TRICONTINENT™
HANDLING LIQUIDS...PRECISELY

Z-Series Pump
Quick Start Configuration Guide

Instructions to get the pump with M-Series controller electronics up and running quickly:

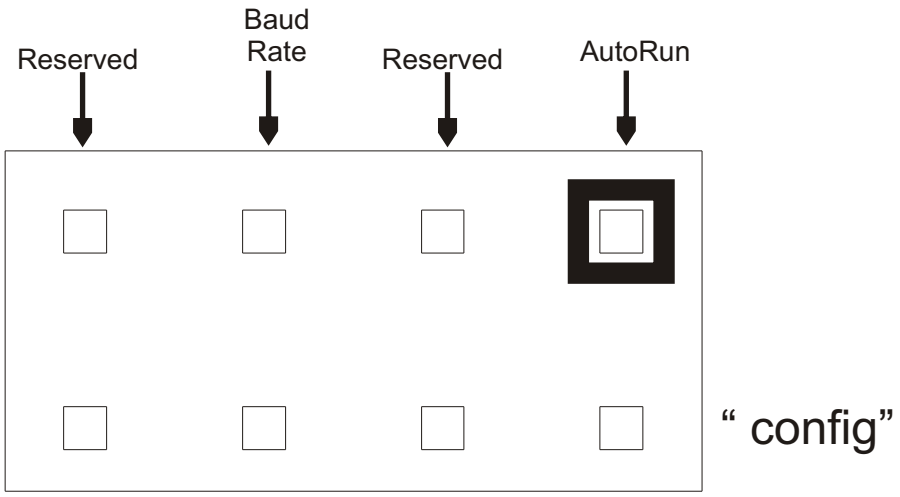
1. Connect pump motor to the controller (figure A).
2. If using the RS485 converter, connect the converter to the PC serial port (figure B).
3. Connect power (red) and ground (black) wires to 24V power supply.
4. Run HyperTerminal (or other terminal emulator program) to communicate to the controller.
5. Set the proper COM port and com settings (9600-8-N-1).
6. Turn on the power supply.
7. Send the following string commands (case sensitive):

/1z1500A0A10z0R	*These commands initialize the pump* to home
/1m68h10R	*This sets run current to 340mA, hold to 50mA*
/1A1000R	*Moves pump 1000 half steps*

CAUTION: ALWAYS TURN OFF THE POWER BEFORE MAKING CONNECTIONS TO THE PUMP!

Configuration Jumpers

Function	Location	Action
AutoRun	JP1	Installed = Autostart
Not Used	JP2	Reserved
Baud Rate	JP3	Installed = 38.4K uninstalled = 9600
Not Used	JP4	Reserved



Address Switch

Note: The software Pump Address is always one value greater than the Switch Address.
For example: Switch Address is 0, Pump Address is 1.

FIGURE A

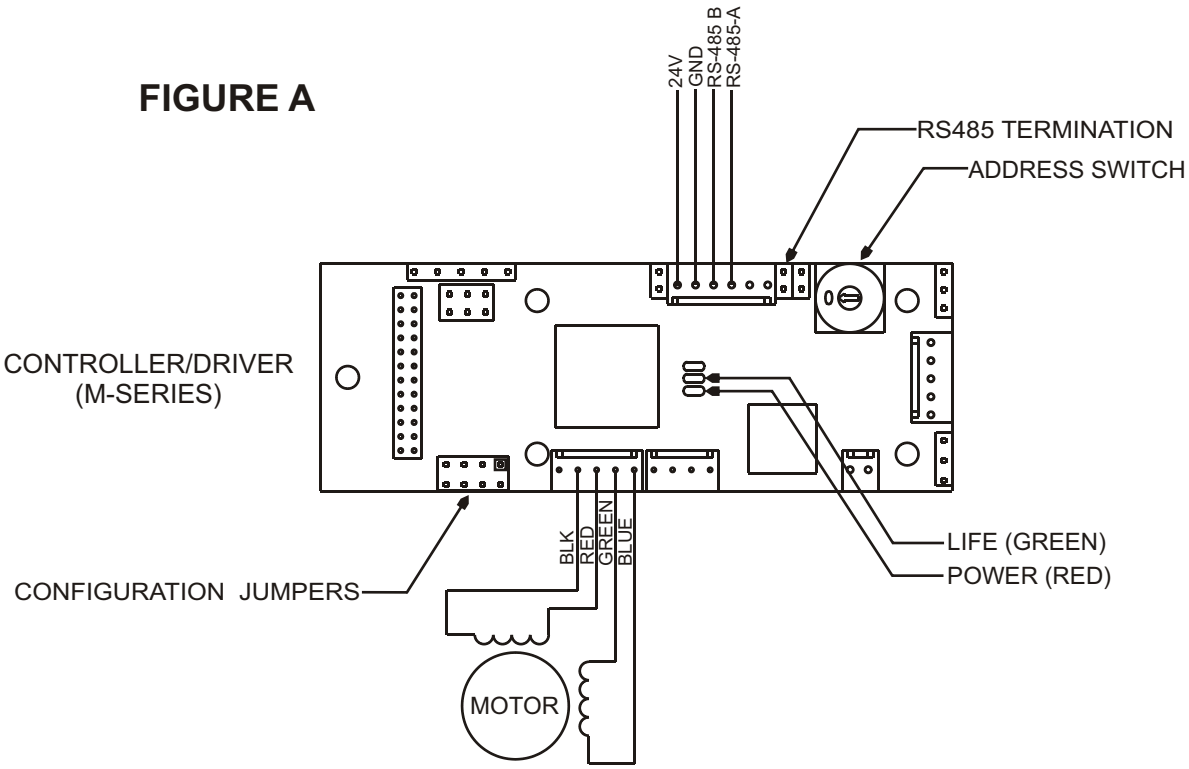
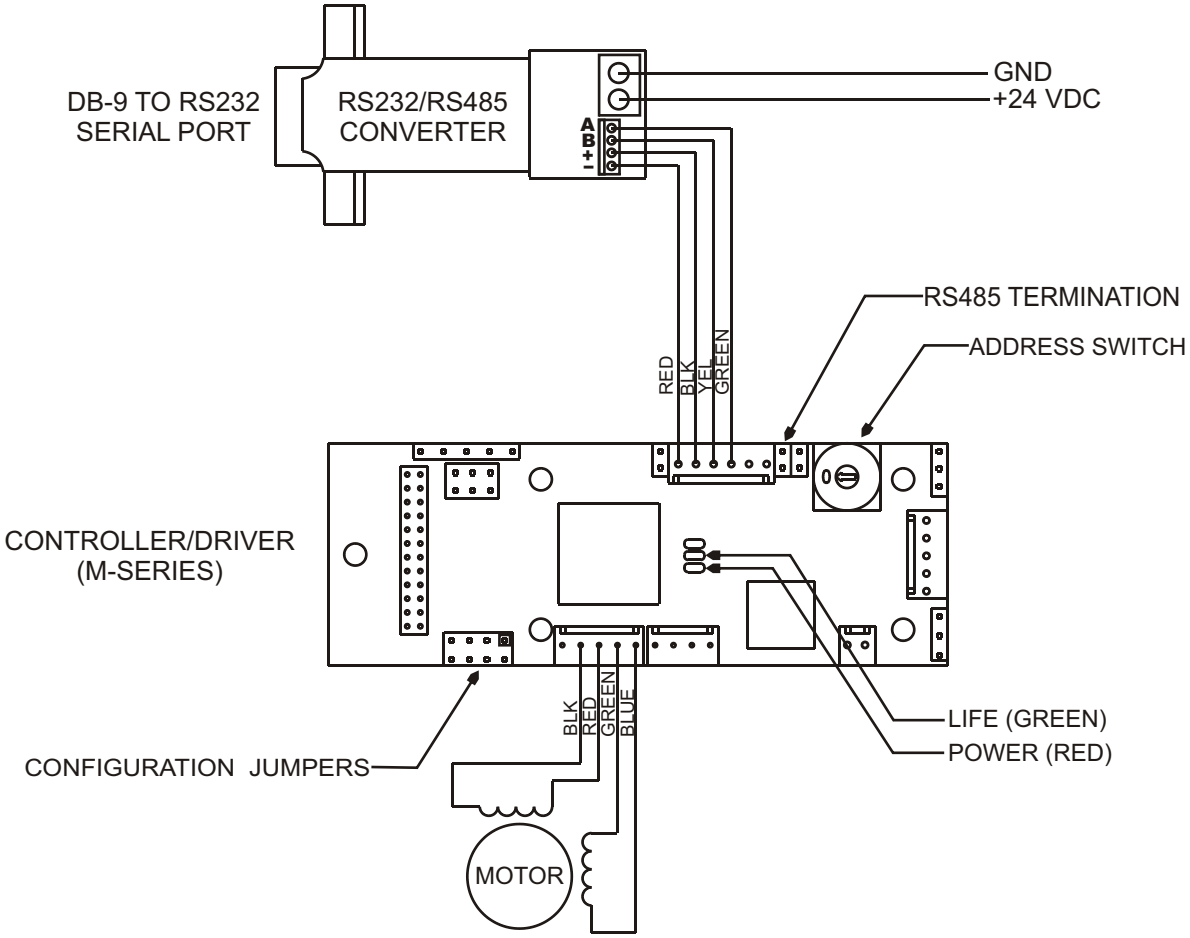


FIGURE B



Communications Protocol and Command Set
M-Series Motion Controller

RS-232 Communications Settings

Baud Rate = 9600 or 38400, jumper selectable, default = 9600
Data bits = 8
Parity = None
Flow Control = None

DT protocol

Command Block (from host)("ASCII Character")
- Start Character ("/" or 2FH)
- Pump Address (switch setting) (1-9 = "1-9" or 31H-39H)(A =":" or 3AH)
  (B =";" or 3BH)(C ="<" or 3CH)(D ="=" or 3DH)
  (E = ">" or 3EH)(F ="?" or 3FH)(0 ="@" or 40H)
- Data (Command(s))
- Carriage Return ([CR(enter)] "♪"or 0DH)

Answer Block (from pump) ("ASCII Character")
- Start Character (" / " or 2FH)
- Master Address ("0" or 30H)
- Status Character
  - No Error
    - Not Busy (" " or 60H)
    - Busy (" " or 40H)
  - Initialization Error
    - Not Busy (" a " or 61H)
    - Busy (" A " or 41H)
  - Invalid Command
    - Not Busy (" b " or 62H)
    - Busy (" B " or 41H)
  - Invalid Operand
    - Not Busy (" c " or 63H)
    - Busy (" C " or 43H)
  - Device Not Initialized
    - Not Busy (" g " or 67H)
    - Busy (" G " or 47H)
  - Command OverFlow
    - Not Busy (" o " or 6FH)
    - Busy (" O " or 4FH)
  - Plunger overload (if optional encoder is installed)
    - Not Busy (" i " or 69H)
    - Busy (" I " or 49H)
  - CAN Bus failure (if optional CAN Bus installed)
  - Not Busy (" h " or 68H)
  - Busy (" H " or 48H)
- ETX (" ♥ " or 03H)
- Carriage Return ([CR(enter)]"♪" or 0DH)
- Line Feed (" ◙ " or 0AH)

OEM protocol

Command Block (from host)("ASCII Character")
Start Character ("^B" or 02H)
Pump Address (switch setting) (1-9 = "1-9" or 31H-39H)(A =":" or 3AH)
(B =";" or 3BH)(C ="<" or 3CH)(D ="=" or 3DH)
(E = ">" or 3EH)(F ="?" or 3FH)(0 ="@" or 40H)
Sequence number (0 7)
Data Block(Command(s))
ETX ("^C "or 03H)
CheckSum 8 bit XOR

Answer Block (from pump) ("ASCII Character")
Start Character (("^B" or 02H))
Master Address ("0" or 30H)
Status Character
Same at DT protocol
Data Block(length n)
ETX (" ^C" or 03H)
CheckSum 8 bit XOR

Command Set

- All commands, except Report commands, will only be executed if followed by a [R] (execute) command. For example: the command [A1000R] moves the motor 1000 steps from the Home (0) position. If an [R] is not included, the command will be stored in a command buffer, which will be executed on the next [R] command
- When a command is sent, the controller answers immediately. If an invalid command is sent, the controller reports an error immediately. If there is an invalid operand in a command containing a Movement Command, the controller executes the command up to the invalid operand and will stop. An Initialization Error requires a reset to clear.

Control Commands

R	Execute the command string or a previously sent command string. Will also resume command execution if halted with the [H] command.
X	Repeat the current command string.
H	Halt current command string. To resume execution, a [R] command must be sent.
T	Terminate current command.
M (5-30000)	Delay for “M” milliseconds.
G (0-3000)	Repeat the command sequence the specified number of times. A value of 0 causes an infinite loop that must be terminated with a [T] command. Loops can be nested up to 10 levels using the [g] command.
g	Mark the start of a repeat loop.
s (0-14)	Store string (0-14) into EEPROM. Each string has a max of 100 characters.
e (0-14)	Executes stored string (0-14).

Set Commands

V (5-6000)	Set top speed in half steps per second.	Default = 1400
v (0-1000)	Set start speed in half steps per second.	Default = 0
c (50-2700)	Set stop speed in half steps per second.	Default = 900
S (0-40)	Set top speed using speed codes.	Default = 11
L (1-20)	Set acceleration factor (accel="L"*2.5 kHz/sec).	Default = 14

m (0-100) Sets the Motor Run current in a % of maximum (500mA). For example, m50R will set the run current to 50% of its maximum (250mA). Similar to the [u2] command, only this setting will be lost when the power is cycled, or it is volatile. Whereas the [u2] is non-volatile.

h (0-100) Sets the Motor Hold current in a % of maximum (500mA). For example, h10R will set the hold current to 10% of its maximum (50mA). Similar to the [u1] command, only this setting will be lost when the power is cycled, or it is volatile. Whereas the [u1] is non-volatile.

N (0-1) N=0, all motor positions are in half steps; N=1, positions are in micro- steps, 8 micro-steps per half-step. Default N= 0 or half-step mode.

k(0-80) Syringe dead volume. After initialization, the plunger will move this many half-steps to minimize the dead volume

u (n_X) Will load pump configuration and calibration info into the internal EEPROM. Note, these parameters are only read on power up. Thus they will only take effect when the power is cycled. Note this command, unlike the Set commands, does not require an [R] to execute.

1.	(1_XXX)	Motor holding current, 0 –100% (100% = 500mA)
2.	(2_XXX)	Motor running current, 0 –100%
3.	(3_XXX)	Max home steps in 100 half-step increments (1-250)
4.	(4_XXX)	Max home speed in 100 half-steps/sec increments (1-100)
5.	(5_XXX)	Homing back-steps in 100 half-steps increments(1-250)
6.	(6_XXX)	Default max V in 100 half-steps/sec increments (1-100)
7.	(7_XXX)	Max plunger stroke in 100 half-step increments (1–250)
8.	(8_XXX)	Home position at top, X= 1, at bottom X= 0
9.	(9_XXX)	Number of user settable outputs(0–4)
10.	(10_X)	No homing opto, X=0. Homing opto installed, X=1
11.	(11_X)	Stall guard level for no-opto homing (1-7)
12.	(12_X)	Solenoid daughter installed, X=1, not installed X=0
13.	(13_X)	CAN Bus option installed, X=1, not installed X=0
14.	(14_X)	Number of backlash steps
15.	(15_X)	Motor winding for LT, X=1, for Z-Pump X=0
16.	(16_X)	Home sensor polarity low = blocked, X=1, low = unblocked X=0
17.	(17_X)	Self test mode string

Initialization Commands

Z (0-1) Initialize plunger using the stallguard feature. Motor will run until a stall is detected. Stallguard measures the back EMF of the motor to detect a stall condition. The level of back-EMF that is considered a stall is set in EEPROM. There are 7 settings, 1-7. 7 is the highest level of EMF that is considered a stall whereas 0 is the lowest EMF.
(0) will initialize at full motor current. (1) will initialize half current.

z (0-1600) Sets current position and initializes the plunger to the value defined by the operand. (0-12,800 in micro-step mode)

Movement Commands

Note: The upper operand limits are based upon the number of half-steps per stroke, which can be set in the EEPROM using the [u] command. The limits below assume 1600 half-steps per stroke. The limit

A (0-1600)	Move motor to absolute position (0-12,800 in micro-step mode)
a (0-1600)	Same as [A], but will give a non-busy status code.
P (0-1600)	Move motor relative number of steps in the aspirate direction (0-12,800 in micro-step mode).
p (0-1600)	Same as [P], but will give a non-busy status code
D (0-1600)	Move motor relative number of steps in the dispense direction (0-12,800 in micro-step mode).
d (0-1600)	Same as [D], but will give a non-busy status code.

Report Commands

Q	Returns a status character. (see Answer Block)
? or ? (0)	Returns current absolute position.
? (1)	Returns start speed.
? (2)	Returns top speed.
? (3)	Returns stop speed.
? (7)	Reports max homing steps.
? (8)	Reports homing speed.
? (9)	Reports homing back steps.
? (10)	Reports syringe dead volume.
? (27)	Reports internal EEPROM parameters. Note the order of the response follows that of the [u] command delimited by commas. For example, /1?27 /0`10,50,20,10,5,10,16,1,4,0,6,0,0,0,0,0,ZR 10 => motor holding current in % 50 => motor running current in %
?30 - ?44	Reports user program strings loaded into external or user EEPROM . ?30 reports string 0, ?31 string 1 and so on.
&	Returns the firmware revision and date.
F	Reports command buffer status. If the buffer is empty, the pump returns status code 0. If a command string is sent to the pump with the [R] command, the buffer status will return 1.