NIKON INC.

REMOTE FOCUS ACCESSORY

50NM RESOLUTION

ERGO DESIGN

PRODUCT #99888

MADE IN U.S.A.

CARE AND MAINTENANCE

Cleaning the painted or plastic surfaces.

Avoid the use of any organic solvents (such as thinner, alcohol, ether, etc.) to clean the painted or plastic surfaces of the accessory. Instead, use a mild solution of soap and water or a neutral detergent.

Never attempt to dismantle.

Never attempt to dismantle the instrument, thereby avoiding the possibility of impaired operational efficiency or accuracy. Contact an authorized Nikon distributor for service and repair.

When not in use.

When not in use, turn off power to the accessory with the power switch on the Controller Module. When unit is not in use for an extended period, unplug transformer from its 120VAC 60Hz outlet.

NOTE: We reserve the right to make alterations in design or function. For this reason, specifications or illustrations in this manual may not conform with models in current production.

Remote Focus Accessory with RS-232C and Display
Nikon Product #99888

Contents

Introduction

To reduce operator fatigue and the risk of sample contamination, the Remote Focus Accessory (**RFA**) enables precise focus control for most Nikon microscopes without the need for operator contact with the instrument. Consisting of a Control Module and a Motor Unit, the Remote Focus Accessory facilitates remote manual focusing via the Control Knob on the Control Module, or computer control of microscope focus using an RS-232C link. In addition to maintaining sample cleanliness, the Remote Focus Accessory provides for easier, more accurate photographic sectioning and can be integrated with automatic inspection processes.

Features:

- Remote Control Knob feels and responds like a manual focus knob. No lag or overshoot. Controller responds instantly to manipulation of the Control Knob.

- Controllable by any computer with RS-232C communication capacity.

- 2 sample programs included which demonstrate control of the Remote Focus Accessory by an IBM-compatible computer.

- Continuous display of focus position in microns.

- 3 operator selectable levels of Control Knob responsiveness.

- Operator selectable right or left hand rotation of Control Knob.

- Clean room compatible.

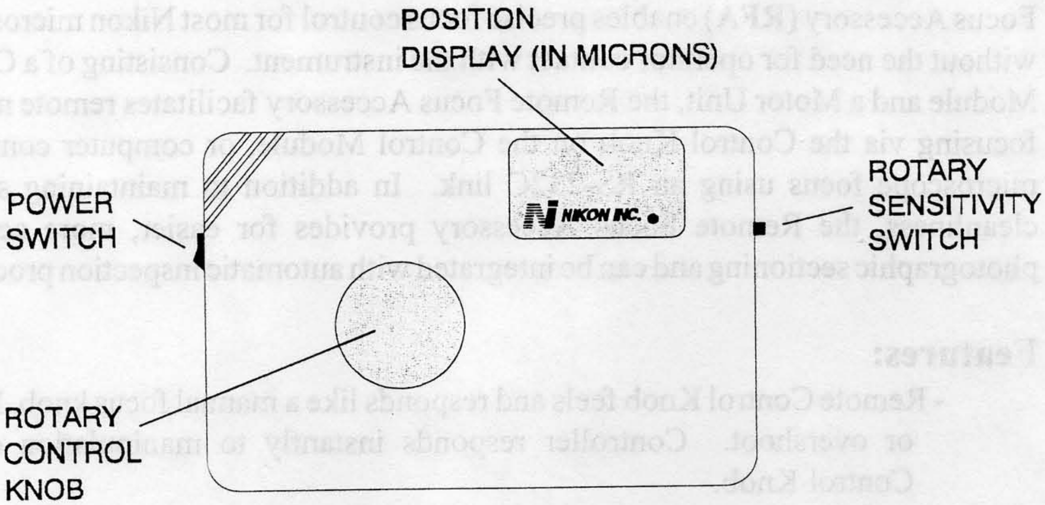
- Aluminum case shields against RFI radiation from controller microprocessor and motor.

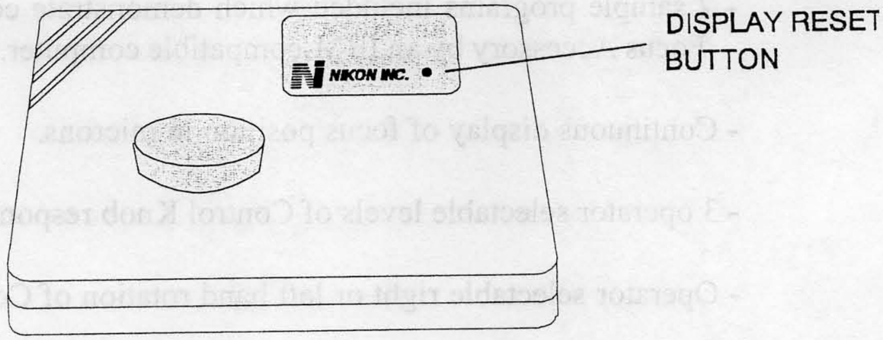
- Resolution of .1um

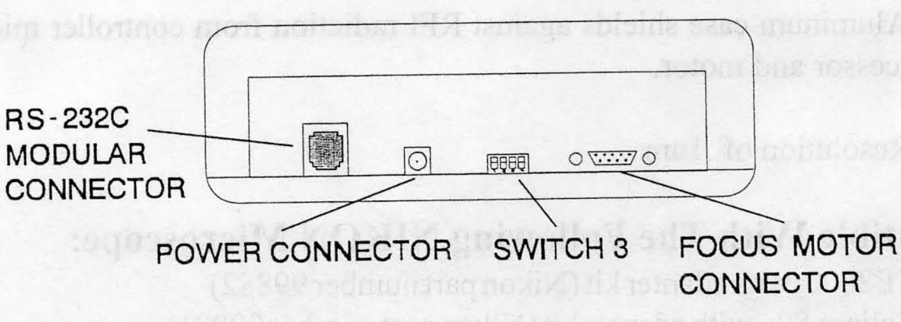
Compatible With The Following NIKON Microscope:

- TE2000, with adapter kit (Nikon part number 99882)
- Eclipse 80i, with adapter kit (Nikon part number 99881)

Control Unit







REAR VIEW OF CONTROLLER

Installation

Installation procedure varies based on adapter kit. Installation instructions are included with the adapter kits.

Connect control and power cables.

(1) Plug the motor control cable into the Motor Unit. Secure with provided captive screws.

(2) Plug the other end of the motor control cable into the Focus Motor Connector of the Control Module. Secure with provided captive screws.

(3) If the Remote Focus Accessory is to be controlled by a computer, connect the Control Module to the computer as described in the section on computer controlled operations.

(4) Insert the cord end connector from the power supply into the Power Connector on the rear of the Control Module.

(5) Plug the power supply into a 120VAC 60Hz receptacle.

Note: Make sure you plug the power connector into the control unit prior to plugging the supply into a wall receptacle.

Operation

Setting Operator Adjustable Controls.

(1) Sense Of Control Knob Rotation.

To accommodate operator preference, the Control Knob may be set to duplicate the sense of rotation of either the right or left hand fine focus knob on the microscope. Because the two standard fine focus knobs are on opposite ends of the same shaft, counterclockwise rotation of one fine focus knob has the same effect as clockwise rotation of the other fine focus knob.

- To set for right hand sense of rotation, set switch 4 of DIP switch SW3 on the Control Module towards the bottom of the module, as viewed from the rear.

- Left hand sense of rotation is set by setting switch 4 of DIP switch SW3 on the Control Module towards the top of the module, as viewed from the rear.

(2) Control Knob Responsiveness.

The responsiveness of the Control Knob (the amount of stage motion per revolution of the Control Knob) is determined by the position of the Rotary Sensitivity Switch, located on the right side of the Control Module.

- Coarse response mode (Rotary Sensitivity Switch slid towards the front of the Control Module), one rotation of the Control Knob will result in stage motion of approximately 48 microns.

- Medium response mode (Sensitivity Switch in the center position) will result in stage motion of approximately 24 microns per rotation of the Control Knob.

- Fine response mode (Sensitivity Switch towards the rear of the Control Module), results in stage travel of approximately 12 microns per revolution of the Control Knob.

Use Of Display.

The digital display indicates relative position of the stage in microns. The motor control and stepper motor are accurate to 0.1 micron. However, achievable system accuracy is dependent upon adjustment and function of the fine focus mechanism and thus may vary.

At power-up, the display indicates position of 0.0 microns. Rotation of the Control Knob will cause the display to change as the motor responds. Increasing display numbers indicates increasing distance between the stage and objective lens. Decreasing display numbers indicate that the stage is moving toward the objective lens.

The display can also indicate negative position numbers, relative to the arbitrarily determined zero position. A new zero position can be established at any time manually or through external computer control.

(1) Manually zeroing the display.

Momentarily pressing the Display Reset Button will set the display to 0.0 microns. The display may be zeroed at any time.

Manual Operation Of The Remote Focus Accessory.

- Rotation of the Control Knob generates an immediate response of the focus control motor. The system will respond without perceptible lag or overshoot.

- The sense of rotation (whether clockwise rotation of the Control Knob results in raising or lowering the stage) is determined by the setting of switch 4 of the DIP switch.

- Responsiveness of the system (the amount of stage motion per revolution of the Control Knob) is determined by the setting of the Rotary Sensitivity Switch.

Computer Controlled Operation Of The RFA.

(1) Connection of communication cable.

A communication cable is provided equipped with MOD 6 connectors. Insert one end of the cable into the RS-232C Modular Connector on the rear of the Controller Module.

An adaptor is provided to convert the MOD 6 connector to DB-9, which is compatible with a standard IBM AT style serial port.

Another adaptor is provided which converts the DB-9 to DB-25, which is compatible with the standard serial port of a IBM PC/XT style computer. For other devices which may require custom adaptors, refer to the Schematic, in the technical section of this manual, for wiring information.

(2) Operation of the Remote Focus Accessory by computer control.

Any computer system capable of generating ASCII alphanumeric character output can be used to control the Remote Focus Accessory. The Control Knob is not disabled while the Accessory is linked to the control computer. The Accessory can be controlled manually at any time during program operation provided that the stepper motor is not moving under computer control.

Demonstration Software

Two demonstration programs are included to provide an introduction to external computer control of the Remote Fine Focus Accessory. These programs are not intended to serve as operational software, or fulfill any application other than to demonstrate external computer control of the Remote Focus Accessory.

The demonstration programs require an IBM-compatible personal computer equipped with a floppy disk drive, DOS 3.1 or above, and 256K memory.

RFADemo.EXE

This demonstration program illustrates the capability of the Remote Focus Accessory under external computer control to precisely execute a sequence of motions. The program adjusts the stage elevation in operator selected steps, and time intervals between the motions. The operator defines the time interval, the step size, and the total number of steps. After the last item is entered, the first step is made, and thereafter at every time interval one step is taken until all the steps have been completed.

To start the program, place the demo disk in drive A: and type

A:RFADEMO ***[COM#]*****<cr>** (bracketed items are optional)

The defaults for the program are COM1, 1200 BAUD, UNIT. The only option is the com-port number. You need to supply this option only if it is different from com1.

NOTE: At any time during either program's operation when the stepping motor is not moving, the focus can be manually adjusted by operator rotation of the rotary control knob.

RFocus.EXE

This demonstration program facilitates control of the Remote Focus Accessory by an external computer through operator entry of single commands. Any of the system commands may be entered one at a time via the keyboard of the control computer. The Remote Fine Focus Accessory will execute the command entered, and return a response upon completion of the task.

To start the program, place the demo disk in drive A: and type

A:RFOCUS ***[COM#]***<cr>

The defaults for the program are COM1, 1200 BAUD, UNIT 0. The only option that you should change is the com# if different from 1, at least until you become familiar with the controller.

The program tries to establish a connection with the Controller. The connection status is displayed at the bottom of the screen. Once a connection has been established, the current location (in microns) of the Remote Focus Accessory is displayed in the upper right of the screen. The controller commands are listed in the right column of the screen. Simply type in a command followed by the 'enter' key and the program will transmit that command to the controller. The responses are displayed as they are receive by the program.

For example,

>MZ 100<cr>	Move to location 100
A:<cr>	Everything okay

From within the program, you can change the COM, BAUD and UNIT settings. Simply Press and hold the ALT key while at the same time pressing C, B or U respectively. This will cause a Menu to appear. At this point, select the appropriate option. The new option should replace the old selection on the screen. To get out of the program type 'EXIT'.

Sample Basic Program

Here is an example Basic program that instructs the RFA Controller to take 200 steps each of which is .5 microns. The current location of the Controller is also displayed on the users output screen. The source code for this program is supplied on the Demo Disk (Demo.bas).

```
'=================================================================
'   This is a demo of the Remote Focus Accessory.
'       Programmed in QuickBasic 4.5
'=================================================================
DECLARE FUNCTION SendAndReceive$ (Strng$)

CLS
OPEN "com1: 1200, N, 8, 1" FOR RANDOM AS #1

FOR I = 0 TO 1000 STEP 5
    LOCATE 1, 1: PRINT SendAndReceive$("Movez" + STR$(I));
    LOCATE 2, 1: PRINT SendAndReceive$("Wherez");
NEXT
END

'
'----------------------------------------------------------------
' PROCEDURE: SendAndReceive$ (Strng$)
'      PURPOSE: Send And Receive data via the RS-232 port.
'      RETURNS: A String of characters Received from the controller.
'----------------------------------------------------------------
FUNCTION SendAndReceive$ (Strng$)

PRINT #1, Strng$
DoAgain = 1
DO
    Receive$ = Receive$ + INPUT$(LOC(1), #1)
    IF LEN(Receive$) > 0 THEN IF ASC(RIGHT$(Receive$, 1)) = 13 THEN
DoAgain = 0
LOOP UNTIL DoAgain = 0
SendAndReceive$ = Receive$
END FUNCTION
```

Computer Control

Communication Specifications

The Remote Focus Communications interface is an interfa between a host computer and the controller. The communication is establish through an RS-232C serial connection. The programming protocol is with te (standard ASCII alphanumeric characters), along with some special contr characters such as carriage returns, spaces and tabs. The controller responds tc set of built-in commands with unique names. The commands can be executed l simply sending the command name with some parameters (if required). T controller will respond in ASCII and may include the result requested. The RF controller is a stand alone system, but was designed to operate with oth components, therefore it is necessary to distinguish it from, say, an xy-stage. this end, the RFA is addressed as if it were the Z-axis of a multi-axis system.

General Format Of Commands

Each line sent to the Controller should have a command and terminated with a carriage return character. The first item on the line is t command. Each line can contain only one command and the Controlle commands are not case sensitive. The allowed commands are listed below. Aft the command are the parameters, some commands have no parameters. Final each command must be terminated with a carriage return character. The carria return indicates to the Controller the end of a command. The specific items c be separated with white space characters (such as spaces, tabs). The ent command string cannot exceed 40 characters.

(command) [*data*] <cr>

where:

(command) any valid ASCII command.
[data] ASCII numeric data (if applicable).

For Example:

Command: **WhereZ<cr>**
Response: **:A 1002<cr>**

Response

:A <*DATA*><cr>	Everything is ok <*returned data*>
:N <ERROR CODE><cr>	Error.

Every command returns a response: The response is in the form of a colon followed by a status character (either an A or N). The colon is sent by the Controller as soon as the command is received. The status character is not sent until the function has completed (i.e. after the motor has moved/stopped). Do not send another command until the last function has been completed and returned a response. If for some unknown reason the Controller does not respond with a colon, then the command was not received properly (due to communications problems) and the command must be resent. In this case, the Controller's internal buffer must be emptied by sending an ESC character (ASCII 27). This is necessary since your last command may have been partially received and still reside in the Controller's internal buffer. It is not a bad idea to send an ESC character before every command, but it is not necessary.

Examples:

command:	**MZ 1001<cr>**	(move to location 1001)
response:	**:A <cr>**	(everything is ok)
command:	**WZ <cr>**	(where is z-axis?)
response:	**:A 1001 <cr>**	(z-axis position is 1001)
command:	**AQRST<cr>**	(an illegal command)
response:	**:N -1 <cr>**	(error code -1)

PRESENTLY ASSIGNED ERROR CODES

-1	unknown command

ASCII Commands

Encoder:

format: **ENCODER ON/OFF<cr>**

This command will turn the encoder located on the controller either on or off. If no parameters are given, this command returns the current status of the encoder.

Response:

A positive response is sent back immediately after the command is received.

:A<CR>

Example:

ENCODER ON<cr>

Response:

:A ON<cr>

ASCII Commands

Halt Motor:

format: **HALT<cr>**
Hex Code: 0x7D

This command halts the motor during a move command. It effectively cancels the current movement.

Response:

A positive response is sent back when the command is complete.
:A<CR>

ASCII Commands

Set Current Location Z-axis:

format: **HEREZ** **XXXX** <cr>
or **HZ** XXXX<cr>

This command will adjust the internal (to the controller) current location of the z-axis. This will effectively adjust the location of the origin.

Response:

A positive response is sent back immediately after the command is received.
:A<CR>

Example:

HEREZ 1000 <cr> The current location becomes the 1000 position internally (+100.0microns).

ASCII Commands

Set Min Speed:

format: **MINSPEED<cr>**

This command sets the start up speed for movement of the stage. The operator can choose a value from 50 to 60,000, where a larger number signifies a slower MINSPEED.

Response: A positive response is sent back when the command is complete with the current setting.

:A XXX<CR>

Example: **MINSPEED 1000<cr>** This will set the MINSPEED to :A 1000

This command can also be used to simply view the current MINSPEED setting.

Example: **MINSPEED<cr>**

Response: **:A 1000<cr>**

ASCII Commands

Move Absolute Z-axis:

format: **MOVEZ XXXX<cr>**

or **MZ XXXX<cr>**

This command will move the z-axis to the location XXXX in tenths of microns.

Response:

A positive response is sent back when the command is complete.

:A<CR>

Example:

MOVEZ 1000 <cr> move the focus to +100.0 microns from the origin.

ASCII Commands

Rampslope:

format: **RAMPSLOPE<cr>** Range (1-255)

This command will set the rate at which the velocity changes. the larger the number, the slower the change in velocity.

Response:

A positive response is sent back when the command is complete.
:A<CR>

Example: **RAMPSLOPE 100<cr>**

This command will set the current RAMPSLOPE to 100.

Response: **:A 100<cr>** The current RAMPSLOPE is 100

<u>ASCII Commands</u>

Move Relative Z-axis:

format: **RELMOVEZ XXXX<cr>**
or **RZ XXXX<cr>**

This command will move the z-axis a relative amount XXXX from the current location in tenths of microns.

Response:

A positive response is sent back when the command is complete.
:A<CR>

Example:

RELMOVEZ 1000 <cr> move the focus +100.0 microns from the current location.

ASCII Commands

Reset the system:

format: **RESET<cr>**
Hex Code: 0x7F

This command will reset the system, as if the power had been turned off. When the hex code is used this command does an automatic power on reset regardless of a command being executed. No response is given if hex code is used.

Response:

A positive response is sent back prior to the command being completed; The command responds prior to reset.
:A<CR>

Example:

RESET<cr>

ASCII Commands

Resolution:

format: **RESOLUTION<cr>**
Hex Code: 0x89

This command will return the units that the controller displays. The units can be in tenths or hundredths of microns.

Response:

A positive response is sent back immediately after the command is received.
:A 1 Tenths<CR>
or
:A 1 Hundredths<CR>

The number represents the smallest increment (resolution) of the system. if it is 2, for example, then the system's minimum step size is 2 (in current units). if it is less then .5 it will be displayed as zero. This means that the fundimental step size of the controller is smaller then the current units.

ASCII Commands

Speed:

format: **SPEED<cr>**

This command will tell the operator the current value of the maximum speed of movement for the MOVE commands. The range of speed is 50 to 60000, with a larger number representing a slower speed.

Response:

A positive response is sent back immediately after the command is received.

:A<CR>

Example: **SPEED<cr>**

Response: **:A 100<cr>** The maximum speed is set at 100.

ASCII Commands

Get Version:

format: **VERSION<cr>**

Hex Code: 0x7C

This command returns the current version code of the firmware.

Response:

A positive response is sent back when the command is complete with the current version number.

:A 2.0<CR>

Example: **Version** <cr> What is the ROM version Number

Response: **:A 2.0**

ASCII Commands

Who:

format: **WHO<cr>**
Hex Code: 0x80

This command will return the current microscope accessory being used. In this case it returns, "**REMOTE FOCUS ACCESSORY**".

Response:

A positive response is sent back immediately after the command is received.
:A<CR>

Example:

WHO<cr>

Response: **:AREMOTE FOCUS ACCESSORY<cr>**

ASCII Commands

Get Current Location Z-axis:

format: **WHEREZ<cr>**
or **WZ <cr>**

This command will query the RFA controller for the current location of the Z-axis.

Response:

A positive response is sent back immediately after the command is received.
:A XXXX<CR> The current location in tenths of microns (XXX.X microns).

Example:

WHEREZ<cr> The current location is sent back from the controller.

Response:

:A 1456<CR> The current location in tenths of microns (145.6 microns).

ASCII Commands

Set Zero Of Origin:

format: **ZERO<cr>**

This command will set the origin to the current location. This results in the current location being the new ZERO (origin).

Response:

A positive response is sent back immediately after the command is received.

:A<CR>

Example:

ZERO<cr> The current location becomes the ZERO position.

DIP Switch Settings (SW3)

Default Dip Switch Settings: Up Down Up Up
1 2 3 4

RS-232C Settings:

Format: 8-Bits, 1-Stop Bit, No Parity
Baud Rates: 300, 1200, 2400, 9600

S1	S2	Baud Rate
Up	Up	9600
Down	Up	2400
Up	Down	1200
Down	Down	300

Motor Mount Side Setting:

Lets the operator choose which side the motor Mount Unit is installed on.

S3	SIDE
Down	Right
Up	Left

NOTE: Leave this switch in the UP position. This unit is designed for microscopes with fine focus knob on the left side.

Right/Left Handed Operations:

This selects the direction of rotation of the motor with respect to operator motion of the Rotary Control Knob.

DIP 4	ORIENTATION
Down	Right
Up	Left

NOTE: Switches are only interrogated at power up, so before making adjustments turn the unit off.

Technical Notes Concerning The RFA

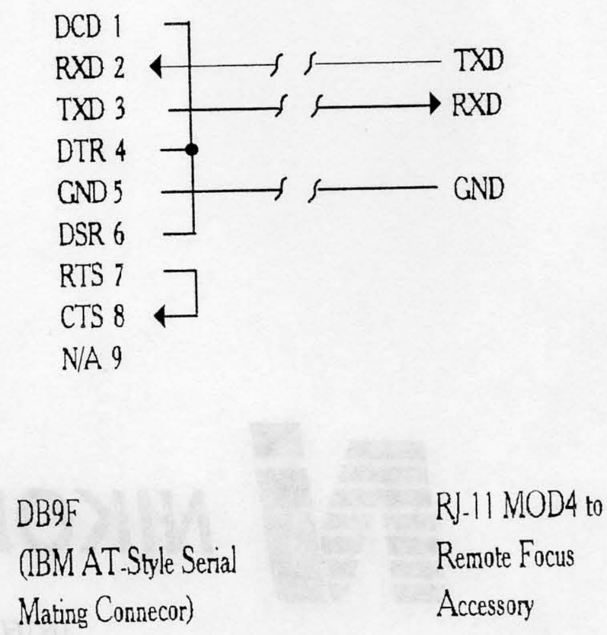
The stepper motor rotates 400 steps per revolution. With the 2.5:1 drive belt step-down ratio, each step is thus equal to 0.1 micron (for the Nikon standard 100 micron per revolution of the fine focus knob). The maximum step rate is 1000 steps per second (or 100 microns per second). No matter how fast the control knob is spun, the system will keep the maximum step rate appropriate for the stepping motor.

Responsiveness of the Control Knob is adjusted by the Rotary Sensitivity Switch. The rotary encoder outputs 480 pulses per rotation. For each pulse from the encoder the stepping motor is advanced one step. The Rotary Sensitivity Switch selects division of the encoder pulses by 1, 2, or 4 before stepping the motor, thus changing the knob sensitivity to 480, 240, or 120 pulses per rotation.

While the motor is stationary, the stepper motor is automatically powered-down. A current only strong enough to provide the required detent torque is applied in this power-down mode. This reduces the power dissipation in the motor and the controller. Full current is automatically applied during rotation of the motor.

The drive belt is made of polyurethane and thus is very clean and abrasion resistant to ensure clean room compatibility.

RS-232C Hardware Connections



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