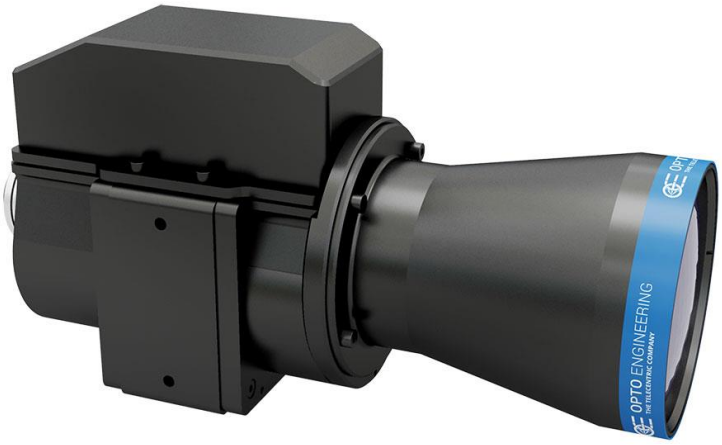
OPTO ENGINEERING

8x Bi-Telecentric zoom lenses with motorized control

TCZR036S
TCZR072S



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1. PRODUCT OVERVIEW

TCZR036S and TCZR072S are zoom revolver telecentric lenses that provide up to four different magnification changes. In particular, TCZR036S and TCZR072S perform discrete (non-continuous) magnification changes while working at the same fixed working F-number and at the same working distance.
TCZRS lenses feature an extremely fast, reliable and precise positioning system with a bipolar stepper motor and an incremental magnetic encoder, delivering exceptional magnification repeatability. Moreover, focusing and image centering stability are guaranteed at every magnification position, thus avoiding recalibration at any given time.

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
  Zoom revolver contains very delicate components that might be permanently damaged if handled carelessly.
- Product must be adequately shielded if employed in dusty and humid places
- Do not use together with machines that generate strong vibrations
  Zoom Revolver might be permanently damaged if deployed in the presence of strong vibrations and impulsive forces
- TCZRS 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 Specifications paragraph.

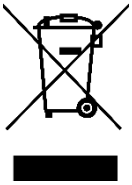
3. PRODUCT WARRANTY

3.1. Warranty

The device warranty is 12 months from the effective delivery date with reference to the device serial number.
The warranty covers the replacement or repairs of the defective part (components, device or part of it) with the exclusion of dismantling and shipping costs.
The replacement of one or more components does not renew the warranty period of the entire device. The manufacturer cannot be held liable for any compensation for whatever reason and the buyer renounces any claims for costs or damages to third parties due to any machine downtime.
The electronics and parts subjected to normal use or deterioration due to atmospheric agents and the external environment are excluded from the warranty. Also, all failure caused by the lack of, insufficient or incorrect maintenance performed by unskilled or unauthorized personnel or due to unintended use or unauthorized replacements, alterations or repairs is excluded from the warranty.

3.2. Applied directives

Opto Engineering srl, with registered office in Strada Circonvallazione Sud 15, 46100 Mantova (Mn), Italy, states that the products described in this manual are marked with "CE" and comply therefore with the following applicable Directives and their amendments: RoHS Directive 2011/65/EU.



2012/19/EU (WEEE directive): Products marked with this symbol cannot be disposed of as unsorted municipal waste in the European Union. For proper recycling, contact Opto Engineering srl which will provide the support for disposal.

4. SPECIFICATIONS

4.1. Specifications table

Optical specifications *Mechanical specifications*

Part number	Mag.	Image circle Ø	WD	wF/#	Telec.	Distortion	Field depth	CTF @70 lp/mm	Mount	Phase adj.	Length	Max height	Max width	Mass
	(x)	(mm)	(mm)		(deg)	(%)	(mm)	(%)			(mm)	(mm)	(mm)	(g)
				[1]	[2]		[3]			[4]				
TCZR036S	0,250	11	74,0	16	< 0.05	< 0.05	13,2	> 40	C	Yes	212,0	144	103	2500
	0,500	11				< 0.04	3,3	> 35						
	1,000	11				< 0.04	0,8	> 40						
	2,000	11				< 0.08	0,2	> 35						
TCZR072S	0,125	11	157,8	16	< 0.05	< 0.1	53,0	> 35	C	Yes	279,7	144	103	2850
	0,250	11				< 0.08	13,2	> 40						
	0,500	11				< 0.05	3,3	> 40						
	1,000	11				< 0.07	0,8	> 35						

Notes

1	Working F/#: the real F/# of a lens when used as a macro. Lenses with smaller apertures can be supplied on request
2	Maximum slope of principal rays inside the lens: when converted to milliradians, it gives the maximum measurement error for any millimeter of object displacement
3	At the borders of the field depth the image can be still used for measurement but, to get a very sharp image, only half of the nominal field depth should be considered.
4	Indicates the availability of an integrated camera phase adjustment feature

Encoder specifications

Number of encoders		1
DC power supply	(V)	5
Maximum supply current	(mA)	80
Type		Magnetic rotary, incremental with reference
Signal outputs		A, B, Z (index)
Interface		RS422
Number of magnetic poles		120
Poles pitch	(mm)	2
Interpolation		500
Pulses per revolution		60000
Motor to encoder ratio[1]		2.56

Notes

1	1 encoder pulse = 2.56 motor µsteps (with a 256 microstepping control)

Motor specifications

Number of motors		1
Type		Bipolar stepper
RMS winding current	(mA)	600
Winding voltage	(V)	24
Steps per revolution		200

Environmental specifications

Operating temperature	(°C)	0 to 40
Storage temperature	(°C)	0 to 50
Humidity	(%)	10-85 non-condensing
IP rating		-
Installation		Indoor use only. The product must be shielded from vibration sources and impulse forces

4.2. Connector

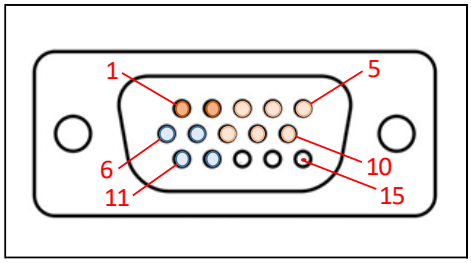


Figure 1: DB15-HD connector, male, panel view

PIN	NAME	DESCRIPTION
1	5V	5V encoder power supply
2	GND	0V encoder reference ground
3	ENC_A +	Encoder quadrature signal – A +
4	ENC_B +	Encoder quadrature signal – B +
5	ENC_Z +	Encoder quadrature signal – Z +
6	MOT_A +	Motor – Phase A +
7	MOT_B +	Motor – Phase B +
8	ENC_A -	Encoder quadrature signal – A -
9	ENC_B -	Encoder quadrature signal – B -
10	ENC_Z -	Encoder quadrature signal – Z -
11	MOT_A -	Motor – Phase A -
12	MOT_B -	Motor – Phase B -
13	N.C.	-
14	N.C.	-
15	N.C.	-

5. INSTRUCTIONS FOR USE WITH MTDV MOTION CONTROLLER

5.1. First use of TCZRS with MTDV motion controller

MTDV motion controller is a general purpose motion controller. If you connect it to a TCZRS zoom lens for the first time, you need to properly configure its parameters. This operation is fast and simple. You only need:

- TCZR072S or TCZR036S zoom lens
- MTDV1CH-22A2 motion controller
- CBMT002 cable
- Ethernet cable
- 24V power supply (power required ~ 40W) and 3 electrical wires
- A browser and internet connection

5.1.1. Download the XML configuration file

Download the XML configuration file of your zoom lens on the web page
https://www.opto-e.com/configuration_files
by typing the serial number of the lens and the Opto Security Number and by clicking the submit button.

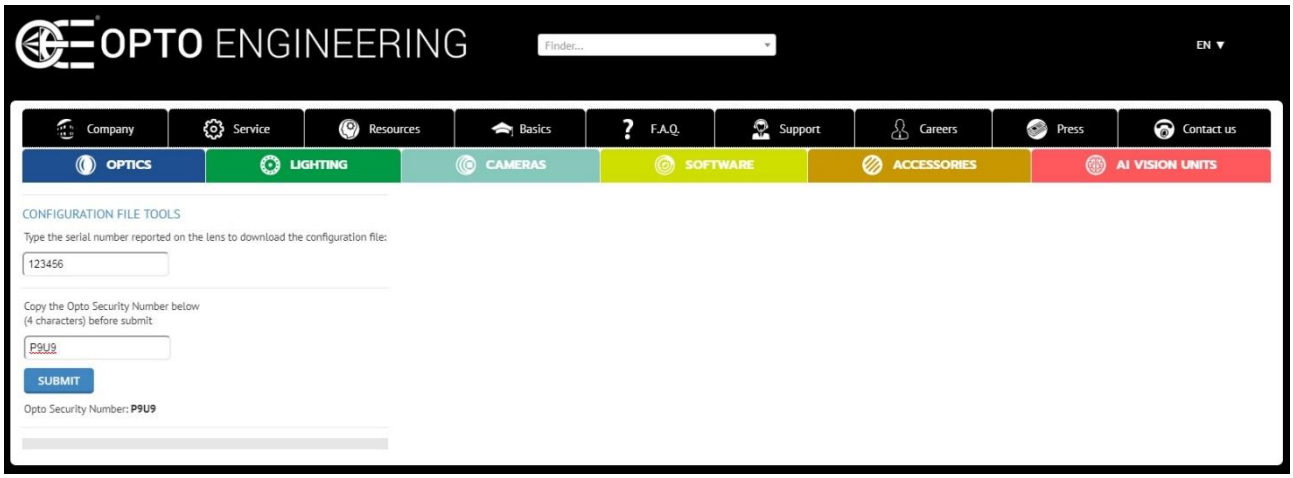


Figure 2: XML downloading page.

5.1.2. Connect the MTDV motion controller

CAUTION: *DO NOT connect TCZRS at this point.*
A not correct MTDV configuration may damage TCZRS devices.

Power on the MTDV1CH-22A2 motion controller by wiring the power supply to power connector of the device (+24V, GND and PE). Configure your network card to a static IP 192.168.1.xxx (xxx goes from 0 to 255 and must be different from 200) with subnet mask 255.255.255.0. Connect the network card to the RJ45 connector of the device using an Ethernet cable. Wait a few seconds.

5.1.3. Open the GUI and Load the XML configuration file

Open a browser and type 192.168.1.200 in the address bar. Now you are in the "Operation" web page of the MTDV GUI.

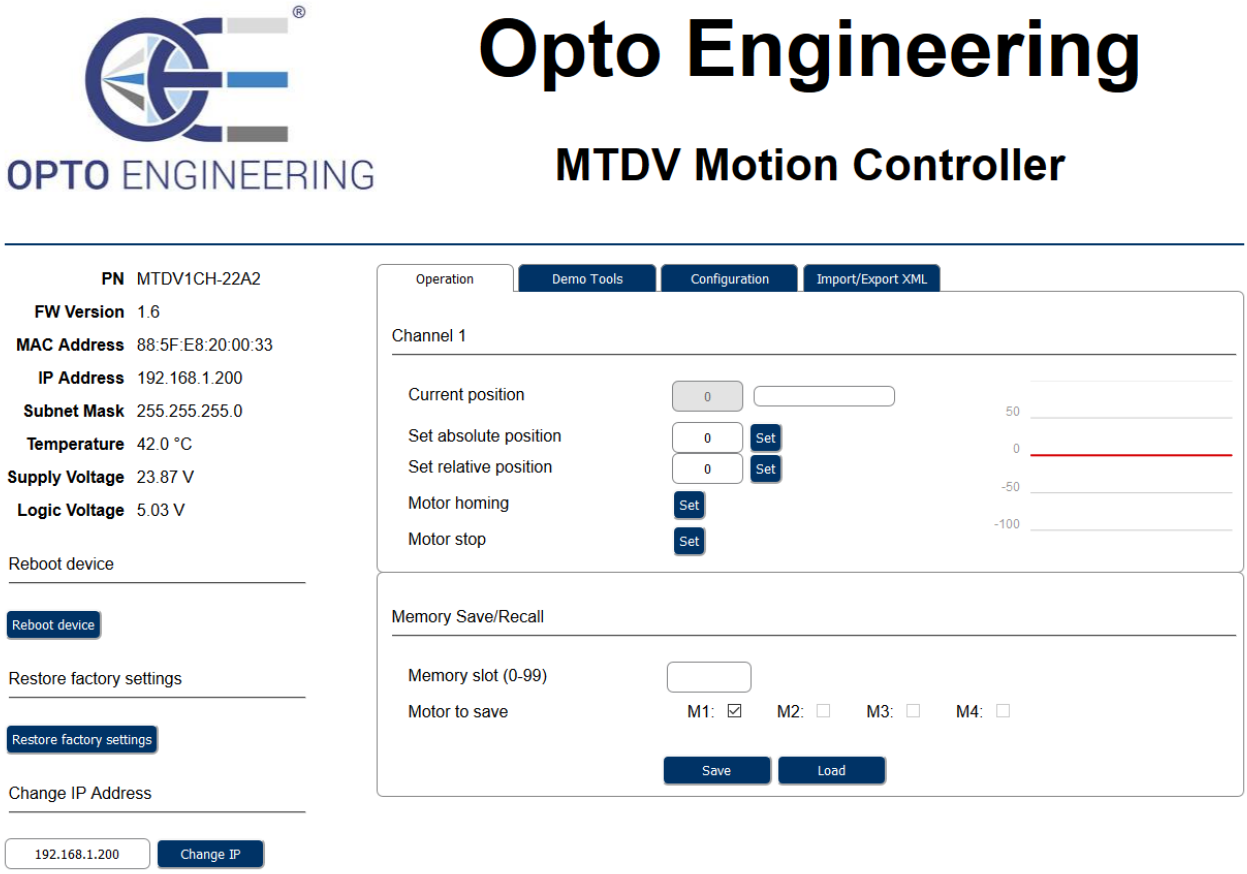


Figure 3: MTDV GUI – Operation tab

Click the button "Import/Export XML" (top-right of the web page) and click "Browse XML file" to select and load the XML file previously downloaded. If you use a multichannel device (i.e. MTDV2CH-22A2, MTDV3CH-22A3, MTDV4CH-22A4) you can choose which channel to associate to the zoom (see Figure 4).
The MTDV has 100 memory slots (from 0 to 99) to save motor positions. The XML file contains the information of the 4 motor positions for the 4 different magnification of the lens. You can specify the memory offset to save this information. For example, if you choose "0" motor positions are saved into 0, 1, 2, and 3 memory slots. If you choose "21" motor positions are saved into 21, 22, 23, and 24 memory slots. Click "Import XML" and your MTDV is configured for your TCZRS family zoom lens. Please refresh the page to see the updated MTDV configuration.

5.1.4. Connect the TCZRS zoom lens

Switch off your MTDV1CH-22A2 motion controller by disconnecting the power connector. Connect the TCZRS zoom lens using CBMT002 cable and power on the controller.
Wait a few seconds, then open a browser and type 192.168.1.200 in the address bar. Now you are in the "Operation" web page of the MTDV GUI. At the bottom of the page there is a text box named "Memory slot (0-99)". Type in that box a number in the range you choose while importing XML information (for example 0 ÷ 3 or 21 ÷ 24) and click "Load" button to load each position of the TCZRS zoom lens.

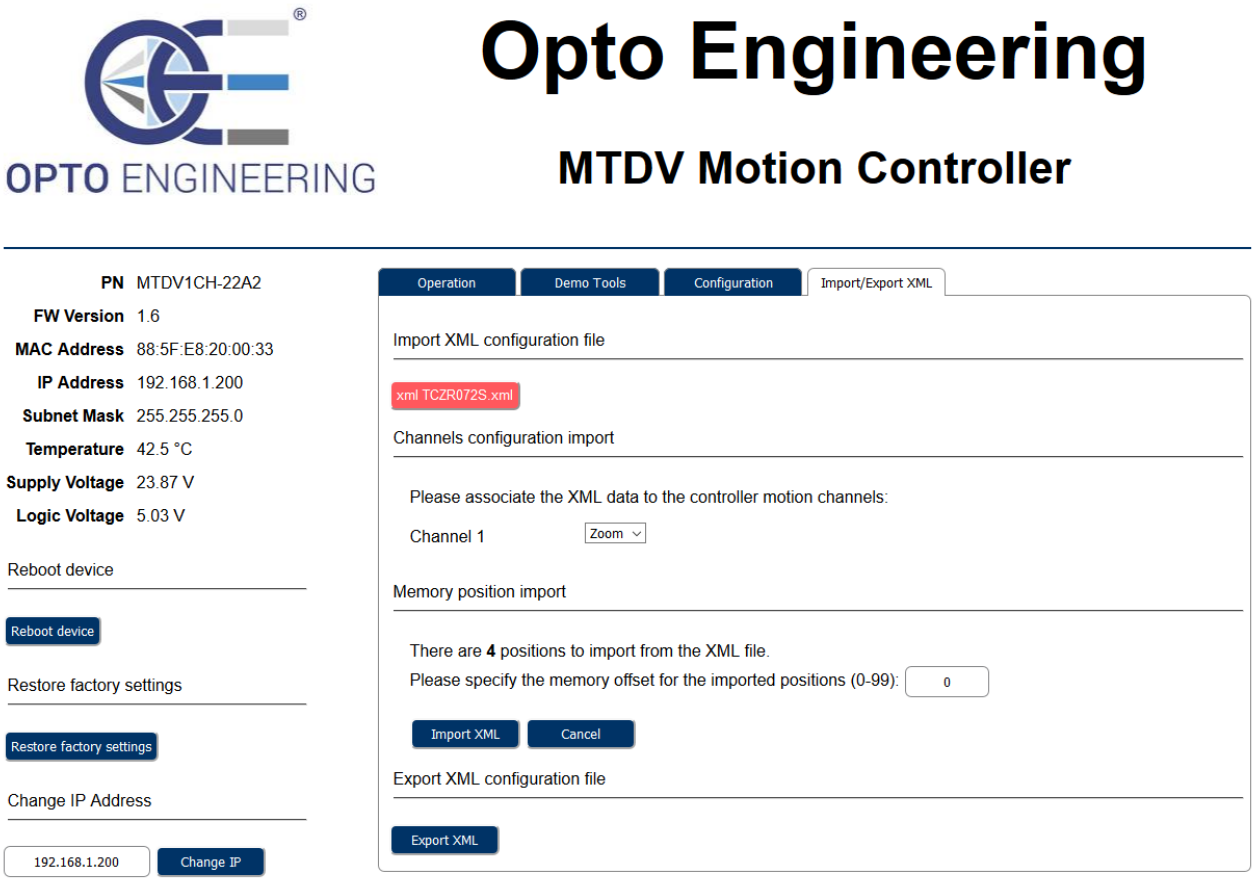


Figure 4: MTDV GUI – Import/Export XML tab after successful loading of XML file.

5.2. Clamping, turning on and focusing

The TCZRS must be mounted on a rigid support by means of adequate clamps. Specifically, it must be clamped using its M6 clamping holes.

CAUTION: *Clamping the product in other positions might seriously damage internal components and alter the overall optical performance.*

NOTE: *In case of first use of your MTDV motion controller, a specific first configuration is needed. Please see section* ***First use of TCZRS with MTDV motion controller****.*

Connect the TCZRS to a MTDV motion controller using the CBMT002, then turn on the product by supplying 24V to the power connector of the MTDV. When you turn on the device, it performs a homing procedure and it stops to the last reached position.
After clamping, 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 test report provided with your TCZRS.
2. Reach the maximum magnification position (see section 5.3).

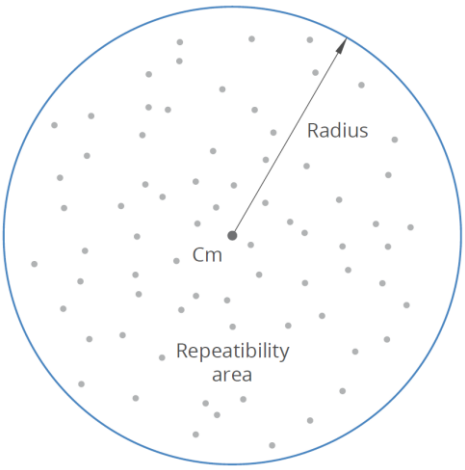
3. Precisely adjust the mount position by means of adding/removing back focal adjustment spacers until you find the best focusing position.
4. Adjust the phase angle. Once you find the right phase, lock the screws (M2 metric thread).

5.3. How to change the magnification with MTDV motion controller

Be sure to correctly load the lens XML configuration file (see sections 5.1.1 and 5.1.3 for details). Now the four different magnifications of the TCZRS zoom lens are saved into the memory slots of the MTDV motion controller.
Go in the "Operation" web page of the MTDV GUI (see Figure 3) at the "Memory Save/Recall" section. Type a number in the range of memory slots you choose when importing XML and click "Load" button to change the magnification.

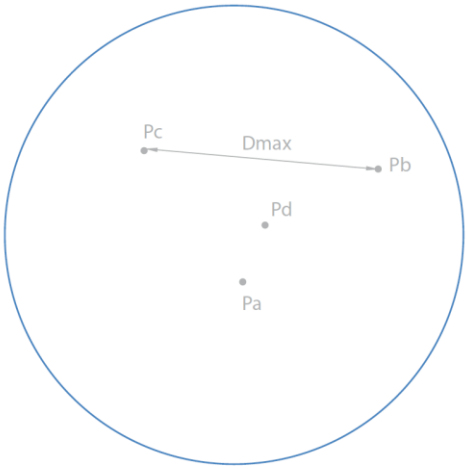
6. CENTER POSITION REPEATABILITY

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 C_1 (X_1;Y_1), after n measurements at the same magnification, the distribution of reference point positions (C_1,C_2,..., C_n) has a mean C_m(X_m;Y_m) 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.



7. 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 the center displacement. To better understand this effect, you can refer to the following picture.

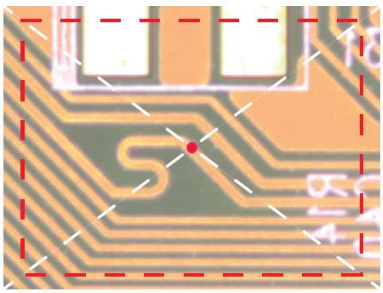


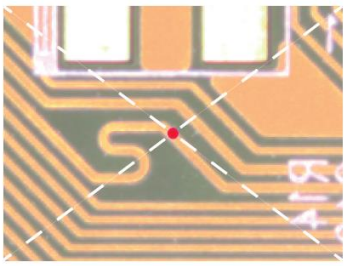
Pi reference point
i=a,b,c,d magnification
Dmax= 250 µm

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 recorded together with other calibration parameters specific for each zoom configuration (magnification factor, residual distortion correction parameters...)

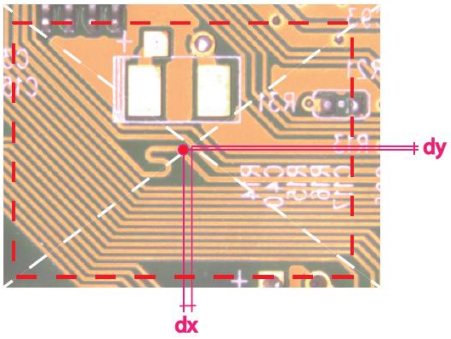
The maximum x or y displacement will define the width and height of a crop-window which will show the image center always perfectly aligned.

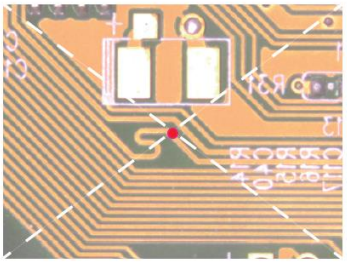
2x



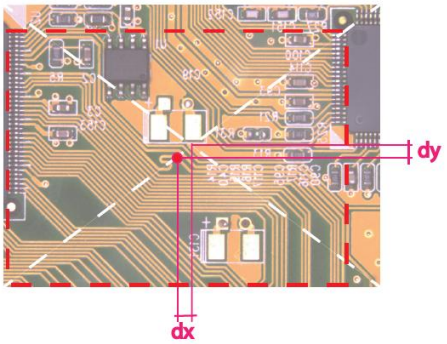


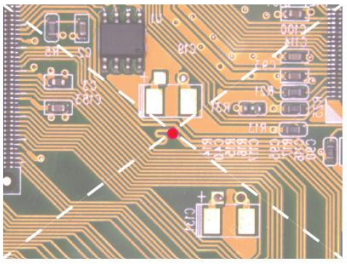
1x



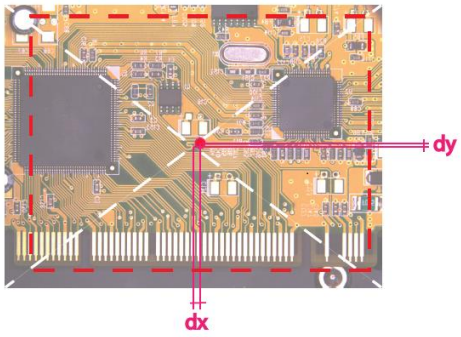


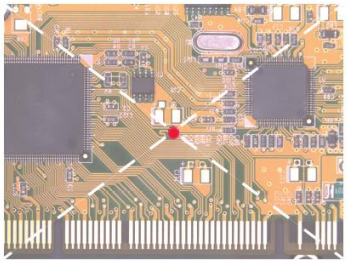
0,5x





0,25x





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