IST8308
3D Magnetometer

Brief Datasheet

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1 General Description

iSentek IST8308 is a 3-axis digital magnetometer with 3.0x3.0x1.0mm^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^{2}C digital output with fast mode up to 400kHz. 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

- Single chip 3-axis magnetic sensor
- 3.0x3.0x1.0mm^3, 16-pin LGA package
- I^{2}C slave, Fast Mode up to 400kHz
- Supports both single measurement and continuous measurement modes
- Dynamic range of maximum ±500uT.
- High output data rate of 200Hz
- Ultra-high sensitivity (maximum 13.2 LSB/uT)
- Ultra-low hysteresis (<0.1%FS)
- Ultra-low sensitivity temperature drift (±0.023%/ ^{o}C)
- Ultra-low offset temperature drift (0.017uT/ ^{o}C)
- Wide operating temperature range
- High precision temperature compensation
- Built-in self-test function
- Built-in noise suppression filter
- Software and algorithm support available (For tilt compensation, soft/hard-iron calibration)

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

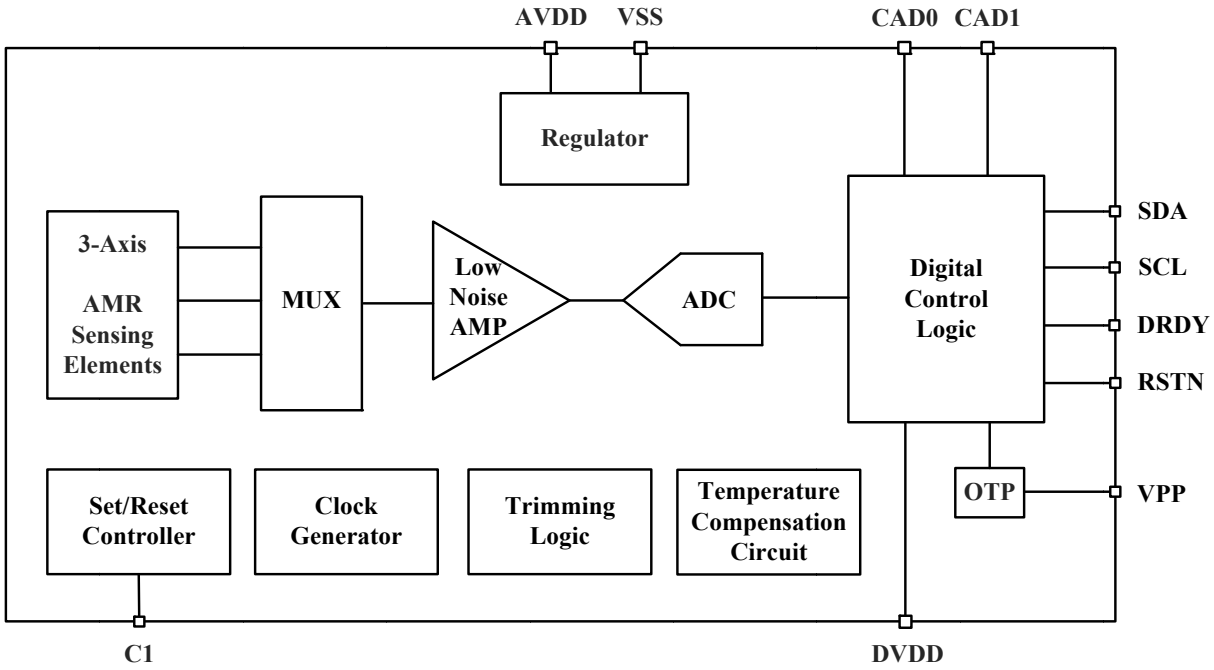
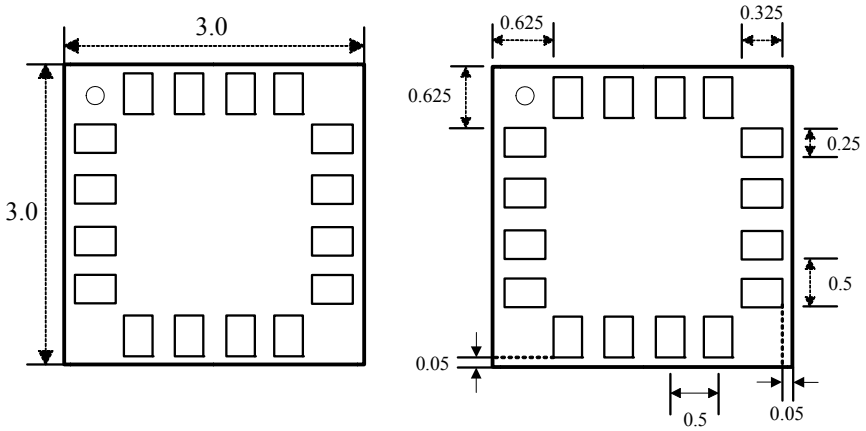


Figure 1. Block Diagram

2.2 Package Dimensions and Pin Description

IST8308 LGA Top View (Looking Through)

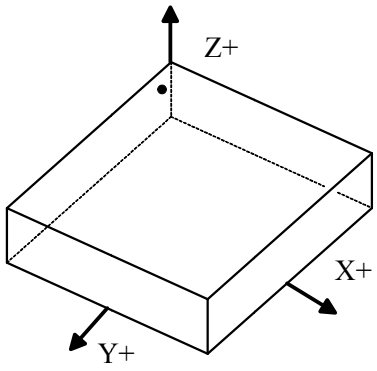


Unit: mm

Tolerance: ±0.1mm

IST8308 LGA Side View

IST8308 3D Top View



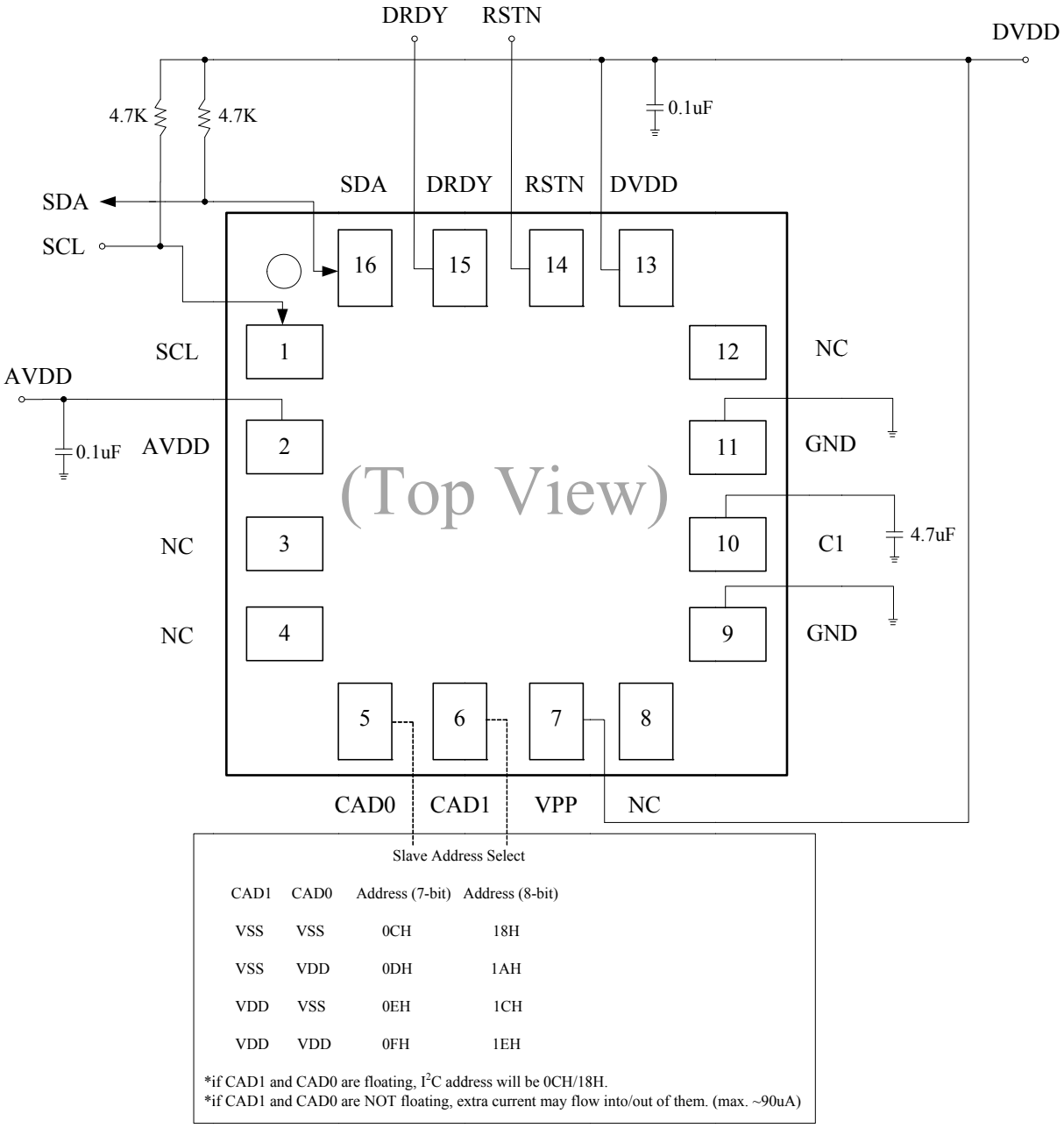
Unit: mm

Tolerance: ±0.1mm

Pin	Name	Function
1	SCL	I^2C serial clock
2	AVDD	Analog supply voltage, 2.4~3.6V
3	NC	Not use
4	NC	Not use
5	CAD0	I^2C slave address
6	CAD1	I^2C slave address
7	VPP	Test pin, connection to DVDD is suggested
8	NC	Not use
9	VSS	GND
10	C1	Set/Reset function, 4.7uF
11	VSS	GND
12	NC	Not use
13	DVDD	Digital supply voltage, 1.72~3.6V
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

*please refer to Figure 2.

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)

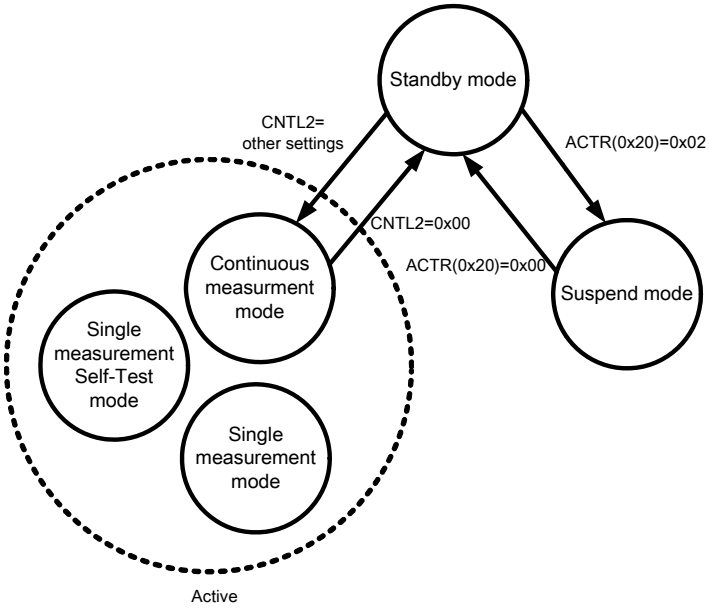
Figure 2. Application Circuit

3 Operational Modes and Functional Descriptions

3.1 Operation modes

IST8308 has following operation modes:

(1) Stand-By Mode
(2) Suspend Mode
(3) Single Measurement Mode
(4) Continuous Measurement Mode
(5) Self-test Mode



4 Electrical Specifications

4.1 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)

4.2 Recommended Operating Conditions

Parameter	Symbol	Min.	Typ.	Max.	Unit
Operating Temperature	TA	-40		+85	°C
Analog Supply Voltage	AVDD	2.4	3.3	3.6	V
Digital Supply Voltage	DVDD	1.72	1.8	3.6	V

4.3 Electrical Specifications

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

Parameter	Symbol	Conditions	Min.	Typ.	Max	Unit
Operating Current	IDD3A	Full operation with OSR*[1]=2 setting,				uA
		10 sps		120		
		20 sps		220		
		50 sps		520		
		100 sps		950		
		200 sps		1850		
Suspend Current	ISPD			2		uA

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 uA (Except SCL and SDA)	DVDD *80%		DVDD	V

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

4.4 Magnetic Sensor Specifications

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

Parameter	Symbol	Condition	Min.	Typ.	Max	Unit
Dynamic Range	DR	TA=25 °C		±500		uT
Linearity	LIN	±200 uT		0.1		%FS
Resolution	RESO	DR setting: ±200 uT		0.075		uT/LSB
		DR setting: ±500 uT		0.15		
Sensitivity	SEN	DR setting: ±200 uT		13.2		LSB/uT
		DR setting: ±500 uT		6.6		
Zero Gauss Offset	ZGD			±0.3		uT
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		uT/ °K

5 Technology Overview

5.1 AMR Technology

IST8308, an iSentek patented magnetometer is designed based on Anisotropy Magneto-Resistance (AMR) technology. The output is generated from the resistance change of the AMR resistors while external magnetic field changes. The sensitivity is about 50 to 200 times larger than traditional Hall element. The high sensitivity allows higher output data rate (ODR), lower noise and lower power consumption.

5.2 High Reliability Planarized Structure Design

IST8308 consists of three full Wheatstone Bridge of AMR resistors. The three bridges detecting magnetic component in three directions orthogonal to each other are located on one chip, wire-bonded to a control ASIC. This planarized structure design enables outstanding stability to thermal shock, making our device highly reliable, while other known AMR magnetometers place z-axis sensor vertical to the substrate using 90-degree flip-chip packaging, suffer from reliability issues.

5.3 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 dynamic offset after encountering a strong external magnetic field impact; that is, the angular accuracy restores automatically without calibration after the removal of interference field. This feature fulfills the requirements for applications when real time calibration is not available. No calibration is required in general conditions.

5.4 Magnetic Setting Mechanism

AMR sensing resistors consist of permalloy thin film and metallization. Permalloy is soft magnetic, irreversible magnetic rotation may occur after 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 is 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 angular accuracy of IST8308 during whole operation.

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

For more information on iSentek's Magnetic Sensors, please contact us by phone at +86-132-6706-8686 (China), +86-755-2991-0201 (China) or +886-2-2698-3306 ext:110 (Taiwan); via e-mail: sales@isentek.com or visit us online at www.isentek.com.

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