

ELIMINATOR

BLDC Electric Chemical Pump Manual

With Flomore 3500 Pump and 5100 Bracket

CARON MEASUREMENT & CONTROLS

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1 SAFETY

1.1 SAFETY PRECAUTIONS

- Throughout this manual the term “buttons” will be used to describe both the faceplate buttons as well as the magnetic switches. Always keep the enclosure cover on tightly unless the area is known to be non-hazardous. The magnetic switches allow configuration while safely keeping the cover closed.
- Follow all Local electrical codes when wiring the chemical pump.
- Always keep all enclosure covers tightly closed while the unit is powered up. Remove power before disconnecting any wires as sparking may result.
- Always use adequate gauge wire to power the pump controller.
- Power to the unit must be fused with the appropriate size fuse. See the wiring section of this manual for amperage ratings.
- The pump starts and stops automatically, keep clear of moving parts.
- ALWAYS disconnect power before servicing
- Keep all covers and guards in place while in operation.

2 INSTALLATION AND OPERATION

The Caron Controls ELIMINATOR BLDC Electronic chemical pump is a compact controller and motor combination to drive various types of mechanical injection pumps. Any pump that is driven by a traditional motor can be used.

Chemical is injected based on a timed interval. The interval is calculated automatically based on the displacement of the chosen injection pump. A rate in L/Day is input into the controller and the interval is automatically adjusted accordingly. The injection pump displacement can be configured to accommodate various size pumps. The controller rotates the motor exactly one rotation per interval. The speed of the motor is varied to achieve desired frequency. If the interval is longer than one rotation at minimum RPM, the controller will rotate the motor once, and stop until the next stroke request.

The injection output pressure capability is based on the chosen fluid end. Consult manufacturers documentation.

2.1 ELECTRICAL

2.1.1 SPECIFICATIONS

Eliminator Controller configured as BLDC Chemical Pump

Voltage	19 – 30VDC
Controller Continuous Current Rating	20A
Actual Maximum Current Draw	10A
Recommended Fuse Rating	10A
Enclosure Rating	Type 4x
Temperature Code	T4A
Ambient Temperature	-20 to 40 °C
Classification	Class I Division 1 Groups C, D

2.1.2 WIRING

The pumps are typically shipped with a 5m length of cable preinstalled with sealed connector. All that is needed is connection to a 24v power source. If this cable needs changed, or is ordered without, power supply connection is made using the VIN and GND terminals on the motor driver board as listed below in figure 2.1.2a. Motor phase connections come prewired.

The controller itself is rated for 20A continuous, however in chemical pump configuration it should not draw more than 10A. A 10A fuse is recommended.

Field connection to the logic board for RS485 and others are listed in figure 2.1.2.1 and 2.1.2.2. Power to the logic board is supplied from the driver board and is prewired.

Main Screw Connectors (Motor Driver Board, bottom of enclosure)

GND	DC SUPPLY NEGATIVE CONNECTION
VIN	DC SUPPLY POSITIVE CONNECTION 10 – 30V
A	MOTOR PHASE A
B	MOTOR PHASE B
C	MOTOR PHASE C

FIGURE 2.1.2

2.1.2.1 MAIN BOARD UP TO VERSION 2.7.3

Main Header (Bottom)

Q1+	OUTPUT 1 +
Q1-	OUTPUT 1 -
Q2+	OUTPUT 2 +
Q2-	OUTPUT 2 -
VDC	DC POSITIVE 9-30V (PREWIRED)
GND	DC NEGATIVE (PREWIRED)

AUXILIARY HEADER (TOP)

A1	NOT CONNECTED
A2	NOT CONNECTED
A3	NOT CONNECTED
A4	NOT CONNECTED
A5	NOT CONNECTED
A6	NOT CONNECTED
A7	RS485 A
A8	RS485 B

FIGURE 2.1.2.1

2.1.2.2 MAIN BOARD AS OF VERSION 3.0.10

J1 Header (Bottom, Left to Right)

Q1	OPEN COLLECTOR OUTPUT Q1 (1A SINK)
Q2	OPEN COLLECTOR OUTPUT Q2 (1A SINK)
DO1	PUSH-PULL DC OUTPUT (100MA @ INPUT VOLTAGE)
DO2	PUSH-PULL DC OUTPUT (100MA @ INPUT VOLTAGE)
-	DC NEGATIVE
-	DC NEGATIVE
+	DC POSITIVE (9-30VDC SUPPLY)
+	DC POSITIVE (9-30VDC SUPPLY)

J5 HEADER (TOP, LEFT TO RIGHT)

V+	PERIPHERAL SUPPLY POSITIVE (@ INPUT VOLTAGE)
DI1	DIGITAL INPUT 1 (5-30VDC)
DI2	DIGITAL INPUT 2 (5-30VDC)
AI3	ANALOG INPUT 3 (1-5V OR 4-20MA)
AI4	ANALOG INPUT 4 (1-5V OR 4-20MA)
AO3	ANALOG OUTPUT 3 (4-20MA VERSION OF ANALOG OUTPUT 2)
A1	PORT 1 RS485 A
B1	PORT 1 RS485 B

FIGURE 2.1.2.2

2.2 INSTALLATION

2.2.1 MOUNTING

The Eliminator Controller with Flomore pump and 5100 bracket is designed to be a direct replacement of a common 51/5100 series pneumatic injector. The same bolt holes are used, and the fluid end will be in the same location allowing the same tubing and fittings to be used.

2.2.2 TUBING

If new tubing lines are to be installed, the connection is the same as any typical high pressure metering injection pump. Consult the manual for the Flomore 3500 Series pump for details.

- Use an appropriate relief valve on discharge of the pump
- Use adequate rated fittings and tubing for system design pressure
- Isolation valves near the pump are recommended for servicing
- Use adequate suction piping size to prevent restriction and air lock.
- Always use a reliable injection point check valve (near the point of injection). Gaugetech GTCV12SS10 or equivalent recommended.

2.3 STARTUP AND OPERATION

2.3.1 STARTUP

The following procedure is for startup of the Caron Eliminator Chemical Pump Controller. There may be additional instructions based on the pump/fluid end equipped. Consult manufacturers documentation.

*Once supply power is turned on, the pump may start automatically

1. Power on the pump
2. Adjust rate to desired amount
3. Purge fluid through pump head.
4. Once all air is removed, verify correct pump displacement (mL per stroke) with sight glass. If adjustment is necessary, use the menu screens to adjust the displacement setting.
5. Periodically verify displacement, purge when necessary.

*The "Low Prime" Alarm may ring in initially based on its configuration. This should clear once the pumping is injecting against process pressure and configured correctly.

2.3.2 RATE ADJUSTMENT

CAUTION: DO NOT remove the housing cover unless the area is known to be non-hazardous.

Adjusting the injection rate is done by pressing the up and down buttons (or magnetic switches) while on the home screen. Local rate adjustment can only be done on the home screen. The home screen displays the pump name, a countdown until next stroke and the current rate setting in L/Day. If the home screen is not displayed, use the "back" and "next" buttons to scroll through the screens. Adjustment can also be made via Modbus.

*For dual head pumps pumping different fluids or to different locations set the rate based on the higher of the 2 volumes with the pump stroke set to full. Adjust the mechanical stroke length of the other head to the desired rate. The rate will be the percentage of the higher rate based on the stroke length. The displacement should be set for the full stroke of the head with the higher rate. See the configuration section for more details.

An example would be Chemical 1 at 40L/Day, chemical 2 at 20L/Day. Set the rate on the screen for Chemical 1. Ensure Chemical 1 is taking a full stroke. Adjust the stroke length on chemical 2 to 50% and verify with sight glass.

The maximum rate depends on the displacement setting and is calculated based on the maximum capable RPM. The current maximum is displayed on the diagnostics screens and is labelled "MR:".

2.3.3 MAXIMUM INJECTION PRESSURES

*The maximum injection pressure is based on the specification of the equipped pump end. See the manufacturers documentation.

The table in section 2.4.2 list maximum pressures and rates for standard model pumps.

2.3.4 DIAGNOSTIC SCREENS

There are a number of diagnostic screens that can give valuable information to assist with startup and reliable operations. From the main screen, scroll right (next) to the diagnostic screen and press up. Scroll right through the available information.

Information available:

- Input Amps: The input current being drawn from the supply power to operate the motor.
- Delta Amps: The difference between peak and trough motor amps. Used for lost prime detection.
- Req SPM: Strokes per minute requested from the timer.
- Act SPM: Actual strokes per minute of the motor. Used to detect stroke faults. This is averaged and can trail changes to rates.
- IC: Live Input Current.
- M: Peak input current since power up
- MR: Maximum rate setting. Calculated based on displacement and max RPM.
- I: Current stroke interval in seconds.
- Driver Faults: Any faults registered in the motor driver will appear here.

2.4 CONFIGURATION

There are a few points that can be configured for accurate injection rates and reliable operation. These will typically be done from factory if ordered with a specific pump.

Configuration of the controller can be done via the display by using the buttons on the face or the Magnetic switches located around the enclosure. The magnetic switches allow configuration without removing the housing cover. The position of each switch is marked on the faceplate. This manual will use the term buttons throughout which describes both the faceplate buttons as well as the magnetic switches. **CAUTION: DO NOT** remove the housing cover unless the area is known to be non-hazardous.

2.4.1 MENU ACCESS

To change configurable settings, navigate to the “Menu Access” Screen using the Left or Right buttons. Once on the screen press up to access the Menu Screens. Scroll left and right to access different settings and use up and down arrows to adjust the setpoints. Adjustments will take effect immediately. When finished, navigate to the “Save & Exit Menu” screen and press down to save the settings to non-volatile memory.

2.4.2 INJECTION PUMP DISPLACEMENT

For accurate rate calculation the controller needs to be configured with the actual displacement per stroke of the equipped injection pump. This will come pre-configured from factory if purchased with an injection pump. To set the pump displacement access the menu and navigate to the “Pump Disp” screen. The setting can be adjusted in 0.1mL increments using the up and down buttons. When finished exit the menu.

*For dual head pumps there are 2 options for setting displacement.

- Pumping same fluid to same location: set displacement of both heads combined
- Pumping to different locations or different fluids: Set displacement of the head needing the highest rate. The second rate will be a percentage of the first, based on adjusted stroke length.

Typical displacements (At full stroke)

Plunger Diameter (Inch)	Volume per stroke (mL)	Maximum Injection Pressure	Maximum Rate *
3/16	0.45	41369kPa/6000psi	34 L/Day
1/4	0.8	27579kPa/4000psi	63 L/Day
3/8	1.8	12410kPa/1800psi	140 L/Day
1/2	3.2	6895kPa/1000psi	247 L/Day

*Maximum rate in most cases is 10 - 15% higher than listed above. The “MR” value in diagnostics screens will indicate the maximum rate achievable based on the set displacement.

2.4.3 LOST PRIME DELTA C

The controller can detect if the injection pump has lost its prime, is not pumping or the discharge line has lost pressure. It does this by monitoring the motor current throughout the stroke cycle. The difference (delta) between the peak and trough is compared against the setpoint. If the average delta amps drops below the setting, and alarm is triggered.

*This setting may need adjustment if the rate is changed significantly.

*At very low rates or pressures with certain plunger sizes this can be hard to detect. To disable this alarm, set to 0.

To adjust this setting access the menu and navigate to the “LostPrime DeltaC” screen and adjust using the up and down buttons. This setting can be adjusted in 0.1A increments. The current average is shown on the right hand side. When finished exit the menu.

2.4.4 RESET VOLUME

To reset the volume accumulator, press the “UP” button 5 times on this screen. This will NOT reset the stroke counter.

2.4.5 DI1 REMOTE ESD

Digital input one can be enabled to use as a remote shutdown input. This input accepts a 5-30v discrete signal. If enabled, when no voltage is applied, the pump will enter an ESD state, will stop pumping and the screen will turn red. When voltage is applied, the shutdown will clear, and the pump will resume normal operation.

*This input is only available on main board versions 3.0.10 and above.

2.4.6 CONTROL MODE

Set the method for controlling the injection rate.

- Modbus
 - Set the rate via Modbus or locally on the screen using magnetic switches or buttons.
 - This is the most accurate method for rate control
- Analog
 - Set the rate based on a 4-20mA signal on input AI3. Manual adjustment is not possible in this mode.

2.4.7 AI LOW FLOW CUT OFF

In analog control mode, set the rate at which below should be considered 0. Analog signals can have calibration offsets, so values close to 4mA should be considered 0 injection rate.

2.4.8 AI SPAN

The injection rate when the analog input signal is at 20mA.

2.4.9 MODBUS SLAVE ID

Adjust the slave ID for Modbus communication. Use the up and down buttons to adjust.

2.4.10 MODBUS BAUD RATE

Adjust the Baud rate for Modbus communication. Use the up and down buttons to adjust.

2.5 MODBUS MAP

Warning: Constantly writing to registers will cause local controls to be over written. Only write when changes are required.

As of Software version 11.00.06

Coils (0x)			
Offset	Description		Type
0	Pump 1 ESD Status(1 = ESD, 0 = Not ESD)	R/W	Bool
1	Pump 1 ESD Reset. Write 1 to Reset	R/W	Bool
2	Pump 1 Reset Volume Accumulator. Write 1 to Reset	R/W	Bool

Input Registers (3x)			
Offset	Description		Type
0	Pump 1 Strokes	RO	long (int32)

Holding Registers (4x)			
Offset	Description		Type
0	Pump 1 Rate (actual rate x10, 3.5L/day = 35. **Float version below)	R/W	int16
1	Pump 1 Status (0=Off, 1=Run). Use this to start and stop the pump remotely.	R/W	int16
2	Pump 1 seconds until next stroke	RO	int16
3	Battery Voltage (x10 ** Float version below)	RO	int16
4	Pump 1 Flags, Bits: 0-Not used 1-Low Prime 2-Stroke Fail (Actual SPM does not match requested) 3-Driver Fault (Motor Driver Fault)	RO	WORD
5	Pump 1 Rate (Float)	R/W	Float
7	Pump 1 Strokes	RO	long (int32)
9	Battery Voltage (Float)	RO	Float
11	Pump 1 Volume Accumulator (Liters)	RO	Float
13	Pump Actual Strokes per minute (SPM).	RO	Float
15	Average Input Amps	RO	Float
17	Driver MOSFET Temperature	RO	Float

2.6 PREVENTATIVE MAINTENANCE

The following steps should be performed periodically to maintain reliable sampler operation. Over the first few weeks, check more frequently and take the time to develop a maintenance schedule.

1. Verify Fluid end is purged and air free.
2. Verify chemical pump displacement.
3. Lubricate sliding or rotating parts when necessary. Factory Lubricated with Molykote 111 or Lucas "Red N Tacky". These are long term, high tack grease for ideal sliding applications and should last a significant amount of service time. NOTE: Some solvent chemicals can down "Red N Tacky" grease, in these cases Molykote 111 should be used.
4. Check set screws and linkages for tightness

3 TROUBLESHOOTING

Symptom	Possible Cause	Solution
No Chemical flow, but pump is stroking	Injection Pump is air locked	Bleed Injection pump following manufacturers instructions
	Chemical recycling through PSV (external field installed).	Check to see if a valve is closed or PSV is set correctly.
	Loose or worn coupler	Inspect shaft coupler and mechanical linkages
Injection pump is not stroking	Low supply Voltage	Check battery Voltage
	Electronics Fault	Check diagnostics screens for active alarms or faults
Pumping too much fluid	Incorrect displacement setting	Verify actual vs configured displacement
Not enough Fluid pumping	Incorrect displacement setting	Verify actual vs configured displacement
	Air lock in fluid end	Purge Fluid end.