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CARTO Capture

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#renishaw

Contents

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Legal information

Terms and conditions and warranty

Unless you and Renishaw have agreed and signed a separate written agreement, the equipment and/or software are sold subject to the Renishaw Standard Terms and Conditions supplied with such equipment and/or software, or available on request from your local Renishaw office.

Renishaw warrants its equipment and software for a limited period (as set out in the Standard Terms and Conditions), provided that they are installed and used exactly as defined in associated Renishaw documentation. You should consult these Standard Terms and Conditions to find out the full details of your warranty.

Equipment and/or software purchased by you from a third-party supplier is subject to separate terms and conditions supplied with such equipment and/or software. You should contact your third-party supplier for details.

Safety

Before using the laser system, consult the *XL laser safety information* booklet (Renishaw part no. M-9908-0363) or the *XM laser safety information* booklet (Renishaw part no. M-9921-0202).

Migrate from Laser XL to CARTO

The importer function allows easy migration from LaserXL and RotaryXL software applications to the CARTO software suite. It allows Laser10, LaserXL and RotaryXL test data and test methods to be imported providing data in a single database location. Importing test data automatically creates test methods and allows existing machine part programs to be used.The ‘How to’ video features instructions to carry out the migration process.

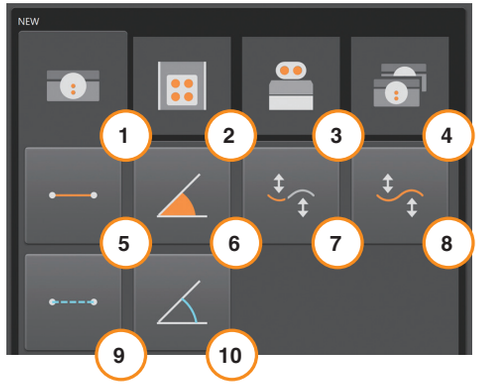
It can be found on the CARTO support page:
http://www.renishaw.com/carto-support.

NOTE: The importer function is found on the landing page of the Explore application.

Home screen

The home screen allows the user to set up a new test or to use an existing test from the database. To return to the home screen at any point, select the ‘Home’ icon on the top left of the screen.

New test — XL-80



For XL-80 use, select the ‘Linear’, ‘Angular’, ‘Straightness’ (short or long range) or ‘Dynamic’ (linear or angular) icon to start setting up a new test in the chosen measurement mode.

1	XL-80
2	XM-60
3	XR20
4	Dual Laser XL-80
5	Linear

6	Angular
7	Straightness (short)
8	Straightness (long)
9	Dynamic (linear)
10	Dynamic (angular)

Dynamic mode – Allows dynamic data capture using XL-80 at the full sample rate of 50 kHz in linear and angular mode. At this frequency the time is limited to 2 minutes of data.

There are two capture modes:

- Live data
- Triggered data

Saved data is in ‘File format’ but can be analysed directly from Capture immediately after completion or browsing through Explore.

This data is not currently saved into the database.

New test — XM-60

For XM-60 use, there are three modes to choose from:

Target-based mode – the number and positions of the targets for data capture are defined before a test is started. Once a test is complete, the results can be saved and opened in Explore for analysis and reporting to international standards.

Dynamic data fit – the number and positions of the targets and the number of dynamic straightness runs for data capture are defined before a test is started. Once a test is complete, the results can be saved and opened in Explore for analysis and reporting to international standards. The drop down menu allows a user to continue an incomplete test.

Free-run mode – the number and positions of targets do not need to be defined before a test is started. This is appropriate for performing informal investigations. Horizontal straightness, vertical straightness, pitch, yaw and roll are all plotted against linear position.

New test — Rotary

For rotary axis measurement using the XR20, select the Rotary button.

Rotary mode – this mode can be used with either the XL-80 or XM-60 laser product. The workflow is very similar to target-based mode described above.

Off axis rotary – the off axis mode enables data capture for rotary axes where on-centre location of the XR20 is difficult or impossible.

New test — Dual Laser

For dual axis measurement using the XL80, select the Dual button.

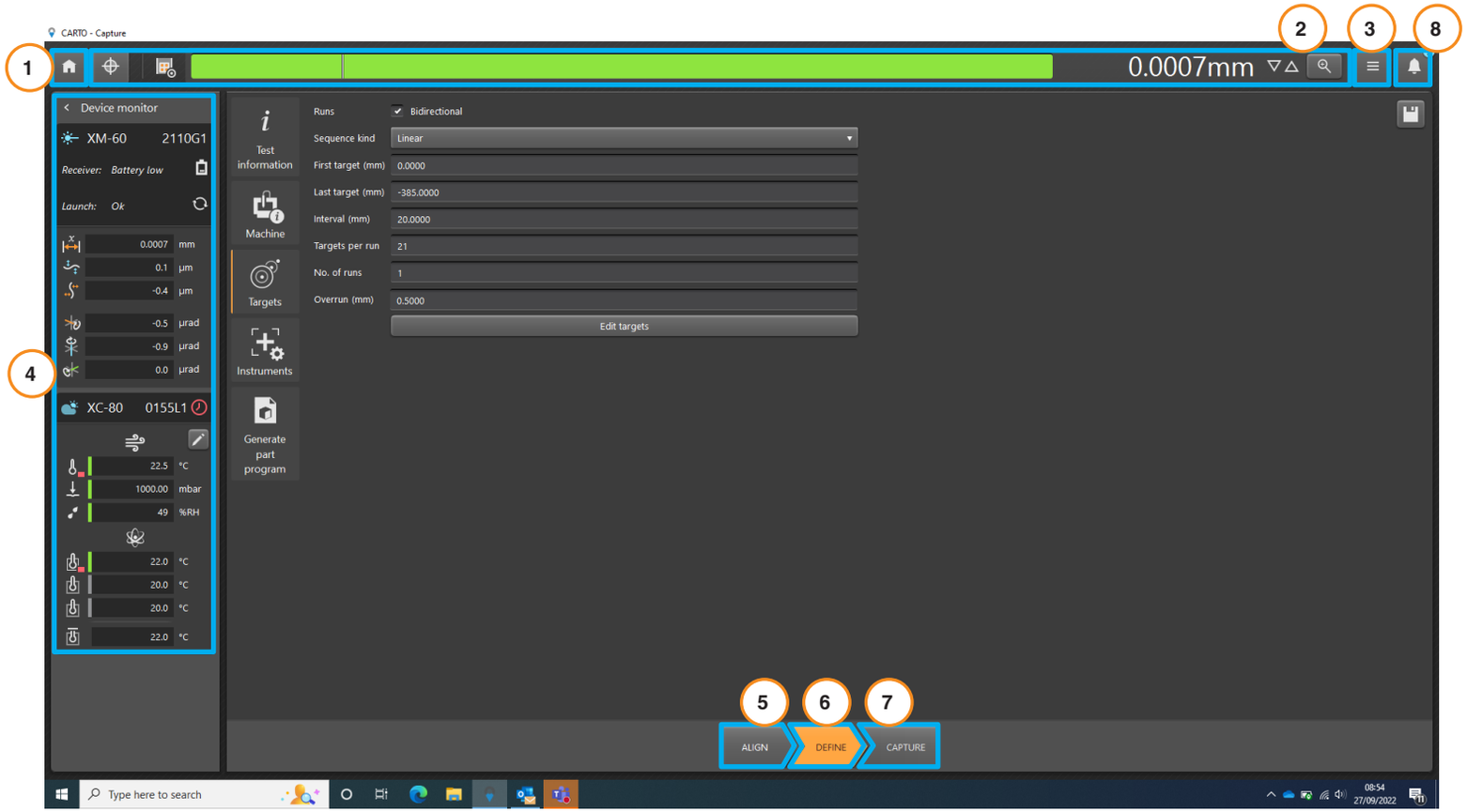
Dual – the dual laser calibration facility enables simultaneous data capture from two XL-80 lasers. This is particularly valuable during calibration of very large gantry machine tools, when calibration times may be halved. The software will capture data from two axes, both with the same target set-up and with each laser in the same measurement mode. Automatic environmental compensation may be provided using one XC-80 environmental compensator acting on both axes or with two XC-80 compensators acting on each individual axis.

Open test

Select the ‘Open test’ icon to view details of the saved tests in the database. To display more or less details of the saved test, check or uncheck the relevant boxes in the ‘Columns’ panel on the left of the screen. The columns can also be moved by holding down the left mouse button on the column header and dragging sideways. Selecting a test method and then selecting the open icon will begin setting up a new test, with all of the fields from the ‘Open test’ table automatically populated.

Measurement screen

The image below highlights the main areas of the Capture interface.



1	Home screen
2	Laser status bar
3	More
4	Device monitor
5	Align tab
6	Define tab
7	Capture tab
8	Notifications

Settings

General

Angular optics – change between Renishaw and HP angular optics.

Standard error names – choose whether the various error directions are named in the VDI 2617 format or the ISO 230-1 format.

Allow live editing of targets – this data capture mode should be used with any axis which is moved into position manually, or an axis which displays its position numerically, but is difficult to position precisely at a target.

With this data capture mode, the software indicates where the next target is and, after moving closer to that target, allows you to enter the actual position of the axis as indicated by the axis' numerical read-out. The software reads the real position of the axis and calculates the error.

This data capture mode is active when the 'Allow live editing of targets' option is checked. To input the actual position, select the target position in the table in the 'Capture' tab and type the value.

Trigger beep – check the box to receive a beep every time data is captured. The sound and volume of the signal can be changed in the settings of the computer.

Calibration notifications – by default, CARTO displays a warning when a connected XL-80, XM-60 or XC-80 is approaching the recommended recalibration date. The timing of these warnings can be edited or disabled.

Units

Type – determine the units to be used for input, display values and general preferences in the 'Settings' window. Toggling between 'Metric' and 'Imperial' automatically sets all the units to the chosen system.

Target units

Linear units – the 'linear units' field determines the units used for the distance between adjacent target positions.

Error units

Linear units – the units used for displaying linear and straightness error values.

Linear units precision – the number of decimal places displayed for linear and straightness error values.

Angular units – the units used for displaying angular error values.

Angular units precision – the number of decimal places displayed for error values in angular mode.

Environmental units

Choose the units used to display temperature and pressure.

Feedrate units (XR20 only)

Choose the units used for angular feedrate.

Customisation

Theme – choose whether Capture has a ‘Light’ or ‘Dark’ appearance.

Custom test info autocomplete suggestions – in the ‘Define’ tab for ‘Test information’ it is possible to add ‘Custom information’. Options for the autocomplete dropdown can be added here.

Help improve CARTO

Choose whether to share technical information to help improve CARTO.

Laser status bar

The bar at the top of the screen reports the status of the laser.

Toggle sign

Select the ‘Toggle sign’ icon to toggle the sign convention between positive and negative. When using an XM-60 and some XL-80 measurement modes, the ‘Toggle sign’ icon is disabled. In these cases, automatic sign detection is used.

Datum (linear measurement only)

The ‘Datum’ function sets the current position of the axis as the reference position. All measurements will be taken relative to the reference position. To minimise dead path error, datum the system when the reflecting optics are close to the laser head. See the *XL-80* user guide (Renishaw part no. F-9908-0683) or the *XM-60* user guide (Renishaw part no. F-9921-0201) for more details.

Signal strength display

The ‘Signal strength display’ indicates how well aligned the laser system is with the reflecting optics and the axis under test.

The colour of the bar illustrates the signal strength:

Green – good signal strength.

Yellow – signal low.

Red – beam obstructed.

The signal strength must be maintained above the ‘Beam obstructed’ threshold for the system to remain operational. When the signal strength appears yellow, system measurement accuracies may degrade from the specification. Every effort should be made to maximise signal strength when capturing data. It is good practice to ensure that ‘Good’ (green) signal strength is maintained throughout the range of the test.

Digital read-out

The ‘Digital read-out’ (DRO) provides a real-time display of the laser reading. When a test is started, the DRO is zeroed at the position of the first target. During a test, the DRO displays the distance between the first target and the current position. To increase or decrease the number of decimal places displayed, use the up or down arrows to the right of the DRO.

Magnify view

The ‘Magnify’ view window gives an enlarged display of the signal strength and DRO. In XL-80 mode, press the F7 key for a numerical signal strength.

Launch Renishaw License Manager

The licensing icon opens Renishaw license manager which is an application that allows you to activate and return software licences for Renishaw products.

More

The ‘More’ icon opens up a list of four options (this can also be accessed from the ‘Home’ page):

- Settings
- Help content
- CARTO webpage link
- Version information for CARTO

Notifications

Software notifications, such as ‘Check for updates’, are displayed here.

Device monitor

The ‘Device monitor’ displays the status of connected devices:

Symbol	Status
	Recommended recalibration date is approaching
	Recalibration is recommended

Hover the cursor over the clock symbol for more information about the notification. The notification period can be adjusted or turned off in ‘Settings’.

The live status of the laser systems will appear under the device name.

Browse for XR20

The ‘Browse’ button allows the user to search and connect to XR20. The ‘Browse for XR20’ dialog box is displayed and a search for the device commences automatically. If the device is not found first time, select the search button again. Select the serial number of the device you wish to use, and select OK. The LEDs on the XR20 unit change to solid blue once connected. If you have any connection difficulties, see the “Diagnostics and troubleshooting” in the *XR20* user guide (Renishaw part no. F-9950-0400).

The following lists explain the meaning of each status message:

XL-80 status messages

Preheat – the laser is currently in the preheating process and is not yet ready for use.

OK – the laser device is connected and ready for use.

Beam Low – the strength of the laser signal received by the XL-80 is low and system measurement accuracy may be lower than specified.

Beam Loss – the strength of the laser signal received by the XL-80 is too low for the system to be operational. If a test was in progress when this occurred, it must be restarted.

Unstable – there are irregularities in the laser signal being received by the XL-80. This may be caused by unwanted reflections returning to the XL-80. Whilst this error state is present, system measurement accuracy may be lower than specified.

Data Loss – the computer running Capture is busy, so data from the XL-80 is being lost. This could be caused by another application on the computer using a large amount of processing power.

Overspeed – the machine movement is too fast and system measurement accuracy may be lower than specified. If a test was in progress when this occurred, it must be restarted.

Saturation – the strength of the laser signal received by the XL-80 is too high and system measurement accuracy may be lower than specified. This may be caused by the optics being very close to the unit when the XL-80 is in high gain mode.

Overflow – there is too much data for the XL-80 to store. This may be related to the other processes that are running on the computer.

Communications Error – there is an interruption in the communication between the XL-80 and computer. There may be a fault with the USB cable.

XM system launch status messages

Calibrating – performing the roll calibration procedure.

Bad checksum – the configuration of the launch unit is corrupt. If rebooting the system does not clear this message, contact your local **Renishaw office**.

Beam break – either the launch unit and receiver have become misaligned or an obstruction is preventing a clear path between the launch unit and receiver. If a test is in progress when this occurs, the test will fail and must be restarted. This error will automatically clear when a test is not running.

Buffer overflow – there is too much data for the XM system to store. This may be related to other processes that are running on the computer. Close all applications and restart CARTO.

Diode tripped – a problem has been detected with the laser signal. If rebooting the system does not clear this message, contact your local **Renishaw office**.

Laser error – a problem has been detected with the laser signal. If rebooting the system does not clear this message, contact your local **Renishaw office**.

Overspeed – the machine movement is too fast and system measurement accuracy may be lower than specified. If a test is in progress when this occurs, the test will fail and must be restarted. This error will automatically clear when a test is not running.

Preheat – the laser is currently in the preheating process and is not yet ready for use.

Unstable – there are irregularities in the laser signal being detected. This could be caused by unwanted reflections returning to the launch unit. Whilst this error state is present, system measurement accuracy may be lower than specified.

XM receiver status messages

Ambient high – a high level of ambient light has been detected by the receiver. This could interfere with the accuracy of roll measurements.

Bad checksum – the configuration on the receiver unit is corrupt. If rebooting the system does not clear this message, contact your local **Renishaw office**.

Battery low – the battery in the receiver unit has almost no power left and needs to be changed.

Poor signal – the laser signal detected by the roll sensor has become too low for measurement. This may be related to the amount of ambient light in the environment. Reduce ambient light sources near the XM-60. Restarting the software or the XM-60 system may clear this error.

Beam low – the strength of the detected laser signal is low and system measurement accuracy may be less than in the specification. Adjusting the alignment of the system may correct this.

Buffer overflow – there is too much data for the XM receiver to store. This may be related to other processes that are running on the computer. Close all applications and restart CARTO.

Beam lost – the roll beam has been obstructed.

Not available – communications with the receiver have been lost. The most likely cause is that the receiver is turned off, or the battery is flat.

Roll out of range – the difference in roll between the launch unit and the receiver is too great. Re-align the system.

Straightness out of range – the difference in straightness (vertical and/or horizontal) is too great. Re-align the system.

XR20 status messages

Powered down – the device has entered power saving mode. The device can be taken out of this mode by clicking the DRO.

Servo/sensor error – an error has occurred in the servo's feedback which has caused the device to lose its reference. This is likely to have been caused by excessive vibration or interference during the test. Re-reference the device and restart the test.

Buffer overflow – there is too much data for the XR20 to store. This may be related to the other processes that are running on the computer. Close all other applications and restart CARTO.

Sensor failure – a problem has been detected with the XR20 sensor system. Contact your local **Renishaw office**.

Not referenced – communication has been established but the XR20 has not been referenced.

Low battery – the battery in the device has almost no power left and needs to be charged.

OK – referenced and ready to perform measurement.

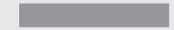
XR20 disconnected – communication with the XR20 has been lost. The most likely cause is that the device has been switched off or the battery is flat.

XC-80 status messages

When an XC-80 device is connected to the computer, the XC-80 icon becomes blue and the serial number is displayed.

Symbol	Description
	The 'Air symbol' shows information about air temperature, air pressure and air relative humidity (absolute humidity as a percentage of the maximum humidity at the current temperature).
	The 'Atom symbol' shows information about material temperature from material temperature sensors 1, 2 and 3 (where connected). Beneath the three material sensor readings, there is an extra reading showing the average of all connected material temperature sensors. When the 'Fixed material temperature' is selected, the average material temperature reading will be replaced by a reading displaying the value of fixed material temperature being used.

Sensor status bar – To the left of each sensor reading is a status bar with different colours to represent the following status:

Symbol	Description
	Sensor connected and sending data.
	Sensor not connected.
	Sensor connected but a fault has been detected.

Align tab

XM-60

NOTE: For XM-60, the ‘Align’ tab functionality is identical for all modes.

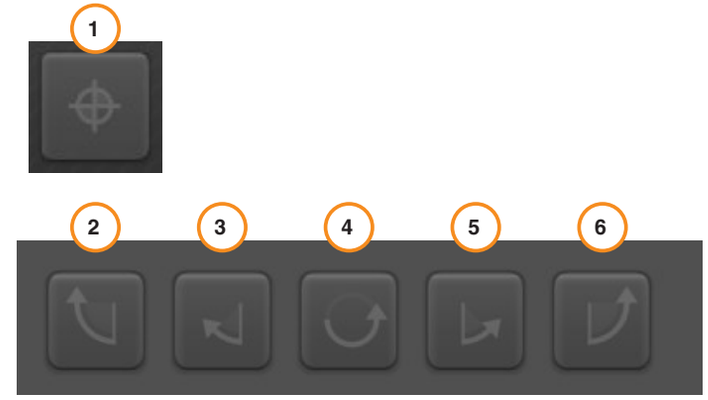
The tab control at the bottom of the screen provides a flow through the measurement process (starting from the left). The tabs which appear will vary depending on the device connected and the measurement mode being used.

When using XM-60, the first tab displayed is the ‘Align’ tab. This contains a target for aligning the laser beams with the receiver and a pointer for aligning the launch and receiver in terms of roll.

If there is a misalignment in pitch or yaw of the receiver whilst moving away from the ‘Align’ tab, the ‘Additional alignment controls’ section will expand to highlight this. This can be ignored if necessary by navigating away from this tab.

XR20

When using XR20, the ‘Align’ tab contains a series of jog control buttons. These assist the user in aligning their laser source to achieve good signal strength. In order for the jog buttons to function, the user must reference the XR20.



1	Reference	4	180° move
2	0.5° move clockwise	5	0.1° move counterclockwise
3	0.1° move clockwise	6	0.5° move counterclockwise

NOTE: Holding down buttons 2 or 6 for an extended duration will perform the following motions: jog, slow sweep, fast sweep.

Ambient light check

In XM-60 mode, there is an ‘Ambient light check’ at the bottom left of the align tab. Ambient light can affect roll measurement accuracy. To check the level of ambient light, select the ‘Play’ icon then move the axis under test through the axis range. Select the ‘Stop’ icon. A tick indicates the ambient light detected is at a normal and acceptable level. A yellow triangle indicates the detected ambient light is at a high level and could potentially affect XM-60 roll measurements. See “Testing precautions” in the *XM-60* user guide (Renishaw part no. F-9921-0201) for more details.

When the system is aligned, select the ‘Define’ tab to move to the next stage of the process.

Offset tab

When making an off axis measurement, the ‘Offset tab’ allows the user to calculate the distance from the XR20 to the centre of rotation of the rotary axis being measured.

Define tab

The ‘Define’ tab allows the parameters of the test to be set. If an existing test method has been loaded and does not need to be edited, this stage can be skipped.

NOTE: If the chosen test method could be improved, the ‘Define’ tab displays a warning symbol. Hover the cursor over the warning symbol for details of the parameter you may wish to consider changing.

Test Information

Test title – enter the title to be used when referring to the test.

Machine operator (optional) – enter the name of the operator conducting the test.

Notes (optional) – enter any information that may be useful when referring to the test.

Tags – tags can be added to a test record to aid filtering when viewing data in Explore.

Custom information – add a key value and associated information to the test record.

Machine

Name (optional) – enter the name of the machine under test.

Serial number (optional) – if required, enter the serial number of the machine under test.

Target resolution – enter the number of decimal places to be used for the position of targets. The target resolution must not be higher than the resolution of the machine under test.

Geometric axis – select the axis under test to match the set-up. In XM-60 mode, there is also the option to select 'Auto detect', meaning the moving axis is detected during automatic sign detection.

Axis – custom axis names can be configured by selecting 'Geometric axis' for the machine and manually entering an 'Axis name'. Explore displays the captured data with the 'Axis' name allocated when the test was carried out.

COE – enter the thermal coefficient of expansion (COE) of the machine under test. This is used for compensation of the measurements, when a material sensor is connected, to show results at 'NTP' (normal, temperature and pressure).

Fixed material temperature – check the fixed material temperature box to manually enter a constant value to be used for material temperature. When this box is checked, readings from all connected material temperature sensors will be ignored.

Error – when setting up an angular or straightness test in XL-80 use, specify the error that is being measured. This will be determined by the orientation of the optics on the machine.

Trigger settings (dynamic only)

Pre-trigger – the period of time before the triggered point.

Post trigger – the period of time after the triggered point.

Trigger source

- **Manual** – starts data capture using F9, the middle mouse key or the trigger button in the software.
- **TPin** – starts capture using a trigger from an external device.
- **Value:**
  - **Rising edge** – will trigger when the laser reading crosses the trigger threshold value in a positive direction.
  - **Falling edge** – will trigger when the laser reading crosses the trigger threshold value in a negative direction.
  - **Higher than** – will trigger at any time when the laser reading is higher than the trigger threshold value.
  - **Lower than** – will trigger at any time when the laser reading is lower than the trigger threshold value.
- **Trigger level** – the criteria for any of the 'value' options.

Targets

Runs – when setting up a target sequence, the direction from which each target is visited must be specified.

- **Unidirectional** – each target is visited from one direction only.
- **Bidirectional** – each target is visited from both directions.

Sequence kind – select the kind of sequence in which the machine moves between targets for data capture. See the **Appendix** for the movement paths of the available sequence kinds.

First target – for the axis under test, input the first position for data to be captured.

Last target – for the axis under test, input the last position for data to be captured.

Interval – for the axis under test, input the distance from each data capture target to the next data capture target in the series. If the interval is specified, inputting the number of targets per run is not required.

Targets per run – input the number of data capture targets for each run (including the first target and last target). If the number of targets per run is specified, inputting the interval is not required.

No. of runs – determine the number of times the target sequence is repeated.

Overrun – specify the required turnaround region at the ends of the axis. For unidirectional runs, the overrun is the distance the machine moves away from the first target before returning (see Figure 1 in **Appendix - Sequence kinds**). For bidirectional runs, the overrun is the distance in front of the first target and the distance beyond the last target that the machine moves before returning (see Figure 2 in **Appendix - Sequence kinds**).

Edit targets – the 'Edit targets' window can be used to check the sequence of targets that have been specified above. To edit a target, select it and enter the required target position (distance between the selected target and the first target). The 'Randomise' function offsets each target position to a random value of less than 30% of the interval away from the nominal target position.

For dynamic data fit only:

Static feedrate – enter the speed of motion for the machine to move between the static targets.

Number of dynamic runs – determine the number of times the dynamic data capture sequence is repeated.

Dynamic feedrate – enter the speed of motion for the machine to move between the dynamic targets.

Sub tests – for multi-session tests it is possible to add or remove additional sub-tests. The software defaults to a multi-session test when the measurement range is greater than 6 m in length. This feature is designed for XM long-range measurements, however a sub-test can be added for a measurement of any length.

No. of overlapping targets – edit the number of overlapping targets used to stitch the data between two sub-tests.

Instruments tab

Laser reading averaging

Averaging – 'Laser reading averaging' can be used to overcome fluctuations in external effects, such as vibration, poor machine stability or air turbulence. Select 'None' (no averaging), 'Fast' (short-term averaging) or 'Slow' (long-term averaging): For most applications, 'fast' data averaging would be recommended.

'None' – no data averaging is used.

'Fast' – the software averages readings from the laser, taken over a nominal period of 462.5 milliseconds, and displays the result in the measurement display. The displayed value is a boxcar average.

'Slow' – the software averages readings from the laser, taken over a nominal period of 3.7 seconds, and displays the result in the measurement display. The displayed value is a boxcar average.

Trigger type

There are four trigger types: position, manual, TPin and time based

Position triggering – this mode automatically captures data by comparing the laser reading with the target position and automatically records a reading when the machine is within the limits given for 'Tolerance', 'Stability period' and 'Stability' range.

- **Tolerance** – the distance either side (plus or minus) of the target where data capture is considered acceptable. If the distance between the measured position of the machine and the target is greater than the 'Tolerance' value, the reading is outside of 'Tolerance' and data is not captured.
- **Stability period** – the time period for which a machine must remain within the 'Stability range' (see below) for a measurement to be captured. If the measured position of the moving part of the machine does not stay within the defined 'stability range' for at least the time of the stability period, data is not captured.
- **Stability range** – the maximum positional variation a machine must hold, to be considered stable enough for a target to be captured. If the measured position of the machine fluctuates by more than the 'Stability range', the 'Stability range' criterion is not met, and data is not captured.

Manual triggering – captures data when the user presses the F9 key on the keyboard or uses the scroll wheel on the mouse.

TPin (remote) triggering (XL-80 only) – captures data when a trigger pulse is received via the auxiliary I/O connector. There are various ways that a trigger pulse can be generated, such as:

- Directly from a machine controller
- Using a touch probe
- From a relay or switch

For more information about TPin triggering, see the *XL laser system* user guide (Renishaw part no. F-9908-0683).

Time based triggering – captures data every time the chosen period of time has elapsed.

Feedrate detection (XR20 only)

There are three types of feedrate detection: automatic, manual and position tracking.

- **Automatic** – the machine performs an overrun move and the XR20 calculates and applies feedrate automatically.
- **Manual** – when manual feedrate detection is selected, a feedrate speed must be entered to match the part program.
- **Position tracking** – this setting allows the user to perform data capture in situations such as manual motion of the axis under test where the feedrate is not constant. It works by monitoring the signal strength of the laser and indexing the optic to optimise the signal.

Pre-lock dwell (XR20 only) – some machine tools have a mechanical brake on the rotary axis to lock the axis between moves. Applying the brake can often cause a small, but measurable, vibration in the axis. If this occurs whilst the XR20 is trying to perform a measurement point, the vibration in the axis will cause the data capture to fail.

To overcome this, specify a dwell time in seconds which will delay the start of data capture for each point. This will allow the machine time to lock and stabilise before the software will capture a reading.

Custom optical factor (angular measurement only)

The angular factor is derived from the separation between the two retroreflectors in the angular reflector. When using calibrated angular optics, enable the ‘Custom optical factor’ and enter the ‘Measured angular factor’ from the calibration certificate.

NOTE: This is only applicable to Renishaw calibrated angular optics.

Save test method

When an XL-80, XM-60 or XR20 test is run and saved, the test method is automatically stored in the database.

To create a test method without running a test, use the ‘Save test method’ icon towards the bottom right of the screen in the ‘Define’ tab.

Generate part program

CAUTION

This software generates CNC part programs that could cause a machine to collide or malfunction. Generated part programs must be checked by experienced machine tool programmers before use. All programs should be checked before running and performed at a low feedrate for the first time. It is assumed therefore that the user is thoroughly familiar with the operation of the machine tool and its controller and knows the location of all the emergency stop switches. Also, 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 manufacturer's operating instructions or relevant codes of practice. Safety procedures should be in accordance with the user's risk assessment.

Define the parameters to be used to generate a part program.

Program ID – enter the name to be given to the generated part program.

Feedrate – enter the speed of motion for the machine to move between targets. The distance units are defined from those configured in settings. When set to metric, the distance is specified in millimetres. When set to imperial, the distance is specified in inches. The time unit is always minutes. For XR20 only, the unit options are: °/min, °/sec, r/min.

Dwell time – enter the length of time the machine controller should remain stationary at each target position. A value for this will be automatically generated based of the trigger 'stability period' and the 'averaging'. However, this can be overridden by entering a new value.

Controller type – use the drop-down list to select the machine controller language in which the part program will be generated.

Include warning – by default, some warning text is included in generated part programs. To exclude this text, uncheck the box.

Include sign detection moves – it is important to define the orientation and direction of the machine's axes in relation to the laser system. Capture will automatically detect the orientation and direction of axes when the X, Y and Z axis are moved a small distance (at least 100 µm) in turn. By default, these small axis movements will be included in generated part programs. To exclude these movements from generated part programs, uncheck the box.

Select axes – if a custom axis name is entered under the machine tab, an option to use this or the geometric axis in the part program is displayed.

Review window – when a part program is generated, it is displayed in the 'Review' window. Use this window to read through the generated part program and if necessary, manually edit the program. After reviewing, select the 'Save part program' icon to save a file.

Capture tab

The ‘Capture’ tab is an area used for running a test once the test parameters have been defined. A graph and table display the data capture results during and after a test. For bidirectional runs, the return runs (from the last target towards the first target) are indicated by red lines on the graph and by white arrows in the table.

To calibrate axes that display position numerically but cannot move precisely, it is possible to carry out ‘live editing of targets’. Refer to **‘Settings’** for more information.

Start test

Press the ‘Start test’ icon to start the data capture process when the machine is positioned at the first target. If the datum icon has not been pressed since the last beam break, the user will be prompted to datum the system.

During linear axis measurement, XM-60 performs an automatic roll calibration procedure after selecting ‘Start test’. Once completed, there will be prompts to perform machine movements for the system to detect the orientation and direction of the axes. If one or more of the three machines axes cannot be moved, select the ‘Skip axes’ icon. In this case, a 3D diagram will be displayed and the orientation and direction of the skipped axes must be manually specified.

NOTE: A maximum of two axes can be ‘skipped’

At the beginning of a rotary axis test, the XR20 performs a calibration of the angular optics. This very accurately measures the separation of the two optics in the rotary head and compensates for any small angular misalignment of the optic.

Stop test

Select the ‘Stop test’ icon to stop the data capture process. The data captured during the test can then be saved and analysed.

Save

Select the ‘Save’ icon to save the test data to the database. The data will then be available to analyse at any time in Explore.

NOTE: Data is not saved until the ‘Save’ icon is manually selected.

Analyse

Selecting the ‘Analyse’ icon opens Explore with the data from the most recently saved test. For more detail, refer to the *CARTO Explore* user guide (Renishaw part no. F-9930-1008).

Dynamic analyse settings (Dynamic data fit only) – set the number of targets to use for dynamic analysis when displaying the straightness result in Explore.

Summary tab (for multi-session test only) – when capturing multi-session measurement, a summary tab is added to provide a preview of the stitched data for a DDF test and the error corrected data for an off axis measurement.

Define tab (‘Free-run mode’)

The ‘Define’ tab allows the parameters of the test to be set. There are three trigger types available:

Manual

Data will be captured every time the F9 key or middle mouse button is pressed.

Select either fast averaging (laser readings are averaged over 462.5 milliseconds) or slow averaging (laser readings are averaged over 3.7 seconds).

NOTE: With averaging applied, the position readings can appear to lag the actual position of the axis. There will also be a delay between motion stopping and the linear position reading becoming settled. Due to this, users should only press a button to trigger when the linear position displayed in the software has stopped changing.

Automatic

When ‘Automatic’ trigger is selected, data will be captured every time the averaged linear reading is stable. The criterion of the stability required for a trigger is that the laser signal stays within the ‘stability range’ for at least the ‘stability period’.

NOTE: The averaged linear reading must be stable for a trigger, therefore the machine dwell time required for data capture will be at least the averaging period (For example, 3.7 seconds for slow averaging) plus the stability period.

Snap tolerance

When returning to a position that has already been captured, the new data point will replace the old data point if the distance between them is less than the snap tolerance.

Continuous

When ‘Continuous’ trigger is selected, data can be captured during motion without the need for dwelling. Data will be captured every time the linear position moves by the ‘trigger interval’.

NOTE: If the captured data interval appears uneven, the speed of motion is too high for the chosen ‘trigger interval’. Either decrease the speed of motion or increase the ‘trigger interval’.

Capture tab (‘Free-run mode’)

Visual alignment gauges

The visual alignment gauges give a live display of the errors of the five channels. The scale of each gauge can be adjusted by editing the number next to the ‘Pen’ icon.

Show/hide error channels

There are five error channels that can all be plotted against linear position. Directly below the signal strength bar is a panel with check boxes to show or hide each of the error channel graphs.

NOTE: Even when an error channel is hidden, data is still recorded for the error channel in the background.

Start and stop

Press the ‘Start test’ icon to start the data capture process when the machine is positioned at the first target. If the ‘Datum’ icon has not been pressed since the last beam break, the user will be prompted to datum the system. Select the ‘Stop test’ icon to stop the data capture process.

Apply fit

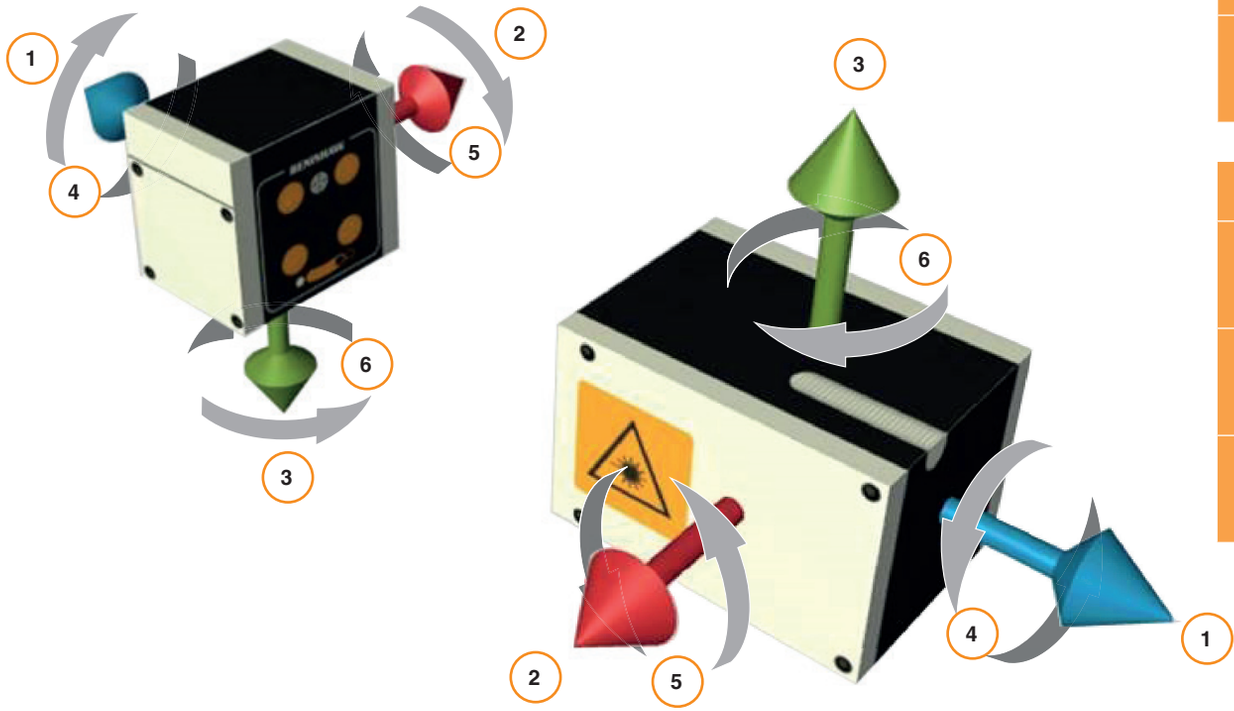
When the ‘Apply fit’ toggle is set to ‘On’, end-point fitting is used to remove the slope error from the vertical straightness and horizontal straightness error channels.

NOTE: The end-point fitting only takes effect when at least three data points have been captured

Data graphs

- A vertical dotted line shows the current linear position.
- Horizontal dotted lines show the current error values.
- A ‘Copy’ button allows each graph to be pasted into other programs as a picture.
- Beside each graph is an icon to indicate which error channel is being shown. Hover the cursor over the icon to display the name of the error channel.

The sign convention used to specify which direction is positive for the error channels is as shown below:



Data table

All captured data appears in the table at the bottom of the screen. No data captured in free-run mode is saved to the database. A ‘Copy’ button allows the data to be pasted into other programs, for example a spreadsheet.

Linear		
1	Position	↔
2	Horizontal straightness	
3	Vertical straightness	

Angular		
4	Roll	
5	Pitch	
6	Yaw	

Appendix – Sequence kinds

Linear sequence

In ‘Linear sequence’ mode each target is visited in turn.

Unidirectional – If the direction is set to unidirectional, each target is visited once during each run, starting at the first target and ending at the last.

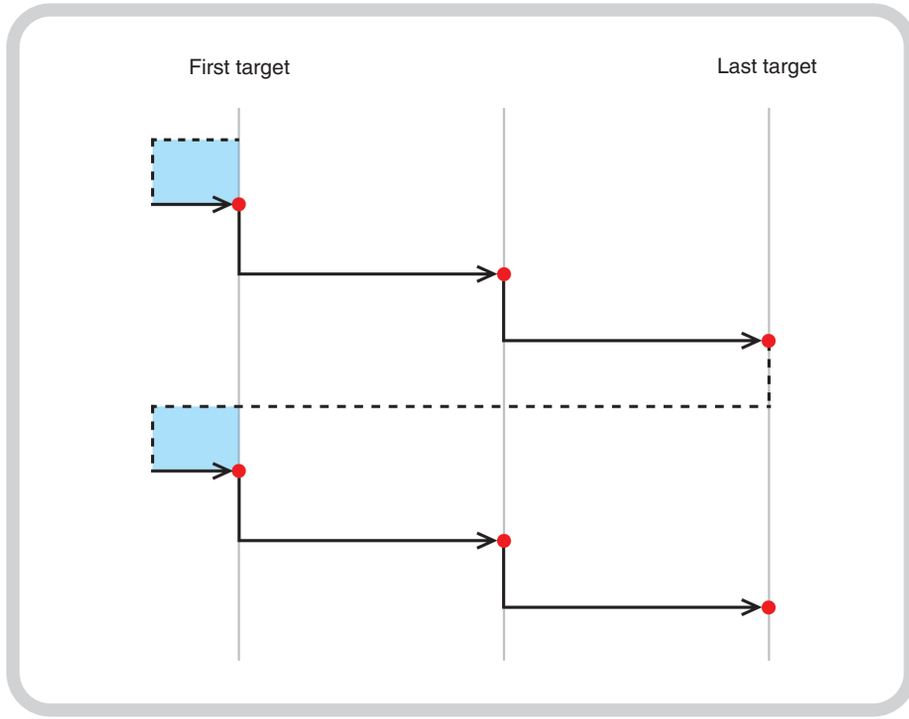


Figure 1 Linear data capture with two unidirectional runs.

= Target captured

= Overrun move

Bidirectional – If the direction is bidirectional, each target is visited twice per run (For example, each target is approached from both directions).

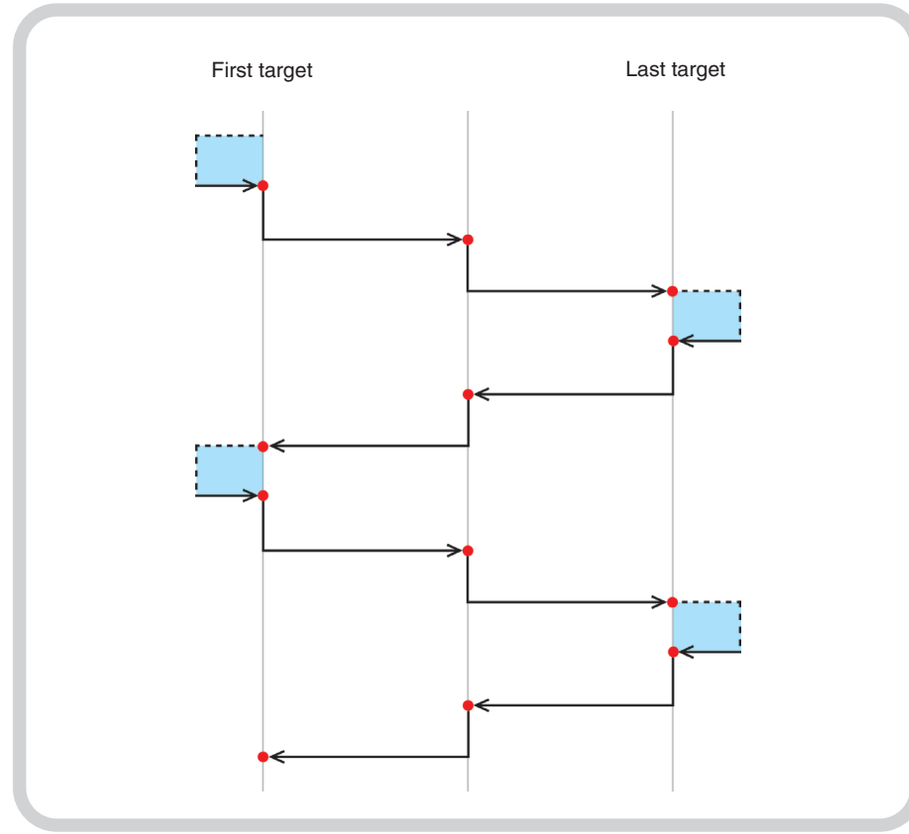


Figure 2 Linear data capture with two bidirectional runs.

Pilgrim sequence – unidirectional

In ‘Pilgrim sequence’ mode each target is visited sequentially according to the specified number of runs.

Unidirectional – If the direction is set to unidirectional, each target is approached from one direction only. After stopping at each target, the machine moves back towards the previous target by the overrun distance and then returns to the target. This is repeated until the number of times the target is visited is equal to the ‘no. of runs’. The machine then moves to the next target in the sequence, and the process is repeated.

= Target captured

= Overrun move

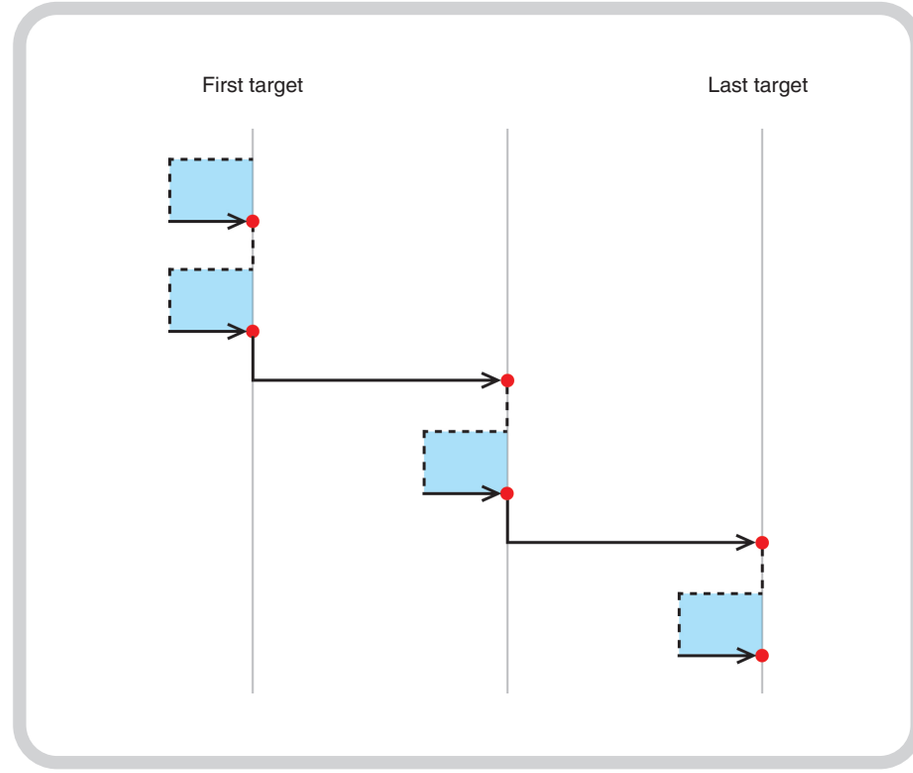


Figure 3 Pilgrim data capture with two unidirectional runs.

Pilgrim sequence – bidirectional

Bidirectional – If the direction is set to bidirectional, the moving part of the machine alternates between pairs of adjacent targets, with all the approaches to one target from one direction being completed before the same target is approached from the opposite direction. During a pilgrim test, the moving part moves progressively along its travel from the first target to the last, completing all runs for each target as it progresses.

= Target captured

= Overrun move

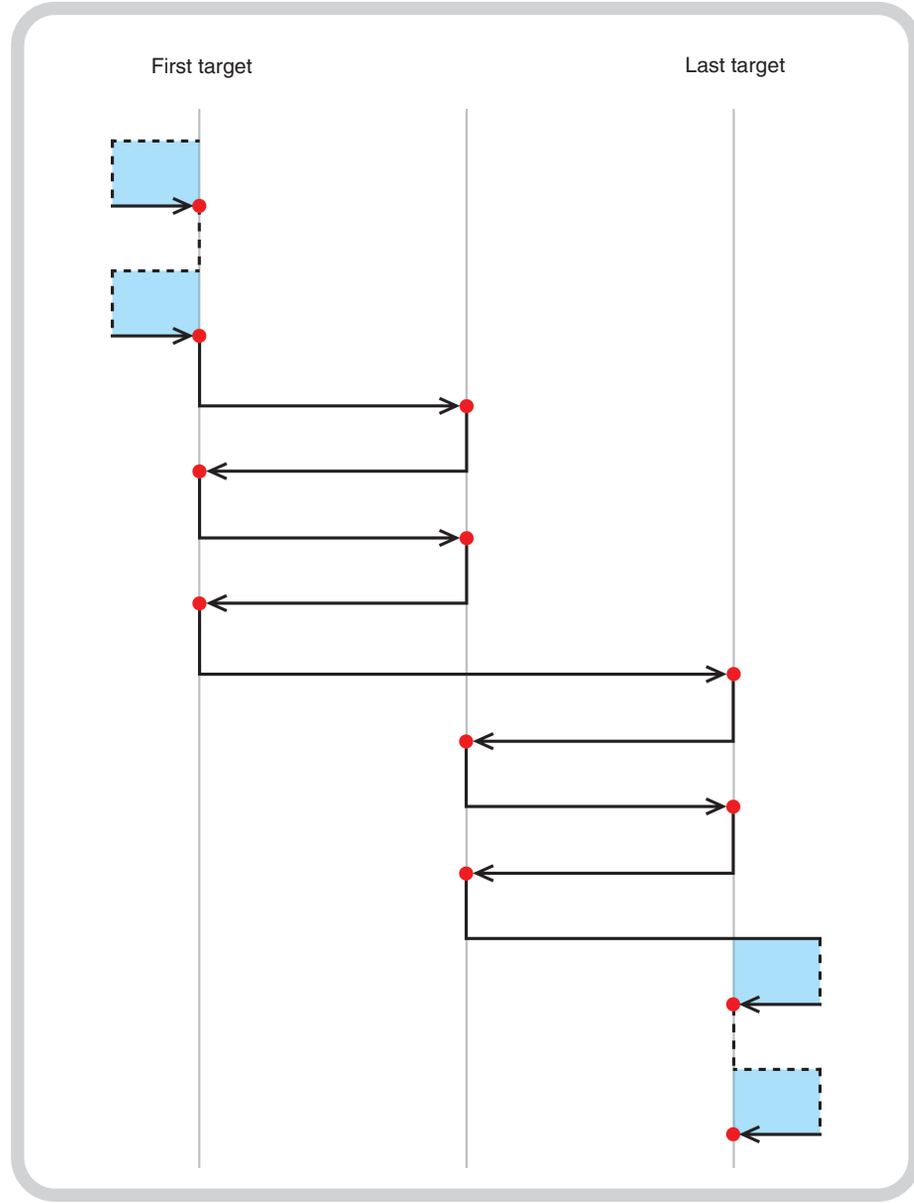


Figure 4 Pilgrim data capture with two bidirectional runs.

Pendulum sequence – unidirectional

In pendulum mode, the moving part of the machine is progressively moved through the targets, starting from the first and ending with the last.

Unidirectional – If the direction is set to unidirectional, each target is approached from one direction only. After stopping at each target, the machine moves back towards the previous target by the overrun distance and then returns to the target. This is repeated until the number of times the target is visited is equal to the ‘no. of runs’. The machine then moves to the next target in the sequence, and the process is repeated

= Target captured

= Overrun move

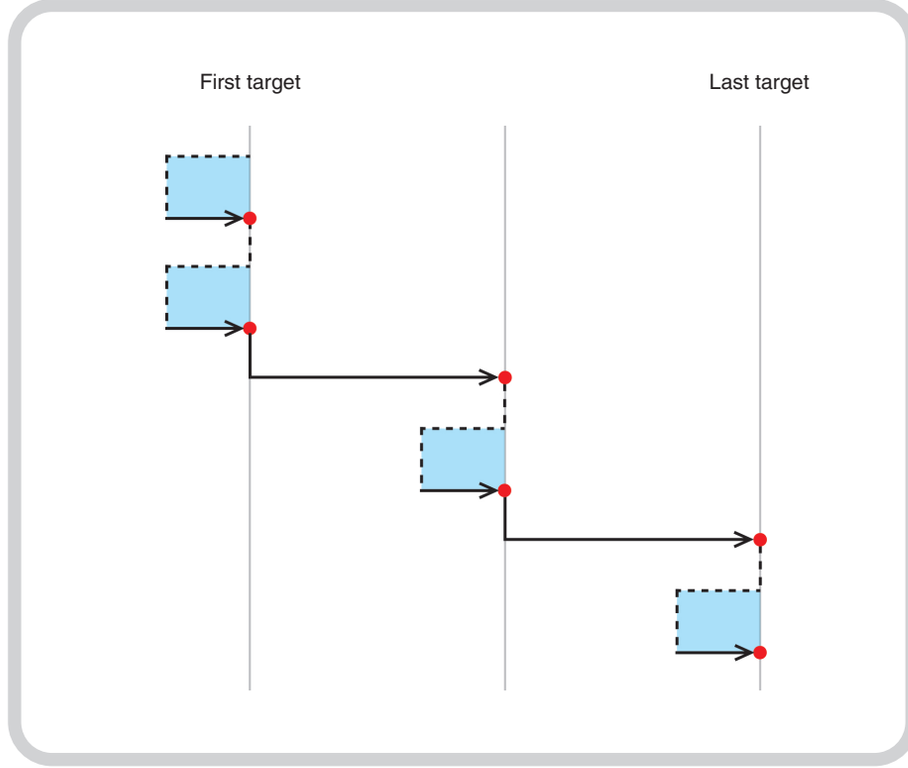


Figure 5 Pendulum data capture with two unidirectional runs

Pendulum sequence – bidirectional

Bidirectional – If the direction is set to bidirectional, each target is approached from two directions. After stopping at each target, the machine moves away from the target by the overrun and returns to the target in both directions. This is repeated until the number of times the target is visited from both directions is equal to the 'no. of runs'. The machine moves to the next target in the sequence, and the process is repeated.

= Target captured

= Overrun move

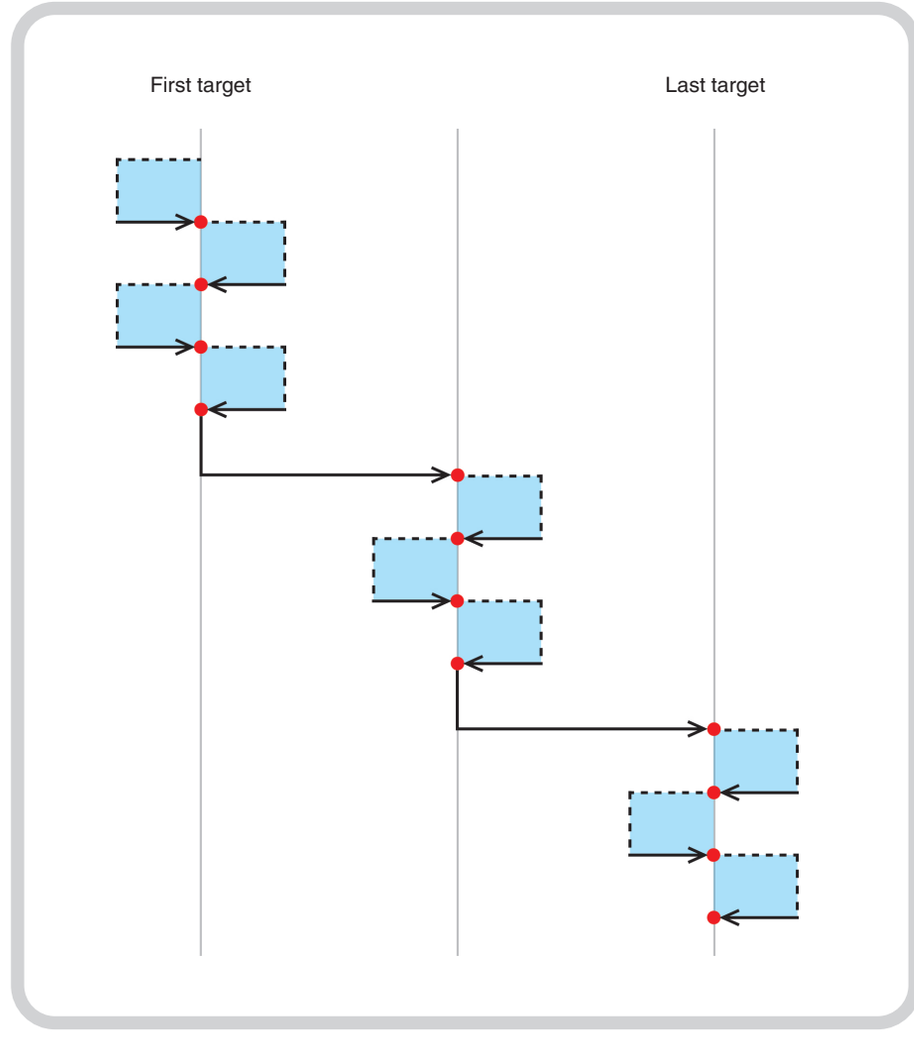


Figure 6 Pendulum data capture with two bidirectional runs.

ISO-10360 sequence

In ‘ISO-10360 sequence’ mode (for use with linear measurement only), the moving part of the machine moves from the first target to each of the other targets sequentially, returning to measure the first target before visiting each subsequent target.

When the moving part of the machine has travelled from the first target to the last target, one run has been completed. This process is repeated for each subsequent run.

= Target captured

= Overrun move

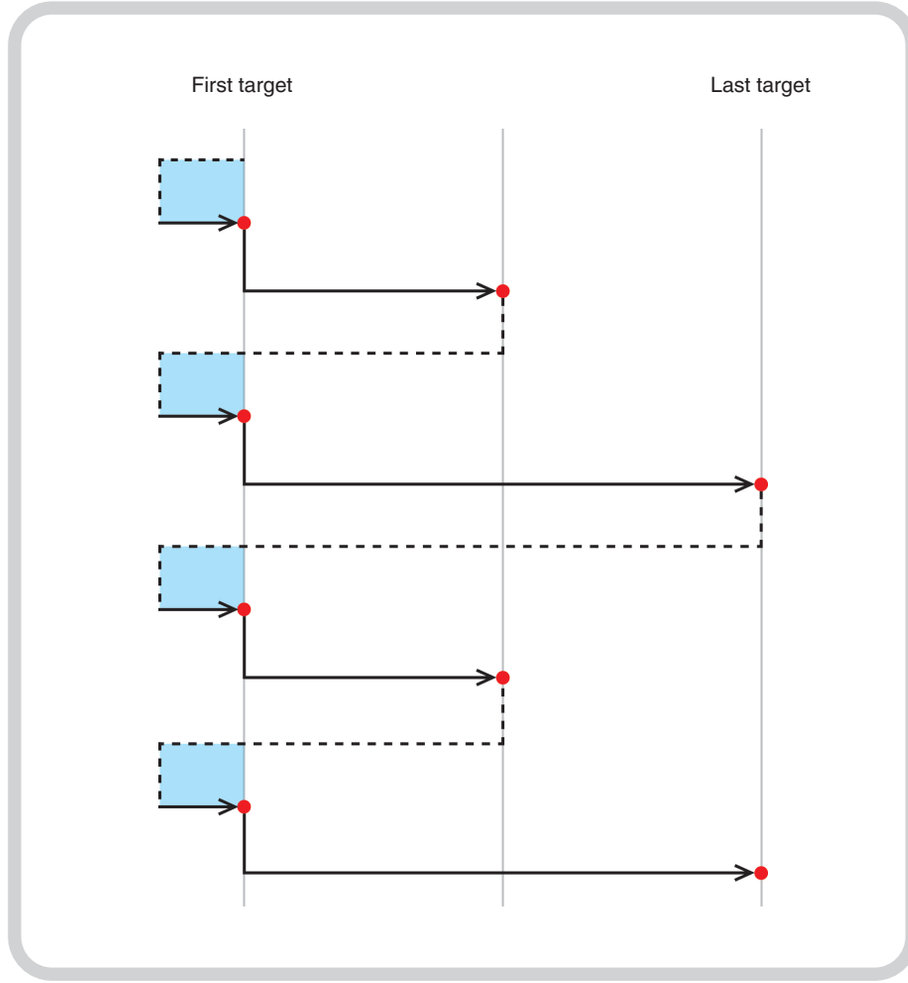


Figure 7 ISO-10360 data capture with two unidirectional runs.

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