SENSIRION
THE SENSOR COMPANY

Application Note for SDP600 Series (SDPxxx)

Changing Measurement Resolution

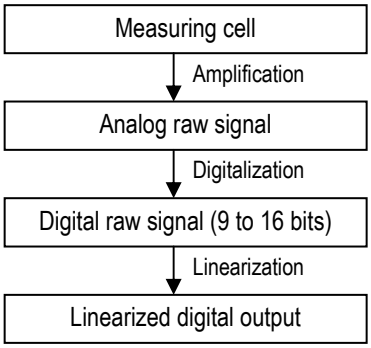
Summary

The differential pressure sensors of the SDP600 series allow to adjust the measurement resolution from 9 to 16 bits. Therefore the user can tune the measuring speed and accuracy to match his specific requirements.

1. Theory

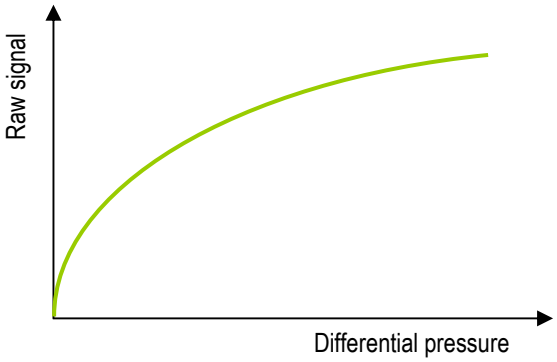
The SDP600 series features a fourth-generation silicon sensor chip called SF04. In addition to a thermal mass flow sensor element, the chip contains an amplifier, Sigma-Delta A/D converter, EEPROM memory, digital signal processing circuitry, and interface.

During the sensor-internal signal conditioning process, the analog signal of the measuring cell is amplified, digitized and linearized (calibrated). Depending on the integration time of the analog raw signal, the Sigma-Delta-ADC delivers a digital signal with a resolution from 9 to 16 bits.



A higher resolution of the signal relates to a longer integration time, which delivers a smoother and more precise differential pressure value. A lower resolution relates to a short integration time, delivering measurement results with faster response times.

The analog raw signal is more sensitive for low differential pressures, as illustrated in the figure below. The resolution of the linearized sensor output is therefore not evenly distributed. At 12bit (default), the digital resolution is about 0.025Pa near zero and about 1.1Pa near full-scale (500Pa).



After the process of linearization, the sensor output is always a 16bit integer value, scaled with the sensor's scale factor of 60Pa^{-1}. However, this 16 bit number is based on the internal digital resolution, which can be adjusted by the customer.

For most applications, Sensirion recommends to work with 12 bit resolution (default setting) in order to combine excellent accuracy with fast response time.

2. Change sensor resolution

The setting for the resolution is stored in the advanced user register. To change the measurement resolution, the following steps have to be done:

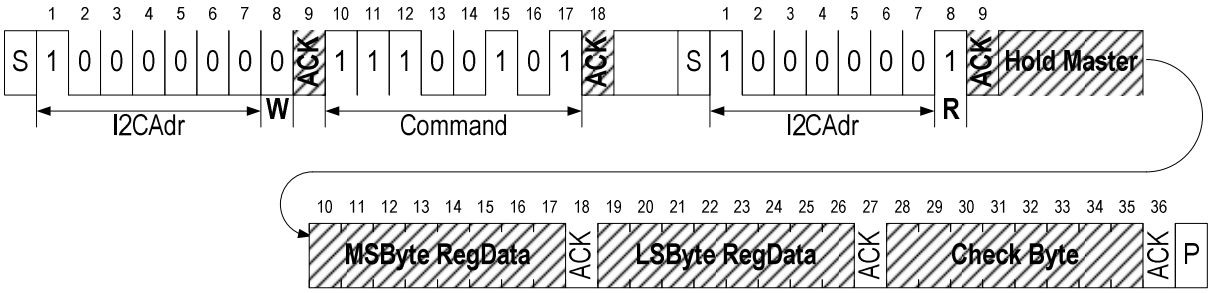
1. Read advanced user register.
2. Define the new register entry according to the desired resolution.
3. Write the new value to the advanced user register.

Read Advanced User Register

Read the content of the advanced user register. After the header with R/_W=1, the sensor system writes the register value to the bus. The first byte written is the most significant byte, the second byte the least significant byte of the register. A CRC byte follows if the master continues clocking the SCK line after the second byte. The sensor system checks whether the master sends an acknowledge after each byte and aborts the transmission if not. Note that two transfer sequences are needed. The first sequence stores the command, while the second sequence invokes the previously stored command in READ mode.

I²C Read Register

8-bit command code: ***hE5***
Command: **Read advanced user register**



Hatched areas indicate that the sensor controls the SDA line.

Advanced user register content

The resolution of measurement is stored in bits 11 to 9 of the advanced user register, whereas bit 15 represents the most significant bit (MSB) and bit 0 represents the least significant bit (LSB).

Bit number	15 MSB	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0 LSB
Default advanced user register setting for most SDP600 sensor versions with 12bit resolution (h7782) *	0	1	1	1	**0**	**1**	**1**	1	1	0	0	0	0	0	1	0
	Do not change!				Resolution			Do not change!								
Changed advanced user register	0	1	1	1	X	X	X	1	1	0	0	0	0	0	1	0

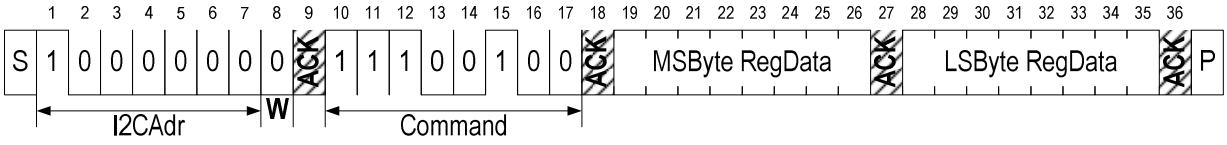
*** If the gray entries differ from the entries in your sensor, do not change the values stored in your sensor.**

The coding of the resolutions is according to the following table.

000:	9 bit	100:	13 bit
001:	10 bit	101:	14 bit
010:	11 bit	110:	15 bit
011:	**12 bit (default)**	111:	16 bit

Write Advanced User Register

Overwrite the register addressed by the command. After the command byte the sensor system reads the new register value from the bus. The first byte is stored as the most significant byte, the second byte is stored as the least significant byte of the register. The sensor system acknowledges successful reception of each byte (ACK)

I²C Write Register
8-bit command code: ***hE4***   Command: **Write advanced user register**

Hatched areas indicate that the sensor controls the SDA line.

Default resolution

After each hard reset or soft reset of the sensor, the default resolution is written to the advanced user register. When working with a different setting, the measurement resolution has to be changed after every power-on or soft reset.

3. Response time

Dependent on the resolution, the internal integration time and therefore the response time of the sensor changes. The following table shows the processing time for different resolutions. Please note that there is an additional delay for the first measurement after a power-on or a soft reset of the sensor.

Resolution [bit]	Processing Time [ms]		
	Min.	Typ.	Max.
9	0.5	0.8	0.9
10	1.0	1.3	1.5
11	2.0	2.4	2.6
12	4.1	4.6	4.9
13	8.2	8.9	9.4
14	16.4	17.5	18.5
15	32.8	34.8	36.7
16	65.5	69.3	73.2

4. Revision history

Date	Author	Version	Changes
Sept. 20, 2008	PHA	V0.1	Preliminary release
June 2009	PHA	v1.0	Release
May 2010	DAT	V1.1	Minor changes

Headquarter and Sales Offices

SENSIRION AG
Laubisruetistr. 50
CH-8712 Staefa ZH
Switzerland

Phone: + 41 (0)44 306 40 00
Fax: + 41 (0)44 306 40 30
info@sensirion.com
www.sensirion.com

SENSIRION Inc
Westlake Pl. Ctr. I, suite 204
2801 Townsgate Road
Westlake Village, CA 91361
USA

Phone: +1 805-409 4900
Fax: +1 805-435 0467
michael.karst@sensirion.com
www.sensirion.com

SENSIRION Japan
Sensirion Japan Co. Ltd.
Shinagawa Station Bldg. 7F
4-23-5 Takanawa
Minato-ku, Tokyo, Japan

phone: +81 3-3444-4940
fax: +81 3-3444-4939
info@sensirion.co.jp
www.sensirion.co.jp

SENSIRION Korea Co. Ltd.
#1414, Anyang Construction Tower B/D,
1112-1, Bisan-dong, Anyang-city,
Gyeonggi-Province, South Korea

Phone: +82-31-440-9925~27
Fax: +82-31-440-9927
info@sensirion.co.kr
www.sensirion.co.kr

SENSIRION China Co. Ltd.
Room 2411, Main Tower
Jin Zhong Huan Business Building,
Postal Code 518048
Futian District, Shenzhen, PR China

Phone: +86 755 8252 1501
Fax: +86 755 8252 1580
info@sensirion.com.cn/
www.sensirion.com.cn

Find your local representative at: http://www.sensirion.com/reps