



Fisher  
**Bioblock Scientific**

Parc d'innovation - BP 50111 - F67403 illkirch cedex

**France**

tél 03 88 67 14 14

fax 03 88 67 11 68

email [infos@bioblock.fr](mailto:infos@bioblock.fr)

[www.bioblock.com](http://www.bioblock.com)

**Belgique / België**

tél 056 260 260

fax 056 260 270

email [belgium@bioblock.com](mailto:belgium@bioblock.com)

[www.be.fishersci.com](http://www.be.fishersci.com)

# Mode d'emploi

## Programmable Pump

## **PROGRAM MODE**

The "program mode " is available on all series 200 models.

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.

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

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 changeing the programmed settings.\* In "Table" review the settings but select "QUIT", do not enter a diameter. In "Dia" the settings will not change providing there is no change to the diameter entered.

## **MODE**

Mode selection reverts back to other pump operations.

## **STEP**

STEP selection starts the programming sequence.

## 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.

#### a) #Start: xxxxx uu

# is step number, automatically assigned

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

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

#### b) #End: xxxxx uu                      xxxxx numerical and uuu units of flowrate

c) Options:

- 1) If  $R1=R2=0$  The pump is stopped, no flowrate.
- 2) if  $R1 < R2$  Flowrate increases LINEARLY from  $R1$  to  $R2$  over the step duration.
- 3) 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

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

a) **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.

b) **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.

**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.

### ***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.

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

### ***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

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),<br>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 recognised only by the infusion/withdrawal models.

## Pump commands and responses

|                       |                                                                                                                                                                                   |
|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>mode prgm</b>      | sets pump in program mode. Response :                                                                                                                                             |
| <b>number n</b>       | sets number of steps in program. n = 1 - 8                                                                                                                                        |
| <b>step n</b>         | sets step number to be programmed. n = 1 - 8<br><b>important</b> that step number be set <b>before</b> entering program settings                                                  |
| <b>time xx:xx:xx</b>  | sets time duration of step to be programmed. hr:min:sec                                                                                                                           |
| <b>travel l (w)</b>   | sets direction to infusion ( withdrawal )                                                                                                                                         |
| <b>rateb nnnnn uu</b> | sets step beginning rate<br>where nnnnn is . , 0 to 9<br>where uu are units ulm , ulh, mlm, mlh.<br><br>Note: if set rate is out of range then response is NA; rate is set a zero |
| <b>ratef nnnnn uu</b> | sets step finish rate<br>where nnnnn is . , 0 to 9<br>where uu are units ulm , ulh, mlm, mlh.<br><br>Note: if set rate is out of range then response is NA; rate is set a zero    |
| <b>portout p</b>      | sets status of output pins 1 and 6<br>where p is      HH    ( 1=high, 6=high )      HL    ( 1=high, 6=low )<br>LH    ( 1=low, 6=high )      LL    ( 1=low, 6=low)                 |
| <b>pause y or n</b>   | sets status of pause<br>y = active<br>n = inactive                                                                                                                                |
| <b>loop y or n</b>    | sets loop status<br>y = yes              n = no                                                                                                                                   |
| <b>loopto n</b>       | set step number to loop to      where n = 1 to 7                                                                                                                                  |
| <b>loopcnt b</b>      | sets number of loops to be repeated      where b = 1 to 100                                                                                                                       |
| <b>save</b>           | saves step settings <b>important</b> that each step is saved                                                                                                                      |
| <b>done</b>           | saves all programmed steps<br><b>important</b> that "done" is entered after all steps saved                                                                                       |
| <b>wait</b>           | stops pump, but can be restarted                                                                                                                                                  |
| <b>continue</b>       | restarts pump after "wait" command, program continues                                                                                                                             |
| <b>mode?</b>          | query mode. Response PGM                                                                                                                                                          |
| <b>activestep?</b>    | queries step running<br>response: n      where n = 1 to 8                                                                                                                         |

|                  |                                                                                                                                                                                 |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>timeleft?</b> | queries time remaining in active step<br>response: xx:xx:xx      where hr:min:sec                                                                                               |
| <b>number?</b>   | queries number of steps in program<br>response: n      where n = 1 to 8                                                                                                         |
| <b>step?</b>     | queries step being programmed ( Not the active step )<br>response: n      where n = 1 to 8                                                                                      |
| <b>time?</b>     | queries time in program step ( Not the active step )<br>response: xx:xx:xx      where hr:min:sec                                                                                |
| <b>travel?</b>   | queries direction of travel in programmable step (not active step)<br>response: I or W      where I is infusion, and W is withdrawal                                            |
|                  | Note: Prompts > or < indicate direction of active step                                                                                                                          |
| <b>rateb?</b>    | queries beginning rate<br><br>response:      nnnnn uu<br>where nnnn is . , 0 to 9      uu is    ul/m, ul/h, ml/m, ml/h                                                          |
| <b>ratef?</b>    | sets finish rate<br><br>response:      nnnnn uu<br>where nnnnn is . , 0 to 9      uu are units ul/m , ul/h, ml/m, ml/h.                                                         |
| <b>portout?</b>  | queries status of output TTL pins 1 and 6<br>response HH, HL, LH, LL                                                                                                            |
| <b>pause?</b>    | queries whether pause<br>response: Y or N      where Y is yes, N is no                                                                                                          |
| <b>loops?</b>    | queries whether loops in program<br>response: Sn:x Sn:x<br><br>where Sn is the step number containing a loop<br>x is the number of loops remaining to be executed (counts down) |
| <b>loop?</b>     | queries loop status in the step<br>response: Y or N      where Y is yes, N is no                                                                                                |
| <b>loopto?</b>   | queries step number to which program loops (not available if no loops)<br>response: n      where n = 1 to 7                                                                     |
| <b>loopcnt?</b>  | queries number of loop repeats (not available if no loops programmed)<br>response: n      where n = 1 to 100                                                                    |

**NOTE:**

- It is important to save each step before programming next step
- 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

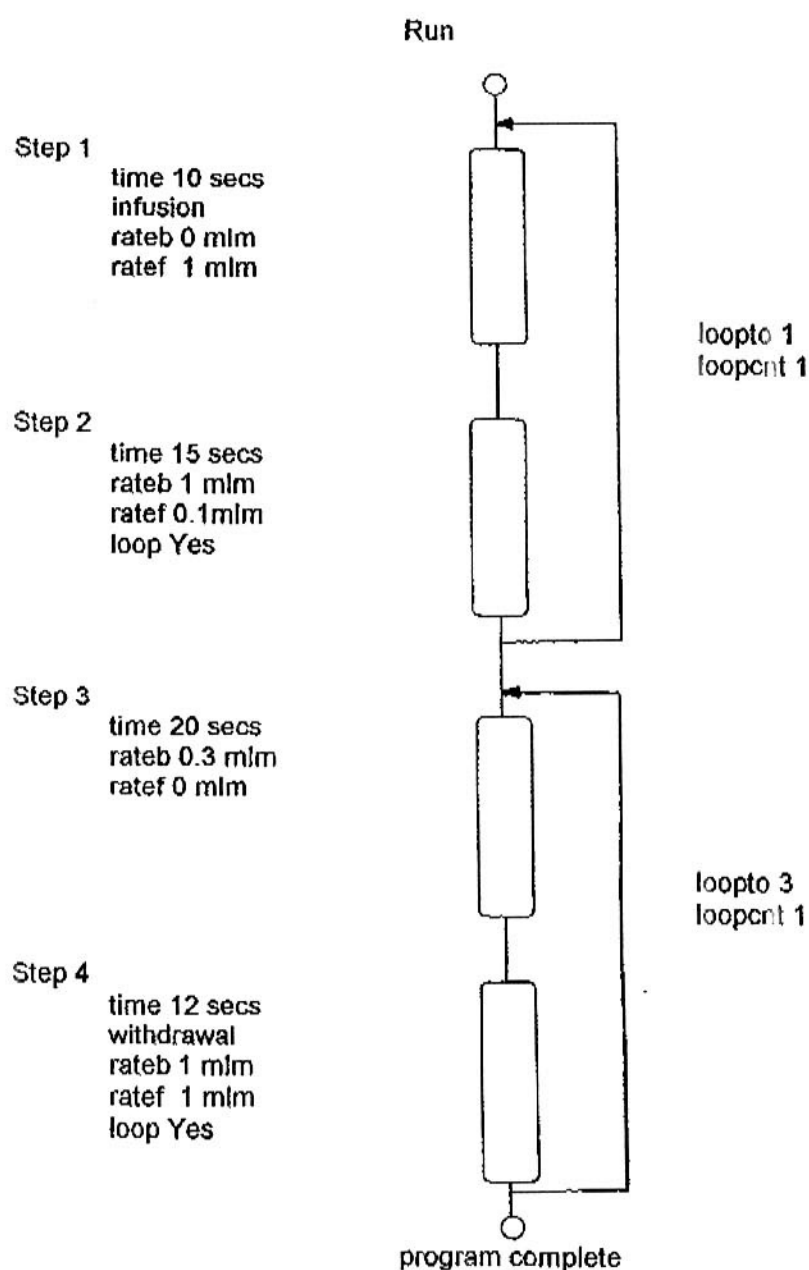
### RS232 programming

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

### Queries:

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

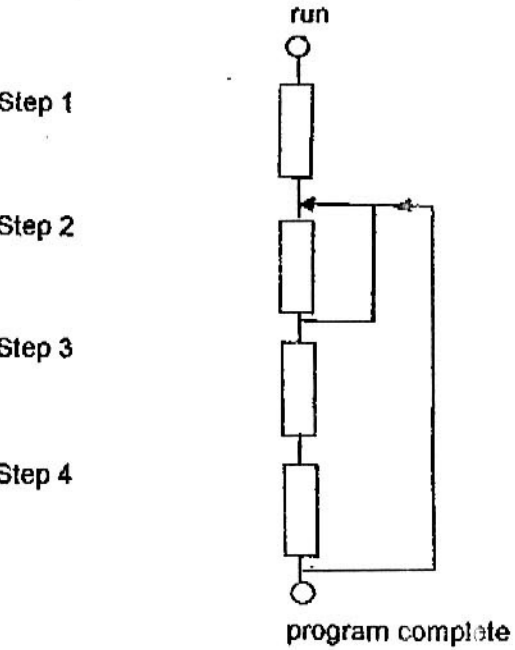
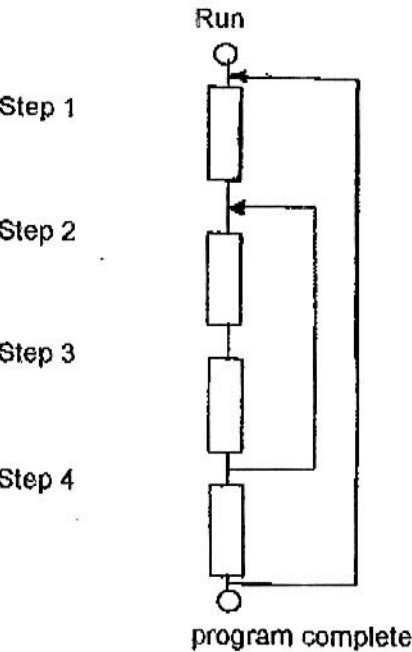
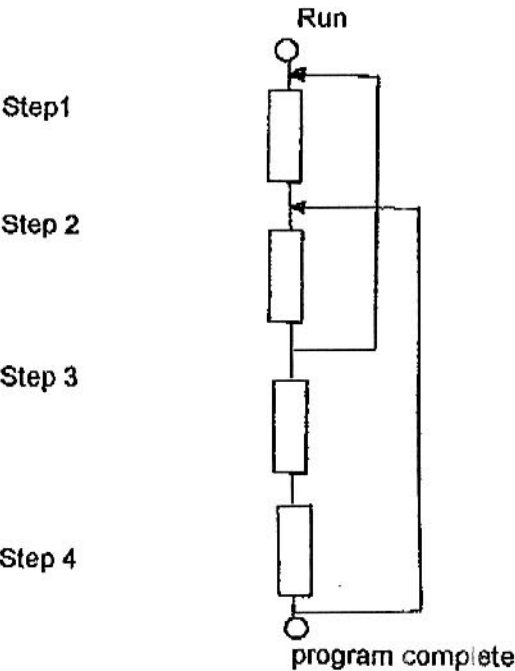
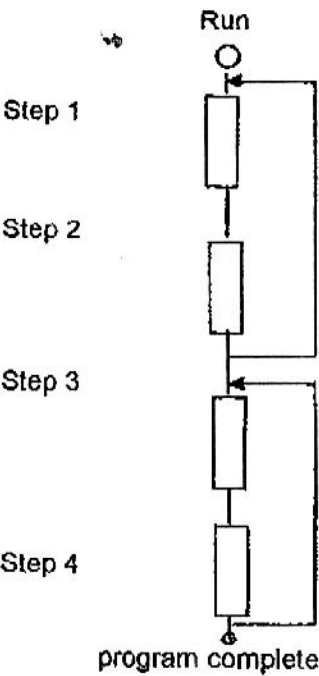
## Program example



## 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        |

**Loop Options:**



## 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<br>( 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<br>run/stop key, or the RS232 commands wait/continue |

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

**logic high** 2V - 5V

**kdScientific**

**Model**

**200**

**Series**

## Contents

|                                               |    |
|-----------------------------------------------|----|
| Introduction                                  | 1  |
| Specifications                                | 2  |
| Features                                      | 3  |
| Operating Instructions                        |    |
| Power switch                                  | 6  |
| Syringe loading                               | 6  |
| Withdrawal operation                          | 6  |
| Menu features                                 | 8  |
| Keypad functions                              | 8  |
| Fast Forward, Fast Reverse                    | 8  |
| Syringe diameter entry                        | 8  |
| Volume setting                                | 9  |
| Units setting                                 | 10 |
| Rate setting                                  | 10 |
| Power interruption (power up)                 | 10 |
| Run/Stop                                      | 10 |
| Change or Review Volume Setting while Running | 11 |
| Mode selection                                | 11 |
| infusion                                      |    |
| withdrawal                                    |    |
| infusion/withdrawal                           |    |
| withdrawal/infusion                           |    |
| continuous                                    |    |
| Manual stall setting and microliter syringes  | 12 |
| Glass syringes                                | 12 |
| Stall Clearance                               | 13 |
| NV Ram Failure                                | 13 |
| RS232C commands                               | 13 |
| TTL Specifications                            | 18 |
| Fuses                                         | 18 |
| Table 1 Syringe diameters                     | 19 |
| Table 2 Maximum and minimum flowrates         | 20 |
| Limited warranty                              | 21 |

## SPECIFICATIONS

Model - model 200 series

Syringe size - 10 microliter to 140 milliliter

Electrical Rating - 230 V~, 0.1A, 50/60 Hz

Fuse - 5x20mm. 250V 0.25AT (slow blow)[USA model] CE model 0.1AT (slow blow)

Voltage operating range - USA 110-125 V~ CE model 220-260 V~

Drive mechanism - microprocessor controlled stepper motor 1/2 - 1/16 microstepping,  
driving a leadscrew through a belt and pulley drive mechanism

Pusher advance per microstep (1/16 step) - 0.165 micron (or .0000064 inch)

Volume per microstep (1/16) with 60ml BD syringe - 0.0919ul

Maximum stepping rate - 1600 @ 1/2 steps/sec

Linear Travel Rate Min:  $5.7 \times 10^{-5}$  cm/hr Max: 12.69 cm/min

Speed range -  $4.26 \times 10^9$ :1

Flowrate range - 0.001ul/hr to 70.57ml/min (60 ml syringe)

Nominal linear force - 35 lb

Dimensions - 11x9x5.5 inch (28x23.5x14 cm)

Weight - 9 lb (4 kilo)

### Atmospheric Specifications

|                            |   |                                      |
|----------------------------|---|--------------------------------------|
| Temperature                | : | -40 to +85 Degrees C                 |
| Humidity                   | : | L.T. 95%                             |
| Mode of Operation          | : | Continuous                           |
| Classification             | : | Class I                              |
| Pollution Degree           | : | 2                                    |
| Installation Category      | : | II                                   |
| Output                     | : | N/A                                  |
| Physiological Effects      | : | N/A                                  |
| Cooling Conditions         | : | No special considerations            |
| Mechanical Stability       | : | No special considerations            |
| Protective Packaging       | : | No special considerations            |
| Earth Terminals            | : | No External connections required     |
| Removable Protective Means | : | N/A                                  |
| Supplier Name              | : | KD Scientific Inc.                   |
| Address                    | : | 33 Sleeper St. Boston, MA 02210, USA |

## GENERAL DESCRIPTION

This manual applies to the KDS200 series pumps; infusion pumps, models 200, 220, 250 and infusion/withdrawal pumps, models 210, 230 and 260.

Most features are common to all pumps. However, the infusion/withdrawal models, 210 and 230 have additional modes selection and related RS232 commands, not available in infusion only models.

Operation of the pumps is simplified by using a keypad to select features from a menu on the alphanumeric LCD display.

All control functions are performed automatically by the pump microcontroller and are based on the syringe diameter and linear motion of the pusher block to deliver a known volume. After entering the syringe diameter, either directly or from a table in memory, a dispense volume and flow rate can be entered, and then all calibration and control functions are performed by the pump automatically.

| model | number syringes | infusion | withdrawal |
|-------|-----------------|----------|------------|
| 200   | 2               | x        |            |
| 210   | 2               | x        | x          |
| 220   | 10              | x        |            |
| 230   | 10              | x        | x          |
| 250   | 4               | x        |            |
| 260   | 4               | x        | x          |

## FEATURES

### **1) Syringe identification**

#### Look up Table

The pump contains a table of standard syringes arranged by manufacturer, material and size. Once the syringe is identified in the table the pump automatically enters the appropriate diameter.

#### Direct Entry

If the syringe used is not included in the table, the internal diameter of the syringe barrel can be measured in millimeters and entered directly from the keypad.

### **2) Infusion and refill rates**

The infusion rate and, where applicable, the withdrawal rate can be set independently and can be changed while the pump is running. After the operating mode selection is made the program will prompt only for the relevant rates associated with that mode.

### **3) Volume**

A target volume can be entered for infusion and refill independently, and the pump automatically stops when this volume is reached. The pump displays an initial volume of zero and increases as the dispense proceeds to the target volume. The target volume can be reviewed or changed as the pump continues to operate.

### **4) Modes of operation**

#### **Infusion**

Rate and volume settings: pump infuses to the set volume and stops.  
Rate setting only: pump runs until manually stopped or stalls.

#### **Withdrawal**

Rate and volume settings similar to above.

#### **Infusion/withdrawal**

Infusion automatically followed by withdrawal. Rate and volume settings can be made independently for infusion and withdrawal, hence the pump can infuse at one rate and volume and then change to a different withdrawal flowrate and volume setting.

#### **Withdrawal/infusion**

Withdrawal immediately followed by infusion. Separate settings for rate and volume can be made for withdrawal and infusion.

#### **Continuous operation**

The pump cycles from infusion to withdrawal continuously. The volume is identical in infuse and withdrawal directions.

**Note:** The displayed menu which prompts the operator for Rate and Volume settings changes with Mode selection. For convenience, only the relevant settings associated with the selected mode are prompted.  
For example, in the Withdrawal / Infusion mode the menu prompts for withdraw and then infuse volumes, followed by withdraw and infuse rates. In Infusion only mode, the menu prompts only for infusion volume and infusion rate.  
In the Continuous mode only one volume is prompted for followed by infusion and withdrawal flow rates.

### **5) RS232C interface**

Multiple pumps can be controlled in a "daisy chain" by a single PC. Programming is reduced to a small number of simple commands.

### **6) TTL**

Input and output controls are available, such as, direction change, run indicator, footswitch or timer control, and valve or relay actuation.

#### **7) Stall detection**

The motor is monitored by an optical encoder to confirm the programmed movement. If the back pressure increases due to jamming or flow restriction then the motor may stall. Stall detection by the encoder results in a pump shutdown. The display will read " Stalled ". The Stall message can be cleared with the Select key.

#### **8) Power disruption**

When power is returned after a temporary power disruption the pump can be programmed to resume operation or remain stopped. However, if a dispense volume is set then the pump always remains stopped.

#### **9) Non-volatile memory**

All operational settings are stored in non-volatile memory for convenience, and are used to set the pump when first switched on.

#### **10) Selection of rate and volume units**

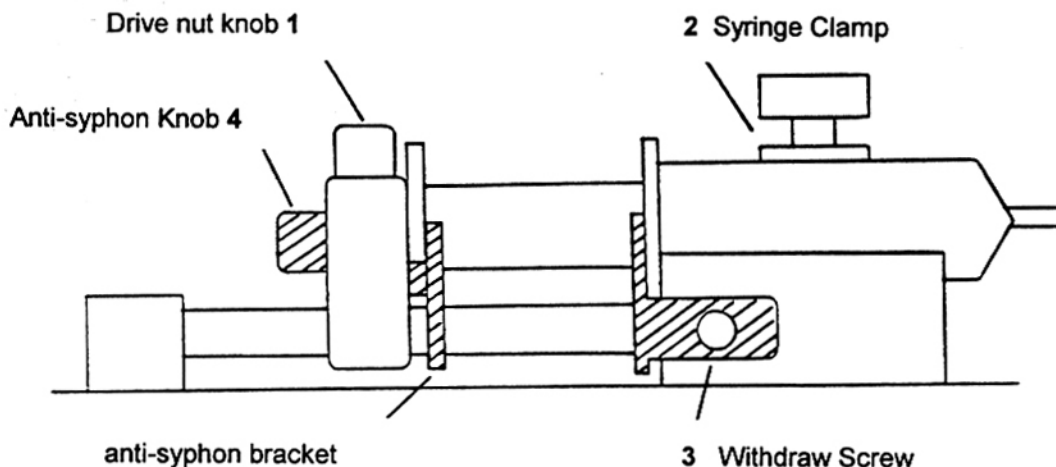
Units of volume (ul or ml) and flowrate (ul/ml per min/hr) can be changed if required.

## OPERATING INSTRUCTIONS

### POWER SWITCH

The power switch is located on the right corner of the rear panel.

### SYRINGE LOADING



To simplify syringe loading the pusher block can be disengaged from the leadscrew by turning the knob(1) and manually moved along the guide rods. Alternately, the Fast forward, Fast reverse feature can be used (press Run and Arrow key simultaneously).

Knob (1) is rotated to release the drive nut from the leadscrew. When the white line on the knob is facing toward the syringe barrel the drive nut is engaged and when the white line faces the keypad the nut is disengaged.

Raise and rotate the spring loaded retaining arm (2) and place the syringe barrel in the "V" of the syringe holder. With the syringe in place release the retaining arm so that it clamps down on the barrel and holds it securely in place.

Release the pusher block mechanism and slide the block along the guide rods until the block presses firmly against the syringe plunger. Rotate the knob (1) to **re-engage** the drive nut.

### KDS210 and KDS230 WITHDRAWAL OPERATION

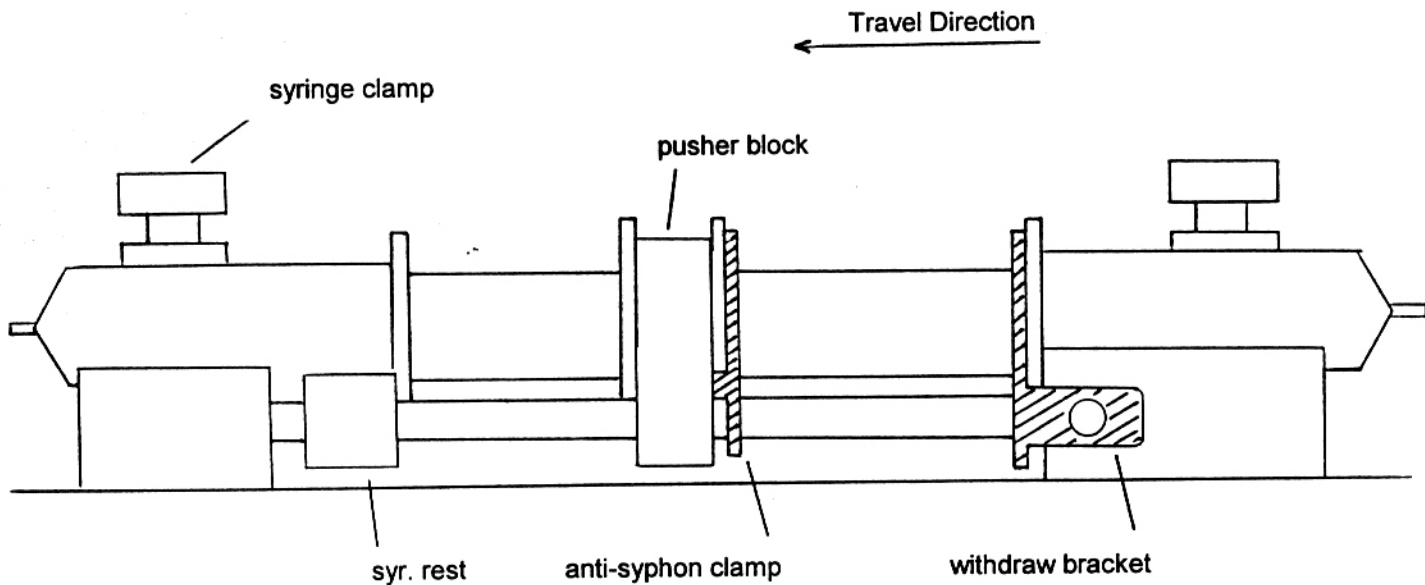
For withdrawal or refill operation the syringe plunger and barrel flange must be secured. Loosen screws (3) on the syringe holder and, after loading the syringe, press the retaining bracket against the barrel flange to secure the flange between the bracket and syringe holder. Tighten screws (3).

To restrain the plunger, rotate knob (4) to release the retaining bracket and position the syringe plunger between the pusher block and retaining bracket. Turn knob (4) clockwise to tighten the retaining bracket and then re-engage the drive nut. (knob 1)

The mechanism is designed to accommodate a wide range of syringe sizes however, there are some syringes which require additional attention. (See page 12)

### KDS260 PUSH-PULL Syringe Pump

### **KDS260 PUSH-PULL Syringe Pump**



Push-Pull operation: operate in Withdraw Mode.

Large volume dispenses using large syringes may not require the use of the syringe rest. Increase travel is possible if the infusion syringe is retained in the left syringe holder without use of the syringe rest.

**KDS260** has all the features of a model KDS210 and, for the push-pull operation the Withdrawal Mode should be selected from the menu. In this mode the pusher block will travel from right to left, as shown above.

## **MENU FEATURES**

When the pump is first turned on the LCD will display the last Rate or Volume setting. Pressing **Select** repeatedly will always return the display to the main menu.

The main menu consists of seven variables, three of which are displayed at all times. The center variable pulses to indicate that this option can be reviewed or changed.

The menu acts as a continuous loop and the **arrow keys**, **← →** are used to move around the loop. Press the **Select** key to select the variable to be changed.

**← → DIA ← → TABLE ← → RATE ← → VOL ← → MODE ← → RS232C ← → PWR UP ← →**

## **KEYPAD FUNCTIONS**

A keypad is used for selection of features from the displayed menu and numerical entries.

### **KEYPAD**

**← →** These keys move the displayed menu left and right respectively.

**select** Used to select the highlighted menu feature (flashing).

**enter** The numerical parameters of the feature selected are set, then **enter** places all the settings in memory ready for operation. All settings are stored in non-volatile memory and will be used next time the pump is operated.

**0 - 9, .** Numerical and decimal entry keys.

**run/stop** Starts and stops the motor. Acts as a pause during a dispense.

## **FAST FORWARD, FAST REVERSE**

Keys **run** and **→** or **←** pressed simultaneously causes the pump to run at maximum speed.

This feature can be used for loading, purging and reversing out of a stall condition.

## **SYRINGE DIAMETER ENTRY**

The pump must be calibrated by identifying the internal diameter of the syringe used. Once entered this data is stored in non-volatile memory and need be modified only when a different syringe is used.

#### TABLE

Use the **arrow** keys to move **TABLE** to the center of the display and press **select** to select this feature. The display now reads abbreviated names of syringe manufacturers and the type of syringe (plastic or glass).

Use the **arrow** and **select** keys to scroll through the list and select the manufacturers name of the syringe used.

The display now lists the size of syringe. Again, use the **arrow** and **select** keys to identify and enter the syringe used.

#### DIAMETER

If the syringe used is not listed in the table of syringes then the internal diameter of the syringe must be measured and entered directly. Scroll through the main menu and select **DIA**.

The display now prompts for entry of the syringe barrel internal diameter measured in *millimeters*. Enter by using the numerical keys and **enter**.

**note:** If the diameter is changed the volume and rate settings are set to zero.

#### VOLUME SETTING

Volume can be reached directly from the main menu or will be prompted after mode selection.

Volume prompt: Vol.: 00.00ml >

- 1) Enter target volume from the numerical keypad.
- 2) If the units and value displayed are correct, **enter**.

The underlined display, or pulsing display segment, indicates that this parameter can be changed. The arrow symbol signifies direction of travel (< indicates withdrawal) and pulses when the pump is running.

**note:** When dispensing, the displayed volume increments in units of the last significant figure of the volume entered. Therefore, to increment by .01 the volume should be set at 1.00. If the volume is set at 1.000 then the volume increments in units .001.

**note:** Volume setting = 0.0

- a) Infusion or Withdrawal modes.  
Volume = 0 is interpreted as no volume and the pump will run until manually stopped or a stall occurs. The LCD will display the rate setting.
- b) Infusion/withdrawal, Withdrawal/infusion and Continuous modes.  
A volume setting must be entered. If no volume is entered the display returns to the mode selection menu to select the appropriate mode.

## UNITS SETTING

prompt: Vol.: 00.00 ml <

The units displayed can be changed if required.

- 1) Use the RIGHT arrow key to move the pulsing indicator to the units displayed.
- 2) Continue to use the RIGHT arrow key to scroll through the possible units.
- 3) The LEFT arrow key will move the active display back to the numerical value.
- 4) When the correct value and units are displayed press **enter**.  
Possible units are:      ul and ml      microliter and milliliter  
                                 ul/m, ul/h and ml/m, ml/h      ul or ml per minute or hour

## RATE SETTING

Display reads:              Rate 00.01 ml/h >

- 1) Enter the flowrate value required with the numerical keypad
- 2) If necessary, change the units using the → key to move to and scroll through the possible units.
- 3) When the displayed settings are correct press **enter**.

**note:** If the number entered exceeds the maximum flow rate possible then the pump displays the maximum feasible rate. To continue enter a rate smaller than the maximum.

**note:** To check the maximum possible rate enter 9's to the required decimal position. For example, enter 99.9 and the maximum displayed is 12.3 whereas, if 99.99 is entered, then the maximum displayed is 12.34.

## POWER UP *run or stop*

This option is only applicable when **no dispense volume** is selected.

When power returns after an interruption the pump can resume operation (select RUN ) or remain stopped ( select STOP ).

If the pump resumes operation the rate display will flash to indicate that a power interruption has occurred. Press **select** to clear the display to resume normal operation.

## RUN/STOP

After all settings are made the pump can be started or stopped by a single press of the **run/stop** key. During a volume dispense the **stop** acts as a "pause" and **run** will resume the dispense.

## **CHANGE OR REVIEW VOLUME SETTING WHILE RUNNING**

While the pump continues to run press **select** to return to the main menu. Scroll through the menu and **select** Volume to display the set dispense volume.

a) **No volume change**

Press **select**. The display returns to the incrementing display volume.

b) **Volume change**

- 1) Make the changes with the numerical keypad and **enter**.
- 2) The display moves to RATE, permitting a change if required. Use the numerical keypad and **enter** to make changes (or leave unchanged).

The pump immediately changes to the new flowrate, if changed, and the volume continues to increment, uninterrupted by the review process, to new target dispense volume when it will stop automatically.

**note:** If the volume is changed to a volume **smaller** than the volume already accumulated then the pump will stop as soon as the new, smaller target volume is entered.

## **MODE SELECTION**

Mode selection is available only on infusion/withdrawal models.

Select **MODE** from the main menu and then scroll through the options displayed and **select** the mode required.

Possible modes are: **infusion**  
**withdrawal**  
**infusion / withdrawal**  
**withdrawal / infusion**  
**continuous**

Note: for bi-directional modes a volume is required.

**infusion** Pump infuses at the set rate and stops automatically when the target volume is reached. The pump can be manually stopped and restarted at any time, that is, the dispense is paused and, when restarted will continue to the set dispense volume.

**withdrawal** Pump withdraws at the set rate to the set volume.

***infusion / withdrawal***

The pump first infuses and when the target volume is reached it immediately changes direction and withdraws. The volume settings for infusion and withdrawal can be different as can the infusion and withdrawal flowrates.

***withdrawal / infusion***

The pump runs first in the withdrawal direction and then automatically changes to the infusion direction. Different setting of rate and volume for withdraw and infuse are permitted.

***continuous***

The pump first infuses and then withdraws, and then cycles continuously. Only one volume setting for infusion and withdrawal is permitted. If the pump is matched to a valve, which is actuated by a TTL pulse from the pump, this mode can be used to infuse and then refill the pump for continuous operation.

The menu now prompts for volume and rate settings relevant to the mode selected.

**MANUAL STALL SETTING AND MICROLITER SYRINGES**

A movable collar, located on the rear guide rod of infusion only pumps, can be set to limit travel of the pusher block. The block moves until stalled against the collar when the electro-optical sensor detects the stall and stops the pump.

Damage to the fine wire plungers of microliter syringes caused by forcing the plunger into the end of the syringe barrel can be prevented by careful adjustment of the collar position.

**GLASS SYRINGES**

In the withdrawal mode the retaining bracket on the pusher block clamps on the head of the plunger. With some glass syringes the corners of the plunger head are rounded and this sometimes causes the head to ride up out of the retaining bracket.

Similarly in the infusion mode the rounded corners of the flange of the syringe barrel cause a tendency for the syringe barrel to ride up out of the syringe holder.

To give a more secure, flatter surface to clamp against an O-ring or metal collar can be placed over the barrel and pressed against the flange.

## **CLEARING A STALL CONDITION**

Should a stall occur the pump motor is stopped to prevent damage.

To clear the display press **select**.

To move the stalled mechanism use the **fast forward** or **fast reverse** to move the pusher block. Using the fast forward or fast reverse feature is not only the most simple way to deal with the stall, it also reduces potential damage to the cam mechanism which releases the halfnut from the leadscrew.

## **NV Ram Failure**

If the settings in the non-volatile memory become corrupted the display will read "NV Ram Failure" and the pump will not operate.

To recover from this condition the pump must be powered down and then turned on again. The pump will be re-initialized to the default settings and can now be programmed as normal

The "NV Ram Failure" message can also be cleared by pressing select and programming a new flow rate. The pump should then be turned off and on to save the settings.

## **RS232C**

The RS232 connections are made through two modular telephone connectors, labeled IN and OUT , located on the rear panel.

A single PC can control up to 100 pumps via a "daisy chain" using the IN and OUT. connectors. When using the daisy chain each pump must be assigned an address and set to the same baud rate. A splitter may be required with greater than 25 pumps.

When controlled via RS232 the pump will still respond to keypad commands but will not respond to keypad and RS232 commands simultaneously. All RS232 command settings, similar to keypad settings, are stored in non-volatile memory.

Select RS232 from the main menu.

**BAUD RATE**      *300, 1200, 2400, 4800,9600*

The available baud rates will now be displayed and can be selected using the **arrow** and **select** keys.

The display now prompts for assignment of a pump address.

## ADDRESS

If, no address is assigned then the pump defaults to a 0 setting.  
All pumps with the same address respond simultaneously to the same commands.  
Use the → key to enter an address, 0 - 99 and press **select** to return to the main menu.

## RS232 COMMANDS

RS232 is used for remote computer control of up to 100 pumps, identified with an address from 0 to 99 and set to the correct baud rate. 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**.

After each command is received and executed by the pump the pump responds with a message and a prompt.

### Commands and Responses

Commands are not case sensitive

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

<CR> = carriage return

<LF> = line feed

<SP> = space

<NSP> = no space

a) Commands:

Address<SP>command<CR><LF>

b) Response:

<CR><LF>address<NSP>prompt

For example: Query pump 2 for withdrawal flow rate ( which is 0.2 ml/minute )

command 2<SP>ratew?<CR><LF>

response 0.2<SP>ml/m<CR><LF>2:

Query a single pump for infusion flow rate ( which is 0.2 ml/minute )

command ratei?<CR><LF>

response 0.4<SP>ml/m<CR><LF>:

## Prompts

|    |                               |
|----|-------------------------------|
| >  | running in infusion direction |
| <  | withdrawing                   |
| :  | stopped                       |
| NA | not applicable                |
| E  | error (see error? command)    |

|                                         |                                                                           |
|-----------------------------------------|---------------------------------------------------------------------------|
| 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),<br>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.

## Pump commands and responses

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

|                  |                                                                                                                                               |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| <b>run</b>       | Starts pump running to present settings, returns prompt > or <<br>If already running command is ignored.                                      |
| <b>stop</b>      | Stops pump if running, otherwise is ignored. Returns prompt :                                                                                 |
| <b>dia nn.nn</b> | Sets syringe diameter in millimeters n = 0 to 9                                                                                               |
| <b>run?</b>      | Query run status, returns prompt.                                                                                                             |
| <b>del?</b>      | Queries delivered volume. (requires a dispense volume to be set)<br>response: nnnnn<SP>u<br>where nnnnn is , 0 to 9 and u are units, ul or ml |
| <b>dia?</b>      | Requests present diameter setting.<br>Response: nn.nn where n = 0 to 9 units always millimeters                                               |
| <b>ratei?</b>    | Queries infusion rate.<br>response: nnnnn<SP>u/u<br>where nnnnn is , 0 to 9<br>u/u are units, ul/m, ul/h, ml/m, or ml/h                       |

**ratew?** Queries withdrawal rate.

Response nnnnn<SP>u/u

where nnnnn is \*, 0 to 9 and u/u is rate unit

**ratei nnnnn u/u** Sets infusion rate.

where nnnnn is \*, 0 to 9, and u/u are units.

Units required but if not specified then defaults to automatic setting based on syringe diameter.

**ratew nnnnn u/u** Sets withdrawal rate.

**voli nnnnn uu** Sets infusion target volume

where nnnnn is \*, 0 to 9 and uu are units ul or ml.

If units not specified then defaults to automatic setting.

**volw nnnnn uu** Sets withdrawal target volume

**voli?** Queries volume setting

response: nnnnn<SP>uu

where nnnnn is \*, 0 to 9 and uu are units ul and ml

**mode I** Sets mode to infusion.

**mode w** Sets mode to withdrawal.

**mode I/w** Sets mode to infusion/ withdrawal.

**mode w/I** Sets mode to withdrawal /infusion.

**mode con** Sets mode to continuous.

Note: A dispense volume **must** be entered before selecting I/W, W/I and CON modes.

**mode?** Query mode. Response I, W, I/W, W/I, CON

**dir rev** Changes direction of running pump. Available only in Infusion and Withdrawal modes.

**dir?** Query direction. Response I (infusion) or W (withdrawal).

Not applicable in infusion only models.

**error?** command returns values from 0 to 7 as listed below

0 = no errors

1 = serial error

2 = stall

3 = stall + serial error

4 = serial overrun

5 = serial error + serial overrun

6 = stall + serial overrun

7 = stall + serial error + serial overrun

**error?** errors 8 - 15 only occur if using pressure switch

8 = overpressure  
9 = serial error overpressure  
10 = stall + overpressure  
11 = stall + serial overrun + overpressure  
12 = serial overrun + overpressure  
13 = serial error + serial overrun + overpressure  
14 = stall + serial overrun + overpressure  
15 = stall + serial error + serial overrun + overpressure

**Note:** sending query also clears all errors.

A serial error indicates a command that is too long for the input buffer.

A serial overrun indicates that a command has been sent before the prior command has been processed.

A stall error indicated that a stall condition has occurred.

Essential that after each command you must wait for the prompt ( indicating that the command has been executed ) before sending the next command.

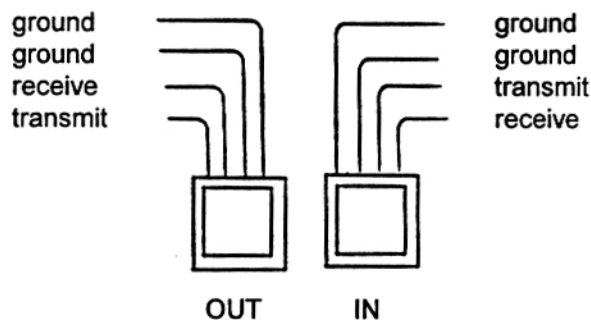
Also, the prompt will indicate that the command has been executed successfully, or not.

**prom?** Queries software version  
response is number 2100.0xx or 2101.0xx

#### RS232 Format

8 data bits  
No parity  
1 stop (can use 2 stops)

Pump uses simple three wire communications - ground, transmit, and receive  
No flow control. No handshaking



PC with 9-pin connector

|          |       |
|----------|-------|
| data IN  | pin 2 |
| data OUT | pin 3 |
| ground   | pin 5 |

PC with 25-pin connector

|          |       |
|----------|-------|
| data OUT | pin 2 |
| data IN  | pin 3 |
| ground   | pin 7 |

## 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 | controllable output with Programmable models -- | could be used for relay or valve control (low - infusing, high - refilling)                                 |
|     | 8   | Trigger                                         | falling edge starts /stops pump eg. Footswitch                                                              |
|     | 4   | Gate                                            | change from high to low - starts<br>when running stays low, change to high - stops<br>eg. footswitch, timer |
|     | 2   | directional output                              | high - infuse, low - refill (stays high when stopped)                                                       |
|     | 5   | undefined input or output                       |                                                                                                             |
|     | 7   | run indicator                                   | high - running, low - stopped                                                                               |
|     | 9   | reverse direction                               | normally high; connect to ground (pin 3) reverses<br>direction (only applies to infuse/ withdraw mode)      |

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

logic high 2V - 5V

## FUSES

The fuses are located, in the power entry module on the rear panel. The linecord must be removed first to gain access to the fuse holder.

FUSE 5x20mm, 250V~ (slow blow)

|           |                  |
|-----------|------------------|
| USA model | 0.25AT slow blow |
| CE model  | 0.1AT slow blow  |

Table 1

## TABLE OF SYRINGE DIAMETERS

## (1) "Air-Tite "All Plastic

|     |        |
|-----|--------|
| 1cc | 4.70mm |
| 2.5 | 9.70   |
| 5.0 | 12.48  |
| 10  | 15.89  |
| 20  | 20.00  |
| 30  | 22.50  |
| 50  | 28.90  |

## (2) Becton Dickinson

Interim, WW design, Plastipak

|     |        |
|-----|--------|
| 1cc | 4.70mm |
| 3   | 8.59   |
| 5   | 11.99  |
| 10  | 14.48  |
| 20  | 19.05  |
| 30  | 21.59  |
| 60  | 26.60  |

## (3) Becton Dickson

Glass - all types

|       |        |
|-------|--------|
| 0.5cc | 4.64mm |
| 1     | 4.64   |
| 2.5   | 8.66   |
| 5     | 11.86  |
| 10    | 14.34  |
| 20    | 19.13  |
| 30    | 22.70  |
| 60    | 28.60  |

## (4) Hamilton

1000-Series Gastight

|      |        |
|------|--------|
| 10ul | 0.48mm |
| 25   | 0.78   |
| 50   | 1.03   |
| 100  | 1.46   |
| 250  | 2.30   |
| 500  | 3.26   |
| 1ml  | 4.61mm |
| 2.5  | 7.28   |
| 5    | 10.30  |
| 10   | 14.57  |
| 25   | 23.03  |
| 50   | 32.57  |

## (5) Popper &amp; Sons, Inc.

Perfektum glass

|      |        |
|------|--------|
| 0.25 | 3.45mm |
| 0.5  | 3.45   |
| 1    | 4.50   |
| 2    | 8.92   |
| 3    | 8.99   |
| 5    | 11.70  |
| 10   | 14.70  |
| 20   | 19.58  |
| 30   | 22.70  |
| 50   | 29.00  |

## (6) Ranfac

|     |        |
|-----|--------|
| 2cc | 9.12mm |
| 5   | 12.34  |
| 10  | 14.55  |
| 20  | 19.86  |
| 30  | 23.20  |
| 50  | 27.60  |

(7) Scientific Glass Engineering  
SGE

|      |        |
|------|--------|
| 25ul | 0.73mm |
| 50   | 1.03   |
| 100  | 1.46   |
| 250  | 2.30   |
| 500  | 3.26   |
| 1ml  | 4.61mm |
| 2.5  | 7.28   |
| 5    | 10.30  |
| 10   | 14.57  |

## (8) Sherwood - Monojet Plastic

|     |        |
|-----|--------|
| 1cc | 4.65mm |
| 3   | 8.94   |
| 6   | 12.70  |
| 12  | 15.90  |
| 20  | 20.40  |
| 35  | 23.80  |
| 50  | 26.60  |

## (9) Terumo

|     |        |
|-----|--------|
| 1cc | 4.73mm |
| 3   | 9.00   |
| 5   | 13.04  |
| 10  | 15.79  |
| 20  | 20.18  |
| 30  | 23.36  |
| 60  | 29.45  |

(10) Unimetrics  
Series 9000

|      |        |
|------|--------|
| 10ul | 0.46mm |
| 25   | 0.73   |
| 50   | 1.03   |
| 100  | 1.46   |
| 250  | 2.30   |
| 500  | 3.26   |
| 1000 | 4.61   |

Table 2

## FLOW RATES

| <u>Syringe size</u> | <u>Minimum</u> | <u>Maximum</u> |
|---------------------|----------------|----------------|
| 10ul                | 0.001ul/h      | 22.98ul/min    |
| 25ul                | 0.001ul/h      | 60.68ul/min    |
| 50ul                | 0.001ul/h      | 105.8ul/min    |
| 100ul               | 0.001ul/h      | 212.6ul/min    |
| 250ul               | 0.001ul/h      | 527.6ul/min    |
| 500ul               | 0.001ul/h      | 1.06ml/min     |
| 1ml                 | 0.001ul/h      | 2.203ml/min    |
| 2.5ml               | 0.001ul/h      | 5.28ml/min     |
| 3ml                 | 0.001ul/h      | 7.36ml/min     |
| 5ml                 | 0.001ul/h      | 14.33ml/min    |
| 10ml                | 0.001ul/h      | 20.91ml/min    |
| 20ml                | 0.001ul/h      | 36.19ml/min    |
| 30ml                | 0.001ul/h      | 46.49ml/min    |
| 60ml                | 0.001ul/h      | 70.57ml/min    |

**Note:** Syringes from different manufacturers can have slightly different limits.

## **LIMITED WARRANTY**

KD Scientific Inc. warrants to the first consumer purchaser, for a period of one year from the date of purchase that this unit, when shipped in its original container, will be free from defective workmanship and materials and agree that it will, at its option, either repair or replace the defective unit.

This warranty does not extend to misuse, neglect or abuse, normal wear and tear, accident, modification or unauthorised repair.

KD Scientific will not be liable or in any way responsible for any incidental or consequential economic or property damage. Some States do not allow the exclusion of incidental or consequential damages, so the above exclusion may not apply to you.

There are no implied warranties of merchantability, or fitness for a particular use, or of any other nature. Some States do not allow this limitation on implied warranty, so the above limitation may not apply to you.

If a defect arises within the warranty period contact KD Scientific Inc., 33 Sleeper Street, Boston, MA 02210.

The customer is responsible for shipping charges and must first obtain a Return Material Authorisation number (RMA) before the unit will be accepted. If a replacement unit is issued it is covered only for the remainder of the original warranty period dating from the purchase of the original device.

This warranty gives you specific legal rights. You may also have other rights which vary from State to State.

**Note:** This pump is not registered with the FDA and is not for clinical use on human beings.

KDS pumps are manufactured by KD Scientific Inc., 33 Sleeper Street, Boston, MA 02210  
tel: 617 426-1887, fax: 617 426-5302