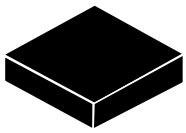
LSM9DS0

iNEMO inertial module: 3D accelerometer, 3D gyroscope, 3D magnetometer

Datasheet - production data



LGA-24 (4x4x1.0 mm)

Features

- 3 acceleration channels, 3 angular rate channels, 3 magnetic field channels
- ±2/±4/±6/±8/±16 *g* linear acceleration full scale
- ±2/±4/±8/±12 gauss magnetic full scale
- ±245/±500/±2000 dps angular rate full scale
- 16-bit data output
- SPI / I^2C serial interfaces
- Analog supply voltage 2.4 V to 3.6 V
- Power-down mode / low-power mode
- Programmable interrupt generators
- Embedded self-test
- Embedded temperature sensor
- Embedded FIFO
- Position and motion detection functions
- Click/double-click recognition
- Intelligent power saving for handheld devices
- ECOPACK®, RoHS and “Green” compliant

Applications

- Indoor navigation
- Smart user interfaces
- Advanced gesture recognition
- Gaming and virtual reality input devices
- Display/map orientation and browsing

Description

The LSM9DS0 is a system-in-package featuring a 3D digital linear acceleration sensor, a 3D digital angular rate sensor, and a 3D digital magnetic sensor.

The LSM9DS0 has a linear acceleration full scale of ±2*g*/±4*g*/±6g/±8*g*/±16*g,* a magnetic field full scale of ±2/±4/±8/±12 gauss and an angular rate of ±245/±500/±2000 dps.

The LSM9DS0 includes an I^2C serial bus interface supporting standard and fast mode (100 kHz and 400 kHz) and an SPI serial standard interface.

The system can be configured to generate interrupt signals on dedicated pins and is capable of motion and magnetic field detection. Thresholds and timing of interrupt generators are programmable by the end user.

Magnetic, accelerometer and gyroscope sensing can be enabled or set in power-down mode separately for smart power management.

The LSM9DS0 is available in a plastic land grid array package (LGA) and it is guaranteed to operate over an extended temperature range from -40 °C to +85 °C.

Table 1. Device summary

Part number	Temperature range [°C]	Package	Packing
LSM9DS0	-40 to +85	LGA-24	Tray
LSM9DS0TR	-40 to +85	LGA-24	Tape and reel

1.2 Pin description

Figure 2. Pin connections

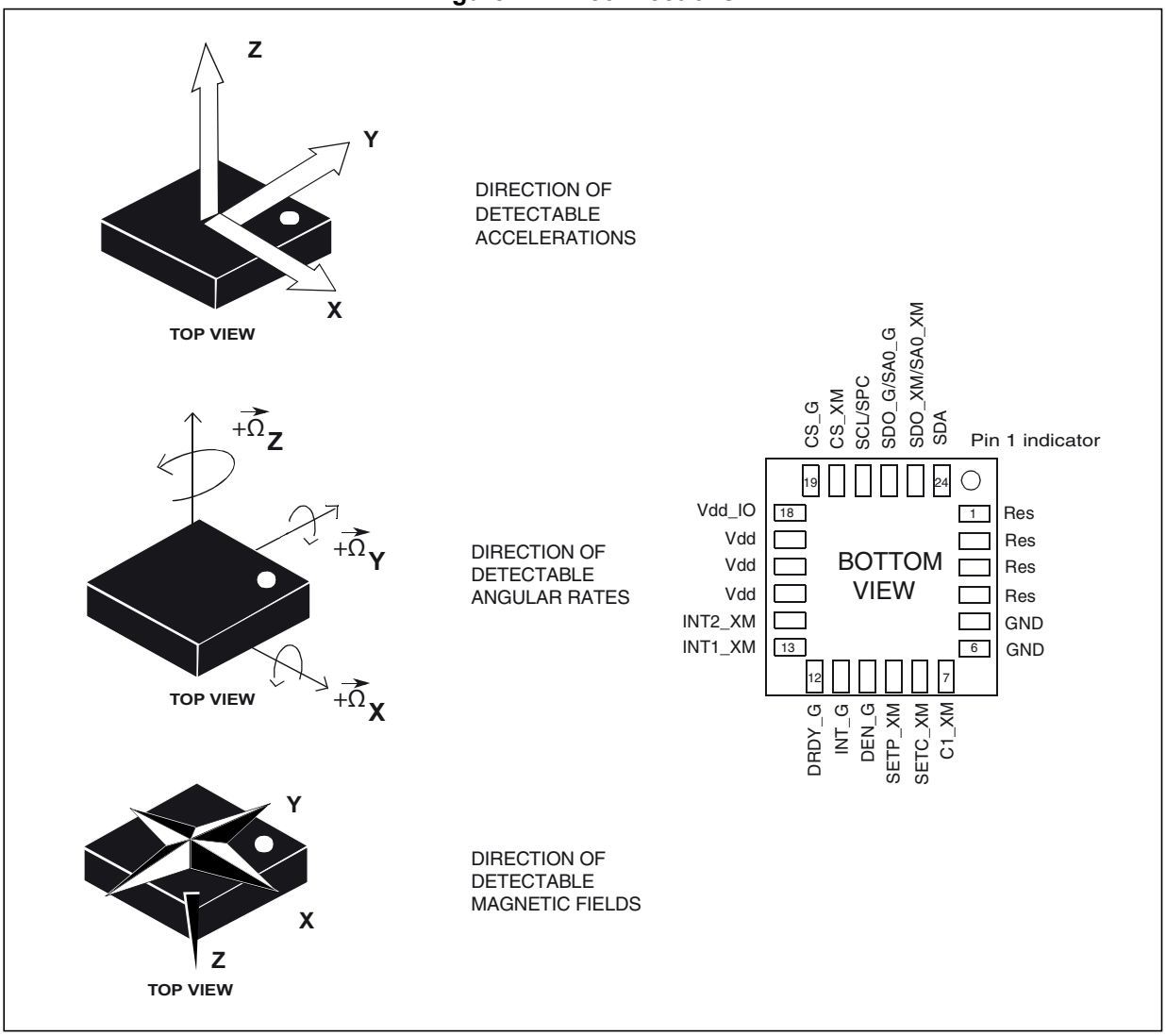


Table 2. Pin description

Pin#	Name	Function
1	Reserved	Leave unconnected
2	Reserved	Connect to GND
3	Reserved	Connect to GND
4	Reserved	Connect to GND
5	GND	0 V supply
6	GND	0 V supply
7	C1_XM	Capacitor connection (C1)
8	SETC_XM	S/R capacitor connection (C2)
9	SETP_XM	S/R capacitor connection (C2)
10	DEN_G	Gyroscope data enable
11	INT_G	Gyroscope programmable interrupt
12	DRDY_G	Gyroscope data ready
13	INT1_XM	Accelerometer and magnetic sensor interrupt 1
14	INT2_XM	Accelerometer and magnetic sensor interrupt 2
15	Vdd	Power supply
16	Vdd	Power supply
17	Vdd	Power supply
18	Vdd_IO	Power supply for I/O pins
19	CS_G	Gyroscope I^2C/SPI mode selection 1: SPI idle mode / I^2C communication enabled 0: SPI communication mode / I^2C disabled
20	CS_XM	Accelerometer and magnetic sensor SPI enabled I^2C/SPI mode selection 1: SPI idle mode / I^2C communication enabled 0: SPI communication mode / I^2C disabled
21	SCL SPC	I^2C serial clock (SCL) SPI serial port clock (SPC)
22	SDO_G SA0_G	Gyroscope serial data output (SDO) Angular rate sensor I^2C less significant bit of the device address (SA0)
23	SDO_XM SA0_XM	Accelerometer and magnetic sensor SPI serial data output (SDO) Accelerometer and magnetic sensor I^2C less significant bit of the device address (SA0)
24	SDA	I^2C serial data (SDA)

2 Module specifications

2.1 Sensor characteristics

@ Vdd = 3.0 V, T = 25 °C unless otherwise noted[a]

Table 3. Sensor characteristics

Symbol	Parameter	Test conditions	Min.	Typ.[1]	Max.	Unit
LA_FS	Linear acceleration measurement range[2]			±2		g
				±4		
				±6		
				±8		
				±16		
M_FS	Magnetic measurement range			±2		gauss
				±4		
				±8		
				±12		
G_FS	Angular rate measurement range			±245		dps
				±500		
				±2000		
LA_So	Linear acceleration sensitivity	Linear acceleration FS = ±2 *g*		0.061		mg/LSB
		Linear acceleration FS = ±4 *g*		0.122		
		Linear acceleration FS = ±6 *g*		0.183		
		Linear acceleration FS = ±8 *g*		0.244		
		Linear acceleration FS = ±16 *g*		0.732		
M_GN	Magnetic sensitivity	Magnetic FS = ±2 gauss		0.08		mgauss/ LSB
		Magnetic FS = ±4 gauss		0.16		
		Magnetic FS = ±8 gauss		0.32		
		Magnetic FS = ±12 gauss		0.48		
G_So	Angular rate sensitivity	Angular rate FS = ±245 dps		8.75		mdps/ digit
		Angular rate FS = ±500 dps		17.50		
		Angular rate FS = ±2000 dps		70		
LA_TCSo	Linear acceleration sensitivity change vs. temperature	From -40 °C to +85 °C		±1.5		%
M_TCSo	Magnetic sensitivity change vs. temperature	From -40 °C to +85 °C		±3		%

a. The product is factory calibrated at 3.0 V. The operational power supply range is from 2.4 V to 3.6 V.

Table 3. Sensor characteristics (continued)

Symbol	Parameter	Test conditions	Min.	Typ.(1)	Max.	Unit
G_SoDr	Angular rate sensitivity change vs. temperature	From -40 °C to +85 °C		±2		%
LA_TyOff	Linear acceleration typical zero-g level offset accuracy(3)(4)			±60		mg
G_TyOff	Angular rate typical zero-rate level	FS = 245 dps		±10		dps
		FS = 500 dps		±15		
		FS = 2000 dps		±25		
LA_TCOff	Linear acceleration zero-g level change vs. temperature	Max delta from 25 °C		±0.5		mg/°C
G_TCOff	Zero-rate level change vs. temperature			±0.05		dps/°C
M_EF	Maximum exposed field	No perming effect on zero reading			10000	gauss
M_DF	Magnetic disturbing field	Sensitivity starts to degrade. Automatic S/R pulse restores the sensitivity(5)			20	gauss
LA_ST	Linear acceleration self-test positive difference (6)(7)	±2 *g* range, X, Y, Z-axis AST1:0 = 01 see *Table 74*	60		1700	mg
G_ST	Angular rate self-test output change (8)(9)	FS = 245 dps	20		250	dps
		FS = 500 dps	70		400	
		FS = 2000 dps	150		1000	
Top	Operating temperature range		-40		+85	°C

1. Typical specifications are not guaranteed
2. Verified by wafer level test and measurement of initial offset and sensitivity
3. Typical zero-*g* level offset value after MSL3 preconditioning
4. Offset can be eliminated by enabling the built-in high-pass filter
5. Set / Reset Pulse is automatically applied at each conversion cycle
6. “Self-test output change” is defined as: OUTPUT[mg]$_{(}$*CTRL_REG2_XM (21h)* $_{\text{AST1:0 enabled)}}$ - OUTPUT[mg]$_{(}$*CTRL_REG2_XM (21h)* $_{\text{AST1:0 disabled)}}$
7. For polarity refer to *Table 77: Self-test mode configuration*
8. “Self-test output change” is defined as: OUTPUT[mg]$_{(}$*CTRL_REG4_G (23h)* $_{\text{ST1:0 enabled)}}$ - OUTPUT[mg]$_{(}$*CTRL_REG4_G (23h)* ST1:0 disabled)
9. For polarity refer to *Table 31: Self-test mode configuration*

2.2 Temperature sensor characteristics

The electrical characteristics concerning the temperature sensor are given in the table below.

@ Vdd = 3.0 V, T=25 °C unless otherwise noted.

Table 4. Temperature sensor electrical characteristics

Symbol	Parameter	Test conditions	Min.	Typ.(1)	Max.	Unit
TSDr	Temperature sensor output change vs. temperature	-		8		LSB/°C
TODR	Temperature refresh rate			M_ODR [2:0](2)		Hz
Top	Operating temperature range		-40		+85	°C

1. Typical specifications are not guaranteed.
2. Refer to *Table 84: Magnetic data rate configuration*.

2.3 Electrical characteristics

@ Vdd = 3.0V, T = 25 °C unless otherwise noted[b]

Table 5. Electrical characteristics

Symbol	Parameter	Test conditions	Min.	Typ.(1)	Max.	Unit
Vdd	Supply voltage		2.4		3.6	V
Vdd_IO	Module power supply for I/O		1.71	1.8	Vdd+0.1	
Idd_XM	Current consumption of the accelerometer and magnetic sensor in normal mode (2)		HR setting CTRL_REG5_XM (M_RES [1,0]) = 11b, see *CTRL_REG5_XM (24h)*	350		µA
Idd_G	Gyroscope current consumption in normal mode(3)			6.1		mA
Idd_G_LP	Gyroscope supply current in sleep mode(4)			2		mA
Idd_Pdn	Current consumption in power-down mode(5)			6		µA
VIH	Digital high-level input voltage		0.8*Vdd_IO			V
VIL	Digital low-level input voltage				0.2*Vdd_IO	V
VOH	High-level output voltage		0.9*Vdd_IO			V
VOL	Low-level output voltage				0.1*Vdd_IO	V
Top	Operating temperature range		-40		+85	°C

1. Typical specifications are not guaranteed
2. Magnetic sensor setting ODR =6.25 Hz, Accelerometer sensor ODR =50 Hz, gyroscope in power-down mode
3. Accelerometer and magnetic sensor in power-down mode
4. Sleep mode introduces a faster turn-on time compared to power-down mode. Accelerometer and magnetic sensor in power-down mode.
5. Linear accelerometer, magnetic sensor and gyroscope in power-down mode

b. LSM9DS0 is factory calibrated at 3.0 V