause severe injury to the eyes and the skin. Before cleaning, make sure that the laser device is switched off and secured against accidentally being switched on.

The mirror surfaces are extremely sensitive and may only be cleaned by experienced personnel. We strongly recommend sending the deflection unit in to RAYLASE for the mirror cleaning, as opening of the deflection unit by unauthorized personnel voids the warranty.

However, if you want to clean the mirrors by yourself, follow the same procedure as for cleaning the lens but with even more care (⇨ above, Instructions for cleaning lenses and protective glasses).

6.2.3 Special notes for mirrors made of beryllium and lenses made of zinc selenide

Warning:
If the deflection unit is provided with one of the adjacent signs, there is a health hazard coming from the material of the optical components.

Behaviour if mirrors or lenses may be or are actually destroyed

- Turn the laser device off immediately!
- Leave the room for at least 30 minutes!
- Under no circumstances remove the protective glass or the F-Theta lens of the deflection unit, to check a possible destruction.
- In the deflection unit, toxic dust or fragments may be created.
- If the deflection unit has nevertheless been opened and fragments have been fallen out, the fragments must be collected wearing appropriate protective clothing and respirators and disposed of as a hazardous substance according to the local regulations.
- Label the defective deflection unit with a clear warning and send the unit airtight and well packaged to RAYLASE.
- The persons commissioned with the dismantling of the deflection unit must wear suitable protective clothing and respirators.
- The room in which the beryllium mirror or the zinc selenide lens has been destroyed, must be cleaned, decontaminated and ventilated sufficiently.
- Wear gloves and a surgical mask for the following steps!
- Gather all the broken pieces carefully and pack them in a sealed plastic container.
- Clean all contaminated components and surfaces with a damp cloth and pack the cloth in a sealed plastic container.
- Send the container to your supplier. He is responsible for the proper disposal of the material.

Hazardous properties of beryllium

With the destruction of a beryllium mirror by laser radiation beryllium dusts may be generated. These dusts can cause cancer, are toxic if swallowed and very toxic by inhalation.

Hazardous properties of zinc selenide

With the destruction of the lenses made of zinc selenide, toxic dusts may be generated with hydrogen selenide and selenium dioxide. These dusts can cause cancer, are toxic if swallowed and very toxic by inhalation.

In order to improve the optical properties of the material, zinc selenide is often provided with an anti-reflective coating, which can contain thorium fluoride. Thorium is an α-emitter and weakly radioactive. It is potentially hazardous to health if inhaled or swallowed. Since the thorium-containing coating is embedded between layers of non-radioactive layers, there is no risk for the user under normal circumstances.

7 TROUBLESHOOTING

Warning:
The laser beam can cause severe injury to the eyes and the skin.

- Never look directly or indirectly into the laser beam during troubleshooting.
- Do not disable any safety precautions to protect against laser radiation.
- Wear protective clothing and/or goggles appropriate for the relevant laser class.

In case of malfunctions, check whether the symptom and a possible remedy are included in the following checklist.

Problem	Possible cause and remedy	
Poor marking quality	Defective power supply	
	Incorrect marking parameters	
Marking quality has deteriorated	Dirty optical system	⇨ page 49, Instructions for cleaning lenses and protective glasses ⇨ page 49, Instructions for cleaning mirrors
	Laser power decreasing	The RAYLASE weldMARK™ marking software can compensate for a loss of laser power. Menu: System > Global adjustments
	Marking parameters changed	
	Beam expander changed	
Laser spot changed	Dirty optical system	⇨ page 49, Instructions for cleaning lenses and protective glasses
	Dirty or damaged mirrors	⇨ page 49, Instructions for cleaning mirrors
		Send deflection unit in for repair
	Laser system out of adjustment	
No laser beam, although process started from PC.	Beam path blocked.	Remove protective cover from beam input and/or output
	Fault in laser drive	
	Fault in laser system	
The deflection unit only deflects the laser beam in one direction or not at all.	Data cable defective	⇨ page 13, Status LED of the linear translator module
X and Y axis reversed	Incorrect cabling	

If the fault cannot be resolved, contact RAYLASE Customer Service for further assistance.

8 DISPOSAL

For the disposal of the deflection unit, note local policies, regulations and laws. If the mirrors are made of beryllium, the local Hazardous Substance Regulations must be considered. The signs shows which deflection units are concerned (⇨ page 6, Signs).

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APPENDIX

Data Sheets:

AXIALSCAN-20-C [100]
AXIALSCAN-20-C [250]
AXIALSCAN-20-DY [200]
AXIALSCAN-20-TY [200]
AXIALSCAN-20-Y [200]
AXIALSCAN-20-Y [600]
AXIALSCAN-30-C [100BO]
AXIALSCAN-30-C [200HP]
AXIALSCAN-30-C [250BO]
AXIALSCAN-30-C [300BO]
AXIALSCAN-30-C [600HP]
AXIALSCAN-30-Y
FOCUSSHIFTER

AXIALSCAN-20-C [100]

General Specifications

Power Supply	Voltage	±15 to ±18 V
	Current	7.5 A, RMS, max. 10 A
	Ripple/Noise	Max. 200 mVpp, @20MHz bandwidth
Ambient Temperature		+15 to +35 °C
Storage Temperature		-10 to +60 °C
Humidity		≤ 80 % non-condensing
Weight		approx. 12.0 kg

Interface Signals	Analog	±5 V, ±10 V
	Digital	XY2-100 Protocol
Max. Input Aperture		15 mm
Field Size		100x100 to 500x500 mm²
Lens Positions		

Specifications for Linear Translator Modules

Field size	100 x 100 mm²	200 x 200 mm²	300 x 300 mm²	400 x 400 mm²	500 x 500 mm²
Mechanical Data:					
Distance D[1)]	83.1 mm	129.93 mm	147.84 mm	157.28 mm	163.11 mm
Working Distance[2)]	89.7 mm	213.4 mm	337.2 mm	460.9 mm	584.7 mm
Dynamic Data:					
Spot Diameter 1/e [3)]	154.0 µm	278.1 µm	402.0 µm	525.4 µm	648.3 µm
Resolution	< 4 µm	< 7 µm	< 10 µm	< 13 µm	< 16 µm
Acceleration Time	≤ 3 ms	≤ 3 ms	≤ 3 ms	≤ 3 ms	≤ 3 ms
Focus Range in Z Direction	-------	32.0 mm	107.0 mm	242.0 mm	463.0 mm

1) From the front edge of the linear translator to the inner side of housing plate, 2) from the bottom edge of deflection unit to the processing field; the distance will vary with laser divergence and lens tolerance. 3) Input beam quality: M^2 = 1,0

Specifications for associated Deflection Units

	SUPERSCAN-20	SUPERSCAN-IIE-20L		
Mechanical Data:				
Beam Displacement	26.0 mm	25.63[3)]/26.28 mm		
Dynamic Data:				
Typical Deflection	±0.393 rad	±0.393 rad		
Repeatability (RMS)	3 µrad	2 µrad		
Max. Gaindrift[1)]	< 50 ppm/K	< 15 ppm/K		
Max. Offsetdrift[1)]	< 30 µrad/K	< 10 µrad/K		
Long-term Drift [1,2)]	< 300 µrad	< 150 µrad		
Long-term Drift with water tempering [W] [W2] [1,2,)]		< 100 µrad		
Mirrors		QU	SI	BE
Acceleration Time (10-90%) (ms)	≤ 0.6	≤ 0.58	≤ 0.61	≤ 0.40

1) Drift per axis 2) after warming-up, variations of ambient temperature < 1K , variations of cooling water <1K 3) Specification for QU fused Silica mirrors

Specifications for Optics

	CO_2
Wavelength	10,600 nm
Coating	AR Coating
Max. Laser Power, cw	700 W/cm²

AXIALSCAN-20-C [250]

General Specifications

Power Supply	Voltage	±15 to ±18 V
	Current	7.5 A, RMS, max. 10 A
	Ripple/Noise	Max. 200 mVpp, @20MHz bandwidth
Ambient Temperature		+15 to +35 °C
Storage Temperature		-10 to +60 °C
Humidity		≤ 80 % non-condensing
Weight		approx. 12.0 kg

Interface Signals	Analog	±5 V, ±10 V
	Digital	XY2-100 Protocol
Max. Input Aperture		15 mm
Field Size		250x250 to 1,500x1,500 mm²
Lens Positions		

Specifications for Linear Translator Modules

Field size	250 x 250 mm²	500 x 500 mm²	750 x 750 mm²	1.000 x 1.000 mm²	1.250 x 1.250 mm²	1.500 x 1.500 mm²
Mechanical Data:						
Distance D[1)]	54.77 mm	98.25 mm	116.88 mm	126.32 mm	132.02 mm	135.83 mm
Working Distance[2)]	275 mm	584.7 mm	894.1 mm	1,203.4 mm	1,512.8 mm	1,822.2 mm
Dynamic Data:						
Spot Diameter 1/e [3)]	281.0 µm	548.79 µm	816.7 µm	1, 085.03 µm	1, 353.66 µm	1, 622.61 µm
Resolution	< 8 µm	< 16 µm	< 24 µm	< 32 µm	< 40 µm	< 48 µm
Acceleration Time	≤ 3 ms	≤ 3 ms	≤ 3 ms	≤ 3 ms	≤ 3 ms	≤ 3 ms
Focus Range in Z Direction	-------	67.0 mm	270.0 mm	647.0 mm	1,287mm	2,357 mm

1) From the front edge of the linear translator to the inner side of housing plate, 2) from the bottom edge of deflection unit to the processing field; the distance will vary with laser divergence and lens tolerance. 3) Input beam quality: M^2 = 1, 0

Specifications for associated Deflection Units

	SUPERSCAN-20	SUPERSCAN-IIE-20L		
Mechanical Data:				
Beam Displacement	26.0 mm	25.63[3)]/26.28 mm		
Dynamic Data:				
Typical Deflection	±0.393 rad	±0.393 rad		
Repeatability (RMS)	3 µrad	2 µrad		
Max. Gaindrift[1)]	< 50 ppm/K	< 15 ppm/K		
Max. Offsetdrift[1)]	< 30 µrad/K	< 10 µrad/K		
Long-term Drift [1,2)]	< 300 µrad	< 150 µrad		
Long-term Drift with water tempering [W] [W2] [1,2)]		< 100 µrad		
Mirrors		QU	SI	BE
Acceleration Time (10-90%) (ms)	≤ 0.6	≤ 0.58	≤ 0.61	≤ 0.40

1) Drift per axis 2) after warming-up, variations of ambient temperature < 1K , variations of cooling water <1K 3) Specification for QU fused Silica mirrors

Specifications for Optics

	CO_2
Wavelength	10,600 nm
Coating	AR Coating
Max. Laser Power, cw	700 W/cm²

AXIALSCAN-20-DY [200]

General Specifications

Power Supply	Voltage	±15 to ±18 V
	Current	7.5 A, RMS, max. 10 A
	Ripple/Noise	Max. 200 mVpp, @20MHz bandwidth
Ambient Temperature		+15 to +35 °C
Storage Temperature		-10 to +60 °C
Humidity		≤ 80 % non-condensing
Weight		approx. 12.0 kg

Interface Signals	Analog	±5 V, ±10 V
	Digital	XY2-100 Protocol
Max. Input Aperture		15 mm
Field Size		200x200 to 1.200x1.200 mm²
Lens Positions		

Specifications for Linear Translator Modules

Field size	200 x 200 mm²	500 x 500 mm²	800 x 800 mm²	1,000 x 1,000 mm²	1,200 x 1,200 mm²
Mechanical Data:					
Distance D[1)]	183.45 mm	127.11 mm	110.1 mm	104.4 mm	100.59 mm
Working Distance[2)]	239.9 mm	491.7 mm	862.9 mm	1110.4 mm	1357.9 mm
Dynamic Data:					
Spot Diameter 1/e [3)]	15.76 µm	35.19 µm	56.06 µm	69.96 µm	83.84 µm
Resolution	< 7 µm	< 17 µm	< 26 µm	< 35 µm	< 42 µm
Acceleration Time	≤ 3 ms	≤ 3 ms	≤ 3 ms	≤ 3 ms	≤ 3 ms
Focus Range in Z Direction	------	119 mm	520 mm	1041 mm	1918 mm

1) From the front edge of the linear translator to the inner side of housing plate, 2) from the bottom edge of deflection unit to the processing field; the distance will vary with laser divergence and lens tolerance. 3) Input beam quality: M^2 = 1,0

Specifications for associated Deflection Units

	SUPERSCAN-20	SUPERSCAN-IIE-20L		
Mechanical Data:				
Beam Displacement	26.0 mm	25.63[4)]/26.28 mm		
Dynamic Data:				
Typical Deflection	±0.393 rad	±0.393 rad		
Repeatability (RMS)	3 µrad	2 µrad		
Max. Gaindrift[1)]	< 50 ppm/K	< 15 ppm/K		
Max. Offsetdrift[1)]	< 30 µrad/K	< 10 µrad/°K		
Long-term Drift [1,2)]	< 300 µrad	< 300 µrad		
Long-term Drift with water tempering [W] [W2] [1,2,3)]		< 100 µrad		
Mirrors		QU	SI	BE
Acceleration Time (10-90%) (ms)	≤ 0.6	≤ 0.58	≤ 0.61	≤ 0.40

1) From bearing surface of lens ring, incl. 1 mm safety clearance, 2) Drift per axis, 3) after warming-up, variations of ambient temperature < 1K, variations of cooling water < 1K 4) Specification for QU fused Silica mirrors

Specifications for Optics

	Nd:YAG doubled
Wavelength	532 nm
Coating	AR Coating
Max. Laser Power, cw	500 W/cm²
Max. Laser Power, 100ns Pulse Width	250 MW/cm²

AXIALSCAN-20-TY [200]

General Specifications

Power Supply	Voltage	±15 to ±18 V
	Current	7.5 A, RMS, max. 10 A
	Ripple/Noise	Max. 200 mVpp, @20MHz bandwidth
Ambient Temperature		+15 to +35 °C
Storage Temperature		-10 to +60 °C
Humidity		≤ 80 % non-condensing
Weight		approx. 12.0 kg

Interface Signals	Analog	±5 V, ±10 V, 0-10 V ±20 mA, 0-40 mA
	Digital	XY2-100 Protocol
Max. Input Aperture		15 mm
Field Size		200x200 to 1.200x1.200 mm²
Lens Positions		

Specifications for Linear Translator Modules

Field size	200 x 200 mm²	500 x 500 mm²	700 x 700 mm²	1,000 x 1,000 mm²	1,200 x 1,200 mm²
Mechanical Data:					
Distance D[1)]	166.83 mm	121.65 mm	112.18 mm	104.89 mm	102 mm
Working Distance[2)]	214 mm	585 mm	832 mm	1,204 mm	1,451 mm
Dynamic Data:					
Spot Diameter 1/e [3)]	10 µm	24 µm	33 µm	46 µm	55 µm
Resolution	< 7 µm	< 17 µm	< 24 µm	< 35 µm	< 42 µm
Acceleration Time	≤ 3 ms	≤ 3 ms	≤ 3 ms	≤ 3 ms	≤ 3 ms
Focus Range in Z Direction	10 mm	237mm	628 mm	2,002 mm	4,283 mm

1) from the front edge of the linear translator to the inner side of housing plate, 2) from the bottom edge of deflection unit to the processing field; the distance will vary with laser divergence and lens tolerance. 3) Input beam quality: M^2 = 1,0

Specifications for associated Deflection Units

	SUPERSCAN-20	SUPERSCAN-IIE-20L		
Mechanical Data:				
Beam Displacement	26.0 mm	25.63[3)]/26.28 mm		
Dynamic Data:				
Typical Deflection	±0.393 rad	±0.393 rad		
Repeatability (RMS)	3 µrad	2 µrad		
Max. Gaindrift[1)]	50 ppm/K	15 ppm/K		
Max. Offsetdrift[1)]	30 µrad/K	10 µrad/K		
Long-term Drift [1,2)]	< 300 µrad	< 150 µrad		
Long-term Drift with water tempering [W] [W2] [1,2)]		< 100 µrad		
Mirrors		QU	SI	BE
Acceleration Time (10-90%) (ms)	≤ 0.6	≤ 0.58	≤ 0.61	≤ 0.40

1) Drift per axis 2) after warming-up, variations of ambient temperature < 1K , variations of cooling water <1K 3) specification for QU fused Silica mirrors

Specifications for Optics

	Nd:YAG tripled
Wavelength	355 nm
Coating	AR Coating
Max. Laser Power, cw	100 W/cm²
Max. Laser Power, 10ns Pulse Width	20 MW/cm²

AXIALSCAN-20-Y [200]

General Specifications

Power Supply	Voltage	±15 to ±18 V
	Current	7.5 A, RMS, max. 10 A
	Ripple/noise	Max. 200 mVpp, @20MHz bandwidth
Ambient Temperature		+15 to +35 °C
Storage Temperature		-10 to +60 °C
Humidity		≤ 80 % non-condensing
Weight		approx. 12.0 kg

Interface Signals	Analog	±5 V, ±10 V
	Digital	XY2-100 Protocol
Max. Input Aperture		15 mm
Field Size		200x200 to 600x600 mm²
Lens Positions		

Specifications for Linear Translator Modules

Field size	200 x 200 mm²	300 x 300 mm²	400 x 400 mm²	500 x 500 mm²	600 x 600 mm²
Mechanical Data:					
Distance D[1)]	122.3 mm	98.07 mm	85.61 mm	78.04 mm	72.95 mm
Working Distance[2)]	221.1 mm	344.9 mm	468.6 mm	592.4 mm	716.1 mm
Dynamic Data:					
Spot Diameter 1/e [3)]	29.9 µm	44 µm	58.2 µm	72.3 µm	86.3 µm
Resolution	< 7 µm	< 10 µm	< 13 µm	< 16 µm	< 19 µm
Acceleration Time	≤ 3 ms	≤ 3 ms	≤ 3 ms	≤ 3 ms	≤ 3 ms
Focus Range in Z Direction	8.0 mm	56.0 mm	143.0 mm	280.0 mm	486.0 mm

1) From the front edge of the linear translator to the inner side of housing plate, 2) from the bottom edge of deflection unit to the processing field; the distance will vary with laser divergence and lens tolerance. 3) Input beam quality: M^2 = 1,0

Specifications for associated Deflection Units

	SUPERSCAN-20	SUPERSCAN-IIE-20L		
Mechanical Data:				
Beam Displacement	26.0 mm	25.63[3)]/26.28 mm		
Dynamic Data:				
Typical Deflection	±0.393 rad	±0.393 rad		
Repeatability (RMS)	3 µrad	2 µrad		
Max. Gaindrift[1)]	50 ppm/K	15 ppm/K		
Max. Offsetdrift[1)]	30 µrad/K	10 µrad/K		
Long-term Drift [1,2)]	< 300 µrad	< 150 µrad		
Long-term Drift with water tempering [W] [W2] [1,2,)]		< 100 µrad		
Mirrors		QU	SI	BE
Acceleration Time (10-90%) (ms)	≤ 0.6	≤ 0.58	≤ 0.61	≤ 0.40

1) Drift per axis 2) after warming-up, variations of ambient temperature < 1K , variations of cooling water <1K 3) Specification for Qu fused Silica mirrors

Specifications for Optics

	Nd:YAG
Wavelength	1,064 nm
Coating	AR Coating
Max. Laser Power, cw	1000 W/cm²
Max. Laser Power, 100ns Pulse Width	500 MW/cm²

AXIALSCAN-20-Y [600]

General Specifications

Power Supply	Voltage	±15 to ±18 V
	Current	7.5 A, RMS, max. 10 A
	Ripple/noise	Max. 200 mVpp, @20MHz bandwidth
Ambient Temperature		+15 to +35 °C
Storage Temperature		-10 to +60 °C
Humidity		≤ 80 % non-condensing
Weight		approx. 12.0 kg

Interface Signals	Analog	±5 V, ±10 V
	Digital	XY2-100 Protocol
Max. Input Aperture		15 mm
Field Size		600x600 to 1,200x1,200 mm²
Lens Positions		

Specifications for Linear Translator Modules

Field size	600 x 600 mm²	700 x 700 mm²	800 x 800 mm²	900 x 900 mm²	1,000 x 1,000 mm²	1,100 x 1,100 mm²	1,200 x 1,200 mm²
Mechanical Data:							
Distance D[1)]	76.1 mm	67.0 mm	60.3m	55.3 mm	51.2 mm	48.0 mm	45.3 mm
Working Distance[2)]	716 mm	840 mm	964 mm	1,087 mm	1,211 mm	1,335 mm	1,459 mm
Dynamic Data:							
Spot Diameter 1/e [3)]	82 µm	97 µm	112 µm	128 µm	143 µm	158 µm	173 µm
Resolution	< 19 µm	< 22 µm	< 25 µm	< 28 µm	< 31 µm	< 34 µm	< 37 µm
Acceleration Time	≤ 3 ms	≤ 3 ms	≤ 3 ms	≤ 3 ms	≤ 3 ms	≤ 3 ms	≤ 3 ms
Focus Range in Z Direction	49.0 mm	108.0 mm	187.0 mm	287.0 mm	412.0 mm	566.0 mm	753.0 mm

1) From the front edge of the linear translator to the inner side of housing plate, 2) from the edge of deflection unit to the processing field; the distance will vary with laser divergence and lens tolerance. 3) Input beam quality: M^2 = 1,0

Specifications for associated Deflection Units

	SUPERSCAN-20	SUPERSCAN-IIE-20L		
Mechanical Data:				
Beam Displacement	26.0 mm	25.63[3)]/26.28 mm		
Dynamic Data:				
Typical Deflection	±0.393 rad	±0.393 rad		
Repeatability (RMS)	3 µrad	2 µrad		
Max. Gaindrift[1)]	50 ppm/K	15 ppm/K		
Max. Offsetdrift[1)]	30 µrad/K	10 µrad/K		
Long-term Drift [1,2)]	< 300 µrad	< 150 µrad		
Long-term Drift with water tempering [W] [W2] [1,2,)]		< 100 µrad		
Mirrors		QU	SI	BE
Acceleration Time (10-90%) ms	≤ 0.6	≤ 0.58	≤ 0.61	≤ 0.40

1) Drift per axis 2) after warming-up, variations of ambient temperature < 1K ,variations of cooling water <1K 3) Specification for Qu fused Silica mirrors

Specifications for Optics

	Nd:YAG
Wavelength	1,064 nm
Coating	AR Coating
Max. Laser Power, cw	1000 W/cm²
Max. Laser Power, 100ns Pulse Width	500 MW/cm²

AXIALSCAN-30-C [100BO]

General Specifications

Power Supply	Voltage	±15 to ±18 V
	Current	7.5 A, RMS, max. 10 A
	Ripple/Noise	Max. 200 mVpp, @20MHz bandwidth
Ambient Temperature		+15 to +35 °C
Storage Temperature		-10 to +60 °C
Humidity		≤ 80 % non-condensing
Weight		approx. 13.5 kg

Interface Signals	Analog	±5 V, ±10 V
	Digital	XY2-100 Protocol
Max. Input Aperture		15 mm
Field Size		100x100 to 500x500 mm² beam optimized
Lens Positions		

Specifications for Linear Translator Modules

Field size	100 x 100 mm²	200 x 200 mm²	300 x 300 mm²	400 x 400 mm²	500 x 500 mm²
Mechanical Data:					
Distance D[1)]	177.9 mm	132.0 mm	114.8 mm	105.5 mm	99.7 mm
Working Distance[2)]	77.0 mm	201.0 mm	325.0 mm	449.0 mm	572.0 mm
Dynamic Data:					
Spot Diameter 1/e [3)]	96 µm	173 µm	250 µm	327 µm	403 µm
Resolution	< 4 µm	< 7 µm	< 10 µm	< 13 µm	< 16 µm
Acceleration Time	≤ 3 ms	≤ 3 ms	≤ 3 ms	≤ 3 ms	≤ 3 ms
Focus Range in Z Direction	-----	34 mm	111 mm	248 mm	473 mm

1) from the front edge of the linear translator to the inner side of housing plate, 2) from the bottom edge of deflection unit to the processing field; the distance will vary with laser divergence and lens tolerance. 3) Input beam quality: M^2 = 1,0

Specifications for associated Deflection Units

	TURBOSCAN-30	SUPERSCAN-IIE-30				SUPERSCAN-III-30							
Mechanical Data:													
Beam Displacement	35.7mm	35.38[4)]/35.82 mm				35.4[4)]/36.0 mm							
Dynamic Data:													
Typical Deflection	±0.393 rad	±0.393 rad				±0.393 rad							
Repeatability (RMS)	2 µrad	2 µrad				2 µrad							
Max. Gaindrift[1)]	70 ppm/K	15 ppm/K				15 ppm/K							
Max. Offsetdrift[1)]	35 µrad/K	10 µrad/K				10 µrad/K							
Long-term Drift [1,2)]	< 400 µrad	< 150 µrad											
Long term Drift with water tempering [W] [W2] [1,2,3)]		< 100 µrad				< 60 µrad[3)]							
Mirrors		QU	SI	SC	BE	QU		SI		SC		BE	
Tunings						LN	RA	LA	RN	LA	RN	LA	RN
Acceleration Time (10-90%) (ms)	0.90	0.90	0.84	0.52	0.50	0.90	0.77	0.85	0.76	0.60	0.52	0.56	0.49

1) Drift per axis, 2) after warming-up, variations of ambient temperature < 1K, variations of cooling water <1K 3) with water tempering at 4.5 l/min and 22°C temperature after 0.5 h warm-up 4) Specification for Qu fused Silica mirrors

Specifications for Optics

	CO_2
Wavelength	10,600 nm
Coating	AR Coating
Max. Laser Power, cw	700 W/cm²

AXIALSCAN-30-C [250BO]

General Specifications

Power Supply	Voltage	±15 to ±18 V
	Current	7.5 A, RMS, max. 10 A
	Ripple/Noise	Max. 200 mVpp, @20MHz bandwidth
Ambient Temperature		+15 to +35 °C
Storage Temperature		-10 to +60 °C
Humidity		≤ 80 % non-condensing
Weight		approx. 13.5 kg

Interface Signals	Analog	±5 V, ±10 V
	Digital	XY2-100 Protocol
Max. Input Aperture		15 mm
Field Size		250x250 to 1,250x1,250 mm² beam optimized
Lens Positions		

Specifications for Linear Translator Modules

Field size	250 x 250 mm²	500 x 500 mm²	750 x 750 mm²	1,000 x 1,000 mm²	1,250 x 1,250 mm²
Mechanical Data:					
Distance D[1)]	161.7 mm	123.3 mm	110.5 mm	104.0 mm	100.2 mm
Working Distance[2)]	263.0 mm	572.0 mm	882.0 mm	1,191.0 mm	1,500.0 mm
Dynamic Data:					
Spot Diameter 1/e [3)]	221.0 µm	440.0 µm	658.0 µm	877.0 µm	1095.0 µm
Resolution	< 8 µm	< 16 µm	< 23 µm	< 31 µm	< 39 µm
Acceleration Time	≤ 3 ms	≤ 3 ms	≤ 3 ms	≤ 3 ms	≤ 3 ms
Focus Range in Z Direction	6 mm	173 mm	602 mm	1540 mm	3710 mm

1) from the front edge of the linear translator to the inner side of housing plate, 2) from the bottom edge of deflection unit to the processing field; the distance will vary with laser divergence and lens tolerance. 3) Input beam quality: M^2 = 1,0

Specifications for associated Deflection Units

	TURBOSCAN-30	SUPERSCAN-IIE-30				SUPERSCAN-III-30							
Mechanical Data:													
Beam Displacement	35.7mm	35.38[4)]/35.82 mm				35.4[4)]/36.0 mm							
Dynamic Data:													
Typical Deflection	±0.393 rad	±0.393 rad				±0.393 rad							
Repeatability (RMS)	2 µrad	2 µrad				2 µrad							
Max. Gaindrift[1)]	70 ppm/K	15 ppm/K				15 ppm/K							
Max. Offsetdrift[1)]	35 µrad/K	10 µrad/K				10 µrad/K							
Long-term Drift [1,2)]	< 400 µrad	< 150 µrad											
Long term Drift with water tempering [W] [W2] [1,2;3)]		< 100 µrad				< 60 µrad[3)]							
Mirrors		QU	SI	SC	BE	QU		SI		SC		BE	
Tunings						LN	RA	LN	RA	LN	RA	LN	RA
Acceleration Time (10-90%) (ms)	0.90	0.90	0.84	0.52	0.50	0.90	0.77	0.85	0.76	0.60	0.52	0.56	0.49

1) Drift per axis, 2) after warming-up, variations of ambient temperature < 1K, variations of cooling water <1K 3) with water tempering at 4.5 l/min and 22˚C temperature after 0.5 h warm-up 4) Specification for QU fused Silica mirrors

Specifications for Optics

	CO_2
Wavelength	10,600 nm
Coating	AR Coating
Max. Laser Power, cw	700 W/cm²

AXIALSCAN-30-C [300BO]

General Specifications

Power Supply	Voltage	±15 to ±18 V
	Current	7.5 A, RMS, max. 10 A
	Ripple/Noise	Max. 200 mVpp, @20MHz bandwidth
Ambient Temperature		+15 to +35 °C
Storage Temperature		-10 to +60 °C
Humidity		≤ 80 % non-condensing
Weight		approx. 13.5 kg

Interface Signals	Analog	±5 V, ±10 V
	Digital	XY2-100 Protocol
Max. Input Aperture		15 mm
Field Size		300x300 to 750x750 mm² beam optimized
Lens Positions		

Specifications for Linear Translator Modules

Field size	300 x 300 mm²	400 x 400 mm²	500 x 500 mm²	600 x 600 mm²	750 x 750 mm²
Mechanical Data:					
Distance D[1)]	206.0 mm	187.0 mm	175.0 mm	167.0 mm	159.0 mm
Working Distance[2)]	325.0 mm	448.0 mm	572.0 mm	696.0 mm	882.0 mm
Dynamic Data:					
Spot Diameter 1/e [3)]	200.0 µm	265.0 µm	330.0 µm	390.0 µm	490.0 µm
Resolution	< 10 µm	< 13 µm	< 16 µm	< 19 µm	< 23 µm
Acceleration Time	≤ 3 ms	≤ 3 ms	≤ 3 ms	≤ 3 ms	≤ 3 ms

1) From the front edge of the linear translator to the inner side of housing plate, 2) from the bottom edge of deflection unit to the processing field; the distance will vary with laser divergence and lens tolerance. 3) Input beam quality: M^2 = 1,0

Specifications for associated Deflection Units

	TURBOSCAN-30	SUPERSCAN-IIE-30				SUPERSCAN-III-30							
Mechanical Data:													
Beam Displacement	35.7mm	35.38[4)]/35.82 mm				35.4[4)]/36.0 mm							
Dynamic Data:													
Typical Deflection	±0.393 rad	±0.393 rad				±0.393 rad							
Repeatability (RMS)	2 µrad	2 µrad				2 µrad							
Max. Gaindrift[1)]	70 ppm/K	15 ppm/K				15 ppm/K							
Max. Offsetdrift[1)]	35 µrad/K	10 µrad/K				10 µrad/K							
Long-term Drift [1,2)]	< 400 µrad	< 150 µrad											
Long term Drift with water tempering [W] [W2] [1,2;3)]		< 100 µrad				< 60 µrad[3)]							
Mirrors		QU	SI	SC	BE	QU		SI		SC		BE	
Tunings						LN	RA	LN	RA	LN	RA	LN	RA
Acceleration Time (10-90%) (ms)	0.90	0.90	0.84	0.52	0.50	0.90	0.77	0.85	0.76	0.60	0.52	0.56	0.49

1) Drift per axis, 2) after warming-up, variations of ambient temperature < 1K, variations of cooling water <1K 3) with water tempering at 4.5 l/min and 22˚C temperature after 0.5 h warm-up 4) Specification for Qu fused Silica mirrors

Specifications for Optics

	CO_2
Wavelength	10,600 nm
Coating	AR Coating
Max. Laser Power, cw	700 W/cm²

AXIALSCAN-30-C [200HP]

General Specifications

Power Supply	Voltage	±15 to ±18 V
	Current	7.5 A, RMS, max. 10 A
	Ripple/Noise	Max. 200 mVpp, @20MHz bandwidth
Ambient Temperature		+15 to +35 °C
Storage Temperature		-10 to +60 °C
Humidity		≤ 80 % non-condensing
Weight		approx 16.5 kg

Interface Signals	Analog	±5 V, ±10 V
	Digital	XY2-100 Protocol
Input Aperture (fbd)		20 mm
Field Size		200x200 bis 600x600 mm² beam optimized
Lens Position		

Specifications for Linear Translator Modules

Field size	200 x 200 mm²	300 x 300 mm²	400 x 400 mm²	500 x 500 mm²	600 x 600 mm²
Mechanical Data:					
Distance D[1)]	112mm	88 mm	76 mm	68 mm	63 mm
Working Distance[2)]	199.2 mm	322.9 mm	446.7 mm	570.4 mm	694.2 mm
Dynamic Data:					
Spot Diameter 1/e [3)]	173.7 µm	255.4 µm	337.1 µm	418.8 µm	500.5 µm
Resolution	< 7 µm	< 10 µm	< 14 µm	< 17 µm	< 20 µm
Acceleration Time	≤ 2.5 ms	≤ 2.5 ms	≤ 2.5 ms	≤ 2.5 ms	≤ 2.5 ms

1) from the front edge of the linear translator to the inner side of housing plate, 2) from the bottom edge of deflection unit to the processing field; the distance will vary with laser divergence and lens tolerance. 3) Input beam quality: M^2 = 1,0

Specifications for associated Deflection Units

	SUPERSCAN-IIE-30				SUPERSCAN-III-30							
Mechanical Data:												
Beam Displacement	35.38[4)]/35.82 mm				35.4[4)]/36.0 mm							
Dynamic Data:												
Typical Deflection	±0.393 rad				±0.393 rad							
Repeatability (RMS)	2 µrad				2 µrad							
Max. Gaindrift[1)]	15 ppm/K				15 ppm/K							
Max. Offsetdrift[1)]	10 µrad/K				10 µrad/K							
Long-term Drift [1,2)]	< 150 µrad											
Long term Drift with water tempering [W] [W2] [1,2,3)]	< 100 µrad				< 60 µrad[3)]							
Mirrors	QU	SI	SC	BE	QU		SI		SC		BE	
Tunings					LN	RA	LN	RA	LN	RA	LN	RA
Acceleration Time (10-90%) (ms)	0.90	0.84	0.52	0.50	0.90	0.77	0.85	0.76	0.60	0.52	0.56	0.49

1) Drift per axis, 2) after warming-up, variations of ambient temperature < 1K, variations of cooling water <1K 3) with water tempering at 4.5 l/min and 22˚C temperature after 0.5 h warm-up 4) specification for QU fused Silica mirrors

Specifications for Optics

	CO_2
Wavelength	10.600 nm
Coating	AR Coating
Max. Laser Power, cw	700 W/cm²

Water tempering

Requirements	
Wasser[1)]	Clean tap water with additives
Temperatur	22-28°C
Druck Maximum	2-3 bar

Flow rate	Pressure loses
2 l / min	0.3 bar
4 l / min	0.6 bar
6 l / min	0.9 bar

(1) **Caution:** When using cooling water including deionized water, suitable additives must be used to prevent the growth of algae and protect the aluminium parts against corrosion.

Additive recommendations: Standard industrial applications e.g. CCL105 (NALCO)

Food & beverage, packaging applications: e.g. polypropylene glycol (Dow Chemical)

Please consult your additive supplier for dosage information

Air flushing

Air	oil-free, technically pure

AXIALSCAN-30-C [600HP]

General Specifications

Power Supply	Voltage	±15 to ±18 V
	Current	7.5 A, RMS, max. 10 A
	Ripple/Noise	Max. 200 mVpp, @20MHz bandwidth
Ambient Temperature		+15 to +35 °C
Storage Temperature		-10 to +60 °C
Humidity		≤ 80 % non-condensing
Weight		approx 16.5 kg

Interface Signals	Analog	±5 V, ±10 V
	Digital	XY2-100 Protocol
Input Aperture (fbd)		20 mm
Field Size		600x600 to 1200x1200 mm² beam optimized
Lens Position		

Specifications for Linear Translator Modules

Field size	600 x 600 mm²	800 x 800 mm²	1000 x 1000 mm²	1200 x 1200 mm²
Mechanical Data:				
Distance D[1)]	162 mm	143 mm	131 mm	123 mm
Working Distance[2)]	694 mm	941 mm	1189 mm	1436 mm
Dynamic Data:				
Spot Diameter 1/e [3)]	492 µm	653 µm	813 µm	974 µm
Resolution	< 20 µm	< 27 µm	< 34 µm	< 40 µm
Acceleration Time	≤ 2.5 ms	≤ 2.5 ms	≤ 2.5 ms	≤ 2.5 ms

1) from the front edge of the linear translator to the inner side of housing plate, 2) from the bottom edge of deflection unit to the processing field; the distance will vary with laser divergence and lens tolerance. 3) Input beam quality: M^2 = 1,0

Specifications for associated Deflection Units

	SUPERSCAN-IIE-30				SUPERSCAN-III-30							
Mechanical Data:												
Beam Displacement	35.38[4)]/35.82 mm				35.4[4)]/36.0 mm							
Dynamic Data:												
Typical Deflection	±0.393 rad				±0.393 rad							
Repeatability (RMS)	2 µrad				2 µrad							
Max. Gaindrift[1)]	15 ppm/K				15 ppm/K							
Max. Offsetdrift[1)]	10 µrad/K				10 µrad/K							
Long-term Drift [1,2)]	< 150 µrad											
Long term Drift with water tempering [W] [W2] [1,2,3)]	< 100 µrad				< 60 µrad[3)]							
Mirrors	QU	SI	SC	BE	QU		SI		SC		BE	
Tunings					LN	RA	LN	RA	LN	RA	LN	RA
Acceleration Time (10-90%) (ms)	0.90	0.84	0.52	0.50	0.90	0.77	0.85	0.76	0.60	0.52	0.56	0.49

2) Drift per axis, 2) after warming-up, variations of ambient temperature < 1K, variations of cooling water <1K 3) with water tempering at 4.5 l/min and 22°C temperature after 0.5 h warm-up 4) specification for QU fused Silica mirrors

Specifications for Optics

	CO_2
Wavelength	10,600 nm
Coating	AR Coating
Max. Laser Power 1/e², cw	700 W/cm²

Water tempering

Requirements	
Wasser[1)]	Clean tap water with additives
Temperatur	22-28°C
Druck Maximum	2-3 bar

Flow rate	Pressure loses
2 l / min	0.3 bar
4 l / min	0.6 bar
6 l / min	0.9 bar

(1) **Caution:** When using cooling water including deionized water, suitable additives must be used to prevent the growth of algae and protect the aluminium parts against corrosion.

Additive recommendations: Standard industrial applications: e.g. CCL105 (NALCO)

Food & beverage, packaging applications: e.g. polypropylene glycol (Dow Chemical)

Please consult your additive supplier for dosage information

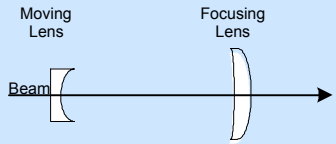
Air flushing

Air	oil-free, technically pure

AXIALSCAN-30-Y [300HP]

General Specifications

Power Supply	Voltage	±15 V to ±18 V
	Current	7.5 A, RMS, max. 10 A
	Ripple/Noise	Max. 200 mVpp, @20MHz bandwidth
Ambient Temperature		+15 °C to +35 °C
Storage Temperature		-10 °C to +60 °C
Humidity		≤ 80 % non condensing
Weight		approx. 16.5 kg

Interface Signals	Analog	±5 V, ±10 V
	Digital	XY2-100 Protocol
Max. Input Aperture		20 mm
Field Size		300x300 mm² to 1200x1200 mm² Beam optimized
Lens Positions		

Specifications for Linear-Translator-Modules

Field Size	300 x 300 mm²	500 x 500 mm²	800 x 800 mm²	1000 x 1000 mm²	1200 x 1200 mm²
Mechanical Data:					
Distance D[1)]	132 mm	104 mm	87 mm	81 mm	77 mm
Working Distance[2)]	332 mm	579 mm	950 mm	1198 mm	1446 mm
Dynamic Data:					
Spot Diameter 1/e[3)]	27µm	44µm	70 µm	87 µm	104 µm
Resolution	< 10 µm	< 17 µm	< 27 µm	< 34 µm	< 41 µm

1) From the font edge of the linear translator to the inner side of the housing plate, 2) From the bottom edge of the deflection unit to the processing field; the distance will vary with laser divergence and lens tolerance. 3) Input Beam Quality: M^2 = 1.0

Specifications for associated Deflection Units

	SUPERSCAN-IIE-30				SUPERSCAN-III-30							
Mechanical Data:												
Beam Displacement	35.38[4)]/35.82 mm				35.4[4)]/36.0 mm							
Dynamic Data:												
Typical Deflection	±0.393 rad				±0.393 rad							
Repeatability (RMS)	2 µrad				2 µrad							
Max. Gaindrift[1)]	15 ppm/K				15 ppm/K							
Max. Offsetdrift[1)]	10 µrad/K				10 µrad/K							
Long-term Drift [1,2)]	< 150 µrad											
Long term Drift with water tempering [W] [W2] [1,2,3)]	< 100 µrad				< 60 µrad[3)]							
Mirrors	QU	SI	SC	BE	QU		SI		SC		BE	
Tunings					LN	RA	LN	RA	LN	RA	LN	RA
Acceleration Time (10-90%) (ms)	0.90	0.84	0.52	0.50	0.90	0.77	0.85	0.76	0.60	0.52	0.56	0.49

1)Drift per axis, 2) after warming-up, variations of ambient temperature < 1K, variations of cooling water <1K 3) with water tempering at 4.5 l/min and 22˚C temperature after 0.5 h warm-up 4) specification for QU fused Silica mirrors

Specifications for Optics

	Nd:YAG
Wavelength	1,064 nm
Coating	AR Coating
Max. Laser Power, cw, W/cm²	1000 W/cm²

Water Tempering

Specifications	
Water[1)]	Clean tap water with additives
Temperature	22°C to 28°C
Maximum Pressure	2 bar to 3 bar

Flow rate	Pressure loss
2 l / min	0.5 bar
4 l / min	0.8 bar
6 l / min	1.1 bar

(1) **Caution:** When using cooling water including deionized water, suitable additives must be used to prevent the growth of algae and protect the aluminium parts against corrosion.

Additive recommendations:

Standard industrial applications e.g. CCL105 (NALCO)

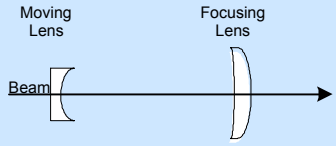
Food & beverage, packaging applications: e.g. polypropylene glycol (Dow Chemical)

Please consult your additive supplier for dosage information

AXIALSCAN-30-Y [260]

General Specifications

Power Supply	Voltage	±15 V to ±18 V
	Current	7.5 A, RMS, max. 10 A
	Ripple/Noise	Max. 200 mVpp, @20MHz bandwidth
Ambient Temperature		+15 °C to +35 °C
Storage Temperature		-10 °C to +60 °C
Humidity		≤ 80 % non condensing
Weight		approx. 16.5 kg

Interface Signals	Analog	±5 V, ±10 V
	Digital	XY2-100 Protocol
Max. Input Aperture		15 mm
Field Size		260x260 mm² to 600x600 mm² Beam optimized
Lens Positions		

Specifications for Linear-Translator-Modules

Field Size	260 x 260 mm²	300 x 300 mm²	400 x 400 mm²	500 x 500 mm²	600 x 600 mm²
Mechanical Data:					
Distance D[1)]	135 mm	128 mm	116 mm	109 mm	104 mm
Working Distance[2)]	282 mm	332 mm	455 mm	579 mm	703 mm
Dynamic Data:					
Spot Diameter 1/e[3)]	22.9 µm	26.15 µm	34.27 µm	42.39 µm	50.5 µm
Resolution	< 8 µm	< 10 µm	< 13 µm	< 16 µm	< 19 µm

1) From the font edge of the linear translator to the inner side of the housing plate, 2) From the bottom edge of the deflection unit to the processing field; the distance will vary with laser divergence and lens tolerance. 3) Input Beam Quality: M^2 = 1.0

Specifications Deflection Unit

	TS-II-30	SS-III-30						
Mechanical Data:								
Beam Displacement	35.7 mm	35.4[4)]/36.0						
Dynamic Data:								
Typical Deflection	35.7 mm	±0.393 rad						
Repeatability (RMS)	2 µrad	< 2 µrad						
Max. Gaindrift[1)]	< 70 ppm/K	< 15 ppm/K						
Max. Offsetdrift[1)]	< 35 µrad/K	< 10 µrad/K						
Long-term Drift [1,2)]	< 400 µrad							
Long-term Drift with water tempering [W] [W2] [1,2,3)]		< 60 µrad[3)]						
Mirrors		QU		SI		SC		BE	
Tunings		LN	RA	LN	RA	LN	RA	LN	RA
Acceleration Time (10-90%) (ms)	≤ 0.90	≤ 0.90	≤ 0.77	≤ 0.85	≤ 0.76	≤ 0.60	≤ 0.52	≤ 0.56	≤ 0.49

1) Drift per Axis, 2) After warming-up, variations of ambient temperature < 1K, variations of cooling water < 1K 3) with water tempering at 4.5 l/min and 22°C water temperature after 0.5 h warm up 4) Specification for QU fused Silica mirrors

Specifications for Optics

	Nd:YAG
Wavelength	1,064 nm
Coating	AR Coating
Max. Laser Power, cw, W/cm²	1000 W/cm²

FOCUSSHIFTER

General Specifications

Power Supply	Voltage	±15 to ±18 V
	Current	7.5 A, RMS, max. 10 A
	Ripple/ Noise	Max.200 mVpp, @20MHz bandwidth

Ambient Temperature		+15 to +35 °C
Storage Temperature		-10 to +60 °C
Humidity		≤ 80 % non-condensing
Interface Signals	Analog	±5 V, ±10 V
	Digital	XY2-100 Protocol

Specifications for Linear Translator Modules

	Nd:YAG	Nd:YAG doubled	Nd:YAG Tripled	CO_2	CO_2
Input Aperture	5.0 mm	5.0 mm	5.0 mm	10.0 mm	10.0 mm
Beam Expansion Factor	3.0	3.0	2.0	1.5	2.0
Focus Range in Z-Direction	+/- 15.0 mm[1)]	+/- 10.0 mm[1)]	+/- 25.0 mm[1)]	+/- 10.0 mm[2)]	+/- 15.0 mm[2)]
Weight	approx. 7.5 kg	approx. 7.5 kg	approx. 7.5 kg	approx. 7.5 kg	approx. 7.5 kg

1) with F-Theta Lens f = 160 mm, 2) with F-Theta Lens f = 250 mm

Specifications for associated Deflection Units

	SS-IIE-15		SS III-15						SUPERSCAN IIE-20		
Mechanical Data:											
Input Aperture (mm)	15.0		15.0 mm						20.0 mm		
Beam Displacement (mm)	18.05[4)]/18.55		18.1[4)]/18.6						26.28[4)]/25.63		
Weight (without Lens) (kg)	approx. 3.8		approx. 2.9 kg						approx. 3.3 kg		
Dynamic Data:											
Typical Deflection	±0.393 rad		±0.393 rad						±0.393 rad		
Repeatability (RMS)	2 µrad		2 µrad						2 µrad		
Max. Gaindrift[1)] (ppm/K)	< 15		< 15						< 15		
Max. Offsetdrift[1)] (µrad/K)	< 10		< 10						< 10		
Long-term Drift [1,2)] µrad	< 150								< 150		
Long-term Drift with water tempering [W] [W2] [1,2,3)]	< 100		< 60 [3)]						< 100		
Mirrors	QU	BE	QU		SI		BE		QU	SI	BE
Tunings			LN	RA	LN	RA	LN	RA			
Acceleration Time (10-90%) ms	≤ 0.36	≤ 0.24	≤ 0.36	≤ 0.31	≤ 0.30	≤ 0.27	≤ 0.23	≤ 0.20	≤ 0.58	≤ 0.61	≤ 0.40

1) Drift per axis, 2) after warming-up, variations of ambient temperature < 1K, variations of cooling water 3) with water tempering at 4.5 l/min and 22° C water temperature after 0.5 h warm up. 4) Specification for QU fused Silica mirrors

Specifications for Optics

	Nd:YAG	Nd:YAG doubled	Nd:YAG Tripled	CO_2
Wavelength	1,064 nm	532 nm	355 nm	10,600 nm
Coating	AR Coating	AR Coating	AR Coating	AR Coating
Max. Laser Power, cw (W/cm^2)	1000	500	100	700

Specifications for F-Theta Lenses

	Nd:YAG	Nd:YAG doubled	Nd:YAG Tripled	CO_2
Wavelength	1,064 nm	532 nm	355 nm	10,600 nm
Lens	f = 160 mm	f = 160 mm	f = 160 mm	f = 250 mm
Typical Field Size	95 mm x 95 mm	95 mm x 95 mm	95 mm x 95 mm	150 mm x 150 mm
Spotdiameter 1/e², TEM00 Aperture 15 mm / 20 mm	30 µm / -	15 µm / -	10 µm / -	270 µm / 220 µm
Working Distance	209 mm +/- focus range	208 mm +/- focus range	248 mm +/- focus range	193 mm +/- focus range