Micro Control Systems

APPLICATION NOTE
APP-066

4-20mA Sensor Connection to MCS-Controllers

Revision History

Date	Author	Description
02/17/11	Weston Klebs	Created application note
01/23/15	DEW	Correct to wiring diagram
01-28-15	DEW	Make edits to wording
02-03-15	DEW	Add MCS-Connect setup

General Concept

To properly read a sensor input that outputs 4-20mA.

In this document we will consider how to convert amps to volts, how to wire the sensor, and also an example to view when setting up this type of sensor yourself.

Amperage to Voltage Calculation

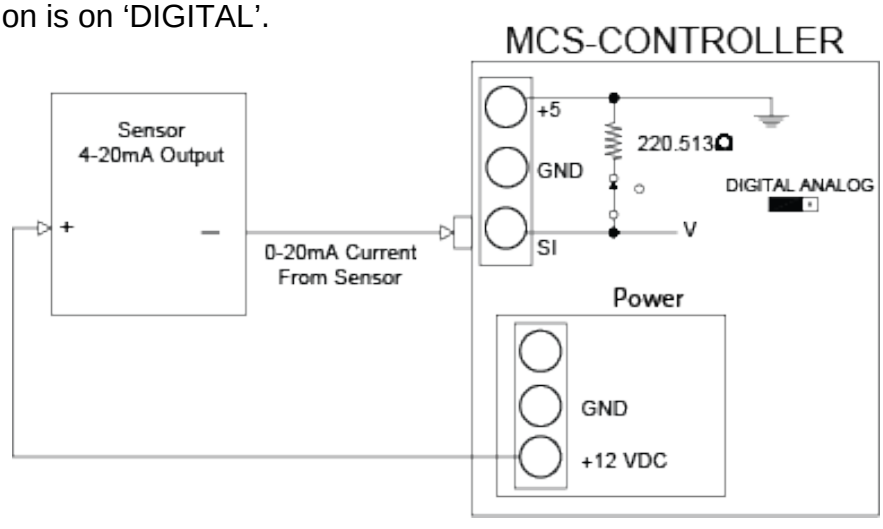
Current (amperage), Resistance (ohms), and Voltage are all related through the formula: *Voltage = Amperage × Ohms* Therefore, if any two of the values are known, the third can be easily calculated. The MCS-Controller's sensor inputs using a 0-5 volt range. To calculate the voltage, take the amp reading given by the sensor and multiply it by the resistance, which is typical 220.513 ohms (Ω) when the sensor input type jumper is set to 'DIGITAL'. With that knowledge we can make the conversion chart:

CONVERSION CHART

milliAmp (Amps)	Ohms (Ω)	Voltage Output
0 mA (0.000)	220.513 Ω	0.000 vdc
1 mA (0.001)	220.513 Ω	0.221 vdc
2 mA (0.002)	220.513 Ω	0.441 vdc
3 mA (0.003)	220.513 Ω	0.662 vdc
4 mA (0.004)	220.513 Ω	0.882 vdc
5 mA (0.005)	220.513 Ω	1.103 vdc
6 mA (0.006)	220.513 Ω	1.323 vdc
7 mA (0.007)	220.513 Ω	1.544 vdc
8 mA (0.008)	220.513 Ω	1.764 vdc
9 mA (0.009)	220.513 Ω	1.985 vdc
10 mA (0.010)	220.513 Ω	2.205 vdc
11 mA (0.011)	220.513 Ω	2.426 vdc
12 mA (0.012)	220.513 Ω	2.646 vdc
13 mA (0.013)	220.513 Ω	2.867 vdc
14 mA (0.014)	220.513 Ω	3.087 vdc
15 mA (0.015)	220.513 Ω	3.308 vdc
16 mA (0.016)	220.513 Ω	3.528 vdc
17 mA (0.017)	220.513 Ω	3.749 vdc
18 mA (0.018)	220.513 Ω	3.969 vdc
19 mA (0.019)	220.513 Ω	4.190 vdc
20 mA (0.000)	220.513 Ω	4.410 vdc

Typically Sensor Wiring

The correct wiring for a 4-20mA sensor is shown in the diagram below. Make sure the jumper position is on 'DIGITAL'.

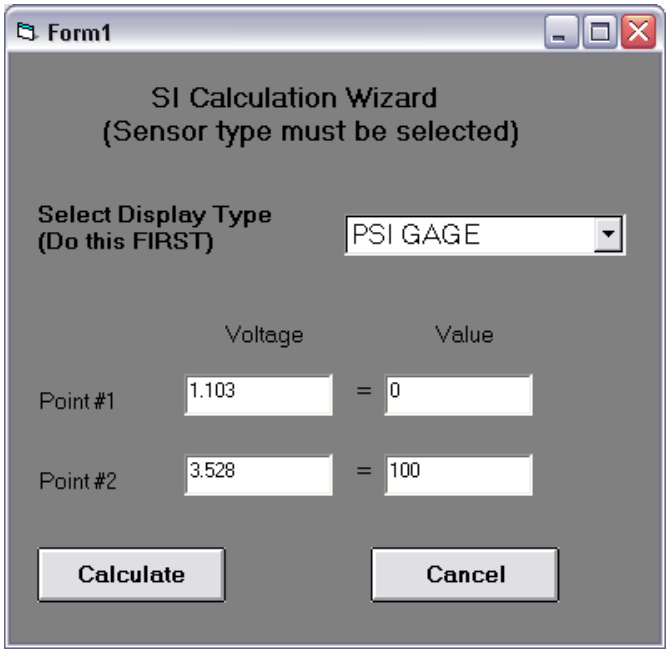


Example MCS-MAGNUM Configuration Setup

The following is an example of a typical 4-20mA sensor setup. Let us assume that the manufacturer's specifications of the sensor say that at a reading of 0 psi the sensor output will be 5mA and at 100 psi the output will be 16mA. Using these values we will be able to calculate the voltages needed to configure the Magnum based on the chart and equation above. At 5mA the voltage will be 1.103 vdc, and at 16mA the voltage will be 3.528 vdc.
In **MCS-Config**, select 'User Defined' as the Display Type for this sensor.

	#	Name (1 to 10 char)	Display Type
▶	1-15	PSI SENSOR	User Defined

When User Defined is selected, a window will pop up in which you can input these values to tell the Magnum how to correctly interpret the signals coming from the sensor.



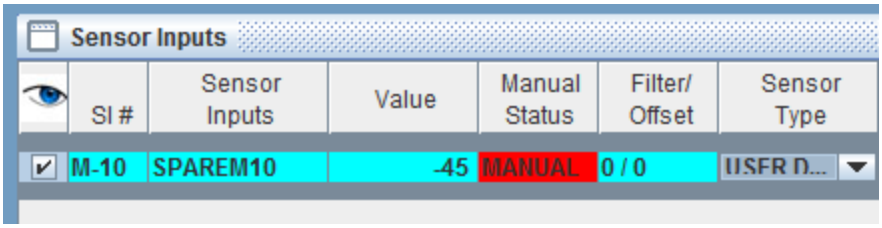
When finished inserting the values in the SI Calculation Wizard, click the Calculate button and the correct calculation will be developed automatically in the Multiplier, Divisor, and Off Set fields.

Multiplier	Divisor	Off Set
100	497.125	-45.48

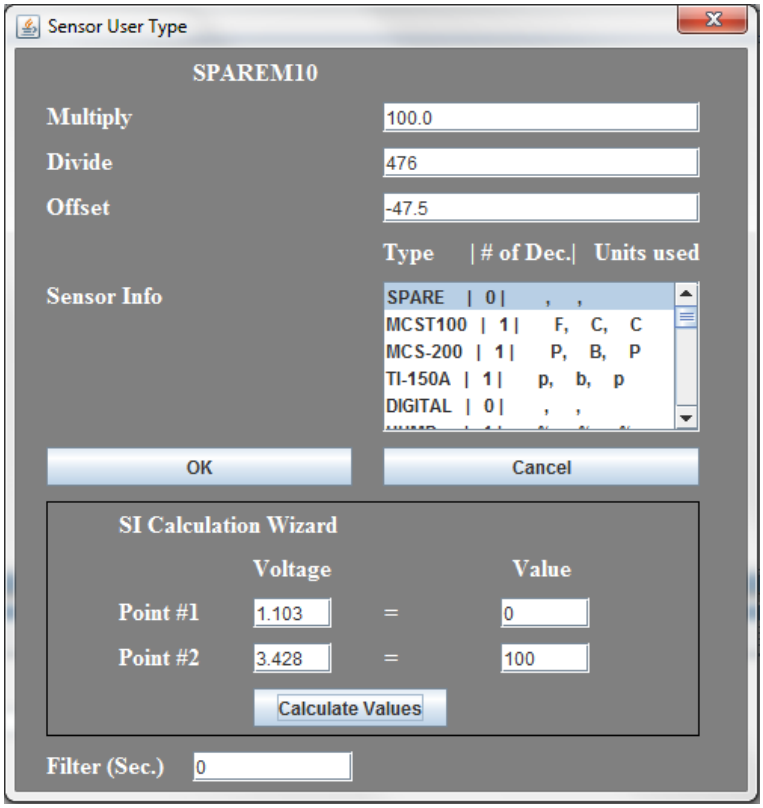
Now the configuration file for a MCS- Magnum has been properly setup and will be able to accurately read the input from the 4-20mA sensor.

Example MCS-CONNECT Setup

In **MCS-CONNECT**, select 'User Defined' as the Display Type for this sensor. When User Defined is selected, a window will pop up in which you can input these values to tell the Magnum how to correctly interpret the signals coming from the sensor.



When finished inserting the values in the SI Calculation Wizard, click the Calculate button and the correct calculation will be developed automatically in the Multiplier, Divisor, and Off Set fields.



Now the configuration file for a MCS-Magnum has been properly setup and will be able to accurately read the input from the 4-20mA sensor.