Motic®

MORE THAN MICROSCOPY

BA210 BASIC BIOLOGICAL MICROSCOPE

Instructions Manual

English

Motic Incorporation Ltd.

CE c UL us UL Listed Product E250223

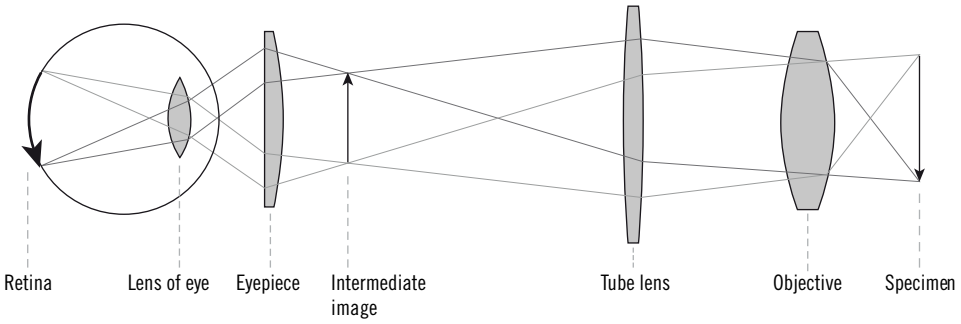
INFINITY OPTICAL SYSTEM

An optical configuration (in which the specimen is located at the front focal plane of the objective) gathers light transmitted through or reflected from the central portion of the specimen and produces a parallel bundle of rays projected along the optical axis of the microscope toward the tube lens.
A portion of the light reaching the objective originates from the periphery of the specimen, and enters the optical system at oblique angles, moving forward diagonally but still in parallel bundles toward the tube lens. All of the light gathered by the tube lens is then focused at the intermediate image plane, and subsequently enlarged by the eyepiece.
The real merit of the infinity based system lies in its ability to accommodate modular accessories in the optical path and produce a flexible design.

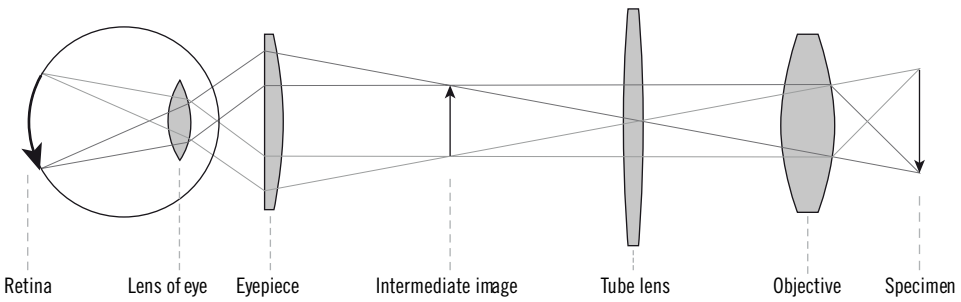
CONVENTIONAL MICROSCOPE

The conventional microscope has a two-stage magnification system. There are two lens systems, the objective and the eyepiece, mounted at opposite end of a body tube. The objective forms an enlarged real image of the object being examined and is called intermediate image. The intermediate is further enlarged by the eyepiece and is seen as a virtual image of the intermediate image. The eye can examine this final image, situated at infinity. The total magnification of the microscope is determined by the focal lengths of the objective and eyepiece.

Optical System Using Infinity Corrected Objectives



Optical System Of A Conventional Microscope



Microscope Terminology

Abbe Condenser
A two-lens sub-stage condenser located below the stage of a microscope and functions to collect light and direct it onto the object being examined. Its high numerical aperture makes it particularly suited for use with most medium- and high-magnification objectives.

Aperture, Numerical (N.A.)
The numerical aperture is an important factor determining the efficiency of the condenser and objective. It is represented by the formula: (**N.A. = ηsinα**), where **η** is the refractive index of a medium (air, water, immersion oil etc.) between the objective and the specimen or condenser, and **α** is half of the maximum angle at which light enters or leaves the lens from or to a focused object point on the optical axis.

Cover Glass Thickness
Transmitted light objectives are designed to image specimens that are covered by a thin cover glass (cover slip). The thickness of this small glass piece is now standardized at 0.17 mm for most applications.

Diaphragm, Condenser
A diaphragm, which controls the effective size of the condenser aperture. A synonym for the condenser illuminating aperture diaphragm.

Magnification
The number of times by which the size of the image exceeds the original object. Lateral magnification is usually meant. It is the ratio of the distance between two points in the image to the distance between the two corresponding points in the object.

Micrometer: um
A metric unit of length measurement
= $1x10^{-6}$ meters or 0.000001 meters

Nanometer (nm)
A unit of length in the metric system equal to 10^{-9} meters.

Phase–contrast (microscopy)
A form of microscopy, which converts differences in object thickness and refractive index into differences in image amplitude and intensity.

Real Viewfield
The diameter in millimetres of the object field.
Real Viewfield = Eyepiece Field of View/Objective Magnification

For example BA210:
Eyepiece field of view = 20mm
Objective magnification = 10X
Diameter of the object field = 20/10 = 2.0mm

Diopter adjustment
The adjustment of the eyepiece of an instrument to provide accommodation for the eyesight differences of individual observers.

Depth of Focus
The axial depth of the space on both sides of the image plane within which the image is sharp. The larger the N.A. of objective, the shallower the depth of focus.

Field of View (F.O.V.)
That part of the image field, which is imaged on the observer's retina, and hence can be viewed at any one time. The field of view number is now one of the standard markings of the eyepiece.

Filter
Filters are optical elements that selectively transmit light. It may absorb part of the spectrum, or reduce overhaul intensity or transmit only specific wavelengths.

Immers ion Oil
Any liquid occupying the space between the object and microscope objective. Such a liquid is usually required by objectives of 3-mm focal length or less.

Resolving Power
A measure of an optical system's ability to produce an image which separates two points or parallel lines on the object.

Resolution
The result of displaying fine details in an image

Total Magnification
The total magnification of a microscope is the individual magnifying power of the objective multiplied by that of the eyepiece.

Working Distance
This is the distance between the objective front lens and the top of the cover glass when the specimen is in focus. In most instances, the working distance of an objective decreases as magnification increases.

X–axis
The axis that is usually horizontal in a two-dimensional coordinate system. In microscopy X-axis of the specimen stages is considered that which runs left to right.

Y–axis
The axis that is usually vertical in a two-dimensional coordinate system. In microscopy Y-axis of the specimen stages is considered that which runs front to back.

We are constantly endeavouring to improve our instruments and to adapt them to the requirements of modern research techniques and testing methods. This involves modification to the mechanical structure and optical design of our instruments.
Therefore, all descriptions and illustrations in this instruction manual, including all specifications are subject to change without notice.

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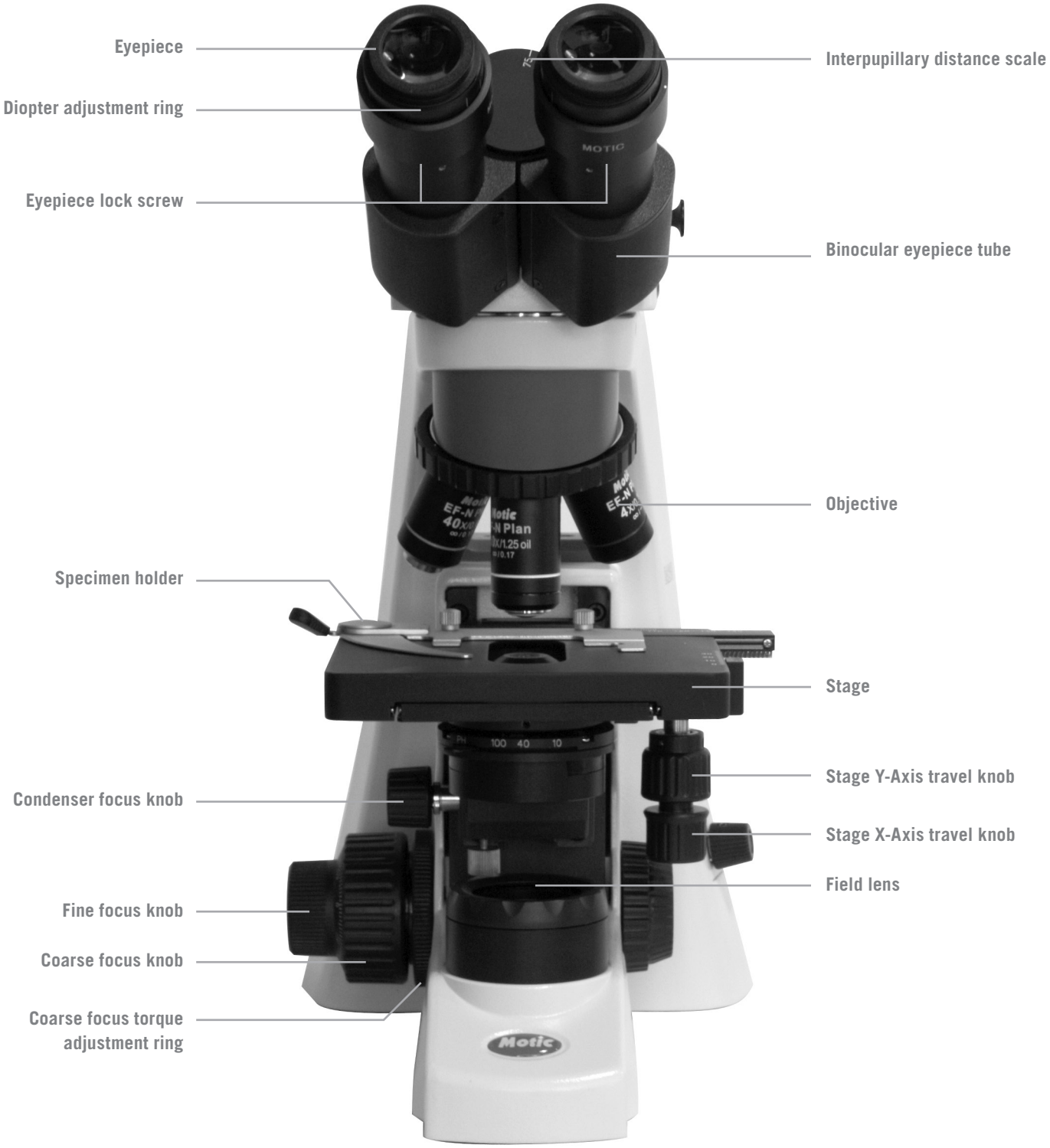
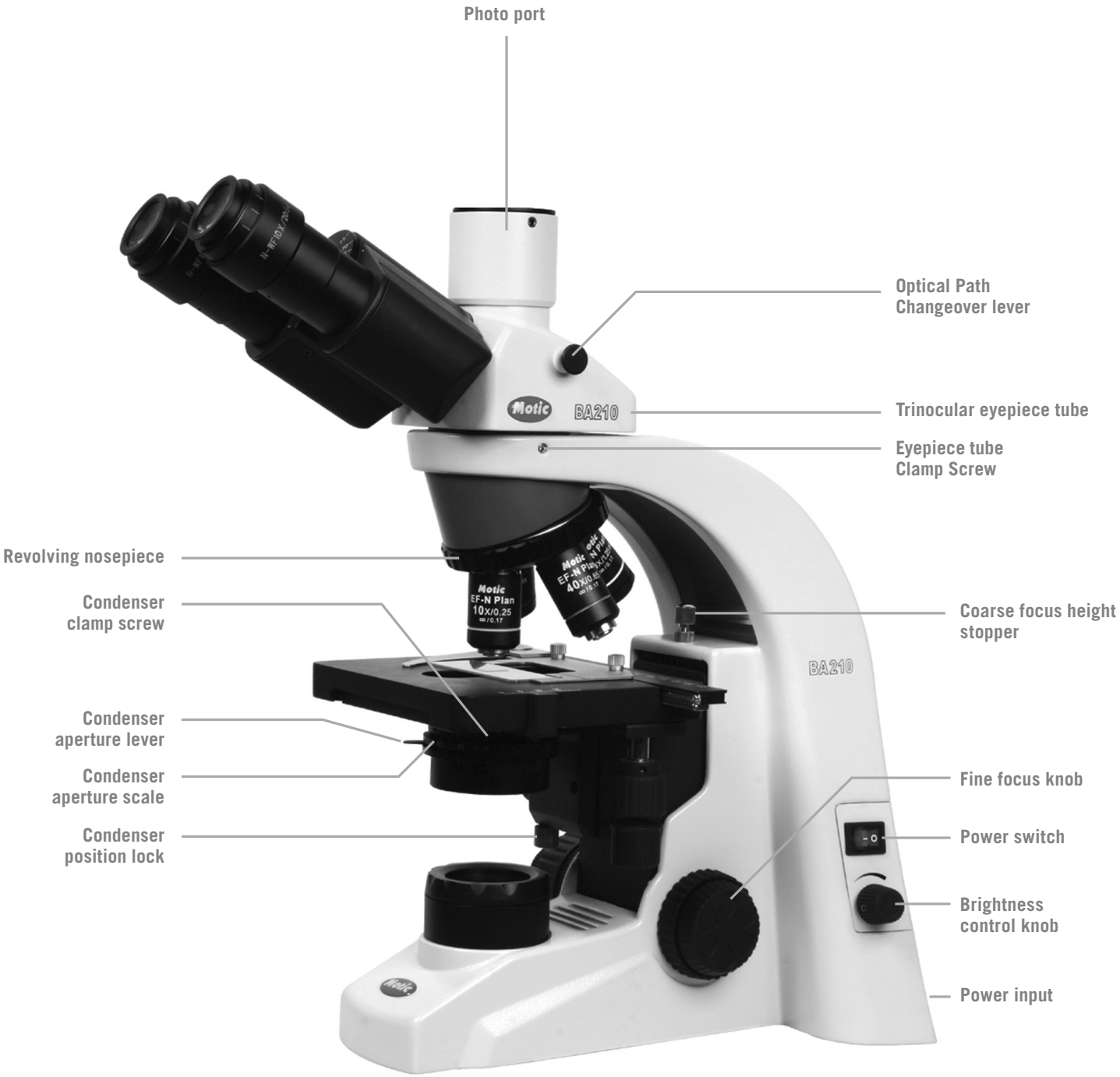
1. Nomenclature





BA210 Trinocular

2. Setting Up The Instrument

Avoid placing the instrument in locations exposed to direct sunlight, dust, vibration, high temperature and high humidity and where it is difficult to unplug the power supply cord.

2.1. Operating environment

- Indoor use
- Altitude: Max 2000 meters
- Ambient temperature: 15°C to 35°C
- Maximum relative humidity: 75% for temperature up to 31°C decreasing linearly to 50% relative humidity at 40°C
- Supply voltage fluctuations: Not to exceed ±10% of the normal voltage.
- Pollution degree: 2 (in according with IEC60664)
- Installation / Overvoltage category: 2 (in according with IEC60664)
- Air pressure of 75kPa to 106 kPa
- No hoar frost, dew, percolating water, rain

3. Assembling The Microscope

3.1. Verifying Input Voltage

- The automatic voltage selection works with a broad range of settings. However, always use a power cord that is rated for the voltage used in your area and that has been approved to meet local safety standards. Using the wrong power cord could cause fire or equipment damage.
- In case of using the extension cord, use only a power supply cord with a protective earth (PE) wire.
- In order to prevent electric shock, always turn the power switch on the power supply off before connecting the power cord.
- Electrical Specifications:

a. Halogen

Input : 90-240V~, 38W, 50-60Hz (Hologen)
Lamp : 6V30W Halogen
Fuse : 250V T2.5A (If the original fuse is blown, please replace with specified fuse)

b. LED

Input : 90-240V~, 6W, 50-60Hz (LED)
Lamp : 3W LED
Fuse : 250V T1A (If the original fuse is blown, please replace with specified fuse)

3.2. Lamp and Lamp House Cover (Replacing The Lamp)

The lamp and the lamphouse become very hot during and after a period of operation.
Risk of burn – Do not touch the lamp during or immediately after period of operation.
Make sure the lamp has cooled sufficiently before attempting to replace the lamp.

a. Halogen

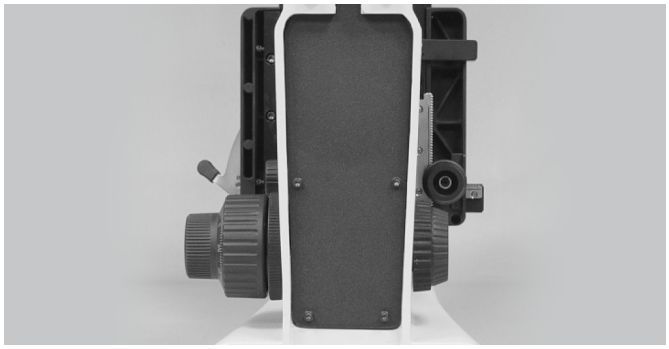
- In order to prevent electric shock always turn the power switch off and unplug the power cord before installing or replacing the lamp.
- Place microscope on its back and pull back the lamp house cover plate.
- Firmly insert the lamp into the socket pinholes until it reaches the limit. Be careful not to tilt the lamp when mounting.
- When installing the lamp, do not touch the glass surface of the lamp with bare fingers. Doing so will cause fingerprints, grease, etc., to burn onto the lamp surface, reducing the illumination provided by the lamp. If the surface is contaminated,

wipe it clean using lens tissue.

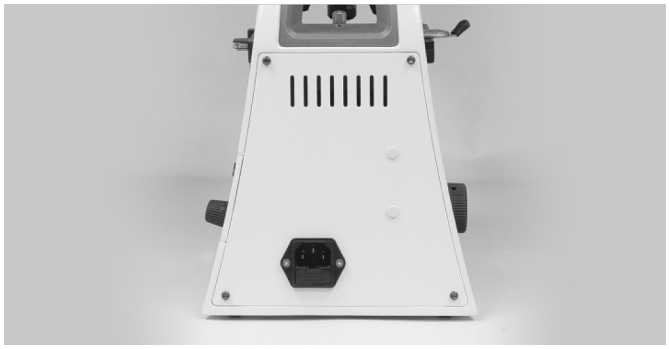
• Close lamp house cover plate and secure until it snaps into position.

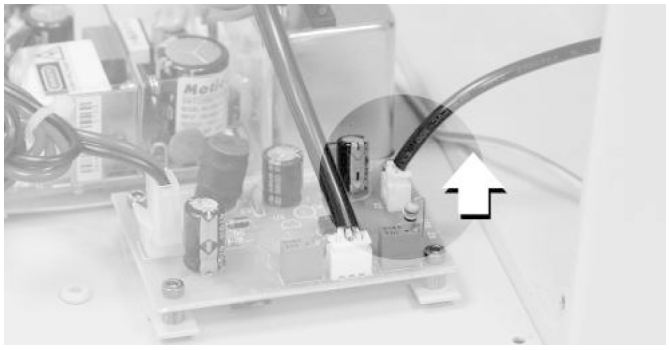
b. LED

1. Unscrew two hexagonal screws retaining the base plate.



2. Unscrew four Allen hex socket cap screws holding back cover plate.
The printed circuit board is located behind the back cover plate.

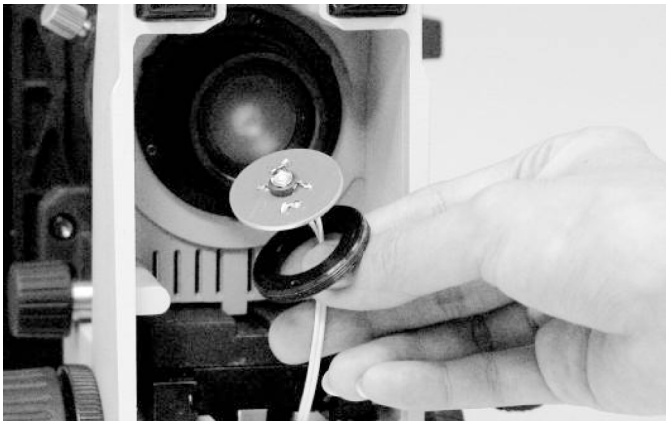




3. Disconnect the LED connection cables from the power supply printed circuit board.

4. Loosen LED board locating ring, take away LED board locating ring.

5. Install the new LED.



6. Feed LED cable through LED board locating ring.
7. Connect the LED connection cables to the power supply printed circuit board, then tighten LED board locating ring.
8. Fasten four Allen hex socket cap screws holding back cover plate.

3.3. Illumination

a. Halogen Lamp

• The quartz halogen lamp, used as a light source, has higher luminance and colour temperature than conventional tungsten lamps. The luminance is approximately four times greater.

• As long as the lamp voltage is kept constant, the halogen lamp maintains the same level of brightness and colour temperature regardless of whether it is new or nearing the end of its life.

b. LED

• This is the first 3W microscopic illumination system with global patent for long life, adjustable high intensity, low heat generation, low energy consumption and safe operation.

3.4. Mechanical Stage

• Remove specimen holder for fast hand scanning of slides.

• Left hand and right hand operation stages for option.

3.5. Specimen Holder

• Attach the specimen holder, using the two mounting holes.

3.6. Objectives

Lower the stage completely. Screw the objectives into the revolving nosepiece so that clockwise rotation of the nosepiece brings the next higher magnification objective into position.

3.7. Condenser

• Raise the stage by turning the coarse focus knob.

• Raise the condenser carrier by turning the condenser focus knob.

• Insert the condenser into the mount with aperture scale facing forward towards the user. Secure with the condenser clamp screw.

• Turn the condenser focus knob to raise the condenser as far as it will go.

3.8. Eyepiece Tube

• Loosen the eyepiece clamp screw. Insert the round dovetail mount on the eyepiece tube into the round dovetail mount on the microscope arm. Tighten the eyepiece tube clamp screw to secure the eyepiece tube in place.

3.9. Eyepieces

• Use the same magnification eyepieces for both the eyes.

• To lock the eyepiece, insert each eyepiece completely into the eyepiece sleeve and tighten the clamp screws.

• Twist the eyepiece (anti-clockwise or clockwise) with 20~30 degree and pull the eyepieces gently out when removing the eyepiece.

3.10. Filters

• Remove the collector cover and place the filter in the filter holder located around the field lens, screw the collector cover, taking care that dust, dirt and fingerprints do not get on the filter and the field lens.

• Filter selection:

Filter	Function
ND2 (T=50%)	For brightness adjustment in photomicrography
ND4 (T=25%)	
ND16 (T=6.25%)	
Blue filter (colour balance filter)	For routine microscopy and photomicrography
Green interference (546nm)	For phase contrast and contrast adjustment with black and white film
HE (didymium filter)	For colour photomicrography of HE stained specimen with tungsten type film

• A diffuser is built into the base of the microscope.

3.11. Power Cord

• Connect the socket of the of the power cord to the AC inlet on the rear of the base of the microscope. Plug in the other end of the cord to an AC outlet with ground conductor.

4. Microscopy

4.1. Coarse And Fine Focusing

• Focusing is carried out with the coarse and fine focus knobs at the left and right of the microscope stand.
• The direction of vertical movement of the stage corresponds to the turning direction of the focus knobs.
• One rotation of the fine focus knob moves the stage 0.2mm. The graduation on the fine focus knob is 2 microns.

• Never attempt either of the following actions, since doing so will damage the focusing mechanism:
• Rotate the left and right knob while holding the other.
• Turning the coarse and fine focus knobs further than their limit.

4.2. Coarse Focus Torque Adjustment

• To increase the torque, turn the torque adjustment ring located behind the left-hand coarse focus knob in the direction indicated by the arrow. To reduce the torque, turn the ring in the direction opposite to that indicated by the arrow.

4.3. Coarse Focus Height Stopper

• The coarse focus height stopper marks the stage position at which the specimen is in focus i.e. by restricting the movement of the coarse focus knob.
• With the specimen in focus, turn the coarse focus stopper knurled screw anti-clockwise until it reaches the stop.
• When the coarse focus stopper is in position, the stage cannot be raised from that position. However, the fine focus knob can move the stage regardless of the limit but will only lower the stage.
• Lower the stage by using the coarse focus knob.

4.4. Optical Path Changeover Slider

• The optical path change over slider of the trinocular eyepiece tube can be used to select the amount of light distributed between the trinocular eyepiece tube and the vertical phototube.
• When the change over slider is pushed in until it reaches the limit, 100% of the light enters the observation tube. When the changer over slider is pulled out to the limit, the ratio of light entering the observation tube and phototube will be 20:80.

4.5. Interpupillary Distance Adjustment

• Before adjusting the interpupillary distance, bring a specimen into focus using the 10x objective.
• Adjust the interpupillary distance so that both the right and left field of view become one.
• This adjustment will enable the user to observe the specimen with both eyes

4.6. Diopter Adjustment

• Diopter adjustment compensates for the differences in vision between the left and right eyes. In addition to making observation through both eyes easier, this adjustment also reduces the extent to which focusing is lost when the objective magnification is changed. In particular, this occurs when a low magnification objective is used.
• The left eyepiece has a separate focusing provision to compensate for slight differences in the focusing of each eye.
• Using the right eye only and viewing through the right-hand eyepiece, adjust the focus with the microscope fine or coarse adjustment until the image of the specimen is at its sharpest.
• Using the left eye only and viewing through the left-hand eyepiece with its independent diopter- focusing ring, focus until the specimen image is at its sharpest.
• The microscope should now be ready binocular viewing.

4.7. Condenser (Sourced Focused (Critical) Illumination)

• Critical illumination relies on using the sub-stage condenser to produce a focused image of the homogeneous light source in the plane of the specimen in order to achieve an even illumination condition over the entire field of view.
• To have the light source focused in the plane of the specimen, an imaging disc with concentric circles (and with its matte surface facing toward the microscope base) is placed on the field lens and is focused on to the specimen plane. This is achieved by moving the condenser up or down with condenser focus knob.
• The correct vertical setting of the condenser remains unaltered when changing magnifications.
Because the light source is imaged onto the specimen, both the specimen and the light source are said to be in the field plane. The condenser iris diaphragm controls the N.A. of the system, and is therefore said to be located in an aperture plane of the microscope.

4.8. Use Of Aperture Diaphragm

• The condenser aperture diaphragm is provided for adjusting the numerical aperture (N.A.) of the illuminating system of the microscope, it decides the resolution of the image, contrast, depth of focus and brightness.
• Stopping down will lower the resolution and brightness but increase the contrast and depth of focus.
• An image with appropriate contrast can be obtained with an aperture setting that is 2/3 of the objective N.A.
• To adjust the aperture diaphragm:
- Adjust the condenser aperture diaphragm lever referring to the condenser aperture scale, or
- by observing the diaphragm image visible on the exit pupil inside the eyepiece tube, or
- by using a centering telescope after removing one of the eyepieces and focusing on the aperture diaphragm.

4.9. Brightness And Contrast Adjustment

• Neutral density filters are used for brightness adjustment in routine microscopy and photomicrography.
• Green interference (546nm) for phase contrast and contrast adjustment with black and white film.
• HE (didymium filter) for colour photomicrography of the Haematoxylin & Eosin (HE) or Fuchsin stained specimen with tungsten type film.

5. Photomicrographic Procedure

• To ensure vibration free operation, set the microscope on a sturdy vibration free table or a bench with a vibration proof device.
• Pull the optical path selection lever of the trinocular eyepiece tube all of the way out to the limit, the ratio of light entering the observation tube and phototube will be 20:80.
• For the same total magnification, select a combination of the highest possible objective magnification and lowest possible projection lens magnification to achieve the utmost image definition and contrast.
• To ensure optimal illumination, check the position and centring of the lamp and position of the condenser.
• Select a blue filter for routine application. An additional colour-compensating filter can also be used depending on the colour rendition.
• Adjusting the field diaphragm is important for the purpose of limiting extraneous light that may cause flare and lower the contrast. Stop down the diaphragm to achieve an illuminated area slightly larger than that of the field of view.
• A change of depth of focus, contrast and resolution of image is attainable with an aperture setting that is 2/3 of the objective N.A.

6. Using Oil Immersion Objectives

• Oil immersion objectives are labelled with the additional engraving “Oil” and are to be immersed in oil between the specimen and the front of the objective.
• The immersion oil supplied by Motic is synthetic, non-fluorescing and non-resining oil, with a refractive index of 1.515
• Normally, cover glass must be used with oil immersion objectives with a few exceptions.
Deviations from thickness are not important as a layer of immersion oil acts as compensation above the cover glass.
• The small bottle of oil supplied with every immersion objective facilitates application of the oil to the cover slip.
• Remove any air bubbles in the nozzle of the oil container before use.
• Immersion oil must be used sparingly. After the examination, the oil should be wiped off the objective with a lens cleaning tissue and the residual film removed with soft cloth moistened with petroleum benzine or absolute alcohol.
• Locate the field of interest, with a lower magnification objective, swing the objective out of the light path, and add one drop of immersion oil over the site of the specimen. Swing in the oil immersion objective. Use the fine focus to make the image sharp.
• Freedom from air bubbles must be ensured. To check for air bubbles, remove an eyepiece, fully open the field and aperture diaphragms, and look at the exit pupil of the objective within the eyepiece tube. Air bubbles are recognized by presence of a surrounding black ring. Bubbles may often be dislodged by moving the slide to and fro or by slightly rocking the revolving nosepiece back and forth. If not successful in clearing the bubbles then the oil must be wiped off and replaced with a fresh drop.

7. Troubleshooting Table

As you use your microscope, you may occasionally experience a problem.
The troubleshooting table below contains the majority of frequently encountered problems and the possible causes.

Optical

Problem	Possible Cause
Vignetting or uneven brightness in the field of view or field of view only partially visible	Lamp not installed properly
	Condenser not mounted correctly
	Condenser is set too low
	Aperture diaphragm closed too far
	Revolving nosepiece not clicked into position
	Trinocular eyepiece tube optical path selector lever in intermediate position
	Filter not in placed in properly
Dust or dirt in the field of view	Aperture diaphragm closed too far
	Condenser is set too low
	Dust or dirt on specimen surface
	Dust or dirt on field lens, filter, condenser or eyepiece
Poor image (low contrast or resolution)	Condenser is set too low
	Aperture diaphragm closed too far
	No cover glass
	Too thick or thin cover glass
	Immersion oil not used on immersion procedure
	Air bubbles in immersion oil
	Specified immersion oil used not used
	Immersion oil on dry objective
	Greasy residue on eye lens
	Incorrect illumination
Uneven focus	Specimen holder not fixed securely on stage
	Specimen not secured in position
	Specimen tilted on stage surface
Image tinged yellow	Lamp voltage is set too low
	Blue filter is not being used
Focusing is not possible with high magnification objectives	Slide is upside down
	Cover glass is too thick
High magnification objectives strike the specimen when changing over from low to high magnification	Slide is upside down
	Cover glass is too thick
	Eyepiece diopter not adjusted
Insufficient parfocality of objectives	Eyepiece diopter not adjusted

Problem	Possible Cause
No cohesion of binocular image	Magnification or field of view of left and right eyepieces differ
	Interpupillary distance not adjusted
	Eyepiece diopter not adjusted
Eye strain or fatigue	Interpupillary distance not adjusted
	Diopter adjustment not made
	Field of view of left and right eyepiece differ
	Inadequate illumination

Electrical

Problem	Possible Cause
Lamp does not light	Power supply not plugged in
	Lamp not installed
	Lamp burnt out
Inadequate brightness	Specified lamp not being used
Lamp blows out immediately	Specified lamp not being used
Lamp flickers	Connectors are not securely connected
	Lamp near end of service life
	Lamp not securely plugged into socket

8. Care And Maintenance

A. Do not disassemble

1. Disassembly may significantly affect the performance of the instrument, and may result in electric shock or injury and will void the terms of the warranty.
2. Never attempt to dismantle any parts other than described in this manual. If you notice any malfunction, contact your nearest Motic representative.

B. Cleaning the Microscope

- Do not use organic solvents such as ether; alcohol or paint thinner on painted surfaces or plastic components. Doing so could result in discolouration of painted or plastic surfaces.
- When cleaning lenses do not use any solvents other than absolute alcohol as, they may damage lens bonding cement.
- Do not use petroleum benzene when cleaning components such as filters or lenses.
- Absolute alcohol and petroleum benzene are highly flammable. Keep away from open flames and when turning the power switch on or off.
- For stubborn dirt, dampen a piece of gauze with diluted neutral detergent and wipe lightly.

C. Disinfecting the Microscope

- Follow the standard procedures for your laboratory.

D. When not in use

- When not in use, cover the instrument with vinyl dust cover and store in a place low in humidity where mould is not likely to form.
- Store the objectives, eyepieces and filters in a container or desiccator with drying agent.
- Proper handling of the microscope will ensure years of trouble free service.
- If repair become necessary, please contact your Motic agency or our Technical Service direct.

Note:

- If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.
- To avoid getting wet, do not use the microscope near water.

9. Warning labels

The following warning labels (or symbols) are found on the microscope, study the meaning of the warning labels (or symbols) and always use the equipment in the safest possible manner.

Indicates that the surface becomes hot, and should not be touched with bare hands.

Indicates that the main switch is ON.

Indicates that the main switch is OFF.

Indicates alternating current.

CAUTION! Risk of danger.
Please consult documentation in all cases where this symbol is used.

The lamp and the lamphouse become very hot during and after a period of operation.
Risk of burn – Do not touch the lamp during or immediately after period of operation.
Make sure the lamp has cooled sufficiently before attempting to replace the lamp.

Don't pick up from the bottom during equipment operation.

Proper handling of the microscope will ensure years of trouble free service.
If repair become necessary, please contact your Motic agency or our Technical Service directly.

Motic®

www.motic.com

Motic Incorporation Ltd. (HONG KONG)
Rm 2907-8, Windsor House, 311 Gloucester Road,
Causeway Bay, Hong Kong
Tel: 852-2837 0888 Fax: 852-2882 2792

Motic Instruments (CANADA)
130 - 4611 Viking Way. Richmond, BC V6V 2K9 Canada
Tel: 1-877-977 4717 Fax: 1-604-303 9043

Motic Spain, S.L. (SPAIN)
Polígon Industrial Les Corts, Camí del Mig, 112 08349
Cabrera de Mar, Barcelona, Spain
Tel: 34-93-756 6286 Fax: 34-93-756 6287

Motic Deutschland GmbH (GERMANY)
Christian-Kremp-Strasse 11, D-35578 Wetzlar, Germany
Tel: 49-6441-210 010 Fax: 49-6441-210 0122

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Design changes
The manufacturer reserves the right to make changes in instrument design in accordance with scientific and mechanical progress, without notice and without obligation.

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