

Stereo Microscope Tutorial

By

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A stereo microscope is an incredibly useful tool for electronics engineers. The word stereo comes from the Greek word for solid. A stereo microscope is called such because there is a perception of depth of field unlike other microscopes. This allows the user to manipulate the viewed object using their hands or tools. For electronics engineers, a stereo microscope makes surface mount soldering and PCB inspection easier.

Fig. 1 shows the front view of a basic stereo microscope. The sample to be viewed is placed on the base. The sample can be held in place by the clips if desired. This is useful when soldering circuit boards. The light can be used to illuminate the sample for better viewing. The light is turned on using the “on” switch and the slider can control the intensity. The user views the sample through the eyepieces. The distance between the eyepieces can be adjusted by moving the swinging eyepiece tubes. The objective lens is the lens closest to the sample. The camera port at the top is used to mount a camera to take pictures of the sample.

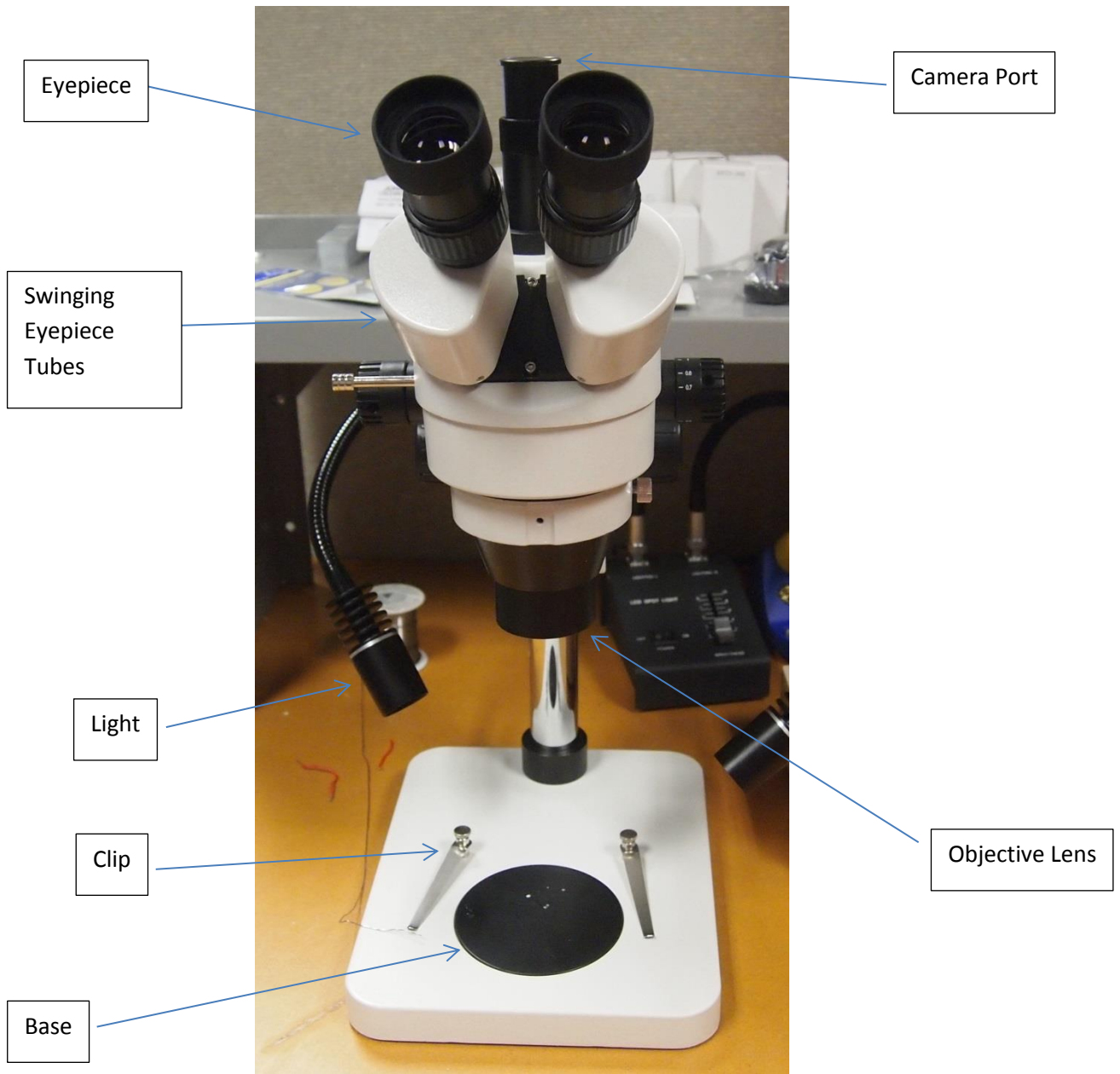


Figure 1 Front View of Stereo Microscope

The magnification is the product of the objective lens magnification and the eyepiece magnification. For example if the objective lens has 2x magnification and the eyepiece has 10x magnification then the combined magnification will be 20x. Fig. 2 shows an example of an eyepiece and an objective lens. The magnifications are 10X and 0.5X respectively. With this combination the magnification is 5X. The “20” on the eyepiece after the magnification means that this is a 20mm lens. The zoom knob on the microscope also has a multiplying effect. This knob is shown in fig. 3. The text on the knob indicates the multiplier. The range of this multiplier is 0.7 to 4.5. Let’s say the multiplier was set to 2. The total magnification would then be $10X * 0.5X * 2$ which is 10.

$$TotalX = ObjectiveX * EyepieceX * Zoom$$



Figure 2 Eyepiece with 10X Magnification (top) and Objective Lens with 0.5X Magnification (bottom)



Figure 3 Zoom Knob with Multiplier

The microscope needs to be focused in order to provide a clear image. The focusing knob can be clearly seen in fig. 4 which is a side view of the microscope. Turning this knob changes the distance of the objective lens to the sample. Adjust this knob until the sample is clearly visible and sharply focused. If the sample is still blurry throughout the entire focusing range then two things need to be checked. The first is diopter. The diopter adjustment is used to compensate for differences between one's eyes. Close one eye and adjust the diopter until the image is clear. Then repeat for the other eye. If the sample is still blurry after this then the height needs to be adjusted. Hold the body of the microscope firmly and then turn the height adjust knob counterclockwise as shown in fig. 5. If the microscope body is not held then the body will drop and could hit the base causing damage or injury to the user. Lock the body at the desired height and readjust focusing until the sample is clear. This may take a few iterations.

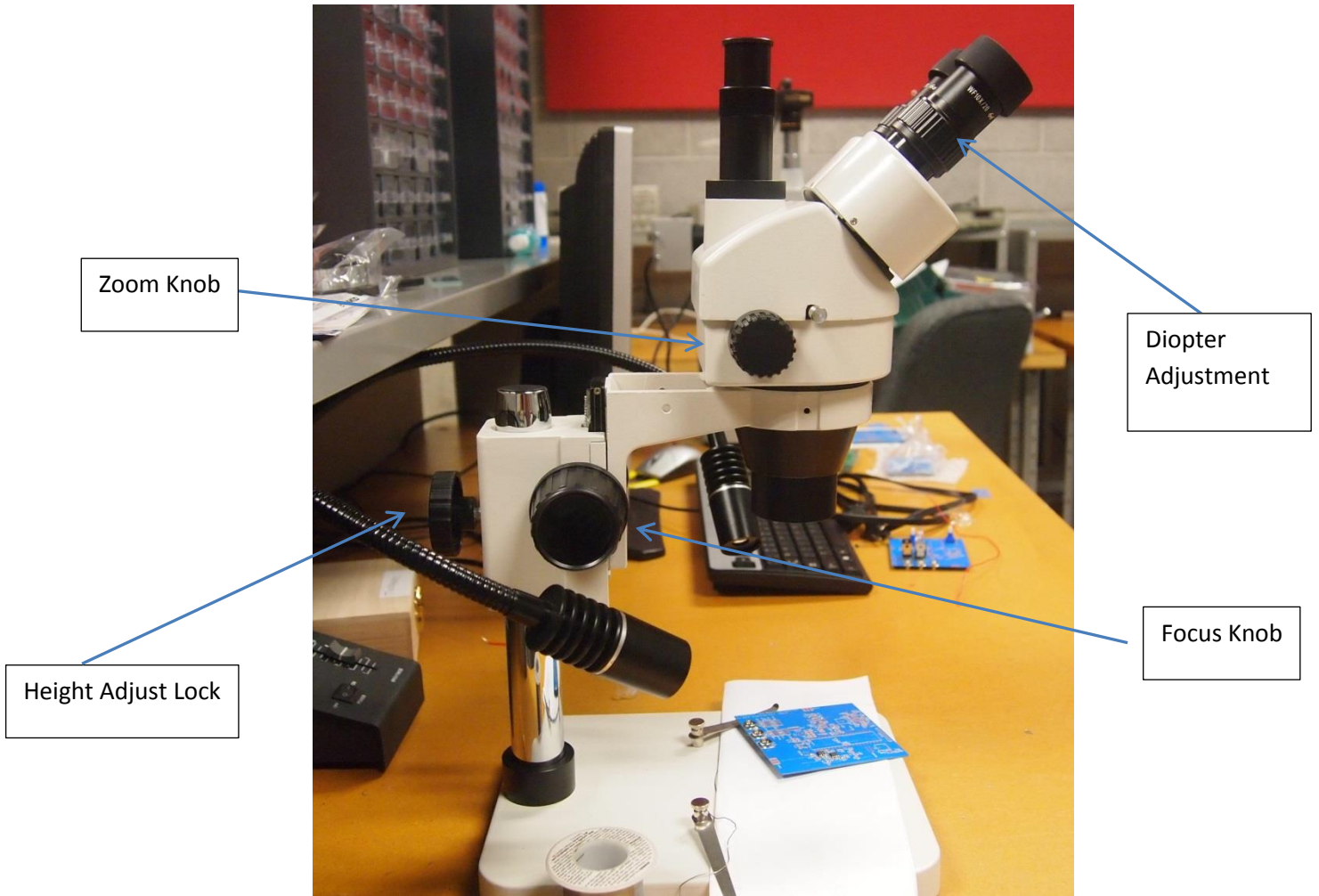


Figure 4 Side View of Stereo Microscope

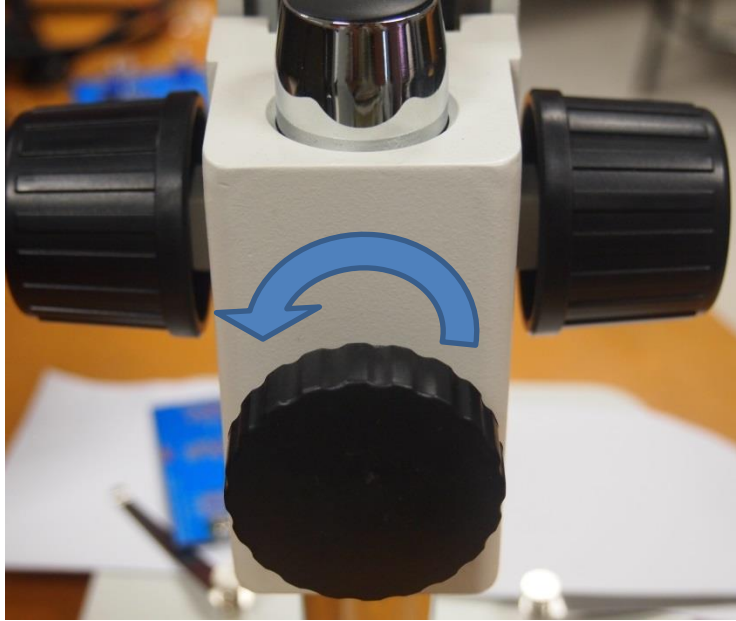


Figure 5 Height Adjust Knob

The stereo microscope can be used to take pictures of a sample. A special camera is used that can fit onto the camera port on the microscope. A picture of this camera is shown in fig. 6. As is this camera is not useable, it is simply a bare 10 MPx CMOS image sensor and associated electronics. It needs the proper lens to work. The lens threads onto the camera as shown in fig. 7. This assembly is then inserted into the camera port as shown in fig. 8. Next connect a USB cable between the top of the camera and a computer. The software used by this particular camera is AmScope 3.1, a free and easy to use program available from AmScope. Refer to manuals on their site for assistance with the software. Finally one of the lens paths needs to be diverted to the camera instead of the eyepiece. This is done by pulling the beam-splitter knob as shown in fig. 9 out which diverts the light going into the left eyepiece to the camera port. When this knob is pulled out nothing will be visible in the left eyepiece. If the camera output is dark, then check that the beam-splitter knob is pulled out.



Figure 6 10 MPx Camera



Figure 7 Camera with Lens



Figure 8 Camera Inserted into Camera Port



Figure 9 Beam-splitter Knob

Calculating the effective magnification with a camera is more complicated and has a degree of imprecision. While magnification through direct viewing is simply the product of objective and eyepiece magnifications, the camera adds its own magnification. The eyepiece is replaced by a camera adapter, camera sensor and monitor combination. The camera adapter used is usually a reduction adapter with a magnification of 0.5X. This is used so that the entire image from the objective can fit onto the image sensor. The ratio of the camera sensor size to monitor size determines another magnification term. For example a 2/3in image sensor and a 20 in monitor result in magnification of 30X. One may think that using a very large monitor would result in a very large magnification. While this is true, it may not be useable due to the resolution of the camera. This is why a high resolution camera is important to get quality images from a microscope.

$$TotalX = ObjectiveX * \frac{Monitor\ Size}{Image\ Sensor\ Size} * AdapterX * Zoom$$

Example calculation:

$$TotalX = 0.5X * \frac{20"}{2/3"} * 0.5X * 4 = 30X$$

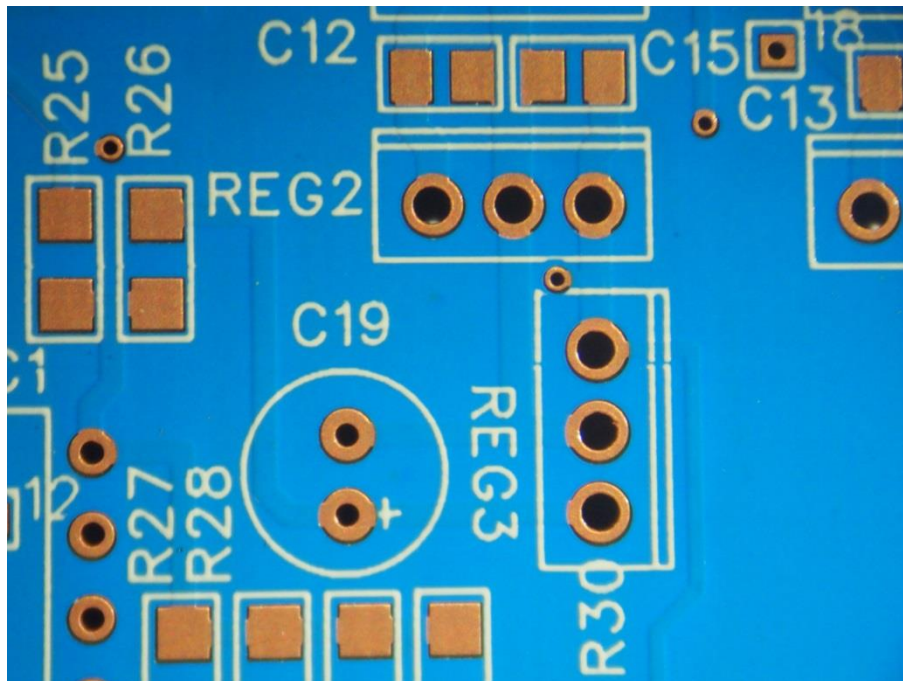


Figure 10 Image Taken With Microscope Camera