Overview:
ClearCore is an industrial quality, I/O and Motion Mini-Controller with numerous wired/wireless connectivity options. When compared to PLCs, custom control boards, and embedded PCs, ClearCore’s hardware and software features reduce the engineering and manufacturing costs of machine controls.

Features:
- Robust electrical hardware with numerous protection features minimize problems during commissioning and in the field.
- All I/O points are compatible with 24V industrial sensors and actuators as well as 3.3-5.0V logic.
- Individual plug terminal blocks for each I/O point include signal and power pins to minimize the need for external wiring devices and harnessing effort.
- All configuration of the I/O and communication port hardware is controlled by software, i.e., no jumpers, DIP switches, trim-pots, etc. need to be manually set.
- C++ HAL interface libraries speed embedded development.
- Rapid machine prototyping is supported by the optional Arduino wrapper libraries.
- The 13 built-in I/O points are configurable as any combination of up to 13 digital inputs, 4 analog inputs, 6 digital outputs, 2 speaker outputs and 1 analog output (0-20mA or 4-20mA).
- Four (4) motor control ports directly control ClearPath® all-in-one servo motors for simplified motion control integration. These ports are also compatible with popular step motor drives.
- I/O can be expanded up to 77 points total using optional CCIO-8, 8-point expansion modules.
- Outputs can directly drive resistive or inductive loads up to 9W.
- Two multi-functional serial ports, individually configurable for use with SPI or UART devices; (each port includes 5V power pins for the remote device, where necessary).
- Included 10Base-T/100Base-TX Ethernet port.
- Accepts Xbee modules for wireless connectivity (Mesh, Wi-fi, Bluetooth, etc.). Think IoT.
- Powered by a single 12-24VDC supply.
- SD card support for data logging, machine configuration data, and disk emulation.
- 32-bit floating point ARM M4F processor @120MHz with 512KB FLASH and 192KB RAM
### Input Equivalent Circuit

<table>
<thead>
<tr>
<th>A/D</th>
<th>A-9 through A-12 configured as analog inputs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( От (НН), AIN_00n = Hi )</td>
</tr>
<tr>
<td>A/D</td>
<td>A-9 through A-12 configured as analog inputs</td>
</tr>
<tr>
<td>0-10V</td>
<td>Vsupply (12-24V)</td>
</tr>
<tr>
<td>30k</td>
<td>Vsupply (12-24V)</td>
</tr>
</tbody>
</table>

#### Typical Sensor Hookup Details

<table>
<thead>
<tr>
<th>Sensor</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>499 Ohm shunt resistor</td>
<td>Close to input terminal block.</td>
</tr>
<tr>
<td>Note:</td>
<td></td>
</tr>
<tr>
<td>IMPORTANT:</td>
<td>Inputs are “negative true”: On&lt;~1.0V, Off&gt;=~1.0V</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Digital “NPN” Sensor</th>
<th>Proximity, Optical, Hall-Effect, etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switch or Relay Contact</td>
<td>5V3.3V Logic System</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Digital “PNP” Sensor</th>
<th>Proximity, Optical, Hall-Effect, etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switch or Relay Contact</td>
<td>5V3.3V Logic System</td>
</tr>
</tbody>
</table>

#### Recommended wire gauge range: 20AWG - 24AWG (0.8mm - 0.5mm)

- **Mating Plug Terminal Block:** Molex/0395105003 (3.81mm pitch)
- **Recommended Ferrule:** American Electrical/1181050 (20-24AWG)
- **Recommended Ferrule Crimp Tool:** American Electrical/TRAP 22-10

<table>
<thead>
<tr>
<th>Analog Sensor (Transducer)</th>
<th>Examples:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure, Force, Torque, Temperature, Angle, Indication, Distance, Level, Velocity, Acceleration, Mass Flow, Electric Current</td>
<td></td>
</tr>
</tbody>
</table>

Sensor Notes:
1. 0-5V output sensors can be used with loss of 1 bit of resolution (provided they are compatible with Vsupply).
2. 0-20mA sensors can be used with some loss of linearity near zero current (sensor dependent).
# Output Equivalent Circuit

**IO-0 through IO-5 configured as digital outputs**

- Vsupply (12-24V)
- OUT[NN]
- IMPORTANT: Outputs are “negative true”: On state turns on transistor, enabling current in load, pulling output <0.5V

- Relay
- Contactor
- Pneumatic Valve
- Fluid Valve

- Vacuum Valve
- Solenoid Guard Lock
- Solenoid Actuator (e.g., diverter)

- DC Motor, Pump, etc. (single direction)

- IMPORTANT:
  - Outputs are “negative true”: On state turns on transistor, enabling current in load, pulling output <0.5V
  - Maximum RMS current must not exceed 1A

## Typical Actuator Hookup Details

**IO-4 or IO-5 configured as variable bi-directional drive (PWM)**

- Vsupply (12-24V)
- POLARITY[NN]
- H-bridge
- 1.0A Max.
- OUT[NN]
- 1.0A Max.

**Average output voltage =**

\[ V_{supply} \times \text{(Duty Cycle of PolarityS - Duty Cycle of Polarity)} \]

- Loudspeaker/Shaker
- DC Motor, Pump, etc. (Fwd/rev direction)
- Galvanometer

**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_DISABLE signal

## Analog Actuator Examples:
- Damper control
- Proportional valve
- Pressure regulator
- Rotary position actuator
- Process meter (display)
- Variable speed drive

**IO-0 when configured as a 4-20mA analog output (0-20mA optional)**

- Vsupply
- GND
- 2-wire Control

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

- IMPORTANT:
  - The sum of the output currents for all outputs (IO-0 through IO-5) must not exceed 2.5A RMS

**Recommended wire gauge range:**
- 20AWG - 24AWG (0.8mm - 0.5mm)

**Mating Plug Terminal Block:**
- Molex/0395105003 (3.81mm pitch)

**Recommended Ferrule:**
- American Electrical/1181050 (20-24AWG)

**Recommended Ferrule Crimp Tool:**
- American Electrical/TRAP 22-10

**Analog Actuator Examples:**
- Damper control
- Proportional valve
- Pressure regulator
- Rotary position actuator
- Process meter (display)
- Variable speed drive
**ClearCore**

**COM Port Equivalent Circuits**

| **COM-[N]** For use with 5V compatible RS-232 transceivers  
(CfgCom[N]_UART_SPIn = Low, CfgCom[N]_Polarity = HS) |
|------------------------------------------------------|
| ![Diagram](image1)  
**View looking into jack** |

**DCE/Modem**

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

**Wire entry view** (i.e., opposite of mating side) shown for all connectors; TIA T568A wire colors shown

**IMPORTANT**: Mating serial port must be compatible with 0-5V signals (or a converter must be used)

| **COM-[N]** For use with 5V logic UART devices  
(non-inverting)  
(CfgCom[N]_UART_SPIn = Low, CfgCom[N]_Polarity = Low) |
|------------------------------------------------------|
| ![Diagram](image2)  
**View looking into jack** |

5VOB Supplies 5V power for any loads connected to the COM-0 and COM-1 connectors. 5VOB also supplies the Xbee module when installed. The total current available from 5VOB is 450mA. (See block diagram on page 7.)

| **COM-[N]** For use with SPI devices  
(CfgCom[N]_UART_SPIn = Hi, CfgCom[N]_Polarity = Low) |
|------------------------------------------------------|
| ![Diagram](image3)  
**View looking into jack** |

5VOB Supplies 5V power for any loads connected to the COM-0 and COM-1 connectors. 5VOB also supplies the Xbee module when installed. The total current available from 5VOB is 450mA. (See block diagram on page 7.)

| **Common Cat-5 Patch Cable**  
Wire Colors |
|-----------------|

**T568A Wire Colors**

- Brown
- White/Brown
- Orange
- White/Blue
- Blue
- White/Orange
- Green
- White/Green

**T568B Wire Colors**

- Brown
- White/Brown
- Green
- White
- Blue
- White/Blue
- Orange
- White/Orange
Pre-fabricated motor control cables available from Teknic.com:

- 10-foot (3.1m): CPM-CABLE-CTRL-MU120
- 55-foot (16.8m): CPM-CABLE-CTRL-MM650

Motor control cable components

- Housing: Molex/35-03-9082 (black)
- Terminals: Molex/35-05-0047 (loose); Molex 38-05-0046 (rash)
- Crimp Tool: Molex/63819-0900
- Extractor Tool: Molex/11-03-0044

IMPORTANT!

Do not power the ClearCore from the motor power supply. Regenerated power from the motor drives will raise the supply voltage causing ClearCore shutdown events.
Removing the cover

Connecting a debugger using a TAG-Connect cable

Installing an Xbee Module
ATSAME53N19A

Signal Name Conventions
- Curly braces "{}" enclose an alternate signal name appropriate when the hardware is configured for the alternate use
- Any signal name ending in lowercase "n" indicates that it is true in a low state (i.e., "negative true")

LED06n LED07n LED08n LED09n LED10n LED11n LED12n

Processor Signal Routing Block Diagram: I/O and Communication