**Solar Production Equipment Corp**

**Chemical Injection pump and PCC controller operation manual**

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Table of Contents

# 1 Overview

## 1.1 PCC Controller

The PCC controller is a chemical injection pumping cycle time controller that comes complete with analog and digital I/O and serial communications. Application programs are imbedded with user changeable parameters to set up the specific control functions. Programming of the PCC controller is achieved by one of two methods, direct keypad entry or via a PC and SPEC graphic user interface (GUI).

The PCC controller has two 4-20mA analog input channels and 2 dry contact inputs, and can operate 1 or 2 chemical injection pumps

There is one serial port which can be operated as either an RS-485 or an RS-232 port. The PCC controller supports direct serial and modem using ASCII Modbus communication.

Note:

System calibration can only be done locally via keypad entry.

## 1.2 Chemical injection pump

The pump is a directly opposed dual head reciprocating piston design. The pump incorporates an eccentric bearing mounted directly to the end of the prime mover shaft. The bearing fits into a close tolerance indentation machined into the middle section of the reciprocating piston shaft. The eccentric bearing moves in an orbit. As the motor spins the bearing assembly drives the piston shaft between the horizontally opposed pump heads. As a result of this motion the pump is drawing fluid into one pump head while pressurizing the other pump head simultaneously. As the bearing moves through 180 degrees it reaches the end of the piston=s travel and the piston assembly reverses direction and repeats the cycle in the opposite direction.

There are two-wafer style poppet valves installed between each of the pump heads and the suction and discharge manifolds. They are located directly opposed to one another and at 90 degrees to the piston and seal assembly as the piston moves into a pump head assembly one valve opens while the other closes. This is the pressure or discharge stroke. As the piston changes direction and withdraws from the pump head the valve operations reverse and this is the suction stroke. As one of the horizontally opposed pump heads is pressurizing the other is drawing fluid from the reservoir at the same time.

The pump repeats this operation (one pressure stroke and one suction stroke at each of the opposing pump heads) for every 360degree rotation of the motor. The motor is rotating at 1750 RPM resulting in 3500 discharge stroke per minute.

## 2 Important Safety Information

Power, input and output (I/O) wiring must be in accordance with Class I, Division 2 wiring methods of CEC within Canada and in accordance with the local authority having jurisdiction.

## 3 Installation

### 3.1 Field Wiring

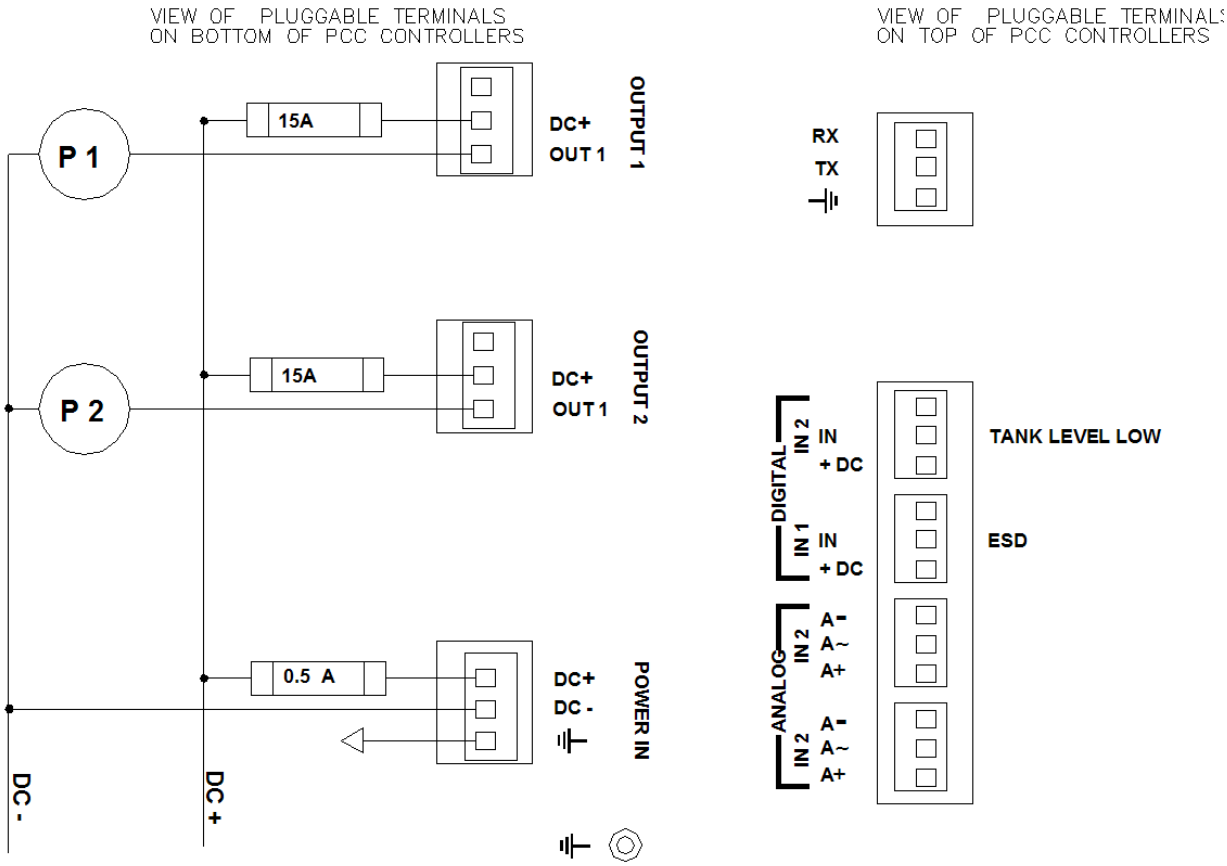
PCC controllers use pluggable screw termination style connectors for termination of field wiring. These connectors accommodate solid or stranded wires from 12 to 22 AWG. The connectors are removable allowing replacement of the PCC controller without disturbing the field wiring. Leave enough slack in the field wiring for the connector to be removed.

**CAUTION: Remove power before servicing unit.**

There are 8 connectors for field wiring. Refer to Figure 1

- The communication port COM connects to a 3 pin removable connector. Refer to section 4.1-RS-232 Serial Communication Port for pin out details and wiring.
- All other field wiring terminates in removable terminal connectors.

**Figure 1: PCC controller field wiring diagram**



## 3.2 Power Supply

The PC controller is powered from a DC power source. Refer to specifications of this manual for the minimum and maximum operating voltages and actual power requirements.

- The PCC controller will shutdown when operating below the minimum recommended voltage.
- Exceeding the maximum input voltage or applying a reverse voltage will blow the input power fuse.

### 3.2.1 System Grounding

In most applications, it is desirable to ground the system by connecting the system power supply common, to the chassis or panel ground. The negative side of the DC power input terminal as well as all I/O point terminals labeled GND are connected to chassis ground.

## 3.3. Analog Inputs

There are two analog inputs available to the user. These analog inputs use an 8-bit analog to digital converter. The analog inputs are transient protected.

The analog inputs are identified as AN1 and AN2.

The analog inputs support loop powered and self powered transmitters

## 3.4 Outputs

The PCC controller provides 2 outputs. Outputs are SSR type sourcing outputs capable of 15A continuous or 20A at max 10% duty cycle

The positive side of the load is connected to the output terminal on the controller. The negative side of the load connects to negative of the DC bus.

Inductive load transient suppression is built into each digital output point.

## 3.5 Digital Inputs

The PCC controller provides 2 digital inputs. The inputs are for use with dry contacts such as switches and relay contacts. The PCC controller can provide the source voltage for the contacts.

# 4 Maintenance

The PCC controller requires no maintenance.

If the PCC controller is not functioning correctly, contact SPEC Technical Support for information on returning the PCC controller for repair.

**Warning: Do not connect or disconnect any field wiring, including the wiring to the Com port, unless the power is off or the area is know to be non-hazardous.**

## 4.1 Fuses

A single 0.5 Amp fast-blow fuse protects the power supply. The fuse is mounted under the cover.

**CAUTION: Remove power before servicing unit.**

Always replace a defective fuse with a fuse of the same rating. Under no circumstances should a fuse be bypassed or replaced with a fuse of a higher rating.

**CAUTION: to maintain area rating use only porcelain or sand filled fuses**

In all cases investigate and correct the cause of the fuse failure before replacement. Common causes of fuse failure are power supply reverse polarity, incorrect polarity on inputs and excessive input voltages.

# 5 Specifications

## 5.1 General

| | |
|---|---|
| I/O Terminations | Pluggable terminal blocks.<br>12 to 22 AWG<br>15A contacts |
| Dimensions | 5.65 inch (144mm) wide<br>6.25 inch (158mm) high |
| Packaging | steel with black powder coat |
| Environment | 5% RH to 95% RH, non-condensing –40$^{o}$C to 60$^{o}$C |

5.3 Communications

| | |
|---|---|
| Communication Port COM | RS-485 serial port OR |
| Communication Port COM | RS-232 compatible serial port (CMOS) |
| Baud | 2400, 9600, 28800 Default: 9600 |
| Parity | even or odd |
| Word Length | 7 bit |
| Stop Bits | 1 bit |
| Isolation | Common ground return connected to Chassis Ground. |
| Cable Length | RS-232 –maximum 3 m<br>RS-485 –maximum 1200 m |
| Protocol | Modbus ASCII |

5.6 Analog Inputs

| | |
|---|---|
| Input Points | 2 - 4/20mA: |
| Accuracy | ±1% of full scale at 25$^{o}$C (77ºF) |
| Isolation | Analog common side connected to Chassis ground. |
| Response Time | 0.8 s typical for 10% to 90% signal change |

5.8 Digital Inputs/Outputs

| | |
|---|---|
| Output Rating | 15A maximum continuous<br>20A maximum @ 10% DC |
| Input Rating | Dry contact input. |

5.9 Approvals and Certifications

| | |
|---|---|
| Safety | Non-Incendive Electrical Equipment for Use in Class I, Division 2 Groups C and D T3 Hazardous Locations. |

6 Operation

Keypad operation

Programming notes:

The PCC controller supports several “hidden” functions. These functions can be accessed using the keypad while the controller display is in calibration.

<1 Calibrating >
<#GO *exit 1PRIME>

While the display is showing the above screen pressing one of the following keys will allow access to the described function:

**Calibration run time:** Depending upon the type of pump or the system=s operating pressure the calibration run time may have to be changed in order to get accurate sight glass readings.

For Pump 1, press the number 7 key while in the calibration mode screen for pump number 1. For pump 2, Press the number 8
In the change calibration time mode the display will show:

< CAL TIME=XX >
< Change=# *=exit >

To change the calibration time, press the # key and enter the new calibration time in 10ths of seconds e.g. 60 = 6 seconds, 100 = 10 seconds etc...

The calibration screen display will show:

<CAL TIME=XX >
<num then # >

Enter the new calibration time, and then press the # key.

**Digital input states:** The PCC controller comes with 2 digital inputs. The digital inputs can be set to monitor either a normally open (NO) or normally closed (NC) switch. Default condition is normally open.

Digital input 1 is configured to operate with an ESD loop or motor stop. Activation of the input will halt the program cycle. The program will begin again where it was halted once the condition is released.

Digital input 2 is configured to monitor the chemical tank level switch. Activation of the switch will set a flag in the Modbus register that can be remotely monitored by the PCC controller user interface or an RTU system.

To change the digital input configuration, press the 9 key while in the calibration mode screen. In the selectable digital input mode the display will show:

< KILL SWITCH=NO >
< #=change *=exit >

To change the digital input configuration press the # key to change from one state to the other. The change digital input configuration screen display will now shows the changed state:

<KILL SWITCH=NC >
<#=change *=exit >

**Number of pumps:** The PCC controller comes defaulted as a 2 pump controller. To change the number of pumps being operated press 4 on the keypad. The display will show:

<Number of Pumps 2 >
<#=change *=exit >

To change the numbers of pumps press the # key to change from 2 to 1. The display will change to indicate the number of pumps the PCC controller is configured to operate. To exit, press the * key

## Hidden command index

These functions can be accessed using the keypad while the PCC controller display is in calibration.

0 - No action
1 - PRIME PUMP
2 - set inverted NC logic for low tank switch 2, default is NO
3 - set device address, default is 191
4 - set 1 or 2 pumps, default is 2
5 - view cycle time pump 1
6 - view cycle time pump 2
7 - set calibration time pump 1, default is 3sec
8 - set calibration time pump 2, default is 3sec
9 - set inverted NC logic for stop switch 1, default is NO

Programming sequence

Note: Programming the PCC controller for 1 or 2 pump operation is identical; The 2 pump method is described in detail. If the PCC is configured for 1 pump operation follow the instructions and program 1 pump only.

6.1 Power up

6 .1.1 Display will briefly flash: < INIT LCD >

Then flash: <.....>
<INIT SYSTEM >

6.1.2 On power up the controller will show:
<1VD 1ON*CAL >
<2VD 2ON*CAL >

6.1.3 If this is a new start up, press the * key to select the calibration menu.

6.1.4 1 and / or 2 to start the controller with out initiating calibration.

6.2 Calibration

6 .2.1 Once you are in the calibration mode the screen will show:
<CALIBRATING >
<1= PUMP1 2=PUMP 2 >

6.2.2 Choose the pump you wish to calibrate by entering the number 1 to select pump number 1 or, enter the number 2 to select pump number 2.

6.2.3 The screen will now indicate the pump you have selected to calibrate and will display two options, the screen will show (assume you have selected pump 1).
< 1 Calibrating >
< #=pump *=Vol/Day >

6.2.3 To start the calibration mode sequence for the pump selected enter # (Proceed to step 6.2.5)

6.2.4 If you feel there is no need to run a calibration but wish to change the volume per day you want the pump to inject , enter * (proceed to step 6.3.1)

6.2.5 In the calibration mode for the pump you have selected the display will show:

<1 Calibrating >
<#GO *exit 1PRIME>

To begin calibration, press the # key.
To return to the pump selection screen, press the * key.
To prime the system, press the number 1 key to start the pump.
Press the number 1 key again to stop the pump from priming.
Pressing the # key begins the pump calibration run and the cal period timer will begin to count down (the default is 3 seconds). The keypad is deactivated for the duration of the calibration run.

6.2.6. When the calibration has been successfully run, the display will prompt:

<1 Run OK? >
<#=yes *=bad >

Pressing the # key will take you to the calibrated volume screen. Pressing the * key will take you back to the calibration mode screen.

6.2.7 Next enter the calibrated volume for the selected pump (this is the volume of fluid that was pumped from the sight glass during the calibration pump run). The display will show:

< 1Enter VOLUME >
< then # >

6.2.8 After entering the calibrated volume the display will prompt to confirm the calibration value. If it is correct, press the # key. If it needs to be changed, press the * key.

6.3 Determining Cycle Time

6.3.1 After the calibration value for the selected pump has been entered the display will prompt for the required volume per day that is required to be pumped.
The display will show:

<1Enter VOL/DAY >
<then # >

6.3.2 Use the keypad to enter the required volume per day required from the selected pump, and then press the # key.
The display will prompt to confirm the value.
If it is correct, press the # key. If it needs to be changed, press the * key and try again.

6.3.3 You have now finished setting up calibrating and entering the required pumping volume for pump 1, the screen will show:

<1VD 0 1ON *CAL >
<2VD 0 2ON *CAL >

6.4 Calibrating Pump 2

6.4.1 Enter * to exit the start screen and re-enter the calibration sequence.

6.4.2 To begin the calibration sequence again to calibrate pump 2, enter the number 2. Repeat the sequence (steps 2.1 -.3.3) for calibrating pump number 2.

6.5 Running

6.5.1 Once the calibration and daily volume have been entered for both pumps the display will show the run start screen:

<1VD 0 1ON *CAL >
<2VD 0 2ON *CAL >

6.5.2 Press the number 1 to start pump number 1, or, press the number 2 key to start pump number 2. If there is a mistake in any entered value, press the * key to return to calibration.

6.6 Power Saver Feature

With the software-running the display will time out and shut off after a period of 5 minutes with no keypad inputs.
Press any key to turn on the display.

6.7 The Pumping Cycle

The pumps duty cycle is automatically calculated in the software and is based upon the daily volume required versus the calibrated pumping volume. The processor will determine the total Aon@ time in seconds per cycle required to meet the daily volume requirement previously entered. Depending on the ratio of daily : calibrated volume, cycles can be calculated by the PCC controller from as low as 1 minute up to 30 minutes to ensure accurate injection volumes.

7 PC User Interface operation

The SPEC GUI user interface is used to facilitate remote operation and monitoring of the PCC controller and Chemical injection pumps.

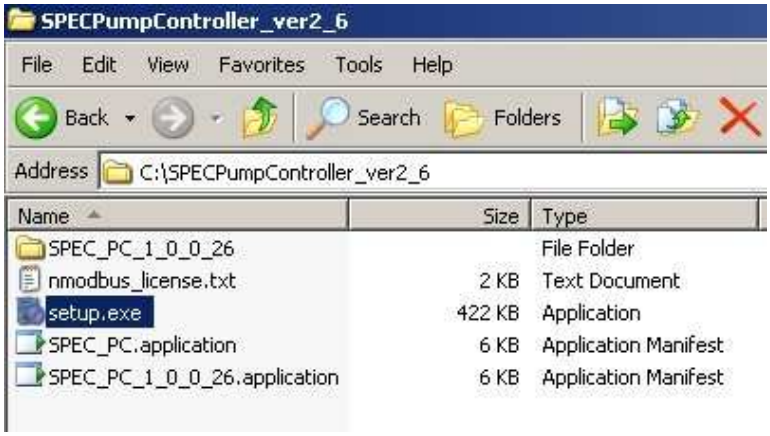
Initial set up and calibration must be done manually via the keypad interface, as local reading of the sight glass is necessary.

7.1 System requirements

Windows XP, Windows Vista. The latest .NET updates (Software will prompt to download from the internet if not already installed). A free Serial Port and Serial cable.

7.1.2 Software installation.

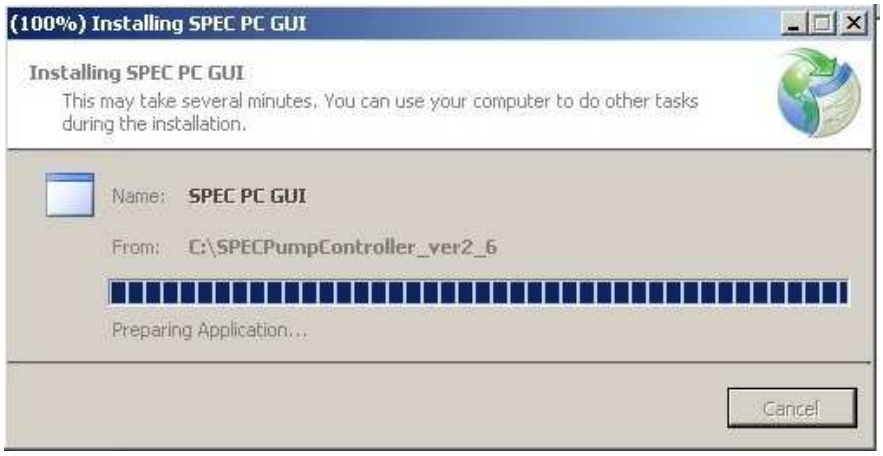
From a CD or a local directory containing the installation files:
Double click on the file **Setup.exe**
Note: Do not attempt to install the software from a network drive, as it will fail.




The setup program will attempt to verify that the target computer has all necessary system files; this may take up to one minute depending on the speed of the target computer.

Once the setup program has found the necessary resources, it will prompt the user to install. Click Install to install the software.  If the required .NET software is not installed on the target computer, the setup software will prompt to install from the internet or a local directory


The software will install on the target pc.



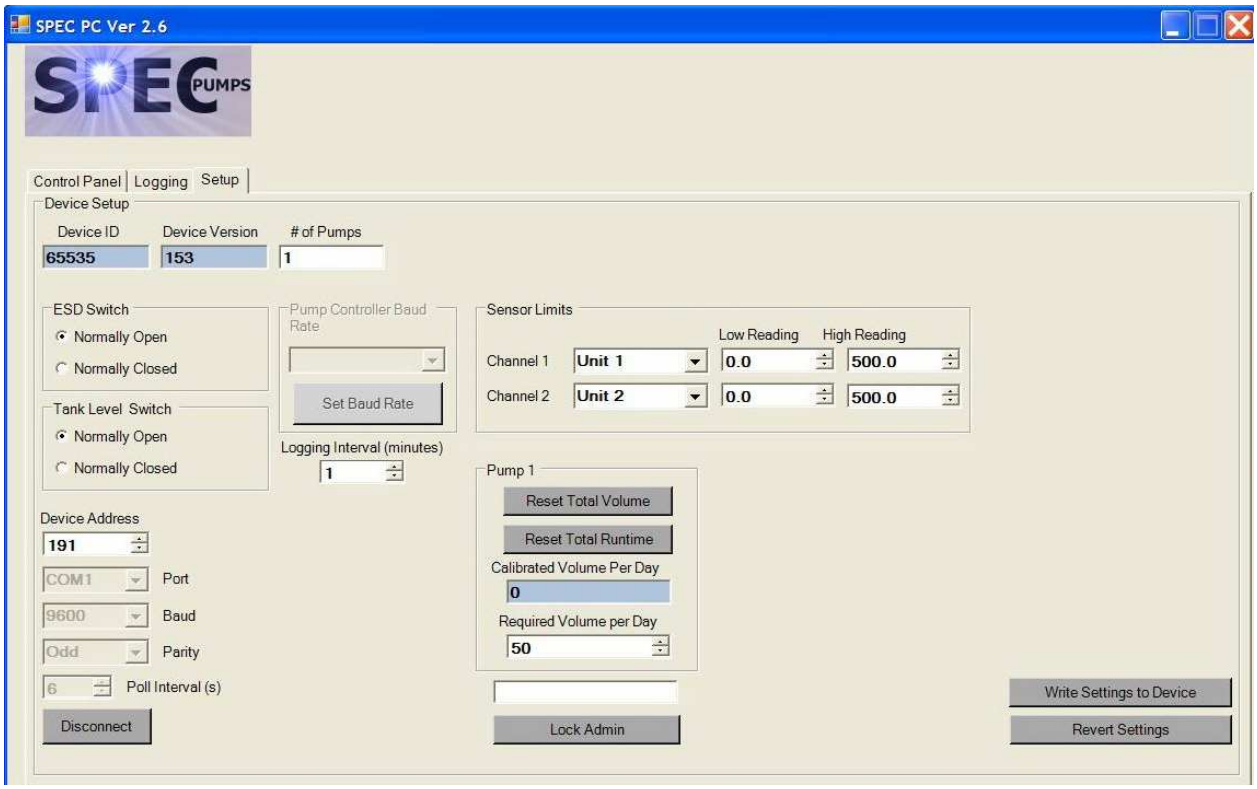

Once the software has installed, the program will automatically load as shown.

(See: 7.2.1)

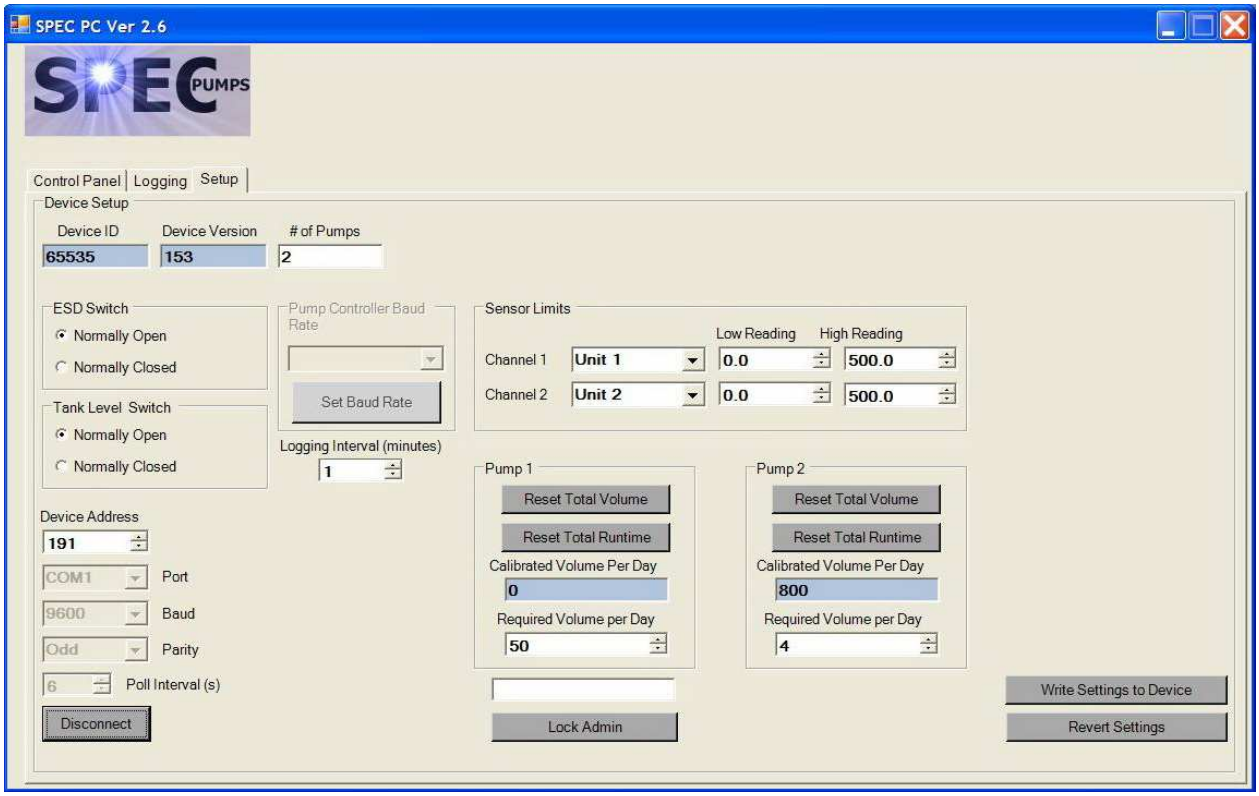
## 7.2 Operation

When the user interface program is opened the user has access to 3 tabbed windows, the windows give access to all programming options except for calibration. The software uses a standard windows interface. The software opens by default in the Control Panel. To begin using the interface, click on the Setup tab to connect to and configure the PCC controller.

### 7.2.1 Setup screen



Setup screen 1 pump



Setup screen 2 pumps

To begin the PCC controller must be wired into the balance of the control system. The PCC controller must have power supplied and be connected to the PC with a properly configured serial cable. (See 9.3.1 COM to PC (DTE))

To connect with the PCC controller ensure the **Port** is selected to match the com port on the PC. The **Baud** rate selected matches the baud rate of the PCC controller, default is 9600. **Parity** bit is correctly set for your system, default is ODD.

The PCC controller should already have been calibrated to the well via the keypad. The keypad entered settings are displayed in the Pump1 and Pump 2 sub windows. The calibrated volumes per day are displayed, but are not adjustable in the interface. If they need to be changed it is necessary to recalibrate manually.

Click on “CONNECT” to connect to the PCC controller. When the **CONNECT** button changes to **Disconnect** the system is communicating.

User changeable fields are indicated by boxes with white backgrounds and black lettering; read only fields are characterized by blue backgrounds. Changes to any field takes place after clicking the Write Settings to Device button. If incorrect information has been written to the PCC controller clicking Revert to Previous Settings will reset all settings.

Settings and controls

Device ID: 0 to 65535 default: 65535

Device Version: Read only, displays software revision of PCC controller

# of Pumps: Read from PCC upon connection, to change, unlock Admin, highlight the number in the text box and enter a new number (1 or 2). Note. Changing the number of pumps will change the look of the window (see above images). Changing a 2 pump system to a one pump system will disable pump 2, even on an operating system.

Logging interval: Sets the interval at which logging elements are recorded to the PCC controller. 1-100 min.

ESD Switch: (Din 1) set type of switch being used Normally Open or Normally Closed

Tank Level Switch: (Din 2) set type of Tank switch being used Normally Open or Normally Closed

Device Address: Set device address range 1-242 default: 191

Port: Match to Com port used by PC, default: COM 1

Baud: set desired baud rate, default: 9600

Parity: set desired parity bit, default: ODD

Poll Interval: Sets frequency of polling of the PCC

Sensor Limits: Channel 1 is associated with AN1 input, Channel 2 with AN2 input. These inputs will monitor a 4-20mA transducer. Enter the converted value of the transducer in the Low Reading and High Reading dialog boxes. See the transducer specs to find these values. EG: pressure transducer has an output of 4-20mA, and a range of 0-500kPa, 0 (kPa) is entered as the Low Reading, 500 (kPa) is entered as the High Reading. Once thresholds are set they are saved to the PCC controller.

Unlock Admin: Unlocks access to the following: (default password: spec555)

Pump 1, Pump2 sub windows

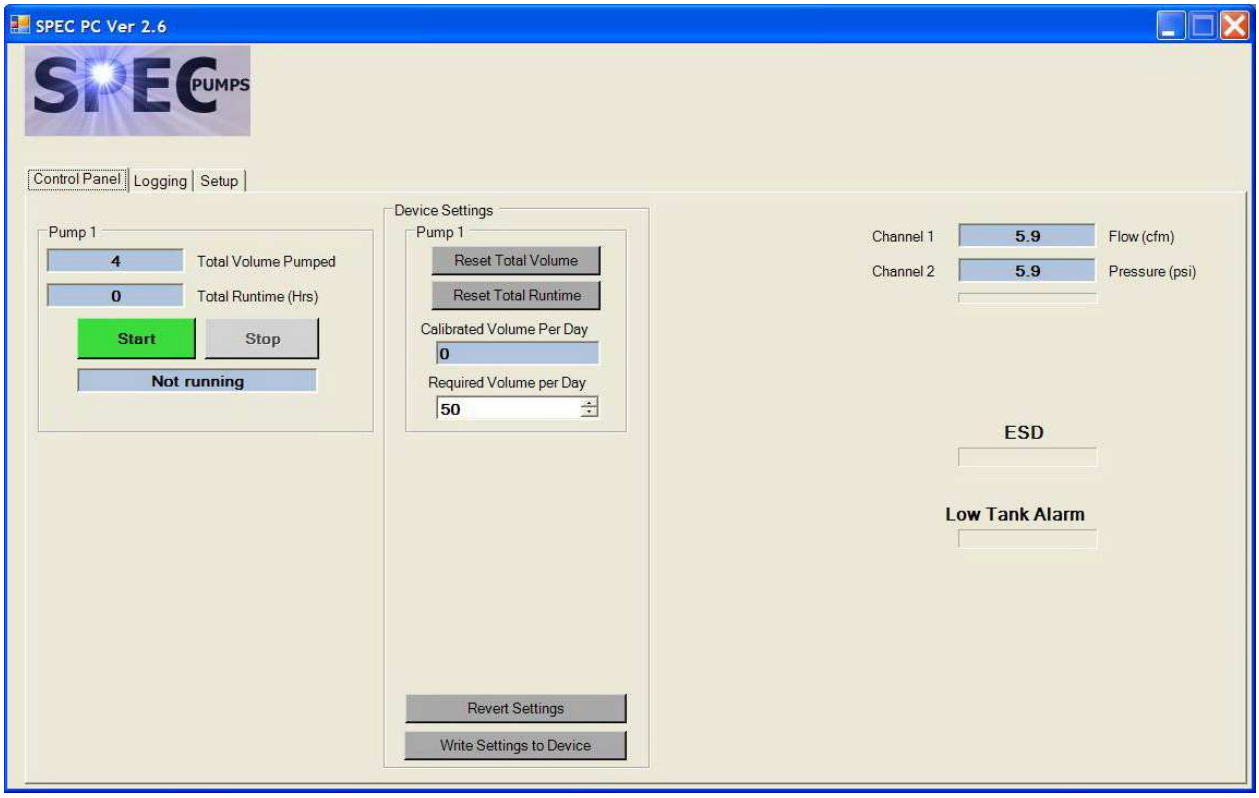
Reset Total Volume: Resets the totalized total pumped volume value displayed on the Control panel.

Reset Total Runtime: Resets the totalized total runtime value displayed on the Control panel

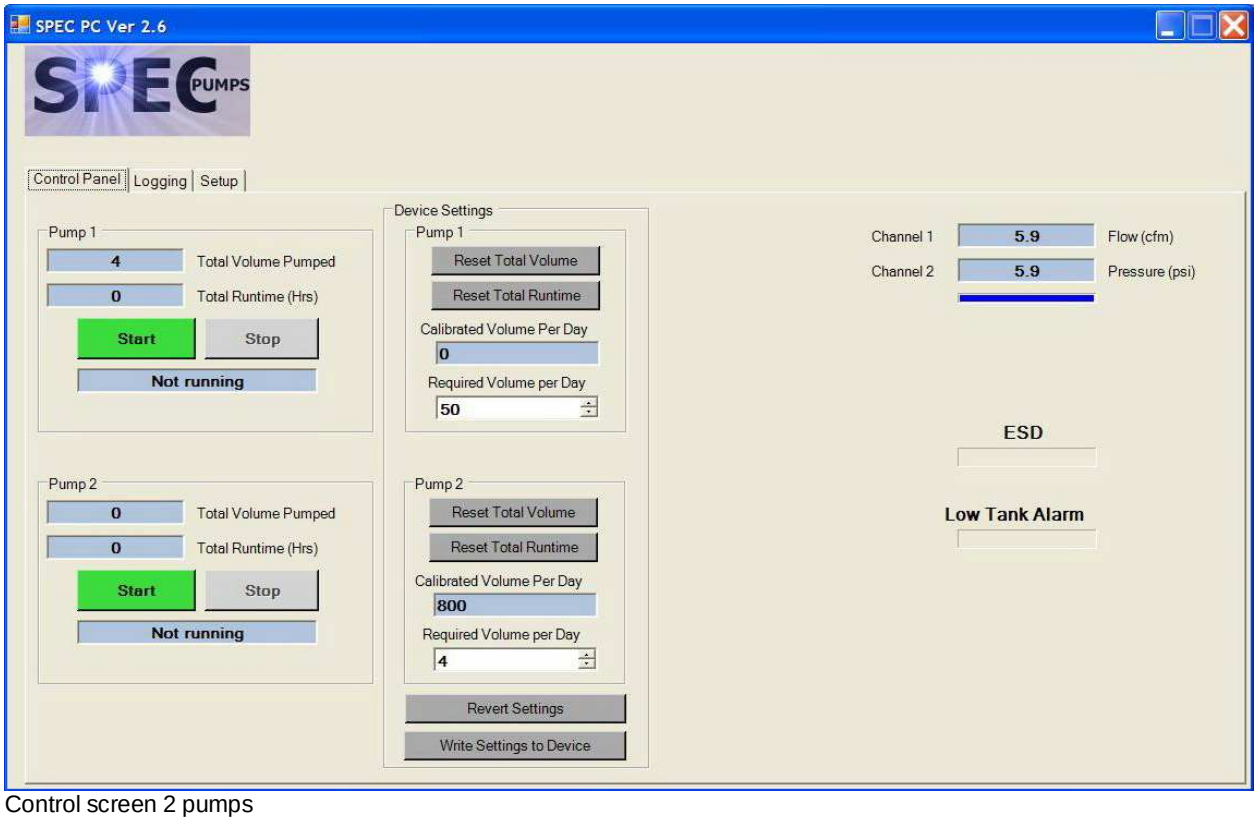
Calibrated Volume per Day: Read only, displays the calculated volume the pump is capable of pumping in 24 hours

Required Volume per Day: Displays the volume of chemical set by the operator. This can be changed at anytime. To change, highlight the number in the text box and over write with the new value, then click the Write Settings to Device button.

### 7.2.2 Control Panel




Control screen 1 pump



Control screen 2 pumps

On start up the interface will launch into the control panel. The control panel tab is used to remotely start and stop the chemical injection pump(s). Other functions associated with the control panel tab are:

. Display current values of well flow and pressure
. Display state of tank level and ESD switches
. Display current calibrated volume of pump(s)
. Display and change required volume per day of pump(s)
. Display current pump operation, running or stopped
. Display and reset of pumped volume and run time totals (when admin is unlocked)

<u>Control panel operation</u>

To start pumps click on the “START” button for the associated pump the not running display below the buttons will change form “Not Running” to “Running”.

To stop pumps click on the “STOP” button for the associated pump the “Running” display below the buttons will change form “Running” to “Not Running”.

Pump 1, Pump2 sub windows

Reset Total Volume: Resets the totalized total pumped volume value displayed on the Control panel.

Reset Total Runtime: Resets the totalized total runtime value displayed on the Control panel

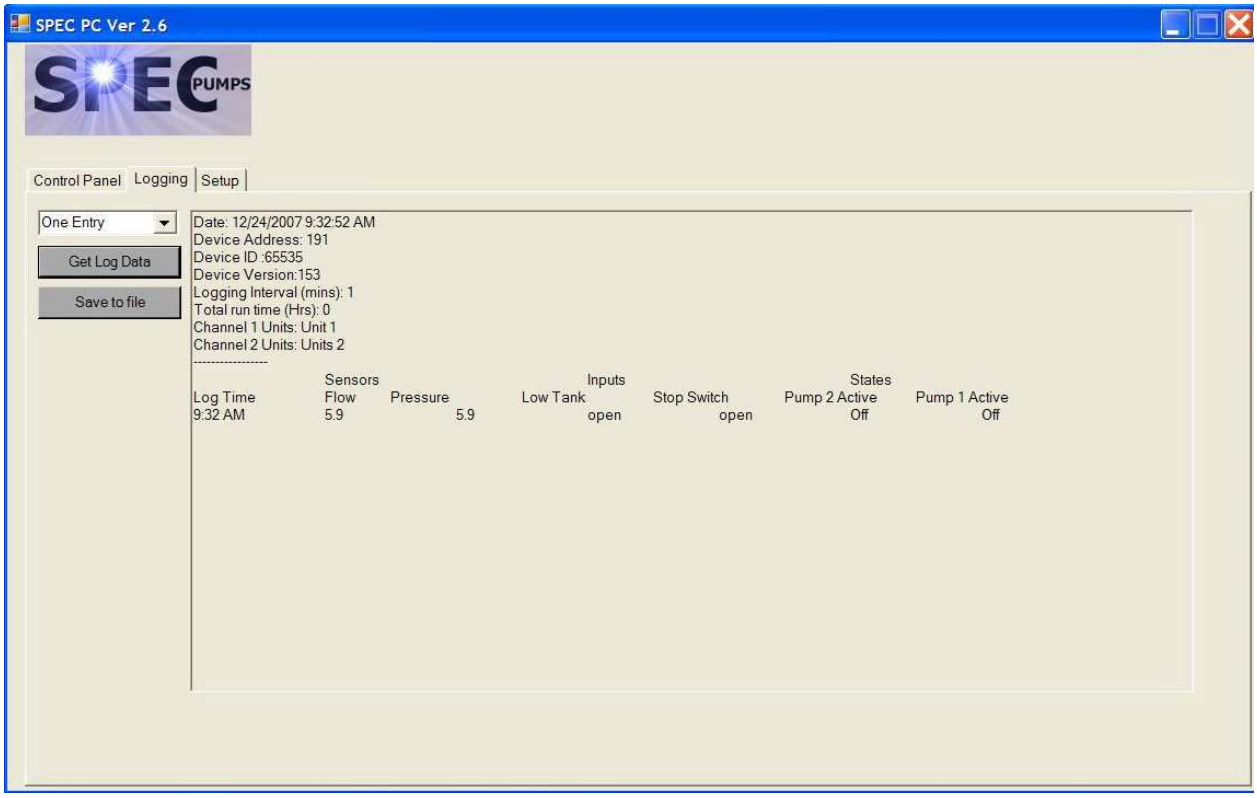
Calibrated Volume per Day: Read only, displays the calculated volume the pump is capable of pumping in 24 hours

Required Volume per Day: Displays the volume of chemical set by the operator. This can be changed at anytime. To change, highlight the number in the text box and over write with the new value, then click the Write Settings to Device button.

ESD Alarm: Displays a red bar when the ESD (Din 1) is active.

Low Tank Level Alarm: Displays a red bar when the Low tank switch (Din 2) is active.

7.2.3 Logging



Logging screen

To access the PCC controller log file click on the Logging tab. The PCC controller records a log of the state of the connected inputs as well as the operating state. Max number of logs stored 16255. Logging can be set to occur from 1 to 100 minute intervals.

Saving logged data

Select via the drop down table the number of logs you wish to access: One Entry, One Hour, One Day or All. Click Get Log Data, the user interface will retrieve the log that you have requested. To save the log Click Save to File. Follow your PC prompts to save. The log will save as a CSV file, which can be stored and used with Excel or Xls formats.

Data points logged

| Data point | Label | return | |
|---|---|---|---|
| An 1 | Flow (default) | value | |
| An 2 | Pressure (default) | value | |
| Din 1 | ESD | Off | On |
| Din 2 | Tank Level | Off | On |
| Out 1 | Pump 1 | Off | On |
| Out 2 | Pump 2 | Off | On |
| | | | |

Sample of saved data log (opened using Excel)

| | |
|---|---|
| Date: | 12/10/2007 15:12 |
| Device Address: | 191 |
| Device ID: | 65535 |
| Device Version: | 150 |
| Logging Interval: | 36000 |
| Total run time: | 6 |
| Total volume pumped: | 3 |
| Flow High Threshold: | 1000 |
| Flow Low Threshold: | 0 |
| Pressure High Threshold: | 1000 |
| Pressure Low Threshold: | 0 |

| | Sensors | | Inputs | | States | |
|---|---|---|---|---|---|---|
| Log Time | Flow | Pressure | Low Tank | Stop Switch | Pump 2 Active | Pump 1 Active |
| 3:13 PM | 0 | 0 | Off | Off | Off | Off |

## 8 Pump models # P-075-M1/8-1750-12, P-075-M1/8-1750-12-SS

8.1 Pump Specs

Type -Dual head reciprocating piston
Voltage - 12 VDC
FLA - 14
Maximum static pressure - 3000 PSI
Maximum operating pressure - 2500 PSI
Pumping capacity - max 1500 liters / day
Class 1 div 1, Group D, T2D

### 8.2 Installation instructions

Location of pump

We recommend that you locate the pump as close to the controller / battery enclosure as possible while still observing the area classification as dictated by section 18 of the Canadian Electrical Code and any local code requirements. It is important to remember that the pump assembly is certified Class 1 Div 1 group D while the MAPPS controller / battery enclosure is certified Class 1 Div 2.
It is necessary to keep the distance between the pump motor and the batteries as short as possible (maximum 20=) to limit the line losses and maximize the pumps output as this is a 12 Volt DC powered system.

The pump is gravity fed design and must therefore be located below the fluid reservoir from which it draws.

Tubing Connections

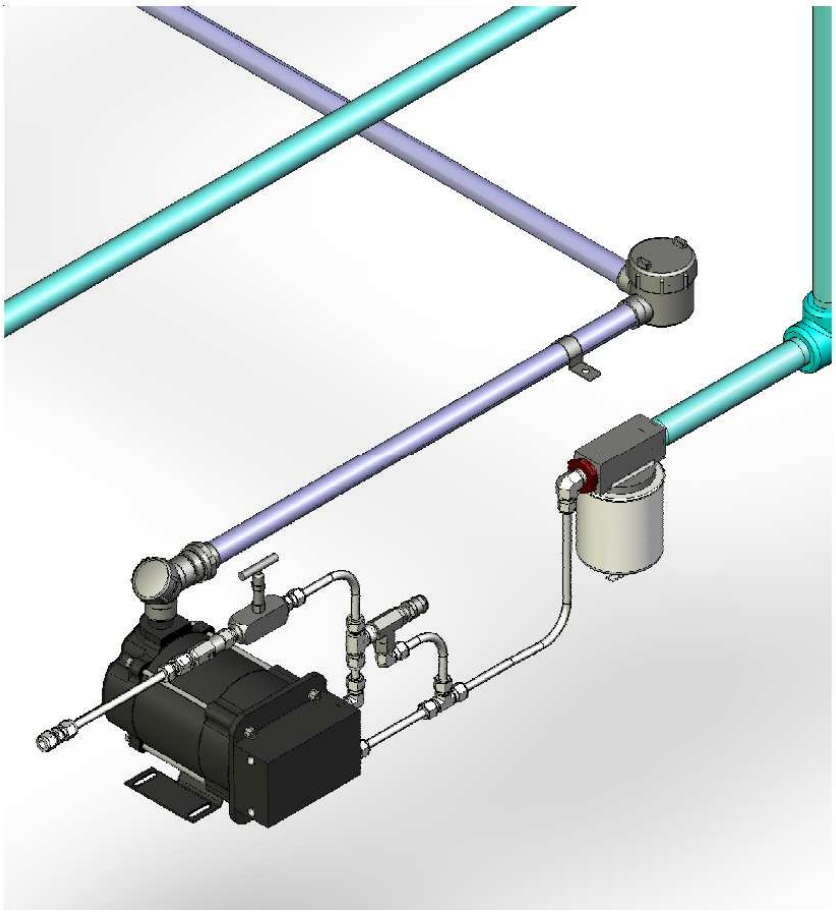
There are two manifolds on the pump, one for suction and one for discharge. Each manifold is common to both the opposing pump heads. There is one threaded entry at each end of both the suction and the discharge manifolds to allow for installation flexibility in the field.
The discharge manifold and its entries are always located at the top of the pump head and the suction manifold and its entries are located at the bottom.

Suction line

The intake or suction connection is identified by a small AS@ stamped into the metal next to the 1/4@ threaded entries on the suction manifold. The entries come from the factory with stainless steel plugs installed. Remove the plug from the desired Asuction@ entry and connect the suction line. It is strongly recommended that the suction line have an appropriate Amedium@ filter installed directly ahead of the pump entry to ensure that particulate does not enter into the pump head and plug up the internal wafer style poppet valves.

Discharge line

The discharge connection is identified by a small AD@ stamped into the metal next to the plugged 1/4@ threaded entries on the discharge manifold. Again, remove the plug from the desired Adischarge@ entry and connect the discharge line.
The discharge line installation should always include a PSV and recycle loop to insure discharge pressure is limited to a safe level for the installation. We also recommend an in line check valve be placed in the discharge line as close to the pump head as possible to eliminate leak back and maximize pump efficiency



Electrical Connections

The pump is a 12 Volt Direct Current machine.
Polarity of the connections is critical for proper functioning of the pump.
Do not run the pump with reversed polarity as significant damage can occur to the piston bearing assembly.

The leads are clearly marked for polarity.
+ Is to be connected to the out + side of the controller load terminals.
- Is to be connected to the DC negative bus.

The motor feeders should be properly fused for protection as per the Canadian Electrical Code.

Priming the pump

The pump is designed to be self-priming and should not require special attention to achieve priming. If you do encounter difficulty, you can remove the plug opposite the suction entry that you are using and allow the medium to flow from the suction manifold until the fluid stream is solid.
Reinstall the plug to stop the flow and the pump should now be easily primed by simply running the pump.

Minimum instrumentation tubing and accessory requirements for proper operation of the pump are:

1) A suitable medium filter placed in the feed line after the sight glass and tank in front of and as close as possible to the suction (intake) port of the pump.
2) A pressure safety valve (PSV) positioned in the discharge line as close as possible to the discharge port of the pump configured so that the discharge line pressure can be safely released back into the suction line in the event of a PSV valve release.
3) A check valve placed in the discharge line as close as possible to the discharge port of the pump.

Typical layout for the electrical feed to pump must incorporate:

1) A CSA Class 1 div 1 electrical fitting approved for terminations to connect the motor and conduit feed system. The motor is factory sealed and employs an ： inch rigid nipple for connection to the fitting.

2) A CSA Class1 div 1 approved flexible conduit or HL approved Teck cable must be installed to allow for vibration as per the applicable codes.

**Routine Maintenance and repair**

Spec pumps are designed for years of reliable service with an absolute minimum of maintenance. All maintenance must be carried out by qualified technicians.

Monthly maintenance check

1) Piston plunger bearing inspection.
- Remove the 4 allen screws that retain the pump nameplate.
- Inspect the piston plunger cavity for debris and remove any foreign objects or debris.
- Apply a small amount of grease to the reservoir pad.
- Reinstall the pump nameplate

2) Pump motor wear check.
- At initial installation use a clamp-on amp meter to read normal motor current draw for the individual installation. Record this measurement.
- During routine maintenance re-check the motor current draw. Readings should be within 10% of recorded measurements unless operating conditions have changed. If the motor current draw rises significantly have the motor inspected by qualified personnel.

Parts Replacement or Rebuild

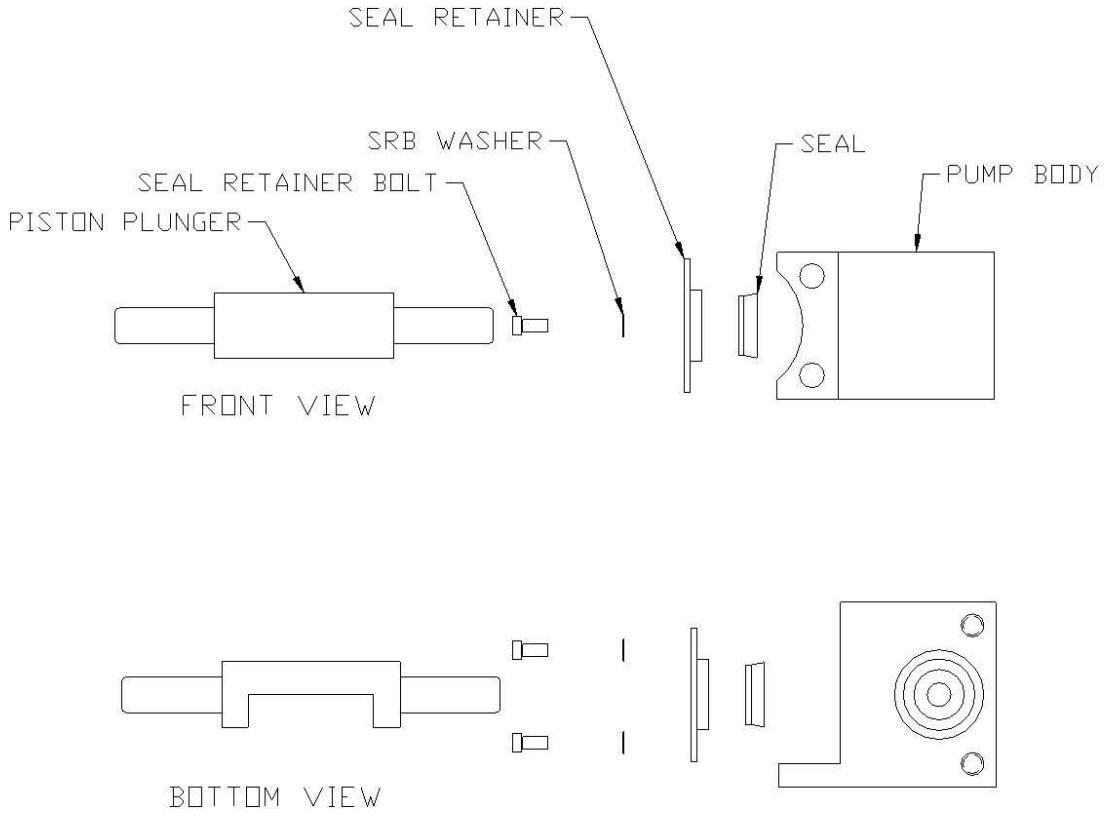
The only wear parts in the pump are the Seals and O-rings. Replacement kits are available from SPEC.
This type of maintenance MUST be done in a clean environment.
The following drawings show an expanded view of the pump assembly.
To replace O-rings and seals:

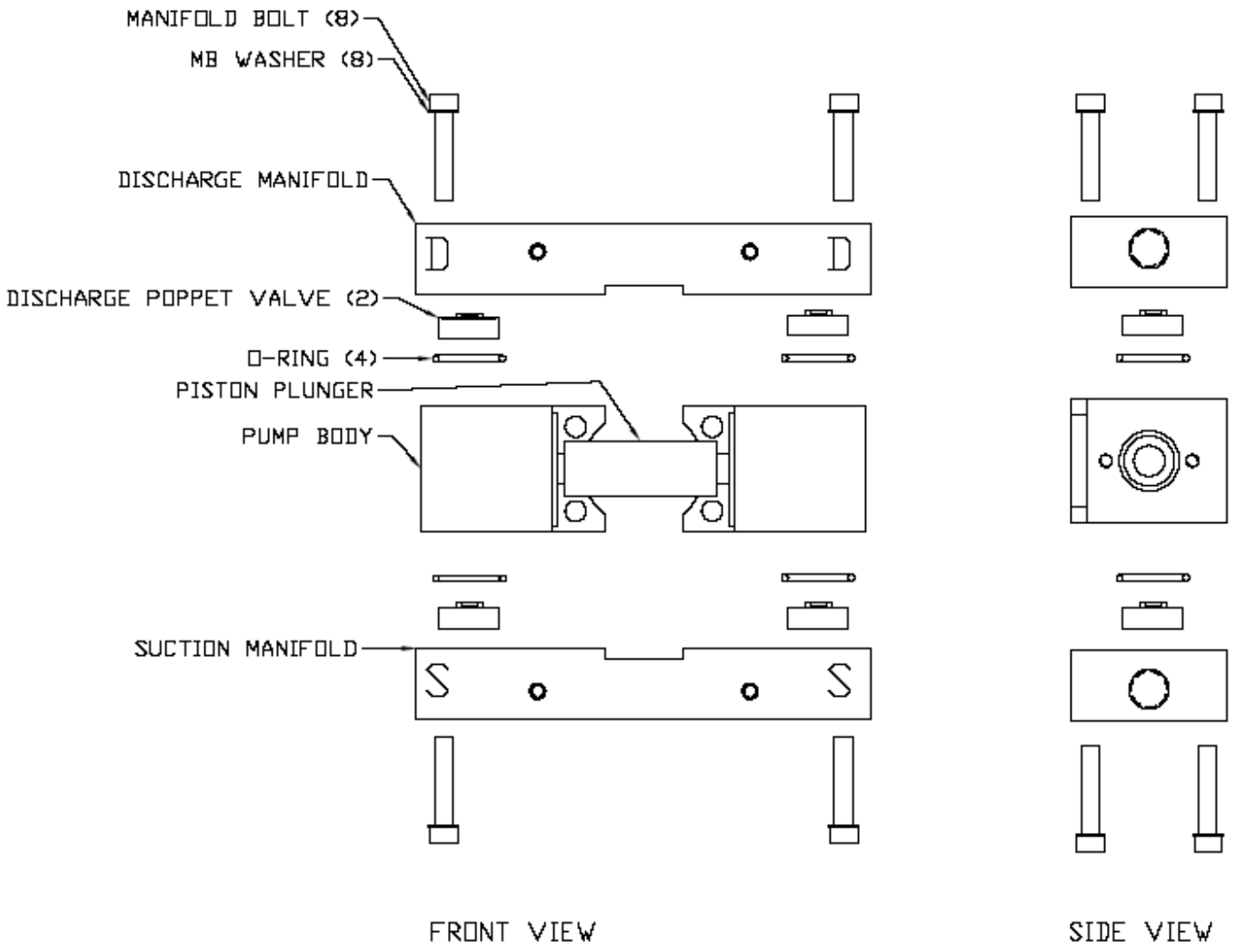
Disconnect all electrical connections before servicing.
- remove pump head from pump motor
- disassemble as per drawings.

O-rings:
Discard old o-rings, new o-rings slip into the recesses provided in the pump body

Seals:
Carefully remove old seals ensuring you do not scratch or mark the seal seats.
Insert new seals into the provided SPEC seal insertion tool and press into place.
** DO NOT ATTEMPT TO INSTALL NEW
SEALS WITHOUT A SPEC SEAL INSERTION TOOL **.

Re-assembly:
Once the new o-rings and or seals have been properly installed, install the pump valves ensuring proper orientation. Align the suction and discharge manifolds with the valves and pump body. Use a large C clamp to press together and align the manifolds with the pump bodies. Install and tighten all 8 manifold bolts. Tighten to 140 in-lbs. Remove clamp and reattach the pump head to the pump motor.




MANIFOLD BOLT (8)
MB WASHER (8)
DISCHARGE MANIFOLD
DISCHARGE POPPET VALVE (2)
O-RING (4)
PISTON PLUNGER
PUMP BODY
SUCTION MANIFOLD
D
D
S
S
FRONT VIEW
SIDE VIEW

# 9 Serial Communications

## 9.1 COM1 RS-232 Serial Port

Serial port COM on the PCC controller is configured as a two wire RS-485 serial communication port and a RS-232 serial communication port. The port can be used for either standard at one time. Do not attempt to use COM for both RS-232 and RS-485.

The following table shows the serial and protocol communication parameters supported by COM.

| Parameter | Supported Values |
|---|---|
| Baud Rate | 2400, 9600, 28800 Default: 9600 |
| Duplex | Half Duplex |
| Parity | Odd, Even Default: Odd |
| Data Bits | 7 Bits |
| Stop Bits | 1 |
| Receive Flow Control | Modbus ASCII |
| Transmit Flow Control | None |
| Device ID | 1 to 65534 Default: 65534 |
| Protocol | Modbus ASCII |
| Modbus Address | 1 to 242 default:191 |

Connections to COM1 are made through a 3 pin pluggable connector. COM supports RxD and TxD plus Ground. The following table provides a description of the function of each pin of the pluggable connector. Max cable length for serial or RS-232 operation is 3 meters.

RS232

| Pin | Function | Description |
|---|---|---|
| 1 | ground | |
| 2 | Tx | to host |
| 3 | Rx | from host |

RS-485

| Pin | Function | Description |
|---|---|---|
| 1 | ground | |
| 2 | D+ | |
| 3 | D- | |

## 9.2 RS-232 Cables

### 9.2.1 COM to PC (DTE)

This cable is used to connect from COM RS-232 port on the PCC controller to D9 connector on a PC serial port.

| COM | PCC controller | PC serial port | D9S |
|---|---|---|---|
| 1 | gnd | NC | 1 |
| 2 | TxD | RxD | 2 |
| 3 | RxD | TxD | 3 |
| | | NC | 4 |
| | | gnd | 5 |
| | | NC | 6 |
| | | NC | 7 |
| | | 8,9 NC | |

### 9.2.2 COM to DE-9P DCE

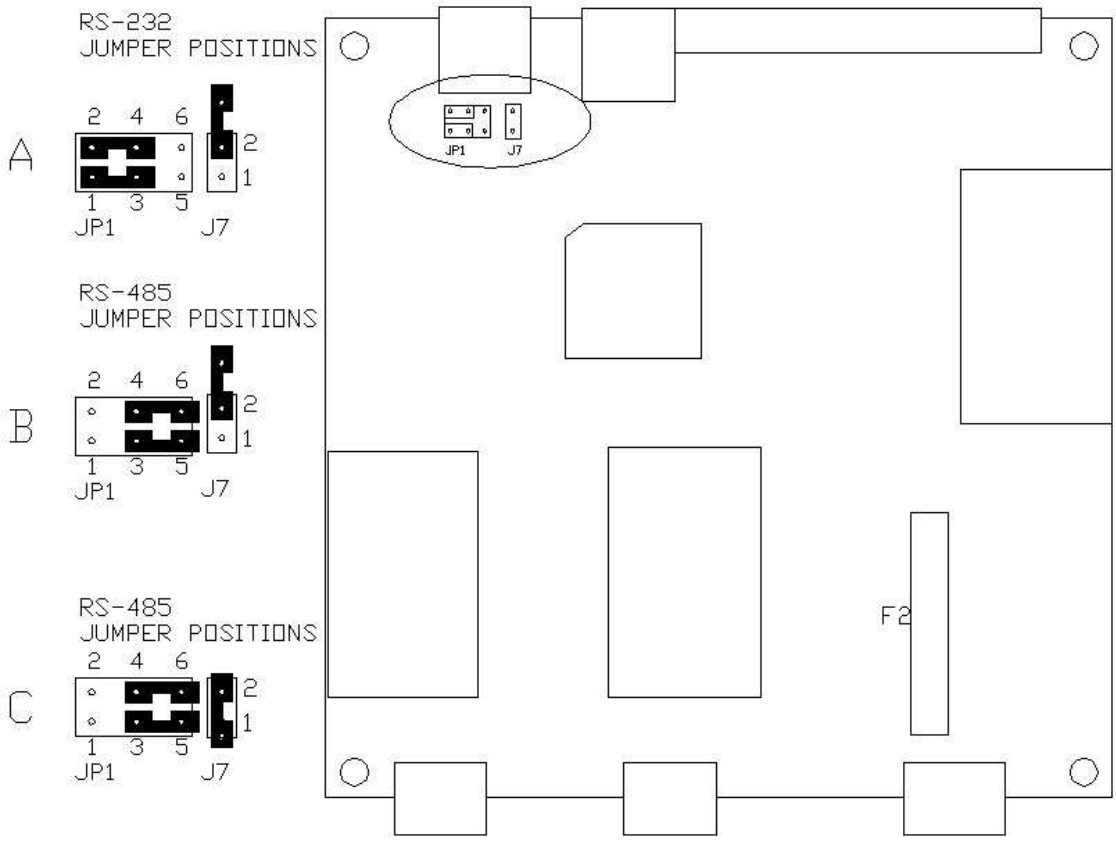
This cable is used to connect from COM RS-232 port on the PCC controller to DE-9S connector on a DCE such as a modem.

| COM | PCC to DCE Function | DB-9S DCE Function | DE-9P |
|---|---|---|---|
| Shield connects to shell | | | |
| 1 | gnd | NC | 1 |
| 2 | TxD | RxD | 3 |
| 3 | RxD | TxD | 2 |
| | | NC | 4 |
| | | gnd | 5 |
| | | NC | 6 |
| | | NC | 7 |
| | | NC | 8,9 |

9.3 RS-485 Serial Communication Port

Serial port COM on the PCC controller is configured as a two wire RS-485 serial communication port and a RS-232 serial communication port default is RS-232. The port can be used for either standard at one time. Do not attempt to use COM for both RS-232 and RS-485 at the same time.

**Figure 3: PCC jumper configuration (RS-232, 485 selections)**




9.4 Configure COM port

Disconnect power source. Remove the 4 screws holding keypad and cover to base. Disconnect the cable connecting the display module to the processor. Set aside display module. Move Jumpers to the positions indicated in Figure 3. Reconnect display module cable and replace cover on base with the screws.

9.5 COM to RS-485

This cable is used to connect from COM configured for RS-485, PCC controller to network.

| com | RS-485 network |
|---|---|
| 1 | gnd |
| 2 | D+ |
| 3 | D- |

9.6 RS-485 termination

J7 in Figure 2 is only used for RS-485 termination. If the PCC controller is to be the end device on a RS-485 network place J7 as shown in Figure 3 “C”.

10 Modbus registers

**Pump controller GUI**
**(Device is address 191, 0xBF**)
(ASCII Modbus, 9600 baud, 7 bit, Odd parity ,1 stop)

10.1

Modbus register set (16 bit registers except as noted)

0x reference - r/w outputs (8 bit)
00001 - bit0 pump1, bit1 pump2 (don't write, use register 51 to start)

1x reference - read discrete inputs (16 bit, low 8 bits valid)
00001 - bit0 sw1 inhibit (stop), bit1 sw2 low tank
- open switch reads as 1
- logic is inverted by (4x reg 46)
- ie if reg 46=1(NO stop) stop if sw1 closed
- ie if reg 46=0(NC stop) stop if sw1 open
- ie if reg 46=2(NO low tank), low if sw2 closed
- ie if reg 46=0(NC low tank) low if sw2 open

3x reference - read inputs (16 bit, low 8 bits valid)
00001 - analog 1 - flow 4-20 mA
00002 - analog 2 - pressure 4-20 mA

00009 - analog 1 - 32 bit float scaled by regs 65,66 and 81,82
00011 - analog 2 - 32 bit float scaled by regs 67,68 and 83,84

4x reference - r/w registers 16 bit (most r/w 2 bytes to nvram)
00001 - version (8 bit)
00002 - threshold low ana 1 (8 bit)
00003 - threshold low ana 2 (8 bit)
00004 - threshold low ana 3 (8 bit) not used
00005 - threshold low ana 4 (8 bit) not used
00006 - threshold low ana 5 (8 bit) not used
00007 - threshold low ana 6 (8 bit) not used
00008 - threshold low ana 7 (8 bit) not used
00009 - threshold low ana 8 (8 bit) not used
00010 - threshold high ana 1 (8 bit)
00011 - threshold high ana 2 (8 bit)
00012 - threshold high ana 3 (8 bit) not used
00013 - threshold high ana 4 (8 bit) not used
00014 - threshold high ana 5 (8 bit) not used
00015 - threshold high ana 6 (8 bit) not used
00016 - threshold high ana 7 (8 bit) not used
00017 - threshold high ana 8 (8 bit) not used
00018 - threshold low alarm enable 1 bit per chan (8 bit)
bit0 enables analog 1 when low to generate an alarm etc.
00019 - threshold high alarm enable 1 bit per chan (8 bit)
bit0 enables analog 1 when high to generate an alarm etc.
00020 - threshold low flags(non writable)(not from nvram) (8 bit)
bit0 indicates analog 1 below threshold etc.

00021 - threshold high flags(non writable)(not from nvram) (8 bit)
bit0 indicates analog 1 above threshold etc.
00022 - alarm (writeable to clear, not from nvram) (8 bit)
bit7= bit6= bit5= bit4=
bit3= bit2= bit1=tank low bit0=analog
00023 - alarm enables (8 bit) (default 00110001)
00024 - log timing (16 bit) in 100 msec ticks max timing is 109 min
00025 - current log address (16bit) each 4 registers (8 bytes) is data
for 1 min in time (logtime). counts up and wraps after 16384
00026 - volume/min, pump 1 (read only)
00027 - volume/min, pump 2 (read only)
00028 - not used
00029 - not used
00030 - not used
00031 - not used
00032 - shutdown switch active (active=1 regardless of logic)
00033 - low tank switch active (active=1 regardless of logic)
00034 - calibration time, pump 1 (100msec ticks)(default 50=5 sec)
00035 - calibration time, pump 2 (100msec ticks)(default 50=5 sec)
00036 - not used
00037 - not used
00038 - cycle time, pump 1 - low rate (100 msec ticks)(read only)
00039 - cycle time, pump 2 - low rate (100 msec ticks)(read only)
00040 - cycle time, pump 1 - high rate (100 msec ticks)(read only)
00041 - cycle time, pump 2 - high rate (100 msec ticks)(read only)
00042 - cumulative run time, pump 1
00043 - cumulative run time, pump 2
00044 - cumulative volume, pump 1
00045 - cumulative volume, pump 2
00046 - switch logic// bit 0 1=+ logic (NO) 0=- logic (NC) for stop
// bit 1 1=+ logic (NO) 0=- logic (NC) for low tank
// switches read 1= open, 0=closed
00047 - baud rate 0=2400, 1=9600, 2=28800,
00048 - parity 0=even, 1=odd (no parity is not permitted)
00049 - modbus type 0=ascii, 1=rtu (rtu not supported)
00050 - device address (1-242, change at your own peril)
00051 - run status bit0=1 pump 1 running, bit1=1 pump2 running
00052 - number of pumps, 0=1 pump, 1=2 pump
00053 – Not implemented
00054 - NOT IMPLEMENTED
00055 - startup state, bit 0- 0=start off, 1=start in last state
bit 7- 0=display off 1=display active (READ ONLY)
00056 - device id (0-65535)
00057 - chan 1, units code
00058 - chan 2, units code
00059 - chan 3, units code

00060 - chan 4, units code
00061 - chan 5, units code
00062 - chan 6, units code
00063 - chan 7, units code
00064 - chan 8, units code

start of 32 bit float registers as pairs of 16 bit regs

00065 - chan 1, conversion m float
00066 - chan 1, conversion m
00067 - chan 2, conversion m float
00068 - chan 2, conversion m
00069 - chan 3, conversion m float
00070 - chan 3, conversion m
00071 - chan 4, conversion m float
00072 - chan 4, conversion m
00073 - chan 5, conversion m float
00074 - chan 5, conversion m
00075 - chan 6, conversion m float
00076 - chan 6, conversion m
00077 - chan 7, conversion m float
00078 - chan 7, conversion m
00079 - chan 8, conversion m float
00080 - chan 8, conversion m
00081 - chan 1, conversion b float
00082 - chan 1, conversion b
00083 - chan 2, conversion b float
00084 - chan 2, conversion b
00085 - chan 3, conversion b float
00086 - chan 3, conversion b
00087 - chan 4, conversion b float
00088 - chan 4, conversion b
00089 - chan 5, conversion b float
00090 - chan 5, conversion b
00091 - chan 6, conversion b float
00092 - chan 6, conversion b
00093 - chan 7, conversion b float
00094 - chan 7, conversion b
00095 - chan 8, conversion b float
00096 - chan 8, conversion b
00097 - volume/day, pump 1 - float
00098 - volume/day, pump 1 -
00099 - volume/day, pump 2 - float
00100 - volume/day, pump 2 -

00101 to 00128 unassigned
000129 to 16384 log readings

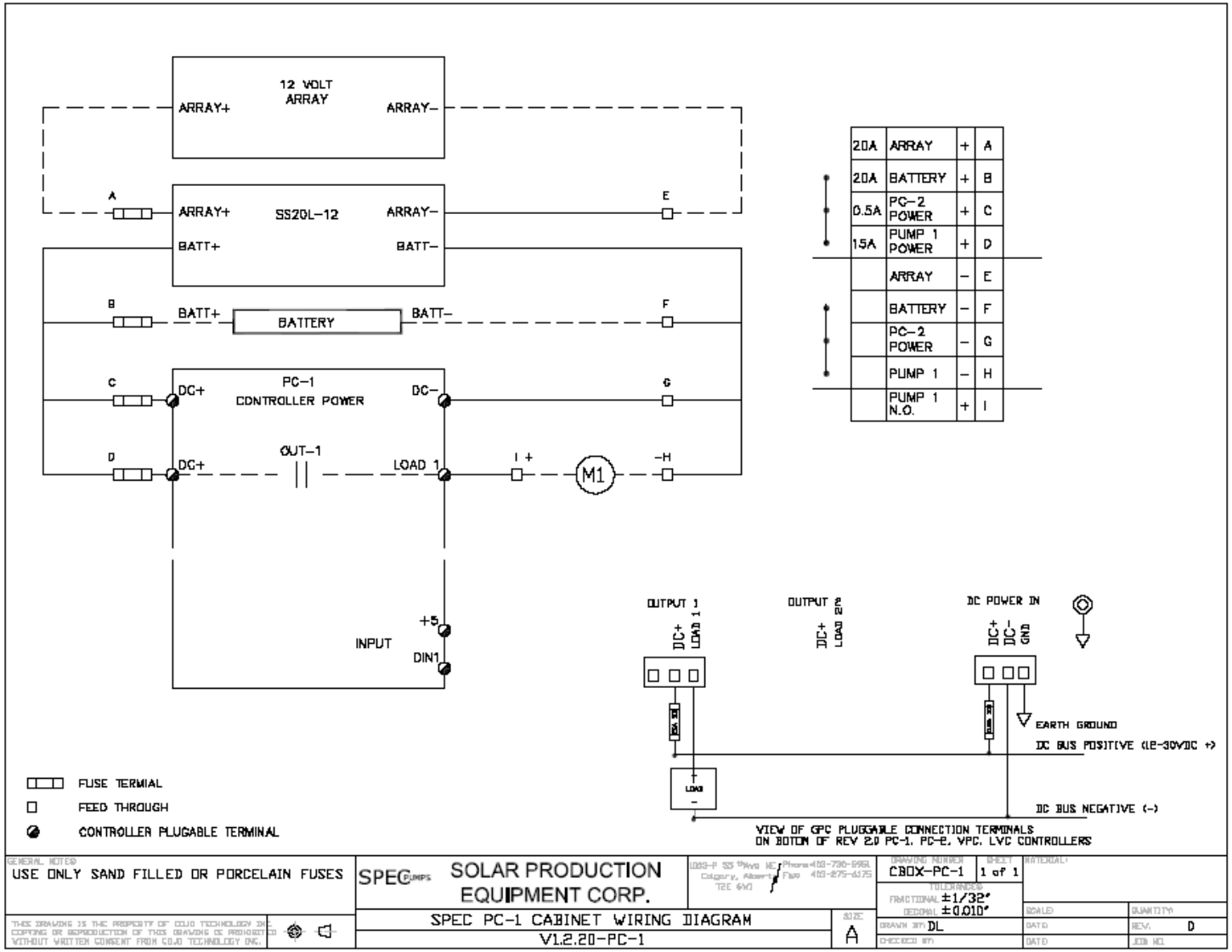
### 10.2 Supported Modbus commands

Modbus command set (function code)

1 read output status 0xxxx
2 read switches 1xxxx
3 read 16 bit register(s) 4xxxx (8 regs max)
4 read analog 3xxxx
5 force single coil (4 per address) output 0xxxx
6 set register 4xxxx
8 reset
15 force multiple outputs 0xxxx
16 set multiple registers 4xxxx (8 regs max)
17 report slave id

Thank you for choosing a Solar Production Equipment Corp pumping product.
Please contact us if you require further assistance:

Solar Production Equipment Corp Tel: (403) 730-5951
1003-P 55Ave.NE
Calgary, Alberta
T2E 6W1




GENERAL NOTES
USE ONLY SAND FILLED OR PORCELAIN FUSES

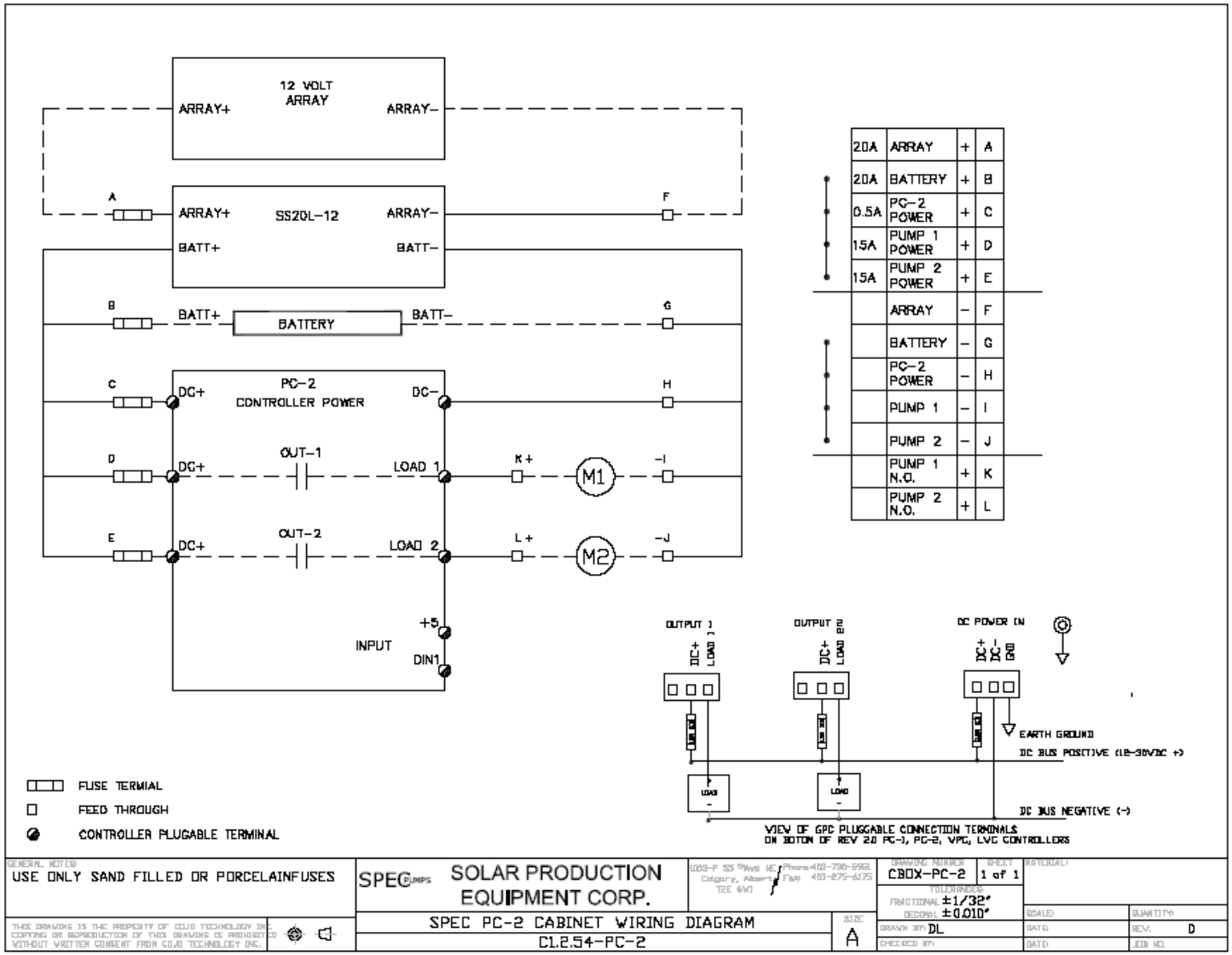


SPEC PUMPS SOLAR PRODUCTION EQUIPMENT CORP.

SPEC PC–1 CABINET WIRING DIAGRAM
V1.2.20–PC–1

SIZE A

DRAWING NUMBER CBOX–PC–1
SHEET 1 of 1
MATERIAL
TOLERANCES
FRACTIONAL ±1/32"
DECIMAL ±0.010"
DRAWN BY DL
CHECKED BY
SCALE
DATE
QUANTITY
REV. D
DATE
JOB NO.




GENERAL NOTES
USE ONLY SAND FILLED OR PORCELAINFUSES



SPEC PUMPS SOLAR PRODUCTION EQUIPMENT CORP.

SPEC PC-2 CABINET WIRING DIAGRAM

C1.2.54-PC-2

SIZE A

DRAWING NUMBER CBOX-PC-2 | SHEET 1 of 1

TOLERANCES
FRACTIONAL ±1/32"
DECIMAL ±0.010"

DRAWN BY: DL

MATERIAL:

SCALE: | QUANTITY:

DATE: | REV. D

CHECKED BY:

DATE: | JOB NO.