

# STACKRAIL IR USER MANUAL

StackRail IR is an infrared remote control based motion control unit, perfect for focus stacking and time-lapse photography, as well as other applications that require motorized rails. It is designed not only for MJKZZ rail products, but also for other DIY motion control projects.

## FEATURES

- IR remote controlled, so it can be operated without touching it.
- 8 levels of micro-stepping modes, from full step to 1/128th micro-stepping. For focus stacking, this allows finer step size and vibration reduction. For time-lapse or videography, this allows flexible speed control.
- 16 levels of power control, from 0.125A to 1.875A current for each phase of bi-polar step motor. This allows flexible motor selection for variety projects.
- 2 limit switch inputs. This is necessary for a lot of application where hardware limit switches can be installed on the rail to prevent accidental ramping into end of rail.
- Lighting control output, this is particularly useful for focus stacking. This feature allows user to trigger a flash or a continuous light in the middle of exposure to avoid vibrations caused by shutter movement. It also allow specification of duration of on time, thus controlling exposure for continuous light.

## PORTS

**Power Port** – this is where power supply is plugged in. The power supply must be between 10V to 24V, typically 12V for best result. The plug should be 2.1mm center positive type.



**Motor Port** – this is where a bi-polar step motor is connected to. It has four pins with 2.54mm (0.1 inch) apart. The pin arrangement is A+, A-, B+, and B-.



**Camera Port** – this is where a camera shutter cable is plugged in. It is a 2.5mm stereo socket. The tip of 2.5mm plug is the camera trigger and the middle ring of the 2.5mm plug is the camera focus.



**Limit Switch Port** – this is where limit switches can be plugged in. It is a 3.5mm stereo socket and supports two limit switch inputs. The two limit switches can be installed at each end of the rail. The base ring of 3.5mm plug is the common ground shared by the two limit switches. The middle ring and the tip are the two limit switches.



**Flash Port** – this is where a flash or continuous light can be plugged in. Parameters for this port can be set in Time menu by pressing **TK**



## REMOTE CONTROL

The IR remote control is used to operate connected rail and modify parameters. Here are explanations of each button on the remote control. Some of these buttons has different functions depending on which parameter is being modified.

**-100** This button has two functions. The first one is to decrease a parameter value being modified by 100 or for some parameters, decrement by one notch. When current position is being modified, it is used to move the rail 100,000 steps backwards or until STOP button is pressed.

**+100** This button has two functions. The first function is to increase a parameter value being modified by 100 or for some parameters, increment by one notch. When current position is being modified, it is used to move the rail 100,000 steps forwards or until STOP button is pressed.

**-10** This button has two functions. The first function is to decrease a parameter value being modified by 10 or for some parameters, decremetn by one notch. When modifying the current position, it moves the rail by 10 times step size backwards unless STOP is pressed while moving. For example, if step size is 10um (10 microns), it will move the rail  $10 \times 10\text{um} = 100\text{um}$  backwards.

**+10** This button has two functions. The first function is to increase a parameter value being modified by 10 for some parameters, increment by one notch. When current position is being modified, it moves the rail 10 times step size forwards unless STOP is pressed while moving. For example, if step size is 10um (10 microns), it will move the rail  $10 \times 10\text{um} = 100\text{um}$  forwards.

**-1** This button has two functions. The first function is to decrease a parameter value being modified by 1 or for some parameters, decrement by one notch. When current position is being modified, it moves the rail by one step size backwards unless STOP is pressed while moving.

 This button has two functions. The first function is to increase a parameter value being modified by 1 or for some parameters, increment by one notch. When current position is being modified, it moves the rail by one step size forwards unless STOP is pressed while moving.

 This button is used to navigate menu, to move menu item up by one.

 This button is used to navigate menu, to move menu item down by one.

 This button is an important button and it is called STOP button. By pressing this button, all active actions, such as rail motion, stacking, time-lapsing, focusing, etc, all will be stopped.

 This button is used to move the rail to the starting position. This is useful to do a final check before stacking or time-lapsing.

 This button is used to move the rail to the end position. This is useful to do a final check before stacking or time-lapsing.

 This is the button to start focus stacking or time-lapsing. It is only active in the MAIN menu page, in other menu pages, it does not do anything, [so be sure you are in the MAIN page.](#)

 This is the button to move menu page to MAIN menu so that you can access parameters in the MAIN menu.



This is the button to move menu page to PARAM menu so that you can access parameters in the PARAM menu. Most parameters in this menu page are related to motor and rail setup.



This is the button to move menu page to TIME menu so that you can access parameters in the TIME menu. Most parameters in this menu page are related to timing, such as hold time, shutter release time, wait time, etc, etc. All these parameters will be explained in details in another section.



This is the button to take a picture, it is as if the camera shutter button is fully pressed, very useful to take a test shot.



This is the button to make camera to focus, it is same as if pressing camera shutter button half way to focus. This is useful when doing time-lapse, to set focus and lock the focus in.



This button is used to copy current position into either start position or end position depending on which one is current menu item being modified. This button does nothing if current menu item is NOT either start position or end position.



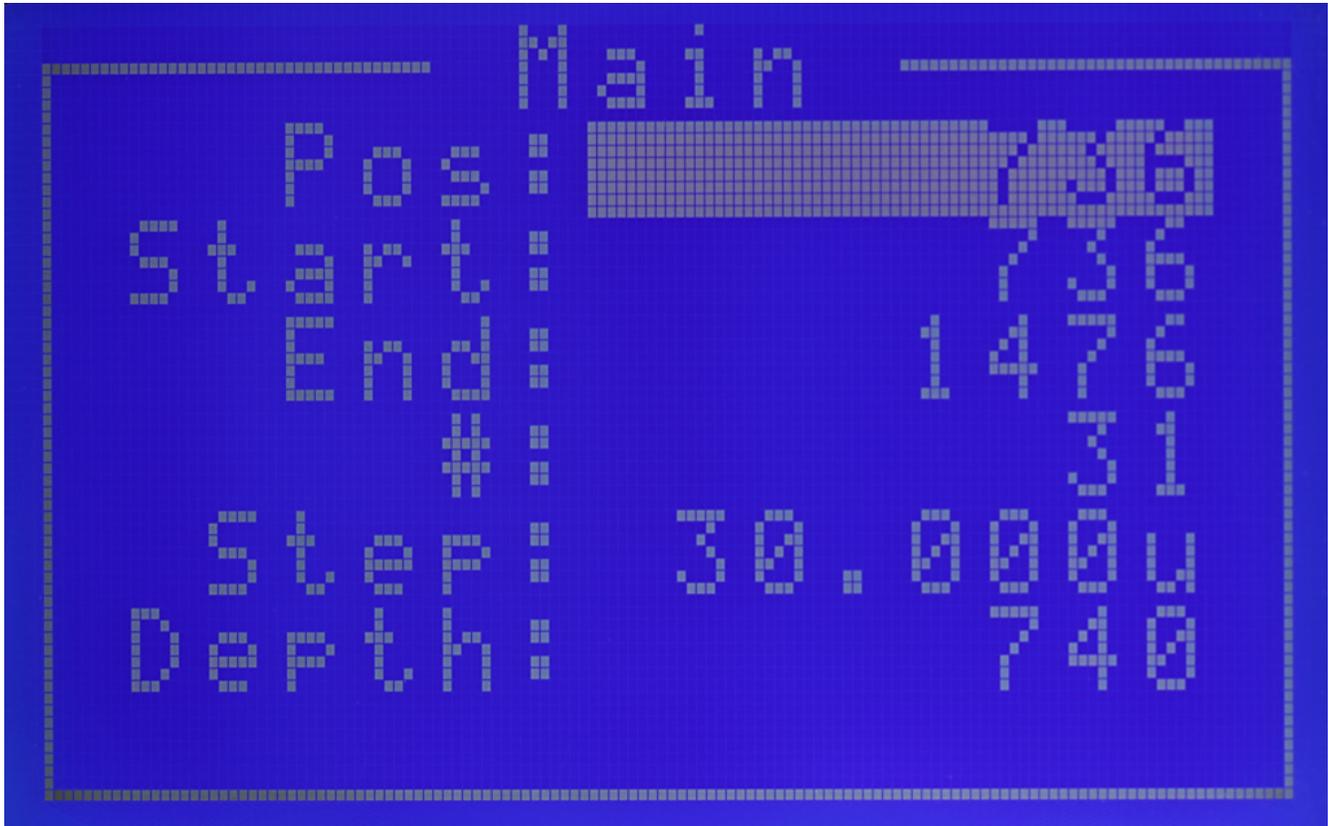
This is the button to recall saved settings from controller' s non-volatile memory.



This is the button to save current settings to controller' s non-volatile memory, meaning, once saved, data will NOT be lost even when power is turned off. This is useful, for example, once rail pitch is set up, it can be saved and recalled upon next power up.

# PARAMETERS

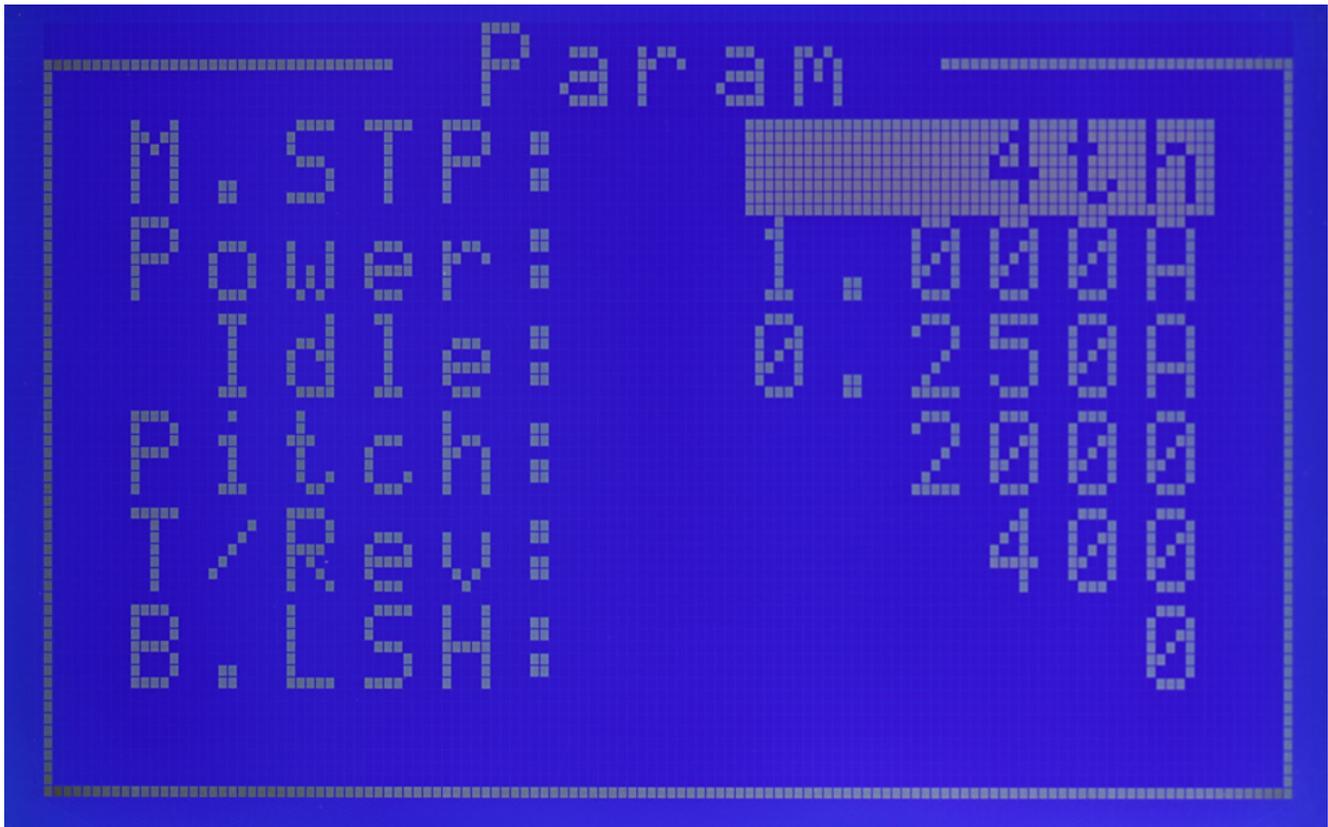
## Main Menu



- Pos – this is the current position of the rail. When it is high lighted, pressing **-100** or **+100** button will move the rail by 100,000 steps backwards or forwards respectively, essentially moving the rail until **STOP** button is pressed. Pressing **-1** or **+1** button will move the rail by one step size backwards or forwards. Pressing **-10** or **+10** button will move the rail by 10 step sizes either backwards or forwards.
- Start – this is the start position for the rail to move from. It can be set using **-1**, **+1**, **-10**, **+10**, **-100**, and **+100** buttons, but it can also be set using the **=** button to copy current position value into Start position.

- End – this is the end position for the rail to move to. It can be set using -1, +1, -10, +10, -100, and +100 buttons, but it can also be set using the = button to copy current position value into End position.
- # – this parameter is total number of shots to be taken during focus stacking or time-lapse. There are some limits on this parameter. If step size is set to one micro step (note, not one micron, it is the smallest step size you can set under micro step settings), this value can not exceed total number of micro steps as it is not possible to further divide one micro step. It also can not be zero because it would be meaningless. If start and end position are the same, this value is set to one. If start and end position is not the same, the minimum value for this is TWO, one shot at start position and one shot at the end position. It can be set using -1, +1, -10, +10, -100, and +100 buttons.
- Step – this is the parameter to specify step size, minimum step size is one micro step (depending on micro step setting, actual physical step size in microns is different). When step size is less than 100um, the ending unit will be display as “u” ; when step size exceeds 100um, the ending unit will be display as “m” for millimeters; when step size exceeds 100mm, the ending unit will be displayed as “M” for meters. It can be set using -1, +1, -10, +10, -100, and +100 buttons.
- Depth – this is the total distance between start and end position. It is read only display.

## Parameter Menu



- M. STP – this is where you set micro stepping value. The range for this parameter is FULL,  $\frac{1}{2}$  step,  $\frac{1}{4}$  step,  $\frac{1}{8}$  step,  $\frac{1}{16}$  step,  $\frac{1}{32}$  step,  $\frac{1}{64}$  step, and finally,  $\frac{1}{128}$  step. Setting this value can affect minimum step size and speed of motor. Note, **-1**, **-10**, **-100** buttons all will decrease this value by one, and **+1**, **+10**, **+100** buttons all will increase this value by one.
- Power – this is the parameter for running power setting where output torque of motor is determined by this value. The higher the current setting, the more torque motor will output. This can also be used for various motors according to their specifications, useful for many DIY projects. Maximum current is 1.875A and minimum is 0.125A. Note, **-1**, **-10**, **-100** buttons all will decrease this value by one, and **+1**, **+10**, **+100** buttons all will increase this value by one.

- Idle – this is the parameter for idling current for motor. When using batteries, it is better to lower the current for the motor to save battery when the rail is not in use. However, it is also necessary to hold the rail in position while idling, so it is a good idea to balance power saving and idle torque requirement. Note, -1, -10, -100 buttons all will decrease this value by one, and +1, +10, +100 buttons all will increase this value by one.
- Pitch – this is where the pitch of lead screw can be specified. Pitch refers to how far the lead screw travels for a full turn and is expressed in microns. For example, MJKZZ focus stacking rail, SR-90P, has pitch value of 1000 (microns), this means, if the lead screw makes a full turn, the rail will travel 1000um, or 1mm. For other lead screws that travel 0.1 inch per turn, it can be specified as 2540um
- T/Rev – this is the parameter that specifies number of FULL steps per revolution of motor. Typical values are 200(1.8 degrees per step) and 400 (0.9 degrees per step). This value will be further divided into micro steps specified in M.STP.
- B.LSH – this is where rail system backlash can be specified. Note, here, to measure the backlash, micro stepping must be set to 1/128 and the value must be total number of micro steps. For example, if actual backlash is 10um on a rail with 1mm pitch and 400 steps per turn motor, the measured value should be  $10 * 128 * 400 / 1000 = 512$ , or it means that it takes motor 512 micro steps to recover the 10um backlash in that system. The reason to measure the backlash in 1/128 micro stepping setting is accuracy.

## Time Menu



- Wait – this parameter specifies amount of time, in milliseconds, to wait before taking a picture after moving. This is to ensure all mechanical parts are settled before taking a picture.
- Hold – this parameter specifies amount of time, in milliseconds, to hold AFTER camera is triggered to take a picture. This is used to synchronize with camera shutter. For example, if camera shutter is set to 1 second, the rail must hold at least 1 second before moving, else the image will be blurred by motion.
- Snap – this is the parameter that specifies amount of time the shutter release must be held to trigger camera release. This value depends on camera model, but most of the time, 300ms is enough to trigger any camera unless some camera IR remote is used.
- L.On – this is the parameter that specifies when flash or light should be turned on AFTER Snap time. For example, if Snap is

300ms, the L.On specifies the time, in milliseconds, after that 300ms, to turn on flash or light. With this value, it is possible to trigger a flash in the middle of exposure, it is particularly good for reducing vibration caused by shutter blades. For Canon users, this is very useful as most Canon cameras can not do rear curtain sync.

- L.Dur – this is the parameter that specifies how long, in milliseconds, the flash/light should be triggered. For flashes, 5ms is more than enough. For continuous light, this value depends on exposure. For example, using a 3W LED light, this value could be as long as 2 seconds to get proper exposure.
- T.Out – this is the parameter that specifies amount of time to wait for inactivity and change into idle power saving mode.

## Loading and Saving Settings

This controller loads the following settings from its non-volatile memory (ie, even after power off, data will not be lost in these memories).

- Pitch expressed in microns
- Turn per revolution of motor (200, 400, etc)
- Running power setting
- Idle power setting
- Micro stepping setting
- Step size
- Backlash
- Wait time
- Hold time
- Snap time, ie, amount to time to hold shutter release down
- Time out, ie, when to set power to idle level
- Flash/Light trigger time-lap

- Light duration.

These values can be modified and saved by pressing  button. And to recall them, press 

## Q & A

Q: I have a 20TPI lead screw, how do I set it up?

A: 20TPI means 20 turns per inch, one inch is 25.4mm, so the pitch is  $25.4 / 20 = 1.27\text{mm}$  or 1270um, so setting the Pitch value in Param Menu to 1270

Q: My motor has 400 steps per revolution, how to set it up?

A: Set T/Rev value in Param Menu to 400

Q: I am moving the rail backwards, all the sudden, the Start and End position becomes non-zero, but I did not set them.

A: This is because when you move backwards, passing zero position, the controller will have to reset the zero position to the new position, but to keep the **physical** Start and End position at the same location on the rail, their value are set to the new values, too, relative to the new zero.

Q: I want to take advantage of “mid-curtain” flash trigger, how do I do that?

A: To be able to fire a flash connected to the Flash port, you can specify L.On value to trigger either flash or a continuous light. Please note, this parameter does not start till camera is triggered.

Q: My shutter speed is  $\frac{1}{4}$  of second, L.On value is set to zero, but I got a black image as if the flash is not working.

A: If the Snap parameter is set to too large, say, 400ms, the controller will not fire the flash until 400ms has lapsed, thus when flash is triggered, the shutter has closed already.

Q: My shutter speed is  $\frac{1}{4}$  of second, L.On is set to zero, Snap is set to 50, but I still get a black image.

A: Even if Snap is set to 50ms, the actual shutter might not start to open in 50ms (this is called shutter lag). Some camera has very long shutter lag, say 250ms, so the shutter is not fully open when flash is triggered.

Q: How do I get reliable “mid-curtain” ?

A: It all depends on a particular camera, even same brand and same model will be different. So, it is all up to empirical trials. But to be on the safe side, set shutter to 1 second or more to wait until shutter settles (after moving), set L.On to something like 200ms less than the full shutter duration is a good start.