

Data Acquisition Solutions

Pressure sensor, barometer, compass, thermostat, air quality monitor

General Description

XEMICS offers a range of mixed-signal ICs for Data Acquisition. The range includes the ZoomingADC™ high resolution ADC with its associated MCU.

XEMICS Data Acquisition Solutions are characterized by their high level of integration and the 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 product features

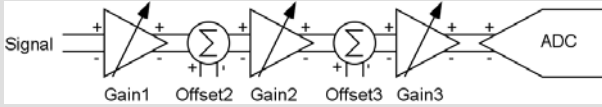
- 16 + 10 bit ZoomingADC
 - gain 1 to 1000
 - offset compensation
 - up to 16 bits resolution
 - $18 \text{ nV}/\sqrt{\text{Hz}}$ input noise
- On-chip Flash RISC CPU with UART
- Compatibility with Xemics XE1200 RF family

Sensors supported

- All piezo-resistive sensors
- Thermovoltaic sensors
- Resistive bridges
- Hall sensors
- GMR
- PTxxx

ZoomingADC™

The ZoomingADC™ 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 piezoresistive bridge.



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, like UART and parallel IO. Some products also include an LCD driver or buffered ADC.

Main Features:

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

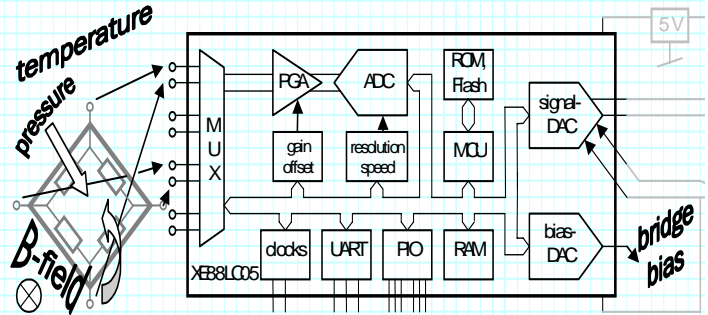
- Multiple Time Programmable (MTP) instruction memory
- UART (300 – 115000 bauds)
- 32 KHz Xtal oscillator
- Internal RC oscillator: 100 kHz - 4 MHz; 2% software trimming
- Analog switches matrix on 8 I/O pins
- 4 cascadable 8 bit up-down counters: PWM, capture and compare

- 8 bits and 16 bits DACs: inclusive buffer for current or voltage output
- 120 segments (1-2-3-4 multiplex) LCD driver: LCD lines can be used as additional I/O

Solutions using the ZoomingADC:

1. Industrial pressure sensor:

Realizing an industrial pressure sensor with a XE88LC05A is quite straightforward. A bridge sensor element (like Motorola MPX2200AP or Intersema AM5801AV) has its bias connected between one of the DAC buffers of the XE88LC05A, 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.



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.

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. RF linked thermostat

A RF linked thermostat can be developed in a few days using the XE1201CDK. It includes two ZoomingADC™ with its MCU and two ISM-band transceiver boards.



The ZoomingADC™ directly reads the temperature sensor(s), and its MCU generates the protocol and sends the information over the transceiver board. The second transceiver is connected to the central station through the second MCU and manages reception of the information.

Bi-directional transmission lowers the power required to ensure reliable communication.

3. 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 XE88LC01A, with its very flexible sleep modes. The XE88LC01A 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 XE88LC01A is lower than 3 microampere.



For a barometer with an LCD display, one can develop with the XE88LC02, as it has a LCD driver in addition to the current LC01A capabilities.

4. Miniature compass

A compass is another sensor that can benefit from a ZoomingADC.

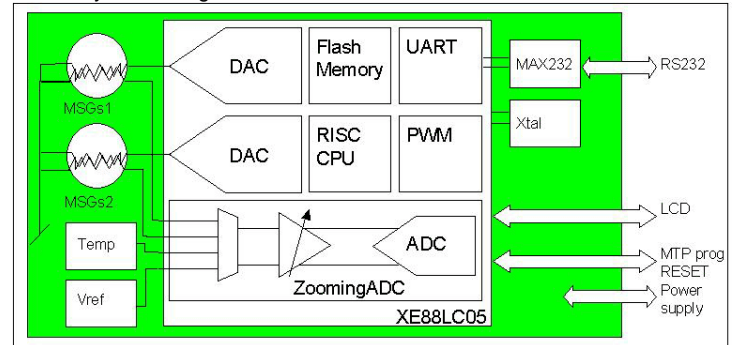
The sensing element can be a “Hall” or a “GMR” sensor, depending on what principle is used for detection of the magnetic field.

One of the main advantages of the XE88LC01A and XE88LC05A 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.

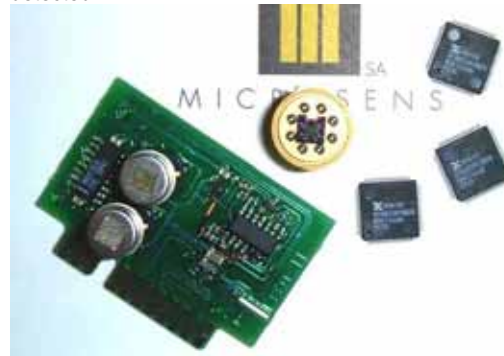
Miniature solutions can be made, as no external components are needed to read the Hall sensor with an XE88LC01A or an XE88LC05A.

5. Air quality monitor

Air quality monitoring can be done with one or a few chemical sensing elements (like 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.

6. 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 XE1201A from XEMICS) to send the acquired data over a RF signal to a main station. The low power-capabilities of the XE8000 let it run on batteries for years, even when working with an RF link.

7. 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.

Product line card for Data Acquisition Solutions:

Supply current			Main function	Main features	Other features	Packages, all circuits also available in die
Supply voltage						
ZoomingADC with high efficiency MCU and serial interfaces						
XE88LC01A	2.4 to 5.5	200 uA	High resolution acquisition path	ZoomingADC™ with 1 to 1000 gain 16 bit oversampled ADC MCU and RAM for local data processing	UART, parallel IO Programmable clock PWM DACs	LQFP44, VQFN48 1
XE88LC02	1.2° 2.4 to 5.5	200 uA	High resolution acquisition path	ZoomingADC™ with 1 to 1000 gain 16 bit oversampled ADC MCU and RAM for local data processing	UART, parallel IO, PWM DACs Programmable clock 120 segments LCD driver	LQFP100 1
XE88LC05A	2.4 to 5.5	200 uA	High resolution acquisition path	ZoomingADC™ with 1 to 1000 gain 16 bit oversampled ADC MCU and RAM for local data processing	UART, parallel IO Programmable clock 2 DACs with buffers	LQFP64 1
Companion ultra low-power MCU						
XE88LC06A	1.2° 2.4 to 5.5	300 uA/ MIPS	Radio transceiver interface	BitJockey™ (NRZ, Manchester, Miller coding) up to 7 MIPS operation PWM DACs, UART	4 low-power comparators Parallel IO Programmable clock	TQFP32 SO28*, SO24* 1
Audio CODEC (ADC-DAC)						
XE3006	1.8 to 3.3	1 mA	Audio CODEC with Sandman feature	84 dB 16 bits ADC and DAC 4 - 20 kHz input sampling 44 kHz output	I2S and MSB justified interface 100 mA power amplifier Microphone supply voltage	SOP20
Radio transceivers						
XE1201A	2.4 to 5.5	6 mA	300 - 500 MHz transceiver	Ultra low-power High data rate (up to 64 kbit/s) SAW based for low-power	Bit synchroniser Fast turn-on time 6 mA reception, 12 mA emission	TQFP32 1
XE1202	2.7 to 3.6	12 mA	433, 868 and 915 MHz transceiver	Low-power High data rate (up to 78.6 kbit/s) PLL based for flexibility	Bit synchroniser Fast turn-on time 12 mA reception, 33 mA emission	LQFP44
XE1209	2.0 to 3.2	200 uA	30 - 70 kHz transceiver	Ultra low-power reception Free band worldwide	200 uA reception, 1.8 mA emission	SOP20 1

*: future products

°: for ROM version only

¹ available lead free

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