Using Solid State Sensors for Inputs for Sentinel B-21/I-21/F-21Instruments

APPLICATION BULLETIN #109A **June 6, 2002**

The Sentinel I-21/B-21/F-21 instruments offer several discrete inputs and outputs to meet a variety of control requirements. This bulletin outlines some of the typical problems users have encountered when using these I/O and some suggested solutions.

Discussion

The Sentinel I-21/B-21/F-21 instruments utilize Gordos brand 8-IAC5 digital input modules (50K ohm impedance) to convert the 120 vac signal switched by your sensor (or PLC) to a 5 vdc signal for the microprocessor. If you use a sensor that makes a mechanical closure such as a reed switch or relay, you should have no problems. Just refer to the user manual for hookup instructions.

A more interesting problem occurs when you use a solid-state sensor. These devices have a "leakage" current. This is current that leaks through them even when the sensor "contacts" are open. The devices also have a minimum "load" current. This is the minimum current required to keep the device "on" when it is supposed to be on. If the leakage current exceeds 1 mA or if this leakage current causes the voltage at the Sentinel input terminal to exceed 40 vac, the Gordos modules can stay "stuck" in the "on" position. (Note: more technically, the maximum drop-out current for the Gordos device is 1 mA). It is fairly easy to see if this condition is occurring. Using a voltmeter or other high impedance measurement device such as an oscilloscope (but *not* a bulb voltage checker), measure the voltage at the desired Sentinel input terminal. If it exceeds 40 vac (it will probably be 120 vac) when the sensor is off (open), the sensor's leakage current exceeds 1 mA and the input will <u>not</u> respond to changes in the sensor state. You will need to implement one of the fixes listed below.

For sensors with a small leakage current (< 3 mA), a pull down resistor tied between the input and L2 (TB4) can be sized to drain the excess leakage current. Other design considerations include resistor temperature and heat dissipation, sensor minimum load current and continuous load current, and voltage drops, etc.

Cincinnati Test Systems, Inc.
Member of *TASI* - A Total Automated Solutions Inc. Company
5555 Dry Fork Road, Village of Cleves, OH 45002 • Tel. 513-367-6699 • Fax 513-367-5426
Website: www.cincinnati-test.com • E-mail: sales@cincinnati-test.com

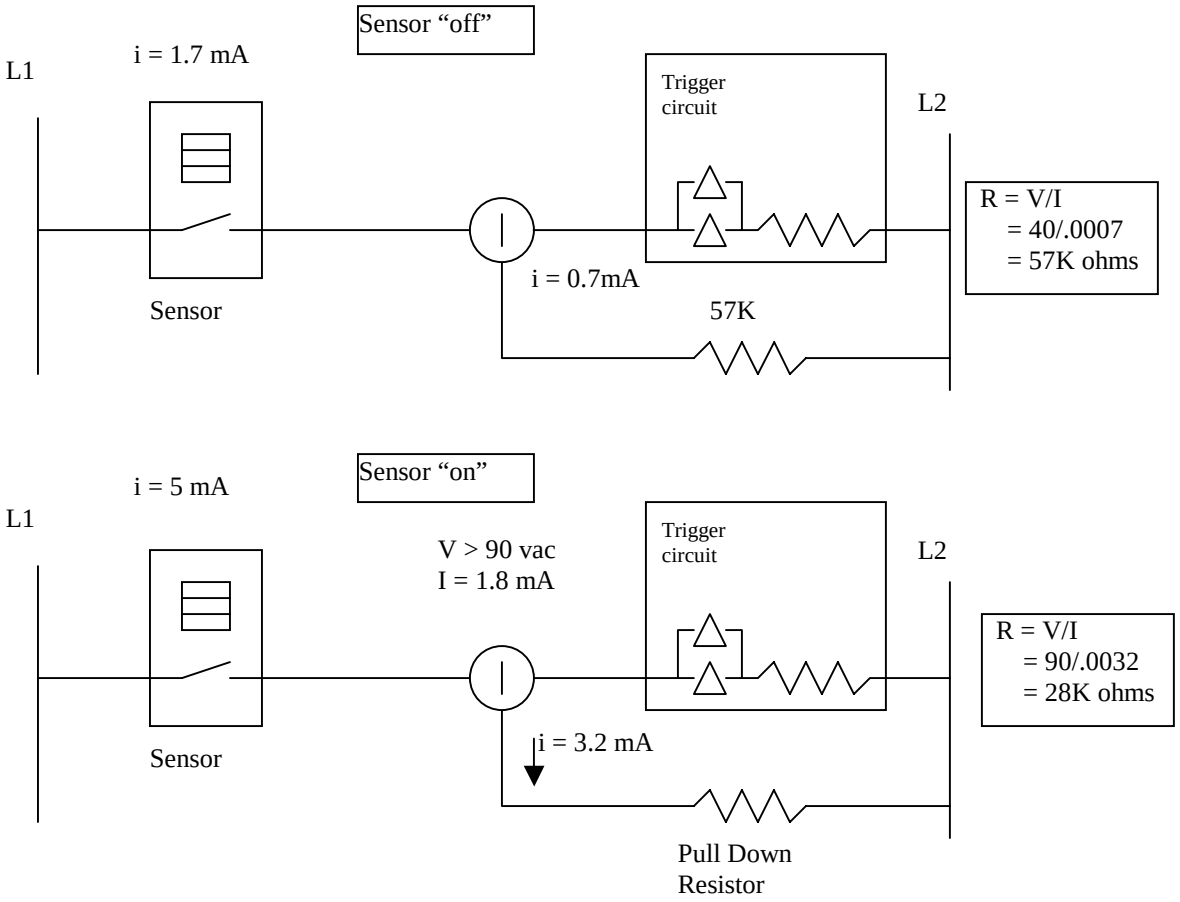
As an example we will use a fictitious sensor with the following specifications:

- Continuous Load Current < 500 mA
- Leakage Current < 1.7 mA
- Minimum Load Current > 5 mA
- Inrush Current < 8 A

The Gordos inputs have the following specifications:

- Minimum Voltage > 90 vac
- Resistance 50K $\pm$ 10% at 25^{o} C
- Drop Out Current < 1 mA
- Voltage for No Output < 40 vac

An equivalent circuit diagram is shown:



Note that this particular sensor has a "minimum load current" requirement, so we are obligated to use as 28K or smaller resistor. To be safe, we would choose a 20K resistor, which would have to dissipate $(120)^2/20{,}000 = 0.72$ Watts. A 1 Watt resistor will get very hot dissipating this much heat. You need to plan accordingly.

When leakage currents exceed 3 mA, a useful (although more expensive) solution is to use an incandescent light bulb in place of the pull down resistor. The bulbs used in the I21 have an "off" resistance of 590 ohms and pull 25 mA when "on". They also can easily dissipate their heat.

With either approach, some experimentation may be necessary. Many solid-state devices vary significantly from their documented specifications.

leakage.doc
B.B./G.G.
6Ju02