Product Portfolio Brief

SEMTECH WIRELESS & SENSING PRODUCTS

Data Acquisition Solutions

Introducing the **ZoomingADC™**:
World's Most Flexible High-Performance Data Converter

Semtech's proprietary ZoomingADC™ technology allows users to achieve high performance functionality using low cost sensors.

Semtech offers a range of low-power mixed-signal ICs for Data Acquisition. The range includes the ZoomingADC high resolution ADC with its associated MCU. Semtech Data Acquisition Solutions are characterized by their miniaturization and low-power operation.

Applications:

- Portable, battery operated instruments
- RF powered instruments
- 4-20 mA loop powered sensors
- Pressure sensors
- Magnetic sensors
- Acceleration and tilt sensors
- Humidity sensors
- Wireless sensing

Key Features:

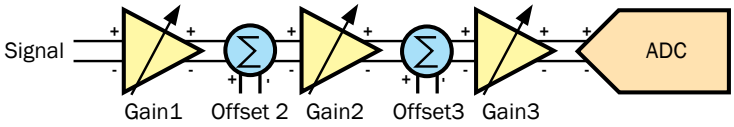
- 16 + 10 bit ZoomingADC
  - gain 1/12 to 1000
  - sensor offset compensation
  - up to 16 bits resolution
- Low power, 200 μA for 16 bits at 1kHz
- Wide voltage range, 2.4 – 5.5V
- On-chip RISC CPU
- Small package, down to 4x4 mm^2

Sensors supported:

- All piezo-resistive sensors, pressure, force…
- Wheatstone bridge sensors
- Thermovoltaic sensors
- Resistive bridges
- Hall sensors, AMR, GMR
- PTxxx
- Chemical MEMS

ZoomingADC™ technology was developed as a result of more than 10 years of knowledge of high-end mixed signal circuits for industrial applications. It includes all the functions necessary to read a piezo-resistive bridge.

ZoomingADC Architecture



It compensates for a low sensitivity sensor with a high gain, and cancels the sensor's offset through a controlled addition of the reference to the signal path.

In addition to the advanced ADC, the circuit also has a complete microcontroller (MCU) for managing the ZoomingADC, and for processing the data. This controller can carry out a simple polynomial correcting in a few microseconds.

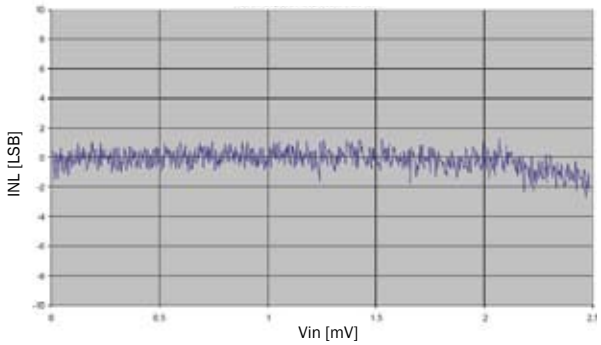
The ZoomingADC also includes the necessary output peripherals, such as UART and parallel I/O. Some products also include an LCD driver or buffered ADC.

Features:

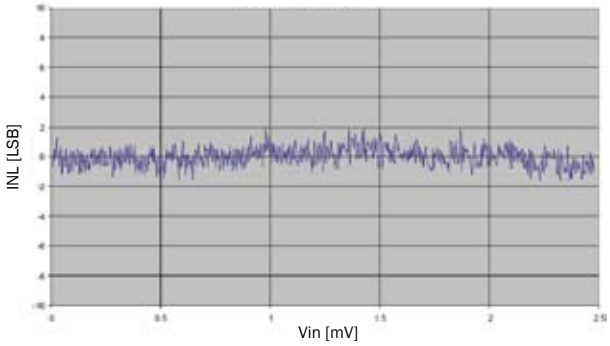
- 16 bits incremental programmable oversampled ADC
- Up to 16 bits in 1 ms, 12 bits in 250 µs, or 8 bits in 75 µs
- Complete internal offset cancellation scheme
- Preamplification gain up to 1000 in steps of 10%
- Offset cancellation up to 15 FS in steps of 10%

Excellent INL over temperature:

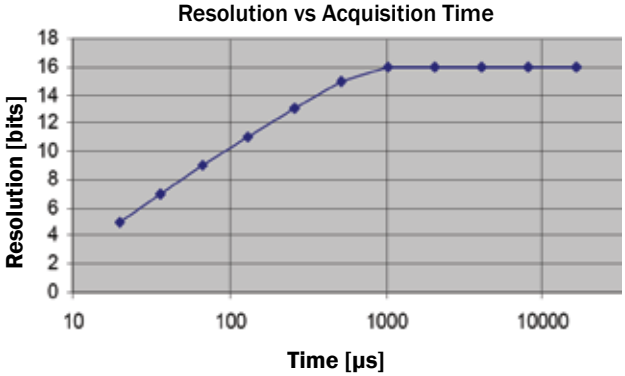
INL: Gain 1000 -40°C
PGA1=10; PGA2=10; PGA3=10;
set_osr=7; set_nelconv=3; Vbat=5V; Vref=5V; Vcommon=0V



INL: Gain 1000 85°C
PGA1=10; PGA2=10; PGA3=10;
set_osr=7; set_nelconv=3; Vbat=5V; Vref=5V; Vcommon=0V



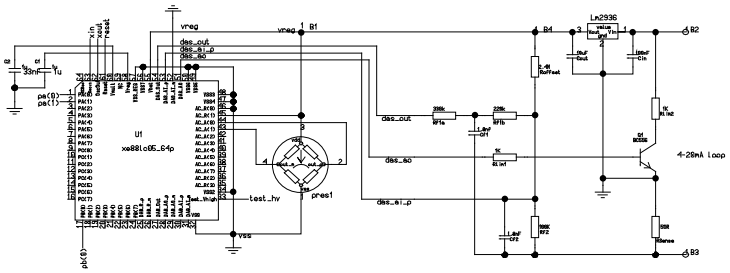
The ZoomingADC resolution can be programmed versus the acquisition time:



1. Industrial Pressure Sensor

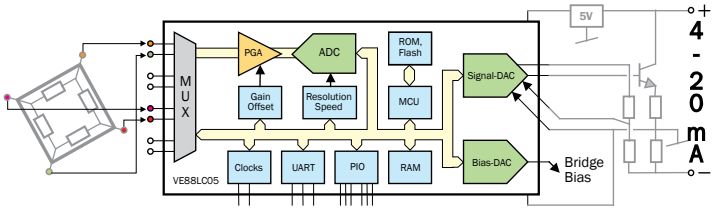
Realizing an industrial pressure sensor with an XE8805A is quite straightforward. A bridge sensor element has its bias connected between one of the DAC buffers of the XE8805A, and the sensing pins are connected to one pair of input of the ZoomingADC. A temperature sensor is connected to a second input pair of the ZoomingADC, if temperature correction is required.

4-20 mA Sensing Application



The PGA (zoom of the ZoomingADC) converts the millivolt output of the bridge to a bigger signal than the ADC can convert with full resolution.

4-20 mA Sensing Block Diagram



The MCU is available for further correction of the signal amplitude and offset. Its high efficiency makes it possible to have rapid computation while using very little current. The following polynomial can be computed with a 16 bits resolution in 150 microsecond with a total current in the MCU of 600 microampere.

$$Out = (A_0 + A_1 \bullet T) \bullet V_{in} + B_0 + B_1 \bullet T$$

Then the signal can be provided to the output via the UART for digital sensor interfaces, or via the second DAC for analog output (like 4-20 mA loop).

Global function (ZoomingADC + MCU for correction computation) uses less than 1.5 milliampere, so there is still ample current to bias the sensor in a 4-20 mA loop.

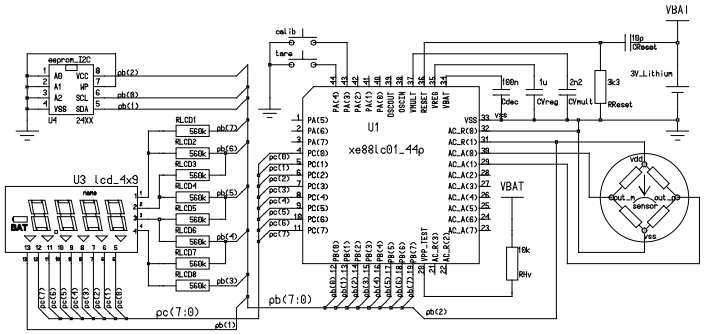
2. Barometer

The barometer is a pressure sensor and can use the same architecture as above (industrial pressure sensor).

The barometer is a very low bandwidth sensor, so its mean current consumption can be significantly reduced by using the XE8801A, with its very flexible sleep modes. The XE8801A can maintain a precise real time clock with less than 2 microampere. By measuring the pressure every second, the mean current consumption of a barometer based on the XE8801A is lower than 3 microampere.

For a barometer with an LCD display, one can develop with the XE8802, as it has a LCD driver. For small displays, the lowest cost solution is to use resistors to create a simple multiplexer around the digital port of the XE8801A.

XE8801A Circuit Diagram



3. Miniature Compass

A compass is another sensor that can benefit from a ZoomingADC. The sensing element can be a “Hall”, “AMR” or a “GMR” sensor, depending on what principle is used for detection of the magnetic field.

Parameter (Typical AMR Sensor)	Value	Unit
Sensor Sensitivity	3.2	mV/V/Oe
Sensor offset	10	mV/V
Full scale signal under earth magnetic field (30 μT)	+/- 1	mV/V

Rem: Oe stands for Oersted. 1 Oe is 1 Gauss in vacuum, 1 Gauss is 100 μT (microTesla).

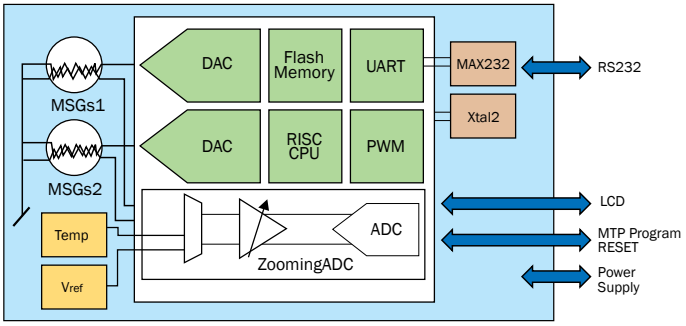
One of the main advantages of the ZoomingADC for this type of application is that one has enough analog differential inputs and digital outputs to change the direction of the sensor bias and get rid of its large offset.

ZoomingADC™ Settings	Value	Unit
Sensor Signal (Offset + Signal)	10 +/- 1	mV/V
Signal out of Preamp. 1, gain 10	100 +/- 10	mV/V
Signal out of Preamp. 2, gain 10, offset -1	0 +/- 100	mV/V
Signal out of Preamp. 3, gain 5	0 +/- 500	mV/V
ADC (Full scale is +/- V_{ref}/2)	+/- 32767	LSB

Miniature solutions can be made, as no external components are needed to read the Hall sensor with an XE8801A or an XE8805A.

4. Air Quality Monitor

Air quality monitoring can be done with one or a few chemical sensing elements (i.e. Microsens MSGS3001 device). These sensing elements must be precisely biased to have correct sensitivity and a long life.



The sensing elements function by rapidly heating a small silicon bridge on which a sensitive resistor is placed. Resistivity of this element changes with the concentration of the chemicals to be detected.

By having good control of the applied voltage, one can also significantly lower the global energy required for reading the sensing elements. This ends with ultra low-power solutions, even if the heating of the sensing element requires several 10 milliwatts. The mean power requirement can be as low as a few 10 microwatts.

5. Wireless Sensing

The low power and excellent computing capabilities of the XE8000 series make them perfectly suited for RF linked sensors.

The XE8000 can directly interface with a transceiver (like the ultra low-power XE1200 series from Semtech) to send the acquired data over a RF signal to a main station. The low power-capabilities of the XE8000 allows it to run on batteries for years, even when working with an RF link.

6. Other Sensors

Most current sensors generate a voltage or a current that is proportional to the signal to be measured. All these sensors can be read directly by the ZoomingADC with the help of an additional resistor to produce a signal-in current.

SX/XE88xx Tools

RS-232

RIDE Base OR **RIDE Enterprise**

- Editor
- Assembler
- C Computer
- Linker
- Simulator (4k)
- In-Socket - Debugger

- RIDE Base +
- Unlimited simulator
- Code Compressor
- Multi-processor
- Script Support

Programmers
BPmicro, Phyton

XE8000MP
Multi-purpose board

PICE-XE
Phyton, LC02 or 06 based, serves all

Target Application

XE8000EV1xx
Chip specific evaluation board

SX87xx Tools

- Evaluation board with USB connection and experimentation wrap area
- Simple GUI with full visibility on all registers
- Same tool base will apply for SX8723 and future data acquisition devices

USB

Short Tools Selection Guide

Most XE88xx customers develop using the free version of Raisonance RIDE (downloaded from Raisonance website), XE8000MP and the corresponding XE8000EV1xx.

XE88xx Products		ProStart II			Emulator PICE		
Product	Package	Software	MP Board	Evaluation Board	Main	POD	Adapter
XE8801AMI027	LQFP44	RIDE	XE8000MP Multi-purpose board	XE8000EV101	MR1-XE-01	PR1-XE-020	AR1-XE-02-Q44
XE8802MI035	LQFP100			XE8000EV110			AR1-XE-02-Q100
XE8805AMI028	LQFP64			XE8000EV104			AR1-XE-02-Q64
	Provider:	Rais. *	Semtech		Phyton, www.phyton.com		

Rais. *= Raisonance. www.raisonance.com

XE87xx Products		Evaluation Kit
SX8722I070	MLPQ44	XE8000EV120
SX8724E082	MLPQ16	XE8000EV121 (also for SX8723 and SX8725)

SX8000 - XE8000 Ordering				
Product*	Description	Package conditioning	MOQ	Ordering**
SX8722	ZoomingADC with embedded SW and I²C	MLPQ44 tape & reel	2000	SX8722I070TRLF
SX8723	ZoomingADC with embedded Vref and GPIO	MLPD12 tape & reel	3000	SX8723E083TRT
SX8724	ZoomingADC with embedded Vref and GPIO	MLPQ16 tape & reel	3000	SX8724E082TRT
SX8725	ZoomingADC with embedded Vref and GPIO	MLPD12 tape & reel	3000	SX8725E083TRT
SX8801R	ROM version of XE8801A	--	100K	Defined with ROM content
XE8801A	ZoomingADC with 8k MTP memory	LQFP44 tray	800	XE8801AMI027LF
XE8802	ZoomingADC with 8k MTP memory and LCD driver	LQFP100 tray	450	XE8802MI035LF
XE8805A	ZoomingADC with 8k MTP memory and DACs	LQFP64 tray	800	XE8805AMI028LF

* Old product name was XE88LC01A, new product name has no "LC"

** All XE8000 products are lead free unless indicated otherwise

Product Line Card

Part Number	Supply Voltage	Supply Current	Main Function	Main Function	Other Features	Packages
ZoomingADC with serial interfaces						
SX8723	2.4V to 5.5V	200 µA	2 differential inputs high resolution acquisition path	ZoomingADC with 1 to 1000 gain 16 bit over-sampled ADC	Embedded voltage reference, I²C interface, 2 parallel I/Os	MLPD12 4x4 mm²
SX8724	2.4V to 5.5V	200 µA	3 differential inputs high resolution acquisition path	ZoomingADC with 1 to 1000 gain 16 bit over-sampled ADC	Embedded voltage reference, I²C interface, 4 parallel I/Os	MLPQ16 4x4 mm²
SX8725	2.4V to 5.5V	200 µA	1 differential input high resolution acquisition path	ZoomingADC with 1 to 1000 gain 16 bit over-sampled ADC	Embedded voltage reference, I²C interface, 2 parallel I/Os	MLPD12 4x4 mm²
ZoomingADC with embedded processing and serial interfaces						
XE8722	2.4V to 5.5V	200 µA	4 differential inputs high resolution acquisition path	ZoomingADC with 1 to 1000 gain 16 bit oversampled ADC	Over and under load detection Local filtering, I²C interface	VQFN44 7x7mm²
ZoomingADC with high efficiency MCU and serial interfaces						
XE8801A SX8801R**	2.4V to 5.5V	200 µA	4 differential inputs high resolution acquisition path	ZoomingADC with 1 to 1000 gain 16 bit oversampled ADC MCU and RAM for local data processing	UART, 24 parallel I/O Programmable clock PWM DACs	LQFP44
XE8802	2.4V to 5.5V	200 µA	4 differential inputs high resolution acquisition path	ZoomingADC with 1 to 1000 gain 16 bit oversampled ADC MCU and RAM for local data processing	UART, up to 60 parallel I/O, PWM DACs Programmable clock, 4 low-power comparators 120 segments LCD driver with voltage reference	LQFP100
XE8805A	2.4V to 5.5V	200 µA	4 differential inputs high resolution acquisition path	ZoomingADC with 1 to 1000 gain 16 bit oversampled ADC MCU and RAM for local data processing	UART, 24 parallel I/O Programmable clock 2 DACs with buffers	LQFP64

** SX8801R is a ROM (Ready only memory) version of the XE8801A