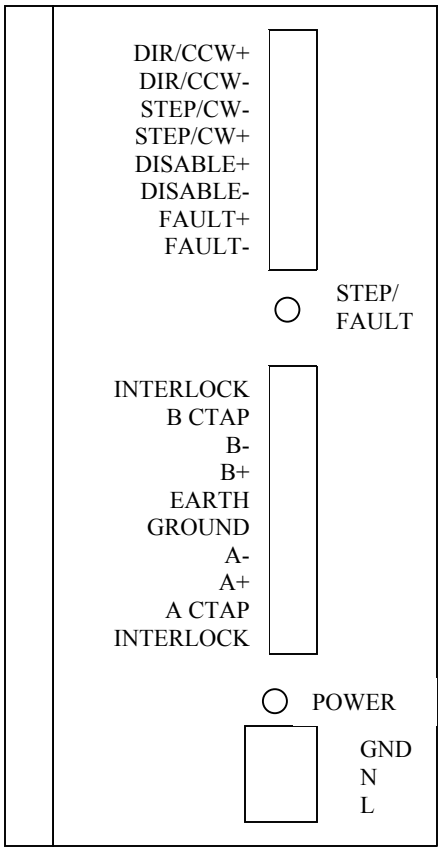
The SD17060 is a 170V 6.3Amp Micro Stepping Stepper Driver. The SD17060 has three input connectors and two status LEDs, as shown in following diagram.



Disable Input

When active, the Disable Input removes power from the motor. The driver does not accept steps while this input is active. The disable input is active high.

Fault Output

The fault input is normally on. This output will turn off when the driver detects a fault condition.

Interlock Terminals

The two INTERLOCK terminals are a safety feature. The SD17060 will not power the motor unless a short wire connects these two terminals. If these terminals are not connected, the Step Fault LED will be on Solid Red.

Center Tap Terminals

The two center tap terminals, A CTAP and B CTAP, are for wiring convenience only. These terminals are electrically isolated from the rest of the driver and are not used to power the motor. These terminals are to be used to connect two motor wires together, such as when an eight lead motor is wired in series.

Specifications

Drive Type
Two bipolar MOSFET H-bridges with 170V output bus. 22KHz PWM current control.

Physical Dimensions
Width: 2.7 inches
Depth: 4.7 inches
Height: 6.2 inches
7.0 inches with mounting tabs

Weight
4.3 lbs. (2.0 kg.)

Inputs
Electrical Characteristics for all Inputs:
Differential. 1500 Vac/dc opto-isolated. Can be wired as single ended inputs.
Step ..... Motor steps on high going pulse. 150µS min. pulse width, 2 MHz maximum input frequency.
Disable ..... Active high. Disables current to motor. Drive does not accept steps while disabled.

Single Ended Current Limiting Resistors

Vdc	R_{Limit}
5 Volts	None
12 Volts	2.0kΩ
15 Volts	2.0kΩ
24 Volts	3.9kΩ

Fault Output
Electrical Characteristics:
Open Collector/Emitter. 1500 Vac/dc optoisolated. 30Vdc, 20 mA max.

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

Reset ..... The drive initialization is not yet complete on power up.
Short Circuit ... Motor Phase to Phase or Phaseto 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 0.0 to 6.3 Armp in 0.1Amp steps.

Idle Current Reduction
Switch selectable to *Not reduced, 69%, 50%, or 0%.* Motor current is reduced to selected level if a step pulse is not received for one second. Current restored to full value on next pulse.

Resolution
16 switch selectable steps/rev: 200, 400, 1000, 2000, 5000, 10,000, 12,800, 18,000, 20,000, 21,600, 25,000, 25,400, 25,600, 36,000, 50,000, and 50,800. Settings are latchable and changes only occur when power is cycled.

Internal Power Fuses
5 Amp Slow Blow. Both Line and Neutral are fused. Fuses are not field replaceable.

Environmental Specifications
Input Power: 95 to 132Vac, 50/60 Hz, 5.0 Apk max.
Drive will retain control of motor down to 85Vac at reduced torque.
Operating Temp 32° to 122°F (0° to 50°C)
Storage Temp: -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 .. 1 mH minimum. 2.5 to 45 mH Recommended

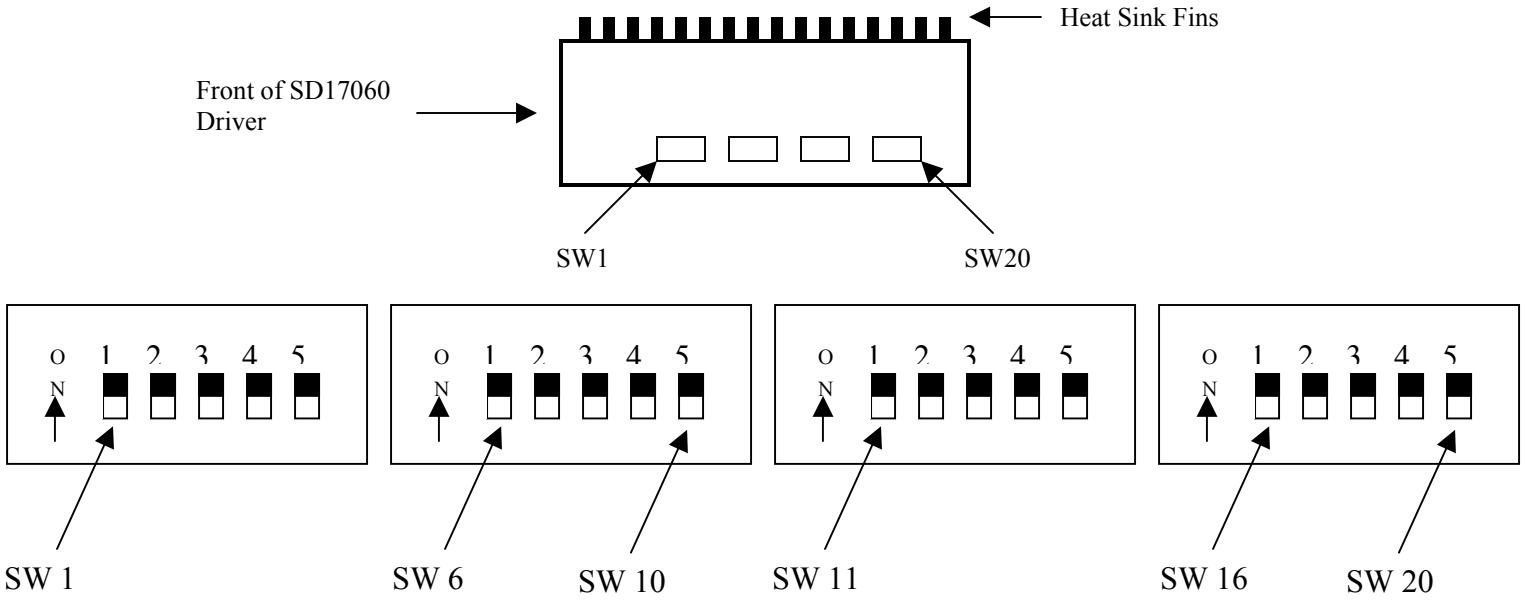
Status LEDs

LED	Color/Pattern	Function
POWER	Green	Supply Voltage over 40Vac
	Off	Supply Voltage under 40Vac or internal fuses are blown
STEP/FAULT	Off	Driver functioning, no motion in progress
	Solid Green	Driver functioning, no motion in progress
	Blinking Green	Driver functioning, motion occurring. The LED blinks at the input step rate
	Solid Red	Fault Condition. 1. Over temperature fault: The temperature of the SD17060's heat sink exceeded 90°C (195°F). 2. Interlock Fault: The two Interlock Terminals on the driver's motor connector are not connected together. 3. Phase to Phase short: There is an electrical short between two motor windings. The short exists in the motor cable or in the motor itself. 4. Phase to Ground Short: One of the motor's windings is shorted to earth ground. (The Earth GND terminal of the driver's motor connector is referenced.) The fault can be in the motor cable or in the motor itself. 5. Attempting an Automatic Current Loop gain identification with the motor current set to zero. 6. An Automatic Current Loop gain identification was attempted with only the interlock wire attached. That is, there was no motor attached to the driver. Because the fault is latched, you will have to correct the fault and cycle power before it will clear.
	Blinking Red/Green	STEP VIOLATION. Indicates that a step violation condition was present. Step Violation means that step signals were received when the drive was inactive (Power Up or when DISABLE input is Active). Power must be cycled to clear the fault

Switch Settings

Four banks of five dip switches are used to configure the stepper driver. Switch one is located towards the front of the driver. When ON, the switches are pushed towards the heat sink fins. The switch settings are latched at power up. Any changes made to the switches while power is applied will be ignored. Power must be removed from the driver before adjusting the switch settings.

The following diagrams show the layout of the four switch banks.



Sw 1 - OFF - STEP/DIR
ON - CW/CCW

Sw 2,3 - OFF, OFF - No Idle Current Reduction.
ON, OFF - 69% Idle Current After 0.01seconds (10ms)
OFF, ON - 50% Idle Current After 1 second
ON, ON - 0% Idle Current After 1 second

Sw 4,5 - OFF, OFF - Pure Sin OUTPUT CURRENT.
ON, OFF - -4% Third Harmonic.
OFF,ON - -6% Third Harmonic.
ON,ON - -10% Third Harmonic.

Note 1: When No Idle Current Reduction and a resolution of other than 200steps/rev are both selected, the current is automatically reduced to 69% of its value after 0.2 seconds of no motion. This prevents overheating of the motor. When working with resolutions above 200 steps/rev, the phase current follows a *sin* pattern with a peak value 1.414 times higher than the RMS value set with the switches.

Note 2: When 200 steps/rev are selected and any Third Harmonic value other than Pure Sin (switches 4 and 5 off) is selected, the driver will enter SELF-TEST mode. The motor will run at 50,000steps/rev with 72 rev/min.

Switches 6 to 10 Select the Current Loop Gain

Sw6	Sw7	Sw8	Sw9	Sw10	GAIN
OFF	OFF	OFF	OFF	OFF	Automatic Identification*
ON	OFF	OFF	OFF	OFF	1
OFF	ON	OFF	OFF	OFF	2
ON	ON	OFF	OFF	OFF	3
OFF	OFF	ON	OFF	OFF	4
ON	OFF	ON	OFF	OFF	5
OFF	ON	ON	OFF	OFF	6
ON	ON	ON	OFF	OFF	7
OFF	OFF	OFF	ON	OFF	8
ON	OFF	OFF	ON	OFF	9
OFF	ON	OFF	ON	OFF	10
ON	ON	OFF	ON	OFF	11
OFF	OFF	ON	ON	OFF	12
ON	OFF	ON	ON	OFF	13
OFF	ON	ON	ON	OFF	14
ON	ON	ON	ON	OFF	15
OFF	OFF	OFF	OFF	ON	16
ON	OFF	OFF	OFF	ON	17
OFF	ON	OFF	OFF	ON	18
ON	ON	OFF	OFF	ON	19
OFF	OFF	ON	OFF	ON	20
ON	OFF	ON	OFF	ON	21
OFF	ON	ON	OFF	ON	22
ON	ON	ON	OFF	ON	23
OFF	OFF	OFF	ON	ON	24
ON	OFF	OFF	ON	ON	25
OFF	ON	OFF	ON	ON	26
ON	ON	OFF	ON	ON	27
OFF	OFF	ON	ON	ON	28
ON	OFF	ON	ON	ON	29
OFF	ON	ON	ON	ON	30
ON	ON	ON	ON	ON	31

Automatic Identification Mode* – With the motor connected at power up, and the driver's current set to match the motor, the driver starts a test procedure that takes about 20 seconds. This procedure identifies the parameters of the motor and when complete displays the recommended value for the ***Current Loops GAIN* with the number of blinks of the status LED. This pattern will be shown only once. The power should be turned off, and after all the LEDs are off, the obtained value for the gain could be set with switches 6 through 10.

Notes:

- The Automatic Identification Mode must be performed with the motor current set to its appropriate value. If the motor current is set to zero, the Step/Fault Led will be on solid red and the Fault Output will be off.
- The driver will indicate a fault if Automatic Identification Mode is attempted and only the Interlock wire is attached to the driver's motor connector.
- It is not necessary to use the value obtained by the automatic identification function. For smoother operations at higher speeds, a higher value of the Current Loop Gain can be set. However, setting a higher than recommended value could result in noisier operations at both low speeds and when the motor is at rest.

Switches 11 to 14 set the Microstepping Resolution

Sw11	Sw12	Sw13	Sw14	RESOLUTION steps/revolution
OFF	OFF	OFF	OFF	200
ON	OFF	OFF	OFF	400
OFF	ON	OFF	OFF	1000
ON	ON	OFF	OFF	2000
OFF	OFF	ON	OFF	5000
ON	OFF	ON	OFF	10’000
OFF	ON	ON	OFF	12’800
ON	ON	ON	OFF	18’000
OFF	OFF	OFF	ON	20’000
ON	OFF	OFF	ON	21’600
OFF	ON	OFF	ON	25’000
ON	ON	OFF	ON	25’400
OFF	OFF	ON	ON	25’600
ON	OFF	ON	ON	36’000
OFF	ON	ON	ON	50’000
ON	ON	ON	ON	50’800

Note 1: When No Idle Current Reduction and a resolution of other than 200steps/rev are both selected, the current is automatically reduced to 69% of its value after 0.2 seconds of no motion. This prevents overheating of the motor. When working with resolutions above 200 steps/rev, the phase current follows a *sin* pattern with a peak value 1.414 times higher than the RMS value set with the switches.

Note 2: When 200 steps/rev are selected and any Third Harmonic value other than Pure Sin (switches 4 and 5 off) is selected, the driver will enter SELF-TEST mode. The motor will run at 50,000steps/rev with 72 rev/min.

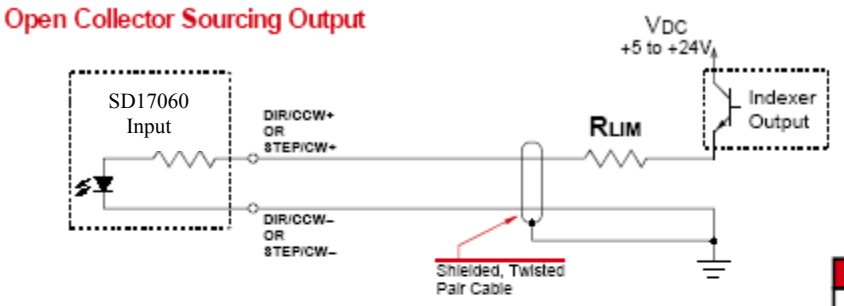
Switches 15,to 20 set the Motor Current Value per Phase (RMS)

Sw15	Sw16	Sw17	Sw18	Sw19	Sw20	Current RMS Amps
OFF	OFF	OFF	OFF	OFF	OFF	0
ON	OFF	OFF	OFF	OFF	OFF	0.1
OFF	ON	OFF	OFF	OFF	OFF	0.2
ON	ON	OFF	OFF	OFF	OFF	0.3
OFF	OFF	ON	OFF	OFF	OFF	0.4
ON	OFF	ON	OFF	OFF	OFF	0.5
OFF	ON	ON	OFF	OFF	OFF	0.6
ON	ON	ON	OFF	OFF	OFF	0.7
OFF	OFF	OFF	ON	OFF	OFF	0.8
ON	OFF	OFF	ON	OFF	OFF	0.9
OFF	ON	OFF	ON	OFF	OFF	1.0
ON	ON	OFF	ON	OFF	OFF	1.1
OFF	OFF	ON	ON	OFF	OFF	1.2
ON	OFF	ON	ON	OFF	OFF	1.3
OFF	ON	ON	ON	OFF	OFF	1.4
ON	ON	ON	ON	OFF	OFF	1.5
OFF	OFF	OFF	OFF	ON	OFF	1.6
ON	OFF	OFF	OFF	ON	OFF	1.7
OFF	ON	OFF	OFF	ON	OFF	1.8
ON	ON	OFF	OFF	ON	OFF	1.9
OFF	OFF	ON	OFF	ON	OFF	2.0
ON	OFF	ON	OFF	ON	OFF	2.1
OFF	ON	ON	OFF	ON	OFF	2.2
ON	ON	ON	OFF	ON	OFF	2.3
OFF	OFF	OFF	ON	ON	OFF	2.4
ON	OFF	OFF	ON	ON	OFF	2.5
OFF	ON	OFF	ON	ON	OFF	2.6
ON	ON	OFF	ON	ON	OFF	2.7
OFF	OFF	ON	ON	ON	OFF	2.8
ON	OFF	ON	ON	ON	OFF	2.9
OFF	ON	ON	ON	ON	OFF	3.0
ON	ON	ON	ON	ON	OFF	3.1
OFF	OFF	OFF	OFF	OFF	ON	3.2
ON	OFF	OFF	OFF	OFF	ON	3.3
OFF	ON	OFF	OFF	OFF	ON	3.4
ON	ON	OFF	OFF	OFF	ON	3.5
OFF	OFF	ON	OFF	OFF	ON	3.6
ON	OFF	ON	OFF	OFF	ON	3.7
OFF	ON	ON	OFF	OFF	ON	3.8
ON	ON	ON	OFF	OFF	ON	3.9
OFF	OFF	OFF	ON	OFF	ON	4.0
ON	OFF	OFF	ON	OFF	ON	4.1
OFF	ON	OFF	ON	OFF	ON	4.2
ON	ON	OFF	ON	OFF	ON	4.3
OFF	OFF	ON	ON	OFF	ON	4.4
ON	OFF	ON	ON	OFF	ON	4.5
OFF	ON	ON	ON	OFF	ON	4.6
ON	ON	ON	ON	OFF	ON	4.7
OFF	OFF	OFF	OFF	ON	ON	4.8
ON	OFF	OFF	OFF	ON	ON	4.9
OFF	ON	OFF	OFF	ON	ON	5
ON	ON	OFF	OFF	ON	ON	5.1
OFF	OFF	ON	OFF	ON	ON	5.2
ON	OFF	ON	OFF	ON	ON	5.3
OFF	ON	ON	OFF	ON	ON	5.4
ON	ON	ON	OFF	ON	ON	5.5
OFF	OFF	OFF	ON	ON	ON	5.6
ON	OFF	OFF	ON	ON	ON	5.7
OFF	ON	OFF	ON	ON	ON	5.8
ON	ON	OFF	ON	ON	ON	5.9
OFF	OFF	ON	ON	ON	ON	6.0
ON	OFF	ON	ON	ON	ON	6.1
OFF	ON	ON	ON	ON	ON	6.2
ON	ON	ON	ON	ON	ON	6.3

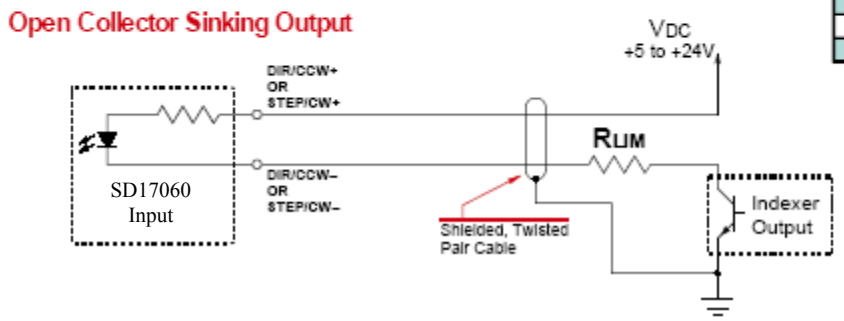
Input Wiring

The following diagrams show how to wire the SD17060's inputs to a single ended sinking or sourcing output. Note that current-limiting resistors must be installed if voltage levels above 5Vdc are being used.

The following diagrams are for both the Step and Direction inputs and the Disable Input.

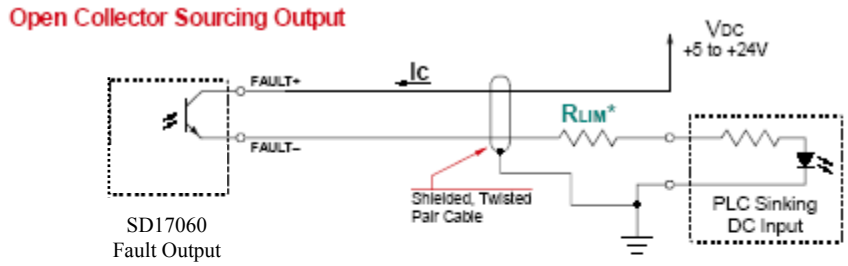


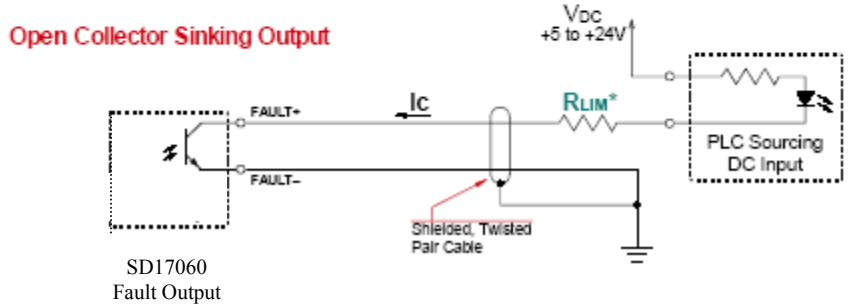
VDC	RLIMIT
5 Volts	None
12 Volts	2.0 KΩ
15 Volts	2.0 KΩ
24 Volts	3.9 KΩ



Fault Output Wiring

The ±Fault Output is an optically isolated transistor capable of driving a typical DC PLC input or equivalent. As shown in the following figure, both ends of the output are floating. Therefore, you can connect the fault output in a sourcing or sinking configuration.



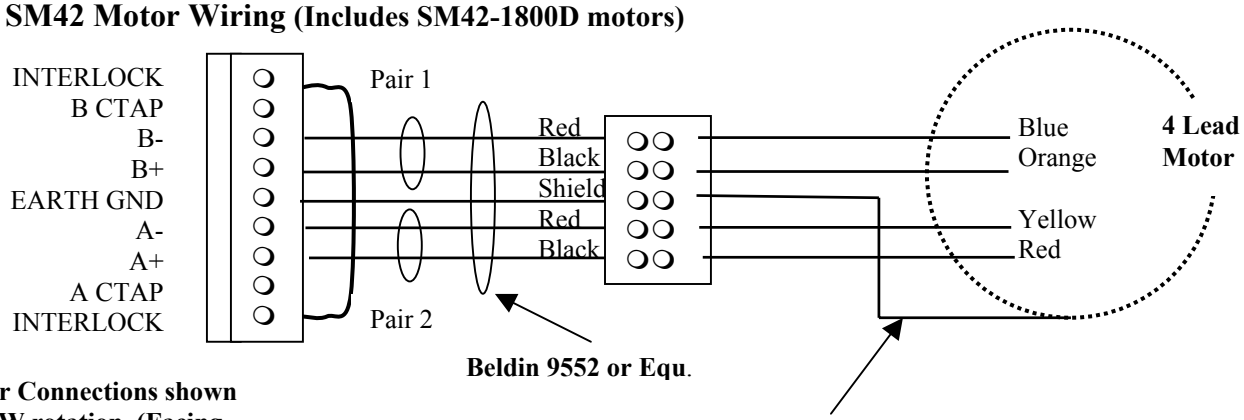


Fault Output
Electrical Specifications

Vdc max: 30Vdc
Vce sat: 1Vdc @20mA
Ic max: 20mA
Power Dissipation: 20mW max

Rlim
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.

SM42 Motor Wiring (Includes SM42-1800D motors)

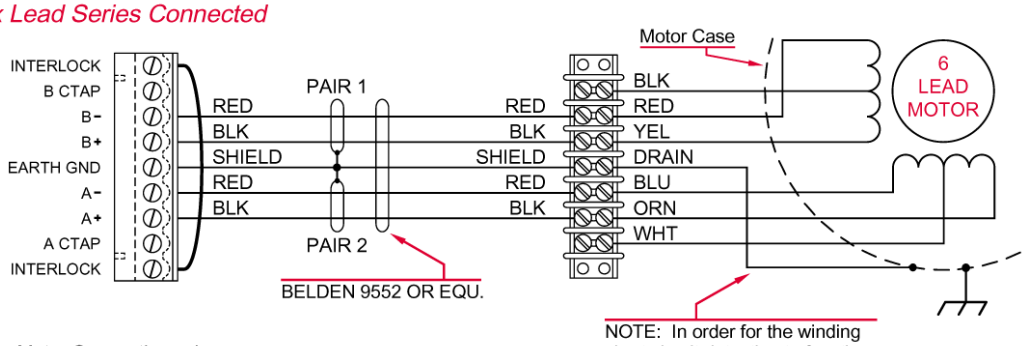


Motor Connections shown for CW rotation. (Facing mounting flange.) For CCW rotation, reverse the Stepper Driver B+ and B- connections

NOTE: In order for the winding short circuit detection to function, you must connect a drain wire from the case of the motor to the shield of the extension cable.

SM34 Motor Wiring (Includes SM34-300, SM34-600, and SM34-900 motors)

Six Lead Series Connected

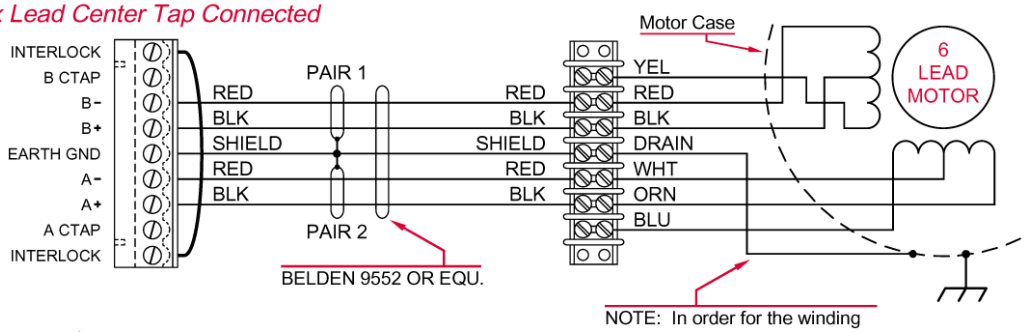


Motor Connections shown for CW rotation. (Facing mounting flange.)

For CCW rotation, reverse Stepper Drive B+ and B– connections.

NOTE: In order for the winding short circuit detection to function, you must connect a drain wire from the case of the motor to the shield of the extention cable.

Six Lead Center Tap Connected



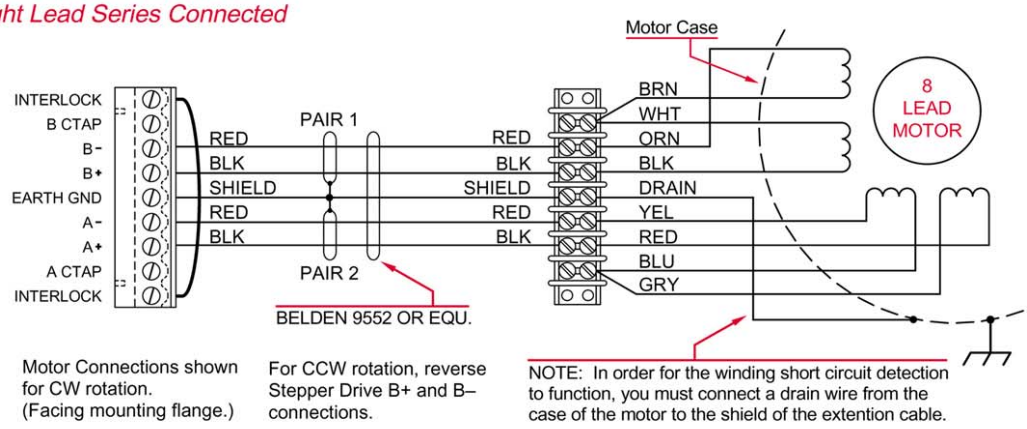
Motor Connections shown for CW rotation. (Facing mounting flange.)

For CCW rotation, reverse Stepper Drive B+ and B– connections.

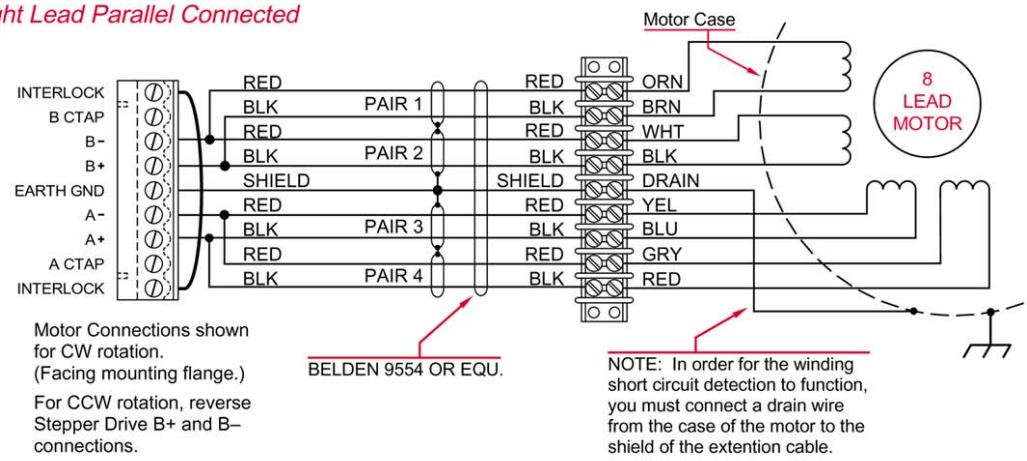
NOTE: In order for the winding short circuit detection to function, you must connect a drain wire from the case of the motor to the shield of the extention cable.

SM23 Motor Wiring (Includes SM23-130 and SM23-240 motors)

Eight Lead Series Connected



Eight Lead Parallel Connected



Extending the Motor Cable

As you extend the motor cable, you increase the chances of forming a ground loop between the motor and the drive. In order to keep this possibility to a minimum, connect the motor and drive to the same point on your earth grounding system.

Even though it is possible to extend the cable length up to forty feet, AMCI recommends installing the drive as close as possible to the motor. This will decrease the chance of forming a ground loop, and has the added benefit of limiting the amount of power loss in the motor cable. If you must extend the cable, you should use a cable with twisted pairs 18AWG or larger and an overall shield.

Installing the Motor Cable

All of the motor connections are high power, high voltage signals. The cable from the motor can be installed in conduit along with ac/dc power lines or high power ac/dc I/O as long as safety codes are followed. It cannot be installed in conduit with low power cabling such as cabling from the drive to the indexer, communication cables, or low power ac/dc/ I/O lines

When extending the motor cable, treat the shield as a signal carrying conductor. Do not connect the shield to earth ground at any junction box.

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 drive or motor. Refer to Status LED table on page 3 for information. 2) If the motor rotates when commanded but has no holding torque, then your Idle Current Reduction switch is set to the *0%* setting that removes motor current when the drive is idle for more than one second. See page 4 for information on setting the Idle Current Reduction switches. 3) The dipswitches that set the SD17060's current have not been changed from the default value of 0.0 amps.
The SD17060 blinks its STEP/FAULT LED green when pulses are applied to the drive, but the motor only emits a high pitch noise. It does not rotate.	1) The acceleration 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 Microstepping Resolution may be set to the desired value.
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 drive is configured for the *Step & Direction* format, the motor will rotate counter-clockwise when the drive receives CW pulses, and it will not rotate at all when the drive receives CCW pulses. If the indexer is sending pulses in the Step & Direction format and the drive 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. This is most commonly the problem with converting from a SD3520 or a SD8055 to a SD17060 because the sense of the ±B phase is reversed between the two drives. 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.

Indexer Problems

Symptom	Solution
My indexer/PLC reports a fault from the SD17060 when everything seems fine.	Your logic maybe reversed. On the SD17060, the Fault Output is on (conducts current) when the drive is working correctly and turns off (stops current flow) when there is a fault with the drive. Therefore, losing power to the drive 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.	This is most likely a problem with the SD17060's Microstepping Resolution setting or the indexer's programming. If the motor is running too fast, then the Microstepping Resolution is set lower than the indexer's programmer expected. If the motor is running slow, the Microstepping Resolution is set higher than the indexer's programmer expected it to be.

Driver Problems

Symptom	Solution
Both LED's are off, and the Fault Output is active. (Not conducting) Power is applied to the drive.	1) The AC line voltage may be too low. It must be greater than 95Vac for the SD17060 to operate properly. The power LED will be on for values over 40Vac. 2) One or both of the 5A fuses may be blown. These fuses will not blow under normal circumstances, so call AMCI for assistance. Blown fuses may be a sign of a serious installation problems.
Both LEDs are green, the Fault Output is inactive, (conducting) but the motor is not powered.	1) The Motor Current may be set to 0. 2) The ±Disable input may be active. If this input is receiving power, the motor current is removed, but the drive does not go into a fault condition. 3) Idle Current Reduction to may be enabled to 0%. When the Idle Current Reduction is turned on, 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 drive. 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 the proper current limiting resistor is installed and that they are wired correctly. If your indexer has sourcing outputs, then the inputs of the SD17060 must be wired as sinking inputs and vice versa.
The STEP/FAULT LED is red.	The drive is experiencing a fault condition. All faults are latched, so once the problem has been corrected, power must be cycled to the drive before the fault will clear. **1) Over Temp Fault.** Is the drive very hot? It shuts down when its internal temperature exceeds 90°C (195°F). **2) Interlock Fault.** The motor is not plugged into the drive or a wire jumper was not installed between the two Interlock pins on the Motor Connector. **3) Short in Motor.** Shut off the SD17060 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 4) An Automatic Current Loop gain identification was attempted with the motor current set to zero. 5) An Automatic Current Loop gain identification was attempted with only the interlock wire attached. That is, there was no motor attached to the driver.

Revision History

Revision 0.0 was the initial release of the specifications.

Revision 1.0 added motor wiring and general information, such as physical dimensions, power requirements, etc, to the specifications.

Revision 2.0 was released on 3/10/04. This revision added a diagram showing the location of the dip switch packages on the SD17060 driver. The function of the idle current reduction switches was also changed from none, 50%, 0%, and 0% to none, 69%, 50%, and 0%.

Revision 2.1 was released on 7/26/04. The following changes were made.

- Text was added describing the function of the interlock and center tap terminal on the motor connector.
- The Specifications were moved to beginning of the document.
- Details were added to the status LED function
- Details were added to the Automatic Current Loop gain function.
- Diagrams showing how to wire the SD17060 to single ended indexers were added.
- A diagram showing the wiring of the fault output was added.
- Trouble shooting tables were added.

Revision 2.2 was released on 11/3/04. This revision changed the maximum input frequency from the incorrect value of 25kHz to the correct value of 2MHz.