StackRail Control Software User Manual

StackRail Control Software for PC is a Windows based motor control for focus stacking application. It can support different hardware platforms by defining a custom hardware profile such as pitch, motor power requirements, etc.

StackRail software supports multiple languages and can be configured by user.

Installation

After downloading StackRail application, just run the setup MSI file, it will install automatically.

Features

- **COM Port** -- StackRail software communicates with hardware via built-in USB-to-Serial converter. When StackRail hardware is plugged into PC running on Windows system, a virtual serial port will appear.
- **Rail Profile** -- User can select a rail profile by selecting from a list of predefined profiles. This list of profiles can be defined by user via XML configuration file.
- **Number of Steps** -- User can specify number of steps by clicking on either up or down arrow. **Important note: it is much more accurate to set step size than setting number of steps. Please see FAQ for explanation.**
- **Settle Time** -- This is the time to wait for sliding block to settle. This parameter is important because after rail has moved, it takes some time for the rail and the whole setup to settle before taking a picture.
- **Hold Time** -- this is the time the system should wait for before moving the rail and the whole setup. For example, if camera exposure time is 1 second, then the hold time should be at LEAST 1 second before moving anything, otherwise blurry image will result. A good practice is to set Hold Time 1 second more than exposure time. In case Nikon camera, when EXPOSURE DELAY is ON, the camera will lift up mirror first and approximately one seconds later it will take a picture. So use Hold Time to compensate this by setting HOLD time to 1 second more, ie, HOLD time is 2 seconds in this case.
- **Shutter** -- this is the minimum time to trigger a camera. Most cameras needs certain amount of time for the taking picture signal to last before actually taking a picture. Usually, camera will act if that signal lasts at least as much as shutter lag. Another scenario for this parameter is when camera is set to BULB mode and aperture needs to be held for certain amount of time.

- **Start Position** -- This is where focus stacking will start, it is the actual number of micro-steps from the beginning position (please see operation on how to set this position). It can be set by pressing "SET" button next it when rail moves to a position. *When either start or end position is chanaged, number of snaps will be recalculated based on step size.*
- **End Position** -- This is the end of position of focus stacking operation and it can be set by pressing "SET" button when rail moves to a position for end of stack. *When either start or end position is chanaged, number of snaps will be recalculated based on step size.*
- **Step Size** -- This is the size of each step when performing focus stacking. **Important note: it is much more accurate to set step size than setting number of steps. Please see FAQ for explanation.**
- **Total Distance** -- this is a calculated parameter based on rail profile and start and end position. It is in micro meters
- **Motor Micro Step** -- user can set micro stepping mode of motor. There are three choices -- 1/4 micro step, 1/8, and 1/32 micro step. 1/4 Micro Step means each step of motor is divided into 4 micro steps, thus increase resolution of motor.
- **Motor Speed** -- user can also control motor speed and there are three options: Fast, Medium, and Slow. This controls how fast the rail moves for a given micro step configuration.
- **Motor Running Power** -- Most step motors are rated by current (vs by voltage). StackRail hardware can be configured to control a motor with 1.5A rating at maximum. Running Power parameter sets how much current will be delivered to motor phases when running -- moving rails back and forth and during focus stacking. This ensures step motor is performing at it optimal performance.
- **Motor Idle Power** -- this is the parameter that controls how much current is delivered to each phase of motor. By selecting a lower current at idle, it can save power consumption. It is also important for some motor that can heat up significantly when driven at higher current (even if it is according to its specification).
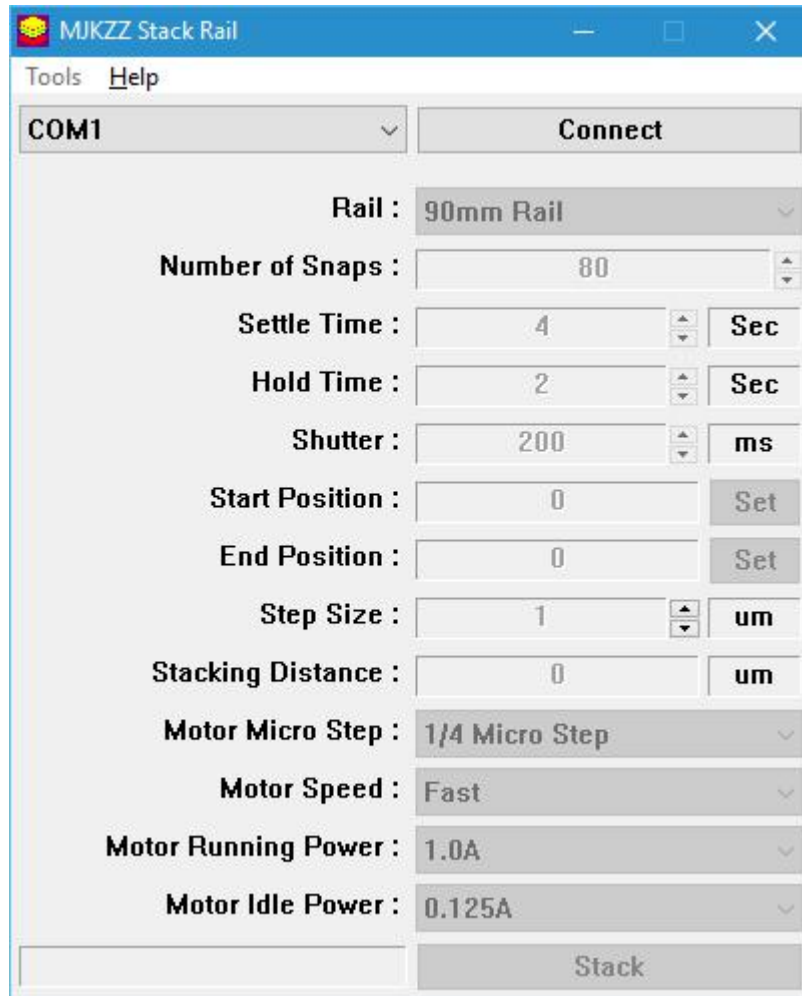
Rail Operation

Setting Range -- When controller is first powered up, the rail is locked at its current position and it can NOT be moved normally unless a range is established. Here are the steps to set this range.

- Hold the SHIFT key on your keyboard.
- Press **UP** or **DOWN** key while **SHIFT** key is held down to move the rail.
- Stop by releasing the **UP** or **DOWN** key held to stop movement of rail.
- Do the above steps for either extreme end of the rail and the **Range** is established at both extreme ends
- It does not have to be extreme end, just a range on any segment of the rail. To extend current range, move to that position and do the above.

Caution here, when you have the StackRail application connected to the controller and the controller power is recycled, do a DISCONNECT and reconnect again. Otherwise, information contained in StackRail PC application will be inconsistent with what is in the controller.

Navigating Rail -- The moving block of any rail can be controlled by keyboard of computer connected to the controller. Here is summary:

- To move motor, thus the rail, use the **UP** or **DOWN** keys on your keyboard for the direction desired.
- If starting and ending position for stacking are set, use the **LEFT** key to move the rail to **Start Position** and the **RIGHT** key to move it to the **End Position.** This is very convenient when checking stacking range.
- To move the rail to the extreme end of the range, hold down **SHIFT** key and use **LEFT** key to move it to the 0 position and the **RIGHT** key to move to the end of range.
- Press **PageUp** or **PageDown** will move slider towards end or start points by **step size.** This allows user to preview at each step before stacking

Taking a test image without touching camera -- press F12 (or fn+F12 on MacBook running windows)

Control focus without touching camera -- press **F6** to activate focus searching, it is just a half-press on shutter button. Press **F5** to deactivate it. For focus stacking, this might not be any use because most of the time focus is not needed. But this is useful for time lapse, etc, when camera is out of reach, and particularly so when using Bluetooth with mobile phone. *Note this function exists for controller with firmware v1.0 or above.*

Stacking -- after the start and end positions have been set, simply click on Stack button. **The controller will move the rail to its starting position automatically.**

Calculator

There are five different calculators that essentially calculates step size based on different lens system. Step size calculation is based on circle of confusion and there is 20% safety margin applied.. Here are list of values for each sensor type:
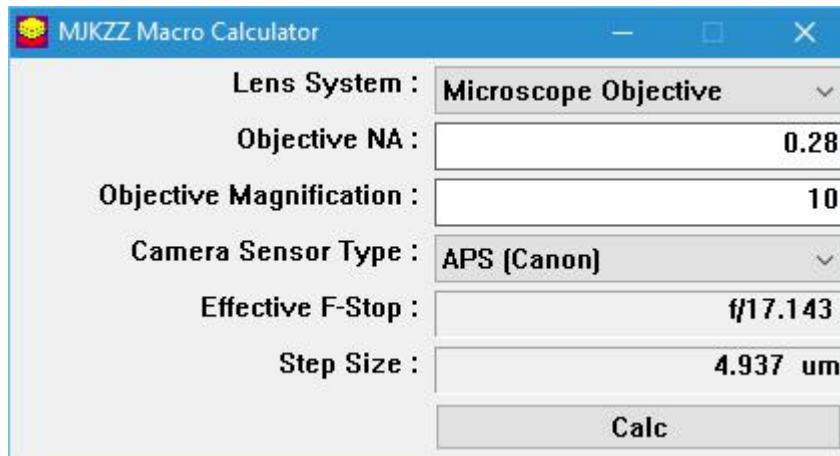
- APS (Canon), this is for most of Canon crop frame cameras, like 550D (T2i), 60D, etc. Circle of confusion value is 0.018
- APS (Nikon/Pentax/Sony), this is for most of other type of APS sensors, mostly used by Nikon, Pentax, or Sony, CoC value chosen in calculation is 0.019
- Full Frame, this is for all full frame cameras. Chosen CoC value is 0.029
- Micro 4/3, this is mostly for Olympus cameras where Micro Four Third sensor is used.

All calculators will calculate magnification (in case it is provide, as in objective, it is

simple take from there), effective aperture, and step size.

Microscope Objective Calculator

This is to calculate step size when an objective is used.

- Objective NA -- this is the Numeric Aperture value, usually marked on the body of objective.
- Objective Magnification -- this is the magnification the objective is designed for when used according to its specification. If the objective is not used according to its specification, this should be the ACTUAL magnification in use. For example, a Mitutoyo 10X 0.28 and 200mm objective can be used with 180mm tube lens, in this case, the actual magnification is 180/200 * 10 = 9x

CloseUp Filter Lens System

This calculator is used for a lens system when a close up filter is used on front of a primary lens -- it could be a normal lens, a zoom lens, or a macro lens (where Primary Lens Magnification can be very high, such a 1x). The calculation also take extension into consideration.

- Dioptor Value -- this is the dioptor value of the closeup filter. Normally this is specified by closeup manufacture, usually in form of +1, +2, +3, +4, +8, +10, etc.
- When using multiple closeup filters, simply use the sum of all dioptor value for this entry. In case this value is NOT specified, here is a list of commonly used closeup filter and their dioptor values.
- Primary Lens Focal Length -- this is the actual focal length used with the closeup filter. In case of zoom lens, enter the actually zoom value.
- Primary Lens Magnification -- this is the actual magnification value for the primary lens. In case of the primary lens is a macro lens, be careful to use ACTUAL magnification -- most macro lens provides maximum magnification, for example 1x, when focused to closest point.
- Extension Tube Length (mm) -- this when an extension tube is used in addition to closeup filter.. If no extension tube is used, simply enter zero
- F-Stop -- this is the aperture used on the primary lens. This will affect the effective aperture.

Lens With Extension

This calculator calculates a single lens on an optional extension tube. If a lens already has enough magnification power, such as Canon MP-E 65, and does not have extension tube added, simple enter zero for Extension Tube Length.

- Primary Lens Focal Length -- the actual focal length for the lens, in case of a zoom lens, read it from the lens barrel.
- Primary Lens Magnification -- this is the actual magnification used on the lens. In case of some macro lens, such as Canon MP-E 65, there are magnification marking on them.
- Extension Tube Length (mm) -- this is the length of extension tube measured in millimeters. Important note, if you do not have an extension, set this value to zero. For example with Canon MP-E lens, very often you do not need extension tube and still have a magnification of 1 to 5X.
- F-Stop -- this is the actual aperture used on the primary lens.

Stacked Lenses

This calculator is for the lens system where two lenses are stacked together with one is reversed on another. Most often, the front lens (ie reversed lens) has shorter focal length and the primary lens has longer focal length.

- Primary Lens Focal Length -- this is the actual focal length set on the primary lens, in case of zoom lens, it can be read from lens barrel
- Reversed Lens Focal Length -- this is the focal length of reversed lens.
- Optional Extension Tube Length -- this is option and if no extension tube is used, simply enter zero
- F-Stop -- this is the aperture set on the reversed lens. In a stacked lenses system, it is better to set the primary lens to wide open and use the reversed lens to control aperture.

Reversed Lens

This calculator is for a system when a lens is reverse mounted on a bellow or extension tube.

- Reversed Lens Focal Length -- this is the focal length of reversed lens
- Reversed Lens Magnification -- this is the magnification of reversed lens, for a normal lens, it is usually very small.
- Extension Tube Length -- this is the length of extension, can be extension tube or bellow. Note, this includes flange distance -- for Canon EOS camera, flange distance is 44mm and for Nikon AI mount, it is 39mm. So, if the actual extension tube length is 150mm, for Canon, the extension is 150+44 = 194mm.
- F-Stop -- this is the aperture set on the reversed lens.

FAQ

Q: After connection all components together and powering up, the rail is not moving, why?

A: Please press and hold LEFT SHIFT key and UP or DOWN key to set moving range whenever you power up the units.

Q: When I set number of steps and without changing the default step size afterwards, the result is a little weird, why?

A: This is caused by integer division. Here is an example, assume the rail has 2mm pitch and motor micro step is 1/8, this result in 1.25um resolution for step size. Now say after setting start and end position for stacking, the total stacking distance is 442um and then set number of steps to 80, this will result step size as 5um because the actual step size is 5.525um, but the next integer step size is 6.25um. However this 5um step size is not enough for the rail to reach the final 442um. The solution is to change the step size manual to 5um (click up and then down on the arrow next to Step Size), this will make the number of steps to be 89, 88 steps of size 5 and one step of size 2um to make a total of 442um

Q: When I set rail for stacking, I have reach the range limit of zero (0), so I extended this range by press and hold SHIFT key and DOWN arrow key, but then my start and end position changed, what happened?

A: When you extend the zero limit side of range, your stacking position becomes invalid. It is highly recommended to set range limit whenever you power up the motor and its driver unit to their max extend. Or whenever you change the range, re-position the rail for stacking.

Q: F6 and F5 to focus and stop focus is not working?

A: Only firmware with version 1.0 or above have this function