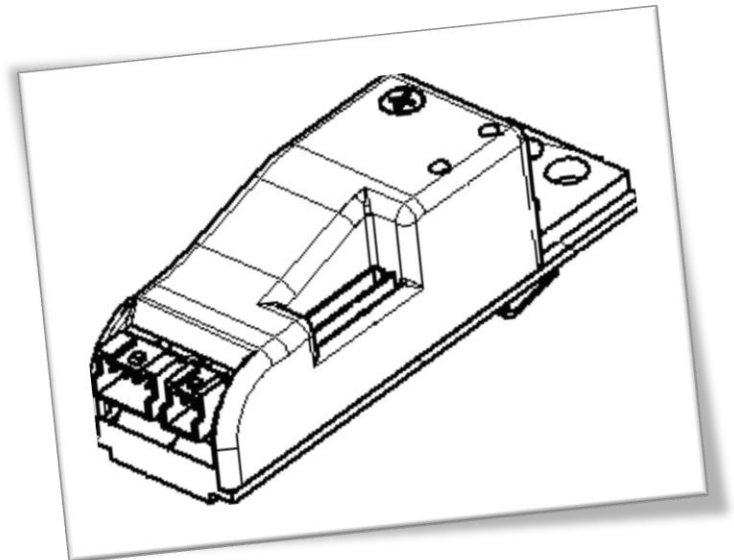

Parker Hannifin Corporation

P₂TM Stepper Drive

Product Manual and User Guide



P/N: 102-4002-01
Rev. 6
3/1/13

ENGINEERING **YOUR** SUCCESS.

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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Since Parker Hannifin constantly strives to improve all of its products, we reserve the right to change this user guide and software and hardware mentioned therein at any time without notice.

In no event will the provider of the equipment be liable for any incidental, consequential, or special damages of any kind or nature whatsoever, including but not limited to lost profits arising from or in any way connected with the use of the equipment or this user guide.

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Revision Notes

Revision 1
Original Document

Revision 2 – 2/8/2011
Spelling correction

Revision 3 – 3/24/2011
Clarified the equations for setting the drive current.

Revision 4 – 6/27/2011
Added section "System Installation Overview" with information for Electromagnetic Compatibility (or EMC).

Revision 5 – 7/07/2011
Added vibration specification.

Revision 6 – 3/1/13
Rebranded as the P2™ Drive



The P2™ Stepper Drive

The Parker P2 Stepper Drive is a complete step and direction indexer for Hybrid step motors. The P2™ is designed to operate stepper motors in full, half, quarter, and sixteenth step modes with an output drive capacity up to 24VDC and ± 2.0 Amps. In an 80mm x 25mm x 25mm package, the P2™ 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 P2™ 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.

Specifications

- Supply Input: 12-24VDC
- Max Motor Output Current: 2.0Amps
- Differential input voltages up to ± 14 VDC (low/high input) Absolute MAX of ± 14 VDC
- Enable, Step & Direction input levels: < 0.8 V Low, > 2 V High
- Minimum STEP Pulse Width: 1.0 μ s
- Minimum STEP Pulse Low Time: 1.0 μ s
- Operating Temperature: 0 to 40°C with natural convection
- Relative Humidity: 5 to 95% non-condensing
- Vibration not to exceed 18G

Mechanical Specifications

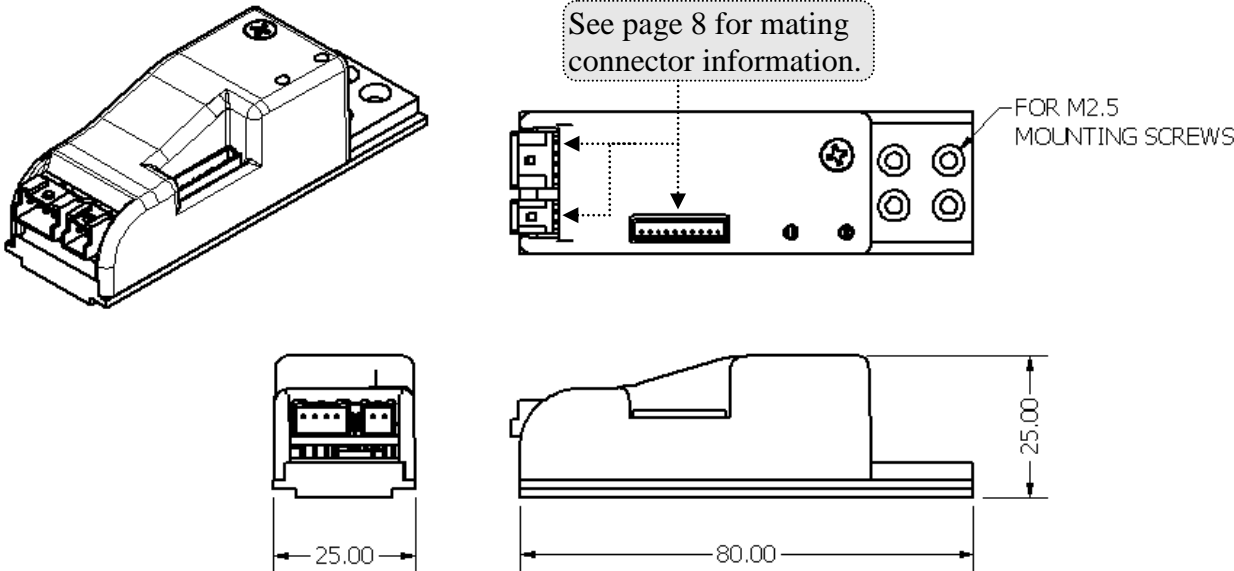


Figure 1: Mechanical Specifications

Mounting Accessories

Mounting Kit to Mount P2™ to LCR22, LCR30 or LCR45

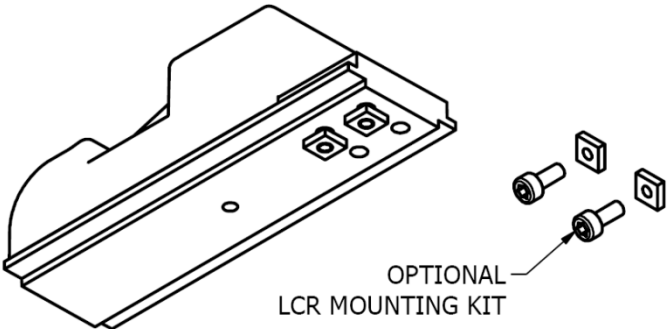


Figure 2: Optional P2™ to LCR Mounting Kit

Din Rail Mounting Accessory

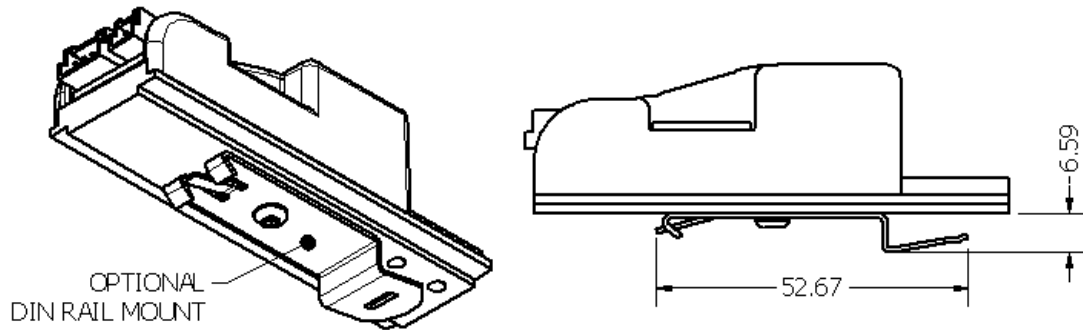


Figure 3: Optional Din Rail Mount

Mounting Accessories	
Description	Part Number
Mounting Kit to Mount P2™ to LCR22, LCR30 or LCR45	002-3295-01
K1 - Din Rail mounting kit	002-3294-01

Connectorized Cable Information

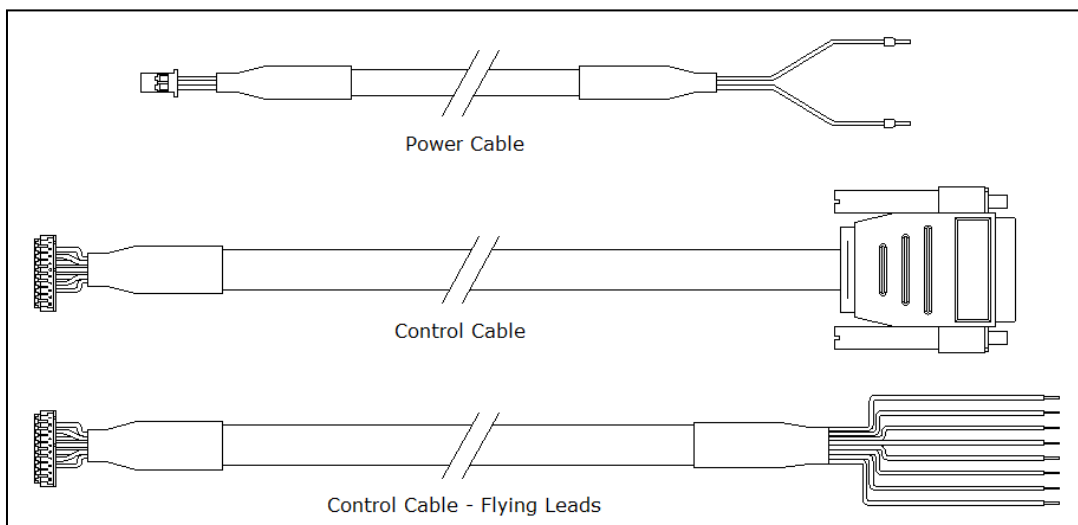


Figure 4: Optional Cables

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

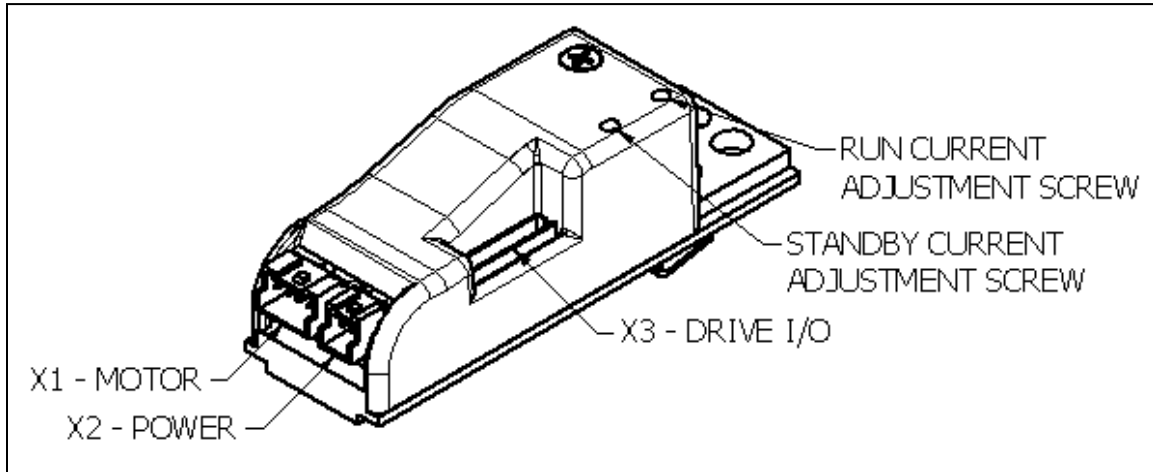


Figure 5: Connection Diagram & Current Adjustment



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.

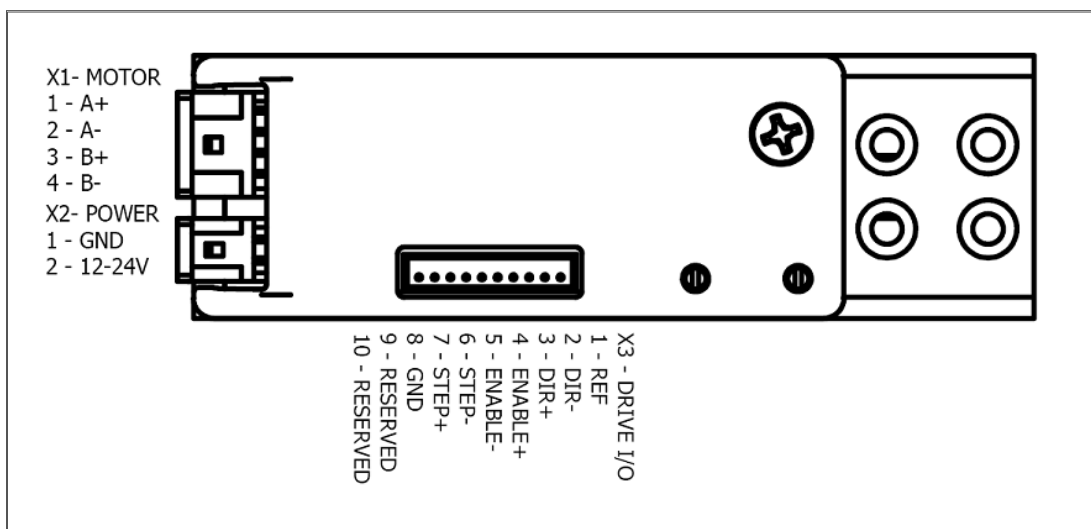


Figure 6: Pin-Out Diagram

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)

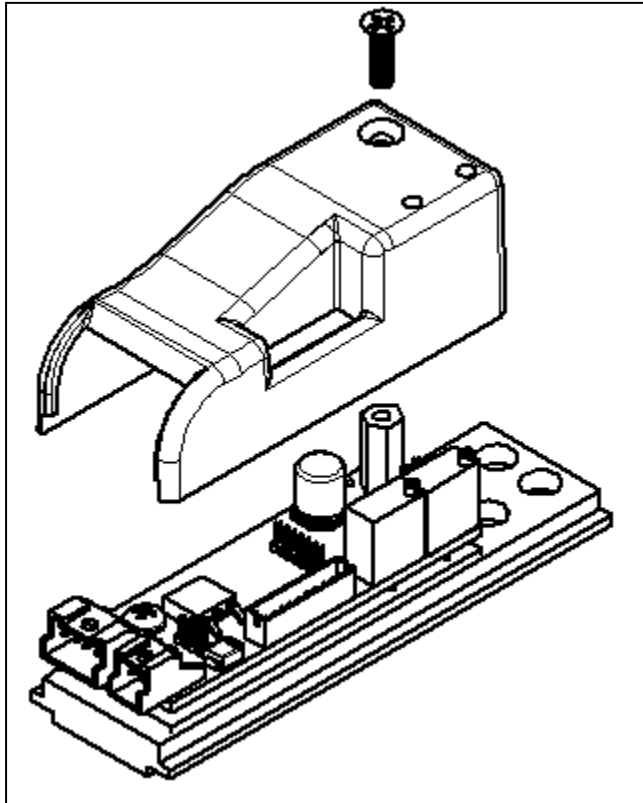


Figure 7. Removing Cover

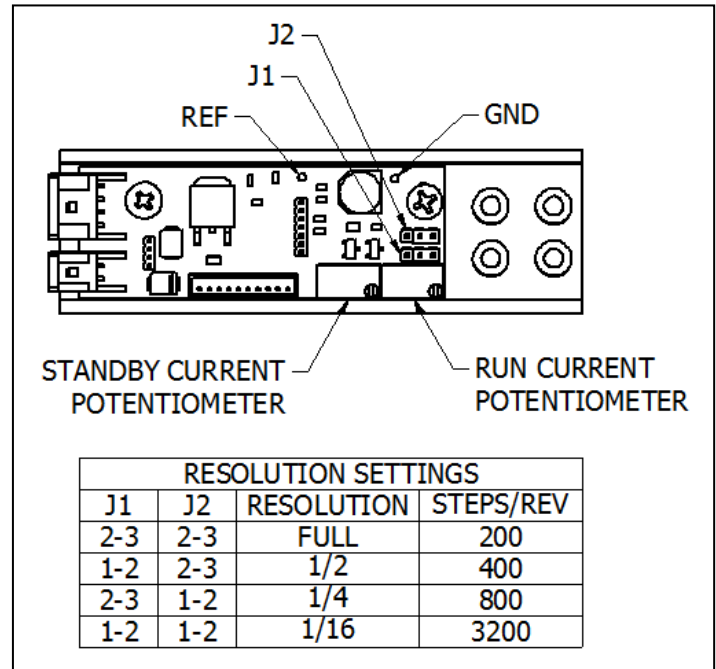


Figure 8. Resolution Settings and Current Settings

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 P2™ 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 P2™ 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.

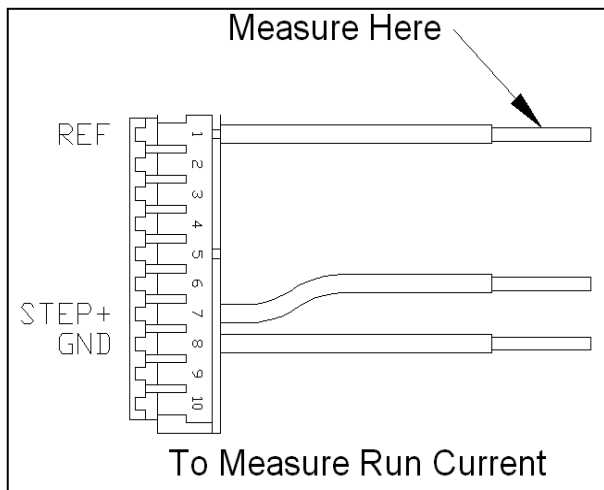


Figure 9. Setting Run Current

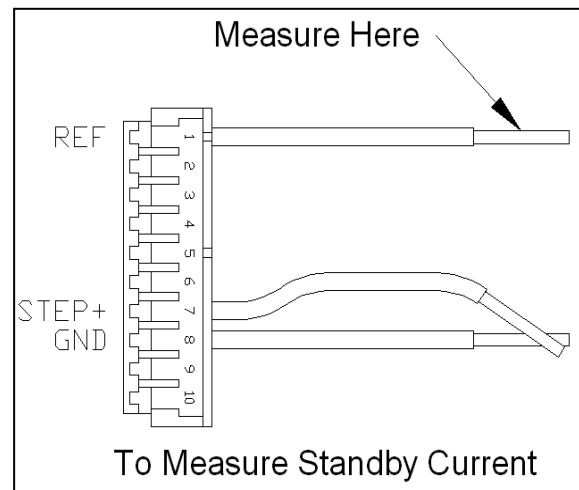


Figure 10. Setting Standby Current

Drive Current Equation

Calculate the Parker P2™ Stepper Drive current with the following equations:

If operating in Half, Quarter, and Sixteenth Stepping Mode

$$\text{Current} = \text{REF} / 1.6$$

Note: Full current is NOT available in Full Stepping Mode.

If operating in Full Stepping Mode

$$\text{Current} = (\text{REF} / 1.6) * 0.707 \text{ (For full stepping mode only)}$$

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 Current or RMS Current. The Parker P2™ 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 called Run Mode or not in motion called Standby Mode. One of the key benefits of the Parker P2™ Stepper Drive is the ability to reduce power consumption and heat generation by adjusting the Run Mode current and the Standby Mode current with potentiometers.

Setting the Drive Current Output Based on the REF Voltage

To set the drive current to the appropriate current level for the stepper motor use the following equations.

If operating in Half, Quarter, and Sixteenth Stepping Mode

Run Current Equation

$$\text{REF} = \text{Motor Current RMS} * 1.414 * 1.6$$

Standby Current Equation

$$\text{REF} = \text{Motor Current RMS} * 1.6 * \% \text{Decrease}$$

If operating in Full Stepping Mode - Drive Current Limited to (Current * 0.707)

Run Current Equation

$$\text{REF} = \text{Motor Current RMS} * 1.414 * 1.6$$

Standby Current Equation

$$\text{REF} = \text{Motor Current RMS} * 1.6 * 1.414 * \% \text{Decrease}$$

System Installation Overview

This section contains information related to installation methods and practices that can be used to aid the systems integrator or machine builder in designing a compliant installation, meeting the needs of global regulatory agencies pertaining to “Electromagnetic Compatibility (or EMC)”.

Although P2™ Stepper Drives are technically considered motion control components and are therefore not within the scope of the European union’s CE (Conformité Européenne) directives, Parker has taken the initiative to provide its customers with easy to integrate motion control products that meet global requirements.

The following constitutes what is typically required to install P2™ Stepper Drives into a CE compliant system. Additional installation measures may be required at some locations. The machine builder has the ultimate responsibility for machine compliance.

General EMC Considerations

The P2™ Stepper Drive is a motion control component and as such will be built in to another machine that will in turn be required to comply with the relevant directives of the marketplace. It is important to remember that for specific installations, the full protection requirements of the EMC directive need to be met before the system is taken in to service. This must be verified either by inspection or by testing. The following EMC installation recommendations are intended to assist in ensuring that the requirements of the EMC directive are met. It may be necessary to take additional measures in certain circumstances and at specific locations. It should be stressed that although these recommendations are based on the expertise acquired during the design and development of the P2™ Stepper Drive, and on tests carried out on similar products, it is impossible for Parker to guarantee compliance of any particular installation. This will be strongly influenced by the physical and electrical details of the installation and the performance of other system components. Nevertheless, it is important to follow all the installation recommendations if an adequate level of compliance is to be achieved.

Installing the P2™ Stepper Drive

The P2™ Stepper Drive has been shown to meet the requirements of EMC directive EN 55011 Class A / EN 61000-4-2 / 61000-4-4 / EN 61000-4-8 when installed according to the recommendations given within this section.

Precautions

During installation, take the normal precautions against damage caused by electrostatic discharges. Wear earth wrist straps.

A Highly-Immune, Low-Emission Installation – Meeting the Requirements of the Electromagnetic compatibility (EMC) Directive

The following information was compiled to aid the machine builder or systems integrator in gaining EMC compliance. For effective control of Conducted and Radiated Emissions, along with maximizing the P2™ Stepper Drive's inherent noise immunity, the following recommendations should be followed.

- Mount the Drive and all components to a clean (not painted), earthed, metal panel. **Important!** To reduce the risk of electrical noise entering your system you must properly earth ground the metal panel, and remove all paint and other non-conductive surface coatings from the panel mounting surface and RF earth bonding locations.
- Install a Main supply filter. The P2™ Stepper Drive requires an EMC main supply filter to meet EMC emission requirements. It is recommended that the drive is mounted on a conductive panel which is shared with the EMC filter. If the panel has a paint finish, it will be necessary to remove the paint in certain areas to ensure filters and drive make a good large-area metal to metal contact between filter case and panel. The recommended EMC main supply filter is manufactured by **Corcom part number 3EB1 (Tyco Electronics part number 6609020-5)**.

Use shielded cables. Parker P2™ Stepper Drive cabling—requires no additional cable preparation. All motor connections must be made using a high quality braided-screen cable. Cables using a metalized plastic bandage for an earth screen are unsuitable and in fact provide very little screening. Care must be taken when terminating the cable screen, the screen itself is comparatively fragile; bending it around a tight radius can seriously affect the screening performance. All cables must maintain high integrity 360 degree shielding. Parker P2™ Stepper Drive cables are fully shielded and provide the required screening.

- Install a P-Clip with 360° connection on the shields of the motor and the power cables and bond them to the aluminum base of the P2™ Stepper Drive. A P-Clip kit is available from Parker that will accommodate both the motor extension cable (006-2357-x.0) and the power cable (006-2342-x.0). Provisions have been made for attaching the P-Clip to either side of the base via two M3 holes with a 6mm screw. The **P-Clip kit part number is 002-3313-01**.

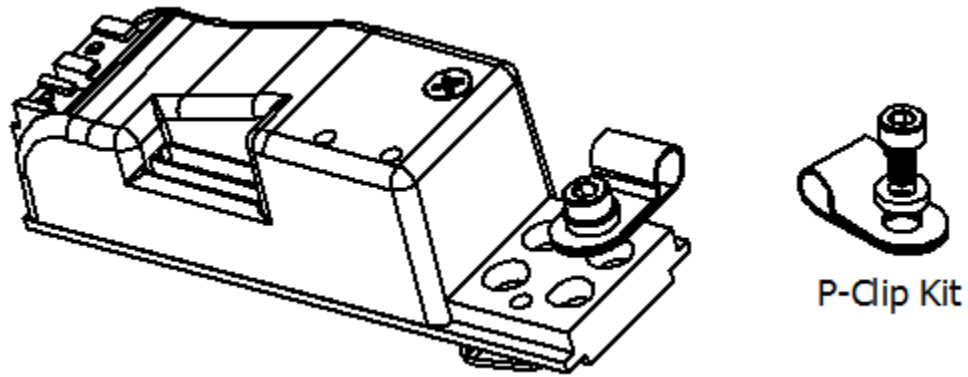


Figure 11. P-Clip Kit

- Install a ferrite on the motor lead after the P-Clip with 2 turns. The recommended ferrite is available from **Fair-Rite part number 0431164181**.

Troubleshooting

Symptoms	Probable Causes	Solutions
The drive loses pulses at high speed	Controller is sending pulsed too 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 your 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 **P2™** 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 **P2™ 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 **P2™ work with the LV or HV Series stepper motors?**

The **P2™** 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 **P2™ 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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