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Design Tips

Digital magnetometer and e-Compass: efficient design tips

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Main components	
LIS2MDL	Digital output magnetic sensor: ultra-low-power, high-performance 3-axis magnetometer
IIS2MDC	High-accuracy, ultra-low-power, 3-axis digital output magnetometer
LSM303AGR	Ultra-compact high-performance eCompass module: ultra-low-power 3D accelerometer and 3D magnetometer
LSM303AH	Ultra-compact high-performance eCompass module: ultra-low-power 3D accelerometer and 3D magnetometer

Purpose and Benefits

The purpose of this design tip is to provide guidelines for a more power-efficient system integration of LIS2MDL, IIS2MDC, LSM303AGR, and LSM303AH.

Description

LIS2DMDL and IIS2MDC are 3-axis digital magnetometers equipped with SPI and I2C interface which are also available in the magnetic sensor of the LSM303AGR and LSM303AH which are eCompass solutions consisting of a 3-axis accelerometer and a 3-axis magnetometer in a System in Package (SiP). In addition, all these devices have dedicated interrupt pin INT/DRY.

LIS2MDL, IIS2MDC, LSM303AGR and LSM303AH are firmware and pin-to-pin compatible solutions

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Interrupt Pins

Table 1 shows the INT/DRDY (LIS2MDL/IIS2MDC) or INT_MAG/DRDY (LSM303AGR/LSM303AH) pin number for the digital magnetometers and eCompass devices. 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
LIS2MDL	Pin 7
IIS2MDC	Pin 7
LSM303AGR	Pin 7
LSM303AH	Pin 7

The INT/DRDY pin is in high impedance. The configuration to push pull condition selecting the INT_on_PIN bit or DRDY_on_PIN bit in the *CFG_REG_C(62h)* for LIS2MDL/IIS2MDC, and *CFG_REG_C_M(62h)* for LSM303AGR/ LSM303AH.

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

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 IEA in the *INT_CTRL_REG(63h)* for LIS2MDL/IIS2MDC, while it is located in *INT_CTRL_REG_M(63h)* for LSM303AGR/LSM303AH. The default value of that bit is set to “0” which is active high.

Default INT/DRY

Interrupt pin in default condition is not configured in latch mode which means that the interrupt will automatically be reset after T=1/ODR, where ODR is the Output Data Rate (controlled by the *CFG_REG_A(60h)* in LIS2MDL/IIS2MDC and *CFG_REG_A_M(60h)* in LSM303AGR/LSM303AH).

Latched INTx

In order to set the latch mode, the bit IEL must be set for INT/DRY in the *INT_CTRL_REG (63h)* for LIS2MDL/IIS2MDC and *INT_CTRL_REG_M(63h)* for LSM303AGR/LSM303AH, respectively.
The interrupt will be reset by reading the *INT_SOURCE_REG (64h) for LIS2MDL/IIS2MDC and INT_SOURCE_REG_M (64h)* for LSM303AGR/LSM303AH, respectively.

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 I2C address.

Table 2: I2C addresses

SAD[6:0]	SAD
0011110	1Eh

At these addresses, it is necessary to add the operation (R/W) on the I2C communication. A read transaction (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 *CFG_REG_C (62h)* for LIS2MDL/IIS2MDC while this is located in *CFG_REG_C_M (62h)* for the LSM303AGR/LSM303AH.

Only the SPI 3-wire is available in the LIS2MDL, IIS2MDC, LSM303AGR, and LSM303AH.

Additional Support Materials

Related Documentation
AN5069: LIS2MDL: ultra-low-power, high-performance 3D magnetometer
AN5080: IIS2MDC: high-accuracy, ultra-low-power, 3-axis digital output magnetometer
AN4825**:** Ultra-compact high-performance eCompass module based on the LSM303AGR
AN5087: LSM303AH: ultra-compact, high-performance eCompass module
TN0018**:** Surface mounting guidelines for MEMS sensors in an LGA package

Revision history

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

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