SR3-mini

Step Motor Drive

User Manual



AMP & MOONS' Automation

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1 Introduction

Thank you for selecting the MOONS' SR3-mini step motor drive. We hope our commitment to performance, quality and economy will make a successful motion control project.

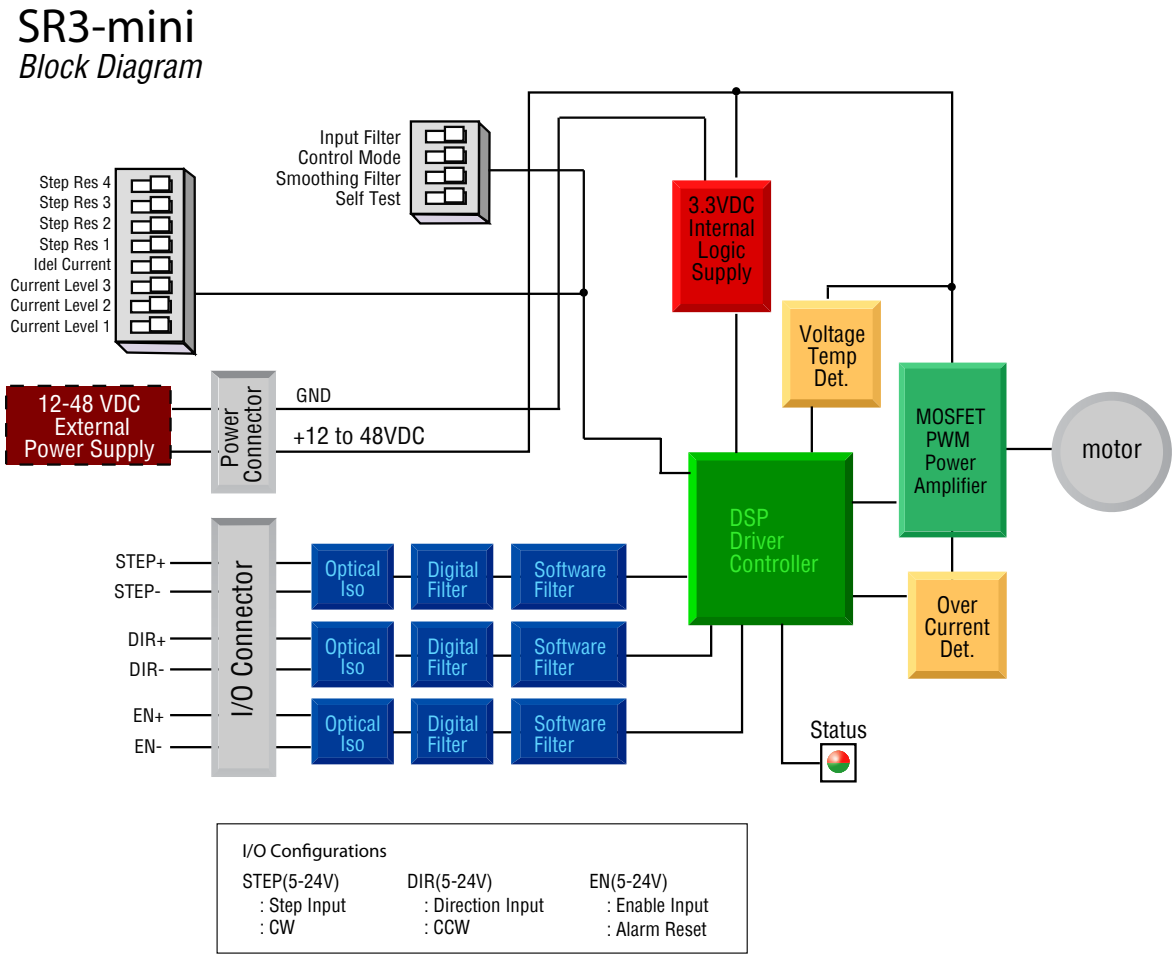
1.1 Overview

The SR3-mini Step motor drive is a cost-effective, high performance drive. The design is based on advanced digital current control technology, and features high torque, low noise and low vibration. Running current, microstep resolution, and other parameters are switch selectable so software configuration is not required.

1.2 Features

- Power Supply - Operates from a 12 to 48 volt DC power supply
- Inputs - 3 optically isolated digital inputs, 5 to 24 volts
- Speed Range - up to 3000 rpm
- Current Control - 3 piano switch setting running current, 3 amps peak maximum
- Idle Current - Switch selectable for reduction to 50% or 90% of running current 1 second after the motor stops
- Self Test - Performs a 2 rev, 1 rps, CW/CCW move test, switch selectable: ON or OFF
- Control Mode - Step & Direction mode, CW/CCW mode
- Microstep Resolution - 4 piano Switch selectable, 16 settings: 200, 400, 800, 1600, 3200, 6400,12800, 25600, 1000, 2000, 4000, 5000, 6000, 8000, 10000, 20000 steps/rev

1.3 Block Diagram



1.4 Safety Instructions

Only qualified personnel should transport, assemble, install, operate, or maintain this equipment. Properly qualified personnel are persons who are familiar with the transport, assembly, installation, operation, and maintenance of motors, and who meet the appropriate qualifications for their jobs.

To minimize the risk of potential safety problems, all applicable local and national codes regulating the installation and operation of equipment should be followed. These codes may vary from area to area and it is the responsibility of the operating personnel to determine which codes should be followed, and to verify that the equipment, installation, and operation are in compliance with the latest revision of these codes.

Equipment damage or serious injury to personnel can result from the failure to follow all applicable codes and standards. MOONS' does not guarantee the products described in this publication are suitable for a particular application, nor do they assume any responsibility for product design, installation, or operation.

- Read all available documentation before assembly and operation. Incorrect handling of the products referenced in this manual can result in injury and damage to persons and machinery. All technical information concerning the installation requirements must be strictly adhered to.
- It is vital to ensure that all system components are connected to earth ground. Electrical safety is impossible without a low-resistance earth connection.
- This product contains electrostatically sensitive components that can be damaged by incorrect handling. Follow qualified anti-static procedures before touching the product.
- During operation keep all covers and cabinet doors shut to avoid any hazards that could possibly cause severe damage to the product or personal health.
- During operation the product may have components that are live or have hot surfaces.
- Never plug in or unplug the step motor drive while the system is live. The possibility of electric arcing can cause damage.

Be alert to the potential for personal injury. Follow all recommended precautions and safe operating practices. Safety notices in this manual provide important information. Read and be familiar with these instructions before attempting installation, operation, or maintenance. The purpose of this section is to alert users to the possible safety hazards associated with this equipment and the precautions necessary to reduce the risk of personal injury and damage to equipment. Failure to observe these precautions could result in serious bodily injury, damage to the equipment, or operational difficulty.

2 Getting Started

To use the SR3-mini step motor drive, the following items are needed:

- A 12 - 48 volt DC power supply, see the section below entitled “Choosing a Power Supply” for help in choosing the right one
- Step & Direction signals
- A small flat blade screwdriver for configuring the switches (included)

2.1 Mounting Hardware

As with any step motor, the SR3-mini must be mounted so as to provide maximum heat sinking and airflow. Keep enough space around the Step motor drive to allow for airflow.



- Never use the drive where there is no airflow or where other devices cause the surrounding air to be more than 40°C (104°F).
- Never put the drive where it can get wet.
- Never use the drive where metal or other electrically conductive particles can infiltrate the drive.
- Always provide airflow around the drive.

2.2 Choosing a Power Supply

The main considerations when choosing a power supply are the voltage and current requirements for the application.

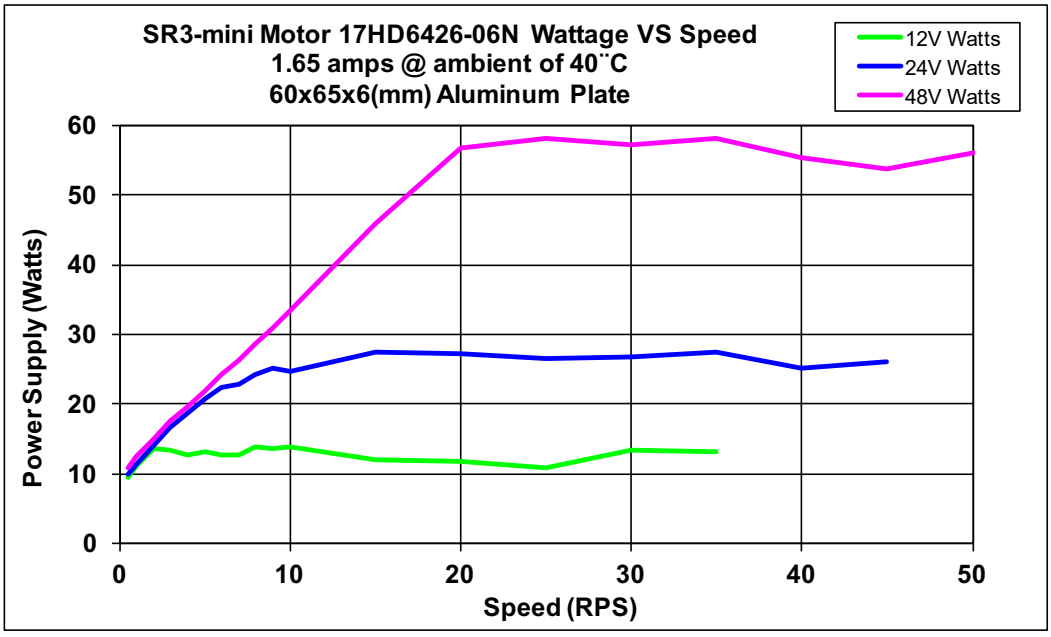
2.2.1 Voltage Selection

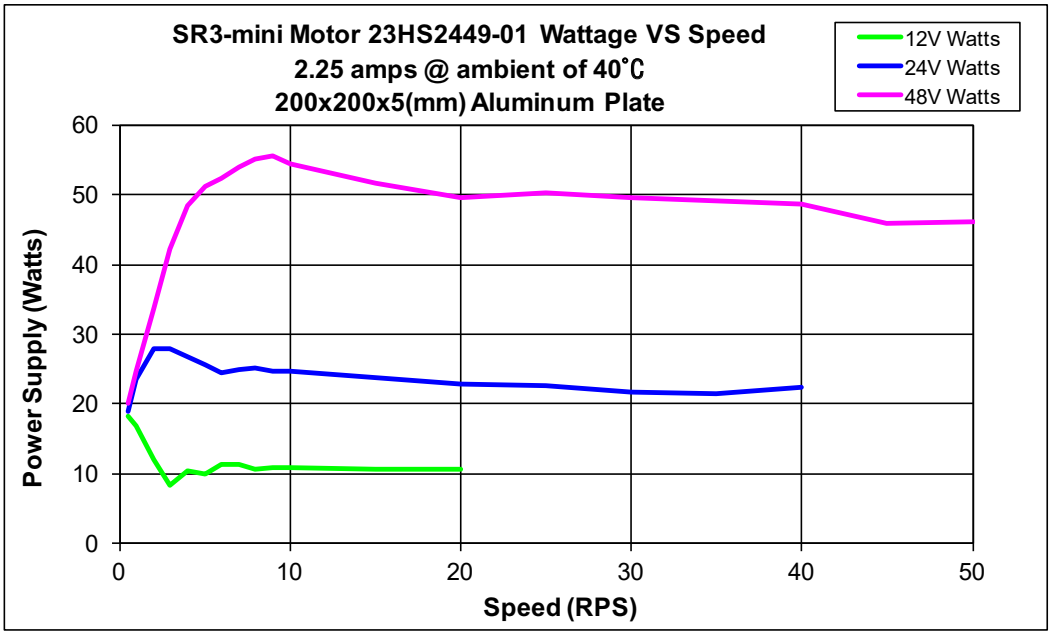
The SR3-mini is designed to give optimum performance between 12 and 48 volts DC. Choosing the voltage depends on the performance needed and motor/drive heating that is acceptable and/or does not cause a drive over-temperature. Higher voltages will give higher speed performance but will cause the SR3-mini to produce higher temperatures. Using power supplies with voltage outputs that are near the drive maximum may significantly reduce the operational duty-cycle.

The extended range of operation can be as low as 10 VDC minimum to as high as 53 VDC maximum. When operating below 12 VDC, the power supply input may require larger capacitance to prevent under-voltage and internal-supply alarms. Current spikes may make supply readings erratic. The supply input cannot go below 12 VDC for reliable operation. Absolute minimum power supply input is 10 VDC. If the Input supply drops below 10 VDC the low voltage alarm will be triggered. This will not fault the drive.

Absolute maximum power supply input is 53 VDC at which point an over-voltage alarm and fault will occur. When using a power supply that is regulated and is near the drive maximum voltage of 53 VDC, a voltage clamp may be required to prevent over-voltage when regeneration occurs. The RC880 Regeneration Clamp is recommended for the SR3-mini in this situation (see 3.1 “Connecting the Power Supply” below). When using an unregulated power supply, make sure the no-load voltage of the supply does not exceed the drive’s maximum input voltage of 53 VDC.

The charts below show the heat output, in watts, of the drive at various speeds and voltages. See section 6.4 on Drive/Motor Heating for more information.

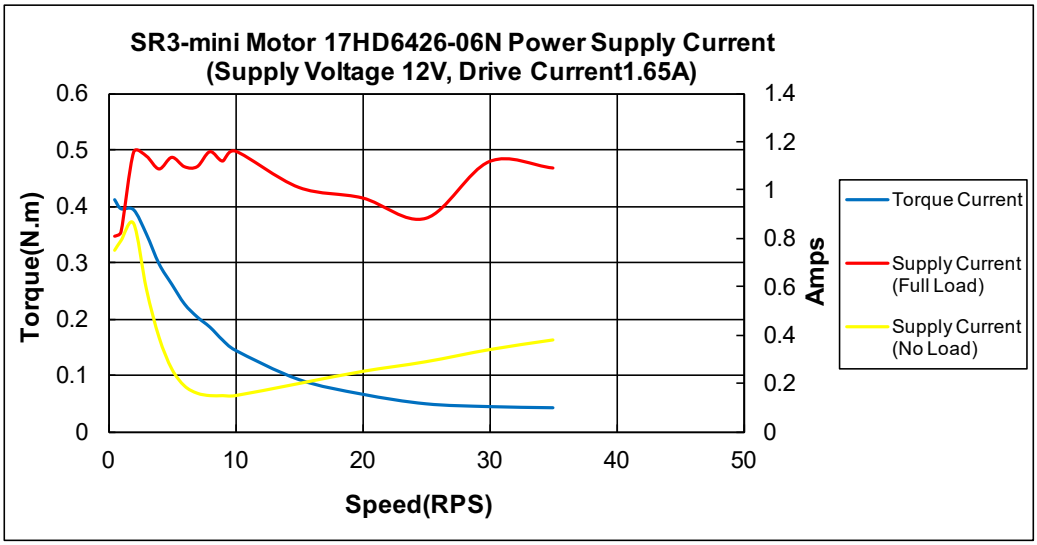


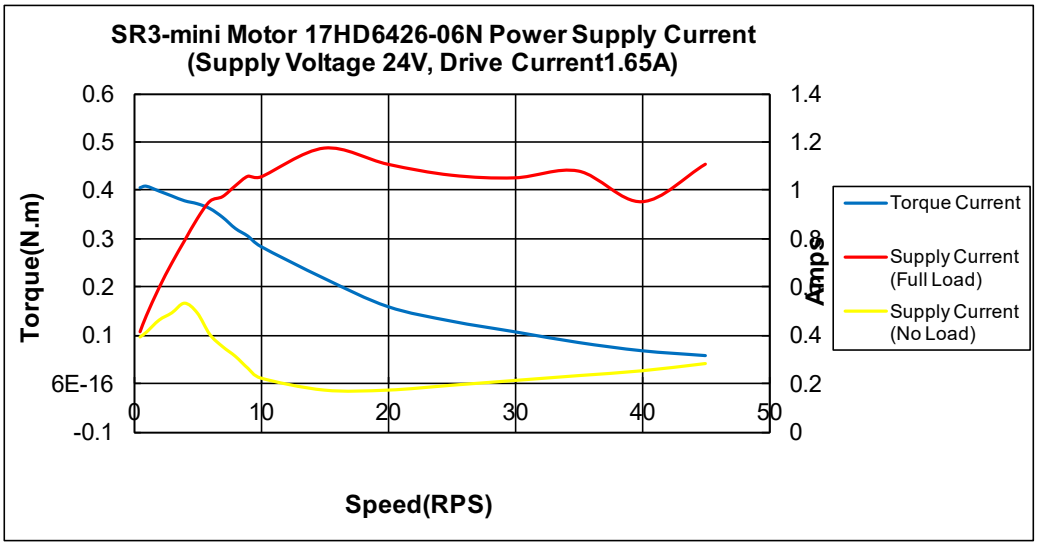

SR3-mini Motor 23HS2449-01 Wattage VS Speed
2.25 amps @ ambient of 40°C
200x200x5(mm) Aluminum Plate
12V Watts
24V Watts
48V Watts
Power Supply (Watts)
60
50
40
30
20
10
0
0
10
20
30
40
50
Speed (RPS)

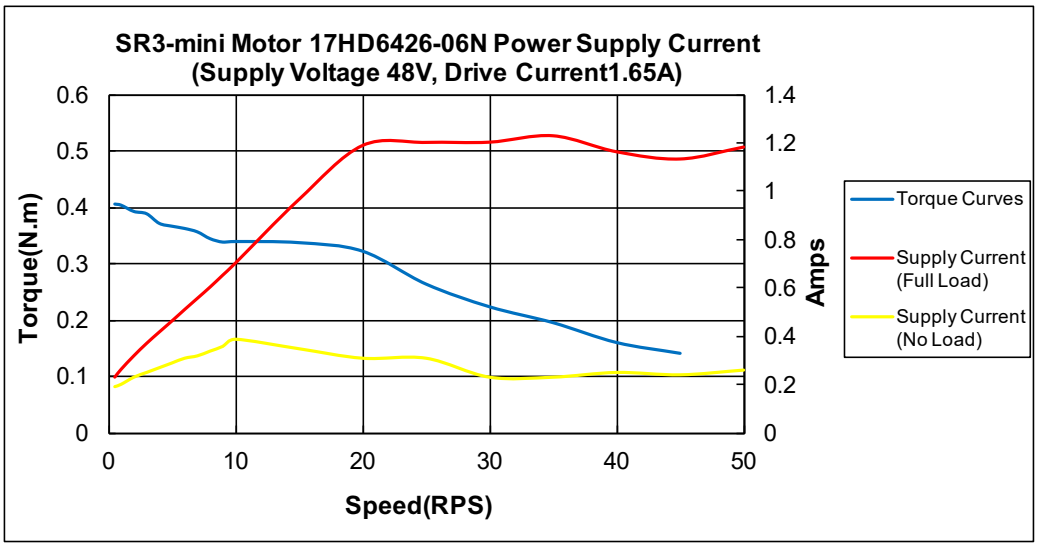
2.2.2 Current

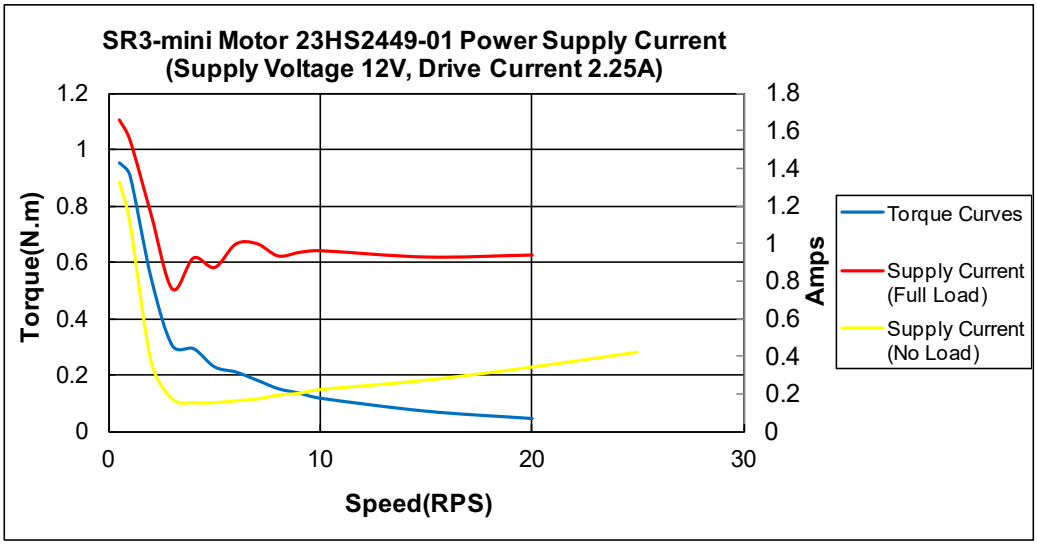
The maximum supply currents required by the SR3-mini are shown in the charts below at different power supply voltage inputs. The SR3-mini power supply current is lower than the winding currents because it uses switching amplifiers to convert a high voltage and low current into lower voltage and higher current. The more the power supply voltage exceeds the motor voltage, the less current will be required from the power supply.

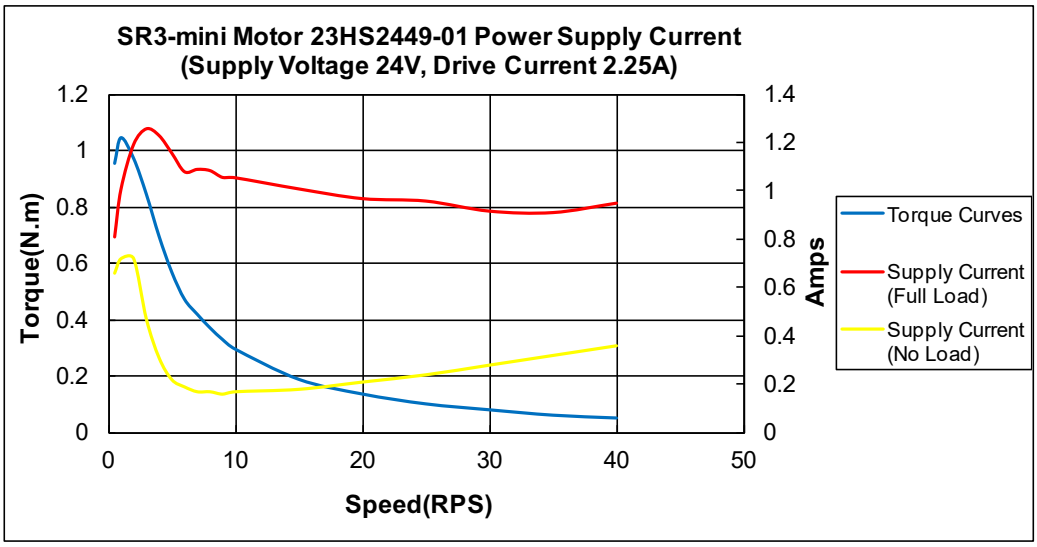
It is important to note that the current draw is significantly different at higher speeds depending on the torque load to the motor. Estimating how much current is necessary may require a good analysis of the load the motor will encounter.

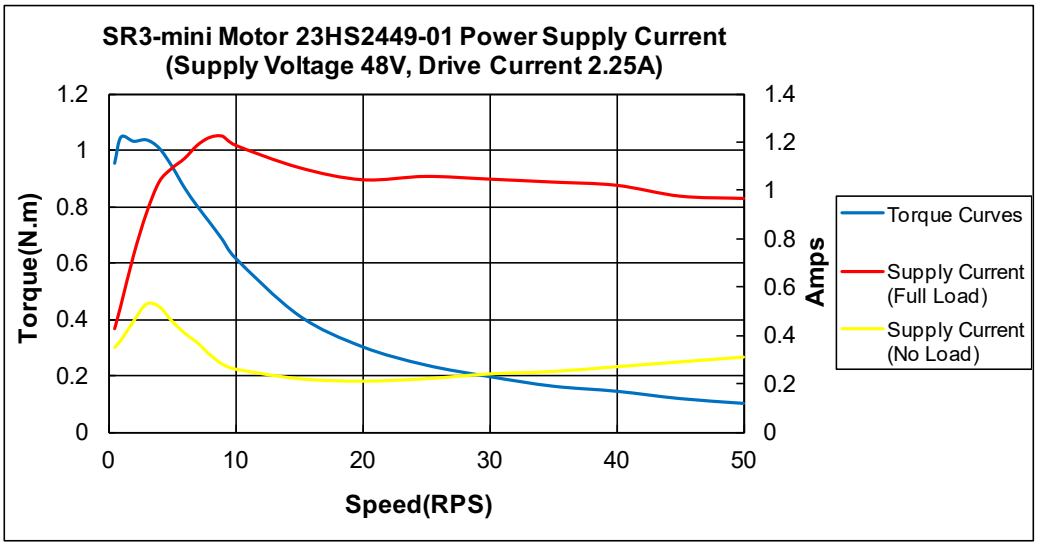





SR3-mini Motor 17HD6426-06N Power Supply Current
(Supply Voltage 48V, Drive Current1.65A)
Torque(N.m)
Amps
Speed(RPS)
Torque Curves
Supply Current (Full Load)
Supply Current (No Load)


SR3-mini Motor 23HS2449-01 Power Supply Current
(Supply Voltage 12V, Drive Current 2.25A)
Torque(N.m)
Amps
Speed(RPS)
Torque Curves
Supply Current (Full Load)
Supply Current (No Load)


SR3-mini Motor 23HS2449-01 Power Supply Current
(Supply Voltage 24V, Drive Current 2.25A)
Torque(N.m)
Amps
Speed(RPS)
Torque Curves
Supply Current (Full Load)
Supply Current (No Load)


SR3-mini Motor 23HS2449-01 Power Supply Current
(Supply Voltage 48V, Drive Current 2.25A)
Torque(N.m)
Amps
Speed(RPS)
1.2
1
0.8
0.6
0.4
0.2
0
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
10
20
30
40
50
Torque Curves
Supply Current (Full Load)
Supply Current (No Load)

3 Connections

3.1 Connecting the Power Supply

If the power supply does not have a fuse on the output or some kind of short circuit current limiting device a fast acting fuse is required. A 3 amp fast acting fuse should be installed in line with the "+" power supply lead.

Connect the power supply "+" terminal to the drive " V+" terminal. Connect the power supply "-" terminal to the drive " V-" terminal.

Be careful not to reverse the wires. Reversing the connection may open the internal fuse and void the warranty.

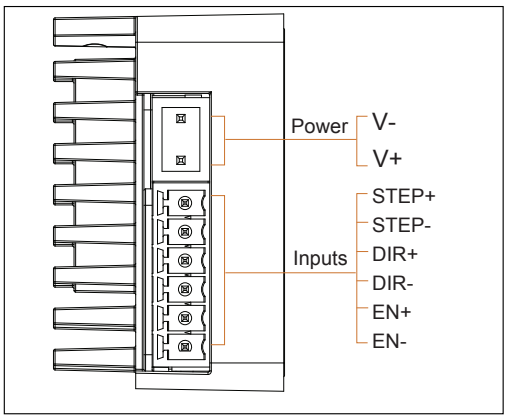
If a regulated power supply is being used, there may be a problem with regeneration. When a load decelerates rapidly from a high speed, some of the kinetic energy of the load is transferred back to the power supply, possibly tripping the over-voltage protection of a regulated power supply, causing it to shut down. This problem can be solved with the use of a MOONS' RC880 Regeneration Clamp. It is recommended that an RC880 initially be installed in an application. If the "regen" LED on the RC880 never flashes, the clamp is not necessary.

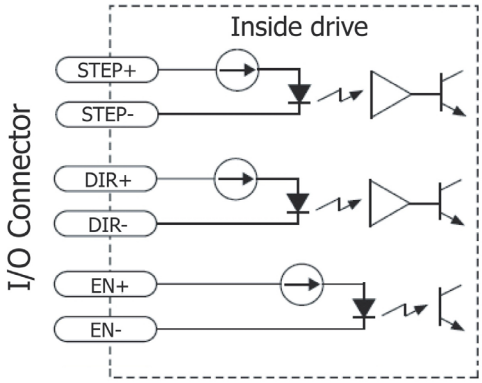


RC880 Regen Clamp

3.2 Connecting the Inputs & Outputs

3.2.1 Connector Pin Diagram



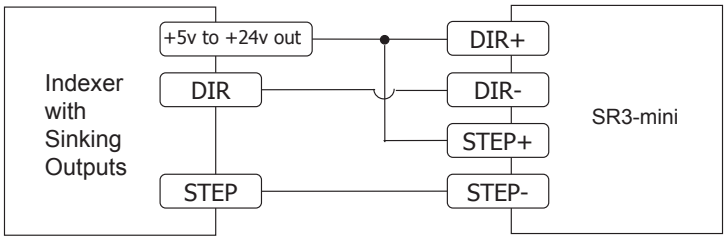


3.2.2 STEP & DIR Inputs

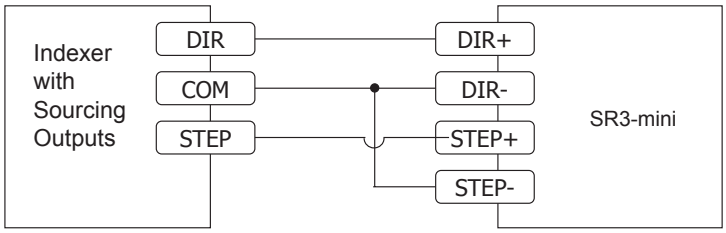
The SR3-mini step motor drive has two high speed optically isolated inputs called STEP and DIR. They accept 5 to 24 volt single-ended or differential signals, up to 500KHz. The maximum voltage that can be applied to the input is 28V.

The motor executes one step when the STEP input closes.

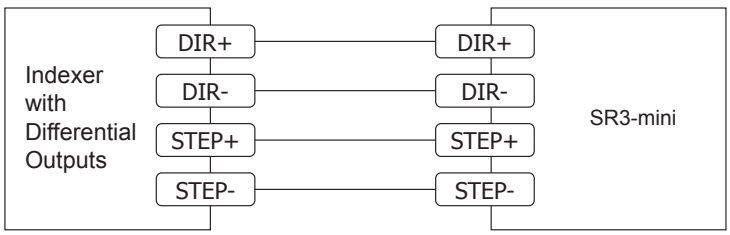
The direction of rotation is controlled by the DIR input state. A closed input (logic “0”) will result in clockwise rotation, and an open input (logic “1”) will result in counterclockwise rotation.



Connecting to Indexer with Sinking Outputs



Connecting to Indexer with Sourcing Outputs



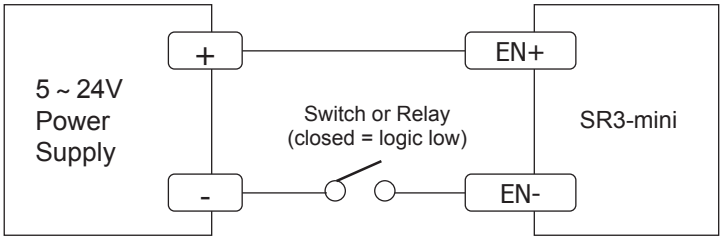
Connecting to Indexer with Differential Outputs
Many high-speed indexers have differential outputs

3.2.3 EN Input

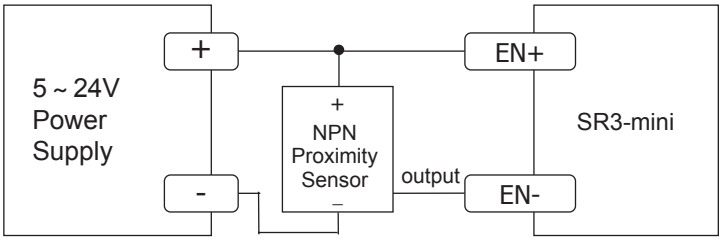
The EN input enables or disables the drive amplifier. It is an optically isolated input that accepts a 5 to 24 volt single-ended or differential signal. The maximum voltage that can be applied to the input is 28V.

When EN input is closed, the drive amplifier is deactivated. All the MOSFETs will shutdown, and the motor is free. When EN input is open, the drive is activated.

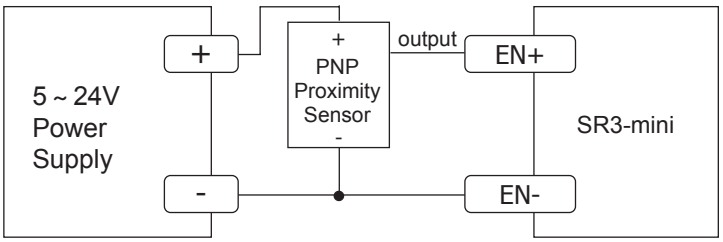
When the drive has encountered an error and the fault is removed from system, a falling signal into the EN input will reset the error status and activate the drive amplifier again.



Connecting the Input to a Switch or Relay

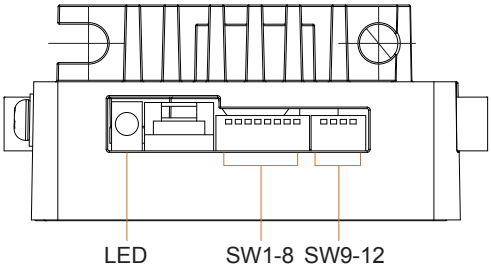


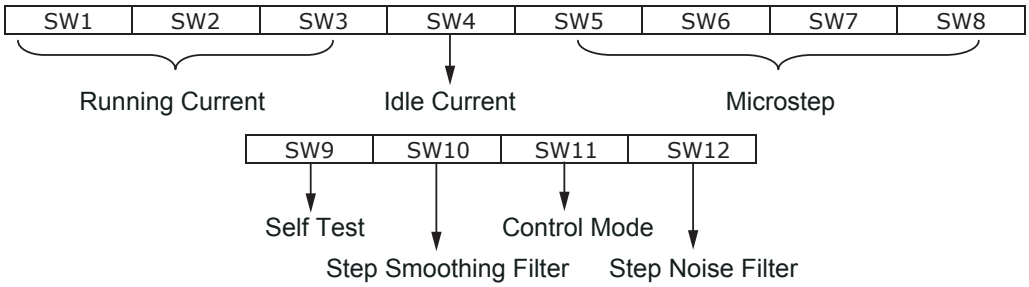
Connecting an NPN type Proximity Sensor to an input
(when prox sensor activates, input goes low)



Connecting an PNP type Proximity Sensor to an input
(when prox sensor activates, input goes low)

4 Switch Selecting

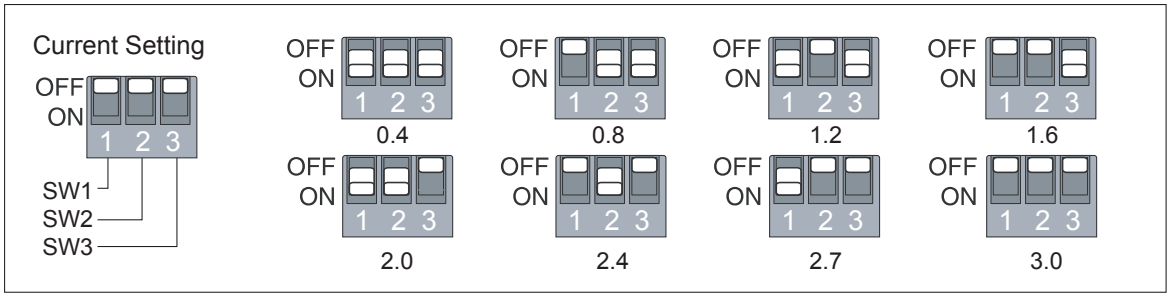




4.1 Running Current

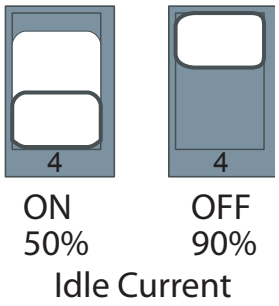
The output current of the SR3-mini step motor drive is set by the SW1, SW2 and SW3 switches and can be changed as necessary. There are 4 settings available according to the ON/OFF combination of the switches.

Current （Amps）	SW1	SW2	SW3
0.4	ON	ON	ON
0.8	OFF	ON	ON
1.2	ON	OFF	ON
1.6	OFF	OFF	ON
2.0	ON	ON	OFF
2.4	OFF	ON	OFF
2.7	ON	OFF	OFF
3.0	OFF	OFF	OFF



4.2 Idle Current

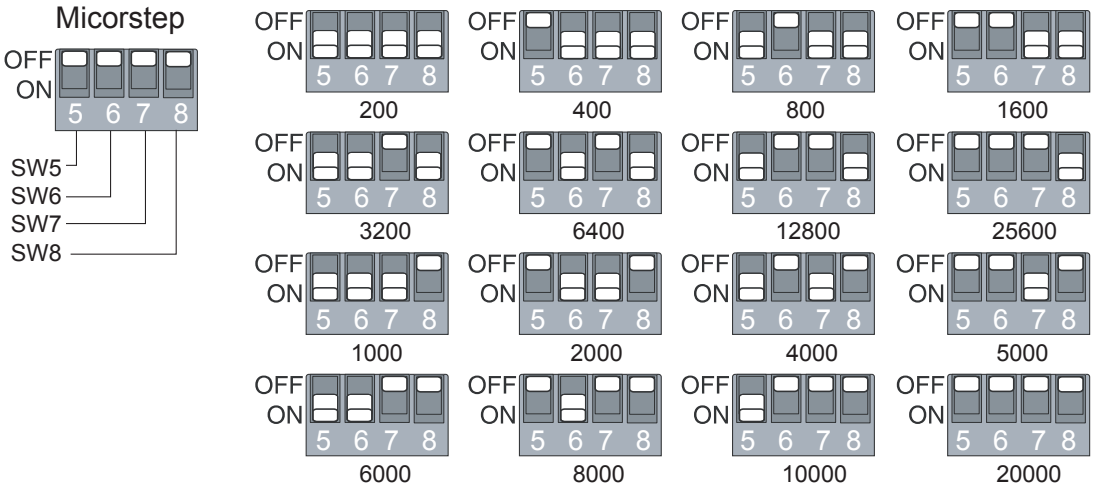
The running current of the SR3-mini is automatically reduced whenever the motor isn't moving. Setting the SW4 switch to ON maintains 50% of the running current. Setting this switch to OFF maintains 90% of the running current. This 90% setting is useful when a high holding torque is required. To minimize motor and drive heating it is highly recommended that the idle current reduction feature be set to 50% unless the application requires the higher setting.



4.3 Microstep Setting

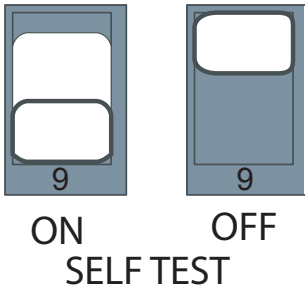
SR3-mini setting switch SW5, SW6, SW7, SW8. There are 16 settings.

Steps/Rev	SW5	SW6	SW7	SW8
200	ON	ON	ON	ON
400	OFF	ON	ON	ON
800	ON	OFF	ON	ON
1600	OFF	OFF	ON	ON
3200	ON	ON	OFF	ON
6400	OFF	ON	OFF	ON
12800	ON	OFF	OFF	ON
25600	OFF	OFF	OFF	ON
1000	ON	ON	ON	OFF
2000	OFF	ON	ON	OFF
4000	ON	OFF	ON	OFF
5000	OFF	OFF	ON	OFF
6000	ON	ON	OFF	OFF
8000	OFF	ON	OFF	OFF
10000	ON	OFF	OFF	OFF
20000	OFF	OFF	OFF	OFF



4.4 Self Test

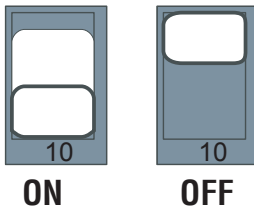
A built-in self-test feature is available on the SR3-mini to check the physical operation of the motor. Setting switch SW9 to ON after the drive is powered up will cause the drive to perform a self test move of 2 revolutions both CW and CCW at 1rps. Setting switch SW9 to OFF disables this feature.



4.5 Step Smoothing Filter

Command signal smoothing can soften the effect of immediate changes in velocity and direction, making the motion of the motor less jerky. An added advantage is that it can reduce the wear on mechanical components. SW10 selects this function - ON enables it, OFF disables it.

This function can cause a small delay in following the control signal, and it should be used with that in mind.

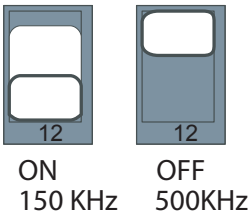


4.6 Control Mode

Switch SW11 sets control mode . Switch OFF sets the Step & Dir mode. Switch ON sets the CW/CCW mode.

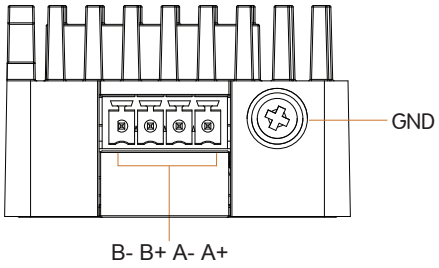
4.7 Step Noise Filter

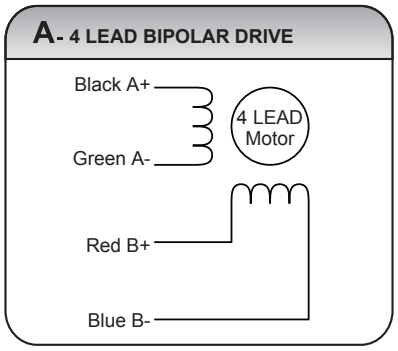
Switch SW12 sets the digital signal filter. The STEP and DIR signal inputs have built-in digital filters and this setting will reduce external noise. If the system works on the low microstep, select the 150 KHz (ON) setting. If the system works on the high microstep, select the 500KHz (OFF) setting.



4.8 Motor Selction

Motor wires setting：





5 Troubleshooting

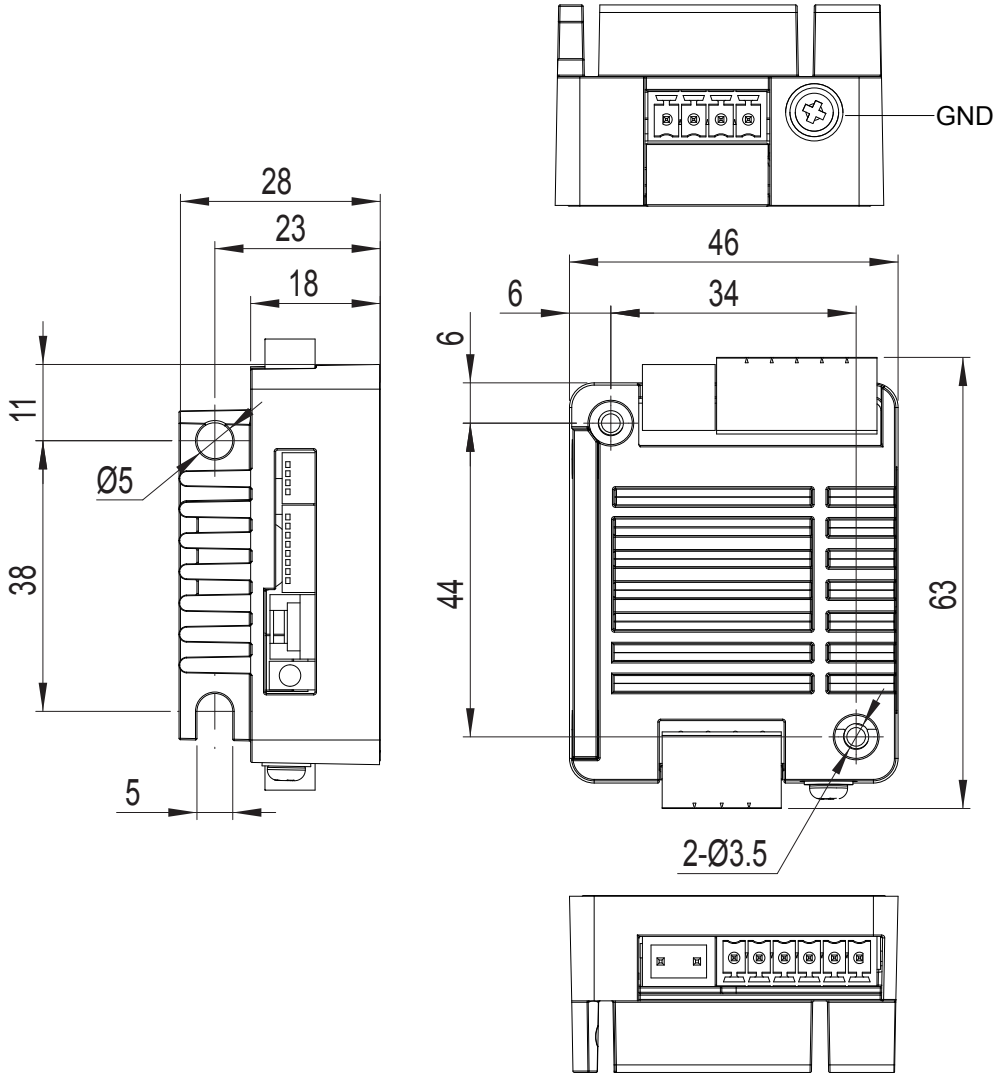
LED Error Codes

The SR3-mini has one bicolor (red/green) LED to indicate status and errors. When the motor is enabled, the LED slowly flashes green. When the LED is solid green, the motor is disabled. If the LED flashes red, an error has occurred. Errors are indicated by a combination of red and green flashes as follows:

Code		Error
	Solid	Motor Disabled
	Flashing	Motor Enabled
	3 red, 1 green	Over Temperature
	3 red, 2 green	Bad Internal Voltage
	4 red, 1 green	Power Supply Over Voltage
	4 red, 2 green	Power Supply Under Voltage
	5 red, 1 green	Over Current/Short Circuit
	6 red, 1 green	Open Widing

6 Reference Materials

6.1 Mechanical Outline

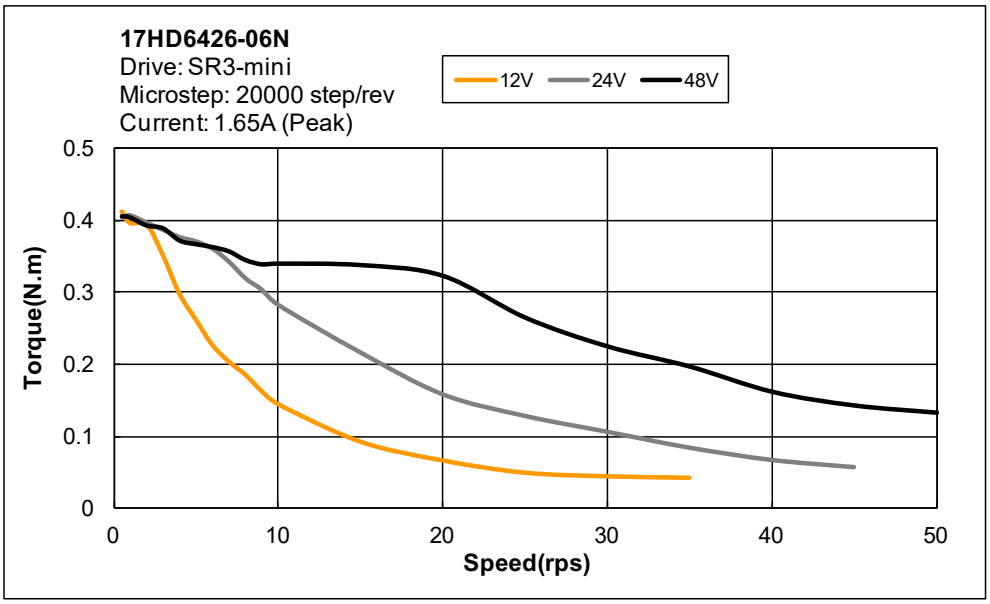


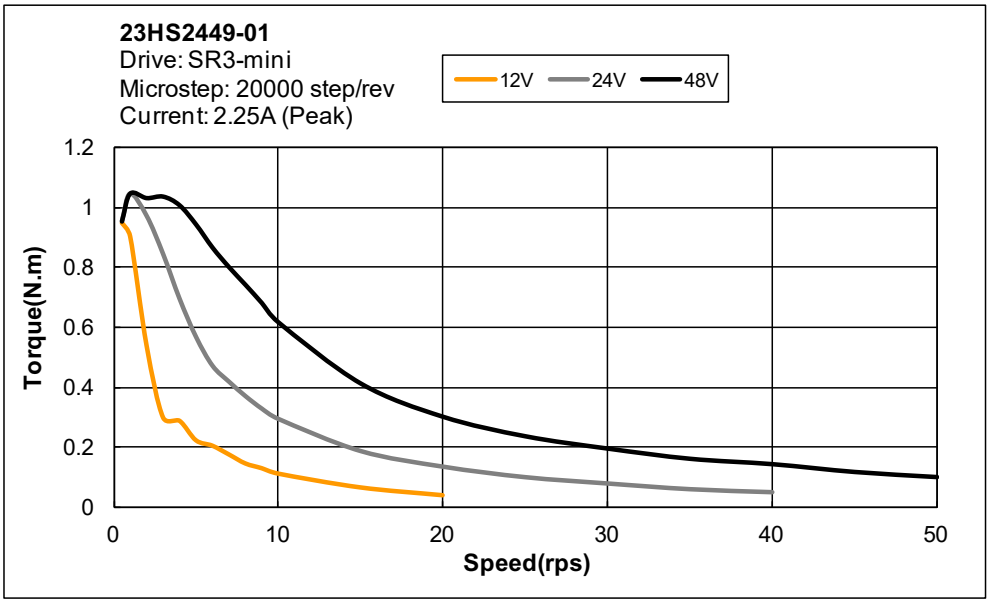
6.2 Technical Specifications

Power Amplifier	
Amplifier Type	Dual H-Bridge, 4 Quadrant
Current Control	4 state PWM at 16 KHz
Power Supply	External 12 - 48 volt power supply required
Input Voltage Range	10 - 53 volts min/max (nominal 12 - 48 volts), voltages outside this range will cause driver faults and/or may damage the drive
Protection	Over-voltage, over-current, under-voltage, over-temp, internal motor shorts (phase-to-phase, phase-to-ground)
Ambient Temperature	0 - 40°C (32 - 104°F) when mounted to a suitable heatsink
Humidity	90% non-condensing

Controller	
Current Control	Advanced digital current control provides excellent high speed torque
Speed Range	Speeds up to 3000 rpm
Auto Setup	Measures motor parameters to configure current control and anti-resonance gain settings
Step Input STEP+/-	Pulse or CW input, Optically isolated, differential, 5-24VDC for high level voltage, minimum pulse width = 1μs, maximum pulse frequency = 500KHz
Direction Input DIR+/-	Direction or CCW input, Optically isolated, differential, 5-24VDC for high levelvoltage, minimum pulse width = 1μs, maximum pulse frequency = 500KHz
Enable Input EN+/-	Motor enable, Optically isolated, differential, 5-24VDC for high level voltage, enable signal filter time is 4ms
Running Current	Switch selectable, 8 settings: 3 amps peak maximum
Idle Current Reduction	Automatically reduces the current 1 second after the motor stops; switch selectable, 2 settings: 50% or 90% of the running current
Microstep Resolution	Switch selectable, 16 settings: 200, 400, 800, 1600, 3200, 6400, 12800, 25600 1000, 2000, 4000, 5000, 6000, 8000, 10000, 20000 steps/rev
Self Test	Checks internal and external power supply voltages, 2 rev move both CW and CCW at 1rps, switch selectable, ON or OFF
Modes Of Control	Step & Direction,CW/CCW

6.3 Torque Curves





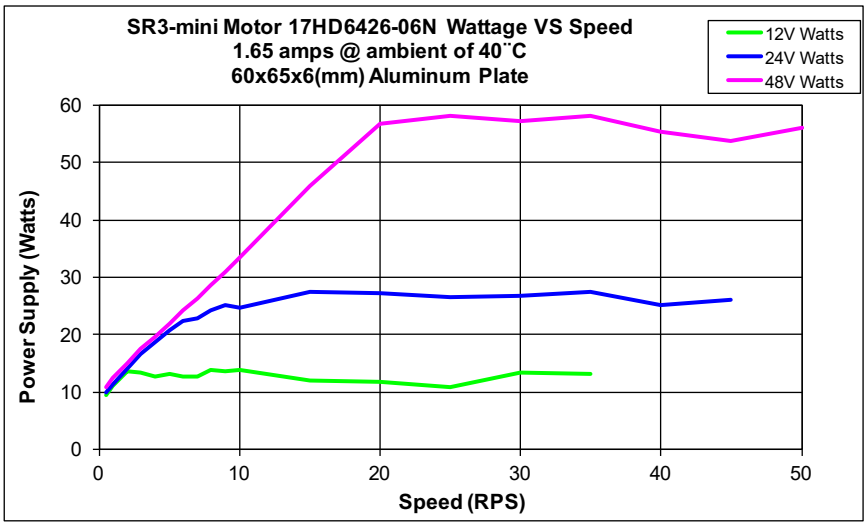
Note: all torque curves were measured at 20,000 steps/rev.

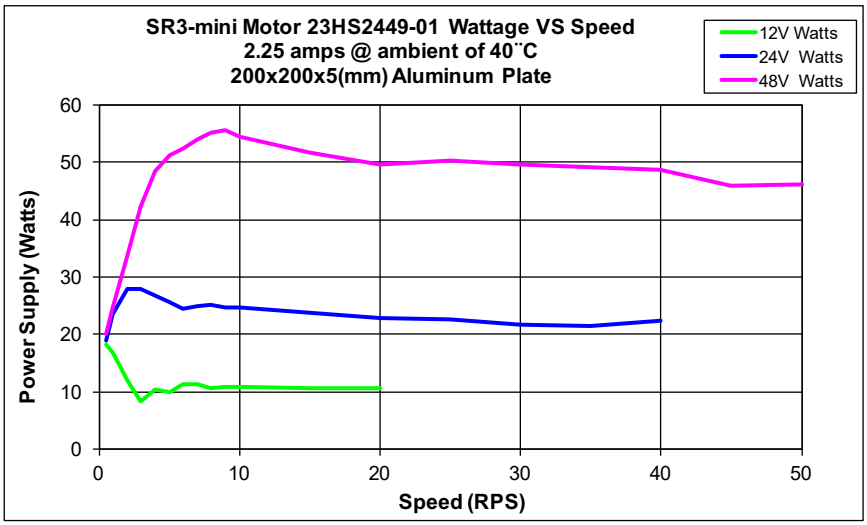
6.4 Drive/Motor Heating

Step motors convert electrical power from the driver into mechanical power to move a load. Because step motors are not 100% efficient, some of the electrical power turns into heat as it passes through the motor. The amount of heating is not so much dependent on the load being driven as on the motor speed and power supply voltage. There are certain combinations of speed and voltage at which a motor cannot be continuously operated without damage occurring to the motor.

A step motor typically reaches its maximum temperature after 30 to 45 minutes of operation. A motor that runs for one minute and then rests for one minute is said to have a duty cycle of 50%. Five minutes of running and five minutes of rest is also a 50% duty cycle. However, one hour of running and one hour of rest has the effect of 100% duty cycle as the motor will reach full and possible excessive temperature during the first hour. The actual temperature of the motor depends on how much heat is conducted, convected or radiated out of it.

The curves below result from measurements made in a 40°C (104°F) environment with the motor mounted to an aluminum plate sized to provide a surface area consistent with the motor power dissipation. Results may vary.





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