AMCI
ADVANCED MICRO CONTROLS INC.

SD17060B
SD17060B-25
Stepper Drivers

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User Manual

AMCI Motion Control Products

GENERAL INFORMATION

Important User Information

The products and application data described in this manual are useful in a wide variety of different applications. Therefore, the user and others responsible for applying these products described herein are responsible for determining the acceptability for each application. While efforts have been made to provide accurate information within this manual, AMCI assumes no responsibility for the application or the completeness of the information contained herein.

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All equipment being returned to AMCI for repair or replacement, regardless of warranty status, must have a Return Merchandise Authorization number issued by AMCI. Call (860) 585-1254 with the model number and serial number (if applicable) along with a description of the problem. An "RMA" number will be issued. Equipment must be shipped to AMCI with transportation charges prepaid. Title and risk of loss or damage remains with the customer until shipment is received by AMCI.

24 Hour Technical Support Number

24 Hour technical support is available on this product. Start at our website, *www.amci.com* if you have internet access. Product documentation and FAQ's are available on the site that answer most common questions.

If you require additional technical support, call (860) 583-7271. Your call will be answered by the factory during regular business hours, Monday through Friday, 8AM - 5PM Eastern. During non-business hours an automated system will ask you to enter the telephone number you can be reached at. Please remember to include your area code. The system will page an engineer on call. Please have your product model number and a description of the problem ready before you call.
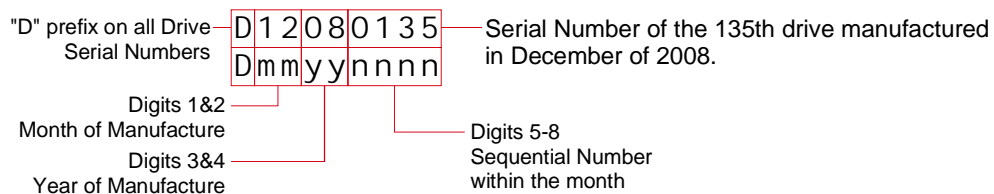
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Manuals at AMCI are constantly evolving entities. Your questions and comments on this manual are both welcomed and necessary if this manual is to be improved. Please direct all comments to: Technical Documentation, AMCI, 20 Gear Drive, Terryville CT 06786, or fax us at (860) 584-1973. You can also e-mail your questions and comments to *techsupport@amci.com*

INTRODUCING THE SD17060B

This manual is designed to get you up and running quickly using the SD17060B or SD17060B-25 stepper drivers. As such, it assumes you have some basic knowledge of stepper systems, such as the resolution you want run your motor at, and the reasons why you'd want to use Idle Current Reduction and the reasons why you wouldn't. If these terms or ideas are new to you, we're here to help. AMCI has a lot of information on our website and we are adding more all the time. If you can't find what you're looking for at http:///www.amci.com, send us an e-mail or call us. We're here to back you up with all of our knowledge and experience.

Applicable Units

This manual applies to all SD17060B and SD17060B-25 drivers manufactured after December of 2008 as well as some SD17060B drivers manufactured during December of 2008. You will be able to determine the date of manufacture from the serial number on the driver. Serial numbers for all AMCI drivers are formed from a date code and sequential number. The serial number format is shown below.

"D" prefix on all Drive Serial Numbers

D 1 2 0 8 0 1 3 5 — Serial Number of the 135th drive manufactured in December of 2008.

D m m y y n n n n

Digits 1&2
Month of Manufacture
Digits 3&4
Year of Manufacture

Digits 5-8
Sequential Number within the month

For SD17060B Drives...

➤ If your year of manufacture is 2009 or later, (digits 3 and 4 are "09" or greater), then this manual applies.

➤ If your month and year of manufacture is December of 2008, (digits 1 through 4 are "1208"), and the sequential number is "0135" or greater, then this manual applies.

➤ If your month and year of manufacture is December of 2008, (digits 1 through 4 are "1208"), and the sequential number is less than "0135" then most of the information in this manual applies. The only difference is that these older SD17060B drivers require external resistors for input signals greater than 5Vdc. Refer to Appendix A on page 16 for additional information.

➤ If your month and year of manufacture is November of 2008 or earlier, (digits 1 through 4 are "1108" or less), then most of the information in this manual applies. The only difference is that these older SD17060B drivers require external resistors for input signals greater than 5Vdc. Refer to Appendix A on page 16 for additional information.

For SD17060B-25 Drives...

➤ If your year of manufacture is 2009 or later, (digits 3 and 4 are "09" or greater), then this manual applies.

➤ If your month and year of manufacture is December of 2008 or earlier, (digits 1 through 4 are "1208" or less), then most of the information in this manual applies. The only difference is that older SD17060B-25 drivers will only accept 24Vdc input signals. Refer to Appendix B on page 17 for additional information.

For SD17060B-24 Drives...

As of this manual, the SD17060B-24 has been phased out of production and replaced by the standard SD17060B. The older SD17060B drivers required an external resistor when using a 24Vdc input signal and the SD17060B-24 drivers had this resistor added internally. With this manual, the standard SD167060B drivers have inputs that accept 5 to 24Vdc signals without the need for an external resistor and they replace the SD17060B-24 in all applications. See Appendix C on page 18 for more information.

The SD17060B and SD17060B-25

The SD17060B and SD17060B-25 are micro-stepping drivers that are part of the growing line of motion control products from AMCI. They are designed for use with a variety of stepper motors including AMCI's size 23 through size 42 motors. The two drivers can be programmed to a maximum resolution of 50,800 steps per turn and output a motor current of 1.0 to 6.3ARMS that is programmable in 0.1ARMS increments. Other features of the two drivers include:

➢ Inputs that accept 5Vdc to 24Vdc without the need of an external current limiting resistor
➢ Anti-Resonance Circuitry
➢ Back-EMF Protection Circuity
➢ Programmable Idle Current Reduction
➢ Programmable Current Loop Gain
➢ Programmable Pulse Train Input (Step/Direction or CW/CCW)
➢ Programmable Active State for the Disable Input

The only difference between the SD17060B and the SD17060B-25 is the resolution settings available on the two drivers. The table below shows the settings available on each driver with the differences highlighted.

SD17060B	200	400	1,000	2,000	5,000	10,000	12,800	18,000	20,000	21,600	25,000	25,400	25,600	36,000	50,000	50,800
SD17060B-25	200	400	1,000	1,600	2,000	3,200	5,000	10,000	12,800	18,000	20,000	21,600	25,000	36,000	50,000	50,800

Figure 1: Available Position Resolutions

Most of the information in this manual applies to both drivers and the "SD17060B" part number is used to refer to both. When giving information that only applies to the SD17060B-25, the "SD17060B-25" part number will be used.

Replacing an Older SD17060B

When replacing a SD17060B that was produced prior to December, 2008 with a unit that was produced after December, 2008, you will have to remove any current limiting resistors if you had driven the inputs with 12 or 24Vdc. Refer to Appendix A, *USING OLDER SD17060B DRIVES*, on page 16.

Upgrading from the SD17060

The SD17060B replaces the AMCI SD17060 in all applications. The SD17060B has several advantages:

➢ The SD17060B uses the latest power switching transistors for greater efficiency and fewer thermal loses.
➢ Greater efficiency and a thinner front panel means you can space the drivers closer together in an enclosure.
➢ The Disable Input on the SD17060B can be used to reset the driver. The SD17060 could only be reset by cycling power to it.
➢ The SD17060B has the same back panel mounting pattern, allowing you to quickly change between units.
➢ The Current Loop Gain now has an automatic setting that allows the SD17060B to determine the appropriate gain when the driver is powered up.

However, improvements sometimes require changes, and there are a few minor changes between the drivers.

➢ The ±STEP/CW pins on the Indexer Connector are swapped. This change makes the SD17060B indexer pinout the same as a majority of our other drivers.
➢ The SD17060 required external resistors to use 12 Vdc or 24 Vdc inputs. These resistors are no longer needed when using the SD17060B and they must be eliminated for proper operation. This statement only applies to SD1760B drivers shipped during the second half of December, 2008 and later. See *Applicable Units* on page 3 to determine when your SD717060B driver was shipped.
➢ The third harmonic switch settings on the SD17060 have been replaced with the following on the SD17060B:
   1) **Disable Input Active State:** Allows you to program the Disable Input to be active when voltage is applied to the input or active when voltage is removed. The default setting   mimics the behavior of the Disable Input on the SD17060.
   2) **Anti-Resonance Enable:** The anti-resonance circuitry can be enabled or disabled.

SPECIFICATIONS

Driver Type

Two bipolar MOSFET H-bridges with 170Vdc output bus. 20KHz PWM current control.

Physical Dimensions

Width: 2.1 inches max.

Depth: 4.0 inches max.

Height: 6.2 inches
7.0 inches with mounting tabs

Weight

2.4 lbs. (1.1 kg.)

Inputs

Electrical Characteristics for all Inputs: .... Differential. 1500 Vac/dc opto-isolated. Can be wired as single ended inputs.

Indexer .... Motor steps on high going pulse. 250 nS min. pulse width, 2 MHz maximum input frequency. 500 nS minimum dwell time between direction changes.

Disable .... Programmable Active State (ON or OFF). Disables current to motor. Driver does not accept steps while disabled.

Fault Output

Electrical Characteristics:
Open Collector/Emitter. 1500 Vac/dc opto-isolated. 30Vdc, 20 mA max.

The Fault Output is normally on. Turns off under the following conditions:

Reset .... The driver initialization is not yet complete on power up.

Short Circuit .... Motor Phase to Phase or Phase to Earth Ground

Over Temp ...... Heat Sink temperature exceeds 90° C (195° F)

No Motor .... The motor interlock terminals are not connected.

Pulse Train Input

Switch selectable to CW/CCW or Step/Direction.

Motor Current

Switch selectable from 1.0 to 6.3A$_{RMS}$ in 0.1 Amp steps.

Idle Current Reduction

Switch selectable to *Not reduced, To 69%, To 50%,* or *To 0%.* Motor current is reduced to selected level if a step pulse is not received for one second for the *To 50%,* and *To 0%* settings. For the *To 69%,* setting, current is reduced after 10 milliseconds. Current is restored to full value on next pulse.

Resolution

SD17060B:
Switch selectable to 200, 400, 1,000, 2,000, 5,000, 10,000, 12,800, 18,000 20,000, 21,600, 25,000, 25,400, 25,600, 36,000, 50,000, or 50,800 steps per turn.

SD17060B-25:
Switch selectable to 200, 400, 1,000, 1,600, 2,000, 3,200 5,000, 10,000, 12,800, 18,000 20,000, 21,600, 25,000, 36,000, 50,000, or 50,800 steps per turn.

Internal Power Fuses

10 Amp Slow Blow. Both Line and Neutral are fused. Fuses are not user replaceable.

Environmental Specifications

Input Power 95 to 132Vac, 50/60 Hz, 5.0 Apk max.

Driver will retain control of motor down to 85Vac at reduced torque.

Ambient Operating Temperature
-4° to 122°F (-20° to 50°C)

Storage Temperature
-40° to 185°F (-40° to 85°C)

Humidity 0 to 95%, non-condensing

Motor Specifications

Type 2 phase hybrid. 4, 6, or 8 lead motor

Insulation Minimum 500Vdc phase-to-phase and phase-to-case

Inductance 0.3 mH minimum. 2.5 to 45 mH recommended

Connectors

All mating connectors are included with driver.

Connector	Wire	Strip Length	Min. Tightening Torque
Indexer	28 - 16 AWG	0.275 inches	1.95 lb-in (0.22 nM)
Motor	24 - 12 AWG	0.275 inches	4.43lb-in (0.5 nM)
Power	24 - 12 AWG	0.275 inches	4.43lb-in (0.5 nM)

ADVANCED MICRO CONTROLS INC.

MOUNTING THE SD17060B

Outline Drawing

There are two ways to mount the SD17060B.

➤ The first method is with four #10-32 screws into its side panel.
➤ The second method is by the mounting tabs. Mounting tabs are for #6 screws.

⚠ **WARNING** Minimum and maximum screw lengths should be observed to prevent a screw from shorting to the PC Board.

NOTE ➤ There are airflow holes in the top and bottom of the enclosure. To ensure adequate convectional airflow, the driver must be mounted in the orientation shown in the drawing.
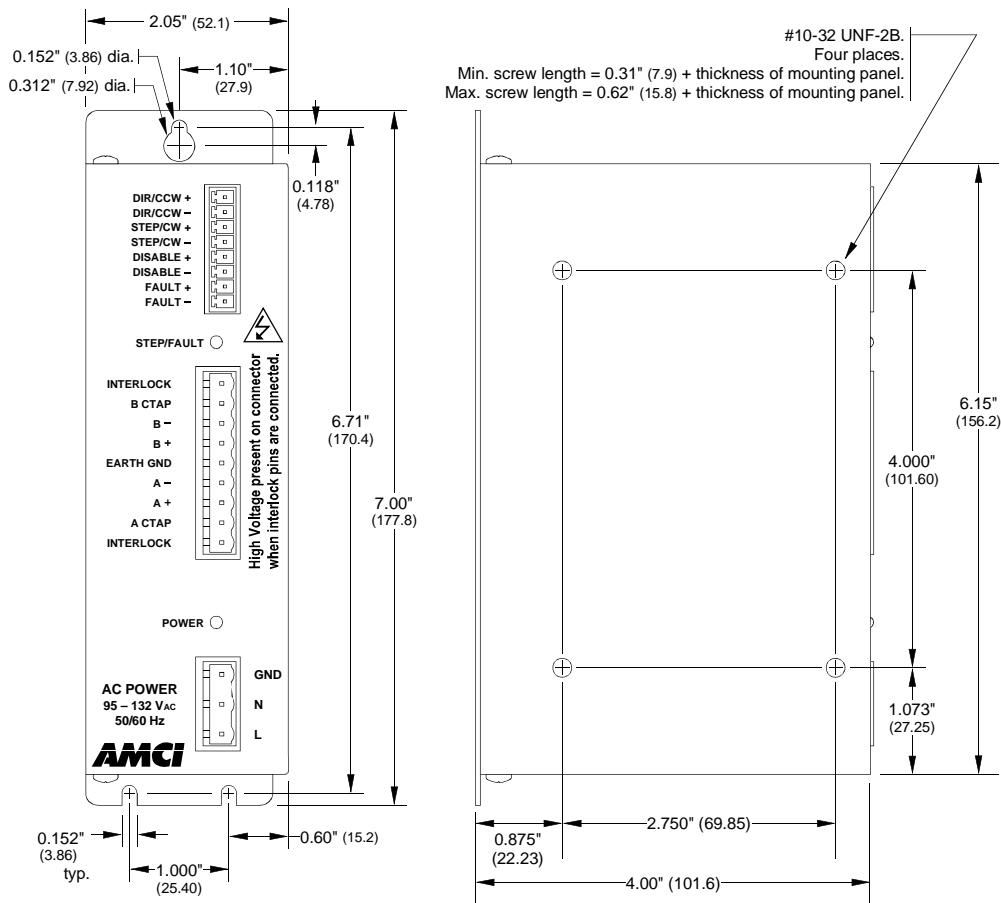
Grounding

The SD17060B must be grounded for proper operation. The **GND** connection on the power connector is connected to the SD17060B enclosure and is a sufficient grounding point for most applications. When mounted the SD17060B on a surface that is electrically conductive and grounded, you should also take steps to ensure that the two are electrically bonded together. If necessary, remove paint for the bolt mounting surfaces of the panel to ensure adequate electrical bonding.

Airflow and Wiring Space

To ensure adequate airflow and wiring space, you need two inches (50 mm) of space above and below the driver, one and one-half inches (37 mm) of space to the left and right of the driver, and one inch (25 mm) of space in front of the driver. These dimensions are typical for convectional cooling. If you have an active cooling system such as enclosure fans, you will be able to mount the drivers closer together.

SWITCH SETTINGS

The SD17060B is configured by DIP switches on the top of the driver. The factory default setting has all switches in their off (0) position except for SB2-1. (CurrentLoop Gain = 1) All switch setting are latched. You must cycle power to the driver before changes take effect.

Note on Idle Current Reduction

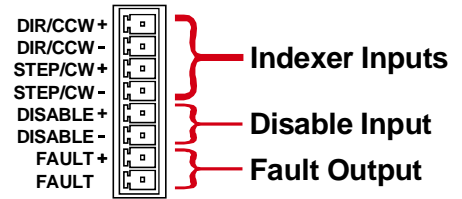The SD17060B controls the RMS current through the motor. Therefore it can momentarily put 1.4 times the motor's rated current through the windings safely. If you choose a setting of No Reduction, the SD17060B will revert to peak current control when the motor is not turning. This feature protects the motor from damage. You will not see a reduction in holding torque.

Disable Input

You can program the Disable Input's active state. When Active High, you must apply power to the input to disable the driver. When Active Low, you must apply power to the input to enable the driver. If you are not using the input, set this switch to Active High and the driver will operate as you expect. When the Disable Input is active, the SD17060B removes power from the motor and stops accepting indexer pulses. Over-temp and Over-current faults are cleared when the driver transitions from a Disabled state.

Anti-Resonance

Allows the SD17060B to compensate for back-EMF generated by the motor. It should be left enabled for most applications. Disable only if you are sure you do not want this feature or under the advice of AMCI tech support.

Current Loop Gain

This setting allows you to compensate for variations in motor properties which will give you smoother motion and better positional accuracy. See the *Setting the Current Loop Gain* section on page 12 for more information.

Self-Test Mode

Self-Test mode is controlled by the switch SB4-1. If you change the state of this switch while power is applied to the SD17060B, the driver will respond by rotating the attached motor clockwise at 60 RPM with a resolution of 50,000 steps per turn. Note that changing this switch does not alter the current supplied to the motor. All switch settings are read and latched on power up. However, you must return this switch to its correct setting for normal operation before cycling power or resetting the SD17060B.

PULSE TRAIN INPUT

STEP/DIR	0
CW/CCW	1

IDLE CURRENT REDUCTION

NO REDUCTION	0	0
TO 50%	0	1
TO 69%	1	0
TO 0%	1	1

DISABLE INPUT ACTIVE STATE

ACTIVE HIGH	0
ACTIVE LOW	1

ANTI-RESONANCE

ENABLED	0
DISABLED	1

CURRENT LOOP GAIN

AutoID	0	0	0	0	0
Gain = 1	1	0	0	0	0
Gain = 2	0	1	0	0	0
Gain = 3	1	1	0	0	0
Gain = 4	0	0	1	0	0
Gain = 5	1	0	1	0	0
Gain = 6	0	1	1	0	0
Gain = 7	1	1	1	0	0
Gain = 8	0	0	0	1	0
Gain = 9	1	0	0	1	0
Gain = 10	0	1	0	1	0
Gain = 11	1	1	0	1	0
Gain = 12	0	0	1	1	0
Gain = 13	1	0	1	1	0
Gain = 14	0	1	1	1	0
Gain = 15	1	1	1	1	0
Gain = 16	0	0	0	0	1
Gain = 17	1	0	0	0	1
Gain = 18	0	1	0	0	1
Gain = 19	1	1	0	0	1
Gain = 20	0	0	1	0	1
Gain = 21	1	0	1	0	1
Gain = 22	0	1	1	0	1
Gain = 23	1	1	1	0	1
Gain = 24	0	0	0	1	1
Gain = 25	1	0	0	1	1
Gain = 26	0	1	0	1	1
Gain = 27	1	1	0	1	1
Gain = 28	0	0	1	1	1
Gain = 29	1	0	1	1	1
Gain = 30	0	1	1	1	1
Gain = AutoMode	1	1	1	1	1

SD17060B — RESOLUTION (Steps / Revolution)

200 STEPS	0	0	0	0
400 STEPS	1	0	0	0
1,000 STEPS	0	1	0	0
2,000 STEPS	1	1	0	0
5,000 STEPS	0	0	1	0
10,000 STEPS	1	0	1	0
12,800 STEPS	0	1	1	0
18,000 STEPS	1	1	1	0
20,000 STEPS	0	0	0	1
21,600 STEPS	1	0	0	1
25,000 STEPS	0	1	0	1
25,400 STEPS	1	1	0	1
25,600 STEPS	0	0	1	1
36,000 STEPS	1	0	1	1
50,000 STEPS	0	1	1	1
50,800 STEPS	1	1	1	1

SD17060B-25 — RESOLUTION (Steps / Revolution)

200 STEPS	0	0	0	0
400 STEPS	1	0	0	0
1,000 STEPS	0	1	0	0
1,600 STEPS	1	1	0	0
2,000 STEPS	0	0	1	0
3,200 STEPS	1	0	1	0
5,000 STEPS	0	1	1	0
10,000 STEPS	1	1	1	0
12,800 STEPS	0	0	0	1
18,000 STEPS	1	0	0	1
20,000 STEPS	0	1	0	1
21,600 STEPS	1	1	0	1
25,000 STEPS	0	0	1	1
36,000 STEPS	1	0	1	1
50,000 STEPS	0	1	1	1
50,800 STEPS	1	1	1	1

OUTPUT CURRENT

0	0	0	0	0	0	1.0
1	0	0	0	0	0	1.0
0	1	0	0	0	0	1.0
1	1	0	0	0	0	1.0
0	0	1	0	0	0	1.0
1	0	1	0	0	0	1.0
0	1	1	0	0	0	1.0
1	1	1	0	0	0	1.0
0	0	0	1	0	0	1.0
1	0	0	1	0	0	1.0
0	1	0	1	0	0	1.0
1	1	0	1	0	0	1.1
0	0	1	1	0	0	1.2
1	0	1	1	0	0	1.3
0	1	1	1	0	0	1.4
1	1	1	1	0	0	1.5
0	0	0	0	1	0	1.6
1	0	0	0	1	0	1.7
0	1	0	0	1	0	1.8
1	1	0	0	1	0	1.9
0	0	1	0	1	0	2.0
1	0	1	0	1	0	2.1
0	1	1	0	1	0	2.2
1	1	1	0	1	0	2.3
0	0	0	1	1	0	2.4
1	0	0	1	1	0	2.5
0	1	0	1	1	0	2.6
1	1	0	1	1	0	2.7
0	0	1	1	1	0	2.8
1	0	1	1	1	0	2.9
0	1	1	1	1	0	3.0
1	1	1	1	1	0	3.1
0	0	0	0	0	1	3.2
1	0	0	0	0	1	3.3
0	1	0	0	0	1	3.4
1	1	0	0	0	1	3.5
0	0	1	0	0	1	3.6
1	0	1	0	0	1	3.7
0	1	1	0	0	1	3.8
1	1	1	0	0	1	3.9
0	0	0	1	0	1	4.0
1	0	0	1	0	1	4.1
0	1	0	1	0	1	4.2
1	1	0	1	0	1	4.3
0	0	1	1	0	1	4.4
1	0	1	1	0	1	4.5
0	1	1	1	0	1	4.6
1	1	1	1	0	1	4.7
0	0	0	0	1	1	4.8
1	0	0	0	1	1	4.9
0	1	0	0	1	1	5.0
1	1	0	0	1	1	5.1
0	0	1	0	1	1	5.2
1	0	1	0	1	1	5.3
0	1	1	0	1	1	5.4
1	1	1	0	1	1	5.5
0	0	0	1	1	1	5.6
1	0	0	1	1	1	5.7
0	1	0	1	1	1	5.8
1	1	0	1	1	1	5.9
0	0	1	1	1	1	6.0
1	0	1	1	1	1	6.1
0	1	1	1	1	1	6.2
1	1	1	1	1	1	6.3

CONNECTING YOUR CONTROLLER

I/O Connector

The I/O connector on the SD17060B accepts inputs from your indexer as well as the Disable Input and Fault Output.

All inputs accept 5Vdc differential signals and can also be wired to accept single ended sinking or sourcing inputs of up to 24Vdc without the need of an additional current limiting resistor. This is true for all SD17060B and SD17060B-25 units sold by AMCI after December, 2008. See *Applicable Units* on page 3 for information on determining when your unit was shipped from the AMCI factory.

Indexer Inputs
DIR/CCW +
DIR/CCW −
STEP/CW +
STEP/CW −
Disable Input
DISABLE +
DISABLE −
Fault Output
FAULT +
FAULT −

Input Wiring

All inputs on the SD17060B are low voltage, low power signals. All wiring should use shielded, twisted pair cable such as Belden 9727 instrumentation cable.

The shield of the cable should be grounded at one end only, preferably at the indexer or controller. Do not ground the shields at the SD17060B. If you must splice the cable, do not connect the shields to ground of the junction box.

Indexer Inputs

These inputs can be programmed to accept Step & Direction or CW/CCW pulses. This setting is controlled by SW1-1.

Disable Input

When active, the motor current is off and the driver does not accept indexer pulses. The active state of the Disable Input is set by switch SB1-4.

R_{LD}

An additional load resistor may be required on some PLC outputs to improve switching time. A symptom of this problem is that the motor will begin to run rough at high speeds. A 470 or 560 ohm resistor should be used. For 5V and 12V systems use a 1W resistor. For 24V systems use a 2W resistor. These power ratings assume that the output can be normally on. For systems where you are sure the output is always normally off, the wattage ratings can be cut in half.

Differential Connection
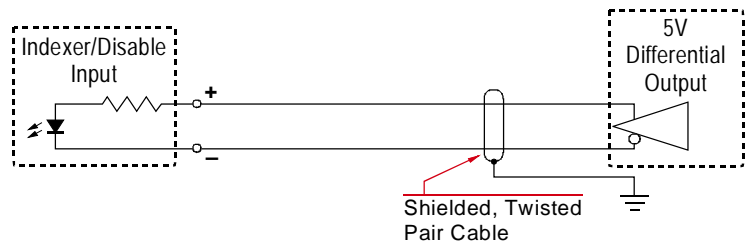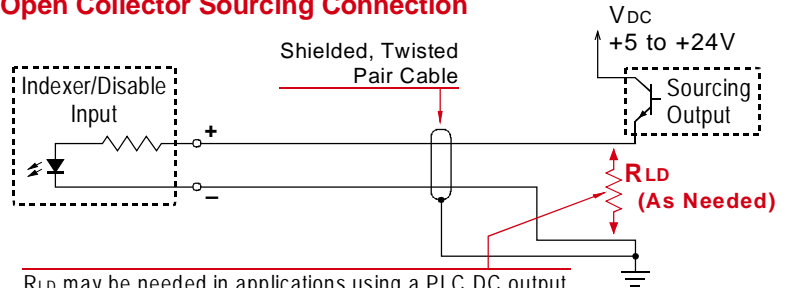
Indexer/Disable Input

5V Differential Output

Shielded, Twisted Pair Cable

Open Collector Sourcing Connection

Indexer/Disable Input

Shielded, Twisted Pair Cable

V_{DC} +5 to +24V

Sourcing Output

R_{LD} (As Needed)

R_{LD} may be needed in applications using a PLC DC output to generate index pulses at high speeds. See the note on this page for more information.

Open Collector Sinking Connection

Indexer/Disable Input

Shielded, Twisted Pair Cable

V_{DC} +5 to +24V

R_{LD} (As Needed)

Sinking Output

R_{LD} may be needed in applications using a PLC DC output to generate index pulses at high speeds. See the note on this page for more information.

ADVANCED MICRO CONTROLS INC.
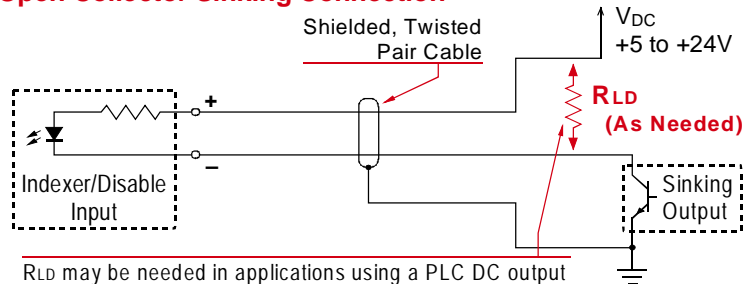
CONNECTING YOUR CONTROLLER

Output Wiring

The ±Fault Output is an optically isolated transistor capable of driving a typical PLC input.   The Fault Output is normally on (conducts current) and turns off under the following conditions:

➤ The Interlock jumper is missing on the motor connector
➤ There is a short in the motor, either phase to phase or phase to ground
➤ The heatsink temperature exceeds 90°C (195°F)
➤ The driver is in its reset state and is not ready to accept pulses

Both ends of the output are uncommitted, so it can be wired as a sourcing or sinking output. The figure shows a typical connection as a sourcing output.

Open Collector Sourcing Output
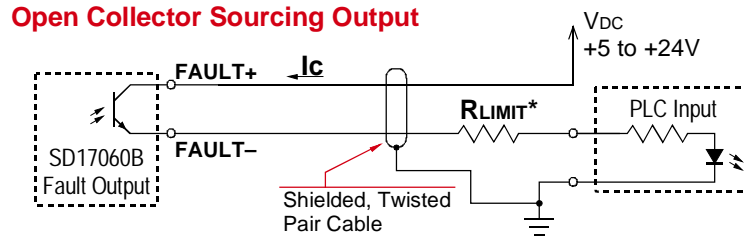
FAULT OUTPUT Electrical Specifications

V_{DC} max: 30Vdc	$V_{CE\,SAT}$: 1Vdc @ 20 mA
Ic max: 20 mA	Power Dissipation: 20 mW max.

R$_{LIMIT}$

A resistor may be needed to limit the current through the Fault Output. The value, and power rating of the resistor is dependent on the value of Vdc, the voltage drop across the input, and the current requirements of the input.

CONNECTING YOUR MOTOR

Compatible Motors

The SD17060B will work with many different motors, including those not sold by AMCI. This section assumes that you have already chosen your motor and you are looking for wiring information. No wire colors are given because there is no single industry wide color coding standard for stepper motor wires. You must refer back to your motor data sheets for this information.

AMCI offers several different stepper motors in sizes 23, 34, and 42. Refer to our website, www.amci.com, for additional information on these products.

Motor Wiring

Eight Lead Series Connected
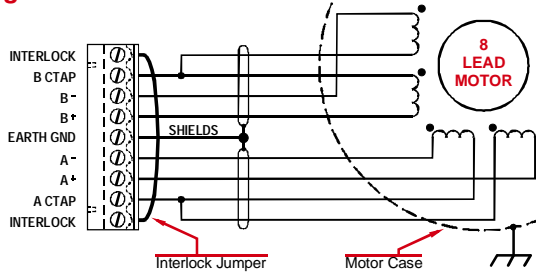
Eight Lead Parallel Connected
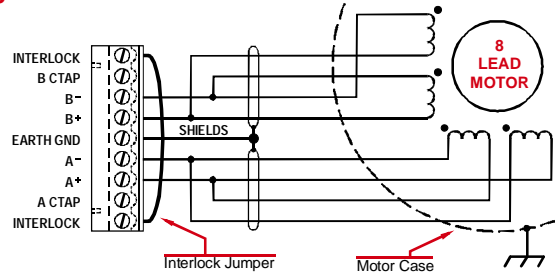
Six Lead Series Connected
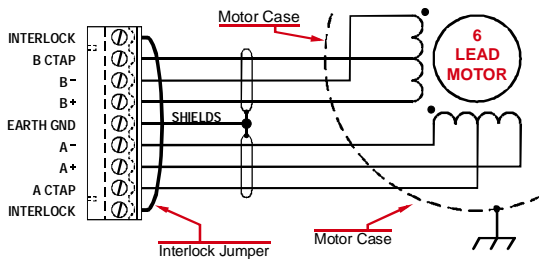
Six Lead Center Tap Connected

Four Lead Connected

NOTES

1) The Interlock jumper is a safety device that is needed for proper operation. The SD17060B will not power the motor without this jumper. When the jumper is installed, up to 170Vdc is present on the connector. Do not use the Interlock for anything other than its intended use as a safety device.

2) 170Vdc is present on the connector when power is applied to the motor. Install the supplied rubber boot on the connector during normal operation.

3) Motor connections should be tight. Loose connections may lead to arcing which will heat the connector. Phoenix Contact specifies a tightening torque of 4.4 to 5.4 lb-in. (0.5 to 0.6 Nm)

Refer to the torque vs. speed curves on your motor's specifications sheet to determine if you should wire the motor to the SD17060B in series, parallel, or centertap configuration.

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POWER CONNECTOR AND INDICATOR LED's

Power Connector

GND
N
L
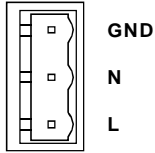
AC POWER
95 – 132 Vᴀᴄ
50/60 Hz

The SD17060B operates on 115Vac. If 230Vac is the only power available, consider using one of the 230Vac drivers available from AMCI. Information on these drivers can be found on our website, http://www.amci.com. If this is not an option, a step-down transformer must be installed to power the SD17060B. The transformer must have a minimum power rating of 800 VA.

The SD17060B must be grounded for proper operation. Grounding is accomplished with the GND pin on the power connector, and through proper bonding to the enclosure. Power connections should be tight. Loose connections may lead to arcing which will heat the connector. Phoenix Contact specifies a tightening torque of 4.4 to 5.4 lb-in (0.5 to 0.6 nM)

Indicator LED's

The SD17060B has two indicator LED's.

STEP/FAULT ○

➤ **Green:** Driver Operational

➤ **Flashing Green:** Driver Operational, Receiving Pulses

➤ **Red:** Driver Fault (The Over Temperature and Over Current faults can be cleared with the Disable Input.)

    1) Over Temperature Fault: The heatsink temperature exceeds 90°C (195°F)

    2) Over Current Fault: Generally, a short exists somewhere in the system. This can be a short in the motor or in the driver itself.

        A) Phase–Phase Short: There is an electrical short between the two motor windings. The short exists in the motor cable or in the motor itself.

        B) Phase–Ground Short: One of the motor's windings is shorted to earth ground. (The EARTH GND terminal of the Motor Connector is used as the reference point.) The fault can be in the motor cable or in the motor itself.

        C) Back EMF: In applications with large motors and high deceleration rates, back-EMF generated by the motor may also cause this fault.

    3) Interlock Fault: The two Interlock Terminals on the motor connector are not connected with a short jumper.

➤ **Flashing Red:** Current Loop Gain AUTOID Error. There is a problem with the motor wiring or the motor current is set to zero.

➤ **Flashing Red/Green @ 1Hz:** Step Violation: The indexer sent step pulses to the SD17060B before the driver was ready for them. The driver was disabled, in a fault condition, or had not completed its initialization sequence on power up or reset. The stepper motor position will be invalid. The motor is not disabled and can still be driven. While there is motion, the LED will flash at approximately 4 Hz.

➤ **CURRENT LOOP GAIN:** This LED is also used when the Current Loop Gain is set to AutoID. (SB2:1-5 all turned off) When set to AutoID, the driver will determine the parameters of the attached motor and will flash the Step/Fault LED green the number of times that the parameter should be set to. Flashing red indicates a problem with the motor wiring or the motor current is set to zero. Further information can be found in the next section of the manual, Verifying System Setup.

Power ○

➤ **Green:** Power is applied to the driver in the range of 95 or 132 Vac.

VERIFYING SYSTEM SETUP

Setting the Current Loop Gain

Setting the Current Loop Gain correctly allows you to maximize your motor's performance. The SD17060B takes into account the line voltage, output current and motor impedances when determining the optimum gain for your system.

Assuming a stable line voltage of 115 Vac, the following gains can be used for AMCI motors. These gain settings are factory suggestions and are average settings for our motors. Your system may benefit from increasing or decreasing these settings. In general, increase the setting by one or two counts to improve high speed performance or decrease the settings for quieter low speed operation.

	MOTOR CURRENT ➜	1 A	1.5 A	2 A	3 A	4 A	5 A	6 A
MOTOR PART #	SM23-130 (Series)	4	6	7				
	SM23-130 (Parallel)			2	3	4		
	SM23-240 (Series)	6	8	10				
	SM23-240 (Parallel)			4	5	6		
	SM34-450			6	9	11		
	SM34-850			11	14	17		
	SM34-1100			12	17	21		
	SM42-1800				10	11	12	14

(Table header spans: **GAIN SETTINGS**)

If you are using a non-AMCI motor, use the AutoID setting to determine the correct gain for your system. Turn off all of the switches in switch bank 2 and then verify that the motor current is set correctly and the motor is attached to the driver. Cycle power to the driver. The **STEP/FAULT** LED will begin to blink almost immediately. Count the number of blinks. This number is what you should initially set the Current Loop Gain to. Use the Switch Setting page of this manual to determine the correct switch settings. When you are done, cycle power to the SD17060B and verify motor operation using the *System Checkout* procedure on the following page and adjust the Current Loop Gain settings up or down depending on your application.

In most cases, the Current Loop Gain can be set to its AutoMode setting and the SD17060B will automatically determine the proper gain on every power up or reset. This procedure is done in under two seconds.

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VERIFYING SYSTEM SETUP

System Checkout

1) Verify all wiring and grounding before applying power to the SD17060B. Make sure the rubber boots are on the driver's motor and power connectors.

2) Apply 115Vac power. With the motor attached, the power and status LED's should come on green. A problem exists if either LED does not light, or the Status LED is red. Remove power and refer to the *Troubleshooting* section of this manual which begins on the following page.

3) Check for holding torque on the motor. If you have less then you expected, the most common causes are improper motor current switch settings or having the Idle Current Reduction turned on.

4) The Self-Test feature of the SD17060B allows you to verify your motor wiring without an indexer. With power applied to the driver, toggle the SB4-1 switch. The motor will begin to rotate clockwise at 60 RPM. You must remove power from the driver to stop the rotation. If the motor rotates in the counter-clockwise direction, swap the +B and –B connections. If the motor does not rotate at all, verify your current setting and the motor's wiring.

5) Have your indexer make a slow move in the clockwise direction for one turn. While the turn is in progress, the STEP LED should blink. Verify that the motor rotated in the correct direction for one complete turn. If you are using an optical encoder or other position feedback, verify that the indexer or controller is reading it properly.

6) Repeat step 4 with a one turn move in the counter-clockwise direction. Again verify that the motor rotated in the correct direction for one turn.

> **NOTE** ▷ Any failures at steps 5 or 6 are usually caused by not setting the Pulse Train Input switch correctly or programming the wrong number of pulses in the indexer profile. If the motor rotates in the wrong direction you can swap the +B and –B connections instead of altering your programming.

7) If you are using the Disable Input, verify its operation with the motor stopped. Note that the motor will have no holding torque while this input is active and the motor's shaft will be free to rotate.

8) If you are using the Fault Output, verify that it is *On* (conducting). Remove power from the SD17060B, disconnect the motor, and re-apply power. The STEP/FAULT LED should be red and the Fault Output should be off (not conducting).

9) Remove power and re-attach the motor. Power the driver.

10) Consider altering the motor current or enabling the Idle Current Reduction if it is not already enabled. Lowering the motor current or enabling Idle Current Reduction can greatly reduce motor heating.

TROUBLESHOOTING

Indexer Problems

Symptom	Solution
My indexer/PLC reports a fault from the SD17060B when everything seems fine.	Your logic may be reversed. On the SD17060B, the Fault Output is on (conducts current) when the driver is working correctly and turns off (stops current flow) when there is a fault with the driver. Therefore, losing power to the driver appears as a fault. If you're expecting the fault output to turn on and conduct current when there is a fault, then your logic is reversed.
The motor is running faster/slower than expected and/or the distance traveled is farther/shorter than expected.	Most likely a problem with the SD17060B's Step Resolution setting or the indexer's programming. If the motor is running too fast, the Step Resolution on the SD17060B is set lower than the indexer's programmer assumed it would. If the motor is running slow, the Step Resolution is set higher than the indexer programmer assumed it would be.

Driver Problems

Symptom	Solution
Both LED's are off, and the Fault Output is active. (Not conducting) Power is applied to the driver.	1) The AC line voltage may be too low. It must be greater than 85Vac for the SD17060B to operate properly. 2) One or both of the 10A fuses may be blown. These fuses will not blow under normal circumstances, so call AMCI for assistance. Blown fuses may be a sign of serious installation problems.
Both LEDs are green, the Fault Output is inactive, (conducting) but the motor is not powered.	1) The ±Disable input may be active. The active state, (power applied or power removed), is set by DIP switch SB1-4. This switch may be set incorrectly. 2) The Idle Current Reduction may be set to its *To 0%* setting. With this setting, current is removed from the motor if a directional pulse is not received for one second.
The STEP/FAULT LED does not blink when the indexer sends pulses to the driver. The motor does not turn.	1) Verify that your two directional inputs on the Indexer Connector are not swapped or cross-wired. 2) If the inputs are wired as a sinking or sourcing instead of differential, verify that they are wired correctly. If your indexer has sourcing outputs, then the inputs of the SD17060B must be wired as sinking inputs and vice versa. Also note, if you are using an older SD17060B-24, or older SD17060B-25, the outputs must be at 24Vdc. 3) If you are using a 24Vdc system and you are converting from an older SD17060B to a newer SD17060B, you must remove the external 3.9K resistors from your wiring. Refer to the *Applicable Units* section on page 3 to determine the age of you driver.
The STEP/FAULT LED is red.	The driver is experiencing a fault condition. All faults are latched, so power must be cycled to the driver or the Disable Input must be toggled before the fault will clear. **1) Over Temp Fault.** Is the driver very hot? It shuts down when its internal temperature exceeds 90°C (195°F). **2) Interlock Fault.** The motor is not plugged into the driver or a wire jumper was not installed between the two Interlock pins on the Motor Connector. **3) Short in Motor.** Shut off the SD17060B and disconnect the motor. Pull back the rubber boot and verify the following with an ohmmeter. a) Open circuit from "A+" to "B+" pins. (Tests for short between phases.) b) Open circuit from "A+" to "Earth Ground" and "B+" to "Earth Ground". (Tests for short between phase and case.) If any of these readings is not an open circuit, then check your wiring. The most common cause of a short between phases is cross-wiring the phases when wiring the connector. If you see a phase-to-case short, make sure you don't have a stray wire from the "B+" or "A-" terminals hitting the Earth Ground terminal on the connector.

TROUBLESHOOTING

Motor Problems

Symptom	Solution
The motor has no holding torque.	1) If the Step/Fault LED is red, then a problem exists with the driver or motor. Refer to *Power Connector and Indicator LED's* on page 11 for information. 2) If the motor rotates when commanded but has no holding torque, then your Idle Current Reduction switch is set to the *To 0%* setting. This setting removes motor current when the driver is idle for more than one second. There are other idle current reduction settings available. See *Switch Settings* on page 7 for more information. 3) The SD17060B ships with the motor current set to its minimum value of 1.0 amp. It's possible that it was not set for your application. See *Switch Settings* starting on page 7 for the proper switch settings.
The SD17060B blinks its STEP/ FAULT LED green when pulses are applied to the driver, but the motor only emits a high pitch noise. It does not rotate.	1) The acceleration or starting speed values may have been set too high when the indexer was programmed. The motor may start to accelerate and stall as the acceleration increases. 2) The Step Resolution may be set to a values lower than you are expecting. For example, if the Step Resolution is set to 200 instead of 400, the acceleration value is effectively doubled.
The motor only runs in one direction.	This problem is usually caused by the directional pulse inputs. If your indexer is sending pulses in the *CW/CCW* format and the driver is configured for the *Step & Direction* format, the motor will rotate counter-clockwise when the driver receives CW pulses, and it will not rotate at all when the driver receives CCW pulses. If the indexer is sending pulses in the Step & Direction format and the driver is configured for the CW/CCW format, the motor will only rotate clockwise, even when the indexer is commanding a counter-clockwise move.
The motor runs backwards. (CW instead of CCW and/or CCW instead of CW)	1) One of the motor phases may be reversed. The "quick fix" is to reverse the connections on the ±B windings. 2) There may be a problem with the directional inputs. Either they are wired incorrectly or the format is wrong. Check wiring and see the previous problem for more information on problems with format.
As its running speed increases, the motor begins to run rough, and eventually stops while pulses are being applied.	1) If you are using single ended outputs for your pulse and direction signals, you may have a problem with the outputs not switching fast enough. See the note on the R$_{LD}$ Resistor in the *Connecting Your Indexer* section on page 8. 2) You may have a problem with resonance in the system. Run the system with the Anti-Resonance feature enabled and disabled to see which give you better performance. The Anti-Resonance feature is set with SB1-5. See page 7 for more information.
The motor runs erratically.	1) The motor is not correctly coupled to the load. 2) The deceleration rate is set to high and the inertia of the load is carrying the motor past the point where it is supposed to stop. 3) You are performing a slow move, (under 1 revolution/second) while the Step Resolution is set to 200 or 400 steps/turn. To correct this problem, try increasing the indexer's starting speed parameter. Do not increase the starting speed beyond your slowest running speed. 4) The motor current is set too low and the motor is unable to move the load. 5) The motor is not correctly wired. Eight lead motors can be wired in series or parallel. Series connection gives you more torque at lower speeds and parallel connection gives you more torque at higher speeds.

NOTE ▷ As noted above, sometimes a problem that appears to be with the motor is actually a problem with the indexer. The SD17060B has a Self-Test feature that allows you to verify motor operation without an indexer. With power applied to the driver, toggle the SB4-1 switch. The motor will begin to rotate clockwise at 60 RPM. You must remove power to the driver to end the self test. Please remember to return SB4-1 to its original position before cycling power to the driver.
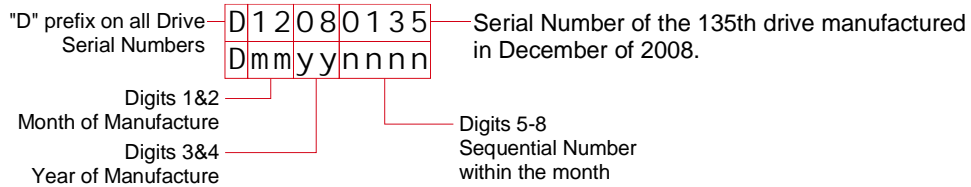
Applicable Units

This appendix applies to all SD17060B drivers manufactured prior to December of 2008 as well as some SD17060B drivers manufactured during December of 2008. The inputs of these units were designed for use with 5Vdc differential outputs and require external current limiting resistors when used with 12Vdc and 24Vdc input signals.

You will be able to determine the date of manufacture from the serial number on the driver. Serial numbers for all AMCI drivers are formed from a date code and sequential number. The serial number format is shown below.

"D" prefix on all Drive Serial Numbers ─── D 1 2 0 8 0 1 3 5 ─── Serial Number of the 135th drive manufactured in December of 2008.
Dmmyynnnn

Digits 1&2 Month of Manufacture
Digits 3&4 Year of Manufacture
Digits 5-8 Sequential Number within the month

For SD17060B Drives...

➤ If your month and year of manufacture is December of 2008, (digits 1 through 4 are "1208"), and the sequential number is less than "0135" then this appendix applies.

➤ If your month and year of manufacture is November of 2008 or earlier, (digits 1 through 4 are "1108" or less), then this appendix applies.

NOTE ▶ If you are replacing an SD17060 with an older SD17060B, then keep any current limiting resistors you already have in the circuit. The only wiring change that you will have to make is swapping the **±STEP/CW** connections on the indexer connections.
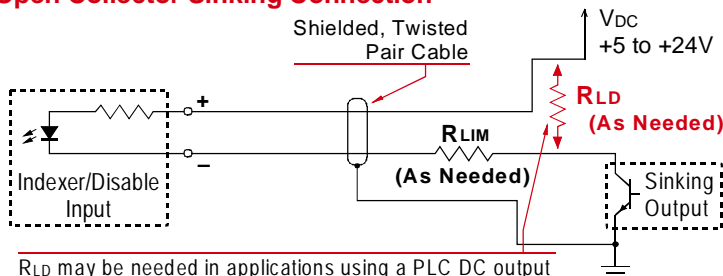
Current Limiting Resistor

Open Collector Sourcing Connection
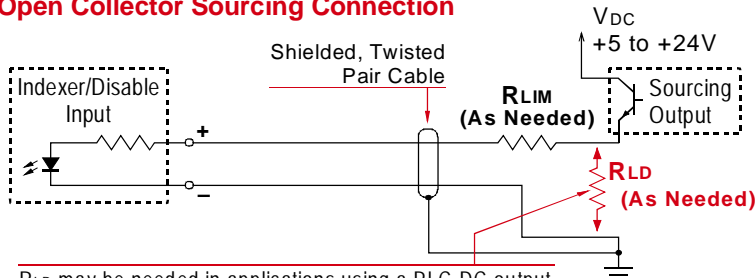
R_{LD} may be needed in applications using a PLC DC output to generate index pulses at high speeds. See the note on this page for more information.

Open Collector Sinking Connection

R_{LD} may be needed in applications using a PLC DC output to generate index pulses at high speeds. See the note on this page for more information.

Common Values of R_{LIM}

V_{DC}	R_{LIM}
5 Volts	None
12 Volts	2.0 KΩ
15 Volts	2.0 KΩ
24 Volts	3.9 KΩ

R_{LD}

An additional load resistor may be required on some PLC outputs to improve switching time. A symptom of this problem is that the motor will begin to run rough at high speeds. A 470 or 560 ohm resistor should be used. For 5V and 12V systems use a 1W resistor. For 24V systems use a 2W resistor. These power ratings assume that the output can be normally on. For systems where you are sure the output is always normally off, the wattage ratings can be cut in half.
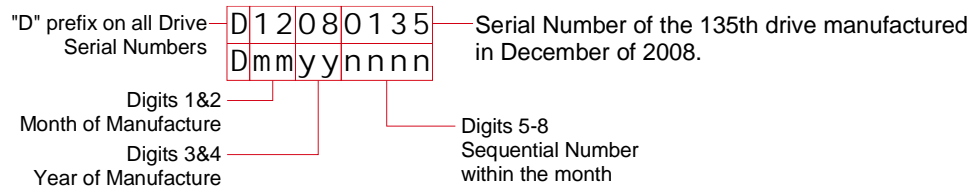
Applicable Units

This appendix applies to all SD17060B-25 drivers manufactured prior to December of 2008. The inputs of these units were designed for use with 24Vdc outputs and will not work with 5Vdc differential input signals.

You will be able to determine the date of manufacture from the serial number on the driver. Serial numbers for all AMCI drivers are formed from a date code and sequential number. The serial number format is shown below.

"D" prefix on all Drive Serial Numbers ── D 1 2 0 8 0 1 3 5 ── Serial Number of the 135th drive manufactured
D m m y y n n n n in December of 2008.

Digits 1&2 Month of Manufacture

Digits 3&4 Year of Manufacture

Digits 5-8 Sequential Number within the month

For SD17060B-25 Drives...

➤ If your month and year of manufacture is December of 2008 or earlier, (digits 1 through 4 are "1208" or less), then this appendix applies.

Using Older SD17060B-25 Units

Because of their internal current limiting resistors, the inputs on older SD17060B-25 drivers require 24Vdc to operate. They cannot be used in 5Vdc or 12Vdc systems.

Newer SD17060B-25 units (manufactured after December, 2008) can replace older SD17060B-25 units without system modification.

USING OLDER SD17060B-24 DRIVERS

Applicable Units

This appendix applies to all SD17060B-24 drivers. The SD17060B-24 has internal current limiting resistors on its inputs and can only be used in 24Vdc systems.   The SD17060B-24 was phased out of production in December of 2008 and replaced by the redesigned SD17060B.

Replacing a SD17060B-24

A SD17060B-24 can be replaced by a SD17060B without changes to the system as long as the SD17060B was manufactured after December of 2008. If the SD17060B was manufactured prior to the second half of December 2008, you will have to add current limiting resistors to the circuit before using the SD17060B. See appendix A on the previous page for more information.

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