DT0132
Design Tips

Digital pressure sensor: efficient design tips

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Main components	
LPS22HH	High-performance MEMS nano pressure sensor: 260-1260 hPa absolute digital output barometer
LPS22HB	MEMS nano pressure sensor: 260-1260 hPa absolute digital output barometer
LPS22HD	Piezoresistive absolute pressure sensor, 260-1260 hPa, digital output barometer, small and thin package
LPS35HW	MEMS pressure sensor: 260-1260 hPa absolute digital output barometer with water resistant package
LPS33HW	MEMS pressure sensor: 260-1260 hPa absolute digital output barometer with water-resistant package

Purpose and Benefits

The purpose of this design tip is to providee guidelines for a more power-efficient system integration of ST pressure sensors.

Description

LPS22HH, LPS22HB, LPS22HD, LPS35HW and LP33HW are digital barometers equipped with SPI and I2C interfaces. In addition, all these devices have dedicated interrupt pins INT/DRY.

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Interrupt Pins

Table 1 shows the INT/DRDY pin number for the digital pressure sensor mentioned above. The fact that the pin is in the same position guarantee a pin-to-pin compatibility between the parts.

Table 1. INT/DRY pin position

	INT/DRDY
LPS22HH	Pin 7
LPS22HB	Pin 7
LPS22HD	Pin 7
LPS35HW	Pin 7
LPS33HW	Pin 7

The INT/DRDY pin is in push-pull as default condition. The configuration from push-pull to open-drain condition by selecting the PP_OD bit in the *CTRL_REG3 (12h)* for LPS22HB, LPS22HD, LPS35HW and LPS33HW while *CTRL_REG2(11h)* for LPS22HH.

The minimum high-level output voltage value (VOH) is 0.8*Vdd_IO, while the maximum low-level output voltage value (VOL) is 0.2.

Polarity

The polarity of the interrupt, which can be active high or low, is managed by changing the proper bit in the configuration register. This particular bit is called INT_H_L in the *CTRL_REG3(12h)*. The default value of that bit is set to “0” which means active high.

Default INT/DRY – No latched

Interrupt pin in default condition is not configured in latch mode which means that both interrupt pins will automatically be reset after T=1/ODR, where ODR is the Output data Rate (controlled by the *CTRL_REG1 (10h)*).

Latched INT/DRY

In order to set the latch mode, the bit LIR must be set in the *INTERRUPT_CFG (0Bh)*, respectively.
The interrupt will be reset by reading the *INT_SOURCE (25h)* for LPS22HB, LPS35HW and LPS33HW while *INT_SOURCE (24h)* for LPS22HH.
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I2C Bus

It is mandatory to set the CS pin to Vdd in order to enable the I2C communication. There is no internal pull-up resistor for that pin. Table 2 shows the pin position for the SDO/SA0 pin

Table 2. SDO/SA0 pin position

	SDO/SA0
LPS22HH	Pin 5
LPS22HB	Pin 5
LPS22HD	Pin 5
LPS35HW	Pin 5
LPS33HW	Pin 5

The SDO/SA0 pin is driven by the internal pull-up resistor.

In order to disconnect the pull-up on the SDO pin for LPS22HB, LPS22HD, LPS35HW and LPS33HW, the MSB bit in the *CTRL_REG(49h)* has to be set to “1”

To avoid compromising the functionality of the device, it is important not to change the rest of the content in *CTRL_REG(49h)* register. The following procedure is required to avoid any modification of the register content:

a = read(0x17) ;

write(0x17, (0x80 OR a))

While for LPS22HH there is a dedicated SDO_PU_EN bit on the IF_CTRL(0Eh) register.

Table 3 shows the I2C addresses based on the SDO/SDA selection

Table 3: I2C addresses based on SDO/SA0 pin selection

SAD[6:1]	SAD[0]=SDO/SA0	SAD
101110	0	5Ch
001100	1	5Dh

At these addresses, it is necessary to add the operation (R/W) on the I2C comunication. A read operation (R) is set as ‘1’, while a write operation (W) is set as ‘0’ as LSB bit (referring to the datasheet).

SPI Bus

If the SPI is the serial protocol selected, it is recommended to disable the I2C in order to avoid spurious transaction, in particular, if the bus is shared with a memory. This can be done by enabling the I2C_DIS bit on the *CTRL_REG2 (11h)* register for LPS22HB, LPS35HW and

LPS33HW, while this bit is located in *IF_CTRL (0Eh)* for LPS22HH. It is possible to select the SPI 4- or 3-wire by selecting the SIM bit in the *CTRL_REG1 (10h)* register.

Recommendation for Power Efficiency

It is recommended to use the default configuration as often as possible in order to avoid additional current consumption at the power-up phase. For instance, when the I2C bus is selected, it is better to set the SDO/SDA pin to Vdd instead of GND in order to leverage the internal pull-up. That will avoid dynamic extra power consumption at the device power up.

Considering the fact that the INT/DRY is a push pull configuration, it is important to avoid inserting pull-up resistors on these pins. When it is used, the push-pull configuration for INT/DRY pin in default condition offers a more efficient power consumption compared to the case when the open drain configuration is selected. That will avoid extra current at the power-up phase before changing the default configuration.

The open drain configuration is a more preferred option when multiple devices share the same interrupt line. Assuming the polarity is in default condition, it is possible to share the INT/DRY line by implementing a pull-up resistor..

Additional Support Materials

Related Documentation
AN5209: LPS22HH: MEMS nano pressure sensor
AN4672**:** LPS22HB/LPS25HB digital pressure sensors: hardware guidelines for system integration
DT0096**:** LPS33HW digital pressure sensor: hardware guidelines for system integration
TN1198**:** Surface mount guidelines for MEMS sensors in HLGA packages

Revision History

Date	**Version**	**Changes**
10-Dec-2018	1	Initial release

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