Application Note AN2016-01

Overcome Wetting Voltage and Current Limitations With an External Wetting Power Supply

Martin Lee

INTRODUCTION

All digital circuits include three elements: a contact, an input, and a power source to drive current through the contact into the input. This application note examines the three most common configurations of these elements and relates them to their common names (wetted inputs, wetted outputs, and external wetting supplies).

The circuit in Figure 1 depicts the simplest arrangement of a battery, a dry contact, and a digital input. The battery in this circuit is an external wetting power supply. Neither the contact nor the digital input is supplying power, so they are referred to as current sinks.

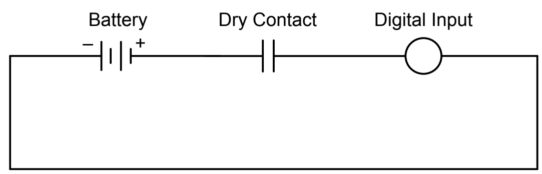

Figure 1 Simple Circuit

PROBLEM

Wetted digital inputs have a number of unavoidable limitations. The digital input module supply and communications bus limit the voltage options and current available for wetting. The bus-supplied wetting voltage is often in proprietary cables that are not field serviceable. Common voltage sources and returns prevent channel-to-channel isolation. Controller-supplied voltage sources include the risk of a controller brownout in the event of a field wiring fault.

SEL SOLUTION

SEL devices use external wetting power supplies, which are more flexible than internal supplies. The isolation possibilities of external wetting power supplies allow for separate power supplies to connect to the same module. Isolated power supplies prevent electrical events on the digital input lines from affecting the controller. External wetting power supplies provide custom solutions to fit each installation.

Wetted inputs indicate that the power source is integrated into the digital input (i.e., the signal line from the input supplies voltage potential to a dry contact). There are a couple of ways to configure a wetted (also often called sourcing) digital input, as shown in Figure 2 and Figure 3.

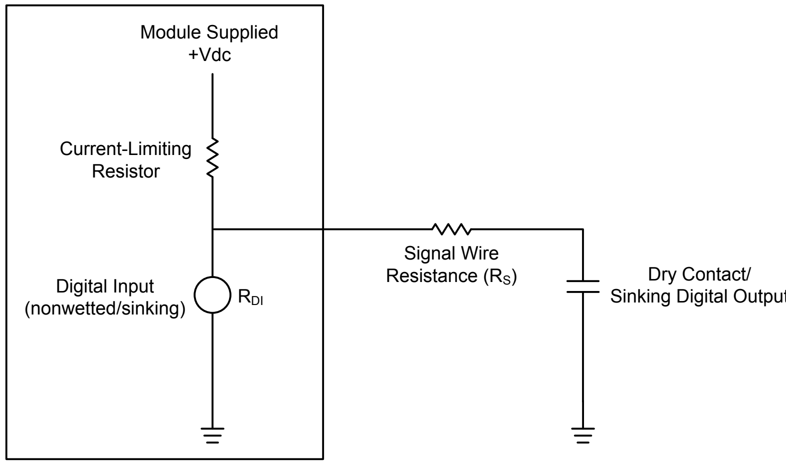

Figure 2 Parallel-Connected Digital Input

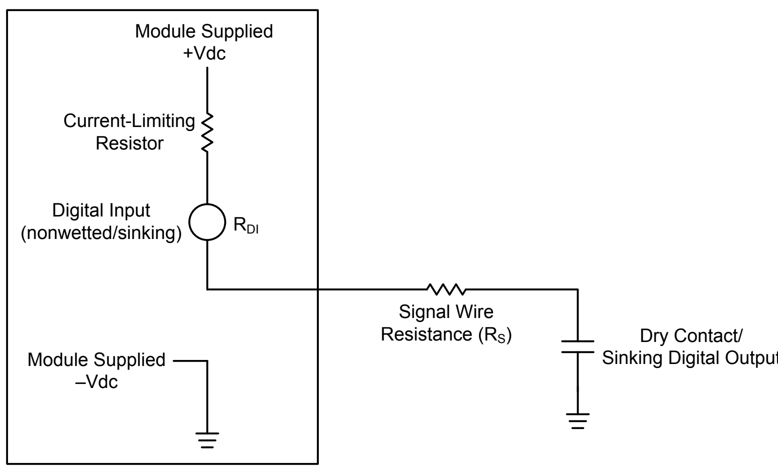

Figure 3 Series-Connected Digital Input

A digital output in parallel with the sensing element (shown in Figure 2) is called a pull-down contact. The current-limiting resistor pulls the voltage up across the sensing element of the digital input. In this configuration, current flowing through the sensing element is a logical 0 to the controller. When the contact closes, the current flows through it instead of the sensing element. This is a logical 1 to the controller.

The signal wire resistance (R_S) shown in Figure 2 and Figure 3 is the accumulated resistance from all elements in the signal path. This resistance comes from the inherent resistance of the signal wire, wire terminations, and contact wear. If this resistance is higher than the digital input impedance (R_{DI}), the digital input may not register a contact closure. Likewise, if the module-supplied voltage source sags or browns out, the controller may interpret that as a logical 1.

The amount of allowable signal wire resistance is determined by the sensitivity of the digital input element and the amount of current the element consumes. According to Ohm’s law, the higher the current flow, the higher the voltage drop across the series resistance. If the supply voltage minus the series voltage drop is lower than the pickup voltage of the digital input, the digital input does not assert.

A wetted digital output is a circuit in which the monitored contact supplies current to the monitoring device input, as shown in Figure 4.

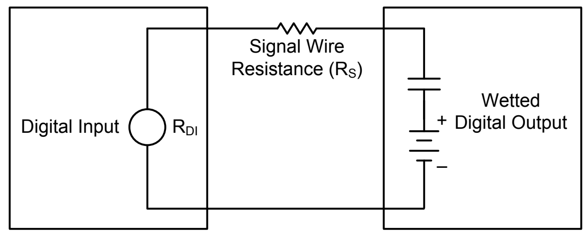

Figure 4 Wetted Digital Output

An externally wetted circuit is one in which neither the input nor the output supply current. The requisite current comes from an external power supply, as shown in Figure 5.

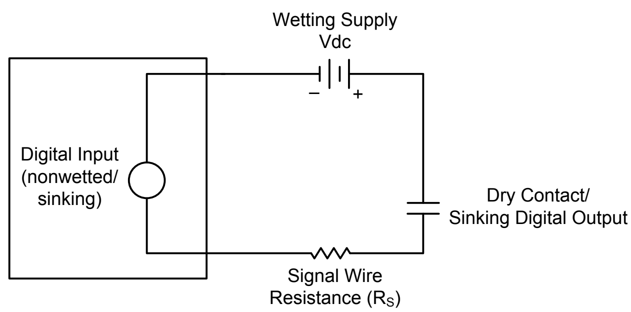

Figure 5 Externally Wetted Circuit

Digital inputs with a common return are wired just like wetted digital inputs, even when using an external wetting power supply. The only difference is that the return side of the digital outputs (shown in Figure 6) connects to the common side of the power supply rather than the common side of the digital inputs.

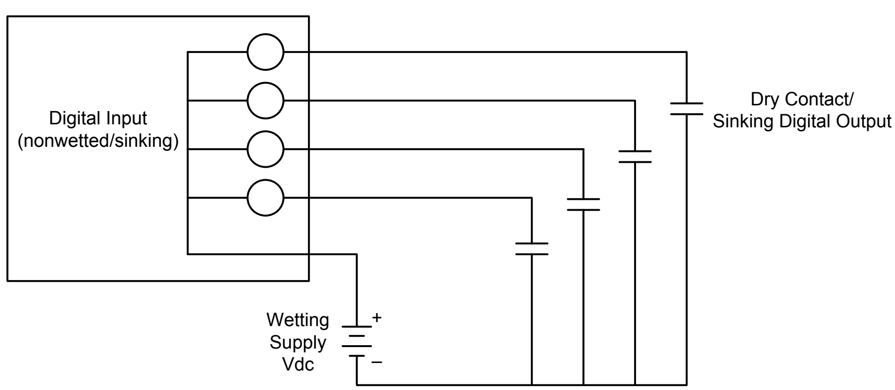

Figure 6 Externally Wetted Nonisolated Circuit

Wetted and nonwetted digital inputs have near identical wiring complexity. Moving the power supply inside the module, as shown with the internally wetted digital input in Figure 7, reduces the wiring by only one jumper wire. The wiring topology is likewise identical if the scope of the nonwetted digital input includes the wetting power supply.

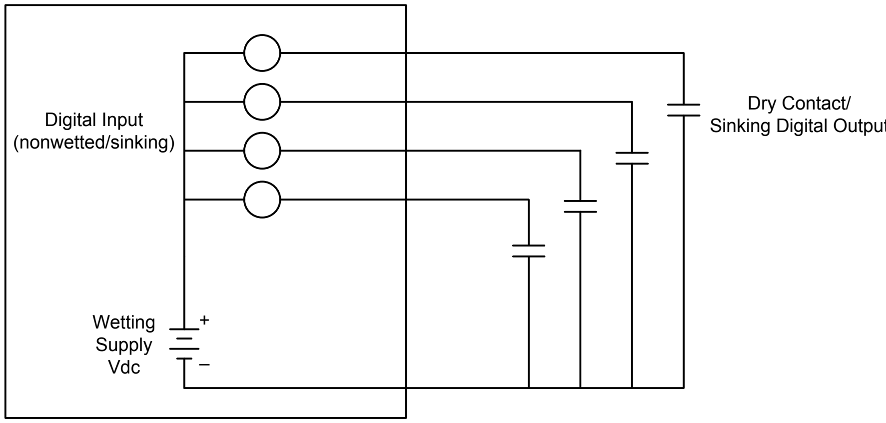

Figure 7 Internally Wetted Nonisolated Circuit

Conclusion

External wetting power supplies are the most flexible and robust solution for monitoring contacts. The isolation possibilities of external wetting power supplies allow for separate power supplies to connect to the same module and prevent ground loops. Isolation increases reliability by preventing minor field wiring faults from interrupting the controller power supply.

© 2016 by Schweitzer Engineering Laboratories, Inc.
All rights reserved.

LAN2016-01

SCHWEITZER ENGINEERING LABORATORIES, INC.
2350 NE Hopkins Court • Pullman, WA 99163-5603 USA
Tel: +1.509.332.1890 • Fax: +1.509.332.7990
www.selinc.com • info@selinc.com