

User guide
F-9921-0201-02-B

RENISHAW 
apply innovation™

SALES & SERVICE:
A Tech Authority, Inc.
13745 Stockton Ave.
Chino CA 91710
909-614-4522
sales@atechauthority.com

XM-60 multi-axis calibrator



XM-60

Multi-axis calibrator



Legal information

Disclaimer and warranty information Trade marks

Disclaimer

Renishaw has made considerable efforts to ensure the content of this document is correct at the date of publication but makes no warranties or representations regarding the content. Renishaw excludes liability, howsoever arising, for any inaccuracies in this document.

Renishaw reserves the right to make changes to this document and to the product described herein without obligation to notify any person of such changes.

Warranty

Equipment requiring attention under warranty must be returned to your equipment supplier.

Unless otherwise specifically agreed in writing between you and Renishaw, if you purchased the equipment from a Renishaw company, the warranty provisions contained in Renishaw's CONDITIONS OF SALE apply. You should consult these conditions in order to find out the details of your warranty but, in summary, the main exclusions from the warranty are if the equipment has been:

- neglected, mishandled or inappropriately used; or
- modified or altered in any way except with the prior written agreement of Renishaw.

If you purchased the equipment from any other supplier, you should contact them to find out what repairs are covered by their warranty.

Renishaw part no: F-9921-0201-02-B

Issued: 04.2017

Trade marks

RENISHAW and the probe symbol used in the RENISHAW logo are registered trade marks of Renishaw plc in the United Kingdom and other countries. **apply innovation** and names and designations of other Renishaw products and technologies are trade marks of Renishaw plc or its subsidiaries.

All other brand names and product names used in this document are trade names, trade marks, or registered trade marks of their respective owners.

Copyright

© 2016 Renishaw. All rights reserved.

This document may not be copied or reproduced in whole or in part, or transferred to any other media or language, by any means without the prior written permission of Renishaw. The publication of material within this document does not imply freedom from the patent rights of Renishaw plc.

Patents

Features of the XM-60 multi-axis calibrator, and other similar Renishaw products, are subject of one or more of the following patents and/or patent applications:

CN	101715540	US	2016/0169710
CN	105637326	US	5975744
EP	3028011	US	6473250
GB	2337339	US	6597505
IN	WO2015/015213	US	7304815
JP	2015/015213	US	8368887
JP	4499924		

XM-60

Multi-axis calibrator



Legal information

International regulations and conformance

EC compliance

Renishaw plc declares that the XM-60 system complies with the applicable directives, standard and regulations. A copy of the full EC Declaration of Conformity is available upon request.

In compliance with BS EN 61010-1:2001 the product is safe to use in the following environmental conditions:

- Indoor use only
- Altitude up to 2000 m
- Maximum relative humidity (non-condensing) of 80% for temperatures up to 31 °C decreasing linearly to 50% relative humidity at 40 °C
- Pollution Degree 2



WEEE

The use of this symbol on Renishaw products and/or accompanying documentation indicates that the product should not be mixed with general household waste upon disposal. Due to fibre optic handling requirements the unit must be returned to Renishaw for disposal. Please contact your local Renishaw office to arrange collection. Correct disposal of this product will help to save valuable resources and prevent potential negative effects on the environment. For more information, please contact your local Renishaw office.



Radio approval

The wireless communication module used within the XM-60 system is pre-approved in a number of regions including EU, EFTA countries, USA and Canada.

Module manufacturer: Laird plc
Part number: TRBLU23-00200
FCC ID: FCC ID PI401B
Module ID No: 1931 B-BISMII

XM-60

Multi-axis calibrator



Legal information

USA and Canadian regulations

FCC

Information to the user (47CFR:2001 part 15.19)

This device complies with Part 15 of the FCC rules. Operation is subject to the following conditions:

This device may not cause harmful interference.

This device must accept any interference received, including interference that may cause undesired operation.

Information to the user (47CFR:2001 part 15.105)

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not used in accordance with this user guide, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case you will be required to correct the interference at your own expense.

Information to the user (47CFR:2001 part 15.21)

The user is cautioned that any changes or modifications, not expressly approved by Renishaw plc or authorised representative, could void the user's authority to operate the equipment.

Special accessories (47CFR:2001 part 15.27)

The user is also cautioned that any peripheral device installed with this equipment, such as a computer, must be connected with a high-quality shielded cable to ensure compliance with FCC limits.

Canada – Industry Canada (IC)

This device complies with RSS 210 of Industry Canada. Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of this device.

L'utilisation de ce dispositif est autorisée seulement aux conditions suivantes : (1) il ne doit pas produire d'interférence et (2) l'utilisateur du dispositif doit être prêt à accepter toute interférence radioélectrique reçue, même si celle-ci est susceptible de compromettre le fonctionnement du dispositif.

XM-60

Multi-axis calibrator



Contents

Safety information	6	Test overview	22	Optics	42
Safety labelling	7	XM-60 set-up	23	System specifications	43
Mechanical safety	8	XC-80 set-up	25	Performance specifications	44
Laser optical safety	8	Basic rules of alignment	26	Operating and storage environment	45
Electrical and power safety	9	Alignment overview	27	Radio communication	46
Battery safety	9	Visual axis alignment	28	Receiver battery and charger	47
Fibre optic safety	10	Fine axis alignment	31	Power supply unit	48
System overview	11	Receiver alignment	33	Weights and dimensions	49
XM-60 multi-axis calibrator	11	Data capture	34	Appendix A	52
System components	13	Data analysis	36	Replacing the receiver battery	52
XM-60 kit	13	Diagnostics and troubleshooting	37	Appendix B	53
Laser / Launch	14	Laser LED	37	Using the 90 degree bracket	53
Receiver	15	Receiver LED	38	Appendix C	54
Calibration software kit	16	Battery charger LED	39	Sign detection	54
XC-80 environmental compensator	17	System troubleshooting	40	Appendix D	55
Fixturing kit	18	Measurement troubleshooting	41	Fixturing kit good practice guide	55
Setting up a test	19	Care and handling	42	Appendix E	60
Testing precautions	19	System	42	Comparison of straightness measurement set-ups	60
Quick start system set-up	21	Conduit	42		

XM-60

Multi-axis calibrator



RENISHAW 
apply innovation™

Safety information



Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

Ensure that you read and understand the XM-60 user guide (supplied on CD) before using any XM system.

The XM system can be used in a variety of environments and applications. To ensure the safety of the user and other personnel in the vicinity it is therefore paramount that a comprehensive risk assessment is carried out for the machine under test before using the XM system.

This should be carried out by qualified users (requiring machine competency, applicable technical knowledge and a trained risk assessor) with consideration for the safety of all personnel. The risks identified must be mitigated prior to using the product. The risk assessment should pay particular attention to machine, manual handling, mechanical, laser, electrical, power and fibre optic safety.

XM-60

Multi-axis calibrator



Safety labelling



COMPLIES WITH FDA PERFORMANCE STANDARDS FOR LASER PRODUCTS EXCEPT FOR DEVIATIONS PURSUANT TO LASER NOTICE NO.50, DATED JUNE 24, 2007

LASER LIGHT DO NOT STARE INTO THE BEAM OR VIEW DIRECTLY WITH OPTICAL INSTRUMENTS
CLASS 2M LASER PRODUCT



LASER LIGHT
DO NOT STARE INTO THE BEAM OR VIEW DIRECTLY WITH OPTICAL INSTRUMENTS
CLASS 2M LASER PRODUCT
EN 60825-1:2007
Wavelength: 630-670nm
Max Power: 1.0mW CW



There are no user-serviceable parts inside the XM system. Do not remove any part of the housing; to do so could expose the user to high voltages and/or Class 3R laser radiation.



Ensure that you read and understand the XM-60 user guide (supplied on CD) before using any XM system.

XM-60

Multi-axis calibrator



Mechanical safety

- When setting up and mounting Renishaw XM and XC-80 systems beware of pinch and/or crush hazards that may be created e.g. due to magnetic mounting bases.
- Beware of trip hazards that may be created when using the XM and XC-80 systems, e.g. due to trailing cables.
- Exercise caution if components are to be mounted to moving or rotating machinery. Beware of cables becoming entangled.
- Exercise extreme caution if XM and XC-80 system components are to be mounted to machinery that may accelerate rapidly or move at high speed, which could lead to items colliding or being ejected.
- If it is necessary to operate the machine with the guards or any safety feature removed or disabled, it is the responsibility of the operator to ensure that alternative safety measures are taken in line with the machine manufacturer's operating instructions or relevant codes of practice.
- 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 the emergency stop button if necessary.
- The XM system weighs approximately 24 kg in the case (31 kg with the fixturing kit attached). Users should exercise caution and follow local manual handling guidelines.



Laser optical safety

- In accordance with (IEC) EN60825-1, XM systems are Class 2M lasers and safety goggles are not required (under normal circumstances the eye will blink and look away before damage can occur).
- Do not stare directly into the laser beams or view them with optical equipment such as telescopes, convergent mirrors or binoculars as permanent retinal damage could occur. Do not direct the beam at other people or into areas where people unconnected with laser work might be present. It is safe to view a diffuse-reflected beam during system alignment.
- FDA compliance (USA) – complies with 21CFR1040.10 and 1040.11 except for deviations pursuant to laser notice no. 50, dated 24 June, 2007.

Rotating the shutter to the closed position (the right hand position on the picture) ensures no beam is emitted.



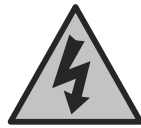
XM-60

Multi-axis calibrator



Electrical and power safety

- The power supply unit must not come into contact with fluids e.g. coolant on the floor.
- The power supply unit must not be positioned inside the machine volume.
- The XM 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 [here](#).
- In the event of damage to the single phase mains cabling section of the power supply (power lead), all power must be isolated from the equipment before any other action is taken.
- Never connect the system to devices not intended to be used with the XM system.



Battery safety

The XM-60 multi-axis calibrator is supplied with rechargeable batteries. Once depleted, recharge the battery in the charger provided: do not attempt to charge the battery by other means.

For specific battery operating, safety and disposal guidelines, please refer to the battery manufacturers' literature.

- Replace the batteries only with the specified type.
- Ensure that all batteries are inserted with the correct polarity.
- Do not store batteries in direct sunlight.
- Do not heat or dispose of batteries in a fire.
- Do not short-circuit or force discharge the batteries.
- Do not disassemble, pierce, deform or apply excessive pressure to the batteries.
- Do not swallow the batteries.
- Keep the batteries out of the reach of children.
- Do not get batteries wet.
- If a battery is damaged, exercise caution when handling it.



XM-60

Multi-axis calibrator



RENISHAW
apply innovation™

Battery safety

Transportation

Please ensure that you comply with international and national battery transport regulations when transporting batteries or XM system kits.

The XM system uses a lithium ion battery. Lithium batteries are classified as dangerous goods and strict controls apply on their shipment by air. To reduce the risk of shipment delays, should you need to return the XM system to Renishaw for any reason, do not return any batteries.

The operation of wireless appliances on aircraft is forbidden by many airlines to prevent interference with communications systems. Remove the battery from the receiver unit when boarding an aircraft to ensure it cannot be switched on inadvertently.

EU REACH SVHC compliance

Please see the relevant battery manufacturer's website for further information:

Varta: <http://www.varta-microbattery.com/en/news-downloads/downloads.html>

The use of this symbol on the batteries, packaging or accompanying documents indicates that used batteries should not be mixed with general household waste. Please dispose of the used batteries at a designated collection point. This will prevent potential negative effects on the environment and human health which could otherwise arise from inappropriate waste handling. Please contact your local authority or waste disposal service concerning the separate collection and disposal of batteries. All lithium and rechargeable batteries must be fully discharged or protected from short circuiting prior to disposal.



Fibre optic safety

The XM system contains fibre optics. In the unlikely event that the flexible steel conduit is cut or severed, fibre optic splinters may be produced.

Fibre optic splinters can be very small and extremely sharp. Should any fibre optic splinter become embedded in the skin, medical attention should be sought immediately.

Should the fibre optic become damaged, the following procedure should be followed (be aware that the affected area might contain splinters of unattached fibre optic which can present a hazard):

- immediately power down the XM system,
- wear eye protection and protective gloves when handling damaged or exposed fibre optics,
- carefully remove the XM system from the machine and package in a suitable thick-walled cardboard box, clearly marked 'Caution: exposed fibre optics, handle with care' on the outside of the box,
- return the unit to the nearest Renishaw office.

No attempt should be made to repair or dismantle the fibres from the laser unit.



Note: Fibre optic splinters do not show up on X-rays.

XM-60

Multi-axis calibrator



System overview

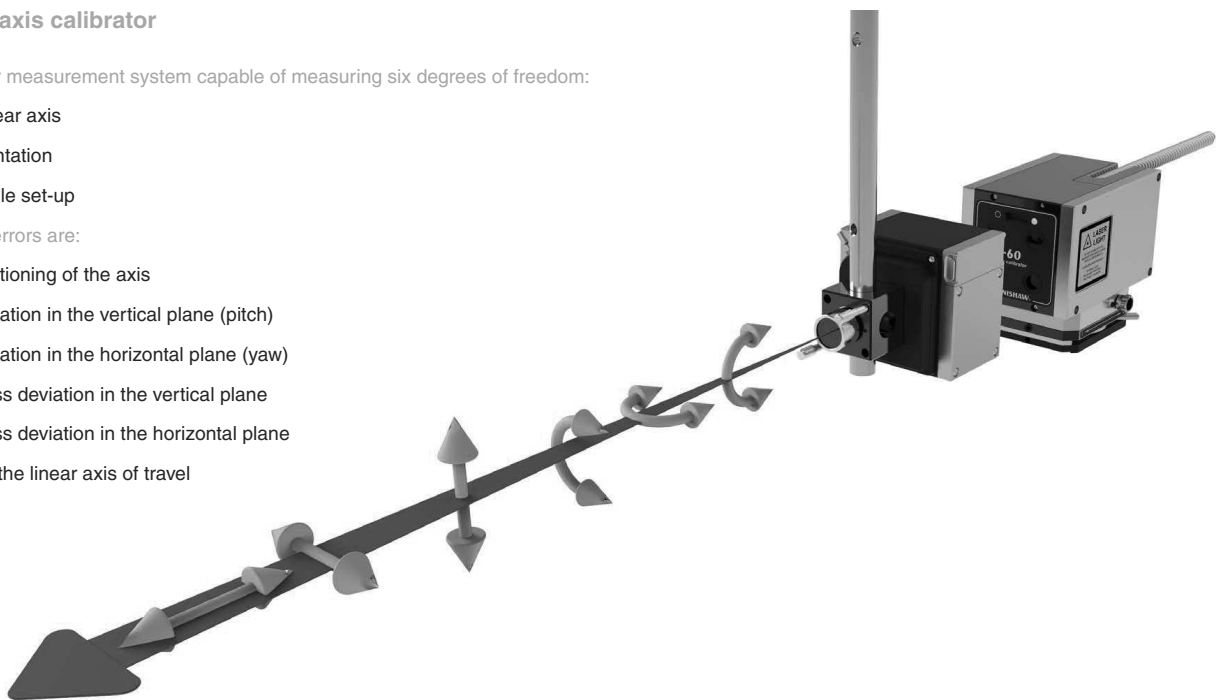
XM-60 multi-axis calibrator

XM-60 is a laser measurement system capable of measuring six degrees of freedom:

- along a linear axis
- in any orientation
- from a single set-up

The measured errors are:

- Linear positioning of the axis
- Angular rotation in the vertical plane (pitch)
- Angular rotation in the horizontal plane (yaw)
- Straightness deviation in the vertical plane
- Straightness deviation in the horizontal plane
- Roll about the linear axis of travel



XM-60

Multi-axis calibrator



RENISHAW
apply innovation™

The XM-60 uses three laser beams (1,2 and 3) to measure the linear, pitch and yaw errors using interferometry. The light emitting diode (LED) beam (4) is used for straightness and roll measurements.

The 4th (diode source) beam is used to measure straightness and roll.

The basic measurement concept is:



Angular

The three interferometric beams provide a linear measurement of the separation between launch and receiver. Because the distance between these beams is known, angular errors of pitch and yaw can be determined by the system.



Straightness

The vertical and horizontal straightness error is measured using a position sensor within the receiver and transmitted back to the laser via wireless communication.



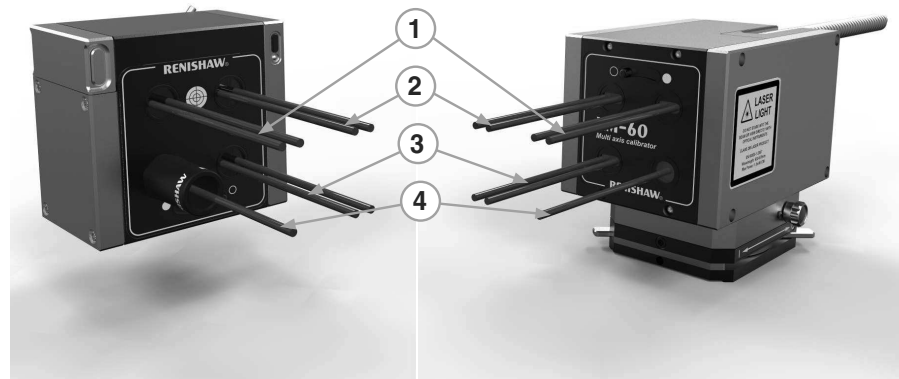
Linear

Using the pitch and yaw measurements, the linear error is determined based on the combination of beams 1, 2 and 3 to calculate the linear error at the position of beam 4.



Roll

Roll measurement is performed optically using a roll detector inside the receiver. Roll measurements are absolute between the launch and the receiver.



XM-60

Multi-axis calibrator



System components

XM-60 kit



1	Laser / Launch
2	Receiver
3	Calibration software kit
4	Beam shroud

5	90 degree bracket
6	Battery Li-Polymer 3.7 V × 3
7	Battery charger
8	Magnetic base

9	Clamp blocks × 2
10	M8 pillars × 4
11	Spirit level
12	Cable clamps × 3

XM-60

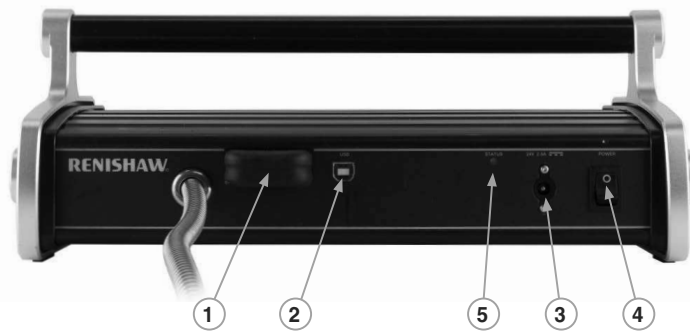
Multi-axis calibrator



Laser / Launch

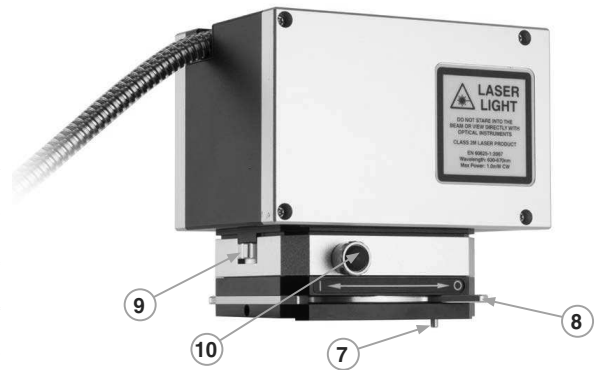
The laser contains a Helium-Neon (HeNe) laser tube providing laser beams to the launch via fibre optics. In addition, the laser contains signal processing electronics.

The laser beam is split into three in the launch for linear and angular measurements. It also houses a diode beam source for roll and straightness measurements.



1	Wireless communication module
2	USB connection port
3	Power connector
4	Power on/off switch
5	System status LED

6	Laser safety shutter
7	Magnetic mount safety pin <i>(prevents accidental magnet operation)</i>
8	Magnetic clamp on/off lever
9	Pitch adjuster
10	Yaw adjuster



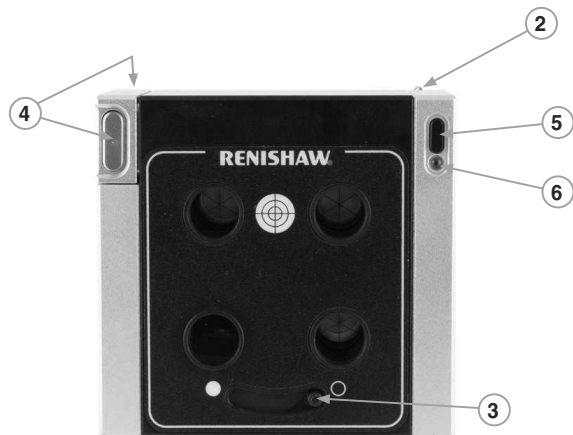
XM-60

Multi-axis calibrator



Receiver

The receiver contains three retro-reflectors for the interferometric laser beams. It also contains a straightness and roll sensor for the diode beam, data from this sensor is transmitted to the laser via wireless communication.



1	Beam shroud
2	Roll adjuster
3	Shutter
4	Battery release buttons
5	Power button
6	Receiver/battery status LED



The beam shroud is attached by a 'push-fit' on to the receiver roll aperture.

XM-60

Multi-axis calibrator



Calibration software kit

The XM-60 system is supplied with the “Calibration software kit” which comprises:

- CARTO suite
- User guides and documentation for XM-60, XC-80 and XL-80

The CARTO suite features two applications:



XM-60

Multi-axis calibrator



RENISHAW 
apply innovation™

XC-80 environmental compensator

The XM-60 specified accuracy for interferometric measurements is only valid when used with a calibrated XC-80 environmental compensator.

Changes in air temperature, pressure and relative humidity affect the wavelength of the laser light and, therefore, the measurement readings taken.

The XC-80 environmental compensator and its sensors very accurately measure the environmental conditions and compensate the wavelength of the laser beam for variations in air temperature, air pressure and relative humidity.



Note: For full details on XC-80 operation and specification please refer to XC-80 user guide.



XM-60

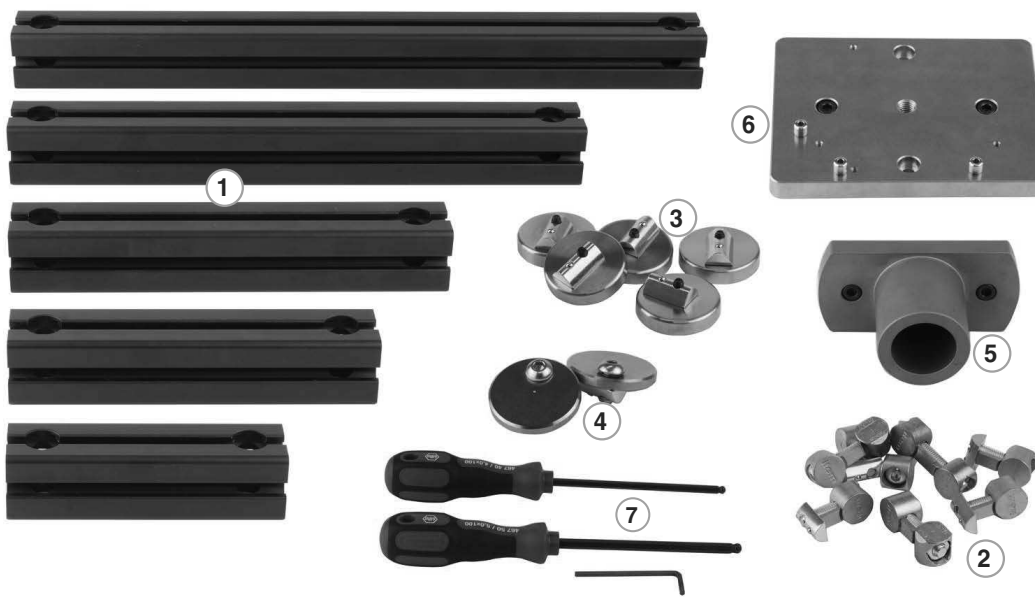
Multi-axis calibrator



Fixturing kit

An optional fixturing kit is available which provides the user with flexible mounting solutions. Typical set-ups of the fixturing kit would allow:

- Mounting the launch into the jaws of the chuck in a lathe or mill-turn machine tool.
- Overhanging a unit to allow full axis of travel to be measured.



1	450 mm extrusion 350 mm extrusion 250 mm extrusion 200 mm extrusion 150 mm extrusion
2	Extrusion connectors × 8
3	Magnets × 5
4	Extrusion alignment aids × 2
5	Lathe adaptor
6	Steel mounting plate
7	Hex drivers × 3



XM-60

Multi-axis calibrator



Setting up a test

Testing precautions

Light interference

External light can cause errors in roll measurement performance.

To minimise the effect of light interference the user should:

- Always use the beam shroud
- Switch off the machine lighting
- Minimise external lighting



Sources of lighting that can affect the performance are:

- Sunlight
- Flashing beacons
- Welding
- LED and fluorescent room lighting



Performance can be affected by abnormal changes in any of the above. It is important to consider light effect and reflections over the full range of the axis under test.

CARTO allows the user to perform an ambient light check. See Capture user guide for details.

XM-60

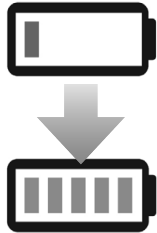
Multi-axis calibrator




Testing precautions

Thermal stabilisation

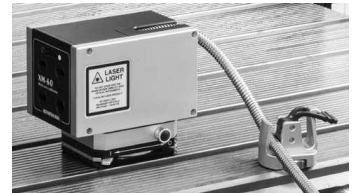
- To meet the quoted specifications the XM-60 must be thermally stable.
- Thermal stability is achieved 45 minutes after the laser/launch and receiver are powered on. Therefore it is recommended to turn the laser/launch and receiver on at the earliest opportunity.
- The receiver and the launch must be removed from the case during the thermal stabilisation period and should be placed at least 200 mm away from each other.
- To prevent further thermal stabilisation, once discharged the receiver battery should be changed within two minutes:



 **Note:** An uninterruptible power supply can be used when moving XM-60 from one machine to the next.

Mechanical set-up

- In order to take relative measurements between the tool and the workpiece, the launch must always be attached to the structure that holds the workpiece, i.e. the machine bed or the chuck on a lathe. See Appendix for comparison with other measurement modes.
- The conduit should be fixed to the machine bed to stop it dragging, misaligning, or causing the launch to drop during machine movement. Please use the cable clamps provided within the kit.
- To ensure sufficient magnetic force do not overhang the launch from the machine bed. In this instance the fixturing kit must be used.



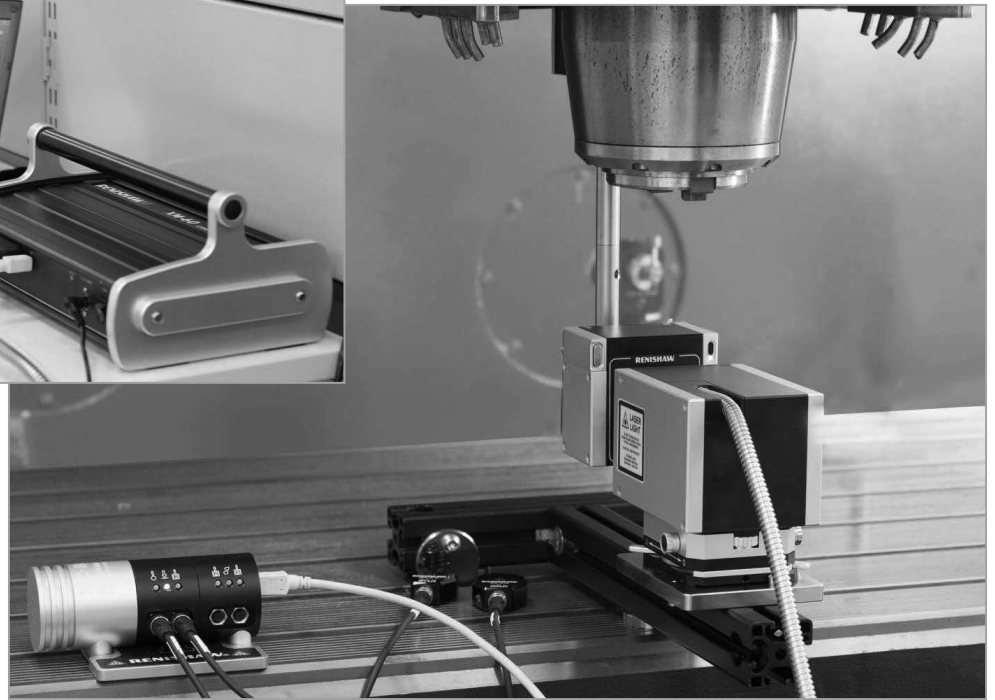
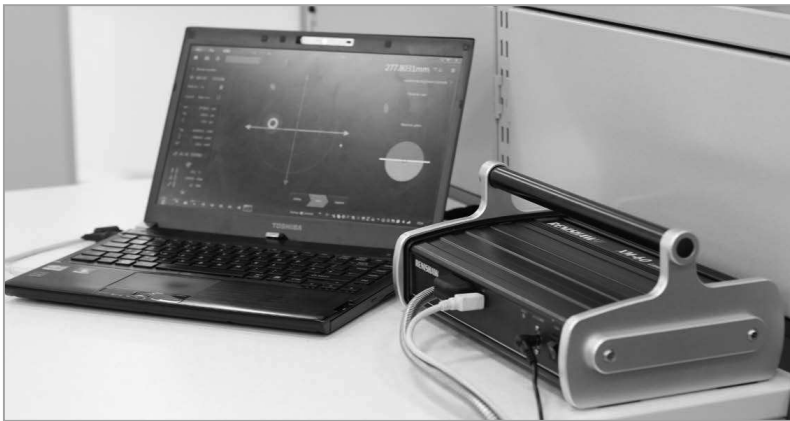
XM-60

Multi-axis calibrator



RENISHAW 
apply innovation™

Quick start system set-up



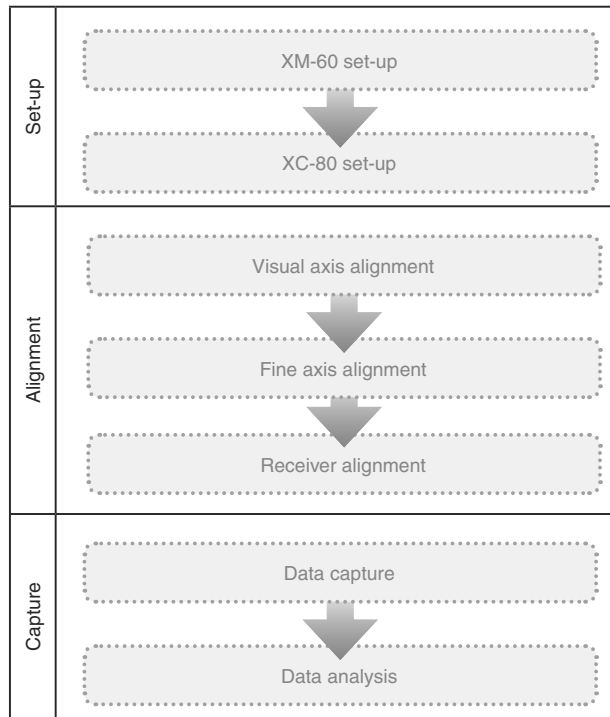
XM-60

Multi-axis calibrator



Test overview

The steps to perform a test using XM-60 are as follows (click on links to jump to relevant section):



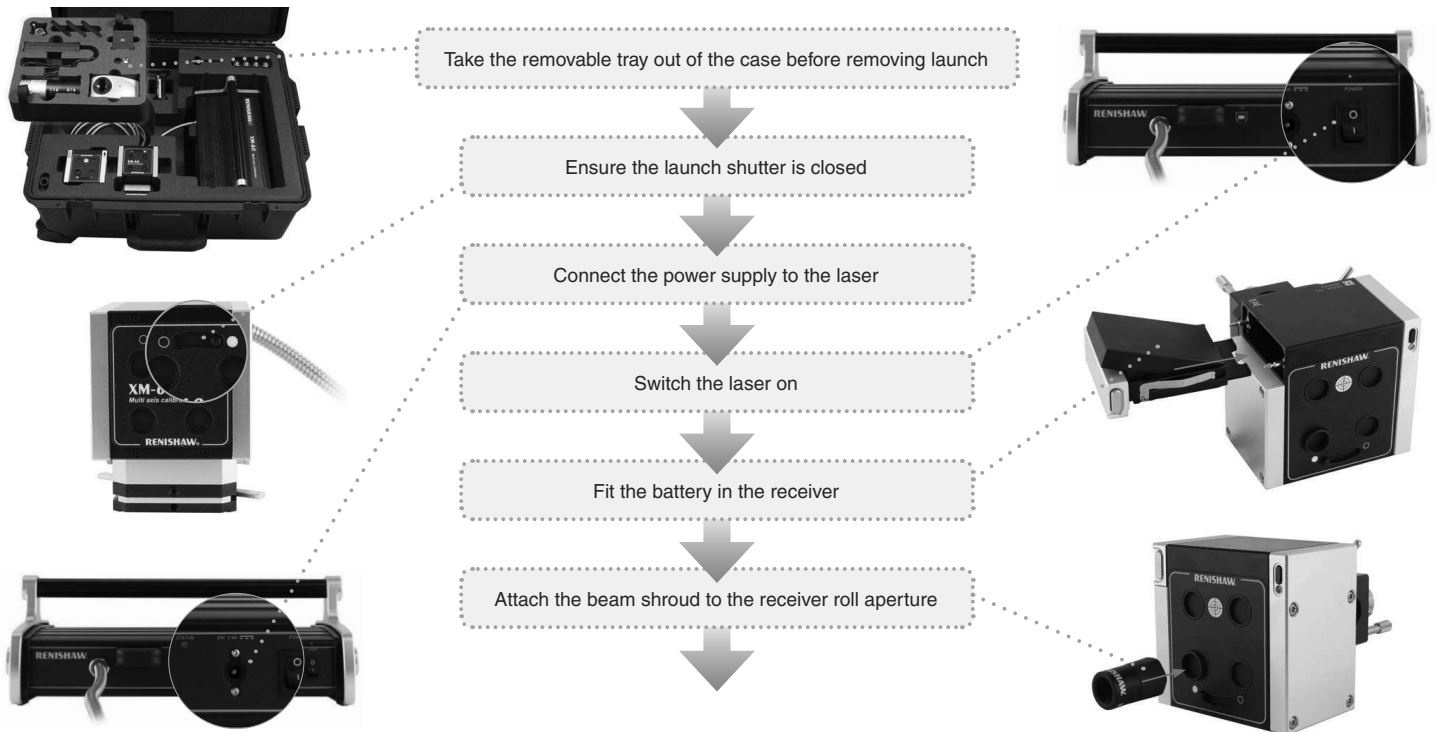
XM-60

Multi-axis calibrator



XM-60 set-up

The recommended set-up sequence for the XM-60 is as follows:

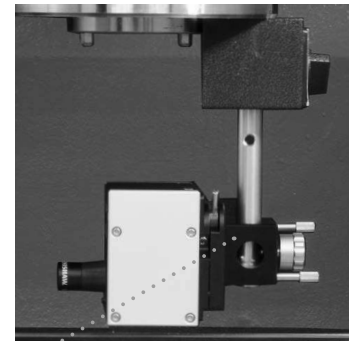
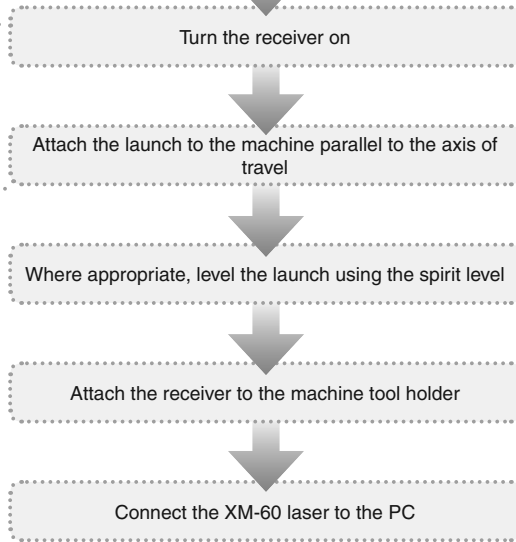


XM-60

Multi-axis calibrator



XM-60 set-up



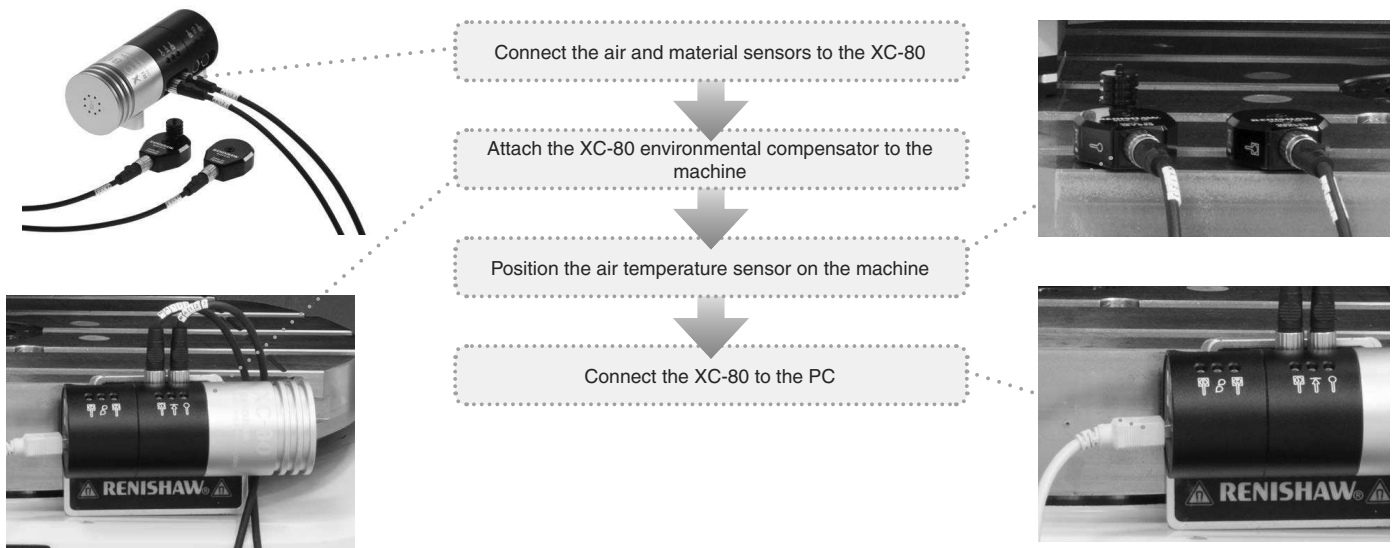
XM-60


Multi-axis calibrator



XC-80 set-up

The recommended set-up sequence for the XC-80 is as follows:



 **Note:** For more information on sensor positioning refer to XC-80 user guide

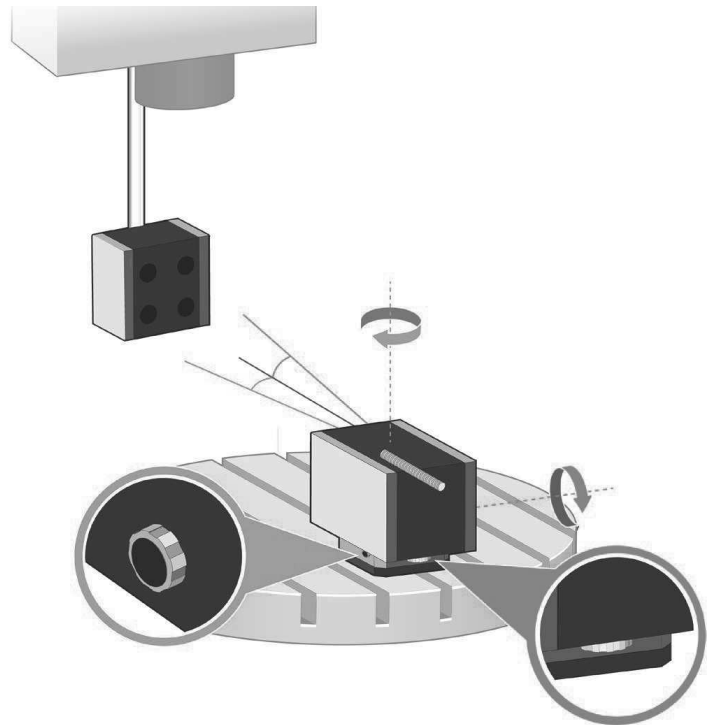
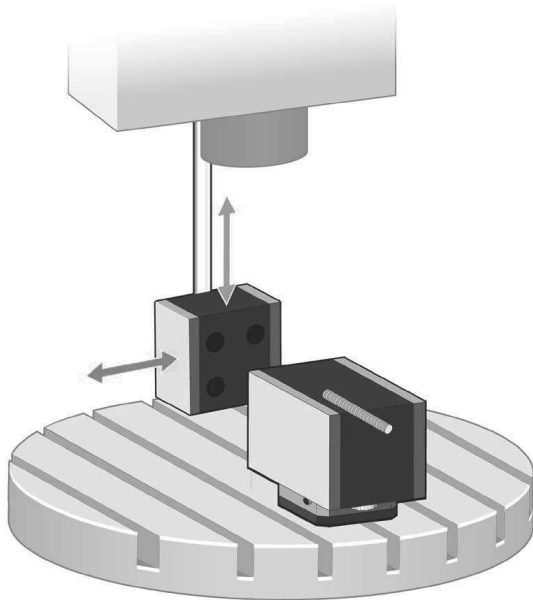
XM-60

Multi-axis calibrator



Basic rules of alignment

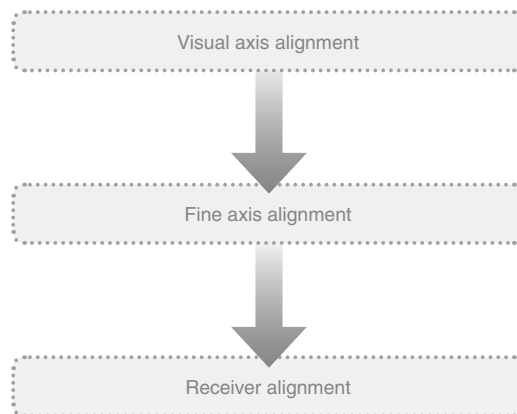
1. Launch and receiver are close to each other = **translation adjustment**
2. Launch and receiver are far from each other = **rotation adjustment**





Alignment overview

The recommended alignment sequence is as follows (click on links to jump to relevant section):



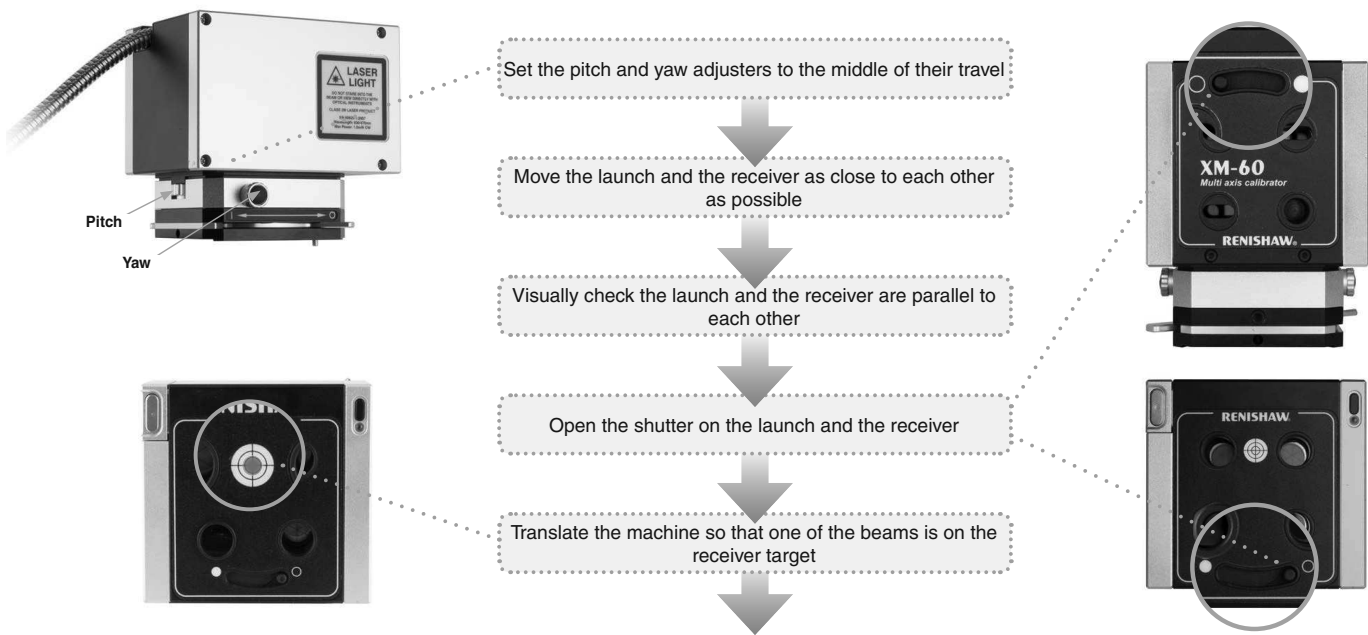
XM-60

Multi-axis calibrator



Visual axis alignment

Visual axis alignment is performed using the target on the front of the receiver.



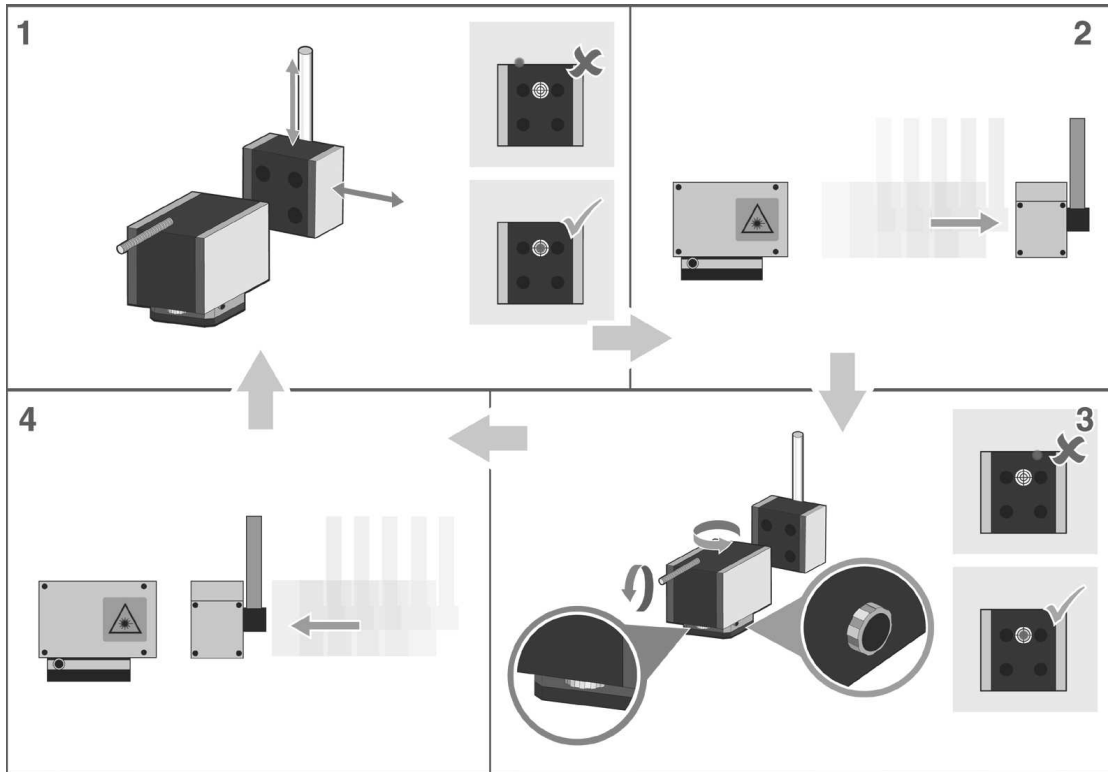
XM-60

Multi-axis calibrator



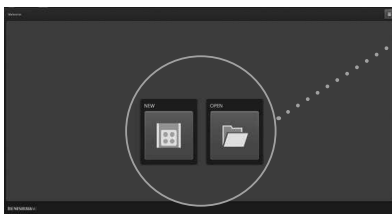
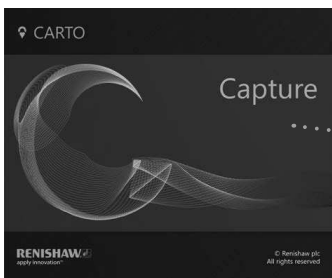
Visual axis alignment

Continue the process below until the beam stays on the target during the full machine movement. Use the machine to perform translations and pitch/yaw adjusters for rotational alignment.



XM-60

Multi-axis calibrator

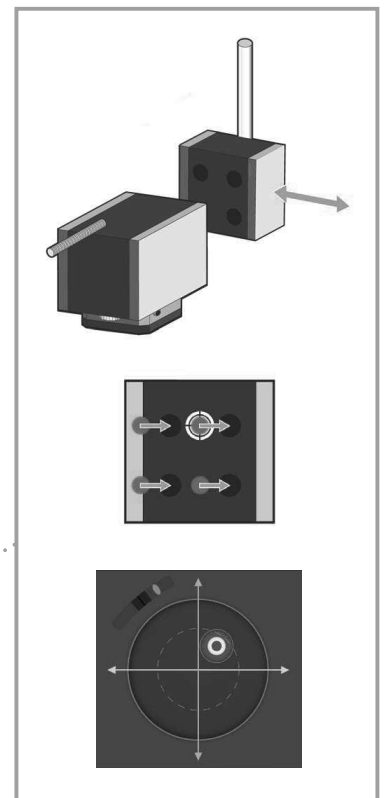


Run Capture

Select New or Open

Select Align

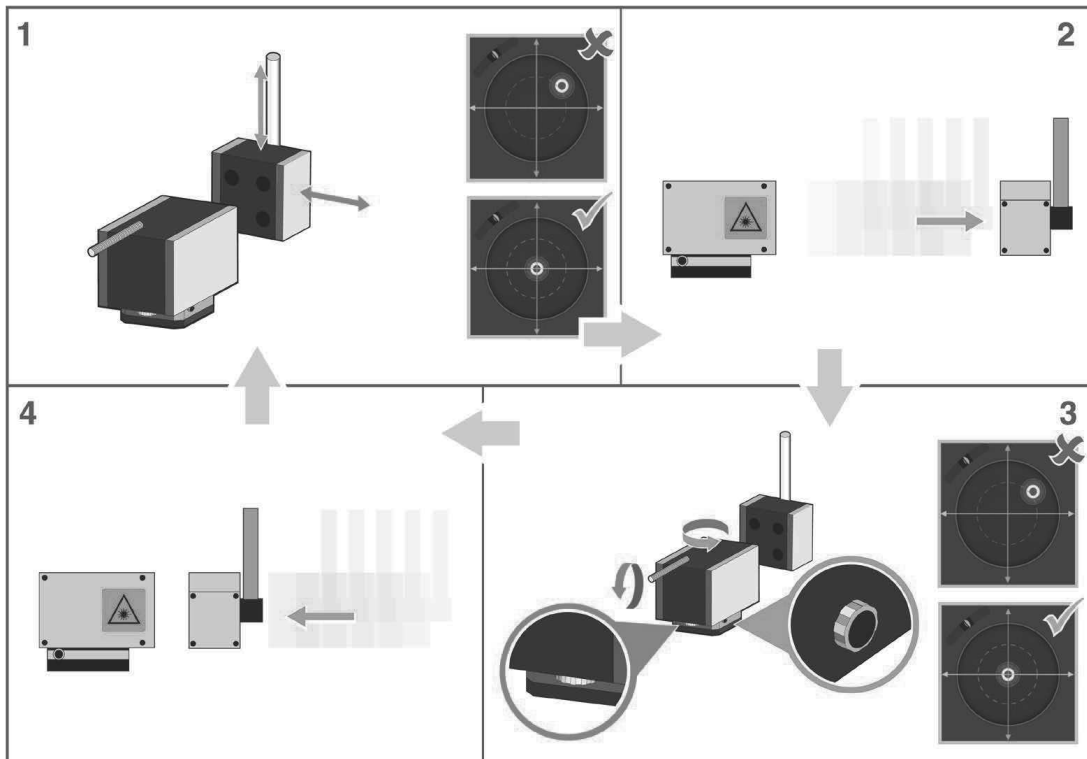
Translate
Move the machine to align the laser beams into the receiver apertures. Adjust position until the straightness beam appears in CARTO





Fine axis alignment

Continue the process below until the beam stays on the target in CARTO software during the machine movement.



XM-60

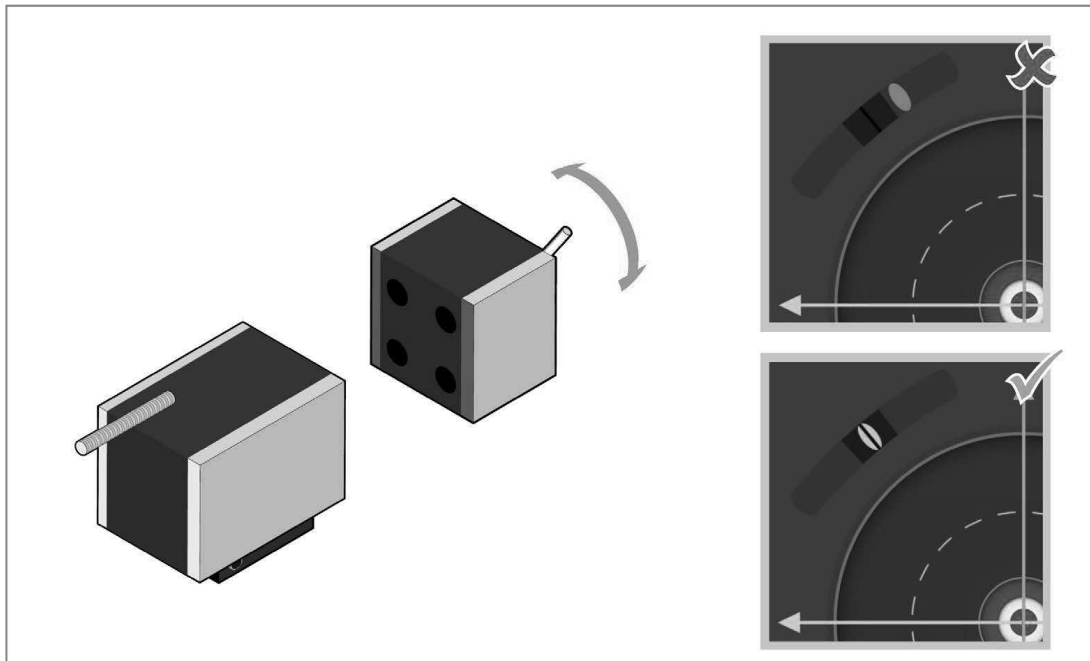
Multi-axis calibrator



Fine axis alignment

Roll alignment

Adjust the roll lever to the centre of the roll display.



XM-60

Multi-axis calibrator

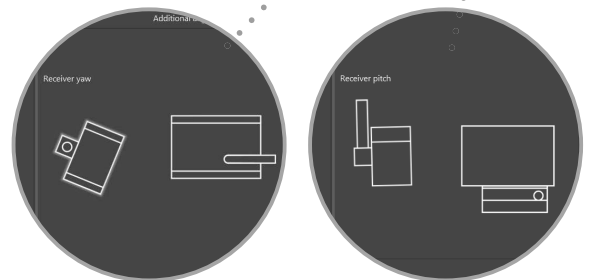
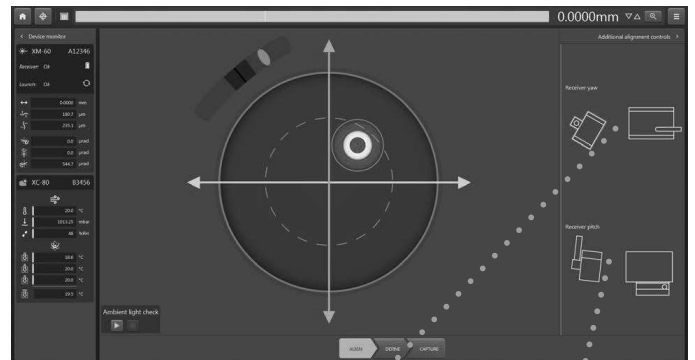


Receiver alignment

- To maintain the system accuracy the launch and the receiver must be parallel to each other.
- The software will check the parallelism on the completion of the fine axis alignment.
- If the parallelism tolerance is not met when selecting **Capture**, the software will prompt the user to physically adjust the mounting of the receiver. Rotate the receiver until the red border disappears. Do not adjust the pitch and yaw adjustment of the launch unit.

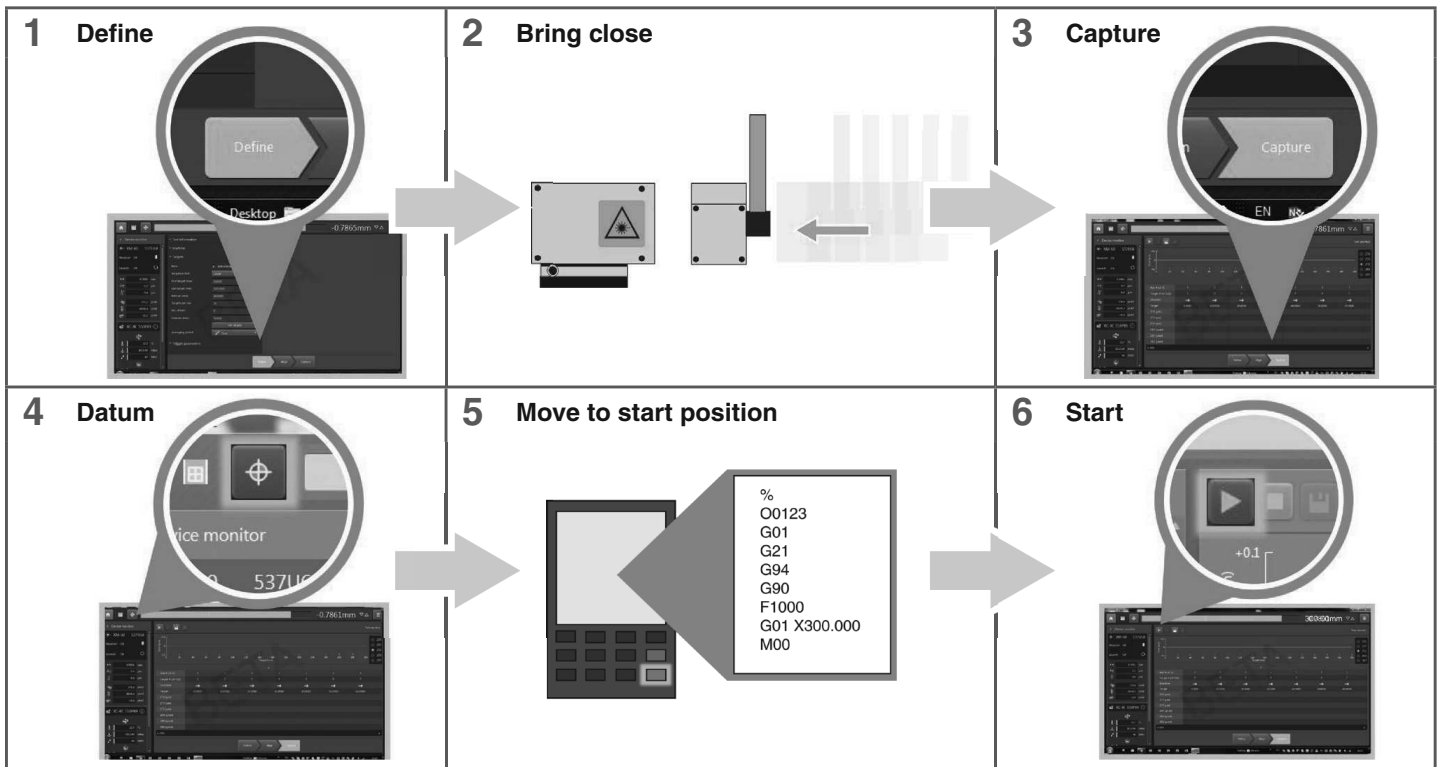
Note: It may be necessary to perform minor translation of the machine after this step is complete.


Note: Once set-up is complete and before capturing data, it is recommended to perform an ambient light check. See Capture user guide for details.





Data capture



 **Note:** For full details on **Capture** please refer to the Capture user guide.

XM-60

Multi-axis calibrator



Data capture

Roll tuning

When **Start** is selected the system will perform a calibration cycle on the roll detection scheme to compensate for the set-up conditions.



Sign detection

To ensure the errors of the machine are measured with the correct sign (+/-) it is important that the coordinate system of the XM-60 (X,Y,Z and their directions) is labelled according to that of the machine. Further details on sign detection can be found here.

There are two methods of sign detection:

- Automatic

Part programs produced with CARTO will perform machine moves to detect the sign.

- Manual

The user can manually jog the machine $\pm 150 \mu\text{m}$ in each axis when prompted by the software to perform sign detection.



Note: Users can skip an axis if they don't have three perpendicular axes. Further details can be found in the Capture user guide.

On completion of these steps the system will start capturing data.

XM-60

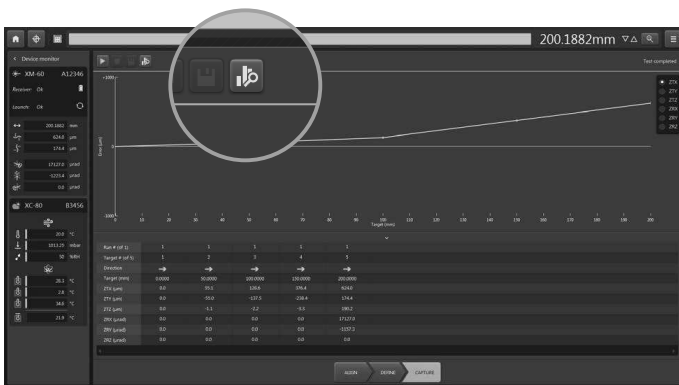
Multi-axis calibrator



RENISHAW
apply innovation™

Data analysis

On completion of the test select **Analyse** to launch Explore.



Note: For further details on Explore please refer to the Explore user guide.



Diagnostics and troubleshooting

Laser LED

This LED demonstrates the laser status and the wireless communication with the receiver.

LED status	Description	Actions
Flashing amber	Pre-heat cycle	No action required
Solid green	<ul style="list-style-type: none"> Laser is stabilised Receiver is not switched on or the wireless communication is not yet established 	Check the receiver is powered on
Solid blue	<ul style="list-style-type: none"> Wireless communication is established Software is not running (not synced) 	Open Capture in XM-60 mode
Flashing blue	<ul style="list-style-type: none"> System operational The software is running and the data is being transmitted from the receiver 	No action required
Solid amber	Laser unstable	<ul style="list-style-type: none"> Check launch/receiver alignment If issue persists, power cycle If issue persists, contact local Renishaw office
Flashing or solid red	Error encountered	<ul style="list-style-type: none"> Check all four beams are present Power cycle the laser If issue persists, contact local Renishaw office



XM-60

Multi-axis calibrator



Receiver LED

After the receiver power button has been pressed, the receiver LED will go through a start-up sequence and after a few seconds will settle on one of the following options:





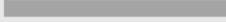

LED status		Description	Actions
Flashing amber		No roll beam detected	<ul style="list-style-type: none"> Open launch/receiver shutters Check launch/receiver alignment If issue persists, contact local Renishaw office
Flashing purple		Launch/receiver not synchronised and/or no roll beam detected	Run Capture while making sure launch/receiver shutters are open
Flashing blue		System is operational	No action required
Periodic one second amber followed by usual operational sequence		Low battery	Replace the battery
None		<ul style="list-style-type: none"> Battery charge too low Battery contacts dirty/damaged Battery inserted incorrectly Receiver not operational 	<ul style="list-style-type: none"> Insert a fully charged battery If issue persists, contact local Renishaw office
Flashing green		Wireless communication device is not operational	<ul style="list-style-type: none"> Power cycle the receiver If issue persists, contact local Renishaw office
Flashing or solid red		Receiver not operational	<ul style="list-style-type: none"> Power cycle the receiver If issue persists, contact local Renishaw office

XM-60

Multi-axis calibrator



Battery charger LED

LED status		Description
Solid amber		Fast charge in progress
Flashing amber		Pre-charge in progress
Solid green		Power on and no battery connected, or battery full
Flashing red		Failure



System troubleshooting

Problem	Action
Software is not installed in my language	<ul style="list-style-type: none">• Check PC system locale is set correctly
XM-60 is not recognised by CARTO	<ul style="list-style-type: none">• Ensure Capture is running in the XM-60 mode• Check the XM-60 is connected to the PC USB port• Try a different USB port on the PC (the port could be damaged)• Disconnect USBs, power cycle XM-60/PC, reconnect USBs• If issue persists, contact local Renishaw office
Cannot align my XM-60	<ul style="list-style-type: none">• Ensure shutters on launch/receiver are open• Check four beams are present from launch using a card as a target. If not present, power cycle XM-60.• Restart XM-60 alignment• If issue persists, contact local Renishaw office
CARTO diagnostic messages	<ul style="list-style-type: none">• Please refer to Capture user guide



Measurement troubleshooting

Problem	Possible causes	Action
Beam strength fluctuating	Environment is outside operating temperature range	Ensure XM-60 environment is between 10 °C - 40 °C
Beam strength fluctuating during machine movement	<ul style="list-style-type: none"> • Normal behaviour at increased speed between targets • Receiver clamp block is not tight 	<ul style="list-style-type: none"> • No action required (this has no effect on metrology) • Tighten the receiver clamp block
All data looks noisy	XM-60 fixed loosely	Improve the rigidity of the system mounting
All data (except for roll) looks noisy	The unit is positioned in turbulent air environment	Reposition the unit to avoid the turbulent air or stir the air with a fan
Noisy straightness measurement	None or short term averaging is used	Select long term averaging in Capture
Drift (most significant for linear measurements)	The system and/or the set-up is not thermally stabilised	<ul style="list-style-type: none"> • Perform a number of runs before capturing data for the machine axis to thermally stabilise • Ensure the laser/receiver are warmed up as per recommendations before testing. Specifications - warm up time. • If the receiver battery has been replaced, follow the thermal stabilisation recommendations. • Avoid excessive handling of the launch/receiver to avoid body heat exchange • If using custom mounting parts, ensure they are suitable to avoid thermal growth

XM-60

Multi-axis calibrator



Care and handling

System

- It is recommended to store the XM-60 in the system case when not in use.
- Do not attempt to clean the system with water or other fluids.
- Avoid exposure to oil and coolant.
- Do not direct the air lines at the XM-60.
- Do not expose the system to impact.

Conduit

- Ensure the conduit is not pinched, crushed or stretched. If damaged, consult the Fibre optic safety section.
- When storing in the case, twist the launch whilst vertical to allow the conduit to coil.
- If the laser is left in the case during measurement, do not close the lid of the case to avoid damage to the conduit.
- Fix the conduit using the magnetic cable clamps to ensure the conduit does not drag, misaligning the launch.
 - Manually check the movement of the axis over the full range of the test, before running a test.
- Never hold the laser or launch by the conduit.

Optics

Cleaning of the optics should be a last resort

To maintain system performance, the XM-60 optics must be kept clean by following good handling practice:

- Close the receiver and launch shutters when not in use.
- Do not touch the optical surfaces.
- Minimise use in contaminated atmospheres.

Cleaning recommendations

- Only use approved solvents for cleaning the optics: Methylated spirit and optical grade IPA only (methylated spirit is preferred to IPA).
- Wipe only with non-abrasive lens tissue or lint-free cloth wrapped around a cotton bud (do not use a cotton bud directly on the optic as this may increase debris).
- Clean the optics using a gentle action. Never use a scrubbing action as this might damage the coatings.


Failure to follow these recommendations may lead to damage to the coatings and glass elements of the optics.

XM-60

Multi-axis calibrator



System specifications

XM system	
Beam source	HeNe laser and light emitting diode (LED) (Class 2M)
Beam power (maximum output)	< 1 mW (sum of four beams)
Mode of operation	Continuous-wave (HeNe) Pulsed (LED)
Nominal laser beam diameter	3 mm
Source wavelengths	633 nm and 655 nm nominal
Recommended recalibration period	2 years under typical use
Warm up time (measured from receiver and laser power on)	45 minutes <ul style="list-style-type: none"> • 15 minutes laser tube pre-heat • 30 minutes thermal drift reduction
Input power connector	Inner core = 24 V Outer core = 0 V 
Maximum velocity	1 m/s

XM-60

Multi-axis calibrator




Performance specifications

Linear	
Measurement accuracy	±0.5 ppm (with environmental compensation)
Resolution	1 nm
Measurement range	0 m to 4 m

Straightness	
Accuracy	±1% (percentage of displayed error value) ±0.5 µm ±2 µm
Resolution	0.25 µm
Measurement range	250 µm radius

Angular (pitch/yaw)	
Accuracy	±0.6% (percentage of calculated angle) ± (0.5 µrad + 0.1M µrad) (M = measured distance in metres)
Resolution	0.03 µrad
Measurement range	±500 µrad

Roll	
Accuracy	±1% (percentage of calculated angle) ±7.6 µrad ±3.4 µrad
Resolution	0.5 µrad
Measurement range	±500 µrad

 Accuracy values are reported to a statistical confidence of 95% (k=2), they do not include the errors associated with the normalisation of the readings to a material temperature of 20 °C.

XM-60

Multi-axis calibrator



Operating and storage environment

Operating environment		
Pressure	600 mbar – 1150 mbar	Normal atmospheric
Humidity	0% to 95% RH	Non-condensing
Temperature	10 °C to 40 °C	

Storage environment		
Pressure	550 mbar – 1200 mbar	Normal atmospheric
Humidity	0% to 95% RH	Non-condensing
Temperature	-20 °C to 70 °C	

XM-60

Multi-axis calibrator



Radio communication

Class 1 wireless communication device	
Output power	0 dBm nominal; +6 dBm maximum
Frequency band	2.402 GHz – 2.480 GHz
Communication distance	12 m typical operation

XM-60

Multi-axis calibrator



Receiver battery and charger



Technical data	
Battery type	Varta EasyPack XL Part # VKB56456702099 (rechargeable Li-Polymer), 3.7 V 2400 mAh 8.9 Wh
Max current	3.2 A
Battery life	3 hours typical operation (for new batteries)



Technical data			
Input voltage	100 V to 240 V AC, 50 Hz / 60 Hz	Output Voltage	4.2 V nominal
Input current	Max. 0.2 A (100 V AC)	Output current	0 A – 1.0 A
		Output power rating	Max. 6 W
Safety standard	EN(IEC)60950		

PC minimum requirements

For details on PC minimum requirements please refer to renishaw.com/lasercalsoftware

XM-60

Multi-axis calibrator



Power supply unit

Input voltage	100 V – 240 V
Input frequency	50 Hz – 60 Hz
Maximum input current	1.5 A
Output voltage	24 V
Maximum output current	3 A
Safety standard	EN(IEC)60950



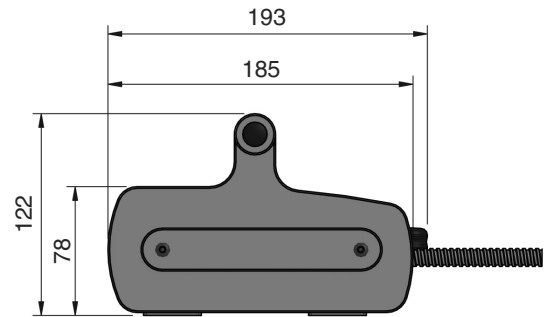
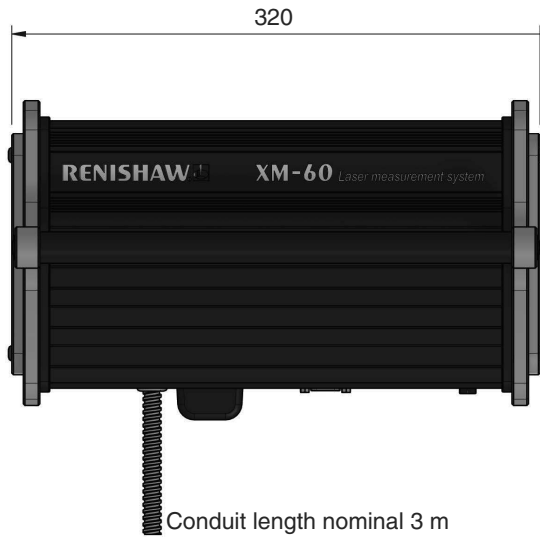
XM-60

Multi-axis calibrator



Weights and dimensions

Weight (approximately)	XM-60: 6.2 kg (complete system in the case excluding optional XC-80 compensator: 23 kg)	Laser	3.7 kg
------------------------	---	-------	--------



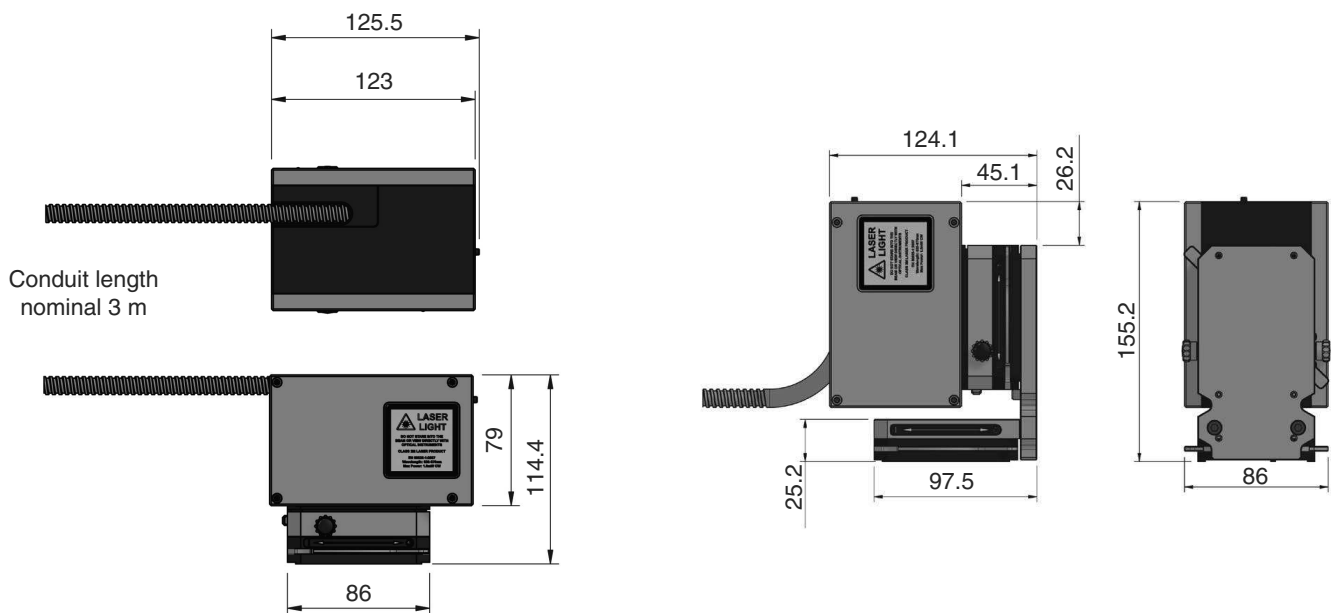
XM-60

Multi-axis calibrator



Weights and dimensions

Weight (approximately)	XM-60: 6.2 kg (complete system in the case excluding optional XC-80 compensator: 23 kg)	Launch 1.9 kg
------------------------	---	---------------



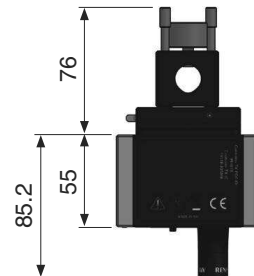
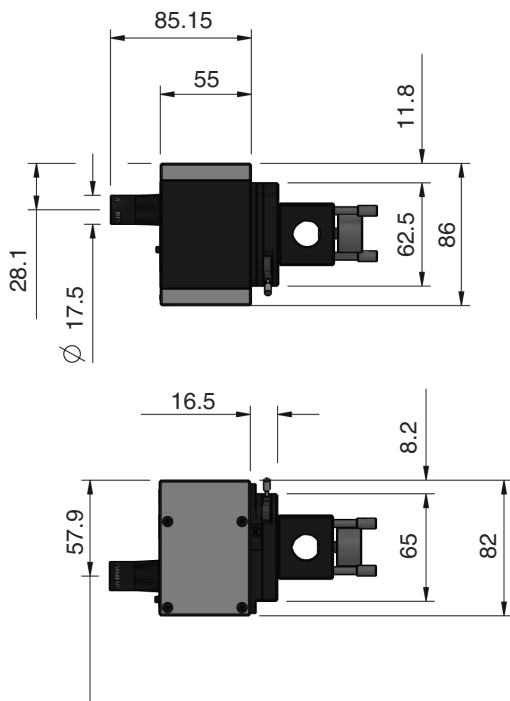
XM-60

Multi-axis calibrator



Weights and dimensions

Weight (approximately)	XM-60: 6.2 kg (complete system in the case excluding optional XC-80 compensator: 23 kg)	Receiver 0.6 kg
------------------------	---	-----------------



XM-60

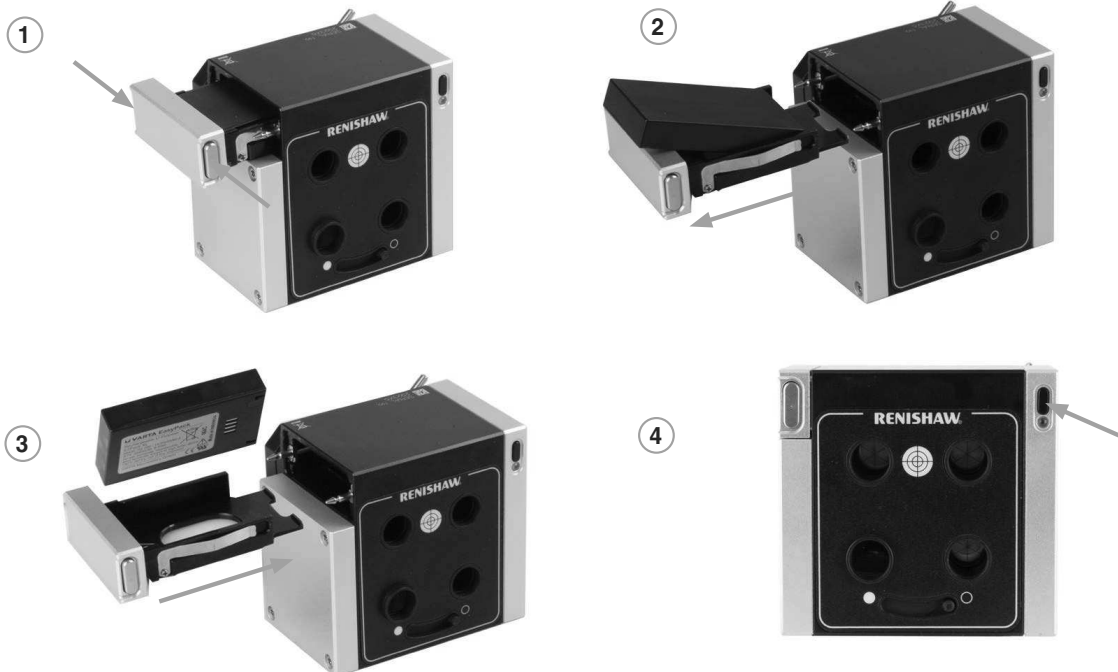
Multi-axis calibrator



Appendix A

Replacing the receiver battery

To replace the battery, follow the procedure below:



XM-60

Multi-axis calibrator

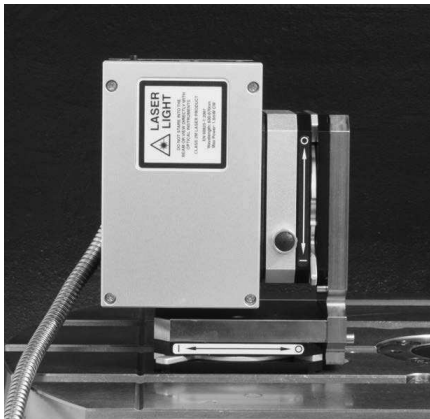


Appendix B

Using the 90 degree bracket

The 90 degree bracket can be used in two orientations (standard and reverse). Reverse orientation allows the launch to be mounted from the side of the machine tool bed to maximise the length of the axis that can be measured.

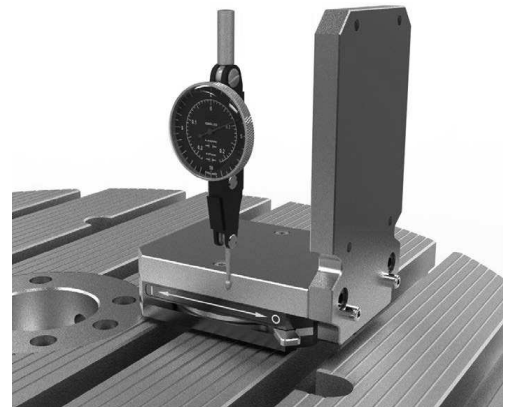
When using the 90 degree bracket the user must clock the side face of the bracket to ensure it is parallel to the axis of travel (e.g. if measuring Z on a vertical machining centre, clock one of the faces of the 90 degree bracket to the X or Y axis of the machine).



Standard orientation



Reverse orientation



Clocking the side face of the bracket

XM-60

Multi-axis calibrator



Appendix C

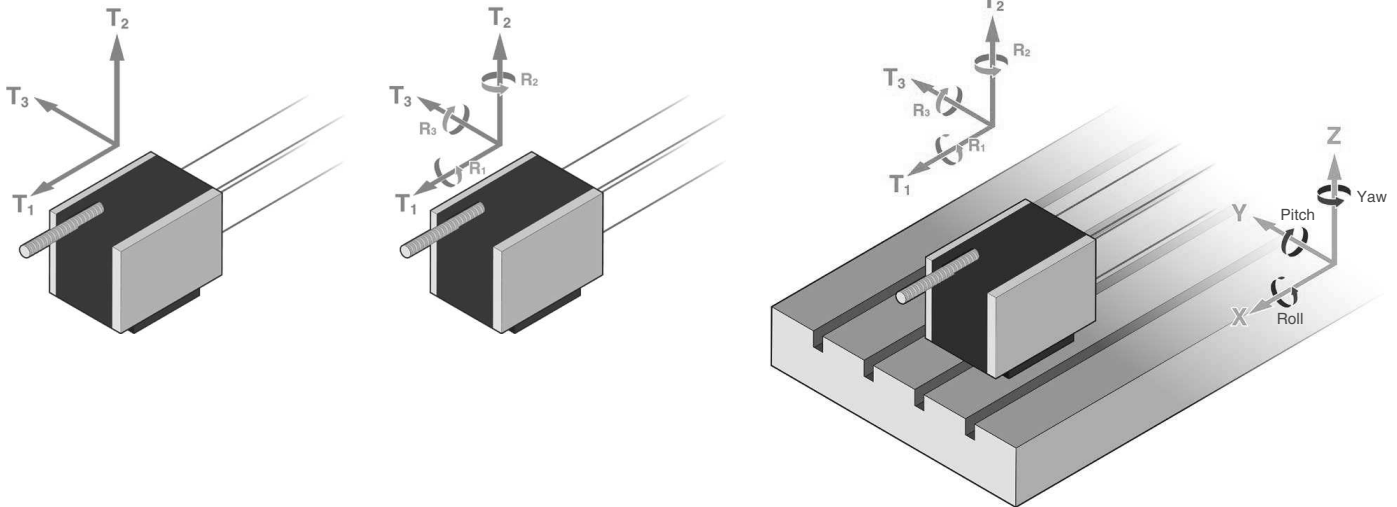
Sign detection

XM-60 has 6 measurement channels:

- 3 channels (T1,T2 and T3) correspond to translations (linear and straightness)
- 3 channels (R1, R2 and R3) correspond to rotations around T1,T2 and T3

Sign detection process performs the following:

- Links the T1,T2 and T3 axes of the XM-60 to the machine linear axes
- Sets the sign (+/-) of the T1,T2 and T3 measurements
- Sets the sign (+/-) of the R1,R2 and R3 measurements



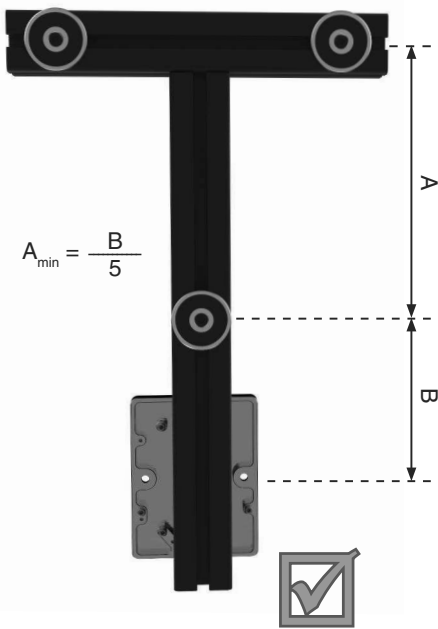
XM-60

Multi-axis calibrator



Appendix D

Fixturing kit good practice guide



× 2



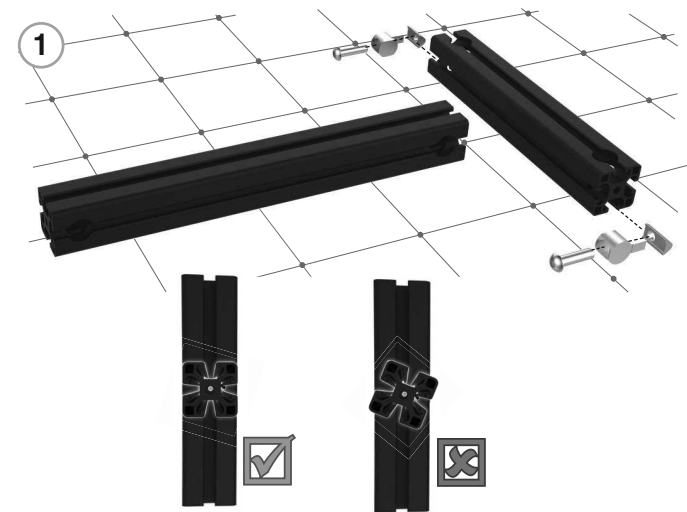
× 1

XM-60

Multi-axis calibrator



RENISHAW 
apply innovation™

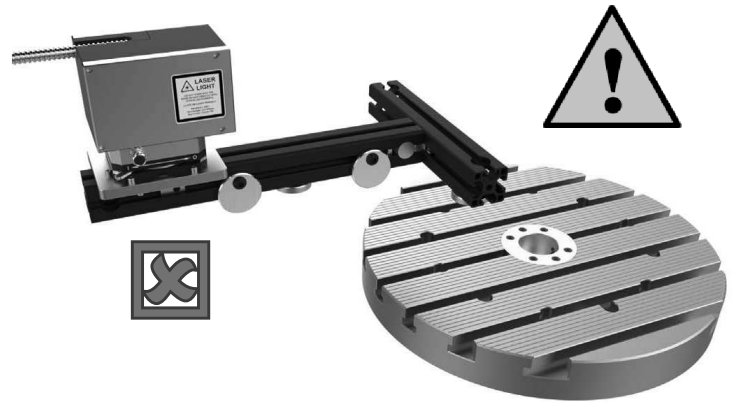
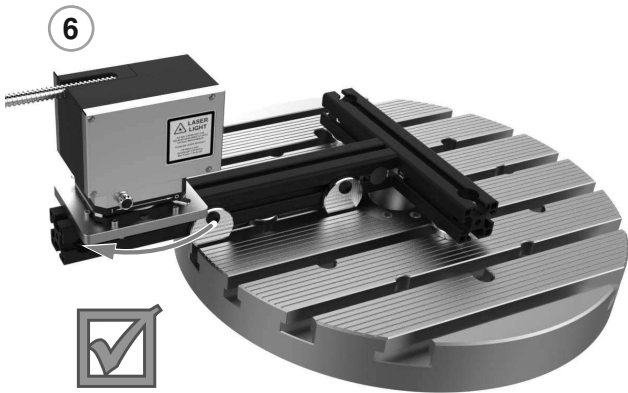


XM-60

Multi-axis calibrator



RENISHAW
apply innovation™

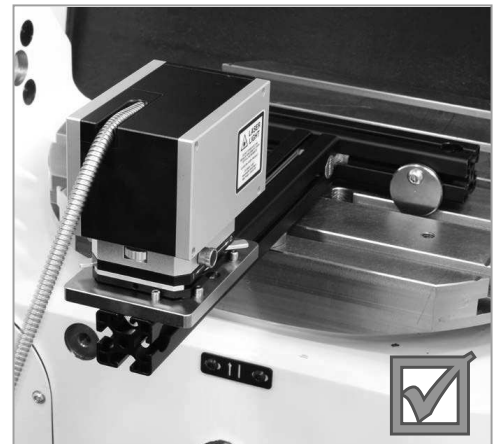
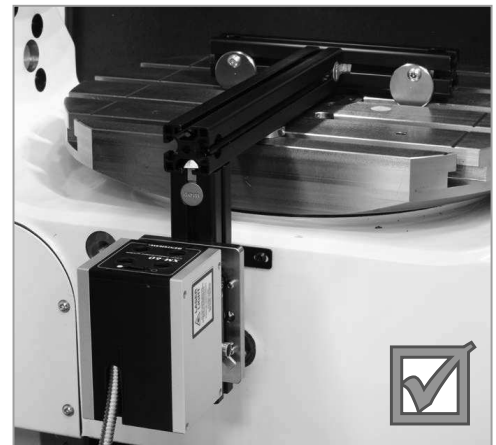
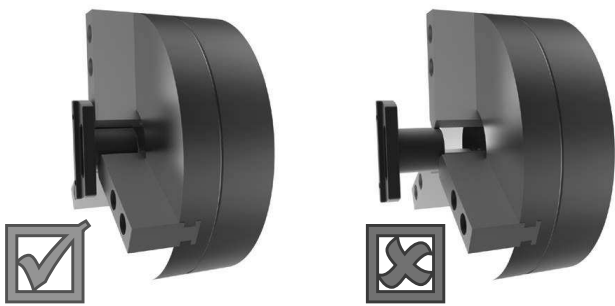
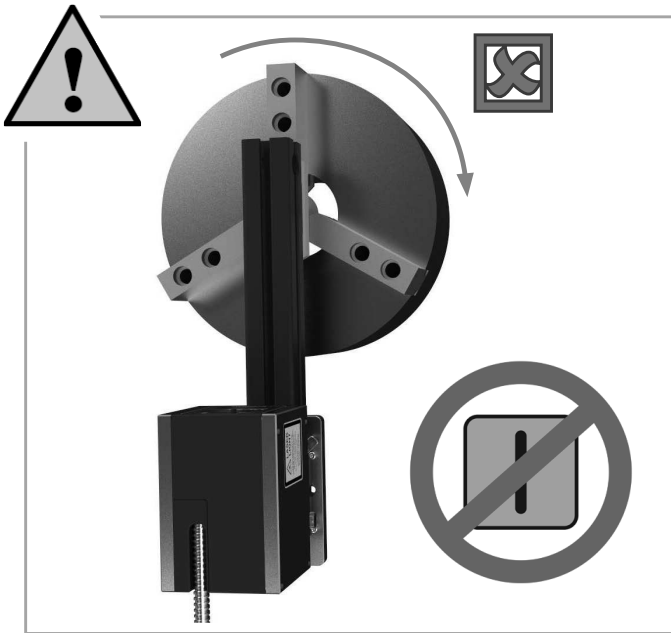


XM-60

Multi-axis calibrator



RENISHAW 
apply innovation™

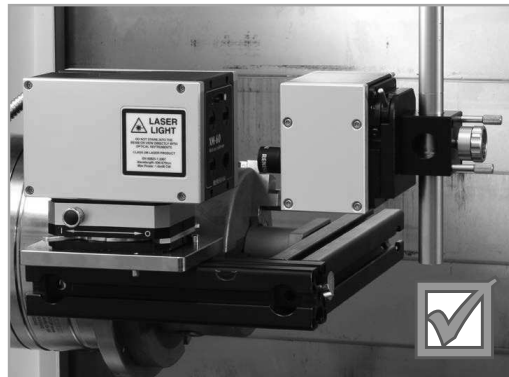
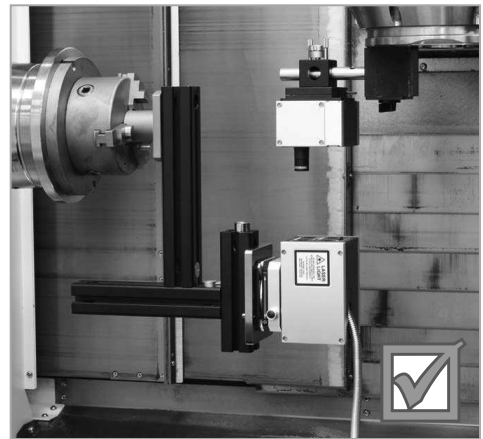


XM-60

Multi-axis calibrator



RENISHAW
apply innovation™





Appendix E

Comparison of straightness measurement set-ups

For indication of produced part accuracy

	XL-80	XM-60	DTI / Straight edge
Moving bed machine			
Moving spindle machine			

Renishaw plc
New Mills, Wotton-under-Edge
Gloucestershire, GL12 8JR
United Kingdom

T +44 (0)1453 524524
F +44 (0)1453 524901
E uk@renishaw.com
www.renishaw.com

RENISHAW 
apply innovation™

SALES & SERVICE:

A Tech Authority, Inc.
13745 Stockton Ave.
Chino CA 91710
909-614-4522
sales@atechauthority.com

For worldwide contact details, visit
www.renishaw.com/contact

