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User's Guide

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LVCN-20 & LVCN-100 Series
Compact Relay Controllers

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The LVCN-20 and LVCN-100 Series are general-purpose level controllers offered in two configurations for pump and valve control. The LVCN-100 Series features a single 16A SPDT relay output and can accept one level sensor as an input. This package has an optional flashing alarm and is ideal for high level or low level alarm/control. The LVCN-20 Series features a single 16A SPDT latching relay output and can accept one or two level sensor(s) as an input. This package is ideal for the automatic filling or emptying of a tank. Package either controller series with level switch sensors and fittings.

Features

- Fail-Safe relay control of pumps, valves or alarms with a 0 to 60 second delay
- Optional flashing alarm brings immediate attention to level alarm conditions.
- Polypropylene enclosure rated NEMA 4X with swivel base for conduit alignment.
- Easy setup with LED indicators for sensor(s), power and relay status.
- Invert switch changes relay state from NO to NC without rewiring.
- AC powered

Table of Contents

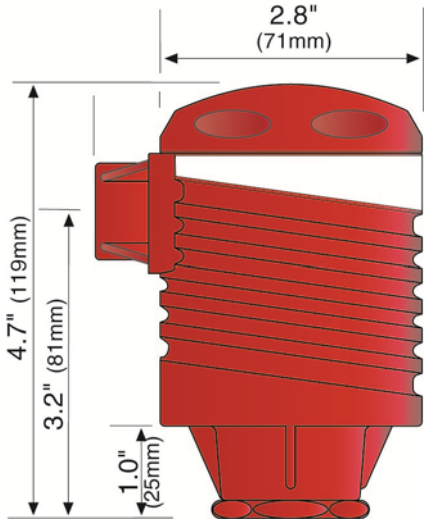
Controller

Supply voltage:	120 / 240 VAC, 50 - 60 Hz.
Consumption:	5 Watts max.
Sensor inputs:	(1) level switch
(LVCN-20 series only)	*(1 or 2) level switches*
Sensor supply:	13.5 VDC @ 27 mA
LED indication:	Sensor, relay & power status
Contact type:	(1) SPDT Relay
(LVCN-20 series only)	*(1) SPDT Relay, Latched*
Contact rating:	250 VAC, 16A
Contact output:	Selectable NO or NC
Contact delay:	0 to 60 seconds
Contact latch:	Select On/Off - *LVCN-20 only*
Electronics temp.:	F: -40°to 158°
	C: -40°to 70°
Enclosure rating:	NEMA 4X (IP65)
Enclosure material:	PP(U.L. 94 VO)
(*LVCN-20 series only)*	*PP(U.L. 94 VO) and Polycarbonate*
Enclosure mount.:	3/4” NPT
Enclosure rotation:	300°swivel base
Conduit entrance:	Single, 1/2" NPT
Certificate number:	LR 79326-3
CE compliance:	EN 61326 EMC
	EN 61010-1 Safety

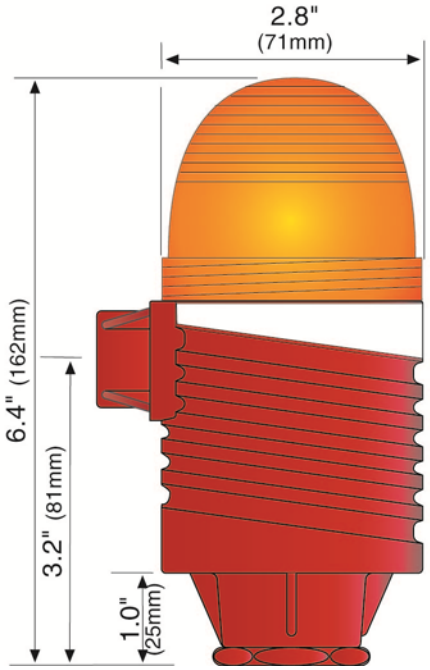
Flash Alarm *(included with LVCN-100 only)*

Flash type:	Xenon tube
Flash frequency:	1 per second
Strobe life:	10M cycles
Supply voltage:	120 VAC, 50-60 Hz.
Consumption:	3 Watts max.
Material:	Polycarbonate
Enclosure rating:	NEMA 4X (IP65)
Color:	Amber

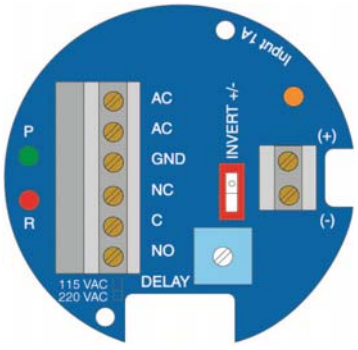
Side View
LVCN-20 & LVCN-110 Series



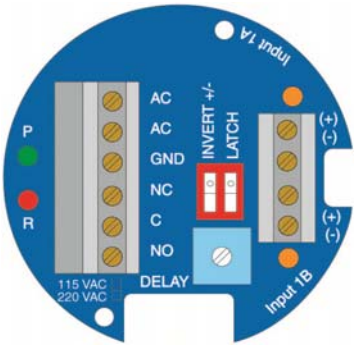
Side View
LVCN-100 Series



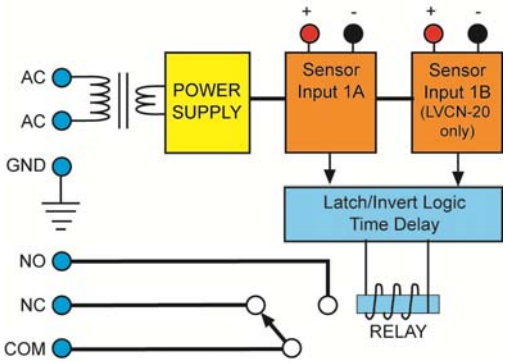
LVCN-100 & LVCN-110 Series



LVCN-20 Series



Functional Diagram



⚠ **About This Manual:** PLEASE READ THE ENTIRE MANUAL PRIOR TO INSTALLING OR USING THIS PRODUCT. This manual includes information on three different models of Compact Relay Controllers from Omega Engineering: LVCN-100, LVCN-110 and LVCN-20. The LVCN-110 series is a single-input controller with an optional Flash Alarm with the LVCN-100 series, and the LVCN-20 is a dual-input controller. Many aspects of installation and use are similar between the three models.

⚠ **User's Responsibility for Safety:** OMEGA ENGINEERING manufactures several models of controller, with different mounting and switching configurations. 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. Wiring should be performed by qualified personnel in accordance with all applicable national, state and local electrical codes.

⚠ **Flammable or Explosive Applications:** *Sensor mount controllers should not be used with explosive or flammable liquids, which require an intrinsically safe or explosion proof rating.* If you are unsure of the suitability of a controller for your installation, consult your Omega Engineering representative for further information.

⚠ **Install In a Dry Location:** The LVCN-100, LVCN-110 & LVCN-20 series controller housing is liquid-resistant and made of Polypropylene (PP). When installed properly, the controller is not designed to be immersed. It should be mounted in such a way that it does not normally come into contact with fluid. 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 16 amp resistive load. Many loads (such as a motor during start-up or incandescent lights) are reactive and may 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 16 amp rating does not provide an ample margin for such inrush currents.

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 buildup 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.

While this manual offers some examples and suggestions to help explain the operation of OMEGA ENGINEERING products, such examples are for information only and are not intended as a complete guide to installing any specific system.

Sensor-mount controllers: The LVCN-100, LVCN-110 & LVCN-20 series are a cost-effective, modular liquid level controller whose body incorporates a female 3/4" NPT (3/4" BSP) fitting, allowing it to be mounted directly onto any Omega Engineering sensor or any 3/4" connection. Simply provide its required AC power and a controlled device such as a valve, pump, or alarm that can be switched by the controller's relay in response to the sensor input.

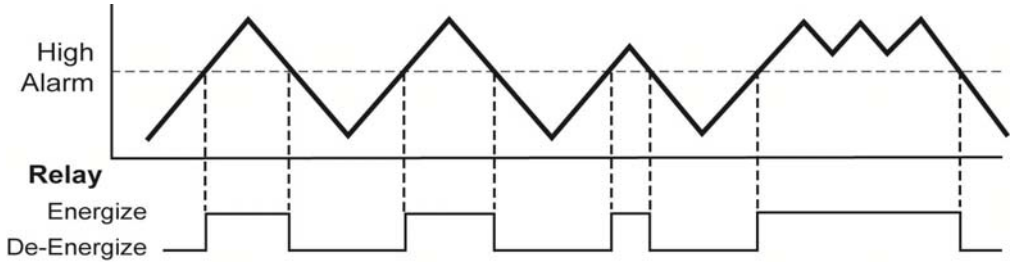
Sensor-mount controllers are particularly appropriate for simple processes such as high or low alarms. They can also be a useful part of more complicated systems, providing a fail-safe backup in case a centralized system fails.

Components:

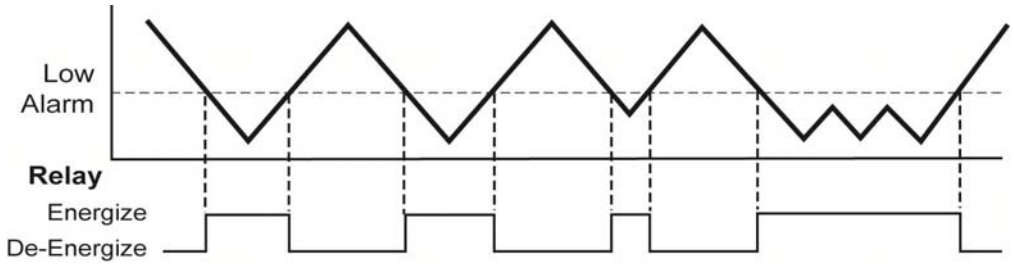
- LVCN-110 - Single Input High or Low Relay Controller
- LVCN-110-CE - Single Input High or Low Relay Controller with CE approval
- LVCN-100 - Single Input High or Low Relay Controller with Flashing Alarm
- LVCN-100-CE - Single Input High or Low Relay Controller with Flashing Alarm & CE approval
- LVCN-100-220VAC - Single Input High or Low Relay Controller with Flashing Alarm configured to 220 VAC
- LVCN-20 - Dual Input Automatic Fill or Empty Relay Controller
- LVCN-20-CE - Dual Input Automatic Fill or Empty Relay Controller with CE approval
- Owner's Manual

Features of the LVCN-100 & LVCN-110 series Single Input Controller: The LVCN-100 & LVCN-110 series are designed to receive a signal from a single liquid sensor. It turns its internal relay ON or OFF (as set by the invert switch) in response to the presence of liquid, and changes the relay status back again when the sensor is dry.

High Alarm:
Invert is OFF. Relay will energize when the switch becomes Wet and will de-energize when the switch becomes Dry (out of liquid).



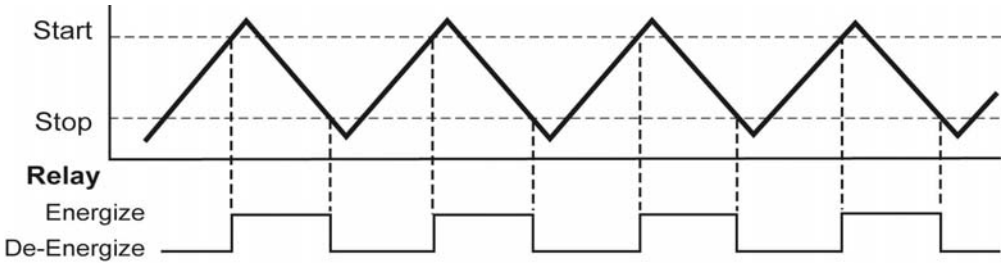
Low Alarm:
Invert is ON. Relay will energize when the switch becomes Dry (out of liquid) and will de-energize when the switch becomes Wet.



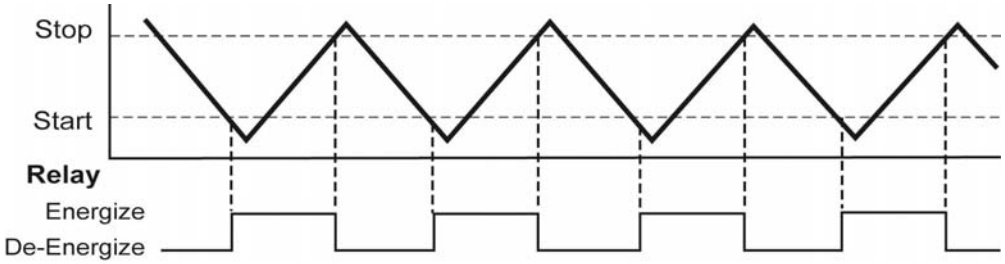
The LVCN-100 & LVCN-110 series may be used with almost any kind of sensor signal: current sensing or contact closure. The relay is a single pole, double throw type; the controlled device can be connected to either the normally open or normally closed side of the relay. A time delay from 0 to 60 seconds can be set before the relay responds to the sensor input. Typical applications for the LVCN-100 & LVCN-110 series are high level or low level switch/alarm operations (opening a drain valve whenever liquid level rises to a sensor point) and leak detection (sounding an alarm when a leak is detected, etc.).

Features of the LVCN-20 series Dual Input Controller: The LVCN-20 series is designed to receive signals from two liquid sensors. It turns its internal relay ON or OFF (as set by the invert switch) in response to the presence of liquid on both sensors, and changes the relay status back again when both sensors are dry.

Automatic Empty:
Latch is OFF & Invert is OFF. Relay will energize when level reaches high switch (both switches are wet). Relay will de-energize when level is below the bottom switch (both switches are dry).

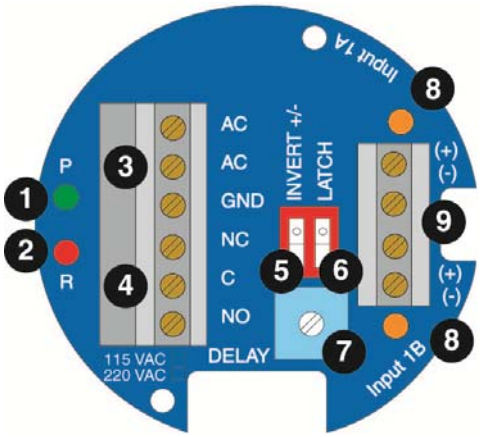


Automatic Empty:
Latch is OFF & Invert is ON. Relay will energize when level is below the bottom switch (both switches are dry). Relay will de-energize when level reaches high switch (both switches are wet).



The LVCN-20 series may be used with almost any kind of sensor signal: current sensing or contact closure. The relay is a single pole, double throw type; the controlled device can be connected to either the normally open or normally closed side of the relay. A time delay from 0 to 60 seconds can be set before the relay responds to the sensor input. Typical applications for the LVCN-20 series are automatic filling (starting fill pump at a low level and stopping pump at a high level) or automatic emptying operations (opening a drain valve at a high level and closing valve at low level).

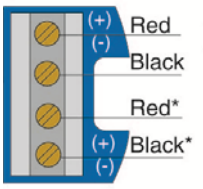
Guide to Controls: Below is a listing and the location of the different components for the controller:



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 proper condition at the sensor input(s) 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 in the Installation section of the 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 non inductive load of not more than 16 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 DIP switch reverses the logic of the relay control in response to the sensor(s): conditions that used to energize the relay will make it turn off and vice versa.
6. **Latch switch (LVCN-20 series only):** This DIP switch determines how the relay will be energized in response to the two sensor inputs. When LATCH is OFF, the relay responds to sensor Input 1A only; when LATCH is ON, the relay will energize or de-energize only when both sensors (1Aand 1B) are in the same condition (wet or dry). The relay will remain latched until both sensors change states.
7. **Time Delay:** After the input(s) change(s) state, this control sets a delay from 0.15 to 60 seconds before the relay will respond.
8. **Input 1Aand 1B indicator:** These amber LEDs will light immediately whenever the appropriate sensor attached to the terminals detects liquid, and will turn off when it is dry.
9. **Input terminals:** Connect the wiring from the sensors to these terminals: A to the upper pair, B (LVCN-20 series only) to the lower pair. Note the polarity: (+) is a 13.5 VDC, 27 mA power supply (to be connected to the red wire of an Omega Engineering sensor), and (-) is the return path from the sensor (to be connected to the black wire of an Omega Engineering sensor). If polarity is reversed, the sensors will not work.

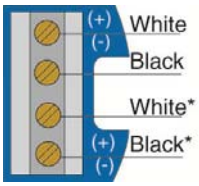
Connecting switches to input terminals: Please note a difference between OMEGA ENGINEERING powered level switches and reed switches. All powered level switches (series LTU-101, LVU-150, LVP-51, LVC-152 & LVF-210) will be wired with the Red wire to the (+) terminal and the Black wire to the (-) terminal. OMEGA ENGINEERING reed switches (series LVV-110 & LVH-200) will have a particular wiring based upon part number. See the illustration below to indicate wiring for your switch. Note: the Shield wire will be used only for long cable runs or where excessive electrical noise is present.

Powered Level Switches



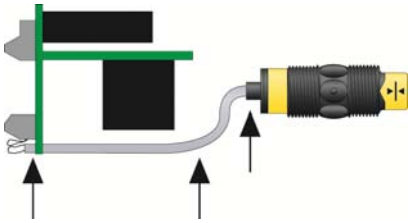
Models:
LTU-101 series,
LUV-150 series,
LVP-51 series
LVC-152 series
LVF-210 series

Reed Switches

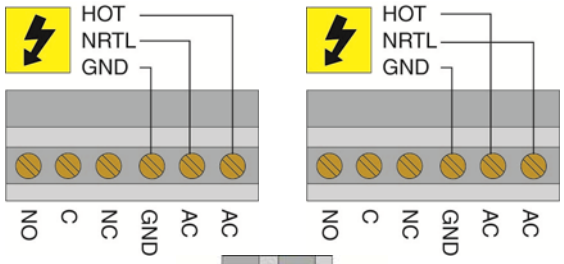


Models:
LVV-110 series,
LVH-200 Series

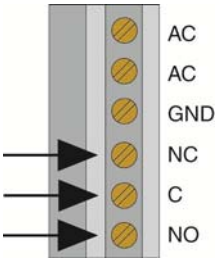
Switch Cable: When installing an Omega Engineering level switch, adjust the cable away from the printed circuit boards in the controller body. Avoid breaking the seal between the top of the level switch and the plastic coated cable.



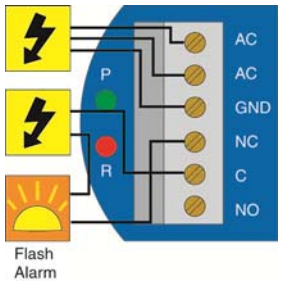
VAC Power Input Wiring: Observe the labeling on the LVCN-100, LVCN-110 & LVCN-20 series. Note: Polarity does not matter with the AC input terminal.



Relay Input Wiring: The relay is a single pole, double throw type rated at 250 Volts AC, 16 Amps. The two terminal NO and NC (normally open and normally closed) will be used in different applications. Remember that the "normal" state is when the relay coil is de-energized and the Red relay LED is Off / de-energized.

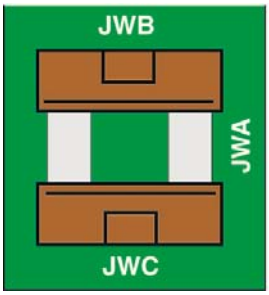


Flash Alarm Output (LVCN-100 series): With the Flash Alarm wired NC; it can be used as a high or low level alarm, depending on the setting for the invert switch. The Flash Alarm can also be wired NO.

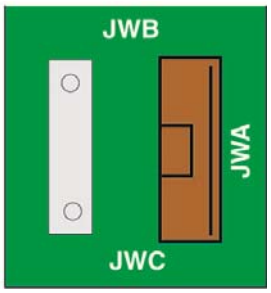


Changing from 120 to 240 VAC:

1. Remove the two screws from the top of the printed circuit board (PCB) and gently slide the PCB from the housing. Use caution when removing the PCB.
2. Located jumpers JWA, JWB and JWC on the PCB.
3. To change to 240 VAC, remove jumpers from JWB and JWC and place a single jumper across JWA. To change to 120 VAC, remove jumper JWA and place jumpers across JWB and JWC.
4. Gently return PCB into housing and replace the two screws.



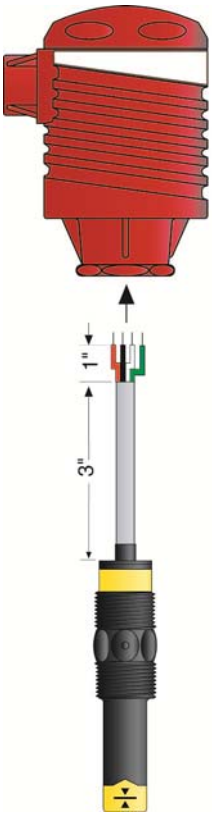
120 VAC Configuration



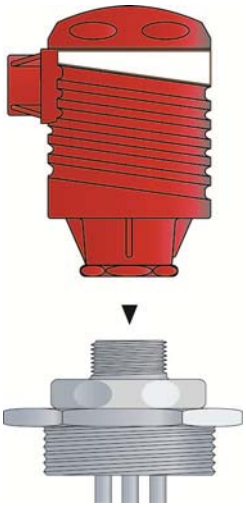
240 VAC Configuration

3/4" NPT Mounting Thread: Installation of the compact relay controller takes advantage of the 3/4" NPT thread located on its base. This makes the controller fully compatible with any of Omega Engineering's level switches or LVM-10 series or LVM-51 Series mounting systems.

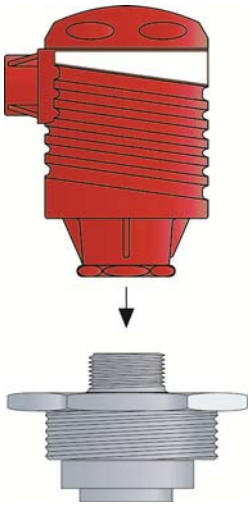
Mounting directly to a sensor



Mounting to LVM-10 Series Level Track Mounting System



Mounting to LVM-50 Series Single Switch Fitting Assembly

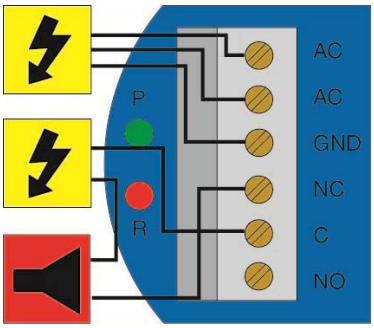


Note: Always tighten the controller from the wrench flat located on the swivel base. Never tighten from the body of the controller.

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 is supposed to sound, alerting the operator of a low level condition.

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

To do this, 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.



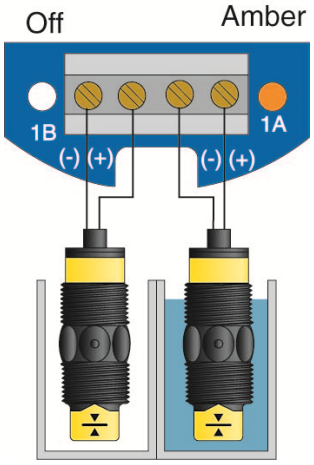
In this application, the normal status if the sensor at the bottom if the tank will be wet, and the relay will be energized holding the alarm circuit open. Both the relay LED and the Input LED will be on simultaneously, so for this application, Invert should be set to the OFF position.

High Level Alarm: In the same manor, this system 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.

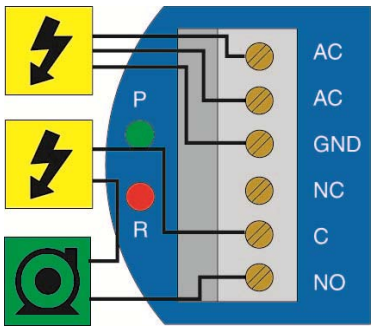
The alarm is still connected to the NC side of the relay to allow for a power failure alarm.

The sensor is normally dry. In this 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 Input LED is Amber. 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.

LED Indication: Use LED's located above the input terminals to indicate whether the switch is in a wet or dry state. With powered switches, Green indicates dry and Amber indicates wet. With reed switches, Amber indicates wet and no LED indicates dry. Note: reed switches maybe wired in reverse so that wet indicates dry and Amber indicates dry.



Automatic Fill: This system consists of a tank with a high level sensor, a low level sensor, and a pump that is controlled by the controller. Part of a proper fail-safe design for this particular system is that if power is lost to the controller for any reason, the pump filling the tank must be turned off. Therefore, we connect the pump to the NO side of the relay. When the relay is energized, the pump will turn on and fill the tank. The relay indicator will correspond directly to the ON/OFF status of the pump.



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

Determining the settings of LATCH and INVERT: This is the way the system must operate:

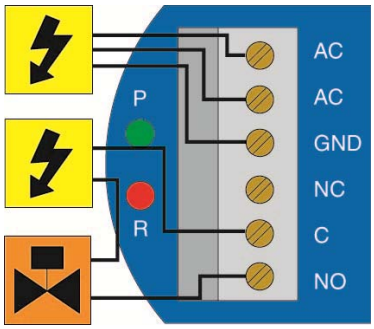
- When both the high and low sensors are dry, the pump should turn on, starting to fill the tank.
- When the low sensor gets wet, the pump should stay on.
- When the high sensor gets wet, the pump should turn off.

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

Invert: Referring to the logic chart in Step Nine, we look for the setting that will de-energize the relay (start the pump) when both inputs are wet (Amber LEDs). In this system, Invert should be ON.

Determining A or B input connections: When LATCH is ON, there is no effective difference between Input A and B, since both sensors must have the same signal in order for status to change. When wiring any two-input relay section, the only consideration for hooking a particular sensor to A or B is if LATCH will be OFF.

Automatic Empty: Note that similar system logic can be used for an automatic empty operation simply by controlling a pump that pumps fluid out of the tank instead of into it. However, note the importance of fail-safe design. If the tank is being passively filled, and a pump must be used to actively empty it, a power failure to either the controller or the pump circuits will cause overflow.



Alternatively, an electrically-controlled drain valve could be used. In this case, the valve should be a type that will automatically open if power is lost; in other words, power must be used to hold it closed. The valve would be connected to the NO side of the relay—if power is lost to the controller, the relay de-energizes, the valve loses the power that was holding it shut, and fluid will drain from the tank into some other safe containment until power is restored. In this system, whenever the red relay LED of the controller is ON, the drain is closed, allowing fluid to rise.

In this case, Invert should be ON: when both sensors are wet, the relay de-energizes, the switch to the valve opens, and the tank will drain.

Controller Logic: Please use the following guide to understand the operation of the controllers.

1. **Power LED:** Make sure the Green power LED is ON when power is supplied to the controller.
2. **Input LED(s):** The input LED(s) on the controller will be Amber when the switch(es) is/are wet and OFF when the switch(es) is/are dry. If the LED's are not switching the input LED, test the level switch.
3. **LVCN-100 & LVCN-110 only:** When the input LED turn OFF and ON, the relay LED will also switch. With invert OFF, the relay LED will be ON when the input LED is ON and OFF when the input LED is OFF. With invert ON, the relay LED will be OFF when the input LED is ON and ON when the input LED is OFF.
4. **LVCN-20 only:** When both inputs are wet (Amber LED's ON), the relay will be energized (Red LED ON). After that, if one switch becomes dry, the relay will remain energized. Only when both switches are dry (both amber LED's OFF) will the controller de-energize the relay. The relay will not energize again until both switches are wet. See the Relay Latch Logic Chart below for further explanation.

Relay Latch Logic Table (LVCN-20 only): The relay can either be an independent relay (high or low level alarm)or can be a latching relay (automatic fill or empty) with latch ON. With Latch OFF, the relay will only respond to the INPUT 1A setting. INPUT 1B will be ignored.

With Latch ON, the relay will actuate when INPUT 1A and INPUT 1B are in the same condition. The relay will not change its condition until both inputs reverse their state.

Invert OFF		Latch Off
Input1A	Input1B	Relay
ON	No Effect	ON
OFF	No Effect	OFF

Invert ON		Latch Off
Input1A	Input1B	Relay
ON	No Effect	OFF
OFF	No Effect	ON

Caution: Some sensors (particularly buoyancy sensors) may have their own inverting capability (wired NO or NC). This will change the logic of the invert switch. Check your system design.

Invert OFF		Latch Off
Input1A	Input1B	Relay
ON	ON	ON
OFF	ON	No Change
ON	OFF	No Change
OFF	OFF	OFF

Invert OFF		Latch Off
Input1A	Input1B	Relay
ON	ON	OFF
OFF	ON	No Change
ON	OFF	No Change
OFF	OFF	ON

Troubleshooting

PROBLEM	SOLUTION
Relay switches only from input 1A (ignores input 1B)	Latch is turned OFF. Flip the latch switch to turn ON.
Level reaches alarm ON, but relay is OFF.	First, check to make sure the input LED is ON. If not, check wiring to sensor. Second, check status of Relay LED. If incorrect, flip the Invert switch to change the relay state.
Pump or Valve is supposed to stop, but it does not.	First, check to make sure the input LEDs are both in the sate state (both ON or both OFF). If not, check wiring to sensor each sensor. Second, check status of Relay LED. If incorrect, flip the Invert switch to change the relay state.
Controller is powered, but nothing happens.	First check the Power LED to make sure it is Green. If not, check the wiring, power and make sure the terminal is seated correctly over the 6-pins.

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