HiCON OEM – pn7752

Breakout Board – pn7775

Ethernet Motion Controller
Data Acquisition System
Logic Controller

User Guide

Document Revision 1.5
(Updated July 9, 2013)

Phoenix, AZ USA

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

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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:

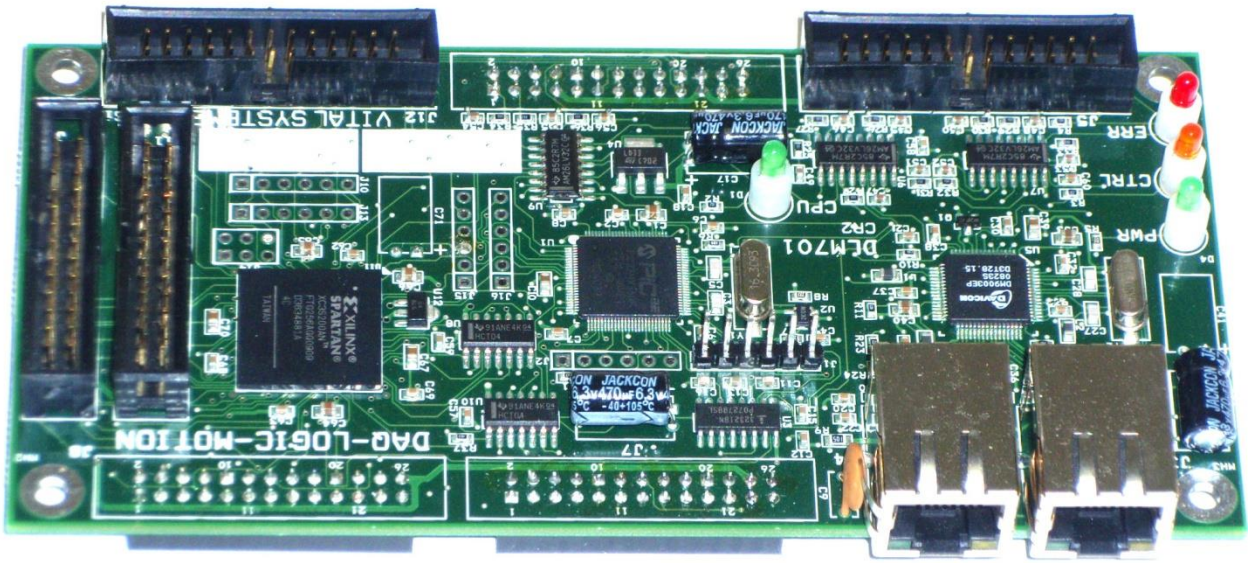
I agree that no-one other than the owner of this machine, will, under any circumstances be responsible, for the operation, safety, and use of this machine. I agree there is no situation under which I would consider Vital Systems, or any of its distributors to be responsible for any losses, damages, or 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.

1. Overview



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

HiCON controller 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:

- **9 Differential Quadrature Encoder Inputs. 32-Bit Resolution**
- **4 Mhz Max Encoder frequency. Encoder resolution multiplied by 4 thru Hardware.**
- **6 Step and Direction Channels. Up to 2MHz Step Frequencies**
- **2 Channel Analog Inputs, Range 0-3.3VVolts, 12-bit Resolution**
- **72 Digital I/O (48 Inputs & 24 Outputs)**
- **Ethernet 100Mb connectivity using TCP/IP interface.**
- **Simple UDP Socket Programming Interface.**
- **Visual Studio 2010 .Net Managed Library for C#, C++, and VB.Net Software Developers.**
- **Standalone Operation by programming the unit with BASIC programming language.**

Software Tool Set:

- **HiCON Firmware Upgrade** – A GUI based software tool to re-flash (burn) the firmware stored on the HiCON board. New versions of this program and firmware can be obtained from the factory.
- **Mach3 Plugin** – Plugin Software for Mach3.
- **Windows .Net Library** – Software Library for custom PC software development.

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.

2. Software setup

2.1 HiCON Mach3 and Mach4 Plugin Setup

To use the HiCON plugin for Mach3 or Mach4, copy the M3HiCON.dll file to PlugIns folder in the Mach install directory. When you run Mach3 or Mach4, it should provide you with a prompt for multiple plugins detected with the HiCON plugin included in the list.

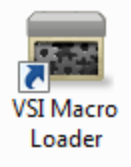
2.2 VSI Device Manager

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 – Unlocks 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 – Unlocks the use of HiCON Basic Programs for standalone operation.
- Analog Input – Unlocks the user of Analog Inputs (0 – 3.3V).

2.3 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.

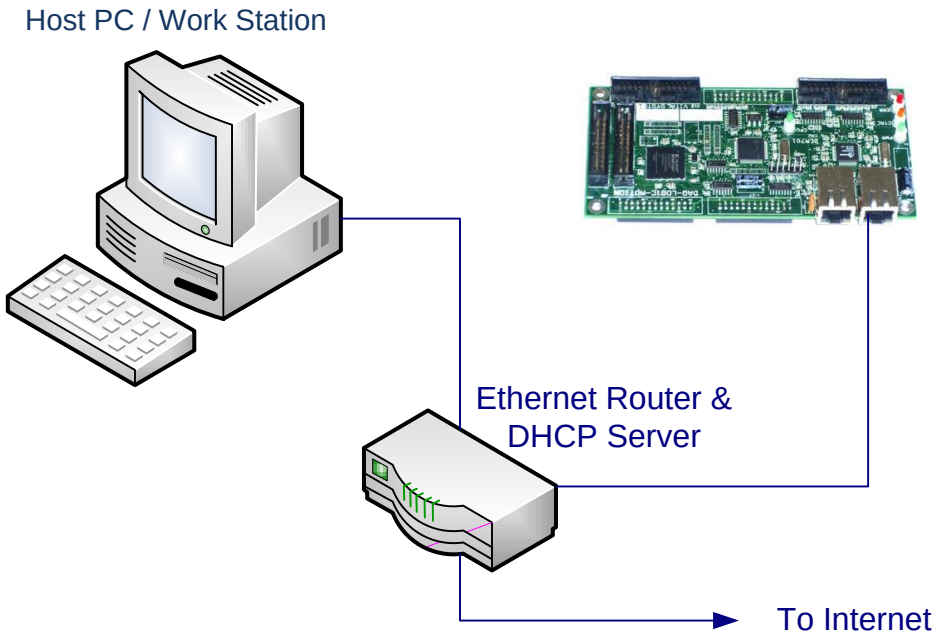
2.4 Custom Software Application with HiCON

Custom Windows applications can be created using the HiCON CLR 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. A demo C# application containing the HiCON CLR library can be downloaded from the vitalsystem website.

3. Network Connection Setup

You can connect the HiCON 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 fixed IP address of the device can be manually changed via the HiCON Upgrade Software.

3.1 Setup IP address using a Router with DHCP Server



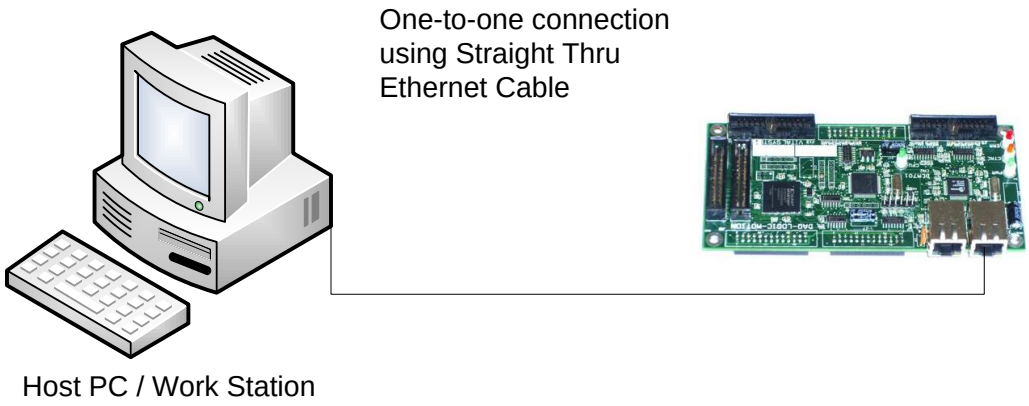
The figure above shows a basic setup using a router on your network. Connect the Ethernet cable from the J3 or J4 Ethernet port of the HiCON to the DHCP server/Router. Connect another Ethernet cable from the DHCP Server/Router to the PC. The DHCP server dynamically assigns IP address both to the PC as well as to the HiCON, and therefore completes the network setup without requiring any intervention from the user.

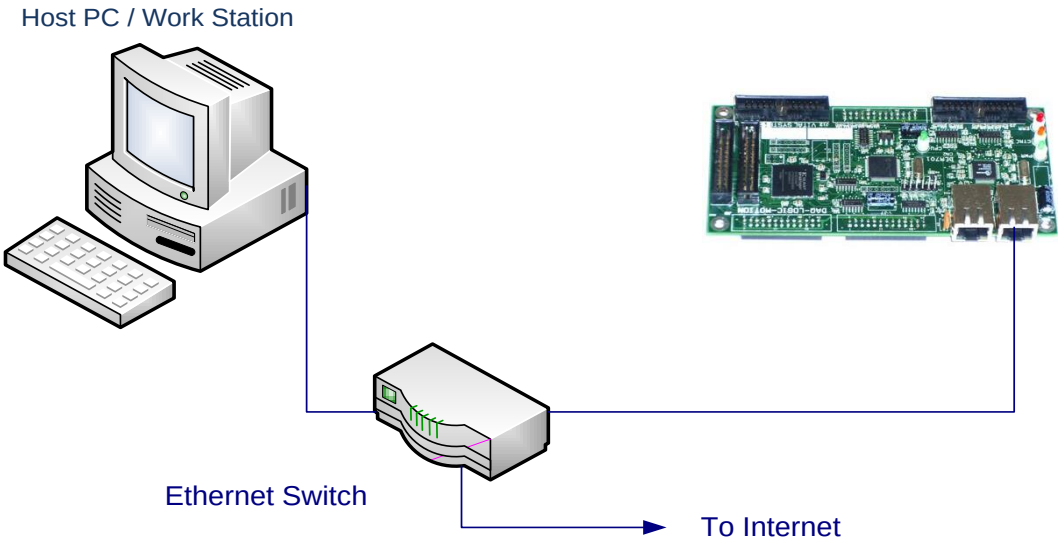
3.2 Manually Assign an IP address

With TCP/IP networking, the PC and the HiCON both need their own unique IP address.

When connecting the PC directly to the HiCON board, you will need to manually assign IP address 192.168.0.10 to your PC. The HiCON board will use its firmware pre-assigned IP address, i.e. 192.168.0.35.

The Ethernet cable is connected from the J3 or J4 Ethernet port of the HiCON board to the PC as shown below:



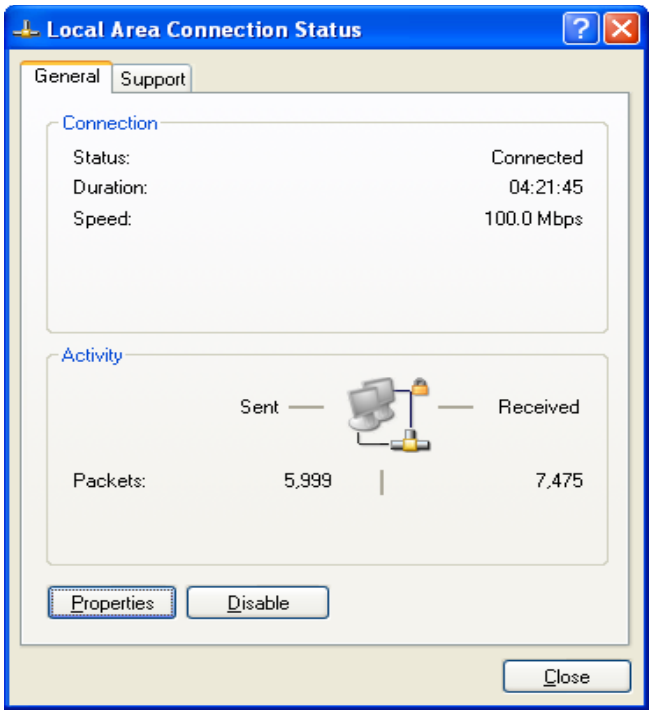


The PC IP Address can be manually assigned or auto-assigned by a DHCP server present on the network.

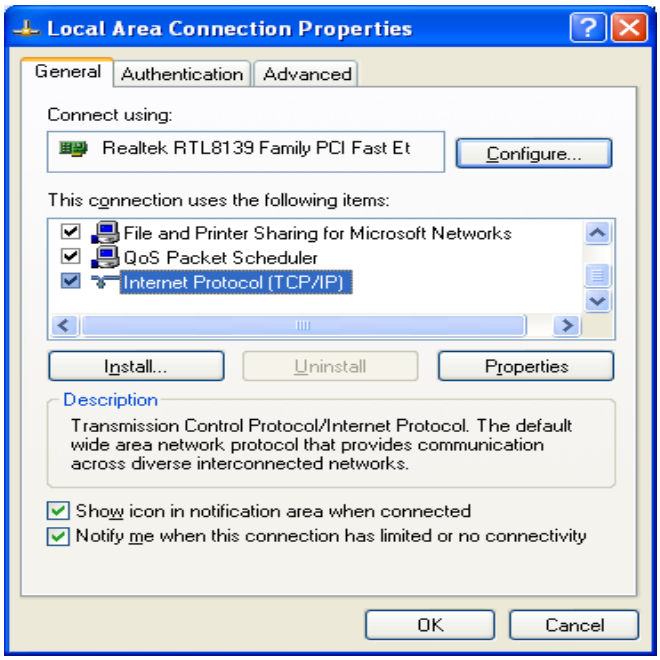
NOTE: If a direct Ethernet connection is made with HiCON, then the PC IP Address must be manually assigned to 192.168.0.10 as shown below:

1. Double click on the 'My Network Places' icon in Windows and open the 'available network connections'.

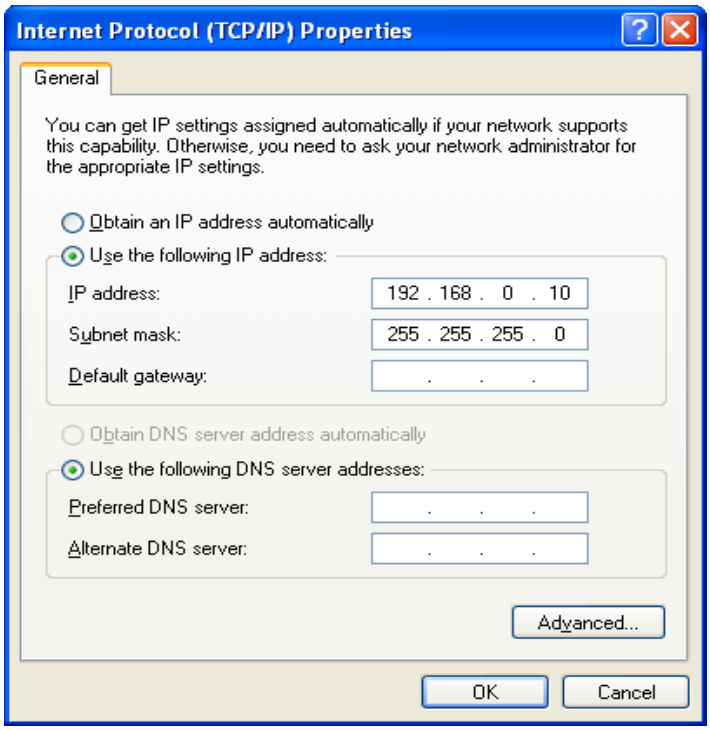
2. Double click on the corresponding LAN Connection over which the device will be setup. The following window appears.



3. Click on the Properties and select the Internet Protocol (TCP/IP) Connection in 'General' Tab

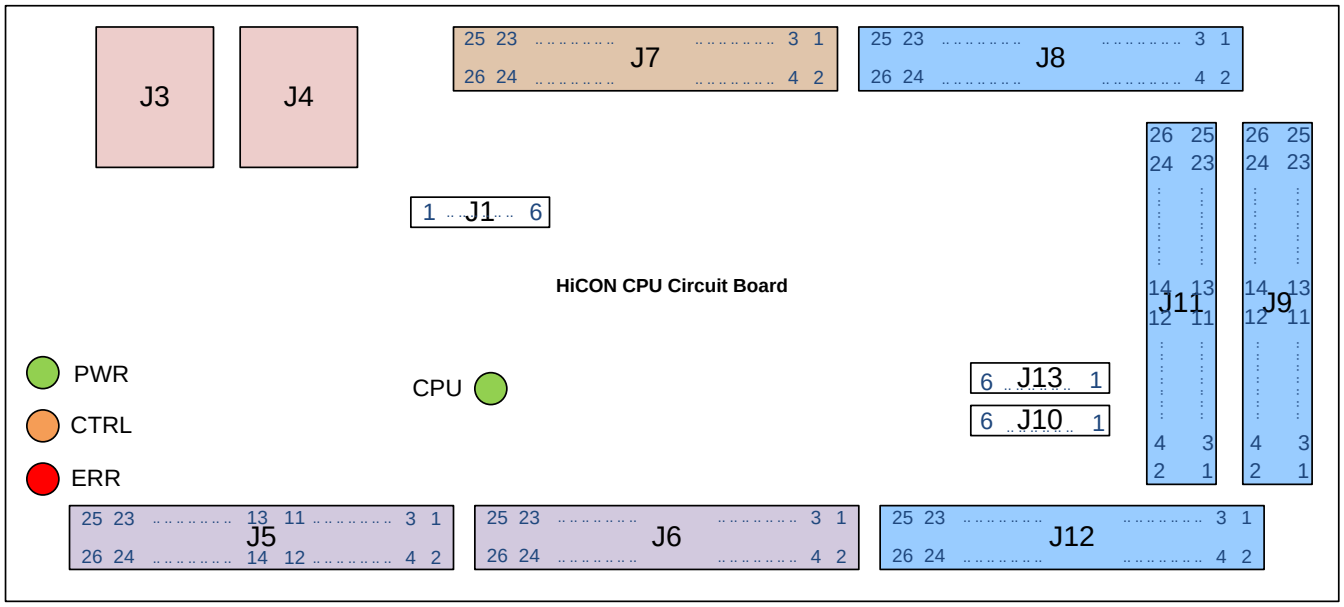


4. Click on the 'Properties' button and make the settings in your PC similar to the one shown in the figure below. After settings are done, click 'OK' button to finish the setup


Internet Protocol (TCP/IP) Properties
General
You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.
Obtain an IP address automatically
Use the following IP address:
IP address:
192 . 168 . 0 . 10
Subnet mask:
255 . 255 . 255 . 0
Default gateway:
Obtain DNS server address automatically
Use the following DNS server addresses:
Preferred DNS server:
Alternate DNS server:
Advanced...
OK
Cancel

4. HiCON CPU Hardware Interface

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



J3, J4 – Ethernet connection
J5 – Differential Encoder inputs (Index 0, 1 and 2).
J6 – Differential Encoder inputs (Index 3), Single-ended Encoder inputs (4 – 7), Digital I/Os
J7 – Stepper Motor outputs, PWM Output, Digital I/Os, Serial RX and TX, Analog Outputs
J8 – Port 11 digital I/Os, provide 16 inputs (0 – 15) and 8 outputs (0 – 7)
J9 – Port 12 digital I/Os, provide 16 inputs (16 - 31) and 8 outputs (8 – 15)
J10 – Single-ended Encoder input 8
J11 – Port 13 digital I/Os, provide 16 inputs (32 - 47) and 8 outputs (16 – 23)
J12 – Port 14 digital I/Os, provide 16 inputs (48 – 63) and 8 outputs (24 – 31)
J13 – Digital Outputs 24 – 29

PWR LED – Green colored LED for Power indication; it glows steadily when Power is on
CTRL LED – Orange colored LED for PIDs in-control; it glows steadily when PID is armed
ERR LED – Red colored LED for error indication.
CPU LED – Green colored LED for Power indication; it blinks steadily when Power is on and running normally. It blinks rapidly if it is on download mode.

4.1 Ethernet Port – J3, J4

The HiCON controller has a built-in Ethernet switch that allows the user to connect up to two Ethernet cables (e.g. for daisy chain). Connect to PC directly or via an Ethernet Hub or switch. The HiCON board supports both 10 MBit and 100 Mbit network speeds. TCP/IP network protocol in UDP mode is used for PC communications.

4.2 Digital I/O Ports – J8, J9, J11, J12, J13

The Digital inputs and outputs on HiCON (J8, J9, J11, J12, and J13) use the 3.3volts standard. The user should make sure that these I/O signals do not connect to a 5volts source. However, 5volts through a 4.7K or higher value resister can be connected to any input or output pin. A direct connection of these pins to 5volts (without a resistor) will damage the unit.

The Vital Systems Opto-Isolated I/O boards 7535, and OPTO22 style modules e.g. G4ODC5 and G4IDC5, are compatible with HiCON Digital I/O Ports.

J8 Pin Assignments:

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

J9 Pin Assignments:

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

J11 Pin Assignments:

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

J12 Pin Assignments:

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

J13 Pin Assignments:

Pin#	Function
1	Digital Output Port 14, Pin 0
2	Digital Output Port 14, Pin 1
3	Digital Output Port 14, Pin 2
4	Digital Output Port 14, Pin 3
5	Digital Output Port 14, Pin 4
6	Digital Output Port 14, Pin 5

4.3 Stepper and Miscellaneous Signals

J7 Pin Assignments:

Pin #	Function	Pin#	Function
1	Step 4	2	Step 5
3	Step 2	4	Step 3
5	Step 0	6	Step 1
7	Direction 4	8	Direction 5
9	Direction 2	10	Direction 3
11	Direction 0	12	Direction 1
13	PWM0 Output	14	Digital Input Port 14, Pin 0
15	Digital Input Port 14, Pin 1	16	Digital Input Port 14, Pin 2
17	UART_TX	18	UART_RX
19	Analog Input 0	20	Analog Input 1
21	Digital Input Port 14, Pin 3	22	Digital Input Port 14, Pin 4
23	+3.3V	24	+5V
25	Ground	26	Ground

4.4 Encoders on J5, J6 and J10

J5 Pin Assignments:

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

J6 Pin Assignments:

Pin #	Function	Pin#	Function
1	Differential Encoder Ch 3 A+	2	Differential Encoder Ch 3 A-
3	Differential Encoder Ch 3 B+	4	Differential Encoder Ch 3 B-
5	Differential Encoder Ch 3 Z+	6	Differential Encoder Ch 3 Z-
7	+5V	8	Ground
9	Single-ended Encoder Ch 4 A	10	Single-ended Encoder Ch 4 B
11	Single-ended Encoder Ch 4 Z	12	Single-ended Encoder Ch 5 A
13	Single-ended Encoder Ch 5 B	14	Single-ended Encoder Ch 5 Z
15	Single-ended Encoder Ch 6 A	16	Single-ended Encoder Ch 6 B
17	Single-ended Encoder Ch 6 Z	18	Single-ended Encoder Ch 7 A
19	Single-ended Encoder Ch 7 B	20	Single-ended Encoder Ch 7 Z
21	+5V	22	Ground
23	Digital Input Port 14, Pin 5	24	Digital Input Port 14, Pin 6
25	Digital Output Port 14, Pin 6	26	Digital Output Port 14, Pin 7

J10 Pin Assignments:

Pin #	Function
1	Single-ended Encoder Ch 8 A
2	Single-ended Encoder Ch 8 B
3	Single-ended Encoder Ch 8 Z
4	Reserved
5	Reserved
6	Reserved

5. Breakout Board 7775

The figure below shows the connector description and wiring diagram for HiCON 7775 Breakout Board.

PNP and NPN I/O Connectors

The 7775 Board has 2 sets of I/O, NPN and PNP. These connectors are optically isolated from the Power Input of the board on K6.

Conn#	Type	Description
K1	PNP Outputs 12-30V	P11, **Output** 0 thru 3
K2	PNP Inputs 12-30V	P11, Input 0 thru 3
K3	PNP Inputs 12-30V	P11, Input 4 thru 7
K11	NPN Inputs 12-30V	P11, Input 8 thru 11
K12	NPN Inputs 12-30V	P11, Input 12 thru 15
K13	NPN Outputs 12-30V	P11, **Output** 4 thru 7

K4 Pin Assignments:

Pin #	Function
1	Differential Encoder Ch 3 A+
2	Differential Encoder Ch 3 A-
3	Differential Encoder Ch 3 B+
4	Differential Encoder Ch 3 B-
5	Differential Encoder Ch 3 Z+
6	Differential Encoder Ch 3 Z-
7	5Volt for Encoder
8	0v (CPU Gnd)

K5 Pin Assignments:

Pin #	Function
1	Reserved
2	Reserved
3	Reserved
4	Single-ended Encoder Ch6 A
5	Single-ended Encoder Ch6 B
6	Single-ended Encoder Ch6 Z
7	Single-ended Encoder Ch7 A
8	Single-ended Encoder Ch7 B
9	Single-ended Encoder Ch7 Z
10	0V CPU Gnd

K6 Pin Assignments: Power Supply Input for HiCON + Breakout.

Pin #	Function
1	24 Volt Power Input, 500ma. This is only used to power the two relays and spindle 0-10volts circuit.
2	0v, CPU Gnd
3	5 Volt Power Input, 2 Amp

K7 Pin Assignments:

Pin #	Function
1	0v (Common, Gnd)
2	Analog Spindle 0 – 10V
3	PWM+
4	PWM-
5	Relay 1 N.O. (P14, **Output** 6)
6	Relay 1 N.O. (P14, **Output** 6)
7	Relay 2 N.O. (P14, **Output** 7)
8	Relay 2 N.O. (P14, **Output** 7)

K8, K9, and K10 Pin Assignments: Stepper Outputs

K8 Pin #	Function	K9 Pin#	Function	K10 Pin#	Function
1	Stepper0+	1	Stepper2+	1	Stepper4+
2	Stepper0-	2	Stepper2-	2	Stepper4-
3	Direction0+	3	Direction2+	3	Direction4+
4	Direction0-	4	Direction2-	4	Direction4-
5	Stepper1+	5	Stepper3+	5	Stepper5+
6	Stepper1-	6	Stepper3-	6	Stepper5-
7	Direction1+	7	Direction3+	7	Direction5+
8	Direction1-	8	Direction3-	8	Direction5-

K16 DB25 Pin Assignments:

The Digital I/O on DB25 uses the NPN power and ground, which isolated from CPU power and gnd.

Pin#	Function	Pin#	Function
1	P14, Digital Input 0, NPN 12-30v	14	UART_TX
2	P14, Digital Input 1, NPN 12-30v	15	UART_RX
3	P14, Digital Input 2, NPN 12-30v	16	Analog Input 0, Use CPU GND
4	P14, Digital Input 3, NPN 12-30v	17	Analog Input 1, Use CPU GND
5	P14, Digital Input 4, NPN 12-30v	18	Differential Encoder Ch 5 Z-
6	P14, Digital Input 5, NPN 12-30v	19	Differential Encoder Ch 5 Z+
7	P14, Digital Input 6, NPN 12-30v	20	Differential Encoder Ch 5 B-
8	GP_W1	21	Differential Encoder Ch 5 B+
9	GP_W2	22	Differential Encoder Ch 5 A-
10	GP_W3	23	Differential Encoder Ch 5 A+
11	GP_W4	24	+5V
12	GP_W5	25	0v CPU Gnd
13	NPN side GND		

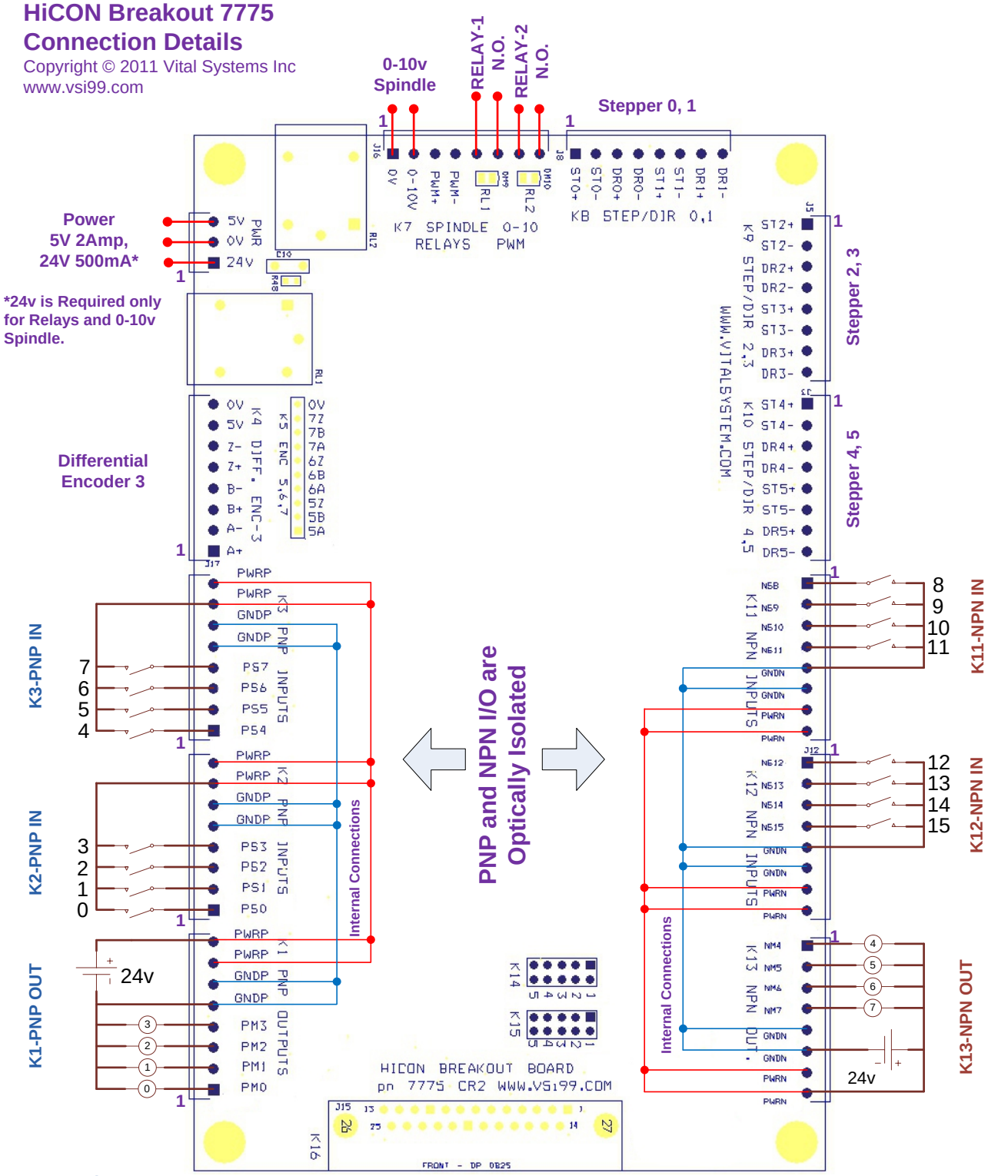
GP_W1 thru GP_W5 can be assigned different signals based on the Jumpers selection on K14 and K15. These signals are shared with the NPN side connectors K11, 12 and 13.

K14 Jumpers to Select Signals on DB25

Jumper#	Generic Name	K14 Jumper Set
1	GP_W1	P11, Digital Input 11
2	GP_W2	P11, Digital Input 12
3	GP_W3	P11, Digital Input 13
4	GP_W4	P11, Digital Input 14
5	GP_W5	P11, Digital Input 15

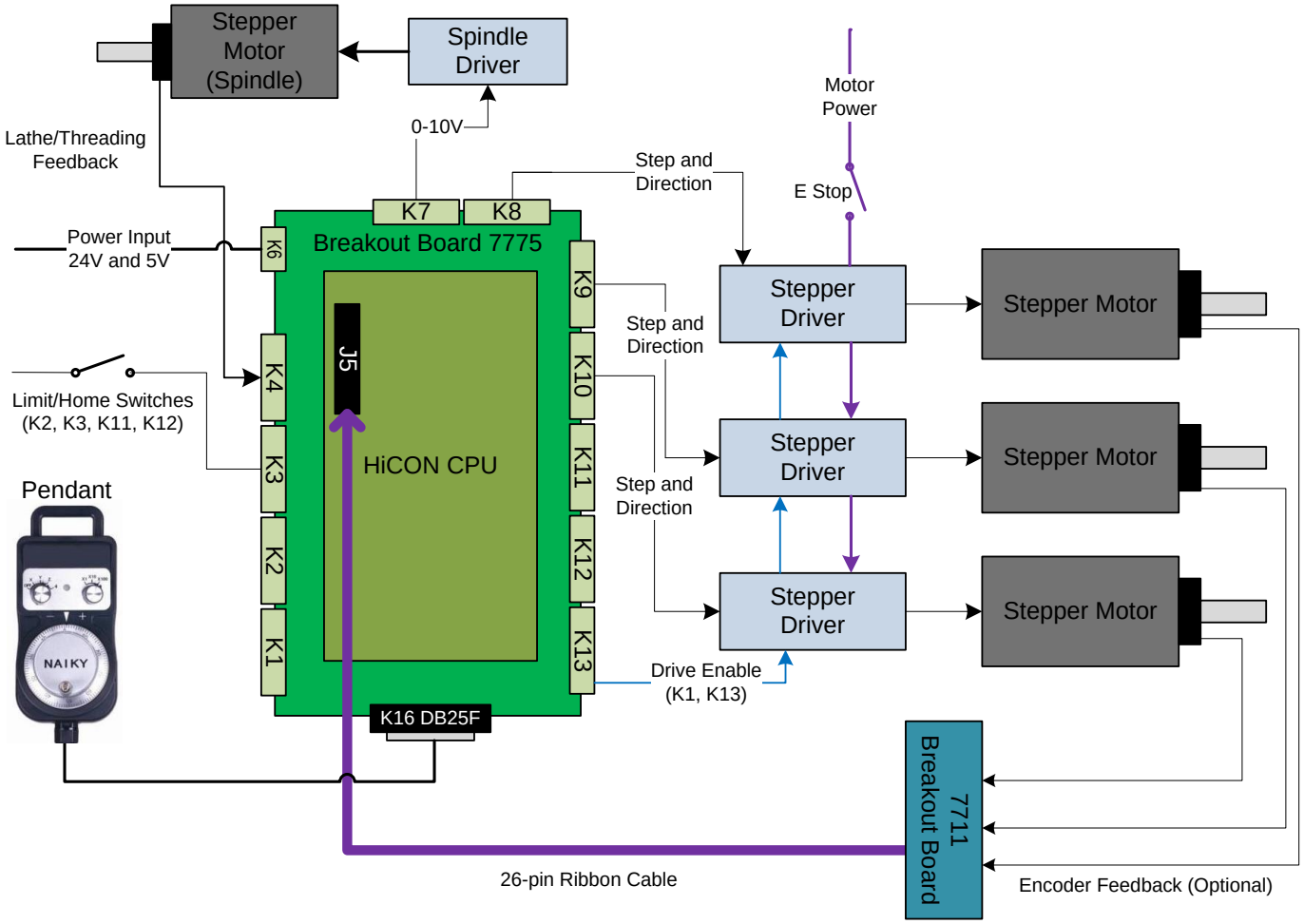
Jumper#	Generic Name	K15 Jumper Set
1	GP_W1	NPN side Power PWR 12-30v
2	GP_W2	P11, Digital Output 4
3	GP_W3	P11, Digital Output 5
4	GP_W4	P11, Digital Output 6
5	GP_W5	P11, Digital Output 7

HiCON Breakout 7775 Connection Details



6. High Level Connection Diagram Using 7775 Breakout Board

The figure below shows a typical Milling/Lathe machine connection using HiCON and Breakout Board 7775.



Further Reading

1. HiCON Mach3 Software Integration
2. HiCON Basic User Guide
3. VSI Device Manager Software