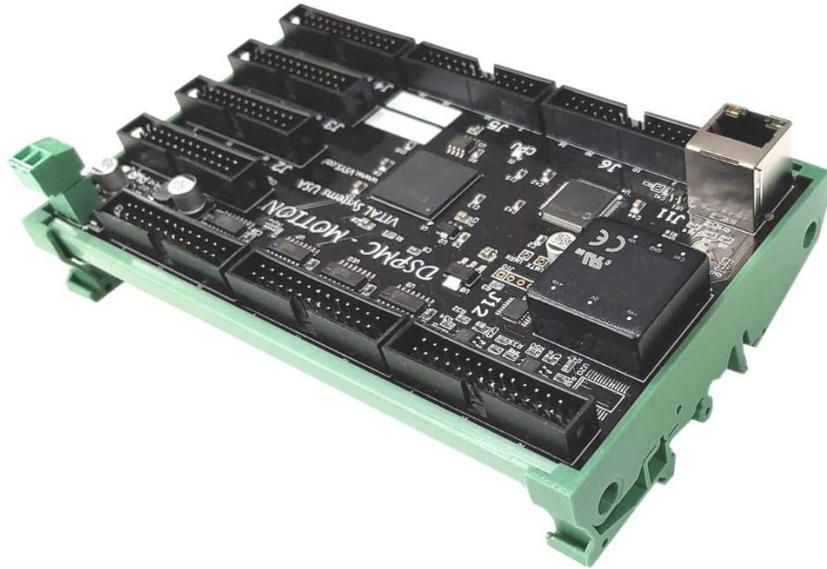


DSPMC v3

7763 Motion Controller

Ethernet Motion Controller



User Guide

Document Revision 3.1

(Updated December 20, 2020)



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Atlanta, Georgia USA

For more information please visit the product web page:

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License Agreement

Before using the DSPMC 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 DSPMC on any machine you must agree to the following license:

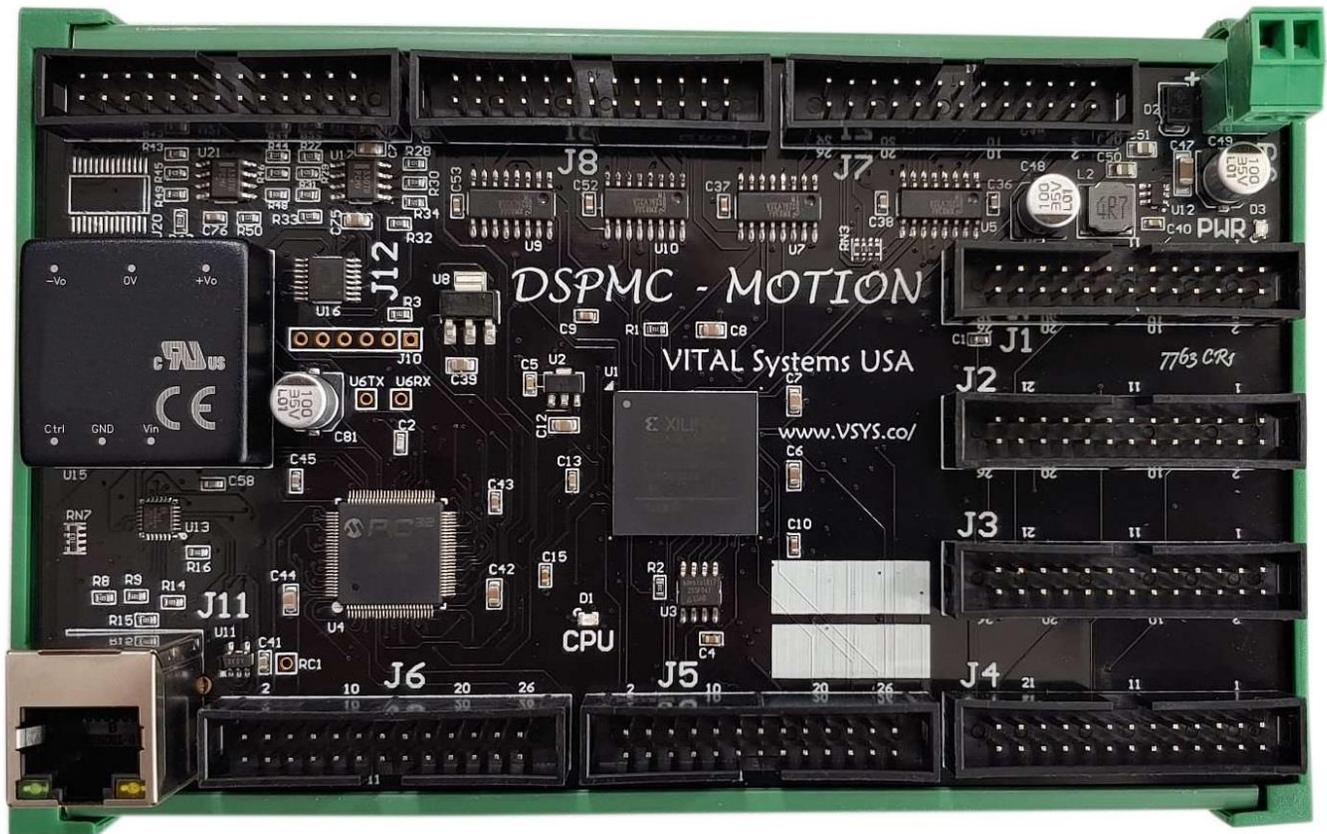
I agree that no-one other than the owner of this machine, will, under any circumstances be responsible, for the operation, safety, and use of this machine. I agree there is no situation under which I would consider Vital Systems, or any of its distributors to be responsible for any losses, damages, or other misfortunes suffered through the use of the DSPMC board and its software. I understand that the DSPMC 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 DSPMC, 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 DSPMC 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 DSPMC motion controller, you agree to the license agreement.

1. Overview



DSPMC 7763 is an Ethernet based motion controller that controls up to 8 Analog $\pm 10V$ Servo Drives, 8 Step and Direction Digital Drives, as well as almost 100 Digital I/O pins. Closed Loop motor control is also possible by utilizing the available 14 Encoder channels. The Step/Direction Drives can drive simple stepper motors, as well as closed loop stepper and servo motors. DSPMC is built on high performance Software and Silicon technologies, and offers a comprehensive set of features for your CNC retrofitting and Motion Control applications. Future expansion will allow controlling EtherCAT servo drives and I/O devices via 7729 adapter board.

Key Features

- 96 Digital I/O (64 Inputs & 32 Outputs)
- 8 Step and Direction Channels. Up to 2MHz Step Frequencies
- 14 Encoders: 6 Differential and 8 Single-Ended Quadrature Encoder Inputs up to 2 MHz
- Up to 8 Analog Input Channels, Range $\pm 10V$ olts, 16-bit
- Up to 8 Channels Servo Drive Analog Outputs, Range $\pm 10V$, 16-Bit
- 1KHz Closed-Loop Servo Control for each axis (Closed Loop feature is available by default)
- Wide input power range 10-28VDC

- Ethernet connectivity with Mach4
- Advanced PID compensation with velocity feedforward, integration limits, and low-pass filter.
- Dedicated limit and estop sensor inputs for ultra-fast system disarm
- Modes of Motion: Point-to-Point, Linear and Circular interpolation, Jogging, Electronic Gearing, Feedrate Override, Mach4 CNC
- Standalone Operation by C macro program (Not required for Mach4)
- SDK Libraries available for Software Developers (Not required for Mach4)

NOTE: Analog I/O Dependent on DSPMC Model

Model	Step/Direction	Analog Outputs	Analog Inputs
7763D	8 Channels	None	None
7763S	8 Channels	8 Analog Outputs	None
7763M	8 Channels	8 Analog Outputs	8 Analog Inputs

Encoder Compatibility Requirements:

- Encoders can be rotary, linear, etc. as long as they have Quadrature TTL signal outputs. The DSPMC 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/0V
+5V
Z-
Z+
B-
B+
A-
A+

5V Single-ended Quadrature Signal Pins
GND/0V
+5V
Z
B
A

NOTE: If you are sourcing the A B Z encoder signals from a servo drive, instead of an actual encoder unit, you do not need to connect +5V to the drive. Only the 0V needs to be connected to the drive.

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.

NOTE: This document uses the name HiCON and DSPMC interchangeably, as the DSPMCv3 is built on our flagship HiCON Motion Controller platform.

2. Software Components

2.1 DSPMC Mach4 Plugin

To use the HiCON/DSPMC plugin for Mach4, copy the M4HiCON.m4pw and M4HiCON.sig files to the “Plugins” folder in the Mach4 install directory, and enabling the plugin from within the “Plugins” tab of the Mach4 Configuration window. For detailed instructions, refer to the *Initial Setup* section of the [HiCON Mach4 Software Integration Manual](#).

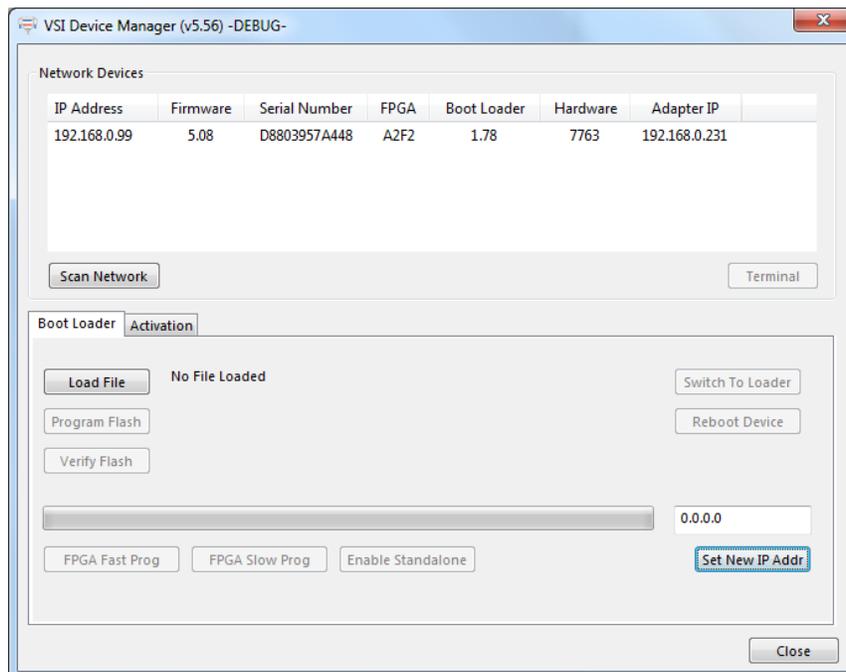
2.2 VSI Device Manager

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



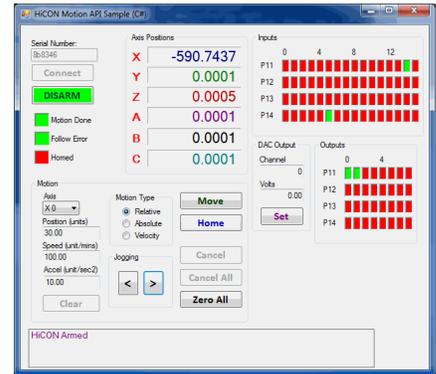
Extended Features available for activation:

- Macro Programming – For advanced users this optional software feature allows the writing of custom programs (In C language) that can be downloaded to the controller for fast execution. It allows the system to run in standalone mode as well as manipulate I/O at extremely high speeds. Most Mach4 CNC installations do not require this feature.
- Torch Height Control – Automatic Torch height positioning for plasma cutting applications
- Rigid Tap – Allows the use of rigid tapping in Mach4.



2.3 VSI Motion Control API

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](#).

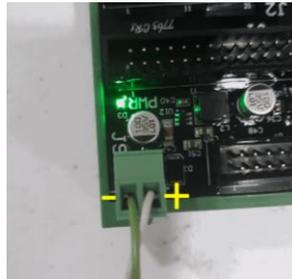


3. Quick Start Guide

The following steps are provided to give the user a basic step-by-step guide for wiring the DSPMC 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. You may refer to the “[DSPMCv3 Hardware Interface](#)” section as needed when knowledge of ports and pin mappings is required.

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 DSPMC. The image below shows the necessary wiring connections for this part of the setup.

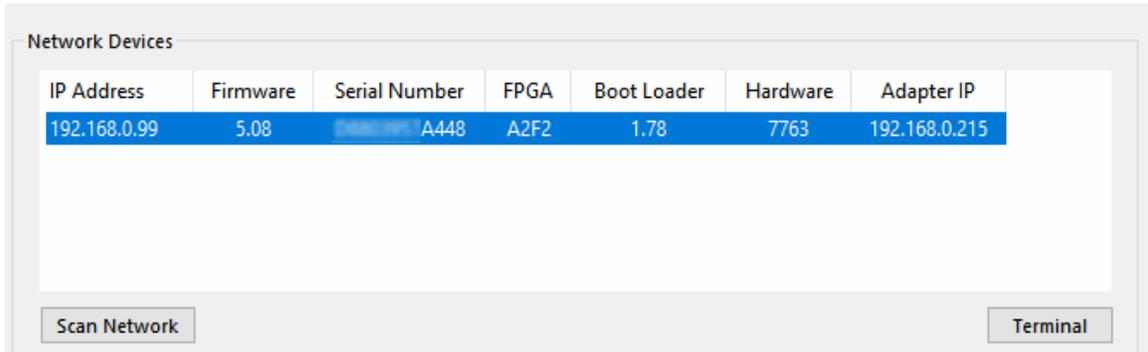


3. If the DSPMC is correctly powered up as seen above, the green power LED should be lit and the blue CPU LED blinks in some pattern.

<u>Troubleshoot Issue</u>	<u>Solution</u>
The green LED is not lit up	Make sure that the wires are adequately stripped, and use a voltmeter to verify that 12-24VDC is present on the connector. 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 contact 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 DSPMC. 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 DSPMC using the “VSI Device Manager” application, as seen below (keep in mind that individual values will differ in your case.)



If the unit does not appear, then try some of the solutions in the “Troubleshoot” table below.

<u>Troubleshoot Issue</u>	<u>Solution</u>
The device does not show up in VSI Device Manager	<ul style="list-style-type: none"> • Make sure that a good quality CAT5e (or better) Ethernet cable is used between the DSPMC and the PC. The DSPMC 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 DSPMC and make sure the orange LED is lit and green LED is blinking. If not, try using a different cable. 

5. Follow along the beginning of the “Initial Setup” section of the [HiCON Mach4 Software Integration manual](#) in order to install the HiCON plugin. This will allow you to access the HiCON status window and confirm that the inputs are being wired correctly in the following steps.
6. After getting the DSPMC 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: *It is recommended to use the same 24V power supply connected on J9 of the DSPMC to power external components so that turning off the power supply shuts off the whole system.*

The Digital I/O on the DSPMC are not tied to any specific functionality in Mach4. Input and Output I/O functions will depend on how they are mapped or scripted within Mach4 (or in custom software). As such, the sensors can be wired now, or later after mapping the I/O signals in Mach4.

Once connected, the sensors may be tested by triggering them manually and watching the associated indicators within the HiCON diagnostic window in MACH4.

- Now it is time to setup and connect the motor drives to the DSPMC as well as the motors they will be powering.

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

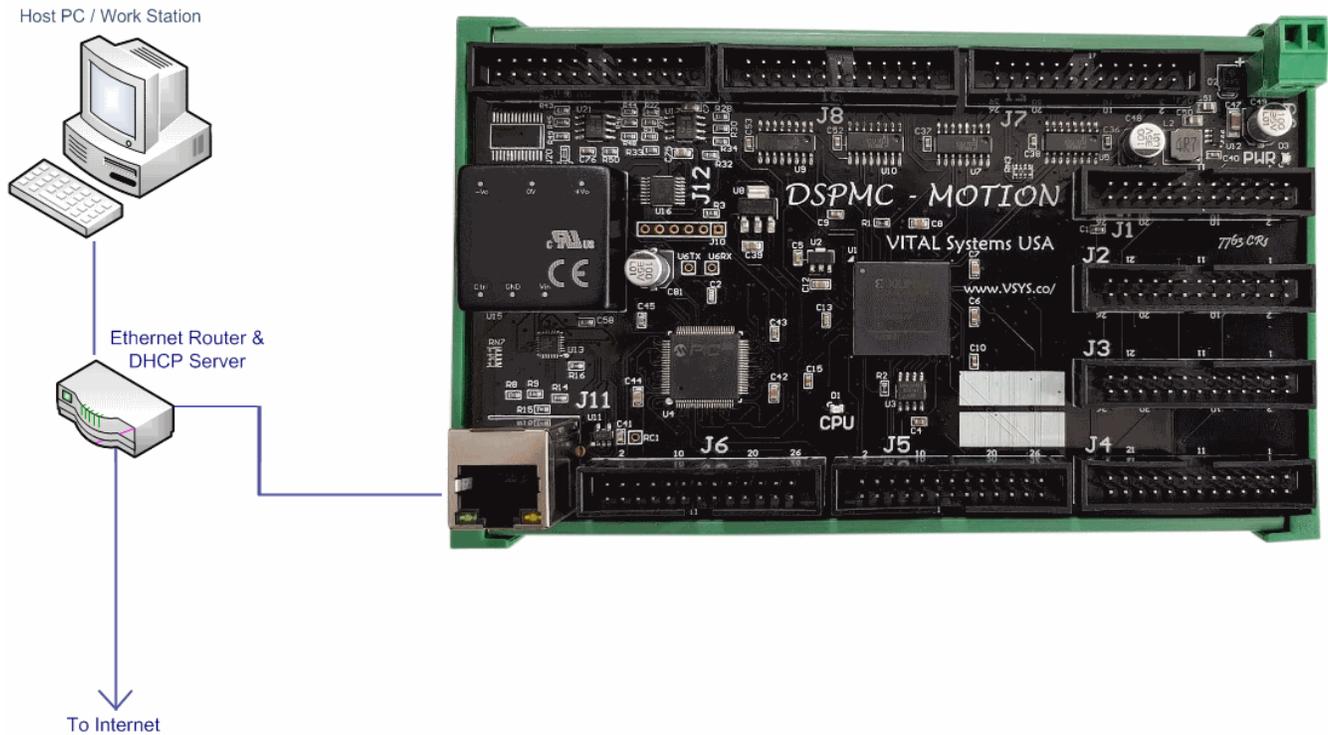
Drive Type	Method
Analog	Connect analog outputs from J12 to each of the servo drives. You will need to identify the +-10V command input and the 0v terminal on the drive which will connect to GND terminal on the DSPMC. Make sure the 0v terminals are earth grounded as well. Then connect digital outputs from the digital I/O ports to the enable inputs of the drives.
Single-Ended Step/Direction	Connect the stepper drives to the step/direction channels located on J5 and J6. Then connect digital outputs from the digital I/O ports to the enable inputs of the drives if required.
Differential Step/Direction	You may use the Vital Systems Differential Step/Dir and Encoder Board 7737 . This will convert the single-ended signals on DSPMC to differential step and direction channels, as well as a simple plug-and-play setup to Yaskawa and other drives via drive interface boards such as the EPx-DIB. See the " DSPMC with 7737 " section for installation instructions.

Once the drives are wired up correctly, you are now ready for the software configuration and testing. Further setup procedures can be found in the [HiCON Mach4 Software Integration manual](#).

4. Network Connection Setup

You can connect the DSPMC directly to your PC or connect via an Ethernet switch. The DSPMC can use the DHCP server on the network or a fixed IP address (firmware pre-assigned IP address is 192.168.0.95). The default IP address of the device can be manually changed via the VSI Device Manager Software.

4.1. Connect using an Internet Router (DHCP Server)

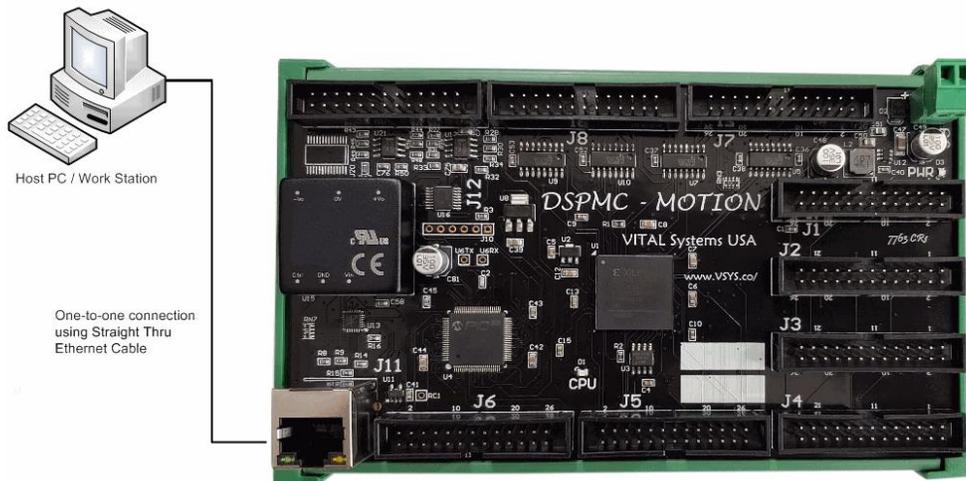


This is the simplest method to connect Mach software to the controller. The figure above shows a basic setup using an Internet router on your network. Connect the Ethernet cable from the J11 Ethernet port of the HiCON to the router. Connect another Ethernet cable from the router to your PC. The router dynamically assigns a 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.

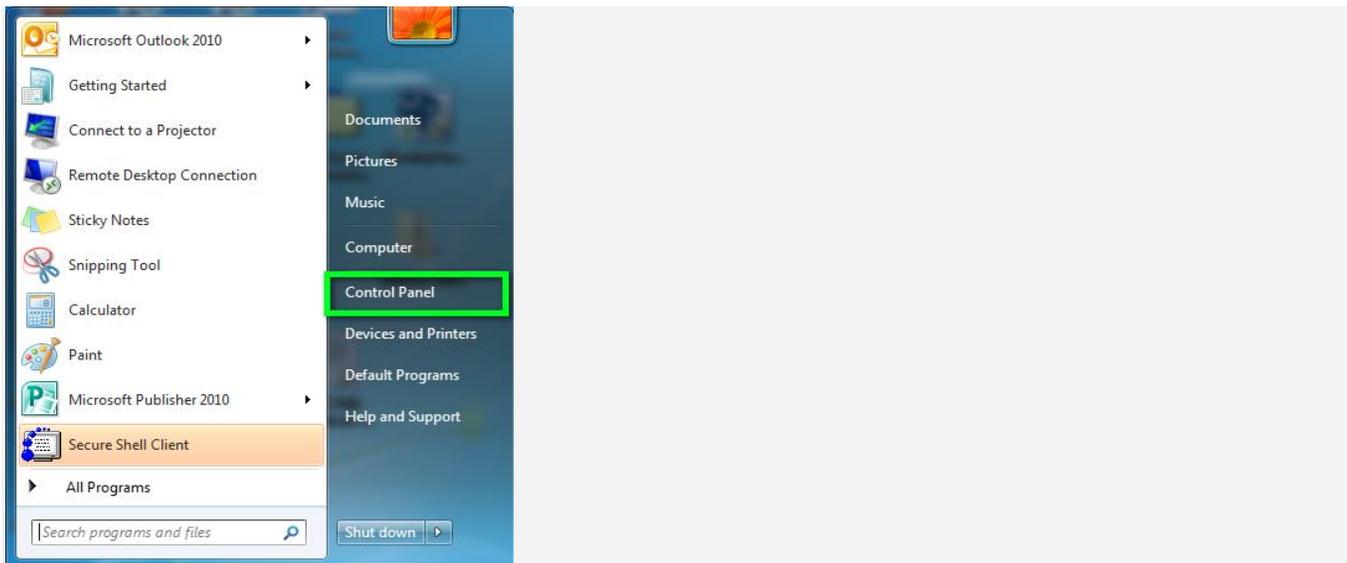
4.2. Direct Connection to the PC

On Windows 10 the network setup occurs automatically when the HiCON is connected to the PC. In case there is a need to manually assign IP address in Windows 7, 8, 10 or newer. The default IP address of the HiCON board is 192.168.0.95 and you may change it using the VSI Device Manager Software. Do not use VSI Device Manager Software to change the HiCON IP address, unless you know exactly what you are doing. If you are 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.

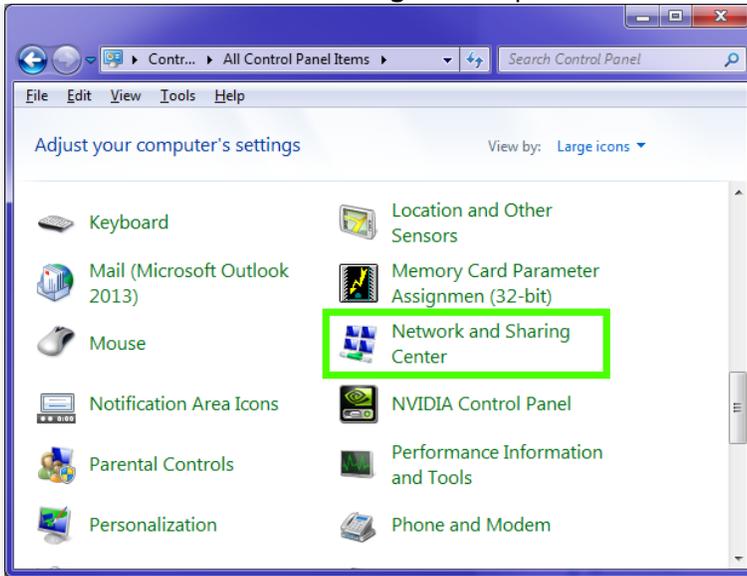
The Ethernet cable is connected from the J11 Ethernet port of the HiCON board to the PC as shown below:



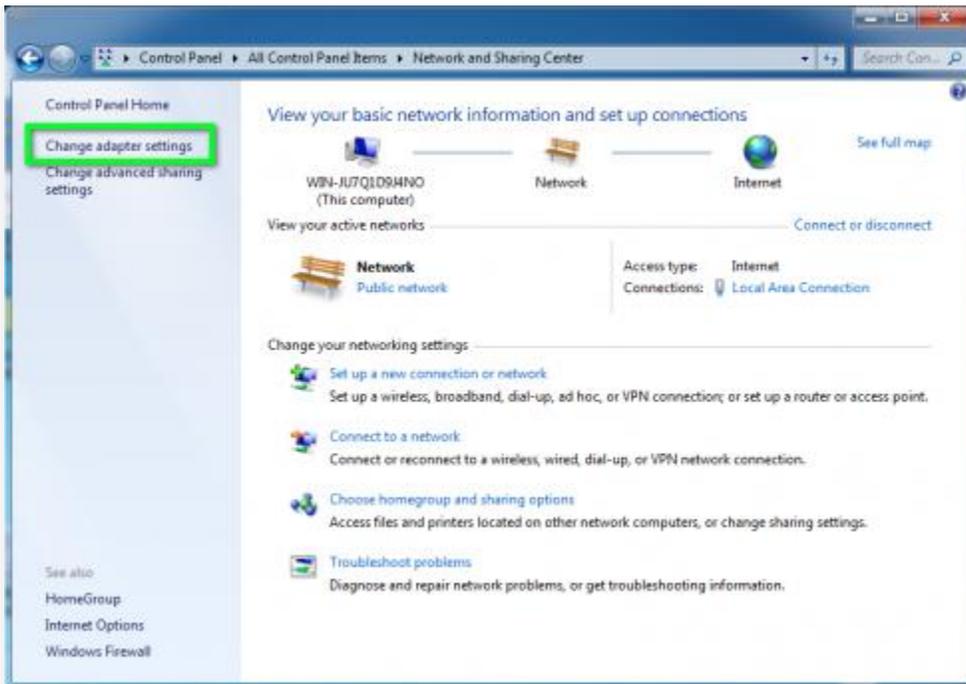
Click the Start menu. Next, click on the Control Panel option.



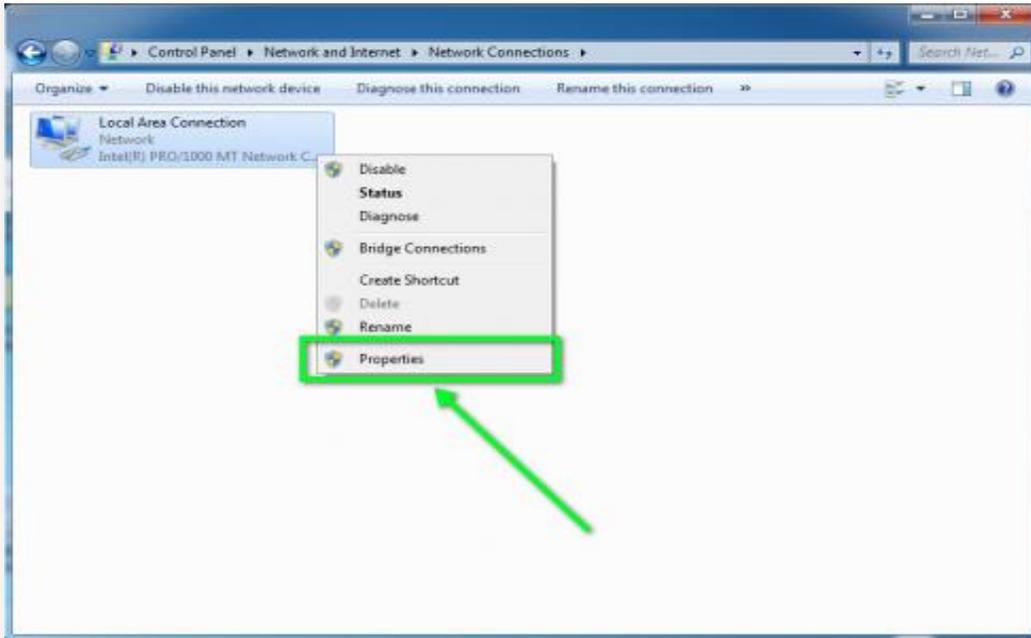
Click on the **Network and Sharing Center** option.



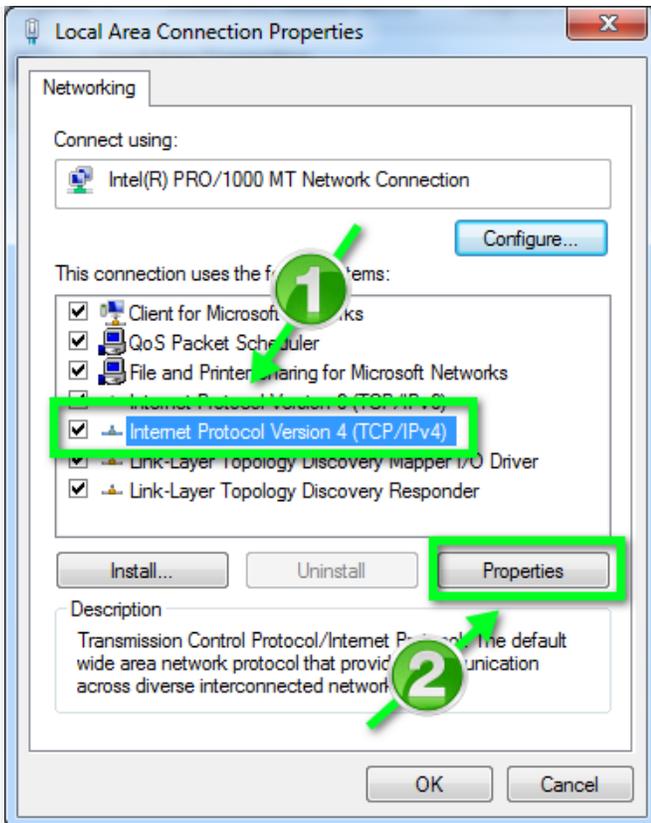
Click on **Change adapter settings** from the left side menu.



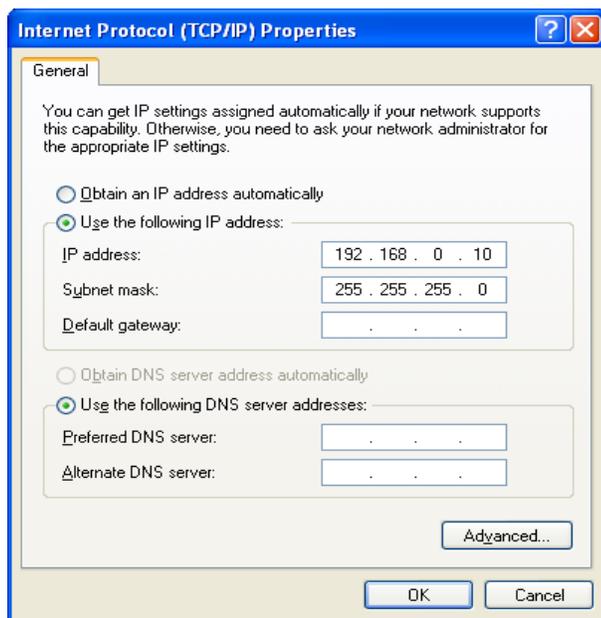
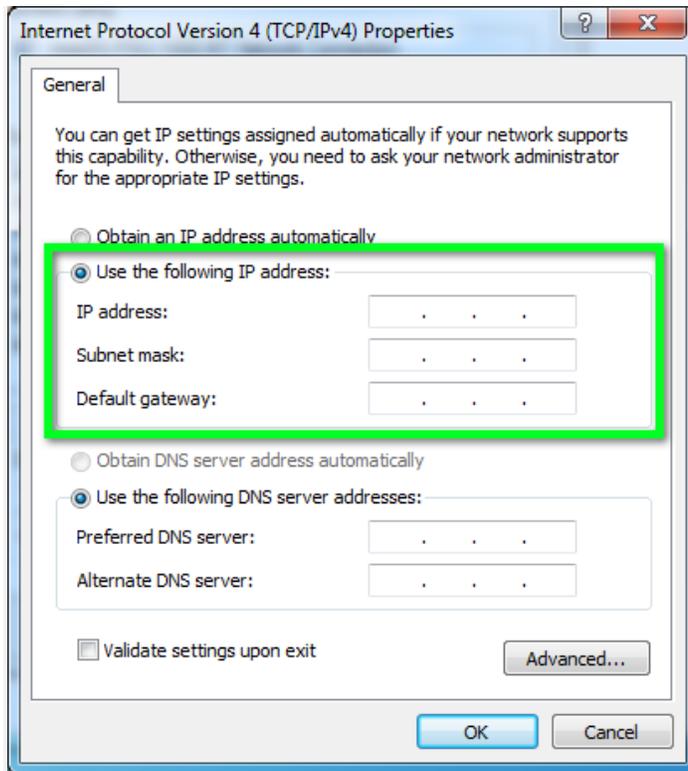
Right-click on the **Local Area Connection** icon, then select **Properties**.



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.



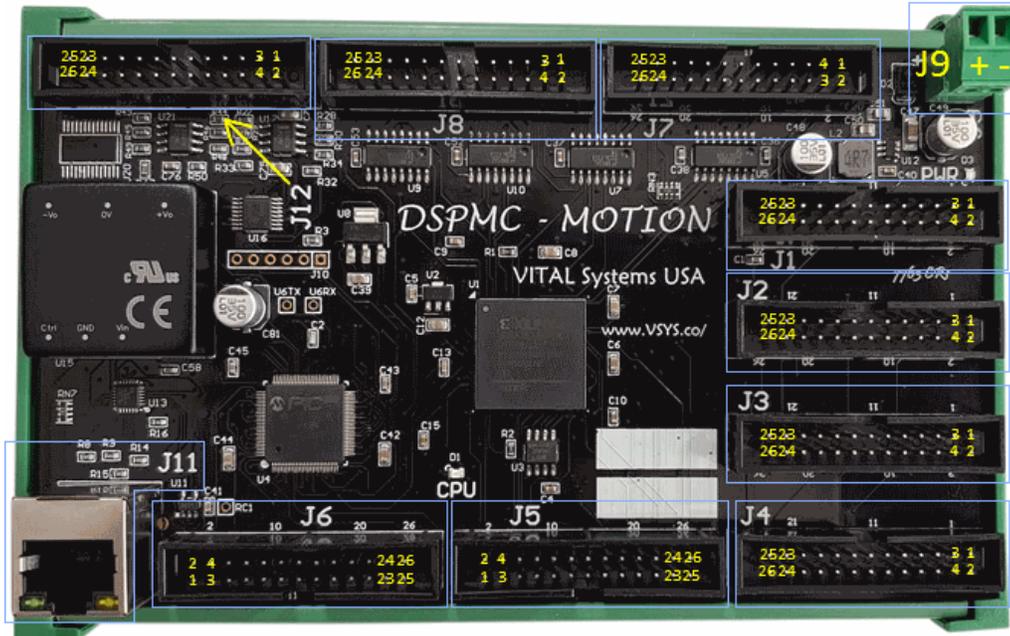
In the window that opens, click the Use the following IP address: radio button. In the IP address: section, type **192.168.0.10**, Subnet mask: **255.255.255.0**, and Default gateway: leave blank. For the DNS server settings, leave both of them blank.



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

5. DSPMCv3 Hardware Interface

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



J1	Digital I/O (16 Inputs, 8 Outputs)
J2	Digital I/O (16 Inputs, 8 Outputs)
J3	Digital I/O (16 Inputs, 8 Outputs)
J4	Digital I/O (16 Inputs, 8 Outputs)
J5	4 Single-Ended Encoder Inputs and 4 Step/Direction channels.
J6	4 Single-Ended Encoder Inputs and 4 Step/Direction channels.
J7	3 Differential Encoder Inputs.
J8	3 Differential Encoder Inputs.
J9	+12-24V power supply input.
J11	Ethernet connection.
J12*	8 Channel analog input (+/- 10 V) and 8 Channel analog output (+/- 10 V)
PWR	Green LED for Power status
CPU	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.

* See below table for feature availability by model

Model Differences

Model	Analog Inputs	Analog Outputs	Step/Direction
7763D	None	None	8 Channels
7763S	None	8 Analog Outputs	8 Channels
7763M	8 Analog Inputs	8 Analog Outputs	8 Channels

5.1. Power Supply (J9)

J9 Pin#	Function
+	+12 - 28VDC (Polarity Protected)
-	Ground

Unit requires at least 15W power input, but more may be required if more devices are connected

5.2. Ethernet Port (J11)

The DSPMC 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 DSPMC supports both 10 MBit and 100 Mbit network speeds. TCP/IP network protocol in UDP mode is used for PC communications.

5.3. Digital I/O 3.3V TTL Ports (J1, J2, J3, J4)

The Digital Low voltage TTL inputs and outputs on the DSPMC use the 3.3V standard. The user should make sure that these I/O signals do not connect to a 5V source directly. However, 5V 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 3.3V.

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.



J1 Digital I/O (3.3V TTL) Pin Assignments:

J1 Pin#	Function	J1 Pin#	Function
1	Ground	2	Digital Output Mach4 Port 11, Pin 0
3	Digital Output Mach4 Port 11, Pin 1	4	Digital Output Mach4 Port 11, Pin 2
5	Digital Output Mach4 Port 11, Pin 3	6	Digital Output Mach4 Port 11, Pin 4
7	Digital Output Mach4 Port 11, Pin 5	8	Digital Output Mach4 Port 11, Pin 6
9	Digital Output Mach4 Port 11, Pin 7	10	Digital Input Mach4 Port 11, Pin 0
11	Digital Input Mach4 Port 11, Pin 1	12	Digital Input Mach4 Port 11, Pin 2
13	Digital Input Mach4 Port 11, Pin 3	14	Digital Input Mach4 Port 11, Pin 4
15	Digital Input Mach4 Port 11, Pin 5	16	Digital Input Mach4 Port 11, Pin 6
17	Digital Input Mach4 Port 11, Pin 7	18	Digital Input Mach4 Port 11, Pin 8
19	Digital Input Mach4 Port 11, Pin 9	20	Digital Input Mach4 Port 11, Pin 10
21	Digital Input Mach4 Port 11, Pin 11	22	Digital Input Mach4 Port 11, Pin 12
23	Digital Input Mach4 Port 11, Pin 13	24	Digital Input Mach4 Port 11, Pin 14
25	Digital Input Mach4 Port 11, Pin 15	26	+5V

J2 Digital I/O (3.3V TTL) Pin Assignments:

J2 Pin#	Function	J2 Pin#	Function
1	Ground	2	Digital Output Mach4 Port 12, Pin 0
3	Digital Output Mach4 Port 12, Pin 1	4	Digital Output Mach4 Port 12, Pin 2
5	Digital Output Mach4 Port 12, Pin 3	6	Digital Output Mach4 Port 12, Pin 4
7	Digital Output Mach4 Port 12, Pin 5	8	Digital Output Mach4 Port 12, Pin 6
9	Digital Output Mach4 Port 12, Pin 7	10	Digital Input Mach4 Port 12, Pin 0
11	Digital Input Mach4 Port 12, Pin 1	12	Digital Input Mach4 Port 12, Pin 2
13	Digital Input Mach4 Port 12, Pin 3	14	Digital Input Mach4 Port 12, Pin 4
15	Digital Input Mach4 Port 12, Pin 5	16	Digital Input Mach4 Port 12, Pin 6
17	Digital Input Mach4 Port 12, Pin 7	18	Digital Input Mach4 Port 12, Pin 8
19	Digital Input Mach4 Port 12, Pin 9	20	Digital Input Mach4 Port 12, Pin 10
21	Digital Input Mach4 Port 12, Pin 11	22	Digital Input Mach4 Port 12, Pin 12
23	Digital Input Mach4 Port 12, Pin 13	24	Digital Input Mach4 Port 12, Pin 14
25	Digital Input Mach4 Port 12, Pin 15	26	+5V

J3 Digital I/O (3.3V TTL) Pin Assignments:

J3 Pin#	Function	J3 Pin#	Function
1	Ground	2	Digital Output Mach4 Port 13, Pin 0
3	Digital Output Mach4 Port 13, Pin 1	4	Digital Output Mach4 Port 13, Pin 2
5	Digital Output Mach4 Port 13, Pin 3	6	Digital Output Mach4 Port 13, Pin 4
7	Digital Output Mach4 Port 13, Pin 5	8	Digital Output Mach4 Port 13, Pin 6
9	Digital Output Mach4 Port 13, Pin 7	10	Digital Input Mach4 Port 13, Pin 0
11	Digital Input Mach4 Port 13, Pin 1	12	Digital Input Mach4 Port 13, Pin 2
13	Digital Input Mach4 Port 13, Pin 3	14	Digital Input Mach4 Port 13, Pin 4
15	Digital Input Mach4 Port 13, Pin 5	16	Digital Input Mach4 Port 13, Pin 6
17	Digital Input Mach4 Port 13, Pin 7	18	Digital Input Mach4 Port 13, Pin 8
19	Digital Input Mach4 Port 13, Pin 9	20	Digital Input Mach4 Port 13, Pin 10
21	Digital Input Mach4 Port 13, Pin 11	22	Digital Input Mach4 Port 13, Pin 12
23	Digital Input Mach4 Port 13, Pin 13	24	Digital Input Mach4 Port 13, Pin 14
25	Digital Input Mach4 Port 13, Pin 15	26	+5V

J4 Digital I/O (3.3V TTL) Pin Assignments:

J4 Pin#	Function	J4 Pin#	Function
1	Ground	2	Digital Output Mach4 Port 14, Pin 0
3	Digital Output Mach4 Port 14, Pin 1	4	Digital Output Mach4 Port 14, Pin 2
5	Digital Output Mach4 Port 14, Pin 3	6	Digital Output Mach4 Port 14, Pin 4
7	Digital Output Mach4 Port 14, Pin 5	8	Digital Output Mach4 Port 14, Pin 6
9	Digital Output Mach4 Port 14, Pin 7	10	Digital Input Mach4 Port 14, Pin 0
11	Digital Input Mach4 Port 14, in 1	12	Digital Input Mach4 Port 14, Pin 2
13	Digital Input Mach4 Port 14, Pin 3	14	Digital Input Mach4 Port 14, Pin 4
15	Digital Input Mach4 Port 14, Pin 5	16	Digital Input Mach4 Port 14, Pin 6
17	Digital Input Mach4 Port 14, Pin 7	18	Digital Input Mach4 Port 14, Pin 8
19	Digital Input Mach4 Port 14, Pin 9	20	Digital Input Mach4 Port 14, Pin 10
21	Digital Input Mach4 Port 14, Pin 11	22	Digital Input Mach4 Port 14, Pin 12
23	Digital Input Mach4 Port 14, Pin 13	24	Digital Input Mach4 Port 14, Pin 14
25	Digital Input Mach4 Port 14, Pin 15	26	+5V

5.4. Single Ended Encoder Inputs and Step/Direction Signals (J5, J6)

The J5 and J6 pins offer 8 single-ended encoder inputs and 8 single-ended step/direction channels. However, these may be converted to differential through the use of the Vital Systems [Differential Step/Dir and Encoder Board 7737](#). Refer to the [“DSPMC With 7737”](#) section for more information.

J5 Pin Assignments:

J5 Pin#	Function	J5 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 P15, pin0)
7	ESTOP (IN P15, pin0)	8	Digital Output Port 15, pin1
9	Drive Error (IN P15, pin1)	10	A Signal Encoder Channel 6
11	B Signal Encoder Channel 6	12	Z Signal Encoder Channel 6
13	A Signal Encoder Channel 7	14	B Signal Encoder Channel 7
15	Z Signal Encoder Channel 7	16	A Signal Encoder Channel 8
17	B Signal Encoder Channel 8	18	Z Signal Encoder Channel 8
19	A Signal Encoder Channel 9	20	B Signal Encoder Channel 9
21	Z Signal Encoder Channel 9	22	Step Signal Channel 0
23	Direction Signal Channel 0	24	Step Signal Channel 1
25	Direction Signal Channel 1	26	+5V

J6 Pin Assignments:

J6 Pin#	Function	J6 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 P15, pin2)
7	ESTOP (IN P15, pin2)	8	Digital Output Port 15, pin3
9	Drive Error (IN P15, pin3)	10	A Signal Encoder Channel 10
11	B Signal Encoder Channel 10	12	Z Signal Encoder Channel 10
13	A Signal Encoder Channel 11	14	B Signal Encoder Channel 11
15	Z Signal Encoder Channel 11	16	A Signal Encoder Channel 12
17	B Signal Encoder Channel 12	18	Z Signal Encoder Channel 12
19	A Signal Encoder Channel 13	20	B Signal Encoder Channel 13
21	Z Signal Encoder Channel 13	22	Step Signal Channel 4
23	Direction Signal Channel 4	24	Step Signal Channel 5
25	Direction Signal Channel 5	26	+5V

5.5. Differential Encoder Inputs (J7, J8)

J7 Pin Assignments:

J7 Pin#	Function	J7 Pin#	Function
1	Differential Encoder 0 A+	2	Differential Encoder 0 A-
3	Differential Encoder 0 B+	4	Differential Encoder 0 B-
5	Differential Encoder 0 Z+	6	Differential Encoder 0 Z-
7	5V power source	8	Ground
9	Differential Encoder 1 A+	10	Differential Encoder 1 A-
11	Differential Encoder 1 B+	12	Differential Encoder 1 B-
13	Differential Encoder 1 Z+	14	Differential Encoder 1 Z-
15	5V power source	16	Ground
17	Differential Encoder 2 A+	18	Differential Encoder 2 A-
19	Differential Encoder 2 B+	20	Differential Encoder 2 B-
21	Differential Encoder 2 Z+	22	Differential Encoder 2 Z-
23	5V power source	24	Ground
25	--	26	--

J8 Pin Assignments:

J8 Pin#	Function	J8 Pin#	Function
1	Differential Encoder 3 A+	2	Differential Encoder 3 A-
3	Differential Encoder 3 B+	4	Differential Encoder 3 B-
5	Differential Encoder 3 Z+	6	Differential Encoder 3 Z-
7	5V power source	8	Ground
9	Differential Encoder 4 A+	10	Differential Encoder 4 A-
11	Differential Encoder 4 B+	12	Differential Encoder 4 B-
13	Differential Encoder 4 Z+	14	Differential Encoder 4 Z-
15	5V power source	16	Ground
17	Differential Encoder 5 A+	18	Differential Encoder 5 A-
19	Differential Encoder 5 B+	20	Differential Encoder 5 B-
21	Differential Encoder 5 Z+	22	Differential Encoder 5 Z-
23	5V power source	24	Ground
25	--	26	--

5.6. Analog Inputs & Outputs (J12)

J12 Pin Assignments

J12 Pin#	Function	J12 Pin#	Function
1	+12V (Max 100 mA draw)	2	+5V (Max 100 mA draw)
3	-12V (Max 100 mA draw)	4	Analog Output 0
5	Analog Output 1	6	Analog Output 2
7	Analog Output 3	8	Ground
9	Analog Output 4	10	Analog Output 5
11	Analog Output 6	12	Analog Output 7
13	Ground	14	Analog Input 0
15	Analog Input 1	16	Analog Input 2
17	Analog Input 3	18	Ground
19	Analog Input 4	20	Analog Input 5
21	Analog Input 6	22	Analog Input 7
23	Ground	24	Ground
25	+5V (Max 100 mA draw)	26	+3.3V (Max 50 mA draw)

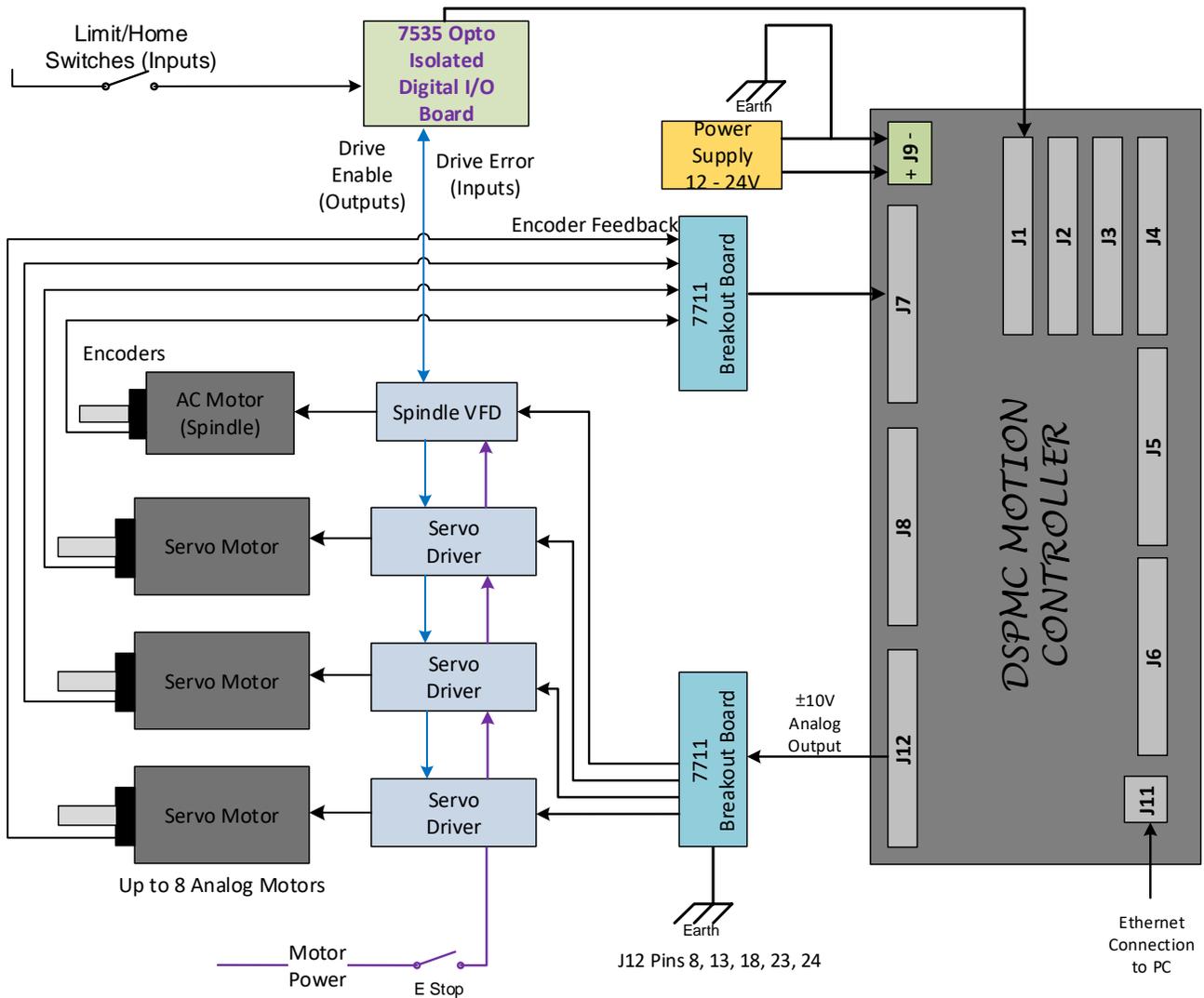
- All analog inputs and outputs have an analog range of -10 to + 10 volts.
- The user can power their device using the power pins available on J12 plug, but do not exceed the listed max current.
- The Analog drives 0v wires should be connected to multiple terminals labelled Ground in the above table, and then connected to Earth ground to drain electrical noise from the servo or VFD drives.

6. Installation Overview

6.1. Analog Drives Setup

The figure below shows a typical machine setup using Analog Servo amplifiers and quadrature encoder feedback. The 7711 and 7535 breakout boards can be used for termination and optical isolation as shown in the figure below.

NOTE: Encoder cables must have adequate shielding and be properly grounded.

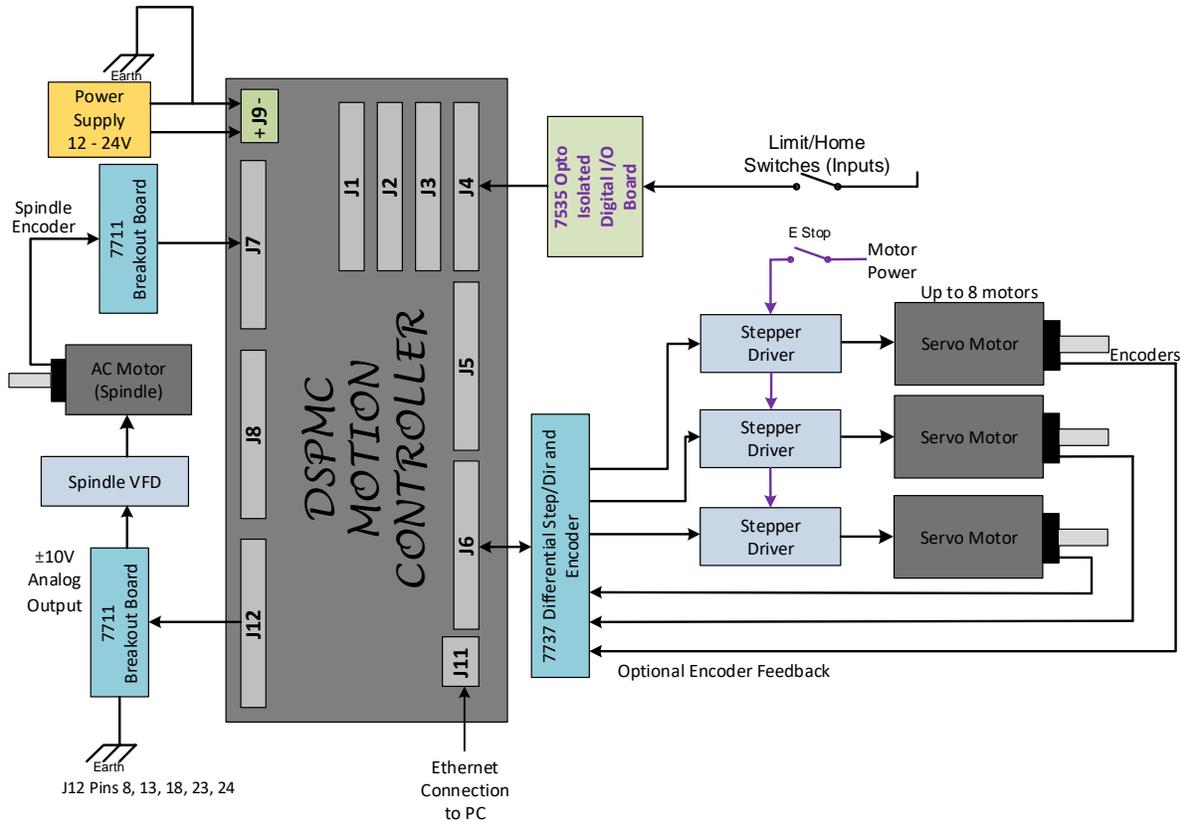


NOTE: It is required to make solid earth ground connections during installation (as shown in the above diagram). Failure to do so may cause electrical noise to disrupt the microcontroller operation and other low-voltage circuits.

6.2. Stepper Step/Direction Setup (With 7737)

The figure below shows a typical machine setup using digital stepper drivers and quadrature encoder feedback. The 7711 and 7535 breakout boards are used for termination and optical isolation. The 7737 both converts the single-ended encoder channels on J5 and J6 into differential, as well as provides a simple plug-and-play setup for the stepper drives with CAT5 RJ45 cables.

NOTE: Encoder cables must have adequate shielding and be properly grounded.



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.

7. DSPMC with 7737 (Optional)

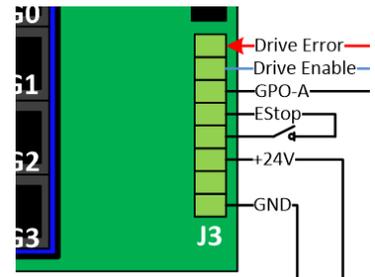
The 7737 both converts the single-ended encoder channels on J5 and J6 into differential, as well as provides a simple plug-and-play setup for the Yaskawa or other drives with CAT5 RJ45 cables.



7.1. Setup Procedures

For this setup procedure, use the setup diagram on the following page as a reference.

NOTE: For this section, ensure that the 7737 is connected to the DSPMC using the provided 26-pin flat cable, and all the setup steps were followed in the previous section.



1. On the J3 screw terminal on the 7737, (with the power supply turned off) connect 24V on the +24V input, and 0V on the GND.

NOTE: It is recommended to use the same 24V power supply connected on J9 of the DSPMC, so that turning off the power supply cuts power on all components.

2. 24V must be supplied on the ESTOP input to deactivate the ESTOP condition on the 7737. The ESTOP signal here also has a built-in function to disengage the step-direction circuit which will completely prevent outputting any command signals on the RJ45 ports.

NOTE: The ESTOP input may simply be connected on the adjacent 24V terminal, but it is recommended to wire a switch on this connection so the ESTOP can be triggered manually as necessary.

3. After connecting the power supply, test the ESTOP input by toggling the ESTOP switch ON and OFF, the ESTOP LED should change the state accordingly.

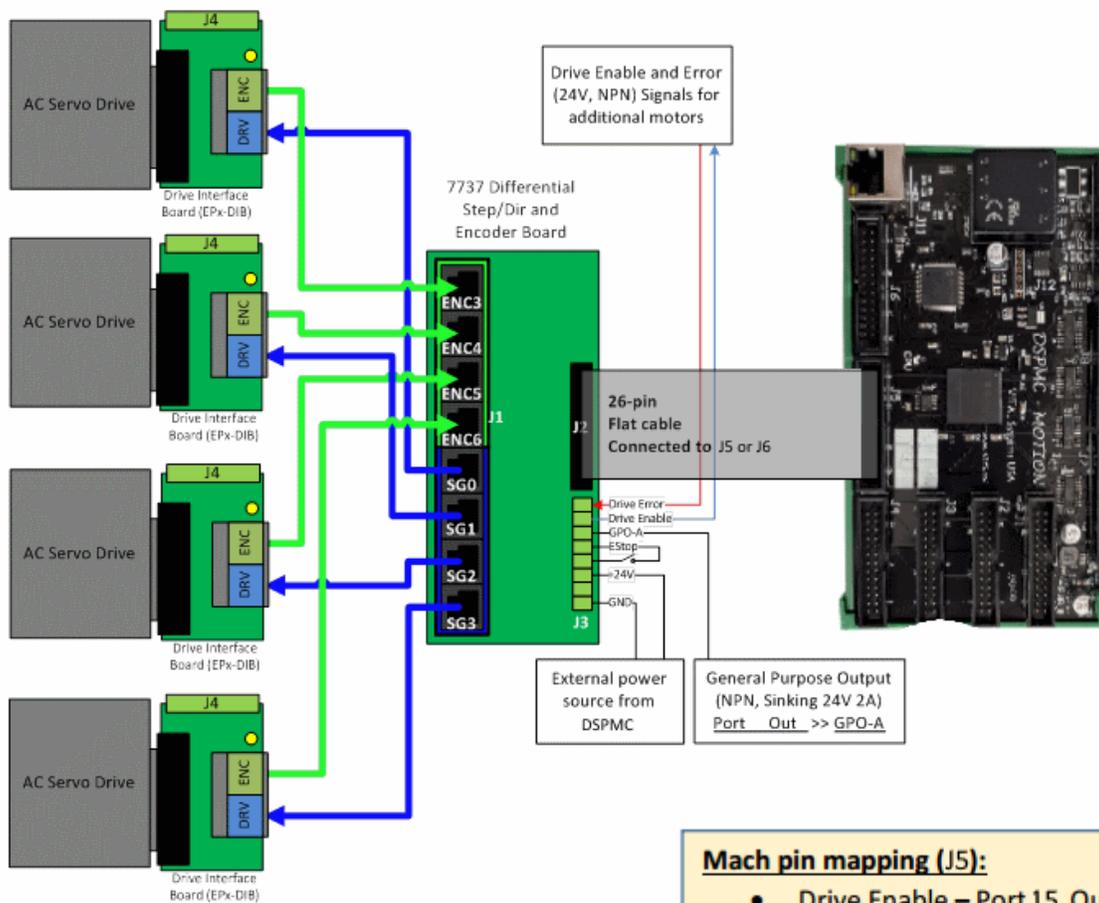
<u>Troubleshoot Issue</u>	<u>Solution</u>
The ESTOP LED is always OFF	<ul style="list-style-type: none"> • Ensure that the 24V and GND wires are adequately stripped and use a Volt meter to read if 24V is properly supplied to the 7737 and that 24V is present on the ESTOP Input.
The ESTOP LED is always ON	<ul style="list-style-type: none"> • Use a Voltmeter to ensure that 24V is present on the ESTOP Input

NOTE: The ESTOP Signal must be enabled in the HiCON tab of the VSIDeviceManager for each of the J5 and J6 ports in use. Conversely, either of these ports that is not in use should have this setting disabled.

- Turn OFF the power supply. If the drives were purchased from Vital System Inc. and the Drive Interface boards were also provided with the package, the connection is simply a matter of plugging the RJ45 cables from the 7737 to the Drive Interface Boards for each drive.

If the drives were not purchased from Vital System Inc., or the Drive Interface Boards were not supplied with the package, you will need to plug one end of the RJ45 cable into the appropriate RJ45 port on the 7737, and cut the other end for wiring into the drive directly. Refer to the “7737 Board to Drive Wiring” diagram on the next page for making the connections on the drive. For these connections, use good quality CAT5e (or better) Ethernet cables.

Setup Diagram for 7737 Board and DSPMC



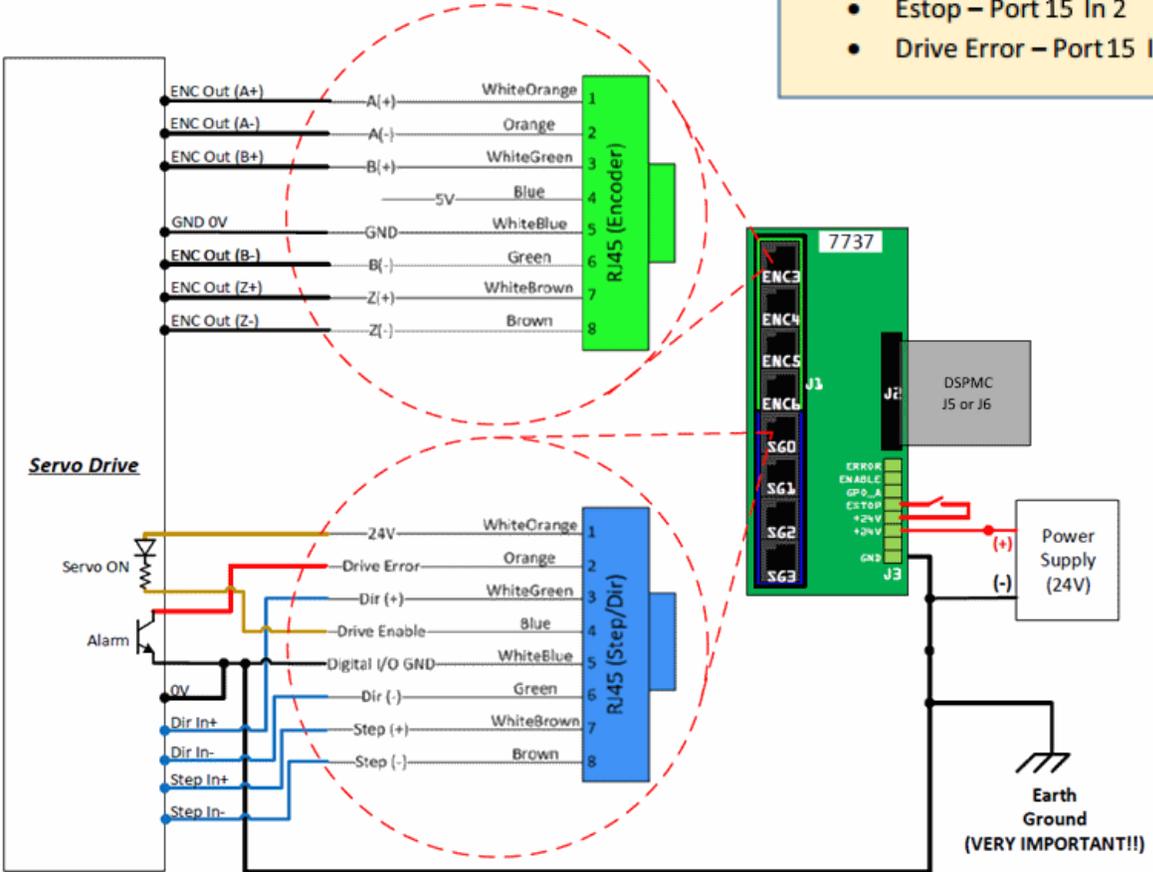
Mach pin mapping (J5):

- Drive Enable – Port 15, Out 0
- GPO-A – Port 15 Out 1
- Estop – Port 15 In 0
- Drive Error – Port 15 In 1

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.

7.2. pn7737 Board to Drive Wiring

- Mach pin mapping (J6):**
- Drive Enable – Port 15, Out 2
 - GPO-A – Port 15 Out 3
 - Estop – Port 15 In 2
 - Drive Error – Port 15 In 3



8. Add-ons and Optional Features

Most CNC applications will only require the DSPMC base unit, pn7763. 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 C 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 language may be used
- Extends Mach4 Functionality

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.

Rigid Tap[*]

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

7737 Step/Dir and Encoder Board

The pn7737 Differential Step/Direction and Encoder Board allows one to convert the single-ended Step/Direction and Encoder channels on J5 and J6 into differential mode, and allows a simple plug-and-play setup using standard RJ45/Ethernet cables. When used with Drive Interface Board (EPx-DIB) for Maxsine and Yaskawa 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 four 7535 (P or N) boards can be plugged into HiCON DSPMCv3, providing 64 optically isolated Inputs and 32 optically isolated outputs.

9. Further Reading

1. [HiCON Mach4 Software Integration](#)
2. [HiCON CMacro User Guide](#)
3. [VSI Device Manager manual](#)