

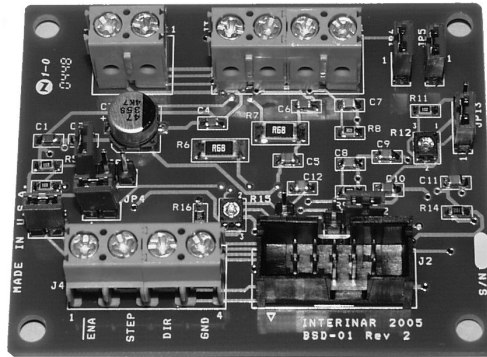
Functional description of BSD-01v2 Module

The BSD-01v2 module is a complete microstepping driver with built-in translator suitable for driving bipolar step motors from 15 to 750mA and up to 30V.

Available in three different versions:

- 15 to 75mA
- 45 to 230mA
- 185 to 750mA

It operates in Full-, Half-, Quarter- or Eighth- Step Modes without requiring any phase-sequence tables, high frequency control lines or complex interfaces to program. Ideal for applications where a complex microcontroller is unavailable or over-burdened.



Features

- +/- 750mA, 30V Output Rating
- Crossover-Current Circuit Protection
- Under-Voltage Lockout Protection
- Thermal Shutdown Protection
- Automatic Current-Decay Mode
- Built-in Step pulse generator
- Chip Enable Select Function
- Built-in Translator
- Sleep Mode
- Reduced audible motor noise
- Increased step accuracy
- Low Quiescent Current (10mA MAX)

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Table 1: 2-pin Terminal Block J1

Pin #	Pin Description
1	GND - power ground.
2	+V _B - motor supply voltage. Min 7.5V , Max 30V.

Table 2: 10-pin Header J2

Pin #	Pin Description
1	ENABLE - input, active-low. When logic-low all outputs are enabled. Board has built in jumper JP3 (<i>see Table 5</i>) for convenience and it is shipped with JP3 ON - module enabled (default). This input may be left disconnected when not used. To control this input from external circuitry remove JP3. This input is also available on pin 1 of J4.
2	+5V DC - output. Up to 100mA can be drained from this pin to supply power to the external logic if used. May be left disconnected when not used.
3	SLEEP - input, active-low. When logic-low all outputs and most of the internal circuitry are disabled. When logic-high, normal operation resumed and translator set to home state. Board has built in pull-up resistor, shipped with normal operation mode as default. This input may be left disconnected when not used.
4	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.
5	DIRECTION - input. Determines the direction of the rotation of the motor. If low was Counter Clockwise then high will be Clockwise and vice-versa. Board has built in pull-up resistor and jumper JP4 for convenience. Shipped with JP4 OFF (default). To control this input from external circuit remove JP4 (<i>see Table 5</i>). Available also on pin 3 of J4.
6	STEP - input. A low-to-high transition advances the motor one increment. The size of the increment is determined by MS1 and MS2 (<i>see Table 5 and Table 6</i>). Board has built in pull-up resistor and internal Step generator (<i>see Table 5</i>). Available also on pin 2 of J4.
7	MS2 - input. Together with MS1 determines the size of the increment of the rotation (<i>see Table 5 and Table 6</i>). Board has built in pull-up resistor and jumper JP6 for convenience. Shipped with JP6 ON (default).
8	MS1 - input. Together with MS2 determines the size of the increment of the rotation (<i>see Table 5 and Table 6</i>). Board has built in pull-up resistor and jumper JP5 for convenience. Shipped with JP5 ON (default).
9	GND - signal ground.
10	GND - signal ground.

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Table 3: 4-pin Terminal Block J3

Pin #	Pin Description
1	O1A - output. Phase 1 output A.
2	O1B - output. Phase 1 output B.
3	O2A - output. Phase 2 output A.
4	O2B - output. Phase 2 output B.

Table 4: 4-pin Terminal Block J4

Pin #	Pin Description
1	ENABLE - input, active-low. When logic-low all outputs are enabled. Board has built in jumper JP3 (see Table 5) for convenience and it is shipped with JP3 ON - module enabled (default). This input may be left disconnected when not used. To control this input from external circuitry remove JP3. This input is also available on pin 1 of J2.
2	STEP - input. A low-to-high transition advances the motor one increment. The size of the increment is determined by MS1 and MS2 (see Table 5 and Table 6). Board has built in pull-up resistor and internal Step generator (see Table 5). Available also on pin 6 of J2.
3	DIRECTION - input. Determines the direction of the rotation of the motor. If low was Counter Clockwise then high will be Clockwise and vice-versa. Board has built in pull-up resistor and jumper JP4 for convenience. Shipped with JP4 OFF (default). To control this input from external circuit remove JP4 (see Table 5). Available also on pin 5 of J2.
4	GND - signal ground.

NOTE 1: SETING THE MAX CURRENT LIMIT BY ADJUSTING V_{REF} IS CRUCIAL FOR MICROSTEPPING 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.

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Table 5: Jumpers Description

JP #	Jumper Position	Description
3	OFF ON	Driver Enable selection. - disable - enable (default)
4	OFF ON	Direction of rotation. - CCW (default) - CW
5	OFF ON	Microstep resolution. - see Table 6 - see Table 6 (default)
6	OFF ON	Microstep resolution. - see Table 6 - see Table 6 (default)
7	OFF 1-2 2-3	Percent Fast Decay Selection. - Mixed-Decay Mode (default) - Fast-Decay Mode - Slow-Decay Mode
12	1-2 2-3	Step Input. - using internal pulse generator (default) (see Table 7) - using external pulse through J4 pin 2 or J2 pin 6
13	1-2 2-3	Speed/Step Pulse Frequency Input. - using R12 on-board trimmer (default) (see Table 7) - connect external potentiometer to pins 2-3 and remove jumper from 1-2.

Table 6: Microstep Resolution Selection

JP 5	JP 6	Resolution
ON	ON	Full Step (default)
OFF	ON	Half Step
ON	OFF	Quarter Step
OFF	OFF	Eighth Step

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Table 7: Switches and Adjustments

Ref ID	Name	Description
R12	SPEED	Board has built-in STEP generator. In simple applications board can be used to control the motor without external STEP input. Jumper JP12 has to be in 1-2 position (see Table 5). Jumper JP13 in 1-2 position. For 1.8deg motor SPEED potentiometer allows to adjust motor speed: from 1 to 160 rpm - in Full Step Mode from 0.5 to 80 rpm - in Half Step Mode from 0.25 to 40 rpm - in Quarter Step Mode from 0.125 to 20 rpm - in Eighth Step Mode
JP13 2-3	SPEED	If more accurate speed adjustment is required use pins 2-3 of JP13 to connect external potentiometer up to 1Mohm. Remove jumper from position 1-2.

NOTE 2: CONTROLLING SLOW-FAST-MIXED DECAY MODE.

JP7 in position 1-2 forces Fast-Decay Mode. JP7 in position 2-3 allows operation in Slow-Decay Mode. By removing JP7 Mixed-Decay Mode is selected. When in Mixed mode the driver operates in fast-decay as the trip point is reached. 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. It is advised to leave JP7 OFF, allowing automatic decay selection. Some application may require slow or fast decay modes. In these cases use JP7 set to appropriate position.

Table 8: Features

Feature	Symbol	Description
Logic Supply Voltage – Output J2 pin 2	V _{CC}	+5V DC. Up to 100mA can be used to supply power to external circuits like optoisolators/buffers.
Load Supply Voltage	V _B	7.5 to 30.0 V DC Max
Output Current	I _{ODC}	Continuous: from 15 to 750mA per each output (version dependant – see pg 1) Peak: +/- 850mA 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 Half Step Quarter Step Eighth Step
Current Decay Modes	-	Slow Current-Decay Fast Current-Decay Mixed Current-Decay Automatic Current-Decay Mode Detection and Selection
Protection	-	Under-Voltage Lockout Protection Crossover-Current Protection Thermal Shutdown Circuitry with hysteresis No special power-up sequencing required
Physical dimensions	inch	2.02" x 2.50" x 0.60" (WxLxH)

WARNING!

DO NOT UNPLUG MOTOR WHILE POWER IS ON.

Disconnecting even one motor lead under this condition will permanently damage the driver.

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	-	30	V
		Sleep Mode	0	-	30	
Motor Output Current	I _B	Continuous	-	-	±750	mA*
		Peak	-	-	±850	mA
Control Logic Supply Voltage	V _C			5	V	
Control Logic Supply Current	I _C		-	-	100	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

* Motor Output Current is limited by duty cycle, ambient temperature and heat sinking. The PCB of the BSD-01 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 °C. In this case internal Thermal Shut Down circuitry will be activated at +165 °C, all outputs will be disabled and motor will stop working. When Junction Temperature falls back below +150°C BSD-01 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)
- increasing rpm
- switching from full-step to micro-step mode
- installing BSD-01 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.

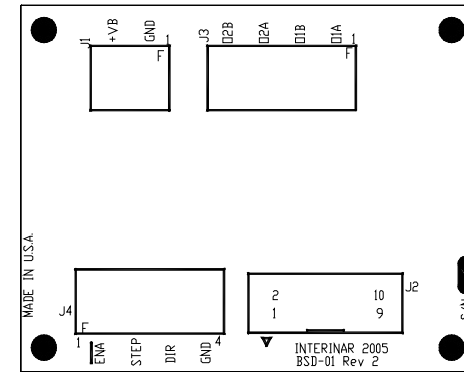


Figure 1. BSD-01 TERMINAL BLOCKS
(see Table 1, 2, 3 and 4 for details)

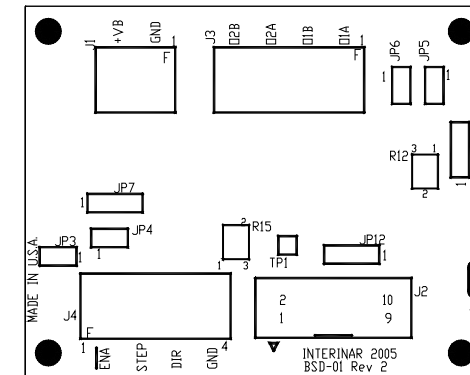


Figure 2. BSD-01 JUMPERS LOCATION
(see Table 5, 6 and 7 for details)