



Product Information
Version 1.0

ZEISS Axio Imager Vario

Examine Large Specimens – Automated and Compatible
with Clean Rooms



We make it visible.

Bring Large Specimens Into Focus – Quickly and Reproducibly

- › **In Brief**

- › The Advantages

- › The Applications

- › The System

- › Technology and Details

- › Service

Axio Imager Vario brings out your research, development, and quality assurance specimens so that they are larger than life, regardless of whether you are working with tiny MEMS sensors or XXL wafers. On top of this, a maximum specimen size of 300 mm × 300 mm and an impressive maximum specimen height of 254 mm make sure that you will be able to analyze large specimens nondestructively. And all this supported by the stability provided by a column design. Examine your wafers in your clean room – Axio Imager Vario is DIN EN ISO 14644-1-certified and meets the requirements corresponding to clean room class ISO 5. Finally, a motorized Z-axis drive and the Hardware Auto Focus system ensure that you will always be able to automatically bring low-contrast, reflective specimens into perfect focus so that you will always get optimum results.



ZEISS Axio Imager Vario: Simpler. More intelligent. More integrated.

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Stretch Your Limits

Select from two manual and one motorized columns and take advantage of a maximum specimen size of 300 mm × 300 mm and an impressive maximum specimen height of 254 mm. Whether dealing with heavy specimens or working in combination with the LSM 700 laser scanning microscope – the sturdy column design provides reliable stability and prevents vibrations. In addition, you can expand your possibilities even further by selecting from various stages for reflected and transmitted light applications, as well as from various specimen holders.

Certified for Clean Room Work

Wafer and photomask inspections are subject to extremely strict requirements concerning cleanliness. This is why Axio Imager Vario is DIN EN ISO 14644-1-certified and, together with a clean room kit, meets the requirements corresponding to clean room class ISO 5. Moreover, extensive accessories, such as a seven-position objective turret with a guard designed to protect against foreign particles and a sneezing guard, ensure that your specimens will always remain perfectly clean. All of this, of course, with your components retaining all of their functionality and performance.

In Focus at all Times

If you need to examine the surface of reflective, low-contrast specimens, you can simply equip Axio Imager Vario with the fast and efficient Hardware Auto Focus system. This system guarantees a high precision of up to 0.3 times the objective's depth of field, and is well suited to both reflected light and transmitted light applications. The sensor detects changes in the focus position, any deviations are compensated automatically. This means that even large specimens will remain perfectly focused while being moved in the X- and Y-axis directions.



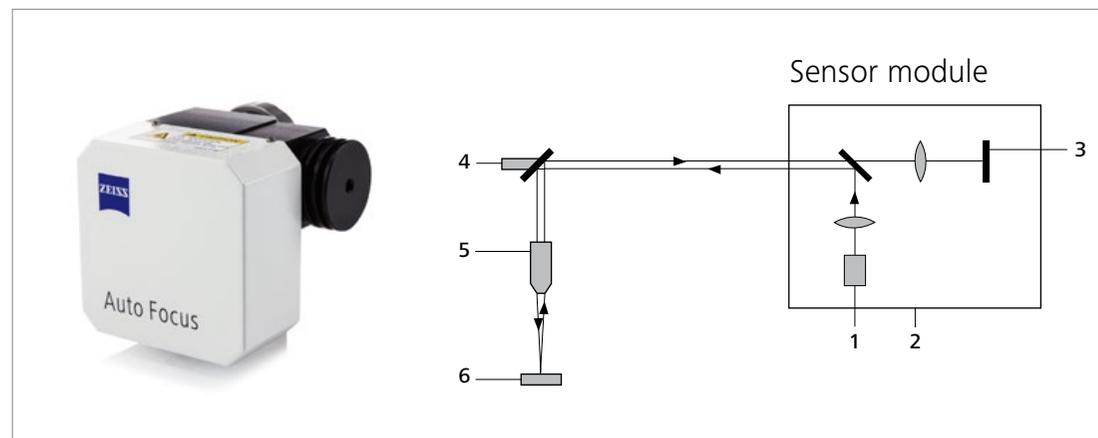
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Examinations in the fields of research and industrial production (e.g. surface examinations of reflective, low-contrast specimens such as metallographic specimens and polished or textured wafers) require a fast focusing system that ensures high precision levels of max. 0.3 times the objective's depth of field. This requirement can be easily met by combining your Axio Imager Vario with the Hardware Auto Focus system to benefit from fast and accurate focusing across a wide capture range of up to 12,000 µm. The Hardware Auto Focus system is designed to work with reflected light and transmitted light microscopy in brightfield, darkfield, polarized light, DIC, and oblique illumination applications.

How it Works

The objective guides the structured light produced by an LED in the Auto Focus system's sensor module onto the specimen, with the specimen's surface reflecting it back. During this process, Auto Focus permanently analyses the properties of the reflected LED light and derives the appropriate control signals for the focus drive, to bring the surface into focus. The Auto Focus system comes with three different modes corresponding to different specimen characteristics (reflective/partially reflective/diffuse) and with three different precision levels (precision/balance/speed). The Auto Focus sensor detects changes and deviations in the focus position. These are then automatically compensated by the direct access of Auto Focus controller to the microscope's Z-drive.



How the Hardware Auto Focus system works: 1) LED 2) Sensor module 3) Sensor 4) Beam splitter 5) Objective 6) Specimen

Objective magnification	Max. capture range in µm (reflective, bright surface)	Maximum precision of focus position (accuracy) (~0.3 times the objective's depth of field), in µm	Minimum size of the object to be brought into focus, in µm
1.25x	>12,000	~170.00	~2,000
2.5x	>10,000	~42.00	~1,000
5x	>10,000	~8.90	~500
10x	>8,000	~2.50	~250
20x	>4,000	~0.60	~125
50x	>700	~0.25	~50
100x	>150	~0.20	~25

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Semiconductor device fabrication work and wafer inspection operations are performed in clean rooms in order to protect components from impurities that could have an impact on their operation. Accordingly, the use of clean rooms is accompanied by especially strict requirements concerning air quality. Clean rooms are categorized into various classes as per DIN EN ISO 14644-1, which relies on the amount and size of particles per cubic meter as defining criteria. Axio Imager Vario is certified for use in clean rooms in accordance with DIN EN ISO 14644-1 and, when used in conjunction with a clean room kit, meets the requirements of the ISO 5 clean room class, which is the one most frequently used; it corresponds to class 100 in the original FED STD 209E (1992) standard. This clean room kit comes with a special seven-position objective turret, as well as with guards providing protection against particles and sneezing. All components are delivered in double packaging, properly cleaned and airlock-ready.



Clean Room Classes as per DIN EN ISO 14644-1

ISO class	Limits (particles per cubic meter) for particles with a size equal to or greater than					
	0.1 µm	0.2 µm	0.3 µm	0.5 µm	1.0 µm	5.0 µm
ISO 1	10	2				
ISO 2	100	24	10	4		
ISO 3	1,000	237	102	35	8	
ISO 4	10,000	2,370	1,020	352	83	
ISO 5	100,000	23,700	10,200	3,520	832	29
ISO 6	1,000,000	237,000	102,000	35,200	8,320	293
ISO 7				352,000	83,200	2,930
ISO 8				3,520,000	832,000	29,300
ISO 9				35,200,000	8,320,000	293,000

Expand Your Possibilities

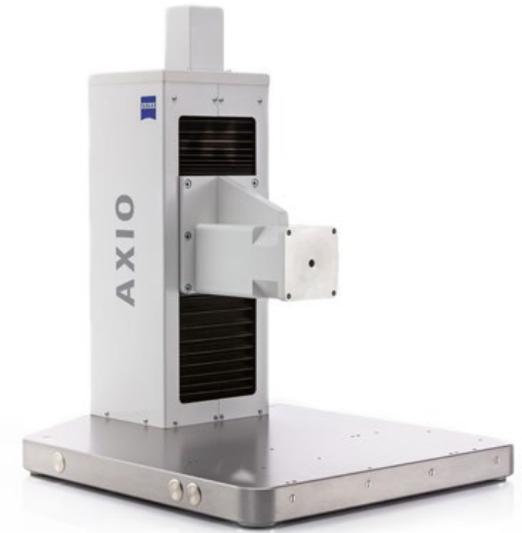
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The small manual column allows for specimen sizes of up to 200 mm × 200 mm in the X- and Y-axis plane and specimen heights of up to 254 mm.



The large manual column allows for specimen sizes of up to 300 mm × 300 mm in the X- and Y-axis plane and specimen heights of up to 254 mm. This track stand post is suitable for use with LSM 700.



The motorized column allows for specimen sizes of up to 300 mm × 300 mm in the X- and Y-axis plane and specimen heights of up to 254 mm, and features three-button controls as per industrial standards. This track stand post is suitable for use with LSM 700.

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ZEISS Axio Imager Vario and ZEISS LSM 700

Combining Axio Imager Vario and LSM 700 opens up a new world of possibilities. In fact, specimens that need to be analyzed at high resolutions with no contact almost seem to have been made specifically for this combination. Extremely fine lateral fragments with sizes as small as approx. 120 nm (scribe line structure/width) can be optically resolved in great detail. And with LSM 700, you can detect the smallest surface defects (with a size of only a few nanometers) with extreme precision so that you can pinpoint their exact location. By using Axio Imager Vario in combination with LSM 700, you can obtain laser scribe topographies and thin-film solar cell surface topologies. You will be able to measure laser scribes and determine surface roughnesses with much greater precision. Another typical application is being able to obtain topographies of the silver paste in crystalline silicon solar cells in order to evaluate the quality of the corresponding print screen.



Tailored Precisely to Your Applications

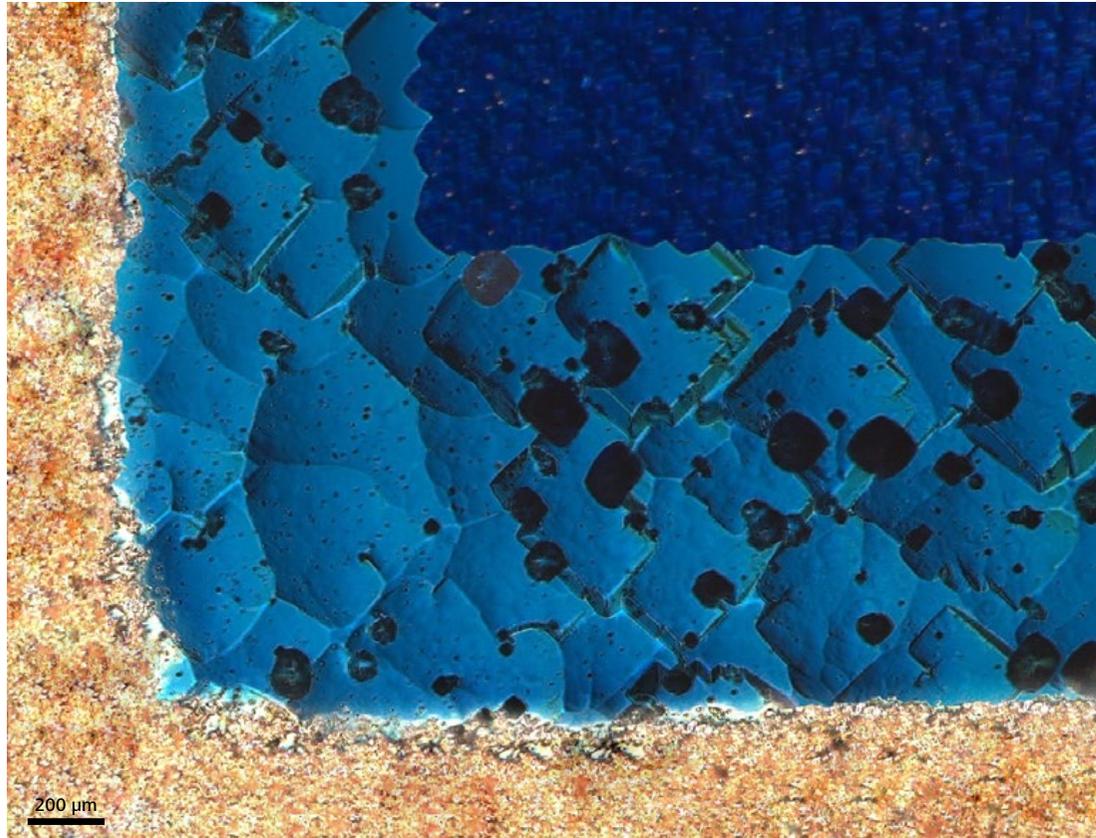
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Typical Applications, Typical Specimens	Task	ZEISS Axio Imager Vario Offers
Crystalline Silicon Solar Cells	<ul style="list-style-type: none"> ■ Surface morphology analyses ■ Metal contact dimensions (silver fingers, bus bars) ■ Laser edge isolation scribe dimensions and continuity 	<ul style="list-style-type: none"> ■ Manual or motorized stage for reflected light ■ Clean room kit
Print Screen for Solar Cells	<ul style="list-style-type: none"> ■ Height and width of holes on template 	<ul style="list-style-type: none"> ■ Manual or motorized stage for reflected light ■ Clean room kit
Thin-Film Solar Cells	<ul style="list-style-type: none"> ■ Laser edge isolation scribe continuity ■ Laser edge isolation scribe penetration depth ■ Crystallographic distribution and orientation, stress and microcracks in the crystalline silicon thin film 	<ul style="list-style-type: none"> ■ Manual or motorized stage with glass carrier ■ Transmitted light module ■ Hardware Auto Focus ■ Clean room kit
Wafers	<ul style="list-style-type: none"> ■ Checking for particles, scratches, pattern defects 	<ul style="list-style-type: none"> ■ Manual or motorized stage with wafer chuck ■ Clean room kit ■ Hardware Auto Focus
Photomasks	<ul style="list-style-type: none"> ■ Checking for extra chromium film and particles ■ Particles on chromium film 	<ul style="list-style-type: none"> ■ Manual or motorized stage with photomask holder ■ Clean room kit ■ Transmitted light module ■ Hardware Auto Focus
TFT LCD Inspections (ISO 13406-2)	<ul style="list-style-type: none"> ■ Checking for hot pixels (fault type 1) ■ Checking for dead pixels (fault type 2) ■ Checking for stuck pixels, hot (fault type 3) ■ Checking for stuck pixels, dead (fault type 3) 	<ul style="list-style-type: none"> ■ Manual or motorized stage with glass carrier ■ Transmitted light module ■ Hardware Auto Focus
Automotive Industry	<ul style="list-style-type: none"> ■ Composite material testing and development ■ Weld quality inspections ■ Checking for inclusions and cracks ■ Determining particle sizes and detecting nonmetallic inclusions 	<ul style="list-style-type: none"> ■ Manual or motorized stage for reflected light ■ Hardware Auto Focus
Natural Resources	<ul style="list-style-type: none"> ■ Texture and structure analyses ■ Pore size analyses ■ Fluorescence analyses ■ 2-D and 3-D imaging 	<ul style="list-style-type: none"> ■ Manual or motorized stage with glass carrier ■ Transmitted light module ■ LSM 700
Aerospace Industry	<ul style="list-style-type: none"> ■ Composite material testing and development ■ Weld quality inspections ■ Checking for inclusions and cracks ■ Determining particle sizes and detecting nonmetallic inclusions 	<ul style="list-style-type: none"> ■ Manual or motorized stage for reflected light ■ Hardware Auto Focus

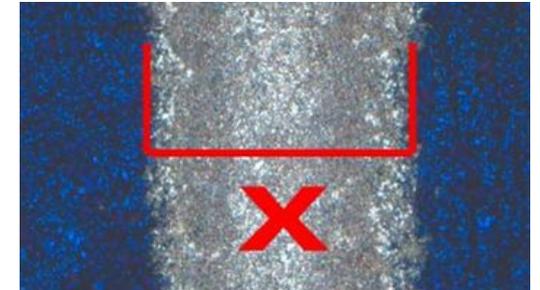
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Monocrystalline Silicon Solar Cell



Reflected light, C-DIC, EC Epiplan-APOCHROMAT 50x/0.95



Silver finger on polycrystalline silicon solar cell;
EC Epiplan-APOCHROMAT 20x/0.60



Silver finger: 3-D reconstruction on monocrystalline silicon solar cell;
EC Epiplan-NEOFLUAR 20x/0.50

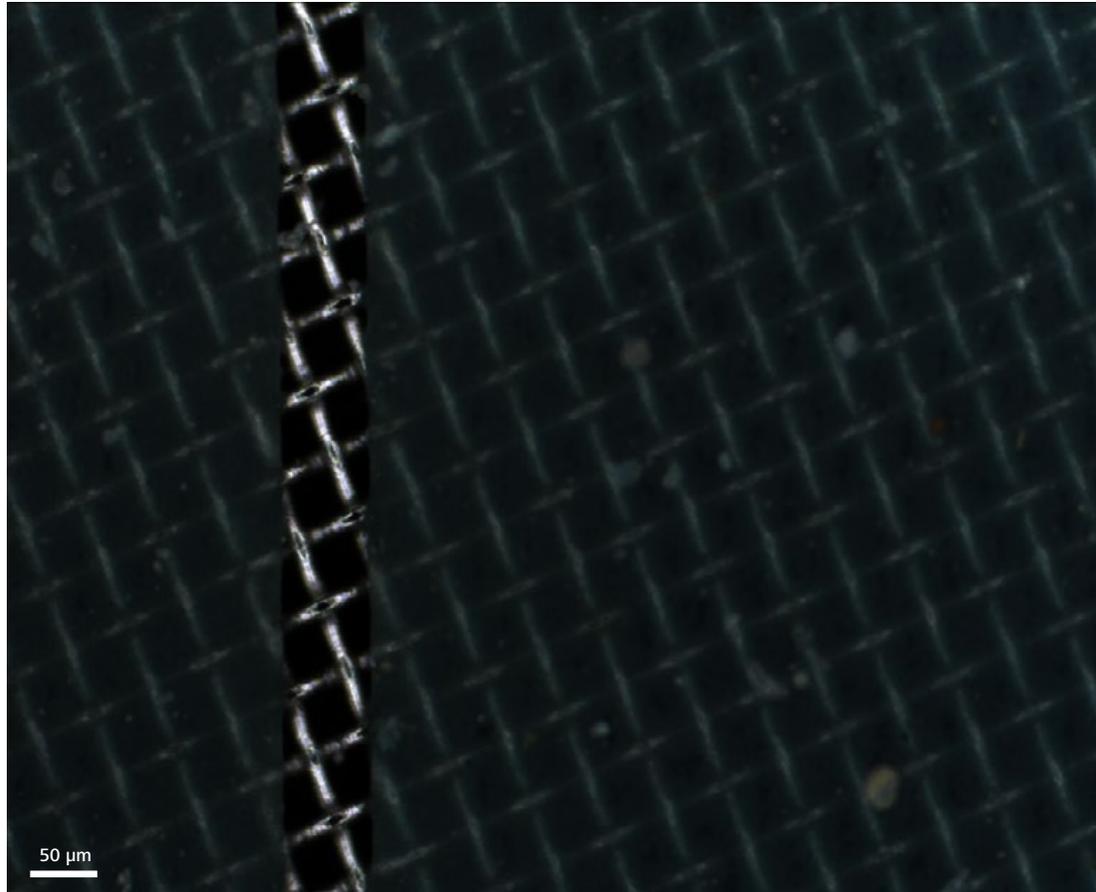


Laser edge isolation scribe: laser-textured edge isolation scribe on monocrystalline silicon solar cell;
EC Epiplan-APOCHROMAT 20x/0.60

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Print Screen



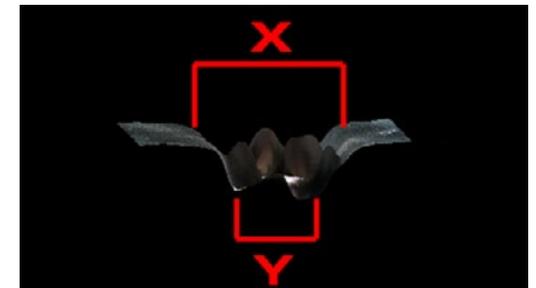
Reflected light, darkfield; EC Epiplan-NEOFLUAR 10x/0.25



Reflected light, darkfield; EC Epiplan-NEOFLUAR 50x/0.95



3-D reconstruction: a Z-series was captured with the AxioVision Topography module and shown as a 3-D reconstruction.

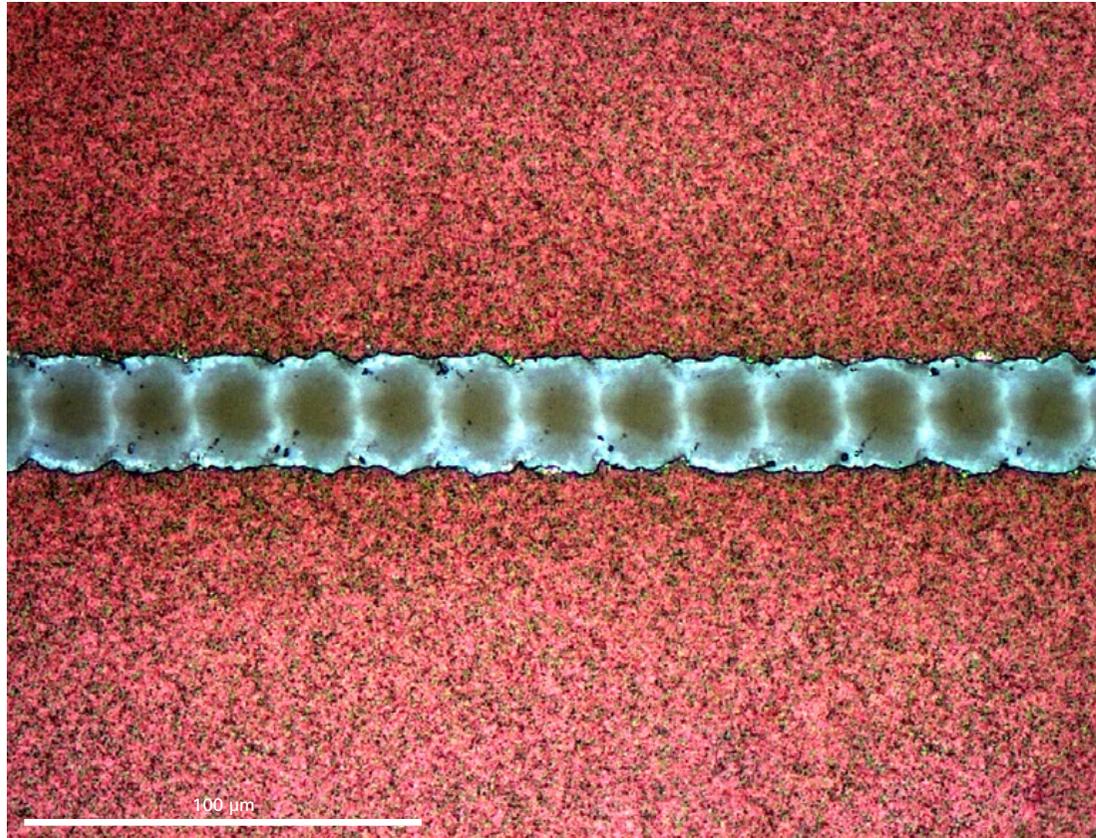


Rotated 3-D reconstruction

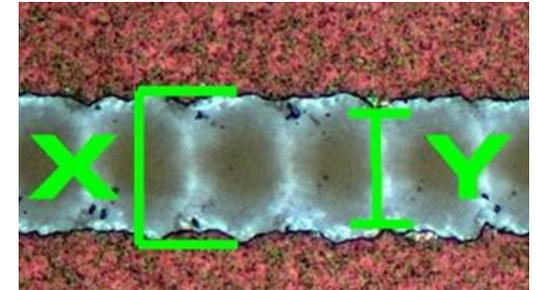
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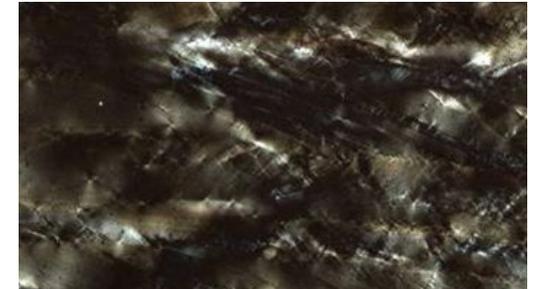
Thin-film Solar Cell



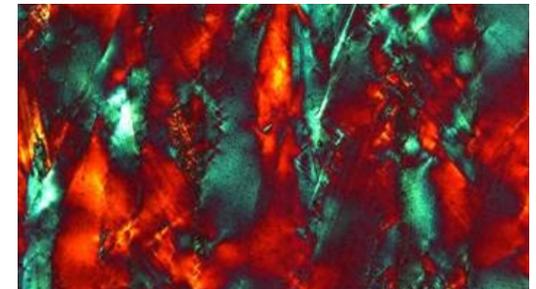
Reflected light, polarized light; EC Epiplan-NEOFLUAR 50x/0.80



CdTe thin-film solar cell: laser texture on thin-film solar cell in TCO coating on glass; reflected light, polarized light; EC Epiplan-NEOFLUAR 50x/0.80



Silicon thin-film solar cell: surface of a thin-film solar cell; reflected light, polarized light; EC Epiplan-APOCHROMAT 50x/0.95

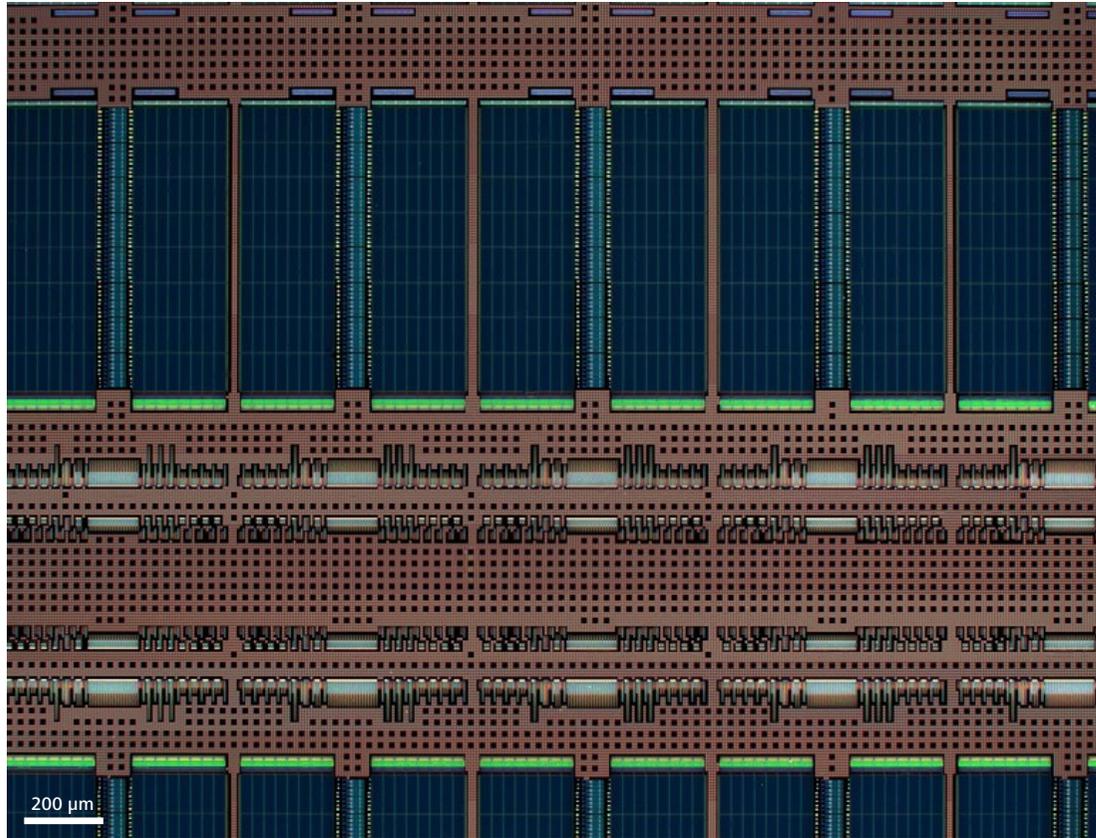


Silicon thin-film solar cell: surface of a thin-film solar cell; reflected light, polarized light with lambda plate; EC Epiplan-APOCHROMAT 50x/0.95

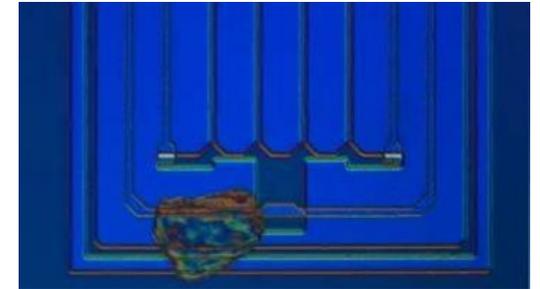
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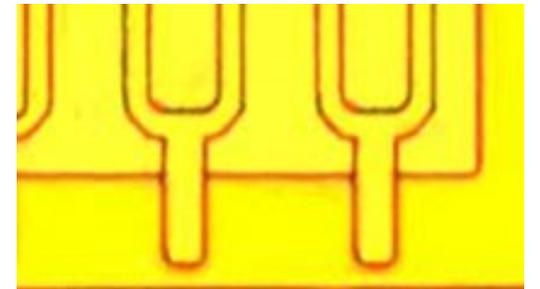
Wafer



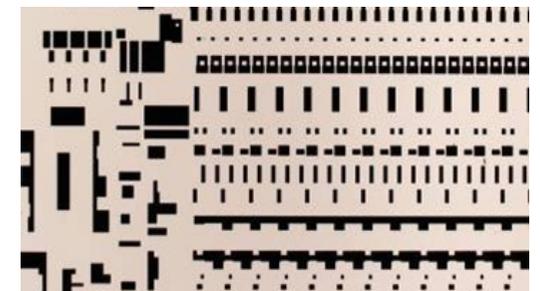
Reflected light, darkfield; EC Epiplan-APOCHROMAT 10x/0.30



Wafer with debris: reflected light, C-DIC, EC Epiplan-APOCHROMAT 50x/0.95



Pattern defects: reflected light, brightfield, EC Epiplan-APOCHROMAT 50x/0.95

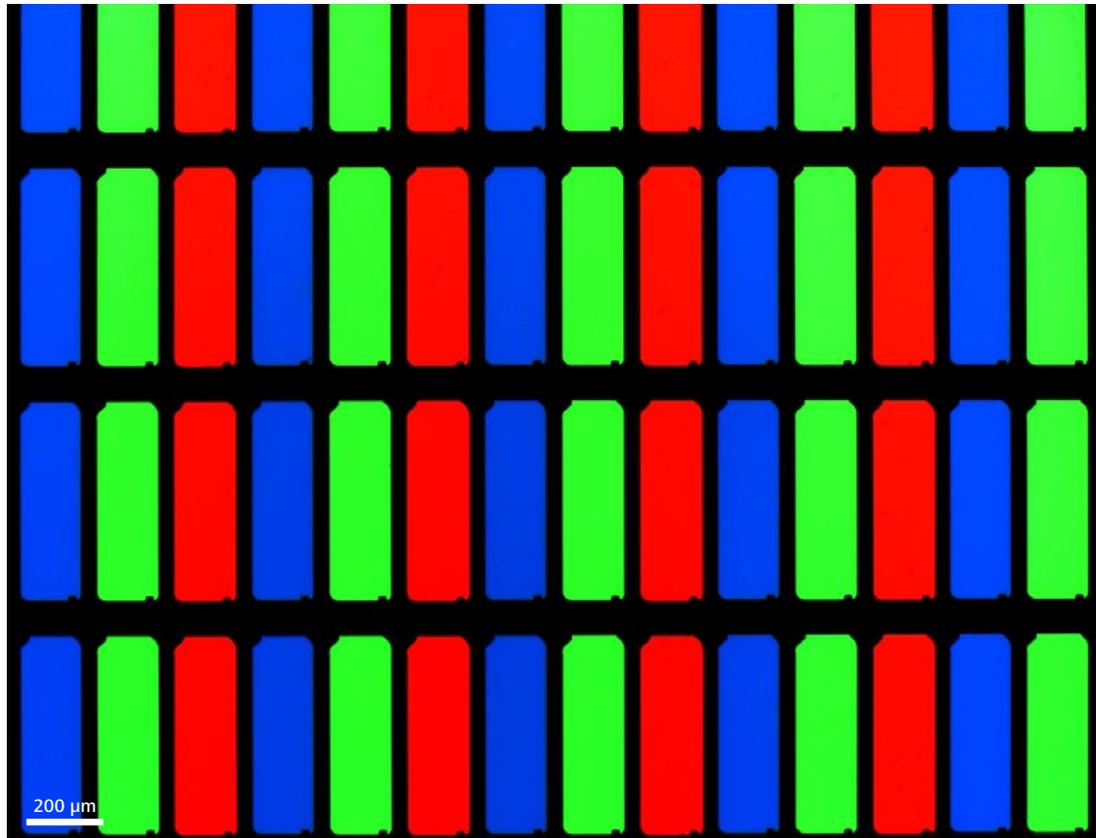


Reticle pattern: transmitted light, brightfield, EC Epiplan-APOCHROMAT 10x/0.30

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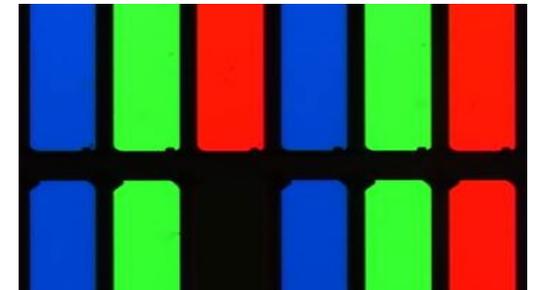
TFT Display



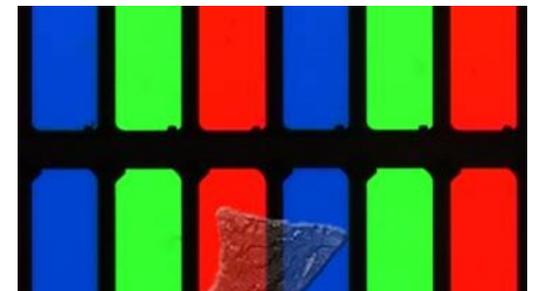
Transmitted light, brightfield, EC Epiplan-APOCHROMAT 10x/0.30



Hot stuck pixel: bright spot on black background caused by blue subpixel stuck in the "ON" state.



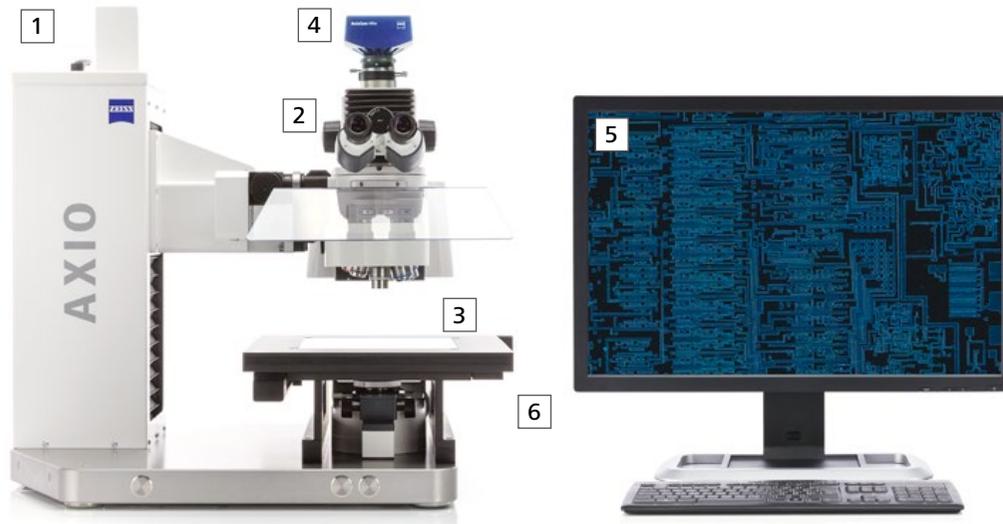
Dead stuck pixel: dark spot on white background caused by red subpixel stuck in the "OFF" state.



Debris on LCD: can result in dark spots; can be distinguished from dead subpixels under a microscope.

ZEISS Axio Imager Vario: Your Flexible Choice of Components

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1 Microscopes

- Axio Imager.A2 Vario (manual, coded)
- Axio Imager.Z2 Vario (capable of being fully motorized)
- Axio Imager.Z2 Vario (without turret focus)

2 Objectives

- Reflected light: EC EPIPLAN, EC Epiplan-NEOFLUAR, EC Epiplan-APOCHROMAT
- Transmitted light: N-ACHROPLAN, EC Plan-NEOFLUAR, Plan-APOCHROMAT, C-APOCHROMAT, FLUAR
- Special purpose: LD EPIPLAN, LD EC Epiplan-NEOFLUAR

3 Illumination

- 12 V 100 W halogen
- 100 W HBO
- microLED

4 Cameras

Recommended cameras:

- AxioCam HRC
- AxioCam MRc5
- AxioCam MRc
- AxioCam ICc 5

5 Software

- AxioVision, AxioVision LE

Recommended AxioVision modules:

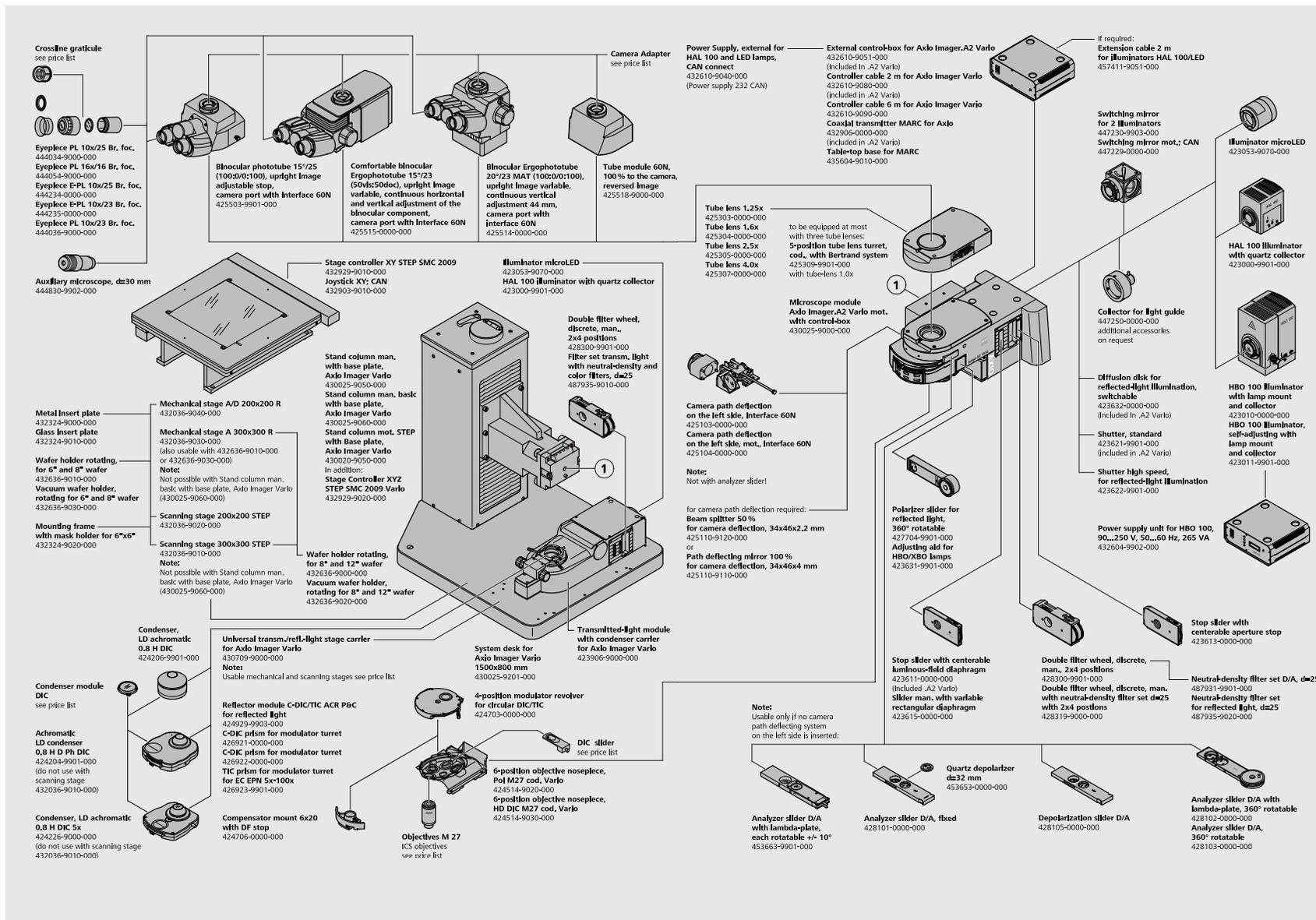
- MosaiX (image acquisition, scanning stage)
- Graphite, Grains, Multiphase, NMI, Particle Analyzer, Comparative Diagrams, Online Measurement, Shuttle & Find (image analysis)

6 Accessories

- Hardware Auto Focus
- Linear sensor
- Stages: XY stage, reflected light/transmitted light, 200 × 200 R
XY stage, reflected light, 300 × 300 R
Scanning stage, 200 × 300 STEP
Scanning stage, 300 × 300 STEP

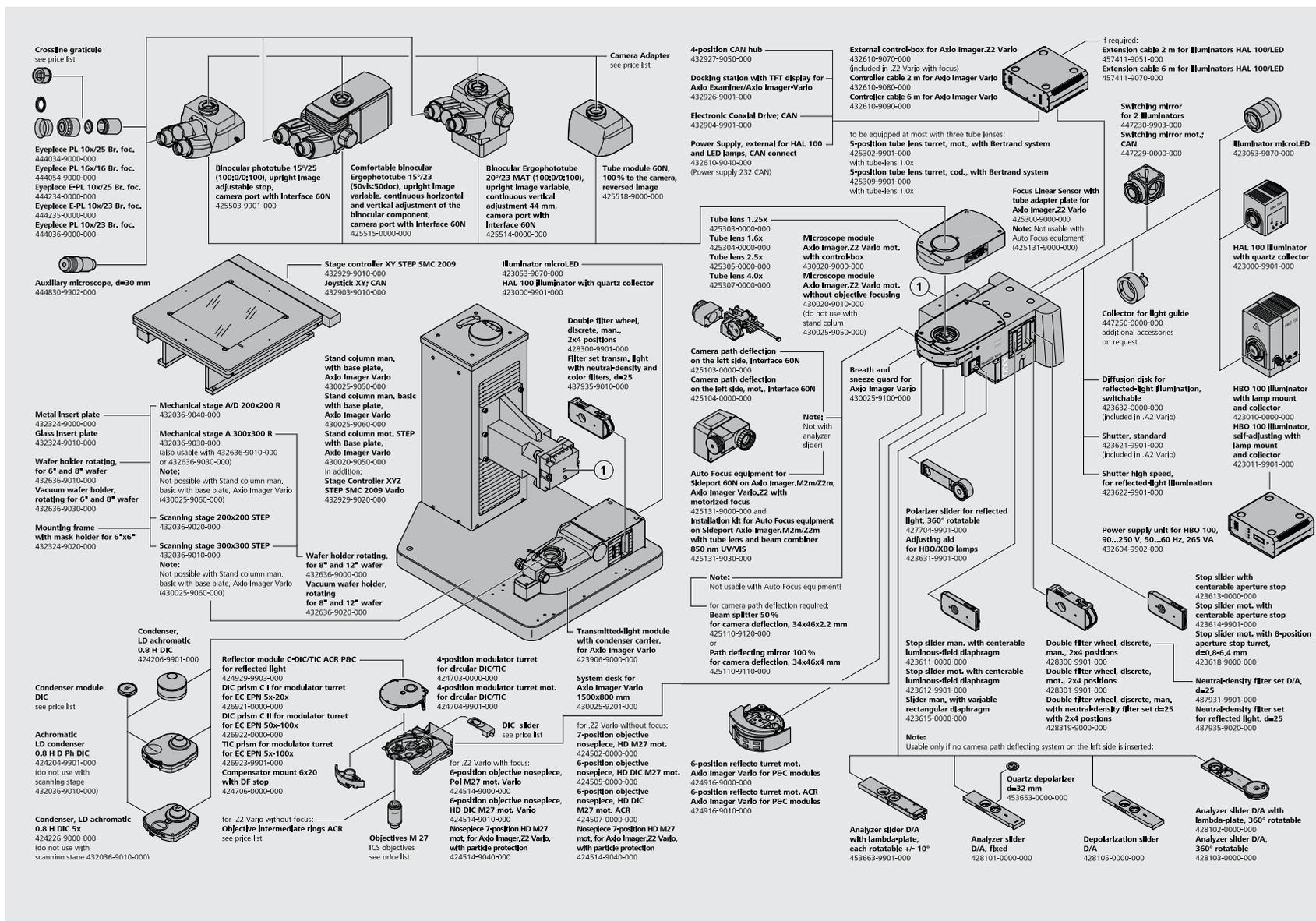
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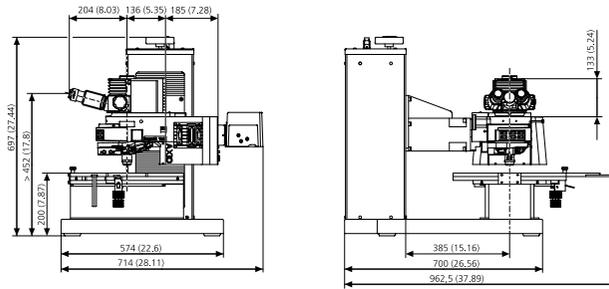
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Component	ZEISS Axio Imager Vario
Maximum specimen height	0–254 mm (using reflected light, no stage) 0–112 mm (using reflected light, with stage) 0–91 mm (using transmitted light, with stage)
Objective turret focus stroke	5 mm
Maximum specimen depth	385 mm (optic axis to post)
Maximum stage travel	300 mm × 300 mm
Maximum transmitted light area	200 mm × 200 mm
Microscope module dimensions	180 mm × 260 mm × 420 mm (height × width × depth)
Microscope module weight	17.5 to 20 kg, depending on the specific equipment
Base plate and column weight	Approx. 78 kg
Base plate dimensions	700 mm × 574 mm (width × depth)
Eyepieces	Field number: 23 or 25
Objective magnification	1×–150×
Objectives	Reflected light: EC EPIPLAN, EC Epiplan-NEOFLUAR, EC Epiplan-APOCHROMAT Transmitted light: N-ACHROPLAN, EC Plan-NEOFLUAR, Plan-APOCHROMAT, C-APOCHROMAT, FLUAR Special purpose: LD EPIPLAN, LD EC Epiplan-NEOFLUAR
Tubes	Tube module without binocular view, binocular tubes, photo tubes, ergo tubes, and ergo photo tubes
Stages	Manual XY stages and motorized scanning stages for reflected light and transmitted light with travel ranges of 200 mm × 200 mm or 300 mm × 300 mm
Illumination	12 V 100 W HAL, 100 W HBO, microLED
Contrasting technique	Reflected light: brightfield, darkfield, differential interference contrast, circularly polarized light differential interference contrast, simple polarized light, fluorescence Transmitted light: brightfield, darkfield, differential interference contrast, polarized light, phase contrast

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Ambient conditions	
Transportation (in packaging)	
Permissible ambient temperature	-40°C to +70°C
Operation	
Permissible ambient temperature	+10°C to +40°C
Permissible relative humidity	Max. 75% at 35°C
Atmospheric pressure	800 hPa to 1,060 hPa
Altitude	Max. 2,000 m
Pollution degree	2
Operating specifications for ZEISS Axio Imager Vario	
Area of use	Closed spaces
Protection type	I
Ingress protection rating	IP 20
Electrical safety	In accordance with DIN EN 61010-1 (IEC 61010-1) while considering CSA and UL standards
Overvoltage category	II
Radio interference suppression	In accordance with EN 55011, class B
Interference immunity	In accordance with DIN EN 61326
Power supply for external control box	100 to 127 V, 200 to 240 V ±10%
Converting the line voltage is not necessary!	
Power frequency	50/60 Hz
Power consumption of Axio Imager.A2 Vario microscope module	Max. 300 VA
Power consumption of Axio Imager.Z2 Vario microscope module	Max. 260 VA
microLED add-on illuminator	400 to 700 nm, peak at 460 nm, LED risk group 1 in accordance with IEC 62471
CAN external power supply for HAL 100	
Area of use	Closed spaces
Protection class	I
Protection type	IP 20
Power supply	100 VAC to 240 VAC
Power frequency	50/60 Hz
Power consumption	Max. 260 VA

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HBO 100 ballast

Area of use	Closed spaces
Protection class	I
Protection type	IP 20
Power supply	100 VAC to 240 VAC
Power frequency	50/60 Hz
Power consumption during operation with HBO 100	Max. 155 VA

Power adapter for SMC 2000

Area of use	Closed spaces
Protection class	I
Protection type	IP 20
Power supply	100 VAC to 240 VAC
Power frequency	50/60 Hz
Power consumption	Max. 2.5 A with 24 VDC

Fuses in accordance with EC 127

Control box for Axio Imager.A2 Vario	T 5.0 A/H / 250 V, 5 × 20 mm
Control box for Axio Imager.Z2 Vario	T 5.0 A/H / 250 V, 5 × 20 mm
External power supply for HAL 100	T 4.0 A / 250 V, 5 × 20 mm
HBO 100 ballast	T 2.0 A/H, 5 × 20 mm

Light sources

Halogen lamp	12 V/100 W
Light source adjustment range	Continuously variable, approx. 0.7 to 12 V
Mercury vapor short-arc lamp	HBO 103 W/2
Power consumption for HBO 103 W/2	100 W

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Component	Option	ZEISS Axio Imager.A2 Vario	ZEISS Axio Imager.Z2 Vario	ZEISS Axio Imager.Z2 Vario without focus
Stand	Manual	+	–	–
	Motorized	–	+	+
Control box	–	–	+	0
Coding (readable from computer)	–	+	+	+
Remote control	MARC	+	0	0
	Docking station with TFT	–	0	0
Contrast manager	–	–	+	+
Light manager	–	+*	+**	+**
Tube lens turret	Coded	0	–	–
	Motorized	–	0	0
Reflector turret	6-position, coded	+	–	–
	6-position, motorized	–	0	0
	6-position, motorized, ACR	–	0	0
Nosepiece turret	6-position, coded, POL Vario	0	–	–
	6-position, coded, HD DIC Vario	0	–	–
	6-position, motorized, POL Vario	–	0	0
	6-position, motorized, HD DIC	–	0	0
	7-position, motorized, HD	–	–	0
Modulator turret for C-DIC/TIC	Manual	0	0	0
	Motorized	–	0	0
Transmitted light illumination	Manual	0	0	0
Transmitted light dual filter wheel	Manual	0	0	0
	Motorized	–	–	–
Reflected light illumination	Manual	+	–	–
	Motorized	–	+	+

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Components	Option	ZEISS Axio Imager.A2 Vario	ZEISS Axio Imager.Z2 Vario	ZEISS Axio Imager.Z2 Vario without focus
Reflected light luminous-field diaphragm	Manual	+	0	0
	Motorized	-	0	0
Reflected light aperture diaphragm	Manual	0	0	0
	Motorized	-	0	0
Reflected light aperture diaphragm with aperture diaphragm turret	Motorized	-	0	0
Reflected light dual filter wheel	Manual	0	0	0
	Motorized	-	0	0
FL attenuator	Manual	0	0	0
	Motorized	-	0	0
Switching between reflected light / transmitted light	Manual	0****	+	+
	With docking station or MARC	0***	0***	0***
Mixed light	Manual	0****	0****	0****
	With docking station	-	0***	0***
Nosepiece turret focus	Motorized, 10 nm increment resolution	-	+	-
	Motorized, 25 nm increment resolution	+	-	-
Auto Focus	-	-	0	-
ApoTome.2	-	0	0	0
Scanning stages	DC stepper motors	0	0	0

- + = Included in microscope module
- 0 = Optionally available
- = Not available
- * = Light manager for manual Imager
- ** = Light manager for motorized Imager
- *** = With additional 422610-9040-000 power supply
- **** = With additional 422610-9060-000 power supply

Count on Service in the True Sense of the Word

- › In Brief
- › The Advantages
- › The Applications
- › The System
- › Technology and Details
- › **Service**

Because the ZEISS microscope system is one of your most important tools, we make sure it is always ready to perform. What's more, we'll see to it that you are employing all the options that get the best from your microscope. You can choose from a range of service products, each delivered by highly qualified ZEISS specialists who will support you long beyond the purchase of your system. Our aim is to enable you to experience those special moments that inspire your work.

Repair. Maintain. Optimize.

Attain maximum uptime with your microscope. A ZEISS Protect Service Agreement lets you budget for operating costs, all the while reducing costly downtime and achieving the best results through the improved performance of your system. Choose from service agreements designed to give you a range of options and control levels. We'll work with you to select the service program that addresses your system needs and usage requirements, in line with your organization's standard practices.

Our service on-demand also brings you distinct advantages. ZEISS service staff will analyze issues at hand and resolve it – whether using remote maintenance software or working on site.

Enhance Your Microscope System.

Your ZEISS microscope system is designed for a variety of updates; open interfaces allow you to maintain a high technological level at all times. As a result you'll work more efficiently now, while extending the productive lifetime of your microscope as new update possibilities come on stream.

Please note that our service products are always being adjusted to meet market needs and maybe be subject to change.

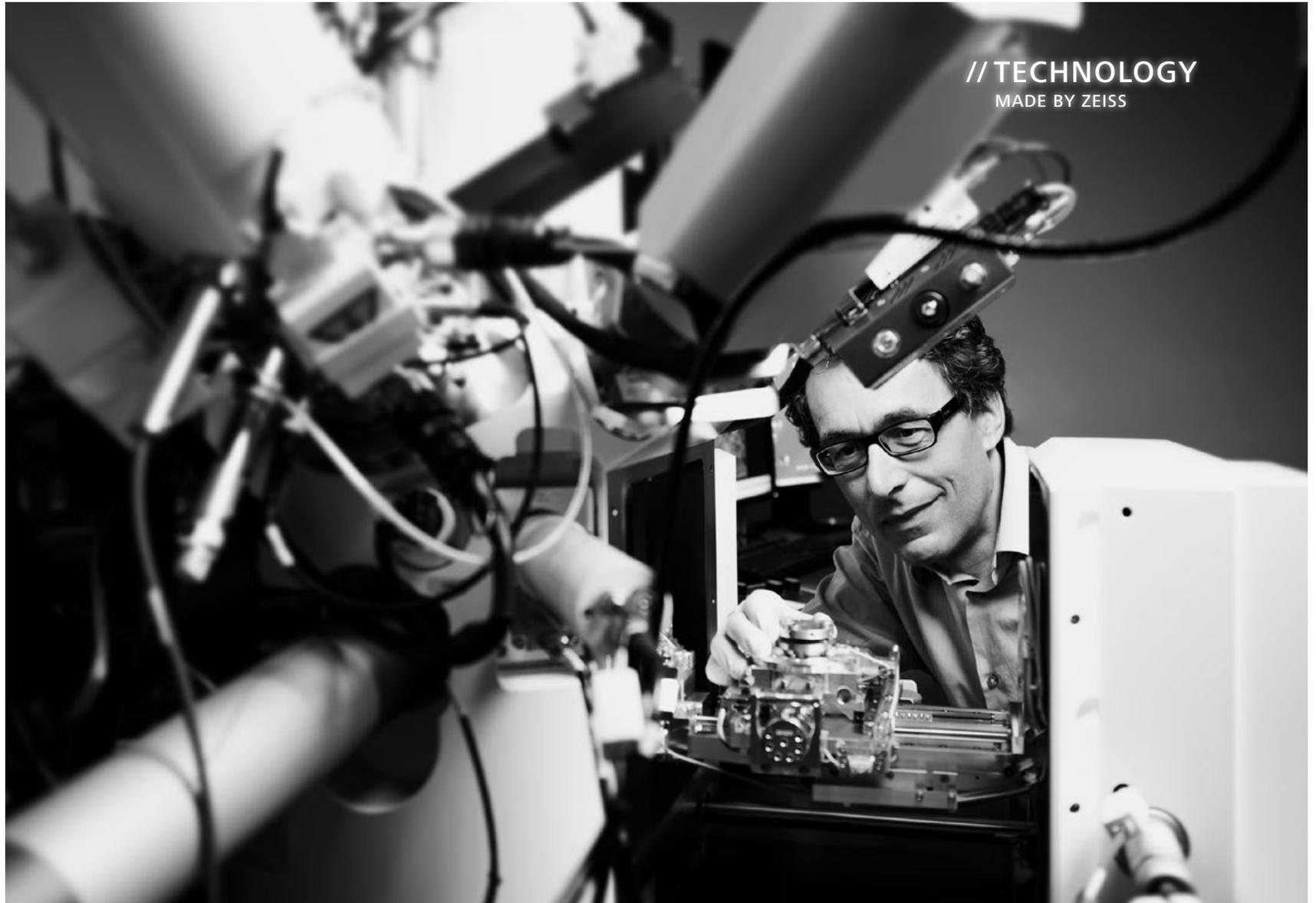


Profit from the optimized performance of your microscope system with services from ZEISS – now and for years to come.

>> www.zeiss.com/microservice

The moment "I think" becomes "I know".
This is the moment we work for.

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We make it visible.