



Diamond Liberator Control

PATENTED

Software Version 1.01

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1. INTRODUCTION

1.1 Scope

This SDRS defines the functional capabilities of the software component of the product. The document defines what software capabilities are required, but not how those capabilities are to be implemented in the software design. The information defining how the capabilities are to be implemented is documented in the software design descriptions and source code that are developed after the software design requirements are specified and approved.

This specification focuses on the basic functional requirements, defining these in terms of the inputs to the software, the processing required by the software and the outputs from the software. The specification also defines the operating mode, interface, performance, safety, installation, maintenance and regulatory requirements.

The SDRS forms the basis for the electronic software validation and product validation testing.

1.2 Definitions, Acronyms and Abbreviations

Abbreviations

Definitions

FIXED RESERVE - A value, either in gallons or percent of capacity, entered into the unit that is subtracted from the calculated capacity remaining for the unit to determine if regeneration is needed. The same reserve value is used independent of usage pattern.

VARIABLE RESERVE - A value that is based upon the historical usage patterns of the softener. This value is subtracted from the calculated capacity remaining to determine if regeneration is needed. Variable and fixed reserves are mutually exclusive options.

The words regenerate and backwash are used interchangeably. A backwash cycle is a regeneration cycle with the brine draw, slow rinse, and refill cycles reduced to zero minutes.

1.3 References

SDRS Diamond Filter ver 0.3.doc

SDRS EPC 742 & 762 software version 1_07.doc

2. GENERAL REQUIREMENTS

2.1 Product Characteristics

This is a standard Logix 762 Control loaded with special customer specific ROM code. It is intended that the control operates much like a standard Logix 762 with exceptions necessary to operate the Diamond Iron Filter System.

2.2 User Characteristics

The control and valve will be installed by a technician that has been trained in the special functions of the control. The control will be programmed and functions like a standard Logix 762 Filter control with a few exceptions. The control will energize a customer provided relay using the chlorine generator output. The output will turn on based on water flow and three programmable parameters custom to this control.

3.3 Standby Power

The standby power routine is called anytime the unregulated voltage falls to a level indicating that AC power has been lost. The microcontroller is placed in a sleep mode waking to maintain the current time of day. Power to operate the microcontroller is supplied by a super capacitor. The display will show the programmed valve number when it wakes from standby power.

3.4 System Setup

The initial programming routine is used to load a set of programmable variables based on the resin volume in the softener. The system setup is a two step process. First the valve is selected, then the resin volume is selected. The system setup routine is normally entered from the power on reset routine if the initial setting (resin volume) is “no setting”. The initial setting can be cleared in the Program and Data Display State.

3.5 Program and Data Display

The program and data display state consists of several routines that allow for setting and displaying programmable values.

3.6 In Service

The in service state uses several routines that handle the monitoring and display function while the valve is in service.

3.7 Regenerating

The regenerating routine handles the operation of the motor to position the cam in various positions as needed to perform regeneration of the resin bed.

4. Programming and Data Display

The six levels of programming the control are Factory Programming, System Setup, Level I Programming, Level II Programming, Cycle Time Programming, and History Data. Factory programming will use a PC to program the flash ROM and information memory in circuit. All other programming will be performed using the Figure 2: Key Pad, Figure 3: 740/742 Liquid Crystal Display and Figure 5: 760/762F Liquid Crystal Display & Overlay Text.

The DOWN key is the down arrow on the far left. The SET key is the square between the down and up arrows. The UP key is the up arrow to the right of the square. The REGENERATION key is the recycle symbol on the far right.

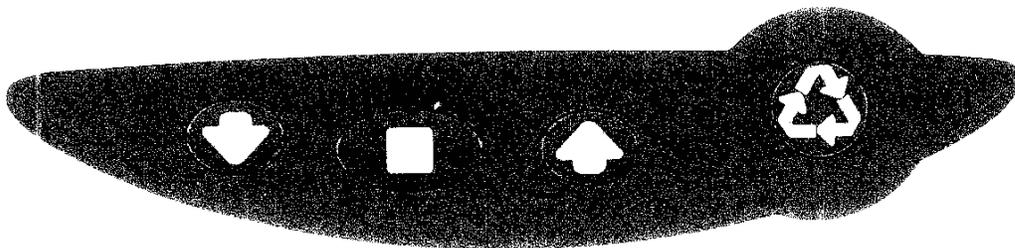


Figure 2: Key Pad

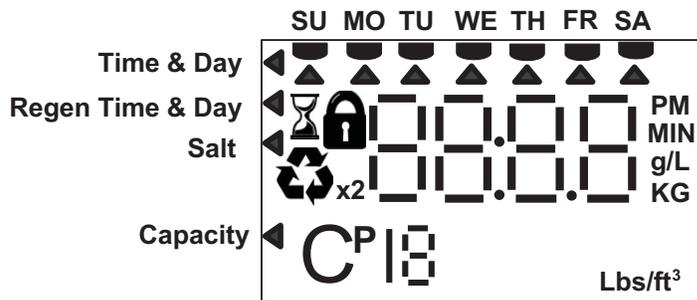


Figure 3: 740/742 Liquid Crystal Display & Overlay Text

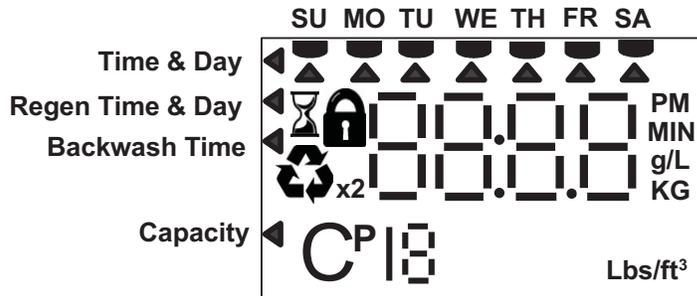


Figure 4: 740F/742F Liquid Crystal Display and Overlay

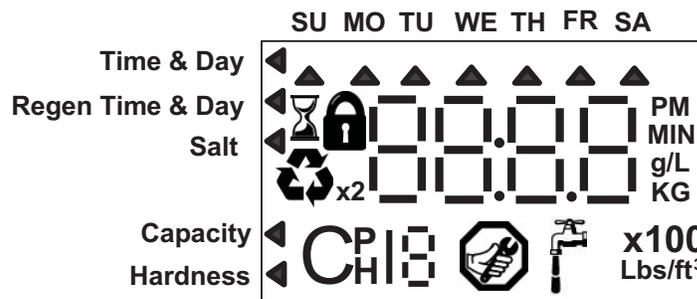


Figure 5: 760/762F Liquid Crystal Display & Overlay Text

4.1 Factory Programming (not part of software)

The special Diamond Iron Filter ROM code will be loaded into the control at the factory immediately before valve testing. A label indicating “Diamond Liberator” will be placed on the control immediately after the ROM code is loaded.

4.2 System Setup

The control will ship from the factory with US units and 12 hour clock. The control will operate with 50 or 60 Hz power. The customer will select the valve model in the first programming step.

263

273

293 (Magnum 3 cycle filter)

The user will press the SET key when the correct valve selection is displayed. Entering the valve number shall load a set of default values that are dependent on valve selection. Table 1 shows the default values loaded with the valve selection.

Table 1: Valve type defaults

Valve	263	273	293
Turbine Type	1 inch	1 inch	Magnum internal NHWB
Backwash 1 Time (min)	14	14	14
Fast Rinse Time (min)	10	10	10
Re-pressurize Time (min)	1	1	N/A
Backwash-2 Time (min)	1	N/A	N/A
Fast Rinse-2 Time (min)	1	N/A	N/A

The resin volume selection shall be limited to “F” for filter if a filter valve is selected.

4.3 Level I Programming

Level I programming can be entered by pressing the UP, DOWN, or SET keys. Pressing the UP or DOWN key shall enter the display mode. All parameters available in Level I programming will be displayed with the corresponding icon pointing to the parameter name. The small “P” on the bottom of the display is off indicating Level I. Pressing the UP key will move to the next item up in Tables 5 and 6. Pressing the DOWN key will move to the next item down in the table. Going up while displaying “Time of Day” will loop to “Hardness” for 760 mode and “Capacity” for 740 mode. The LOCK icon will turn on if the parameter being viewed is locked out.

Pressing the SET key will enter the change mode at “Time of Day”. The change mode will be entered at the displayed parameter if the control is in data mode when the SET key is pressed. The displayed parameter will flash. Pressing the UP or DOWN key will change the flashing value of the parameter. Holding the UP or DOWN key will scroll the flashing parameter value at a 20 counts per second rate. Pressing the SET key again will enter the flashing value in the appropriate parameter and advance to the next parameter.

Table 2: Level I programming parameters (filter valves 263, 273, and Magnum-293)

	Parameter Description	Range of Values	Minimum Increment	Default	Units of Measure	Notes
P1	Time of Day	1:00 - 12:59 AM or PM 0:00 - 23:59	1 minute	12:00 PM	hour :minute	Range depends on value selected for P10
P2	Day of Week	N/A	1 day	None	N/A	Uses arrows under days of week on overlay.
P3	Time of Regeneration	1:00 - 12:59 AM or PM 0:00 - 23:59	1 minute	2:00 AM	hour :minute	Range depends on value selected for P10
P4	Calendar Override	0-99	1	3	days	0 = no calendar override, .5 = regeneration twice a day at time of regeneration and 12 hours latter. Calendar Override skipped if at least one Day of Regeneration selected. Can be locked out of changes in Level I programming.
P5	Day of Week Regeneration	N/A	1 day	None	N/A	Uses bars under days of week on overlay. Day of Week Regeneration is skipped if calendar override is more than zero. 742 only.
P6	Backwash Time (3 cycle filter mode)	0-200	1	14		Minutes of backwash in 3 cycle filter mode. Uses the arrow that points to salt amount on control in softener mode.
P7	Capacity of unit (demand only)	0-90,000 0-900	100 1	0	Gallons M ³	Unit of measure depends on value selected for P9.
P8	Backwash 1 Pump On	0-1	1	1	N/A	0 = Auxiliary Output off during Regeneration 1 = Auxiliary Output on during Backwash 1 cycle
Notes:						

4.4 Level II Programming

Level II display mode is entered by pressing and holding the UP and DOWN keys for 3 seconds. The display will show the small “P” in the lower portion of the display indicating the control is in Level II programming. Programming in Level II is the same as programming in Level I. Other values in tables 3 and 4 are viewed by pressing the UP or DOWN keys. Items that are locked out of Level I programming will have a flashing LOCK icon. The flashing LOCK is turned on or off by pressing the REGENERATE key.

Pressing the SET key while in Level II display mode will enter Level II programming mode. The displayed parameter will flash. Pressing the Up or DOWN key will change the flashing value of the parameter. Holding the UP or DOWN key will scroll the flashing parameter value at a 20 counts per second rate. Pressing the SET key again will enter the flashing value in the appropriate parameter and advance to the next parameter.

Table 3: Level II programming parameters (filter valves 263, 273, and Magnum-293)

	Parameter Description	Range of Values	Minimum Increment	Default	Units of Measure	Notes
P9	Units of measure	0-1	1	0		0 = US 1 = Metric.
P10	Clock mode	0-1	1	0		0 = 12 hour clock 1 = 24 hour clock.
P11	Service Interval	0-250	1	0	Months	Uses 30 days for each month.
P12	Remote regeneration switch delay	3-250	1	60	seconds	Time remote switch must be active to start regeneration on 742 time clock units.
P13	Pump Gallons Set	0 – 250	1	2	gallons kiloliters	The pump will start at first turbine pulse if “0” is set
P14	Pump Run Time	1 –250	1	10	Seconds	
P15	Pump Run Calendar Override	0-30	1	0	days	0 = no calendar override
P16 (3)	Reserve Type (demand only)	0-3	1	0		0=variable reserve delayed regeneration 1=fixed reserve delayed regeneration 2=variable reserve immediate regeneration 3=fixed reserve immediate regeneration
P17 (3)	Initial average or fixed reserve (demand only)	0-70	1	30	% of Capacity	Depends on value entered in P16
P18 (3)	Flow sensor select (demand only)	0-5	1	(1)		0=internal magnum NHWB, 1=1” Autotrol turbine, 2=2” Autotrol turbine, 3=User define K-Factor, 4=User defined Pulse Equivalent, 5=internal Magnum HWB
P19 (3)	K-factor or Pulse Equivalent	1.00-99.99 1-9999	0.01 1	0.01 1		K-factor P18=3; Pulse Equivalent P18=4

4.5 Cycle Time Programming

The cycle times display mode is entered by pressing and holding the UP and SET keys for 3 seconds when the control is in the “in service mode”. The display shall show the small “C” in the lower portion of the display indicating the control is in cycle times programming. Pressing the UP and DOWN keys shall display the programmed time to remain in each cycle. Pressing the REGENERATION key shall exit the cycle times display mode.

Pressing the SET key while a programmed cycle time is displayed shall enter the change cycle time mode. The cycle time in minutes shall flash indicating it can be changed from zero to 200 minutes. Pressing the UP or DOWN keys shall change the flashing time. Pressing the SET key while the cycle time is flashing shall enter the flashing value displayed in the display cycle number. The draw and refill cycle times may be programmed for 3 cycle filters.

Table 4: Cycle positions

	263 valve	273 valve	Magnum valves 293/298
Description	C# Displayed	C# Displayed	C# Displayed
1-Backwash	1	1	1
2-Draw (2)	2 (1)	2	2 (3)
3-Rinse	2 (1)	3	3 (3)
4-Re-pressurize	4 (*)	4	N/A
5-Fast Rinse	5	5	5
6-2 nd Backwash	6	N/A	N/A
7-2 nd Fast Rinse	7	N/A	N/A
8-Refill (2)	8	8	8
(1) Draw and Rinse use the same position on 255 & 268 valves.			
(2) Draw and Refill times are calculated on softener valves using draw and refill rates and salt setting. Draw and Refill times may be programmed in minutes on 3 cycle filter valves.			
(3) Separate draw and rinse positions are present on 278 and 298. Control shall stay in the brine draw position for both the draw and rinse times then proceed through the rinse position with no dwell time.			
(*) Wide Gap			

4.6 History Data

History Data mode is entered by pressing and holding the DOWN and SET keys for three seconds. The stored initial setting will be flashing on the display. The initial setting is reset to the as shipped condition by pressing and holding the SET key for three seconds while it is being displayed. The UP and DOWN keys are used to scroll through the available History Data values as seen in Table 5.

The days Sunday through Saturday in H7 through H13 assume the overlay used has Sunday on the far left and Saturday on the far right.

The average usage for each day of the week will be set to initial average (P17 value)% of the total water the system will treat prior to any usage history being recorded. Averages will also be reset to this initial average % value anytime the hardness value is changed.

Table 5: History Data

	Description	Range	Notes
H0	Initial Setting Value	Cubic Feet or Liters	Resin Volume
H1	Days since last regeneration	0-255	
H2	Current Flow Rate	Depends on Turbine Used	
H3	Water used today in gallons / m ³ since Time of Regeneration	0-131,070 gallons or 0-1,310.70 m ³	
H4	Water used since last regeneration in gallons / m ³	0-131,070 gallons or 0-1,310.70 m ³	
H5	Total water used since reset in 100s	0-999900 gallons or 0-9999 m ³	
H6	Total water used since reset in 1,000,000	4,294 x 10 ⁶ gal or 4264 x 10 ⁴ m ³	
H7	Average usage for Sunday in gallons or m ³	0-131,070 gallons or 0-1,310.70 m ³	
H8	Average usage for Monday in gallons or m ³	0-131,070 gallons or 0-1,310.70 m ³	
H9	Average usage for Tuesday in gallons or m ³	0-131,070 gallons or 0-1,310.70 m ³	
H10	Average usage for Wednesday in gallons or m ³	0-131,070 gallons or 0-1,310.70 m ³	
H11	Average usage for Thursday in gallons or m ³	0-131,070 gallons or 0-1,310.70 m ³	
H12	Average usage for Friday in gallons or m ³	0-131,070 gallons or 0-1,310.70 m ³	
H13	Average usage for Saturday in gallons or m ³	0-131,070 gallons or 0-1,310.70 m ³	
H14	Average service cycle	0-255 days	
H15	Peak Flow Rate	0-200 GPM or 1000 Lpm	
H16	Day and Time of Peak Flow Rate	Time and day that peak flow occurred	
H17	Months since service	0 – 2184 months	
H18	Days since last (Auxiliary on) pump run.	0-255	

4.7 Manual Regenerations

The REGENERATION key is used to program manual regenerations.

4.7.1 Delayed Manual Backwash

A delayed manual regeneration is programmed by pressing the REGENERATION key. The regeneration icon on the LCD will flash indicating a regeneration will start when the time of day reaches the programmed time of regeneration. Pressing the REGENERATION key again will turn off the regeneration icon and cancel the delayed regeneration.

4.7.2 Immediate Manual Backwash

An immediate manual regeneration is programmed by pressing and holding the REGENERATION key for three seconds. The regeneration icon on the LCD will turn on. The control will go to the regenerating mode.

4.7.3 Delayed Second Backwash

A delayed second regeneration is programmed by pressing the REGENERATION key while the control is in the regenerating mode. The x2 icon next to the regeneration icon will flash indicating a second regeneration will start when the time of day reaches the programmed time of regeneration.

4.7.4 Double Immediate Manual Backwash

Back to Back manual regenerations are programmed by pressing and holding the REGENERATION key for three seconds while the control is in the regenerating mode. The x2 icon next to the regeneration icon will turn on indicating a second manual regeneration will start immediately after current regeneration is complete.

5. Operating Requirements

There are five operating modes for the control. The operating modes are In Service, In Regeneration, Standby Power, Self Test, Display Error.

5.1 In Service

The valve is delivering treated water while the control is in service.
The cam is in the home position.

5.2 Display Error

The display error mode will be called when ever one of the errors described in the previous sections occurs. The following functions will be performed:

- Display "Err1" if both locations of the 742/762 designation are corrupt. Overwrite the primary and secondary locations for the 742/762 designations with 762N for 60Hz and 762W for 50Hz.
- Display "Err1" if NOVRAM data corrupt. Overwrite all NOVRAM locations except the primary and secondary locations for the 742/762 designation with zeros and re-compute the checksum if any key is pressed.
- Display "Err2" if a "North American" control is being operated with a 50Hz supply.
- Display "Err3" and turn on motor if the photointerrupter is blocked when it should be open in the service position. Run motor until the service position is found.
- Display "Err3" and turn on motor if the control detects the service position before the end of a regeneration cycle. Run motor until the service position is found.