SEMTECH WIRELESS & SENSING PRODUCTS

Data Acquisition Solutions
Low power, high precision
World's most flexible acquisition solutions

Semtech's over-sampled ADC technology allows users to achieve high performance functionality using low cost sensor and minimal power supply.

Semtech offers a range of low-power mixed-signal ICs for Data Acquisition. The range includes The ZoomingADC™ high resolution ADC with serial interface and with MCU, as well as digital temperature sensors.

Semtech Data Acquisition Solutions are characterized by their miniaturization, flexibility and low-power operation.

Applications

- Portable, battery operated instruments
- RF powered instruments
- Solar powered instruments
- 4-20 mA loop powered sensors
- Wireless sensors
- Pressure sensors
- Magnetic sensors
- Acceleration and tilt sensors
- Humidity sensors
- Temperature monitoring
  - Printers
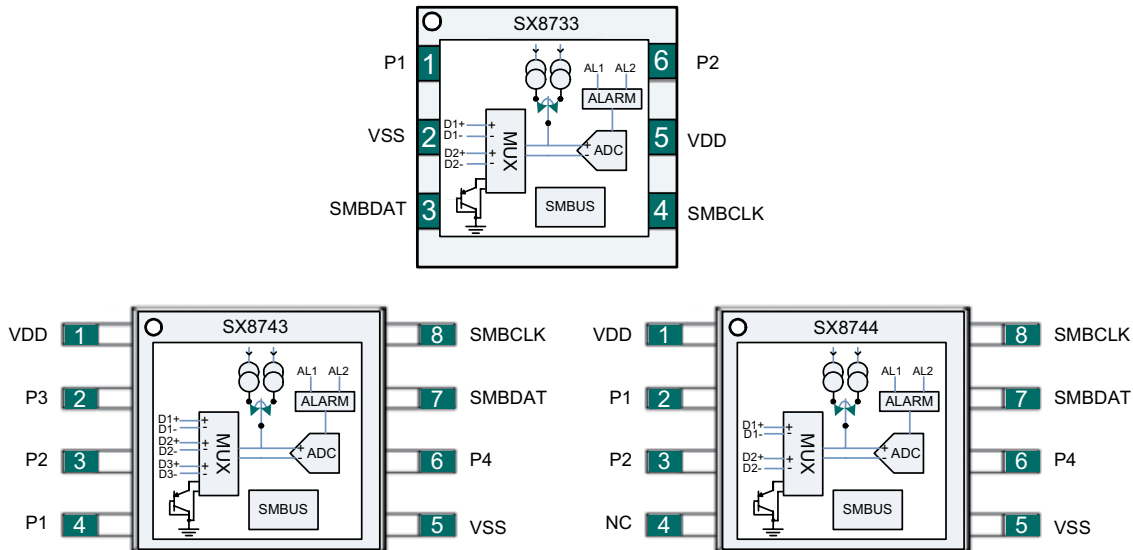 - Servers
  - Set Top Boxes
  - Projectors

Key Features

- ZoomingADC:
  - 16 bit ADC
  - Embedded programmable gain 1/12 to 1000
  - Embedded sensor offset compensation
  - Low power, 200 uA for 16b at 1kHz

- On chip CPU:
  - Wide voltage range, 2.4 – 5.5 V
  - Low power, 300 uA/MIPS

- Digital temperature sensor:
  - Precision +/- 0.5 °C typ
  - Low power, 250 uA at 10 Hz
  - Up to 4 temperature zones
  - Resistive error cancellation

General Description

The SX8733, SX8743 and SX8744 are digital temperature sensors with a 2-wire SMBus interface. It provides a lowcost solution to monitor the temperature of remote diodes as well as its own temperature with an on-chip PN junction sensor.

Depending on the device version, 2, 3 or 4 programmable ports are included. They offer the possibility to trig under-/over- temperature alarms which can be used as an interrupt or to connect up to 3 external sensors in single-ended mode or 2 external sensors in differential mode. The parasitic resistances in series with the temperature monitoring diode can be cancelled by an algorithmic, a 3-point or a Kelvin (4-wire) method.

The SX8744 is pin-to-pin compatible with the LM86 part.

The SX8733 (2 programmable ports) is available in MLPD- 6 package.

The SX8743 (4 programmable ports) and SX8744 (3 programmable ports) are available in MSOP-8 package.

Ordering Information

Part Number	Feature	Package
SX8733EWLTRT	2 Programmable ports	MLPD-6
SX8743EMSTRT	4 Programmable ports	MSOP-8
SX8744EMSTRT	3 Programmable ports	MSOP-8

Applications

- Printer
- Server
- Set top box
- Projector
- Batteries charger monitoring

Key Product Features

- 1 internal and up to 3 external sensors

- Remote diode temp. accuracy of ±0.5°C on the temp. range 25°C to 100°C

- 2 temp. output formats: 0°C to 127°C and -40°C to 140°C with 0.125°C resolution

- Parasitic series resistance cancellation: Algorithmic, 3- point and Kelvin (4-wire)

- Under-/over- temp. alarms with programmable thresholds programmable conversion rate for optimal power consumption

- 250 uA active current @ 10Hz sampling rate

- SMBus v2.0 interface supports timeout

- Pb-Free, halogen free, RoHS/WEEE compliant

SX8733 / SX8743 / SX8744 include an on-chip PN junction to measure local temperature TJ.

The device has a 2-level current source and an ADC to measure each diode's forward voltage to compute the temperature. The input multiplexer allows 3 external and 1 internal sensors to be connected to the ADC.

Two alarms can provide to the system the information that a sensor temperature has reached the programmable threshold.

The chip is configured with a 2-wire SMBus serial line.

A wide range of operating modes are proposed to measure from a single temperature zone up to 4 zones, and generate up to two alarms triggered by different temperature levels. Sensor can be connected in differential mode for best cancellation of noise or single ended to allow for more sensors. Algorithms are included to cancel the effect of lines resistivity.

Mode	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
External Sensor	1	1	1	0	2	2	1	1	1	1	1	2	2	2	2	2	3	3	3		1
Differential	x	x							x	x		x	x								x
Single-ended			x		x	x	x	x			x			x	x	x	x	x	x		
Algorithmic track resistance cancellation		x				x		x		x			x		x			x			
3-point track resistance cancellation			x								x					x			x		
Kelvin (4-wire) track resistance cancellation																					x
Alarm #	0	0	0	2	0	0	1	1	2	2	2	0	0	2	2	1	1	1	1		0

In a typical application, the SX8743 will monitor its own temperature and one sensor. When any of these is higher than a predefined threshold, it shall send an alarm to trigger its host CPU. One alarm could also be directly connected to a fan to cool down the system without waking the host.

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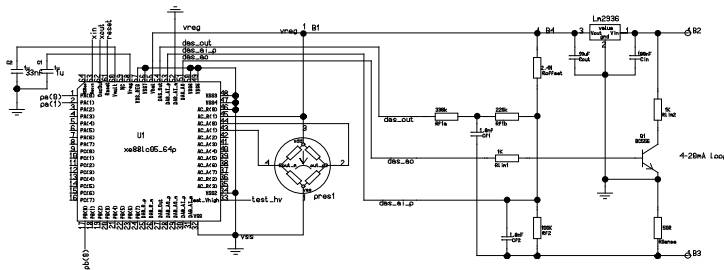
The PGA (zoom of the ZoomingADC) converts the millivolt output of the bridge to a bigger signal than the ADC can convert with full resolution.

4-20 mA Sensing Block Diagram
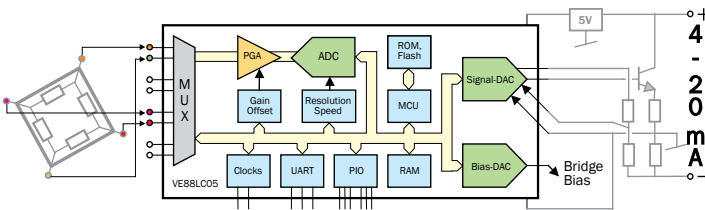
The MCU is available for further correction of the signal amplitude and offset. Its high efficiency makes it possible to have rapid computation while using very little current. The following polynomial can be computed with a 16 bits resolution in 150 microsecond with a total current in the MCU of 600 microampere.

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

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
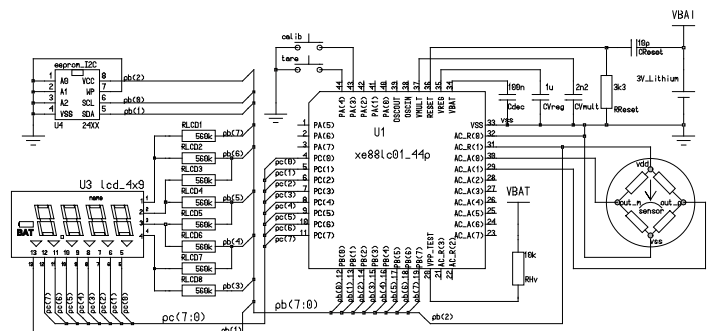
3. Miniature Compass

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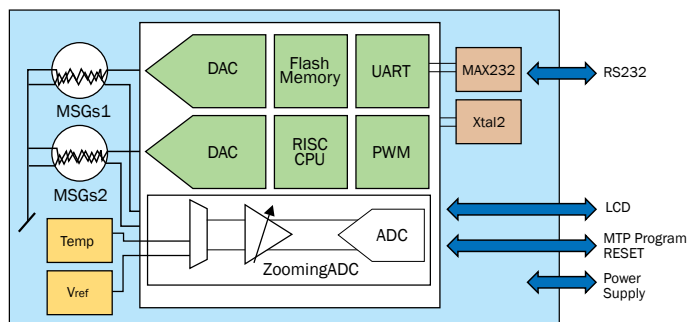
The sensing elements function by rapidly heating a small silicon bridge on which a sensitive resistor is placed. Resistivity of this element changes with the concentration of the chemicals to be detected.

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.
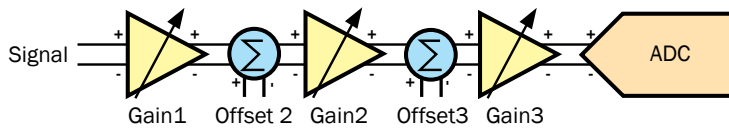
6. Other Sensors

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.

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

- Pre amplification gain up to 1000 in steps of 10%

- Offset cancellation up to 15 FS in steps of 10%

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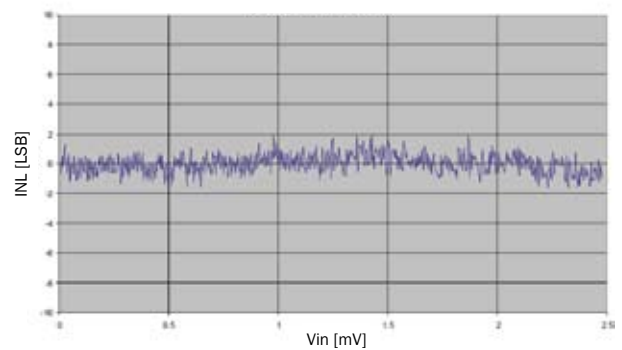
INL: Gain 1000 -40°C
PGA1=10; PGA2=10; PGA3=10;
set_osr=7; set_nelconv=3; Vbat=5V; Vref=5V; Vcommon=0V
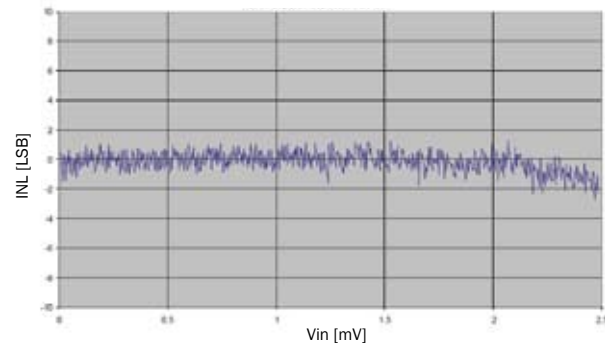
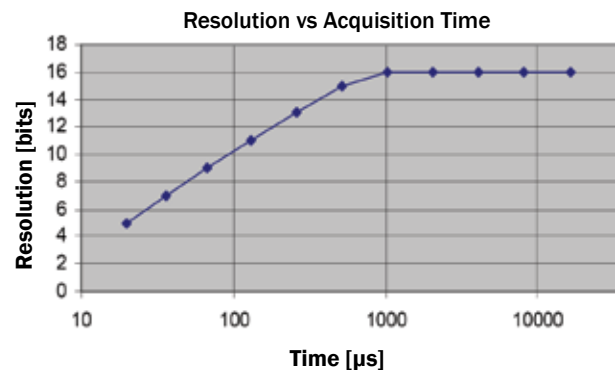

INL: Gain 1000 85°C
PGA1=10; PGA2=10; PGA3=10;
set_osr=7; set_nelconv=3; Vbat=5V; Vref=5V; Vcommon=0V

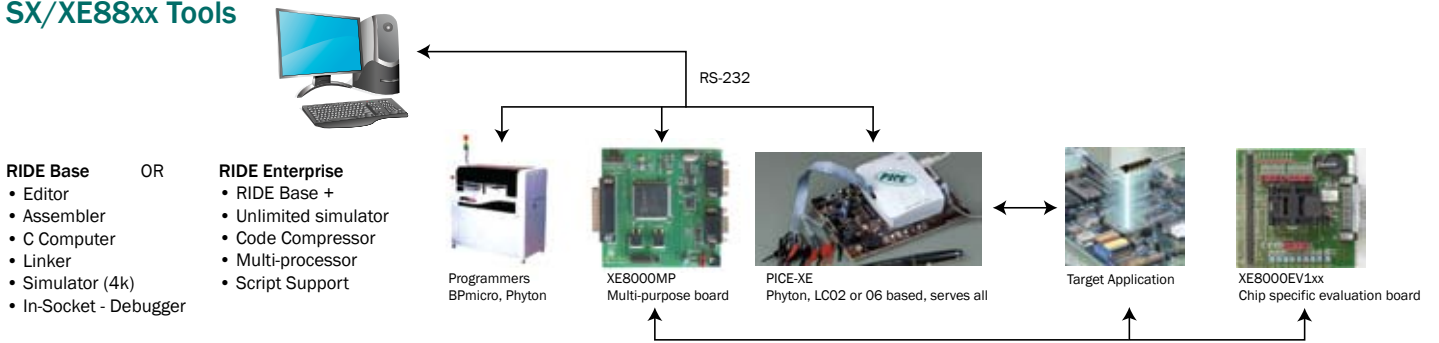The ZoomingADC resolution can be programmed versus the acquisition time:

SX87xx Tools

- Evaluation board with USB connection and experimentation wrap area
- Simple GUI with full visibility on all registers

USB

SX87xx Products		
Product	Package	Evaluation Kit
SX8723E083TDT	MLPD-12	XE8000EV121 based on SX8724E082TDT
SX8724E082TDT	MLPQ-16	
SX8725E083TDT	MLPD-12	
SX8723CWLTDT	MLPD-12	
SX8724CWLTDT	MLPQ-16	
SX8725CWLTDT	MLPD-12	
SX8733EWL	MLPD-6	SX8000EV126
SX8743EMS	MSOP-8	
SX8744EMS	MSOP-8	

SX/XE88xx Tools

RS-232

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

RIDE Enterprise
- 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

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	Soft-ware	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

ZoomingADC with serial interfaces

Part Number	Supply Voltage	Supply Current	Inputs	Main Function	Other Features	Packages
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, 2-wire i/f, 2 parallel I/Os	MLPD12 4x4 mm^2
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, 2-wire i/f, 4 parallel I/Os	MLPQ16 4x4 mm^2
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, 2-wire i/f, 2 parallel I/Os	MLPD12 4x4 mm^2
SX8723C	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, I^{2}C interface, 2 parallel I/Os	MLPD12 4x4 mm^2
SX8724C	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, I^{2}C interface, 4 parallel I/Os	MLPQ16 4x4 mm^2
SX8725C	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, I^{2}C interface, 2 parallel I/Os	MLPD12 4x4 mm^2

Digital temperature sensing

Part Number	Supply Voltage	Supply Current	Inputs	Main Function	Other Features	Packages
SX8733	2.7 to 5.5 V	250 µA	Internal sensor, up to 2 external sensors	Precision temperature acquisition	SMBus interface, resistive cancellation	MLPD-6 3x3 mm^2
SX8743	2.7 to 5.5 V	250 µA	Internal sensor, up to 3 external sensors	Precision temperature acquisition	SMBus interface, resistive cancellation	MSOP-8 3x3 mm^2
SX8744	2.7 to 5.5 V	250 µA	Internal sensor, up to 2 external sensors	Precision temperature acquisition, LM86 pin compatible	SMBus interface, resistive cancellation	MSOP-8 3x3 mm^2

ZoomingADC with high efficiency MCU and serial interfaces

Part Number	Supply Voltage	Supply Current	Inputs	Main Function	Other Features	Packages
XE8801A SX8801R**	2.4V to 5.5V	200 µA	4 differential inputs high resolution acquisition path	ZoomingADC with 1 to 1000 gain 16 bit over-sampled 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 over-sampled 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 over-sampled 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

SEMTECH