COUPP Small Pressure Controller Manual (Short Version)

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This document package describes the design and operation of the COUPP bubble chamber pressure controllers built by the Fermilab Lab 8 group. Four of these units have been manufactured.

Contents:

Note: this is a short version of the manual for distribution in electronic form. The pressure controllers will ship with binders that contain detailed parts lists, manufacturer's data for individual components, complete mechanical drawings , software CDs and a printout of the PLC code.

COUPP Pressure Cart Operation

The COUPP Pressure cart is a pressure controller designed to provide hydraulic pressurization and control. It uses two different pressurization techniques in its operation and has a PLC control system to monitor and operate its functions. The PLC has a small display unit called a DV1000 on the front of the cabinet. This document is intended to give an overview of that operation.

The system consist of a Hydraulic Piston driven by a stepper motor connected to a second smaller cylinder driven by a pneumatic cylinder operated through a fast reacting valve. This allows for both long term accurate control of pressure and fast pressurization. There is a set of instruments that monitor the operation and display conditions or allow for external operation and monitoring. There are pressure gauges on both the hydraulic and pneumatic systems, position sensors on both the motor and pneumatic driven hydraulic cylinders and limit switches on the motor driven cylinder. There is also a safety switch on the hydraulic pressure which is settable from 60 to 500 psi that can be interlocked into the control system.

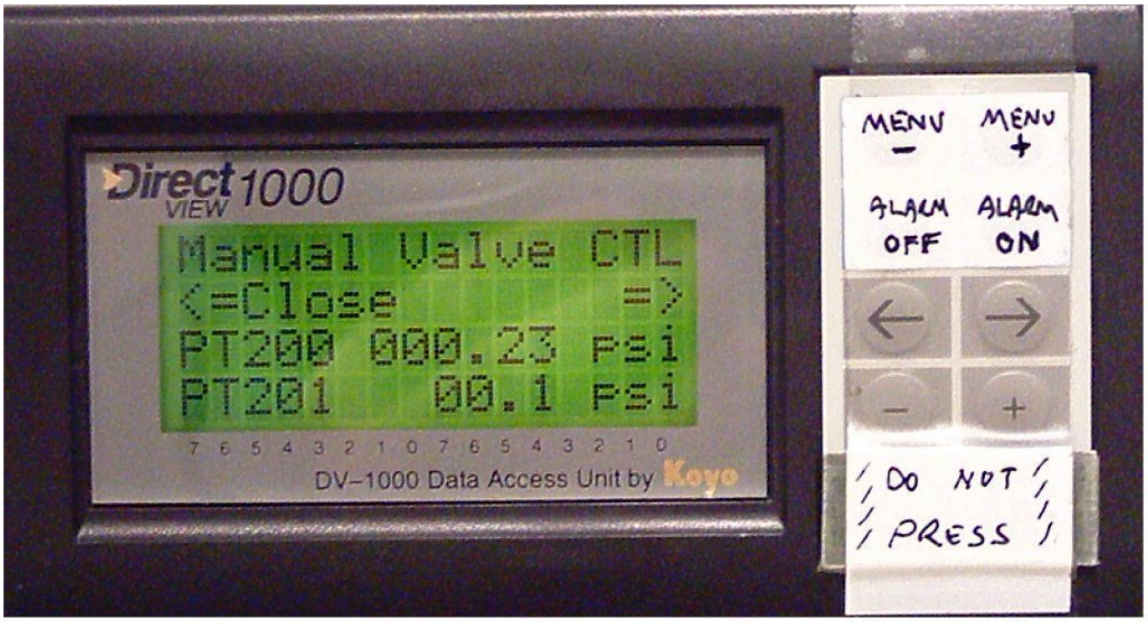
Operation is intended to be controlled through a Labview/Ethernet interface connection to the PLC and an operations connector that allows direct control of the fast acting pneumatic air valve. Some basic operations are possible from the DV1000 display that is on the front panel. There is another manual that details the Labview Operation. If the Labview/Ethernet interface is active then operation from the DV1000 is limited. To transfer operation to the DV1000, Labview must be stopped. The Menu+ and Menu- keys will then allow the four menus to be selected for operation.

Caution:

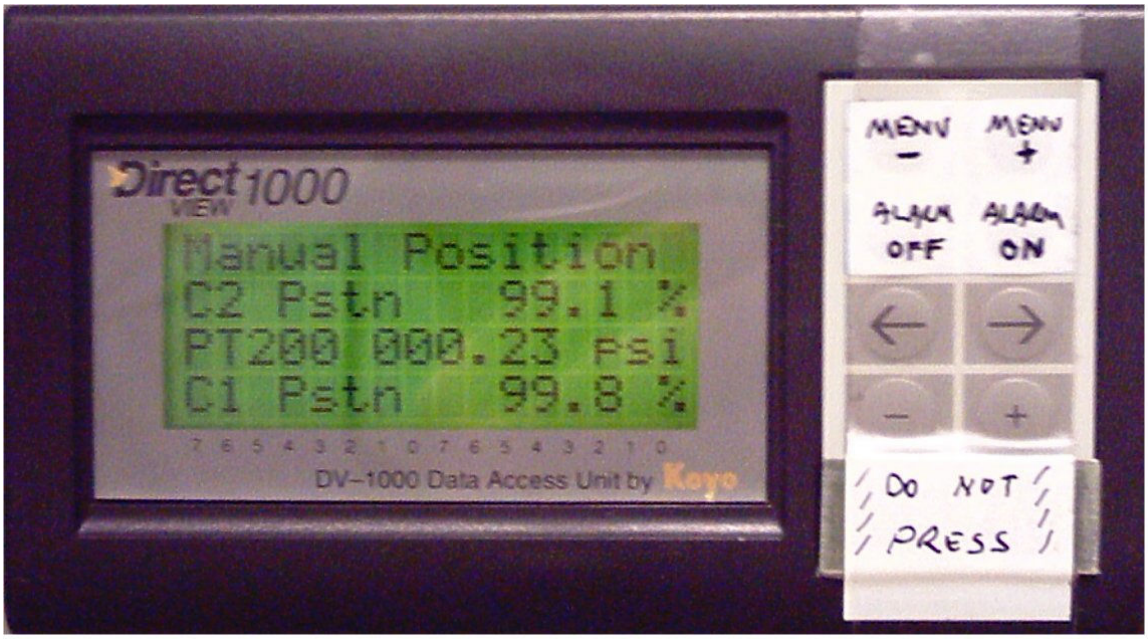
Caution must be exercised in bringing Air Pressure on to system since the Air valve is normally open the Pneumatic cylinder will be pressurized when no power is applied or system is turned off. If Hydraulic system is not filled then the Pneumatic Cylinder will be slam to the pressurized state very hard and could damage its operation. To prevent this occurrence Air Pressure should be minimized (less then 5 psi) until the Hydraulic system is filled and can withstand pressurization.

In local control there are four menus available on the DV1000 as pictured below.

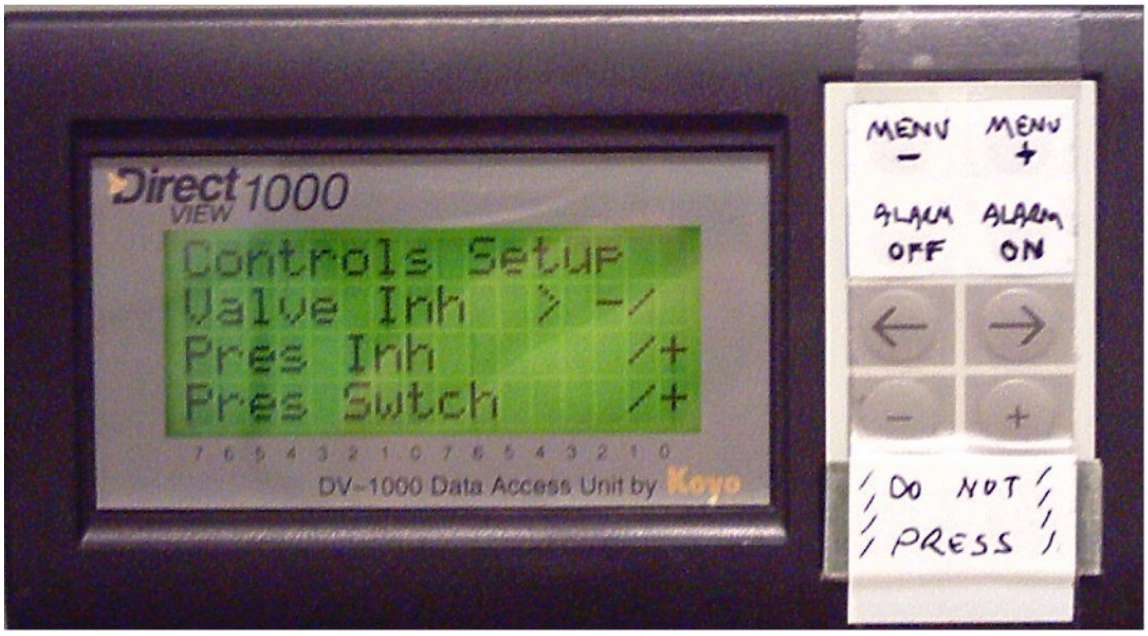
Manual Pressure Menu



Manual Valve Menu



Manual Position Menu



Controls Setup Menu

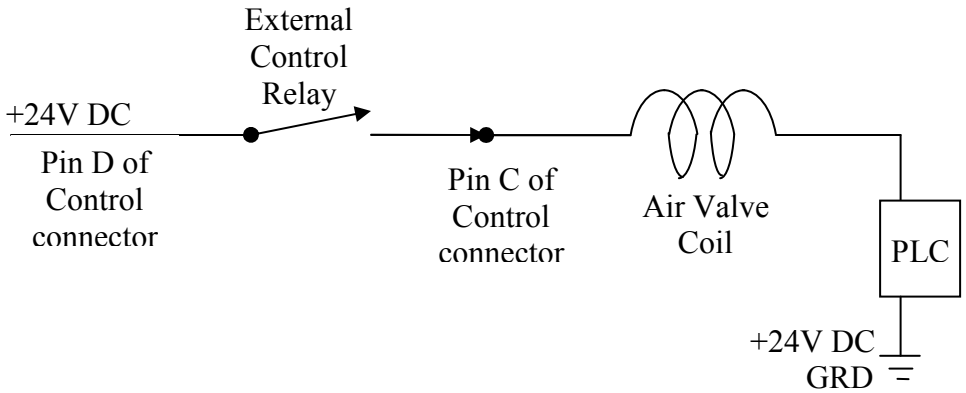
Some of the controls on these menus are affected by settings that are made in through the Labview Control. The Menu -/+ keys at top will rotate between the different screens. Alarm Off/On are used to locally turn the alarm signal on the Alarm connector (Grd signal on Pin B) Off or On. The bottom two keys should not be pressed as they change the DV1000 display mode (it needs to be in Bit Control Mode).

Manual Pressure Control Mode

In the Manual Pressure Menu the <- and -> keys activate or deactivate the pressure control mode. The + and – keys allow the SetPoint (SP) to be set. The pressure control mode can be inhibited by settings on the Controls Setup Menu. Once activated it will use the Motor Drive to adjust the pressure in the system to the setpoint and maintain that pressure to within 0.1 psi. The PT200 pressure reading is the Hydraulic pressure on the system. The limits on the Motor Driven Hydraulic ram are active and will stop motion in the appropriate direction if the pressure calls for operation into that area so pressure control will not be maintained in that case. These limits protect the system by preventing the Motor/Ram from being driven into the mechanical stops

Manual Valve Control Mode

In this mode the Pneumatic valve position can be changed using the <- and -> keys. This function can be affected by settings in Labview. PT200 is the Hydraulic pressure on the system and the PT201 is the Pneumatic pressure on the system. The Air Valve is a normally open valve so for the pneumatic system to be depressurized air valve will be activated. If power is loss with air pressure on system the pneumatic valve will open pressurizing the hydraulic system. The PLC and External control of the Air Valve through the Control connector (relay connection between pins C and D) are or'ed so that either one can turn the Air Valve off (Pressurize System) both must be true to depressurize system. If local control is needed then a jumper between C and D must be installed. Note diagram showing wiring.



Manual Position Control Mode

In this mode the Motor Driven Piston is directly controlled by the DV1000 using the <- and -> keys. The <- key decreases the volume of the Cylinder or Pressurizes. The -> key increases the volume of the Cylinder or Depressurizes the system. The Limits prevent operation beyond allowable position ranges but pressure is not limited in this mode unless the Pres Switch Control is turned On.. The display shows the C2 (Motor Driven Piston Position, % of Volume), the PT200 (Hydraulic Pressure) and the C1 (Pneumatic Piston Position, % of Volume).

Controls Setup Mode

This mode allows some of the control modes to be set On or Off as indicated be the + or – flashing.
The first Control is the Valve Inh (ibit). This control inhibits changing the Valve status (Open or Closed) either from the DV1000 or Labview when On. Note that when power is lost with air pressure on the Valve the air pressure will be allowed to pressurize the Air cylinder no matter what the state of this control.
The second Control is Pres(sure) Inh(ibit) which will prevent the Motor Drive system from activating when the System is Pressurized (Valve Off). This Control when On will prevent the system from adjusting the Motor Position when the Valve closed is so return to depressurization state (Pressure Control Mode) will be faster.
The third Control is the Pres(sure) Switch which when On stops the Motor Drive from pressurizing the system beyond the Pressure Safety Switch set point. It acts as a Down limit on the Motor Drive based on pressure when this control is On. See hardware manuals for setting of the pressure switch operating pressure.

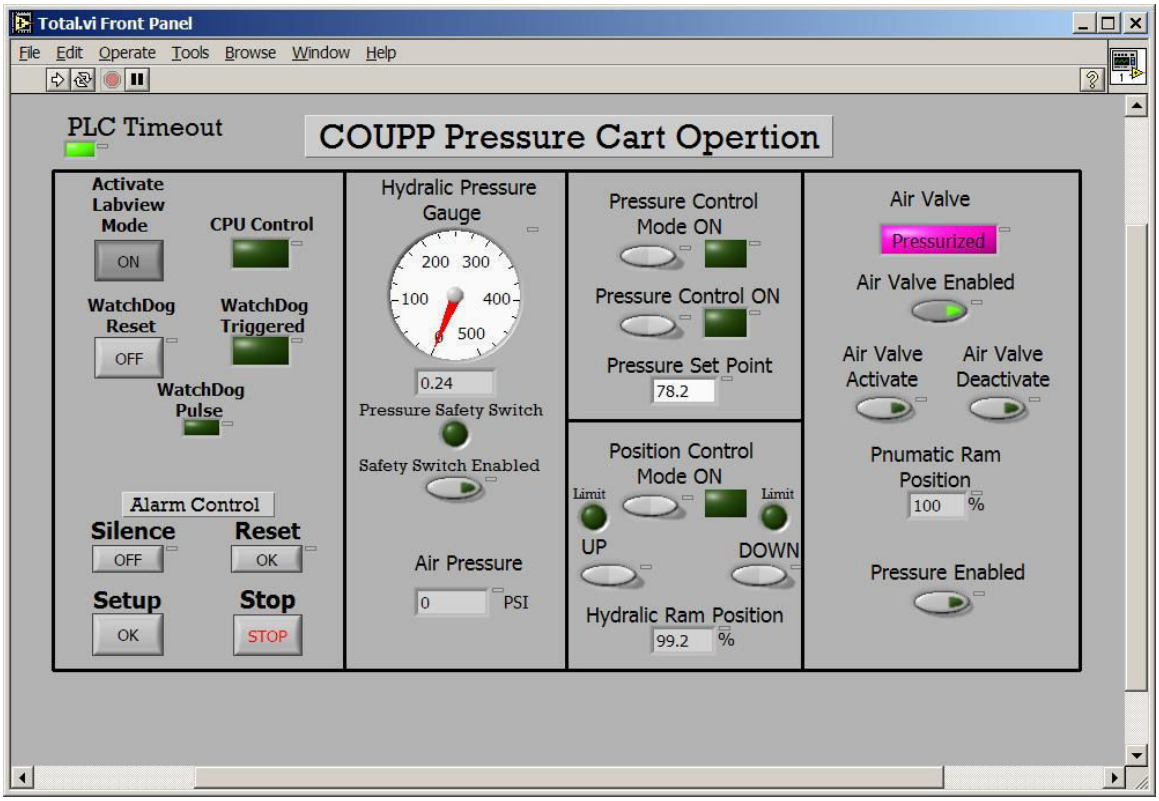
Other functionality can be added but requires that the PLC Ladder program be modified. This can only be done using the DirectSoft32 programming software from Automation Direct which is not included with this documentation package.

This document will explain the basic operation of the COUPP pressure cart through the Ethernet interface using Labview and KepDirect software. Labview and KepDirect will need to be installed on the host computer with an Ethernet interface. The Ethernet interface will have to be connected to the Pressure cart either directly or through a hub. The IP address that is set in the pressure cart interface is listed on the included documentation. It can be changed using the NetEdit software included on the Documentation CD. Labview is available from National Instruments and KepDirect is available from Automation Direct.

The KepDirect interface requires that the coupp.opf file be loaded and active. This file includes the Controls and Variables in the PLC that allow for the Labview operation. This exported file is documented with this package. All of the controls and variables are available for Labview use but not all are used. KepDirect is an OPC server that runs in the background as a service so normally has no window. Only if modifications are needed will it be run like changing the IP address if that is necessary or setting up the .opf file.

The basic ladder program in the PLC can only be modified using the Directsoft32 program which is not included and not necessary for operation but would be necessary if Ladder coding requires changes. DirectSoft32 is available from Automation Direct the manufacturer of the PLC.

There are two Labview Vi's included, Total.vi and Setup.vi. Total.vi is the main operation vi and it calls Setup as a sub vi. This is the Total VI screenshot.



Operation of Labview Control

Once Total VI is started the Labview control of the pressure cart operation can be started by pressing the arrow button in the top left of the screen. This will run the Labview code. To Stop the Labview code the Stop Button on the screen is the recommended way. When running, connection to the PLC is monitored by the Timeout indicator. This indicator and most of the other displays or indicators are connected to the PLC with a DataSocket connection through the KepDirect interface as indicated by the small indicators next to the displays. DataSocket connections attached to indicators or controls are enabled by right clicking on the control and going to Data Operations, DataSocket. Using the Kepdirect Software descriptors (part of the cart information package) to select the appropriate signal to connect to.

To activate the Labview Mode which allows control of the system the Activate Labview mode button needs to be pressed and is confirmed by the CPU Control indicator. If for any reason the communication between the PLC and Labview is disrupted for more then two seconds the Watchdog Triggered indicator is turned on. This is reset using the Watchdog Reset Button.

Once in the Labview Control Mode, Labview can be used to operate the different modes of operation. Pressures for the Hydraulic and Air Systems are displayed, Position of the two pistons in % Volume is displayed and Status of the Limits and Air Valve are displayed.

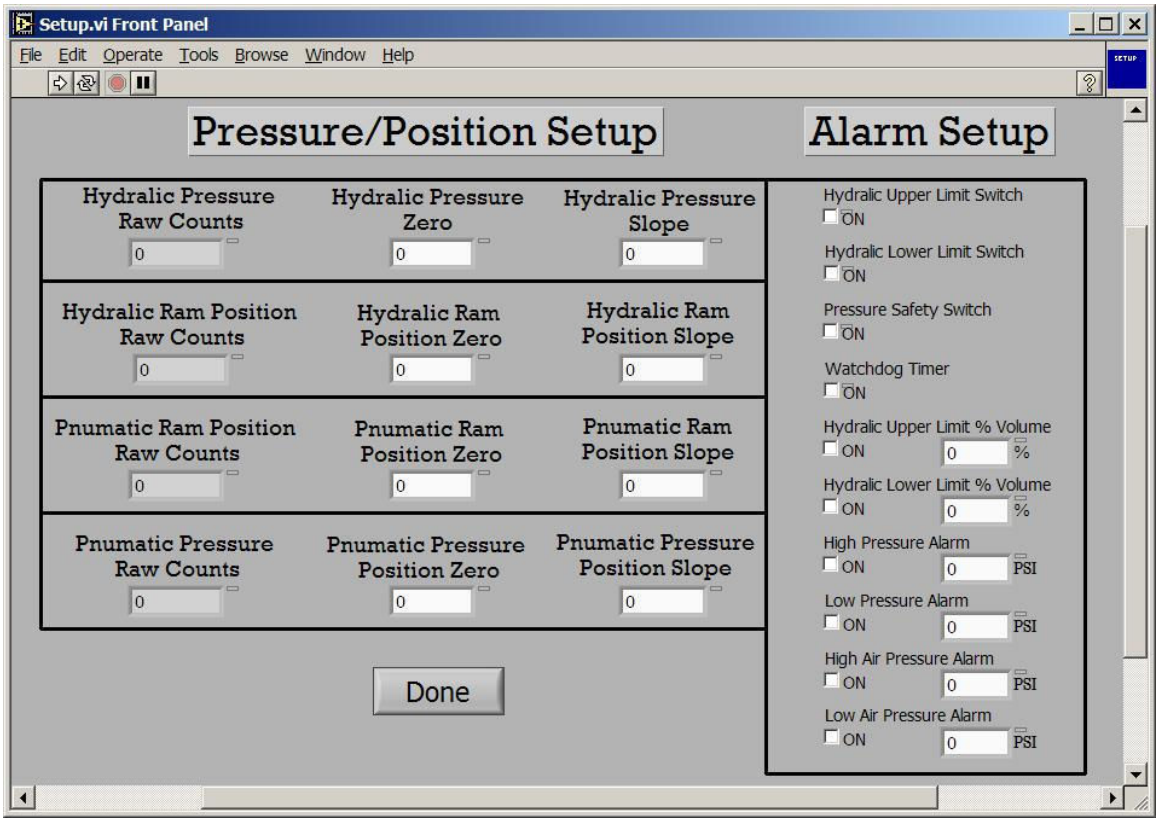
The Air Valve control is available at anytime along with the Control settings. Air Valve Activate will depressurize the system if the Air Valve Enabled control is On. Air Valve Deactivate will pressurize the system if the Air Valve Enabled control is On.

There are two basic mode of operation, Pressure Control Mode and Position Control Mode. These two modes can not be operated at the same time.

In the Pressure Control Mode the Labview system will tell the PLC what pressure it wants to be maintained and the PLC will try to maintain that pressure within 0.1 PSI with some conditions. To activate the mode first press the Pressure Control Mode On button this activates the mode but does not activate the Motor to move. The desired pressure can be put in the Set Point box. Then pressing Pressure Control On will start the motor moving the piston to regulate the pressure to the set point pressure. Several things can effect this operation. If a limit switch is encounter operation in that direction will be stopped. If the Pressure safety Switch is encountered and the Safety Switch is enabled then motion is stopped in the down (Pressurizing) direction. If the Pressure Enabled switch is on and the air valve is deactivated (Pressurized) then pressure control is deactivated but will reactivate once the air valve is activated (Normal). Note that if the Position of the Air Cylinder is not at 100%, pressure control is limited since Air Cylinder will move in response to any motion of the Hydraulic Cylinder.

In the Position Control Mode the Labview allows the operator to Manual move the Hydraulic Piston to a desired position. This operation is effected by the same things as in the Pressure Control Mode.

The Setup VI is called using the Setup Button and allows some parameters and alarm conditions to be set. Here is the screenshot for this VI.



The Pressure/Position Setup area allows the four active sensors on the cart to be linearly calibrated for operation. These numbers should not need to be adjusted but if necessary they can be. The Raw A/D encoder counts are displayed so a calibration can be calculated. The form of the calibration is Raw Counts minus Zero times Slope to produce the Converted (Displayed) Value. The Raw Counts is an integer (0 to 4096) for positions and Pneumatic Pressure and (0 to 65536) for the Hydraulic Pressure. The Zero's are the same and the Slope is a Real Number of 6 digit accuracy (0.123456).

The Alarm Setup allows the system to monitor certain conditions and activate an alarm passed upon those conditions. Which conditions are monitored are set using the check boxes and at what point they activate is set in the corresponding box. This alarm shows on the Total VI display and if On turns on the output on the Alarm connector on the Cart. This does not effect the operation of the safety controls operation (limits and pressure safety switch).

The KepDirect PLC.CSV Description Document contains a element by element description of the .CSV file used by KepDirect to communicate with the PLC. This is used to connect the KepDirect Tag Name to the PLC Address code. The csv file also has information about type of data, scan rate and any scaling of the signal that is used.

The KepDirect Tag Name is what is looked up when a DataSocket connection is made in Labview. With this the appropriate signal can be connected to the appropriate control in Labview. Elements can be added to the .CSV file then Imported back into KepDirect and saved in the COUPP.OPF file that is actually used for the communication.

KEP Direct PLC.CSV Description Document			
Tag Name	**Address**	**Data Type**	**Description**
C.AirValveEnable	C1000	Boolean	Allows Air Valve State to be changed from Software (PLC or Labview)
C.PressureCtrlInhibit	C1001	Boolean	Stops Motion of Ram when Air Valve is deactivated, system pressurized
C.SafetySwitchEnable	C1002	Boolean	Stops Motion of Ram (Minus) when Hydralic Safety Switch is Activated
C.UpAlrmLmtInhibit	C100	Boolean	Alarm Controls - Setting these on will enable that control to produce an alarm.
C.LowAlrmLmtInhibit	C101	Boolean	Alarm Controls - Setting these on will enable that control to produce an alarm.
C.PresSafetySwInhibit	C102	Boolean	Alarm Controls - Setting these on will enable that control to produce an alarm.
C.WatchDogInhibit	C103	Boolean	Alarm Controls - Setting these on will enable that control to produce an alarm.
C.UpHydPstnInhibit	C104	Boolean	Alarm Controls - Setting these on will enable that control to produce an alarm.
C.LowHydPstnInhibit	C105	Boolean	Alarm Controls - Setting these on will enable that control to produce an alarm.
C.UpHydPresInhibit	C106	Boolean	Alarm Controls - Setting these on will enable that control to produce an alarm.
C.LowHydPresInhibit	C107	Boolean	Alarm Controls - Setting these on will enable that control to produce an alarm.
C.UpAirPresInhibit	C110	Boolean	Alarm Controls - Setting these on will enable that control to produce an alarm.
C.LowAirPresInhibit	C111	Boolean	Alarm Controls - Setting these on will enable that control to produce an alarm.
C.AlarmOff	C2	Boolean	Key Commands from DV1000 or from Labview. Read/Writable - Momentary
C.AlarmOn	C3	Boolean	Key Commands from DV1000 or from Labview. Read/Writable - Momentary
C.MinusArrow	C4	Boolean	Key Commands from DV1000 or from Labview. Read/Writable - Momentary
C.PlusArrow	C5	Boolean	Key Commands from DV1000 or from Labview. Read/Writable - Momentary
C.Alarm	C22	Boolean	Active Alarm Occuring - Monitor only
C.AlarmSilenceOFF	C23	Boolean	Disables the Alarm Output on the Alarm connector (Grd on pin B)
C.Alarmed	C27	Boolean	Shows an alarm occurred must be reset by Labview or power cycle
C.RemoteAirVON	C24	Boolean	Activates Air Valve from Labview which will release the air cylinder pressurization
C.RemoteAirVOFF	C25	Boolean	Deactivates the Air Valve from Labview which Pressurizes system with Air Cylinder
C.WatchdogCtrl	C40	Boolean	Activates the Watchdog operation
C.WatchdogReset	C41	Boolean	Used to prove communication from PLC to Labview
C.InCPUMode	C42	Boolean	Shows that communication is good
C.LostCPU	C43	Boolean	Indicates loss of communication
C.LockoutLost	C44	Boolean	
C.LabviewPresCtr	C45	Boolean	Activates Pressure Control mode from Labview
C.PressureCtrlON	C50	Boolean	Turns Pressure Controlling on

C.LabviewPstnCtr	C46	Boolean	Activates Position Control Mode from Labview
S.ManualPres	S11	Boolean	Indicates Pressure Control Mode active
S.ManualPosition	S13	Boolean	Indicates Position Control Mode Active
V.RawAnalog1	V1300	Word	Raw A/D counts of 12 bit Channel 1 input - Hydralic Ram Position
V.RawAnalog2	V1301	Word	Raw A/D counts of 12 bit Channel 2 input - Pnumatic Ram Position
V.RawAnalog3	V1302	Word	Raw A/D counts of 12 bit Channel 3 input - Air Pressure
V.RawAnalog4	V1303	Word	Raw A/D counts of 12 bit Channel 4 input - Unused
V.RawAnalogH1DW	V1320	Long	Raw A/D counts of 16 bit Channel 1 input - Hydralic Pressure
V.RawAnalogH2DW	V1322	Long	Raw A/D counts of 16 bit Channel 2 input - Unused
V.RawAnalogH3DW	V1324	Long	Raw A/D counts of 16 bit Channel 3 input - Unused
V.RawAnalogH4DW	V1326	Long	Raw A/D counts of 16 bit Channel 4 input - Unused
V.HydRamZero	V1340	Word	
V.HydRamSlope	V1341	Float	
V.PnumRamZero	V1343	Word	
V.PnumRamSlope	V1344	Float	
V.AirPresZero	V1350	Word	
V.AirPresSlope	V1351	Float	
V.HydPresZero	V1353	Long	
V.HydPresSlope	V1355	Float	
V.DisplayCtrlValue	V1400	BCD	PLC Control Mode Value (0=Labview,1 through 4 are Control Menus)
V.DisplayMove	V1401	BCD	
V.HydRamPstn	V1500	BCD	Converted value of Hyd. Ram Position in % (format XXX.X)
V.PnumRamPstn	V1501	BCD	Converted value of Pnum. Ram Position in % (format XXX.X)
V.AirPres	V1502	BCD	Converted value of Air Pressure in PSI (format XXX.X)
V.HydPres	V1510	LBCD	Converted value of Hyd. Pressure in PSI (format XXX.XX)
V.PresCtrlValue	V1540	BCD	
V.PresCtrlSetPt	V1541	BCD	Target Value for the Pressure Control Mode in PSI (format XXX.X)

V.PresCtrlDeltaV	V1542	BCD	Internal Pressure Control use
V.PresCtrlDltVX10	V1543	BCD	Internal Pressure Control use
V.ManualPstnSpeed	V1600	BCD	Speed of Motor Drive from 4 to 2500 X10 steps/sec
X.AirValvePstn	X0	Boolean	Indicates the Air Valve Position - On is Activated, System is Depressurized
X.UpperLimitHydNC	X4	Boolean	NC signal from Upper Limit Switch (Unused) - Monitor only
X.UpperLimitHyd	X5	Boolean	Upper Limit Switch on Hydralic Ram - Monitor only
X.LowerLimitHydNC	X10	Boolean	NC signal from Lower Limit Switch (Unused) - Monitor only
X.LowerLimitHyd	X11	Boolean	Lower Limit Switch on Hydralic Ram - Monitor only
X.HydSafetySwNC	X14	Boolean	NC signal from Pressure Safety Switch (Unused) - Monitor only
X.HydSafetySw	X15	Boolean	Pressure Safety Switch - Monitor only
X.IntfaceConnPinG	X6	Boolean	Control Signal out Control connector pin G (undefined)
X.IntfaceConnPinH	X7	Boolean	Control Signal out Control connector pin H (undefined)
Y.AirValve	Y0	Boolean	Activates the Air Valve - Independent of External connector Activation
Y.IntfaceConnPinG	Y1	Boolean	Control Signal into Control connector pin E (undefined)
Y.IntfaceConnPinF	Y2	Boolean	Control Signal into Control connector pin F (undefined)
Y.AlarmOutput	Y4	Boolean	Alarm output Grd Signal on pin B, 24VDC on pin A supplied

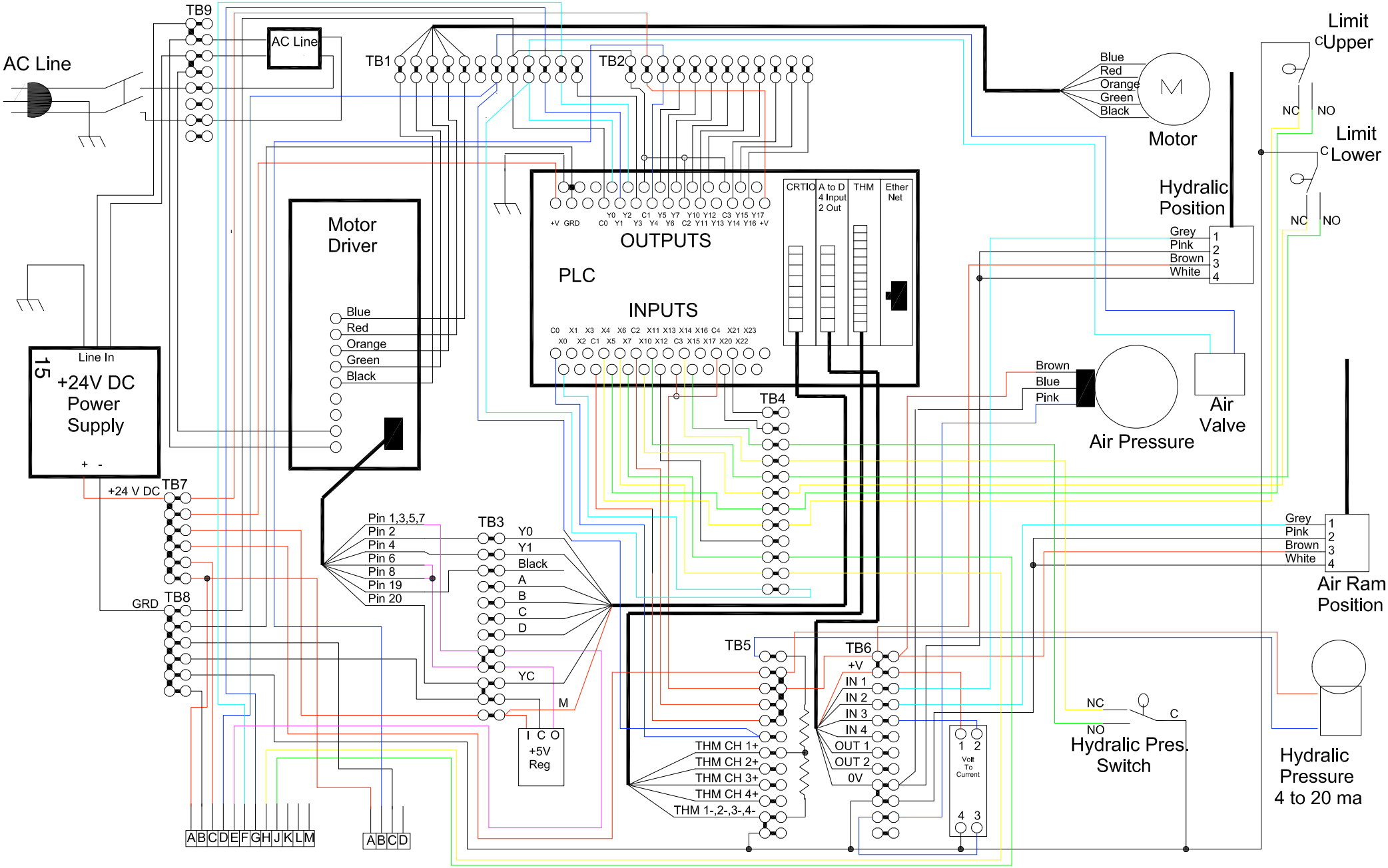
COUPP Connector Wiring List

Control Connector
BURNDY TRIM TRIO BANTAM GOB 14-92 SNE, 12 SOCKET CONTACTS

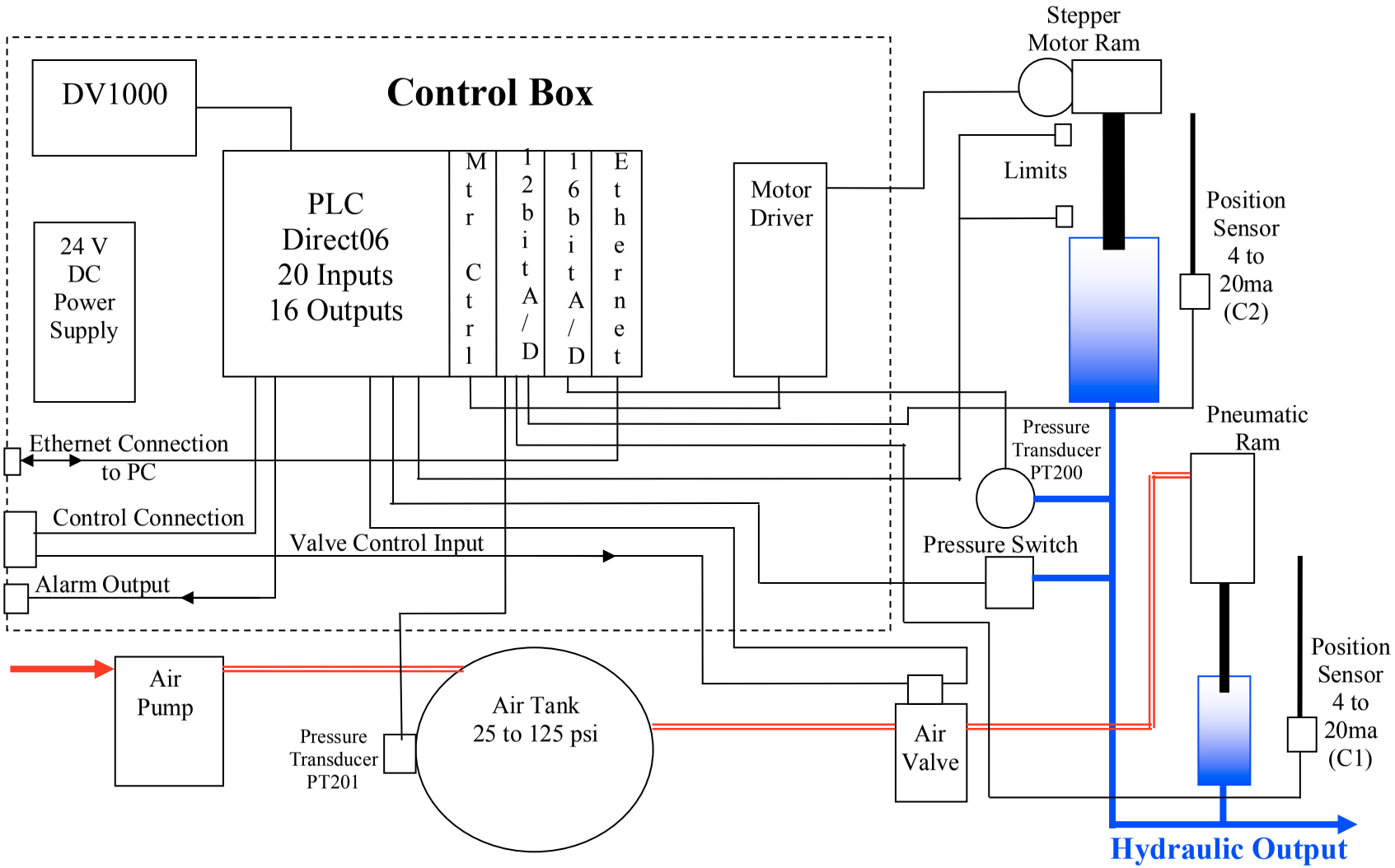
Pin A	+24 V DC Power	1 amp available
Pin B	+24 V Ground	
Pin C	Valve Power (+24 VDC)	
Pin D	Valve Return (Control)	+24 V needs to be supplied to this pin to activate (depressurize) system
Pin E	+5V DC Power	300 ma avalable
Pin F	Control Signal Out	Unassigned (Pulled Down, Grd when On)
Pin G	Control Signal Out	Unassigned (Pulled Down, Grd when On)
Pin H	Control Signal In	Unassigned (Grd signal is On)
Pin J	Control Signal In	Unassigned (Grd signal is On)
Pin K		
Pin L		
Pin M		
Pin N		

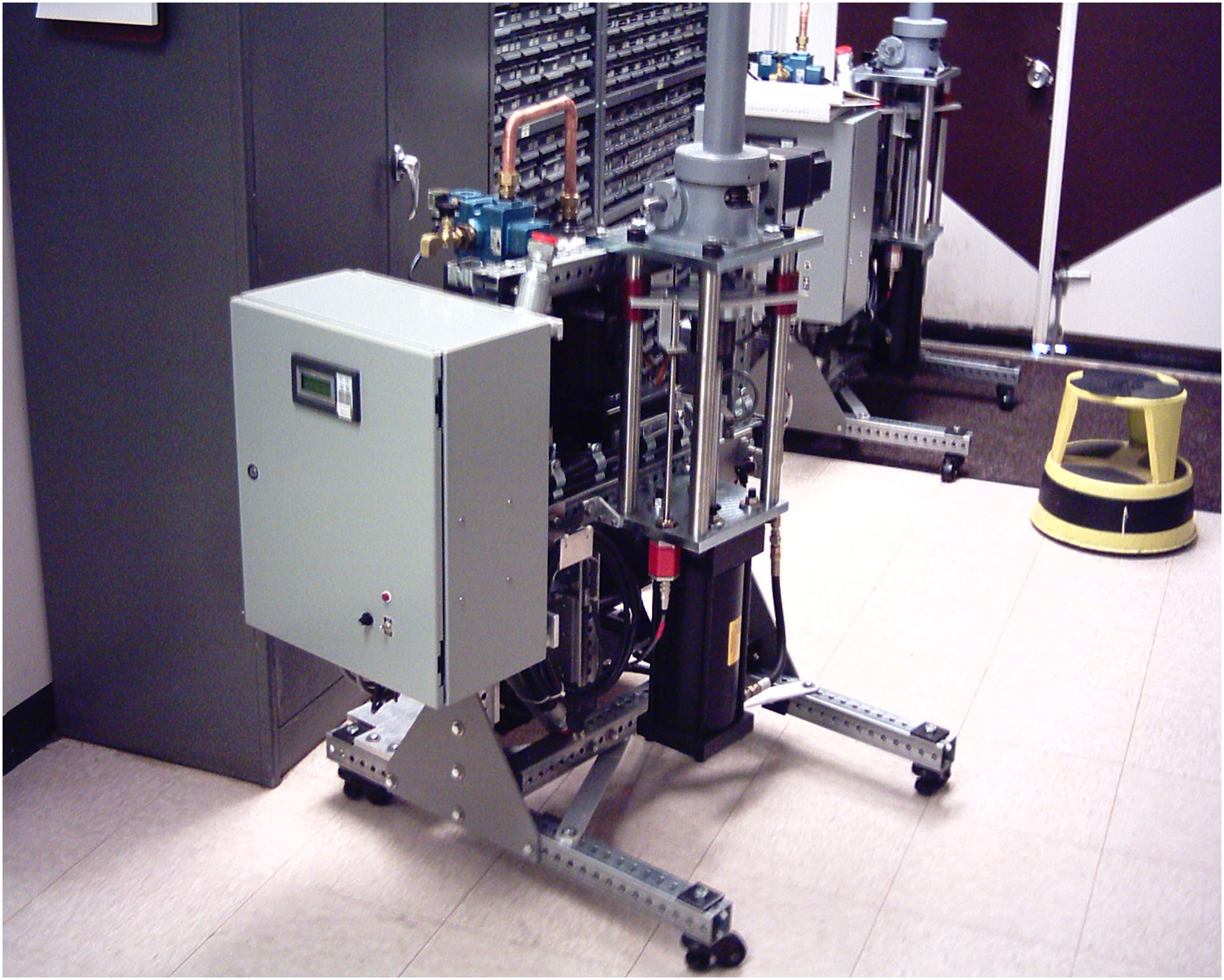
Alarm Connector
BURNDY TRIM TRIO BANTAM GOB 10-4 SNE, 4 SOCKET CONTACTS

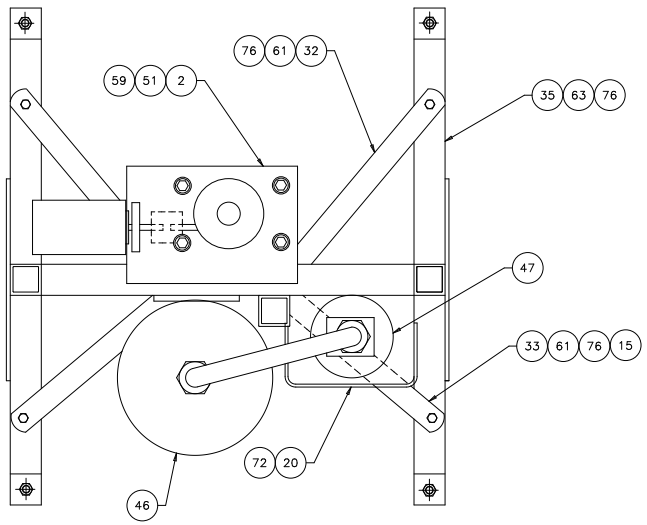
Pin A	+24 V DC Power	1 amp available
Pin B	Alarm Output	PLC Controlled Alarm Signal (Grd is ON)
Pin C	+24 V Ground	
Pin D		

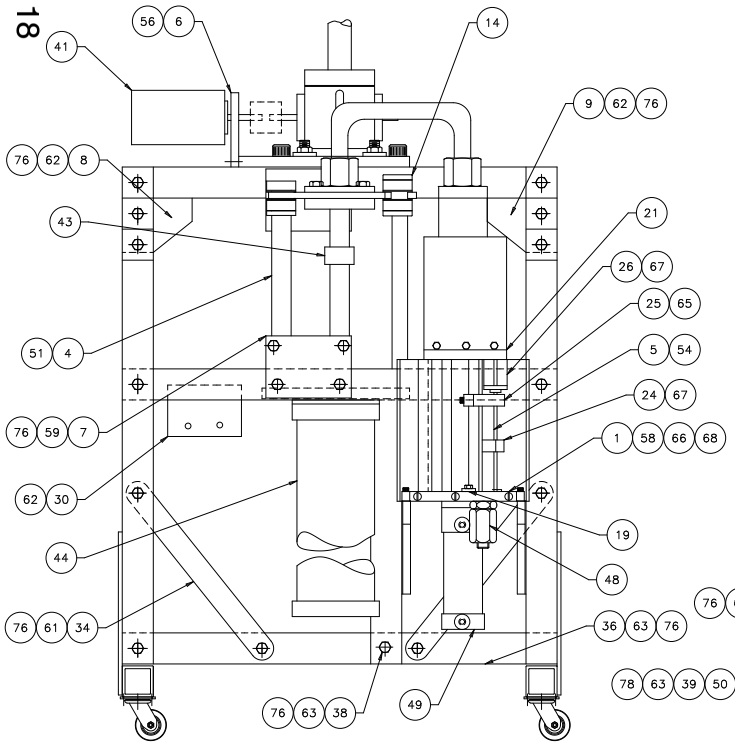

AC Line
TB9
AC Line
TB1
TB2
Blue
Red
Orange
Green
Black
Motor
Limit
C Upper
NC
NO
Limit
C Lower
NC
NO
Hydralic
Position
Grey
Pink
Brown
White
1
2
3
4
Motor
Driver
Blue
Red
Orange
Green
Black
+V GRD
Y0 Y2 C1 Y5 Y7 Y10 Y12 C3 Y15 Y17
C0 Y1 Y3 Y4 Y6 C2 Y11 Y13 Y14 Y16 +V
OUTPUTS
PLC
INPUTS
C0 X1 X3 X4 X6 C2 X11 X13 X14 X16 C4 X21 X23
X0 X2 C1 X5 X7 X10 X12 C3 X15 X17 X20 X22
CRTIO
A to D
4 Input
2 Out
THM
Ether
Net
Line In
15
+24V DC
Power
Supply
+ -
TB4
Brown
Blue
Pink
Air Pressure
Air
Valve
+24 V DC
TB7
Pin 1,3,5,7
Pin 2
Pin 4
Pin 6
Pin 8
Pin 19
Pin 20
TB3
Y0
Y1
Black
A
B
C
D
YC
M
GRD
TB8
I C O
+5V
Reg
TB5
TB6
+V
IN 1
IN 2
IN 3
IN 4
OUT 1
OUT 2
0V
THM CH 1+
THM CH 2+
THM CH 3+
THM CH 4+
THM 1-,2-,3-,4-
1 2
Volt
To
Current
4 3
NC
C
NO
Hydralic Pres.
Switch
Grey
Pink
Brown
White
1
2
3
4
Air Ram
Position
Hydralic
Pressure
4 to 20 ma
A B C D E F G H J K L M
A B C D

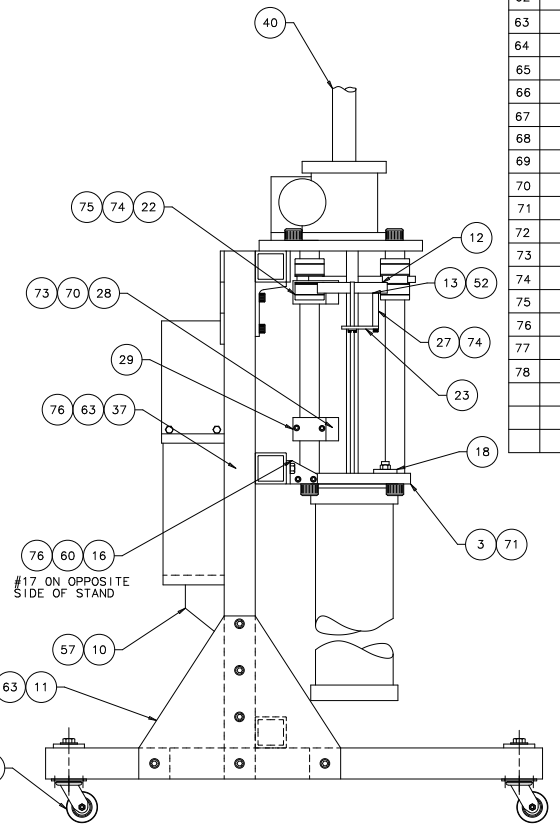
Functional Block Diagram











18

			REV
43		1"-14 COUPLER	1
44		5"ø x 10" STROKE HYD. CYL.	1
45		MACK 1/2 NPT VALVE CV=5	1
46		3 GALLON PRESSURE VESSEL	1
47		#24 BELLOFRAM CYL. 5.24" STROKE	1
48		TEMPOSONICS TRANSDUCER 4-20 ML.	1
49		2 1/2ø x 4 STD. W/SAE #8 PORTS	1
50		CASTERS	4
51		SCREW 3/4-16 x 1 SH.	12
52		SCREW 5/8-11 x 3/8 HH.	4
53		SCREW 5/8-11 x 1 HH.	4
54		SCREW 5/8-11 xX 1 1/2 SH.	4
56		SCREW 5/8-11 x 1 SH.	6
57		SCREW 5/16-18 x 3/4 SH.	6
58		SCREW 3/8-16 x 1 HH.	3
59		SCREW 3/8-16 x 7/8 HH.	2
60		SCREW 3/8-16 x 3/4 SH.	20
61			
62		SCREW 3/8-16 x 1/2 HH.	4
63		SCREW 3/8-16 x 2 1/2 HH.	28
64			
65		SCREW 1/4-20 x 1 SH.	4
66		SCREW 1/4-20 x 7/8 SH.	4
67		SCREW 1/4 -20 x 3/4 SH.	6
68		SCREW 1/4-20 x 5/8 BH.	3
69			
70		SCREW 1/4-20 x 5/8 SH.	4
71		SCREW 1/4-20 x 1/2 SH.	4
72		SCREW 1/4-20 x 3/16 BH.	3
73		SCREW 10-32 x 5/8 SH.	8
74		SCREW 10-32 x 1/2 SH.	4
75		SCREW 6-32 x 1/2 SH.	4
76		NUT 3/8-16	24
77		NUT 5/8-11	4
78		FLAT WASHER 3/8	24

		DESCRIPTION	DRAWN / APPROVED	DATE
42				
41		VEXTA STEEPER #RK596AA-N25		1
40		5 TON ANTI-BACKLASH JACK		1
39		2 x 2 SQ. UNISTRUT WASHER		16
38	MC-241875	PRESSURE CONTROL STAND "D"		1
37	MC-241875	PRESSURE CONTROL STAND "C"		2
36	MC-241875	PRESSURE CONTROL STAND "B"		3
35	MC-241875	PRESSURE CONTROL STAND "A"		2
34	MB-241879	DIAGONAL BRACE-3		1
33	MB-241878	DIAGONAL BRACE-2		1
32	MB-241877	DIAGONAL BRACE		1
31				
30	MB-241876	SENSOR MOUNTING PLATE		1
29	MB-241872	CLAMP		2
28	MB-241871	SWITCH MOUNT		2
27	MB-241866	PRESSURE CONTROL SPACER		1
26	MB-241857	QUENCHER SPACER		1
25	MB-241856	ROD CLAMP		1
24	MB-241855	TORQUE RESTRAINT		1
23	MB-241858	QUENCHER MAGNET MOUNT		1
22	MB-241865	MAGNET MOUNT		1
21	MB-241887	CYLINDER CAP MODIFICATION		1
20	MB-241854	QUENCH COVER		1
19	MB-241852	QUENCH CYLINDER MOUNTING		4
18	MB-241853	QUENCH PRESS CTRL CYLINDER MOUNT		4
17	MB-241869	RH BRACKET LOWER PLATE		1
16	MB-241870	LH BRACKET LOWER PLATE		1
15	MB-241883	BRACKET SHIM		2
14	MB-241867	BUSHING MODIFICATION		2
13	MB-241864	ADAPTER PLATE		1
12	MB-241863	TORQUE ARM		1
11	MB-241880	SIDE BRACE		2
10	MB-241884	QUENCH CYLINDER MOUNT		2
9	MB-241885	R H UPPER CORNER GUSSET		1
8	MB-241882	L H UPPER CORNER GUSSET		1
7	MB-241881	TANK BRACKET		1
6	MB-241868	MOTOR MOUNTING PLATE		1
5	MB-241859	TIE ROD		4
4	MB-241860	PRESSURE CONTROL TIE ROD		4
3	MB-241861	LOWER PLATE		1
2	MB-241862	JACK MOUNTING PLATE		1
1	MB-241850	MOUNTING PLATE		1

UNLESS OTHERWISE SPECIFIED			ORIGINATOR	C.LINDENMEYER	25-SEP-2006
			DRAWN	S.KINDELBERGER	25-SEP-2006
±	±	±	CHECKED	C.LINDENMEYER	25-SEP-2006
			APPROVED	C.LINDENMEYER	25-SEP-2006

1. BREAK ALL SHARP EDGES MAX.
2. DO NOT SCALE DRAWING.
3. DIMENSIONS BASED UPON
4. MAX. ALL MACH. SURFACES
5. DRAWING UNITS:

USED ON

MATERIAL

FERMI NATIONAL ACCELERATOR LABORATORY
UNITED STATES DEPARTMENT OF ENERGY

COUPP QUENCHER STAND ASSEMBLY

SCALE	DRAWING NUMBER	SHEET	REV
1:4	9219.400-MD-241888	1 OF 1	

CREATED WITH : Ideas12NXSeries | GROUP: PPD/MECHANICAL DEPARTMENT