User Guide
Falcon 3-axis Non Contact Measurement Systems
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Vision Engineering's Falcon is a compact 3-axis non-contact semi-automated measurement system, designed to give cost-effective accurate results.

The repeatable 5-position zoom optics provide the user with a high resolution clear image of intricate parts. Accurate repeatable results are achieved in X and Y, by the NLEC calibrated stage, and in Z by the unique camera iris control reducing the depth of field.

Health & Safety

Vision Engineering and its products conforms to the requirements of the EC Directives on Waste Electrical and Electronic Equipment (WEEE) and Restriction of Hazardous Substances (RoHS).

EN61326-1:2006
FCC Part 15
EN60950-1:2001

WARNING: ALL EQUIPMENT PLUGGED INTO THIS UNIT MUST BE APPROVED TO EN60950-1:2001 AND CHECK CURRENT RATING OF OUTPUT SOCKET IF USED.

FALCON EQUIPMENT – WARNING

This warning refers to CNC systems

Warning – hazardous moving parts.
To avoid entrapment keep fingers and other body part away from moving parts

To stop all CNC movement in an emergency situation move the joystick in ANY direction.

This will interrupt the CNC programme and stop any movement.

In the case of a system failure or crash, to stop the CNC movement switch the Control Power Supply off or switch off the mains power to the system.
Unpacking the Falcon stand (all systems)

Falcon with M3 software (manual) system by box content

- **Box 1**: Stand, accessory box (objectives, ringlight, cable (x1))
- **Box 2**: M3 software preinstalled PC, keyboard, mouse
- **Box 3**: Touch Screen Monitor
- **Box 4**: M3 USB interface box
- **Box 5**: Manual stage (150mm x 100mm or 150mm x 150mm), control unit, cables (x5)

Falcon with M3-CNC software (motorised) system by box content

- **Box 1**: Stand, accessory box (objectives, ringlight, cable (x1))
- **Box 2**: M3-CNC software preinstalled PC, keyboard, mouse
- **Box 3**: Touch Screen Monitor
- **Box 4**: M3-CNC USB interface box
- **Box 5**: Motorised stage (150mm x 150mm), joystick, CNC control unit, cables (x7)

Falcon QC-5000 (manual) system by box content

- **Box 1**: Stand, accessory box (objectives, ringlight, cable (x1))
- **Box 2**: QC-5000 PC, keyboard, mouse
- **Box 3**: Monitor
- **Box 4**: Manual stage (150mm x 150mm or 150mm x 100mm), control unit, cables (x4)

Falcon QC-5000 (motorised) system by box content

- **Box 1**: Stand, accessory box (objectives, ringlight, cable (x1))
- **Box 2**: QC-5000 PC, keyboard, mouse
- **Box 3**: Monitor
- **Box 4**: Motorised stage (150mm x 150mm), joystick, CNC control unit, cables (x6)
Stand & objectives

1. Stand
2. Low magnification objective lens
3. High magnification objective lens
4. LED ringlight
5. Toolkit

Stage

1. 150mm x 100mm manual stage
2. 150mm x 100mm adapter
3. 150mm x 150mm manual stage
4. 150mm x 150mm motorised stage
Control units

1. Manual control power supply unit (z-axis rocker switch or mouse control)
2. Z-Axis mouse controller
3. CNC control power supply unit & joystick (motorised stage only)
4. Trackerball controller (option for motorised stage only)

M3 microprocessor

M3 USB interface unit

Note: Please ensure your Windows® operating system is kept up to date through Windows® Update.

Note: In applications where the USB signal/power is weak (i.e. with long leads and some laptops) we recommend using a powered hub or repeater cable (available from your local PC retailer).

QC-5000 PC

1. QC-5000 PC
2. Monitor
3. Keyboard and mouse

Note: Please ensure your Windows® operating system is kept up to date through Windows® Update.
Removing the transit protection

- Remove the 3 securing screws 1 and then remove the transit plate 2.
- Unscrew and remove the rear transit bolt 3.

Note: Keep the transit protection for future transport of your Falcon.

It is highly recommended that you refit the transit protection whenever you transport your system.

Attaching the LED array

- Connect the flying lead socket 1 into the fixed plug 2 on the LED array 3.
- Carefully position the array and secure it by tightening the single securing screw 4 using the Allen key supplied.
Stage assembly (150mm x 150mm) - manual and motorised

Note: Although the manual stage is illustrated, the assembly procedure for the motorised stage is identical (with the exception of the transit clamps - see below)

► Use the stand’s levelling foot 1 to ensure the base is stable.

► Place the stage on the stand ensuring the retractable foot (position B4 in diagram 2 below) is fully retracted.

► Check the stand base plate 3 and the underside of the 150mm x 150mm stage 4 are clean and free of any debris.

► Loosely fit the stage bolts 6 in position B1, B2 and B3 (also in diagram 2) to a light (finger tight) tension.

Note: Do not tighten the stage bolts as the stage will need to be aligned (see page 11).

► Remove all red transit clamps from the stage.
Stage assembly (150mm x 100mm)

- Check the adjustable pad (foot) ① on the stage adaptor is retracted up into the plate. The adjustable pad is controlled by the screw in the rear left hole in the plate.

- Check the stand mounting pads ② and the underside of the plate ③ are clean and free of debris.

- Place the adaptor plate on the stand base mountings and align the three bolt holes ④, insert the bolts and do them up until they touch down. Then, back them off a small amount, when all the bolts are in. Tighten them to torque setting of 2.9Nm which is approximately equal to bolt touch down, plus a quarter of a turn. The bolts should be tightened in the following sequence: front right, front left and then back right.

- Once the bolts are done up, the adjustable pad should be set. To do this, use a small screwdriver to just touch down the screw. DO NOT then add any torque to the screw, as this could distort the base plate. The screw has a special coating which prevents it from working loose.

- Fit the stage in accordance with the instructions.

- Remove all red transit protection from the stage.

- Check the adjustable pad ⑤ on the stage is retracted up into the stage bottom plate. The adjustable pad is controlled by the screw in the rear left hole in the aperture under the stage glass.

- Check the top of the adapter ⑥ and the underside of the stage are clean and free of any debris.

- Place the stage on the adapter and align the three bolt holes ⑦. Screw in the Allen bolts (using the Allen key provided) but DO NOT tighten them at this time.
Objective lens attachment

- Place the objective lens ① up into the head ② and screw it into position.

- For further information, see Objective lens on page 17.
All connectors must be engaged fully and secured with the screws.

Note: In applications where the USB signal/power is weak (i.e. with long leads and some laptops) we recommend using a powered hub or repeater cable (available from your local PC retailer).

Note: Please ensure your Windows® operating system is kept up to date through Windows® Update.

Cable connection M3-VED (manual systems)

WARNING: To comply with safety regulations, easy access to the mains socket must be maintained.

Cable connection M3-CNC (CNC systems)

WARNING: To comply with safety regulations, easy access to the mains socket must be maintained.
ASSEMBLY

All connectors must be engaged fully and secured with the screws.

Cable connection QC-5000 (manual systems)

WARNING: To comply with safety regulations, easy access to the mains socket must be maintained.

Cable connection QC-5000 (CNC systems)

WARNING: To comply with safety regulations, easy access to the mains socket must be maintained.
Z-Axis mouse setup

Connection

- Plug the supplied Z-Axis mouse controller into the USB port ① at the rear of the box.

**Note:** Only use the mouse supplied. The mouse supplied is an enhanced mouse. A mouse with a non-enhanced interface will not work.

- Set the z-axis motion switch ② to ON to enable mouse controller and disable the rocker switch.

Calibration

**Note:** It is recommended that this calibration is repeated as part of the system scheduled service and calibration.

A function has been provided to remove MOST of the backlash evident when changing direction.

- Remove the calibration cover panel ① from the rear of the control unit.

- Ensure all DIP switches ② are set to OFF (up position).

- Scroll the mouse wheel away from you until movement is seen at the DRO scale readout.

- Switch DIP switch 5 ON (down position).

- Scroll the mouse wheel towards you, one click at a time, until movement is seen at the DRO. Please be patient as this may take a while.

- Switch DIP switch 5 OFF and switch DIP switch 6 ON.

- Scroll the mouse wheel away from you, one click at a time, until movement is seen at the DRO. Please be patient as this may take a while.

- When movement is detected, switch DIP switch 6 OFF.

- Ensure to reset the DIP switch to the required speed setting (see Speed setting on page 10).
**Speed setting**

The control power supply unit has two speed settings depending on your preferences and if you are using a HI magnification (x20 – x100) or LOW magnification (x10 – x50) objective.

The default setting is for HI magnification. The speed setting can be set by adjusting the position of DIP switch No.1 as follows:

- Remove the calibration cover panel from the rear of the control unit.
- Set the position of DIP switch 1 as required according to the table below.
- Refit cover panel.

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HI magnification (default)</strong></td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td><strong>LOW magnification</strong></td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
</tr>
</tbody>
</table>
Stage alignment

- Turn on the Falcon using the switch on the front of the control unit - see page 15.
- Switch on the measurement PC supplied and follow on screen instructions for crossing reference marks.
- If a high magnification objective is being used, set the magnification control to 2. If a low magnification objective is being used, set the control to 4.
- Focus on the three horizontal lines in the centre of the alignment plate attached to the stage.
- Rotate the stage by hand until the horizontal lines are parallel to the horizontal crosshair on the measurement PC supplied.
- Use the X axis control to check reference lines remain parallel with the crosshair.

IMPORTANT: Before the alignment plate can be removed the relevant stage securing procedure should be carried out (see below or page 12 as appropriate).

Securing the stage (150mm x 150mm)

With the stage assembled (see page 4) and aligned (see above), secure the stage as follows:

- Being careful not to move the stage, loosen the floating stage foot securing screw 1.
- Insert and screw in the last stage bolt 2 and tighten until finger tight.
- Use the Allen key supplied to progressively tighten all 4 screws through the appropriate holes in the alignment plate in the numbered sequence (shown in the diagram below) to a torque of 2.8Nm.
- Lightly tighten the floating stage foot securing screw.
- Remove the alignment plate.

Note: If you need to remove the stage for any reason, re-attach the alignment plate and ensure the horizontal lines are parallel to the horizontal crosshair before removing the stage.
Securing the stage (150mm x 100mm)

With the stage assembled (see page 5) and aligned (see page 11), secure the stage as follows:

- Use the Allen key supplied to progressively tighten all 3 screws through the appropriate holes 1 in the alignment plate in the numbered sequence (shown in the diagram below) to a torque of 2.8Nm.

- Set the adjustable pad 3 using a flat headed screwdriver. Adjust the screw until it just touches down - DO NOT USE FORCE! If this screw is over tightened, the base plate will distort.

- Remove the alignment plate.

Note: If you need to remove the stage for any reason, re-attach the alignment plate and ensure the horizontal lines are parallel to the horizontal crosshair before removing the stage.
Fitting the stage glass

- Fit the stage glass 1 into its recess, taking care to locate it against the location springs and on to the supports 2.

Note: The above procedure should be used for both types of stage.

Stage glass levelling

- Use the X axis 1 and Y axis 2 controls to bring the rear right-hand corner of the stage glass (fixed corner) 3 into view.

- Use the stage focus control to bring the glass surface into sharp focus.

- Use the axis controls to bring the front right-hand corner into view. Use the relevant adjustable glass support to bring the surface of the glass into sharp focus.

- Repeat for the remaining 2 corners.

- Repeat the above steps if necessary until all 4 corners are in focus.
Falcon family tree

Falcon Bench Stand complete with quadrant ringlight

Manual Stages
- Precision Measuring Stage 150mm x 100mm (6”x4”)
  Manual & adapter plate
  F-025
- Precision Measuring Stage 150mm x 150mm (6”x6”)
  Manual
  F-006
- M3 microprocessor (VED)
  F-020
- Control Unit
  F-302
- QC-5000 PC
  H-139

Motorised Stage
- Precision Measuring Stage 150mm x 150mm (6”x6”)
  Motorised
  F-006M
- M3 microprocessor (CNC)
  F-021
- Control Unit
  F-302
- Footswitch
  H-038
- QC-5000 PC
  H-141
- Joystick
  F-310
- Control Unit
  F-302
- Footswitch
  H-038
- QC-5000 PC
  H-141
- Joystick
  F-310
- Cables
  F-010L

Key
- Mandatory Parts
- Optional Parts

Objectives
- Objective Lens Low Magnification
  F-003
- Objective Lens High Magnification
  F-004
- LED Substage Illuminator (spare)
  LED-003
- LED Surface Illuminator (spare)
  LED-004
- Filter (optional)
  FIL-1570
- Dust Cover
  F-011
Main system controls

1. Zoom Control
2. Camera iris control
3. Substage illumination iris control
4. Y axis control
5. X axis control
6. Focus rocker control
7. Z-axis mouse controller
8. Joystick controls (CNC systems only)

Default Joystick button functions:
1 = Enter
2 = Speed Toggle
3 = Finish

Z-axis mouse button functions:
1 = Scroll switch
   Toggles between high and low speed modes
2 = Scroll forward
   Increments Z+
3 = Scroll back
   Increments Z-
4 = LH button
   Z- (focus down)
5 = RH button
   Z+ (focus up)
4 & 5 single click together = enables/disables constant speed mode
Measurement system settings and advanced features

Your Falcon system has been configured and set up to work with the measurement PC supplied.

Standard factory settings include calibrated magnifications for easy selection and measurement consistency using the zoom index system.

For information on how to set up and edit the standard features on the PC please refer to the PC user manual.

The software user manual also contains information relating to archiving images, writing measurement routines and other advance measurement features that will enhance using the Falcon 3 axis measurement system. The camera may be switched to a lower resolution in certain software, if a faster refresh rate is required.

Move the zoom to the desired position and focus on the subject by moving the head up or down, either by using the switch at the front of the stand or by using the Z axis mouse control.

To achieve optimum results from your Falcon measuring system, illumination and optics need to be optimised to provide the best possible image. Certain lighting configurations are better for some applications than others.

Substage illumination should be used for profile measurement (optional colour filter available) whilst surface illumination is for subjects with surface features.

Illumination and focus should be adjusted until the image is clear and bright, with good contrast. Maximum contrast improves accuracy and repeatability.

Contact your nearest Vision Engineering branch or Distributor if you require further information.

**Iris controls**

The camera and substage illuminator are both fitted with a 5-position adjustable iris, allowing the user to change the aperture of the lens. Changing the position of the controls results in the iris opening and closing. This changes the amount of light passing back through the lens, slightly increasing or decreasing the depth of field, ideal for subjects where greater surface definition is required.

**Camera iris:**
- Position 1 = large iris (smaller depth of field)
- Position 4 = small iris (larger depth of field)
- Position Z is used for height measurement

The iris on the substage illuminator is used to give sharper edge definition on profiles of 3-dimensional subjects.

**Substage illuminator iris:**
- Position 1 = large iris
- Position 5 = small iris
Objective lens

Magnification table

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
<th>Zoom Ratio</th>
<th>Total System Magnification</th>
<th>Working Distance</th>
<th>Field of View</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-003</td>
<td>Low Magnification Objective</td>
<td>5:1</td>
<td>10x - 50x</td>
<td>91mm</td>
<td>2.7 - 13.5mm</td>
</tr>
<tr>
<td>F-004</td>
<td>High Magnification Objective</td>
<td>5:1</td>
<td>20x - 100x</td>
<td>61mm</td>
<td>1.35 - 6.75mm</td>
</tr>
</tbody>
</table>

Best practice

To ensure the most accurate measurements are taken it is recommended that during the measurement process these following guidelines are followed:

- Ensure fan exhaust area is not blocked or obstructed
- Do not adjust Magnification.
- Do not adjust camera or substage iris once image has been optimised.
- Do not lean on or shake the upper arm of your Falcon product.
- When measuring subjects in the Z axis, it is recommended that the approach direction to achieve clear focus is the same for both references.
- When viewing subject to locate measurement feature, it is recommended that the Falcon is focused at max magnification then select lower mag if required.

Select the correct magnification for the component being measured, based on size of component and field of view (see magnification table above). Ensure that the lens has been calibrated and selected on the M3/QC-5000 (see appropriate user guide for details).

Focus on the subject, using the control at the front of the stand or the Z axis mouse to move the head, then move the zoom control to the desired position.

To achieve the very best from your Falcon non-contact measuring system, you should carry out regular routine maintenance as well as undertaking a schedule of service and calibration (see service and calibration record, at the end of this user guide).
Getting the most from your Falcon

Routine maintenance (see page 19)

- The outside of the instrument should be wiped down to remove dirt and dust.
- The instrument and accessories should be checked for loose or damaged components.
- When not in use, protect your Falcon with the dust cover.

Consumable & replacement parts

<table>
<thead>
<tr>
<th>Description</th>
<th>Specification</th>
<th>Part Number</th>
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<tbody>
<tr>
<td>Stage glass</td>
<td>150mm x 100mm</td>
<td>F-102</td>
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<tr>
<td>Stage glass</td>
<td>150mm x 150mm</td>
<td>201-80686</td>
</tr>
<tr>
<td>Surface light LED array</td>
<td>20 LEDs, 1,100 LUX (filtered)</td>
<td>F-001</td>
</tr>
<tr>
<td>Substage LED</td>
<td>330 LUX (filtered)</td>
<td>MN-006</td>
</tr>
</tbody>
</table>

Environmental considerations

Falcon is an accurate, industrial gauging instrument. To achieve the optimum accuracy and repeatability, the following considerations should be taken into account

- Position the Falcon on a firm, rigid and level table.
- Avoid locating the instrument near to a source of vibration.
- Do not place the instrument close to a radiator or similar heat source.
- Do not place the instrument close to a cold temperature source such as an air conditioning unit.
- Do not position the instrument in direct sunlight, or where bright reflections will affect the camera image.
Substage LED changing

- Disconnect the unit from the mains supply.
- Carefully turn the stand on its side.
- Remove the two bolts ① from the substage illuminator base plate ② and remove it, complete with substage illuminator unit ③.
- Disconnect the inline connector ④ and remove the substage illuminator unit.
- Fit the new unit by reversing the above procedure.

LED Ringlight replacement

- Using the Allen key supplied, unscrew the securing screw ① at the rear of the ringlight assembly.
- Lower the assembly and disconnect the inline connector ②.
- To replace the LED ringlight, reverse the above procedure.
Falcon Serial Number ________________
Stage Serial Number ________________

<table>
<thead>
<tr>
<th>Service Type</th>
<th>Comments</th>
<th>Date of Service</th>
<th>Date of Next Service</th>
<th>Company</th>
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WARRANTY

This product is warranted to be free from defects in material and workmanship for a period of one year from the date of invoice to the original purchaser.

If during the warranty period the product is found to be defective, it will be repaired or replaced at facilities of Vision Engineering or elsewhere, all at the option of Vision Engineering. However, Vision Engineering reserves the right to refund the purchase price if it is unable to provide replacement, and repair is not commercially practicable or cannot be timely made. Parts not of Vision Engineering manufacture carry only the warranty of their manufacturer. Expendable components such as fuses carry no warranty.

This warranty does not cover damage in transit, damage caused by misuse, neglect, or carelessness, or damage resulting from either improper servicing or modification by other than Vision Engineering approved service personnel. Further, this warranty does not cover any routine maintenance work on the product described in the user guide or any minor maintenance work which is reasonably expected to be performed by the purchaser.

No responsibility is assumed for unsatisfactory operating performance due to environmental conditions such as humidity, dust, corrosive chemicals, deposition of oil or other foreign matter, spillage, or other conditions beyond the control of Vision Engineering.

Except as stated herein, Vision Engineering makes no other warranties, express or implied by law, whether for resale, fitness for a particular purpose or otherwise. Further, Vision Engineering shall not under any circumstances be liable for incidental, consequential or other damages.
For more information...

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www.visioneng.com