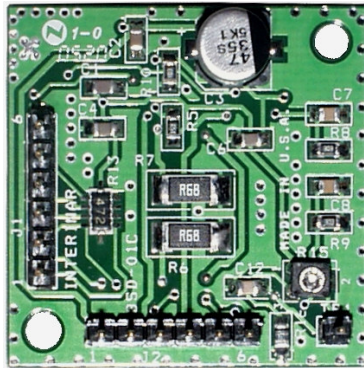


Functional description of BSD-01C Module

The BSD-01C module is a complete full step driver with built-in translator suitable for driving bipolar step motors from 185 to 750mA and up to 30V.

It operates in full step mode without requiring any phase-sequence tables, high frequency control lines or complex interfaces to program. BSD-01C is a Step/Direction type driver, used in variety of CNC machines. Ideal for applications where a complex microcontroller is unavailable or over-burdened.



Features

- +/- 750mA, 24V Output Rating
- Crossover-Current Circuit Protection
- Under-Voltage Lockout Protection
- Thermal Shutdown Protection
- Automatic Current-Decay Mode
- Chip Enable Select Function
- Built-in Translator
- Sleep Mode
- Reduced audible motor noise
- Increased step accuracy
- Low Quiescent Current (10mA MAX)
- Extremely small footprint 1.25" x 1.25" (32mm x 32mm)

Table 1: 6-pin Header J1

Pin #	Pin Description
1	SLEEP - input, active-low. When logic-low all outputs and most of the internal circuitry are disabled. When logic-high, normal operation resumes and translator is set to home state. Board has built in pull-up resistor and is shipped with normal operation mode as default. This input may be left disconnected when not used.
2	DIRECTION - input. Determines the direction of the rotation of the motor. If low was Counter Clockwise then high will be Clockwise and vice-versa. Initial direction depends on order in which motor was connected. Reversing connection order of only one phase will change the initial direction. Board has built in pull-up resistor.
3	STEP - input. A low-to-high transition advances the motor one step. Board has built in pull-up resistor.
4	ENABLE - input, active-low. When logic-low all outputs are enabled. Board has built in pull-up resistor.
5	RESET - input, active-low. When logic-low all outputs are off and translator is set to predefined home state. STEP input is ignored until RESET goes high. Board has built in pull-up resistor. This input may be left disconnected when not used.
6	GND - signal ground.

Table 2: 6-pin Header J2

Pin #	Pin Description
1	Vb – POSITIVE motor and logic supply voltage 7.5 to 30V
2	GND – power supply GND
3	O1A - output. Motor Phase 1 output A.
4	O1B - output. Motor Phase 1 output B.
5	O2A - output. Motor Phase 2 output A.
6	O2B - output. Motor Phase 2 output B.

Table 3: Adjustments

Ref ID	Name	Description
R15	Vref	Board has build-in potentiometer for adjusting the maximum current of the driver according to motor's specification. It allows to adjust Vref in range from 1V to 5V.
TP1	Vref	Vref can be observed by connecting voltmeter between TP1 and GND.

SETTING THE MAX CURRENT LIMIT BY ADJUSTING V_{REF} IS CRUCIAL FOR DRIVER-MOTOR OPERATION.

To assure proper operation of the motor it is important to adjust Max Current Limit by adjusting V_{REF} to appropriate level. Calculation of V_{REF} is based on the following formula:

$$V_{REF} [V] = k * I_{max} [A]$$

where: $k=5.44$ for drivers with 0.68Ω sensing resistors (ver. 185-750mA)
 $k=21.6$ for drivers with 2.70Ω sensing resistors (ver 45-230mA)
 $k=65.6$ for drivers with 8.20Ω sensing resistors (ver 15-75mA)

for example: if motor is rated 0.4A and driver is 185-750mA version with 0.68Ω resistors then V_{REF} should be approx. 2.2V ($5.44 * 0.4 = 2.2V$).
 Use Voltmeter connected to TP1 and GND and adjust R15 to appropriate level.
 V_{REF} will not fall below 1V and exceed 5V.

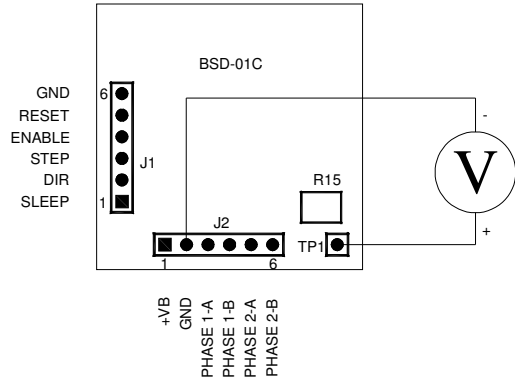


Figure 1. BSD-01C VOLTMETER CONNECTION

* Motor Output Current is limited by duty cycle, ambient temperature and heat sinking. The PCB of the BSD-01C was designed with heat sinking capability (increased copper area around the driver IC) which should be sufficient for most applications. In some cases when the motor works with extremely low rpm or standstill (idle) for long time waiting for the next step with outputs enabled (Enable signal low) the temperature of the driver IC may exceed max Junction Temperature of $+150^{\circ}C$. In this case internal Thermal Shut Down circuitry will be activated at $+165^{\circ}C$, all outputs will be disabled and motor will stop working. When Junction Temperature falls back below $+150^{\circ}C$ BSD-01C will resume normal operation. *This thermal protection is intended only to protect the driver from failure when junction temperature exceeds specified limit and should not imply that output short circuits are permitted.*

If your application forces described above working condition then you may consider following option:

- disabling outputs (ENABLE= HIGH) when motor standstill (idle phase)
- installing BSD-01C on any metal surface and using thermal conductive material for transferring the heat from IC to the metal or installing heat-sink directly on IC using thermal conductive epoxy adhesive

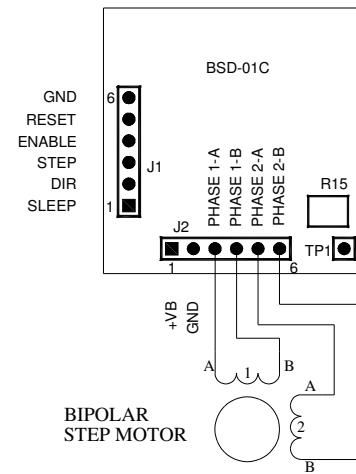


Figure 2. BSD-01C MOTOR CONNECTION

MIXED DECAY MODE.

BSD-01C operates in Mixed-Decay Mode. As the trip point is reached the driver operates in fast-decay. After this fast-decay portion the driver will switch to slow-decay for the remainder of the fixed off-time period. Fixed off-time is set at 30usec during manufacturing process.

SIGNAL CONNECTION.

Header J1 provides all necessary control signals. Please notice that Pin #6 – GND should be use exclusively as a ground (return) for these signals only. Never use it for connecting GND of the power supply.

Header J2 provides connection to the power supply and the motor. Do not reverse the polarity of the power supply connections or damage to the driver will occur.

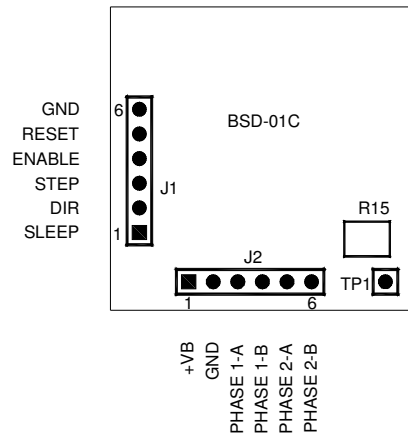


Figure 3. BSD-01C HEADERS
(see Table 1 and 2 for details)

MOUNTING OF THE DRIVER.

Driver should be mounted on isolating stand-offs to provide sufficient clearance for component mounted on the bottom of the pcb.

Diameter of the mounting holes allows use of standard 4-40 screws.

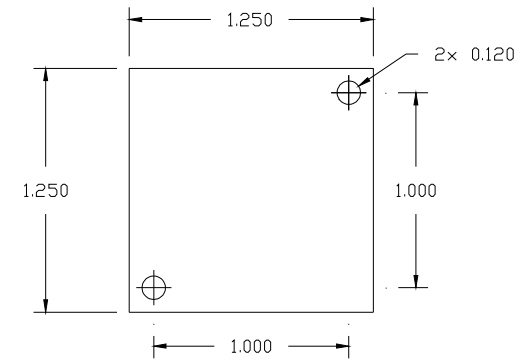


Figure 4. BSD-01C DIMENSIONS AND MOUNTING HOLES LOCATION

IMPORTANT

CONNECTING ANY VOLTAGE EXCEEDING +5V OR LOWER THAN -0.5V TO ANY INPUTS OF THE HEADER J1 WILL RESULT IN PERMANENT DAMAGE TO THE DRIVER.

CONNECTING VOLTAGE EXCEEDING +30V TO PIN #1 OF THE HEADER J2 WILL RESULT IN PERMANENT DAMAGE TO THE DRIVER.

CONNECTING OR DISCONNECTING ANY WIRES OF THE MOTOR WHILE VB IS PRESENT ON PIN #1 OF THE HEADER J2 WILL RESULT IN PERMANENT DAMAGE TO THE DRIVER.

CONNECTING ANY DMM OR OSCILLOSCOPE DIRECTLY TO THE OUTPUTS OF THE DRIVER MAY RESULT IN DAMAGE TO THE DRIVER. IF VERIFICATION OF SHAPE AND VALUE OF THE PHASE CURRENT IS IMPORTANT, THEN WE RECOMMEND TO USE THE OSCILLOSCOPE CONNECTED DIRECTLY TO THE SENSING RESISTORS INSTEAD. PHASE CURRENT CAN BE CALCULATED BASED ON OBSERVED VOLTAGE DROP ON THESE RESISTORS. THE ONLY DIFFERENCE IS THE POLARITY OF THE OBSERVED SIGNAL WHICH WILL BE POSITIVE ALL THE TIME, NO MATTER WHICH PHASE IT REPRESENTS.

Table 8: Main Features

Feature	Symbol	Description
Load Supply Voltage	V_B	7.5 to 24.0 V DC Max
Output Current	I_{ODC}	Continuous: from 15 to 750mA per each output (version dependant – see pg 1) Peak: +/- 750mA per each output. Output Current Rating will be limited by duty cycle, ambient temperature and heat sinking. Do not exceed the specified current rating or a junction temperature of 150C.
Step Modes	-	Full Step
Current Decay Modes	-	Mixed Current-Decay Automatic Current-Decay Mode Detection and Selection
Protection	-	Under-Voltage Lockout Protection Crossover-Current Protection Thermal Shutdown Circuitry with hysteresis
Physical dimensions	inch	1.25" x 1.25" x 0.50" (WxLxH)

Table 8: Electrical Characteristics at Ta=+25°C

Characteristic	Symbol	Test Condition	Limit			Unit
			Min	Typ	Max	
Motor Supply Voltage	V_B	Operating	7.5	-	24	V
		Sleep Mode	0	-	30	V
Motor Output Current	I_B	Continuous	-	-	±750	mA*
		Peak	-	-	±750	mA
Logic Input Voltage	$V_{IN(1)}$		3.5	-	-	V
	$V_{IN(0)}$		-	-	1.5	V
Logic Input Current	$I_{IN(1)}$		-20	<1.0	20	µA
	$I_{IN(0)}$		-20	<1.0	20	µA
Maximum Step Frequency	f_{STEP}		500	-	-	kHz
Comparator Blank Time	t_{BLANK}		1.1	1.4	1.7	µs
Fixed Off Time	t_{OFF}		24	30	36	µs
Operating Temperature Range			-20	-	+85	°C