

# Motorized Zoom Beam Expander (56B-30-1X-4X) Users' Manual

Special Optics' Motorized Zoom Beam Expanders are designed to receive a collimated laser beam and to increase the beam diameter while maintaining a collimated output beam. Model 56B-30-1X-4X- $\lambda$  is a beam expander that offers 13 different expansion ratios: 1.00X, 1.25X, 1.50X, ...4.00X. The user specifies a wavelength when ordering the beam expander. This assures that the antireflection coatings on the lenses will be optimized for the user's primary wavelength. Model 56B-30-1X-4X is designed to operate at 13 standard wavelengths: 256 nm, 355 nm, 458 nm, 488 nm, 514.5 nm, 532 nm, 632.8 nm, 780 nm, 800 nm, 1064 nm, and 1550 nm. Custom versions for other wavelengths are available. Since the fused-silica optics are identical for all wavelengths, only the wavelength settings in software need to be changed. Special Optics has developed a Dynamic Link Library (dll) to operate our Motorized Zoom Beam Expander. This dll can be called from any program, but we provide an executable file (exe), which operates in a Windows environment, to drive the dll.

## 1. Optical Layout

The Motorized Zoom Beam Expander comprises three lens groups, two of which move during operation. Figure 1 shows the three lens groups and indicates that Lens Group 1 and Lens Group 2 move when the expansion ratio is changed. There are two motors in the system. Motor 1 moves Lens Group 1, thereby controlling the air space ( $t_1$ ) between Lens Group 1 and the Motor Mounting Plate. Motor 2 moves Lens Group 2 and controls the air space ( $t_8$ ) between Lens Group 2 and Lens Group 3, which is fixed. The unit is supplied with a text files that contain nominal values of  $t_1$  and  $t_8$  for eleven wavelengths and thirteen expansion ratios. These values were established at Special Optics using a shear-plate interferometer to optimize collimation settings at all of the expansion ratios for several wavelengths. Values for these two air spaces will vary from laboratory to laboratory since they are a function of the collimation properties of the testing beam. Users should verify that the settings are optimized for their particular set of beam parameters.

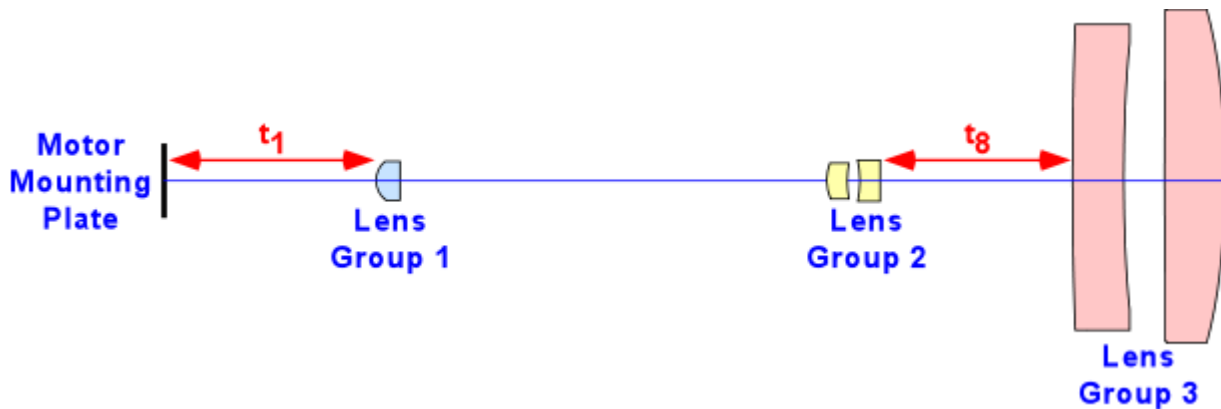


Figure 1. Optical components in zoom beam expander.

## 2. Files

The system is supplied with an installation disk for a Windows operating system. The user should double click on the **setup** icon to start the installation. This will install all necessary files in their proper locations on the user's computer. Included in this installation is National Instrument's Runtime Engine 8.0, which is required to operate the dll file since it includes calls to functions in National Instruments' LabVIEW 8.0 software. The default location for the all of the files is C:\Program Files\Special Optics BE.

Key files that are installed include:

- Beam Expander Controller.exe - This is the executable that will operate the software for the Zoom Beam Expander.
- BE\_Controller - This is a dll (digital link library) that can be called by any programming language.
- Config.ini - Startup file containing key parameters (see below)
- t1 and t8\_λ - txt files containing air spaces for 13 expansion ratios at 11 wavelengths (λ)
- Factory Def Files - Folder containing a copy of txt files (to allow restoration if needed). The eleven txt files containing the motor positions are stored in the default directory. If the files become damaged, original values can be restored by copying the original files from the 'Factory Def Files' folder into the default directory. **Do not change the default files.**
- BE\_Controller Configuration Settings - parameter definitions needed if programming in C++ or another language.

### Config.ini

This file identifies:

1. COM port (default = 1) over which the RS-232 communications occur. This can be changed to another appropriate port on the user's system.
2. M1 Offset and M2 Offset are offset values for the two motors. These are set during calibration at Special Optics and should not be changed by the user.
3. Default wavelength. When the system is started, it will automatically display the default wavelength on the front panel. You can change the wavelength actively on the front panel, or you can change the default wavelength in the Config.ini file:

0 = 256 nm	1 = 355 nm	2 = 458 nm
3 = 488 nm	4 = 514 nm	5 = 532 nm
6 = 633 nm	7 = 780 nm	8 = 800 nm
9 = 1064 nm	10 = 1550 nm	

4. Tweak step. During adjustment of the calibration, the user activates the Tweak function. Motor steps are 0.2, 0.4, or 1.0 times the tweak step in millimeters. The default value is 0.2 mm. It is unlikely that the user will need to change this, but the option is available.
5. File path. The default location for the files called by the program is C:\Program Files\Special Optics BE. If you move the files to another location, this path will need to be changed.

### 3. Operation

The software for the Motorized Zoom Beam Expander was written in LabVIEW 8.0 by National Instruments. All of the key commands are compiled in a dll file. We have written an executable LabVIEW file that calls the dll to operate the system. It is not necessary to have LabVIEW installed on your computer to operate the system. However, the installer does load National Instruments' Runtime Engine 8.0 on your system in order to permit calls to LabVIEW functions from the dll.

The executable file was written in LabVIEW to provide a user-friendly graphical user interface (GUI) to operate the zoom lens. Figure 2 shows the GUI in its start-up condition. The WAIT button is dark since the unit's two motors begin a homing procedure on start-up. The top two lights on the control box will remain red until the homing procedure is completed. The top light remains red until Motor 1 has homed; the middle light remains red until Motor 2 homes. **If the lower light becomes red and one or both of the Drive Faults on the GUI become red, home the system again using the RE-HOME button on the GUI.** In Figure 2, this is the WAIT button. WAIT will change to RE-HOME after the homing sequence has ended.

### Wavelength

The Motorized Zoom Beam Expander is designed to operate over a wavelength range from 256 nm to 1550 nm. Antireflection coatings on the lenses must be changed for the different wavelengths, but the five internal lenses are identical for all versions of the system. We have pre-programmed the system for eleven common wavelengths (256, 355, 458, 488, 514, 532, 633, 780, 800, 1064, and 1550 nm). The pull-down menu on the GUI allows the user to select any of these eleven wavelengths.

### Expansion Ratio

The Motorized Zoom Beam Expander starts up with both motors in their home positions. Click on the slide labelled Expansion Ratio to move the system into a collimation condition with an expansion ratio given by the slide position and the readout at the bottom of the slide. This version of the Motorized Zoom Beam Expander is set for thirteen expansion ratios (1.00X, 1.25X, 1.50X, ... 4.00X). Each time the user moves the slide or clicks on it, the software determines the calibrated positions for Motor 1 and Motor 2 and moves both lens carriages to the proper locations. The pre-set motor positions for each wavelength and expansion ratio are stored in txt files (e. g., 't1 and t8\_633.txt' lists 13 expansion ratios and air spaces at 633 nm). The air spaces in the txt files are converted to motor positions by the dll.

## Tweak

Because beam divergences of input test beams vary, it is possible that the factory settings of lens positions may not be perfect for the user's system. We have provided a Tweak control to make adjustments to the lens positions. There are three speeds (slow, med, and max) in both the positive and negative directions. Moving the slide to one of these positions will cause both of the lens groups to shift slightly from their original positions. The lens carriages will make a series of movements until the user moves the slide back to the zero position. The software automatically updates the appropriate txt file so that the stored lens positions will be the values determined by the Tweak operation. For the entire file to be adjusted, the user must tweak the positions for all 13 expansion ratios (1.00X, 1.25X, 1.50X, ... 4.00X). When you restart the system, the Motorized Zoom Beam Expander will move to the values determined by the user during calibration (tweaking) the last time the system was operated. Only the txt file for the selected wavelength will be updated. All other txt files will retain their factory values.

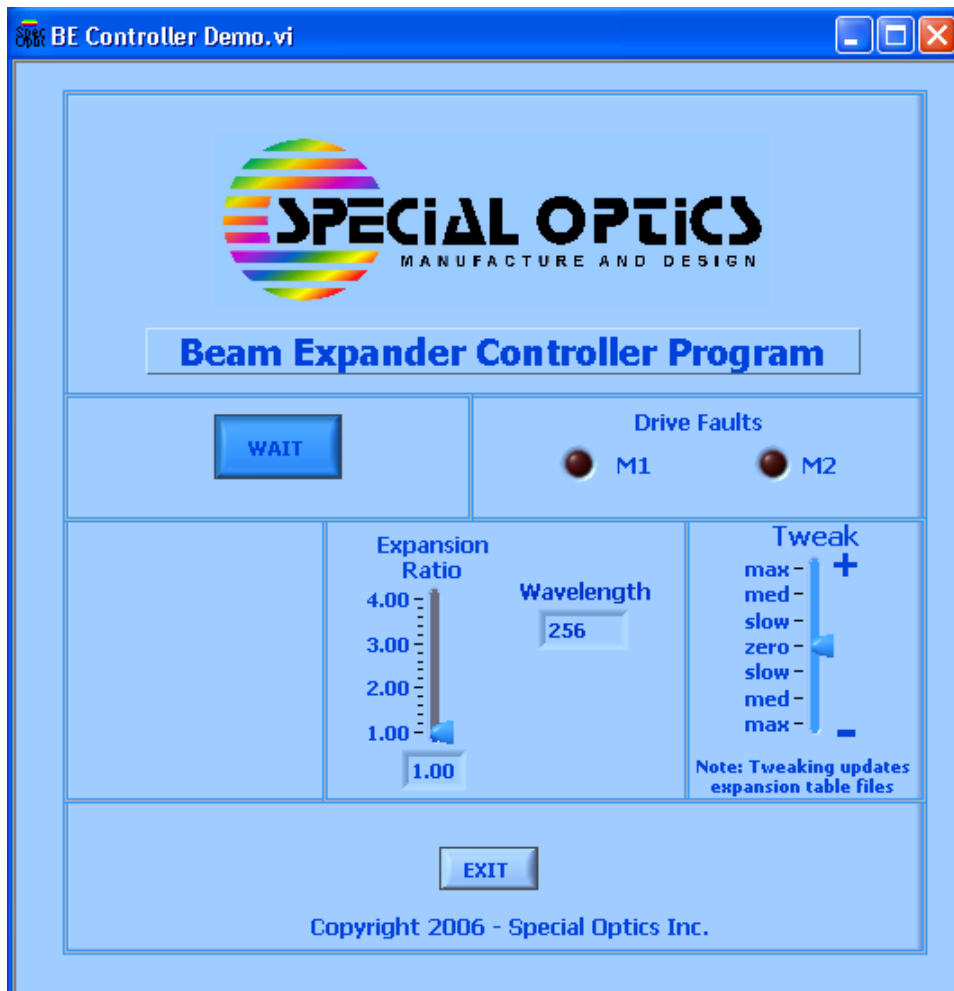


Figure 2. GUI for Special Optics' Motorized Zoom Beam Expander (56C-30-1X-4X-λ).