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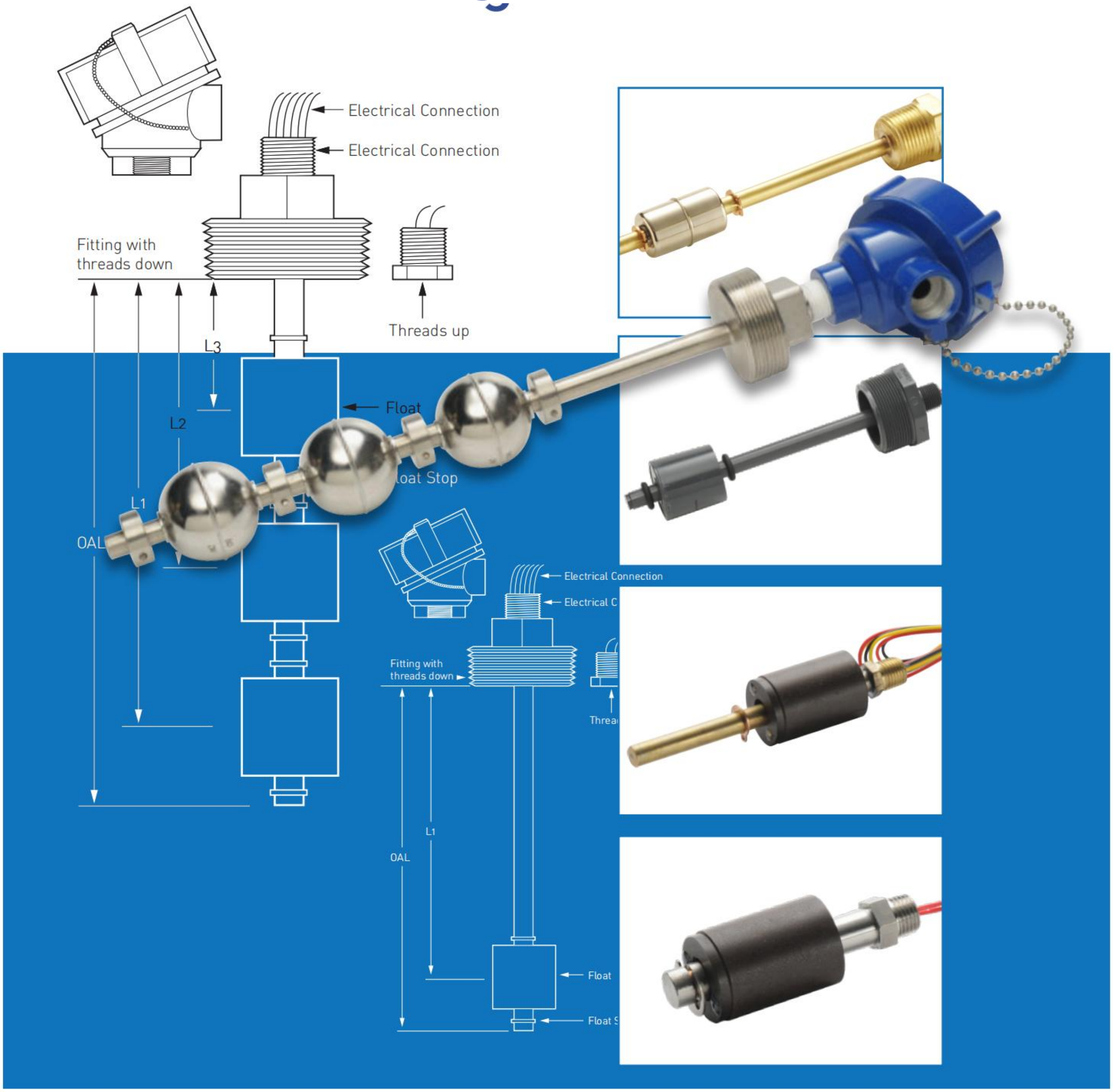
The Ultimate Guide to Float Level Sensors:

Electrical Ratings for Float Switches



APPENDIX 2: Understanding electrical ratings of float switches

A common inquiry about float switches is if the switch can properly handle the applications electrical load. It is easier to determine electrical load capabilities if you understand how the liquid level sensors internal components work. Float level switches utilize reed switch technology. Specifically, they are glass encapsulated, hermetically sealed, magnetically actuated reed switches. When a magnetic field (contained in the float) surrounds or comes in close proximity to the reed switch, the contact changes state. The size of the reed switch limits its electrical load handling capability. The internal reed switches can only handle a relatively small load. See reed switch ratings below for more detail.

Reed switch ratings

When selecting your float level sensor, it is important that your electrical load requirements do not exceed the switch's rating. Care must be taken so that your load does not exceed ANY of the maximum ratings for wattage, current, and voltage of the reed switch selected. See the following table for an example of maximum reed switch electrical parameters.

Maximum wattage, voltage and current ratings of reed switches

Switch	Max. wattage	Max. voltage	Max. current
10W switch	10 watts	175 VAC/VDC	500 mA
50W switch	50 watts	265 VAC/VDC	1 amp
100W switch	100 watts	265 VAC/VDC	3 amp

To determine if your electrical load will not exceed the float switches capability, determine the operating voltage and multiple that by the current draw of your load. This will give you the Wattage of your electrical load. (Watts=Volts x Amps) Now compare your wattage, voltage and current values of your electrical load to insure all 3 of these values are less than the maximum ratings of the switch. Remember if any one of your load parameters exceeds the switches parameters, a different switch or different circuit design must be used.

Assuming some common load voltages, the following table shows the maximum amperage that can be drawn through the system.

Maximum current allowed based on voltage used and wattage of reed switch selected

Wattage of selected reed switch	Voltage used	Maximum current (amps)
10W	240 AC	0.04
	120 AC	0.08
	24 DC	0.4
50W	240 AC	0.2
	120 AC	0.4
	24 DC	1.0
100 W	240 AC	0.4
	120 AC	0.8
	24 DC	3

— Formula used: Imax (current)= Watts/Voltage

— These ratings are for resistive loads only. For inductive loads, it is important to determine your load's peak in rush current and voltage

Note: The power drawn by loads can be expressed in either Watts (W) or Volt-Amps (VA). The power in Watts is the actual power drawn by the equipment and Volt-amps is used for apparent power in AC circuits and equals Volts x Amps. Volt-Amps is the product of voltage and current, without considering the type of load (resistive or inductive). When talking about resistive loads, Watts and VA can be used interchangeably in the chart above.

Switching Resistive, inductive and capacitive loads

It is important to understand the characteristics of your load that you are switching to ensure that the float switch can handle the electrical load. The electrical ratings of the float switch are commonly defined as peak load ratings. Resistive loads or "dry contact" loads (Common for PLC's or custom controllers) are typically stable because the switching load is similar to the ongoing carrying load. Inductive loads, such as a solenoid, small motor, or light bulbs can have "flyback power" where the peak voltage or current and peak wattage can be 10 times – 20 times (or more) than the rated steady state electrical load when the circuit opens. Capacitive loads "store" energy and when the switch is opened up, a large power spike can result as the stored energy is drained from the load. An example of this would be long lead wire or electrical circuitry with a large current load. If these load characteristics are not taken into consideration, these peak currents and voltage spikes can easily damage your float level sensor switch.

LOAD EXAMPLES:

Resistive load:	Resistors, dry contact input, controllers
Capacitive Loads:	Lead wires that exceed 200 ft, electrical equipment
Inductive Loads:	Relay's, Solenoids, Light bulb

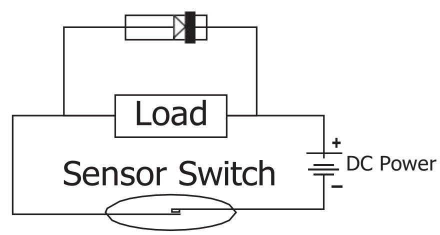
Designing for Inductive loads and Capacitive loads

If your load's capacitive or inductive peaks are not managed correctly, the internal reed switch can be damaged and can result in pre-mature sensor failure. One option to protect the sensors' reed switch is to design a general-purpose isolation relay in the application. In this scenario, the float switch will be connected to the relay coil, although this is an inductive load, typically will have a peak current less than 500 mA. The float switch will control the relay coil and open and close the relay's output contacts. The relay contacts carry the high in-rush current created by the applications inductive load.

Design suggestions for both DC INDUCTIVE and CAPACITIVE LOADS

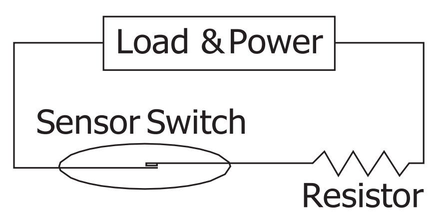
DC voltage lamps, DC Inductive or DC Capacitive Loads:

When switching DC voltage inductive or capacitive loads, a high peak power spike can be experienced when the switch opens. These "fly back" spikes can be 10 times or more the normal voltage and/or current state. One solution to protect the switch in these situations is to install a diode in parallel with the DC load. This diode provides a path for the fly back current that is generated from the inductive field, protecting the reed switch from being exposed to this power spike. A "1N4004" diode is a common choice. Install the diode so the cathode side (white ring) is connected to the positive power side of the load. (Diode circuit diagram)



Diode circuit diagram

Alternatively, another option is to install a resistor in series with the reed switch. It is important to understand the resistor could affect your applications performance. We suggest you test to insure the additional resistance added to your electrical load does not cause any performance problems. For best protection, the larger the resistor value, the more protected your switch will be. If your circuitry allows for it, a 470-ohm resistor is a common choice. (Resistor circuit diagram)



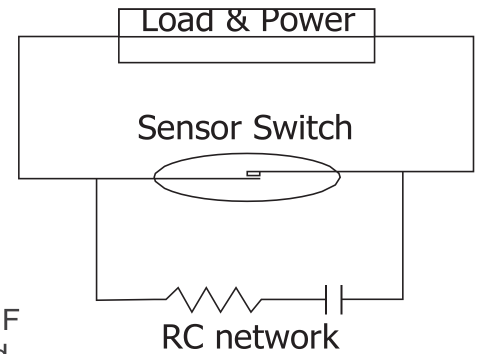
Resistor circuit diagram

Design suggestions for both AC INDUCTIVE and CAPACITIVE LOADS

AC Relay Coil, AC Solenoid, AC Motors and other AC inductive loads:

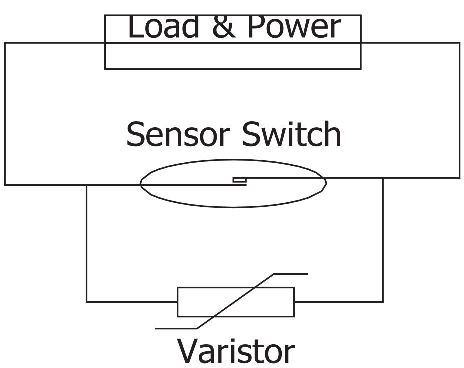
AC inductive loads can have peak power spikes 10-20 times greater than the rated full load power. This peak power spike exists both when the switch closes and when the switch opens (Lasting a fraction of a second or longer). Although this power pike only lasts a very short time, it will still damage and/or destroy the switch. There are several solutions to help reduce the impact of the AC power spikes to the sensor's switch.

Across the sensor's switch (parallel wiring), wire a resistor and capacitor in series. Calculate the approximate resistor value by multiplying 2 times the peak voltage value divided by the current across the switch. A resistor within 20% of this value is a good starting point. Commonly a .1uF capacitor is used. See (RC network diagram).



RC network diagram

Another option is to wire a varistor in parallel with the sensor's switch. Consult with the varistor manufacturer to determine the correct model and rating of the varistor for your application. (Varistor diagram)



Varistor diagram

In summary

Electrical current overload is a common cause of failure for reed switch-based liquid level switches. If proper measures are not taken with your sensor design, switch failure will likely occur when switching inductive and capacitive loads. When you take the proper protective measures to ensure that your liquid level switch is operated at its rated electrical load, you can expect this highly reliable reed to deliver millions of switching cycles over the course of its lifetime.