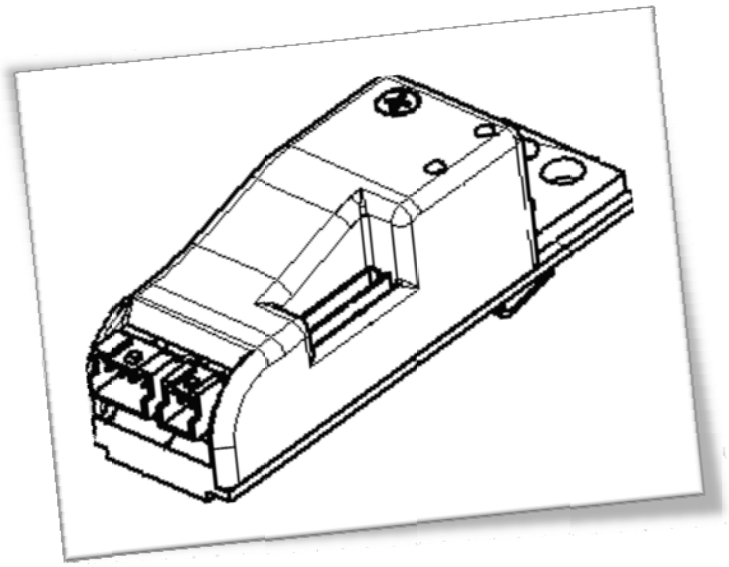
Parker Hannifin Corporation

ion Stepper Drive

Product Manual and User Guide



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User Information

Warning - Motion control products are used to control electrical and mechanical components of motion control systems. You should test your motion system for safety under all potential conditions. Failure to do so can result in damage to equipment and/or serious injury to personnel.

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The ion Stepper Drive

The Parker ion Stepper Drive is a complete step and direction indexer for Hybrid step motors. The ion is designed to operate stepper motors in full, half, quarter, and sixteen step modes with an output drive capacity up to 24VDC and ±2.0Amps. In an 80mm x 25mm x 25mm package, the ion can be installed by using two of the four mounting holes (the additional mounting holes are for different mounting orientations) or with the optional din rail mount the ion can be installed on a standard 35mm din rail.

Key Features

- Supply Voltage 12 to 24VDC
- 2 Amp chopper stepper driver
- ENABLE, STEP & DIRECTION inputs are 14V tolerant
- Adjustable Run Current and Standby Current with Potentiometers
- Adjustable Current up to 2.0Amps
- Differential and Single Ended inputs for the ENABLE, STEP & DIRECTION
- Din Rail Mountable (Optional)
- Resolutions of 200, 400, 800 & 3200 steps/rev (with 1.8° Step Motor)
- Small package (80mm x 25mm x 25mm)
- Automatically goes into standby current in 1.5seconds after last step signal goes low
- Disable standby current by ending move with step signal high.

Electrical Specifications

- Supply Input: 12-24VDC
- Max Motor Output Current: 2.0Amps
- Differential input voltages up to ±14VDC (low/high input) Absolute MAX of ±14VDC
- Enable, Step & Direction input levels: <0.8V Low, >2V High
- Minimum STEP Pulse Width: 1.0µs
- Minimum STEP Pulse Low Time: 1.0µs
- Operating Temperature: 0 to 40°C with natural convection
- Relative Humidity: 5 to 95% non-condensing

Mechanical Specifications

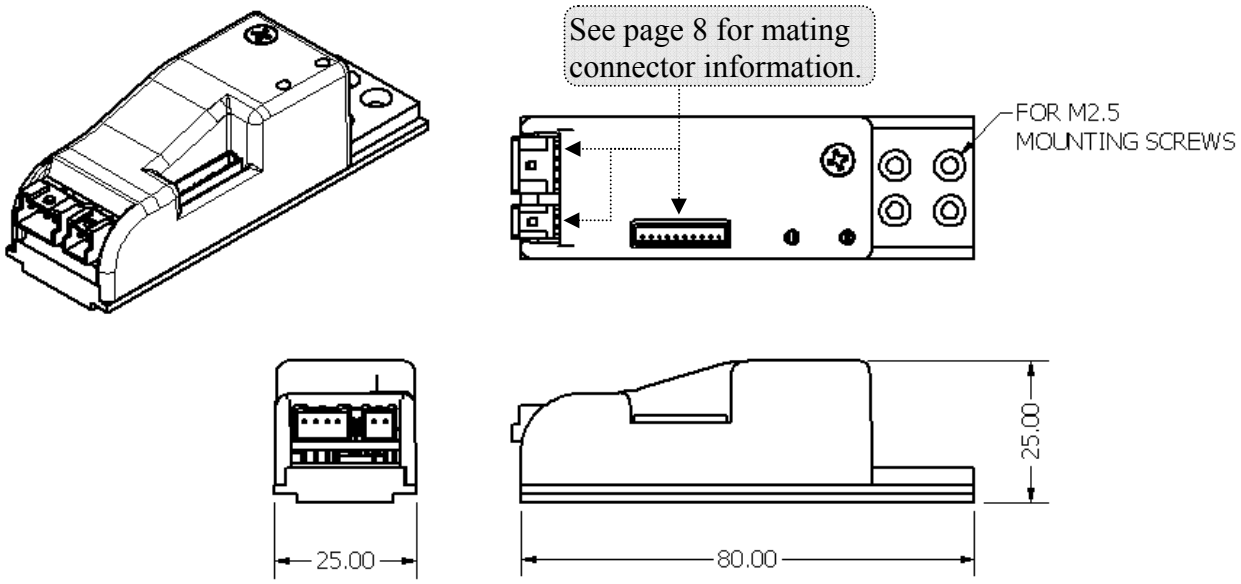


Figure 1: Mechanical Specifications

Mounting Accessories

Mounting Kit to Mount ion to LCR22, LCR30 or LCR45

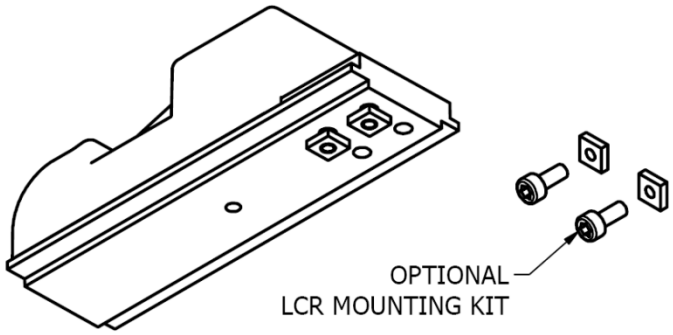


Figure 2: Optional ion to LCR Mounting Kit

Din Rail Mounting Accessory

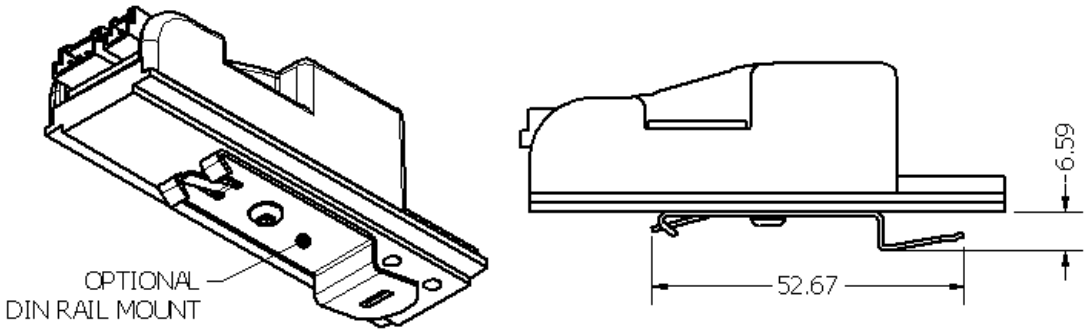


Figure 3: Optional Din Rail Mount

Mounting Accessories	
Description	**Part Number**
Mounting Kit to Mount Ion to LCR22, LCR30 or LCR45	002-3295-01
K1 - Din Rail mounting kit	002-3294-01

Connectorized Cable Information

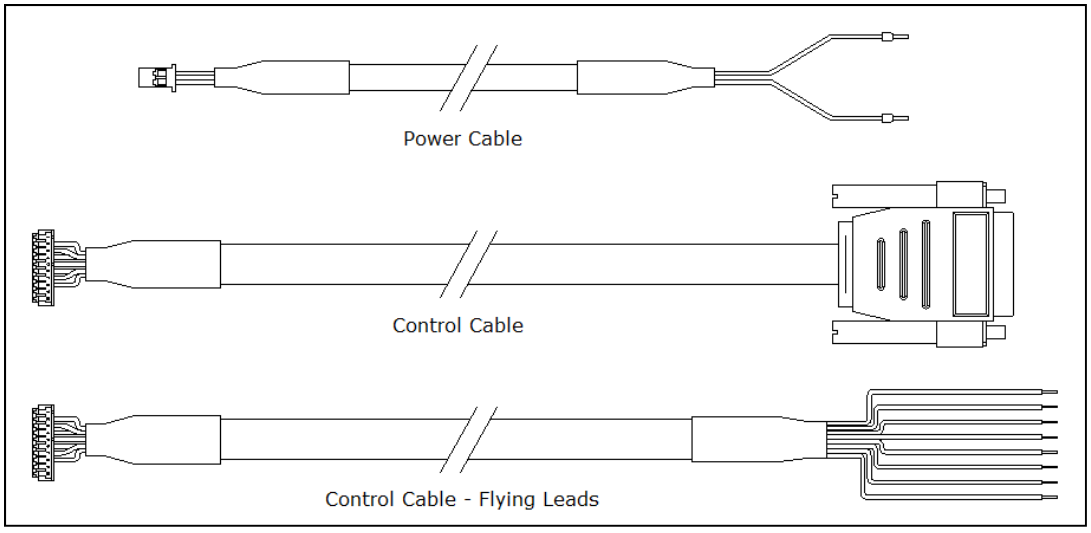


Figure 4: Optional Cables

Table 1: Individual Cable Part Numbers

Individual Cables	
Description	**Part Number**
1m Power Cable	006-2342-1.0
3m Power Cable	006-2342-3.0
1m 6K Control Cable	006-2343-1.0
3m 6K Control Cable	006-2343-3.0
1m ACR Control Cable	006-2344-1.0
3m ACR Control Cable	006-2344-3.0
1m Control Cable Flying Leads	006-2345-1.0
3m Control Cable Flying Leads	006-2345-3.0
1m Motor Power Extension	006-2357-1.0
3m Motor Power Extension	006-2357-3.0

Table 2: Cable Set Part Numbers

Cable Sets		
Description	**Part Number**	**Includes the following cables**
FL1 – 1m Flying Lead Cable Set	002-3296-1.0	1m Power Cable 1m Control Cable Flying Leads
FL3 - 3 m Flying Lead Cable Set	002-3296-3.0	3m Power Cable 3m Control Cable Flying Leads
AC1 - 1 m Cable Set to ACR	002-3297-1.0	1m Power Cable 1m ACR Control Cable
AC3 - 3 m Cable Set to ACR	002-3297-3.0	3m Power Cable 3m ACR Control Cable
6K1 - 1 m Cable Set to 6K	002-3298-1.0	1m Power Cable 1m 6K Control Cable
6K3 - 3 m Cable Set to 6K	002-3298-3.0	3m Power Cable 3m 6K Control Cable

Connector Locations & Pin-Out Description

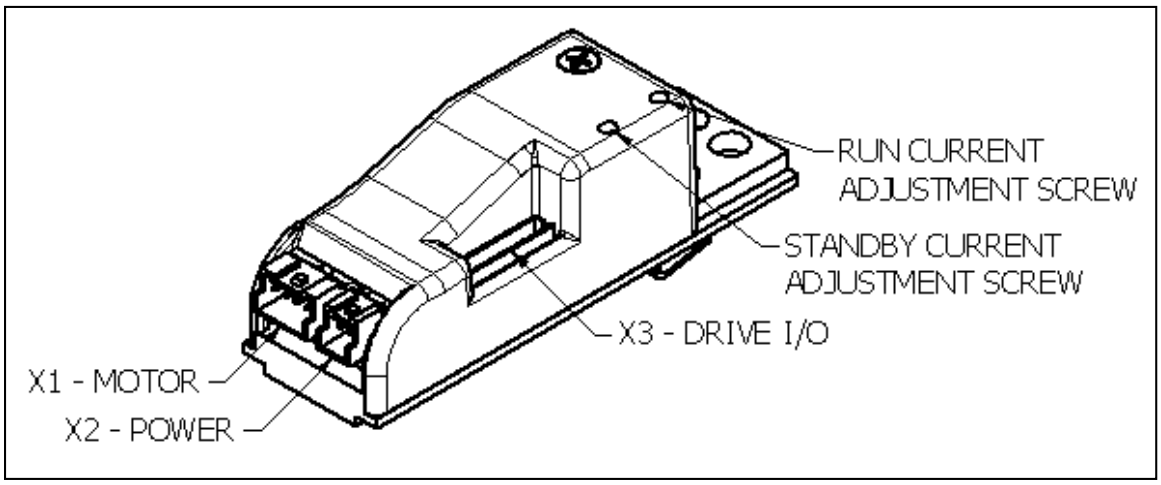


Figure 5: Connection Diagram & Current Adjustment

Warning - Do not unplug motor while power is on!

Warning - The motor output is **NOT** short circuit protected. Before enabling the drive verify each phase of the motor is properly connected.

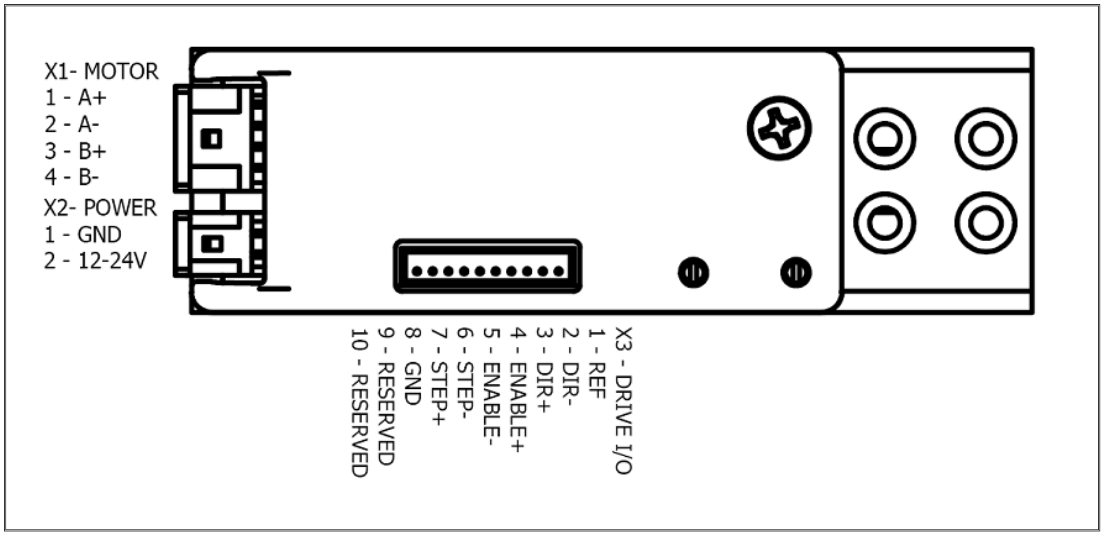


Figure 6: Pin-Out Diagram

X3 – DRIVE I/O Function Description

Reference Output (REF). Current reference measurement taken from this pin (see Current Setup).

Direction Input (DIR). The state of the DIR input determines the direction of rotation of the motor. Any changes made to this input does not take effect until the next rising edge of the step command input signal.

Enable Input (ENABLE). A differential low enables the drive outputs. A differential high disables the drive outputs. Disconnecting the ENABLE signal also disables the outputs.

Step Input (STEP). A low-to-high transition on the STEP input advances the motor one increment. With a high signal the Standby mode is disabled.

Ground (GND). Logic ground.

Note:

The Drive I/O will accept differential or single-ended STEP, DIRECTION & ENABLE signals. To use single ended mode with an active high connect STEP+, DIR+ & ENABLE- and leave STEP-, DIR- & ENABLE+ disconnected. To use single ended mode with an active low connect STEP-, DIR- & ENABLE+ and leave STEP+, DIR+ & ENABLE- disconnected. Other combinations of active low and active high can also be used.

Mating Connectors

- X1 – Connector Housing, Mfg. JST, Part # PAP-04V-S(P) (Digikey Part # 455-1488-ND)
  - Pins, Mfg. JST Part # SPHD-001T-P0.5 (Digikey Part # 455-1325-1-ND) for 26-22AWG wire or Mfg. JST Part # SPHD-002T-P0.5 (Digikey Part # 455-1313-1-ND) for 24-28AWG wire
  - Crimp Tool, Mfg. JST Part # YC-610R (Digikey Part # 455-1906-ND) for SPHD-001T-P0.5 or Mfg. JST Part # WC-620 (Digikey Part # WC-620-ND) for SPHD-002T-P0.5
- X2 – Connector Housing, Mfg. JST, Part # PAP-02V-S(P) (Digikey Part # 455-1486-ND)
  - Pins, Mfg. JST Part # SPHD-001T-P0.5 (Digikey Part # 455-1325-1-ND) for 26-22AWG wire or Mfg. JST Part # SPHD-002T-P0.5 (Digikey Part # 455-1313-1-ND) for 24-28AWG wire
  - Crimp Tool, Mfg. JST Part # YC-610R (Digikey Part # 445-1906-ND) for SPHD-001T-P0.5 or Mfg. JST Part # WC-620 (Digikey Part # WC-620-ND) for SPHD-002T-P0.5
- X3 – Connector Housing, Mfg. JST, Part # ZHR-10 (Digikey Part # 455-1197-ND)
  - Pins, Mfg JST Part # SZH-003T-P0.5 (Digikey Part # 455-1281-1-ND) for 32-28AWG or Mfg JST Part # SZH-002T-P0.5 (Digikey Part # 455-1130-1-ND) for 28-26AWG
  - Crimp Tool, Mfg. JST Part # WC-490 (Digikey Part # 445-1259-ND) for SZH-003T-P0.5 or Mfg. JST Part # YRS-491 (Digikey Part # YRS-491-ND) for SZH-002T-P0.5

Drive Setup (Drive Resolution and Drive Current Output)

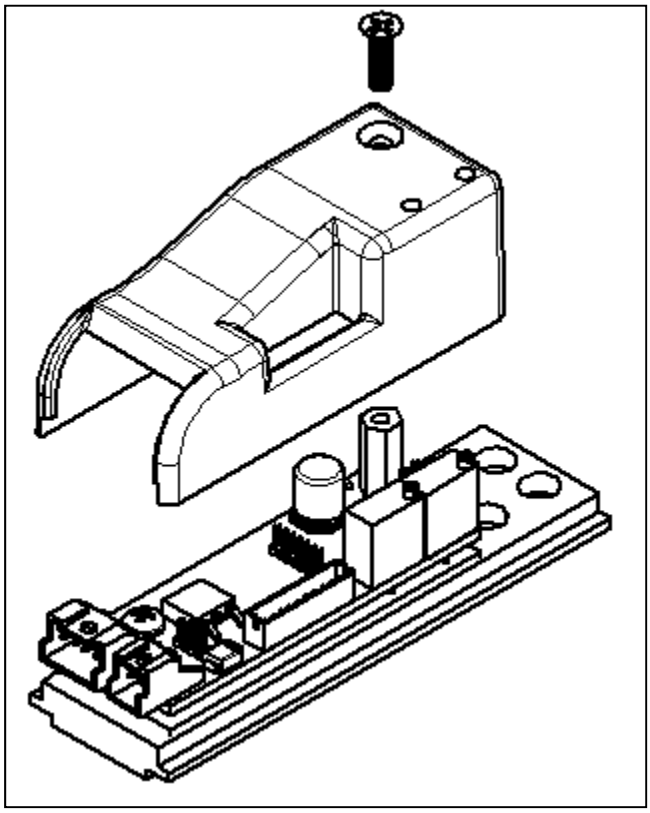
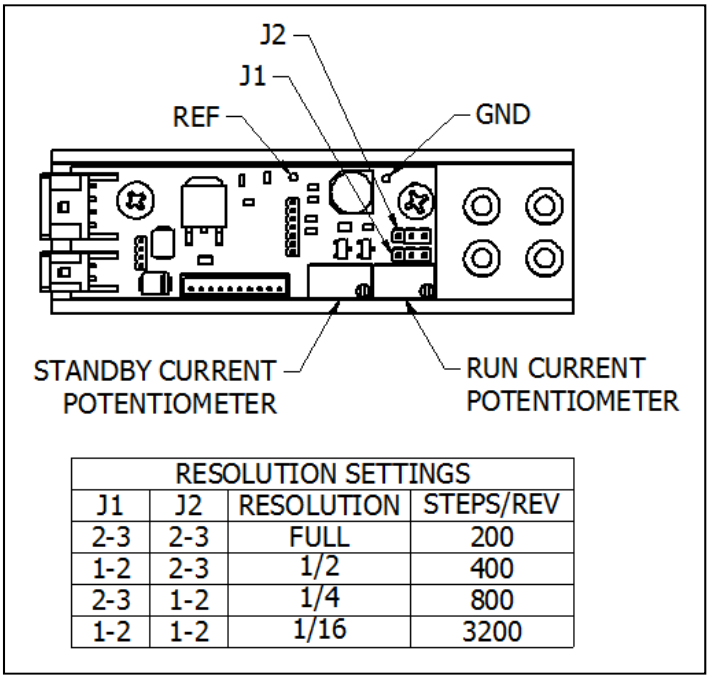


Figure 7. Removing Cover



RESOLUTION SETTINGS			
J1	J2	RESOLUTION	STEPS/REV
2-3	2-3	FULL	200
1-2	2-3	1/2	400
2-3	1-2	1/4	800
1-2	1-2	1/16	3200

Figure 8. Resolution Settings and Current Settings

Resolution Settings

In order to select the desired resolution of the drive jumpers J1 & J2 will need set. First start by removing the cover by removing the single phillips-head screw (see figure 7). Then lift the cover straight up to expose the printed circuit board. Using the chart in Figure 8 select the desired resolution then place the appropriate jumpers on the proper position. For example to achieve a resolution of 3200 steps per revolution place jumpers J1 & J2 on positions 1-2 for both jumpers. **The factory standard resolution upon shipping unless otherwise specified is 3200 steps per revolution.**

Setting Drive Current Output

Run and Standby currents can be adjusted by measuring the voltage on the printed circuit board using a controller and associated cable or it can be done using a special X3 connector.

Setting Drive Current with 6K or ACR Controller

To measure the drive current using a 6K or ACR controller you will need to power up the controller and the Parker ion Stepper Drive. To measure the REF voltage you will need to remove the cover. Start by removing the single phillips-head screw, and then lift the cover straight up to expose the printed circuit board. Place the voltage leads on the GND and REF pads (see figure 8). With the control cable **NOT** connected to X3, measure the Run Current and adjust the voltage using the Run Current Adjustment screw (see figure 5). With the control cable connected between the controller and the drive on connector X3, measure the Standby Current and adjust the voltage using the Standby Current Adjustment screw. Use the appropriate drive current equation from the following pages to determine the current.

Note: When setting the Standby Current with the control cable connected to the controller and to the drive, the controller STEP output must be low and not commanding motion.

Safety Warning - Motion control equipment is capable of producing rapid movement and high forces. Unexpected motion may occur especially during the development of controller programs. KEEP WELL CLEAR of any machinery driven by stepper or servo motors. Never touch any part of the equipment while it is in operation.

Setting Drive Current with X3 10 Pin Connector Housing

In order to measure the REF voltage from connector X3 you will need the 10 position connector housing with three wire going to Pin 1 (REF), Pin 7 (STEP+) and Pin 8 (GND). With the ion Drive powered up, plug in the connector show in Figure 9 to X3. To measure the Run Current leave STEP+ disconnected. Adjust the voltage using the Run Current Adjustment screw. To measure the Standby Current, connect STEP+ to GND as shown in figure 10. Adjust the voltage using the Standby Current Adjustment screw. Use the appropriate drive current equation from the following pages to determine the current.

Note: The reference voltage will require 1.5sec to reach the standby current level.

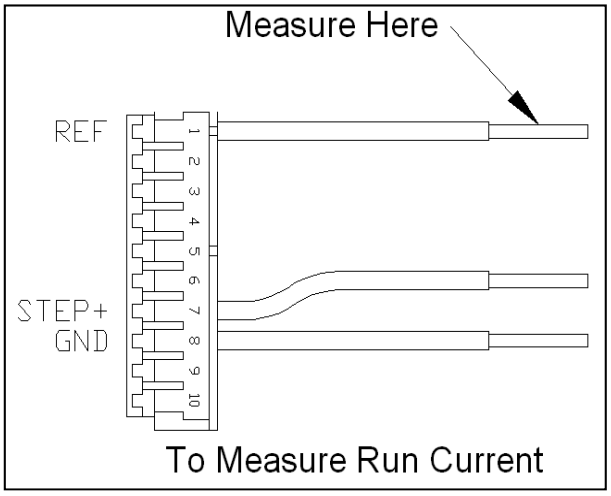


Figure 9. Setting Run Current

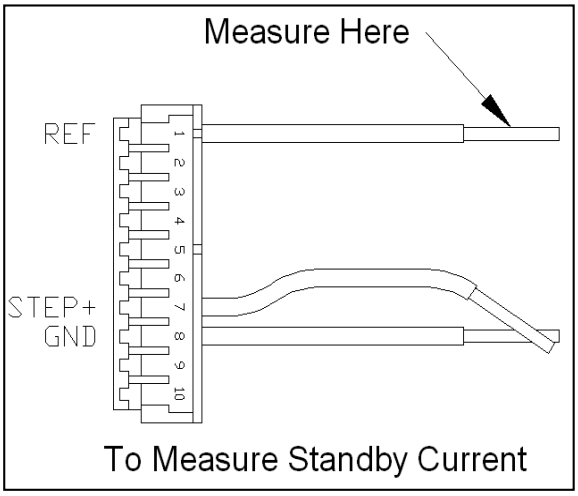


Figure 10. Setting Standby Current

Drive Current Equation

Calculate the current with the following equations:

Current = REF / 1.6
Note: Full current is NOT available in Full Stepping Mode.

Current = (REF / 1.6) * 0.707 (For full stepping mode only)

Stepper Motor Current (RMS or Peak)

Stepper motor drives are rated by the amount of current they output to the motor. The rating can be either Peak or RMS Current. The Parker ion Stepper Drive is rated in Peak Current. Stepper motors are rated either by Peak or RMS current; refer to the motor's documentation to determine the correct rating. In order to achieve the maximum torque output of the motor the current must be set based on the stepping mode and whether or not the motor is in motion. One of the key benefits of the Parker ion Stepper Drive is the ability to reduce power consumption and heat generation by adjusting the run current and standby current potentiometers.

When a stepper motor is moving the magnitude of the current is varying. So we use the RMS current to determine the effective amount of current to determine the amount to torque being produce. To determine the RMS current we use the following equation:

$$\text{RMS Current} = \frac{\text{Ipeak}}{\sqrt{2}} \quad \text{or} \quad \text{RMS Current} = \text{Ipeak} \cdot 0.707$$

Knowing that the effective RMS current is decreased when in motion, we need to increase the current while running. To do this we simply multiply the Peak current by 1.414 and use this value to set the Run Current. For example, you have a 1A Peak Stepper motor and you would like full torque during running. Use the following equation to set the effective current to run at full torque.

1A * 1.414 = 1.414A

Now using 1.414A as the Peak Current to determine the effective RMS Current

1.414A * 0.707 = 1A RMS

Full Stepping Mode

For the ion Stepper Drive, Full stepping mode current is limited to the RMS of the Peak Drive current. So when in Full Stepping mode use the following equation to determine the effective motor current.

Effective Motor Current = Peak Current * 0.707

This is true when the motor is in motion or when the motor is stopped. So the average effective motor current will always equal to the RMS current in Full Stepping Mode.

Half, Quarter, and Sixteenth Stepping Mode

For Half, Quarter, and Sixteenth Stepping Mode the effective motor current while in motion is equal to the RMS Current. When not in motion the effective current will be the Peak Current. The Effective current can be determined by the following equations:

Effective Motor Current while Running = Peak Current * 0.707

Effective Motor Current while NOT Running = Peak Current

Run Current vs. Standby Current

Since we are able to determine the effective running motor current we can use this information to set the Run Current and the Standby Current. Using an example of a motor that has a Peak Current rating of 1Amp, running in Sixteenth Stepping Mode; we need full torque when running and full torque when not running.

Using the instructions from the section "Setting Drive Current Output" we will first need to set the Run Current. Since we need full current for full torque when running we use the following equations:

1A * 1.414 = 1.414A for the Current when running

To get the effective current in RMS we use the following equation:

1.414A * 0.707 = 1A RMS this will be the effective run current also known as the Peak rated current of the motor

So now we need to set the Run Current potentiometer for 1.414A. The equation for this is:

Current = REF / 1.6

We rearrange the equation to get **Current * 1.6 = REF**

1.414 * 1.6 = 2.26 for REF

We now adjust the Run Current potentiometer to get 2.26V from the REF output.

Now we need to set the Standby Current. As we said above we want full torque when not in motion so that means we need the full current of 1Amp.

1 * 1.6 = 1.6 for REF

We now adjust the Standby Current potentiometer to get 1.6V from the REF output.

Troubleshooting

Symptoms	Probable Causes	Solutions
The drive loses pulses at high speed	Controller is sending pulsed to fast	Verify that the controller has a minimum STEP Pulse Width of 1.0µs and a minimum STEP Pulse Low Time of 1.0µs
	Motor is out of torque	Verify that the motor is sized correctly for you application
The motor stalls at high speeds	The velocity is too high	Decrease the velocity
	Motor current is not set correctly	Check the current settings
	Motor is under sized for application	Verify that the motor is sized correctly for your application
The motor stalls during the acceleration	Motor current is not set correctly	Check the current settings
	The acceleration is set too high	Decrease the acceleration
	Motor is under sized for application	Verify that the motor is sized correctly for your application
Motor does not move commanded distance	Motor resolution is set incorrectly	Determine the resolution on your controller and verify that the drive resolution setting is the same.
Controller moves motor in wrong direction	There is a direction conflict within the controller	Verify controller direction
	Motors is wired incorrectly	Change direction by swapping motor leads A+ and A-
	Control cable is wired incorrectly	Verify the controller leads for DIR+ and DIR-
There is little or no holding torque during move and/or holding position	Run current is not set correctly	Check the Run current settings
	Standby current is not set correctly	Check the Standby current settings

Frequently Asked Questions

What communication protocols are available?

At this point the ion drive only accepts a step and direction input; it does not offer a bus network option yet.

Can I get the stepper drive as a board only, without the cover and mounting kit?

Yes, it is available as a board only for OEM use. Please contact the factory for more details.

Does the ion have any of the active damping or electronic viscosity patented features that the Zeta or GT offer?

No, this is a basic board level amplifier. Users must be careful when sizing the motor / drive combination to account for resonance zones.

Will the ion work with the LV or HV Series stepper motors?

The ion is a 2 amp drive so it will work with the LV Series of stepper motors, but will not be high enough power for the HV Series.

Can I use an ion for any other mechanical actuators other than the LCR?

Yes, you must be sure that the motor running torque and breakaway torque do not exceed the available current output of the drive though.

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