



Programmable Pump Option

for SP200 Series Syringe Pumps

INSTRUCTION MANUAL

Serial No. _____

2.98

Programmable Pump Option for SP200 Series Syringe Pumps

Keypad Programmable Pumps

The “program mode” is available on all series 200 models and permits multistep dispenses without the need for computer control.

From the pump keypad, a custom program can be entered, which will control the pump from seconds to days; permit the flowrate to be changed for discrete time periods; repeat dispenses; control output TTL signals to coordinate with other laboratory instruments (or valves); or respond to inputs from other devices, such as switches or relays, and to perform loops, where dispense sequences are repeated.

The program is divided into time periods called STEPS, each of which can be up to 12 hours long. Each step is automatically numbered and, to simplify programming, a menu prompts the user to select the options available in each STEP.

The flowrate can be ramped up or down, or kept constant for a defined time period for a volume dispense. The initial and final flowrate for each period is entered and the pump automatically makes rate changes over the time period. No need to enter increments for a ramp up or down; the pump automatically ramps the rate linearly.

The pump can be paused and then restarted, either by a time delay or by a TTL input. Both TTL inputs and outputs can be controlled by the pump. The pump can therefore, respond to switch closures or send out signals to actuate valve, or other relays, switches etc.

Two separate loops can be programmed so that steps can be repeated. The number of repeat operations is controlled by the “loop count”. For example, this is helpful when a volume dispense is required, over and over again, triggered by a switch.

The two loops can be “nested” so that the program can run for days and complex dispenses can be repeated many times.

The initial and final Parameters in each step:

- Time duration
- Infuse or withdraw
- Start flowrate
- End flowrate
- TTL output settings
- Pause, wait for TTL input actuation
- Loops to repeat previous steps

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To simplify the programming, previously programmed settings are stored in non-volatile memory and are displayed when Program Mode is selected. Whenever possible, options are displayed with the “active” option flashing. If flashing, this parameter can be selected or changed.

The pump can be programmed by first selecting MODE on the mainline menu and then selecting Program (PRGM).

Display and Programming Sequence

After selecting Program Mode, display reads:

Table
Dia
Step
Mode

DIA and TABLE

If the pump was previously used in Program Mode the pump will be initialized in Program Mode when it is switched on. For convenience, should a syringe change be required, it is possible to enter a new syringe size, either from the stored Table or DIA, without leaving the Program Mode.

If a syringe size change is made however, this will change all program values to defaults and will require reprogramming.

It is possible to review the syringe size in “Dia” or “Table” without changing the programmed settings.

In “Table” review the settings but select “QUIT”, do not enter a diameter.

In “Dia” the settings will not change if there is no change to the diameter entered.

MODE

Mode selection reverts back to other pump operations.

STEP

STEP selection starts the programming sequence.

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MENU OPERATION

After selecting MODE and then PROGRAM the display will show STEP which leads into editing the program.

1. Number of STEPS

Menu prompts "NUM of Steps". Enter total number of program steps using numerical keypad and press SELECT or ENTER to save.

2. Edit STEP

The menu automatically increments the step number, however, it is possible to enter a different number.

If the step number displayed (flashing) is required then press SELECT to save and continue editing.

3. Time

Step # Time xx:xx:xx.

Time xx:xx:xx in hours, minutes and seconds.

Use the → key to move from left to right and enter the time using the numerical keypad. When the correct time is displayed press ENTER to load this time into memory.

4. Infusion/ Withdraw

The direction of travel for each step must be selected.

Initially, "Infusion" direction will be flashing. The direction keys, → and ← are used to switch between directions. SELECT key is then used to load the direction into memory.

5. Rate

The program requires the initial rate (Start), the ending rate (End), and the units.

5a. #Start: xxxxx uuu

is step number, automatically assigned

xxxxx is the numerical flowrate. Enter from the numerical keypad.

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uuu are flowrate units. Use the arrow key → to select units (displayed flashing) Repeat to move through the unit options. Options are: ul/m or ul/h, ml/m or ml/h

The ← key is used to move back to the numerical display. Press ENTER to save.

The menu now prompts for the final rate which is entered in the same manner.

5b. #End: xxxxx uuu

xxxxx numerical and uuu units of flowrate

5c. Options:

if R1=R2=0

The pump is stopped, no flowrate.

if R1<R2

Flowrate increases LINEARLY from R1 to R2 over the step duration.

if R1>R2

Flowrate decreases LINEARLY from R1 to R2 over the step time.

6. Pin Out

TTL Output pins can be controlled to set the levels high (H) or low (L) during the step. This change in status of an output pin can be used to trigger another external event.

Pins 1 and 6 on the 9-pin TTL connector can be controlled in the program.

The display reads: # Pinout: 1= H, 6= H

Options: HH, HL, LH, LL

The arrow keys are used to toggle through the options. Select and Enter are used to save the settings.

7. Pause

If the Pause option is selected in a step, the pump completes the step and pauses at the end of the step.

The display reads: **Paused @ end of n** where n is the step number.

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The pump is programmed but stopped, waiting to be actuated, either by:

- a. Run/Stop key
- b. "RUN" command via RS232
- c. TTL input, Pin 8 ; level change from High to Low.

The display reads: **# Pause: Inactive Active**

Use the arrow key and SELECT to save.

8. LOOP

A loop permits the program to return to and execute a previous step, or steps, and repeat these steps a specified number of times (up to 100).

The menu first prompts for a loop selection: **# Loop?: Yes No**

Loop selection is made using the arrow keys to move to Yes or No.
SELECT to save

8a. LOOP to STEP

The menu now prompts for the Step # the program Loop should return to. For example, if the program is at step 5 and the loop step selected is #3, then the program executes step 3, 4 and 5 again.

Loop to Step ?

The step number is entered from the numerical keypad followed by ENTER or SELECT.

8b. LOOP COUNT

After setting the initial step number of the loop, the menu will prompt for the "loop count", the number of times the loop will be repeated.
Maximum repeat number is 100.

Display reads: **# Loop Count: x**

The number of loops to be executed, x is entered from the numerical keypad followed by ENTER.

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NOTE:

a) Maximum number of loops is two.

Once both loops are entered the loop option will NOT be displayed in menu. To change loops, if two are already entered, one loop must be cancelled before the new loop can be programmed.

b) A LOOP within a LOOP

It is possible to have a loop running within a loop.

9. Saving the Step

As there are many options in each step the program gives one more option, "Redo" to make changes before storing the Step.

menu prompts: **# Step: Save Redo**

The arrow keys are used to highlight the required option which can be saved with ENTER or SELECT.

10. Program End

After saving the step the program prompts: # Next Step Done

"Next Step" is selected, unless all steps are completed, and the above process is repeated for the number of steps required, up to 8. When all steps are programmed "Done" should be entered, with SELECT or ENTER to complete the programming.

The pump and display will now move to Step 1 ready to start the programmed dispense.

display **Stp 1 xx:xx:xx →**

RUNNING THE PROGRAM

Run The Run key starts the program; the displayed time counts down and the direction arrow flashes.

Hold / Continue

If the Run/Stop key is pressed while running a program, the pump is stopped but gives an option to end the program, or restart the pump and continue the program to its end.

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Program changes when operating

Once a step has commenced no changes are possible in that step. However, while dispensing changes are permitted to steps still to be executed.

Syringe size changes

If the pump was previously used in Program Mode the pump will be initialized in Program Mode when it is switched on. For convenience, it is possible to enter a new syringe size, either from the stored Table or DIA, without leaving the Program Mode.

Note: If a syringe change is made this will change all program values to the default settings and will require reprogramming. A diameter change causes the pump to stop; resets the “number” of steps to 1; resets the “activestep” to 1; and all values will be set to the initial default settings. The initialization of the new settings takes approximately two seconds.

Stall Condition

The Fast Forward & Fast Reverse features do not work in Program Mode. Should a stall occur then go to Infusion Mode where the Fast Forward/Fast Reverse features works, and use these features to end the stall condition.

By going to the infusion mode the program is still saved in memory.

RS232 COMMANDS and RESPONSES

All commands and responses in standard pumps remain the same, however, the program mode does have additional commands and responses.

Each pump can be controlled either from the keypad or via RS232 at all times, but the pump can only respond to one command at a time. When under RS232 control the display reads “REMOTE”. All settings made via RS232 are stored in non-volatile memory.

To move the pump from Remote (RS232) to keypad control press select.

Commands and Responses

Commands are not case sensitive

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After each command is received and executed the pump responds with prompt sequence:

a. Query commands:

carriage return (<CR>)line feed, text, <CR>, line feed, 1 or 2 digit address, prompt character

b. Other commands:

<CR>, line feed, 1 or 2 digit address, prompt character

Prompts

>	running in infusion direction
<	withdrawing
:	stopped
NA	not applicable
E	error (see error? command)
P	pump is paused

carriage return <CR> All pumps chain interpret this as a stop command.

pump address <CR> Pump with the specified address responds with a prompt.

pump address (optional), command <CR> Pump at the address executes the command and then responds with a prompt.

Note: If there are multiple pumps in the daisy chain and a pump address is not used then all pumps will respond to the non-specific command and return prompts. Multiple prompts results in a communications breakdown.

Note that withdrawal and continuous mode commands are recognized only by the infusion/withdrawal models.

Pump commands and responses

mode prgm sets pump in program mode. Response :

number n sets number of steps in program. n = 1 - 8

step n sets step number to be programmed. n = 1 - 8

Important that step number be set *before* entering program settings.

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<i>activestep?</i>	queries step running response: n where n = 1 to 8
<i>timeleft?</i>	queries time remaining in active step response: xx:xx:xx where hr:min:sec
<i>number?</i>	queries number of steps in program response: n where n = 1 to 8
<i>step?</i>	queries step being programmed (Not the active step) response: n where n = 1 to 8
<i>time?</i>	queries time in program step (Not the active step) response: xx:xx:xx where hr:min:sec
<i>travel?</i>	queries direction of travel in programmable step (not active step) response: I or W where I is infusion, and W is withdrawal Note: Prompts > or < indicate direction of active step
<i>rateb?</i>	queries beginning rate response: nnnnn uuu where nnnn is . , 0 to 9 uuu is ul/m, ul/h, ml/m. ml/h
<i>ratef?</i>	sets finish rate response: nnnnn uuu where nnnnn is . , 0 to 9 uuu are units ul/m , ul/h, ml/m, ml/h.
<i>portout?</i>	queries status of output TTL pins 1 and 6 response HH, HL, LH, LL
<i>pause?</i>	queries whether pause response: Y or N where Y is yes, N is no
<i>loops?</i>	queries whether loops in program response: Sn:x Sn:x where Sn is the step number containing a loop x is the number of loops remaining to be executed (counts down)
<i>loop?</i>	queries loop status in the step response: Y or N where Y is yes, N is no

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loopto? queries step number to which program loops (not available if no loops)
 response: n where n = 1 to 7

loopcnt? queries number of loop repeats (not available if no loops programmed)
 response: n where n = 1 to 100

NOTE:

- a. It is important to save each step before programming next step
- b. Only two loops are permitted, therefore recommend to query number of loops in an existing program before modifying the program. If loops are present it will be necessary to delete an existing loop before a new loop can be programmed.

Program example

Syringe selected, 4.70 mm diameter

RS232 programming

mode prgm	Select Program mode
Number 4	sets number of steps in the program
Step 1	selects Step 1 for programming
time 00:00:10	Step 1 time duration is 10 seconds
travel I	infusion selected
rateb 0 mlm	step 1 beginning rate is 0 ml/minute
ratef 1 mlm	step 1 finishing rate is 1 ml/minute
portout hh	output pins 1 and 6 set at high/high
pause n	pause inactive
loop n	No loops
save	save step settings
Step 2	ready to program step 2
time 00:00:15	set time duration to 15 seconds
rateb 1 mlm	Assumes previous travel direction (infusion), and sets step 2 beginning rate 1 ml/minute.
ratef 0.1 mlm	finishing rate 0.1 ml/minute
loop y	select a loop

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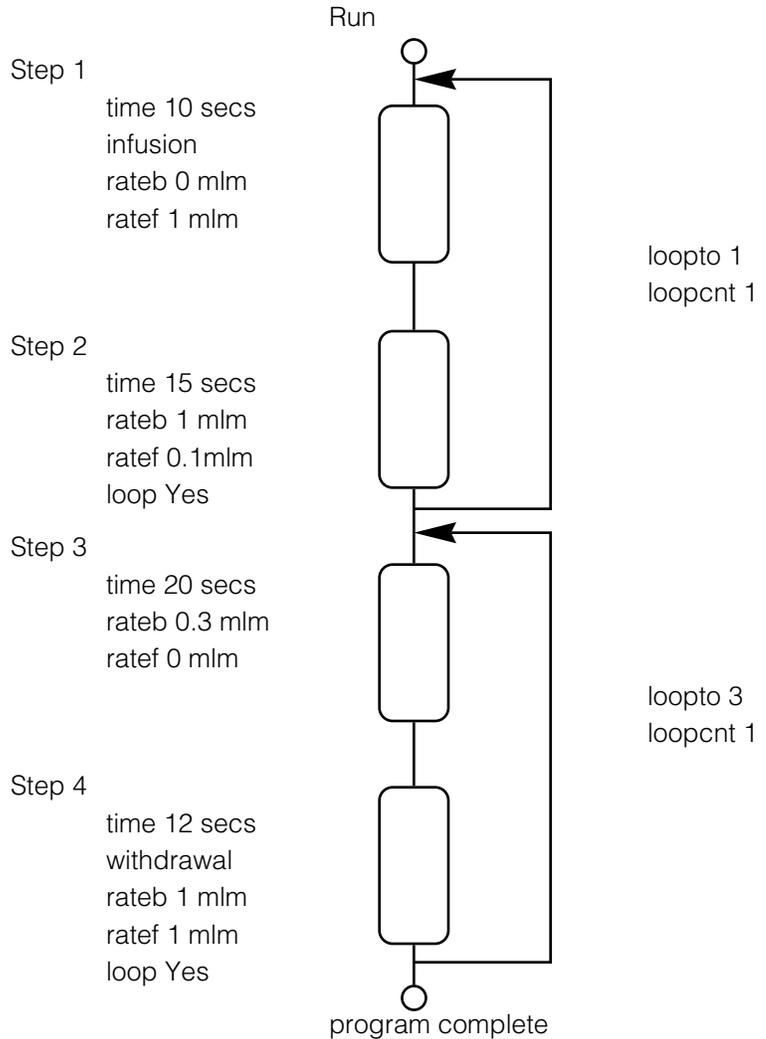
<p>loopto 1 loopcnt 1 save</p> <p>step 3 time 00:00:20 rateb .3 mlm</p> <p>ratef 0 mlm save</p> <p>step 4 time 00:00:12 travel w rateb 1 mlm ratef 1 mlm loop y loopto 3 loopcnt 1 save done</p>	<p>program will loop back to step 1 after completing step 2 will repeat the loop one time</p> <p>ready to program step 3 time of step 3 is 20 seconds sets begin rate to 0.3 ml/min. Assumes no direction change. sets finish rate to 0 ml/min.</p> <p>program step 4 time duration 12 seconds change direction to withdrawal withdraw rate set to 1.0 ml/minute. finish rate 1 ml/min. select a loop after step 4 will loop back to and repeat step 3. will repeat loop one time.</p> <p>completes and saves program</p>
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Queries:

- | | | |
|---------------------------|-----------|---|
| a) loops? | S2:1 S4:1 | loop in step 2, loop count is 1; loop in step 4,
count 1 |
| b) step 3 portout? | HH | Portout set in step 1 and remained unchanged |
| c) step 1 ratef? | 1 ml/m | finish rate in step 1 is 1.0 ml/minute |

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Program Example

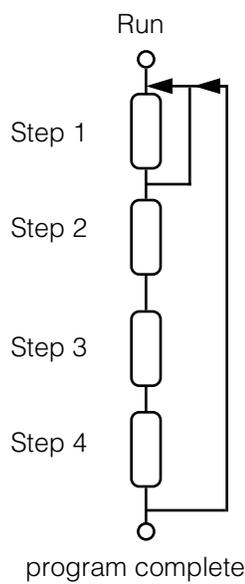
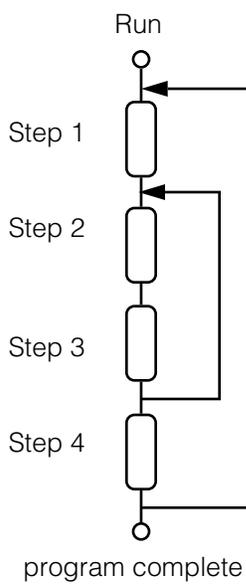
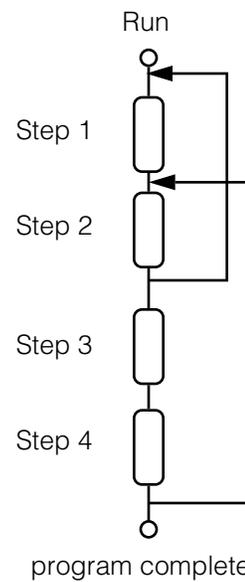
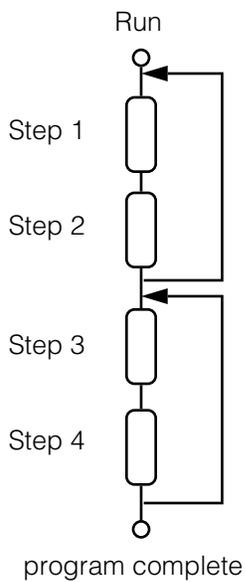


RS232 Commands and Queries

Run	starts program
Wait	halts and holds program
Continue	restarts program and continues to complete program
activestep?	responds with step number running
timeleft?	responds with time remaining in active step

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Loop Options:



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TTL SPECIFICATIONS

5 4 3 2 1

9 8 7 6

. . . as viewed from rear of the pump.

Pin	3	Vss, ground ref.	
	1,6	controlled output	High / Low states set at start of each step (could be used for valve control)
	8	Trigger	falling edge ends pause and starts next step
	4	undefined	
	2	directional output	high - infuse, low - refill (stays high when stopped)
	5	audible alarm option	pulses with "end of program" audible alarm feature
	7	run indicator	high - running, low - stopped
	9	pause/continue	When running High/Low state change acts like run/stop key, or the RS232 commands wait/continue

logic low 0 - 0.5V, max. 2 ma current sink

logic high 2V - 5V

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Warranty

WPI (World Precision Instruments, Inc.) warrants to the original purchaser that this equipment, including its components and parts, shall be free from defects in material and workmanship for a period of one year from the date of receipt. WPI's obligation under this warranty shall be limited to repair or replacement, at WPI's option, of the equipment or defective components or parts upon receipt thereof f.o.b. WPI, Sarasota, Florida U.S.A. Return of a repaired instrument shall be f.o.b. Sarasota.

The above warranty is contingent upon normal usage and does not cover products which have been modified without WPI's approval or which have been subjected to unusual physical or electrical stress or on which the original identification marks have been removed or altered. The above warranty will not apply if adjustment, repair or parts replacement is required because of accident, neglect, misuse, failure of electric power, air conditioning, humidity control, or causes other than normal and ordinary usage.

To the extent that any of its equipment is furnished by a manufacturer other than WPI, the foregoing warranty shall be applicable only to the extent of the warranty furnished by such other manufacturer. This warranty will not apply to appearance terms, such as knobs, handles, dials or the like.

The foregoing obligations set forth in this paragraph are in lieu of all obligations and liabilities, including all warranties of merchantability or otherwise, expressed or implied or statutory, and state WPI's entire and exclusive liability and purchaser's exclusive remedy for any claim of damages in connection with the sale or furnishing of all equipment, including design, suitability for use, operation, or installation. There are no warranties which extend beyond the description of the face hereof. In no event shall WPI be liable for any special or consequential damages.

Warning: This equipment is not designed or intended for use on humans.

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