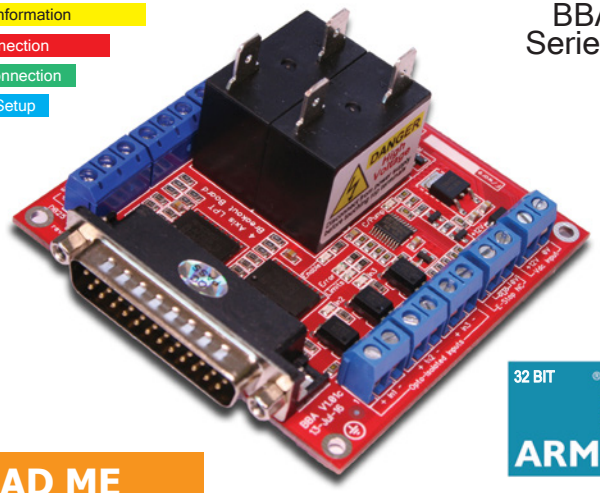
Quick Start Guide

Safety Information
PC Connection
CNC Connection
Mach3 Setup

BBA Series



Doc: BBAQSG Rev 1.0

READ ME BEFORE USE:

Machdrives CNC Breakout Board

Introduction: This guide contains four sections. Safety Information in the YELLOW section, connecting the breakout board to your PC in the RED section, connecting the breakout board to your CNC machine in the GREEN section, and setting up Mach3 in the BLUE section.

Safety Information - Read Carefully

WARNING: This device is used to control powered machinery and may cause sudden uncontrolled machine motion. You shall never place yourself, others or property in the path of the machine where machine motion could cause property damage, personal injury or death. CNC machines involve electrical and mechanical risks. Only persons suitably qualified or experienced shall install or operate this device on powered machinery. By installing and using this device you acknowledge and accept all such risks.

PC Connection

Connecting the Breakout Board to your PC is easy. Simply plug a DB25 male to female parallel cable from the board to your PC printer port. Remember to use a good quality shielded cable to block any electrical noise. Older surplus PCs with printer ports are ideal for running Mach3. USB to parallel port adapters will not work as they do not preserve the correct signal timings. You do not normally need to worry about the DB25 pin out, this is included below for customers using motion controllers other than Mach3 or doing other custom setups.

Pin	Description	Direction	Active
1	$\overline{\text{Enable}}$	PC → BB	Low
2	X Step	PC → BB	High
3	X Direction	PC → BB	High
4	Y Step	PC → BB	High
5	Y Direction	PC → BB	High
6	Z Step	PC → BB	High
7	Z Direction	PC → BB	High
8	A Step	PC → BB	High
9	A Direction	PC → BB	High

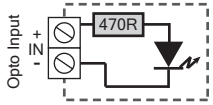
Pin	Description	Direction	Active
10	Error	PC ← BB	High
11	$\overline{\text{Opto 3}}$	PC ← BB	Low
12	$\overline{\text{Opto 2}}$	PC ← BB	Low
13	$\overline{\text{Opto1}}$	PC ← BB	Low
14	Chge Pump	PC → BB	High
15	$\overline{\text{Limits}}$	PC ← BB	Low
16	$\overline{\text{Relay 2}}$	PC → BB	Low
17	$\overline{\text{Relay 1}}$	PC → BB	Low
18+	Ground	PC ↔ BB	N/A

CNC Connection - All Drive Types

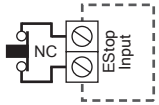
+12VDC Input: The breakout board requires a 12VDC supply to power the circuitry as well as the two relays. This can be provided from a small PSU or wall adapter, as less than 200mA is needed. If an existing PSU is used it must not share a common ground with power circuitry.

Relay Outputs: The two relays use 6.3mm spade terminals on their top surface as output connections. These are normally open (NO) and are rated at 250VAC 20A each. There are no output connections on the underside of the PCB to help meet safety clearance and creepage requirements. Remember to use insulated crimp connectors, and route power wires well away from low voltage control lines.

Opto Inputs: There are three general purpose isolated inputs that can be used to signal ON/OFF conditions to Mach3 such as a touch probe for zeroing of Z axis. Inputs are active when the plus terminal is positive with respect to the negative terminal by 5V. If higher voltages are to be used, an additional series resistor should be added to limit the ON current to around 8mA.

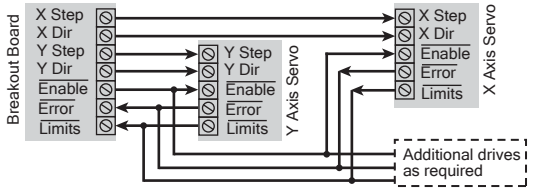


EStop Input: The EStop terminals must be shorted together for the drives and relays to operate. This is typically achieved with a normally closed latching switch. Fail-safe designs should also include an electro-mechanical device to physically remove power from motors.



CNC Connection - Machdrives Brand Servos

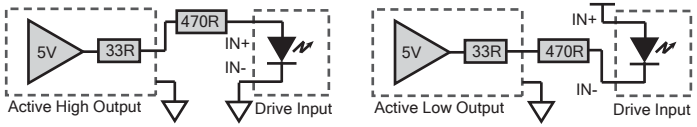
Machdrives brand servos have isolated control circuitry, so connecting up is straight forward. All the signals match exactly in name and polarity. Simpily connect up as shown.



CNC Connection - Other Brand Servo/Steppers

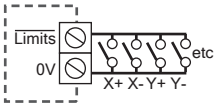
On most other brand drives the control circuitry shares the same ground as the power switches and motor. Therefore optocouplers are used to isolate the individual signals. This section does NOT apply if connecting up Machdrives brand servo drives.

Outputs: The following shows how to connect the breakout board outputs to optocouplers for both active high outputs (Step and Direction) and active low outputs ($\overline{\text{Enable}}$). Each output consists of a 5V HC245 driver with a series 33 ohm resistor. The absolute maximum sink/source current per output must not exceed 35mA. Most common optocouplers operate satisfactorily with an ON current of around 8mA.

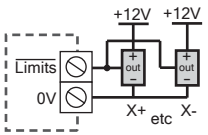


Error Input: The $\overline{\text{Error}}$ input is active low and is pulled up to +5V internally with a 4K7 resistor. If this feature is not required it should be left unconnected. To signal an error condition to Mach3 the input should be activated by pulling it low. This would normally be done with a switch or relay contacts or an NPN transistor as appropiate.

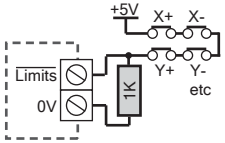
Limits Input: The $\overline{\text{Limits}}$ input is active low and is pulled up to +5V internally with a 4K7 resistor. If this feature is not required it should be left unconnected. To signal a limit condition to Mach3 the input should be activated by pulling it low. Either Normally Open (NO) or Normally Closed (NC) limit switches can be used as shown below.



Normally Open Mechanical Limit Switches in Parallel



NPN Normally Open Inductive Proximity Switches in Parallel



Normally Closed Mechanical Limit Switches in Series

Mach 3 Software Configuration - Outputs

Motor Outputs: The Step and Direction outputs go from Mach3 to the motor drives. A step occurs on the low to high transition of the step signal. A low on the Dir pin indicates axis movement in the positive direction, a high indicates movement in the negative direction. Unused axis pins can be used as general purpose outputs.

Signal	Enabled	Step Pin #	Dir Pin #	Dir Low Active	Step Low Active	Step Port	Dir Port
X Axis	✔	2	3	✖	✖	1	1
Y Axis	✔	4	5	✖	✖	1	1
Z Axis	✔	6	7	✖	✖	1	1
A Axis	✔	8	9	✖	✖	1	1

Enable Output: The Enable output goes from Mach3 to the motor drives. Enable is active low with a low level enabling the drives and a high level disabling them.

Signal	Enabled	Port #	Pin Number	Active Low
Enable 1	✔	1	1	✔

Charge Pump Output: The charge pump output is used by the breakout board to verify that Mach3 is open and running properly. This is an important safety feature that prevents incorrect signal states during Win/Mach3 startup or during application crashes or hanging. Also tick "Charge Pump on in EStop" under "General Configuration".

Signal	Enabled	Port #	Pin Number	Active Low
Charge Pump	✔	1	14	✖

General Configuration
☑ Charge Pump on in EStop

Relay Outputs: The Relay Outputs control the two 250V 20A relays on the breakout board. These are active low with a low level activating the relay and closing the contacts. These can be used for any purpose such as ON/OFF control of spindle motor, coolant pump, vacuum etc.

Signal	Enabled	Port #	Pin Number	Active Low
Output #1	✔	1	17	✔
Output #2	✔	1	16	✔

For example to use Relay 1 for spindle control, set the spindle relay "Output #" to "1" under "Relay Control" in the "Spindle Setup" tab. Likewise to use Relay 2 for coolant pump control set "Output #" to "2" under "Flood Mist Control" in the "Spindle Setup" tab.

Mach 3 Software Configuration - Inputs

EStop Input: The EStop control between the breakout board and Mach3 is active high, with a high level signaling an EStop condition.

Signal	Enabled	Port #	Pin Number	Active Low	Emulated	HotKey
EStop	✔	1	10	✖	✖	0

Opto Inputs: General purpose isolated inputs are available on pins 13, 12 and 11. These are active low and can be used to signal an input condition change to Mach3. The example below shows how to configure Opto 1 input (pin 13) as a touch probe for zeroing the Z axis.

Signal	Enabled	Port #	Pin Number	Active Low	Emulated	HotKey
Probe	✔	1	13	✔	✖	0

Limit/Home Inputs: All limit and home inputs are passed in to Mach3 on pin 15. This input is active low, with a low level indicating a limit or home position has been reached. The example below show limits and home configured for the X, Y and Z axes with the A axis not being used.

Signal	Enabled	Port #	Pin Number	Active Low	Emulated	HotKey
X ++	✔	1	15	✔	✖	0
X --	✔	1	15	✔	✖	0
X Home	✔	1	15	✔	✖	0
Y ++	✔	1	15	✔	✖	0
Y --	✔	1	15	✔	✖	0
Y Home	✔	1	15	✔	✖	0
Z ++	✔	1	15	✔	✖	0
Z --	✔	1	15	✔	✖	0
Z Home	✔	1	15	✔	✖	0
A ++	✖	1	0	✖	✖	0

Input Debounce/Noise: The printer cable between the breakout board and the PC can pick up noise from motors and switching that may cause false signals. This can be prevented by setting the "Debounce Interval" in the "Inputs Signal Debouncing/Noise rejection" section on the "General Configuration" page. 20ms (500 x 40us) works well.

Inputs Signal Debouncing/Noise rejection
Debounce Interval: 500 x 40us