ANM005 - USING MULTIPLE SENSORS ON SINGLE $I^2C$ BUS

<table>
<thead>
<tr>
<th>Description</th>
<th>Order code</th>
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<tr>
<td>3-axis Acceleration Sensor</td>
<td>2533020201601 / 25330202016011</td>
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<tr>
<td>6-axis Inertial Measurement Unit</td>
<td>2536030320001 / 25360303200011</td>
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<td>Absolute Pressure Sensor</td>
<td>2511020213301 / 25110202133011</td>
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<td>Differential Pressure Sensor</td>
<td>25131308xxx01</td>
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<td>Humidity Sensor</td>
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<td>Temperature Sensor</td>
<td>2521020222501</td>
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**Version 1.1**

**February 7, 2023**
## Revision history

<table>
<thead>
<tr>
<th>App note version</th>
<th>Notes</th>
<th>Date</th>
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<tbody>
<tr>
<td>1.0</td>
<td>• Initial release of the app note</td>
<td>June 2022</td>
</tr>
<tr>
<td>1.1</td>
<td>• Added 6 Axis inertial measurement unit WSEN-ISDS: 2536030320001 &amp; 25360303200011</td>
<td>February 2023</td>
</tr>
<tr>
<td></td>
<td>• Updated figures in section 2.2</td>
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</table>
1 Introduction

Current Würth Elektronik eiSos sensor portfolio consists of semiconductor based digital sensors. These sensors have either digital I\(^2\)C or SPI (or both) interfaces through which the host controller communicates with the sensors. On an I\(^2\)C bus each device has an unique 7-bit address through which the Microcontroller (Master) identifies a particular device. So a single I\(^2\)C bus theoretically supports up to 128 slave devices with unique I\(^2\)C device. Würth Elektronik eiSos sensors have following 7-bit slave addresses available.

<table>
<thead>
<tr>
<th>Sensor</th>
<th>Available (^2)C address</th>
<th>Address-1 (hex)</th>
<th>Address-2 (hex)</th>
</tr>
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<tbody>
<tr>
<td>WSEN-HIDS</td>
<td>1</td>
<td>0x5F</td>
<td>-</td>
</tr>
<tr>
<td>WSEN-ITDS</td>
<td>2</td>
<td>0x18</td>
<td>0x19</td>
</tr>
<tr>
<td>WSEN-PADS</td>
<td>2</td>
<td>0x5C</td>
<td>0x5D</td>
</tr>
<tr>
<td>WSEN-PDUS</td>
<td>1</td>
<td>0x78</td>
<td>-</td>
</tr>
<tr>
<td>WSEN-TIDS</td>
<td>2</td>
<td>0x38</td>
<td>0x3F</td>
</tr>
<tr>
<td>WSEN-ISDS</td>
<td>2</td>
<td>0x6B</td>
<td>0x6A</td>
</tr>
</tbody>
</table>

Two of each WSEN-PADS, WSEN-TIDS, WSEN-ISDS and WSEN-ITDS could be connected to the same I\(^2\)C bus since, two I\(^2\)C slave addresses (based on the SAO pin connection) are available for these sensors. Only one of each WSEN-HIDS and WSEN-PDUS could be connected to a single I\(^2\)C bus since only one I\(^2\)C slave address is available.

However, some applications require the use of same sensors multiple times on a single I\(^2\)C bus. For example, to have more than two pressure sensors on a single I\(^2\)C bus. In these cases, the maximum number of devices that could be connected to the I\(^2\)C bus depends on the available slave addresses of that particular device.

![Figure 1: Two WSEN-PADS with separate slave address on an I\(^2\)C bus](image)
2 How to implement multiple sensors with same I\(^2\)C Address?

Two ways are described below on how one can use multiple sensors with the same I\(^2\)C address on a single communication bus and avoid address conflicts.

2.1 Multiplexers

Multiple sensors are connected to the microcontroller (master) through a multiplexer. The master communicates with the multiplexer through one I\(^2\)C address and selects whichever channel the user wants to enable. In this way the I\(^2\)C address conflicts can be resolved and one or more sensors with the same I\(^2\)C address could be enabled.

For example TCA9548A from Texas Instruments is an 8-Channel I\(^2\)C multiplexer and can support up to 8-devices. The Multiplexer has 8 bidirectional translating switches that can be controlled through the I\(^2\)C bus from the master. Each channel consists of a pair of data and clock line and any individual channel or combination of channels can be selected through the programmable registers.
2.2 De-selecting not required sensors through GPIO pins of microcontroller

Using microcontroller GPIO pins, each sensor can be taken into operation (GPIO Pin logic HIGH) one by one, and keeping rest of the sensors de-selected (GPIO logic LOW). Hence, at a time, only one sensor is in working state. This set-up requires use of multiple GPIO pins on the microcontroller side.

For example, WSEN-TIDS SAO pin can be connected to the GPIO pins of microcontroller. By switching the SAO pins of each sensor high one by one, each TIDS sensor can be addressed through one I²C address (SAO= High = 0x38). Rest of the TIDS sensors have their SAO pins at logic LOW with I²C address 0x3F and hence they are de-selected.

Number of sensors that can be attached to the microcontroller in this way also depends upon the number of available GPIO pins.

This is possible only for the sensors with two I²C address. (WSEN-ITDS, WSEN-ISDS, WSEN-PADS and WSEN-TIDS.)
Figure 4: Sensor-1 in operation with I²C address 0x38 because GPIO-1 is high

Figure 5: Sensor-2 in operation with I²C address 0x38 because GPIO-2 is high

For more information about the sensors please refer to the sensor user manuals here
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more than you expect

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