



OPTO ENGINEERING



INSTRUCTIONS MANUAL

# MTDV3CH-00A1

Bipolar stepper motor controller,  
3 axis, RS485/USB, Modbus RTU/USB,  
max output 1.5 A



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## 1. Disclaimer

Always deploy and store Opto Engineering products in the prescribed conditions in order to ensure proper functioning: failing to comply with the following conditions may shorten the product lifetime and/or result in malfunctioning, performance degradation or failure.

Ensure that incorrect functioning of this equipment cannot cause any dangerous situation or significant financial loss to occur. It is essential that the user ensures that the operation of the controller is suitable for their application. All trademarks mentioned herein belong to their respective owners.

Except as prohibited by law:

- All hardware, software and documentation is provided on an “as is” basis.
- Opto Engineering accepts no liability for consequential loss, of any kind.

Upon receiving your Opto Engineering product, visually examine the product for any damage during shipping. If the product is damaged upon receipt, please notify Opto Engineering immediately.

## 2. Safety notes

Please read the following notes before using this controller. Contact your distributor or dealer for any doubts or further advice.

This device must not be used in an application where its failure could cause a hazard to human health or damage to other equipment. Keep in mind that if the device is used in a manner not foreseen by the manufacturer, the protection provided by its circuits and by its enclosure may be impaired.

This device has limited protection against transients caused by inductive loads.

If necessary, use external protection devices like fast diodes or, better, specific transient protectors.

The controller outputs pulses with high energy content. The user must be careful to connect the outputs correctly and to protect the output wiring and load from unintentional short-circuits. When the device is switched off, there is still energy stored in the internal capacitors for at least 5 minutes.

Never exceed the power ratings stated in the manual.

## 3. General description

MTDV3CH-00A1 is a three-axis motion controller for bipolar stepper motors with supply voltage up to 24 VDC and winding current of 500 mA rms each. It provides a simple ready-to-use solution for driving a variety of Opto Engineering motorized lenses, manually or using a PC or PLC.

Communication with MTDV3CH-00A1 is achieved via a RS-485 or from a USB port.

When the controller is connected to a PC via USB, a specific configuration software (MTSW) can be used to control MTDV3CH-00A1 and communicate with the PC.

The configuration software is available for download at [www.opto-engineering.com](http://www.opto-engineering.com). Users can also use the DLL functions to develop their own application software. MTWS configuration software runs on Windows OS only.

Up to 32 controllers can be networked through the internal RS-485 communication link. User can read and/or write MODBUS registers to control the device.

All the necessary software, including lens configuration files, are available at [www.opto-engineering.com](http://www.opto-engineering.com)

### 3.1. Content of delivery

- MTDV3CH-00A1
- USB cable

### 3.2. Specifications

Part number		MTDV3CH-00A1
<b>Electrical specifications</b>		
User interface type	Manual:	push buttons, slider
	PC/PLC:	RS485 <b>1</b> / USB <b>2</b>
Supply voltage	(V, DC)	24
Connector type		DB15F (D-sub type A 15 sockets)
LED indication		power, motion, motors end stop, fault (overtemperature, overcurrent)
Non-volatile memory		yes
Automatic position saving		yes <b>3</b>
Protections		ESD protection, Output overcurrent protection, wrong power polarity protection, Voltage overload protection, External power supply current limitation, Thermal shutdown protection
Software		Windows demo software, dll
Motion modes	Manual:	CW/CCW constant speed move
	PC/PLC:	move relative, move absolute move to F-number, move to magnification, move to working distance WD <b>4</b>
Control type		open loop
<b>Motor parameters</b>		
Number of motors		up to 3
Supported motor type		Bipolar stepper
Winding current	(A)	0.5 fixed
Max speed	steps/s	1000
<b>Mechanical specifications</b>		
Length	(mm)	185
Height	(mm)	64
Width	(mm)	85
Mounting		DIN rail
<b>Compatibility <b>5</b></b>		
Lenses		ENMT series, MZMT series
Cable <b>6</b>		CBMT001 (circular standard DIN 13Pos Female to DB15M connector cable, 2 m)
Accessories		ADPT001 (adapter RS485-USB + cable with 3 elements)

**1** With Modbus RTU slave protocol.

**2** Mini-B plug.

**3** Automatic position saving can be disabled.

**4** Download configuration file from Opto Engineering to enable these features.

**5** All compatible products must be ordered separately

**6** Cable is required to connect MTDV3CH-00A1 controller to ENMT/MZMT series.

Table 1: table of specification

## 4. Mechanical fixing

The controller must be mounted on a DIN rail.

The controller has an IP rating of 20 and should be installed so that moisture and dirt cannot enter it.

An enclosure may also be required for other parts of the system such as power supplies. That enclosure would provide both mechanical and environmental protection in industrial applications.

## 5. Connections

Refer to section 3.2 “Specifications” section for information on connection ratings.

→ Outputs

CBMT001 cable (to be purchased separately) is required to connect MTDV3CH-00A1 with optics motorized by up to three stepper motors. The cable must be connected to the DB15F connector (D-sub type A 15 sockets) positioned on one side of the controller (refer to figure 1).

→ Inputs

Power supply and RS485 connections are made via screw terminals. USB connection (mini-B plug type) is made via the included USB cable. Power supply, RS485 and USB ports are positioned on the other side of the controller (refer to figure 1).

Carefully check all the connections before switching on the equipment.

### 5.1. Layout of connectors

The following diagram depicts all the controller connections. Connectors are identified by their designators (P1, P2, P3 and P4)

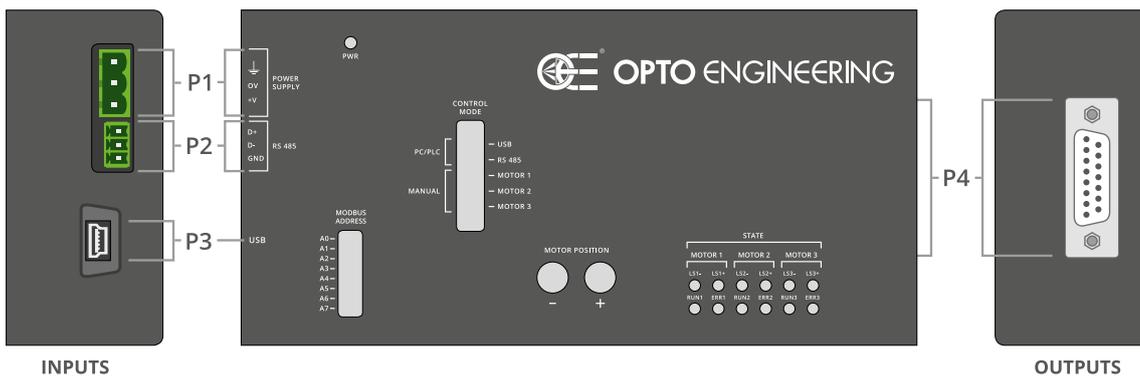


Figure 1: connectors layout

P1 and P2 connectors are standard Phoenix Contact parts. For both P1 and P2 connectors, mating plugs are included in the controller package; for convenience refer to the following table where the relevant manufacturer part numbers are listed.

Connector designator	Manufacturer	Mating plug part number
P1	Phoenix Contact	1757022
P2	Phoenix Contact	1803581

Table 2: connector mating plugs

P3 is a mini-B USB socket.

P4 is a DA-15 (D-sub 15) socket.

### 5.2. Power supply

A regulated 24V DC±10% 3A supply is recommended. The external power supply must be capable of supplying at least the average output power for all active motor channels.

Choose a power supply unit that limits its output current by design or use protecting fuses. The fuses should be appropriately de-rated if mounted in an enclosure, as the inside temperature can be higher than the ambient temperature.

Ensure that the wire gauge used for these power connections is appropriate for the current to be drawn.

The power supply is connected on the +V (positive) and 0V (negative) screw terminals of connector P1. Connector pinout, ordered from left to right, is listed in the following table.

Number	Name	Description
1	PE	Protective Earth
2	0V	Power supply. Negative terminal
3	24V	Power supply. Positive terminal

Table 3: connector P1 pinout

Ensure that the polarity of +V and 0V is correct.

### 5.3. Power outputs

The output connector P4 is a D-subminiature 15 wires socket (type DA-15). It is used to connect the MTDV3CH-00A1 to the lens motors using CBMT001 cable (to be purchased separately).

Each stepper motor has two windings (named A and B). A current of 500 mA flows into each of the motor windings while the motor is moving.

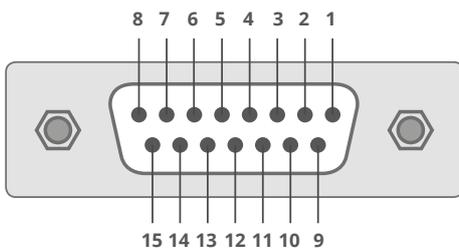


Figure 2: connector P4 pinout

The pinout of the P4 DA-15 socket is listed below:

Pin number	Description
1	Motor 3 winding A
2	Motor 3 winding A\
3	Motor 3 winding B
4	Motor 3 winding B\
5	Motor 2 winding A
6	Motor 2 winding A\
7	Motor 2 winding B
8	Motor 2 winding B\
9	Motor 1 winding A
10	Motor 1 winding A\
11	Motor 1 winding B
12	Motor 1 winding B\
13	Not connected
14	Not connected
15	Not connected

Table 4: connector P4 pinout

## 5.4. Serial port

The MTDV3CH-00A1 can communicate with a PC or a PLC using two different serial ports: USB or RS485. USB and RS485 cannot be used simultaneously: only one serial communication port at a time can be used select RS485 or USB by moving the control mode slider (see Fig. 6).

### 5.4.1. USB

P3 connector is a mini-B USB socket. Use a standard USB cable shorter than 3 meters for a reliable communication in a high electromagnetic noise environment.

### 5.4.2. RS485

The serial port is connected to the D+, D- and GND screw terminals of connector P2.

Connector pinout, ordered from left to right, is listed in the following table.

Number	Name	Description
1	D+	RS485 data signal. Positive terminal
2	D-	RS485 data signal. Negative terminal
3	GND	RS485 reference ground

Table 5: connector P2 pinout

Please note that GND is not the same as 0V of connector P1.

## 6. Getting started

Carefully read the sections on Safety Notes and check whether the product fits your needs. Mount the controller using a DIN rail as described in section Mechanical fixing.

Connect the controller as described in section Connections. CBMT001 (to be purchased separately) must be used to connect MTDV3CH-00A1 with Opto Engineering motorized lenses.

When the controller powers up, the LED indicator “PWR” will turn on (stable green color).



Figure 3: PWR LED indicator

When MTDV3CH-00A1 is connected to a 24V power supply, it automatically performs the following procedure:

- PHASE 1: starting procedure
  - LS1+ LED turns on (orange color)
  - LS2+ LED turns on (orange color)
  - LS3+ LED turns on (orange color)
  - LS1+, LS2+ and LS3+ turn off

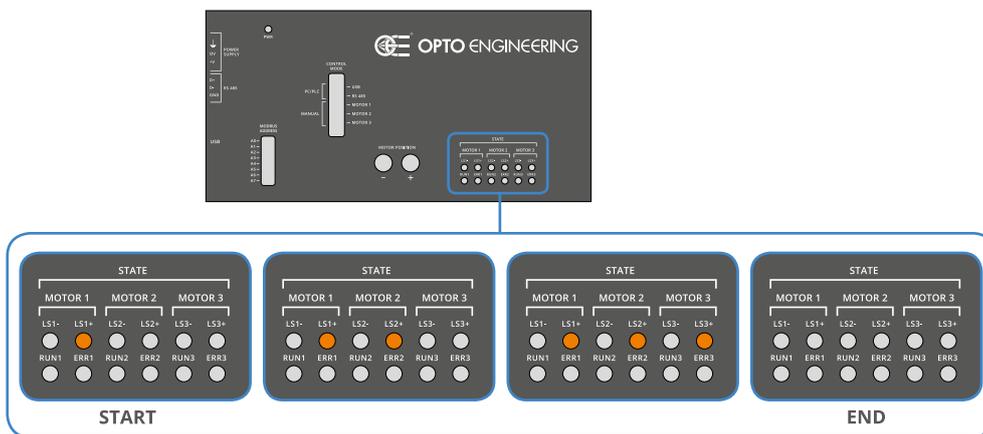


Figure 4: Starting procedure

- PHASE 2: homing procedure
  - RUN1, RUN2 and RUN3 simultaneously turn on (green color)
  - RUN1, RUN2, RUN3 LEDs turn off (non simultaneously)

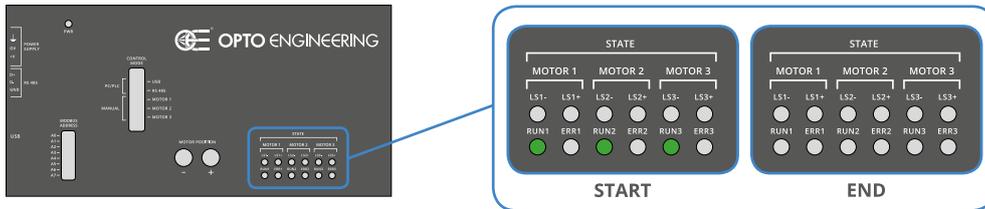


Figure 5: Homing procedure

Once PHASE 1 and PHASE 2 are completed, user may deploy the controller.

To control MTDV3CH-00A1 using MTSW configuration software (available at [www.opto-engineering.com](http://www.opto-engineering.com)):

- move the slider to USB position (see Fig. 6).
- go to section 9 “Demo configuration software” for detailed instructions about MTSW usage.

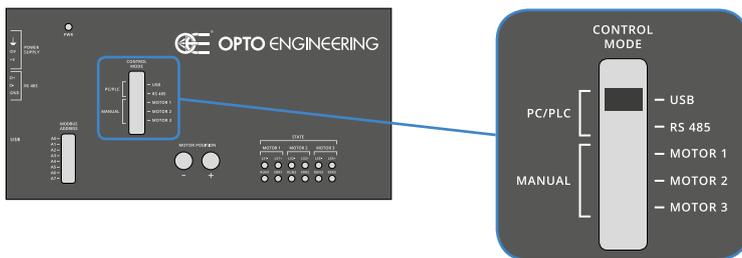


Figure 6: Control mode slider

### 6.1. Configuration files

In order to take full advantage from MTDV3CH-00A1 features, user should download from [www.opto-engineering.com](http://www.opto-engineering.com) the lens configuration file (XML format). The specific lens configuration can be loaded into the non-volatile memory of MTDV3CH-00A1.

Read section 9.8 “Load lens XML file” for detailed information about usage of XML configuration files.

## 7. User interface

User can control MTDV3CH-00A1 in two different ways: manually or by means of a PC/PLC.

### 7.1. Manual

The manual control is achieved by positioning the slider in either Motor1, Motor2 or Motor3 positions (see Fig. 7).

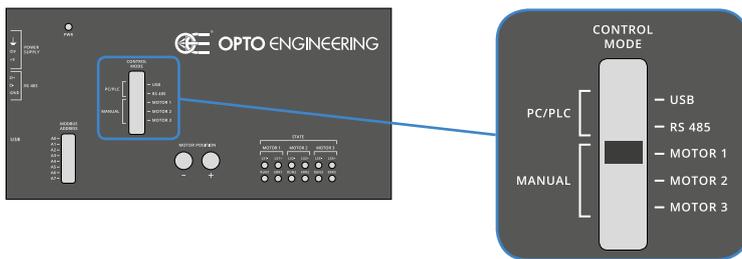


Figure 7: Control mode slider set to manually control MOTOR 1

#### → Set motor position

When the slider is in one of these positions user can move the corresponding motor using the push buttons. “+” Button increases the position of the corresponding motor while “-” Button decreases the position of the corresponding motor (see Fig. 8). If the minimum position or the maximum position is reached, LED indicators named  $LSn-$   $LSn+$  turn on (see Section 8 “Visual indicators”) and the motion stops. Once the motor reaches the minimum or maximum position, user can use the other button to move the motor to the opposite direction.

#### → Homing

Homing is the process of positioning a motor to its end stop that corresponds to “0” position (indicated with the LED indicator named “ $LSn-$ ”).

Select a motor by moving the control mode slider. By simultaneously pressing “+” and “-” buttons for 0.5 seconds, the “homing” procedure for the selected motor starts. Once “homing” is completed the selected motor is set to the minimum position.

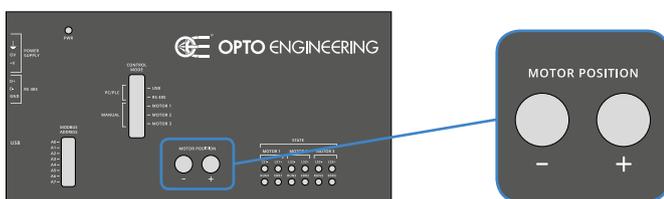


Figure 8: Push buttons for manually setting the selected motor position

### 7.2. PC/PLC communication

User can communicate with the MTDV3CH-00A1 using a RS485 Serial port or using a USB serial port.

7.2.1. RS485

The controller implements a subset of the Modbus RTU slave protocol and, as such, can also be configured and managed by any programmable logic controller (PLC) with a proper interface.

All the settings are stored in non-volatile memory; the controller will retain these settings even when the supply is removed.

7.2.1.1. RS485 settings

There is a 8-way dip switch in a hollow accessible from the top panel of the controller. The eight switches are used to set the Modbus address of the controller.

The exact meaning of each of the switches is listed in the following table.

Number	Name	Description
1	A0	Bit 0 of the Modbus address (1 when ON, 0 when OFF) - MSB
2	A1	Bit 1 of the Modbus address (1 when ON, 0 when OFF)
3	A2	Bit 2 of the Modbus address (1 when ON, 0 when OFF)
4	A3	Bit 3 of the Modbus address (1 when ON, 0 when OFF)
5	A4	Bit 4 of the Modbus address (1 when ON, 0 when OFF)
6	A5	Bit 5 of the Modbus address (1 when ON, 0 when OFF)
7	A6	Bit 6 of the Modbus address (1 when ON, 0 when OFF)
8	A7	Bit 7 of the Modbus address (1 when ON, 0 when OFF) - LSB

Table 6: meaning of the dip switches

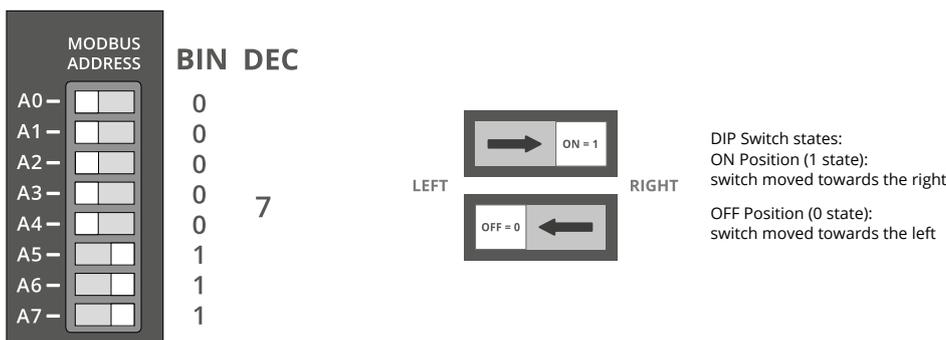


Figure 9: Modbus address example

Please note that valid Modbus addresses for slave devices are in the range 1 to 247; remaining addresses are reserved by the standard for special purposes and must not be used. It is of great importance to ensure, at the time of assigning the slave address, that there are not two devices with the same address. In such a case, an abnormal behavior of the whole serial bus can occur, the master being then in the impossibility to communicate with all the slaves present on the bus.

The controller operates at 9600 bits per second, with no parity check. These speed and parity settings are not modifiable in any way.

These switches should be operated only when the controller is switched off.

**7.2.1.2. RS485 Communication protocol**

The controller has a RS485 communication port that implements a subset of the Modbus RTU slave protocol. It can be configured and managed by any PC and programmable logic controller (PLC) with a suitable interface.

Being simple and robust, over the years Modbus became a well known communication protocol and it is now a commonly available means of connecting industrial electronic devices. The development and update of Modbus protocols has been managed by the Modbus Organization since April 2004. The Modbus Organization is an association of users and suppliers of Modbus compliant devices that seeks to drive the adoption and evolution of Modbus.

The organization web site is:

<http://www.modbus.org>

More information, including Modbus specifications, implementation guides and code fragments can be downloaded from:

<http://www.modbus.org/specs.php>

The user may choose from a wide variety of libraries to implement the low level aspects of the Modbus protocol needed to control MTDV3CH-00A1. They are available for the majority of Operating Systems and programming languages. Additionally most of them are free.

**7.2.1.2.1. Supported function codes**

Modbus is a request/reply protocol and offers services specified by function codes.

The following table lists the Modbus function codes supported by the controller with the current firmware.

Function Name	Function Code
Read Holding Registers	0 x 03
Write Single Register	0 x 06
Write Multiple Registers	0 x 10

*Table 7: function codes supported by the controller*

Any Modbus request containing an unimplemented function code is silently ignored by the controller and no response, of any kind, is given back to the master.

These supported function codes can be used to access the controller internal register file, organized as an array of two-byte values. These function codes are briefly described in the following sections.

**7.2.1.2.1.1. Read holding Registers (0x03)**

This function code is used to read the contents of a contiguous block of registers from the controller register file. The master specifies the starting register address and the number of registers to be read. Registers are addressed starting at zero.

The register data in the response message are packed as two bytes per register.

For each register, the first byte contains the high order bits and the second contains the low order bits.

**7.2.1.2.1.2. Write single register (0x06)**

This function code is used to write a single register in the controller register file. The master specifies the address of the register to be written and the actual data to be written. Registers are addressed starting at zero. The register data in the request message are packed as two bytes per register. For each register, the first byte contains the high order bits and the second contains the low order bits. The normal response is an echo of the request, returned after the register contents have been written.

**7.2.1.2.1.3. Write multiple registers (0x10)**

This function code is used to write a block of contiguous registers in the controller register file. The master specifies the starting register address, the number of registers and the actual data to be written. Registers are addressed starting at zero. The register data in the request message are packed as two bytes per register. For each register, the first byte contains the high order bits and the second contains the low order bits. The normal response returns the function code, starting address, and quantity of registers written.

**7.2.1.2.2. Registers list**

The following table lists all the Modbus registers implemented in the controller. There are 48 registers, each of two bytes in size. The registers are mapped at addresses from 0 to 47.

Add	Name	Type	Range	Description	Notes
0	MCU_VER	R	0-255	Microcontroller firmware version	
1	MAX_WFN	R	10-9990	Maximum working F number*	WFN=regValue/10.0
2	MIN_WFN	R	10-9990	Minimum working F number*	WFN=regValue/10.0
3	WFN	R	10-9990	Actual working F number*	WFN=regValue/10.0
4	TAR_WFN	RW	10-9990	Target working F number*	WFN=regValue/10.0
5	MAX_MSP1	R	1000-65535	Max manual speed motor 1	Speed=regValue/10.0
6	MAX_MSP2	R	1000-65535	Max manual speed motor 2	Speed=regValue/10.0
7	MAX_MSP3	R	1000-65535	Max manual speed motor 3	Speed=regValue/10.0
8	MAX_ASP1	R	1000-65535	Max automatic speed motor 1	Speed=regValue/10.0
9	MAX_ASP2	R	1000-65535	Max automatic speed motor 2	Speed=regValue/10.0
10	MAX_ASP3	R	1000-65535	Max automatic speed motor 3	Speed=regValue/10.0
11	MAX_AAC1	R	1000-65535	Max automatic acceleration motor 1	Accel=regValue/10.0
12	MAX_AAC2	R	1000-65535	Max automatic acceleration motor 2	Accel=regValue/10.0
13	MAX_AAC3	R	1000-65535	Max automatic acceleration motor 3	Accel=regValue/10.0
14	MSP1	RW	1000-65535	Manual speed motor 1	Speed=regValue/10.0
15	MSP2	RW	1000-65535	Manual speed motor 2	Speed=regValue/10.0
16	MSP3	RW	1000-65535	Manual speed motor 3	Speed=regValue/10.0
17	ASP1	RW	1000-65535	Automatic speed motor 1	Speed=regValue/10.0
18	ASP2	RW	1000-65535	Automatic speed motor 2	Speed=regValue/10.0
19	ASP3	RW	1000-65535	Automatic speed motor 3	Speed=regValue/10.0
20	AAC1	RW	1000-65535	Automatic acceleration motor 1	Accel=regValue/10.0
21	AAC2	RW	1000-65535	Automatic acceleration motor 2	Accel=regValue/10.0
22	AAC3	RW	1000-65535	Automatic acceleration motor 3	Accel=regValue/10.0
23	HSP1	R	1000-65535	Home speed motor 1	Speed=regValue/10.0
24	HSP2	R	1000-65535	Home speed motor 2	Speed=regValue/10.0
25	HSP3	R	1000-65535	Home speed motor 3	Speed=regValue/10.0
26	HAC1	R	1000-65535	Home acceleration motor 1	Accel=regValue/10.0
27	HAC2	R	1000-65535	Home acceleration motor 2	Accel=regValue/10.0
28	HAC3	R	1000-65535	Home acceleration motor 3	Accel=regValue/10.0
29	MAX_POS1	R	0-65535	Max position motor 1*	

Add	Name	Type	Range	Description	Notes
30	MAX_POS2	R	0-65535	Max position motor 2*	
31	MAX_POS3	R	0-65535	Max position motor 3*	
32	POS1	R	0-65535	Actual position motor 1	
33	POS2	R	0-65535	Actual position motor 2	
34	POS3	R	0-65535	Actual position motor 3	
35	TAR_POS1	RW	0-65535	Target position motor 1	65535 == home
36	TAR_POS2	RW	0-65535	Target position motor 2	65535 == home
37	TAR_POS3	RW	0-65535	Target position motor 3	65535 == home
38	STATUS1	R	0-8	Status motor 1	0=RUN, 1=LS1E,
39	STATUS2	R	0-8	Status motor 2	2=LS1D, 3=LS2E,
40	STATUS3	R	0-8	Status motor 3	4=LS2D, 5=STE, 6=STD,
41	AUTOSAVE	RW	0-1	Autosave option	7=ERR, 8=HOME
42	MAX_MAG	R	1-65535	Maximum magnification*	1=active
43	MIN_MAG	R	1-65535	Minimum magnification*	Mag=regValue/1000.0
44	TAR_MAG	RW	1-65535	Target magnification*	Mag=regValue/1000.0

\*available only if the proper configuration file is loaded on the device (see Section 9.8).

Table 8: MTDV3CH-00A1 registers list

#### 7.2.1.2.2.1. Register MCU\_VER

This register contains the microcontroller firmware version in bit field [7:0]. Bit field [15:8] of this register is unused.

#### 7.2.1.2.2.2. Register MAX\_WFN

This register contains the lens maximum working F number. The working F number can be calculated as follows:

$$WFN = \frac{registerValue}{10.0}$$

Equation 1

NOTE: This register contains a useful information only if the proper configuration file is loaded on the device.

#### 7.2.1.2.2.3. Register MIN\_WFN

This register contains the lens minimum working F number. The working F number can be calculated using the Equation 1.

NOTE: This register contains a useful information only if the proper configuration file is loaded on the device.

#### 7.2.1.2.2.4. Register WFN

This register contains the lens actual working F number. The working F number can be calculated using the Equation 1.

NOTE: This register contains a useful information only if the proper configuration file is loaded on the device.

#### 7.2.1.2.2.5. Register TAR\_WFN

This register contains the lens target working F number. User can write to this register to obtain the desired working F Number. The working F number can be calculated using the Equation 1.

NOTE: This register contains a useful information only if the proper configuration file is loaded on the device.

#### 7.2.1.2.2.6. Registers MAX\_MSP[N]

These registers contain the maximum speeds for manual operations that user can set for each motor. The speed value is measured in step over second and can be calculated as follows:

$$Speed = \frac{registerValue}{10.0} \left[ \frac{step}{sec} \right]$$

Equation 2

#### 7.2.1.2.2.7. Registers MAX\_ASP[N]

These registers contain the maximum speeds for PC/PLC operations that user can set for each motor. The speed value is measured in step over second and can be calculated according to the Equation 2.

#### 7.2.1.2.2.8. Registers MAX\_AAC[N]

These registers contain the maximum accelerations for PC/PLC operations that user can set for each motor. The acceleration value is measured in step over square second and can be calculated as follows:

$$Acceleration = \frac{registerValue}{10.0} \left[ \frac{step}{sec^2} \right]$$

Equation 3

#### 7.2.1.2.2.9. Registers MSP[N]

These registers contain the actual speeds for manual operations for each motor. The speed value is measured in step over second and can be calculated according to the Equation 2. User can write to these registers to set the desired speed for manual operation. Recommended value for reliable operations is 3000 (i.e. 300.0 step/sec).

#### 7.2.1.2.2.10. Registers ASP[N]

These registers contain the actual speeds for PC/PLC operations for each motor. The speed value is measured in step over square second and can be calculated according to the Equation 2. User can write to these registers to set the desired speed for automatic operation (PC/PLC user interface). Recommended value for reliable operations is 5000 (i.e. 500.0 step/sec).

#### 7.2.1.2.2.11. Registers AAC[N]

These registers contain the actual accelerations for PC/PLC operations for each motor. The acceleration value is measured in step over square second and can be calculated according to Equation 3. User can write to these registers to set the desired acceleration for automatic operation (PC/PLC user interface). Recommended value for reliable operations is 2500 (i.e. 250.0 step/sec<sup>2</sup>).

#### 7.2.1.2.2.12. Registers HSP[N]

These registers contain the homing speeds for each motor. The speed value is measured in step over second and can be calculated according to the Equation 2.

#### 7.2.1.2.2.13. Registers HAC[N]

These registers contain the homing accelerations for each motor. The acceleration value is measured in step over square second and can be calculated according to Equation 3.

#### 7.2.1.2.2.14. Registers MAX\_POS[N]

These registers contain the maximum positions for each motor. The position value is measured in step.

NOTE: This registers contain a useful information only if the proper configuration file is loaded on the device.

#### 7.2.1.2.2.15. Registers POS[N]

These registers contain the actual positions for each motor. The position value is measured in step.

#### 7.2.1.2.2.16. Registers TAR\_POS[N]

These registers contain the target positions for each motor. The position value is measured in step. User can write to these registers to move each motor to the desired position. Write 65535 (0xFFFF) to these registers to send to the MTDV3CH-00A1 a home command.

**7.2.1.2.2.17. Registers STATUS[N]**

These registers contain the status of each motor. The status information is listed below:

Register value	Description
0	Motor is moving to the target position
1	Motor is stopped at position zero and enabled
2	Motor is stopped at position zero and disabled
3	Motor is stopped at its maximum position and enabled
4	Motor is stopped at its maximum position and disabled
5	Motor is stopped and enabled
6	Motor is stopped and disabled
7	Motor is in over-current or over-temperature error
8	Motor is homing

*Table 9: Status description*

**7.2.1.2.2.18. Register AUTOSAVE**

This register contain the information on the autosave option. If set to 1 (default value) last positions of all three motors are saved into non-volatile memory. When the MTDV3CH-00A1 is switched on, it moves the motors to the “autosaved” positions. Set this register to 0 to disable autosave.

**7.2.1.2.2.19. Register MAX\_MAG**

This register contains the maximum magnification achievable for a lens of MZMT family. The magnification can be calculated as follows:

$$Magnification = \frac{registerValue}{1000.0}$$

*Equation 4*

NOTE: This register contains a useful information only if the proper configuration file is loaded on the device.

**7.2.1.2.2.20. Register MIN\_MAG**

This register contains the minimum magnification achievable for a lens of MZMT family. The magnification can be calculated according to the Equation 4.

NOTE: This register contains a useful information only if the proper configuration file is loaded on the device.

**7.2.1.2.2.21. Register TAR\_MAG**

This register contains the minimum magnification achievable for a lens of MZMT family. The magnification can be calculated according to the Equation 4. User can write to this register the desired magnification.

NOTE: This register contains a useful information only if the proper configuration file is loaded on the device.

**7.2.2. USB**

MTDV3CH-00A1 can be connected to PC via USB 2.0 (cable COCBUSB20 provided). Connect the standard-A plug end of the cable to the PC and the mini-B plug end of the cable to the device.

**7.2.2.1. DLL functions**

User can download from [www.opto-engineering.com](http://www.opto-engineering.com) website the DLL including the set of commands available to control the MTDV3CH-00A1 via USB (Windows only).

**The full description of every function can be found in the header file "OESerial.h"** (included in the MTSW zip file). The meaning of every function is described below:

**7.2.2.1.1. Function SerialOpen**

Open a serial COM port with the specified parameters.

Following parameters must be set at following values:

Parameter	Value
Baudrate	9600
Parity	0
Bytesize	8
Stopbits	0

*Table 10: SerialOpen fixed parameters list.*

**7.2.2.1.2. Function SerialClose**

Close the serial port.

**7.2.2.1.3 Function SerialReset**

Reset/change port settings. Use parameters listed in Table 10.

**7.2.2.1.4 Function SerialWrite**

Write on the serial port.

**7.2.2.1.5 Function SerialRead**

Read from the serial port.

**7.2.2.1.6 Function SerialClear**

Reset serial buffers.

**7.2.2.1.7 Function MoveTo**

Move the specified motor to an absolute position. If desired absolute position is less than zero or greater than maximum motor position, the MTDV3CH-00A1 moves till the minimum or maximum position.

#### 7.2.2.1.8 Function MoveToAll

Same as Function MoveTo for all three motors.

#### 7.2.2.1.9 Function Move

Move the specified motor to relative position. If the parameter is positive the actual position is increased by the amount specified, while if the parameter is negative the actual position is decreased.

If desired target position is less than zero or greater than maximum motor position, the MTDV3CH-00A1 moves to the minimum or maximum position.

#### 7.2.2.1.10. Function MoveAll

Same as Function Move for all three motors.

#### 7.2.2.1.11. Function GetPosition

Get the actual and maximum positions for a specified motor.

#### 7.2.2.1.12. Function GetPositionAll

Get the actual and maximum positions for all three motors.

#### 7.2.2.1.13. Function GetStatus

Get the status of the specified motor.

#### 7.2.2.1.14. Function GetStatusAll

Get the status of all three motors.

#### 7.2.2.1.15. Function MoveToFnumber

Move the iris motor to obtain the desired working F number.

NOTE: This function should be used only if the proper configuration file is loaded on the device.

#### 7.2.2.1.16. Function GetFnumber

Get the actual working F number of the lens.

NOTE: This function should be used only if the proper configuration file is loaded on the device.

#### 7.2.2.1.17. Function Stop

Execute a soft stop of the specified motor.

#### 7.2.2.1.18. Function StopAll

Execute a soft stop of all three motors.

#### 7.2.2.1.19. Function Home

Function "Home" positions a motor to its minimum end stop (indicated with LED indicator named "LSn-").

#### 7.2.2.1.20. Function HomeAll

Execute the homing of all three motors.

#### 7.2.2.1.21. Function ChangeParameters

Change the motion parameters of the specified motor: manual speed, automatic speed and automatic acceleration.

#### 7.2.2.1.22. Function SaveCurrentParameters

Save the current parameters for the specified motor in the specified on-board memory location. Memory locations allowed in the range 1 ÷ 20.

Memory location 1 is the default for motor1 (loaded when the MTDV3CH-00A1 switches on)

Memory location 2 is the default for motor2 (loaded when the MTDV3CH-00A1 switches on)

Memory location 3 is the default for motor3 (loaded when the MTDV3CH-00A1 switches on)

#### 7.2.2.1.23. Function SaveCurrentParametersAll

Save the current parameters of all the motors in the specified on-board memory locations.

Memory locations allowed in the range 1 ÷ 20.

Memory location 1 is the default for motor1 (loaded when the MTDV3CH-00A1 switches on)

Memory location 2 is the default for motor2 (loaded when the MTDV3CH-00A1 switches on)

Memory location 3 is the default for motor3 (loaded when the MTDV3CH-00A1 switches on)

#### 7.2.2.1.24. Function LoadParameters

Load the specified motor parameters for the specified motor from the on-board memory. Memory locations allowed in the range 1 ÷ 20.

#### 7.2.2.1.25. Function LoadParametersAll

Load the specified motor parameters for all three motors from the on-board memory.

Memory locations allowed in the range 1 ÷ 20.

#### 7.2.2.1.26. Function SaveCurrentPositions

Save the current positions of all three motors to the on-board memory. Memory locations allowed in the range 1 ÷ 100.

Memory location 100 is the default (loaded when the MTDV3CH-00A1 switches on) and it's the memory location used by the autosave function.

#### 7.2.2.1.27. Function LoadPositions

Load the positions of all three motors from the on-board memory. Memory locations allowed in the range 1 ÷ 100.

#### 7.2.2.1.28. Function ToggleAutoSavePositions

Enable/disable motors positions autosaving. Acts as a toggle.

#### 7.2.2.1.29. Function GetCurrentParameters

Get the current motion parameters of all three motors: manual speed, automatic speed and automatic acceleration.

**7.2.2.1.30. Function MoveToMagnification (MZMT only)**

Drives the motors to obtain an optical configuration with the specified magnification. The correct magnification is achieved if the working distance matches the nominal working distance and the flange distance matches the nominal flange distance. Otherwise a fine tuning of focus might be necessary.

NOTE: This function should be used only if the proper configuration file is loaded on the device.

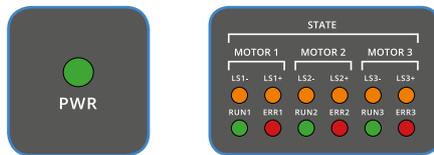
**7.2.2.1.31. Function MoveToWD (ENMT only)**

Drives the motors to obtain an optical configuration with the specified working distance. The correct magnification is achieved if the flange distance matches the nominal flange distance. Otherwise a fine tuning of focus might be necessary.

NOTE: This function should be used only if the proper configuration file is loaded on the device.

## 8. Visual indicators

There are thirteen LEDs on the top panel of the controller. One of them is used to show that power supply is present, others are used to indicate motors status. The exact meaning of each of the LEDs is listed in the following table.



Number	Name	Color	Description
1	PWR	Green	Stable when power supply is present
2	RUN1	Green	Stable when motor 1 is moving
3	ERR1	Red	Stable when over-current or over-temperature occurs on motor 1
4	LS1-	Orange	Stable when motor 1 is at its minimum position
5	LS1+	Orange	Stable when motor 1 is at its maximum position
6	RUN2	Green	Stable when motor 2 is moving
7	ERR2	Red	Stable when over-current or over-temperature occurs on motor 2
8	LS2-	Orange	Stable when motor 2 is at its minimum position
9	LS2+	Orange	Stable when motor 2 is at its maximum position
10	RUN3	Green	Stable when motor 3 is moving
11	ERR3	Red	Stable when over-current or over-temperature occurs on motor 3
12	LS3-	Orange	Stable when motor 3 is at its minimum position
13	LS3+	Orange	Stable when motor 3 is at its maximum position

Table 11: meaning of LED indicators

## 9. Demo configuration software

The MTDV3CH-00A1 can be used with a single PC running the MTSW configuration software (available from [www.opto-engineering.com](http://www.opto-engineering.com)).

In order to run the configuration software the following requirements must be satisfied:

- Windows XP operating system or newer
- 30 Mbyte of available disk space
- 512 Mbyte of system RAM
- One USB port available

### 9.1. Software installation

Unpack the software archive downloaded from our web site and run the main application executable named "MTSW.exe".

### 9.2. Main window

The following picture shows the configuration software main window just after start up.

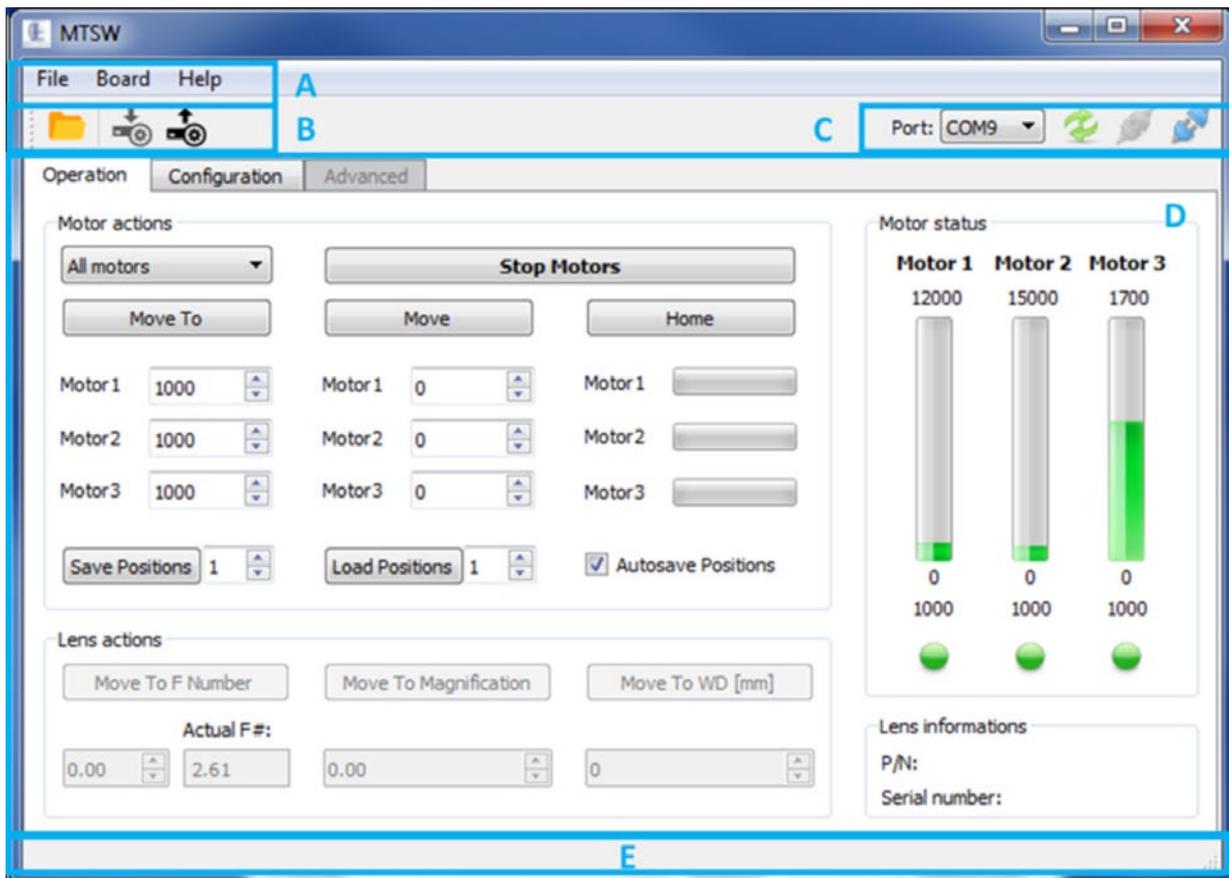


Figure 10: main window of demo software

The main window is divided into five parts:

- Part A contains the main menu
- Part B is the main toolbar that allows quick access to most common functionalities
- Part C is the connection toolbar
- Part D contains all the available commands
- Part E is the status toolbar

### 9.3. Controller connection

MTDV3CH-00A1 can be connected to PC via USB 2.0 (USB cable COCBUSB20 provided).

Switch on the controller, then connect the standard-A plug end of the cable to the PC and the mini-B plug end of the cable to the device and move the MTDV3CH-00A1 slider to USB position.

The device should be automatically recognized by Windows OS. If the device is not automatically recognized, the appropriate virtual COM port drivers must be downloaded from FTDI website (<http://www.ftdichip.com/Drivers/VCP.htm>) according to your OS version.

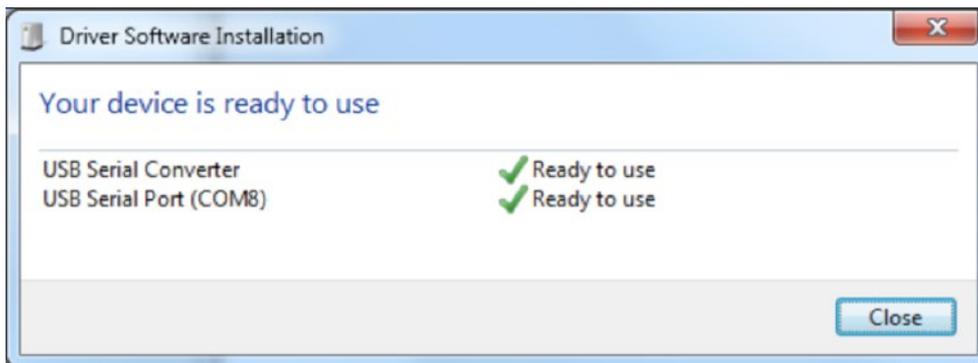


Figure 11: Automatic driver software installation

### 9.4. COM configuration

To ensure a reliable communication between MTDV controller and your PC, make sure to correctly configure the COM port settings:

Open the Device Manager, select the right COM port (labeled USB Serial Port), right click and select "Properties"

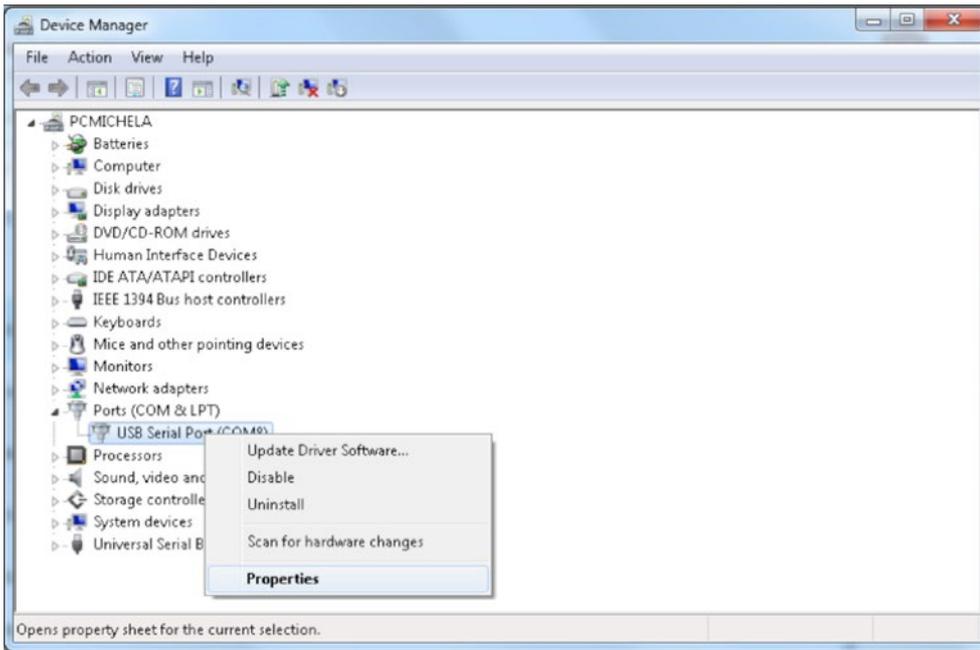


Figure 12: Device Manager Settings

Then go to "Port Settings" tab and click on "Advanced".

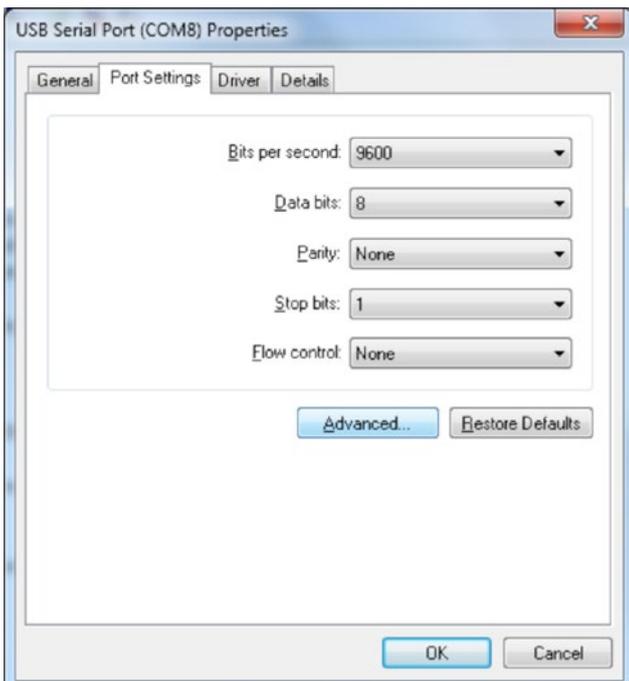


Figure 13: COM Port advanced settings

Under section “BM Options”, set “Latency Timer (msec):” to “1” and click OK.

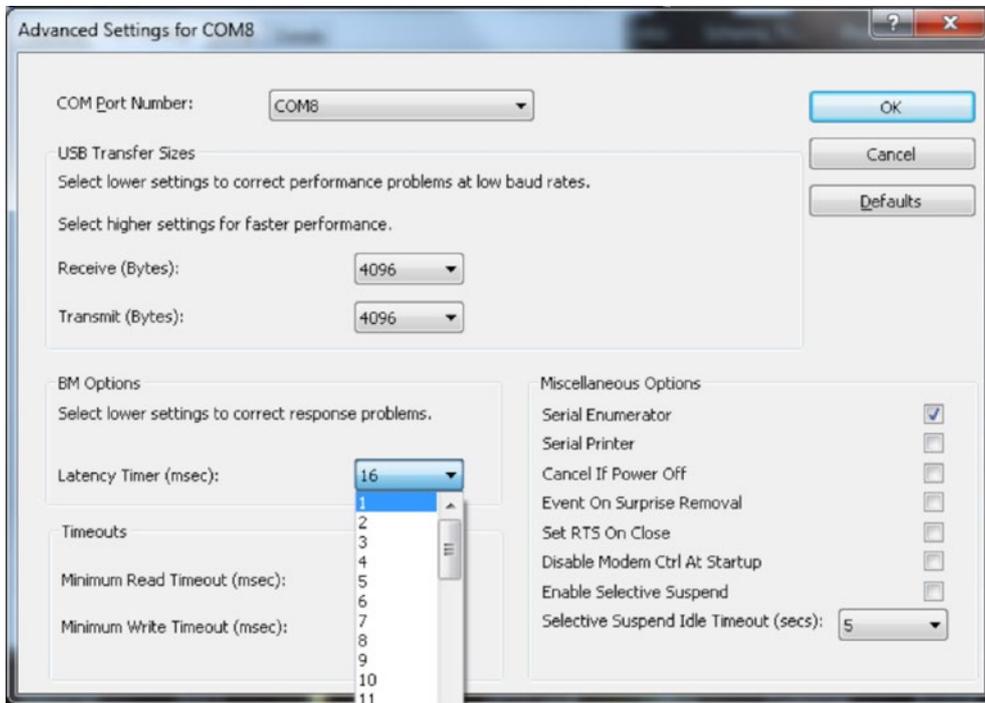


Figure 14: latency timer option

### 9.5. Refresh COM

Press the “refresh button” to show the COM ports identified by your operating system.

### 9.6. Connect the device

The first step after launching the software is to enable the communication between the computer and the controller. The connection toolbar positioned at the upper right corner shows the currently selected COM port.

Make sure that the control mode slider is set to USB.

Select the correct COM port and press the connect button:

The status bar will now display “COM open”.

### 9.7. Read the configuration

Press the read button to read the configuration that was previously saved on MTDV3CH-00A1 on-board memory: in a few seconds the software will populate the interface with the current configuration values and the status bar will be updated to display “Get Parameters: OK”.

### 9.8. Load lens XML file

User can download the appropriate configuration file from the following Opto Engineering webpage: [http://www.opto-engineering.com/configuration\\_files](http://www.opto-engineering.com/configuration_files).

Digit the S/N (serial number) reported on the lens to download the configuration file and save it on a local path.

Press the open button, browse the XML file and select it.

In the lens information area (in the bottom right corner) will appear lens Part Number and lens Serial Number.

### 9.9. Write the configuration

Once a lens XML file is loaded, "Write configuration" button is enabled.

Click this button to write the lens configuration on the MTDV3CH-00A1 memory. The status bar will be updated and it will display "Set Parameters: OK"

### 9.10. Disconnect the device

To disconnect the device, press the disconnect button:

The status bar will display "COM closed".

### 9.11. Operation tab

The first tab of the software is the "Operation" tab. Here user can find common commands to move the lens motors.

Find below the available commands:

#### 9.11.1. Motor selection drop-down list

From the "Select a motor" drop-down list select "All motor" or a specific motor.

- Select "All motors" to control all the motors.

#### MZMT series

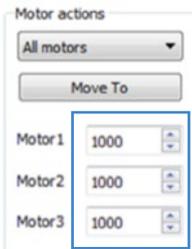
- Select "Motor 1" to control the lens zooming
- Select "Motor 2" to control the lens focusing
- Select "Motor 3" to control the lens iris

#### ENMT series

- "Motor 1" is not connected
- Select "Motor 2" to control the lens focusing
- Select "Motor 3" to control the lens iris

**9.11.2. Move To button**

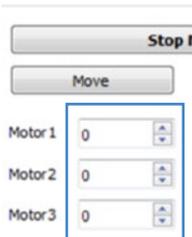
Click the “Move To” button to move the selected motor to a specific absolute position. Digit the absolute position (expressed in number of steps) of each motor within its corresponding field.



If the desired absolute position is less than zero or greater than the maximum motor position, MTDV3CH-00A1 moves until the minimum or maximum position is reached.

**9.11.3. Move button**

Click the “Move” button to move the selected motor to a specific relative position. Digit the relative position (expressed in number of steps) of each motor within its corresponding field. If the number is positive the actual position is increased by the amount specified, while if the parameter is negative the actual position is decreased.



If the desired target position is less than zero or greater than the maximum motor position, MTDV3CH-00A1 moves to its minimum or maximum position.

**9.11.4. Home button**

Click the “Home button” to move the selected motor to its minimum end stop (indicated with LED indicator named “LSn-”) that corresponds to the zero position.

Progress bars indicate the progress of the homing procedure.



**9.11.5. Stop Motors button**

Execute a soft stop of the selected motor, i.e. decelerates according to the actual acceleration until the motor stops.

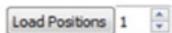
**9.11.6. Save Positions button**

Save the current positions of all three motors to the on-board memory at the location specified in the numeric control on the right of the button. Memory locations allowed are in the range 1 ÷ 100. Memory location 100 is the default (loaded when the MTDV3CH-00A1 switches on) and it's the memory location used by the autosave function.



**9.11.7. Load Positions button**

Load the positions of all three motors from the on-board memory at the location specified in the numeric control on the right of the button and move motors to obtain the loaded positions. Memory locations allowed in the range 1 ÷ 100.



**9.11.8. Autosave Positions check box**

Enable or disable the autosave function. When autosave is enabled the last target positions are saved in the on-board memory. If the MTDV3CH-00A1 switches off and switches on, after the homing procedure the motors will move to the last "autosaved" positions.

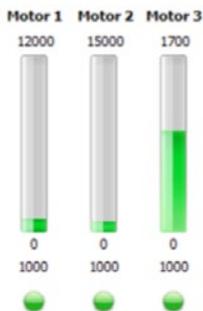


**9.11.9. Motor status bars and indicators**

On the left of the "operation" tab there are three position bars. On the top of each bar is displayed the max absolute position for each motor, and at the bottom (below the zero that is the minimum position) is displayed the actual position. Bars represent the actual position with respect to the maximum positions.

Below there are three indicators. Each indicator can be of a different color:

- Green: motor is motionless
- Yellow: motor is moving to the target position
- Light blue: motor is stopped at its maximum or minimum position
- Red: motor is in over-current or over-temperature error



**9.11.10. Move To F Number button**

Moves the iris motor to obtain the working F number specified in the field below.

This button is available only if a proper XML configuration file is loaded.

#### 9.11.11. Move To Magnification button (MZMT only)

Drives the motors to obtain an optical configuration with the magnification specified in the field below. The correct magnification is achieved if the working distance matches the nominal working distance and the flange distance matches the nominal flange distance.

Otherwise, a fine tuning of focus might be necessary.

This button is available only if a proper XML configuration file is loaded.

#### 9.11.12. Move To WD button (ENMT only)

Drives the motors to obtain an optical configuration with the working distance specified in the field below. The correct working distance is achieved if the flange distance matches the nominal flange distance. Otherwise, a fine-tuning of focus might be necessary.

This button is available only if a proper XML configuration file is loaded.

### 9.12. Configuration tab

The second tab of the software is the "Configuration" tab. Here users can find commands to change motor parameters (i.e. speed and acceleration).

Find below the list of the commands:

#### 9.12.1. Set Parameters

Change the motion parameters of the specified motor:

- manual speed is the speed for manual operations. Default value is 300 step/sec, minimum value is 100 step/sec
- automatic speed is the speed for serial communication operations. Default value is 500 step/sec, minimum value is 100 step/sec
- automatic acceleration is the acceleration for serial communication operations. Default value is 250 step/sec<sup>2</sup>, minimum value is 100 step/sec<sup>2</sup>

This command does not save new parameters to the on-board memory of the controller.

#### 9.12.2. Save Parameters button

Save the current parameters for the specified motor in the specified on-board memory location. Memory locations allowed are in the range 1 ÷ 20.

Memory location 1 is the default for motor1 (loaded when the MTDV3CH-00A1 switches on)

Memory location 2 is the default for motor2 (loaded when the MTDV3CH-00A1 switches on)

Memory location 3 is the default for motor3 (loaded when the MTDV3CH-00A1 switches on)

#### 9.12.3. Load Parameters button

Load the specified motor parameters for the specified motor from the on-board memory. Memory locations allowed are in the range 1 ÷ 20.

### 9.13. Advanced tab

The third tab of the software is the "Advanced" tab. This tab is protected by password and can be used for remote support.



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