FXPS7xxxDI4S - Initialize and configure, self-test, and mission mode procedures

Introduction

This application note provides an overview of the recommended initialization and configuration of the FXPS7xxxDI4S I²C series pressure sensors (See Table 1. Applicable parts) for I²C operation only. In addition, it provides a self-test features overview given that the device includes analog and digital self-test utilities. The self-test utilities to verify the functionality of the transducer, signal chain, and sensor integrity prior to normal operation. To conclude, there are two examples showing the conversion from the register read values to calculate both pressure in kPa and temperature in °C.

The configuration and self-test features described in this application note assume that the user has reviewed the latest released data sheet for the applicable device. This application note also assumes that the user is familiar with the recommended application circuit and the register space definition. References to individual registers are made throughout this document and the definitions for such registers are present in the product data sheet.

1 Applicable parts

Table 1. Applicable parts details the individual part numbers and their respective pressure range for all I²C devices in this product family.

Table 1. Applicable parts

Part number	Description
FXPS7115DI4ST1	40 kPa to 115 kPa I²C-based digital absolute pressure sensor
FXPS7165DI4ST1	60 kPa to 165 kPa I²C-based digital absolute pressure sensor
FXPS7250DI4ST1	20 kPa to 250 kPa I²C-based digital absolute pressure sensor
FXPS7400DI4ST1	20 kPa to 400 kPa I²C-based digital absolute pressure sensor
FXPS7550DI4ST1	20 kPa to 550 kPa I²C-based digital absolute pressure sensor

2 Sensor initialization

After applying power, the user must wait for the ST configuration to load. Sensor self-tests are then initiated if required by the application. Configuring additional device register settings may also be necessary prior to entering normal run mode. The following procedure should be used with this pressure sensor family.

To initialize and configure the FXPS7xxxDI4S sensor properly, it is important to employ the following steps:

1. Apply power to the FXPS7x device using the ramp rates specified in the data sheet.
   - The device is verified to start with ramp rates from 10^{-6} V/µs to 10 V/µs.
   - Wait up to 2 ms. The data sheet specifies 1.0 ms max from POR to first command before I²C communication reads and writes are available.
2. Read register 0x01 (DEVSTAT) up to 5 times. This step is in addition to the prior 2 ms wait.
   - The waits are for the flash to boot, allowing the part to take in the ST configuration settings, and to make sure that all errors are as expected.
   - Failure to follow the steps above (reading 0x01 'too fast') produces invalid data like all FFs or 00s meaning the device is not ready.
   - The DSP error flag (DSP_ERR) is set until at least one self-test is complete.
   - A DEVINIT error condition can also appear during the read cycles for some period of time. This error condition is not an error in the true sense and is normal until the DSP is initialized. After initialization, no other errors should occur.
3. Soft reset, wait 2 ms. The data sheet specification is 1.0 ms max from POR to first command.
   - Write register 0x10
   - Requires three sequential writes to perform a soft reset as described in the data sheet, Table 46, *DEVLOCK_WR - lock register writes register (address 0x10) bit allocation*.
4. Read register 0x01 (DEVSTAT) up to 5 times
   - Wait for flash boot and allowing the part to take in the ST configuration, and make sure that all errors are as expected.
   - DSP error flag (DSP_ERR) is set until at least one self-test is run and the DEVINIT error flag may also be set during read cycles.
5. If the application requires, register 0x40 (DSP_CFG_U1[1]), bits[7:4].configure the LPF (1 kHz is default). Refer to the data sheet, Table 65, *Low-pass filter selection bits (LPF[3:0])*.
   - Wait 10 ms (data sheet specification is 7 ms max) to allow the DSP to initialize with the new filter setting anytime it is changed.

1. *There are five DSP Configuration registers, however, only DSP_CFG_U1, DSP_CFG_U4 and DSP_CFG_U5 are used when the device is in SPI or I²C mode. The DSP_CFG_U2 and DSP_CFG_U3 registers are for factory use only and are used for internal tests.*

3 Self-test overview

The device includes analog and digital self-test functions to verify the functionality of the transducer and the signal chain. The self-test functions are selected by writing to the ST_CTRL[3:0] bits in the DSP_CFG_U5 register. The ST_CTRL bits determine the desired self-test according to the description in the following sections.

Once the ENDINIT bit is set, the ST_CTRL bits are forced to 0000b. Future writes to the ST_CTRL bits are disabled until a device reset. The ENDINIT function is a safety feature to prevent unintentional writes to the self-test during normal operation.

ST recommends at least one self-test. For the most sensor coverage and if only one test is desired, the P_{ABS} common mode self-test should be used as it verifies the functionality of the transducer and the signal chain.

Note: The remainder self-test procedures are similar and detailed in the data sheet, and will not be covered by this application note.

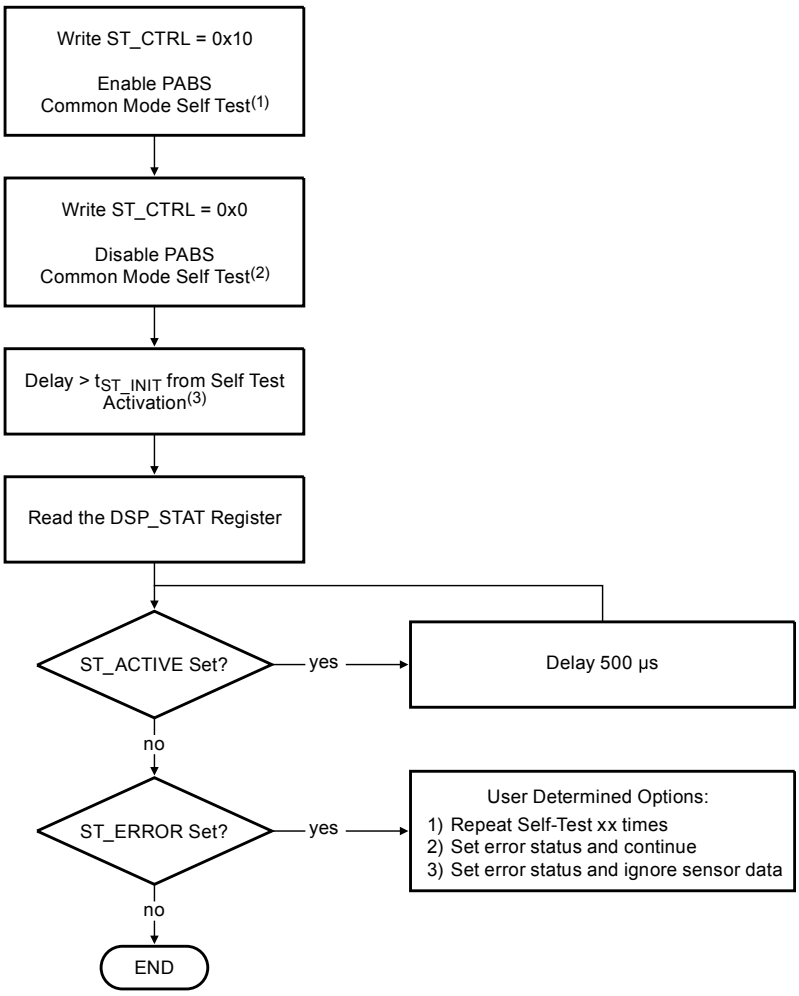
3.1 P_{ABS} common mode verification self-test

When the P_{ABS} common mode self-test is selected, the ST_ACTIVE bit is set, the ST_ERROR is cleared, and the device begins an internal measurement of the common mode signal of the P cells and compares the result against a predetermined limit. If the result exceeds the limit, the ST_ERROR bit is set.

The P_{ABS} common mode self-test repeats continuously every tST_INIT when the ST_CTRL bits are set to the specified value. Once the test is disabled, the ST_ERROR bit is updated with the final test result within tST_INIT of disabling the test. The ST_ACTIVE bit remains set until the final test result is reported.

Figure 1. **User-controlled P_{ABS} common mode self-test flowchart** shows the flowchart including register writes and timing for a user-controlled P_{ABS} common mode self-test procedure.

Figure 1. User-controlled P_{ABS} common mode self-test flowchart



(1). To initialize PABS self-test, write register 0x44 (DSP_CFG_U5), 0x01
(2). To disable PABS self-test, write register 0x44 (DSP_CFG_U5), 0x00
(3). The PABS self-test will repeat continuously every t_{ST_INIT}

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4 I²C read pressure data

Once the device has been initialized and any configuration updates and self-test are complete, the pressure measurement data is ready to be read from their corresponding registers.

The pressure measurement from the sensor is retrieved by reading the two registers:

- 0x62, 0x63 (SNSDATA0_L and SNSDATA0_H)

The device includes an I²C wrap-around allowing looping through the following registers:

- Read 0x61 (DEVSTAT_COPY), 0x62, 0x63 (SNSDATA0_L, SNSDATA0_H)
- Register 0x61(DEVSTAT_COPY) checks for error flags (DSP_ERR, SUPPLY_ERR, MEMTEMP_ERR, etc.). In a safety application for example, there can be a requirement to check if there is a power supply or memory error for application-specific safety requirements.

Note: If I²C read wrap-around mode is set, the device can be configured to read in a loop indefinitely for maximum efficiency.

Finally apply the scaling equation to convert raw pressure to kPa. Refer to the data sheet section, *Absolute pressure output data scaling equation*.

4.1 Steps to read and convert the sensor's pressure/temperature data

- To obtain pressure, read registers 0x62 and 0x63 (SNSDATA0_L, SNSDATA0_H).
- Apply the scaling equation to convert raw pressure to kPa. Refer to the data sheet section titled *Absolute pressure output data scaling equation*. See example 1.

$$P_{ABS_{kPa}} = \frac{P_{ABS_{LSB}} - P_{ABSOFF_{LSB}}}{P_{ABS_{SENSE}}} \quad (1)$$

- Example 2 shows the temperature variable and conversion using equation 2. Refer to the data sheet section titled *Temperature sensor output scaling equation.* See example 2.

Example 1:

The FXPS7250DI4S has the following pressure scaling values:

- PABSOffLSB (LSB): 28661.6
- PABSSENSE (LSB/kPa): 30.42
- Reading 0x62,0x63, provides 31657 LSB
- Applying equation 1 results in **98.5 kPa**

The temperature equation is used to convert temperature readings with the variables specified. Apply the scaling equation to convert raw temperature to °C. Refer to the data sheet section titled *Temperature sensor output scaling equation*.

$$T_{DEGC} = \frac{T_{LSB} - T0_{LSB}}{T_{SENSE}} \quad (2)$$

Example 2:

The FXPS7250DI4S has the following temperature scaling values:

- T0LSB (LSB): 68
- TSENSE (LSB/C): 1
- Reading 0x0E provides 142 LSB
- Applying Eq. (2) results in 74 °C

Revision history

Date	Version	Changes
28-Oct-2026	1	Initial release from ST, rebranded NXP document

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