

399 SERIES DUPLEX PUMP CONTROLLER INSTRUCTION MANUAL



Sigma Controls, Inc.

PROCESS CONTROLS AND INSTRUMENTATION

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INTRODUCTION:

The Sigma 399 Series (Duplex Pump Controller) is a state of the art microprocessor based, user configurable instrument for the monitoring and control of two (2) constant speed or (2) variable speed driven pumps.

The 399 Series performs all of the functions found in a full size control panel.

- Displays level in alpha and numeric forms
- Displays pump run status
- Allows full user selection of all system variables
- Monitors critical alarms (motor overtemperature, etc.)
- Monitors non-critical alarms (seal leak, etc.)
- Monitors hand off auto selection switch position
- Monitors pump (VFD) 'run' feedback
- Provides relay outputs for pump control, level alarm, and general alarm.
- Provides 4/20MA output for VFD speed setting, proportional control, or retransmission.
- Continuous sensor monitor with general alarm output
- Visual alarms
- Allows simulation of level to exercise pumps or verify operation
- Provides PID control and calculated flow (optional).
- Available in ¼ DIN panel mount or Nema 4X enclosures (optional)

ORDERING INFORMATION:

- | | |
|----------------------|----------------------|
| ▪ 1/4 DIN Case | Sigma 399 Series DPC |
| ▪ Wall Mount Nema 4X | Sigma 399 Series-N4X |

SPECIFICATIONS:

- ANALOG INPUT (1 ea.)
Analog, 4/20MA isolated with common negative, +/-0.1% accuracy.
- DIGITAL INPUTS (8 ea.)
Digital 10-30V DC (Grounding)
- ANALOG OUTPUT: (1 ea.)
Analog, with common negative 0-20MA, 4/20MA, 0-5V, 0-10V (voltage output requires a resistor).
- RELAY OUTPUTS: (4 ea.)
SPDT, Form 'C' 5A Relay
- DISPLAY:
LCD, 2 line Alphanumeric, Backlit.
- ALARM RESET/SILENCE INPUT

- **LOOP POWER:**
24VDC regulated output, 100MA max. (with 110VAC option).
- **3 USER KEYS:**
Up, Down, Enter
- **ACCURACY:**
0.1% of calibrated span
- **LOCKOUT:**
User password, user configurable
- **INPUT IMPEDANCE:**
Voltage 100K, current 100 OHMS
- **POWER:**
24VDC, (110VAC optional)
- **ENVIRONMENTAL:**
Operating, 0-65° C
Storage, -40° -80° C
R.H., 0-90% non-condensing
- **ENCLOSURE:**
¼ DIN, ABS plastic 96 X 96 X 110MM or Nema 4X wall mount 12 x 8 x 8 inches
- **FRONT PANEL:**
Gasketed Nema 4X
- **ACCESS: (DIN CASE)**
Chassis & boards remove from front of case.
- **TERMINAL STRIP:**
(24) Removable for ease of wiring 28 – 16 AWG
- **CONNECTIONS:**
Removable screw terminal blocks 28 – 16 AWG wire. (27 with 110VAC option)
- **CONTROL OUTPUTS:**
4 relay outputs, user programmable, SPDT Form 'C' relays 5 AMP.
- **CPU Activity Monitor**
- **PROGRAMMING:**
Menu based, all parameters and setpoints are user configurable via menu prompts and user keys. The preconfigured screens and 'pull down' sub menus with English prompts assures rapid setup and commissioning.

- 1 YEAR WARRANTY
- OPTIONS:
Expansion cards, networking
- MODBUS® Master/Slave
Network allows multiple units to be connected together for distributed applications or remote monitoring SCADA applications.
- EXPANSION CARDS:
Significant expansion is possible via additional control boards and 'MODBUS®' networking.

FEATURES:

- Microprocessor Based
- LCD Display
- 3 Function Keys
- Isolated 24VDC Sensor Power (with 110VAC option)
- 4/20MA, Programmable input
- 1 Analog Input
- 1 Analog Outputs
- 8 Digital Inputs
- 4 Form 'C' Relay Outputs
- Fully User Programmable in English
- 2 Ea. RS485 Ports (Programming and SCADA) MODBUS® Master/Slave.
- CPU Activity Monitor

OPTIONAL I/O CARD

Adds:

- 1 ea. 4/20MA input and output
- 8 ea. Programmable digital inputs/outputs
- Digital barometer
- Bubbler pressure sensor

WIRING DETAIL

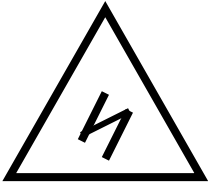
- Inputs, see Dwg # 26-32
- Outputs, see Dwg # 26-32



CAUTION

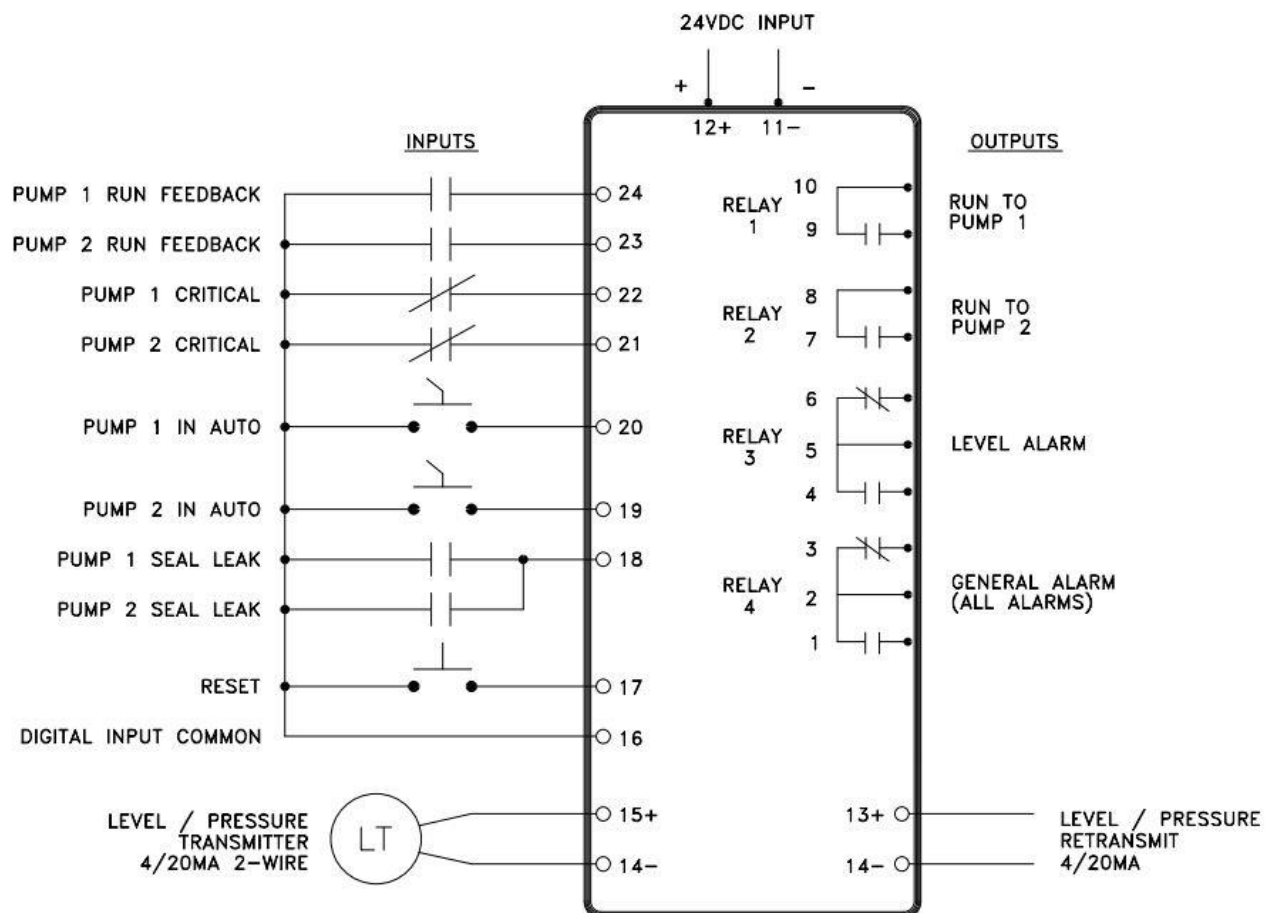
All electrical wiring must be in accordance with all local state and national codes that apply.

Do not exceed the rated current of the D.C. power supply (100MA) or the form 'C' relay outputs (5A/240VAC resistive).



WARNING

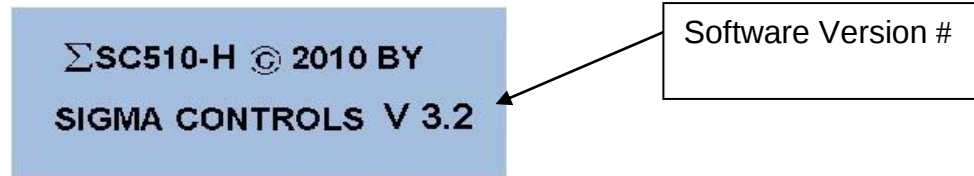
Hazardous voltages are present within the enclosure. Installation or service should only be carried out by trained personnel.



PROGRAMMING & SETUP

Review Screens

The 399 Series utilizes 'plain English' menu driven screens which are sequential and intuitive. When the unit powers up, the startup screen will appear as follows:



After the initial screens have appeared, the unit will show the 'MAIN SCREEN'.

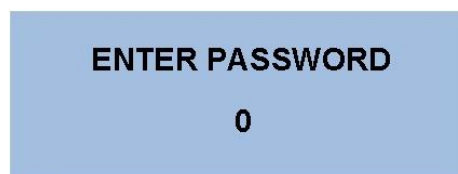


NOTE: The lower line in the 'Main' screen can show multiple process related information. Press the **↑↓** buttons to scroll to the following information:



PROGRAMMING SCREENS

From the Main Menu, Press the ENTER button to access the Password Screen:



Use the $\uparrow\downarrow$ buttons to enter the preprogrammed password, then press ENTER to advance to the Menu Screens.
Begin at 'Scaling' Screen.

*****MENU SELECTION*****
SCALING

Enter the Scaling Menu by pressing the ENTER button and advance to:

LOCATE DECIMAL POINT
.0

Press the $\uparrow$ button to select the number of decimal points desired: .0, .00, .000 or 0 (none), then press ENTER to advance to the Analog Input screen.

ANALOG INPUT LOW
.00 = 4.00MA

Use the $\uparrow\downarrow$ buttons to select the process value that will be displayed when the input is 4.00MA. Example shows that .00 will be displayed at 4.00MA input. Press ENTER to advance to Analog Input High Screen.

ANALOG INPUT HIGH
144.0 = 20.00 MA

Use the $\uparrow\downarrow$ buttons as before to select a value to be displayed when the input is 20.00MA.

Press the ENTER button to advance to the Analog Output Low Screen.

ANALOG OUTPUT LOW
.00 = 4.00MA

Use $\uparrow\downarrow$ buttons to select a process value to output 4.00MA then ENTER to advance to the Analog Output High Screen and select the desired value.

ANALOG OUTPUT HIGH
144.0 = 20.00 MA

This completes the 'Scaling' section. Press ENTER to save any changed values and return to the 'Main Menu' Screen. As previously described, enter the MENU selection and select the 'SETPOINTS' menu, where process setpoints are entered. The first screen is the Lead On Setpoint selection.

This is the point at which the lead pump will start.

LEAD ON SETPOINT
80.0

Press ENTER to advance to the:

Lead pump turns off

LEAD OFF SETPOINT
30.0

Press ENTER to advance to the:

LAG OFF SETPOINT
90.0

Press ENTER to advance to the:

HIGH ALARM SETPOINT
140.0

And ENTER to advance to:

HIGH ALARM RESET
138.0

NOTE: High Alarm Reset value must be less than High Alarm Setpoint.

Press ENTER to advance to System Timers:

CALL ON DELAY
2 SEC.

Delays the pump for X seconds after the setpoint has been read out.

CALL OFF DELAY
2 SEC.

Keeps the pumps running for X seconds after the off setpoint has been reached.

ALARM DELAY
7 SEC.

Length of time an alarm condition must exist before being considered actual.

This is the end of the setpoints screen section. Press ENTER to save values and return to the main menu.

ALTERNATION

The alternation screens are provided to alternate the lead/lag sequence to equalize view. Several options are available as follows:

From the Main Menu, navigate to the Alternate Menu. Select Between the following options:

**ALTERNATE
NEVER**

This screen prevents alternation. The sequence will remain fixed at lead then lag.

**ALTERNATE
WHEN ALL STOP**

This screen will change the lead/lag order when all pumps have stopped at the end of cycle.

**ALTERNATE
ON RUN TIME**

This screen selects pump alternation when a user selected run time has elapsed. A pump will alternate after it has run for this time period.

**ALTERNATE
ON TIME**

This screen selects a fixed time interval to alternate pumps regardless of actual pump run time.

**HOURS UNTIL ALT
6.0**

Once the alternate selection has been made, scroll to pump sequence screen.

**LEAD IS
1**

**LAG IS
2**

Select desired sequence and press ENTER to return to the main menu.

SETUP

Setup screen provides 'global' parameters, which affect overall performance and operation.

PASSWORD SCREEN

**PASSWORD (MAKE NOTE)
0**

Setting a password 'Locks' out unauthorized access to program items. **NOTE: Please make a note of the password value if changed. Access to the Menus will be unavailable without the correct password.**

Press ENTER to move to the ETM (Elapsed Time Meter) screens for each pump. ETM's can be reset here by setting value to 0.

A blue rectangular screen displaying the text "ETM 1 150" in black, bold, sans-serif font.A blue rectangular screen displaying the text "ETM 2 160" in black, bold, sans-serif font.

Press ENTER to select the desired ETM screen then ENTER to advance to the 'Input Filter' screen.

A blue rectangular screen displaying the text "INPUT FILTER" in black, bold, sans-serif font, with the number "1" centered below it.

NOTE: The input filter 'slows down' the process display and is of use in applications where the process is "noisy" such as monitoring the pressure on a pump discharge. Increasing the filter value will slow down the process display and stabilize pump action. Use caution too large a filter number can cause potential ill effects. Increase filter number 1 unit at a time and observe results before increasing further.

Press ENTER to advance to the unit text screen.

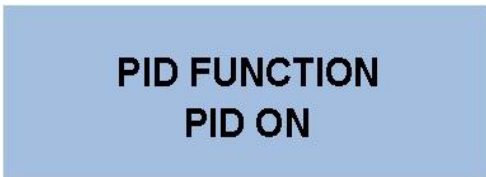
A blue rectangular screen displaying the text "UNIT TEXT" in black, bold, sans-serif font, with "INCHES" centered below it.

The following engineering units are available:

Inches, Feet, Degrees C, Degrees F, PPM, NTU, MGD, Inch Hg, Blank, LPM, PSI, and GPM. Select the desired units and press ENTER to advance to the PID function screen.

A blue rectangular screen displaying the text "CAUTION" in black, bold, sans-serif font.

Scroll to the PID screen. PID functions can be turned on or off in this item.

A blue rectangular screen displaying the text "PID FUNCTION" in black, bold, sans-serif font, with "PID ON" centered below it.

Use the **↑↓** buttons to move between PID, ON or Off.

NOTE: P.I.D. function provides proportional control of the output with a user selected setpoint. It is used for the modulation of a valve or variable speed drive to maintain a constant process value, with process load changes.

It is strongly recommended that the user be familiar with this control method prior to using it in a 'live' application.

Scroll to PID settings, change values with **↑↓**.

SETPOINT 40.0
OUT % .00

Analog Output
to Controlled Device

GAIN 5.1
OUT % .00

Gain is the
Speed of Response

INTEGRAL .50
OUTPUT .00

Integral (Reset)
Returns the Process to
the Setpoint after a
Load Change

DEADBAND .00
OUT % .00

Deadband is a value
around the Setpoint in
which no Output Change
will Occur.

MINIMUM % .00
OUT % .00

Sets the Value of the
Minimum Output

MAXIMUM % .00
OUT % .00

Sets the Value of the
Maximum Output

AUTO
OUT % .00

Select between AUTO and
MANUAL to take Manual
Control of the Output

MANUAL POSITION
OUT % .00

Allows User to
Manually Control the
Output Value

SETUP (continued)**FLOW CALCULATION**

The calculation estimates the station flow rate by measuring the influent flow volume during the time the pumps are turned off. It is necessary to enter into the controller a value for gallons/inch which requires the calculation of the area of the wet well. For example: Gallons per inch.

If the wet well is 10 FT X 10 FT, then the area is $10 \times 10 = 100$ SQ FT, multiply by 1" depth to get the volume of liquid in 1 inch of level.

NOTE: Use same units for calculation

$120" \times 120" \times 1" = 14,400$ Cubic Inch

Factor: 1 Cubic inch = .00043290 U.S. Gallons

Therefore, $14,400 \text{ CU IN} = 14,400 \times 0.00043290 \text{ Cubic Inch} = 62.33$

$1" = 62.33$ Gallons

Enter the value into the volume screen:

GALLONS PER INCH
62

SIMULATOR SCREEN

The simulator screen allows the user to simulate a changing process to test all system setpoints and functions.

From the main menu select the simulator screen, the current process value will be displayed.

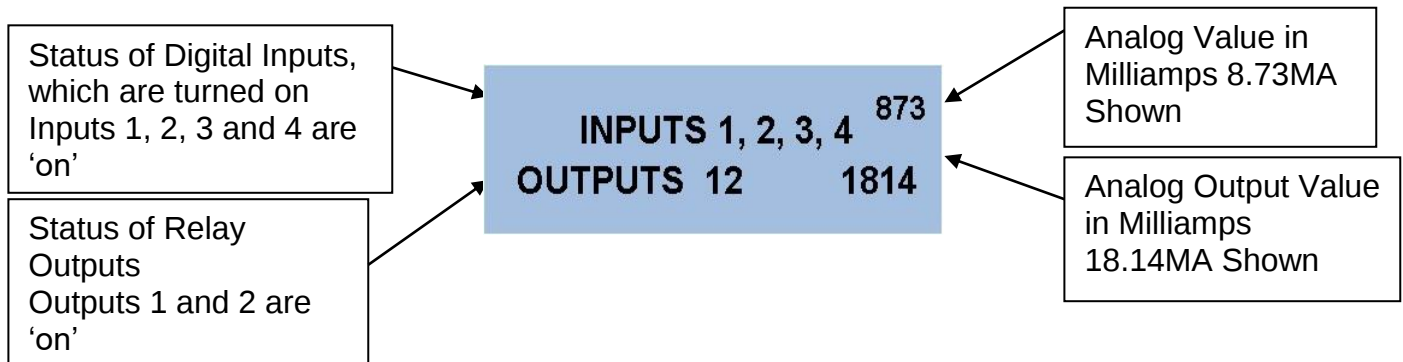
Press the $\uparrow\downarrow$ buttons to raise or lower the process value.

42.5 INCHES
!!!! SIMULATOR !!!!

Note the screen will flash the word 'simulator' to remind the operator that the controller is in the simulate mode. If no buttons are pressed, the controller will return to the main menu in 30 seconds.

DIAGNOSTIC SCREEN

The diagnostic screen is provided as an aid to troubleshooting. This screen provides the status of all digital inputs, relay outputs and analog input and output.



The diagnostic screen provides information about the current status of inputs and outputs and provides valuable information to aid in trouble shooting.

The screen shows the status of the 'RAW' analog input 1 and output 1 values. These raw values are approximately the input and output range in the selected input value; as shown, the input is 8.73MA and the output is 18.14MA. These raw values can provide help in determining if the 399 Series DPC is receiving the correct analog input.

The input/outputs are as follows:

ANALOG

AI

Raw input from level sensor (4AI)

AO

Raw output at speed output #1 (AOI)

DIGITAL

DIGITAL INPUT

Pump 1 Run Feedback	1DI
Pump 2 Run Feedback	2DI
Pump 1 Critical Alarm	3DI
(Normally Closed)	
Pump 2 Critical Alarm	4DI
(Normally Closed)	
Pump 1 HOA in Auto	5DI
Pump 2 HOA in Auto	6DI
Seal Fail	7DI
External Reset	8DI

DIGITAL OUTPUT

1	Relay 1 Run to Pump 1	RLY1
2	Relay 2 Run to Pump 2	RLY2
3	Level Alarm	RLY3
4	General Alarm	RLY4

NOTES ON ALARMS

General Alarm output is energized if any alarm in the system becomes active.

PUMP ALARMS

(1) Pump Fail, after a pump has been 'called' to run a digital input (normally from the auxiliary contact on the respective motor starter) is 'feedback' to the controller at 1DI and 2DI. If the controller fails to see this input within the alarm timer setting it assumes the motor starter has failed to energize and it energizes the 'Pump Failed to Run' alarm, removes this pump from the sequence and brings on the next available pump.

(2) Critical Alarm, the critical alarm inputs 3DI and 4DI or normally closed inputs usually from the pump motor thermostats or VFD faults. If the controller 'sees' either of these inputs go open, then the "critical alarm" is brought up on the screen and the respective pump is shut down. The next pump is brought on.

NOTE: If these inputs are not used they should be 'jumped'.

(3) Seal Leak, both seal leak inputs are connected to a single digital input 7DI. When either of these are closed the non-critical alarm is activated. The pumps are not shut down.

(4) H.O.A. selectors, are monitored for their position at 5DI and 6DI. If an HOA is not in the 'Auto' position that pump will not be permitted to run.

5) External Reset button can be connected to 8DI. When activated, it will clear any active alarm.

SERIES 399 DPC PROGRAMMING RECORD SHEET

Model Number: _____

Serial Number: _____

Vers: _____

Password: _____

• **Scale:**

Input Type _____

Decimal Point _____

Input Scale 2:

Input = _____

Display = _____

Engineering Units _____

Display Filter # _____

• **Analog Output Scale 1:**

Display = _____

Output = _____

• **Analog Output Scale 2:**

Display = _____

Output = _____

• **Setup:**

Trend Speed _____

• **Settings:**

Lead on at _____

Lead off at _____

Lag on at _____

Lag off at _____

Pump on Delay _____

Pump off Delay _____

Alarm Time Delay _____

• **Alarms:**

Low level alarm set _____

Low Level alarm reset _____

High level alarm set _____

High level alarm reset _____

Alarm Timer _____

Alternation: _____

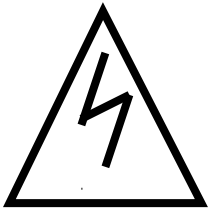
MAINTENANCE AND TROUBLE SHOOTING

The Series 399 DPC is a digital solid-state device, which requires no periodic maintenance.

Occasional physical checks of the unit should be carried out for physical and mechanical security of mounting, terminal blocks, and electrical wiring.

TROUBLE SHOOTING

- **UNIT 'LOCKS UP'** -- Recycle power to the unit by removing AC power, waiting 10 seconds and reconnecting power.



NOTE: This should be done by using the user provided circuit breaker or fuse, not by removing the power wires at the terminal block. **Serious injury or death can occur if contact is made with the incoming AC power.**

- **DISPLAY REMAINS AT ZERO OR SHOWS NO CHANGE** -- If the display remains at zero or shows no change but the process is changing, check for DC voltage on the loop. With 2 wire (4/20MA) instruments check with a DC voltmeter at the level instrument, by disconnecting the level instrument from its 2 wires and measuring across these 2 wires with a DC voltmeter for the presence of 24VDC. Check the diagnostic screen for analog input value.

If DC voltage is present, reconnect the negative wire of the supply and insert a milliamp meter between the positive wires. The loop should provide a signal between 4 and 20 MA. If no current is present or & current exceeds 20MA consult the level instrument supplier.

If DC voltage is not present check the user supplied power supply or if using the 399 DPC supply measure across terminals 24VDC and + and -. If no 24VDC is present consult factory. If 24VDC is present check field wiring between the 399 DPC and the field device and recheck 'SCALE' functions to ensure correct setup.



WARRANTY

All Sigma Controls, Inc. products are warranted to be free from defective materials and workmanship for one (1) year from date of shipment. Sigma reserves the right to repair or replace at its option any product found to be defective. In no event shall Sigma Controls, Inc. be liable for any consequential, incidental, or special damages and the limit of its liability shall not exceed the purchase price of the supplied equipment.

*******IMPORTANT*******

SENSORS AND CABLE THAT HAVE BEEN USED IN WASTE WATER OR HAZARDOUS LIQUIDS MUST BE THOROUGHLY CLEANED BEFORE RETURNING. UNITS RETURNED UNCLEANED WILL BE CONSIDERED UNREPAIRABLE AND RETURNED TO SENDER OR DISCARDED. NOTE: DO NOT SUBMERGE UNITS FOR CLEANING WITH CABLE CUT OR REMOVED. THIS WILL ALLOW CLEANING FLUID TO ENTER HOUSING, DAMAGING ELECTRONICS AND VOIDING THE WARRANTY.

RETURN FOR REPAIR POLICY (WARRANTY/NON-WARRANTY REPAIR)

Return status can be determined upon factory inspection of returned equipment.

A completed Return Authorization form must accompany all items returned for repair.

Repairs will be evaluated as quickly as possible. Cost for non-warranty repairs will be provided before repairs are initiated and repairs will be completed only after approval by customer.

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