Pump Chain Commands - Model '44' Protocol

Symbol	Meaning
[. . .]	optional
{. . .}	select one
|	either/or
f	digits 0 – 9 or a decimal point
d	digits 0 – 9
<cr>	carriage return (ASCII 13)
<lf>	line feed (ASCII 10)
<float>	f f f f f f
<integer>	ddddd
<time>	d:dd:dd
<text>	any string of ASCII characters

Command Formats and Meanings:

Command Format	Meaning
<cr>	Stops all pumps. All pumps on the pump chain interpret this as a stop command.
pump address, <cr>	Request for prompt The pump with the indicated address responds with its prompt
optional pump address,	Send a command to a pump.
command, <cr>	The pump with the indicated address executes the command then responds with its prompt. The optional pump address, if not specified, will default to pump address 0.

After each command is received and executed, the pump acknowledges the command with a prompt. Preceding the prompt may be some additional text responses.The additional text will be one or more lines of ASCII text, each preceded by a line feed and terminated by a carriage return:

<lf>, <text>, <cr>

A prompt is a string of ASCII characters sent by a pump indicating the pumps address and its present state:

<lf>, 1 or 2 digit address, prompt character

Prompt Characters	Meaning
:	Pump stopped
>	Pump infusing
<	Pump refilling
/	Pause interval (pump stopped)
*	Pumping interrupted (pump stopped)
^	Dispense trigger wait (pump stopped)

Pump Commands and Responses

RUN Starts pumping according to the present setting of the pump. If pump is already pumping, a 'Not Applicable' response will be given.

STP Stops pump if it was running. If pump was already stopped, a 'Not Applicable' response will be given.

DEL Request for volume delivered, in ml.
Response is of the following format:
space, space, f f f f f f

CLD Request to zero volume delivered. If the pump was interrupted, it will cancel the interrupted condition. If the pump is running, request will not be accepted and a 'Not Applicable' response will be given. Otherwise, no response is given.

RAT [<float> [<units>]]

Request to set or query infusion rate setting.

Set infusion rate:
RAT rate

Set infusion rate and units:
RAT rate units

Rate is of format: f f f f f f

Units are one of:

	Definition
UM	µl/mn
UH	µl/hr
MM	ml/mn
MH	ml/hr

If rate is accepted and valid, rate will become the new infusion rate.
If the rate is invalid, an 'Out Of Range' response will be given.
Command will not be accepted if the pump is running in the Program Mode and
a 'Not Applicable' response will be given.

Query infusion rate: RAT

Response is of the following format:
space, space, f f f f f f units

Where units is one of the following:

ml/mn
ul/mn
ml/hr
ul/hr

RFR [<float> [<units>]]

Request to set or query refill rate setting.

Set refill rate:
RFR rate

Set refill rate and units:
RFR rate units
Rate is of format: f f f f f f
Units are one of:

	Definition
UM	µl/mn
UH	µl/hr
MM	ml/mn
MH	ml/hr

If rate is accepted and valid, rate will become the new refill rate.
If the rate is invalid, an 'Out Of Range' response will be given.
Command will not be accepted if the pump is running in the Program Mode and
a 'Not Applicable' response will be given.

Query refill rate: RFR

Response is of the following format:
space, space, f f f f f f units
Where units is one of the following:
ml/mn
ul/mn
ml/hr
ul/hr

PGR Request for the rate of pumping set during the running of a program.
Response is of the following format:
space, space, f f f f f f units
Where units is one of the following:
ml/mn
ul/mn
ml/hr
ul/hr

DIA [<float>]

Request to set or query syringe diameter setting.

Set diameter:

DIA diameter
Diameter is of format: f f f f f f
Units are MM.

INFUSE and REFILL rates will be set to zero and AUTO FILL will be set to off.

If diameter is accepted and valid, diameter becomes new diameter.
Diameter will not be accepted if the pump is running and a 'Not Applicable' response will be given.
If the diameter is invalid, an 'Out Of Range' response will be given.

Query diameter: DIA

Response is of the following format:
space, space, f f f f f f
Units are MM.

TGT [<float>]

Request to set or query target volume setting.

Set target volume:

TGT volume
Volume is of format: f f f f f f
Units are ML.
If volume is accepted and valid, volume becomes new target volume.
Volume will not be accepted if the pump is running and a 'Not Applicable' response will be given.
If the volume is invalid, an 'Out Of Range' response will be given.

Query volume:TGT

Response is of the following format:
space, space, f f f f f f
Units are ML.

MOD [{PMP|VOL|PGM}]

Request to set or query pumping mode
Set: MOD PMP (Puts pump in Pump Mode)
MOD VOL (Puts pump in Volume Mode)
MOD PGM (Puts pump in Program Mode)

Command will not be accepted if the pump is running and a 'Not Applicable' response will be given.

Query: MOD
If mode is PUMP, response will be:
PUMP
If mode is VOLUME, response will be:
VOLUME
If mode is PROGRAM response will be:
PRGRAM

DIR [{INF|REF|REV}]

Request to set or query pumping direction

Set: DIR INF (sets pumping direction to infusion)
DIR REF (sets pumping direction to refill)
DIR REV (reverses current pumping direction)

Command will not be accepted if the pump is running in volume or program modes and a 'Not Applicable' response will be given.

Query: DIR
If pump direction is infusion, response will be:
INFUSE
If pump direction is refill, response will be:
REFILL

AF [{ON|OFF}]

Request to set or query auto fill setting

Set: AF ON (turns Auto Fill feature on)
Note: The syringe volume is also needed for auto fill to operate. (See SYR command)
AF OFF (turns Auto Fill function off)
Command will not be accepted if the pump is running and a 'Not Applicable' response will be given.

Query: AF
If Auto Fill function is ON, response will be: ON
If Auto Fill function if OFF, response will be: OFF

SYR [<float>]

Request to set or query syringe volume setting for auto fill.
Used in conjunction with Auto Fill feature. (See AF command).

Set syringe volume: SYR volume
Volume is of format: f f f f f f
Units are ML.
If volume is accepted and valid, volume will become the new syringe Auto Fill volume.
Volume will not be accepted if the pump is running and a 'Not Applicable' response will be given.
If the volume is invalid, an 'Out Of Range' response will be given.

Query syringe volume: SYR
Response is of the following format:
space, space, f f f f f f

IN d

Request to read the TTL logic level of the specified pin on the external 9 pin D-SUB connector. Valid pin numbers for input are:
6, 7, 8 and 9
If the pin specified is valid and if the pin level is high, response will be:
ON
If the pin level is low, response will be:
OFF
If the pin specified is invalid:
An 'Out Of Range' response will be given

OUT d = <ON|OFF>

Request to set the TTL logic level at the specified pin on the external 9 pin D-SUB connector.
Valid pin number for output is: 4
If the pin specified is invalid:
An 'Out Of Range' response will be given

Example:
Set pin 4 high:
OUT 4 = ON
Set pin 4 low:
OUT 4 = OFF

SEQ [<integer>] [<entry>]

Request to set or query programming sequences. <integer> is sequence number.
Default is Sequence 1. Command only applicable while pump is stopped. Valid
sequence numbers, 'n', are 1 to 10. 'n' defaults to 1 wherever it is optional. See program
examples.

Query entire program: SEQ

Example response:

```
SEQ 1: DISPENSE
75.000 ml/mn
43.155 ml
0:00:01 INTERVAL
   3 REPEAT
INFUSE
SEQ 2: PROFILE
100.00 ml/mn
150.00 ml
REFILL
SEQ 3: RESTART
```

Query program sequence [n]: SEQ n

Example response to the command 'SEQ 2' with the previous example's program:

```
SEQ 2: PROFILE
100.00 ml/mn
150.00 ml
REFILL
```

Query program sequence n's mode: SEQ [n] MOD

Response will be according to the following table:

Response	Description	Response	Description
STP	stop	RST	restart
PRO	profile	GOT	go to
INC	increment	EVN	event
DEC	decrement	PMP	pump
DIS	dispense	OUT	TTL out
PAS	pause		

Query data item of program sequence n:

Command	Description
SEQ [n] RAT	Query rate Response: f f f f f f units Where units is one of the following: ml/mn ul/mn ml/hr ul/hr
SEQ [n] GOT	Query go to sequence number Response: <n>
SEQ [n] TGT	Query target volume Response: <float>
SEQ [n] INT	Query time interval Response: <time>
SEQ [n] RPT	Query repetition count Response: <float>
SEQ [n] OUT	Query output pin level setting Response: <ON/OFF>
SEQ [n] DIR	Query pumping direction Possible responses: INFUSE REFILL

Set mode of program sequence n:

SEQ [n] MOD mode

Where mode is as follows:

Mode	Description	Mode	Description
STP	stop	RST	restart
PRO	profile	EVN	event
INC	increment	GOT	go to
DEC	decrement	OUT	set output pin
DIS	dispense	PMP	pump
PAS	pause		

Set data item of program sequence n:

Set sequence's rate:

SEQ [<n>] RAT <float> [<units>]

Rate is of format: f f f f f f

Units are one of :	Description
UM	µl/mn
UH	µl/hr
MM	ml/mn
MH	ml/hr

Set sequence's go to sequence number
SEC [<n>] GOT <n>
Set sequence's target volume:
SEQ [<n>]TGT <float>
Set sequence's time or target:
SEQ [<n>] INT <time>
Set sequence's repetition number:
SEQ [<n>] RPT <integer>
Set sequence's pumping direction:
SEQ [<n>] DIR <INF|REF>
Set sequence's output pin level
SEQ [<n>] OUT <ON|OFF>

VER Request for version of pumps embedded software.

Pump Chain Error Messages

Error messages are in the format:
<lf>, space, space, <message>, <cr>,

Where <message> is one of the following:

?	Syntax error in a received command
NA	Command not applicable at this time
OOR	Control data is out of the operating range of the pump

Note: If assistance is needed in programming pump control via RS-232, call Harvard Apparatus Customer Service Support at 1-800-272-2775.