AND9212/D

Calibrating Smart Passive Sensors

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APPLICATION NOTE

Introduction

ON Semiconductor's Smart Passive Sensors powered by a Magnus®−S integrated circuit (IC) are RFID sensor tags that return a 5-bit Sensor Code which measures the property the tag was designed to sense. Since this is simply a value between 0 and 31, it is not scaled to actual physical units, such as degrees or pounds per square inch (PSI). Furthermore, manufacturing tolerances will introduce small variations from tag to tag, so that the same physical conditions might result in different Sensor Codes from two different tags. These issues can be resolved by using the built-n tag memory to store calibration information.

An Example Calibration Procedure

Suppose we have a tag that was designed to sense pressure and we want the user to receive a result from the reader in units of PSI. To maximize accuracy, we first calibrate the tag by using it to measure pressure under known controlled conditions, and store the results in the tag memory. Then, in normal use, we read back the calibration data as use it to appropriately scale the raw measurement data.

Step 1: Recording and Storing

If the response of the tag is linear, we only need to calibrate at two points: for example, 0 and 30 PSI. The raw output of the tag will be the two Sensor Code values at these conditions. Suppose we measure an average Sensor Code of 4.75 at a known pressure of 0 PSI and 22.375 at 30 PSI. We can store these two values in the tag's non-volatile memory. Magnus−S ICs have 9 user-programmable words of 16-bits each. Since 8 bits is sufficient to store a value between 0 and 31 with increments of 0.125, we can store both average Sensor Codes in a single memory word with adequate precision (Figure 1).

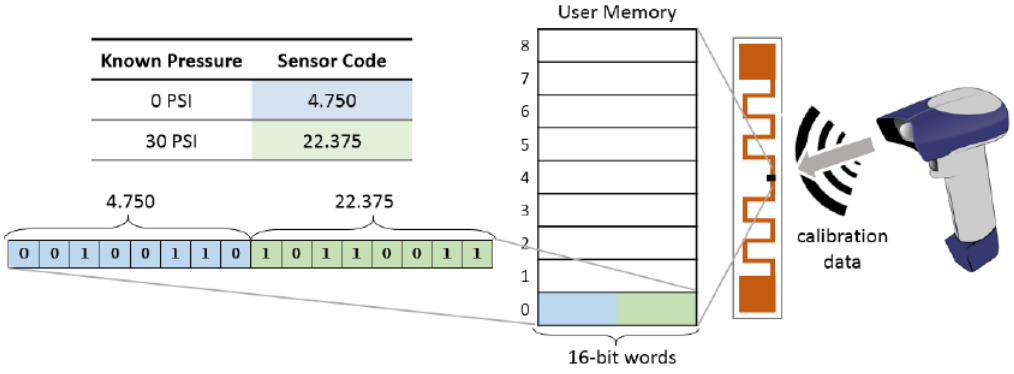

Figure 1. Calibration Data can be Stored in the Sensor Tag Memory

Step 2: Reading and Using Calibration Data

The application software on the reader is programmed with the location and format of the calibration data, and the known conditions under which it was taken. When the user takes a measurement, the reader reads both the Sensor Code and the tag's calibration data. The application software then has all the information needed to display a calibrated pressure reading to the user. For example, if the raw Sensor Code value is 13.56, then based on the calibration data and the linear nature of the tag response, the application performs an interpolation and displays 15 PSI (Figure 2).

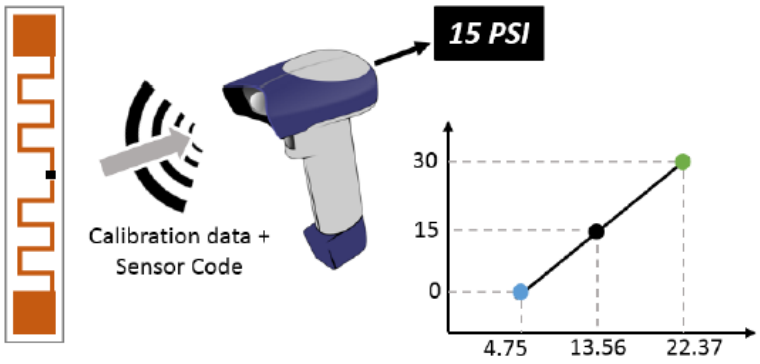

Figure 2. Reading and Applying Calibration Data to an Average Sensor Code Reading of 13.56

Additional Calibration Schemes

Other calibration schemes are also possible. For example, if the response of the tag is nonlinear, multiple calibration points can be used to construct a curve. Or, instead of storing just the Sensor Code data in the tag and programming the reader with the known conditions under which they were taken, both sets of information can be stored in the tag. This would enable the user to calibrate the tag at whatever conditions are most convenient or applicable at the time it is installed.

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