

Motorized Beam Expander Manual.



LINOS

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Section 1: Introduction



The Motorized Beam Expander

LINOS Photonics GmbH & Co KG presents with the Motorized Beam Expander a product with superior user friendliness over existing, variable beam expanding systems.

This Motorized Beam Expander has all optical properties of the manual version while offering full motorized adjustment.

The Motorized Beam Expander has been designed for an alignment of zoom and focus without the necessity to open up the instrument for doing adjustments on the Beam Expander (e.g. in a laser engraving system). This means that interruptions of the production process required with manual Beam Expanders will be decreased to a minimum.

With the Motorized Beam Expander, the alignment of the laser beam expansion and the focus position of your optical system can be remotely adjusted. This will be done by two separate lens groups which are moved by built-in adjustment motors. Separate control electronics and software have been developed for this purpose. The user software allows to change expansion or back focal length of your optical system. The lens groups will move automatically to their calculated position. Independent movements of the lens groups are also possible to create any desired variation of your laser beam.

Available models and options

Wavelength	1064 nm	
Entrance beam diameter	8 mm	
Beam Expander order no.	4401-345-000-21	
Wavelength	532 nm	
Entrance beam diameter	8 mm	
Beam Expander order no.	4401-351-000-20	(available on request)
Controller for above models	4402-004-000-21	(must be ordered separately)

Section 2: Optical Data and Drive System

The Motorized Beam Expander offers an expansion range from 2x to 8x. The current version is designed for a wavelength of 1064 nm and an entrance beam diameter of 8 mm. A Motorized Beam Expander for a wavelength of 532 nm with an entrance beam diameter of 8 mm is available on request.

The two lens groups are positioned independently by two motors. The position sensing of the two lens groups is realised by conduction plastic linear transducers. The combination of the motion pick-ups and the selected drive concept guarantees reproducibility precision better than 0.05 mm.

The connection of the Motorized Beam Expander to the control electronics is made by a standard 25-pin Sub-D connector.

General Data overview

Nominal expansion range	2x to 8x continuous
Input aperture	up to 8 mm
Output aperture	max. 32 mm
Field of view	$\pm 0,5^\circ$
Transmission	$\geq 96 \%$
Mechanical length	170 mm
Maximum diameter	56.5 mm (+7 mm for Sub-D plug)
Pick-up diameter	39 _{h11} (0/-160 μm)
Adjustment motor	Type 1016012G (Faulhaber)
Position pick-up	Type PTN-025 (Novotechnik)
Controller dimensions (W x H x L)	35 mm x 67 mm x 109 mm)
External main supply (W x H x L)	55 mm x 95 mm x 38 mm)



Environmental conditions for the Motorized Beam Expander

Operating temperature	:	+15°C to +45°C
Operating humidity	:	max. 80 %
Storage temperature	:	-20°C to +60°C

Environmental conditions for the Beam Expander Controller

Operating temperature	:	+10°C to +50°C
Operating humidity	:	max. 80 %
Storage temperature	:	-20°C to +60°C

Controller and Beam Expander software



The Beam Expander Controller

The optional Beam Expander Controller forms the interface between your computer and the 'Motorized Beam Expander'. The Beam Expander to controller connection is made via a 25 pin standard Sub-D straight cable on which one side has a female plug (connection to the controller) and the other side has a male plug (connection to the Beam Expander). All 25 pins should be connected. Keep the cable (not included in delivery) as short as possible. Electromagnetic interference might cause a loss in precision of the lens positioning system. See also section 5: Pin assignment and wiring of the Beam Expander.

The connection between controller and computer serial RS 232C interface is made by a standard serial cable. A 9 pin Sub-D connector (male) fits the serial interface of the Controller; a 9- or 25-pin Sub-D connector (female) should be connected to your computer (depending on your computer). The connecting cable should deliver a non crossed (not a NULL modem) connection between the computer and the controller (see Section 4 for details).

The controller needs a power supply of +12V/1A. This will be delivered by an external 'world voltage range power supply' which works at the whole voltage range of 90V – 265V and it is part of delivery of the controller system 4402-004-000-21. The connection between the controller box and the 'world voltage range power supply' will be done by a TiniQ-G miniature connector (self fixing by latch lock and can be released by fingertip on black button). The plug will be fixed at the receptacle of the controller.

There is an optical WindowsTM remote control software to be used together with the Beam Expander Controller. The 32 Bit software is suitable for WindowsTM 95/98, WindowsTM NT4.0, WindowsTM 2000 and WindowsTM XP. The software is described in Section 3. It is also possible to control the Beam Expander Controller by a different operating system (e.g. DOS, UNIXTM, etc.) with your own program. The controller may be controlled by simple serial command sequences. The commands and input value ranges are shown in Section 6.

The current software version permits the entry of any desired expansion factor between 2x and 8x. You will also be enabled to compensate the divergence or convergence of the laser beam as well as its

focus. The correct positions of the optical elements to expand or focus a laser beam are calculated and adjusted automatically by the WindowsTM software. The software determines the exact position of the lens groups depending on offset values. These offset values have been evaluated at LINOS and are stored permanent in an EEPROM inside the Motorized Beam Expander.

System tolerances, such as divergence or convergence of the beam and also spherical deviations of the optical system components such as mirrors or lenses can be compensated with the Motorized Beam Expander. To adjust the Beam Expander, the variable lens components can also be controlled and moved individually by the software.

With the user interface software you are able to store 8 separate alignment positions of the Beam Expander. You can use this feature to check focussing alignments as well as different applications for example.

Accessories Supplied

Accessories for the Beam Expander

- This manual has to be ordered separately (order no. 4401-345-150-00).
- Front lens protection cap.

Accessories for the Beam Expander Controller

- World voltage range power supply (100V – 240V ($\pm 10\%$) / 47Hz-63Hz / 0.2A max.)
- Serial connection cable 9 pin Sub-D (2 m length).
- European power supply cord according DIN 49441 (2 m length).
- WindowsTM user interface software (WindowsTM 95/98, NT 4.0, WindowsTM 2000 and WindowsTM XP).
- Optional mounting accessories are available from Bopla GmbH (www.bopla.de).

The WindowsTM software is only suitable for the Beam Expander Controller 4402-004-000-21 and may only be used with the above mentioned Beam Expander. The software is checked for viruses. Any change of data files delivered by LINOS Photonics GmbH & Co. KG will result in the loss of warranty and other claims. Software updates will not be delivered automatically and may not be free of charge.

Important Handling Information

The Motorized Beam Expander, as well as the Beam Expander Controller, are precise instruments and should be handled with care, as any other precise opto-electronic instrument. Static electric charges may cause malfunction and even destroy parts of the Beam Expander Controller or electronic components inside the Motorized Beam Expander. The order of connecting the Beam Expander and controller may help to avoid this. Opening the Beam Expander or Beam Expander Controller will result in the loss of warranty and other claims.

- First:** Take care that your controlling computer is switched off.
- Second:** Connect the Beam Expander to the Beam Expander Controller. (To adapt the controller directly to the motorized beam expander, remove the bolts of the 25pin-plug at the controller.)
- Third:** Connect the Beam Expander Controller to the controlling computer (PC),
- Fourth:** Connect the Beam Expander Controller with the main power supply.

These precautions are only important when wiring the Beam Expander and the Beam Expander Controller during installation, the power up order (i.e. if the controlling computer or the Beam Expander Controller is powered up first) has no effect on the functionality of the Beam Expander.

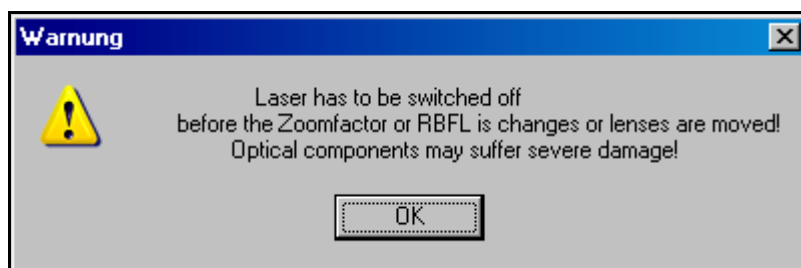
- Please tear off the protection foil at the beam entry side and the protection cap before using the Beam Expander.
- Whenever you change the alignment of the Beam Expander, switch off your laser beam first.



Section 3: Software

Running the Windows™ Software

The Windows™ 95/98, NT4.0, Windows™ 2000 and Windows™ XP version of the Beam Expander Controller Software is delivered on compact disk (including a Windows Help-file). To run the program launch the Explorer, choose your CD drive and execute 'beamex.32.exe' by double clicking. If you want to run the program from hard disk or a network drive, please copy 'beamex.32.exe' and 'beamex32.hlp' (including 'beamex.32.cnt') into a common directory before running the software. It is necessary that the directory is writable for storing the individual Beam Expander configuration file.

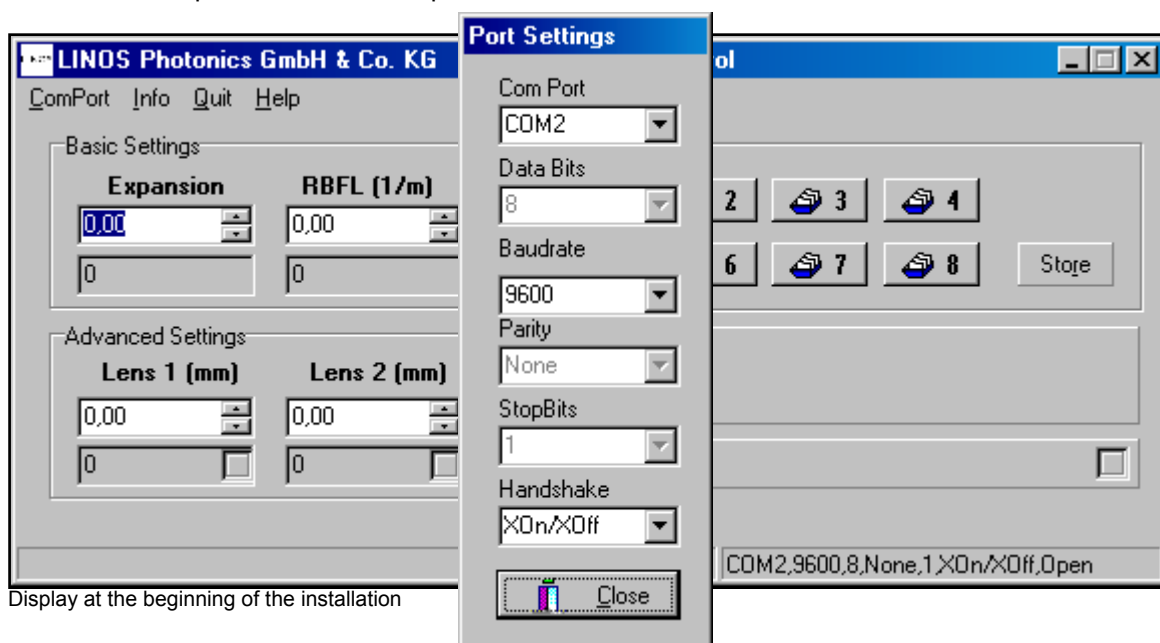


Warning information

After launching the software you have to confirm that your laser beam is switched off. The laser has to be switched off, because changing the expansion (zoom factor) or RBFL means moving lens elements inside the Beam Expander. During moving, it is possible that the variable lens groups focus the laser beam on a lens element. This may destroy lenses inside the Beam Expander.

Using the Windows™ User Interface

When you are running the Beam Expander user program for the first time on your PC, the serial communication port to the Beam Expander has to be defined first.

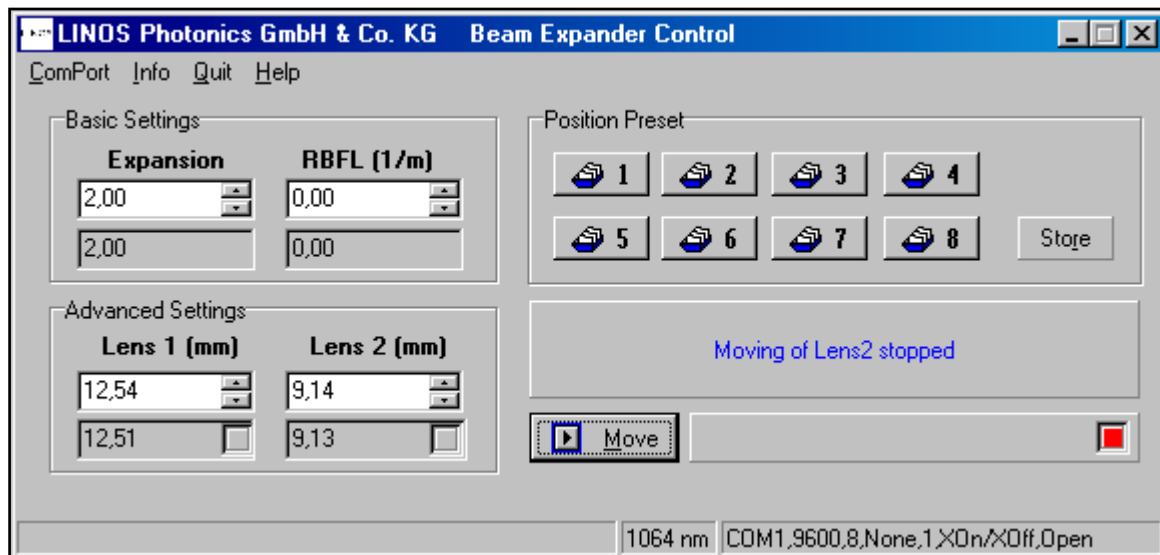


Display at the beginning of the installation

The window 'Port Settings' describes the interface between the PC and the controller. Check on which port you connected the 9-pin serial connector on your PC and choose the corresponding entry in the table. If you want to select a different baud rate than 9600 Bd, choose the corresponding as well as the type of handshake. If this has been done, close the window. Default settings are 9600 Bd, no parity, 8 bits, 1 stop bit, XON/XOFF. In general these default settings need not to be changed.

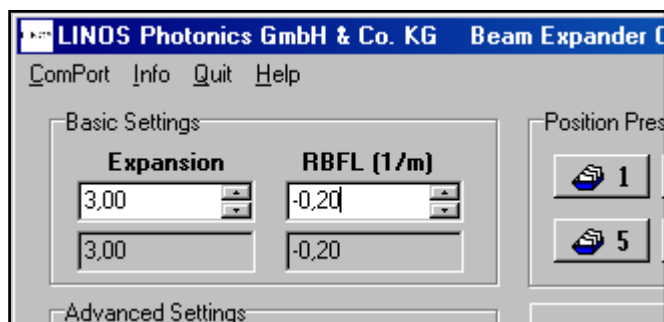
Running the Motorized Beam Expander

When the PC connection parameters have been defined the software is ready to operate the Motorized Beam Expander.



Control-software for the Motorized Beam Expander

Basic Settings



Basic Settings

1. Expansion

This input field enables you to enter a value between 2 and 8. Any real values inside this range are allowed (e.g. 4 or 6,3). The decimal separator for the entry is depending on your Windows country setting (normally ',' or '.'). The maximum beam diameter on the entry side is Ø 8mm. The maximum beam diameter on the exit side is limited to Ø 32mm.

For an expansion factor of 8, the laser beam diameter on the entry side should not exceed 4mm. With an entrance laser beam diameter of more than Ø 4mm vignetting will occur.

To run the Beam Expander for the first time, insert the expansion you need. Align the Beam Expander for an afocal image (supposing to have an ideally parallel entrance laser beam) and insert 0 for RBFL (Reciprocal Back Focal Length). Deviations from a parallel laser beam (slightly divergent or convergent laser beam) can be compensated by changing RBFL as well as special focussing or your optical system.

Attention: The laser has to be switched off before the expansion and/or RBFL is changed.

2. RBFL = Reciprocal Back Focal Length

Insert here the desired reciprocal back focal length RBFL of the Beam Expander [unit: 1/ m] Insert 0 (zero) if you want to have a parallel beam at the output (supposed that you have a parallel beam at the entry). Insert a number below zero to get a divergent beam or a number above zero for a convergent beam.

Changing RBFL is useful for slightly changing the back focal length s' of your focussing system (that follows the Beam Expander). You can estimate this change of focus (Δs) by

$$RBFL[1/m] = -\frac{\Delta s[m]}{f^2[m]}$$

f is the nominal focal length of your additional focussing system [unit: m] (e.g. F-Theta lens).

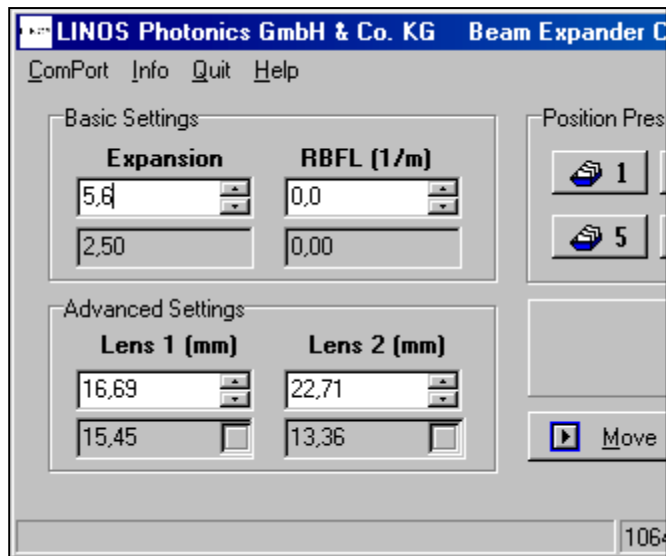
To optimise your focus, first set-up your optical path with the desired Expansion and zero for RBFL. Use your focussing system for finding roughly the best focal point. Then change RBFL in small positive steps. The result will be a reduction of the back focal length of your focussing system. In opposite a negative RBFL increases the back focal length.

Attention: The laser has to be switched off before the expansion and /or RBFL is changed.

Note: All windows with white background can be edited with a desired value. After committing your input by 'Return' or 'Tab', the software calculates the resulting values for the remaining variables automatically.

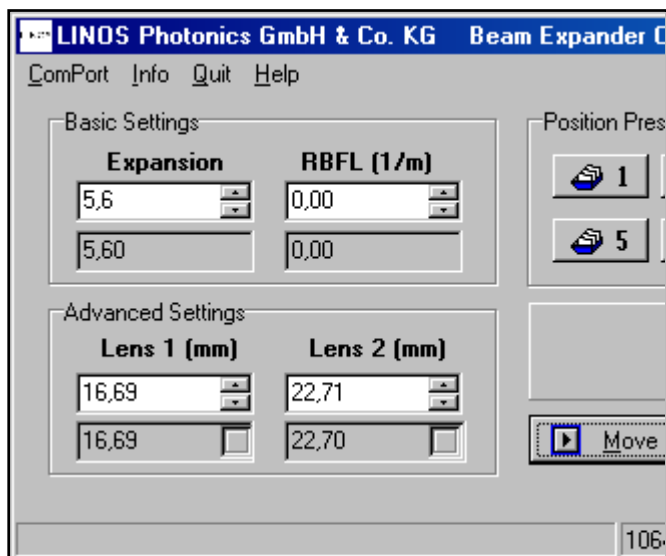
Example:

Inserting 5.6 for expansion and remaining RBFL at 0, results into the following window.



Expansion and RBFL before 'Move'

The white windows are showing calculated values. The grey shaded fields below show the actual value of expansion and RBFL calculated with the actual lens position of Lens1 and Lens2. Please find below detailed information about Lens1 and Lens2.



Expansion and RBFL after 'Move'

To move the Beam Expander optics to an expansion of 5,6 at RBFL = 0, press the 'Move' button. After a few seconds the lens elements have been positioned to their calculated position. The calculated position will be achieved within a tolerance of 0,05 mm.

To align the Beam Expander according to your entries, press 'Move' to position the lens elements.

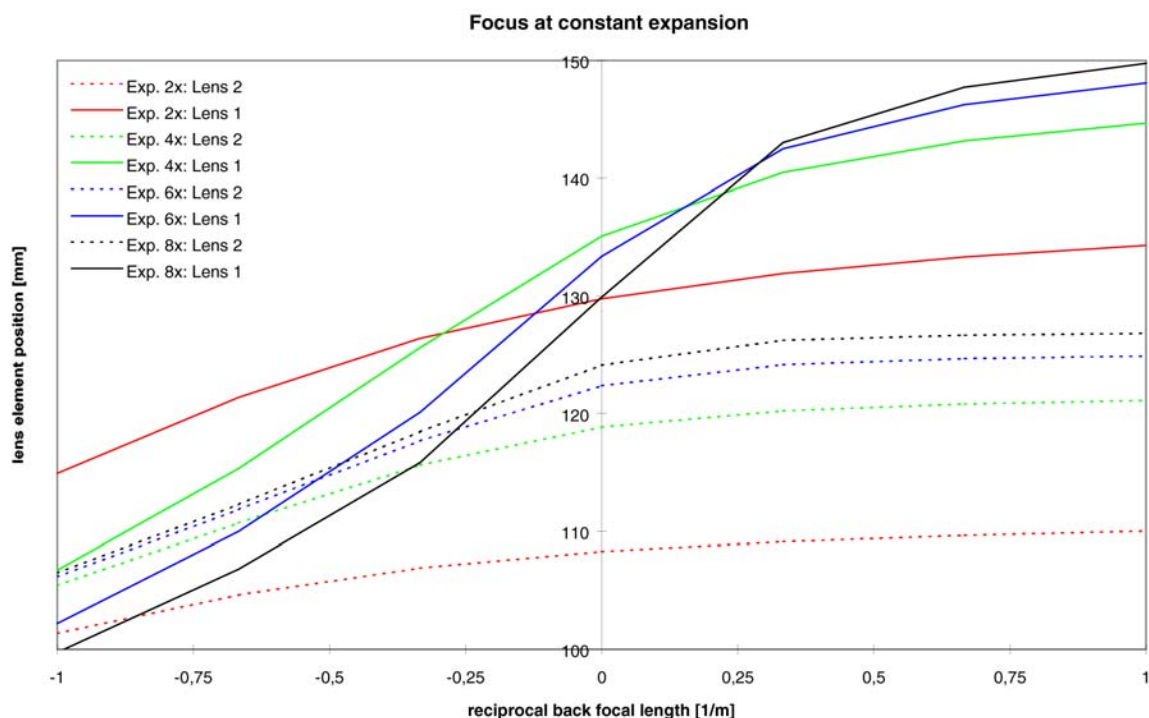
3. Changing focus (RBFL) or Expansion

Expansion and RBFL are dependent on both variable lens groups inside the Motorized Beam Expander. Changing the value of expansion or RBFL influences the movement of both lens groups (picture below). We would like to point out that not all positions are available. As shown in the diagram below, limits of movement are indicated where the lines of equal colour but different style cross each other.

Please note, that the following diagrams do not contain any mechanical restrictions. The calculation is based on paraxial equations.

Changing Focus

To change the focal plane with constant value of expansion, change the value of RBFL accordingly. The variable lens elements inside the Beam Expander are moving as shown in the diagram below.



Movement of the two lens groups while changing the focus (RBFL) at a fix expansion.

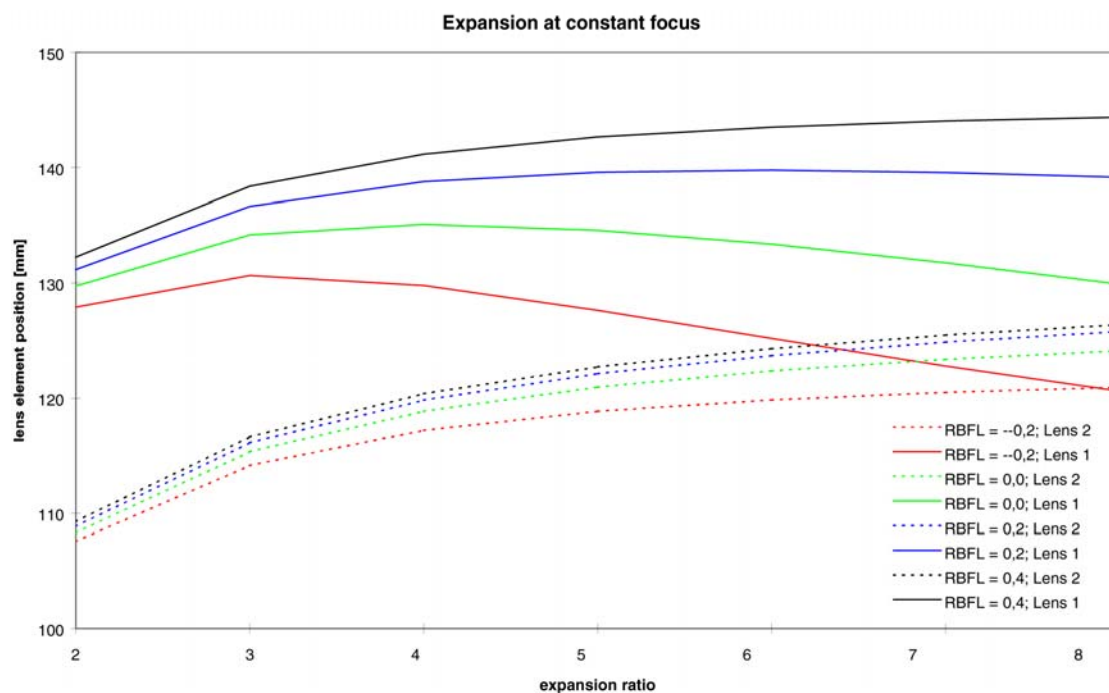
Basic Settings		Position Pres
Expansion 5,6 5,60	RBFL (1/m) -0,2 -0,20	
Advanced Settings		1 5 Move
Lens 1 (mm) 8,94 8,94	Lens 2 (mm) 20,34 20,33	

Actual and rated positions

Above picture shows a change of RBFL with constant expansion of 5.6 after the 'Move' button has been pressed. The actual values have changed according to the calculated.

Changing expansion

To change the expansion with constant value of RBFL (constant focal plane) change the value of expansion. The variable lens elements inside the Beam Expander move as shown in the diagram below.



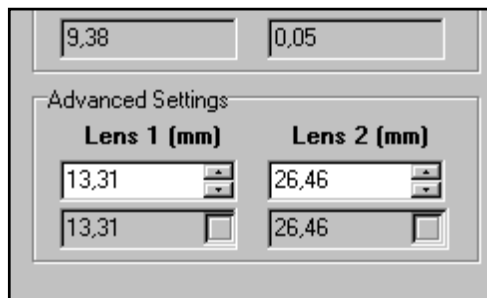
Movement of the two lens groups while changing expansion at a fix focus (RBFL).

The controller prevents collisions between the two variable lens elements by calculation, considering the individual collision points of the Beam Expander. These parameters are stored in an EEPROM inside the Beam Expander.

Attention: The laser has to be switched off before expansion and/ or RBFL is changed.

Advanced Settings

As mentioned above, changing expansion and/ or RBFL always results in a movement of both lens groups. In some cases it can be useful to have the possibility to influence each lens position separately. By changing the value of Lens1 and/ or Lens2 you are able to realise an expansion of 9,38 at a RBFL of 0,05 for example.



Section view: Advanced Settings

1. Lens 1

The value of Lens 1 corresponds with the position (in [mm]) of the according lens element. This value will change automatically when expansion and/ or RBFL are changed.

The Lens 1 entry field allows to change the position of Lens1 directly. Changing the value of Lens1 influences all other variables as well. Therefore, expansion and RBFL will change their value if you change the position of Lens1.

We suggest to work with the variable Lens1 only if you are familiar with the alignment and behaviour of Beam Expander systems.

Attention: The laser has to be switched off before the position of Lens1 is changed.

2. Lens 2

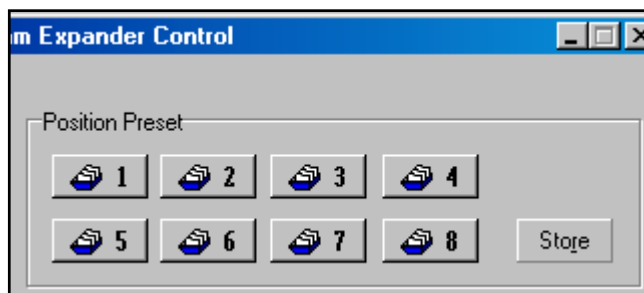
The value of Lens 2 corresponds with the position (in [mm]) of the according lens element. This value will change automatically when expansion and/ or RBFL are changed.

The Lens 2 entry field allows to change the position of Lens 2 directly. Changing the value of Lens 2 influences all other variables as well. Therefore, expansion and RBFL will change their value if you change the position of Lens 2.

We suggest to work with the variable Lens 2 only if you are familiar with the alignment and behaviour of Beam Expander systems.

Attention: The laser has to be switched off before the position of Lens 2 is changed.

Position Pre-set



Position Pre-set

The 'Position Preset' enables you to store different settings of the Beam Expander. You can recall up to 8 different pre-adjusted positions, after you stored them first.



Position Preset store activated

Align the Beam Expander to a position you need in your working process by setting expansion, RBFL, Lens1 or Lens2 entry. Afterwards, select the 'Store' button and then select one of the 8 Position Presets.



Position Preset recall activated

To recall a previously stored position, select the 'Position Preset' you want to recall. After pressing the 'Move' button, the Beam Expander will be aligned.

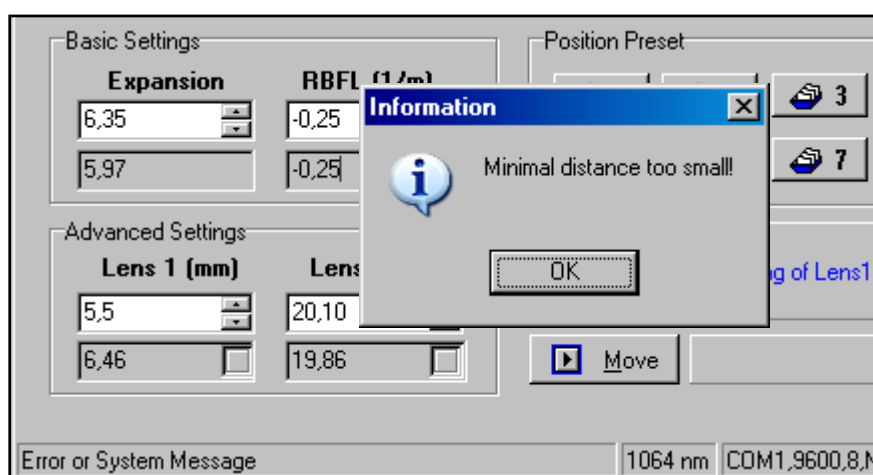
Miscellaneous

The software provides several information about the system and communication between the PC and the Beam Expander.



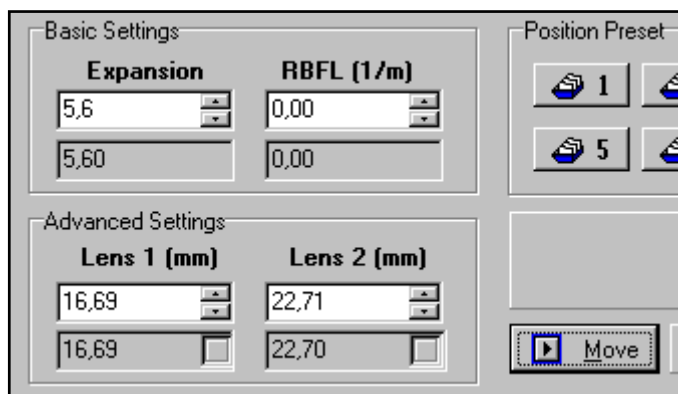
System message

As shown in this picture, the controller gives an information about the last action in this example. As shown in this picture, the controller stopped moving Lens 1.



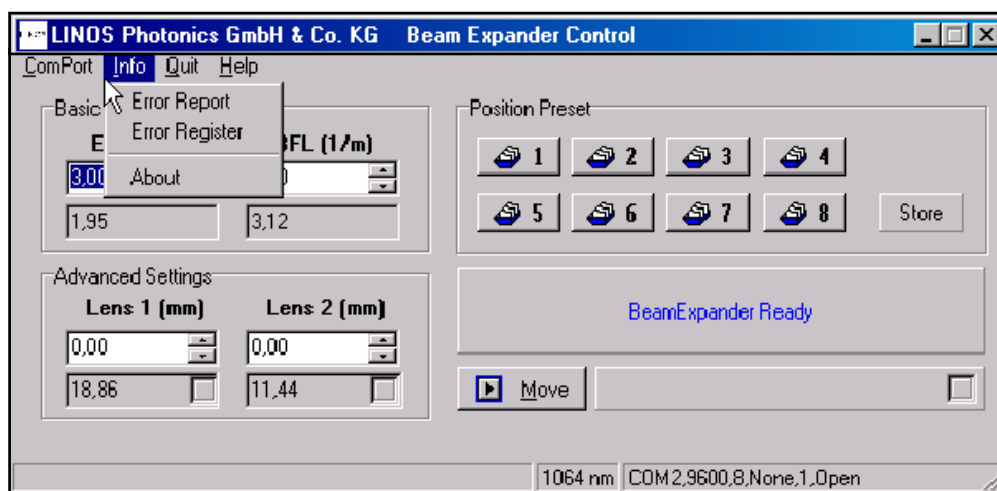
System information

It is also possible that you tried to align an expansion or RBFL that is not possible due to mechanical restrictions. For example the variable lens groups will not be moved when the minimal distance between the lens elements would become too small.



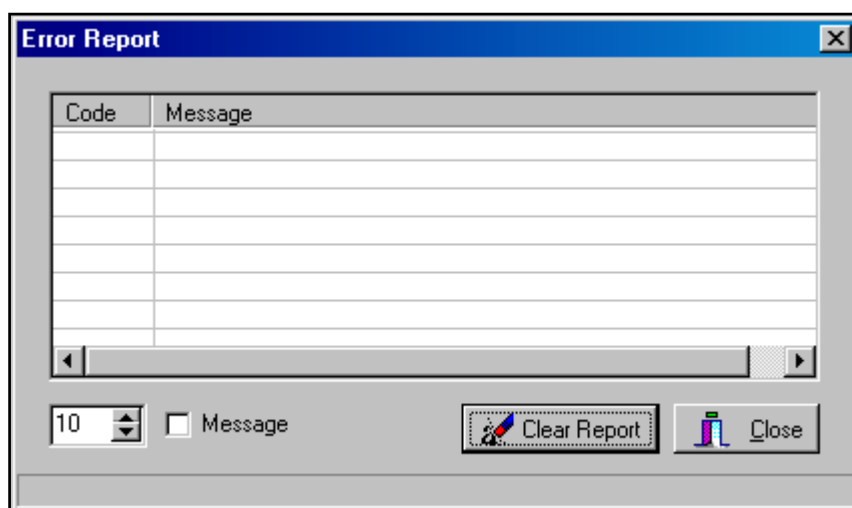
Display: actual and rated values

After the lens elements stopped their movements, you can compare their actual and calculated position.



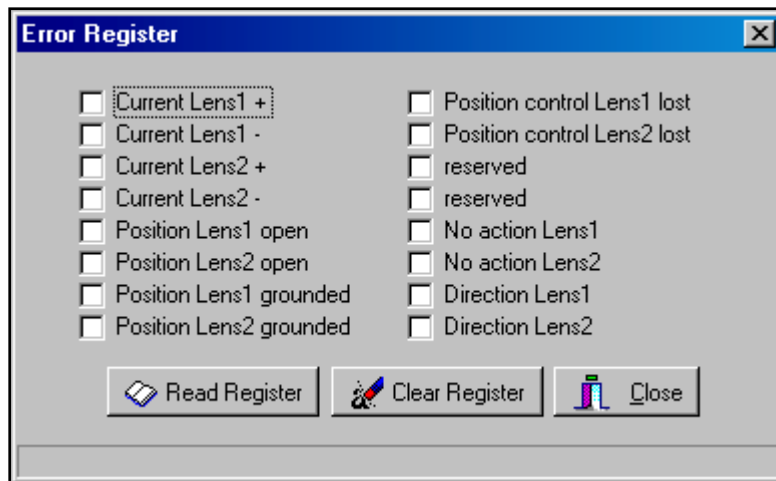
Accessing information

In the pull-down menu info, an Error Report and an Error Register is available.



Error Report

The window Error Report provides the possibility to get detailed information about the communication between the controller and the Beam Expander. This is useful to detect a communication failure or an error inside the Beam Expander. Selecting the checkbox 'Message' means that all messages of the system and not only error messages will be recorded and displayed.



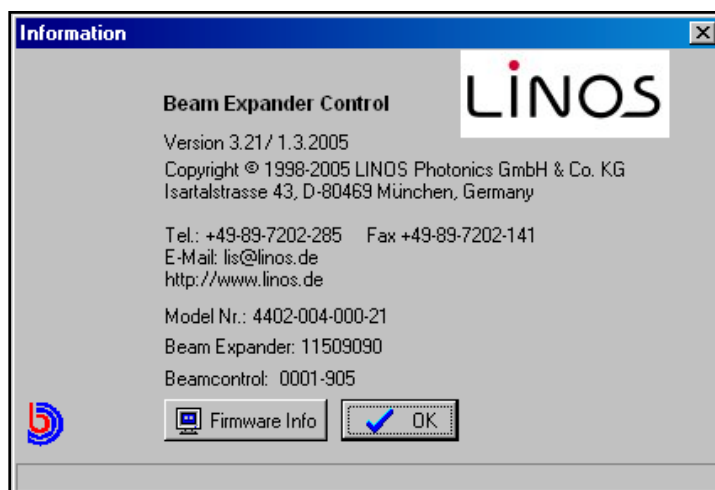
Error Register

The Error Report gives detailed information about the system. The Error Register gives an overview of all messages. The content of the Error Register is only valid, if it has been cleared previously.

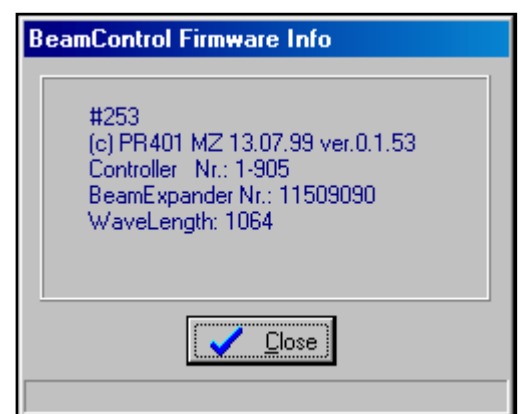
Example: If you run the Beam Expander unattended, you get a general overview about messages that have been sent from the controller in the meantime. To update the information press 'Read Register'.

The content of Error Report and Error Register is also helpful for a support of LINOS Photonics, in case of malfunction of your Beam Expander.

The following pictures show detailed information like serial number of the Motorized Beam Expander, the controller and the wavelength of the Beam Expander you use.



Beam Expander Information



Firmware Info

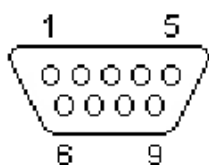
Section 4: Serial Interface of the Beam Expander Controller

RS-232C Signal Levels

The RS-232C interface of the Beam Expander Controller may receive input signals as high as ± 17 Volts. The output level of the communication interface is adjusted to ± 9 Volts. The input voltage range between $+3$ Volts and -3 Volts is undefined and invalid and should be avoided. Logical data signals are defined as negative voltage for a logical '1' and positive voltage for a logical '0'.

RS-232C Serial Interface Lines & Connectors

Pinning at the Beam Expander Controller



9 PIN SUB-D FEMALE CONNECTOR
at the Beam Expander Controller

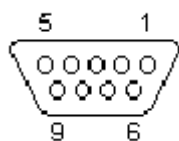
Pin number	Function	Data direction flow
2	Transmit Data	To Computer
3	Receive Data	From Computer
5	System Ground	Common Ground level

Cable connection between Beam Expander Controller and computer (DTE to DCE cable)

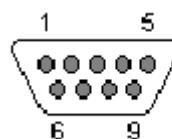
Shown are the minimum necessary number of connection lines between the computer and the Beam Expander Controller. In any case, a connection to the protective ground of the Beam Expander, as well as the controller, may be necessary for increased functional security. Grounding connectors are available at the grounding screw on the Beam Expander Controller and on the grounding flat connector on the Beam Expander optics.

Connection between computer and Beam Expander Controller is made by a cable with the following wiring scheme, if the computer has 9 pin Sub-D serial output. This cable is delivered as standard accessory, with the Beam Expander Controller from LINOS Photonics GmbH & Co. KG.

View onto the connectors, situated on the cable ends.



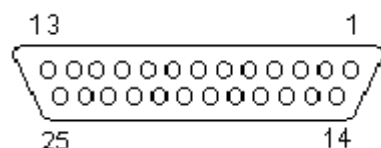
9 PIN SUB-D FEMALE
to the PC side



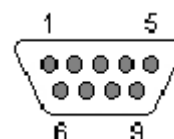
9 PIN SUB-D MALE
to the Beam Expander Controller side

Pin number at PC side	Pin number at Beam Expander Controller side
2	2
3	3
5	5

Connection between Computer and Beam Expander Controller, if computer has
25 PIN Sub-D Serial



25 PIN SUB-D FEMALE
to the PC side



9 PIN SUB-D MALE
to the Beam Expander Controller side

Pin number at PC side	Pin number at Beam Expander Controller side
3	2
2	3
7	5

Serial transmission speed and communication handshake

The communication speed between the Beam Expander Controller and the controlling computer is adjusted to 9600 Bd. by default. There is a XON / XOFF software handshake for the communication. There are 8 data bits, one stop bit and no parity as timing frame parameters (→ 9600,n,8,1).

XON / XOFF handshake protocol

The XON / XOFF protocol is a standard software handshake protocol. The reason for this kind of handshake communication is, that each of the both communication partners (controller and computer) is able to tell the other, when XOFF is the character 0x13 (this means hexadecimal character 13, decimal 19). After this character is transmitted by the controller, the transmission of information from the computer must be stopped.

When the controller is ready to receive more information from the computer, the XON character 0x11 (hexadecimal character 11, decimal 17) is transmitted to the computer, to signalise that the controller is ready to receive more information from the computer.

There may be a one byte overrun inside the input buffer of the Beam Expander Controller. In case of receiving additional overrun bytes, the controller signalises the overrun by sending an 'E50' error (look Appendix: Error messages from the Beam Expander Controller). All bytes which are sent in excess after the 'E50' message are omitted until the XON character is sent from the controller.

Changing the communication parameters

For some reasons, as using a proprietary control system instead of a PC, it might be necessary to change the communication speed. This is possible by sending the 'Change Baudrate' command to the controller by a terminal program using the momentary adjusted baudrate (a list of all command sequences can be found in section 6).

54: baudrate

Available values for baudrates are: 2400, 4800, 9600, 19200, 38400 Baud

The command for changing the baudrate takes effect, after the next reset, which can be initiated by the command '#0' (using the prior communication speed) on the terminal or a hardware reset. After the reset, all communication is done in the new adjusted communication speed. The communication speed is stored permanently inside the Beam Expander Controller.

'Echo' of the controller

For some reason (e.g. checking the communication to the controller) it might be necessary to enable the controller to return the received commands. This behaviour is called 'echo', because the received command is returned without modification. The command to enable the 'echoing' of commands is

50:1

The command for stopping the 'echoing' of commands is

50:0

The configuration of 'echoing' the commands is stored permanently inside the Beam Expander controller.

Reset to default communication parameters

It might occur that the adjusted and stored communication speed between Beam Expander Controller and the driving computer becomes unknown, or is changed by a user mistake and are also unknown. For regaining control over the Beam Expander, it is necessary to switch to the default transmission speed (9600,n,8,1). This is made by the following procedure:

- unpower the Beam Expander Controller
- power the Beam Expander Controller
- press the reset button, at the Beam Expander Controller **six** times, once per second. It is important that no communication over the serial interface takes place during this procedure.
- the Beam Expander Controller is now switched back to its default communication parameters.

This procedure is just necessary in case of a 'forgotten' communication speed.

Energy saving mode

The Beam Expander Controller automatically enters an 'energy saving mode' after three seconds without communication or movement of the Beam Expander. The user does not need to take care of this feature during ordinary use of the Beam Expander.

DC – Power supply requirements

For some reason the Beam Expander Controller can also be supplied by a low voltage DC supply instead of using the AC power supply delivered with the Beam Expander Controller. This external supply has to comply the following characteristics as minimum:

12 VDC +/- 10%, 1 A, 100 mV ripple (50 / 60 Hz) maximum under load/no load condition.

DC – Power Supply connector at the Beam Expander Controller

Switchcraft 3 PIN TINI – Q TB3M (MALE)



Pin number	Function	Value
1	Positive Power Supply	+ 12 Volts
2	No Connection	do not use
3	Power Ground	0 Volts

Section 5: Beam Expander connection

Pin assignment and wiring of the Beam Expander

The Beam Expander to Controller connection is made by a 25 pin standard Sub-D straight (not electrically crossed) cable on which one side has a female plug (connection to the Beam Expander Controller) and the other side has a male plug (connection to the Beam Expander). All 25 pins should be connected. Keep the cable (not included in delivery) as short as possible. Electromagnetic interference might cause a loss in precision of the lens positioning system. Depending on your environment additional shielding of the cable might be necessary. Electromagnetic compatibility can be improved by using a twisted pair flat cable. If using a twisted pair cable, take care of the correct alignment of the twisted wires: Pin 1 of the Sub-D connector must be a single wire, pin 2 and 14, 3 and 15 ... 13 and 25 must be twisted pair wires.

Assignment of the 25 pin SUB-D connector (Interface of the Motorized Beam-Expander)

Pin number	Function	Optical element	state / function
1	Common Ground		
2	Motor	Lens 1	-
3	Motor	Lens 2	-
4	VCC (+5 Volts)		Logic Supply Voltage
5	Data in		Data input to the EEPROM
6	CS-EEPROM (active Low)		Chip Select for EEPROM
7	AGND		reference Ground
8	AGND		reference Ground
9	AGND		Analog reference ground
10	AGND		reference Ground
11	Common Ground		
12	Common Ground		
13	Common Ground		
14	Motor	Lens 1	+
15	Motor	Lens 2	+
16	Common Ground		
17	CLK		For future use only
18	Data out		Data output from the EEPROM
19	Common Ground		
20	Potentiometer	Lens 1	sliding contact

21	Potentiometer	Lens 2	sliding contact
22	Vref (+ 5V)		Positive reference voltage
23	Common Ground		
24	Common Ground		
25	Common Ground		

Section 6: Programming Interface of the Beam Expander Controller

Control Codes and Sequences

For advanced system features or controlling the Beam Expander by your own developed software, it is necessary to know some internal technical flow. The programming of the expansion, RBFL and other system parameters may be controlled by simple commands, which are sent via the serial interface of the computer. Internal system parameters i.e. offset values and serial numbers can also be read out by simple commands.

After power on, manual reset (pressing of the reset button at the Beam Expander Controller), or software reset (Command # 0), an 'OK' is sent to the controlling computer to signalise the correct power up. All messages, which are transmitted from the Beam Expander Controller, end with a 'carriage return' character (0x0d) and a 'line feed' (0x0a). All commands to the Beam Expander Controller, have to end with a 'carriage return' character (0x0d) sign, to start the execution of the command. The 'Backspace' (0x8) character will delete the last character inside the command buffer of the Beam Expander Controller. This is useful when correcting a manual entry of commands with a terminal program. The XON (= 0x11) and XOFF (= 0x13) characters are controlling the communication according to the standardised XON / XOFF protocol.

The commands 12 to 50 (including) and 54 can only be executed in the advanced mode, which can be selected by command '# 51:1'. The return code sequences are only enabled in advanced mode as well. After any case of 'Reset', the controller is in its default 'non advanced mode'.

Command strings	Value of Argument (<Value>)	Action
# 0 [:] [;]		Software Reset
# 1:<Value> [;]	1...4095	Travel lens2 to absolute position
# 2:<Value> [;]	1...4095	Travel lens1 to absolute position
# 3:<Value> [;]	-9...0...9	Travel lens2 with corresponding speed and turn direction (+/-) until stop command (0 = No travel; 9 = Max. speed)
# 5:<Value> [;]	-9...0...9	Travel lens1 with corresponding speed and turn direction (+/-) until stop command (0 = No travel; 9 = Max. speed)
# 7 [:] [;]		Position query lens2; Response: 1...4095
# 8 [:] [;]		Position query lens1; Response: 1...4095
# 9:<Value1>;<Value2> [;]	1...4095 in each case	Travel lens1 to 'Value 1' and lens2 to 'Value 2'
# 12:<address> [;]	address 1...512	read stored value from controller
# 13:<address> [;]	address 1...512	read stored value from Beam Expander
# 22:[:] [;]	integer value / 100	read offset value lens1
# 23:[:] [;]	integer value / 100	read offset value lens2
# 50:<Value> [;]	'0' is off, '1' is on	serial echo on / off
# 50: [;]		query serial echo on / off
# 51:<Value> [;]	'0' is off, '1' is on	advanced mode on / off
# 51: [;]		query advanced mode on / off
# 54:<Value> [;]	1200 2400 4800 9600 19200 38400	adjust communication baudrate
# 253:[:] [;]		Output Copyright and Version
# 254:[:] [;]		Stop command

Characters in '[' ']' brackets may be omitted.

All not mentioned command codes and sequences are reserved and should be avoided.

Return Codes and Sequences

Query return messages from the Beam Expander controller

Answer string	Value of Argument (<Value>)	Meaning
OK		Reset successful
(\$7:)<Value>	1...4095	Lens1 position (\$7: only in advanced mode)
(\$8:)<Value>	1...4095	Lens2 position (\$8: only in advanced mode)
\$12:<Value>	1...65535	read value from controller
\$13:<Value>	1...65535	read value from Beam Expander
\$22:<Value>	0...+/- 327,67	offset Lens1
\$23:<Value>	0...+/- 327,67	offset Lens2
\$50:<Value>	'0' is off, '1' is on	echo mode status
\$51:<Value>	'0' is off, '1' is on	advanced mode status

Messages from the Beam Expander Controller in advanced mode	Meaning
WOK	Message after 'wake up' from energy saving mode (Exception: also during not advanced mode)
L1	value over mechanical limit for lens1
L2	value over mechanical limit for lens2
S1	motor lens1 stopped
S2	motor lens2 stopped
S3	motor lens1 and motor lens2 stopped
M1	positive limit position lens1 reached
M2	positive limit position lens2 reached
N1	negative limit position lens1 reached
N2	negative limit position lens2 reached
D1	minimum distance lens1 to lens2 reached (lens1 moving)
D2	minimum distance lens2 to lens1 reached (lens2 moving)
Px	Current limit of motors (binary coded 0...15)

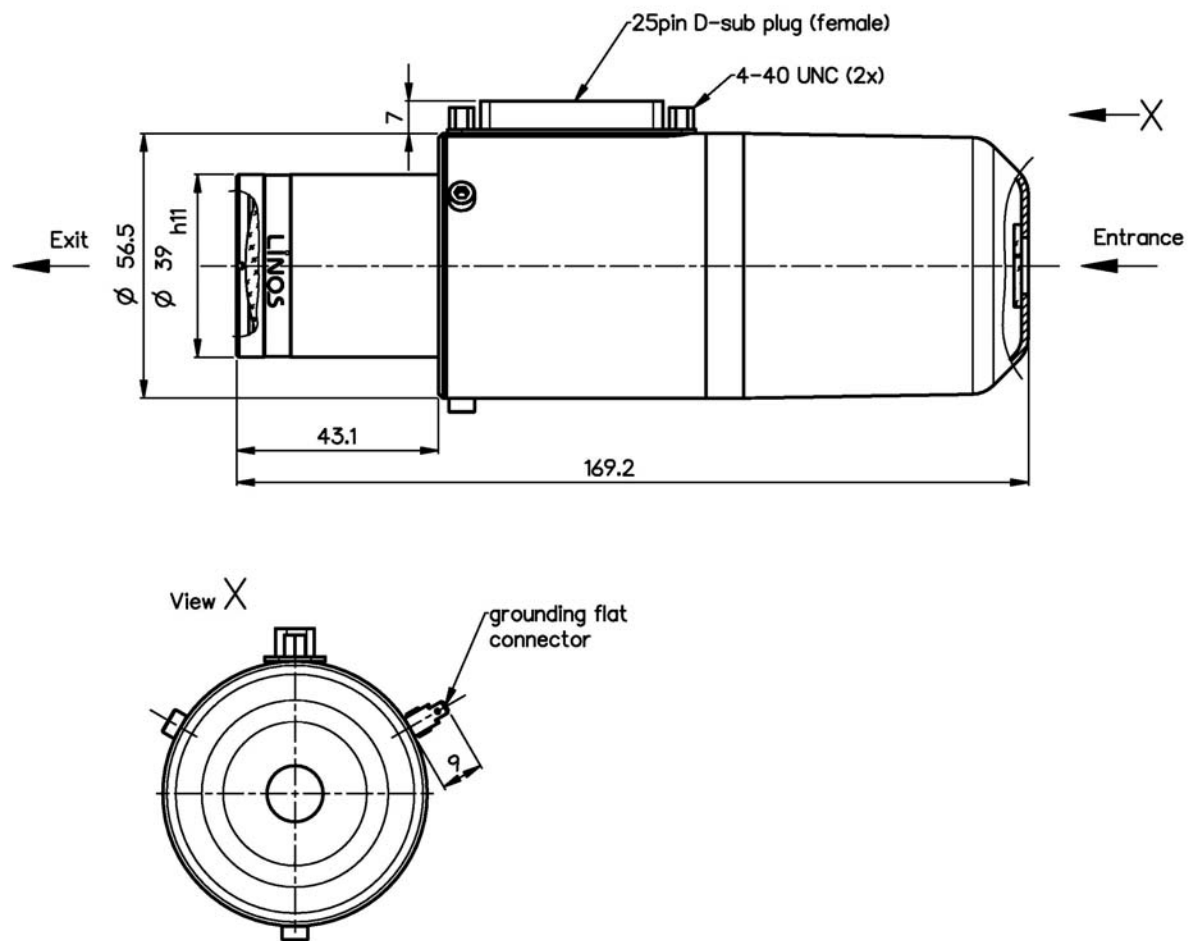
Error messages from the Beam Expander Controller	Meaning
E00	invalid command
E01	open connection to position sensing lens1
E02	open connection to position sensing lens2
E03	shorted connection to position sensing lens1
E04	shorted connection to position sensing lens2
E05	measuring system lens1 defective
E06	measuring system lens2 defective
E10	no movement of lens1 detected
E11	no movement of lens2 detected
E50	serial buffer overrun
MEx	checksum error in Beam Expander EEPROM

All not mentioned error codes are reserved.

The non-volatile memory of the Beam Expander

Inside the Beam Expander, is a non volatile memory used for storing necessary values for the controlling of the Beam Expander. In case of building a proprietary control electronics, it is necessary to know how to access the stored data. Detailed information on how to access these data is available on request from LINOS Photonics GmbH & Co. KG.

Section 7: Beam Expander Drawing



External dimensions and section view of the Motorized Beam Expander

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