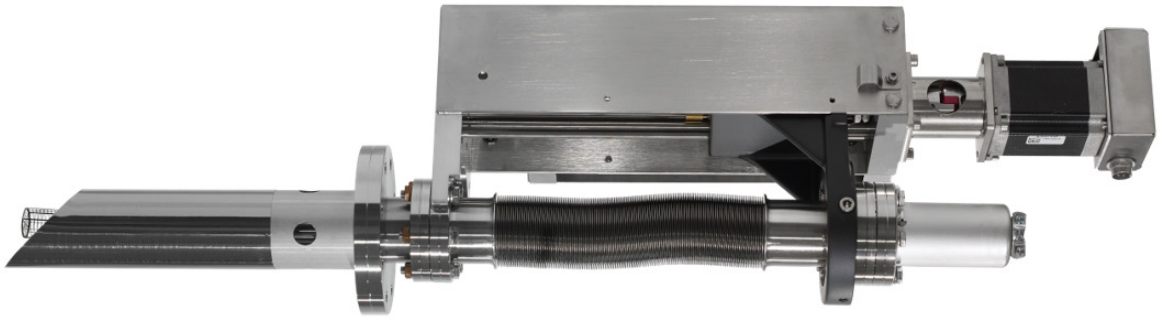
DCA INSTRUMENTS

User Manual

Beam Flux Monitor

Motor Control Unit – BFM



These are the original English instructions

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All pertinent state, regional, and local safety regulations must be observed when installing and using this component.

Failure to observe this information can result in injury or equipment damage.

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Component Modifications

Year	Type	Modifications
2020	MCU Version	GAL 1.5.30

Document Revisions

Date	Version Number	Document Changes
15-12-2021	1.0	Initial draft
02-11-2022	1.01	Minor text revisions

Table of Contents

1 PREFACE

1.1 Purpose of These Instructions

Thank you for purchasing this Beam Flux Monitor. The purpose of this document is to make you familiar with the features and functions of the Beam flux monitor and the accompanying motor control unit (if applicable), so that you can safely operate it as an end-user.

This documentation should therefore be regarded as an integral part of the Motor Control Unit. These instructions are intended for the following product models:

- BFM - LXXX – Ta/C/GV – M/H
- MCU-BFM (S)
- MCU-BFM (L)

1.2 Using this manual

To make best use of this manual:

- **Read the entire manual first.** Do not attempt to operate or perform maintenance of any kind on the product before you have thoroughly reviewed this manual.
- **Pay close attention to all safety information!** All MBE applications include inherent hazards and require strict adherence to safety standards. Read *Operator Safety* in this preface for critical safety information. Also see *Safety Hazards* in this preface to learn how safety hazards are indicated in this manual.
- **Use this manual as a tool for putting your own knowledge into practice.** This manual does not cover the theory, principles, or best practices for any particular MBE application. It aims to provide useful information to help you achieve your own objectives.
- **Remember that many DCA products are configurable.** It is not possible to address all aspects of all configurations in a single manual. If you are not finding the information you need, please consult *Additional Resources* in this preface, or contact us using the *Technical Support* information.
- **Refer to all graphics in context.** The graphics in this manual may not exactly match your product. Graphics are intended to illustrate only the features relevant to the topic at hand. Any optional, configurable, or missing features are identified, if contextually relevant.

1.3 Explanation of Safety Warnings

⚠WARNING

Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

⚠CAUTION

Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE

Indicates information considered important, but not hazard-related.

1.4 Intended User

This manual is intended for professionals and technicians experienced with UHV processes, and persons under the direct guidance of such individuals. If you are not among these groups, please do not attempt to use the information in this manual to operate the equipment.

Read and understand this manual and its safety instructions before using this product. Failure to do so can result in serious injury or component/system damage.

The manufacturer is not liable for cases of material damage or personal injury caused by incorrect handling or non-compliance with the safety instructions. In such cases, the warranty will be voided.

1.5 Obtaining Documentation and Information

1.5.1 Additional Resources

In addition to these user instructions, the following related documentation should be consulted:

- DCA System User Manual (if applicable)
- DCA Software User Manual (if applicable)
- Inficon Vacuum Gauge Controller VGC083A, User Manual

1.5.2 List of Component Manuals Ordering Documentation

Documentation, user instructions and technical information can be requested by contacting DCA Instruments Oy at info@dca.fi.

1.5.3 Other languages

This is the English user manual. Manuals in other languages are available upon request.

1.5.4 Documentation Feedback

If you are reading DCA Instruments Oy product documentation on the internet, any comments can be submitted on the support website. Comments can also be sent to info@dca.fi.

We appreciate your comments.

1.5.5 Technical Support and Service

For other service-related questions, information, technical assistance or ordering user instructions, please contact the manufacturer:

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2 CRITICAL INFORMATION

This chapter provides important safety information, product cautions and a summary of important notes about your DCA component.

2.1 Safety Precautions

Carefully study this user guide and any related documentation listed in 1.5.1. Only properly trained personnel should operate or maintain the product.

The manufacturer cannot be held liable for damage resulting from errors, unintended or unprofessional use of the Beam Flux Monitor.

The manufacturer is not liable for cases of material damage or personal injury caused by incorrect handling or non-compliance with the user guide. In such cases, the warranty will be voided.

2.1.1 Personal protective Equipment

The Beam Flux Monitor should be handled per general UHV practices. Powder-free protective gloves should be used to avoid contamination.

If using the Beam Flux Monitor with toxic materials, consult the relevant material safety data sheet(s) (MSDS) for advice on how to handle contaminated parts and the appropriate personal protective equipment required.

2.1.2 Installation safety information

⚠WARNING

Heavy weight! Risk of user injury. Use suitable lifting equipment (e.g. hoist) when transporting, lifting, or unpacking the component.

Inspect the Beam Flux Monitor for damage before installation. If there is any visible damage, do not install the Beam Flux Monitor and notify the manufacturer within one week of receiving the product.

2.1.3 Maintenance safety information

All cleaning and maintenance tasks shall only be carried out by qualified and skilled personnel. To ensure the optimal performance of the Beam Flux Monitor, regular maintenance shall be carried out by qualified personnel in accordance with the manufacturer's instructions.

Maintenance and inspection should be done on a regular basis. If there is any visible damage, a strong odour, or excessive overheating of components, stop using the Beam Flux Monitor.

⚠WARNING

Modification to the Beam Flux Monitor is not permitted. Any alterations made to the Beam Flux Monitor without written permission from the manufacturer will void the warranty.

See the Appendix for an overview of the spare parts. You can always order spare parts by contacting the manufacturer.

Only clean the component with a lint-free cleanroom compatible cloth and suitable solvent (e.g., ethanol or IPA).

The Beam Flux Monitor may feature safety marks in areas that pose a risk of injury or with other important instructions. Always replace missing or damaged safety marks immediately. If you replace safety marks with new ones, make sure that you place the new safety marks in the same places.

2.1.4 Repair and modification Safety information

⚠WARNING

DO NOT attempt to repair components without permission and explicit instructions from the manufacturer. Contact DCA Instruments if the component requires repair. Do not attempt to modify the component before consulting DCA Instruments.

2.1.5 Safe Disposal

Do not dispose of electric equipment, accessories, and packaging together with household waste material (only for EU countries). In observance of European Directive 2012/19/EC on waste of electric and electronic equipment and its implementation in accordance with national law, electric equipment that have reached the end of their life shall be collected separately and returned to an environmentally compatible recycling facility.

The component main body is constructed from stainless steel and may therefore be recycled with metal waste. Before disposal, ensure the component has been cleaned thoroughly from any harmful/toxic materials that may be present. The stepper motor should be treated as electrical equipment.

2.2 Graphical Symbols

2.2.1 Explanation of safety information on the system

Table 1 below provides safety information relevant to the Beam Flux Monitor. The labels are located as close as possible to the relevant area it is applicable to.

Table 1 Explanation of safety information relating to the system and the location of safety labels.

Symbol	Warning / Caution	Hazard Location
	**ENTANGLEMENT/CRUSHING** Exposed gears and moving parts can cause injury. Turn power off before servicing. Keep fingers, hands, hair, loose clothing, gloves, and tools away from moving parts.	Linear bellows assembly

	**ELECTRICITY** May cause electric shock or burn. Trained personnel only.	Electronic rack MCU

2.2.2 Personal Protective Equipment

PPE	Instruction
	Wear suitable protective gloves when handling in-vacuum parts.
	Wear protective clothing

3 INTRODUCTION

This manual is comprised of two parts, the first part describes the mechanical features of the beam flux monitor, and second part describes the operation of the motor control unit (if applicable).

NOTICE

This manual should be read in conjunction with the Inficon Vacuum Gauge Controller Manual VGC083A.

The beam flux monitor model configuration is described in Fig. 3-1.

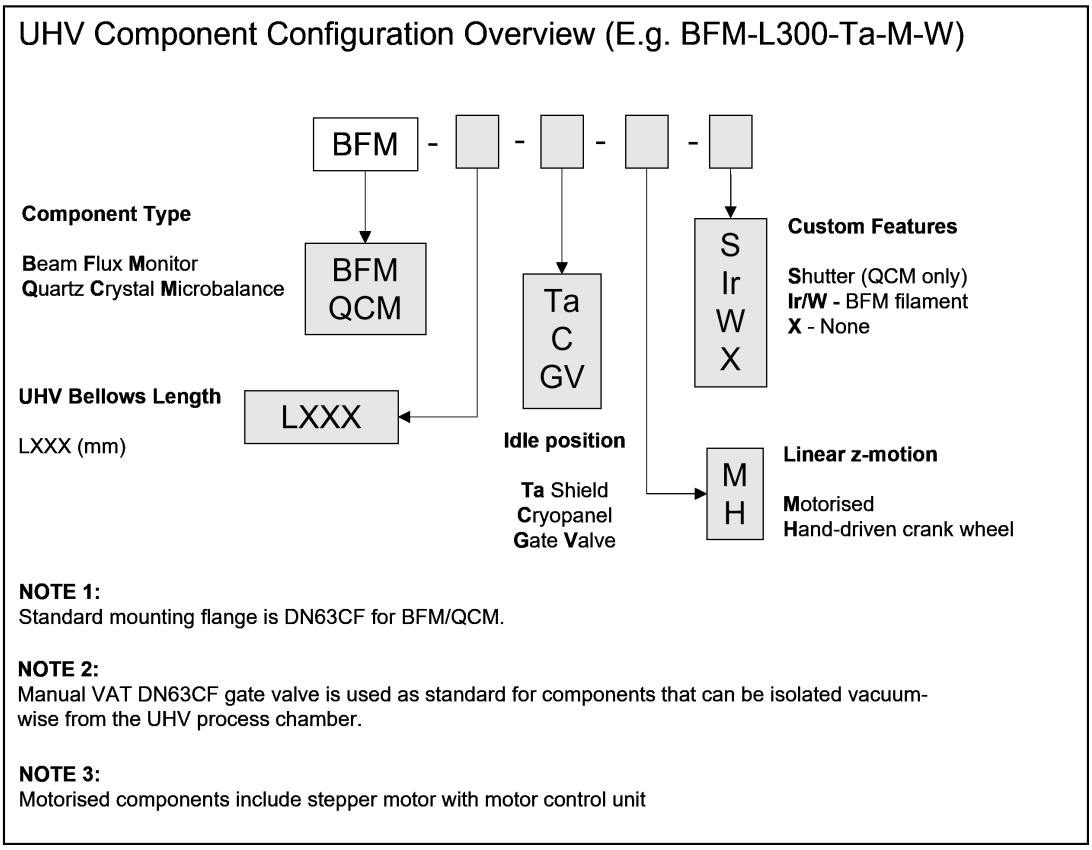


Fig. 3-1 Naming convention used to identify the BFM model and related features.

3.1 Product Description

The **Beam Flux Monitor** (BFM) (Fig. 3-3) is designed to measure the beam equivalent pressure (BEP) of the atomic/molecular beam emitted by a source in a UHV process chamber. The BEP can be used to calibrate the flux for each source (e.g., effusion cell) and determine a suitable flux ratio for growth. The BFM should be mounted just below substrate level so that the ionization gauge (IG) can be positioned directly beneath the substrate for measurement.

The Beam Flux Monitor includes:

- Bayard-Alpert type nude ionization gauge head – with twin-tungsten filament for improved durability and thermal stability
- UHV sealed bellows assembly with linear z-motion,
- Limit switch with optical sensor
- (If applicable) Stepper motor with mounting adapter and clutch
- (If applicable) Hand crank wheel

The BFM motion can be either manual or motorised. For motorised BFM motion, a stepper motor with motor control unit (MCU) is provided. This allows the user to operate the BFM locally from the human-machine interface (HMI) in the electronic rack (i.e., the MCU), or remotely (from the PC or higher-level logics controller (PCC)) using DCA Software. For manually controlled BFM motion, a hand crank wheel is attached to the linear motion; this can be turned clockwise/anticlockwise to extend/retract the BFM.

The BFM may be equipped with a protective tantalum tube, that shields the ion gauge from the beam while in standby mode. If the BFM is not equipped with a tantalum shield, the ion gauge head is retracted behind the chamber cryopanel while in standby. A BFM support frame is included when required.

A motion interlock is implemented to prevent the BFM from error conditions that may occur, this should always be enabled during normal operation.

Examples of the BFM versions are shown in Fig. 3-2 and Fig. 3-3.

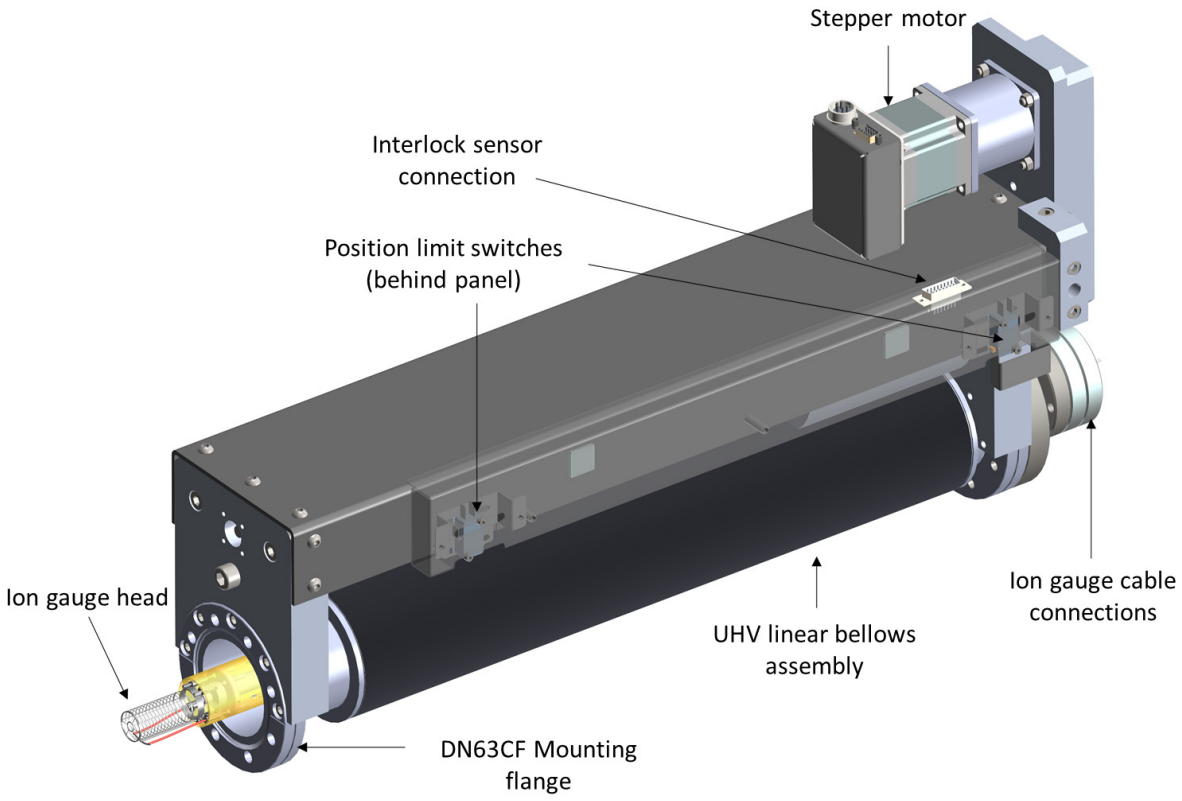


Fig. 3-2 Beam flux monitor designed to retract behind the process chamber cryopanel while in standby.

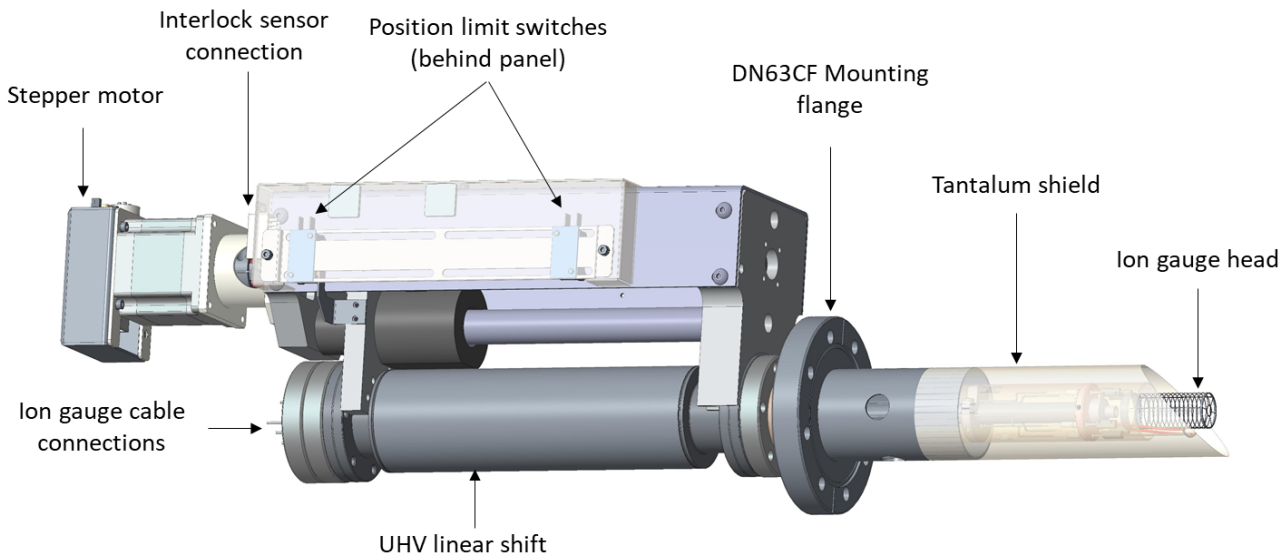


Fig. 3-3 Beam Flux Monitor with a tantalum shield to prevent beams coating the ion gauge while in standby.

Fig. 3-4 Motor control unit (BFM) front panel with a Status LED, black push button for Park/Retract, red push button for Measure/Extend, a motor power switch, and a small Power LED. The Beam Flux Monitor should only be used with the original accessories supplied; these are listed in Table 2 below.

Table 2 Summary of components/accessories included with the Beam Flux monitor and their intended use.

Accessory	Description
Vacuum gauge controller	Displays the BEP (Torr) from the BFM ion gauge. Standard model: Inficon VGC083A (models may vary)
Nude ion gauge cable	BAG050, bakeable to 200°C, connects the IG to the vacuum gauge controller.
Motor control unit (MCU)	The MCU-BFM supplies power to the stepper motor and controls the linear z-motion. Includes a human-machine interface (HMI), communication interface, and digital interface. The IP address is labelled on the MCU rear panel. The stepper motor and cable are not bakeable and must be removed before bakeout.
Power cable (MCU)	Connects the MCU to main power supply
Stepper motor cable	Connects the MCU to the BFM stepper motor
Interlock sensor cable	Motion interlock prevents collisions with other components that may occupy the same space within the process chamber.

3.2 Product Standard Features

The BFM model number indicates the features included: BFM-LXXX-Ta/C/GV-M/H

E.g. Beam flux monitor – Long/Short - L300 (bellows length in mm) – Retract behind Tantalum shield/Cryopanel/Gate Valve – Motorised/Hand driven (manual)

Table 3 Standard features for the Beam Flux Monitor.

Feature	BFM-S-Ta-H	BFM-S-Ta-M	BFM-L-C-M	BFM-L-C-M
Mounting flange	DN63CF	DN63CF	DN63CF	DN63CF
UHV Linear bellows (mm)	150	150	300	400
Motorised	No	Yes	Yes	Yes
Manual crank wheel	Yes	No	No	No
Support frame	No	No	No	No
Weight (kg)	10	10	15	15

Table 4 Standard features of the Motor Control Unit-BFM.

Feature	Included
Supports linear drive of DCA beam flux monitor with stepper motors	✓
User interface (HMI) for monitor extension (Measure) and retraction (Park), status indication	✓
Digital interlock input	✓
Ethernet interface for remote control	✓

3.3 Special Features

The Beam Flux assembly may be equipped with the special feature that allows it to be isolated vacuum-wise from the process chamber (Fig. 3-5). This allows the user to perform maintenance on the BFM (e.g., exchange the ion gauge) without venting the process chamber, increasing the system up-time, and improving usability.
This includes the following additional items with the standard BFM:

- Manual DN63CF VAT gate valve
- T-piece with pump and vent ports
- Support frame with

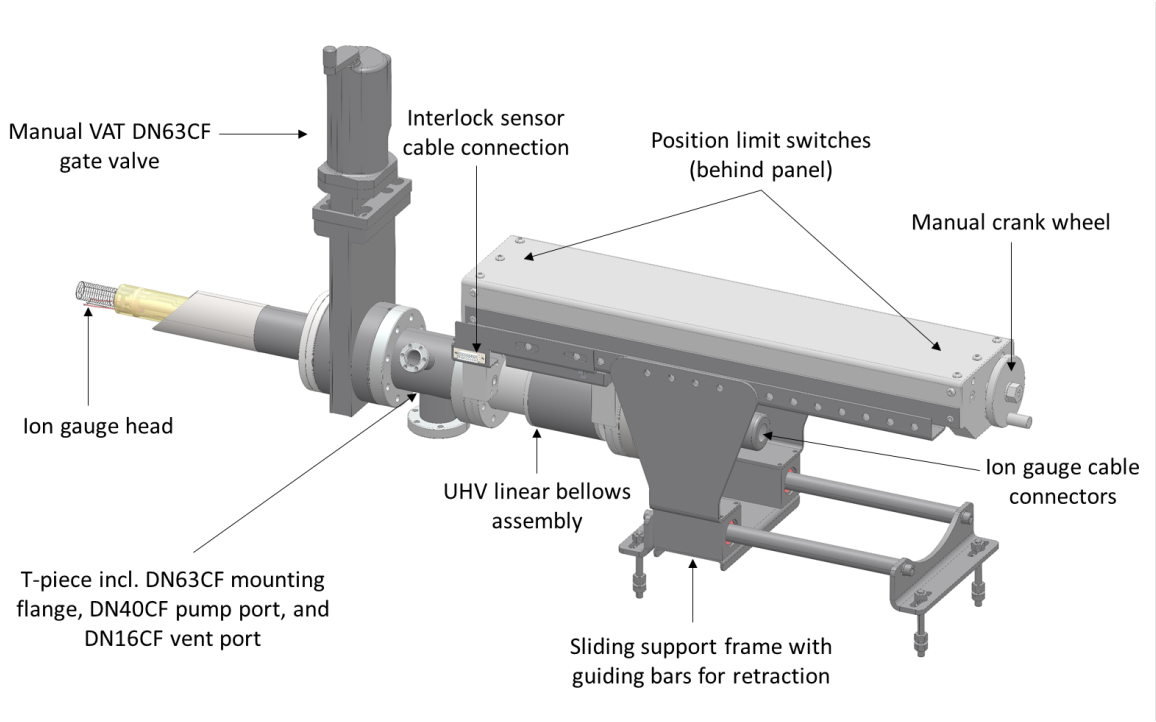
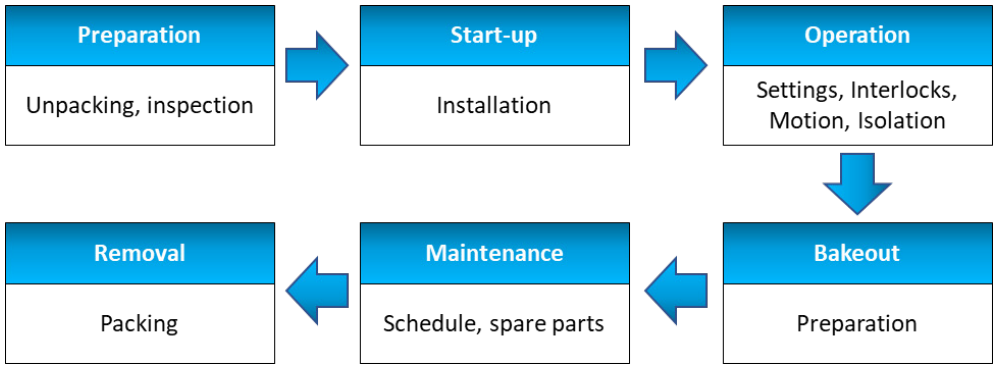


Fig. 3-5 Example beam flux monitor with the ability to be isolated vacuum-wise from the UHV process chamber.

3.4 Operational Flow Chart

The flow chart gives an overview of the processes required for the Beam Flux Monitor. Each process is described in the following chapters of this manual.



4 PREPARATION

4.1 Unpacking

⚠CAUTION

HEAVY WEIGHTS! – Do not lift items greater than 25 kg without the assistance of a suitable lifting assembly. The lifting assembly must only be attached to the designated hooks/support handles on the component. Do not lift the component from the bellows. Ensure there is a secure connection before attempting to lift.

When the Beam Flux Monitor (BFM) is first received, first check the external shipping box for any obvious signs of physical damage. Secondly, inspect the status of any impact or shock sensors attached to the shipping box. If any kind of mishandling of the box during transportation is suspected, please contact DCA immediately.

If the shipping box has been cleared after the initial inspection, the BFM can then be carefully unpacked from the shipping box. The BFM is shipped with a protective tube to shield the in-vacuum parts. This is attached to the mounting flange with bolts and an O-ring for sealing. After removing the packaging material, move the BFM with the protective tube to a clean area (e.g. cleanroom or similar contamination free space). This may require a lifting tool if the weight exceeds 25 kg, refer to section 4.1.1. In the clean area, the protective transfer tube may be removed. Refer to section 4.1.2 on how to handle the component.

After unpacking the BFM from the shipping container and removing the protective tube, inspect for any signs of damage that may have occurred during the shipment. Notify DCA immediately if any damage is found.

If the component will not be mounted to the vacuum system immediately, it should be stored within the protective tube. The shipping container and protective tube should be stored safely so that the component may be shipped back to DCA for repair/maintenance if needed.

NOTICE

Handle the BFM in a clean area with powder free gloves to prevent contamination.

4.1.1 To lift the components safely:

1. Use the designated hooks/handles provided when attaching the lifting assembly.
2. Use the support handles or support frame when attempting to lift the component manually.
3. Move slowly and ensure the component is well supported to prevent it from colliding with nearby objects.
4. Avoid contact with the in-vacuum region unless wearing clean-room compatible gloves.
5. When placing the BFM on a surface, ensure it is stable i.e., it will not freely rotate or topple without support.

4.1.2 To handle the components safely:

1. Handle outer vacuum sections only using UHV cleanroom compatible gloves.
2. Avoid handling in-vacuum parts.

4.1.3 Storing the component

Store the BFM in a dry, clean, well-ventilated area.

If the BFM is contaminated with toxic material, ensure the contaminated parts are sealed to prevent the toxic material from being released into the surrounding area/packing material. Ensure suitable labelling is used to warn of toxic materials being present.

Store the component out of reach of unauthorized persons and do not allow persons unfamiliar with the component or these instructions to operate it.

5 START-UP

5.1 Installation of the Beam Flux Monitor

⚠CAUTION

Installation of the BFM must only be performed by DCA Instruments personnel or a trained professional who has read and understood these instructions.

When mounting the BFM to the UHV process chamber, it is recommended to always use a new silver-coated copper gasket (DN63CF).

The process of how to attach the stepper motor and limit switch assembly is described below. Although the BFM is delivered with these attached, this process is required after bakeout.

5.1.1 Mount the stepper motor

If the stepper motor is not mounted to the assembly, perform the following:

1. Check the MCU is powered off and the motor control cable is not connected.
2. Assemble motor, clutch, motor mounting adapter. Watch the bevel at the motor shaft when installing the clutch. Ensure there is a clearance of approx. 1 mm in total between the plastic and metal parts of the clutch.
3. Tighten the screws at the clutch securely.

5.1.2 Mount the limit switch assembly

1. When mounting the assembly onto the drive, ensure the bevel at the linear-drive shaft remains accessible.
2. Ensure that the outer limit switch is positioned correctly behind the actuator.
3. Tighten the mounting screws on top of the panel.
4. Check travel, limit switch level and actuation.

5.1.3 Connect the cables

NOTICE

Refer to the Inficon VGC083A User manual for detailed installation and operating instructions.

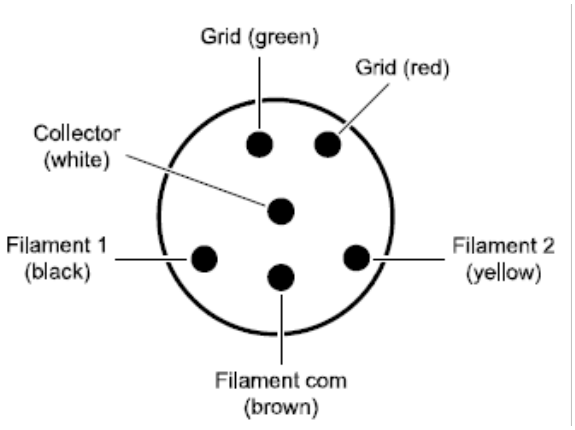


Fig. 5-1 Inficon nude ion gauge cable (BAG050) connections (from Inficon Manual VGC083).

Connect the nude IG cable connectors as indicated in Fig. 5-1.

Plug the IG cable to the VGC as shown in Fig. 5-2.

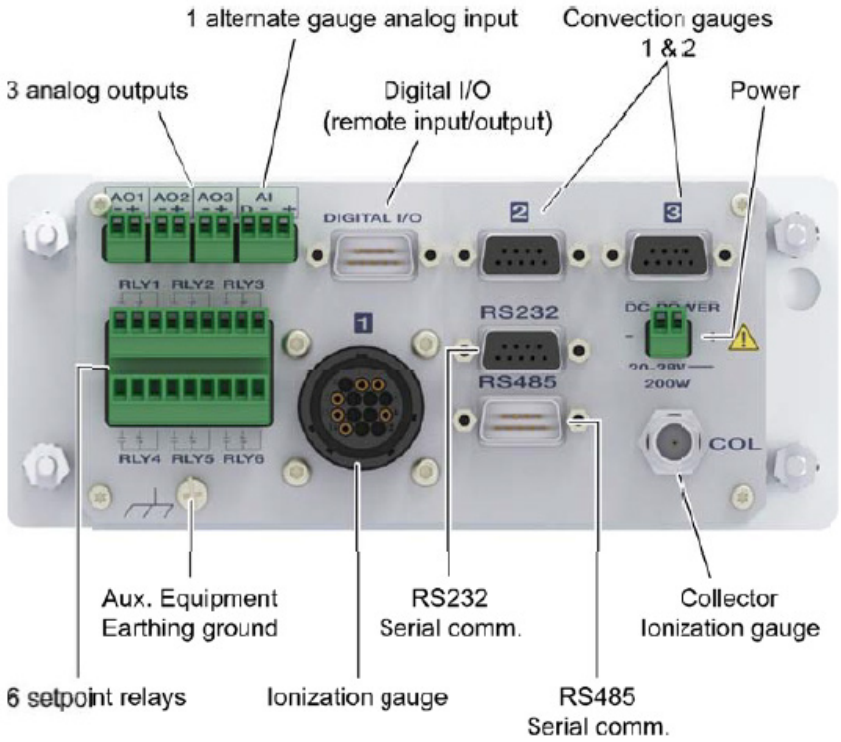


Fig. 5-2 Inficon vacuum gauge controller back panel electrical connections (from Inficon Manual VGC083).

Ensure the MCU-BFM is powered off, then connect the following to the MCU rear panel (Fig. 5-3):

- Plug the motor cable to the motor and (J2) Motor Output,
- Plug the interlock sensor cable (J5),
- I/O cable (J6),
- Mains cable (J1),
- and communication cable (J4) for PC/PCC control.

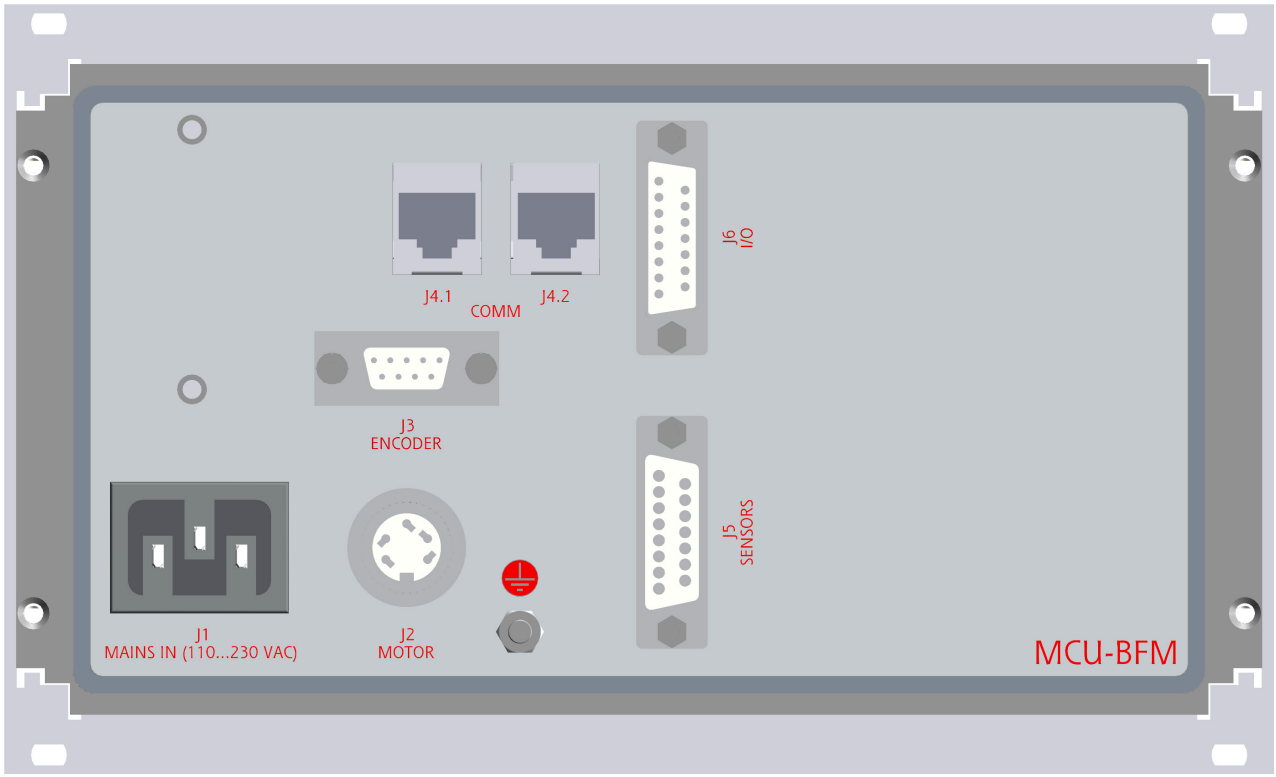


Fig. 5-3 : MCU rear panel: J1: Mains (110…240) VAC, J2: Motor Output, J3: Encoder, J4.1/J4.2: Ethernet, J5: Sensors, J6: I/O.

5.2 Motor Control Unit Set-up

Perform the first check to ensure the motor drive is operating correctly:

1. Power up the MCU with (Measure & Park) kept pressed. The status LED will change from blinking to steady yellow to indicate Emergency Jog mode.
2. Press Park – the drive retracts and should stop at outer limit.
3. Press Measure – the drive extends and should stop at the inner limit.

The measure position of the BFM is set at the DCA factory. However, if required, the measure position can be adjusted using the inner limit switch position. As the motion profiles are position-based, the MCU's position register needs to be calibrated against the sensor positions. To do this, perform the following steps:

1. Cycle power (normal mode), i.e. switch off and on.
2. Park – drive retracts and resets position register at outer limit (i.e. 'homing')
1. Power off with drive at retracted limit.
2. Power up MCU with 'Measure' & 'Park' kept pressed – enters Emergency Jog mode. Status LED: blink to steady yellow.
3. Adjust inner limit to appropriate position (sensor head).
4. Press 'Measure' – drive extends, keep pressed until drive stops at inner limit (let MCU stop at max. travel).
5. Press and hold 'Measure' & 'Park': Status LED goes from blinking to steady yellow. MCU saves configuration and leaves Emergency Jog mode. This may take a few seconds and the Status LED shows blinking yellow/red.

NOTICE

The internal Galil Motion Controller powers up when main and control voltages (via J6) are applied. The stepper motor output and sensor supply voltage remain off as those are controlled by the POWER switch of the MCU.

⚠WARNING

Do not open the MCU with the mains cable connected – hazardous voltages are present inside even with the POWER switch being off.

⚠CAUTION

Never plug/unplug the motor cable with the MCU powered up. Failing to follow this advice may lead to permanent damage of the MCU.

6 OPERATION

6.1 Measuring the beam flux

When measuring the BEP, it is important to note that the order in which the source materials are measured may affect later measurements. It is therefore recommended when performing calibrations that they are performed in the same sequence when possible. Additionally, if measuring low vapour pressure materials, these may alter the filament current permanently as it cannot be easily degassed from the ion gauge filament.

To measure the beam flux:

1. Check that the main shutter is closed.
2. Check that other components that may occupy the same space have been retracted (e.g. the substrate manipulator in manual transfer systems, or quartz crystal microbalance).
3. Fully extend the BFM to the centre of the chamber by pressing the Extend push button.
4. Monitor the background chamber pressure from the Vacuum Gauge Controller (VGC-BFM).
5. Open the source shutter, wait for the pressure to stabilise (this is dependent on the source material) and note the BEP before closing the source shutter.
6. Wait for the VGC-BFM to return to background pressure before repeating the calibration.

6.2 Degassing the Ion Gauge

If the VGC-BFM is showing unstable or higher than usual pressure, it is recommended to degas this ion gauge filament. The degas duration is pre-set by the Inficon VGC, consult the Inficon VGC083A manual for more details.

Before degassing the BFM IG filament, the BFM should be positioned in the measure position. Check that there is no substrate in the manipulator, or that the main shutter is closed to prevent contamination of the substrate.

6.3 Motor Control Unit-BFM - Local Operation

This section describes how to operate the BFM linear motion locally from the MCU-BFM located in the electronic rack. The Status Indicator on the front panel of the MCU-BFM has three possible colours (red, yellow, and green). Table 5 below provides the description of what the Status indicator shows.

Table 5 Description of the status indicator meanings.

	Indicator	Description
Power Switch		To enable/disable the motor output, sensors, HMI of the MCU. Never plug/unplug the motor cable with the Power Switch ON.
LED Power		MCU is powered up and passed self-test. Software running, motor output enabled.
LED Status		**Monitor retracted** (‘Park’ position sensor active)
		**Monitor retracted** (‘Park’ position sensor active) Drive not referenced (See note[1)])

		**Monitor partially retracted** [2)]
		**Monitor extended** (‘Measure’ sensor active)
		**Monitor at intermediate or unknown position**
		**Drive moving**
	Flickering 	Operation not allowed
		Hold input while LED flickers for 2nd Function
	Flashing 	**MCU interlocked/HMI blocked**: …while drive is moving.
		…at intermediate/unknown position.
		…at retracted position (park) [low frequency] …at partially retracted position [high frequency].
		at extended position (measure).
	Blinking in sequences 	**Error** (see error codes)
Retract/Park (Push Button)		• Press briefly to retract the monitor[1)] • Press and hold for 2s to retract the monitor partially (to pre-set position)[2)] • Press to stop an ongoing move.
Extend/Measure (Push Button)		• Press briefly to extend the monitor[1)] • Press and hold for 2s to extend the monitor partially (to pre-set position)[2)] • Press to stop an ongoing move.

1) After start-up or upon reset from error conditions, the drive performs a homing sequence towards that limit switch it was commanded to move to. After the switch has tripped, the drive reverses as much as needed to release it, and then changes direction again until it stops with the switch actuated. Lower than normal speed is applied during the initial move. The internal position register is referenced to the trip point of the switch to allow for absolute positioning.

2) When referenced, the drive can be commanded to move to a pre-set position setpoint (‘partially retracted position’). This functionality is disabled per factory default.

6.3.1 Positioning

When commanded to extend to the ‘measure’ position or retract to the ‘park’ position, the drive applies maximum speed moving towards the respective limit. It decelerates well before reaching the limit switch and finally stops with the switch actuated.

The move can be aborted at any time.

6.3.2 Emergency Jog

In emergency jog mode, the drive can be jogged in either direction by pressing the corresponding Push-Button as desired without prior initialization. The motor stops when the button is released, or the limit switch is activated.

To enter this mode of operation, press and hold both pushbuttons simultaneously upon power-up until the Status LED stops flickering.

6.3.3 Calibration

The motion profile of the motor is calibrated against the drive. Re-calibration may be necessary, for example, if the distance between the limit switches has been altered. For calibration perform the following steps:

- Initialize the drive against the Retract Limit
- Enter Emergency Jog mode
- Jog the drive all way against the Extend Limit, press and hold down the Extend Push Button
- While holding down the Extend Button, press and hold the Retract Button for 2 sec, then release both. The MCU saves parameters to non-volatile memory (takes about 3 sec) and resets.
- Initialize the drive against the Retract Limit.

6.4 Motor Control Unit-BFM – Remote Operation

A handshake protocol is implemented in order to allow remote control of the MCU. DCA Instruments provides a software driver to operate the MCU via its Ethernet interface. Refer to the separate DCA Software Manual.

In addition to simple extension/retraction, software control allows for absolute positioning of the drive and for defining the position set-point for partial retraction.

6.4.1 Automated Transfer System Application

PCC Prioritization (PRIO)

The MCU features a digital input that can be configured to prioritize the communication of a higher-level logics controller (PCC) over that of the device driver running on a PC or a command execution from the HMI. This input being reset will make the MCU refuse motion commands given from the device driver or from the HMI (block).

The blocking mechanism is latching. This means once activated, it remains active after setting the digital input until the ‘unlock’-command is given from the higher-level logics controller or the MCU is power-cycled.

6.5 Interlock

The MCU features a digital input which can be configured to interlock the MCU when reset. The response on the interlock being activated can be:

1. Immediate stop and lock,
2. Immediate stop, auto retract, and lock,
3. Immediate stop and lock, retract by dedicated DI,
4. Immediate stop, partial lock (retraction allowed).

In all cases, an active interlock will stop an ongoing extension move. With configuration 1) and 2) all moving requests (from HMI or communication interface) are refused. With 2), a retraction move will start automatically. With 3) a dedicated digital input can be used to start a retract move at active interlock. With 4) retract commands received through the communication interface or from the HMI or via the dedicated digital input will be executed.

When integrated in systems with automated transfer, the HMI and the PC communication interface can be blocked (PCC communication prioritized).

The interlocked/locked status is indicated by the LED Status flashing.

6.6 Error Indication

In case an error occurs during the move, the MCU will stop with indicating an error code by a blinking sequence of the LED Status. See Section 9 for the list of errors codes for troubleshooting. Error indication will reset with the next command issued.

7 BAKEOUT

Before initiating bakeout, check that the BFM is fully retracted in the park position. The BFM is bakeable to 200°C, however the following parts must be removed before bakeout:

- Stepper motor with red plastic coupling
- Limit switch assembly
- Motor and interlock cables

7.1 Dismounting the motor

To dismount the motor perform the following steps:

1. Switch off the MCU.
2. Disconnect the cables from motor and switch assembly.
3. Remove the reference switch assembly.
4. While supporting the motor, remove the motor mounting screws (as shown in Fig. 7-1).
5. Pull off the motor assembly – the clutch will split.
6. Ensure the red plastic coupling of the clutch comes off along with the motor as it is non-bakeable.

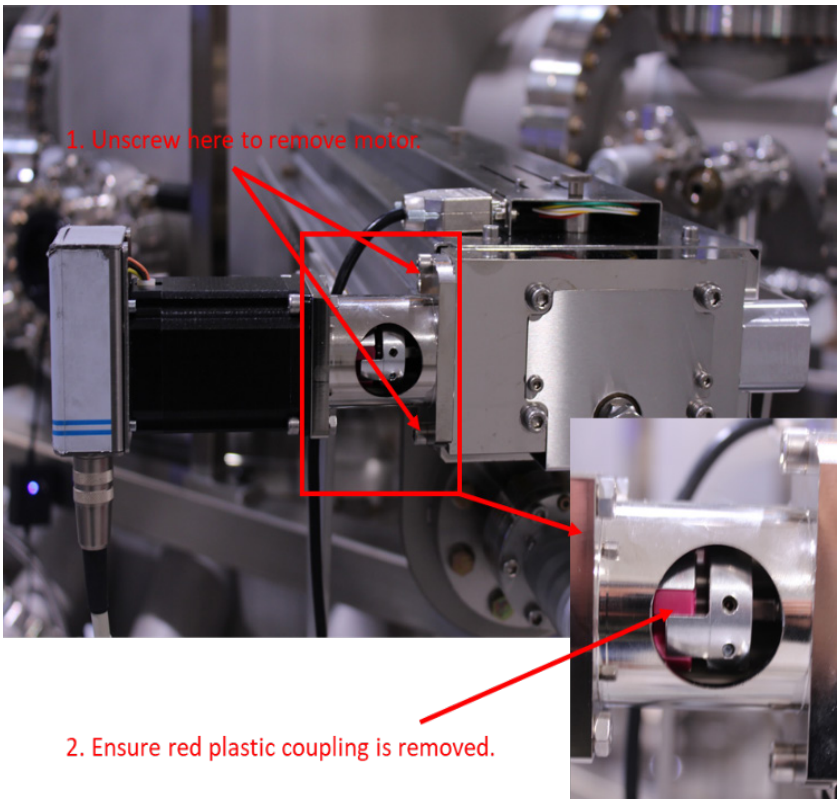


Fig. 7-1 Removal of the stepper motor from the BFM.

7.2 Removing the limit switches

To remove the limit switches, unscrew the two/three screws from the top panel. This should allow the entire assembly to be lifted away (Fig. 7-2).

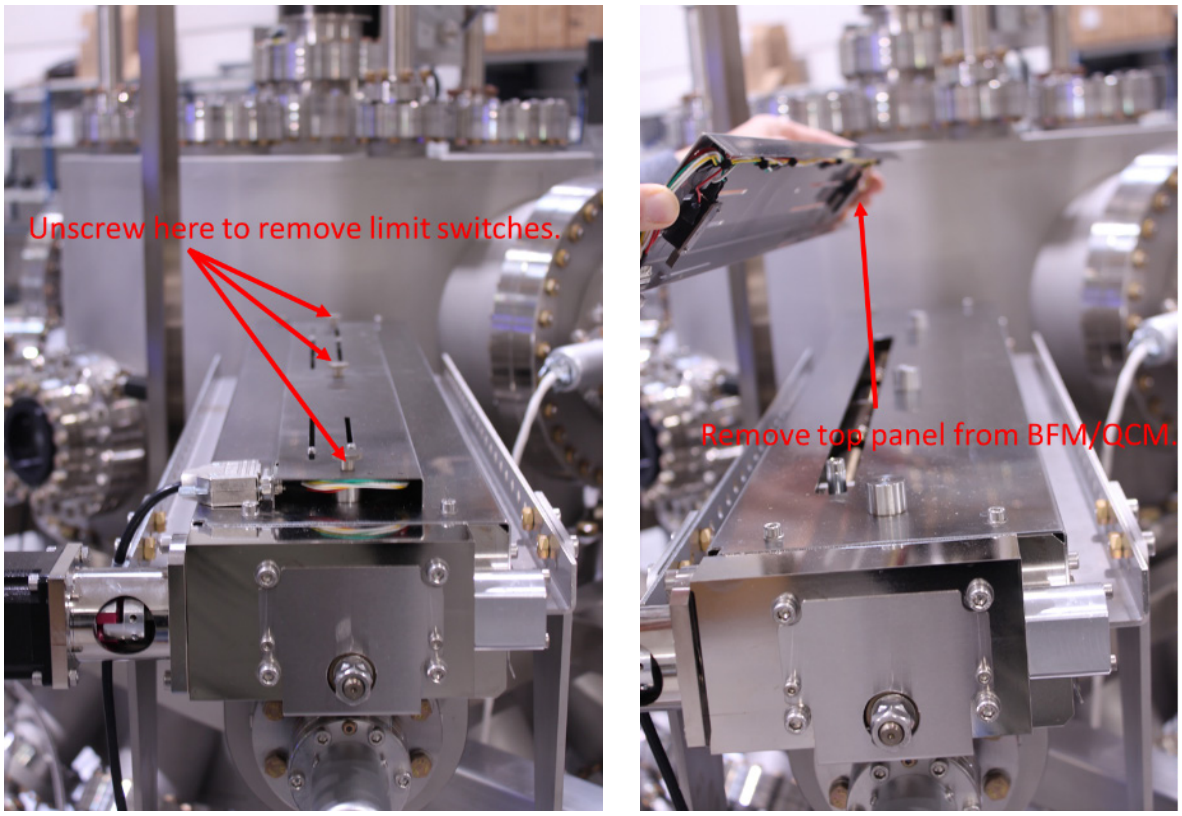


Fig. 7-2 Removal of the limit switches from the BFM.

NOTICE

When replacing the limit switch assembly, ensure that the outer limit switch is positioned correctly behind the actuator.

8 MAINTENANCE

⚠WARNING

The system shall only be maintained by a qualified and trained person.

Following the bakeout procedure, the linear drive should be checked and maintained in terms of sufficient lubrication, adequate functioning, and correct seating of all relevant parts. The state and secure seating of the motor clutch and the switch assembly in particular should be checked regularly.

DCA recommends MoS_2 containing high temperature lubricants (like C100 by FEL-PRO) for the worm gear and Fomblin® oil or similar for ball screw and bearings.

The following parts (Fig. 8-1 and Fig. 8-2) should be lubricated after bake-out:

1. Radial bearings – requires removal of the motor.
2. Worm gear – requires removal of front plate.
3. Radial bearings on opposite ends of linear drive.
4. Ball screw and bearings.
5. Linear bearings (along the shafts).

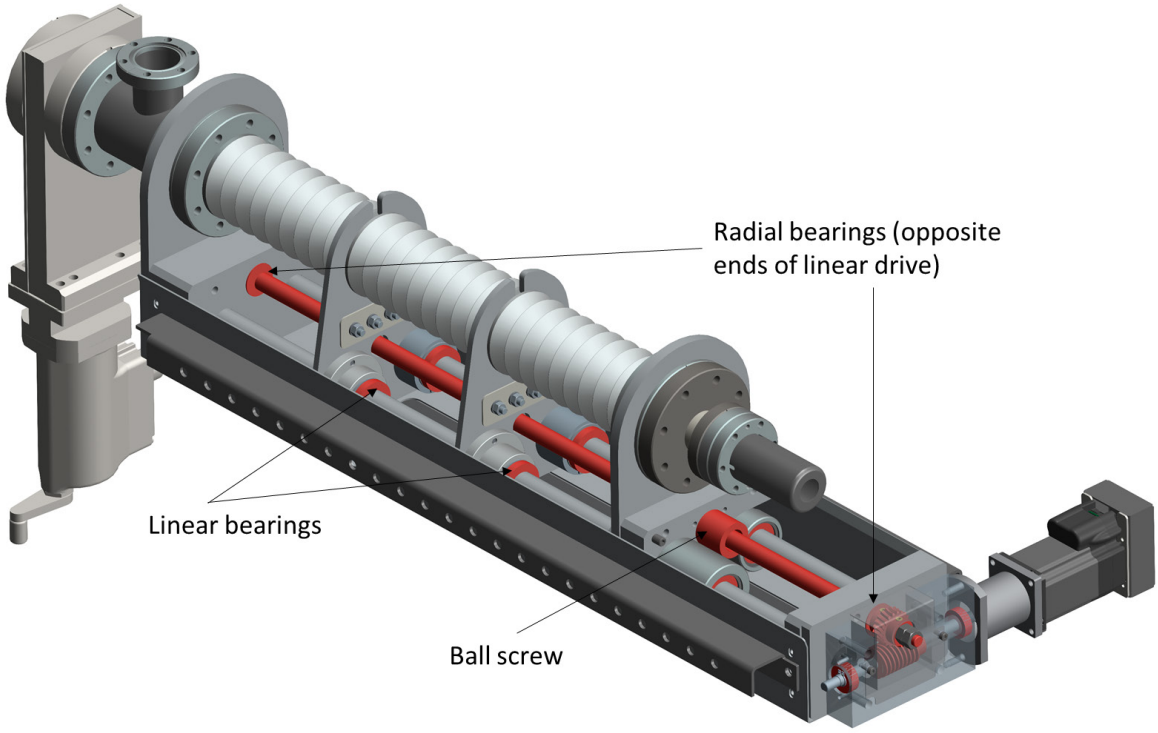


Fig. 8-1 Schematic (1/2) showing the BFM parts (highlighted red) that require lubrication.

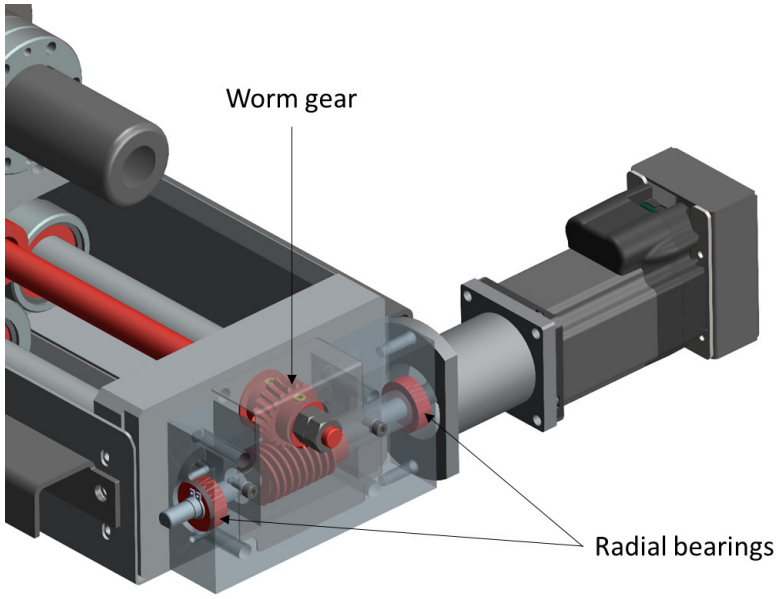


Fig. 8-2 Schematic (2/2) showing the BFM parts (highlighted red) that require lubrication, access requires the dismounting of the stepper motor and the outer plate.

9 TROUBLESHOOTING - ERROR CODE LIST

Code	Meaning	Remarks
2	Positive limit active unexpectedly	Inner limit active at unexpected position. Internal motor step clock and drive position mismatch. This could indicate a limit switch problem or failure, or the switch has been moved after the initialization of the drive. Check inner limit position, wiring, and mechanical integrity. Consult the factory if error persists.
3	Negative limit active unexpectedly	Outer limit active at unexpected position. Internal motor step clock and drive position mismatch. This could indicate a limit switch problem or failure, or the switch has been moved after the initialization of the drive. Check outer limit position, wiring, and mechanical integrity. Consult the factory if error persists.
4	Both limit switches active	Limit switches are wired normally closed. Hence, this error occurs not only if both switches are actuated but also if they are disconnected. Check cabling, switch integrity, and switch wiring.
5	Home sensor not found	The home sensor (here: outer limit switch) is found staying inactive while the drive tries to change its state during the initial retracting move. Check the sensor and its wiring.
6	Can't creep off from Home sensor	The home sensor (here: outer limit switch) is found staying active while the drive tries to free the switch during the creep-off step of the homing sequence. See above.
8	Stall detected	Limit switch gets activated at unexpected position. Internal motor step clock and drive position mismatch. While this could be due to a limit switch problem or failure, it may indicate a mechanical issue with the z-drive (e.g. abnormally high friction, loose clutch). Check the wiring of the limit switches. Check the z-drive for mechanical issues. Consult the factory if the error persists.
10	Positioning error	May be triggered as a result of a hardware failure of the indexer. Consult the factory.
12	Positive position indicator not active	While the drive has been stopped by the inner limit switch, the MCU does not recognize the inner position indicator (that is the normally open contact of the physical switch) being actuated. Check wiring of the inner switch and its mechanical integrity.
13	Negative position indicator not active	While the drive has been stopped by the outer limit switch, the MCU does not recognize the outer position indicator (that is the normally open contact of the physical switch) being actuated. Check wiring of the outer switch and its mechanical integrity.
26	Hardware failure	Consult the factory.
27	Stop code generator not started	Internal logic error. Consult the factory.
29	Internal error (unknown command)	Consult the factor.

30	Internal error (timeout while saving)	Consult the factory

10 WARRANTY

I. DCA Instruments warrants that the Beam Flux Monitor is free from defects in material and workmanship for a period of 12 months from the completed installation date.

II. DCA Instruments shall incur no liability under this warranty if
   a. the allegedly defective goods are not returned prepaid to DCA Instruments within thirty (30) days of the discovery of the alleged defect and in accordance with DCA Instruments' repair procedures; or
   b. DCA Instruments' tests disclose that the alleged defect is not due to defects in material or workmanship.

III. DCA Instruments' liability shall be limited to either repair or replacement of the defective goods, at DCA Instruments' option.

IV. DCA Instruments makes no express or implied warranties regarding the quality, merchantability, or fitness for a particular purpose beyond those that appear in the applicable DCA Instruments user's documentation. DCA Instruments shall not be responsible for consequential, incidental, or punitive damage, including, but not limited to, loss of profits or damages to business or business relations. This warranty is in lieu of all other warranties.

APPENDIX I – FACTORY SETTINGS

Factory Settings

VCG083A Emission Current : 10 mA

Interlock: Disabled

Partial Retract: Disabled

APPENDIX II - SUPPLIED ACCESSORIES, CONSUMABLES, AND SPARE PARTS

For ordering accessories, consumables and/or spare parts, please contact:

DCA Instruments Oy
Aerotie 6, Turku 20360 Finland
sales@dca.fi
+358 2 238 2500

Supplied accessories/components

Manufacturer	Item Description	Model
DCA Instruments	Beam Flux Monitor (BFM)	BFM-LXXX-Ta/C/GV-M/H
Inficon	Vacuum Gauge Controller	VGC083A
If applicable:		
VAT	Manual DN63CF Gate Valve	

Spare/replacement parts

DCA #	Item	Description
GASKETS		
10081	GASKET DN63CF	COPPER SILVERED
FILAMENTS		
12260	GAUGE ION NUDE FILAMENT	TWIN TUNGSTEN
LINEAR BELLOWS ASSEMBLY		
	300mm (BFM/QCM) P/M-600	Standard
	400mm (BFM/QCM) P/M-800	Standard
	500mm (BFM/QCM) P/M-1000	Standard
GV BONNET SEAL		
12835	VAT SEAL BONNET RECT 63215-01	LARGE FOR GV 10836-CE (DN63)