AN4833
Application note

Measuring pressure data from ST's LPS22HB digital pressure sensor

Introduction

This application note describes the methods and techniques for measuring pressure data from LPS22HB.

The LPS22HB is an ultra-compact piezo-resistive absolute pressure sensor which functions as a digital output barometer. The device comprises a sensing element and an IC interface which communicates through I^2C or SPI from the sensing element to the application. The sensing element, which detects absolute pressure, consists of a suspended membrane manufactured using a dedicated process developed by ST.

This document does not modify the content of the official datasheet. Please refer to the datasheet for parameter specifications.

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1 Overview

The LPS22HB features three operating modes: power-down, one-shot and continuous mode.

1.1 Power-down mode

When the device is in power-down mode, almost all internal blocks of the device are switched off to minimize power consumption. The I²C interface is active to allow the communication with the device. The content of the configuration registers is preserved and the output data registers are not updated. Therefore the last sampled data are kept in memory once the device goes in power-down mode.

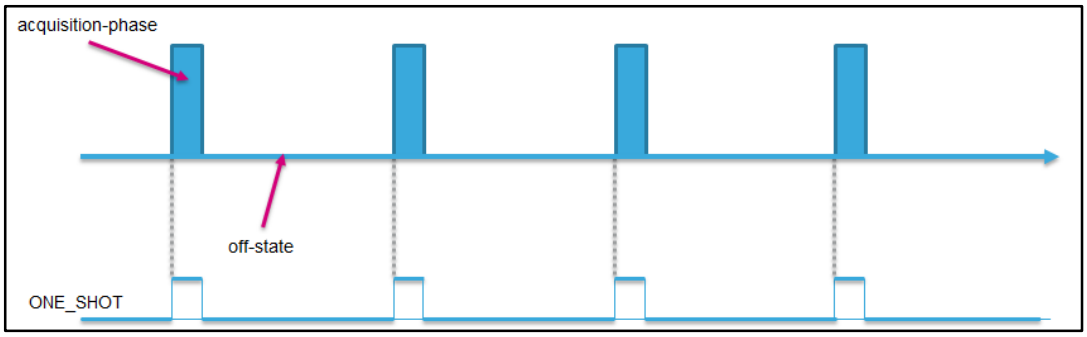
The device is in power-down mode when ODR[2,0] bits in CTRL_REG1 (10h) are set to ‘000’.

1.2 One-shot mode

When the device is one-shot mode, it acquires a new conversion when it is requested. After the acquisition has been completed, the device automatically is set to power-down mode.

One shot mode can be enabled when the device is in power-down mode (ODR[2,0] bits in CTRL_REG1 (10h) set to '000') and when the ONE_SHOT bit in CTRL_REG2 (11h) is set to '1'.

Figure 1: One-shot mode



Once the acquisition is completed and the output registers updated, the device automatically enters in power down mode and ONE_SHOT bit is self-cleared.

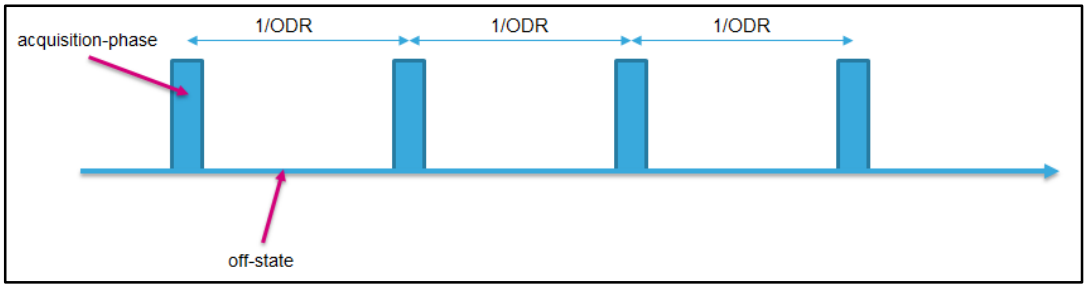
1.3 Continuous mode

When the ODR[2,0] bits in CTRL_REG1 (10h) register are set to a value different than '000', the device is in continuous mode and automatically acquires a set of data (pressure and temperature) at the frequency selected through ODR[2,0] bits in CTRL_REG1 (10h) register.

Table 1: Sampling frequency selection

ODR2	ODR1	ODR0	Pressure ODR	Temperature ODR
0	0	0	Power down / one-shot mode enabled	
0	0	1	1 Hz	1 Hz
0	1	0	10 Hz	10 Hz
0	1	1	25 Hz	25 Hz
1	0	0	50 Hz	50 Hz
1	0	1	75 Hz	75 Hz

Figure 2: Continuous mode



1.4 Resolution configuration

The LPS22HB can be configured in two resolution modes that can be used in both one-shot mode and continuous mode.

The LC_EN bit in RES_CONF (1Ah) register defines the resolution mode:

- LC_EN set to '0': Normal mode –enabled by default
- LC_EN set to '1': Low current mode.

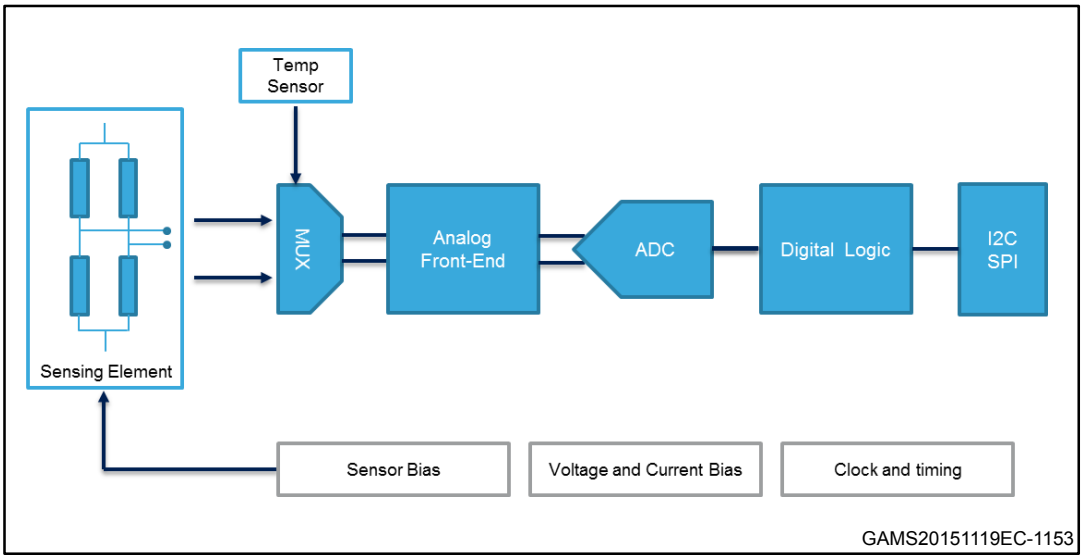
In normal mode, the device is optimized to lower the noise, while in low current mode the device minimizes the current consumption.

For the proper behavior of the pressure sensor, the LC_EN bit must be changed only when the device is in power down.

2 Device architecture

The LPS22HB is a piezoresistive absolute pressure sensor which functions as a digital output barometer. The device comprises a sensing element and an IC interface which communicates through I²C or SPI from the sensing element to the application.

Figure 3: LPS22HB architecture block diagram



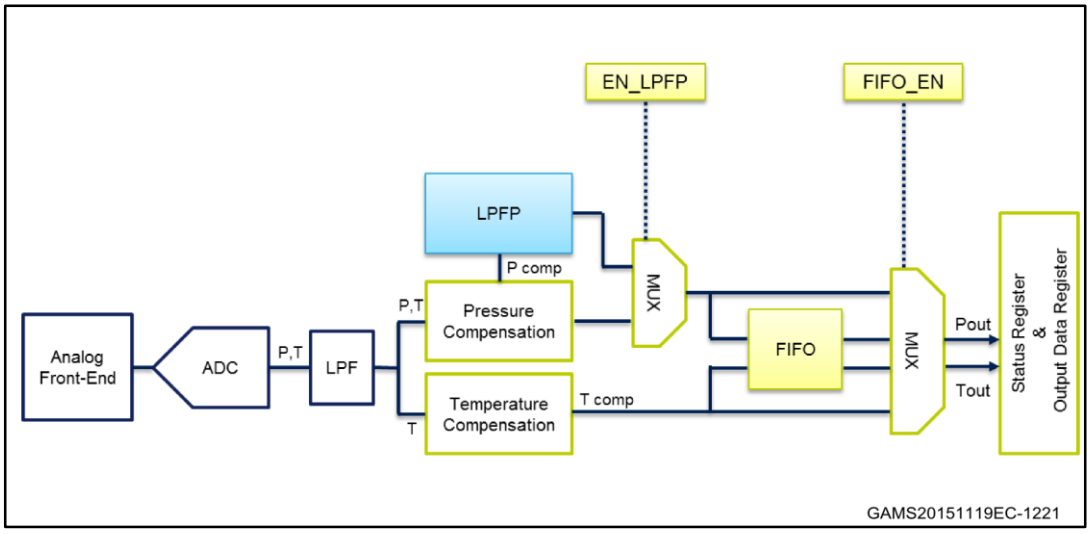
The sensing element, which detects absolute pressure, consists of a suspended membrane manufactured using a dedicated process developed by ST.

Information on how to interpret the pressure and the temperature readings can be found in the technical note *"TN1229: How to interpret pressure and temperature readings in the LPS22HB pressure sensor"*, available on www.st.com.

2.1 Digital low pass filter

The LPS22HB has an additional low pass filter embedded that can be applied on the pressure readout path when the device is in continuous mode.

Figure 4: Device architecture



The optional digital filter can be enabled setting the EN_LPFP bit in CTRL_REG1 (10h) and its bandwidth can be configured acting on LPFP_CFG bit in CTRL_REG1 (10h) register.

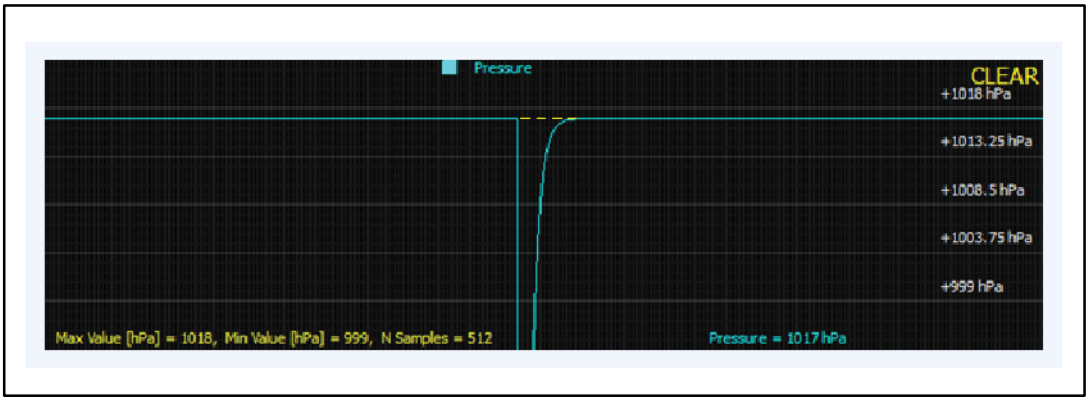
Table 2: Low pass filter settings

EN_LPFP	LPF_CFG	Additional low pass filter status	Device bandwidth
0	X	Disabled	ODR/2
1	0	Enabled	ODR/9
1	1	Enabled	ODR/20

2.1.1 Filter reset

If the LPFP is active, in order to avoid the transitory phase, the filter can be reset by reading the register LPFP_RES (33h) before getting out pressure measurements.

Figure 5: LPFP reset



Every time the LPFP is used, it is suggested to perform a reset of the filter immediately after the ODR has been set.

2.1.2 Examples of device LPF configurations

Table 3: ODR bits in CTRL_REG1 (10h) set to '100': ODR = 75 Hz

EN_LPFP	LPF_CFG	Additional low pass filter status	Device bandwidth [Hz]
0	x	Disabled	37.5
1	0	Disabled	8.3
1	1	Enabled	3.75

Table 4: ODR bits in CTRL_REG1 (10h) set to '001': ODR =1Hz

EN_LPFP	LPF_CFG	Additional low pass filter status	Device bandwidth [Hz]
0	x	Disabled	0.5
1	0	Disabled	0.1
1	1	Enabled	0.05

3 FIFO

The LPS22HB has embedded a 32-slot FIFO for pressure and temperature data in order to decrease the host processor interaction and facilitate post processing data for events recognition.

Using FIFO allows a consistent power saving for the system, it can wake-up only when needed and burst the significant data out from the FIFO.

The FIFO buffer can work according to seven different modes that guarantee a high-level of flexibility during application development:

1. Bypass mode
2. FIFO mode
3. Stream mode
4. Stream-to-FIFO mode
5. Bypass-to-Stream
6. Bypass-to-FIFO mode
7. Dynamic-Stream mode

A description of the FIFO mode is provided in *Section 3: "FIFO"*, while examples can be found in *Section 7: "Appendix"*.

FIFO can also be programmed to generate interrupt events on the INT_DRDY pin.

3.1 FIFO description

The FIFO buffer is able to store up to 32 pressure and temperature samples of 24-bit and 16-bit words respectively.

The data samples set consists of 5 bytes (PRESS_OUT_XL, PRESS_OUT_L, PRESS_OUT_H, TEMP_OUT_L, TEMP_OUT_H) and they are released to the FIFO at the selected output data rate (ODR).

3.2 Retrieving data from FIFO

FIFO data is read through PRESS_OUT registers (28h, 29h, 2Ah) and TEMP_OUT registers (2Bh,2Ch).

A read operation on PRESS_OUT registers provides the pressure data stored in the FIFO, while on TEMP_OUT registers the temperature data. Every time a data set is read from the FIFO, the oldest entry is placed in the PRESS_OUT registers. Both single read and multiple read operations can be used.

In case of multiple reads, the device automatically updates the reading address and it rolls back to 28h when register 2Ch is reached. To read all FIFO levels in multiple byte reading, 160 bytes (5 output registers by 32 levels) must be read.

Information on how to interpret the pressure and the temperature readings can be found on the technical note TN1229: How to interpret pressure and temperature readings in the LPS22HB pressure sensor, available on www.st.com.

3.3 FIFO setting and control

At the device power up, the FIFO is not enabled, and the pressure and temperature data are not stored in the FIFO, but stored in the output temperature and pressure registers.

The FIFO can be controlled using three registers:

- CTRL_REG2 for enabling the FIFO and the watermark level definition
- FIFO_CTRL(14h) for setting the FIFO mode and watermark level
- FIFO_STATUS(26h) for reading out the FIFO status during running

To enable the FIFO buffer FIFO_EN bit in CTRL_REG2 (11h) has to be set to '1' and the FIFO working mode is defined by the FIFO_MODE[2:0] bits in FIFO_CTRL (14h), as indicated in the table below.

Table 5: FIFO mode selection

F_MODE2	F_MODE1	F_MODE0	FIFO mode selection
0	0	0	Bypass mode
0	0	1	FIFO mode
0	1	0	Stream mode
0	1	1	Stream-to-FIFO mode
1	0	0	Bypass-to-STREAM Mode
1	0	1	Reserved
1	1	0	Dynamic-Stream mode
1	1	1	Bypass-to-FIFO mode

The FIFO buffer can store up to 32 level of data. The FIFO depth can be limited by setting the STOP_ON_FTH bit in CTRL_REG2(11h) to ‘1’ and by defining the needed FIFO depth defining a watermark level with the WTM bits in FIFO_CTRL(14h). To convert the WTM bits in the number of level stored in the FIFO, it is enough to convert from binary to decimal the value in WTM bits and add 1. As example, if the FIFO depth needs to be limited to 12 level, the WTM bits have to be set to ‘01011’.

FIFO_STATUS (26h) register provides information about the FIFO status:

- FTH_FIFO bit goes to ‘1’ if the number of unread samples is greater than or equal to water mark level selected by WTM[4:0] in FIFO_CTRL (14h).
- OVR bit goes to ‘1’ if the FIFO buffer is full and at least one sample in the FIFO has been overwritten
- FSS[5:0] provides information on the data stored in the FIFO buffer.
  - FSS is equal to ‘000001' when 1 data set is stored in the FIFO
  - FSS is equal to ‘100000’ when 32 data set is stored in the FIFO

3.4 FIFO modes

3.4.1 Bypass mode

In Bypass mode (FIFO_CTRL(FMODE2:0) = ‘000’) the FIFO is not operational and the buffer remains empty. The pressure and temperature values are sent directly to PRESS_OUT and TEMP_OUT registers.

3.4.2 FIFO mode

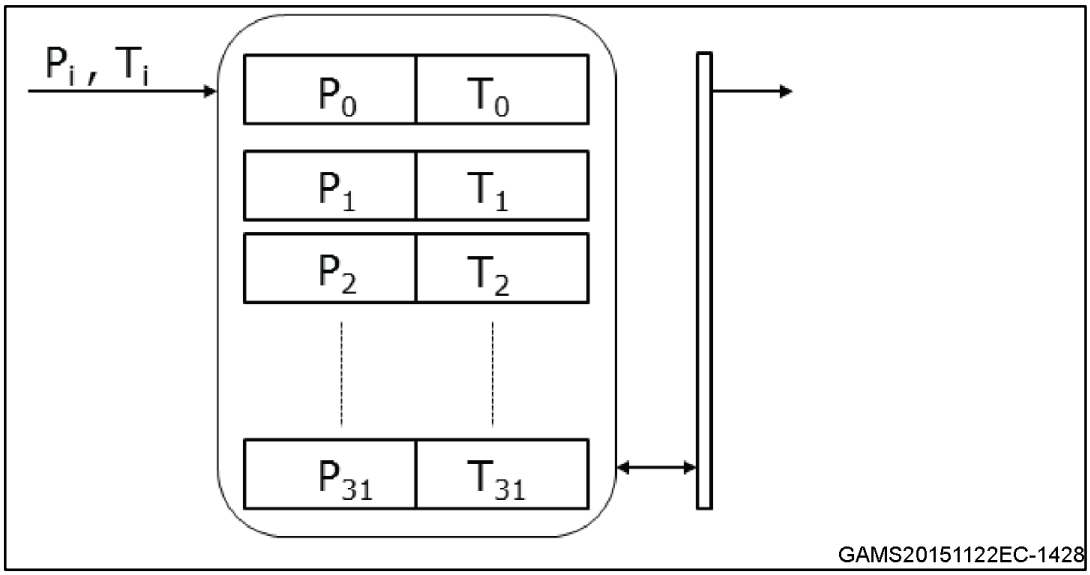
In FIFO mode (FIFO_CTRL(FMODE2:0) = ‘001’) the pressure and temperature acquired are stored in the buffer: the content of the registers PRESS_OUT_XL (0x28), PRESS_OUT_L (0x29), PRESS_OUT_H (0x2A), TEMP_OUT_L (0x28) and TEMP_OUT_H (0x2A) are stored in the FIFO.

When the FIFO is full or the watermark is reached, the update on the FIFO is stopped until the buffer is read or reset.

It is mandatory to reset the FIFO in case of the FIFO is full and another sample is collected.

To reset FIFO content, the value '000' must be written in FIFO_CTRL(FMODE2:0). After this reset command, it is possible to restart FIFO mode writing the value '001' in FIFO_CTRL(FMODE2:0).

Figure 6: FIFO mode

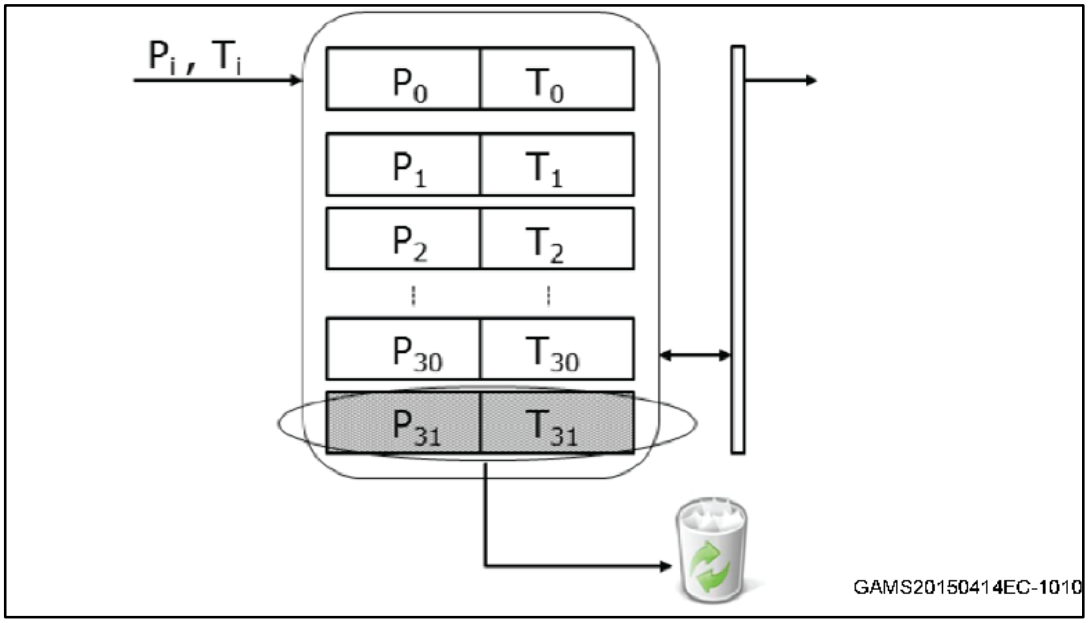


3.4.3 Stream mode

In Stream mode (FIFO_CTRL(FMODE2:0) = ‘010’), the pressure and temperature acquired are stored in the buffer: the content of the registers PRESS_OUT_XL (0x28), PRESS_OUT_L (0x29), PRESS_OUT_H (0x2A), TEMP_OUT_L (0x28) and TEMP_OUT_H (0x2A) are stored in the FIFO. Once the FIFO is full or the watermark level is reached, the new data replace the older ones stored in the buffer.

Once the entire FIFO has been read, the last data read remains in the FIFO. When a new sample is acquired, the FIFO_STATUS(FSS5:0) value rises from 0 to 2.

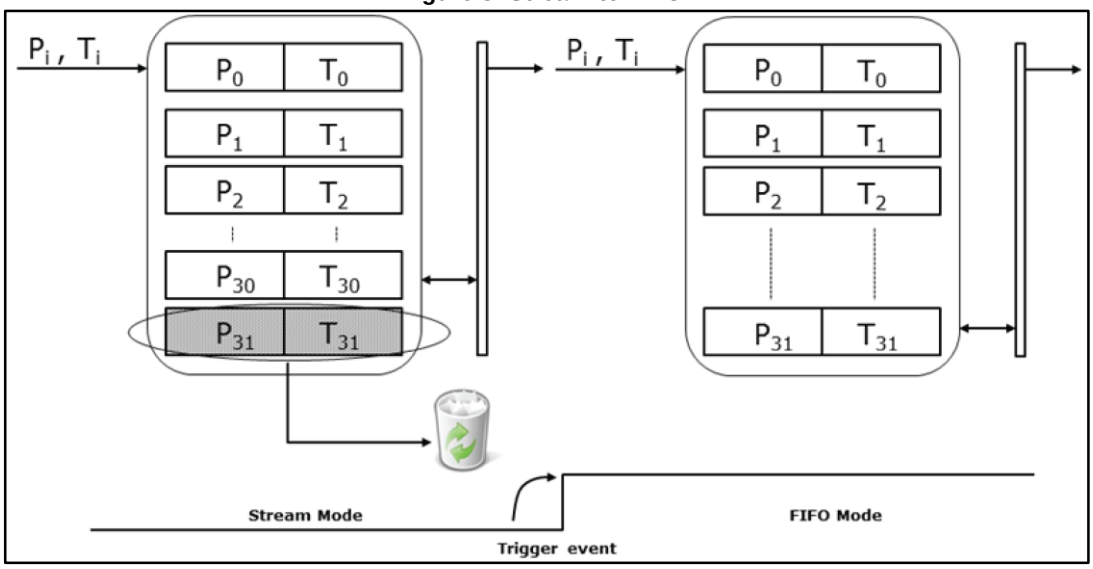
Figure 7: Stream mode



3.4.4 Stream-to-FIFO mode

In Stream-to-FIFO mode (FIFO_CTRL(FMODE2:0) = ‘011’), the FIFO works in Stream mode until a trigger event is generated and then in FIFO mode. The trigger event can be set through INTERRUPT_CFG (0Bh). If the interrupt is triggered, INT_SOURCE(IA) bit is equal to '1', the FIFO switch from Stream to FIFO mode. When the interrupt is de-asserted, INT_SOURCE(IA) bit is equal to '0', the FIFO switch back to Stream mode.

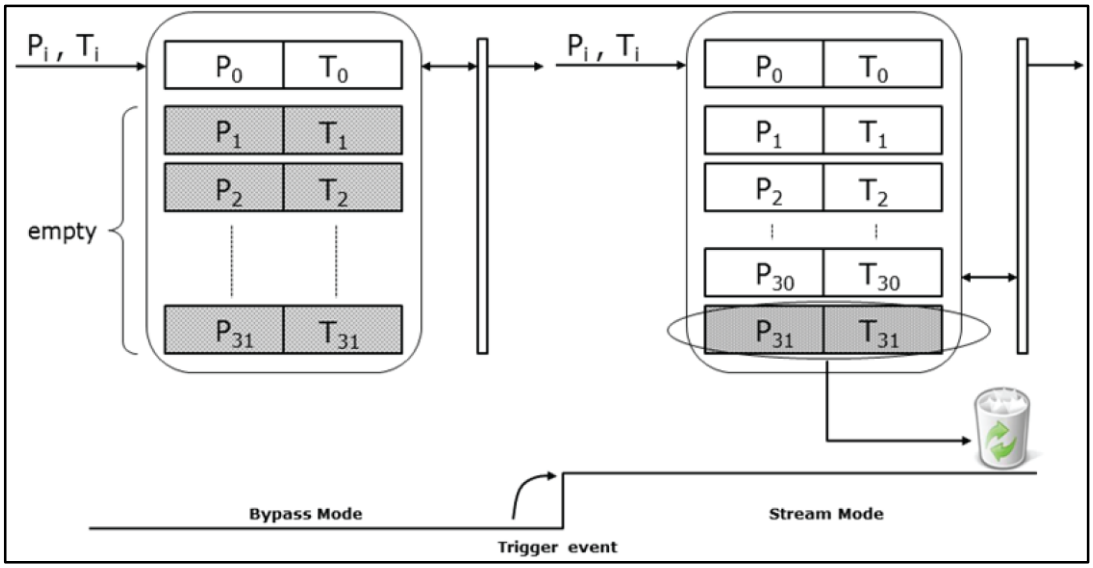
Figure 8: Stream-to-FIFO



3.4.5 Bypass-to-Stream mode

In Bypass-to-Stream mode (FIFO_CTRL(FMODE2:0) = ‘100’), the FIFO works in Bypass mode until a trigger event is generated and then in Stream mode. The trigger event can be set through INTERRUPT_CFG (0Bh). If the interrupt is triggered, INT_SOURCE(IA) bit is equal to '1', the FIFO switch from Bypass to Stream mode. When the interrupt is de-asserted, INT_SOURCE(IA) bit is equal to '0', the FIFO switch back to Bypass mode.

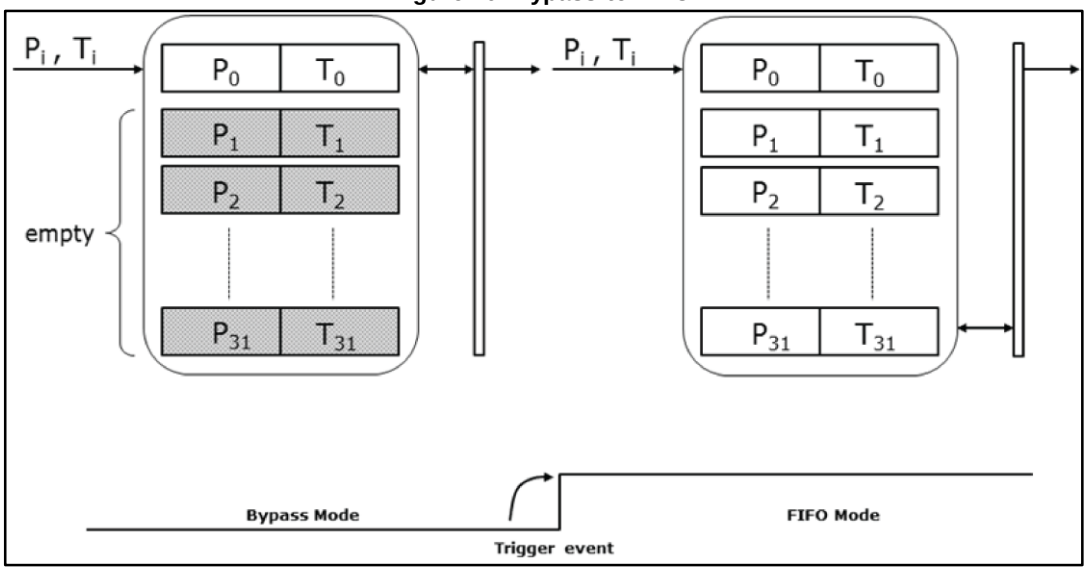
Figure 9: Bypass-to-Stream



3.4.6 Bypass to FIFO mode

In Bypass-to-FIFO mode (FIFO_CTRL(FMODE2:0) = ‘111’), the FIFO works in Bypass mode until a trigger event is generated and then in FIFO mode. The trigger event can be set through INTERRUPT_CFG (0Bh). If the interrupt is triggered, INT_SOURCE(IA) bit is equal to '1', the FIFO switch from Bypass to FIFO mode. When the interrupt is de-asserted, INT_SOURCE(IA) bit is equal to '0', the FIFO switch back to Bypass mode.

Figure 10: Bypass-to-FIFO

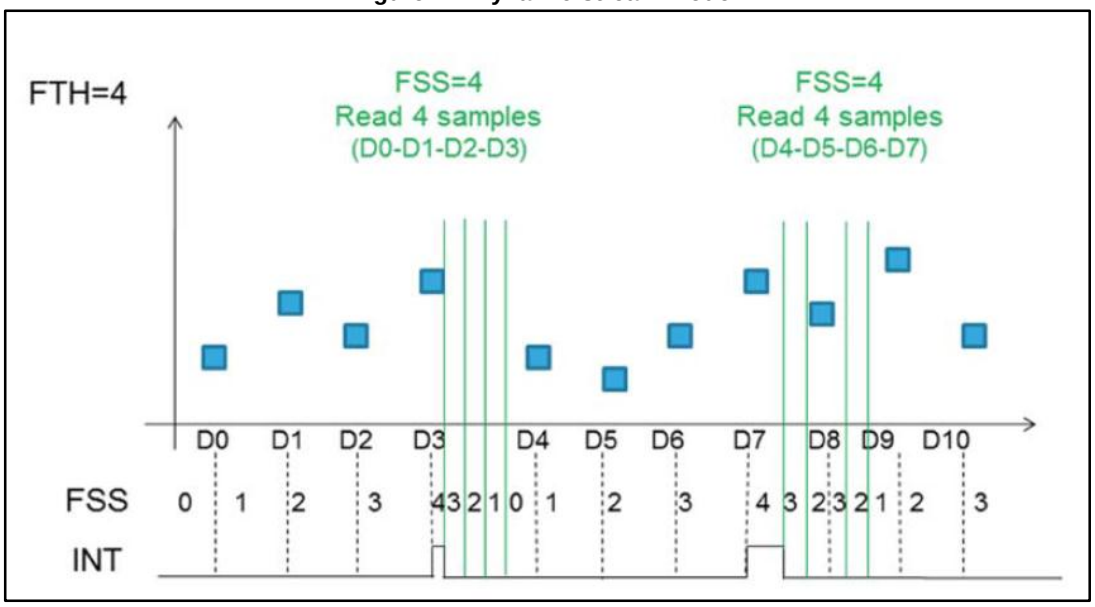


3.4.7 Dynamic-stream mode

In dynamic-stream mode (FIFO_CTRL(FMODE2:0) = 110) after emptying the FIFO, the first new sample that arrives becomes the first to be read in a subsequent read burst. In this way, the number of new data available in FIFO does not depend on the previous reading.

In dynamic-stream mode FIFO_STATUS(FSS5:0) is the number of new pressure and temperature samples available in the FIFO buffer.

Figure 11: Dynamic-stream mode



4 Offset compensation (OPC)

If, after the soldering of the component, a residual offset is still present, it can be removed with a one-point calibration.

After the soldering, the measured offset can be stored in the RPDS (18h, 19h) registers and automatically subtracted from the pressure output registers: the output pressure register PRESS_OUT (28h,29h and 2Ah) is provided as the difference between the measured pressure and the content of the register 256*RPDS (18h, 19h) (DIFF_EN = ‘0’, AUTOZERO =‘0’, AUTORIFP= ‘0’)[a].

[a] DIFF_EN = ‘0’, AUTOZERO =‘0’, AUTORIFP= ‘0

5 Block data update (BDU)

The BDU (Block Data Update) bit is located in CTRL_REG1 (10h) and it is used to inhibit the update of the output registers between the reading of upper, medium and lower register parts.

In default mode (BDU = ‘0’), the lower, medium and upper register parts are updated continuously.

When the BDU is activated (BDU = ‘1’), the content of the output registers is not updated until PRESS_OUT_H register is read, avoiding output data corruption. To guarantee a correct behavior of the BDU function, PRESS_OUT_H (2Ah) must be the last register to be read.

6 Interrupt settings mode

The LPS22HB can be configured to generate interrupt events related to pressure acquisition and FIFO status. A dedicated pad (INT_DRDY) can be set to bring out selected interrupt events.

The interrupt mode related to pressure acquisition are the following:

- Data available
- Threshold based

The interrupt modes related to the FIFO are the following:

- FIFO watermark
- FIFO full
- FIFO overrun

Interrupt examples can be found in *Section 7: "Appendix"*.

6.1 Interrupt events related to pressure acquisition

6.1.1 Data available

If enabled, it is possible to identify when a new pressure or temperature data is generated. Every time a new pressure data is generated, the bit P_DA in STATUS (27h) register is set to ‘1’. This can be also made available on INT_DRDY pin.

Every time a new temperature data is generated, the bit T_DA in STATUS (27h) register is set to ‘1’.

6.1.2 Threshold based

With the LPS22HB pressure sensor, it is possible to generate an interrupt event based on a user defined threshold. To be enable the functionality, DIFF_EN bit in INTERRUPT_CFG (0Bh) register must be set to ‘1’ and the threshold values stored in THS_P registers (0Dh and 0Ch). The threshold value for pressure interrupt generation is a 15-bit unsigned right justified value composed by THS_P_H (0Dh) and THS_P_L (0Ch). The value is expressed as:

Interrupt threshold (hPA) = ±THS_P / 16

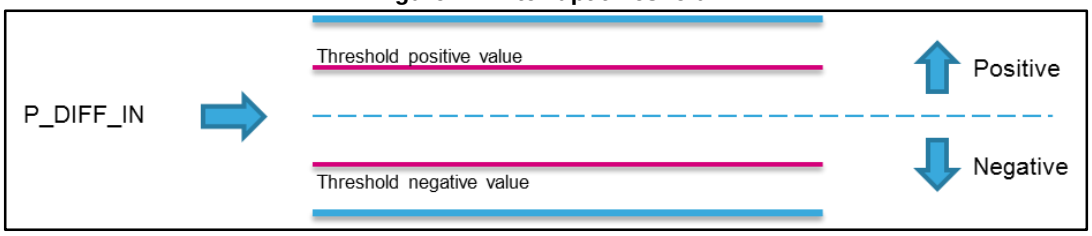
When DIFF_EN=1, PHE bit or PLE bit or both bits in INTERRUPT_CFG (0Bh) have to be enabled. PHE and PLE bits enable the interrupt generation on the positive or negative event respectively.

When DIFF_EN is enabled and AUTOZERO or AUTORIFP is enabled, the defined pressure threshold values in THS_P (0Ch, 0Dh) is compared with:

P_DIFF_IN = measured pressure – pressure reference

The value of pressure reference is assigned depending on the AUTOZERO and AUTORIFP modes reported in *Section 6.1.2.1: "AUTOZERO mode"* and *Section 6.1.2.2: "AUTORIFP mode"*.

Figure 12: Interrupt threshold



6.1.2.1 AUTOZERO mode

When AUTOZERO bit is set to ‘1’, the measured pressure is used as pressure reference on the register REF_P (15h, 16h and 17h). From now on, the output pressure registers PRESS_OUT (28h, 29h and 2Ah) are updated and the same value is used for the interrupt generation.

PRESS_OUT = measured pressure – REF_P

After the first conversion, the AUTOZERO bit is automatically set to ‘0’. To return back to normal mode, RESET_AZ bit in INTERRUPT_CFG (0Bh) register has to be set to ‘1’.

6.1.2.2 AUTORIFP mode

When AUTORIFP bit is set to ‘1’, the measured pressure becomes the pressure reference on the register REF_P (15h, 16h and 17h) as in the case of AUTOZERO mode, but the output pressure registers are not updated. Therefore, PRESS_OUT (28h, 29h and 2Ah) gives out the difference between the measured pressure and the content of the RPDS registers (18h, 19h):

PRESS_OUT = measured pressure – RPDS*256.

After the first conversion, the AUTORIFP bit is automatically set to ‘0’. To return back to normal mode, RESET_ARP bit in INTERRUPT_CFG (0Bh) register has to be set to ‘1’.

6.1.3 Interrupt events for FIFO triggers

The interrupt events related to pressure acquisition can be used to trigger FIFO dynamic mode transition. For the FIFO mode Stream-to-FIFO, Bypass-to-Stream and Bypass-to-FIFO, the IA bit in INT_SOURCE register is used as trigger events to drive the switch from one FIFO mode to the other one.

For example, considering the FIFO in Stream-to-FIFO mode, when the interrupt event is generated, the FIFO switches from Bypass mode to FIFO mode.

6.2 Interrupt events related to FIFO status

6.2.1 FIFO interrupts triggered by FIFO status

With the LPS22HB pressure sensor, it is possible to generate interrupts based on FIFO status. In particular it is possible to generate the following events by properly configuring the CTRL_REG3(12h) register:

- FIFO full condition: F_FSS5 set to ‘1’
- FIFO watermark level reached: F_FTH set to ‘1’
- FIFO overrun: F_OVR set to ‘1’

Once the interrupt events are generated, they are made available to the INT_DRDY pin based on INT_S bits in CTRL_REG3(12h).

6.3 Interrupt events on INT_DRDY pin

Interrupt events can be made available to INT_DRDY pin, acting on INT_S bits in CTRL_REG3(12h), as reported in *Figure 13*.

Figure 13: Interrupt architecture

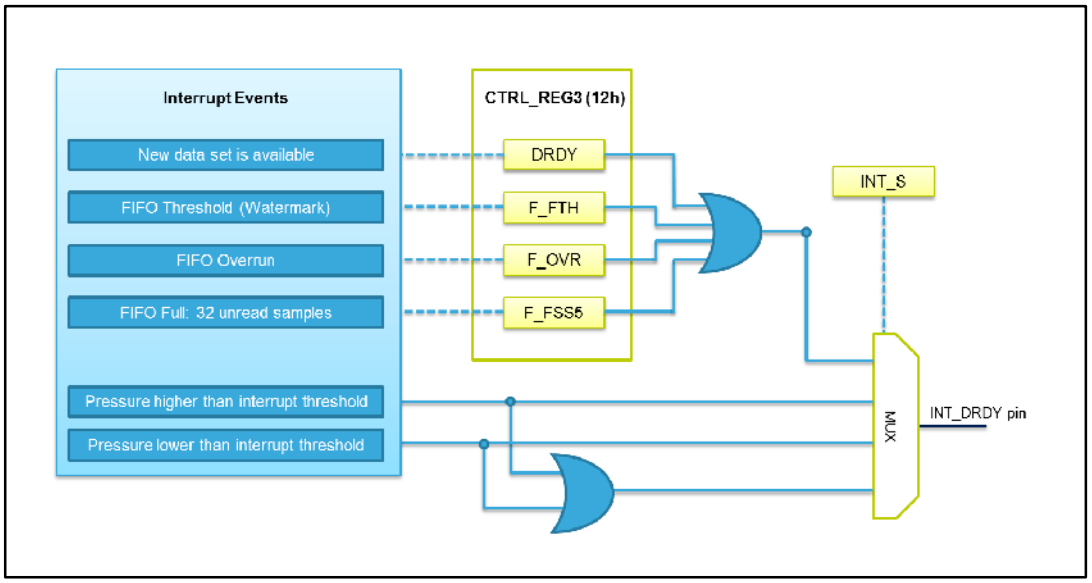


Table 6: INT_DRDY pin configuration

INT_S2	INT_S1	INT_DRDY pin configuration
0	0	Data signal. Refer to *Figure 13: "Interrupt architecture"*
0	1	Pressure high (P_high)
1	0	Pressure low (P_low)
1	1	Pressure low OR high

7 Appendix

7.1 FIFO bypass example

Sensor configuration	**DEFAULT CONFIGURATION** CTRL_REG1 = ‘00111010’ binary = ‘3A’ Hex => ODR = 25Hz (continuous mode), LPF active with ODR/9, BDU active CTRL_REG2 = ‘00010000’ binary = ‘10’ Hex => FIFO OFF and Multiple reading ON
Readings	The device provides data in continuous mode without using the FIFO. Readings is done by reading out the following registers: PRESS_OUT_XL (0x28), PRESS_OUT_L (0x29), PRESS_OUT_H (0x2A), TEMP_OUT_L (0x2B) and TEMP_OUT_H (0x2C).
Notes	The FIFO is fully bypassed.

7.2 FIFO mode example

Sensor configuration	**DEFAULT CONFIGURATION** CTRL_REG1 = ‘00111010’ binary = ‘3A’ Hex => ODR = 25Hz (continuous mode), LPF active with ODR/9, BDU active CTRL_REG2 = ‘00010000’ binary = ‘10’ Hex => FIFO OFF and Multiple reading ON **FIFO CONFIGURATION** CTRL_REG2 = ‘01011000’ binary = ‘50’ Hex => FIFO is ON and multiple reading active (IF_ADD_INC) FIFO_CTRL = ‘00100000’ binary = ‘20’ Hex => FIFO set to FIFO mode
FIFO reading and restart:	FIFO Reading OUT by using the registers PRESS_OUT_XL (0x28), PRESS_OUT_L (0x29), PRESS_OUT_H (0x2A), TEMP_OUT_L (0x2B) and TEMP_OUT_H (0x2C). **FIFO RESTART** CTRL_REG2 = ‘01011000’ binary = ‘50’ Hex => FIFO is ON and multiple reading active (IF_ADD_INC) FIFO_CTRL = ‘00000000’ binary = ‘00’ Hex => FIFO RESET for flushing the FIFO FIFO_CTRL = ‘01000000’ binary = ‘20’ Hex => FIFO set to FIFO mode
Notes	FIFO is automatically stopped when full.

7.3 Stream mode example

Sensor configuration	**DEFAULT CONFIGURATION** CTRL_REG1 = ‘00111010’ binary = ‘3A’ Hex => ODR = 25Hz (continuous mode), LPF active with ODR/9, BDU active CTRL_REG2 = ‘00010000’ binary = ‘10’ Hex => FIFO OFF and Multiple reading ON **FIFO CONFIGURATION** CTRL_REG2 = ‘01011000’ binary = ‘50’ Hex => FIFO is ON and multiple reading active (IF_ADD_INC) FIFO_CTRL = ‘01000000’ binary = ‘40’ Hex => FIFO set to STREAM mode
FIFO reading and restart	FIFO Reading OUT by using the registers PRESS_OUT_XL (0x28), PRESS_OUT_L (0x29), PRESS_OUT_H (0x2A), TEMP_OUT_L (0x2B) and TEMP_OUT_H (0x2C). **FIFO RESTART** CTRL_REG2 = ‘01011000’ binary = ‘50’ Hex FIFO_CTRL = ‘00000000’ binary = ‘00’ Hex => FIFO RESET for flushing out the FIFO FIFO_CTRL = ‘01000000’ binary = ‘40’ Hex => FIFO set to STREAM mode
Notes	FIFO doesn’t stop automatically. Data are continuously streamed out from the device. The oldest data in the FIFO is discarded out and replaced with newest one.

7.4 Stream-to-FIFO example

Sensor configuration	**DEFAULT CONFIGURATION** CTRL_REG1 = '00111010' binary = '3A' Hex => ODR = 25Hz (continuous mode), LPF active ODR/9, BDU active CTRL_REG2 = '00010000' binary = '10' Hex => FIFO OFF and Multiple reading ON **INTERRUPTS CONFIGURATION** CTRL_REG3 = '00000001' binary = '01' Hex => INT_S[2 :1]=01 Pressure High INTERRUPT_CFG = '00001101' binary = '0D' Hex => DIFF_EN, LIR, PHE THS_P_L = '20' Hex THS_P_H = '00' Hex => Threshold set at 2 hPa INTERRUPT_CFG = '00101101' Hex='2D' => to activate the AUTOZERO **FIFO CONFIGURATION** CTRL_REG2 = '01011000' binary = '50' Hex => FIFO is ON and multiple reading active (IF_ADD_INC) FIFO_CTRL = '01100000' binary = '60' Hex => FIFO set to STREAM to FIFO mode
FIFO readings and restart	After that the interrupt occurs, FIFO changes to FIFO mode. FIFO Reading OUT is made by using the registers PRESS_OUT_XL (0x28), PRESS_OUT_L (0x29), PRESS_OUT_H (0x2A), TEMP_OUT_L (0x2B) and TEMP_OUT_H (0x2C). **INTERRUPT RESET** INT SOURCE (25) READING FOR RESETTING THE INTERRUPT **FIFO RESTART IN STREAM TO FIFO MODE** CTRL_REG2 = '01011000' binary = '50' Hex => FIFO is ON and multiple reading active (IF_ADD_INC) FIFO_CTRL = '00000000' binary = '00' Hex => FIFO RESET TO BYPASS MODE for flushing the FIFO FIFO_CTRL = '01100000' binary = '60' Hex => FIFO set to STREAM to FIFO mode

7.5 Bypass-to-stream

Sensor configuration	**DEFAULT CONFIGURATION** CTRL_REG1 = ‘00111010’ binary = ‘3A’ Hex => ODR = 25Hz (continuous mode), LPF active ODR/9, BDU active CTRL_REG2 = ‘00010000’ binary = ‘10’ Hex => FIFO OFF and Multiple reading **INTERRUPTS CONFIGURATION** CTRL_REG3 = ‘00000001’ binary = ‘01’ Hex => INT_S[2 :1]=01 Pressure High INTERRUPT_CFG = ‘00001101’ binary = ‘0D’ Hex => DIFF_EN, LIR, PHE THS_P_L = ‘20’ Hex THS_P_H = ‘00’ Hex => Threshold set at 2 hPa INTERRUPT_CFG = ‘00101101’ Hex=‘2D’ to activate the AUTOZERO **FIFO CONFIGURATION** CTRL_REG2 = ‘01011000’ binary = ‘50’ Hex => FIFO is ON and multiple reading active (IF_ADD_INC) FIFO_CTRL = ‘10000000’ binary = ‘80’ Hex => FIFO set to BYPASS to STREAM mode
FIFO reading and restart	After that the interrupt occurs, FIFO changes to STREAM mode. FIFO Reading OUT is made by using the registers PRESS_OUT_XL (0x28), PRESS_OUT_L (0x29), PRESS_OUT_H (0x2A), TEMP_OUT_L (0x2B) and TEMP_OUT_H (0x2C). **INTERRUPT RESET** INT SOURCE (25) READING FOR RESETTING THE INTERRUPT **FIFO RESTART IN BYPASS TO STREAM MODE** CTRL_REG2 = ‘01011000’ binary = ‘50’ Hex => FIFO is ON and multiple reading active (IF_ADD_INC) FIFO_CTRL = ‘00000000’ binary = ‘00’ Hex => FIFO RESET TO BYPASS MODE for flushing the FIFO FIFO_CTRL = ‘10000000’ binary = ‘80’ Hex => FIFO set to BYPASS to STREAM mode

7.6 Bypass-to-FIFO

Sensor configuration	**DEFAULT CONFIGURATION** CTRL_REG1 = '00111010' binary = '3A' Hex => ODR = 25Hz (continuous mode), LPF active ODR/9, BDU active CTRL_REG2 = '00010000' binary = '10' Hex => FIFO OFF and Multiple reading **INTERRUPTS CONFIG** CTRL_REG3 = '00000001' binary = '01' Hex => INT_S[2 :1]=01 Pressure High INTERRUPT_CFG = '00001101' binary = '0D' Hex => DIFF_EN, LIR, PHE THS_P_L = '20' Hex THS_P_H = '00' Hex => Threshold set at 2 hPa INTERRUPT_CFG = '00101101' Hex='2D' to activate the AUTOZERO **FIFO CONFIGURATION** CTRL_REG2 = '01011000' binary = '50' Hex => FIFO is ON and multiple reading active (IF_ADD_INC) FIFO_CTRL = '11100000' binary = 'E0' Hex => FIFO set to BYPASS to FIFO mode
FIFO reading and restart	After that the interrupt occurs, FIFO changes to FIFO mode. FIFO Reading OUT is made by using the registers PRESS_OUT_XL (0x28), PRESS_OUT_L (0x29), PRESS_OUT_H (0x2A), TEMP_OUT_L (0x2B) and TEMP_OUT_H (0x2C). **INTERRUPT RESET** INT SOURCE (25) READING FOR RESETTING THE INTERRUPT **FIFO RESTART IN BYPASS TO FIFO MODE** CTRL_REG2 = '01011000' binary = '50' Hex => FIFO is ON and multiple reading active (IF_ADD_INC) FIFO_CTRL = '00000000' binary = '00' Hex => FIFO RESET TO BYPASS MODE for flushing the FIFO FIFO_CTRL = '11100000' binary = 'E0' Hex => FIFO set to BYPASS to FIFO mode

7.7 Dynamic stream mode

The following example shows how to set the FIFO in Dynamic Stream Mode at ODR = 75 Hz and how to get out pressure and temperature readings:

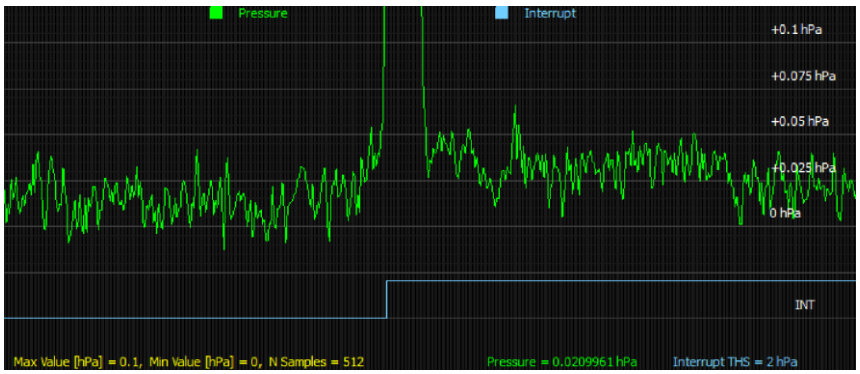
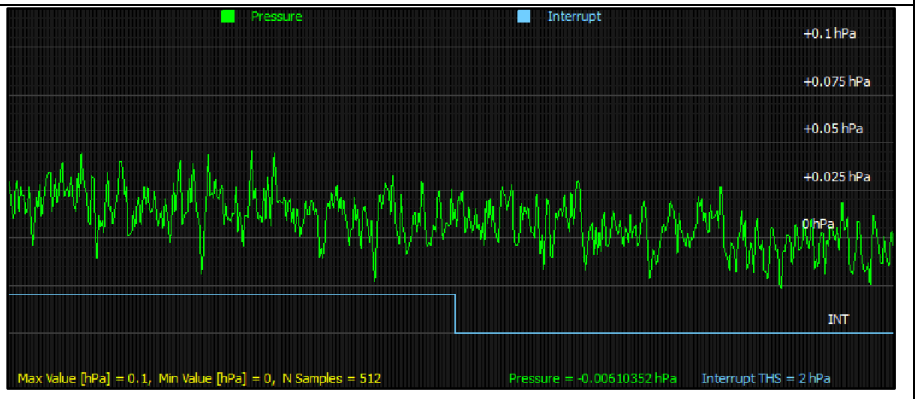
DEFAULT CONFIGURATION
CTRL_REG1 = ‘00111010’ binary = ‘3A’ Hex
=> ODR = 25Hz (continuous mode), LPF active ODR/9, BDU active
CTRL_REG2 = ‘00010000’ binary = ‘10’ Hex
=> FIFO OFF and Multiple reading
INTERRUPTS AND FIFO CONFIG
Write CTRL_REG3(12h) to 0xC8
Set INTERRUPT pin to OpenDrain/Active Low and FIFO OverRun flag
Write FIFO_CTRL(14h) to 0x00
Clear FIFO buffer
Write FIFO_CTRL(14h) to 0xC4
Set FIFO dynamic Stream Mode and Watermark(WTM) to 4
Write CTRL_REG2(11h) to 0x70
Enable FIFO-depth to acquire up to WTM+1 samples
Write CTRL_REG1(10h) to 0x52
Set ODR to 75Hz and Block Data Update active

Device Reading procedure

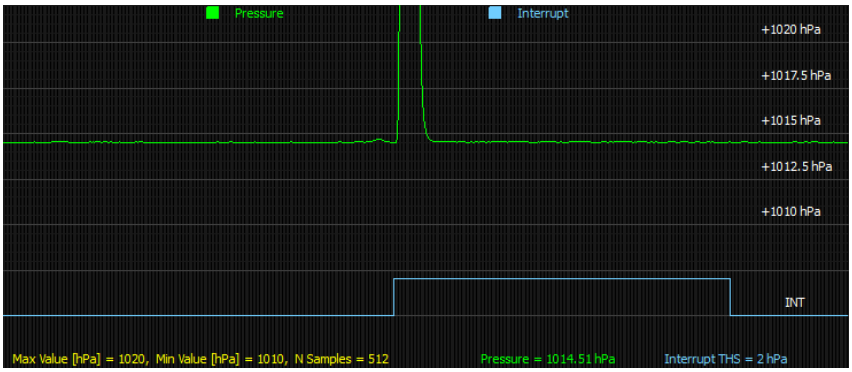
Trigger on INT_DRDY pin (pin7) event
For i=1 to (WTM+1)
Read PressOut(28h-29h-2Ah) and TempOut(2Bh-2Ch)
Read 5 times (WTM+1) the Output Data Registers

7.8 Interrupt: autozero mode example

Sensor configuration	**DEFAULT CONFIGURATION** CTRL_REG1 = ‘00111010’ binary = ‘3A’ Hex => ODR = 25Hz (continuous mode), LPF active ODR/9, BDU active CTRL_REG2 = ‘00010000’ binary = ‘10’ Hex => FIFO OFF and Multiple reading **INTERRUPTS CONFIG** CTRL_REG3 = ‘00000001’ binary = ‘01’ Hex => INT_S[2 :1]=01 Pressure High INTERRUPT_CFG = ‘00001101’ binary = ‘0D’ Hex => DIFF_EN, LIR, PHE THS_P_L = ‘20’ Hex THS_P_H = ‘00’ Hex => Threshold set at 2 hPa INTERRUPT_CFG = ‘00101101’ Hex=‘2D’ to activate the AUTOZERO

Reading	PRESS_OUT_XL (0x28), PRESS_OUT_L (0x29), PRESS_OUT_H (0x2A), TEMP_OUT_L (0x2B) and TEMP_OUT_H (0x2C).
Interrupt triggered by Differential Pressure> 2 hPa	
Interrupt line reset	INT SOURCE (29) READING FOR RESETTING THE INTERRUPT
	

7.9 Interrupt: AUTORIFP mode example

Sensor Configuration	**DEFAULT CONFIGURATION** CTRL_REG1 = ‘00111010’ binary = ‘3A’ Hex => ODR = 25Hz (continuous mode), LPF active ODR/9, BDU active CTRL_REG2 = ‘00010000’ binary = ‘10’ Hex => FIFO OFF and Multiple reading **INTERRUPTS CONFIG** CTRL_REG3 = ‘00000001’ binary = ‘01’ Hex => INT_S[2 :1]=01 Pressure High INTERRUPT_CFG = ‘00001101’ binary = ‘0D’ Hex => DIFF_EN, LIR, PHE THS_P_L = ‘20’ Hex THS_P_H = ‘00’ Hex => Threshold set at 2 hPa INTERRUPT_CFG = ‘00001101’ Hex=‘8D’ to activate the AUTORIFP
Reading	PRESS_OUT_XL (0x28), PRESS_OUT_L (0x29), PRESS_OUT_H (0x2A), TEMP_OUT_L (0x2B) and TEMP_OUT_H (0x2C).
Interrupt triggered by Differential Pressure> 2 hPa	

8 Related documentation

Table 7: Technical references

Document type	Title	Description
Datasheet	LPS22HB	MEMS pressure sensor: 260-1260 hPa absolute digital output barometer
Evaluation board	STEVAL- MET001V1	LPS22HB adapter board for standard DIL24 socket
	UM0979	STEVAL-MKI109V2 - eMotion motherboards for MEMS adapter boards
Evaluation software	UM1049	Unico graphical user interface (GUI)
	UM1064	Software guide for Unico lite
Application note	AN4672	LPS22HB/LPS25HB digital pressure sensors: hardware guidelines for system integration
Technical note	TN1229	How to interpret pressure and temperature readings in the LPS22HB pressure sensor.
MCU drivers and Linux/Android drivers for LPS22HB	STSW-MEMS039	Platform-independent device driver for LPS22HB

9 Revision history

Table 8: Document revision history

Date	Version	Changes
16-Mar-2016	1	Initial release.

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