# Timeless Sensor Sources

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Over the years, I have accumulated articles, books and application notes that relate to sensors and measurement techniques. In this column – a change of pace from ECN's usual Embedded Systems column format – I share many of those resources with you. Some of this information may seem "old," so you may not know about these sources or an Internet search will not find them.

Some publications and companies put information in unusual places on Web sites, so when possible, our links take you directly to a paper or to an article. You can obtain books from the suppliers noted or through libraries, local book stores or from online book dealers. If I missed your favorite book or resource, send me a short message so I can keep this list up to date. I also welcome information from companies about their white papers, Web tutorials and other information.

**Books**

The "Data Conversion Handbook," ($69.95. ISBN: 978-0750678414) produced by the staff of Analog Devices contains a wealth of information about how to convert information between the analog and digital realms. The book was offered in 1986 as the "Analog-Digital Conversion Handbook," (ISBN: 0130328480) also produced by the Analog Devices staff, but now out of print. I recommend both highly, and I still refer to the latter volume.

The third edition of the "Signal Conditioning & PC-Based Data Acquisition Handbook" from IOtech provides several chapters that explain how to acquire useful signals from a variety of sensor types. Order this book directly from IOtech. Price: $29.95. www.iotech.com [1].

"Analog Interfacing to Embedded Microprocessors: Real World Design," 2nd ed., by Stuart R. Ball, Newnes. ($58.95. ISBN: 978-0750677233) provides information about getting analog information to and from MCUs. Although not strictly about sensor interfacing, the book provides helpful information for developers.

"Analog-to-Digital Conversion: A Practical Approach," by Kevin M. Daugherty, McGraw-Hill. (ISBN: 0070156751) Although a bit dated, this book still provides useful information about ADCs and conversion techniques. Used copies sell for about $30.

"Data Acquisition and Control Handbook," from Keithley Instruments includes information about interfacing sensors with data-acquisition equipment. Chapters emphasize proper signal-handling techniques. You can obtain this excellent book directly from Keithley. www.keithley.com [2].

"Hall Effect Sensors: Theory and Application," by Ed Ramsden, Advanstar. (ISBN:

0929870581) Unfortunately, this excellent handbook has gone out of print, but it is worth searching for if you use or plan to use Hall-effect sensors. Try Amazon or AbeBooks.

**General App Note Sources**

National Instruments provides an extensive library of application notes about sensor use, interfacing and signal conditioning. Search the NI Developer Zone for a sensor type, then click on "Tutorials and Application Notes" to narrow your search. Unfortunately, search results do not always appear in order of relevance. www.ni.com [3].

Dataforth offers more than 30 application notes on sensor applications, signal-conditioning techniques and related subjects. The materials contain practical information, diagrams and equations. www.dataforth.com [4]. Registration is required.

**Articles and Papers**

Stewart, David, "Sampling Rates for Analog Sensors," Embedded Systems Programming, July 2003. pp. 24-29. This article will help you determine how fast to sample analog signals, and it provides the math to back up its examples. Engineers often overlook this important design criterion. www.embedded.com/story/OEG20030610S0038 [5].

Hunt, David L. and Ralph D. Brillhart, "Smart Sensors, Dumb Engineers: How to Avoid Crossed Signals in Instrumentation," Sound and Vibration, April 2005. pp. 32-36. The authors discuss how to get the most out of accelerometers by paying careful attention to installation, cabling and data management. These techniques apply to other sensors too. www.sandv.com/downloads/0504hunt.pdf [6].

Mark, John and Paul Hufnagel, "The IEEE 1451.4 Standard for Smart Transducers." This paper provides a solid overview of the standard that covers the transducer electronic data sheet (TEDS) that comes built into some sensors, and that provides information about calibration, range and so on. The original source of this document remains unknown, but you can find a copy on the IEEE Web site: http://standards.ieee.org/regauth/1451/IEEE_1451d4_Standard_Genl_Tutorial_090104.pdf [7].

"Resistive Bridge Basics: Part 1" from Maxim Integrated Products discusses the use of Wheatstone-bridge sensors. There are no signs of Part 2 on the Maxim Web site, although the company has several other useful sensor-related app notes. http://pdfserv.maxim-ic.com/en/an/AN3426.pdf [8]

"Delta Sigma A/D Conversion Techniques Overview, AN10, Rev. 1" from Crystal Semiconductor, now part of Cirrus Logic. This paper provides a solid introduction to delta-sigma ADCs. www.cirrus.com/en/pubs/appNote/an10.pdf [9].

You may not think of Freescale Semiconductor as a supplier of sensors, but the

company offers a variety of pressure, acceleration and proximity sensors. The company provides many app notes that cover pressure sensors, some of which stress general principles while others focus on specific Freescale products. www.freescale.com [10]. Under Products, select Sensors. Then under Design Resources, choose Application Notes.

**From the ECN Archives**

"Devise a Sensor Network That Makes Waves [11]," November 2006, pg. 21

"Fingertip Sensors Give Consumers a Hand [12]," July 2006, pp. 31-33.

"Isolate Yourself [13]," July 2006, pg. 21.

"Sensors Get Smart [14]," October 2005, pp 27-28.

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