

How-to Guide

Use an Open Collector Output

All the latest Gill liquid level sensors have an in-built secondary function which operates as a high or low level switch (or both when programmed appropriately). This is implemented using an electronic switch known as an 'open collector'.

So what is this and how can it be used?

Essentially, the level sensor has an on-board electronic switch (MOSFET). This simulates a switch and can be thought of as a set of relay contacts. The switch can be set-up to open or close at a given liquid level by using the GS Level configuration tool, available for download from our website gillsc.com/support.

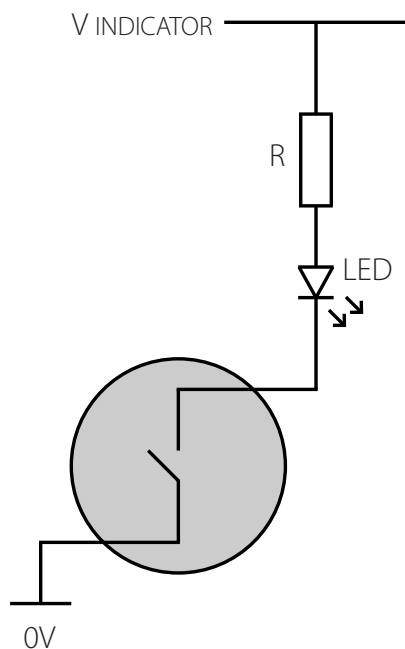
When combined with other components, the Open Collector Output can be used to drive LEDs, indicators, small pumps or relays (to operate larger pumps). Alternatively, the switch can drive an input to a controller such as a PLC or a computer board such as a Raspberry PI or an Arduino (please see instructions of the PLC/computer on how to set the input measurement).

There are a few restrictions using the electronic switch:

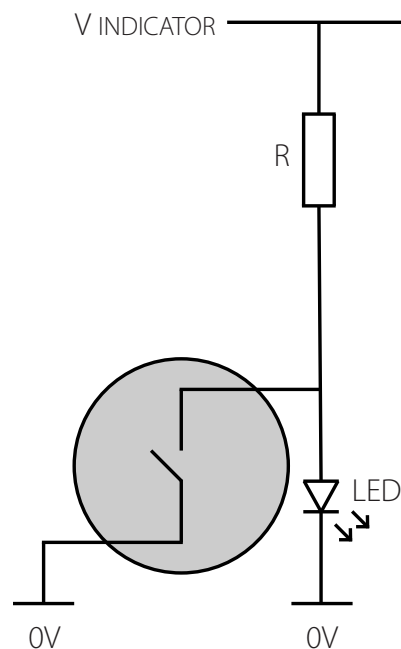
- One side of the switch is connected to the sensor ground wire.
- There is a maximum voltage of 50V and a maximum current of 0.5A.

Uses:

Driving an LED indicator or opto-isolator.



LED illuminates when switch is closed



LED extinguishes when switch is closed

How Do I Choose the Right Value for 'R'?

The Resistor 'R' sets the current in the circuit. This needs to be sufficient to light the LED but not to exceed the electronic switch maximum. In addition, the resistor must not exceed its own power rating.

So three issues to be aware of, let's look at each.

Resistor Value – R

$$R = (V_{\text{INDICATOR}} - V_{\text{LED}}) / I_{\text{LED}}$$

V_{LED} = Voltage drop across the LED

I_{LED} = Current through LED

$V_{\text{INDICATOR}}$ = Supply Voltage

Example Calculation

V_{LED} = typically 2.0V for Red LED

I_{LED} = 20mA (0.02A)

$V_{\text{INDICATOR}}$ = 6V 12V 24V

R = 200Ω 500Ω 1100Ω

Preferred Value 220Ω 560Ω 1.2KΩ

Power Rating 73mW 179mW 403mW

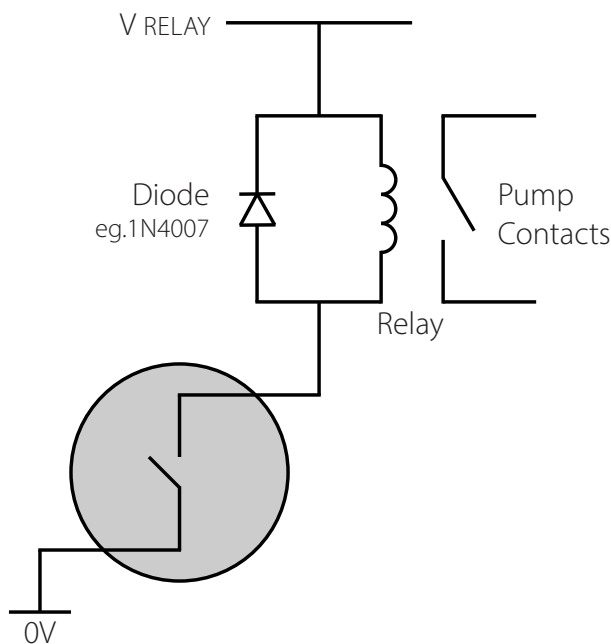
Preferred Value 100mW 250mW 500mW

Resistor Power Rating

$$W = (V_{\text{INDICATOR}} - V_{\text{LED}})^2 / R$$

For example, if the **maximum switch voltage** is 24V, the **maximum switch current** is 0.02A, well within the device capability.

The same circuit arrangement can also be used to switch a relay. This is a useful method of increasing the electronic switch capability.



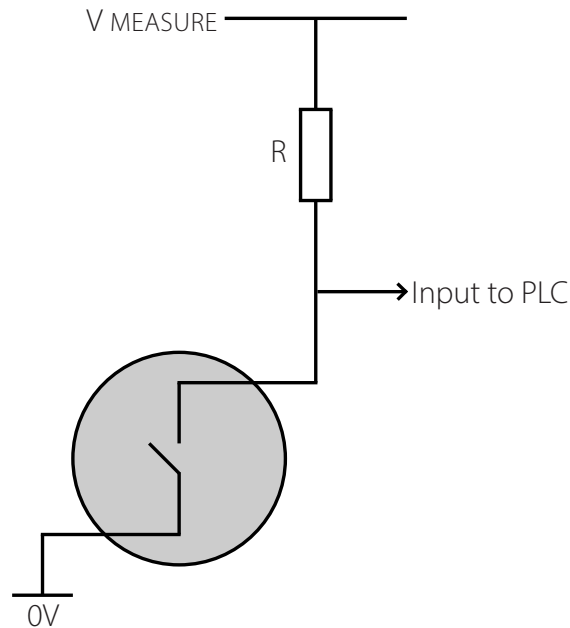
The diode **MUST** be fitted across the relay coil as shown to prevent potentially high voltages being generated by the relay coil when switched off - known as 'back EMF'.

Without the diode, the voltage can rise to several hundreds of volts and destroy the electronic switch.

In this configuration the relay is energised when the switch is closed, supplying power to an external pump. Using the electronic switch in this way would allow a large single or three phase pump to reduce the liquid level in a tank from a maximum to minimum level – see programming example later in this guide.

Note, the relay coil is selected based on V_{RELAY} and the pull-in current, i.e. how much current the coil draws when energised. This must be not exceed the electronic switch maximum operating limits (50V/0.5A). The contacts must also be rated for the pump characteristics too, i.e. the voltage and current requirements including any power on surge current.

To monitor the switch using a PLC or computer board, the switch needs to change a voltage level that the PLC can measure. The same basic circuitry is used.



V MEASURE is selected to match the PLC measurement requirements but must not exceed the electronic switch maximum ratings. The input channel on the PLC may be an 'analogue' or 'digital' line depending upon V MEASURE. The value for R is arbitrary, a typical range being 1K Ω to 10K Ω .

Switch Condition	Input to PLC
OFF	V MEASURE
ON	0V

To prevent rapid switching of the electronic switch at the set level point, i.e. oscillations caused as the fluid level is very close to the switching point, an amount of 'hysteresis' can be programmed, i.e. 10%. This would mean that once the switch had activated, the level would have to fall by 10% before the switch would turn off.

This feature may be used to provide high and low level switching points for use with a pump installation. See the pump control programming example later in this guide.

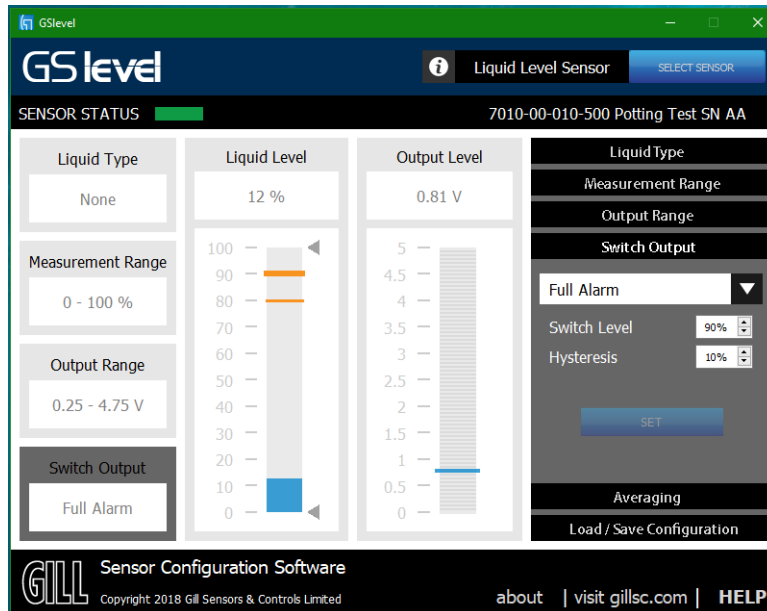
Using GS Level to Programme the Open Collector Output of the Sensor

The following information applies to our 7010 / 4223 / 7014 sensors.

The GS Level application software is used to programme the liquid level sensors many internal parameters. (please see the GS Level User Guide for instructions on how to access, install, interface to the sensor and use the software).

The programming example described here demonstrates how to set the point at which the open collector output activates, the setting of the hysteresis and how to use the feature for high and low level sensing which would be suitable for tank level pump control.

Alarm Setting - Full Alarm



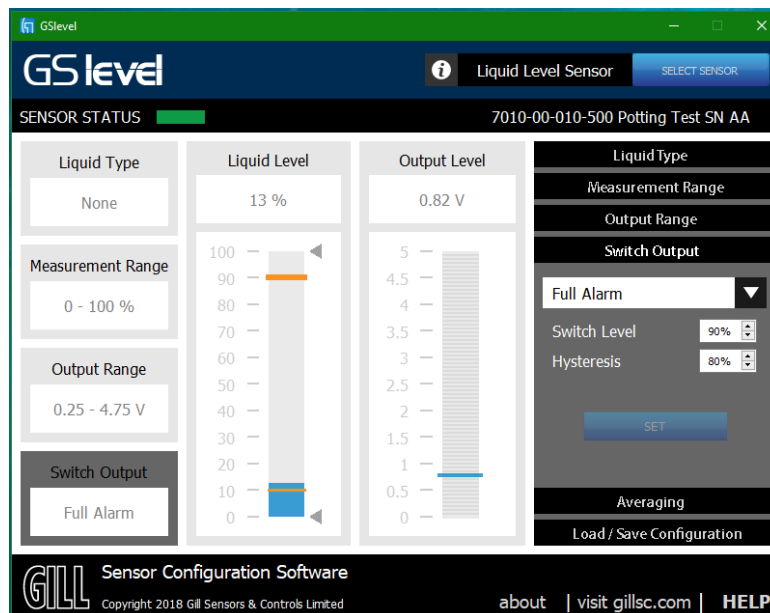
This example shows the Switch Output set to a FULL ALARM with a Switch Level of 90%. When the liquid level reaches 90% the open collector switch will activate.

To prevent the level oscillating (ON/OFF), the hysteresis is set to 10% which indicates the level would need to drop to 80% before the open collector switch turns off.

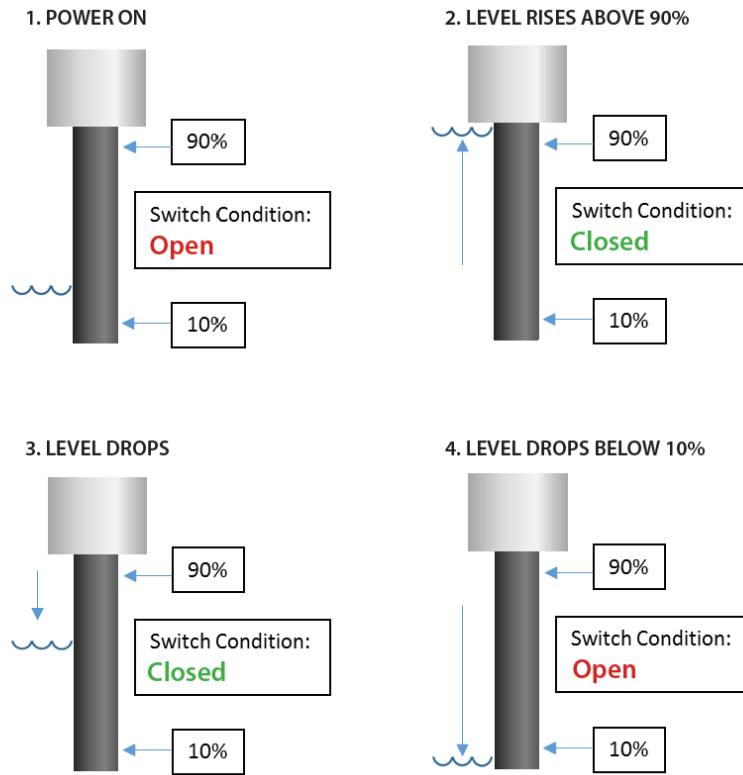
The hysteresis value will depend upon a number of factors:

- Fluid turbulence – if the fluid is moving or sloshing then a higher setting will be required, i.e. 10% to 20%.
- Fluid viscosity – high viscosity fluids do not change level quickly, making a lower value acceptable, i.e. 2% to 5%.

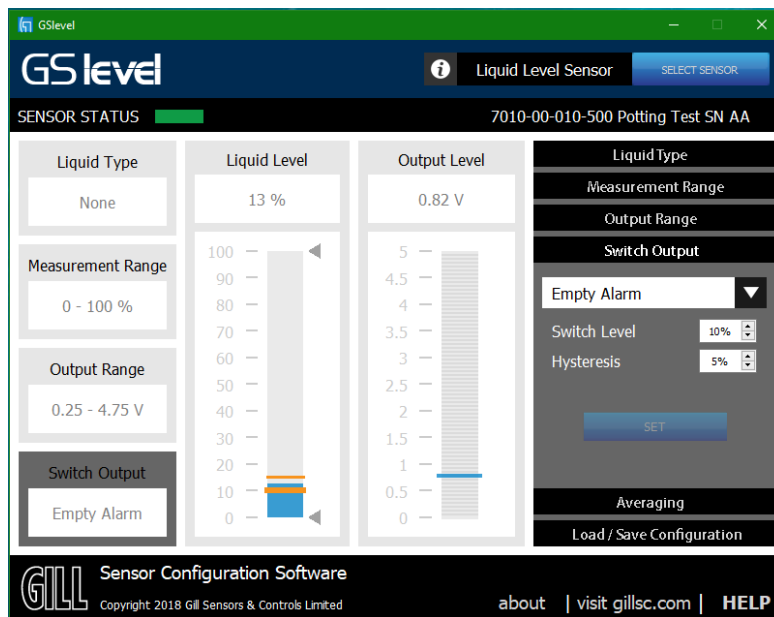
Pump Control



In this example, the switch point is set to 90% with 80% hysteresis. The open collector switch will activate at 90% and turn off again at 10%. In this set-up, the sensor will provide signals to start and stop a pump in a closed loop operation to empty a tank.



Alarm Setting - Empty Alarm



This example shows the Switch Output set to an EMPTY ALARM with a switch level of 10%. When the liquid level reaches 10% the open collector switch will activate. This may operate a pump or a valve to add fluid to the tank.

To prevent the level oscillating (ON/OFF) the hysteresis is set to 5%, meaning the level would need to rise to 15% before the open collector switch would turn off. The hysteresis may be increased to raise the switch-off point as required.