Ajax CNC

Installation Manual

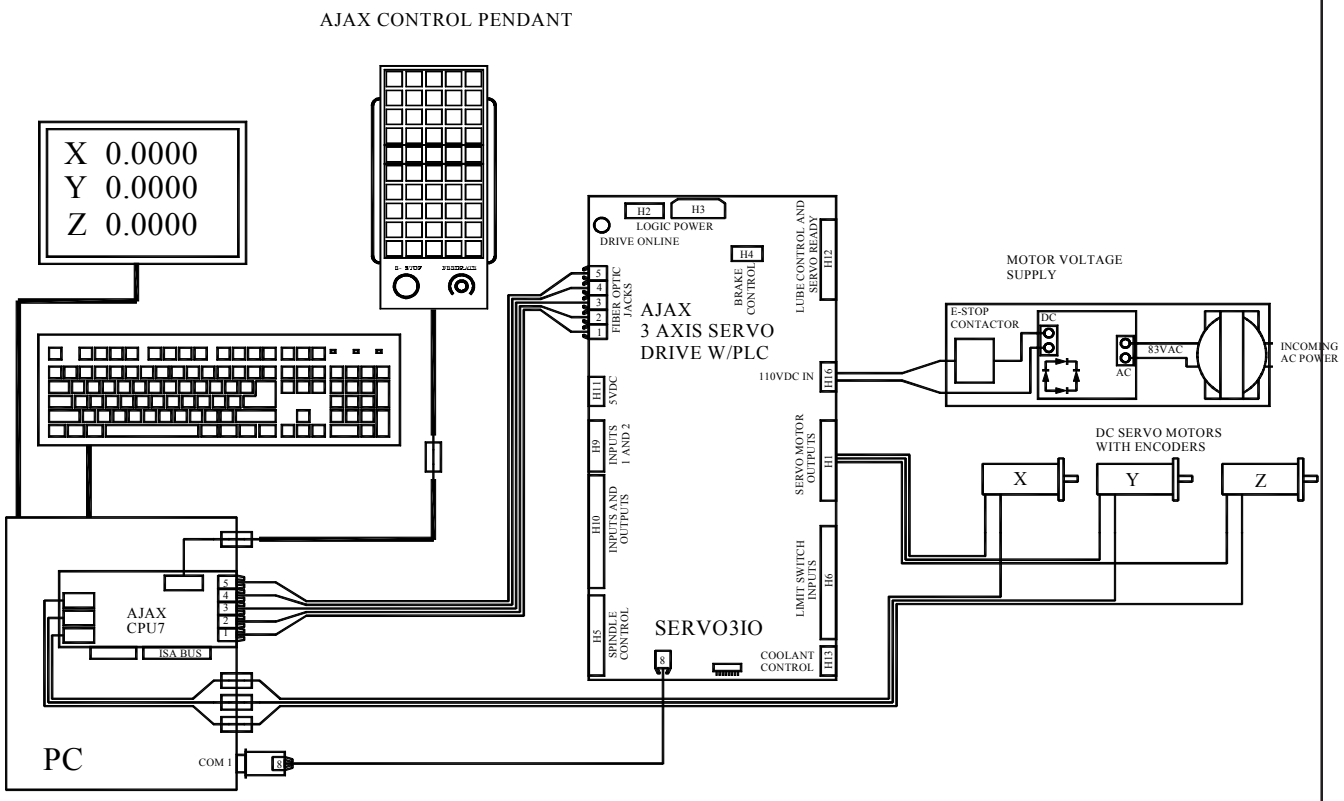
Rev. 030613

Table of Contents

1 Introduction

This manual describes how to hookup the AJAX CNC (Computerized Numerical Control) system. It is strongly recommended that you follow each step in order without skipping steps. The PC based AJAX CNC system provides 3 axis closed loop servo interpolated motion, controlled by industry standard G-codes. The system is intended for CNC control of milling machines, routers, lathes, flame, plasma, laser and water jet cutters and other specialized applications. The AJAX system is intended for use by competent installers, retrofitters and machine tool builders who want to do their own installation. This manual is not intended for casual end users. A separate operators manual is available for end users on CD ROM and hardcopy.

Figure 1: AJAX System Overview



1.1 System Overview

The AJAX system is based on two main printed circuit boards and an optional control pendant. Figure 1 shows (1) the CPU7 motion control card and (2) the SERVO3 I/O servo driver board, (3) the jog panel/pendant. Also notice the DC brush servo motors and the DC motor voltage unregulated supply. Servo motors and other CNC components are available from AJAX cnc.com.

CPU7 - Motion Control Card

- SERVO3 I/O - Three axis servo amplifier with I/O
- DB9TX5 - 12 Bit spindle speed interface board
- Control Pendant - Provides control keys for the operator

1.2 AJAX Components

Qty.	Part No.	Description
1	10464	CPU7 motion control card
1	10250	Encoder/Jog Panel Bracket w/ribbon cables
1	10483	SERVO3 IO Servo Drive
6	10234	5' fiber optic cables
1	10274	Jog Pendant
1	10237	Intermediate Jog Pendant Cable
1	10160	DB9-TXS serial port optical transmitter spindle inverter control
1	--	Ajax CNC CD-containing manuals
1	--	Software floppy disk
1	10209	Digitizing plug assembly

1.3 Installer Supplied Components

Your PC should have the following minimum specifications:

A. Pentium 166MHZ or better

B. 16MB Hard Drive or better

C. 1MB Memory or better

D. DOS Operating Software (6.22 recommended)

E. 1 open ISA slot

Electrical Enclosure

24" x 36" x 12" minimum recommended

1.4 Optional Installer or AJAX supplied components

Axis motors

a) 17in-lb, 29in-lb, and 40in-lb DC brush motors with encoders are available from AjaxCNC.com.

b) Pre-wired motor cables are available from AjaxCNC.com.

DC Power Supply consisting of the following:

a) Primary transformer with secondary 83VAC output provides 120VDC after rectification.

b) Capacitor, 12,000uf minimum, 160VDC

c) Fuse Holders & 15A fuses

Misc. Electrical components	Suggested Source
a) Rotary electrical disconnect	AjaxCNC.com
b) Fuse Holders	AjaxCNC.com
c) Quencharc	AjaxCNC.com
d) Terminal strips	AjaxCNC.com
e) E-Stop contactor, E stop switch	AjaxCNC.com
f) Spindle inverter	Automationdirect.com
g) E-Stop contactor	AjaxCNC.com
h Coolant contactors	AjaxCNC.com
i) Spindle reversing contactors	AjaxCNC.com
j) Limit Switches, normally closed type	Automationdirect.com

2 CPU7 Motion Control Card

The CPU7 motion control card is an ISA PC interface card. The CPU7 card accepts encoder inputs from the servo motors and uses a DSP to perform the servo PID control algorithm. The CPU7 card outputs torque commanded serially down onto two fibers (DATA and SYNC) to the SERVO3 I/O board. The CPU7 card also passes PLC I/O information to the SERVO3 I/O card through the RXS, CKS, and TXS fibers.

2.1

Plug the CPU7 motion control card into an ISA slot in your PC motherboard. Notice the AJAX CPU7 requires only one ISA slot.

Figure 2

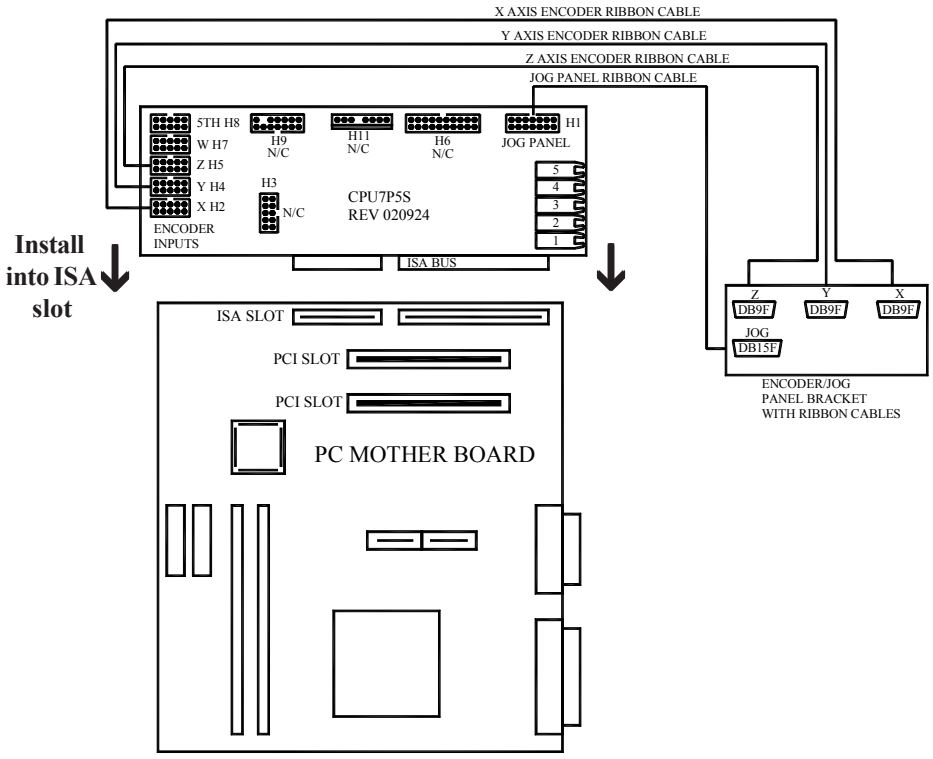
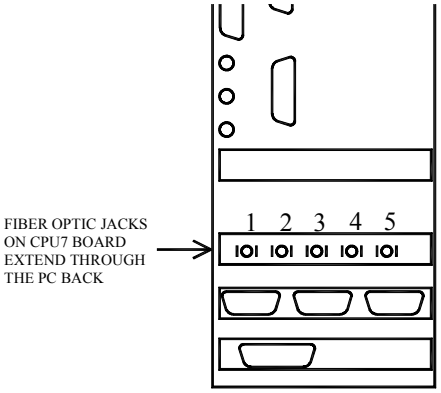


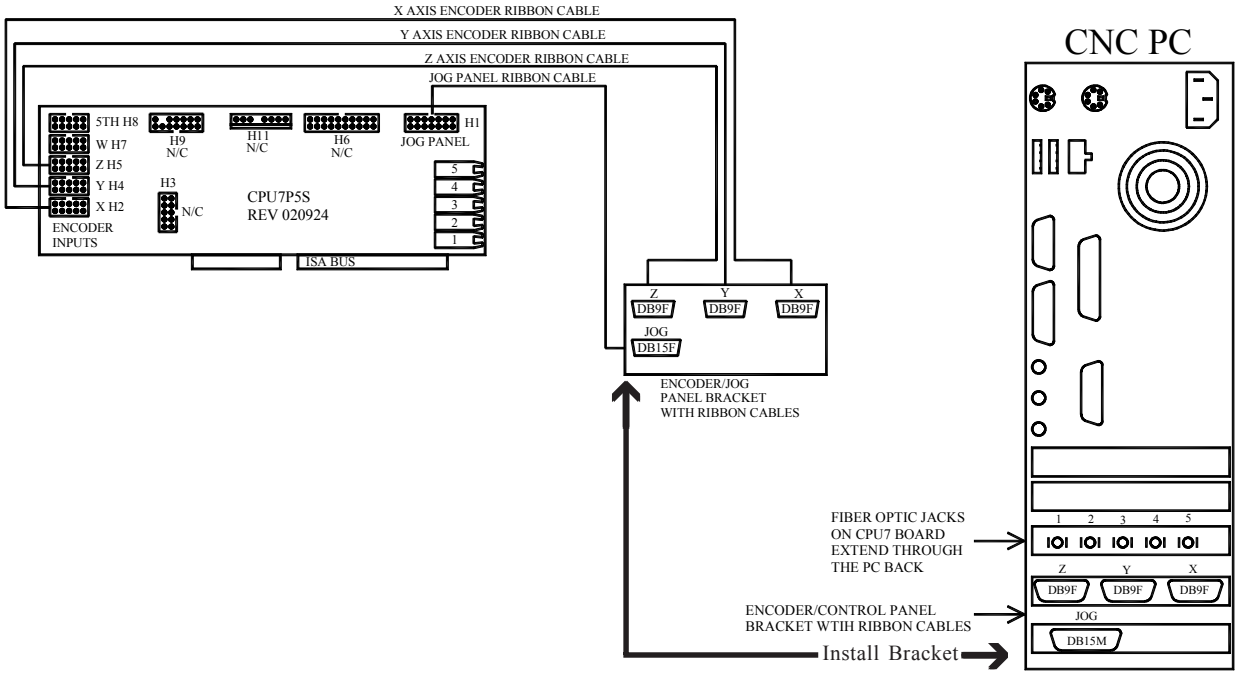
Figure 2.1: CPU7 Fiber Optic Connections



2.2 Encoder/Pendant Bracket Installation

Install the backpanel connector bracket into the PC backpanel. Connect the internal encoder ribbon cables to their respective axes on the CPU7 before plugging into the ISA slot.

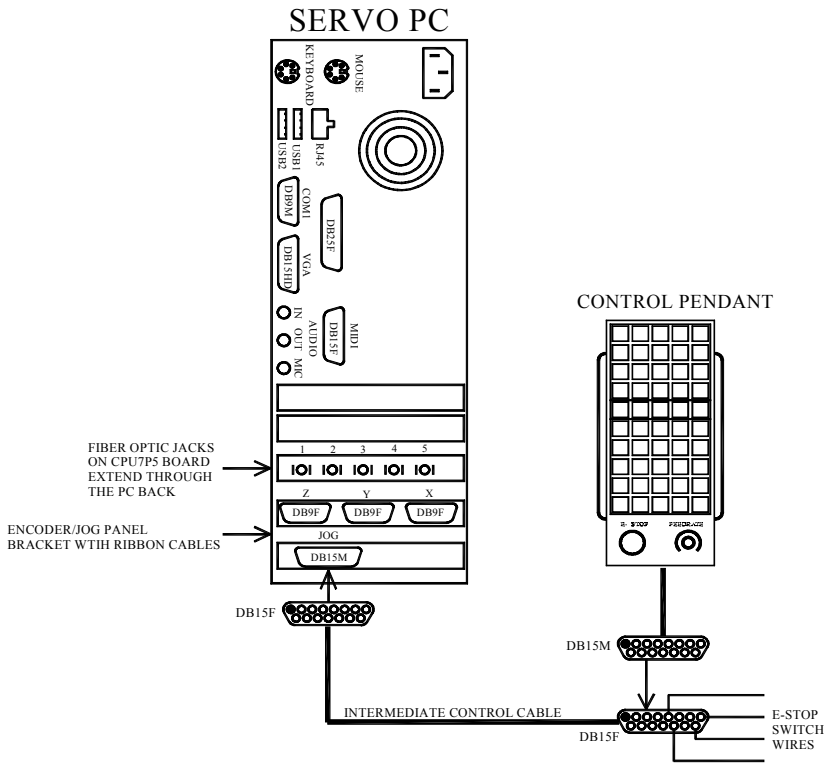
Figure 3 - Encoder Panel Bracket Install



3 Control Pendant Installation

Install the Control Pendant Intermediate Cable in your electrical cabinet and plug the end without the red and blue wires into the DB15 pendant connector on the back of your PC.

Figure 4 - Control Pendant Cable Hookup



All key press data and optional MPG data is sent serially to the Control Panel cable, plus an LED indicator status is sent back.

See the E-Stop section and the Schematic for E-Stop circuit hookup (Red and Blue wires from the pendant E-Stop button).

4 Software

AJAX motion control software (CNC7) is a DOS based program. This software will run on an MS-DOS compatible operating system as well as from a full screen DOS window under Windows 95, Windows 98, and Windows ME. After installing the operating system on your PC, you will be ready to install the AJAX software.

4.1 Software Installation Instructions

The following process will create installation disks for the CNC7 control software and the PLC program specific to your machine.

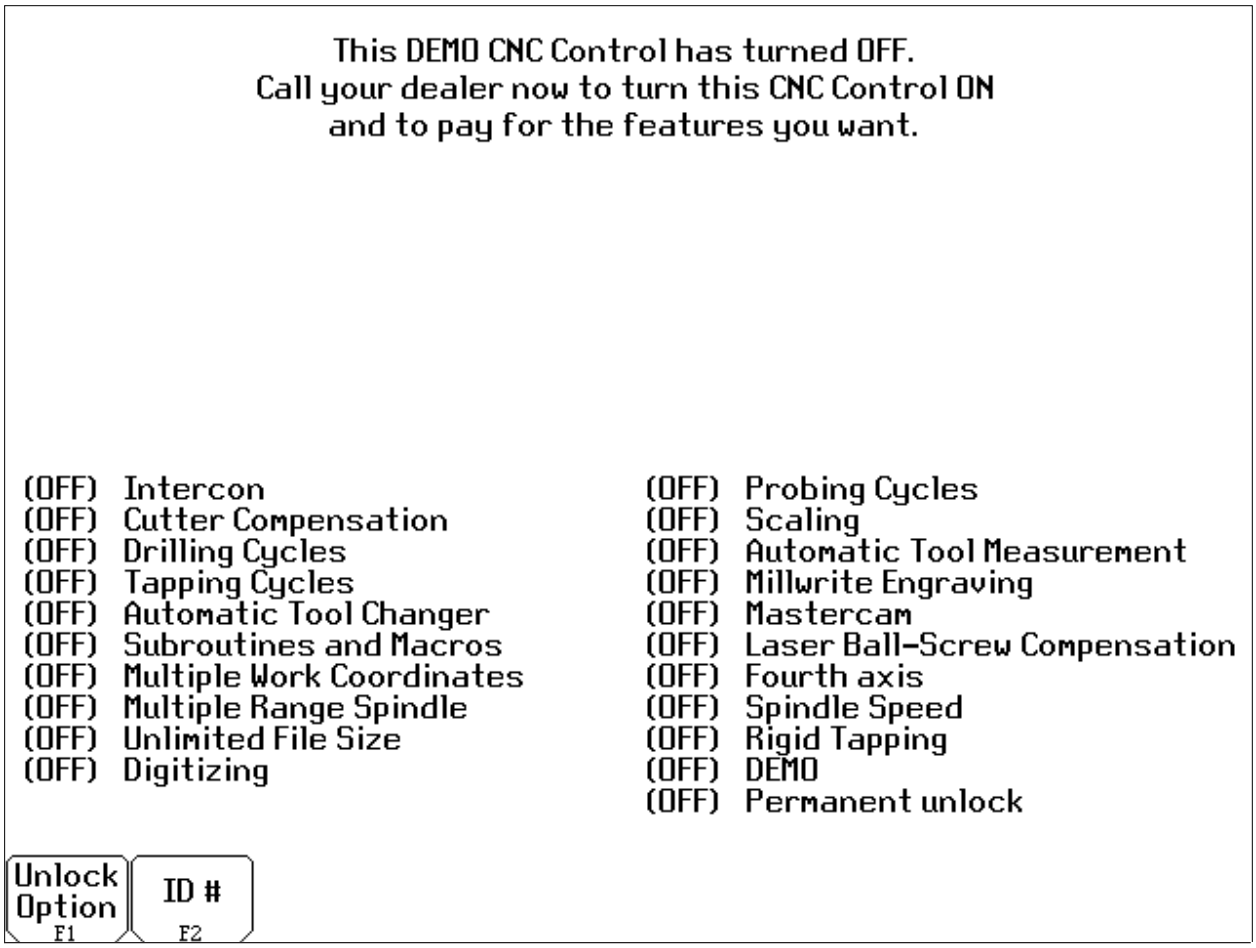
1.) Insert a blank floppy , and from the AjaxCNC CD run the batch file "**Make Installation Disks**". You will be asked a series of questions about your machine to create the appropriate installation disks. Example: What type of machine is this?(1=mill, 2=lathe). When the control installation disk is finished, you will be prompted to insert another disk for the PLC programs. Now you are ready to install your software.

2.) Insert the CNC7 v8.20 Installation Disk into the control PC and type **A:\INSTALL** at the DOS prompt. When the control software is finished installing, you will be prompted to install the PLC program files.

3.) When prompted, enter the PLC Installation Disk and type **A:/INSTALL**. After the PLC program has been installed, you will be prompted to reboot the computer. Reboot, then move on to step 3.

4.) When the CNC7 software starts, it will be necessary to enter the unlock codes for all the options you have purchased. The unlock codes are supplied separately and the instructions on how to enter them are given below. An example unlock sheet is located on the following page

Note that after software installation, it is normal to have errors displayed in the status window, depending upon whether or not the SERVO3 I/O or Control Pendant are connected.



Software Option Unlock Instructions:

1. Press <F1> to bring up the Special Parameter dialog box.
2. Enter the first Parameter Number on the Software Unlock sheet listed with a Parameter Value and press <Enter>.
3. Then enter the Parameter Value and press <Enter>.
4. Repeat this process for the remaining purchased options.

Example Software Unlock Parameter Sheet

Company	| Name:		
Serial #	Software Version	7.X	Fax #

The following are necessary to unlock software features:

1. Go to the main screen of the CNC7 software. (Setup, Load, MDI ... across bottom of screen)
2. Press <F1> to enter the Setup screen.
3. Press <F3> to enter the Configuration screen.
4. Type “137” in the window which asks for the password. Press <ENTER> to accept this.
5. Press <F3> to goto the Parameters screen.
6. Press <F1>, then begin entering a parameter number.
7. Delete all current values, position the cursor to the far left of the field using the arrow keys, enter the parameter value and then press <enter>.
8. Repeat step 7 and 8 for each given parameter value.
9. When finished with all parameters press <F10> to save.

Option	Parameter #	Parameter Value
Cutter Comp	200	
Drilling Cycles	201	
Compression Tapping	202	
Subs/Macros	204	
Multiple Work Coords.	205	
Multi-Range Spindle	206	
Unlimited File Size	207	
Digitizing	208	
Probing Cycles	209	
Scaling/Mirror	210	
Auto Tool Measurement	211	
Laser Measurement	212	
Spindle Speed	214	
Demo Mode 45 day	297	
Demo Mode 10 day	297	
Permanent Unlock	298	
Intercon	300	
Engraving Software	500	

5 Electrical Panel System Schematic

A "D" size AJAX system schematic is provided with every kit. The schematic can also be found as an AutoCAD.dwg file on the Ajax CD that came with your kit along with several other smaller schematics. They are listed below for your reference. Also provided on the Ajax CD is a program for viewing CAD files.

Included 8 1/2" X 11" Detailed Schematics:

- Inverter Power and Control
- Coolant Control
- Lube Pump
- Inputs and Outputs
- 110VDC Power Supply
- Indexer
- E-Stop circuit
- Brake
- Control Pendant
- Probe/Digitizing Connection

6 Electrical Panel Layout

The illustration below is how we suggest you lay out your electrical panel. This is only a suggestion, however, and you may need to modify this arrangement to better suit your needs.

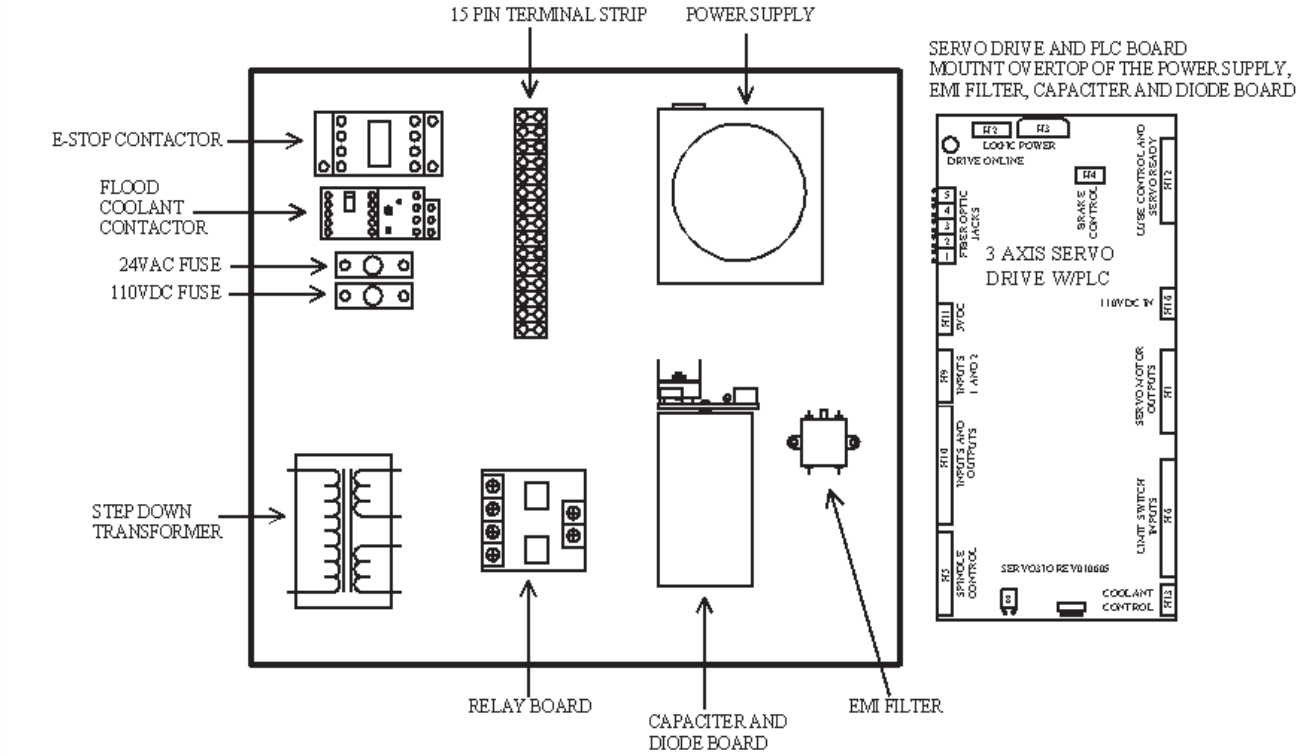


Figure 6 - Panel Layout (Suggested)

7 Servo Motor Drive: SERVO3 I/O

The SERVO3 I/O combines a three axis brushed DC servo motor drive along with sufficient I/O to control most lathes, mills or routers. For example, with suitable 29in-lb motors the SERVO3 I/O can easily drive a Bridgeport Boss Series I milling machine.

As the name implies, SERVO3 I/O stands for 3 axis SERVO drive with integrated I/O.

Specifications of the SERVO3 I/O Board:

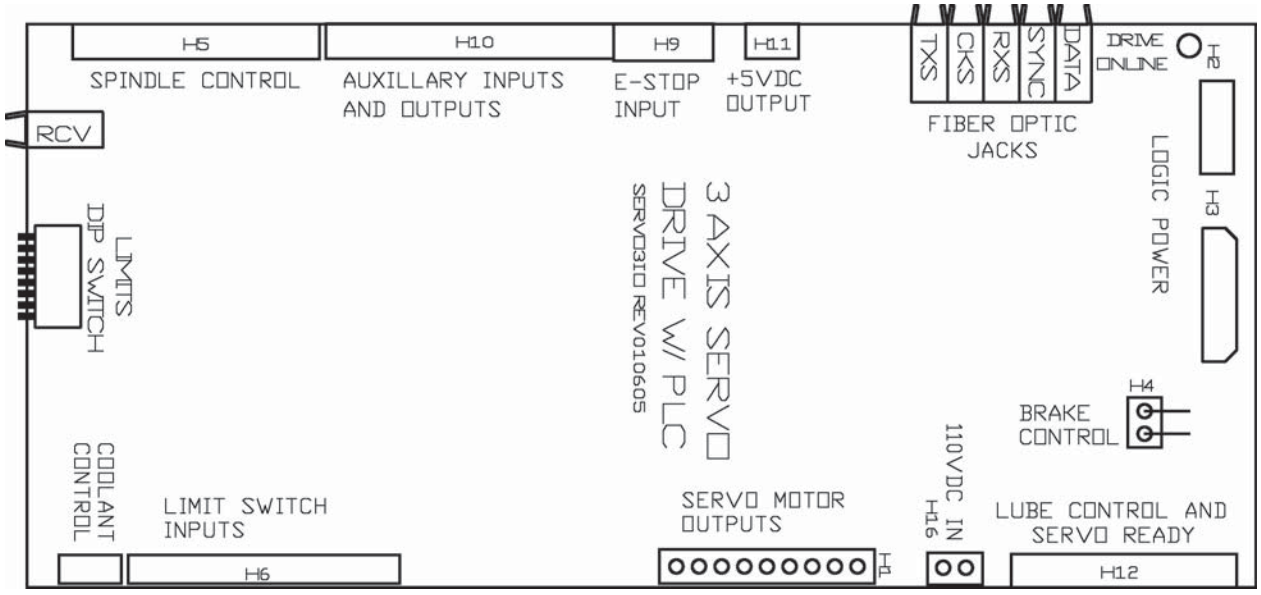
- 3 DC brush servo motor outputs up to 15Amp at 120VDC
- 6 General purpose outputs (recommended for, but not dedicated to coolant, brake and auxiliary controls)
- 4 Dedicated outputs: lube, spindle enable, CW and CCW
- 1 Spindle speed control, 12 bit DAC
- 1 E-Stop series connection relay contacts
- 6 Dedicated limit switch inputs
- 7 General purpose inputs
- 2 Dedicated inputs, E-Stop + Drivefault

7.1 Installing the SERVO3 I/O board on your electrical panel

Warning: Do not hookup or apply motor voltage at this stage.

Motor voltage will be applied in Chapter 11. All systems must be checked out first. Refer to the AJAX detailed schematic.

Check the connections from the SERVO3 I/O to the power supply. The SERVO3 I/O is supplied with +12 and +5VDC from the power supply via the H2. Ensure that H2 is connected to the power supply. These DC voltages are used to power the logic of the servo drive and the logic of the I/O section.



8.1 Motors and Encoders

AJAX motors are DC brush servo motors and have 2000 line/8000 count per revolution encoders. Differential line signalling is used for noise immunity. Encoder cables should use shielded wire with twisted pair signal lines for noise immunity reasons (See Figure 8.2). Reliable operation at distances up to 50' are possible. Motors may be "hard wired" without the use of MS connectors for cost reduction reasons. Fully wired servo motors with cables may be ordered from AJAXcnc.com.

8.2 Installation

Wire your motor cables to H1 on the SERVO3 I/O board. The SERVO3 I/O board has labels next to each terminal on H1 to aid in the wiring. The earth ground (EGND) terminals are used for shield connections.

Plug the X, Y, and Z axis encoder cables into the X, Y, and Z encoder sockets on the PC's back panel (Once again pay close attention to matching up each axis with its corresponding location). Wildly erratic motor motion will result if encoder and motor hookups are not correct. Refer to the AJAX schematic.

8.3 Encoder Check

Power up the PC, but do not apply power to the drive (SERVO3 I/O). With the PC powered up and without any power to the drive and motors, you can test the encoder feedback. Go to the PID menu to verify encoder feedback. To do this, press <F1>, <F3>, <enter password(137)>, <F4> from the main CNC7 screen. Turn each axis motor shaft slowly and watch the absolute position (Abs Pos) column for smooth counting. Turning the motor shaft in the other direction should count down. Ignore "full power w/o motion" or "Position Error" messages in the message box. Ensure that the correct readout changes for each axis motor.

Figure 8.1 - Motor Power Diagram

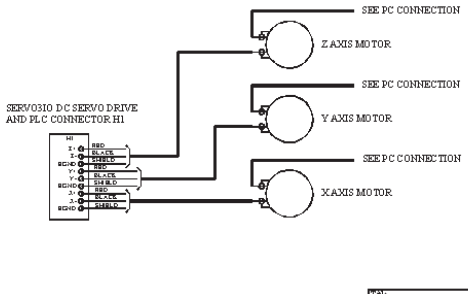
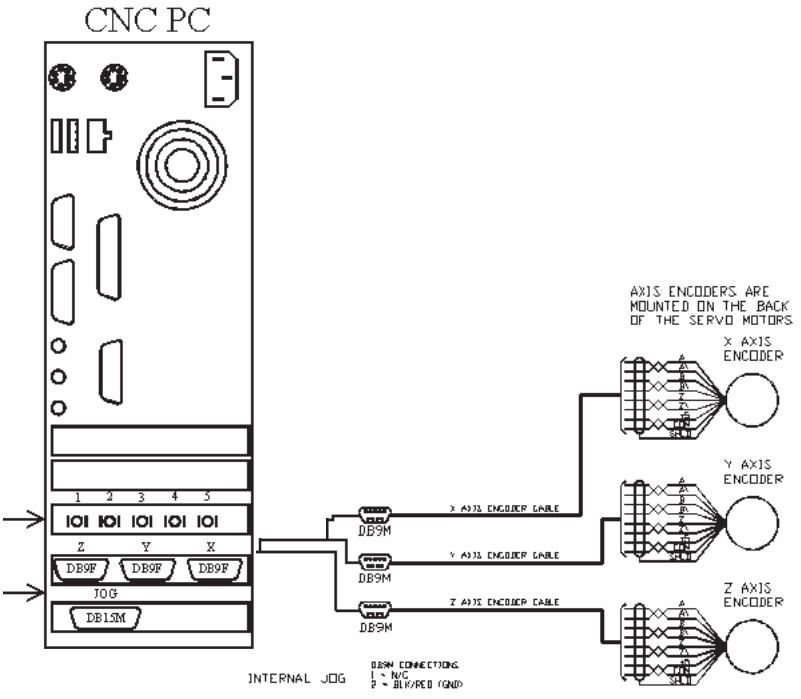


Figure 8.2 - Motor Encoder Diagram



9 ESTOP Circuit

An effective emergency stop (E-Stop) circuit is essential to any machine tool. The E-Stop circuit allows the operator to push an E-Stop button and stop all axes and the spindle. The E-Stop circuit shown on the AJAX schematic is based on a 24volt AC voltage which is required to power the E-Stop coils. As long as the E-Stop circuit is not broken, the system will operate. The 24VAC 1 coil voltage is "routed" through the SERVO3 I/O relay contacts labeled RLY1/RLY2. From there the E-Stop coil voltage must pass through the E-Stop button and then through the inverter fault contacts before returning to the 24VAC 2 terminal. E-Stop may be tripped by pushing the E-Stop button, by a Servo Drive fault, or by an Inverter fault.

9.1 Blue Loop Installation

The blue loop consists of two blue wires on the Intermediate Control Pendant cable. These two wires must be connected to terminals 1 and 2 on H9. Terminals 1 and 2 on H9 are the Input Common and Input 1, as shown on the AJAX schematic.

9.2a Red Loop Installation, With Inverter

The Red Loop is a 24 Volt AC circuit that is required to power the E-Stop contactor coils. To complete the circuit connect the first red wire on the Intermediate Control Pendant cable to the Inverter Normally Closed Fault terminal. Then connect the Inverter Fault Common terminal to the RLY1 (pin 9) pin on the H12 on the SERVO3 I/O. The RLY2 pin on the H12 (pin 10) must be connected to terminal 1 on the 24 VAC supply. The second red wire on the Intermediate Control Pendant cable must be connected to terminal 2 on the 24 VAC supply.

9.2b Red Loop Without an Inverter, Using Reversing Contactor

The Red Loop is a 24 Volt AC circuit that is required to power the E-Stop contactor coils. To complete the circuit, route the first red wire on the Intermediate Control Pendant cable through the Spindle overload protectors, normally a closed circuit, and then connect it to the RLY1 (pin 9) on the H12 on the SERVO3 I/O. Connect the second red wire on the Intermediate Control Pendant cable to terminal 1 on the 24 VAC supply. To complete the loop, terminal 2 on the 24 VAC supply must be connected to RLY2 (pin 10) on H12 on the SERVO3 I/O.

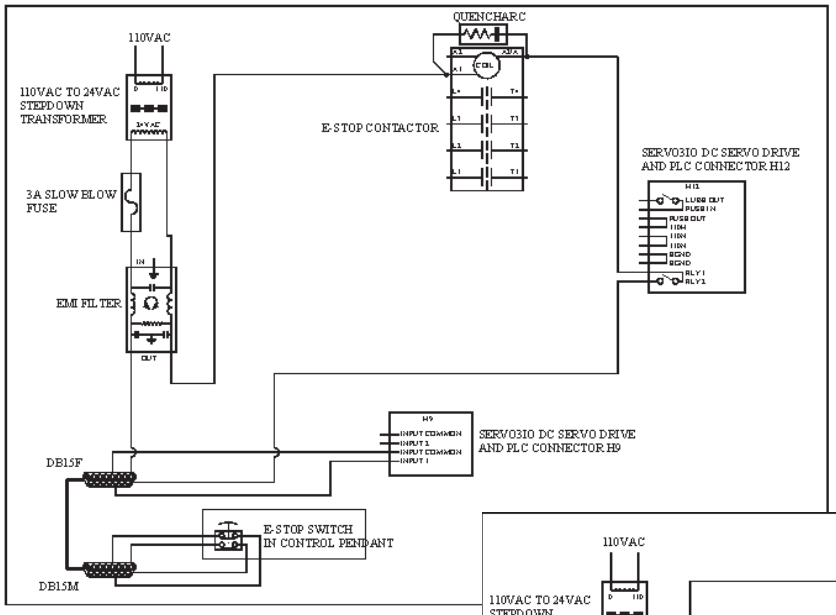


Figure 9.1 - E-Stop Circuit with Pendant

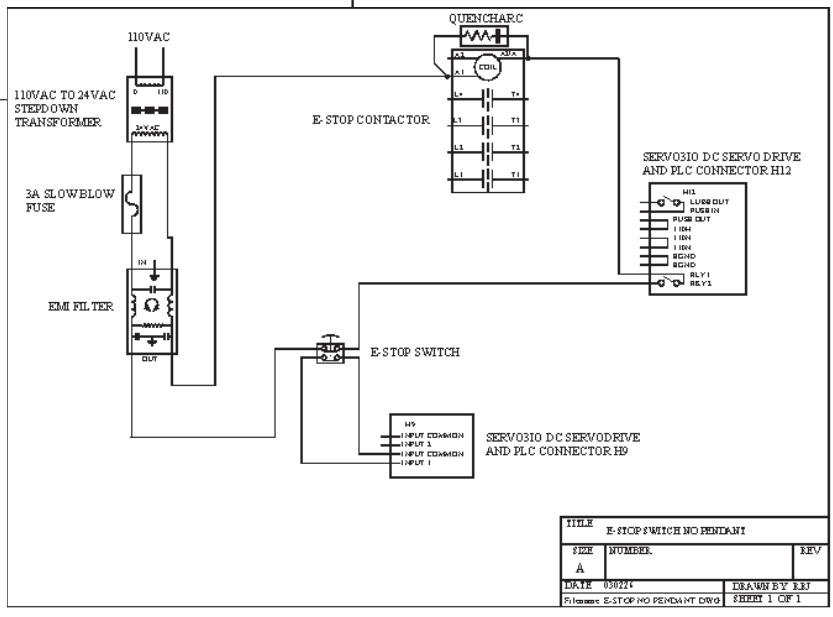


Figure 9.1 - E-Stop Circuit without Pendant

10 Limit Switches

Limit switches are required to be normally closed switches, which are attached to H6 of the SERVO3 I/O board. Each Limit switch input is actually pulling down on an optoisolator input on the SERVO3 I/O board (Figure 10.1). The Limit switches are normally closed. When a limit is reached the Limit switch will trip the optoisolator circuit. Typical Limit switches are used for both overtravel protection and system HOMING/Machine Zero at powerup.

A typical Limit switch hookup is shown in the diagram below (Figure 10.2). Connect each Limit switch on the X, Y, and Z axis to it's respective pin on H6 on the SERVO3 I/O, as shown in the schematic.

The AJAX system can be operated without limit switches. To defeat the need for limit switches, flip up (on) all the paddles on the LIMIT DEFEAT DIP switches. This is very useful for initial testing, but always remember to push all the dip switches down when you want to install your limit switches (See TB061).

The AJAX system also supports software travel limits and Machine Home to Mark (See Chapter 3 of the AJAX user's manual).

Figure 10.1 - Typical Optoisolated Input

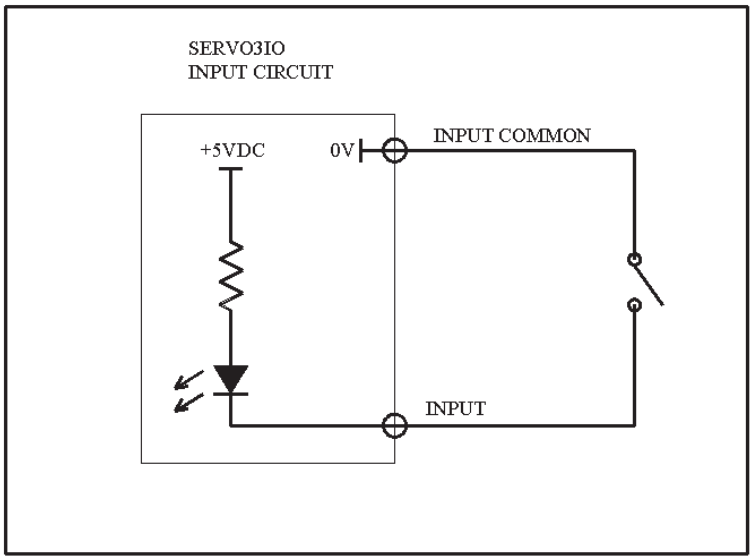
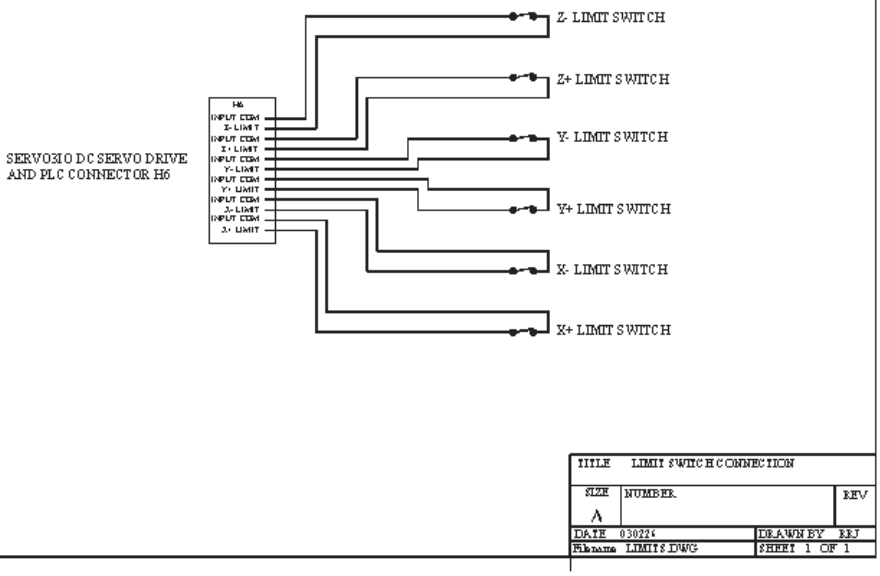


Figure 10.2 - Limits Input



11 Motor Power

Warning: Only a qualified electrical / electronics person should perform these steps.

Install your main power connections. Do Not Turn on the power yet, just make and check all connections.

Check all Motor Supply (Vm) related connections on the AJAX schematic.

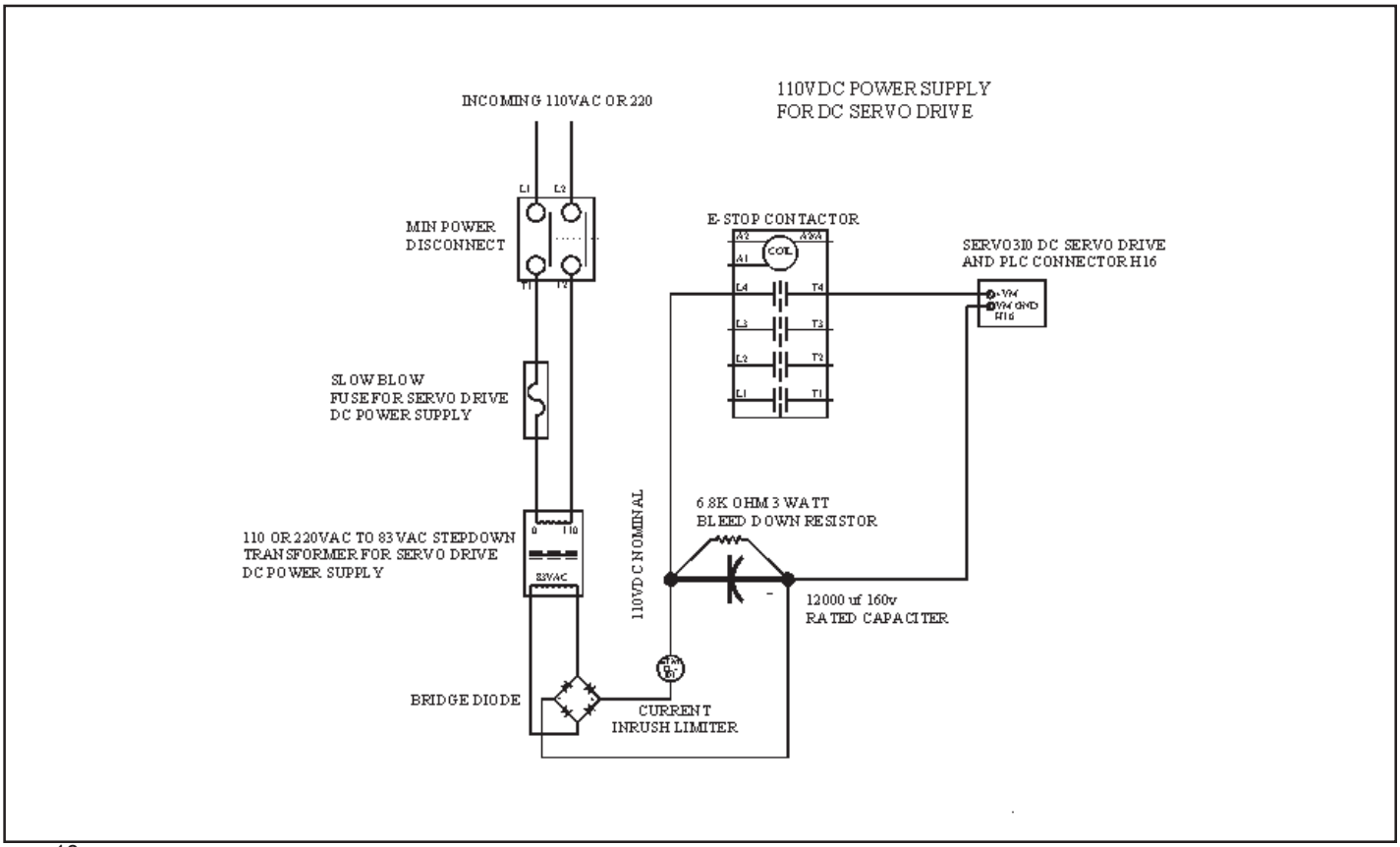
1. Main Disconnect
2. Step down transformer for Vm (Motor Supply Voltage)
3. Rectifier Bridge (Vm)
4. Capacitor (Vm) (double check bridge vs capacitor polarity)
5. Inrush limiter
6. Bleed down resistor (6.8k 5W)
7. Vm fuse 15A
8. Connection to E-Stop Contractor
9. PC and SERVO3 I/O's 110VAC power supply connection
10. Ajax Power bridge.

With the E-Stop pushed in, apply the AC voltage to the input of the motor power supply. Check the motor voltage (Vm) from the supply at the capacitor terminals. There should be 120VDC across the terminals. Notice the DC, this is for servo motor power and is not to be confused with 120VAC input voltage. If you intend to use lower voltage motors such as Pittman 24VDC motors, then a suitable transformer must replace the 83 VAC secondary winding transformer referred to in the AJAX examples. Do not attempt to apply voltages above the servo motor's maximum rating.

If you have installed and checked everything up to this point you can now check axis motion operation without installing the other optional subsystems such as spindle, coolant, and lube controls. Connect the DATA and SYNC fiber cables between the SERVO3 I/O and CPU7 cards. See sections 5 and 6 if you have trouble locating the DATA and SYNC connectors on the cards. Release the E-Stop button and the E-Stop contactor should make a "clunk" sound as it turns on. If you're using an inverter, you will have to power it up and clear any fault conditions to get the E-Stop contactor to close.

Power should now be applied to the drive's Vm and GNDm connections. Jog each axis in both directions and verify smooth motion from the motors, see section 11.1 if movement problems are encountered. If the motors are not mounted on the machine yet, mount them before continuing to section 11.2.

Figure 11 - DC Servo Motor Power Circuit



11.1 Servo Motor and Encoder Troubleshooting

CNC7 Error Message	Motor Symptoms	Possible Problems	Solutions
? Axis position error	Makes a quick jump when jog button is pressed	Motor wires may be reversed or A and B encoder channels have been swapped	Reverse motor lead connection
? axis full power w/o motion	Moves full speed until error condition is detected	Encoder is not plugged in or encoder is bad, drive is not powered up	Check connections for each axis -- an encoder is plugged into the axis but may not be from the correct motor, replace encoder and check drive and E-Stop connections.
? axis home to close to switch	Will not home correctly	Index pulse is missing	Check Z and /Z channel wiring, replace encoder if necessary.
? axis runaway: check motor wiring	No Motion condition is detected -- runaway is not on axis that was moving	Encoder cables for two axes are swapped	Plug the cables into the correct locations and restart the control PC (this error latches and requires a cold restart)
? axis runaway: check motor wiring	No Motion	Encoder cabling is faulty or encoder was plugged in with power on	Check cables, restart control PC (this error latches and requires a cold restart)
? axis encoder connection is bad	No Motion	Encoder cable is not plugged encoder cable is faulty	Check encoder connections
	Strange sounds or rough motion	PID parameters not correct, encoder problem, or motor problem	Run autotune, swap encoder with a known good unit to locate problem source.

Note: ? will be either X, Y or Z

11 Servo Motor Power

The following steps should be taken to ensure accurate motion control after motors have been mounted on the machine:

(1) Check the encoder count settings in the machine setup screen (Press <F1>, <F3>, <enter password>, <F2> from the main screen). The encoder counts should be 8000 for AJAX supplied motors.

(2) Make sure each jog key moves its axis in the desired direction. See the “Conventions” section in Chapter 1 of the AJAX user’s manual for the recommended axis setup. If an axis is moving in the opposite direction, change the direction reversal settings in the machine setup screen.

(3) Setup the motor revolutions per inch for each axis. Refer to tech bulletin TB036 for assistance.

(4) Autotune should be run to set up the motor PID parameters. This can be reached by pressing <F1>, <F3>, <enter password>, <F4>, <F5> from the main CNC7 screen. On screen instructions will tell you how to start the tuning process. For more information on autotune results refer to TB045 and TB004.

Run dragplot. This feature will help reveal mechanical problems that may effect performance. TB047 details running dragplot.

Technical bulletins can be found on the supplied CD.

12 Automatic Lubrication Pump

The lube pump should be connected to H12 as shown in the diagram below (Figure 12). The 110 VAC supply for the lube pump should also be connected to H12 as shown in the diagram and on the schematic.

After the lube pump is installed, you must connect the lube low warning circuit. Connect the pump alarm common to DC common on the H11 (pin 1) on the SERVO3 I/O. Then connect the lube pump alarm (NC) to Input 6 (pin 4) on H10 on the SERVO3 I/O.

If you are not using a lube pump, you will need to place a jumper between the DC common on H11 (pin 1) and Input 6 (pin 4) on H10.

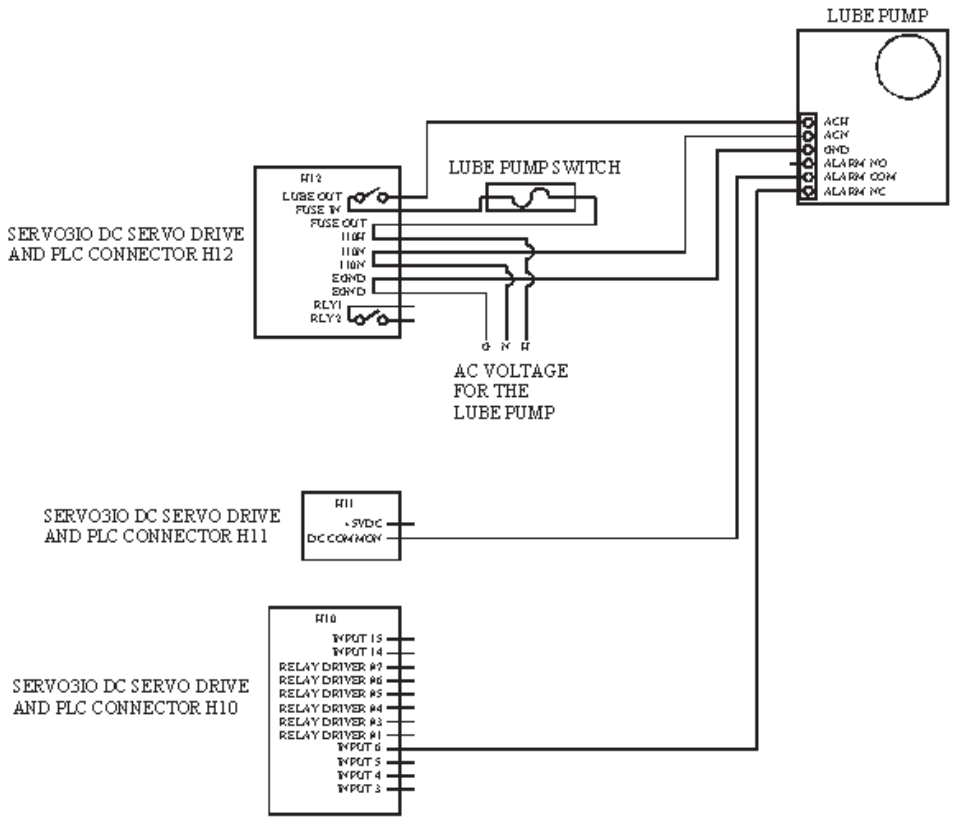
13 Coolant Control

The SERVO3 I/O is capable of controlling a coolant pump using a coolant pump contactor.

13.1 Coolant Pump Contactor

The coolant pump contactor requires a 24 VAC supply to power the contactor coils. You must connect Terminal 1 on the 24 VAC supply to A2 on the coolant contactor, as shown on the AJAX schematic. A1 on the coolant contactor must then be wired to Relay Output 3 (H13) on the SERVO3 I/O board. Terminal 2 on the 24 VAC supply must then be connected to the other pin on Relay Output 3 (H13) as indicated on the schematic.

Figure 12 - Lube Connections



14 Spindle Control

The spindle control section of the SERVO3 I/O provides an analog output that is factory preset for 0-10V output to an inverter in 0.004 v increments. The internal Digital to Analog Converter (DAC) converts a 12 bit value for high resolution spindle speed control.

14.1 Spindle Motor

The AJAX system is capable of driving a spindle motor using either an Inverter (recommended), or by using a Reversing Contactor.

14.2 Spindle Motor with Inverter

A typical Inverter wiring diagram is shown on the schematic (Figure 14.1). Exact wiring will vary from one Inverter to the next, so refer to your Inverter manual for specific wiring instructions.

In the example shown on the schematic the supply voltage is routed through the Inverter and E-Stop contactor before going to the spindle motor. The Spin Forward, Spin Reverse, Inverter Common, 0-10 VDC Input, and the 0-10 VDC Common pins on the Inverter are all connected to H5 as shown on the schematic (Figure 14.1). Again, the schematic shows only a typical Inverter Installation, for details on connecting your Inverter please refer to your Inverter Manual.

14.3 Spindle Motor with Reversing Contactor

On the AJAX schematic you see a typical circuit diagram for wiring the spindle motor with a reversing contactor. For the SERVO3 I/O to be able to control spindle direction, Pins CW and CCW on H5 must be connected to the Reversing Contactor coils as shown on the schematic.

Terminal 2 on the 24 VAC supply must be connected to the Spin ENCOM pin on H5 as in the schematic. Terminal 1 on the 24 VAC supply must then be connected to one side of the Reversing contactor coils as shown. The other side of the Contactor coils must be wired as shown to allow the SERVO3 I/O to control the Reversing Contactor.

It is essential that the 220 VAC supply for the reversing Contactor and the Spindle Motor be connected to the output side of the E-Stop Contactor and NOT the 220 VAC input side of the E-Stop Contactor so that the E-Stop circuit is capable of controlling the power to the Spindle Motor and Spindle Speed Control with inverter.

14.4 DB9TXS

The DB9TXS card plugs into COM1 of your PC and transmits the 12 bit spindle speed to the SERVO3 I/O board (Figure 14.0). The wiring has a specific orientation on the DB9 to the Encoder (Figure 14.3).

14.5 Spindle Speed Setup

1) Change maximum spindle speed to match your spindle and inverter.
   a) From the CNC7 main screen press <F1>, <F3>, <F1>.
   b) Enter a minimum spindle speed of 0.
   c) Change the value for maximum spindle speed so that it's the same as the specs for the inverter and spindle.
   d) Press <F10> to save this screen and exit.

14.6 Troubleshooting Spindle Output

1) Parameters
   a) Press <F1>, <F3> to enter the parameters screen.
   b) Edit parameter 31. Enter a 1 if the Spin232 is hooked up to COM1 or 2 for COM2.
   c) Edit parameter 32. Enter the baud rate of 19200.
   d) Edit parameter 33. Enter your spindle gear ratio.
   e) Press <F10> to save and exit.
   f) Press <ESC> until CNC7 main screen appears.
2) Make sure that the spindle is not inhibited by the PLC program.
   a) The E-Stop must be released to start the spindle.
   b) The digitizing probe must be unplugged.

Figure 14.0 - Spindle Motor Inverter Control Hookup

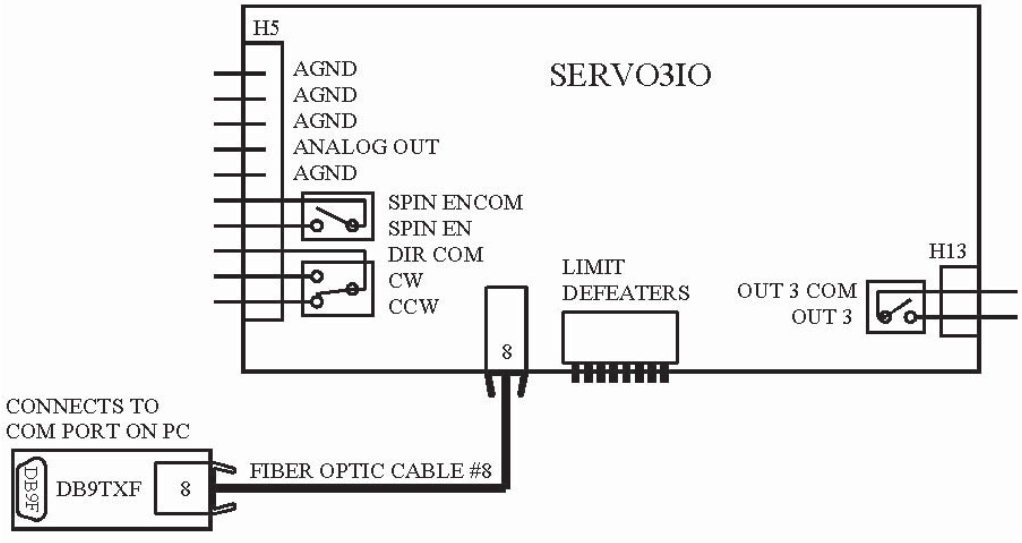
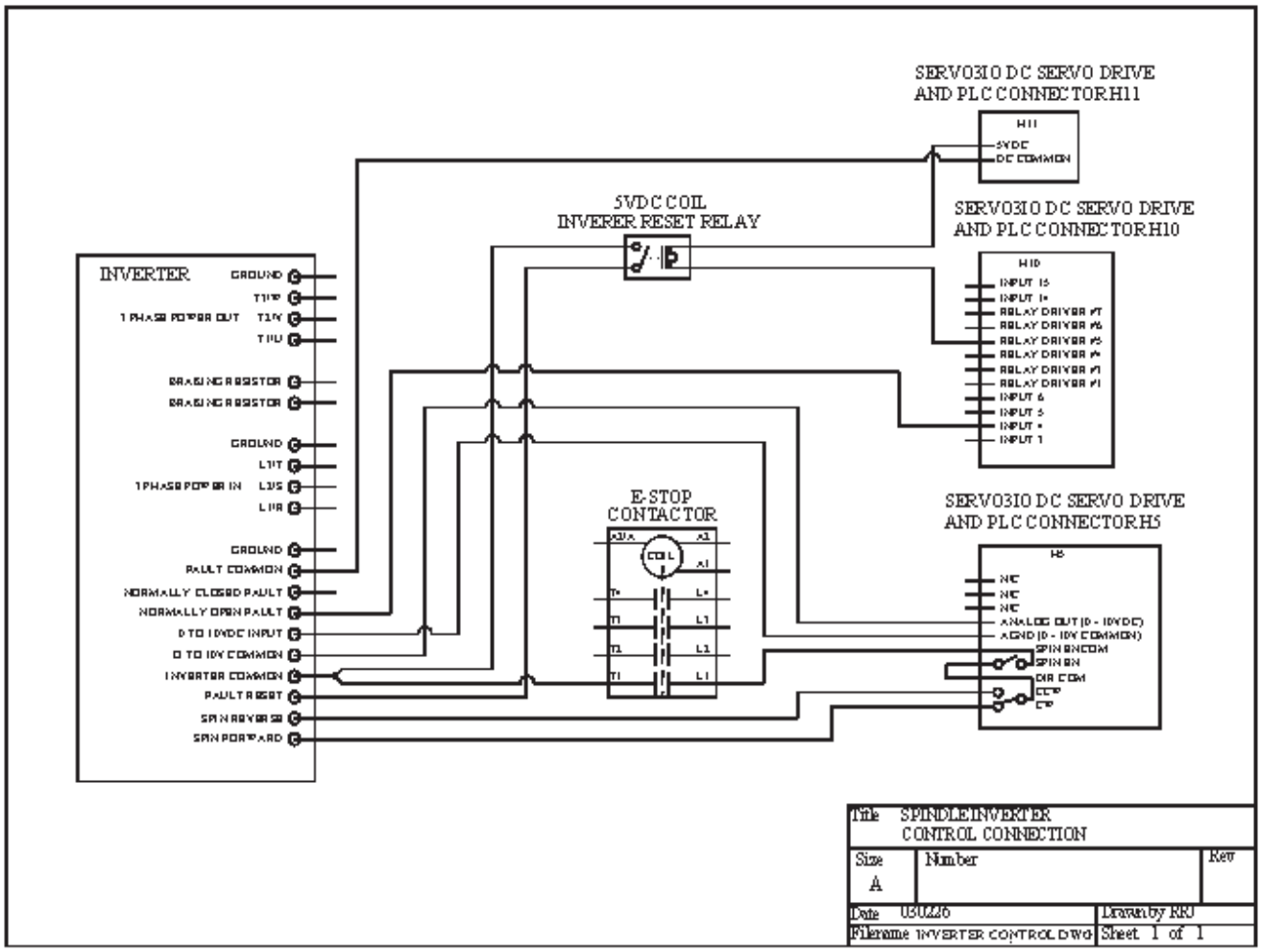


Figure 14.1 - Spindle Inverter Control Diagram



14.7 Spindle Inverter Fault Input

Refer to your AJAX schematic and PLC programming manual D

14.8 Spindle Hi-Low Range

Refer to your AJAX schematic and PLC programming manual/Appendix D special locations

Figure 14.2 - Hi Low Range Diagram

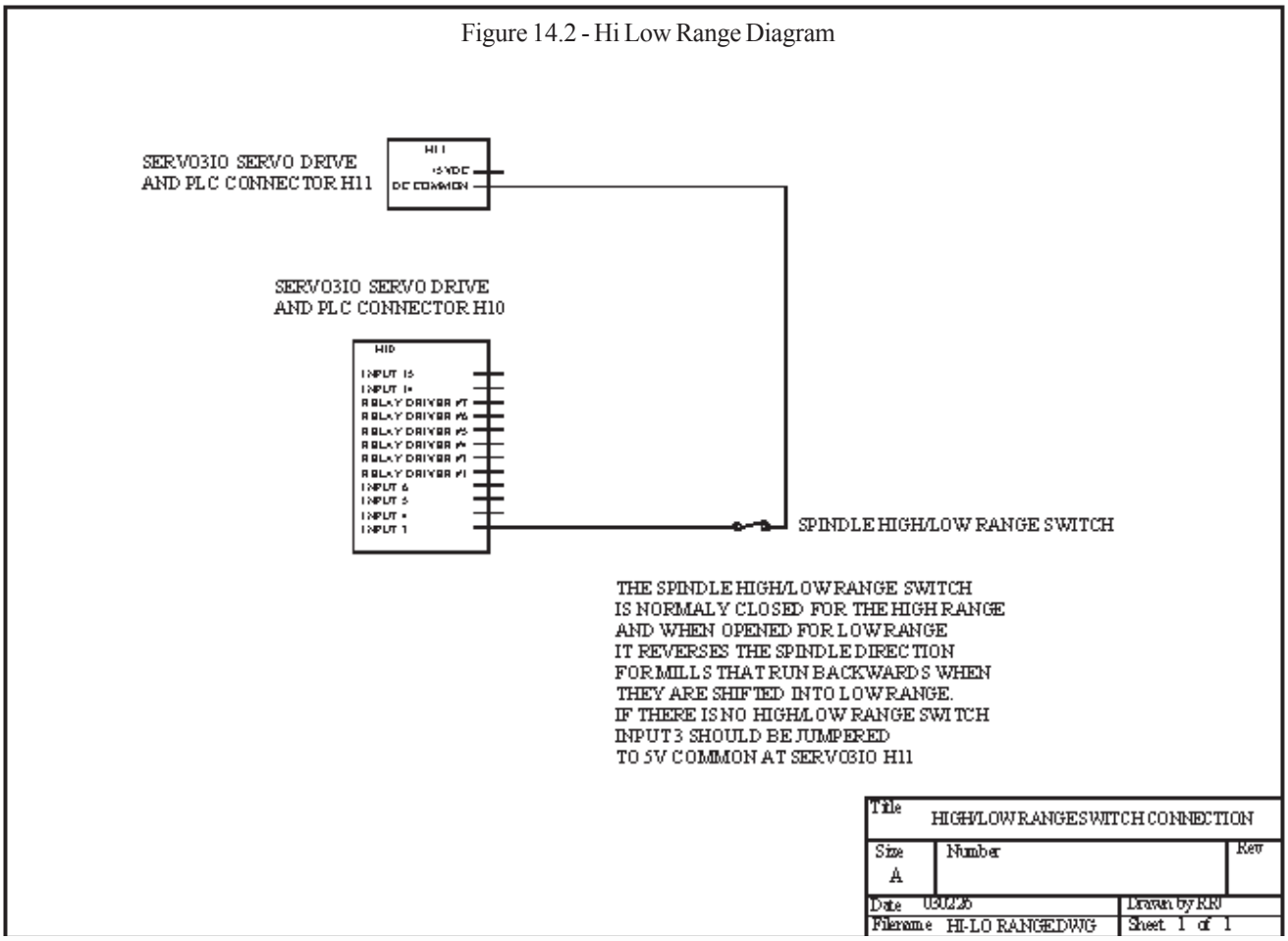
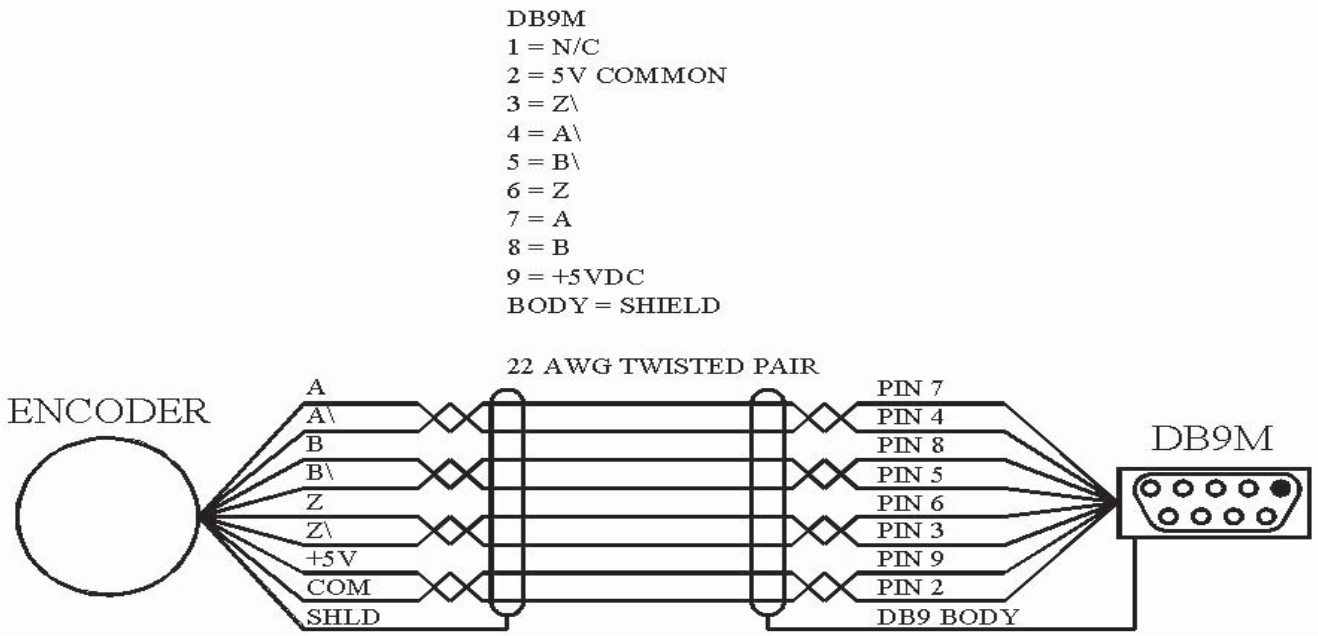


Figure 14.3- Spindle Encoder Cable Hookup Diagram



14.9 Spindle Encoder Settings

The Ajax supplied encoder is a 2000 line encoder which yields 8000 counts per revolution of the spindle. Spindle encoders have to be connected directly to the spindle shaft at a 1:1 ratio. Other line encoders may be used. 1000, 1024 etc. and the control parameter must be adjusted accordingly.

The encoder cable used should be a shielded cable. Ajax spindle encoder cable spec: Minimum 22 awg, 4 twisted pair. Attach shield wire to DB9 case, typically soldered, and other end to encoder case/cover that is grounded to the machine. Listed are some configuration parameters related to the spindle encoder. Parameter # Description:

•P34: Spindle Encoder Counts Settings:
Must be set to the number of counts for the Spindle Encoder. 1000 line=4000 counts, 2000 line=8000 counts etc..

•P35: Spindle Encoder Input, selects which encoder port the spindle encoder is hooked to. Settings:
0 - Encoder port 1 1 - Encoder port 2
2 - Encoder port 3 3 - Encoder port 4
4 - Encoder port 5
This is the one to use. This is the 5th axis encoder input which is primarily used for spindle encoder input. Set P35=4 when connecting encoder cable to the 5th axis encoder input as per Ajax drawing.

•P78: Spindle speed display. Settings:
0 - Displays programmed spindle speed
1 - Displays actual spindle speed, from the spindle encoder.

•P31: Spindle output port. Settings:
1 - Com port 1 2 - Com port 2

•P32: Spindle Output port Baud Rate: Settings:
19200 - Recommended setting

•P36: Rigid Tapping. Settings:
0 - Disable Rigid Tapping 1 - Enable Rigid Tapping
3 - Enable Rigid Tapping and Do Not wait for Index pulse
5 - Same as 1, but enable spindle override during tapping
7 - Same as 3, but enable spindle override during tapping

•P37 - Spindle deceleration time. Settings:
Time in seconds for spindle deceleration during rigid tapping. Typical time = 3 seconds. (Note: Your inverter should be set up with a braking resistor and set up to decel faster than this setting.)

•P68 - Minimum Rigid Tapping Spindle speed. Settings:
Typical setting is 500 to 600 rpm for Rigid Tapping.

•P69 - Duration for minimum spindle speed. Settings:
Amount of time to wait when at speed set in P68
Typical setting is 1.5 to 2.

•P82 - # of degrees of rotation before bottom of rigid tap hole that the cycle will spin at slow rpm setting #P68

15 Other Outputs

There are 6 relay outputs on the SERVO3 I/O board. These relay outputs are preprogrammed for specific actions. For example; one of these relay outputs is designated for a lube pump (located on connector H12), another for a coolant pump (located on H13). The coolant output can be used to energize a three phase contactor OR can directly be connected to a solenoid that draws under 1 amp of power. Other outputs available are TTL +5 volt dc outputs that are designed to energize small relay coils (which then in turn can energize other larger relays or contactors). These outputs are activated and controlled thru M-codes. You can write your own PLC program to activate these outputs (with a custom M code that you create and/or thru an Auxiliary key on the jog panel) OR you can also use one of the standard supplied Ajax PLC programs which you will find on the Ajax CD. Select the PLC program that is closest to your needs. M-codes support TTL outputs using relay drivers on H10.

Outputs Description Functionality

•OUT1 Mist M7 Turns on, M9 Turns off (also M94/5 turns on and M95/5 turns off)
•OUT2 Lube On when program is running or in MDI
•OUT3 Flood M8 Turns on, M9 Turns off (also M94/3 turns on and M95/3 turns off)
•OUT4 Brake On when in auto brake mode and spindle is off
•OUT5 Inverter Reset On when there is an inverter fault and E-Stop is pressed
•OUT6 & OUT7 Unused / not used

M codes Function

•M3 Spindle on CW (Spin En Relay ON - Spin Dir Relay OFF)
•M4 Spindle on CCW (Spin En Relay and Spin Dir Relay ON)
•M5 Spindle off (Spin En Relay and Spin Dir Realy OFF)
•M7 Output 1 ON - Output 3 OFF
•M8 Output 3 ON - Output 1 OFF
•M9 Output 1 OFF - Output 3 OFF

T-39sa.plc Standard Lathe PLC program (use this for Turning/Lathe applications)

M codes support TTL outputs using relay drivers on H10.

Outputs Description Functionality

•OUT1 Mist M7 Turns on, M9 Turns off (also M94/5 turns it on, M95/5 turns it off)
•OUT2 Lube On when program is running or in MDI
•OUT3 Flood M8 Turns on, M9 Turns off (also M94/3 turns it on, M95/3 it turns off)
•OUT4 Brake On when in auto brake mode and spindle is off
•OUT5 Inverter Reset On when there is an inverter fault and E-Stop is pressed
•OUT6 Aux Output 1 Aux 1 Key toggles the state of output
•OUT7 Aux Output 2 Aux 2 Key toggles the state of output

M codes Function

•M8 Output 3 ON - Output 1 OFF
•M9 Output 1 OFF - Output 3 OFF
•M41 Spindle Range is LOW
•M42 Spindle Range is MED
•M43 Spindle Range is HIGH

Figure 15.1 - Relay Output Circuit

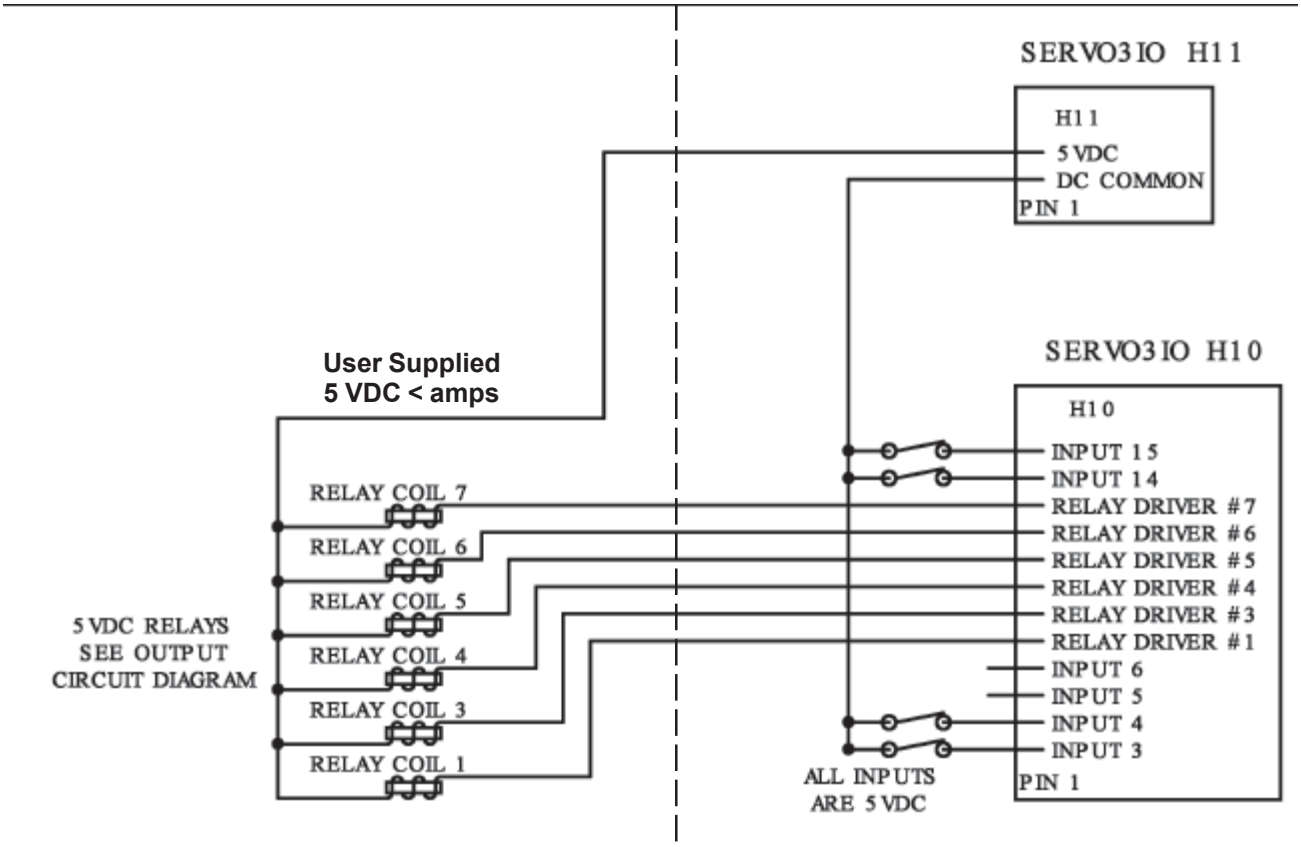


Figure 15.2 - Output Driver SERVO3 I/O Circuit

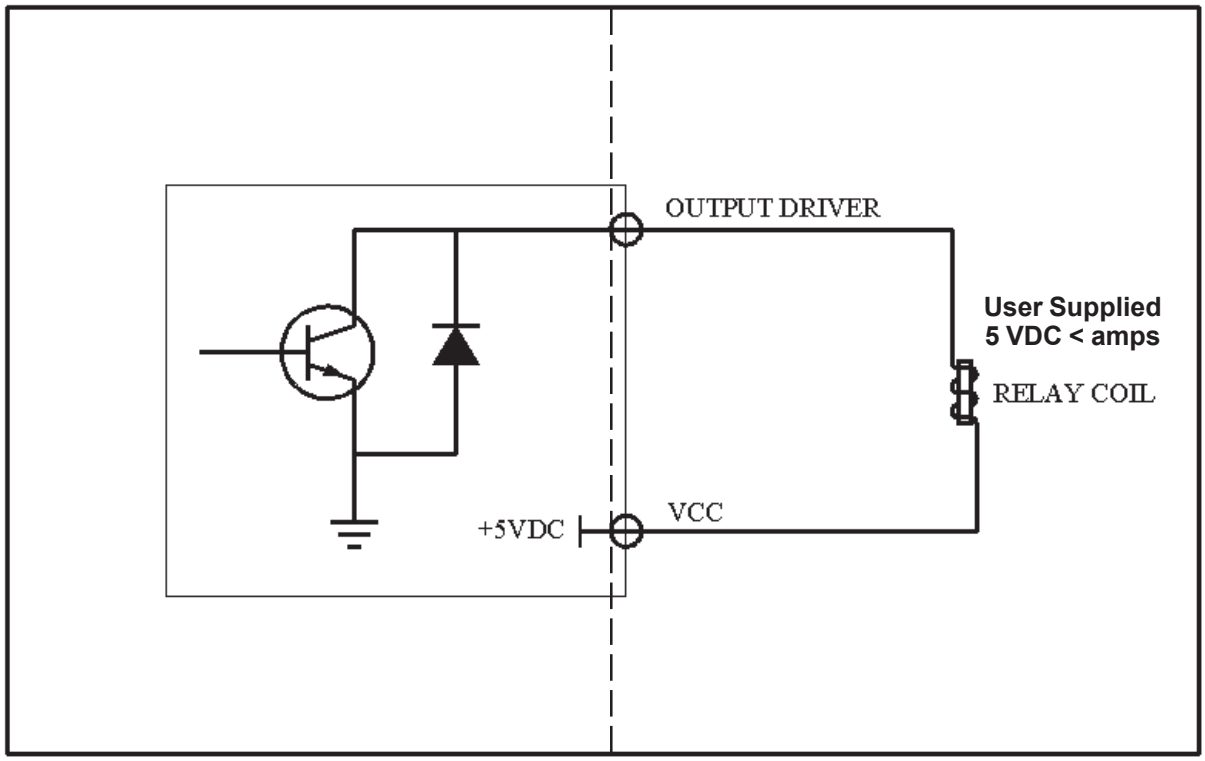
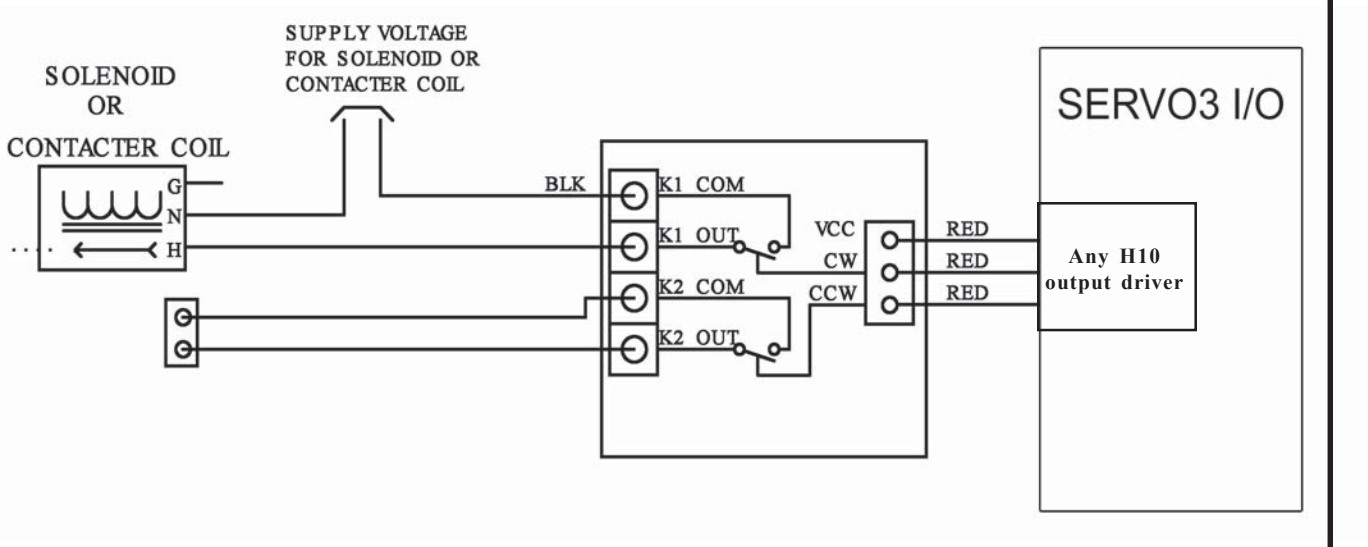


Figure 15.3- Ajax Dual Relay Board



16 Digitizing/Probe Connector

The Digitizing/Probe connector allows the use of an optimal Digitizer/Probe with the AJAX system.

16.1 Digitizing/Probe Installation

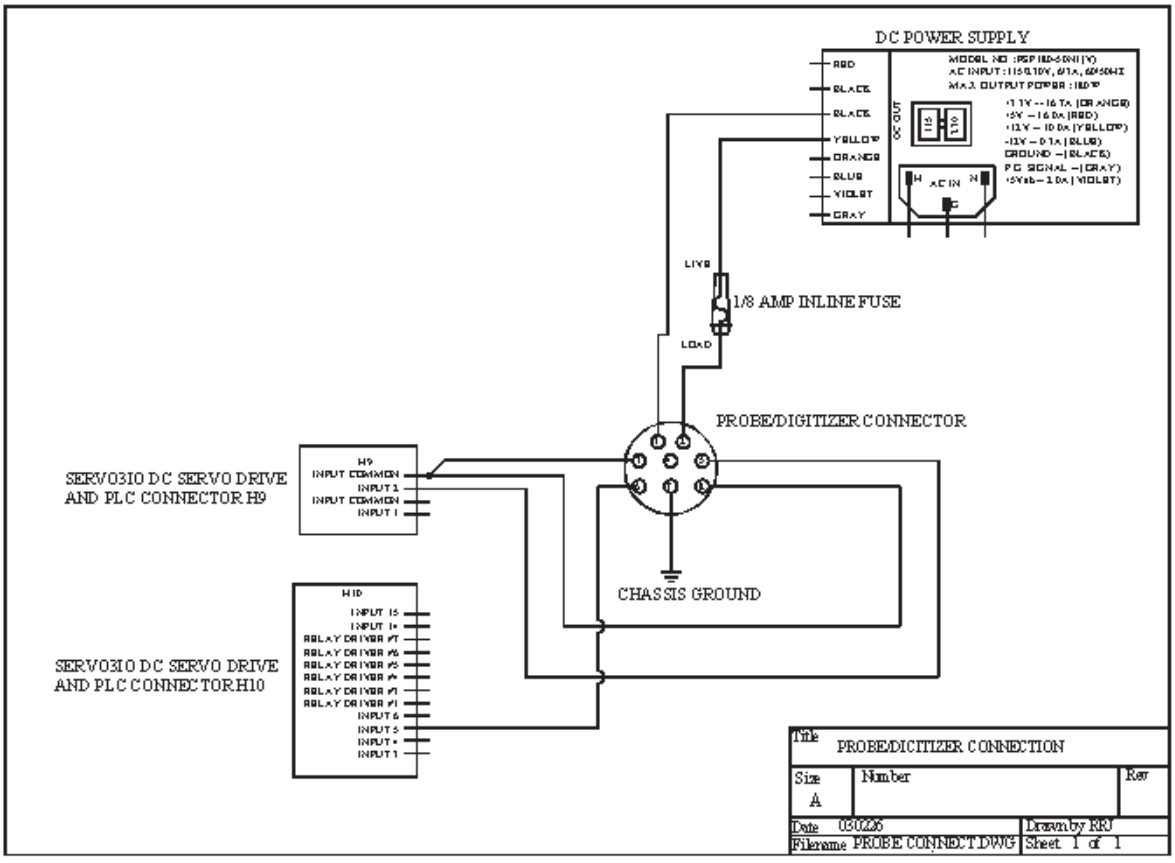
The Digitizing/Probe (D/P) connector receives power through the attached Molex connector which must be plugged into H3 on the SERVO3 IO board.

The remaining wires on the D/P connector must be connected as follows:

1) Connect the blue and brown wires to pin 4 on H9.
2) Connect the white wire to pin 3 on H9.
3) Connect the yellow wire to Input 5 (pin 3) on H10

Visit our web site for free downloads of other PLC programs for specific machines. www.ajaxcnc.com.
Keep in mind that just because a standard M code is labeled for a certain function that does not mean you have to use it for that purpose. For example: M8 is used for Coolant. You can use this output to activate a Flood pump OR a mister solenoid. You can use the M8 output to activate a vacuum pump, a clamp, etc….M8 turns it on and M9 turns it off.

Figure 16.1 - Probe / Digitizing Connection



Control Pendant Cable

Order Part #

Uses BELDEN #9682 24 AWG, 6 Twisted Pair with shield + drain wire

Parts List:
(1) 14' length of BELDEN #9682 cable
(1) DB15 male solder pot with hood
(1) 8 position Waldom 0.1" housing
(8) Waldom 0.1" crimp terminals
(1) 1" length of 1/16" diameter shrink tube
(1) 3" length of 1/16" diameter shrink tube
(1) Pendant back cover w/ strain relief & E-Stop button pre-mounted

Cut cable and strip insulation 1 1/2'. Leave gray/white, white/gray, red/blue, and blue/red wires 1 1/2' long. Cut the rest back to 1'. Cut the drain wire to 6", cover with 1/16" heat shrink. After the cable is in the jog pendant, solder a #6 solder tab to the drain wire and terminate the 1' wires to the 8 position Waldom conn. The other wires get soldered to the E-Stop button as shown.

DB-15 Male	Signal Name	8-pin Waldom **(CPU7xx)**	Wire Color **(crimp term.)**	E-Stop Button
1	DO+	1	Green/White	
2	RI+	3	Blue/White	
3	5V	7	Orange/White	
4	5V	5	Brown/White	
5	INPUT1		Gray/White	+NC
6	n/c			
7	n/c			
8	24V IN		Red/Blue	-NC
9	DO-	2	White/Green	
10	RI-	4	White/Blue	
11	GND	8	White/Orange	
12	GND	6	White/Brown	
13	INCOM		White/Gray	+C
14	n/c			
15	24V OUT		Blue/Red	-C

NOTE: drain wire is soldered to DB15

* Wire Colors are listed as Background Color/Stripe Color.

Waldom Pin	Wire
8	White/Orange
7	Orange/White
6	White/Brown
5	Brown/White
4	White/Blue
3	Blue/White
2	White/Green
1	Green/White

Control Pendant Intermediate Cable

Order Part #

Uses BELDEN 9682 24 AWG/ 6 PR. SHIELDED CABLE

Parts List:

(1) 5' length of BELDEN 9682 SHIELDED CABLE (JOG PIC)
(1) 8' length of BELDEN 8771
(2) 3' lengths of 20 AWG Blue insulated stranded copper wire (PLC)
(2) 3' lengths of 20 AWG Red insulated stranded copper wire (24VAC)
(1) DB15 female solder pot with hood (PC)
(1) DB15 female solder pot with hood (cabinet)
(2) 7/8" lengths of 1/16" diameter shrink tube
(1) 1" length of 1/4" diameter shrink tubing
(2) DB09 hoods

DB-15 Female **(cabinet)**	Signal Name **(CPU7xx)**	DB-15 Female **(PC)**	Wire Color **(cable)**	Free Wire **(E-Stop circuit)**
1	DO+	10	Green/White	
2	RI+	12	Blue/White	
3	5V	13	Orange/White	
4	5V	14	Brown/White	
5	INPUT1			Blue 20AWG
6	10V		White	To Inverter
7	0V		Black	To Inverter
8	24V IN			Red 20AWG
9	DO-	9	White/Green	
10	RI-	11	White/Blue	
11	GND	1	White/Orange	
12	GND	2	White/Brown	
13	INCOM			Blue 20AWG
14	Center Tap		Red	To Inverter
15	24V OUT			Red 20AWG

*with 2K pot