

MC6000 Multi-Channel Syringe Pump Operator's Manual



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Introduction

The MC6000 is a precision OEM multi-channel pump module designed for use with automated instrumentation. All typical aspiration and dispensing operations expected from an OEM multi-channel module can be accomplished with this unit. The stepper motor driven syringe will accurately and precisely handle fluids from 5 μ L to 5 mL. Standard resolution is 6,000 steps per full syringe stroke and can be set into Hi-Res mode providing 48,000 steps. Other resolutions are configurable for backwards compatibility.

An MC6000 is ideal for experienced instrument manufacturers who are looking to maximize the investment they have already made in existing instrumentation, by using the MC6000 as a direct replacement for the competitive product. This pump utilizes standard communication protocols and mounting configurations used by other multi-channel pump designs, thereby eliminating the need to perform expensive and time consuming re-development.

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 Guide is included in this manual that illustrates only those areas that are unique to the TriContinent MC6000.

For those customers that are just being introduced to the MC6000 design, this manual includes basic information you will require to get started. However, a complete MC6000 Multi-Channel Syringe Pump Software Manual is available upon request.



MC6000 Multi-Channel Precision Pump Module

Quick Start Configuration Guide (for replacing an XL3008/XMP3008/XMP6008)

Configuration Jumpers

The MC6000 has the configuration jumpers located in different locations (see figure on back). The functions of the jumpers are also slightly different. Please see below for jumper settings compared to XL3008, XMP3008, and XMP6008:

Function	MC6000 ¹	XL3008	XMP ¹	Action
Protocol ²	N/A	SW2-2	N/A	ON = OEM
Reserved	N/A	SW2-3	N/A	Reserved
RS232/USB ³	J2-1	N/A	N/A	Installed = RS232
EEPROM Mode	J2-2	N/A	N/A	Installed = Autostart
Overload Detection	J2-3	SW2-1	N/A	Installed/On = Disabled
RS232 Communication Rate ⁴	J2-4	SW2-4	N/A	Installed/On = 38.4 K/125 K

Note 1 - The MC6000 and XMP use software configuration settings.

Note 2 - The MC6000 and XMP have automatic protocol detection.

Note 3 - The MC6000 provides RS232 or USB for PC connection.

Note 4 - The XL3008 and XMP3008 do not have a CAN interface.

RS485 and CAN Termination Jumpers

The MC6000 has the configuration jumpers located in different locations (see figure on next page). Pumps are shipped with termination jumpers installed. Remove them if not needed.

Function	MC6000	XL3008	XMP3008	XMP6008	Action
RS485A	J9-1	JP7,1-2	J4,1-2	J1,1-2	Installed = Terminated
RS485B	J9-2	JP7,3-4	J4,3-4	J1,3-4	Installed = Terminated
CAN	J9-3	N/A	N/A	N/A	Installed = Terminated

Software Compatibility

The MC6000 is 100% compatible with the XL and XMP 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	NA for MC6000 ¹
z	none	Set position count to encoder count	NA for MC6000 ¹
?4		Report actual position of plunger	NA for MC6000 ¹
?22		Report current value from fluid sensor	NA for MC6000 ¹
&		Report firmware version	New response ²
#		Report firmware checksum	New response ²

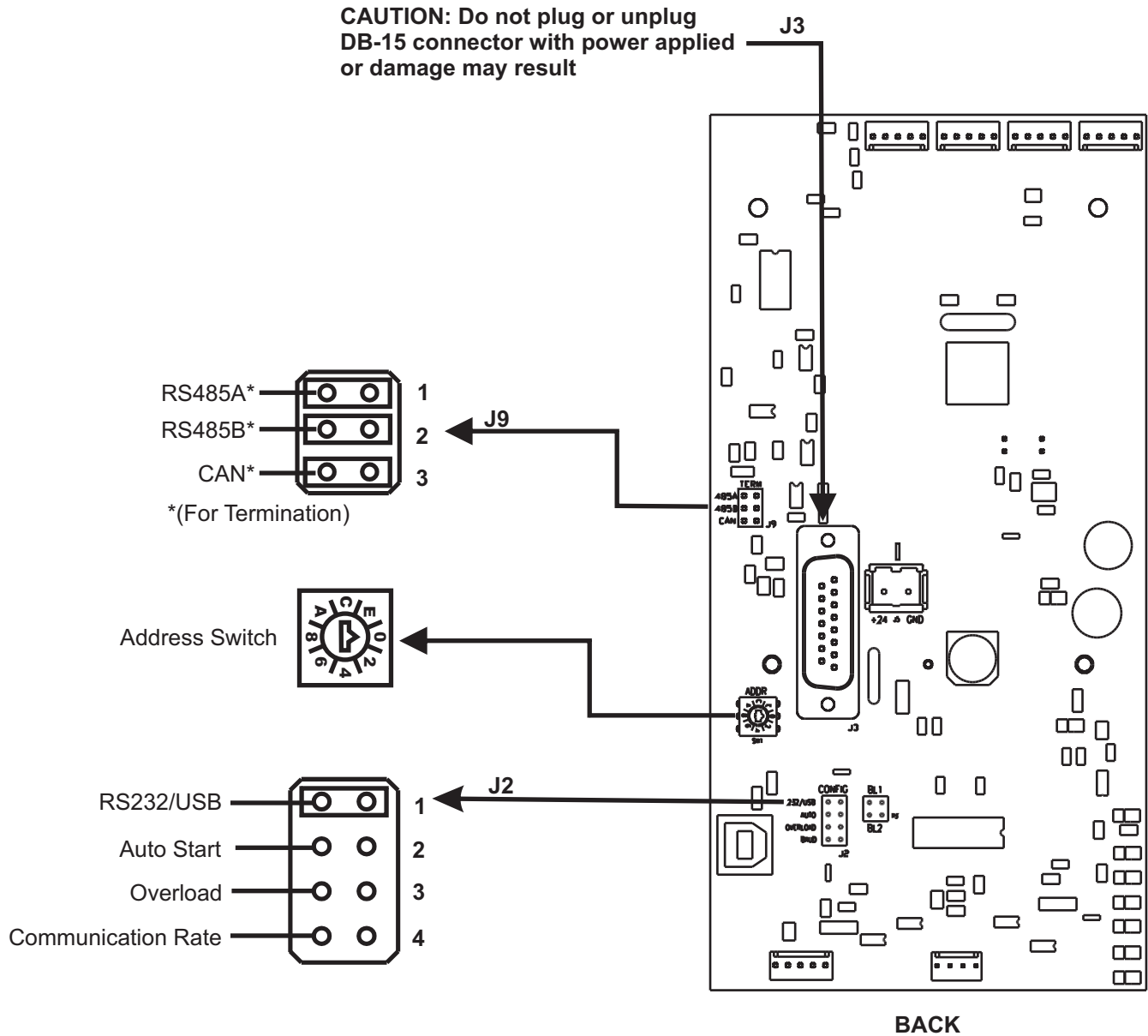
Note 1 - The MC6000 does not include a valve fluid detector circuit or a high resolution encoder. These commands are accepted, but are not functional.

Note 2 - The MC6000 has different electronics and firmware. These report commands will respond with the same amount of characters, but with different response data.

Quick Start Configuration Guide

MC6000 Jumper Locations

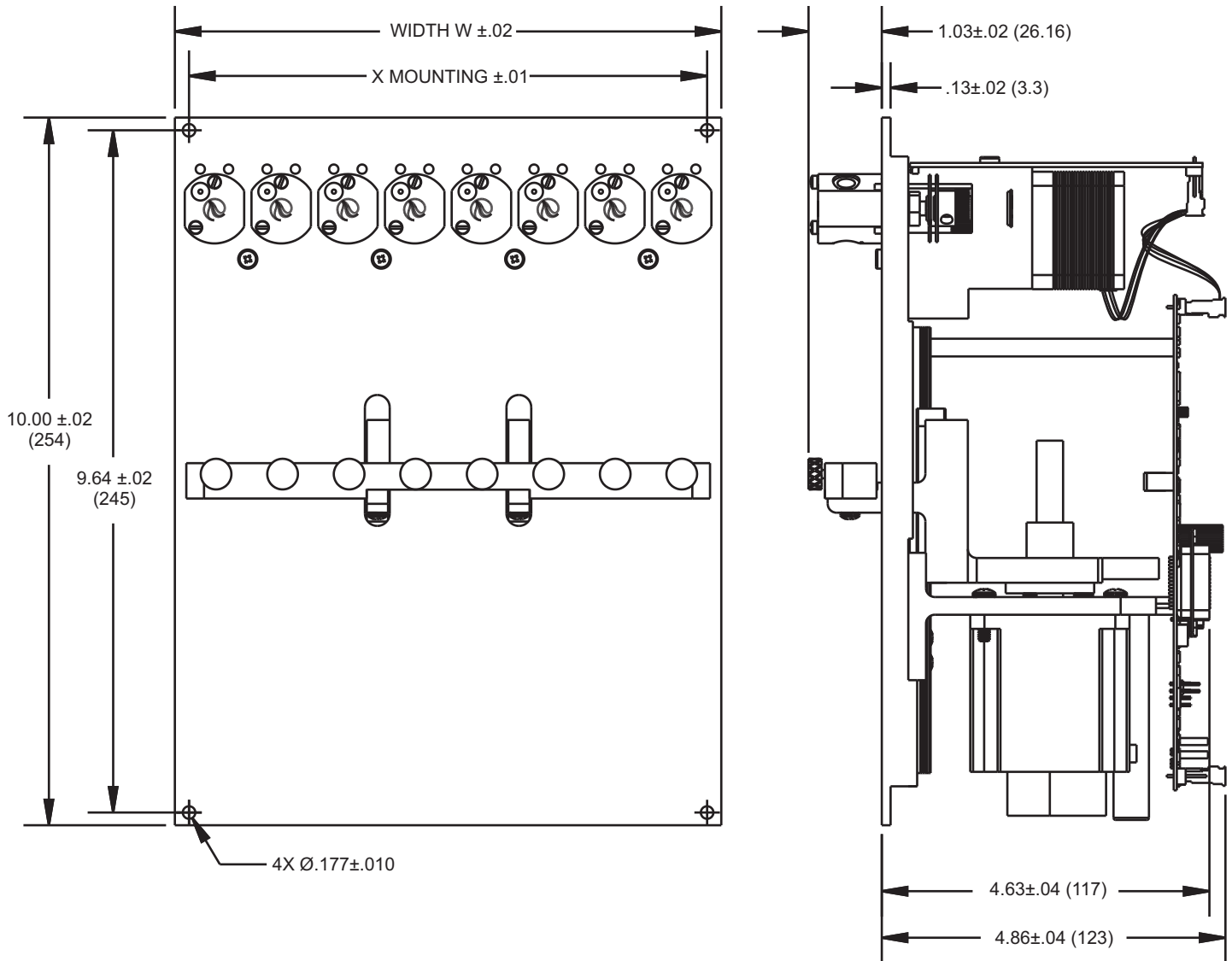
CAUTION: Do not plug or unplug DB-15 connector with power applied or damage may result



Specifications

Pump Type	Positive displacement multi-channel syringe pump		
Drive Design	Stepper motor/leadscrew with 30 mm of travel		
Speed	1.2 seconds to 800 minutes per stroke		
Step Resolution	Selectable: Standard mode 6,000 or 3,000 steps, Hi-Res mode 48,000 or 24,000 steps		
Accuracy within	±1.0% with 1 mL syringes (full stroke)		
Precision within	0.05% CV with 1 mL syringes (full stroke)		
Dimensions	4-Channel	6-Channel	8-Channel
Height	10.0 in. (254.0 mm)	10.0 in. (254.0 mm)	10.0 in. (254.0 mm)
Width	5.12 in. (130.0 mm)	6.43 in. (163.3 mm)	7.72 in. (196.1 mm)
Depth	6.0 in. (152.4 mm)	6.0 in. (152.4 mm)	6.0 in. (152.4 mm)
Syringe Design	30 mm stroke glass syringe with ¼ - 28 fitting PTFE seals (long-life UHMWPE seals available upon request)		
Available Volumes	50 µL, 100 µL, 250 µL, 500 µL, 1 mL, 2.5 mL and 5 mL		
Valve Design	3-way rotary shear valves provide: ¼ - 28 female ports Integrated bypass capability High flow (0.060 in. diameter flow paths) No "pumping" when switched Chemically inert flow path		
Valve Drive	Stepper motor with position sensors ≤250 ms between neighboring ports		
Power Requirement	24 VDC ±10%		
Power Rating	≤2.5 Amp (peak)		
Fluid Contact Materials	Syringe - Borosilicate glass and PTFE or UHMWPE (seal) Valve - PEEK (body) and UHMWPE (rotary plug) and Silicon-Nitride Ceramic (plug)		
Interface			
Type	USB, RS232, RS485 or CAN		
Communication Rates	9600 or 38400 baud (USB, RS232, RS485) 100 K or 125 K, 250 K, 500 K, 1 M baud (CAN)		
Format (RS232/485)	Data Bits - 8, Parity - None, Stop Bit - 1 Half Duplex, Data Terminal and OEM protocols		
Addressing	Maximum of 15 pumps addressed individually		
Environmental (Operating)			
Temperature	15°C to 40°C (59°F to 104°F)		
Humidity	20% to 95% RH at 40°C (104°F)		
Regulatory Compliance	TriContinent operates a manufacturing facility with an ISO 13485 compliant quality system. The MC6000 is a general laboratory module not subject to FDA regulatory approval. UL approved components are used wherever possible. The MC6000 does not carry an independent CE mark as it is a component designed for use within larger systems, which are subject to independent testing and certification.		

ENVELOPE AND MOUNTING DRAWING



NO. OF CHANNELS	WIDTH	X-MOUNTING
4	5.12	4.74
6	6.43	6.03
8	7.72	7.32

ALL DIMENSIONS UNLESS
OTHERWISE SPECIFIED
.XXX $\pm .008$ (.02 mm)
(MILLIMETERS SHOWN IN BRACKETS)

Hardware

J3 Mating Connectors

Manufacturer	Description	Manufacturer's P/N
AMP	15 pin female-solder cup,receptacle	747909-2
Cinch	15 pin female-solder cup,receptacle	DA-155
AMP	Plastic shield w/male screw retainers	207908-4
Cinch	Plastic shield w/male screw retainers	SDH-15GL-CS

J3 Wiring

Power and communication is supplied via a single cable to the MC6000.

Pin	Function	Details
1	24 VDC	See Below
2	RS232 TxD line	Output Data
3	RS232 RxD line	Input Data
4	+5 VDC	100mA Output
5	CAN HI Signal line	
6	CAN LO Signal line	
7	AUX Input #1	TTL Level
8	AUX Input #2	TTL Level
9	Ground	Power and Logic
10	Ground	Power and Logic
11	RS485 A line	
12	RS485 B line	
13	AUX Output #1	TTL Level
14	AUX Output #2	TTL Level
15	AUX Output #3	TTL Level

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

Note: A DB15 to card edge converter module is available for existing XL3008 users.

Power Supply Requirements

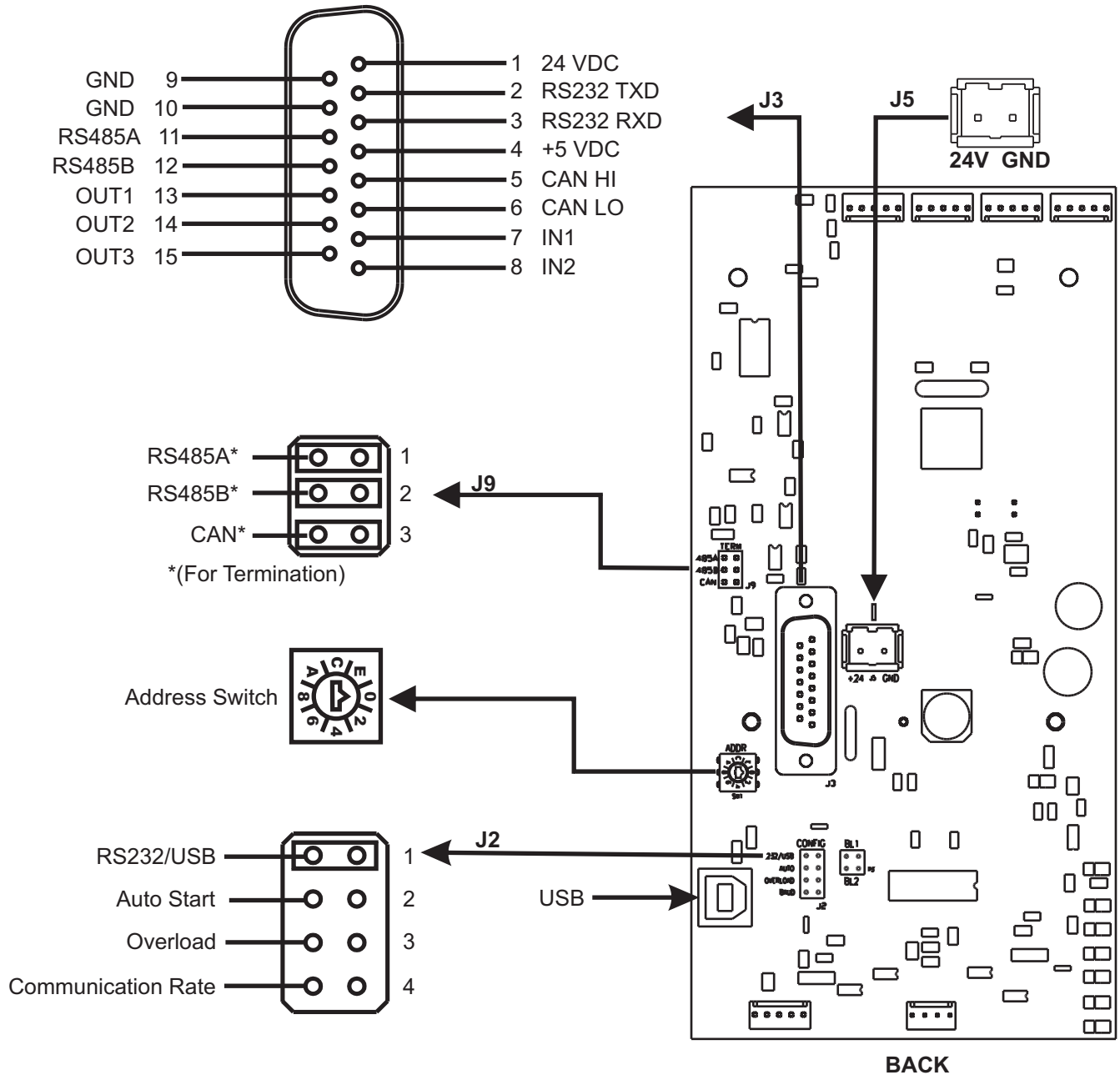
Linear or switching supplies may be used.

Output Voltage	24 VDC Nominal +/-10%
Output Current	≥ 2.5 A Peak

Fluid Connectors

The MC6000 has 1/4-28" fittings as the standard configuration.

Electrical Connector Locations



Configuration Jumper and Switch Settings

J2

Jumper	Function	Jumper Installed	Jumper Removed
J2-1	RS232/USB Select	RS232	USB
J2-2	EEProm Autostart	Enabled	Disabled
J2-3	Plunger Overload	Disabled	Enabled
J2-4	Communication Rate	38,400 Baud (RS232/485) 125 K CAN	9,600 Baud (RS232/485) 100 K CAN

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

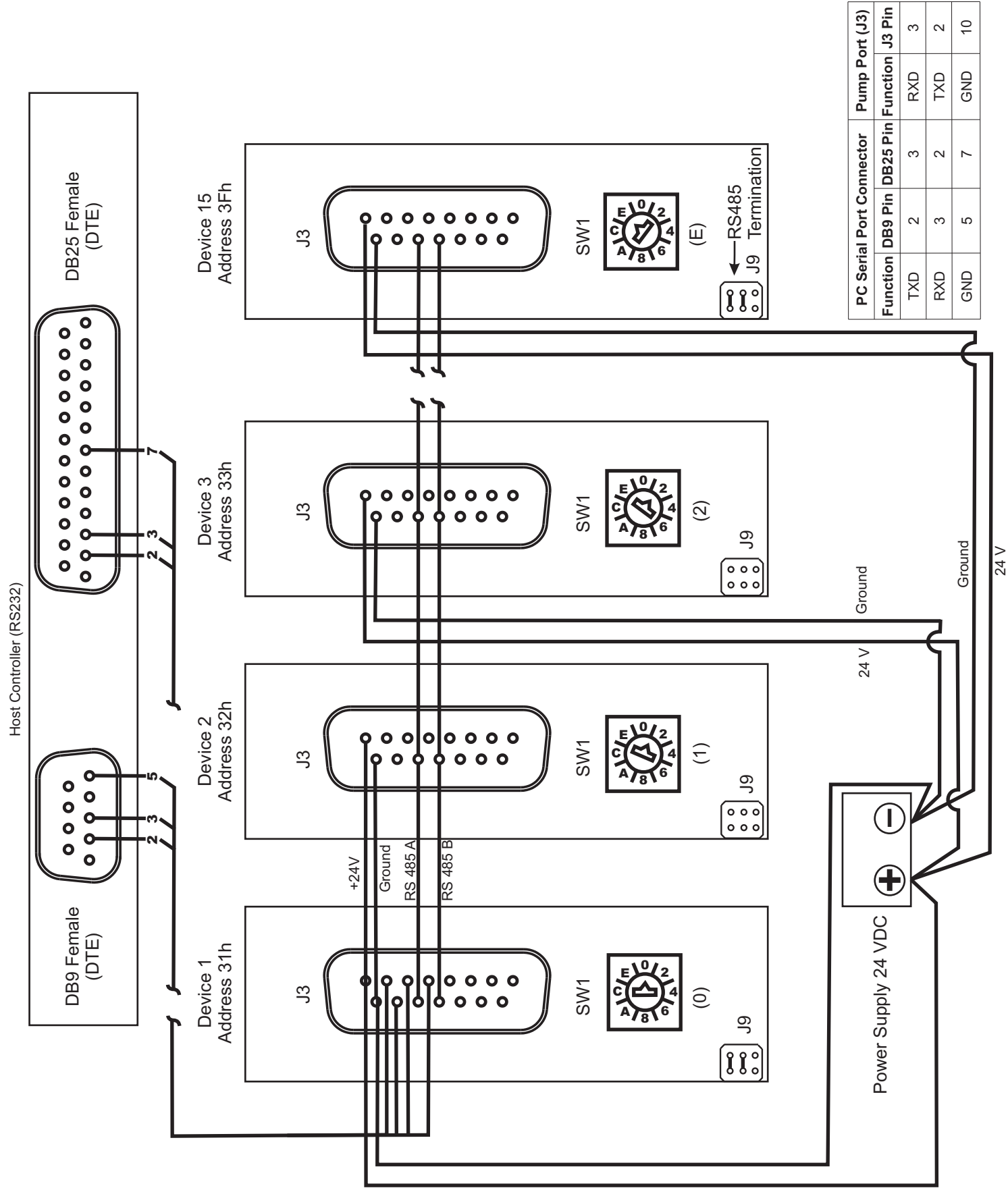
Address Switch

The address switch is used to provide each MC6000 a unique address in a multi-channel 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.

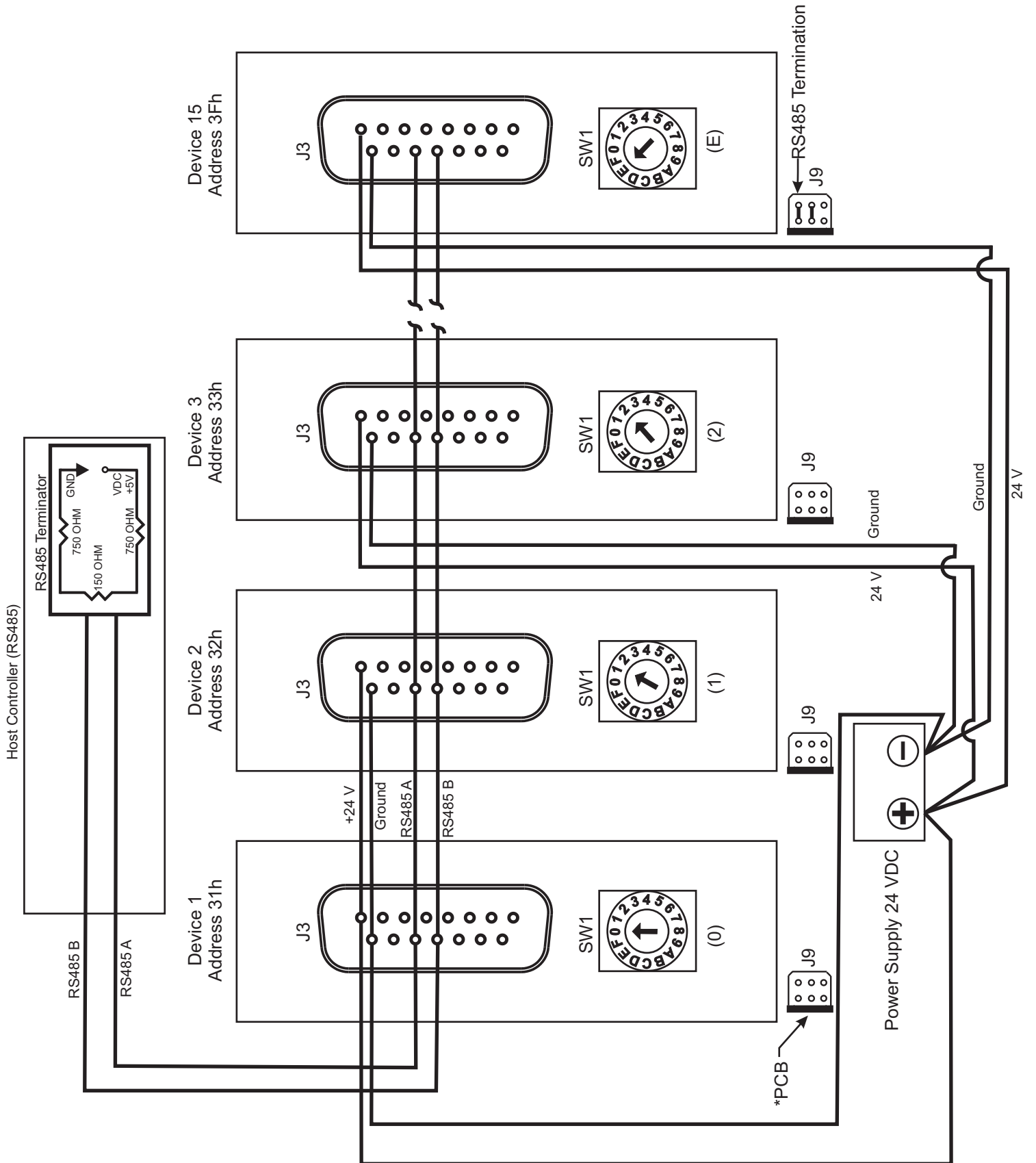


Address Switch

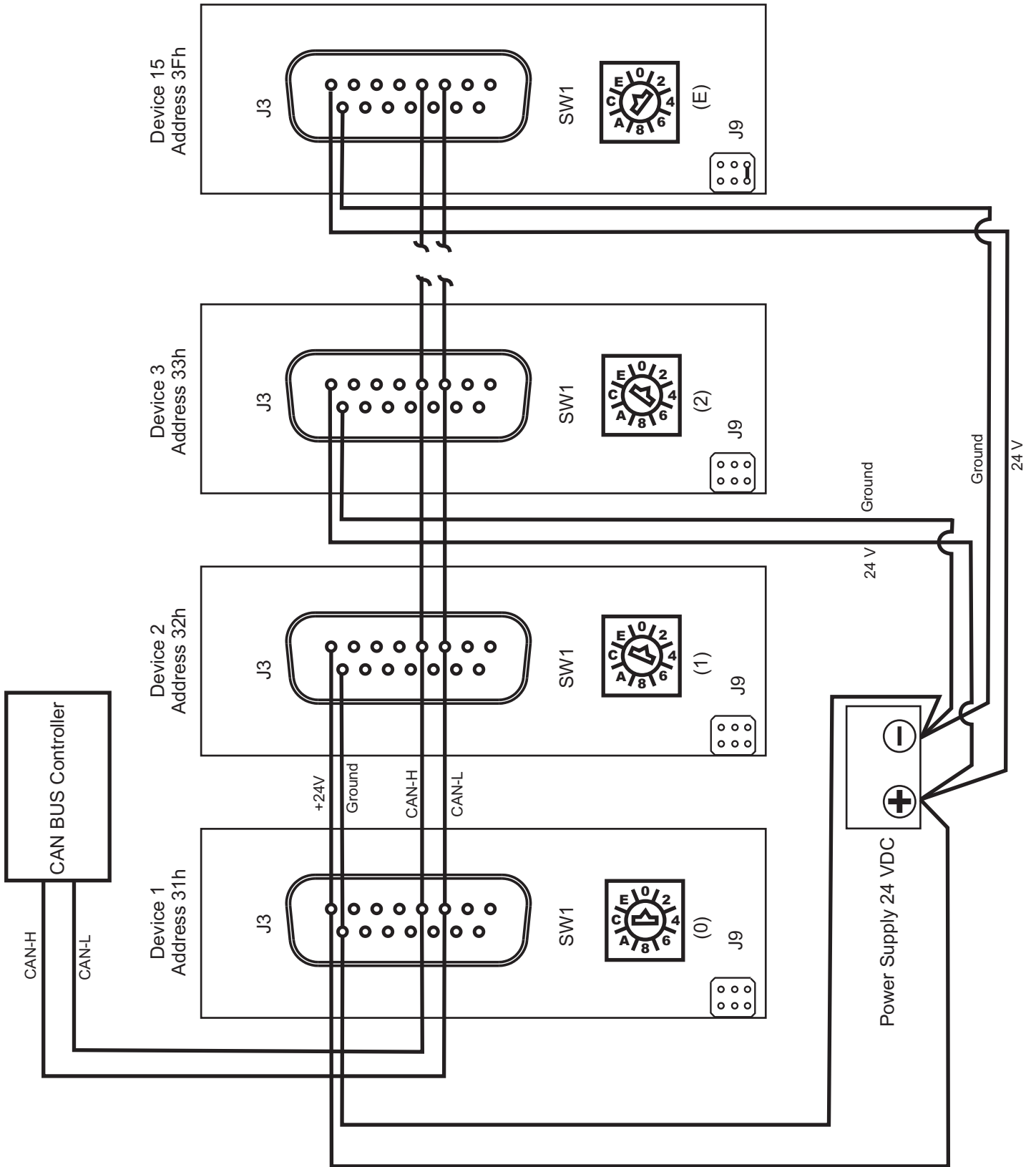
RS232 Cabling Diagram



RS485 Cabling Diagram



CAN Cabling Diagram



MC6000 RS232 and RS485 Command Summary

Control Commands

Command	Operand Range <n>	Default Operand	Power Up Default	Operand Description	Command Description
R	N/A	N/A			Execute command string
y<n>	0...3	N/A		<0> - Execute if Input2 is Low and Input1 is Low <1> - Execute if Input2 is Low and Input1 is High <2> - Execute if Input2 is High and Input1 is Low <3> - Execute if Input2 is High and Input1 is High	Execute next command in buffer based on Aux inputs
X	N/A	N/A			Re-execute last executed command string
G<n>	0...30000	0		0 = loop forever	Repeat command sequence
g	N/A	N/A			Mark the start of a repeat sequence
M<n>	0...30000	N/A		milliseconds	Delay command execution
H<n>	0-2	0		<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	Halt command execution
T	N/A	N/A			Terminate command

Initialization Commands

Command	Operand Range <n>	Default Operand	Power Up Default	Operand Description	Command Description
Z<n>	0,10...40	0		<0> or no arg, default initialization speed <10-40> initialize at defined plunger speed	Initialize plunger, valve to the right
Y<n>	0,10...40	0		<0> or no arg, default initialization speed <10-40> initialize at defined plunger speed	Initialize plunger, valve to the left
W<n>	0,10...40	0		<0> or no arg, default initialization speed <10-40> initialize at defined plunger speed	Initialize plunger without valve
z<n>	0...6000	0			Set pump's internal position counter to value specified
k<n>	0...255		122		Syringe dead volume command
x<n>	25..100		100		Set initialization force as a percentage of the maximum force
J<n>	10...40			XL mode only	Set initialization speed

RS232 and RS485 Command Summary

Plunger Movement Commands

Command	Operand Range <n>	Default Operand	Power Up default	Operand Description	Command Description
A<n>	0...6000	0			Move plunger to absolute position
a<n>	0...6000	0			Move plunger to absolute position; Not busy
P<n>	0...6000	0			Relative pickup
p<n>	0...6000	0			Relative pickup; Not Busy
D<n>	0...6000	0			Relative dispense
d<n>	0...6000	0			Relative dispense; Not busy

Valve Commands

Command	Operand Range <n>	Default Operand	Power Up Default	Operand Description	Command Description
I	N/A	N/A			Move all valves to Input position
O	N/A	N/A			Move all valves to Output position
B	N/A	N/A			Move all valves to Bypass position
B<n>	0000...1111	N/A			Move each valve pair to the input or output position defined by the binary argument
E<n>	0..255	N/A			Move each valve pair to the input or output position defined by the exponential argument

Set Commands

Command	Operand Range <n>	Default Operand	Power Up Default	Operand Description	Command Description
K<n>	0...255	0	48		Backlash steps
L<n>	1...20		7		Set acceleration/deceleration slope
v<n>	0...1000		901		Set start velocity in Hz
V<n>	1...6000		901		Set top velocity in Hz
S<n>	0...40				Set speed
c<n>	50...2700		901		Set cutoff velocity in Hz
h<n>	0...100		10		Set motor hold current in %
m<n>	0...100		100		Set motor run current in %
N<n>	0...2		0	<0> = normal mode <1> = microstep position mode <2> = microstep position and velocity mode	
J<n>	0...7			0 = all outputs Low 7 = all outputs High	Sets the 3 TTL auxiliary outputs
j<pppp>	<pppp> 1...6000			<pppp> = syringe position <n> = auxillary outputs	Sets the 3 auxiliary outputs based on syringe position

RS232 and RS485 Command Summary

EEPROM Commands

Command	Operand Range <n>	Default Operand	Power Up Default	Operand Description	Command Description
s<n>	0...14				Load program string into EEPROM
e<n>	0...14				Execute EEPROM string
><n1><n2>	<n1> 0..15 <n2> 0..255				Store user data <n2> at specified location <n1>
U30	N/A				Sets auto run
U31	N/A				Clears auto-run
u_	0...12			For factory use only	Set system configuration parameter into EEPROM
!	N/A				Load EEPROM settings

RS232 and RS485 Command Summary

Report Commands

Command	Operand Range <n>	Default Operand	Power Up Default	Operand description	Command Description
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
?4	N/A	N/A			Report plunger position, same as ?
?5	N/A	N/A			Same as ?
?6	N/A	N/A			Reports Valve Position
?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			Non- Functional, Will always report 1
?16	N/A	N/A			Non- Functional, Will always report 1
?17	N/A	N/A			Non- Functional, Will always report 1
?18	N/A	N/A			Number of valve movements since last ?18, same as %
?20	N/A	N/A			Report firmware checksum, same as #
?21	N/A	N/A			Reports plunger hold current as a percentage
?22	N/A	N/A			Reports plunger run current as a percentage
?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
?26 or *	N/A	N/A			Reports +24V
?27	N/A	N/A			Reports configuration EEPROM data as set using the [u] command
?28	N/A	N/A			Reports syringe motor step mode
?30 - ?44					Reports user EEPROM execution strings, ?30 = s0, ?31 = s1 and so on
?76					Same as ?27
F	N/A	N/A			Report Command buffer status, same as ?10
&	N/A	N/A			Report firmware version, same as ?23
#	N/A	N/A			Report firmware checksum, same as ?20
< <n>	0 ..15	N/A			Reports user stored data.
%	N/A	N/A			Number of valve movements since last report, same as ?18

MC6000 CAN Bus Command Summary

On-the-fly Commands

Frame Type = 0

Command	Operands	Command Description
V	Same as RS232/485	Top velocity
T	N/A	Terminate

Action Commands

Frame Type = 1

Command	Operands	Command Description
		All RS232/485 commands, With the exception of Report commands, are valid Action commands in CAN mode

Common Commands

Frame Type = 2

Command	Operands	Command Description
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

MC6000 CAN Bus Command Summary

Report Commands

Frame Type = 6

Command	Operands	Command Description
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 ?10
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 returns a 1.
16	N/A	Number of plunger movements, like ?16, Note, currently not implemented, always returns a 1.
17	N/A	Number of valve movements, like ?17. Note, currently not implemented, always returns a 1.
18	N/A	Number of valve movements since last report, like ?18
20	N/A	Firmware checksum, like ?20
22	N/A	Non-functional command to maintain backward firmware compatibility. Always returns 255, like ?22
23	N/A	Firmware version, like ?23
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.

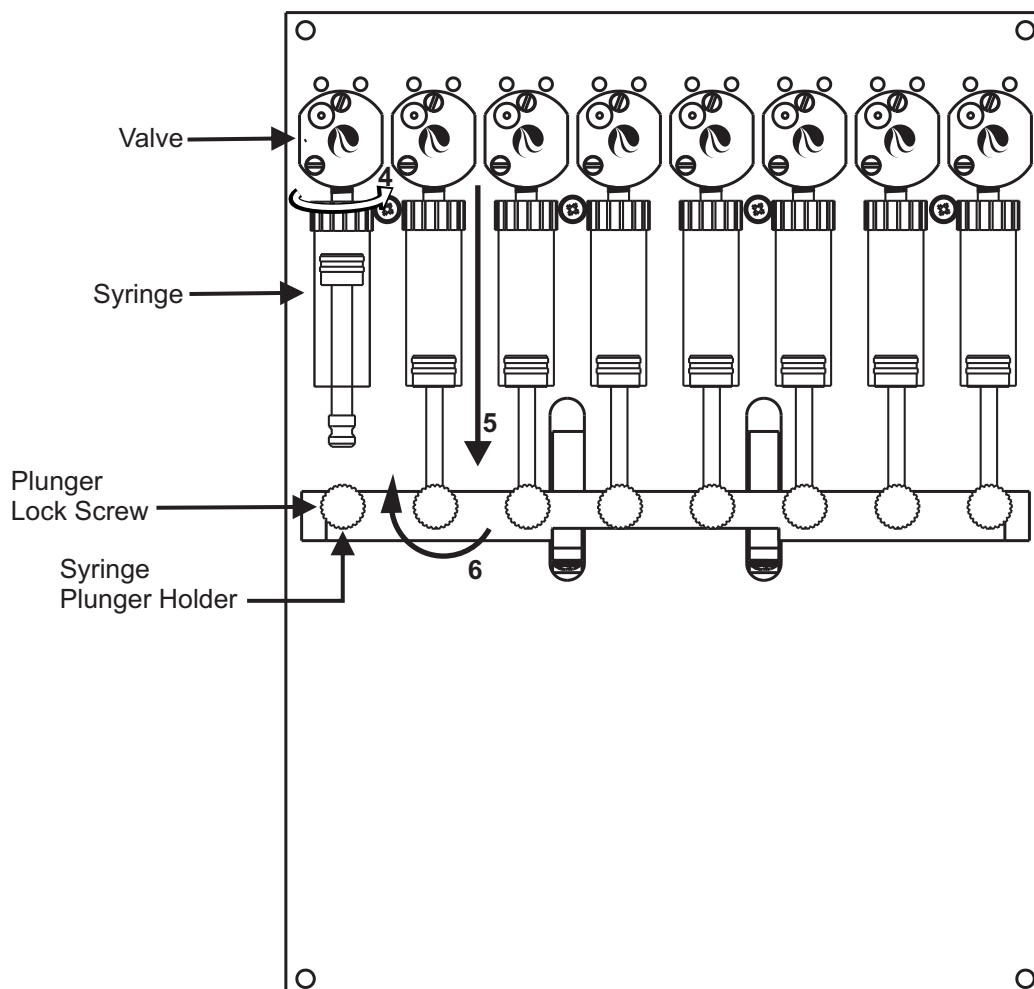
SYRINGE REPLACEMENT

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

1. To replace the syringe, lower the plunger driver. If the power is on, this can be done by sending the A3000R command.
2. Turn the plunger lock screw counterclockwise 3 turns.
3. Turn the syringe counterclockwise and remove from the valve.

To install the syringe follow the steps below:

4. Screw the threaded portion of the syringe clockwise into the valve. Align barrel plunger to center of hole in the plunger holder.
5. Fully seat the plunger into the syringe plunger holder.
6. Securely tighten (clockwise) the plunger lock screw.
7. Initialize the pump.



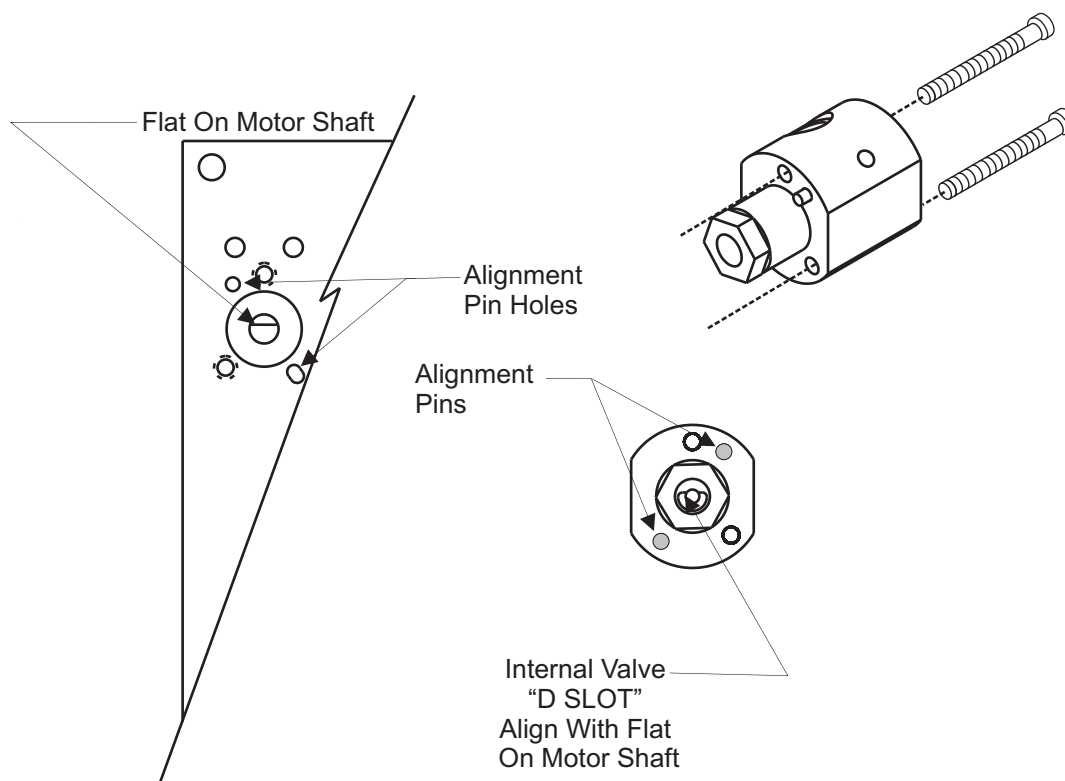
VALVE REPLACEMENT

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

1. Remove syringe as described in steps 1 - 3 on page 19.
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.

To install the valve follow the below steps:

5. Align internal valve “D” slot with the flat on the motor shaft.
6. Gently push and rotate the valve into the correct position to align the pins with the holes in the panel.
7. Securely tighten (clockwise) the plunger lock screws.
8. Initialize the pump.



Order Information

MC6000 Configurations

Catalog #	Description
10154	MC6000-8 with 120° 3-Port, 1/4-28" Valve (PEEK with UHMWPE Plug)
10155	MC6000-6 with 120° 3-Port, 1/4-28" Valve (PEEK with UHMWPE Plug)
10156	MC6000-4 with 120° 3-Port, 1/4-28" Valve (PEEK with UHMWPE Plug)

Syringes

Catalog #	Description
10080	Syringe, 50 µL with PTFE Seal
10081	Syringe, 100 µL with PTFE Seal
10082	Syringe, 250 µL with PTFE Seal
10083	Syringe, 500 µL with PTFE Seal
10084	Syringe, 1 mL with PTFE Seal
10085	Syringe, 2.5 mL with PTFE Seal
10086	Syringe, 5 mL with PTFE Seal

Note: UHMWPE Syringes are available upon request.

Valves

Catalog #	Description
10153	MC 120° 3-Port, 1/4-28" Fitting (PEEK with UHMWPE Plug)

Accessories and Replacement Parts

Catalog #	Description
10160	Converter Module - DB15 to XL Cardedge
10158	PCBA, Main Controller
10159	PCBA, Valve Controller

Contact Information

TriContinent is committed to exceeding our customers expectations when it comes to our products and services. To place an order or inquire on the MC6000 or any TriContinent product, please contact TriContinent at one of the following:

Phone: 800-937-4738
530-273-8888

Fax: 530-273-2586

E-mail: liquidhandling@tricontinent.com

Web: www.tricontinent.com

Address: TriContinent Scientific, Inc.
12555 Loma Rica Drive
Grass Valley, CA 95945

Warranty and Returns

TriContinent is an ISO 13485 certified company that operates under a stringent quality assurance program. We design and manufacture our syringe pumps to be the most reliable product available. We stand behind the MC6000 with an unconditional **2-year** warranty. During the warranty period, should a MC6000 fail for any reason, just call us with an explanation of malfunction and TriContinent will issue a Return Material Authorization (RMA) number for repair or replacement free of charge, no questions asked.

It is the responsibility of the customer to determine the suitability of an application and the material compatibility of our product with your application.

When returning a product for repair or replacement, please contact TriContinent Customer Service to receive a RMA number. When calling please be sure to have the following information available:

- Cat number
- Serial number
- Explanation of Malfunction

TriContinent will not accept the return of any product without prior approval. TriContinent reserves the right to refuse a return on product that has been used with infectious microbiological or radioactive substances or any other materials that may be deemed hazardous.

The RMA number should be referenced on the outside of the shipping container when returning to TriContinent.

Warranty Exclusions

The above warranty shall not apply for defective products resulting from:

- Improper or Inadequate maintenance by the customer
- Unauthorized maintenance or service
- Customer misuse
- Operation outside of the environmental specifications for the product
- Instruments returned without proper packaging

There is no warranty expressed for the following components:

- Valves
- Syringes
- Plungers

Note: For equipment damaged in shipping, please contact the shipper directly.