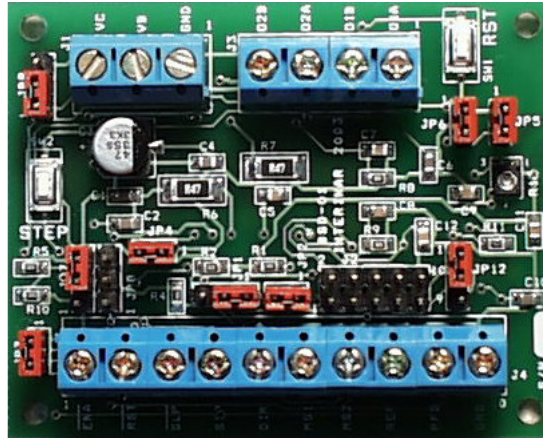


Functional description of BSD-01 Module

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

Table 1: 10-pin Terminal Block J4

Pin #	Pin Description
1	ENABLE - input, active-low. When logic-low all outputs are enabled. Board has build in jumper JP3 (<i>see Table 4</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 circuit remove JP3.
2	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 build in pull-up resistor. RESET push-button for diagnostic purposes is optional (<i>see Table 6</i>). This input 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 build in pull-up resistor, shipped with normal operation mode as default. This input may be left disconnected when not used.
4	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 Table4 and Table 5</i>). Board has built in pull-up resistor. STEP push-button for diagnostic purposes is optional (<i>see Table 6</i>). To advance the motor one increment push this button down, when button released motor will make one increment.
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 ON (default). To control this input from external circuit remove JP4 (<i>see Table 4</i>).
6	MS1 - input. Together with MS2 determines the size of the increment of the rotation (<i>see Table4 and Table 5</i>). Board has built in pull-up resistor and jumper JP5 for convenience. Shipped with JP5 ON (default).
7	MS2 - input. Together with MS1 determines the size of the increment of the rotation (<i>see Table4 and Table 5</i>). Board has built in pull-up resistor and jumper JP6 for convenience. Shipped with JP6 ON (default).
8	REFERENCE - input. Sets the maximum value of the current limit. Board has built-in jumpers JP1 and JP2 (<i>see Table 4</i>) for convenience and it is shipped with JP2 OFF - setting current limit to 0.5A (or 0.37A) (default). To control this input from external circuit move JP1 to 2-3. See Note 1 to calculate required Voltage REFERENCE.
9	PERCENT FAST DECAY - input. Automatic current-decay selection for improving microstepping performance by reducing the distortion of the current waveform due to the motor BEMF. Board has build in jumpers JP7 and JP8 (<i>see Table 4</i>) for convenience and it is shipped with JP7 OFF - setting mixed-decay mode (default). To control this input from external circuit move JP8 to 1-2. See Note 2.
10	GND - signal ground.

Table 2: 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 3: 3-pin Terminal Block J1

Pin #	Pin Description
1	GND - power ground.
2	V_B - load supply voltage. Min 4.75V , Max 30V. If motor requires voltages in range of 7.5V to 15V then V_B may also be used to supply control logic instead of using separate V_C . In this case JP9 should be in 2-3 position (<i>see Table 4</i>).
3	V_C - control logic supply voltage. Min 7.5V, Max 15V. If motor requires voltages above 15V then separate V_C should be used. In this case JP9 should be in 1-2 position (<i>see Table 4</i>).

NOTE 1: SETING THE MAX CURRENT LIMIT BY ADJUSTING V_{REF} IS CRUCIAL FOR MICROSTEPPING OPERATION J4-PIN8.

To assure proper operation of the motor it is important to adjust Max Current Limit by providing appropriate V_{REF} to pin 8 of J4. Calculation of V_{REF} is based on the following formula:

$$V_{REF} = k * I_{max}$$

where: $k=3.76$ for drivers with 0.47Ω sensing resistors

$k=5.44$ for drivers with 0.68Ω sensing resistors (ver. BSD-01A)

for example: if your motor is rated 400mA V_{REF} should be 1.5V for 0.47Ω resistor. There is no need to provide external V_{REF} for motors rated 500mA and 750mA (or 370mA and 550mA for version BSD-01A). In this case use JP1 and JP2 (see table 1). V_{REF} cannot fall below 1V and exceed 5V.

If motor is rated less than 265mA order version BSD-01A with 0.68Ω sensing resistors.

Table 4: Jumpers Description

JP #	Jumper Position	Description
1	1-2 2-3	Current Limit selection. - current limit set internally by JP2 (default) - current limit set externally by Reference Voltage through J4 pin 8
2	OFF ON	Current Limit selection. - 0.50A for 0.47Ω sensing resistor or 0.37A for 0.68Ω resistor (default) - 0.75A for 0.47Ω sensing resistor or 0.55A for 0.68Ω resistor
3	OFF ON	Driver Enable selection. - disable - enable (default)
4	OFF ON	Direction of rotation. - CCW - CW (default)
5	OFF ON	Microstep resolution. - see Table 5 - see Table 5 (default)
6	OFF ON	Microstep resolution. - see Table 5 - see Table 5 (default)
7	OFF 1-2 2-3	Percent Fast Decay Selection. - Mixed-Decay Mode (default) - Slow-Decay Mode - Fast-Decay Mode
8	1-2 2-3	Percent Fast Decay Selection. - PFD set externally through J4 pin 9 - PFD set internally by JP7 (default)
9	1-2 2-3	Control Voltage Supply. - external voltage 7.5 - 15 V (default) - using V _B if stays in the range of 7.5 -15V
12	1-2 2-3	Step Input. - using internal pulse generator (default) (<i>see Table 6</i>) - using external pulse through J4 pin 4 or push-button SW2 (STEP)

Table 5: Microstep Resolution Selection

JP 5	JP 6	Resolution
ON	ON	Full Step
OFF	ON	Half Step
ON	OFF	Quarter Step
OFF	OFF	Eighth Step

Table 6: Switches and Adjustments

Ref ID	Name	Description
SW1	RST	RESET push-button for diagnostic purposes (<i>see Table 1</i>). <i>NOTE: this component is optional.</i>
SW2	STEP	STEP push-button for diagnostic purposes (<i>see Table 1</i>). To advance the motor one increment push this button down, when button released motor will make one increment. <i>NOTE: this component is optional.</i>
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 (<i>see Table 4</i>). 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

NOTE 2: CONTROLLING SLOW-FAST-MIXED DECAY MODE J4-PIN9.

Voltage less than 1.05V forces Fast-Decay Mode. Voltage above 3.00V allows operation in Slow-Decay Mode. By providing voltage between 1.05V and 3V Mixed-Decay Mode is selected. When in Mixed mode the time driver operates in fast-decay (as the trip point is reached) can be changed in range of 3:1 by adjusting voltage on this pin between 1.05V (Max time) and 3.00V (min time). 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.

Table 7: Features

Feature	Symbol	Description
Logic Supply Voltage	V_C	jumper selectable - JP9: (1-2): 7 to 15 V external non-stabilized voltage supply. (2-3): using Load Supply Voltage V_B – only when V_B is in range 7 to 15V.
Load Supply Voltage	V_B	4.75 to 30.0 V Max
Output Current	I_{ODC}	Continuous: +/- 750mA per each output 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	2.00 x 2.50 x 0.55" (WxLxH)

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

Characteristic	Symbol	Test Condition	Limit			Unit
			Min	Typ	Max	
Motor Supply Voltage	V_B	Operating	4.75	-	30	V
		Sleep Mode	0	-	30	
Motor Output Current	I_B	Continuous	-	-	±750	mA*
		Peak	-	-	±850	mA
Control Logic Supply Voltage	V_C		7.5	9	+15	V
Control Logic Supply Current	I_C	Operating	-	-	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
Mixed Decay Trip Point	PFD_H		-	3.00	-	V
	PFD_L		-	1.05	-	V
Reference Input Voltage Range	V_{REF}	Operating	1.0	-	5.0	V
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 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 motors 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.

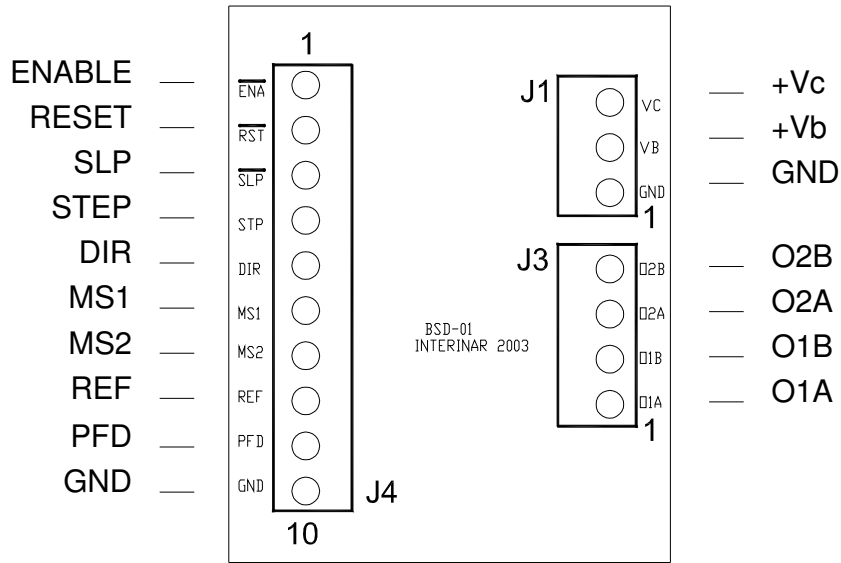


Figure 1. BSD-01 TERMINAL BLOCKS
(see Table 1, 2 and 3 for details)

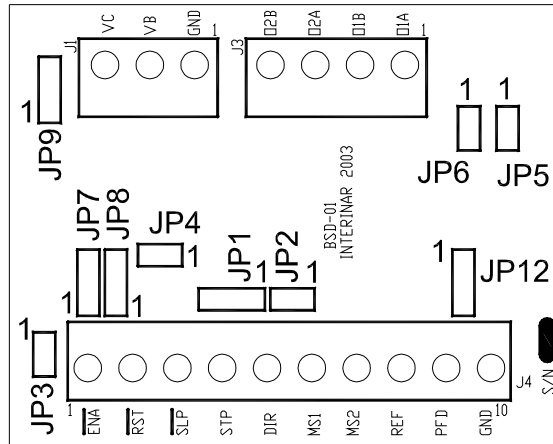


Figure 2. BSD-01 JUMPERS LOCATION
(see Table 4 and 5 for details)