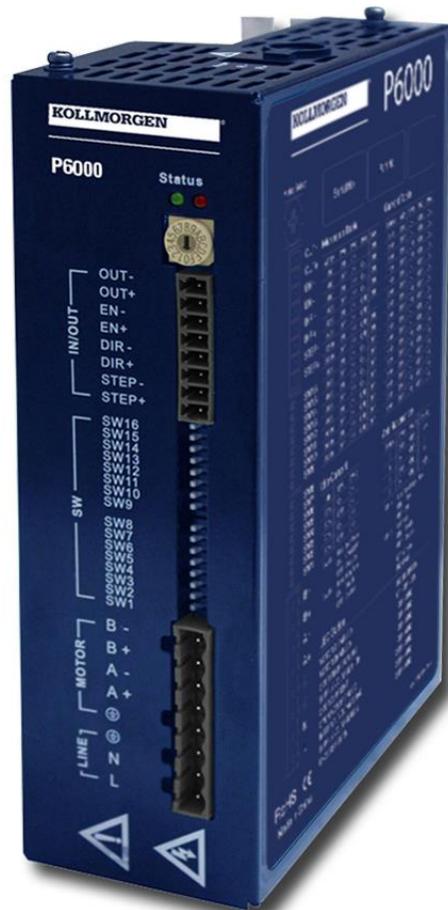


Kollmorgen P60660 (AC) Installation Manual



Edition: A, May 2016
Part Number: 903-600001-00
Original Document

Keep all manuals as a product component during the life span of the product.
Pass all manuals to future users / owners of the product.

Record of Document Revisions

| Revision | Remarks |
|-------------|---------------|
| A, 5/4/2016 | First edition |

IMPORTANT NOTICE

Copyright© Kollmorgen™2016. All rights reserved. Kollmorgen holds the copyright to this manual. All rights are reserved and no part of this publication may be reproduced or transmitted in any form or by any means without prior written consent from Kollmorgen.

Disclaimer

The information in this manual was accurate and reliable at the time of its release. However, Kollmorgen reserves the right to change the specifications of the product described in this manual without notice at any time.

This document contains proprietary and confidential information of Kollmorgen. The contents of the document may not be disclosed to third parties, translated, copied or duplicated in any form, in whole or in part, without the express written permission of Kollmorgen.

Registered Trademarks

Kollmorgen is a registered trademark of Danaher Corp.

Technical changes which improve the performance of the device may be made without prior notice!

Printed in the United States of America

This document is the intellectual property of Kollmorgen. All rights reserved. No part of this work may be reproduced in any form (by photocopying, microfilm or any other method) or stored, processed, copied or distributed by electronic means without the written permission of Kollmorgen.

| | | |
|----------|---|-----------|
| 1 | General | 5 |
| 1.1 | Features | 5 |
| 1.2 | Warranty..... | 5 |
| 1.3 | Safety Symbols | 5 |
| 2 | Overview..... | 6 |
| 2.1 | Part Number Scheme..... | 6 |
| 2.2 | Accessories..... | 6 |
| 2.3 | System Components..... | 7 |
| 3 | Installation..... | 8 |
| 3.1 | Safety | 8 |
| 3.1.1 | Your Responsibility | 8 |
| 3.1.2 | Safety Guidelines | 8 |
| 3.2 | Unpacking and Inspecting..... | 9 |
| 3.2.1 | Unpacking Procedure..... | 9 |
| 3.2.2 | Inspection Procedure | 9 |
| 3.2.3 | Storing the Unit | 9 |
| 3.3 | Selecting Other System Components..... | 9 |
| 3.3.1 | Indexer Selection | 9 |
| 3.3.2 | Motor Selection | 9 |
| 3.4 | Mounting | 10 |
| 3.4.1 | Panel Mounting | 10 |
| 3.4.2 | Mounting Guidelines | 10 |
| 3.5 | Wiring..... | 11 |
| 3.5.1 | Electrical Noise Reduction | 11 |
| 3.5.2 | Shock Hazard Reduction | 11 |
| 3.5.3 | Terminal and Mating Connectors..... | 11 |
| 3.5.4 | Input Power Connection – LINE..... | 12 |
| 3.5.5 | Motor Power Connection - MOTOR..... | 12 |
| 3.5.6 | Signal Connector – IN/OUT | 13 |
| 3.5.6.1 | Step and Direction Inputs..... | 13 |
| 3.5.6.2 | Enable Input | 14 |
| 3.5.6.3 | Fault Output | 14 |
| 4 | Configuration | 16 |
| 4.1 | Setting the Rotary and Dip Switches | 16 |
| 4.2 | Motor Selection | 17 |
| 4.2.1 | Rotary Switch Setting for P60660-SDx-000..... | 17 |
| 4.2.2 | Rotary Switch Setting for P60660-SDx-001..... | 18 |
| 4.2.3 | Step Size..... | 18 |
| 4.2.4 | Motor Current Level | 19 |
| 4.2.5 | Idle Current Reduction | 20 |
| 4.2.6 | Anti-Resonance..... | 21 |
| 4.2.7 | Step Command Mode | 21 |
| 4.2.8 | Input Signal Noise Filter..... | 22 |
| 4.2.9 | Step Smoothing Filter..... | 22 |
| 4.3 | Testing the Installation | 23 |
| 4.3.1 | Self-Test Procedure | 23 |

- 4.4 Getting Help23
- 5 Troubleshooting24**
 - 5.1 LED Drive Status.....24
 - 5.2 Common Symptoms and Corrective Actions25
- 6 Appendix A: Specifications26**
 - 6.1 Electrical Specifications26
 - 6.2 Environmental Specifications28
 - 6.3 Mechanical Specifications.....28
 - 6.3.1 Mating Connectors28
 - 6.4 Regeneration Clamping Circuit29

1 GENERAL

This manual contains information and procedures to install, setup, and troubleshoot the P60660 stepper motor drive. The most effective way to use this manual is to follow the installation and configuration instructions contained in [Chapter 3: Installation](#) and [Chapter 4: Configuration](#).

1.1 Features

The Kollmorgen P60660 stepper motor drive converts step and direction inputs into motor winding currents to control a two-phase stepper motor. Standard features include:

- No programming required!
- Switch selectable current output up to 5.7 Arms, 8.0 Apeak
- 120/240 VAC Input (160/320 VDC Bus)
- Kollmorgen Stepper Optimum Motor Pairing; switch selectable
- All Inputs and Outputs are Optically Isolated
- Single-Ended and Differential Step and Direction or Step CW/CCW Command
- Enable Input
- Fault Output (sinking or sourcing)
- Status LEDs for easy troubleshooting
- Switch Selectable Micro-Stepping Resolution Settings
- Step Smoothing Filter
- Idle Current Reduction
- Anti-Resonance based on Load Inertia
- Self-Test conducts Spin Test to Confirm Proper Connection
- RoHS & CE certified

1.2 Warranty

The Kollmorgen P60660 drive has a one year warranty against defects in material and assembly. Products that have been modified by the customer, physically mishandled, or otherwise abused through incorrect wiring or switch settings are void from the warranty plan.

1.3 Safety Symbols

- | | |
|------------------|---|
| ▲ WARNING | <i>Alerts users to potential physical danger or harm. Failure to follow warning notices could result in personal injury or death.</i> |
| ▲ CAUTION | <i>Directs attention to general precautions, which if not followed, could result in personal injury and/or equipment damage.</i> |
| NOTE | <i>This is not a safety symbol. Highlights information critical to your understanding or use of the product.</i> |

2 OVERVIEW

This chapter introduces the P60660 stepper motor drive. Topics covered:

- 2.1 Part Number Scheme
- 2.2 Accessories
- 2.3 Other System Components and System Diagram

2.1 Part Number Scheme

Use the part number scheme for product identification only.

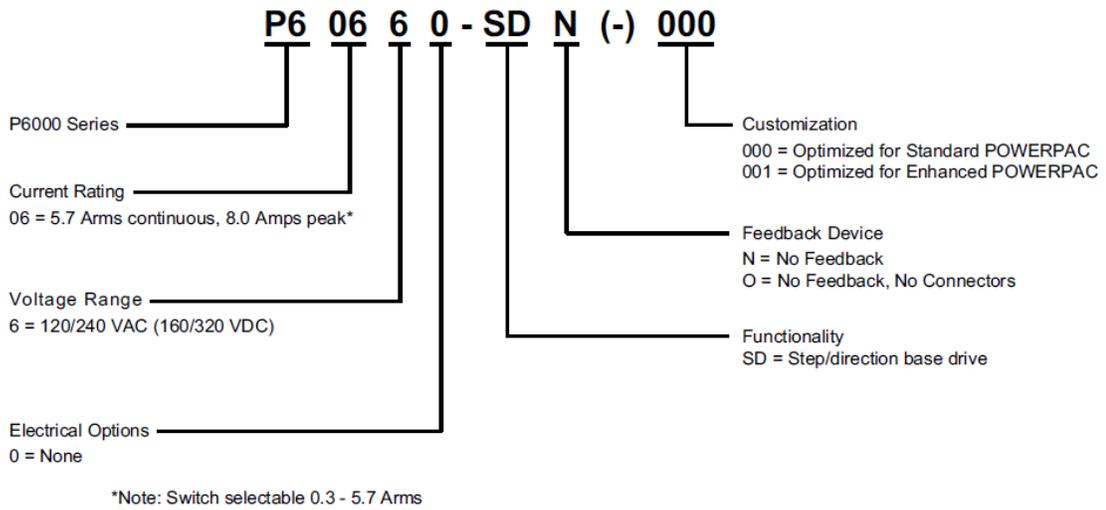


Figure 1: Part Numbering Scheme

2.2 Accessories

The following accessories are available for the P60660 stepper motor drive.

| Accessory | Description |
|---------------|--|
| P60660-CONKIT | Mating connectors for motor power, line power and I/O connectors |

2.3 System Components

The other components that, along with the drive, comprise a motor control system are:

- Indexer or pulse generator
- Motor

Installation guidelines for these components are described in [Chapter 3: Installation](#).

The following connection and system diagram provides an overview of the drive in a typical system setup:

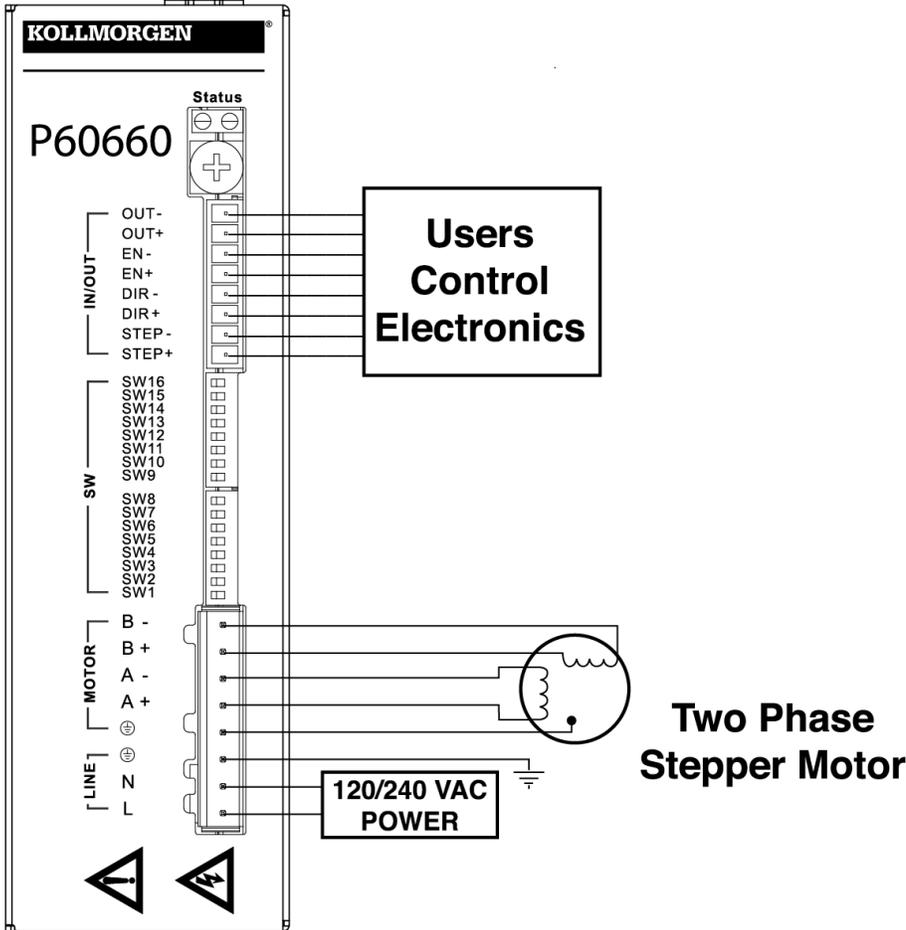


Figure 2: Connection and System Diagram

3 INSTALLATION

This chapter explains how to install the P60660 stepper motor drive.

Topics covered:

- 4.1 Safety
- 4.2 Unpacking and Inspecting
- 4.3 Selecting other System Components
- 4.4 Mounting
- 4.5 Wiring

3.1 Safety

This section describes the safety requirements for the P60660 stepper motor drive.

3.1.1 Your Responsibility

As the user or person applying this unit, you are responsible for determining the suitability of this product for any application you intend. In no event will Kollmorgen be responsible or liable for indirect or consequential damage resulting from the misuse of this product.

Read this manual completely too effectively and safely operate the P60660 unit.

⚠ WARNING *The circuits in the P60660 drive are a potential source of severe electrical shock. Follow the safety guidelines to avoid shock.*

3.1.2 Safety Guidelines

It is the machine builder's responsibility to insure that the complete machine complies with the Machine Directive (EN60204). The following requirements relate directly to the stepper controller:

- Do not operate the drive without the motor case tied to earth ground.

NOTE

This is normally done by connecting the motor's case to earth ground.

- Do not make any connections to the internal circuitry. The input and output signals are the only safe connection points.
- Never plug or unplug connectors with power applied.
- Never connect or disconnect any wires to terminals with power applied.
- Be careful of the motor terminals when disconnected from the motor. With the motor disconnected and power applied to the drive, these terminals have high voltage present, even with the motor disconnected.
- Do not use the Enable input as a safety shutdown. Always remove power to the drive for a safety shutdown.
- If the drive indicates a fault condition, find the cause of the fault and fix it prior to resetting the fault or power cycling the drive.

3.2 Unpacking and Inspecting

This section describes unpacking, inspection, and storing procedures for the P60660 stepper motor drive.

3.2.1 Unpacking Procedure

1. Remove the P60660 and any other contents from the shipping container. Remove all packing material from the shipping container. Be aware that some connector kits and other equipment pieces may be quite small and can be accidentally discarded.
2. A label located on the side of the unit identifies the unit by model number and serial number.

3.2.2 Inspection Procedure

Inspect the unit for any physical damage that may have been sustained during shipment. If damage is detected, either concealed or obvious, notify the carrier immediately.

3.2.3 Storing the Unit

After inspection, store the drive in a clean, dry place. The storage temperature must be between -10 °C and 70 °C. To prevent damage during storage, replace the unit in the original shipping carton.

3.3 Selecting Other System Components

This section describes the indexer and motor selection of the P60660 stepper motor drive.

3.3.1 Indexer Selection

The P60660 drive requires step and direction or CW/CCW step inputs. Select an indexer that provides, as a minimum, these commands (5-24 volt logic). A compatible indexer will provide the capability to drive the input circuits shown in section 3.5.3. For most applications that operate at speeds above 300 rpm, an indexer that can ramp the step frequency is required.

3.3.2 Motor Selection

The P60660 is designed for use with a select group of Kollmorgen's POWERPAC and POWERMAX II hybrid stepper motors or most other 2 phase stepper motors. When using the select Kollmorgen motors, the drive's output waveform is optimized to maximize smoothness in order to achieve the best system performance. When using non Kollmorgen motors, the motor winding current and voltage rating must be compatible with the drive package, to ensure safe operation. Rotary Switch is set for the select Kollmorgen motors listed within this manual. For non-Kollmorgen motors the Rotary Switch may be left at 0.

Refer to the torque and speed curves in the "Kollmorgen Stepper Solutions Catalog" for best motor selections. Alternatively, contact your local Kollmorgen distributor for sizing and motor compatibility assistance.

3.4 Mounting

This section provides the panel mounting and dimensions for the P60660 stepper motor drive.

3.4.1 Panel Mounting

The P60660 drive can only be mounted on the narrow side of the chassis. M4 screws should be used in the two holes on the back of the drive. The drive should be securely fastened to a smooth, flat, non-painted metal surface that will help conduct heat away from the chassis.

CAUTION Never use the drive in a space where there is no air flow or where other devices cause the surrounding air to be more than 40 °C.

CAUTION Never put the drive where it can get wet or where metal or other electrically conductive particles can get on the circuitry.

NOTE Always provide air flow around the drive. When mounting multiple drives near each other, maintain at least 50 mm (1.0 inch) or more of space between drives and 100 mm (3.9 inches) or more above and below the drive.

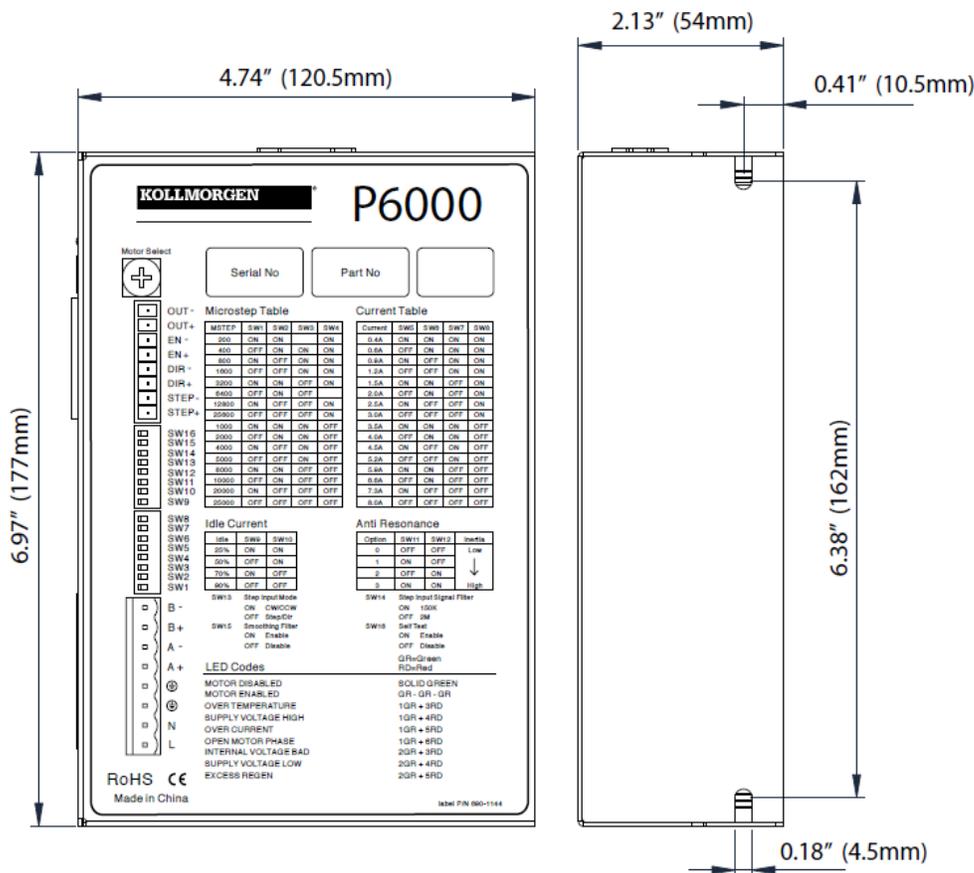


Figure 3: Mounting Dimensions

3.4.2 Mounting Guidelines

Your installation should meet the following guidelines:

- Vertical orientation of the unit
- Flat, solid surface capable of supporting the approximate 2.8 lbs. weight (1.26 kg mass) of the unit
- Free of excessive vibration or shock
- Minimum unobstructed space of 4 inches above and below the unit
- Maximum ambient temperature of 40 °C
- Maximum case temperature of 70 °C

3.5 Wiring

Wiring sizes, wiring practices, grounding, and shielding techniques described in the following section represent common wiring practices and should prove satisfactory in the majority of applications.

⚠ CAUTION *Non-standard applications, local electrical codes, special operating conditions, and system configuration wiring needs take precedence over the information included here. Therefore, you may need to wire the drive differently than what is described here.*

3.5.1 Electrical Noise Reduction

Use shielded and twisted cabling for the signal and power cables. This precaution reduces electrical noise.

3.5.2 Shock Hazard Reduction

Refer to section 3.1 for safety information that must be followed to reduce shock hazard.

3.5.3 Terminal and Mating Connectors

The P60660 has 3 terminal connectors. LINE-MOTOR is used for motor power and input power; IN/OUT is used for command input and output signals. Three mating connectors are supplied with the SDN drive variant. The mating connector kit includes three plug-in screw terminal/type connectors; it can be purchased separately as part number P60660-CONKIT.

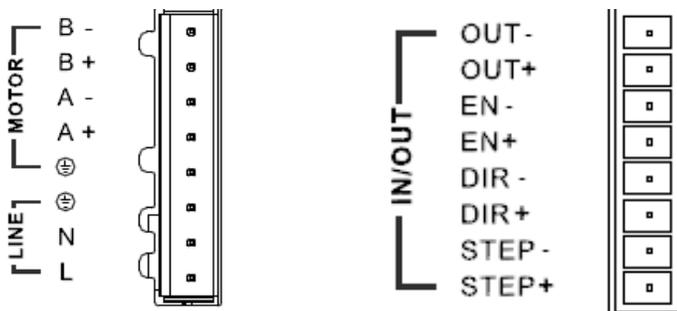


Figure 4: Connector Diagrams

3.5.4 Input Power Connection – LINE

The LINE connector connects the drive to the 120/240 VAC single-phase power supply. Use 16 AWG wire for Line (L) and Neutral (N). Use 14 AWG for Earth Ground (G). The P60660 contains an internal 10 A fast acting fuse.

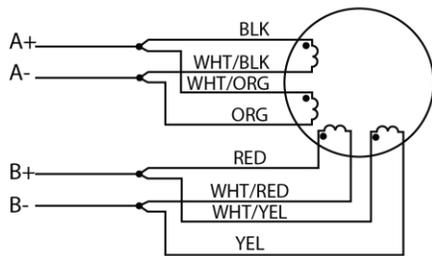
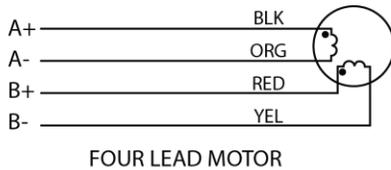
CAUTION Care should always be taken when working with high voltages.

NOTE An auto transformer can be used to drop the voltage to the correct level.

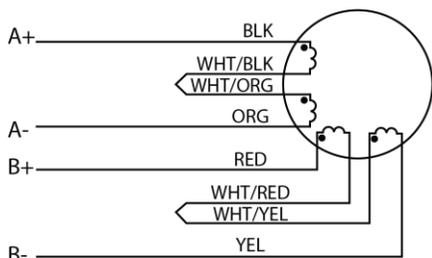
3.5.5 Motor Power Connection - MOTOR

The MOTOR connector connects the drive to the motor phases and motor case. The MOTOR connector utilizes a plug-in screw terminal type connector to simplify assembly and allow for quick connect and disconnect.

The diagrams below show the required connections between the P60660 MOTOR connector and Kollmorgen stepper motors with flying leads. Connections are shown for 4 lead motors, 8 lead motors with paralleled windings, and 8 lead motors with series windings.



EIGHT LEAD MOTOR CONNECTED IN PARALLEL



EIGHT LEAD MOTOR CONNECTED IN SERIES

Figure 5: Motor Phase Connection Configurations

3.5.6 Signal Connector – IN/OUT

The IN/OUT connector accepts step, direction and enable signals from an indexer or other source and outputs a signal indicating a fault condition in the P60660 drive.

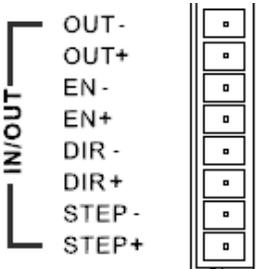
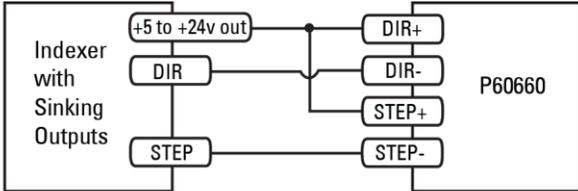


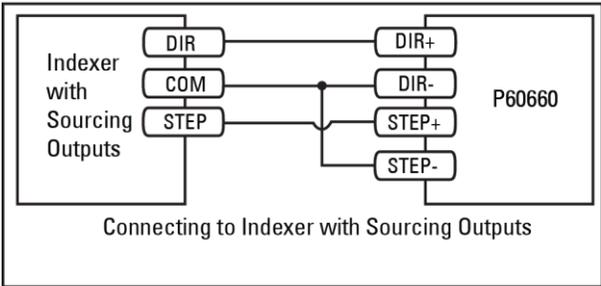
Figure 6: IN/OUT Signal Connector Diagram

3.5.6.1 Step and Direction Inputs

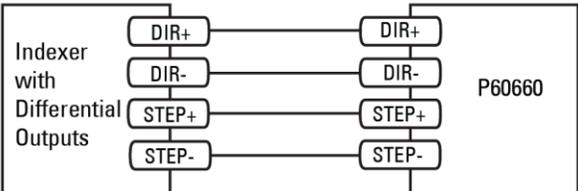
The P60660 has two high-speed optically isolated inputs called STEP and DIR. They accept 5 to 24 volt single-ended or differential signals up to 2 MHz. The maximum voltage that can be applied to the input is 28 V. The STEP input is used to command motor rotation. The motor executes one step when the 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



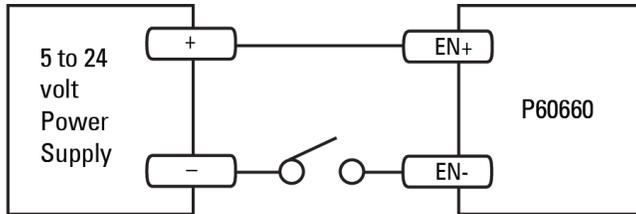
Connecting to Indexer with Differential Outputs
Many high-speed Indexers have differential outputs

Figure 7: IN/OUT Signal Connector Diagram

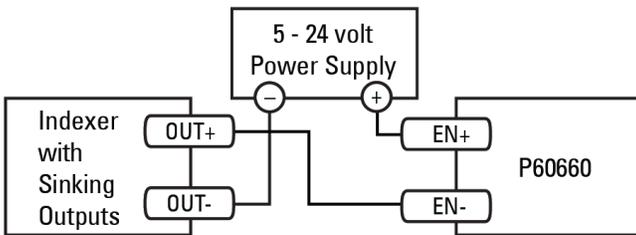
3.5.6.2 Enable Input

The EN input enables and disables the P60660 power stage. It is an optically isolated input that accepts 5-24 volt single-ended or differential signal. The maximum voltage that can be applied to the input is 28 V. When the EN input is closed, the driver amplifier is deactivated, all the MOSFETs will shut down and the motor will be free. When the EN input is open, the drive is activated.

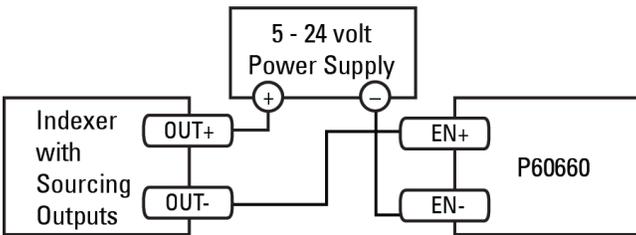
After the drive has encountered an error and the fault is removed from the system, a falling signal into the EN input will reset the error status and activate the drive amplifier.



Connecting the Input to a Switch or Relay



Connecting the Input to Sinking Outputs

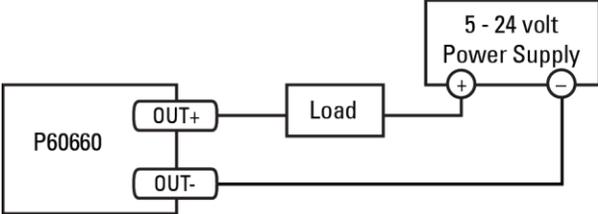


Connecting the Input to Sourcing Outputs

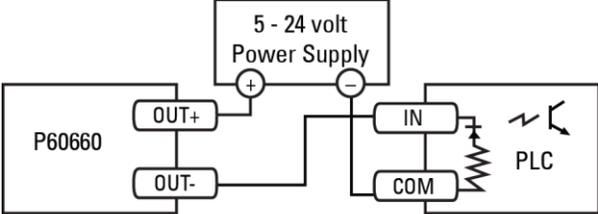
Figure 8: Enable Input Connection Configurations

3.5.6.3 Fault Output

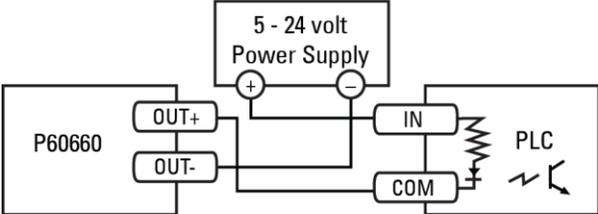
The P60660 stepper motor drive has one optically isolated output called OUT. The output signals a fault condition in the drive amplifier. The maximum collector current is 100 mA, and the maximum collector to emitter voltage is 30 V. The output can be wired to sink or source current. When the drive is working normally, the output is open. When the drive encounters an error, the output closes. For more information about fault conditions, see "[LED Drive Status](#)".



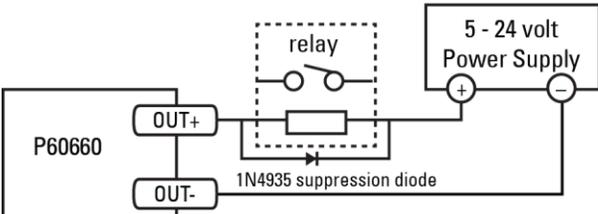
Connecting a Sinking Output



Connecting the Input to Sourcing Outputs



Connecting a Sourcing Output again



Driving a Relay

Figure 9: Fault Output Connection Configurations

4 CONFIGURATION

The chapter explains how to configure the P60660. Topics covered are:

4.1 Setting the Rotary and Dip Switches (SW1 – SW15)

4.2 Testing the installation (SW16)

This section is intended to familiarize the user with the hardware adjustments and settings required to power and operate the P60660 drive.

4.1 Setting the Rotary and Dip Switches

The P60660 stepper motor drive is specifically designed for use with Kollmorgen's POWERPAC and POWERMAX II hybrid stepper motors. The rotary switch selects the motor to be paired with the drive. This selection optimizes the drive's output waveform for the specified motor in order to achieve the best system performance. Many of the operational parameters of the drive can be set or changed using the dip switches – either by a single switch or combination of on/off settings of two or more switches.

The dip switches SW1 – SW15 set the following:

- Step size
- Motor current level
- Idle current reduction
- Anti-resonance based on load inertia
- Command Mode
- Input Signal Noise Filter
- Step Smoothing Filter

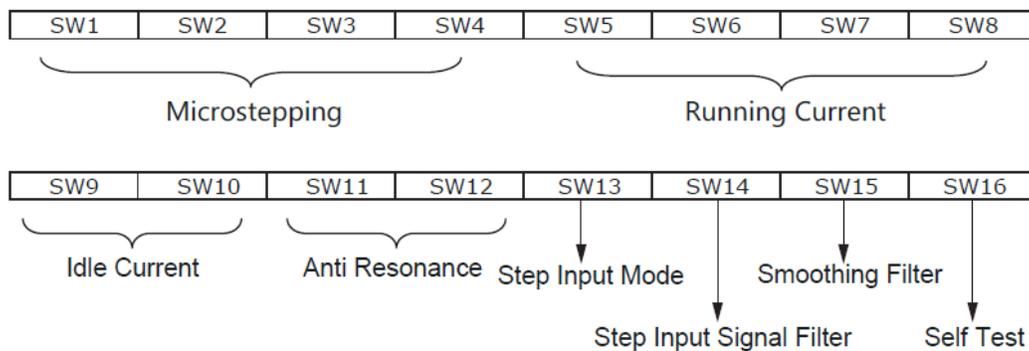


Figure 10: Dip Switch Description Diagram

4.2 Motor Selection

The P60660 stepper motor drive is optimized for use with carefully selected Kollmorgen stepper motors. Each position of the 16-bit rotary switch selects a different Kollmorgen stepper motor for optimum smoothness and performance. It automatically sets some of the configuration parameters in the drive. Additionally the dip switches must be configured. The P60660 drive comes programmed with 13 motors as factory defaults. The remaining 3 positions are reserved.

To select a motor, simply move the rotary switch to the letter or number that corresponds to the motor being used. This selection should be made before applying power to the drive so that you do not risk applying too much current to the motor.

If the motor being used is not listed in the table below, position the rotary switch to 0, and set the Current dip switch to the motor's rated current, or below.

NOTE *Not all motors can be run safely at or above 160 VDC.*

Check with motor manufacturer to ensure the non-library motor is rated for 160 VDC or 320 VDC operation.

NOTE *The drive power must be cycled if the motor selection is changed.*

4.2.1 Rotary Switch Setting for P60660-SDx-000

Standard POWERPAC stepper motors for use with P60660-SDx-000.

| Switch Bit | Standard POWERPAC Stepper Motor | RMS Current (Arms) | Voltage (VDC) | Holding Torque (oz.-in) | Inductance (mH) | Rotor Inertia (oz-in-sec ²) |
|------------|---------------------------------|--------------------|---------------|-------------------------|-----------------|---|
| 0 | N42HRHF | 5.1 | 160 | 2,923 | 14.4 | 0.1546 |
| 1 | N42HRLF | 2.8 | 320 | 2,923 | 57.7 | 0.1546 |
| 2 | N41HRHF | 4.7 | 160 | 1,675 | 12.2 | 0.078 |
| 3 | N41HRLF | 2.5 | 320 | 1,675 | 48.9 | 0.078 |
| 4 | N33HRHE | 3.1 | 160 | 1,698 | 13.6 | 0.057 |
| 5 | N33HRLE | 1.8 | 320 | 1,698 | 54.5 | 0.057 |
| 6 | N32HRHD | 3.2 | 160 | 1,196 | 16.5 | 0.038 |
| 7 | N32HRLD | 1.4 | 320 | 1,196 | 66.1 | 0.038 |
| 8 | N31HRHH | 2.5 | 160 | 635 | 12.5 | 0.0202 |
| 9 | N31HRLH | 1.4 | 320 | 635 | 50.1 | 0.0202 |
| A | P22NRXD (Series) | 1.0 | 320 | 203 | 24.8 | 0.0036 |
| B | P21NRXD (Parallel) | 1.4 | 160 | 109 | 10.3 | 0.0017 |
| C | P21NRXD (Series) | 0.64 | 320 | 109 | 41.2 | 0.0017 |
| D | Reserved | | | | | |
| E | Reserved | | | | | |
| F | Reserved | | | | | |

4.2.2 Rotary Switch Setting for P60660-SDx-001

Enhanced POWERPAC stepper motors for use with P60660-SDx-001.

| Switch Bit | Enhanced POWERPAC Stepper Motor | RMS Current (Arms) | Voltage (VDC) | Holding Torque (oz.-in) | Inductance (mH) | Rotor Inertia (oz-in-sec ²) |
|------------|---------------------------------|--------------------|---------------|-------------------------|-----------------|---|
| 0 | K42HRHF | 5.1 | 160 | 3,697 | 11.1 | 0.1546 |
| 1 | K42HRLF | 2.8 | 320 | 3,697 | 44.2 | 0.1546 |
| 2 | K41HRHF | 4.7 | 160 | 2,168 | 7.5 | 0.078 |
| 3 | K41HRLF | 2.5 | 320 | 2,168 | 29.8 | 0.078 |
| 4 | K33HRHE | 3.1 | 160 | 2,125 | 10.6 | 0.057 |
| 5 | K33HRLE | 1.8 | 320 | 2,125 | 42.2 | 0.057 |
| 6 | K32HRHD | 3.2 | 160 | 1,509 | 13.0 | 0.038 |
| 7 | K32HRLD | 1.4 | 320 | 1,509 | 51.9 | 0.038 |
| 8 | K31HRHH | 2.5 | 160 | 805 | 10.2 | 0.0202 |
| 9 | K31HRLH | 1.4 | 320 | 805 | 40.7 | 0.0202 |
| A | M22NRXD (Series) | 1.0 | 320 | 238 | 20.0 | 0.0036 |
| B | M21NRXD (Parallel) | 1.4 | 160 | 135 | 8.7 | 0.0017 |
| C | M21NRXD (Series) | 0.64 | 320 | 135 | 34.8 | 0.0017 |
| D | Reserved | | | | | |
| E | Reserved | | | | | |
| F | Reserved | | | | | |

4.2.3 Step Size

The step size sets the amount of rotation per input step. Sixteen step sizes are available using dip switches SW1-SW4. Note selecting a microstep size of $\frac{1}{4}$ or smaller results in:

- Higher resolution
- Smoother low speed operation
- Ability to operate in low-speed resonance region

NOTE *The drive power must be cycled if the Step Size is changed.*

For all Kollmorgen stepper motors and all 1.8° step motors, step size can be converted to micro-step resolution (steps per revolution) using the following table:

| Step Size | Microstep (steps/rev) | SW1 | SW2 | SW3 | SW4 |
|-----------|-----------------------|-----|-----|-----|-----|
| Full | 200 | ON | ON | ON | ON |
| Half | 400 | OFF | ON | ON | ON |
| 1/4 | 800 | ON | OFF | ON | ON |
| 1/8 | 1600 | OFF | OFF | ON | ON |
| 1/16 | 3200 | ON | ON | OFF | ON |
| 1/32 | 6400 | OFF | ON | OFF | ON |
| 1/64 | 12800 | ON | OFF | OFF | ON |
| 1/128 | 25600 | OFF | OFF | OFF | ON |
| 1/5 | 1000 | ON | ON | ON | OFF |
| 1/10 | 2000 | OFF | ON | ON | OFF |
| 1/20 | 4000 | ON | OFF | ON | OFF |
| 1/25 | 5000 | OFF | OFF | ON | OFF |
| 1/40 | 8000 | ON | ON | OFF | OFF |
| 1/50 | 10000 | OFF | ON | OFF | OFF |
| 1/100 | 20000 | ON | OFF | OFF | OFF |

4.2.4 Motor Current Level

The P60660 drive running current is set by the SW5-SW8 switches. There are 16 settings. The current setting should be compatible with the RMS current motor ratings.

NOTE

The drive power must be cycled if the Current switch is changed.

The following table provides the motor current settings.

| RMS Current (Arms) | SW5 | SW6 | SW7 | SW8 |
|--------------------|-----|-----|-----|-----|
| 0.28 | ON | ON | ON | ON |
| 0.42 | OFF | ON | ON | ON |
| 0.64 | ON | OFF | ON | ON |
| 0.85 | OFF | OFF | ON | ON |
| 1.3 | ON | ON | OFF | ON |
| 1.4 | OFF | ON | OFF | ON |
| 1.8 | ON | OFF | OFF | ON |
| 2.1 | OFF | OFF | OFF | ON |
| 2.5 | ON | ON | ON | OFF |
| 2.8 | OFF | ON | ON | OFF |
| 3.2 | ON | OFF | ON | OFF |

| RMS Current (Arms) | SW5 | SW6 | SW7 | SW8 |
|--------------------|-----|-----|-----|-----|
| 3.7 | OFF | OFF | ON | OFF |
| 4.2 | ON | ON | OFF | OFF |
| 4.7 | OFF | ON | OFF | OFF |
| 5.2 | ON | OFF | OFF | OFF |

4.2.5 Idle Current Reduction

In the P60600 the Idle Current Reduction (ICR) function automatically reduces the running current at times when no motion is commanded. Motor current is reduced when no step commands are received for one second. The SW9 and SW10 switches control the percentage of running current to which the idle current is reduced; possible settings are shown in the table below. The 90% setting is useful when high holding torque is required (factory default). It is highly recommended that the idle current reduction feature be set as low as the application can tolerate to minimize motor and drive heating.

NOTE *The drive power must be cycled if the Idle Current Reduction switch is changed.*

The following table provides the idle current reduction settings.

| Idle | SW9 | SW10 |
|------|-----|------|
| 25% | ON | ON |
| 50% | OFF | ON |
| 75% | ON | OFF |
| 90% | OFF | OFF |

The benefits of using ICR include:

- Reduces motor and drive heating during stand-by operation
- Reduces power consumption

4.2.6 Anti-Resonance

In the P60660 the Anti-Resonance function reduces the effect of low-end resonance typical of step motors. The SW11 and SW12 dip switches select the load-to-motor inertia ratio. There are 4 settings. The inertia ratio selection sets the gain parameter for the P60660 drive and helps to stabilize the motor at low speeds. If the load inertia is close to that of motor rotor, the low setting should be selected. If the load inertia is higher than that of the motor rotor, a proportionally higher setting should be selected.

NOTE *The drive power must be cycled if the Anti-Resonance switch is changed.*

The following table provides the anti-resonance settings.

| Options | SW11 | SW12 | Inertia Ratio |
|---------|------|------|---------------|
| 0 | ON | ON | Low |
| 1 | OFF | ON | ↓ |
| 2 | ON | OFF | |
| 3 | OFF | OFF | High |

The benefits of using anti-resonance include:

- Reduces the effects of low-end resonance
- Stabilizes the motor at low speeds

4.2.7 Step Command Mode

Most indexers and motion controllers provide motion commands in the Step and Direction format. The step signal pulses once for each motor step and the direction signal commands the direction of rotation.

Some PLCs use a CW/CCW command signal: one signal pulses once for each desired step in the clockwise direction (CW Step), while a second signal pulses for counter clockwise motion (CCW Step). In the CW/CCW command mode, the CW signal should be connected to the STEP input and the CCW signal to the DIR input.

Setting SW13 to OFF enables the Step and Direction command format (factory default). The ON position enables the CW/CCW command format.

| SW13 | Common Mode |
|------|------------------|
| ON | CW/CCW |
| OFF | Step & Direction |

NOTE *The drive power must be cycled each time the position of SW13 is changed.*

4.2.8 Input Signal Noise Filter

The STEP and DIR inputs have a built-in digital filter to reduce susceptibility to external noise. This filter dictates the maximum step frequency. The SW14 switch selects the digital signal filter. ON sets the filter to 150 kHz. OFF sets the filter to 2 MHz. If the system is being operated at a low microstep resolution (<5000) the 150 kHz setting should be selected. If the system is being operated at a high microstep resolution (>5,000) the 2 MHz setting should be used (factory default).

When SW14 is set to ON, step pulses must have a minimum width of 3 microseconds. Pulses less than 3 microseconds in width will be rejected. With SW14 set to OFF, step pulses must be a minimum of 0.25 microseconds wide. Therefore, the maximum step frequency is 150 kHz with the switch set to ON and 2 MHz with the switch set to OFF.

| SW14 | Max Step Frequency |
|------|--------------------|
| ON | 150 kHz |
| OFF | 2 MHz |

The following benefits of using the input signal noise filter include:

- Reduces effects of external noise on STEP and DIR input signals

NOTE

The drive power must be cycled each time the position of SW14 is changed.

4.2.9 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. SW15 selects this function. ON enables it; OFF disables it (factory default).

| SW15 | Step Smoothing |
|------|----------------|
| ON | Enabled |
| OFF | Disabled |

NOTE

This function can cause a small delay in following the control signal. Please keep this in mind when using this functionality.

Benefits

- Reduce jerk
- Reduce wear on mechanical components

NOTE

The drive power must be cycled each time the position of SW15 is changed.

4.3 Testing the Installation

The following self-test verifies the P60660 is installed and configured properly as well as that the drive was not damaged during shipment.

4.3.1 Self-Test Procedure

After installing the drive as described in [Chapter 3: Installation](#), test your installation as follows.

⚠ WARNING *Perform this initial power up with the motor shaft disconnected from the load. Improper wiring, improper setup, or undiscovered shipping damage could result in undesired motor motion. Be prepared to remove power if excessive motion occurs!*

1. Check all mounting, wiring, and switch settings to verify correct installation.
2. Turn drive power ON.
3. Verify that the motor has holding torque by attempting to rotate the motor shaft. The energized motor shaft is either immovable or is resistant to rotation.
4. The next step WILL cause motion to occur!!
5. Set SW16 to the ON position.

NOTE

The drive will automatically rotate the motor 2 revolutions at 1 RPS in both directions (clockwise and counter-clockwise).

6. Set SW16 to the OFF position to disable the self-test.

NOTE

Any time SW16 is set to the ON position, the drive will automatically execute the self-test.

| SW16 | Self-Test |
|------|-----------|
| ON | Enabled |
| OFF | Disabled |

4.4 Getting Help

If you need further assistance with your installation, please contact your local distributor.

5 TROUBLESHOOTING

This chapter covers troubleshooting of the P60660.

5.1 LED Drive Status

The P60660 has two LEDs to indicate drive status. These display the condition of the power stage as well as provide further diagnostics when the fault output signal (OUT) is closed and the drive is in a fault condition. When the drive is enabled, the green LED flashes slowly. When the drive is disabled, the green LED is solid. If a fault condition has occurred, the red LED flashes. Specific errors are indicated by combinations of red and green flashes as shown below:

| Code | Error |
|--|----------------------|
|  Solid green | Motor Disabled |
|  Flashing green | Motor Enabled |
|  3 red, 1 green | Over Temperature |
|  3 red, 2 green | Bad Internal Voltage |
|  4 red, 1 green | Supply Voltage High |
|  4 red, 2 green | Supply Voltage Low |
|  5 red, 1 green | Over Current |
|  5 red, 2 green | Excess Regen |
|  6 red, 1 green | Open Motor Phase |

5.2 Common Symptoms and Corrective Actions

The table provides common symptoms and suggested corrective actions for each.

| Symptom | Corrective Action |
|---|---|
| ON motor produces no torque. | <ol style="list-style-type: none"> 1. Ensure the EN input is driven with at least 5 mA. 2. Re-check MOTOR connector wiring and verify the MOTOR connector is plugged into the drive properly. 3. Verify that SW5-SW8 (running current select) is set correctly. 4. Verify the input voltage is correct for the motor. 5. Remove AC power. Disconnect the motor connector. Check the motor for shorts across the phases or between the phases and motor case. |
| Motor produces torque, but does not turn. | <ol style="list-style-type: none"> 1. Make sure the STEP input is switching and meets the specified electrical and timing requirements. |
| Motor rotates in the wrong direction. | <ol style="list-style-type: none"> 1. Check polarity of the DIR input. Also check that the DIR input signal satisfies the specified electrical and timing requirements. 2. Reverse motor phases A and A'. |
| Motor does not reach expected position. | <ol style="list-style-type: none"> 1. Check that the step size setting of the drive is the same as the step size setting of the indexer. 2. Verify that the motor does not stall. If it does: <ol style="list-style-type: none"> a) Re-check sizing calculations. Be sure that the input supply voltage is correct for the motor being used. b) Use a finer step size to avoid low-speed resonance problems. 3. Check the STEP and DIR inputs satisfy all electrical and timing requirements. |

6 APPENDIX A: SPECIFICATIONS

6.1 Electrical Specifications

The following table provides the electrical specifications for the P60660 stepper motor drive.

| Electrical | P60660 Stepper Motor Drive | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|--|---------|-------|--------|--|-----|------|------|-----|------|------|------|-----|------|------|-----|-----|------|------|-----|------|------|------|------|------|------|-------|------|------|-------|-------|------|-------|-------|-------|-------|-------|
| Input Power Supply | 120/240 VAC Supply Voltage Low Alarm: 80 VAC Supply Voltage High Alarm: 295 VAC | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Operational Range | 90 VAC ~240 VAC (-15%, +10%) 50/60 Hz Note: Wait 5 seconds before touching after removing power! | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Rated Drive Output Current (Motor Phase Current) | 0.3 to 5.7 Arms, 8.0 A peak | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Motor Inductance Range | 1.4 - 20 mH @ 120 VAC 5.6 - 80 mH @ 240 VAC | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Max Input Line Current | 6.0 Amp RMS | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Max Input Power | 660 Watts | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Voltage Alarm | Drive is monitoring DC Bus Power Over Voltage alarm trigger at 430 VDC, when input is 295 VAC. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Recommended Fusing | 600VAC 200KA Class J15A time delay fuses for external connecting. Example: LPJ15 or DFJ type from Bussmann | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Drive Circuit | Two-phase, bipolar chopper current regulated | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Chopper Frequency | 20 KHz, nominal | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Step Size | Shows steps and motor revolution: <table border="1"> <thead> <tr> <th colspan="2">Decimal</th> <th colspan="2">Binary</th> </tr> </thead> <tbody> <tr> <td>1/5</td> <td>1000</td> <td>Full</td> <td>200</td> </tr> <tr> <td>1/10</td> <td>2000</td> <td>Half</td> <td>400</td> </tr> <tr> <td>1/20</td> <td>4000</td> <td>1/4</td> <td>800</td> </tr> <tr> <td>1/25</td> <td>5000</td> <td>1/8</td> <td>1600</td> </tr> <tr> <td>1/40</td> <td>8000</td> <td>1/16</td> <td>3200</td> </tr> <tr> <td>1/50</td> <td>10000</td> <td>1/32</td> <td>6400</td> </tr> <tr> <td>1/100</td> <td>20000</td> <td>1/64</td> <td>12800</td> </tr> <tr> <td>1/125</td> <td>25000</td> <td>1/128</td> <td>25600</td> </tr> </tbody> </table> | Decimal | | Binary | | 1/5 | 1000 | Full | 200 | 1/10 | 2000 | Half | 400 | 1/20 | 4000 | 1/4 | 800 | 1/25 | 5000 | 1/8 | 1600 | 1/40 | 8000 | 1/16 | 3200 | 1/50 | 10000 | 1/32 | 6400 | 1/100 | 20000 | 1/64 | 12800 | 1/125 | 25000 | 1/128 | 25600 |
| Decimal | | Binary | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1/5 | 1000 | Full | 200 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1/10 | 2000 | Half | 400 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1/20 | 4000 | 1/4 | 800 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1/25 | 5000 | 1/8 | 1600 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1/40 | 8000 | 1/16 | 3200 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1/50 | 10000 | 1/32 | 6400 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1/100 | 20000 | 1/64 | 12800 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1/125 | 25000 | 1/128 | 25600 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Signal Input Characteristics | Optically isolated. Sourcing, sinking or differential signals can be used. Drive steps on falling edge of STEP+ input. Motor rotates in the clockwise direction with a closed DIR+ input. 5-24 VDC logic Minimum "on" voltage: 4 VDC. Maximum voltage: 28 VDC. Input current: 5 mA typical at 4V, 15 mA typical at 30V. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

| Electrical | P60660 Stepper Motor Drive |
|------------------------------|--|
| | Minimum STEP pulse width: 3 μ sec at 150 KHz setting 0.25 μ sec at 2 MHz setting Minimum DIR pulse width: 50 μ sec Logic Hi 4 to 28 Volts (≥ 7 mA). Logic Lo -3 to 2 Volts (< 7 mA) |
| Fault Output Characteristics | Optically isolated. Sourcing or sinking output. Output closes when the drive encounters a fault condition. Maximum output voltage: 30 VDC Maximum output current: 100 mA |
| Maximum Step Frequency | 150 KHz or 2 MHz (set by SW14) |
| Step/Direction Timing | The figure below shows the required timing relationship between the STEP and DIR inputs. |

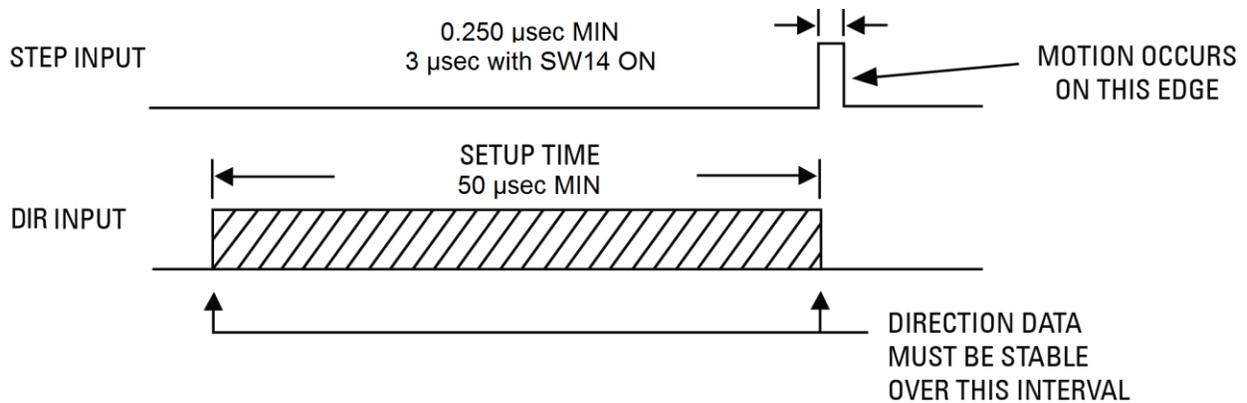


Figure 11: STEP and DIR Input Diagram

6.2 Environmental Specifications

The following table provides the environmental specifications for the P60660 stepper motor drive.

| Environmental | P60660 Stepper Motor Drive |
|----------------------------|---|
| Operating Temperature | 0°C – 40 °C |
| Storage Temperature | -10 °C – 70 °C |
| Maximum Case Temperature | 70 °C Higher temperatures will reduce the life of the product. |
| Maximum Ambient Humidity | 90%, non-condensing |
| Heat Sinking Method | Natural cooling or fan-forced cooling |
| Surrounding Air Conditions | Avoid dust, oily mist and corrosive air |
| Shock | 5.9 m/s ² maximum |

6.3 Mechanical Specifications

The following table provides the mechanical specifications for the P60660 stepper motor drive

| Mechanical | P60660 Stepper Motor Drive |
|-------------|---|
| Dimensions | 2.13 x 6.97 x 4.74 inches (54 x 177 x 120.5 mm) overall. Refer to section 2.2.4. |
| Weight | 43.6 oz. (1.26 kg) including mating connectors |
| Accessories | P60660-CONKIT |

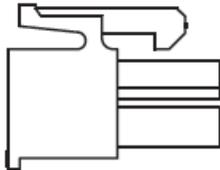
6.3.1 Mating Connectors

The following table provides the mating connectors for the P60660 stepper motor drive. Note LINE, MOTOR, IN/OUT connectors are included with P60660-SDN-xxx.

| Connector | Description | Manufacture | P/N |
|-----------|-------------|-----------------|---------|
| MOTOR | 5 position | Phoenix Contact | 1757048 |
| LINE | 3 position | Phoenix Contact | 1757022 |
| IN/OUT | 8 position | Phoenix Contact | 1803633 |

6.4 Regeneration Clamping Circuit

High speed motion generates high voltages which can be transferred to the drive during rapid deceleration, and the drive may indicate an over-voltage error condition after stopping from a high speed motion. The P60660 has regeneration clamping circuitry built in, but may require an external resistor for some applications. To protect the P60660 in high speed, high load inertia applications, we recommend connecting to a 40 ohm, 50 watt resistor to the 2 pin regen connector located on the top of the P60660 stepper drive package.



Housing: 39-01-3028(MOLEX)

Crimp: 39-00-0038(MOLEX)

Figure 12: External Resistor Connector

About Kollmorgen

Kollmorgen is a leading provider of motion systems and components for machine builders. Through world-class knowledge in motion, industry-leading quality and deep expertise in linking and integrating standard and custom products, Kollmorgen delivers breakthrough solutions that are unmatched in performance, reliability and ease-of-use, giving machine builders an irrefutable marketplace advantage.

For assistance with your application needs, visit www.kollmorgen.com or contact us at:

North America Kollmorgen

203A West Rock Road
Radford, VA 24141 USA

Web: www.kollmorgen.com
Mail: support@kollmorgen.com
Phone: 1-540-633-3545
Fax: 1-540-639-4162

Europe Kollmorgen

Pempelfurtstraße 1
40880 Ratingen, Germany

Web: www.kollmorgen.com
Mail: technik@kollmorgen.com
Phone: + 49-2102-9394-0
Fax: + 49 -2102-9394-3155

China & Southeast Asia Kollmorgen

Rm 202, Building 3
Lane 168, Linhong Rd.
Changning District, Shanghai, China

Web: www.kollmorgen.com
Mail: sales.asia@kollmorgen.com
Phone: + 86-400-661-2802
Fax: +86-21-6071-0665

KOLLMORGEN[®]

Because Motion Matters™