IST8315

3D Magnetometer

Datasheet

TABLE OF CONTENTS

1. General Description

iSentek IST8315 is a 3-axis digital magnetometer. The devices are offered in two packages: 1.6x1.6x1.2mm^3, 12-pin BGA, and 1.6x1.6x1.0mm^3, 12-pin LGA. It is an integrated chip with 3-axis magnetic sensors, digital control logic, built-in temperature compensation circuit and self-test function. IST8315 provides an I^{2}C digital output with fast mode up to 400kHz. The ultra-high output data rate, ultra-low noise, ultra-low hysteresis and excellent temperature drift performance features make it a perfect candidate for high speed, high accuracy applications.

Features

- Single-chip 3-axis magnetic sensor
- I^{2}C slave, Fast Mode up to 400 kHz
- 14-bit data output
- Built-in FIFO with 32 depths for each axis
- Ultra-high output data rate with a maximum value of 1000 Hz
- Dynamic range of ±1000 uT.
- Ultra-low hysteresis (< 0.1 %FS)
- Ultra-low sensitivity temperature drift (±0.025 %/°C)
- Ultra-low offset temperature drift (0.016 uT/°C)
- High precision temperature compensation
- Wide operating temperature range
- Built-in self-test function
- Built-in noise suppression filter
- Software and algorithm support are available (for tilt compensation, soft/hard-iron calibration)
- RoHS, HF and TSCA compliant

Applications

- Augmented/Virtual Reality Applications
- Quadcopter/Drone Applications
- Navigation Applications
- Industrial Applications
- Magnetometry
- IoT devices
- Heading
- Gaming

2. Block Diagram, Package Dimension and Application Circuit

2.1. Block diagram

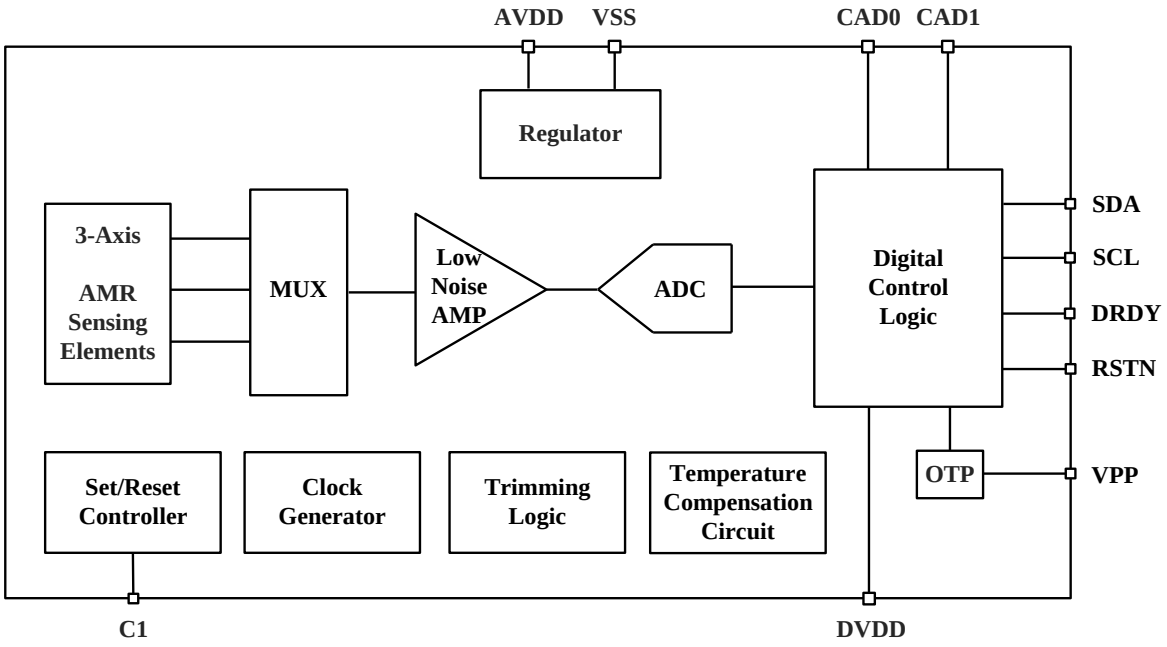


Figure 1. Block Diagram

2.2. Package Dimensions

2.2.1. 12-pin BGA package

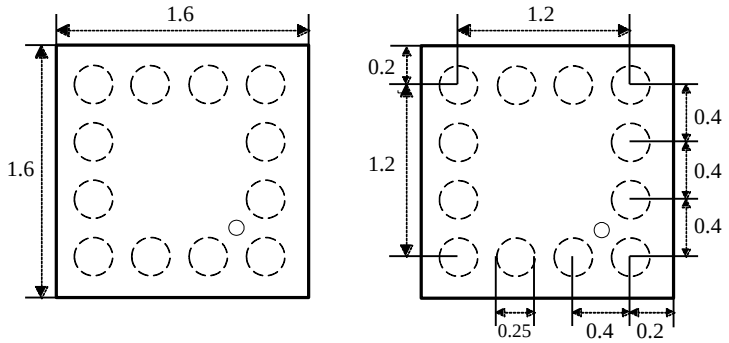


Figure 2. IST8315 BGA Top View

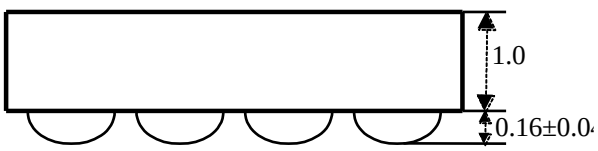


Figure 3. IST8315 BGA Side View

2.2.2. 12-pin LGA package

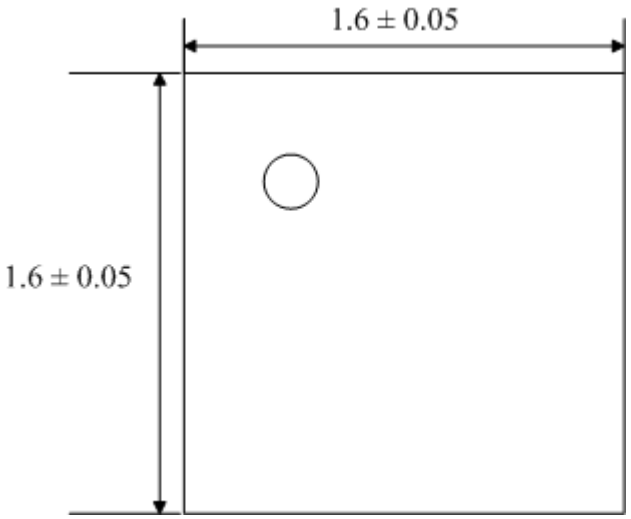


Figure 4. IST8315 LGA Top View

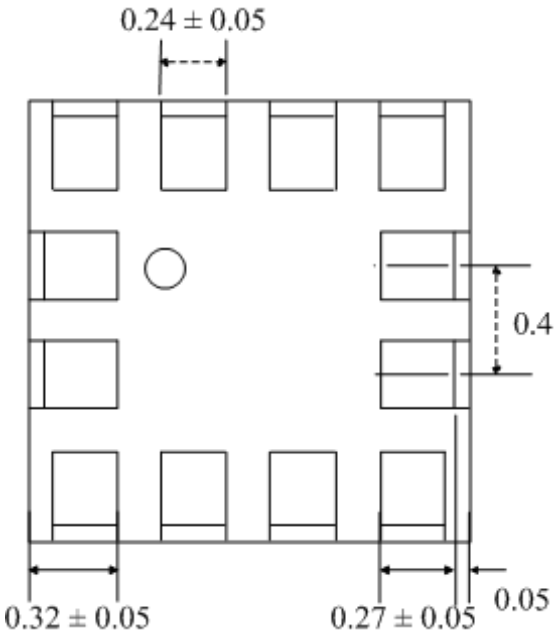
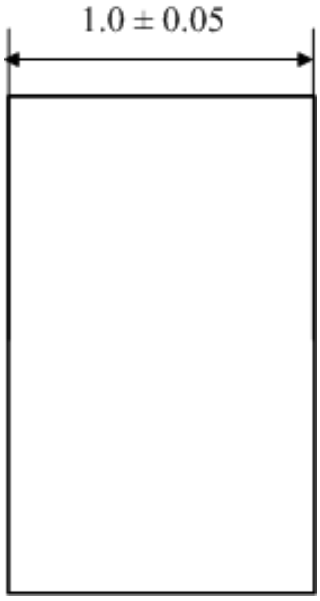


Figure 5. IST8315 LGA Bottom View



Unit: mm

Figure 6. IST8315 LGA Side View

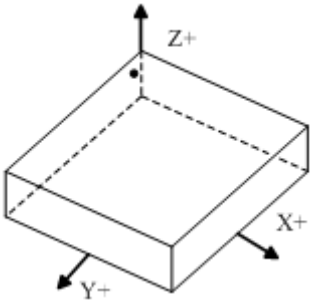


Figure 7. 3D top view

2.3. Application Circuits and Pin Descriptions

Slave Address Select

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

*if CAD1 and CAD0 are floating, I²C address will be 0CH/18H.
*if CAD1 and CAD0 are NOT floating, extra current may flow into/out of them. (max. ~90uA)

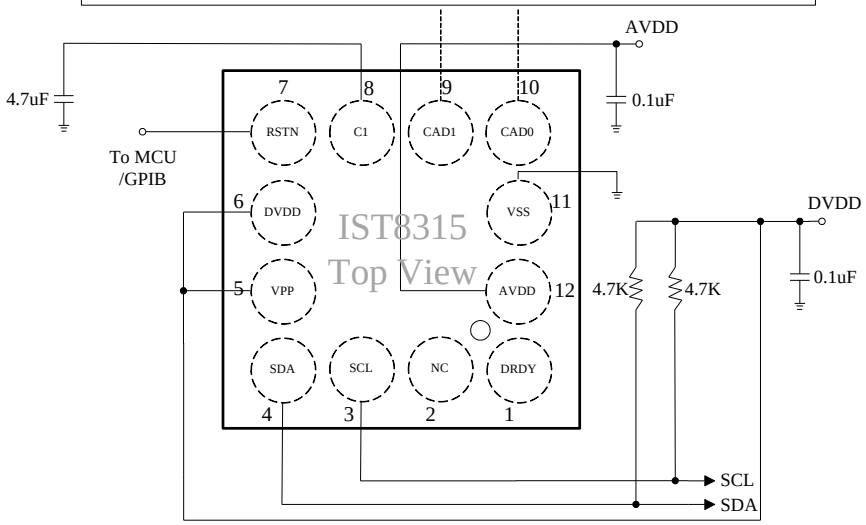


Figure 8. Ap IST8315 application Circuit

Pin[*1]	Name	Function
1	DRDY	Data ready
2	NC	Not use
3	SCL	I²C serial clock
4	SDA	I²C serial data
5	VPP	Test pin, connect to DVDD or keep floating[*2]
6	DVDD	Digital supply voltage, 1.72 ~ 3.6 V
7	RSTN	Reset
8	C1	Set/Reset function
9	CAD1	I²C slave address select, internally pulled to “high” by default
10	CAD0	I²C slave address select, internally pulled to “low” by default
11	VSS	GND
12	AVDD	Analog supply voltage, 2.4 ~ 3.6 V

[*1] Please refer to Figure 8.

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

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		+85	°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 °C; 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]=1 setting, at 10 sps 20 sps 50 sps 100 sps 200 sps 333 sps 500 sps 1000 sps		 100 200 400 750 1450 2350 3450 6900		uA
Suspend Current	ISPD			2		uA
Output Data Rate (ODR)	ODR				1000*[2]	Hz
Over Sampling Rate*[1]	OSR		1		32	
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. 1000Hz ODR can be achieved with OSR = 1.

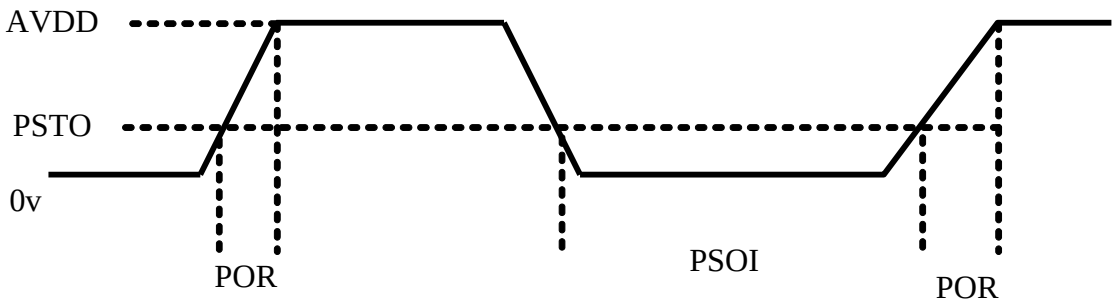
3.4. Magnetic Sensor Specifications

(Operating conditions: TA = +25 °C; 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		±1000		uT
Linearity	LIN			0.5		%FS
Resolution	RES			0.3		uT/LSB
Sensitivity	SEN			3.3		LSB/uT
Zero Gauss Offset	ZGD			±0.3		uT
Hysteresis	HS			0.1		%FS
Sensitivity Temperature Drift	TD_S	-40 ~ 85 °C		±0.025		%/°C

Zero-B Offset Temperature Drift	TD_O	-40 ~ 85 °C		0.016		uT/°C

3.5. Power On Reset (POR) Specifications



PSTO: Power Supply Turn Off voltage
PSOI: Power Supply Turn Off Interval
POR: Power On Reset

PSTO: max=0.7volt
PSOI: min=10ms
POR: max:50ms

When POR circuit detects a rise of AVDD voltage, it resets all internal circuits and initializes all registers. After reset, IST8315 transits to Standby mode.

4. Technology Overview

4.1. AMR Technology

iSentek's patented magnetometer IST8315 is designed using Anisotropy Magnetoresistance (AMR) technology. The output is generated by the change in resistance of the AMR resistors as the 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

IST8315 consists of three full Wheatstone Bridges of AMR resistors. The three bridges detecting magnetic components in orthogonal directions are wire-bonded to a control ASIC on a single chip. This planarized structural design offers exceptional thermal shock stability, making our device extremely reliable, whereas other known AMR magnetometers with z-axis sensors placed vertically on the substrate employing 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 the 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 IST8315. A magnetic field is generated within IST8315 to align the magnetization of AMR sensing resistors before every measurement. This auto-zeroing mechanism ensures the stability of the IST8315's angular accuracy throughout the operation.

5. Ordering Information

Order Number	Package Type	Packaging	Marking Information
IST8315	LGA – 12 pin	Tape and Reel: 3k pieces per reel	$X_1X_2X_3$ 15● X_1: Last number of the year X_2X_3: Week number 15: Product code

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

The U.S. patents 9297863 and 9562953B2 and the Taiwanese patents I437249, I420128, I463160, and I565958 cover our described magnetic sensor technology.

6. Legal Disclaimer

6.1. Warranty and Liability Disclaimer

iSentek Inc. warrants the information in this datasheet. It is assumed that the specification is accurate and reliable. However, iSentek Inc. makes no warranties or claims regarding the accuracy or completeness of this information and takes no responsibility for the use of the information, nor does it convey any license under its patent rights or the rights of third parties.

iSentek Inc. shall not be liable for any consequential, incidental, indirect, or punitive damages (including, but not limited to, profit loss, business interruption, and further expenses related to the removal, replacement, or rework of any products).

6.2. Application Disclaimer

iSentek's products are unsuitable for life-critical and safety-critical applications. For the use of its products in such applications, iSentek disclaims all liability. The customer agrees to indemnify and hold iSentek harmless from and against all liabilities and losses.

6.3. Disclaimer Regarding Changes

iSentek reserves the right to modify the contents of this datasheet, including specifications and descriptions, at any time and without prior notice. This document supersedes all previously issued information.