DCA INSTRUMENTS

User Manual

UHV Motorised Throttle Valve

Including MCU-TV (v. GAL 1.03.13)

These are the original English instructions

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Component Modifications

Year	Type	Modifications

Document Revisions

Date	Version Number	Document Changes
14-06-2019	1.0	Initial draft
24-06-2022	1.01	Updated – minor text revisions

Table of Contents

1 PREFACE

1.1 Purpose of These Instructions

The purpose of this document is to make you familiar with the features and functions of the Throttle Valve Drive that accompanies the UHV Throttle Valve, so that you can safely operate it as an end-user. This manual is applicable to the following models:

- Butterfly throttle valve (single blade)
- Precision throttle valve (multiblade)

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 UHV 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.

1.3 Explanation of Safety Warnings

⚠WARNING

Warning indicates a hazard with a medium level of risk which, if not avoided, would result in significant negative effect only in the longer term, requires significant effort to reverse by specialist intervention, irreversible without this intervention and effort.

⚠CAUTION

Caution indicates a hazard with a low level of risk which, if not avoided, would result in a negative effect, usually completely reversible within the short term without specialist intervention.

NOTICE

Indicates information considered important, but not hazard-related.

1.4 Obtaining Documentation and Information

1.4.1 Additional Resources

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

- 01_XXXX_UHV Deposition System User manual (if applicable)
- 02_UHV System Bakeout User Guide (if applicable)

1.4.2 Technical Support and Service

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

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

The manufacturer cannot be held liable for damage resulting from errors, unintended or unprofessional use of the Throttle Valve Drive.

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 Repair and modification Safety information

⚠CAUTION

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

2.1.2 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.

2.2 Graphical Symbols

2.2.1 Explanation of safety information on the system

Table 1 below provides safety information relevant to the Throttle Valve Drive. 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
	**ELECTRICITY** May cause electric shock or burn. Trained personnel only.	MCU

3 INTRODUCTION

3.1 Product Description

The **UHV Throttle Valve** is used to regulate the downstream pressure of the UHV process chamber using control software. The throttle valve drive includes a stepper motor with integrated differential position encoder and motor control unit for precise and reliable position and stall detection.

⚠CAUTION

Only use the original accessories supplied with the product.

The motor control unit (MCU) allows the operation of the valve in either of the following ways:

1. Using the Human Machine Interface (HMI)
   The valve can be virtually continuously adjusted by jogging the motor using the jog-toggle at the controller or handheld control. The MCU features two push buttons for fast positioning to two independently and freely define-able position set-points.

2. Using the Computer Interface (Ethernet), applicable equally with 1)
   The valve can be adjusted to any position set-point given via a simple communication protocol.

3. Using the analog control interface, applicable alternatively to 1) and 2)
   The valve can be adjusted according to an analog control signal ranging 0…+5 VDC.

3.1.1 Throttle Valve Drive

The motorised UHV Throttle Valve is supplied with the following accessories:

- Stepper motor with planetary gear and differential position encoder
- Mounting for the stepper motor
- Motor control unit (MCU-TV) with HMI (human-machine interface) and computer interface, digital interface, analog control interface
- Handheld control (may be shared with other MCUs) and cable
- Mains power cable – connects the MCU to mains power supply
- Stepper motor cable – connects the MCU to stepper motor
- Encoder/Sensor cable – Connects MCU to encoder
- Communication cable – connects MCU to PC

3.2 Standard Features

The MCU-TV powers and controls the stepper motor of the DCA UHV Throttle Valve drive. It can be operated locally (HMI) or remotely (PC or higher-level logics controller (PCC)).

The MCU-TV has the following features:

- Supports the DCA throttle valve drive with stepper motor and differential encoder
- User interface (HMI) for position-based valve control
  - Jog toggle for position adjustment
  - Two programmable position set-points
  - Status indication, position read-out
  - Optional handheld remote control
- Digital input to freeze/force the valve open
- Configurable: speed, backlash compensation, force input response
- Input (0…5V) for analog position programming
- Ethernet interface for remote control

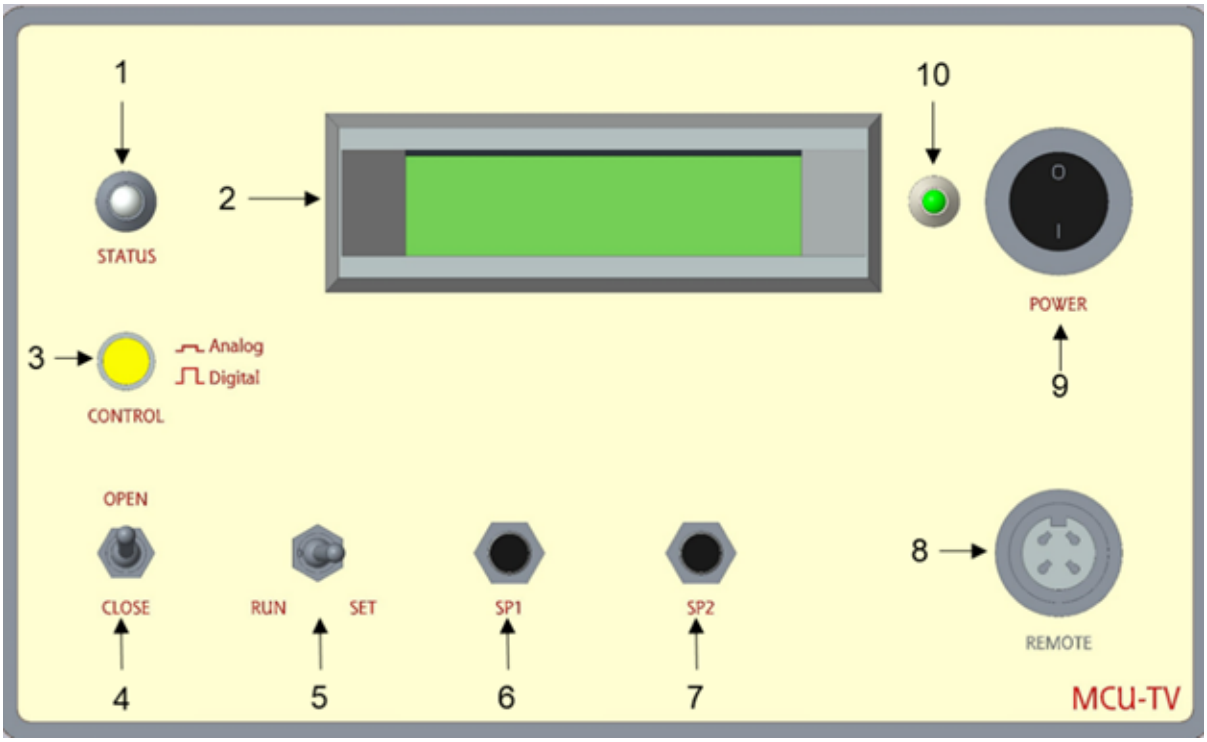


Figure 1: MCU-TV: 1. Status LED, 2. Display Module, 3. Control mode selector Analog/Digital, 4. Jog Open/Close Toggle, 5. Mode Toggle Run/Set, 6. . Set-point 1 push button, 7. Set-point 2 push button, 8. Connection port for handheld control, 9. Motor power switch, 10. Power LED.

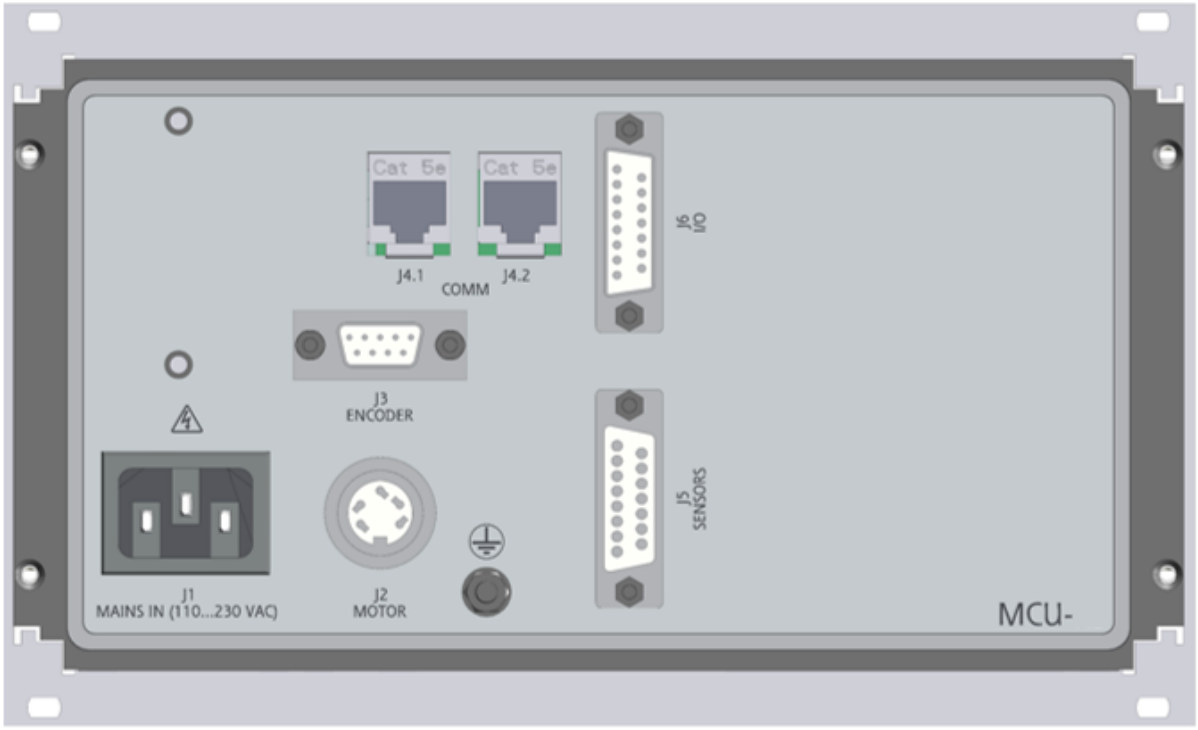


Figure 2: MCU rear panel: J1: Mains (110…240) VAC, J2: Motor Output, J3: Encoder, J4. Ethernet, J5: Sensors (n/a), J6: I/O.

Figure 3: Combined MCU-RS/Z handheld control with toggle switch for jogging the rotary drive +/- or for changing the rotation speeds and a push button to start/stop the continuous rotation (top). Shared with other MCUs.

4 INSTALLATION

⚠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.

⚠WARNING

Do not open the MCU with the mains cable connected – hazardous voltages are present inside even when the power switch is off.

4.1 Mounting the Motor

1. Switch off power to the MCU.
2. Disconnect the motor cable.
3. Assemble motor, planetary gear, clutch (motor side). Watch the bevel at the motor shaft. The valve comes with a mounting adapter and the valve sided part of the clutch readily mounted and pre-adjusted.
4. Tighten the screws securely.
5. When mounting the assembly onto the drive, make sure there is at least 1 mm total clearance between the plastic and the metal parts of the clutch.
6. Attach the reference switch assembly.

   ⚠CAUTION

   Do not modify the position of the actuator – it is pre-adjusted. If, for some reason, the actuator or its position has been altered, consult the factory prior to take the drive into operation.

7. Connect the motor and encoder cables.
8. Power up the MCU.
9. The MCU starts a self-test and initializes itself.

4.2 Dismounting the Motor

The motor is non-bakeable and must be dismounted from the drive prior to baking the system.

1. Switch off the MCU.
2. Disconnect the cables from the motor and encoder.
3. Remove the reference switch assembly.
4. Remove the mounting screws and pull off the motor-gear package. Ensure the plastic part of the clutch comes off along with it as it is not bakeable.

4.3 Set-up

Install the stepper motor differential encoder and home switch assembly.

For the motor control unit with the power switch set OFF, connect the following cables to the rear MCU panel:

- motor cable (J2),
- encoder/sensor cable (J3)
- sensor cable (J5),
- I/O cable (J6),
- mains power cable (J1),
- and communication cable (J4) for PC control.

NOTICE

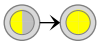
The internal Galil Motion Controller powers up when main and control voltages (via J6) are applied. The stepper motor output and sensor supply voltage remain off as those are controlled by the Power switch of the MCU.

5 LOCAL OPERATION

5.1 Start-up

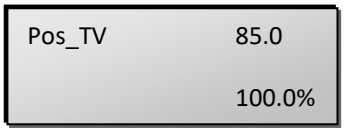
Action	Status indicator	Description	Display
Switch on 'Power'		MCU starts up and runs self-test.	MCU-TV v. 01.03 MCU displays device name and software version during start-up.

5.2 Initialization

Action	Status indicator	Description	Display
MCU in RUN Mode.		MCU needs initialization.	Pos_TV ******* Position reading is invalid.
The MCU starts initialization automatically within 3 seconds after startup. Otherwise operate and hold JOG (CLOSE), release when LED STAT is steady on to initiate initialization when that is required.		MCU performs Homing sequence. Valve is driven until home switch is triggered and then moved back to the starting position.	Pos_TV -15.8 R R indicates the position read out from the encoder is relative to initial position
		Position reading switches from relative (R) to absolute display	Pos_TV 42.0 051.0% Valve at initial position after homing.

5.3 Positioning

5.3.1 Digital Control Mode

Action	Status indicator	Description	Display
Operate JOG to adjust the valve position.		LED STAT lights up: Yellow - driver is in motion, Red - valve in fully closed position (0) Green - valve in fully open position (according to its set allowed travel). The applied speed is adjustable: see Configuration >jgspd	 Position reading (valve blade tilt angle): upper line in deg, second line is the percentage of allowed travel.
Press SP1 (SP2) to position the valve at position set-point #1 (#2). Move can be aborted by operating JOG, SP1, or SP2.		LED STAT lights up yellow while the drive is moving. The applied speed is adjustable: see Configuration >mvspd For how to change the position set-point setting: see Configuration>SP1/SP2	
Operate and hold JOG (CLOSE) AND press SP1 to fully close the valve fast (mvspd applied). Move can be aborted by operating JOG, SP1, or SP2		LED STAT lights up red when Close Position is reached.	
Operate and hold JOG (OPEN) AND press SP2 to fully open the valve fast (mvspd applied). Move can be aborted by operating JOG, SP1, or SP2		LED STAT lights up green when Open Position (according to allowed travel) is reached. The allowed travel is adjustable: see Configuration >Trvl.	

5.3.2 Analog Control Mode

Action	Status indicator	Description	Display
With the Control Mode Selector set to Analog (depressed) all other controls at the HMI are disabled. The Control Mode Selector lights up when Analog position programming is activated.		LED STAT lights up: Yellow - drive is moving, Red - valve in fully closed position (0), Green - valve in fully open position (according to its allowed travel).	 Lower left line is the spanned relative control signal (ACS). Refer to the Appendices for variables. ACS = (AISc*AIN+AISh)/5V. (AIN being the control voltage between 0 and +5V.) For how to adjust AISc and AISh, see Configuration > AISc/AISh.

See Appendix III **Error! Reference source not found.** for wiring information for the analog input (J6).

5.4 Configuration

5.4.1 Start-up

Action	Status indicator	Description	Display
MCU in Digital control mode, mode toggle in SET. Operate JOG to scroll through configuration menus. Use SP1/SP2 to select the variable to be changed.		In case of the force/freeze input getting active, the MCU will leave the configuration mode.	- - Conf TV - - <jgsp> <mvspd> See Appendix for the list of variables.
Variable selected. Use JOG to increase/decrease parameter. Press SP1 to discard changes, SP2 to apply and save changes.	 	Hint: By holding SP1 or SP2 for 3 seconds when selecting SP1, SP2 or Trvl for change, the current position reading is copied into the configuration screen. Parameters can be changed within predefined limits. Changes will be internally evaluated before saving. Parameters are saved to non-volatile memory. The LED STAT is blinking red/yellow while MCU is busy with that.	SP1: 50.5* BCK SET * indicates the parameter has been modified.

5.5 Force Digital Input

Action	Status indicator	Description	Display
When the FORCE digital input is activated, the drive is forced open or locked at its current position depending on the input response setting (see configuration>AMvE) but independently from which control mode is selected or from whether or not the MCU is set for configuration.	   	LED STAT flashes: Red/Yellow - while drive is moving. Off/Red - valve is locked at its closed position (0). Red/Off - drive is locked at arbitrary position, Red/Green – drive locked fully open. If in analog control mode, the analog mode indicator is also flashing while the input is active.	Pos_TV 85.0 (FrcO) Force Input active.

See Appendix III for wiring information for the digital force input at J6.

5.6 Remote Control

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 for detailed instructions.

5.7 Error Indication

Action	Status indicator	Description	Display
In case an internal error occurs, the MCU stops and displays an error code.		The LED STAT blinks in sequences corresponding to the error code. A new motion request resets the MCU.	MCU-TV Error: 8 Refer to the Appendix for a list of error codes for troubleshooting.

6 BAKEOUT

⚠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.

Before bakeout, the following items must be removed from the throttle valve:

- Differential encoder (four screws - #1 shown green in Figure 4)
- Stepper motor (four screws - #2 shown green in Figure 4)
- Red coupling plastic

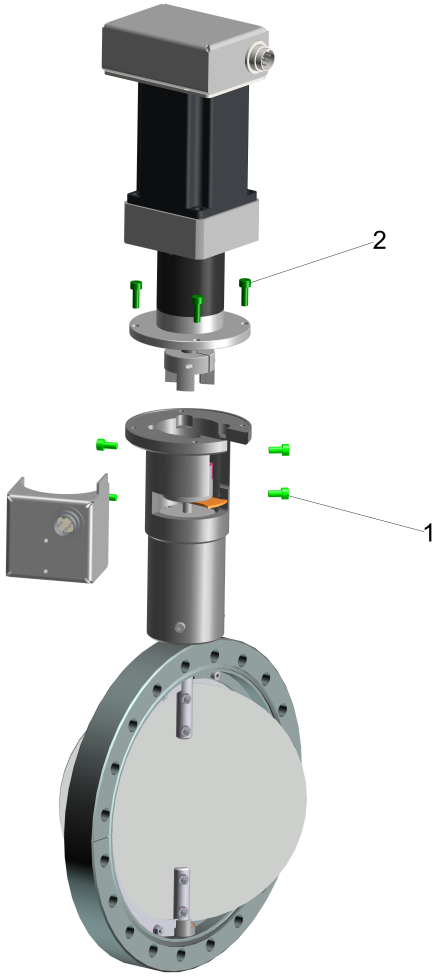


Figure 4 Schematic of the UHV throttle valve (single blade), showing the parts that must be removed prior to bakeout.

APPENDIX I – MCU-TV ERROR CODES

Code	Meaning	Remarks
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	Internal motor step clock and encoder counter mismatch. While this could be due to an encoder wiring problem or encoder failure, it may indicate a mechanical problem of the valve or the drive. Check the wiring of the encoder. Check the valve and the drive for mechanical issues. Consult DCA if the error persists.
10	Positioning error	May be triggered as a result of a hardware failure of the indexer. Consult the factory.
26	Hardware failure	Consult the factory.
27	Stop code generator not started	Internal logic error. Consult the factory.

APPENDIX II – MCU-TV VARIABLES

Variable	Meaning	Min	Max	Default
JgSpd	Speed applied for jog move (deg/s)	0.05	80.0	.5
MvSpd	Speed applied for positioning move (deg/s)	0.05	80.0	40.0
SP1	Position setpoint #1 (deg)	0	85.0	40.0
SP2	Position setpoint #2 (deg)	0	85.0	60.0
Trvl	Allowed travel (deg) Distance between fully closed position and open position.	26.0	85.0	85.0
Bklsh	Overshoot for backlash compensation (deg) If greater zero, the drive will overshoot a closing move by this distance before it returns to the target position. Doing so, gear backlash is compensated as any (final) position is always approached from the same side. No Backlash compensation for target position < Bklsh.	0	5.0	0
AMvE	Force input response (auto move enable). If auto move is enabled (AMvE=1), the valve will be opened in case the force input gets activated (electric low). Otherwise, the driver will stay at current position. In either case, the MCU is locked until the input is reset, all motion commands are refused.	0	1	1
Reset	Reset to factory defaults. If set 1, the MCU will reset all parameters to their factory defaults.	0	1	0
AISc	Factor to span the analog input AIN (0…5V) In analog control mode, the target for positioning is calculated according to: Trvl * (AISc* AIN + AISh) / 5V	0.5	2.0	1.0
AISh	Constant to shift the analog input AIN.	-2.0	2.0	0

APPENDIX III – PINOUT J6

Pinout J6 - Mating connector: Sub-D 15 Female

Table 2 J6 I/O interface pin-out for MCU-TV.

Pin	Signal	Remark
1	MCU Power On	IN: Powers MCU's control circuit. 24 VDC, >100 mA must be supplied to power up the MCU.
2	Motor Enable	IN: Enables motor output. To be used for external EMO circuit. 24 VDC must be applied to enable the motor output.
3-6	n/c	
7	Analog In	Analog input (12-bit resolution) Range: 0…5 V Impedance: 100 KOHM Connect 7 and 8 to an external voltage source for analog programming.
8	Analog Return (AGND)	
9	Reserved	Do not connect
10	Not MCU Force	IN: To be used for external logics circuit. 24 VDC must be applied to activate the input. (input open or drawn to 0 will make the MCU act according to the Force-Input response setting (see AMvE parameter)
11	Jog+ (RC)	IN: copy of the remote-control inputs at the front. (24VDC, Active high)
12	Jog- (RC)	
13	Analog Ready	OUT: sourcing 24VDC, 20 mA if analog control mode is active.
14	Reserved	Do not connect
15	DGND	Reference for digital inputs.