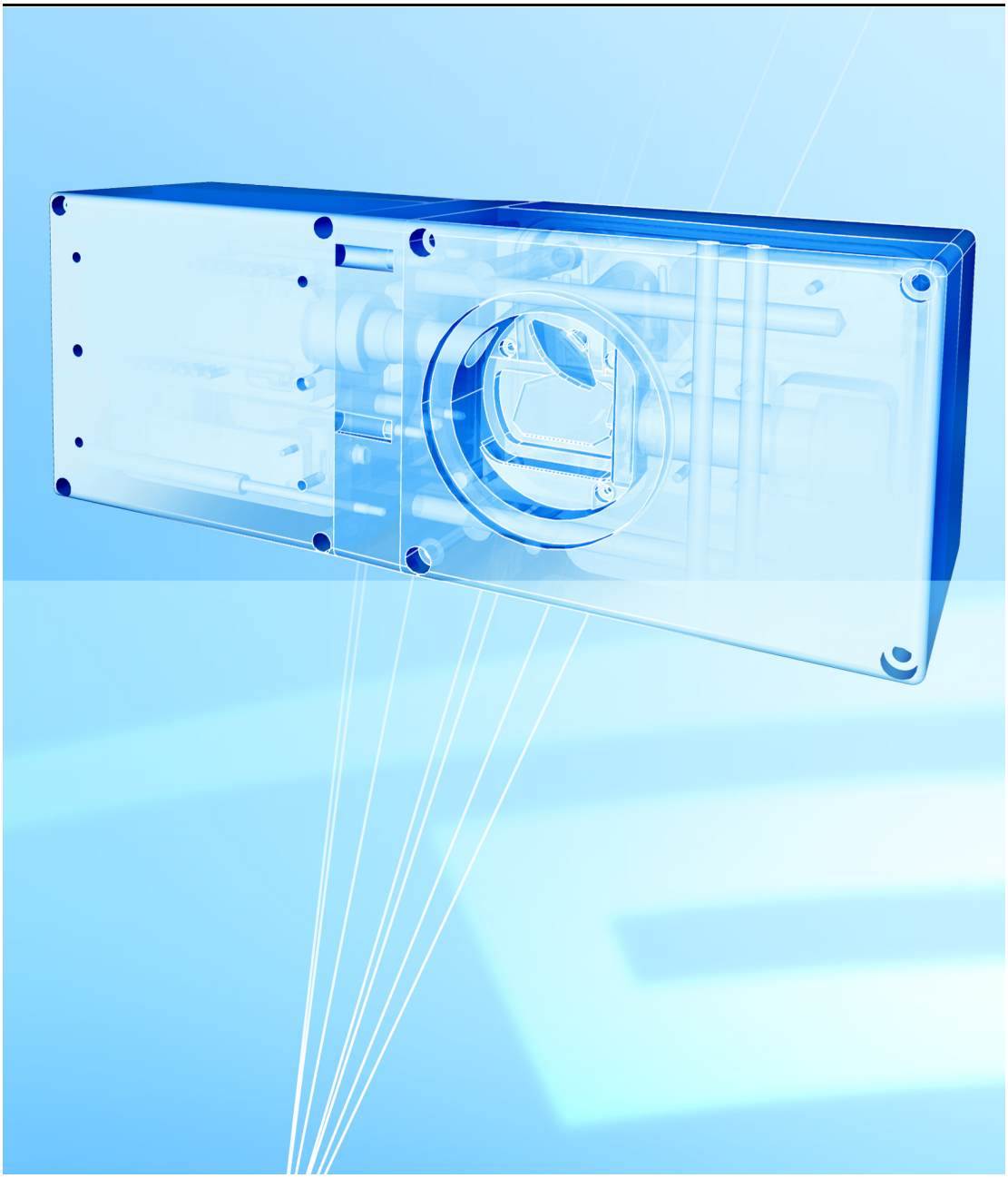
RAYLASE
focus on laser

3-Axis Subsystems for Laser Beam Deflection

FOCUSSHIFTER COMPACT SIZE



This manual has been compiled by RAYLASE for its customers and employees.

RAYLASE reserves the right to change the product described in this manual and the information contained therein without prior notice.

CONTENTS

1 BASIC INFORMATION

1.1 Introduction

This manual describes the general handling of FOCUSSHIFTER COMPACT SIZE subsystems. For reasons of clarity in the following text the general term "subsystem" is used. Each subsystem is assembled according to customer specifications and the modules are optimally adjusted in the factory under clean room conditions. A change in the composition as well as changing the adjustment is not possible in the field. The present type of each subsystem can be verified on the nameplate (⇨ page 9, Rating plate code).

This manual contains important information on qualified and safe handling of the subsystem. You should therefore first become familiar with the contents of this manual before taking the subsystem into operation. If in doubt, please contact RAYLASE.

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

1.2 Package contents

- FOCUSSHIFTER COMPACT SIZE (subsystem)
- Correction files and datasheets on CD

Optional:

- F-Theta objective
- Control card
- Connecting cable [RAYLASE control card - Subsystem]
- Software package

1.3 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.

For shipping, pack the product in the original packaging or in packaging that provides equivalent protection.

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 surfaces.
- If the product has been damaged because of unqualified cleaning of the optical surfaces.
- 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 subjected to separate warranty conditions. Refer to corresponding manuals for information.

1.4 Manufacturer

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82234 Wessling
Germany
Tel.: +49 (0) 81 53 - 88 98 - 0
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http://www.raylase.de
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1.5 Customer Service

The RAYLASE customer service is available for your problems either in respect to the subsystem or this manual. Before calling the customer service, please make sure you have refered to any appropriate sections in the manuals on the supplied CD, that may answer your question.

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

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

... ask for the customer service

2 BASIC SAFETY INSTRUCTIONS

2.1 Laser safety

The operator of a laser device is responsible for safe operation and for safeguarding the surrounding area against hazards which may be caused by laser radiation. This manual interprets a selection of accident prevention regulations from the perspective of using laser subsystems in industrial plants. OEM customers need to ensure that all local and national standards, rules, regulations and laws are observed.

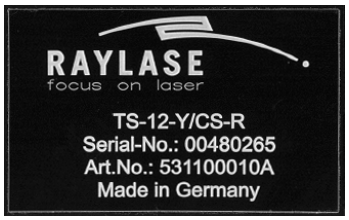
2.2 Laser shutter

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

The laser device must be of sufficient quality, so that the laser beam can only be emitted at the beam output on the subsystem.

2.3 Labeling

The following labels must be attached to the subsystem. These labels may not be removed. Labels that have become illegible need to be replaced by suiting ones.



With the **nameplate** and the type code printed on it, important properties of the subsystem can be determined (⇨ page 9, Rating plate code). The serial number and the item number are also used to identify the subsystem.

The **ground symbol** identifies the ground connection of the subsystem. This connection can be used 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 label** warns against unauthorized opening of the subsystem. If the 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. It provides information about the type of radiation, the 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).

2.4 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. by 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 comply with 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 comply with 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. The laser device may require additional protective equipment as a result.

2.5 Laser area

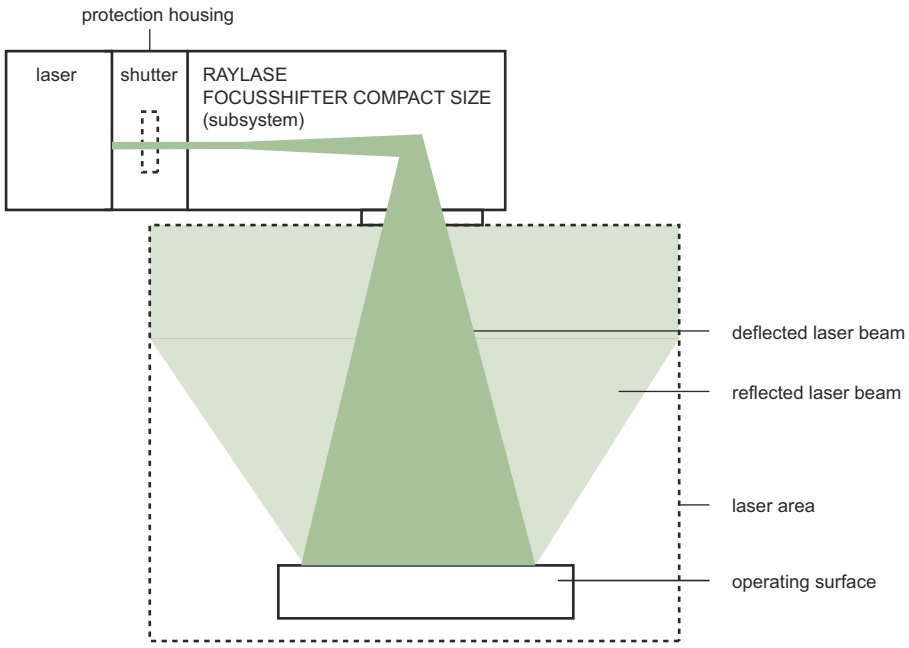
For the purposes of accident prevention, the laser area is defined as the area in which the maximum permitted radiation value can be exceeded. This is generally applicable for class 3B, 3R and 4 lasers. For class 1 to 2M laser devices, a laser area can be produced by focusing the laser beam.

The laser area is the area that can be exposed to radiation covering the entire radiation angle of the subsystem and including the reflection from objects. Note that even matte and dark surfaces can reflect laser radiation and that a laser beam wich 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, since they could be ignited by the energy of the laser beam.

Fig. 1
Laser area



3 TECHNICAL DATA

Consecutively the common features of all subsystems of the FOCUSSHIFTER COMPACT SIZE series are listed. For type-specific features, please refer to the corresponding data sheet. The individual data can be assigned using the rating plates code (⇨ below).

3.1 Rating plate code

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

Linear Translator Module

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-------------------------------------------------------------------------------------------------
┌ TYPE DESIGNATION
│ LTM-FS-CS.................................LINEAR TRANSLATOR MODULE FOR FOCUSSHIFTER COMAPCT SIZE
│
│         ┌ amplification factor
│         │ Lx.............................Beam Expansion Factor x
│         │
│         │  ┌ aperture (mm)
│         │  │
│         │  │    ┌ 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-CS-Lx-XX [X] X Vx X /X
-------------------------------------------------------------------------------------------------
```

3.2 Conformity with directives

The subsystem conforms to the requirements of the following directives:

- EU Directive 89/336/EEC or German law on electromagnetic compatibility (EMVG)
- EU Directive 2002/95/EC or German law on electrical equipment (ElektroG)

For details of conformity with other directives, please contact RAYLASE.

4 FUNCTIONAL DESCRIPTION

The subsystem can be used to deflect a laser beam in XY and Z direction. This results in a three-dimensional area, within a laser can be directed at any position. This area is known as the "operating area" and is shown in (⇨ Fig. 2).

The deflection of the laser beam in the XY direction is made by two mirrors, which are driven by galvanometer scanner. The focus shift is performed by a linearly movable lens (Z-axis). This makes it possible to perform three-dimensional processing. For example this is useful on uneven surfaces or in deep processing of materials.

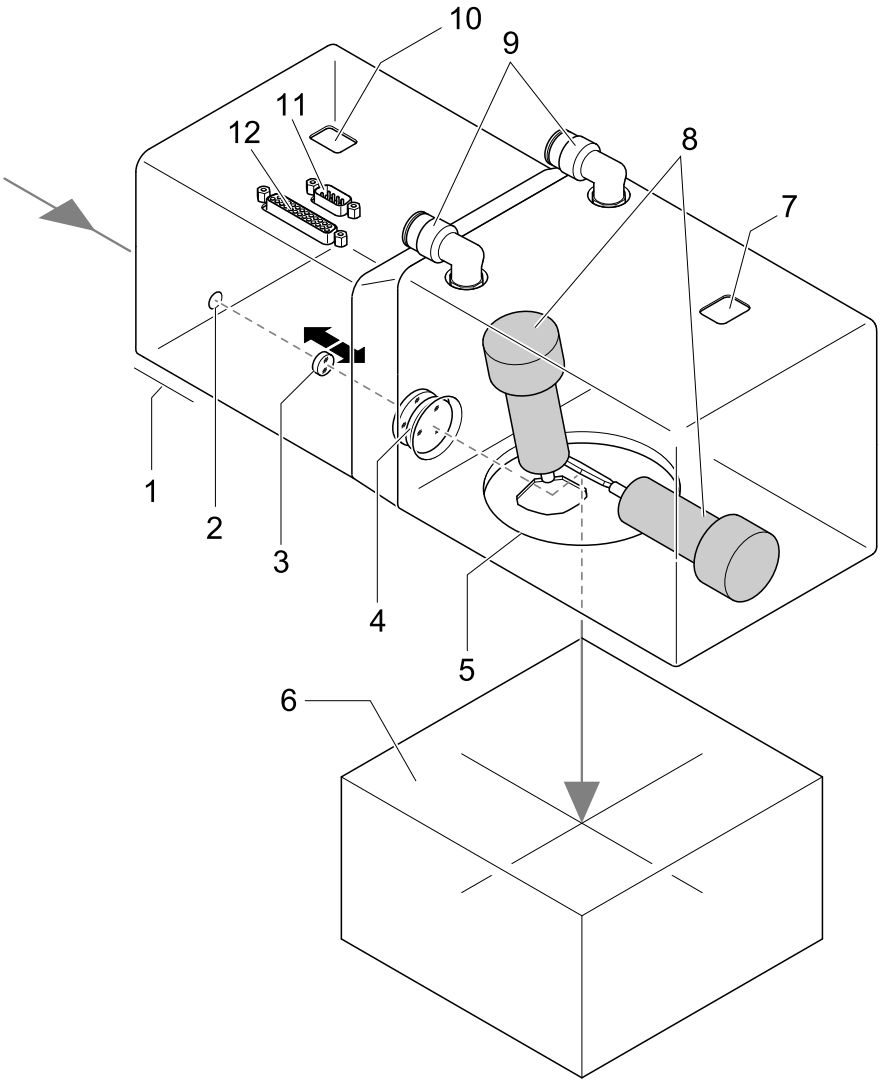


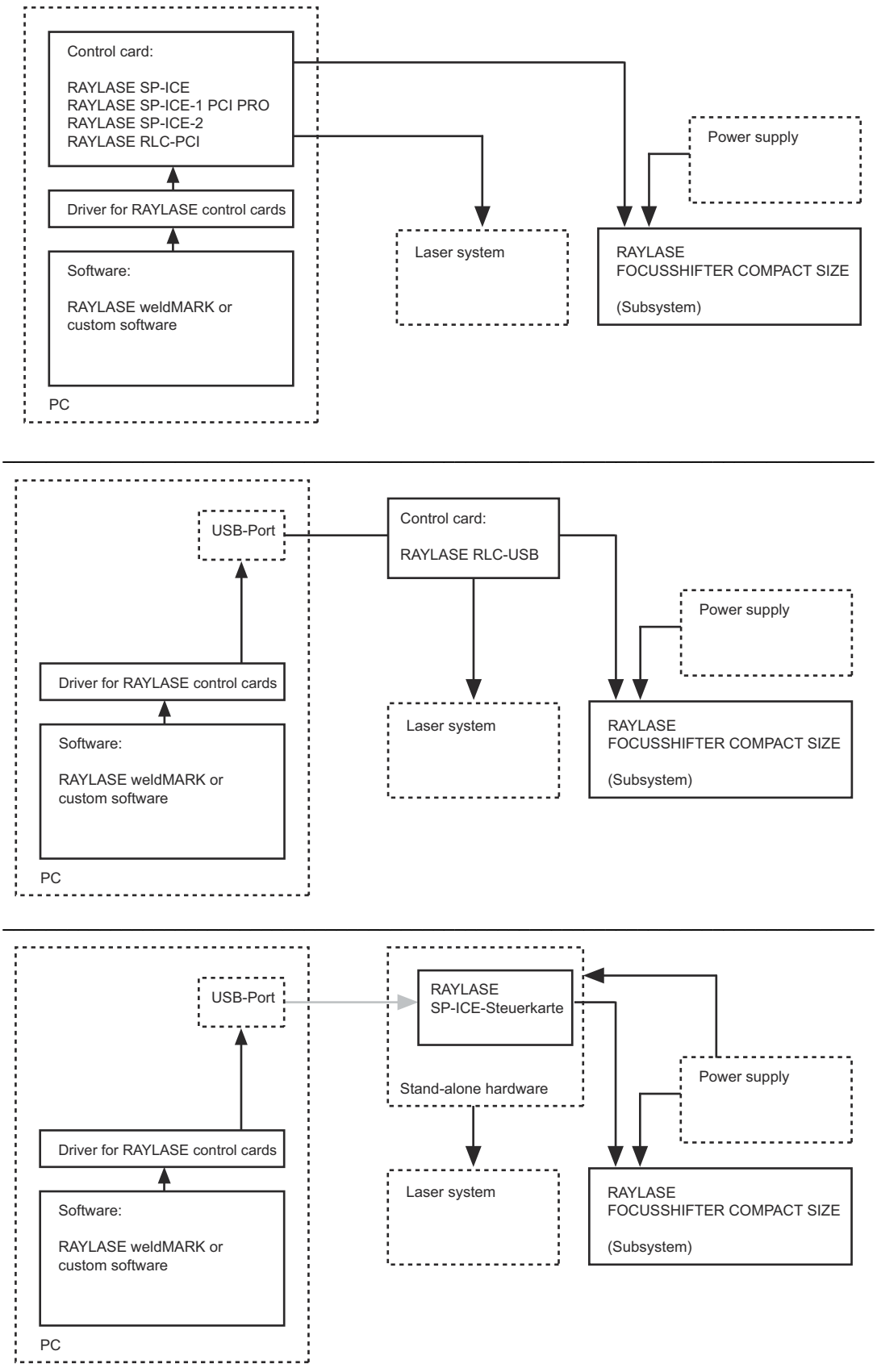
Fig. 2
Functional principle

1 Subsystem cpl.
2 Beam input
3 Lens with linear movement
4 Focusing lenses
5 Beam output
6 Operating area
7 Status LEDs for the XY axis
8 Galvanometer scanner with mirrors
9 Water cooling (optional)
10 Status LEDs for the Z axis
11 Power supply of the subsystem
12 Digital interface of the subsystem

4.1 Typical Configurations

The following graphic shows three typical laser devices with digital control that are realized with the subsystem and other modules of RAYLASE. Customer-specific modules are shown by dashed lines.

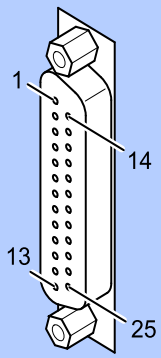
Fig. 3
Typical Configurations



4.2 Interfaces of the subsystem

4.2.1 Digital Interface

The subsystem is connected to a RAYLASE control card using the 25-pin D-SUB connector. All signals are compatible with 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 = Input, O = Output, nc = not connected

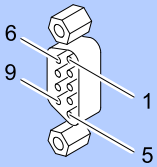
Specifications

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	

4.2.2 Power supply

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

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

Designation	Voltage	Current	Residual ripple	Noise factor
-VSS	-15V to -18V	min 7A	≤100mV	≤0,5% DC at 30MHz
+VSS	+15V to +18V	min 7A		

4.3 Status LEDs

With the status LED's important functions and states of the subsystem can be checked. The status LEDs are located behind a protective window on the top of the subsystem (⇨ page11, Fig. 2).

4.3.1 Status LEDs for the XY axis

LED arrangement	Name	Color	Meaning	
D7 D11 D3 D5 D9 D1 D2 D4 D8 D6 D10	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	LEDs light when power supply is turned on.
	D11	green	-VCC	

4.3.2 Status LEDs for the Z axis

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

5 INSTALLATION

The following sections describe the installation of the subsystem to a laser device. Before assembly, it has to be checked whether the optical axis of the laser device is coaxial with the optical axis of the subsystem. Otherwise, every focus change causes a displacement of the laser beam. The subsystem is optimized in the factory and can not be changed. Therefore, the laser beam must be set to the subsystem. To enable this, RAYLASE provides the subsystem with an adjusting device that can be seen as a dummy subsystem. When the laser beam radiates coaxially through the adjusting device, the beam coupling for the subsystem is suitable. The appropriate steps are described in the following sections.

Warning:

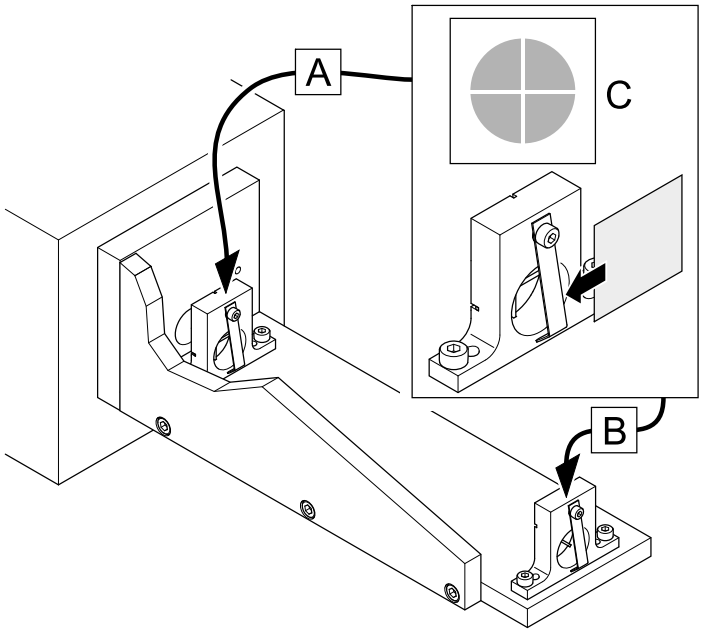
- The laser beam can cause severe injury to the eyes and the skin. Note that even apparently matte objects can reflect a laser beam. All persons in the room must wear appropriate laser protection goggles and, if necessary, protective clothing.
- Never look into the laser beam directly, even when wearing protective goggles.
- In combination with the, the subsystem, the laserdevice may 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 laser device must be of sufficient quality that the laser beam can only be emitted at the beam output on the subsystem.
- 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 with 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 Check respectively adjust the beam coupling

Follow the safety instructions for installation (⇨ page 15, Installation).

- Insert locating pins into the corresponding holes and tighten the adjusting device with screws to the properly prepared mounting surface
  Note: The adjustment device must be mounted with the specified RAYLASE pins and screws! Please refer to the enclosed scale drawing!

Abb. 4
Check coupling



Check entry point

- Mount the cross line device close to the entrance hole (A).
- Clamp a piece of thermal transfer paper behind the cross line device.
- Turn the laser on at low power for just long enough to create clearly visible effect on the thermo transfer paper (C).
- Check the beam diameter. It must be smaller than the input aperture specified in the data sheet.
- Check if the laser beam appears in the center of the cross line. If not, the exit point of the laser beam needs to be adjusted.

Check entry angle

- Mount the cross line device at position (B).
- Clamp a piece of thermal transfer paper behind the cross line device.
- Turn on the laser on at low power for just long enough to create a clearly visible effect on the thermo transfer paper.
- Check the beam diameter. It needs to be the same size as the one measured at position (A). If the beam diameter at position (B) is bigger than at position (A), this indicates a too large divergence of the laser beam. In this case, collimate the laser beam, for example, with a suitable beam expansion.
- Check if the laser beam appears in the center of the cross line. If not, the exit angle of the laser beam needs to be adjusted.

Optimizing settings

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

5.2 Assembling the subsystem

After the laser output is adjusted with the adjusting device the RAYLASE subsystem can be mounted as follows.

- Remove the adjusting device.
- Attach the RAYLASE subsystem to the mounting surface of the laser system.
  Note: The subsystem may only be installed using the pins and screws specified by RAYLASE. Follow the installation drawing supplied.
- Connect the power supply and the control unit.

6 MAINTENANCE AND CLEANING

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

Repairs may only carried out by RAYLASE or RAYLASE Certified Service Centres because special know-how and comprehensive testing methods are required.

RAYLASE offers worldwide certified service and repair centers.
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 switch-on.

The subsystem 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 optical components

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 switch-on.

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

The following circumstances can cause increased contamination.

- 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 completely avoided, 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.

To clean the mirrors, we strongly recommend sending the subsystem to RAYLASE. If you want to clean the mirrors from outside by yourself nevertheless, please proceed with caution and observe the instructions in the following section.

6.2.1 Instructions for cleaning F-Theta lenses and protection windows

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 switch-on.

Fingerprints contain aggressive substances that can damage the optical surfaces. Therefore, optical surfaces should only be touched with suitable gloves or with a lens cleaning cloth.

- Only touch the optical elements with unpowdered latex gloves and at their edge.
- 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 across 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 focusing lenses and 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 switch-on.

The optical surfaces are extremely sensitive and may only be cleaned by experienced persons.

For cleaning the mirrors and the moving lens, we strongly recommend sending the subsystem to RAYLASE, as opening of the subsystem voids the warranty.

6.2.3 Special instructions for zinc selenide optical elements

Zinc selenide (ZnSe) is an inorganic orange material that can be used for optical components (e.g. lenses, beam splitters, mirrors) in CO_2 laser systems.

Properties of zinc selenide

Melting point:	1,520°C
Density:	5.27g/cm³ at 25°C
Solubility:	Sensitive to water

To improve the optical properties of the material, zinc selenide is often given an anti-reflex coating that can contain thorium fluoride. Thorium is a α emitter and is slightly radioactive. Thorium is potentially hazardous to health if it is inhaled or swallowed. As the coating containing thorium is enclosed between non-radioactive layers, there is no risk to the user under normal circumstances.

Damage on selenide optical elements

Under normal conditions, no special precautions are necessary when handling or storing zinc selenide. In case of damage on a zinc selenide optical element or its anti-reflex coating, follow the in-structions below.

Damage on anti-reflex coating

- Possible causes:
  - Coating coming into contact with water, acids or alkalis
  - Mechanical damage due to improper cleaning or handling
- Action:
  - Pack the optical elements in an airtight sealed plastic container.
  - Return the container to your supplier. He is responsible for professional disposal of the material.

Damage on optical element

- Possible causes:
  - Optical element coming into contact with water, acid or alkali
  - Mechanical damage due to improper cleaning or handling
- Action:
  - Avoid inhaling dust!
  - Carefully collect up fragments and pack them in an airtight sealed plastic container.
  - Return the container to your supplier. He is responsible for professional disposal of the material.

Damage on optical element due to laser radiation

- Cause:
  - Damage to optical element due to laser radiation (laser radiation is no longer completely transmitted but is absorbed into the element due to damage to the anti-reflex coating or contamination of the optical element)
- Action:
  - Switch off the laser device immediately!
  - Leave the room for at least 30 minutes!
  - Wear gloves and a mouth protector while performing the subsequent steps!
  - Carefully collect up all fragments and pack them in an airtight sealed plastic container.
  - Clean all contaminated components and surfaces with a moistened cloth and pack the cleaning cloths in a sealed plastic container.
  - Return the containers to your supplier.He is responsible for professional disposal of the material.

Warning: Because of the risks outlined, zinc selenide optical elements must be cleaned with special care and is performed entirely at your own risk!

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 18, Cleaning optical components)
	Laser power decreasing	The RAYLASE "weldMARK™" marking software can compensate a loss of laser power. Menu: System > Global adjustments
	Marking parameters changed	
	Beam expander changed	
Laser spot changed	Dirty optical system	(⇨ page 18, Cleaning optical components)
		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	
X and Y axis reversed	Incorrect cabling	

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

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FOCUSSHIFTER COMPACT SIZE

General Specifications

Power Supply	Voltage	±15 bis ±18 V	Ambient Temperature		+15 bis +35 °C
	Current	7,5 A, RMS, Peak current 10 A	Storage Temperature		-10 bis +60 °C
	Ripple/ Noise	Max. 200 mVpp,@20 MHz bandwidth	Humidity		≤ 80 % non condensing
			Interface signals	Digital	XY2-100 Protocol

Specifications for linear translator modules

Laser	Nd:YAG	Nd:YAG Doubled
Input aperture	5 mm	5 mm
Beam expansion factor	3	3
Focus range in Z-direction	± 13,5 mm [1)]	± 14,0 mm [1)]
Tracking error	750 µs	750 µs
Acceleration time	1,3ms	1,3ms
Typical processing speed	≤ 340 mm/s	≤ 340 mm/s
Step response time 1/100	3 ms	3 ms
Step response time 1/10	6 ms	6 ms
Step response time ½	11 ms	11 ms
Step response time 1/1	17 ms	17 ms
Weight [3)]	ca. 2,9 kg	ca. 2,9 kg

1) with F-Theta-Objective f = 160 mm, Head SS-II-15; 3) Weight including adapter plate, without scan head.

Specifications for associated deflection units

Deflection unit	MS-10	MS-12	MS-14	SS-II-10	SS-II-12	SS-II-15
Mechanical data:						
Input aperture	9,5 - 10 mm (Variant specific)	12,0 mm	14,0 mm	10,0 mm	12,0 mm	15,0 mm
Beam displacement	12,4 mm	14 mm	17,0 mm	12,4 mm	14 mm	18,3 mm
Weight (without objective)	ca. 0,8 kg	ca. 1,6 kg	ca. 1,6 kg	ca. 3,7 kg	ca. 3,8 kg	ca. 3,8 kg
Dynamic data:						
Typical deflection	±0,393 rad	±0,393 rad	±0,393 rad	±0,393 rad	±0,393 rad	±0,393 rad
Repeatability (RMS)	2 µrad	2 µrad	2 µrad	2 µrad	2 µrad	2 µrad
Max. Gaindrift[1)]	50 ppm/K	50 ppm/K	50 ppm/K	50 ppm/K	50 ppm/K	50 ppm/K
Max. Offsetdrift[1)]	30 µrad/K	30 µrad/K	30 µrad/K	30 µrad/K	30 µrad/K	30 µrad/K
Long-term drift over 8 hours[1 2)]	< 300 µrad	< 300 µrad	< 300 µrad	< 300 µrad	< 300 µrad	< 300 µrad
Long-term drift over 24 hours [1 2)] SUPERSCAN-II-LD				< 200 µrad	< 200 µrad	< 200 µrad
Acceleration time (10-90%)	0,22 ms	0,28 ms	0,46 ms	0,19 ms	0,28 ms	0,32 ms

1) Drift per axis 2) After warming-up, variations of ambient temperature < 1K

Specifications for optics

Laser	Nd:YAG	Nd:YAG doubled
Wavelength	1.064 nm	532 nm
Coating	AR Coating	AR Coating
Max. Laser power cw	1000 W/cm^2	500 W/cm^2

F-Theta-Objective

3 X Expansion	Nd:YAG	Nd:YAG doubled
Wavelength	1.064 nm	532 nm
Objective	f = 160 mm	f = 160 mm
Typical field size [2)]	98,9mm x 98,9mm [1)]	98,7mm x 98,7mm [1)]
Spotdiameter 1/e², TEM00 Aperture 12 / 14 / 15 mm	27 / 21 / 20 µm	14,0 / 12 / 11 µm
Working distance	210,3 mm ± Fokushub	225,4 mm ± Fokushub

1) With F-Theta-Objective f=160 mm, Head SS-II-15; 2) Field size in centre z-position

All optical data refer to configuration examples and can vary substantially depending on the configuration of the FOCUSSHIFTER COMPACT SIZE