IST8308
3D Magnetometer

Datasheet

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1. General Description

iSentek IST8308 is a 3-axis digital magnetometer with 3.0 x 3.0 x 1.0 mm^3, 16-pin LGA package. It is an integrated chip with 3-axis magnetic sensors, digital control logic, built-in temperature compensation circuit and self-test function. IST8308 provides an I^2C digital output with fast mode up to 400 kHz. The high output data rate, ultra-low noise, ultra-low hysteresis, and excellent temperature drift features make it a perfect candidate for high accuracy applications.

Features

- Ultra-high sensitivity (maximum 1320 LSB/Gauss)
- Built-in five operation modes to fulfill user's requirements (standby mode, single measurement mode, continuous mode, self-test mode, suspend mode)
- Built-in noise suppression filter to provide ultra-low noise performance
- I^2C slave, Fast Mode up to 400 kHz
- 14-bit data output
- Dynamic range of maximum ±500 μT.
- High output data rate of 200 Hz
- Ultra-low hysteresis (< 0.1 %FS)
- Ultra-low sensitivity temperature drift (±0.023 %/°C)
- Ultra-low offset temperature drift (0.017 μT/°C)
- Wide operating temperature range
- High precision temperature compensation
- Software and algorithm support are available (for tilt compensation and soft/hard-iron calibration)
- RoHS, HF and TSCA compliant

Applications

- Quadcopter/Drone Applications
- Augmented Reality Applications
- Virtual Reality Applications
- Location Based Services
- Navigation Applications
- Industrial Applications
- Magnetometry
- IOT devices
- Heading
- Gaming

2. Block Diagram, Package Dimension and Application Circuit

2.1. Block diagram

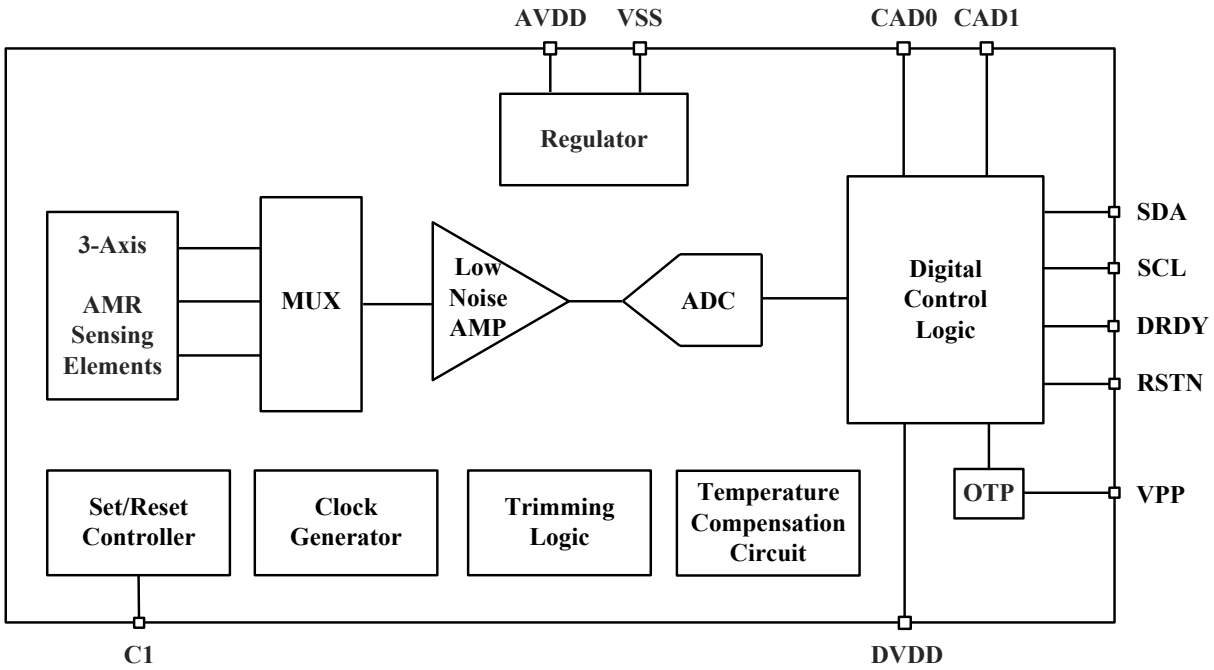
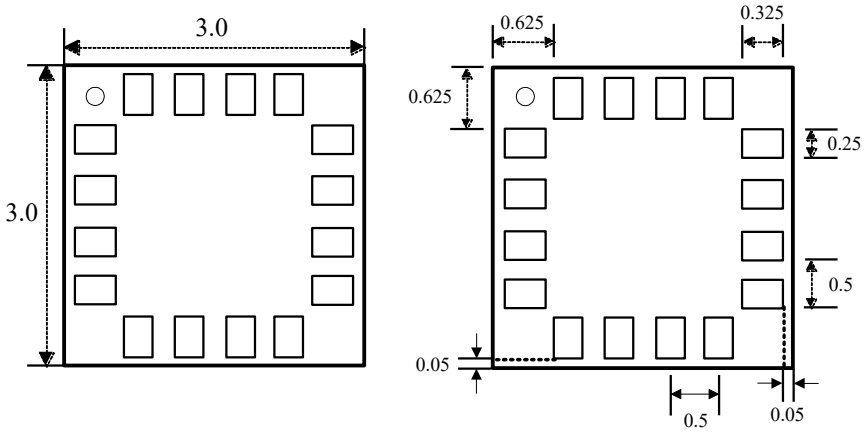


Figure 1. Block Diagram

2.2. Package Dimensions and Pin Description

IST8308 LGA Top View (Looking Through)

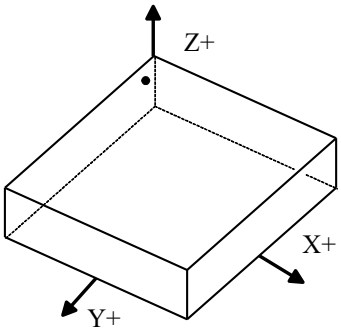


Unit: mm

Tolerance: ±0.1 mm

IST8308 LGA Side View

IST8308 3D Top View



Unit: mm

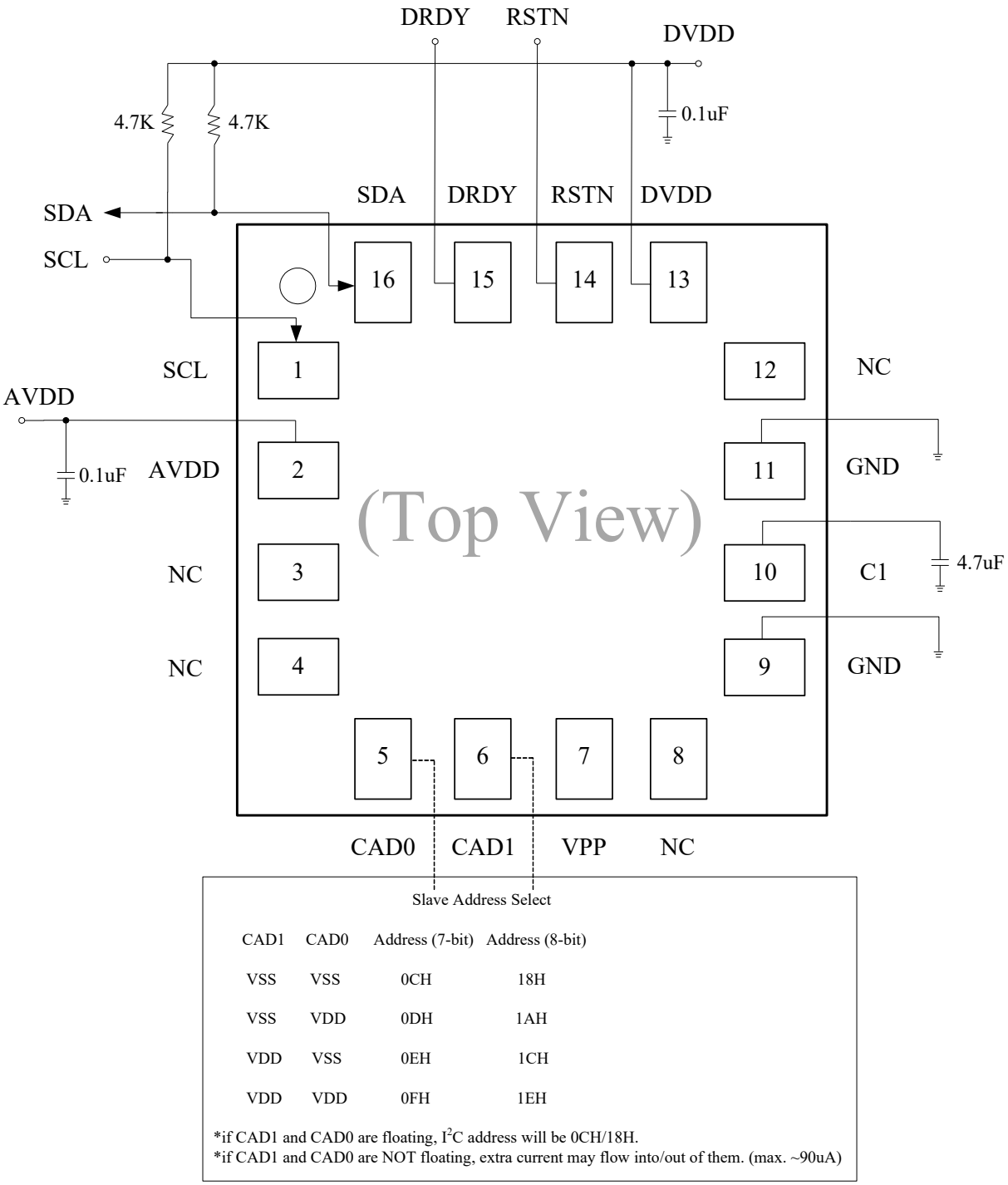
Tolerance: ±0.1 mm

Pin[*1]	Name	Function
1	SCL	I^2C serial clock
2	AVDD	Analog supply voltage, 2.4 – 3.6 V
3	NC	Not use
4	NC	Not use
5	CAD0	I^2C slave address
6	CAD1	I^2C slave address
7	VPP	Test pin, connect to DVDD or keep floating[*2]
8	NC	Not use
9	VSS	GND
10	C1	Set/Reset function, 4.7 μF
11	VSS	GND
12	NC	Not use
13	DVDD	Digital supply voltage, 1.72 – 3.6 V
14	RSTN	Reset pin, resets registers by setting it to “Low”. Internally pulled to “High” for floating connection MCU connection is suggested (but not necessary)
15	DRDY	Data ready indication, output pin only
16	SDA	I^2C serial data

[*1] Please refer to Figure 2 on datasheet page 7.

[*2] Please keep RSTN and CAD1 floating if VPP is floating.

2.3. Application Circuit



Slave Address Select

CAD1	CAD0	Address (7-bit)	Address (8-bit)
VSS	VSS	0CH	18H
VSS	VDD	0DH	1AH
VDD	VSS	0EH	1CH
VDD	VDD	0FH	1EH

*if CAD1 and CAD0 are floating, I^2C address will be 0CH/18H.
*if CAD1 and CAD0 are NOT floating, extra current may flow into/out of them. (max. ~90uA)

Figure 2. Application Circuit

3. Electrical Specifications

3.1. Absolute Maximum Ratings

Parameter	Symbol	Limits	Unit
Storage Temperature	TSTG	-40 to 150	°C
Analog Supply Voltage	AVDD	-0.5 to 3.6	V
Digital Supply Voltage	DVDD	-0.5 to 3.6	V
Digital Input Voltage	VIN	-0.3 to DVDD + 0.3	V
Electrostatic Discharge Voltage*[1]	VESD_HBM	-4000 to 4000	V
Electrostatic Discharge Voltage*[2]	VESD_MM	-300 to 300	V
Electrostatic Discharge Voltage*[3]	VESD_CDM	-700 to 700	V
Reflow Classification	JESD22-A113 with 260 °C Peak Temperature		

1. Human Body Model (HBM)

2. Machine Model (MM)

3. Charge Device Model (CDM)

3.2. Recommended Operating Conditions

Parameter	Symbol	Min.	Typ.	Max.	Unit
Operating Temperature	TA	-40		125	°C
Analog Supply Voltage	AVDD	2.4	3.3	3.6	V
Digital Supply Voltage	DVDD	1.72	1.8	3.6	V

3.3. Electrical Specifications

(Operating conditions: TA = 25 ℃; AVDD = 2.5 V; DVDD = 1.8 V; 4.7 μF ceramic capacitors tied to C1 pin with maximum allowed line width and 5 mm distance.)

Parameter	Symbol	Conditions	Min.	Typ.	Max	Unit
Operating Current	IDD3A	Full operation with OSR*[1] = 2 setting, 10 sps 20 sps 50 sps 100 sps 200 sps		 120 220 520 950 1850		μA
Suspend Current	ISPD			2		μA
Output Data Rate (ODR)	ODR				200*[2]	Hz
Input Low Voltage	VIL		0		DVDD *30%	V
Input High Voltage	VIH		DVDD *70%		DVDD	V
Output Low Voltage	VOL	IOL = 4 mA	0		DVDD *20%	V
Output High Voltage	VOH	IOH = -100 μA (Except SCL and SDA)	DVDD *80%		DVDD	V

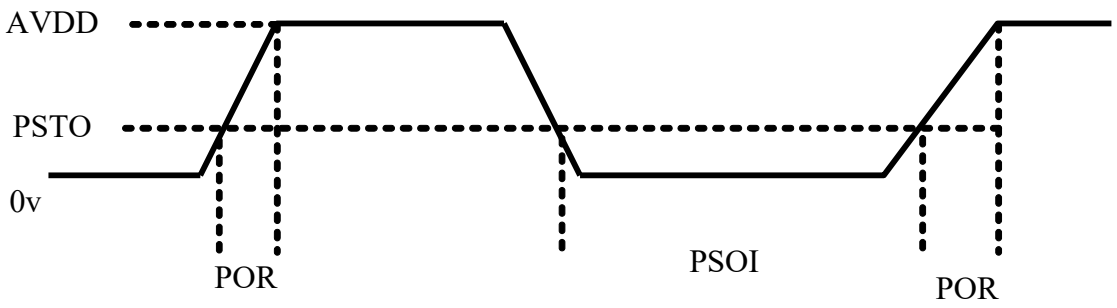
1. Register OSRCNTL(0x41) controls OSR setting.
2. 200 Hz ODR can be achieved with OSR≦8.

3.4. Magnetic Sensor Specifications

(Operating conditions: TA = 25 ℃; AVDD = 2.5 V; DVDD = 1.8 V; 4.7 μF ceramic capacitors tied to C1 pin with maximum allowed line width and 5 mm distance.)

Parameter	Symbol	Condition	Min.	Typ.	Max	Unit
Dynamic Range	DR	TA = 25 °C		±500		μT
Linearity	LIN	±200 μT		0.1		%FS
Resolution	RESO	DR setting: ±200 μT		0.075		μT/LSB
		DR setting: ±500 μT		0.15		
Sensitivity	SEN	DR setting: ±200 μT		13.2		LSB/μT
		DR setting: ±500 μT		6.6		
Zero Gauss Offset	ZGD			±0.3		μT
Hysteresis	HS			0.1		%FS
Sensitivity Temperature Drift	TD_S	-40 – 85 °C		±0.023		%/°C
Zero-B Offset Temperature Drift	TD_O	-40 – 85 °C		0.027		μT/°C

3.5. Power On Reset (POR) Specifications



PSTO: Power Supply Turn Off voltage	PSTO: max=0.7volt
PSOI: Power Supply Turn Off Interval	PSOI: min=10ms
POR: Power On Reset	POR: max:50ms

When POR circuit detects a rise of AVDD voltage, it resets all internal circuits and initializes all registers. After reset, IST8308 transits to Standby mode.

4. Technology Overview

4.1. AMR Technology

IST8308, an iSentek patented magnetometer is designed based on Anisotropy Magnetoresistance (AMR) technology. The output is generated from the resistance change of the AMR resistors as external magnetic field varies. The sensitivity is approximately 50 to 200 times greater than conventional Hall elements. The high sensitivity allows a higher output data rate (ODR), lower noise, and lower power consumption.

4.2. High Reliability Planarized Structure Design

IST8308 consists of three full Wheatstone Bridges of AMR resistors. The three bridges detecting magnetic components in three orthogonal directions are wire-bonded to a control ASIC on a single chip. This planarized structure design enables outstanding stability to thermal shock, making our device highly reliable, whereas other known AMR magnetometers with z-axis sensors placed vertically on the substrate using 90-degree flip-chip packaging suffer from reliability issues

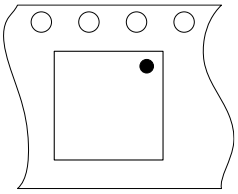
4.3. Ultra-low Hysteresis Design

iSentek has developed a specialized high permeability (μ) material for magnetic field detection. This high-μ material has ultra-low residual magnetization below 0.1 %FS in the field range as large as ±500 G. The ultra-low hysteresis design prevents the magnetometer from experiencing dynamic offset after encountering a strong external magnetic field impact;

that is, the angular accuracy is restored automatically without calibration after the removal of interference field. This feature fulfills the requirements for applications when real-time calibration is unavailable. No calibration is required in general conditions.

4.4. Magnetic Setting Mechanism

AMR sensing resistors consist of permalloy thin film and metallization. Permalloy is a soft magnetic material. Irreversible magnetic rotation may occur when the strength of external magnetic field exceeds half of the anisotropy field of the sensing resistor, resulting in angular error induced by offset. To solve this issue, a magnetic setting mechanism has been introduced in IST8308. A magnetic field is generated within IST8308 to align the magnetization of AMR sensing resistors before every measurement. This auto-zeroing mechanism ensures the stability of IST8308's angular accuracy throughout the operation.



5. Packing Information

Reel tape with round hole facing up, Pin 1 positioned at the top right.
Moisture Sensitivity Level (MSL): 3

6. Ordering Information

Order Number	Package Type	Packaging	Marking Information
IST8308	LGA – 16 pin	Tape and Reel: 5k pieces per reel	$X_1X_2X_3X_4$ 008● X_1: Last number of the year X_2X_3: Week number X_4: Lot number 008: Product code of IST8308

For more information on iSentek's magnetic sensors, please send an email to sales@isentek.com or visit our website at www.isentek.com.

US Patent 9,297,863, Taiwan Patents I437249, I420128 and I463160 apply to our magnetic sensor technology described.

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