Axio Imager 2
Upright microscope
Operating Manual

Knowledge of this manual is required for operation of the device. You should therefore familiarize yourself with its contents, paying particular attention to instructions concerning safe handling of the device.

We reserve the right to make changes in the interest of technological advancement; the Operating Manual is not subject to updating or revision.

All names of companies and products mentioned in this manual may be trademarks or registered trademarks. Third party products are cited for information purposes only. This does not represent approval or recommendation of these products.

Carl Zeiss Microscopy AG accepts no liability for the performance or use of such products.

Issued by:

Carl Zeiss Microscopy GmbH
Carl-Zeiss-Promenade 10
07745 Jena, Germany

microscopy@zeiss.com
www.zeiss.com/microscopy

Carl Zeiss Microscopy GmbH
Königsallee 9-21
37081 Göttingen, Germany

Document number: 430000-7544-001

Date of issue: Version 10 – 13.01.2016

CONTENTS

1 INTRODUCTION

1.1 Notes on device safety

The Axio Imager 2 microscopes have been designed, produced and tested in compliance with DIN EN 61010-1 (IEC 61010-1) and IEC 61010-2-101 "Safety requirements for electrical equipment for measurement, control, and laboratory use".

The devices meet the requirements of the European Directive IVDD 98/79/EC (In Vitro Diagnostic Medical Devices) and RoHS Directive 2011/65/EC and carry the CE mark.

The devices are disposed of in accordance with WEEE Directive 2012/19/EC.

This Operating Manual contains information and warnings that must be followed by the owner/operator personnel.

The following warning and information symbols are used in this Operating Manual:

NOTE
This symbol indicates an instruction which requires particular attention.

ATTENTION
This symbol indicates a potential hazard to the instrument or system.

CAUTION
This symbol indicates a potential hazard to the user.

CAUTION
Hot surface!

CAUTION
Emission of UV radiation!

CAUTION
LED radiation in 400 nm to 700 nm range! LED risk group 1 in accordance with DIN EN 62471:2009
Do not look into the LED light!

CAUTION
Disconnect the instrument from the power supply before opening!

CAUTION
Risk of crushing!

ATTENTION
Stand-by: Switching the Axio Imager.Z2 and Z2m off using the standby switch only turns off the internal computer. The mains supply is not switched off.

The Axio Imager 2 microscopes and their original accessories are to be used only for the microscopy procedures described in this Operating Manual.

Particular attention must be paid to the following instructions:

The manufacturer cannot assume any liability for any other applications of the instrument, including the use of individual modules or components. This also applies to all service or repair work that is not carried out by authorized service personnel. Failure to comply with this shall render all warranty claims invalid.

The power plugs may only be connected to sockets with an earth contact. The protective capacity must not be rendered ineffective by the use of extension cables with no grounding conductor.

If protection measures no longer prove effective, the instrument must be switched off and safeguarded against inadvertent operation. Please contact ZEISS Service or the Carl Zeiss Microscopy Service to repair the instrument.

On stands with motorized focusing drive, there is the risk of fingers being crushed between the stage carrier and the base of the stand when the stage is lowered. Do not, therefore, place your hands under the stage carrier.

The manual microscopes (Axio Imager.A2, .A2 LED, .A2m, .D2 and .D2m) have a power supply integrated in the stand which allows line voltages to be used in the ranges 100 to 127 V and 200 to 240 V AC ±10 %, 50 Hz – 60 Hz, without the voltage setting on the instrument having to be changed.

The motorized models (Axio Imager.M2, .M2m, .Z2 and .Z2m) are powered by the separate power supply VP232-2 belonging to the stand. The voltage setting need not be changed in the line voltage range 100 to 240 V ±10 %, 50 Hz – 60 Hz on this power supply, either.
The HBO 100 (ebq 100 dc) and XBO 75 (ebx 75 isolated) ballast units are designed for a line voltage range from 100 to 240 V AC, 50 Hz – 60 Hz, and automatically adapt to the supplied line voltage.

Before switching on the instrument, check whether suitable line voltage is available.
Disconnect the device from the mains power supply before gaining access to the interior of the device or changing the fuse. See Section 5.2.2.
Only use fuses specified in the information given in the Technical Data. Use of makeshift fuses and short-circuiting of the fuse holders are not permitted.

The Axio Imager microscopes are not equipped with any special devices for protection from substances that are corrosive, potentially infectious, toxic, radioactive, or other substances that could be hazardous to health. Observe all legal regulations, particularly the relevant national accident prevention regulations when handling such substances.

Operation of the devices in explosive environments is not permissible. Operation of the devices is only permitted in closed rooms.

Gas discharge lamps, e.g. HBO 50; HBO 100 or XBO 75, emit ultraviolet radiation, which can cause burns to the eyes and skin. Therefore, never look directly into the light of these lamps and avoid direct, unprotected incidence of their light on your skin. When using the microscope, always use the protective devices belonging to the instrument (e.g. special attenuation filters or the fluorescence shield). When they are hot, gas discharge lamps are under high internal pressure. Therefore, change them only when they have cooled down, and make sure protective gloves and a face guard are worn.

When fluorescence filters are used, the heat protection filter for heat emitted by the microscope illuminator must not be removed, since fluorescence filters are sensitive to heat and their performance could be impaired.

Avoid touching the hot lamp housing. Always disconnect the power plug before changing the lamps and allow the instrument to cool down for approx. 15 minutes.

Dust and dirt may impair the instrument's performance. The instrument must be effectively protected from such influences and covered with the dust cover when not in use. Always check whether the instrument is switched off before you cover it.

Clogged or covered ventilation slots may lead to heat build-up that will damage the device and, in extreme cases, cause a fire. Always keep the ventilation slots clear and ensure that no objects enter or fall into the instrument through the ventilation slots.

The instruments may only be operated by trained personnel who must be aware of the possible dangers involved with microscopy and the particular application concerned. The Axio Imager microscopes are high-precision instruments that can be impaired in their performance or destroyed if handled improperly.

The LED illuminator is a class 2M device. Do not look directly into the LED light.

Do not dispose of defective instruments in regular domestic waste; these should be disposed of in accordance with prevailing legal requirements.
Specimens should also be disposed of in compliance with the prevailing legal requirements and internal operating procedures.

For stands equipped with motorized focusing drives, there is a **risk of fingers being crushed** in the working area when the microscope stage is lowered.

- Do not reach into the area between the microscope stage / stage carrier / condenser carrier and the stand base while the stage is being lowered.
- The automatic movement can be stopped by pressing the STOP button on the TFT display. (See Fig. 2).

When a scanning stage (approx. weight: 4 kg) is used, the high-performance focus must be activated to protect the focusing drive (see page 53). Sample weights of up to 5 kg can be placed on the stage if the high-performance focus is activated.

It is essential to read the safety data sheet provided with Immersol 518 F®immersion oil.

Immersol 518 F® immersion oil is a skin irritant. Avoid contact with skin, eyes and clothing.
In the event of contact with the skin, rinse with plenty of water and soap.

In the event of contact with the eyes, rinse the eyes immediately with plenty of water for at least five minutes. If irritation persists, consult a physician.

Correct disposal of Immersol 518 F® immersion oil. Ensure that the immersion oil does not enter surface water or the sewage system.

Do not replace detachable power cables with power cables that do not meet the specifications. Only the specified power cables should be used.

The Axio Imager.Z2 or Z2m can only be disconnected from the mains supply using the on/off switch on the external VP232-2 power unit.

1.2 Warning labels

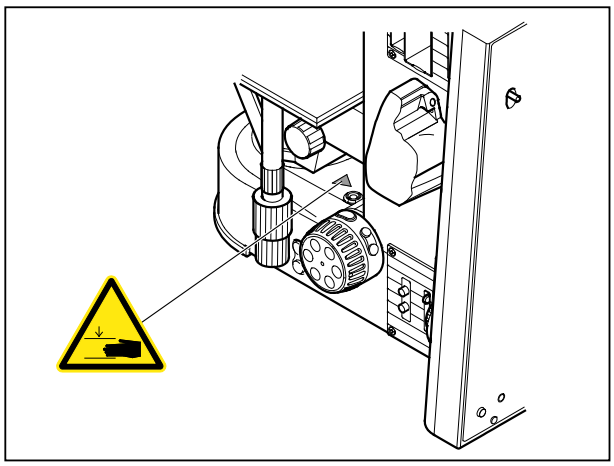


Fig. 1 "Crushing Hazard" label warning on the base of motorized stands

Fig. 2 STOP button

The STOP button on the TFT display switches off the movement of the focusing drive instantaneously to prevent a collision with the stage or the specimen placed on it.

Actuation of the STOP button halts the movement of the focusing drive immediately.

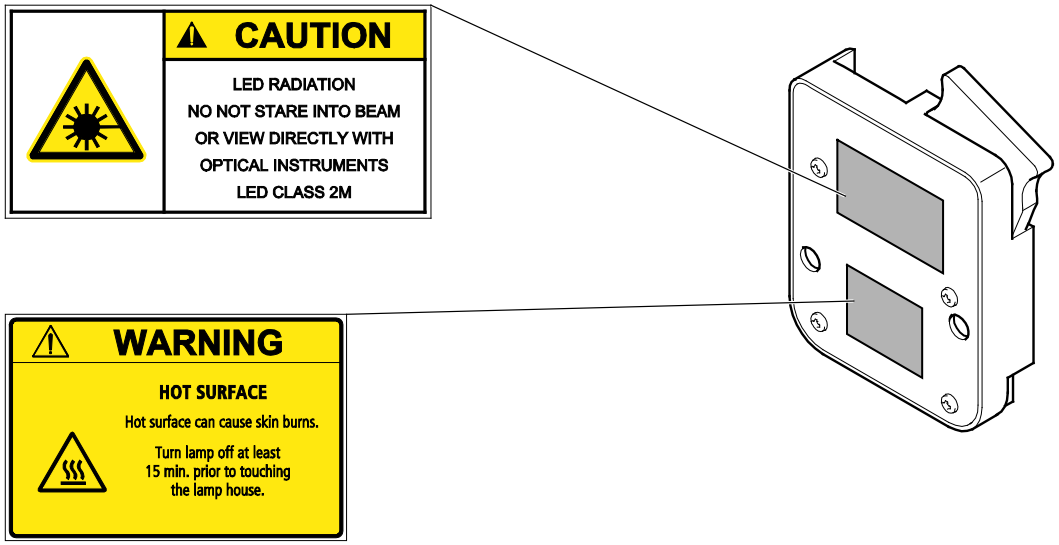


Fig. 3 Warning labels on the underside of the LED illuminator

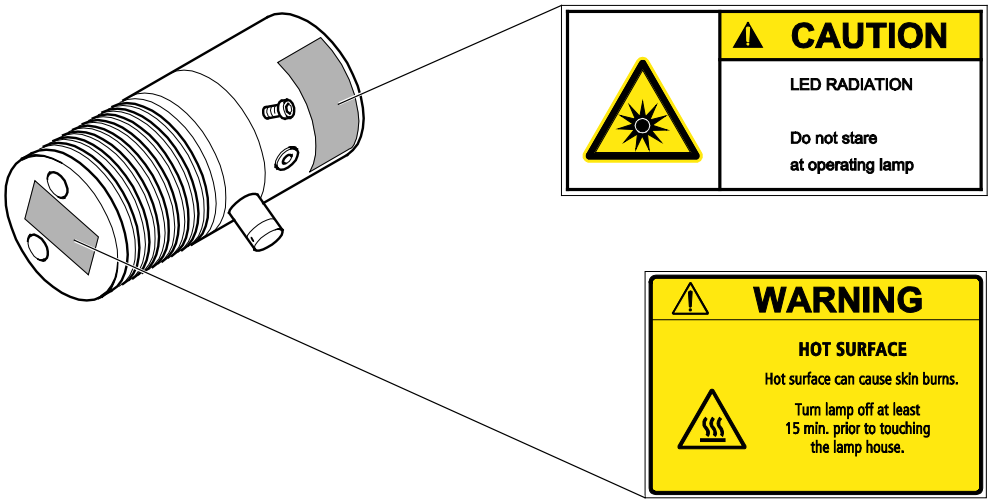


Fig. 4 **Warning labels on the VIS-LED attachment lamp**

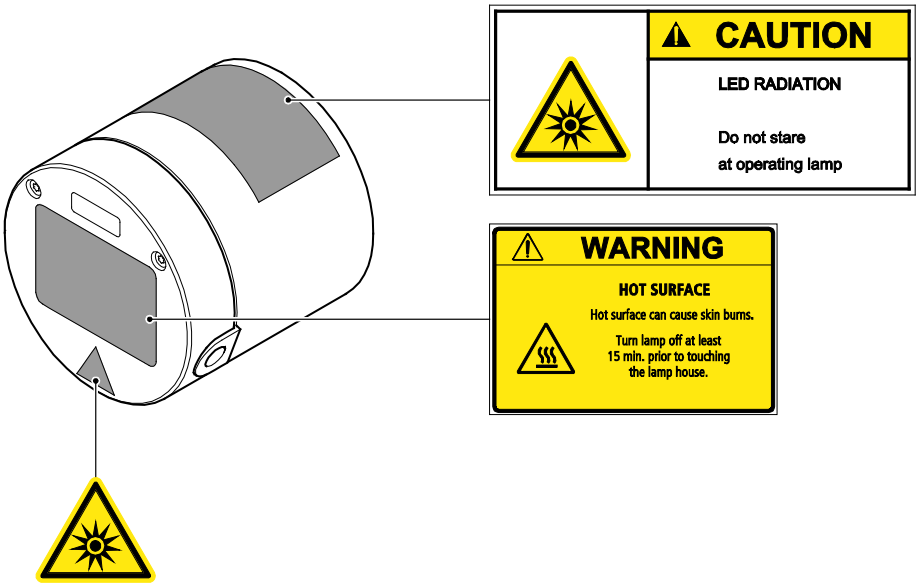


Fig. 5 **Warning labels on the underside of the microLED**

1.3 Warranty information

The manufacturer guarantees that the instrument is free of material or manufacturing defects upon delivery. Any defects must be reported immediately and steps taken to minimize damage. If such a defect is reported, the instrument manufacturer shall be obliged to correct the fault, either by repairing the instrument or replacing it with a new one, at the manufacturer's discretion. No warranty is given for defects caused by natural wear and tear (particularly of wearing parts) and improper use of the instrument.

The instrument manufacturer shall not be liable for damage caused by misuse, negligence or any other tampering with the instrument, particularly the removal or replacement of instrument components, or the use of accessories from other manufacturers. Such actions shall invalidate any warranty claims.

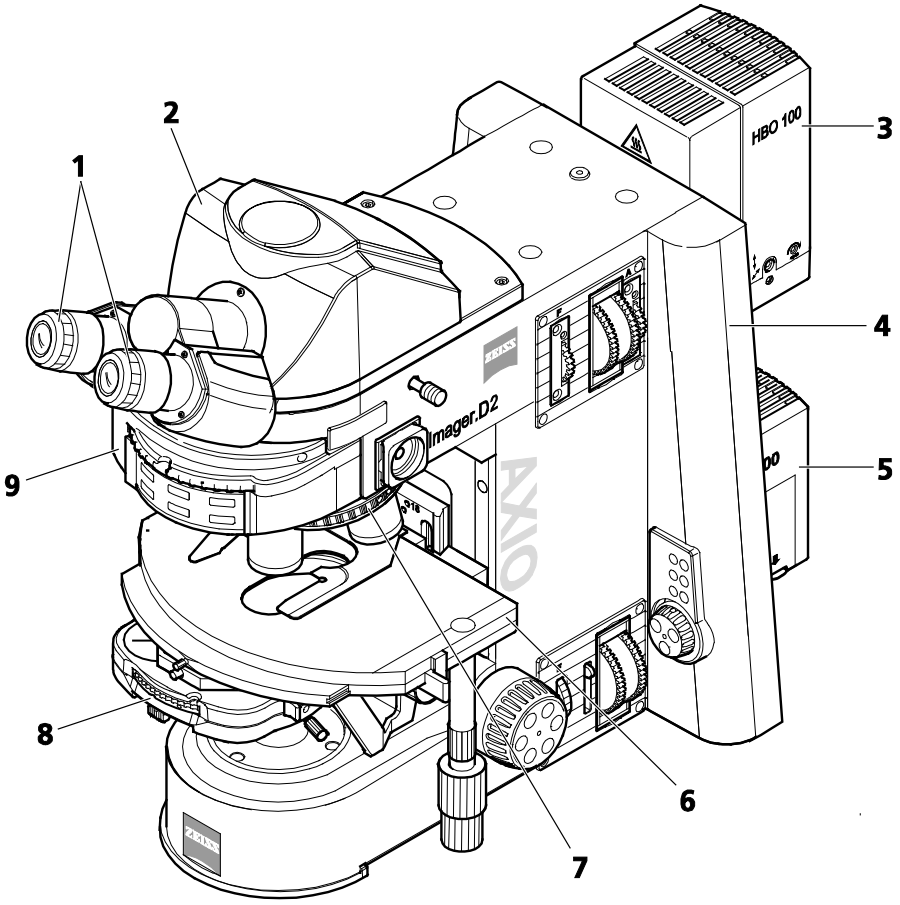
With the exception of the work described in this Operating Manual, no maintenance or repair work is to be carried out on the Axio Imager 2. Repairs may only be performed by ZEISS Service or individuals specially authorized by ZEISS Service. In the event of a problem with the instrument, please contact your local ZEISS representative.

1.4 Other operating manuals

In addition to the operating manual for the Axio imager 2, the following operating manuals should also be consulted:

- Axio Observer Microscope Operating Manual
- ZEN Software Description (blue edition) (online version)
- Operating manual: Installation handbook for peripheral equipment
- Operating manual for the computer system
- Operating manual for the reflected light fluorescence illuminator HBO 100
- Operating manual for HXP 120 V
- Operating manual for the control computer
- Operating manual for the monitor
- Operating manuals for each incubation system
- Operating manual for the SVB 1 signal distribution box
- Operating manual for Auto Focus
- Operating manual for multidiscussion equipment

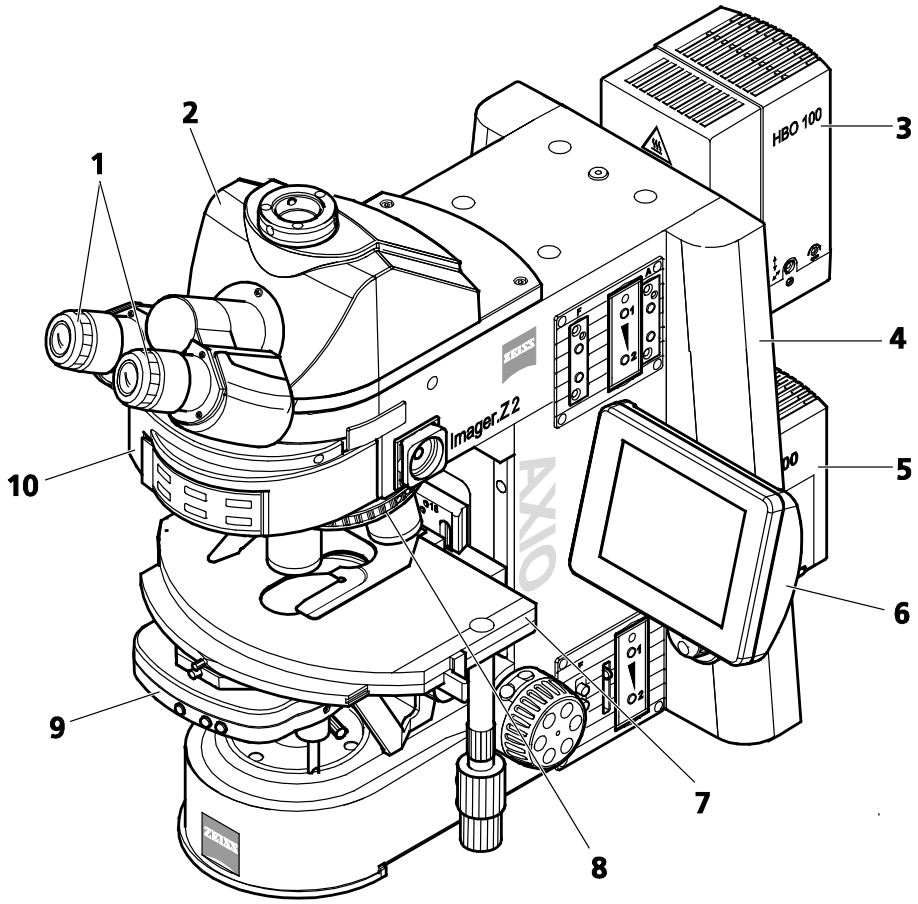
1.5 Overall view of Axio Imager 2 - coded



1 Eyepieces
2 Binocular tube
3 Reflected-light illuminator (HBO 100)
4 Microscope stand, manual
5 Transmitted-light illuminator (HAL 100)
6 Mechanical stage
7 Nosepiece
8 Condenser
9 Reflector turret

Fig. 6 Overall view of Axio Imager 2 - coded

1.6 Overall view of Axio Imager 2 - motorized



1 Eyepieces
2 Binocular phototube
3 Reflected-light illuminator (HBO 100)
4 Microscope stand, motorized
5 Transmitted-light illuminator (HAL 100)
6 TFT display
7 Mechanical stage
8 Nosepiece
9 Condenser
10 Reflector turret

Fig. 7 Overall view of Axio Imager 2 - motorized

2 INSTRUMENT DESCRIPTION

2.1 Name and designated use

Manufacturer's designation:	**Axio Imager:**	**Axio Imager MAT:**	**Axio Imager LED:**
	Axio Imager.A2	Axio Imager.A2m	Axio Imager.A2 LED
	Axio Imager.D2	Axio Imager.D2m	
	Axio Imager.M2	Axio Imager.M2m	
	Axio Imager.M2p	Axio Imager.Z2m	
	Axio Imager.Z2		

The Axio Imager / Axio Imager MAT microscopes have been designed as universal microscopes for applications in biology and medicine for the examination of blood and/or tissue specimens from the human body, as well as for materials examinations.

They may also be used as true reflected-light microscopes or, if equipped with transmitted-light equipment, as combined reflected-light/transmitted-light microscopes.

Typical biomedical applications of the Axio Imager 2 microscopes include:

– Medical examinations in laboratories (research), clinics and medical practices
– Science and research (colleges, universities) in the fields of medicine and biology
– Industrial applications (pharmacology, food technology)

Typical applications of the Axio Imager MAT microscopes include:

– Metallographic laboratories
– Automotive industry
– Microsystems engineering

2.2 Instrument description and main features

With its advanced pyramid and modular design, the Axio Imager microscope incorporates time-tested principles in microscope construction, combining modern requirements in design, ergonomics, operating convenience and function with technical performance.

Depending on the instrument configuration, the following microscopy and contrasting techniques are possible:

Transmitted light:

- Brightfield (H)
- Darkfield (D)
- Phase contrast (Ph)
- Differential Interference Contrast (DIC)
- Polarization contrast (Pol)
- Circular polarization

Reflected light:

- Brightfield (H)
- Darkfield (D)
- Differential Interference Contrast (DIC)
- Differential Interference Contrast in circularly polarized light (C-DIC)
- Polarization contrast (Pol)
- Fluorescence

The Axio Imager 2 microscope is available in ten different stand versions. However, the scope of the equipment of these stands is variable and can be customized to the user's requirements within the range of optional microscope components.

Coded models:

Axio Imager.A2, A2m and A2 LED

Partially motorized models:

Axio Imager.D2, D2m

Motorized models:

Axio Imager.M2, M2m, M2p
Axio Imager.Z2 and Z2m

The binocular phototubes and suitable adapters permit one microscope camera, one reflex camera or one digital / video camera to be attached for documentation purposes.

2.3 Equipment and compatibility table

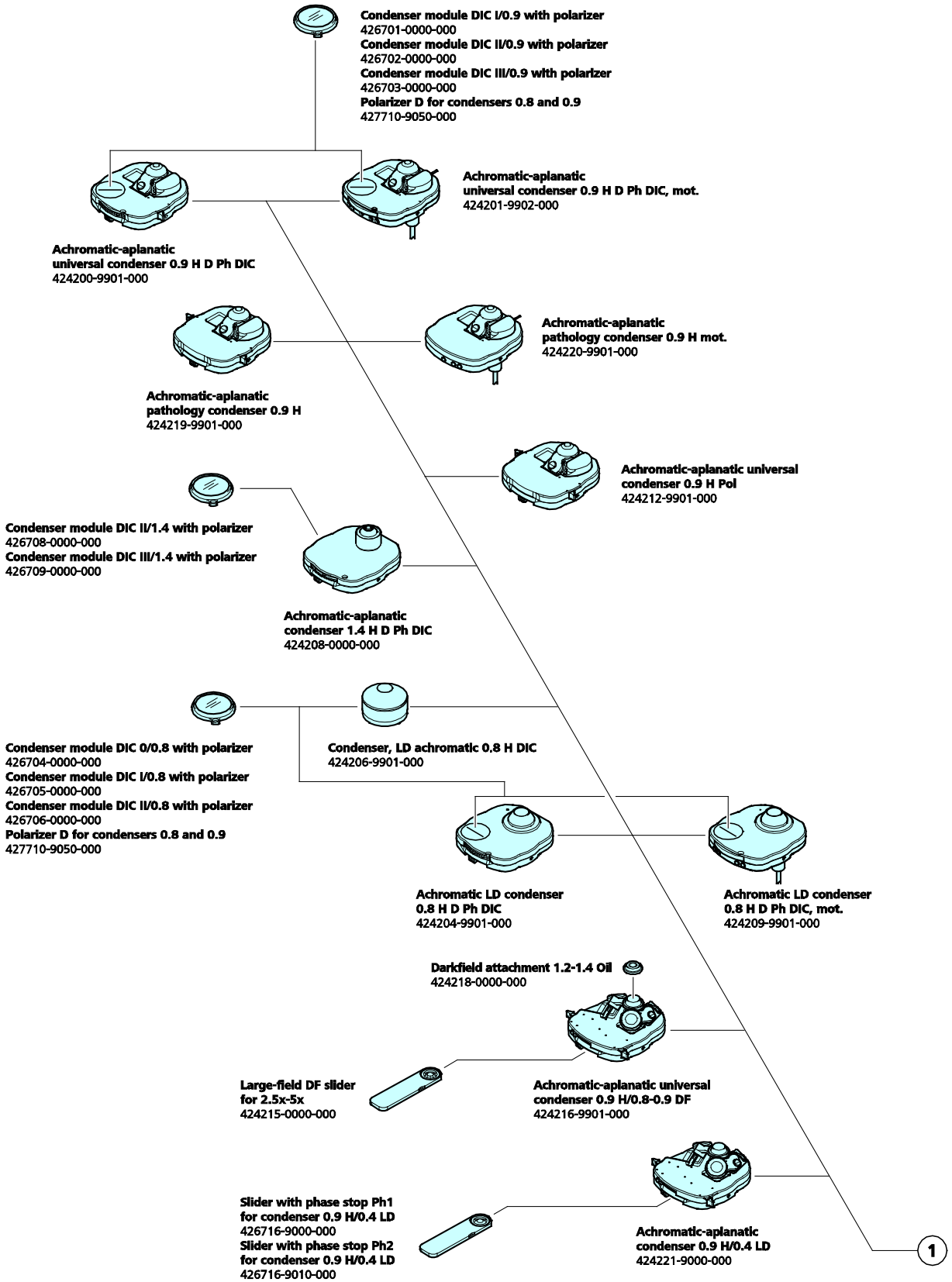
Component	Option / comment	Stand									
		A2 LED	A2	M2p	M2	D2	Z2	A2m	M2m	D2m	Z2m
Microscope stand	coded	+	+	-	-	+	-	+	-	+	-
	motorized	-	-	+	+	O*	+	-	+	O*	+
Coding	PC readable	+	+	+	+	+	+	+	+	+	+
Tube lens turret	coded	O	O	O	O	O	O	O	O	O	O
	motorized	-	-	O	O	-	O	-	O	-	O
Reflector turret	6 positions, coded	O	O	O	O	O	O	O	-	O	O
	6 positions, motorized	-	-	O	O	O	O	-	+	O	O
	6x motorized HD	-	-	-	-	-	O	-	-	-	O
	10x motorized ACR**	-	-	-	-	O	O	-	-	O	O
Objective nosepiece	6x coded POL	O	O	-	O	O	O	O	O	O	O
	6x coded HD DIC	O	O	-	O	O	O	O	O	O	O
	6x motorized HD DIC	-	-	-	O	-	O	-	O	-	O
	6x motorized HD DIC ACR	-	-	-	O	-	O	-	O	-	O
	7x coded HD	O	O	+	O	O	O	O	O	O	O
	7x motorized HD	-	-	-	O	-	O	-	O	-	O
Modulator turret for C-DIC / TIC	manual	O	O	O	O	O	O	O	O	O	O
	motorized****	-	-	-	O	-	O	-	O	-	O
Modulator turret for transmitted light - DIC	motorized****	-	-	-	-	-	O	-	-	-	O
Attachable stage carrier with condenser carrier	0 mm – 25 mm	+	+	+	+	+	O	O	O	O	O
Attachable stage carrier for detachable condenser carrier	0 mm – 45 mm	O	O	O	O	O	O	O	O	O	O
Attachable reflected-light stage carrier	0 mm – 63 mm	-	O	-	O	O	O	O	O	O	O
Transmitted-light illumination	manual	-	+	-	-	+	-	O	O	O	O
	motorized	-	-	-	+	-	+	-	-	-	O
LED transmitted light on condenser carrier	-	+	O	+	O	O	O	O	O	O	O
Transmitted light double filter wheel	manual	-	+	-	O	O	O	O	O	O	O
	motorized	-	-	-	O	-	O	-	-	-	O
Reflected-light illumination	manual***	O	O	O	O	O	O	+	-	+	-
	motorized***	-	-	-	-	-	O	-	+	-	+
Reflected-light luminous-field diaphragm	manual	O	O	O	O	O	O	+	O	+	O
	motorized	-	-	-	-	-	O	-	O	-	O

Component	Option / comment	Stand									
		A2 LED	**A2**	**M2p**	**M2**	**D2**	**Z2**	**A2m**	**M2m**	**D2m**	**Z2m**
Reflected-light aperture diaphragm slider	manual	O	O	O	O	O	O	O	O	O	O
	motorized	-	-	-	-	-	O	-	O	-	O
Reflected light double filter wheel	manual	O	O	O	O	O	O	O	O	O	O
	motorized	-	-	-	-	-	O	-	O	-	O
FL Attenuator	manual	O	O	O	O	O	O	O	O	O	O
	motorized	-	-	-	-	-	O	-	O	-	O
Reflected light / transmitted light selection	manual	+	+	-	-	+	-	+	-	+	-
	Software	-	-	+	+	-	+	-	+	-	+
Mixed light with extra power supply	external power supply	+	+	-	-	+	-	+	-	+	-
	external power supply, CAN	-	-	+	+	-	+	-	+	-	+
Focus (z-axis)	manual	+	+	-	-	+	-	+	-	+	-
	motorized, 25 nm	-	-	+	+	-	-	-	+	-	-
	High-performance focus (motorized, 10 nm)	-	-	-	-	-	+	-	-	-	+
Focus linear sensor	-			O	O		O		O		O
Auto Focus	- / 6)			O	O		O		O		O
TFT display	-	-	-	O	+	-	+	-	+	-	+
ApoTome	-	O	O	O	O	O	O	O	O	O	O
Power supply	External	-	-	+	+	-	+	-	+	-	+
	Internal	+	+	-	-	+	-	+	-	+	-
Mechanical CAN stages	motorized****	O	O	O	O	O	O	O	O	O	O
Scanning stages	Piezo	O	O	O	O	O	O	O	O	O	O
	DC / stepper motors	O	O	O	O	O	O	O	O	O	O
Fast z-piezo operation	With manual stage	O	O	O	O	O	O	O	O	O	O
	With scanning stage	O	O	O	O	O	O	O	O	O	O
Motorized 2TV tube	-	-	-	O	O	-	O	-	O	-	O
Condensers	manual	O	O	O	O	O	O	O	O	O	O
	motorized	-	-	O	O	-	O	-	O	-	O

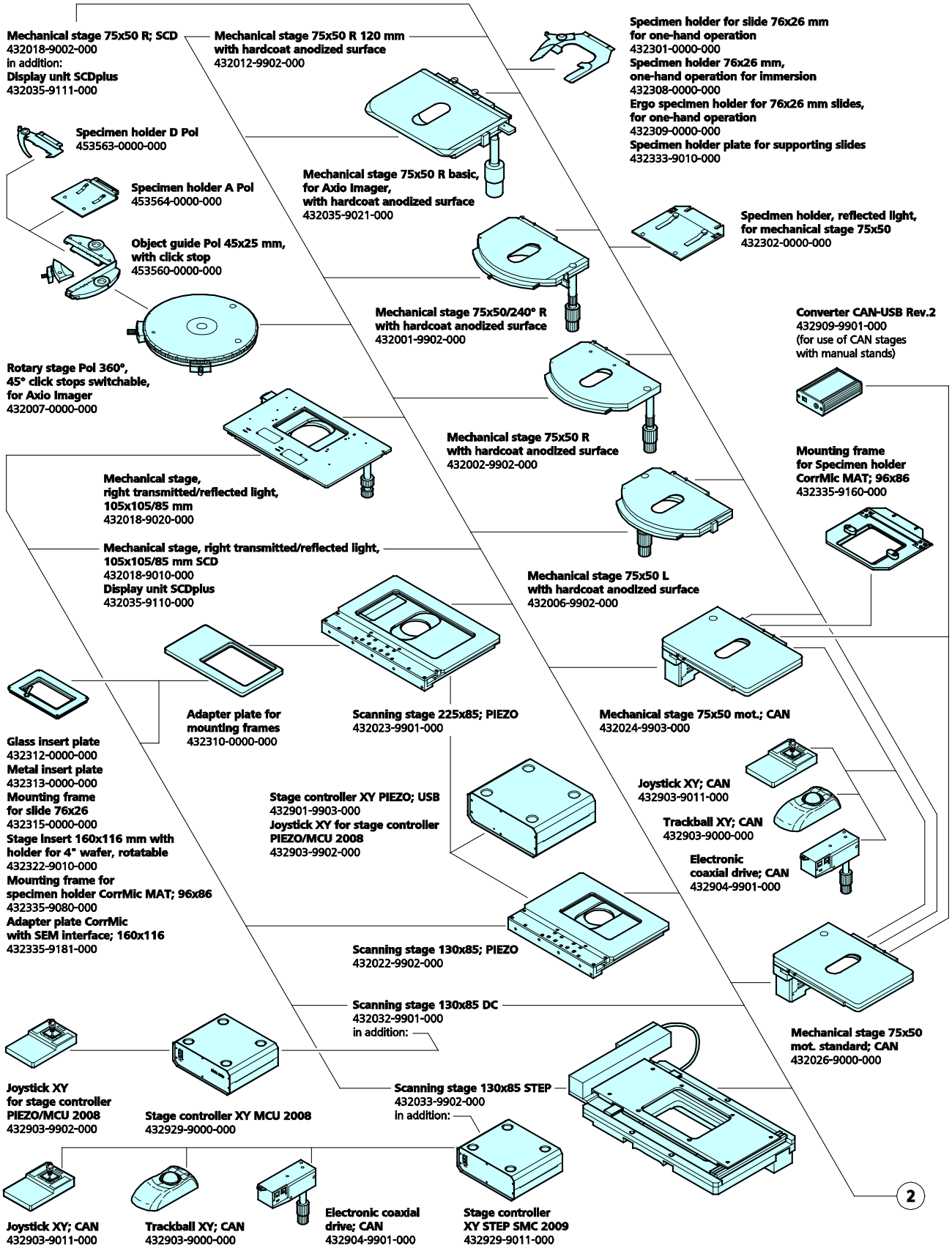
\+ = Included in stand
O = Optional
\- = Not possible
* = Motorized (6-position and 10-position) reflector turret may be used.
** = ACR function not available with Axio Imager D2 and D2m.
*** = All reflected-light illumination systems come with a motorized shutter.
For fluorescence applications, this may be replaced optionally by a high-speed shutter.
**** = USB/CAN converter 432909 is required for use on Axio Imager A2 LED, A2, A2m, D2 and D2m.
***** = Motorized only if used with an objective nosepiece.
6) = Sideways camera path deflection is used, analyzer slider plane cannot be used for slider.

2.4 System overview of Axio Imager 2

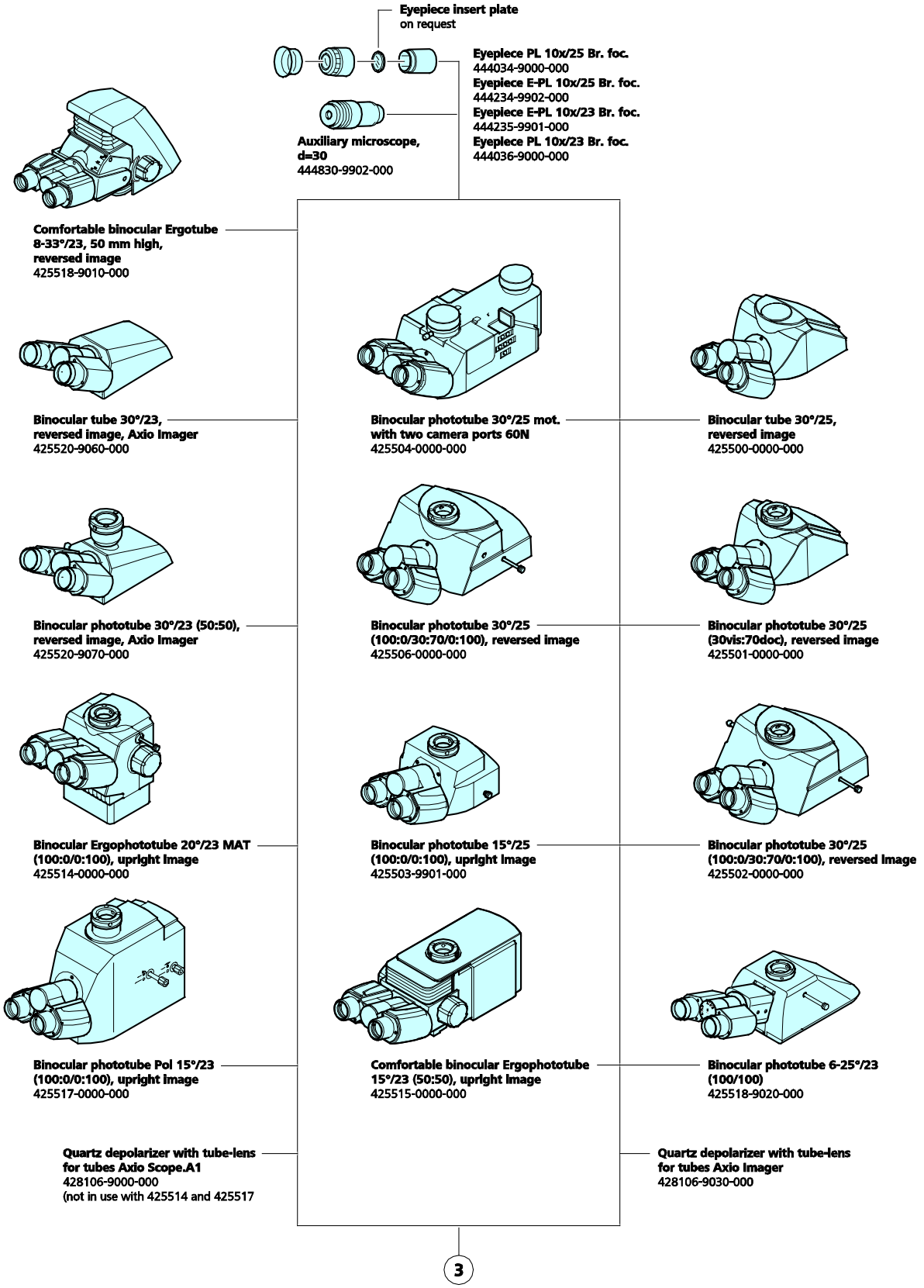
Condensers



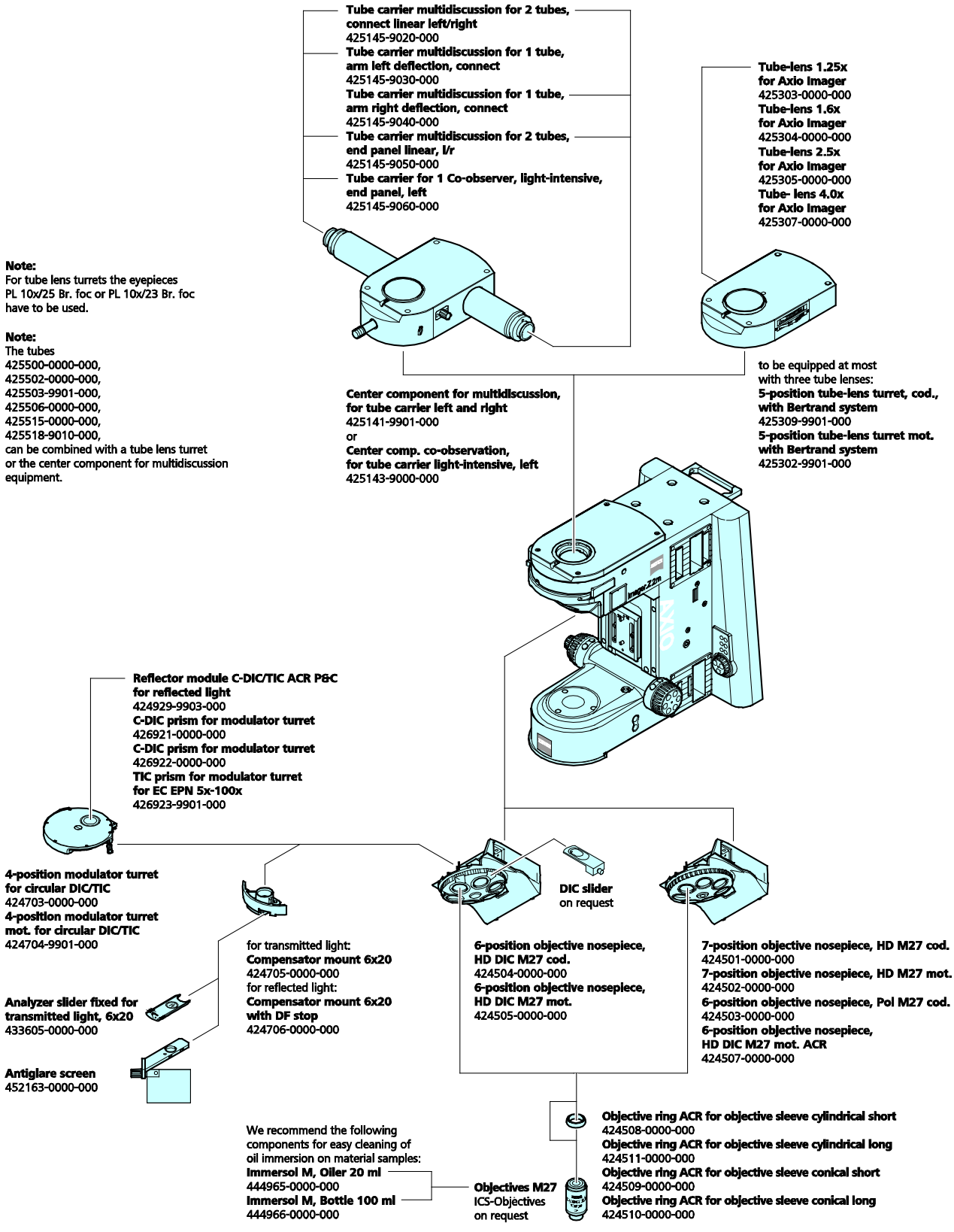
Microscope stages



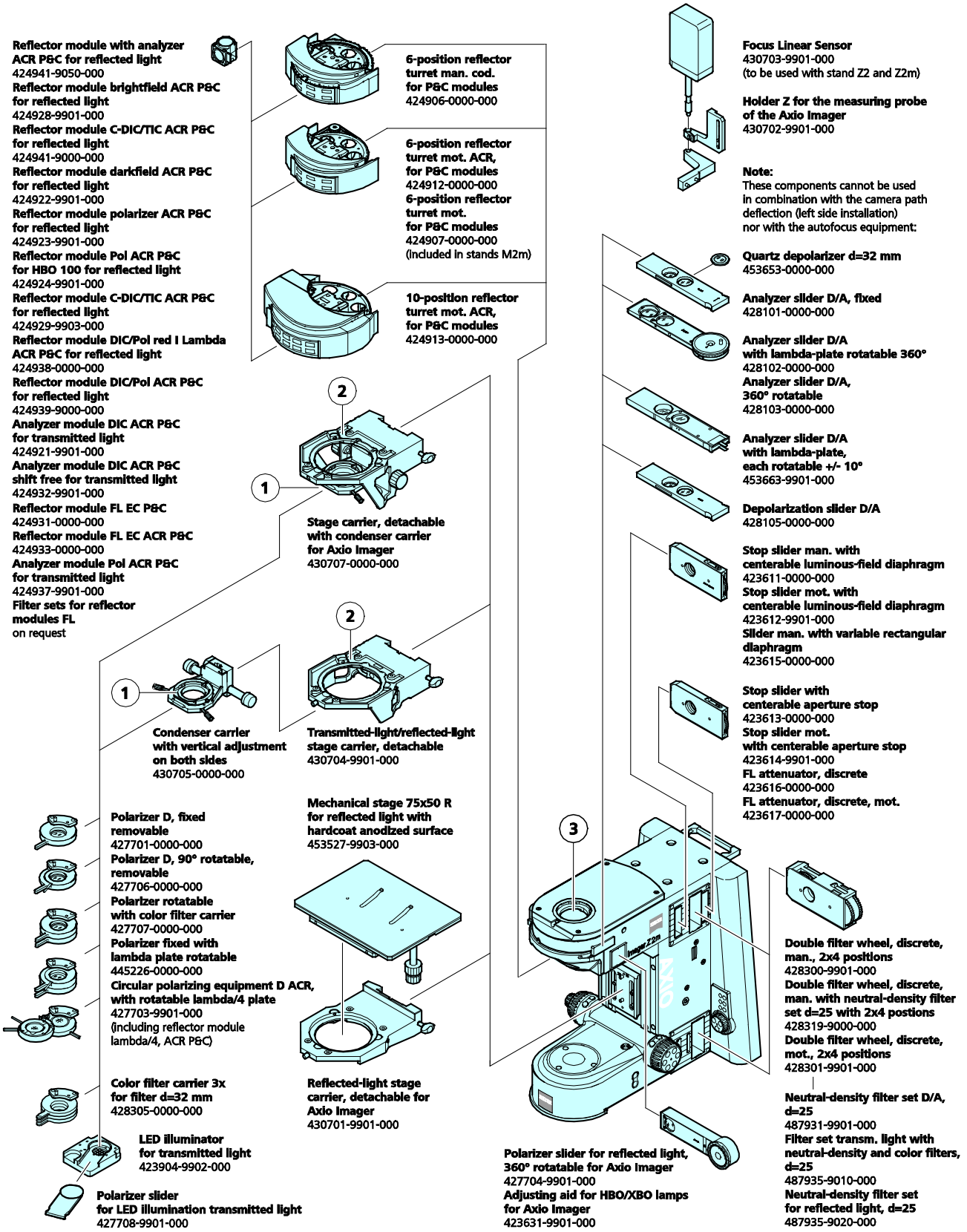
Tubes, eyepieces



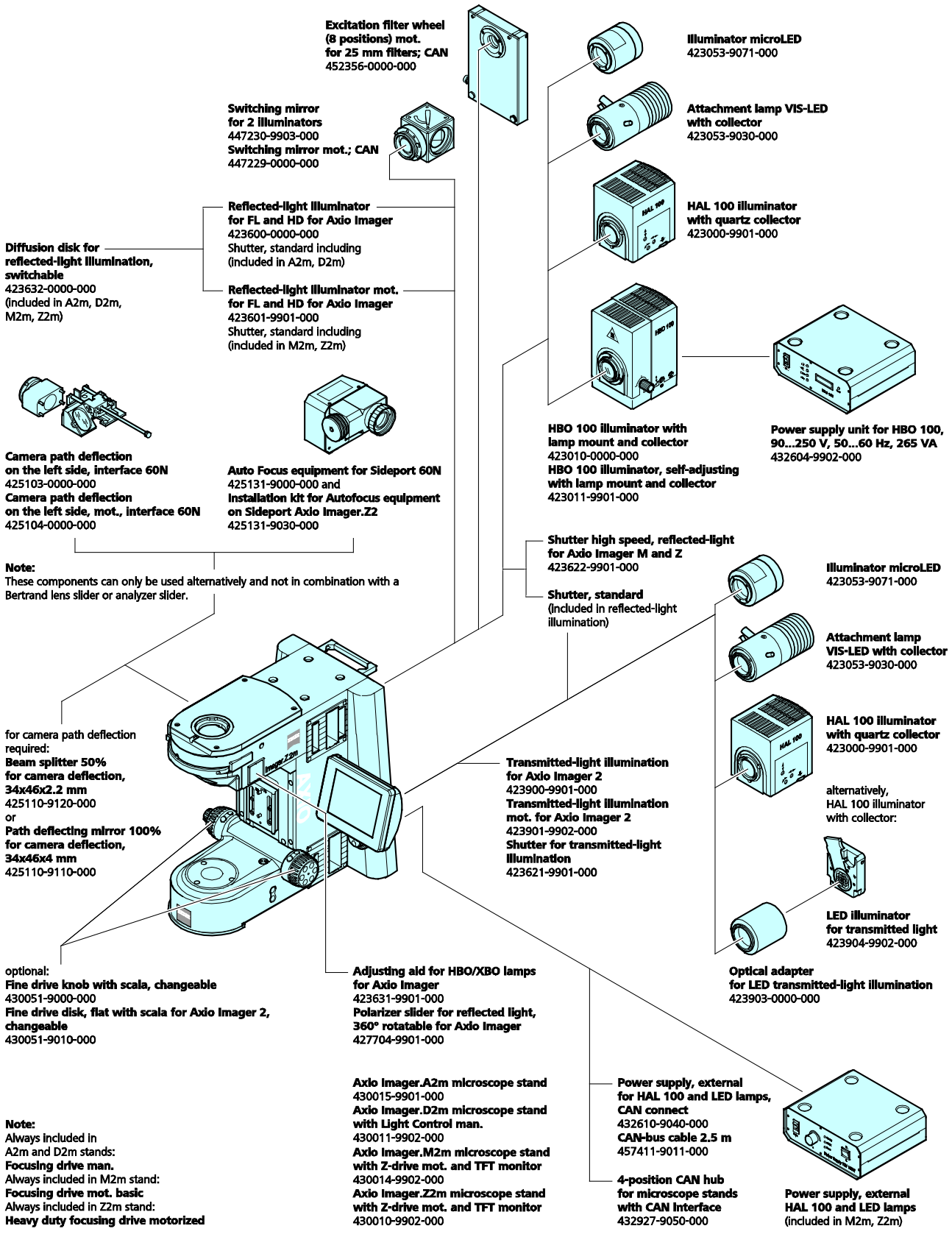
Tube carrier, objective nosepiece



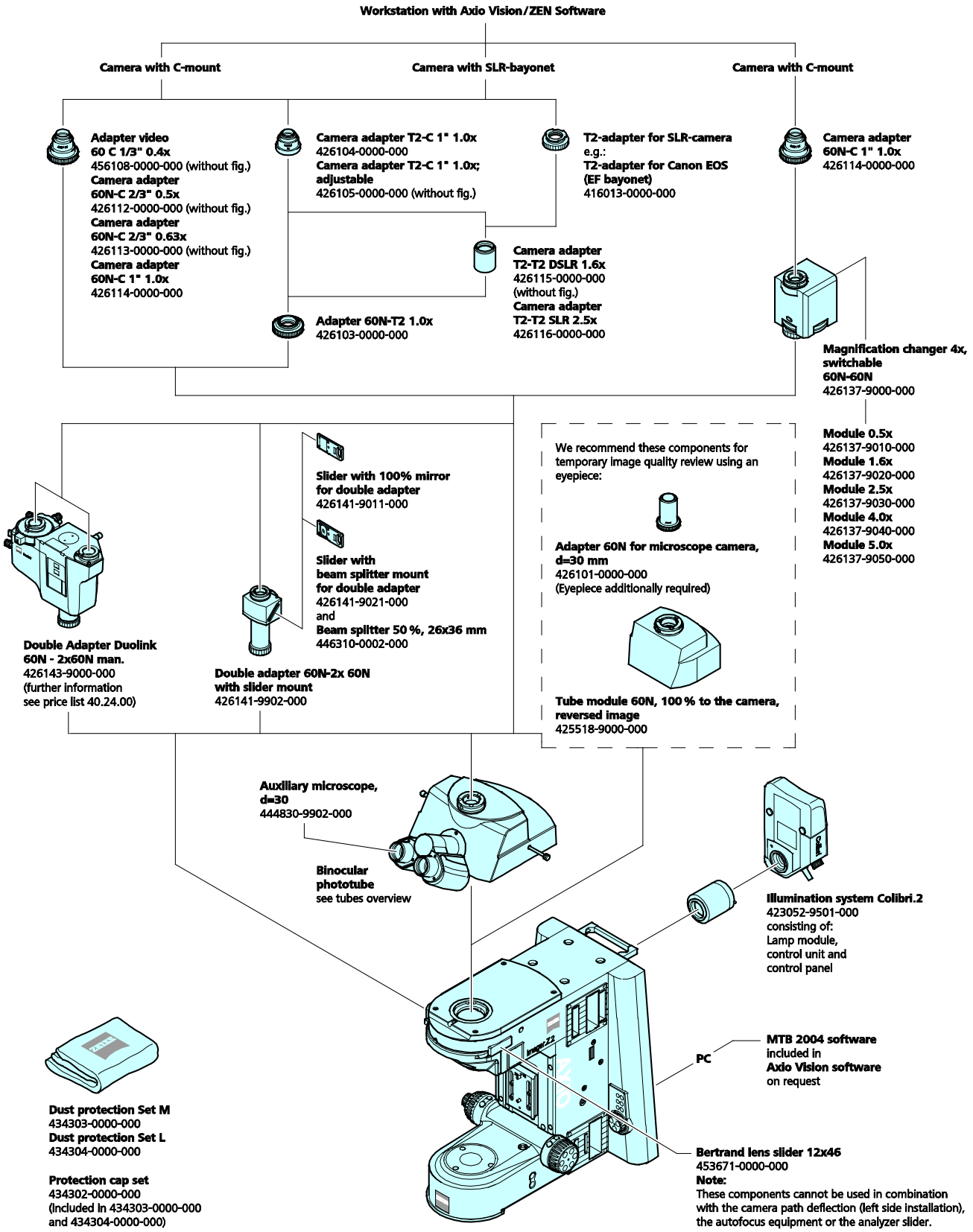
Modules, sliders, filters



Illumination



Documentation



2.5 Objectives

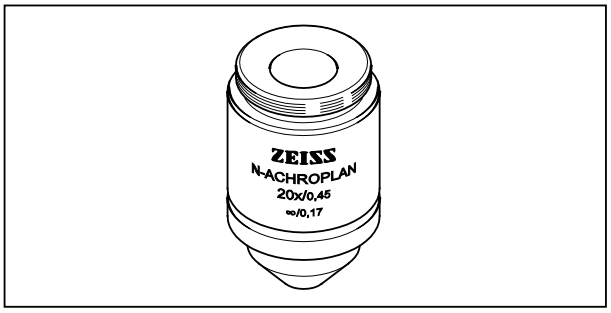


Fig. 8 Objective

The objectives are the optical heart of the microscope. They may be labeled as follows:

N-ACHROPLAN 20x/0.45 ∞/0.17.

where

20x : Objective magnification, with a defined color ring on the objective allocated to each magnification step (ZEISS color code)

0.45 : Numerical aperture

∞ : Infinite image distance; these objectives can only be used with ICS microscopes from Carl Zeiss.

0.17 : Can only be used with cover slip thickness D = 0.17 mm.

or

– : Can be used with cover slip thickness D = 0 or 0.17 mm.

Other labels:

Oil : Oil immersion objective

Ph 2 : Phase-contrast objective with green inscription and phase stop Ph 2

The color of the inscription denotes the contrasting method the objective is designed for:

Black: Standard
Green: Phase contrast
red: Strain-free for polarization (Pol); low-strain for differential interference contrast (DIC)

The color rings indicate the magnification of the objective (color code):

Color ring on objective	Black	Brown	Red	Orange	Yellow	Green	Light blue	Dark blue	White
Magnification factor	1x; 1.25x	2.5x	4x; 5x	6.3x	10x	16x; 20x; 25x; 32x	40x; 50x	63x	100x; 150x

Objective magnification multiplied by eyepiece magnification (usually 10x) yields overall visual magnification: e.g. 10 x 10 = 100x.

When working with the microscopes, total magnification should not be above or below the range of useful magnification. The range of useful magnification is defined by Ernst ABBE as 500 to 1,000 times the numerical aperture of the objective used. The human eye cannot resolve any details beyond this. Accordingly, the range of useful magnification for an objective with a numerical aperture of 0.3 is between 150x and 300x.

The higher the numerical aperture of the objective, the greater the necessity for exact observance of the cover slip thickness of 0.17 mm. For this reason, certain objectives are equipped with a correction mount for adjustment to different cover slip thicknesses. To this end, a specimen area should be searched for, and the position of the correction ring where optimum focus and image contrast are obtained determined (refocusing is invariably required).

When immersion objectives are used, the air between the cover slip and the objective is replaced by a liquid, which in most cases is immersion oil. The plastic oiler containing 20 ml of Immersol 581 F® immersion oil (n_D = 1.518) is ideal for this purpose.

To prevent oil contamination of the specimen when the nosepiece is turned, the snap-in sockets of the immersion objectives can be locked in their raised position by turning them clockwise (do not forget to re-release them!).

2.6 Eyepieces

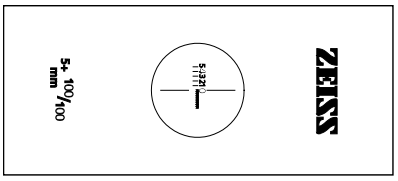
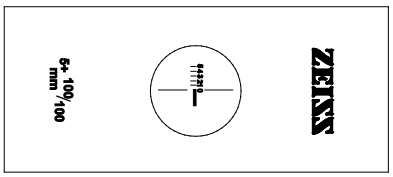
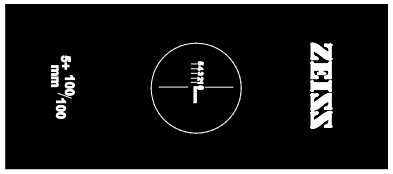
The field number of the eyepieces PL 10x/25 Br. foc. and E-PL 10x/25 Br. foc. is 25 mm; that of eyepieces W-PL 10x/23 Br. foc. and E-PL 10x/23 Br. Foc. is 23 mm.

W-PL and PL in the eyepiece designation indicates excellent image flatness up to the edge of the field of view.

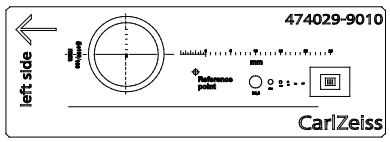
If required, eyecups for the eyepieces can be ordered under Cat. No. 444801-0000-000.

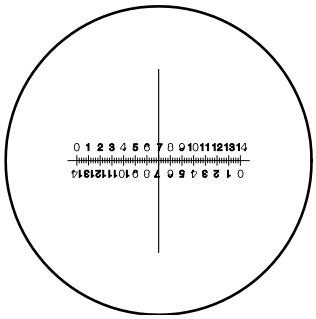
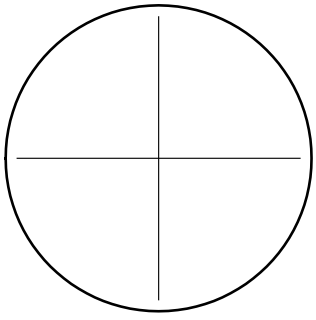
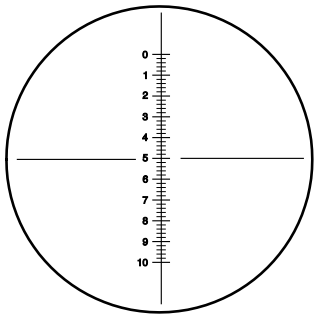
2.7 Stage micrometers and eyepiece reticles

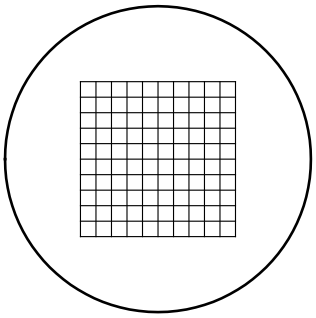
Measuring and counting using a microscope requires stage micrometers and eyepiece reticles, a selection of which is listed below:

Symbol	Designation, technical data	Cat. No.
	**Stage micrometer, positive 5 + 100/100 y** D = 0.17 mm Graduation on +y axis: 5 mm in 5 intervals Graduation on –y axis: 1 mm in 100 intervals with 2 opposing scales = 10 µm, accuracy ±1 µm	474026-0000-000
	**Stage micrometer positive for transmitted light** 1 scale division = 0.01 mm, line width = 0.001 mm *with calibration certificate	474026-9800-000
	**Stage micrometer negative for transmitted-light** 1 scale division = 0.01 mm, line width = 0.001 mm	

Symbol	Designation, technical data	Cat. No.

	**Universal calibration slide D=0**
	Without cover glass; positive version
	– Precision retrieval of objects
	– Location of the reference mark relative to the left and
	– upper edge of specimen slide X = 38 mm / Y = 13 mm, ± 5 µm
	– 50mm line for parallelism check
	– Stage micrometer-function "Micro" and "Stemi":
	  – 5 lines at 1 mm intervals in y direction
	  – 100 lines at 1/100 mm intervals in y direction
	  – 25 lines at 1 mm intervals in x direction
	  – 50 lines at 1/10 mm intervals in x direction
	– Circular areas with diameter of 2.5/1.0/0.5/0.1/0.05/0.01 mm
	– Concentric rectangles 8x6/4x3/2x1.5/ 1x0.75 mm
		474029-9010-000

	**Crossline micrometer 14:140 / d = 26 mm** Graduation length = 14 mm Increments = 0.1 mm Graduation tolerance ≤ 0.001 mm	454060-0000-000
	**Eyepiece reticle / d = 26 mm** For the alignment of the reticle using alignment specimen.	474064-0000-000
	**Crossline micrometer 10:100 / d = 26 mm** Graduation length = 10 mm Increments = 0.1 mm Graduation tolerance ≤ 0.001 mm	474066-9901-000

Symbol	Designation, technical data	Cat. No.
	**Net micrometer 12.5x12.5/5;10 / d = 26 mm** Area 12.5 x 12.5 mm, divided into 10 x 10 fields	474068-0000-000

☞ If eyepiece reticles are used, the binocular tube or the must be equipped with two focusing eyepieces ("foc."). The eyepiece reticle should be mounted into one of these.

2.8 Technical data

Dimensions (width x depth x height)

Axio Imager stand, manual with HBO 100 ..... approx. 300 mm x 721 mm x 505 mm
Axio Imager stand, motorized with HBO 100 and TFT display ..... approx. 390 mm x 721 mm x 505 mm

Weight

Axio Imager 2, coded / motorized (dependent on equipment) ..... approx. 18 kg to 40 kg

Ambient conditions

Transport (in packaging):

Permissible ambient temperature ..... -40 °C to +70 °C

Storage:

Permissible ambient temperature ..... -40 °C to +40°C
Permissible relative humidity (no condensation) ..... max. 75% at 35 °C

Operation:

Permissible ambient temperature ..... -40 °C to +40 °C
Permissible relative humidity ..... max. 75% at 35 °C
Atmospheric pressure ..... 800 hPa to 1060 hPa
Altitude ..... max. 2000 m
Pollution degree 2

Operating data for coded Axio Imager 2, equipped with an integrated power supply or motorized Axio Imager 2 using the VP232-2 external power supply

Operating environment ..... Closed room
Protection class I
Ingress protection rating ..... IP 20
Electrical safety ..... in compliance with DIN EN 61010-1 (IEC 61010-1) including CSA and UL directives
Overvoltage category II
Radio interference suppression ..... in accordance with EN 55011 Class B
Noise immunity ..... in accordance with DIN EN 61326-1

Line voltage for integrated power supply ..... 100 V to 127 V and 200 V to 240 V ±10 %
Line voltage conversion is not required!
Line voltage for external power supply VP232-2 ..... 100 V to 240 V ±10 %
Line frequency ..... 50 Hz – 60 Hz
Power consumption of coded Axio Imager ..... max. 300 VA
Power consumption of motorized Axio Imager ..... max. 190 VA
LED illuminator ..... 400 nm to 700 nm, peak at 460 nm
Attachment lamp VIS-LED ..... 400 nm to 700 nm, peak at 460 nm

Ballast unit HBO 100

Operating environment ..... Closed room
Protection class I
Ingress protection rating ..... IP 20
Line voltage ..... 100 VAC ... 240 VAC
Line frequency ..... 50 Hz – 60 Hz
Power consumption when HBO 100 is used ..... 155 VA

Fuses in accordance with IEC 127

Axio Imager microscope stand, coded ..... T 5.0 A / H / 250V, 5x20 mm
Power supply VP232-2 for Axio Imager, mot. ..... T 4.0 A / 250V, 5x20 mm
Ballast unit HBO 100 ..... T 2.0 A/H, 5x20 mm

Light sources

Halogen lamp ..... 12 V/100 W
Adjustment of light source ..... continuous, approx. 0.7 V to 12 V
Mercury vapor short-arc lamp ..... HBO 103 W/2
Power consumption of HBO 103 W/2 ..... 100 W

Axio Imager 2, coded

Stand with manual stage focusing
- Coarse drive ..... 2 mm/revolution
- Fine drive ..... 0.2 mm/revolution; 2 µm increment
- Lifting range ..... max. 25 mm
- Height stop ..... mechanically adjustable

Achromatic-aplanatic universal condenser 0.9 H D Ph DIC with swivel-type front lens, achromatic-aplanatic 0.9 DIC,
- for objective magnifications $V_{obj.}$ < 10x ..... front lens 0.9 swiveled out
- for objective magnifications $V_{obj.}$ ≥ 10x ..... front lens 0.9 swiveled in

8-position turret disk

Objective change:
- Coded ..... via 6-position or 7-position nosepiece, HD or HD DIC M27

Changing the contrast method
- Coded ..... via 6-position reflector turret

Axio Imager 2, motorized

Stand with motorized stage focusing:
- Step size of stepper motor ..... 25 nm (Axio Imager.M2)
  10 nm (Axio Imager.Z2)
- Rapid lowering/lifting of stage ..... 10 mm
- Lifting range ..... 25 mm
- Height stop ..... electronic
- Focusing speed ..... variable

Achromatic-aplanatic universal condenser 0.9 H D Ph DIC, mot. with swivel-type front lens, achromatic-aplanatic 0.9 DIC,
- for objective magnifications $V_{obj.}$ < 10x ..... front lens 0.9 swiveled out
- for objective magnifications $V_{obj.}$ ≥ 10x ..... front lens 0.9 swiveled in

8-position turret disk

Objective change:
- coded / motorized ..... via 6-position or 7-position nosepiece

Changing the contrast method
- coded / motorized ..... via 6-position or 10-position reflector turret
- manually / motorized ..... via DIC or C-DIC modulator turret

High-performance focus for scanning stages ..... Applicable for specimens weighing up to 5 kg

DIN EN 62471:2009 rating
- HXP 120, HBO 100, XBO 75 ..... Risk Group 2 (moderate risk)
- HAL 100, VIS-LED, microLED ..... Risk Group 1 (low risk)

3 FIRST-TIME SET-UP

The Axio Imager 2 microscope can be installed, modified and started up independently by the customer. On request, the microscope can also be installed or modified by the ZEISS Service department (fee charged).

☞ Before installing and starting-up the microscope, carefully read the **notes on instrument safety** (see Section 1).

3.1 Unpacking and installing the microscope

The basic instrument is packed to commercial standards in a polyethylene case with cardboard packaging.

It contains the following components: stand, binocular tube, objectives, eyepieces, condenser, HAL 100 illuminator, microscope mat and various small parts, such as DIC slider, spare lamp, dust cover, tool bag with tools.

The following components are factory-mounted onto the microscope stand: mechanical stage, specimen holder, objectives, polarizer, filter holder, reflected-light illuminator and adjusting aid for HBO / XBO lamps.

Additional optional accessories are supplied in a separate box.

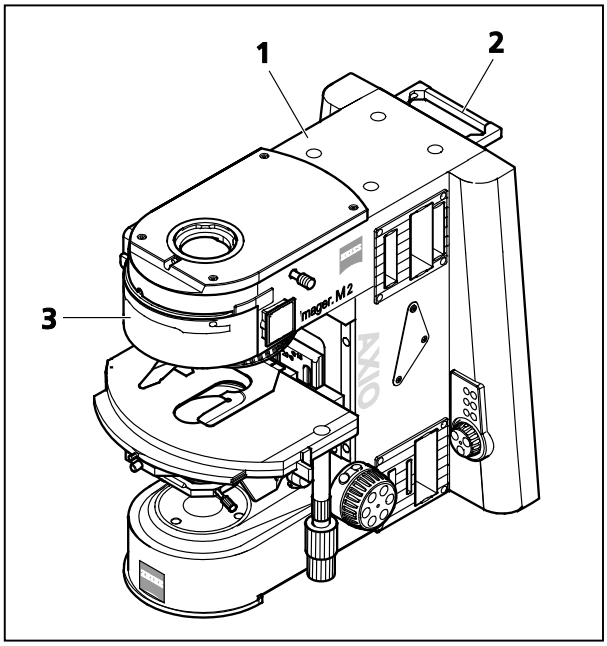


Fig.9 Setting up the microscope

- Remove all components from the packaging, observing the instructions provided for unpacking the instrument.

! The stand can be carried using the handle (Fig.9/**2**) at the rear of the stand. The second holding point must never be on the microscope stage itself, as this could damage the guide. The grip recess on the cover part Fig.9/**3**) constitutes a safe second holding point.

- Use the delivery note to check that the delivery is complete.
- Place the instrument (Fig.9/**1**) onto a vibration-free, flat worktable.
- Keep the original packaging for storage or for returning the instrument to the manufacturer, or dispose of it properly.

3.2 Installation conditions and notes

The ambient conditions (humidity, temperature, pressure) specified in Section 2.8 should be adhered to.

☞ When documenting fluorescence preparations, do not expose the microscope to direct sunlight. This helps minimize the influence of stray light.

☞ For prolonged experimental procedures using the microscope (e.g. involving incubation or long image-recording procedures) choose an installation location with minimum vibration.

Vibration stemming e.g. from forced ventilation, floor impact noise or other shocks can have an impact on the supplementary modules of the microscope, some of which react sensitively. It can also lead to reduced image quality and experimental errors.

☞ To reduce vibrations at the microscope installation location, ZEISS offers various passive and active damping options (Axio Imager (000000-0477-190 anti-vibration plate); small, air-damped system table (000000-1984-812), table top mat TS 150).

☞ Select an installation site which is as temperature-stable as possible for long-term observations.

For reliable long-term observations, the device must first warm up. The temperature equilibrium is attained within 3-5 hours, depending on the light source, electronics and room temperature control. This time must be planned into critical studies.

3.3 Attaching or changing binocular tube or phototube

All binocular tubes listed in the system overview (refer to Section 2.4) can be attached to the manual or the motorized stand as described below.

- Use an AF 3 ball-headed screwdriver to undo clamping screw (Fig. 10/**4**) and remove the tube (Fig. 10/**2**) upwards.
- Place dust cap (Fig. 10/**3**) for tube lens protection on the dovetail of the binocular tube.
- Remove dust cap (Fig. 10/**6**) from the desired tube.
- Insert the tube (Fig. 10/**1**) with the dovetail into the stand opening (Fig. 10/**5**) and align it.
- Tighten clamping screw (Fig. 10/**4**).

Do not hold the tube by the two eyepiece supports when carrying it.

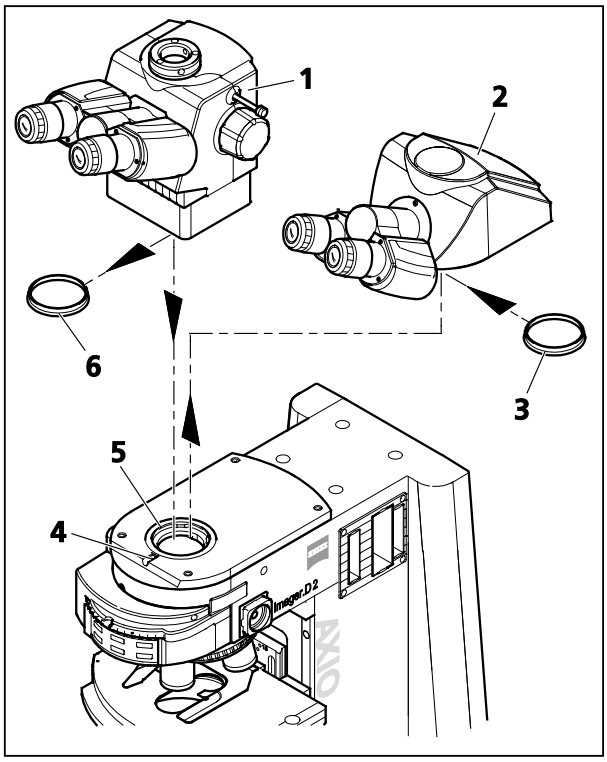


Fig. 10 Changing the binocular tube

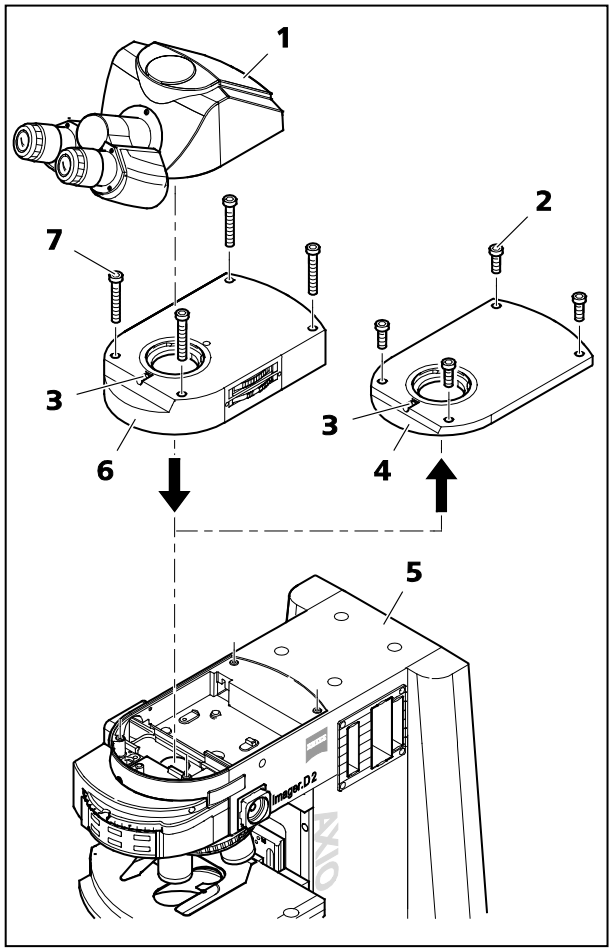


Fig. 11 Mounting the tube lens turret

3.4 Mounting the tube lens turret

- Use an AF 3 ball-headed screwdriver to loosen clamping screw (Fig. 11/**3**) and remove the tube (Fig. 11/**1**) upward.
- Unscrew the four fastening screws (Fig. 11/**2**), remove coupler plate (Fig. 11/**4**) upward and store it for future use.
- Put tube lens turret (Fig. 11/**6**) onto stand (Fig. 11/**5**) and screw it down using the four fastening screws (Fig. 11/**7**) supplied.
- Unscrew the tube lens by hand from the tube to be used (Fig. 11/**1**). Store it in the storage box.
- Insert tube (Fig. 11/**1**) without tube lens and dovetail into the mount of the tube lens turret (Fig. 11/**6**) and tighten clamping screw (Fig. 11/**3**).

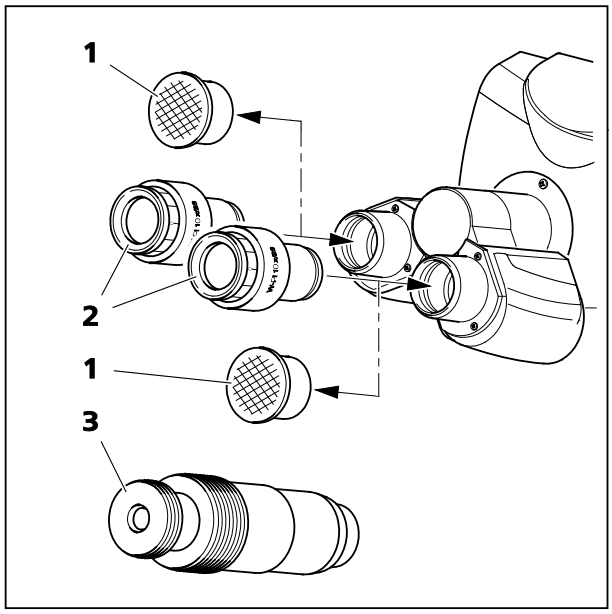


Fig. 12 Inserting eyepieces

3.5 Inserting the eyepieces and auxiliary microscope

- Remove both dust caps (Fig. 12/**1**) from the binocular tube.
- Remove both eyepieces (Fig. 12/**2**) from their cases and insert them into the binocular tube as far as they will go.
- The auxiliary microscope (Fig. 12/**3**) can be inserted into one of the eyepiece sockets of the binocular tube in place of an eyepiece. It is used to view the objective pupil and to center phase and darkfield stops. These diaphragms and stops can be focused using the adjustable eye lens; the setting can then be locked by means of the clamping screw.

3.5.1 Inserting the eyepiece reticles

Eyepiece reticles (Fig. 13/**3**) may be inserted into focusable / adjustable eyepieces marked with a red dot.

The slight image shift caused by the additional glass path is taken into account on the diopter scale by the fact that the zero point position is indicated not by the white dot, but the red dot.

Make sure the reticles figure always faces the field stop.

☞ Eyepiece reticles may only be installed by Zeiss service technicians working in a dust-free environment.

3.5.2 Compensation of ametropia when eyepiece reticles are used

Correct use of eyepiece reticles requires two focusing eyepieces, e.g. PL 10x/23 Br. foc, to enable users to compensate for ametropia differences of their eyes.

- Use the focusing lens of the adjustable eyepiece to focus on the line figure of the eyepiece reticles.
- Viewing through the eyepiece, use the focusing drive to focus the microscope image of a specimen placed on the stage.
- As soon as the microscope image and the eyepiece reticles are focused in the eyepiece, turn the focusing eye lens of the second eyepiece to focus the microscope image for the second eye.

Both microscopic images and that of the eyepiece reticles should then be clearly focused.

You should subsequently focus only using the focusing drive.

3.5.3 Inserting the fold-over eyecups

The eyepieces have a rubber spectacle protection ring to prevent scratching. The protection rings can be replaced with fold-over eyecups when required.

- Remove the spectacle protection rings (Fig. 13/**2**) from the eyepieces and attach the eyecups (Fig. 13/**1**).
- Sometimes the spectacle protection rings are seated very tightly in the eyepiece groove, occasionally requiring the use of a blunt object (wooden stick) to remove them.

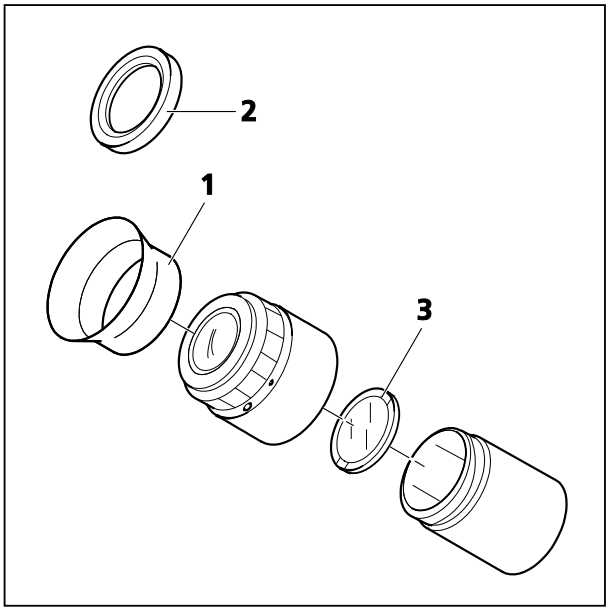


Fig. 13 Inserting the fold-over eyecups

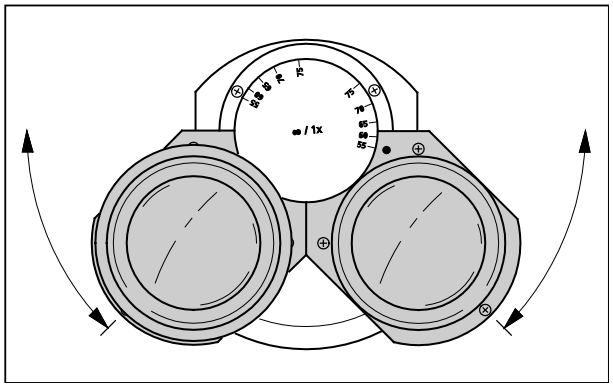


Fig. 14 Setting the interpupillary distance on the binocular tube

3.6 Setting the interpupillary distance on the binocular tube

- To adjust the eyepiece distance to your individual interpupillary distance, swing the eyepiece tubes symmetrically toward or away from one another (Fig. 14).

The adjustment of the interpupillary distance is correct when you see only **one** round image while looking through the two eyepieces!

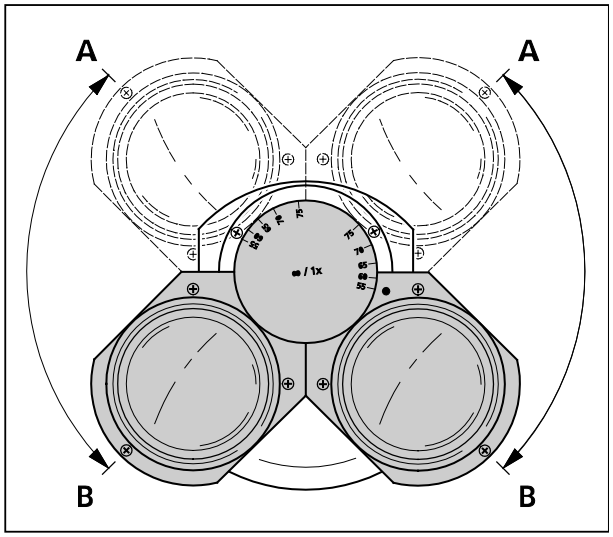


Fig. 15 Setting the viewing height on the binocular tube

3.7 Setting the viewing height

- The viewing height can be adjusted to individual requirements by swiveling the eyepiece tubes up (Fig. 15/**A**) or down (Fig. 15/**B**).

The ergonomic binocular tubes (425511-0000-000, 425512-0000-000 and 425515-0000-000) provide continuous height adjustment over a range of 50 mm. Adjustment is by means of the rotary knob.

3.8 Connecting equipment to the camera port on the binocular phototube

Adapter for Interface 60N (external thread M52 x 1)

☞ The Axio Imager uses a new "Interface 60N" connector type to adapt the camera. The adapters for "Interface 60" (inside diameter 30 mm), however, can continue to be used.

Microscope cameras (e.g. Carl Zeiss AxioCam), customary SLR cameras (Single Lens Reflex; 35 mm film or digital) or compact digital cameras may be connected to the camera port.

☞ When working with microphotographic devices, consult the corresponding manuals of the cameras as well.

- Fix the camera adapter 60N (Fig. 16/**1**; **2**) to the camera.
- Remove the dust cap from the camera port.

☞ Please note: The three set screws (SW 3) (Fig. 16/**4**) in the camera port must not extend either to the external thread or to the internal bore hole.

- Attach the pre-assembled unit to the camera port, adjust it and fasten the union nut of the adapter (Fig. 16/**1** or **2**) fingertight.

Adapter for Interface 60 (plug-in diameter 30 mm)

- Attach the camera adapter 60 (Fig. 16/**3**) to the camera.
- Remove the dust cap from the camera port.
- Insert the pre-assembled unit in the camera port (do not screw set screw in too deeply).
- Turn the set screw (SW 3) on the tube clockwise (Fig. 16/**4**) until the adapter is tight.

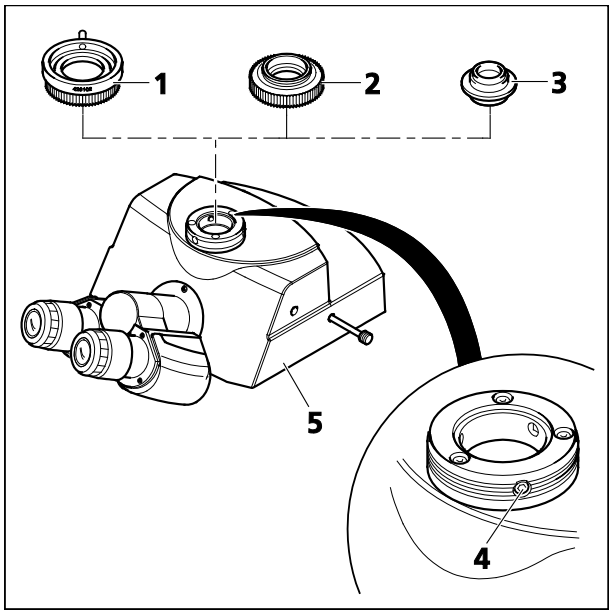


Fig. 16 Fitting components to the phototube

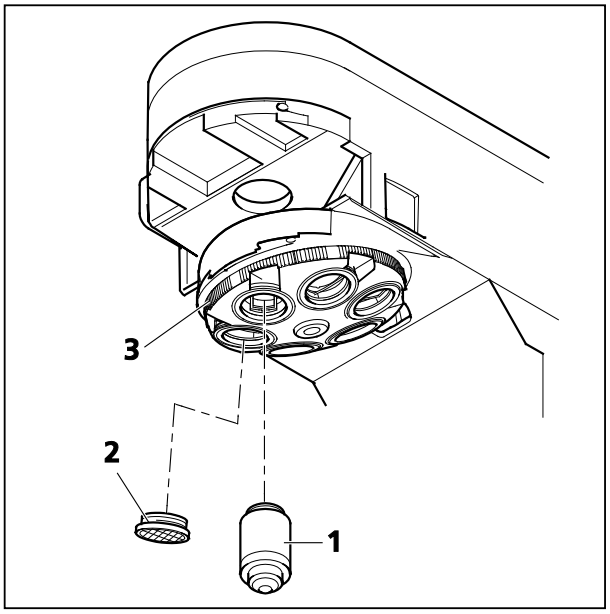


Fig. 17 Screwing in objectives

3.9 Screwing in objectives

- Move the mechanical stage with stage carrier to the lower stop position.
- Remove dust covers (Fig. 17/**2**) from the respective openings on the objective nosepiece.
- Remove objectives (Fig. 17/**1**) from the case and screw them into the nosepiece (Fig. 17/**3**) starting with the lowest magnification (clockwise rotation).
- Make sure that the unused objective mounts of the nosepiece are covered by dust caps.

☞ Use adapter M27x0.75 "0" on W 0.8 (000000-1095-168) in combination with objectives with W 0.8" thread.

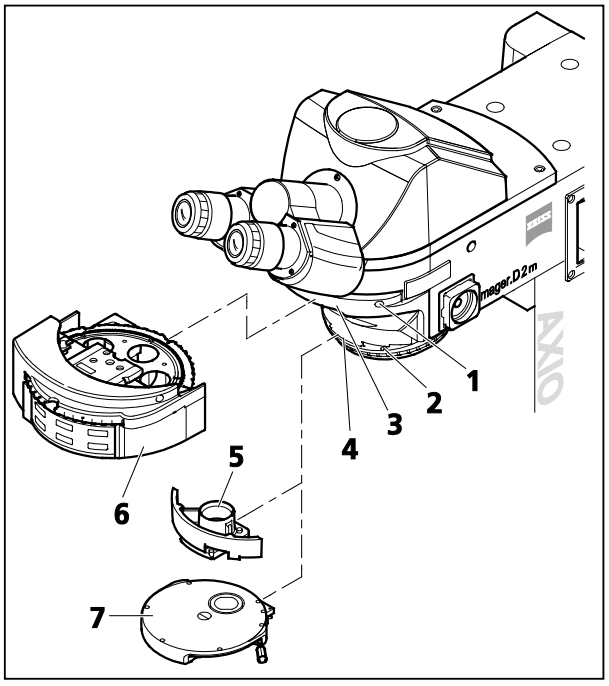


Fig. 18 Inserting reflector turret, compensator mount or modulator turret

3.10 Inserting reflector turret, 6x20 compensator mount or 4-position modulator turret

! Install or change the motorized reflector turret or modulator turret only when the microscope is switched off.

- Loosen the clamping screw (Fig. 18/**1**). Pull out the reflector turret (Fig. 18/**6**) or the cover part, using the grip recess (condition on delivery).
- Insert the compensator mount (Fig. 18/**5**) or the 4-position modulator turret (Fig. 18/**7**) manual or motorized) fully into guide (Fig. 18/**4**) on the top part of the stand. Tighten clamping screw (Fig. 18/**2**).
- Attach reflector turret (Fig. 18/**6**) to the guide (Fig. 18/**3**) in the top part of the stand and push it in until it (audibly) snaps in.
- Tighten clamping screw (Fig. 18/**1**).
- If the reflector turret was supplied without inserted reflector modules, insert them as described in Section 3.11.

☞ If the instrument is to be transported to another location, the reflector turret must be replaced again by the cover part with grip recess.

3.11 Installing and removing P&C reflector modules

Normally, the reflector turret is factory-equipped with P&C (Push&Click) reflector modules if requested by the customer. However, the user can also change the equipment of these turrets.

The reflector turret is designed to hold a maximum of six or ten reflector modules, depending on the model.

3.11.1 Installing a module

- Fold up cover flap (Fig. 19/**4**) to the right on reflector turret (Fig. 19/**3**) and unhinge it using the handle (Fig. 19/**7**) on the left.
- Turn the reflector turret until the desired position (position ID labeled on reflector turret) can be accessed in the mounting hole.
- Holding it by the handles (Fig. 19/**5**) to the right and left of the module, insert the module (Fig. 19/**6**) obliquely from the bottom into the upper spring clips (Fig. 19/**1**) on the reflector turret.
- Then press the bottom of the module until it snaps securely into the lower spring clips (Fig. 19/**2**) of the reflector turret as well.

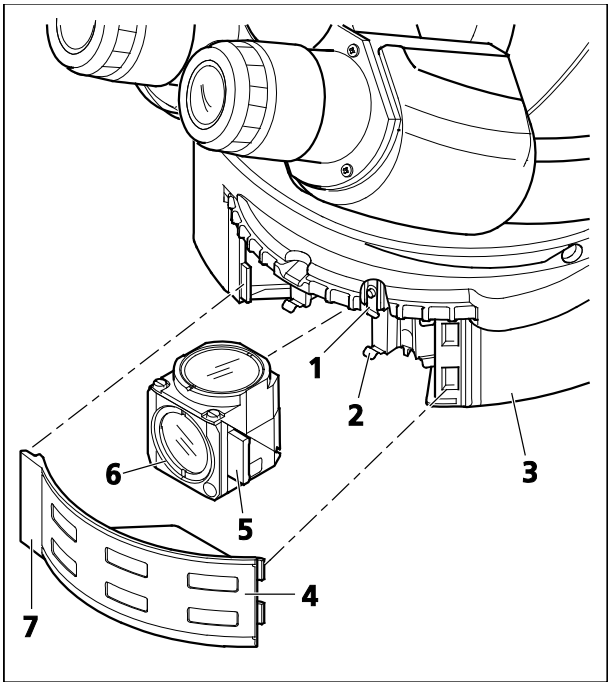


Fig. 19 Changing P&C reflector modules

3.11.2 Removing a module

- Slightly tilting the module, release it first from the bottom spring clips and then from the top spring clips. Remove it completely.
- After having removed and installed the reflector modules, re-apply the cover flap and let it snap in.
- Turn the reflector turret through three or five positions (10-position reflector turret) to swing the newly installed module into the optical path.
- After equipping the turret as desired, label the adhesive labels with the new filter combination and affix them to the corresponding fields on the cover flap.

3.12 Changing the filter set in the reflector module FL P&C

The filter sets for the FL P&C reflector module can be combined and assembled individually by the customer.

Insert only fluorescence filters with a free aperture of ≥ 22 mm, otherwise the image may be masked. Make sure this requirement is met when using filters from other manufacturers.

Filter sets or fully assembled FL P&C reflector modules can be ordered from ZEISS.

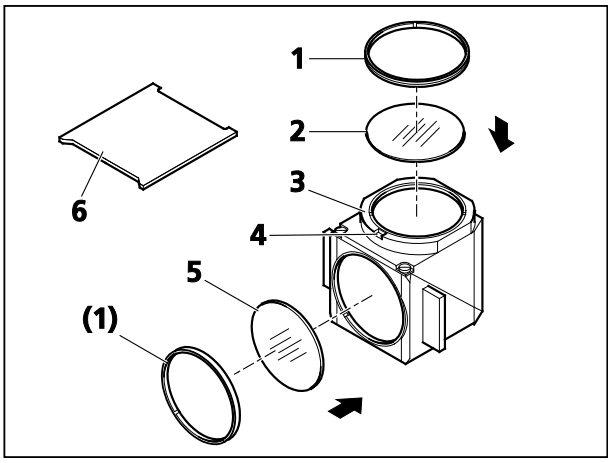


Fig. 20 Changing the filter set in reflector module FL P&C

- Remove reflector module FL P&C (Fig. 20/**3**) from the reflector turret and place it on a surface (refer to Section 3.11).
- Use mounting plate (Fig. 20/**6**) from the tool kit to unscrew retaining ring (Fig. 20/**1**).
- Turn the reflector module and let the filter (Fig. 20/**2** or **5**) drop out onto a soft surface.
- Insert the barrier filter (emission filter) at (Fig. 20/**2**), the exciter filter at (Fig. 20/**5**). Secure both filters by means of retaining rings (Fig. 20/**1**).

The barrier filter and exciter filter may have a designation and an arrow on their circumference. The arrow indicates the direction in which the particular filter is to be installed in the reflector module; it must always point inwards (refer to arrows in Fig. 20).

To minimize image offset during multiple fluorescence image captures, an additional label can be provided on the barrier filter to indicate the position of the wedge angle.

This label should be aligned to the orientation groove (Fig. 20/**4**) when you insert the barrier filter in the reflector module. This is to ensure that the wedge angle of the barrier filters is in the same defined position in the reflector modules, thus compensating or minimizing the already minimal module-to-module image shift when ZEISS filter sets are used.

If it is necessary to mount filters that carry no directional mark (arrow), the following procedure is recommended:

Mount the filters with the reflective dielectric layers in such a way that the reflective layer (Fig. 21/**6**) on the exciter filter (Fig. 21/**5**) points outwards (relative to the reflector module). On the barrier filter (Fig. 21/**1**), the reflective layer (Fig. 21/**2**) points inwards (Fig. Fig. 21).

The reflective layer (Fig. 21/**4**) of the beam splitter (Fig. 21/**3**) should point downward when in its mounting position.

The arrows (Fig. 21/**7**) mark the illumination and imaging beam path.

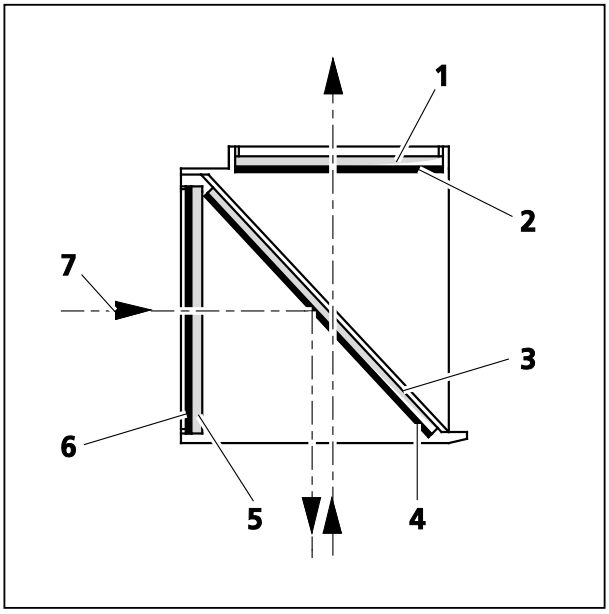


Fig. 21 Installing filter and beam splitter

3.13 Changing the beam splitter in the reflector module FL P&C

When mounting filters and beam splitters, take extreme care to prevent damage to and contamination of the optical components.

We recommend ordering fully equipped FL P&C reflector modules, since changing the beam splitter is a challenging task.

However, if you should choose to change the beam splitter, follow this procedure:

- Remove the FL P&C reflector module from the reflector turret (also refer to Section 3.11.2).
- Unscrew the two slotted screws (Fig. 22/**1**) with a screwdriver.
- Hold both halves of the reflector module together (**emission** half (Fig. 22/**2**) and **excitation** half (Fig. 22/**3**), turn to the position opposite the installation position and put it down.

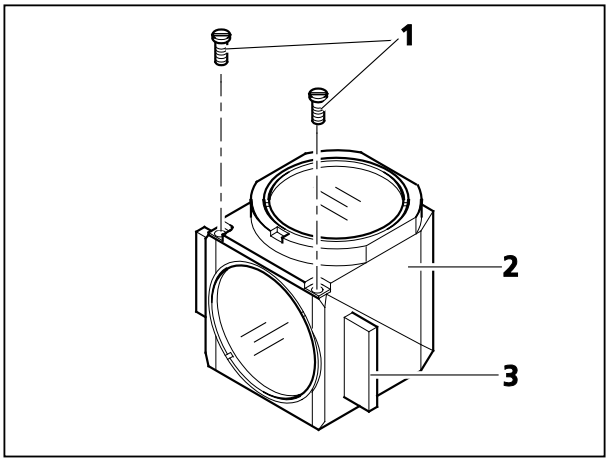


Fig. 22 Changing the beam splitter

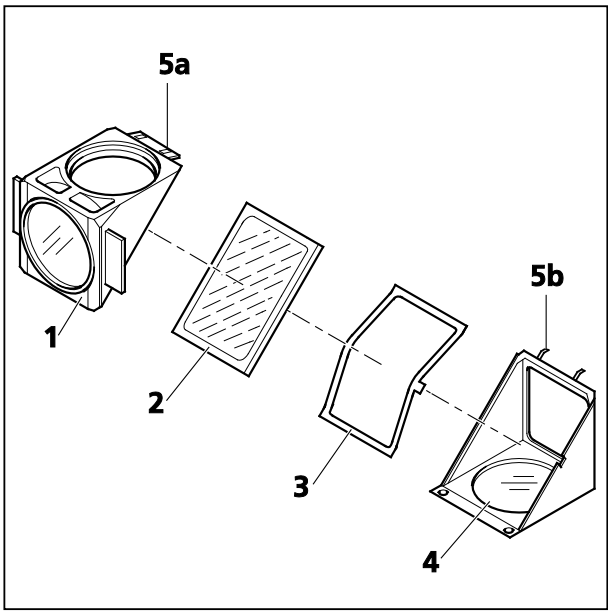


Fig. 23 Changing the beam splitter - Continued

- Tip up the **excitation** half of the module (Fig. 23/**1**), which now is on top, and remove it from the retaining pins (Fig. 23/**5b**) on the bottom **emission** half of the module (Fig. 23/**4**).
- Remove the beam splitter (Fig. 23/**2**) and spring-loaded frame (Fig. 23/**3**) from the bottom half of the module.
- Remove the old beam splitter and carefully place the new one onto the spring-loaded frame (Fig. 23/**3**) with the reflective side facing up. Then insert both parts together into the bottom half of the module. Ensure that the side tongue of the spring-loaded frame is in the appropriate recess in the bottom half of the module.

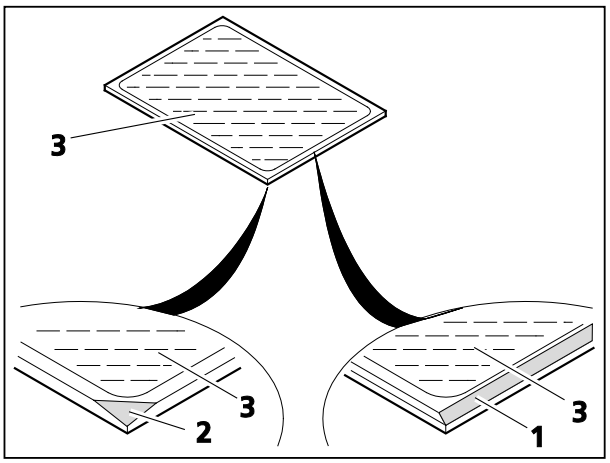


Fig. 24 Labelling of beam splitter

☞ The reflective (coated) side (Fig. 24/**3**) of the beam splitter has a beveled edge (Fig. 24/**1**) or corner (Fig. 24/**2**).

- Place the **excitation** half of the module (Fig. 23/**1**) onto the **emission** half (Fig. 23/**4**) (retaining pins Fig. 23/**5b** and eyelets Fig. 23/**5a** mesh with one another). Hold both halves together and turn them back into the installation position.
- Re-insert the slotted screws and tighten them.
- Finally, affix the adhesive label with the name of the filter combination to the side of the module.

3.14 Attaching or changing the condenser

- Use the coarse focusing drive to move the stage carrier to the upper stop position.
- Turn height control (Fig. 25/**1**) to lower condenser carrier (Fig. 25/**2**).
- Unscrew clamping screw (Fig. 25/**4**) (SW 1.5) slightly, if necessary.
- If available, swivel out the front lens (Fig. 25/**8**) of the condenser using lever (Fig. 25/**7**).
- Insert the condenser (Fig. 25/**6**) fully into the centering condenser mount (Fig. 25/**5**) between the condenser carrier (Fig. 25/**2**) and the stage carrier (Fig. 25/**9**). Turn the set screw on the bottom of the condenser towards the groove (Fig. 25/**3**).
- Tighten the clamping screw (Fig. 25/**4**) on the condenser mount. To avoid any damage to the condenser mount, do not apply excessive force.
- When using a motorized condenser (Fig. 26/**1**) (on the motorized stand) thread the connecting cable (Fig. 26/**3**) through the opening in the stage carrier to the back and insert the plug into socket (Fig. 26/**2**) on the right of the stand base.

Remove the condenser in the reverse order.

☞ When using other types of condensers, use the same process.

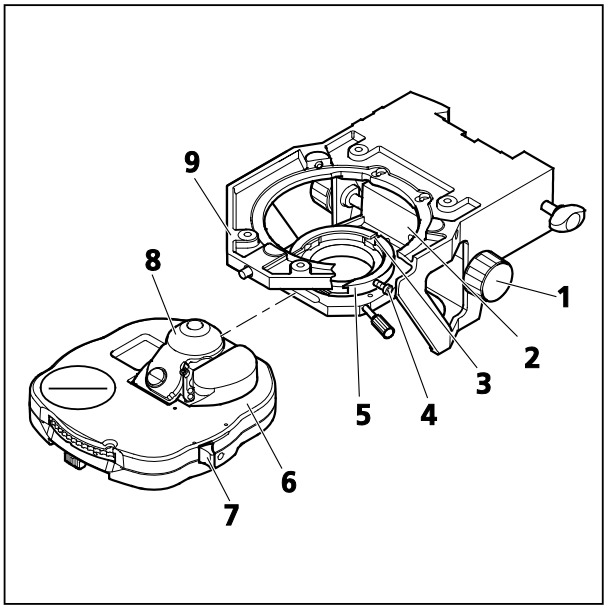


Fig. 25 **Attaching the achromatic-aplanatic universal condenser**

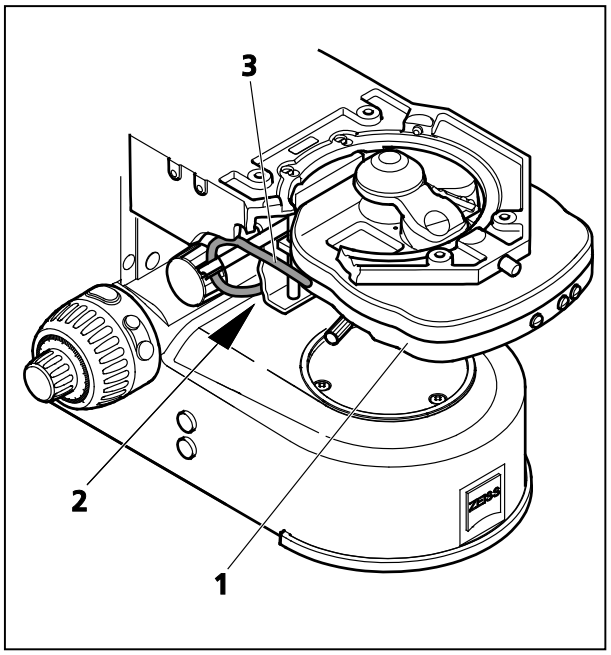


Fig. 26 **Attaching the achromatic-aplanatic universal condenser, mot.**

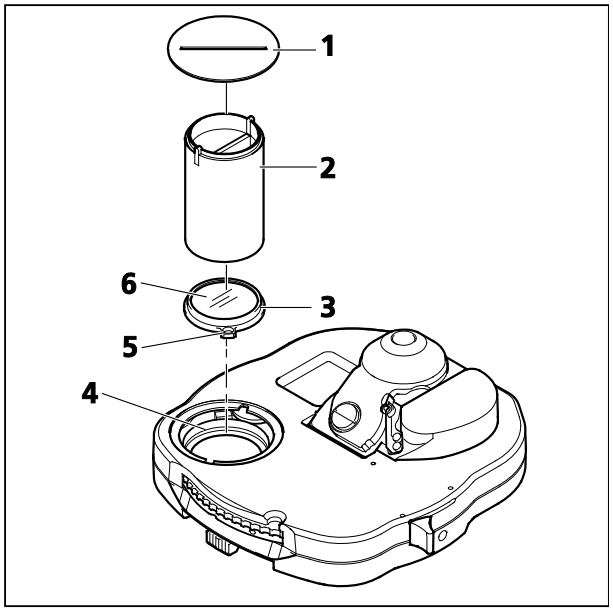


Fig. 27 Replacing the DIC prism

3.15 Replacing the DIC prism on the universal condenser

Before replacing the prism on the motorized universal condenser, ensure that you open the aperture iris first with the corresponding control button to prevent damage of the iris blades.

- Use the tool to remove cover (Fig. 27/**1**), or to unscrew it (if the cover is at the bottom). Turn the turret disk until the DIC prism to be replaced appears in the blank aperture (Fig. 27/**4**). Hold the disk by its knurled ring.
- Unscrew the retaining ring using the so-called dual-function tool (Fig. 27/**2**).
- Then, screw the tool (Fig. 27/**2**) with the threaded side into the prism mount (Fig. 27/**3**) and pull out the DIC prism (Fig. 27/**6**).
- Remove DIC prism (Fig. 27/**6**) from the tool and screw on the new, desired DIC prism.
- Mount the DIC prism in reverse order, paying particular attention to the correct orientation of the DIC prism: tongue Fig. 27/**5** must be in the recess of the mount in the condenser. Ensure that the labeling on the knurled ring of the turret disk is correct.

3.16 Changing the DIC prism of the modulator turret (mot.)

- Unscrew clamping screw (Fig. 28/**1**) on the turret.
- Pull the modulator turret forwards out of the stand and set it down.
- Manually turn the turret disk until the desired position is accessible in the opening (Fig. 28/**4**) from the top.
- Screw out the retaining ring, using the dual-function tool (Fig. 28/**2**).
- Now, screw the threaded side of the tool (Fig. 28/**2**) into the prism mount (Fig. 28/**3**) and then pull the DIC prism (Fig. 28/**5**) out.
- Remove the DIC prism from the tool and screw on the new DIC prism. Proceed in reverse order to install the DIC prism.
- Mount the DIC prism in reverse order, paying particular attention to the correct orientation of the DIC prism (tongue Fig. 28/**6** must be located in the recess of the mount provided in the modulator turret). Ensure that the labeling on the knurled ring of the turret disk is correct.

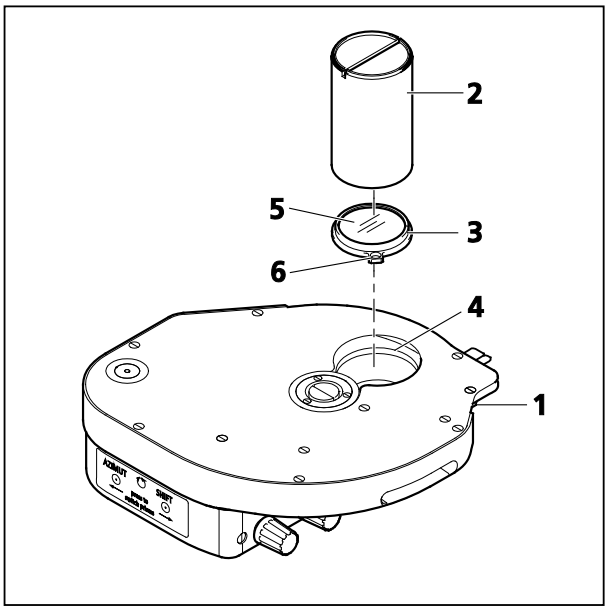


Fig. 28 Changing the DIC prism of the modular turret

☞ For correct operation it is necessary to inform the system of the (amended) configuration using the TFT of the stand or the MTB config.exe.

3.17 Changing the stage carrier

- To remove the stage carrier (Fig. 29/**3**), grip it firmly and loosen the clamping lever (Fig. 29/**2**) until the stage carrier can be taken out of the guide from the right to the left.
- Check the position of the stop screws provided for the adjustment of the dovetail guide and alter it, as required, for the stage carrier or microscope stage used. (See Section 3.18.)
- To attach the stage carrier, insert it on the left into the guide and push it horizontally against the supporting surface of the guide and vertically against the upper stop bolt (Fig. 29/**1**).
- Tighten clamping screw (Fig. 29/**2**) and verify that the stage carrier is sitting snugly in the guide.

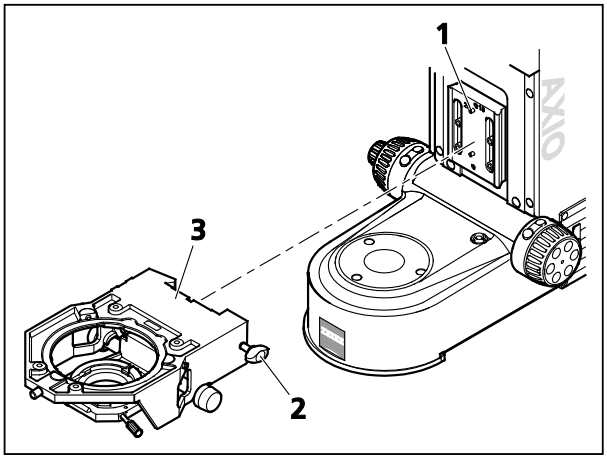


Fig. 29 Changing the stage carrier

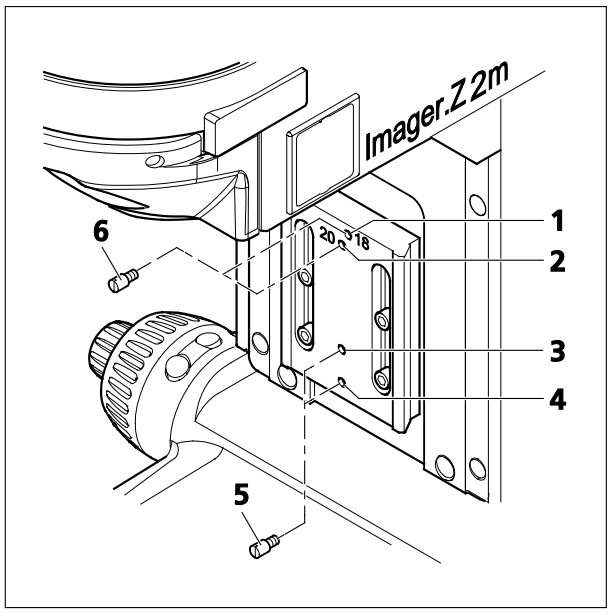


Fig. 30 Setting dovetail guide stops

3.18 Setting stops for the adjustment range of the stage carrier dovetail guide

Lower stop screw (Fig. 30/**5**):

- When employing the reflected-light / transmitted-light stage carrier with condenser carrier 430707-0000-000, use a slot-head screwdriver to screw the lower stop screw into the upper tapped hole (Fig. 30/**3**).
- When employing the reflected-light or reflected-light/transmitted-light stage carrier 430704-9901-000 or 430701-9901-000, screw the lower stop screw into the lower tapped hole (Fig. 30/**4**).

Upper stop screw (Fig. 30/**6**):

- When an 18-mm thick microscope stage is used, screw the upper stop screw into the tapped hole marked with number "18" (Fig. 30/**1**).
- When a 20-mm thick microscope stage is used, screw the upper stop screw into the tapped hole marked with number "20" (Fig. 30/**2**).

☞ The thickness of the stage is shown right next to the order number on a sticker attached to the microscope stage.
If there is no sticker on the microscope stage, the stop screw is to be set to 18 mm to maintain focusability.

3.19 Setting the dovetail guide of the stage carrier

When stage carrier 430701-9901-000 is used, the specimen space needs to be moved for specimens of less than 13 mm, so that the specimen can be focused.

To do so, proceed as follows:

- Remove the stage carrier (see Section 3.17).
- **Loosen** the four clamping screws (Fig. 31/**1** to **4**) of the dovetail guide.
- Move the guide plate (Fig. 31/**5**) as far **up** as it will go in the slots.
- Then, tighten the four screws. **Always** proceed in the following order:
  - upper left screw (Fig. 31/**1**),
  - lower left screw (Fig. 31/**2**),
  - upper right screw (Fig. 31/**3**),
  - lower right screw (Fig. 31/**4**),
- Attach the stage carrier (see Section 3.17).

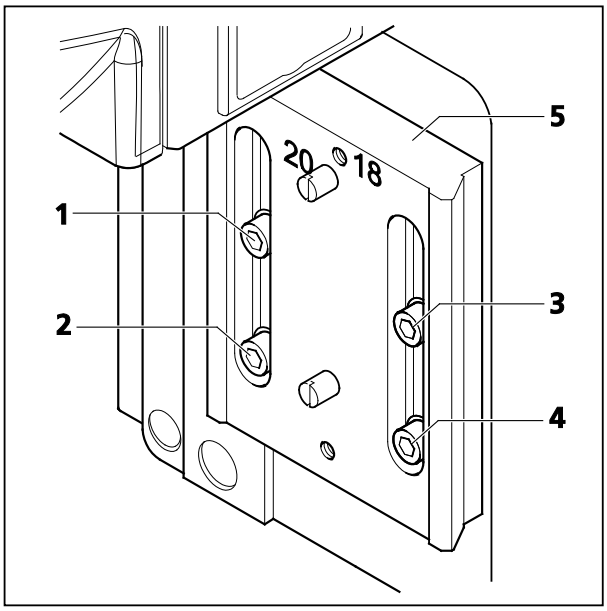


Fig. 31 Setting the dovetail guide up for specimen space expansion

☞ If stage carrier 430701-9901-000 is no longer used, the guide plate must be set back to the **lower** position (normal position).

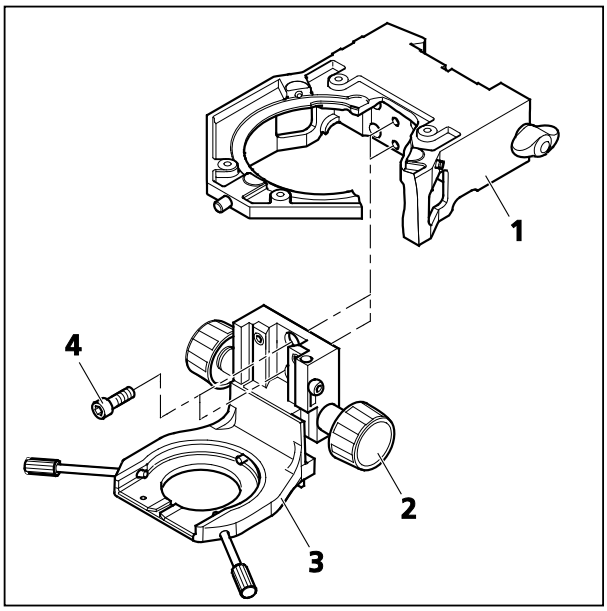


Fig. 32 **Attaching the condenser carrier to the stage carrier**

3.20 Attaching the condenser carrier to the transmitted-light / reflected-light stage carrier

- Use the drive knob (Fig. 32/**2**) to adjust the guide of the condenser carrier (Fig. 32/**3**) in such a way that the two screws (Fig. 32/**4**) are accessible.
- Attach the condenser carrier to the stage carrier (Fig. 32/**1**). Push it firmly in a straight line to the upper stop, and tighten the two screws.

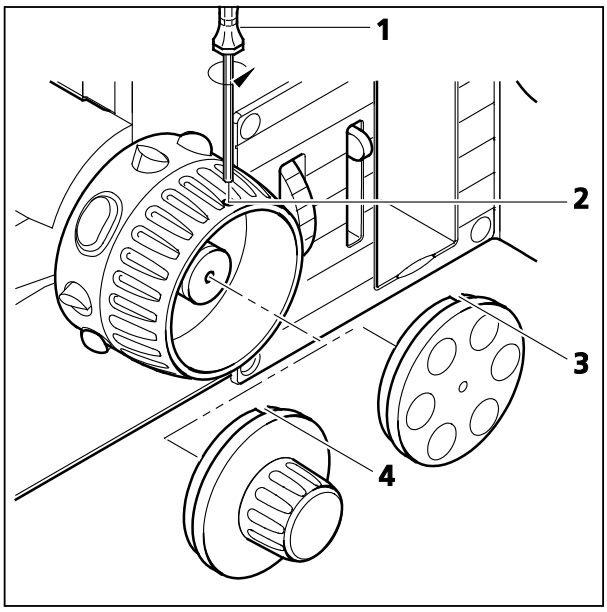


Fig. 33 **Changing the fine-drive knob or fine-drive disk**

3.21 Changing the fine-drive knob or the fine-drive disk on the stand

The fine-focusing drive to the right and left on the stand can be provided either with a fine-drive knob or a fine-drive disk.

To change the fine-drive knob or the fine-drive disk, proceed as follows:

- Turn the coarse-drive knob on the relevant side of the stand so that the mounting hole (Fig. 33/**2**) points upward.
- Insert the ball-headed screwdriver SW 1.5 (Fig. 33/**1**) into the mounting hole and loosen the locking screw of the fine-drive knob or the fine-drive disk.
- Pull the fine-drive knob or the fine-drive disk sideways off the shaft.
- Slide the fine-drive disk or the fine-drive knob onto the shaft, so that the recess (Fig. 33/**3** or **4**) is located under the mounting hole.
- Tighten the locking screw.

3.22 Insert the filter in the double filter wheel

3.22.1 Double filter wheel, manual

The supplied neutral-density filter set for transmitted light or reflected light consists of:

- 1 x 50 % filter
- 2 x 25 % filters
- 1 x 12 % filter
- 1 x 6 % filter
- 1 x 1.5 % filter
- 8 retaining rings (3 as spares)

The manual double filter wheel need not be opened to insert the filters in the two filter wheels.

The figures engraved onto the filter wheel (Fig. 34/**1** or **3**) indicate which filter position of the respective filter wheel is in the filter opening (filter wheel 1: Fig. 34/**2** or filter wheel 2: Fig. 34/**4**). The figure indicates the transmission (in %) of the set filter position.

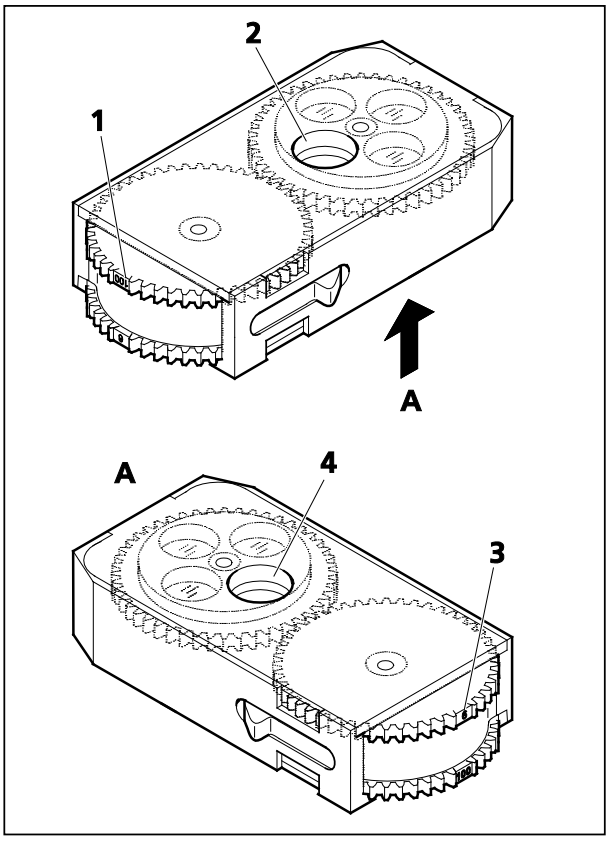


Fig. 34 Equipping the double filter wheel, manual

- Set the desired position on the filter wheel. Insert the corresponding filter with the reflective side up. Ensure that no dirt gets onto the filter surface.
- Screw in the retaining ring.

Insert the following filters in filter wheel 1:

Position **100**: No filter (100 % transmission)

Position **50**: Neutral-density filter 50 %

Position **25**: Neutral-density filter 25 %

Position **12**: Neutral-density filter 12 %

Insert the following filters in filter wheel 2:

Position **100**: No filter (100 % transmission, two positions available)

Position **6**: Neutral-density filter 6 %

Position **0.4**: Neutral-density filter 1.5 % (to be inserted first) and neutral-density filter 25 %

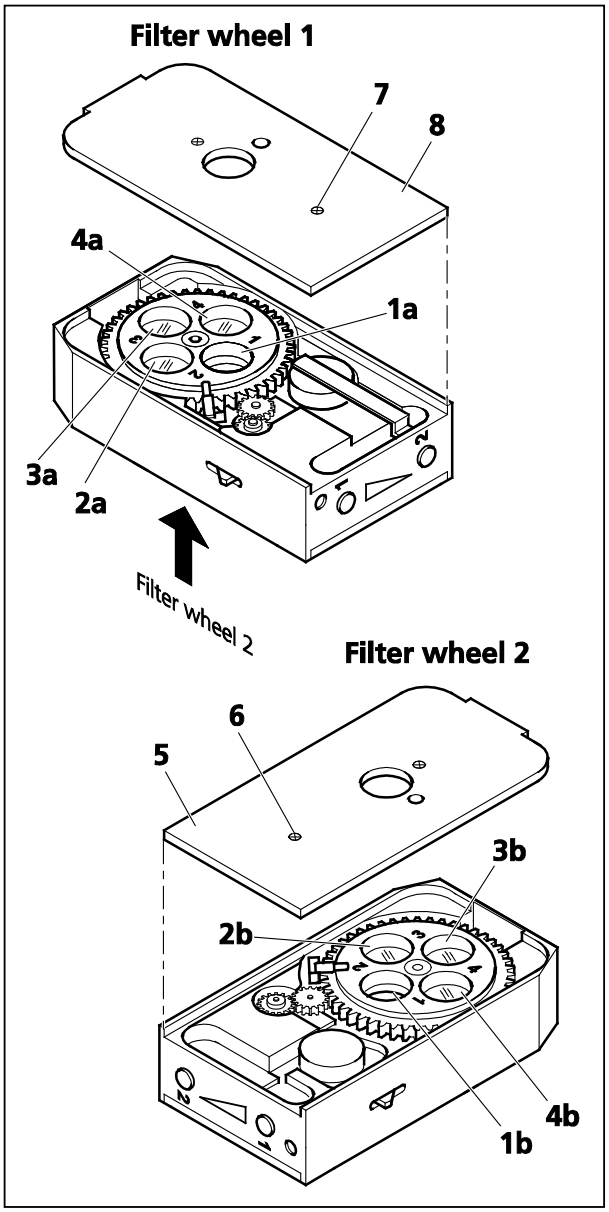


Fig. 35 **Equipping double filter wheel, motorized (only for 428301-9901-000)**

3.22.2 Double filter wheel, motorized

The motorized double filter wheel is equipped with the same filter set as the manual double filter wheel.

To insert the filters in the two filter wheels, the motorized filter wheel 2x must be opened on the corresponding side.

The filter mounts are labeled with the corresponding position numbers 1 to 4 (Fig. 35/**1a** to **4a** and **1b** to **4b**).

- Loosen both screws (Fig. 35/**6** and **7**) and remove cover plate (Fig. 35/**5** and **6**).
- Insert the corresponding filter in the relevant position with the reflective coating side up. Ensure that no dirt gets onto the filter surface.
- Screw in the retaining ring.
- After all filters have been inserted, put on the cover plate and screw it down.

Insert the following filters in filter wheel 1 (428301-9901-000; Fig. 35):

Position **1a**: No filter (100 % transmission)

Position **2a**: Neutral-density filter 12 %

Position **3a**: Neutral-density filter 25 %

Position **4a**: Neutral-density filter 50 %, reflective coating facing up

Insert the following filters in filter wheel 2:

Position **1b**: No filter (100 % transmission)

Position **2b**: Neutral-density filter 6 %

Position **3b**: No filter (100 % transmission)

Position **4b**: Neutral-density filter 0.5 % and neutral-density filter 25 %, reflective coating facing down

3.23 Axio Imager.Z2 / Z2m High-performance Focus

The high-performance focus allows precision functioning of the focusing drive of the microscope with heavy loads (weight of the object table and specimen more than 4 kg). The high-performance focus is a standard component of all Axio Imager.Z2 / Z2m.

The high-performance focus of the microscope is always deactivated for delivery.

The microscope must **always** be transported with the high-performance focus deactivated.

If a scanning stage is used, this must be removed for transport.

With loads of more than 4 kg (stage and specimen), the high-performance focus must be activated to protect the focusing drive.
Once the high-performance focus has been activated, specimen weights of up to 5 kg can be placed on the stage.

Reading the status of the high-performance focus on the microscope

Head of the locking pin **visible**: High-performance focus is **activated**.
Head of the locking pin **not visible**: High-performance focus is **deactivated**.

3.23.1 Activating the high-performance focus

- Use the Z drive to move the microscope stage into the lowest position.
- Using the AF 3 ball-head screwdriver (Fig. 36/**1**) release the two locking pins (Fig. 36/**2**) on the right **and** left of the stand by turning them **90 degrees anticlockwise** (Fig. 36/**3**).
  The locking pin is released from its locked position (Fig. 36/**4**) by spring action. The head of the locking pin is now visible, and the high-performance focus is active.
- Use the Z drive to move the microscope stage into the working position.

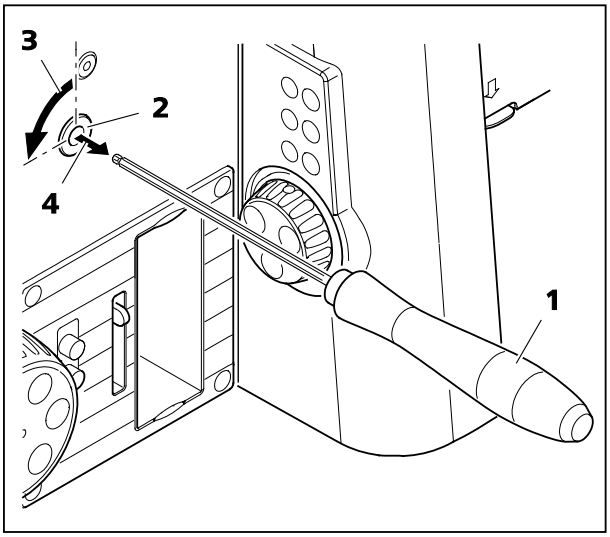


Fig. 36 Activating the high-performance focus

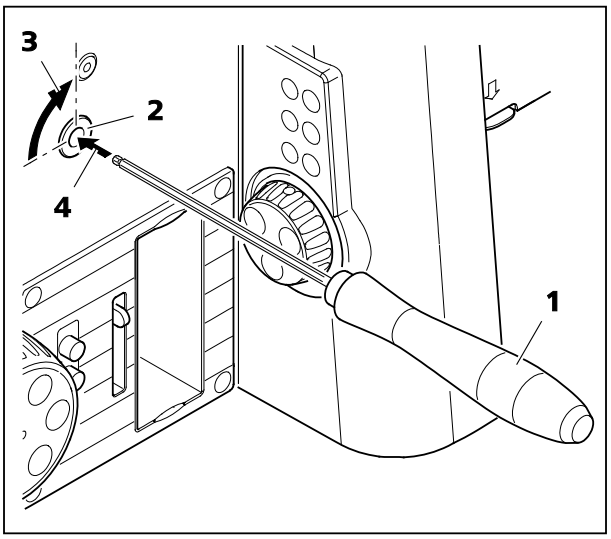


Fig. 37 Deactivating the high-performance focus

3.23.2 Deactivating the high-performance focus

- Use the Z drive to move the microscope stage into the lowest position.
- Using the AF 3 ball-head screwdriver (Fig. 37/**1**) release the two locking pins (Fig. 37/**2**) on the right **and** left of the stand (Fig. 37/**3**) by turning them **90 degrees anticlockwise** (Fig. 37/**4**).

  The head of the locking pin is now no longer visible, and the high-performance focus is inactive.
- Use the Z drive to move the microscope stage into the working position.

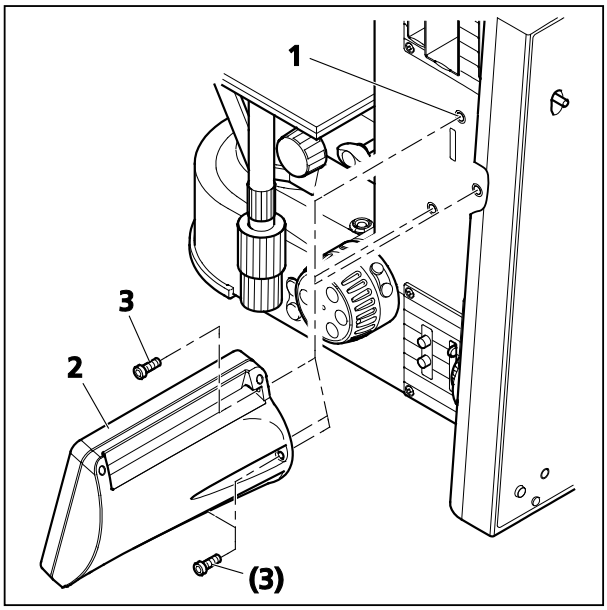


Fig. 38 Mounting the TFT display

3.24 Mounting the TFT display on the motorized stand

When mounting the TFT display, the microscope must be switched off.

- Mount the TFT display (Fig. 38/**2**) on the right side of the motorized stand (Fig. 38/**1**) using the three screws (Fig. 38/**3**).

During the mounting, the stand and TFT display are automatically connected electrically via the plug contact.

3.25 Attaching the TFT display to the docking station

To connect the TFT display and the docking station, the microscope must be switched off.

- To hook the docking station up to the motorized stand, the corresponding plug-in module carrying the **DOC** port must be built into the back of the stand.

The plug-in module should only be installed by the sales technician.

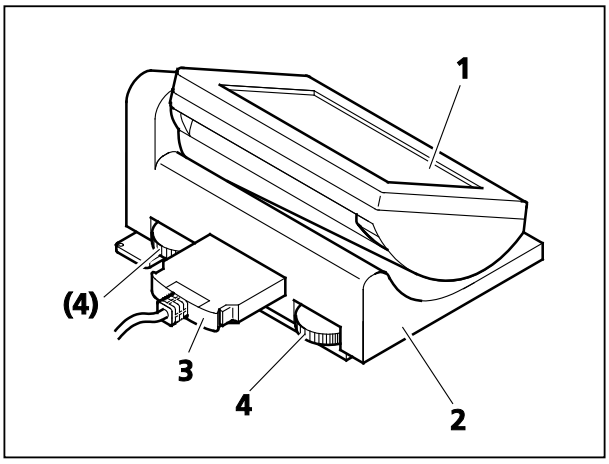


Fig. 39 Attaching the TFT display to the docking station

- If the TFT display is already mounted on the motorized stand, it should first be removed.
- The mounting holes and the opening for the plug-in contact on the stand must then be sealed with the caps supplied.
- Apply the TFT display (Fig. 39/**1**) to the docking station (Fig. 39/**2**) and screw it on, using the long Allen key provided. Make sure that the plug-in contact is inserted precisely into the opening.
- Use the connection cable (Fig. 39/**3**) to connect the docking station to the **DOC** port on the back of the stand.
- The angle of the TFT display can be changed with the aid of the two knurled thumb screws (Fig. 39/**4**) located on the back of the docking station.

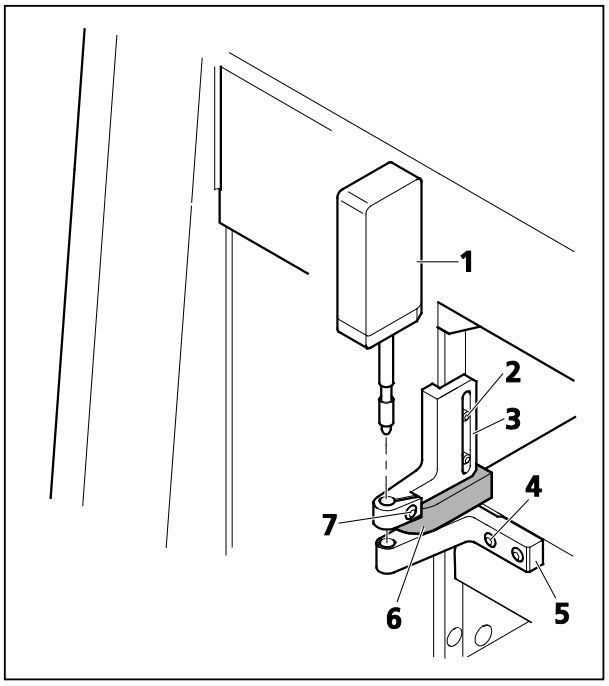


Fig. 40 Installing the focus linear sensor

3.26 Installing the focus linear sensor

☞ Only in connection with Axio Imager.Z2 / .Z2m stands.

☞ Adjusting block 430702-0102-000 is required for installation.

- Switch on the microscope (see Section 4.3.1).
- Screw the objective which is in the optical path out of the nosepiece.
- Move the mechanical stage with stage carrier to the upper stop position.
- Apply the adjusting block (Fig. 40/**6**) to the stage carrier and fix the top part of holder Z (Fig. 40/**3**) on it.
- Bring the top part of holder Z (Fig. 40/**3**) into line with the adjusting block and fasten it to the stand using both screws (Fig. 40/**2**).
- Press the bottom part of holder Z (Fig. 40/**5**) against the adjusting block, so that the stage carrier and the bottom part of holder Z are flush.
- Fasten the bottom part of holder Z (Fig. 40/**5**) with both screws (Fig. 40/**4**) to the stage carrier.
- Insert the focus linear sensor (Fig. 40/**1**) in the top part, bring it into line with the lower edge and fasten it by means of clamping screw (Fig. 40/**7**).
- Move the stage carrier to the lower stop position and remove the adjusting block.
- Switch off the microscope (see Section 4.3.2).
- Plug the cable of the focus linear sensor into connector (Fig. 42/**7**) on the rear side of the stand and switch on the microscope (see Section 4.3.1).

☞ Incorrect installation of the focus linear sensor can cause problems in focusing the object.

☞ The focus linear sensor can be activated and deactivated via the TFT display (see Section **Closed Loop** on page 133).

3.27 Assembling the multidiscussion equipment

Explanations and additional notes on the installation and operation of the multimedia discussion equipment for Axio Imager 2 can be found in the operating manual for the multi discussion equipment (425145-7144-000).

3.28 Connecting to power

3.28.1 Coded stand

- Plug the power cable first into the power socket (Fig. 41/**1**) of the microscope and then into a power outlet. The microscope can be connected to a line voltage of 100 V to 127 V or 200 VAC to 240 VAC, 50 Hz – 60 Hz. The power unit **automatically** adapts to the line voltage available.

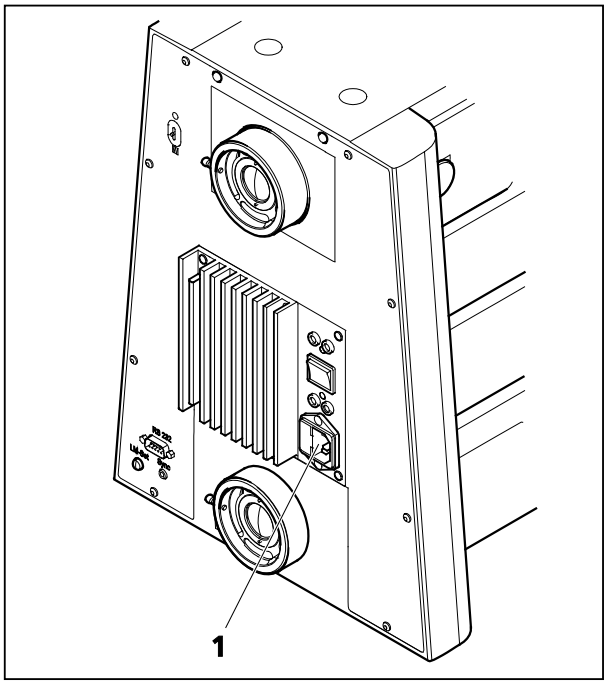


Fig. 41 Overall view of Axio Imager 2 - coded

3.28.2 Motorized stand

- Insert the connecting plug (Fig. 42/**2**) of power supply VP232-2 (Fig. 42/**3**) into the corresponding socket (Fig. 42/**1**) on the rear of the stand.
- Plug the power cable first into the power socket (Fig. 42/**4**) of power supply VP2322 and then into a power outlet.
  The power supply can be connected to a line voltage of 100 VAC… 240 VAC, 50 Hz – 60 Hz. The power unit adapts **automatically** to the line voltage available.

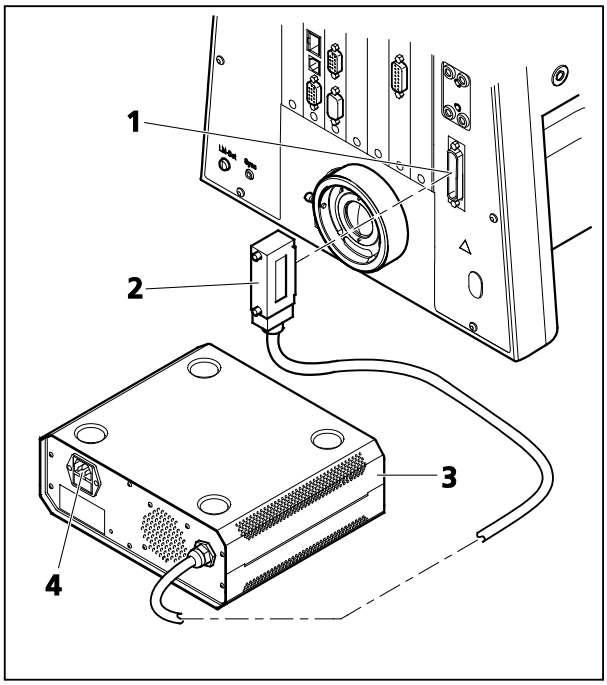


Fig. 42 Axio Imager 2, motorized

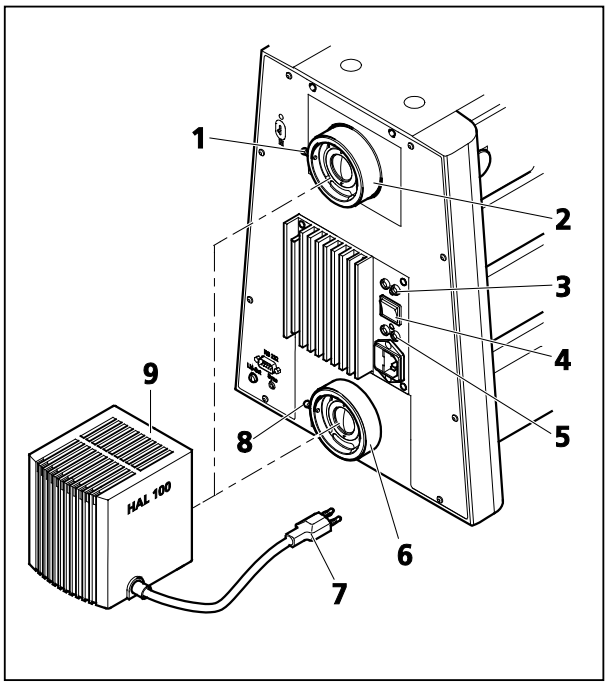


Fig. 43 Attaching the HAL 100 halogen illuminator

3.29 HAL 100 halogen illuminator

The HAL 100 illuminator is used as the light source for transmitted-light and reflected-light procedures (except fluorescence) on the Axio Imager. The method for attaching the halogen illuminator to the reflected-light or transmitted-light socket is the same in both cases.

3.29.1 Attaching the HAL 100 halogen illuminator

Before using the halogen illuminator, the halogen lamp replacement tool should first be removed from the housing. Otherwise, it might be damaged by heat (refer to Section 3.29.4)

- Remove the protective cap from the reflected-light or transmitted-light socket.
- Insert the dovetail mount of the lamp housing (Fig. 43/**9**) into the corresponding socket (Fig. 43/**2** or Fig. 43/**6**) and, using the SW 3 ball-headed screwdriver, tighten it with clamping screw (Fig. 43/**1** or Fig. 43/**8**).
- Insert the 3-pole lamp plug (Fig. 43/**7**) into the 3-pole 12 V / 100 W socket (Fig. 43/**3** – for reflected light or Fig. 43/**5** - for transmitted light) on the back of the instrument.
- Switch the toggle switch for transmitted / reflected light (Fig. 43/**4**) to the required position. If the motorized stand is used, switch between reflected light and transmitted light using the TFT display touch screen.

☞ The halogen illuminators installed for reflected light and transmitted light can only be switched on alternately.

☞ The light manager functionality depends on the position of the toggle switch.

3.29.2 Separate power supply of the HAL 100 halogen illuminator for reflected light

The Axio Imager 2 allows two 100 W halogen lights to be operated independently and at the same time on a microscope.
For the combined use of transmitted light and reflected light (mixed light) on the Axio Imager 2, the halogen illuminator needs to be connected to a separate reflected light power supply.

For the coded stand, the external power supply for HAL 100 and LED illuminators (power supply 12 V 100 W) is to be used, while the external power supply for HAL 100 and LED illuminators with CAN connection (power supply 232 CAN) is to be employed for the motorized stand.
To connect the HAL 100 to a separate power supply, proceed as follows:

Coded stand

- For reflected light, connect the three-pin plug of the HAL 100 to the RL socket (Fig. 44/**4**) on the back of the 12 V 100 W power supply.
- Set the transmitted-light / reflected-light toggle switch (Fig. 44/**3**) to the position for reflected light (**RL**).
- Use a power cord to connect the power connector (Fig. 44/**5**) to a power outlet.
- For reflected light, use the ON / OFF switch (Fig. 44/**1**) on the power supply to turn the HAL 100 on or off, as required.
- Use the rotary knob (Fig. 44/**2**) on the power supply to adjust illumination intensity.

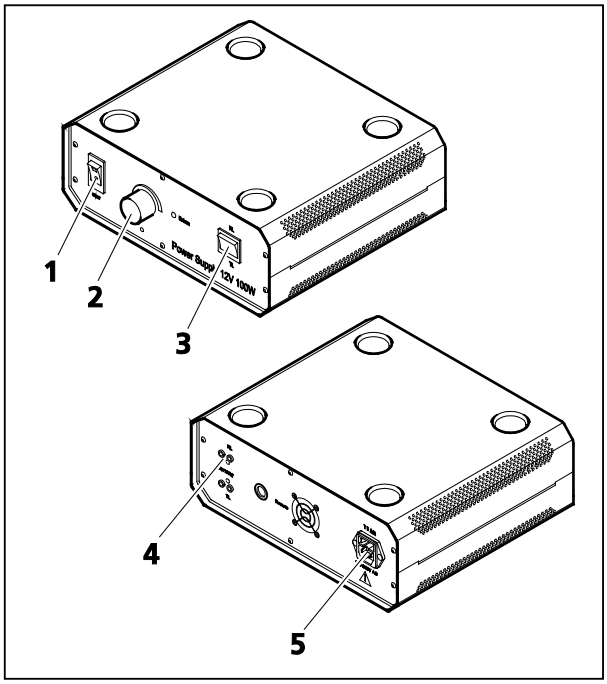


Fig. 44 Reflected light power supply 12V 100W for HAL 100

Motorized stand

- For reflected light, connect the three-pin plug of the HAL 100 to the socket (Fig. 45/**3**) on the back of power supply 232 CAN.
- Use a CAN connection cable to connect the CAN connector on the power supply (Fig. 45/**2**) with a free CAN connector on the back of the stand.
- Use a power cord to connect the power connector (Fig. 45/**4**) to a power outlet.
- For reflected light, use the ON / OFF switch (Fig. 45/**1**) on the power supply to turn the HAL 100 on or off, as required.
- Set the illumination intensity of the HAL 100 on the TFT display.

☞ The separate power supply is integrated into the light manager where this is enabled (see Section 4.6 ff.).

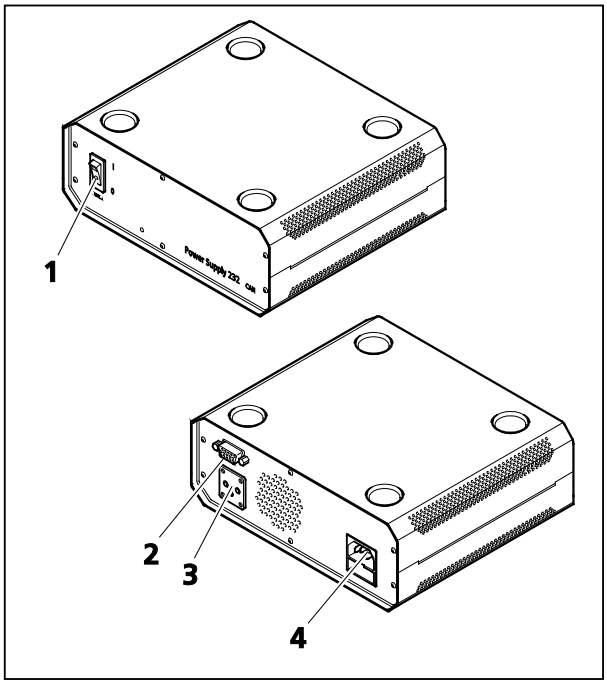


Fig. 45 Power supply 232 CAN for HAL 100 in reflected light mode

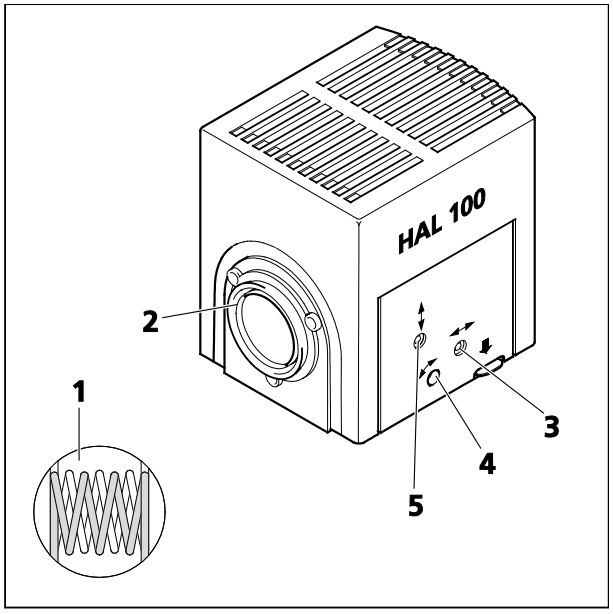


Fig. 46 Adjusting the HAL 100 halogen illuminator

3.29.3 Adjusting the HAL 100 halogen illuminator

(1) Coarse adjustment

- Loosen clamping screw (Fig. 43/**1** or Fig. 43/**8**) and remove the operational halogen illuminator (Fig. 46/**2**) from the microscope stand.
- Switch on the microscope as described in Section 4.3.
- Direct the light beam to a projection surface (wall) at least 3 m away.

Do not look into the light exit aperture of the illuminator.

- Using the SW 3 ball-headed screwdriver turn adjusting screw (Fig. 46/**3**) until both images of the lamp filament appear as sharp as possible on the projection surface.
- Then, turn adjusting screws (Fig. 46/**4** and **5**) until the lamp filament of one image exactly fills the gaps of the reflected filament image (Fig. 46/**1**).

(2) Fine adjustment

- Reattach the microscope illuminator to the microscope stand and lock it with the clamping screw.
- Turn off the diffusion disk for reflected or transmitted light and remove the filter wheels from the respective slot.
- Use ≤ 40x objective to focus on a free area of the specimen.
- Remove the eyepiece and, in the pupil image visible in the eyepiece socket, center the lamp filament and its reflection with adjusting screws (Fig. 46/**4** and **5**).
- Using adjusting screw (Fig. 46/**3**) optimize the evenness of illumination of the pupil image.

☞ It is advisable to use the adjusting aid (Fig. 76/**5**) for fine adjustment of the halogen illuminator mounted to the reflected-light socket. After the adjusting aid has been pulled out, the lamp filament and its reflection can be viewed directly in its viewing glass.

- Move the diffusion disk in and reinsert the filter wheels.

3.29.4 Replacing the HAL 100 halogen lamp

Hot surface!

You do not need to remove the lamp housing from the stand to replace the halogen lamp. **Do not** store the supplied replacement tool (Fig. 47/**7**) for lamp replacement in the lamp housing while the illuminator is operating.
The replacement lamp (Fig. 47/**8**) may remain fitted in the lamp housing.

- Switch off the microscope as described in Section 4.3, disconnect plug (Fig. 43/**7**) from connector 12 V/100 W (Fig. 43/**3** – reflected light or Fig. 43/**5** – transmitted light) and allow to cool down for approximately 15 minutes.
- Depress unlock button (Fig. 47/**3**) of halogen illuminator HAL 100 (Fig. 47/**1**), extract lamp carrier (Fig. 47/**2**) fully and put it down separately.
- Depress both spring levers (Fig. 47/**5**) and remove the old halogen lamp (Fig. 47/**6**) upward.
- Depressing both spring levers, insert the new lamp in the lamp socket (Fig. 47/**4**) and release the spring levers. Always hold/grasp the halogen lamp by means of the replacement tool (Fig. 47/**7**), as even traces of grease on the lamp may affect its lifetime.
- Shortly depress the spring levers once more to center the lamp.
- Insert the lamp carrier until it locks.

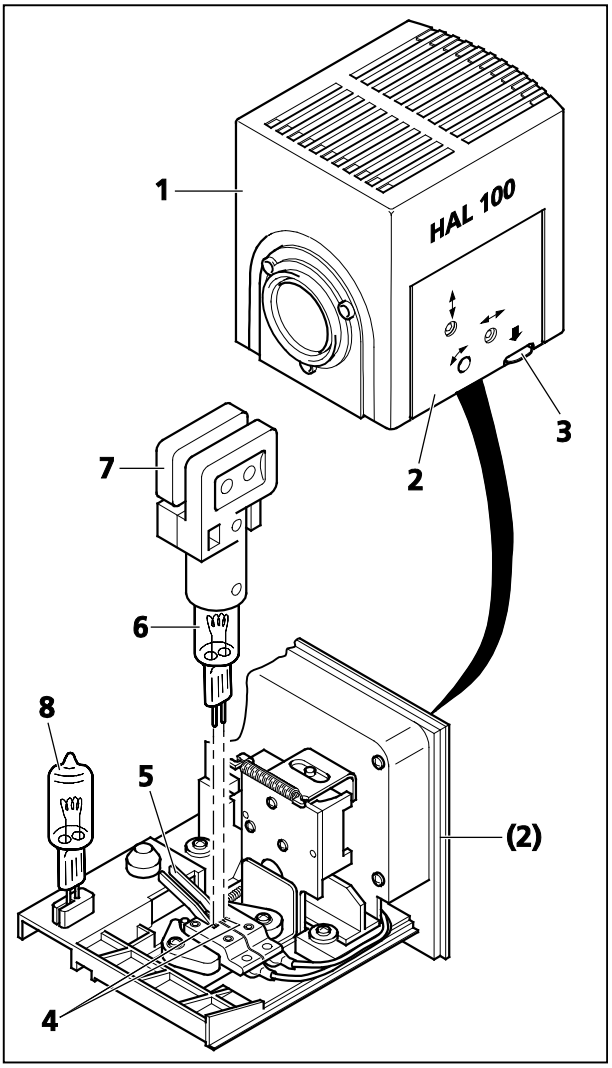


Fig. 47 Changing the halogen lamp

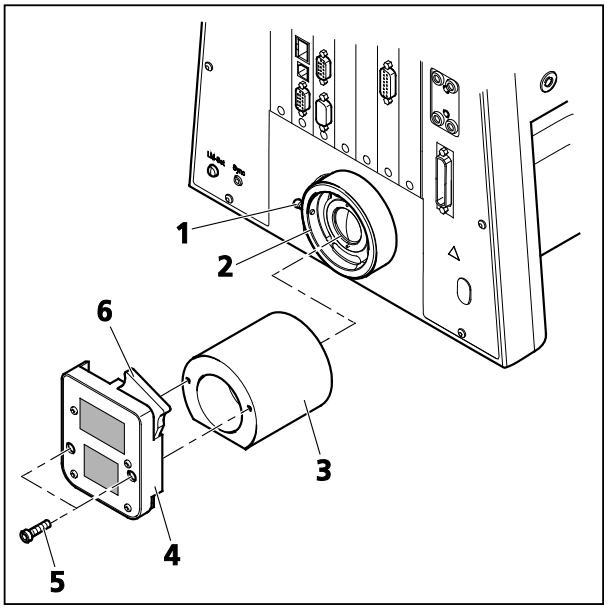


Fig. 48 Installing the LED illuminator

3.30 Installing the LED illuminator for transmitted light

The LED illuminator for transmitted light can be installed optionally on the transmitted light port on the rear of the instrument or on the bottom of the condenser carrier.

The LED illuminator delivers light of constant color temperature, independent of the set light intensity.

Do not look directly into the LED light.

Always make sure that the instrument is switched off when mounting or dismounting the LED illuminator onto/from the transmitted-light port.

Installing the LED illuminator on the transmitted light port

- Loosen clamping screw (Fig. 48/**1**) on transmitted-light port (Fig. 48/**2**). Remove the halogen lamp.
- Disconnect the illuminator plug from the 12 V / 100 W connector (transmitted light) on the back of the instrument.
- Insert adapter optics for LED illuminator (Fig. 48/**3**) in the transmitted-light port with the slant pointing down, then tighten the clamping screw.
- Screw LED illuminator (Fig. 48/**4**) onto the adapter optics using the Allen screws (Fig. 48/**5**) provided.
- Push slider with diffusion disk 10° (Fig. 48/**6**) into the LED illuminator.
- Insert the plug of the LED illuminator into the 12 V / 100 W connector (transmitted light) on the back of the instrument.

☞ The color temperature for specimen observation can be changed by inserting color temperature filters in the slider with diffusion disk (held by retaining ring).

Installing the LED illuminator on the condenser carrier

- Remove the halogen illuminator from the transmitted-light port and disconnect the illuminator plug. Cover the transmitted-light port with the cover cap.
- Move the microscope stage and condenser carrier to the top position using the focusing drive (stage) and height control (condenser).
- Screw bolts (Fig. 49/**5**) by hand into the tapped holes (Fig. 49/**6** and **7**) in the bottom of the condenser carrier.
- Hold the LED illuminator (Fig. 49/**2**) parallel to the underside of the condenser carrier (Fig. 49/**1**). Move it upwards so that the bolts (Fig. 49/**5**) fit into the corresponding holes on the illuminator. Fasten the illuminator by means of the countersunk screws (Fig. 49/**3**) located on the left of the LED illuminator.
- Push the slider with diffusing glass 80° (Fig. 49/**4**) into the LED illuminator, or for transmitted-light polarization, push in the polarizer for LED (427708-9901-000).

When using the polarizer, simple polarization contrast is possible. However, conoscopy is not.

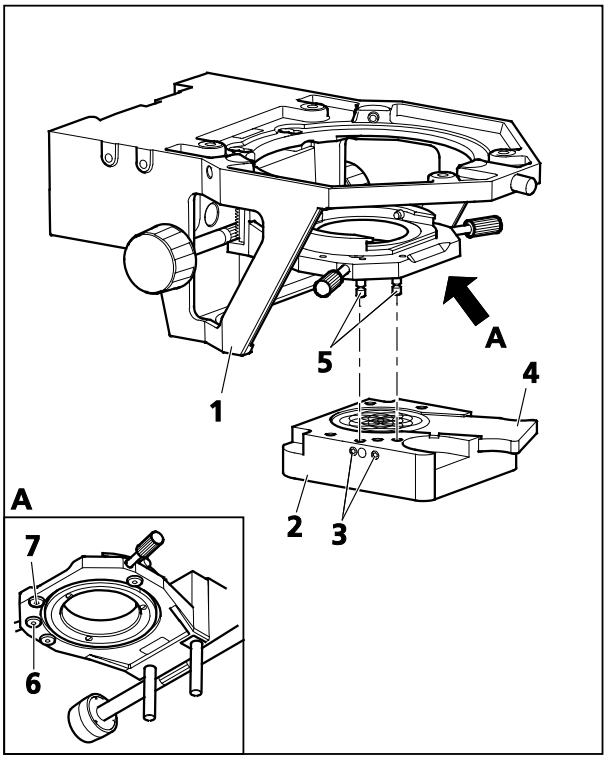


Fig. 49 Installing the LED illuminator

- Insert the plug of the LED illuminator into the 12 V / 100 W connector (transmitted light) on the back of the instrument.

☞ The color temperature for specimen observation can be changed by inserting color temperature filters in the slider with diffusion disk (held by retaining ring).

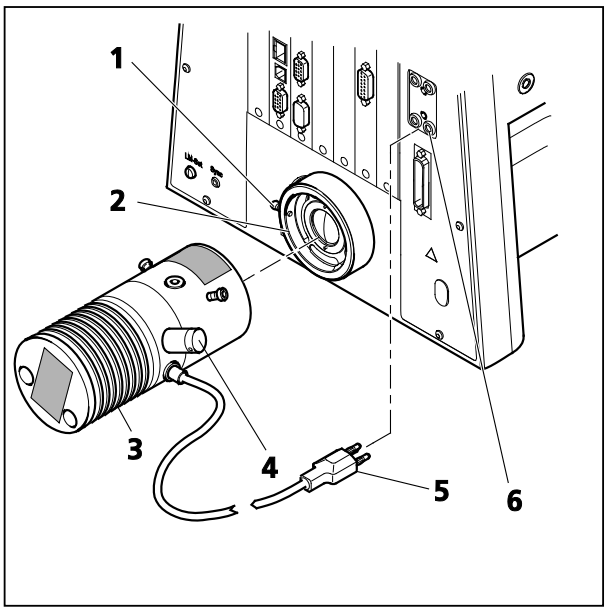


Fig. 50 Installing the VISLED attachment lamp

3.31 VIS-LED attachment lamp for transmitted light

3.31.1 The VIS-LED attachment lamp is only intended for use with transmitted light.

The VIS-LED attachment lamp is only intended for transmitted light operation.

Do not look directly into the LED light.

Only insert or remove the VIS-LED attachment lamp in / from the transmitted-light port while switched off.

- Loosen clamping screw (Fig. 50/**1**) on transmitted-light port (Fig. 50/**2**). Remove the halogen lamp.
- Use an AF 3 ball-headed screwdriver and clamping screw (Fig. 50/**1**) to lock the attachment lamp (Fig. 50/**3**) with dovetail mount firmly into socket (Fig. 50/**2**).
- Connect the three-pin illuminator plug (Fig. 50/**5**) to the lower three-pole 12 V / 100 W socket (Fig. 50/**6**) for transmitted light (**TL**) on the back of the instrument.
- For the coded stand, set the transmitted-light/reflected-light toggle switch to the position for transmitted light (**TL**). If the motorized stand is used, switch between reflected light and transmitted light using the TFT display touch screen.

☞ If the AxioCam MRm is used for documentation purposes, the 12 % gray filter provided must be employed to attenuate light intensity.

The add-on illuminator is equipped with a BNC port (Fig. 43/**4**) for TTL trigger control.

3.31.2 Adjusting the VIS-LED attachment lamp

- Switch on the attachment lamp via the microscope.
- Switch off the diffusion disk for transmitted light and remove the filter wheels for transmitted light.
- Use ≤ 40x objective to focus on a free area of the specimen.
- Remove the eyepiece. Use the adjusting screws (Fig. 51/**1** and **2**) to center the image of the illuminator in the pupil image.
- Use adjusting screw (Fig. 51/**3**) to achieve optimally even illumination of the pupil image.
- Switch the diffusion disk for transmitted light on again and insert the filter wheels for transmitted light.

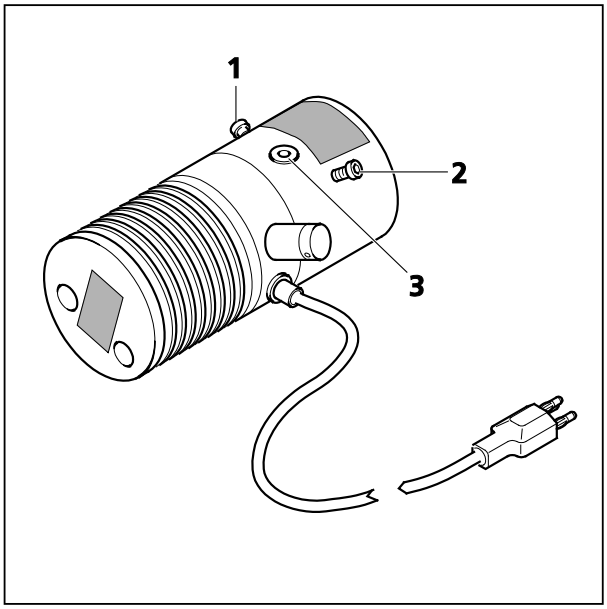


Fig. 51 Adjusting the VIS-LED attachment lamp

3.32 Mounting the microLED attachment lamp for transmitted light

The microLED attachment lamp is only intended for transmitted light operation.

Do not look directly into the LED light.

Only insert or remove the microLED attachment lamp in/from the transmitted-light port while switched off.

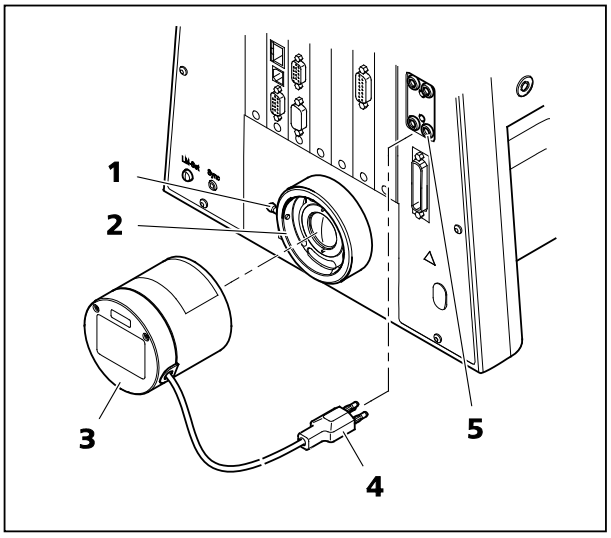


Fig. 52 Mounting the microLED attachment lamp

- Loosen clamping screw (Fig. 52/**1**) on transmitted-light port (Fig. 52/**2**). Remove the halogen lamp.
- Use an AF 3 ball-headed screwdriver and clamping screw (Fig. 52/**1**) to lock the attachment lamp (Fig. 52/**3**) with dovetail mount firmly into socket (Fig. 52/**2**).
- Connect the three-pin illuminator plug (Fig. 52/**4**) to the lower three-pole 12 V / 100 W socket (Fig. 52/**5**) for transmitted light (TL) on the back of the instrument.
- For the coded stand, set the transmitted-light / reflected-light toggle switch to transmitted light (TL). If the motorized stand is used, switch between reflected light and transmitted light using the TFT display touch screen.

The microLED must be configured as VIS-LED on the Axio Imager .M2 / .Z2.

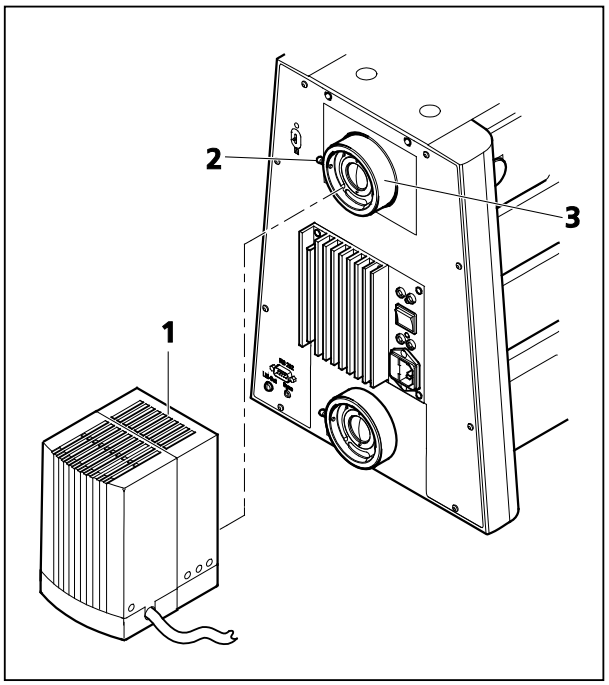


Fig. 53 Attaching the HBO 100 illuminator

3.33 HBO 100 illuminator

3.33.1 Inserting the HBO 103 W/2 mercury vapor short-arc lamp

For safety reasons, the HBO 100 illuminator and the HBO 103 W/2 mercury vapor short-arc lamp are supplied in separate packages.

Therefore, inserting the HBO 103 W/2 lamp into the lamp housing is the first step in starting up this illuminator.

For a description of how to insert or replace the HBO 103 W/2 lamp, read the instructions for use supplied with it.

To change the transmission, use a discrete FL attenuator (423616-0000-000 or 423617-0000-000). The gray filters mounted in the 2-position filter wheels (428300-9901-000 or 428301-9901-000) are not permanently stable.

Only the gray filter set (487935-9020-000) can be used.

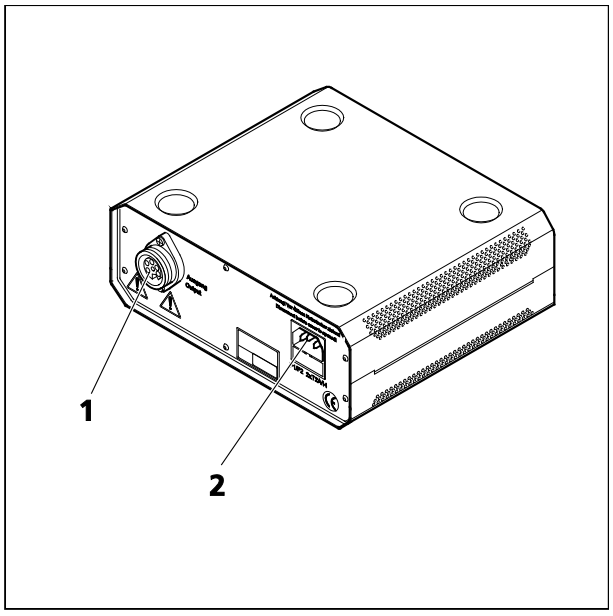


Fig. 54 HBO 100 transformer

3.33.2 Attaching the HBO 100 illuminator

- Remove the cover from the reflected-light socket (Fig. 53/**3**).
- Insert the dovetail of the lamp housing (Fig. 53/**1**) into the reflected-light socket (Fig. 53/**3**) on the back of the instrument and tighten the clamping screw (Fig. 53/**2**) using a SW 3 ball-headed screwdriver.
- Insert the multi-pin plug of the HBO 100 illuminator into the device connector (Fig. 54/**1**) on the HBO 100 transformer and secure it by means of a coupling ring.
- First, connect the power cable to the power socket (Fig. 54/**2**) on the HBO 100 transformer, and then connect it to a power outlet.

3.33.3 Aligning the HBO 100 illuminator

The HBO 100 illuminator is available in two versions (manual and automatic alignment).

The self-adjusting HBO 100 (423011-9901-000) is aligned automatically after switching on the transformer of the illuminator.

The alignment of the manually aligned HBO 100 illuminator (423010-9901-000) is described below.

☞ If the FL attenuator (manual or motorized) is in the reflected-light path, set it to 100% transmission for illuminator alignment.

- Switch on the HBO 100 illuminator (Fig. 56/**1**) via the HBO 100 transformer (Fig. 85/**2**) and allow it to warm up to the operating temperature.
- Pull adjusting aid (Fig. 55/**1**) out of the microscope stand. The brighter arc spot of the HBO 103 W/2 lamp and its slightly darker reflected image become visible in the black-glass window of the adjusting aid.
- Turn the knurled knob (Fig. 56/**4**) for collector adjustment to focus the brighter arc spot.
- Use the adjusting screws (Fig. 56/**2** and **3**) to adjust the darker arc spot (reflected arc image) within the marked alignment circle as shown in the arc spot illustration (Fig. 55/**2**).
- Replace the adjusting aid.

☞ The two arc spots of the HBO 103 W/2 lamp in the alignment circle of the adjusting aid should be right next to each other!

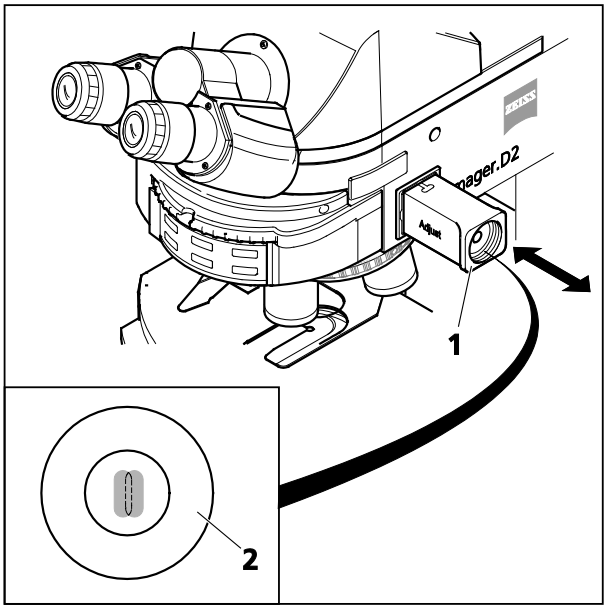


Fig. 55 Adjusting aid

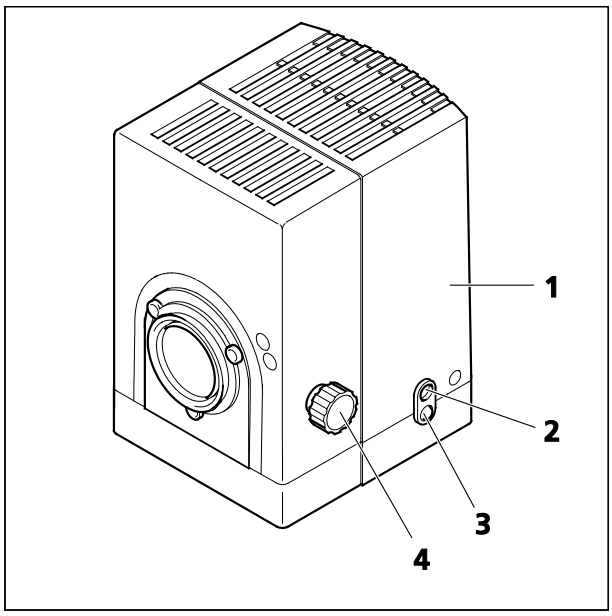


Fig. 56 Aligning the HBO 100

3.33.4 Setting up the switching mirror for two illuminators (manual or motorized)

With the aid of a switching mirror, two illuminators can be connected to the reflected-light port of the Axio Imager stand simultaneously, e.g. a halogen illuminator (HAL 100) and a fluorescence illuminator (HBO 100).

While the manual switching mirror can be used on all Axio Imager stands, the motorized switching mirror may only be employed on the M1 / M2 or Z1 / Z2 stands (firmware version 01.318 or higher).

The switching lever (Fig. 57/**6**) on the upper side of the manual switching mirror serves to switch manually between the two illuminators.

The motorized switching mirror can be controlled either using the operator buttons on the stand, the touch screen on the TFT display or, if a PC is connected, using the AxioVision (Release 4.6 or higher) or ZEN (blue edition) software. Control via the CAN / USB converter is not possible.

To install the switching mirror, proceed as follows:

- If necessary, remove the illuminator if already mounted. To do so, grip the illuminator firmly and loosen the clamping screw (Fig. 57/**2**) on the reflected-light socket (Fig. 57/**1**), using ball-headed screwdriver AF 3.
- Insert the switching mirror (Fig. 43/**4** or **8**) with the dovetail ring into the socket (Fig. 57/**1**). Align it (with the mounts for the two illuminators pointing to the right and left, respectively) and fix it with the clamping screw (Fig. 57/**2**).
- Plug the connecting cable of the motorized switching mirror into a free CAN connector on the back of the stand.
- Loosen the right and left clamping screws (Fig. 57/**5** and **7**, respectively) on the switching mirror. Remove the protective caps and attach the two illuminators, e.g. HAL 100 (Fig. 57/**3**) and HBO 100 (Fig. 57/**9**), to the switching mirror, in the same way as if they were mounted directly onto the microscope. Then, fasten them with the relevant clamping screw (Fig. 57/**5** or **7**).
- Next, connect the illuminators electrically to the stand and the power supply unit, respectively.

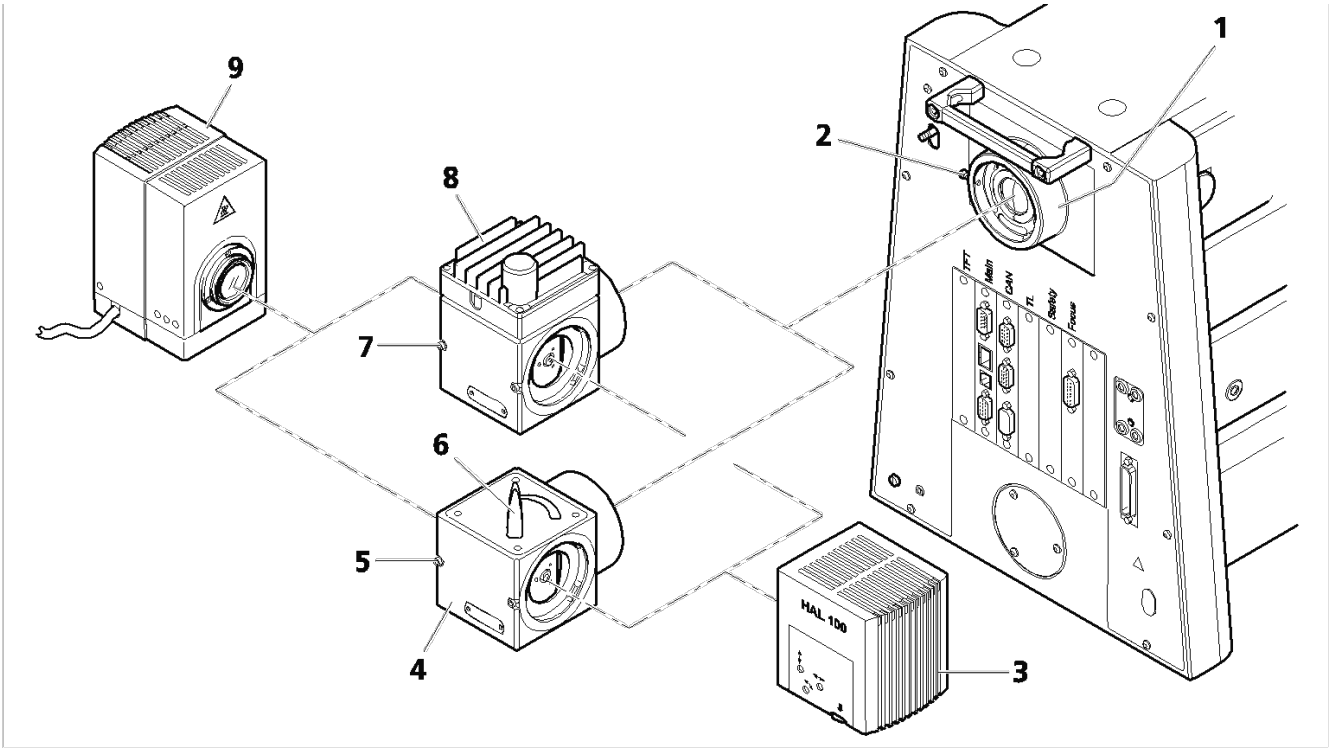


Fig. 57 Installing the switching mirror

3.34 Electrical connections on the rear of the microscope

3.34.1 Coded stand

Key to Fig. 58:

1 Ports for reflected-light halogen illuminator
2 Toggle switch for reflected / transmitted light (HAL)
3 Ports for transmitted-light halogen illuminator
4 Power connector
5 Sync connector for camera synchronization
6 LM set button for light manager function
7 RS 232 port

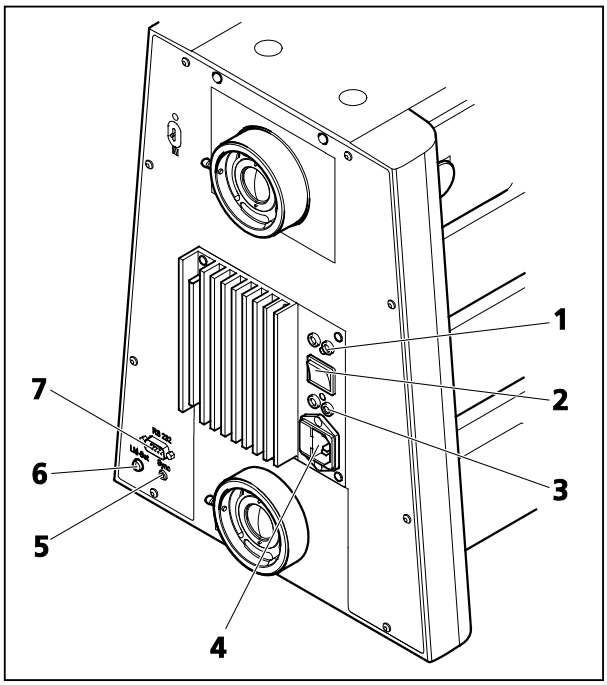


Fig. 58 Axio Imager 2, coded (rear side)

3.34.2 Motorized stand

Key to Fig. 59:

1 CAN port
2 USB port
3 Ethernet port
4 RS232 port
5 CAN port
6 CAN port
7 Port for linear sensor for focus adjustment
8 Ports for reflected-light halogen illuminator (RL)
9 Ports for transmitted-light halogen illuminator
10 Port for power supply VP232-2
11 RS232 port (intended for later applications)
12 Sync port for camera synchronization
13 LM set button for light manager function

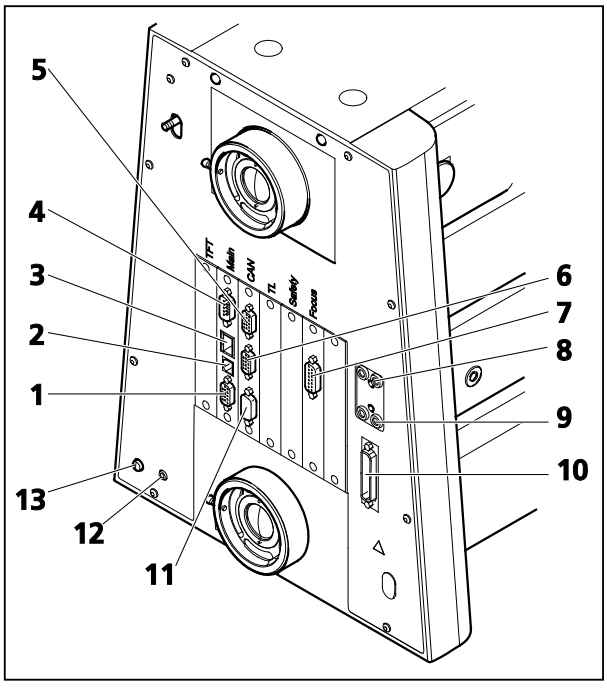


Fig. 59 Axio Imager, motorized (rear)

3.35 Mount sample stage

Sample stages can be bolted on or turned and centered depending on their type. The range of stage travel is 75 mm in the x direction and 50 mm in the y direction. The drives of the fixed stages are either on the right or left. The drive is to the right on the rotatable mechanical stage.

The travel range of this table depends on the type.

☞ To facilitate assembly of the stage, the stage carrier may be removed from the stand.

The stage to be mounted is placed upside down on a flat surface and the stage carrier mounted onto it.

The pre-assembled stage-stage carrier assembly is then turned over and fixed to the stage carrier dovetail.

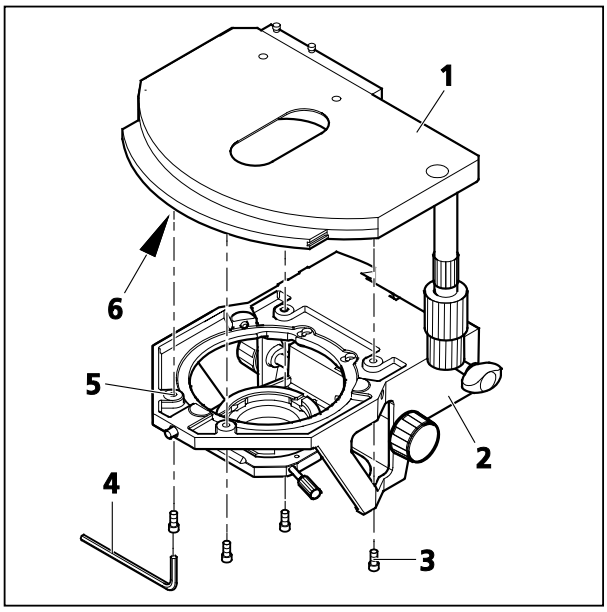


Fig. 60 Changing the fixed mechanical stage

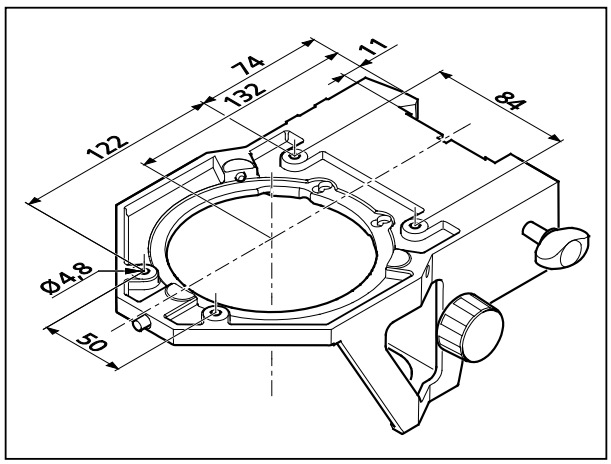


Fig. 61 Hole spacing of the stage carrier

3.35.1 Fixed mechanical stage 75x50 R

(1) Removing the stage

- Unscrew the four fastening screws (Fig. 60/**3**) on stage carrier (Fig. 60/**2**) using the offset AF 3 Allen key (Fig. 60/**4**).
- Remove stage (Fig. 60/**1**) upwards from the stage carrier.

(2) Attaching the stage

- Place the stage (Fig. 60/**1**) onto the stage carrier (Fig. 60/**2**) so that the threaded holes on the bottom of the stage (Fig. 60/**6**) are positioned above the stage carrier openings (Fig. 60/**5**).
- Insert four fastening screws (Fig. 60/**3**) through the stage carrier from below and screw them into the bottom of the stage; use the shorter screws for the front.
- Orient stage in the x-y direction and tighten the fastening screws.

☞ The hole spacings of the stage carrier are shown in Fig. 61.

☞ The hole spacings of the specimen holder are shown in Fig. 62.

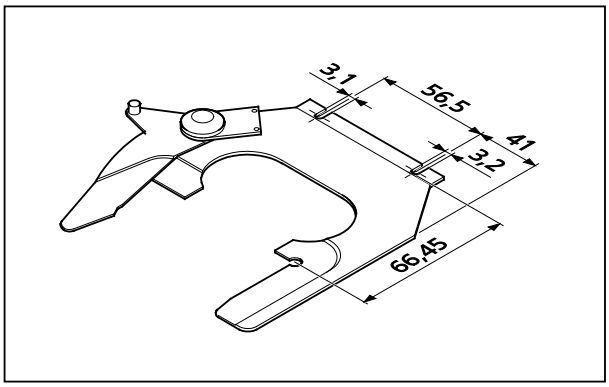


Fig. 62 Hole spacing of the slide

3.35.2 Rotatable mechanical stage 75x50/240° R

(1) Removing the stage

- Loosen screw cap (Fig. 63/**3**) from the spring housing (roughly three rotations).
- Turn back centering screws (Fig. 63/**1**), if necessary.
- Press the stage to the front against spring pin (Fig. 63/**4**), lift it off the stage carrier (Fig. 63/**2**) from the back and remove it upwards.
- Retighten screw cap (Fig. 63/**3**).

(2) Attaching the stage

- Loosen screw cap (Fig. 63/**3**) from the spring housing (roughly three rotations).
- Place the stage with the dovetail groove on the spring pin (Fig. 63/**4**).
- Press the stage to the front against the spring pin and lower it towards the back of stage carrier (Fig. 63/**2**), and then release it.
- Retighten screw cap (Fig. 63/**3**).

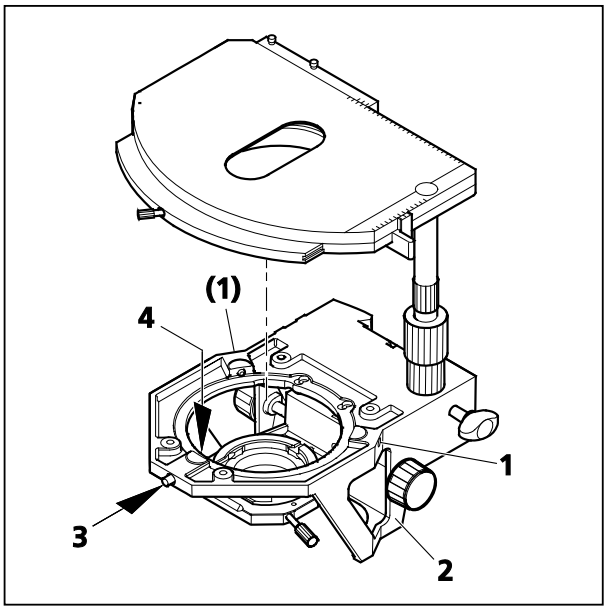


Fig. 63 Changing the rotatable mechanical stage

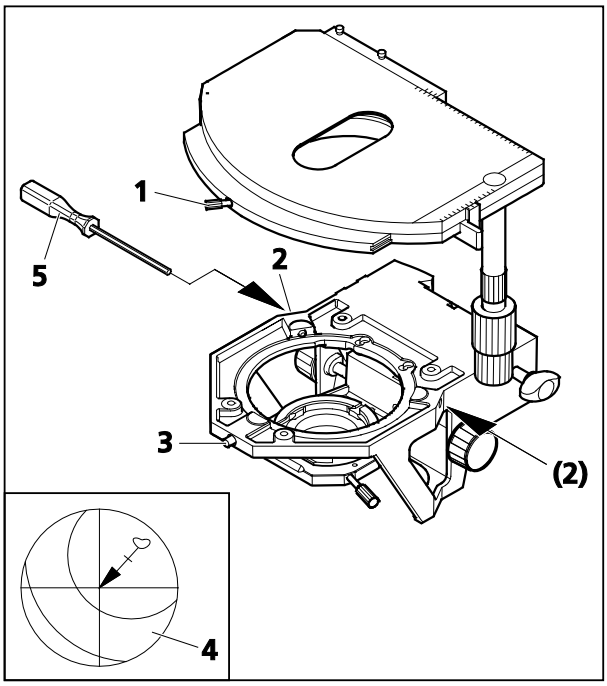


Fig. 64 **Centering the rotatable mechanical stage**

(3) Centering the stage

When objectives with high magnification are used, the centering can only be exact for one selected objective.
All stages are factory-precentered, i.e. a set specimen detail remains in the image center when the stage is rotated. If the image detail moves from the image center (Fig. 64/**4**), recenter the stage as follows:

- Loosen stage clamping screw (Fig. 64/**1**) and the screw cap on the stage carrier (Fig. 64/**3**).
- Rotate the stage to determine the maximum specimen deflection (Fig. 64/**4**, tip of arrow) to the eyepiece reticles.
- Reset the two centering screws on the stage carrier (Fig. 64/**2**) using one SW 1.5 Allen screwdriver (Fig. 64/**5**) each to move the specimen detail by half the arrow length in the direction of the crossline center. Check whether the specimen detail moves when the stage is rotated again; repeat the procedure, if required.
- When centering is finished, tighten screw cap (Fig. 64/**3**) again.

The stage can be turned by 240° within an adjustment range of y ≤ 27 mm. No rotation is possible beyond this.

3.35.3 Adjusting the stage drive length on the ergonomic drive

On mechanical stages with ergo-drive, the length of the **x** and **y** stage drive can be extended by **max. 15 mm** by axial movement of the drive knobs to further improve operating ease.

3.35.4 Removing and attaching additional sleeves

Both drive knobs are fitted with additional sleeves (optional). These help achieve more sensitive adjustment of an object position and can be removed if faster specimen movement is more important.

- First, loosen the two clamping screws (Fig. 65/**4**) on the bottom additional sleeve (Fig. 65/**3**) and remove the latter downwards, then loosen the two clamping screws (Fig. 65/**2**) on the top additional sleeve (Fig. 65/**1**) and pull it down as well.
- Mount the additional sleeves back on the drive knobs in reverse order and tighten both clamping screws.

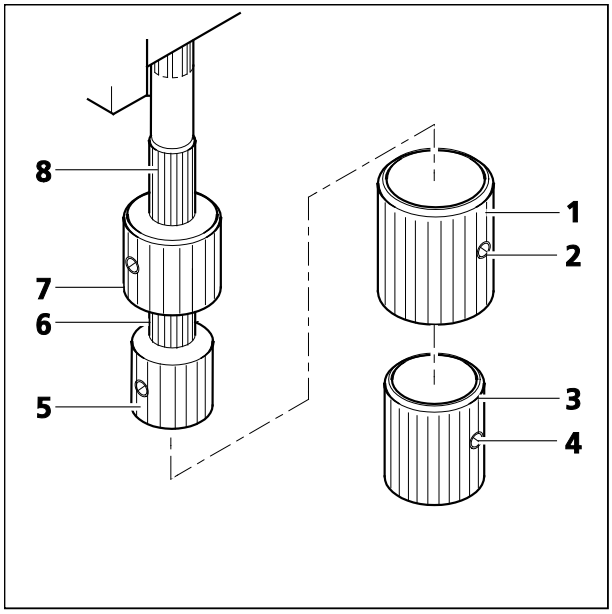


Fig. 65 Setting the ergonomic drive

3.35.5 Adjusting the action (torque) of the two drive knobs of the ergonomic drive

The ergonomic drive has been factory-set to an average torque. You can change this setting as follows:

(1) Adjusting the x direction

- Remove the additional sleeves (Fig. 65/**1** and **3**) from the drive knobs if necessary. Loosen the clamping screws to do so.
- Push the x drive knob (Fig. 65/**5**) down and the y drive knob (Fig. 65/**7**) up.
- Hold the x drive knob (Fig. 65/**5**) and turn the light knurled ring (Fig. 65/**6**) above it clockwise (easy action) or counterclockwise (sluggish action) until the desired torque is achieved.

(2) Adjusting the y direction

- Hold the y drive knob (Fig. 65/**7**) and turn the light knurled sleeve (Fig. 65/**8**) above it clockwise right (sluggish action) or counterclockwise (easy action) until the desired torque is achieved.
- Replace the additional sleeves if necessary and tighten the clamping screws.

☞ To ensure a long service life for the stage, remove any grit from the specimen slide at regular intervals. Make sure that the grit does not get into the guiding components for x adjustment.

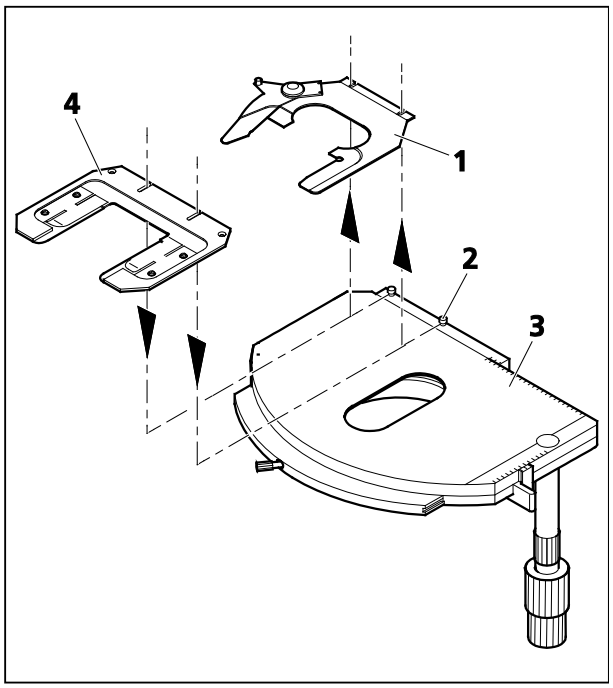


Fig. 66 Changing the specimen holder

3.35.6 Changing the specimen holder

- Loosen the two knurled screws (Fig. 66/**2**).
- Remove the specimen holder (Fig. 66/**1**) from the mechanical stage (Fig. 66/**3**) to the front.
- Attach the desired specimen holder (Fig. 66/**4**) to the mechanical stage with the slots under the heads of the knurled screws and tighten it using the knurled screws.

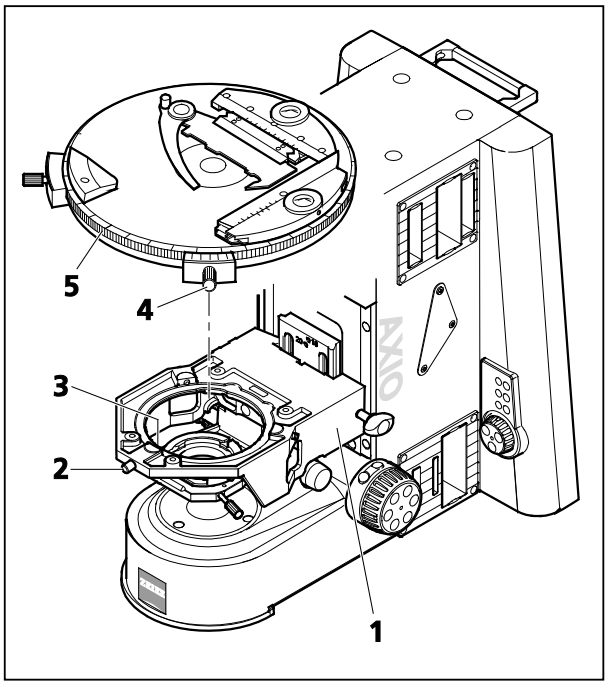


Fig. 67 Attaching the rotary stage Pol

3.36 Rotary stage Pol

3.36.1 Removing the rotary stage Pol

- Loosen screw cap (Fig. 67/**2**) from the spring housing (roughly three rotations).
- Press rotary stage Pol (Fig. 67/**5**) to the front against spring-loaded pin (Fig. 67/**3**), lift it off the stage carrier (Fig. 67/**1**) from the back and remove it upwards.
- Retighten screw cap (Fig. 67/**2**).

3.36.2 Attaching rotary stage Pol

- Where necessary, loosen screw cap (Fig. 67/**2**) of the spring housing with about three rotations.
- Place rotary stage Pol (Fig. 67/**5**) with the groove of the dovetail (stage bottom) on spring-loaded pin (Fig. 67/**3**).
- Attach the rotary stage with the clamping screw (Fig. 67/**4**) pointing to the front right.
- Press the rotary stage Pol to the front against the spring-loaded pin and lower it towards the back into the stage carrier (Fig. 67/**1**), then release it.
- Retighten screw cap (Fig. 67/**2**).

3.36.3 Centering rotary stage Pol

With high-power objectives, stage centricity can only be exact for one selected objective.

The centricity will be exact for all objectives, if an objective nosepiece Pol is used.

In this case, turn to the objective position with DIC slot.

All stages are factory-precentered, i.e. when the stage is rotated, the set specimen detail will remain in the center of the image. If the detail moves out of the center of the field of view (Fig. 68/**5**) while rotating the stage, the stage should be recentered by following this procedure:

- Before centering the stage, the microscope illumination must first be adjusted using KÖHLER's rules (see Section 4.12.1).
- To center the stage, use a high-contrast specimen and an eyepiece with crossline reticle.
- Loosen the stage ratchet (Fig. 68/**4**) or stage clamp (on rotary stage Pol with clamping device) and the screw cap of the stage carrier (Fig. 68/**1**).
- Rotate the stage to determine the maximum specimen deflection (Fig. 68/**5**, tip of arrow) to the eyepiece reticles.
- Turn each of the two centering screws on the stage carrier (Fig. 68/**2**) using an SW 1.5 Allen key (Fig. 68/**3**) to move the specimen detail by half of the arrow length towards the reticle center. Check whether the specimen detail moves when the stage is rotated again; repeat the procedure, if required.
- When centering is finished, tighten screw cap (Fig. 68/**1**) again.

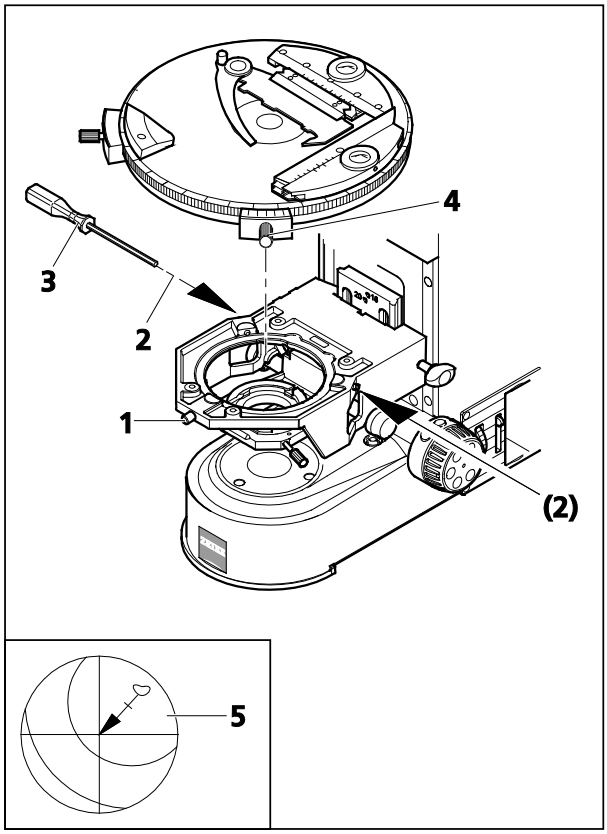


Fig. 68 Centering rotary stage Pol

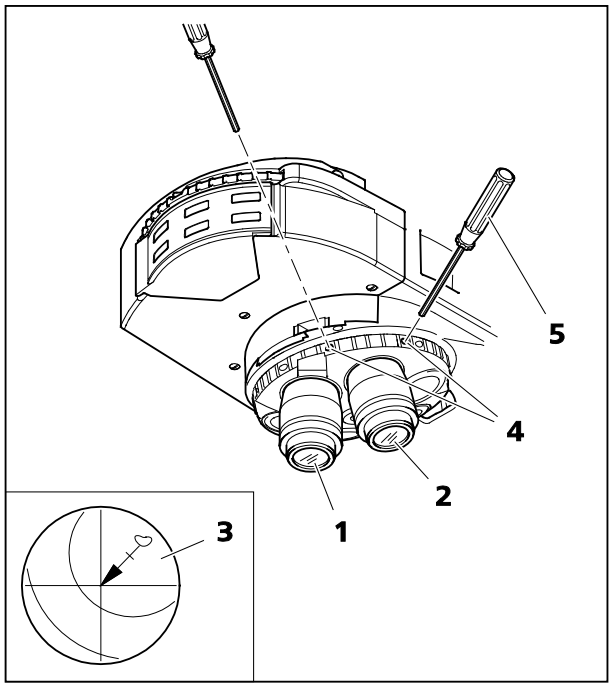


Fig. 69 Centering rotary stage and objectives

3.36.4 Centering objectives

The 6-position objective nosepiece Pol of the Axio Imager is equipped with five centering objective mounts (without DIC slot) and one objective mount with DIC slot (non-centering). This mount is centered relative to the stage. Accordingly, all objectives can be centered relative to the rotary stage.

Stage centering is necessary to ensure that a specimen detail located in the center of the field of view does not shift when the stage is rotated. By centering all objectives, the specimen detail remains in the center of the field of view even after the objective has been changed.

- Before centering the stage, the microscope illumination must first be adjusted using KÖHLER's rules (see Section 4.12.1).
- To center the stage, use a high-contrast specimen and an eyepiece with crossline reticle.
- First turn the nosepiece to swing the non-centerable objective mount (Fig. 69/**1**) (mount with DIC slot) into the light path. Center the rotary stage for the non-centerable objective mount as described in 3.36.3.
- Turn the nosepiece to move a centerable objective mount into the light path (Fig. 69/**2**).
- Rotate the stage to determine the maximum specimen deflection (Fig. 69/**3**, tip of arrow) to the eyepiece reticles.
- Turn each of the two centering screws on the nosepiece (Fig. 69/**4**) using an SW 1.5 Allen key (Fig. 69/**5**) to move the specimen detail by half of the arrow length towards the reticle center. Check whether the specimen detail moves when the stage is rotated again; repeat the procedure, if required.
- Center the other five objectives in the same manner.

☞ To preserve this centered state it is advisable to change the objectives only by turning the nosepiece using the knurled ring.

3.37 Mechanical stage 75x50 mot. CAN

To position the 75x50 mot. CAN stage,

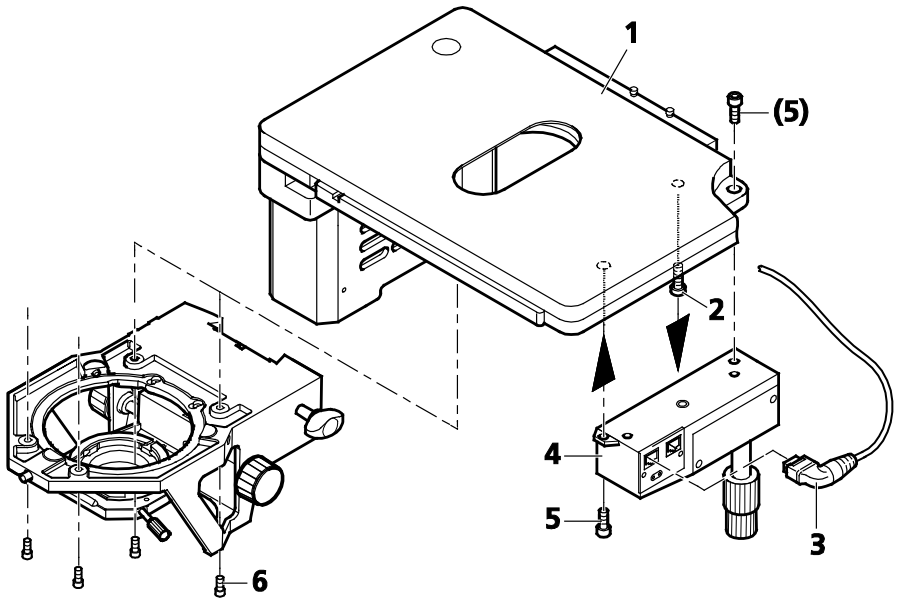
– the coaxial drive,
– the trackball or
– the joystick

can be used.

3.37.1 Assembling and connecting 75x50 mot. CAN mechanical stage with coaxial drive

On delivery, the mechanical stage has a transport lock. This should be removed before attaching the stage, as otherwise the mechanical stage could be damaged.

- Unpack the mechanical stage and remove the transport lock (Fig. 70/**2**).
- Slide the stage plate (Fig. 70/**1**) forwards and fasten coaxial drive (Fig. 70/**4**) to the underside of the stage using two screws (Fig. 70/**5**).
- Place mechanical stage (Fig. 70/**1**) onto the stage carrier so that the holes in the underside of the mechanical stage coincide with the through holes of the stage carrier.
- Using the angled Allen key (AF 3), screw four screws (Fig. 70/**6**) from the bottom into the underside of the stage, with the shorter screws being inserted in the front holes.



1 Mechanical stage 75x50 mot. CAN
2 Transport lock (screw)
3 Angled CAN bus connector of the connection cable (100-0600-144)
4 Electronic coaxial drive CAN
5 Fastening screws on coaxial drive
6 Fastening screws on stage carrier

Fig. 70 Assembling Mechanical Stage 75x50 mot. CAN

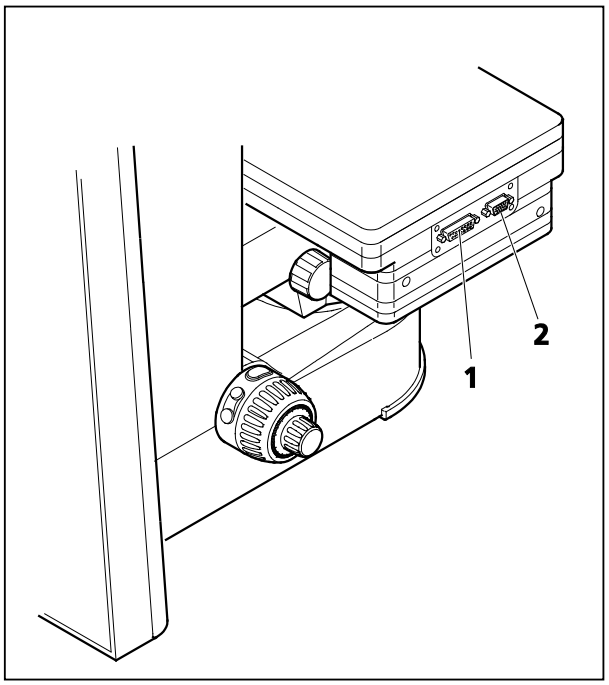


Fig. 71 **Connecting Mechanical Stage 75x50 mot. CAN (Version 2 and mot. standard)**

- Insert the mechanical stage-coaxial drive cable with angled CAN bus connector (Fig. 70/**3**) into one of the two sockets on the coaxial drive, and the other plug into the socket (Fig. 71/**1**) of the mechanical stage.

☞ The connector panel of the mechanical stage 75x50 mot. CAN (Version 2 and mot. standard) is located on the left-hand side.

- Connect the CAN connection socket on the mechanical stage (Fig. 71/**2**) to that on the rear of the stand using a CAN-bus cable.

☞ The motorized stages can be connected directly to the M2 /. M2m /. Z2 /. Z2m stands via CAN-bus. In this case the travel speed can be adjusted via the TFT display in accordance with the objective magnification (see Section **Focus tab** on page 131).

☞ If the objectives are specified when you switch on the stand (.M2 / .M2m / .Z2 / .Z2m), the optimum speed of stage travel is calculated directly. However, you may change (and store) this speed, if necessary.

3.37.2 Assembling mechanical stage 75 x 50 mot. CAN and connecting joystick / trackball

On delivery, the mechanical stage has a transport lock. This should be removed before attaching the stage, as otherwise the mechanical stage could be damaged.

- Unpack the mechanical stage and remove the transport lock (Fig. 70/**2**).
- Place mechanical stage (Fig. 70/**1**) onto the stage carrier so that the holes in the underside of the mechanical stage coincide with the through holes of the stage carrier.
- Using the angled Allen key (AF 3), screw four screws (Fig. 70/**6**) from the bottom into the underside of the stage, with the shorter screws being inserted in the front holes.
- Remove cover (Fig. 72/**1**) by loosening the two screws.
- Depending on which is used, insert the CAN connecting plug (Fig. 72/**5**) of the joystick (Fig. 72/**6**) or the trackball (Fig. 72/**7**) into the connection socket on the mechanical stage (Fig. 72/**4**).
- Connect the CAN connection socket on the mechanical stage (Fig. 72/**2**) to that on the rear of the stand (Fig. 72/**8**) using a CAN-bus cable (Fig. 72/**3**).
- Replace the cover (Fig. 72/**1**).

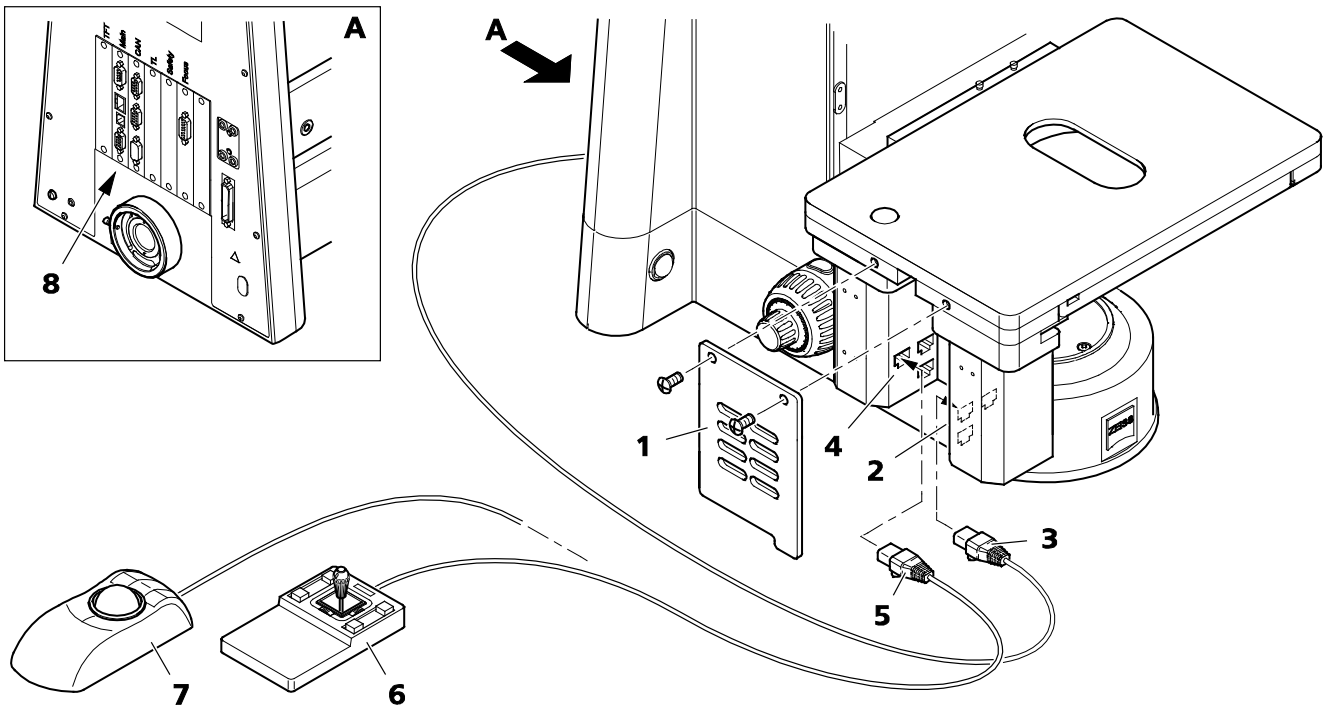


Fig. 72 Assembling mechanical stage 75 x 50 mot. CAN and connecting joystick / trackball

3.37.3 Mounting the specimen holder on the mechanical stage

- Mount the desired mechanical stage, see Section 3.35.6 on page 74.

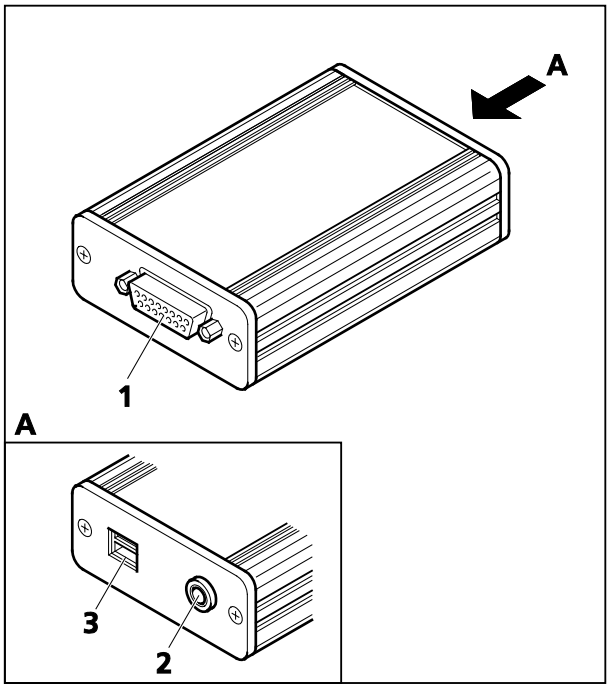


Fig. 73 CAN/USB converter

3.37.4 CAN/USB converter

On manual stands, CAN bus stages (432024-9903-000 or 432026-9000-000) can be connected directly to the PC via the CAN / USB converter.

Unlike motorized stands, the speed of stage travel cannot be adjusted depending on magnification.

- Use the CAN bus cable to connect the CAN connector of the mechanical stage (Fig. 71/**1**) to the CAN connector of the CAN / USB converter (Fig. 73/**1**).
- Use the USB cable to connect the USB port of the PC to the CAN / USB converter (Fig. 73/**3**).
- Connect the DC voltage input terminal of the CAN / USB converter (Fig. 73/**2**, 24 V DC / 1.25 A) to the plug-type power supply output (output 24 V DC, 1.25 A). Then plug that power supply into the power outlet.

☞ The CAN/USB converter may only be operated with the power supply unit provided by the manufacturer.

The plug-type power supply is a protection class II device (totally insulated). If its housing is damaged, the power supply unit should be taken out of operation.

The plug-type power supply and the CAN / USB converter must not come into contact with moisture.

The USB / CAN converter is equipped with a plug-type power supply, which allows line voltages ranging from 100 V to 240 V ±10 % (50 / 60 Hz) to be used, without requiring any change of voltage on the unit.

3.37.5 Docking station

- The docking station can only be used in conjunction with the motorized stand.
- If it is inconvenient to operate the microscope stand from the right-hand side, the functions of the touch screen TFT display (Fig. 74/**3** on the docking station), the control ring to the right (corresponds to Fig. 74/**2** on the docking station) and the focusing drive to the right (corresponds to Fig. 74/**1** on the docking station) can be operated via the docking station, detached from the stand.
- Default button allocation can be altered via the TFT display.
- It is possible to change the angle of the TFT display with the aid of the two knurled screws (see also Fig. 38/**4**) located on the back of the docking station.
- The coaxial drive (Fig. 70/**4**) of the motorized mechanical stage may be removed from the latter (see Section 3.37.1). With the help of two screws, it can be vertically fastened to the back of the docking station.

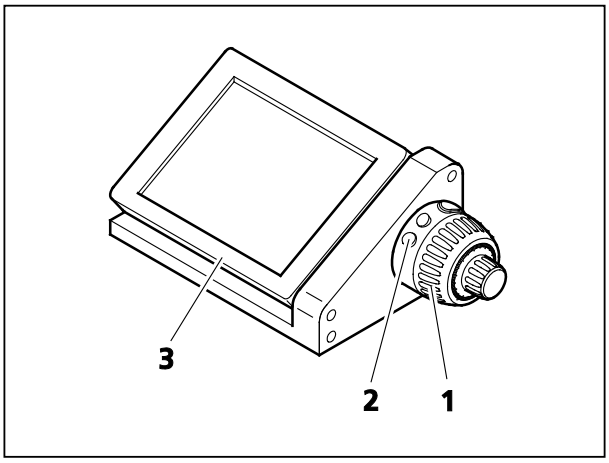


Fig. 74 **Docking station with TFT display, control ring and focusing drive**

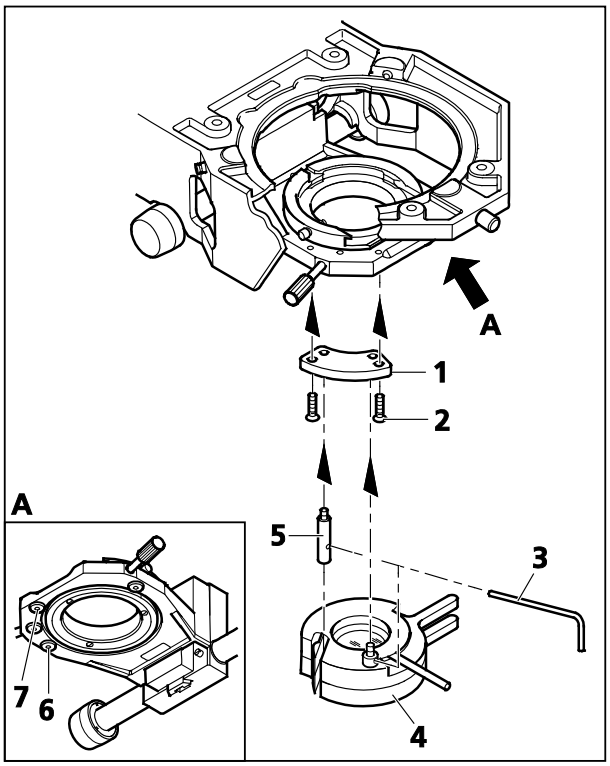


Fig. 75 Installing Polarizer D, fixed

3.38 Installing Polarizer D, fixed

☞ If the stand has a detachable stage carrier, remove it (see Section 3.17), set it aside, upside down, and install the polarizer from above.

- Remove any installed polarizer or color filter carrier from the condenser carrier.
- Fasten adapter plate (Fig. 75/**1**) with screws (Fig. 75/**2**) to the condenser carrier, using holes (Fig. 75/**6** and **7**).
- Hold the polarizer (Fig. 75/**4**) parallel to the bottom side of the condenser carrier. Using the offset adjusting lever (Fig. 75/**3**), screw the retaining bolt of the polarizer (Fig. 75/**4**) into the rear tapped hole of the adapter plate as far as it will go.
- Using the adjusting lever (Fig. 75/**3**), screw the detent bolt (Fig. 75/**5**) into the front tapped hole of the adapter plate as far as it will go.

For the installation of other polarizers or of the color filter carrier, proceed in the same way.

4 OPERATION

4.1 Coded Axio Imager 2, coded, operation and function controls

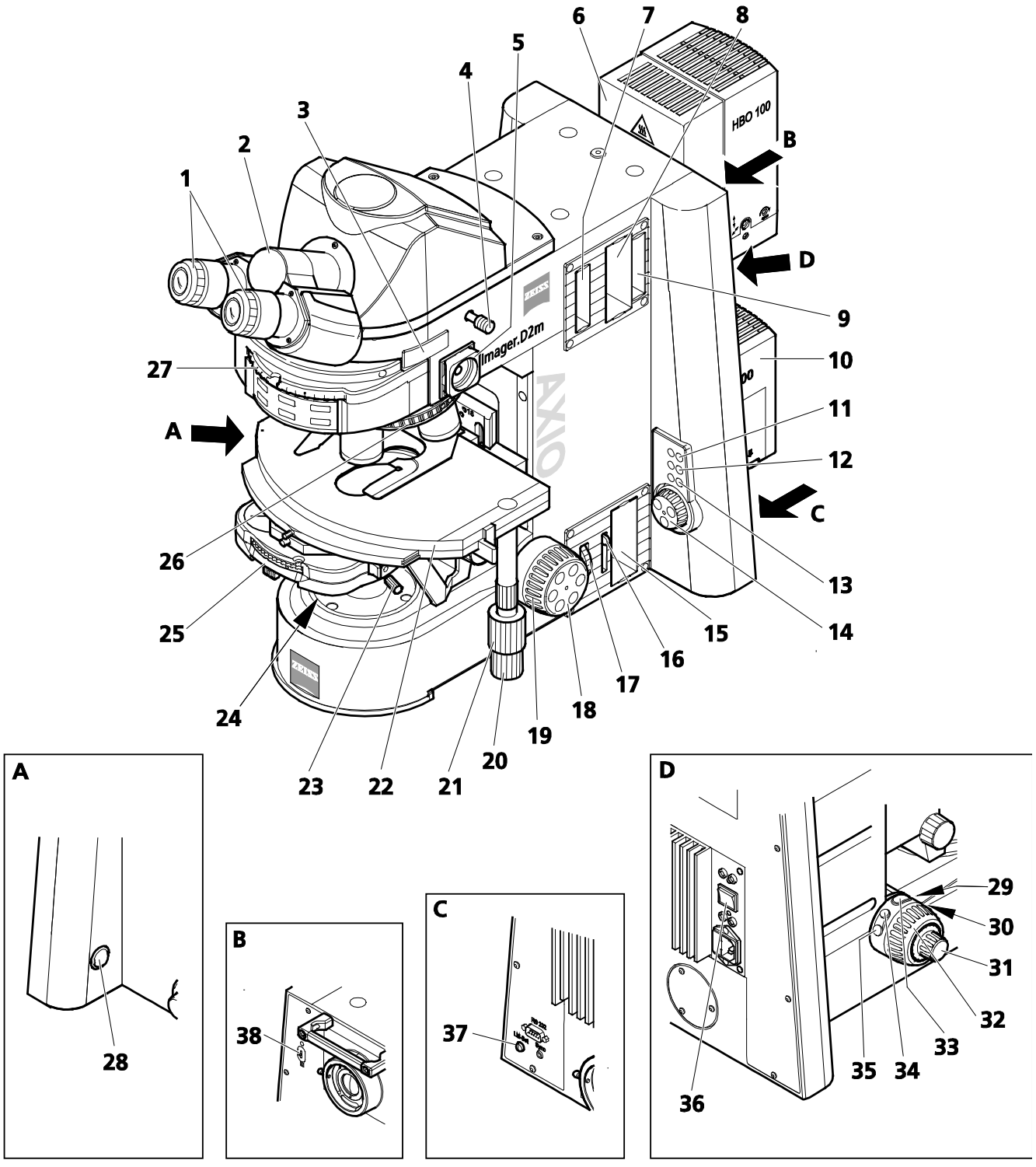


Fig. 76 Axio Imager 2, coded, operation and function controls

Key to Fig. 76:

1 Eyepieces (see page 85)
2 Binocular tube (see page 85)
3 Slot for analyzer slider (usable only if the camera path deflection, left, is not installed) (see page 85)
4 Push-pull rod for camera path deflection, left, with interface 60N (see page 85)
5 Adjusting aid for HBO / XBO illuminators (see page 85)
6 Illuminator HBO 100 for fluorescence applications
7 Slot F for stop slider with centerable luminous-field diaphragm (see page 85)
8 Slot for 2-position filter wheels, discrete: The filter wheels are not suitable for fluorescence applications. (see page 85)
9 Slot A for FL attenuator, discrete (see page 86)
10 Halogen illuminator HAL 100
11 RL Button - Reflected-light shutter on/off with monitoring LED (see page 86)
12 3200K Button - Color temperature of 3200 K on/off with monitoring LED (see page 86)
13 TL Button - Transmitted-light shutter on/off with monitoring LED (see page 86)
14 Light intensity control (see page 86)
15 Slot for 2-position filter wheels, discrete (see page 86)
16 Lever for transmitted-light diffusing glass (see page 86)
17 Control wheel for luminous-field diaphragm (see page 86)
18 Focusing drive - Fine focusing control, right side (see page 86)
19 Focusing drive - Coarse focusing control, right side (see page 86)
20 Control knob for X travel of mechanical stage
21 Control knob for Y travel of mechanical stage
22 Mechanical stage
23 Condenser carrier (see page 87 and also Fig. 77)
24 Polarizer for transmitted light (see page 87)
25 Condenser (see page 88)
26 Objective nosepiece with objectives (see page 88)
27 Reflector turret (see page 88)
28 On / off switch (see page 88)
29 Button for transmitted-light shutter on / off (see page 88 and Section 4.8.7)
30 Button for reflected-light shutter on / off (see page 88 and Section 4.8.7)
31 Focusing drive - Fine focusing control, left side (see page 88)
32 Focusing drive - Coarse focusing control, left side (see page 88)
33 Button (not used)
34 Button for reducing light intensity of Halogen illuminator HAL (see page 89)
35 Button for increasing light intensity of Halogen illuminator HAL (see page 89)
36 Toggle switch for transmitted / reflected light halogen illuminator (see page 89)
37 Button LM-Set (light manager) (see page 89)
38 Lever for reflected-light diffusing glass (see page 89)

Eyepieces (Fig. 76/1)

– All "Br. foc" eyepiece types have a correction function to compensate for ametropia of the user's eyes (see Section 3.5). They also permit eyepiece reticles to be mounted (see Section 2.7).

Binocular tubes (Fig. 76/2)

– The binocular tubes offered permit individual setting of the interpupillary distance and of the viewing height by swiveling the eyepiece sockets (see also Sections 3.6 and 3.7) within set limits. The tubes permit – dependent on the model – the viewing height to be adjusted in a range of 50 mm. Tubes are available with viewing angles of 15°, 20° or 30°.
– Used in combination with corresponding adapters, the binocular phototubes allow the installation of a camera of the user's choice. The optical path is selected by means of a push-pull rod located on the right side of the tube, with two or three operating positions. The binocular phototube 30°/25 (425502-0000-000 and 425501-0000-000) additionally features an eyepiece shutter that is operated via a second push-pull rod on the left side or via a button on the right-hand side (425506-0000-000, motorized eyepiece shutter).

Slot for analyzer slider (Fig. 76/3)

– To accommodate an analyzer slider or Bertrand lens slider PH (453671-0000-000).
– If the camera path deflection is installed (camera path deflection, left), this slot cannot be used.

Push-pull rod for camera path deflection, left (Fig. 76/4)

– Switching the optical path to the camera path deflection, left, with interface 60N.
– The camera path deflection may optionally be equipped with 50 % beam splitter or with 100 % deflection mirror.
– Push-pull rod pushed in: 100 % observation through eyepieces
– Push-pull rod pulled out: 50 % : 50 % Eyepiece/camera path (with beam splitter) or
100 % camera path (with deflection mirror)

Adjusting aid for HBO/XBO illuminators (Fig. 76/5)

– For viewing arc spot and arc spot reflection during lamp alignment.
– Adjusting position (Adjust): Adjusting aid pulled out up to the stop

Slot F for stop slider (Fig. 76/7) with centerable luminous-field diaphragm

– With the stop slider with centerable luminous-field diaphragm inserted in slot F, you can center the luminous-field diaphragm and adjust its diameter in the reflected-light path.
– When inserting the stop slider, the clamping spring points upward.
– Adjustment of the diameter is via the knurled wheel, centering is performed by means of the two centering screws of the stop slider.
– To remove the luminous-field diaphragm slider from the slot, put a ball-headed screwdriver into the free hole on the stop slider, slightly cant the screwdriver and pull the stop slider out.

Slot for double filter wheel, discrete (Fig. 76/8)

– When using the HAL 100 halogen illuminator in the reflected-light path, the 2-position filter wheels, discrete, can be used for light-intensity adjustment. The unit contains four filters each (neutral-filters) mounted on two filter wheels.

Gray filters are not suitable for fluorescence applications, as they may be damaged.

– When inserting the filter wheel, the clamping spring points upward.

– To remove the filter wheel, introduce a screwdriver into the top hole, slightly cant it and pull the filter wheel out of its slot.
– The positions of the two filter wheels are labeled and are set by turning the knurled wheels. Any combination of filters can be used.

Slot for FL attenuator, discrete (Fig. 76/9)

– To attenuate the fluorescence path when using the HBO 100, the FL attenuator, discrete should be used.
– When the FL attenuator is inserted, the clamping spring points upward.
– To remove the FL attenuator, introduce a screwdriver into the top hole, slightly cant it and pull the FL attenuator out of its receptacle.
– The FL attenuator has six labeled positions that are set by turning the knurled wheel.

RL button - Reflected light shutter on / off (Fig. 76/11) with monitoring LED

– Alternately opens or blocks the reflected-light path; function corresponds to Fig. 76/**30**.
– The monitoring LED lights up when the shutter is open.

3200K button - Color temperature 2300 K on / off (Fig. 76/12) with monitoring LED

– Adjusts the connected halogen lamp to the voltage corresponding to the color temperature of 3200 K. A color temperature of 3200 K is necessary for color photographs.
– The monitoring LED lights up when the color temperature of 3200 K is set.

TL button – Transmitted-light shutter on / off (Fig. 76/13)

– Alternately opens or blocks the transmitted-light path; function corresponds to Fig. 76/**29**.
– The monitoring LED lights up when the shutter is open.

Light-intensity control (Fig. 76/14)

– Used to adjust the d.c. voltage supply of the halogen illuminator in the range of approx. 1.8 to 12 V; function corresponds to Fig. 76/**34** and **35**.
– The annularly arranged LED's indicate the set voltage in 15 stages.

Slot for double filter wheel, discrete (Fig. 76/15)

– When using the HAL 100 halogen illuminator, the double filter wheel, discrete, can be used for light-intensity adjustment. The unit contains four filter positions each (neutral filters) mounted on two filter wheels.
– When inserting the filter wheel, the clamping spring points upward.
– To remove the filter wheel, introduce a screwdriver into the top hole, slightly cant it and pull the filter wheel out of its slot.
– The positions of the two filter wheels are labeled and are set by turning the knurled wheels. Any combination of filters can be used.

Lever for transmitted-light diffusion disk (Fig. 76/16)

– Lever in top position: Diffusion disk in light path
– Lever in bottom position: Diffusion disk not in light path

Control wheel for luminous-field diaphragm (Fig. 76/17)

– Control wheel for continuous adjustment of the luminous-field diaphragm (transmitted light)

Focusing drive – Fine focusing control (Fig. 76/18), right-hand side

– Focusing drive for fine focusing
– 1 revolution of fine focusing control = 0.1 revolution of coarse-focusing control

Focusing drive – Coarse focusing control (Fig. 76/19), right-hand side

– Focusing knob for coarse focusing
– 1 revolution of coarse focusing control = approx. 2 mm
– Total focusing range: approx. 24 mm

Condenser carrier (Fig. 76/23)

– The condenser carrier (Fig. 77/**6**) is part of the stage carrier (Fig. 77/**5**).
– Insert the condenser in the mount of the condenser carrier and fasten it by means of clamping screw (Fig. 77/**2**).
– To center the condenser, turn the two centering screws (Fig. 77/**1**).
– Turn the height adjustment control (Fig. 77/**4**) to adjust the condenser (condenser carrier) in the Z-axis.
– The clamping screw (Fig. 77/**3**) limits the top adjustment range of the condenser. The limit facilitates finding the KÖHLER illumination position again.

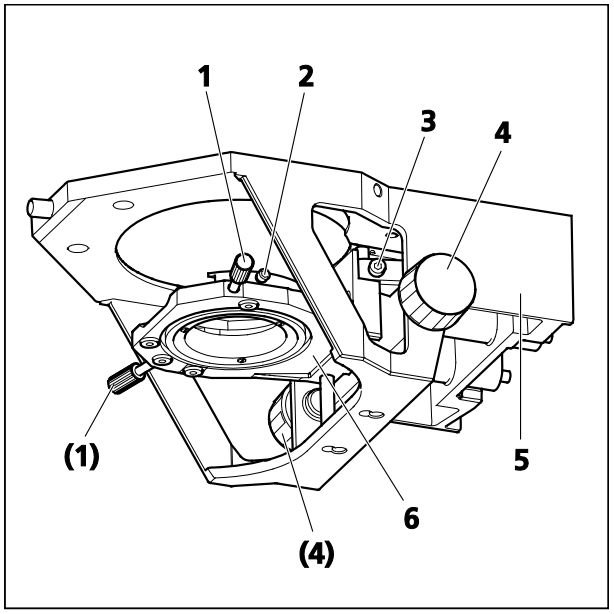


Fig. 77 Condenser carrier

Polarizer for transmitted light (Fig. 76/24)

Various types of transmitted-light polarizers are available: with fixed or rotatable polarizer or with additional lambda or lambda/4 plate or with additional neutral filter position (cf. system overview of Axio Imager 2, Section 2.4).

- Using handle (Fig. 78/**3**) swing the polarizer (Fig. 78/**1**) (or the neutral filter position, if necessary) into the light path until it is securely fixed by the detent bolt (Fig. 78/**4**).
- If available, rotate the lambda plate or the lambda/4 plate by a maximum of 45 degrees to the right or left by moving lever (Fig. 78/**2**).

☞ The color filter carrier is operated the same way as the polarizer.

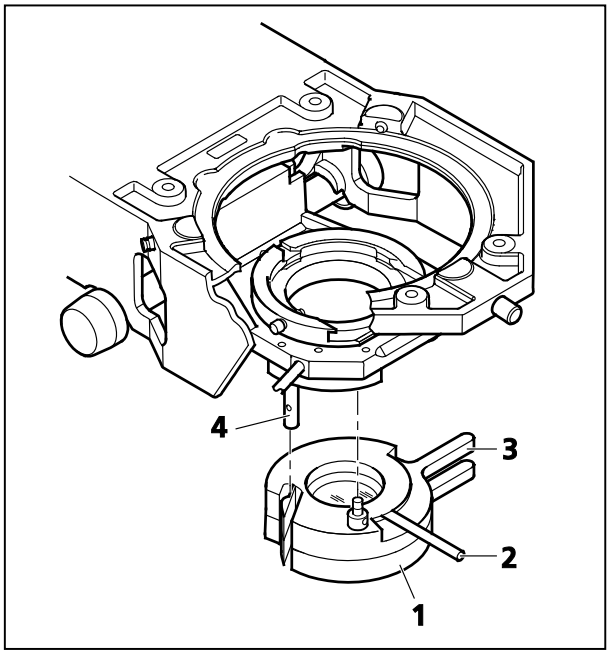


Fig. 78 Polarizer for transmitted light

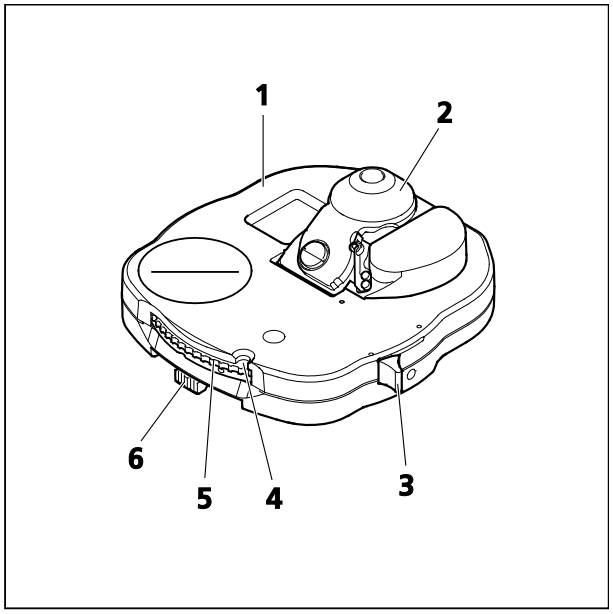


Fig. 79 **Achromatic-aplanatic universal condenser 0.9 H D Ph DIC**

Condenser (Fig. 76/25)

Dependent on the model, the achromatic-aplanatic universal condenser (Fig. 79/**1**) is equipped with:

- Swivel-type front lens
- Turret disk for:
  Brightfield - **H**
  Darkfield - **D**
  Phase contrast - Ph **1**, Ph **2**, Ph **3**
  Interference contrast - DIC **I**, **II**, **III**
- Aperture diaphragm (iris diaphragm)

The front lens (Fig. 79/**2**) is moved in/out using lever (Fig. 79/**3**). By turning turret disk (Fig. 79/**5**) the brightfield insert and the contrasting stops are moved into the light path. In window (Fig. 79/**4**), the ID of the set turret position (e.g. **D**) is visible. Using sliding control (Fig. 79/**6**), you can open or close the aperture diaphragm.

Objective nosepiece (Fig. 76/26)

- Dependent on the model, the nosepiece is equipped with six or seven M27 objective mounts with slot for DIC slider or seven M27 objective mounts.
- Objectives are quickly changed (objective position) by turning the knurled ring of the objective nosepiece.

Reflector turret (Fig. 76/27)

- With six mounts for replaceable P&C reflector modules or P&C analyzer modules
- Reflector modules (reflector positions) are quickly changed by turning the knurled ring of the reflector turret.
- The active turret position is indicated in the window.

On/off switch (Fig. 76/28)

- Position O = Instrument switched off.
- Position I = Instrument switched on.

On/off button for transmitted-light shutter (Fig. 76/29)

- Alternately opens or blocks the transmitted-light path; function corresponds to Fig. 76/**13**.

On/off button for reflected-light shutter (Fig. 76/30)

- Alternately opens or blocks the reflected-light path; function corresponds to Fig. 76/**11**.

Focusing drive – Fine focusing control (Fig. 76/31), left-hand side

- Control for fine focusing

Focusing drive – Coarse focusing control (Fig. 76/32), left-hand side

- Focusing knob for coarse focusing

Light intensity button (Fig. 76/34)

– Reduces the light intensity of halogen illuminator HAL; function corresponds to Fig. 76/**14**.

Light intensity button (Fig. 76/35)

– Increases the light intensity of halogen illuminator HAL; function corresponds to Fig. 76/**14**.

Toggle switch for transmitted / reflected-light halogen illuminator (Fig. 76/36)

– Alternately switches the halogen illuminator for transmitted light or reflected light on / off.
– Toggle switch up: Reflected-light halogen illuminator ON (transmitted-light OFF)
– Toggle switch down: Transmitted-light halogen illuminator ON (reflected-light OFF)

Button LM-Set (Fig. 76/37)

– Saves the values of the current light intensity and the optical path nosepiece position (short beep).

Lever for reflected-light diffusion disk (Fig. 76/38)

– Lever in top position: Diffusion disk in light path
– Lever in bottom position: Diffusion disk not in light path

4.2 Axio Imager 2 operation and function controls (motorized version)

In this section, the operation and function controls of the motorized version of the Axio Imager are described that are different from the manual version. Controls not described here correspond to the manual version.

As many components are offered as options, the structure of your microscope may differ from the following description. It is also possible, for instance, to use manually controlled components (such as reflector turret, condensers, filter wheels) on the motorized stand. In this case, however, the functionality of the microscope, particularly its operation via TFT display (touchscreen) will be restricted.

☞ Precise configuration is essential for the correct functioning of the motorized instrument, especially the light source(s) used, objective magnifications as well as reflector modules and filters.

Most of the settings can be made directly on the TFT display (see Section 4.8.6 on page 126).

More specific and less frequently used configurations, such as a special assembly of the condenser or your own filter sets in the double filter wheel, can be made using the configuration software MTB 2011 config.exe.

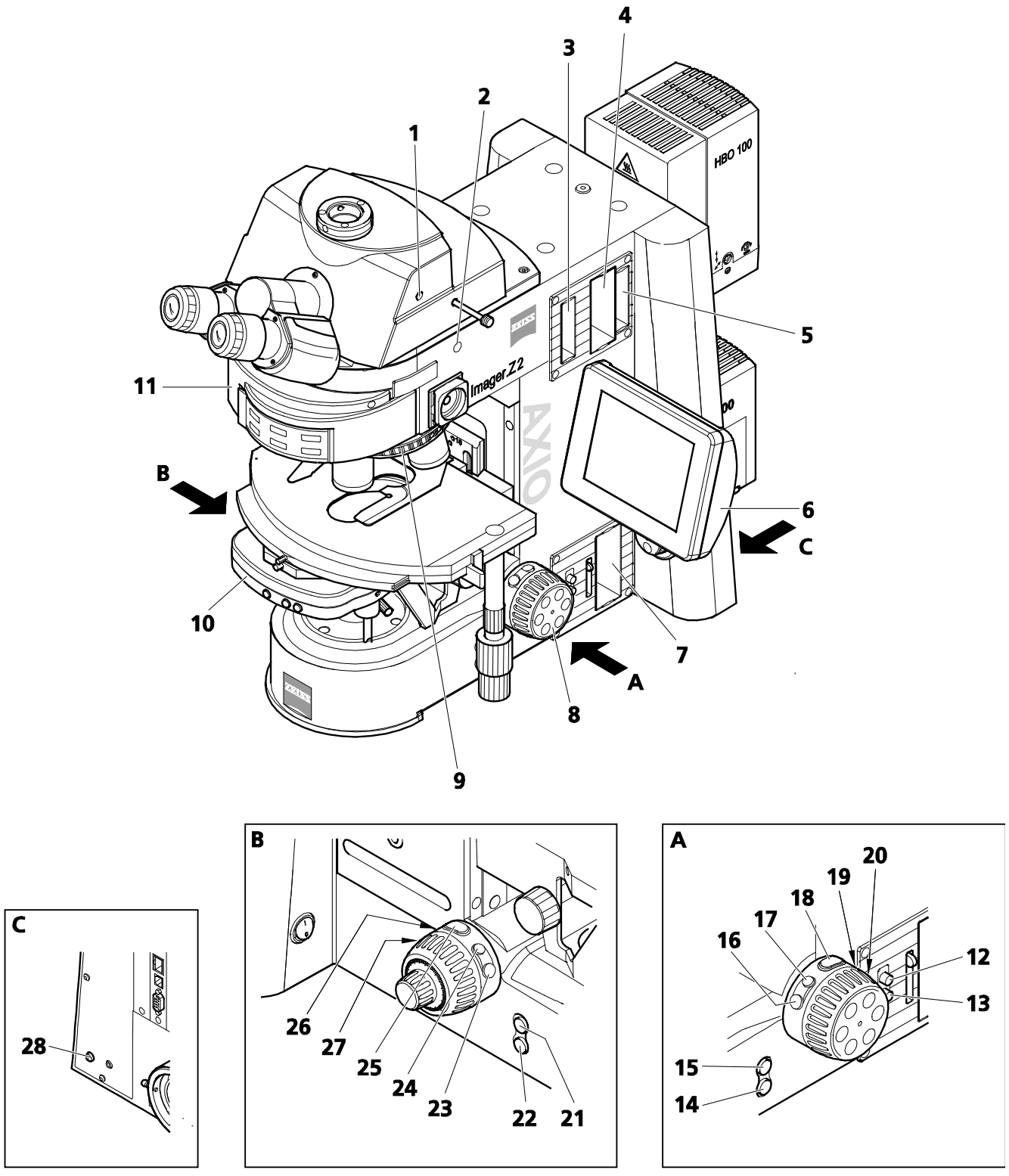


Fig. 80 **Axio Imager 2 operation and function controls (motorized version)**

Key to Fig. 80:

1 Binocular phototube with motorized eyepiece shutter – Button for opening/closing the eyepiece shutter (see page 92)
2 Camera path deflection left, with interface 60N (built into stand) - Operation via TFT display (touchscreen) (see page 92)
3 Slot F for stop slider with centerable luminous-field diaphragm (see page 92)
4 Slot for double filter wheel, discrete, mot.: The filter wheels are not suitable for fluorescence applications. (see page 92)
5 Slot A for FL attenuator, discrete, mot. (see page 93)
6 TFT display (touchscreen) for operation and adjustment of microscope (refer to Section 4.7)
7 Slot for double filter wheel, discrete, mot. (see page 92)
8 Motorized focusing drive coarse / fine (see page 93)
9 Motorized objective nosepiece
10 Motorized condenser
11 Motorized reflector turret
12 Button for opening the luminous-field diaphragm
13 Button for closing the luminous-field diaphragm
14 Button for quick-action lowering of stage LOAD POSITION (see page 93)
15 Button for quick-action lifting of stage OPERATING POSITION (see page 94)
16 Button (setting depends on stand type)
17 Button (setting depends on stand type)
18 Button (setting depends on stand type)
19 Button for rotating nosepiece anticlockwise by one position (factory-set)
20 Button for rotating nosepiece clockwise by one position (factory-set)
21 Button for quick-action stage lifting OPERATING POSITION (see page 94)
22 Button for quick-action stage lowering LOAD POSITION (see page 93)
23 Button (not used in factory setting)
24 Button (not used in factory setting)
25 Button (not used in factory setting)
26 Button for turning reflector turret clockwise by one position (factory-set)
27 Button for turning reflector turret anticlockwise by one position (factory-set)
28 Button LM-Set

☞ The assignment of keys 10 to 23 can be changed individually on the TFT display (see Section 4.7: Touchscreen - **Settings tab**).

Further motorized components (such as the motorized stop slider, motorized filter wheels, motorized FL attenuator and the motorized tube lens turret) are operated using the buttons on the respective components themselves.

Binocular phototube with motorized eyepiece shutter (Fig. 80/1)

– In addition to the manually operated beam splitter, the binocular phototube with motorized eyepiece shutter 30°/25 (425506-0000-000) is equipped with a motorized eyepiece shutter which is operated via the button on the right side (alternately on / off) or via the TFT display.

Motorized camera path deflection, left (Fig. 80/2)

– The motorized camera path deflection (100:0/50:50) is exclusively operated via the TFT display.

Switch off the microscope before inserting stop slider mot., double filter wheel mot. and FL attenuator discrete mot. into the corresponding slots.

Slot F for stop slider mot. (Fig. 80/3) with centerable luminous-field diaphragm

– The motorized stop slider is to be inserted in the same way as the motorized double filter wheel discrete mot. and the FL attenuator discrete mot.

– The diaphragm is opened or closed by pushing the respective button on the slider.

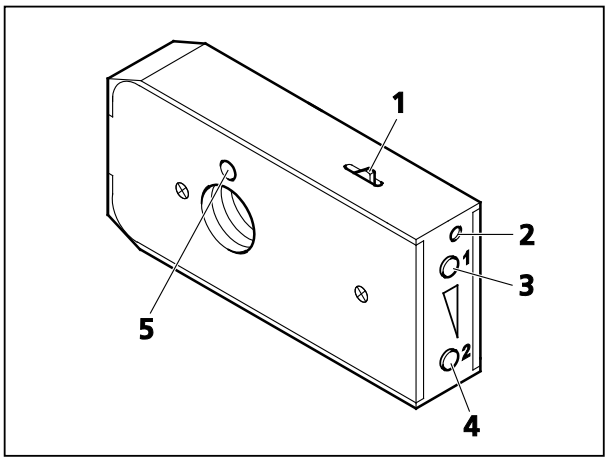


Fig. 81 Inserting/removing double filter wheel discrete mot.

Slot for double filter wheel, discrete mot. for reflected light (Fig. 80/4) and transmitted light (Fig. 80/7)

– When using the HAL 100 halogen illuminator in the reflected-light and the transmitted-light path, the double filter wheel discrete mot. can be used for brightness adjustment. This contains four filter positions (neutral-filters) on two filter wheels.

Gray filters are not suitable for fluorescence applications, as they may be damaged.

– Before inserting the filter wheel module, first activate the click-stop mechanism (Fig. 81/**1**) by pushing it in. At the right-hand front end (Fig. 81/**2**) a small silver plate becomes visible. Then push the filter wheel module into the corresponding slot until you hear it click into place.

– To remove the filter wheel module, introduce a screwdriver into the top hole (Fig. 81/**2**) and push in the silver plate to deactivate the click-stop mechanism. Slightly cant the screwdriver in the hole and pull the filter wheel module out of the slot.

– Adjust the desired positions of the filter wheels by pushing the top (Fig. 81/**3**) or the bottom button (Fig. 81/**4**). When the filter wheel module has been removed, the selected transmission can be read from the sight glass (Fig. 81/**5**). The positions of the two integrated filter wheels can be combined with each another in any configuration.

The stop slider aperture / attenuator mot. are configured in the TFT (Fig. 160 on page 141.

FL attenuator discrete mot. for reflected light (Fig. 80/5)

- Use the FL attenuator, discrete, to attenuate the light in the fluorescence path when using the HBO 100.
- Before inserting the FL attenuator, first activate the click-stop mechanism (Fig. 82/**1**) by pushing it in. At the right-hand front end (Fig. 82/**2**) a small silver plate becomes visible. Then, push the FL attenuator into the corresponding slot until you hear it click into place.
- To remove the FL attenuator, insert a screwdriver into the top hole (Fig. 82/**2**) and push in the silver plate to deactivate the click-stop mechanism. Slightly cant the screwdriver in the hole and pull the FL attenuator out of the slot.

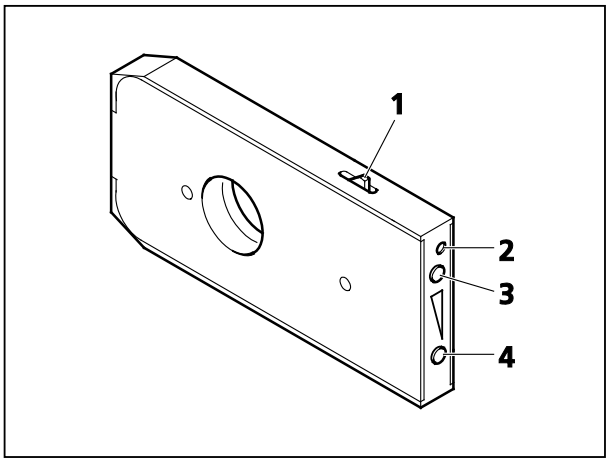


Fig. 82 **Inserting / removing the FL attenuator mot.**

- The FL attenuator has six positions that can be set by pushing buttons (Fig. 82/**3**) or (Fig. 82**4**) for forwards or backwards.

Motorized focusing drive coarse / fine (Fig. 80/8), on both sides of stand

- This is operated manually by turning the coarse or fine focusing controls (on both sides of stand) which act on an electric encoder, or by the AxioVision 4.3 software.

Motorized universal condenser (Fig. 80/10)

- Adjustment of aperture diaphragm via buttons (Fig. 83/**2** - open) and (Fig. 83/**3** - close)
- Swiveling in / out the front lens (Fig. 83/**1**) using button (Fig. 83/**4**)
- Rotating the condenser turret clockwise by means of button (Fig. 83/**5**), anticlockwise by means of button (Fig. 83/**6**)

Button for quick-action stage lowering to LOAD POSITION (Fig. 80/14 or 22)

- Upon actuation of this button, the stage will be lowered slightly to move it out of the focus position. The current focus position will be saved.
- The specimen can be changed.

☞ Once the motorized focusing drive (Fig. 80/**14**) is moved to the load position, the saved operating position is deleted and the current position saved instead.

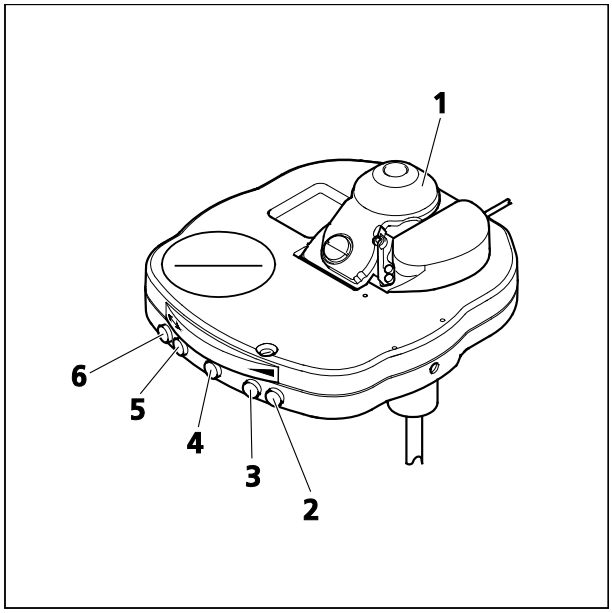


Fig. 83 **Achromatic-aplanatic universal condenser, mot.**

Button for quick-action stage lifting to OPERATING POSITION (Fig. 80/15 or 21)

– When this switch is activated, the stage is moved into the last focus position which was saved.

☞ You can abort the automatic travel of the stage to the load position / operating position by pressing the button again or by pressing the **STOP** button on the TFT display.

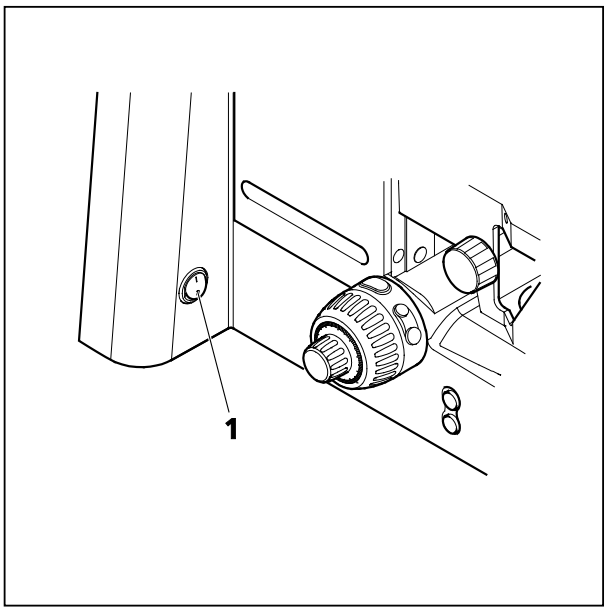


Fig. 84 Switching the manual microscope on/off

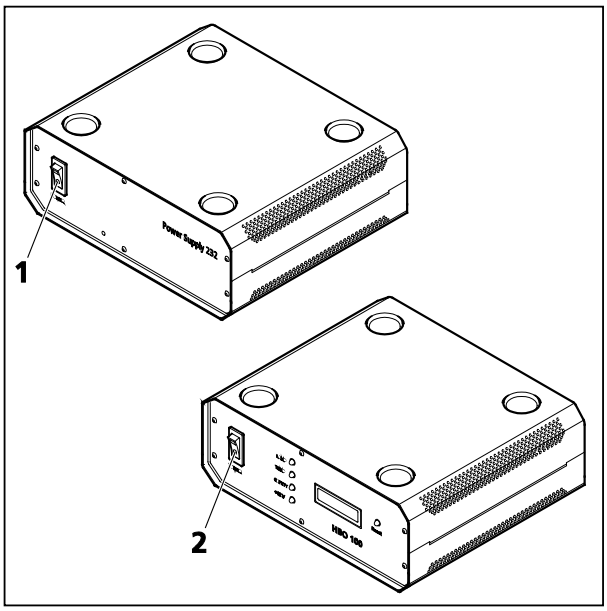


Fig. 85 Switching motorized microscope and HBO 100 illuminator on/off

4.3 Switching the microscope and HAL 100 illuminator on/off

4.3.1 Switching on

- Remove the dust covers from the instrument.
- Switch on the manual version of the microscope at the on/off (Fig. 84/**1**) switch located on the left of the stand. With the motorized microscope, first switch on the power supply VP232-2 at its on / off switch (Fig. 85/**1**), and then operate the on / off switch on the stand (Position **I**).
- Set the desired light intensity using the light intensity control.
- If you installed one HAL 100 halogen illuminator each for reflected and for transmitted light, use toggle switch (Fig. 76/**36**) to switch to the desired illuminator (reflected light: toggle switch up; transmitted light: toggle switch down).

☞ The functioning of the light manager depends on the setting of the toggle switch.

4.3.2 Switching off

- After use, switch the manual and the motorized microscope off by means of the on/off switch (Fig. 84/**1**) on the left side of the stand. Then, on the motorized version, switch off the power supply VP232-2 at the on / off switch (Fig. 85/**1**) (Position **O**).
- Cover the instrument with the dust covers.

4.4 Switching the HBO 100 on/off

- The HBO 100 illuminator, which is used in place of the HAL 100 illuminator for fluorescence contrast examinations, is switched on and off using the on/off switch (Fig. 85/**2**) of the HBO 100 transformer.
- After switching the illuminator off, allow it to cool down for approx. 15 minutes before switching it on again. Failure to do so will unnecessarily shorten the service life of the mercury vapor short-arc lamp.

4.5 Binocular phototube 30°/25 mot. with two camera ports (2TV tube mot.)

The 2TV tube mot. (Fig. 86) is available for all Axio Imager stands of type .M2 / .M2m and .Z2 / .Z2m.

It is mounted on the coupler plate like any other binocular tubes and connected via CAN bus to the stand. To do so, connect the cable to one of the three available CAN connecting sockets (Fig. 59).

The 2TV tube has two TV ports (Fig. 86/**2**).

The front TV port is adjustable in the X, Y and Z axis and to the rear (fixed) TV port.

The tube is configured via the TFT display or the MTB 2011.

LEDs on the tube display (Fig. 86/**3**, Fig. 87) indicate the selected light path setting.

If you find the illumination of the display a hindrance, you can switch it off by pushing the eyepiece shutter button (Fig. 88/**1**) for three seconds.

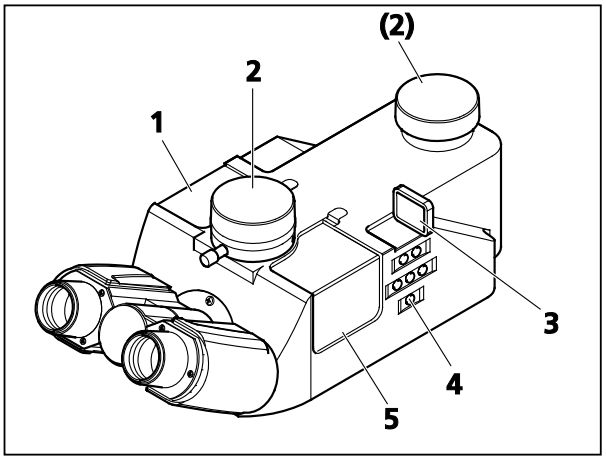


Fig. 86 **Binocular phototube 30°/25 mot. with two camera ports (2TV tube mot.)**

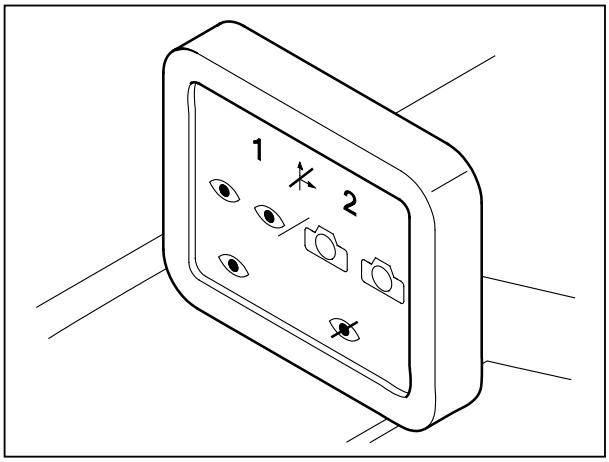


Fig. 87 **Tube display**

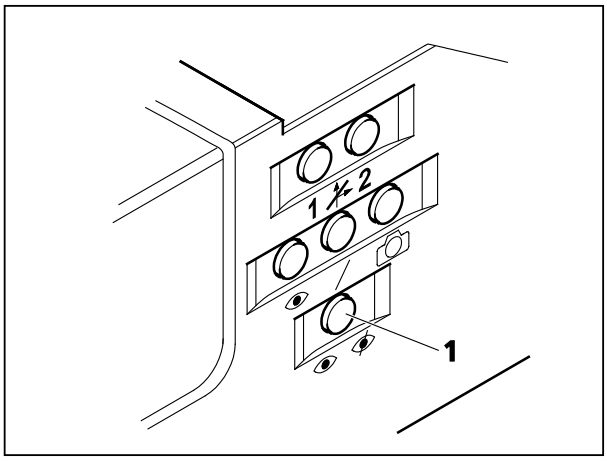


Fig. 88 Control panel

You can set the light path and the eyepiece shutter via the buttons of the control panel (Fig. 86/**4**, Fig. 88/**1**) on the right side of the tube.

If you activated the dazzle protection on the TFT display (see Section 4.8.6.2), you can use the eyepiece shutter instead of the light path shutter.

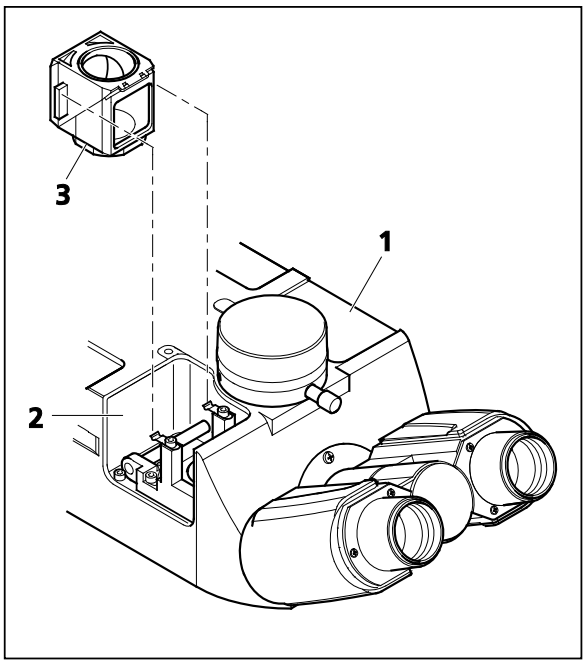


Fig. 89 Receptacles for P&C modules

In addition, the 2TV tube has two receptacles (Fig. 89/**1** and **2**), into which P&C modules (Fig. 89/**3**) can be inserted.

One of these receptacles is factory-fitted with a 100 % mirror, allowing 100% of the light to be directed to either the front or the rear TV port.

Two receptacles for P&C modules are available for the user to install e.g. an additional beam splitter for dual camera operation.

- To insert P&C modules into the 2TV tube, remove the corresponding magnetically held covers (Fig. 86/**1** and **5**) by lifting them off.
- Insert the P&C module(s) and reattach the cover(s).

4.6 The Light Manager

It is the function of the Light Manager temporarily to create optimum illumination settings for the various contrast methods and magnifications used and to make these settings reproducible to the user by providing the possibility to store them permanently.

The Light Manager has three operating modes: OFF, CLASSIC, SMART. The scope of functions available in the individual modes depends on various optional stand components.

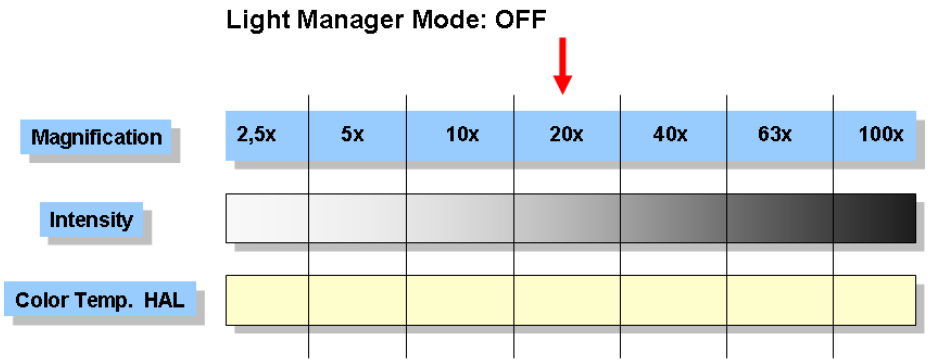
The Light Manager is available for the transmitted-light contrast methods (brightfield, phase contrast, DIC, darkfield, polarization), for the reflected-light contrast methods (brightfield, darkfield, DIC, polarization) and for reflected light fluorescence. When working in reflected light, the motorized stop slider, the neutral-density double-filter wheel and the motorized fluorescence attenuator, as far as available, are also included in the Light Manager functionality.

The following table shows which operating modes of the Light Manager can be used for the individual stand models and the contrast methods mentioned.

Axio Imager Stand		**A2 LED**	**A2**	**A2m**	**D2**	**D2m**	**M2**	**M2m**	**Z2**	**Z2m**
OFF temporary		+	+	+	+	+	-	-	-	-
OFF permanent		-	-	-	-	-	+	+	+	+
CLASSIC	TL	+	+	+	+	+	+	+	+	+
CLASSIC	RL (MAT)	+	+	+	+	+	+	+	+	+
CLASSIC	FL (BioMed)	-	-	-	-	-	-	-	+	+
SMART	TL	-	-	-	-	-	+	+	+	+
SMART	RL (MAT)	-	-	-	-	-	+	+	+	+
SMART	FL (BioMed)	-	-	-	-	-	-	-	-	-

☞ RL (MAT) / FL (BioMed): Only one brightness value available per objective.

4.6.1 Light Manager Mode: OFF

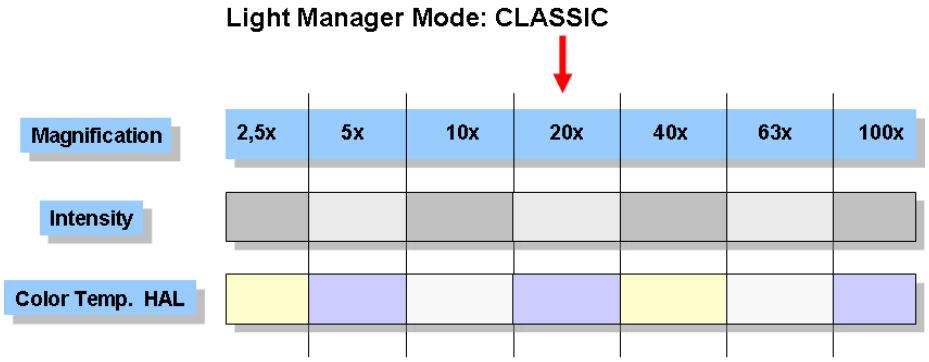


If the Light Manager is (temporarily) switched off, the microscope behaves like a normal light microscope.

Starting by selecting a magnification and a corresponding lamp voltage, the operator must readjust the voltage manually to achieve a comparable image brightness when setting higher or lower magnifications.

However, the color temperature of the halogen lamp varies with the lamp voltage and so the operator would additionally have to use neutral-density filters to achieve a comparable impression of the specimen.

4.6.2 Light Manager Mode: CLASSIC

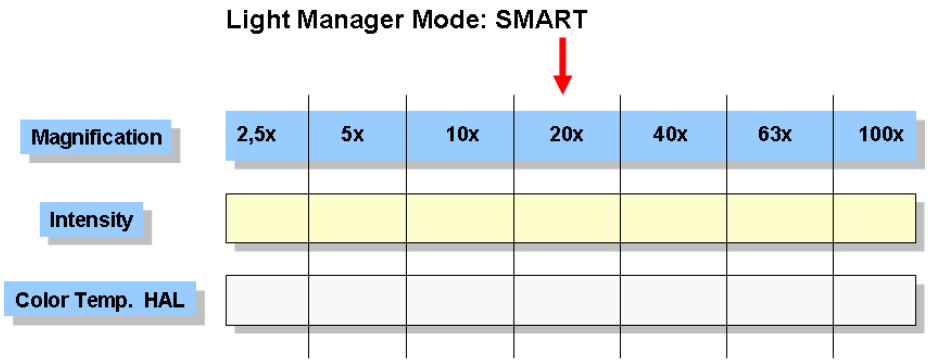


If the Light Manager is operated in CLASSIC mode, the operator can choose his own "optimal" illumination settings for each magnification.

The corresponding values are automatically stored in the temporary memory of the Light Manager when changing the objective.

If the settings are to be stored permanently (even after the microscope has been switched off), the **LMSet** button on the back right of the stand should be pushed once before switching off. After a confirmation beep, all available values will be stored. After a second beep approximately three seconds later, the microscope can be switched off.

4.6.3 Light Manager Mode: SMART



In SMART mode, the Light Manager automatically calculates the optimum brightness for all objectives specified via the TFT display (or the MTB 2011) for a specific contrast method.

If a motorized filter wheel with neutral-density filters is in the transmitted-light path, the color temperature is kept constant by the different filters.

The lamp voltage is readjusted only if it is impossible to achieve optimum illumination through the neutral-density filters. The computed values are automatically stored in the temporary memory of the microscope.

As in CLASSIC mode, the values can be stored permanently by pushing the **LM-Set** button on the back right of the stand.

In SMART mode, the operator can vary lamp intensity and neutral-density filter attenuation by ±60 % for all magnifications, without recalculation of the complete magnification range.

Any additionally installed coded or motorized microscope components (tube lens turret and Optovar modules in reflector turret) will also be taken into consideration when computing the brightness.

4.6.4 Light Manager of the coded microscope

The Light Manager of the manual microscope controls the light intensity for specimen observation via the lamp voltage. The functioning depends on the Light Control used:

Light control, manual

Lamp voltage saved for each

- Objective nosepiece position (coded)

Light control, motorized

Lamp voltage saved for each

- Objective nosepiece position (coded)
- Reflector turret position (coded)
- Tube lens turret position (motorized)

On manual stands, the CLASSIC mode of the Light Manager is active. In this mode, no illumination values are computed for the range of objectives used. The operator adjusts the brightness for each objective individually. The values are stored permanently by pressing the **LM-Set** button on the rear of microscope. This must be done for each individual objective.

When an objective is swung into the light path for which the light intensity has already been set, the system will automatically set the corresponding stored value.

The light intensity settings of the halogen lamp or LED illuminator are stored separately for transmitted and reflected light. If the Light Manager is used for reflected-light contrast methods, be sure to pre-set the voltage selector on the back right of the stand to reflected light. Otherwise, the Light Manager will assume that the stand is configured for fluorescence illumination. If a motorized neutral-density double filter wheel has been configured in reflected light, it will be set to 100 % transmission and is thus inactive.

☞ On the Axio Imager.A2, .A2m, .D2, .D2m manual stands, the Light Manager can be deactivated temporarily. To do so, keep the RL reflected-light shutter on / off button (Fig. 76/**11**) depressed while switching on the microscope.

4.6.5 Light Manager and Dazzle Protection control on manual stands

- Keep the **RL** button depressed while switching on the instrument:
  -> **Light Manager (LM) & Dazzle Protection (DP)** are permanently deactivated / activated

4.6.6 Light Manager of motorized microscope

The Light Manager of the motorized microscope (Axio Imager.M2, .M2m, .Z2, .Z2m) controls the light intensity for the observation of specimens in such a way that the operator obtains the same image brightness for all set magnifications. The operating mode of the Light Manager can be selected via the Settings menu on the TFT screen (OFF, CLASSIC, SMART). Then, proceed as follows:

- Select the required contrast method.
- Adjust the light intensity for all objective nosepiece positions.
- Press the **LM-Set** button. The current settings will then be transferred to the permanent memory. They will thus be available again when you switch on the microscope the next time.

The light intensity is changed for all other objectives, too, depending on the objective and post-magnification. When the nosepiece is turned the light manager sets the light intensity as follows:

- if installed, the motorized filter wheels are turned to keep the color temperature constant.
- If this is not sufficient to completely match the calculated light-intensity levels, the intensity of the halogen lamp is varied by changing the lamp voltage. This, of course, also changes the color temperature for specimen observation.
- The luminous-field diaphragm is adapted to the visual field of the eyepieces (see also Section 4.8.6.1 from page 126); the user, however, may readjust it individually.
- The aperture diaphragm is set according to the objective aperture (changes will be saved separately for brightfield and DIC).
- If you want to reset temporary Light Manager values to the last settings saved with the **LM-Set** button, you can do this by pressing the **User defined** button. The temporarily stored values are then overwritten by the permanently stored ones and activated.
- If the manufacturer's default settings are to be used instead, press the **Default** button. The default values will then be loaded, written to the temporary memory and activated. If you want to use the default settings permanently, write them to the permanent memory by pressing the **LM-Set** button. The manufacturer defaults cannot be overwritten.

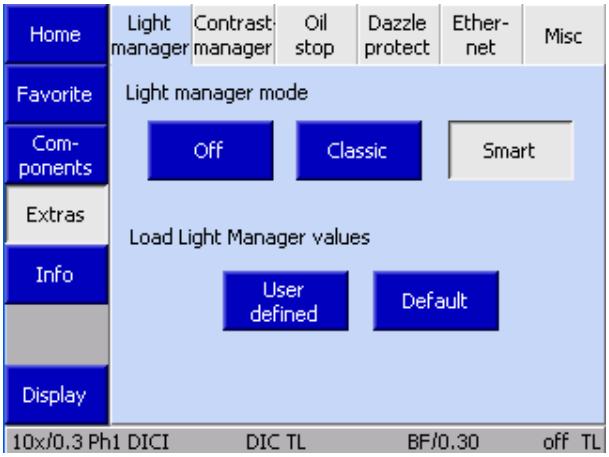


Fig. 90 **Setting / resetting the Light Manager**

☞ The calculated intensities apply only to the contrast technique selected. That means the intensity must be adjusted specifically for each contrast technique.

☞ The Light Manager works only if all dependent components are configured correctly (see Section 4.8.6).

4.7 The Contrast Manager

The Contrast Manager is at the heart of the operation efficiency design employed in all motorized Axio Imagers. With its help, the various possible contrast methods are set automatically and reproducibly.

The following table shows which function elements the user must set on a manual microscope before the specimen can be examined. During a method change or at the beginning of a session it must always be checked whether the correct components (in some cases several are possible) are in the correct position.

Abbr.	Method	Minimum components to be set
FL	Reflected light fluorescence	Fluorescence filter set in the reflector turret, condenser front lens, illuminator cap
BF	Brightfield	Transmitted light: Empty position in the reflector turret, condenser front lens and front lens, illuminator cap
PH	Phase contrast	Transmitted light: Empty position in the reflector turret, condenser front lens and front lens, illuminator cap
DF	Darkfield	Transmitted light: Empty position in the reflector turret, condenser front lens and front lens, illuminator cap
DIC	Differential interference contrast	Transmitted light: Analyzer position in the reflector turret, condenser front lens and front lens, illuminator cap
C-DIC / TIC	Circular diff. interference contrast, total interference contrast	Reflected light: Contrast module in reflector turret, motorized modulator turret
Pol	Polarization contrast	Reflected light: Reflector turret, motorized modulator turret Transmitted light: Analyzer in the reflector turret, polarizer in the condenser turret and front lens, illuminator cap

The great advantage for users is that the instrument will automatically activate all the different components that are needed for a contrast procedure when a method is selected. The user no longer needs to worry about whether all the necessary aspects involved in setting a contrast method and in optimizing the image have been considered. This is a considerable labor saving feature which leaves more time to focus on the essential details of the specimens being examined.

The contrast manager function can be switched **on** and **off** globally (page **Settings-> Contrast manager** tab on page 142). If the function is switched off, the **Contrast** tab is not available in the TFT. It is not possible to select a contrast directly; all components can be used independently of each other.

If the contrast manager is switched **on** globally, it is then always **active** if a contrast button is pressed. A transmitted light contrast method which is dependent on both a condenser module and a reflector module (such as DIC), can be activated both by the contrast button in the contrast manager bar on the TFT and the reflector position on the **Contrast** tab (page 113) or using the **Reflector** tab (page 113). In this example, the differential interference contrast would be set by pressing the Analyzer position (DIC TL) on the contrast or reflector page.

If the contrast manager is **globally on** but **not active**, it can be **activated** both on the **Objectives** tab as well as on the **Reflector** tab.

The transmitted-light contrast methods plus fluorescence are available on the **Objectives** tab. All the reflector-dependent contrast methods can be selected on the **Reflector tab**. This is of particular interest for reflected-light methods.

The **shutter** or illuminator channel switches are incorporated into the functionality of the contrast manager, but can be switched independently.

This variety of possible ways to select or operate a contrast method may seem confusing at first. In fact, however, it grants the user maximum flexibility since only a maximum of two different TFT pages are needed for a particular application.

4.8 Operating the motorized microscope via the touchscreen of the TFT display

On the motorized Axio Imager 2, the operator can operate and configure the microscope, set it up for different users and use optional functions via the TFT- display. The TFT-display has a touch-sensitive screen.

☞ Coded components (e.g. reflector turret or objective nosepiece) can be configured using the TFT display but not positioned.

However, the active position can be read on the TFT display.

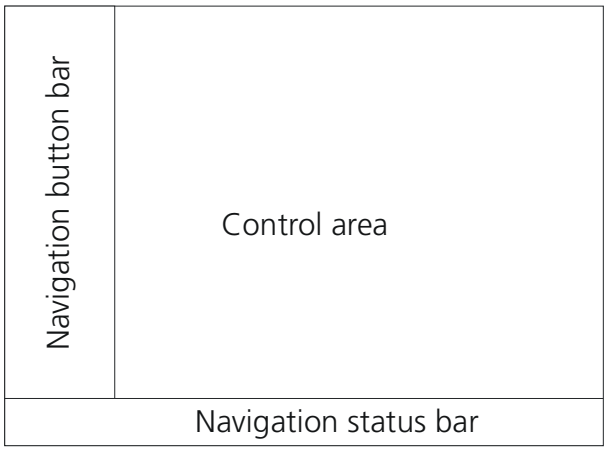


Fig. 91 Main areas of the TFT display

4.8.1 Screen layout

The control elements and information displays are contained on various, thematically organized pages. Basically, each page on the TFT display is divided into the following main areas (Fig. 91).

4.8.1.1 Navigation button bar

The navigation button bar down the left side of the screen contains buttons for activating all pages. Which buttons are available depends on the page currently being displayed. However, the following buttons are accessible on all pages:

- **Home** Activates the start page
- **Favorites** Calls up the favorites page
- **Display** Activates the display page

4.8.1.2 Status line

The status line on the lower edge of the screen provides information on the current settings of the:

objective nosepiece,

reflector turret,

condenser,

lamp voltage or intensity,

switching status of the internal power supply.

Pop-up windows are not shown in the status line

4.8.1.3 Control area

The control area is where the actual operation of controllable components takes place.

The control area is divided into further sub-areas (see Fig. 92):

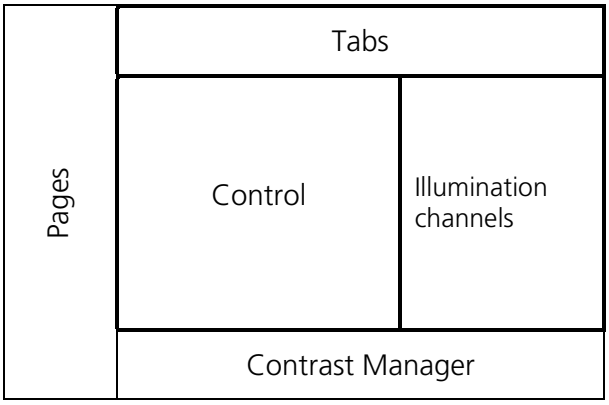


Fig. 92 Control area of the TFT display

(1) Tabs

The user can call the desired component function up via the *tabs*. These functions are shown in the *Control* section. A maximum of six tabs per page are available.

(2) Illumination channels

The buttons for reflected light (**RL illumination**) and transmitted light (**TL illumination**) are located on the right edge of the control area. The **Close** and **Open** buttons function like switches, i.e. the shutter in the optical path of the microscope is either open or closed. If there are no shutters, the configured halogen or LED illuminators are controlled directly. If no illuminator has been configured, the control buttons will not appear.

(3) Control

This area contains control elements dependent on the button selected on the navigation button bar or the tab.

(4) Contrast Manager

At the bottom edge of the control area there is a bar containing buttons for selecting the contrast method. The Contrast Manager is controlled via the following page: **Microscope –> Turret –> Contrast**.

The contrast methods result from the interaction of condenser, reflector, modulator turret and shutter positions as well as other parameters. The current contrast method is automatically recognized and displayed on the TFT-display. In the event of inadmissible manual settings (e.g., vacant reflector position or wrong position of the condenser turret), no contrast method can be indicated or the contrast manager is switched off.

Which contrast methods are available depends on the current microscope configuration. The following contrast methods are available:

Abbr.	Method	Requirements (these components must be present and configured)
FL	Fluorescence	Reflected light shutter (standard), FL filter set used in reflector turret
BF	Brightfield	Reflected light: Reflector turret with brightfield module Transmitted light: Configuration of a transmitted-light illuminator
DIC	Differential interference contrast	Transmitted light: motorized achr. apl. condenser 0.9 H D Ph DIC or motorized LD condenser 0.8 H D Ph DIC Reflected light: Motorized reflector turret with C-DIC module
PH	Phase contrast	Transmitted light: motorized achr. apl. condenser 0.9 H D Ph DIC or motorized LD condenser 0.8 H D Ph DIC
DF	Darkfield	Transmitted light: motorized achr. apl. condenser 0.9 H D Ph DIC or motorized LD condenser 0.8 H D Ph DIC Reflected light: Motorized reflector turret with darkfield module
C-DIC TIC	Circular DIC, Total Interference Contrast	Reflected light: Motorized modulator and coded or motorized reflector turret with C-DIC module
POL	Polarization contrast	Transmitted light: motorized achr. apl. condenser 0,9 H D Ph DIC or motorized 0.8 H D Ph DIC LD condenser available, polarizer in condenser, analyzer module in reflector turret or analyzer slider Reflected light: Polarizer / analyzer module in reflector turret

(5) Popup windows

Popup windows are overlaid on a page:

- To prompt the operator for additional entries: The operator must make a choice (e.g. adapt the configuration after initialization, enter values, etc.).
- To display error messages or special information: The operator may have to confirm such messages using the **Close** button.
- They display the operation status (wait time): Such windows close automatically.

☞ When popup windows are open, the overlaid page cannot be operated.

4.8.2 Menu structure

☞ Depending on the microscope configuration, the actual menu structure may deviate from the structure shown below. It shows the total scope inclusive of optional components and menu items that are accessible only if the user has administrator privileges (without administrator login, the user only has read-only access).

☞ In the second product generation, Axio Imager 2, the stand type (BioMed or Material) no longer has to be preselected in the user interface!

Navigation bar Level 1 (start page)	Navigation bar Level 2	Tabs in the control area Level 3					
Home Page 108	**Home** Page 108						
Favorite Page 111	**Favorite** Page 111						
Microscope Page 111	**Turret** Page 112	**Objectives**	**Contrast**	**Reflector**	**TL turret**	**C-DIC / TIC**	
	Illumination Page 116	**Light path**	**Brightness**	**F / A TL**	**F / A RL**	**FluoArc**	
	Auto. operation Page 122	**Soft Keys**	**HW Settings**				
	XZY Page 123	**Position**	**Measure**				
Config Page 126	**Components** Page 126	**Objectives**	**Reflector**	**Focus**	**Stage**	**Camera ports**	**Misc**
	Extras Page 142	**Light manager**	**Contrast manager**	**Oil stop**	**Dazzle protection**	**Ethernet**	**Misc**
	Info Page 144	**Firmware**					
User Page 145	**User selection** Page 145	**User**					
	User config. Page 146	**HW Settings**	**Settings**	**Buttons, left**	**Buttons, right**	**Docking station**	**Favorites page**
	Admin Page 150	**Settings**	**User admin.**				
Display	**back**						

Fig. 93 Menu structure

On the navigation button bar, the buttons of the *first level* appear on the very left (Fig. 93). Press the **Microscope**, **Config**, **User** and **Display** buttons to change the button assignment on the navigation button bar.
The buttons in the *second level* of the navigation button bar activate the corresponding tabs. By pressing the tabs, further buttons appear in the control area of the screen.

☞ All the operating functions are exclusively displayed in the control area (Fig. 94/**2**) or in Popup windows. The instrument status can simply be read from the navigation bar or the Home page.

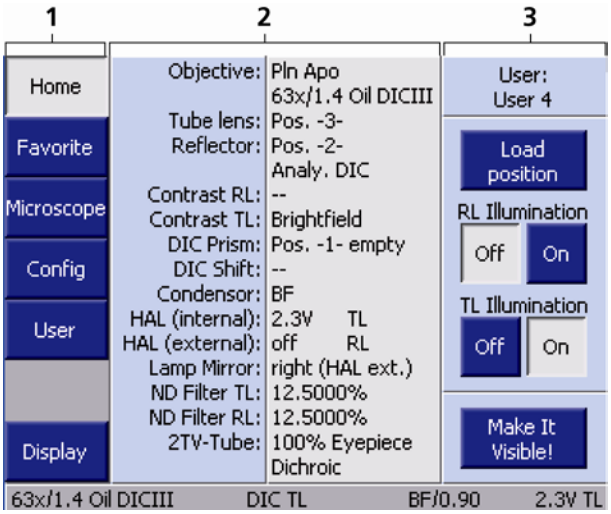


Fig. 94 Home page

4.8.3 Home page

After being switched on, the microscope is initialized. This process takes a few seconds. The **Home** page (Fig. 94) appears when the instrument is first started up.

☞ If coded / motorized components are exchanged or removed while the instrument is switched off, the operator may possibly have to reconfigure the instrument after it has been switched on again.

You can access all other pages via the buttons on the **navigation button bar** (Fig. 94/**1**).

The **control area** (Fig. 94/**2**) shows the identified configuration and its current status. All coded and motorized control elements detected during initialization appear in the status field, otherwise, the character "-" is displayed. The control elements are arranged from top to bottom according to their significance.

The following operation controls are located along the right edge (Fig. 94/**3**):

– **User** button:
When this button is pressed, the user selection page will appear (Fig. 95).
A preconfigured user may be chosen on the **user selection page**. For the configuration of a user, see Section 4.8.6.

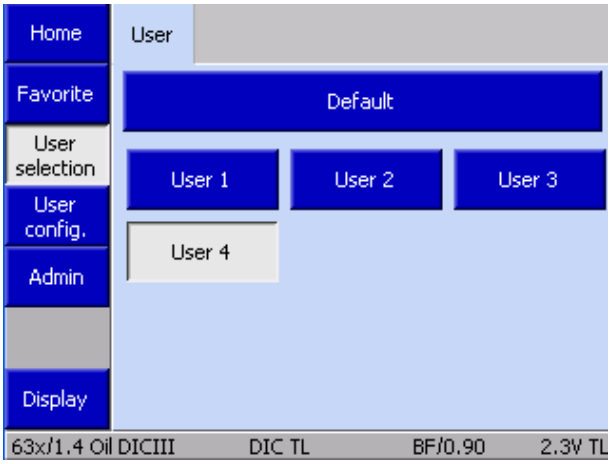


Fig. 95 **User selection page**

– **Load Position** button:
When this button is pressed, the stage travels to the load position. The load position is approximately 10 mm below the operating position. The load travel of the stage can be interrupted using the **STOP** button (Fig. 96) or any button on the stand base.
When the stage arrives in the load position, the **Load Position** popup window (Fig. 97) appears with the following control elements:


Stage returns to operating position.


While this button is pressed, the stage travels to the operating position (up to the upper stage stop).


While this button is pressed, the stage moves down (to the lower stage stop).

When this button is pressed, the current focus position is set as the operating position.

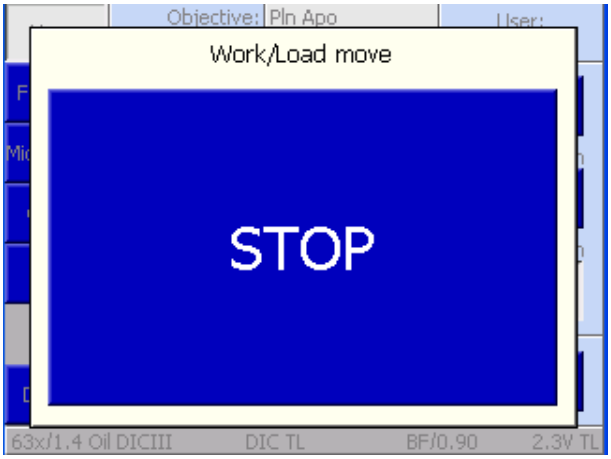


Fig. 96 **STOP button**

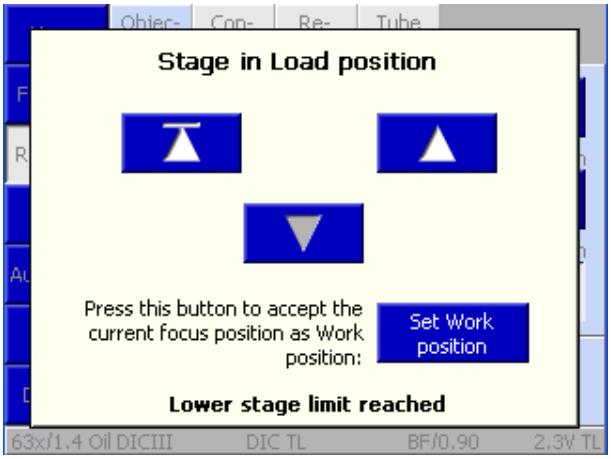


Fig. 97 **Stage in load position**

☞ Caution! If the set operating position is below the current focus position, the focusing drive will move downward when the  button is pressed.

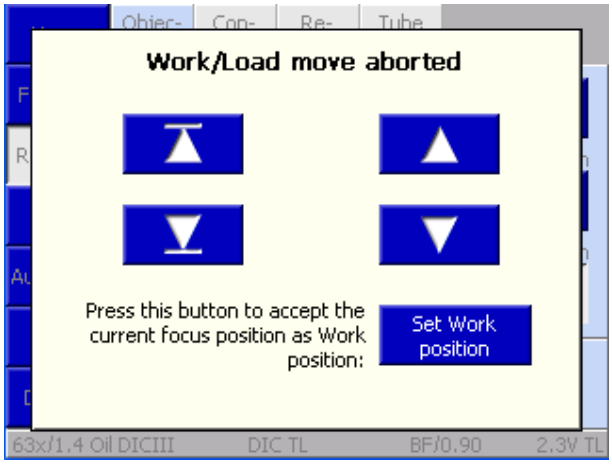


Fig. 98 Travel aborted

When the **STOP** button is pressed, the load travel is aborted and a pop-up window (Fig. 98) is displayed. The additional button which appears here serves to move the stage to the load position which was originally intended.

When the lower stage stop is reached, the message "Lower stage stop reached" appears.

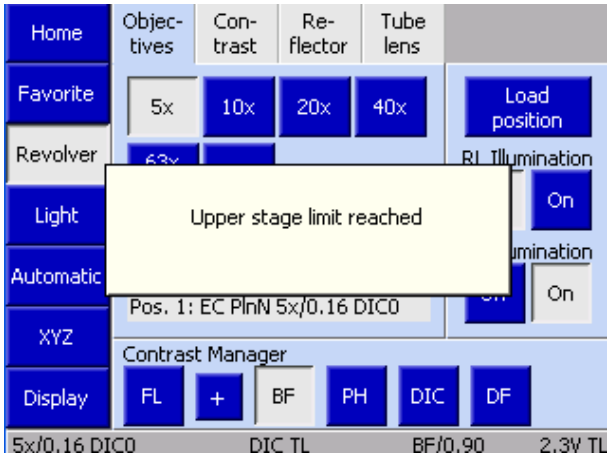


Fig. 99 Motorized focusing drive reaches stage limit switch

Under normal focusing drive operation, a pop-up window (Fig. 99) appears as soon as the upper or lower limit stop is reached.

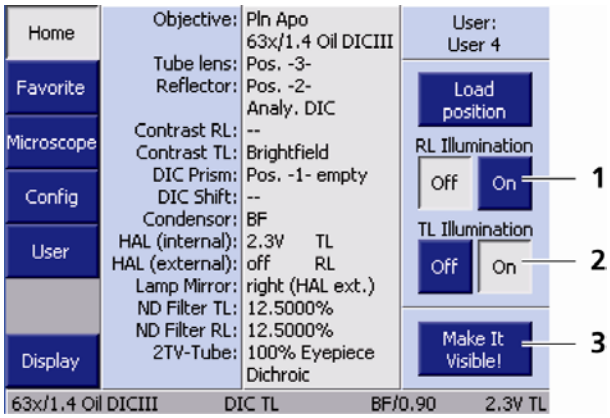


Fig. 100 Controls

- **Reflected-light illumination** button (Fig. 100/**1**)
  The **Off** and **On** buttons serve to open or close the shutter for reflected light (RL).
- **Transmitted-light illumination button** (Fig. 100/**2**)
  The **Off** and **On** buttons serve to open or close the shutter for transmitted light (TL). If there is no shutter in the transmitted-light path, the voltage of the configured lamp will be adjusted instead.

– **Make It Visible!** Button (Fig. 100/**3**)
This button switches the microscope to a basic state:

Transmitted-light lamp set to medium intensity (2.3 V),

Luminous-field diaphragm opened,

Aperture diaphragm opened

TL shutter open,

RL shutter closed,

All filter wheels in transmitted light switched to blank aperture (100% directed to eyepieces),

Condenser switched to brightfield,

Reflector turret switched to the nearest HAL- position (Halogen = transmitted light),

Light path switched 100% to eyepieces.

4.8.4 Favorite page

In order to increase the operation efficiency of the microscope, a frequently used page can be set as a favorites page. When selected, the system jumps directly to this page. For the procedure of how to define this page, see also Section 4.8.6.

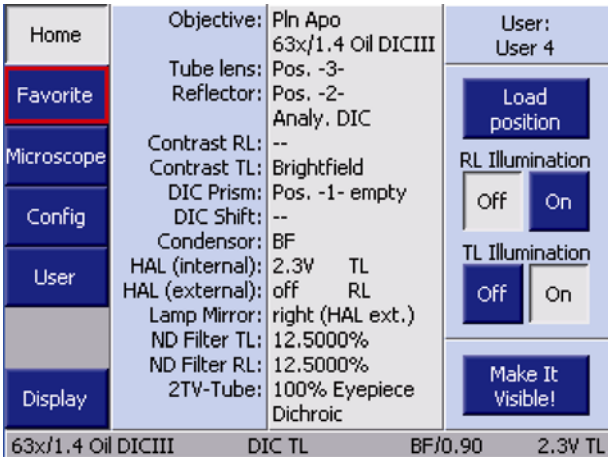


Fig. 101 Favorites page

4.8.5 Microscope page

By pressing the **Microscope** button in the navigation bar on the **Home** page, the user can access the microscope operation pages (compare Fig. 103):

– **Turret**
– **Illumination**
– **Automatic operation**
– **XYZ**

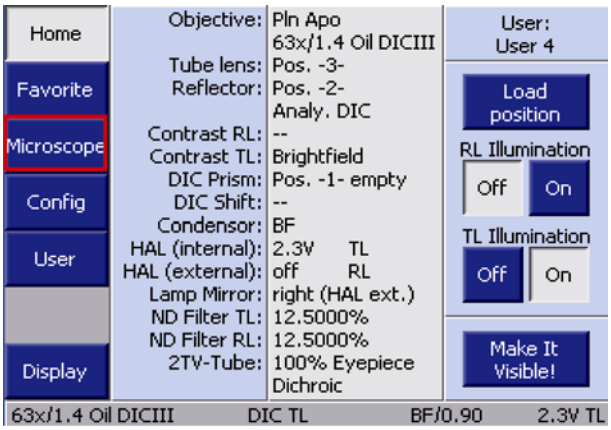


Fig. 102 Selecting the Microscope page

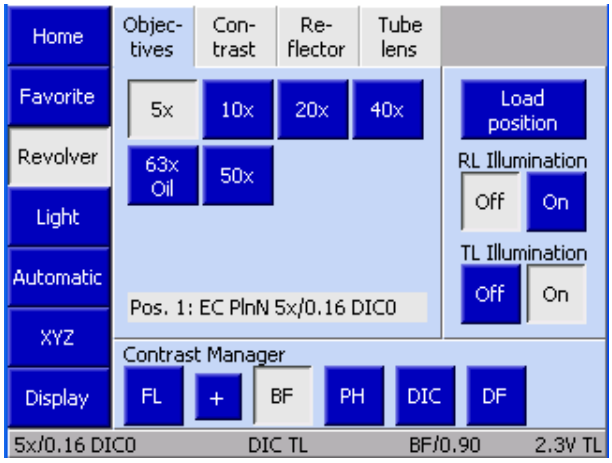


Fig. 103 Microscope -> Revolver -> Objectives

4.8.5.1 Revolver page

Depending on the configuration carried out under the **Settings** menu item, different tabs and information will appear on the **Revolver** page. These are described below.

(1) Objectives tab

Depending on the nosepiece installed (all motorized ones), up to seven control elements will appear for the various objective positions (Pos. 1 to Pos. 7). For pre-configured objective positions, the system will display the magnification and, where applicable, the following additional information:

- Oil: Oil immersion objective
- W: Water immersion objective
- Imm: Immersions

☞ There is no operation page for objectives with coded nosepieces. The active objective is only indicated in the status line.

☞ If the light manager is active, it is automatically used in the event of a change of objective.

☞ If a contrast method was set in the contrast manager prior to a change of objective, the contrast manager will automatically try to adapt the method to the objective (i.e. positions on the condenser turret and reflector turret may change). If the contrast method is not available for the objective concerned, the system will switch to brightfield.

(2) Contrast tab

The desired contrast can be selected on this page, depending on which reflector modules, condenser modules and objectives have been configured. This applies both to the reflected-light and transmitted-light contrast methods.
Reflected-light fluorescence counts here as a reflected-light method. For this reason, the second-generation Axio Imager 2 has no **FL** button. If motorized components are installed, the corresponding contrast is set at the touch of the button.

The **+** button is provided only if the active light channels (reflected light and transmitted light) are not controlled via the internal power supply.

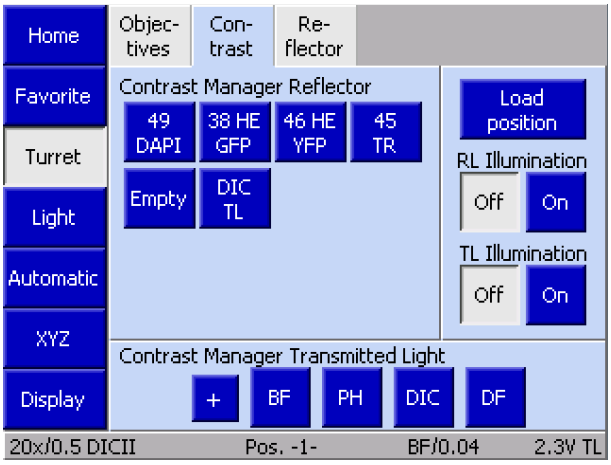


Fig. 104 Microscope -> Revolver -> Contrast

☞ The **Contrast** tab will be available only if the contrast manager has been switched **ON** globally.
For more information, refer to Section 4.8.6.

(3) Reflector tab

Depending on the reflector turret installed, 6 or 10 control elements for reflector positions 1 to 6 or 1 to 10 will appear. The reflector modules already configured are recognizable by the text showing on the button.

- To swivel in the desired reflector module, press the relevant button.

If the contrast manager is activated on this page and if components valid for the contrast method determined by the reflector module have been installed, the appropriate method will be set. If this is not possible, the contrast manager cannot be activated at this reflector position.

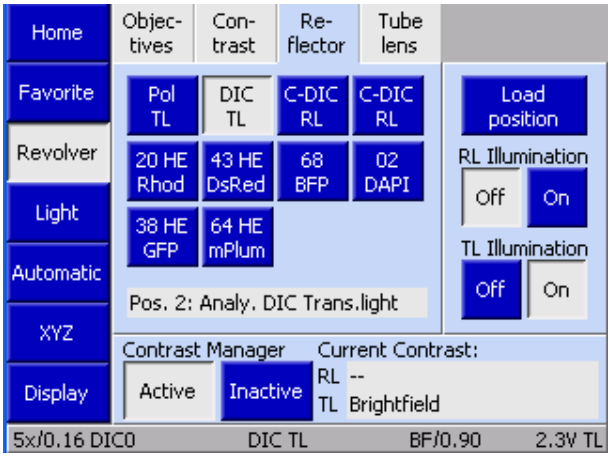


Fig. 105 Microscope -> Revolver -> Reflector

The last transmitted-light contrast method to be chosen will be set at an empty or transmitted-light position.

If an invalid reflector position is selected while the contrast manager is active, the system will travel to the selected position, but without the contrast being adjusted. No contrast method will be displayed.

☞ The tab will not be available if no motorized reflector turret is installed. The active reflector module will only be indicated in the status line (Fig. 94).

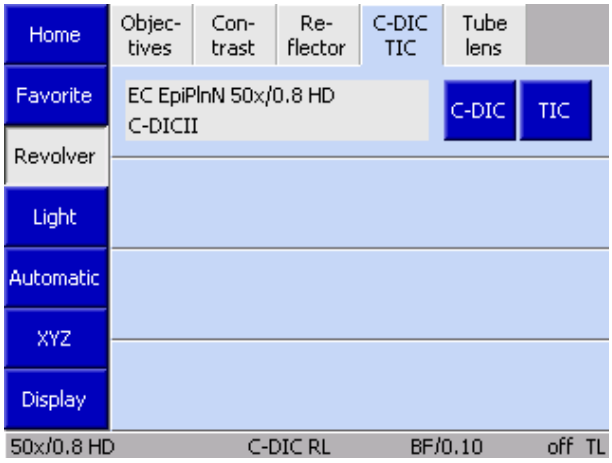


Fig. 106 Microscope -> Revolver -> C-DIC/TIC

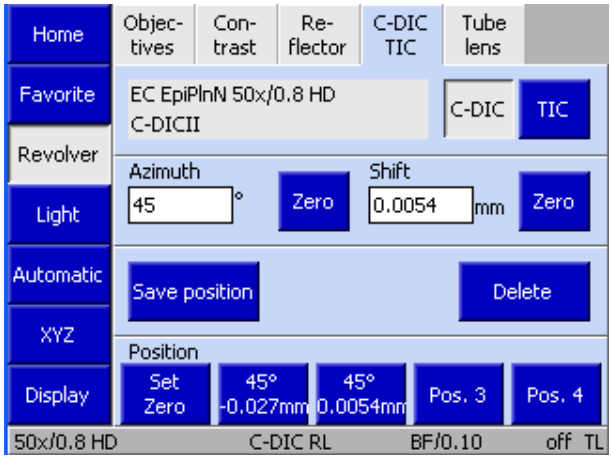


Fig. 107 C-DIC settings

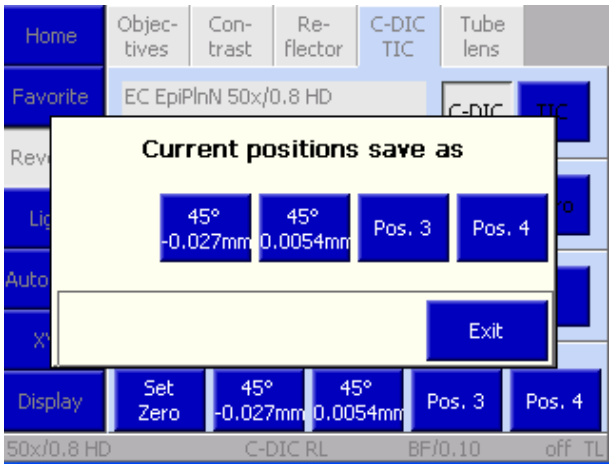


Fig. 108 Saving the position

(4) C-DIC / TIC tab

On this page, the desired method can be selected by pressing the relevant button, provided the configured objective and the analyzer installed in the reflector turret are suitable for this method.

Depending on the objective used, the settings for **C-DIC** or **TIC** can be made on this tab.
Azimuth and shift (for C-DIC only) are set directly using the setscrews provided on the modulator turret. This data cannot be entered directly on the TFT display.

Circular DIC

- To set the azimuth value, turn the front setscrew on the modulator turret. The relevant values are shown directly. Each click-stop position of the setscrew corresponds to a one-degree change.
  Press the **Zero** button to set the mid-position.
- Turn the rear setscrew to set the shift value. Each click-stop position of the setscrew corresponds to a 0.05-mm change.
  Press the **Zero** button to reset the value to 0.

The **Azimuth** and **Shift** values are saved automatically and temporarily for each objective. If no **Azimuth** or **Shift** has already been set for a given objective, the settings of the objective last used will be employed. In the event that there are no values to fall back on for any of the objectives, the default azimuth and shift values will be used.

In addition, it is possible to save up to four pairs of fixed values for azimuth and shift. These can be restored via the **Position** buttons located on the lower edge of the screen.

Assigned buttons are labeled with the set azimuth and shift values. Unallocated buttons are labeled Pos. 1 to Pos. 4. The **Reset to Zero** button sets the **Azimuth** to mid-position and **Shift** to zero.

- First make the desired settings for **Azimuth** and **Shift** to store fixed positions.
- Press the **Save position** button.
  A pop-up window (Fig. 108) with the four position buttons will open.
- Press the desired position.
  A security query will appear if the position has already been allocated. If you acknowledge by pressing **Yes**, the new position will be stored on the selected button.

TIC

The procedure for the TIC method is similar to that for C-DIC. The difference is that only the azimuth value needs to be set. There is no **Zero** button.

☞ The tab will not be available if no motorized reflector turret is installed.

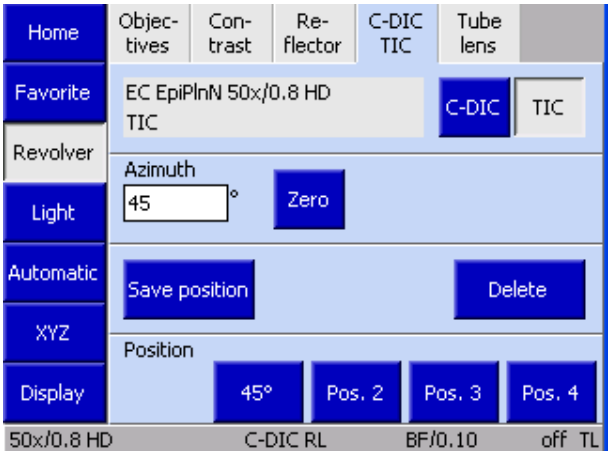


Fig. 109 TIC settings

(5) Tube lens tab

Depending on the type of tube lens turret employed, up to four control elements may be available for tube lens positions 1 to 4. If the tube lenses have been configured, the names will be displayed. The fifth position is always fitted with the Bertrand lens.

The **BT** button swivels the Bertrand lens in and out.

- The relevant button needs to be pressed to swivel the desired tube lens into the optical path.

☞ The tab will not be available if no motorized tube lens turret is installed. The active tube lens will only be indicated in the status line (Fig. 94).

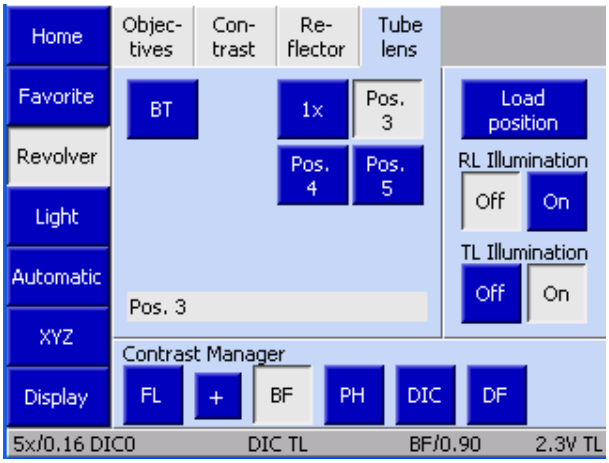


Fig. 110 Microscope -> Revolver -> Tube lens

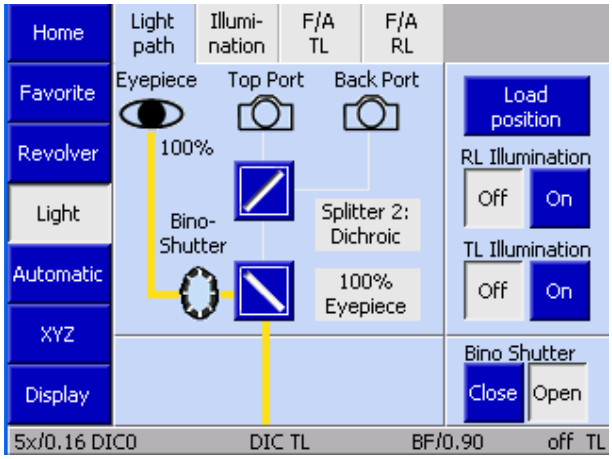


Fig. 111 Light page

4.8.5.2 Light page

Light path and intensity control functions are contained on the **Light** page.
As many as four tabs are available here, depending on the configuration of the microscope:

- **Light path**: Light path control
- **Illumination**: Filter wheels and lamp voltage for reflected and transmitted light
- **F/A TL**: Field and aperture diaphragm control in transmitted light
- **F/A RL**: Field and aperture diaphragm control in reflected light

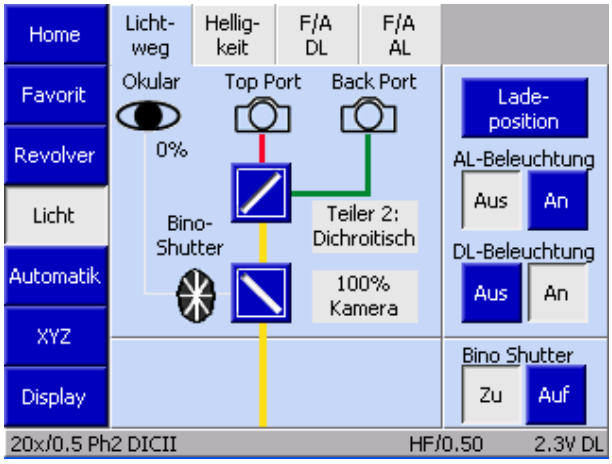


Fig. 112 Microscope -> Light -> Light path

(1) Light path tab

The light path of the microscope on the imaging side is shown in a schematic diagram beneath the **Light path** tab.

Colored lines symbolize the light path.

- **yellow**
  Active light path, which can be adjusted via mirrors
- **gray**
  Inactive (unknown) light path, which cannot be adjusted

Special case: Dichroic deflection

- **blue**
  "Side Port deflected" deflection plane (first dichroic deflection)
- **green**
  "Side Port in pass-through mode" deflection plane (second dichroic deflection) or deflected for 2TV tube
- **red**
  2TV tube in pass-through mode (dichroic passage)

The light path can be controlled by pressing the  buttons. Various options are available, depending on the type of component.
The first light path switch in the 2TV tube is controlled in Fig. 113. Fig. 114 shows the controls of the second light path switch in the 2TV tube.

If an eyepiece shutter is installed, the **Bino Shutter** option is displayed in the **Light path** tab.

The eyepiece shutter is controlled independently of the remaining light path by pressing the **Open** and **Close** buttons.

☞ This tab will not be available if there is no light switch.

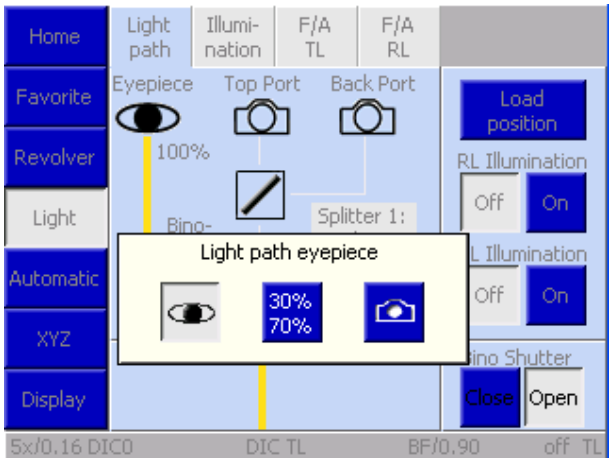


Fig. 113 Light path switch 1 in 2TV tube

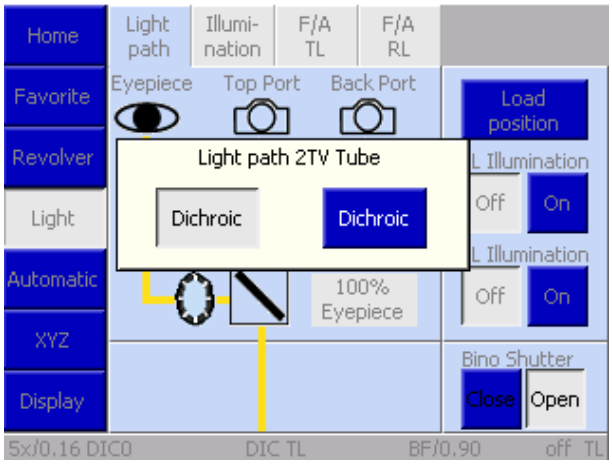
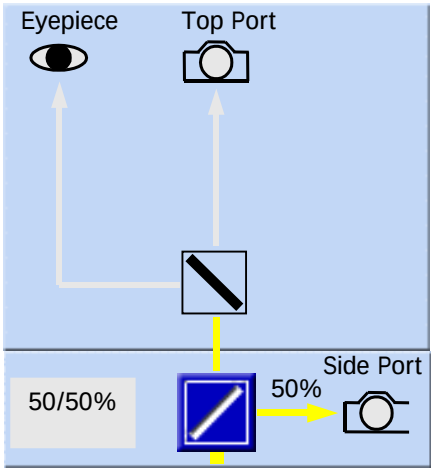
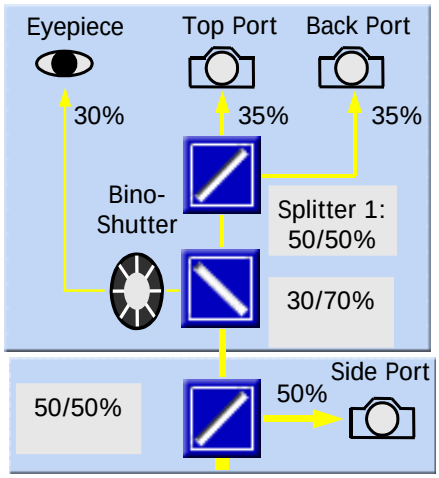


Fig. 114 Light path switch 2 in 2TV tube

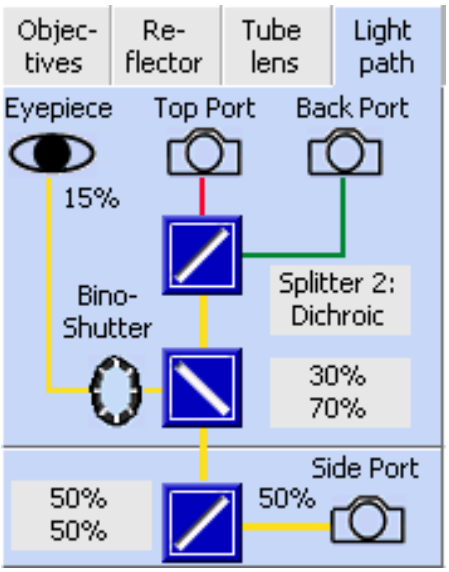
☞ One of the following schematic diagrams, or a similar one, is displayed in the control area to show the light path. The configuration is determined during the microscope initialization process, which is why tube changes must take place while the microscope is switched off.



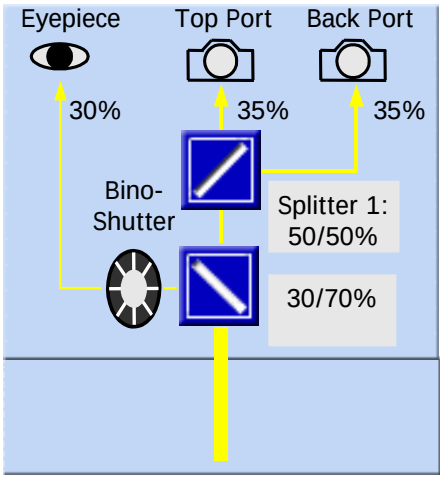
– The motorized camera path deflection is available at the Side Port. The deflection plane mirror is active.
– A manual tube (no 2TV tube, no Bino Shutter (eyepiece shutter)) is installed. The "Eyepiece" mirror is inactive and the light path unknown.



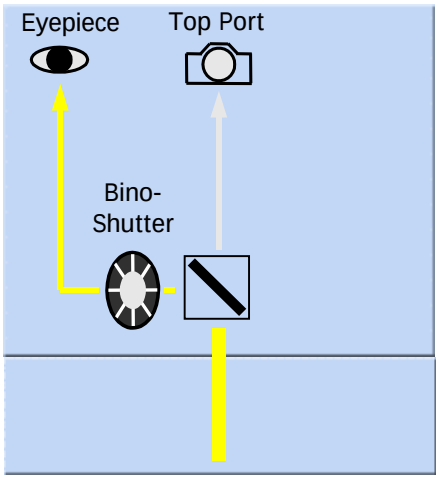
- 2TV tube (Top Port/Back Port) and motorized camera path deflection are installed at the Side Port.
- Three mirrors (deflection plane, eyepieces, Top Port/Back Port) are active.



- 2TV tube (Top Port / Back Port) and motorized camera path deflection are installed at the Side Port.
- Two mirrors (deflection plane, eyepiece, Top Port) and a dichroic beam splitter are active at the Back Port.
- The active light paths are displayed in yellow, inactive light paths appear in extra light gray (line width: 1 pixel).
- The line width for the active light paths depends on the amount of light transmitted in each case:
  - 100 % = 4 pixels
  - 50 % = 3 pixels
  - 25 – 15 % = 2 pixels
  - <15 % = 1 pixel
- If a dichroic beam splitter is used, the light path to the top port is shown in red, while the deflected one appears in green. The line width is reduced by one pixel each time.



- 2TV tube installed. Mirror for eyepieces and Top Port / Back Port installed
- No motorized camera path deflection installed at Side Port.



– Tube with Bino Shutter (eyepiece shutter) installed
– Mirror for deflection to eyepieces is unknown.
– Light path for Top Port is unknown.
– No motorized camera path deflection installed at Side Port.

(2) Illumination tab

The lamp voltage in transmitted and reflected light and the filter wheels can be monitored here. These functions are available only if motorized filter wheels / attenuators are used.

When the internal power supply is configured both in reflected light and transmitted light, only one bar is displayed, which changes accordingly.

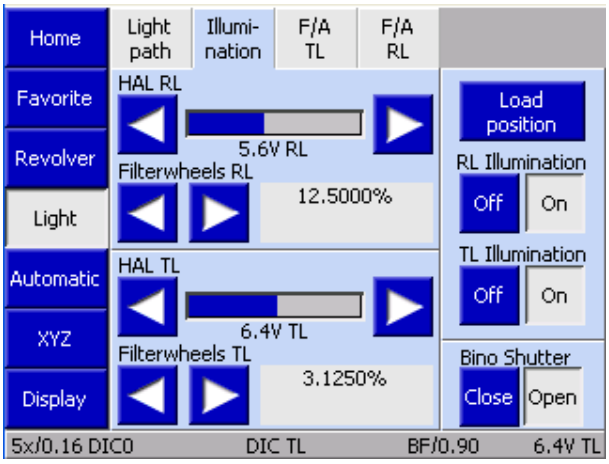


Fig. 115 Microscope -> Light -> Illumination

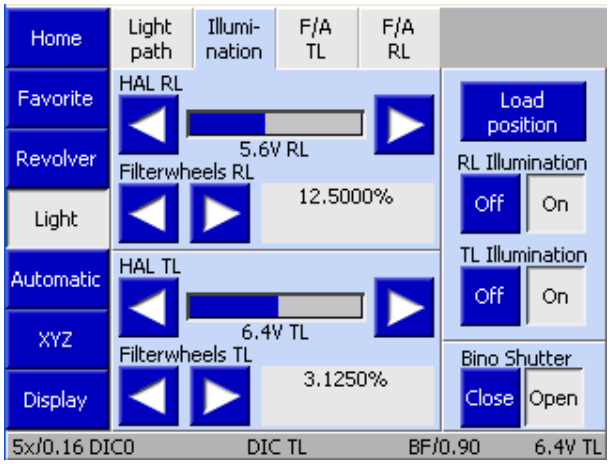


Fig. 116 Use of two power supplies and illuminators

Working with two power supplies and two illuminators:

Second-generation Axio Imagers 2 can be equipped with an additional external CAN bus-enabled power supply. When such a device is detected during the switch-on operation, it will be automatically initialized. To use it, the power supply must be assigned to a light source under: **Settings -> Components -> Miscellaneous -> TL/RL illumination**.

Using two power supplies, two halogen or LED illuminators may be operated in reflected and transmitted light at their full power, completely separately or jointly. The desired illuminator is selected via the **On** or **Off** buttons on the TFT, the light control buttons or, if there is no transmitted light shutter, it can also be selected directly via the incremental encoder of the light control.

Generating mixed light:

To generate mixed light, the two illuminators need to be switched on. The two power supplies are then controlled synchronously. This means that the brightness of the two illuminators is adjusted up and down in parallel, independently of the intensity regulator.

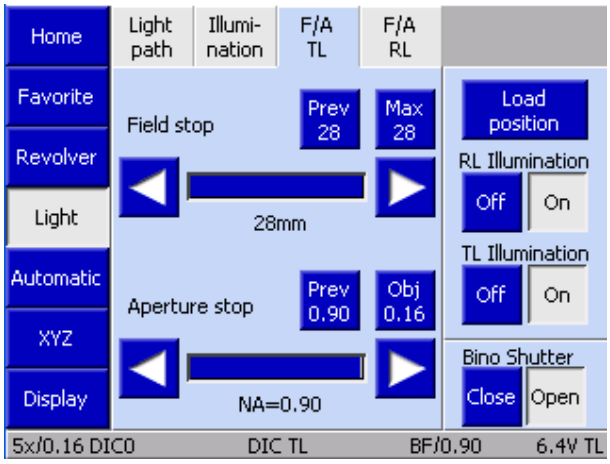


Fig. 117 Microscope -> Light -> F/A TL

(3) F/A TL tab

The luminous-field diaphragm diameter and the aperture diaphragm for the transmitted-light path can be set here.

☞ This function is only available if a motorized field diaphragm or aperture diaphragm is installed.

(4) F/A RL tab

The luminous-field diaphragm diameter and the aperture diaphragm for the reflected-light path can be set here.

☞ This function is only available if a motorized field diaphragm or aperture diaphragm is installed.

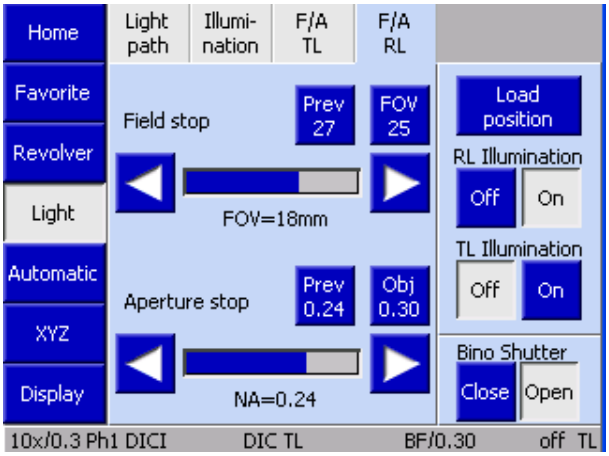


Fig. 118 Microscope -> Light -> F/A RL

☞ The following applies to all diaphragms in reflected and transmitted light:

No configuration of objectives and eyepieces available:
Diaphragm aperture data are unscaled. The values presented are absolute in relation to the physical aperture of the diaphragms.

Configuration of objectives and eyepieces available:
Diaphragm aperture data are presented for the field number of the eyepieces and aperture of the objective used.

Prev (previous) button:
this always shows the value last set.

Max/SF button:
this shows the maximum useful (optically scaled) diameter of the diaphragms.

When one of the two buttons is pressed, the relevant diaphragm is automatically set to the value displayed.

Whenever the light manager is used, the optimum diameter is set automatically. Other values, which may range up to the maximum diaphragm diameter physically attainable, can be set via the arrow buttons.

The last set values are lost when the objective is changed.

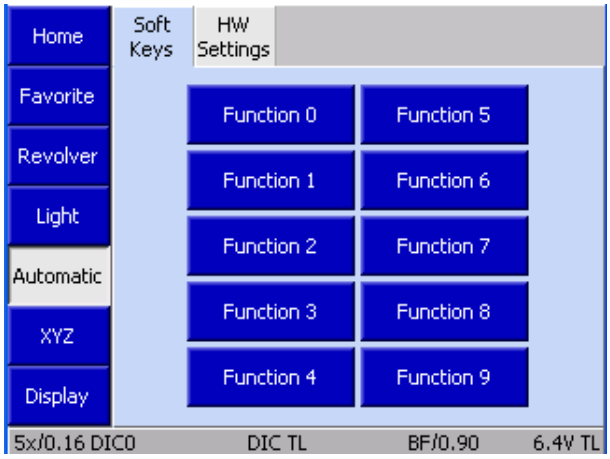


Fig. 119 **Microscope -> Automatic -> Soft Keys**

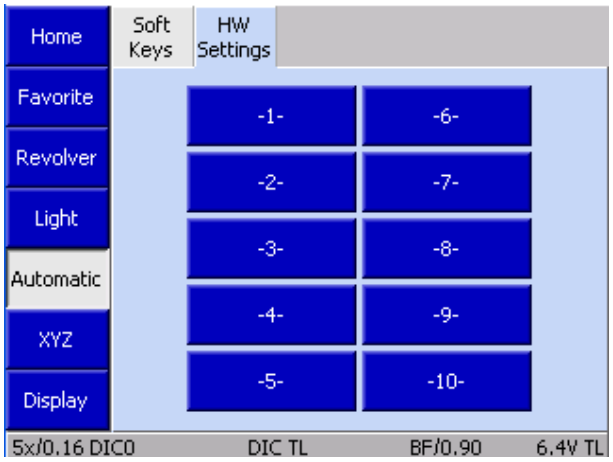


Fig. 120 **Microscope -> Automatic -> HW Settings**

4.8.5.3 Automatic operation page

This menu item contains two tabs:

- **Soft Keys** and
- **HW Settings**

(1) Soft Keys tab

On this page, ten functions or courses of action can be selected by the Axio Vision which may then be called up from here when the program is being run.
These can be simple settings, or a camera snapshot, or even a complex experiment. The selection is made under the **My AxioVision** menu item.

These functions are only active when the AxioVision software is running and connected to the microscope.

(2) HW Settings tab

Hardware settings defined on the microscope can be called up on this page. Complex settings can be saved in an easy and user-specific manner and called up later at the touch of a single button.

For allocation, see also Section 4.8.6.

4.8.5.4 XYZ page

The **Microscope/XYZ** page contains two tabs: **Position** and **Measure**.

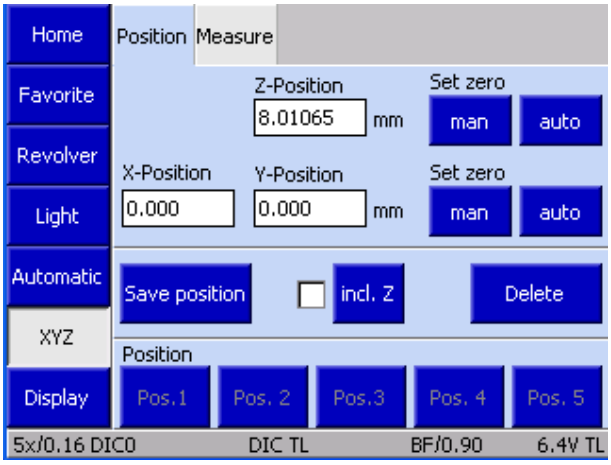


Fig. 121 Microscope -> XYZ

☞ The availability of the **XYZ** page depends on the microscope stage used:

- Motorized stages (only CAN bus stages that are directly connected to stands .M2 / .M2p / .M2m or .Z2 / .Z2m):
  Settings for XY coordinates and Z focusing drive settings possible
- Manual stage:
  Settings for Z focusing drive only possible (no XY controls),
  Measure tab not accessible
- Manual stage / manual Z focusing drive:
  XYZ page is not accessible

☞ During microscope initialization, the system detects whether a stage is installed. Thus, the stage can only be changed with the microscope switched off.

(1) Position tab

The control area under the **Position** tab is subdivided into three functional blocks.

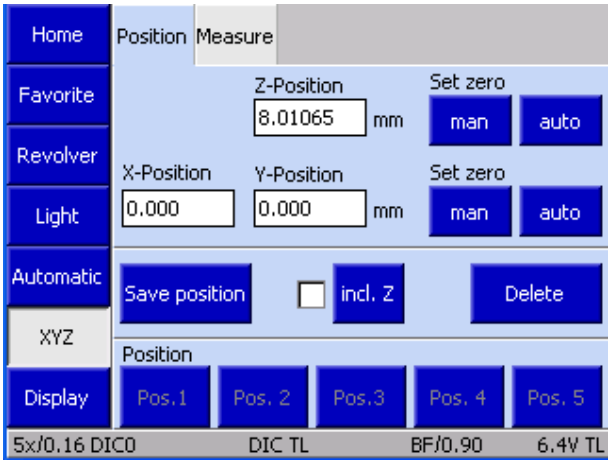


Fig. 122 Microscope -> XYZ -> Position

☞ If no motorized stage is used, the **Start** button is available in place of the XY controls (see (2) Measure) below.

Current position display / Set Zero

Displays the current positions of Z, X and Y in millimeters (mm).

☞ If no motorized Z focusing drive is installed, the Z position is not accessible.

For XY and Z, the two pairs of **Set Zero** buttons function as follows:

man	*Manual* zero setting, i.e. the current position is defined as the zero point and the display set to zero.
auto	*Automatic* zero setting, i.e. the stage moves into the end position that was defined as the zero point. The display is then set to zero.

☞ Before the stage moves into the bottom Z end position, the following popup window appears: "Caution! Remove specimen before stage moves into end position!" Confirm the message with **OK** if no specimen is on the stage, or with **Cancel** to stop stage movement.

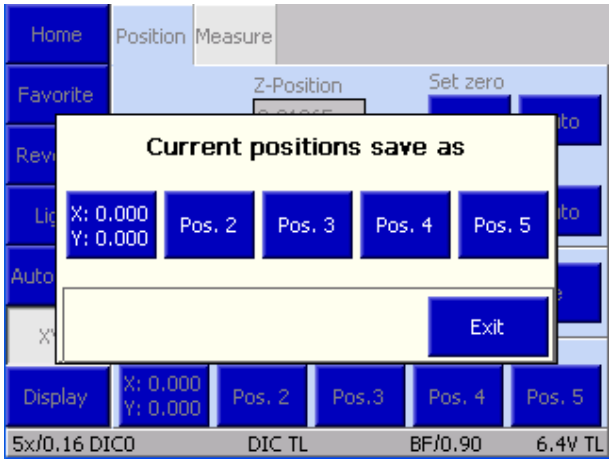


Fig. 123 Microscope -> XYZ-> Save Position

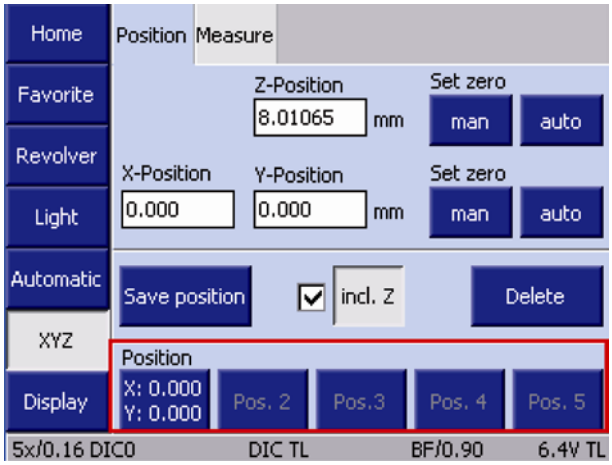


Fig. 124 Microscope -> XYZ -> Move to Position

Save Position

Using the **Save Position** button, the operator can define coordinate positions for the five lower position buttons as follows:

- Move to the desired XYZ position.
- If the Z value is to be stored, activate the **incl. Z** check box.
- Press the **Save Position** button. The **Current positions save as** pop-up window opens (Fig. 123).

There are five buttons, Pos.1 ... Pos.5, in the window. If a button is occupied, the XYZ data appear as labels, otherwise its number is shown.

- Save the current position by pressing a position button. If coordinate data have already been assigned to this button, a safety query appears asking you if you want to overwrite the stored data.
- Close the window using the **Cancel** button.

To delete data, press the **Delete** button, select the position button and confirm the safety query with **Yes**.

☞ The positions will only be saved temporarily, i.e. they will be available only as long as the microscope is switched on.

Moving to saved position

There are five buttons in the bottom **Position** field. Press a button to move to the saved coordinate position. How to save coordinate positions is described above in **Save position**.

(2) Measure tab

☞ This tab is only accessible if you use a motorized (CAN bus) stage. Otherwise, the **Start** button and a display for the Z-distance ΔZ are displayed on the **Position** tab.

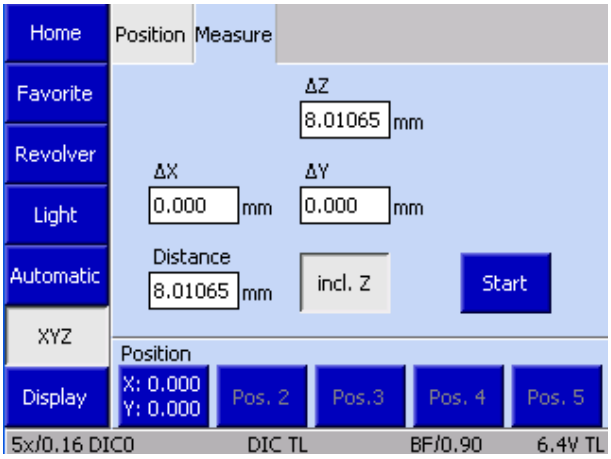


Fig. 125 Microscope -> XYZ-> Measure

Using the controls on the **Measure** tab, the operator can perform simple distance measurements in millimeters (mm). Three options are available for these measurements:

- Distance between two manually set positions
- Distance between a manually set position and a defined position
- Distance between two defined positions

☞ If the Z distance is to be measured, activate the **incl. Z** button.

- Move to initial position.
- Press the **Start** button. The display fields ΔX, ΔY and ΔZ are set to zero.

Every stage movement is shown in the, ΔX, ΔY and ΔZ fields.

The position buttons function as described in **(1) Position tab** above.

4.8.6 Config page

The **Config** page can be accessed from the **Home** page by pressing the **Config** button on the navigation button bar.

The motorized stage is configured in this part of the software.

Some of the information is required for the automatic Light Manager and Contrast Manager functions. This includes configuration of the objectives, eyepieces and the illumination configuration for reflected and transmitted light (see below). This is essential, since other functions (TL / RL switching, the control ranges of the illuminators (HAL, LED and VIS-LED), Light Manager calculation and Contrast Manager) depend on this.

The **Config** page provides access to the following pages: **Components**, **Extras** and **Info**.

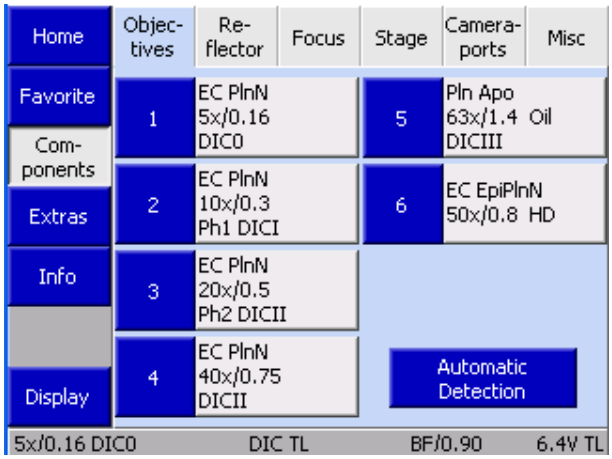


Fig. 126 **Microscope -> Config -> Components -> Objectives**

4.8.6.1 Components page

(1) Objectives

The tab allows the user to configure the objectives.

The tab contains up to seven buttons, depending on the actual number of objective mounts on the nosepiece. Before any objectives have been configured, the buttons are labeled only with the numbers of the nosepiece positions.

After an objective position has been configured, the following data is displayed: Designation of objective, Magnification, Numerical Aperture (NA), Immersion.

- Press the relevant button to configure a turret position.

In the **Configure Objective #** popup window, you can choose among various options:

- **Empty position** button
  Deletes the objective configuration from the current position. Acknowledge the confirmation prompt with **Yes**.
- **Manual** button
  The user must manually enter magnification, numerical aperture (NA) and immersion information. (See Fig. 128)
  To execute the configuration procedure, press the **Save** button. To abort the procedure, press the **Cancel** button.
- **From list** button
  The user chooses a magnification from the **Preselect Magnification** list and an appropriate objective from the **Objective list** (Fig. 129).
  To execute the configuration procedure, press the **Save** button. To abort the procedure, press the **Cancel** button.

  A number of DIC prisms / sliders are allocated to certain objectives which are suitable for differential interference contrast (DIC). This allocation is made when the selection of the objective is acknowledged.

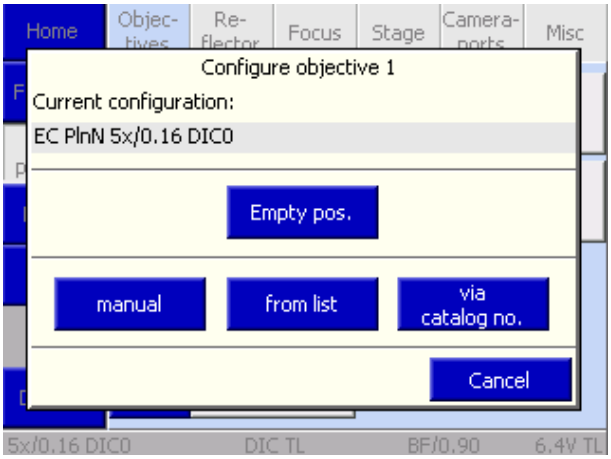


Fig. 127 Config -> Components -> Configure objective

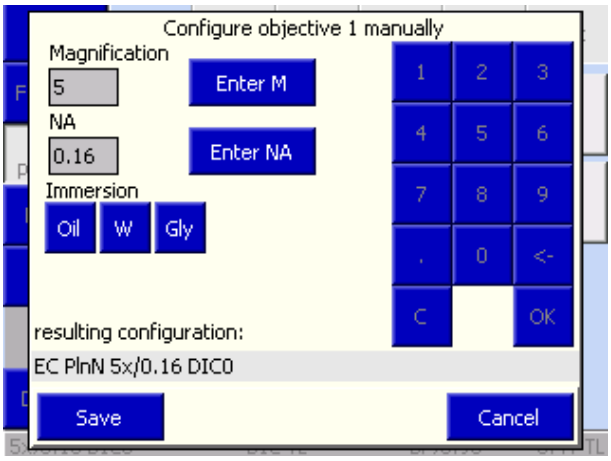


Fig. 128 Configuring objective manually

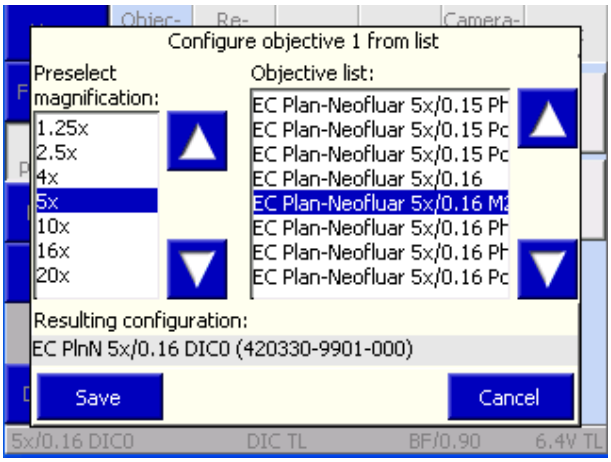


Fig. 129 Configuring of objective from list

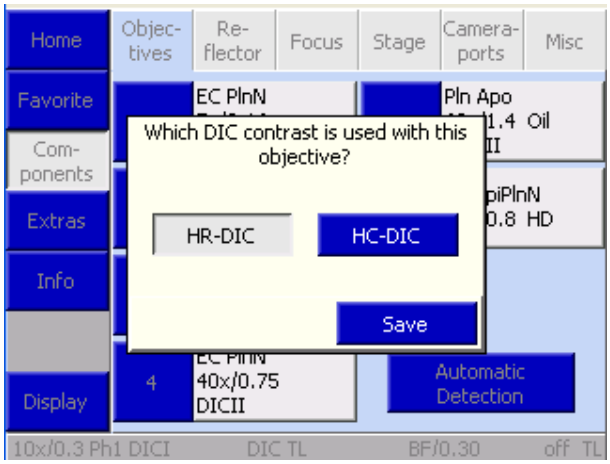


Fig. 130 Allocating the DIC slider

– The DIC slider to be used can be chosen in the following pop-up menu. If a motorized condenser is utilized, the condenser disk will automatically move to the correct condenser position when the contrast method is selected.

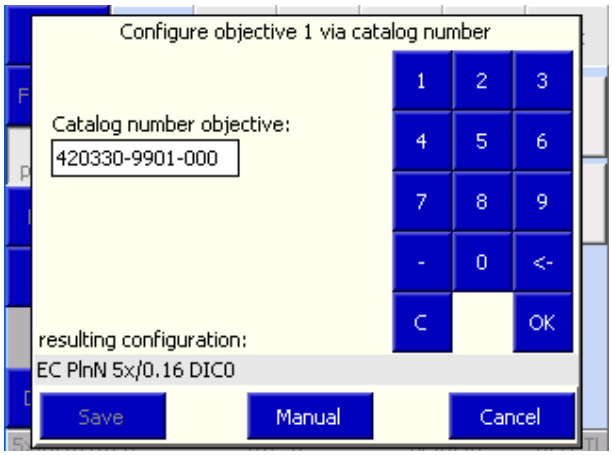


Fig. 131 Configuring the objective via reference number

– **Via Catalog No.** button
The user must enter the Zeiss catalogue number (XXXXXX-XXXX-XXX) to select an objective.
To execute the configuration procedure, press the **Save** button. To abort the procedure, press the **Cancel** button.

☞ When entering the 15-digit Zeiss catalogue no., the prefixed six zeros or the affixed seven zeros should not be entered (after 123456 enter a hyphen (-) or enter 1234-567 and press **OK**). The missing zeros will be added automatically.

If a nosepiece and objectives with automatic component detection have been selected as stand equipment, objective configuration can be triggered by pressing the **Automatic detection** button. The user does not then to make any further manual settings.

☞ Manually edited objective positions will not be overwritten by Automatic Component Detection. They must be entered manually as empty positions beforehand.

☞ Once a new objective has been allocated, the relevant objective button on the **Microscope turrets** page will show the magnification and immersion data of that objective.

(2) Reflector tab

Use the controls on this tab to configure the reflector turret.

The tab shows up to ten buttons, depending on the actual number of objective mounts on the nosepiece. The number of turret positions is detected by the system during initialization (and on activation of the **Settings-Components** page).

Before any reflectors have been configured, the buttons are labeled only with the numbers of the turret positions.

After a reflector position has been allocated, the following data is displayed: Designation (Type), Reflected-light module (RL), Transmitted-light position / module (TL).

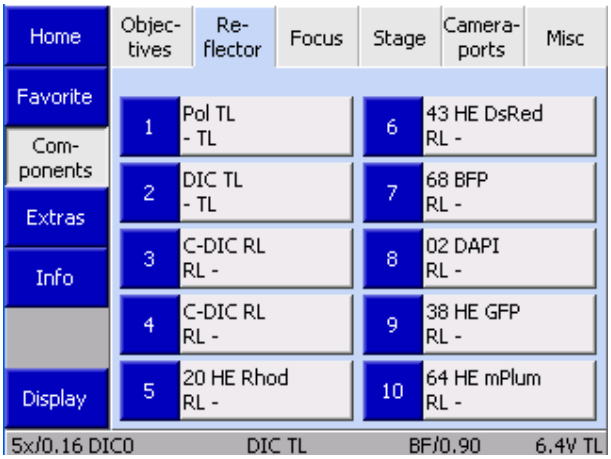


Fig. 132 **Microscope -> Config -> Components -> Reflector**

- Press the relevant button to configure a turret position.
- Choose the respective reflector from the list in the **Configure reflector position #** popup window. The current selection is displayed in the **Resulting Configuration** line.
- Press the button for **RL** and/or **TL**, as appropriate.
- Press the **Save** button.
  If the turret position has already been configured, a confirmation prompt will appear.

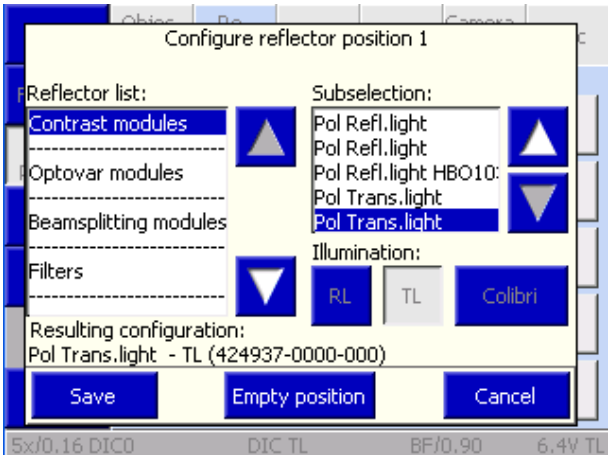


Fig. 133 **Configuring the reflector position**

The type of module can first be selected from the reflector list:

- Contrast module
- Optovar
- Beam splitter
- Filter
- Fluorescence filter set

Under **Contrast modules** and **Optovars**, the selection can subsequently be specified via the subselection options provided on the right-hand side.

The same applies for **Beam splitter**. Please note that additional laser safety functions are activated when LSM components are selected. For more details, see the LSM Operator Instructions.

Empty modules and RGB modules can be found in the **Filter** list. RGB filters are used, for example, when color images are to be generated with a monochrome camera via the multi-channel image recording module within the Axio Vision software. This option is used exclusively in transmitted light.

Only dyes may be selected instead of fluorescence filter sets. In this case, the user chooses the relevant dye from the subselection options listed.

Fluorescence filter sets can be selected by their numbers. Additionally, a suitable dye may be picked for each filter set from the submenu.

☞ Once a new reflector has been allocated, the relevant reflector button on the **Microscope operation** page will show the corresponding information.

☞ Further information about the programming of rewritable ACR reflector modules can be found in Section 4.11 on page 157.

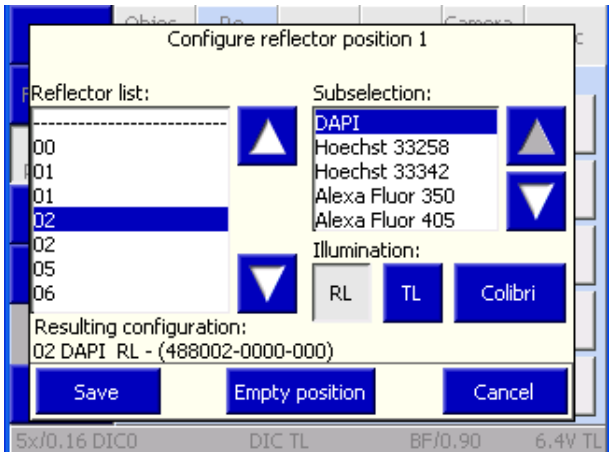


Fig. 134 Configuring the reflector position using Colibri

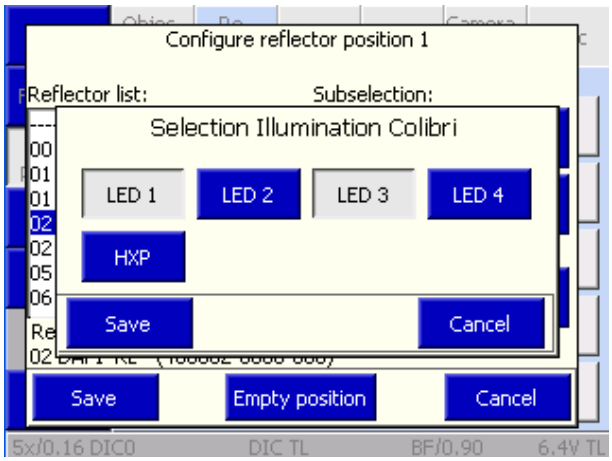


Fig. 135 Selecting Colibri / HXP 120 illumination

Configuring a reflector position, using Colibri as a source of illumination

Once Colibri has been recognized and configured as a source of illumination, an appropriate LED can be selected for each filter set or dye.

- Press the **Colibri** button.
- In the following pop-up menu (Fig. 135) select one or more LEDs to match the selected reflector position.
  Alternatively, an optional white-light source (HXP 120) can also be selected. Note that LED and HXP cannot be chosen at the same time.
- Acknowledge the selection procedure by pressing **Save** or press **Cancel** to discard the selection.
- Acknowledge the selection procedure a second time by pressing **Save** or press **Cancel** to discard the selection.
- Acknowledge the confirmation prompt with **OK**.

- If a lamp-switching mirror is employed in the reflected-light path, the **Lamp port** to be used needs to be allocated to that mirror in the last configuration step.
- Press the **Save** button to acknowledge the selection made.

☞ If the contrast manager is activated, the relevant Colibri LEDs will then be switched on when this reflector position is selected.

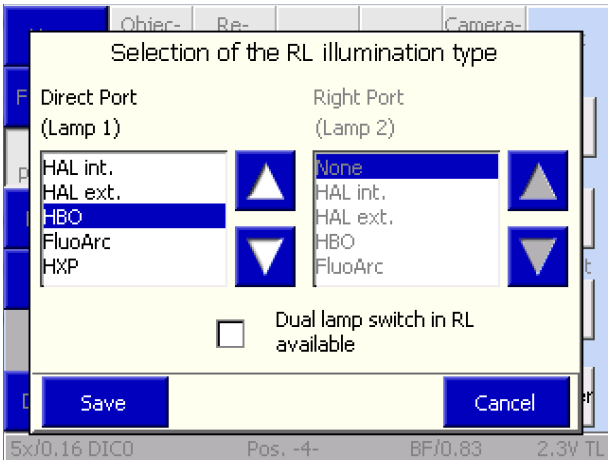


Fig. 136 Allocating the lamp port

(3) Focus tab

On this tab, you can enter the firmware settings for the focusing drive. The speed of the focusing drive can be individually adjusted for every objective.

Furthermore, **parfocality**, **linear sensor focus**, **stage lowering** and **electronic limit switches** can also be set on this tab.

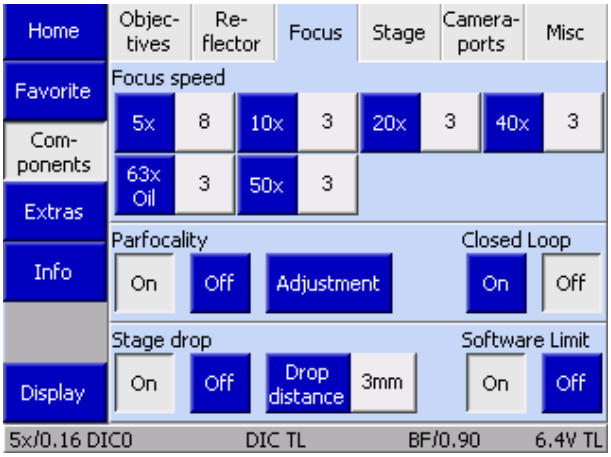


Fig. 137 Microscope -> Config -> Components -> Focus

Focus Speed

The tab contains up to seven buttons, depending on the actual number of objective mounts on the nosepiece. The number of turret positions is detected by the system during initialization (and on activation of the **Settings-Components** page). Before any objectives have been configured, the buttons are labeled only with the numbers of the nosepiece positions.
After an objective is assigned to a specific button, the magnification appears on the left (blue) half of the button. The right (gray) half of the button contains the focusing speed.

- To change the focusing speed for an objective, press the respective gray part of the button.
- Set the desired speed in the **Focus Speed for Objective #** popup window using the ◄► buttons. The higher the numerical value, the higher the focus speed in the selected magnification.
- Press the Save button.

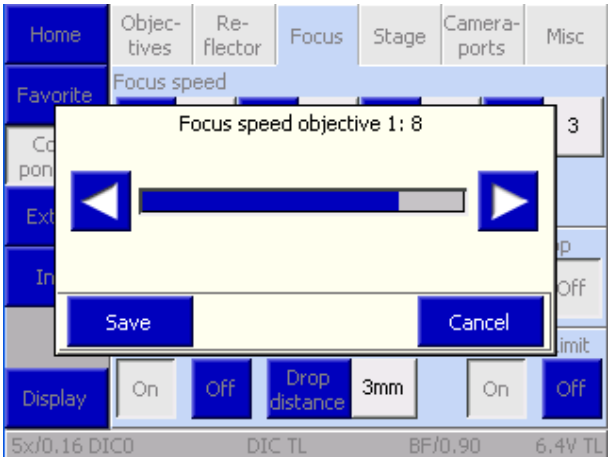


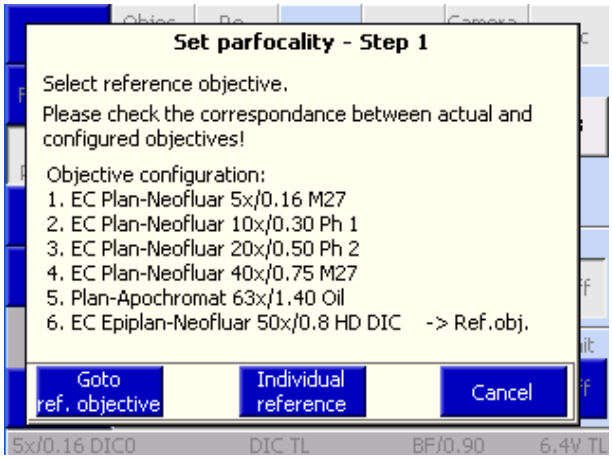
Fig. 138 Setting the focusing speed

Parfocality

In this section so-called parfocality alignment can be carried out for the objectives configured in the objective nosepiece. The purpose of this function is to detect mechanical and optical tolerances between the objective nosepiece and objectives in the Z-axis for each position, and to compensate these reciprocally.

All IC2S objectives are aligned to a common parfocal length of 45 mm. Dependent upon the different depths of the different objective magnifications and the mechanical tolerances of the objective nosepiece in combination with the objective, the image may appear blurry when changing from one magnification level to the next. Use the motorized focus drive to align and save the tolerances between all objectives.

The parfocality function is activated and deactivated using the **On** and **Off** buttons. Stored values remain in the memory of the device after deactivation.



Use the **Adjustment** button to start the parfocality alignment. On pressing this button, a wizard appears to guide you through the procedure.

If a motorized mechanical stage or scanning stage is connected to the microscope via CAN bus, a so-called parcentricity alignment is also carried out using the wizard. Here the tolerances in the x and y coordinates of the individual objectives are compensated and saved in a similar way to that described above.

Fig. 139 Setting parfocality

☞ During simultaneous adjustment of focus and centricity, ensure that the axial position of the specimen is not inadvertently changed because otherwise this value is saved as x / y offset between two objectives. The parcentricity alignment is described in the section on the **(4) Stage** tab.

All objectives must be focused successively. Start with all dry objectives, from the highest to the lowest magnification. Then, proceed with all immersion objectives from the highest to the lowest magnification. Press the **Next Objective** button to rotate the nosepiece to the next objective. After all objectives have been focused, press the **End** button.

☞ If no TFT is installed (Axio Imager M2p), parfocality may also be adjusted manually. For this to be possible, the objectives must have been successfully configured with the aid of the MTB 2011 configuration program. Perform this as follows:

- Activate programming mode by keeping the **LM Set** button depressed for a while (> 3 s - acknowledged by a prolonged double beep). When programming mode is active, every second LED on the LED bar graph is lit. To start parfocality adjustment, press the **RL** button on the light control.
- Turn in the reference objective. This is usually the objective with the highest magnification and air immersion. The position to be moved to on coded objective nosepieces is displayed on the LED bar graph. However, if a motorized objective nosepiece is used, this is swiveled in automatically.
- Focus on the specimen and then press one of the middle buttons on the control ring on the stand.
- Change to the next displayed magnification. This happens automatically if a motorized nosepiece is used.
- Repeat steps 3 and 4 until all the objectives have been adjusted. A tone will sound as acknowledgment.
- Complete the procedure by pressing the LM Set button again. (Acknowledgment by a single long prolonged beep. Bar graph LED returns to standard display.)

Closed Loop

In the Axio Imager .Z2 / m, a focus linear sensor can be used for position monitoring of the focusing drive. If present, this can be switched on and off.

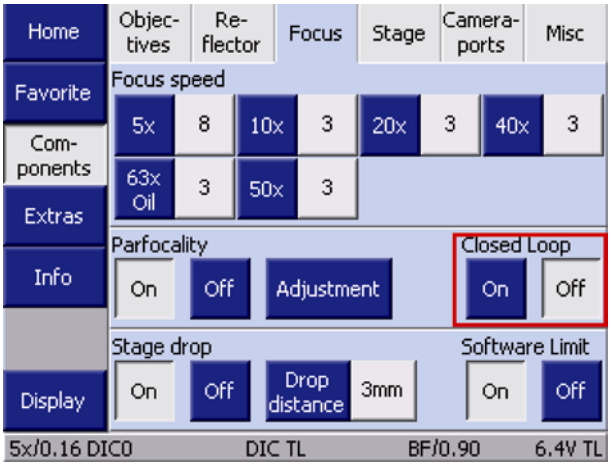


Fig. 140 Closed Loop

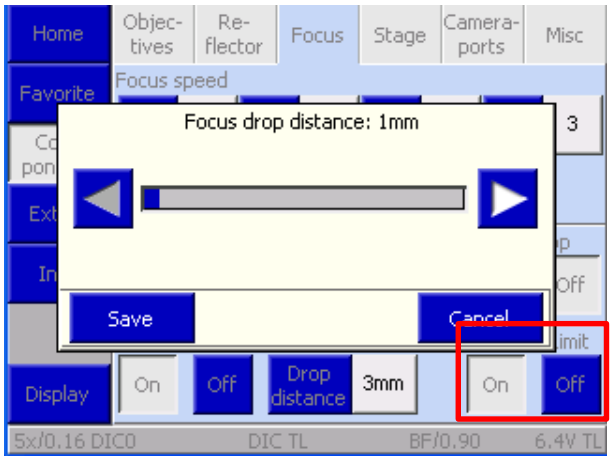


Fig. 141 Stage lowering

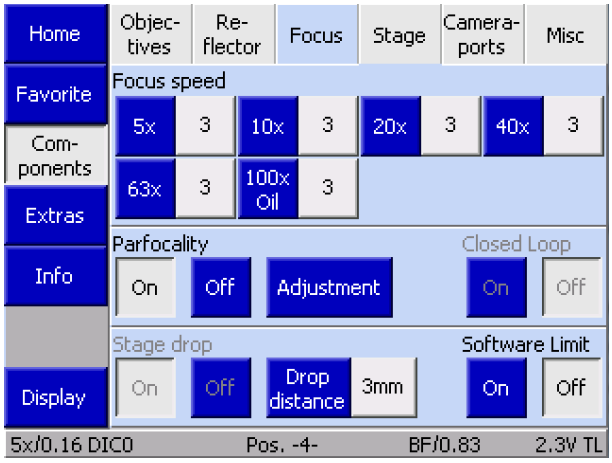


Fig. 142 Focus delimiter

Stage lowering

The stage lowering function is activated or deactivated using the **On** and **Off** buttons.

The lowering depth can be set in 1 mm steps using the ◄► buttons in a range of values between 1 mm and 20 mm. To run the configuration procedure, press the **Save** button. To abort the procedure, press the **Cancel** button.

Software limit (Focus delimiter)

The motorized stands of the second generation Axio Imager 2 are equipped with a software focus limiter which can be set by users. They can be globally switched **On** or **Off** here.

Once the software limit function is active, the focus delimiter can also be set and altered using the Work / Load buttons on the stand.

– To set the focus limit:
  Keep the upper button depressed for more than 3 seconds. (A beep will sound as acknowledgment.)

– To shift the focus limit:
  Keep the upper button depressed for more than 3 seconds (a beep will sound as acknowledgment) while moving the focus to the new position. When the button is released, the current focus position will be saved and acknowledged by a message appearing on the TFT.

– To delete the focus limit:
  Press the **Off** button on the TFT.

(4) Stage tab

If a motorized microscope stage (equipped with a CAN bus controller) is used, this tab will be displayed. Once an objective has been configured, the stage is assigned a defined travel speed for the objective position concerned.

Pressing one of the position buttons allows the travel speed of the motorized stage to be adapted to the individual objective magnification using the ◄► buttons.

Use the **Stage in load position** function to activate or deactivate the XY stage movement for the load position / operating position. This has an effect on the functionality of the **Load position** button available on the **Microscope operation** page.
When the function is activated, the focusing drive will first move into the load position. The stage subsequently travels forward toward the user. This allows the specimen to be changed easily.

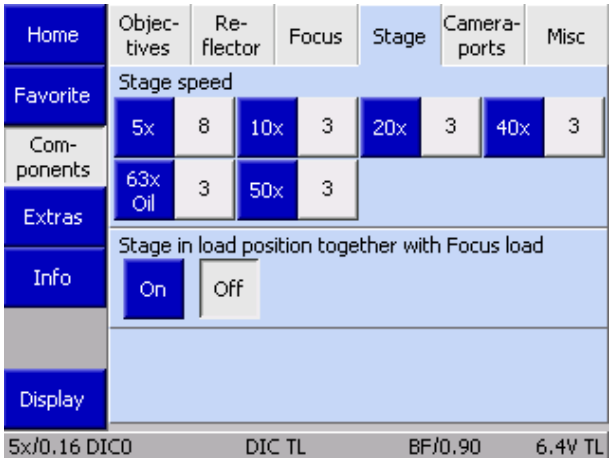


Fig. 143 Microscope -> Config -> Components -> Stage

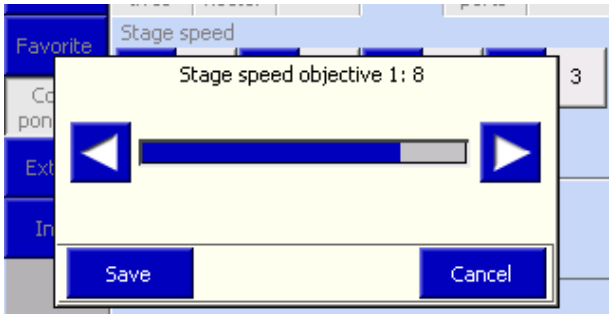


Fig. 144 Setting the stage speed

Parcentricity

In this section a so-called parcentricity alignment can be carried out for the objectives configured in the objective nosepiece. The purpose of this function is to detect mechanical and optical tolerances between the objective nosepiece and objectives in the Z and Y axis for each position of the objective nosepiece, and to offer these as a compensatory offset during objective changes. For this, a reference point is positioned centrally in the field of view for each objective.

For this function to be used effectively, a reticle must be inserted in an eyepiece. This crossline is overlaid with the reference point in the specimen. If a camera is used, it is also recommended to use an adjustable camera adapter. In the live image of the software, the middle of the live image can now be superimposed on the reference point of the specimen by adjusting the camera adapter.

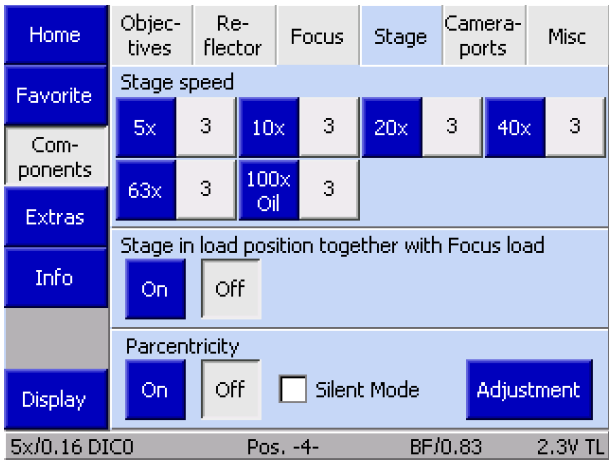


Fig. 145 Parcentricity

The parcentricity function is activated or deactivated by means of the **On** and **Off** buttons. Stored values remain in the memory of the device after deactivation. When active, this function ensures that the same spot always appears in the center of the field of view when changing objectives.

Use the **Adjustment** button to set up the parcentricity alignment. On pressing this button, a wizard appears to guide you through the procedure. During the parcentricity alignment a parfocality alignment is also always performed. Therefore, it is important that the reference point is always focused on regardless of the magnification.

After the alignment, the functionality must be activated by pressing the **On** button.

The **Silent Mode** function is used to display (check box activated) or not to display (check box deactivated) the offset in x and y coordinates when changing objectives.

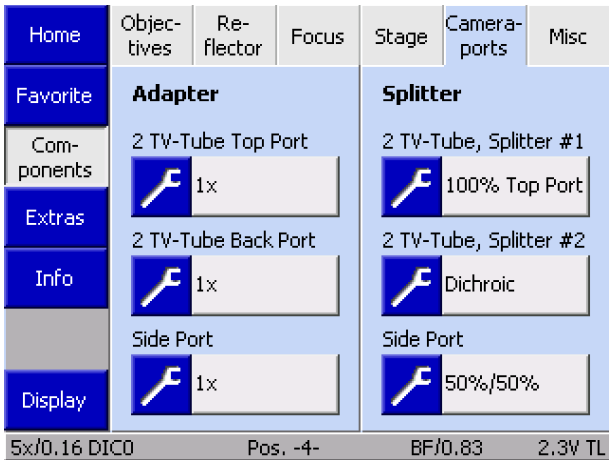


Fig. 146 **Microscope -> Config -> Components -> Camera ports**

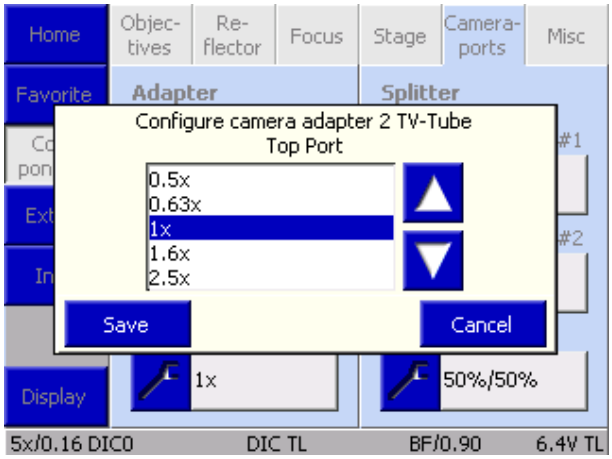


Fig. 147 **Selecting the camera adapter**

(5) Camera ports tab

This tab allows you to configure the adapters and beam splitters (beam-splitting mirrors / reflecting mirrors) for the camera ports (Top Port / Back Port / Side Port).

☞ Before attaching/removing the camera path deflection, left (Side Port) or before any tube change, switch off the microscope to ensure that the system detects the correct port status during the next initialization process.

Adapter

Up to three buttons are displayed here depending on the equipment of the camera path deflection and the tube used. The status of the ports is detected by the system during initialization (and on opening the **Settings - Components** page).

- To assign an adapter to a button, press the gray button.
  The **Configure Camera Adapter** (Fig. 147) list opens.
- Choose the appropriate adapter from the list using the ▲ ▼ buttons.
- Press the **Save** button to assign the selected adapter to the port. Press the **Cancel** button to close the window without any selection.

The button is now labeled with the magnification factor. Proceed in the same way for the other ports.

Splitter

Up to three buttons are displayed here depending on the equipment of the camera path deflection and the tube used. The status of the ports is detected by the system during initialization (and on opening the **Settings - Components** page).

- To select a splitting ratio, press the gray button.

  This will bring up the **Select Splitting Ratio** list.
- Press the buttons for the desired splitting ratio; multiple selections are possible.
- Press the **Save** button to store the selected splitting ratio. Press the **Cancel** button to close the window without any selection.

The button is now labeled with the splitting ratio. Proceed in the same way for the other ports.

☞ The configured splitting ratios will then be offered for selection on the **Light Path** tab of the **Microscope - Operation** page.

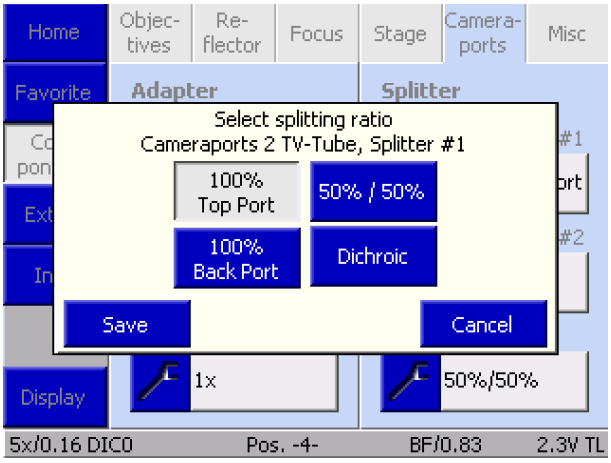


Fig. 148 Selecting splitting ratio - Splitter 1

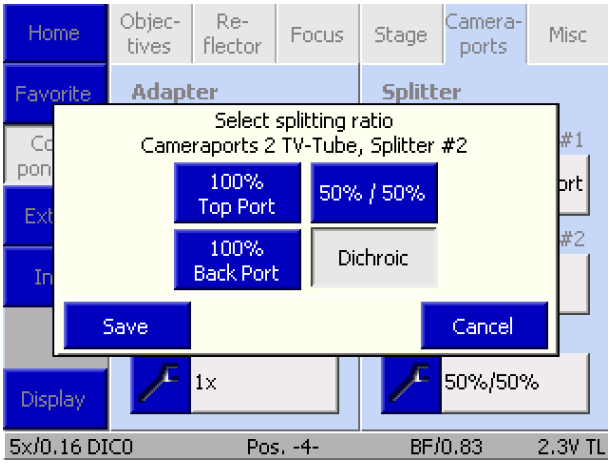


Fig. 149 Selecting splitting ratio - Splitter 2

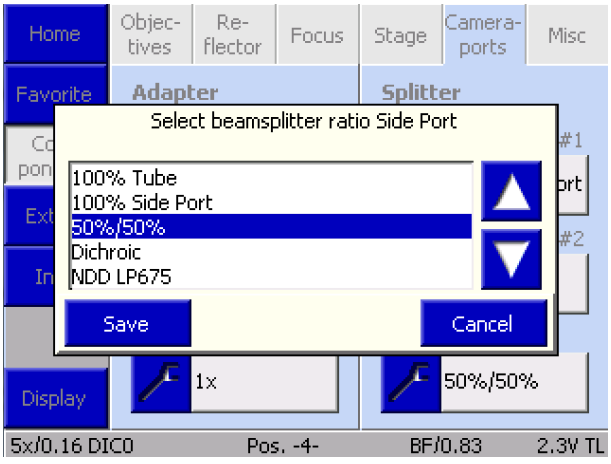


Fig. 150 Selecting splitting ratio - Side Port

Possible ratios:

- 100 % tube
- 100 % side port
- 50 % / 50 %
- Dichroic
- NDD LP675
- NDD LP745
- *NDD_MP690P*
- *NDD_MP760P*

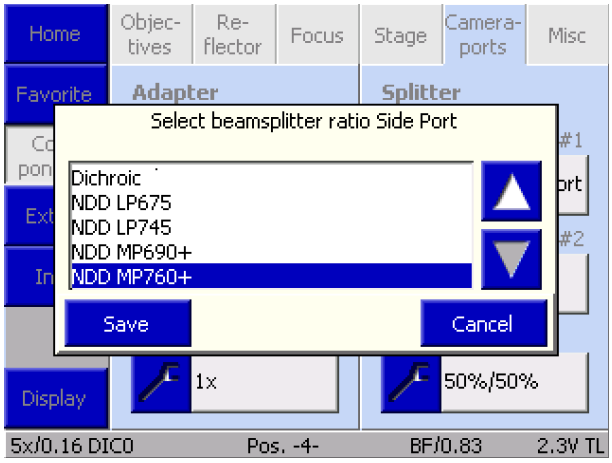


Fig. 151 Select splitting ratio - Splitter decflection plane - cont.

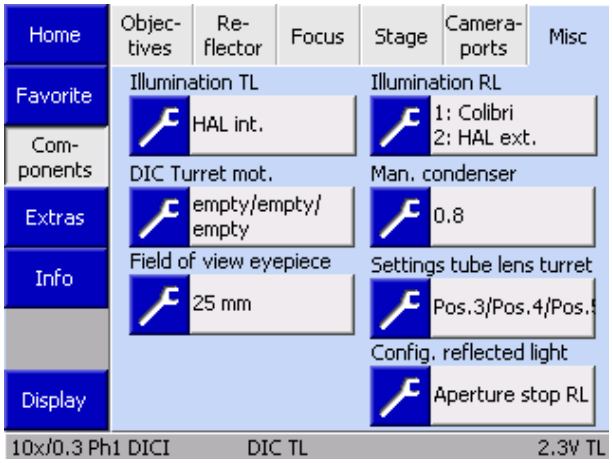


Fig. 152 Microscope -> Config -> Components -> Misc(ellaneous)

(6) Miscellaneous tab

This tab is used to configure other optional components of transmitted-light and reflected-light illumination.

- Illumination TL
- Illumination RL
- Motorized DIC turret
- Manual condenser
- Field of view of eyepieces
- Tube lens turret
- Reflected-light configuration

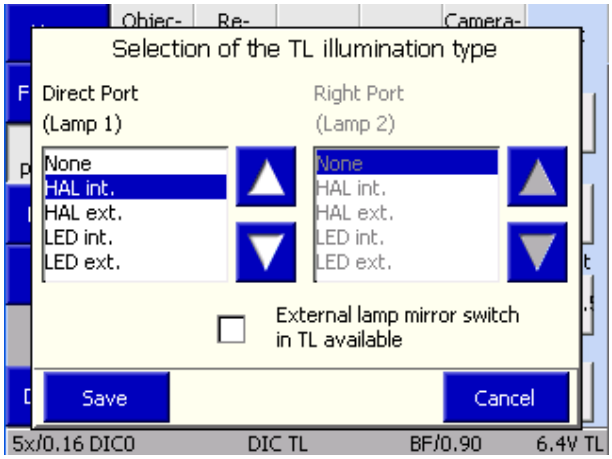


Fig. 153 TL illumination

Illumination TL

The light source to be employed for transmitted light must be specified here. An optional switching mirror for two illuminators may also be used. The appropriate check box must be ticked for this.

Illumination RL

The light source to be employed for reflected light must be indicated here.

If a switching mirror for two illuminators is used, it will appear in this configuration menu following successful initialization. It is operated either via the function buttons (for allocation, see below), or the function is automatically linked with the selection of an allocated reflector module. This means that the user does not have to consider any additional components.

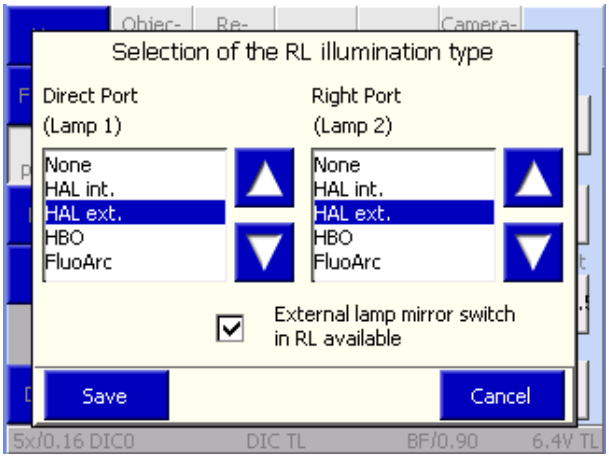


Fig. 154 RL illumination

Sources of illumination:

- None
- HAL int.
- HAL ext.
- HBO
- FluoArc
- HXP
- Colibri
- LED int.
- LED ext.
- VisLED int.
- VisLED ext.

The "internal" or "external" suffix denotes that the component is connected either to the power supply incorporated in the stand or to an external CAN bus power supply connected to the stand via CAN bus.

Only different types of lamps can be configured. An error message will appear in the event of dual allocation.

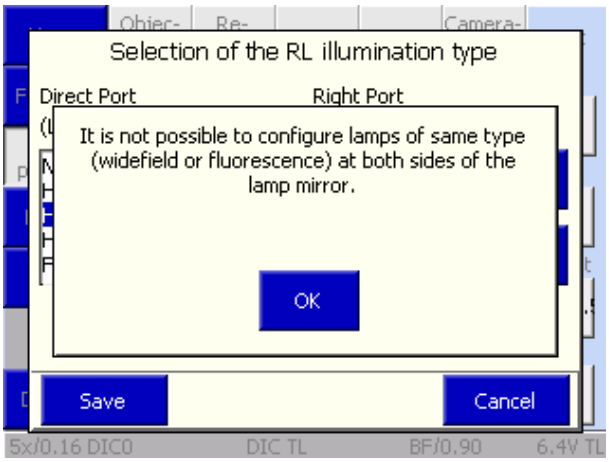


Fig. 155 RL illumination error message

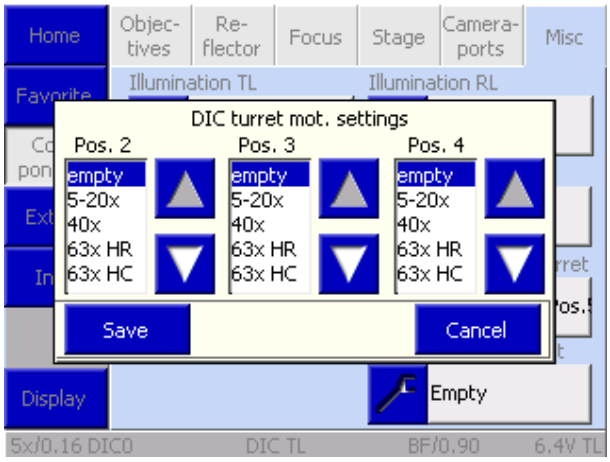


Fig.156 DIC turret mot.

Motorized DIC turret

Modulator turret allocation for transmitted-light DIC. This is where the user selects the appropriate DIC prisms for turret positions 2, 3 and 4. **Important:** The contrast manager can only adjust the DIC contrast correctly if the analyzer module specified for the motorized DIC turret has been selected in the reflector turret.

☞ Motorized C-DIC modulator turret for material:
No settings are to be made here, as the positions for C-DIC, TIC and brightfield are always fixed.

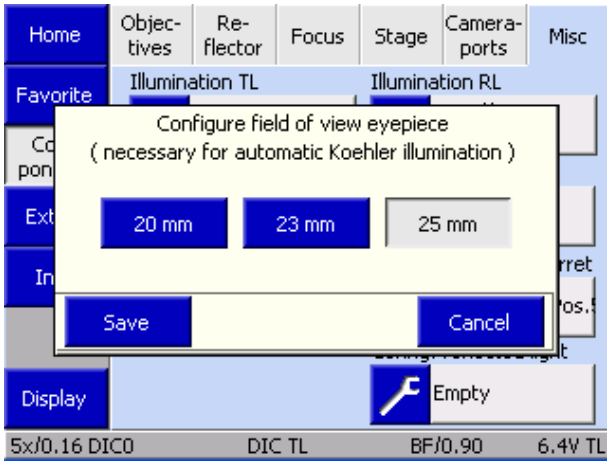


Fig. 157 Field of view of eyepieces

Field of view of eyepieces

The user chooses the eyepieces to be employed in the **Field of view eyepiece selection** pop-up window.

This is an important setting, as the correct scaling of the aperture of the motorized stop slider depends on this information.

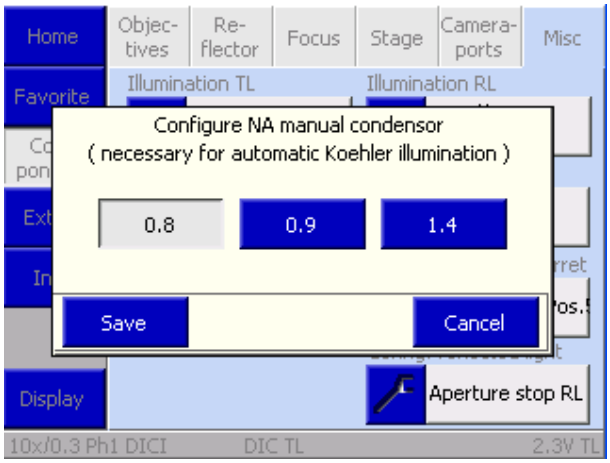


Fig.158 Mounted condenser

Manual condenser

If you use a manual condenser but a motorized luminous-field diaphragm, you should enter the condenser aperture here. This is necessary, as the light manager automatically adapts the luminous-field diaphragm to the field of view of the eyepieces, and the various condensers have different magnification factors.

☞ With the second-generation Axio Imager 2, it is possible to configure a number of positions for the motorized condenser. This is carried out in the MTB 2011 configuration program, and the configuration is then written directly into the condenser. The following options are available:

- Plate – Serves as a shutter if there is no shutter in the transmitted-light path and an LED light source is used on the lamp socket or if an LED light source is mounted directly beneath the condenser.
- Polarizer
- DIC prisms

Any condenser configured by the user in this way is fully integrated in the light and contrast manager. This means the following:

- Plate: If the contrast manager is used, any front lens is swiveled out as soon as the fluorescence function is selected, and the plate moved into the transmitted-light path.
- Polarizer: If the POL contrast is selected in transmitted light, the polarizer is automatically moved into the light path.
- DIC prisms: The correct DIC prism is swiveled in for the chosen objective.

Tube lens turret

The **Tube lens turret settings** selection list allows the user to choose the appropriate magnification factor for turret positions 2, 3 and 4.

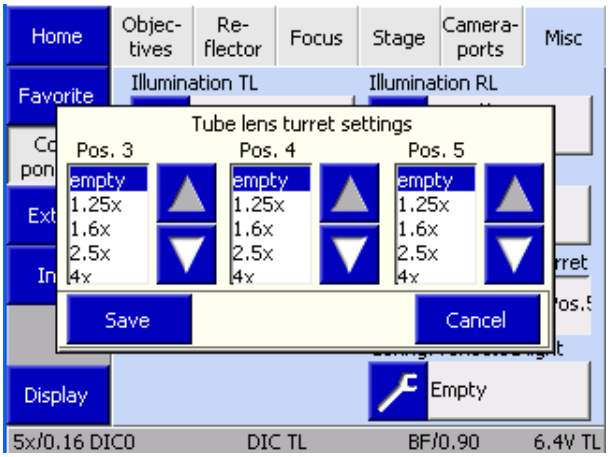


Fig. 159 Tube lens turret

Reflected-light configuration

Whenever a motorized stop slider or an attenuator is used in reflected light, the component in question needs to be specified here. The settings are transferred by restarting the instrument.

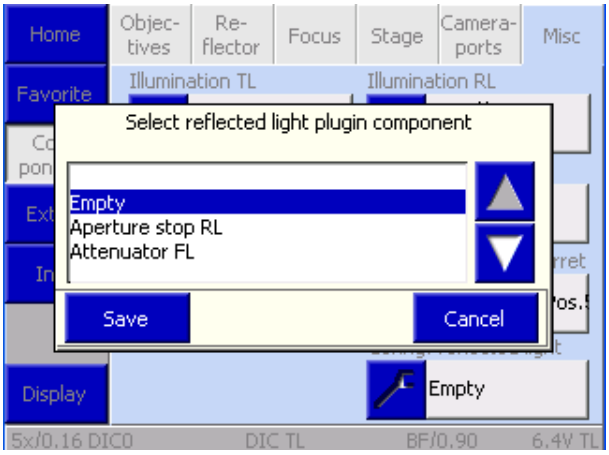


Fig. 160 Reflected-light configuration

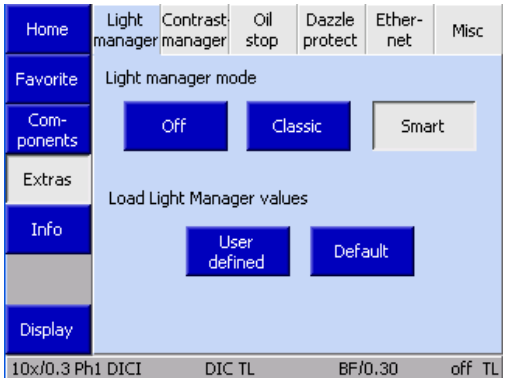


Fig. 161 **Microscope -> Config -> Extras -> Light manager**

4.8.6.2 Extras page

From the Extras page you can access the Light manager, Contrast manager, Oil stop, Dazzle protection, Ethernet and Miscellaneous tabs.

(1) Light manager tab

This tab allows the user to switch the light manager on and off.

The light manager automatically adjusts the light intensity. For its uses, see Section 4.6.

Buttons beneath **Load light manager values**:

The **User-defined** button loads the values last saved via the **LM set** button.

Pressing the **Default** button restores the factory settings.

☞ New transmitted light and reflected light filter set combinations (neutral-density, color and neutral-density filters) are offered for second-generation Axio Imager 2 units. These filters are fully integrated into the light manager functions. For the sake of clarity, the MTB 2011 configuration program writes those filters directly into the filter wheel, without the user having to do so through the TFT. This is also an ACR-enabled component. This means that any equipment mounted on it is automatically read out by the microscope during initialization. For this reason, a filter wheel of this type can be installed on every stand without having to be reconfigured.

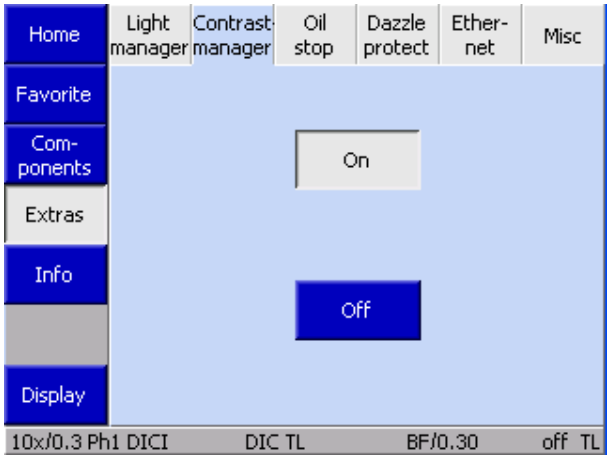


Fig. 162 **Microscope -> Config -> Extras -> Contrast manager**

(2) Contrast manager tab

This tab switches the contrast manager globally **ON** and **OFF**. The contrast manager can be switched off here if contrast-related motorized components are not to be moved.

(3) Oil stop tab

This tab allows the user to switch the oil stop on and off. This function prevents a dry objective from being swiveled into immersion liquid by lowering the stage whenever you switch from an immersion to a dry objective.

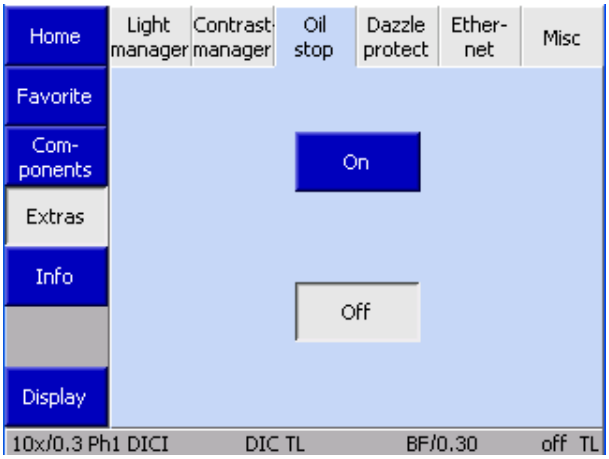


Fig. 163 Microscope -> Config -> Extras -> Oil stop

(4) Dazzle protection tab

If the Dazzle Protection function is globally deactivated, all other options on this tab are grayed out.

If a Bino Shutter is installed and dazzle protection has been activated, the two other dazzle protection fields (TL/RL) are inactive. Dazzle protection is, therefore, deactivated through these components.

If one of the above components is not installed, the corresponding buttons are not available.

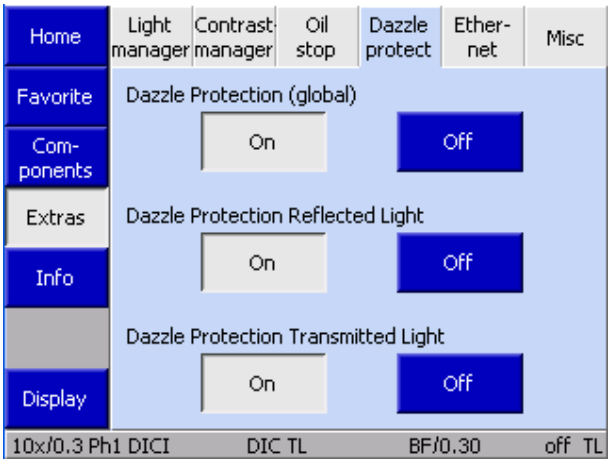


Fig. 164 Microscope -> Config -> Extras -> Dazzle protection

(5) Ethernet

This tab is used to choose settings for connecting the Axio Imager via Ethernet.

A manually entered IP address will only be accepted if acknowledged with **OK**.

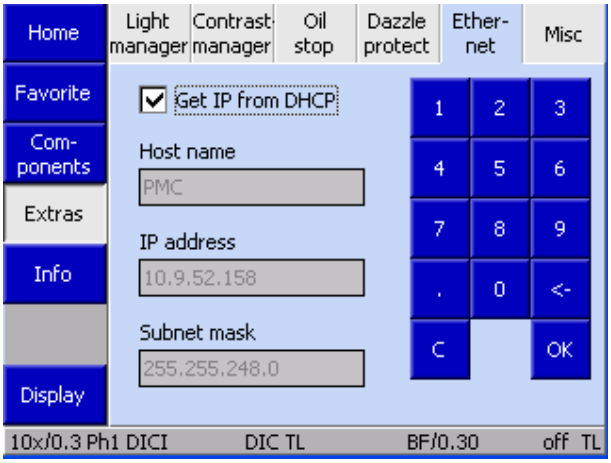


Fig. 165 Microscope -> Config -> Extras -> Ethernet

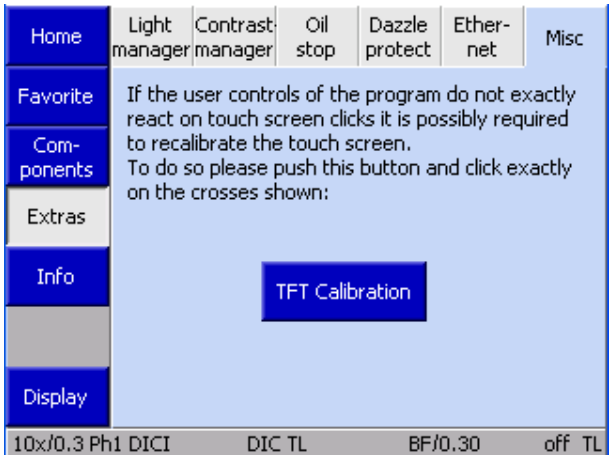


Fig. 166 Microscope -> Config -> Extras -> Misc(ellaneous)

(6) Miscellaneous

This tab is used to calibrate the TFT display.

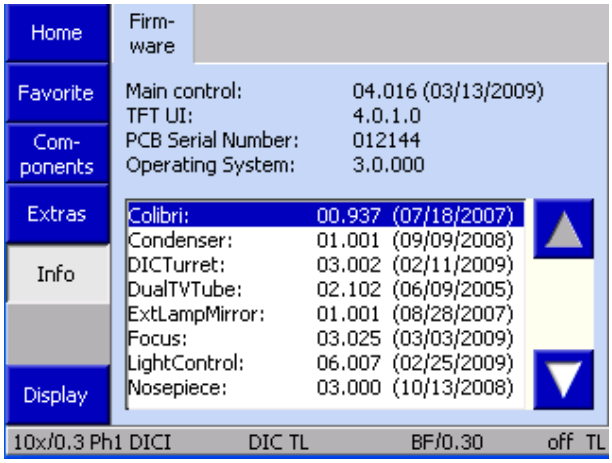


Fig. 167 Microscope -> Config -> Info -> Firmware

4.8.6.3 Info page

The **Info** page only contains the **Firmware** tab

This tab allows the user to identify the firmware version.

4.8.7 User page

The user can access three other pages from this one:

- **User selection**
- **User configuration**
- **Admin**

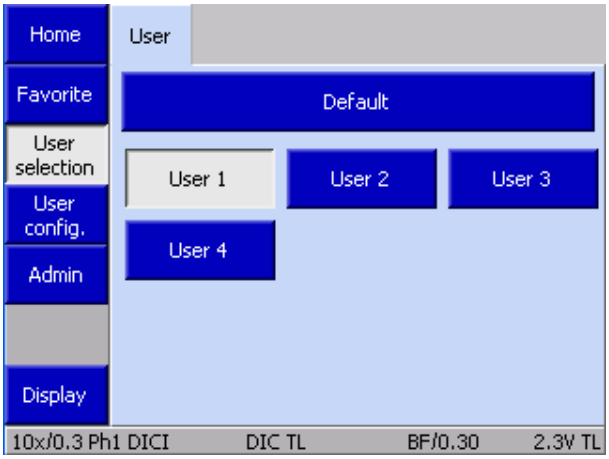


Fig. 168 Microscope -> User -> User selection

4.8.7.1 User selection page

The **User selection** page contains a tab for selecting a previously created and configured user.

A default user may also be chosen. This user contains the standard assignment of the buttons located on the instrument and the docking station, based on an automatic assignment plan. Hardware settings may be assigned. These are retained after switch-off. Light manager values will be saved.

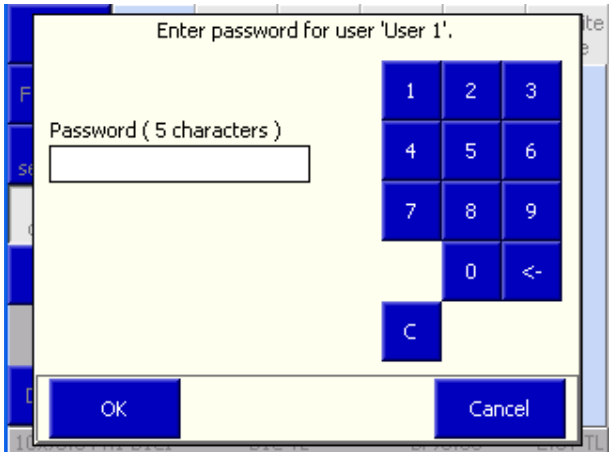


Fig. 169 Password query

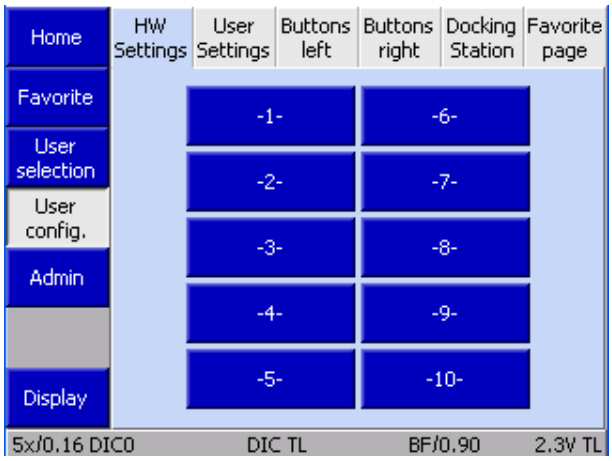


Fig. 170 Microscope -> User -> User configuration -> HW Settings

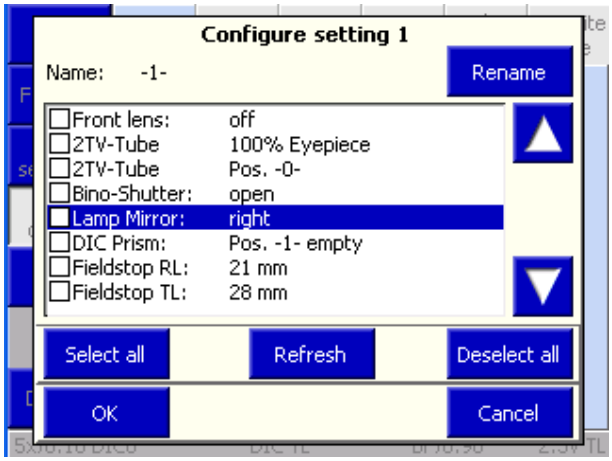


Fig. 171 HW Settings list

4.8.7.2 User configuration page

User-defined configurations can be created and saved on this page. This page is password-protected.

Once the user password has been entered, the configuration of the user chosen on the **User selection** page can be changed.

The following tabs are available for user configuration:

- **HW Settings** Hardware settings
- **Settings** Change password
- **Buttons on left** Left drive knob
- **Buttons on right** Right drive knob
- **Docking station buttons**
- **Favorites page** Select favorites page

(1) HW Settings tab

As many as ten hardware settings can be assigned to each user. Each setting may consist of a combination of controllable microscope components. The components available appear in a selection list.

- Click on the desired components.
  Clicking on a component will save its current status for the setting. If a different value is to be saved, it must be changed using the buttons on the stand or via the TFT before it can be saved.
- To adopt the new value, press the **Update** button afterwards.

Each setting can be given an individual name.

- Press the **Rename** button.
- Enter the name and acknowledge by pressing the **ENTER** key on the keyboard.
- Complete this procedure by pressing the **OK** button or discard the entry by pressing the **Cancel** button.

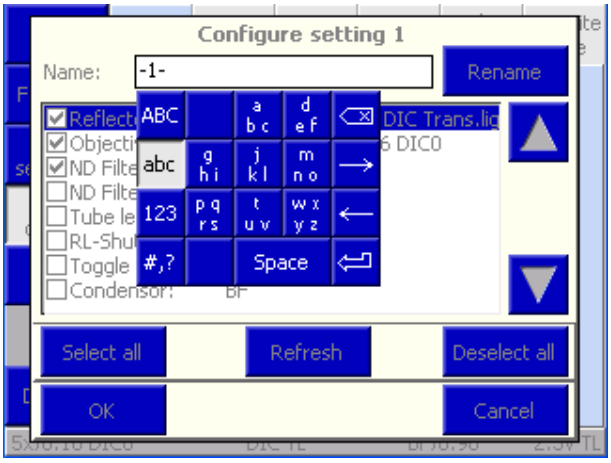


Fig. 172 Renaming HW Setting

(2) User Settings tab

This tab allows the password for the user to be changed.

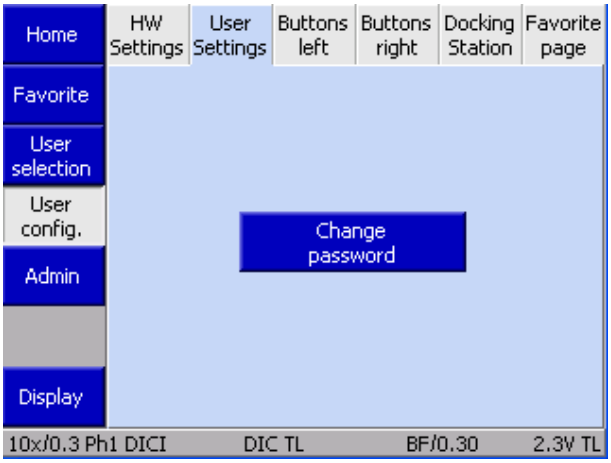


Fig. 173 Microscope -> User -> User configuration ->Settings

- Press **Change password**.
- Enter the old password.
- Enter the new password (at least five characters).
- Repeat the new password.
- Acknowledge by pressing the **OK** button on the numeric pad.
- Accept the change by pressing the **OK** button or discard it by pressing the **Cancel** button.

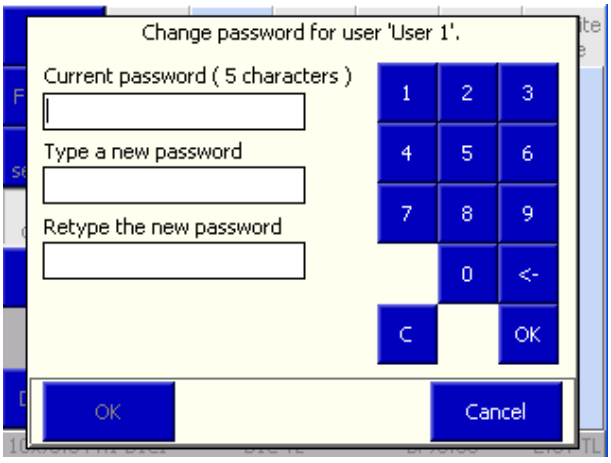


Fig. 174 Changing the password

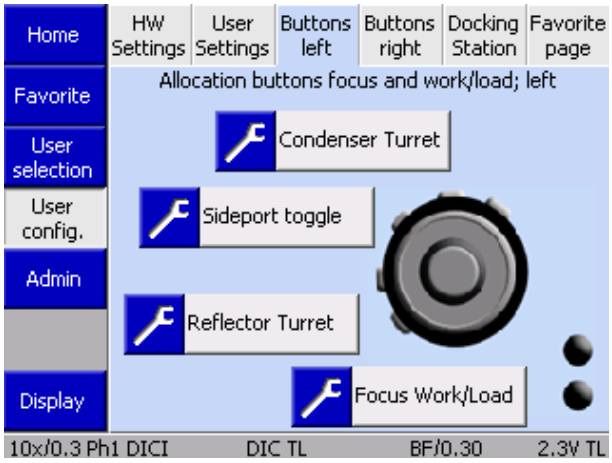


Fig. 175 Microscope -> User -> User configuration -> Left buttons

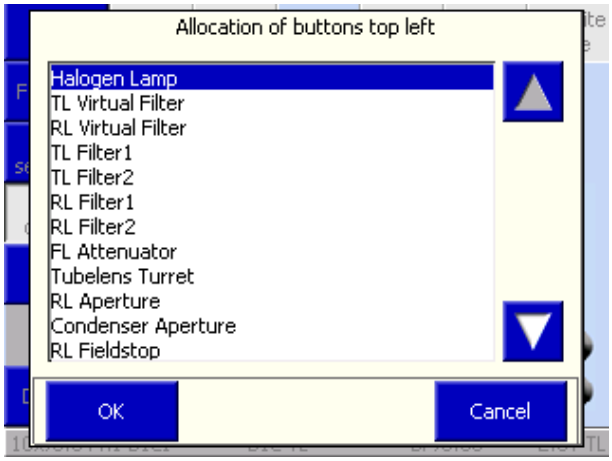


Fig. 176 Assignment of top left button pair

(3) Buttons left tab

The control buttons on the left-hand side of the stand can be assigned on this tab.

- Click on the **top left** button pair.
- Use the arrow buttons to select the desired assignment.
- Acknowledge with **OK** or discard with **Cancel**.

Use the same method for all other button assignments.

(4) Buttons right tab

The control buttons on the right-hand side of the stand can be assigned on this tab.

- Click on the **top right** button pair.
- Use the arrow buttons to select the desired assignment.
- Acknowledge with **OK** or discard with **Cancel**.

Use the same method for all other button assignments.

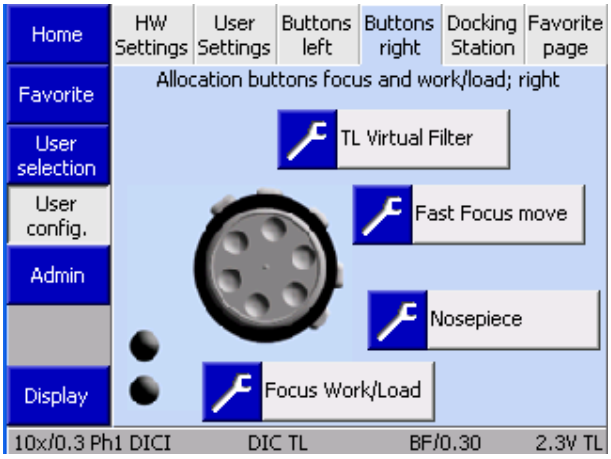


Fig. 177 Microscope -> User -> User configuration -> Right buttons

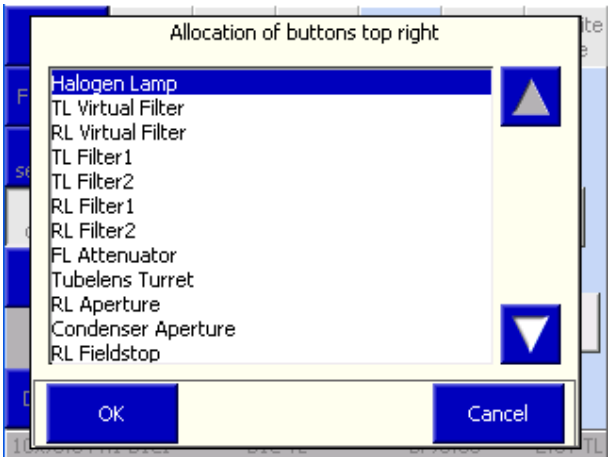


Fig. 178 Assignment of top right button pair

(5) Docking Station tab

To assign the docking station buttons, use the same method as in Sections **(3) Buttons left tab** and **(4) Buttons right tab**.

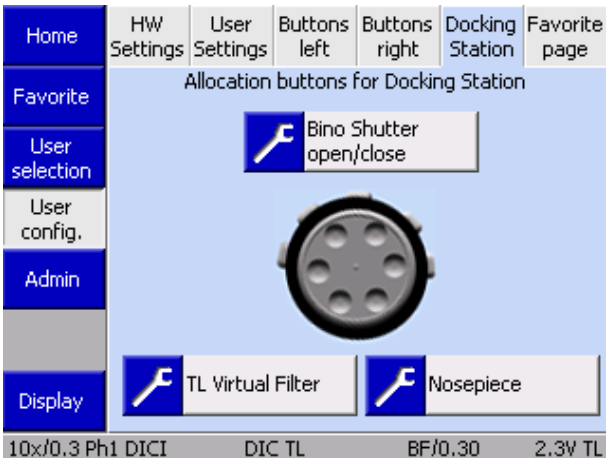


Fig. 179 Microscope -> User -> User configuration -> Docking station

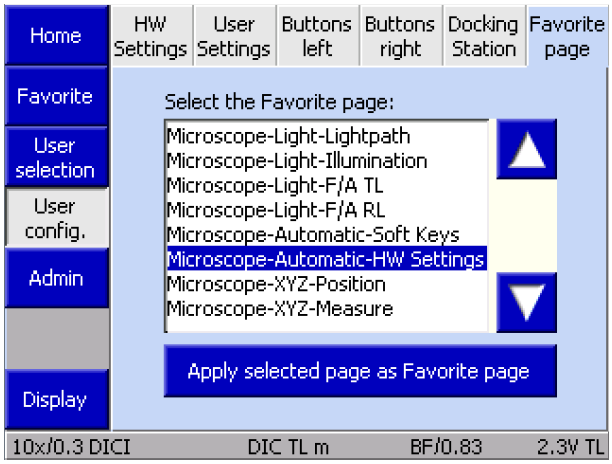


Fig. 180 Microscope -> User -> User configuration ->Favorites page

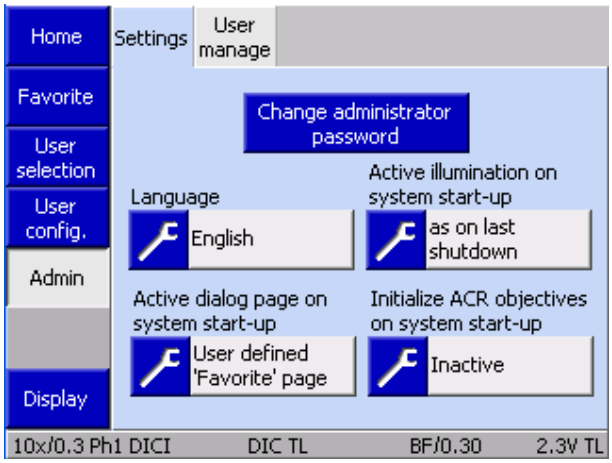


Fig. 181 Microscope -> User -> Admin -> Settings

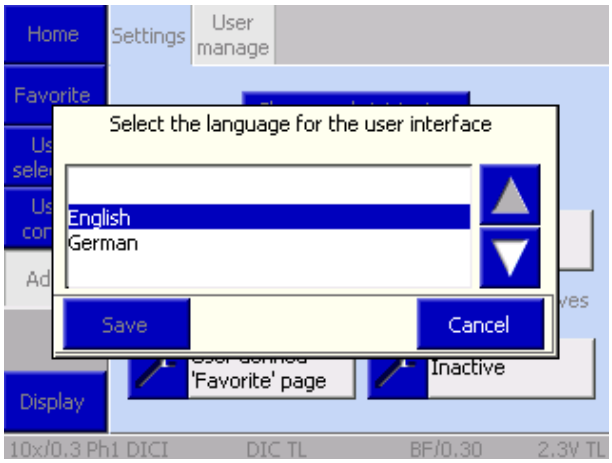


Fig. 182 Select language

(6) Favorites page tab

On this page, the user can define one of the listed tabs as a direct link.

- Use the arrow buttons to select the Favorites page.
- To acknowledge, press the **Adopt page as favorite page** button.
  Important: This function is executed without any confirmation prompt.

4.8.7.3 Admin page

There are two tabs on the **Admin page**:

- Settings
- User administration

(1) Settings tab

The following settings can be defined on this tab:

- Language
- Active illumination after switch-on
- Start page after switch-on
- Initialization of ACR objectives after switch-on

Language

German or **English** can be selected here.

Pressing the **Save** button results in the instrument being restarted. After the restart, the microscope is initialized with the selected language.

Active illumination after start-up (light path)

Here, the user can select the active light path when the microscope is switched on.

- **Reflected light:**
  The microscope starts with the reflected-light illumination previously activated.
- **Transmitted light:**
  The microscope starts with the transmitted-light illumination previously activated.
- **As on last shutdown:**
  The microscope launches in the state in which it was turned off.

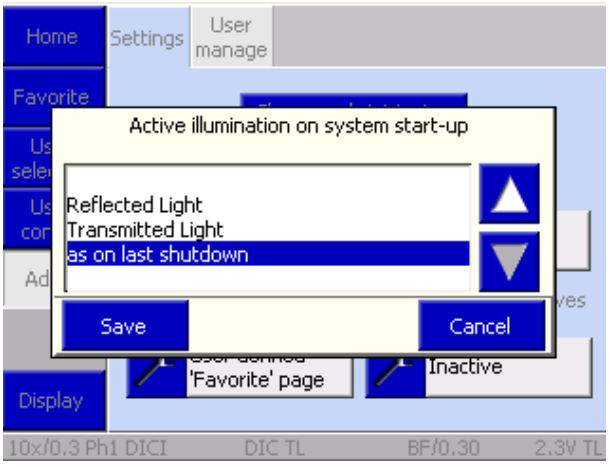


Fig. 183 Light path upon switch-on

Start page after start-up

The page to be shown after starting the microscope can be defined here. There are two options:

- **User selection**
  Primarily of interest for multi-user operation.
- **Favorites page**
  Particularly useful whenever a specific page is preferred.

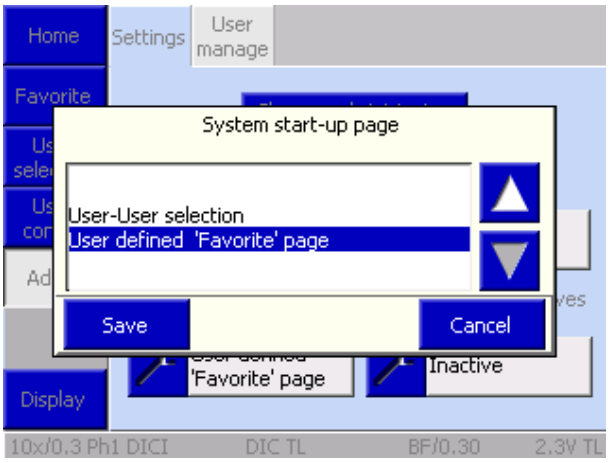


Fig. 184 Start page after switch-on

Initialization of ACR objectives after start-up

There are two options:

- **Active**
  When the instrument is started, a recognition cycle may (!) be triggered by the user. A confirmation prompt is displayed prior to the recognition cycle.
- **Inactive**
  The recognition cycle is triggered only if a specific instruction is given in the settings menu.

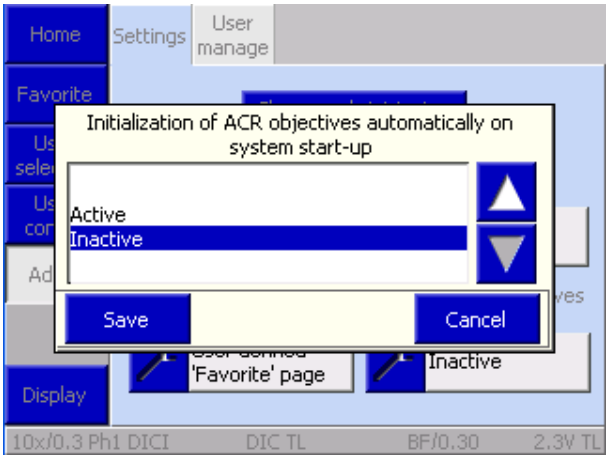


Fig. 185 Initialization of ACR objectives after switch-on

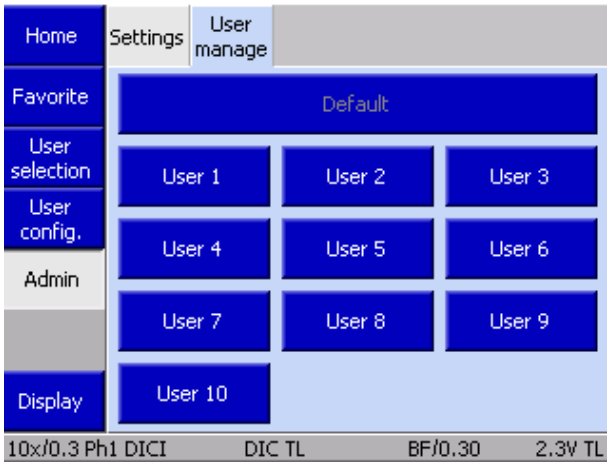


Fig. 186 Microscope -> User -> Admin -> User administration

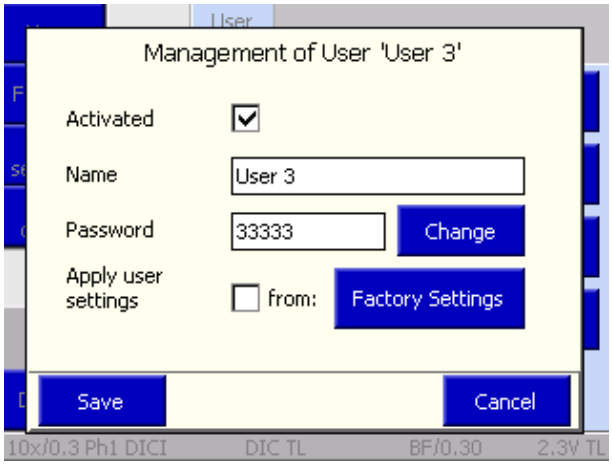


Fig. 187 User administration for User 3

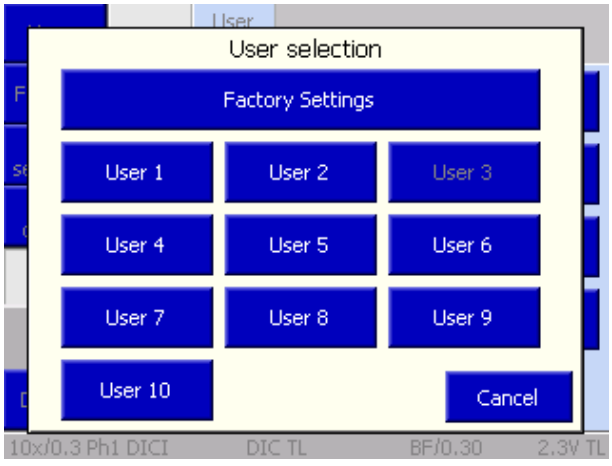


Fig. 188 Adopting user settings

(2) User manage tab

On this tab, the administrator can create, manage and preconfigure users.

Upon pressing the **User #** button, a pop-up menu appears containing the following functions:

- User activation / deactivation
- User's name
- Allocation of password
- Adoption of user settings

If user settings are to be transferred from an existing user, the **Adopt user settings** checkbox must be activated.

Pressing **Factory Settings** then opens another pop-up menu. The user whose settings are to be adopted can be chosen here.

Important: The adoption will only function for previously configured users.

- After being adopted, the new user must be activated by clicking the checkbox.
- Pressing the **Save** button completes this operation.

The new user can now be chosen on the **User selection** page and the configuration refined, if necessary.

4.8.8 Display page

Using the ◄► buttons on the **Display** page, the user can adjust the brightness of the TFT display and the light control LEDs.

Pressing the **Display off** button turns the TFT display off. Pressing that button a second time switches the TFT display on again.-*delete*

To dim the TFT display, press the **Display** button on the navigation bar for more than a second. Touching anywhere on the TFT display again switches the display back on.

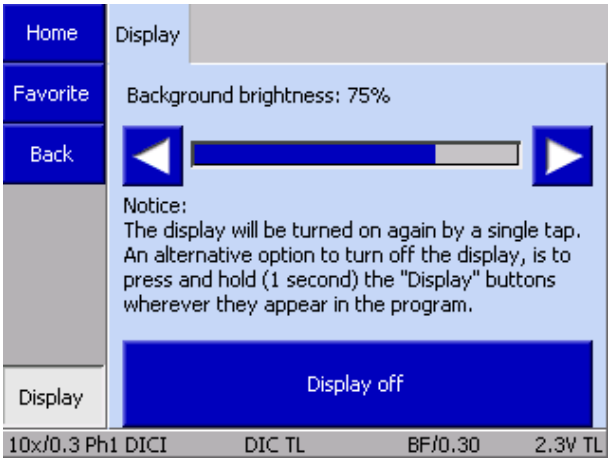


Fig. 189 Home -> Display

☞ After the TFT display is switched off, it returns from the **Display** page to the page from which it was activated. This page will be shown when the display is switched on again.

4.9 Capturing large overviews (tiles or MosaiX images) on Axio Imager 2

Preparatory steps:

1. Insert a reticle in an eyepiece and mount the eyepiece (see Section 3.5 on page 36 f).
2. Assemble and turn on the stage in accordance with instructions.
3. Insert the mounting frame into a 3-plate stage or apply a scanning stage or an object guide to a 2-plate stage or CAN bus stage and manual mechanical stage (see Section 3.35 from page 70).
4. Insert the calibrating specimen and focus along the x-axis (parallel line of the specimen).
5. Adjust the stage so that the specimen holder runs exactly parallel to the stand.
   - Unscrew the connecting bolts from the stage on the stage carrier,
   - Align the stage or
   - Adjust the specimen holder.
6. Adjust the mounting frame (if applicable), to minimize the focusing operation of the specimen on the x and y axis.
7. Orient the camera to the center of the beam path to center the illumination.
   - Search for a reference object on the calibrating specimen (cross-hairs or similar) which is then superimposed on the crosshairs of the inserted reticle in the eyepiece using the stage control (joystick, coax drive or trackball).
   - Move the reference object to the center of the optical field of view and focus.
   - Activate crosshairs in the live camera image on the computer monitor and, if necessary, focus the camera image using an adjustable camera adapter.
   - Turn the adjusting screws for the x and y axis of the adapter until the crosshairs of the reference object in the field of view (microscope) are overlaid with the crosshairs in the live image (camera) on the screen.
8. Set the axis orientation in the MTB 2011 config.exe and in the AxioVision or ZEN (blue edition) imaging software.
9. Set the camera image orientation.
   The orientation and amalgamation of the final image on the screen should correspond to the position of the specimen on the specimen stage (e.g. label to the left).

☞ Settings must be made for the last two items of the stage / stage controller used. These are shown in the following table.

Settings of the orientation of the camera image in the live image window and the axis orientation in software for capturing large overview images (mosaics) in the Axio Imager 2:

	Image position	Camera orientation in software	x axis	y axis
Eyepiece	"p"			
Stage	"d"			
Camera on top port of inverse tube	"p"			
WSB05 / WSB08		180° rotation	Inverted	./.
SMC 2009		180° rotation	Inverted	Inverted
CAN bus		180° rotation	Inverted	./.
Ludl MAC 6000		180° rotation	Inverted	./.
Camera on side port	"q"			
WSB05 / WSB08		Horizontal reflection	Inverted	./.
SMC 2009		Vertical reflection	Inverted	Inverted
CAN bus		Horizontal reflection	Inverted	./.
Ludl MAC 6000		Horizontal reflection	Inverted	./.
Camera on top port upright tube	"p"			
WSB05 / WSB08		180° rotation	Inverted	./.
SMC 2009		180° rotation	Inverted	Inverted
CAN bus		180° rotation	Inverted	./.
Ludl MAC 6000		180° rotation	Inverted	./.

An Axiocam was used for this installation. The camera was oriented with the label pointing towards the user and the cable to the rear.

Now you can use the Tiles&Positions module of e.g. the ZEN software to acquire huge overview images.

4.10 Relocate an event on a sample carrier

4.10.1 Microscope equipment and basic settings

☞ The basic setting on the microscope corresponds to the preparatory steps for capturing large overview shots, see Section 4.9 on page 154.

4.10.2 Calibration of the stage

After basic adjustment of the microscope, the stage needs to be calibrated.

Proceed as follows:

1. Calibrate the stage using the software. Define the zero position of the stage and the polarity of the axes.
2. If necessary select a suitable specimen holder (carrier, slide, etc.) in the software.
3. Set a reference point on the sample carrier (slide).
   This is normally set as the zero point of the specimen using the software (or on the stand) to give the specimen unique reference coordinates. This allows each marked event to be retrieved at any time regardless of the stand or the stage used.

☞ The reference point should be selected for the particular sample carrier so that it can be retrieved on all relevant systems.

After setting the reference point you can use your imaging software to restore previously stored coordinates on your sample.

4.11 Automatic component recognition and user-defined component equipment

The ZEISS-patented automatic component recognition (ACR) system allows essential and frequently changed microscope components such as reflector modules, objectives, filter wheels and condensers plus their equipment (such as filter sets, specifications, LED modules, spectral information, etc.) to be recognized when the system is switched on or when components are changed during operation of the microscope, and for the system configuration to be updated accordingly.

Special ACR turrets are required in order to be able to read the information for objectives and reflector modules. For filter wheels and condensers, the configuration is allocated to the microscope via the PC application MTB 2011 config.exe.

ACR greatly simplifies microscope work because users can be sure at all times that the configuration displayed on the microscope TFT corresponds to the actual equipment.

For the first time it is now possible to use custom filter sets for reflector modules. After the information has been transferred to the component the user can also deploy this on other devices such as other Axio Imagers and Axio Observers without having to make any adjustment to the configuration on the other device.

Correct configuration of the microscope influences other functionalities such as the lighting and contrast manager. Unless properly configured, the manager functions cannot guarantee reproducible settings.

The definition of component equipment is performed using the microscope configuration software MTB 2011 config.exe. User-defined filter sets, neutral density filters, etc. are first created in **Menu > Extras > Options** and selected in the configuration section for the microscope.

4.11.1 Programming of rewritable ACR reflector modules

ZEISS offers ACR-enabled (automated component recognition) reflector modules for the Axio Imager 2. Their equipment can be read automatically using ACR reflector turrets, eliminating the need for configuration by the user.

These reflector modules are now available in a stand-writable variant (reflector module FL EC ACR P&C, stand RW 424941-9060-000). This allows users to generate their own filter sets and to transfer their properties to the corresponding modules in the stand.

The programming involves a few simple steps:

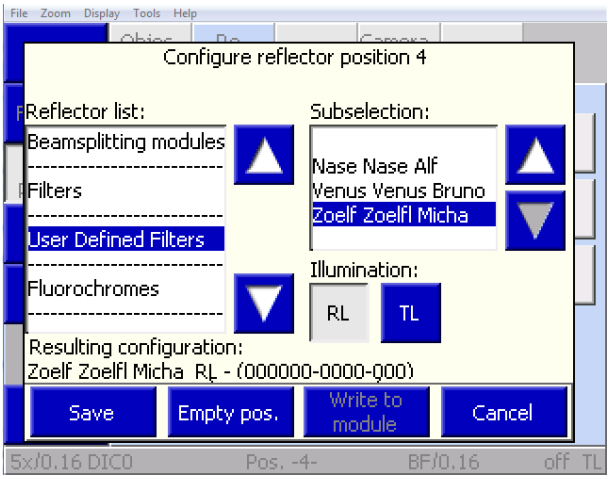


Fig. 190 Assigning a filter set to the saved reflector position

1. Turn on the microscope.
2. Start MTB 2011 config.exe configuration software on the PC.
3. Select **Menu > Extras > User defined filters**.
   New filter sets can be created in this menu.
4. Insert a rewritable reflector module P&C in the ACR reflector turret and note the position (see Fig. 19 on page 41).
   An ACR cycle is triggered when the cover is closed. All the positions are queried and automatically entered in the device configuration.
5. Select **Settings > Revolver > Reflector** on the TFT.
6. Select the reflector position with the rewritable reflector module.
7. On the TFT, under the heading **User defined filter** select the user-defined filter set from the list and assign it to the saved position of the reflector (see Section 4.8.6.1, **(2) Reflector tab** on page 129).
8. Press the **Write to module** button to save the configuration directly on the module. This filter is then immediately ready for use on other ACR-enabled stands, i.e. the saved user-defined filter set is correctly applied in the TFT configuration during an ACR detection cycle.

4.11.2 Configuration of user-defined filter wheels

ZEISS offers several pre-defined filter sets for the discreetly populated double filter wheels which can be assigned to the filter wheels using the MTB 2011 microscope configuration software. Currently, 3 pre-defined filter sets can be ordered from ZEISS:

a. 487931-9901-000 – This is the standard grey filter set for all brightfield applications

b. 487935-9010-000 - This gray filter set additionally contains a blue color filter for color compensation when working with halogen illumination, as well as a green filter for phase contrast applications.

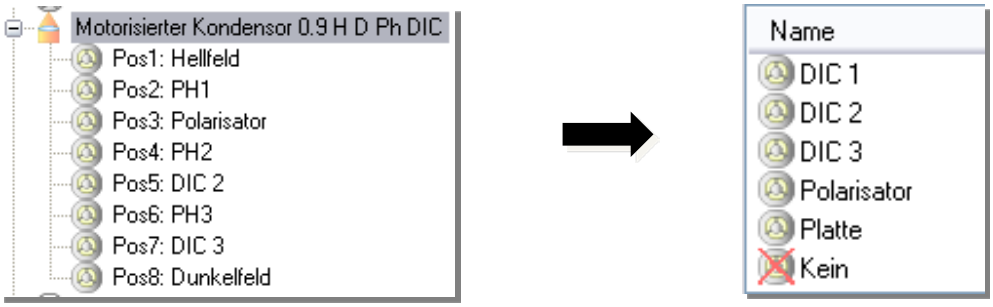
c. 487935-9020-000 – This gray filter set consists of colored neutral gray lenses. In contrast to the first two, this filter set can be used for the attenuation of HBO light.

Naturally, custom combinations are also possible in addition to these predefined filter combinations. These can be specified via the **User defined filter set** menu item. In order to use the user-defined filter set later on the microscope in a reproducible way, the CLASSIC MODE must first be selected for the light manager in the settings page on the TFT. This mode allows you to define and save your own filter settings for each objective. To do this, press the **LM SET** button after making each setting (see Section 4.8.6.2 page 142).

4.11.3 Configuration of motorized condensers

It is also possible to occupy some positions of the universal condensers. This information is used by the contrast and lighting managers to generate reproducible settings for the user.

The equipment of the universal condensers is defined using the MTB 2011 config.exe configuration program.



Other options can be set for the DIC and the DF position: the number of the prism, a polarizer or a plate can be selected. When applied, these options require a different action from the light manager or contrast manager.

If a DIC prism with the corresponding number is selected, the contrast manager registers which position is swivelled in. The configuration of a polarizer allows the polarization contrast on the TFT to be set later (permitting motorized Pol contrast). Configuration of the plate is useful if work is carried out in transmitted light with a LED light source and there is no additional shutter in the beam path. In this case, the plate is incorporated in the light channel and thus serves as a shutter. If fluorescent light is activated, the plate is automatically swivelled as a TL light path shutter into the beam path. This prevents excitation of the LED lamp and thus unintended exposure of the sample by the light source in the DL light path.

4.12 Illumination and contrast methods

4.12.1 Setting transmitted-light brightfield according to KÖHLER

(1) Application

Transmitted-light brightfield microscopy is the most common of all optical microscopic techniques, as it permits high-contrast or stained specimens (e.g. blood smears) to be viewed easily and quickly.

Beside the so-called direct bundles of rays, the indirect bundles (i.e. those diffracted and scattered by specimen details) are also of major importance for providing true imaging of the object. The higher the proportion of indirect bundles of rays (aperture), the more realistic the microscopic image according to ABBE.

To fully exploit the optical performance of the microscope, particularly that of the objective, the condenser, luminous-field diaphragm and aperture diaphragm should be set based on the rules of the KÖHLER illumination principle. These fundamental rules of microscope adjustment are described in detail below in Section 4.12.1 (3) "Transmitted-light brightfield according to KÖHLER" for the Axio Imager 2.

(2) Instrument equipment

– All Axio Imager 2 microscopes and their equipment allow transmitted-light brightfield microscopy.
– For the use of the achromatic-aplanatic universal condenser 0.9 H/0.8-0.9 DF, refer to Section 4.12.2 (4).

(3) Setting transmitted-light brightfield according to KÖHLER

– The microscope should be set up correctly as described in Section 3.
– Switch on the microscope.

- Set the toggle switch for the halogen illuminators on the rear of the instrument to transmitted light.
- Turn voltage control (Fig. 191/**2**) on the microscope base to adjust the image brightness. If the transmitted-light shutter is closed (indicator LED not lit), open it by means of button (Fig. 191/**1**).
- Place a high-contrast specimen on the mechanical stage.
- Swivel in the front lens of the condenser (for objectives ≥ 10x) and use the vertical control of the condenser (Fig. 191/**5** or Fig. 192/**3**) to move it up to the upper stop. The stop must have been set in such a manner that the specimen is not touched by the condenser (for information on setting the stop of the vertical condenser drive, refer to Section 4.12.1 (4)).
- Swivel in 10x objective (yellow ring, also refer to Section 2.5) on nosepiece (Fig. 191/**7**) and bring the specimen into sharp focus using the focusing drive (Fig. 191/**4**).
- Close luminous-field diaphragm (Fig. 191/**3**) until it becomes visible (not necessarily in focus) in the field of view (Fig. 191/**A**).
- Turn the vertical control of the condenser drive (Fig. 191/**5** or Fig. 192/**3**) to lower the condenser until the edge of the luminous-field diaphragm appears in focus (Fig. 191/**B**).

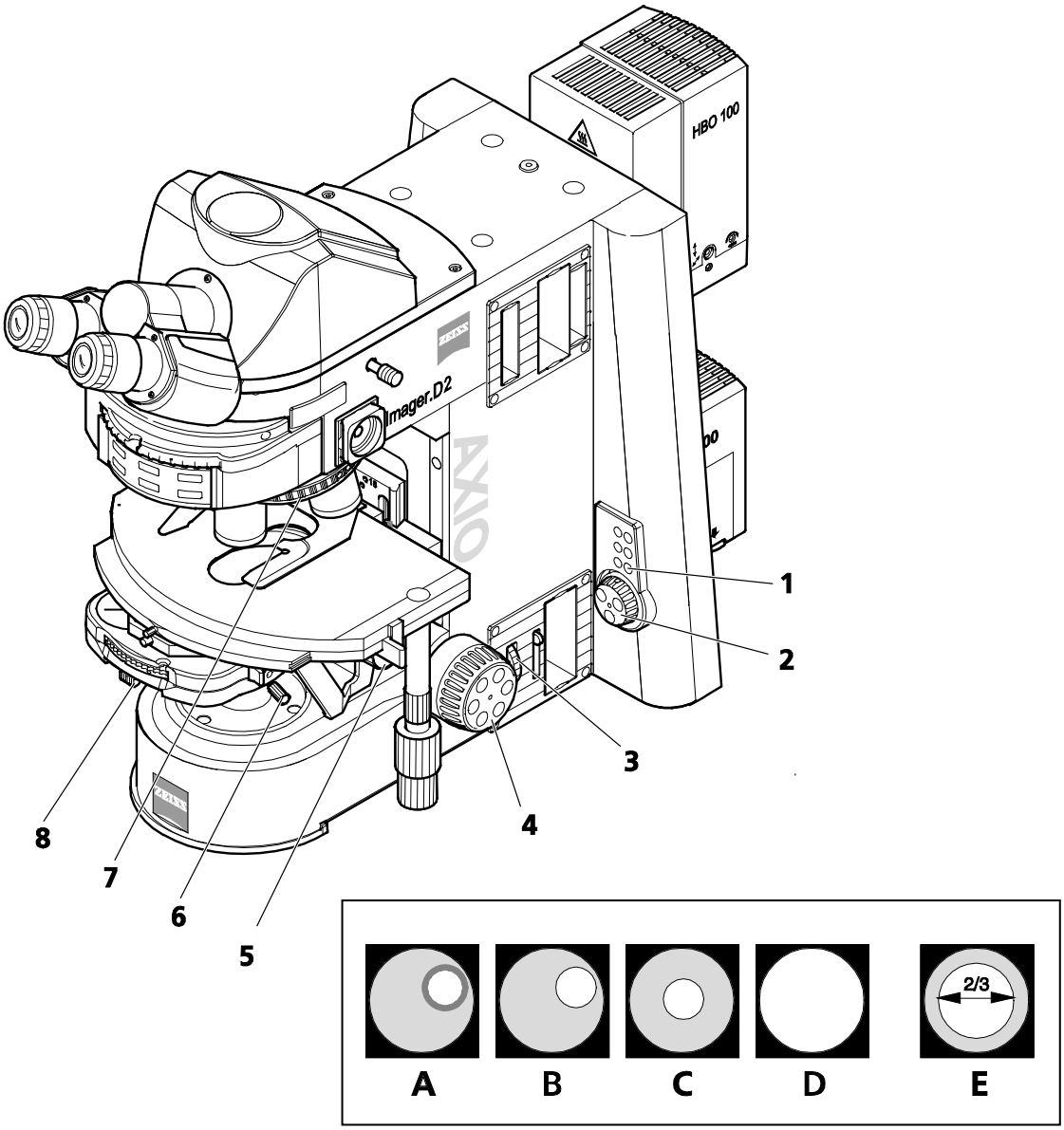


Fig. 191 Microscope settings on the Axio Imager 2 for transmitted light - brightfield

- Use both centering screws (Fig. 191/**6** or Fig. 192/**1**) on the condenser carrier to center the luminous-field diaphragm image (Fig. 191/**C**). Then, open the diaphragm until its edge just disappears from the field of view (Fig. 191/**D**).

☞ When changing the condenser, the luminous-field diaphragm normally remains centered, unless the centering screws have been adjusted.

- To adjust the aperture diaphragm (contrast), remove one eyepiece from the tube and look through the tube with the naked eye. Adjust the aperture diaphragm (Fig. 191/**8**) to approx. 2/3 ... 4/5 of the diameter of the exit pupils of the objectives (Fig. 191/**E**). In most applications, this aperture diaphragm setting provides optimum contrast at almost ideal resolution, and is therefore the best compromise for the human eye.
- Insert the eyepiece back in the tube socket.

☞ The specimen field size and objective aperture change after every objective change. The centering may also alter slightly. Therefore, readjust the luminous-field diaphragm and aperture diaphragm to obtain optimum results.

For < 10x objectives, the front lens of the universal condenser (if used) must be folded out and the aperture diaphragm fully opened. In the case of such large fields, the luminous-field diaphragm can also be used for better contrasting by reducing its opening to a certain range. Avoid closing it too far, otherwise this will impair the evenness of the field of view illumination.

(4) Setting the height stop on the condenser carrier

- Loosen the fastening screw of the height stop (Fig. 192/**2**) using an SW 3 ball-headed screwdriver.
- Use the focusing drive to bring the specimen into sharp focus.
- Close the luminous-field diaphragm and focus it by turning the vertical control (Fig. 192/**3**) of the condenser.
- Carefully raise the condenser slightly without lifting the specimen.
- Tighten fastening screw (Fig. 192/**2**) of the height stop.

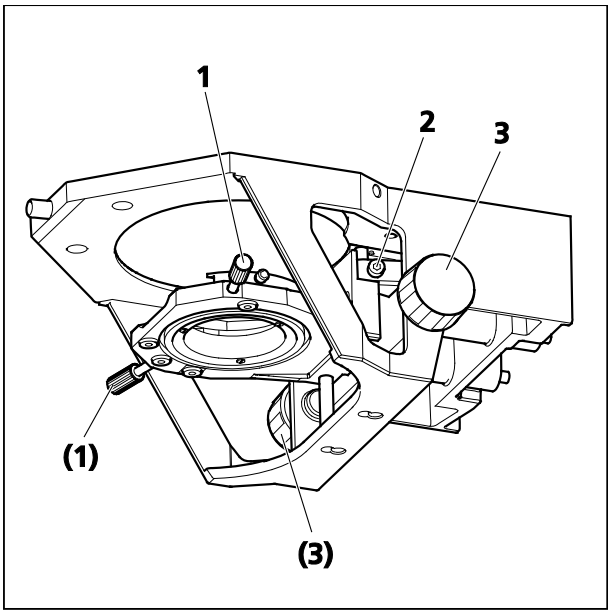


Fig. 192 Setting the height stop on the condenser carrier

4.12.2 Setting the transmitted-light darkfield

(1) General principle

Due to their transparency, unstained biological specimens, such as bacteria or living cell cultures, are often barely visible (or not at all) in the transmitted-light brightfield. This changes significantly if such specimens are observed in the transmitted light darkfield. In principle the specimen is illuminated with an illumination aperture which is greater than that of the objective used.

In the darkfield, only the diffracted and scattered light components which are important for imaging reach the objective, while the direct unchanged light bundles are directed past the objective. This is one reason why even fine structures can be resolved which are sometimes below the resolving power of the light microscope and which appear very bright on a dark background.

(2) Instrument equipment

- Universal condenser with darkfield stop in position D
- Achromatic-aplanatic universal condenser 0.9 H/0.8-0.9 DF (424216-0000-000), for low magnifications with wide-field-DF-slider for 2.5x-5x (424215-0000-000)
- Use of ICS objectives up to the maximum aperture of 0.75. Objectives with a higher aperture can be used in conjunction with the above universal condenser only in the equipment version with an integrated aperture iris stop and/or the screw-on darkfield attachment 1.2–1.4 Oil (424218-0000-000).

(3) Setting transmitted-light darkfield

- Set KÖHLER illumination in the same way as for transmitted-light brightfield. However, use the objective with the highest aperture instead of the 10x objective.
- Turn the MKM of the universal condenser to position D and swivel in the condenser front lens.
- Remove the eyepiece from the tube (or replace it with the auxiliary microscope) and check the centering of the darkfield stop in the exit pupil of the objective. If the central darkfield stop D in the universal condenser is outside of or decentered to the exit pupil of the objective, and if the exit pupil is not homogeneously dark, the darkfield stop must be recentered.
- To center the darkfield stop, use the two SW 1.5 Allen screwdrivers (Fig. 193/**1** and **4**) to turn the two centering screws (Fig. 193/**2** and **3**) until the exit pupil of the objective appears homogeneously dark. After centering, remove both SW 1.5 screwdrivers from the condenser.

Leaving the two Allen screwdrivers unintentionally in the motorized universal condenser does not pose a risk to the drives of the condenser as these instantly switch off if a mechanical resistance is encountered. After removing the source of the resistance, you can continue using the condenser as usual.

☞ Since the apertures of objectives with an integrated aperture iris stop are too high for transmitted-light dark field, the aperture iris stop must be closed to the limit aperture of 0.65.

The darkfield method is correctly set when the background of the field of view appears as dark as possible.

- Reinsert the eyepiece in the tube.
- If the height of the dark-field condenser is set correctly and sensitively, it is possible to reduce any residual brightening in the field of view, and the luminous-field diaphragm image is almost perfectly in focus.
- Finally, match the size of the luminous-field diaphragm to that of the field of view.

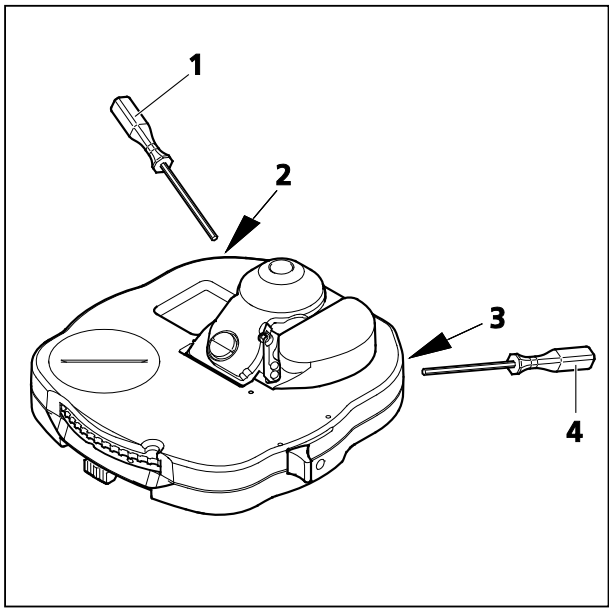


Fig. 193 Centering the darkfield aperture on the universal condenser

☞ Darkfield microscopy requires specimens to be considerably cleaner than in other techniques. Fingerprints, dirt or dust particles, in particular, have negative effects, since they brighten the background of the field of view and decrease the contrast of the object image.

(4) Use of the achromatic-aplanatic universal condenser 0.9 H/0.8-0.9 DF

The achromatic-aplanatic universal condenser 0.9 H/0.8-0.9 DF (Fig. 194/**1**) is equipped with a front lens for brightfield (Fig. 194/**3**) and for darkfield (Fig. 194/**2**), as well as with an aperture diaphragm (Fig. 194/**6**). For brightfield applications, refer to Section 4.12.1.

The conditions for using the universal condenser in combination with individual objectives are given in the table below.

Magnification	Brightfield applications	Darkfield applications
2.5x … 5x	Without brightfield front lens H	Without darkfield front lens D, with wide-field DF slider for 2.5x-5x
10x … 40x	With brightfield front lens H	With darkfield front lens D
40 x … 100x	With brightfield front lens H	With darkfield front lens D, with darkfield attachment 1.2-1.4 Oil, Objective with adjustable iris stop

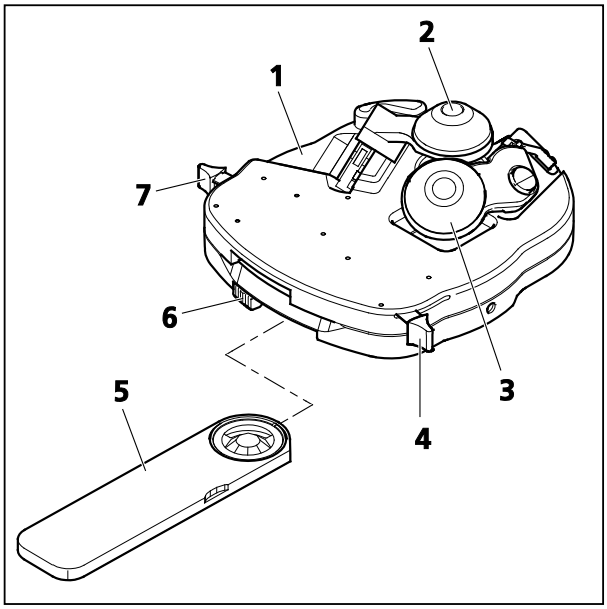


Fig. 194 Achromatic-aplanatic universal condenser 0.9 H/0.8-0.9 DF

- To swivel the brightfield front lens **H** into the optical path, set lever (Fig. 194/**4**) to position **I** (darkfield front lens **D** swiveled out). To swivel it out, set lever to position **0**.
- Before swiveling the darkfield front lens **D** in or out, the wide-field DF slider (Fig. 194/**5**) should be extracted from the universal condenser (outer click-stop position). To swivel this lens in, set lever (Fig. 194/**7**) to position **0**. To swivel it out, set the lever to position **I**.
- For immersion applications, screw the darkfield attachment 1.2-1.4 Oil onto the darkfield front lens and apply Immersol 518 F® immersion oil.

(5) Use of achromatic-aplanatic condenser 0.9 H/0.4 LD

The achromatic-aplanatic condenser 0.9 H/0.4 LD is equipped with a 0.9 front lens for brightfield use and a second front lens (0.4) for brightfield and phase contrast applications together with slider Ph 1 or Ph 2 at a working distance of approximately 14 mm.

- The front lenses are swiveled in and out in the same manner as described for achromatic-aplanatic universal condenser 0.9 H/0.8-0.9 DF.
- Slider Ph must be removed from the condenser when front lens 0.4 is swiveled in or out.

4.12.3 Setting transmitted-light phase contrast

(1) General principle

The phase contrast technique is ideal for examining thin, unstained specimens, e.g. culture cells. The human eye is unable to see phase differences (differences in refractive index and thickness) between the different cell components.

The phase contrast technique uses the optical modulators "phase stop and phase ring" as well as the interference procedures during formation of the intermediate image in order to change the small phase differences into intensity and color differences that are visible to the eye.

The high-intensity, direct light components are attenuated with the optically defined ring channel "phase stop and phase ring" and given a constant phase shift. The indirect light components diffracted at different cell components, however, bypass this optical channel. The phase is influenced by the different refractive indexes and thicknesses in the specimen.

In the intermediate image plane, these differently influenced partial beams interfere with each other and are amplified or attenuated, depending on the phase position. This interference results in differences in intensity and color in the image which are perceptible to the human eye.

(2) Instrument equipment

– Phase-contrast objectives with phase rings Ph 1, Ph 2 or Ph 3 for different average numerical apertures that can also be used in brightfield without any restriction.
– Brightfield Universal condenser with turret disk containing centerable phase stops Ph 1, Ph 2 and Ph 3 for different average numerical apertures.
– The phase stop on the universal condenser swiveled into the light path must match the corresponding label on the objective, e.g. Ph 1.

(3) Setting transmitted-light phase contrast

- Swivel a phase-contrast objective, e.g. Ph 1, into the light path.
- On the turret disk of the universal condenser, swivel in the phase stop with the same designation as the phase-contrast objective, e.g. Ph 1.
- To check the centering and congruence of the bright phase stop (in the condenser) with the dark phase ring (in the objective), remove one eyepiece from the tube and replace it with the auxiliary microscope. Use the correction device on the auxiliary microscope to focus on the phase stop and the phase ring in the exit pupil of the objective.

☞ To check the centering, you can also use the Bertrand lens slider PH. However, this is only possible if no camera path deflection is installed on the left side of the microscope stand.

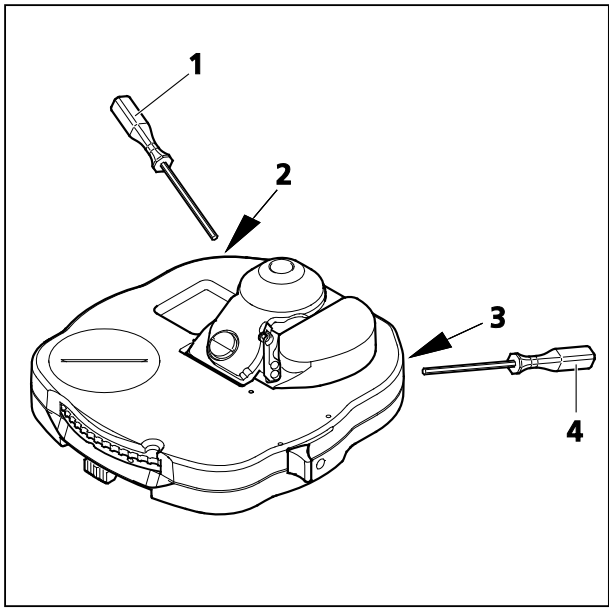


Fig. 195 Centering the phase stop on the universal condenser

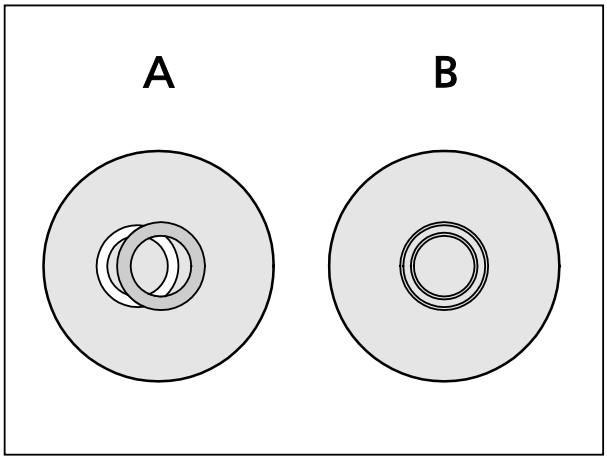


Fig. 196 Centering the phase stop (bright ring in condenser) to the phase ring (dark ring in objective)

- If there is not perfect congruence (Fig. 196/**A**), use the two SW 1.5 screwdrivers (Fig. 195/**1** and **4**) to turn the two centering screws (Fig. 195/**2** and **3**) to recenter the bright phase stop until complete congruence with the dark phase ring is achieved (Fig. 196/**B**).
- Finally, remove the auxiliary microscope from the tube and reinsert the eyepiece.

Normally, however, no centering is required, since the phase stops are factory-centered and the centering is retained even if the universal condenser is removed from the condenser carrier and re-attached.

To enhance the image contrast, an interference wide-band filter, green 32 x 4, can be inserted in the color glass holder (requires color glass holder for 32 mm filter size).

Perfect phase contrast is only achieved if the bright phase stop (in the condenser) and the dark phase ring (in the objective) are exactly congruent in the illumination beam path (Fig. 196/**B**).

4.12.4 Setting transmitted-light differential interference contrast (DIC)

(1) General principle

The transmitted-light DIC method is an alternative contrast method to polarization which allows high-contrast, 3D presentation of transparent specimen details.

The light is linearly polarized by a polarizer and split into two partial beams by a birefringent prism. The beams pass through two adjacent places of the specimen resulting in path differences caused by differences in the refractive index and thickness of the specimen. The two partial beams are then recombined in a second birefringent prism and, after passing through the analyzer, have the same vibration direction. Thus, both partial beams can interfere with each other in the intermediate image; the different path differences are converted into different gray values (intensities). A compensator λ (full-wave plate) then converts the gray values to colors.

(2) Instrument equipment

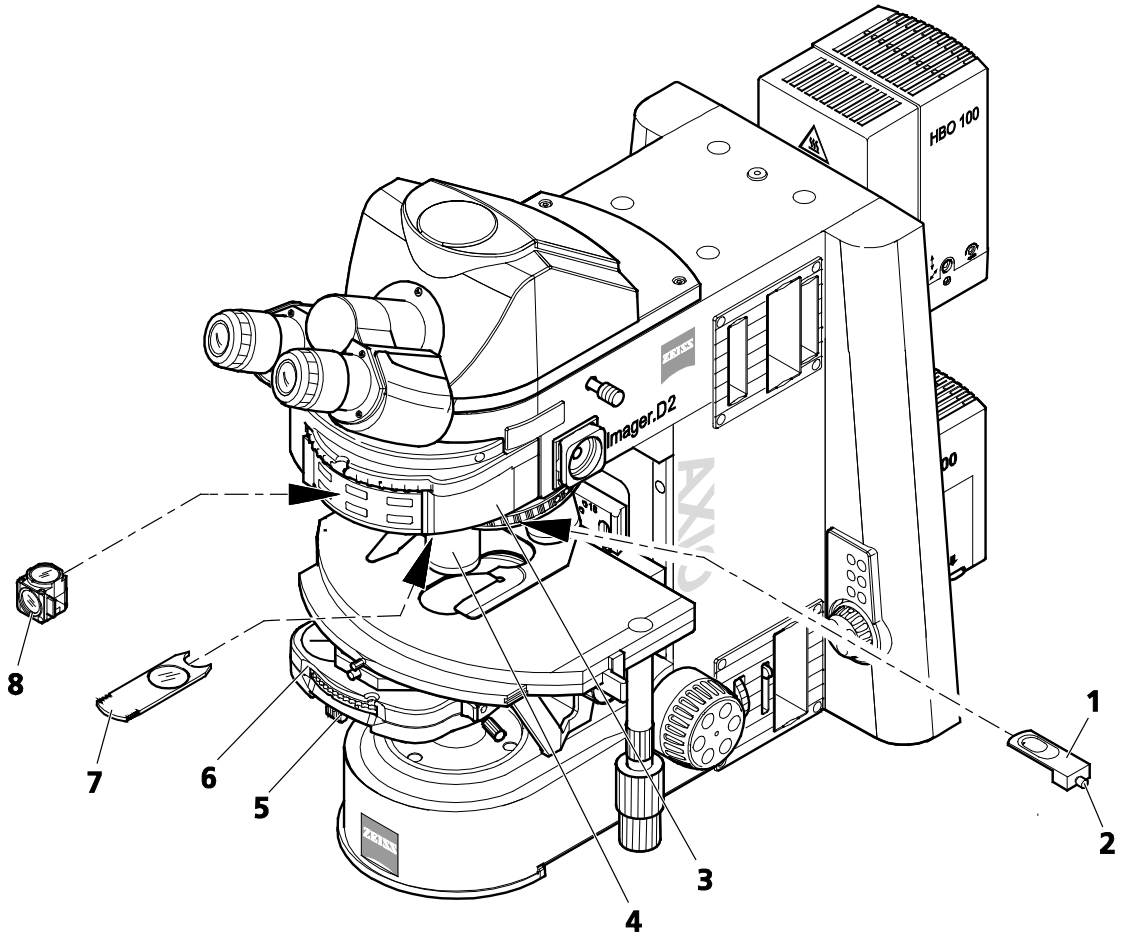
- Objectives supplied with the DIC equipment, e.g. Plan-Neofluar objectives
- Objective nosepiece with slot for DIC slider, matching the objectives used
  or
  Motorized four-position modulator turret in combination with analyzer module DIC ACR shiftfree for transmitted light
- Condenser with turret disk containing DIC prisms (DIC I, DIC II, DIC III)
- Analyzer module D DIC P&C (424921-9901-000) in reflector turret. Only this module may be used on the Axio Imager 2 as it provides a homogeneous field of view in combination with the special condenser modules I, II and III.
- Preferably a rotary mechanical stage

(3) Adjusting the transmitted-light DIC with DIC slider and DIC prism in the condenser turret

- On the nosepiece, swivel the objective (Fig. 197/**4**) suitable for DIC into the light path.
  Push the corresponding DIC slider (Fig. 197/**1**) into the slot of the respective objective position. Make sure the DIC slider clicks in.
- On the reflector turret (Fig. 197/**3**), swivel in the analyzer module D DIC (Fig. 197/**8**).
- Swivel in the suitable DIC prism I, II or III (digit label on turret disk of condenser (Fig. 197/**6**)).
- Adjust the luminous-field diaphragm and aperture diaphragm (Fig. 197/**5**) in accordance with the rules of KÖHLER illumination.
- Turn knurled screw (Fig. 197/**2**) on DIC slider (Fig. 197/**1**) to obtain optimum contrast. When adjusting the DIC slider symmetrically around its mid-position, the specimen details can be imaged in such a way that they appear three-dimensionally, as if they were raised or recessed.
- If desired, the compensator λ (Fig. 197/**7**) can be inserted into the slot for the analyzer slider above the nosepiece to obtain colored DIC contrast.

For 63x objectives, in addition to the DIC sliders HR (High Resolution), another type - HC (High Contrast) - is available which should be used depending on the type of specimen and examination to be performed.

☞ The DIC method employs polarized light and therefore is disturbed by birefringent objects, such as films, in the light path between polarizer and analyzer which are occasionally used in conjunction with histological sections. The same applies to acrylic glass culture chambers, if the chamber bottom is made of plastic. In these cases, it is advisable to use chambers with bottom plates of glass to avoid loss of optical performance.



1 DIC slider
2 Knurled screw
3 Reflector turret
4 Objective on nosepiece
5 Sliding button for aperture diaphragm
6 Condenser with DIC prism and polarizer
7 Compensator λ
8 Analyzer module

Fig. 197 Components required for transmitted-light DIC

(4) Adjusting the transmitted-light DIC with motorized four-position modulator turret for transmitted light

- On the nosepiece, swivel in the objective suitable for DIC.
- On the reflector turret, swivel in the analyzer module DIC ACR shiftfree for transmitted light.
- On the modulator turret, swivel in the appropriate DIC prism by **pressing** knob (Fig. 198/**1**) for forward rotation or knob (Fig. 198/**2**) for backward rotation of the turret.
- Adjust the luminous-field diaphragm and aperture diaphragm according to KÖHLER.
- Set the optimum contrast by turning knob (Fig. 198/**2**).
- If desired, the compensator λ can be inserted into the slot for the analyzer slider located above the nosepiece to create a differential interference contrast (DIC) in color.

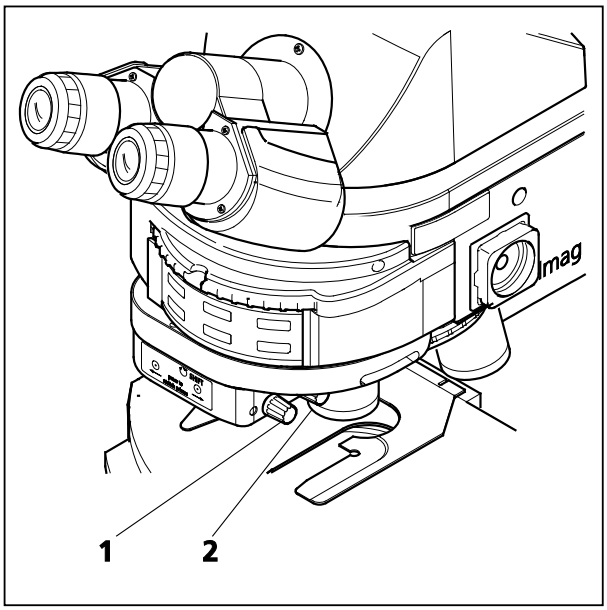


Fig. 198 Motorized four-position modulator turret for transmitted-light DIC

4.12.5 Setting transmitted-light polarization for orthoscopic observation

Magnified viewing (e.g. of a thin section) in polarized light is called orthoscopy (Greek: orthos = straight; skopein = seeing) because illumination is by "straight" light rays which travel parallel to the microscope axis, with the aperture diaphragm almost closed.

4.12.5.1 Detecting birefringence

(1) Application

The technique of transmitted-light polarization is used for specimens that change the state of polarization of light. These specimens - including crystals, minerals or polymers - are called birefringent. When these birefringent substances are viewed between crossed polarizers (polarizer ⊥ analyzer), they appear brightened, while their surroundings remain dark.

Birefringent substances are identified by the fact that they exhibit four bright and four dark positions when rotated through 360° between crossed polarizers. Dependent on the birefringence, thickness and orientation of the specimen, interference colors ranging from gray (mostly with biological specimens) to white, yellow, red and blue appear in this process. These interference colors can be of the first or any higher order.

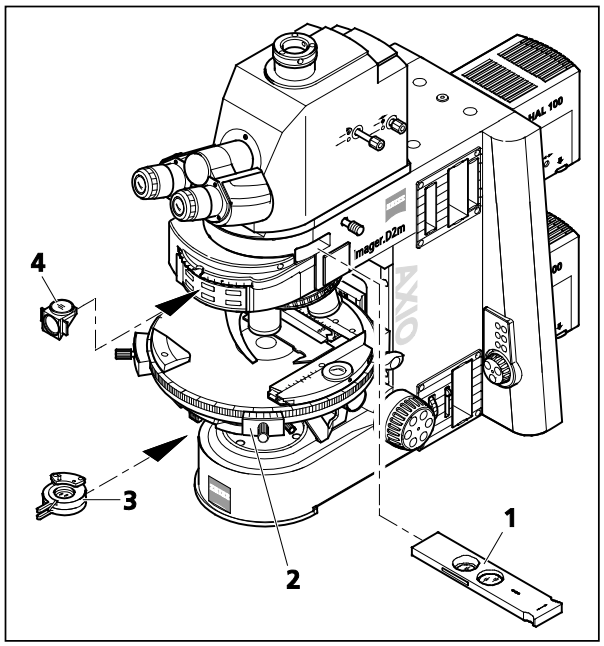


Fig. 199 Components for transmitted-light polarization

(2) Instrument equipment

- Phototube Pol
- Achromatic-aplanatic universal condenser Pol
- Strain-free objectives
- Rotary stage Pol (Fig. 199/**2**)
- Polarizer D (rotatable or fixed) (Fig. 199/**3**)
  or
  polarizer integrated in the turret disk of the condenser
- Analyzer slider (Fig. 199/**1**) or analyzer module D (Fig. 199/**4**) in reflector turret (only on microscopes equipped with a reflector turret)

(3) Setting the microscope

- Set the microscope as for transmitted-light brightfield according to KÖHLER (see Section 4.12.1 (3)).
- Center rotary stage Pol (Fig. 199/**2**) and objectives (if not yet completed – see Section 3.36.3).
- Swivel polarizer (Fig. 199/**3**) into the light path and, if it is rotatable, turn it to 0°.

- Push the analyzer slider (Fig. 199/**1**) into the respective slot or swivel in the analyzer module (Fig. 199/**4**) on the reflector turret. The field of view appears dark due to the crossed polarizers.

☞ If you work with the analyzer slider on the Axio Imager 2, swivel the reflector turret to a blank turret position.

- Move the specimen feature you want to examine into the field of view and rotate it with the rotary stage Pol through 360°. When rotated between crossed polarizers, birefringent (anisotropic) specimens should now show the variations in color and intensity described above. However, optically anisotropic substances may also remain dark if an isotropic direction, e.g. of optically uniaxial or biaxial crystals, is oriented parallel to the direction of observation.

4.12.5.2 Determining the vibration direction n_γ'

(1) Application

The determination of the vibration directions of n_γ and n_γ' (vibration direction with the highest absolute or relative refractive index) and n_α and n_α' (vibration direction with the lowest absolute or relative refractive index) in relation to the morphological directions, e.g. of crystal surfaces, crystal needles or fibers, provides an important recognition criterion. It is also used for the diagnosis of biocrystals (e.g. gout, pseudo-gout).

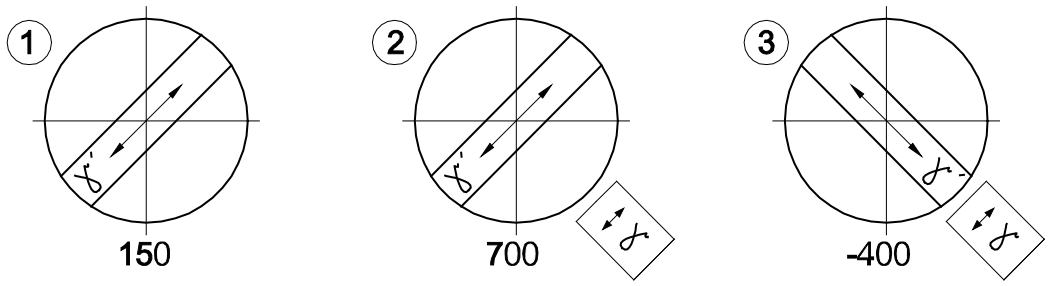


Fig. 200 Determining the vibration direction n_γ' based on the example of a synthetic fiber

(2) Instrument equipment

– Phototube Pol
– Achromatic-aplanatic universal condenser Pol
– Strain-free objectives
– Rotary stage Pol
– Polarizer D (rotatable or fixed)
– Analyzer slider or analyzer module D in reflector turret (only on microscopes equipped with a reflector turret)

(3) Setting the microscope

The microscope has been prepared as described in Section 4.12.5.1 (3).

- Rotate the rotary stage Pol with the specimen, e.g. a synthetic fiber, until the specimen appears as dark as possible. In this position, the fiber extends parallel to one of the two directions of the crosslines reticle.
- Next, turn the rotary stage Pol through a further 45° until the longitudinal axis of the fiber is oriented NORTH-EAST (NE) – SOUTH-WEST (SW) (Fig. 200). In this position, the specimen exhibits the maximum brightness (diagonal position) and may appear in any color.
- Push in the full-wave compensator λ.

Like the specimen, the compensator λ is a birefringent object, though one with a defined path difference of 550 nm and a defined principal vibration direction n_γ oriented NE-SW.

By moving the compensator λ into the light path, the specimen changes its color. The nature of the color change depends on the orientation of the specimen (NE-SW or NW-SE).

The changes in color are due to optical interference. The interference colors (path differences) in both diagonal positions (NE-SW and NW-SE) of the specimen must be compared.

The path difference results from the superposition (interference) of the vibration direction of the specimen with the vibration direction of the compensator λ.

There is a greater path difference if the vibration direction of the specimen with the highest absolute or relative refractive index (n_γ or n_γ') is parallel to the principal vibration direction of the compensator λ. The specimen will then appear, for instance, greenish-blue (Fig. 200/**2**).

The smallest path difference occurs if the vibration direction of the specimen with the lowest absolute or relative refractive index (n_α or n_α') is perpendicular to the vibration direction of the compensator λ. The specimen will then appear e.g. yellow (Fig. 200/**3**).

(4) Conclusions

The grayish-white color appearing first in the bright position in the above example (Fig. 200/**1**) corresponds to a path difference of 150 nm according to the Michel-Lévy color chart (Fig. 201).

When the compensator λ is brought into the light path, the non-birefringent "surroundings" of the synthetic fiber appear in a dark red color, which corresponds to the path difference of the compensator of 550 nm (1st order interference color for the path difference of 550 nm corresponds to 1 λ).

If the vibration direction (n_γ or n_γ') of the birefringent specimen to be examined is parallel to the principal vibration direction (n_γ) of the compensator λ, i.e. NE-SW, the path difference of the specimen (e.g. grayish-white: 150 nm) and the path difference of the compensator λ (red: 550 nm) are added together. This results in a color change of the specimen from grayish white to greenish-blue (resulting path difference = 700 nm).

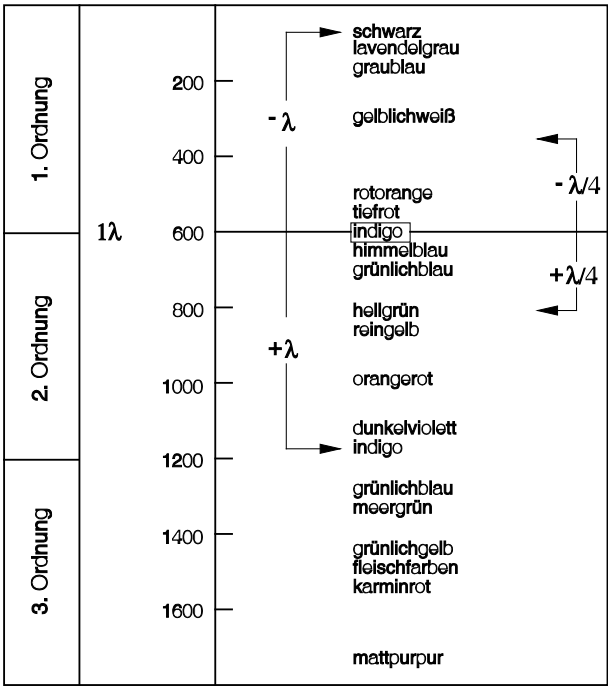


Fig. 201 Schematic diagram of the color charts according to Michel-Lévy

If the vibration direction of the specimen to be examined is perpendicular to the principal vibration direction of the compensator λ, i.e. NW-SE, the path difference of the specimen (e.g. grayish-white: 150 nm) is subtracted from the path difference of the compensator λ (red: 150 nm). In this case, the interference color of the specimen visibly changes from grayish-white to orange (resulting path difference = 400 nm).

☞ Color charts according to Michel-Lévy are available under Cat. No. 42-312.

4.12.5.3 Measuring path differences

Measuring compensators are required for the accurate measurement of path differences. These compensators reset or compensate the path difference produced by the specimen to zero (1st order black).

In the above methods, the addition and subtraction positions are of interest, whereas **only** the subtraction position is relevant for the measurement.

Path differences in the specimen can have very small (1/50 λ or 10 nm) and very great values (more than 10 λ or approx. 5500 nm and more) and thereby determine which compensator is appropriate for the measurement.

To find the appropriate compensator proceed as follows:

- Set up the microscope as for transmitted-light polarization (refer to Section 4.12.5.1 (3)).
- Position the specimen feature to be examined directly under the center of the reticle.
- Restrict the size of the aperture to a value of about 0.2.
- Rotate the rotary stage Pol until the specimen is in extinction position, i.e. it appears **entirely dark**. Once in this position, activate the 45° click stop.
- Rotate the stage **once** (by 45°), so that the specimen is diagonal (brighter).

The intensity of the interference or color produced by the specimen allows the following conclusion to be drawn:

– If interference colors of varying intensity appear on the object, the path difference ranges between approximately 1/2 λ and 5 λ.
The appropriate compensator is:
Tilting compensator B 0-5 λ (Accessory 000000-1115-700).

– If the object-side color changes from light gray/white to a strong interference color when a compensator λ (473704-0000-000) is inserted in the compensator slot, the path difference is (1/4 ... 1/2) λ.

☞ A precondition for the color change effect is evaluation in two specimen positions which are 90° apart. Rotate the centered stage (by 2 click stops) to do this.

The appropriate compensator is: **Tilting compensator B 0-5 λ** (Accessory 000000-1115-700).

– After inserting the compensator λ and rotating the specimen by 90° (2 click stops), the interference color remains white. It is then, however, a "higher-order white" and thus the path difference is > 5 λ. The appropriate compensator is:
Tilting compensator K 0-30 λ (Accessory 000000-1115-698)
– A dark gray as interference color suggests very small path differences (λ/10 or 54.6 nm).

- Push the compensator into the slot as far as it will go.

Use the enclosed operating instructions for preparing and conducting the measurement.

4.12.5.4 Transmitted-light circular polarization contrast

(1) Application

Unlike standard polarization contrast, circular polarization contrast does not show any dark (extinction) positions that depend on the angle of rotation (azimuth) of the specimen relative to the polarizer or analyzer. This means that the image will always look the same when the stage is rotated, as there are no bright and dark positions. With optical anisotropy, all transparent specimens show the interference colors that are characteristic to them.

(2) Instrument equipment

- Phototube Pol
- Achromatic-aplanatic universal condenser Pol
- Strain-free objectives
- Rotary stage Pol
- Polarizer D (rotatable or fixed)
- Circular polarization equipment D, ACR, with λ/4 plate, rotatable for transmitted light, including reflector module λ/4, ACR, P&C (427703-9901-000)
- Analyzer slider

(3) Setting the microscope

- Set the microscope as for transmitted-light brightfield according to KÖHLER (see Section 4.12.1 (3)).
- Center rotary stage Pol and objectives (if not yet completed - see Sections 3.36.3, 3.36.4).
- For the further settings, **do not** use a specimen initially.
- Push the analyzer slider (Fig. 202/**6**) into the light path.
- Install the circular polarizer D (see Section 3.38), and insert reflector module λ/4, ACR, P&C (Fig. 202/**5**) in the reflector turret.
- Swivel the bottom part of the circular polarizer D (Fig. 202/**3**) into the light path up to the click stop and, at full light intensity, assess the extinction (darkening) of the field of view without specimen.

  If the extinction is not optimal, correct the position of the vibration direction by slightly and sensitively turning the polarizer mount (use the adjusting slots (Fig. 202/**4**) on the bottom of the polarizer for this) until maximum extinction is obtained. Normally, however, this will not be necessary, as the position of the vibration direction of the polarizer is factory-adjusted.
- Then, swivel the top part of the circular polarizer D (Fig. 202/**2**) into the light path.
- Rotate the lever of the λ/4 plate of the circular polarizer D (Fig. 202/**1**) until maximum extinction is obtained (dark-gray field of view) (lever points 45° to the right).

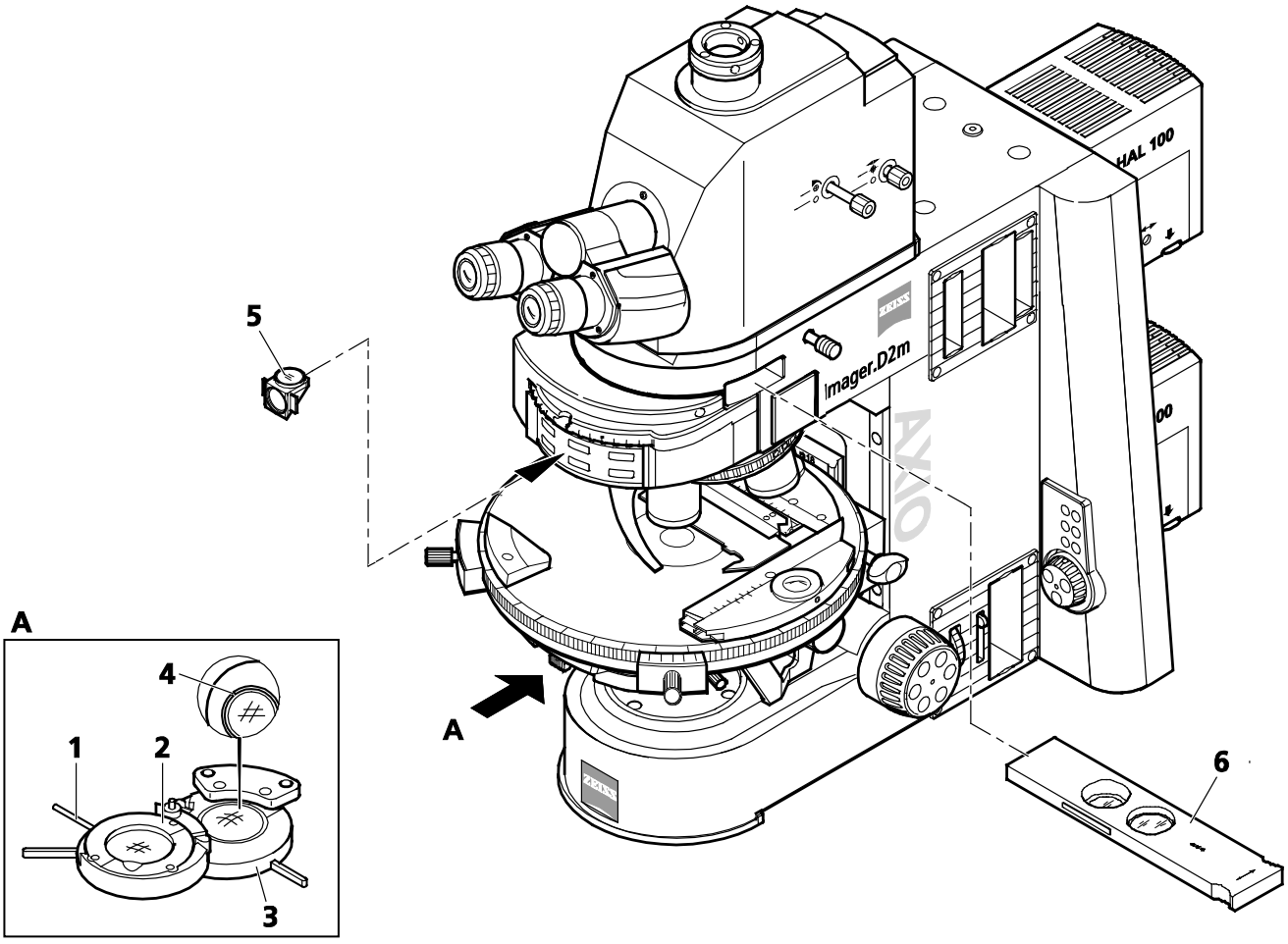


Fig. 202 Components for circular polarization contrast

- Do not view an (anisotropic) specimen unless the above adjustment has been made.
- Place the specimen to be examined onto the stage.

The specimens appear constantly and independently of the stage rotation in their specific interference color. This is determined by the material, specimen thickness and orientation.

☞ To obtain a high-contrast image at high objective magnifications (from approx. 20x), reduce the illumination aperture to a value of between 0.15 and 0.20, i.e. close the aperture diaphragm accordingly.

The effect of the λ/4 plate (Fig. 202/**2**) can be cancelled either by swiveling it out of the light path or turning it with lever (Fig. 202/**1**) into one of its two click-stop positions.

4.12.6 Setting transmitted-light polarization for conoscopic observation – determining the optical character of crystals

For the classification (and thus identification) of crystalline matter, the examination of the interference image in the objective pupil yields more valuable information than that obtained by viewing the specimen itself. The interference image becomes visible in the eyepiece if an additional optical system (fixed or focusing Bertrand lens or, on the basic version, the auxiliary microscope or diopter) is used.

In contrast to orthoscopy, this technique is called conoscopy, because here the specimen is ideally illuminated by a wide-open cone. In practical microscopy this means that the condenser front lens (0.9 or 1.4) must be in the light path, the aperture diaphragm fully open and the objective should also have a large aperture.

(1) Application

The determination of the optical character of transparent and weakly absorbing crystals is used to diagnose crystals. This method is also termed conoscopy. Its main application is classical mineral microscopy. However, it also allows synthetic crystals, industrial minerals and plastics (e.g. films) to be identified and characterized.

(2) Instrument equipment

- Stand with installed phototube Pol or with Bertrand lens slider or with the tube lens turret with integrated Bertrand lens optics
- Strain-free objectives
- Achromatic-aplanatic universal condenser 0.9 H
- Rotary stage Pol
- Polarizer D (rotatable or fixed)
- Analyzer slider or analyzer module D in reflector turret

☞ The phototube Pol can be installed on all Axio Imager stand types.

(3) Setting the microscope for conoscopy with the phototube Pol

In the case of uniaxial crystals, the most favorable orientation for conoscopic viewing is obtained with the specimen features (e.g. thin sections) that change the brightness as little as possible in orthoscopic viewing during stage rotation. In this case, the direction of viewing and the optical axis are parallel. The same applies to biaxial crystals if they are viewed along or in the approximate direction of one of the two optical axes.

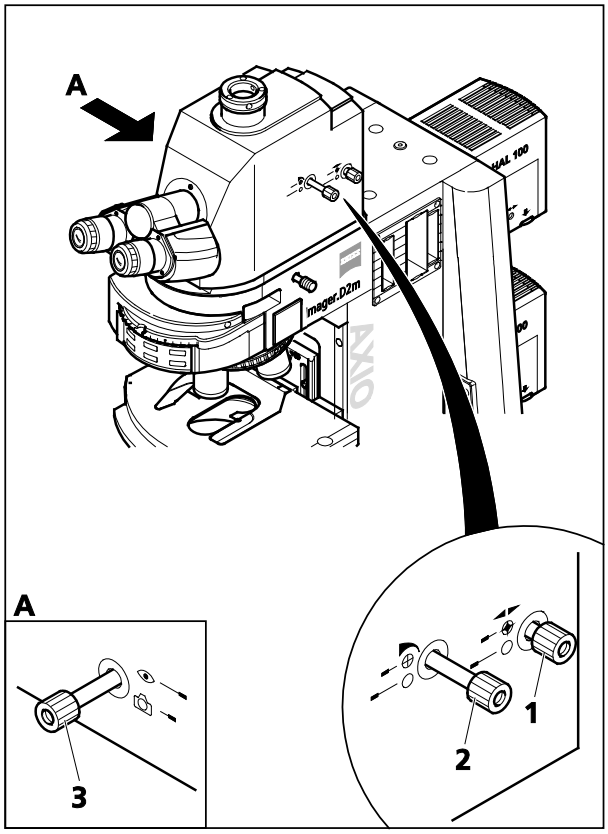


Fig. 203 **Axio Imager 2 with mounted phototube Pol**

- Set up the microscope as for transmitted-light polarization (refer to Section 4.12.5.1 (3)).
- Place the specimen on the stage and bring it into focus.
- Switch phototube Pol to visual observation, if necessary. To do so, pull out the push-pull rod on the left side (Fig. 203/**3**).
- On phototube Pol, push in the front push-pull rod (Fig. 203/**2**) on the right side to move the reticle into the light path.
- Move a selected crystal to the center of the reticle.
- Swivel in the 40x, 50x or 100x objective and, if necessary, refocus the specimen using the focusing drive.
- Check the centering of the objective by rotating the microscope stage. Recenter it, if necessary.
- Turn the front push-pull rod (Fig. 203/**2**) to close the luminous-field stop until only the selected specimen feature remains visible. This is to prevent the axial figure of the crystal being examined from being overlapped by the axial figures of adjacent crystals. This allows crystals from 10 µm diameter to be viewed in conoscopic illumination.
- Move the Bertrand lens on the phototube Pol into the light path. To do so, push in the rear push-pull rod (Fig. 203/**1**) on the right side. The axial figure then appears in the field of view. To focus the axial figure, turn the rear push-pull rod.

(4) Setting the microscope with Bertrand lens slider or tube lens turret with Bertrand lens optics for conoscopy of large-size specimens

- Set up the microscope as for transmitted-light polarization (refer to Section 4.12.5.1 (3)).
- Place the specimen on the stage and bring it into focus.
- Swivel in the 40x, 50x or 100x objective and, if necessary, refocus the specimen using the focusing drive.
- Check the centering of the objective by rotating the microscope stage. Recenter it, if necessary.
- Close the luminous-field diaphragm until only the selected specimen feature remains visible.

- Push the Bertrand lens slider into the light path. Focus the axial figure by means of the lever of the slider,
  or,
  on the tube lens turret, swivel the position with the Bertrand lens into the light path, and focus the axial figure by turning the focusing wheel.

(5) Evaluation

Crystalline anisotropic specimens can be classified into optically uniaxial and biaxial specimens, each with an "optically positive" or "optically negative" character.

Uniaxial crystals exhibit a **black cross** if the optical axis is oriented parallel to the viewing direction. **Dependent on the degree of birefringence and the specimen thickness,** concentrically arranged colored **interference fringes (the so-called isochromats)** might appear (see Fig. 204, second row).

This cross remains closed when you rotate the stage. It can be located inside or outside the imaged objective pupil, depending on the position of the section.

With **optically biaxial** crystals, the cross resolves into two **dark hyperbola branches (the so-called isogyres) depending on stage rotation** which are surrounded by colored interference patterns depending on the amount of birefringence and specimen thickness (suggestive of the figure "8").

Inserting a compensator λ (473704-0000-000) or λ/4 (473714-0000-000) or a wedge compensator 0-4 λ (000000-1140-663) in the compensator slot when the initial state of the axial figure is as shown in Fig. 204 results in the following changes in color shown schematically (blue and yellow areas) to the axial figure, thus allowing differentiation into "optically positive" and "optically negative".

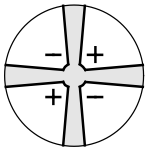
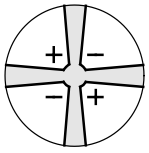
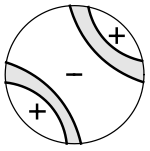
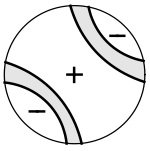
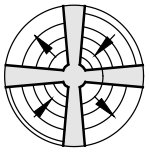
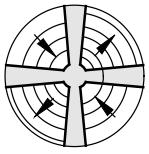
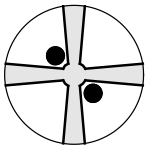
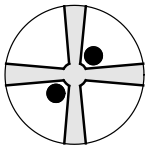
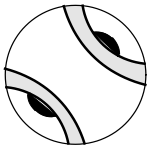
	Optically uniaxial		**Optically biaxial**		
	Positive	Negative	Positive	Negative	
λ plate (white→ blue → yellow)					+ = blue – = yellow
Quartz wedge (Direction of motion during insertion)					↗ Direction of ↙ movement
λ/4 plate (position of black spots)					

Fig. 204 Determining the optical character

If the positions of the section are less favorable, i.e. the center of the cross of optically uniaxial, or the isogyre of optically biaxial specimens is outside the objective pupil, the optical character can be assessed as follows:

- The specimen is **optically uniaxial** if the isogyres are **straight** and run parallel through the pupil (relative to the reticle).
- The specimen is **optically biaxial** if the black isogyres are **curved lines** traveling across the pupil on a circular path.

With appropriate care, even axial figures such as these (not illustrated in Fig. 204) can be interpreted.

☞ Axial figures can often be more effectively represented by circular polarization. Determining the axial angle of optically biaxial specimens (basically the space between isogyres) is much less ambiguous as a result. The optical character can also be determined. The compensator λ (6 x 20), inserted in the compensator slot, is used for this.

4.12.7 Setting reflected-light brightfield

☞ For all reflected-light contrasting techniques, the 6x20 compensators must be removed from the light path (slot for compensators).

(1) Application

Reflected-light brightfield microscopy is the simplest and most widely used microscopy technique for examining opaque samples or specimens e.g. polished sections or wafers.

For true-to-object imaging, indirect ray bundles, i.e. ray bundles diffracted and scattered on the specimen details, are of major importance besides the so-called direct ray bundles. The higher the proportion of indirect rays (aperture), the more realistic the microscope image will be, according to ABBE's rule.

The incoming, bundled light from the reflected-light illuminator is reflected by a neutral-colored beam splitter. Then it passes to the objective which focuses the beams onto the specimen surface (so-called condenser function). The objective collects the light reflected by the object and generates the intermediate image of the microscope together with the tube lens, which is then observed visually or can be documented objectively.

(2) Instrument equipment

– Axio Imager MAT with connected and adjusted HAL 100 halogen illuminator.
– H P&C reflector module in reflector turret, 6x20 compensator mount with darkfield stop for reflected light (424706-0000-000) or 4-position modulator turret.

(3) Setting reflected-light brightfield according to KÖHLER

– The microscope should be set up correctly as described in Section 3.
– Switch on the microscope.

- Switch on the halogen lamp for reflected light using the reflected-light / transmitted-light toggle switch (Fig. 76/**36**) on the microscope stand.

Depending on the equipment installed, the microscope contains a 6x20 compensator mount or a 4-position modulator turret for setting the contrasting techniques. The 6x20 compensator mount can be used for both brightfield and darkfield. For C-DIC and TIC examinations, the corresponding 6x20 slider is also required. Refer also to Section 4.12.9.

The 4-position modulator turret has a combined brightfield/darkfield position (**H/D**) as well as three additional positions for C-DIC (**C1**, **C2**) and TIC (**TIC**). Refer also to Section 4.12.10.

- If the 6x20 compensator mount is used, remove the 6x20 slider, if necessary. If the 4-position modulator turret is used, set the **H/D** position.
- Swivel the reflector turret into brightfield position **H**.
- Adjust light-intensity control (Fig. 205/**5**) on the microscope stand.
- Place a high-contrast reflected-light specimen on the stage.
- Turn nosepiece (Fig. 205/**7**) to swing in 10x objective (yellow ring, see also Section 2.5).
- Use focusing drive (Fig. 205/**6**) to focus on the specimen. In doing so, always focus away from the specimen, if possible, to avoid any collision between objective and specimen.
- Remove the reflected-light diffusion disk. Turn the adjusting screws of the HAL 100 halogen illuminator to focus and center the image of the lamp filament in the exit pupil of the objective. To do so, either pull out the adjusting aid or remove one eyepiece from the binocular tube. Afterwards, push the adjusting aid in again or reinsert the eyepiece. Move the reflected-light diffusion disk into the light path again.
- Set the aperture diaphragm (Fig. 205/**2**) in mid-position (roughly half open or closed) by turning its knurled wheel.
- Reduce the size of the luminous-field diaphragm (Fig. 205/**4**) by turning its knurled wheel until it becomes visible in the field of view (Fig. 205/**A**).
- Turn the focusing drive (Fig. 205/**6**) to refocus on the edge of the luminous-field diaphragm (Fig. 205/**B**) and (using the SW 3 ball-headed screwdriver) turn the centering screws (Fig. 205/**3**) until the luminous-field diaphragm is concentric with the edge of the field of view (Fig. 205/**C**).
- Then, open the luminous-field diaphragm (Fig. 205/**4**) so that it just disappears from the field of view (Fig. 205/**D**).
- To set the aperture diaphragm (image contrast), remove one eyepiece from the binocular tube and look into the tube with the naked eye or insert the auxiliary microscope in place of the eyepiece.
- Center the aperture diaphragm with the centering screws (Fig. 205/**1**) and, for specimens with average contrast, adjust the size of the aperture diaphragm to about 2/3 to 4/5 of the exit pupil diameter of the objective (Fig. 205/**E**) by means of knurled wheel (Fig. 205/**2**).

In most applications, this aperture diaphragm setting provides optimum contrast at almost ideal resolution, and is therefore the best compromise for the human eye.

- Finally, reinsert the eyepiece, refocus with the coaxial coarse and fine focusing drive (Fig. 205/**6**) and adapt the image brightness to the specimen being examined.

☞ Never use the aperture diaphragm to control the image brightness. Instead use the light intensity control (Fig. 205/**5**), or swivel attenuation filters of the 2-position filter wheels into the light path!

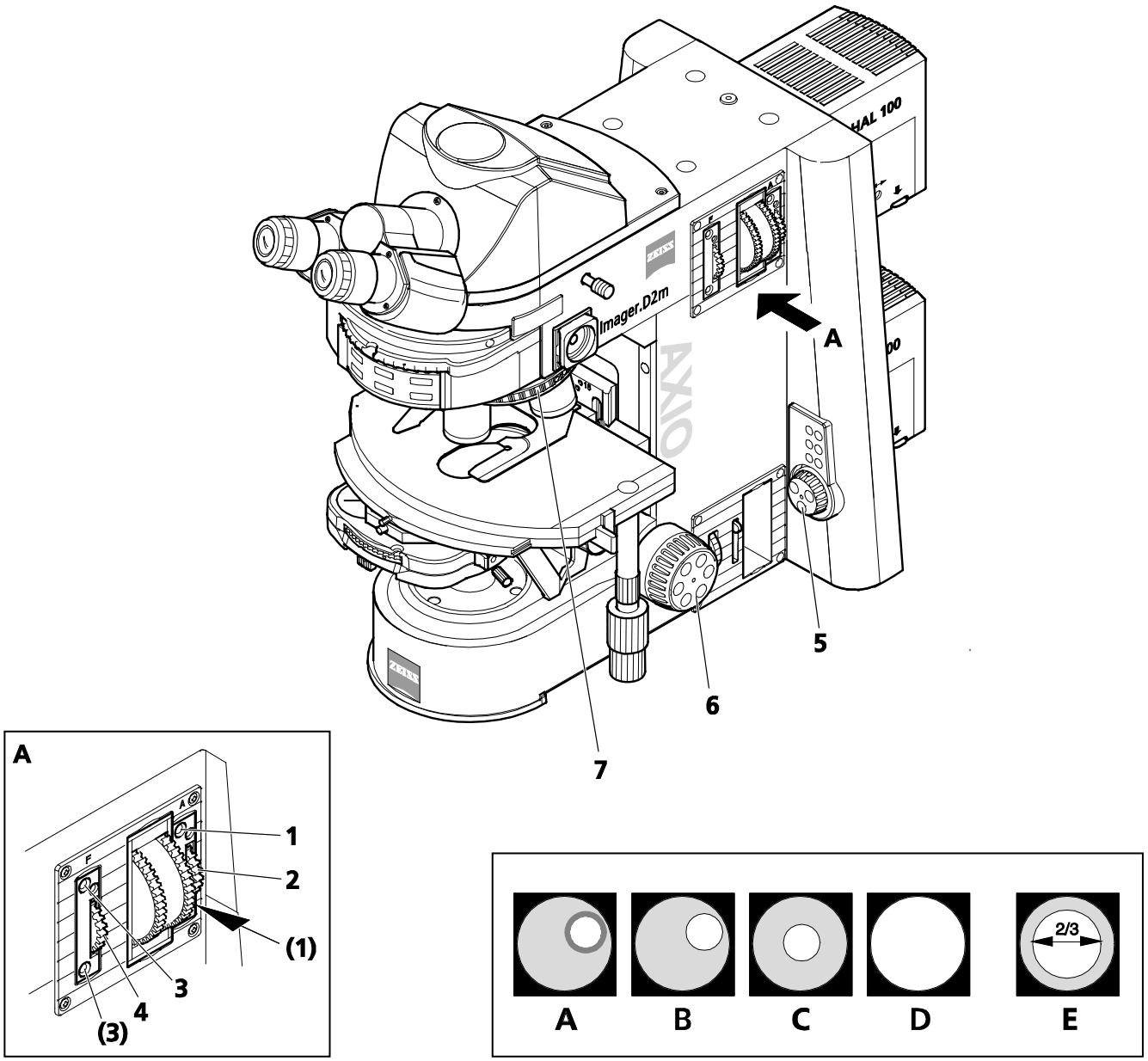


Fig. 205 Microscope settings on Axio Imager MAT in reflected-light brightfield

4.12.8 Setting reflected-light darkfield

(1) Application

The reflected light darkfield technique is used to examine specimens that not only have reflective surfaces of different reflectivity (ideal brightfield objects), but also exhibit scratches, cracks, pores, i.e. flat surface deviations. All these light-scattering details shine brightly in the darkfield whilst the reflective flat surfaces stay dark.

(2) Instrument equipment

- Axio Imager MAT with connected and adjusted HAL 100 halogen illuminator.
- Epiplan-Neofluar, EC Epiplan-Neofluar, Epiplan objectives additionally labeled "HD".
- Reflector module DF P&C, 6x20 compensator mount with darkfield stop for reflected light (424706-0000-000) or 4-position modulator turret

(3) Setting reflected-light darkfield

- Prepare the microscope as described in Section 4.12.7 for reflected-light brightfield. The luminous-field diaphragm should just disappear from the field of view to avoid reflections.
- Rotate the reflector turret to move the DF P&C reflector module into the light path.
- If the 6x20 compensator mount is used, remove the 6x20 slider, if necessary. If the 4-position modulator turret is used, set the **H/D** position.
- Rotate the nosepiece to swing in the darkfield objective (HD).
- Fully open the aperture diaphragm and remove any neutral filter from the light path.
- Place the specimen on the stage and bring it into focus.

4.12.9 Setting reflected-light DIC and reflected-light C-DIC

(1) Application

The reflected-light DIC and reflected-light C-DIC technique (DIC = Differential Interference Contrast, CDIC = Differential Interference Contrast in Circularly polarized light) produces high-contrast images of phase specimens, i.e. specimens which only change the phase of the light (in contrast to amplitude specimens).

(2) Instrument equipment

- Axio Imager MAT with connected and adjusted HAL 100 halogen illuminator.
- Rotary mechanical stage 75x50/240°
- EC Epiplan-Neofluar, Epiplan objectives additionally labeled "DIC" or "Pol".
- Matching DIC slider for the objective, the magnification and aperture of which are engraved on the top of the slider or 6x20 C-DIC slider (in connection with the reflector module C DIC P&C), 6x20 compensator mount or 4-position modulator turret).

(3) Reflected-light DIC, preferably for Epiplan 5x - 100x and LD-Epiplan 10x - 100x objectives

- Prepare the microscope as described in Section 4.12.7 for reflected-light brightfield. Open the luminous-field diaphragm until the edge just disappears from the field of view to avoid reflections.
- Rotate the reflector turret to move the C DIC P&C reflector module into the light path.
- Rotate the nosepiece to swing in the objective position with DIC slider slot.
- Push the DIC slider into the slot on the nosepiece (above the objective).
- Place the specimen on the stage, bring it into focus and rotate the mechanical stage until the specimen structure of interest appears at maximum contrast.
- Turn the knurled screw on the DIC slider to optimize the contrast.

(4) Reflected-light C-DIC

- Prepare the microscope for reflected-light brightfield.
- On the nosepiece, swivel in the objective suitable for DIC.
- Bring the C DIC P&C reflector module into the light path.
- Push the C-DIC slider 6x20 (Fig. 206/**3**) into the 6x20 compensator mount (Fig. 206/**4**) or rotate the 4position modulator turret (Fig. 206/**6**) using turret wheel (Fig. 206/**5**) to swing in the desired C-DIC position (**C1** or **C2**).

☞ C1 for 5x … 20x objectives;
C2 for 50x … 100x objectives.

When using objectives of 50x or higher, it is advisable to deploy the reflected-light diffusion disk.

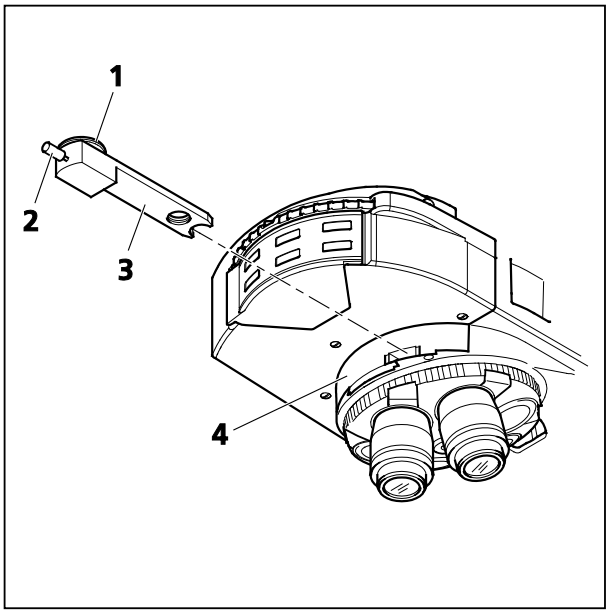


Fig. 206 6x20 compensator mount with 6x20 C-DIC slider

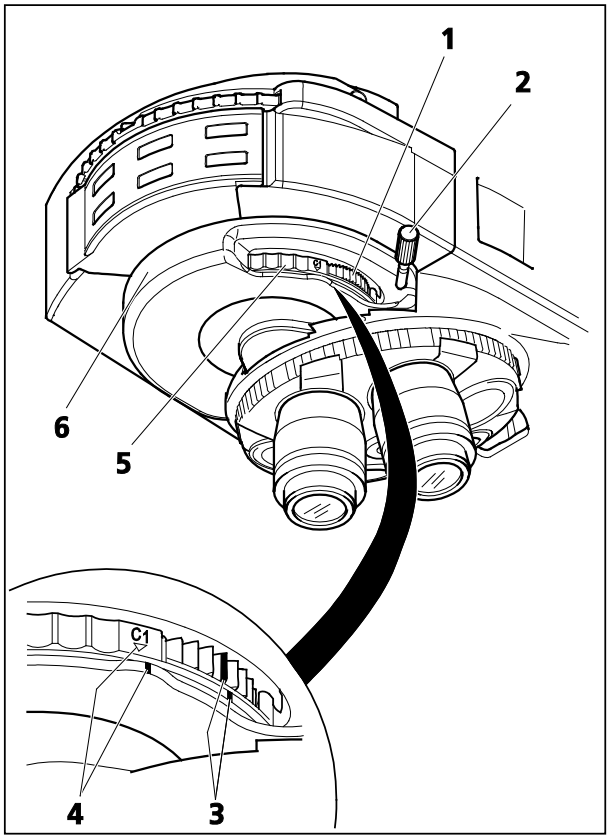


Fig. 207 4-position modulator turret

- Place the specimen on the stage, focus on it and rotate the control wheel (Fig. 206**1**) on the CDIC slider 6x20 or the modulator turret (Fig. 207/**1**) until the specimen detail of interest is visible at maximum contrast. Rotating the stage is no longer necessary. When both line marks face each other (Fig. 207/**3**), this corresponds to the mid-position. 45° rotation in both directions is possible.
- The contrast can be optimized by turning the setscrew (Fig. 206/**2**) on the C-DIC slider or on the modulator turret (Fig. 207/**2**). When the triangular and line marks face each other (Fig. 207/**3**), this corresponds approximately to the extinction position (best contrast).

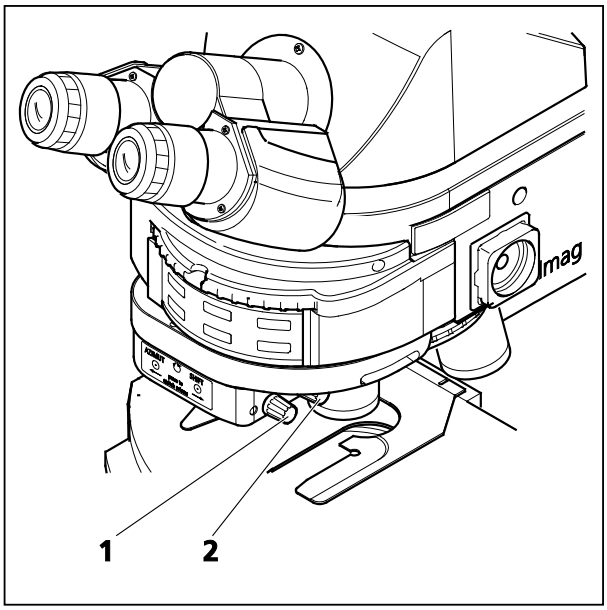


Fig. 208 Motorized four-position modulator turret for circular DIC/TIC

(5) Setting the reflected light DIC with motorized four-position modulator turret for circular DIC/TIC

- Prepare the microscope for reflected-light brightfield.
- Bring the C DIC P&C reflector module into the light path.
- On the nosepiece, swivel in the objective suitable for DIC.
- On the modulator turret, swivel in the appropriate DIC prism by **pressing** button (Fig. 208/**1**) for forward rotation or on button (Fig. 208/**2**) for backward rotation of the turret.
- Place the specimen on the stage, bring it into focus and turn knob (Fig. 208/**2 SHIFT**) so that the structure of interest can be seen in maximum contrast.
- The contrast can be optimized by turning knob (Fig. 208/**1** - **AZIMUTH**) on the modulator turret.

4.12.10 Setting reflected-light TIC

(1) Application

The reflected-light TIC technique (microinterferometry; TIC = Total Interference Contrast in circularly polarized light) can be used to image and measure object structures available in different azimuths.

(2) Instrument equipment

- Axio Imager MAT with connected and adjusted HAL 100 halogen illuminator.
- EC Epiplan-Neofluar, Epiplan objectives additionally labeled "DIC" or "Pol".
- 6x20 compensator mount or 4-position modulator turret
- 6x20 TIC slider with accompanying C DIC P&C reflector module.

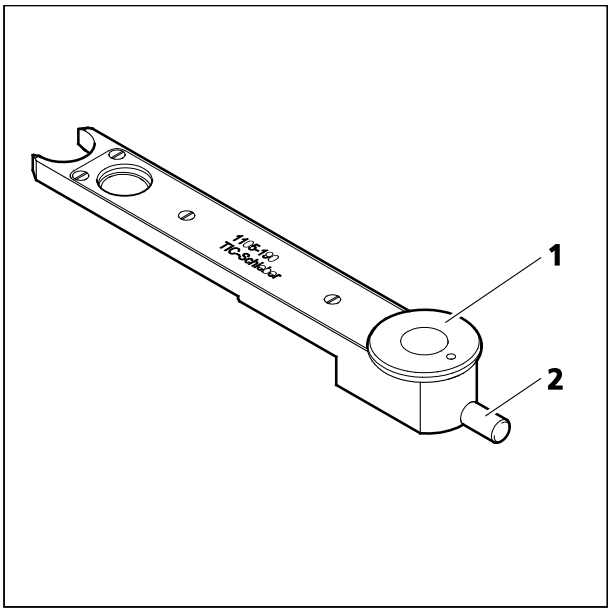


Fig. 209 6x20 TIC slider

(3) Setting reflected-light TIC

- Place the specimen (e.g. a step-shaped object) on the stage and prepare the microscope as described in Section 4.12.7 for reflected-light brightfield.
- Rotate the reflector turret to swing C DIC P&C reflector module into the light path.
- Push the 6x20 TIC slider into the 6x20 compensator mount (Fig. 206/**4**) or rotate turret wheel (Fig. 207/**5**) of the 4position modulator turret (Fig. 206/**6**) into TIC-Position (**TIC**). Colored interference fringes appear in the field of view. Turn the setscrew (Fig. 209/**2**) of the TIC slider or the modulator turret to shift the black interference fringe until it appears to be in the center of the field of view.
- To select the structure to be measured, turn control wheel (Fig. 209/**1**) of the TIC slider or modulator turret until the interference fringe system is vertical to the splitting direction of the specimen (see Fig. 210). The interference fringes can be shifted by means of setscrew (Fig. 209/**2**) of the TIC slider or the modulator turret.

☞ Refer to Section 4.12.9 (5) for the use of the motorized four-position modulator turret for the reflected-light TIC technique.

The step height is then determined using the following formula:

$$d = \frac{n\Delta}{2} = \frac{\lambda b}{2a}$$

where: d = step height in nm
n = refractive index of the environment, usually air (n = 1)
Δ = path difference
a = spacing of interference fringes
b = offset of interference fringes at the step
λ = wavelength of the illumination in nm

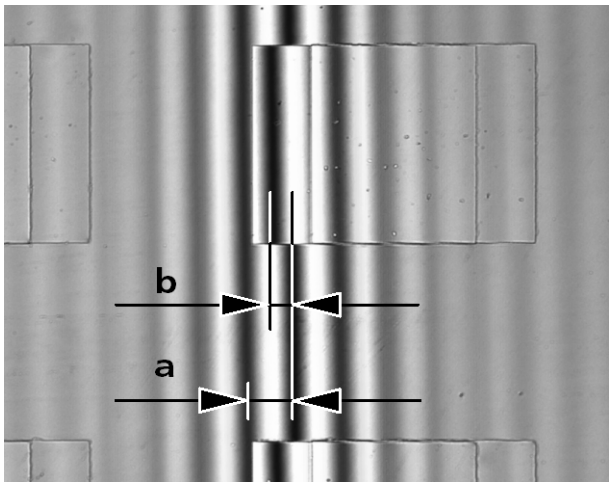


Fig. 210 Interference fringe pattern

The values for a and b (see Fig. 210) are determined using the eyepiece reticle or the micrometer eyepiece.

If you are working with white light (without interference filter), λ = 550 nm must be used. When using interference filters, their center wavelength applies.

The measured path difference is aperture-dependent and decreases with increasing illumination aperture.

Accordingly, the following correction values must be taken into account depending on the objective used:

Objective	Correction factor k
5x/0.15	1.0057
10x/0.25	1.0161
10x/0.30	1.0236
20x/0.4	1.0436
20x/0.50 and 50x/0.75	1.0718
50x/0.60	1.1111
50x/0.75 and 100x/0.75	1.2038
50x/0.80	1.2500
50X/0.90 and 100x/0.90	1.3929
100X/0.95	1.5241

Table 1: Aperture-dependent correction

Example:

a = 11 mm b = 5 mm

λ = 550 nm Objective 20x/0.50

$$d = \frac{\lambda \cdot b \cdot k}{2a} = \frac{550\ \text{nm} \cdot 5\ \text{mm} \cdot 1.0718}{22\ \text{mm}} = 134\ \text{nm}$$

Important:

- If the step and the environment are of different materials, the phase jumps inherent in the material must be taken into account. The phase jump for all non-conductors is 180° and for semiconductors it only deviates slightly from 180°, i.e. the measuring error is negligible, however the measured values may be falsified for metals on glass for example. The phase jumps in table 2 calculated for vertically incident light and compact material serve as recommended values because it can be assumed that the phase jumps depend on the layer thickness and the angle of incidence of the light. Accurate determination of the thickness is only possible by coating the entire object with a homogeneous layer and then measuring the path difference.
- If the layers or steps are transparent (e.g. silicon dioxide on silicon), the interference fringes may change their color. Determination of the interference order then becomes problematical. This can also be remedied by coating the surface with an additional homogenous layer.

Material	**Phase jump ϕ**
Copper	140.0°
Gold	142.5°
Silver	151.0°
Bismuth	151.0°
Nickel	157.0°
Iron	157.5°
Zinc	159.0°
Platinum	160.0°
Aluminum	160.0°
Tin	160.5°
Chromium	165.0°
Carbon	160.0°
Graphite	165.0°
Silicon	177.0°
Glass	180.0°

Table 2: Calculated phase jumps for compact material and vertically incident light

Half the difference of the phase jumps is included in the determination of the thickness:

$$d = \frac{\Delta}{2} - \frac{\delta\phi}{2}$$

Example: Extreme case: copper on glass

$\Phi_{copper} = 140°$, $\Phi_{glass} = 180°$ therefore part of the phase jump

$$\frac{\delta\phi}{2} = 20° \text{ or } \frac{\lambda}{18} = 30 \text{ nm}$$

without taking the phase jump inherent in the material into account the measured value would be 30 nm too large.

4.12.11 Setting reflected light fluorescence

To change the transmission, use a discrete FL attenuator (423616-0000-000 or 423617-0000-000). The gray filters mounted in the 2-position filter wheels (428300-9901-000 or 428301-9901-000) are not permanently stable.

The gray filter set (487935-9020-000) may be used since colored glass filters are used here.

(1) General principle

The reflected light fluorescence technique enables high-contrast images of fluorescent substances to be displayed in typical fluorescence colors. In the reflected light fluorescence microscope, light generated by a high-performance illuminator reaches the exciter filter (band pass) through a heat protection filter. The filtered short-wave excitation light is reflected by a dichroic beam splitter and focused on the specimen via the objective. The specimen absorbs the short-wave light and then emits the long-wave fluorescence light (Stoke's law) which is now gathered by the objective and transmitted by the dichroic beam splitter. Finally, the rays pass through a barrier filter (long pass/band pass) which only allows the long-wave light from the specimen to be transmitted.

Exciter and barrier filters must be perfectly matched from a spectral viewpoint. They are arranged in a reflector module FL P&C together with the corresponding dichroic beam splitter.

(2) Instrument equipment

- Recommended objectives: EC Plan-Neofluar or Fluar objectives (UV excitation)
- Reflector module FL P&C in reflector turret
- Mercury vapor short-arc lamp HBO 100 for reflected-light illumination
- Halogen illuminator HAL 100 for transmitted-light illumination

Before using the reflected light fluorescence technique, ensure that the mercury vapor short-arc lamp is aligned by using the adjusting aid as described in Section 3.33.3. Re-alignment may be necessary depending on the operating time.

(3) Setting reflected light fluorescence

The initial reflected light fluorescence set up is much simpler if you begin with the EC-Plan-Neofluar objective 20x/0.50 and a strongly fluorescing specimen. Demonstration specimens may also be used first.

Before setting reflected light fluorescence, make sure the compensator λ (Fig. 197/**7**) is removed from the slot above the nosepiece which may have been left there from a previous transmitted-light DIC examination.

- Switch on halogen illuminator HAL100.
- Swivel in EC-Plan-Neofluar objective 20x/0.50.
- First, swivel the condenser turret to the brightfield position H (or phase contrast Ph) and identify the specimen feature to be examined.
- Keep the beam path in the reflected-light illuminator initially blocked with reflected-light shutter RL (rear right on microscope stand) (indicator LED lit).

- Switch on the HBO 100 mercury vapor short-arc lamp (Fig. 211/**1**) and allow it to warm up to operating temperature for about 15 minutes.
- On the reflector turret (Fig. 211/**2**), select the reflector module FL P&C containing the desired fluorescence filter combination (depending on the desired kind of excitation) and swivel it in.
- Remove the reflected-light shutter RL from the light path in the reflected-light illuminator and close the transmitted-light shutter TL.
- Remove one eyepiece from the tube and set the aperture diaphragm with bare eye. To do so, open the aperture diaphragm (Fig. 211/**4**) until it clears the full exit pupil of the objective. Center the aperture diaphragm to the exit pupil using the two centering screws (Fig. 211/**3** and **5**), if necessary.
- Reinsert the eyepiece in the tube and close the luminous-field diaphragm (Fig. 211/**7**) until it is visible in the field of view.
- Use the two centering screws (Fig. 211/**6** and **8**) to center the luminous-field diaphragm to the edge of the field of view.
- Open the luminous-field diaphragm until it just disappears from the field of view or, if there is a risk of specimen bleaching, close it until it is visible in the field of view.
- Finally, refocus on the specimen and optimize the position of the HBO 100 collector as described in Section 3.33.3. Adjust the collector so that the field of view is illuminated as evenly as possible when using the short-wave excitation reflector module. When long-wave excitation modules are used, no correction of the collector position is required.

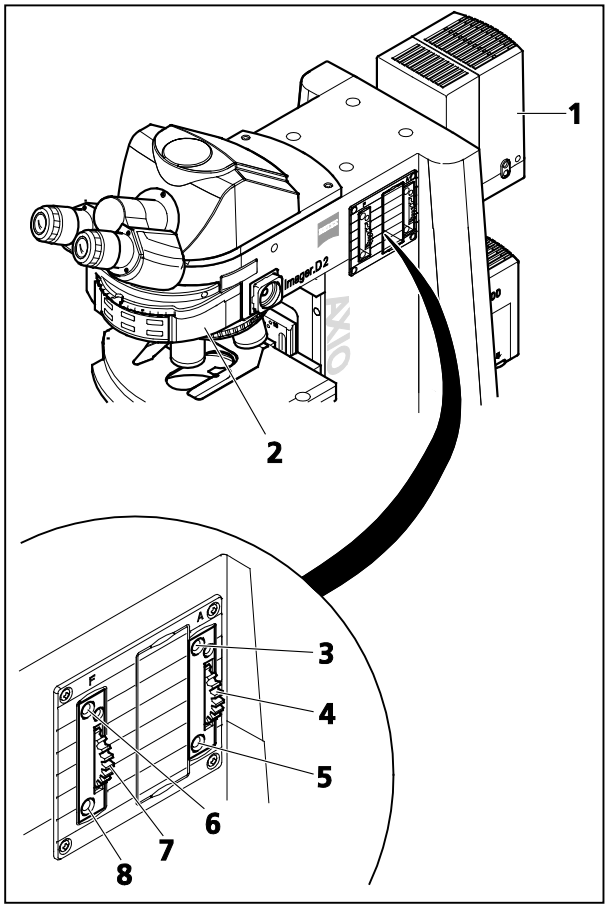


Fig. 211 **Epi-fluorescence components on Axio Imager 2**

4.12.12 Setting reflected-light polarization – Detection of bireflection and reflection pleochroism

(1) Application

Reflected light polarization presents a further contrasting option for polished sections of ore minerals, coals, ceramic products, certain metals and metal alloys, as these specimens often exhibit varied reflection behavior in linearly polarized light depending on the orientation of the crystals and specimen features.

The illumination light is linearly polarized by the polarizer and directed through the objective onto the specimen surface, where it is reflected. Here, the light rays experience structure-dependent path differences or polarization-optical rotations which, on passing the analyzer, appear as different gray-scale values. A compensator with lambda plate permits conversion from gray to color contrast. **Important! Nevertheless, no 6x20 compensator should be used for this purpose!**

With very low magnification objectives, a rotatable λ/4 plate in front of the objective (Antiflex cap) permits reflections to be eliminated even with "dark" specimen surfaces which otherwise would be unavoidable.

(2) Instrument equipment

- Stand with connected and aligned HAL 100 halogen illuminator.
- Epiplan-Neofluar Pol, EC Epiplan-Neofluar Pol, Epiplan Pol objectives.
- Reflector module DIC P&C or DIC Rot I P&C in reflector turret;
  or reflector module Pol P&C plus analyzer slider;
  or analyzer slider plus polarizer slider.

(3) Setting reflected-light polarization

- Set the microscope for reflected-light brightfield as described in Section 4.12.7.
- If you use the objective position with DIC slider slot, remove the DIC slider if installed.
- On the reflector turret (Fig. 212/**3**), swing the reflector module DIC P&C (Fig. 212/**4**) into the light path. You may also swing in reflector module Pol P&C and insert the analyzer slider in the corresponding slot. When using the combination of analyzer slider (Fig. 212/**1**) and polarizer slider (Fig. 212/**2**), you may also push these into the corresponding slots. If you use the fixed versions of these sliders, the polarizer is oriented EAST-WEST and the analyzer NORTH-SOUTH.
- Put the specimen onto the stage, set the desired magnification, focus and observe the specimen in the polarization contrast now available while rotating the stage.

If the specimen features exhibit variations in brightness and color when the stage is rotated, the specimen is said to have bireflection.

If the specimen only has weak bireflection, it is advisable to use the analyzer with rotatable lambda plate.

Pleochroism can be recognized from color variations occurring in the specimen when the stage is rotated (with the reflected-light polarizer in the light path but not the analyzer).

☞ If the microscope is equipped with the phototube Pol, the following settings are required for this contrast method: The Bertrand lens must be inactive (rear push-pull rod (Fig. 212/**6**) on right side pulled out). The luminous-field diaphragm must be open (front push-pull rod (Fig. 212/**5**) turned counterclockwise as far as it will go). The crossline reticle must be inactive (front push-pull rod (Fig. 212/**5**) pulled out).

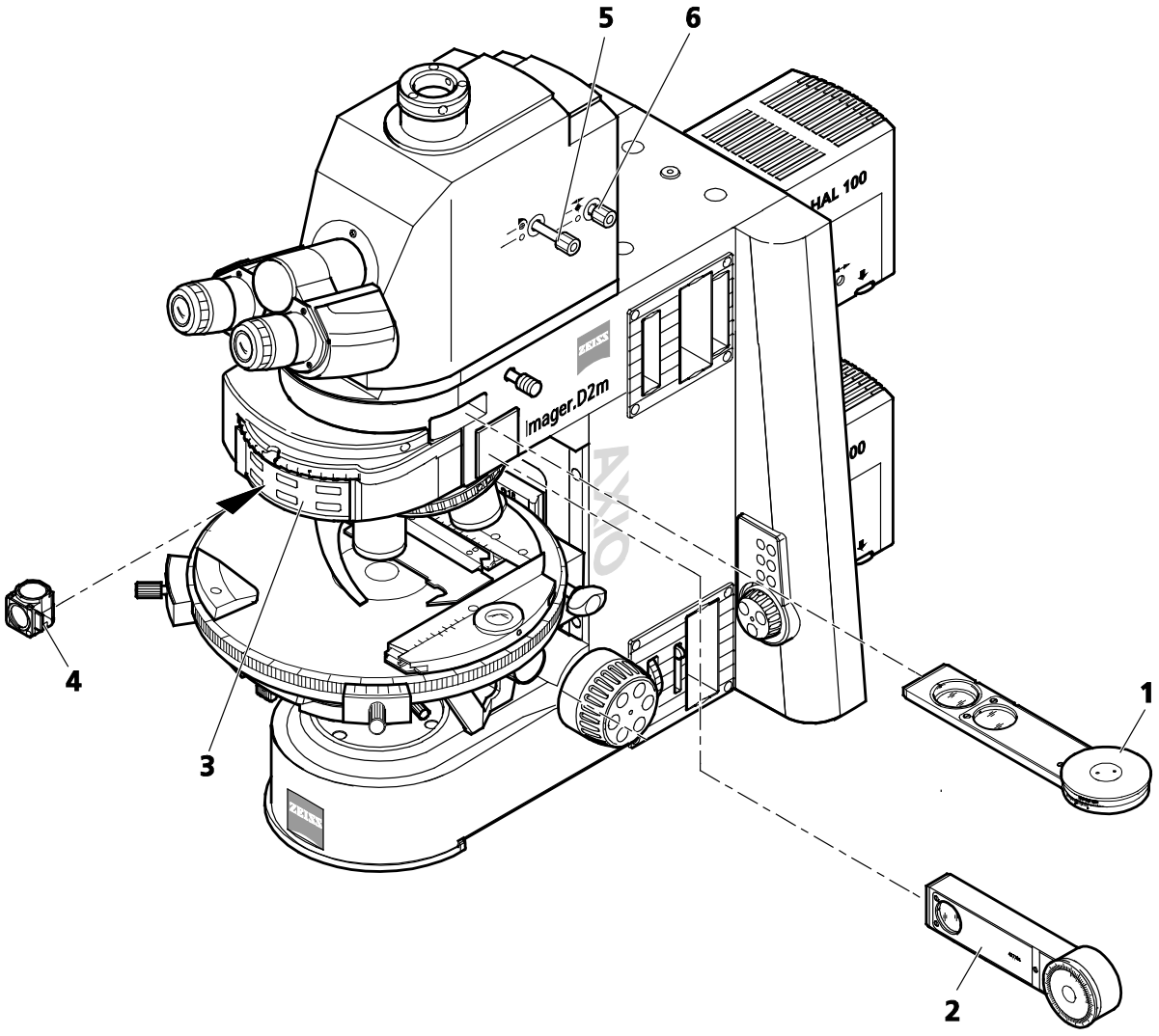


Fig. 212 Components for reflected-light polarization

5 CARE, MAINTENANCE, TROUBLESHOOTING AND SERVICE

5.1 Instrument care

Care of the Axio Imager is restricted to the following operations:

The Axio Imager microscopes are not equipped with any special devices for protection from substances that are corrosive, potentially infectious, toxic, radioactive, or other substances that could be hazardous to health. Observe all legal regulations, particularly the relevant national accident prevention regulations when handling such substances.

- Eliminate contamination of the instrument according to the accident prevention regulations.
- Switch off the instrument after each use and place the instrument cover on it to protect it from dust and humidity.
- Do not set up the instrument in a humid room; maximum humidity $\leq$ 75%.
- Cover open tubes with dust caps.
- Remove dust and loose dirt on visible optical surfaces with a brush, blower brush, cotton bud, optics cleaning tissue or cotton cloth.
- Remove water-soluble dirt (coffee, cola, etc.) by blowing on it and wiping it off with a lint-free cotton cloth or a cloth moistened with water to which a mild detergent may also be added.
- Wipe off stubborn, oily or fatty dirt (such as fingerprints and immersion oil) with a cotton swab or lint-free cotton cloth and the optics cleaning solution L.
  The cleaning solution consists of 90 vol% gasoline and 10 vol% isopropanol (IPA). The individual components are also known as:
  Gasoline: Medical alcohol, petroleum ether
  Isopropanol: 2-Propanol,
  Dimethylcarbinol,
  2-Hydroxypropane

Clean optical surfaces by polishing in circles, starting in the middle and moving to the edges (only use slight pressure).

When using the microscope in humid climatic zones, proceed as follows:

- Store the instrument in bright, dry and well-ventilated rooms with a humidity of < 75 %. Optical components and accessories that are particularly susceptible to fungus growth, e.g. objectives and eyepieces, should be stored in a dry closet.

The risk of fungus growth on opto-mechanical instruments invariably exists in the following conditions:

– Relative humidity > 75% and temperatures between +15 °C and +35 °C for more than three days.

– Installation in dark rooms without air ventilation.

– Dust deposits and fingerprints on optical surfaces.

5.2 Instrument maintenance

5.2.1 Performing checks

- Makes sure the available line voltage matches the required operating voltage.
- Check the power cable and plug for defects.
- If any damage is visible, switch off the instrument. Only have the instrument repaired by qualified technicians.
- Check the reading of the operating hour meter of the power supply to ensure that the maximum operation time of the mercury vapor short-arc lamp has not been exceeded.

5.2.2 Changing fuses on the manual stand

Always disconnect the power plug before changing the fuses.

If any fuses fail, the cause of the failure must first be determined. Any technical defect should be repaired by trained personnel.

On the manual Axio Imager model, the fuse compartment is on the back of the microscope and contains two **T 5.0 A/H / 250 V, 5x20 mm** fuses.

- Disconnect the power plug.
- Pull out fuse holder (Fig. 213/**2**) forward. Use a small screwdriver, if necessary.
- Remove the fuses from the holder and insert new fuses.
- Push the fuse holder back into the fuse compartment (Fig. 213/**1**) as far as it will go.
- Connect the power plug.

The motorized Axio Imager model is powered by the VP232-2 power supply. (For fuse changes, see Section 5.2.3).

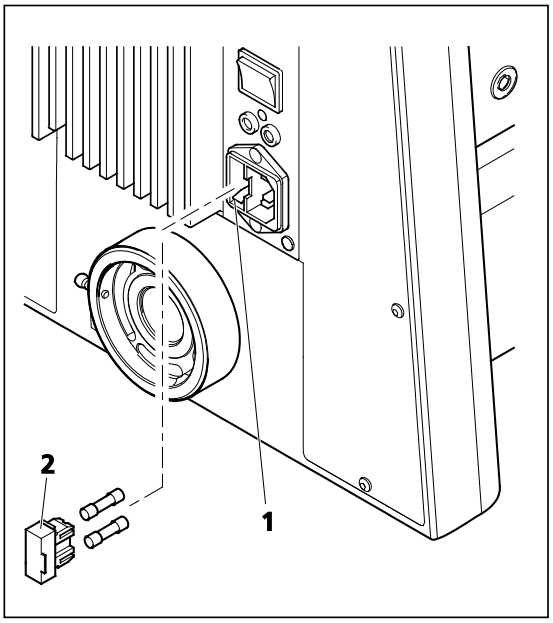


Fig. 213 Changing fuses on the stand

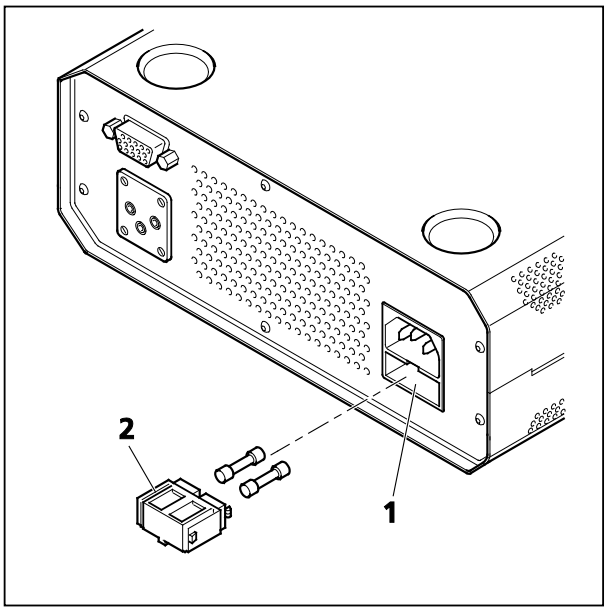


Fig. 214 Changing fuses on the power supply

5.2.3 Changing fuses on the VP232-2 CAN power supply

Always disconnect the power plug before changing the fuses.

If any fuses fail, the cause of the failure must first be determined. Any technical defect should be repaired by trained personnel.

The fuse compartment is located on the back of the power supply and contains two type **T 4.0 A / 250 V, 5x20 mm fuses**.

- Disconnect the power plug.
- Pull out fuse holder (Fig. 214/**2**) forward. Use a small screwdriver, if necessary.
- Remove the fuses from the holder and insert new fuses.
- Push the fuse holder back into the fuse compartment (Fig. 214/**1**) as far as it will go.
- Connect the power plug.

5.3 Troubleshooting

Problem	Cause	Troubleshooting
Shadows or uneven image brightness levels in the field of view; the field is not entirely visible.	The vis/doc push-pull rod on the phototube is not in the correct position (intermediate position).	Move the vis/doc push-pull rod to the correct position (end position).
	The nosepiece with objective has not clicked into place.	Turn the nosepiece with the objective until it clicks into place.
	The condenser is not set correctly.	Set the condenser correctly (adjust, center); see p. 161 ff.
	The aperture diaphragm is not set correctly.	Set the aperture diaphragm correctly (centering, aperture); see p. 161 ff.
	The luminous-field diaphragm is not set correctly.	Set the luminous field-diaphragm correctly (centering, opening); see p. 161 ff.
	The filter has not been inserted correctly in the filter mount.	Insert the filter correctly in the filter mount.
No DIC effect	The polarizing elements are not in the beam path.	Move the polarizing elements into the beam path and set them to crossed position.
Double images in brightfield examinations	DIC slider in the light path.	Remove DIC slider from the light path.
Low resolving power and poor image contrast.	The aperture diaphragm has not been opened to the correct size.	Set the aperture diaphragm using the 2/3 rule or to match the specimen features; see p. 162 ff.
	The condenser has not been focused correctly and front lens 0.9 not swiveled in / out correctly.	Focus the condenser and swivel front lens 0.9 correctly in or out; see p. 162 ff.
	Wrong cover glass thickness used for transmitted-light objectives with 0.17 mm cover glass thickness.	Use standardized 0.17 mm cover glasses.
	Specimen slide placed upside down.	Turn slide so that specimen is facing up.
	Use of no or non-specified immersion oil with immersion objectives.	Use Immersol 518 F® immersion oil from Carl Zeiss; see p. 202.
	Air bubbles in the immersion oil.	Remove the bubbles by applying new oil.

Problem	Cause	Troubleshooting
Low resolving power and poor image contrast.	Immersion oil on the front lens of a dry objective.	Clean the front lens of the dry objective; see p. 196.
	The cover-slip correction ring has not been set to the correct cover-slip thickness.	Set the correction ring to the correct thickness; see p. 27.
	Dirt or dust on the optical surfaces of objectives, eyepieces, condensers or filters.	Clean the respective optical components; see p. 196.
Asymmetrically blurred images, e.g. one side in focus, one side not.	The condenser has not been set correctly.	Set the condenser correctly; see p. 162 ff.
	The nosepiece has not clicked into place.	Turn nosepiece until it clicks into place (click-stop).
	The specimen has not been clamped in position on the stage.	Correctly insert the specimen in the specimen holder and clamp it.
Major focus differences after objective change.	The focusing eyepieces have not been set correctly.	Set the focusing eyepieces to the appropriate ametropia; see p. 37.
	The objective has not been screwed in completely.	Screw the objective in as far as it will go.
	The tube lens has either not been inserted or has been inserted but is superfluous.	Insert the tube lens or remove the superfluous tube lens.
Left and right fields of view cannot be combined to create one image.	The interpupillary distance of the binocular tube has not been set correctly.	Set the interpupillary distance correctly; see p. 38.
	The focusing eyepieces have not been set correctly.	Set the focusing eyepieces to the appropriate ametropia; see p. 37.
Eye-fatiguing microscopy.	The interpupillary distance of the binocular tube has not been set correctly.	Set the interpupillary distance correctly; see p. 38.
	The focusing eyepieces have not been set correctly.	Set the focusing eyepieces to the appropriate ametropia; see p. 37.
	The image brightness is not acceptable.	Adjust the lamp voltage or insert the conversion filter.
	Binocular tube optically / mechanically out of alignment.	Have it checked / repaired by Microscopy Service.

Problem	Cause	Troubleshooting
Dirt or dust in the field of view.	The condenser has not been focused correctly and front lens 0.9 not swiveled in / out correctly.	Focus the condenser and swivel front lens 0.9 correctly in or out; see p. 162 ff.
	The aperture diaphragm opening is too small.	Set the aperture diaphragm using the 2/3 rule or to match the specimen features; see p. 162 ff.
	Dirt or dust on the optical surfaces of the objectives, eyepieces, condensers, filters or specimens.	Clean the optical surfaces of the affected components; see p. 196.
The 12 V 100 W halogen lamp does not function although the on / off switch is set to "on".	The power plug has not been connected to the power outlet.	Connect the power plug to an appropriate power outlet for the power requirements of the instrument.
	12 V 100 W halogen lamp has not been installed.	Insert 12 V 100 W halogen lamp; see p. 61.
	12 V 100 W halogen lamp is defective.	Replace 12 V 100 W halogen lamp; see p. 61.
	Failure to use the specified 12 V 100 W halogen lamp.	Use the specified 12 V, 100 W halogen lamp; see p. 202.
	The fuses are defective.	Replace defective fuses; see p. 197.
	The electronic module is possibly defective.	Have electronic module checked by Service and replaced, if required; see p. 203.
	The power outlet does not supply any voltage.	Use another power outlet.
The 12 V 100 W halogen lamp flickers, the light intensity fluctuates.	End of average service life of 12 V 100 W halogen lamp.	Replace 12 V, 100 W halogen lamp; see p. 61.
	Incorrectly installed or broken power cable.	Connect the power cable correctly or replace it.
	The pins of the 12 V 100 W halogen lamp haven not been inserted correctly in the receptacle.	Insert the pins of the 12 V 100 W halogen lamp correctly in the receptacle; see p. 61.

5.4 Spares, consumables and tools

Designation	Cat. No.	Designated use
12V 100W halogen lamp	380059-1660-000	For HAL 100 illuminator
HBO 103 W/2 mercury vapor short-arc lamp	380301-9350-000	For HBO 100 illuminator
SW 1.5 ball-headed screwdriver *	000000-0460-470	For changing condensers and stages
AF 3 ball-headed screwdriver *	000000-0069-551	For changing tubes and illuminators
SW 4 offset screwdriver *	000000-0015-278	For removing the carrying handle
Eyepiece eyecup	444801-0000-000	Recommended for suppressing reflections in low-light techniques
Dust cap for nosepiece Dust cap for eyepiece sockets	462981-0000-000 000000-0168-373	For sealing instrument openings not in use
Immersion medium Immersol 518 F®; Oiler, 20 ml Bottle, 100 ml Bottle, 250 ml	 444960-0000-000 444962-0000-000 444963-0000-000	For oil immersion applications n_D = 1.518
Cleaning tissue, 300 sheets	462975-0000-000	For cleaning optical surfaces
G-fuse inserts (5 x 20 mm); T 5.0 A/H / 250 V; 2x (Stand, manual) G-fuse inserts (5 x 20 mm); T 4.0 A / 250 V; 2x (Power supply VP232-2 for motorized stand)		Protects the integrated power supply from excessive load Protects the integrated power supply from excessive load
Dust cover set M Dust cover set L Set of cover caps (included in 434303-0000-000 and 434304-0000-000)	434303-0000-000 434304-0000-000 434302-0000-000	For covering the instrument when it is not in use. For covering eyepieces

* Included in the tool kit that is supplied in the tool bag with the instrument (451892-0000-000).

5.5 Requesting service

All repairs of mechanical, optical or electronic components inside the instrument and of the electrical components of the Axio Imager 2 microscopes may only be performed by ZEISS service staff or specially **authorized** personnel.

To ensure optimum settings and trouble-free functioning of your microscope over a longer period of time, we recommend concluding a service/maintenance agreement with ZEISS.

For follow-up orders or when service is required, please get in touch with your local ZEISS representative.

For additional information, contact us at

mikro@zeiss.de

http://www.zeiss.de/AxioImager

http://www.zeiss.de/AxioImagermat

online.

6 APPENDIX

6.1 List of abbreviations

AC	Alternating current
ACR	Automatic component recognition
RL	Reflected light
Br.	*Brille* / Suitable for eyeglass wearers
cod.	coded
CSA	Canadian Standards Association
D	*Dicke* / Cover slip thickness
D / DF	Darkfield
d	Diameter (e.g. of filters)
DIC	Differential Interference Contrast
DIN	*Deutsches Institut für Normung* / German Standards Institute
TL	Transmitted-light LED
doc	Documentation
EC	European Community
EN	European standard
EMC	Electromagnetic compatibility
FL	Fluorescence
foc.	focusing
H	*Hellfeld* / Brightfield
HAL	Halogen lamp
HBO	Mercury vapor short-arc lamp for fluorescence
ICS	Infinity color-corrected system
IEC	International Electrotechnical Commission
IP	Internal Protection (protection by instrument casing)
ISO	International Organization for Standardization
IvD	In vitro diagnostic medical devices
LED	Light Emitting Diode
man.	manual
MC	Microscope camera
mot.	motorized
n_D	Refractive index for D line (sodium)
Ph	Phase contrast
PL	Plan
Pol	Polarization

P&C	Push&Click
R	Right (drive knob to the right of the mechanical stage)
RL	Reflected light
AF	Wrench size across flats
T	Slow-blow (fuse type)
TL	Transmitted light
TV	Television
UL	Underwriter Laboratories
UV	ultraviolet
VDE	*Verband Deutscher Elektrotechniker* / Association for Electrical, Electronic & Information Technologies
vis	visual
V_{obj}	*Vergrößerung* / Magnification of objective
W 0.8"	Whitworth-type thread 0.8"
W-PL	Wide-field eyepiece
XBO	Xenon short-arc lamp

6.2 Index

T

U

V

W

6.3 Industrial property rights

Instruments, instrument components or methods described in this manual are protected by patents and registered utility models:

US6276804

US6392796

US5015082

CH691699

GB2306585

US6123459

DE29821694