For safe and proper use, follow these instructions. Keep for future use.
Front Matter

Record of Document Revisions

<table>
<thead>
<tr>
<th>Version</th>
<th>Date</th>
<th>Notes</th>
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<tr>
<td>A</td>
<td>June 2023</td>
<td>Initial documentation</td>
</tr>
<tr>
<td>B</td>
<td>August 2023</td>
<td>Circuitry of the Control Ports diagram and Model Nomenclature update</td>
</tr>
<tr>
<td>C</td>
<td>September 2023</td>
<td>Updated Modbus cable, Service SCI Interface, and connections information. Added thermal dissipation table.</td>
</tr>
<tr>
<td>D</td>
<td>September 2023</td>
<td>Added Thermal Dissipation information</td>
</tr>
<tr>
<td>E</td>
<td>November 2023</td>
<td>Updated Wiring Guidelines and Safety Guidelines</td>
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1 Introduction

This manual describes the P80360-R4E series of stepper drives. The drives are operated in systems together with other Kollmorgen devices. Please observe the entire system documentation, consisting of:

- Instruction manual for the stepper amplifier
- Manual Bus Communication
- Kollmorgen Space Help
- Motor technical specifications
- Technical description of the P8000 series of drives

More background information can be found in the Support section of the Kollmorgen website at www.kollmorgen.com/en-us/developer-network/.

Kollmorgen Space Help can be found at: https://webhelp.kollmorgen.com/space/content/index.htm.
2 Additional System Components and System Diagram

In addition to the drive, the components that comprise the motor control system include:

- AC Power (100-240 V\textsubscript{AC}, single-phase, 50/60 Hz)
- DC Power Supply (24V\textsubscript{DC}) for STO inputs and Digital Outputs
- Stepper Motor
- Modbus Master Controller (if applicable)
2.1 System Diagram

NOTE: Your installation may vary from this configuration.
3 You Should Read This
This section contains guidelines for the safe installation of the drives and the stepper motor.

3.1 Safety Symbols

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Indication</th>
</tr>
</thead>
<tbody>
<tr>
<td>![WARNING]</td>
<td>Alerts users to potential physical danger or harm. Failure to follow warning notices could result in personal injury or death.</td>
</tr>
<tr>
<td>![CAUTION]</td>
<td>Directs attention to general precautions, which if not followed, could result in personal injury and/or equipment damage</td>
</tr>
<tr>
<td>![NOTE]</td>
<td>This symbol indicates important notes.</td>
</tr>
<tr>
<td>![EMC]</td>
<td>Warning of a danger (general). The type of danger is specified by the text next to the symbol.</td>
</tr>
<tr>
<td>![EMC]</td>
<td>An essential element to stay within the limits specified by the EMC directives is, in addition to the use of filters, the installation in accordance with the EMC requirements.</td>
</tr>
</tbody>
</table>

3.2 Safety
This section describes the safety requirements for the P8000 stepper drive.

3.3 Your responsibility
Only qualified personnel are permitted to transport, assemble, commission, and maintain this equipment. Properly qualified personnel are persons who are familiar with the transport, assembly, installation, commissioning and operation of motors, and who have the appropriate qualifications for their jobs.

Read all available documentation before assembling and using. Incorrect handling of products in this manual can result in injury and damage to persons and machinery. Strictly adhere to the technical information regarding installation requirements. 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 to effectively and safely operate the P8000 unit.

- The circuits in the P8000 drive are a potential source of severe electrical shock. Follow the safety guidelines to avoid shock.
- Miswiring of the P8000 drive may result in damage to the unit and void the warranty. Improper grounding of the drive may cause serious injury to the operator.
3.4 Safety Guidelines

It is the machine builder’s responsibility to ensure 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.
- 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. During operation, the product has electrically charged components and hot surfaces. Control and power cables can carry a high voltage, even when the motor is not rotating.
- Never disconnect or connect the product while the power source is energized. Remove the power supply before touching or removing a connection. After removing the power source from the equipment, wait at least 3 minutes before touching or disconnecting sections of the equipment that normally carry electrical charges (e.g., capacitors, contacts, screw connections). To be safe, measure the electrical contact points with a meter before touching the equipment.
- Be careful of the motor terminals (CN2 Port) 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.
- The negative pole of the power supply is NOT connected to the ground through an internal connection to the drive. Ensure PE connection is made to the external screw on the drive case. The Protective Earth connection (PE) has to comply with the local requirements in force. Keep all covers and cabinet doors shut during operation.
- 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.
- Wait until the green LED light is switched off before manipulating or executing maintenance to the drive.
- 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.
- Pay attention to the temperature of the drive. Using the drive in extreme applications can result in some surfaces reaching high temperatures. Wait until the drive has cooled down before disconnecting it.
- Integral solid state short circuit protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with the Manufacturer Instructions, National Electrical Code, and any additional local codes.

3.5 Electromagnetic Compatibility

- Take all precautions and requirements which are necessary for the compliance with the electromagnetic compatibility. The drive is in Category C3 following standard EN 61800-3 without an EMC line filter. With an appropriate EMC line filter, the drive will meet Category C2.
- The drive should be installed using EMC best practices.
- When making the connections, take into account the requirements of the Wiring Guidelines.
3.6 Unpacking and Inspecting
This section describes the unpacking and inspection procedures for the P8000 stepper drive.

3.6.1 Unpacking Procedure
1. Remove the P8000 and any other contents from the shipping container.
2. 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.
3. A label located on the side of the unit identifies the unit by both the model number and serial number.

3.6.2 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.

3.7 Wiring Guidelines
For proper drive installation:

<table>
<thead>
<tr>
<th>Guideline For Wiring</th>
<th>Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Establish the PE connection on the drives by means of a mechanical screw. (Tightening torque = 1.51 Nm)</td>
<td>Necessary electrical safety connection. Increases the immunity against irradiated disturbances and electrostatic discharges (ESD).</td>
</tr>
<tr>
<td>Connect both ends of the signal cable’s shielding to the earth/ground.</td>
<td>Increases the immunity against disturbances and reduces the irradiated and conducted emissions.</td>
</tr>
<tr>
<td>Use shielded cables for the motor connection. When a shielded cable is used for the motor, connect the shield to PE screw on the drive. AVOID the connection of the shield to the motor body.</td>
<td>Increases the immunity against disturbances and reduces the irradiated and conducted emissions.</td>
</tr>
<tr>
<td>Connect the body of the motor to the earth/ground. The motor body and the cable shield must be connected to the ground terminal by means of 2 separated cables.</td>
<td>Necessary electrical safety connection. Reduces the conducted emissions.</td>
</tr>
<tr>
<td>Keep the cables between the motor and the drive as short as possible and avoid ground loops.</td>
<td>Increases the immunity against disturbances and reduces the irradiated and conducted emissions.</td>
</tr>
<tr>
<td>The paths of the signal cables must be separated and/or shielded from the motor cables and power supply to avoid inductive coupling that can cause erratic behavior.</td>
<td>Increases the immunity against disturbances.</td>
</tr>
</tbody>
</table>

**NOTE**
Only use:
- 60/75 °C wires
- Copper conductors
4 General Drive Description

The information in this manual refers to all released versions of the P80360 drive. This manual contains the procedures for installation, start up, and maintenance of the drive. For information regarding the operating software, consult Kollmorgen Space Help. Functions of the drive may vary depending on the drive model used.

P80360 Series drives utilize a control algorithm that optimizes the output current to the motor phases, whether full-stepping or micro-stepping, enabling smooth motion across the full speed range.

The drives can control 2-phase or 4-phase hybrid stepper motors with phase currents up to 3.0 A_{RMS} (4.2 A_{pK}).

The drive features include:

- Active monitoring of the system status
- Fault indicators such as:
  - Overvoltage/Undervoltage
  - Overheating/Overtemperature
  - Over Current
  - Open Motor Phase/Short Circuit

**NOTE**

Integral solid state short circuit protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with the Manufacturer Instructions, National Electrical Code, and any additional local codes.

- Capability to generate operational ramps for the motor

The diagram shows the functional blocks composing the drives:

- AC Power Supply
- AC/DC
- DC/DC
- Protections
- Power Stage
- Digital Signal Processor Controller
- Opto-isolators
- Opto-isolators
- Dip Switches, Roto & LEDs
- Isolators
- Encoder Input
- Step Motor
- Service SCI
- Fieldbus
- Up to 4 Digital Inputs
- Up to 3 Digital Outputs
5 Model Nomenclature

P-Series

P8  P8000 Series

Current Rating

03  3.0 $A_{rms}$ continuous (AC models only)
06  5.5 $A_{rms}$ continuous (DC models only)

Voltage Range

3  24-75 $V_{dc}$
6  100-240 $V_{ac}$, single-phase

P8  06  3  0  –  SDN  –

Customization

Omit field for standard configurations
001, 002, 003... = Special

Functionality

SDN  Pulse Input Step/Direction or CW/CCW
     (Open Loop, DC model only)
R4E  Modbus RS485 RTU programmable
     (Open or Close Loop, AC model only)
ECE  EtherCAT DS402
     (Open or Close Loop, AC model only)

Electrical Options

0  None
6 Choosing the Stepper Motor

The P80360 drives have been designed to function with 2-phase hybrid stepper motors with the following characteristics:

*The nominal winding current depends on the drive model.*

<table>
<thead>
<tr>
<th></th>
<th>MIN</th>
<th>TYP</th>
<th>MAX</th>
<th>UNIT</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor current</td>
<td>—</td>
<td>—</td>
<td>3.0</td>
<td>A_{RMS}</td>
<td>SW setting</td>
</tr>
<tr>
<td></td>
<td>—</td>
<td>—</td>
<td>4.2</td>
<td>A_{pk}</td>
<td></td>
</tr>
</tbody>
</table>

The stepper motor is chosen depending on the application requirements including the:

- Torque required by the shaft
- Speed
- Size of the motor
- Current
- Inductance

**NOTE**

When selecting a Kollmorgen stepper motor, always be sure to consult the Stepper Optimizer tool when sizing your application. Certain voltage levels may cause overheating when operating at or near maximum current.
7 Technical Data Overview

- Power Supply: 100 – 240 V\textsubscript{AC}, single-phase, 50/60Hz
- Mandatory, Dual Safe Torque Off (STO) Inputs (isolated): 24 V\textsubscript{DC}
- Phase Current: up to 3.0 A\textsubscript{RMS} (4.2 A\textsubscript{peak})
- Chopper Frequency: ultrasonic 40KHz
- Micro-stepping Range: Full-Step up to 1/256 (51,200 steps/rev)
- Fault Indicators: over current, overvoltage/undervoltage, overheating, short circuit between motor phase-to-phase and phase-to-ground
- Modbus RTU communication interface
- Incremental Encoder Input: 5V Differential (RS422) or 5V single-ended TTL/CMOS
- Service SCI interface for programming and real-time debugging
- Digital Inputs: 4
- Digital Outputs: 3
- Dimensions: 180.7 x 138.5 x 50 mm (without connectors)
- Weight: 800g
- Protection Degree: IP20
- Pollution Degree: 2
- Overvoltage Category III
- Short Circuit Current: 5 kA
- Protection Class: Class I Equipment
- Working Temperature 5 °C to 50 °C
- Storage Temperature -25 °C to 55 °C
- Humidity: 5% to 85%, non-condensing
8 Mechanical Data

CN1: Power Supply Inputs
CN2: Motor Connections
CN3: Digital Inputs/Outputs
CN4: Feedback Connections
CN5A or CN5B: Modbus RTU Interface
CN6: Service SCI Interface
CN7: STO Inputs (mandatory)


8.1 Connections

8.1.1 CN1: Power Supply Inputs

<table>
<thead>
<tr>
<th>CN1.1</th>
<th>ACin</th>
<th>PWR_IN</th>
<th>AC power supply input</th>
</tr>
</thead>
<tbody>
<tr>
<td>CN1.2</td>
<td>ACin</td>
<td>PWR_IN</td>
<td>AC power supply input</td>
</tr>
</tbody>
</table>

**WARNING**

Ensure PE (Ground) connection for the AC Power Supply Input is connected to the PE Screw located on the drive.

8.1.2 CN2: Motor Connections

<table>
<thead>
<tr>
<th>CN2.1</th>
<th>A+ (A)</th>
<th>PWR_OUT</th>
<th>Motor phase A+ (A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CN2.2</td>
<td>A- (A/)</td>
<td>PWR_OUT</td>
<td>Motor phase A- (A/)</td>
</tr>
<tr>
<td>CN2.3</td>
<td>B+ (B)</td>
<td>PWR_OUT</td>
<td>Motor phase B+ (B)</td>
</tr>
<tr>
<td>CN2.4</td>
<td>B- (B/)</td>
<td>PWR_OUT</td>
<td>Motor phase B- (B/)</td>
</tr>
</tbody>
</table>

The following diagrams show the required connections between the P80360 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.

**CAUTION**

If applicable, ensure motor ground wire is connected to the PE screw located on the drive.
### 8.1.3 CN3: Digital Inputs/Outputs

*14 position, pitch 2.54mm double row, PCB header connector*

| CN3.1  | +B0_IN3    | DIG_IN | Digital input B0_IN3 positive side |
| CN3.2  | -B0_IN3   | DIG_IN | Digital input B0_IN3 negative side |
| CN3.3  | +B0_IN2   | DIG_IN | Digital input B0_IN2 positive side |
| CN3.4  | -B0_IN2   | DIG_IN | Digital input B0_IN2 negative side |
| CN3.5  | +B0_IN1   | DIG_IN | Digital input B0_IN1 positive side |
| CN3.6  | -B0_IN1   | DIG_IN | Digital input B0_IN1 negative side |
| CN3.7  | +B0_IN0   | DIG_IN | Digital input B0_IN0 positive side |
| CN3.8  | -B0_IN0   | DIG_IN | Digital input B0_IN0 negative side |
| CN3.9  | B0_OUT0   | DIG_OUT | PNP digital output B0_OUT0 |
| CN3.10 | B0_OUT1   | DIG_OUT | PNP digital output B0_OUT1 |
| CN3.11 | V_OUT     | PWR_IN | 24 Vdc input supply for digital outputs |
| CN3.12 | VSS #1    | PWR_IN | Negative side of supply for digital outputs |
| CN3.13 | B0_OUT2   | DIG_OUT | PNP digital output B0_OUT2 |
| CN3.14 | VSS #2    | PWR_IN | Negative side of supply for digital outputs |
## 8.1.4 CN4: Feedback Connections

**NOTE**

CN4 Encoder Inputs are only used when operating in Closed Loop operation mode.

16 positions, pitch 2.54mm double row, PCB header connector

<table>
<thead>
<tr>
<th>CN4.1</th>
<th>SHIELD</th>
<th>/</th>
<th>Cable Shield connection for feedback interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>CN4.2</td>
<td>Reserved</td>
<td>—</td>
<td>Reserved</td>
</tr>
<tr>
<td>CN4.3</td>
<td>Reserved</td>
<td>—</td>
<td>Reserved</td>
</tr>
<tr>
<td>CN4.4</td>
<td>Reserved</td>
<td>—</td>
<td>Reserved</td>
</tr>
<tr>
<td>CN4.5</td>
<td>Reserved</td>
<td>—</td>
<td>Reserved</td>
</tr>
<tr>
<td>CN4.6</td>
<td>Reserved</td>
<td>—</td>
<td>Reserved</td>
</tr>
<tr>
<td>CN4.7</td>
<td>Reserved</td>
<td>—</td>
<td>Reserved</td>
</tr>
<tr>
<td>CN4.8</td>
<td>Reserved</td>
<td>—</td>
<td>Reserved</td>
</tr>
<tr>
<td>CN4.9</td>
<td>ENCZ+</td>
<td>DIG_IN</td>
<td>Encoder Zero differential input positive</td>
</tr>
<tr>
<td>CN4.10</td>
<td>ENCZ-</td>
<td>DIG_IN</td>
<td>Encoder Zero differential input negative</td>
</tr>
<tr>
<td>CN4.11</td>
<td>ENCB+</td>
<td>DIG_IN</td>
<td>Encoder Phase B differential input positive</td>
</tr>
<tr>
<td>CN4.12</td>
<td>ENCB-</td>
<td>DIG_IN</td>
<td>Encoder Phase B differential input negative</td>
</tr>
<tr>
<td>CN4.13</td>
<td>ENCA+</td>
<td>DIG_IN</td>
<td>Encoder Phase A differential input positive</td>
</tr>
<tr>
<td>CN4.14</td>
<td>ENCA-</td>
<td>DIG_IN</td>
<td>Encoder Phase A differential input negative</td>
</tr>
<tr>
<td>CN4.15</td>
<td>+5V OUT</td>
<td>PWR_OUT</td>
<td>5 VDC power supply output</td>
</tr>
<tr>
<td>CN4.16</td>
<td>E_GND</td>
<td>PWR_OUT</td>
<td>Negative side of supply</td>
</tr>
</tbody>
</table>
8.1.5 CN5A or CN5B: Modbus RTU Interface

<table>
<thead>
<tr>
<th>CN5.1</th>
<th>N.C.</th>
<th>—</th>
<th>Not Connected</th>
</tr>
</thead>
<tbody>
<tr>
<td>CN5.2</td>
<td>N.C.</td>
<td>—</td>
<td>Not Connected</td>
</tr>
<tr>
<td>CN5.3</td>
<td>N.C.</td>
<td>—</td>
<td>Not Connected</td>
</tr>
<tr>
<td>CN5.4</td>
<td>DATA+</td>
<td>Digital I/O</td>
<td>Positive RS485 signal</td>
</tr>
<tr>
<td>CN5.5</td>
<td>DATA-</td>
<td>Digital I/O</td>
<td>Negative RS485 signal</td>
</tr>
<tr>
<td>CN5.6</td>
<td>N.C.</td>
<td>—</td>
<td>Not Connected</td>
</tr>
<tr>
<td>CN5.7</td>
<td>0VA</td>
<td>PWR_OUT</td>
<td>Signal Ground for Modbus</td>
</tr>
<tr>
<td>CN5.8</td>
<td>N.C.</td>
<td>—</td>
<td>Not Connected</td>
</tr>
</tbody>
</table>

8.1.6 CN6: Service SCI Interface

<table>
<thead>
<tr>
<th>CN6.1</th>
<th>TX/RX</th>
<th>Transmit / Receive Line</th>
</tr>
</thead>
<tbody>
<tr>
<td>CN6.2</td>
<td>DE/RE</td>
<td>Drive Enable Negated / Receive Enable</td>
</tr>
<tr>
<td>CN6.3</td>
<td>+5V</td>
<td>+5V power out</td>
</tr>
<tr>
<td>CN6.4</td>
<td>GND+</td>
<td>GND power out</td>
</tr>
</tbody>
</table>

NOTE: This connection is only possible with hardware and software provided by Kollmorgen.

8.1.7 CN7: STO Inputs (Mandatory)

<table>
<thead>
<tr>
<th>CN7.1</th>
<th>STO1-</th>
<th>PWR_IN</th>
<th>STO1 input negative side</th>
</tr>
</thead>
<tbody>
<tr>
<td>CN7.2</td>
<td>STO1+</td>
<td>PWR_IN</td>
<td>STO1 input positive side</td>
</tr>
<tr>
<td>CN7.3</td>
<td>STO2-</td>
<td>PWR_IN</td>
<td>STO2 input negative side</td>
</tr>
<tr>
<td>CN7.4</td>
<td>STO2+</td>
<td>PWR_IN</td>
<td>STO2 input positive side</td>
</tr>
</tbody>
</table>

8.1.8 Jumpers

<table>
<thead>
<tr>
<th>Position 1</th>
<th>Reserved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Position 2</td>
<td>120 Ohm resistor INSERTED</td>
</tr>
</tbody>
</table>
8.2 Switches Settings

8.2.1 Dip-Switches Settings
The drives are equipped with a series of dip-switches and roto-switches with which the user parameters can be set.

![Dip-Switches Diagram]

**NOTE**
- The device reads the dip-switches only during the power up sequence. If it’s necessary to change settings: shut down the system, change the settings, and start up the system again to implement the changes.
- Before setting the dip-switch and roto-switch settings: shut down the system, remove the CN1 power supply connector, and wait until all LEDs are switched off.
- For fieldbus communications other than Modbus the Dip-Switches and Roto-Switches functionality depends on the firmware installed on the drive. See Kollmorgen Space Help for more information.
- Default positions are:
  - Dips SW1, SW2, and SW3 = OFF; SW4 = ON
  - Roto R1=1 and R2=0

### Drive Baud Rate Selection

<table>
<thead>
<tr>
<th>SW2</th>
<th>SW3</th>
<th>SW4</th>
<th>Modbus</th>
</tr>
</thead>
<tbody>
<tr>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>115200</td>
</tr>
<tr>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
<td>57600 (Default)</td>
</tr>
<tr>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>38400</td>
</tr>
<tr>
<td>OFF</td>
<td>ON</td>
<td>ON</td>
<td>19200</td>
</tr>
<tr>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>9600</td>
</tr>
<tr>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
<td>4800</td>
</tr>
<tr>
<td>ON</td>
<td>ON</td>
<td>OFF</td>
<td>2400</td>
</tr>
<tr>
<td>ON</td>
<td>ON</td>
<td>ON</td>
<td>1200</td>
</tr>
</tbody>
</table>

### 8.2.1.1 Dip-Switches Setting SW1

<table>
<thead>
<tr>
<th>Position</th>
<th>U0 Software Defined</th>
</tr>
</thead>
<tbody>
<tr>
<td>ON</td>
<td></td>
</tr>
<tr>
<td>OFF</td>
<td>X (Default)</td>
</tr>
</tbody>
</table>
8.2.2 Roto-Switches Settings

The Node ID roto-switches utilize a hexadecimal system when setting the Node ID. To interpret the correct Node ID, you must convert the hexadecimal value of the roto-switches to a decimal format.

For example, if Node ID = R2R1

<table>
<thead>
<tr>
<th>Node ID</th>
<th>R2 Value</th>
<th>R1 Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>202</td>
<td>C</td>
<td>A</td>
</tr>
<tr>
<td>172</td>
<td>A</td>
<td>C</td>
</tr>
</tbody>
</table>

Node ID Selection

<table>
<thead>
<tr>
<th>Node ID #</th>
<th>Reserved</th>
<th>1 (Default)</th>
<th>2</th>
<th>3</th>
<th>...</th>
<th>100</th>
<th>101</th>
<th>102</th>
<th>...</th>
<th>200</th>
<th>201</th>
<th>202</th>
<th>...</th>
<th>253</th>
<th>254</th>
<th>255</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td></td>
<td>4</td>
<td>5</td>
<td>6</td>
<td></td>
<td>8</td>
<td>9</td>
<td>A</td>
<td></td>
<td>D</td>
<td>E</td>
<td>F</td>
</tr>
<tr>
<td>R2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
<td>6</td>
<td>6</td>
<td>6</td>
<td></td>
<td>C</td>
<td>C</td>
<td>C</td>
<td></td>
<td>F</td>
<td>F</td>
<td>F</td>
</tr>
</tbody>
</table>
# 9 Working Status (LED)

<table>
<thead>
<tr>
<th>Visualization Status</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1️⃣ Green ON</td>
<td>Driver enabled (Properly functioning)</td>
</tr>
<tr>
<td>2️⃣ Green Blinking</td>
<td>Driver disabled (Enable Off, Current zero)</td>
</tr>
<tr>
<td>3️⃣ Blue ON</td>
<td>Error: Connect with Service SCI Interface kit and check with Kollmorgen Space Drive Diagnostic window.</td>
</tr>
<tr>
<td>4️⃣ Blue ON + Yellow ON</td>
<td>Drive in boot mode. A new firmware should be downloaded to the drive.</td>
</tr>
<tr>
<td>5️⃣ Blue ON + Red Blinking (200ms)</td>
<td>Initialization phase. Should last for a few seconds. Drive is not fully operational while present.</td>
</tr>
<tr>
<td>6️⃣ Yellow ON</td>
<td>Missing (I_{\text{nominal}}) current setting</td>
</tr>
<tr>
<td>7️⃣ Yellow Blinking (500ms)</td>
<td>Warning: Connect with Service SCI Interface kit and check with Kollmorgen Space.</td>
</tr>
<tr>
<td>8️⃣ Red ON</td>
<td>Protection: Motor is in open phase condition.</td>
</tr>
<tr>
<td>9️⃣ Red Blinking (200ms)</td>
<td>Protection: Motor phase shortcut (short circuit).</td>
</tr>
<tr>
<td>10️⃣ Red ON (1s) + Yellow 1 Blink</td>
<td>Protection: Overvoltage.</td>
</tr>
<tr>
<td>11️⃣ Red ON (1s) + Yellow 3 Blink</td>
<td>Protection: Undervoltage.</td>
</tr>
<tr>
<td>12️⃣ Red ON (1s) + Yellow 4 Blink</td>
<td>Thermal Protection: Overtemperature.</td>
</tr>
<tr>
<td>13️⃣ Red ON (1s) + Yellow 5 Blink</td>
<td>Motor Feedback Error</td>
</tr>
<tr>
<td>14️⃣ Red ON (1s) + Yellow 6 Blink</td>
<td>Missing Torque Enable (24 V(_{\text{DC}}) STO not powered before AC supply).</td>
</tr>
<tr>
<td>15️⃣ Red ON (1s) + Yellow 7 Blink</td>
<td>Motor Current Regulation is out of range.</td>
</tr>
</tbody>
</table>

## NOTE

The drive could be considered in a correct status if LEDs don't show Red, Yellow, or Blue. In general:

- Red LED: an alarm or a drive protection
- Yellow LED: a warning
- Blue LED: a software internal fault or a non-operative condition
When any of the following situations occur, the drive is placed in a fault condition.

<table>
<thead>
<tr>
<th>Defect</th>
<th>Cause</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intervention of the thermal protection</td>
<td>Can be caused by a prolonged duty cycle, high current in the motor, or high voltage paired with a low inductance motor.</td>
<td>It is necessary to wait until the temperature is within the acceptable range. Next, improve the drive cooling by a natural or fan air flow. Consider using a motor with a higher torque vs current rating.</td>
</tr>
<tr>
<td>Intervention of the current protection</td>
<td>Short circuit on the motor power stage of the drive, excessive current absorption or power supply current too low.</td>
<td>Remove the power to the drive to eliminate the cause of the protection. Next, check motor windings and cables to remove the short circuits replacing faulty cables or motor if necessary. Can also occur due to power supply current being too low.</td>
</tr>
<tr>
<td>Intervention of the over/under voltage</td>
<td>Supply voltage out of range. Too high, too low, or increased voltage due to BEMF generated by the motor</td>
<td>It is necessary to wait until the voltage is within the acceptable range. Check the value for the supply voltage and verify it is within the input voltage limit for the drive.</td>
</tr>
<tr>
<td>Open phase motor protection</td>
<td>Motor windings to the drive are not connected properly</td>
<td>Remove the power to the drive to eliminate the cause of the protection. Next, check the motor cables and connections to the drive.</td>
</tr>
</tbody>
</table>

**NOTE**

The fault condition will remain until the drive is reset by the following method:
- Power Cycle
- Alarm Reset within Kollmorgen Space Drive Diagnostic window

When any of the following situations occur, the drive does NOT work, and is NOT placed in an error condition.

<table>
<thead>
<tr>
<th>Defect</th>
<th>Cause</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noisy motor movement with vibrations</td>
<td>Can be caused by a lack of power supply to a phase of the motor or a poor regulation of the winding currents</td>
<td>Check the cables and connections of the motor and/or change the motor speed to avoid a resonance region.</td>
</tr>
<tr>
<td>The external fuse on the power supply of the drive is burned.</td>
<td>Can be caused by a wrong connection of the power supply.</td>
<td>Connect the power supply correctly and replace the fuse.</td>
</tr>
<tr>
<td>At high speed, the motor torque is not enough.</td>
<td>Can be due to a &quot;self limitation&quot; of motor current and torque.</td>
<td>Increase the motor current (always within the limits).</td>
</tr>
</tbody>
</table>
10 Installing the Drive

Mount the P80360 drive to either a cold plate or the wall of the electric cabinet (panel) using M4 screws.

ENVIRONMENT

- The environment in which the drive will be installed needs to be free of impurities, corrosive vapor, gases or liquids.
- Avoid environments where vapor and humidity will condensate.
- Never put the drive where it can get wet or where metal or other electrically conductive particles can get on the circuitry.

When installing the drive in an electrical cabinet (panel), make sure that the opening of the air stream or the cooling system of the cabinet (panel) doesn't make the internal temperature rise above the maximum allowed working temperature (75 °C).

When the drives are built into machines or a plant, the drive must not be used until it has been established that the machine or plant fulfills the requirements of the regional directives.

ASSEMBLY GUIDE

Your installation should meet the following guidelines:

- Securely fastened to a flat, solid, non-painted, conductive, PE grounded metal surface that will support up to a 1200g mass in a vertical orientation.
- Free of excessive vibration or shock
- Maximum case temperature of 75 °C. If the case exceeds this temperature, it may shut down due to overheating and potentially reduce the lifespan of the drive. Fan cooling or a lower working temperature may be required to allow the drive to run properly.
- Minimum unobstructed space of 1.5 in. (38.1mm) of space around all sides.

COOLING

Cooling of the drive requires adequate thermal conduction area from the mounting plate within the cabinet, air flow by forced or passive convection, and by thermal radiation. Insufficient cooling can increase the drive temperature until the overtemperature threshold is reached and thermal protection engages (signaled by LEDs).

10.1 Thermal Dissipation

<table>
<thead>
<tr>
<th>P80360 Thermal Dissipation Specifications</th>
<th>W</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal dissipation with motor powered at max rated current (3.0 A RMS)</td>
<td>36.0</td>
</tr>
<tr>
<td>Thermal dissipation with motor disabled</td>
<td>4.4</td>
</tr>
</tbody>
</table>
11 Power Supply Connections

An AC power supply is needed to operate P80360 drives.

For the technical specifications, limitations, and connections regarding the power supply, see Planning the Power Supply.

- AC power supply: 100-240 V\textsubscript{AC}, Single-Phase, 50/60Hz (1)

- Input Voltage Limit: 85-265 V\textsubscript{AC} (including ripple and network fluctuations)

- Output Phase Current: Continuous up to 3.0 A\textsubscript{RMS} (4.2 A\text{peak}) (2)

- Chopper frequency: ultrasonic 40kHz

- Step Angle: Full-Step up to 1/256 (51,200 steps/rev)

- Rotation speed limit: 3000 rpm (3)

1. Drive must be supplied by single-phase (split-phase) three-wire system, AC.

<table>
<thead>
<tr>
<th>Phase-to-Phase / Phase-to-Earth Voltage</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>100/50 - 240/120 V\textsubscript{AC}, 1 Ph</td>
<td>50/60Hz</td>
</tr>
</tbody>
</table>

2. Maximum current and power consumption depend on the motor characteristics, load applied to the shaft, and the motion parameters set.

3. Theoretical rotation speed limit is managed by the drive depending on the following parameters: Power supply voltage, output phase current, dynamic motor characteristics, and shaft loading. Above this rotation speed limit, the drive is not able to guarantee a proper control sequence.
# 11.1 Protections

<table>
<thead>
<tr>
<th>Protection</th>
<th>Trigger</th>
<th>Effect</th>
<th>Restore</th>
</tr>
</thead>
<tbody>
<tr>
<td>Over current:</td>
<td>Short circuit on the motor power stage of the drive or excessive current absorption.</td>
<td>• Opening of the drive power stages • LEDs signaling</td>
<td>Remove the power supply to the drive to eliminate the cause of the protection. Check motor windings and cables to remove the short circuits replacing faulty cables or motor if necessary.</td>
</tr>
<tr>
<td>Open Motor Phase</td>
<td>Motor windings to the drive are not properly connected</td>
<td>• Opening of the drive power stages • LEDs signaling</td>
<td>Remove the power supply to the drive to eliminate the cause of the protection. Check motor cables and connections to the drive.</td>
</tr>
<tr>
<td>Overheating/Overtemperature</td>
<td>Temperature of heatsink &gt;75 °C</td>
<td>• Opening of the drive power stages • LEDs signaling</td>
<td>It is necessary to wait until the temperature is within the acceptable range. Improve the drive cooling by a natural or fan air flow. Consider using a motor with a higher torque vs current rating</td>
</tr>
<tr>
<td>Overvoltage/Undervoltage</td>
<td>Low power supply voltage, too high, increased voltage due to BEMF generated by the motor</td>
<td>• Opening of the drive power stages • LEDs signaling</td>
<td>It is necessary to wait until the voltage is within the acceptable range. Check the value for the supply voltage and verify it is within the Input Voltage Limit.</td>
</tr>
</tbody>
</table>

When the protection interrupts the power supply to the motor, no current is supplied to the motor (no holding torque) and the load can move to a rest. The user must provide devices that will ensure the safety of the load.

A detailed description of the protections and the related causes/actions are given in Working Status (LED).
11.1.1 Functional Diagram of Protections

- **Alarm Power Supply Voltage**
- **Open Phase Protection**
- **Temperature Protection**
- **Overcurrent Protection**

**Power ON**

**Visualization with LEDs + Communication via Fieldbus**

**Program Interruption**

**Motor Current = 0**

**Stop Motor**
12 Planning the Power Supply

An AC power input is needed to operate the P80360 drives.

**NOTE**
Digital inputs require a 5-24V\textsubscript{DC} supply.

# 12.1 Circuit and Power Supply Connection Schemes

A transformer is required for use with 240 V\textsubscript{AC} in Europe. A transformer with a center tap should be used in order to maintain 120 V\textsubscript{AC} (line-to-ground) maximum rated voltage. The transformer is optional, or unnecessary, for 120 V\textsubscript{AC} (line-to-ground) power systems.
12.2 Main Characteristics of the Power Supply

<table>
<thead>
<tr>
<th>Primary Protectors</th>
<th>Use Class J or RK1 Time Delay fuses on the AC bus or an equivalent safety switch.</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMC Filters</td>
<td>Generally necessary to satisfy the EMC compatibility requirements related to the emissions. An EMC filter is recommended in case of sensitive circuits powered by an AC line. If a commercial line filter is chosen, take into account the total RMS current of the powered system.</td>
</tr>
<tr>
<td>Transformer</td>
<td>The AC line filter needs to be installed following the builder's directives. Generally, the filter needs to be inserted between the principal AC line and the drive. If a transformer is used, then the filter should be placed between the transformer and the drive.</td>
</tr>
</tbody>
</table>

**Note:** Alternatively, the following procedure can be used to approximately define the power supply characteristics:

1. Power to the motor shaft for each load in Watts:
   \[ W_n = \pi \times N_n \times \left[ \frac{T_n[N_m]}{30} \right] \]
2. Power to support the total load in Watts: \( WS = \text{sum of the } W_n \text{ of the loads moving simultaneously} \)
3. Power of the transformer in Watts: \( TW = 2 \times WS \) (efficiency = 0.5)
4. Power of the transformer in VA:
   \[ TVA = \frac{TW}{0.7} \] (single phase)
   \[ TVA = \frac{TW}{0.8} \] (three phase)
5. Take into account a voltage drop of about 8% for the transformer during the application of the load (the secondary voltage must not exceed a voltage value of 108% of the nominal value when the load is zero).

A simple and fast alternative method to calculate the power in VA of the transformer is:

\[ TVA \text{ (VA)} = \sqrt{3} \times VDC_{BUS} \times I_{max_{PHASE}(RMS)} \]
## 12.3 Inrush Current and Fusing

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Peak Current</strong></td>
<td>4.2 A_{peak} (3.0 A_{RMS})</td>
</tr>
<tr>
<td><strong>Suggested External Fusing</strong></td>
<td>3A Slow Blow (Class J or RK1 Time Delay)</td>
</tr>
</tbody>
</table>

**NOTE**
The suggested external fusing refers to applicable external fuses on the power supply. Fuses should be wired in series over the AC line inputs as shown in the power supply diagram in [Circuit and Power Supply Connection Schemes](#). If you suspect the drive may be damaged, contact Kollmorgen Customer Support to evaluate repair or replacement options.
13 Modbus RS485 Interface

The Modbus interface allows a multi-point link connection conforming to the standard RS-485 CCITT V.11 X.27. The isolated interface is supplied of power through an internally isolated DC/DC converter. No external power supply is needed.

The presence of the Modbus interface depends on the system version.

The drive version, P80360-R4E, is equipped with two RJ45 connectors with 8 parallel pins (CN5A and CN5B) to simplify the connection of the nodes to the MODBUS ® network.

Cat. 5 Ethernet cables can be used for connection between P80360-R4E drives and between the P80360-R4E drive and the Modbus master (HMI, controller, etc.).

Connection between the P80360-R4E drive and Modbus master may require a RJ45 to RS485 Serial Converter or Modbus gateway. Ensure the Modbus master and P80360-R4E drive are powered off when making the connection. Please reference the manual for your Modbus master for compatibility and connection diagrams.

NOTE

Shielded cables are required for use with the communication interfaces. The machine layout influences the shielded connection. Connecting the shield to the ground on both ends is recommended. Follow the instructions under Wiring Guidelines to ensure proper usage.
13.1 Connection to the RS485 Network

Note: A termination resistor must be inserted in the first and last driver of the circuit.

If a system is present at the beginning or at the end of the network, the terminal resistor can be inserted by closing the JUMPER in position 2. The position of the JUMPER is indicated in Connections.
14 Input Connections

14.1 Digital Input Connections

The drives are equipped with a CN3 connector with 4 digital inputs (opto-isolated) which can use voltages between 5-24V\textsubscript{DC} in PNP, NPN and Line-Driver connection.

14.1.1 Examples of connections to digital inputs

### Standard (B0\textsubscript{IN0} & B0\textsubscript{IN1})

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Min</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal Supply Voltage</td>
<td>5</td>
<td>24</td>
<td>V\textsubscript{DC}</td>
</tr>
<tr>
<td>Input Frequency Limits</td>
<td>—</td>
<td>10</td>
<td>kHz</td>
</tr>
<tr>
<td>Threshold Switching Voltage</td>
<td>1.9</td>
<td>2.4</td>
<td>V\textsubscript{DC}</td>
</tr>
<tr>
<td>Current at 5 V\textsubscript{DC}</td>
<td>—</td>
<td>6.28</td>
<td>mA</td>
</tr>
<tr>
<td>Current at 24 V\textsubscript{DC}</td>
<td>—</td>
<td>8.75</td>
<td>mA</td>
</tr>
</tbody>
</table>

### High-Speed (B0\textsubscript{IN2} & B0\textsubscript{IN3})

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Min</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal Supply Voltage</td>
<td>5</td>
<td>24</td>
<td>V\textsubscript{DC}</td>
</tr>
<tr>
<td>Input Frequency Limit</td>
<td>—</td>
<td>250</td>
<td>kHz</td>
</tr>
<tr>
<td>Threshold Switching Voltage</td>
<td>1.9</td>
<td>2.4</td>
<td>V\textsubscript{DC}</td>
</tr>
<tr>
<td>Current Draw at 5 V\textsubscript{DC}</td>
<td>—</td>
<td>7.52</td>
<td>mA</td>
</tr>
<tr>
<td>Current Draw at 24 V\textsubscript{DC}</td>
<td>—</td>
<td>10</td>
<td>mA</td>
</tr>
</tbody>
</table>

NOTE

Shielded cables are required for use with the Digital Inputs. The machine layout influences the shielded connection. Connecting the shield to the ground on both ends is recommended. Follow the instructions under Wiring Guidelines to ensure proper usage.
14.2 Incremental Encoder Input Connection

The CN4 connector on the P80360 drives allow a direct interface (isolated) for incremental encoder connection in two configurations:

- Differential 5 V\(_{\text{DC}}\) meeting the RS422 standard
- Single-Ended 5 V\(_{\text{DC}}\) TTL/CMOS

Kollmorgen Space software settings:

- 0 = Incremental Encoder (AB)
- 3 = Incremental Encoder + Zero (ABZ)

**NOTE**

The maximum supply current of the 5V is 100 mA.

The following figure shows the connection schematic for a differential incremental encoder:

![Differential Incremental Encoder Schematic](image1)

The following figure shows the connection schematic for a single-ended incremental encoder:

![Single-Ended Incremental Encoder Schematic](image2)

**NOTE**

Shielded cables are required for use with the Encoder Inputs. The machine layout influences the shielded connection. Connecting the shield to the ground on both ends is recommended. Follow the instructions under Wiring Guidelines to ensure proper usage.
14.3 Service SCI Interface

The CN6 connector on the P80360 drives is dedicated to the Service SCI interface.

The Service SCI interface allows a point-to-point connection between the drive and the PC. This CN6 port is used for the programming and debugging of the application via the Kollmorgen Space graphical user interface (GUI).

In addition, the Service SCI Interface may be used for initial Modbus setup, testing, and simulation using software such as Modbus Poll. You cannot simultaneously program or debug your application using the Kollmorgen Space GUI while using Modbus simulation software.

Refer to Kollmorgen Space Help for information on using the Service SCI interface.

**NOTE**

This connection is only possible with P8SI-KIT-RJ11 hardware and software provided by Kollmorgen.
15 Safe Torque Off (STO) Inputs (Mandatory)

Two terminals, 24 V<sub>DC</sub> compatible (opto-isolated)

<table>
<thead>
<tr>
<th>STO1</th>
<th>STO2</th>
<th>Drive Status</th>
<th>Motor Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>+24 V&lt;sub&gt;DC&lt;/sub&gt;</td>
<td>+24 V&lt;sub&gt;DC&lt;/sub&gt;</td>
<td>Enabled</td>
<td>SW Controlled</td>
</tr>
<tr>
<td>+24 V&lt;sub&gt;DC&lt;/sub&gt;</td>
<td>Not Connected</td>
<td>Disabled</td>
<td>Inertia Controlled Stop</td>
</tr>
<tr>
<td>Not Connected</td>
<td>+24 V&lt;sub&gt;DC&lt;/sub&gt;</td>
<td>Disabled</td>
<td>Inertia Controlled Stop</td>
</tr>
<tr>
<td>Not Connected</td>
<td>Not Connected</td>
<td>Disabled</td>
<td>Inertia Controlled Stop</td>
</tr>
</tbody>
</table>

Safety Specifications

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety Function</td>
<td>STO</td>
<td>Safe Torque Off</td>
</tr>
<tr>
<td>Category</td>
<td>4</td>
<td>In accordance with EN ISO 13849-1</td>
</tr>
<tr>
<td>Performance Level</td>
<td>PLe</td>
<td>In accordance with EN ISO 13849-1</td>
</tr>
<tr>
<td>Safety Integrity Level</td>
<td>SIL3</td>
<td>In accordance with EN ISO 13849-1, table 3</td>
</tr>
<tr>
<td>DCavg [%]</td>
<td>99</td>
<td>Average Diagnostic Coverage</td>
</tr>
<tr>
<td>PFHD [1/h]</td>
<td>7.04 x 10&lt;sup&gt;-9&lt;/sup&gt;</td>
<td>Probability of dangerous failures per hour</td>
</tr>
<tr>
<td>T Service Life [Years]</td>
<td>20</td>
<td>In accordance with EN ISO 13849-1</td>
</tr>
<tr>
<td>Type Test</td>
<td>The STO function has been certified by an independent testing body.</td>
<td></td>
</tr>
</tbody>
</table>
### 15.1 Safe Torque Off (STO): Safety

#### 15.1.1 Safety and Requirements for using Safe Torque Off (STO)

This document only describes the usage of the safety function Safe Torque Off (STO) in accordance with EN ISO 13849-1, which is implemented in the series of drives reported which is implemented in the P80360 drive.

#### 15.1.2 Safety

When commissioning electrical drives:

- Always observe the safety instructions and warnings in the product documentation.
- Switch off the supply voltage and secure it against being switched on again before mounting and installing the device. Only switch the supply voltage on when mounting and installation is complete.
- Never remove or insert a plug connector when the motor controller is powered.
- Observe the handling specifications for electrostatically sensitive devices.
- Only enable the controller if the drive has been professionally installed and fully parametrized.
- Do not carry out repairs on the device. If defective, replace the device.

#### 15.1.3 Safety instruction for the STO safety function

In order to achieve safety characteristics according to EN ISO 13849-1:

- Conduct a risk assessment of the application.
- Select the components and connect them in accordance with the required category in accordance with EN ISO 13849-1.

Failure of the safety function can result in serious, irreversible injuries.

- Do not bypass the connections for safety equipment.
- Observe the input voltage ranges of the device.
- Only use the STO function when all of the necessary safeguards have been set up and are functional.
- Validate the STO function to complete commissioning.

Severe injuries can result from uncontrolled movement of the passive actuators when switching off the power output stage. The STO function is insufficient as the sole safety function for drives that are subject to permanent torque (e.g., through suspended loads).

- Shut down the passive actuators mechanically, if required, e.g., via a brake. This especially applies to vertical axes without automatic locking arrangement, clamping units or counterbalancing.
- Reliably prevent movement of the actuators by suspended loads or other external forces, e.g., with a mechanical holding brake.
NOTE
The device is not intended to provide any automatic or manual reset/restart safety function. Manual Reset and Restart operation have to be provided in end application.

15.1.4 Intended use of the STO function
The drive supports the STO safety function (Safe Torque Off) in accordance with EN ISO 13849-1. The STO function is intended to disconnect the torque from the integrated motor and prevents the unexpected restart of the motor. The STO function may only be used for applications in which the specified safety characteristics suffice.

15.1.5 Safety characteristics
The STO function satisfies the requirements for the following safety characteristic values:

- PLe/cat.4 in accordance with EN ISO 13849-1 (Performance Level/PL)

The achievable safety level depends on the other components that are used to implement the safety function.

The device must be activated via the connection [CN7] with the category required for the application in accordance with EN ISO 13849-1.

15.1.6 Foreseeable misuse of the STO function
Unintended use includes the following misuses:

- Bypassing of the safety function
- Applications where switching off can result in hazardous movements or conditions

⚠️WARNING
The STO function does not provide protection against electric shock, only against dangerous movements.
15.1.7 Diagnostic coverage (DC)

Diagnostic coverage depends on how the device is integrated in the control chain and on the measures implemented for the diagnostics.

In order to achieve the specified diagnostic coverage, the status of the FAULT output (B0_OUT0) could be evaluated by the control system every time the STO function is requested.

If the signal of the FAULT output (B0_OUT0) does not have the expected value, a potentially dangerous malfunction may exist. In this case, appropriate measures must be implemented to maintain the safety level.

**IMPORTANT**

The drive cannot detect a cross circuit in the input circuit by itself.
- Find out if cross-circuit detection is needed for the input circuit and wiring in final application.
- If required, use a safety switching device with cross-circuit detection.
15.1.8 Requirements for product use
For correct and safe use of the product in a machine or system:

- Provide the complete product documentation of the product to the following specialists:
  - the design engineer and the installer of the machine or system
  - the personnel responsible for commissioning
- Have the documentation available throughout the entire product lifecycle.
- Ensure compliance with all of the specifications in the documentation for the device
- Take into consideration the documentation for the other components (e.g. cables).
- Take into consideration all of the legal regulations that are applicable for the installation site, as well as the following documents:
  - regulations and standards
  - regulations of the testing organisations and insurers
  - national specifications

For correct and safe use of the STO function:

- Conduct a risk assessment for your machine or system.
- Comply with the specified safety characteristics.
- Comply with the connection and environmental conditions, in particular the voltage ranges of the product and all connected components. Only compliance with the limit values and load limits will enable operation of the product in compliance with the specified safety regulations.

15.1.9 Training of specialized personnel
The function should only be integrated into the machine by a qualified electrical technician of the machine manufacturer. The qualified technician must be familiar with:

- installation and operation of electrical control systems
- applicable regulations for operating safety-engineering systems
- applicable regulations for accident prevention and operational safety
- documentation for the product

15.1.10 Range of application
The device has the CE marking and certain configurations of the product have been certified by Underwriters Laboratories Inc. (UL) for the USA and Canada.

Additional information including certificates and EU Declarations of Conformity can be found on the Kollmorgen website.

15.1.11 Specified standards
Version Status ISO 13849-1:2015
15.1.12 Function and application

The securely switched-off torque safety function (Safe Torque Off) enables 2-channel, secure disconnection of the motor.

The safety function is requested solely via the control ports of the STO connection [C7] of the device.

Safety-oriented circuitry for additional interfaces of the device is not required.
15.1.13 Circuitry of the control ports

**IMPORTANT**

To protect against unintended start-up, the device must be powered via the connection [CN7] with the category required for the application in accordance with ISO 13849-1.

The following components can be connected to the control ports to request the STO function:

- Safe semiconductor outputs (electronic safety switching devices, active safety sensors, e.g. light curtains with OSSD signals) (Output signal switching device/OSSD)
- Switch contacts (safety switching devices with relay outputs, passive safety sensors, e.g. forced position switches)

![Diagram of circuitry of the control ports]

**Functional description**

The STO function is requested over 2 channels via switch S1, whereby the control voltage (+24 V DC, item 2 in the previous graphic) is switched off at both control ports STO 1 and STO 2.

The control ports should be switched simultaneously. The discrepancy value between the two inputs is monitored continuously by the hardware diagnostic circuit. If the values are different the diagnostic circuit disables the power of the output stage, informs the microcontroller that there is a fault and a diagnostic message is generated on the display (flashing S) and the FAULT output of the drive opens.

The drive monitors the status of the control ports. The control ports are of equal value. As soon as logic 0 (0 V) is present at one of the control ports, the drive reacts as follows:

- **Channel 1 (STO 1):** As long as logic 0 is present at the STO 1 input, the output stage drivers are not supplied with voltage. The motor will not generate a torque.
- **Channel 2 (STO 2):** As long as logic 0 is present at the STO 2 input, the output stage drivers are not supplied with voltage. The motor will not generate a torque.
Behavior of the drive when the STO 1 or STO 2 is opened

- Behavior of the drive with a running motor: The movement of the drive is not decelerated via a braking ramp. The drive continues to move uncontrolled through inertia or external forces until it comes to a standstill by itself.
- Behavior of the drive with a stopped motor: The drive is uncontrolled and can move through external forces.

This design implements Safe Torque Off (STO) functionality by using dual-channel, isolated STO signals that enable or disable the power (VCC) to the gate-driver integrated circuit (IC) through load switches providing a redundant option. To ensure a high degree of safety, two independent STO control channels are implemented in hardware. The STO circuit is designed such that a fault in one control channel will not affect the other channel's ability to prevent the drive from starting (single fault tolerant).

This implementation of the STO works with negative logic, deactivating the power stage by default. In order to activate the power stage, and therefore allow the motor to operate, two differential inputs must be energized. These inputs activate two optocouplers that enable the power supply of the Half-Bridge Gate-Drives that control the power stage. If the STO inputs are not energized, the transistors of the power stage are turned off because the Half-Bridge Gate-Drives are turned off.

Severe injuries can result from uncontrolled movement of the passive actuators when switching off the power output stage. The STO function is insufficient as the sole safety function for drives that are subject to permanent torque (e.g. through suspended loads).

- Shut down the passive actuators mechanically, if required, e.g. via a brake. This especially applies to vertical axes without automatic locking arrangement, clamping units or counterbalancing.
- Reliably prevent movement of the actuators by suspended loads or other external forces, e.g. with a mechanical holding brake.

⚠️ IMPORTANT

If the output stage of the device fails when an STO function is active, it may result in the drive jerking through a limited detent movement of the rotor. The maximum rotation angle/travel corresponds to the pole pitch of the motor used.
15.2 STO Interface [CN7]

15.2.1 Switching statuses
As long as a logic 1 (+24 V\textsubscript{DC}) is present at both control ports, the motor can be operated (STO function is inactive). If there is a logic 0 (0 V\textsubscript{DC}) at one or both of the control ports, the power to the motor is interrupted.

<table>
<thead>
<tr>
<th>STO 1</th>
<th>STO 2</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Normal operation</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>The STO function is open on one channel, e.g. in the event of a failure of a channel:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• The output stage is switched off on one channel.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• The motor can no longer be operated.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• STO function is inactive.</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>The STO function is open on two channels:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• The output stage is switched off on two channels.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• The motor can no longer be operated.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• The STO function is active.</td>
</tr>
</tbody>
</table>

Switching Statuses [CN7]

Control ports STO1/STO2

- Deactivate STO[V\textsubscript{DC}]
- Active STO[V\textsubscript{DC}]

N.B. Intermediate range is undefined

\( > 19 \)

\( < 5 \)

The amount of energy stored in the components of the STO function (e.g. capacitors) depends on the input voltage level. These amounts of energy must be charged or discharged depending on the switching operation. Depending on the input voltage, this results in different values for the transition to the safe status (STO) and the tolerance time (buffer time) regarding OSSD signals.

<table>
<thead>
<tr>
<th>Signal</th>
<th>Switching Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>STO1/STO2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Activate STO [ms]</td>
</tr>
<tr>
<td></td>
<td>Deactivate STO [ms]</td>
</tr>
</tbody>
</table>

15.2.2 Reaction to test pulses
Short test pulses from a safety control are tolerated and thus do not trigger the STO function.

<table>
<thead>
<tr>
<th>Control Ports STO1/STO2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum permissible test pulse width</td>
</tr>
</tbody>
</table>
15.3 Installation and Commissioning

Danger of electric shock from voltage sources without protective measures.

Danger of electric shock from voltage sources without protective measures.

- Use for the electrical power supply only PELV circuits (Protective extra-low voltage/PELV) in accordance with EN 60204-1.
- Also observe the general requirements for PELV circuits in accordance with EN 60204-1.
- Use only voltage sources which guarantee reliable electrical isolation of the operating and load voltage in accordance with IEC 60204-1.

15.3.1 Installation

Unexpected and unintended movement of the drive during mounting, installation and maintenance work.

- Before starting work: Switch off power supplies.
- Secure the power supplies against accidental reactivation

Installation instructions:

- Observe all of the information on electrical installation of the device reported on the user manual.
- Comply with the handling specifications for electrostatically sensitive devices.
- Connect the control ports in 2 channels with parallel wiring.
- For the connection [CN7], use the mating connector Phoenix 1708329.

⚠️ IMPORTANT

The STO function must never be bridged. Make sure that no jumpers, etc. can be used parallel to the safety wiring.
15.3.2 Note on Commissioning
Recommendation for first commissioning without complete safety equipment:

- Set-up at least with emergency stop switching device and 2-channel shut-down via the control ports STO 1 and STO 2 [CN7].
- Implement the set-up in such a way that it must be forcibly removed when the final protection wiring is carried out.

NOTE
Incorrect wiring or use of inappropriate components will result in failure of the STO function or non-compliance with the requirements of EN ISO 13849-1 (category).

Prior to commissioning:

- Make sure that components are used and wired in accordance with the required category according to EN ISO 13849-1.
- Check the electrical installation (connecting cable, pin allocation).
- Validate the STO function to conclude the installation process and after every modification to the installation.
- Only use the STO function when all of the necessary safeguards have been set up and are functional.

For a performance test of the STO function:

1. Switch off each channel individually and check the reaction of the motor.
2. Switch off both channels and check the reactions.

15.3.3 Diagnostic

<table>
<thead>
<tr>
<th>Diagnostic</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FAULT Output (B0_OUT0)</td>
<td>Low</td>
</tr>
<tr>
<td>LED Signaling</td>
<td>Red and Yellow</td>
</tr>
</tbody>
</table>

15.3.4 Obligations of the machine operator
The implemented safety function must be subjected to a regular and documented performance test by a specialist during the machine’s period of use. The frequency of these tests must be determined by the machine operator based on the specifications of the machine manufacturer.

Check the drive at least once per year.
### 15.3.5 Electrical Data

<table>
<thead>
<tr>
<th>Control ports STO1/STO2 [CN7]</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal voltage [V\text{DC}]</td>
<td>24</td>
</tr>
<tr>
<td>Voltage Range [V\text{DC}]</td>
<td>19-30</td>
</tr>
<tr>
<td>Overvoltage-safe up to [V]</td>
<td>50</td>
</tr>
<tr>
<td>Nominal current @ 19V\text{DC} [mA]</td>
<td>8</td>
</tr>
<tr>
<td>Input voltage thresholds</td>
<td>N.B.: intermediate range is undefined</td>
</tr>
<tr>
<td>Deactivate STO [V\text{DC}]</td>
<td>&gt; 19</td>
</tr>
<tr>
<td>Activate STO [V\text{DC}]</td>
<td>&lt; 5</td>
</tr>
<tr>
<td>Activate STO function switching time [ms]</td>
<td>50</td>
</tr>
<tr>
<td>Deactivate STO function switching time [ms]</td>
<td>10</td>
</tr>
<tr>
<td>Protective function</td>
<td>Protection against polarity reversal</td>
</tr>
</tbody>
</table>

### Signal Lines

| Maximum cable length [m] | 30 |
| Conductor cross-section [mm²] | 0,12 – 1,3 |
16 Digital Output Connections

16.1 Digital Output Connections (B0_OUT0 and B0_OUT1)

The drives have a CN3 connector with 2 digital outputs (opto-isolated), which can be used at 24\text{V}_\text{DC} in PNP connection (forcing at 24\text{V}_\text{DC}).

The digital outputs are designed to function at \( V_{OUT_{\text{max}}} = 24\text{V}_\text{DC}, I_{OUT_{\text{max}}} = 100\text{mA} \) and they are protected from inversion of the polarity.

<table>
<thead>
<tr>
<th>Output type</th>
<th>Characteristics</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>PNP Transistor Output</td>
<td>Power Supply Output Voltage</td>
<td>19</td>
<td>24</td>
<td>30</td>
<td>\text{V}_\text{DC}</td>
</tr>
<tr>
<td></td>
<td>Output Current (load dependent)</td>
<td>—</td>
<td>—</td>
<td>100</td>
<td>mA</td>
</tr>
<tr>
<td></td>
<td>Output Frequency</td>
<td>—</td>
<td>—</td>
<td>250</td>
<td>kHz</td>
</tr>
</tbody>
</table>

⚠️ CAUTION ⚠️

- Digital outputs ARE NOT over-current protected.
- Provide an external current limitation device (I_{OUT_{\text{max}}} = 100\text{mA}).
- The protective device may be placed on the output power conductor +24\text{V}_\text{DC} (CN3.11).

NOTE

Shielded cables are required for use with the Digital Outputs. The machine layout influences the shielded connection. Connecting the shield to the ground on both ends is recommended. Follow the instructions under Wiring Guidelines to ensure proper usage.

The functions of the digital outputs depend on the firmware installed on the drive.
### 16.2 Digital Output Connections (B0_OUT2)

The drives have a CN3 connector with a digital output (opto-isolated) which can be used at 24VDC in PNP connection (forcing at 24VDC).

The digital output is designed to function at $V_{OUT_{\text{max}}} = 24\text{V}_{DC}$, $I_{OUT_{\text{max}}} = 1.3\text{A}$ and they are protected from inversion of the polarity.

#### Output type Characteristics

<table>
<thead>
<tr>
<th>Output type</th>
<th>Characteristics</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>PNP Transistor Output</td>
<td>Power Supply Output Voltage</td>
<td>19</td>
<td>24</td>
<td>30</td>
<td>V$_{DC}$</td>
</tr>
<tr>
<td></td>
<td>Output Current (load dependent)</td>
<td>—</td>
<td>—</td>
<td>1.3</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>Output Frequency</td>
<td>—</td>
<td>—</td>
<td>1</td>
<td>kHz</td>
</tr>
</tbody>
</table>

⚠️ **CAUTION**

- Digital outputs ARE NOT over-current protected.
- Provide an external current limitation device ($I_{OUT_{\text{max}}} = 100\text{mA}$).
- The protective device may be placed on the output power conductor +24V$_{DC}$ (CN3.11).

Shielded cables are required for use with the Digital Inputs. The machine layout influences the shielded connection. Connecting the shield to the ground from both sides is recommended. The cables must not be exposed to disturbing sources. Follow the instructions under [Wiring Guidelines](#) to ensure proper usage.
## 17 Mating Connectors

<table>
<thead>
<tr>
<th>Connector</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CN1</td>
<td>Phoenix 1758856</td>
</tr>
<tr>
<td>CN2</td>
<td>Phoenix 1731196</td>
</tr>
<tr>
<td>CN3</td>
<td>Dinkle 0156-1B14-BK</td>
</tr>
<tr>
<td>CN4</td>
<td>Dinkle 0156-1B16-BK</td>
</tr>
<tr>
<td>CN7</td>
<td>Phoenix 1839636</td>
</tr>
</tbody>
</table>

**NOTE**

These connectors can also be purchased from Kollmorgen by ordering CONKIT-P80360-R4E. See Accessories.
## Connection Specification Chart

<table>
<thead>
<tr>
<th>Function</th>
<th>Wire Cross-Section</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Minimum</strong></td>
<td><strong>Maximum</strong></td>
</tr>
<tr>
<td>Power Supply, Motor Outputs, and PE (CN1/CN2)</td>
<td>0.2 mm² (AWG24)</td>
</tr>
<tr>
<td>Inputs and Outputs (CN3) &amp; Encoder Input (CN4)</td>
<td>0.25 mm² (AWG24) – solid or stranded</td>
</tr>
<tr>
<td></td>
<td>0.25 mm² (AWG24) for wire-end ferrule</td>
</tr>
<tr>
<td>STO Input (CN7)</td>
<td>0.14 mm² (AWG26)</td>
</tr>
</tbody>
</table>

**NOTE**

It is recommended to use copper conductor only. If using ferrules, follow the ferrule manufacturer's guidelines. Per mating connector manufacturer, a 7-8mm ferrule strip length is recommended. Wiring should meet all applicable regulations.
19 Accessories

<table>
<thead>
<tr>
<th>CONKIT-P80360-R4E</th>
<th>Mating Connector Kit for P80360-R4E (CN1, CN2, CN3, CN4, and CN7 Ports)</th>
</tr>
</thead>
<tbody>
<tr>
<td>P8SI-KIT-RJ11</td>
<td>Service SCI Interface Kit (CN6 Port) - Programming and Debugging Cable for P80360 drives.</td>
</tr>
</tbody>
</table>

**NOTE**
A set of mating connectors are included with each drive purchase. The P8SI-KIT-RJ11 SCI Interface kit is not included with each drive purchase and must be purchased separately. Only 1 kit should be needed per customer for programming and debugging.
20  Return (RMA) Procedure

In case it is not possible to resolve the problem using this manual, please contact Kollmorgen Technical Support and provide the following information:

- The drive model (Ex. P80360-R4E) and any other information printed on the drive labels.
- The complete problem description and the conditions when the problem occurs.
- The drive's configuration in the application including:
  - Current
  - Step type
  - Functioning type
- The value of the power supply voltage and its characteristics including:
  - Single phase
  - Ripple
- The description of the power supply and control signals cabling and the presence of other components in the installation.
- The description of the application including:
  - Motor movements
  - Loads
  - Velocity

Return Procedure

To return a damaged drive and initiate the RMA process, contact Kollmorgen Customer Support.
Email: orders@kollmorgen.com
Phone: (540) 633-3545
21 Initial Startup Procedure

1. Check all connections: power supply and motor.
2. Ensure application settings are correct.
3. Ensure the power supply characteristics are suitable for the drive.
4. If possible, remove the load from the motor shaft to avoid damage from potentially incorrect initial movements.
5. Supply power to the drive and make sure the green LED is switched ON or blinking. If the green LED remains OFF, shut down the system immediately and check that all connections are correct.
6. Enable the current to the motor and verify if motor holding torque is present.
7. Execute a movement of some steps and verify the rotation direction is the desired direction.
8. Disconnect the power supply, affix the motor to the load then re-enable the power supply. Once enabled, check the full functionality.
22  Regulatory Information

22.1  Conformance with RoHS
The P80360 drives are manufactured in conformance with RoHS Directive 2011/65/EU with delegated directive 2015/863/EU for installation into a machine.

22.2  Conformance with EU
Kollmorgen declares the conformity of the product series P80360 drives with the following directives:


EU Declarations of Conformity can be found on the Kollmorgen website.
The drives have been tested by an authorized testing laboratory using the configuration described in this documentation. The user is responsible for ensuring conformance with regulatory requirements.

The compliance with the Electromagnetic Compatibility directives of the P80360 product can only be verified if the entire machine, where the drive is a component, has been designed and realized in compliance with the requirements for Electromagnetic Compatibility.

The installation of the drive must be executed in accordance with the guidelines outlined in this manual.
About KOLLMORGEN

Kollmorgen, a Regal Rexnord brand, has more than 100 years of motion experience, proven in the industry's highest-performing, most reliable motors, drives, linear actuators, AGV (Automated Guided Vehicle) control solutions, and automation control platforms. We deliver breakthrough solutions that combine exceptional performance, reliability and ease of use, giving machine builders an irrefutable marketplace advantage.

Join the Kollmorgen Support Network for product support. Ask the community questions, search the knowledge base for answers, get downloads, and suggest improvements.

North America
KOLLMORGEN
201 West Rock Road
Radford, VA 24141, USA
Web:  www.kollmorgen.com
Mail:  support@kollmorgen.com
Tel.:  +1 - 540 - 633 - 3545
Fax:  +1 - 540 - 639 - 4162

Europe
KOLLMORGEN Europe GmbH
Pempelfurtstr. 1
40880 Ratingen, Germany
Web:  www.kollmorgen.com
Mail:  technik@kollmorgen.com
Tel.:  +49 - 2102 - 9394 - 0
Fax:  +49 - 2102 - 9394 - 3155

South America
KOLLMORGEN
Avenida João Paulo Ablas, 2970
Jardim da Glória, Cotia – SP
CEP 06711-250, Brazil
Web:  www.kollmorgen.com
Mail:  contato@kollmorgen.com
Tel.:  +55 11 4615-6300

China and SEA
KOLLMORGEN
Room 302, Building 5, Lihpao Plaza,
88 Shenbin Road, Minhang District,
Shanghai, China.
Web:  www.kollmorgen.cn
Mail:  sales.china@kollmorgen.com
Tel.:  +86 - 400 668 2802
Fax:  +86 - 21 6248 5367