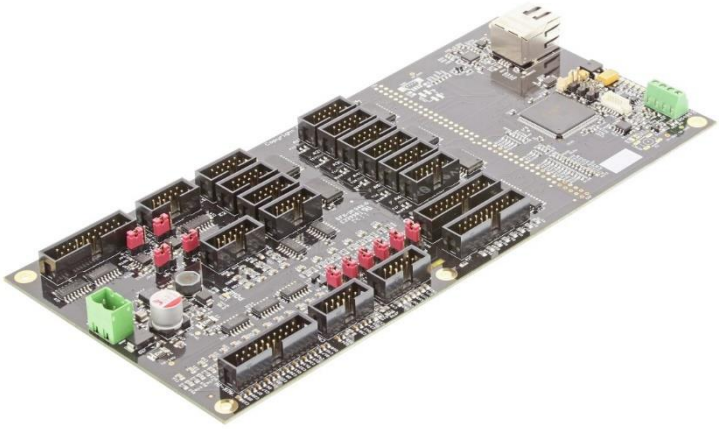
Hardware Manual

CNC760

Revision 7 19 March, 202020

Released



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History:

Revision	Date	Author
1	22-5-2017	AB
2	23-6-2017	AB
3	6-12-2017	AB
4	22-2-2018	AB
5	23-10-2018	AB
6	12-2-2020	JH
7	19-3-2020	AB

Revision overview:

Revision	Remarks
1	Initial version.
2	Fixed typo's in AUX-IN overview
3	Correcting pinning HOME connector
4	Correcting ALM+/- on axis outputs. Added clarifications.
5	Added clarification about use of NPN/PNP home inputs
6	Updated descriptions
7	Added timing info about Charge Pump

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1 Introduction

1.1 Purpose

This manual describes the hardware of the CNC760.

The CNC760 is a 6-asix CNC controller with additional 4 extruder controllers. The basic specification is:

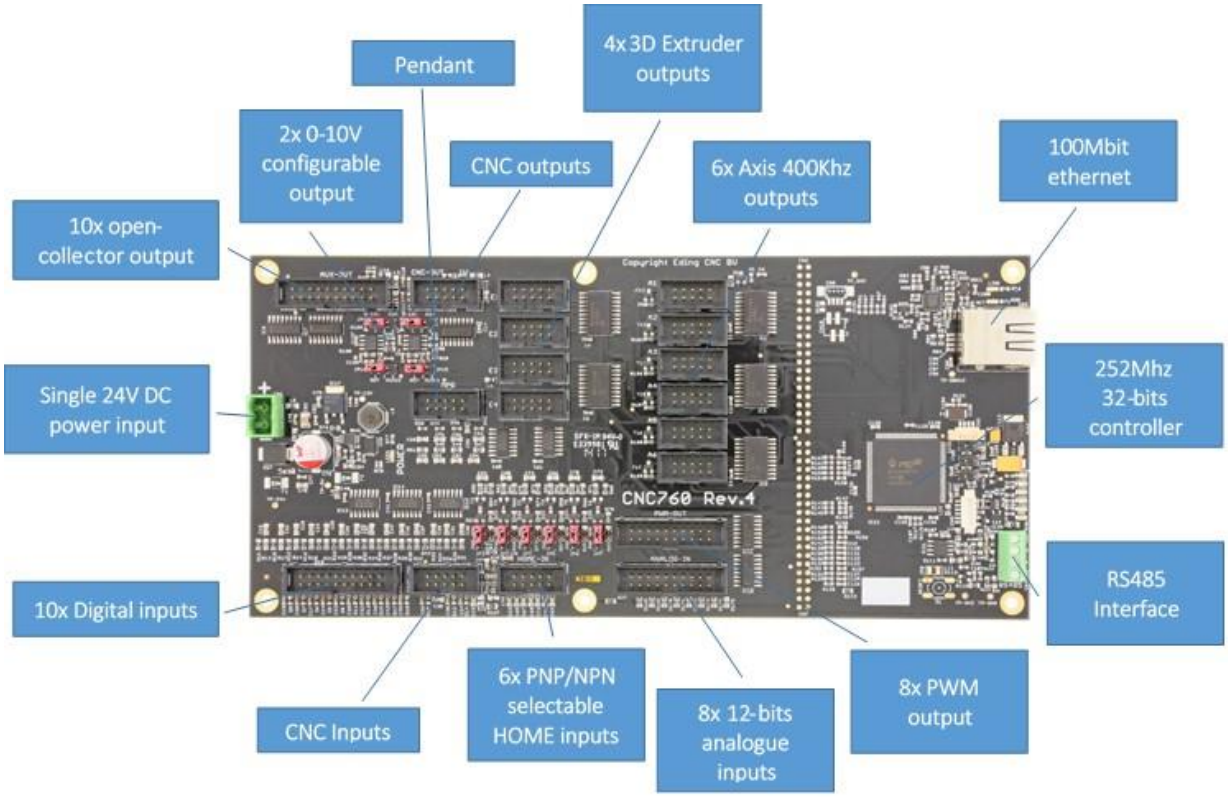
6x axis controller interface	Pulse/Direction	5V (max. 400Khz)
	Enable	5V or open-collector (max. 24V)
	Alarm	
4x extruder interface	Enable/Direction/Step	5V
6x digital HOME inputs	24V	
10x digital outputs	Open collector (max. 24V)	
10x digital inputs	24V	
8x analog inputs	0-3.3v (12 bits)	
2x analog outputs	0-10V	
2x cooling outputs	Open collector (max. 24V)	
8x PWM outputs	Open collector (max. 24V)	
Safety relay I/O	Output System Ready	Output for safety relay (Watchdog) Open Collector
	Input External Error	24V
	Input E-Stop	24V
1x Length detection input (Probe)	24V	
1x Spindle encoder input	5V input	
1x RS485 interface	RS485, MODBUS compatible (for connecting extra I/O or functionality, cable length up to 20m)	
Handwheel interface (Pendant)	2x digital input	5V
	2x MPG input	5V
	2x dedicated analog input	0-3.3V
Interface	100Mbit Ethernet	
Power Supply	24VDC	
Dimension	230x107mm (suitable for DIN rail mounting)	
Others	Firmware upgradable through network connection	

1.2 Scope

This document describes the hardware of the CNC760.

2 Board overview

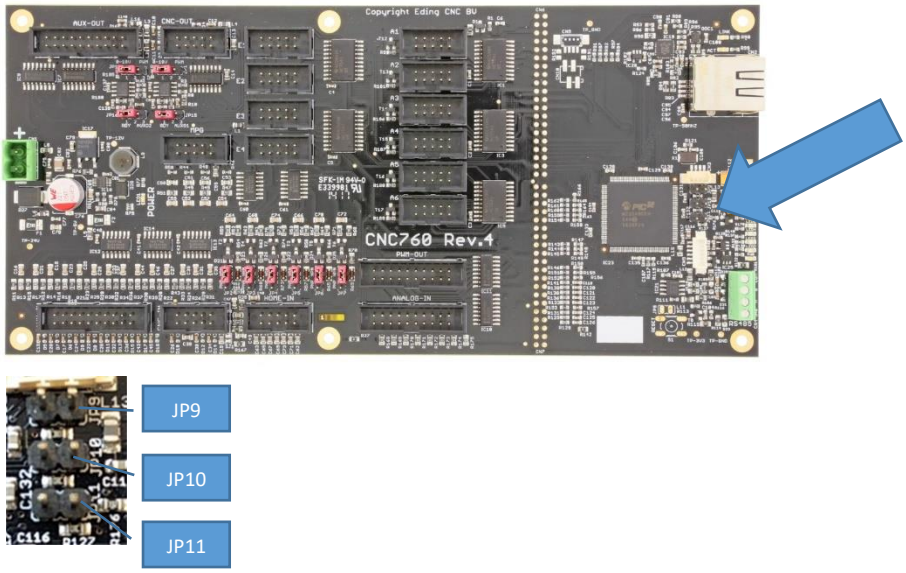
The image below shows an overview of the CNC760.



3 Board jumpers and indicators

3.1 JP9, JP10, JP11

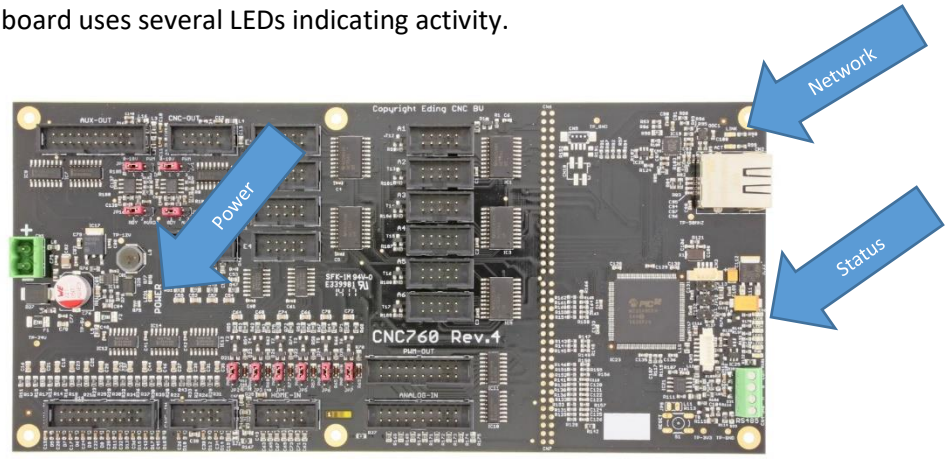
With these jumpers, several settings can be forced:



JP9	Reserved
JP10	Startup with default IP address 172.22.2.100
JP11	Skip bootloader

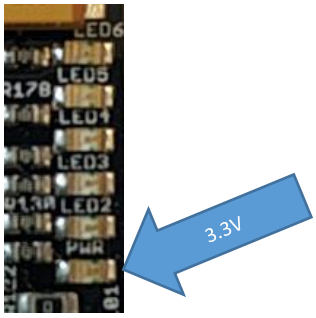
3.2 LED indications (LED2-LED6)

The board uses several LEDs indicating activity.



Power LEDs:

LED1: indicates that the external power is connected, this means that 24V and 5V are available.



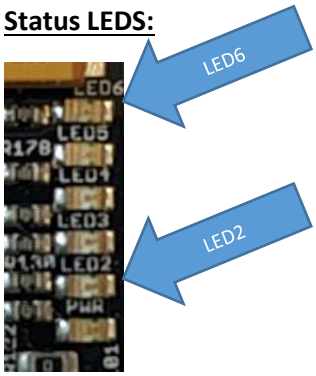
PWR: this LED indicates that the power for the processor is available (3.3V).

Network LEDs:

Yellow = Network activity

Green = Network connection

Status LEDS:



LED6	RED	SYSREADY, indicates when CNC system is ready for operation. Can be used in cooperation with safety relay.
LED5	RED	WATCHDOG charge pump, indicates operation of the watchdog circuitry
LED4	GREEN	Controller 'heartbeat' indicating the board is active
LED3	GREEN	Indicates 'Machine On'
LED2	GREEN	Flashing when application is starting up. After startup, will be switch ON if E-STOP occurred.

Please note, when in bootloader mode LED2 and LED3 will toggle to indicate this.

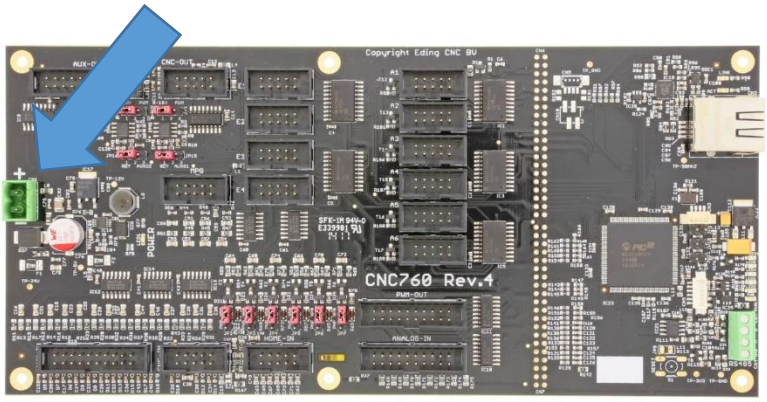
4 Connectors

4.1 Power

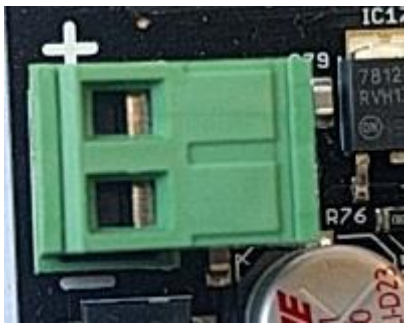
The voltage of the supplied power is 24V DC.

Warning: Due to a protection diode at the input the 24V, that is available on some connectors, will be a bit lower, please check when connecting 24V devices to that connector if they will operate correctly.

Warning: Although the 24V is also available on numerous connectors, it is advisable to use separate wiring for powering 24V devices if much current is needed.



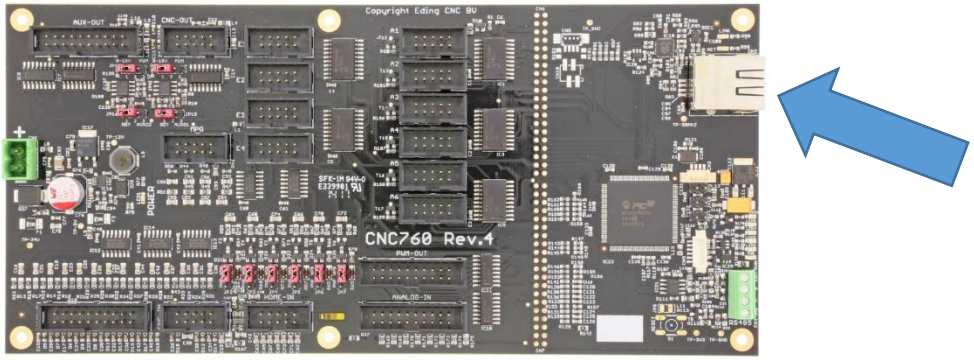
The image below shows the power connector.



Warning: Check the polarity of the power, damage to the board may occur if the polarity is reversed.

4.2 Network

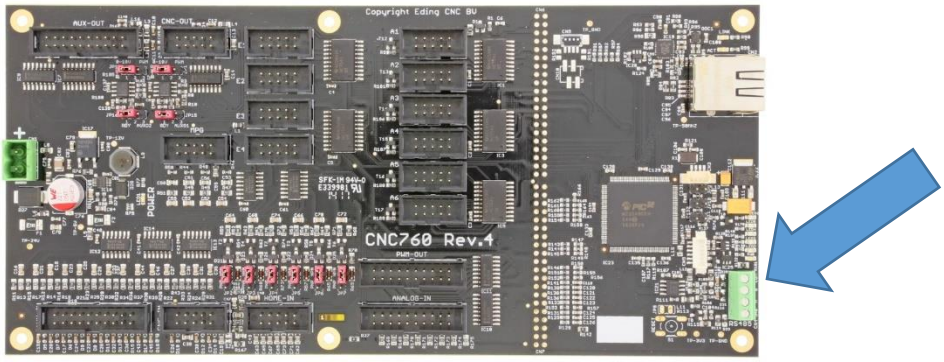
The board needs to be connected via *cross* cable of type CAT5 or CAT5E. We advise to use properly shielded network cables type SF/UTP. The default IP address is 172.22.2.100.



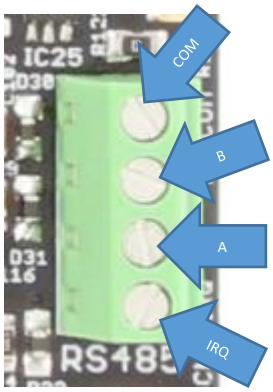
Note: Make sure that the PC that the board is connected to is correctly setup and has the correct IP address, make sure there is no IP address conflict.

4.3 RS485

Via the RS485 connector external hardware can be connected. RS485 is a balanced signal, this decreases susceptibility to interference. The protocolled that is used is MODBUS.



The image below shows a close-up of the connector.

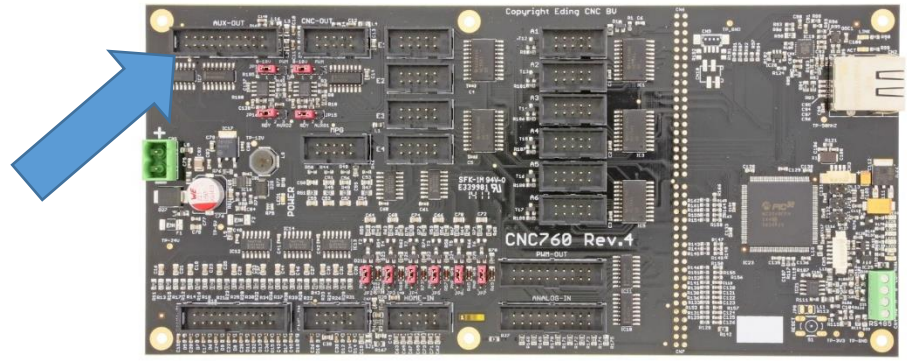


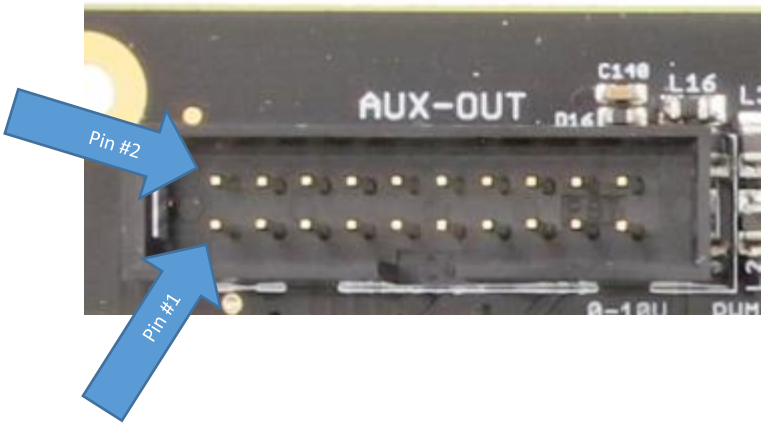
The connector consists out of 4 signals:

COM	Common	
B	Balanced signal	
A		
IRQ	IRQ	Input for external interrupt

4.4 AUX-OUT

The auxiliary outputs can be used for switching external devices.





Below an overview of all connections of this connector:

Pin #	Name	Direction	Type	Function	Electrical Spec.	Remarks
1	GND		GROUND			
2	GND		GROUND			
3	AUX OUT1	OUTPUT	Open Collector	Aux Output 1	Max. rating 50V/500mA	Optional used for controlling 0-10V output1
4	SYSRDY	OUTPUT	Open Collector	System Ready	Max. rating 50V/500mA	System Ready, indicates that system is ready for operation.
5	AUX OUT2	OUTPUT	Open Collector	Aux Output 2	Max. rating 50V/500mA	Optional used for controlling 0-10V output2
6	AUX OUT9	OUTPUT	Open Collector	Aux Output 9	Max. rating 50V/500mA	Shared with AEE3
7	AUX OUT3	OUTPUT	Open Collector	Aux Output 3	Max. rating 50V/500mA	
8	AUX OUT10	OUTPUT	Open Collector	Aux Output 10	Max. rating 50V/500mA	Shared with AEE4
9	AUX OUT4	OUTPUT	Open Collector	Aux Output 4	Max. rating 50V/500mA	
10	GND		GROUND			
11	AUX OUT5	OUTPUT	Open Collector	Aux Output 5	Max. rating 50V/500mA	
12	GND		GROUND			
13	AUX OUT6	OUTPUT	Open Collector	Aux Output 6	Max. rating 50V/500mA	
14	GND		GROUND			
15	AUX OUT7	OUTPUT	Open Collector	Aux Output 7	Max. rating 50V/500mA	Shared with AEE1
16	PWM-VOLT2	OUTPUT	*PWM or 0-10V, see also 'Configuring the analogue outputs'*			
17	AUX OUT8	OUTPUT	Open Collector	Aux Output 8	Max. rating 50V/500mA	Shared with AEE2
18	GND		GROUND			
19	+24V		POWER		+24V/1A	
20	+24V		POWER		+24V/1A	

Warning: The total combined current of the 24V outputs should not exceed 1A

The auxiliary outputs are *open-collector* outputs. An open-collector output means it switches the connected wire to GND. This enables the user to switch devices that do not need the same voltage rating as the controller has.

In the image below such an output is shown.

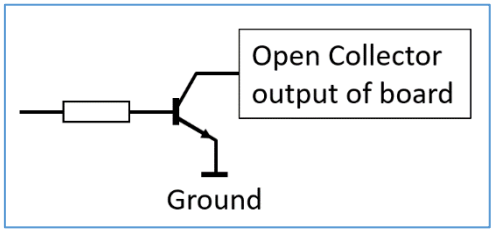


Figure 1 Open collector output.

This output can directly be used, for example, to switch a relay. If a logic signal is needed a pull-up resistor is required.

Please note, an open-collector output *cannot* be measured with e.g. a multimeter, to test an output connected a 10k resistor between output and +5V or 24V, now you should be able to measure this output switching.

Warning: Connecting an open-collector output directly to a positive voltage e.g. 24V will cause a short-circuit damaging the board.

The drawing below shows how an open-collector output connector can be used to create different output signal levels by using a pull-up resistor. The value of this resistor can vary depending on the load of the output. Typical values are 4.7k or 10k.

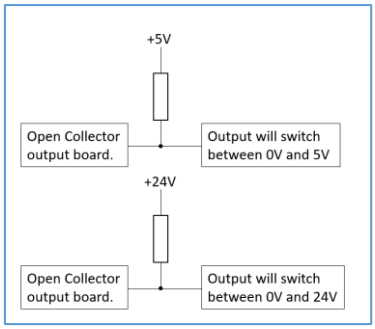


Figure 2 Creating different output levels with open-collector output.

With open collector output it is very simple to use a relay in order to switch bigger loads. Connecting a relay is shown in the drawing below.

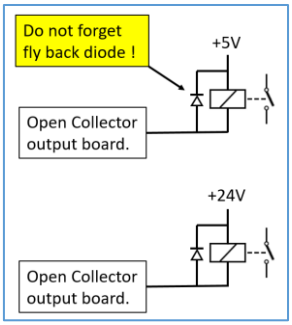


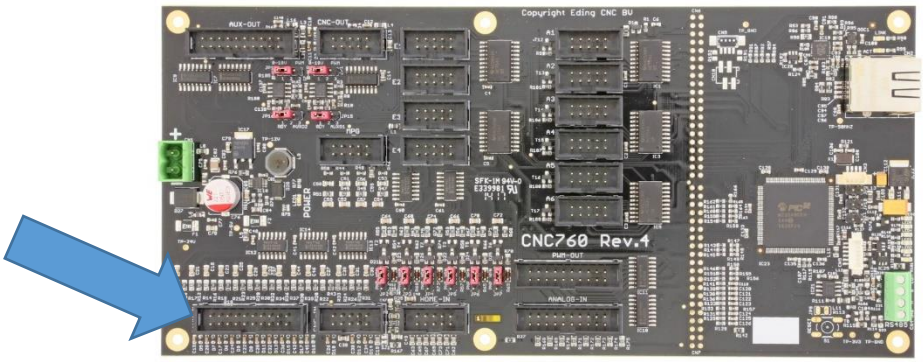
Figure 3 Connecting a relay to an open collector output.

In the above example a 5V relay and 24V relay is used, both will switch. However please consider that a 5V relay will need more current to switch. This can limit the total number of used relays because of the maximum total current that can be switched.

Also, ***VERY important*** is it to use a fly back diode. This is necessary to limit spikes that occur when switching a relay. A typical diode that is used is e.g. 1N4007.

4.5 AUX-IN

The auxiliary inputs are digital inputs, used to retrieve the status of an external signal, for example a switch.



Each input has a pull-down, this means that when no signal is connector the board will see a 'low' signal. Connecting an input to 24V will cause the board to detect an 'high' signal.

Pin #	Name	Direction	Type	Function	Electrical Spec.	Remarks
1	GND		GROUND			
2	GND		GROUND			
3	AUX IN1	INPUT	Digital in	Aux Input 1	Input voltage 24V	
4	GND		GROUND			
5	AUX IN2	INPUT	Digital in	Aux Input 2	Input voltage 24V	
6	AUX IN9	INPUT	Digital in	Aux Input 9	Input voltage 24V	
7	AUX IN3	INPUT	Digital in	Aux Input 3	Input voltage 24V	
8	AUX IN10	INPUT	Digital in	Aux Input 10	Input voltage 24V	
9	AUX IN4	INPUT	Digital in	Aux Input 4	Input voltage 24V	
10	GND		GROUND			
11	AUX IN5	INPUT	Digital in	Aux Input 5	Input voltage 24V	
12	GND		GROUND			
13	AUX IN6	INPUT	Digital in	Aux Input 6	Input voltage 24V	
14	GND		GROUND			
15	AUX IN7	INPUT	Digital in	Aux Input 7	Input voltage 24V	
16	GND		*GROUND*			
17	AUX IN8	INPUT	Digital in	Aux Input 8	Input voltage 24V	
18	GND		GROUND			
19	+24V		POWER		+24V/1A	
20	+24V		POWER		+24V/1A	

Warning: The total combined current of the 24V outputs should not exceed 1A

In the image below, you see the input circuit for each AUX input.

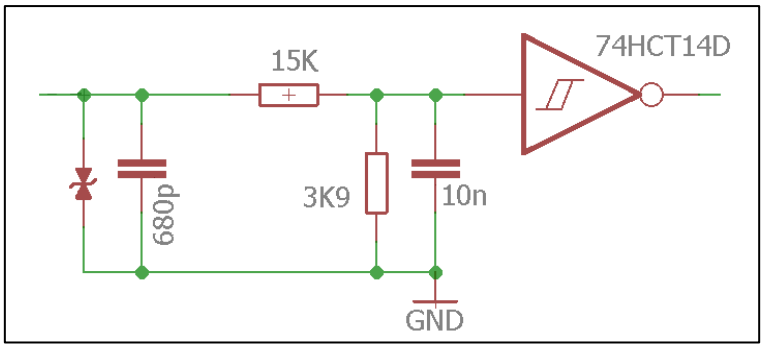


Figure 4. AUX input circuit.

The image shows how to connect a switch to an AUX input:

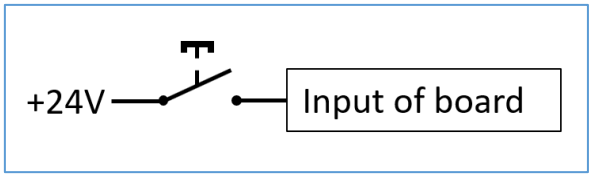
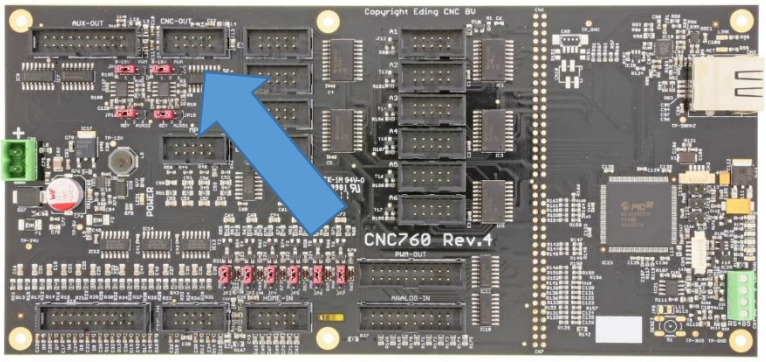
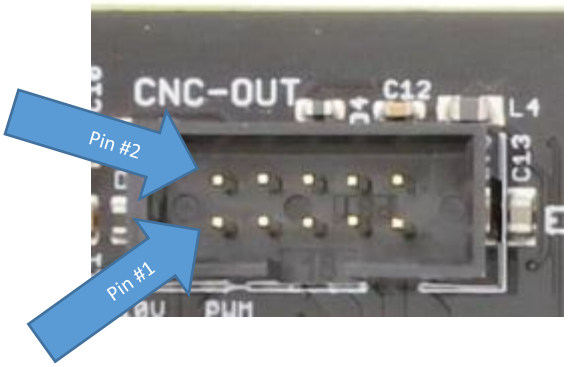


Figure 5 Connecting a switch to an AUX input.

4.6 CNC-OUT

The CNC-OUT signals are output signals and are typical related to controlling the CNC functionality.





Below an overview of all connections of this connector:

Pin #	Name	Direction	Type	Function	Electrical Spec.	Remarks
1	PWM-VOLT1	Output	*PWM or 0-10V, see also 'Configuring the analogue outputs'*			
2	SYSRDY	Output	Open Collector	System Ready	Max. rating 50V/500mA	System Ready, indicates that system is ready for operation.
3	TOOLON	Output	Open Collector	Switch tool ON (eg. Spindle)	Max. rating 50V/500mA	
4	TOOLDIR	Output	Open Collector	Set tool direction	Max. rating 50V/500mA	
5	COOL2	Output	Open Collector	Coolant2 signal	Max. rating 50V/500mA	
6	COOL1	Output	Open Collector	Coolant1 signal	Max. rating 50V/500mA	
7	+24V		Power		+24V/1A	
8	Charge Pump	Output	Open Collector	Watchdog signal	Max. rating 50V/500mA	Pulsed signal
9	+5V	Output	Power		5VDC/500mA	
10	GND		Ground			

Warning: Connecting an open-collector output directly to a positive voltage e.g. 24V will cause a short-circuit damaging the board.

Warning: The total combined current of the 24V outputs should not exceed 1A

In the image below such an output is shown. An open-collector output means it switches the connected wire to GND. This enables the user to switch devices that do not need the same voltage rating as the controller has.

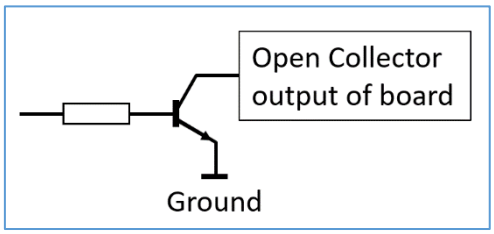


Figure 6 Open collector output.

The drawing below shows how an open-collector output connector can be used to create different output signal levels by using a pull-up resistor. The value of this resistor can vary depending on the load of the output. Typical values are 4.7k or 10k.

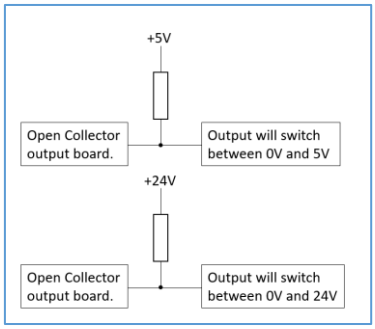


Figure 7 Creating different output levels with open-collector output.

With open collector output it is very simple to use a relay in order to switch bigger loads. Connecting a relay is shown in the drawing below.

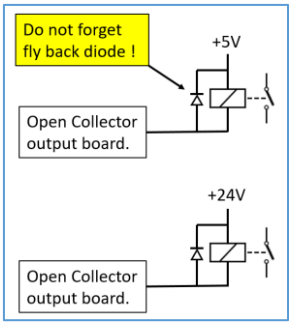


Figure 8 Connecting a relay to an open collector output.

In the above example a 5V relay and 24V relay is used, both will switch. However please consider that a 5V relay will need more current to switch. This can limit the total number of used relays because of the maximum total current that can be switched.

Also, ***VERY important*** is it to use a fly back diode. This is necessary to limit spikes that occur when switching a relay. A typical diode that is used is e.g. 1N4007.

4.6.1 Charge pump vs System Ready

The Charge Pump signal is a signal of about 10Hz with a 50% duty cycle. This signal is active if the controller is activated through the PC software. The image below shows this signal.

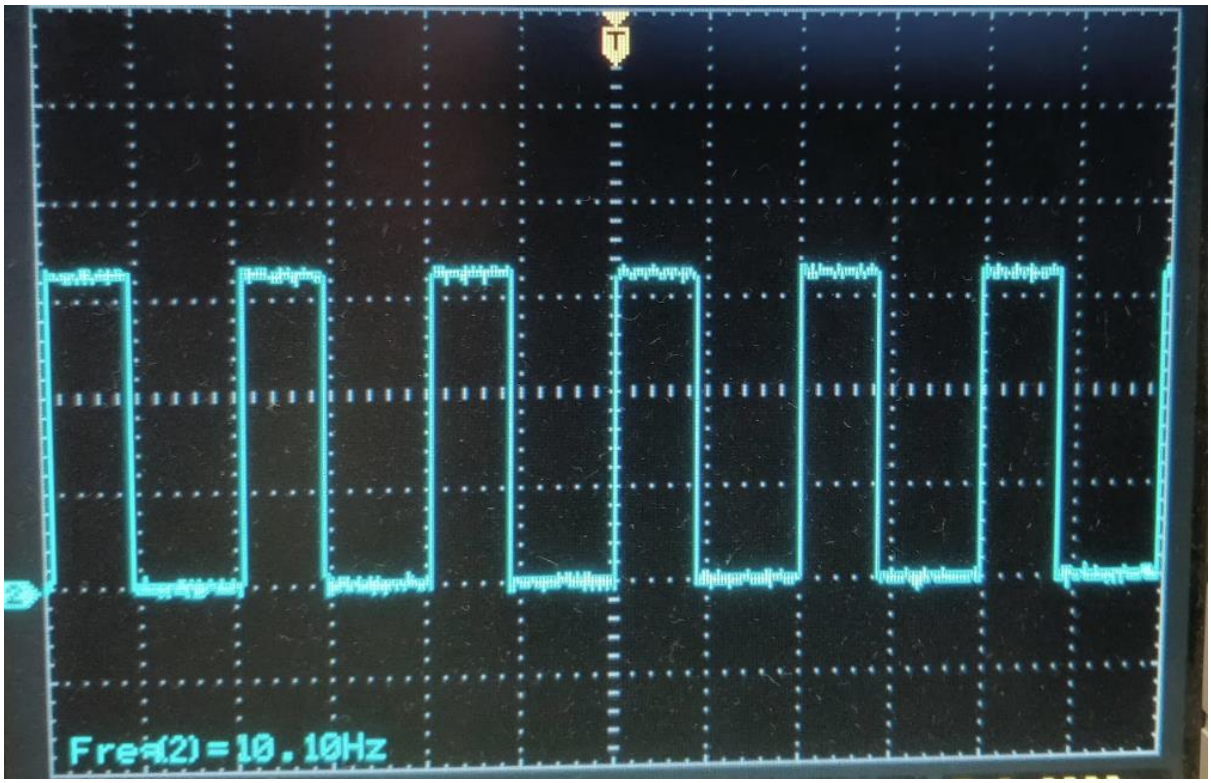


Figure 9 Charge pump signal.

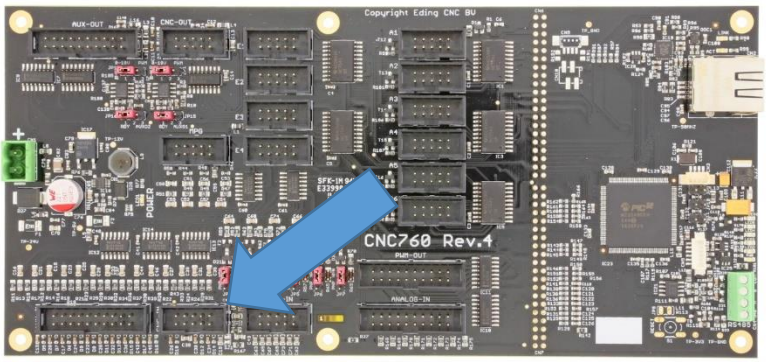
This signal can be used eg. for external control of a safety circuitry.

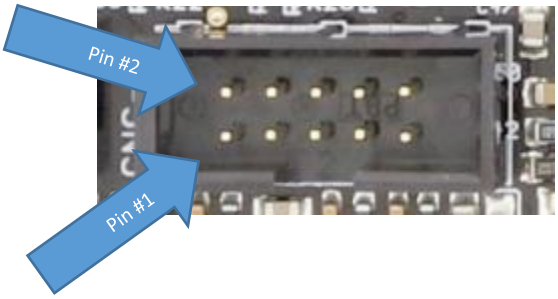
Please note, the frequency of this signal can vary if the controller is moving axis. In that case the frequency can go down to about 7.3 Hz.

The use of this signal is not recommended, instead we integrated a hardware solution which is the SYSTEM READY signal. This solution uses the Charge Pump signal so will also indicate when the controller is active. However, it is not influenced by activity of the controller. Since the SYSTEM READY signal is generated in hardware instead of software it is safe to use that signal to indicate that the system is operational. So even if the board somehow would stop working the circuitry will switch off this output.

4.7 CNC-IN

The CNC-IN signals are CNC related inputs.





Below an overview of all connections of this connector:

Pin #	Name	Direction	Type	Function	Electrical Spec.	Remarks
1	PROBE	Input	Digital	Input signal for external probe signal	Max. input voltage 24V	Active low
2	SPINDLEX	Input	Digital		Max. input voltage 5V	Active low
3	ESTOP	Input	Digital	External EMERGENCY STOP signal	Max. Input voltage 24V	
4	EXTERR	Input	Digital	External ERROR signal	Max. Input voltage 24V	
5	PROBE	Input	Digital			Shared with pin #1
6	SPINDLEA	Input	Digital	Signal A input	Max. Input voltage 5V	Active low
7	+24V		POWER		+24V/1A	
8*	SPINDLEB/GND	Input/Ground	Digital	Signal B input	Max. Input voltage 5V	Active low
9	+24V		POWER		+24V/1A	
10	GND		Ground			

Warning: The total combined current of the 24V outputs should not exceed 1A.

Note, pin #8 can be connected to Ground for backward compatibility by removing resistor R167, and closing the pads of SJ1

Please not that PROBE, ESTOP and EXTERR requires input signals of 24V, however SPINDLEX, SPINDLEA and SPINDLEB have *maximum* input levels of 5V, and are damaged if 24V is connected.

Below the input circuit is shown for both types:

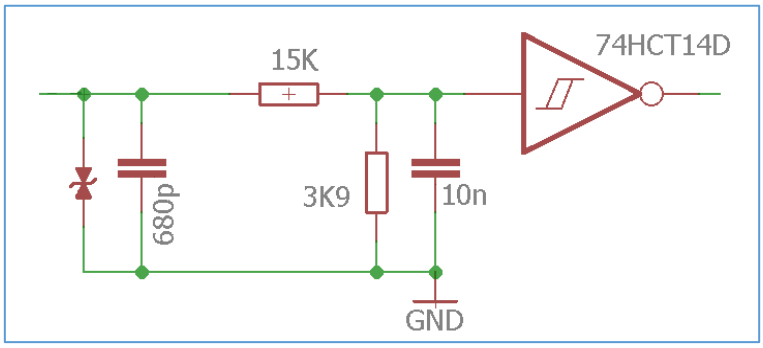


Figure 10 Input circuit of PROBE, ESTOP, EXTERR.

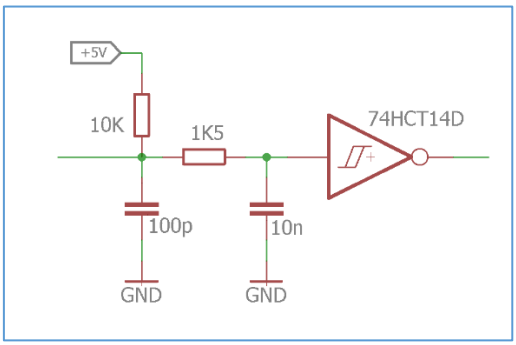


Figure 11 Input circuit SPINDLEX, SPINDLEA and SPINDLEB.

For using the PROBE, ESTOP or EXTERR the input signal needs to switch to 24V, in the image below this is shown.

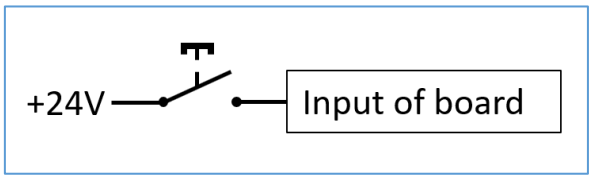


Figure 12. Input signal for PROBE, ESTOP and EXTERR.

Using SPINDLEX, SPINDLEA, SPINDLEB the input signal needs to switch to ground to be active. The image below shows this.

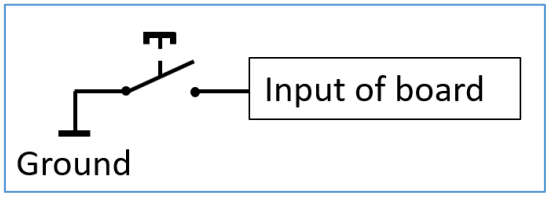
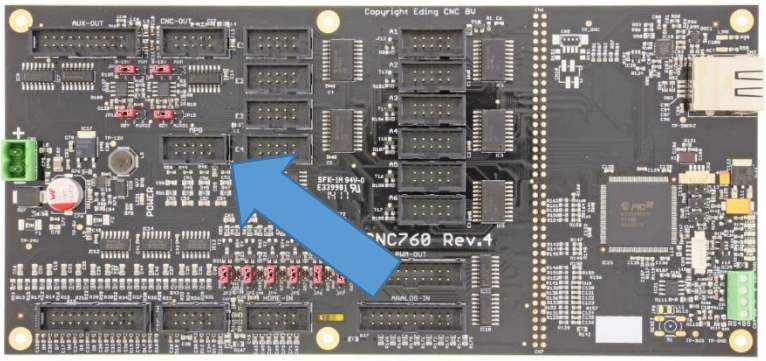
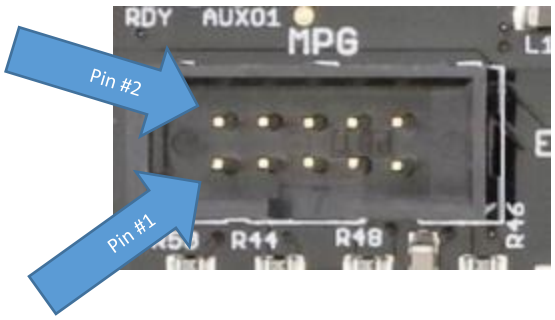


Figure 13 Input signal for SPINDLEX, SPINDLEA and SPINDLEB.

4.8 MPG

The MPG connectors makes it possible to connect directly a wired pendant to the controller.





Below an overview of all connections of this connector:

Pin #	Name	Direction	Type	Function	Electrical Spec.	Remarks
1	AN7	Input	Analogue	Analogue input for additional selections	Max. Input voltage 3.3V	This is actual AN7, so not an extra analog input
2	PAUSE	Input	Digital	Pause switch	Max. Input Voltage 5V	Active low
3	HW-A	Input	Digital	Handwheel A input	Max. Input voltage 5V	
4	RUN	Input	Digital	Run switch	Max. Input voltage 5V	Active low
5	HW-B	Input	Digital	Handwheel B input	Max. Input voltage 5V	
6	AN8	Input	Analogue	Analogue input for additional selections	Max. Input voltage 3.3V	This is actual AN8, so not an extra analog input
7	+3.3V	Output	Power		+3.3V/100mA	
8	GND		Ground			
9	+5V	Output	Power		+5V/500mA	
10	GND		Ground			

Note, 3.3V on pin #7 not present on revision 4 of hardware.

The analogue inputs AN7 & AN8 can be used to have extra selection for axis and multiplication factor.

In the image below is a schematic of each ***digital*** input:

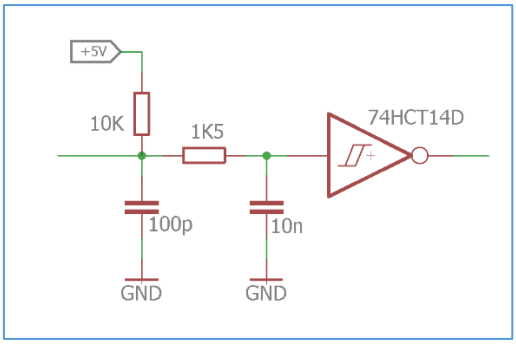


Figure 14 Pendant digital inputs schematic.

Using the PAUSE or RUN input is simply connecting a push button to it, with one side connected to GROUND and the other to the input of the board.

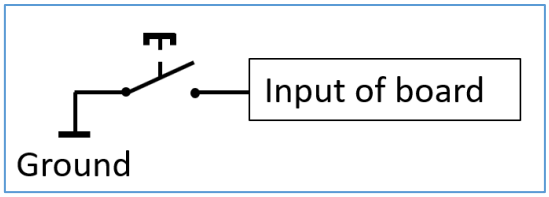
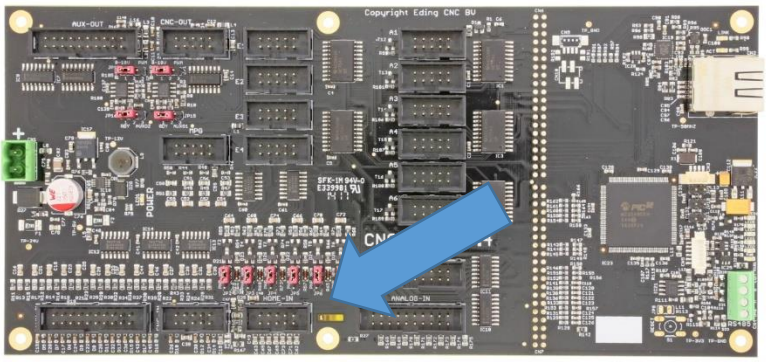
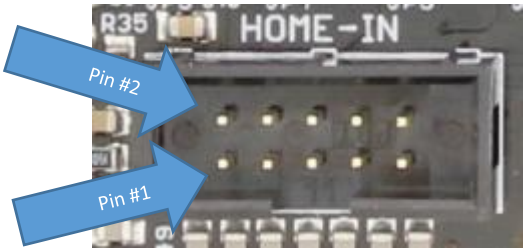


Figure 15 Connecting switch to PAUSE or RUN input.

4.9 HOME-IN

The HOME inputs are required for the machine to be able to detect the 'home' position.





Below an overview of all connections of this connector:

Pin #	Name	Direction	Type	Function	Electrical Spec.	Remarks
1	HOME1	Input	Digital	Home input 1	Max. input Voltage 24V	
2	HOME4	Input	Digital	Home input 4	Max. input Voltage 24V	
3	HOME2	Input	Digital	Home input 2	Max. input Voltage 24V	
4	HOME5	Input	Digital	Home input 5	Max. input Voltage 24V	
5	HOME3	Input	Digital	Home input 3	Max. input Voltage 24V	
6	HOME6	Input	Digital	Home input 6	Max. input Voltage 24V	
7	+24V		POWER		+24V/1A	
8	GND		Ground			
9	Reserved					Do not connect
10	GND		Ground			

Warning: The total combined current of the 24V outputs should not exceed 1A.

The home-input can be configured into two modes, each mode describes what type of switch or sensor is connected. If the switch or sensor is activated, it means that it will switch either to ground (0V) or to a voltage, in this case 24V. A switch or sensor that switches to 0 (negative) is called NPN, a switch or sensor that switches to 24V (positive) is called PNP.

PNP = Input should be 'HIGH' (24V) to detect the switch/sensor being activated.

NPN = Input should be 'LOW' (0V) to detect the switch/sensor being activated.

*Please note, that ALL home inputs are **EITHER** NPN or PNP. Currently it is **not possible** to mix the inputs types.*

This mode selection is done via several jumpers:

The *default* settings are NPN.

Each jumper corresponds to an input:

Jumper	Input
JP2	Home input 1
JP3	Home input 2
JP4	Home input 3
JP5	Home input 4
JP6	Home input 5
JP7	Home input 6

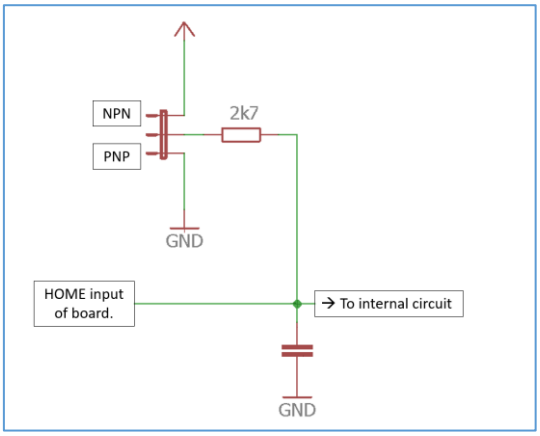


Figure 16 Input circuit of HOME input.

Switching in NPN mode:

When in NPN mode the input needs to switch to ground to be activated.

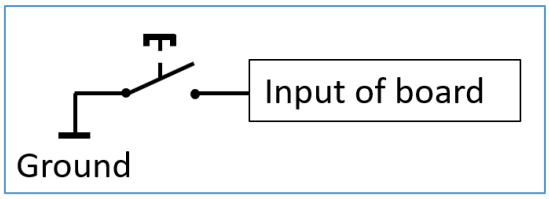


Figure 17 Switching HOME input in NPN mode.

Switching in PNP mode:

When in PNP mode the inputs need to switch to +24V to be activated.

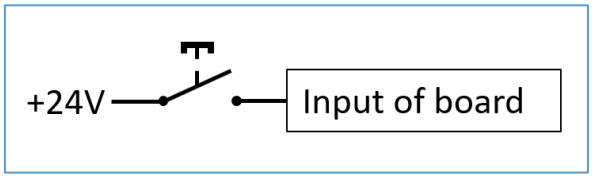
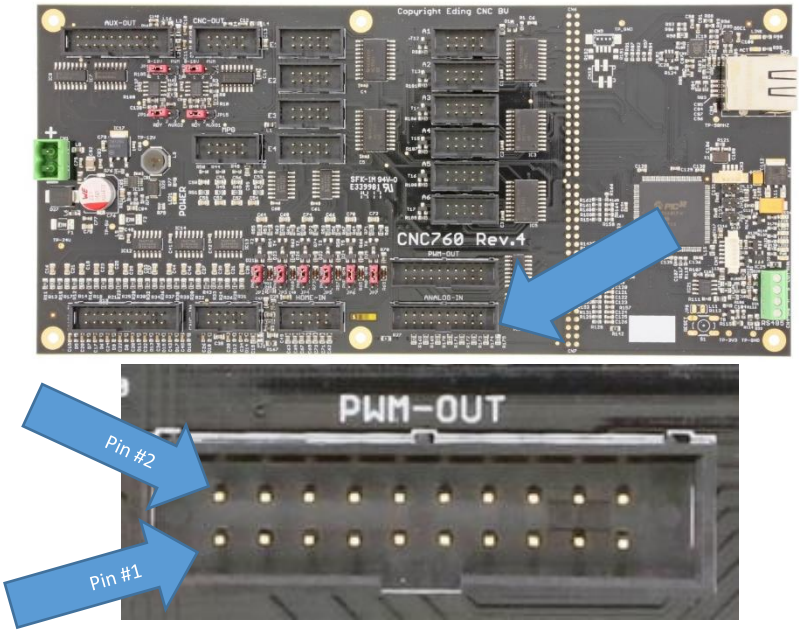


Figure 18 Switching HOME input in PNP mode.

4.10 PWM-OUT

The PWM outputs enable the user to add extra control of devices that use PWM signals for control.



Below an overview of all connections of this connector:

Pin #	Name	Direction	Type	Function	Electrical Spec.	Remarks
1	GND		Ground			
2	GND		Ground			
3	PWM1	Output	Open Collector	PWM Output 1	Max. rating 50V/500mA	Also used for generating 0-10V output1
4	SYSRDY	Output	Open Collector	System Ready	Max. rating 50V/500mA	System Ready, indicates that system is ready for operation.
5	PWM2	Output	Open Collector	PWM Output 2	Max. rating 50V/500mA	Also used for generating 0-10V output2
6	GND		Ground			
7	PWM3	Output	Open Collector	PWM Output 3	Max. rating 50V/500mA	
8	GND		Ground			
9	PWM4	Output	Open Collector	PWM Output 4	Max. rating 50V/500mA	
10	GND		Ground			
11	PWM5	Output	Open Collector	PWM Output 5	Max. rating 50V/500mA	
12	GND		Ground			
13	PWM6	Output	Open Collector	PWM Output 6	Max. rating 50V/500mA	
14	GND		Ground			
15	PWM7	Output	Open Collector	PWM Output 7	Max. rating 50V/500mA	
16	GND		Ground			
17	PWM8	Output	Open Collector	PWM Output 8	Max. rating 50V/500mA	
18	GND		Ground			
19	+24V		POWER		+24V/1A	
20	+24V		POWER		+24V/1A	

Warning: Connecting an open-collector output directly to a positive voltage eg. 24V will cause a short-circuit damaging the board.

Warning: The total combined current of the 24V outputs should not exceed 1A

The PWM outputs are *open-collector* outputs. An open-collector output means it switches the connected wire to GND. This enables the user to switch devices that do not need the same voltage rating as the controller has.

In the image below such an output is shown.

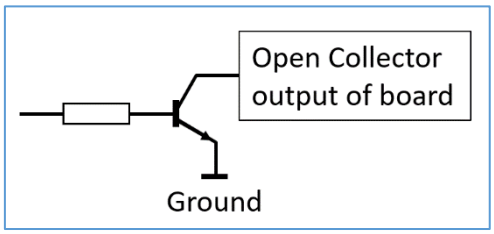


Figure 19 Open collector output.

This output can directly be used, or if a logic signal is needed a pull-up resistor is required.

Please note, an open-collector output *cannot* be measured with e.g. a multimeter, to test an output connected a 10k resistor between output and +5V or 24V, now you should be able to measure this output switching.

Warning: Connecting an open-collector output directly to a positive voltage e.g. 24V will cause a short-circuit damaging the board.

The drawing below shows how an open-collector output connector can be used to create different output signal levels by using a pull-up resistor. The value of this resistor can vary depending on the load of the output. Typical values are 4.7k or 10k.

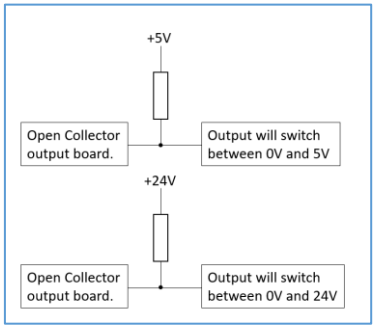
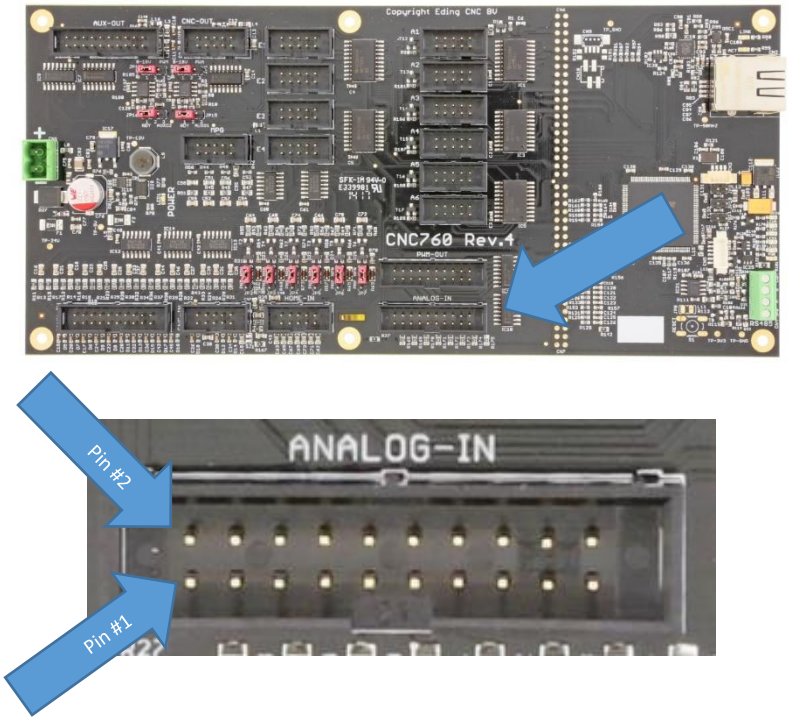


Figure 20 Creating different output levels with open-collector output.

4.11 ANALOG-IN

The analog inputs can be used to capture input voltages. The maximum voltage is 3.3V, make sure you do not exceed this limit as it will damage this input, or even the rest of the board.



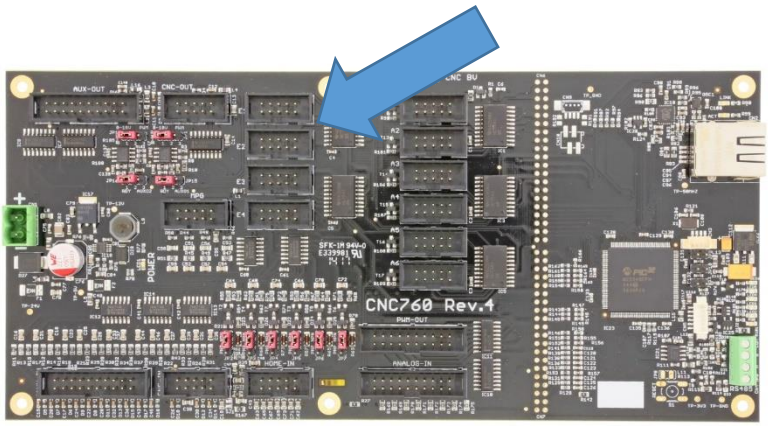
Below an overview of all connections of this connector:

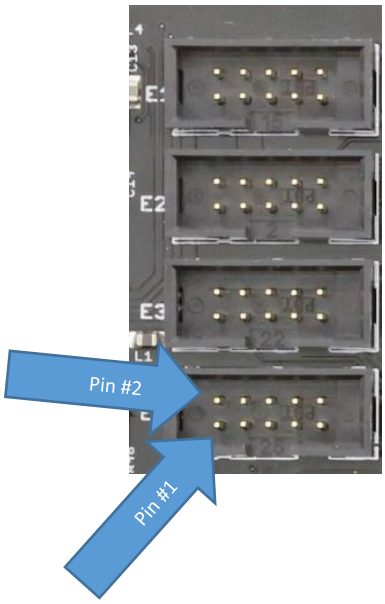
Pin #	Name	Direction	Type	Function	Electrical Spec.	Remarks
1	GND		Ground	Ground		
2	GND		Ground	Ground		
3	AN1	Input	Analogue	Analog input 1	Max. input voltage 3.3V	Pulled down with 100k resistor
4	Reserved					Do not connect
5	AN2	Input	Analogue	Analog input 2	Max. input voltage 3.3V	Pulled down with 100k resistor
6	GND		Ground	Ground		
7	AN3	Input	Analogue	Analog input 3	Max. input voltage 3.3V	Pulled down with 100k resistor
8	GND		Ground	Ground		
9	AN4	Input	Analogue	Analog input 4	Max. input voltage 3.3V	Pulled down with 100k resistor
10	GND		Ground	Ground		
11	AN5	Input	Analogue	Analog input 5	Max. input voltage 3.3V	Pulled down with 100k resistor
12	GND		Ground	Ground		
13	AN6	Input	Analogue	Analog input 6	Max. input voltage 3.3V	Pulled down with 100k resistor
14	GND		Ground	Ground		
15	AN7	Input	Analogue	Analog input 7	Max. input voltage 3.3V	Pulled down with 100k resistor
16	GND		Ground	Ground		
17	AN8	Input	Analogue	Analog input 8	Max. input voltage 3.3V	Pulled down with 100k resistor
18	GND		Ground	Ground		
19	+24V		POWER		+24V/1A	
20	AVDD	Output	Power		+3.3V/100mA	

Warning: The total output current of pin #19 should not exceed 1A.

4.12 Extruder E1-E4

The extruder outputs can be used in 3D printer applications, controlling up to 4 extruders. The four outputs are designated E1 to E4.





On the next page all signals for the extruders are shown.

> Note, the enable output for each of the 4 extruders are shared with an AUX OUT output, please check in your application that no pinning conflicts occurs!

> Note, the step and direction signal for each extruder is combined with these signals for axis 6

Below an overview of the 4 extruder connectors:

Extruder 1:

Pin #	Name	Direction	Type	Function	Electrical Spec.	Remarks
1	AEE1	Output	Digital	Extruder enable E1	5V/15mA	Shared with AUX OUT7
2	GND		Ground			
3	DIRE1	Output	Digital	Extruder direction signal E1	5V/15mA	Shared with DIR6
4	GND		Ground			
5	STEPE1	Output	Digital	Extruder step signal E1	5V/15mA	Shared with STEP6
6	GND		Ground			
7	GND		Ground			
8	GND		Ground			
9	+5V	Output	Power		+5V/500mA	See warning.
10	GND		Ground			

Extruder 2:

Pin #	Name	Direction	Type	Function	Electrical Spec.	Remarks
1	AEE2	Output	Digital	Extruder enable E2	5V/15mA	Shared with AUX OUT8
2	GND		Ground			
3	DIRE2	Output	Digital	Extruder direction signal E2	5V/15mA	Shared with DIR6
4	GND		Ground			
5	STEPE2	Output	Digital	Extruder step signal E2	5V/15mA	Shared with STEP6
6	GND		Ground			
7	GND		Ground			
8	GND		Ground			
9	+5V	Output	Power		+5V/500mA	See warning.
10	GND		Ground			

Extruder 3:

Pin #	Name	Direction	Type	Function	Electrical Spec.	Remarks
1	AEE3	Output	Digital	Extruder enable E3	5V/15mA	Shared with AUX OUT9
2	GND		Ground			
3	DIRE3	Output	Digital	Extruder direction signal E3	5V/15mA	Shared with DIR6
4	GND		Ground			
5	STEPE3	Output	Digital	Extruder step signal E3	5V/15mA	Shared with STEP6
6	GND		Ground			
7	GND		Ground			
8	GND		Ground			
9	+5V	Output	Power		+5V/500mA	See warning.
10	GND		Ground			

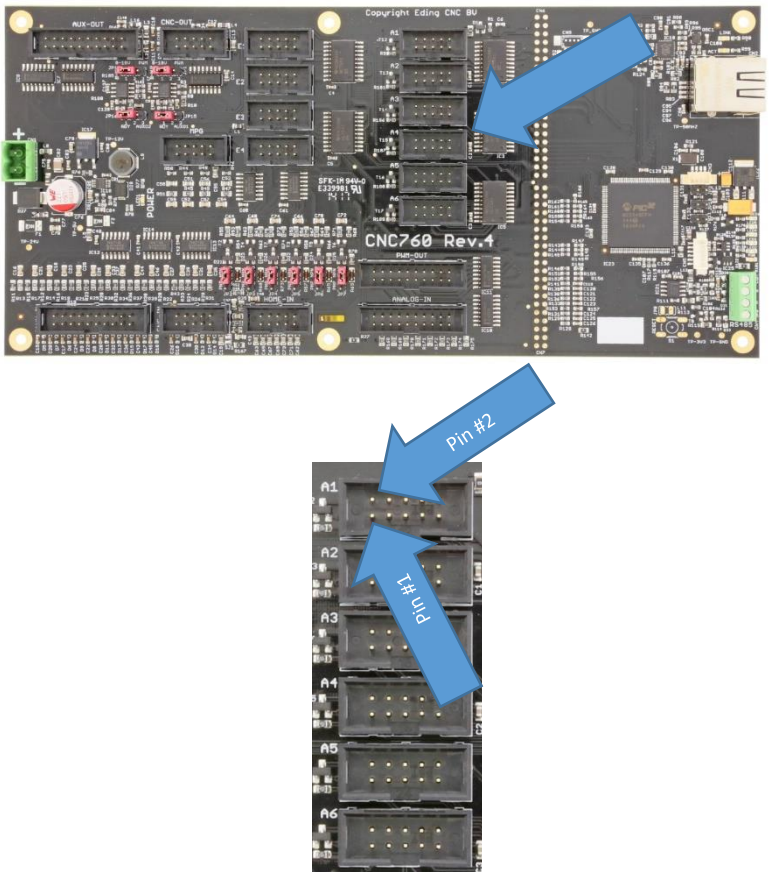
Extruder 4:

Pin #	Name	Direction	Type	Function	Electrical Spec.	Remarks
1	AEE4	Output	Digital	Extruder enable E4	5V/15mA	Shared with AUX OUT10
2	GND		Ground			
3	DIRE4	Output	Digital	Extruder direction signal E4	5V/15mA	Shared with DIR6
4	GND		Ground			
5	STEPE4	Output	Digital	Extruder step signal E4	5V/15mA	Shared with STEP6
6	GND		Ground			
7	GND		Ground			
8	GND		Ground			
9	+5V	Output	Power		+5V/500mA	See warning.
10	GND		Ground			

Warning: The total combined output current of pin #9 of the extruders should not exceed 500mA.

4.13 Axis A1-A6

These outputs can control up to 6 axes simultaneously, these outputs are designated A1 to A6. Beside the step and direction signal each output has several extra signals.



Below an overview of the 6 axis connectors:

Axis 1:

Pin #	Name	Direction	Type	Function	Electrical Spec.	Remarks
1	ENABLE1	Output	Digital	Amplifier enable 1	5V/15mA	
2	ENABLE1	Output	Open collector	Amplifier enable 1	Max. rating 40V/100mA	
3	DIR1	Output	Digital	Direction signal 1	5V/15mA	
4	GND		Ground			
5	STEP1	Output	Digital	Step signal 1	5V/15mA	
6	GND		Ground			
7	GND		Ground			
8	DRV-ALM-					
9	+5V	Output	Power		+5V/500mA	See warning.
10	DRV-ALM+	Input	Digital	Alarm input		Pulled up with 4k7

Axis 2:

Pin #	Name	Direction	Type	Function	Electrical Spec.	Remarks
1	ENABLE1	Output	Digital	Amplifier enable 1	5V/15mA	
2	ENABLE1	Output	Open collector	Amplifier enable 1	Max. rating 40V/100mA	
3	DIR1	Output	Digital	Direction signal 1	5V/15mA	
4	GND		Ground			
5	STEP1	Output	Digital	Step signal 1	5V/15mA	
6	GND		Ground			
7	GND		Ground			
8	DRV-ALM-					
9	+5V	Output	Power		+5V/500mA	See warning.
10	DRV-ALM+	Input	Digital	Alarm input		Pulled up with 4k7

Axis 3:

Pin #	Name	Direction	Type	Function	Electrical Spec.	Remarks
1	ENABLE1	Output	Digital	Amplifier enable 1	5V/15mA	
2	ENABLE1	Output	Open collector	Amplifier enable 1	Max. rating 40V/100mA	
3	DIR1	Output	Digital	Direction signal 1	5V/15mA	
4	GND		Ground			
5	STEP1	Output	Digital	Step signal 1	5V/15mA	
6	GND		Ground			
7	GND		Ground			
8	DRV-ALM-					
9	+5V	Output	Power		+5V/500mA	See warning.
10	DRV-ALM+	Input	Digital	Alarm input		Pulled up with 4k7

Axis 4:

Pin #	Name	Direction	Type	Function	Electrical Spec.	Remarks
1	ENABLE1	Output	Digital	Amplifier enable 1	5V/15mA	
2	ENABLE1	Output	Open collector	Amplifier enable 1	Max. rating 40V/100mA	
3	DIR1	Output	Digital	Direction signal 1	5V/15mA	
4	GND		Ground			
5	STEP1	Output	Digital	Step signal 1	5V/15mA	
6	GND		Ground			
7	GND		Ground			
8	DRV-ALM-					
9	+5V	Output	Power		+5V/500mA	See warning.
10	DRV-ALM+	Input	Digital	Alarm input		Pulled up with 4k7

Axis 5:

Pin #	Name	Direction	Type	Function	Electrical Spec.	Remarks
1	ENABLE1	Output	Digital	Amplifier enable5	5V/15mA	
2	ENABLE1	Output	Open collector	Amplifier enable5	Max. rating 40V/100mA	
3	DIR1	Output	Digital	Direction signal 5	5V/15mA	
4	GND		Ground			
5	STEP1	Output	Digital	Step signal 5	5V/15mA	
6	GND		Ground			
7	GND		Ground			
8	DRV-ALM-					
9	+5V	Output	Power		+5V/500mA	See warning.
10	DRV-ALM+	Input	Digital	Alarm input		Pulled up with 4k7

Axis 6:

Pin #	Name	Direction	Type	Function	Electrical Spec.	Remarks
1	ENABLE1	Output	Digital	Amplifier enable 6	5V/15mA	
2	ENABLE1	Output	Open collector	Amplifier enable 6	Max. rating 40V/100mA	
3	DIR1	Output	Digital	Direction signal 6	5V/15mA	
4	GND		Ground			
5	STEP1	Output	Digital	Step signal 6	5V/15mA	
6	GND		Ground			
7	GND		Ground			
8	DRV-ALM-					
9	+5V	Output	Power		+5V/500mA	See warning.
10	DRV-ALM+	Input	Digital	Alarm input		Pulled up with 4k7

Warning: The total combined output current of pin #9 of the axis should not exceed 500mA.

Each connecting has an alarm input is available. The alarm inputs pins of all axes are wired together. It is assumed that the alarm output of the drives are open-collector outputs so that the alarm outputs of all drives can be coupled together. So, each output can pull the alarm input low to generate an alarm.

Please check that the motor driver ALARM output is configured to be ‘open’ if not active.

The image below shows such a setup.

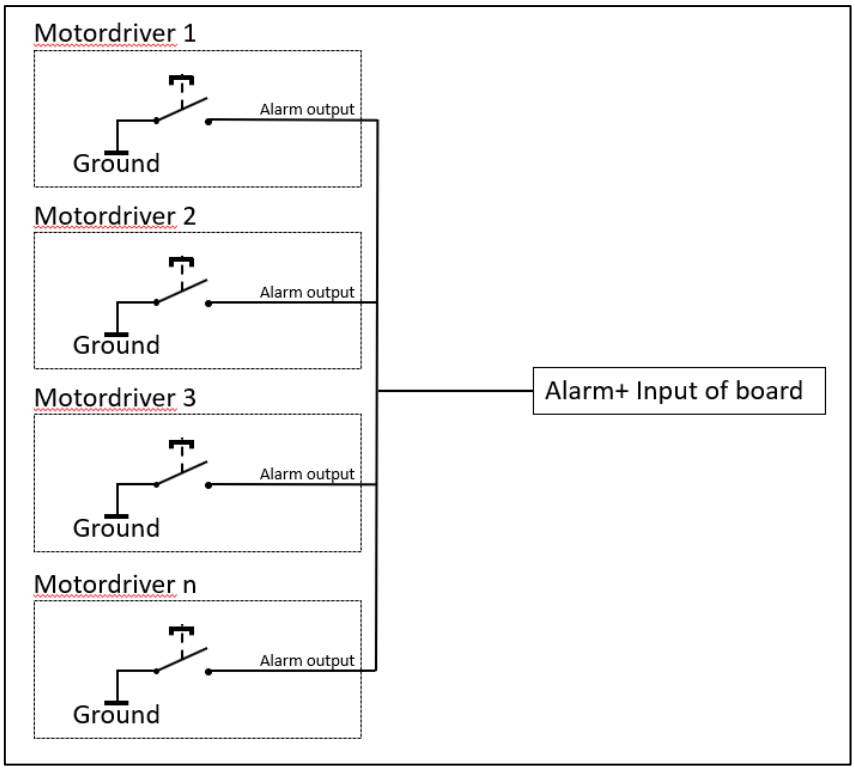


Figure 21 Combining open collector outputs of drivers.

Below is image that shows the input circuit of the alarm input. The alarm input is active if the DRVALM+ input is pulled low.

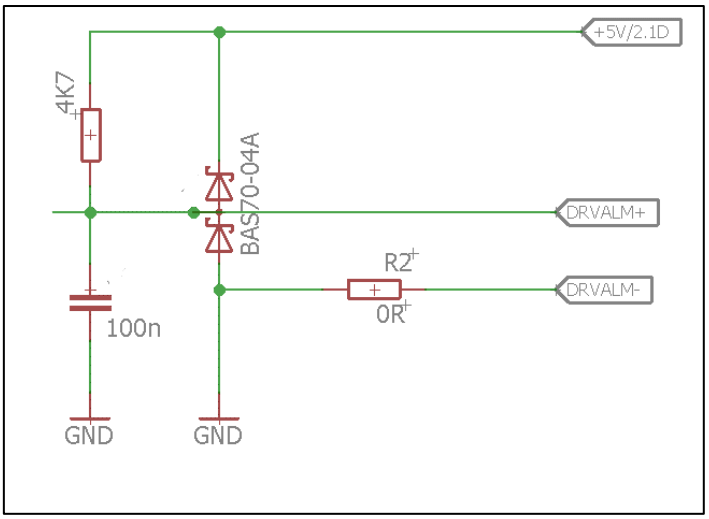


Figure 22 Alarm input circuit.

In the CNC.INI file the alarm input behavior needs to correctly defined. Please check that '**driveErrorInputSenseLevel'** is set to '0'.

Warning: Make sure you test the alarm input before start to use it.

Each axis output has a two enable outputs, these signals are used to enable to motor driver. The difference between these two signals is that one signal is a digital +5V signal, and the other is an open-collector signal. This helps in connecting the controller to different kind of drives.

The enable signal with an open-collector output is able to switch higher voltages compared to the +5V output. In the image below such an output is shown. An open-collector output means it switches the connected wire to GND. This enables the user to switch devices that do not need the same voltage rating as the controller has.

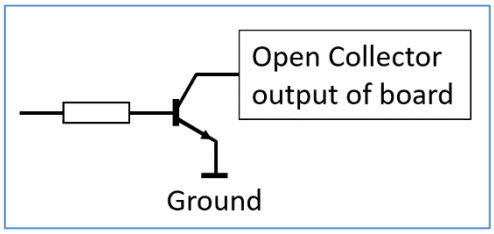


Figure 23 Open collector output.

The drawing below shows how an open-collector output connector can be used to create different output signal levels by using a pull-up resistor. The value of this resistor can vary depending on the load of the output. Typical values are 4.7k or 10k.

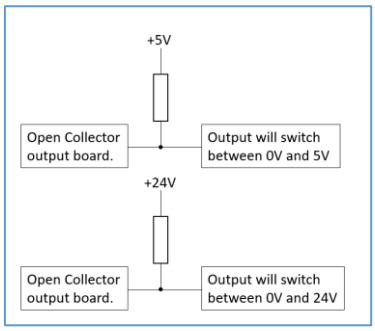


Figure 24 Creating different output levels with open-collector output.

With open collector output it is very simple to use a relay in order to switch bigger loads. Connecting a relay is shown in the drawing below.

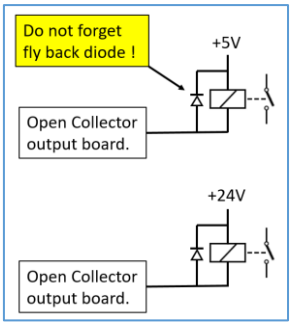


Figure 25 Connecting a relay to an open collector output.

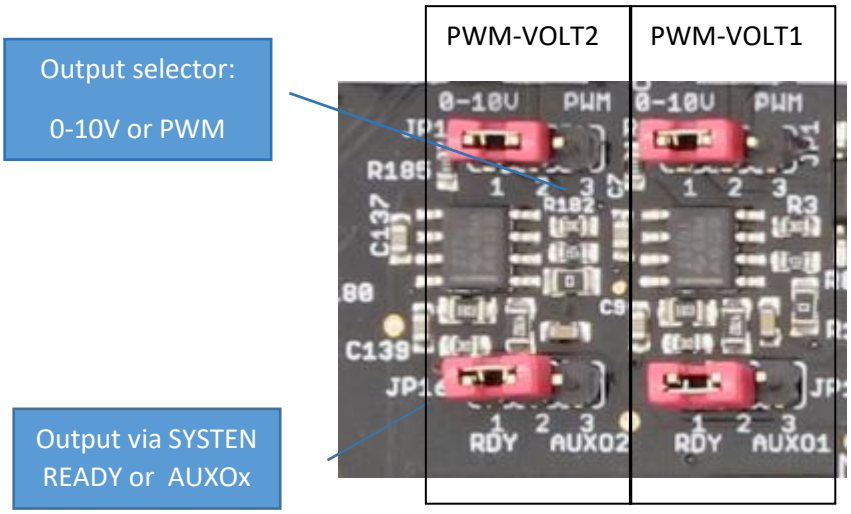
In the above example a 5V relay and 24V relay is used, both will switch. However please consider that a 5V relay will need more current to switch. This can limit the total number of used relays because of the maximum total current that can be switched.

Also, ***VERY important*** is it to use a fly back diode. This is necessary to limit spikes that occur when switching a relay. A typical diode that is used is e.g. 1N4007.

Look at the manual of your driver to see how it can be enabled.

5 Configuring the analog outputs

The CNC760 board contains two identical 0-10V outputs. There are 2 jumpers for each output that can be used to configure the behavior of these outputs.



Output signal type:

The top jumper selects what signal is present on the output. Either 0-10V, which is default, or the standard PWM signal. These outputs use the existing PWM outputs of the board.

From the picture above, the left output (PWM-VOLT2) uses analog 0-10V output generated by the PWM2 output, the right output (PWM-VOLT1) uses analog 0-10V output, generated by the PWM1 output.

When the PWMx output signal is selected it's identical to the PWMx signal on the PWM output connectors, that means that this signal is an open-collector output.

Warning: Connecting an open-collector output directly to a positive voltage e.g. 24V will cause a short-circuit

Output enable behavior:

The bottom jumper selects whether the output is enabled when the 'SYSTEM READY' is available, the default behavior, or that it is controlled via an AUXOx output.

From the pictures above, the left output (PWM-VOLT2) uses SYSTEM READY output to control the output, the right output (PWM-VOLT1) uses SYSTEM READY output to control the output. Change the jumper position to have the output be controlled by the AUX0x output.

WARNING: If the jumper is set to enable the output via one of the AUXOx outputs, the 'SYSTEM READY' signal will no longer switch off this output.

6 Getting started

Before installing the board it's a clever idea to validate that the board is operational.

Validate the board

Step 1. The first step is to validate the board is operational. Connect the network cross cable to the board and the PC. Make sure you have set the correct IP address on the PC. For a description on how to setup the PC please refer to the software manual.

Step 2. Connect the power, as a result both blue power LEDs should turn on. And observe that the status LEDs indicates that the board is active, indicated by the 'heart beat'.

Step 3. Try to connect to the board.

The board is now able to communicate with the application software.

Check for motion

Now the board is operational the next step is to check whether the machine and home switches work correctly. We start with the homing switches. Make sure that the power is off.

Step 1. The first step is to determine how to configure the jumpers. For now, the most important once are the jumpers for the home inputs. Set these jumpers to the correct position based on the type of the home switches used.

Step 2. Power up the board and connect.

Step 3. By using the I/O screen of the application validate that the switches are correctly detected; if you need to invert the signal do this in the setup of the software. If this is done, power down the board.

Step 4. Connect the drivers to the board. You can choose to connect all motors at once or just one at a time. Please check the manual of the driver on how to connect it to the controllers, also check that the enable is correctly connected; directly or via the open-collector output. Some drivers will automatically be enabled when this input is not connected, and they are powered up.

Step 5. DOUBLE check all connections.

Step 6. Power up the board and driver(s) and connect to the board.

Step 7. Normally with the default settings of the software you should be able to get some motion. If not, please check the following:

- Are all signals correctly connected?
- Do some signals need to be inverted (e.g. enable)?

TIP: By using the software I/O screen you can manually check the enabling of the drivers. When the drive is not enabled you will be able to move it by hand, if it is enabled this should not be possible.

If all went ok, your machine has now a basic setup. From here you can continue to connect more I/O to the board, please check all I/O via the software; also check whether inversion is necessary.

Please note that the system will need to be tuned to each specific machine. This means that machine parameters as speed/acceleration etc. will need to be changed to get optimum performance. Please make sure you know who to do this, and If not request support.

And finally perform each part of the setup step by step, so you know where to look in case something does not work immediately.