Nikon

ECLIPSE TE2000 INVERTED MICROSCOPE

PERFECT FOCUS SYSTEM

T-PFB Perfect Focus Module

T-PFC Perfect Focus Controller

T-FLC2-E Motorized Cassette Holder

Instructions

Preface

Thank you for purchasing the Nikon products.

This instruction manual is written for the users of the Nikon's Eclipse TE2000-E Inverted Microscope Perfect Focus System.

To ensure correct usage, read this manual carefully before operating the instrument.

- It is prohibited to reproduce or transmit this manual in part or whole without Nikon's expressed permission.
- The contents of this manual are subject to change without notice.
- Although every effort has been made to ensure the accuracy of this manual, if you note any points that are unclear or incorrect, contact your nearest Nikon representative.
- Some of the products described in this manual may not be included in the set you have purchased.
- Be sure to read the instruction manuals for TE2000-E/U/S Inverted Microscope.

Warning for Using this Product

WARNING and CAUTION Symbols

Although Nikon products are designed to provide the utmost safety during use, incorrect usage or failure to follow the safety instructions provided may cause personal injury or property damage. To ensure correct use, read the instruction manual carefully and thoroughly before using the instrument. Do not discard the manual; keep it handy for easy reference.

Safety instructions within this manual are accompanied by the following symbols to highlight their importance. For your safety, always follow the instructions accompanying these symbols.

Symbol	Meaning
 **WARNING**	Disregarding instructions accompanying this symbol may lead to serious injury or death.
 **CAUTION**	Disregarding instructions accompanying this symbol may lead to injury or property damage.

WARNING

1. LED safety

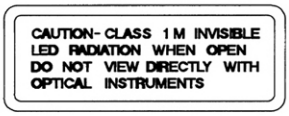
This product uses the near-infrared region lights (infrared band) emitted from an infrared LED to perform focus control. This product has European safety standard EN60825-1: 2001 and International safety standard IEC60825-1: 2001 approval. And its LED safety class is categorized as Class 1.

Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

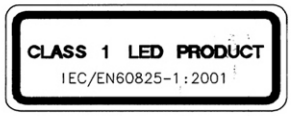
Location of the safety labels on the T-PFB Perfect Focus module

- The safety labels are affixed on the T-PFB Perfect Focus module.
- Under normal conditions, infrared rays are irradiated from the part in the figure below. Be careful.

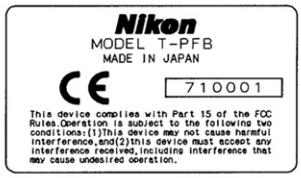
(1) Caution label

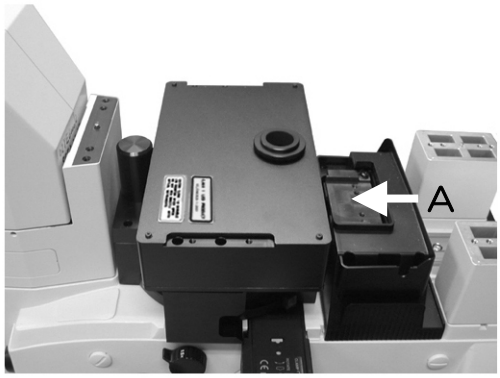


(2) Class 1 LED product label



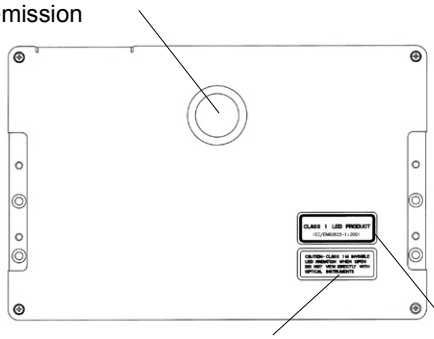
(3) Safety standard label





T-PFB Perfect Focus module
(For easy understanding, each part is removed in this picture.)

Aperture for the infrared light emission



View A

WARNING

2. Handle the system gently.

Components of this system are precision optical instruments. Handle them carefully, and do not subject them to any shocks.

In particular, the precision of the objectives can be adversely affected even by weak shocks.

3. Do not disassemble.

Disassembly may cause malfunction and / or electric shock, and will lead to the forfeiture of all claims against warranty. Do not disassemble any part other than those described in this manual. If you experience any problem with this product, contact your nearest Nikon representative.

4. AC adapter of the perfect focus (PF) controller

The PF controller uses the AC adapter as the power source. Be sure to use the adapter specified in Chapter IX, “Specification.” Use of other adapter may cause a malfunction, abnormal heating, or serious damage.

- To avoid malfunction or the risk of fire, locate the AC adapter on the well-ventilated place. Do not cover the AC adapter with any materials, otherwise poor heat radiation may cause overheating of it.
- Before connecting the AC adapter to the PF controller, be sure to turn off the power switch of the PF controller (flip to the O side) to avoid malfunctions.

5. Power cord for the AC adapter of the PF controller

To prevent electric shock, always turn off the power switch (switch to the O side) of the PF controller before attaching or detaching the power cord. Use one of the power cords specified in Chapter IX, “Specification.” Use of an improper power cord can result in fire or other hazard. Also note that the power supply is classified as subject to the protection class I against electric shock. Therefore, be sure to connect it to a protective earth terminal.

CAUTION

1. **Do not take a look at the radiation light from the LED.**

   When this instrument is turned on, weak near-infrared rays (infrared band) are emitted through the objective. The light intensity is categorized as Class 1 level and is not harmful. But avoid direct viewing.

2. **Do not wet the instrument.**

   If the instrument gets wet, a short circuit may cause a malfunction or abnormal heating. If you accidentally spill a liquid on the instrument, immediately turn off the power switch (flip to the O side) and unplug the power cord from the wall outlet. Then use a dry cloth to wipe away the moisture. If any liquid gets inside the instrument, do not use it; instead, contact your nearest Nikon representative.

3. **Dirt on the lens**

   Scratches, dirt, and fingerprints on the optical parts, such as lenses and filters, will adversely affect the microscope image. If these parts get dirty, clean them by following the instructions described in Chapter VIII, “Care and maintenance.”

4. **Installation location**

   Using or storing this instrument under unsuitable conditions may damage it or may have an adverse effect on its accuracy. The following conditions should be kept in mind when selecting the installation location:

   - Choose a flat surface with little vibration.
   - Choose a location less exposed to hazards in the event of collisions, earthquakes, or other potential disasters. If required to keep the device from falling, use strong wires or other means to secure this product to the worktable or to another heavy, stable item.
   - Avoid a brightly lit location such as a room that receives direct sunlight.
   - Choose a location that is free from dust or dirt.
   - Do not install this product in a hot and humid location. (Mold or condensation will form on the lenses and filters.)
   - The room light just above the microscope may come into the objective as an extraneous light. (Especially when using a condenser lens with longer working distance such as SLWD, ELWD and LWD lenses.) To avoid this, Nikon recommends turning off the room light above the microscope when observing the image.
   - Install the equipment in a location where the power cord can be easily unplugged from the AC inlet of the AC adapter in case of emergency.

5. **Focusing knobs**

   - Never turn the focus knobs on the left and right sides of the microscope in opposite directions at the same time, as doing so can result in damage to the microscope.
   - Turning the coarse focus knob as far as it will go and then attempting to turn it further will result in damage to the microscope. Never use undue force to turn the knob.
   - The coarse focus knob turns in sync with the motorized escape, refocus movements, or calling of the nosepiece up/down position. To prevent malfunctions, avoid contact with the coarse focus knob during the knob is rotating.

6. **Vibrations during motorized operation**

   This product is designed to minimize vibrations caused by motors inside, however, note that even the minimized vibration may affect on image observation depending on service condition.

7. **Electromagnetic waves**

   This product emits weak electromagnetic waves. The accuracy of any precision electronic equipment may be adversely affected if positioned too close. If this product affects TV or radio reception, move the radio or TV further away from the product.

Contents

I Overview

This chapter explains the overview of the perfect focus system.

1 Overview

Nikon perfect focus system is provided for Nikon inverted microscope ECLIPSE TE2000-E to track the focus automatically.

This system detects the boundary surface between the cover glass* and aqueous solution of the specimen. When a dry type objective is used, this system detects the boundary surface between the cover glass and air. And the detection is performed by using a near infrared light (infrared band), which does not interfere with general observations, and controls the focus of the microscope by tracking the vertical fluctuation of the boundary surface. That is, this system is free from the specimen's state change and color fading during fluorescent observation and keeps the focus at a steady position by automatically correcting the minute defocus caused by changes over time, stage movement, and so on. This system is, therefore, suitable for continuous observations and capturing images with a camera for changes of a living organic cell and so on.

*: The cover glass is the bottom part of the glass bottom dish.

2 Features

- As the infrared band light is used for the focusing control, which is insensitive to a specimen and does not interfere with the fluorescent microscopy, the focus-keeping and the fluorescent microscopy can be done simultaneously.
- The focus position can be adjusted manually with the optical offset function.
- The vertical position (position on the Z-axis) of the nosepiece and the focus offset amount for each objective can be registered.
- The focus can be kept on the image-capturing specimen located at any place in the view field.
- Automatic adjustment of the defocusing can be done for any type of observation cameras and methods including observation by naked eyes, that is, without restriction by the camera type, not alike the image contrast method.

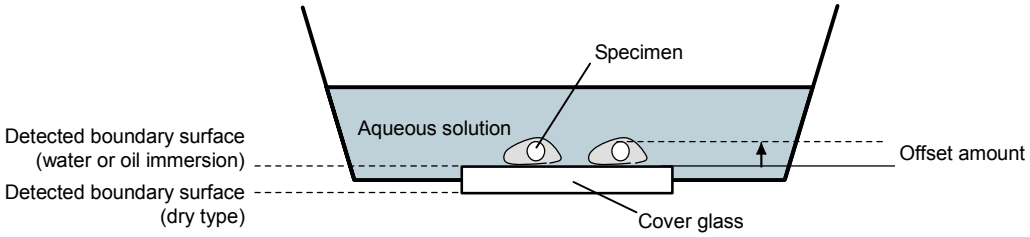
3 Offset function

This system detects the boundary surface between the cover glass and aqueous solution of the specimen using a near infrared light (infrared band) and controls focusing using the boundary surface as the reference position.

The objective of the microscope tracks the up/down changes of the boundary surface caused by the defocusing over time and the stage movement when controlling the focus.

To focus on a desired point on the specimen, adjust the OFFSET knob on the perfect focus controller.

The offset amount is defined as the deviation of the focus point from the reference position (boundary surface) to where the focus point is moved by adjusting the OFFSET knob. Keeping the specified offset amount, focusing can be controlled so as to track the up/down changes of the boundary surface. The range of the offset amount depends on the objective. In particular, when a water or oil immersion type objective is used, the offset amount is limited in the downward.



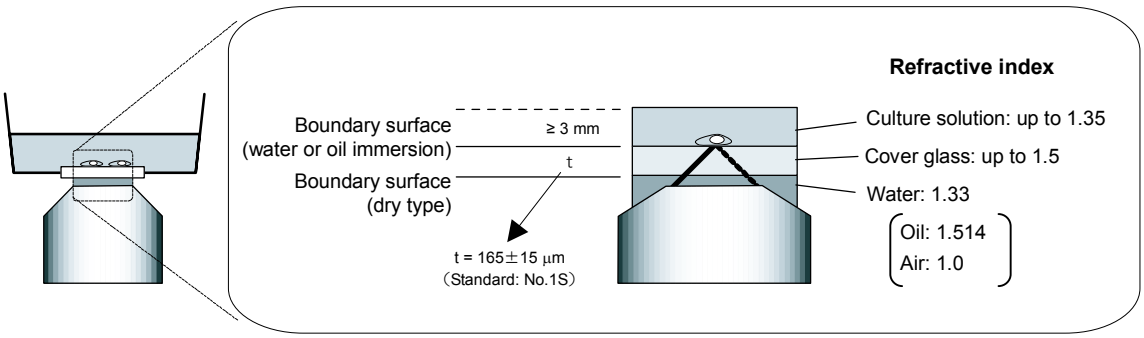
4 Specimen

4.1 Suitable specimen

Cells touching the upper surface of the cover glass of the glass bottom dish

Cover glass thickness: 150 to 180 μm (No.1S)
refractive index: 1.5

Aqueous solution (culture solution) depth: 3 mm or more
refractive index: 1.33 or near



4.2 Suitable objectives

The following objectives are suitable for this system. If another objective is attempted to be used, an error will occur and the LED of the [Obj Err] on the perfect focus controller will be lit.

If the LED of the [Obj Err] is lit, refer to the VII. Troubleshooting.

Name	NA	WD (mm)	Type
Plan Fluor 40x	0.75	0.72	dry
Plan Fluor 40xH	1.30	0.2	oil immersion
Plan Fluor ELWD 20xC	0.45	7.6	dry
Plan Fluor ELWD 40xC	0.6	2.9	dry
Plan Fluor ELWD DM 20xC	0.45	7.6	dry
Plan Fluor ELWD ADL 20xC	0.45	7.6	dry
Plan Fluor ELWD ADL 40xC	0.6	2.9	dry

Name	NA	WD (mm)	Type
Plan Apo VC 60xH	1.40	0.13	oil immersion
Plan Apo VC 100xH	1.40	0.13	oil immersion
Plan Apo VC 60xWI	1.20	0.27	water immersion
Plan Apo 60xHA	1.40	0.21	oil immersion
Plan Apo 100xH	1.40	0.13	oil immersion
Plan Apo 60xWI	1.20	0.22	water immersion
Plan Apo 20x	0.75	1.00	dry
Plan Apo DM 60xH	1.40	0.21	oil immersion
Plan Apo DM 100xH	1.40	0.13	oil immersion
Plan Apo TIRF 60x	1.45	0.13	oil immersion

4.3 Not-suitable specimen

The following specimens are hard to be observed. Because the focus control cannot be performed by reason of that the reflection signal of the infrared is weak or the scattered light is strong.

(1) Fixed specimen
Usually a fixed specimen is filled with mounting medium. And this medium has a high refractive index. So, the difference of the refractive indexes between the cover glass and the specimen is relatively small. Therefore, enough reflection for the detection cannot be get.

(2) Sliced specimen
A sliced specimen is thick and its scattered light is strong. So, the reflection is hard to detect because the reflection from the boundary surface is relatively weak.

(3) Specimen of strong reflection or strong light scattering
In addition to the sliced specimen, if a specimen has a strong light scattering, the weak reflection from the boundary surface is hard to detect as is the case of (2).

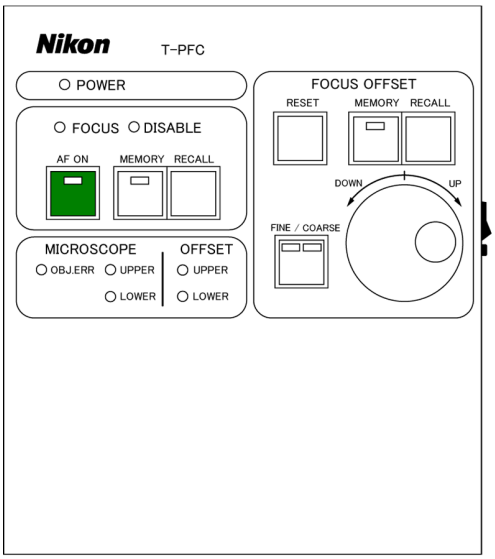
(4) Cells touching the bottom glass with the thickness of 170 μm or more
When a dry type objective is used for a specimen with a thick bottom glass, the offset amount may be insufficient to observe the boundary surface. So, the focusing range cannot be secured. (For an oil immersion type objective, the boundary surface may be detected. But this method is not recommend. Use the cover glass of No.1S.)

(5) Specimen mounted on a plastic dish
A plastic dish is not recommended because the boundary surface is not suitable for the detection.

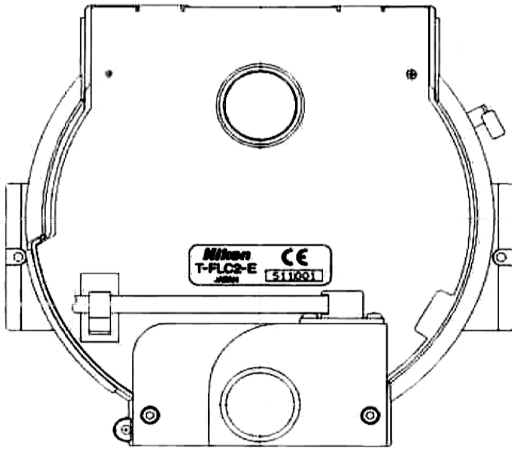
(6) Specimen mounted on a dirty cover glass
This system detects the surface of the cover glass and controls focusing. So, if the surface of the cover glass is not clean, it will adversely affect the detection. Please clean the cover glass beforehand.

II Name and Function of Each Part

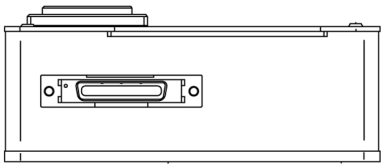
1 Name of Each Part



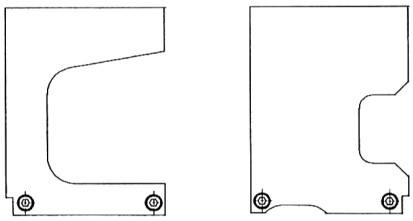
T-PFC perfect focus controller



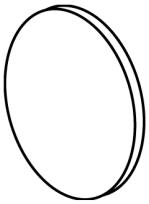
T-FLC2-E motorized cassette holder



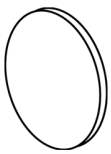
T-PFB perfect focus module



T-PFB perfect focus module pillars



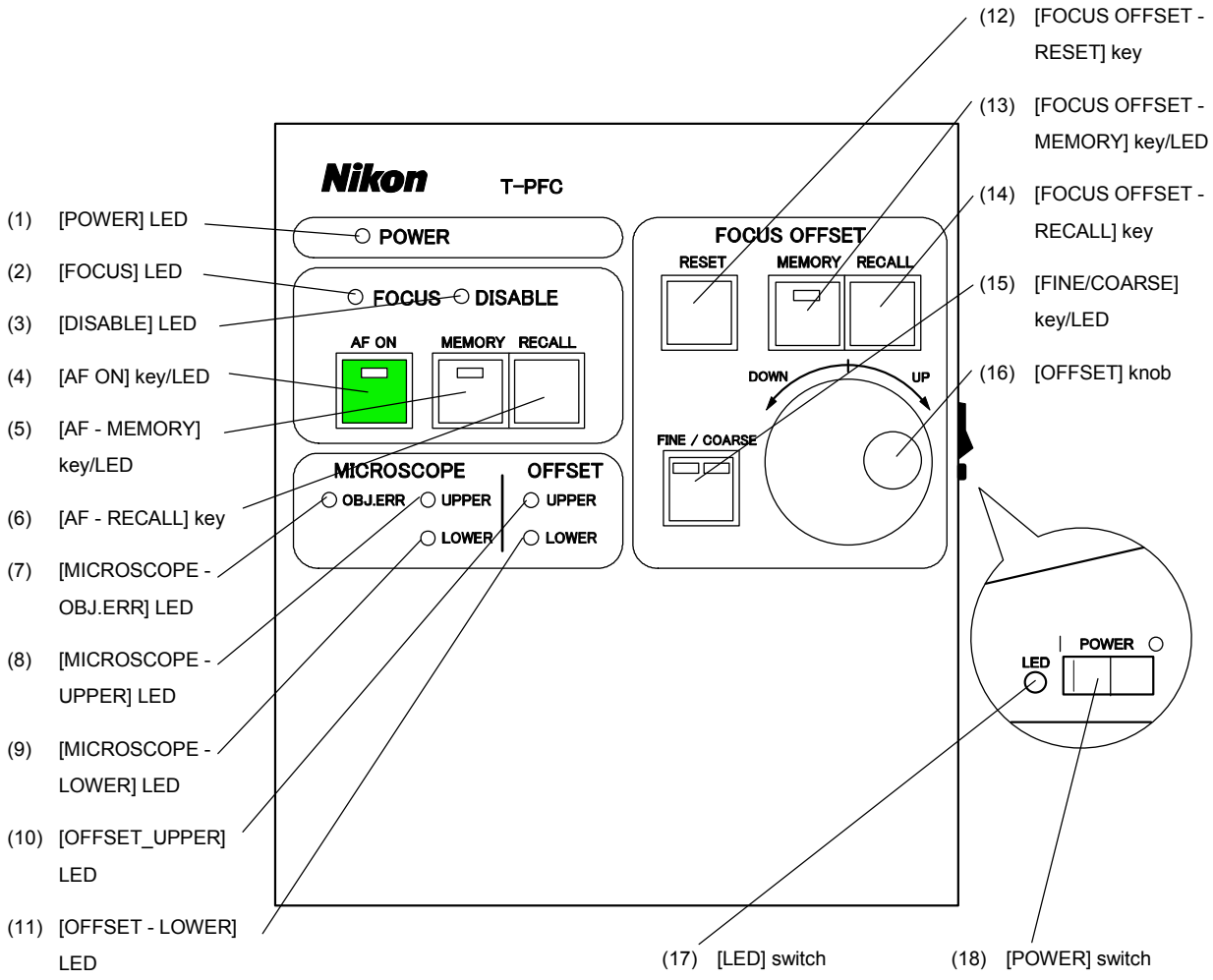
IR-CUT filter of 45 mm diameter



IR-CUT filter of 25 mm diameter

2 T-PFC PF Controller

T-PFC PF controller



(1) [POWER] LED
This LED indicates the power on or off state, and is lit when the power is on.

(2) [FOCUS] LED
This LED is lit when the boundary surface comes into focus when controlling the focus (or when the [AF ON] LED is lit). And, this LED blinks when the boundary surface comes into the focus control range.

(3) [DISABLE] LED
This LED blinks when the boundary surface is out of the focus control range (or when the [AF ON] LED is lit). Or, this LED blinks when the nosepiece vertical position (the Z-axis position) is being restored.

(4) [AF ON] key/LED
This key switches the focus control status. The LED is lit when the focus control is on.

(5) [AF - MEMORY] key/LED
This key registers the nosepiece vertical position (the Z-axis position). The LED is lit when the vertical position is registered.

(6) [AF - RECALL] key
This key restores the registered nosepiece vertical position (the Z-axis position), and starts the focus control.

(7) [MICROSCOPE - OBJ.ERR] LED
This LED is lit when an error occurs. (Refer to VII. Troubleshooting.)

(8) [MICROSCOPE - UPPER] LED
This LED is lit when the objective reaches the upper limit of its movable range.

(9) [MICROSCOPE - LOWER] LED
This LED is lit when the objective reaches the lower limit of its movable range.

(10) [OFFSET_UPPER] LED
This LED is lit when the offset amount reaches the upper limit of the adjustable range.

(11) [OFFSET - LOWER] LED
This LED is lit when the offset amount reaches the lower limit of the adjustable range.

(12) [FOCUS OFFSET - RESET] key
This key moves the vertical position to where the offset amount is zero.
(The position may be shifted from the boundary surface because of variations of cover glass thickness or microscopy conditions.)

(13) [FOCUS OFFSET - MEMORY] key/LED
This key registers the offset amount. The LED is lit when the offset amount is registered.

(14) [FOCUS OFFSET - RECALL] key
This key calls the registered offset amount.

(15) [FINE/COARSE] key/LED
This key switches the [OFFSET] knob between the fine adjustment and the coarse adjustment. The left LED is lit when the fine adjustment and the right LED is lit when the coarse adjustment.

(16) [OFFSET] knob
To adjust the offset amount, rotate this knob.

(17) [LED] switch
This switch turns on/off all LEDs on the controller.

(18) [POWER] switch
This switch turns on/off the power.

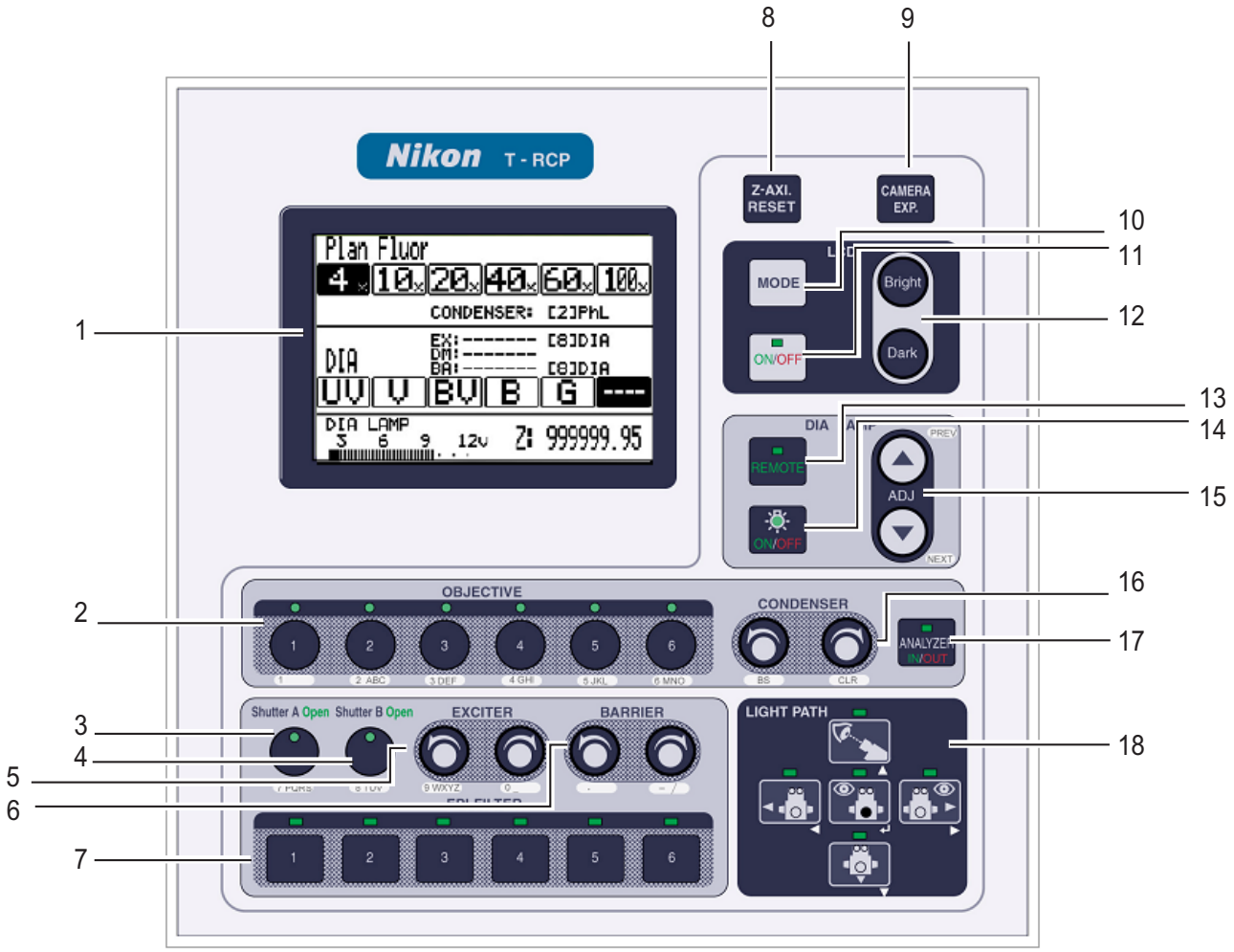
Electronic sound at operation

While performing the PF controller, pressing any of the usable keys issues a short electronic sound to notify an operator that the specified operation is started. Pressing a key disabled by the device issues no sound and executes nothing.

III Preparation

Before using this system, information of objectives must be registered into the T-RCP remote control pad. This chapter explains the procedure to register the information of objectives into the remote control pad.

1 T-RCP Remote Control Pad



No.	Name	Functions available when the operation window is displayed	Functions available when the setting menu or maintenance menu is displayed
1	LCD	The operation window displays the positions of motorized parts and the information on the installed optical parts.	The setting menu displays the settings of motorized parts.
2	[OBJECTIVE] keys	These keys switch the objectives.	These keys are used to enter alphanumeric characters.
3	[Shutter A] key	This key opens/closes the shutter allocated to the shutter A.	
4	[Shutter B] key	This key opens/closes the shutter allocated to the shutter B.	
5	[EXCITER] keys	These keys switch the excitation filters.	
6	[BARRIER] keys	These keys switch the barrier filters.	
7	[EPI-FILTER] keys	These keys switch the filter blocks.	
8	[Z-AXI.RESET] key	This key resets the indication of the Z-axis position to “0.”	
9	[CAMERA EXP.] key	This key produces an external trigger output.	
10	[LCD MODE] key	This key switches the LCD display mode.	This key switches the LCD display mode.
11	[LCD ON/OFF] key	This key turns on/off the backlight of the LCD.	
12	[LCD Bright/Dark] keys	These keys adjust the brightness of the backlight of the LCD.	
13	[DIA LAMP REMOTE] key	This key switches on/off the remote control for the dia-illumination lamp.	
14	[DIA LAMP ON/OFF] key	This key turns on/off the dia-illumination lamp.	
15	[DIA LAMP ADJ.] keys	These keys adjust the lamp voltage for the dia-illumination.	PREV and NEXT keys (These keys changes the selection.)
16	[CONDENSER] keys	These keys switch the condenser cassettes.	BS key (This key deletes the entered character.), CLR key (This key clears all characters.)
17	[ANALYZER IN/OUT] key	This key moves in/out the analyzer.	
18	[LIGHT PATH] keys	These keys switch the optical path.	Cursor keys (These keys select item.), Return key (This key accepts the selection.)

2 Startup and Shutdown of the Remote Control Pad

1 Startup

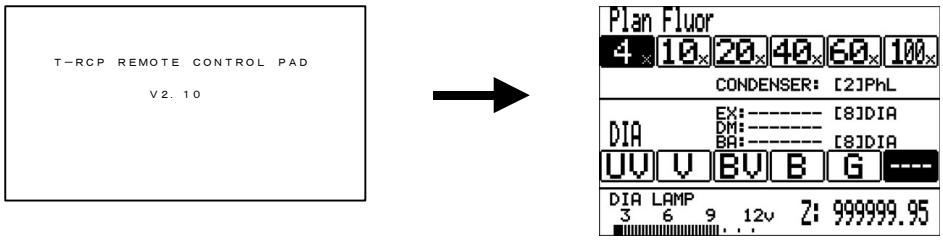
1) Turn on the power supply for the dia-illumination lamp. When you use the Uniblitz shutter, be sure to power on the Uniblitz shutter controller.

2) Power on the hub controller.

3) The hub controller supplies the power to the remote control pad.

[HUB controller side view]

The [Title] window appears on the LCD of the remote control pad, then, the [Operation] window appears in a few seconds.

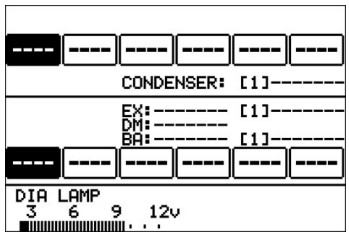


[Title] window

[Operation] window

Note

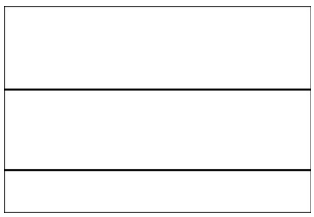
When the remote control pad is used at the first time, the [Operation] window is displayed as shown below because the default settings of the installation information for the objectives and so on are “not installed.”



“---“ denotes “not installed.”

Besides, if a motorized device is not connected to the hub controller, the display for it is left blank. If the device is connected in a wrong way, the hub controller cannot recognize the device and the display for the device is also left blank.

If all motorized devices are not connected, the subject field is displayed as shown below.



2 Shutdown

1) Power off the hub controller.

2) Power off the dia-illumination lamp and Uniblitz shutter controller.

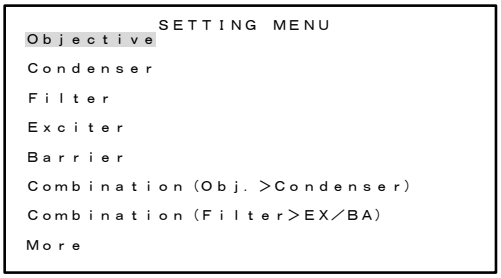
3 Registering Data of the Objectives

Before shipping, most data of objectives available in this system have been registered into the remote control pad. To use objectives not registered in the pad, such objectives as newly put in the market, data for the objectives concerned must be newly registered into the remote control pad.

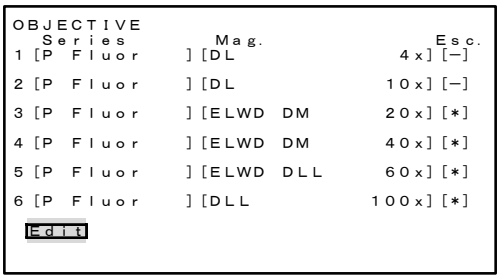
- Up to nine data of objectives can be registered.
- A wrong data registration disables this system for safety consideration.
- For the list of objectives those need registrations, see “List of objectives requiring registration,” in this section.

1 Press the [MODE] key. The [SETTING] menu appears.

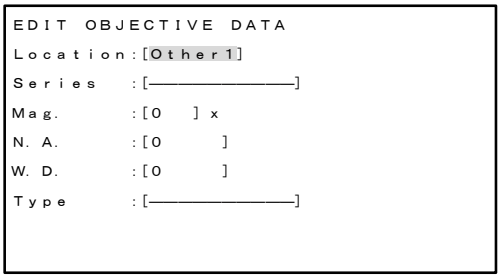
Select “Objective” by manipulating the [▲] or [▼] key, then press the [↵] key.



2 Select “Edit” by manipulating the [▲] or [▼] key, then press the [↵] key.

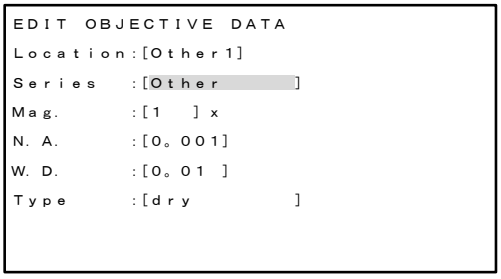


3 By manipulating the [PREV] and [NEXT] keys, select one of “Other 1” to “Other 9” in the “Location” field to register the desired objective.



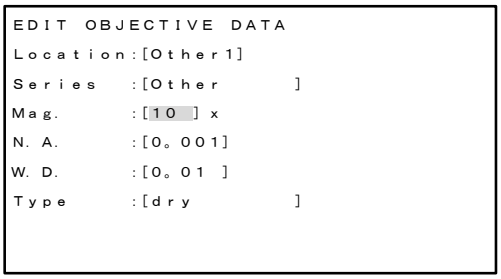
4 Move the cursor to “Series” by manipulating the [▲] or [▼] key.

Select the series name of the objective by using the [PREV] and [NEXT] keys.



5 Move the cursor to “Mag.” by manipulating the [▲] or [▼] key. Select the magnification of the objective by using the [PREV] and [NEXT] keys.

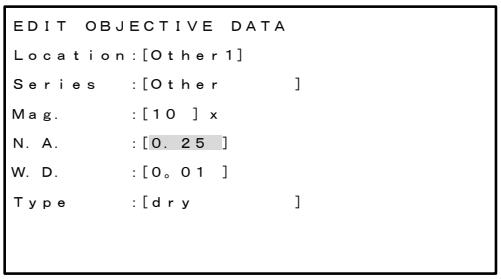
Note that the cursor may not move to “Mag.”, if any data is not entered in the field of “Series” (shown as [-----]).



6 Move the cursor to “N.A.” by manipulating the [▲] or [▼] key.

By manipulating the numerical key, [◀] key, and [▶] key, enter the numerical aperture.

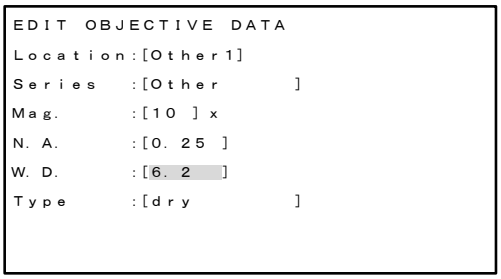
Note that available values are from 0.001 to 2.000. If an entered value exceeds the lower or upper limit, that value is automatically set to the appropriate limit.



7 Move the cursor to “W.D.” by manipulating the [▲] or [▼] key.

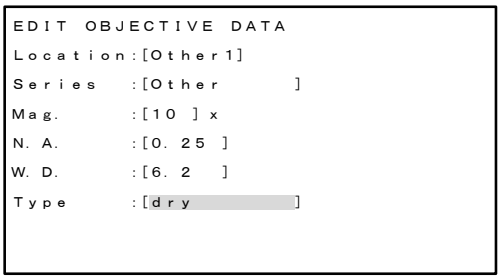
By manipulating the numerical key, [◀] key, and [▶] key, enter the working distance.

Note that available values are from 0.01 to 40.00. If an entered value exceeds the lower or upper limit, that value is automatically set to the appropriate limit.

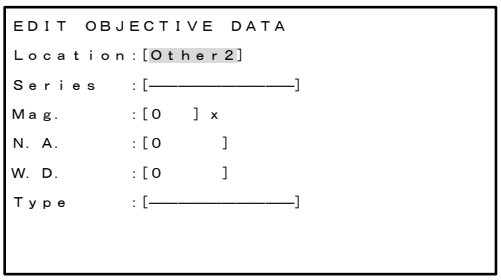


8 Move the cursor to “Type” by manipulating the [▲] or [▼] key.

Select the type of the objective by using the [PREV] and [NEXT] keys.



9 To continue the registration, move the cursor to “Location” by manipulating the [▲] or [▼] key.
Then repeat steps from 3 to 8.



10 When settings are completed, press the [MODE] key. The [Operation] window reappears.

For deleting the registered data

(1) Manipulating the [▲] or [▼] key, move the cursor to “Location”. Then select the data to be deleted by using the [PREV] and [NEXT] keys.

(2) Press the [CLR] key.

Important: list of objectives requiring data registration

To use the objectives below, data should be registered beforehand.

Name of objective	Value to be registered				
	Series	Mag	N.A.	W.D.	Type
Plan Apochromat VC60xH	PlanApo	60	1.40	0.13	oil
Plan Apochromat VC100xH	PlanApo	100	1.40	0.13	oil
Plan Apochromat VC60xWI	PlanApo	60	1.20	0.27	WI/C
Plan Apochromat TIRF60xH	PlanApo	60	1.45	0.13	oil

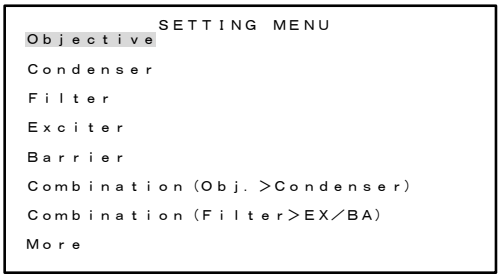
4 Registering Installation Information of Objectives Mounted on Nosepiece

Register the installation information of the objectives mounted on the nosepiece.

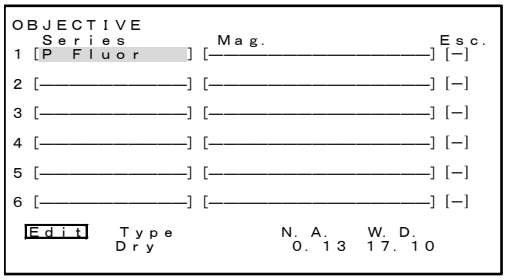
- Register the installation information of each objective mounted on one of the six addresses on the nosepiece.
- If the corresponding objective has not been registered, its data must be registered. For the detailed information, see Section 3, “Registering Data of Objectives” in this chapter.

1 Press the [MODE] key, then, the [SETTING MENU] window appears.

Select “Objective” by manipulating the [▲] or [▼] key, then press the [↵] key.

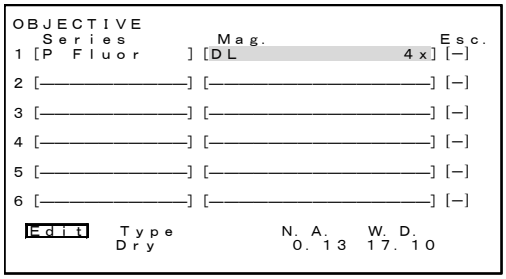


2 Select the “Series” type for the objective by manipulating the [PREV] and [NEXT] keys. The number at the left denotes the address on the nosepiece.



3 Move the cursor by manipulating the [◀] or [▶] key.

Select the “Mag.” (magnification) for the objective, by using the [PREV] and [NEXT] keys.



4 Move the cursor by manipulating the [◀] or [▶] key.

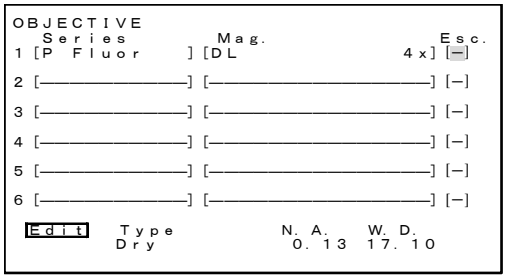
Specify the “Esc.” setting for the objective, by using the [PREV] or [NEXT] key.

*: When changing the objective, the subject objective automatically goes down to the escape position and restores after the change is completed.

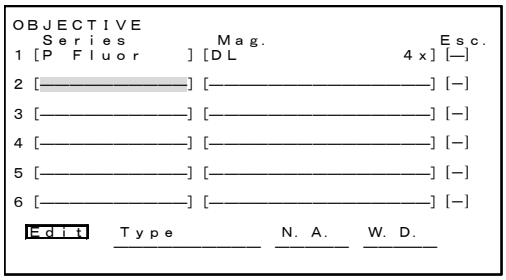
-: The objective is changed without escaping.

Note

When the “*” set objective exists between “-“ set objectives, changing “-“ set objectives each other causes automatic escape.



5 Change the objective address by using the [▲] or [▼] key and repeat steps from 2 to 3.



6 When settings are completed, press the [MODE] key. The [Operation] window reappears.

IV Operating Procedures

This chapter explains the basic operation to observe specimens with the perfect focus system by following the actual observation procedures.

- If the system has not been assembled, see Chapter VI, " Assembling."
- For operating procedures of each part of the microscope, see the instruction manual attached to the microscope. (Inverted Microscope ECLIPSE TE2000-E Instructions)
- Before using this system, read warnings and cautions described in "Warning and Caution for Using this Product" carefully and thoroughly, and be sure to follow them.
- For the devices using with this system (epi-fl attachment, differential interference contrast attachment, various motorized devices, and so on), read warnings and cautions described in the instruction manuals of these devices carefully and thoroughly, and be sure to follow them.

1 Basic Operation

1 Power on the microscope.

Caution: When the PF controller is turned on, the PF module will be initialized for about 10 seconds and the information about the objectives on the nosepiece are acquired from the HUB controller. So, before the PF controller, the microscope must be turned on.
Besides, if the information of the objectives is changed, the PF controller must be turned off once, and then, turned on again.

2 Using the T-RCP remote control pad, register the information of the objectives mounted on the microscope into the hub controller.

For detailed information about the registration procedure, see Chapter III, "Before Using this System."

3 Turn on the power switch (switch to "I") located on the right side face of the PF controller to power on the controller.

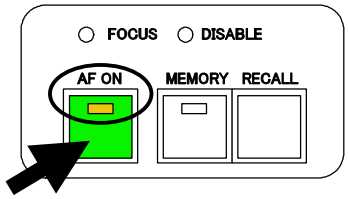
The [POWER] LED, located on the front face of the PF controller, is lit.

4 Select the desired objective and put the specimen on the stage.

- Put the objective supported by this system into the optical path. Refer to IX. Specifications.
- The objective can be selected by using the remote control pad. For more information, see the instruction manual of the remote control pad.
- Apply water immersion or oil immersion, if required. For more information, see, the instruction manual of the microscope.

5 **Focus on the specimen by using the coarse/fine focus knob on the microscope.**

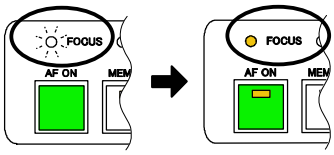
6 Press the [AF ON] key on the PF controller.



(1) The LED of the [AF ON] key is lit and the focus control starts.

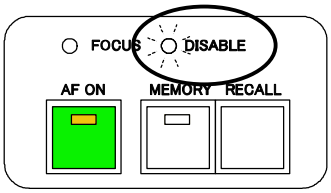
Caution: Manual operation of the fine focus knob is disabled during the focus control. Do not touch the coarse focus knob, however, because this knob is not disabled during the focus control.

(2) When the objective comes into the focus control range, the [FOCUS] LED blinks. When the reference position (boundary surface) comes into focus, the [FOCUS] LED is lit.



* The focus control range is defined that the focus control can be performed, and is predetermined for each objective.

For blinking of the [DISABLE] LED:
The reference position (boundary surface) is not in the focus control range if the LED blinks. Adjust the objective position by moving using the coarse/fine focus knob of the microscope so that the reference position (boundary surface) comes into the focus control range. When the reference position (boundary surface) comes into the focus control range, the focus control starts.



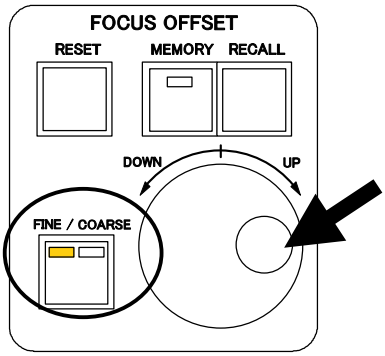
* The completion of focusing on the boundary surface does not mean that the target position of the specimen comes into the focus. Perform the step 7 below, the [OFFSET] knob operation, for your target. In particular, when a dry type objective is used, the initial position may be shifted from the boundary surface because of variations of cover glass thickness. So, after the [FOCUS] LED is lit, adjust the offset knob to focus on the target.

Time-out function:
This system has the time-out function to keep the objective from contact with specimen. This function will be activated and the objective will be stopped if the signal cannot be detected within 5 seconds during the focusing with the [AF ON] operation. (The objective moves about 400 μm for the 5 seconds.)
When the time-out function is activated, the buzzer beeps, the LED of the [AF-ON] turns off, and the up/down movement of the objective stops.

Recovery from the time-out function:
The reference position (boundary surface) is out of the range. Push the [OFFSET-RESET] key to restore the offset amount to its original status. Focus on the specimen manually. And then, push the [AF-ON] key again.

7 Focus on the target of the specimen by manipulating the [OFFSET] knob on the PF controller and start observation.

- Fine and coarse operations are provided for the function of the [OFFSET] knob. The [FINE/COARSE] key can be used to switch between the FINE operation and the COARSE operation.
- The FINE/COARSE state can be checked with the LED on the key.



Caution: The offset amount can be operated only when the focus is being controlled (when the [AF ON] LED is lit).

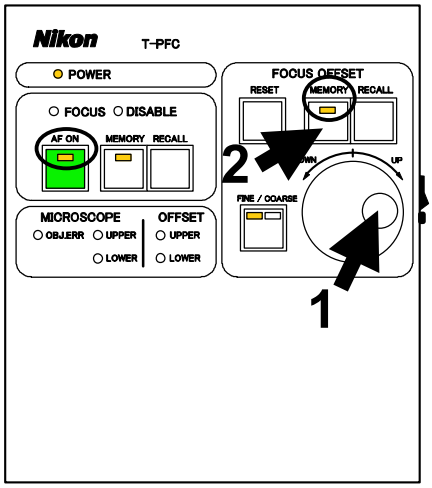
2 Registering and Restoring the Offset Amount

The offset amount specified during the observation can be registered into the memory of the PF controller. By pressing the [FOCUS OFFSET – RECALL] key, the registered offset amount can be restored even after the offset amount is changed by manipulating the [OFFSET] knob.

- The offset amount setting can be overwritten if required.
- Only one offset amount can be registered for one objective (one objective address). (Six positions are available in total.)
- The registered offset amounts is stored while the PF controller is powered on.

2.1 Registering the Offset Amount

1 Adjust the offset amount by manipulating the [OFFSET] knob, when the LED on the [AF ON] key of the PF controller is lit.



2 Press the [FOCUS OFFSET – MEMORY] key for over two seconds.

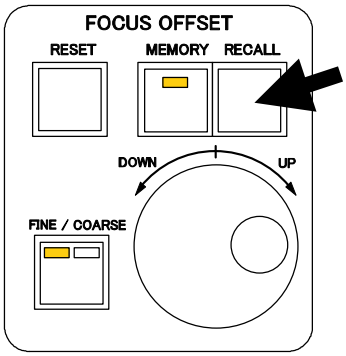
The LED on the [MEMORY] key is lit and the offset amount is registered.

2.2 Restoring the Offset Amount

1 Press the [FOCUS OFFSET – RECALL] key.

The nosepiece automatically moves to the position for where the offset is registered.

Caution: Manual operation of the fine focus knob is disabled during the focus control. Do not touch the coarse focus knob, however, because this knob is not disabled during the focus control.



3 Registering and Restoring the Vertical Position of the Nosepiece

The TE2000-E microscope has a linear encoder inside, and the vertical position (the Z-axis position) of the nosepiece can be reproduced by using the coordinates of the linear encoder. With this function, the vertical position of the nosepiece can be registered into the memory of the PF controller for the desired observation condition.

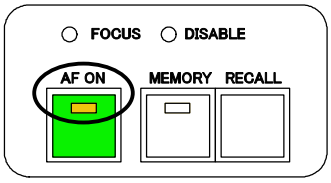
Once the position is registered, pressing the [AF – RECALL] key can return the nosepiece to the registered position or its vicinity and then the system restarts the focus control even after the nosepiece position was changed by manipulating the coarse and fine focus knobs. (Note: The nosepiece may not return to its registered absolute position of the vertical movement. It will start the focus control again from the vicinity of the registered position.)
This function is useful for the case supplying oil to the objectives or replacing the specimen where the objectives must be escape.

- The vertical position of the nosepiece can be overwritten if required.
- Only one offset amount can be registered for one objective (one objective address). (Six positions are available in total.)
- The registered vertical position of the nosepiece is stored while the PF controller is powered on.

3.1 Registering the Vertical Position of the Nosepiece

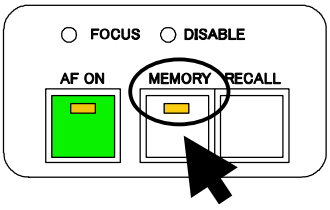
1 Focus on the target of the specimen.

- When the [AF ON] LED is lit:
  Focus on the target by rotating the [OFFSET] knob.
- When the [AF ON] LED is not lit:
  Focus on the target by rotating the coarse/fine focus knob on the microscope.



2 Press the [FOCUS OFFSET – MEMORY] key for over two seconds.

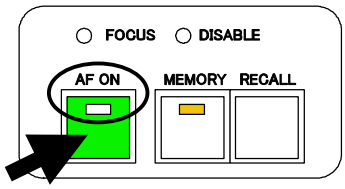
The LED on the [MEMORY] key is lit and the vertical position of the nosepiece is registered.



3.2 Escaping the Objective

1 Press the [AF ON] key on the PF controller (when the [AF ON] LED is lit).

The LED of the [AF ON] key is turned off and the focus control is canceled.



Caution; The focusing control must be canceled before changing or replacing the objectives.

2 Lower the nosepiece by manipulating the coarse focus knob, then, perform the required operation.

Examples of the operation:

- Replacing specimens
- Changing objectives
- Supplying oil or deionized water (or distilled water) to the objective
- The coarse focus knob is manipulated for other reasons, but the specimen is not moved.

3.3 Restoring the Vertical Position of the Nosepiece

1 **The status must be one of the following two conditions.**

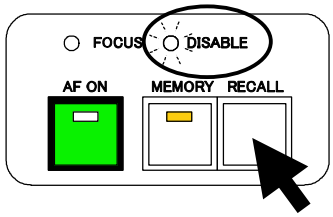
[AF - MEMORY] LED: ON
[AF – ON] LED: OFF
↓
AF = OFF

or

[AF - MEMORY] LED: ON
[AF - ON] LED: ON
[DISABLE] LED: Blink
↓
And no signal was detected although the [AF - ON] key was pressed.

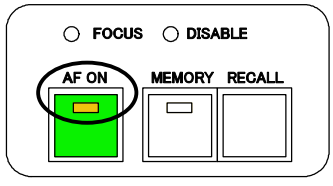
2 Press the [AF – RECALL] key of the PF controller.

The buzzer sounds (one short beep). And then, the nosepiece starts moving with blinking the [DISABLE] LED.



Caution: Manual operation of the fine focus knob is disabled while restoring the nosepiece vertical position. Do not touch the coarse focus knob, however, because this knob is not disabled while restoring.

3 **Action of the equipment:** When the nosepiece returned to the registered vertical position or its vicinity, the [AF ON] LED is lit and the focus control starts.



If the buzzer sounds (twice short beep or one long beep), the vertical position of the nosepiece could not be restored. Perform the followings:

- Manipulate the [AF – MEMORY] operation at the focus position again.
- Change the height of the stage by manipulating the coarse/fine focus knob.

* The completion of focusing on the boundary surface does not mean that the target position of the specimen comes into the focus. Perform the step 7, the [OFFSET] knob operation, in “Basic Operation ” for your target. In particular, when a dry type objective is used, the initial position may be shifted from the boundary surface because of variations of cover glass thickness. So, after the [FOCUS] LED is lit, adjust the offset knob to focus on the target.

3.4 About the Movement of the Objective in Registering and Restoring the Vertical Position of the Nosepiece

(1) Push the [AF-MEMORY] key after focusing.

The vertical position of the nosepiece is stored. (The tip of the objective is defined as “Z1” in this explanation.)

(2) Escape the objective to perform an operation such as oil exchange or so on.

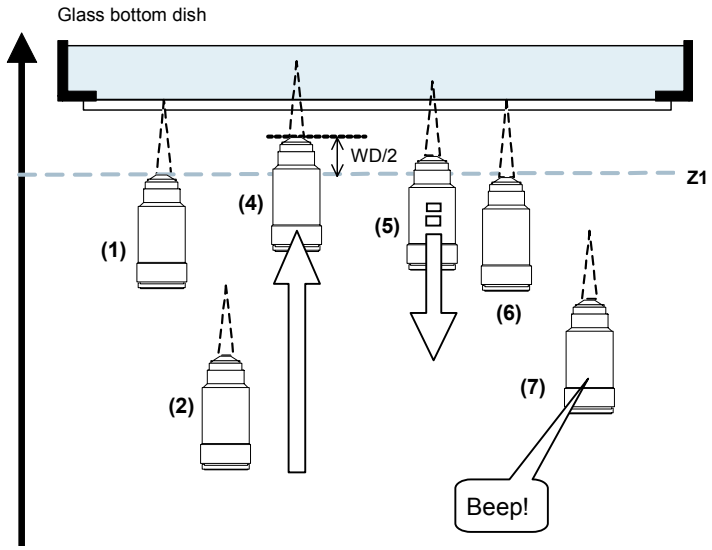
(3) Push the [AF-RECALL] key.

(4) The nosepiece is driven to the registered vertical position, Z1, and additionally driven upward at a distance of the half of the WD. (The WD is the working distance of the objective.)
However, if the half of the WD is greater than 750 µm, 750 µm is set in place of the calculated value.

(5) The focus position (boundary surface) is searched for downward.

(6) When the focus position is detected, the searching operation ends and the AF is turned on.

(7) If the focus position cannot be detected, the search operation ends in 20 seconds and a sound beeps.



V Connecting a PC

The hub controller can be controlled from the IBM PC-AT compatible computer connected to it.

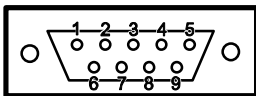
Connecting a PC

Using a cross wired cable with D-SUB (9 pins) connectors, connect the “PC connector” of the hub controller and the “serial port” of the PC.

Pin number of the PC connector	Signal	Direction of the signal
1	DCD	—
2	RxD	Input
3	TxD	Output
4	DTR	Output
5	SG	(GND)
6	DSR	Input
7	RTS	—
8	CTS	—
9	RI	—

PC connector

PC connector: D-SUB (9pin) male



Pins numbered one, seven, eight, and nine are opened inside the hub controller.

Communications cable

D-SUB (9 pins: female to female) and general cross wired cable (three meters maximum)

Specification for serial interface communication

Interactive signal connection circuit	RS-232C (EIA standard compliant)
Baud rate	9600 bps
Data length	8 bit
Start bit	1
Stop bit	1
Parity check	None

Communication commands

Contact your nearest Nikon representative.

VI Assembling

This chapter explains how to assemble this system and how to connect required components.

Warning

- Before assembling, read warnings and cautions described in “Warning and Caution for Using this Product” carefully and thoroughly, and be sure to follow them.
- To prevent electric shock and fire, always turn off the power switch (switch to “O”) of all devices and unplug the power cord from the wall outlet.

Caution

- Do not let fingers or hands get caught in parts or components.
- Scratches or finger prints on the lens adversely affects the image quality. Pay close attention to assemble the system and do not touch the lens.
- Components of this system are precision optical instruments. Handle them carefully, and do not subject them to any shocks. The precision of the objectives in particular can be adversely affected even by a weak shock.

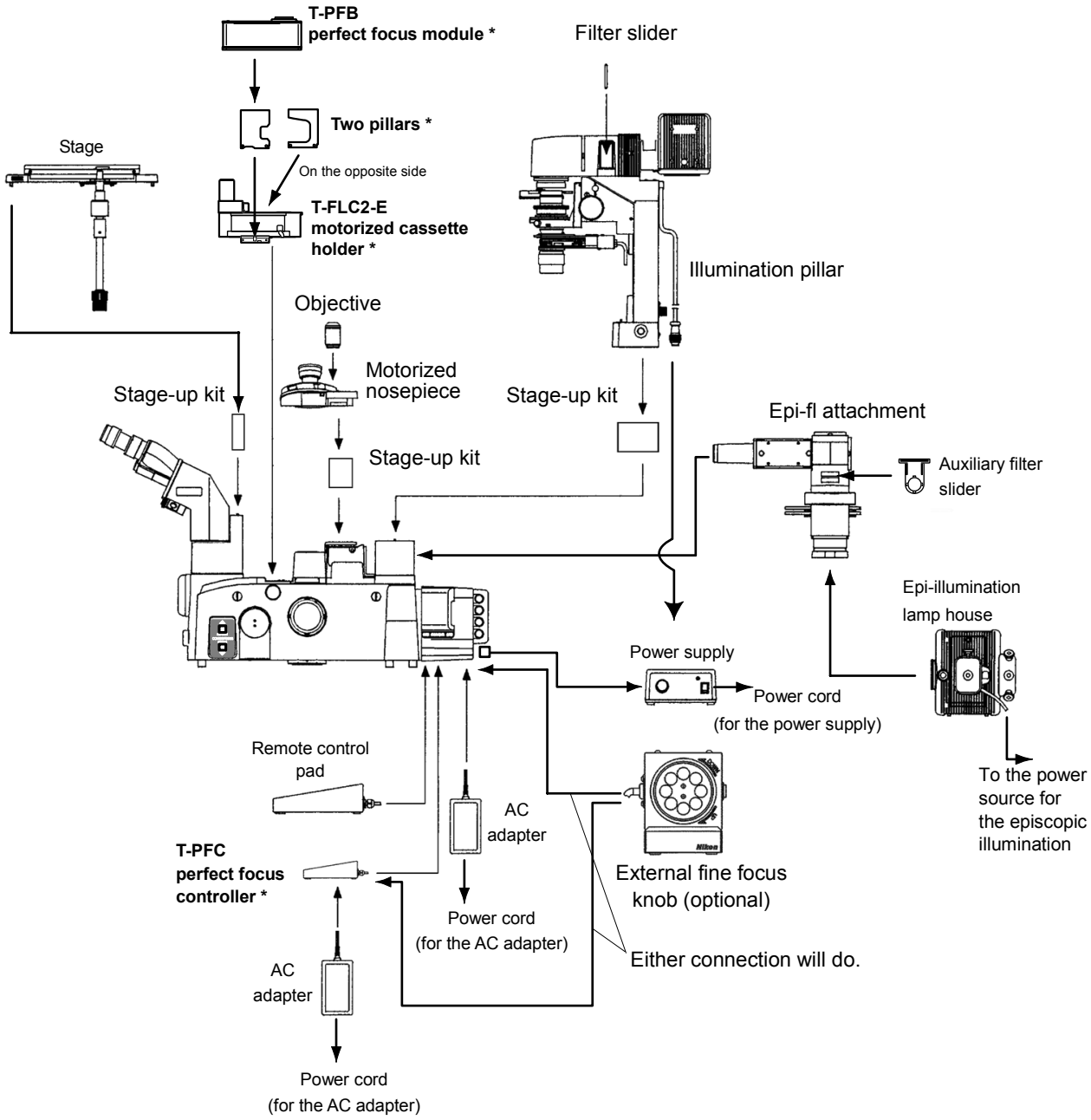
Required tools

Two 2-mm hexagonal screwdrivers (supplied with the microscope)

One 4-mm hexagonal wrench (supplied with the microscope)

One 2.5-mm hexagonal wrench (supplied with the motorized cassette holder)

Block diagram



"*" denotes the component of this system.

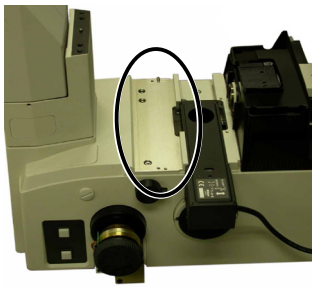
1 Checking Components

Check that the following components are prepared.

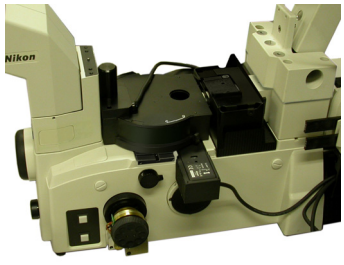
1. TE-2000E main body (including the hub controller and remote control pad)
2. TE-2000E stage-up kit
3. T-FLC2-E motorized cassette holder
4. T-PFB PF module (including two pillars)
5. T-PFC PF controller
6. Sensor cable
7. Control cable
8. Serial cable
9. AC adapter (for the PF controller)
10. IR-CUT filter (diameter 25 mm x 1 and 45 mm x 1)

2 Mounting the T-FLC2-E Motorized Cassette Holder

1 Insert the cassette holder into the attaching groove from over the microscope.



2 Remove filter block cover. And fix the cassette holder with screws on the left and right side by using the hexagonal wrench.

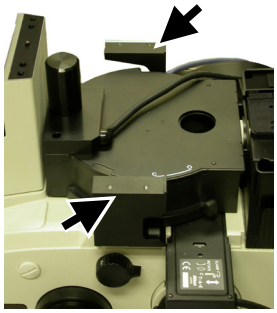


3 Connect the cable of the cassette holder to the connector of the FL block on the hub controller .

3 Mounting the T-PFB PF Module

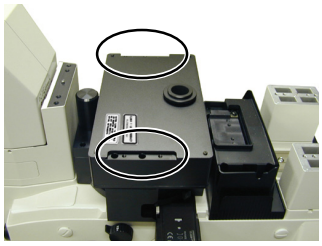
1 Mount the two pillars for the PF module onto the motorized cassette holder.

Viewing from the microscope's front, mount the pillar with a smaller cut on the right side of the holder facing the cut to the rear.
On the left side of the holder, mount the pillar with a larger cut facing to the front.
Fix each pillar using two hexagon socket headed bolts.



2 Mating the groove to the protrusions of each pillar, place the module on the pillars.

3 Retain the PF module on the pillars using four hexagon socket headed bolts.

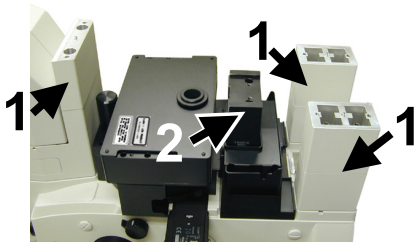


4 Mounting Stage-up Kits

1 Mount three stage pillars.

Mating the positioning protrusions of the pillars to the grooves of the microscope's main body and retain each of them using two hexagon socket headed bolts.

2 Fit the nosepiece pillar and retain it with two hexagon socket headed bolts.



5 Mounting the Motorized Nosepiece

1 Mount the main body of the motorized nosepiece on the nosepiece pillar attached in step 4, "Mounting Stage-up Kits."

2 Retain the nosepiece with two M5-hexagon socket headed bolts.

3 Connect the cable to the “Nosepiece connector” on the hub controller.

Caution: Be sure to insert the objectives after mounting the stage because they may be damaged if made contact.

6 Mounting the Stage

1 Place the stage on the stage pillars attached in step 4, “Mounting Stage-up Kits.”

2 Retain the stage using four M5-hexagon socket headed bolts.

7 Mounting IR-cut Filters

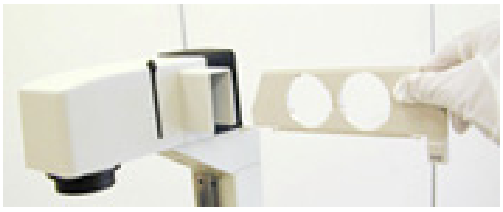
This system uses the near infrared light (infrared band) derived from the infrared LED for the focus control. Since the near infrared light (infrared band) used for the illumination system affects adversely on the focus control, therefore, place the IR-cut filter on each optical path of the diascopic illumination and epi-fl illumination.

Caution: The Attached IR-cut filter reduces the intensity of ultraviolet rays too. Pay attention to observe with fluorescent technique using the strong ultraviolet rays.

1 Attach the IR-cut filter (45 mm in diameter)

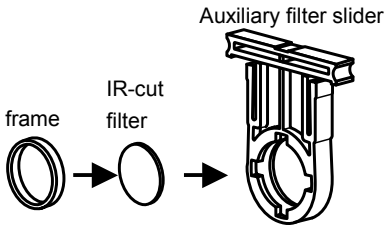
(1) Attach the filter to the filter slider.

(2) Insert the filter slider into the illumination pillar.

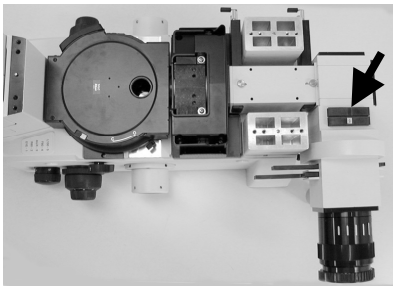


2 Attach the IR-cut filter (25 mm in diameter)

(1) Attach the filter to the auxiliary filter slider.



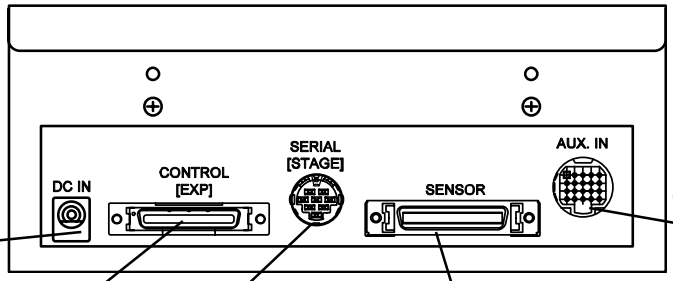
(2) Insert the filter slider into the epi-fl attachment.



8 Connecting Cables

Locate the PF controller on the stable place near the microscope, and then, connect the following cables. Be sure to check that the hub controller and PF controller are both not powered when connecting cables.

Rear view of the PF Controller



(1) DCIN connector
Connects to the DC power supply from the AC adapter.

(2) CONTROL (EXP) connector
Connects to the EXP connector on the hub controller with the control cable.

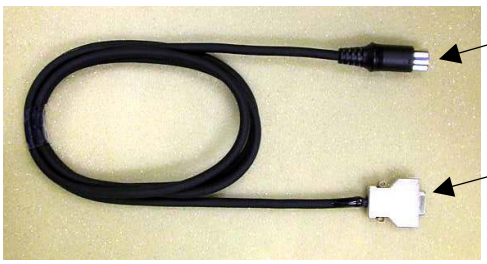
(3) SERIAL (STAGE) connector
Connects to the STAGE connector on the hub controller with the serial communication cable,

(4) SENSOR connector
Connects to the SENSOR connector of the PF module with the sensor cable.

(5) AUX. IN connector
Connects the cable of the T-EFN external fine focus knob (option). (This connection is not required if the T-EFN external fine focus knob is not used.)

Cables

1. Control cable

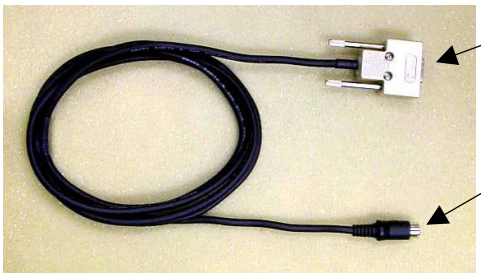


Round type plug: to the EXP connector of the hub controller

Rectangular type plug: to the control (EXP) connector of the PF controller

Caution: Be sure to connect the round type plug to the EXP connector of the hub controller. Do not plug to the AUX.IN connector of the PF controller.

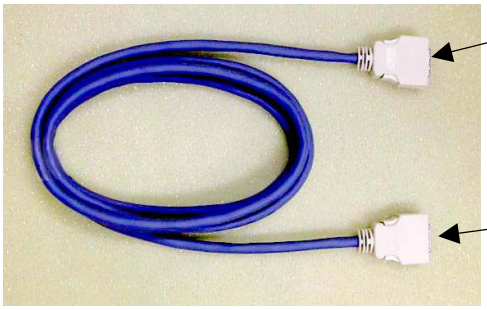
2. Serial communication cable



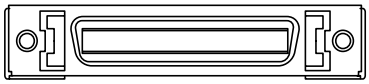
Rectangular type plug: to the STAGE connector of the hub controller

Round type plug: to the SERIAL (STAGE) connector of the PF controller

3. Sensor cable



To the SENSOR connector of the PF controller



To the SENSOR connector of the PF module

Checking Connections

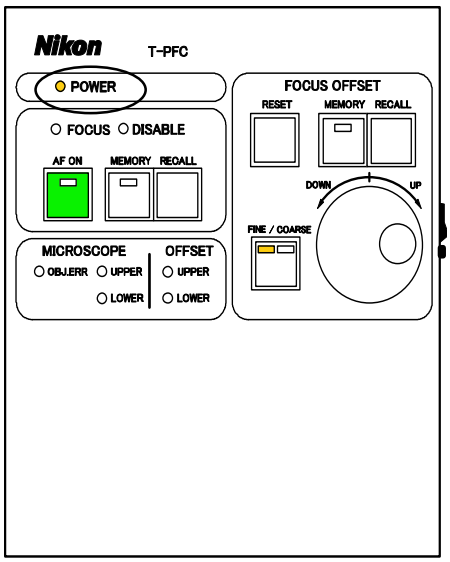
After connecting cables, power on the system and check to see each component.

1 Turn on the microscope.

Caution: When the PF controller is turned on, the PF module will be initialized for about 10 seconds and the information about the objectives on the nosepiece are acquired from the HUB controller. So, before the PF controller, the microscope must be turned on.
Besides, if the information of the objectives is changed, the PF controller must be turned off once, and then, turned on again.

2 Turn on the [POWER] switch (switch to “I”) of the PF controller.

Check that the [POWER] LED is lit and the [OBJ.ERR] LED is not lit.



VII Troubleshooting

If the system does not function properly, take appropriate action as described below. If the problem is still not resolved after referring to this section, please contact your nearest Nikon representative.

1 During System Startup

Problems	Causes	Countermeasures
The buzzer issues beeps twice in a row.	• The motorized nosepiece is not mounted on the microscope. • The objective is not in the click stop position.	• Mount the motorized nosepiece on the microscope. • Rotate the objective into the click stop position.
Both the [OFFSET_UPPER] LED and the [OFFSET_LOWER] LED are lit at the same time.	• The SENSOR connector of the PF module and the SENSOR connector of the PF controller are not connected with the SENSOR cable.	• Connect the SENSOR connector of the PF module and the SENSOR connector of the PF controller with the SENSOR cable.
The [MICROSCOPE-OBJ.ERR] LED is blinking.	• The EXP connector of the hub controller and the CONTROL (EXP) connector of the PF controller are not connected with the CONTROL cable.	• Connect the EXP connector of the hub controller and the CONTROL (EXP) connector of the PF controller with the CONTROL cable.

2 While Using the Perfect Focus Functions

Problems	Causes	Countermeasures
The [FOCUS] LED is lit at times while the [AF ON] LED is not lit.	-	It is normal. The [FOCUS] LED is lit when the boundary surface is detected. Use it as a guide of focusing.
The [MICROSCOPE-OBJ.ERR] LED is lit.	• The hub controller has no usable objective. • No usable objective is selected. • The cable connection is wrong.	• Register a usable objective into the hub controller. • Select a usable objective. For usable objectives, see the list of objectives in the Specification. • Connect cables correctly referring to the Chapter VI, “Assembling.”
The [MICROSCOPE-OBJ.ERR] LED is lit. And the buzzer issues beeps twice in a row.	The objective is not in the click stop position.	Rotate the objective into the click stop position.
The [MICROSCOPE-UPPER] LED is lit.	The objective reaches the upper limit of the vertical control.	Lower the specimen position (lower the stage).
The [MICROSCOPE-LOWER] LED is lit.	The objective reaches the lower limit of the vertical control.	Raise the specimen position (raise the stage).

Problems	Causes	Countermeasures
The [OFFSET_UPPER] LED is lit.	The offset amount reaches the upper limit of the adjustable range.	Lower the objective with the [OFFSET] knob until the LED is turned off.
The [OFFSET_LOWER] LED is lit.	The offset amount reaches the lower limit of the adjustable range.	Raise the objective with the [OFFSET] knob until the LED is turned off.
Pressing the [FOCUS OFFSET-MEMORY] key causes nothing (no beep from the buzzer).	• The key was not pressed long enough. • The [AF-RECALL] operation is in progress.	• Press the key longer than two seconds. • The [FOCUS OFFSET-MEMORY] key is disabled during the [AF-RECALL] operation.
Pressing the [AF-MEMORY] key causes nothing (no beep from the buzzer).		• Press the key longer than two seconds. • The [AF-MEMORY] key is disabled during the [AF-RECALL] operation.
Pressing the [AF-RECALL] key causes nothing (no bleep from the buzzer).	• The [AF-MEMORY] operation has not been done. • No usable objective is selected (the [MICROSCOPE-OBJ.ERR] LED is lit).	• Perform the [AF-MEMORY] operation in advance. • Select a usable objective.
Pressing the [AF-RECALL] key causes beeps twice from the buzzer and the [AF-RECALL] does not work.	The objective is close to the upper or lower limit of the vertical control.	Change the stage position so that its vertical position is apart from the upper or lower limit.
The [AF-RECALL] operation ends after a long sound of buzzer.	• The focus position could not be detected. • The objective reached the upper or lower limit of the vertical control while focusing. • The nosepiece is rotated during the [AF-RECALL] operation. (The system operation is stopped for safety if the nosepiece is rotated during the [AF-RECALL] operation.) • The focusing signal is distorted during the [AF-RECALL] operation. If one of the following actions is taken, the focusing signal may be distorted and the system stops its operation because of safety: (* Abrupt vertical position change is done by manipulating the coarse focus knob of the microscope. * The specimen is inclined. * The specimen is removed.)	• Perform the [AF-MEMORY] operation at the focus position again. • Change the stage position so that its vertical position is apart from the upper or lower limit.

Problems	Causes	Countermeasures
Pressing the [AF ON] key causes nothing (no bleep from the buzzer).	• No usable objective is selected (the [MICROSCOPE-OBJ.ERR] LED is lit).	• Select a usable objective.
The [DISABLE] LED is blinking.	• No specimen is set. • The objective is far from the boundary surface of the specimen. • The shape or material of the specimen is not supported by this system.	• Set a specimen and focus on it manually. • Adjust the objective closer to the boundary surface of the glass by manipulating the [OFFSET] knob. • This perfect focus system may not work precisely for specimens covered by a thick glass plate or having a high refractive index (n is nearly equal to 1.5). See p.7, 4.1 “Suitable specimen.”
About 5 second after starting the [AF ON] operation, the buzzer beeps and the focusing stops.	• No specimen is set. • The objective is far from the boundary surface of the specimen. • The shape or material of the specimen is not supported by this system.	• Set a specimen and focus on it manually. • Push the [OFFSET-RESET] key to restore the offset amount to its original status. • This perfect focus system may not work precisely if the specimen is covered by a thick glass plate or the aqueous solution has a high refractive index (n is nearly equal to 1.5). See p.7, 4.1 “Suitable specimen.”

VIII Care and Maintenance

1 Lens Cleaning

Do not let dust, fingerprints, and so on get on the lenses. Dirt on the lenses, filters, and so on will adversely affect the view of the image. If any of the lenses get dirty, clean them as described below:

- Brush away dust with a soft brush, or wipe it away gently with gauze.
- Only if there are fingerprints or grease on a lens, dampen a piece of soft, clean cotton cloth, lens tissue, or gauze with absolute alcohol (ethyl or methyl alcohol) and wipe.
- Only when removing the immersion oil off from the objective, use petroleum benzine. If you cannot obtain petroleum benzine, use methyl alcohol. However, because methyl alcohol does not clean as well as petroleum benzine, it will be necessary to wipe the surfaces repeatedly. (Usually, wiping three or four times is sufficient to clean the lenses.) Wipe with absolute alcohol (ethyl or methyl alcohol) to finish.
- Never use petroleum benzine to clean the entrance lens at the bottom of the eyepiece tube and prism surface of the eyepiece tube.
- Absolute alcohol and petroleum benzine are highly flammable. Be careful when handling it, when around open flames, when turning the power switch on / off, and so on.
- When using absolute alcohol, be sure to follow the instructions provided by the manufacturer.

2 Cleaning This Product

- Nikon recommends that you use a silicon cloth to clean this product.
- For persistent dirt, dampen a piece of gauze with neutral detergent and wipe lightly.
- Note that using organic solvents could result in discoloration of the plastic parts.

3 Disinfecting This Product

- Nikon recommends that you use 70% medical alcohol for normal disinfection of this product.
- If a specimen is spilled, check that the specimen is a safe material or not. In case of spillage of a hazardous specimen onto this product, follow your standard laboratory procedures.
- Note that using organic solvents could result in discoloration of the plastic parts.

4 Storage

Store this product in a dry place where mold is not likely to form.

Store the objectives and eyepieces in a desiccator or similar container with a drying agent.

Put a vinyl cover over this product to protect them from dust.

Before putting on the vinyl cover, turn off the power switch on the microscope (flip it to the “O” side) and wait until the lamphouse is cooled down.

5 Periodical Inspections (Expenses Charged)

Nikon recommends inspecting this product periodically (expenses charged) in order to maintain peak performance. Contact your nearest Nikon representative for details.

IX Specifications

Microscope model		TE2000-E			
Target specimen		Specimen in liquid (culture cell and so on)			
Available container		Glass bottom dish (glass thickness: No. 1S)			
Glass thickness		Standard No. 1S (150 to 180 μm)			
Detection method		Active type, infrared LED image projection method			
Detected boundary surface	**Water or oil immersion type objective**	Boundary surface between the glass and specimen (culture medium) Refer to the figure on p.6 in Chapter I. “3. Offset function.”			
	Dry type objective	Boundary surface between the glass and the air Refer to the figure on p.6 in Chapter I. “3. Offset function.”			
Detector		Inline CCD			
Detector light source		Infrared LED wavelength: 770 nm illumination power: 0.1 mW or less			
Offset method		Optical offset type: The offset value can be operated with the knob of the controller.			
Offset amount		Dry type objective: +100 to –10 μm Water immersion type objective: +50 to –2 μm Oil immersion type objective: +10 to –0.5 μm Note: Some objectives are available for greater offset amount than above.			
Focusing time		700 msec or less (near the boundary surface)			
Focusing accuracy		1/3 of the depth of focus for each objective			
Available microscopy		Bright field microscopy, phase contrast microscopy, DIC microscopy, epi-fl microscopy, TIRF microscopy			
Available objective		**Name**	**NA**	**WD (mm)**	**Type**
		Plan Fluor 40x	0.75	0.72	dry
		Plan Fluor 40xH	1.30	0.2	oil immersion
		Plan Fluor ELWD 20xC	0.45	7.6	dry
		Plan Fluor ELWD 40xC	0.6	2.9	dry
		Plan Fluor ELWD DM 20xC	0.45	7.6	dry
		Plan Fluor ELWD ADL 20xC	0.45	7.6	dry
		Plan Fluor ELWD ADL 40xC	0.6	2.9	dry
		Plan Apo VC 60xH	1.40	0.13	oil immersion
		Plan Apo VC 100xH	1.40	0.13	oil immersion
		Plan Apo VC 60xWI	1.20	0.27	water immersion
		Plan Apo 60xHA	1.40	0.21	oil immersion
		Plan Apo 100xH	1.40	0.13	oil immersion
		Plan Apo 60xWI	1.20	0.22	water immersion
		Plan Apo 20x	0.75	1.00	dry
		Plan Apo DM 60xH	1.40	0.21	oil immersion
		Plan Apo DM 100xH	1.40	0.13	oil immersion
		Plan Apo TIRF 60x	1.45	0.13	oil immersion

Memory function 1	Offset value registering/calling (for each objective, up to 6 values)
Memory function 2	Nosepiece up/down position registering/calling (for each objective, up to 6 positions)
Dimensions and weight	T-PFB： H 46 x W 210 x D 125 mm (without protrusions) 1.5 Kg T-PFC： H 65 x W 150 x D 202 mm (without protrusions) 2.2 Kg T-FLC2-E： H 56 x W 166 x D 165 mm (partially H 117) 1.3 Kg
Service condition	**Operating environment** Temperature: +20 to +38 °C (for control unit: 0 to +40 °C). Relative humidity: 60% or less (for control unit: 80% or less) * No condensation. Altitude: 2000m max. Pollution degree: Degree 2 Installation category: Category II Electric shock protection class: Class I (AC adapter) Indoor use only **Storage environment** Temperature: - 20 to +60 °C Relative humidity: 90% or less. * No condensation.
Designated AC adapter	Manufacturer: ILAN Electronics Ltd. Type: F1650K Input ratings: 100 to 240 VAC, max 1.2 A, 50-60 Hz. Output ratings: 12 VDC, max 3.5 A Others: UL listed product, GS approved, and CE satisfied.
Power cord	**For using in the area supplied voltage is 100 to 120 V:** UL listed detachable cord set, 3 conductor grounding Type SVT, AWG 18, 3 m long maximum, rated at 125 V AC minimum. **For using in the area supplied voltage is 220 to 240 V:** Approved cord set according to EU/EN standards, 3 conductor grounding type HO5VV-F, AWG 18, 3 m long maximum, rated at 250 V AC minimum.
Safety standards compliance	**LED product category:** Class 1 LED Product **CE marking** This product meets EU Low Voltage Directive requirements. This product meets EU EMC Directive requirements. (EN61326) This equipment has been tested and found to comply with the limits 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 is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense. 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. This product meets Australian EMI. (AS/NZS CISPR11 Group 1 Class B)