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Information and Testing Procedures for Electronic Level Switch

The Problem

Are the Electronic Level Switches eating your lunch? There are any number of issues that could cause you some headaches with these controllers, especially if you are not all that familiar with them. It's possible that you are testing them incorrectly or operating them outside of the electronic parameters they were designed for. Before you become frustrated with these controllers we should take a look at a few things.

The simplest solution to your problem is to provide you with the correct information so that you will be able to determine more efficiently what issues are plaguing your Electronic Level Switch and combat those issues then.

Here is some basic information and testing procedures for the electronic level switches:



Horizontal Switch Load Ratings

The Kimray CEB1/CEB2/CEC1/CEC2 level switches are rated at **3W minimum load, 100W maximum load**. They employ a mechanical reed switch which uses Tungsten contacts.

Using The Level Switch Below The Minimum Rating

If the level switch has been in operation for some period of time with a switching load of less than 3W, there is a possibility that the tungsten contacts in the internal reed switch have become oxidized and will increase in resistance. This would be observed when measuring an increased resistance in closed contacts. Typically, a user can expect the closed contact resistance to be a few Ohms or less.

Identifying Potential Oxidation Issues

If the contact resistance is much higher than a few Ohms, or the resistance of closed contacts seems to be reading erratically, it is very possible that the contacts have become oxidized. This effect can usually be repaired by applying a heavier switching load to the contacts. There are a number of ways this could be done. It all comes down to allowing electric current to flow through the contacts.



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Bench Testing The Horizontal Level Switch

One way of bench testing a level switch to check for contact oxidation would be as follows:

1. Disconnect the level switch from the monitoring circuit.
2. Measure and record the open and closed resistance for each of the contact pairs:
 - a) normally open (NO) and common (COM)
 - b) normally closed (NC) and common (COM).
3. Apply a switching load of greater than 3W, but less than 100W to the normally open pair.
4. Actuate the manual override switch (if equipped) and verify that the load switches on and off appropriately. If a manual override is not available; then raising the level in the tank, or manually operating the float will be needed.
5. Move the switching load to the normally closed pair.
6. Actuate the level switch and verify that the load turns off and on appropriately.
7. Disconnect the switching load from the level switch and measure the open/closed resistance for each of the pairs again.
8. By operating a heavier load with the switch, the contacts will have conducted a higher current that can burn through any oxidation and provide clean contacts once again. However, this *will not* prevent re-occurrence if the level switch is controlling a very light load ($< 3W$).

Preventing Problems

If the switch is connected to a minimum load of 3W, oxidation should not become a problem. If the switch is connected to a much lighter load, the above bench testing method may temporarily clean the contacts, but *will not* prevent the oxidation from re-forming over time.

A Case Example

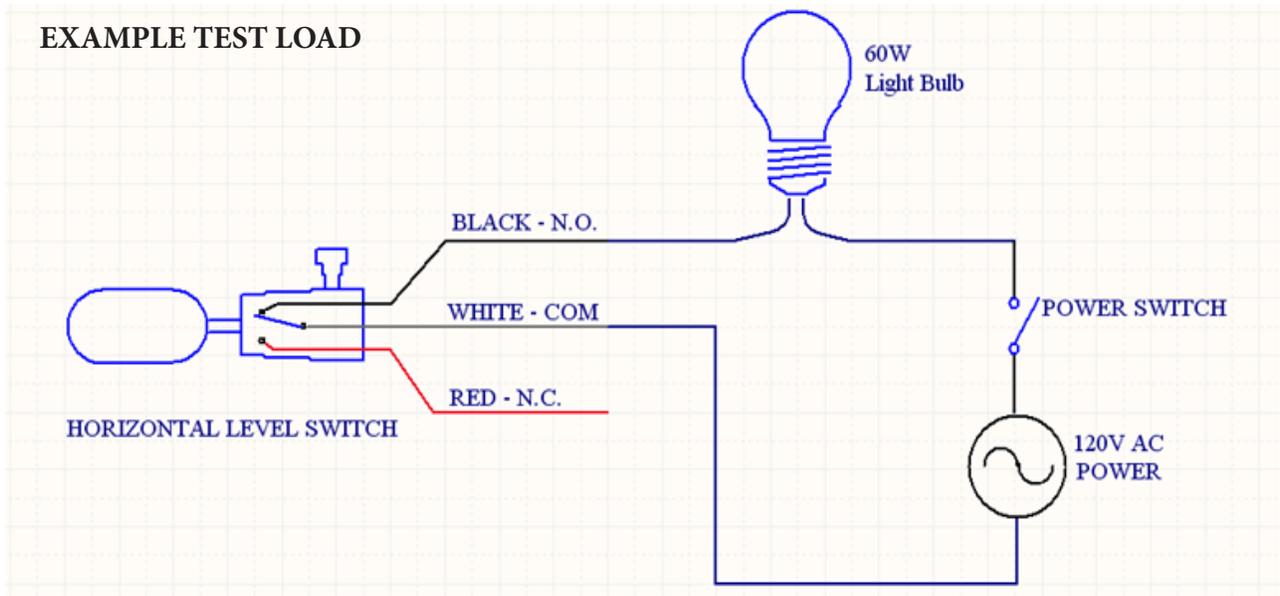
One occasion of this type of failure came from a customer report of a level switch falsely indicating liquid level on a known empty vessel. The level switch was then removed from the vessel and returned to Kimray. Upon receiving the level switch, the switch contacts were tested with an Ohmmeter and found to be working correctly – the customer complaint could not be verified. Upon further investigation, the application was discovered to be detecting the level switch using a microcontroller with very low current levels (micro-amp range).

At these low currents, it only takes a thin oxidation layer to dramatically increase the resistance of the contacts – causing a false reading of the level position. The auto-ranging Ohmmeter can supply a varying amount of current. In this particular case, simply measuring the resistance of the contacts apparently corrected the minor amount of oxidation present, thereby “repairing” the level switch.



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This is an example of a simple circuit for testing the level switch using an ordinary household 60W light bulb.

By closing the power switch and manually moving the float (or manual override), the light will turn on and off as the float makes and breaks contact of the reed switch.

In the above circuit, the level switch is controlling a 60W load.

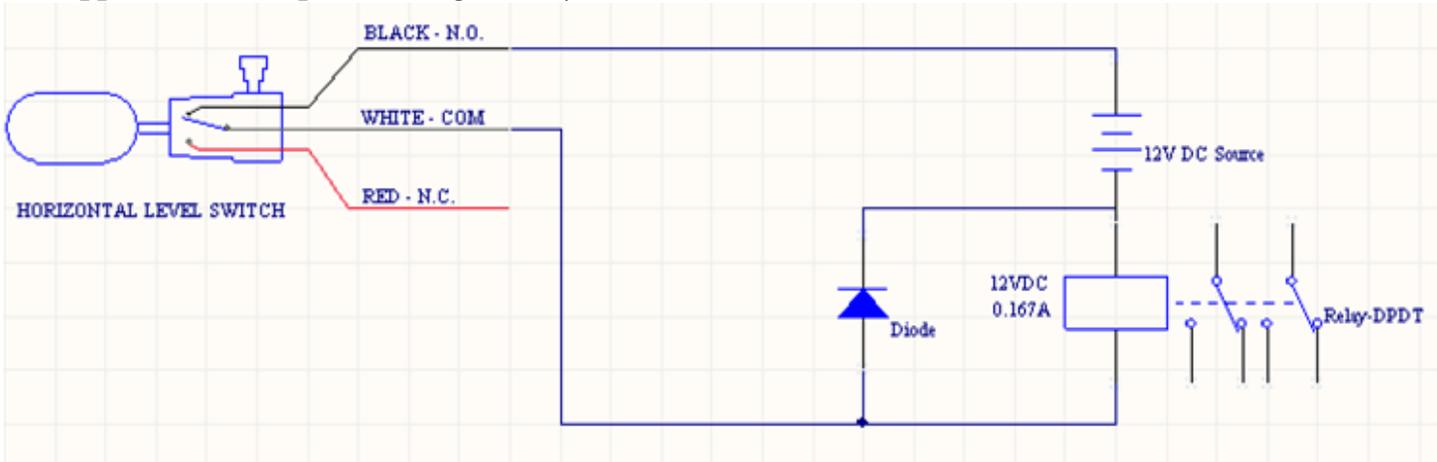
The maximum voltage the switch contacts experience is 120VAC and the maximum current through the contacts is approximately 500mA AC current.



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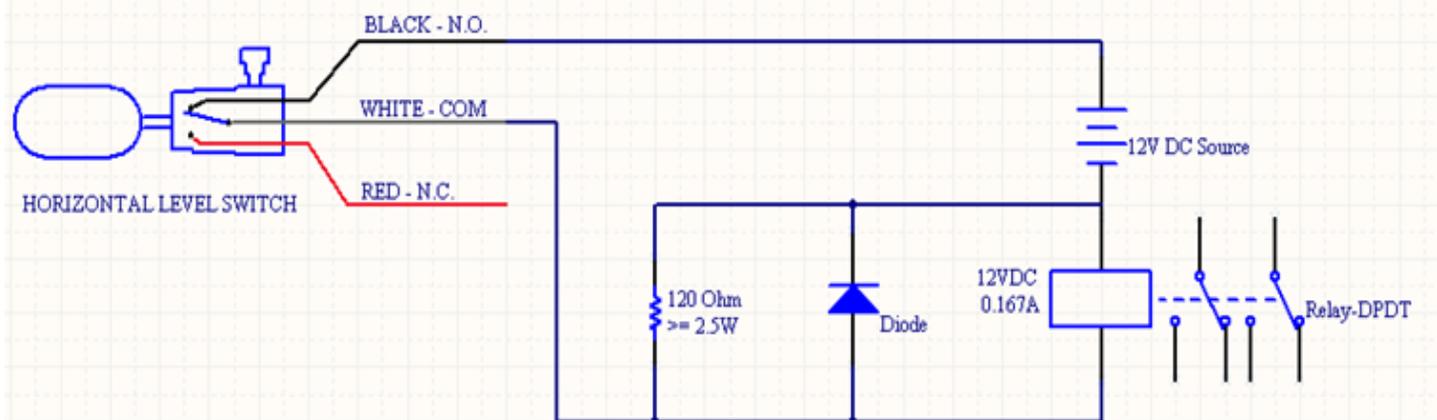
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An Application Example - Driving A Relay



In this example application, the Horizontal Level Switch is controlling a 12V DC DPDT relay. The relay coil is rated at 12VDC, 0.167A (2.0W). That is below the minimum switch rating for the Horizontal level switch. This application might experience failure over time caused by oxidation of the contacts.

An easy solution for this application is to add a parallel resistance to the relay – increasing the overall switching power of the circuit.



In this circuit, the relay is still only consuming 2W of power. However, the parallel resistor is drawing an additional 100mA ($12V / 120 \text{ Ohms} = 0.10 \text{ A}$) and consuming an additional 1.2 W of power [$(12V)^2 / 120 \text{ Ohms} = 1.2W$]. It is good practice to use a safety factor of at least 2.0 when selecting wattage of resistors.

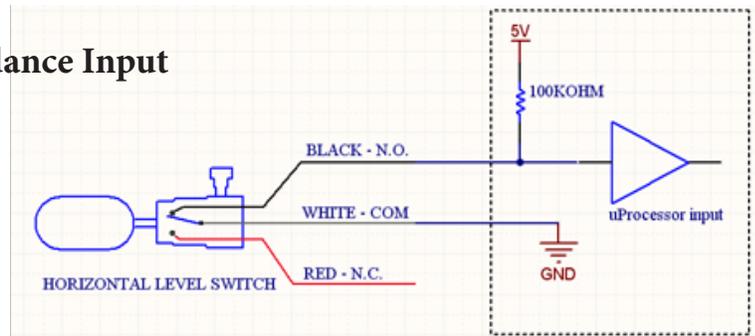
Since the resistor normally consumes 1.2 W of power, it should be selected with a power rating of greater than 2.4W. Total power consumption of the switched load is now 3.2W.



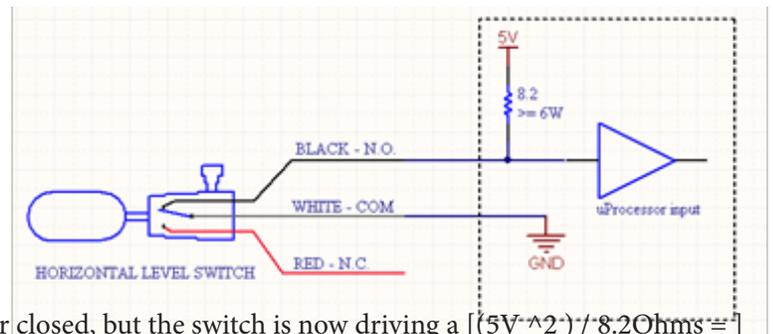
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Application Example - Driving A High Impedance Input

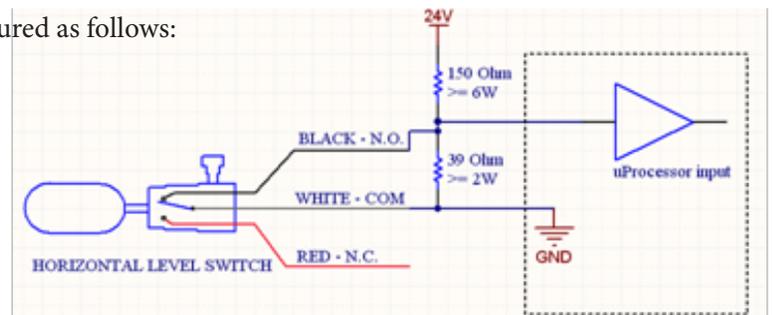


In this circuit, the horizontal switch is being read by a microprocessor. The input buffer is pulled high with a 100KOhm resistor and the input buffer itself has a very high impedance input. When the switch is closed, the uProcessor should read a high input near 5V. When the switch is closed, the user would expect the input to be very low – close to 0V. However, the closed contacts of the switch only see $(5V / 100K \text{ Ohm} =) 50\mu\text{A}$ of current. The resistor only consumes $[(5V \wedge 2) / 100K \text{ Ohm} =] 0.25\text{mW}$ of power. The tungsten contacts in the level switch can easily begin to build oxidation under these conditions causing the switch contact resistance to dramatically increase. If there is sufficient current available from the 5V source, this circuit could be fixed by replacing the 100K pull-up with a low value power resistor....



In this circuit, the uProcessor still reads 5V for open, 0V for closed, but the switch is now driving a $[(5V \wedge 2) / 8.2\text{Ohms} =] 3.0\text{W}$ load. Current through the resistor is now 0.61A.

If a higher voltage is available, the circuit could be reconfigured as follows:



The above circuit reads 4.95V for closed contacts and the switch is driving a 3.8W load. For open contacts, the uProcessor reads near 0.0V and the resistor divider power consumption is 3.0W.