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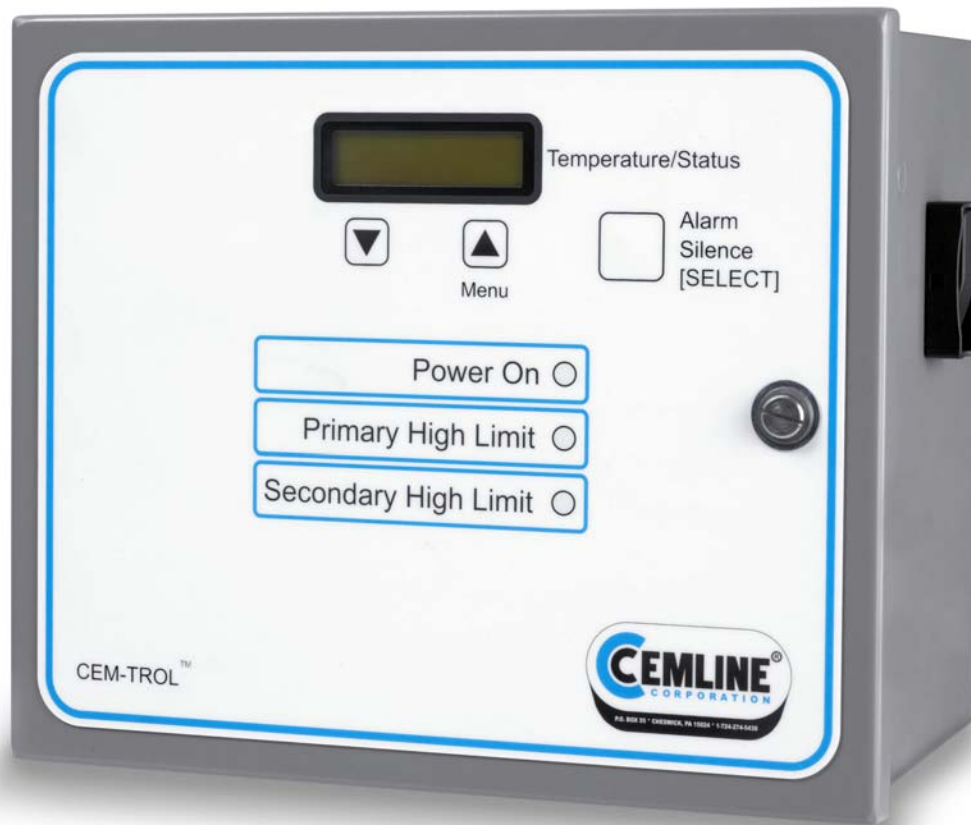
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# Installation, Operation, and Maintenance Manual

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**CEMLINE CORPORATION®**

**CEM-TROL Solid State Control Module  
and Electronic Control Valves**



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## Table of Contents

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<b><u>Section</u></b>	<b><u>Page</u></b>
Disclaimers .....	1
Contact Information .....	1
General Notes and Warnings .....	2
Notes .....	2
Warnings .....	2
Connection Electrical Power Source .....	3
The Controller Overview .....	4
Contractor Wiring .....	7
Ratings .....	7
Control Screens .....	8
Setting the Controller .....	9
Home Screen .....	10
Alternative Home Screen .....	11
Set Point Degree F .....	11
Primary High Limit Temperature .....	12
Primary High Limit Temperature Reset Differential .....	13
Secondary High Limit Temperature .....	14
Secondary High Limit Temperature Reset Differential .....	14
Control Valves .....	15
PID Gain Kp (Proportional) .....	16
PID Gain Ki (Integral) .....	16
PID Gain Kd (Derivative) .....	17
Remote Control .....	17
Control Output .....	18
Maximum Output .....	20
Initial Settings .....	20
Diagnostics .....	20

About.....	21
Quit.....	21
Terminal Board Layout.....	22
Building Automation Control Interface.....	23
Remote On-Off.....	23
Remote Temperature Read Out.....	24
Remote Temperature Set Point.....	24
Testing the Temperature Sensor.....	25
Wiring Diagram for Self-Contained Temperature Pilot Operated Control Valves.....	26
Wiring Diagram for Pneumatically Operated Control Valves.....	27
Wiring Diagram for Warren Controls with AmurAct Actuator.....	28
Wiring Diagram for MXG and MFX Valves.....	29
Wiring Diagram for M2H and M3P Valves.....	30
Wiring Diagram for MVF Valves.....	31
MXG and MXF Valve Information.....	32
M3P and M2H Valve Information.....	34
MVF Valve Information.....	35
General Valve Information.....	37
Magnetic Coil Resistance Information.....	38
Warren Controls AmurAct Actuator Valve Information.....	39

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## Disclaimers

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This Installation, Operation, and Maintenance Manual is intended to be as complete and up to date as possible. It covers the installation, operation, and maintenance procedures for CEMLINE CORPORATION's CEM-TROL control module and electronic control valves. CEMLINE® reserves the right to update this manual and other product information concerning installation, operation, and/or maintenance, at any time and without obligation to notify product owners of such changes.

CEMLINE is not responsible for inaccuracies in specifications, procedures and/or the content of other product literature, supplied by the manufacturers of components used in CEMLINE CEM-TROL control module. CEMLINE strives to use only the highest quality components; however, CEMLINE has no direct control over their manufacture, or their consistent quality.

CEMLINE is not responsible for injury to personnel or product damage due to the improper installation, operation, and/or maintenance of CEMLINE Electronic Controls. All installation, operation, and maintenance procedures should only be performed by trained/certified personnel. All personnel performing these procedures should completely and carefully read and understand all supplied materials before attempting the procedures. All personnel should pay strict attention to all Notes, Cautions, and Warnings that appear within the procedures detailed in this manual.

CEMLINE welcomes user input as to suggestions for product or manual improvement.

### Contact Information

For information concerning warranties, or for questions pertaining to the installation, operation or maintenance of CEMLINE products, contact:

CEMLINE CORPORATION  
P.O. Box 55  
Cheswick, PA 15024

USA Phone: (724) 274-5430  
USA Fax: (724) 274-5448  
[www.cemline.com](http://www.cemline.com)

To order replacement parts, contact CEMLINE CORPORATION at the address listed above, or call toll free:

USA/Canada/Caribbean Phone: (800) 245-6268

***Note: Please include the model and serial number of the unit for which the parts are being ordered. If ordering by phone, please have this information readily available.***

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## General Notes and Warnings

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### Notes

- ❖ This manual is intended to cover installation, operation, and maintenance procedures for CEMLINE CORPORATION CEM-TROL control module and electronic control valves.  
  
If questions are not answered by this manual, or if specific installation, operation, and/or - maintenance procedures are not clearly understood, contact CEMLINE CORPORATION for clarification before proceeding.
- ❖ All installation, operation, and maintenance procedures should be performed only by experienced, trained and certified personnel. Personnel should be trained in and familiar with correct piping and electrical procedures and methods, and should be experienced in working with hot/boiler water systems and steam systems.
- ❖ CEMLINE CORPORATION CEM-TROL control module and other electronic controls are designed for indoor use only, unless otherwise required by design specifications.
- ❖ If the unit is damaged during installation, operation, or maintenance, complete the following steps:
  1. Turn off and lock out the electric power supply to the unit in an approved manner.
  2. Turn off all incoming steam/hot water valves.
  3. Contact in-house maintenance personnel or CEMLINE CORPORATION for instructions.

### Warnings

As with any piece of equipment that utilizes hot/boiler water or steam and electricity, **the potential exists for severe personal injury** if proper installation, operation, and maintenance procedures are not followed. Listed on the following pages are specific warnings pertaining to CEMLINE Electronic Controls. **All warnings should be carefully read and understood.** All precautions contained in the warnings should be carefully followed to reduce the chance of injury.

**Note: Throughout this manual, warnings will be denoted by the symbol ▼ .**

All documentation for each major component has been included with the unit. It is strongly recommended that each document be reviewed before attempting any installation, operation, or maintenance procedures.

The documentation for each major component may also contain warnings and cautions identified by the manufacturer of each component. These warnings and cautions may be specific for the particular component, and therefore not covered in this general Installation, Operation, and Maintenance Manual. They should also be carefully reviewed before attempting installation, operation, or maintenance procedures.

- ▼ The combination of electricity and water can pose a **very dangerous situation**. Assure that all power has been **shut off/disconnected and locked out** in an appropriate manner, before attempting any installation or maintenance procedures.
- ▼ Areas of potential danger:
  1. all electric power leads and connections;
  2. all hot/boiler water lines, steam lines, joints, valves, and relief valves; and
  3. all joints at valve, gauges, etc.
- ▼ Before attempting any installation, operation, or maintenance procedures pertaining to the unit.
  1. Assure that the electric power supply has been turned off and locked out in an approved manner;
- ▼ Hot/boiler water and steam present a situation that can be very dangerous due to the fact it is under pressure and at very high temperatures. To avoid possible injury or death, use common sense and follow all accepted and recommended procedures when performing installation, operation, and maintenance procedures.

### **Connecting the Electric Power Source**

- ▼ All installation procedures involving electric power connection should only be performed by trained, certified electricians.
- ▼ Hot/boiler water and steam present a situation that can be very dangerous because of the high temperatures and pressures. Use common sense and follow all accepted and recommended procedures when performing installation, operation, and maintenance procedures to avoid possible injury or death.
- ▼ The combination of electricity and water can pose a very dangerous situation. Assure that all power has been shut off/disconnected and locked out in an approved manner, before attempting any installation or maintenance procedures.

The CEMLINE Packaged Water Heaters have been wired during assembly. Connecting the electric power supply to the unit consists of connecting the correct voltage, phase, and amperage power leads to the terminal strip or circuit breaker. The exact voltage, phase, and amperage requirements for the unit can be determined from the rating plate affixed to the jacket of the unit, or from the Submittal Sheet and Wiring Diagrams supplied with the unit.

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## The Controller - Overview

---

Cemline CEM-TROL control module is a solid state controller designed to control temperatures and limit(s) on Cemline Packaged Water Heaters.

The CEM-TROL is supplied with a LED backlit LCD display. LED pilot lights are supplied to indicate On-Off, primary high limit temperature, and secondary high limit temperature. The CEM-TROL control module allows the owner to set the operating temperature, primary high temperature limit and the secondary temperature high limit on the display screen. The CEM-TROL control module has over temperature alarm lights and an alarm horn with built in alarm silence relay. The CEM-TROL control module is supplied with dry contact closure outputs to indicate to building automation system (BAS): power on, primary high temperature, secondary high temperature, and any alarm. The CEM-TROL control module allows the BAS to turn the Cemline Packaged Water Heater on or off through a remote relay suitable for 24 VAc, 1 amp. The control module allows the BAS to remotely monitor the operating temperature and remotely set the operating temperature. The control module is supplied with an on-off switch and is mounted in a NEMA 4 enclosure.

**Built in remote start stop:** This feature allows the Packaged Water Heater to be started or stopped from a remote location. Typically this would be accomplished from the Building Automation System (BAS). Requires a dry contact suitable for 24 VAc and 1 amp. Terminal block P1 terminals 1 – 2 on the panel is where the BAS on-off is wired.

**Built in On-Off Switch:** Allows for local on-off and is convenient for service in the unlikely event service is required. This switch is mounted in the side of the panel.

**Built in Alarm Horn:** The alarm horn will sound and LED will light red on primary high temperature limit and/or secondary high temperature limit. If either high temperature limits are exceeded the alarm horn will also sound and the alarm light(s) will light red. The CEM-TROL also features an alarm silence relay which will silence the alarm but not the fault light when the generator is being serviced. When the fault is cleared both the alarm and fault light(s) will automatically reset.

**Built in PID controller:** The PID control in the CEM-TROL allows the user to easily select the operating temperature set point of the water heater. The controller reads the temperature of the heated water from a temperature sensor in the water heater. Based upon the water temperature, the controller then sends a 0 –10 VDC output signal to the control valve to open or close the valve accordingly. In order to use this functionality of the CEM-TROL must be wired to either a pneumatic control valve with an I-P transducer or an electronic control valve. This feature is not functional when using a pilot operated valve with a self-contained temperature pilot.

The CEM-TROL is designed with the P-I-D control logic.

P is proportional. The proportional is used to handle the present. Proportional is a constant used to send a signal to the output. Proportional control with a set point of 140 °F and a proportional band of 10 would have a 100% (10 VDC) output at 130 deg F, 50% (5 VDC) output at 135 °F and 10% (1 VDC) output at 139 deg F °F.

I is integral. The integral measures error over a short period of time to develop a constant used to send a signal to the output. The integral is then added to the proportional to eliminate error.

D is derivative. The derivative is often referred to as rate. Derivative is used to respond to a change in the system. The larger the derivative the more rapidly the controller can respond to changes within the system.

Built in operating temperature readouts: The CEM-TROL features an easy to read LED digital readout of the water temperature in the water heater.

Built in primary high temperature cut off and alarm: In the event of high temperature, the CEM-TROL will close the source steam, boiler water, or HTHW supply valve and sound an alarm.

Built in secondary high temperature limit and alarm: In the event of secondary high temperature set point is exceeded the CEM-TROL will open an optionally supplied domestic water solenoid valve to relieve the vessel of overheated water and sound an alarm.

Built in remote temperature set point: The BAS can remotely set the operating temperature of the water heater. This requires the use of a pneumatic control valve with an I-P transducer or an electronic control valve. This feature is not functional when using a pilot operated valve with a self-contained temperature pilot.

Built in LED/LCD display of functions and alarms: The CEM-TROL is designed for the user to tell at a glance how the system is operating. The built in LED displays make troubleshooting simple.

<b>Function</b>	<b>LED Indicator 1</b>	<b>LED Indicator 2</b>
Power ON	Green = Power On	Blank = No power
Primary High Limit	Blank = Temperature below primary high limit set point.	Red = Primary high limit set point has been exceeded.
Secondary High Limit	Blank = Temperature below secondary high limit set point.	Red = Secondary high limit set point has been exceeded.

CEM-TROL units version 2.0 and higher will display the below alarm status on the LCD screen if the temperature sensor(s) are not attached or are defective. In order to determine the version of the CEM-TROL please refer to the 'About' section on page 21 of this manual

<b>LCD Display</b>	<b>Description</b>
Sensor Loss 1	The primary sensor wired to terminal block P2 - terminals 1 & 2 is not connected and needs to be connected or the sensor is faulty or defective and needs to be replaced.
Sensor Loss 2	The secondary sensor wired to terminal block P2 - terminals 3 & 4 is not connected and needs to be connected or the sensor is faulty or defective and needs to be replaced.
Sensor Loss 3	Both the primary sensor wired to terminal block P2 - terminals 1 & 2 and the secondary sensor wired to terminal block P2 - terminals 3 & 4 are not connected and need to be connected or the sensors are faulty or defective and need to be replaced.



Built in contacts to notify BAS (Building Automation System) of functions and alarms: This control allows for simple and reliable interface from a remote location. The BAS can also start and stop the packaged water heater. BAS can remotely read the temperature in the packaged water heater via a 4 – 20 mA signal whereby 4 mA = 32 °F and 20 mA = 212°F. BAS can remotely set the temperature of the packaged water heater between 50 and 160 °F using a 4 – 20 mA signal whereby 4 mA = 32 °F and 20 mA = 212 °F.

Power ON
Primary High Limit
Secondary High Limit
Alarm
Operating temperature (via a 4-20 mA signal) (4 mA = 32 °F; 20 mA = 212 °F)

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## Contractor Wiring

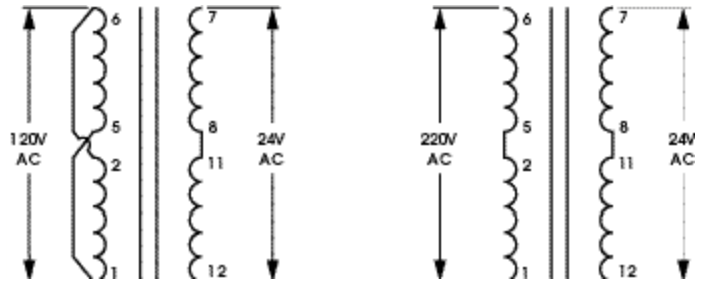
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**All Power Connections should be performed by a trained , certified electrician. Be sure the factory supplied on-off switch is in the OFF position before connecting to building power.**

**Field wiring:** Installer must run feed wires to terminals on panel mounted on-off disconnect switch and green ground wire to ground lug. *Units are normally wired for 120 volt single phase input.*

**Warning: Before drilling hole in panel for conduit connection of power carefully open door and verify that nothing in panel will be interfered with. BE CAREFUL not to get any drill shavings or metal slug on board or transformer or disconnect switch.**

Panel is normally factory shipped for 120 Volt/ 1 phase/60/50 Hz. If so desired 220/1/50 or 60 Hz power can be used. To convert to 220 volt input it is necessary to reconfigure the 24 volt output transformer. Below is the wiring diagram for 120 volt and 220 volt input.



▼ **CAUTION: Before attempting to rewire the transformer be sure power coming to the unit is turned off and locked out in an approved manor.**

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## Ratings

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Input: selectable 120/220 VAC – 50/60 Hz @120 Vac min 90 volt max 130 volt

Output Contacts: 1 amp at 24 Vac

Building Automation outputs: Dry contacts, NO .5 amp maximum, non inductive

Display: LED display with resolution of

.3 % of scale

Available temperature set range:

50 – 160 °F

Operating ambient temperature:

Min 32 Deg F max 140 deg F

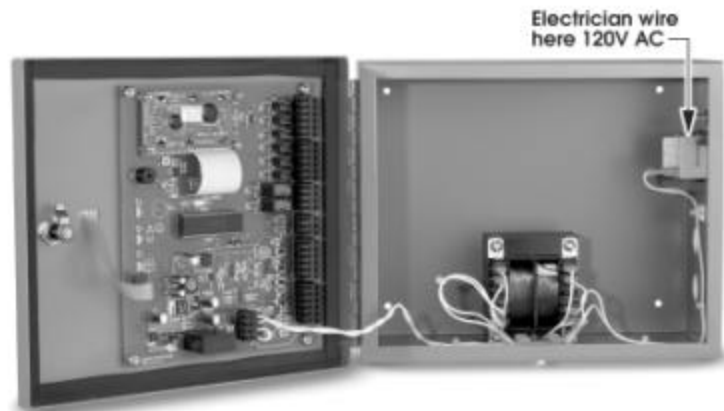
Operating Humidity:

5% to 95% relative humidity (RH)

non condensing

Alarm approximately 103 db.

NEMA 4 enclosure



The Cemline CEM-TROL is a self contained board and can not be field repaired. For a replacement board contact Cemline Corporation at the address shown on page one of this manual.

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## Controller Screens

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### Controller screens:

There are three tactile keys on the front of the panel. The center key, labeled Menu (▲), is pushed to select the desired function. The right key, labeled Alarm Silence [SELECT], is pushed to access the desired screen. Both the function and setting are read on the LED backlit LCD display.



Pushing the center (Menu ▲) key will display, in sequence, the following screens :

Screen 1 (Home)

SET: XXX [MODE]  
TEMP: XXX

Screen 2

Setpoint Deg F.

Screen 3

High Limit 1

Screen 4

Differential 1

Screen 5

High Limit 2

Screen 6

Differential 2

Screen 7

Control Valves

Screen 8

PID Gain Kp

Screen 9

PID Gain Ki

Screen 10

PID Gain Kd

Screen 11

Remote Control

Screen 12

Control Output

Screen 13

Maximum Output

Screen 14

Initial Settings

Screen 15

Diagnostics

Screen 16

About

Screen 17

Quit

After 60 seconds in any screen "Home" screen will be displayed.

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## Setting the Controller

---

There are three tactile keys on the front of the panel. The center key, labeled Menu▲, is pushed to select the desired function. The right key, labeled Alarm Silence [SELECT], is pushed to access the desired screen. Both the function and setting are read on the LED backlit LCD display. The sequence to access and change any screen is as follows:

1. Press "[Menu ▲]" (center key) key until desired function appears on the screen.
2. Press "Alarm Silence / [SELECT]" (right key) and a setting will appear on the second line of the screen.
3. Press "▲" key to change setting in an increasing or forward direction or press "▼" key to change the setting in a decreasing or reverse direction. Continue pressing either the "▲" or "▼" keys, which will scroll through available settings until desired setting is on the screen.
4. Press "[SELECT]" key which will store last screen setting into memory and return to controller screen to "HOME"

## Instructions for setting each screen:

### Home Screen

*Below is the screen displayed during normal operation for Cem-trol version 1.0 to 2.9:*

Screen 1

Home

SET: XXX	[MODE]
TEMP: XXX	

**MODE** will display either show a voltage output or ALARM. The mode will read a voltage output in normal operation and alarm if any alarm condition occurs. If an alarm condition is cleared the mode will switch back to normal reading. The voltage output displayed shows the number of volts the controller is sending to the control valve. The volts displayed will be between 0 – 10, where at 0 volts the control valve will be closed and at 10 volts the control valve will be full open.

**SET:** This is the operating temperature set point of the water heater.

**TEMP:** This is the temperature reading of the water in the heater.

*CEM-TROL Version 3.2 and higher the display screen will be slightly different than above and is shown below:*

Screen 1

Home - Normal Operation

SET: XXX	V1:XX
TEMP: XXX	

Screen 1

Home – ALARM Mode

SET: XXX	[ALARM]
TEMP: XXX	

Screen 1

Home – Two Control Valves

SET: XXX	V1:XX
TEMP: XXX	V2: XX

**SET:** This is the operating temperature set point of the water heater.

**TEMP:** This is the temperature reading of the water in the heater.

**V1:** This is the control voltage output to Control Valve 1.

**V2:** This is the control voltage output to Control Valve 2. If two valve configuration is selected, see the “Control Valves” section on page 15 of this manual for more information.

▼ **NOTE: The display of V1 and V2 is only available on CEM-TROL’s version 3.2 and higher. See page 21 and the “About” section to determine the version of the CEM-TROL.**

## Alternative Home Screen

This screen can be displayed during operation displaying the temperature of both temperature sensors being used to operate the controller.

- ▼ **The primary temperature sensor, displayed as PRM, temperatures may fluctuate faster and/or at wider range than the TEMP temperature due to the location of the sensor within the tank. Cemline allows for the screen to be viewed as the primary sensor is controlling the number of volts being displayed on the screen and being sent to the control valve.**
- ▼ **When using the self-contained temperature pilot the PRM temperature sensor is not required because the operating temperature of the water heater will be set by the self-contained temperature pilot and not the CEM-TROL. Therefore, the PRM will display a temperature of 212 °F, which will not affect the operation of the unit.**

This screen can be displayed by :

*To view the alternative home screen:*

1. Press and hold the [▼] key for 5 seconds and the following screen will appear.
2. This screen will return to the Home Screen after 60 seconds

### Alternative Home Screen 1

SET: XXX	[XXX]
TEMP: XXX	PRM: XXX

**MODE** will display either show a voltage output or ALARM. The mode will read a voltage output in normal operation and alarm if any alarm condition occurs. If an alarm condition is cleared the mode will switch back to normal reading. The voltage output displayed shows the number of volts the controller is sending to the control valve. The volts displayed will be between 0 – 10, where at 0 volts the control valve will be closed and at 10 volts the control valve will be full open.

**SET:** This is the operating temperature set point of the water heater.

**TEMP:** This is the secondary temperature sensor temperature reading.

**PRM:** This is the primary temperature sensor temperature reading.

## Set Point Degree F.

This is the operating temperature set point of the water heater. If the water heater was supplied with either a pneumatic control valve with an I-P transducer or an electronic control valve the temperature set point of the water heater will be selected using the CEM-TROL. This feature is not functional when using a pilot operated valve with self-contained temperature pilot.

*To set the operating temperature set point:*

1. Press the [Menu ▲] key one (1) time and the following screen will appear:

Screen 2

Setpoint Deg F.

2. Press the [SELECT] key and the screen will read.

Screen 2

Setpoint Deg F.

Degrees F

[xxx]

3. Press “▲” key to change temperature setting in an increasing direction or press “▼” key to change the temperature setting in a decreasing direction until the desired operating temperature appears on the screen. The set point temperature is adjustable between 50-160 °F in 1 °F increments. The default value of the operating temperature set point is 140 °F. *If the temperature output desired is above 160 °F, please contact the factory for special instructions.*
4. Press [SELECT] key to place setting in memory and to return to home screen.

## Primary High Limit Temperature or Cut Out

This is the primary high limit temperature which is typically set 10 to 20 °F higher than the desired operating temperature. When the primary high limit temperature or cut out temperature is reached the controller will cause the main control valve to close.

- ▼ **CAUTION: When using a pilot operated control valve with a self-contained temperature pilot the operating temperature of the water heater will be set by the self-contained temperature pilot and not the CEM-TROL. See the Celine Water Heater I O & M manual and the self-contained temperature pilot I O & M manual for setting the operating temperature.**
- ▼ **CAUTION: When using the self-contained temperature pilot DO NOT set the operating temperature greater than the primary or secondary high limit settings. This will cause improper operation of the unit, with the potential for DANGER by causing alarms and dump valves to go off.**

1. Press the [Menu] key two (2) times and the following screen will appear:

Screen 4

High Limit 1

2. Press the [SELECT] key and the screen will read:

Screen 4

High Limit 1
Degrees F [xxx]

3. Press “▲” key to change temperature setting in an increasing direction or press “▼” key to change the temperature setting in a decreasing direction until the desired high limit temperature appears on the screen. The range of the primary high limit temperature set point is between 5 °F greater than the operating temperature set point and 220 °F in 1 °F increments. The default value of the primary high limit temperature is 150 °F.
4. Press [SELECT] key to place the setting in memory and return to the home screen.

### Primary High Limit Temperature Reset Differential

This is the temperature differential from the primary high limit set point at which the primary high temperature limit will reset. Normally it is set at 5 °F but can be set between 1 to 20 °F in 1 °F increments.

*To set the primary high limit temperature differential:*

1. Press the [Menu] key three (3) times and the following screen will appear:

Screen 4

Differential 1
----------------

2. Press the [SELECT] key and the screen will read:

Screen 4

Differential 1
Reset Deg F            [xxx]

3. Press “▲” key to change temperature setting in an increasing direction or press “▼” key to change the temperature setting in a decreasing direction until the desired primary high limit temperature differential appears on the screen. The range is 1-20 °F in 1 °F increments.
4. Press [SELECT] key to place the setting in memory and return to the home screen.



## Secondary High Temperature Limit

This is the secondary high limit temperature is typically set 20-30 °F higher than the desired operating temperature. When the secondary high limit temperature is reached a solenoid opens to dump overheated water to drain. *Be sure to pipe the outlet from this solenoid to drain.*

- ▼ **CAUTION: When using the self-contained temperature pilot DO NOT set the operating temperature greater than the primary or secondary high limit settings. This will cause improper operation of the unit, with the potential for DANGER by causing alarms and dump valves to go off.**

4. Press the [Menu] key four (4) times and the following screen will appear:

Screen 5

High Limit 2

5. Press the [SELECT] key and the screen will read:

Screen 5

High Limit 2  
Degrees F [xxx]

6. Press “▲” key to change temperature setting in an increasing direction or press “▼” key to change the temperature setting in a decreasing direction until the desired high limit temperature appears on the screen. The range of the secondary limit temperature set point is between 2 °F greater than the primary high limit temperature set point and 230 °F in 1 °F increments. The default value of the primary high limit temperature is 160 °F.
4. Press [SELECT] key to place the setting in memory and return to the home screen.

## Secondary High Limit Temperature Reset Differential

This is the temperature differential from the secondary high limit set point at which the secondary high limit temperature will reset. Normally it is set at 5 °F but can be set from 1 to 20 °F in 1 °F increments.

*To set the secondary high limit temperature differential:*

5. Press the [Menu] key five (5) times and the following screen will appear:

Screen 6

Differential 2

6. Press the [SELECT] key and the screen will read:

Screen 6

Differential 2 Reset Deg F            [xxx]
--

7. Press “▲” key to change temperature setting in an increasing direction or press “▼” key to change the temperature setting in a decreasing direction until the desired secondary high limit temperature differential appears on the screen. The range is 1-20 °F in 1 °F increments.
8. Press [SELECT] key to place the setting in memory and return to the home screen.

## Control Valves

If desired the control module can be used to control two control valves set up in a 1/3 – 2/3 piping configuration.

*To set the control valve option:*

1. Press the [Menu] key six (6) times and the following screen will appear:

Screen 7

Control Valves
----------------

2. Press the [SELECT] key and the screen will read:

Screen 7

Control Valves Single Control
----------------------------------

3. Press “▲” key to change control valve setting in an increasing direction or press “▼” key to change the control setting in a decreasing direction until the desired control valve setting appears on the screen. The control valve choices are “Single Control” when one control valve is being utilized or “Dual Control” when two control valves are being utilized.
4. Press [SELECT] key to place setting in memory and return to home screen.

## Setting PID Gain Kp (Proportional)

The operating controls are factory preset for optimal control of the water heater. The Kp (Proportional) is used to handle the present. Kp (proportional) is a constant used to send a signal to the output. The proportional control with a set point of 140 °F and a proportional band of 10 would have a 100% output at 130 °F, 50% output at 135 °F and 10% output at 139 °F. The default value of the Kp (proportional) is 8 (°F). The Kp (Proportional) setting of the controller can be determined and if necessary changed as follows:

1. Press the [Menu] key seven (7) times and the following screen will appear:

Screen 8

PID Gain Kp
-------------

2. Press the [SELECT] key and the screen will read:

Screen 8

PID Gain Kp Kp[8]
----------------------

3. Press “▲” key to change the Gain Kp setting in an increasing direction or press “▼” key to change the Gain Kp setting in a decreasing direction until the desired secondary high limit temperature differential appears on the screen. The range is 5-30 (°F).
4. Press [Menu] key to place the setting in memory and return to the home screen.

## Setting PID Gain Ki (Integral)

The operating controls are factory preset for optimal control of the water heater. The Ki (Integral) measures error over a short period of time to a constant used to send a signal to the output. The default value of the Ki (integral) is 2. The Ki (integral) setting of the controller can be determined and if necessary changed as follows:

1. Press the [Menu] key eight (8) times and the following screen will appear:

Screen 9

PID Gain Ki
-------------

2. Press the [SELECT] key and the screen will read:

Screen 9

PID Gain Ki Ki[2]
----------------------

3. Press “▲” key to change Gain Ki setting in an increasing direction or press “▼” key to change the Gain Ki setting in a decreasing direction until the desired secondary high limit temperature differential appears on the screen. The range is 0-30.
4. Press [SELECT] key to place the setting in memory and return to the home screen.

### Setting PID Gain Kd (Derivative)

The operating controls are factory preset for optimal control of the water heater. The Kd (derivative) measures error over a short period of time to a constant used to send a signal to the output. The default value of the Kd (derivative) is 10. The Kd (derivative) setting of the controller can be determined and if necessary changed as follows:

1. Press the [Menu] key nine (9) times and the following screen will appear:

Screen 10

PID Gain Kd
-------------

2. Press the [SELECT] key and the screen will read:

Screen 10

PID Gain Kd Kd[10]
-----------------------

3. Press “▲” key to change Gain Kd setting in an increasing direction or press “▼” key to change the Gain Kd setting in a decreasing direction until the desired secondary high limit temperature differential appears on the screen. The range is 0-30.
4. Press [SELECT] key to place the setting in memory and return to the home screen.

### Remote Control

The CEM-TROL can operate with a remote temperature set point. The remote temperature set point allows the Building Automation System (BAS) to supply a constant 4 – 20 mA signal to the controller.

- ▼ **CAUTION: When using the remote set point DO NOT set the operating temperature greater than the primary or secondary high limit settings. This will cause improper operation of the unit, with the potential for DANGER by causing alarms and dump valves to go off.**
- ▼ **CAUTION: Once the Remote Control is Enabled the local setting is no longer used unless the Remote Control has been Disabled.**

The remote temperature set point of the temperature of the packaged water heater can be set between 50 and 160 °F using a 4 – 20 mA signal whereby 4 mA= 32 °F and 20 mA = 212 °F.

1. Press [Menu] key ten (10) times and the following screen will appear:

Screen 11

Remote Control
----------------

2. Press [SELECT] key and the screen will read:

Screen 11

Remote Control Remote Disabled
-----------------------------------

3. Press “▲” key to change control valve setting in an increasing direction or press “▼” key to change the Remote Setting in a decreasing direction until the desired control valve setting appears on the screen. The “Remote Control” choices are “Remote Disabled” when the CEM-TROL local temperature setting (Setpoint Deg F) is being utilized or “Remote Enabled” when a remote temperature set point via a 4-20 mA input signal is being utilized.
4. Press [SELECT] key to place the setting in memory and return to the home screen.

## Control Output

The CEM-TROL has three output settings options. The output setting options are 0 – 10, 2 – 10, or a AIR VALVE. The 0-10 setting will output a 0-10 VDC control output signal to the control valve, the 2 –10 setting will output a 0-10 VDC control output signal to the control valve, and the AIR VALVE setting will output a 1.5 – 7.5 VDC control output signal to an electronic- to-pneumatic transducer. The electronic-to-pneumatic transducer converts the input voltage (1.5 to 7.5 VDC) to an output 3-15 psig air signal to the air operated control valve.

- ▼ **CAUTION: DO NOT set the “Control Output” to 2 – 10 VDC or AIR VALVE setting for a control valve that operates on a 0 – 10 VDC control signal. This will prevent the control valve from closing as the CEM-TROL will output a MINIMUM of 2 or 1.5 VDC. This will cause improper operation of the unit, with the potential for DANGER by causing alarms and dump valves to go off.**
- ▼ **THE VALVES DESCRIBED IN THIS MANUAL ON PAGES 31 – 37 REQUIRE A 0 –10 VDC CONTROL SIGNAL. THESE VALVES ARE MANUFACTURED BY SIEMENS BUILDING CONTROLS.**

- ▼ **WARREN CONTROLS AMURACT ACTUATOR REQUIRES 2 - 10 VDC CONTROL SIGNAL.**
- ▼ **AIR OPERATED CONTROL VALVES USE THE AIR VALVE SETTING. THE ELECTRONIC-TO-PNEUMATIC TRANSDUCER REQUIRES 1.5 – 7.5 VDC INPUT CONTROL SIGNAL TO PRODUCE A 3 – 15 PSIG OUTPUT AIR SIGNAL TO THE CONTROL VALVE.**
- ▼ **CAUTION: DO NOT set the “Control Output” to 0 – 10 VDC or AIR VALVE setting for a control valve that operates on a 2 – 10 VDC control signal. This will cause improper operation of the unit, with the potential for DANGER by causing alarms and dump valves to go off.**
- ▼ **NOTE: The “Control Output” selection option is only available on CEM-TROL’s version 2.0 and higher. Versions 2.0 – 2.9 have two options 0-10 or 2 –10 output. Versions 3.2 and higher have three options 0-10, 2-10 or AIR VALVE. See page 21 and the “About” section to determine the version of the CEM-TROL.**

It is extremely important that the control signal of the control valve supplied and the “Control Output” listed in the CEM-TROL be the same. The water heater is factory shipped with the “Control Output” properly set for the supplied control valve’s actuator.

1. Press [Menu] key eleven (11) times and the following screen will appear:

Screen 12

Control Output
----------------

2. Press [SELECT] key and the screen will read:

Screen 12

Control Output 0 – 10 VDC
------------------------------

3. Verify that the “Control Output” listed on the screen and control valve’s required control signal supplied on the water heater are the same. IF AND ONLY IF the control valve’s required signal is different than the “Control Output’s” screen setting should the screen setting by changed. To change the screen setting press “▲” key to change control valve setting in an increasing direction or press “▼” key to change the Control Output Setting in a decreasing direction until the desired control valve setting appears on the screen. The “Control Output” choices are “0 –10 VDC” when the control valve requires a 0 – 10 VDC control signal , “2 – 10 VDC” when the control valve requires a 2 – 10 VDC control signal, or “AIR VALVE” when using an air operated control valve.
4. Press [SELECT] key to place the setting in memory and return to the home screen.

## Maximum Output

The CEM-TROL can be adjusted to limit the maximum output voltage being sent to the control valve. The maximum output setting can be set as 10, 9, 8, 7, 6, or 5 VDC. The maximum output setting is used to limit the maximum stroke of the control valve. The maximum output adjustment is only available when the “Control Signal” is set to 0 – 10 VDC or 2 – 10 VDC.

The water heater is factory shipped with the “Maximum Output” set for 10.

1. Press [Menu] key twelve (12) times and the following screen will appear:

Screen 13

Maximum Output

2. Press [SELECT] key and the screen will read:

Screen 13

Control Output  
Maximum [10]

3. Press “▲” key to change control output setting in an increasing direction or press “▼” key to change the control output setting in a decreasing direction until the desired maximum control output appears on the screen. The range is 10 - 5.
4. Press [SELECT] key to place the setting in memory and return to the home screen.

▼ **NOTE: The “Maximum Output” selection option is only available on CEM-TROL’s version 3.2 and higher. See page 21 and the “About” section to determine the version of the CEM-TROL.**

## Initial Settings

The initial settings are for factory use only and can not be accessed

## Diagnostics

Are used for factory testing and are not field useable. To go to “home” screen press [SELECT].

Screen 15

DIAGNOSTICS

## About

This screen lists the version of the controller. When contacting the factory about the controller be sure to mention the version.

1. Press the [Menu] key fifteen (15) times and the following screen will appear:

Screen 16

ABOUT
-------

2. Press the [SELECT] key and the screen will read:

Screen 16

ABOUT
CEMLINE VER      [xxx]

3. Be sure to note the version when contacting the factory.
4. Press the [SELECT] key to return to the home screen.

## Quit Screen

This screen is **only** used to return to the home screen

1. Press [Menu] key sixteen (16) times and the following screen will appear:

Screen 17

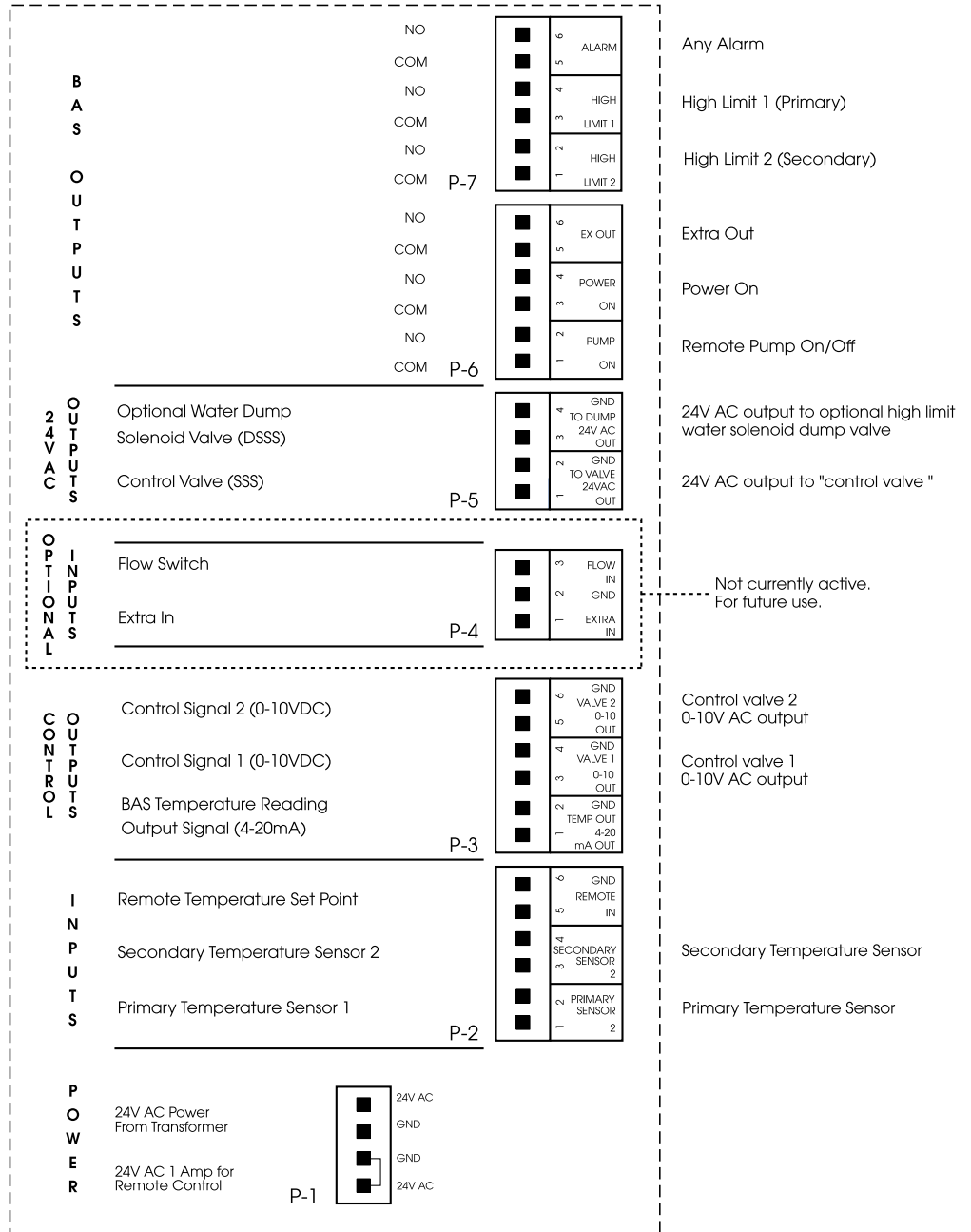
QUIT
------

2. Press [SELECT] key and the program will return to the home screen

**Note: After 60 seconds in any screen “home” screen will be displayed.**



# Terminal Board Layout



---

## Building Automation System (BAS) Interface

---

The CEM-TROL has built in contacts to interface with the building automation system (BAS).

### Remote On-Off:

Terminal block P-1 is a four pole block with the two poles connected in series with the 24 VAC incoming power from the supply transformer. The CEM-TROL is shipped with a jumper installed between terminals 1- 2 of terminal block P-1. To wire for remote on-off remove this jumper and install a switch or relay contacts connecting terminals 1 and 2.

- ▼ **CAUTION: TERMINALS 1 -2 ARE 24 VAC AND WILL HAVE A LOAD OF 1 AMP. BE SURE THE SWITCH OR RELAY CONNECTED TO THESE TERMINALS IS RATED FOR A MINIMUM OF 24 VAC 1 AMP.**

**Built in contacts to notify BAS of functions and alarms:** This control allows for simple and reliable interface with the BAS via dry contact to enable the BAS to monitor the following functions from a remote location:

Power ON
Primary high limit
Secondary high limit
Remote Pump On/Off
Alarm

Refer to the “Terminal Board Layout” page of this manual for the key to and location of terminal connections to the BAS. Note that all of the function relays supply a normally open (NO) dry contact output. The rating of the dry contacts are 1 amp at 24 VAC or .5 amp at 120 VAC.

- ▼ **CAUTION: Do not connect any voltage above 120 volts across the BAS contacts on terminal block.**

Contact closure as follows:

Power ON	COM - NO contact made when power is on to the board.
Primary high limit	COM - NO contact made when primary high limit temperature set point is exceeded.
Secondary high limit	COM - NO contact made when secondary high limit temperature set point is exceeded.
Remote Pump On/Off	COM – NO contact made when control valve is open (i.e., between 1 to 10 VDC output to the control valve)
Alarm	COM - NO contact made when any alarm occurs

### **Remote Temperature Read-Out (via a 4-20 mA signal):**

Terminal block P-3 (terminals 1-2) will output a 4-20 mA signal. This signal will be scaled as 4 mA = 32 °F and 20 mA = 212 °F.

- ▼ **CAUTION: Terminal block P-3 terminals 1-2 are connected to an isolated chassis ground. This may interfere with the BAS system. BAS engineering should determine if BAS needs isolation for this signal.**
- ▼ **CAUTION: No AC voltage should be applied to terminals P-3.**

### **Remote Temperature Set Point (via a 4-20 mA signal):**

Terminal block P-2 (terminals 5-6) will input a 4-20 mA signal to remotely set the operating temperature of the packaged water heater.

**NOTE: In order to use the remote set point the Remote Control must be enabled see page 17 to read how to enable the remote temperature set point.**

- ▼ **CAUTION: When using the remote set point DO NOT set the operating temperature above the primary or secondary high limits. This will cause improper operation of the unit, with the potential to cause alarms and dump valves to go off.**

The remote temperature set point of the temperature of the packaged water heater can be set between 50 and 160 °F using a 4 – 20 mA signal whereby 4 mA= 32 °F and 20 mA = 212 °F.

When the remote set point is enabled the main screen will be as shown below. EXT will be in the upper left hand corner of the LCD display indicating the remote set point has been enabled.

EXT: XXX	[MODE]
TEMP: XXX	

**NOTE: If no mA signal is applied to the remote set point the EXT temperature will default to 50 °F.**

- ▼ **CAUTION: Terminal block P-2 is connected to an isolated chassis ground. This may interfere with the BAS system. BAS engineering should determine if BAS needs isolation for this signal.**
- ▼ **CAUTION: No AC voltage should be applied to terminals P-2.**

## Testing the Temperature Sensor

The temperature sensors used are a 1000 ohm Platinum PT 1000 sensing element. To test the temperature sensor:

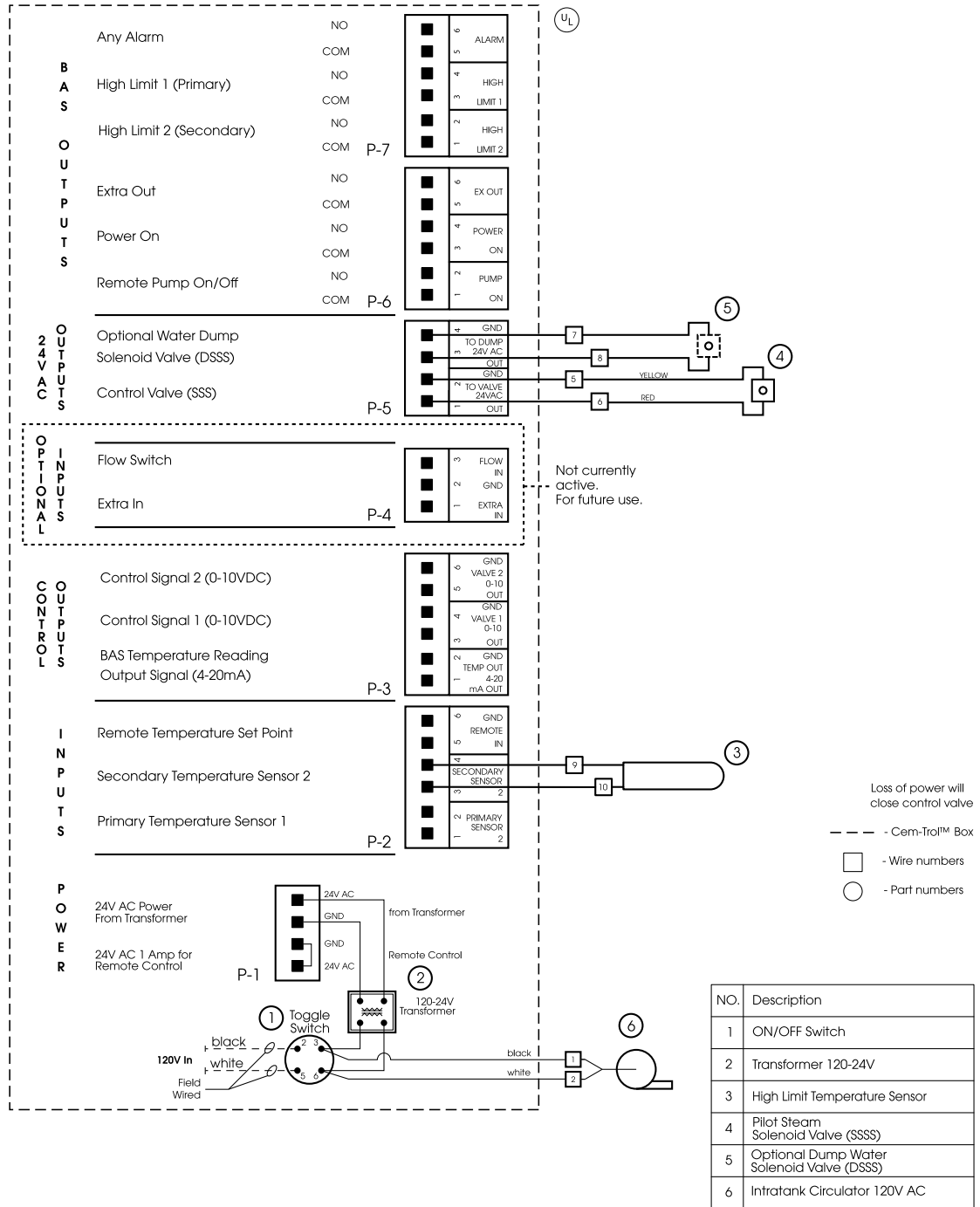
1. Turn the power off to the unit.
2. Remove the temperature sensor connection plug from the controller.
3. Measure the resistance between terminal block P-2 terminals 1 and 2 for one probe, and terminal block P-2 terminals 3 and 4 for the second probe.
4. Compare the resistance read and the corresponding temperature of the water heater to the chart shown on the right to verify accuracy of the temperature sensor.
5. Replace the temperature sensor connection plug.
6. Turn power back on.

Degree Fahrenheit	Resistance In OHMS
40	1017
50	1039
60	1060
70	1082
80	1104
90	1125
100	1147
110	1168
120	1190
130	1211
140	1232
150	1254
160	1275
170	1296
180	1317

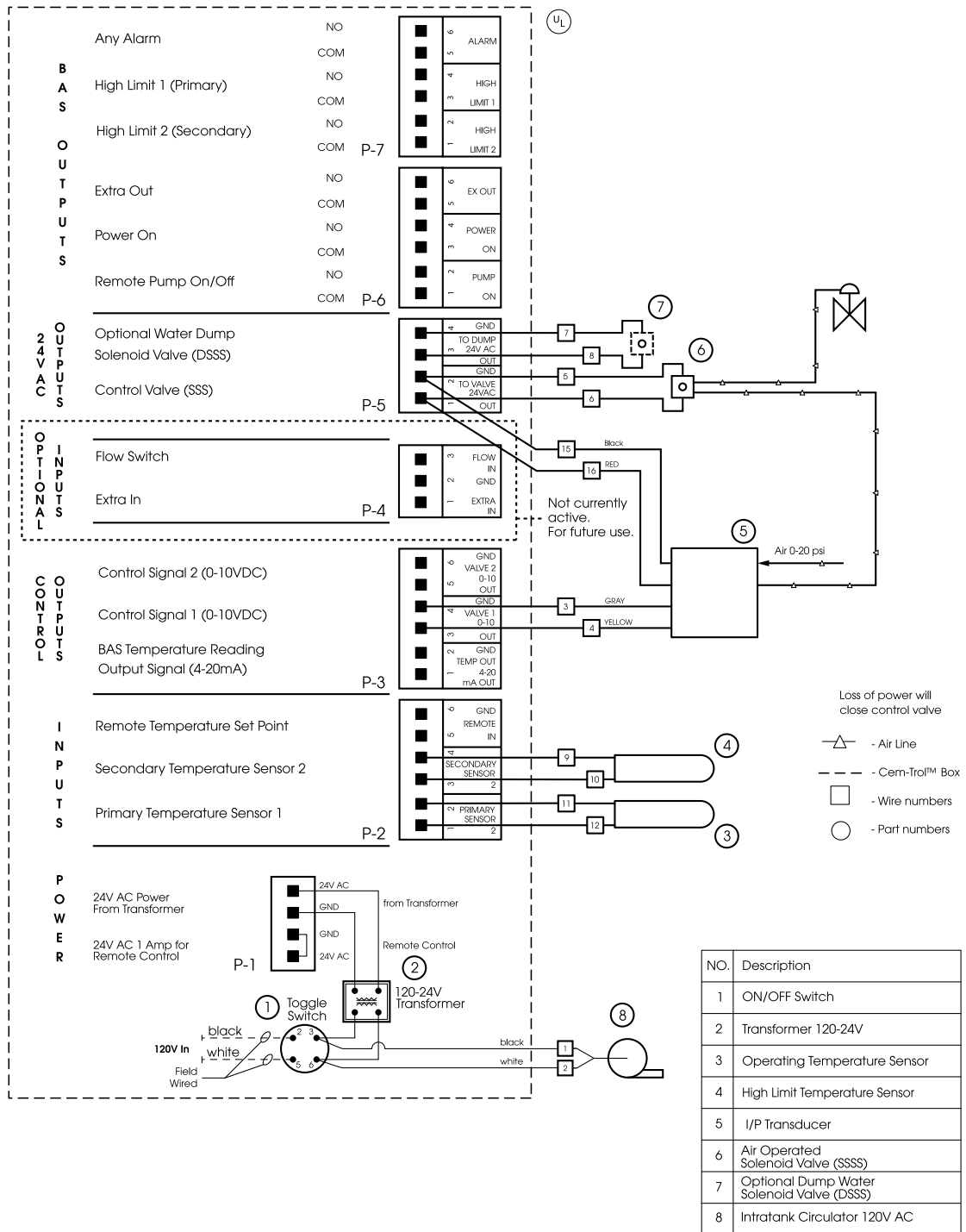
Cem-trol units version 2.0 and higher will display the below alarm status on the LCD screen if the temperature sensor(s) are not attached or are defective. In order to determine the version of the Cem-trol please refer to the 'About' section on page 21 of this manual

LCD Display	Description
Sensor Loss 1	The primary sensor wired to terminal block P2 - terminals 1 & 2 is not connected and needs to be connected or the sensor is faulty or defective and needs to be replaced.
Sensor Loss 2	The secondary sensor wired to terminal block P2 - terminals 3 & 4 is not connected and needs to be connected or the sensor is faulty or defective and needs to be replaced.
Sensor Loss 3	Both the primary sensor wired to terminal block P2 - terminals 1 & 2 and the secondary sensor wired to terminal block P2 - terminals 3 & 4 are not connected and need to be connected or the sensors are faulty or defective and need to be replaced.

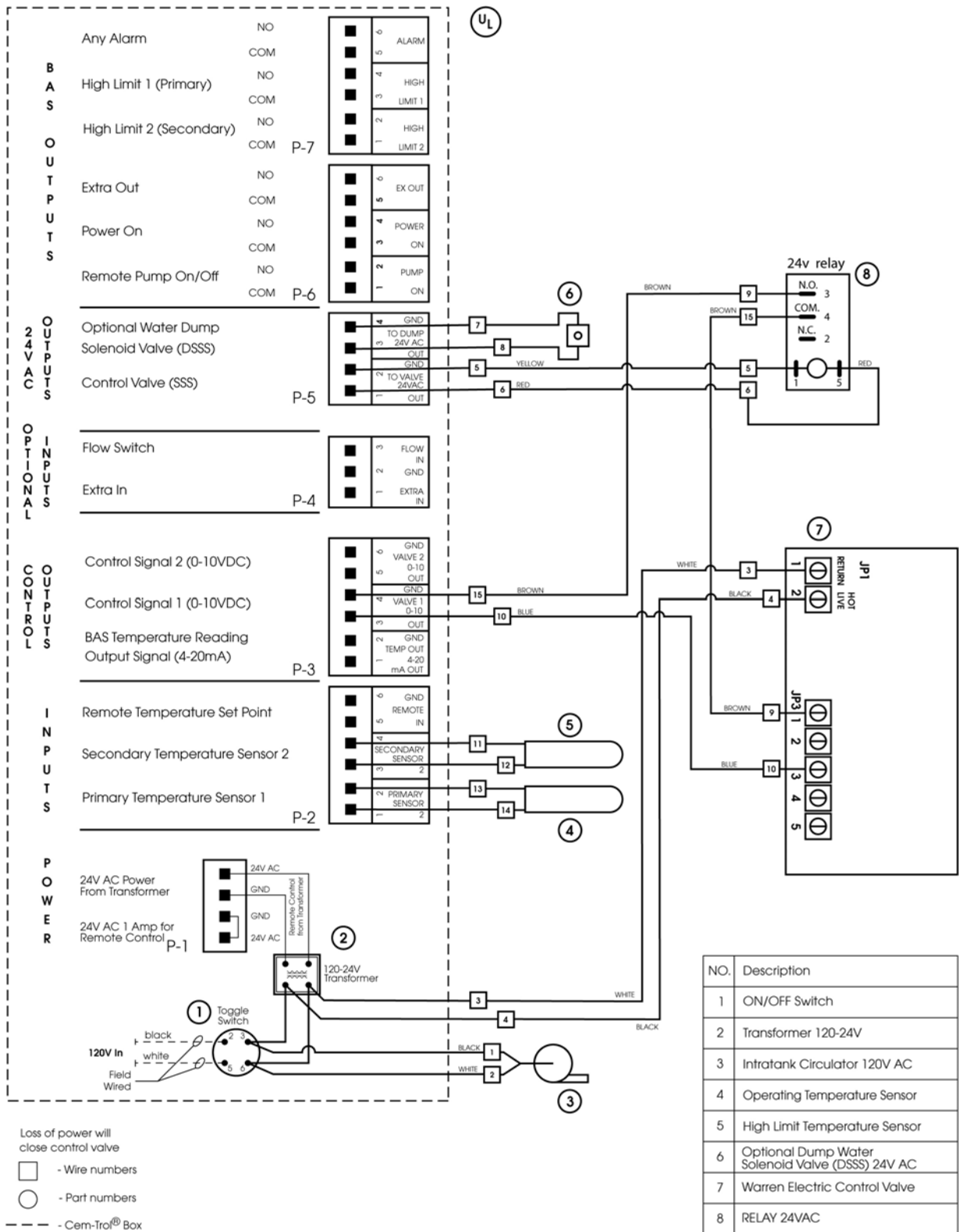
# Wiring Diagram – Self-Contained Temperature Pilot Operated Control Valves



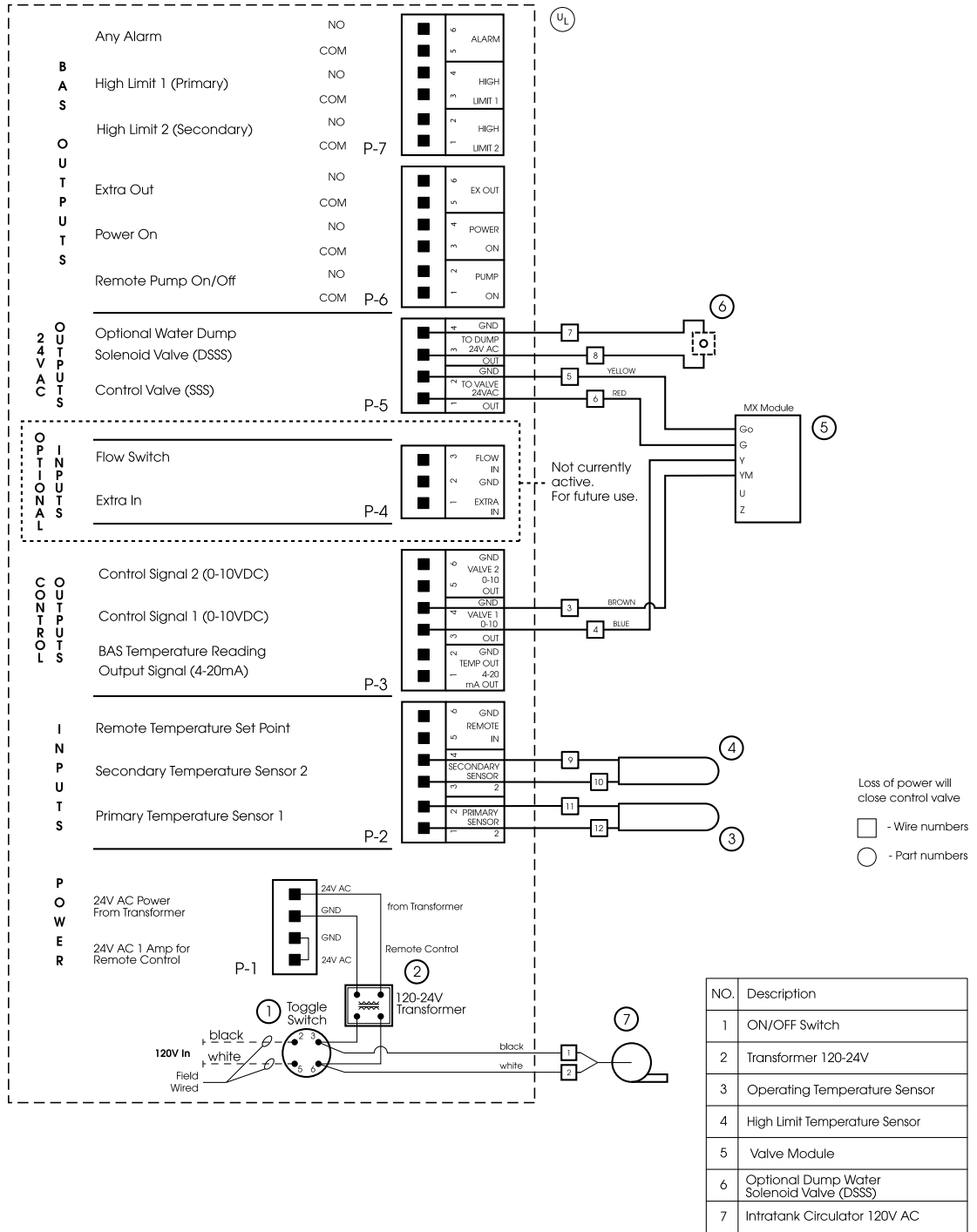
# Wiring Diagram – Pneumatic Operated Control Valves with I-P Transducer



# Wiring Diagram – Warren Controls Valve - Amuract Actuator

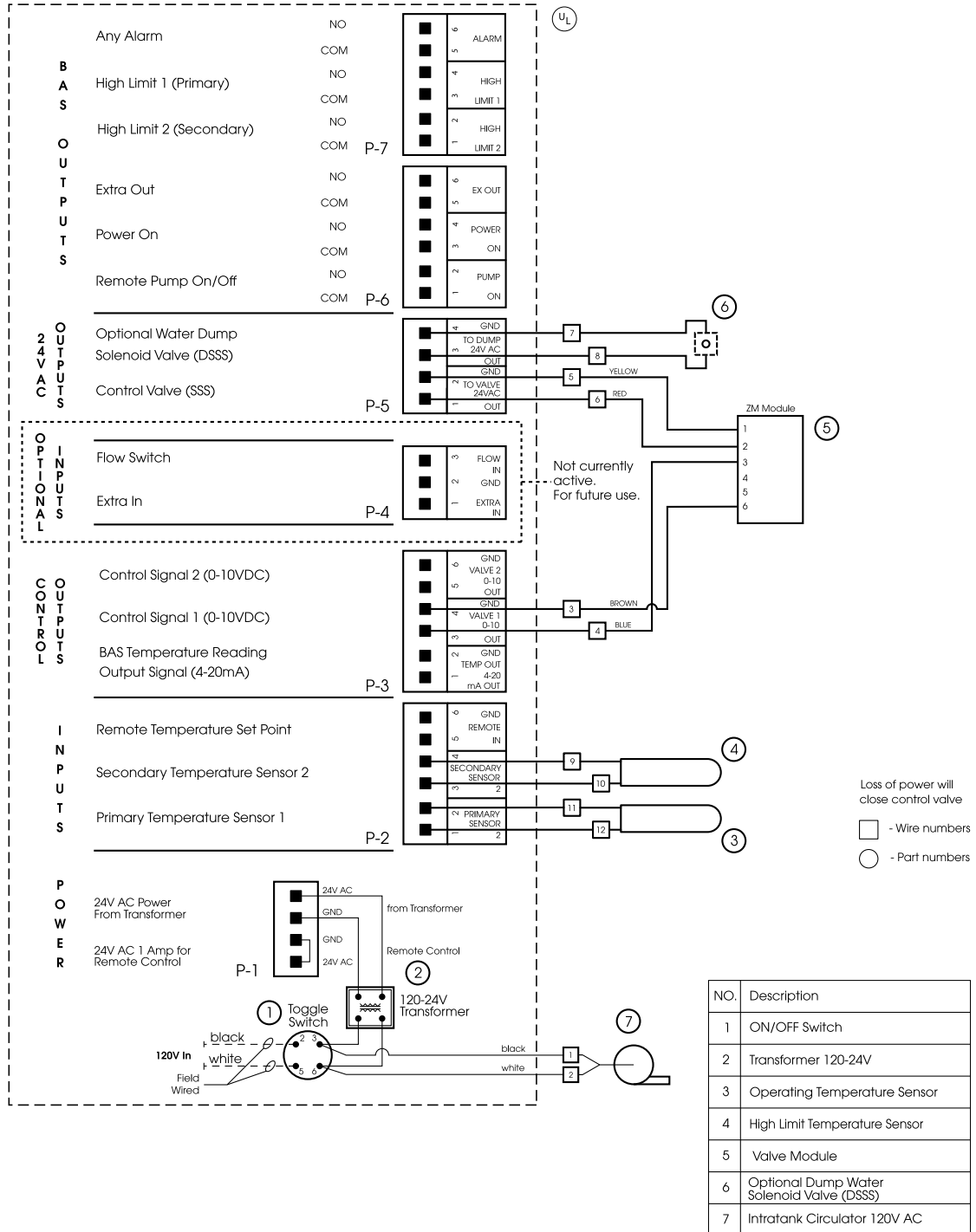


# Wiring Diagram – MXG and MXF Valves

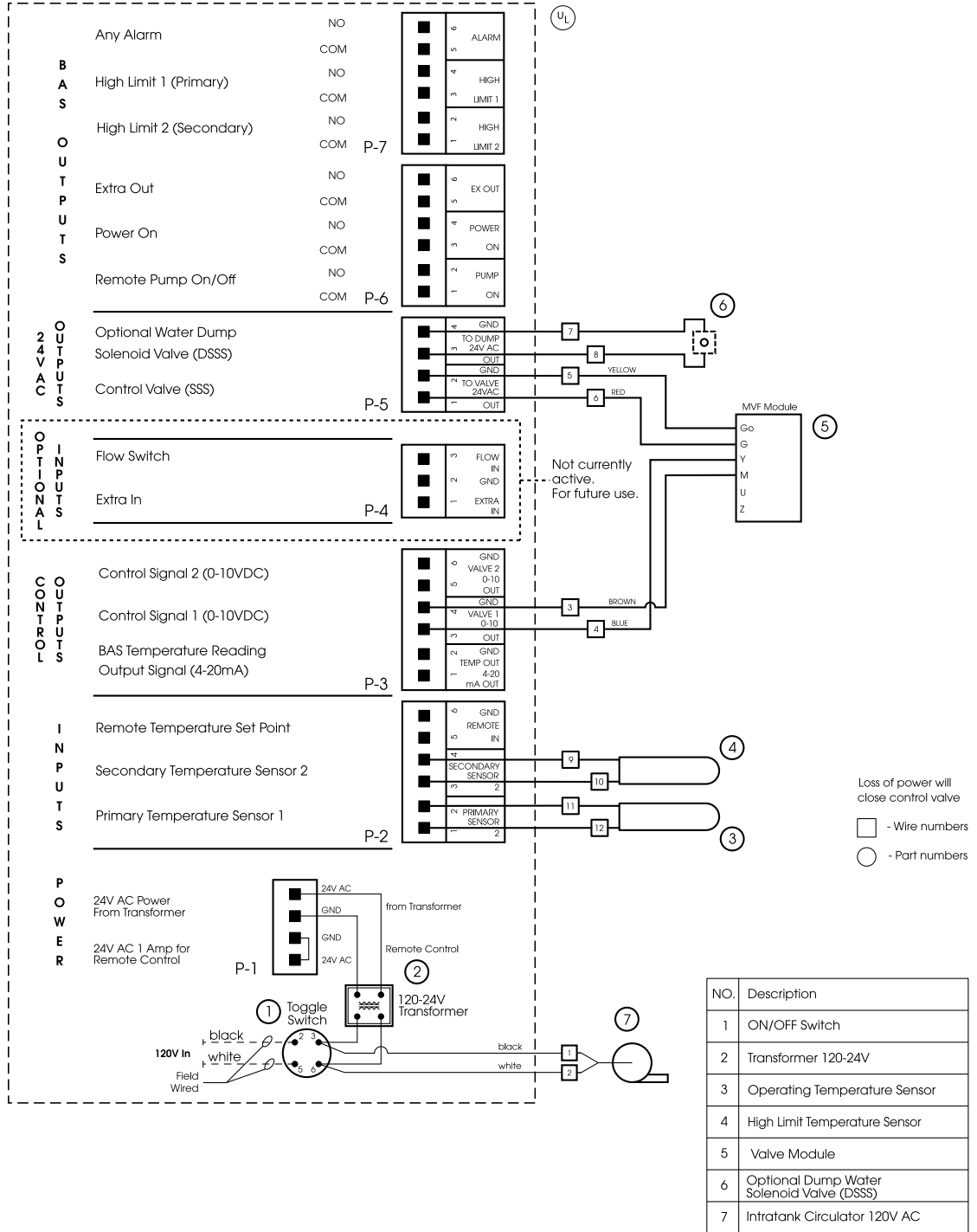




# Wiring Diagram – M2H and M3P Valves

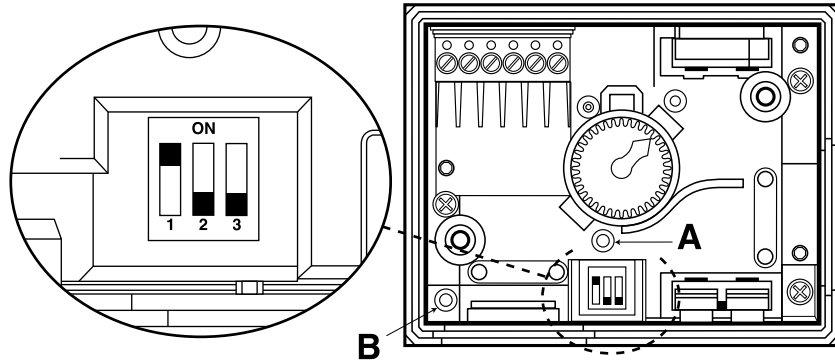


# Wiring Diagram – MVF Valves



## MXG and MXF Valve Information

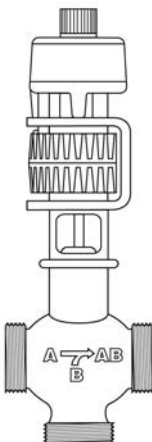
The MXG and MXF valves can be configured for linear and equal percentage operation. Factory setting is equal percentage.



Switch	OFF	ON
1	Characteristic Linear	Equal percentage *
2	Control signal — must be in the OFF position	
3	Volts or mA — must be in the OFF position	

### Valve Calibration

The MXG and MXF valves are factory-calibrated at 0% and 100% stroke. When commissioning the valves, however, (especially under extreme conditions of use) there may still be some leakage via control path A → AB (below, and marked on the valve). In this case, the valve can be recalibrated simply and quickly as follows. Remove the screws from the top of the electrical housing on the control valve and remove the cover. Using a pointed implement (2mm diameter) to operate the button in the opening [A] in the terminal housing. While recalibration is in progress, the LED [B] in the electronics module will flash green for approximately 10 seconds. The valve will be briefly closed and fully opened.



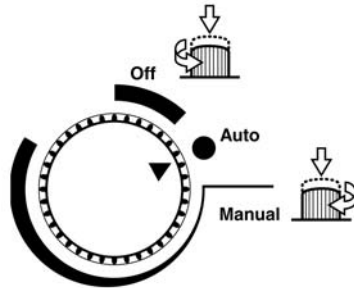
The two-color LED display [B] indicating operating status can be viewed by opening the cover of the electronics module.

<b>LED green</b>	On continuously	Automatic mode: 'Auto' (normal, no faults)
	Flashing	<ul style="list-style-type: none"> <li>– Mechanically set to 'Manual'</li> <li>– Mechanically set to 'Off'</li> <li>– Currently in 'Calibration' mode</li> </ul>
<b>LED red</b>	On continuously	<ul style="list-style-type: none"> <li>– General fault</li> <li>– General calibration error</li> <li>– Micro controller fault</li> </ul>
	Flashing	– Faulty AC 24 V supply (e.g. too low)
	<b>LED</b>	Off

As a general rule, the LED can assume only the states shown above (continuously red or green, flashing red or green, or off).

## Warning

The control valve has a hand wheel knob on the top of the valve (see diagram below). This control knob must be placed into the automatic position (AUTO). The AUTO position allows automatic control of the valve to occur. By placing the hand wheel in the OFF position the valve will not close. **Do not place the wheel in the manual position.** By placing the wheel in the manual position prevents the control program to function correctly and is dangerous to the operation of the unit. **The hand wheel knob must be in the auto position.**



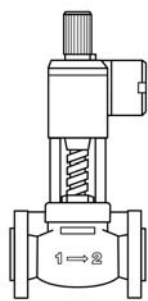
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## M3P and M2H Valve Information

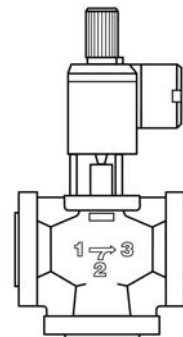
---

### Valve Calibration

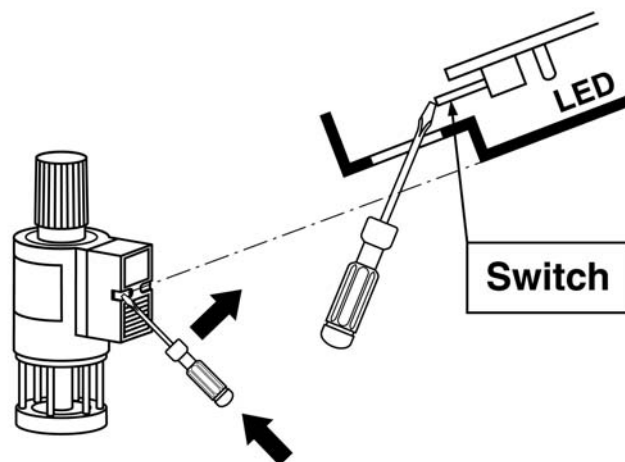
The M3P and M2H valves are factory-calibrated at 0% and 100% stroke. When commissioning the valves, however, (especially under extreme conditions of use) there may still be some leakage via control path 1 → 2 for the M2H and 1 → 3 for the M3P (*see below*, and marked on the valve) with a 0% stroke control signal (DC 0V, DC 4 mA or DC 2 V). In this case, the valve can be recalibrated simply and quickly as follows. Remove the left screw of the electronic module also known as the ZM module. Use a pointed implement (2mm diameter) or a screwdriver No. 0 or 1 to push in the switch in the electronics module (*see below*). While recalibration is in progress, the LED in the electronics module will flash green for approximately 10 seconds. The valve will be briefly closed and fully opened, full stroke is maintained for 1 to 3 seconds and the valve closes again. The valve will then go to the position which corresponds to the position signal. If the LED continues to flash after 10 seconds there was an error in operation during the calibration process or there is another fault.



**M2H**

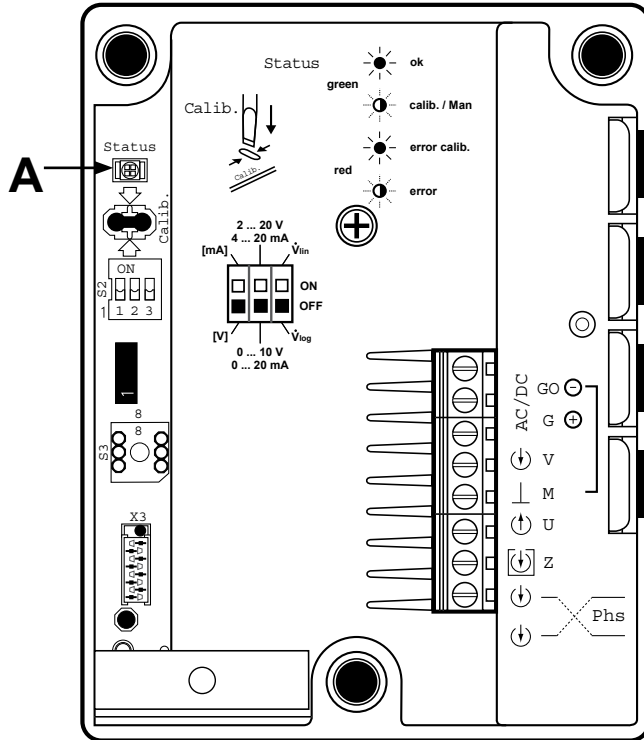


**M3P**



## MVF Valve Information

The MVF valve can be configured for linear and equal percentage operation. Factory setting is equal percentage.

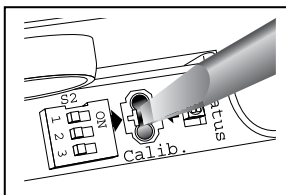


Switch	OFF	ON
1	Volts or mA — must be in the OFF position	
2	Correcting span — must be in the OFF position	
3	Characteristic Equal percentage *	Linear

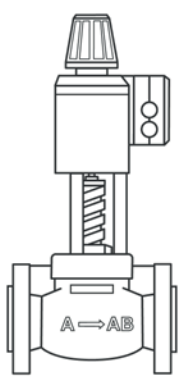
### Valve Calibration

The MVF valves are factory-calibrated at 0% and 100% stroke. When commissioning the valves, however, (especially under extreme conditions of use) there may still be some leakage via control path A → AB and the valve's electronics must be recalibrated. To recalibrate, the hand wheel must be set into the automatic position (AUTO).

Remove the screws from the top of the electrical housing on the control valve and remove the cover. The printed circuit board has a slot for calibration (see diagram below). Calibrate by bridging the contacts located behind the slot on the printed circuit board, using a screwdriver. The valve will then travel across the full stroke to store the end positions. While recalibration is in progress, the LED [A] in the electronics module will flash green for approximately 10 seconds. The valve will be briefly closed and fully opened. The valve will then go to the position which corresponds to the position signal. If the LED continues to flash after 10 seconds there was an error in operation during the calibration process or there is another fault.

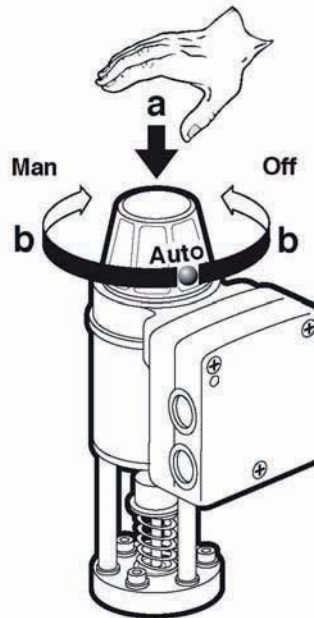


The two-color LED display [A] indicating operating status can be viewed by opening the cover of the electronics module.

 <p style="text-align: center;"><b>MVF</b></p>		<b>Indication</b>	<b>Operating State, Function</b>	<b>Remarks, Troubleshooting</b>
	Green	Lit	Control mode	Normal operation; everything OK.
		Flashing	Calibration In manual control	Wait until calibration is finished (green or red LED will be lit) Hand wheel in Man or Off position
	Red	Lit	Calibration error Internal error	Recalibrate (bridge contacts behind the calibration slot) Replace electronics module
		Flashing	Main fault DC Supply - / +	Check electric main network (outside the frequency or voltage range); VDC supply +/- connection polarity
	Both	Dark	No power supply Electronics faulty	Check electric main network, check wiring Replace electronics module

## Warning

The control valve has a hand wheel knob on the top of the valve (see diagram below). This control knob must be placed into the automatic position (AUTO). The AUTO position allows automatic control of the valve to occur. By placing the hand wheel in the OFF position the valve will not close. **Do not place the wheel in the manual position.** By placing the wheel in the manual position prevents the control program to function correctly and is dangerous to the operation of the unit. **The hand wheel knob must be in the auto position.**



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## General Valve Information

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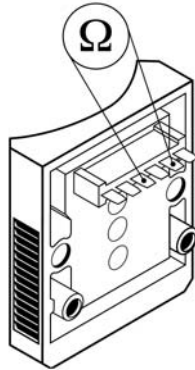
The valve is factory assembled and does not require repacking or other periodic service.

### Testing

1. Turn the power off to the unit.
2. Remove the control module from the valve by loosening the two mounting screws.
3. Measure the resistance between the two terminals indicated on the drawing on page 36. Also see chart on page 36 for resistance for valve coil. Look on valve for the model number that corresponds with the chart.
4. Check one of above terminals to ground. The resistance should be infinite.
5. Measure the voltage at 24 volt transformer between points 7 and 12 as seen on the wiring diagram from page 7.
6. Reconnect the control module.
7. Reconnect the power to the CEM-TROL.



## Magnetic Coil Resistance Information



1) Magnetic Coil Resistance (Kl. 7+8)

Valve Model	Actuator Coil
	Resistance (Ω)
M2H15F	21
M2H20FY	21
M2H25FY	21
M2H32FY	15.3
M2H40FY	10
M2H50FY	10
M3P80FY	5.187
M3P100FY	3.34

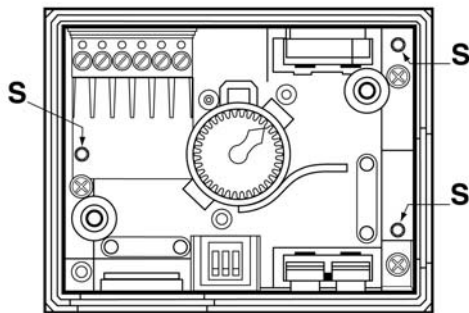


Diagram A

1. Remove the screws from the top of the electrical housing on the control valve and remove the cover.
2. Using a 3 mm Allen wrench remove the 3 Allen head screws (S) which hold the electronic module to the control valve housing (see diagram A).
3. Measure the magnetic coil resistance across the two exposed terminals (see diagram B) and compare the resistance to the chart below.
4. Carefully re-install the electronic control module and cover.

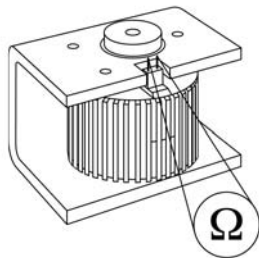


Diagram B

Valve Model	Actuator Coil
	Resistance (Ω)
MXF461.15	9.2
MXF461.65	4.87
MXG461.25	9.2
MXG461.32	9.2
MXG461.40	5.55
MXG461.50	5.55
MXG461.15	9.2

Magnetic Coil Resistance  
(Stem stroke length cannot be measured)

## Warren Controls AmurAct Valve Information

- ▼ For complete information on the Warren Valve and Actuator see the Warren Controls Amuract Actuator Linkage and Motor Installation, Operation, & Maintenance Manual supplied with the unit. The IOM manual is installed inside a plastic envelope adhered to the inside of the safety shield of the AmurAct linkage, otherwise the manual can be found online at [www.amuract.com](http://www.amuract.com).

Warren AmurAct Series Control Valves with F3 & F4 Motors.

**TB1 Terminals.**

- 1 = Common Signal (-)
- 2 = Not Used
- 3 = Control Signal (+) ( 2 – 10 VDC)
- 4 = Not Used
- 5 = Feedback signal (+) (Output)

**DS1 Dip Switch.**

See settings below.

**TB5 Terminals.**

- 1 & 2 are 120 VAC (single phase 50/60 HZ).
- 1 = Neutral
- 2 = Line (120 VAC)

Fuse is a Littelfuse part number 3720315041  
315 mA Slow Blow with T41 terminations.

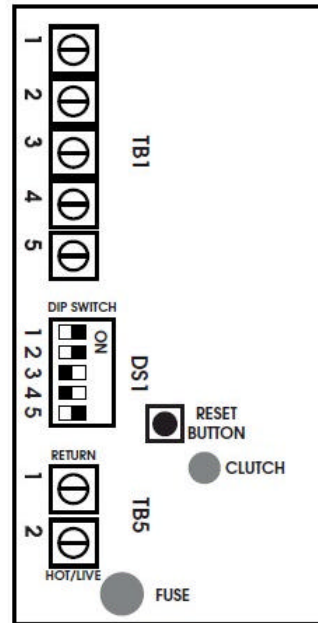


Diagram C

The AmurAct valve dipswitch configurations and descriptions can be seen below. The Cemline factory settings for the dip switches are shaded below.

Switch	Description	ON	OFF	Notes:
1	Rotation	CCW	CW	Required in the ON position( CCW) to open the valve upon increased control signal andclose the valve upondecreased control signal.
2	Failsafe Return	90°	0°	Required in the ON position (90°) to close the valve upon loss of power.
3	Control Signal	4-20 mA	2 – 10 Vdc	Required in the OFF position (2-10 Vdc) to work with Cem-trol.
4	Feedback	Vdc	mA	Can supply feedback signal if required.
5	Characteristic	Linear	Non-Linear	Required in the ON position (Linear)

## Warning

The 30-second pause occurs each time power is applied to the motor and allows the motor to recall its internal settings. No operator action is needed to return the fully automatic operation following a power outage. The Enerdrive fail-safe energy supply is fully restored within one minute after power is restored.

## Valve Calibration

The AmurAct valves are factory-calibrated at 0% and 100% stroke. When commissioning the valves or following an intentional shut down, adjustment, or maintenance, the valve's electronics will need to be recalibrated for proper performance of the valve.

Turn OFF the Cem-trol controller via the on / off switch on the side of the unit. Close the steam or hot water isolation valves to the unit. Verify the linkage safety covers are in place. Remove the screws from the top of the electrical housing on the control valve and remove the cover. Confirm the valve is properly wired for power and switches properly positioned. Remove the control signal output plug P-3 from the Cem-trol printed circuit board (see wiring diagram on page 28 of this manual). Turn ON the power to the Cem-trol which will power the valve's motor. Confirm the LED light on the printed circuit board of the remains on for 30 seconds once power is applied. After the LED turns off, indicating the Enerdrive capacitors are sufficiently charged, press and release the RESET button in the valve's printed circuit board for calibration (see Diagram C). The valve will perform a slow speed calibration by travelling across the full stroke to store the end positions.

Once the valve has been calibrated, return the control signal by plugging in plug P-3 into the Cem-trol printed circuit board. Observe the control valve responds correctly by opening with an increasing signal and closing with a decreasing signal. Install the motor cover. Test the fail-safe operation of the valve by de-energizing power to the Cem-trol and the valve. There will be a 30 second time delay once power is returned to the valve. Finally, with control signal properly connected and the power ON to the unit, slowly and carefully open the isolation valves. Confirm the unit is working properly and in normal operation before leaving the area.



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