Document: Sensotec--Plug & Play Considerations (White Paper)
Writer: Martin Armson, Marketing Director, Sensotec Inc, Columbus OH
Date: October 2002

Before You Plug and Play: Things to Consider

Plug and play technology implemented according to IEEE P1451.4 promises to considerably simplify the configuration of automated measuring systems. An important point to keep in mind is that P1451.4 deals only with making sensor self-identification data available in a universally readable format. This deliberately narrow focus means that some important aspects of plug and play technology are not explicitly covered by the standard. You're unlikely to encounter anything that will keep you from using plug and play successfully, but you'll want to plan carefully to make sure that your implementation will go smoothly.

A Quick Review

Plug and play is a data acquisition technology that can simplify the configuration of automated measuring systems by making a sensor's unique identification data electronically available. As implemented according to P1451.4, those data are in the form of a **t**ransducer **e**lectronic **d**ata **s**heet, or TEDS, inscribed on an EEPROM located on the sensor. When you plug the sensor in, a properly adapted signal conditioner interrogates the sensor and presents you with the self-identification data. A major benefit of the technology is the elimination of the need for paper calibration sheets. Plug and play can also simplify labeling and cabling problems as well as inventory control by letting you burn location data onto the TEDS when you're installing the sensor. Finally, because all sensors manufactured according to the standard will carry the same basic self-identification information formatted in exactly the same way, plug and play means that you'll be able to mix and match sensors and appropriate signal conditioners across manufacturers.

What About the Hardware?

Teaming sensors from one manufacturer with appropriate signal conditioners from another will indeed be possible with P1451.4 plug and play—that is, as long as the connection plugs fit. The standard does not specify connector types or pin configuration. You'll sometimes need, therefore, to do some plug changing before you can play, and you'll have to sort out which pins go where. The IEEE 1451 Committee is considering addressing connectors and pin configurations. Meanwhile, when you order your equipment, specifying flying leads on the sensor and a terminal block on the signal conditioner will give you a workaround.

You Don't *Automatically G*et Automatic Setup

The term "plug and play" suggests completely automatic system set up, but only in an *active* plug and play implementation is the process completely free of user intervention. In such an implementation, the signal conditioner not only interrogates the TEDS but also adjusts its own electronics and within few seconds begins taking measurements from the sensor.

In a *passive* implementation, you need to complete the configuration—essentially telling the system what to do with the TEDS information—by entering excitation voltage, display resolution, and other operating parameters.

The IEEE standard leaves room for manufacturers to decide whether they want to implement plug and play actively or passively. Before you begin setting up a plug and play system, therefore, you'll want to consider which implementation makes the most sense for you. Technical experts may prefer the latitude offered by passive plug and play. The passive implementation also enables you to easily re-range your sensors for a series of short-term applications. For other users, the convenience of active plug and play will override any other considerations.

What Happens When the Calibration "Shelf Life" Expires?

Sensor manufacturers generally consider calibration data to be accurate for one year, at which point they recommend recalibration. The dilemma for plug and play users is that once the sensor is recalibrated, the onboard, factory-calibrated TEDS is no longer accurate, which means the benefits of plug and play are negated.

But the industry has already devised a solution—the TEDS burner. If you send a sensor back to the manufacturer for recalibration, they will reburn the TEDS to make sure that it carries the latest calibration data. Some calibration shops are already offering this service as well. For those who want to do their own reburning, some manufacturers, such as National Instruments and Sensotec, are either already selling TEDS burners or have plans to bring such products to the market.

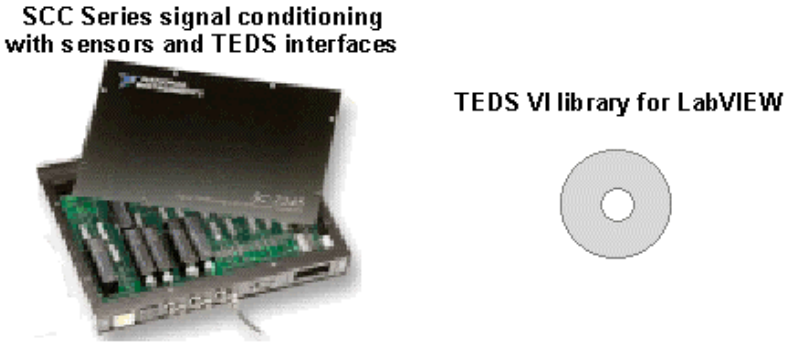

Fig 1 The National Instruments Plug and Play Sensor Development Kit includes hardware and software to update the TEDS information on IEEEP1451.4 sensors

Can Legacy Sensors Be Used in a Plug and Play System?

You can indeed use legacy sensors in a plug and play system without encountering any physical or electronic barriers. But you won't really be able to plug and play because the sensor carries no data for the signal conditioner to interrogate.

You could use the old method of manually entering the data that you find on the paper calibration sheet. But manufacturers have already developed a couple of more attractive solutions for legacy users. For those whose systems are PC-enabled, National Instruments has developed the concept of Virtual TEDS, whereby sensor calibration data

are downloaded directly to your signal conditioning system. The company is becoming a clearinghouse for TEDS—gathering calibration data from many sensor manufacturers and posting it on their Web site.

Another good solution is to retrofit your legacy sensors by adding TEDS EEPROMs to them. Sensotec already provides a kit with which the EEPROM can be mounted in the connector, in the sensor itself (the sensor is cut apart and rewelded), or in a special adaptor attached to the sensor cable.

Fig 3 A TEDS Eeprom fitted into a sensor connector and a connector and cable for a IEEE1451.4 retrofit of a legacy sensor

If Virtual TEDS or retrofit won't work for your application, you can still take advantage of the "paperless calibration" feature of plug and play by accessing sensor calibration data from your manufacturer's Web site. Sensotec has already made such online data available.

If You Prefer the "Pots"

Some users, when setting up their systems, like to adjust zero and full-scale output by changing the potentiometers, or "pots," mounted on the sensor. But if you make such adjustments to a sensor with an onboard TEDS, you lose the ability to plug and play because your sensor no longer reflects its onboard calibration data. To make sure that you can get the full benefits of having the TEDS onboard, you'll want to consider making your adjustments at the signal conditioner rather than at the sensor end. As an extra precaution, you could seal the pots to prevent tampering. The simplest solution may be simply switching to sensors manufactured without pots.

Summing Up

Any business that regularly uses automated measuring systems will appreciate the simplified setup made possible by plug and play and its governing standard, IEEE P1451.4. A little planning will go a long way toward making sure that your implementation of plug and play goes smoothly and that you get the maximum benefits offered by this promising new data acquisition technology.

For more information on IEEEP P1451.4 plug and play technology, see "IEEE Standard on the Way for Smart Plug and Play Systems," from National Instruments and "Good News for Sensor Users: IEEE P1451.4 Meets Plug and Play," from Sensotec.