

Manual amendments detail document

Title of manual:	LaserXL
Document number:	M-9908-9137-04
Date:	May 2017

Matched straightness pairs

Section – Straightness measurement, Straightness measurement optics

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Straightness measurement optics

Figure 1 - Straightness measurement optics

The straightness measurement optics are used to measure straightness errors in a linear axis. Straightness errors are displacements perpendicular to the axis of travel. A kit comprises the following elements shown in Figure 1 above:

- [straightness interferometer](#)
- [straightness reflector](#)

The straightness measurement kit is available in two versions: short-range for measurements from 0.1 m (4 in) up to 4 m (160 in) and long-range for measurements between 1 m (40 in) and 30 m (1200 in).

Note: These distances refer to the separation between the straightness interferometer and the straightness reflector, i.e. the length of the axis that can be tested.

The range of straightness measurement is ± 2.5 mm (± 0.1 in).

The straightness interferometer and reflector are matched pairs. Therefore, you cannot interchange elements with other straightness kits. Each straightness interferometer and reflector is marked with a unique serial number.

The standard [optics mounting kit](#) can be used to attach the optics to the machine.

When measuring vertical straightness in a horizontal axis, or straightness in a vertical axis of a machine, the [straightness accessory kit](#) is also required.

For details of performing straightness measurements using this kit, refer to the straightness measurements section.

See the [dimensions and weights](#) section for the dimensions of the straightness measurement optics.

If the straightness interferometer and reflector are manufactured before 2002 they **are a matched pair**.

All straightness interferometers and reflectors manufactured after 2002 **are not matched pairs** as the manufacturing process was improved.

Therefore, it is possible to interchange post 2002 elements with other straightness kits manufactured after this date.

Analogue signal output

Analogue output is now standard on all units and is no longer an 'option'.

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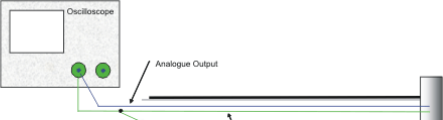
- Welcome
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 - Front panel
 - Rear panel
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 - Long range meas
 - Auxiliary I/O
 - Remote trigge
 - Quadrature ou
 - Analogue out**
 - Dip switch set

Analogue signal output †

† Analogue output is available as a factory set option.

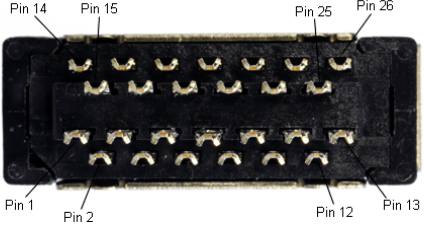
The analogue signal output facility outputs a voltage which is proportional to the displacement of the measurement optics. It can be used for monitoring high frequency vibration (for example, Piezo applications).

In a typical application, the output voltage is connected to an oscilloscope as shown in figure 1.



Section – Hardware components, XL laser, Aux I/O, Analogue signal output

- Care and maintenance
- Cleanliness of optics
- Digital indicator interfac
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- Dimensions and weight
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 - Reference
 - Linear measurement
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 - Straightness measurement
 - Squareness measurement
 - Parallelism measurement
 - Dynamic data capture and
 - QuickViewXL™
 - RX10 rotary indexer
 - Dual laser calibration system



* Quadrature output is available as a factory set option
† Analogue output is available as a factory set option

Section – Hardware components, XL laser, Auxiliary I/O,

procedure
set-up
specification
stabilisation of XL laser
stability
stage
height adjustment
setting up
standard methods for assessing flat
starting the data capture software
starting the software
status display panel
status lamps
steerer
step data plot
straightness accessory kit
straightness accuracy
straightness alignment - horizontal a
straightness alignment - vertical axis
straightness base
straightness beam alignment
straightness data analysis
straightness error
straightness interferometer
straightness measurement
accessory kit
configurations

Weight	3.8 kg	8.38 lb
--------	--------	---------

Auxiliary I/O

- Remote triggering
- Quadrature output (Factory option)
- Analogue output (Factory option)**

XC environmental compensation unit and sensors

	Metric	Imperial
Air temperature sensor measurement range	0-40 °C	32-104 °F

Section – Reference, Specifications

Specification updates

Section – Reference, Specifications

Navigation: Hide, Back, Forward, Home, Print

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- Dynamic data capture and analysis
- QuickViewXL™
- RX10 rotary indexer
- Dual laser calibration system
- Digital indicator interface
- Federal 832 amplifier interface
- T810 trigger box
- Generic positioning error compensation

System	
Warranty period (terms and conditions apply)	3 years (with 5 year option)

System storage	
Storage temperature range	-25 to 70 °C
Storage humidity range	0% to 95% non-condensing
Storage pressure range	10 to 1200 mbar

Computer	
Computer	PC or close compatible
Processor	1 GHz minimum
Memory	512 MB RAM
Hard disk drive space needed for software installation	100 MB
Operating system	Windows XP (SP2) and Windows Vista
Drives	CD-ROM drive for software installation
Screen	1024 x 768 pixels resolution minimum, SVGA
Interface	Recommended 3 free USB 2 ports for XL laser, XC compensator and USB mouse. More USB ports may be required if an RX10, error compensation or dual functionality is required. Note: a USB hub can be used to increase the number of available USB ports.
Peripherals	Keyboard and Microsoft mouse or compatible pointing device

XC environmental compensation unit and sensors		
	Metric	Imperial
Air temperature sensor measurement range	0-40 °C	32-104 °F
Air temperature sensor measurement accuracy	±0.2 °C	±0.36 °F
Air pressure sensor measurement range	650-1150 mbar	22-34 in Hg
Air pressure sensor measurement accuracy	±1.0 mbar*	±0.03 in Hg*
Relative humidity sensor measurement range	0-95% (non-condensing)	
Relative sensor measurement humidity accuracy	±6%	
Wavelength compensation accuracy	±0.5 ppm T*	
Material temperature sensor measurement range	0-55 °C	32-131 °F

straightness base
straightness beam alignment
straightness data analysis
straightness error
straightness interferometer
straightness measurement
accessory kit
configurations
factors affecting accuracy
optics
principle
procedure
set-up
specification
straightness optics - mounting
straightness reflector
straightness shutter
surface plate
swallowtail data plot
swivel mirror
synchronising the indexer and rotary
system calibration
system cases

Storage pressure range updated:
650 mbar- 1150 mbar

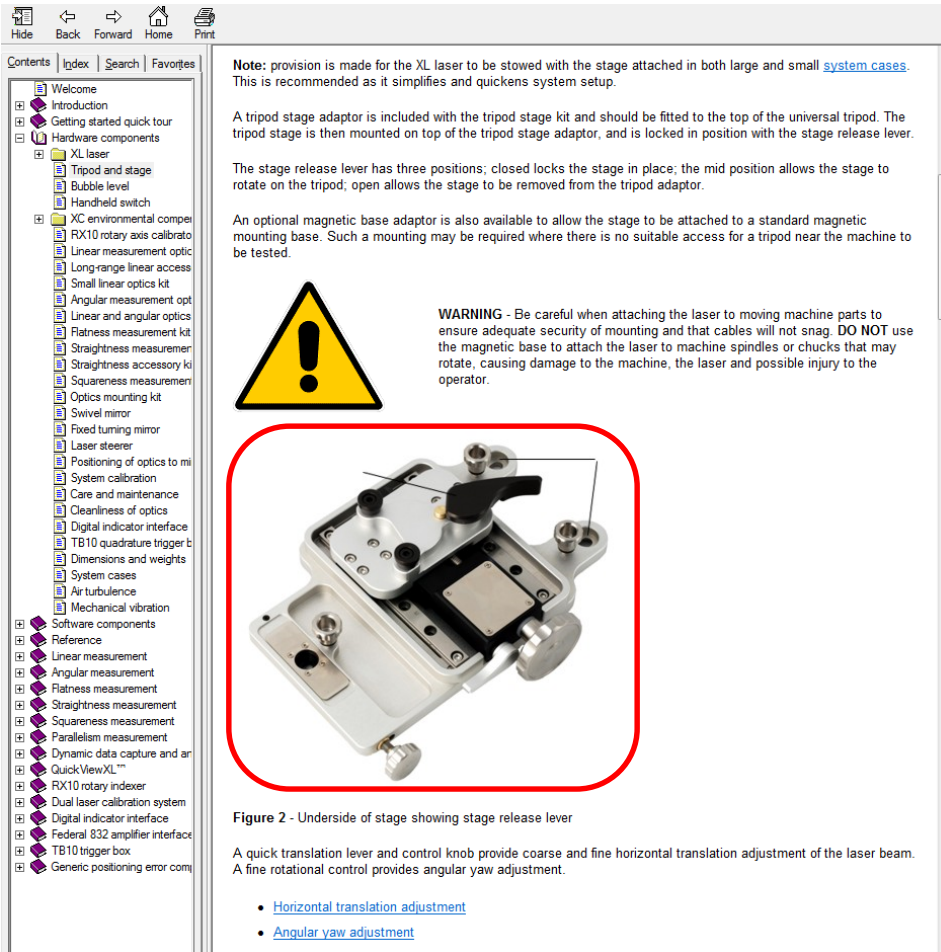
We no longer quote minimum PC requirements for our Laser calibration products in help manuals.

For an up to date minimum PC specification please go to the XL-80 Calibration software page on the website.

Correction to match degrees celcius:
32 – 131°F

Tripod stage text

Section – Hardware components, Tripod and stage



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 - Linear measurement optic
 - Long-range linear access
 - Small linear optics kit
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 - Positioning of optics to mi
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- Dual laser calibration system
- Digital indicator interface
- Federal 832 amplifier interface
- TB10 trigger box
- Generic positioning error com

Note: provision is made for the XL laser to be stowed with the stage attached in both large and small [system cases](#). This is recommended as it simplifies and quickens system setup.

A tripod stage adaptor is included with the tripod stage kit and should be fitted to the top of the universal tripod. The tripod stage is then mounted on top of the tripod stage adaptor, and is locked in position with the stage release lever.

The stage release lever has three positions; closed locks the stage in place; the mid position allows the stage to rotate on the tripod; open allows the stage to be removed from the tripod adaptor.

An optional magnetic base adaptor is also available to allow the stage to be attached to a standard magnetic mounting base. Such a mounting may be required where there is no suitable access for a tripod near the machine to be tested.



WARNING - Be careful when attaching the laser to moving machine parts to ensure adequate security of mounting and that cables will not snag. **DO NOT** use the magnetic base to attach the laser to machine spindles or chucks that may rotate, causing damage to the machine, the laser and possible injury to the operator.




Figure 2 - Underside of stage showing stage release lever

A quick translation lever and control knob provide coarse and fine horizontal translation adjustment of the laser beam. A fine rotational control provides angular yaw adjustment.

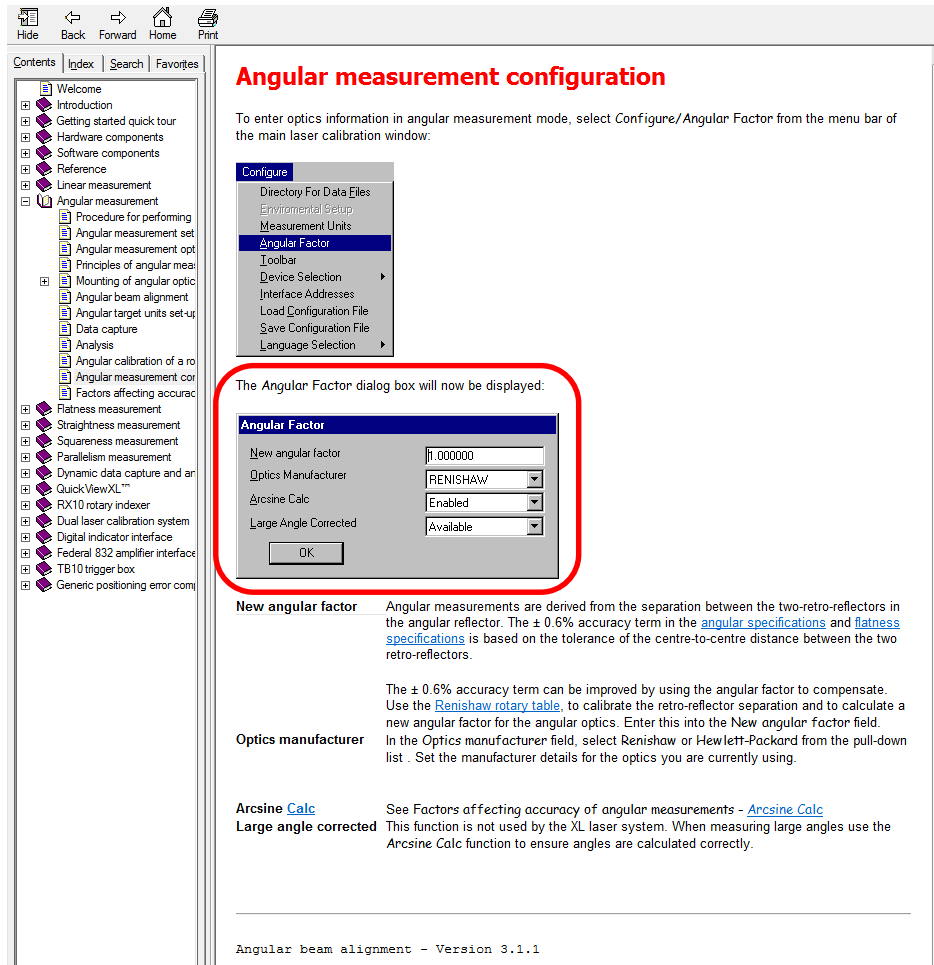
- [Horizontal translation adjustment](#)
- [Angular yaw adjustment](#)

Labelling lines removed



Angular factor

Section – Angular measurements, Angular measurement configuration



Angular measurement configuration

To enter optics information in angular measurement mode, select Configure/Angular Factor from the menu bar of the main laser calibration window.

The Angular Factor dialog box will now be displayed:

Angular Factor

New angular factor: 1.000000
Optics Manufacturer: RENISHAW
Arcsine Calc: Disabled
Large Angle Corrected: Available

OK

New angular factor Angular measurements are derived from the separation between the two retro-reflectors in the angular reflector. The $\pm 0.6\%$ accuracy term in the [angular specifications](#) and [flatness specifications](#) is based on the tolerance of the centre-to-centre distance between the two retro-reflectors.

The $\pm 0.6\%$ accuracy term can be improved by using the angular factor to compensate. Use the [Renishaw rotary table](#), to calibrate the retro-reflector separation and to calculate a new angular factor for the angular optics. Enter this into the New angular factor field.

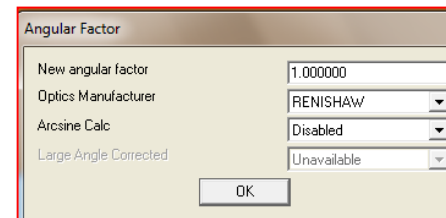
Optics manufacturer In the Optics manufacturer field, select Renishaw or Hewlett-Packard from the pull-down list. Set the manufacturer details for the optics you are currently using.

Arcsine Calc See Factors affecting accuracy of angular measurements - [Arcsine Calc](#)

Large angle corrected This function is not used by the XL laser system. When measuring large angles use the Arcsine Calc function to ensure angles are calculated correctly.

Angular beam alignment - Version 3.1.1

'Arcsine Calc' is now disabled:



Angular Factor

New angular factor: 1.000000
Optics Manufacturer: RENISHAW
Arcsine Calc: Disabled
Large Angle Corrected: Unavailable

OK

Calibration periods

Section – Hardware components, XL laser, Calibration

XL laser calibration

Your XL laser is supplied with a comprehensive calibration certificate. This is a valuable document which gives you proof of your laser's performance after manufacture, including actual test measurements, traceability and other data and information in accordance with the provisions of ISO 17025.

To maintain the Renishaw calibration system within its specified accuracy, we advise that the XL laser is calibrated every two to three years. More frequent calibration is advised for units used in extreme environmental conditions, or where damage is suspected. The requirements of your quality assurance programme or national/local regulations may also dictate more frequent recalibration. Also, during storage, transportation and use, they should not be subjected to excessive shock, vibration or extremes of temperature, pressure or moisture, since any of these factors could invalidate their calibration. If in doubt, refer to your local Renishaw distributor.

All the reference standards used in the calibrations are traceable to international standards. Typically this is directly to the National Physics Laboratory (NPL) in the UK or to NPL via an UKAS-accredited calibration house. NPL is a signatory to the CIPM Mutual Recognition Agreement. As such the validity of NPL's standards and their calibration and measurement certificates is recognised by all major National Metrology Institutes who have signed the agreement. (e.g. LNE: France; NIST: USA; PTB: Germany).

The uncertainty calculations have been carried out according to the European co-operation for Accreditation document EA-4/02.

All calibrations above are covered by Renishaw's EN ISO 9001:2000 quality assurance system. The system is audited and certified by a UKAS accredited agency. UKAS accreditation is recognised in many countries world-wide by the relevant national body in that country.

Refer to the certificate supplied with your laser or the [Renishaw website](#) for details of the calibration procedure used.

XL laser specification

The laser measurement system accuracy makes an allowance for reasonably foreseeable drift between calibrations, but the unit is not guaranteed to remain within specification between calibrations. The laser measurement system accuracy value makes no allowance for uncertainties associated with the set-up and alignment of the system and excludes the errors and uncertainties associated with normalisation of readings to a material temperature of 20 °C.

Renishaw offers a recalibration service for the XL laser. For more information, refer to your local Renishaw distributor.

XC compensator calibration

Additional clarification:

Renishaw recommends that XL-80 is recalibrated every three years. This is defined as three years from sale rather than from the calibration date on the certificate. This is because the units are stored under controlled conditions by Renishaw prior to sale.

Positioning of humidity sensors

Section – Linear measurements, Positioning or air sensors

The screenshot shows a technical manual page with a navigation pane on the left and a main content area on the right. The navigation pane lists various topics, including 'Positioning of air sensors'. The main content area is titled 'Positioning of air sensors' and contains several sections:

- Positioning of air sensors**
- Positioning of air temperature sensor**
- CAUTION**: TO ENSURE THERMAL STABILISATION, THE AIR TEMPERATURE SENSOR SHOULD BE IN THE MEASUREMENT ENVIRONMENT FOR UP TO 15 MINUTES BEFORE STARTING MEASUREMENT.
- The [air temperature sensor](#) should be placed as close as possible to the laser beam's measurement path and about halfway along the axis of travel. Avoid placing the sensors close to localised heat sources, for example motors, or in cold draughts.
- When measuring long axes, check for the presence of air temperature gradients. If the air temperature changes by more than 1 °C along the axis, use a fan to circulate the air. (This is particularly relevant on long vertical axes where air temperature gradients are more likely.) Avoid routing sensor signal leads close to sources of major electrical interference such as high power or linear motors.
- For ease of mounting, the air temperature sensors have a 'through hole' to enable them to be bolted to a surface.
- CAUTION**: DO NOT PUT THE RENISHAW AIR TEMPERATURE SENSOR NEAR COMPUTER DISKS OR TAPES OR ANYTHING WHICH WOULD BE DAMAGED BY ITS MAGNETIC FIELD.
- Air pressure/relative humidity sensors**
- The pressure and humidity sensors are mounted within the [XC compensator environmental compensation unit](#). In general, it is not necessary to measure air pressure or relative humidity in the immediate vicinity of the beam path. This is because large variations in pressure and humidity are required to give a significant error in measurement and there should be no significant variation in either, across the work area. However, the relative humidity sensor should be positioned away from sources of heat or draught.
- When calibrating vertical axes over 10 metres long, it is also recommended to place the pressure sensor halfway up the axis of travel.
- Positioning of air sensors - Version 3.1.1
- © 2007-2011 Renishaw plc. All rights reserved.

Additional statement added:

It is important to ensure the humidity sensor is not obstructed when mounting.

Positioning of XC-80 sensors

Section – Linear measurements, XC environmental compensation unit

XC environmental compensation unit

Figure 1 - XC environmental compensation unit

The XC compensator is key to your XL system's measurement accuracy. By very accurately and precisely measuring environmental conditions it compensates the wavelength of the laser beam for variations in air temperature, air pressure and relative humidity, virtually eliminating any measurement errors resulting from these variations.

<input type="checkbox"/>	Wavelength compensation
<input type="checkbox"/>	Material thermal expansion compensation

The sensor readings from the XC compensator are used to compensate the laser readings in linear measurement mode only. If compensation is not performed then variations in the refractive index of air can lead to significant measurement errors. Although it is possible to manually enter the environmental conditions (using handheld instruments etc), the benefit of using the XC compensator is that compensation is performed accurately and automatically updated every 7 seconds.

The XC compensator can also accept inputs from up to three material sensors, which measure the temperature of the machine or material under test. Provided the appropriate material thermal expansion coefficient has been entered into the LaserXL™ software, this will allow measurements to be normalised to a machine (material) temperature of 20 °C (68 °F).

<input type="checkbox"/>	Automatically updated environmental compensation with XC compensator
<input type="checkbox"/>	Manually updated environmental compensation with XC compensator
<input type="checkbox"/>	Compensation using manually entered data (no XC compensator)

Environmental compensation can be performed in three ways:

A full XC compensator specification is given in the [specifications](#) section.

Additional CAUTION statement:

CAUTION
THE XC-80 SHOULD BE MOUNTED WITH THE CYLINDER IN A HORIZONTAL ORIENTATION TO BE ACCURATE WITHIN QUOTED SPECIFICATION.



Power supply connector dimensions

Section – Hardware components, Dimensions and weights

Weight = 0.49 kg

Figure 3 - XC environmental compensation unit (dimensions in mm)

Sensor weights

Air temperature sensor	48 g	1.69 oz
Material temperature sensor	45 g	1.59 oz

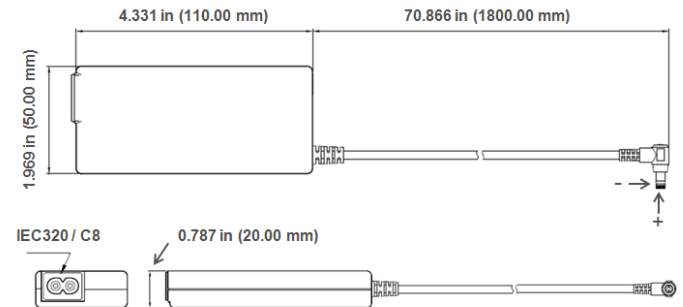
Power supply connector

Linear measurement optics

Figure 4 - Linear reflector

RED SPOT
NO THREAD (24 POSITIONS)

Missing information added:



DC Plug Type: V+ — (●) — V-
DC Plug: Right Angle (Ø5.5 / Ø2.5) L12 mm
 18AWG / 1800mm

Maximum manual target positions

Section – Software components Target positions

This target generation dialog is similar to the [auto target generation](#) dialog but with an additional entry, which allows the maximum size of the random element to be determined. Any value entered for the interval size will be the nominal interval before the addition or subtraction of a computer-generated random element.

Manual target entry

The manual target entry option allows the user to enter target positions which are not evenly spaced.

Select Targets/Manual Set-up from the menu. The following dialog will appear.

Enter the number of target positions (maximum number is 1000) and select OK.

A dialog box is displayed showing a list of target positions, each one being initially set to zero.

Target	Position (mm)
Target 1:	0.000000
Target 2:	0.000000
Target 3:	0.000000
Target 4:	0.000000
Target 5:	0.000000
Target 6:	0.000000
Target 7:	0.000000
Target 8:	0.000000
Target 9:	0.000000
Target 10:	0.000000
Target 11:	0.000000

Edit each target by entering the required position.

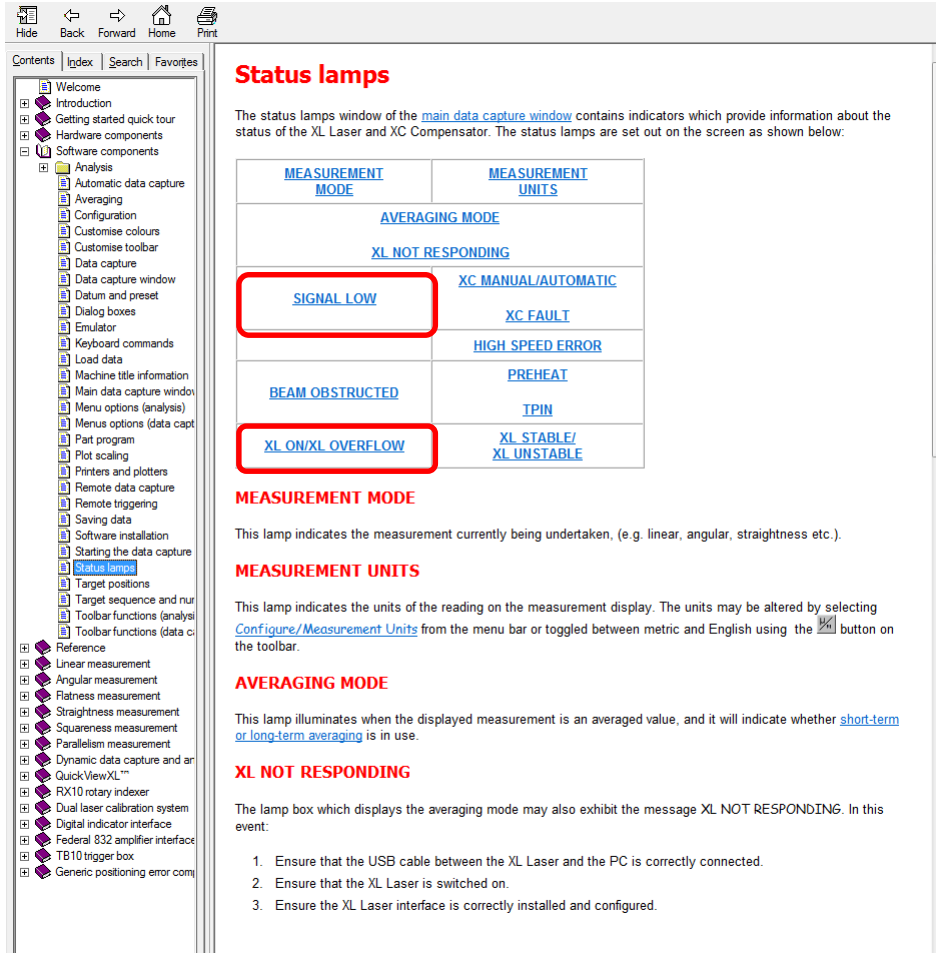
Target	Position (mm)
Target 1:	0.000000
Target 2:	90.000000
Target 3:	210.000000
Target 4:	295.000000
Target 5:	405.000000
Target 6:	501.000000
Target 7:	602.000000
Target 8:	705.000000
Target 9:	798.000000
Target 10:	890.000000
Target 11:	1000.000000

Correction:

Maximum number of target positions is 10000 as documented in the image above.

Error status lamps

Section – Software components Status lamps




The screenshot shows a software help page with a table of status lamps. Two lamps, 'SIGNAL LOW' and 'XL ON/XL OVERFLOW', are highlighted with red boxes. The page includes a table with two columns: 'MEASUREMENT MODE' and 'MEASUREMENT UNITS'. The 'SIGNAL LOW' lamp is in the 'MEASUREMENT MODE' column, and 'XL ON/XL OVERFLOW' is in the 'MEASUREMENT UNITS' column. The page also contains text descriptions for each lamp and a list of troubleshooting steps for the 'XL NOT RESPONDING' lamp.

MEASUREMENT MODE	MEASUREMENT UNITS
AVERAGING MODE	
XL NOT RESPONDING	
SIGNAL LOW	XC MANUAL/AUTOMATIC
	XC FAULT
	HIGH SPEED ERROR
BEAM OBSTRUCTED	PREHEAT
	TPIN
XL ON/XL OVERFLOW	XL STABLE/ XL UNSTABLE

MEASUREMENT MODE

This lamp indicates the measurement currently being undertaken, (e.g. linear, angular, straightness etc.).

MEASUREMENT UNITS

This lamp indicates the units of the reading on the measurement display. The units may be altered by selecting [Configure/Measurement Units](#) from the menu bar or toggled between metric and English using the  button on the toolbar.

AVERAGING MODE

This lamp illuminates when the displayed measurement is an averaged value, and it will indicate whether [short-term](#) or [long-term averaging](#) is in use.

XL NOT RESPONDING

The lamp box which displays the averaging mode may also exhibit the message XL NOT RESPONDING. In this event:

1. Ensure that the USB cable between the XL Laser and the PC is correctly connected.
2. Ensure that the XL Laser is switched on.
3. Ensure the XL Laser interface is correctly installed and configured.

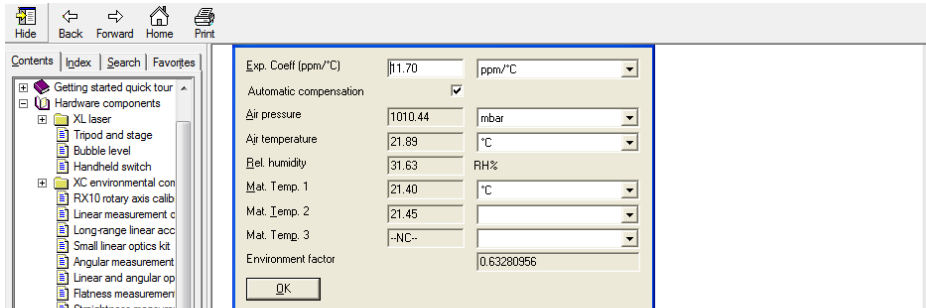
Correction:

Signal low
XL overflow

XL on

Thermal compensation on a test machine

Section – Linear measurement, Automatically updated environmental compensation with XC compensator



Alternatively, automatic compensation can be enabled in the environmental window that is normally displayed on the right hand side of the screen. Again ensure that the Automatic compensation checkbox is ticked. If this area is being used for another function, i.e. showing the optical configuration for linear measurement or displaying the current session properties, select the Window/Environment menu option to display the environmental window. The environmental window is useful for monitoring the current environment as measured by the sensors.

Where only one or two material temperature sensors are used, the lines corresponding to those not in use will read '-NC-' (not connected).

The units of any environmental parameter (except relative humidity) can be changed by clicking on the arrow to the right of the units box.

To define the default units which are used when the calibration software is started refer to [configuration](#).

CAUTION

BEFORE STARTING ANY CALIBRATION RUN:

- MAKE SURE THAT THE MACHINE TO BE CALIBRATED HAS BEEN EXERCISED SUFFICIENTLY TO WARM UP THE DRIVE AND SCALE OF THE AXIS TO BE CALIBRATED.
- MAKE SURE THAT THE CORRECT VALUE HAS BEEN ENTERED FOR THE [COEFFICIENT OF THERMAL EXPANSION](#) BY ADJUSTING THE [Material Expansion Compensation](#) PARAMETER.

XC compensator update cycle

Every seven seconds, a reading is taken from one of the six environmental sensors and passes to the PC. With this reading, the environmental compensation factor is updated. The order in which the environmental sensor readings are taken is as follows: air temperature, relative humidity, air pressure and the 3 material temperature sensors.

Automatic environmental compensation with XC compensator - Version 3.1.1

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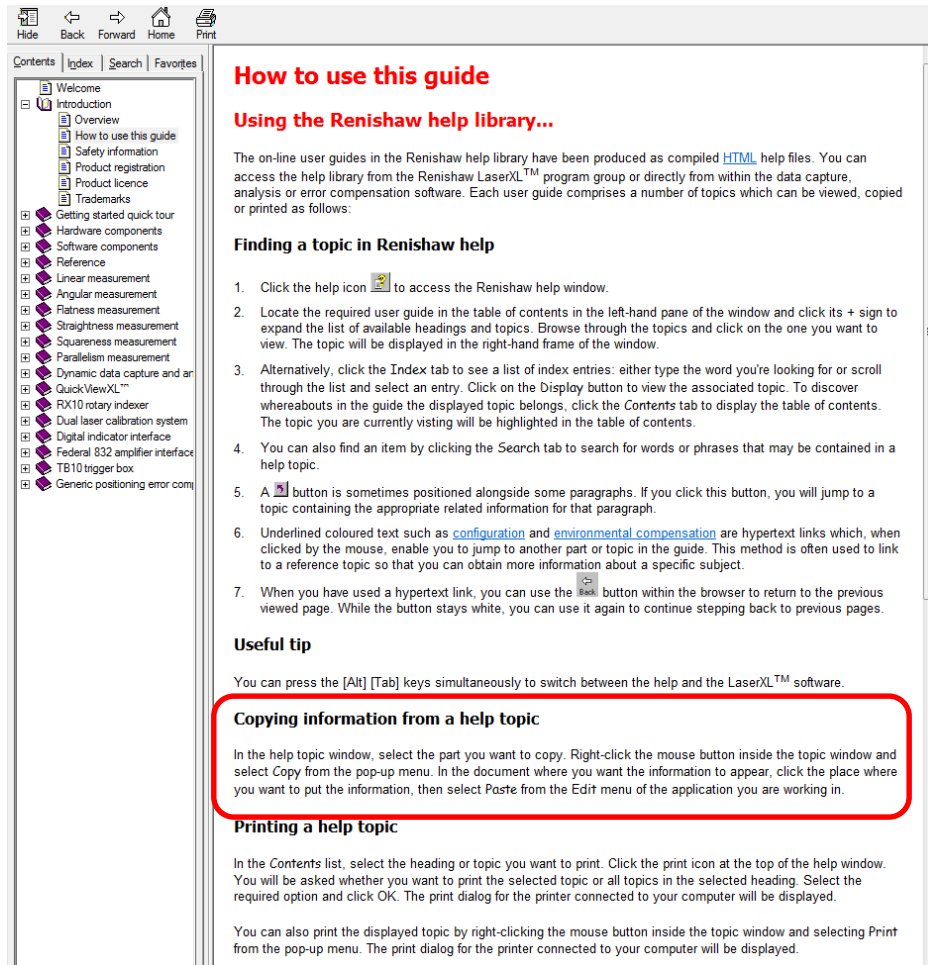
Additional CAUTION statement:

CAUTION

IF A MACHINE UNDER TEST HAS ENVIRONMENTAL COMPENSATION TURNED "ON" THEN ENSURE LASERXL COMPENSATES THE RESULTS USING AN IDENTICAL COEFFICIENT OF THERMAL EXPANSION AND SIMILAR TEMPERATURE READING. THE PLACEMENT OF THE XC-80 MATERIAL SENSOR SHOULD REFLECT THE TEMPERATURE OF THAT INTENDED BY THE TEMPERATURE SENSOR USED TO CORRECT THE MOVEMENT OF A MACHINE.

Copying information from a help topic

Section – Overview, How to use this guide






The screenshot shows a web browser window with a navigation bar at the top containing icons for Hide, Back, Forward, Home, and Print. Below the navigation bar is a 'Contents' tab, and a sidebar on the left lists various help topics. The main content area is titled 'How to use this guide' and contains the following sections:

How to use this guide

Using the Renishaw help library...

The on-line user guides in the Renishaw help library have been produced as compiled [HTML](#) help files. You can access the help library from the Renishaw LaserXL™ program group or directly from within the data capture, analysis or error compensation software. Each user guide comprises a number of topics which can be viewed, copied or printed as follows:

Finding a topic in Renishaw help

1. Click the help icon  to access the Renishaw help window.
2. Locate the required user guide in the table of contents in the left-hand pane of the window and click its + sign to expand the list of available headings and topics. Browse through the topics and click on the one you want to view. The topic will be displayed in the right-hand frame of the window.
3. Alternatively, click the Index tab to see a list of index entries: either type the word you're looking for or scroll through the list and select an entry. Click on the Display button to view the associated topic. To discover whereabouts in the guide the displayed topic belongs, click the Contents tab to display the table of contents. The topic you are currently visiting will be highlighted in the table of contents.
4. You can also find an item by clicking the Search tab to search for words or phrases that may be contained in a help topic.
5. A  button is sometimes positioned alongside some paragraphs. If you click this button, you will jump to a topic containing the appropriate related information for that paragraph.
6. Underlined coloured text such as [configuration](#) and [environmental compensation](#) are hypertext links which, when clicked by the mouse, enable you to jump to another part or topic in the guide. This method is often used to link to a reference topic so that you can obtain more information about a specific subject.
7. When you have used a hypertext link, you can use the  button within the browser to return to the previous viewed page. While the button stays white, you can use it again to continue stepping back to previous pages.

Useful tip

You can press the [Alt] [Tab] keys simultaneously to switch between the help and the LaserXL™ software.

Copying information from a help topic

In the help topic window, select the part you want to copy. Right-click the mouse button inside the topic window and select Copy from the pop-up menu. In the document where you want the information to appear, click the place where you want to put the information, then select Paste from the Edit menu of the application you are working in.

Printing a help topic

In the Contents list, select the heading or topic you want to print. Click the print icon at the top of the help window. You will be asked whether you want to print the selected topic or all topics in the selected heading. Select the required option and click OK. The print dialog for the printer connected to your computer will be displayed.

You can also print the displayed topic by right-clicking the mouse button inside the topic window and selecting Print from the pop-up menu. The print dialog for the printer connected to your computer will be displayed.

This information is obsolete as copying is consistent with all Windows platforms.

ISO 230-2 2006 clarification

Section – Software, Analysis, Analysis standards

Analysis standards

Renishaw LaserXL™ measurement software is capable of performing the following analyses:

- Linear analysis
- Angular analysis
- Flatness analysis
- Straightness analysis
- Squareness analysis
- Parallelism analysis
- Dynamic analysis
- Rotary analysis

Captured data can be analysed in accordance with a number of international standards in addition to a series of proprietary Renishaw analyses. Individual international standards describe the method required for collecting and analysing data, with various factors, such as the number of target positions required, varying depending on the standard used and machine type being tested. When carrying out any analysis of captured data, ensure the analysis you select is suitable for the type of machine you are testing and your test requirements.

The major international standards supported by this software are:

ASME B5.54	Methods for performance evaluation of computer numerical controlled machining centres.
ASME B89.1.12M	Methods for performance evaluation of co-ordinate measuring machines.
ISO 230-2	Test code for machine tools. Determination of accuracy and repeatability of positioning numerically controlled axes.
NMI/BA	Positional accuracy calibration of both linear and rotary axes of machine tools.
VDI 2617	Measurement of positional accuracy, angular deviation, straightness and squareness of co-ordinate measuring machines.
VDI 3441	Basic principles of operational and positional accuracy calibration of machine tools.

Other standards supported by the software (which may have been revised, replaced by other standards, or made obsolete) include:

BS 3800	Methods for testing the accuracy of machine tools.
BS 4656	Accuracy of machine tools and methods of test.
E60-099	Determination of reversibility and repeatability accuracy of machine tools.
GB 10931-89	Determination of accuracy and repeatability of positioning in numerically controlled machine tools.
GB/T 17421	"Test code for machine tools - Part 2: Determination of accuracy and repeatability of positioning numerically controlled axes".
JIS B6300	Test code for performance and accuracy of numerically controlled machine tools.

Additional statement added:

LaserXL analysis software was designed to meet ISO 230-2 1997. The current standard (ISO 230-2 2006) altered the analysis of the data by introducing the determination and reporting of a value for measurement uncertainty, which is not reported in LaserXL analysis software. There has been no change to the data capture process or to the previous analysis calculations from ISO 230-2 1997.

It is up to the user to define and complete a range of tests for the uncertainty parameters specified in ISO 230-2 2006. Once a total measurement uncertainty value has been calculated, the new Renishaw analysis software (XCal-View) provides the user the space to manually enter it into reporting.

Small optics kit specification

Section – Hardware components, Small linear optics kit

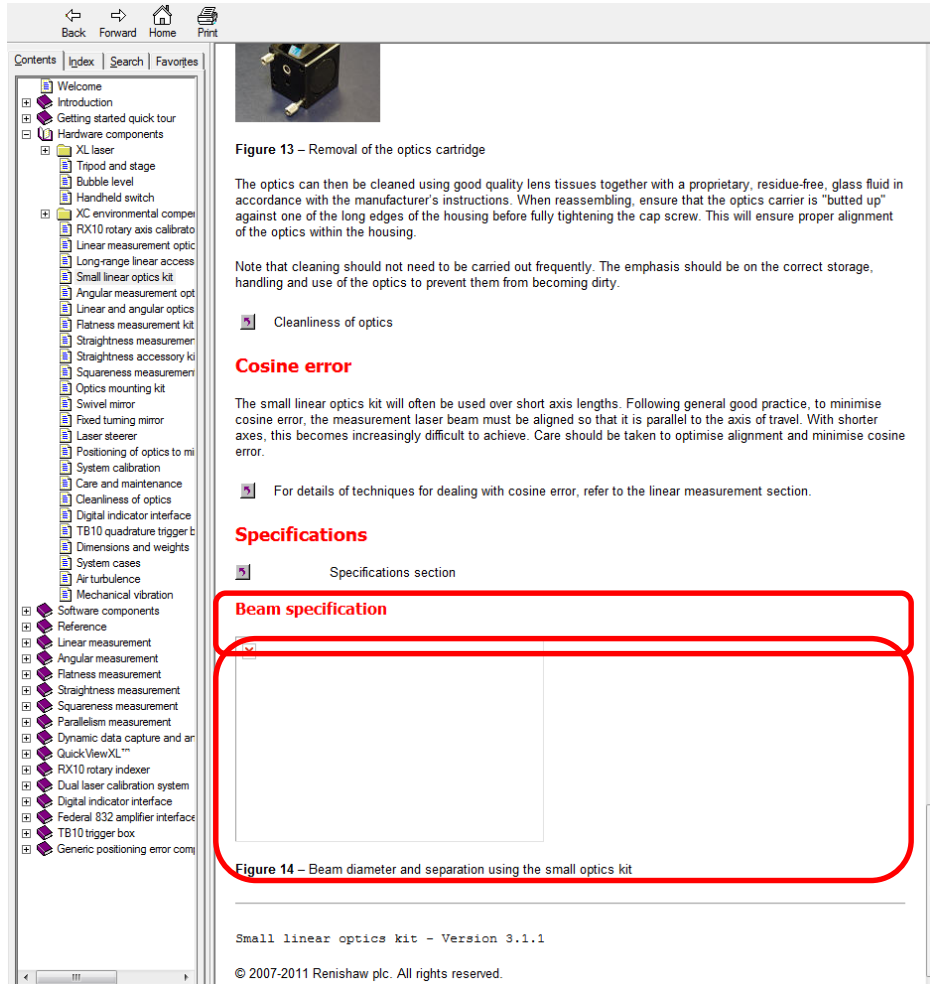


Figure 13 – Removal of the optics cartridge

The optics can then be cleaned using good quality lens tissues together with a proprietary, residue-free, glass fluid in accordance with the manufacturer's instructions. When reassembling, ensure that the optics carrier is "butted up" against one of the long edges of the housing before fully tightening the cap screw. This will ensure proper alignment of the optics within the housing.

Note that cleaning should not need to be carried out frequently. The emphasis should be on the correct storage, handling and use of the optics to prevent them from becoming dirty.

Cleanliness of optics

Cosine error

The small linear optics kit will often be used over short axis lengths. Following general good practice, to minimise cosine error, the measurement laser beam must be aligned so that it is parallel to the axis of travel. With shorter axes, this becomes increasingly difficult to achieve. Care should be taken to optimise alignment and minimise cosine error.

For details of techniques for dealing with cosine error, refer to the linear measurement section.

Specifications

Specifications section

Beam specification

Figure 14 – Beam diameter and separation using the small optics kit

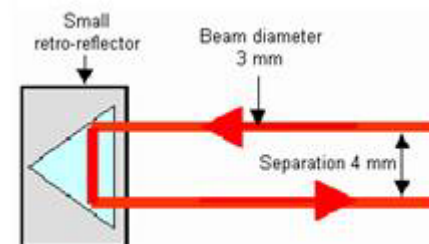
Small linear optics kit - Version 3.1.1

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Missing specification:

Small linear optics kit	
Maximum measurement range	4 m

Missing picture:



Aux I/O connector

Section – Hardware components, XL laser, Auxiliary I/O,

The screenshot shows a software manual with a table of specifications for the Auxiliary I/O connector kit. The table lists pins 2 through 26 with their respective functions. A photograph of the connector kit is included, with pins 1, 2, 12, 13, 14, 15, and 26 labeled. A red circle highlights the photograph.

2	0 V
3	Analogue position voltage output†
4	0 V
5	Reserved - do not connect
6	Reserved - do not connect
7	/B output*
8	B output*
9	Reserved - do not connect
10	Reserved - do not connect
11	0 V
12	+5 V ± 10%
13	0 V
14	Fast trigger input
15	Slow trigger input
16	Clear error and Datum input
17	0 V
18	Reserved - do not connect
19	Reserved - do not connect
20	/A output*
21	A output*
22	/ALARMOUT output*
23	ALARMOUT output*
24	Reserved - do not connect
25	Reserved - do not connect
26	Reserved - do not connect

The auxiliary I/O connector kit enables users to configure cables for their own applications.

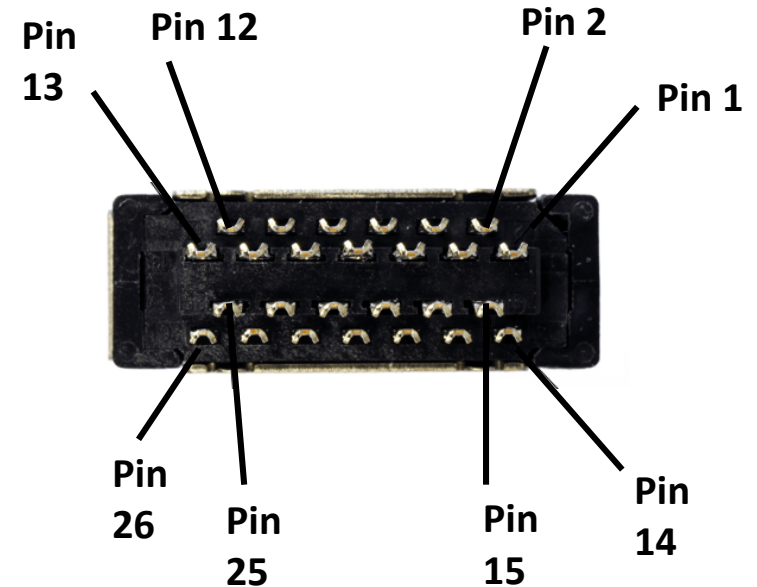
Auxiliary I/O connector kit

Pin 14 Pin 15 Pin 25 Pin 26
Pin 1 Pin 2 Pin 12 Pin 13

* Quadrature output is available as a factory set option
† Analogue output is available as a factory set option

XL laser - Version 3.1.1

The connector picture was incorrectly oriented by 180 degrees. Corrected image below:



Electrical interface for TPin fast triggering

Section – Hardware components, XL laser, Auxiliary I/O, Remote triggering

Remote triggering

The remote trigger facility allows data to be captured by the LaserXL™ calibration software, upon receipt of a trigger signal generated remotely, e.g. from a machine under test.

The trigger signal is input via the [auxiliary I/O port](#) on the rear panel of the XL laser.

The XL laser supports two types of trigger signal - 'slow trigger' and 'fast trigger'. These are accessed by two different pins on the [auxiliary I/O connector](#).

Fast trigger

The fast trigger mode provides a high-speed hardware trigger facility with a short delay (< 1 µsec) between the leading edge of the trigger input pulse and the instant that the laser reading is recorded.

The fast trigger mode is ideal for recording measurements when the machine under test is moving. Thus, in a typical application, a CNC machine tool or CMM would be programmed to move along an axis and laser measurement readings would be captured each time a trigger signal is received by the XL laser. These trigger signals might be time dependent (i.e. derived from a clock) or machine position dependent (i.e. derived from the CNC controller, an encoder feedback system or from a touch trigger probe).

The TB10 quadrature trigger box can be used to remotely trigger the XL laser. This device monitors the position feedback signals between a machine's encoders and its controller and feeds trigger signals to the XL laser. This allows synchronisation of data capture from the XL laser head to encoder position or movement. For more information, refer to the [TB10](#) section of this guide.

The fast trigger signal must be a clean, debounced TTL, CMOS or SSR signal applied to the fast trigger pin on the [auxiliary I/O connector](#), as shown in figure 1.

Figure 1 - Electrical interface for fast triggering

This may be provided, for example, from a Renishaw probe module interface (e.g. PI 4-2 or MI 5), as shown in figure 2. The probe contacts are wired to the 'probe' connection of the interface module and the fast trigger input of the XL laser [auxiliary I/O](#) should be connected to the output connection on the interface module.

Correction:

The supply voltage is +3.3V

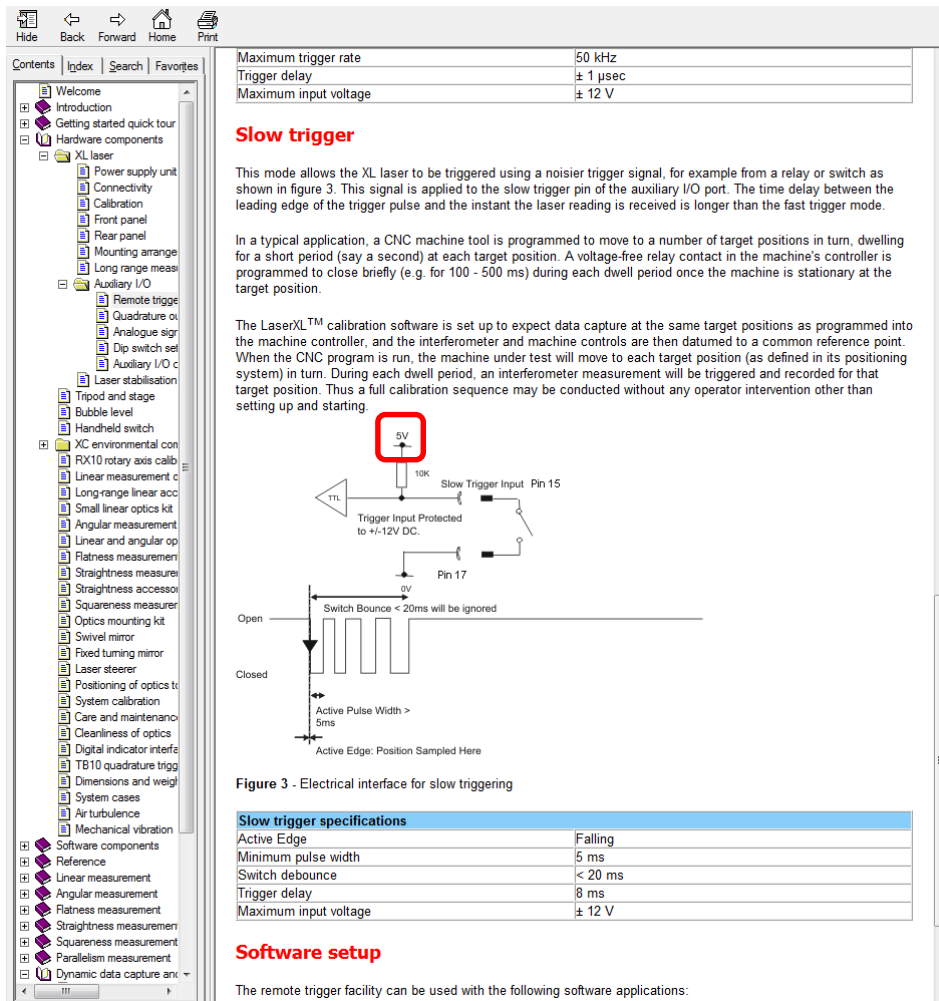
Electrical interface for TPin slow triggering

Section – Hardware components

XL laser

Auxiliary I/O

Remote triggering



The screenshot shows a software interface with a table of specifications and a diagram of the electrical interface for slow triggering.

Maximum trigger rate	50 kHz
Trigger delay	± 1 µsec
Maximum input voltage	± 12 V

Slow trigger

This mode allows the XL laser to be triggered using a noisier trigger signal, for example from a relay or switch as shown in figure 3. This signal is applied to the slow trigger pin of the auxiliary I/O port. The time delay between the leading edge of the trigger pulse and the instant the laser reading is received is longer than the fast trigger mode.

In a typical application, a CNC machine tool is programmed to move to a number of target positions in turn, dwelling for a short period (say a second) at each target position. A voltage-free relay contact in the machine's controller is programmed to close briefly (e.g. for 100 - 500 ms) during each dwell period once the machine is stationary at the target position.

The LaserXL™ calibration software is set up to expect data capture at the same target positions as programmed into the machine controller, and the interferometer and machine controls are then dumtmed to a common reference point. When the CNC program is run, the machine under test will move to each target position (as defined in its positioning system) in turn. During each dwell period, an interferometer measurement will be triggered and recorded for that target position. Thus a full calibration sequence may be conducted without any operator intervention other than setting up and starting.

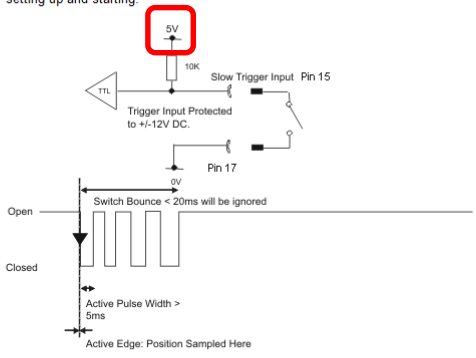


Figure 3 - Electrical interface for slow triggering

Slow trigger specifications	
Active Edge	Falling
Minimum pulse width	5 ms
Switch debounce	< 20 ms
Trigger delay	8 ms
Maximum input voltage	± 12 V

Software setup

The remote trigger facility can be used with the following software applications:

Correction:

The supply voltage is +3.3V

Removal of ML10 laser engraving

Section – Hardware components, Small linear optics kit

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 - QuickViewXL™
 - RX10 rotary indexer
 - Dual laser calibration system
 - Digital indicator interface
 - Federal 832 amplifier interface
 - TB10 trigger box
 - Generic positioning error com

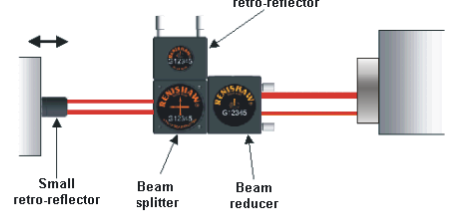


Figure 6 – Side view of main optics set-up

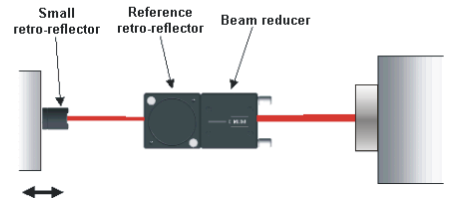


Figure 7 – Top view of main optics set-up

1. Set up the optics and XL laser as shown above, mounting the beam reducer on the input face of the linear beam splitter using the clamp screws provided.

Note: The beam reducer optic should be orientated so that its position relative to the laser is as indicated by the laser diagram on the top of the optic housing.


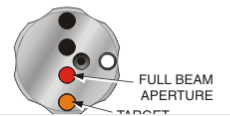


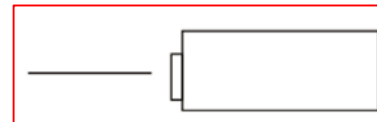
Figure 8 – Laser diagram

2. Using the tripod and laser head adjusters, align the laser beam by eye to be parallel to the axis of the machine. Ensure that the beam splitter/beam reducer optical assembly is square to the axis.
3. Rotate the XL laser shutter until the full beam diameter is output and a target is on the input port.



FULL BEAM APERTURE
TARGET

Diagram update:



Power supply input voltage

Section – Reference, Specifications

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- Federal 832 amplifier interface
- TB10 trigger box
- Generic positioning error compensation
- Acramatic 2100 Positioning Error Compensation
- Cincinnati A850/A950 positioning error compensation
- Fanuc positioning error compensation
- Fanuc 0 positioning error compensation
- Mazak M positioning error compensation
- NUM positioning error compensation
- Siemens 800 position error compensation
- Siemens 810D/840D position error compensation

Power supply unit	
Input voltage	90 to 264 V
Input frequency	47 to 63 Hz
Output voltage	24 V ± 2%
Maximum output current	1.5 A
Safety standard	EN (IEC) 60950

Mounting stage and laser - alignment adjustment	
Pitch range	±1.5 degrees
Yaw range	±1.5 degrees
Horizontal translation range	72 mm






Tripod	
	Metric
Positioning height range of laser when mounted on top of tripod	0.53-1.56 m
Collapsed length	0.64 m
Weight	3.8 kg

Correction:

The input voltage is 100 to 240V +/-10%

XL laser power supply unit

Section – Reference, Safety information

Contents Index Search Favorites		<p>When setting up and mounting Renishaw XL calibration products, beware of pinch and/or crush hazards that may be created e.g. due to magnetic mounting bases or the universal tripod.</p> <p>Beware of trip hazards that may be created when using the Renishaw XL calibration system e.g. due to trailing cables.</p> <p>Exercise caution if Renishaw XL calibration products are to be mounted to moving or rotating machinery. Beware of cables becoming entangled.</p> <p>Exercise extreme caution if Renishaw XL calibration products are to be mounted to machinery that may accelerate rapidly or move at high speed, which could lead to items colliding or being ejected.</p> <p>If it is necessary to remove or disable any guards or safety features on the machine under test, it is the responsibility of the operator to ensure that appropriate alternative safety measures are adopted in line with the machine manufacturer's operating instructions or code of practice.</p> <p>If you are using a part program or error correction parameters generated by the Renishaw software, it is the responsibility of the user to validate these at low feedrate and be prepared to operate an emergency stop button if necessary.</p>	
			
	XL laser power supply unit		
		<p>The XL laser system has been qualified for use with the power supply unit supplied with the system. A specification for this power supply unit can be found in the specification section of the electronic manual.</p> <p>Take care not to allow the power supply unit to come into contact with fluids e.g. coolant on the floor.</p>	
	Quadrature output		<p>Do not use the quadrature output facility of the XL laser to provide positional feedback control for a machine. The system is not designed to be used for feedback control and injury could result to the operator if used for this purpose.</p>

Amendment to safety statement

Do not use or handle the power supply unit if it comes into contact with fluids, e.g. coolant or the case is cracked or otherwise physically damaged.

Angular measurement specification

Section – Reference, Specifications

Angular measurement		
	Metric	Imperial
Axial range	0-15 m	0-590 in
Angular measurement range	±175 mm/m	±10°
Angular accuracy	High accuracy angular optics	±0.2% ±0.1 ±0.007F arc sec
	Standard accuracy angular optics	±0.6% ±0.5 ±0.1M arc sec
Resolution	0.1 µm/m	0.01 arc sec

Where:
M = measurement distance in metres
F = measurement distance in Feet
 % = percentage of calculated angle

Amendment to angular accuracy

Specification	Metric	Imperial
Angular accuracy	±0.002A ±0.5 ±0.1M µ rad	±0.002A ±0.1 ±0.007F arc sec
Angular accuracy (calibrated)	±0.0002A ±0.5 ±0.1M µ rad*	±0.0002A ±0.1 ±0.007F arc sec

• for 20° C ±5° C
 A = displayed angular reading M = measurement distance in metres F = measurement distance in feet