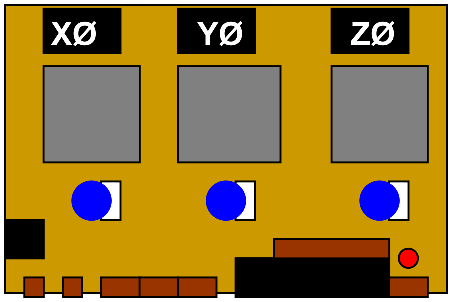
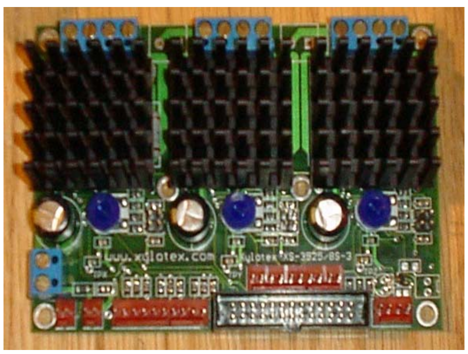
XS-3525/8S-3

Single Supply (v1s)





Standard Pinout Information

The 26 pin header is configured to allow easy connection via ribbon cable to an IDC DB-25 connector. This facilitates direct connection to standard PC parallel ports.

The drive uses the following signals:

DB25 pin	IDC26	Usage
Pin 2	3	Step X
Pin 3	5	Dir X
Pin 4	7	Step Y
Pin 5	9	Dir Y
Pin 6	11	Step Z
Pin 7	13	Dir Z

The remaining signals are fed to other headers to allow off-board devices to use the other parallel port signals.

Also provided are HOME(HPO#) outputs, ENABLE(ENA#), and SLEEP# inputs for each axis.

- Small Size 4.275 X 2.84 inches.
- Drives up to 35Volts @ 2.5 A/phase
- 4 different microstepping step levels from Full-Step(FS) to 1/8 step/FS
- Simple TTL interface
- 5 Volt Logic Supply (VCC)
- Isolated Logic & Power Planes

Microstepping Truth Table

axS1	axS0	Output
0	0	Full Step
0	1	Half Step
1	0	Quarter Step
1	1	Eighth Step

1 means jumper **NOT** installed

The XS-3525/8S-3 Stepper Driver is a 3 axis pulse-width-modulated (PWM) current controlled bipolar micro-stepping controller.

Each axis drive has a ±2.5 Amp/phase @ 35Volt maximum continuous Output Rating. The drive circuitry has thermal shutdown protection and crossover-current protection. Synchronous rectification circuitry eliminates the need for external clamp diodes in most applications.

Each axis accepts Step & Direction signals, along with 2 jumper inputs to define microsteps per full step. Home Position Output(HPO#) is provided as an indicator when the motor is being commanded to the HOME position (see below).

The board is of 4-Layer construction with Isolated Power and Logic supply planes. The drive circuitry has a heat sink attached to allow cooler operation.

Power

On Single Supply (v1s) style boards, jumper wires are soldered on the bottom of the board and used to connect all three separate axis power supply planes to a single supply header.

Each axis can be separately setup to deliver different maximum current levels by adjusting an on-board potentiometer (VRX, VRY, & VRZ). The potentiometer creates a voltage which is input to the drivers Vref (Voltage Reference) pin. The Vref voltage is referenced to ground (GND) and can be monitored at the test points TPX,TPY and TPZ. The reference voltage at the test points is related to the motor drive current by the following formula:

Max Motor Current=Vref/1.44

<u>for example:</u>

2.5 Amp = Vref 3.6V
2.0 Amp = Vref 2.88V
1.5 Amp = Vref 2.16V
1.0 Amp = Vref 1.44V
0.5 Amp = Vref 0.72V

Thus if Vref is set to 3.60 volts, the resulting maximum drive current supplied to the motor will be:

2.5Amps ~= 3.60/1.44

The Vref circuitry is based on a 5 volt VCC input, although voltages as low as 4.90 volts can still be used to obtain a Vref of 3.6V. Because of this, it is possible to set the Vref input to higher than 3.60 volts when using a full 5.0 Volt logic power source. This will cause the drive circuitry to attempt to deliver more current than it is rated for, which can cause overheating of the device. Overheating the device lowers life expectancy of the circuitry as well as introducing the possibility of a thermal shutdown cycle (which can lead to motor/system position losses). You should never drive the motor at a current higher than specified by the motor manufacturer. Generally, very little extra torque will be achieved, and the motor will probably overheat.

The Vref voltage is compared to onboard Sense Resistors which have a ±5% accuracy rating. Full current can be achieved with voltages as low as 3.42V on Vref. When attempting to deliver 2.5A/phase, start with a Vref voltage of 3.42V.

The system motor drive circuitry can handle up to 35 volts <u>**which includes Back EMF**</u> (BEMF). A system using 35 volts as a motor supply voltage <u>**may require an external capacitor**</u> to be used if BEMF (i.e. from rapid motor decelerations) would cause voltages to exceed 35V. Exceeding the maximum voltage (35V) will destroy the circuitry!

Because stepper motors are current driven, rather than voltage driven devices, it is generally acceptable, and most often necessary, to drive the motor at a voltage higher than the motor's rated voltage. The on-board drive circuitry limits the source/sink current to the motor without the need for external power resistors. A higher voltage allows the motor to be driven to the correct position faster, thus allowing for higher motor RPM.

12 Volt and 24 volt power supplies are the most common power sources with voltage outputs under the maximum 35V. Of the two, 24V will provide much better performance, while 12V supplies are a little more common and thus less expensive. System running with 24V generally do not require any external capacitors. Other supplies like 27V and 30V, while available are generally much more expensive, and may require the addition of external capacitors to the circuitry to keep voltage levels from exceeding the maximum 35V.

The minimum motor supply voltage is 8.0 volts. Minimum current selectable ~0.39A

Connector **J15** is tied to the system ground (**GND**) and motor power supply planes (**VBB**). In systems using 12 or 24 volts, this connector can be used to supply power to a cooling fan rated for the appropriate voltage. <u>**Use of a cooling fan is recommended for systems operating at or near the maximum current rating**</u> (see below).

The board is manufactured with 4 layers. The copper on the top and bottom layers are covered with tin/lead solder reflow.

ABSOLUTE MAXIMUM RATINGS

T_A=+25°C

which should not be exceeded

Load Supply Voltage(V_{BB}) (including Back EMF)	**35V**
Output Current(I_{OUT})	**±2.5A**
Logic Supply Voltage(V_{cc})	**7.0V**
Operating Temperature Range(T_A)	**–20°C to +85°C**
Junction Temperature(T_J)	**+150°C**

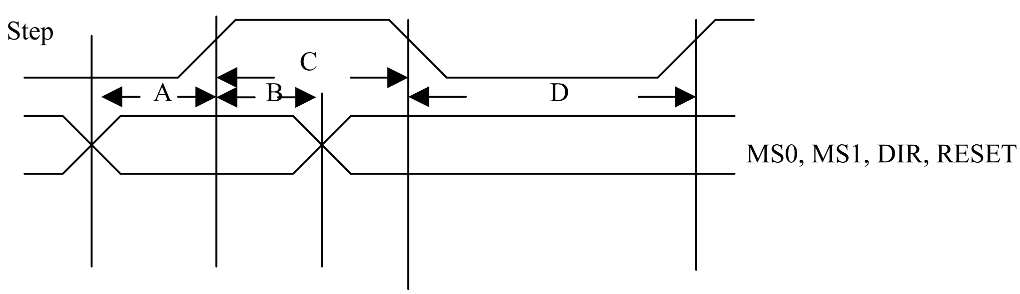
Logic Input Voltage (with Vcc = +5V)

Logic HIGH min. voltage 3.5V
Logic LOW max. voltage 1.5V

If you are using a parallel port to drive the board, be sure that it meets the above logic requirements. (Some motherboards with on-boards parallel port may not meet the requirements).

Restrictions

Do **NOT** adjust the Vref voltages with VBB powered
Do **NOT** adjust the Vref voltages to more than 3.60V
Never connect **or** disconnect motors, fans, etc when the drive is powered with VCC or VBB.
Do **NOT** place a fuse between the motors and the drive.
Do **NOT** allow voltages to exceed the ratings above (Be sure VBB isn't connected to VCC)



A) Minimum Command Active Time Before Step Pulse	200nS
B) Minimum Command Active Time After Step Pulse	200nS
C) Minimum STEP Pulse Width	1.0uS
D) Minimum STEP Low Time	1.0uS

Step Sequencing

Table 1.

FULL	HALF	QUARTER	EIGHTH	ANGLE	NOTE:
	1	1	1	0	
			2	11.25	
		2	3	22.50	
			4	33.75	
1	2	3	5	45	HOME#
			6	56.25	
		4	7	67.50	
			8	78.75	
	3	5	9	90	
			10	101.25	
		6	11	112.50	
			12	123.75	
2	4	7	13	135	
			14	146.25	
		8	15	157.50	
			16	168.75	
	5	9	17	180	
			18	191.25	
		10	19	202.50	
			20	213.75	
3	6	11	21	225	
			22	236.25	
		12	23	247.50	
			24	258.75	
	7	13	25	270	
			26	281.25	
		14	27	292.50	
			28	303.75	
4	8	15	29	315	
			30	326.25	
		16	31	337.50	
			32	348.75	
	9 or 1	17 or 1	33 or 1	360 or 0	restart cycle

360 is 4 FULL Steps

Connectors

J1 is used for motor status/controls.

The Enable Signal (i.e. ENAX#) is pulled HIGH on-board. This signal must be pulled LOW to enable the motors.

The Sleep (i.e. SLEEPX#) is pulled HIGH on-board. This signal does not need modification for normal operations. To put the an axis into a sleep mode this must be pulled LOW.

The HOME# signal is driven active LOW when the system is driving the motor to the HOME position. This position corresponds to 45° out of a full 360°. Traversing a full 360° signifies travelling a FOUR FULL steps

J1 is a 10-pin Molex header. A controlling system can be used to enable the axes separately via ENA#, or they can be tied directly to GND. A GND pin is available on **J1** (see schematic)

J9 is used for Motor Power Supply (VBB) (Min 8.0 Volts, Max 35.0 Volts)

J8 is used for System Logic Power Supply (VCC) (5.0 Volts typical)

J15 is connected to system VBB and GND. Systems using 24V (or 12V) for motor power supply can use this connector to power a 24V (or 12V) DC fan used for improving air flow across the heat sinks (recommended for enclosed systems running higher voltage/full amperage).

J7 is used as a source for the axes STEP and DIRECTION signals. The following is a pin-to-pin correspondence a typical usage.

IDC Pin	Typical Usage	Parallel Port	DB25 Pin Number
3	STEP X	PD0	2
5	DIR X	PD1	3
7	STEP Y	PD2	4
9	DIR Y	PD3	5
11	STEP Z	PD4	6
13	DIR Z	PD5	7
10,12,14,16	GND (Pin18)	GND	18,19,20,21
18,20,22,24	GND	GND	22,23,24,25

Connectors **J10** and **J11** are used to route signals from the parallel port connector **J7** that are not used by the system. **J10** is generally used for limit switch inputs and probing options. The following is a pin-to-pin correspondence for **J10** and a typical usage.

IDC Pin	Typical Usage	Parallel Port	DB25 Pin Number	Printer Usage
25	G61SW	SELECT	13	IN
23	LIMN	PE	12	IN
19	LIMP	ACK#	10	IN

J11 has the ADDITIONAL following pin correspondences:

IDC Pin	Name	Parallel Port	DB25 Pin Number	Printer Usage
1	PPA	STROBE#	1	IN/OUT
15	PPB	PD6	8	IN/OUT
17	PPC	PD7	9	IN/OUT
21	PPD	BUSY	11	IN
2	PPE	AFEED#	14	OUT

4	PPF	ERROR#	15	IN
6	FFG	PINIT#	16	OUT
8	PPH	SLIN#	17	OUT

VCC is also available on J11 (see schematic)

Pin 26 on J7 is connected to system VCC. In most configurations, the pin will not be connected since typical IDC – DB25 adapters do not use this pin. Special designs may use this pin as a voltage source if **J8** is used to supply logic power(5 Volts), or alternatively, logic power may be fed in on this pin.

J4 is the X axis power connector
J5 is the Y axis power connector
J6 is the Z axis power connector

Setup & Operation

Before applying motor power (VBB) to connector J9, the Vref of each motor needs to be set up. The ground pad labeled (G) on the lower right hand side of the board can be used for ground reference when testing the voltage present at the TPX, TPY or TPZ. With +5V applied to **J8**, turn the appropriate potentiometer until the proper voltage has been achieved. Under no circumstances should the voltage be allowed to go above 3.60 volts, as this represent then maximum allowable current drive of 2.5 Amps. As noted above, 3.42V on Vref is a good starting voltage for 2.5Amp/phase output.

The 10 pin Molex headers **J1** has ENA# pins which must be pulled active LOW before the drives will be enabled. A single 10 pin connector tying the ENA# lines can be used if the controlling system will not be dynamically enabling and disabling the axis drives.

Never connect **or** disconnect motors, fans, etc when the drive is powered with VCC or VBB.

If the motors run backwards, swap either the A-A#, or B-B# wire pairs (but not both)

Logic Requires < 50 mA at 5.0V at **J8**

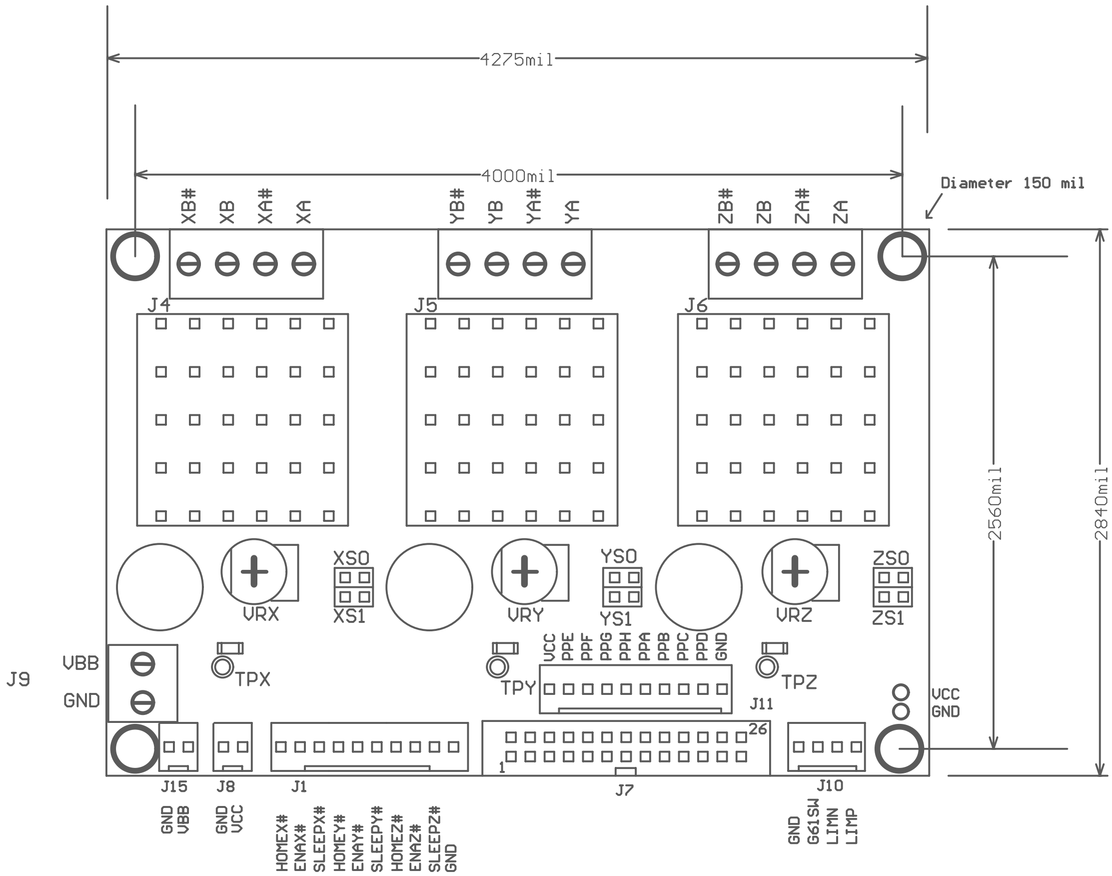
Pulling the SLEEP# input active LOW will disable the axis outputs, and stop its' charge pumps. This helps to reduce power consumption when the axis is not in use. Wait at least 1 mS when coming out of SLEEP# mode to allow the charge pumps to stabilize before issuing a STEP command. Default operations is non-SLEEP mode, and no jumpers are required to be in non-SLEEP mode

The **Heat Sinks** are attached with thermally conductive adhesive pad. The driver board is meant to operate in a **Horizontal** position. The adhesive pad has NOT been tested for holding strength when the driver board is operated in a vertical position.

At power-up, the drive puts equal current to both coil to bring it to the HOME position (see Table 1.). To do this it places ~.7 max current on each coil thus consuming ~1.4 max amps per motor. With three similar motors, this would be 1.4 * Maximum-rated current * 3. This would be the Maximum current draw at high speed running. At standstill (HOME), it will actually be much less.

Unipolar Motor Note:

When Setting Vref for a UNIPOLAR rated motor, use a current of 50.0% of the rated unipolar current, weh wired for series mode. EX: rated at 2.5A, wired in series mode would be setup for 1.25A, or Vref of 1.80 Volts. Half winding mode would use the full 2.5A rating, Vref = 3.60V.



Example settings for the X axis