BEI Device Interface
User Manual

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2 Installation

2.1 System Requirements

Microsoft Windows XP, 2000, 7, 8
Mac OS X 10.6 - 10.9.5

Bluetooth or serial port connection to lens module
Internet connection for software updates

2.2 Installation – Mac

The application is supplied as a zipped disk image (.dmg.zip). The application can be downloaded from the Birger Engineering website. Double-click to uncompress the disk image. Then double-click to mount the disk image. The application can then be dragged to your applications folder.
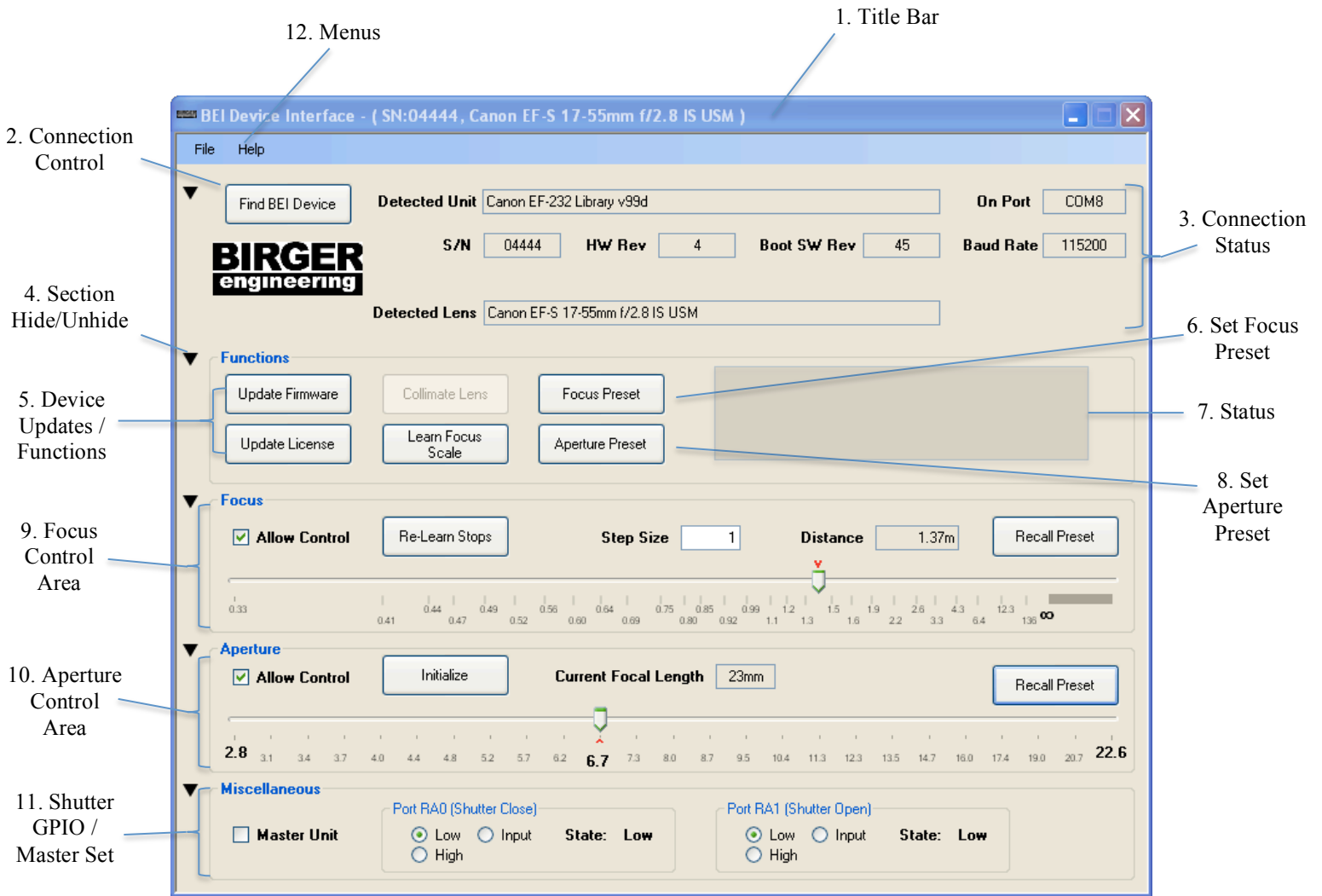
2.3 Installation – PC

The application is supplied as zipped self-installer. The application can be downloaded from the Birger Engineering website. Unzip the setup files into a folder. You should have the files setup.exe, BEIDeviceInterfaceSetup.msi and the folder vcredist_x86. Double-click setup.exe to begin the installation process.

3   Overview

3.1   Main Window, Mac

1. Title Bar

2. Connection Control

BEI Device Interface – (SN:04444 , Canon EF-S 17-55mm f/2.8 IS USM)

Find BEI Device   Detected Unit   Canon EF-232 Library v21c

3. Connection Status

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S/N   04444   HW Rev   4   Boot SW Rev   45

On Port   /dev/cu.BIRGER05001-SerialPort   Baud Rate   115200

4. Section Hide/Unhide

Detected Lens   Canon EF-S 17-55mm f/2.8 IS USM

6. Set Focus Preset

▼ Functions

5. Device Updates / Functions

Update Firmware   Collimate Lens   Focus Preset

Update License   Learn Focus Scale   Aperture Preset

7. Status

8. Set Aperture Preset

▼ Focus

9. Focus Control Area

☑ Allow Control   Learn Limits   Step Size   1   Distance   0.707m   Recall Preset

0.33   0.44   0.49   0.56   0.64   0.75   0.85   0.99   1.2   1.5   1.9   2.6   4.3   12.3   ∞
0.41   0.47   0.52   0.60   0.69   0.80   0.92   1.1   1.3   1.6   2.2   3.3   6.4   136

▼ Aperture

10. Aperture Control Area

☑ Allow Control   Initialize   Current Focal Length   23mm   Recall Preset

2.8   3.1   3.4   3.7   4.0   4.4   4.8   5.2   5.7   6.2   6.7   7.3   8.0   8.7   9.5   10.4   **11.3**   12.3   13.5   14.7   16.0   17.4   19.0   20.7   **22.6**

▼ Miscellaneous

11. Shutter GPIO / Master Set

Port RA0 (Shutter Close)   Port RA1 (Shutter Open)

☐   ⦿ Low   ○ Input   State: Low   ⦿ Low   ○ Input   State: Low
Master Unit   ○ High   ○ High

3.2 Main Window, PC

12. Menus

1. Title Bar

2. Connection Control

3. Connection Status

4. Section Hide/Unhide

6. Set Focus Preset

5. Device Updates / Functions

7. Status

8. Set Aperture Preset

9. Focus Control Area

10. Aperture Control Area

11. Shutter GPIO / Master Set

BEI Device Interface - (SN:04444, Canon EF-S 17-55mm f/2.8 IS USM)

File   Help

Find BEI Device   Detected Unit Canon EF-232 Library v99d   On Port COM8

BIRGER engineering   S/N 04444   HW Rev 4   Boot SW Rev 45   Baud Rate 115200

Detected Lens Canon EF-S 17-55mm f/2.8 IS USM

Functions

Update Firmware   Collimate Lens   Focus Preset

Update License   Learn Focus Scale   Aperture Preset

Focus

☑ Allow Control   Re-Learn Stops   Step Size 1   Distance 1.37m   Recall Preset

0.33 0.41 0.44 0.47 0.49 0.52 0.56 0.60 0.64 0.69 0.75 0.80 0.85 0.92 0.99 1.1 1.2 1.3 1.5 1.6 1.9 2.2 2.6 3.3 4.3 6.4 12.3 136 ∞

Aperture

☑ Allow Control   Initialize   Current Focal Length 23mm   Recall Preset

2.8 3.1 3.4 3.7 4.0 4.4 4.8 5.2 5.7 6.2 **6.7** 7.3 8.0 8.7 9.5 10.4 11.3 12.3 13.5 14.7 16.0 17.4 19.0 20.7 **22.6**

Miscellaneous

☐ **Master Unit**   Port RA0 (Shutter Close)   ⦿ Low ○ Input   State: Low   Port RA1 (Shutter Open)   ⦿ Low ○ Input   State: Low
    ○ High   ○ High

3.3 Main Window Controls

1. Title Bar

The title bar contains the program name, the serial number of the device to which the program is communicating, and the name of the attached lens.

2. Connection Control

This button, labeled "Find BEI Device," will cause the program to search for a lens controller that is connected over a serial port within the host computer; the serial port can be a real physical connection or a virtual serial port enabling Ethernet or Bluetooth communications.

3. Connection Status

The connection status area contains information for the connected device and lens, along with connection errors.

Detected Unit : Shows the name of the software library that is loaded into the device.
S/N : The serial number of the connected device.
HW Rev : The hardware revision of the connected device.
Boot SW Rev : The revision of the bootloader on the device.
On Port : The serial port over which the computer is communicating with the device.
Baud Rate : The speed of the serial port connection.
Detected Lens: The name of the lens that is connected to the lens controller. The lens does not have a name itself; rather it is constructed from information learned from the lens. All of the lenses that might match are listed in this drop-down box. You can select the name of the lens that most closely matches the lens you have connected. Many settings that are preserved are associated with the name of the lens, so you will want to have this as accurate as possible.

4. Section Hide/Unhide

Each section has a disclosure control shaped like a triangle. Clicking the disclosure triangle will collapse or expand the corresponding section. This can be used to show only the controls desired.

5. Device Updates / Functions

Update Firmware : Press this button to update the firmware inside the lens controller. This button can also be used to update the firmware in an Impero controller that is connected to the lens controller (Mac version only). Pressing the button brings up a file dialog window in which you will make a selection on the firmware that you wish to load. The firmware is obtainable only from Birger Engineering.

Update License : Birger Engineering will at times roll out test features in new firmware. In order to activate these features you will need to load a license file into the device. Pressing this button brings up a file dialog window in which you will select the correct license file. The license file is obtainable only from Birger Engineering.

Collimate Lens : Certain combinations of hardware and software will enable the ability to fine-tune the mounting of the lens / lens controller to the target camera. This button is only enabled if you have the ability to perform this procedure.

Learn Focus Scale : Press this button to learn the focus scale for the currently connected lens. The focus scale is displayed in the focus control area underneath the focus control bar.

The focus scale is an approximation of the focus distance at the current lens focus point. It is based on information learned from the lens and is only as accurate as the lens is capable of reporting. Not all lenses are capable of reporting focus scales. Once the focus scale is learned, it will be remembered for the particular lens name, and will be recalled when a lens with the same name is connected. If the same lens is connected then this will retain the original accuracy. If a different lens of the same name (type) is connected, then it will be an approximation, as each lens will have construction tolerances that may alter the focus scale. You can always learn a new focus scale by pressing the button again.

6. Focus Preset

Pressing the "Focus Preset" button will save the current focus location as the focus preset. When the preset is recalled, the lens will move its focus to the preset location. A red arrow will appear in the focus scale marking the position where the preset is stored. The focus preset is associated with the lens controller serial number and the currently connected lens name.

7. Status

The status area contains information pertaining to firmware / license file updates, lens collimation, and other miscellaneous messages.

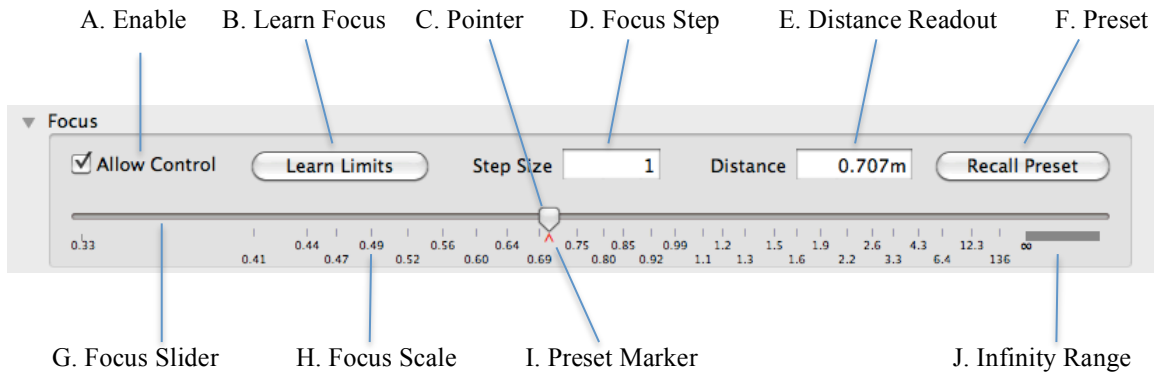## 8. Aperture Preset

Pressing the "Aperture Preset" button will save the current aperture location as the aperture preset. When the preset is recalled, the lens will move its aperture to the preset location. A red arrow will appear in the aperture scale marking the position where the preset is stored. The aperture preset is associated with the lens controller serial number and the currently connected lens name.

9. Focus Control Area
(Mac version shown, PC version is similar)

A. Enable   B. Learn Focus   C. Pointer   D. Focus Step   E. Distance Readout   F. Preset

▼ Focus

☑ Allow Control   (Learn Limits)   Step Size [1]   Distance [0.707m]   (Recall Preset)

0.33   0.44 0.49   0.56   0.64   0.75 0.85   0.99   1.2   1.5   1.9   2.6   4.3   12.3   ∞
    0.41   0.47   0.52   0.60   0.69   0.80   0.92   1.1   1.3   1.6   2.2   3.3   6.4   136

G. Focus Slider   H. Focus Scale   I. Preset Marker   J. Infinity Range

A. Enable : The "Allow Control" checkbox is used to enable control of the lens focus by dragging the focus pointer (C) along the focus slider bar (G). If the box is not checked then the focus area functions as readout only.

B. Learn Focus: Press this button to learn the limits of the lens; the limits are the zero focus stop and the infinity focus stop. It is necessary to learn the limits, and thus the range of the lens, in order for the focus control to work properly. Some lenses will drift after repeated focusing commands (e.g. repeatedly dragging the pointer back and forth), and this button is then used to re-learn the limits and restore correct mapping to the focusing controls.

C. Pointer : The focus pointer shows the current focus location, and can be clicked and dragged to re-position the lens focus to any point along the focus bar, as long as the enable box (A) is checked.

D. Focus Step : The focus step value controls how far the pointer is moved for each fine focus change via the keyboard hotkeys. This value has no effect on the focus slider control functionality. Edit the text box to input the desired step size. The step is unitless. A value of one is the smallest possible step. A course focus step via the keyboard uses ten times the value of this setting.

E. Distance Readout: The distance readout contains the focus distance of the lens, approximated by the lens' current focal position and the information learned for the focus scale. This is an approximation only.

F. Preset : Press the "Recall Preset" button to move the lens focus to the stored preset position. The stored position is shown by the red preset marker (I). If there is no stored focus preset then this button will not be enabled and no red marker will be shown.

G. Focus Slider: The focus slider represents the focus range of the lens from zero to infinity. The focus pointer (C) is moved within this range to change the focus of the lens.

H. Focus Scale: The focus scale represents the focus distance of the lens mapped into the focusable range using information learned from the lens with the "Learn Focus Scale" button. These are approximate values.
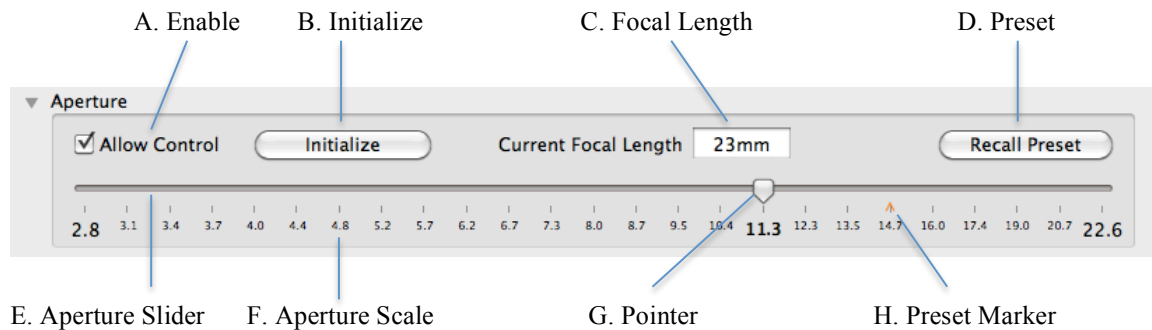
I. Preset Marker: The preset marker is a small red arrow that marks the position of the focus preset, if it is stored for this particular lens and device combination.

J. Infinity Range: Some lenses will focus past optical infinity to compensate for

temperature effects. The infinity range represents the part of the lens focal range from where the infinity position was first reported to the mechanical infinity.

10. Aperture Control Area
(Mac version shown, PC version is similar)

A. Enable   B. Initialize   C. Focal Length   D. Preset

E. Aperture Slider   F. Aperture Scale   G. Pointer   H. Preset Marker

A. Enable   : The "Allow Control" checkbox is used to enable control of the lens aperture by dragging the aperture pointer (G) along the aperture slider bar (E). If the box is not checked then the aperture area functions as readout only.

B. Initialize   : Press this button to zero the lens aperture mechanism. This is absolutely necessary as the position of the lens aperture is relative to the zero position, and no aperture commands will work if the zero position is not known.

C. Focal Length: This is the readout of the current lens focal length, as learned directly from the lens. This value will update live as the lens focal length is adjusted on zoom lenses.

D. Preset   : Press the "Recall Preset" button to move the lens aperture to the stored preset position. The stored position is shown by the red preset marker (H). If there is no stored aperture preset then this button will not be enabled and no red marker will be shown.

E. Aperture Slider: The aperture slider represents the aperture range of the lens from fully open to fully closed, within the lenses capabilities. The aperture pointer (G) is moved within this range to change the aperture of the lens.

F. Aperture Scale: The aperture scale displays the lens' f-stop in ¼ stop increments. The aperture to which the lens is currently set is marked with larger type.

G. Pointer   : The aperture pointer shows the current lens aperture, and can be clicked and dragged to re-position the lens aperture to any point along the aperture bar, as long as the enable box (A) is checked. The aperture can only be changed in discrete steps as marked by the aperture scale (F).

H. Preset Marker: The preset marker is a small red arrow that marks the position of the aperture preset, if it is stored for this particular lens and device combination.

11. Shutter GPIO / Master Set

(Mac version shown, PC version is similar)

B. GPIO RA0   C. GPIO RA1

A. Master Enable   D. Output Control   E. Set Input   F. State Readout
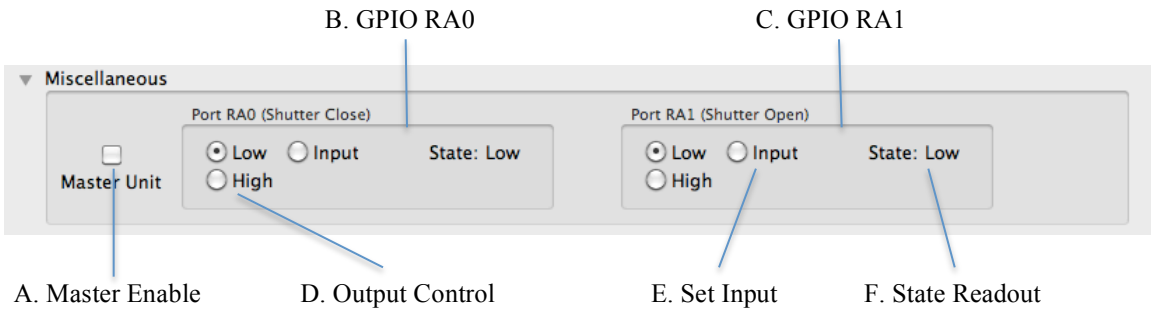
A. Master Enable: The "Master Unit" checkbox is used to mark this application and lens controller instance as the master controller in a master/slave pair. The slave lens controller will follow the focus and aperture settings of the master. The master/slave functionality is unlocked with a special license file from Birger Engineering.
B. GPIO RA0: General-Purpose Input/Output RA0. This control signal will be wired to the shutter close signal if the shutter adapter is in use.
C. GPIO RA1: General-Purpose Input/Output RA1. This control signal will be wired to the shutter open signal if the shutter adapter is in use.
D. Output Control: The output control consists of two radio-buttons, "Low" and "High" which will set the GPIO in question to output a low (0V) or high (5V) signal.
E. Set Input : Setting the "Input" radio button will convert the GPIO to an input whose state is displayed in (F).
F. State Readout: This text is "Low" or "High" and corresponds to the current state of the GPIO in question, whether it is an output or input.

12. Menus (PC)

The "File" and "Help" selections are additional menus for setting preferences, filing reports, and other functions. Consult the menus section for more detail. The Mac menus can be found on the screen's menu bar as usual.

3.4 Menus

3.4.1 Main Menu

The main menu is accessed by clicking the "File" menu in the Windows version and the "BEI Device Interface" menu in the Mac version. The options available from the main menu are the same between the two versions, except that the Mac version has additional standard Mac items, which will not be described here.

Main Menu, PC:
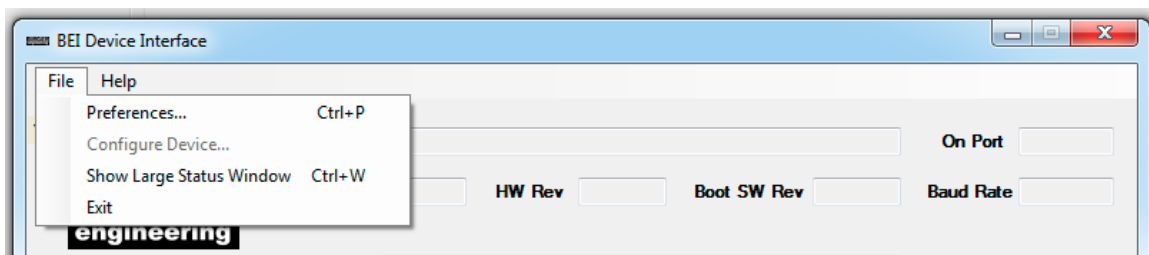
Main Menu, Mac:

About BEI Device Interface (Mac) – Select this item to see the software version of the interface program.

Preferences – Select this to open up the preferences window.

Configure Device – Select this to write specific configurations to the device.

Show Large Status Window – Select this to open a window with lens status (focus distance, focal length, aperture) in large type for viewing from a distance.

Exit (PC), Quit BEI Device Interface (Mac) – Exits the program.

3.4.2   Help Menu

The help menu is accessed by clicking the "Help" menu in either the Windows or Mac version of the program.

Help Menu, PC:
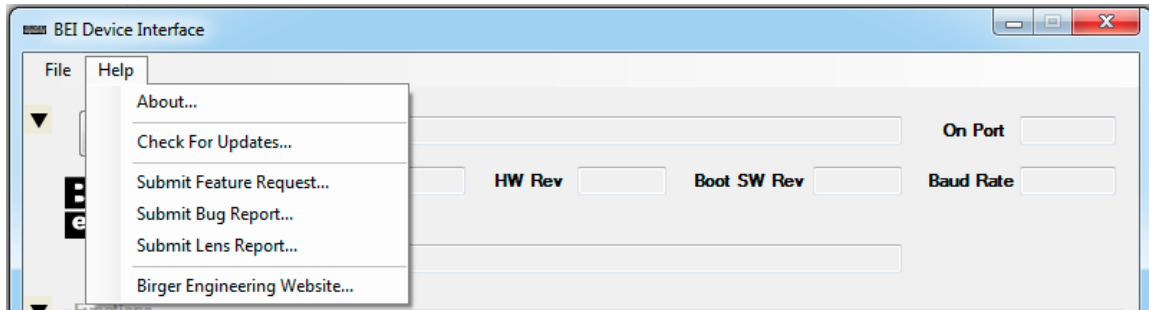
Help Menu, Mac:
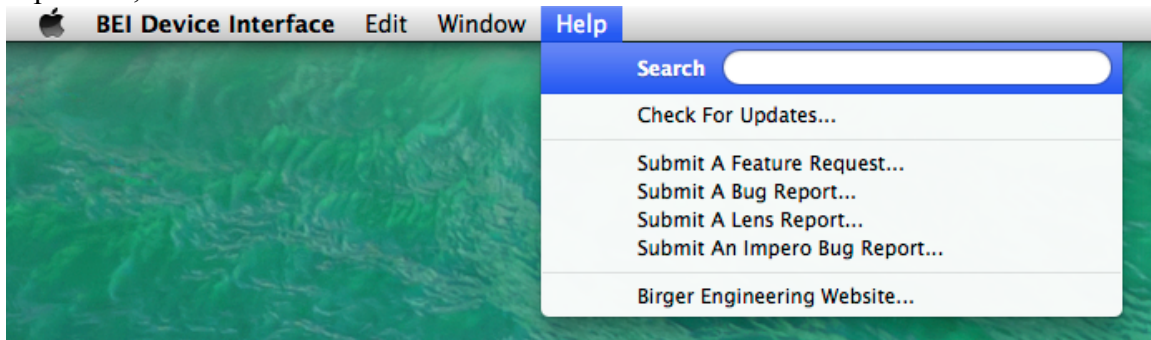
About (PC) – Select this item to see the software version of the interface program.

Check For Updates – Select this to check the website for updates to the interface program or device firmware. This will also check for an update to an Impero controller if it is connected (Mac version only).

Submit A Feature Request – Please select this item to fill out a form along with your request for a feature you would like to see implemented.

Submit A Bug Report – Select this item to report a problem you have discovered with either the interface software or lens controller.

Submit A Lens Report – Select this item to report satisfaction or problems with a particular lens. If you have a lens that is not currently supported with a proper name, you will need to submit a lens report for support to be added.

Submit An Impero Bug Report (Mac Only) – Select this to a report a problem with an Impero controller. This selection is only for problems with Impero controllers.

Birger Engineering Website – Opens up your default browser to the Birger Engineering website.

3.5   Preferences – PC

The Preferences window is activated by selecting "Preferences…" from the file menu in the main window.
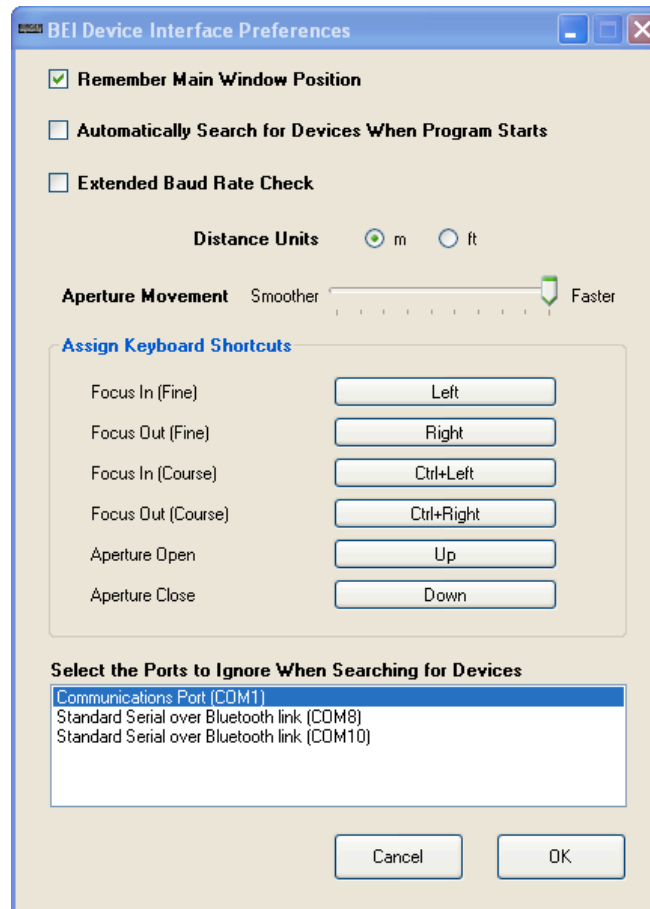
Remember Main Window Position – Check this box to remember the placement of the main window. When the program is launched it will appear in the place that it last was.

Automatically Search for Devices When Program Starts – Check this box to cause automatic device detection, as if the "Find BEI Device" button were pressed, when the program in launched.

Extended Baud Rate Check – Check this box to include additional baud rates in the search for the lens controller. You do not need this for serial ports that operate over Bluetooth or Ethernet; this is for directly connected lens controllers.

Distance Units – Select feet or meters for the readout of the focus scale and distance.

Aperture Movement – Select the aperture increment that is used when changing between aperture settings. The smoother end of the scale results in the smallest possible movement that the aperture mechanism is capable of making; the faster end results in the aperture change occurring in a single move.

Assign Keyboard Shortcuts – Use this section to assign keyboard shortcuts for focus and aperture movements. To assign a key, press the button corresponding to the function to which you wish to assign the key, and then press the desired key combination. The course focus movement moves ten times the increment as the fine focus step, which is set on the main window.

Select the Ports to Ignore When Searching for Devices – This box will list all of the serial ports currently found in the host computer. Highlight the ports that should be ignored when searching for a connected lens controller.

3.6   Preferences – Mac

    The preferences window is activated by selecting "Preferences…" from the BEI Device Interface application menu. The Mac preferences are split up among several panels as part of a tabbed control.

3.6.1   Mac Preferences – Main
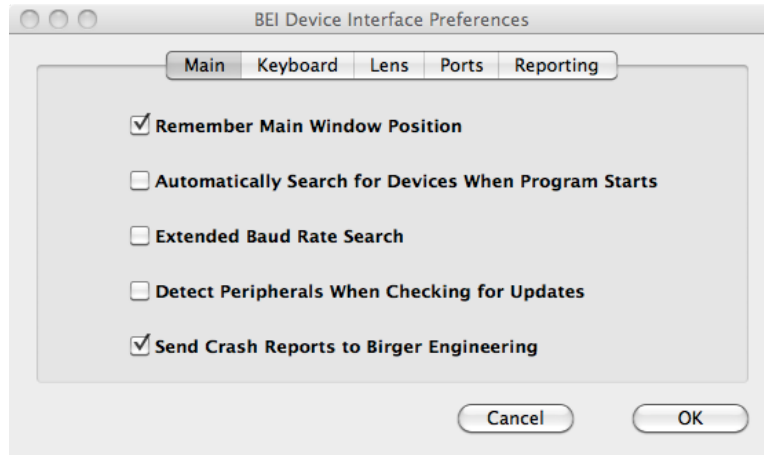
Remember Main Window Position – Check this box to remember the placement of the main window. When the program is launched it will appear in the place that it last was.

Automatically Search for Devices When Program Starts – Check this box to cause automatic device detection, as if the "Find BEI Device" button were pressed, when the program in launched.

Extended Baud Rate Search – Check this box to include additional baud rates in the search for the lens controller. You do not need this for serial ports that operate over Bluetooth or Ethernet; this is for directly connected lens controllers.

Detect Peripherals When Checking for Updates – Check this box to look for software updates for any peripherals connected to the lens controller, such as an Impero controller, during normal update checking.

Send Crash Reports to Birger Engineering – Check this to email application crash reports to Birger Engineering. Crash reports help debug and improve the software.

3.6.2 Mac Preferences – Keyboard Assignments
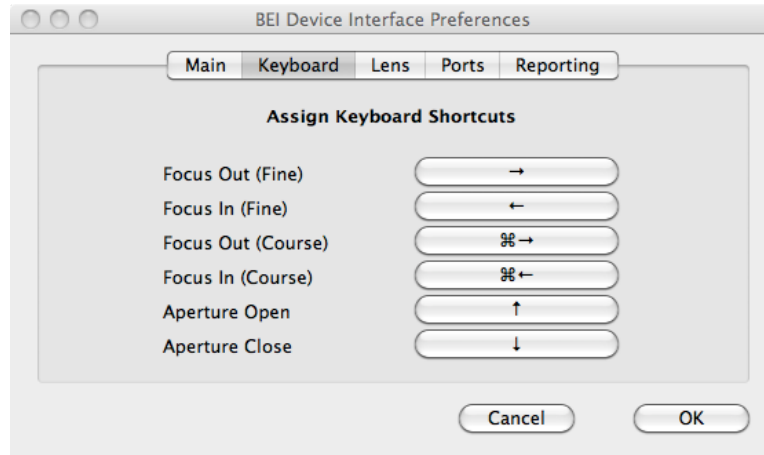
     The keyboard preferences tab is used to set the keyboard shortcuts for focus and aperture control. To assign a key, press the button corresponding to the function to which you wish to assign the key, and then press the desired key combination. The course focus movement moves ten times the increment as the fine focus step, which is set on the main window.
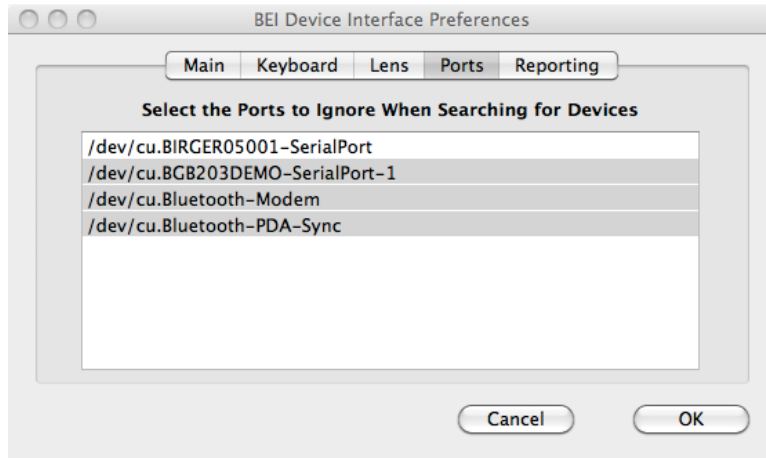
3.6.3 Mac Preferences – Lens
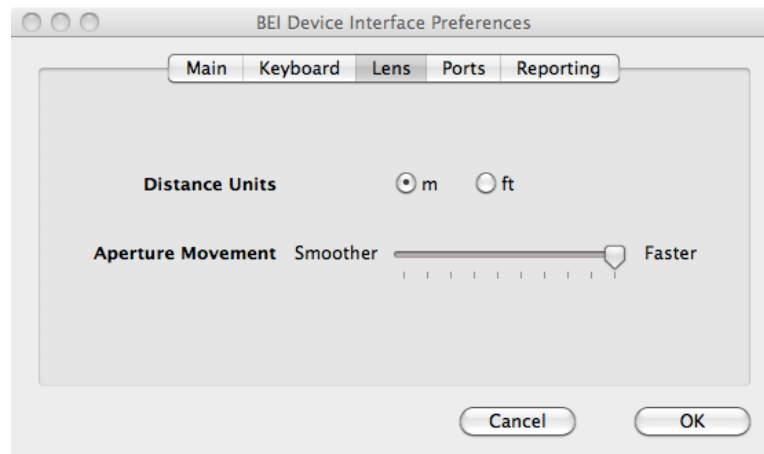
Distance Units – Select feet or meters for the readout of the focus scale and distance.

Aperture Movement – Select the aperture increment that is used when changing between aperture settings. The smoother end of the scale results in the smallest possible movement that the aperture mechanism is capable of making; the faster end results in the aperture change occurring in a single move.

3.6.4 Mac Preferences – Ports

This box will list all of the serial ports currently found in the host computer. Highlight the ports that should be ignored when searching for a connected lens controller.

3.6.5 Mac Preferences – Reporting
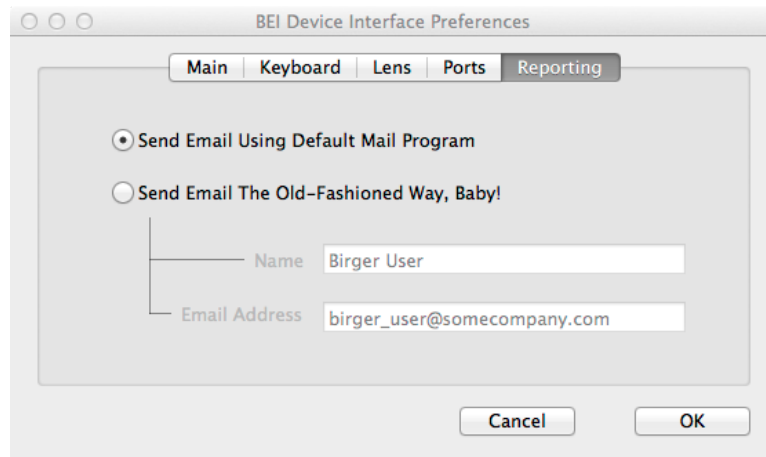
The reporting window is used to select the method for sending reports to Birger Engineering. If you would like to send email using your default account and default email program, which should have been configured prior to using this feature, then select the radio button "Send Email Using Default Mail Program".

If you do not have an email program or account set up on the host computer, then select the second radio button to transmit email from the program (bug reports, lens reports, etc.) using brute-force SMTP protocols. You must supply a name and return email address.

3.7   Status Window

Select "Large Status Window" from the main menu (see Section 3.4.1) to bring up the Large Status Window. The status window displays the current lens focal distance, the current lens focal length, and the current lens aperture. This information is the same as that found on the main window but it is shown in a much larger type so that you may view it at a distance from the computer screen.

Focal Distance

Focal Length

Aperture

Status

0.707m

23mm

f/11.3
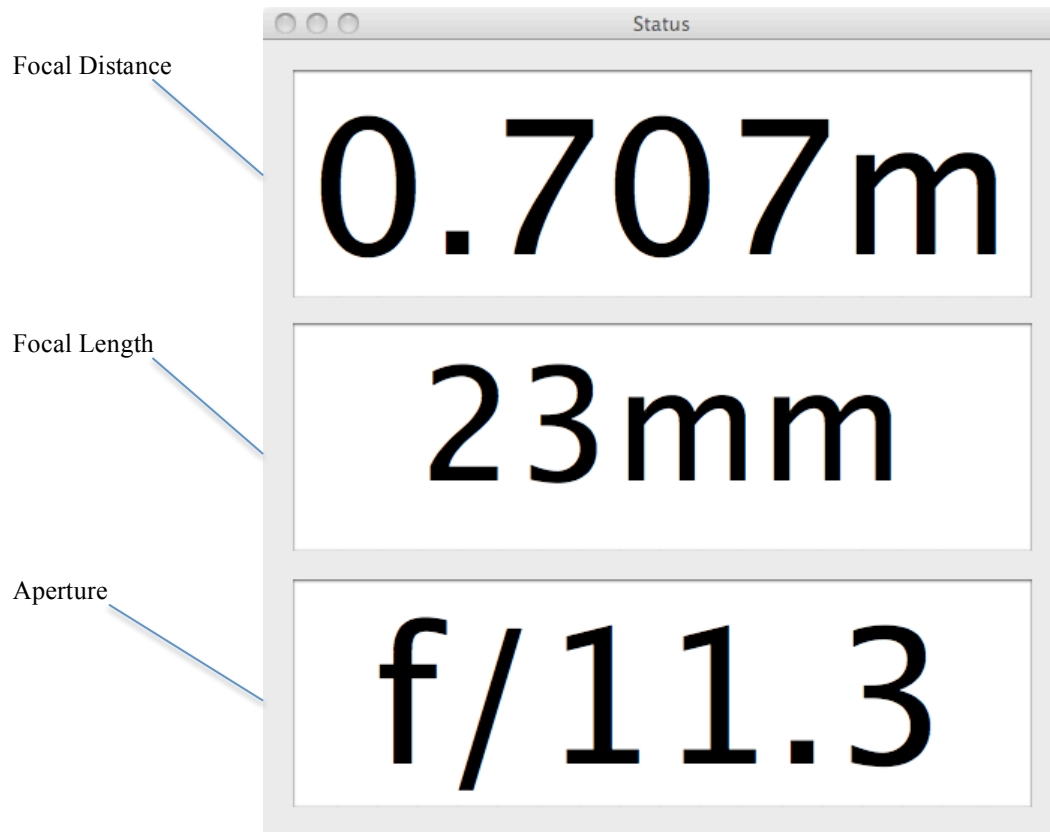
3.8   Reports

There are various reports that can be sent to Birger Engineering. The report window can be accessed by selecting any of the reports under the "Help" menu.

A. Report Type

B. Lens Info

C. Lens Name

D. Summary

E. Comments

Email A Report To Birger Engineering	
Report Type	Feature Request
☐ Submit Lens Info	
	Please Type or Select the Lens Name
Lens Name	
	Please Type or Select a Brief Summary
Summary	
Additional Comments	Type your comments here...
Cancel	Send

A. Report Type   : Select the report type in this drop-down box.

B. Lens Info   : Check this box to submit lens information along with the report. This box is automatically checked if you are sending a lens report. Lens information is gathered from the connected lens.

C. Lens Name   : Select the type of the lens that is connected from this drop-down box. The lens name will automatically be selected if it is known.

D. Summary   : Select a brief summary from the drop-down box or type your own summary for the report.

E. Comments   : Type any additional comments to Birger Engineering here. If you are reporting a bug, please report any steps that can be taken to reproduce the problem.

Click "Cancel" to dismiss the window without sending any information. Click "Send" to send the report to Birger Engineering. If you are using your default email program then you will be able to see all of the information that will be sent to Birger Engineering. If you are using the brute-force SMTP method then you will be shown a summary of all of the information that will be sent to Birger Engineering and you can then confirm or cancel whether or not you want to send the information.

4   Theory of Operation

The application communicates with the lens controller using the ASCII protocol outlined in the document *Canon EF-232 Library User Manual*, available from Birger Engineering.

4.1   Lens Controller Detection

The application looks for possible lens controllers by polling the available serial ports in the host computer. It does this by opening a serial port and configuring it for communications, and then issuing a few basic commands to see if a lens controller responds. The baud rate of a lens controller can be programmed but is 115200 by default. The lens controller requires 8 data bits, 1 stop bit, and no parity.

The application first attempts to put the lens controller in its normal state by issuing two commands:

```
routeesc,0
rm0,1
```

The first command cancels any port routing that may have been set up on the lens controller, so that the application is talking directly to the connected controller. The second command configures the communications mode to be terse and to use the new protocol method.

The application then issues a version query command:

```
vs
```

If there is a lens controller connected to that serial port and configured for the baud rate, it will respond with a brief string that resembles:

```
s:C2v17
```

The 's:' response appears always, followed by a two-character library identifier. In this case 'C2' indicates it is the Canon EF-232 library. The library version then follows.

4.2   Status Updates

The application stays in sync with the lens controller by requesting status updates. There are two forms of status updates – a regular periodic polling and event-generated updates.

The application first tells the lens controller to stay in sync with the lens by turning on background querying. The application also puts the aperture movement into servo mode. These settings are accomplished by issuing the command:

```
sm12
```

The application is then able to query the library for basic lens information by issuing:

```
lc
```

This command is issued once per second. If there is no response to the command for several seconds then the lens controller is considered to have been disconnected. Otherwise basic lens status is reported from the library.

The application gathers the initial status by issuing:

```
gs
```

The application also configures the library to report status changes spontaneously. This is accomplished by issuing:

```
sr1
```

Once configured this way, the library will emit all status changes, even if they were caused outside of the application. The statuses are decoded as they come in to the application. The status strings are given in Section 3.9 of the *Canon EF-232 Library User Manual.*

4.3   Focus Control

In order for focus control to work properly, the mapping between the control and the lens must be established. This is accomplished inside of the lens controller. The lens controller learns the position of the zero-stop and the mechanical infinity-stop and maps that range to an absolute value of 0 to 16383 (0 to 3FFF hex).

The application will issue the command:

```
la
```

when it needs to instruct the library to re-learn the lens range, or in response to

the user pressing the 'Learn Limits' (Mac) or 'Re-Learn Stops' (PC) button.

The application maps the range 0 to 16383 to the focus bar. Focus is controlled using the servo focus command 'eh', which is constructed using the focus value from the pointer location on the focus bar plus a checksum.

In C-code this would look like:

```
fprintf(ioport, "eh%04x,%x", focus, checksum);
```

The checksum can be calculated as such:

```
unsigned char checksum = 0;
unsigned char i;
unsigned int  mask = 0x1000;

for (i = 0; i < 4; i++)
{
    checksum ^= (focus / mask);
    mask >>= 4;
}

checksum &= 0x0F;
```

4.4 Aperture Control

Aperture control relies on specifying an aperture opening value which is indexed from the fully open (minimum f-number) position. Aperture control will not work unless the library learns the position of the fully-open aperture. This is accomplished by issuing the initialization command:

```
in
```

The application will issue the initialization command if it is needed, or in response to the user pressing the 'Initialize' button. The aperture range is mapped to the aperture control bar using the fully-open position as one end, and the fully-closed position at the other end. The fully closed position is learned from the response to the 'lc' command that is periodically sent.

The application sends aperture control commands using the move absolute command 'ma' in response to moving the pointer along the aperture control bar. The argument to the 'ma' command is in ¼ stop increments starting with 0 as the fully-open position.