HiCON Integra – 7800 Series

7866 & 7854 Motion Controllers

Ethernet Motion Controller

User Guide

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Atlanta, Georgia USA

For more information please visit the product web page:
www.vitalsystem.com/integra

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License Agreement

Before using the HiCON and accompanying software tools, please take a moment to go thru this License agreement. Any use of this hardware and software indicate your acceptance to this agreement.

It is the nature of all machine tools that they are dangerous devices. In order to be permitted to use HiCON on any machine you must agree to the following license:

I agree that no-one other than the owner of this machine, will, under any circumstances be responsible, for the operation, safety, and use of this machine. I agree there is no situation under which I would consider Vital Systems, or any of its distributors to be responsible for any losses, damages, or other misfortunes suffered through the use of the HiCON board and its software. I understand that the HiCON board is very complex, and though the engineers make every effort to achieve a bug free environment, that I will hold no-one other than myself responsible for mistakes, errors, material loss, personal damages, secondary damages, faults or errors of any kind, caused by any circumstance, any bugs, or any undesired response by the board and its software while running my machine or device.

I fully accept all responsibility for the operation of this machine while under the control of HiCON, and for its operation by others who may use the machine. It is my responsibility to warn any others who may operate any device under the control of HiCON board of the limitations so imposed.

I fully accept the above statements, and I will comply at all times with standard operating procedures and safety requirements pertinent to my area or country, and will endeavor to ensure the safety of all operators, as well as anyone near or in the area of my machine.

WARNING: Machines in motion can be extremely dangerous! It is the responsibility of the user to design effective error handling and safety protection as part of the system. VITAL Systems shall not be liable or responsible for any incidental or consequential damages. By using the HICON motion controller, you agree to the license agreement.

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1. Overview

The HiCON Integra is an Ethernet based controller for motion control, data acquisition, and general PID control system applications. Utilizing the latest Microchip technology, the HiCON Integra offers a comprehensive set of features for your demanding applications.

HiCON Integra can be applied in a variety of applications involving PC based Motion Control, Storage and Retrieval Systems and CNC Milling / Lathe Machines. Equipped with a rich set of hardware interfaces, it can also be used for wide variety of applications involving PID control, e.g., speed, oven temperature control and so on.

Key Features

- 3 Quadrature encoder inputs (Expandable to 9). 1 Differential (5V) and 8 Single-Ended (3.3V).
- 6Mhz Max Encoder frequency. Encoder resolution multiplied by 4 thru Hardware.
- Up to 6 Step and Direction Channels. Up to 2MHz Step Frequencies
- Optional 2 Channel Analog Inputs, Range 0 - 3.3Volts, 10-bit Resolution
- Up to 79 Digital I/O (55 Inputs & 24 Outputs) and 3 Relay outputs
- Industrial grade metal enclosure
- Ethernet 100Mb connectivity using TCP/IP interface.
- Simple UDP Socket Programming Interface for custom programming using software library.
- VSI Motion Control native API library for Custom Software development (C++, C# and VB.Net).
- Standalone Operation by programming the unit with C or BASIC programming language.

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NOTE: ***7866 Offers 6 Motors Step/Dir channels. 7854 supports 4 Motor channels.***

Compatibility Requirements:

- Drives can be stepper or servo types, but they must be able to take Step and Direction (digital) command signals. This is also referred to as "Position mode" in some drive manuals.
- Encoders can be rotary, linear, etc. as long as they have Quadrature TTL signal outputs. HiCON Integra uses both Single-ended and Differential signal types.

The table below shows the typical pins that are used for both types of Quadrature signals.

5V Differential Quadrature Signal Pins
GND
+5V
Z-
Z+
B-
B+
A-
A+

5V Single-ended Quadrature Signal Pins
GND
+5V
Z
B
A

Extremely Important Reminder

Extreme precautions must be observed when operating machinery. Machines are known to have enormous power even with a small motor. Never come within a machine's path while powered.
Failure to observe caution while operating machines can result in severe injuries or even death.

NOTE: *Several notes such as this can be found throughout this document which list key points and comments worth remembering.*

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2. Electrical Specifications

General Specifications	
Power requirements, J1	+18V to +26V , 5W
Operational temperature	-10 to +50 deg C
Humidity	20 – 90 % RH, non-condensing
Overall Dimensions	18.2 x 12.2 x 2.5 cm (L x W x H)
Processor	FPGA, 32 Bit CPU
Communication	10/100 Base-T Ethernet with Auto MDIX
Position Range	64-bit
+5V (J6, J7, J8) power from Controller	**You may draw max 150mA (Combined)**
+3.3V power from Controller	**You may draw max 100mA**
Do not connect any power supply to +5V or 3.3v terminals.	
J2, J3, J4 (Step and Direction)	
Differential Pairs S+/S- and D+/D-	+5V, max 20mA per pin
Max frequency per channel	2Mhz
J5 (Ethernet)	
RJ-45 receptacle	10/100 Base-T Ethernet with Auto MDIX
J6 (Single-ended encoder input. Analog Inputs 0 and 1)	
+5V Supply for external devices	See General Specifications[1]
Single ended encoder input - 2Z, 2B, 2A	+3.3V (TTL), +3V to +3.45V max input voltage
Analog Inputs - AN0, AN1	0 – 3.3V max input voltage range
+3.3V Supply for external devices	See General Specifications[1]
GND	Common Ground 0V
J7 and J8 (Digital I/O)	
Pin 1	0V Ground
Pin 2 - Pin 9	Outputs 0 - 3.3V max, Active low, sinking type - 12mA. Internal pull up to 3.3V
Pin 10 – Pin 25	Inputs 3.3V, 3V – 3.45V. Internal pull up to 3.3V
Pin 26, Supply for external devices	+5V, See General Specifications[1]

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J9 (Estop Input)	
+24V	+24V output (This is coming from J1. Do not connect another power supply here)
Estop input	18V to 26V max (For normal operation)
	Note: Any voltage below 18V will trigger emergency shutdown
J10 (Pendent/MPG)	
Pin1: +5V for external devices.	See General Specifications[1]
Pin 2, 3: Single Ended Encoder A, B Signals	0-3.5V max.
Pin 5, 6,7 ,8 ,9, 10, 12, 13, 14,15 Digital Inputs	0-3.5V max.
Special Function: Force to bootloader mode	Short Pin 4 and 9 on DB15 and cycle power
J11 (Differential Encoder)	
GND	Common ground, 0V
+5V	See General Specifications[1]
Differential encoder pairs A+/A-, B+/B-, Z+/Z-	0v to +5V max (TTL)
J12 (Relays and 0-10V analog output for VFDs)	
RL1, RL2, RL3	Relay Dry Contacts, Normally Open
	Max switching voltage 36V, Max Switch Current 1A
Analog 0-10V	0 – 10V Analog Output, 25mA
J13 (NPN Inputs)	
Pin 8 - 15	Opto-Coupled, max sink current 5mA
J14 (PNP Inputs)	
Pin 0 - 7	Opto-Coupled, max input current 5mA @24V
J15 (NPN & PNP Outputs)	
Pin 0 - 3	NPN Sinking Output Max 300mA
Pin 4 – 7	24V, PNP Output Max 300mA

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J16 (Additional 24V and GND)	
24V Power for external devices	+24V Power Supplied by J1, Current limited to 500mA
GND	Common ground, 0V

3. Software Components

3.1 HiCON Mach4/MachPro Plugin Setup

To use the HiCON plugin for Mach4 or MachPro, download the ZIP file and extract or copy its contents into the **Plugins** folder of your Mach4/MachPro installation directory. When you launch Mach4 or MachPro, the software will detect multiple available plugins and display a prompt that includes the HiCON plugin in the list.
For detailed step-by-step instructions, refer to the link below:

- HiCON Mach Software Integration

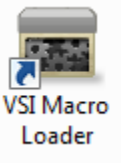
3.2 VSI Device Manager

In order to change or update the firmware installed on the HiCON, or activate features, you will have to install the VSI Device Manager application. For instructions on using the program, see the provided manual.

Extended Features:

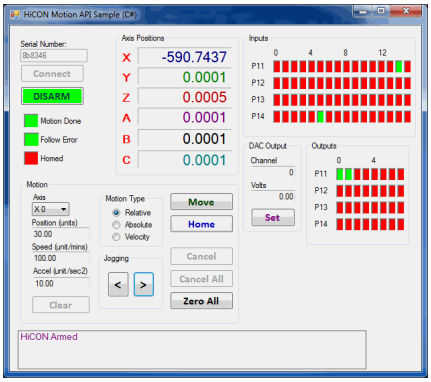
- Extended I/O – Modifies J7 and J8 for an additional 32 Inputs and 16 Outputs. Default number of I/O is 23 inputs, 8 outputs, and 5 relay outputs.
- Basic Macro – Allows the use of HiCON Basic Programs for standalone operation.
- Analog Input – Allows the use of Analog Inputs (0 – 3.3V).
- Closed Loop Encoder Feedback – Allows the use of Encoder Channels 3 – 8 for axis position feedback (also activates the Extended I/O activation).
- Torch Height Control – Automatic Torch height positioning for plasma cutting applications
- Synced Outputs – Allows the utilization of the Synced outputs feature in Mach4/MachPro. This allows digital outputs to be set ON or OFF at a precise position during GCode execution (useful for lasers).
- Rigid Tap – Allows the use of rigid tapping in Mach4/MachPro.

3.3 VSI Macro Loader



VSI Macro Loader is an application that is used to install and debug the HiCON Basic Program on the HiCON controller. The user can select the HiCON Basic file (.bas file) and download it to the controller. After launching the HiCON Basic program, the user can see the print statement outputs on the output window.

3.4 Custom Software Application with HiCON



Custom Windows applications can be created using the **VSI Motion Control API** library. The Library is an API designed to allow communication (via Ethernet) using commands to arm/disarm, control and read I/O, and command motion among others. Sample applications and a user guide may be found here.

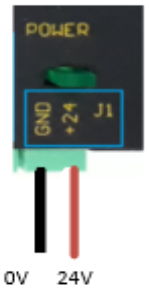
4. Quick Start Guide

The following steps are provided to give the user a basic step-by-step guide for wiring the Integra on a target machine. These instructions assume that the user has some knowledge about working with electrical wiring, adequate knowledge about the target machine, and has some experience with building or retrofitting CNC machines.

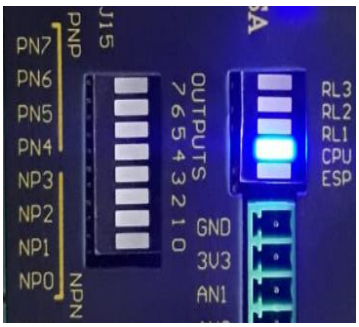
1. Download and install the VSI Device Manager application. If you haven't already.

   - VSI Device Manager
   - VSI Device Manager manual

2. Connect power to the Integra. The image below shows the necessary wiring connections for this part of the setup. Only turn on the power supply once all the connections below are made.



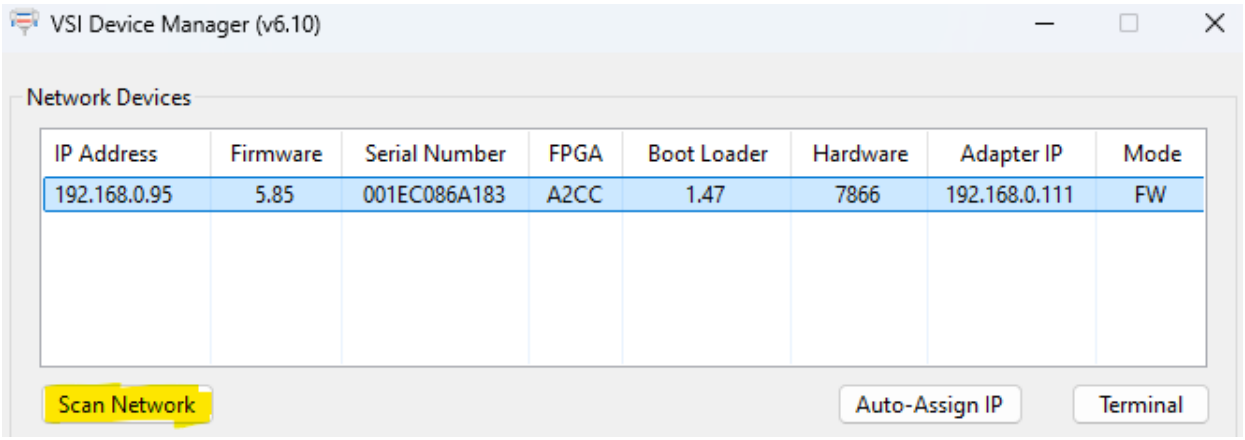
3. If the Integra is correctly powered up, the green power LED should be lit and the blue CPU LED blinks in some pattern.



Troubleshoot Issue	Solution
The green LED is not lit up	Make sure that the wires are adequately stripped, and use a voltmeter to verify that 24V is present on the connection. If not, then the power supply may be the issue.
The CPU blue LED does not light up	If the green LED is lit up and the CPU LED is not, try cycling the power. If that still doesn't work, please email support@vitalsystem.com for assistance.
The CPU LED blinks very rapidly and Mach cannot connect	Try cycling the power on the unit. If the blinking is still rapid, after a couple of tries, please email support@vitalsystem.com for assistance.

4. Establish a network connection to the Integra. Follow the "Network Connection Setup" Section. If a direct connection to the PC is used, make sure to carefully follow the steps for setting the PC IP address.

   If all instructions were followed correctly, you should be able to scan the Integra using the "VSI Device Manager" application. If the unit does not show up, then try some of the solutions in the "Troubleshoot" table below.



Troubleshoot Issue	Solution
The device does not show up in VSI Device Manager	• Make sure that a good quality CAT5e (or better) Ethernet cable is used between the Integra and the PC. The Integra has Auto-MDIX, so cross-over or straight-through cables can be used. • Try disabling windows firewall temporarily to see if it interferes with the connection. • If more than one network adapter is present (for example, a laptop with a wifi connection and Ethernet port). Try disabling the other network adapter. • Check the RJ45 port on the Integra and make sure the orange LED is lit and green LED is blinking. If not, try using a different cable

5. After getting the HiCON on the network, you may then proceed to turn off the power and wire the machine sensors and switches to the Digital I/O on the unit.

> **NOTE**: *For safety reasons, It is highly recommended to first set up the ESTOP and limit switches before attempting any motion on the machine.*

The Integra 7800 series uses both PNP and NPN circuits for the Digital I/O (sourcing type, or the hot wire has the switch). The Digital I/O on the Integra are not tied to any specific functionality. Input and Output I/O functions will depend on how they are mapped or scripted within Mach4/MachPro (or in custom software). As such, the sensors can be wired now, or later after mapping the I/O signals in Mach.

Wiring sensors and switches to the screw terminals can be found on the "Digital I/O 24V Ports" section and wiring examples are provided on the "Wiring Examples" section.

Once wired into the screw terminals, the sensors may be tested by triggering them manually and watching the Input LEDs on the Integra.

> **NOTE**: *It is recommended to use the same 24V power supply connected on J1 of the Integra, so that turning off the power supply cuts power on all components.*

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Troubleshoot Issue	**Solution**
The Input LEDs do not light up when the sensor/switch is triggered	• Ensure that the 24V LED is lit up. The Digital I/O circuit requires that 24V power is supplied on the Integra. If it is not lit, go back to step1. • Make sure that the wires are adequately stripped, and use a voltmeter to verify that 24V is present when the sensor/switch is triggered.
Some Input LEDs are turned ON, or their states are not following the sensor/switch	• Using the "Example I/O Connections" diagram as a reference, ensure that solid earth ground connections are present, because electrical noise accumulation can disrupt the microcontroller operation in the Integra. • Make sure that the wires are adequately stripped, and use a voltmeter to verify that the sensor properly sends 24V and 0V when triggered or not.

6. Connect the stepper/servo drives to the HiCON. If only the pn7866 Integra was purchased (without the 7737 breakout board), connect the drives to the stepper output channels located on J2, J3 and J4. Information on pin layouts can be found on the "Step and Direction Signals" section.

   If the HiCON was purchased with the 7737 breakout board, connect the 7737 board to the HiCON using the provided 26-pin flat cable, and For wiring instructions and setup details, refer to the guide here: (Integra with 7737 Setup).

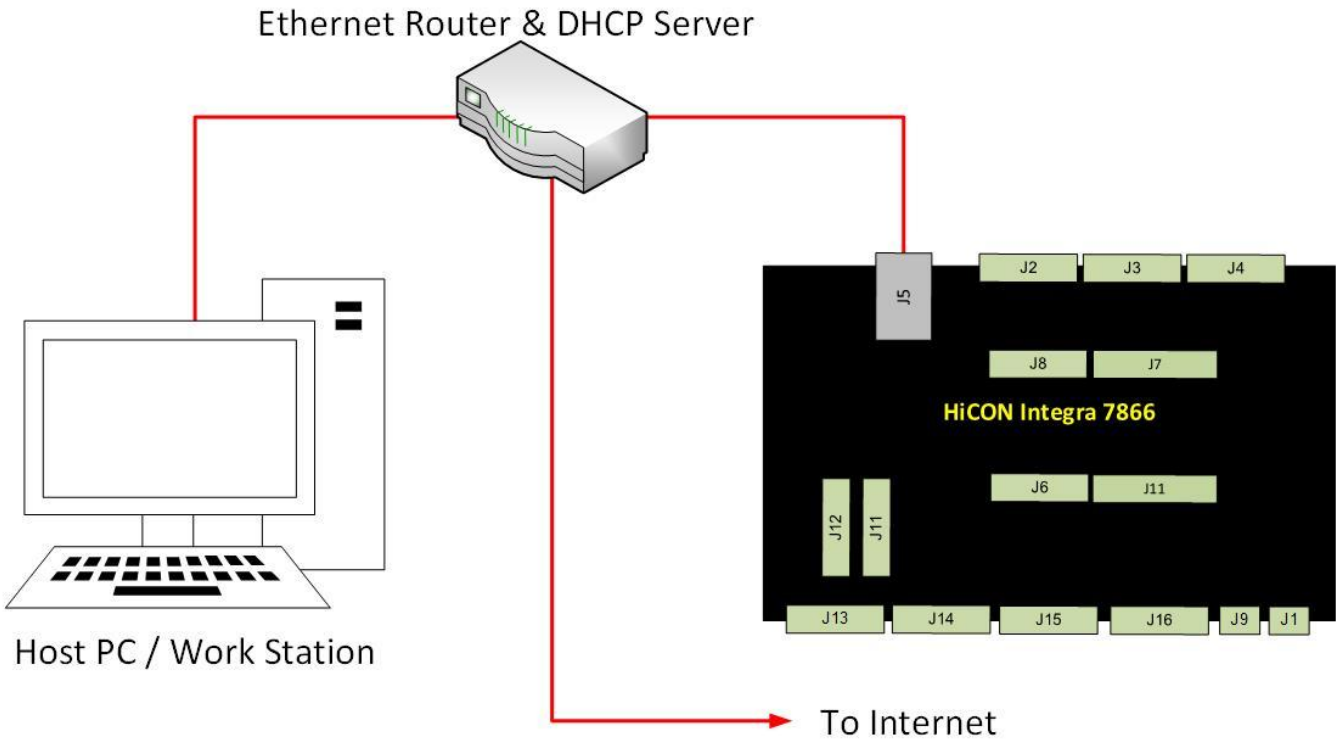
   Once the drives are wired up correctly, you are now ready for the software configuration and testing. Further setup procedures can be found on either:

   - HiCON Mach Software Integration manual

5. Network Connection Setup

You can connect the HiCON Integra directly to your PC or connect via an Ethernet switch. The HiCON board can use the DHCP server on the network or a fixed IP address (firmware pre-assigned IP address is 192.168.0.35). The default IP address of the device can be manually changed via the VSI Device Manager Software.

5.1. Connect using an Internet Router (DHCP Server)



This is the simplest method to connect Mach software to the controller. The figure above shows a basic setup using an Internet router on your network. Connect the Ethernet cable from the J5 Ethernet port of the HiCON to the router. Connect another Ethernet cable from the router to your PC. The router dynamically assigns unique IP address both to the PC as well as to the HiCON, and therefore completes the network setup without requiring any intervention from the user.

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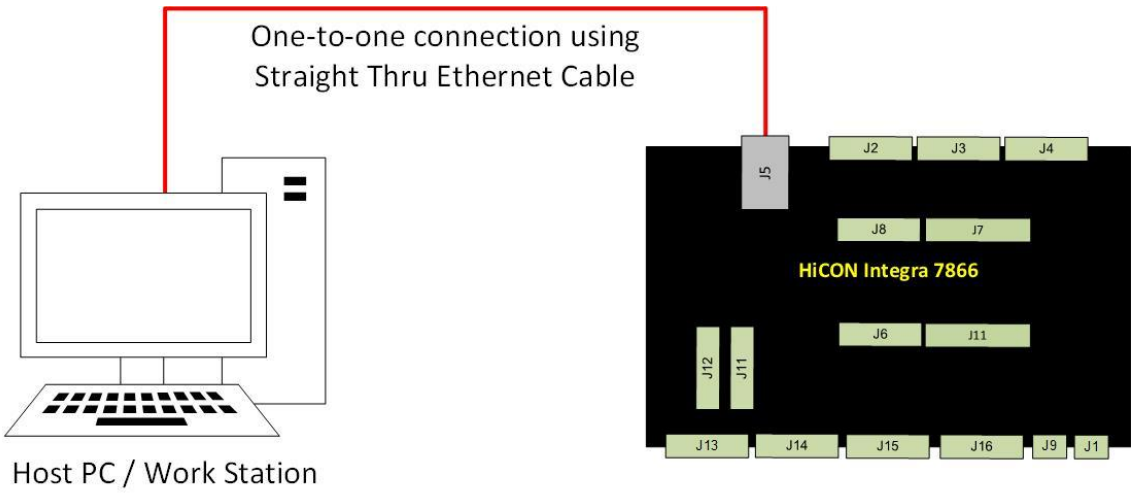
5.2. Direct Connection to the PC

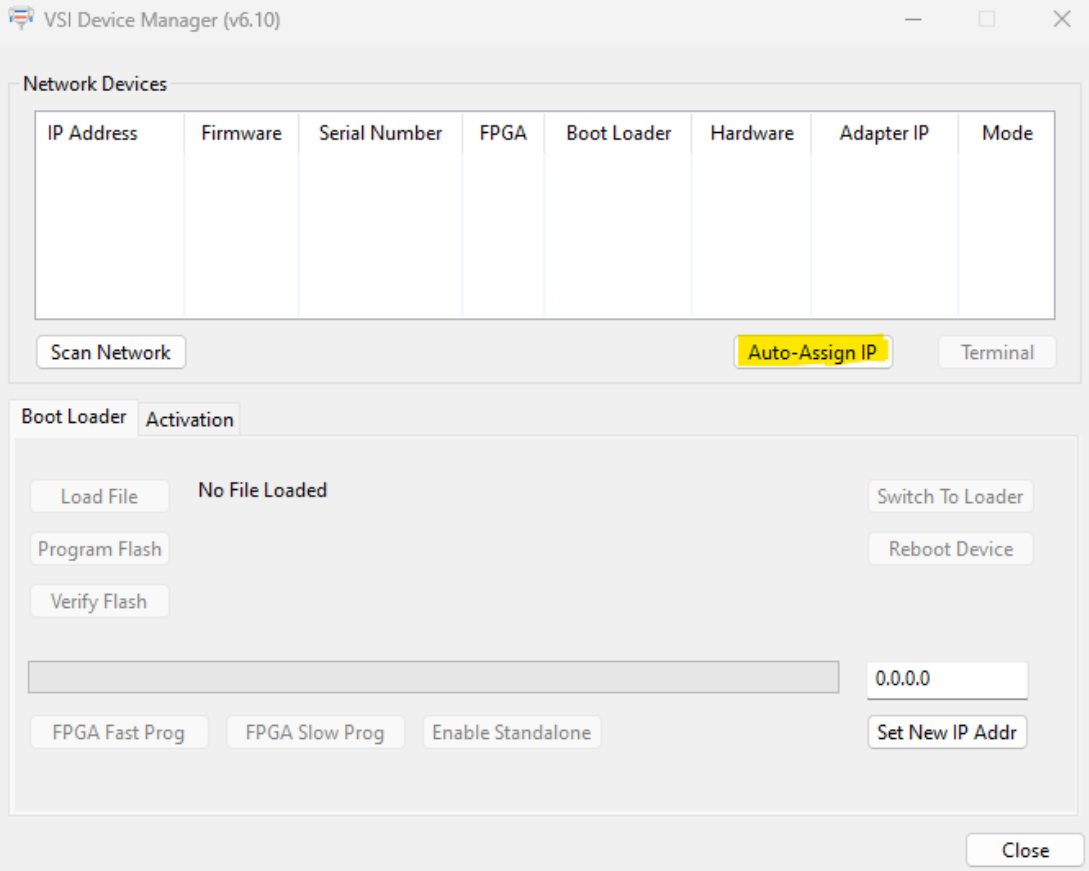
The Ethernet cable is connected from the J5 Ethernet port of the HiCON board to the PC as shown below:



When this configuration is used, the network address of the Integra must match that of the PC's ethernet adapter. The default IP address of the HiCON board is 192.168.0.95. This means that we must change the PC's adapter IP to a static IP with the form 192.168.0.xxx. The following two methods will demonstrate how to accomplish this.

Primary Method:

To connect your PC directly to the HiCON, begin by clicking on the "Scan Network" option. The HiCON board should appear in the Network Devices list. If the device does not appear, click the "Auto-Assign IP" button. Afterward, cycle the power of the HiCON board to ensure the new IP address takes effect. This method will automatically assign an IP address to the HiCON board, facilitating a seamless connection.



When connecting the PC directly to the HiCON, you may need to manually assign IP address 192.168.0.10 in Windows XP, 7 or newer in case Auto-Assign IP does not take effect. The HiCON board will use its firmware default IP address, i.e., 192.168.0.35. Do not use VSI Device Manager Software to change the HiCON IP address, unless you know exactly what you doing. If not sure, please email VSI for more information (support@vitalsystem.com). Network setup is a pretty simple task, but wrong settings can get you stuck for many hours.

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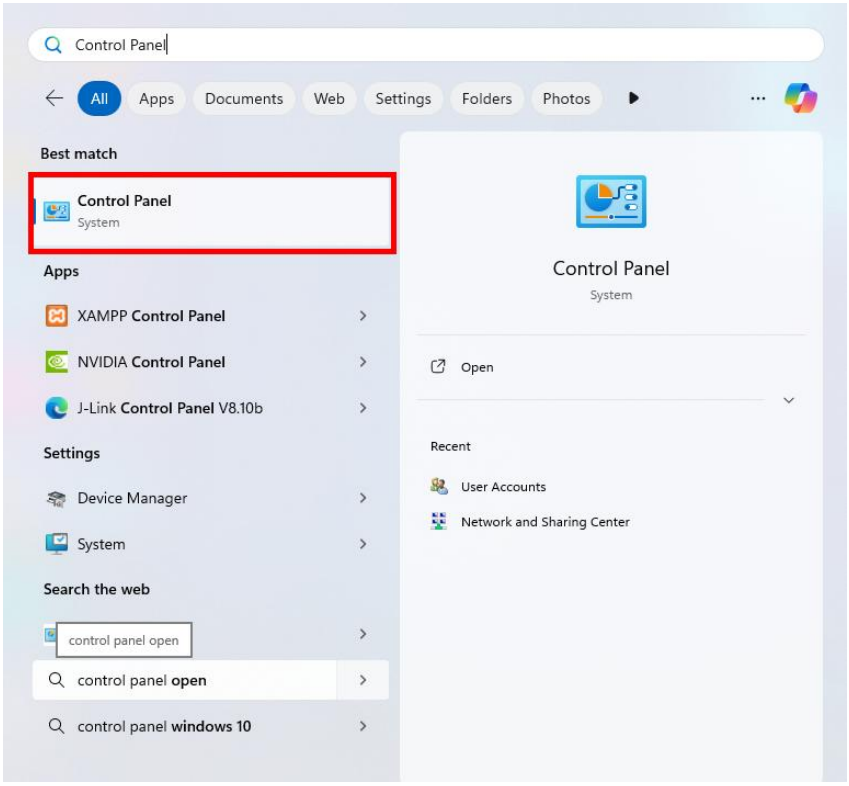
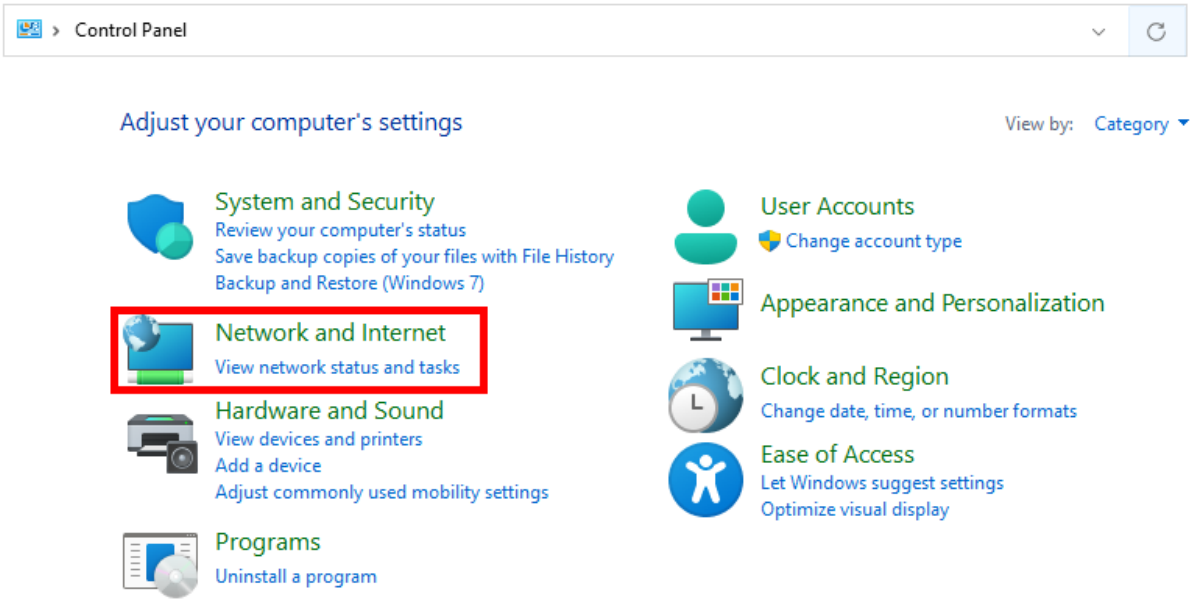
Secondary Method:

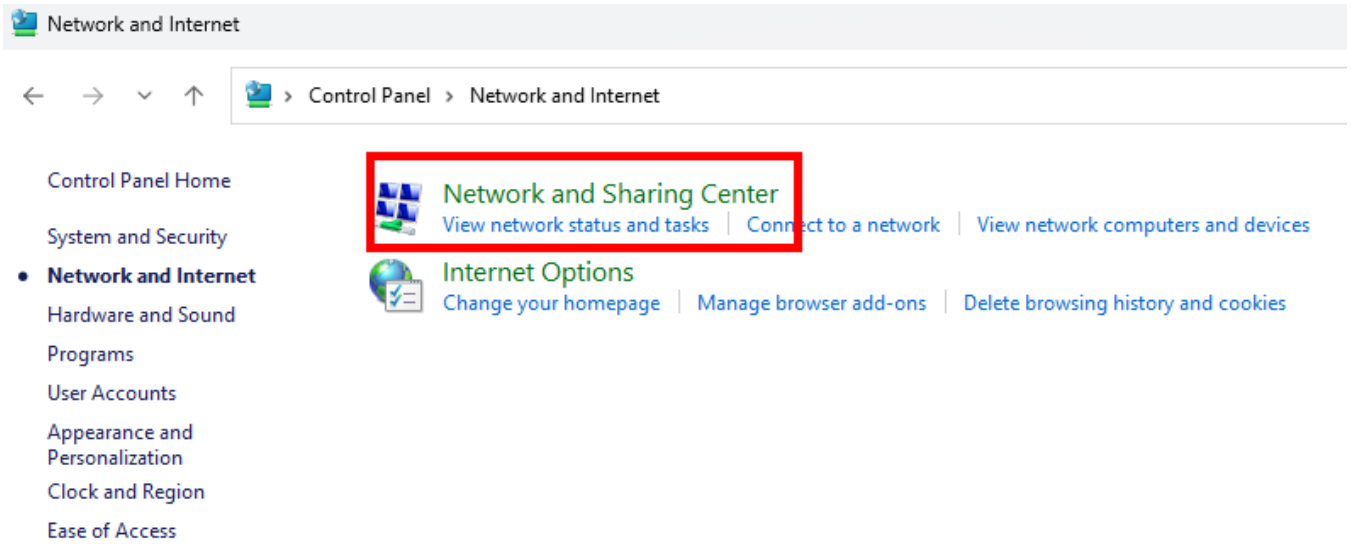
Click the **Start** menu. Next, click on the **Control Panel** option.



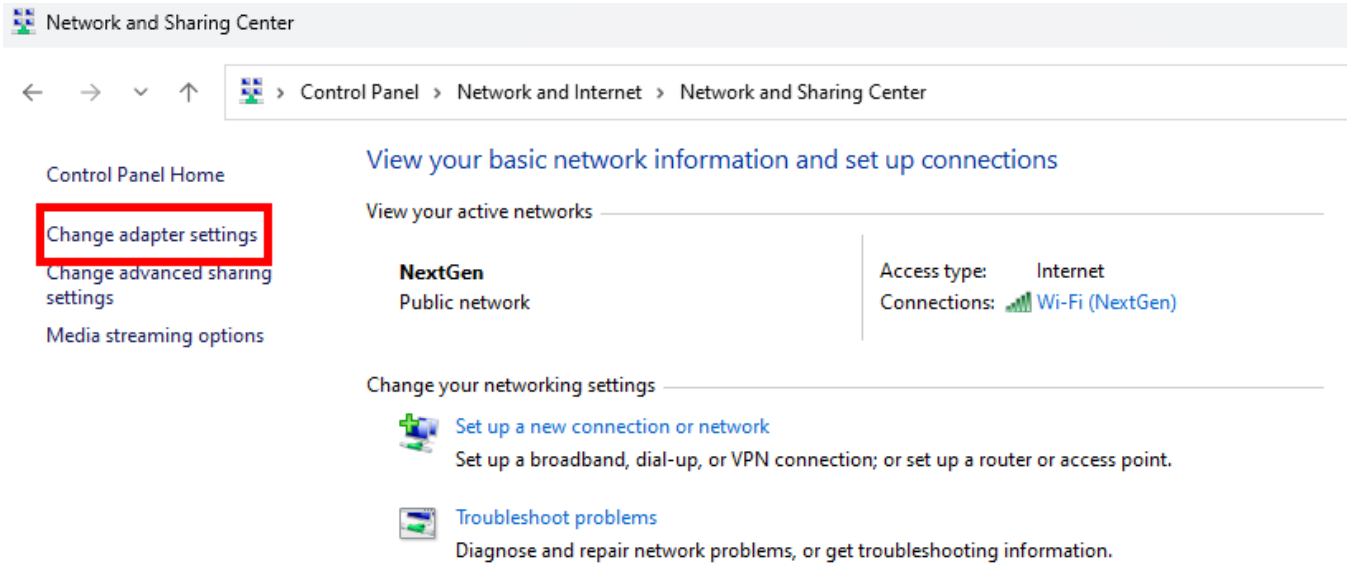
Click on the **Network and Internet** option.



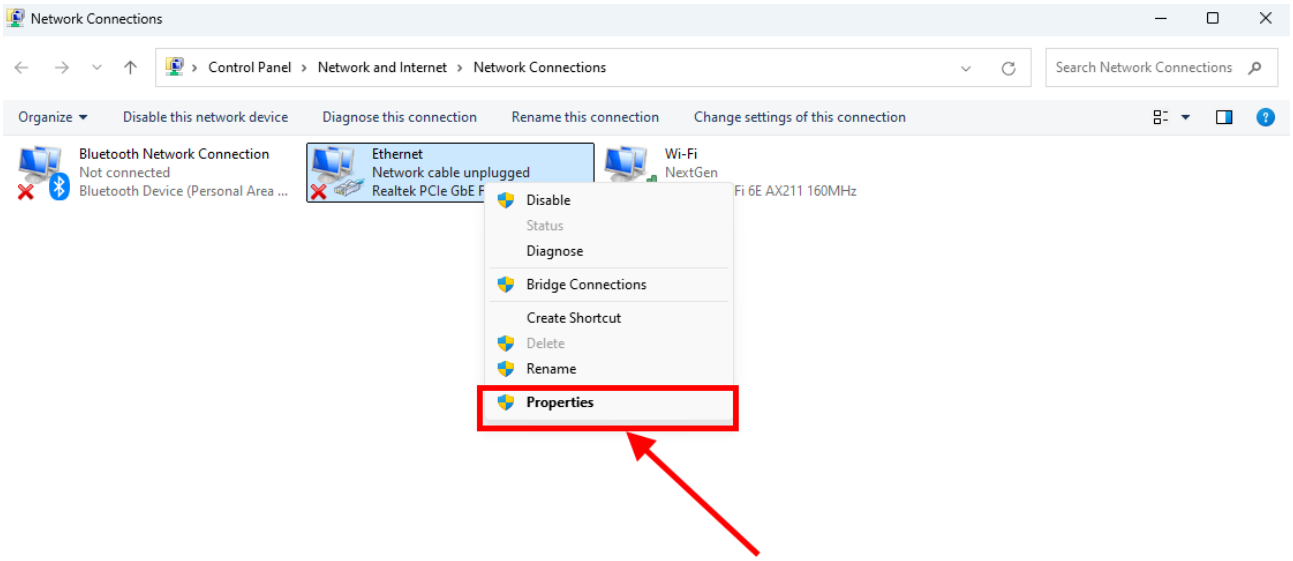
Click on the **Network and Sharing Center** option.



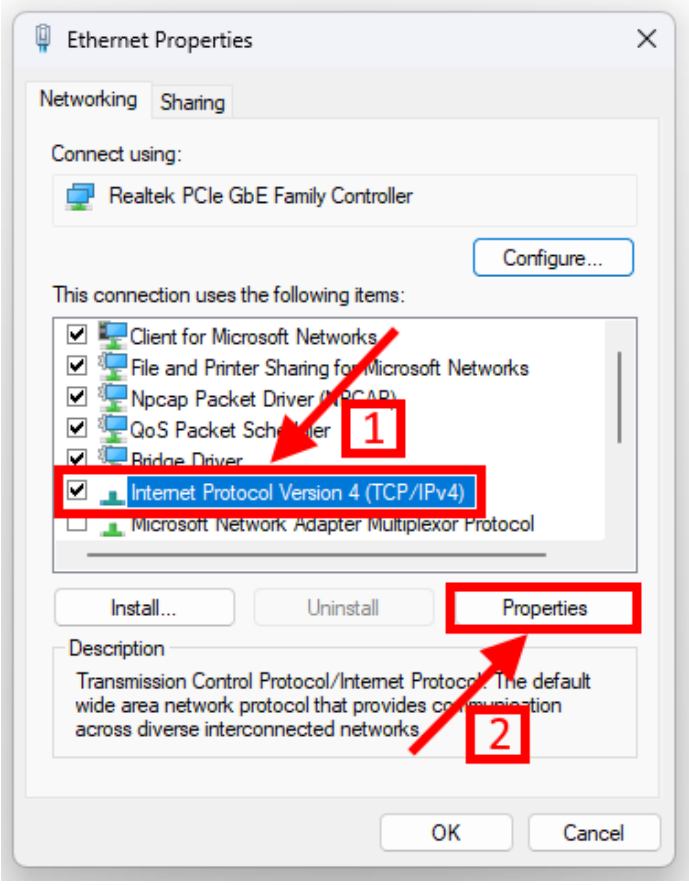
Click on **Change adapter settings** from the left side menu.



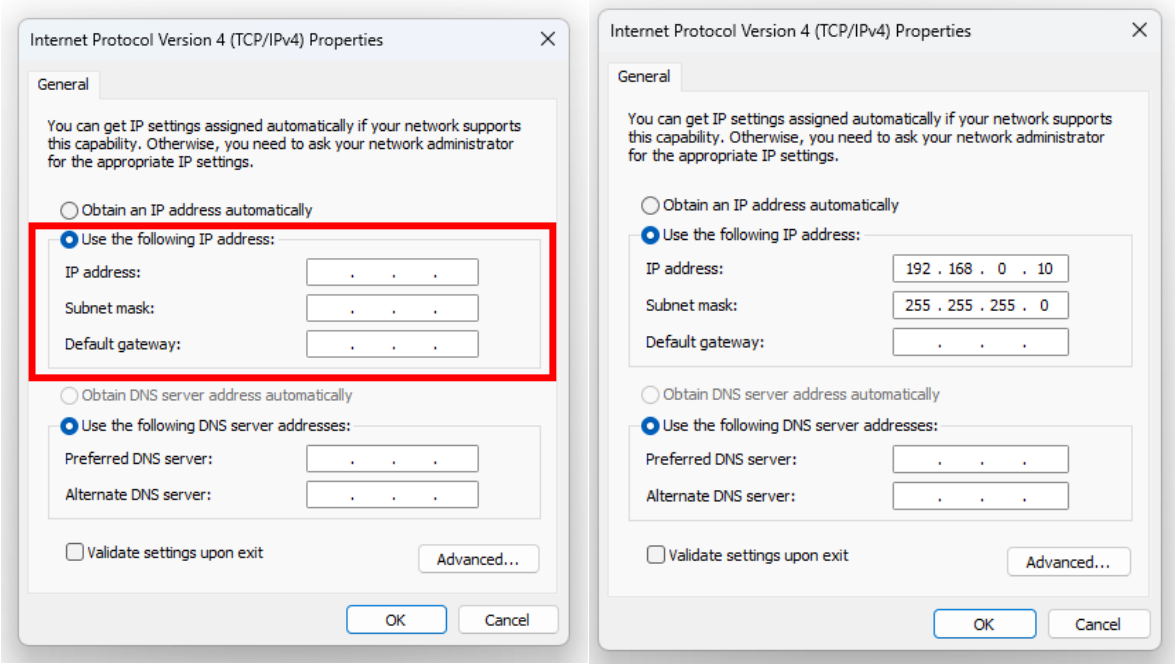
Right-click on the **Ethernet** icon, then select **Properties**.



In the window that opens, click on the **Internet Protocol Version 4 (TCP/IPv4)** (you may need to scroll down to find it). Next, click on the **Properties** button.



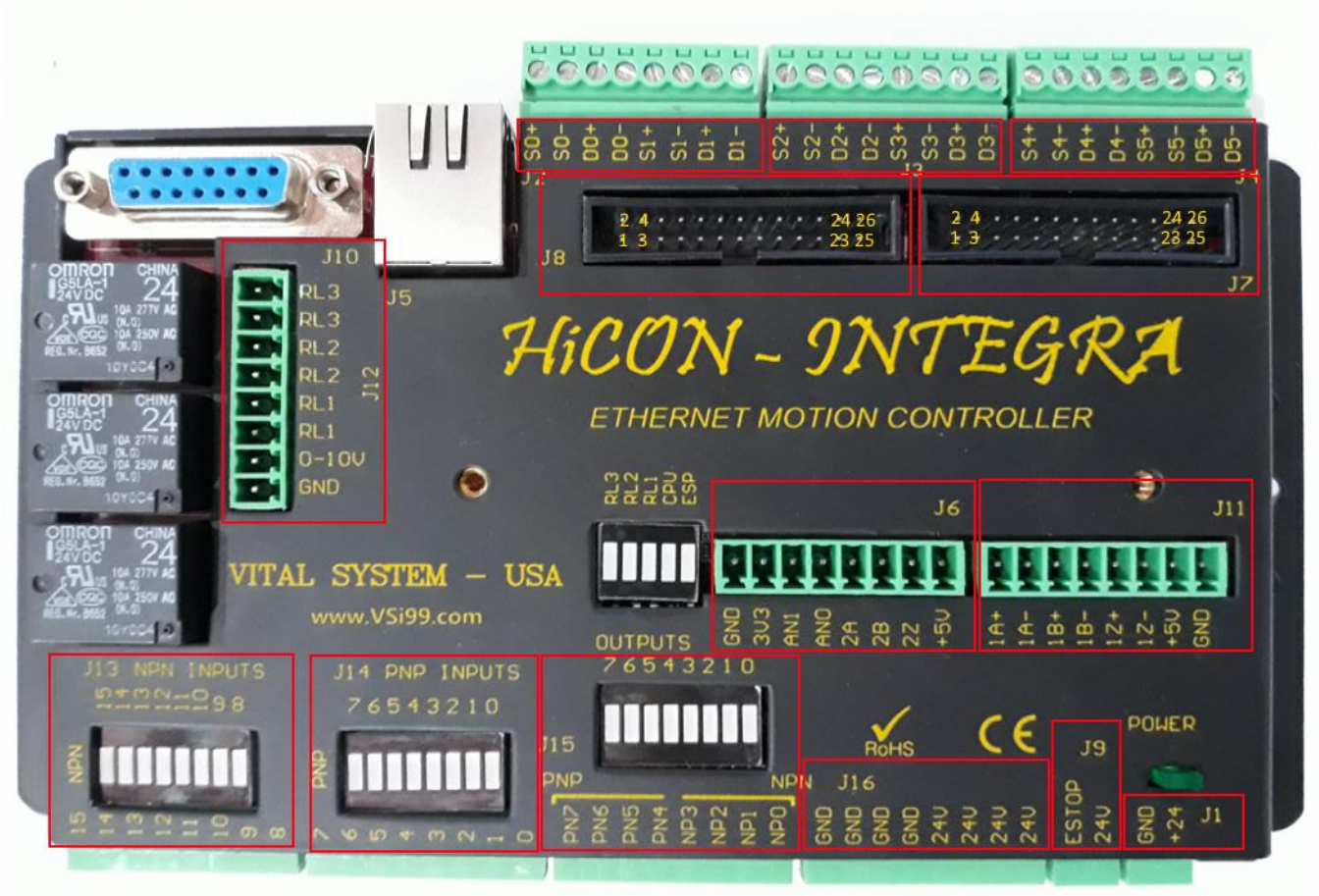
In the window that opens, click the Use the following IP address: radio button. In the **IP address:**, type **192.168.0.10,** **Subnet mask: 255.255.255.0**, and **Default gateway: leave blank.** For the DNS server settings, leave both of them blank.



Click OK to save the setting. After a few seconds, you should be able to connect HiCON from Mach software.

6. HiCON Integra Hardware Interface

The HiCON Integra board has several interface ports and indicator LEDs. The figure below shows a top view of the HiCON Integra board with interface ports and other components:



J1	+24V 1Amp to power the unit.
J2	Step and Direction Outputs 0 and 1.
J3	Step and Direction Outputs 2 and 3.
J4	Step and Direction Outputs 4 and 5.
J5	Ethernet connection
J6	Single-ended encoder input. Analog Inputs 0 and 1.
J7	Port#12 Digital I/O (16 Inputs, 8 Outputs) or Drive and Encoder Interface
J8	Port#13 Digital I/O (16 Inputs, 8 Outputs) or Drive and Encoder Interface
J9	E-Stop input
J10	Pendant: Includes Single-Ended Encoder for hand-wheel MPG, 7 Digital Inputs (3.3V TTL), +5v to power the Pendant.
J11	Differential Encoder Input #1
J12	Relay Outputs 1 – 3, Analog Output (0-10v).
J13	Digital Inputs Port#11, Pins 8 – 15 (NPN or Sinking type).
J14	Digital Inputs Port#11, Pins 0 – 7 (PNP or Sourcing Type).

J15	Digital Outputs Port#11 Pins 0 – 7 (4 NPN, 4 PNP).
J16	+24V and 0V power for Digital Outputs.
+24V LED	Green LED for Power status.
ESP LED	Red LED for E-STOP indication.
CPU LED	Blue colored LED for operation indication; it has a heartbeat blink when Power is on and running normally. It blinks rapidly if it is on bootloader mode.

6.1. Ethernet Port (J5)

The HiCON Integra controller has an Ethernet Port that allows the user to make a PC connection using an Ethernet cable. Connect to PC directly or via an Ethernet Hub or switch. For more detailed information see section 3. Network Connection Setup. The HiCON board supports both 10 MBit and 100 Mbit network speeds. TCP/IP network protocol in UDP mode is used for PC communications.

6.2. Digital I/O 3.3V TTL Ports (J7, J8, J10)

The Digital Low voltage TTL inputs and outputs on HiCON Integra (J7, J8, and J10) use the 3.3V standard. The user should make sure that these I/O signals do not connect to a 5V source directly. However, 5volts through a 3.3K or higher value resistor can be connected to these input or output pins. A direct connection to 5V (without a resistor) will damage the unit.

Maximum current draw from these outputs is 10mA per pin. The I/O type is open drain with 10K internal pull up to 3.3volts.

To use these I/O with 24V signals, use the Vital Systems **Opto-Isolated I/O boards 7535**, or OPTO22 style modules e.g. G4ODC5 and G4IDC5.

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J7 Digital I/O (3.3V TTL) Pin Assignments:

J7 Pin#	Function	J7 Pin#	Function
1	Ground	2	Digital Output Mach Port 12, Pin 0
3	Digital Output Mach Port 12, Pin 1	4	Digital Output Mach Port 12, Pin 2
5	Digital Output Mach Port 12, Pin 3	6	Digital Output Mach Port 12, Pin 4
7	Digital Output Mach Port 12, Pin 5	8	Digital Output Mach Port 12, Pin 6
9	Digital Output Mach Port 12, Pin 7	10	Digital Input Mach Port 12, Pin 0
11	Digital Input Mach Port 12, Pin 1	12	Digital Input Mach Port 12, Pin 2
13	Digital Input Mach Port 12, Pin 3	14	Digital Input Mach Port 12, Pin 4
15	Digital Input Mach Port 12, Pin 5	16	Digital Input Mach Port 12, Pin 6
17	Digital Input Mach Port 12, Pin 7	18	Digital Input Mach Port 12, Pin 8
19	Digital Input Mach Port 12, Pin 9	20	Digital Input Mach Port 12, Pin 10
21	Digital Input Mach Port 12, Pin 11	22	Digital Input Mach Port 12, Pin 12
23	Digital Input Mach Port 12, Pin 13	24	Digital Input Mach Port 12, Pin 14
25	Digital Input Mach Port 12, Pin 15	26	+5V

J8 Digital I/O (3.3V TTL) Pin Assignments:

NOTE: *This is the pin layout when using the 7535 I/O board. If using the 7737 Board, see this section.*

J8 Pin#	Function	J8 Pin#	Function
1	Ground	2	Digital Output Mach Port 13, Pin 0
3	Digital Output Mach Port 13, Pin 1	4	Digital Output Mach Port 13, Pin 2
5	Digital Output Mach Port 13, Pin 3	6	Digital Output Mach Port 13, Pin 4
7	Digital Output Mach Port 13, Pin 5	8	Digital Output Mach Port 13, Pin 6
9	Digital Output Mach Port 13, Pin 7	10	Digital Input Mach Port 13, Pin 0
11	Digital Input Mach Port 13, Pin 1	12	Digital Input Mach Port 13, Pin 2
13	Digital Input Mach Port 13, Pin 3	14	Digital Input Mach Port 13, Pin 4
15	Digital Input Mach Port 13, Pin 5	16	Digital Input Mach Port 13, Pin 6
17	Digital Input Mach Port 13, Pin 7	18	Digital Input Mach Port 13, Pin 8
19	Digital Input Mach Port 13, Pin 9	20	Digital Input Mach Port 13, Pin 10
21	Digital Input Mach Port 13, Pin 11	22	Digital Input Mach Port 13, Pin 12
23	Digital Input Mach Port 13, Pin 13	24	Digital Input Mach Port 13, Pin 14
25	Digital Input Mach Port 13, Pin 15	26	+5V

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6.3. Digital I/O 24V Ports (J12, J13, J14, J15)

J12 (24V) Relays and Analog Output Pin Assignments:

Physical Pin#	Function
RL3	Relay N.O. 3 – Mach Port 14, Pin 7
RL3	Relay N.O. 3
RL2	Relay N.O. 2 – Mach Port 14, Pin 6
RL2	Relay N.O. 2
RL1	Relay N.O. 1 – Mach Port 14, Pin 5
RL1	Relay N.O. 1
0-10V	Analog Output (0-10V)
GND	Ground 0V

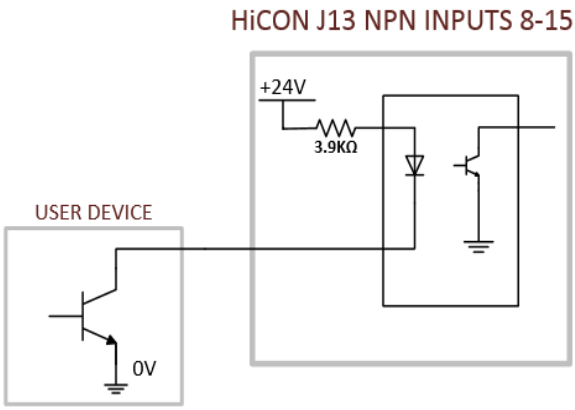
WARNING

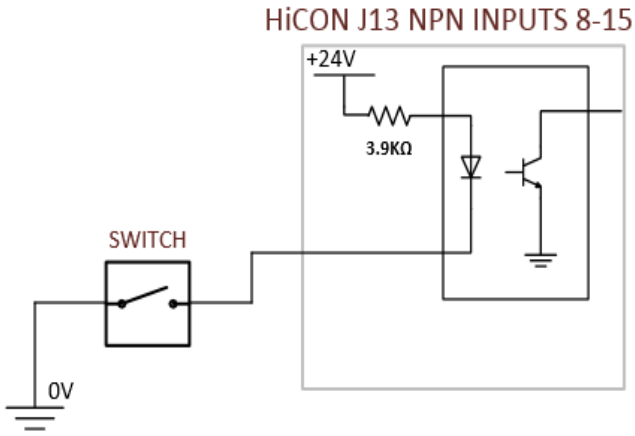
Do not put more than 30V through the relay contacts.

J13 (24V) NPN Digital Inputs Pin Assignments:

Physical Pin#	Function
8	Digital Input, Mach Port 11, Pin 8
9	Digital Input, Mach Port 11, Pin 9
10	Digital Input, Mach Port 11, Pin 10
11	Digital Input, Mach Port 11, Pin 11
12	Digital Input, Mach Port 11, Pin 12
13	Digital Input, Mach Port 11, Pin 13
14	Digital Input, Mach Port 11, Pin 14
15	Digital Input, Mach Port 11, Pin 15

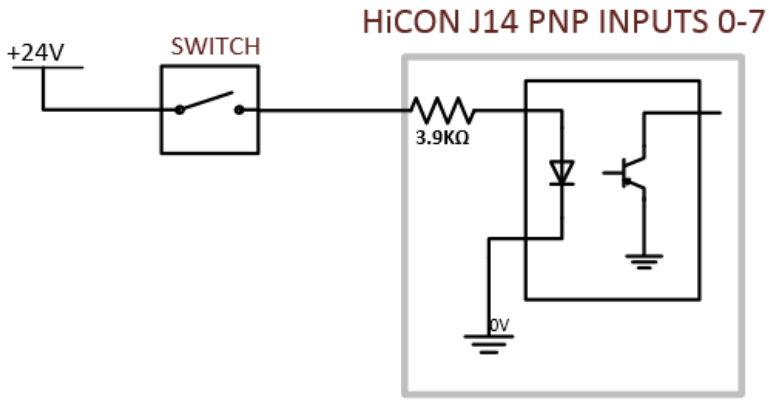
On J13 you may connect a switch or a transister as shown below:

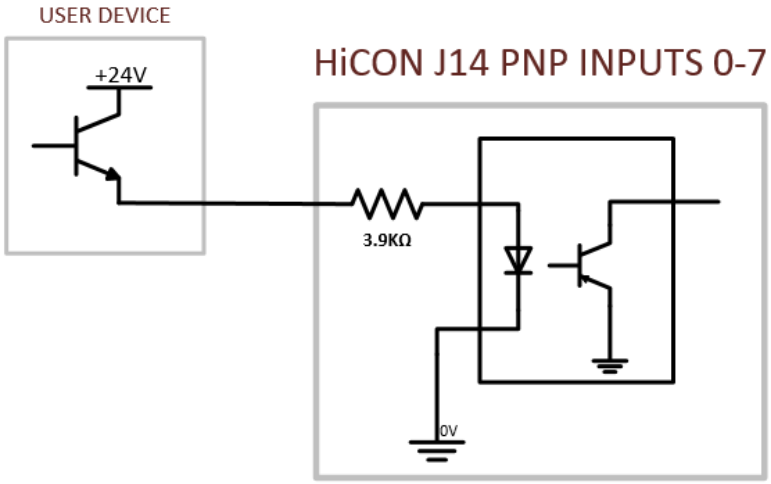




J14 (24V) PNP Digital INPUTS Pin Assignments:

Physical Pin#	Function
0	Digital Input Mach Port 11, Pin 0
1	Digital Input Mach Port 11, Pin 1
2	Digital Input Mach Port 11, Pin 2
3	Digital Input Mach Port 11, Pin 3
4	Digital Input Mach Port 11, Pin 4
5	Digital Input Mach Port 11, Pin 5
6	Digital Input Mach Port 11, Pin 6
7	Digital Input Mach Port 11, Pin 7

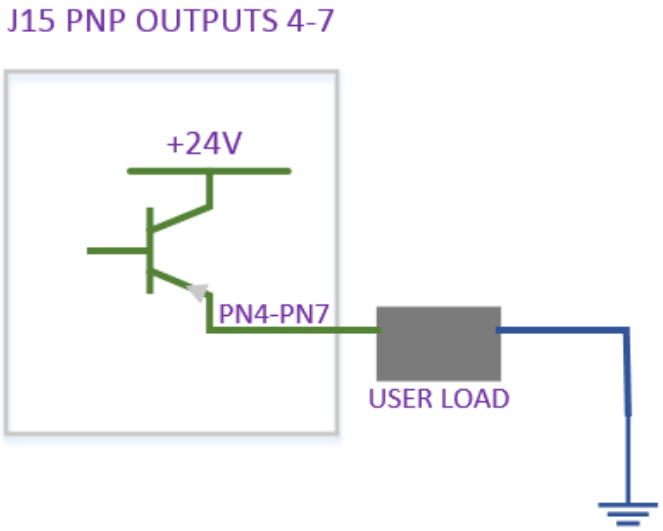


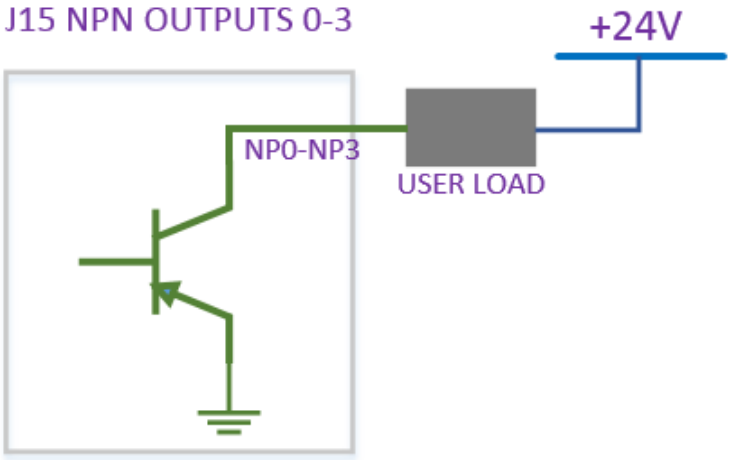


J15 (24V) Digital OUTPUT Pins Assignments:

Pin#	Function
NP0	Digital Output Mach Port 11, Pin 0
NP1	Digital Output Mach Port 11, Pin 1
NP2	Digital Output Mach Port 11, Pin 2
NP3	Digital Output Mach Port 11, Pin 3
PN4	Digital Output Mach Port 11, Pin 4
PN5	Digital Output Mach Port 11, Pin 5
PN6	Digital Output Mach Port 11, Pin 6
PN7	Digital Output Mach Port 11, Pin 7

NOTE: *Max O/P current: 250mA.*





J16 Pin Assignments:

These pins allow easy connection for 24v and 0v wiring.

Pin#	Function
+24V	Power (Fused)
+24V	Power (Fused)
+24V	Power (Fused)
+24V	Power (Fused)
GND	Ground
GND	Ground
GND	Ground
GND	Ground

Note: +24V on J16 is sourced from +24V on J1 via a 500mA resettable fuse.

6.4 Step and Direction Signals

HiCON Integra provides 5volts differential step and direction signals. You can also connect them in single ended mode by using either the + or – signal, the other side must be left open.

J2 Pin Assignments:

Pin#	Function
S0+	+Step 0
S0-	-Step 0
D0+	+Direction 0
D0-	-Direction 0
S1+	+Step 1
S1-	-Step 1
D1+	+Direction 1
D1-	-Direction 1

J3 Pin Assignments:

Pin#	Function
S2+	+Step 2
S2-	-Step 2
D2+	+Direction 2
D2-	-Direction 2
S3+	+Step 3
S3-	-Step 3
D3+	+Direction 3
D3-	-Direction 3

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J4 Pin Assignments:

Pin#	Function
S4+	+Step 4
S4-	-Step 4
D4+	+Direction 4
D4-	-Direction 4
S5+	+Step 5
S5-	-Step 5
D5+	+Direction 5
D5-	-Direction 5

6.5 Encoders on J6, J7, J8, J10, and J11

J6 Pin Assignments:

Pin#	Function
+5V	+5 V
2Z	Single-ended Encoder (enc 2) Z
2B	Single-ended Encoder (enc 2) B
2A	Single-ended Encoder (enc 2) A
AN0	Analog Input Channel0 (0 – 3.3V)
AN1	Analog input Channel1 (0 – 3.3V)
3V3	3.3 V
GND	Common Ground 0V

6.5.1. J7 and J8 Pin Assignments with 7737 Breakout Board

The 7737 Step/Dir and Encoder Board is designed to be plugged directly into J7 or J8 (via 26-pin ribbon cable) for 24V optical isolation and RJ45 connectors for differential encoders and differential step and direction signals. As such, the pin assignments vary from the default setting used for Digital I/O.

NOTE: *The use of Encoder Channels 3 – 8 requires the "Integra Closed Loop" Feature to be activated.*

NOTE: *All signals on J7 and J8 use 3.3Volts. As such, it is highly recommended to only access these pins by using the 7737 breakout board*

J7 Pin Assignments for 7737 Breakout Board:

Pin#	Function	Pin#	Function
1	Ground	2	Step Signal Channel 2
3	Direction Signal Channel 2	4	Step Signal Channel 3
5	Direction Signal Channel 3	6	Drive Enable (OUT P12, pin4)
7	ESTOP (INP P12, pin12)	8	Digital Output Port 12, Pin 6
9	Drive Error (INP P12, pin13)	10	A Signal Encoder Channel 3
11	B Signal Encoder Channel 3	12	Z Signal Encoder Channel 3
13	A Signal Encoder Channel 4	14	B Signal Encoder Channel 4
15	Z Signal Encoder Channel 4	16	A Signal Encoder Channel 5
17	A Signal Encoder Channel 5	18	Z Signal Encoder Channel 5
19	Z Signal Encoder Channel 6	20	B Signal Encoder Channel 6
21	B Signal Encoder Channel 6	22	Step Signal Channel 0
23	Direction Signal Channel 0	24	Step Signal Channel 1
25	Direction Signal Channel 1	26	+5V

J8 Pin Assignments for 7737 Breakout Board:

Pin#	Function	Pin#	Function
1	Ground	2	Step Signal Channel 6
3	Direction Signal Channel 6	4	Step Signal Channel 7
5	Direction Signal Channel 7	6	Drive Enable (OUT P13, pin4)
7	ESTOP (INP P13, pin12)	8	Digital Output Port 13, Pin 6
9	Drive Error (INP P13, pin13)	10	A Signal Encoder Channel 7
11	B Signal Encoder Channel 7	12	Z Signal Encoder Channel 7
13	A Signal Encoder Channel 8	14	B Signal Encoder Channel 8
15	Z Signal Encoder Channel 8	16	A Signal Encoder Channel 9
17	B Signal Encoder Channel 9	18	Z Signal Encoder Channel 9
19	A Signal Encoder Channel 10	20	B Signal Encoder Channel 10
21	Z Signal Encoder Channel 10	22	Step Signal Channel 4
23	Direction Signal Channel 4	24	Step Signal Channel 5
25	Direction Signal Channel 5	26	+5V

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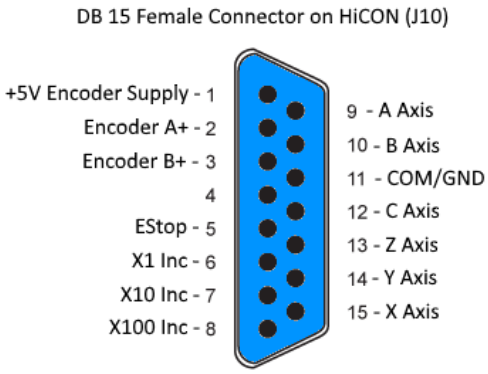
J10 Pendant Pin Assignments:

Digital Inputs on J10 are all 3.3v TTL.

Pin #	Function	Pin#	Function
1	+5V, up to 200mA	2	Single-ended Encoder A (3.3v)
3	Single-ended Encoder B (3.3v)	4	<Reserved>
5	Digital Input Port 14, Pin 10	6	Digital Input Port 14, Pin 4
7	Digital Input Port 14, Pin 2	8	Digital Input Port 14, Pin 0
9	Digital Input Port 14, Pin 6	10	Digital Input Port 14, Pin 7
11	Ground	12	Digital Input Port 14, Pin 14
13	Digital Input Port 14, Pin 5	14	Digital Input Port 14, Pin 3
15	Digital Input Port 14, Pin 1		



J11 Pin Assignments:

Pin#	Function
GND	Ground
+5V	5V power source for encoder on J 11.
1Z-	Differential Encoder (enc 1) Z-
1Z+	Differential Encoder (enc 1) Z+
1B-	Differential Encoder (enc 1) B-
1B+	Differential Encoder (enc 1) B+
1A-	Differential Encoder (enc 1) A-
1A+	Differential Encoder (enc 1) A+

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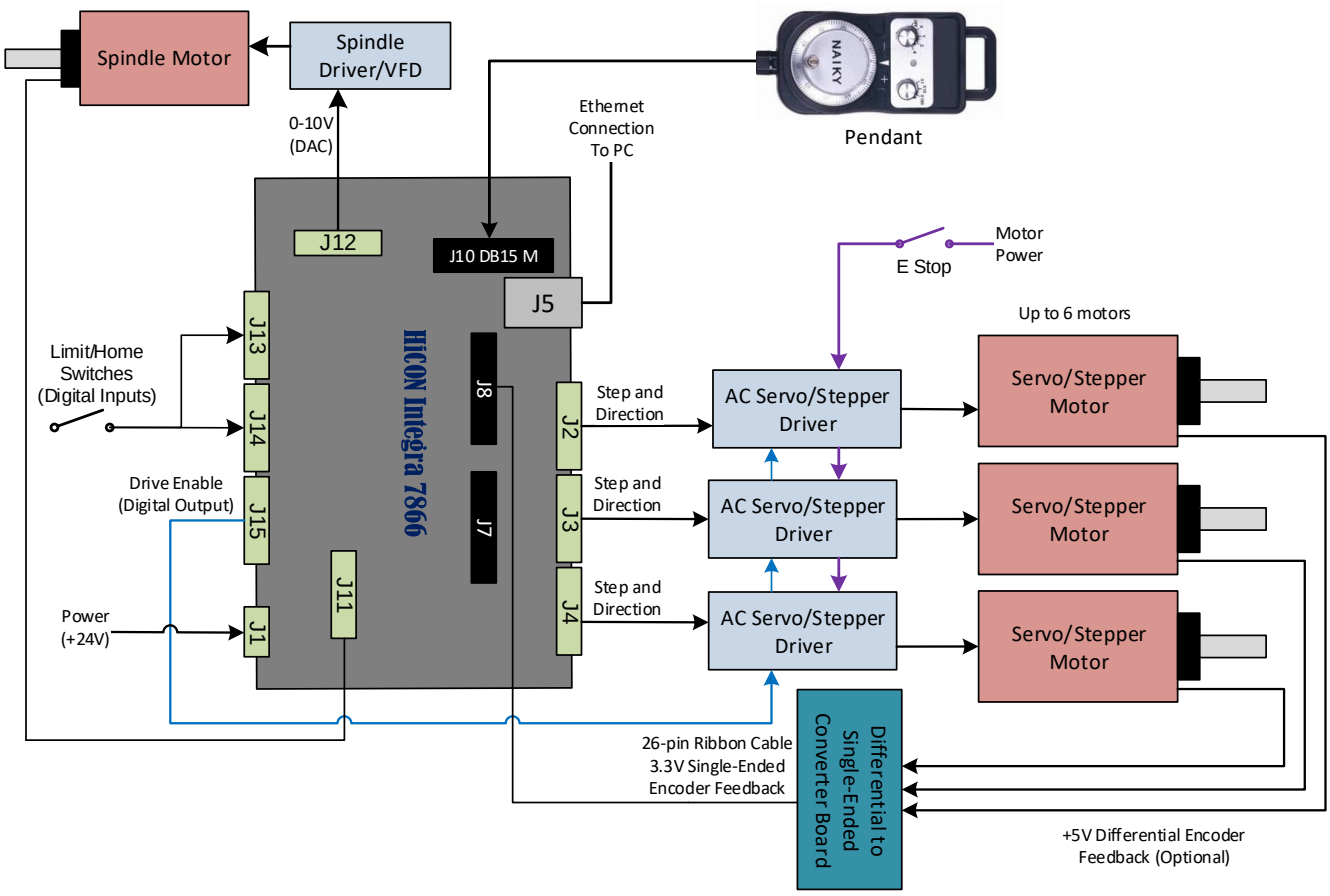
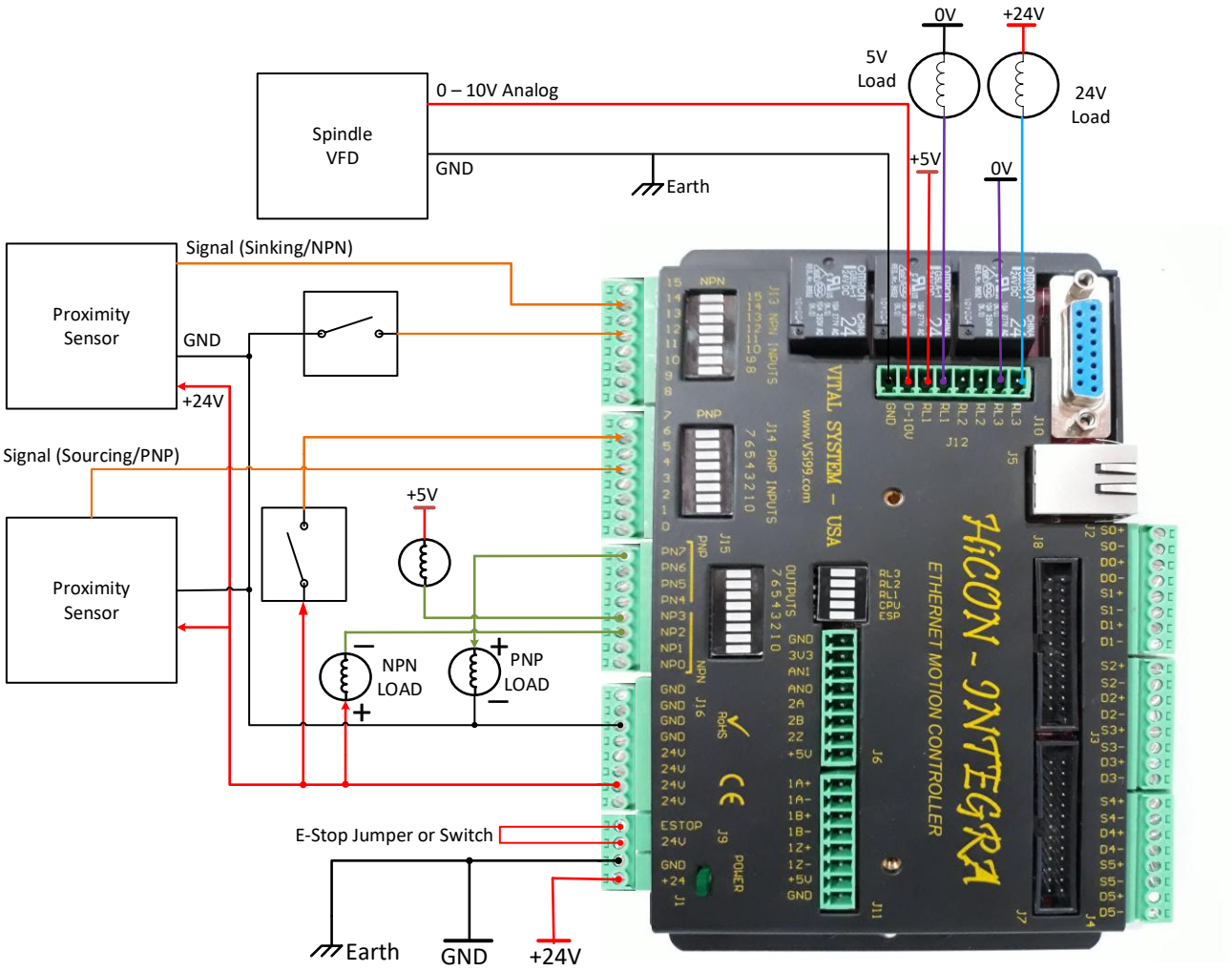
7. High Level Connection Diagram

The figure below shows a typical Milling/Lathe machine connection using HiCON Integra.



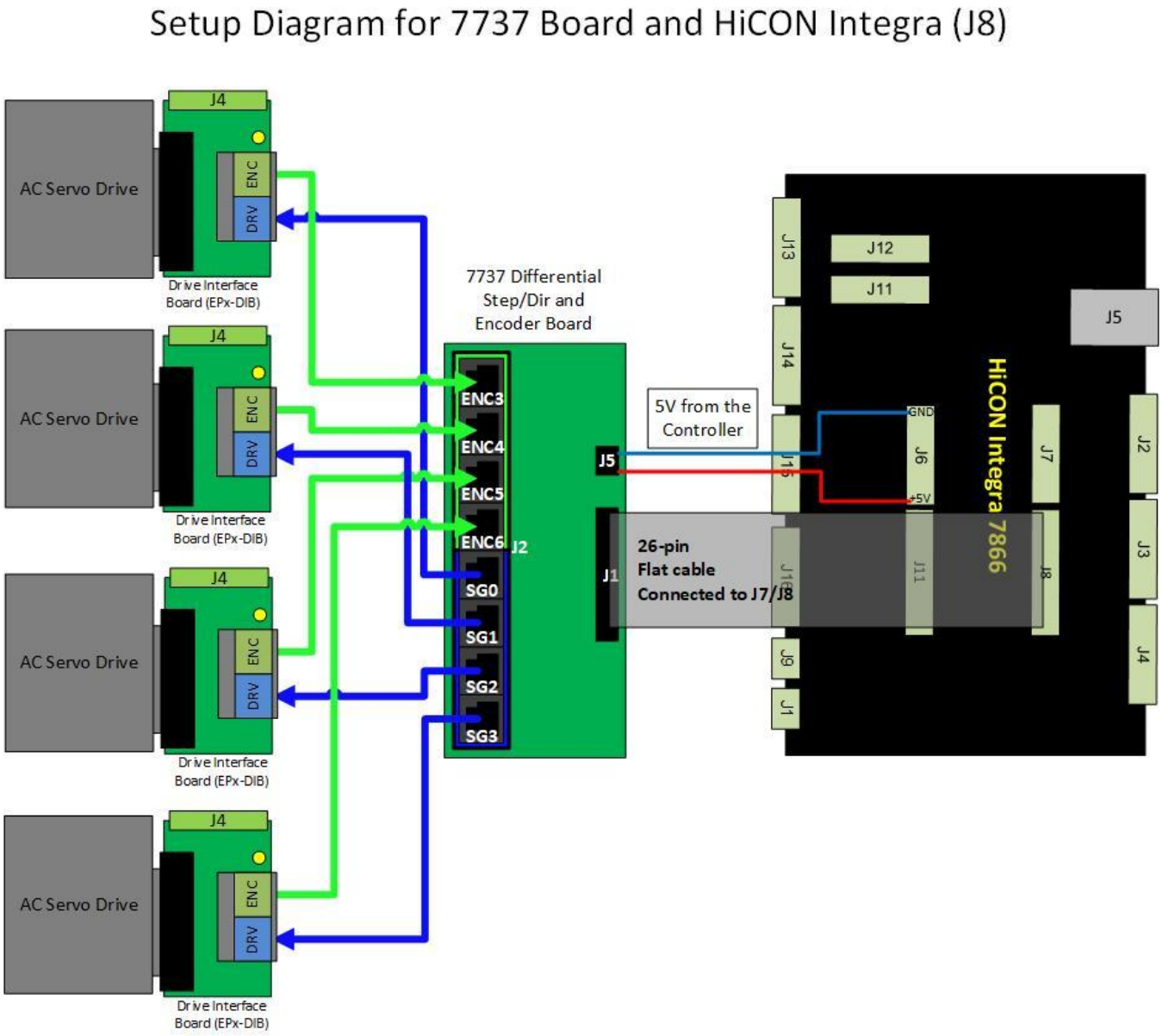
8. Wiring Examples

8.1 Example I/O Connections



NOTE: *It is required to make solid earth ground connections during installation (as shown in the above diagram). Failure to do so may cause electrical noise to disrupt the microcontroller operation and other low-voltage circuits.*

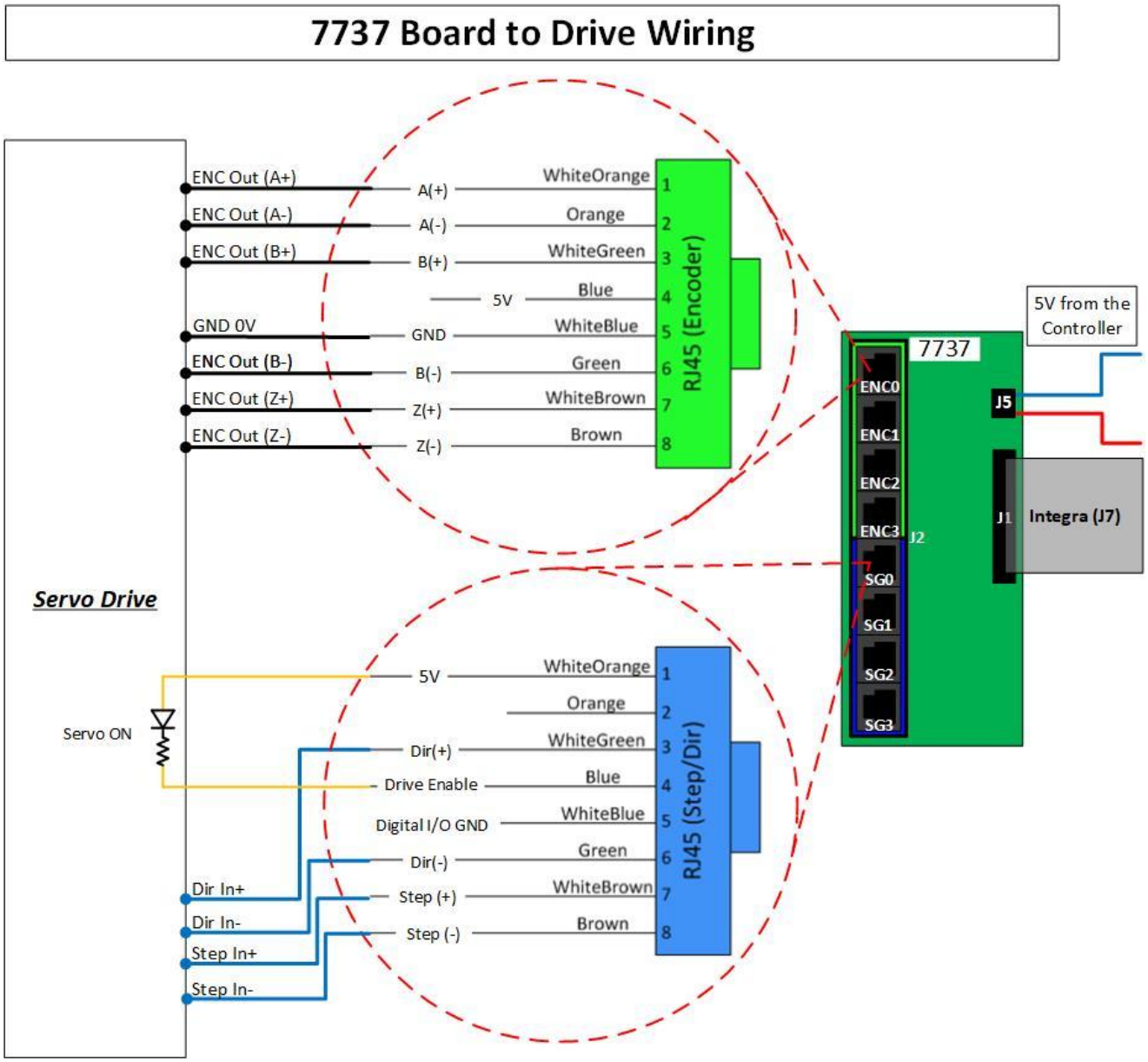
8.2 Integra and 7737 setup



Mach pin mapping (J8):
Drive Enable – Port14, Out4

NOTE: *The Drive Error signal has no built-in functionality and will not do anything in Mach by default. This is because handling the Drive Error signal varies across several models (e.g. warning or disarm). A custom script may be used to perform any necessary actions when this signal is activated.*

8.3 7737 Board to Drive Wiring



Mach pin mapping (J7):
Drive Enable – Port12, Out4

NOTE: *The Drive Error signal has no built-in functionality and will not do anything in Mach by default. This is because handling the Drive Error signal varies across several models (e.g. warning or disarm). A custom script may be used to perform any necessary actions when this signal is activated.*

9. Add-ons and Optional Features

Most CNC applications will only require the Integra base unit, pn7866. However, advanced and production applications can benefit from these add-ons:

NOTE: *[*] - These items may be purchased any time before or after shipping as they are software features and are acquired via activation codes.*

HiCON-MACRO[*]

This software feature allows the user to write custom programs (in vb/BASIC language)which can be downloaded to the controller for fast execution. Advantages of the HiCON-Macro feature include:

- Real-time program execution on the firmware
- Ultra-fast I/O control and response
- C or BASIC language may be used
- Extends Mach4/MachPro Functionality

HiCON-EXTIO[*]

This software feature extends the number of available I/O by enabling ports J7 and J8. Useful if the built-in 16 inputs and 8 outputs are not sufficient. If you purchase the 7535 or 7737 boards, then this feature is provided FREE of charge.

HiCON-ADC[*]

This software feature allows the use of the 2 analog inputs located on J6.

INTG-CLOOP[*]

Enables the Integra Closed Loop Options. This software feature allows the use of Step/Dir channels [0 – 3] and Encoder channels [3 – 6] on J8, as well as Step/Dir channels [4 – 5] and Encoder channels [7 – 8] on J7. Advantages of this feature include:

- Closed loop operation accounts for any missing steps during transmission, and will automatically apply the necessary correction at the start of the next move. This prevents following errors from accumulating.
- The machine will only need to be homed (referenced) once on system power up. Axis position is preserved during ESTOP due to out of band axes even if Mach is closed or stopped.
- Allows Mach to display the physical machine coordinates based from encoder feedback on the Mach display DROs. Open loop operation only displays the position based from the outputted step signals.
- Closed Loop feedback is a requisite for switching to and from Manual mode operation.

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- Enables 6 Additional Encoder Channels on the Integra. The pins are single ended type and available on J7 and J8. The 7737 breakout board is used to convert them to 5Volt Differential and RJ45 plugs for plug-and-play setups.
- Feedback from rotary, linear (or glass scale) encoders may be used. Feedback gain may be configured to match step resolution.

Torch Height Control[*]

Allows the use of Automatic Torch Height Control where the Z axis height is regulated at a distance over the cutting surface based off feedback voltage from a dedicated torch height controller. This feature is almost always a requisite for Plasma cutting machines.

Synced Outputs[*]

Allows the use of the Synced Outputs feature of Mach4/ MachPro. Synced outputs allows an output to be triggered ON or OFF at a precise real-time position which can be indicated in a GCode file. Unlike MCodes, the Synced outputs feature will not halt motion to trigger an output, but rather, only trigger it at a precise position value while keeping motion continuous. Extremely useful for applications that make use of laser cutting.

Rigid Tap[*]

Allows the use of Rigid Tapping in Mach4/MachPro. This feature makes use of the actual spindleRPM to regulate the feedrate of a tapping head (usually the Z axis).

7737 Breakout Board

The pn7737 Differential Step/Direction and Encoder Board allows access to the Step/Direction and Encoder channels on J7 and J8 plugs, and allows a simple plug-and-play setup using standard RJ45/Ethernet cables. When used with Drive Interface Board (EPx-DIB) for Maxsine AC Servo Drives, this board provides a true plug-and-play connection.

7535 Breakout Board (P or N version)

The I/O Termination board (7535P or 7535N) allows access to additional 24V optically isolated digital inputs and outputs. Each board allows access to 16 input terminals and 8 output terminals. All I/O terminals are clearly marked for quick and easy installation. A maximum of two 7535 (P or N) boards can be plugged into HiCON Integra, providing an additional 32 Inputs and 16 outputs.

10. Further Reading

1. HiCON Mach Software Integration
2. HiCON Basic User Guide
3. HiCON CMacro User Guide
4. VSI Device Manager manual
5. 7737 Breakout Board
6. 7735 Breakout Board