INSTRUCTION MANUAL

505834

Aladdin Firmware Upgrade 1.0

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070924

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ABOUT THIS MANUAL

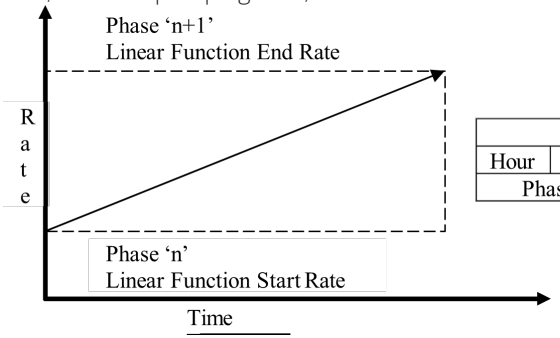
This User Manual is an addendum to the standard 505384 User Manual and supersedes it

1. UPGRADED AND NEW PROGRAMMING FUNCTIONS

L inr

Linear/Gradient Flow Rate Ramping

Linearly ramps up or down the flow rate. The pump will deliver a smooth, linearly increasing or decreasing, flow rate as defined by the starting flow rate, ending flow rate, the total pumping time, and direction.



Linear Function Time			
Hour	Minutes	Seconds	Tenths Seconds
Phase 'n'		Phase 'n+1'	

The Linear Flow Rate function is specified by using two Linear Functions L inr, in two consecutive Program Phases, defined by four parameters:

1) Starting flow rate

2) Ending flow rate

3) Total time, expressed as "Hours : Minutes : Seconds : Tenth Seconds"

4) Pumping direction

The Linear Flow rate function is entered as follows, in two consecutive Pumping Program Phases:

Time is entered using the "Volume" key. The "min" minutes LED will be lit when time is displayed. The units and pumping directions of the starting and ending flow rates must be the same.

Phase	Function	Rate/Units	Time
n	L inr	Starting Flow Rate	Total Time: [Hours : Minutes]
n+1	L inr	Ending Flow Rate	Total Time: [Seconds : Tenth Seconds]

RS-232 Remote Support

Linear function command: FUN LIN

The time parameter is sent to the pump or queried using the "TIM" remote function:

TIM [<nn> : <nn>]

RECIPROCATING PUMPING FOR AUTO-REFILL APPLICATIONS

The Reciprocating Pumping function will continuously reverse the pumping pumping direction at the end of the progammed dispense volume. This function is setup the same as the Rate function. Set the rate, dispense volume and pumping direction.

After the set Target Volume is dispensed (or withdrawn), the pumping direction is reversed and the pump will withdraw (or infuse) the set Target Volume. If the pumping rate is changed, the pump will continue pumping at the new rate when the pumping direction is reversed.

With the addition of a dual check valve on the syringe, this function can be used to create an auto-refill system.

With the addition of a second pump, attached to the first pump with the control cable, CBL-DUAL-3, the dual pump plumbing kit, P-DKIT, and the setting of the Reciprocating communications mode, a continuous infusion system can be setup. One pump will always be infusing while the other pump is refilling.

RS-232 Remote Support:

Reciprocating function command: FUN REC

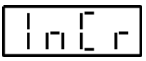
BASE PUMPING RATE AND VOLUME

The Base function operates identical to the RATE function, except that the BASE Function's Rate and Volume will be used to override the settings for subsequent RATE functions. This will allow the user to make modifications to the Rate and/or Volume settings in one place, instead of having to make edits to each RATE function in a program individually.

The Base function can also simplify complex programs or multiple sub-programs with a common section.

RS-232 Remote Support:

Base Rate function command: FUN BAS



INCREMENT AND DECREMENT FUNCTIONS

The INCR and DECR functions have been modified from previous versions to pump for a period of time instead of volume dispensed.

The dispense time is set using the "Volume" key and is expressed as "Minutes : Seconds". The "min" minutes LED will be lit when time is displayed.

RS-232 Remote Support:

Increment function command: FUN INC Decrement function command: FUN DEC

The time setting is sent to the pump or queried using the "TIM" remote function: TIM [<nn> : <nn>]

LOOP: JUMP TO END IF LAST LOOP

This function is intended to be used as a short-cut to reduce Pumping Program complexity.

When [LP:JE] is executed within a counted loop, it will cause an immediate jump to the end of the current loop when executing the final iteration of the loop. Otherwise, this function will be ignored and execution will continue with the next Program Phase. A minimum loop count of 2 is required. Can be used with nested loops. Counted loops end with the function [LP:nn].

Example

Phase 1	Function:	Rate	Rate: 500 mL/hr	Volume: 3.0 mL	Direction: Withdraw
Phase 2	Function:	LP:ST	Loop Start		
Phase 3	Function:	Rate	Rate: 5 mL/hr	Volume: 0.3 mL	Direction: Infuse
Phase 4	Function:	LP:JE	Loop: Jump to end if last loop		
Phase 5	Function:	PS:10	Pause 10 Seconds		
Phase 6	Function:	LP:10	Loop 10 times		
Phase 7	Function:	Stop			

The above example eliminates the final 10 second pause after the final dispense. Within the 10th loop, Phase 4 will jump to Phase 6, ending the program loop.

RS-232 Remote Support:

FUN LPJ

SE:nn STALL EVENT

"Stall Event" allows a Pumping Program to relieve the pressure on a syringe after a pump stall by jumping to a Phase that reverses the pumping direction.

"Stall Event" creates a background event interrupt trap for a pump stall. If the pump stalls, the Pumping Program will continue execution with the Program Phase 'nn' defined by the "Stall Event" function. After the pump stops, the "Stall" message is cleared and the Pumping Program continues execution at the Stall Event Phase defined by parameter 'nn'.

After a "Stall Event" trap is executed, the event trap is cleared. The "Stall Event" function needs to be set again to trap another stall. "Stall Event" is independent from the standard "Event" and "Event Square" functions.

The "Event Reset" function will clear the "Stall Event" trap along with any other Event trap.

RS-232 Remote Support:

FUN SEV [<nn>]

rEt PROGRAM SUB-ROUTINE RETURN

The "Return Function" is paired with Pumping Program Functions that cause the Pumping Program to branch to a different Program Phase number. When executed, the "Return Function" causes the Pumping Program to continue Program execution at the interrupted Phase (for Event Functions) or next Program Phase after the paired Program branch function. This changes the Program Branch function into a Program Sub-routine call.

Program Branching functions affected are: Functions that return to the next Phase:

JP:nn Jump unconditionally to Program Phase 'nn' IF:nn Conditional jump if the Program Input pin is low

Event functions that return to the interrupted Phase:

ET:nn Set a background conditional jump on an event falling edge to Program Phase 'nn' ES:nn Set a background conditional jump on any event edge to Program Phase 'nn'

These functions will operate normally, but when the next RET function is executed after the Program Branch function, program operation will return to the Program Phase immediately following the Phase where the Pumping Program most recently

branched from, or the Program Phase that was interrupted for events:

IF:nn, JP:nn

After one of these functions cause a Program Phase Branch to Phase 'nn', a RET function will return the Program to the Phase following the function that caused the most recent branch, thus converting these Pumping Program branch functions into program sub- routine call functions.

ET:nn, ES:nn

These functions create a background Event trap. When the Event trap is triggered, the Pumping Program immediately jumps to Program Phase 'nn'. A RET function will return to the Program Phase that was interrupted by the Event trap. NOTE: When the Pumping Program returns to the interrupted Phase, the Program Phase starts over and not at the point that was interrupted. For example, if the interrupted Phase specified a pumping volume, on return, the entire pumping volume will be dispensed, not just the remainder of volume from the point of interruption.

RS-232 Remote Support:

Return function command:

BEEP FUNCTION

This is a modification of the standard Beep Program Function

The Beep Function will beep a specified number of times. This modified function can only be set through the RS-232 remote command. When the function executes, the pump will sound a beep, followed by a pause, then another beep, for the number of beeps specified by the function setting. The beep count setting can be from 1 to 9 beeps. The beep function does not affect the pumping operation.

The keypad entry of the Beep Function is unmodified and will continue to sound a single beep. It will continue to be displayed as [BEEP]. The remotely set count will not be displayed.

Consecutive Beep Functions in a program will result in only the last Beep Function in the sequence being executed.

RS-232Remote Support:

FUN BEP [<n>]

Where <n> is the number of beeps. Valid values are 1 to 9.

2. USER INTERFACE CHANGES

Re-ordering of Program Function Selection Menu

The Program Function Selection menu has been broken up into a top menu and a control function sub-menu for easier entry.

The top menu is as follows:

BASE Base Rate and Dispense Volume Function

RATE Rate and Dispense Volume Function

FILL Fill Function

RECP Reciprocating pumping Function

INCR Rate increment and Dispense Time Function

DECR Rate decrement and Dispense Time Function

LINR Linear Ramp Rate and Dispense Time Function (1st and 2nd halves)

PS:00 Pumping Pause Timer Function

STOP Program Stop Function

CTRL Select Control Functions Sub-menu

Control Function sub-menu is as follows:

JP:01 Jump to phase number

LP:ST Loop start

LP:EN Continuous loop end

LP:01 Loop for a set number of iterations

LP:JE Loop: Jump to end if last loop

PR:IN Query user for sub-program number

PR:01 Define start of sub-program

IF:01 If programmable input logic pin is low, jump to Phase number

ET:01 Set background event trap to jump to Phase number

ES:01 Set background event square input event trap to jump to Phase number

SE:01 Set Stall Event background event trap to jump to Phase number

ET:RS Reset all Event traps

RET End Sub-Routine and return to Phase after calling Phase number

BEEP Sound a single beep, or multiple beeps when set remotely

OUT.0 Set program output logic pin low or high

CLR.D Clear total volume dispensed.

tr:Ft Temporary trigger input configuration. (“Ft” is configuration sub-menu)

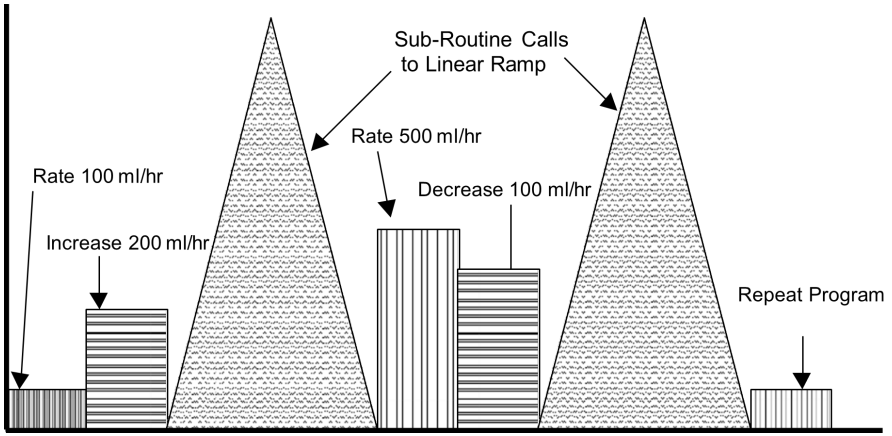
3. PRE-DEFINED PROGRAM SELECTION

Press and hold the “Program Function” (Volume) key while turning on power to the pump. This will pre-load the Continuous Pumping Program. See below for details.

In addition, this will set the pump’s RS-232 communication to Continuous pump control with a second 505384X syringe pump. Cable CBL-DUAL-3 is required to control the second pump.

4. EXAMPLE

Linear Ramp, Sub-Routines, Increment, Decrement



Phase	Function	Rate	Volume	Direction
1	RATE	100 ml/hr	1.0 ml	Infuse

Start Infusing at 100 ml/hr for 1 ml

Phase	Function	Rate	Time	Direction
2	INCR	200	00:10	Infuse

Increase rate 200 ml/hr and continue infusing for 10 seconds

Phase	Function
3	JP:08

Call Linear Ramp Sub-Routine

Phase	Function	Rate	Volume	Direction
4	RATE	500 ml/hr	5.0 ml	Infuse

Infuse at 500 ml/hr for 5 ml

Phase	Function	Rate	Time	Direction
5	DECR	100	00:10	Infuse

Decrease rate 100 ml/hr and continue infusing for 10 seconds

Phase	Function
6	JP:08

Call Linear Ramp Sub-Routine

Phase	Function
7	JP:01

Repeat Program

Linear Ramping Sub-Routine

Phase	Function	Rate	Time	Direction
8	LINR	0 ml/hr	00:10	Infuse

Linearly ramp the infusion rate from 0 ml/hr to 1000 ml/hr over 10 minutes

Phase	Function	Rate	Time	Direction
9	LINR	1000 ml/hr	00:00	Infuse

Linearly ramp the infusion rate from 1000 ml/hr to 0 ml/hr over 10 minutes

Phase	Function	Rate	Time	Direction
10	LINR	1000 ml/hr	00:10	Infuse

Phase	Function	Rate	Time	Direction
11	LINR	0 ml/hr	00:00	Infuse

Return to Phase following calling Program function

Phase	Function
12	RET

The above program would be entered from RS-232 with the following commands:

```
PHN 1 FUN RAT
RAT 100 MH
VOL 1
DIR INF

PHN 2
FUN INC
RAT 200
TIM 00:10
DIR INF

PHN 3
FUN JMP 08

PHN 4
FUN RAT
RAT 500 MH
VOL 5.0
DIR INF
```

```
PHN 5 FUN DEC
RAT 100.0
TIM 00:10
DIR INF

PHN 6
FUN JMP 08

PHN 7
FUN JMP 01

PHN 8
FUN LIN
RAT 0.0
TIM 00:10
DIR INF
```

```
PHN 9 FUN LIN
RAT 1000 MH
TIM 00:00
DIR INF

PHN 10
FUN LIN
RAT 1000 MH
TIM 00:10
DIR INF

PHN 11
FUN LIN
RAT 0.0 MH
TIM 00:00
DIR INF

PHN 12
FUN RET
```

5. DUAL PUMPS SYNCHRONIZATION ENHANCEMENTS AND NEW MODES

For Detailed instructions: See CBL-DUAL-3 cable documentation.

Requirement:

1) 2 Pumps from the 505384 syringe pump series with FW-1-X firmware upgrades.

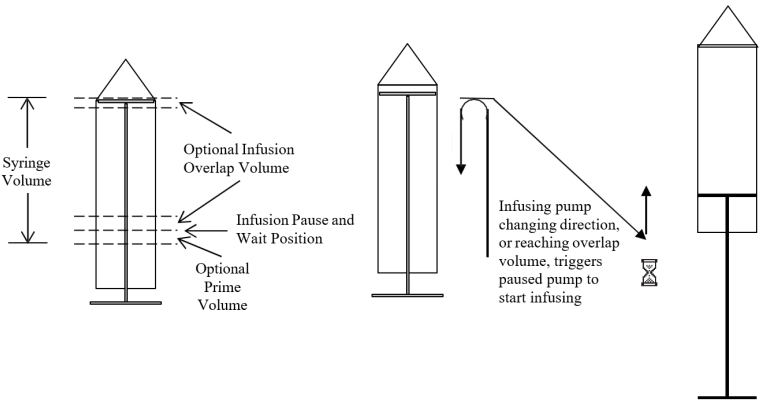
2) CBL-DUAL-3 dual pump synchronization cable.

Hardware Setup

Attach the cable, CBL-DUAL-3, to the "To Computer" connector on the back of both pumps.

Mode	Display in Setup	'X Firmware Version Only	Description
Dual Pumps	dUAL		Secondary pump duplicates the master pump
Reciprocating Pumps / Continuous Infusion	rECP		Continuous infusion / auto-refill
Alternating Pump Control	ALtr	Extra Features	Second pump starts when first pump stops.
Next Generation Continuous Infusion	COnt		Continuous infusion while minimizing flow rate pauses and drop outs when changing directions
Constant Flow Rate Gradient	GrAd		Dual pumps inverse linear functions combine for a constant flow rate

Next Generation Continuous Pumping Mode



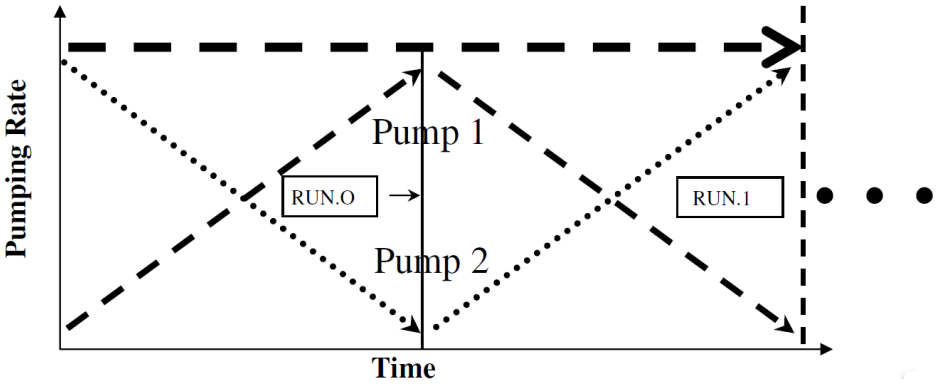
The continuous pumping mode eliminates the problem of flow rate drop-off that is typical with continuous syringe pump systems where one pump is refilling the syringe while the other infuses, and then they switch directions.

In this system, the refilling pump refills at a faster rate than the infusing pump giving it time to prime the syringe, then it pauses and waits for the infusing pump to empty.

Then, when the pumps switch directions, the refilled pump is primed and starts infusing at the set rate immediately. Additionally, an overlap can be set, whereby the refilled syringe begins infusing before the infusing pump is completely empty.

Dual Pumps Inverse Gradient Pumping Mode

Pump 1 + Pump 2 = Constant Rate



Maintains a constant total flow rate between 2 syringe pumps. A gradient (Linear function) dispensing function is programmed into the Master pump. The secondary pump will be automatically programmed with the inverse of the Master pump's gradient function. The sum of the two pump's flow rates will be a constant. Both pumps will increase and decrease pumping rates in tandem.

2 Modes of Operation

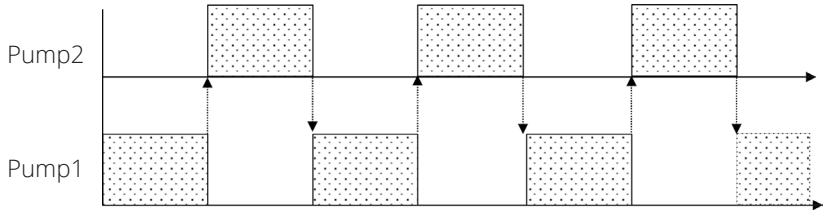
- **Single cycle:** Single ramp up or ramp down, then stop.

Set TTL setup setting RUN.0

- **Continuous cycle:** Ramp up, then ramp down, and repeat continuously.

Set TTL setup setting RUN.1

Alternating Pumps Mode (Enhanced Features



Creates a semi-automated continuous infusion system using pre-loaded syringes.

The infusing pump will automatically start the alternate pump when the Pumping Program stops. A Pause Function at the beginning of the alternate pump's program will delay the start of pumping. The empty syringe can then be manually replaced during the infusion of the alternate pump.

Set both pumps to Alternating communications mode ("ALtr") to create a continuous system.

• Starts alternate pump after either a Pause function or when the program stops.

Set the TTL setup setting: RUN.0, (Default setting) Alternate pump will start on execution of Pause function.

Set the TTL setup setting: RUN.1

Alternate pump will start when the Pumping Program has stopped

• Overlap start of alternate pump.

Pumping Program Function: OUT.0

Immediately sends start to alternate pump when OUT.0 function is executed.

Allows the creation of an overlap between the infusing and the alternate pump to allow the alternate pump to prime the syringe before the infusing pump stops.

Simultaneously start both pumps: If Phase 1 is set to function OUT.0, the alternate pump will immediately start when the Master pump starts.

Overrides sending a start command to the alternate pump when the pump stops.

• Stop Alternating Mode

Set TTL Trigger Mode to "Off". When trigger is set to "Off", start command will not be sent to alternate pump.

Within a Pumping Program, the trigger mode can be changed with the Trigger Off function: ("tr:of"). This allows a Pumping Program to limit the number of times that the alternate pump will execute its Pumping Program.

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