AMS 5915 AN01
Data readout of AMS 5915 pressure sensors with Arduino Uno

This application note describes, how to interface the OEM pressure sensor AMS 5915 [1] with an Arduino Uno development board [2]. Analog Microelectronics offers a suitable sensor shield to simplify connecting the AMS 5915 to an Arduino Uno and reading data from AMS 5915's I2C port.

Arduino Uno is a popular microcontroller development board featuring an Atmega microcontroller and several I/O-pins including an I2C port and is often used to read data from sensors. As Arduino Uno's I2C port operates at 5 V it is not possible to read data from AMS 5915, a board-mount pressure sensor operating at 3.3 V, without a level shifter.

To simplify the connection of the AMS 5915 pressure sensor with an Arduino board Analog Microelectronics offers the shield *AMS 5915 – Arduino PCB* (available at www.analog-micro.com), which can easily be mounted onto Arduino Uno's pin sockets and provides all the connections needed to power AMS 5915, do the level conversion on the SDA and SCL lines and read I2C data from the sensor. As soon as an AMS 5915 is mounted into the PCB's socket and the PCB is connected to Arduino Uno the system is ready to use (see *Figure 1*).
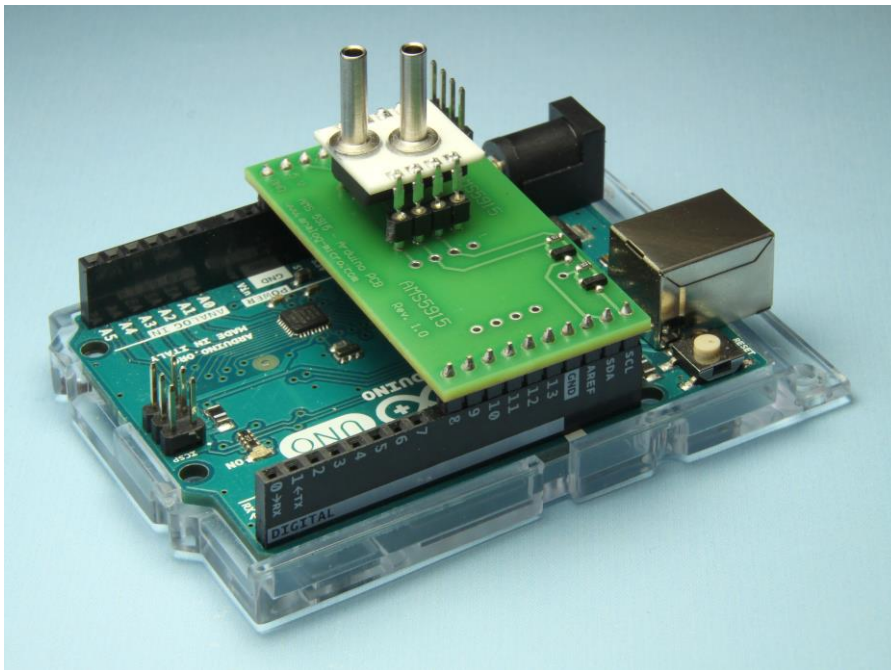

Figure 1: **Arduino Uno with AMS 5915 - Arduino PCB and an AMS 5915 pressure sensor**

Furthermore the *AMS 5915 – Arduino PCB* provides pins to connect another device to the 3.3 V I2C bus on the PCB and a second solder position for a second AMS 5915.

Please note: If two or more AMS 5915 pressure sensors are connected to the same I2C bus the sensors have to respond to different I2C addresses. Individual I2C addresses can be programmed using AMS 5915's starter kit [3] or the pressure sensors can be purchased with pre-programmed individual addresses from Analog Microelectronics.

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Figure 2 illustrates the principle electrical connections which are established by the *AMS 5915 – Arduino PCB* and which are needed for readout of AMS 5915's I2C data using an Arduino. Arduino's 3.3 V voltage source and GND are connected to AMS 5915's corresponding pins directly. As AMS 5915's I2C bus operates at 3.3 V and Arduino Uno's bus works at 5 V a level converter is used to separate both voltage levels and additional pull-up resistors have to be added on the 3.3 V side. Due to Arduino's internal pull-up resistors its SDA and SCL ports are connected to the level converter directly.
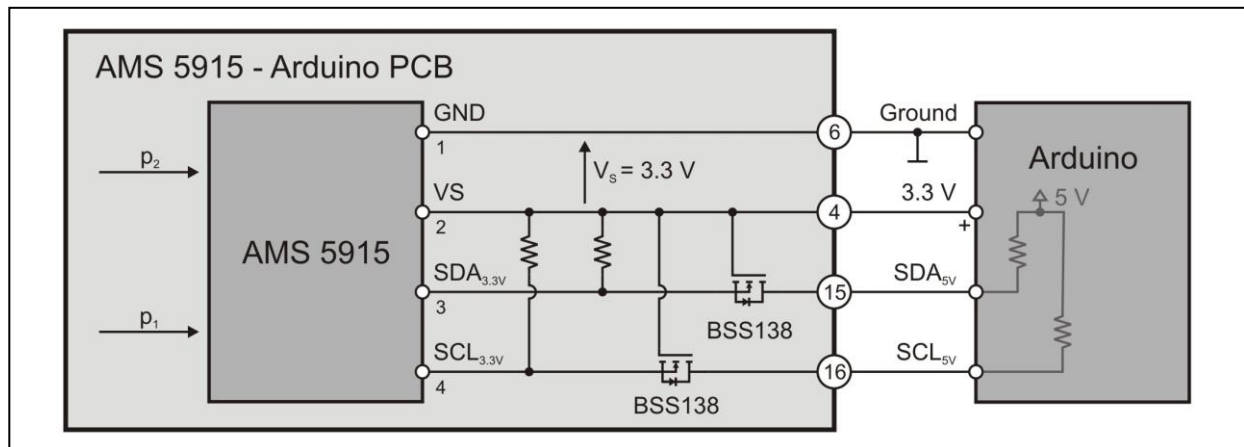

Figure 2: **Connecting AMS 5915 to Arduino**

A simple bidirectional level shifter is realized using an N-channel enhancement MOSFET (e.g. BSS138 [4]) with a threshold voltage of $V_{GS(th)} < 3.3$ V. Two MOSFETs are needed: one for the SCL line and one for the SDA line. The gate is connected to Arduino's 3.3 V supply voltage, the source is connected either to AMS 5915's SCL or SDA pin and the drain to Arduino Uno's respective SCL or SDA pin (for more information see [5]).

For bidirectional level conversion using N-channel enhancement MOSFETs three cases have to be considered:

1. As long as both the 3.3 V and the 5 V part of the level converter are pulled up to their respective HIGH level V_{GS} is 0 V leading to the MOSFET being not conducting and both sides staying on their HIGH level.

2. If the level converter's 3.3 V side is pulled down to LOW level V_{GS} becomes 3.3 V, the MOSFET starts to conduct and the 5 V side is also pulled down to LOW level.

3. In the case that the 5 V side is pulled down to LOW level the drain substrate diode pulls the 3.3 V side down until V_{GS} is larger than $V_{GS(th)}$ and the MOSFET begins to conduct leading to both sides being pulled down to LOW level.

Using those two MOSFET level shifters the I2C communication between AMS 5915 and Arduino Uno is established although they operate at different voltages.

To simplify programming Arduino Uno to read data from AMS 5915's I2C interface Analog Microelectronics has developed the AMS Arduino library [6] for Arduino's integrated development environment (IDE) [7]. It is described in the document "Arduino library for AMS 5812, AMS 5915, AMS 6915" [8] and can be downloaded for free from www.analog-micro.com. With this library the digital pressure and temperature values can easily be read via I2C as soon as the electrical connection between AMS 5915 and Arduino Uno is established. Following the description in the library reference it is only necessary to adjust the pressure range in the initialization sequence to the sensor's pressure range and the sensor's I2C address.

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References:

1.) AMS 5915's data sheet
(see https://www.analog-micro.com/products/pressure-sensors/board-mount-pressure-sensors/ams5915/ams5915-datasheet.pdf)
2.) Arduino Uno (https://www.arduino.cc/en/Main/ArduinoBoardUno)
3.) AMS 5915's starter kit
(see https://www.analog-micro.com/products/pressure-sensors/board-mount-pressure-sensors/ams5915/ams5915-UsersGuide-starterkit.pdf)
4.) BSS138's data sheet (see http://www.onsemi.com/PowerSolutions/product.do?id=BSS138)
5.) AN10441 (https://www.nxp.com/docs/en/application-note/AN10441.pdf)
6.) AMS Arduino library "AMS.zip" (see https://www.analog-micro.com/products/pressure-sensors/board-mount-pressure-sensors/ams5812/AMS.zip)
7.) Aduino's IDE (https://www.arduino.cc/en/Main/Software)
8.) AMS Arduino library reference
(available at https://www.analog-micro.com/products/pressure-sensors/board-mount-pressure-sensors/ams5812/AMS_arduino_lib.pdf)

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