



C-Series Precision  
Syringe Pump  
(C3000/C24000)  
Operator's Manual

# C-Series Operator's Manual

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## C-Series Introduction

The C3000 and C24000 are precision OEM syringe pump modules designed for automated instrumentation.

The C3000 is a seamless replacement for the XP, XCalibur and PSD/4 syringe pumps. All normal aspiration and dispense operations expected from an OEM syringe pump module can be accomplished with this unit. The stepper motor driven syringe will accurately and precisely handle fluids from a few microliters to 12.5 milliliters. The syringe drive arm can be easily back driven (on the C3000), making syringe installation or replacement extremely quick and easy.

The C24000 is a high-resolution version that achieves full syringe resolution to 192,000 micro-steps. The C24000 is perfect for low flow rate and low pulsation requirements.

The C-Series syringe pumps utilize a proprietary high-efficiency, direct-drive design that does not use belts that can stretch or wear out. The robust drive mechanism has been life-tested to several million cycles with no maintenance required throughout its life. The pumps are outfitted with TriContinent's long-life valves available in various configurations and material combinations.

The C-Series syringe pumps are ideal for experienced IVD instrument manufacturers who are looking to maximize the investment they have already made in existing instrumentation. They utilize standard communication protocols and mounting configurations used by other compact syringe pump designs, thereby eliminating expensive and time consuming re-development. The C-Series hardware and firmware automatically detect the communication interface and communication protocol. The pump can also be configured to operate at different communication speeds. Each pump provides two digital inputs and three outputs that can be used for synchronization with external devices. Multi-pump communication is possible through RS485 or CAN interface, addressing up to 15 modules through a single communication bus.

This manual was created specifically for the use of instrument designers with the knowledge of existing firmware of similar designs or those looking to upgrade and/or retrofit existing applications. In order to make your product transition quick and simple, a Quick Start Configuration Guide is included in this manual that illustrates only those areas that are unique to the TriContinent C-Series.

For those customers that are just being introduced to the C-Series design, this manual includes basic information you will require to get started. However, a complete C-Series Precision Pump Software Manual is available upon request.

## Quick Start Configuration Guide (for replacing common 3 cm stroke pumps)

### Configuration Jumpers

The C-Series has the configuration jumpers located in different locations (see figure on next page). The functions of the jumpers are also slightly different. Please see below for jumper settings compared to other pumps with standard software and microstep-enabled software:

Function	C-Series	XP (std)	XP (μstep)	XC	PSD/4 <sup>4</sup>	Action
Protocol	N/A	JP1-2 <sup>3</sup>	N/A	N/A	N/A	Installed = OEM
Reserved <sup>1</sup>	J2-1	N/A	N/A	N/A	N/A	
EEPROM Mode	J2-2	JP1-3	JP1-3	N/A	SW2	Installed = Autostart
Overload Detection	J2-3	JP1-1	JP1-1	N/A	SW1	Installed = Disabled
Communication Rate	J2-4	JP1-4	JP1-4	N/A	SW3	Installed = 38.4 K/125 K baud rate
Valve <sup>2</sup>	J2-5	JP4, 1-2	N/A	N/A	SW4 – SW6 (ALL OFF)	Installed = 120° Valves

**NOTE 1:** A spare jumper is provided on J2-1 on the C-Series Pumps.

**NOTE 2:** The C-Series has a jumper to select between a 120° and a 90° valve. All other Valve types are EEPROM selectable. XC also uses EEPROM settings.

**NOTE 3:** The XP does not have automatic protocol detection.

**NOTE 4:** The PSD/4 uses DIP switch settings instead of jumpers.

### RS485 Termination Jumpers

The C-Series has the Termination jumpers located in different locations (see figure on next page). Pumps are shipped with termination jumpers installed. Remove them if not needed.

Function	C-Series	XP	XC	PSD/4 <sup>1</sup>	Action
RS485A	J9-1	JP2, 1-2	J1,1-2	SW7 (ON)	Installed = Terminated
RS485B	J9-2	JP2, 3-4	J1,3-4	SW8 (ON)	Installed = Terminated
CAN	J9-3	N/A	N/A	N/A	Installed = Terminated

**NOTE 1:** The PSD/4 uses DIP Switch settings

### Software Compatibility

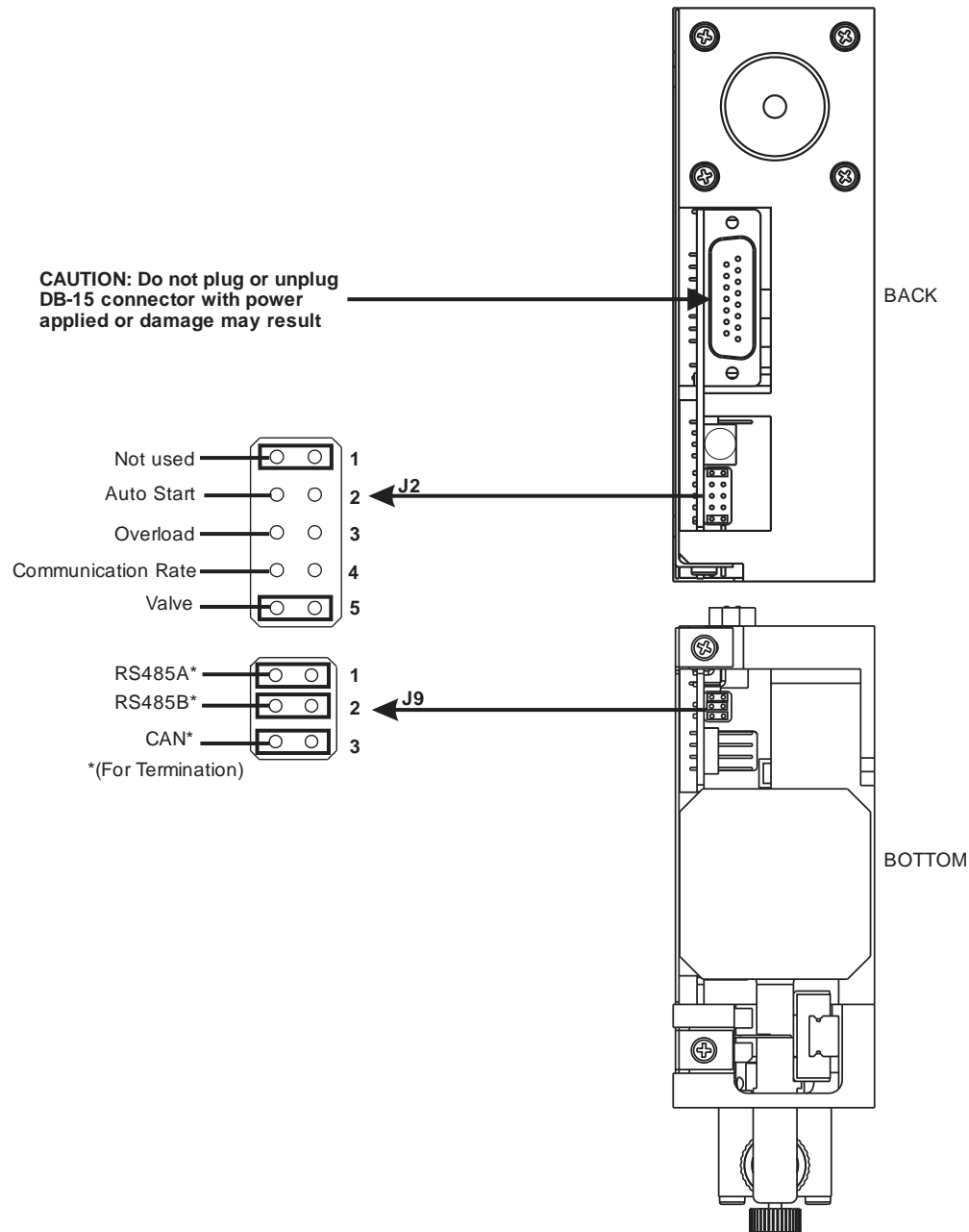
The C-Series is compatible with the XP and XC protocols and documented command set. There are some commands and responses that are different as shown below:

Command	Value	Description	Difference
^	< n > 0..255	Sets threshold value for fluid detection	N/A for C-Series <sup>1</sup>
z	none	Set position count to encoder count	N/A for C-Series <sup>1</sup>
?22		Report current value from fluid sensor	N/A for C-Series <sup>1</sup>
&		Report firmware version	New response <sup>2</sup>
#		Report firmware checksum	New response <sup>2</sup>

**NOTE 1:** The C-Series pump does not require a valve fluid detector circuit. These commands are accepted, but are not functional.

**NOTE 2:** The C-Series has unique electronics and firmware. These report commands will respond with the same amount of characters, but with different response data.

## Quick Start Configuration Guide (C-Series Jumper Locations)



## Specifications

Downloadable specifications can be found on the TriContinent website at <http://www.tricontinent.com>.

## Hardware

### J3 Mating Connectors

Manufacturer	Description	Manufacturer's P/N
TE/TYCO	15 pin female-solder cup, receptacle	747909-2
TE/TYCO	Plastic shield with male screw retainers	5207908-4

**NOTE:** Examples are not supplied by TriContinent.

### J3 Wiring

Power and communication is supplied via a single cable to the C-Series.

Pin	Function	Details
1	24 VDC	See Below
2	RS232 TxD line	Output Data
3	RS232 RxD line	Input Data
4	RTS	
5	CAN HI Signal line	
6	CAN LO Signal line	
7	AUX Input #1	TTL Level (4.7K pullup)
8	AUX Input #2	TTL Level (4.7K pullup)
9	Ground	Power and Logic
10	Ground	Power and Logic
11	RS485 A line	
12	RS485 B line	
13	AUX Output #1	TTL Level (1K pullup Max Source/Sink current = $\pm 20\text{mA}$ )
14	AUX Output #2	TTL Level (1K pullup Max Source/Sink current = $\pm 20\text{mA}$ )
15	AUX Output #3	TTL Level (1K pullup Max Source/Sink current = $\pm 20\text{mA}$ )

**CAUTION:** Do not plug or unplug DB-15 connector with power applied or damage my result.

### Power Supply Requirements

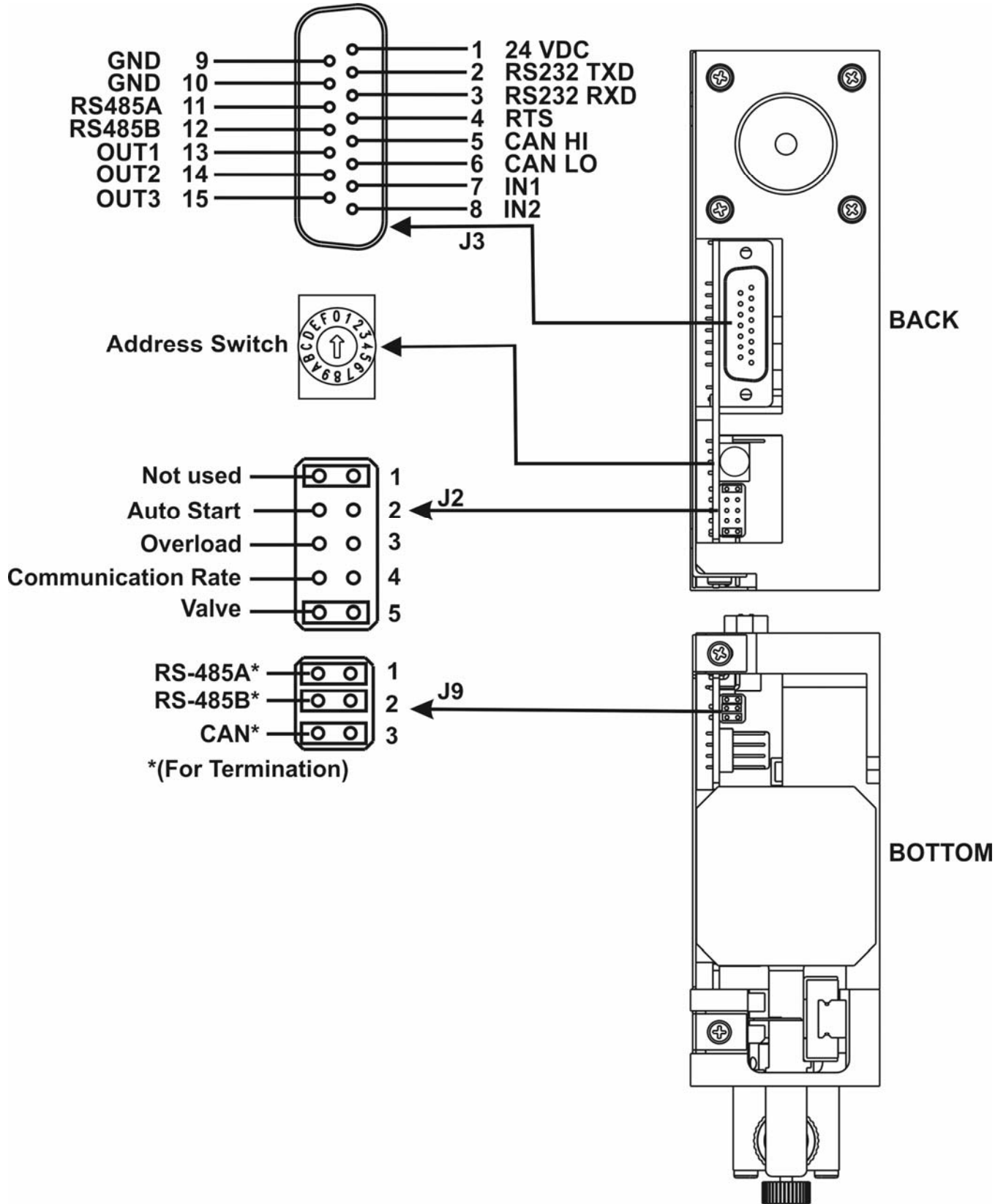
Linear or switching supplies may be used.

Output Voltage	24 VDC Nominal $\pm 10\%$
Output Current	$\geq 1.5$ Amp Peak

### Fluid Connectors

The C-Series has 1/4-28" fitting ports as the standard configuration. Other port configurations may be obtained through special order. Please contact your TriContinent Sales Representative for details.

# Electrical Connector Locations



## Configuration Jumper and Switch Settings

### J2

Jumper	Function	Jumper Installed	Jumper Removed
J2-1	Unused	Spare	
J2-2	EEProm Autostart	Enabled	Disabled
J2-3	Plunger Overload	Disabled	Enabled
J2-4	Communication Rate	38,400 baud (RS232/RS485) 125 kbit/s (CAN)	9,600 baud (RS232/RS485) 100 kbit/s (CAN)
J2-5 <sup>1</sup>	Valve	120° 3-port	90° 4-port

**NOTE:** For Distribution, Loop and T Valves, the pump is configured using EEPROM settings. If it is desired to change from a standard 120° 3-port or 90° 4-port valve to one of these valves, please refer to the Software Manual and contact your local TriContinent Representative.

### J9

Jumper	Function	Jumper Installed	Jumper Removed
J9-1	RS485 Termination A	Terminated	Not Terminated
J9-2	RS485 Termination B	Terminated	Not Terminated
J9-3	CAN Termination	Terminated	Not Terminated

### Address Switch

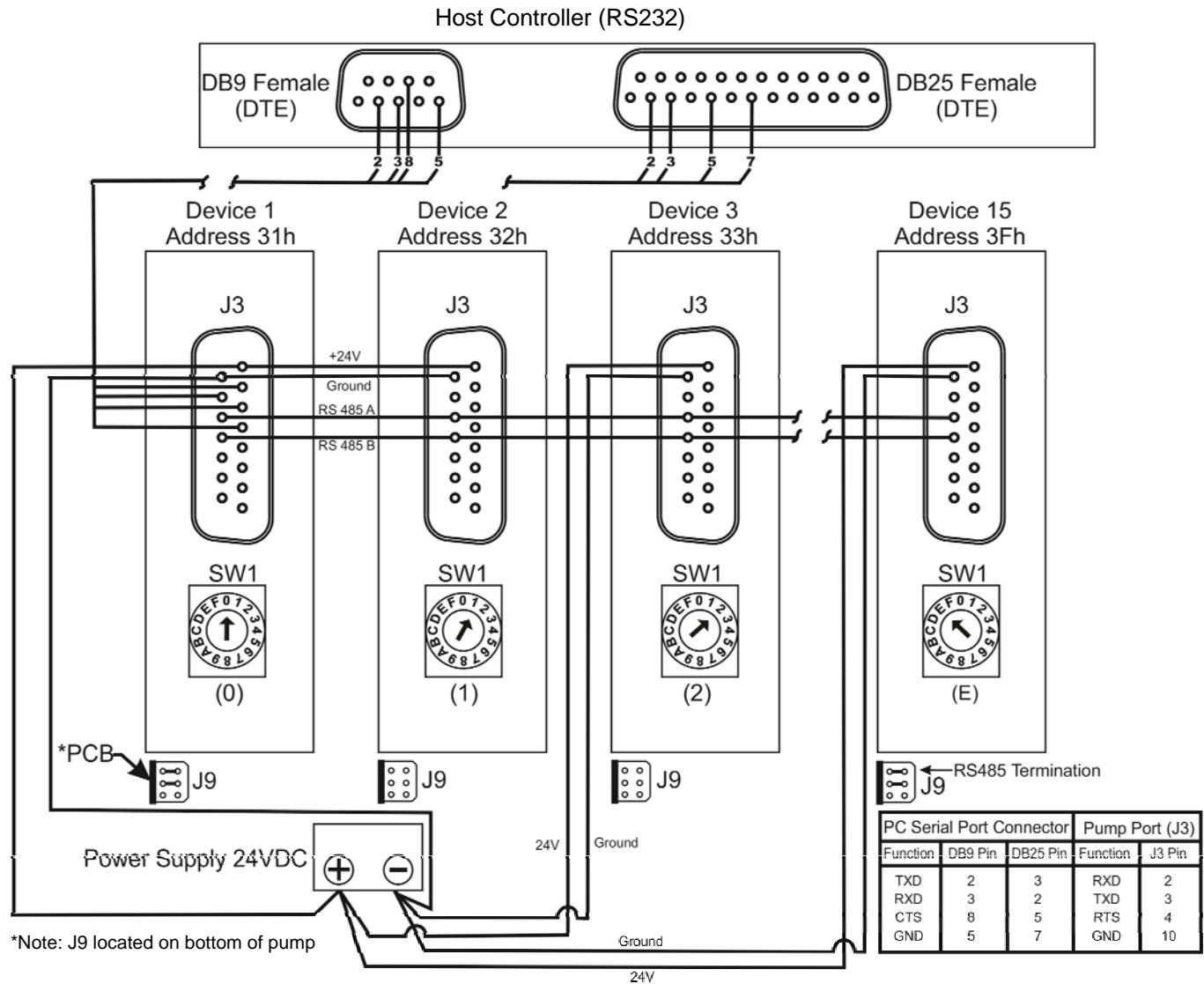
The address switch is used to provide each C-Series Pump a unique address in a multi-pump application. The address switch has 16 locations (0-E). The F address location is used to activate the self-test. The address locations can be set by using a small flathead screwdriver and rotating the switch in either direction to the appropriate address.



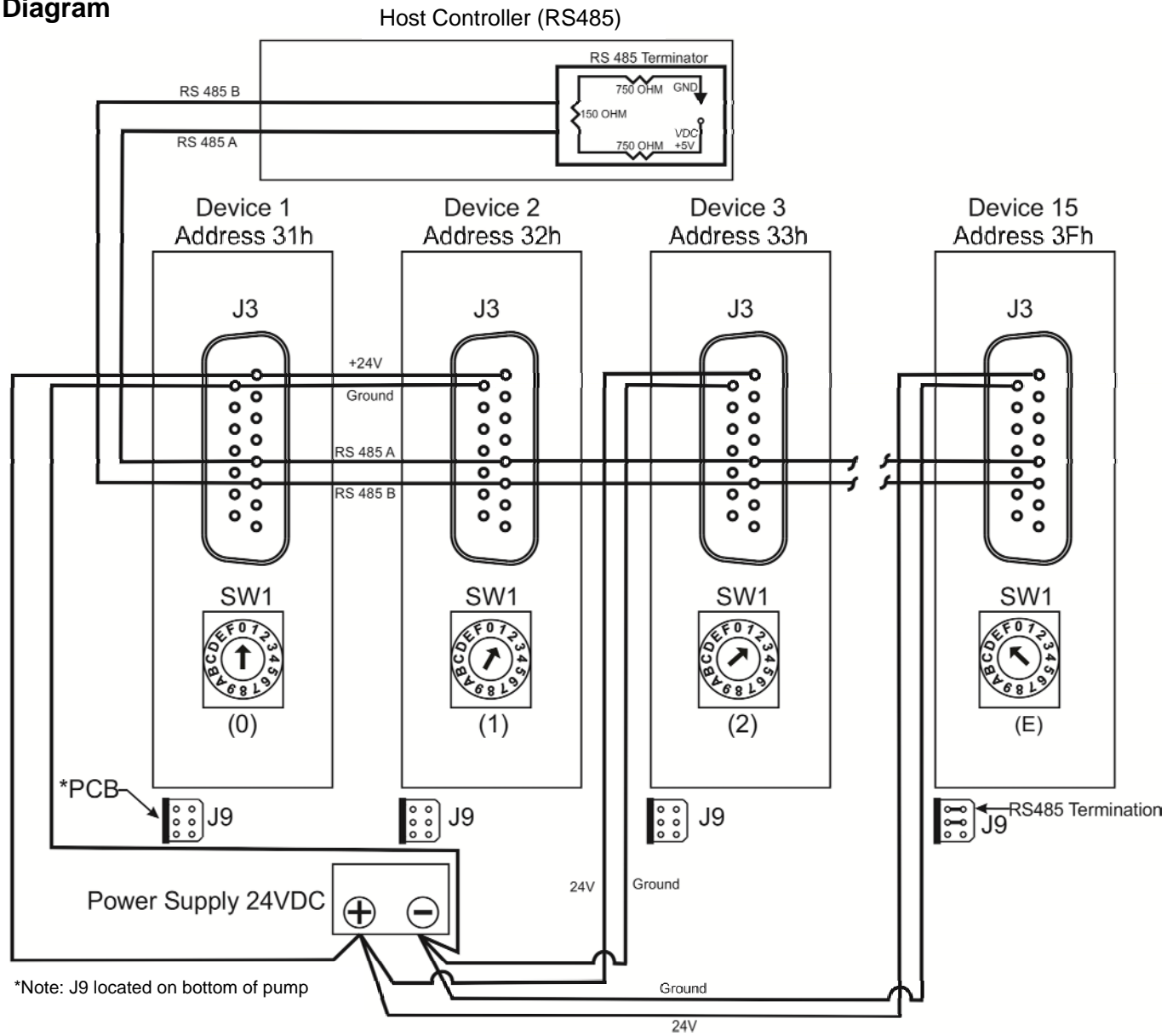
Address Switch



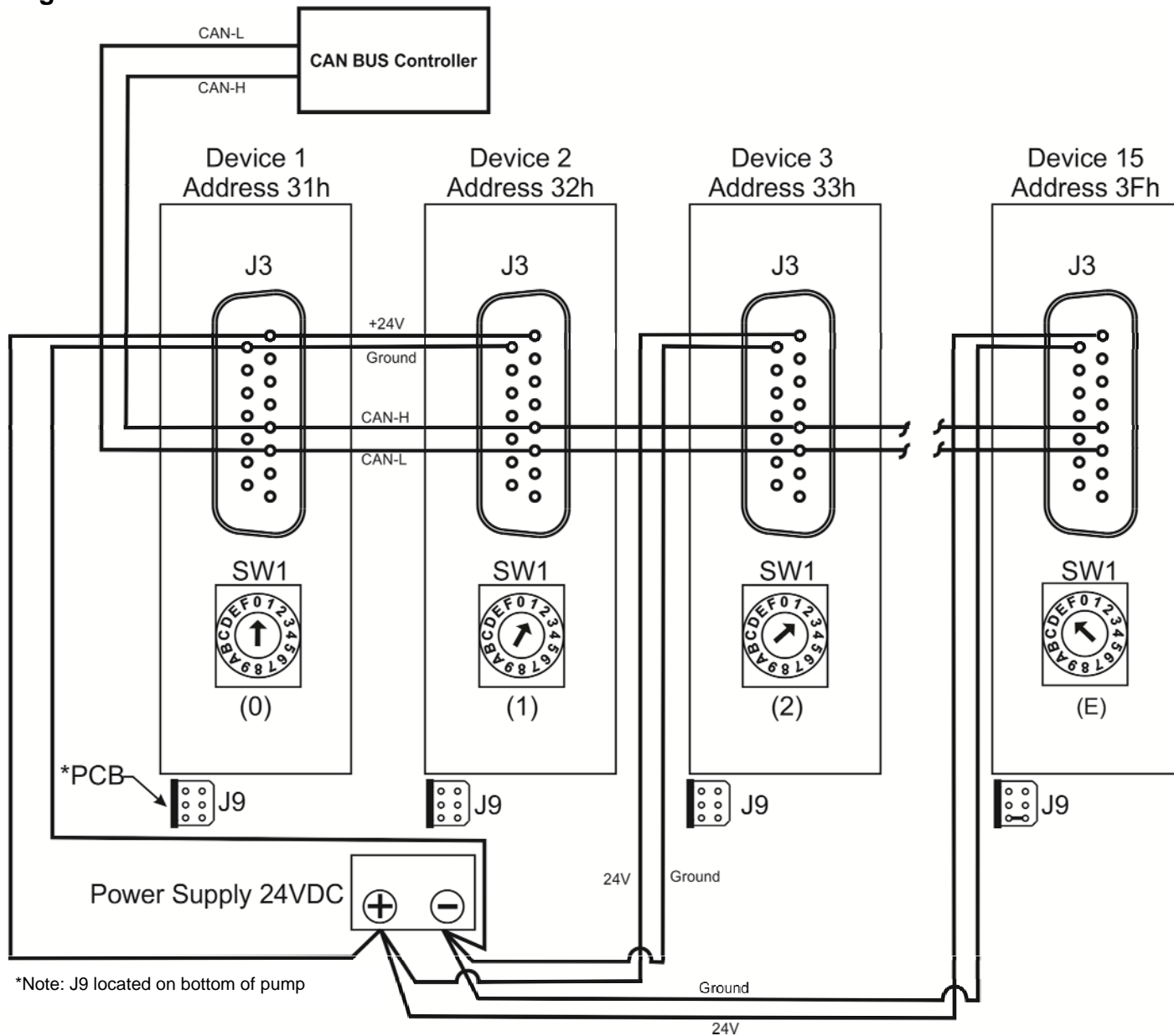
# RS232 Cabling Diagram



# RS485 Cabling Diagram



# CAN Cabling Diagram



# Software

## RS232 and RS485 Command Summary

Command	Operand Range <n>* ( ) = Microstep Mode Limits	Default Operand	Power Up Default	Command Description	Operand Description
<b>Control Commands</b>					
R	N/A	N/A		Execute command string	
x	0...3	N/A		Execute next command in buffer based on auxiliary inputs	<0> = Execute if input 2 is Low and Input 1 is Low <1> = Execute if Input 2 is Low and Input 1 is High <2> = Execute if Input 2 is High and Input 1 is Low <3> = Execute if Input 2 is High and Input 1 is High
X	N/A	N/A		Re-execute last executed command string	
G<n>	0...30000	0		Repeat command sequence	0 = Loop forever
g	N/A	N/A		Mark the start of a repeat sequence	
M<n>	0...30000			Delay command execution	Milliseconds
H<n>	0-2	0		Halt command execution	<0> = Wait for [R] or either input 1 or 2 to go low <1> = Wait for [R] or input 1 to go low <2> = Wait for [R] or input 2 to go low
T	N/A	N/A		Terminate command	
<b>Initialization Commands</b>					
Z<n>	0...40	0		Initialize plunger, valve to the right	<0> = Initialize at full plunger force <1> = Initialize at low plunger force <2> = Initialize at lower plunger force than <3> = Initialize at speed 16, low plunger force <4> = Initialize at speed 18, low plunger force <5-9> = same as <0> <10-40> = initialize at defined plunger speed
Y<n>	0...40	0		Initialize plunger, valve to the left	Same as Z<n>
W<n>	0...40	0		Initialize plunger without valve	Same as Z<n>
z<n>	0...3000 (0...24000)	0		Set pump's internal position counter to value specified	
k<n>	0...120 (0...960)		24	Syringe dead volume command	

\*Operand range listed for C3000 only.

## RS232 and R485 Command Summary

Command	Operand Range <n>* ( ) = Microstep Mode Limits	Default Operand	Power Up Default	Command Description	Operand Description
<b>Plunger Movement Commands (Note: Argument limits are for C3000 configuration)</b>					
A<n>	0..3000 (0..24000)	0		Move plunger to absolute position	
a<n>	0..3000 (0..24000)	0		Move plunger to absolute position, not busy	
P<n>	0..3000 (0..24000)	0		Relative pickup	
p<n>	0..3000 (0..24000)	0		Relative pickup, not busy	
D<n>	0..3000 (0..24000)	0		Relative dispense	
d<n>	0..3000 (0..24000)	0		Relative dispense, not busy	
<b>Valve Commands</b>					
I	N/A	N/A		Move valve to Input position	
O	N/A	N/A		Move valve to Output position	
B	N/A	N/A		Move valve to Bypass position	
E	N/A	N/A		Move valve to Extra position. Valid for 4 position valves only.	
<b>Set Commands</b>					
K<n>	0...100 (0...800)	10		Backlash steps	
L<n>	1...20	14		Set acceleration/deceleration slope	
v<n>	0...1000	900		Set start velocity in Hz	
V<n>	1...6000	1400		Set top velocity in Hz	
S<n>	0...40	11		Set speed	
c<n>	1...2700	900		Set cutoff velocity in Hz	
h<n>	0...100	10		Set syringe hold current in %	
m<n>	0...100	75		Set syringe run current in %	
C<n>	0..025	0		Cutoff velocity in Steps	
N<n>	0...2	0		Set microstep positioning and velocity mode	<0> = Both microstep position and velocity mode off <1> = Microstep position mode on velocity mode off <2> = Both microstep position and velocity mode on
J<n>	0...7			Sets the 3 TTL auxiliary outputs	<0> = All outputs low <7> = All outputs high
J<ppppn>	<pppp> 1-3000 <n>...0..7			Set auxiliary outputs based on syringe position	
^<n>	0...255			Non-functional command	
b	N/A	N/A		Non-functional command	
<b>EEPROM Commands</b>					
s<n>	0...14			Load program string into EEPROM	
e<n>	1...14			Execute EEPROM string	
U				Set pump configuration parameters	Refer to Software Manual
u	1...16			Set system configuration parameter into EEPROM	For factory use only

\*Operand range listed for C3000 only.

## RS232 and RS485 Command Summary

Command	Operand Range <n>* ( ) = Microstep Mode Limits	Default Operand	Power Up Default	Command Description	Operand Description
<b>Report Commands</b>					
Q	N/A	N/A		Report system status	
?	N/A	N/A		Report absolute plunger position	
?0	N/A	N/A		Same as ?	
?1	N/A	N/A		Report start velocity in Hz	
?2	N/A	N/A		Report peak velocity in Hz	
?3	N/A	N/A		Report cutoff velocity in Hz	
?4	N/A	N/A		Report absolute plunger position, same as ?	
?5	N/A	N/A		Same as ?	
?6	N/A	N/A		Reports valve position (i, o, b and e)	
?10	N/A	N/A		Report command buffer status, same as F	
?12	N/A	N/A		Report number of backlash steps	
?13	N/A	N/A		Report status of aux 1 input	
?14	N/A	N/A		Report status of aux 2 input	
?15	N/A	N/A		Report number of pump initializations Counter not implemented, will always report 1	
?16	N/A	N/A		Report number of plunger movements Counter not implemented, will always report 1	
?17	N/A	N/A		Report number of valve movements Counter not implemented, will always report 1	
?18	N/A	N/A		Number of valve movements since last ?18, same as %	
?19	N/A	N/A		Reports if pump is initialized with a Y, Z, z or W command. 0 = not initialized 1 = initialized	
?20	N/A	N/A		Report firmware checksum, same as #	
?22	N/A	N/A		Non-functional command for compatibility will always return 255	
?23	N/A	N/A		Report firmware version, same as &	
?24	N/A	N/A		Report the syringe's dead volume as set by the k command	
?25	N/A	N/A		Report hold current in %	
?26				Report run current in %	
?27				Report EEPROM configuration data as set by the u command	
?28				Report if 3 or 4 position valve is installed (jumper status)	
?29				Current status, same as Q	
?30-?44				Report user EEPROM execution strings	
F				Report command buffer status, same as ?10	
&				Report firmware version, same as ?23	

Command	Operand Range <n>* ( ) = Microstep Mode Limits	Default Operand	Power Up Default	Command Description	Operand Description
#				Report firmware checksum, same as ?20	
RZ				Report absolute plunger position, same as ?	
RV				Report firmware version, same as & and ?23	
%				Number of valve movements since last report, same as ?18	

\*Operand range listed for C3000 only.

## CAN Command Summary

Command	Operands	Command Description
<b>On-the-fly Commands Frame Type = 0</b>		
V	Same as RS232/RS485	Top velocity
T	N/A	Terminate
<b>Action Commands Frame Type = 1</b>		
		All RS232/RS485 commands, with the exception of Report commands, are valid Action commands in CAN mode.
<b>Common Commands Frame Type = 2</b>		
0	N/A	Reset mode
1	N/A	Start loaded command
2	N/A	Clear loaded command
3	N/A	Repeat last command, like X
4	N/A	Stop action immediately, same as T command
<b>Report Commands Frame Type = 4</b>		
0	N/A	Plunger position
1	N/A	Reports encoder position, like ?4
2	N/A	Same as report command 0
3	N/A	Reports valve position, like ?6
4	N/A	Top velocity, like ?2
6	N/A	Start velocity, like ?1
7	N/A	Cutoff velocity, like ?3
10	N/A	Buffer status, like F
12	N/A	Backlash steps, like ?12
13	N/A	Input 1 status, like ?13
14	N/A	Input 2 status, like ?14
15	N/A	Number of pump initializations, like ?15. Note, currently not implemented, always return a 1.
16	N/A	Number of plunger movements, like ?16. Note, currently not implemented, always return a 1.
17	N/A	Number of valve movements, like ?17. Note, currently not implemented, always return a 1.
18	N/A	Number of valve movements since last report, like ?18
19	N/A	Report if pump is initialized. 1 = initialized, 0 = not initialized
20	N/A	Firmware checksum, like ?20
22	N/A	Non-Functional command to maintain backward firmware compatibility. Will always return 255.
23	N/A	Firmware version, like &
24	N/A	Syringe dead volume, like ?24
29	N/A	Current status, like Q



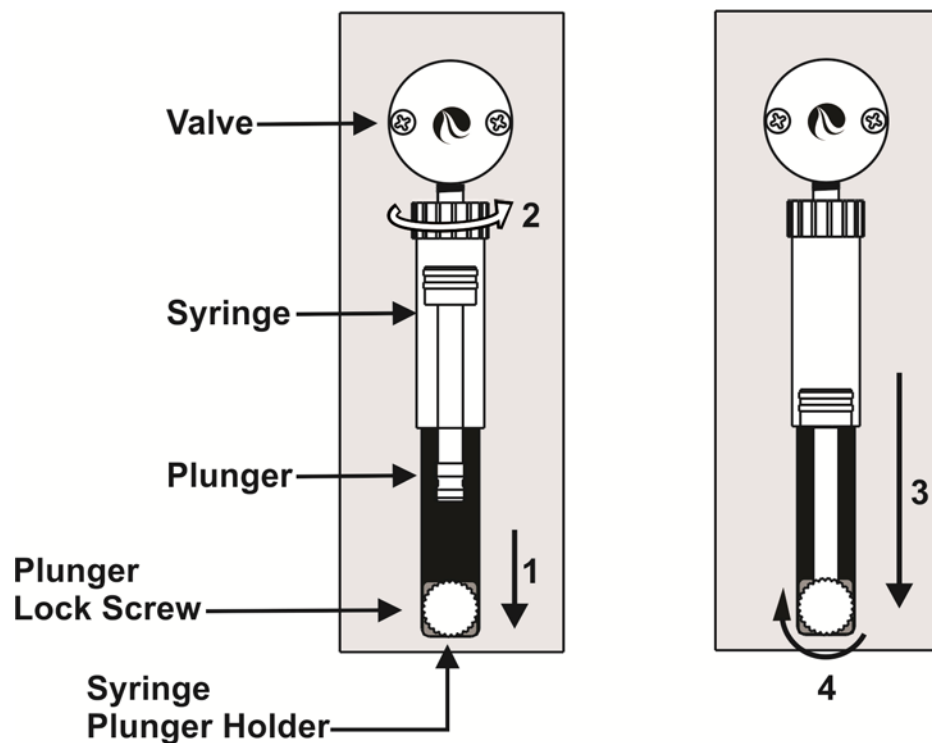
# Maintenance

## Recommended Maintenance

Daily Maintenance	Action
Inspect syringe seals and valves for leaks and proper operation	Replace as required
Inspect tubing fittings for leaks	Tighten or replace as required
Inspect for any fluid or material on outside of pump	Clean as required
"Park" inactive syringes	Flush with DI water at end of use and "park" syringe full of system fluid in full down position

## Syringe Installation

Refer to figure below:



To install a syringe, follow the steps below:

- 1) Lower the syringe plunger holder to ensure sufficient room to install the syringe.
  - a. For the C3000 pump, if the pump is powered off, manually lower the plunger by pushing firmly down on the Syringe Plunger Holder. If the power is on, this can be done by sending the A3000R command, or
  - b. For the C24000 pump, with the power on, send the A24000R command. The plunger cannot be manually lowered on the C24000 pump due to the high resolution of the drive system.

- 2) Screw the threaded portion of the syringe clockwise into the valve.

**CAUTION:** Do not over tighten the syringe or fittings. This can cause damage to the syringe and valve which can lead to leakage and reduced life.

Torque Spec: 21 oz-in (maximum)

Technique: Install syringe until it bottoms in the valve, then tighten another 1/4 turn (this roughly corresponds to 16 oz-in). If a more secure installation is needed, loosen the syringe and repeat the process approximately 24 hours after initial installation.

Teflon® tape should never be used on syringe or fitting threads as all syringe port seals are “face” seals (not thread sealing). Teflon® tape can lead to valve damage due to over stress on the valve seat from excessive torque applied to the syringe or fittings.

- 3) Fully seat the plunger into the syringe plunger holder.
- 4) Securely tighten (clockwise) the Plunger Lock Screw.
- 5) Initialize the pump.

### **Syringe Replacement**

To replace the syringe, drain all fluid from the syringe, and follow the steps below:

- 1) Lower the Syringe Plunger Holder as described above.
- 2) Turn the Plunger Lock Screw counterclockwise at least 2 full turns (do not completely remove the Plunger Lock Screw).
- 3) Turn the syringe counterclockwise and remove from the valve.
- 4) To install the syringe follow the steps listed above under “Syringe Installation”.

## Valve Replacement

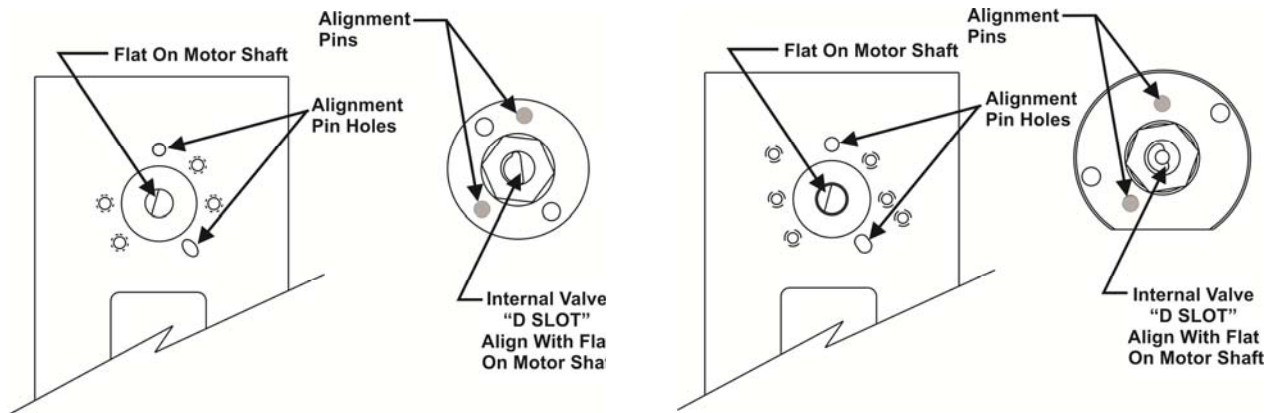
To replace the valve, remove all fluid from the syringe, and follow the steps below:

- 1) Remove syringe as described in the Syringe Replacement Section.
- 2) Disconnect the tubing from the valve.
- 3) Remove the two valve screws used to secure the valve to the panel.
- 4) Remove the valve from the pump by pulling directly away from the pump's front face.

To install the valve follow the below steps:

- 1) Align internal valve "D" slot with the flat on the motor shaft.
- 2) Gently push and rotate the valve into the correct position to align the pins with the holes in the panel.
- 3) Securely tighten (clockwise) the plunger lock screws.

### Common Pump and Valve Interfaces



## Accessories, Ordering & Warranty

### Accessories and Replacements

To view available Accessories (e.g. Evaluation Kits, Cables and Power Supplies) and/or Replacement items (Syringes & Valves) for the C-Series Pumps, please visit our website at <http://www.tricontinent.com>.

### Ordering Information / Customer Service

TriContinent is committed to exceeding our customers' expectations when it comes to our products and services.

To place an order or inquire about the C-Series or any TriContinent product, please contact TriContinent at one of the following:

By Mail: TriContinent, 12555 Loma Rica Drive  
Grass Valley, CA 95945

By Phone:

From within the United States: (800) WE-PIPET (800-937-4738)

From within the United States: (530) 273-8888, FAX (530) 273-2586

By E-mail: [liquidhandling@tricontinent.com](mailto:liquidhandling@tricontinent.com)

Company Website: <http://www.tricontinent.com>

### Warranty and Returns

TriContinent is an ISO 13485 registered company that operates under a stringent quality assurance program. We design and manufacture our syringe pumps to be the most reliable products available. We stand behind the C-Series with a **1-year** warranty on material and workmanship, excluding abuse and misuse. If notified of such defects during the warranty period, TriContinent will, at its option, either repair or replace products which prove to be defective. Please refer to the TriContinent website <http://www.tricontinent.com> for detailed warranty and return information.