

# hydra-wave Continuous Relay Controller



◆ CAUTION

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It is essential that all instructions in this manual be followed precisely to ensure proper operation of the equipment.

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## Instruction Manual

# NOTICE

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## SAFETY PRECAUTIONS

### ◆ **User's Responsibility for Safety:**

It is the user's responsibility to select a controller model that is appropriate for the application, install it properly, perform tests of the installed system, and maintain all components.

### ◆ **Electrical Shock Hazard:**

It is possible to contact components on the controller that carry high voltage, causing serious injury or death. All power to the controller and the relay circuit(s) it controls should be turned OFF prior to working on the controller. If it is necessary to make adjustments during powered operation, use extreme caution and use only insulated tools. Making adjustments to powered controllers is not recommended.

### ◆ **Flammable or Explosive Applications:**

Controllers should not be used with explosive or flammable liquids, which require an intrinsically safe rating. If you are unsure of the suitability of a controller for your installation, consult KM at 1-800-426-9010.

### ◆ **Install In a Dry Location:**

The controller housing is not designed to be immersed. It should be mounted in such a way that it does not come into contact with liquid. Its case is made out of PP (polypropylene). Refer to an industry reference to ensure that compounds that may splash onto the controller housing will not damage it. Such damage is not covered by the warranty.

### ◆ **Relay Contact Rating:**

The relay is rated for a 10 amp resistive load. Many loads (such as a motor during start-up or incandescent lights) are reactive and have an inrush current characteristic that may be 10 to 20 times their steady-state load rating. The use of a contact protection circuit may be necessary for your installation if the 10 amp rating does not provide an ample margin for such currents. In critical applications, redundant backup systems and alarms must be used in addition to the primary system. Such backup systems should use different sensor technologies where possible.

### ◆ **Make a Fail-Safe System:**

Design a fail-safe system that accommodates the possibility of relay or power failure. If power is cut off to the controller, it will de-energize the relay. Make sure that the de-energized state of the relay is the safe state in your process. For example, if controller power is lost, a pump filling a tank will turn off if it is connected to the Normally Open side of the relay.

While the internal relay is reliable, over the course of time relay failure is possible in two modes: under a heavy load the contacts may be "welded" or stuck into the energized position, or corrosion may build up on a contact so that it will not complete the circuit when it should. In critical applications, redundant backup systems and alarms must be used in addition to the primary system. Such backup systems should use different sensor technologies where possible.

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# Introduction

*This chapter describes the organization, manual conventions, and provides contact and technical service information.*

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## Description

This manual describes the installation of the *hydra-wave* Continuous Relay Controller. It includes instructions for installation, product specifications, troubleshooting notes, and practical examples.

Contact KM at 1-800-426-9010 if you have any questions regarding the installation. Outside the USA and Canada, call 425-486-6600.

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## About this manual

The chapters are organized in the following way:

Chapter 1: Pre-Installation of the *hydra-wave* Continuous Relay Controller

Chapter 2: Installation of the *hydra-wave* Continuous Relay Controller

Appendix A through D include specifications, definitions, troubleshooting, and practical examples.

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## Manual Conventions

Three kinds of special explanations appear throughout the manual — *Warning*, *Caution* and *Note*. The format and significance of each is defined below:

 **WARNING**

Possible danger to people. Injury may result if this information is ignored.

 **CAUTION**

Possible risk to the product. The Controller or other equipment may be damaged if this information is ignored.

 **Note**

Contains additional information about a step or feature critical to the installation or operation of the Controller.

## Contact Information



You may reach Kistler-Morse corporate headquarters at the following:

Mail: Kistler-Morse  
19021 120th Ave NE Suite 101  
Bothell, Washington USA 98011-9505

Telephone: 1-800-426-9010  
(425) 486-6600

Fax: (425) 402-1500

E-mail: [sales@kistlermorse.com](mailto:sales@kistlermorse.com)

Website: <http://www.kistlermorse.com>

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## Technical Service

A complete, unabridged copy of our product warranty is available upon request from KM. A summary of the warranty, *subject to the terms and conditions listed fully in the warranty*, follows:

KM warrants the equipment to be free from defects in material and workmanship for two years from date of shipment to original user. KM will replace or repair, at our option, any part found to be defective. Buyer must return any part claimed defective to KM, transportation prepaid.

KM maintains a fully trained staff of field service personnel who are capable of providing you with complete product assistance. Our field service staff is based in Bothell, Washington USA (corporate headquarters).

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### Phone Consultation

Our Customer Service staff provides the following services by telephone, via our regular and toll free number (toll free in U.S.A. and Canada only):

- Technical, application, and troubleshooting assistance
  - Spare parts assistance
  - Warranty (replacement) assistance
- 

### On-Site Consultation

KM's Field Service staff can provide additional services at your request. Contact KM for rate and scheduling information for the following services:

- Technical, application, startup, and troubleshooting assistance on-site
- Training on-site or at our corporate office
- Service calls
- Equipment updates to our latest configuration

General descriptions of some of these standard services follow. Of course, if your service needs vary from those described, we are available to discuss them with you.

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### Installation, Startup Assistance, and On-Site Training

The system will be powered up and checked for proper electrical operation. Recommendations for the optimal performance of the system will be provided.

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### Troubleshooting

KM will troubleshoot systems for mechanical, electrical, calibration, and wiring errors. Normal component repairs will be made and wiring errors will be corrected, including replacement of non-repairable printed circuit boards.

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### Service Calls

KM will perform on-site repair/replacement services.

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### Return Material Authorization

If a part needs to be sent to the factory for repair, contact KM's corporate office and request a Return Material Authorization (RMA) number. The RMA number identifies the part and the owner and must be included with the part when it is shipped to the factory.

# Chapter 1:

## Pre-Installation of the hydra-wave Continuous Relay Controller

*This chapter describes the pre-installation procedures and wiring for the hydra-wave Continuous Relay Controller.*

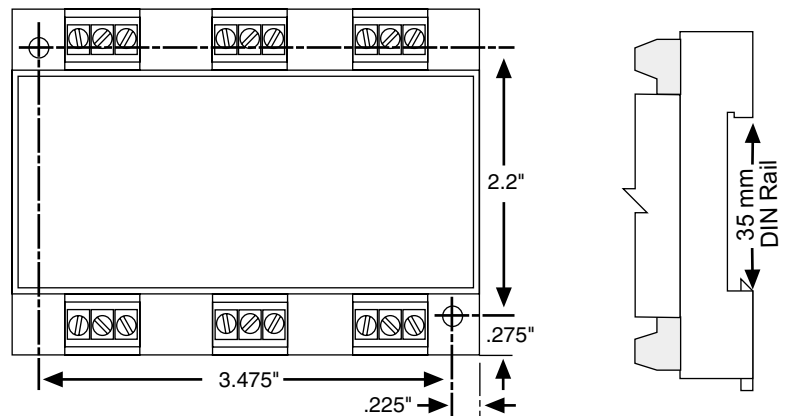
### Mounting:

★ *Note: Always install the controller in a location where it does not come into contact with liquid.*

#### Panel DIN Rail Mounting:

The Controller may be mounted by:

- A. Using a back panel, placing two screws through mounting holes located at the corners of the Controller or,
- B. By snapping the Controller on 35 mm DIN Rail.



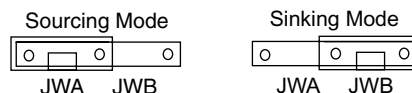
### Changing Settings:

★ *Note: Loop powered devices can operate in either the sourcing or sinking modes.*

#### Input Polarity:

The Controller can be set in one of two modes, **sourcing** and **sinking**. The Controller is shipped from the factory in the *sourcing* mode. All standard KM hydra-wave transmitters are sourcing devices.

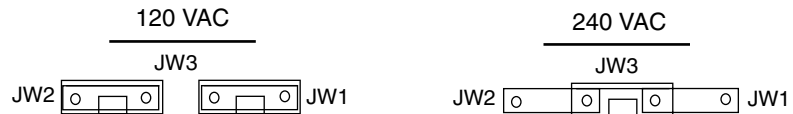
1. Remove the back panel of the Controller and gently slide the printed circuit board (PCB) from the housing. Use caution when removing the PCB.
2. Locate jumpers JWA and JWB on the PCB.
3. To change from sourcing to sinking, remove jumper from JWA and place on JWB. The Controller is shipped from the factory in the sourcing mode (JWA active).
4. Gently return PCB into housing and replace back panel.



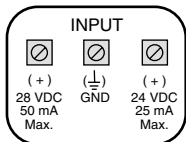
★ *Note: The hydra-wave Continuous Relay Controllers are configured for 120 VAC operations.*

### Changing from 120 to 240 VAC:

1. Remove the back panel of the controller and gently slide the printed circuit board from the housing. Use caution when removing the PCB.
2. Locate jumpers JW1, JW2 and JW3 on the PCB.
3. To change to 240 VAC, remove jumpers from JW1 and JW2 and place a single jumper across JW3.
4. To change to 120 VAC, remove jumper JW3 and place jumpers across JW1 and JW2.
5. Gently return PCB into housing and replace back panel.



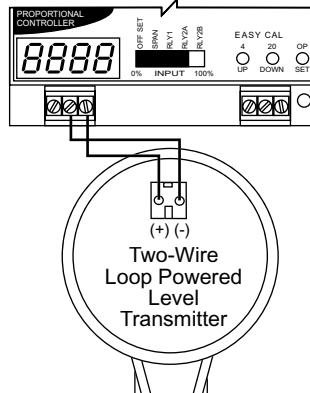
### Wiring to Input Terminals:



Signal input is always through the 24 VDC terminal. The 28 VDC terminal is used as an alternative power supply for three-wire devices. Please note a difference between 2-wire and 3-wire level transmitters below.

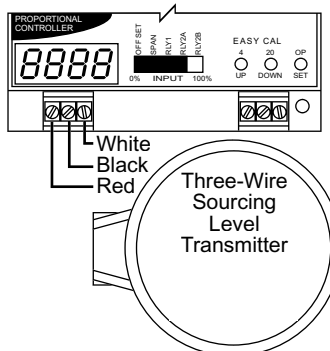
#### Two-Wire Transmitter

(Sourcing Mode / JWA)

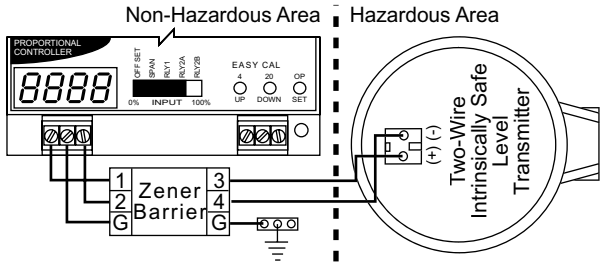


#### Three-Wire Transmitter

(Sourcing Mode / JWA)

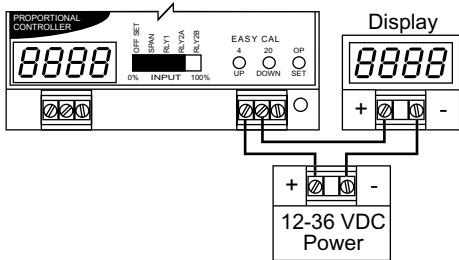


Intrinsically-Safe Two-Wire Transmitter  
(Sinking Mode / JWB)



Repeater Output:

The isolated repeater output reproduces the input current signal. External power is required and should not exceed a maximum of 36 VDC.



# Chapter 2: Installation of the *hydra-wave* Continuous Relay Controller

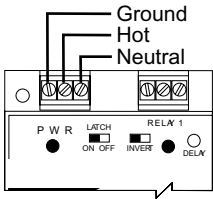
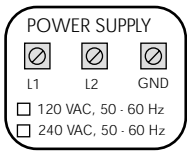
*This chapter describes the installation procedures including the wiring and programming.*

## Wiring

### VAC Power Input Wiring:

Observe the POWER SUPPLY label on the Controller. The label identifies the power requirement (120 or 240 VAC) and the terminal wiring.

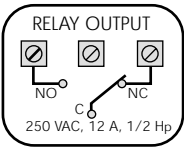
★ *Note: Polarity does not matter with the AC input terminal.*



### Relay Input Wiring:

The single pole, double throw isolated relay 250 VAC, 10 A, 1/2 Hp. The two terminals marked Normally Open (NO) and Normally Closed (NC) will be used in different applications.

★ *Note: The "Normal" state is when the relay's coil is de-energized and the Red relay LED is Off.*



### Low Level Alarm:

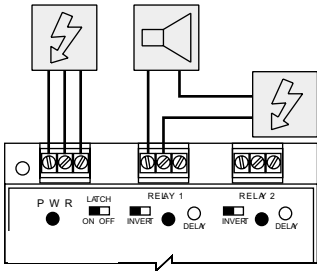
The goal is to make sure that the liquid level does not fall below a certain point. If it does, an alarm will sound, alerting the operator of a low-level condition.

If power is accidentally cut to the controller, the sensor's ability to warn the operator of a low-level condition could be lost. The system must alert the operator not only to low fluid level, but to controller power loss.

To ensure the alarm sounds, connect the hot lead of the alarm to the NC side of the relay terminal of the Controller. If power is lost, the relay will be de-energized, and the alarm will sound (if there is still power to the alarm circuit itself). The alarm circuit should have a non-interruptible

power supply or some other indicator or backup alarm to warn of a power failure in the alarm circuit.

In this application, the normal status of the sensor at the bottom of the tank will be wet, and the relay will be energized holding the alarm circuit open. Both the red relay LED and amber input LED will be on simultaneously, so for this application, INVERT should be set to the OFF position.



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### High Level Alarm:

In the same manner, the controller can be used to sound an alarm when fluid reaches a high level, with just a change in the location of the sensor and the setting of the INVERT switch.

The alarm is still connected to the NC side of the relay to allow for a power failure alarm.

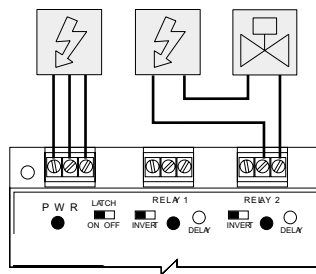
The sensor is normally dry. In this dry condition, we want the relay to be energized so the alarm does not sound: i.e., the red relay LED should be on whenever the amber sensor LED is off. So we turn INVERT ON. If the fluid level rises to the high sensor point, the sensor goes on, the relay de-energizes, and the alarm sounds.

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### Automatic Fill:

This system consists of a tank with a valve controlled by the

hydra-wave Controller. At a low set point, the valve opens, filling the tank. At the high set point, the valve closes. Part of a proper fail-safe design for this particular system is that if power is lost to the controller for any reason, the valve filling the tank must close. Therefore, we connect the valve to the NO side of the relay. When the relay is energized, the valve will open and fill the tank.



The relay indicator will correspond directly to the Open/Close status of the valve.

### Determining the settings of LATCH and INVERT

This is the way the system must operate:

1. When the liquid level is below the low set point, the valve should open, starting to fill the tank.
2. When the liquid is above the low set point, the valve will remain open.
3. When the liquid reaches the high set point, the valve will close.

**Latch:** In any two-sensor control system, LATCH must be ON.

**Invert:** Referring to the logic chart in Appendix A-2, we look for the setting that will de-energize the relay (valve close) when both inputs are ON (High level reached). In this system, Invert should be ON.

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### Automatic Empty:

In the same manner, the controller can be used to automatically empty a tank with just a change to the setting of the INVERT switch.

The valve is still connected to the NO side of the relay to allow for a power failure fail-safe condition.

The normal state of the valve is closed. In this state, we want the relay to be energized at the high set point (opening valve to drain tank). The relay will de-energize at the low set point (closing valve).

★ *NOTE: If the device's load exceeds the rating of the controller's relay, a stepper relay of higher capacity must be used as part of the system design.*

★ *Note: A fail-safe design is important. If the tank is being passively filled, and a valve must be used to actively empty it, a power failure to either the controller or the pump circuits will cause overflow.*

## Programming:

### OFFSET:

Equivalent to the 4 mA set point on the transmitter. Enter the value you would like to see when the Controller receives 4 mA.

### SPAN:

Equivalent to the 20 mA set point on the transmitter. Enter the value you would like to see when the Controller receives 20 mA.

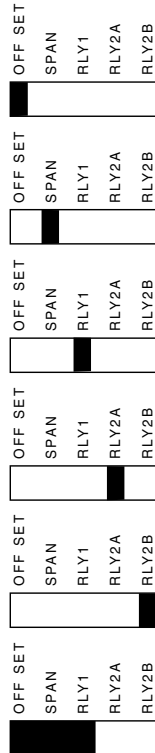
### RLY1, RLY2A, RLY2B:

Set points for Relays. Values must be between OFFSET and SPAN.

### Setting values:

RLY2B will not show during the programming section with Latch Off.

1. Press the SET button once. Immediately, the LED bar graph will begin to flash one Green bar next to OFFSET.
2. Use UP / DWN buttons to change display to the desired OFFSET value.
3. Press the SET button again. Immediately, the LED bar graph will jump one Green bar to the right next to SPAN.
4. Use UP / DWN buttons to change display to the desired SPAN value.
5. Press the SET button again. Immediately, the LED bar graph will jump one Green bar to the right next to RLY1.
6. Use UP / DWN buttons to change display to the desired RLY1 value.
7. Press the SET button again. Immediately, the LED bar graph will jump one Green bar to the right next to RLY2A.
8. Use UP / DWN buttons to change display to the desired RLY2A value.
9. Press the SET button again. Immediately, the LED bar graph will jump one Green bar to the right next to RLY2B.
10. Use UP / DWN buttons to change display to the desired RLY2B value.
11. Press the SET button again. Immediately, the LED bar graph will return back to it normal operation of solid bars.



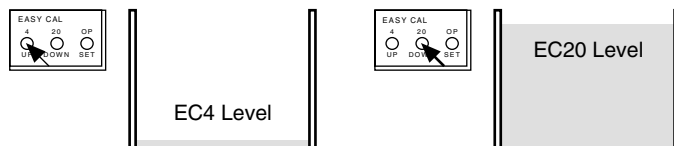
★ *Note: The level of the tank must physically be at its desired level when using EasyCal™. If not, the EasyCal™ will accept the level and the values on the display will be incorrect. Use the factory reset to start over if this occurs.*

### EasyCal™ Calibration:

The Offset and Span points may be programmed directly to a specific level in the tank. These are the EasyCal 4 (EC4) and EasyCal 20 (EC20) values.

To calibrate EC4, set the tank to the new Offset level. Press [4] button once and [E] will appear in the display. Press [4] button again and [C] will appear in the display and EC4 is set.

To calibrate EC20, set the tank to the new Span level. Press [20] button once and [E] will appear in the display. Press [20] button again and [C] will appear in the display and EC20 is set.



# Appendix A: Product Specifications

## Electrical:

Supply voltage:	120 VAC (240VAC), 50-60 Hz.
Consumption:	5 Watts
Sensor input:	(1) transmitter
Sensor supply:	24 VDC @ 1.5 Watts
Loop power:	4-20 mA, 18 VDC
Set point adjustment:	Push button

## Configuration:

- 1: High or low level alarm
- 2: High and low level alarm
- 3: Automatic fill or empty
- 4: Automatic fill or empty with alarm

## Display:

Type:	Alphanumeric, 3.5 digit
Indicators:	Power and Relay status
Bar graph display:	4-20 mA with set points
Alarm Indication:	Amber: <4 mA Red: >20mA
	Lock out mode

## Security:

### Relay:

Relay types:	(1) SPDT (1) Latched SPDT
Relay rating:	250 VAC, 10A, 1/2 hp
Relay mode:	Selectable, NO or NC
Relay latch:	ON or OFF
Time delay:	0-60 secs.

### Fail-safety:

Power fail-safe

### Repeater output:

4-20 mA, 12-36 VDC

### Temperature:

Temperature rating:	F: -40° to 158° C: -40° to 70°
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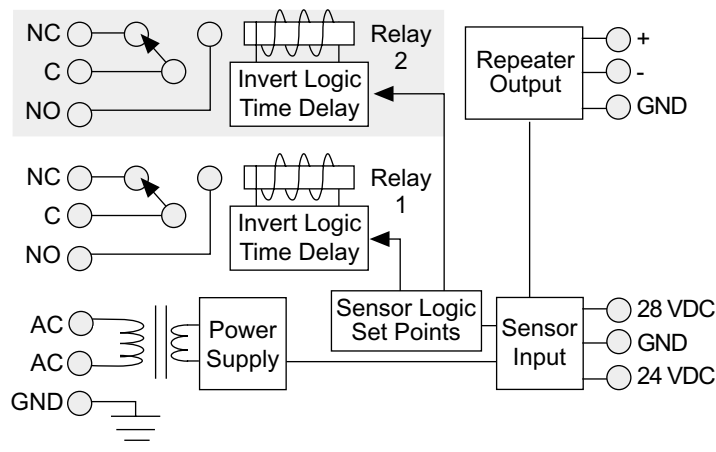
## Physical:

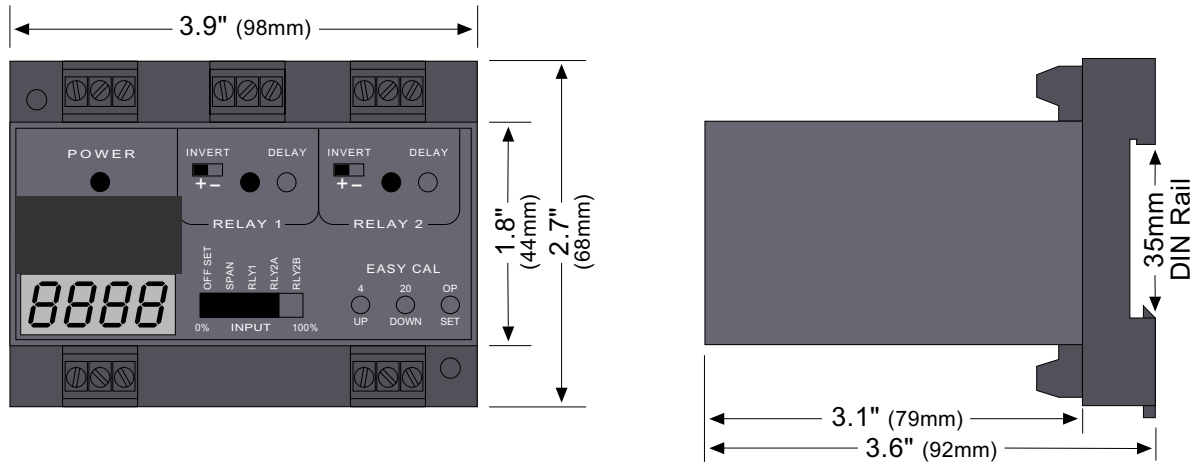
Enclosure mounting:	35mm DIN (EN 50 022)
Enclosure material:	Polypropylene, U.L. 94VO

## CE compliance:

EN 50082-2 immunity  
EN 55011 emission  
EN 61010-1 safety

## Internal Wiring Logic





Relay Logic Table (Refer to page 2-2):

Relay 2 can either be an independent relay similar to relay 1 or can be a latching relay with latch ON. With Latch Off, relay 2 will only respond to the RLY2A setting. RLY2B will be ignored.

With Latch ON, relay 2 will actuate when RLY2A and RLY2B are in the same condition. The relay will not change its condition until both inputs reverse their state.

Invert OFF		Latch Off
RLY2A	RLY2B	Relay
ON	No Effect	ON
OFF	No Effect	OFF

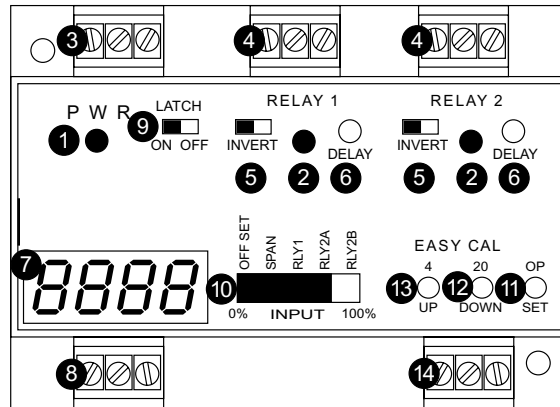
Invert ON		Latch Off
RLY2A	RLY2B	Relay
ON	No Effect	OFF
OFF	No Effect	ON

Invert OFF		Latch ON
RLY2A	RLY2B	Relay
ON	ON	ON
OFF	ON	No Change
ON	OFF	No Change
OFF	OFF	OFF

Invert ON		Latch ON
RLY2A	RLY2B	Relay
ON	ON	OFF
OFF	ON	No Change
ON	OFF	No Change
OFF	OFF	ON

# Appendix B: Guide to Controls

*This section contains definitions for button functions.*



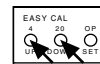
- 1. Power indicator:** This Green LED lights when AC power is ON.
- 2. Relay indicator:** This Red LED will light whenever the controller energizes the relay, in response to the transmitter input and after the time delay.
- 3. AC Power terminals:** Connection of 120 VAC power to the controller. The setting may be changed to 240 VAC if desired. This requires changing internal jumpers; this is covered on page 1-2 of this manual. Polarity (neutral and hot) does not matter.
- 4. Relay terminals (NC, C, NO):** Connect the device you wish to control (pump, alarm etc.) to these terminals: supply to the COM terminal, and the device to the NO or NC terminal as required. The switched device should be a noninductive load of not more than 10 amps; for reactive loads the current must be derated or protection circuits used. When the red LED is ON and the relay is in the energized state, the NO terminal will be closed and the NC terminal will be open.
- 5. Invert switch:** This switch reverses the logic of the relay control in response to the switch(es); conditions that used to energize the relay will now de-energize the relay and vice versa.
- 6. Time delay:** Sets delay from 0 to 60 seconds. Hold Delay button to increase delay in 5 second increments.
- 7. Digital display:** Shows the current 4-20 mA signal in engineering units.
- 8. Input terminals:** Connect the transmitter wires to these terminals: A 24 VDC power is provided for current loop with an additional 28 VDC power terminal if required.
- 9. Latch switch (relay 2):** This switch determines how the relay will be energized in response to the two set points. When LATCH is OFF, the relay responds to set point RLY2A only; when LATCH is ON, the relay will energize or de-energize only when both set points (RLY2A and RLY2B) are in the same condition (both wet or both dry). The relay will remain latched until both set points change conditions.
- 10. Bar Graph:** Displays 4-20 mA signal as a percentage of the range.
- 11. OP/SET:** Used to scroll between set points during programming.
- 12. 20/Down:** Used to decrease display value during programming and for EasyCal™ Span set up.
- 13. 4/Up:** Used to increase display value during programming and for EasyCal™ Offset set up.
- 14. Repeater Output:** Isolated terminal which reproduces the input 4-20 mA signal. Terminal requires 12-36 VDC power for operation.

# Appendix C: Troubleshooting

*This section includes troubleshooting notes for the hydra-wave Continuous Relay Controller.*

## Factory Reset:

Returns the Controller to its original factory set points, including setting the OFFSET to 4 mA and the SPAN to 20 mA. Hold both the 4/UP and 20/DOWN buttons when adding power to the Controller.

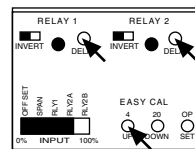
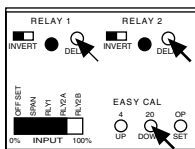


## Factory Settings for the Controller

OFFSET	SPAN	RLY 1	RLY 2A	RLY 2B
4.0	20.0	6.0	18.0	8.0

## Lock Out Function: (Security)

Press both delay buttons and the DOWN button to lock out all push button functions on the Controller. Press both delay buttons and the UP button to unlock all push button functions on the Controller.



## Re-Span the Controller:

✦ *Note: the R23 Potentiometer can be reached by removing the front label of the Controller and using a long jewelers screwdriver to reach it. R23 is located underneath the red LED on the LED bar graph approximately halfway down the PCB. Use extreme caution when adjusting R23.*

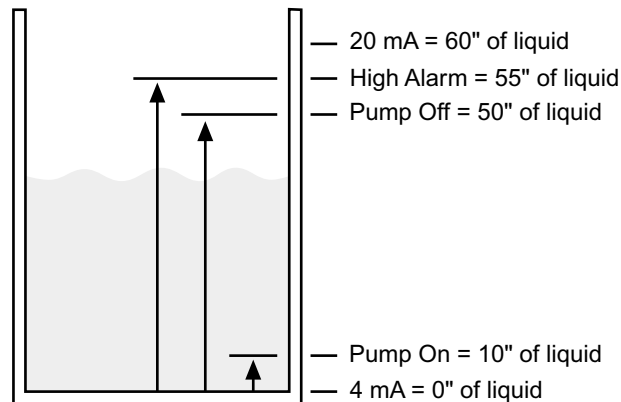
Do a factory reset of the Controller (holding the [4] and [20] buttons while adding power to the unit). Next set the level transmitter to send a 20 mA current. On the Ultrasonic Level Transmitter (ULT), set the EC20 to the level the ULT is currently reading. While a 20 mA current is being sent to the Controller, adjust the R23 potentiometer until the display reads 20.0. Once completed, repackage and program the Controller and return the EC20 value on the ULT back to its correct setting.

# Appendix D. Inventory Control Feature

## Examples

*The following section includes examples to demonstrate the inventory control feature.*

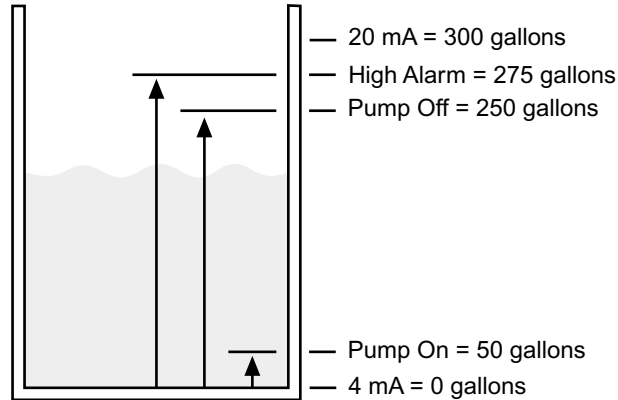
- I. The following example demonstrates inventory control with automatic filling and a high level alarm. The usable range is 60 inches of liquid. The pump starts filling at 10 inches of liquid and stops filling at 50 inches of liquid. A high level alarm occurs at 55 inches of liquid.



Enter all values into the Controller in inches. The OFFSET is the corresponding 4 mA setting in inches. The SPAN is the corresponding 20 mA setting in inches. RLY2A and RLY2B is dedicated to the filling of the tank because RELAY2 is a latching relay. RLY1 is dedicated to the high level alarm because it is a single set point relay. Use the following values for programming the Controller.

OFFSET	SPAN	RLY 1	RLY2A	RLY2b
0.0	60.0	55.0	50.0	10.0

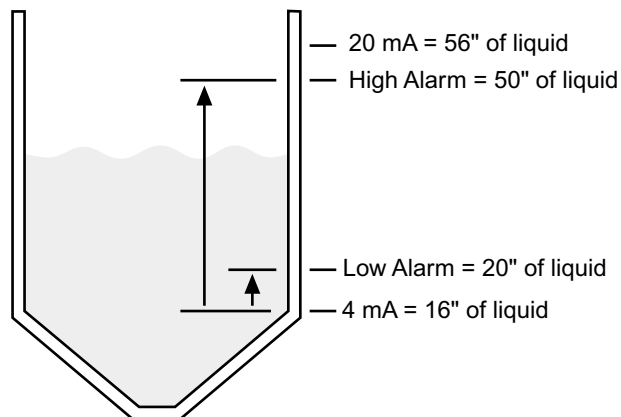
- II. The next example demonstrates the same inventory control with automatic filling and a high level alarm. However, the units have been changes from inches to gallons. Within the tank, 1" = 50 gallons of liquid. The usable range is now 300 gallons of liquid. The pump starts filling at 50 gallons of liquid and stops filling at 250 gallons of liquid. A high level alarm occurs at 275 gallons of liquid.



Enter all values into the Controller in gallons. The OFFSET is the corresponding 4 mA setting in gallons. The SPAN is the corresponding 20 mA setting in gallons. RLY2A and RLY2B is dedicated to the filling of the tank because RELAY2 is a latching relay. RLY1 is dedicated to the high level alarm because it is a single set point relay. Use the following values for programming the Controller.

OFFSET	SPAN	RLY 1	RLY 2A	RLY 2b
0	300	275	250	50

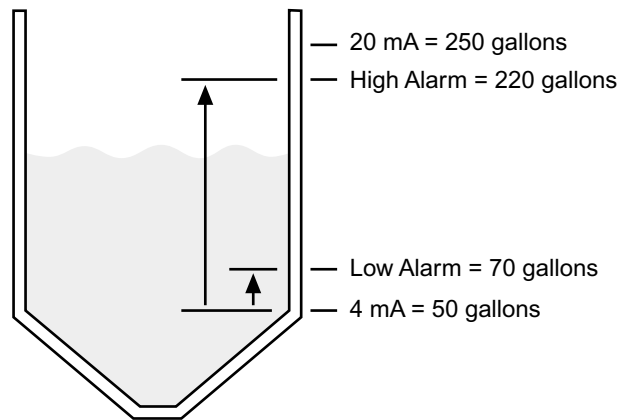
- III. The following example demonstrates inventory control with a high and low level alarm. The usable range is between 16 and 56 inches of liquid. The high level alarm occurs at 50 inches of liquid and the low level alarm occurs at 20" of liquid.



Enter all values into the Controller in inches. The OFFSET is the corresponding 4 mA setting in inches. The SPAN is the corresponding 20 mA setting in inches. RLY1 is dedicated to the high level alarm because it is a single set point relay. RLY2A is dedicated to the low level alarm because the latch is turned off on Relay 2. Use the following values for programming the Controller.

OFFSET	SPAN	RLY1	RLY2A
16.0	56.0	50.0	20.0

IV. The next example demonstrates the same inventory control with a high and low level alarm. However, the units have been changed from inches to gallons. Along the straight side of the tank, 1" = 50 gallons of liquid. The usable range is now from 50 to 250 gallons of liquid. The high level alarm occurs at 220 gallons of liquid. The low level alarm occurs at 70 gallons of liquid.



Enter all values into the Controller in gallons. The OFFSET is the corresponding 4 mA setting in gallons. The SPAN is the corresponding 20 mA setting in gallons. RLY1 is dedicated to the high level alarm because it is a single set point relay. RLY2A is dedicated to the low level alarm because the latch is turned off on Relay 2. Use the following values for programming the Controller.

OFFSET	SPAN	RLY1	RLY2A
50	250	220	70