OPTO ENGINEERING

INSTRUCTIONS MANUAL

MCZR0XX-00Y

Macro Zoom lenses with motorized control

OPTICS

Table of contents

1. Product overview

Macro Zoom Revolver MCZR 0XX-00Y are zoom lenses that provide up to four different magnification changes. In particular, they are varifocal lenses, i.e. they perform discrete (non-continuous) magnification changes while working at the same fixed working f-number WF/#.

2. Safety warnings

➜ **Read carefully this instructions manual**
This document contains the necessary information to use the product properly.

➜ **Do not inspect the internal parts of the product. Warranty will not be valid if product is opened**
This product contains very delicate components that might be permanently damaged if handled without care.

➜ **Product must be adequately shielded if employed in dusty and humid places**

➜ **Do not use togheter with machines that generate strong vibrations**
Macro Zoom Revolver might be permanently damaged if deployed in the presence of strong vibrations and impulsive forces

➜ **Zoom Revolver must be properly clamped before usage**
Zoom Revolver must be mechanically constrained by adequate clamps, specifically where indicated (see Mechanical Specifications)

➜ **Do not use the product out of the fields of usage marked in the specifications**
See paragraph 4 for the Specifications.

3. Warranty

Opto Engineering offers 100,000 magnification changes as warranty for products that have been installed according to the installation instructions supplied. The product will be either replaced or repaired in case of defects presence in any component. Warranty does not cover parts damaged as a result of incorrect usage.

4. Specifications

4.1 Optical specifications

4.1.1 Optical parameters specifications

The following MCZR0XX-00Y optical specifications are relative to a 2/3″ detector (8.8 mm x 6.6 mm).

MCZR 033-008

MCZR033-008 performs the following 4 magnification changes: 0.083x, 0.167x, 0.250x, 0.333x. The following table lists usage specifications for each different magnification:

OPTICAL PARAMETERS	0.083x	0.167x	0.250x	0.333x
Working Distance[1] WD	208.4 mm	208.4 mm	208.4 mm	208.4 mm
F number [2] F/#	5	5	5	5
Distortion	< 0.2%	< 0.1%	< 0.05%	< 0.05%
Field depth	18 mm	4.5 mm	2 mm	1.1 mm
CTF@50 [lp/mm]	> 40%	> 50%	>60%	> 60%
Object field of view [mm x mm]	105.8 x 79.4	52.8 x 39.6	35.2 x 26.4	26.4 x 19.8

1. Distance between the front lens and the object. Set this distance within +/- 3% of the nominal value for maximum resolution and minimum distortion

2. Working F-number: the real F-number of a lens when used as a macro

MCZR 025-006

MCZR025-006 performs the following 4 magnification changes: 0.063x, 0.125x, 0.188x, 0.251x. The following table lists usage specifications for each different magnification

OPTICAL PARAMETERS	0.063x	0.125x	0.188x	0.251x
Working Distance[1] WD	275.9 mm	275.9 mm	275.9 mm	275.9 mm
F number [2] F/#	5	5	5	5
Distortion	< 0.2%	< 0.1%	< 0.05%	< 0.05%
Field depth	30 mm	8 mm	3.5 mm	1.9 mm
CTF@50 [lp/mm]	> 50%	> 50%	> 60%	> 50%
Object field of view [mm x mm]	140.6 x 105.5	70.2 x 52.6	46.8 x 35.1	35.1 x 26.3

MCZR 018-004

MCZR018-004 performs the following 4 magnification changes: 0.047x, 0.094x, 0.141x, 0.188x. The following table lists usage specifications for each different magnification:

OPTICAL PARAMETERS	0.047x	0.094x	0.141x	0.188x
Working Distance[1] WD	384.8 mm	384.8 mm	384.8 mm	384.8 mm
F number [2] F/#	5	5	5	5
Distortion	< 1.0%	< 0.2%	< 0.1%	< 0.05%
Field depth	55 mm	14 mm	6 mm	3.5 mm
CTF@50 [lp/mm]	> 40%	> 40%	>60%	> 60%
Object field of view [mm x mm]	187.5 x 140.6	93.6 x 70.2	62.4 x 46.8	46.8 x 35.1

1. Distance between the front lens and the object. Set this distance within +/- 3% of the nominal value for maximum resolution and minimum distortion

2. Working F-number: the real F-number of a lens when used as a macro

MCZR 014-003

MCZR014-003 performs the following 4 magnification changes: 0.035x, 0.070x, 0.105x, 0.140x. The following table lists usage specifications for each different magnification:

OPTICAL PARAMETERS	0.035x	0.070x	0.105x	0.140x
Working Distance[1] WD	532.3 mm	532.3 mm	532.3 mm	532.3 mm
F number [2] F/#	5	5	5	5
Distortion	< 1.0%	< 0.2%	< 0.1%	< 0.05%
Field depth	100 mm	25 mm	11 mm	6 mm
CTF@50 [lp/mm]	> 40%	> 40%	>60%	> 60%
Object field of view [mm x mm]	252.1 x 189.1	125.8 x 94.4	84 x 63	63 x 47.2

4.3 Electrical and electronic specifications

- Input voltage: 24V±2%;
- MCZR can be connected to PC via USB 2.0 (cable provided). Connect the standard-A plug end of the cable to the PC and the mini-B plug end of the cable to the MCZR.
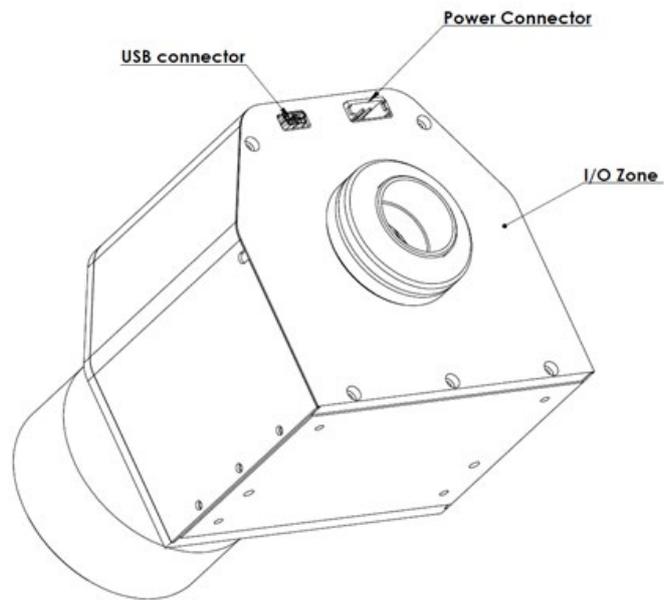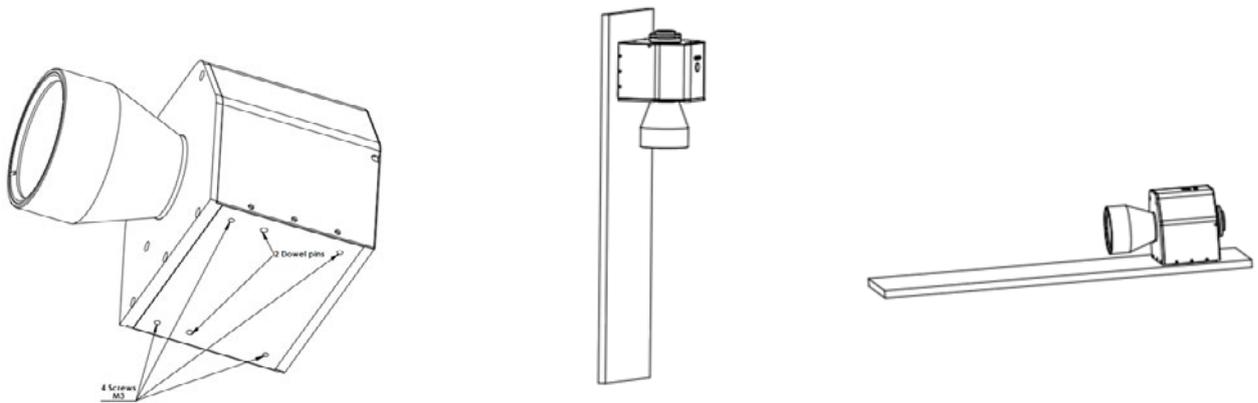

4.4 Working conditions

- Max temperature: 60 °C;
- The product must be shielded from vibration sources and impulse forces

5. Instructions for use

5.1 Clamping, turning on and focusing

MCZR must be mounted on a rigid support. It can be locked on a support through the 4 threaded holes located on the bottom.

Turn on the product by connecting the power supply cable to a 24V direct current source. When you turn on the device, it emits a specific acoustic signal (trill / "trillo") and the first available magnification position is automatically selected. The device should always emit the characteristic acoustic signal (trill). If this is not the case, please contact the seller.

After mounting, attaching the camera and turning on the device, please follow step by step the focusing procedure explained below:

1. Adjust the WD until it is equal to the WD value listed on the optic specifications.
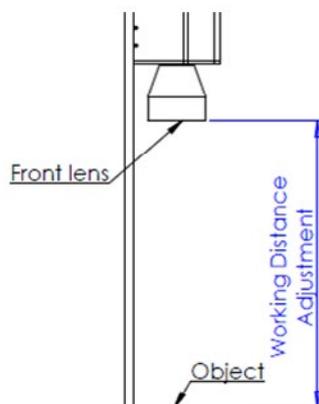
2. Set the maximum magnification position (see section 5.2) until you reach the maximum magnification position, marked by the third LED counting from the left;

3. Precisely adjust the mount position by means of adding/removing back focal adjustment spacers until you find the best focusing position.
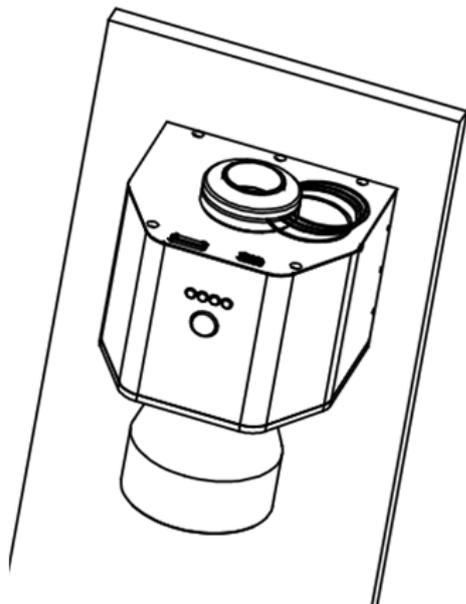
4. Adjust the phase angle. Once you find the right phase, lock the screws (M2 metric thread)

5.2 How to change magnification
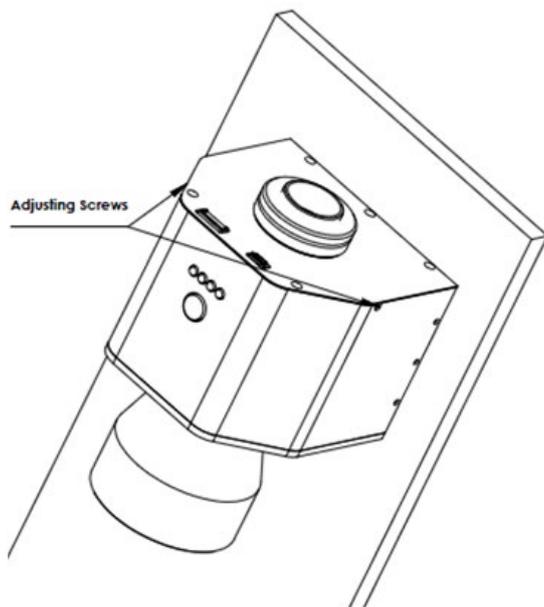
Macro Zoom Revolver offers two ways to change magnification:
Stand alone mode by pressing the button;
On-line mode by DLL.

5.2.1 Magnification change by pressing the button
When used in "stand alone" mode, MCZR is not connected to a PC: change magnification by simply pressing the blue magnification button located below the LED position indicators. Just press the button until you reach the desired magnification position (the corresponding LED position indicator will show the position): after a few seconds the carousel will rotate until it reaches the selected position and the corresponding LED position indicator will turn green.

In case of failure of the procedure defined above, connect the MCZR to a PC and proceed as described in paragraph 5.2.3.

5.2.2 Magnification change by DLL
On-line mode magnification change requires the following system specification:

- 512 MB RAM
- 1.5 MB free hard disk space
- XGA or higher-resolution monitor
- Mouse or other pointing device
- Intel® Pentium® III/M 1.4 GHz Processor minimum
- Operating System 32 bit:
- Microsoft® Windows XP Home or Professional (SP2)
- Microsoft® Windows Vista (requires Administrator rights)
- Microsoft® Windows 7 (requires Administrator rights)

You additionally need to implement a DLL that resembles the following DLL Function prototypes.

5.2.3 Alarms, errors and solutions

In case of failure, MCZR must be connected to a PC in order to visualize the error type.

Once your Macro Zoom Revolver is connected to the PC, call the *GetState function to get the error type. You can subsequently visualize the device state, in particular:

Position	return the current position of the device
ErrorOverSupply	return 1 if supply voltage (Vin) is too high, otherwise 0
ErrorUnderSupply	return 1 if supply voltage (Vin) is too low, otherwise 0
ErrorOverCurrent	return 1 if coil current is too high (over Imax), otherwise 0
ErrorI2T	return 1 if I2T error, otherwise 0
ErrorPosition	return 1 if position not reached, otherwise 0
WarningPosition	return 1 if position reached with more steps than StepPulse, otherwise 0
StepDone	return to the steps performed to reach the position
Busy	return 1 if the device is busy, otherwise 0
Run	return 1 if the device is moving, otherwise 0

In case of:
ErrorOverSupply
ErrorUnderSupply
ErrorOverCurrent

Adjust the system's power supply. If that is not the cause of the failure, contact the seller.

State **ErrorI2T** is a self-protective condition of the system: the device stops working and then automatically re-starts after a certain amount of time. In case of **ErrorI2T** keep monitoring error state and wait for system recovery. Contact the seller if the system does not re-start correctly.

In case of ErrorPosition call the DLL *Trillo or reboot the system. If the problem persists contact the seller.

```
// DLL Function prototypes  -------------------------------------------------

// Start communication ------------------------------------------------------
//
// Parameters:
// PortNumber: Serial port number  1 = COM1 , 2 = COM2 etc.. etc.. max 99
// Baud       : Baud 1200,2400,4800,9600,19200,38400,57600,115200
//
// Return value: 0 = ok, -1 = error
int  (__stdcall *InitComm)(int PortNumber,int Baud) ;

// ---------------------------------------------------------------------------

// Close communication ------------------------------------------------------
//
// Parameters  : none
//
// Return value: none
//
void (__stdcall *CloseComm)(void) ;

// ---------------------------------------------------------------------------

// Return the DLL version-----------------------------------------------------
//
// Parameters: none
//
// Return value: pointer to the version string
//
char * (__stdcall *GetDllVersion)(void) ;

// ---------------------------------------------------------------------------

// Set the timeout for a command response  -----------------------------------
//
// Parameters  : timeout in ms (value > 0 and <= 5000) default 500 ms
//
// Return value: 0 = OK, -1 = value <= 0, -2 = value > 5000
//
int (__stdcall *SetTimeOutRxCommand)(int milliseconds) ;

// ---------------------------------------------------------------------------

// Return the firmware version ------------------------------------------------
//
// Parameters:
//
// Version     : pointer to the string which contains the version (minimum size 10 bytes)
//
// Return value: 0 = 0k ; -1 = timeout error; -2 = Checksum error , -3 = serial communication not
started (InitComm)
//
int (__stdcall *GetFwVersion)(char *Version) ;

// ---------------------------------------------------------------------------
```

```
// Return the device status ----------------------------------------------
//
// Parameters:

// Position           : return the current position of the device
// ErrorOverSupply    : return 1 if supply voltage (Vin) is too high, otherwise 0
// ErrorUnderSupply   : return 1 if supply voltage (Vin) is too low, otherwise 0
// ErrorOverCurrent   : return 1 if coil current is too high (over Imax), otherwise 0
// ErrorI2T           : return 1 if I2T error, otherwise 0
// ErrorPosition      : return 1 if position not reached, otherwise 0
// WarningPosition    : return 1 if position reached with more steps than StepPulse, otherwise 0
// StepDone           : return to the steps performed to reach the position
// Busy               : return 1 if the device is busy, otherwise 0
// Run                : return 1 if the device is moving, otherwise 0
//
//
// Return value: 0 = 0k ; -1 = timeout error ; -2 = Checksum error ; -3 = serial communication not
started (InitComm)
//
int (__stdcall *GetState)(char unsigned *Position,char unsigned *ErrorOverSupply,
                          char unsigned *ErrorUnderSupply,char unsigned *ErrorOverCurrent,
                          char unsigned *ErrorI2T,char unsigned *ErrorPosition,
                          char unsigned *WarningPosition,char unsigned *StepDone,
                          char unsigned *Busy,char unsigned *Run) ;


// ------------------------------------------------------------------------
// ------------------------------------------------------------------------

// Read working parameters stored in the device --------------------------------
//
// Parameters:
//
// T1          : 0 .. 10000 ms  |
// T2          : 0 .. 10000 ms  | <- Pulse
// T3          : 0 .. 10000 ms  |
// TDuty       : 0 .. 2         | (0 = 25%, 1 = 50%, 2 = 75%)

// TT1         : 0 .. 10000 ms  |
// TT2         : 0 .. 10000 ms  | <- special pulse (Trillo)
// TT3         : 0 .. 10000 ms  |
// TTDuty      : 0 .. 2         | (0 = 25%, 1 = 50%, 2 = 75%)

// I2Tmax      : 0 .. 1000000     Thermal image limit
// VinMin      : 0 .. 60000 mV    minimum input voltage
// VinMax      : 0 .. 60000 mV    maximum input voltage
// Imax        : 0 .. 60000 mA    maximum current
// StepPulse   : 0 .. 200         pulses needed to move to a position (step)
// ExtraPulse  : 0 .. 200         Extra pulses
//
// Return value: 0 = 0k ;  -1 = timeout error; -2 = Checksum error ; -3 = serial communication not
started (InitComm)
//

int (__stdcall *GetParameters)(int *T1,int *T2,int *T3,int *TDuty,int *TT1,int *TT2,int *TT3,int
```

```
*TTDuty,int *I2Tmax,int *VinMin,int *VinMax,int *Imax,int *StepPulse,int *ExtraPulse) ;

// --------------------------------------------------------------------------------

// Move command --------------------------------------------------------------
//
// Parameters:
//
// Position    : 0 .. 3  possible positions of the device
//
// Return value: 0 = 0k, -1 = timeout error; -2 = Checksum error , -3 = NAK device busy; -4 = serial
communication is not open (InitComm)
//

int (__stdcall *GoToPosition)(int position) ;

// --------------------------------------------------------------------------------

// Trillo command (special pulse) -----------------------------------------------
//
// Parameters: none
//
//
// Return value: 0 = 0k, -1 = timeout error; -2 = Checksum error ; -3 = NAK device busy; -4 = serial
communication is not open (InitComm)
//

int (__stdcall *Trillo)(void) ;

// --------------------------------------------------------------------------------

// Functions for debugging purposes ---------------------------------------------

// Return the pointer to the transmit buffer (for debugging)
char * (__stdcall *DebugBufferTx)(void) ;

// Return the pointer to the receive buffer (for debugging)
char * (__stdcall *DebugBufferRx)(void) ;

// --------------------------------------------------------------------------------
```

6. Software demo

Together with your MCZR, you additionally get the demo software "test DLL".
System requirements for installing the demo software are the following:
·   512 MB RAM;
·   1.5 MB free hard disk space;
·   XGA or higher-resolution monitor;
·   Mouse or other pointing device;
·   Intel® Pentium® III/M 1.4 GHz processor minimum;
·   Operating Systems 32 bit:
      Microsoft® Windows XP Home or Professional (SP2);
      Microsoft® Windows Vista (requires Administrator rights);
      Microsoft® Windows 7 (requires Administrator rights).

Run the executable file (setup.exe) to start software installation.

6.1 DEMO mode Control Panel

MCZR control panel consists of 5 sections:
·   Ports
·   Parameters
·   Versions
·   Device Status
·   Commands

In section Ports press the OPEN button to connect your TCZR to the PC. The "Common Port" window shows the virtual serial port number where the device is found. Three state coloured indicators show state messages: the system is correctly connected if the Connected indicator turns green while Timeout and Checksum are error messages.

In section Parameters, the default factory settings are listed. Press the "GET" button to update and get the present values.

Section Versions lists the DLL release and firmware version.
In the Device Status Section, the following error, warning and state indicators are listed.

In detail:
1.   Over supply error (see 5.2.3);   5.   Position Error (see 5.2.3);
2.   Under supply error (see 5.2.3);   6.   Position warning (see 5.2.3);
3.   Over current error (see 5.2.3);   7.   Busy (see 5.2.3);
4.   I2T error   8.   Run (see 5.2.3).

Commands section allows the user to set the Macro Zoom Revolver magnification by selecting the corresponding position (0,1,2,3). In case of position Error, press the "Trillo" button to recover the position.
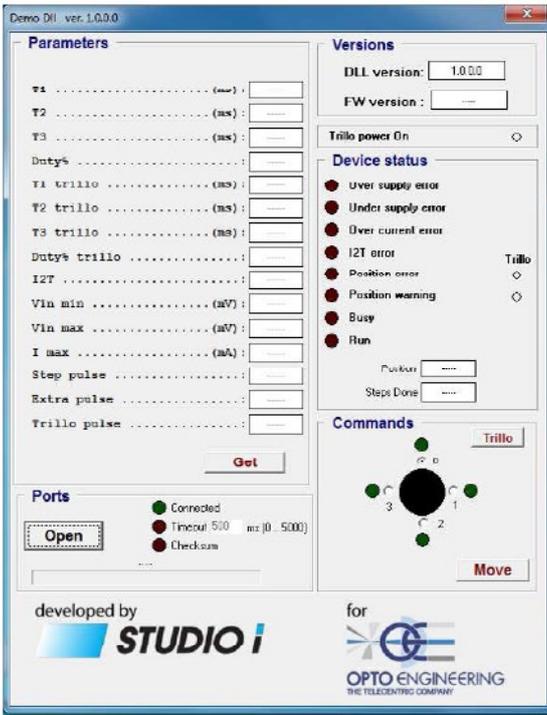
You can download the complete software package from this location:

www.opto-engineering.com/products/mczr#downloads

7. Center position repeatability

Center position repeatability is defined as the positional stability of a reference point at the same magnification, keeping the same measurement configuration.

Choosing a reference point C1 (X1;Y1), after n measurements at the same magnification, the distribution of reference point positions (C1,C2,..., Cn) has a mean Cm(Xm;Ym) that is the Center of the repeatability area. The radius of this area is the maximum distance between the mean of the distribution and any other reference point registered in testing.
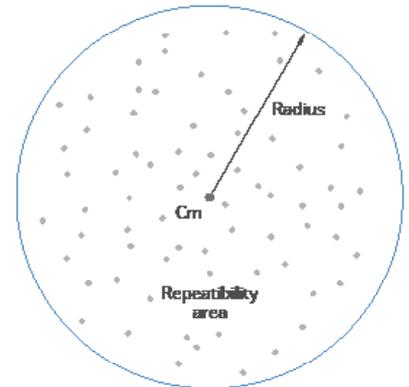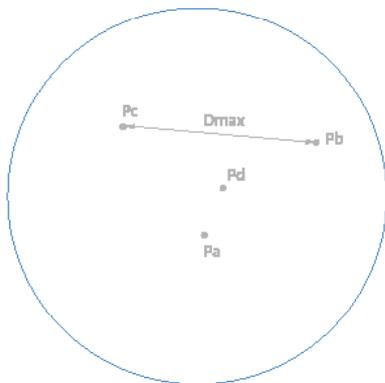

8. Center displacement

Every zoom system shows different image centering at different magnification settings.

Choosing a reference point at a given magnification, when magnification is changed this point shifts. The maximum distance between reference points at different magnifications is center displacement.

To better understand this effect you can refer to the following picture.

To eliminate this effect you can select a reference point at the image center when the lens is set at its maximum magnification. Then you can measure the x and y image center displacements at the other three magnifications.

The x and y (dx and dy) displacements must be receorded together with other calibration parameters specific for each zoom configuration (magnification factor, residual distortion correction parameters...)

The maximum x or y displacement will define the width and height of a crop-window which will show the image center always perfectly aligned.
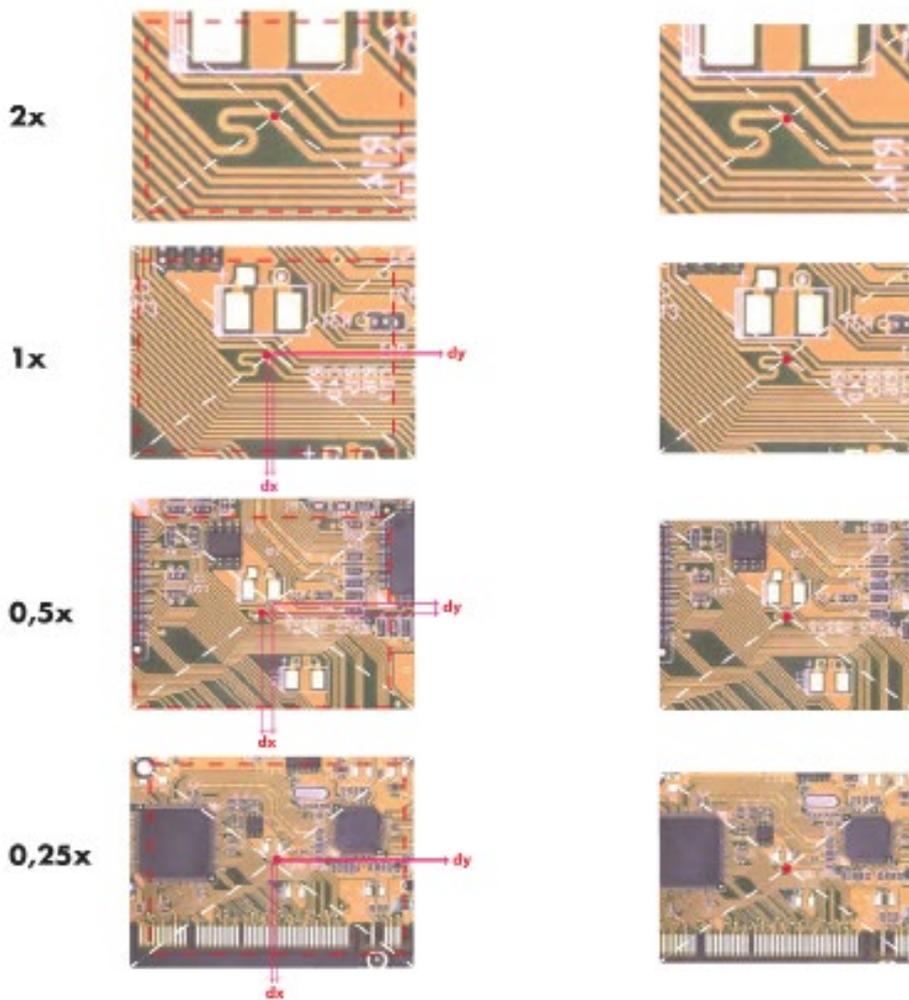
CE Conformity

Opto Engineering declares that product MCZR series complies with the provisions
of the Community Directive 2004/108/CE (EMC) according to EN 61326-1
(Measuring Devices and Control Laboratory), including all applicable amendments.
All standards and/or technical specifications mentioned below have been applied.

Method	Title
CEI EN 61326-1:2007-03	Electrical equipment for measurement, control and laboratory use EMC requirements. Part1: General requirements
CEI EN 61000-4-2:2011-04	Electromagnetic compatibility (EMC) Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test
CEI EN 61000-4-3:2007-04 CEI EN 61000-4-3/A1:2009-01 CEI EN 61000-4-3/A2:2011-01	Electromagnetic compatibility (EMC) Part 4-3 : Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity Test
CEI EN 61000-4-8:1997-06 CEI EN 61000-4-8/A1:2001-10	Electromagnetic compatibility (EMC) Part 4: Testing and measurement techniques Section 8: Power frequency magnetic field immunity test - Basic EMC Publication

DISCLAIMER
Specifications within this document are subject to change without notice. Photos and pictures are for illustration purposes only and may differ from the real product's appearance.

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