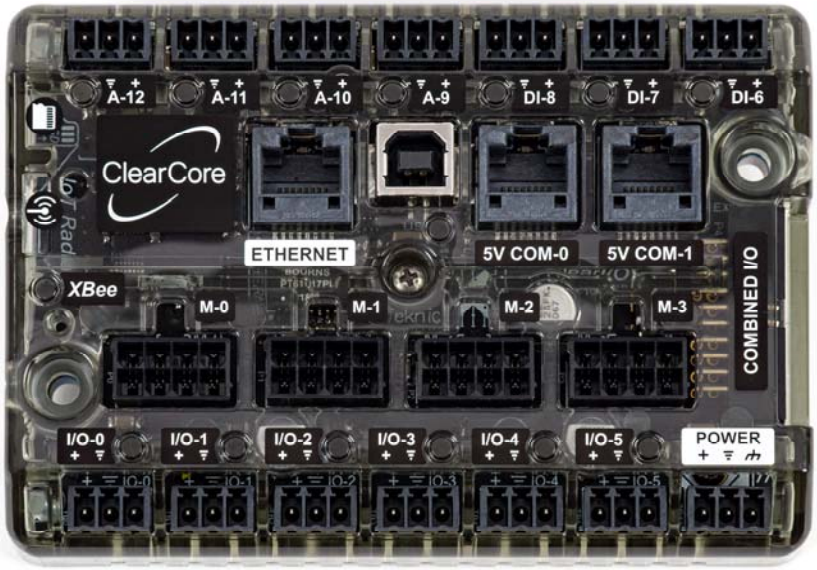
ClearCore Hardware and Wiring Manual

Includes wiring information for CCIO-8 (I/O Expansion Board) and CL-ENCDR-DFIN (Encoder Input Adapter Board)

Rev. 1.14 December 17, 2025



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Introduction

Welcome

Thank you for purchasing a ClearCore programmable, I/O and motion controller. This document is a hardware reference manual for both the ClearCore controller (Teknic p/n **CLCR-4-13**) and the ClearCore I/O expansion board (Teknic p/n **CCIO-8**).

For programming information, please see the ClearCore programming reference.

Complete documentation for ClearCore and its accessories can be found on our Downloads page under the ClearCore heading.

What's in this Document

- Parts of a ClearCore (callout diagram)
- Wiring diagrams for common I/O and motor devices
- Power supply requirements
- Mating hardware information
- Product specifications
- Mechanical dimensions
- Mounting information

Safety Information

Please read this safety information before using a ClearCore controller.

Precautionary Statement

Always follow appropriate safety precautions when installing and using any automated motion control equipment. Motion control systems should be designed and utilized to prevent personnel from coming into contact with moving parts and electrical contacts that could potentially cause injury or death. Read all cautions, warnings, and notes before attempting to install or operate this device. Follow all applicable codes and standards when using this equipment. Failure to use this equipment as described may impair or neutralize protections built into the product.

General Disclaimer

The User is responsible for determining the suitability of this product for his or her application. The User must ensure that Teknic's products are installed and utilized in accordance with all local, state, federal and private governing bodies and meet all applicable health and safety standards.

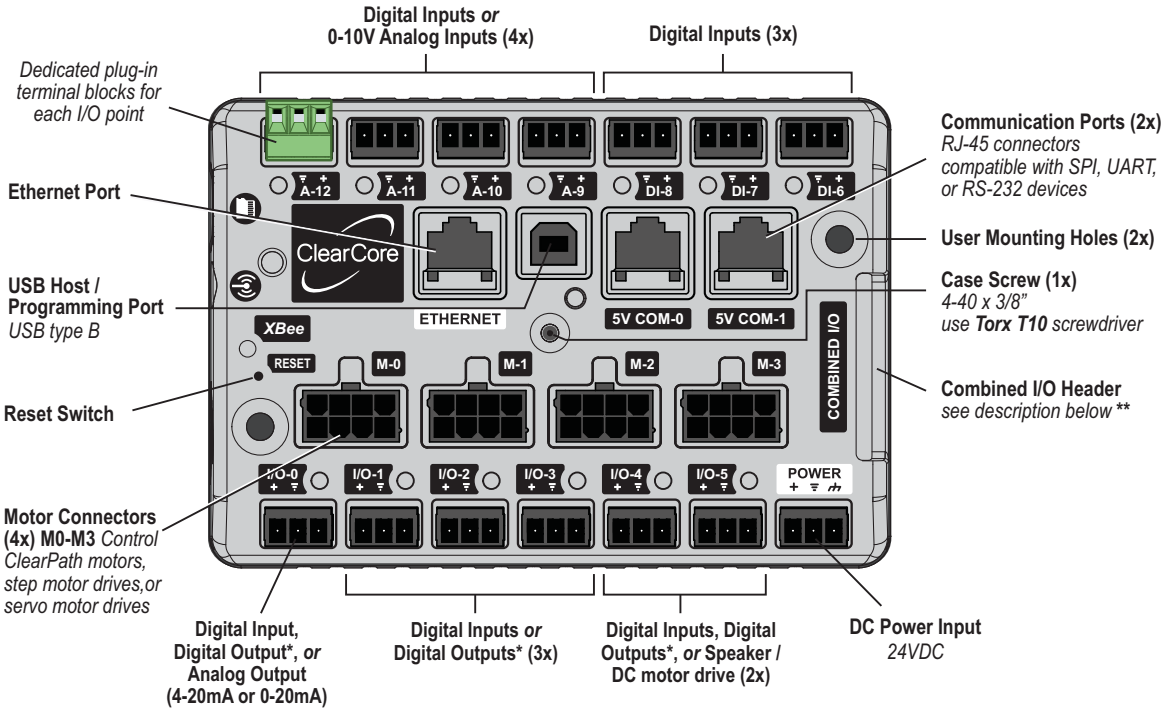
Teknic has made all reasonable efforts to accurately present the information in the published documentation and shall not be responsible for any incorrect information which may result from unintentional oversights.

Due to continuous product improvements, the product specifications as stated in the documentation are subject to change at any time and without notice. The User is responsible for consulting a representative of Teknic for detailed information and to determine any changes of information in the published documentation.

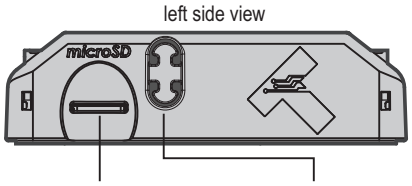
Should Teknic's products be used in an application that is safety critical, the User must provide appropriate safety testing of the products, adequate safety devices, guarding, warning notices and machine-specific training to protect the operator and/or bystanders from injury.

Parts Overview

Parts of a ClearCore

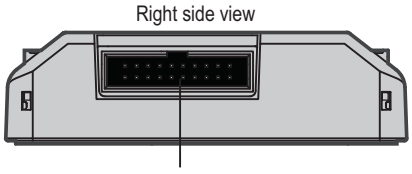


*All digital outputs (I/O-0 through I/O-5) have built-in clamping circuitry and are capable of driving coils of up to **9-watts max**.



Micro SD Card Slot
Read/write capable, data storage, data logging

Antenna knockout
for optional XBee wireless module



****Combined I/O Header**
Can be used in only one of two ways listed

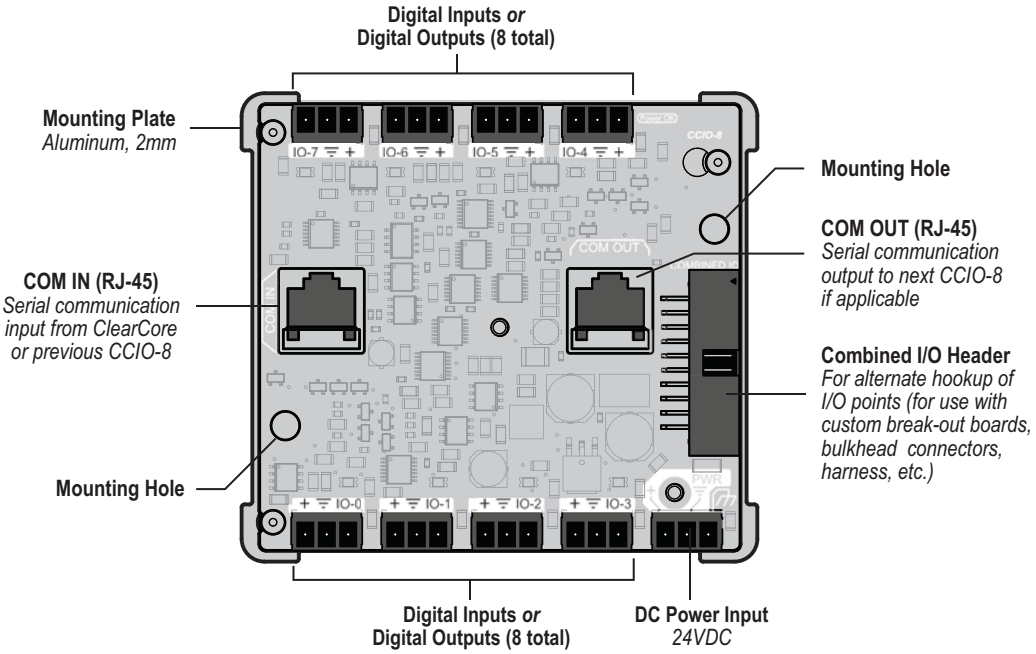
Breaks out all 13 I/O points. (Provides an alternative hookup path to the individual 3-pin I/O connectors.)

or

*Connect optional Teknic differential encoder input board here (Teknic PN **CL-ENCDR-DFIN**).*

ClearCore top and side views

Parts of a CCIO-8 (I/O Expansion Board)



CCIO-8 I/O expansion board

Powering ClearCore and CCIO-8

ClearCore and CCIO-8 are 24VDC compatible devices. This section includes ClearCore power supply recommendations and wiring instructions.

Important: *Do not use your ClearCore power supply to also supply DC bus power to servo or stepper drives attached to ClearCore (this applies to ClearPath motors as well).* ***Always use a separate, dedicated supply, such as the IPC-5, designed to handle the power and regenerated energy requirements of servo or step motor drives.***

Recommended Power Supply

PWR-IO-24VDC

The **PWR-IO-24VDC power supply** (Mean Well PN LRS-150-24) is an inexpensive, 24VDC, 6.5A (156W) switching supply capable of powering most ClearCore applications.

Product Datasheet

Installation Information

Why choose a "higher current" power supply?

A power supply of 6.5A or more is recommended for ClearCore applications to ensure that the ClearCore processor remains powered under adverse operating conditions such as overloads or shorts. Note: *Lower current supplies will work with ClearCore*, but may experience shutdowns or brown outs if ClearCore is overloaded or shorted due to user/application error.

Wiring DC Power to ClearCore and CCIO-8

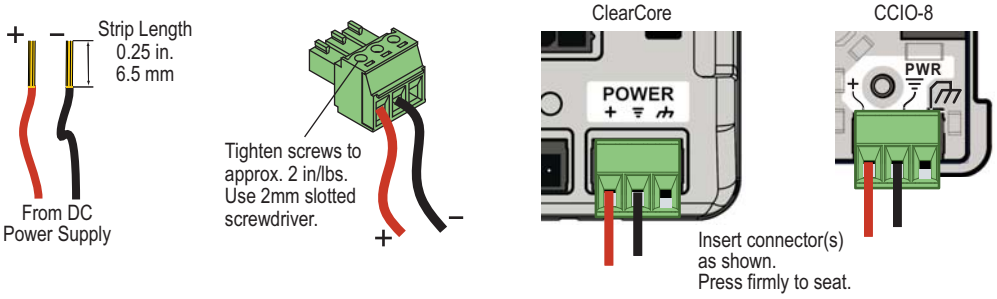
See below for instructions on wiring 24VDC power to ClearCore and CCIO-8.

Tools Required

- Slotted screwdriver with max. 2mm wide blade
- Wire cutter/stripper
- 3-position screw terminal connector, Molex part # 0395105003

Procedure

1. Turn off power supply.
2. Strip DC output wires from power supply. Expose approximately **6.5mm (0.25")** of bare wire.
3. Fully insert V+ and V- wires fully into terminal block "+" and ground positions.
4. Tighten terminal screws.
5. Inspect connector for good wire capture. Verify that no wire insulation is captured in the closure, and that no loose wire strands are sticking out of the connector.
6. ***Recommended:*** Before connecting the terminal block to ClearCore, test for correct voltage polarity between "+" and ground terminals.



Connecting power to ClearCore and CCIO-8

Chassis Connection

Mount ClearCore and CCIO-8 to a machine frame or chassis continuous with Protective Earth. Alternately, connect the chassis terminal on the 3-position power connector to machine frame using conductive hardware.

I/O Wiring

Introduction

This section discusses the function and wiring of ClearCore and CCIO-8 user-configurable I/O points.

ClearCore I/O at a Glance

- (13) software configurable I/O points
- Up to (13) digital inputs
- Up to (4) analog inputs
- Up to (6) digital outputs (with PWM)
- Up to (1) 4-20mA (or 0-20mA) output
- Separate ground and power for all I/O points (grounds not isolated)
- A dedicated status LED for every I/O point
- Add up to 64 more digital in/out points with Teknic's CCIO-8 (I/O expansion modules)

I/O Overview Table

The table below lists all ClearCore and CCIO-8 I/O connectors and their supported I/O types. Refer to the ClearCore programming reference for instructions on how to configure ClearCore and CCIO-8 I/O connectors.

Label	Digital Input	Digital Output[1]	0-10V Analog Input	4-20 mA Output[2]	Servos or Steppers	Speaker Tones	DC Motor Drive
I/O-0	yes	yes		yes			
I/O-1	yes	yes					
I/O-2	yes	yes					
I/O-3	yes	yes					
I/O-4	yes	yes				yes	yes
I/O-5	yes	yes				yes	yes
DI-6	yes						
DI-7	yes						
DI-8	yes						
A-9	yes		yes				
A-10	yes		yes				
A-11	yes		yes				
A-12	yes		yes				
M-0					yes[3]		
M-1					yes[3]		
M-2					yes[3]		
M-3					yes[3]		
CCIO-8[4]	yes	yes					

Note 1: All digital outputs are PWM capable (except for those on the CCIO-8 expansion board).

Note 2: This output can also provide 0-20mA, which is less commonly used.

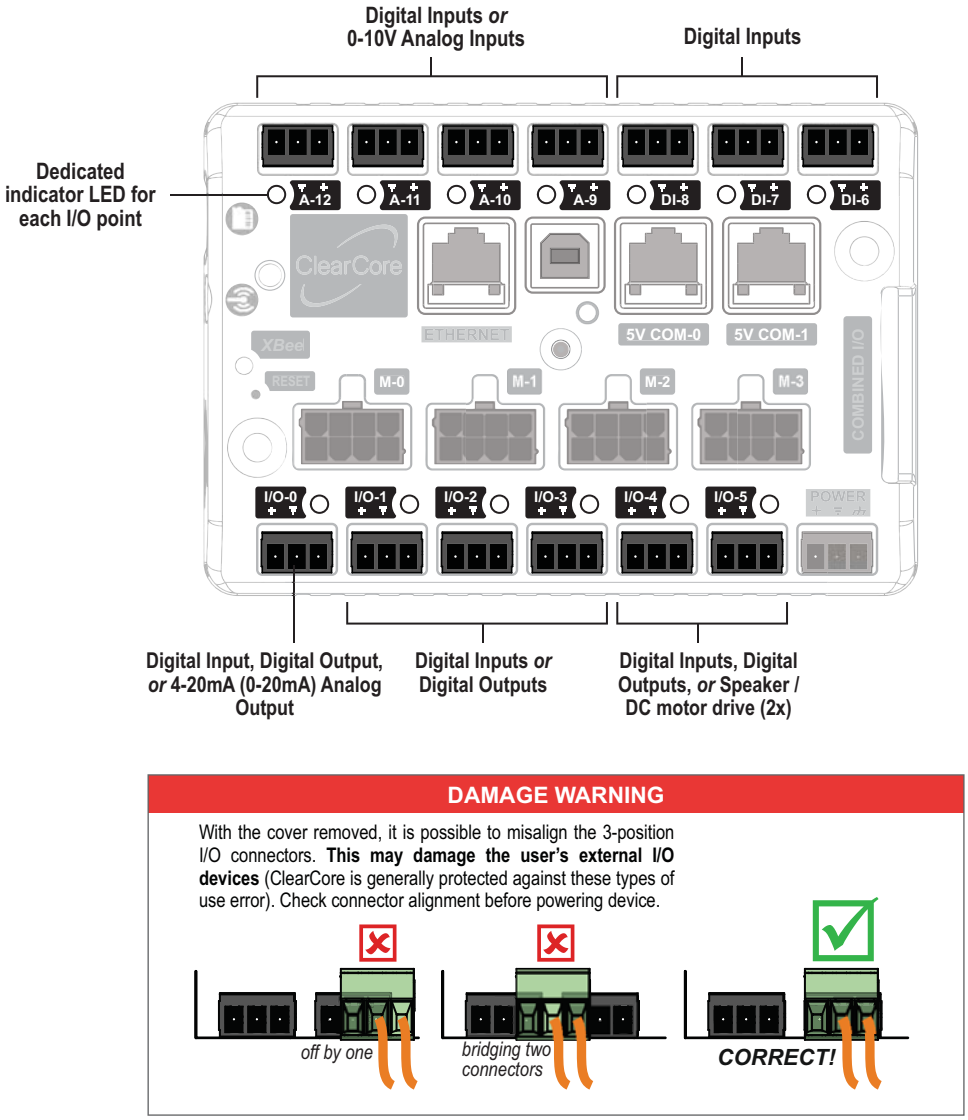
Note 3: Each motor connector has 3 digital outputs (step, dir., enable) and 1 digital input.

Note 4: There are 8 of these I/O points on the CCIO-8 expansion module.

ClearCore I/O overview table

Wiring I/O Devices to ClearCore

This section explains how to wire common I/O devices to a ClearCore controller. Each subsection includes a diagram of the ClearCore internal circuitry and several example hookup diagrams.

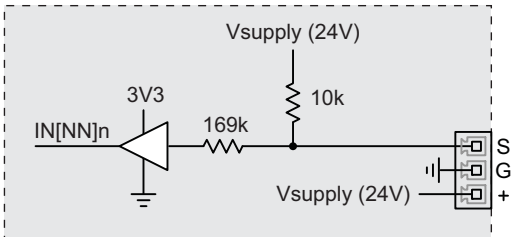


ClearCore I/O connectors

I/O-0 through I/O-5 configured as DIGITAL INPUTS

Note: *The wiring examples shown below* ***also apply to all CCIO-8 I/O points configured as digital inputs.***

Input Equivalent Circuit

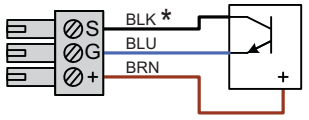


IMPORTANT:
Inputs are “negative true”:
On <= ~0.75V, Off >= ~2.75V

“Ease of Use” Note: 5V Sensors

Before using 5VDC sensors, consider either 1) sourcing 24V alternatives, or 2) providing a separate 5VDC supply to power your 5V sensors.

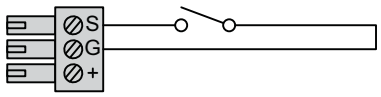
Typical Sensor Hookup Details



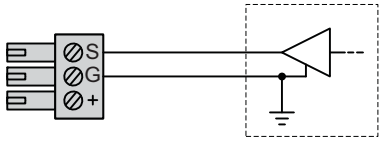
Digital “NPN” Sensor:
Proximity
Optical
Hall-Effect, etc.

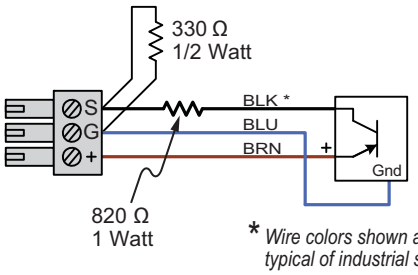
* *Wire colors listed are typical of industrial sensors*

Switch or Relay Contact



5V/3.3V Logic System





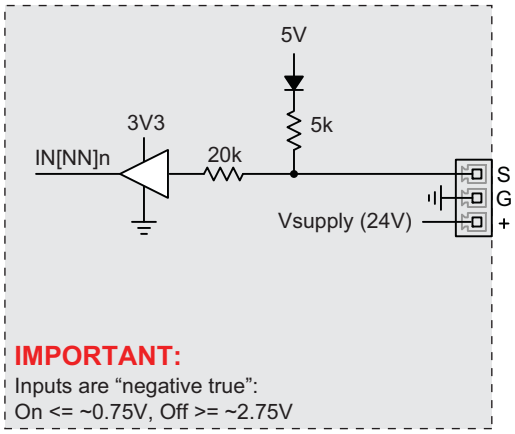
Digital “PNP” Sensor:
Proximity
Optical
Hall-Effect

* *Wire colors shown are typical of industrial sensors*

- *Resistors sized for 24VDC supply voltage*
- *External resistors not included*

A-9 through A-12 and DI-6 through DI-8 configured as **DIGITAL INPUTS**

Input Equivalent Circuit

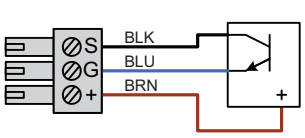


IMPORTANT:
Inputs are “negative true”:
On <= ~0.75V, Off >= ~2.75V

“Ease of Use” Note: 5V Sensors

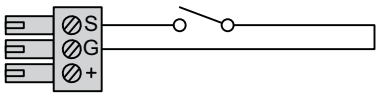
Before using 5VDC sensors, consider either: 1) sourcing 24V alternatives, or 2) providing a separate 5VDC supply to power your 5V sensors.

Typical Sensor Hookup Details

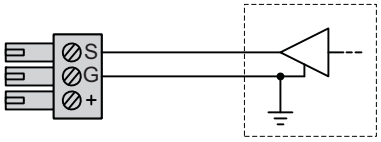


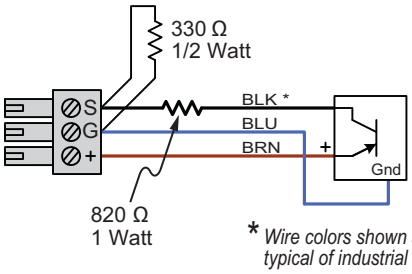
Digital “NPN” Sensor:
Proximity
Optical
Hall-Effect, etc.

Switch or Relay Contact



5V/3.3V Logic System





Digital “PNP” Sensor:
Proximity
Optical
Hall-Effect

* *Wire colors shown are typical of industrial sensors*

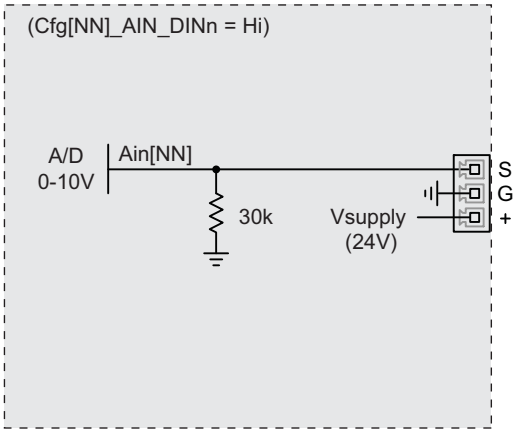
- *Resistors sized for 24VDC supply voltage*
- *External resistors not included*

A-9 through A-12 configured as ANALOG INPUTS

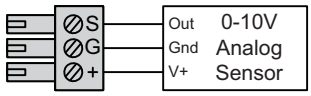
ClearCore is compatible with a variety of analog sensors (transducers) including the following:

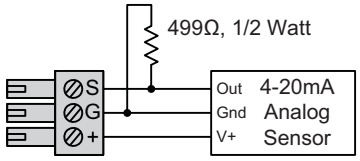
- Pressure
- Force
- Torque
- Temperature
- Angle
- Inclination
- Distance
- Level
- Velocity
- Mass
- Flow
- Electric current

Input Equivalent Circuit



Typical Sensor Hookup Details



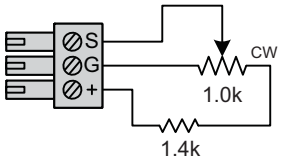


Note:

Place the 499 Ohm shunt resistor close to input terminal block.

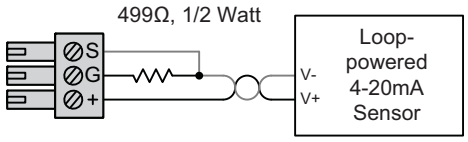
Typical Sensor Hookup Details

Potentiometer



Engineering Note:

The repeatability of this circuit will be affected by the drift and regulation of the power supply connected to Vsupply. (Values shown for a 24V supply.)



Notes:

- Place the 499 ohm shunt resistor close to input terminal block.
- Use twisted pair wire as shown to minimize noise pickup.

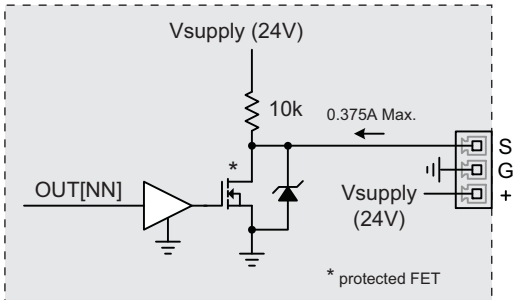
Sensor Notes:

- 0-5V output sensors can be used with ClearCore, but there will be a loss of 1 bit of resolution (provided they are compatible with the ClearCore supply voltage (V_{supply}).
- 0-20mA sensors can be used with ClearCore, but there will be some loss of linearity near zero current (this is sensor dependent).

I/O-0 through I/O-5 configured as DIGITAL OUTPUTS

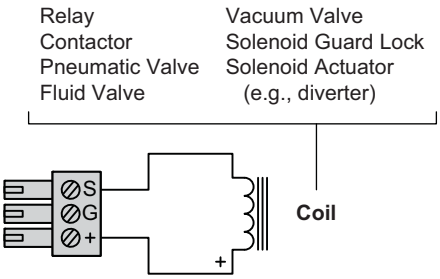
Note: *The wiring shown in this section* ***also applies to all CCIO-8 points configured as digital outputs.***

Output Equivalent Circuit



IMPORTANT:
Outputs are “negative true”:
On state turns on transistor, enabling current in load, pulling output <0.5V

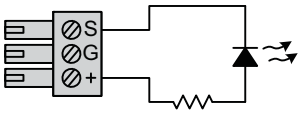
Typical Actuator Hookup Details



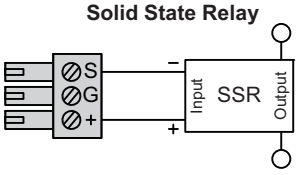
No Shunt Diode Required
(Outputs have built-in active clamping)

Typical Actuator Hookup Details

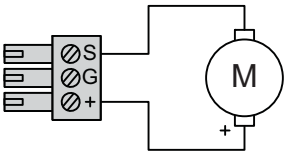
LED Indicator



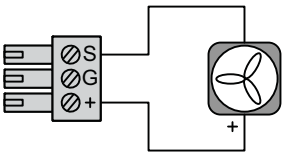
Solid State Relay



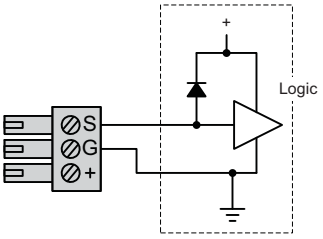
DC Motor. Pump, etc. (single direction)



DC Fan



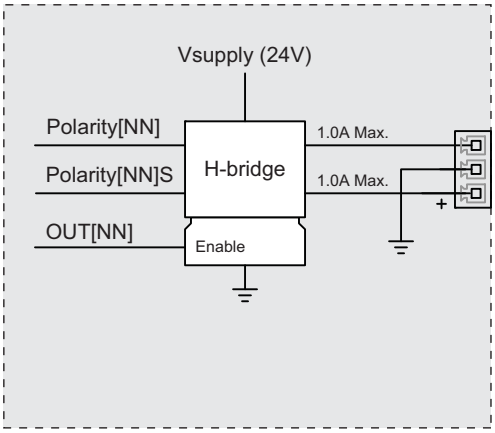
5V/3.3V Logic System



External clamping diode to logic supply may be required, consult logic IC datasheet.

I/O-4 or I/O-5 configured as Variable, Bi-directional Drive (PWM)

Output Equivalent Circuit



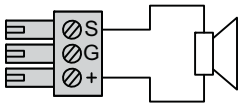
Average output voltage equation
Vsupply*(Duty Cycle of PolarityS - Duty Cycle of Polarity)

Notes:

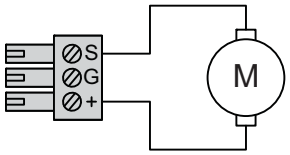
1. For use with loudspeaker/ shaker loads the maximum RMS current must not exceed 1A
2. Exceeding output current ratings will require resetting both IO-4 and IO-5 outputs by cycling the OverV_DISABLEn signal

Typical Actuator Hookup Details

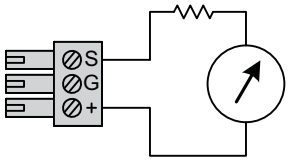
Loudspeaker/Shaker



DC Motor. Pump, etc. (fwd/rev direction)



Galvanometer

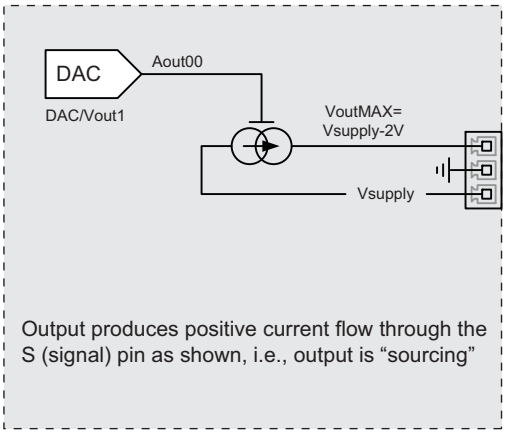


I/O-0 configured as a 4-20mA (or 0-20mA) OUTPUT

ClearCore's **I/O-0** connector can be configured to supply a variable 4-20mA analog signal to control a wide variety of analog actuators. A few examples of devices that can be controlled using 4-20mA signaling include:

- Damper control
- Pressure regulator
- Rotary position actuator
- Variable speed display
- Proportional valve
- Linear position actuator
- Process meter (display)

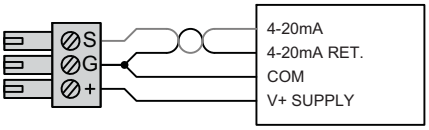
Output Equivalent Circuit



Output produces positive current flow through the S (signal) pin as shown, i.e., output is “sourcing”

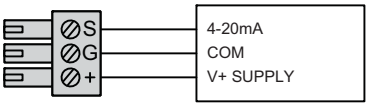
Typical Actuator Hookup Details

4-wire Actuator



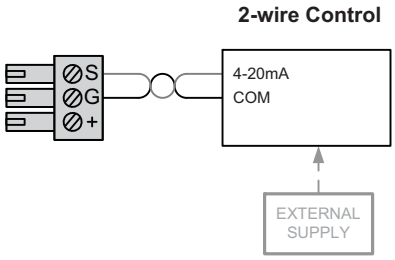
Notes:
- Connect signal and supply return wires close to output terminal block
- Use twisted pair as shown for best noise immunity

3-wire Actuator



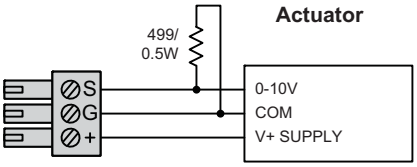
Typical Actuator Hookup Details

2-wire Control



May be required depending on device

3-wire 0-10V Actuator

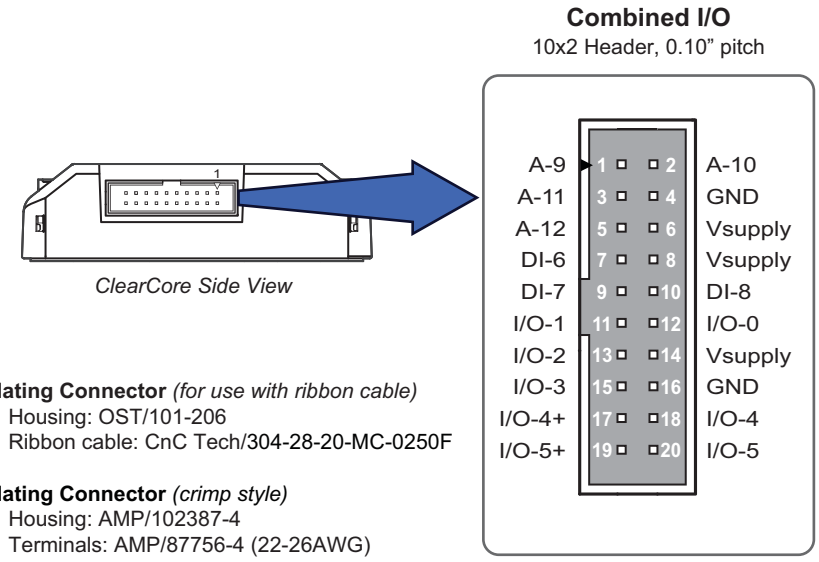


Note:
Place 499 Ohm shunt resistor close to actuator

ClearCore Combined I/O Header

The ClearCore I/O header (labeled "Combined I/O" on the case) provides an alternate, functionally identical way to connect I/O devices to ClearCore's I/O points.

Note: V_{supply} pins are intended to provide courtesy 24V power to external I/O devices. Please contact Teknic if you have any further questions.



Mating Connector *(for use with ribbon cable)*
Housing: OST/101-206
Ribbon cable: CnC Tech/304-28-20-MC-0250F

Mating Connector *(crimp style)*
Housing: AMP/102387-4
Terminals: AMP/87756-4 (22-26AWG)

ClearCore I/O Header

Wiring I/O Devices to CCIO-8

IMPORTANT NOTES

- All CCIO-8 I/O points are electrically identical to ClearCore I/O points I/O-1, I/O-2, and I/O-3. ***The only functional difference is that the CCIO-8 points cannot output PWM signals*.**
- CCIO-8 I/O points can be configured as either digital inputs or digital outputs.

I/O-0 through I/O-7 configured as DIGITAL INPUTS

The wiring for all 8 of these I/O points (as inputs) is the same as the wiring for ClearCore **I/O-0 through I/O-5 configured as DIGITAL INPUTS**

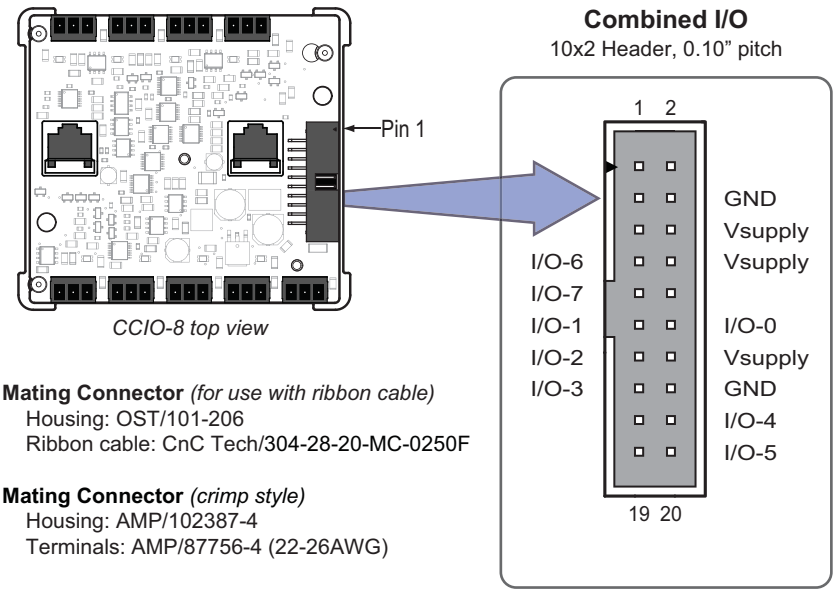
I/O-0 through I/O-7 configured as DIGITAL OUTPUTS

The wiring for all 8 of these I/O points (as outputs) is the same as the wiring for ClearCore **I/O-0 through I/O-5 configured as DIGITAL OUTPUTS**

CCIO-8 Combined I/O Header

The CCIO-8 I/O header (labeled "Combined I/O" on the board) provides an alternate, functionally identical way to connect I/O devices to ClearCore's I/O points.

Note: V_{supply} pins are intended to provide courtesy 24V power to external I/O devices. Please contact Teknic if you have any further questions.



Mating Connector *(for use with ribbon cable)*
Housing: OST/101-206
Ribbon cable: CnC Tech/304-28-20-MC-0250F

Mating Connector *(crimp style)*
Housing: AMP/102387-4
Terminals: AMP/87756-4 (22-26AWG)

CCIO-8 I/O Header

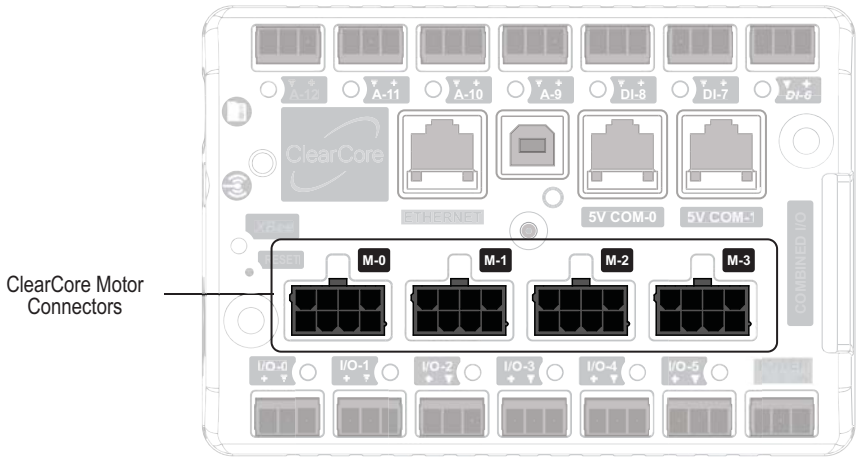
Motor Connectors (M-0, M-1, M-2, M-3)

ClearCore includes four multi-function motor connectors that each feature three (3) specialized outputs and one (1) specialized input. They are plug and play compatible with Teknic ClearPath motors, but are not limited to only ClearPath motors.

ClearCore can be programmed to send different types of signals to the motor connectors, including:

- Step & Direction signals to ClearPath-SD (Step & Dir) series motors
- Step & Direction signals to third-party compatible servo or step motor drives
- Digital control signals to ClearPath-MC (Motion Controller) series motors

Note: ClearCore motor connectors are designed to send and receive *low-power signals only*. ***These connectors cannot directly power the phase windings of servo or stepper motors.***



ClearCore motor connectors

How to Wire a ClearPath Motor to ClearCore

Connect ClearPath motors to ClearCore with a Teknic controller cable (or make your own).

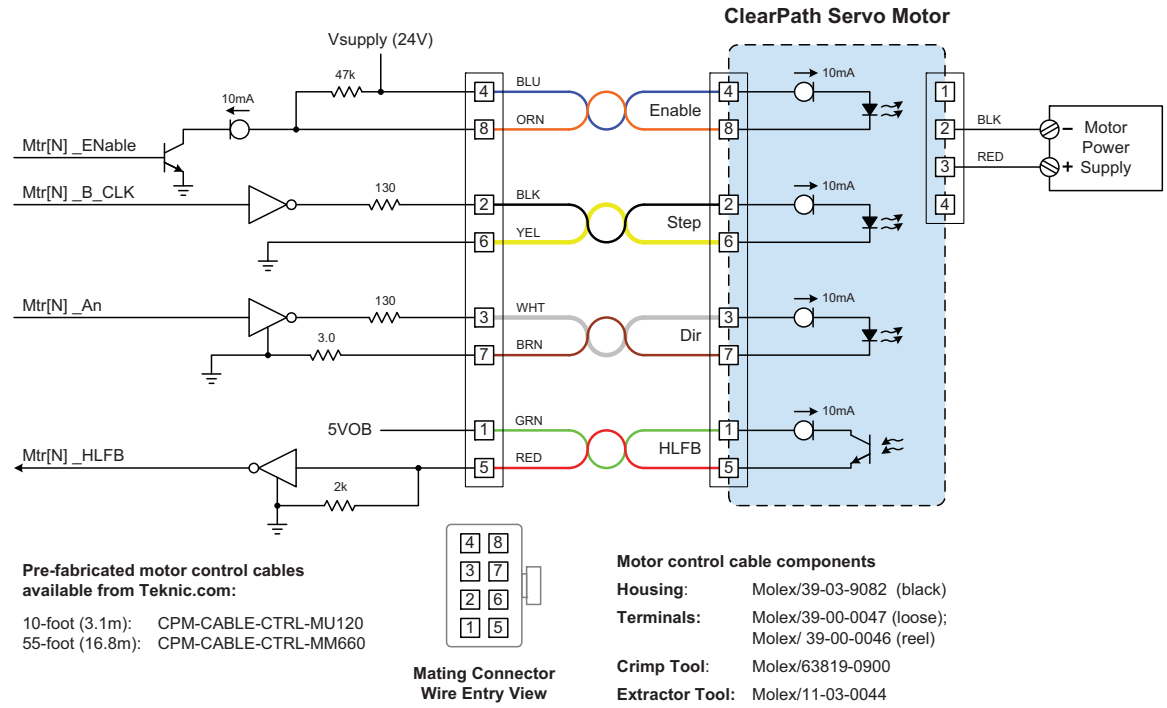
ClearPath Controller Cables

Order from Teknic. The quickest way to connect a ClearPath motor to ClearCore is with a ClearPath controller cable available from teknic.com. See links below for information and pricing.

CPM-CABLE-CTRL-MU120 *10 ft. ClearPath controller cable*

CPM-CABLE-CTRL-MM660 *55 ft. ClearPath controller cable*

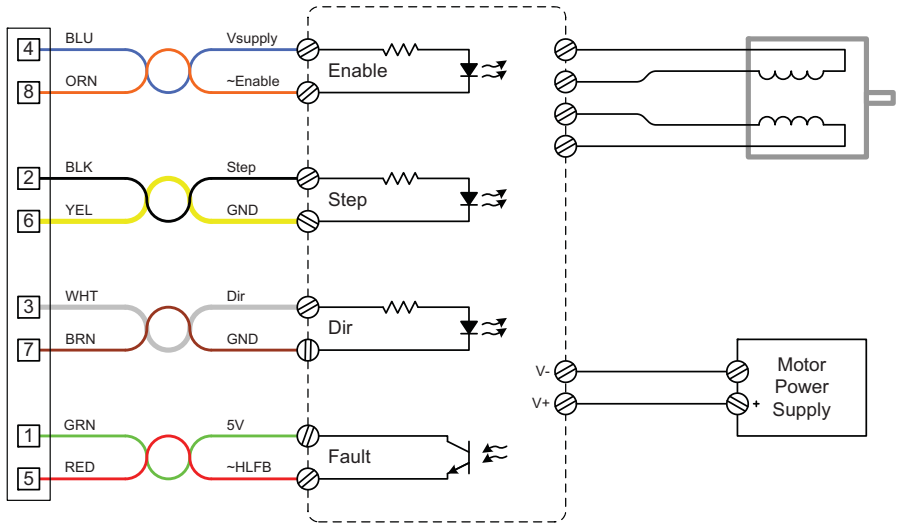
Build your own. ClearPath controller cables can also be built with off-the-shelf components available from electronics distributors like Dig-Key. See Appendix C for a full list of parts and tools required to build ClearPath controller cables.



ClearPath motor connected to ClearCore

Wiring a Stepper Motor Drive to ClearCore

Typical Stepper Motor Drive



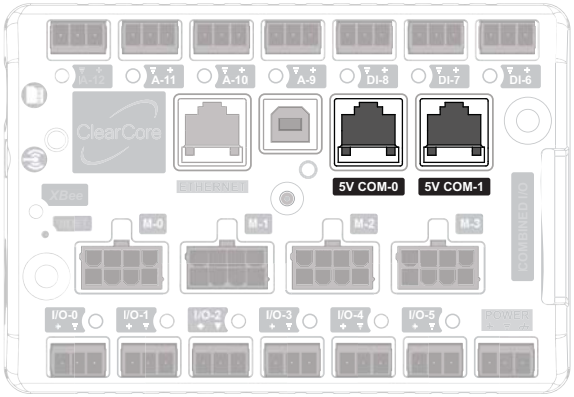
Stepper motor drive wired to ClearCore controller

Serial COM Ports (COM-0, COM-1)

ClearCore includes two multi-function serial ports: COM-0 and COM-1. These ports are accessed through RJ-45 connectors as shown below. Each port is individually configurable for use with SPI devices, UART devices, or RS-232 transceivers. Each port includes a 5V power pin to power the remote device if needed.

Notes

- The CCIO-8 (I/O expansion board) can be connected to ClearCore at COM-0 or COM-1 using a standard CAT-5e cable.
- Only one branch of CCIO-8 expansion boards is supported (i.e. you can't connect a CCIO-8 board to both ports simultaneously).



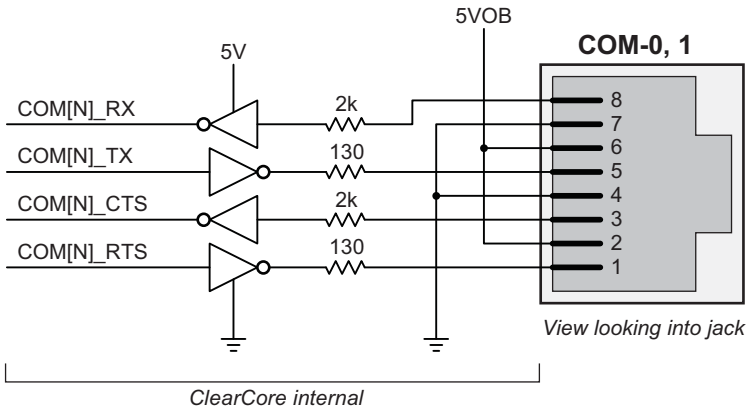
Serial Ports COM-0 and COM-1

COM-0, COM-1 with 5V compatible RS-232 transceivers

COM Port Equivalent Circuit

COM-[N] For use with 5V compatible RS-232 transceivers

(CfgCom[N]_UART_SPIn = Low, CfgCom[N]_Polarity = Hi)

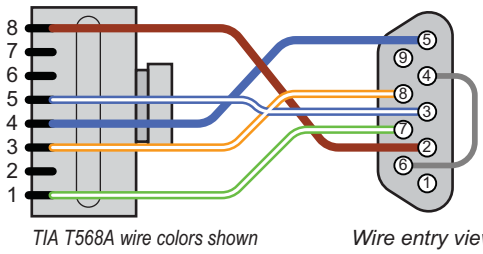


Typical Hookup Details

IMPORTANT: Mating serial ports must be compatible with 0-5V signals or a converter must be used.

DCE/Modem

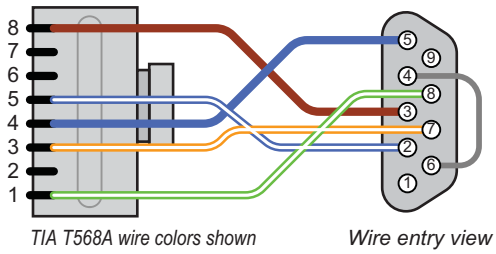
Male Connector Shown
(e.g. Amphenol/DE09P064TXLF)



TIA T568A wire colors shown *Wire entry view*

DTE/Host

Female Connector Shown
(e.g. Amphenol/DE09S064TLF)



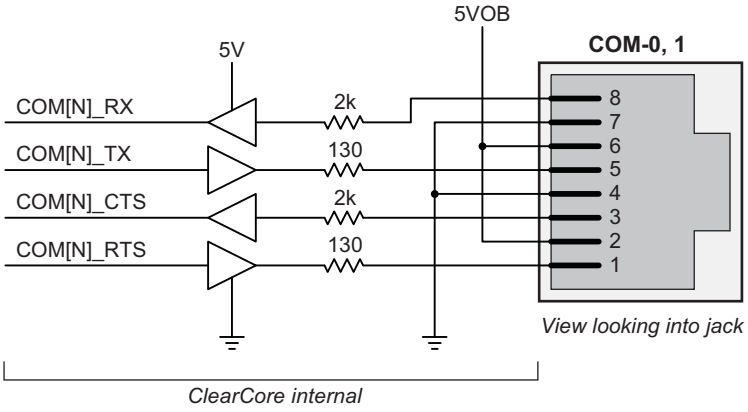
TIA T568A wire colors shown *Wire entry view*

COM-0, COM-1 configured for RS-232

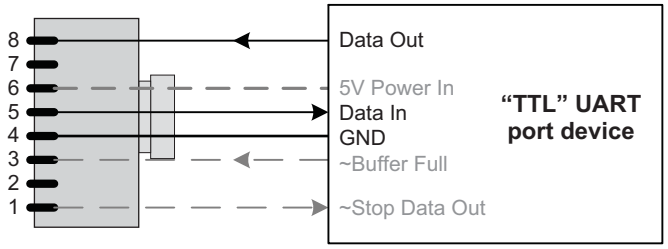
COM-0, COM-1 configured for 5V logic UART devices

COM Port Equivalent Circuit

COM-[N] For use with 5V logic UART devices (non-inverting) (CfgCom[N]_UART_SPIn = Low, CfgCom[N]_Polarity = Low)



Typical Hookup Details



- 5VOB supplies 5V power for any loads connected to COM-0 and COM-1 connectors
- 5VOB also supplies the optional XBee module if installed
- Total current available from 5VOB is 450mA
- See block diagram in appendix E for details

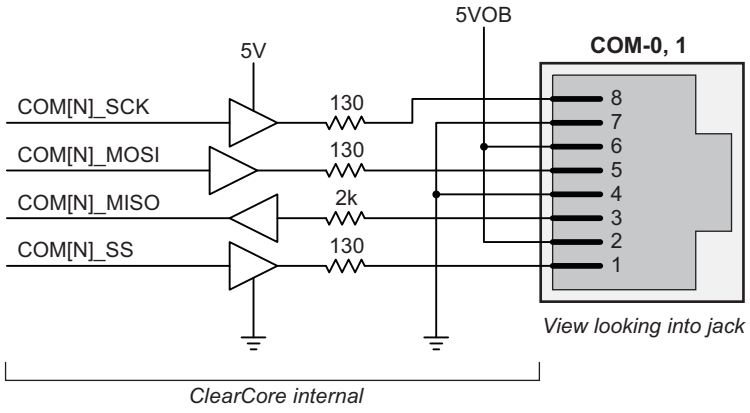
COM-0, COM-1 configured for 5V UART devices

COM-0, 1 configured for SPI devices

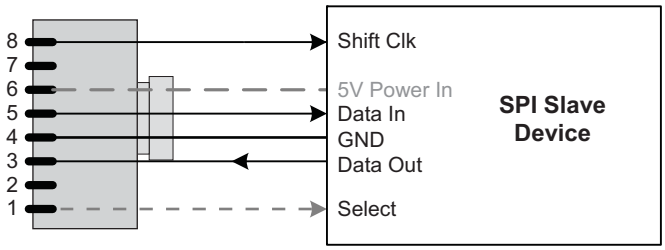
COM Port Equivalent Circuit

COM-[N] For use with SPI devices

(CfgCom[N]_UART_SPIn = Hi, CfgCom[N]_Polarity = Low)



Typical Hookup Details



- 5VOB supplies 5V power for any loads connected to COM-0 and COM-1 connectors
- 5VOB also supplies the optional XBee module if installed
- Total current available from 5VOB is 450mA
- See block diagram in appendix E for details

COM-0, COM-1 configured for use with SPI devices

Other Ports and Connectors

USB Port

The USB (type-B) serial port can be used for uploading application code as well as serial communication with a PC or other device.

Ethernet Port

ClearCore includes a 10Base-T/100Base-TX Ethernet connector to provide network connectivity to your ClearCore. Access is through a standard RJ-45 jack. Use only CAT5e cable or better (non-crossover type).

XBee Connector

Note: The ClearCore cover must be temporarily removed to install or remove an XBee module.

The following XBee modules are compatible with ClearCore. *Note: Only the **through-hole versions** of these XBee devices can be used with ClearCore.*

- Digi XBee 3
- Digi XBee Wi-Fi (S6B)
- XBee or XBee-PRO Zigbee
- XBee or XBee-PRO DigiMesh 2.4 (S2C)
- XBee or XBee-PRO 802.15.4
- XBee-PRO 900HP (S3B)

Notes

- 2G/3G and 4G-LTE cellular XBee modules ***are not compatible*** with ClearCore.
- The ClearCore's polycarbonate cover has holes and knockouts to accommodate select XBee antenna types.

JTAG Connector

An onboard JTAG connector is provided for developers who wish to connect a third-party debugging tool during development. Note: You must remove The ClearCore cover to access the JTAG connector.

Recommended debugger: Atmel p/n: **ATATMEL-ICE** (for use with Atmel Studio 7 IDE)

Cable for above debugger : TAG-Connect p/n: **TC2030-CTX-LEMTA**, 6-Pin, "plug of nails" connector that connects directly to the ClearCore board. The opposite end of this cable connects to the ICE debugger's "SAM" port.

**LEMTA option must be selected for compatibility with the Atmel-ICE debugger.*

Micro-SD Card Drive

ClearCore includes a built-in micro-SD card drive with read/write capability. Typical uses include:

- Data logging for debugging and troubleshooting
- Machine configuration data storage
- General file storage

Micro-SD Card Compatibility

Use only Micro SDHC cards (which utilize **FAT32 file systems** by default) with your ClearCore. These cards typically range from 4Gb to 32Gb of storage capacity. Micro-SD cards with file systems other than FAT32, for example **exFAT and NTFS, *will not work with ClearCore*** and must be formatted to FAT32 file systems to be compatible with ClearCore.

CL-ENCDR-DFIN Encoder Input Adapter Board

Introduction

The CL-ENCDR-DFIN encoder input adapter board lets you send externally generated encoder data to your ClearCore or ClearLink device. This accessory board is sold separately at Teknic.com.

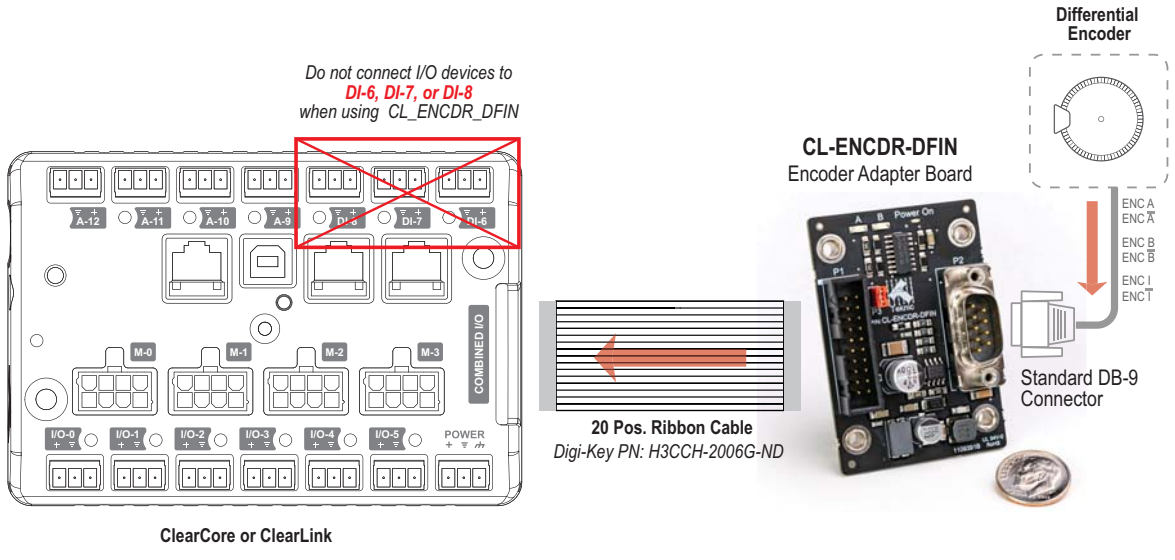
Note: CL-ENCDR-DFIN takes input from one, three-channel differential encoder only. ClearCore and ClearLink devices can receive input from one external encoder per unit.

IMPORTANT: When using CL-ENCDR-DFIN, **do not connect external I/O devices to connectors DI-6, DI-7 and DI-8 on your ClearCore or ClearLink device.** Doing so will likely result in intermittent or nonexistent encoder feedback and may permanently damage your CL-ENCDR-DFIN board.

Index channel bypass. If you do not need to use the index channel from your encoder, you may remove jumper P3 from the CL-ENCDR-DFIN board. This will allow you to use DI-8 as a standard input on your ClearCore or ClearLink.

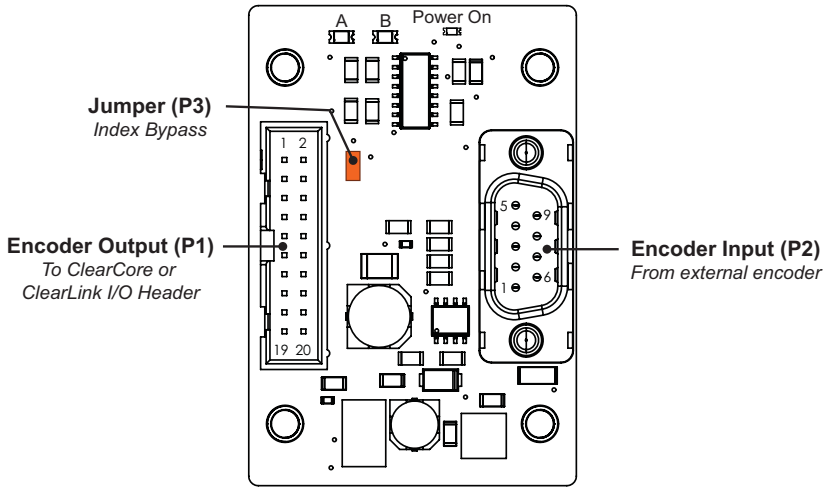
Supported encoders. Many third-party encoders with standard, 3-channel, differential output signals will work seamlessly with CL-ENCDR-DFIN. Check the encoder manufacturers specifications to verify compatibility with CL-ENCDR-DFIN before attempting to use.

For information on how to use external encoder data, see the software documentation for your ClearCore or ClearLink device.



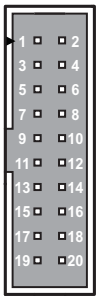
CL-ENCDR-DFIN Encoder Input Adapter Board

Connectors and Pinouts



P1 - To ClearCore or ClearLink	
Pin	**Signal Name**
1	N/C
2	N/C
3	N/C
4	GND
5	N/C
6	N/C
7	Encoder A
8	N/C
9	Encoder B
10	Encoder I
11	N/C
12	N/C
13	N/C
14	V+
15	N/C
16	GND
17	N/C
18	N/C
19	N/C
20	N/C

P1



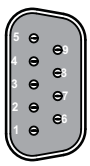
Ribbon Cable Assembly
20 Position Cable Assembly, Rectangular Socket to Socket, 0.500' (152.40mm, 6.00")
Digi-Key PN: H3CCH-2006G-ND

Mating Connector *(for use with ribbon cable)*
Housing: OST/101-206
Ribbon cable: CnC Tech/304-28-20-MC-0250F

Mating Connector *(crimp style)*
Housing: AMP/102387-4
Terminals: AMP/87756-4 (22-26AWG)

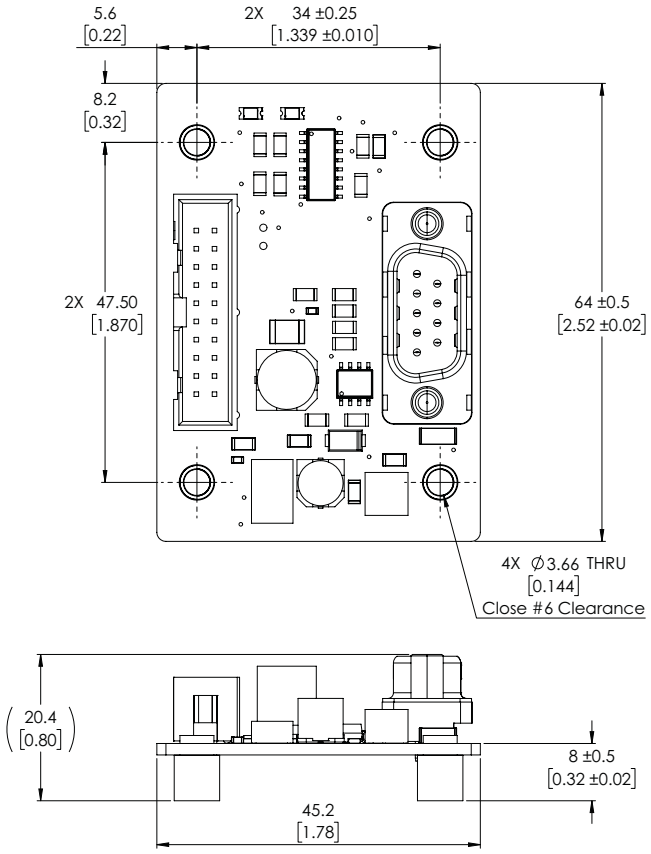
P2 - Encoder Input	
Pin	**Signal Name**
1	GND
2	I+
3	B+
4	A+
5	5V
6	I-
7	B-
8	A-
9	GND

P2



Mating Connector
Standard D-sub 9 shell, female contacts

Dimensions



Specifications

Specification	Min.	Typ.	Max.	Unit
Operating Temperature	-20		50	ºC
Count Rate			2	MHz
5V Output Current			300	mA
A, B, I Signal Termination Impedance		470		Ω
Index Capture Delay		2		uS
Common Mode Input Voltage	-7		7	V
Input Differential Hysteresis		60		mV

Appendix A: Troubleshooting

Recovering From a Crash

It is possible to crash the ClearCore's processor (see "How to Crash a ClearCore" below). During a processor crash, the blue under-glow LEDs will alternate between fully on and fully off (normally they exhibit a gradual on/off "breathing" pattern). ***Note:*** *If your ClearCore has no LEDs glowing verify that DC power is present at the ClearCore power connector.*

To recover from a processor crash, double click the ClearCore's RESET button with a paperclip or similar. This action will force the ClearCore into bootloader mode. After entering bootloader mode, upload and run a *known good program* to rule out other possible problems with the unit.

For more information on the ClearCore bootloader:

https://teknic-inc.github.io/ClearCore-library/BootloaderMain.html

How to Crash a ClearCore

- Read or write to an array address outside of the array. This can happen if, for example, a buffer array used for external communication doesn't check for a full buffer.
- Create a memory leak within the program (e.g. creating an excessive number of variables without letting them go out of scope is one way).
- Disrupt power and/or communication during program upload.
- Use the wrong external hardware (or miswire proper hardware).

Status Blink Codes

A full description of the ClearCore status blink codes is available in the ClearCore Library reference document at the following URL:

https://teknic-inc.github.io/ClearCore-library/BlinkCodes.html

Windows 7 Known Issues

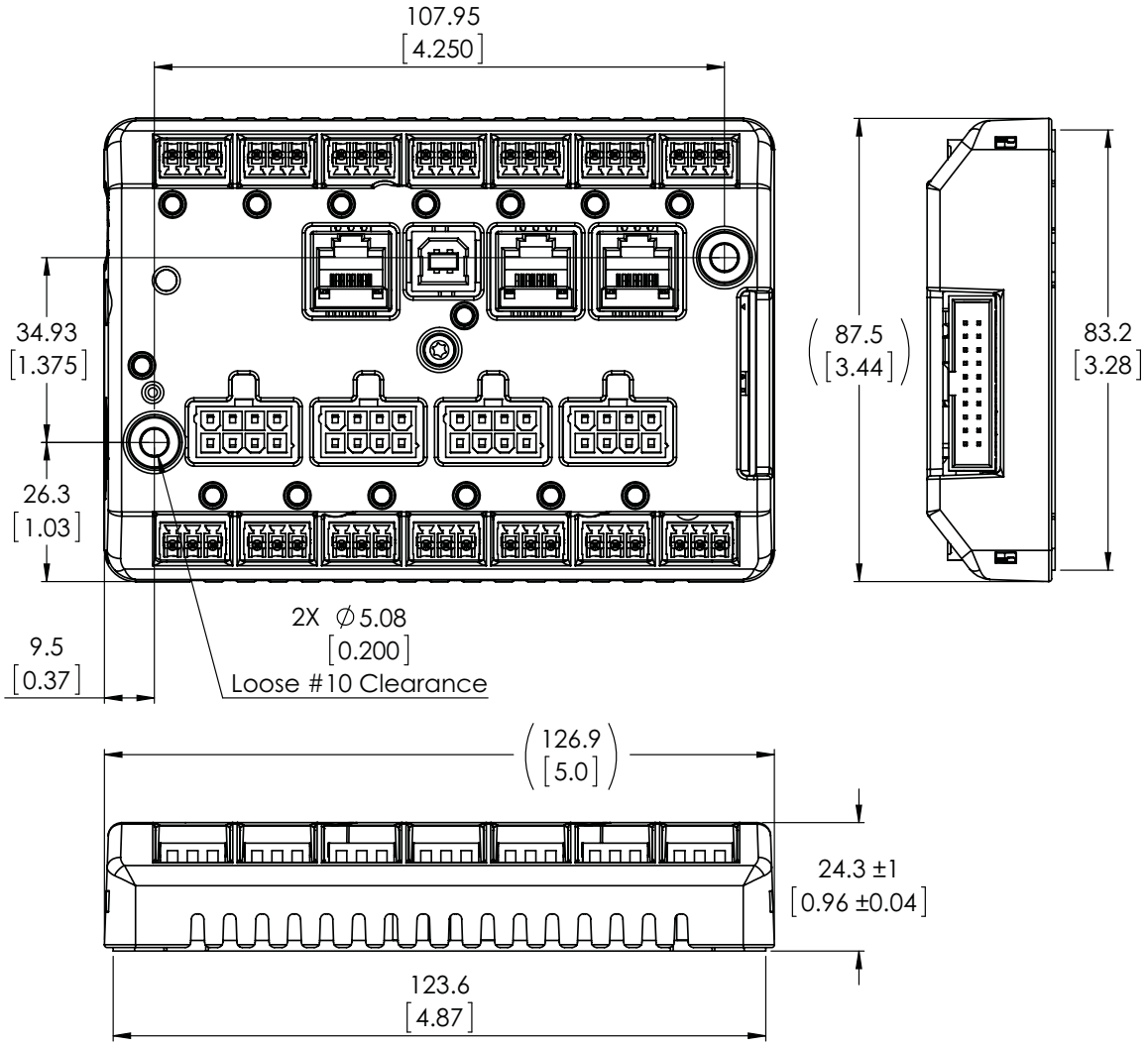
USB driver management in Win 7 may cause issues affecting code uploads to ClearCore. Manual steps may be required to upload code in these systems.

If you have issues uploading code to ClearCore using Win 7, try the following:

- Press ClearCore reset button
- Turn off USB selective suspend (this is the Windows USB power save feature). Google the above phrase for instructions
- Insert a USB 2.0 hub between the PC and ClearCore
- Load the latest USB 3.0 drivers for your PC's hardware

Appendix B: Mechanical Reference

ClearCore Mounting and Clearance Dimensions

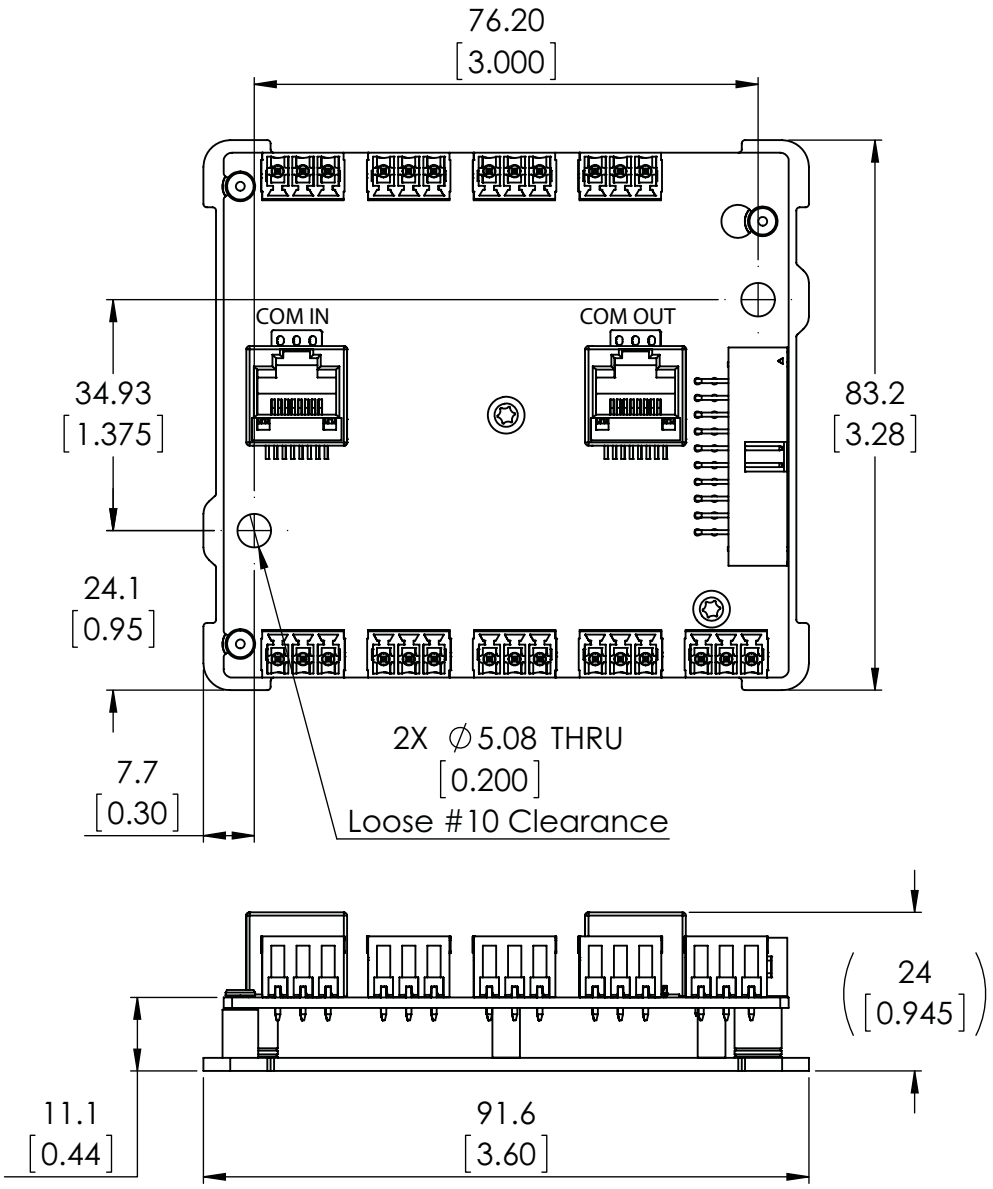


ClearCore Mounting Dimensions

ClearCore Mounting and Clearance Notes

- Leave a minimum of 1.5" (38.1mm) clearance around all ClearCore surfaces (except the mounting plate) for appropriate ventilation.
- Provide appropriate clearance for top and side-mounted cables. Note: some Ethernet and USB cables may require up to 2" clearance.

CCIO-8 Mounting and Clearance Dimensions



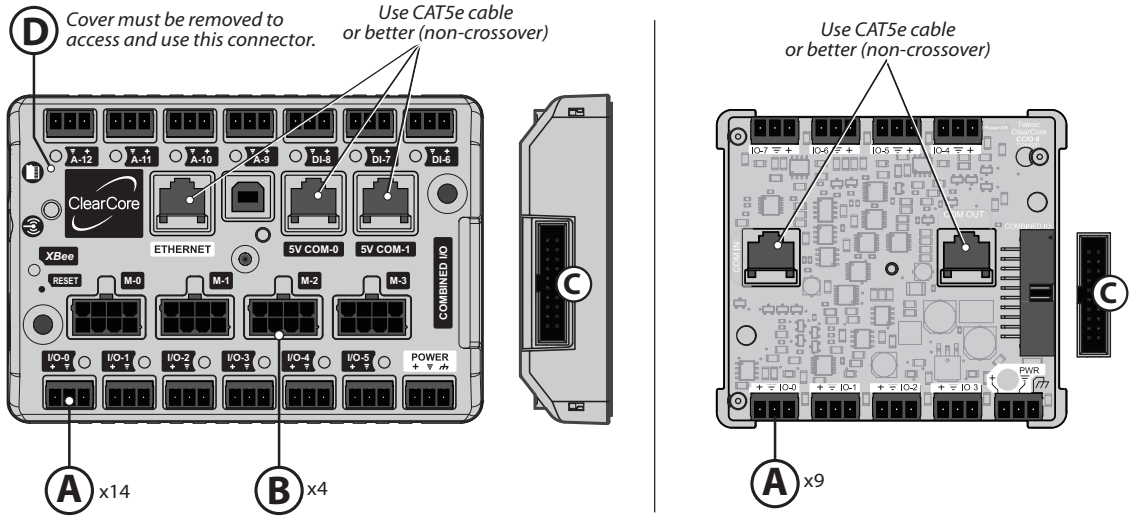
CCIO-8 Mounting Dimensions

CCIO-8 Mounting and Clearance Notes

- Leave a minimum of 1.5" (38.1mm) clearance around all CCIO-8 surfaces (except the mounting plate) for appropriate ventilation.
- Provide clearance for top and side-mounted cables. Note: some Ethernet and USB cables may require up to 2" clearance.

Appendix C: Mating Connectors and Terminals

Ref.	Mating Connector Description	Mating Connector or Cable PN	Terminal Description	Terminal PN	Tooling	Wire Gauge (AWG)
A	Screw terminal block, 3-position, 3.81mm pitch	Molex/0395105003	**OPTIONAL** Wire ferrule, 20-24 AWG, white	**OPTIONAL** American Electrical 1181050	**OPTIONAL** Crimp Tool American Electrical TRAP 22-10	20-24
B	Molex MiniFit-Jr, receptacle, 8-position	Molex part numbers: 39-01-2080 (natural, UL 94V-2) 39-01-3085 (black, UL 94V-2) 39-01-2085 (natural, UL 94V-0) 39-03-9082 (black, UL 94V-0)	Female crimp terminal, tin plate, 22-28 AWG	Molex/39-00-0046 (reel) Molex/39-00-0047 (loose)	**Crimp tool** Molex/63819-1000 --- **Extraction tool** Molex/11-03-0044	22
C	**Crimp style connector**, 20 positon, free hanging, panel mount, 0.10" (2.54mm) pitch	TE/102387-4	Socket contact, gold plate, 22-26 AWG crimp	TE/87756-4	**Crimp tool** TE/169481-1	22-26
	Ribbon cable connector, 20-position, IDC, gold finish	**Connector** OST/101-206 **Ribbon cable stock** CnC Tech/304-28-20-MC-0250F	N/A	N/A	N/A	N/A
D	JTAG, 6-pin, "Plug-Of-Nails" connector for ARM CORTEX SWD (single wire debug) applications	**Teknic cable part number:** P/N **TC2030-CTX-LEMTA** **for use with Atmel ICE debugger** P/N **ATATMEL-ICE-BASIC.**	N/A			



Appendix D: Specifications

ClearCore Specifications

Mechanical	
Dimensions	5.0" x 3.5" x 1.0" (127mm x 88.9mm x 25.4mm)
Weight (with cover)	0.41 lbs (186 g)
Material	3mm thick polycarbonate cover, aluminum mount frame
Electrical	
Voltage Input	20-28 VDC (24VDC nominal)
Output Current Capability	I/O 0,1,2,3 - 375 mA RMS, (750 mA peak) I/O 4,5 - 750 mA RMS, (1000 mA peak)
Indicator LEDs for each input	yes
IP rating	IP20
Operating Temperature/Humidity	-20C to 50C, 0-90% non-condensing
Storage Temperature	-40C to 85C
Power Consumption	300mA@24V Adding an XBee will add as much as an additional 100mA@24V
Protection features	Overcurrent protection on all outputs Inductive clamping on all outputs Board master overvoltage and overcurrent protection ESD protection features on all I/O circuits
Capacitive load (max.)	Capacitance on I/O-0 through I/O-5 (and expansion port power pins) collectively may not to exceed 250uF.
Processing/Communication	
Total I/O	13 built-in I/O points, software configurable as any combination of up to 13 digital inputs, 4 analog inputs, 6 digital outputs, 2 H-Bridge/speaker outputs and 1 analog output (4-20mA or 0-20mA). See I/O table below. Another 64 digital I/O can be added by using optional 8-point I/O expansion modules (p/n CCIO-8).
Serial communication	2 Multi-functional, individually configurable serial ports that can be used as a UART, SPI, or RS-232 at up to 115.2kBaud. Rates up to 2MBaud are achievable depending on cable length, slave transceiver circuit and grounding. 5V power pins are available on each port.
Ethernet	10Base-T/100Base-TX Ethernet
USB	USB 2.0
Wireless connectivity	Accepts Xbee modules for wireless connectivity (Wi-Fi, Bluetooth, Mesh, etc.)
Programming Language	C++
Recommended IDE	Microchip Studio 7 (or higher), or Arduino IDE 1.8.x (or higher) if used with the ClearCore Arduino Wrapper Library.
Memory Capability	512 KB Flash 192 KB RAM Storage expansion via onboard SD card drive
Supported development environment	Windows 10, Windows 7* (see note)

Processor type and speed	32 bit floating point ARM M4F processor 120 MHz (p/n SAME53N19A)
Max Step Rate	500kHz
	* Win 7 note: *USB driver management in Windows 7 causes issues in some installations which affect the uploading of code to ClearCore. Extra manual steps may be required to upload code in these systems.*
Compliance	
	CE, RoHS
I/O Function Table	

Label	Digital Input	Digital Output[1]	0-10V Analog Input	4-20 mA Output[2]	Servos or Steppers	Speaker Tones	DC Motor Drive
IO-0	yes	yes		yes			
IO-1	yes	yes					
IO-2	yes	yes					
IO-3	yes	yes					
IO-4	yes	yes				yes	yes
IO-5	yes	yes				yes	yes
DI-6	yes						
DI-7	yes						
DI-8	yes						
A-9	yes		yes				
A-10	yes		yes				
A-11	yes		yes				
A-12	yes		yes				
M-0					yes[3]		
M-1					yes[3]		
M-2					yes[3]		
M-3					yes[3]		
CCIO-8[4]	yes	yes					

Note 1: All digital outputs are PWM capable (except for those on the CCIO-8 expansion board).

Note 2: This output can also provide 0-20mA, which is less commonly used.

Note 3: Each motor connector has 3 digital outputs (step, dir., enable) and 1 digital input.

Note 4: There are 8 of these I/O points on the CCIO-8 expansion module.

CCIO-8 Specifications

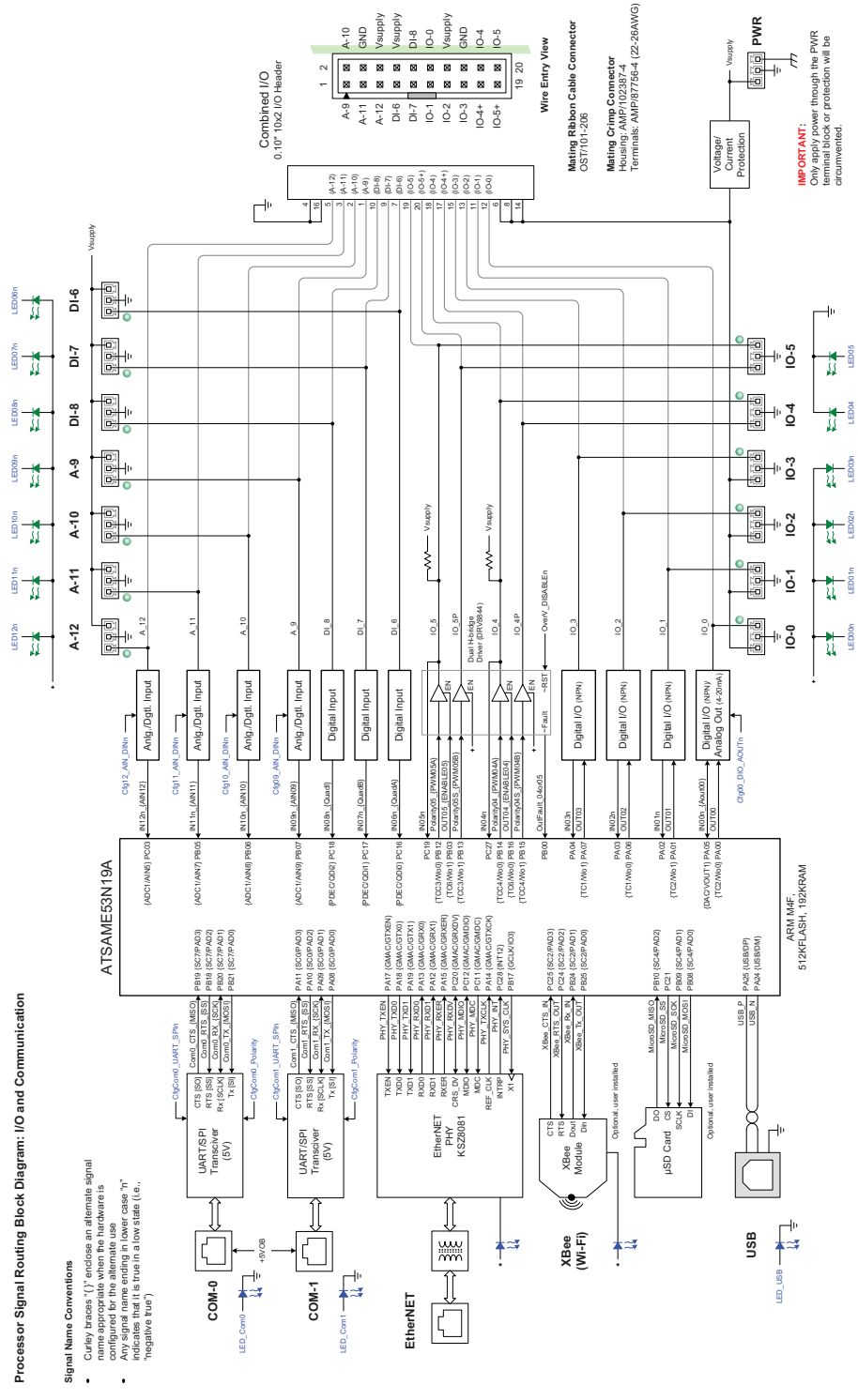
Mechanical	
Dimensions	3.6" x 3.28" x 1.0" (91.5mm x 83.3mm x 25.4mm)
Weight	3.18 oz. (90 g)
Material	Assembled circuit board with aluminum mount frame
Electrical	
Voltage Input	20-28 VDC
Output Current Capability	All I/O points 375mA RMS (750mA peak)
Indicator LEDs for each input	Yes
IP Rating	IP20
Operating Temperature/Humidity	-20C to 50C, 0-90% non-condensing
Storage Temperature	-40C to 85C
Power Consumption	100mA@24V or 150mA@12V
Protection Features	Overcurrent protection on all outputs Inductive clamping on all outputs ESD protection features on all I/O circuits
Processing / Communication	
Total I/O	***Note:*** *All I/O points on CCIO-8 are electrically identical to I/O-1, I/O-2, and I/O-3 on ClearCore/ClearLink.* 8 built-in I/O points, software configurable as any combination of up to 8 digital inputs and 8 digital outputs. A total of 8 CCIO-8 boards can be connected to one ClearCore, for a total of 64 additional digital I/O points. All configuration of I/O hardware is controlled by software, i.e., there are no jumpers, DIP switches, trim-pots, etc.
I/O Update Rate	0.2mS (1-2 boards), 0.4mS (3-4 boards), 0.6mS (5-6 boards), 0.8mS (7-8 boards)
Connectivity	ClearCore connects to "COM IN" of the first CCIO-8. Any additional CCIO-8 boards are connected COM OUT -> COM IN. Use CAT5e cable (non-crossover) or better. Max cable length = 100 feet.
Compliance	
	CE, RoHS

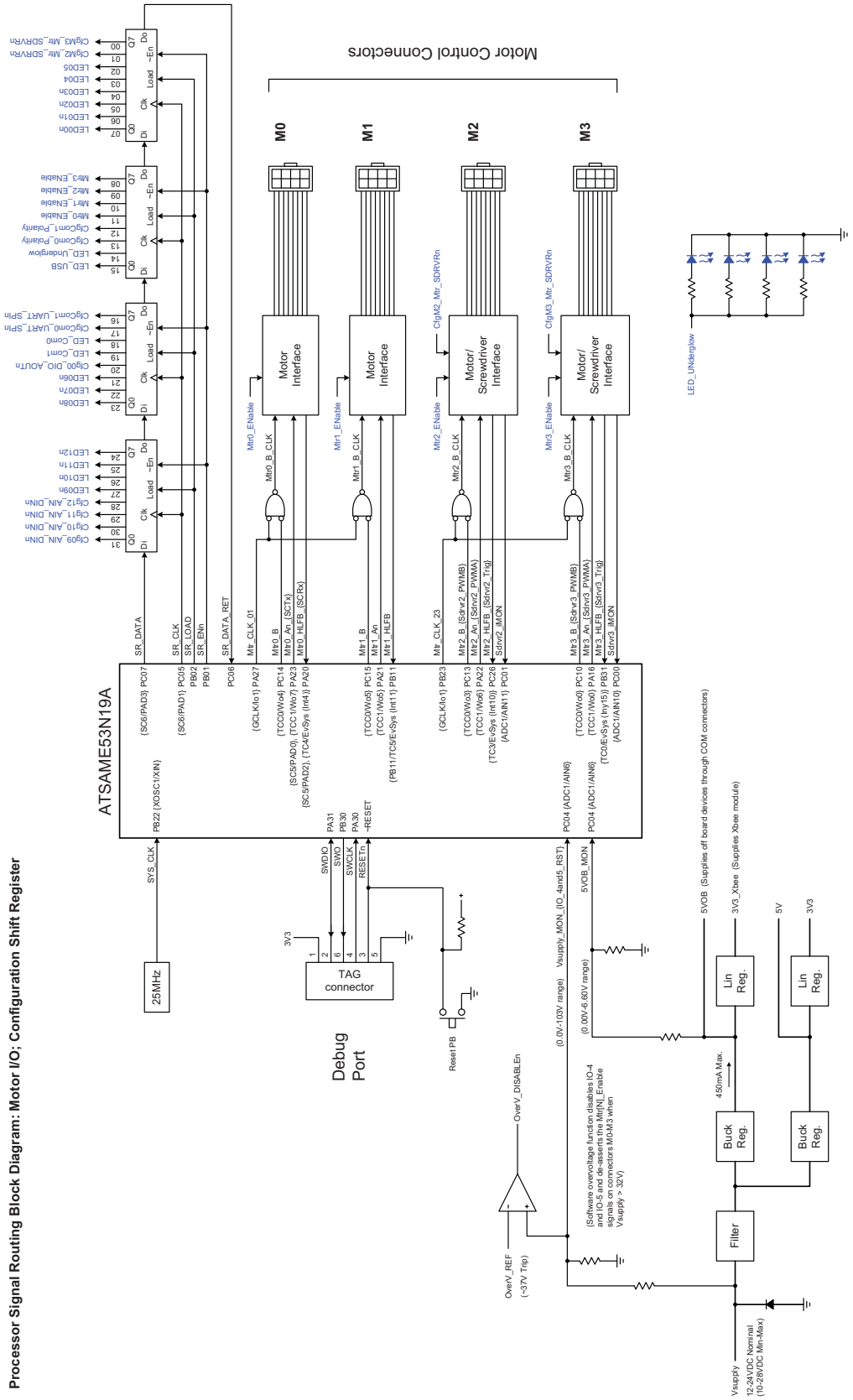
I/O Function Table

Label	Digital Input	Digital Output[1]	0-10V Analog Input	4-20 mA Output	Servos or Steppers	Speaker Tones	DC Motor Drive
I/O-0	yes	yes					
I/O-1	yes	yes					
I/O-2	yes	yes					
I/O-3	yes	yes					
I/O-4	yes	yes					
I/O-5	yes	yes					
I/O-6	yes	yes					
I/O-7	yes	yes					

Note 1: Digital outputs on CCIO-8 are not PWM capable.

Appendix E: Processor Signal Routing Schematics




Motor Control Connectors
M0
M1
M2
M3
Motor Interface
Motor/ Screwdriver Interface
ATSAME53N19A
SR_DATA
SR_CLK
SR_LOAD
SR_ENn
SR_DATA_RET
Mtr_CLK_01
Mtr_CLK_23
Mtr0_ENable
Mtr1_ENable
Mtr2_ENable
Mtr3_ENable
Mtr0_B_CLK
Mtr1_B_CLK
Mtr2_B_CLK
Mtr3_B_CLK
CfgM2_Mtr_SDRVRn
CfgM3_Mtr_SDRVRn
LED_UNderglow
SYS_CLK
25MHz
SWDIO
SWO
SWCLK
RESETn
-RESET
TAG connector
3V3
Debug Port
Reset PB
OverV_DISABLEn
OverV_REF
(~37V Trip)
Vsupply_MON_(IO_4and5_RST)
5VOB_MON
(0.0V-103V range)
(0.00V-6.60V range)
(Software overvoltage function disables IO-4 and IO-5 and de-asserts the Mtr[N]_Enable signals on connectors M0-M3 when Vsupply > 32V)
5VOB (Supplies off board devices through COM connectors)
3V3_Xbee (Supplies Xbee module)
450mA Max.
Lin Reg.
Buck Reg.
Filter
5V
3V3
Vsupply
12-24VDC Nominal
(10-28VDC Min-Max)
Processor Signal Routing Block Diagram: Motor I/O; Configuration Shift Register

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