XEMICS

AN8000.11
Application note

A general purpose air quality monitor system with RF link

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Introduction

This application note is used to describe how the XE1201, the XE88LC05 and a gas sensor (Microsens MSGS3000) combined can be implemented into an air quality monitoring system. For this implementation, the following components are needed: a chemical gas sensor MSGS3000; a XE1201 transceiver and a XE88LC05 mixed-signal microcontroller (sensing machine).

General Description

A general purpose air quality monitoring system description

Figure 1 shows an air quality monitoring system. It is divided into two distinct systems. One is a portable (Mobile System) and the other is at a fixed point (Base System).

A MSGS3000 gas sensor, a XE1201 transceiver and a XE88LC05 microcontroller (Mobile Sensing Machine) compose the Mobile System.

A XE88LC05 microcontroller (Base Sensing Machine), a XE1201 transceiver and a PC compose the Base System.

The Mobile Sensing Machine performs the gas sensor value acquisition and sends the acquired value using the transceiver.

The Base Sensing Machine receives the value sent by the Mobile System using the transceiver. It then sends the received data using the serial port of the microcontroller (UART) to the PC showing this data on a chart.

Description of the different components

Gas Sensor

A semiconducting metal oxide layer characterizes the low power MSGS3000 sensor. The measurement of specific oxidizing or reducing gases are based on reversible conductivity change of sensing element at an appropriate working temperature. For more information about this product consult http://www.microsens.ch .

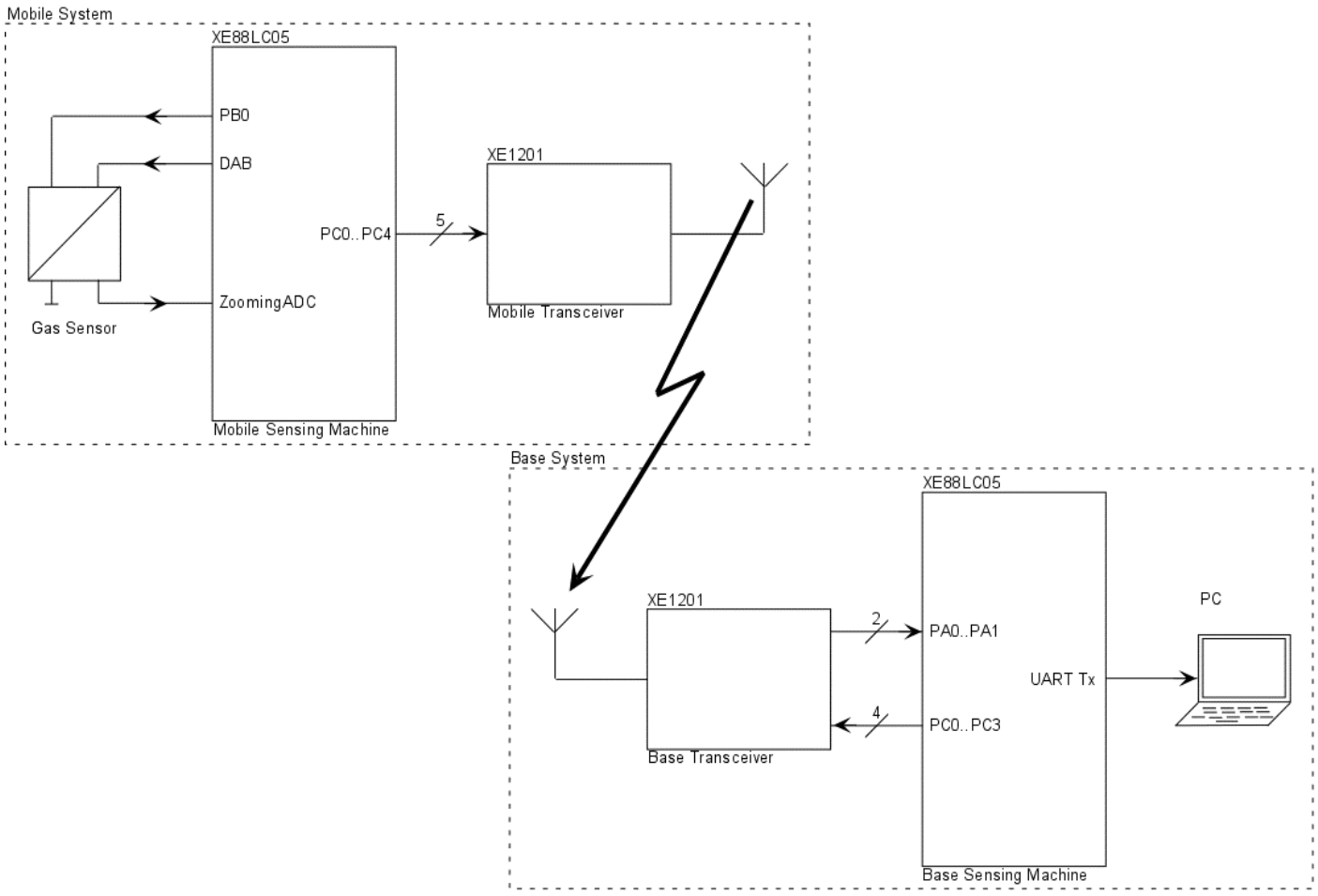


Figure 1 Global application description

XE1201 transceiver

The XE1201 is a half-duplex FSK transceiver for operation in the 433 MHz ISM band and in the 300-500 MHz band. The modulation used is the Continuous Phase, 2 level Frequency Shift Keying (CPFSK). The direct conversion (zero IF) receiver architecture enables on-chip channel filtering. The XE1201 includes a bit synchronizer so that glitch free data with synchronized clock can be directly read in our case by the XE88LC05 microcontroller.

XE88LC05 microcontroller

The XE88LC05 is an ultra low-power microcontroller unit associated with a versatile analog-to-digital converter including programmable offset and gain pre-amplifier and digital-to-analog converters.
For more information on the XE88LC05 and the XE1201, please consult XEMICS' web site http://www.xemics.com.

Application architecture

Software for this application is available on XEMICS web site. http://www.xemics.com

Mobile system application

Every five seconds the Mobile Sensing Machine activates the gas sensor and its value is read. Once the measurement is finished the Mobile Sensing Machine sends the data to the Base System using the XE1201 transceiver.
The Mobile Sensing Machine is in HALT mode 4.5 seconds / 5 seconds.
For the remaining 0.5 seconds the mobile sensing machine continues to run and it executes the following program steps:

1. Wakeup from HALT.
2. Powers the gas sensor
3. Generates the voltage shape with the XE88LC05 digital to analog converter to stimulate the sensor.
4. Measures the value of sensor with the XE88LC05 ZoomingADC™ converter.
5. Powers up the XE1201 transceiver.
6. Sends the measured data using the transceiver.
7. Mobile Sensing Machine goes into HALT mode.

Base system application

The base system microcontroller (Base sensing machine see Figure 1) waits for the data packet sent by the mobile system. When the base system microcontroller has detected the data packet, it then sends the data packet to the PC.

PC application

The PC application calculates and displays the signal value using the following equation:

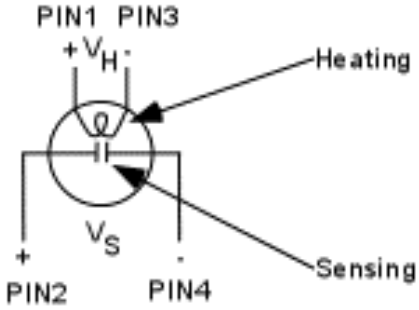
$$Signal = Offset + Gain * Code + Gain2 * Code^2$$

The user can customize the **Offset**, **Gain** and **Gain2** parameters on the PC program.

Code is the digital code sent by the portable system application.

Sensor measuring

Figure 2 shows the gas sensor schematic. The sensor is divided into two parts: a heating part and a sensing part



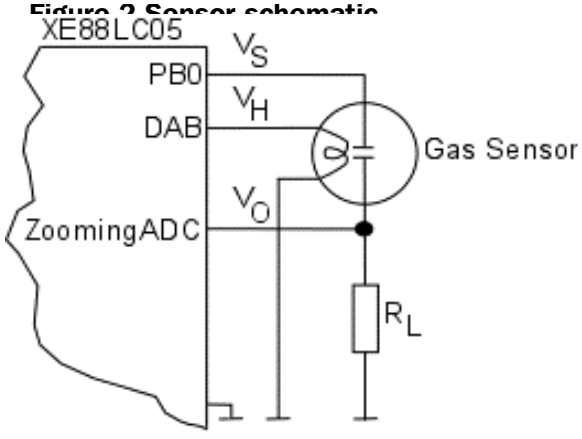


Figure 3 Sensor & XE88LC05 connection

Figure 3 above displays the gas sensor and the XE88LC05 connection.

The Mobile Sensing Machine generates the 2 voltages that are necessary to get the gas sensor working (refer to Figure 3.). The V_S voltage is generated by one digital output of the Mobile Sensing Machine. The DAC Bias converter generates the V_H voltage.

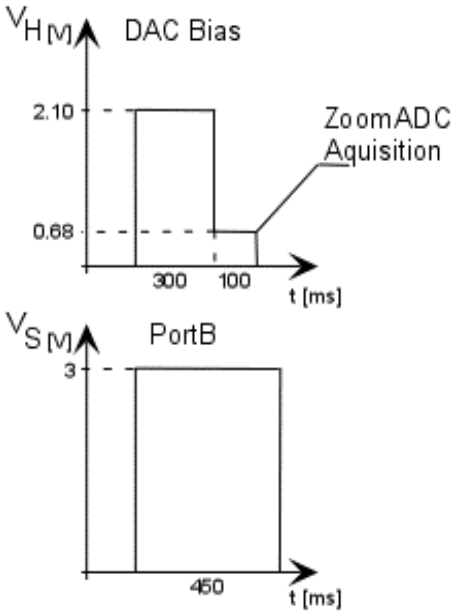


Figure 4: V_H & V_S voltage shape

Having then generated the two voltages, the Mobile Sensing Machine measures the voltage on resistor divider using the ZoomingADC™ converter.

In order to adapt the scale measurement of the ZoomingADC™ to the gas sensor MSGS3000, (refer below to Figure 4.), the ZoomingADC™ converter is configured with a gain of 1 for the first and third PGA and an offset of -2.5V for the third PGA. The second PGA is disabled.

XE88LC05 and XE1201 interface

Base System (Receiver)

The XE88LC05 and the XE1201 for the receiver application are connected as follows:

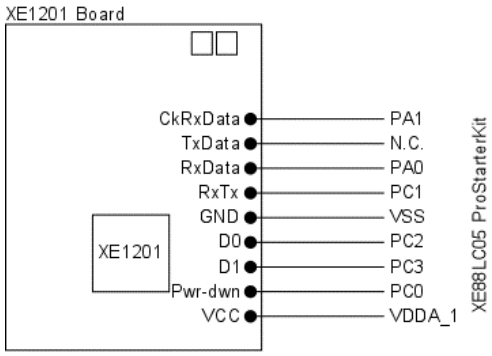


Figure 5: Receiver

Mobile System (Transmitter)

The XE88LC05 and the XE1201 for the transmitter application are connected as follows:

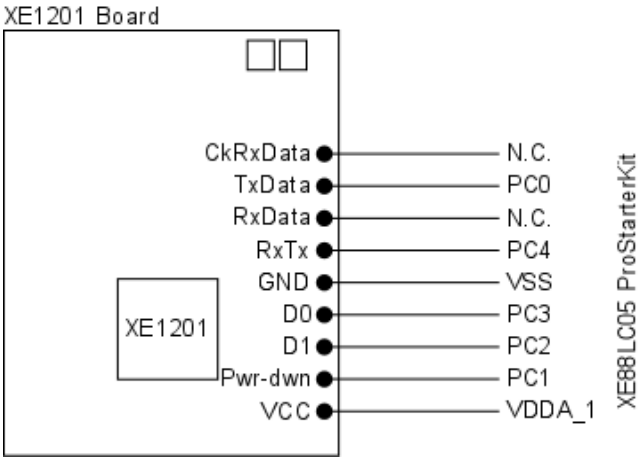


Figure 6: Transmitter

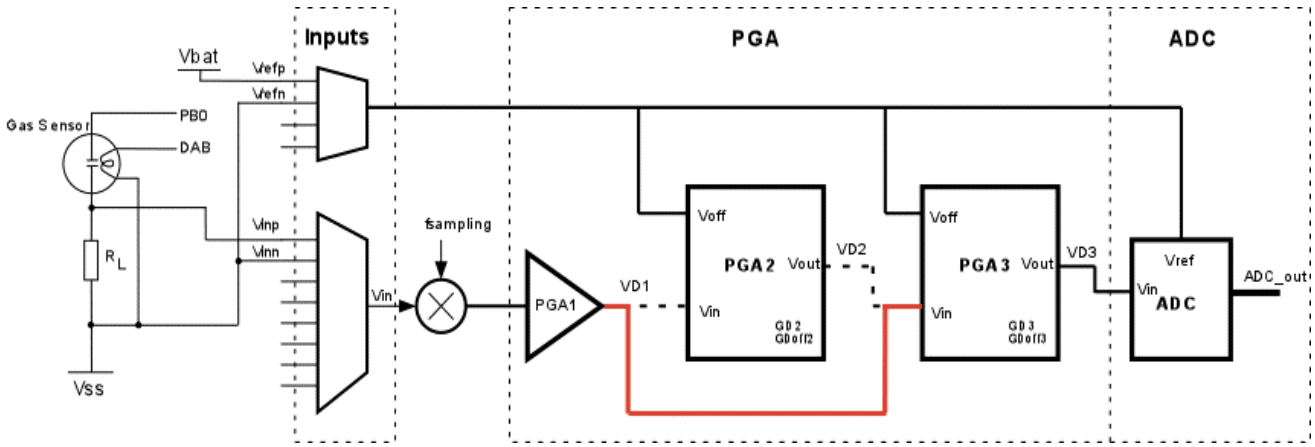


Figure 7: ZoomingADC™

Software description

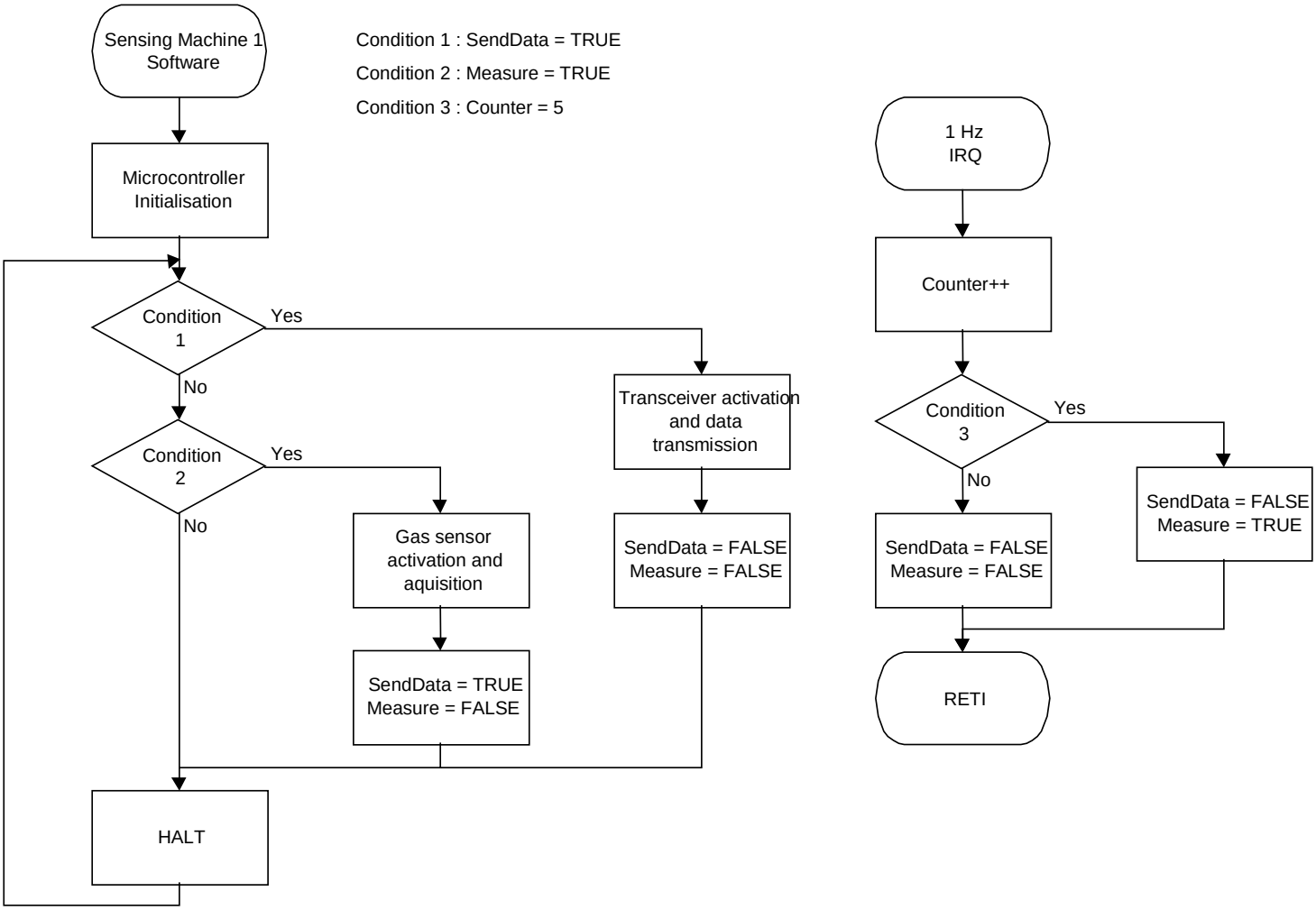


Figure 8: Mobile Application

Base Application

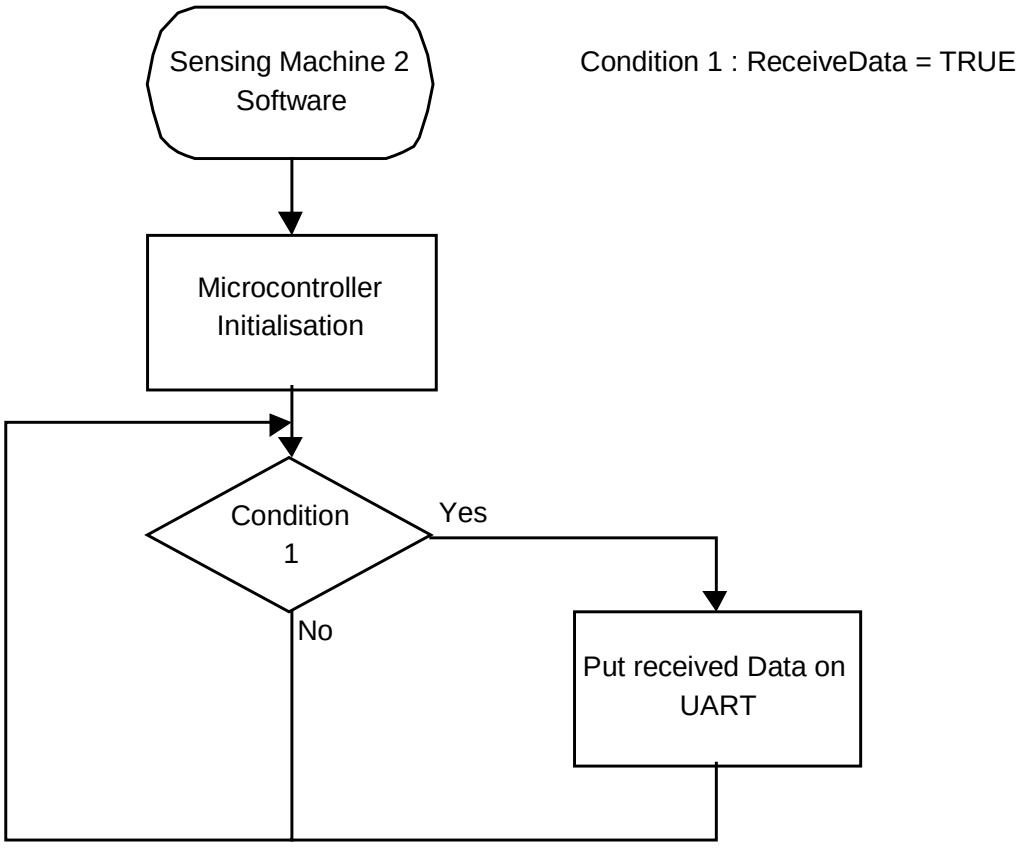


Figure 9: Base Application

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