

Nikon

Measuring Microscope MM-400/800 Series

Instructions

MICROSCOPY + METROLOGY SERVICES
Suisse made



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Thank you for purchasing this Nikon product.

This instruction manual, which describes basic microscope operations, is intended for users of the Nikon measuring microscope MM-400 and MM-800 series.



To ensure correct use, please read this manual carefully before operating the product.

- This manual may not be reproduced or transmitted in whole or in part without Nikon's express consent.
- The contents of this manual are subject to change without notice.
- Although every effort has been made to ensure the accuracy of this manual, errors or inconsistencies may remain. If you note any points that are unclear or incorrect, please contact your nearest Nikon representative.
- Some of the products described in this manual may not be included in the set you have purchased.
- Make sure you have read the manuals for any other products attached to or to be used with this product.

● Warning/Caution symbols used in this manual

Although Nikon products are designed to provide the utmost safety, ignoring safety precautions or improper use may result in personal injury or property damage, as well as voiding the terms of the warranty. To ensure safe use, please read the instruction manual carefully and thoroughly before trying to operate the instrument. Do not discard this manual. Store in a convenient location near the product for ready reference.

In this manual, safety precautions are indicated by the following symbols. For safe, correct use of the product, always follow the instructions indicated by these symbols.

Symbol	Meaning
 WARNING	Disregarding instructions indicated by this symbol may result in death or serious injury.
 CAUTION	Disregarding instructions indicated by this symbol may result in injury or property damage.

● Meaning of symbols used on the product

When appearing on the product, the symbols below indicate the need for caution at all times during use. Consult the instruction manual and read the relevant instructions before attempting to use or adjust any part to which the symbol has been affixed.

Caution for heat

This symbol is found on the 12V 50W lamphouse to call attention to the following:

- The lamp and surrounding areas (including the lamphouse) become very hot during and immediately after a period of illumination.
 - Risk of burns. Do not touch the lamp or surrounding areas during or immediately after a period of illumination.
 - To avoid fires, keep combustibles (*1) at a distance from the lamphouse during and immediately after a period of illumination.
- *1 Combustibles: Cloth, paper, highly flammable volatile substances (e.g., gasoline, petroleum benzene, thinner, alcohol)
- Make sure the lamp and surrounding areas have cooled sufficiently before attempting to replace the lamp.

 **Caution: Pinch Point**

On models with a motorized focusing mount (specifically, MM-800/LM or MM-400/LM), the pillar is labeled with this symbol, which urges caution of the following nature.

- The focusing mount is motorized. Keep your fingers and other objects away from the area around this symbol during operations to prevent injury or damage from moving parts.



Safety Precautions

WARNING

1. Intended use of the product

This product is a precision measuring instrument. Use only for measurements and observations.

2. Do not disassemble.

Disassembly may result in malfunctions and/or electric shock and will void the terms of the warranty.

Never attempt to disassemble any part other than the parts described in this manual. If you experience problems with the product, contact your nearest Nikon representative.

3. Read the instruction manual carefully

To ensure safety, carefully read this manual and the manual provided with any other equipment used with this product. Observe all warnings and cautions given at the beginning of each manual.

4. Use only the power cord specified (when using the motorized focusing mount driver box and AC adapter).

To avoid electric shock, turn off the microscope main power switch before plugging or unplugging the power cord.

Always use the specified power cord. (Refer to Section 8.16 for the specific power cord.) Use of a cord other than the specified type may lead to malfunction or fire.

This product is classified as subject to Class I protection against electrical shock. Make sure it is connected to an appropriate ground terminal.

5. Turn off the power switch before plugging in the power cord.

Always turn off the microscope main power switch (press it to the "O" position) before plugging in the power cord.

Plugging in the power cord with the power switch on may result in electric shock or malfunction.

6. Use the specified AC adapter (when using a main unit other than the MM-400/LM or MM-800/LM, the DP console, and the motorized UEPI driver).

Always use the specified AC adapter. (Refer to Section 8.8 for the specific adapter.)

Use of an adapter other than the specified type may lead to malfunction, overheating, or fire.

7. Handling the AC adapter

Keep the AC adapter in a well-ventilated place.

Covering or placing an object on top of the adapter will block heat radiation and may result in overheating.

When connecting the AC adapter, always turn off the microscope main switch (press it to the "O" position).

Connecting the adapter with the power switch on may result in malfunction.

 **WARNING**

8. Heat from the light source

The lamp and surrounding areas (including the lamphouse) will become very hot during and immediately after a period of illumination.

- Risk of burns. Never touch the lamp or surrounding areas during or immediately after a period of illumination.
- To avoid fires, keep combustibles (*1) at a distance from the lamphouse during and immediately after a period of illumination.

*1 Combustibles: Cloth, paper, highly flammable volatile substances (e.g., gasoline, petroleum benzene, thinner, alcohol)

- Make sure the lamp and surrounding areas have cooled sufficiently before attempting to replace the lamp.

9. Always turn off the lamp when changing filter cubes.

When changing filter cubes, always turn off the light source of the product.

Changing filter cubes with the lamp left on may expose the individual changing the filter cubes to harsh glare.

10. Take all appropriate precautions around the laser.

The U-AF unit is a Class 1 laser product.

Before using the U-AF unit, carefully read the instructions in the instruction manual supplied with this unit.

11. LEDs

This product uses LEDs, and is designated a Class 1 LED product.

 **CAUTION**

1. Isolate the products from the power source during assembly, connection/disconnection of cords, lamp replacement, and maintenance.

Always turn off the power switch(es) of the product (press it (them) to the "○" position) and unplug the power cord from the wall outlet before assembly, connecting or disconnecting of cords, lamp replacement, and cleaning of the product.

Attempting replacement with the microscope connected to a power source may result in electric shock or malfunction.

2. Lamp replacement precautions

- The lamp and its peripheral area (including the lamphouse) are very hot during and immediately after a period of illumination.
- To avoid burns, wait at least 30 minutes after the lamp is turned off to give it sufficient time to cool.
- To avoid electric shock or malfunctions, never attempt to replace the lamp without first turning off the main power switches for the product (press them to the "○" position) and unplugging the power cord from the wall outlet.
- To avoid electric shock, burns, or damage to the product, make sure the lamphouse cover is securely fitted to the lamphouse after lamp replacement. Never turn on the lamp while the lamphouse cover is open.
- Do not break up used lamps; instead, dispose of them as special industrial waste or as specified by local regulations.

3. Use the specified illuminator.

Always use the specified illuminator device (e.g., LED, lamp, lamphouse). (Refer to Sections 8.13 - 8.15 for the specific illuminator.)

Use of an illuminator other than the specified type may lead to malfunction, overheating, or fire.

4. Measuring microscope weight

The MM-400 main unit by itself weighs approximately 60 kg, while the MM-800 by itself weighs approximately 80 kg. The heaviest stage weighs 75 kg, and the system as a whole weighs between 150 and 200 kg, depending on the combination of equipment.

When installing or moving the microscope, note the following to avoid injury or malfunction that may result if the microscope falls or is knocked over:

- Remove the stage when transporting the microscope. Always refer to the stage instruction manual for details on attaching or detaching the stage.
- Always use the transportation rod when moving the microscope.
- The center of gravity is located at the rear pillar. Be careful to avoid dropping the microscope when lifting.
- For transporting, the microscope must be carried by at least four people.
- Do not grasp the microscope by the focusing mount, optical head, or controller on the back of the pillar. Doing so may damage the microscope.
- Install the microscope on a surface plate or sturdy work bench.

 **CAUTION**

- Do not use the microscope on an uneven or unstable surface.
- When installing the microscope, be careful to avoid catching your fingers or hands.

5. Avoid contact with water.

Never allow water to come into contact with the product, and keep the product away from liquids.

Splashing water onto the product may cause a short, resulting in malfunction or abnormal heating.

If water is splashed onto the product, immediately turn off the power switch (press it to the "O" position) and remove the power cord from the receptacle. Then wipe off moisture with a dry cloth or something similar.

If water enters the product, do not use; in this case, contact your nearest Nikon representative.

6. Do not place any object on top of the product.

Do not place any object on top of the product or cover it with a cloth or the like. The system temperature will rise, resulting in malfunctions.

7. Cautions on assembling and installing the product

- Take care to avoid pinching your fingers or hands during product assembly.
- Scratches or fouling such as fingerprints on optical components (such as lens and filters) will degrade microscope images. Be careful to avoid scratches or direct contact with the lens and filters.
- The main unit by itself weighs between 60 and 80 kg. For transporting, the microscope must be carried by four people using the carrying bars. Remove the stage before transporting.

8. Remove any covers from the product before switching on.

Do not use the product while covered with a cloth, etc., as this will give rise to abnormal heat, which could cause a fire.

9. Caution concerning long, sustained observations

To relieve fatigue resulting from long observation sessions, limit continuous observations to one hour.

Take at least 10- to 15-minute breaks between observation sessions. Adjust the layout of other equipment and the height of your chair.

10. Precautions for initial operations after turning on the microscope (for models with motorized focusing mounts)

When using a model with a motorized focusing mount (specifically, MM-800/LM or MM-400/LM), keep in mind that the focusing mount will automatically lift approximately 3 mm if it is near the bottom position when you turn the microscope on.

11. Be careful to avoid pinching your fingers in the focusing mount

When using a model with a motorized focusing mount (specifically, the MM-800/LM or MM-400/LM), keep in mind that the mount is motorized. Keep fingers and other objects away from the focusing mount during operations to prevent injury or damage from moving parts.

Notes on handling the product

1. Handle the product gently.

This product is a precision optical instrument and requires gentle handling. Avoid subjecting it to sudden impact and shocks.

Even relatively minor impacts are capable of affecting the precision of the objective.

2. Weak electromagnetic waves

The product emits weak electromagnetic waves. Do not place precision electronic devices near the product to avoid degrading their performance. If TV or radio reception is affected, move the TV or radio farther away from the product.

3. Scratches, dirt, and foreign particles on the lens

Scratches or fouling such as fingerprints on optical components (such as lens and filters) will degrade microscope images. If these parts become dirty, clean them as described in chapter "7. Care and Maintenance" at the end of this manual.

4. Dirt on the lamps

Never touch the lamp with bare hands. Dirt or fingerprints on the lamp will result in uneven illumination and reduce the service life of the lamp. Always wear gloves when handling lamps.

5. Installation location

This product is a precision instrument. Use or storage in inappropriate environments may result in malfunctions or poor performance. Consider the following factors when selecting an installation location:

- If at all possible, install in a location with a constant temperature and humidity or in a dry location. Installing the product in hot, humid locations may result in mildew formation or condensation, impairing performance or generating malfunction.
- Install in a vibration-free place.
- Install on a surface plate or work bench.
- Do not use on an uneven or unstable surface.
- Before installing the microscope, make sure that the upper surface of the table is level and free of dust and dirt.
- Install the product at least 10 cm away from walls.
- Choose a location less exposed to hazards in the event of collisions, earthquakes, or other potential disasters. To keep the product from falling, use strong rope or other means if necessary to secure it to the working desk or to another heavy, stable item. (Two M20 screw holes are provided on each side of the base to secure the microscope.)
- Avoid locations exposed to direct sunlight, locations immediately under room lights, and other bright locations.
- Avoid locations with excessive dust. Keep the microscope covered when not in use (for example, with a cover to avoid dust accumulation).
- To avoid splashes, do not use the product near water.
- Select a layout that allows easy removal of the power cord from the AC inlets of the motorized focusing mount's driver box and the AC adapter in the event of an emergency.
- Room lights just above the product may enter the objective as extraneous light. If possible, switch off room lights directly above the product when making observations.

6. Focusing knobs

- Never turn the focus knobs on the left and right sides of the product in opposite directions at the same time. Doing so may damage the product.
- Turning the coarse focus knob past its farthest point will damage the product. Never use undue force when turning the knob.
- Avoid excessive loosening of the rotation torque for the coarse focus knob. Excessive loosening may cause the observation section to drop down on its own weight, damaging the work or objective.

7. For high-magnification objectives, adjust focus by moving the observation section away from the work.

High-magnification objectives have short working distances (W.D.: distance between objective end and focal surface), and focusing may force the lens end to hit against the work. To avoid this, lower the objective end to the position slightly within the working distance, then focus by raising the focusing mount.

8. Protect the ports from dust and extraneous light

To keep out extraneous light and dust, always attach the supplied cap to any port not currently in use.

9. Handling of filters

Interference filters (especially excitation filters, which are exposed to strong light) degrade over time. Replace them after the appropriate hours.

Filter characteristics may alter if the filter is exposed to high humidity. To prevent changes in or degradation of filter characteristics, avoid using or storing the filters under conditions of high humidity or high temperature. Avoid subjecting filters to rapid temperature changes. When a filter is not in use, store in a desiccator or hermetically sealed container with a drying agent.

The filters in the nine types of filter cubes listed below offer sharp, high-resolution waveform characteristics superior to normal filters. However, due to their sophisticated coatings, they must be handled with special care. In particular, take care to avoid abrasion from cleaning. (Follow the procedure described in section "7.1 Lens Cleaning.")

- Single-band filter cubes: DAPI, FITC, TxRed, GFP
- Multi-band filter cubes: F-R, F-T, D-F, D-F-R, D-F-T

10. Handling of the D-FLD dark-field illumination cube

There are two wings in front of the D-FLD dark-field illumination cube, to prevent light leakage. Do not apply any pressure onto the wings, as malfunction may result.

11. Disposal

Before disposing of the microscope, contact a waste contractor for disposal as industrial waste, or dispose in accordance with applicable ordinances and rules.



12. Sequence in which equipment is turned on

If you plan to use the measuring microscope with peripherals (e.g., DP console or printer), turn on the peripheral(s) first. The measuring microscope should be the last device turned on.

Turning on peripherals after the microscope may prevent the microscope from detecting them and may lead to malfunctions.

If you do not plan to turn on peripherals connected via E-BUS, disconnect the E-BUS connecting cable. Leaving unused peripherals connected may lead to malfunctions.

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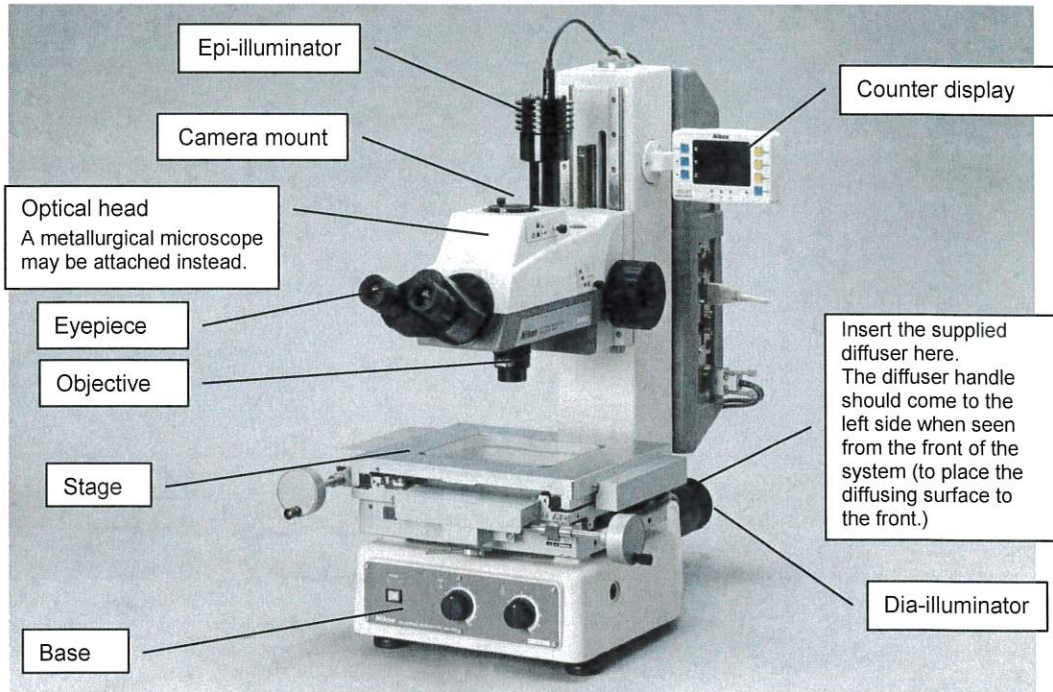
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1. Overall Configuration

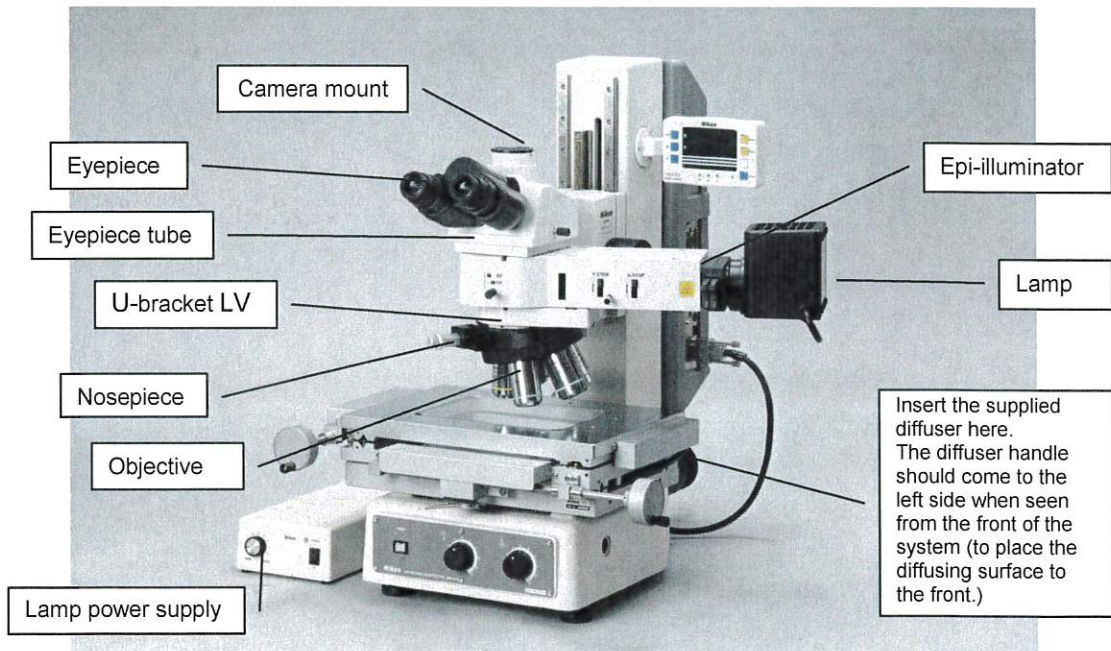
The Measuring Microscope MM400/800 Series is a system product that allows selection of components based on the work size and measurement needs.

From the illustration and table shown below, confirm the parts combinations of your measuring microscope.

● With the optical head attached



● With a metallurgical microscope attached



1.1 Base

Up to ten types are available, based on variations in the following: (1) mountable stage size; (2) presence or absence of a measurement controller; (3) presence or absence of the Z-axis scale; and (4) use of a motorized or manual focusing mount. Confirm the model on the nameplate provided at the back of the main unit.

<List of base variations>

Base model	(1) Mountable stage size	(2) Measurement controller Yes/No	(3) Z-axis scale Yes/No	(4) Motorized/ manual focusing mount
MM-800	Large* ¹	Yes	No	Manual
MM-800/L			Yes	
MM-800/LM		No* ³	No	Motorized* ⁴
MM-800/LS				Manual
MM-800/S				
MM-400	Small* ²	Yes	No	Manual
MM-400/L			Yes	
MM-400/LM		No* ³	No	Motorized* ⁴
MM-400/LS				Manual
MM-400/S				

*1 Large: 10x6 and 12x8 stages may be mounted. With the stage adapter attached, 2x2, 03L, 4x4, 6x4 and 8x6 stages may be mounted.

*2 Small: 2x2, 03L, 4x4 and 6x4 stages may be mounted.

*3 Measurement of X, Y, and Z travel requires a counter or data processor with measurement capabilities.

*4 A separate power supply and console for the motorized focusing mount are required.

1.2 Camera

A C-mount camera may be attached. (We recommend Nikon DS-2M.) An adapter is required to attach the camera head. Refer to the instruction manual provided with the camera to connect the camera head and CCU (camera control unit).

<Camera head and required adapter>

Camera	Adapter
Nikon DS-2M	C-mount and L-T13 TV adapters
C-mount camera (all kinds)	

1.3 Optical head

Up to ten optical head configurations are possible, based on variations in the following: (1) binocular or monocular head; (2) fixed or variable magnification; (3) presence or absence of focus aid capability; and (4) presence or absence of camera port.

<List of optical head functions>

Optical head model	(1) Binocular/monocular	(2) Focus aid capability Yes/No	(3) Camera port Yes/No	(4) Light source
Fixed magnification optical head	Binocular	No	Yes	LED
Fixed magnification FA optical head		Yes		
Monocular optical head	Monocular	No	No	

A metal microscope may be attached via the U bracket LV instead of an optical head.

<Attachable metal microscopes>

Required bracket	Lamp	Lamp motorized operation Yes/No	Autofocus unit (U-AF unit) attachable Yes/No	Eyepiece tube	Revolving nosepiece	Light source
U-bracket LV	LV-UEPI2A	Yes* ¹	Yes* ²	L-T13 T1 ESD trinocular eyepiece tube or LV-TT2 trinocular eyepiece tube	Universal five-hole revolving nosepiece	Halogen
	LV-UEPI2	No				
	LV-UEPI					
	LV-UEPI FA		No			
	LV-EPI LED		Yes* ²		Sextuple revolving nosepiece for brightfield* ³	LED

*1 Motorized operation of the lamp requires a motorized UEPI driver and motorized UEPI-AF controller, available separately.

*2 The autofocus unit (U-AF unit) is a Class 1 laser product. Read and follow the instructions given in the instruction manual provided with the unit.

*3 Although the nosepiece contains six holes, no more than five objectives may be attached.

1.4 Special eyepiece and protractor

Special measuring eyepieces and protractors other than the normal eyepieces may be attached. For more information, refer to Section 3.7.4.

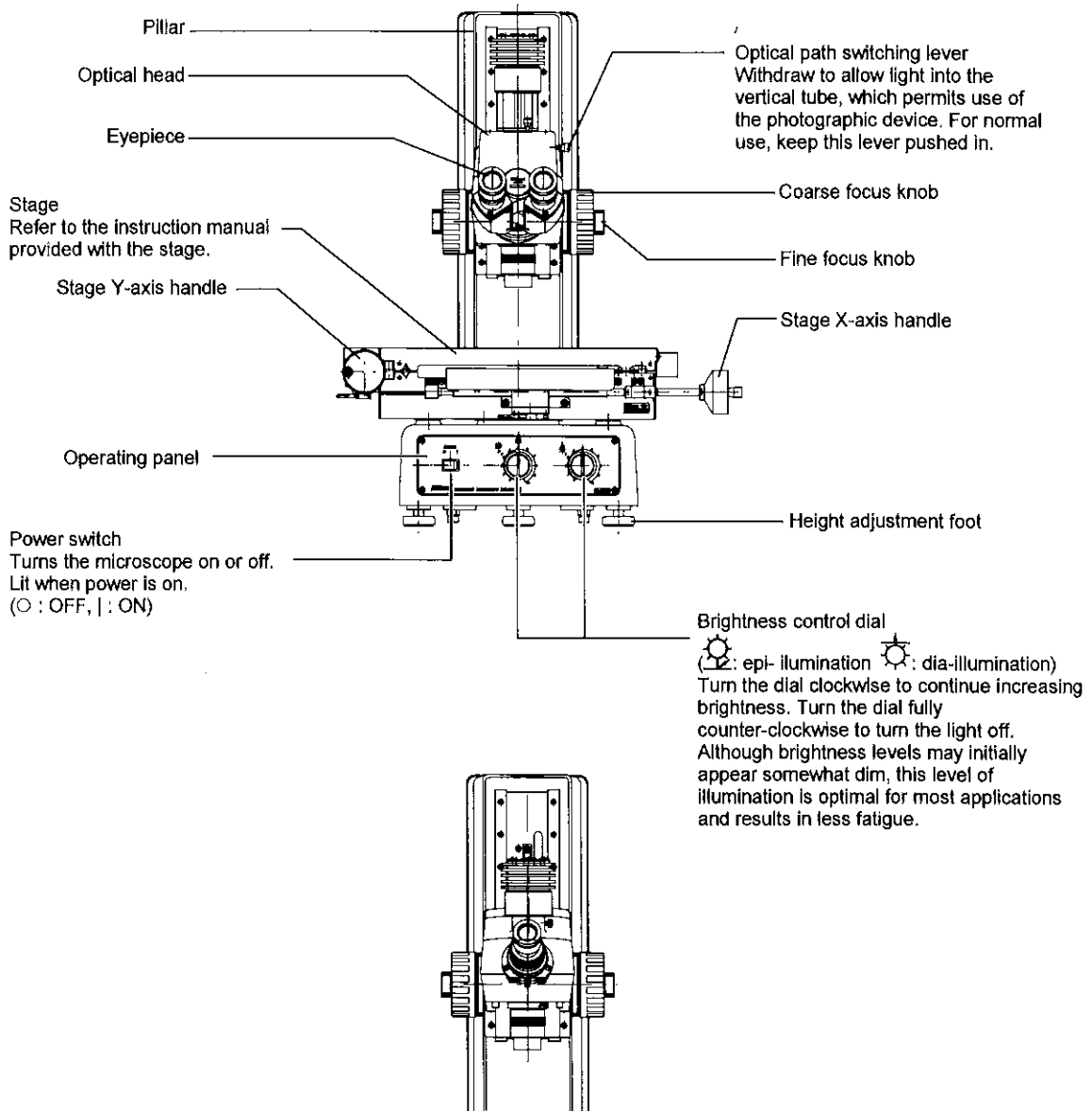
1.5 Illuminator

Use either LED or halogen illuminators for the epi-illumination and dia-illumination. We recommend an LED illuminator for normal use. Use a halogen illuminator if you need more intense illumination.

Note that certain optical heads or illuminators may support only one type of illuminator, either LED or halogen. For more information, refer to Section 1.3, "Optical head."

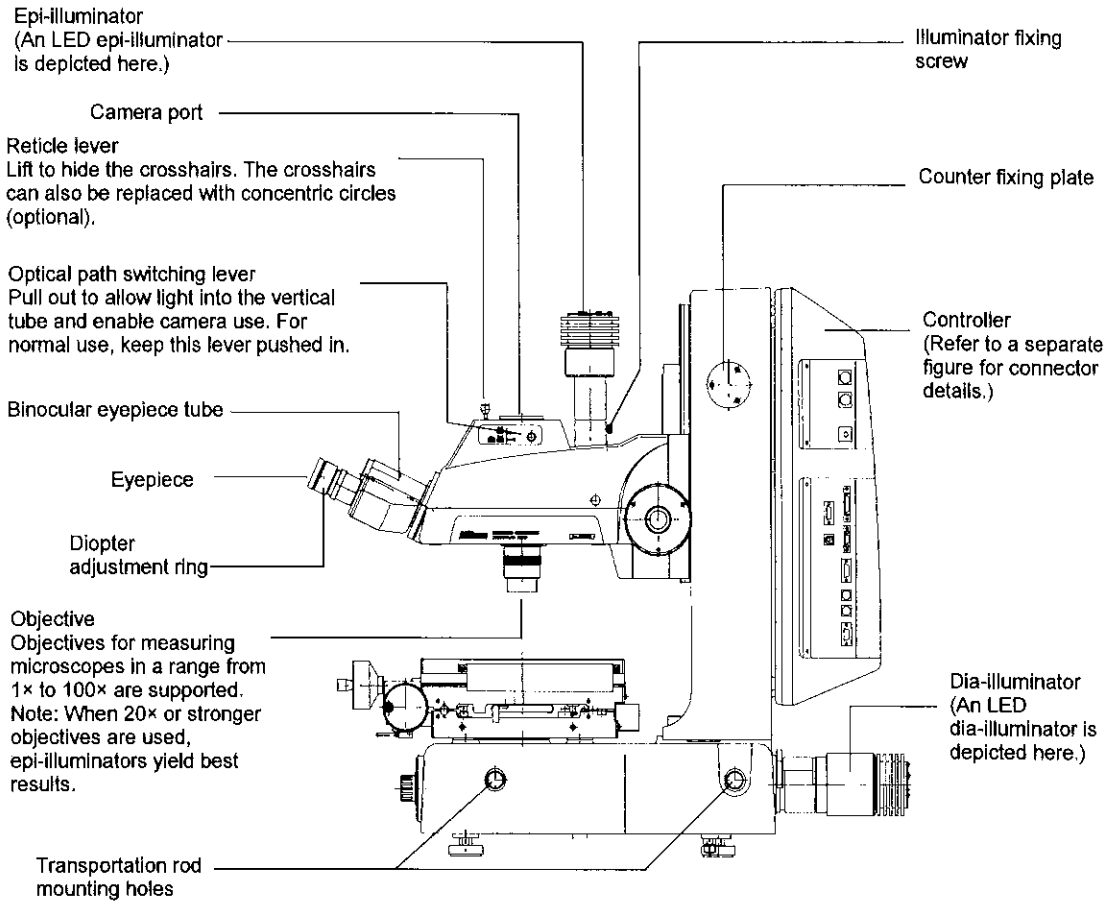
2. Part Names and Functions

2.1 Front view

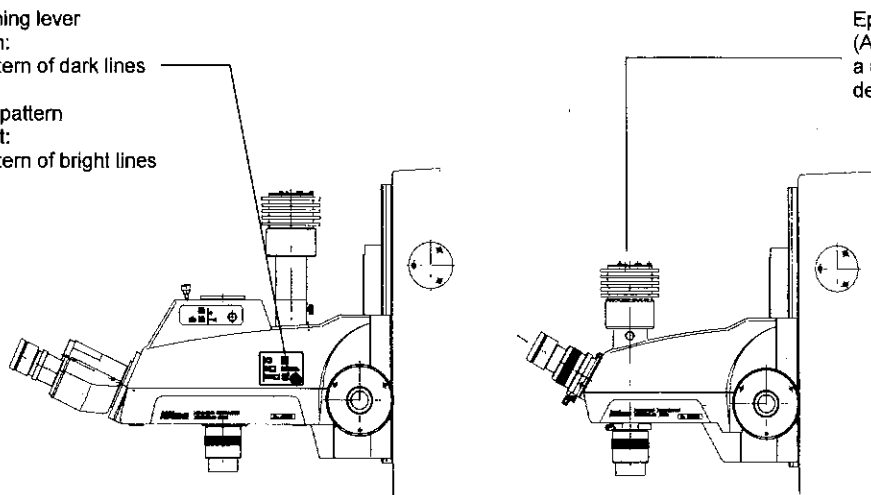


When using a monocular optical head

2.2 Right-side view



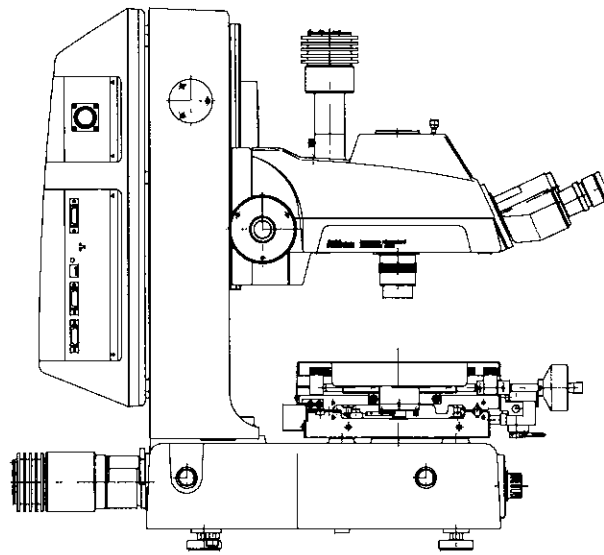
FA-switching lever
 Pushed in:
 FA pattern of dark lines
 Midway:
 No FA pattern
 Pulled out:
 FA pattern of bright lines



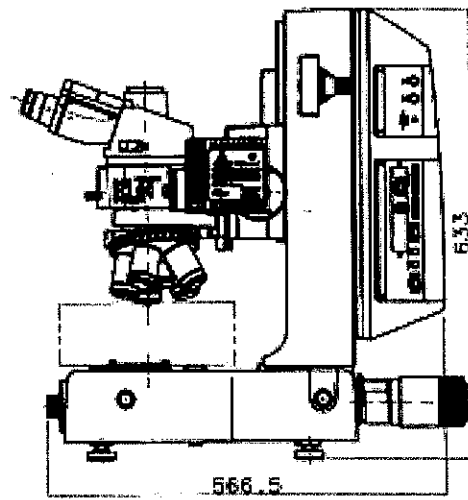
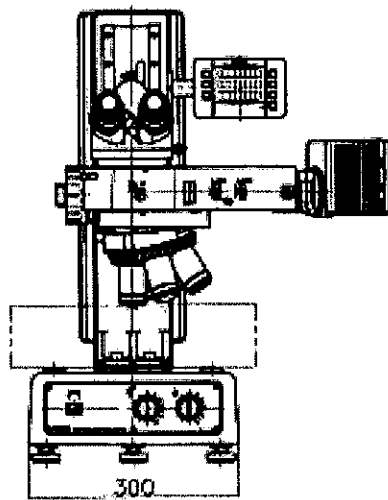
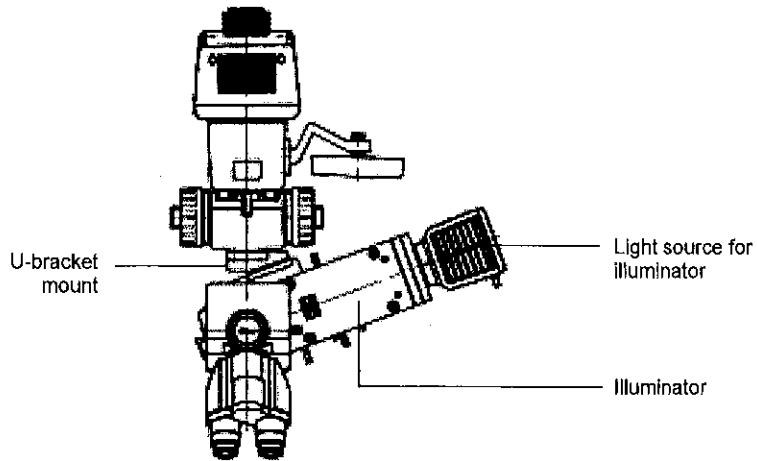
When using a focus-aided optical head

When using a monocular optical head

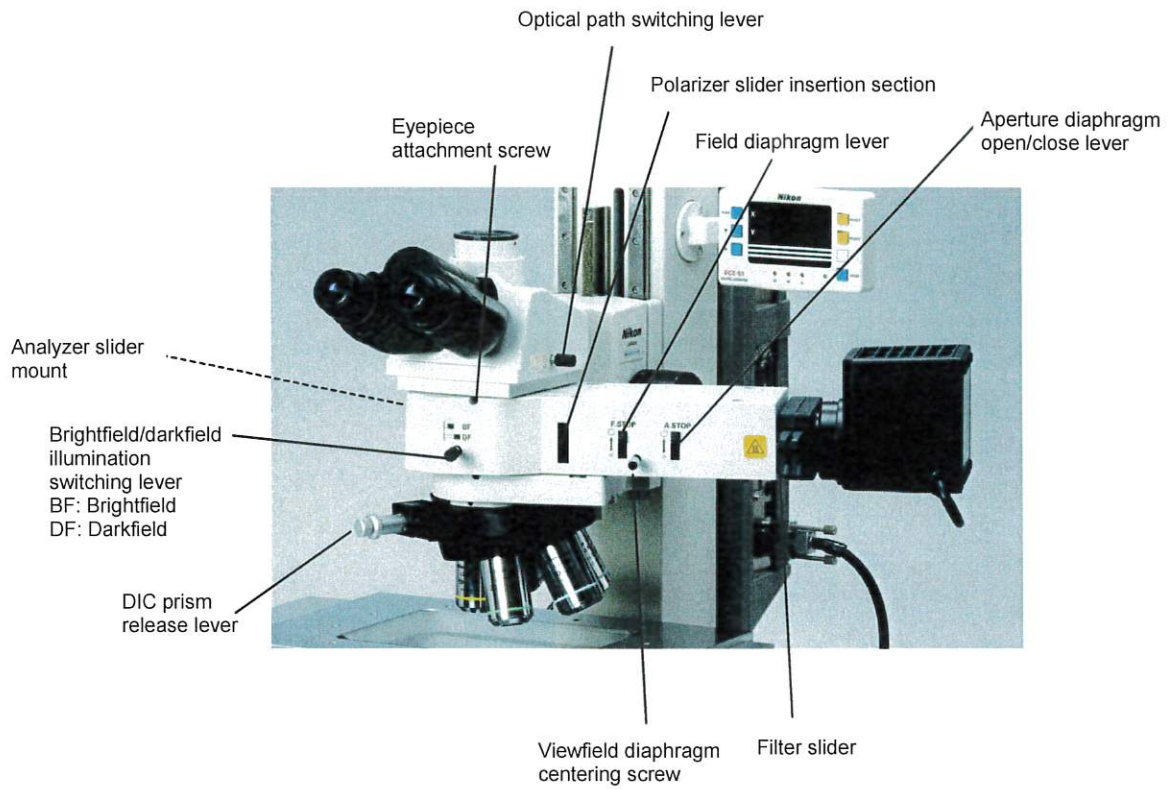
2.3 Left-side view



2.4 When a metallurgical microscope is attached instead of an optical head

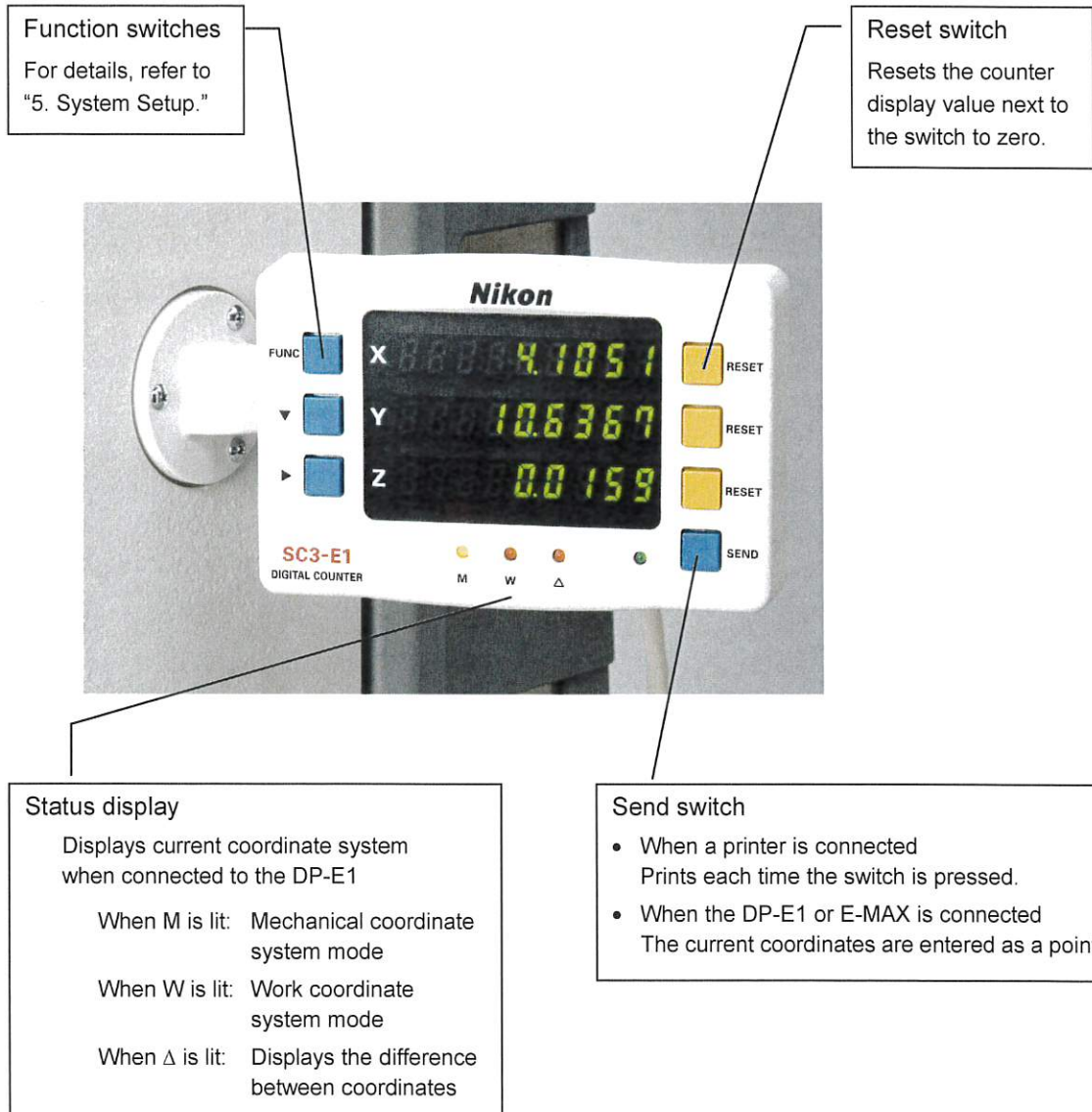


2. Part Names and Functions



2.5 Counter display

2.5.1 3-axis digital counter SC3-E1

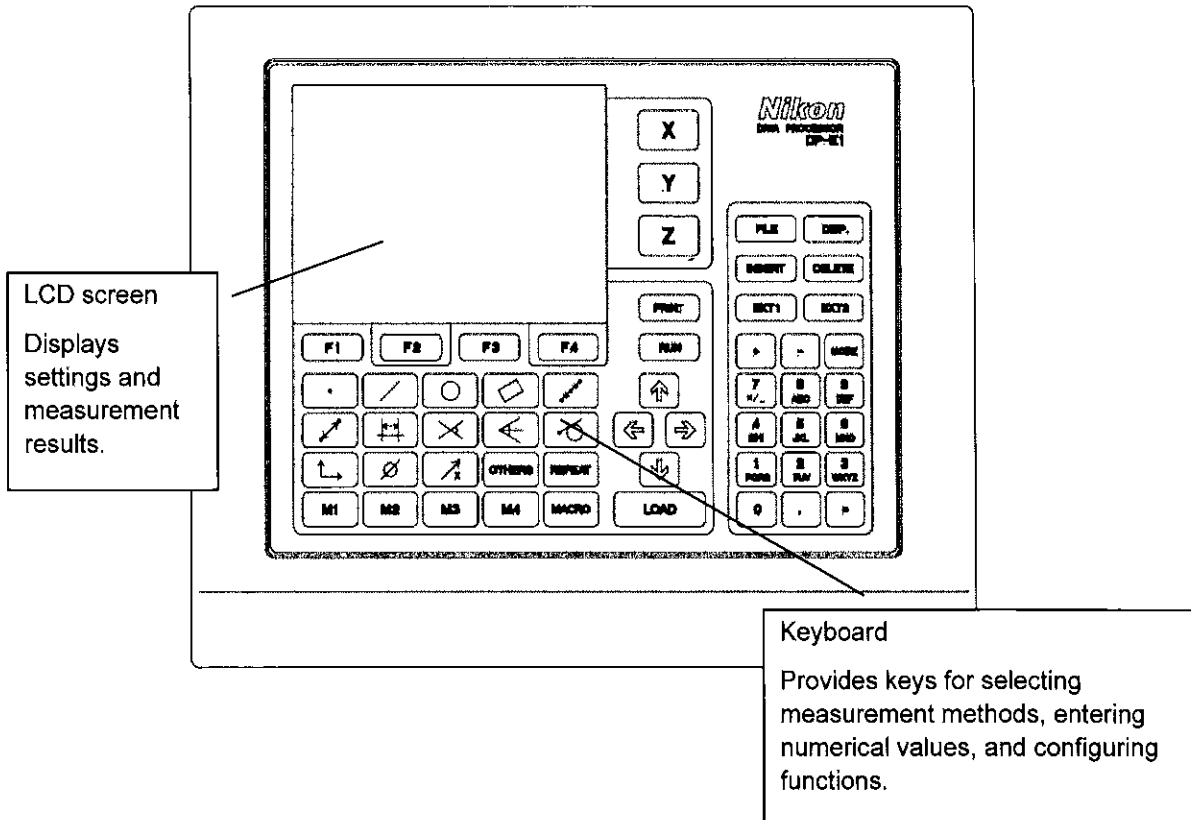


2.5.2 2-axis digital counter SC2-E1

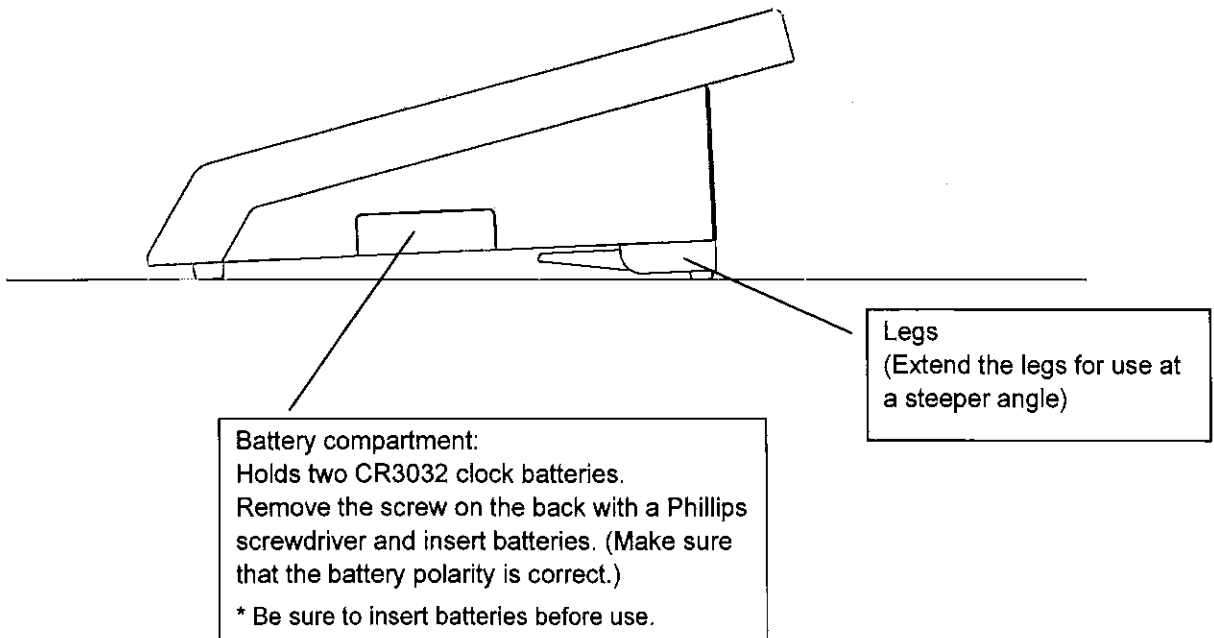


The SC2-E1 does not include a Z-axis display or reset switch

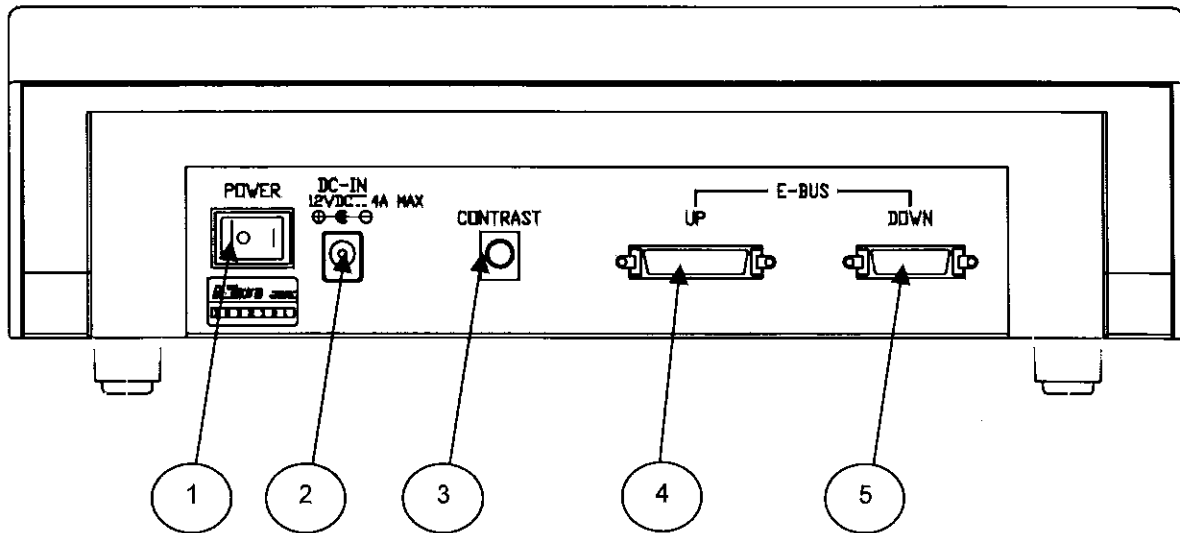
2.6 Data Processor Console DP-E1



* For detailed information, refer to the DP-E1 user's manual.



2. Part Names and Functions



- ① POWER On: Press toward the | side. Off: Press toward the ○ side.
- ② DC-IN Power inlet. Always use the specified dedicated AC adapter.
- ③ CONTRAST Dial for contrast adjustment of the LCD screen.
- ④⑤ E-BUS UP, DOWN interfaces
Interfaces for use when the unit is daisy-chained with other E-BUS equipment. Connect a MM-400/800 series measuring microscope or RU-E1 to the highest position on the UP side. If this system is the final addition, leave the DOWN connector OPEN.

2.7 Controller interfaces

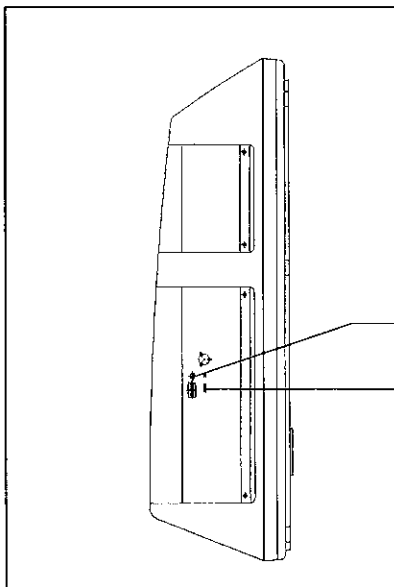
2.7.1 MM-800, MM-800/L, MM-400, and MM-400/L

Right-side view



- | | |
|---------------|---|
| 1: EPI | Connected to an LED epi-illuminator or halogen illuminator. |
| 2: DIA | Connected to an LED dia-illuminator or halogen illuminator. |
| 3: DC-IN | Connected to the AC adapter. |
| 4: E-BUS (D) | Connected to the DP-E1 Data Processor Console or similar equipment |
| 5: RS-232C | Connected to peripherals (such as printers) when using an RS-232C connection. |
| 6: USB (D) | Connected to peripherals (such as computers) when using a USB connection. |
| 7: SC-E1 | Connected to the SC2-E1 2-axis counter or SC3-E1 3-axis counter. |
| 8: EXRST/FOOT | Connected to a remote switch or foot switch. |
| 9: TURRET | Not used. |
| 10: OPTION | Connected to optional equipment. |
| 11: STAGE | Connected to the stage. |

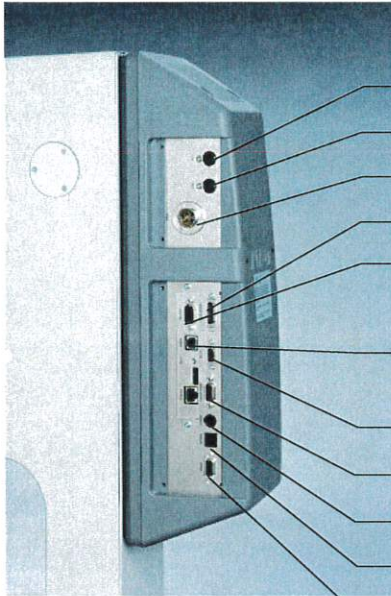
Left-side view



- | | |
|-------------|---|
| 12: BZ | Volume control for the buzzer. |
| 13: USB (H) | Connected to a USB memory device, as needed.
(Use FAT-formatted USB memory.) |

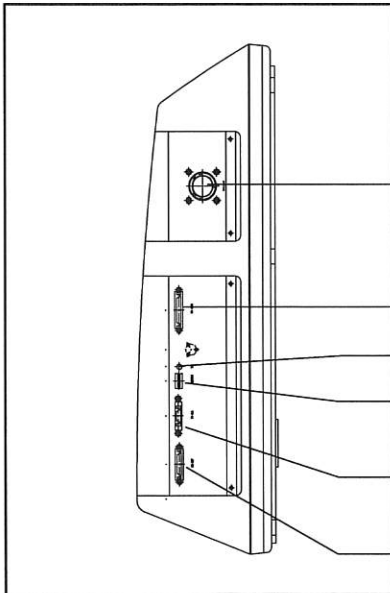
2.7.2 MM-800/LM and MM-400/LM

Right-side view



- 1: EPI Connected to an LED epi-illuminator or halogen illuminator.
- 2: DIA Connected to an LED dia-illuminator or halogen illuminator.
- 3: MAIN Connected to the motorized focusing mount driver box.
- 4: E-BUS (D) Connected to the DP-E1 Data Processor Console or similar equipment
- 5: RS-232C Connected to peripherals (such as printers) when using an RS-232C connection.
- 6: USB (D) Connected to peripherals (such as computers) when using a USB connection.
- 7: SC-E1 Connected to the SC2-E1 2-axis counter or SC3-E1 3-axis counter.
- 8: EXRST/FOOT Connected to a remote switch or foot switch.
- 9: TURRET Not used.
- 10: OPTION Connected to optional equipment.
- 11: STAGE Connected to the stage.

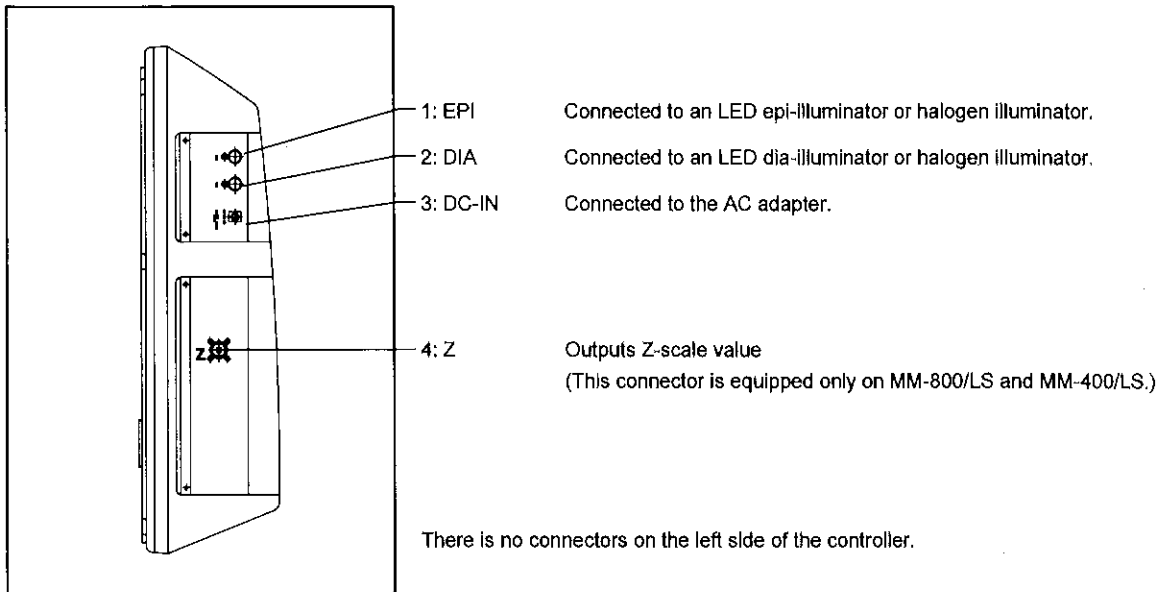
Left-side view



- 12: MOTOR Connected to the focusing mount motor.
- 13: UAF-E1 Connected to the U-AF unit, UAF-E1.
- 14: BZ Volume control for the buzzer.
- 15: USB (H) Connected to a USB memory device, as needed. (Use FAT-formatted USB memory.)
- 16: UC-E1 Connected to the motorized AF/UEPI console (UC-E1), if needed. (Normally, connect the UC-E1 to the UC-E1 driver box.)
- 17: ZM-E1 Connected to the motorized Z-drive console, ZM-E1.

2.7.3 MM-800/S, MM-800/LS, MM-400/S, and MM-400/LS

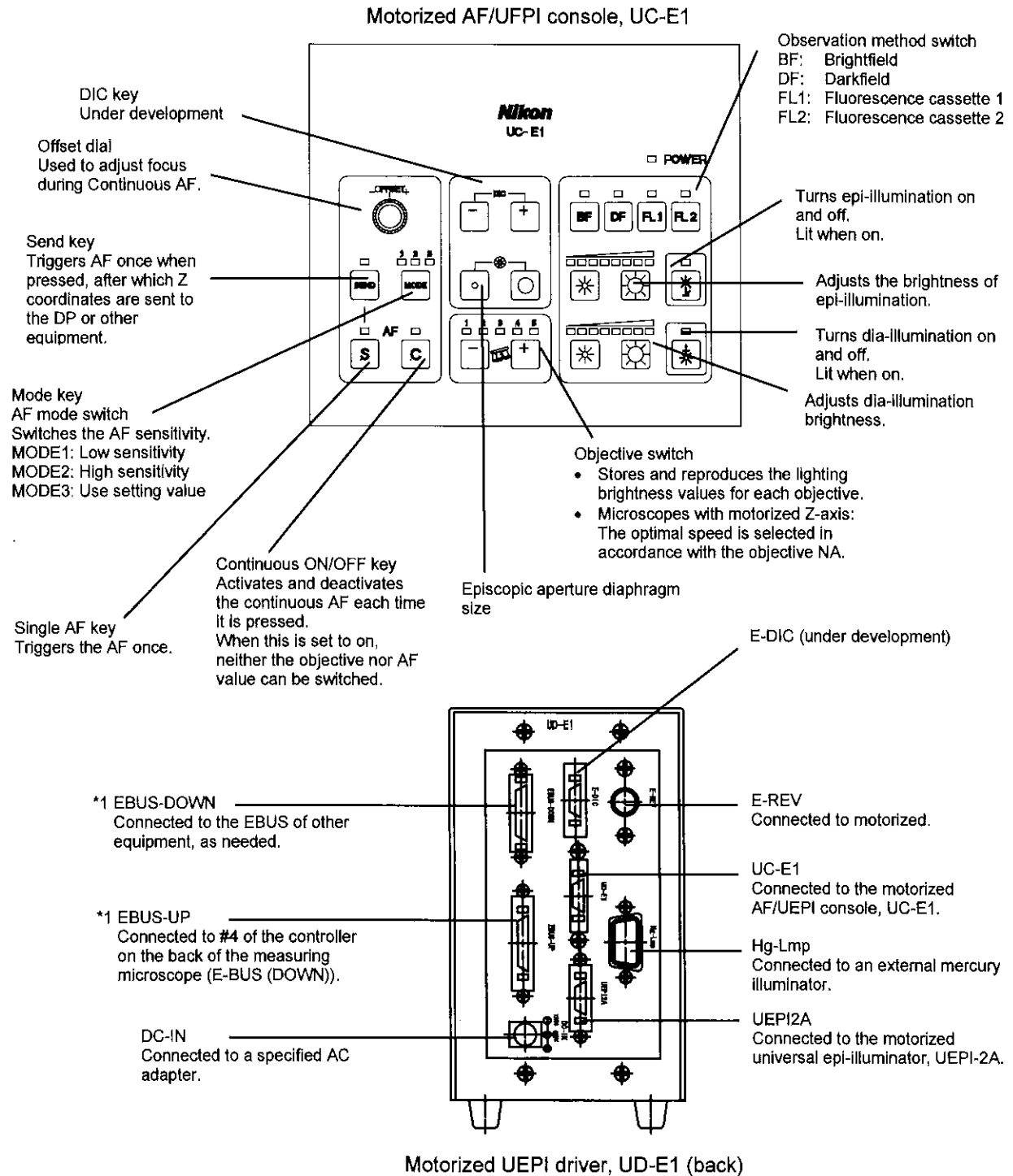
Right-side view



2.8 Motorized AF/UEPI console

Required when using a motorized illuminator or laser AF unit.

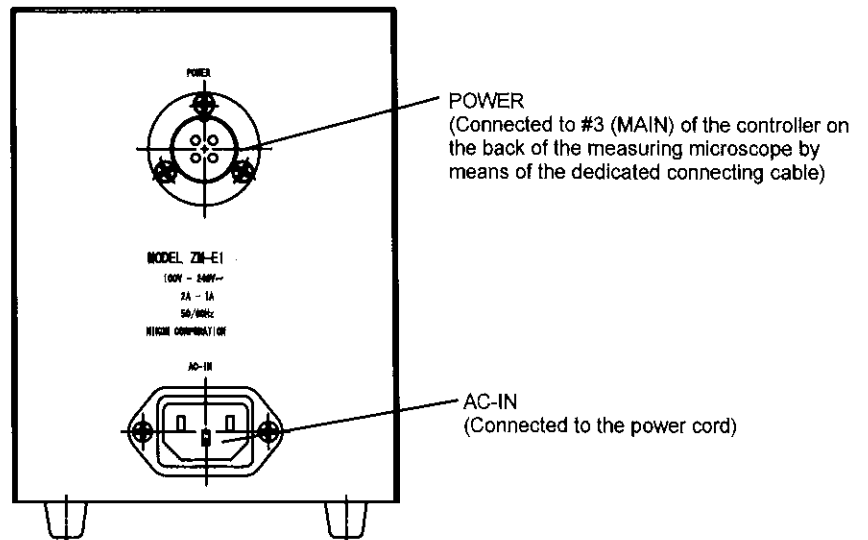
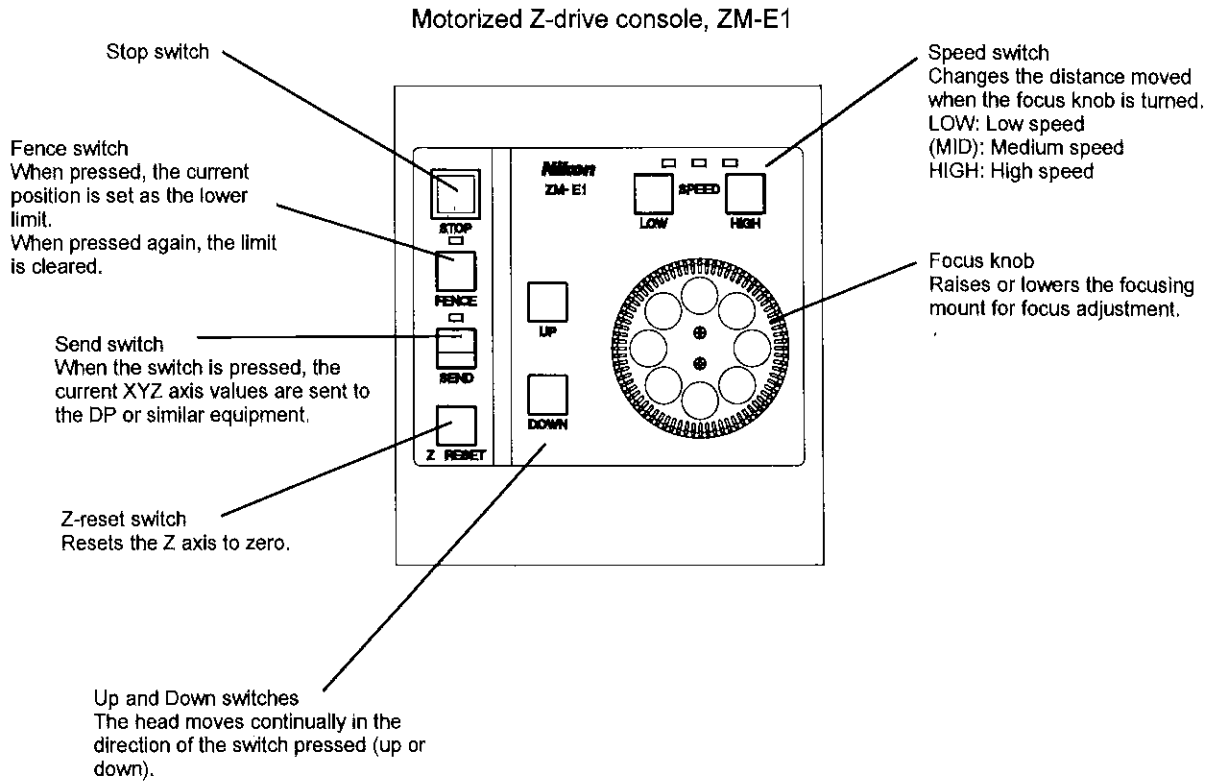
Refer to the instruction manual supplied with the laser AF unit for method of operation.



*1: If other equipment is connected to the E-BUS (DOWN) interface of the controller, connect to the E-BUS (DOWN) interface of that equipment.

2.9 Motorized focusing mount

Required for measuring microscopes with a motorized Z -axis.



Motorized focusing mount driver box, ZM-E1 (back)

3. Measurement



Before starting measurement, be sure to read the **Warning** and **Caution**, and Notes on handling the product sections at the beginning of this manual. Carefully observe all of the instructions provided therein. Read the instruction manuals supplied with other instruments you intend to use with this measuring microscope, including stages and lamps.

To ensure accurate measurement, follow the procedures described in Section 3.4, "Checking parallel positioning of the stage," and Chapter 5, "System Setup."

3.1 Illumination

Press the power switch on the front of the base toward ON (toward the | side). Turn the brightness control dial on the front of the base clockwise to activate the dia-illuminator or epi-illuminator. Keep turning the dial clockwise to continue increasing the brightness. To turn off the light, turn the dial fully counter-clockwise.

The following illumination methods are supported. Use the appropriate illumination for the work being examined.

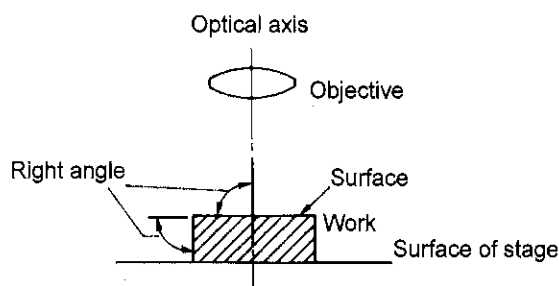
- Diascopic (DIA) illumination  Enables observation of the contours of the work, which appear in outline.
- Vertical episcopic (EPI) illumination  Enables observation of the surface of non-transparent works.
- Simultaneous dia/epi-illumination Enables simultaneous observation of the contours and surface of the work.

Connect the measuring microscope to the motorized AF/UEPI console, UC-E1, for operation synchronized with key input from the UC-E1.

3.2 Positioning the work

Position the work so that the contours (cross-sectional details) or surface for measurement are perpendicular to the optical axis of the objective. Failure to do this will prevent uniform focus throughout the field of view.

The top of the stage is perpendicular to the optical axis. Works with two parallel surfaces or in other shapes that present surfaces perpendicular to the optical axis can be just placed on the stage.



3.3 Focusing

- For instructions on using the z-axis knob, refer to Section 3.5, "Z-axis knob."
- When using a motorized unit, use the motorized Z-drive console (ZM-E1) instead of the z-axis knob. Instead of using the coarse focus knob, use the Up and Down keys. Use the focus knob instead of the fine focus knob.
- When using the U-AF auto focus unit, be sure to read the instruction manual provided with the U-AF.

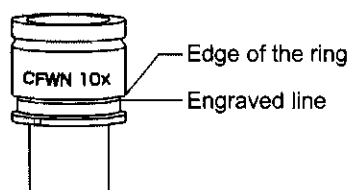
3.3.1 If an optical head is attached

- 1 Turn the Diopter adjustment ring on the eyepiece to focus on the template (that is, the lines visible through the eyepiece).
- 2 Turn the coarse focus knob to raise or lower the optical head. Adjust so that the work surface is about 126 mm from the thrusting end of the objective, based on a visual estimate. (That is, the focal plane is 126 mm from the thrusting end of the objective, regardless of magnification.)
- 3 While looking through the eyepiece, turn the fine focus knob to bring the work into sharp focus. (See Note 1.)
- 4 Confirm that the work is in focus.
 - 4-1 While looking through the eyepiece, carefully examine the lines of the template while moving your head up, down, left, and right. If the position of the work image changes relative to the lines of the template, the work is still out of focus. (This phenomenon is known as *parallax*.)
 - 4-2 Adjust the focus to correct parallax as follows.
Again, carefully examine the lines of the template while moving your head left and right. If the work image moves in the same direction as your head, bring the optical head closer to the work.
If the work image moves in the direction opposite the direction you move your head, move the optical head farther from the work.

Note 1: Stronger objectives have shorter working distances. (Also called "WD," this is the distance from the tip of the objective to the focal plane.) For this reason, during focusing, the tip of the lens may sometimes come into contact with the work. To avoid this, initially lower the tip of the objective to a point just beyond the WD, then adjust the focus by raising the optical head.

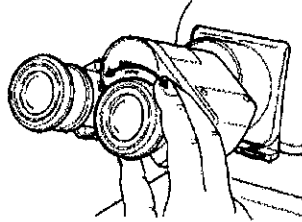
3.3.2 If a metallurgical microscope is attached

- 1 Adjust the diopter. (Make diopter adjustments with both eyepieces on the eye piece tube.)
 - 1-1 Turn the diopter adjustment ring on the eyepiece to align the engraved line and the edge of the diopter adjustment ring. (This is the diopter adjustment position "0.")



3. Measurement

- 1-2 Rotate the revolving nosepiece to choose a 50x objective (or one with magnification close to 50x). Turn the z-axis knob to focus on the specimen.
- 1-3 Switch to a 10x objective. Without turning the z-axis knob, turn the diopter adjustment ring on the eyepiece to focus the left and right eyepieces respectively.



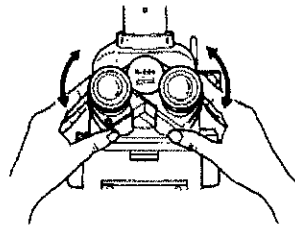
- 1-4 Repeat steps 1-2 and 1-3 to achieve optimum diopter adjustment.

The preceding operations will correct differences in diopter between the left and right eyepieces, aiding binocular observation. These steps also reduce focus shifts when switching objectives.

When using the LV-TT2, a trinocular tilting eyepiece tube with built-in template

Simply turn the diopter adjustment ring on the eyepiece to focus on the template. This completes the diopter adjustment.

- 2 Adjust the interpupillary distance. While looking through the eyepiece, adjust the interpupillary distance so that the left and right images merge into one image. This operation aids binocular observation.



- 3 Turn the coarse focus knob to raise or lower the optical head. Adjust so that the work surface is about 60 mm from the thrusting end of the objective, based on a visual estimate. (Regardless of magnification, the focal plane is 60 mm from the thrusting end of the objective.)
- 4 While looking through the eyepiece, turn the fine focus knob to bring the work into sharp focus. (See Note 1.)
- 5 Confirm that the work is in focus.
 - 5-1 While looking through the eyepiece, carefully examine the crosshairs while moving your head up, down, left, and right. If the position of the work image changes relative to the lines of the crosshairs, the work is still out of focus. (This phenomenon is known as *parallax*.)
 - 5-2 Adjust the focus to correct parallax as follows. Again, carefully examine the crosshairs while moving your head left and right. If the work image moves in the same direction as your head, bring the optical head closer to the work. If the work image moves in the direction opposite the direction you move your head, move the optical head farther from the work.

Note 1: Stronger objectives have shorter working distances. (Abbreviated "WD," working distance is the distance from the tip of the objective to the focal plane.) During focusing, the tip of the lens may contact the work. To prevent this, initially lower the tip of the objective to a point just beyond the WD, then adjust the focus by raising the focusing mount.

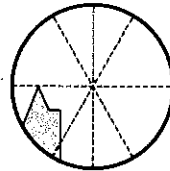
3.4 Checking parallel positioning of the stage

Also refer to the instruction manual provided with the stage.

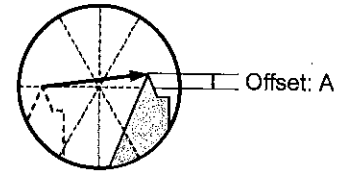
Activate the dia-illuminator or epi-illuminator and look through the eyepiece. The lines of the template are visible. To ensure accurate measurement, you must adjust the position at which the stage is attached to the base so that the direction of movement of the stage aligns perfectly with the template crosshairs. (Except for one at back left, screw holes for attaching the stage are large enough to permit adjustment, mainly by pivoting the stage placing the attachment bolt in the back-left as the center.)

- 1 Attach the 3x objective to the optical head and position the work on the mounting glass of the stage.
If a metallurgical microscope is attached, insert the lowest magnification objective into the optical path.
- 2 Turn on the measuring microscope. (Press the power switch toward the | side.) Turn the brightness control dial clockwise and activate dia-illumination or epi-illumination.
- 3 Adjust focus.

- 4 Move the stage along the X and Y axes to align a clear portion of the work (the corner of the image, for example) in the template crosshairs.

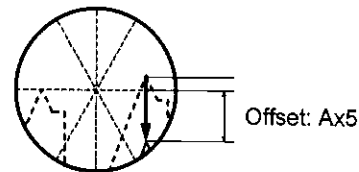


Align one point of the image with the crosshairs.



When stage is moved in X direction, the image moved away from the crosshairs.

- 5 Move the stage along the X-axis to make sure the image moves without going out of alignment with the crosshairs. If the image moves away from the crosshairs, pivot the stage on the attachment bolt in the back-left so that the image moves approximately five times opposite the distance by which it was originally out of alignment.



Adjust the stage so that the image moves in the direction of alignment, but overcompensate by approximately five times the distance it was originally out of alignment.

6. Repeat steps 4 and 5 until you can move the stage without the image drifting from the crosshairs. When using a 3x objective, complete this adjustment so that the offset amount is 0.01 mm or less relative to the template (equivalent to two line widths or less of the dotted line on the template).

After adjustment, firmly tighten the stage attachment bolts.

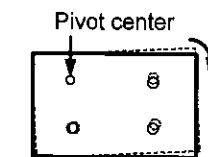


Image of stage pivot.

3.5 Z-axis knob

When adjusting the torque of the coarse focus knob, be careful to avoid loosening it to the point that the optical head begins to drop under its own weight.

Z-axis knob comprises coarse and fine focus knobs.

You can adjust the rotational torque for the coarse focus knob.

Distance the optical head moves per knob revolution

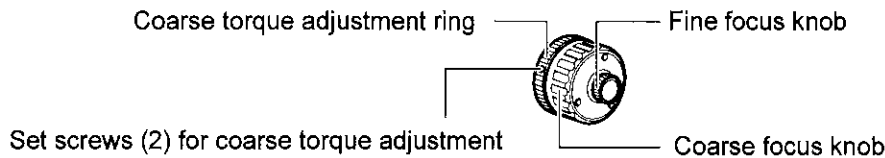
Coarse focus knob: Approx. 38.3 mm/rev.

Fine focus knob: Approx. 0.18 mm/rev.

Adjusting the rotational torque of the coarse focus knob

Loosen the two set screws of the coarse torque adjustment ring. As you turn the ring, notice how the resistance of the coarse focus knob changes. Adjust the torque in a range that ensures that the optical head does not begin dropping under its own weight. (The rotational torque of the coarse focus knob is factory-set so that the basic optical heads will not drop under their own weight.)

Note: Use the knob on the right side to adjust the torque.



3.6 When a metallurgical microscope is attached

If a metallurgical microscope is attached to the measuring microscope, refer to the instruction manual provided with the illuminator for illuminator instructions.

3.7 Measurement examples

Instructions for measurement using the counter display are given below.

3.7.1 Measurement using the DP

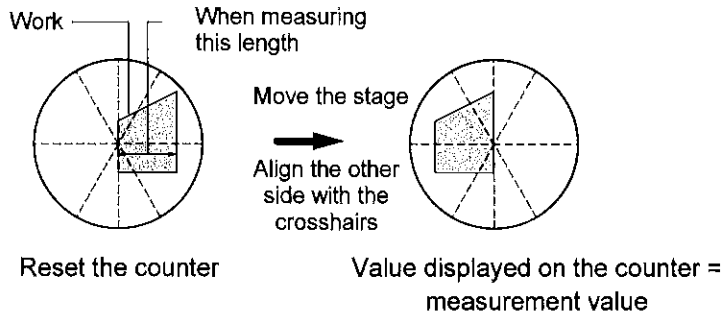
Before using a measuring microscope with an attached measurement controller, refer to the instruction manual provided with the DP console for instructions on measurement with DP consoles.

3.7.2 Length measurement (distance between two parallel sides)

This microscope is equipped with a stage for which the amount of movement is expressed digitally and displayed on the counter. Monitor this display to measure the distance between two parallel sides of a work. Before measurement, always check parallel positioning of the stage and complete system setup.

- 1 Align one side of the work with the crosshairs. Reposition the work so that the side is parallel to one of the template crosshairs.
- 2 Reset the counter display by pressing the counter Reset switch for both the X-axis and Y-axis.
- 3 Move the stage to align the other side of the work with the crosshairs.

- 4 The value displayed on the counter is the measurement value (i.e., the distance between the two sides).
 Measurement value = value displayed on the counter



- When using a focus-aided optical head, turn the field-switching knob to the “Normal” side before measurement.

3.7.3 Measurement of the diameters of cylinders and spheres

To measure the diameter of a cylinder or sphere, use the MM-800 equipped with a telecentric diaphragm.

- 1 Position the work parallel to the direction of movement of the stage.
 In measuring cylinders, it may be helpful to use a tilting center fixture (an optional accessory).
- 2 Determine the telecentric diaphragm diameter, based on the diameter of the work.

Günther's empirical formula $D = 0.18F(1/d)^{1/3}$
D: Telecentric diaphragm diameter
d: Diameter of the object
F: Focal distance of the collimator lens

Note: Choosing a diaphragm diameter (D) of 3 mm or smaller may result in uneven illumination in the field of view. This does not indicate a mechanical problem.

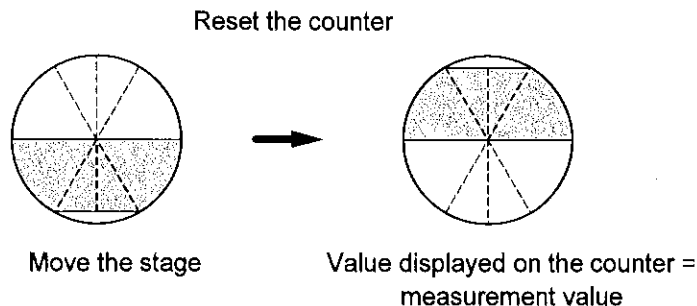
Table 1. Relationship between D and d according to Günther's empirical formula

dmm	Dmm	dmm	Dmm	dmm	Dmm	dmm	Dmm
1	17.4	8	8.7	20	6.4	60	4.4
2	13.8	9	8.4	25	5.9	70	4.2
3	12.0	10	8.1	30	5.6	80	4.0
4	10.9	12	7.6	35	5.3	90	3.9
5	10.2	14	7.2	40	5.1	100	3.7
6	9.6	16	6.9	45	4.9	150	3.3
7	9.1	18	6.6	50	4.7	200	3.0

You will obtain optimal results at the conditions given by the preceding empirical formula, according to Günther. We recommend following the guidelines given in the table, unless doing so poses difficulties.

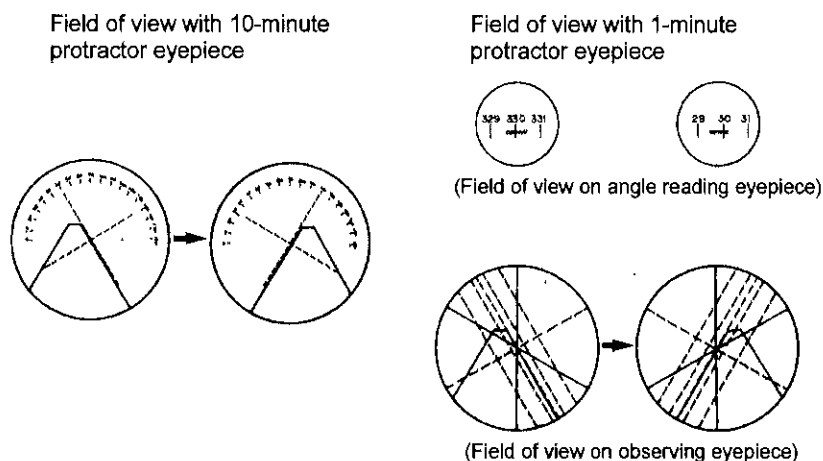
Illuminating high-precision measurement of works with depth, such as spheres or cylinders, presents considerable difficulties, such as determining the portion half in shadow. We recommend calibration using contact-type measurement equipment for high-precision measurement of such works.

- 3 Align the contours of the cylinder with the horizontal lines of the template, then reset the counter.
- 4 Move the stage and align the contours of the opposite side with the crosshairs.
- 5 The value displayed on the counter is the measurement value.



3.7.4 Angle measurement

You can perform angle measurement using various optional accessories like the 10-minute or 1-minute reading protractor eyepieces.



- 1 Remove the binocular eyepiece tube and use the monocular adapter to attach the protractor eyepiece.
- 2 Lift the reticule lever on top of the optical head. This removes the crosshairs from the field of view.
- 3 Align one side of the image for measurement with a crosshair or the 60° line of the protractor eyepiece. Read the angle.
- 4 Next, align another side with the same crosshair or 60° line. Read that angle.
- 5 The difference between the values read in steps 3 and 4 is the measurement value.
 - To measure large oblique angles, it is easier to use the crosshairs of the protractor eyepiece as a reference right angle when reading the difference. (Similarly, for the 1-minute reading protractor eyepiece, you can use the lines at 30°, 60°, and 120° as reference lines.)
 - When the stage is used with protractor eyepieces, you do not need to center the vertical angle of the image in the crosshairs. This allows faster measurement.

- When one side of the image for measurement is aligned with the crosshairs, leave a slight gap parallel to the side to improve alignment accuracy.
 - When you perform both angle and length measurements, the work must be parallel positioned.
- 6 After angle measurement is complete and you have reattached the binocular eyepiece, lower the reticule lever to the lowest position.
- ▶ When using a focus-aided optical head, turn the field-switching knob to the Normal side before measurement.

3.7.5 Height measurement (units with a built-in Z-axis scale only)

When using units with a built-in Z-axis scale, you can perform height measurements by connecting the 3-axis counter display (SC3-E1).

3.7.5.1 If the unit does not support focus aids

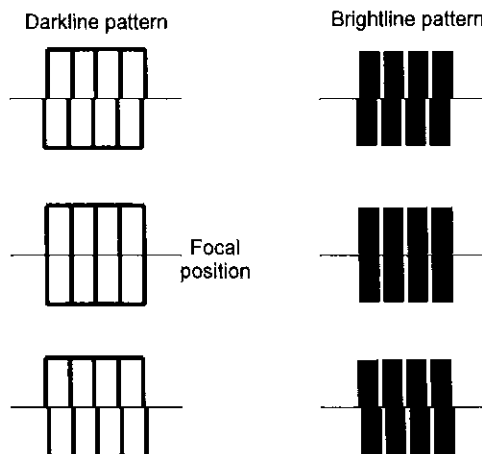
Use an objective of 20x or stronger. Since lower magnification objectives have a deeper depth of focus, images will be in focus through a wider margin of error, reducing measurement precision.

- 1 Move the portion of the work that will serve as the reference for the height into the field of view. Bring it into sharp focus.
- 2 Press the Reset switch for the Z-axis counter to reset the counter display to zero.
- 3 Move the stage so that the portion of the work on which the difference in height will be measured enters the field of view. Bring it into sharp focus.
- 4 Read the counter display.
Value displayed on the counter = measurement value

3.7.5.2 If the unit supports focus aids

Although objectives in the range from 5x to 50x are supported, we recommend 20x and 50x objectives for better repeatability in focusing precision. Depending on the surface properties of the work, the focus aid pattern may be difficult to see in certain cases, and focusing precision repeatability may be poor.

- 1 Use the FA switching lever to choose a pattern of dark or bright lines. Push in the lever for darkline pattern in the field of view, or pull out for brightline pattern. (To remove the pattern, restore the lever to the intermediate position.)
- 2 A focus aid pattern appears in the field of view, as shown in the following figures.
- 3 Use the Z-axis knob again until the top and bottom halves of the pattern in the focus aid pattern are aligned. (The image is in focus when both halves of the pattern are aligned.)





3. Measurement

- 4 Press the Reset switch for the Z-axis counter to reset the counter display to zero.
- 5 Move the stage so that the portion of the work at which the difference in height will be measured enters the field of view.
- 6 Use the focus aid pattern to adjust the focus. (Use the Z-axis knob until both halves of the pattern are aligned.)
- 7 Read the counter display.
Value displayed on the counter = measurement value

4. Assembly

4.1 Assembly Precautions

- Before assembling the instrument, be sure to read the “ WARNING”, “ CAUTION” and “Notes on handling the product” at the beginning of this manual and heed all the instructions written therein.
- Be also sure to read the instruction manuals supplied with other instruments to be used together with this measuring microscope.
- Install the instrument at a suitable location meeting the installation requirements. (Refer to P. 7 for requirements.)

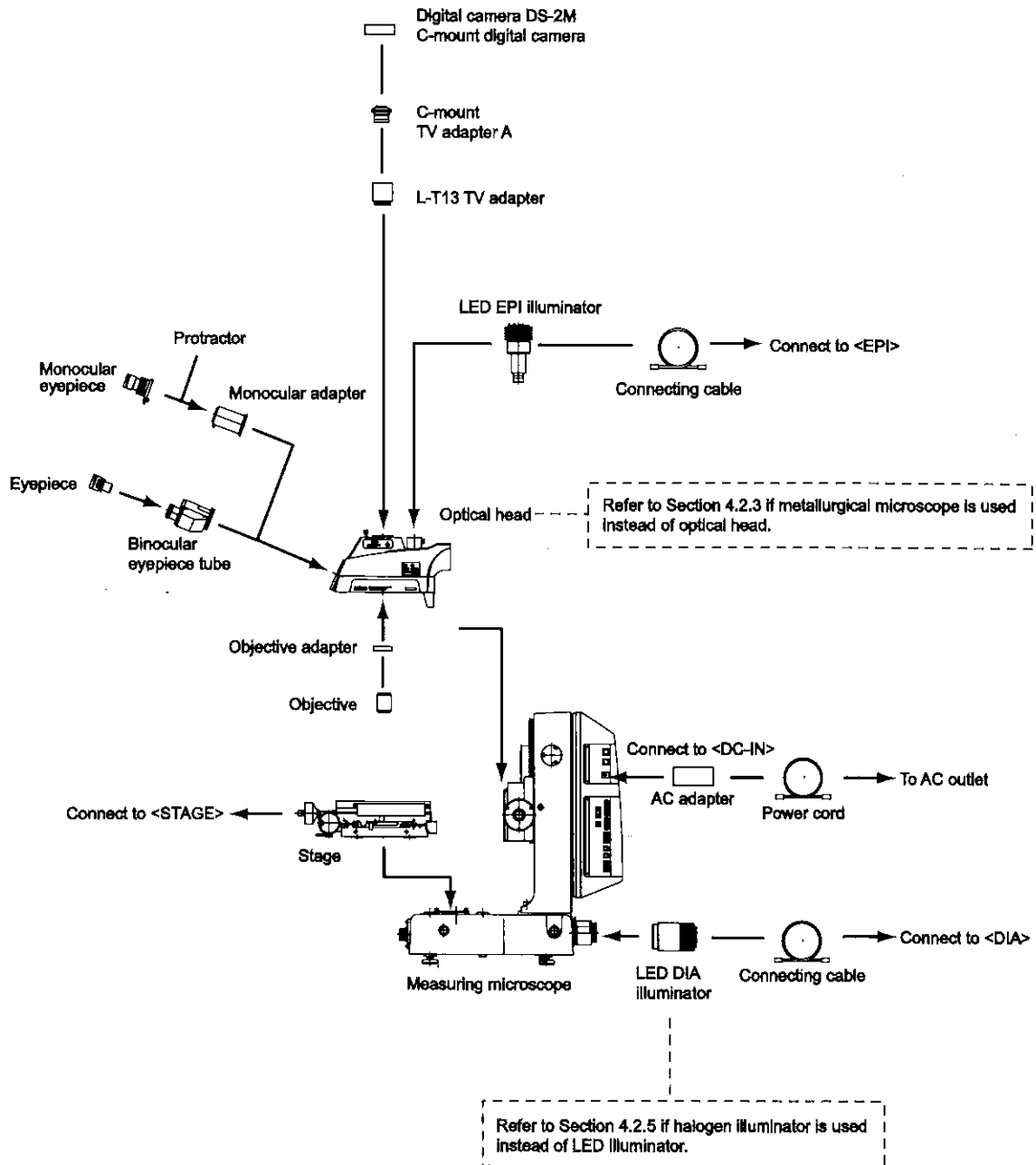
<Tools>

Hexagonal screwdriver
Hexagonal wrench
Flat-tip screwdriver

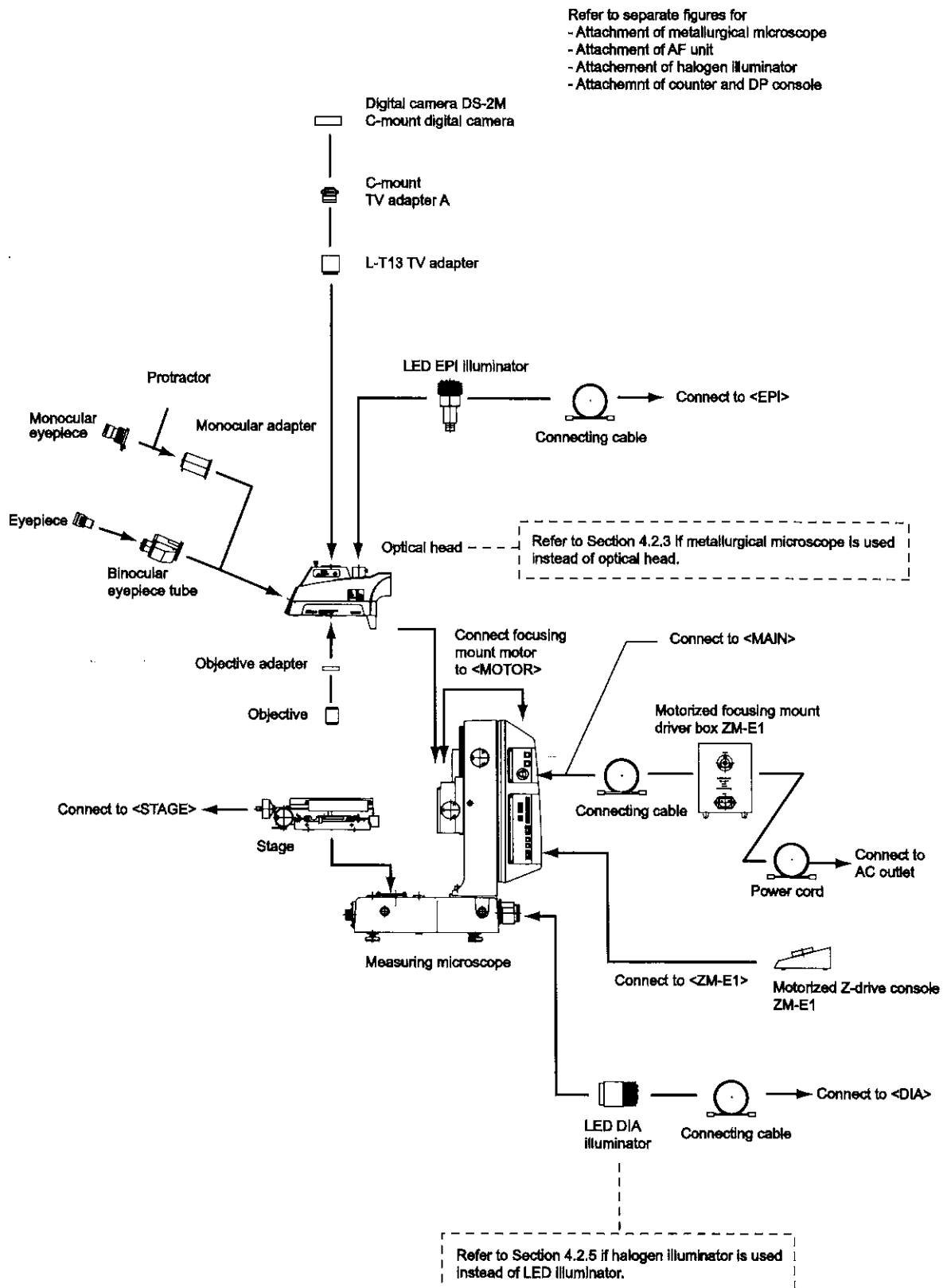
4.2 Connection examples

4.2.1 Basic assembly: MM-800, MM-800/L, MM-400, and MM-400/L

Refer to separate figures for
 - Attachment of metallurgical microscope
 - Attachment of AF unit
 - Attachment of halogen illuminator
 - Attachment of counter and DP console



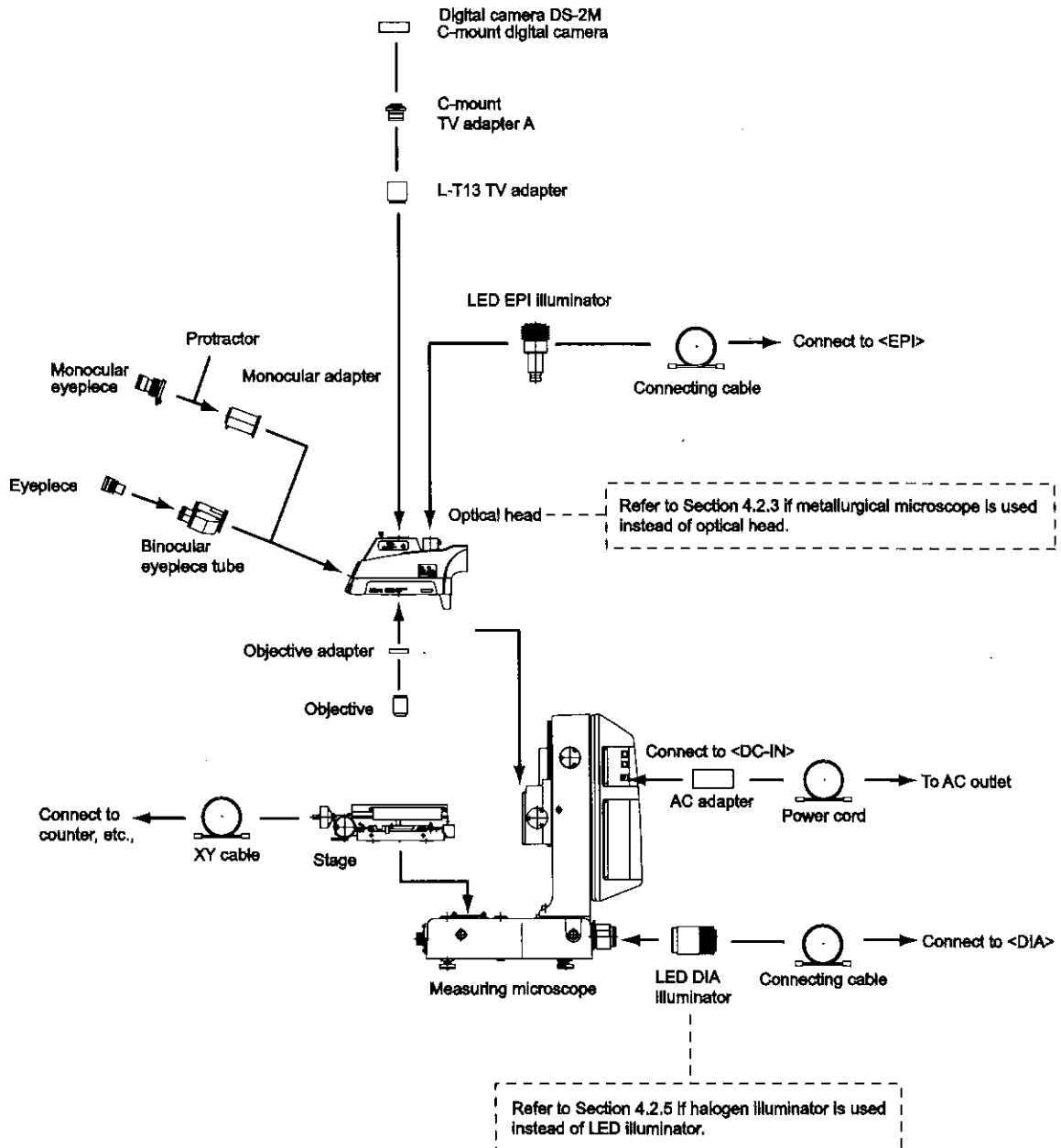
4.2.2 Basic assembly: MM-800/LM and MM-400/LM



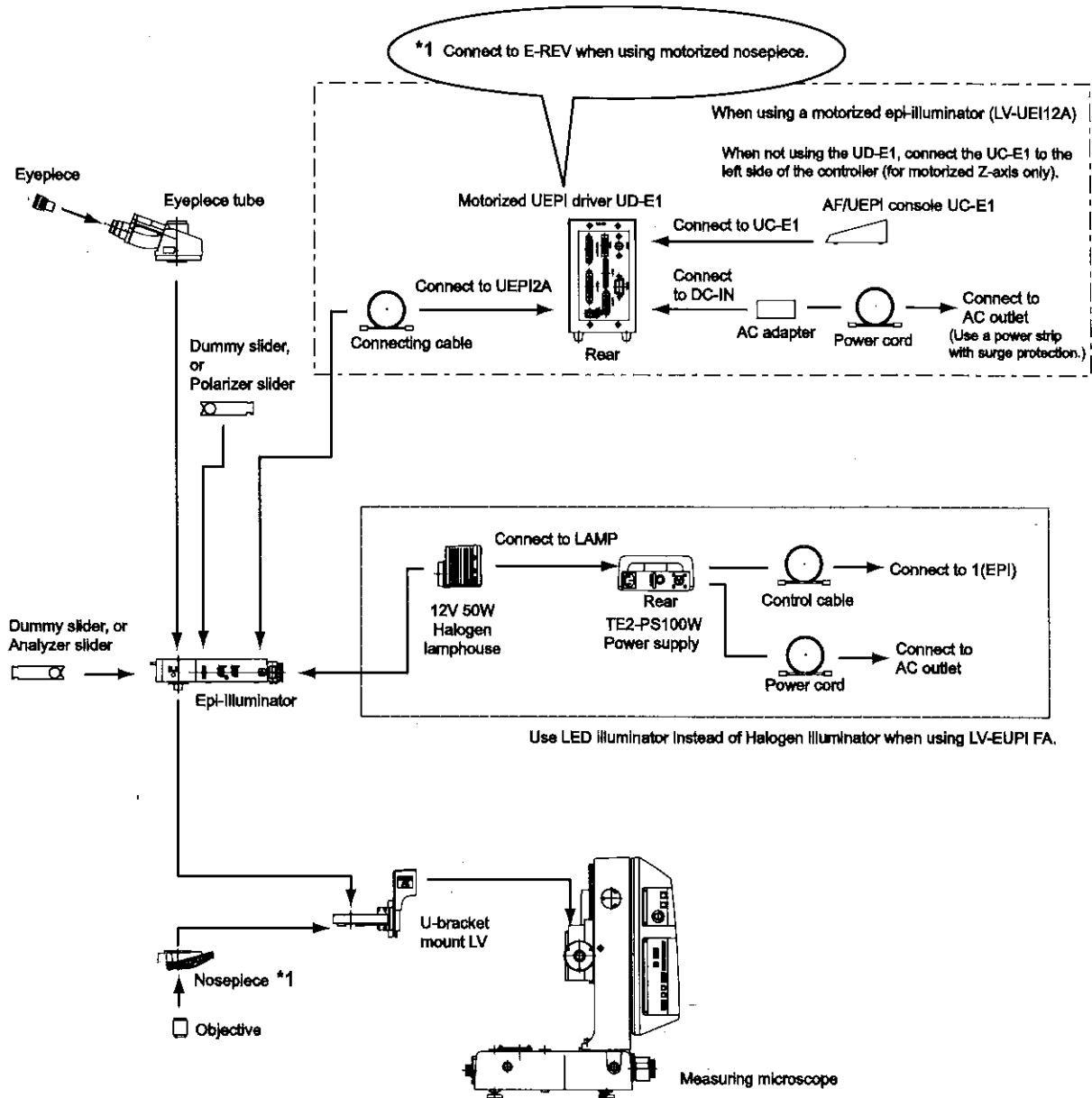
4. Assembly

4.2.3 Basic assembly: MM-800/LS, MM-800/S, MM-400/LS, and MM-400/S

Refer to separate figures for
 - Attachment of metallurgical microscope
 - Attachment of AF unit
 - Attachment of halogen illuminator
 - Attachment of counter and DP console



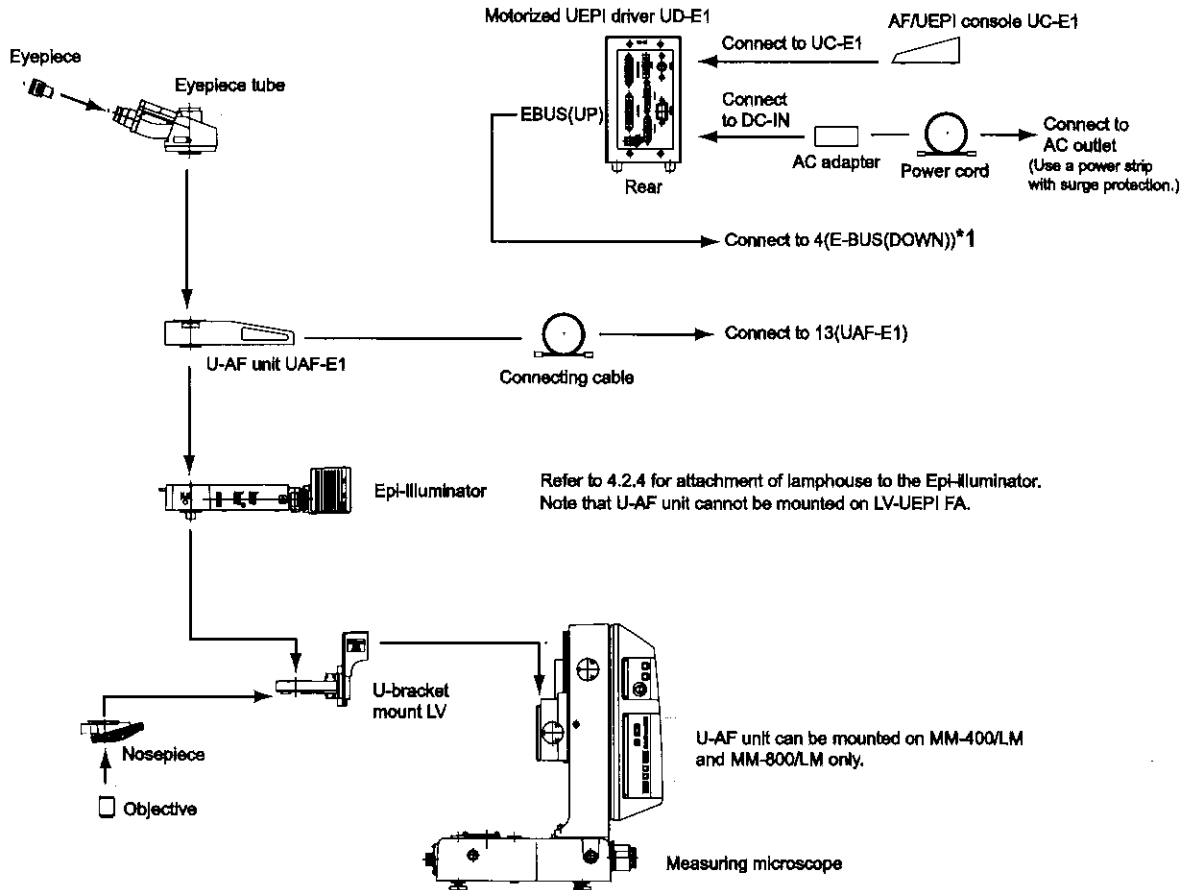
4.2.4 Attaching a metallurgical microscope



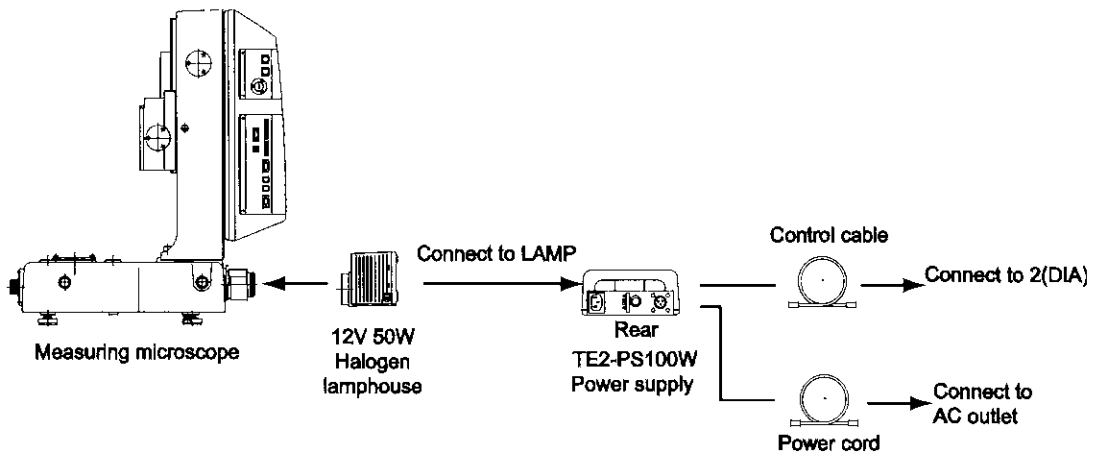
4.2.5 Attaching the AF unit

*1: When E-BUS(DOWN) connector on the controller is already occupied by another device, connect to the E-BUS(DOWN) connector on that device.

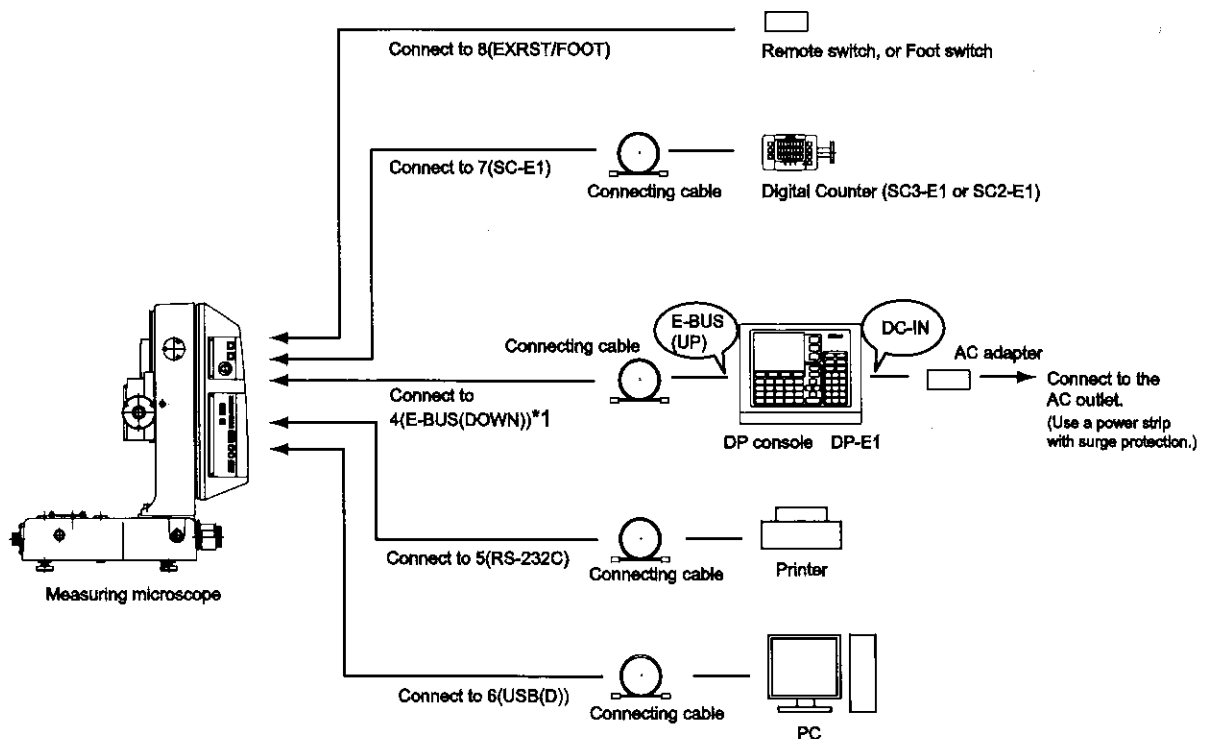
When not using the UD-E1, connect the UC-E1 to the left side of the controller.



4.2.6 When using a halogen illuminator



4.2.7 Attaching a counter display, DP console, remote switch, foot switch, computer, or printer



*1: When E-BUS(DOWN) connector on the controller is already occupied by another device, connect to the E-BUS(DOWN) connector on that device.

4.3 Assembly procedure

4.3.1 Basic assembly

1. Base

Position the base on a solid table.

The base is heavy and requires special care during transport.

Adjust the leveling screws to level the top surface of the base (keep the auxiliary leg at the rear of the base slightly off the table surface).

2. Stage

Place on the base. (Some stages require adapters.)

Align the holes for attaching the stage with the screw holes on the base. Insert four hexagonal socket head bolts and washers and tighten loosely.

Connect the XY cable (provided with the stage) to the controller interface labeled "Stage."

- For more information, refer to the instruction manual provided with the stage.
- Perform parallel positioning of the stage after assembly.

3. Optical head

* Refer to Section 4.3.2, "If a metallurgical microscope is attached" when attaching a metal microscope.

Attach to the focusing mount by sliding down along the dovetail on the mount. When the optical head reaches the limit, secure by evenly tightening the two hexagonal socket head screws on the left side.

4. Binocular eyepiece tube or monocular adapter

* This step is not necessary with monocular optical heads.

Attach to the circular dovetail mount on the optical head. Use a flat-tip screwdriver to secure the clamp screws.

5. Attaching the eyepiece

<Binocular eyepiece tube>

Insert into the eyepiece tube sleeve.

To insert, align the three grooves on the eyepiece with the three projections on the eyepiece tube sleeve.

Attach the eye cups (if used) to the eyepieces.

<Monocular optical head>

Attach to the circular dovetail mount on the optical head. Secure with clamp screws.

If you use a protractor, attach the protractor to the circular dovetail mount first, then attach the eyepiece.

<Monocular adapter>

Attach the eyepiece to the monocular adapter.

If you use a protractor, attach the protractor to the circular dovetail mount first, then attach the eyepiece.

6. Objective

Attach to the objective mount on the bottom of the optical head.

Attach an objective adapter to the objective.

Insert the objective into the objective mount so that the marking on the objective adapter appear on the front.

After insertion, screw in the objective counter-clockwise (as viewed from above) as far as possible. Tighten the objective clamp screw to secure it in place.



7. Digital camera

When using any other camera, use the L-T13 TV adapter and C-mount adapter in combination.

For information on making camera connections, refer to the instruction manual provided with the camera.

8. LED episcopic illuminator

Attach to the top rear of the optical head and secure with clamp screws.

Connect to the controller's EPI connector with the connection cable supplied with the illuminator.

9. LED diascope illuminator

* Refer to Section 4.3.3, "When attaching a 12V 50W halogen light source" when using 12V-50W halogen light source.

Attach to the back of the base and secure with clamp screws.

Connect to the controller's DIA connector with the connection cable supplied with the illuminator.

10. Motorized focusing mount driver box and console

* This step is not necessary with a manually-operated base.

Connect the motorized focusing mount driver box to the controller's MAIN with the supplied connection cable.

Connect motorized Z-drive console ZM-E1 to the controller's ZM-E1.

Connect the black motor unit, provided on the measuring microscope's motorized focusing mount, and the controller's MOTOR, with the supplied connection cable.

11. Counter Display Unit

The counter display can be attached to either the right or left side of the pillar. (Note that, in the case of a motorized model, it should be attached to the right side as viewed from the front of the measuring microscope.)

When used in combination with a metallurgical microscope, the counter display may become difficult to see. In this case, use the extension arm (optional).

Secure with three hexagonal socket head screws.

Connect to the controller's SC-EI with the connection cable supplied with the counter display unit.

12. Data Processing Console DP-E1

Connect to the controller's E-BUS (DOWN) with the connection cable supplied with the DP-E1.

Connect the AC adapter to the DP-E1. Plug the AC adapter into a grounded 2-prong outlet with the specified power cord.

When using the AC adapter, be sure to use a surge-suppressing table tap.

- Multiple devices with the E-BUS connector can be connected in a row to the controller's E-BUS (DOWN) using UP and DOWN. Keep in mind that any powered-down devices must be left unconnected. The presence of any powered-down device among the connected devices may result in malfunction.

13. External illumination adapter

To attach an illumination source such as an LED ring, dual arm fiber illuminator, fluorescent or ring fiber illuminator, attach the external illumination adapter to the bottom of the optical head.

Attach the luminescent section of the illuminator to the external illumination adapter.

14. AC adapter and power cord (for the non-motorized bases)

Connect one end to the DC-IN connector of the controller at the back of the base.

Connect the other end to the grounded two-pole outlet.

When using an AC adapter, use a power strip with surge protection.

Basic assembly is now complete.

4.3.2 If a metallurgical microscope is attached

1. U-bracket mount

Attach the U-bracket mount to the focusing mount by sliding it down along the dovetail on the mount.

When the optical head is fully inserted, secure in place by evenly tightening the two hexagonal socket head screws on the left side.

2. Illuminator

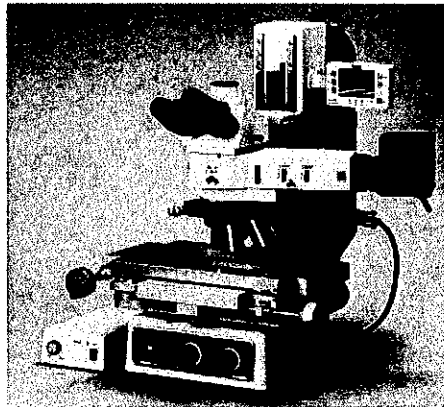
With the rear of the illuminator swung clockwise to 70° position as viewed from above, set it into the circular dovetail of the U-bracket mount. (Refer to the photo.)

Tighten the attachment screw of the U-bracket mount to secure in place.

For motorized illuminators, connect the U-driver box (UD-E1) and AF/UEPI console (UC-E1). Use the provided connecting cable to connect the illuminator to the U-driver box (UD-E1) interface labeled "UEPI2A."

Connect the motorized AF/UEPI console (UC-E1) to the U-driver box (UD-E1) interface labeled "UC-E1."

Connect the AC adapter to the U-driver box (UD-E1) interface labeled "DC-IN."



3. Eyepiece tube

Place the eyepiece tube of the metallurgical microscope on the illuminator and tighten the illuminator attachment screw to secure in place.

4. Eyepiece

Inert the eyepiece into the sleeve of the eyepiece tube.

To insert, align the grooves on the eyepiece with the three projections on the eyepiece tube sleeve.

Attach the eye cups to the eyepieces, as needed.

5. Nosepiece

Insert the nosepiece from the front into the dovetail groove on the bottom of the U-bracket. Secure with clamp screws.

6. Objective

Attach the lowest magnification objective to nosepiece hole #1. Attach the remaining objectives in ascending order of magnification. Be careful to avoid dropping the objectives.

7. Light source (for episcopic illumination)

When using LV-UEPI FA, use an LED dia-illuminator. If you plan to use another illuminator, use an LED dia-illuminator or a 12V 50W halogen light source.

< LED dia-illuminator >

Attach this illuminator to the back of the illuminator. Secure with clamp screws.
Use the connecting cable (provided with the illuminator) and connect it to the controller interface labeled "EPI."

< When using a 12V 50W halogen light source >

Refer to Section 4.3.3, "When attaching a 12V 50W halogen light source."

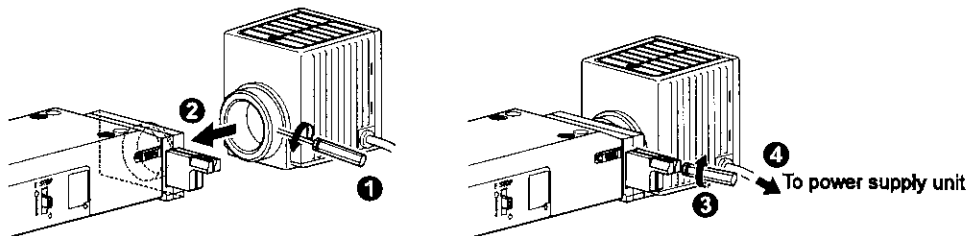
4.3.3 When attaching a 12V 50W halogen light source

⚠ Caution

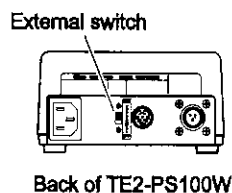
- To avoid electrocution and equipment damage, always turn off the light source and unplug the power cord before attaching or detaching the lamphouse.
- To avoid burns, wait at least 30 minutes after lamps have been turned off before attempting to replace them. Proceed with replacement only after the lamp and lamphouse have cooled sufficiently.
- Use the lamphouses and lamps specified at the end of this manual.
- Do not touch the glass lamp bulb with bare hands. Fingerprints or grease from your fingers may burn into the lamp surface, impairing illumination. If fingerprints, perspiration, or grease from your fingers adheres to the bulb, wipe the bulb clean before use.
- After lamp replacement, firmly close the lamphouse cover. Never activate the lamp while the lamphouse cover is removed.
- Dispose of used lamps without breaking them. Treat used lamps as industrial waste. Request assistance from a disposal service, or otherwise dispose of them in accordance with local regulations.
- Keep cables away from the lamphouse to prevent contact. Placing cables on top of the lamphouse may melt cable coatings, increasing the risk of electrocution or fire.

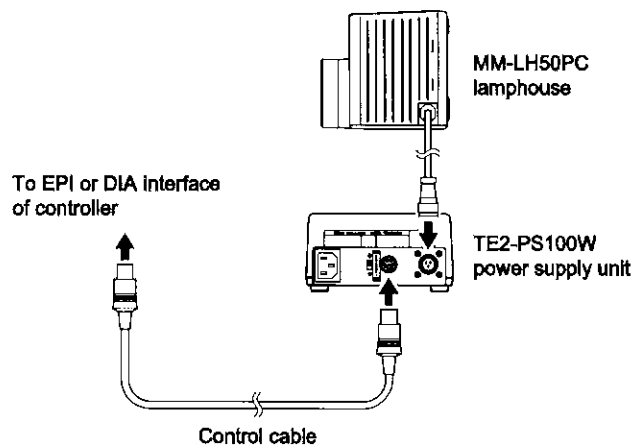
4.3.3.1 Attachment

- 1 Use a hex screwdriver to loosen the clamp screw on the connection side before attaching the lamphouse to the illuminator. Push in all the way. Tighten the clamp screw to secure the lamphouse.



- 2 Connect the lamphouse cable to the power supply unit (TE2-PS100W) interface labeled "Output."
- 3 Use the controller cable to connect the power supply unit (TE2-PS100W) interface labeled "External" and the controller interface "EPI" or "DIA." (Connect the cable to "EPI" when using as epi-illuminator and "DIA" when using as dia-illuminator.)

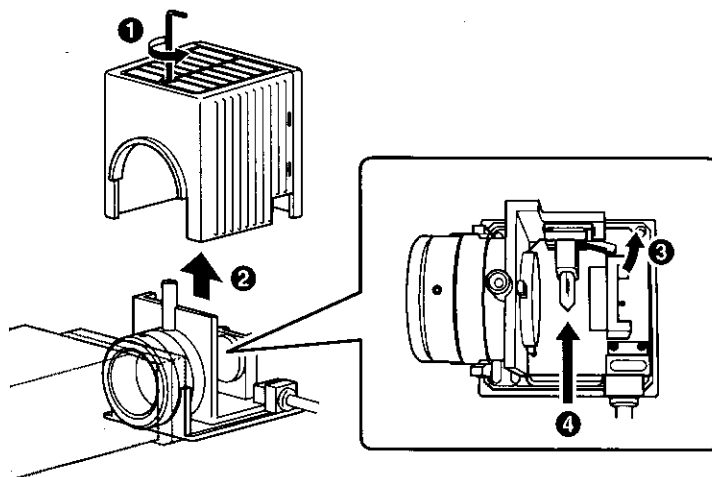




4.3.3.2 Lamp attachment and replacement

You can replace lamps while the illuminator is attached.

- 1 Turn off the measuring microscope and TE2-PS100W. (Push the power switch to the ○ side.) Unplug the power cord. Wait at least 30 minutes after the lamp has been turned off, then check the lamp and lamphouse to make sure they have cooled.
- 2 Use a hex wrench to loosen the clamp screw on the lamphouse cover.
- 3 Remove the lamphouse cover.
- 4 Push down the lamp clamp lever and remove the old lamp.
- 5 While holding down the lamp clamp lever, insert the electrodes of the new lamp into the pin holes of the socket. After pushing in the new lamp all the way, release the lamp clamp lever to secure in place.
Be careful to avoid touching the glass lamp bulb.
When releasing the lamp clamp lever, make sure the lamp is not tilted.
- 6 Close the lamphouse cover. Restore it to its original state. Tighten the clamp screw to secure in place.



4.4 Connecting peripherals

1. Printer

A printer can be connected to the RS-232C interface of the controller.

We recommend the DPU-414 thermal printer (Seiko Instruments).

Always use the dedicated cable (the DPU-414 cable) to connect the DPU-414 to the counter.

- Turn on the printer before turning on the measuring microscope.
Startup sequence: Printer → DP-E1 → Measuring microscope

<Printer software DIP SW (dip switch) settings>

After referring to the DPU-414 instruction manual, configure the software DIP SW as follows.
(For other software DIP SW settings, you may use the default settings.)

Input method	→	Serial
Carriage return	→	Carriage return
Printing mode	→	Normal
International characters	→	Japan
Data bit length	→	8 bits
Parity	→	None
Baud rate	→	9600 bps

<Sample printout> (When using a 2-axis counter)

Counting starts from "1."	001	X=	25.418	Y=-	17.830
	002	X=	25.418	Y=-	17.830
	003	X=	25.418	Y=-	17.830
	004	X=	25.427	Y=-	17.794
	005	X=	25.444	Y=-	17.769
	006	X=	25.399	Y=-	17.783
	007	X=	25.399	Y=-	17.783
	008	X=	25.399	Y=-	17.783
	009	X=	50.010	Y=-	20.035
		Z=	13.852		
	010	X=	- - -		

The results are printed in two lines when using a 3-axis counter.

2. Computer

You can connect a computer to the controller RS-232C interface.

However, when using a computer running Nikon E-MAX data processing software, connect the computer via the "USB(D)" interface.

4.5 Optional accessories

4.5.1. 10' reading protractor eyepiece

The 10' reading protractor eyepiece with monocular eyepiece adapter is mounted in place of the standard binocular eyepiece tube.

This eyepiece has cross hairs and a protractor in its viewfield. Turning the protractor ring will rotate the cross hairs together with the vernier by 180°, permitting measurement of angles with the cross hairs as its standard.

4.5.2. 1' reading protractor eyepiece

The 1' reading protractor eyepiece with monocular eyepiece adapter is mounted in place of the standard binocular tube.

This eyepiece has a small angle reading eyepiece in addition to the observing eyepiece. Turning the micrometer knob on the back will rotate the vernier together with the cross hairs in the viewfield of the observing eyepiece. This permits measurement of angles with the cross hair as its standard in the same way as with the 10' reading protractor eyepiece. (The angle can be read through the angle reading eyepiece.) There is an illuminating mirror on the back of the angle reading eyepiece. Adjust the direction and inclination of the mirror to obtain the brightest viewfield.

4.5.3. Optional reticles

(e.g., concentric circle reticle, 3 micron reticle)

The optional reticle is to be mounted instead of the standard cross hairs reticle.

The concentric circles reticle is to be used in combination with the 3x objective. It can be used to measure the diameters of small circles as well as their center coordinates.

1. Loosen the screws to remove the panel with "RETICLE" indication at the upper part of the optical head.
2. Remove the phillips screw inside and pull up the reticle lever to remove the standard cross hairs reticle from the optical head.
3. Screw off the standard reticle from the reticle lever and screw on the optional reticle instead.
4. Insert the optional reticle in the optical head, fasten the phillips screw, and attach the panel.
5. Press down the reticle lever as far as it goes to place the optional reticle in the viewfield.

4.5.4 Ring Illumination

You can attach an eight-direction LED ring illuminator to the bottom of the optical head.

With the external illumination adapter attached to the bottom of the optical head, you can attach a ring fiber illuminator and fluorescent illuminator.

For more information, refer to the instruction manuals supplied with the illuminators.

5. System Setup

When you are finished with assembly, proceed with system setup. System setup is performed from the 3-axis or 2-axis counter display or from the DP-E1 data processing console.

This manual provides a description of the setup procedure from the 3-axis or 2-axis counter display. To proceed with setup from the data processing console, refer to the instruction manual supplied with the DP-E1.

The following parameters can be set:

Table 1

No.	Category	Item
1	System connection setup	Optical head, revolving nosepiece, illuminator
2	Counter display setup	Number of displayed digits, averaging, direction
3	Objective setup (*1)	Magnification, WD, NA, type
4	Single AF setup	Trigger laser AF parameters
5	Continuous AF setup	Continuous laser AF parameters
6	Stage setup	XYZ correction values, motorized focusing parameters
7	Counter communication setup	

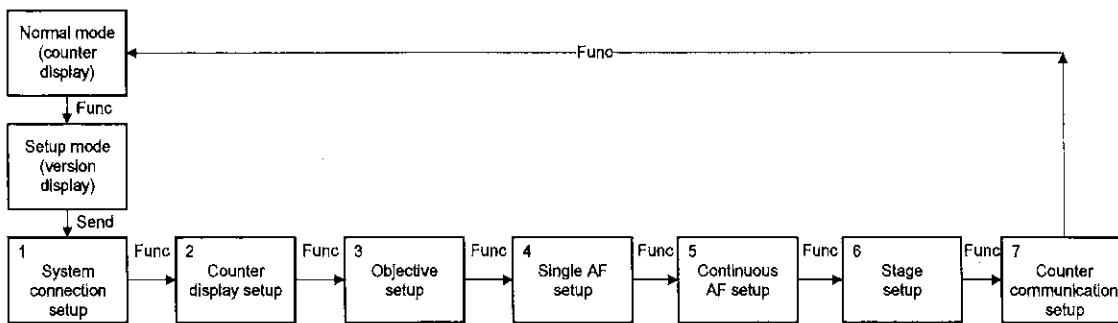
*1: The factory settings are as shown at right for "3: Objective setup."

When you use the objectives listed, attach them to the nosepiece holes in accordance with the factory settings; this will permit you to skip the setup procedures.

Table 2

Nosepiece Hole No.	Objective (factory setting)
1	CFI LU Plan Fluor BD 5X
2	CFI LU Plan Fluor BD 10X
3	CFI LU Plan BD ELWD 20X
4	CFI LU Plan BD ELWD 50X
5	CFI LU Plan BD ELWD 100X

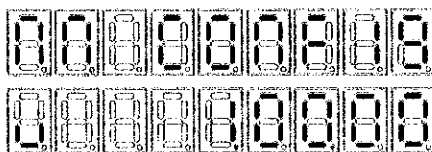
<Invoking Setup Mode>



When you turn on the power, the counter starts in "normal mode." (In normal mode, count values are shown.)

To enter setup mode, press the Func key with the counter in normal mode.

The firmware version appears on the counter display.



MM CONFIG

Version (v1.00.00)

At this point, press the Send key to display "1: System connection setup."

(No status change takes place if you press keys other than the Send and Func keys.)

5. System Setup

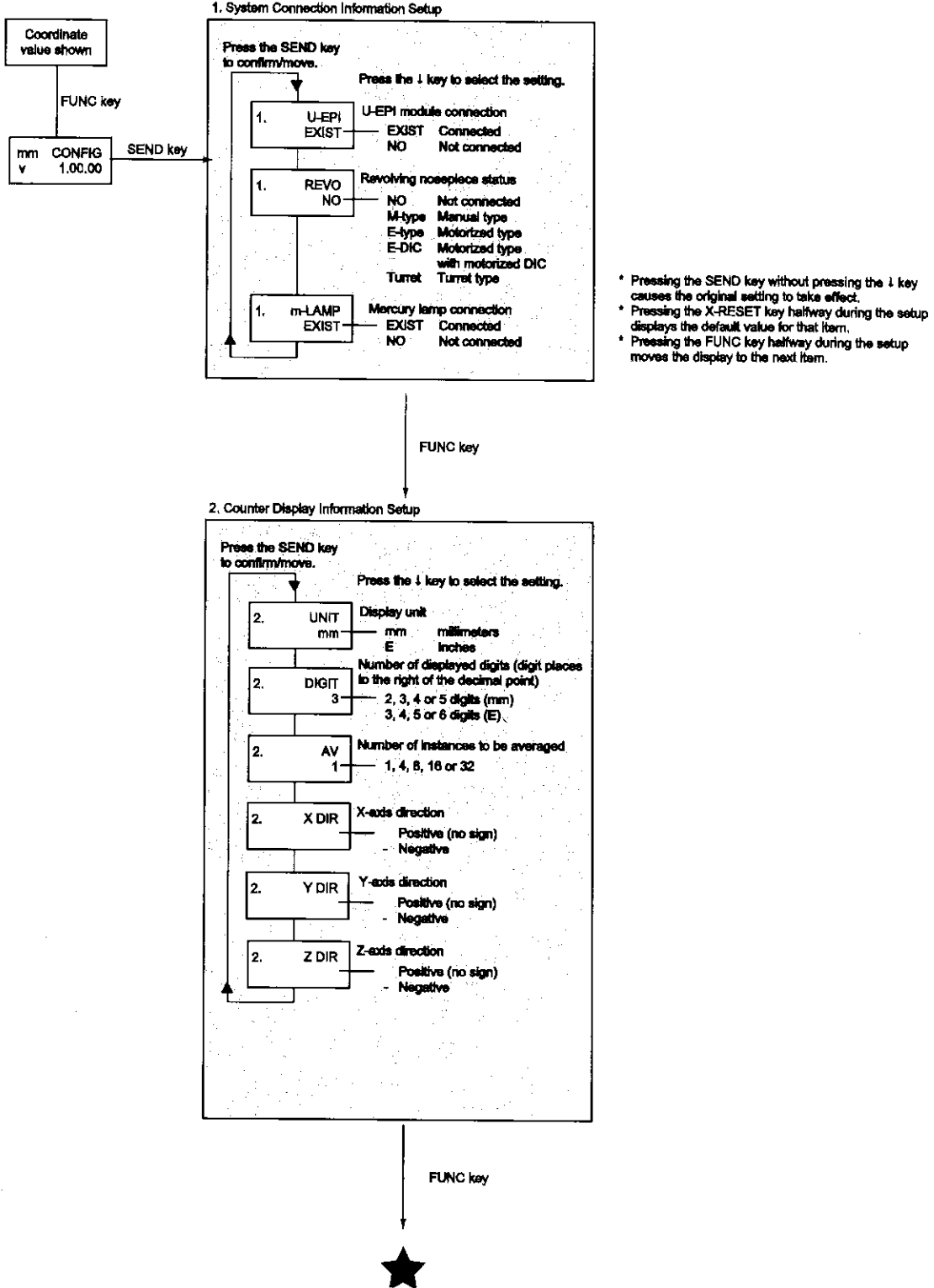
With "1: System connection setup" displayed, press the Func key to move to "2: Counter display setup."

Pressing the Func key again will move the display to "3: Objective setup."

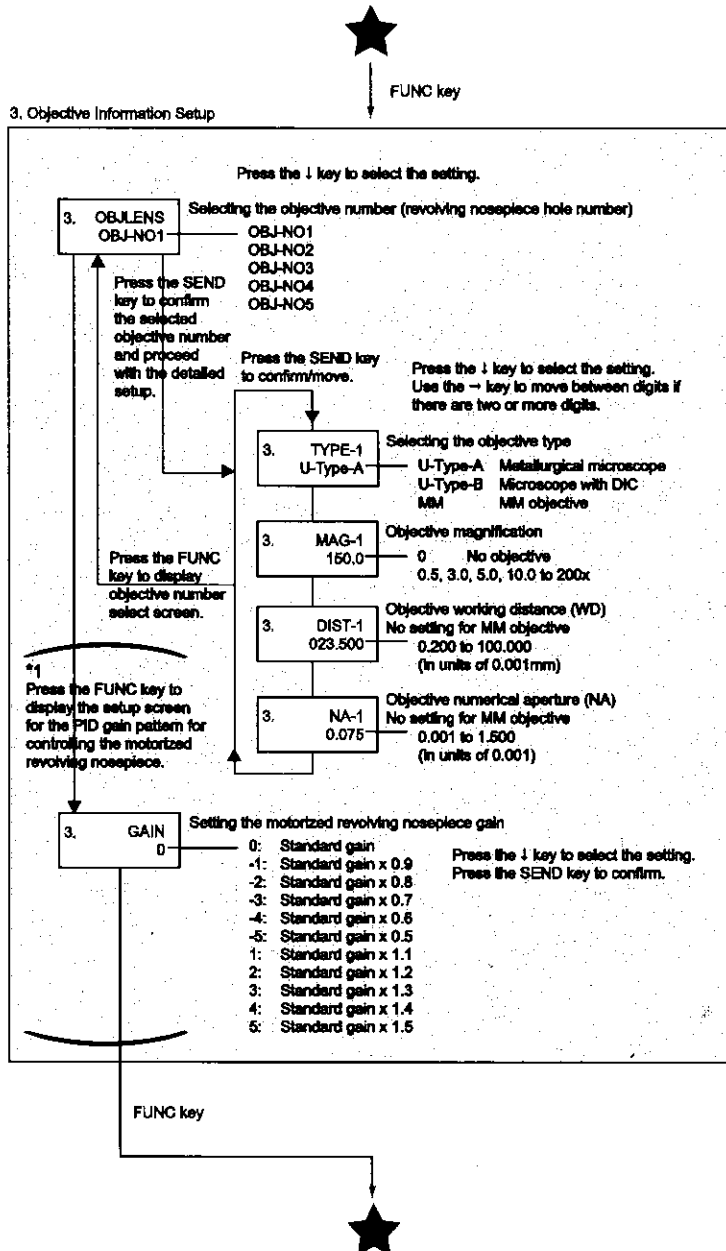
As described above, press the Func key repeatedly until the desired item number appears at the top left of the counter.

Press the Func key when "7: Counter communication setup" is shown to return to normal mode.

5. System Setup



5. System Setup



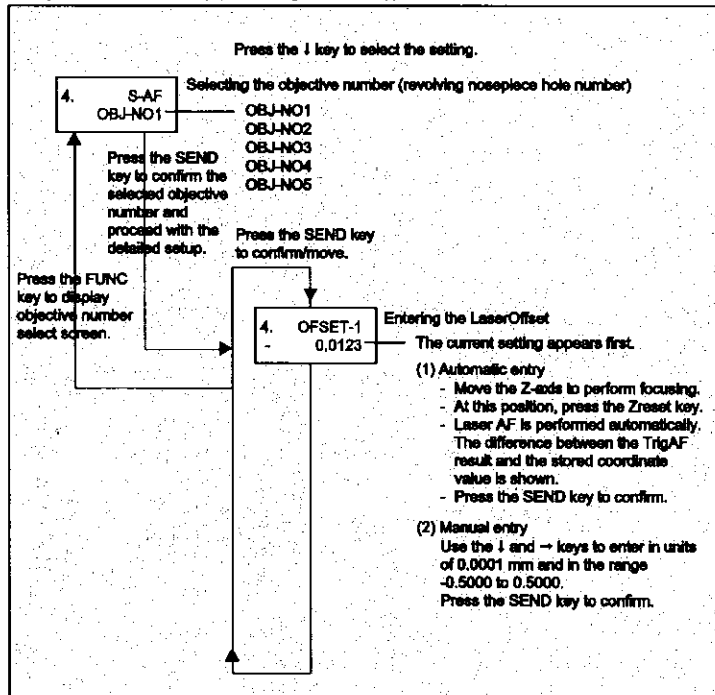
*1: Only when "E-Type" (motorized revolving nosepiece) is selected for the revolving nosepiece in system connection setup.

5. System Setup



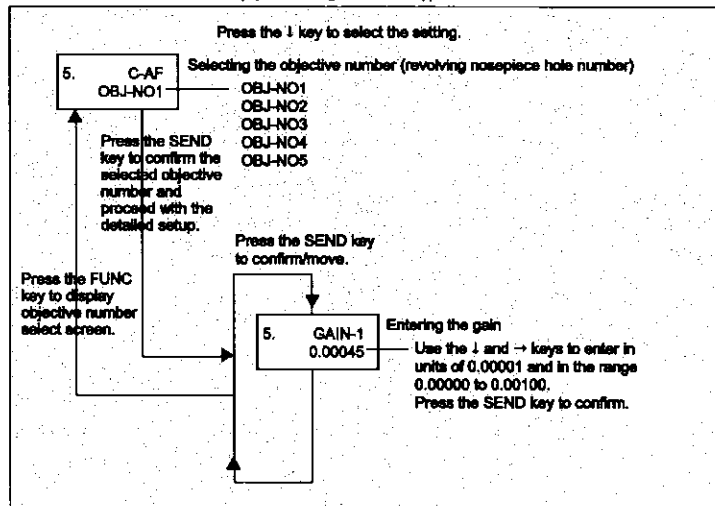
FUNC key

4. Single AF Information Setup (when using laser AF only)



FUNC key

5. Continuous AF Information Setup (when using laser AF only)



FUNC key

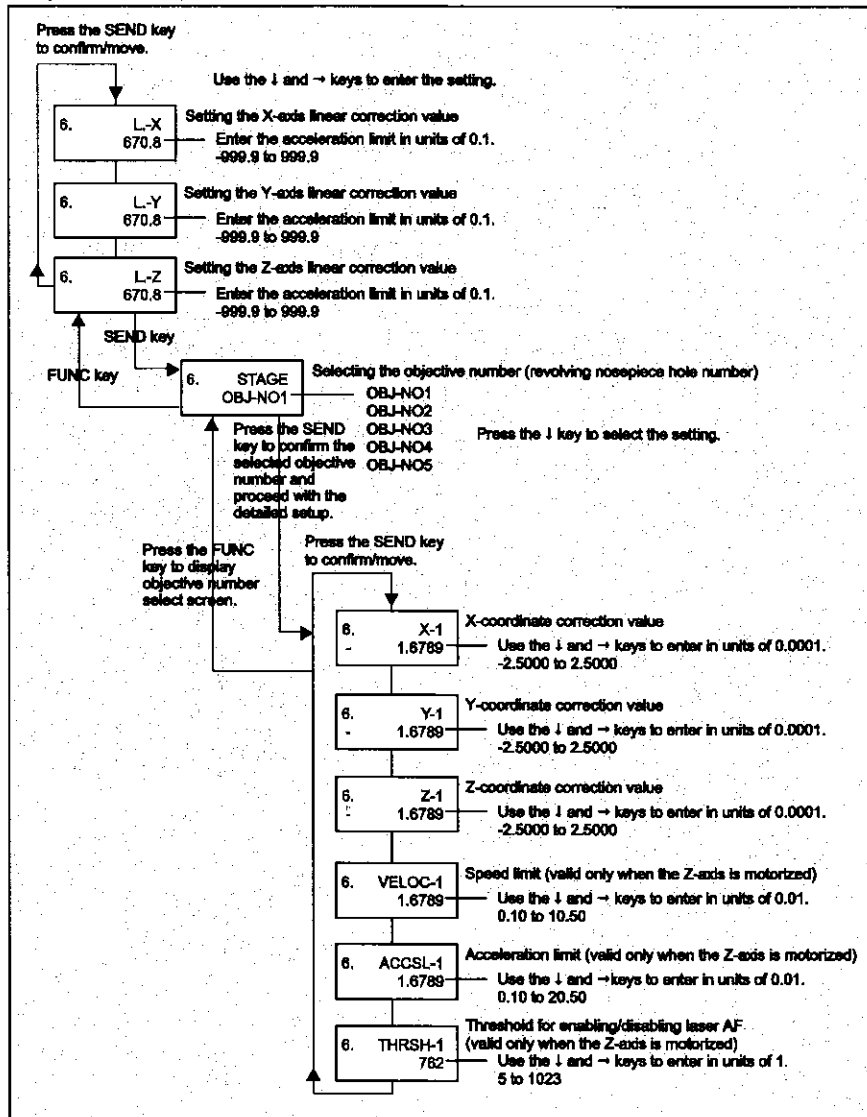


5. System Setup



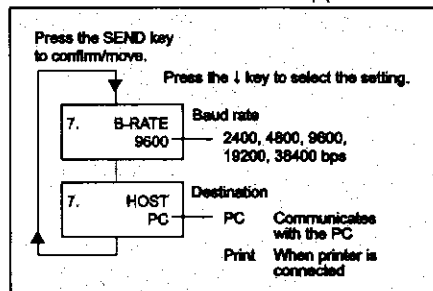
FUNC key

6. Stage Information Setup



FUNC key

7. Counter Communication Information Setup (COM Port Setup)



FUNC key

Back to 1. System Connection Information Setup

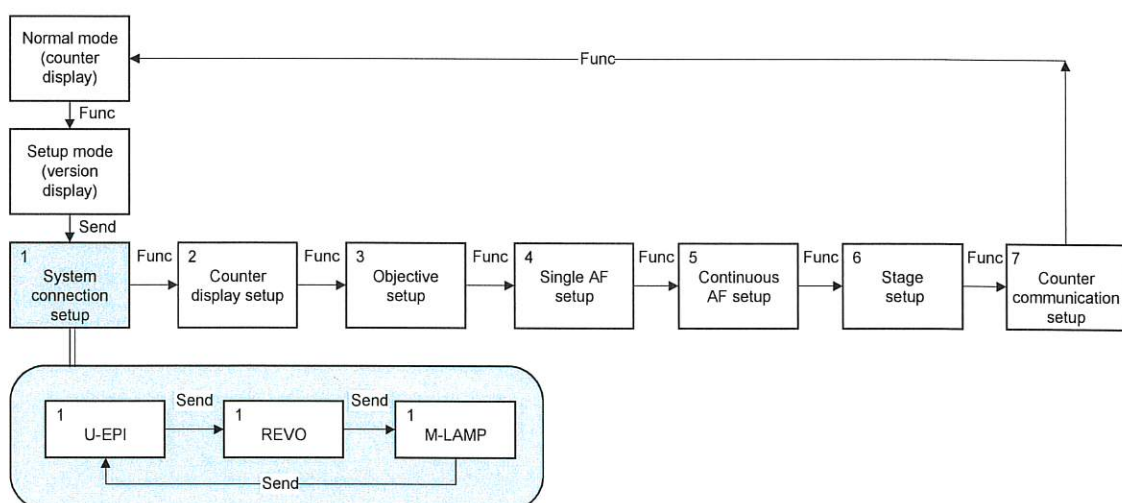
5.1 System Connection Information Setup

This item lets you set the connection status of the MM system's peripheral modules. "1" appears at the top left of the counter (most significant X axis digit place).

The following three setup screens are available:

- U-EPI: Sets the presence or absence of the U-EPI module.
- REVO: Sets the REVO module.
- M-LAMP: Sets the presence or absence of the mercury lamp module.

Press the Func key to move to the next setup item ("2: Counter display setup"). If you press the Func key during setup, the settings will be restored to their original state, switching the display to the next setup item. The three setup screens will be displayed in series until you press the Func key.



- 1) From normal mode, press the Func and Send keys to enter "1: System connection setup" mode. (You are in the "1: System connection setup" screen when "1" appears at the top left of the counter.)
- 2) The **U-EPI** screen lets you establish whether or not the motorized U-EPI module is connected. The display shows "Exist" and "no" alternately at the bottom each time you press the ↓ key. When the desired option is shown, press the Send key to confirm the selection.

Exist: The UEPI2A optical head for the motorized metallurgical microscope is in use.

no: The UEPI2A optical head for the motorized metallurgical microscope is not in use. (The optical head for the measuring microscope objective is in use.)

	1. U-EPI	Connected
	EXIST	Connected
	NO	Not connected





- 3) The **REVO** screen lets you set the mounted nosepiece type. The display will show the options "no," "M-Type," "E-Type," and "E-Dic" at the bottom in series each time you press the ↓ key. When the desired option is shown, press the Send key to confirm the selection.

no: Optical head is attached.

M-Type: Manual revolving nosepiece is attached.

E-Type: Motorized revolving nosepiece for metallurgical microscope is attached.




E-DIC: (Not available)

	1. REVO	
	NO	No connection
	M-TYPE	Manual type
	E-TYPE	Motorized type

- 4) The **M-LAMP** screen lets you establish whether or not an epi-illumination mercury lamp is connected. You can control the mercury lamp brightness through the RS-232C when you select "EXIST." The display shows "EXIST" and "no" alternately at the bottom each time you press the ↓ key. When the desired option is shown, press the Send key to confirm the selection.

EXIST: Epi-illumination mercury lamp is connected.

NO: Epi-illumination mercury lamp is not connected.

	1. M-LAMP	
	EXIST	Connected
	NO	Not connected

- 5) You will return to the **U-EPI** screen. Press the Func key to move to the next setup item ("2: Counter display setup").

Notes:

1. Pressing the Send key without pressing the ↓ key in each of the screens restores the setting to its original status and switches the display to the next screen.
2. Pressing the Func key during setup restores the settings to their original status and switches the display to the next setup item.

5.2 Counter Display Information Setup

This item lets you set the information shown on the MM system's counter display. "2" appears at the top left of the counter (most significant X axis digit place).

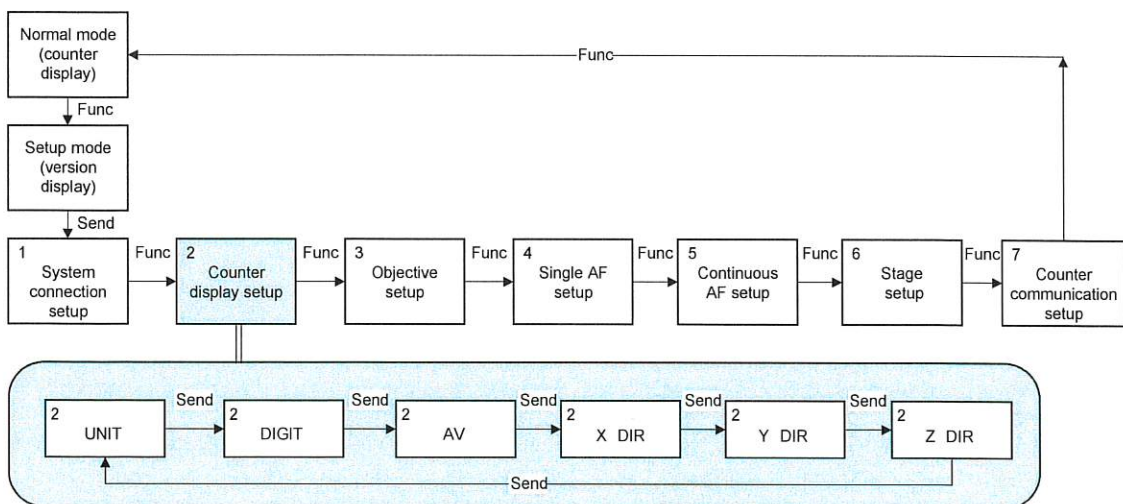
The following six setup screens are available:

- UNIT: Display units (mm or E)
- DIGIT: Number of displayed digits (digits to the right of the decimal point: 2, 3, 4, 5 in mm/3, 4, 5, 6 in E)
- AVE: Number of instances to be averaged (1, 4, 8, 16, or 32)
- X DIR: Counting direction of the X-axis (- or no sign)
- Y DIR: Counting direction of the Y-axis (- or no sign)
- Z DIR: Counting direction of the Z-axis (- or no sign)

Press the Func key to move to the next setup item ("3: Objective setup").

Pressing the Func key during setup restores the settings to their original status and switches the display to the next setup item.

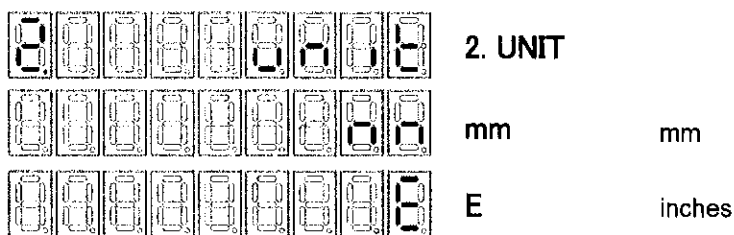
The six setup screens will be displayed in series until you press the Func key.



- 1) From normal mode, press the Func key, then the Send key, then the Func key again to enter "2: Counter display setup" mode.
(You are in the "2: Counter display setup" screen when "2" appears at the top left of the counter.)
- 2) The **UNIT** screen lets you set the counter display unit. The display shows "mm" and "E" alternately at the bottom each time you press the ↓ key. When "mm" is shown, press the Send key to confirm the selection.

mm: Values indicated in mm

E: Values indicated in inches



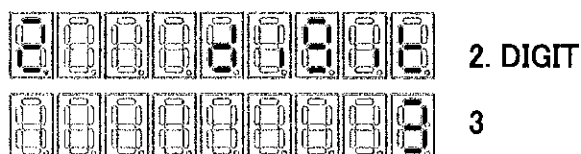
2. UNIT

mm mm

E inches

- 3) The **DIGIT** screen lets you set the number of displayed digits to the right of the decimal point. The display will show the options "2," "3," "4," and "5" at the bottom in series each time you press the ↓ key. When the desired option is shown, press the Send key to confirm the selection. ("3," "4," "5," and "6" appear when "E" is selected.)

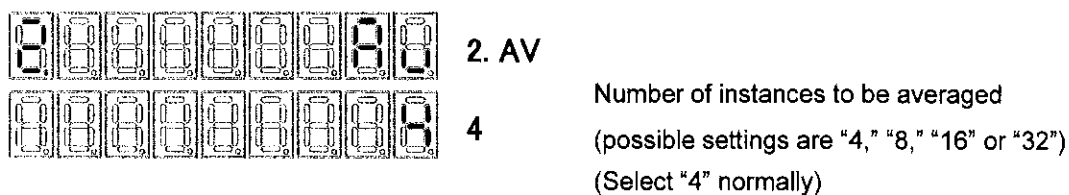
- 2: Two digit places are shown to the right of the decimal point.
- 3: Three digit places are shown to the right of the decimal point.
- 4: Four digit places are shown to the right of the decimal point.
- 5: Five digit places are shown to the right of the decimal point.



2. DIGIT

3

- 4) The **AV** screen lets you set the number of instances to be averaged. The display will show the options "1," "4," "8," "16," and "32" at the bottom in series each time you press the ↓ key. When the desired option is shown, press the Send key to confirm the selection. Normally select "4."



2. AV

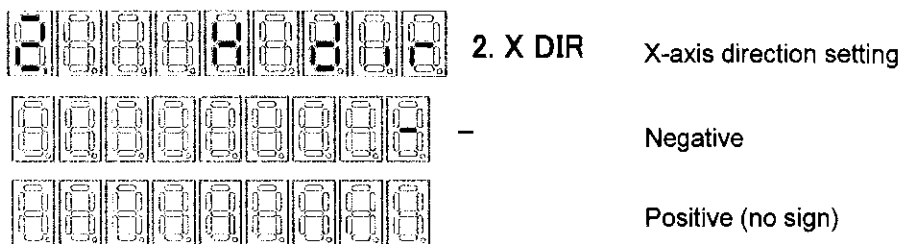
4

Number of instances to be averaged
(possible settings are "4," "8," "16" or "32")
(Select "4" normally)

- 5) The **X DIR** screen lets you set the counting direction of the X-axis. The display shows "-" and " " (no sign) alternately at the bottom each time you press the ↓ key. When the desired option is shown, press the Send key to confirm the selection.

-: Negative

: Positive (no sign)



2. X DIR

X-axis direction setting

-

Negative

Positive (no sign)

- 6) The **Y DIR** screen lets you set the counting direction of the Y-axis.
Set the direction in the same manner as in the **X DIR** screen.



2. **Y DIR** Y-axis direction setting

- 7) The **Z DIR** screen lets you set the counting direction of the Z-axis.
Set the direction in the same manner as in the **X DIR** screen.



2. **Z DIR** Z-axis direction setting

- 8) You will return to the **UNIT** screen.
Press the Func key to move to the next setup item ("3: Objective setup").

Notes:

1. Pressing the Send key without pressing the ↓ key in each of the screens restores the setting to its original status and switches the display to the next screen.
2. Pressing the Func key during setup restores the settings to their original status and switches the display to the next setup item.

5.3 Objective Setup

This item lets you set the objective information for the MM system.

"3" appears at the top left of the counter (most significant X axis digit place).

This item is comprised of two components: the "objective information setup" component and the "gain setup" component for motorized revolving nosepiece control.

The objective information setup component provides four screens to set objective information following selection of objective number.

- TYPE: Sets the objective type.
- MAG: Sets the objective magnification.
- DIST: Sets the working distance (WD).
(This setting will be used to change conditions when a revolving nosepiece is switched.)
- NA: Sets the objective numerical aperture (NA).
(The MM objective has no NA indication: NA is automatically set in accordance with the magnification.)

Table 2

Objective information is factory-set as shown at right. When you use the objectives listed, attach them to the nosepiece holes in accordance with the factory settings; this will permit you to skip the setup procedures.

The objective information you have set will be used for the following operations:

Nosepiece Hole No.	Objective (factory setting)
1	CFI LU Plan Fluor BD 5X
2	CFI LU Plan Fluor BD 10X
3	CFI LU Plan BD ELWD 20X
4	CFI LU Plan BD ELWD 50X
5	CFI LU Plan BD ELWD 100X

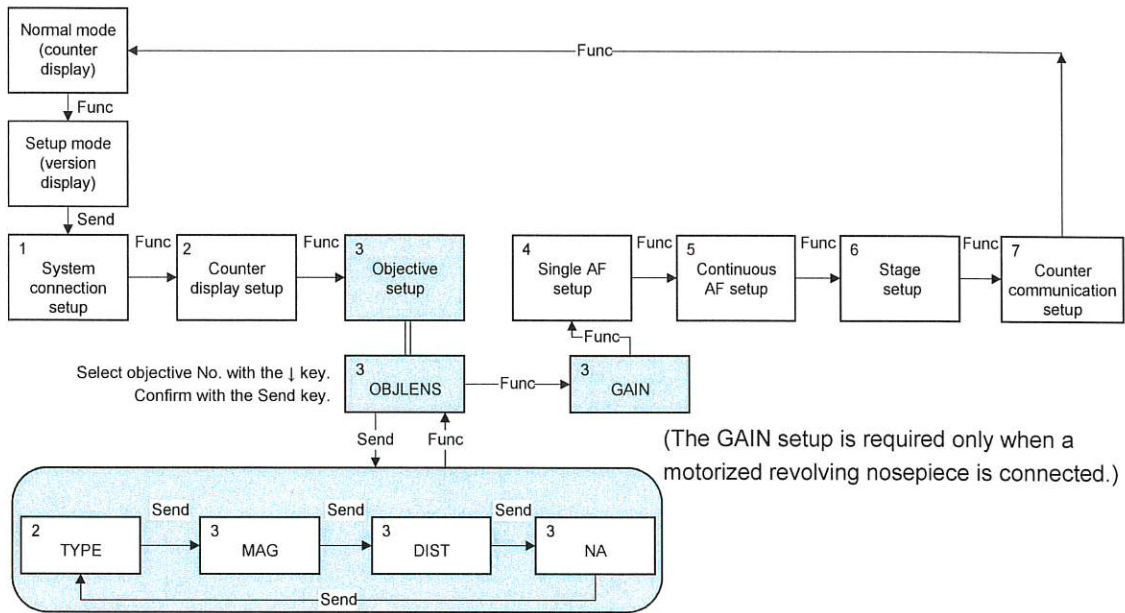
- For a measuring microscope with a motorized focusing mount, the optimal focusing speed is determined for the objective used.
- The optimal parameters are selected when the UAF-E1 autofocusing unit is used.

The gain setup component for motorized revolving nosepiece control is designed for the motorized revolving nosepiece. No setup is required if you do not use a motorized revolving nosepiece.

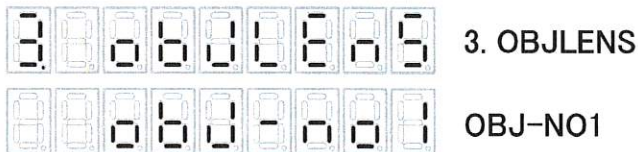
Press the Func key to move to the next setup item ("4: Single AF setup").

Pressing the Func key during setup restores the settings to their original status and switches the display to the next setup item.

5. System Setup



- 1) From normal mode, press the Func and Send keys once each, and then press the Func key twice to enter "3: Objective setup" mode.
(You are in "3: Objective setup screen" when "3" appears at the top left of the counter.)
- 2) The **OBJLENS** screen lets you specify the desired objective number (revolving nosepiece hole number).
The display will show the options "OBJ-NO1," "OBJ-NO2," "OBJ-NO3," "OBJ-NO4," and "OBJ-NO5" at the bottom in series each time you press the ↓ key. When the desired option is shown, press the Send key to confirm the selection.
(When an optical head is used, the selection is limited to "OBJ-NO1.")
(If you press the Func key without pressing the Send key, you will move to the PID gain setup screen for motorized revolving nosepiece control.)



- 3) The **TYPE** screen lets you set the objective type. (The number following "TYPE" and hyphen indicates the currently selected objective number.)
The display will show the options "U-TYPE-A," "U-TYPE-B," and "MM" at the bottom in series each time you press the ↓ key. When the desired option is shown, press the Send key to confirm the selection.

- U-Type-A:** Objective for metallurgical microscope
- U-Type-B:** Objective for metallurgical microscope with DIC
- MM:** Objective for measuring microscope (MM objective)

	3. TYPE-1	
	U-TYPE-A	U-Type-A
	U-TYPE-B	U-Type-B
	MM	MM-Type

- 4) The **MAG** screen lets you set the objective magnification. (The number following "MAG" and hyphen indicates the currently selected objective number.)
Use the ↓ and → keys to enter the magnification and press the Send key to confirm the selection.

↓ key: Increments the value of the flashing digit each time it is pressed.

→ key: Moves the flashing cursor to the next digit each time it is pressed. Use this key to cause the desired digit to flash.

Ex.) 0: Objective not attached
0.5: 0.5×
5.0: 5×
10.0: 10×
⋮
200.0: 200×

	3. MAG-1
	150.0

- 5) The **DIST** screen lets you select the objective working distance (WD). (The WD can be set only when U-TYPE-A or U-TYPE-B is selected for "TYPE.")
(The number following "DIST" and hyphen indicates the currently selected objective number.)
Use the ↓ key to enter the WD and press the Send key to confirm the selection.
The WD can be entered in units of 0.001 mm and in a range from 0.200 to 100.000.

	3. DIST-1
	023.500

- 6) The **NA** screen lets you select the objective numerical aperture (NA).
(The NA can be set only when U-TYPE-A or U-TYPE-B is selected for "TYPE.") (The number following "NA" and hyphen indicates the currently selected objective number.)
Use the ↓ key to select the NA and press the Send key to confirm the selection.
The NA can be set in units of 0.001 and in a range from 0.030 to 1.500.

	3. NA-1
	0.075

- 7) You will return to the **TYPE** screen again.
Press the Func key to return to the **OBJLENS** screen.
- 8) Go back to Step 2 and set the information for the next objective. When setup is complete for all objectives, press the Func key when the **OBJLENS** screen appears; this will take you to the PID gain setup screen for motorized revolving nosepiece control if such a nosepiece is connected. If not, you will move to the next setup item ("5: Single AF setup").
- 9) The GAIN screen (with "GAIN" shown on top) lets you set the PID gain for controlling the motorized revolving nosepiece. No setup is required if you do not use a motorized revolving nosepiece. Use the ↓ key to select the gain and press the Send key to confirm the selection.
- | | | |
|--------------------------|--------------------------|-------------------------|
| 0 : Standard gain × | -4 : Standard gain × 0.6 | 3 : Standard gain × 1.3 |
| -1 : Standard gain × 0.9 | -5 : Standard gain × 0.5 | 4 : Standard gain × 1.4 |
| -2 : Standard gain × 0.8 | 1 : Standard gain × 1.1 | 5 : Standard gain × 1.5 |
| -3 : Standard gain × 0.7 | 2 : Standard gain × 1.2 | |
- 10) Press the Func key to move to the next setup item (5: Single AF setup).

Notes:

1. Pressing the Send key without pressing the ↓ key in each of the screens restores the setting to its original status and switches the display to the next screen.
2. Pressing the Func key during setup restores the settings to their original status and switches the display to the next setup item.
3. Pressing the X-RESET key during setup displays the default value for that item.

Default Values

Objective No.	Mag.	WD	NA
1	5.0	18.0	0.15
2	10.0	15.0	0.3
3	20.0	13.0	0.4
4	50.0	9.8	0.55
5	100.0	3.5	0.8

GAIN	0
------	---

4. If you have turned on the power with a non-motorized nosepiece selected, changing your setting to the motorized type will show the GAIN setup screen, but you will not be able to set the gain. In this case, turn the power off and back on again.

5.4 Single AF Information

This item lets you set Single AF information for the MM system.

"4" appears at the top left of the counter (most significant X axis digit place).

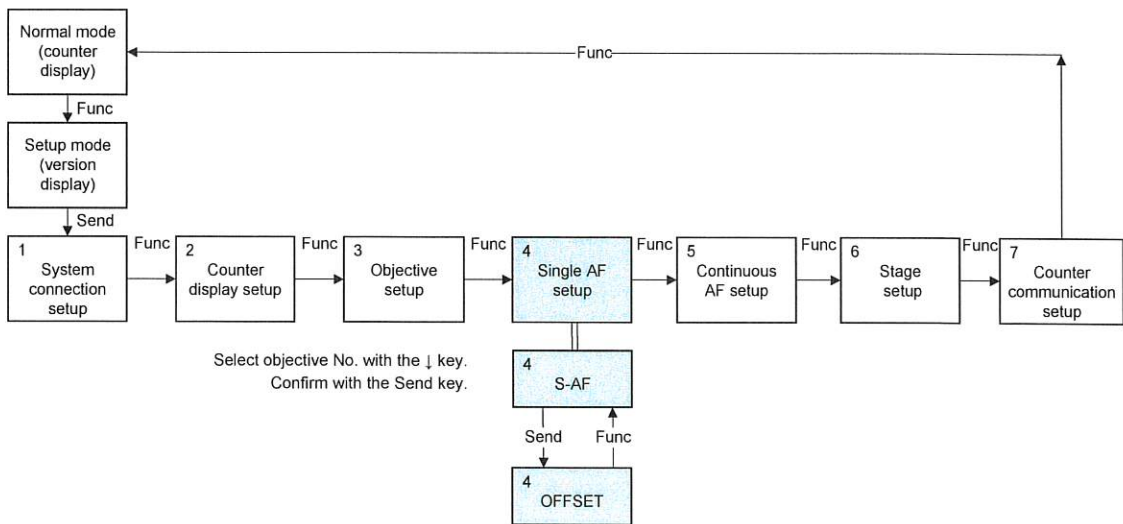
This item is provided for optional laser AF. No setup is required if you are not using laser AF.

First, select the objective number and set the laser offset value for the selected objective.

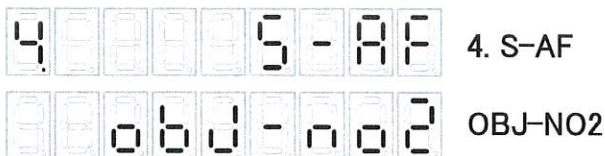
- **OFFSET:** Sets the Z-axis offset value for laser AF (manual or auto)

Press the Func key to move to the next setup item (5: Continuous AF setup).

Pressing the Func key during setup restores the settings to their original status and switches the display to the next setup item.



- 1) From normal mode, press the Func and Send keys once each, and then press the Func key three times to enter "4: Single AF setup" mode.
(You are in the "4: Single AF setup" screen when "4" appears at the top left of the counter.)
- 2) The **S-AF** screen lets you specify the desired objective number (revolving nosepiece hole number).
The display will show the options "OBJ-NO1," "OBJ-NO2," "OBJ-NO3," "OBJ-NO4," and "OBJ-NO5" at the bottom in series each time you press the ↓ key. When the desired option is shown, press the Send key to confirm the selection.
(When an optical head is used, the selection is limited to "OBJ-NO1.")
(If you press the Func key without pressing the Send key, you will move to the next setup item, "5: Continuous AF setup.")



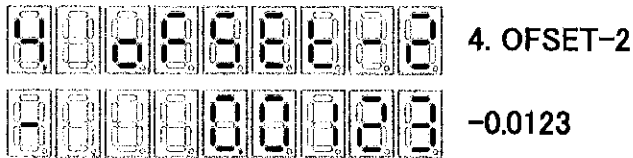
- 3) The **OFFSET** screen lets you set the Z-axis offset value for laser AF. (The current offset value is shown at the bottom.)
 (The number following "OFFSET" and hyphen indicates the currently selected objective number.)
 The offset value can be entered in two ways: automatically or manually.

4) Automatic entry

- 4) - 1 Move the microscope's Z-axis to achieve focus.
- 4) - 2 In this position, press the Z-Reset key. (This stores the Z value.)
 Laser AF (Single AF) is performed automatically, showing the difference between the Single AF result and the stored coordinate value at the bottom.
- 4) - 3 Press the Send key to confirm the value.
- 4) - 4 Press the Func key to return to the **S-AF** screen.

5) Manual entry

- 5) - 1 Use the ↓ and → keys to enter (edit) the offset value.
 The offset value can be entered in units of 0.0001 mm and in a range from -0.5000 to 0.5000.
- 5) - 2 Press the Send key to confirm the selection.
- 5) - 3 Press the Func key to return to the **S-AF** screen.



The minus sign appears at the leftmost position.

Allowable range

Item	Unit	Range
Laser Offset	0.0001 mm	-0.5000 to 0.5000

- 6) Go back to Step 2 and set the offset value for the next objective. When the setup for all objectives is complete, press the Func key when the S-AF screen appears, to move to the next setup item ("5: Continuous AF setup").

Notes:

- 1. Pressing the Send key without pressing the ↓ key in each of the screens restores the setting to its original status and switches the display to the next screen.
- 2. Pressing the Func key during setup restores the settings to their original status and switches the display to the next setup item.
- 3. Pressing the X-RESET key during setup displays the default value for that item.
 Default value is 0.0 for all objective numbers.

5.5 Continuous AF Setup

This item lets you set Continuous AF information for the MM system.

"5" appears at the top left of the counter (most significant X axis digit place).

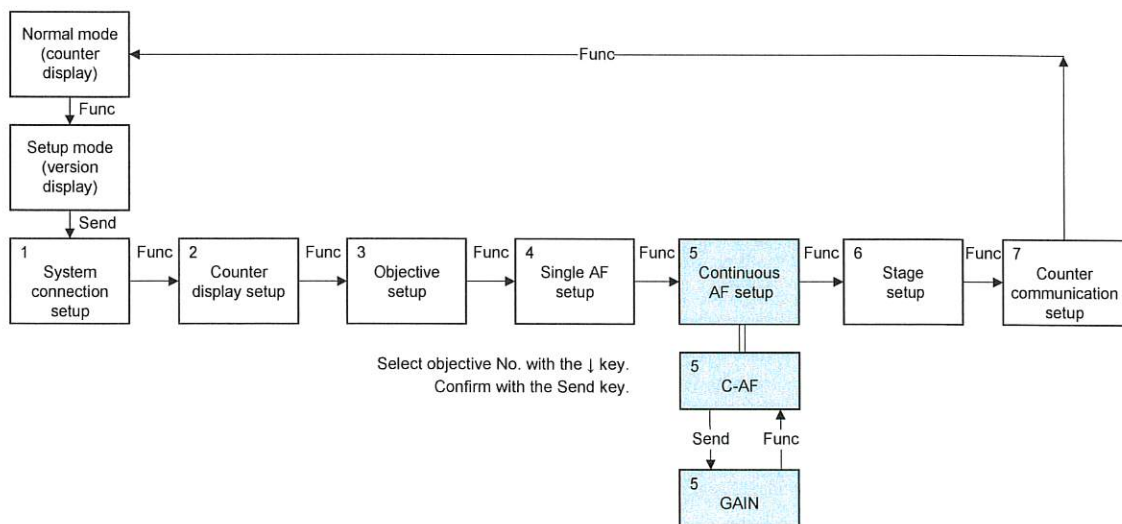
This item is provided for optional laser AF. No setup is required if you are not using laser AF.

First, select the objective number and set the gain for the selected objective.

- **GAIN:** Sets the gain for Continuous AF.

Press the Func key to move to the next setup item ("6: Stage setup").

Pressing the Func key during setup restores the settings to their original status, switching the display to the next setup item.



- 1) From normal mode, press the Func and Send keys once each, and then press the Func key four times to enter "5: Continuous AF setup" mode.
(You are in the "5: Continuous AF setup" screen when "5" appears at the top left of the counter.)
- 2) The **C-AF** screen lets you specify the desired objective number (revolving nosepiece hole number).
The display will show the options "OBJ-NO1," "OBJ-NO2," "OBJ-NO3," "OBJ-NO4," and "OBJ-NO5" at the bottom in series each time you press the ↓ key. When the desired option is shown, press the Send key to confirm the selection.
(When an optical head is used, the selection is limited to "OBJ-NO1.")
(If you press the Func key without pressing the Send key, you will move to the next setup item, "6: Stage setup.")

- 3) The **GAIN** screen lets you set the gain. (The number following "GAIN" and hyphen indicates the currently selected objective number.)
 Use the ↓ and → keys to enter the gain and press the Send key to confirm the selection.
 The gain can be entered in units of 0.00005 and in a range from 0.00000 to 0.00100.

↓ **key:** Increments the value of the flashing digit each time it is pressed.

→ **key:** Moves the flashing cursor to the next digit each time it is pressed. Use this key to cause the desired digit to flash.

5. C-AF

OBJ-NO3

Continuous AFGain setting on the display

5. GAIN-3

0.00045

Allowable range

Item	Unit	Range
Continuous AFGain	0.00005	0.00000 to 0.00100

Notes:

1. Pressing the Send key without pressing the ↓ key restores the setting to its original status and switches the display to the next item.
2. Pressing the X-RESET key during setup displays the default value for that item.

Default Value

Objective No.	Continuous AFGain
1	0.001
2	0.00025
3	0.000068
4	0.000015
5	0.000005

3. Pressing the Func key during setup switches the system from Continuous AF information mode to the next setup mode.

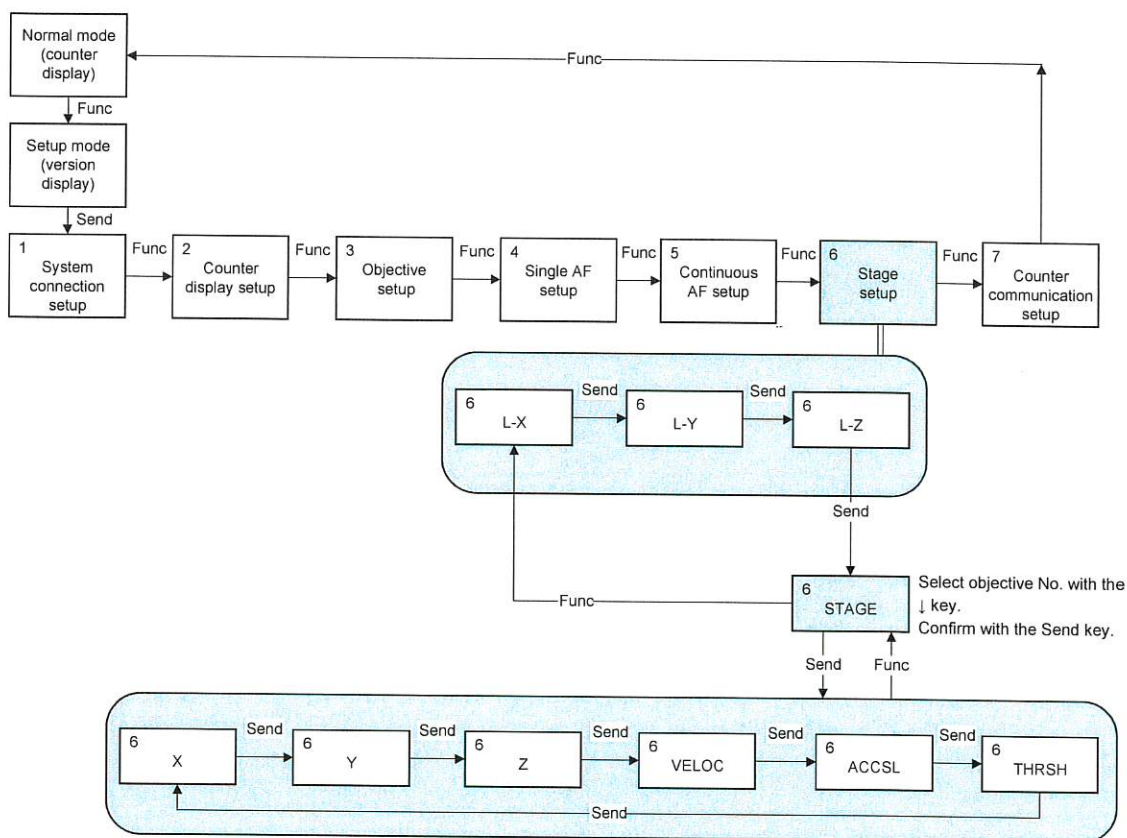
5.6 Stage Information

This item lets you set stage information for the MM system.

“6” appears at the top left of the counter (most significant X axis digit place).

The following five parameters can be set:

- L-X, L-Y, L-Z: Linear correction values for the XYZ axes
- X, Y, Z: XYZ coordinate correction (X, Y = coaxial correction, Z = parfocal)
Lets you enter a correction value for each objective that will maintain coordinates even if revolving nosepieces or turrets are changed.
- VELOC: Speed limit (only for a microscope with motorized focusing mount) (Enter a value for each objective number.)
- ACCSL: Acceleration limit (only for a microscope with motorized focusing mount) (Enter a value for each objective number.)
- THRSH: Threshold (only when laser AF is used)



- 1) From within normal mode, press the Func and Send keys once each, and then press the Func key five times to enter “6: Stage setup” mode.
(You are in the “6: Stage setup” screen when “6” appears at the top left of the counter.)

- 2) The **L-X** screen lets you set the X linear correction value.
 Use the ↓ and → keys to enter the correction value and press the Send key to confirm the selection.
 The correction value can be entered in increments of 0.1 and in a range from -999.9 to 999.9. (±)
 If you enter 10.0, the correction value is 1.0 μm when moving the stage by 100 mm.

↓ **key:** Increments the value of the flashing digit each time it is pressed.

→ **key:** Moves the flashing cursor to the next digit each time it is pressed. Use this key to cause the desired digit to flash.

(Pressing the Func key without pressing the Send key will switch the display to the next setup item; i.e., the objective number selection screen.)



[Example display]

- 3) The **L-Y** screen lets you set the Y linear correction value.
 Set the correction value in the same manner as in the L-X screen.



- 3) The **L-Z** screen lets you set the Z linear correction value.
 Set the correction value in the same manner as in the L-X screen.



- 4) The **STAGE** screen lets you specify the desired objective number (revolving nosepiece hole number).
 The display will show the options "OBJ-NO1," "OBJ-NO2," "OBJ-NO3," "OBJ-NO4," and "OBJ-NO5" at the bottom in series each time you press the ↓ key. When the desired option is shown, press the Send key to confirm the selection.
 (If you press the Func key without pressing the Send key, you will return to the L-X screen.)



- 5) The **X** screen lets you set the X-coordinate correction value. (The value shown at the bottom is the current setting.) (The number following "X" and hyphen indicates the currently selected objective number.)

Use the ↓ and → keys to enter the correction value and press the Send key to confirm the selection.

The correction value can be entered in increments of 0.0001 and in a range from -2.5000 to 2.5000.

↓ **key:** Increments the value of the flashing digit each time it is pressed.

→ **key:** Moves the flashing cursor to the next digit each time it is pressed. Use this key to cause the desired digit to flash.

 6. X-4

 -1.6789

- 6) The **Y** screen lets you set the Y-coordinate correction value. Set the correction value in the same manner as in the **X** screen.

 6. Y-4

- 7) The **Z** screen lets you set the Z-coordinate correction value. Set the correction value in the same manner as in the **X** screen.

 6. Z-4

- 8) The **VELOC** screen lets you set the speed limit. (The value shown at the bottom is the current setting.) (The number following "VELOC" and hyphen indicates the currently selected objective number.)

This item is valid for models with a motorized Z-axis. No setup is required for models with a manual Z-axis.

Use the ↓ and → keys to enter the speed limit and press the Send key to confirm the selection. The speed limit can be entered in increments of 0.01 and in a range from 0.10 to 10.50.

↓ **key:** Increments the value of the flashing digit each time it is pressed.

→ **key:** Moves the flashing cursor to the next digit each time it is pressed. Use this key to cause the desired digit to flash.

 6. VELOC-4

 10.00

- 9) The **ACCSL** screen lets you set the acceleration limit. (The value shown at the bottom is the current setting.) (The number following "ACCSL" and hyphen indicates the currently selected objective number.) This item is valid for models with a motorized Z-axis. No setup is required for models with a manual Z-axis.

Use the ↓ and → keys to enter the acceleration limit and press the Send key to confirm the selection.

The acceleration limit can be entered in increments of 0.01 and in a range from 0.10 to 20.50.

↓ **key:** Increments the value of the flashing digit each time it is pressed.

→ **key:** Moves the flashing cursor to the next digit each time it is pressed. Use this key to cause the desired digit to flash.



6. ACCSL-4



20.00

- 10) The **THRSH** screen lets you set the threshold for enabling/disabling laser AF. (The value shown at the bottom is the current setting.) (The number following "THRSH" and hyphen indicates the currently selected objective number.)

This item is valid only when laser AF is used. No setup is required if laser AF is not used.

Use the ↓ and → keys to enter the threshold and press the Send key to confirm the selection.

The threshold can be entered in increments of 1 and in a range from 5 to 1023.

↓ **key:** Increments the value of the flashing digit each time it is pressed.

→ **key:** Moves the flashing cursor to the next digit each time it is pressed. Use this key to cause the desired digit to flash.



6. THRSH-4



255

- 11) You will return to the **X** screen.

Press the Func key to return to the **STAGE** screen. Then, following the above steps beginning with Step 4, set the information for the next objective.

- 12) Press the Func key twice from the **STAGE** screen to move to the next setup item ("7: Counter communication setup").

5. System Setup

Allowable range

Item	Increment	Range	Default
Linear X	0.1	-999.9 to 999.9	0.0
Linear Y	0.1	-999.9 to 999.9	0.0
Linear Z	0.1	-999.9 to 999.9	0.0
X	0.0001 mm	-2.5000 to 2.5000 mm	0.0
Y	0.0001 mm	-2.5000 to 2.5000 mm	0.0
Z	0.0001 mm	-2.5000 to 2.5000 mm	0.0
LimitVeloc	0.01	0.1 to 10.50	10.0
LimitAccel	0.01	0.1 to 20.50	20.0
Threshold	1	5 to 1023	80

Notes:

- Linear correction
Assuming ABC is the setting, calculate the correction value as follows:
Correction value = $1 + ABC \times 10^{-6}$
- XYZ coordinate correction (X, Y = coaxial correction, Z = parfocal)
The deviation relative to the reference objective (revolving nosepiece hole number) must be determined in advance. Set the correction value of the reference objective to 0 for all X, Y, and Z axes.
- Pressing the X-RESET key during setup displays the default value for that item.

Default Value

Linear X	0.0
Linear Y	0.0
Linear Z	0.0

Objective No.	X	Y	Z	LimitVeloc	LimitAccel	Threshold
1	0.0	0.0	0.0	10.0	20.0	10
2	0.0	0.0	0.0	10.0	20.0	20
3	0.0	0.0	0.0	10.0	20.0	30
4	0.0	0.0	0.0	10.0	20.0	40
5	0.0	0.0	0.0	10.0	20.0	50

- Pressing the Send key without pressing the ↓ key restores the setting to its original status and switches the display to the next item.

5.7 Counter Communication Information Setup

This item lets you set up the MM system COM port.

"7" appears at the top left of the counter (most significant X axis digit place).

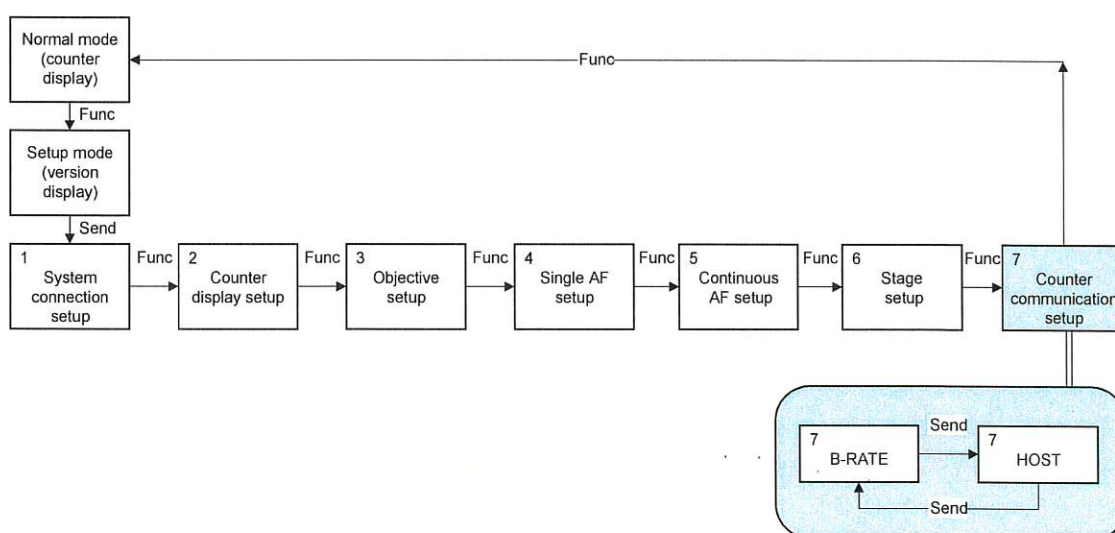
The following two setup screens are available:

- **B-RATE:** Baud rate (2400, 4800, 9600, 19200, 38400)
- **HOST:** Destination (PC, printer)

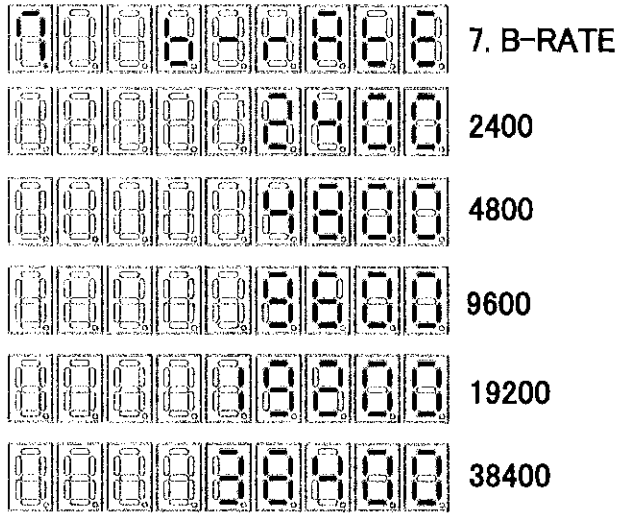
Press the Func key to return to normal mode.

Pressing the Func key during setup restores the setting to its original status and switches the display to normal mode.

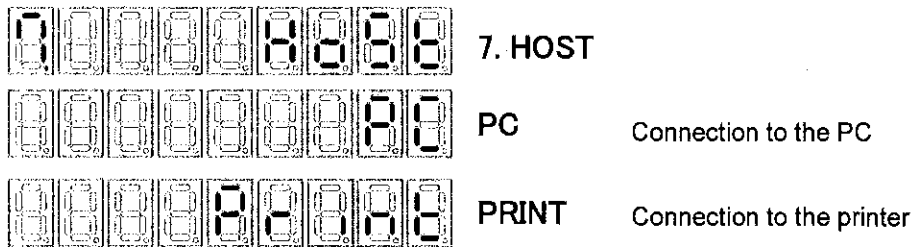
The two setup screens will be displayed alternately until the Func key is pressed.



- 1) From normal mode, press the Func and Send keys once each, and then press the Func key six times to enter "7: Counter communication setup" mode. (You are in the "7: Counter communication setup" screen when "7" appears at the top left of the counter.)
- 2) The **B-RATE** screen lets you set the baud rate. The display will show the options "2400," "4800," "9600," "19200," and "38400" at the bottom in series each time you press the ↓ key. With the desired option shown, press the Send key to confirm the selection. Normally, select "9600."



- 3) The **HOST** screen lets you set the destination. The display will show the options "PC" and "PRINT" at the bottom alternately each time you press the ↓ key. With the desired option shown, press the Send key to confirm the selection.



- 4) You will return to the **B-RATE** screen. Press the Func key to return to normal mode.

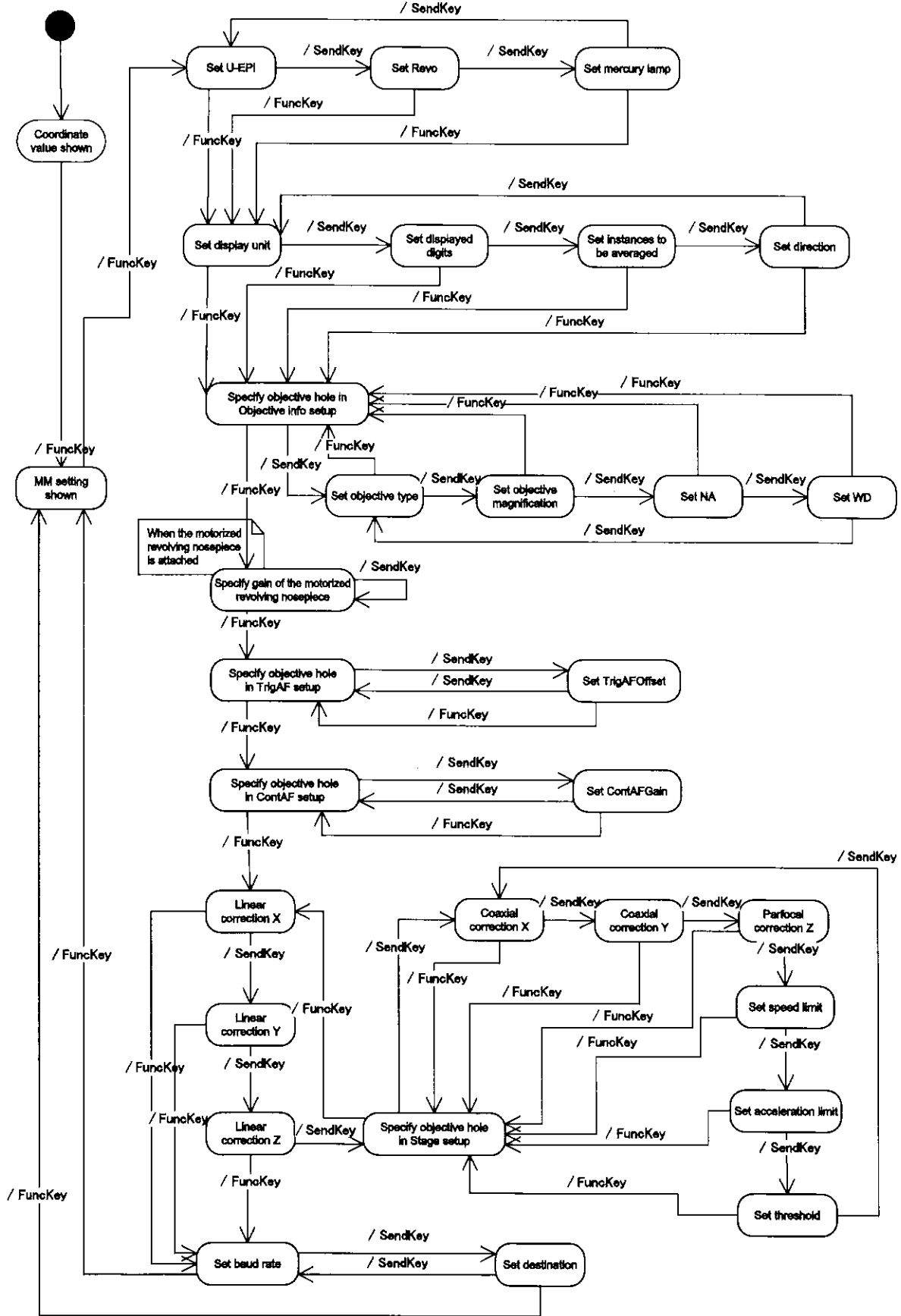
Allowable range

Item	Unit	Range
Baud rate	bps	2400, 4800, 9600, 19200, 38400
Destination	None	Computer or printer

Note:

1. Pressing the Send key without pressing the ↓ key restores the setting to its original status and switches the display to the next item.

5.8 Setup Flow



6. Troubleshooting

If the microscope does not function correctly, perform the inspections described below. If the problem persists, contact your nearest Nikon representative.

6.1 Measuring microscope main unit (Viewing)

1. **Incomplete field of view. Uneven brightness across field of view.**
 - Parts are not attached correctly.
 - ⇒ Make sure all parts are attached correctly.
 - Moveable parts were switched improperly.
 - ⇒ Make sure you correctly switch moveable parts such as the optical path changeover lever, revolving nosepiece, and filter slider. (Set to the position that provides tactile feedback.)
 - The specified illuminator is not used.
 - ⇒ Use the specified illuminator.
2. **Noticeable dirt and dust in the field of view**
 - Dust is deposited on the lens, filter, or specimen surface.
 - ⇒ Clean off dust.
3. **Some parts of the image are out of focus.**
 - The specimen is not properly positioned on the stage surface.
 - ⇒ Make sure the specimen is attached correctly.
4. **Excessive brightness**
 - Excessive illumination lamp voltage
 - ⇒ Adjust with the brightness control knob.
5. **Unable to achieve focus with high-magnification lens.**
 - Not diopter-adjusted.
 - ⇒ Perform diopter adjustment.
6. **Images will not merge into a single image when viewed through a binocular optical head.**
 - Not adjusted for interpupillary distance.
 - ⇒ Adjust interpupillary distance
 - Not diopter-adjusted.
 - ⇒ Perform diopter adjustment.

6.2 Measuring microscope main unit (Operation and control)

1. **The power will not turn on, even when the power switch is switched on.**
 - The power cord is either not connected or connected improperly.
 - ⇒ Make sure the cord is properly connected.
2. **The lamp fails to light.**
 - The power is off.
 - ⇒ Switch to ON.
 - The lamp cord is either not connected or improperly connected.
 - ⇒ Make sure the cord is properly connected.
3. **The specimen will not move straight.**
 - The stage is not adjusted for parallel positioning.
 - ⇒ Perform parallel positioning adjustment of the stage.
 - The base is not level.
 - ⇒ Adjust the leveling legs until the base is level.
4. **No reading or an incorrect reading is displayed on the counter display unit.**
 - The counter cables are not connected.
 - ⇒ Make sure the cables are properly connected.
5. **No reading or an incorrect reading is displayed on the DP console.**
 - The cables are not connected.
 - ⇒ Make sure the cables are properly connected.

Turning the equipment on in the wrong order may result in malfunctions.

Turn on the equipment in proper sequence in accordance with the instructions given in "Sequence in which equipment is turned on" on P.8.

6.3 Counter display

First check the following items if you suspect the unit is broken.

Symptom	Check
No power	<ul style="list-style-type: none"> • Are you using the correct power cable?
Does not count	<ul style="list-style-type: none"> • Is there a problem with the input connector or cable? • Turn the unit off, wait three seconds, then turn back on.
Miscounts	<ul style="list-style-type: none"> • Is the unit of display set correctly? • Is there a problem with the input connector or cable? • Is a significant noise source positioned nearby? • Is the unit fully grounded?
Odd display	<ul style="list-style-type: none"> • Is the voltage correct?
Measurement is imprecise	<ul style="list-style-type: none"> • Is there any mechanical bending or excess play? • Has the temperature risen to abnormal levels? • Has the correction coefficient been set correctly?
RS-232C communication problem	<ul style="list-style-type: none"> • Are you using the RS-232C cross-cable? • Is the baud rate set to 9600 bps?
Unable to send data to printer	<ul style="list-style-type: none"> • Are the communication specifications met (i.e., criteria such as data bit length)? • Are you using the required RS-232C cable (dedicated cable for the DPU-414)? • Is the baud rate set to 9600 bps?
"Ec Error" appears. Encoder connection error	<ul style="list-style-type: none"> • Is the cable connected to the STAGE port faulty? • The cable connection may be loose. Turn off the microscope and check the connection.
"dv Error" appears. Overdeviation error	<ul style="list-style-type: none"> • Is the focusing mount moving at the proper speed? • Is the proper objective information set? Ensure that you have set the correct objective information, as the focusing mount speed varies depending on this setting.
"Mo Error" Motor error	<ul style="list-style-type: none"> • Is the cable connected to the MOTOR port faulty? • The cable connection may be loose. Turn off the microscope and check the connection.
"StoP On" appears.	<ul style="list-style-type: none"> • Is the STOP switch pressed on the console? • Release the STOP switch.
"E-----11" Undefined RS-232C communication command error	<ul style="list-style-type: none"> • Have you entered an undefined command for RS-232C communication? • Press the Send key and enter a correct command.

If you cannot resolve the problem after checking the preceding items, contact your dealer or nearest Nikon representative.

7. Care and Maintenance

7.1 Lens Cleaning

Keep the lens free of dust, fingerprints, etc. Dirt on the lenses or filters will affect image quality. If any of the lenses become dirty, clean them by the procedure given below.

To clean other areas, such as inside the eyepiece tube, please contact your nearest Nikon representative.

- Brush away dust with a soft brush or wipe away gently with gauze.
- If fingerprints or grease gets on a lens, moisten a piece of soft, clean cotton cloth, lens tissue, or gauze with absolute alcohol (ethyl or methyl alcohol) and wipe.
- Absolute alcohol and petroleum benzine are highly flammable. Be careful when handling these materials, particularly around open flames or when turning the power switch on or off.
- Follow the instructions provided by the manufacturer when using absolute alcohol.

7.2 Cleaning the Product

- We recommend using a silicon cloth to clean the product.
- For stubborn dirt, dampen a piece of gauze with dilute neutral detergent and wipe gently.
- Use of organic solvents on plastic parts may result in discoloration.

7.3 Protection against dust

- Always take care to protect the measuring microscope from dust, particularly the sliding surfaces of the stage and the focusing mount guide. Cover the microscope with a cover or similar article when the microscope is not in use.

7.4 Lubrication

- Under normal use, the focusing mount guide and rack should require no lubrication for extended periods. If lubrication is required, use an approved lubricant/grease such as Epinoc Grease AP-O from Nippon Oil Corporation.

7.5 Storage

- Store the product in a dry location where mold is unlikely to form.
- Store the objectives and eyepieces in a dry box or similar container with a drying agent.
- Place the vinyl cover over the product to protect it from dust.
- Switch off the product (press the switch to the "O" position) and wait for the lamphouse to cool before covering the product with the vinyl cover.

7.6 Periodic Inspections (fee charged)

To maintain the peak performance of the microscope, we recommend periodic inspections. Contact your nearest Nikon representative for more information. (Parts and service charges apply for this service.)

8. SPECIFICATIONS

8.1 System configuration

- Main unit: Ten (10) types are available to choose from, two (2) of which are motorized types and the remaining eight (8) of which are manual types.
 [Motorized type] MM-400/LM, MM-800/LM
 [Manual type] MM-400, MM-400/L, MM-400/LS, MM-400/S
 MM-800, MM-800/L, MM-800/LS, MM-800/S
- Power supply: A motorized focusing mount driver is used for the motorized types, and an AC adapter is applied for the manual types.
- Optical head: A fixed magnification optical head is employed when the device is used as a measuring microscope.
 The U bracket and an illuminator are employed when the device is used as a metallurgical microscope.
- Stage: MM-400 Series: 2x2, O3L, 4x4, 6x4, 8x6
 MM-800 Series: 2x2, O3L, 4x4, 6x4, 8x6 (these are used with a stage adapter), 10x6, 12x8
- Counter display: A 3-axis or 2-axis counter display can be used.

8.2 Optical head when used as measuring microscope

- Image: Upright, erect image
- Eyepiece tube: Binocular tube: 25° inclination
 Monocular tube: 30° inclination

8.3 Eyepiece when used as measuring microscope

- Magnification: 10×
 Diopter adjustment range: -8 to +5 m⁻¹

8.4 Objectives when used as measuring microscope

Magnifying power	Real viewfield mm	N.A.	Depth of focus μm	Working distance (W.D.) mm	Weight g	Accuracy of magnification %
1×	φ±20	0.03	782	79	120	±0.1
3×	φ6.6	0.09	87	75.5	150	±0.1
5×	φ4	0.13	38	64	150	±0.1
10×	φ2	0.2	14	49.5	200	±0.1
20×	φ1	0.4	3.5	20.3	650	±0.15
50×	φ0.4	0.55	1.4	15.1	600	±0.3
100×	φ0.2	0.75	0.7	4.1	550	±0.5

Mounting screw: M26 × 0.75

Distance from objective thrusting end to the image: 200 mm

Distance from objective thrusting end to the sample: 126 mm

8.5 Overall magnification accuracy when used as measuring microscope

Same as that of the objectives in the center 1/2 of viewfield

8.6 Focusing mount

(1) Travel

MM-400: 150mm

MM-800: 200mm

(2) Travel per rotation of knob (MM-400, MM-400/L, MM-400/LS, MM-400/S, MM-800, MM-800/L, MM-800/LS, MM-800/S only)

Coarse focus: approx. 38.3 mm/rev

Fine focus: approx. 0.18 mm/rev

(3) Max. speed of motorized focusing mount (MM-400/LM, MM-800/LM only)

10 mm/s

8.7 Supporting pillar

Shape: Rectangular, fixed

8.8 Power supply

[Power supply for motorized types]

Motorized focusing mount driver box: ZM-E1

Input ratings: 100-240 V AC, 50/60 Hz, 2 A

Voltage fluctuation: $\pm 10\%$

Protection class: Class I

[Power supply for manual types]

Specified AC adapter

Manufacturer: Medi Power Electronics Inc.

Model: AD-1260B

Input ratings: 100-240 V AC ($\pm 10\%$), 50/60 Hz, 1.2 A max.

Output ratings: 12 V DC, 5 A max.

Protection class: Class I

Others: GS-approved, UL-approved, CE-compatible

8.9 Stage

Stage supporting the MM-800 Series only: 10×6, 12×8

Stage supporting both the MM-400 and MM-800 Series: 2×2, O3L, 4×4, 6×4, 8×6

(Note that the stage adapter is required for attachment to the MM-800.)

8.10 Counter display

Model: SC3-E1 (capable of 3-axis display), SC2-E1 (capable of 2-axis display)

Display: X, Y, and Z axes (no Z-axis display on the SC2-E1)

±9,999.999 mm (resolution: 1.0 µm)

±9,999.9995 mm (resolution: 0.5 µm)

±9,999.9999 mm (resolution: 0.1 µm)

Display when reset: X, Y, and Z axes (no Z-axis display on the SC2-E1)

0.000 mm (resolution: 1.0 µm)

0.0000 mm (resolution: 0.5/0.1 µm)

Outer dimensions: 130 (W) × 84.74 (H) × 26.53 (D) mm

Weight: approx. 0.5 kg (including supplied cable)

8.11 Data processing console

Model: DP-E1

Display device: 5.7" monochrome liquid crystal device

Power supply: Specified AC adapter

Manufacturer: Medi Power Electronics Inc.

Model: AD-1260B

Input ratings: 100-240 V AC (±10%), 50/60 Hz, 1.2 A max.

Output ratings: 12 V DC, 5 A max.

Protection class: Class I

Others: GS-approved, UL-approved, CE-compatible

Input voltage: +12 V DC

Power consumption: approx. 50 VA

Backup battery: CR2032, 2 pcs, (service life: 3 years)

Outer dimensions: 300 (W) × 99 (H, with feet folded) × 240 (D) mm

Weight: approx. 4 kg

8.12 Motorized UEPI driver / AF/UEPI console

Model: Motorized UEPI driver: UD-E1

AF/UEPI console: UC-E1

Power supply: Specified AC adapter

Manufacturer: Medi Power Electronics Inc.

Model: AD-1260B

Input ratings: 100-240 V AC (±10%), 50/60 Hz, 1.2 A max.

Output ratings: 12 V DC, 5 A max.

Protection class: Class I

Others: GS-approved, UL-approved, CE-compatible

8.13 LED illuminator

Model: LED epi-illuminator MM-EP1
 LED dia-illuminator MM-ED1
 LED monocular illuminator MM-ME1

Light source: White LED

Power consumption: 3 W

Class 1 LED product

8.14 Epi-illuminator

- When using optical head for measuring microscope: Use the LED epi-illuminator MM-EP1.
- When using focus-aided optical head for metallurgical microscope: Use the LED dia-illuminator MM-ED1.
- Epi-illuminator LED: LV-EPILED
- When using as metallurgical microscope: Use any of the following:

Universal epi-illuminator LV-UEPI

Universal epi-illuminator 2 LV-UEPI2

Motorized universal epi-illuminator 2A LV-UEPI2A

Lamphouse MM-LH50PC

Specified lamp LV-HL50W (12 V 50 W long-life halogen lamp)

Halogen lamp rating: 12 V 50 W

Power supply: TE2-PS100W

Input ratings: 100-240 V AC ($\pm 10\%$), 50/60 Hz, 2.4 A

Voltage fluctuation: $\pm 10\%$

Protection class: Class I

Others: GS-approved, UL-approved, CE-compatible

8.15 Dia-illuminator

LED dia-illuminator MM-ED1

Lamphouse MM-LH50PC

Lamp V-HL50W (12 V 50 W long-life halogen lamp)

Halogen lamp rating: 12 V 50 W

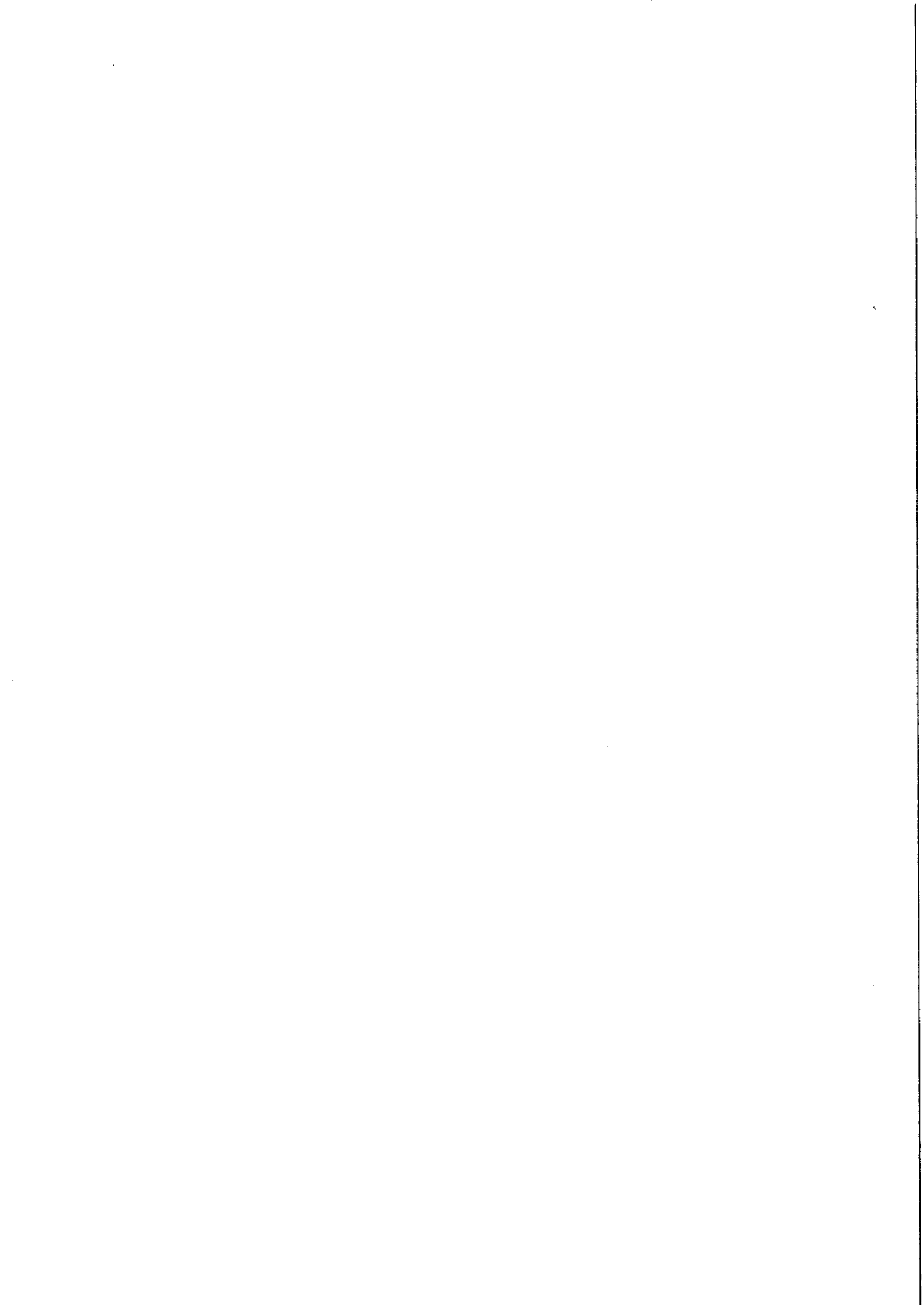
Power supply: TE2-PS100W

Input ratings: 100-240 V AC ($\pm 10\%$), 50/60 Hz, 2.4 A

Voltage fluctuation: $\pm 10\%$

Protection class: Class I

Others: GS-approved, UL-approved, CE-compatible



Conforming standards

CE Marking

This product meets EU LV Directive (Low Voltage Directive) requirements.
This product meets EU EMC Directive requirements.



This product meets FCC 15B Class A requirements.

This equipment has been tested and found to comply with the specifications for a Class A digital device, pursuant to Part 15 of the FCC Rules.

These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment.

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications.

Operation of this equipment in a residential area may cause harmful interference, in which case the user will be required to correct the interference at his own expense.

This product conforms to Canadian EMI regulations.

This class A digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.

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