

## Connecting a 4-20 mA Sensor

### Introduction

A wide variety of sensors available today have as their output a standard 4-20mA current signal. These type of sensors include pressure transducers, temperature transmitters, level meters, flow meters and many others. The following document covers the connection of a two, three, or four wire 4-20mA sensor to a Data Dolphin precision input.

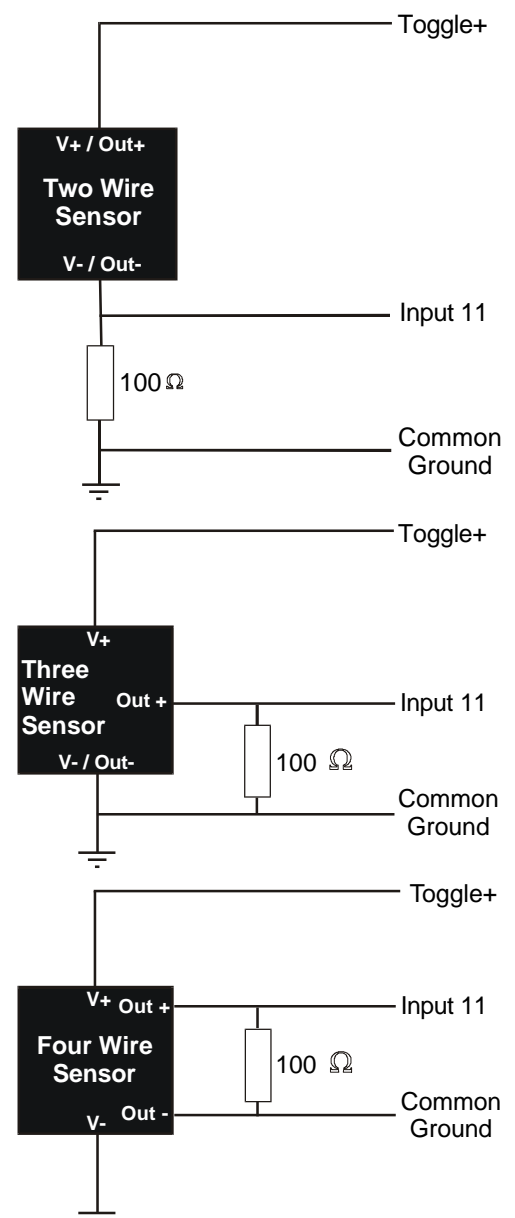
### How do I connect a 4-20mA sensor to a Data Dolphin input?

Since the Data Dolphin datalogger reads and records voltages (and not current) on its inputs, the output of a current signal device must be converted to a voltage. This is done with a precision 100Ω shunt resistor. A 100Ω resistor will, with a 4-20mA current source, produce voltages in the 0.4V (4mA) to 2.0V (20mA) range. As an option, a 125Ω precision resistor can be used to produce voltages in the 0.5V (4mA) to 2.5V (20mA) range. However, as 2.5V is the top of the Dolphin input's readable scale, currents in excess 20mA will simply be read on the input as a full scale voltage when using a 125Ω shunt resistor.

4-20mA sensing devices are available in two, three or four wire configurations. In the two-wire configuration, one wire is connected to the "Toggle+" on the Data Dolphin and the other wire to a precision input. The shunt resistor is connected between the input and analog common ground. The Data Dolphin will provide power (12V<sub>DC</sub>) to the "Toggle+" terminal just prior to taking a reading on its inputs to activate the sensor.

With a three-wire sensor, one wire is connected to a power source or the Dolphin "Toggle+" terminal, one wire is connected to the precision input on the Data Dolphin and the third wire is connected to ground. Again, the shunt resistor is connected between the Dolphin's precision input and ground to create the voltage for the Data Dolphin's input.

A four-wire sensor will have two of the wires connected to a power source or the Dolphin's "Toggle+" and ground. The other two wires will supply the 4-20 mA signal. The positive current signal wire will connect the Data Dolphin's precision input, and the negative current signal wire will connect to analog common ground. As above, the shunt resistor is connected between the Dolphin's precision input and ground.



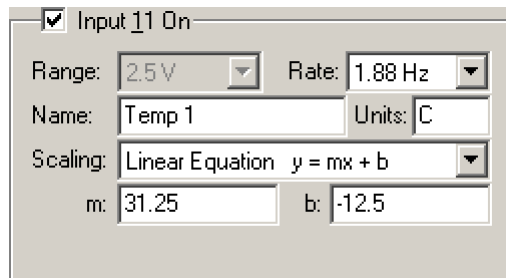
## A bit about grounding

There are a few small differences with respect to the analog common ground terminal and the power source ground terminal next to the “Toggle +” output. If high precision is desired from the 4-20mA sensing device, and some noise is tolerable on the other input channels, use the analog common ground terminal for grounding. On the other hand, if high precision is desired on all the other channels and some imprecision (introduced by the Data Dolphin circuitry) is tolerable on the 4-20mA channel, then it is suggested that you use the power source ground. In some cases, additional circuitry may be required. If you are uncertain about the grounding requirements for your 4-20mA sensing device, contact a technician at Optimum Instruments for more information.

## How do I configure a Data Dolphin Input?

Once you have ensured that the 4-20 mA sensor is wired correctly to the Data Dolphin, you will want to enable and configure the input that the sensor is connected to by using the Data Dolphin software. As an example, precision input 11 on the Data Dolphin has been correctly configured in the following procedure to convert the current output from a temperature sensor (0 - 50°C) into a temperature measurement, in degrees centigrade. Follow the example in the following procedure to configure the Data Dolphin’s input for your 4-20 mA sensor.

1. Power-up the Data Dolphin and the sensor. Connect your Data Dolphin to the serial port of your computer, and load the Data Dolphin software on your computer, and establish a direct, on-site connection to the Data Dolphin (see “Data Dolphin Software manual”).
2. Open the Dolphin Setup window by clicking the Setup button on the Data Dolphin software’s toolbar.
3. Click on the “Precision Inputs” tab to view the Precision Inputs configuration page. Load the precision input settings from the Data Dolphin into the Data Dolphin software by clicking on the “Load from Dolphin” button. The Data Dolphin precision input settings should load into the controls of the inputs sections on this page. If the settings did not load (the Status bar in the Data Dolphin software reads “No response from data logger”) check your cable and power connections and repeat this step
4. Now, determine which input you have connected the sensor to. Each section on this page contains the configuration controls for a single precision input eg. The controls in the section marked “Input 11” configure the Data Dolphin’s precision input 11, marked “In + Alg 11” on its screw terminal. Note that the settings for inputs 15-18 are displayed by clicking on the “Show Inputs 15-18” button. Once you have determined which input you have connected your sensor to, ensure that the input is enabled (the “On” checkbox has a check), and properly named (i.e. “Temp 1”). The voltage range should be 2.5V, the “Rate” combo box should have 1.88Hz selected, and the type of scaling used should be linear equation.



Input 11 On

Range: 2.5V Rate: 1.88 Hz

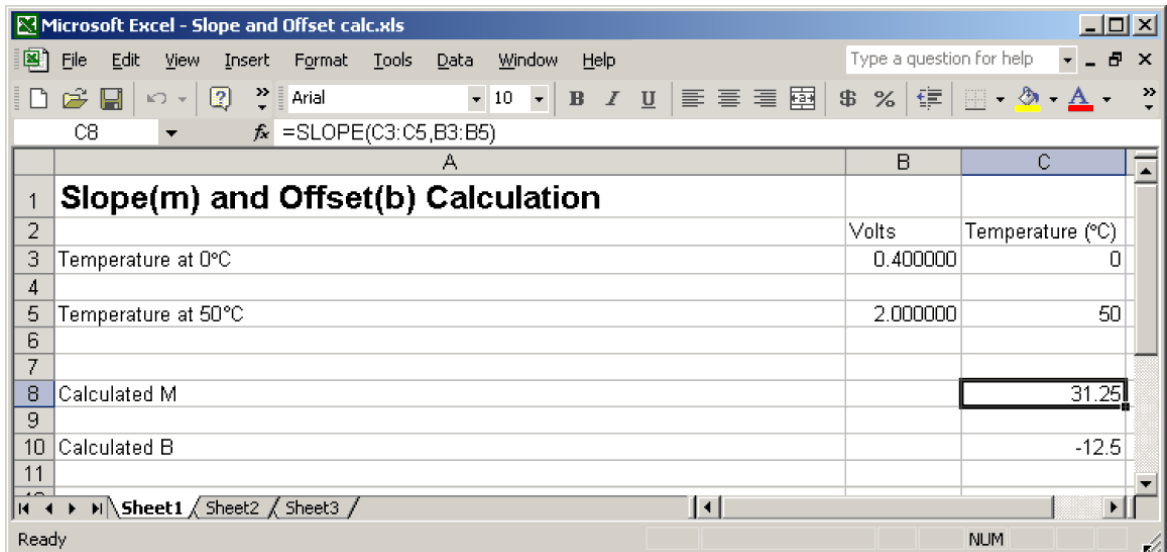
Name: Temp 1 Units: C

Scaling: Linear Equation  $y = mx + b$

m: 31.25 b: -12.5

5. To calculate the final m and b values, open a spreadsheet in Microsoft Excel and enter the depth and the corresponding input voltages into two separate columns. An example spreadsheet is

shown in below. These entries assume that the voltage read at the input, with a 100Ω resistor and the sensor at 0°C, is 0.4V. Also assumed is that when full scale temperature (50°C) is applied to the sensor, it will output 20 mA, which will be read at the input as 2.0V



	A	B	C
1	<b>Slope(m) and Offset(b) Calculation</b>		
2		Volts	Temperature (°C)
3	Temperature at 0°C	0.400000	0
4			
5	Temperature at 50°C	2.000000	50
6			
7			
8	Calculated M		31.25
9			
10	Calculated B		-12.5
11			

- Click on the cell where you want the slope value to appear, and type the following into the formula bar:

**=SLOPE(<range of depth values>,<range of voltage values>)**

The format for the range of depth and voltage values is in the spreadsheet formula format, such as C3:C5, where C3 is the first cell in the range, and C5 is the last. Hit return, and the value that appears in this cell is the final slope (m) value.

- Finally, click on the cell where you want the offset value to appear, and enter the following formula into the formula bar:

**=INTERCEPT(<range of depth values>,<range of voltage values>)+ <distance from depth sensor to the invert of pipe>**

Hit the return button to calculate the offset (b).

- Enter the slope (m) and offset (b) values into the textboxes as shown in step 4. Click the apply button to program the input's settings into the Data Dolphin.
- The Data Dolphin input is now correctly programmed for the 4-20 mA sensor. If possible, confirm that the sensor is working correctly by exposing it to known conditions, and verifying its reading in the Data Dolphin Status window. In our example, this would correspond to exposing our temperature sensor to a known temperature, and verifying that this temperature is displayed in the Data Dolphin Status window.