IST8315-L
3D Magnetometer

Datasheet

Table of Contents

1. General Description

iSentek IST8315-L is a 3-axis digital magnetometer with a 1.6 x 1.6 x 1.0 mm^3, 12-pin LGA package. It is an integrated chip with 3-axis magnetic sensors, digital control logic, a built-in temperature compensation circuit, and self-testing function. IST8315-L provides an I^2C digital output with fast mode up to 400 kHz. Its ultra-high output data rate, ultra-low noise, ultra-low hysteresis and excellent temperature drift performance features make it a perfect candidate for applications requiring high speed and high precision.

Features

- Single-chip 3-axis magnetic sensor
- 1.6 x 1.6 x 1.0 mm^3, 12-pin LGA package
- I^2C 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)

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

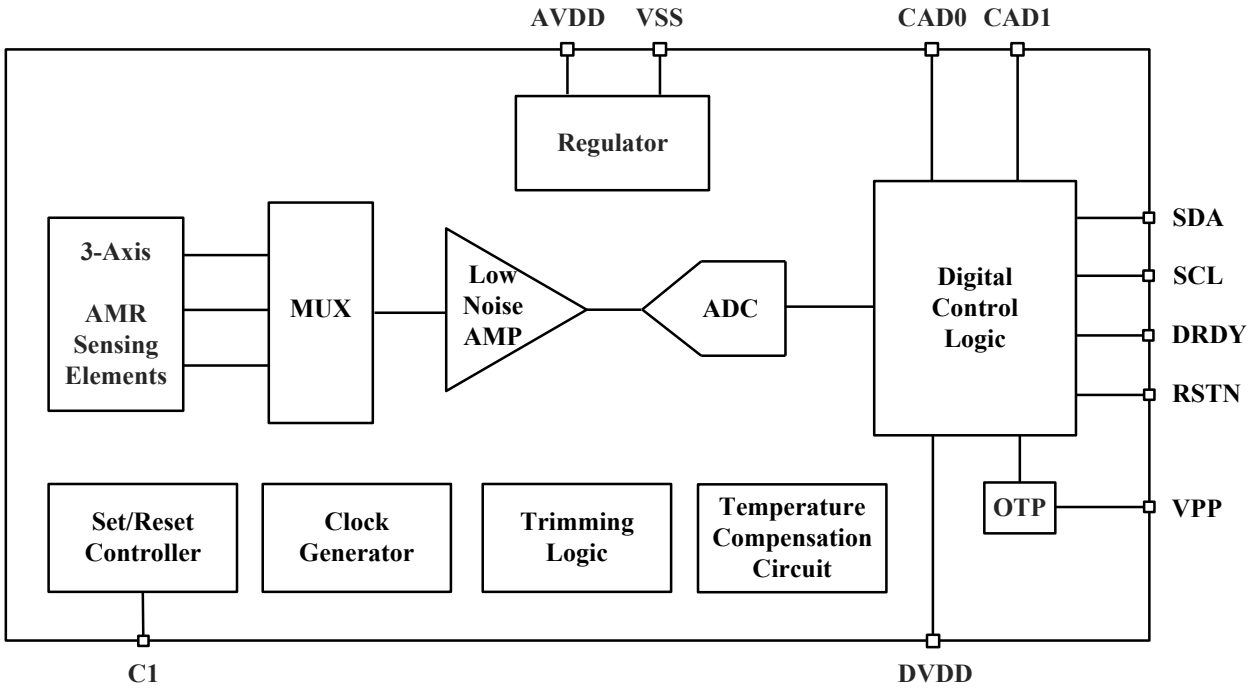


Figure 1. Block Diagram

2.2. Package Dimensions

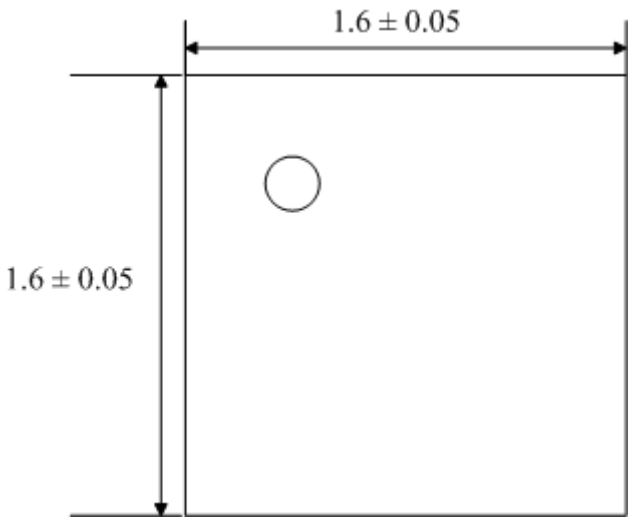


Figure 2. IST8315-L Top View

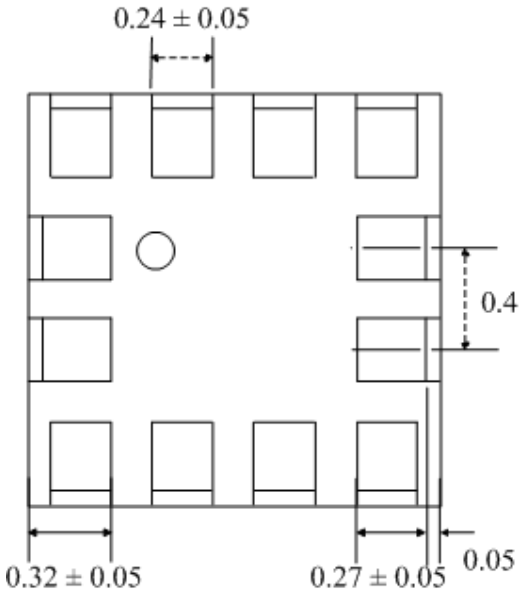
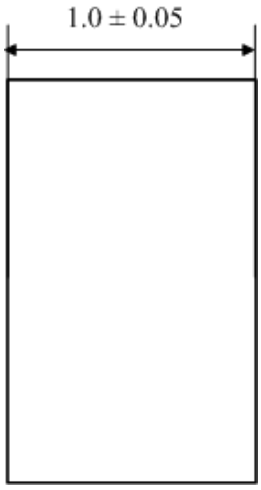


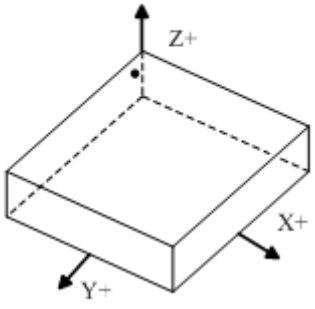
Figure 3. IST8315-L Bottom View



Unit: mm

Figure 4. IST8315-L Side View

IST8315-L 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)

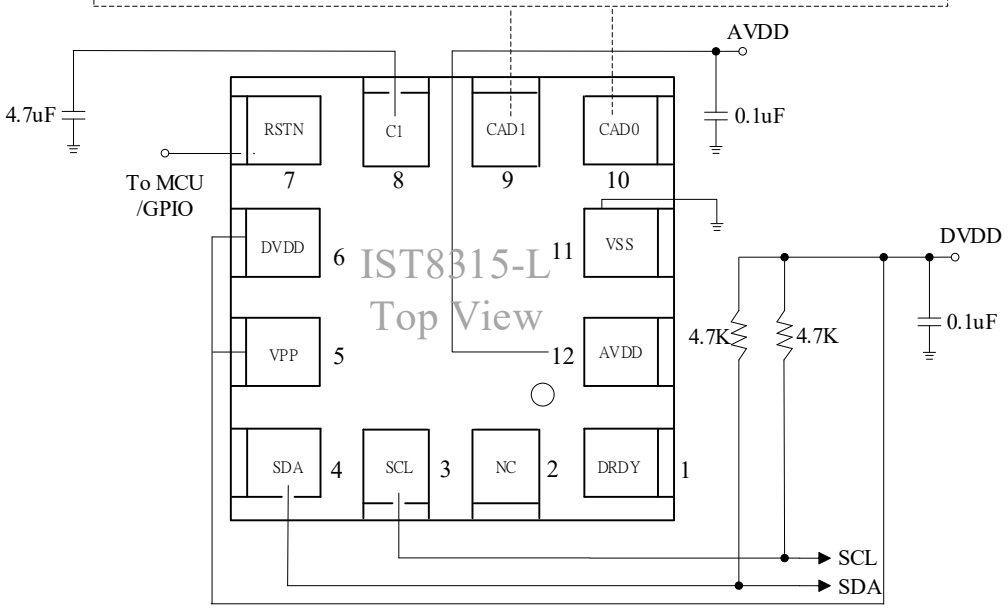


Figure 5. IST8315-L Application Circuit

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 “low” 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 5 on page 7.

*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 ℃; 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		μA
Suspend Current	ISPD			2		μA

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

1. Register OSRCNTL(0x41) controls OSR setting.

2. 1000Hz ODR can be achieved with OSR = 1.

Typical Operating Current vs. ODR and Averaging

(AVDD = 3.3 V, T = 25 °C, unless otherwise specified)

ODR (Hz)	0.5	1	8	10	20	50	100	200	333	500	1000	Unit
AVR=0	58	58	99	120	201	407	755	1447	2356	3489	6928	μA
AVR=2	58	58	114	142	254	533	1003	1927	3137	4656	6396	
AVR=4	58	58	142	185	354	776	1473	2847	4677	–	–	
AVR=8	58	58	198	268	548	1237	2399	4688	–	–	–	
AVR=16	58	58	309	434	934	2163	4239	–	–	–	–	
AVR=32	59	59	530	766	1632	4008	–	–	–	–	–	

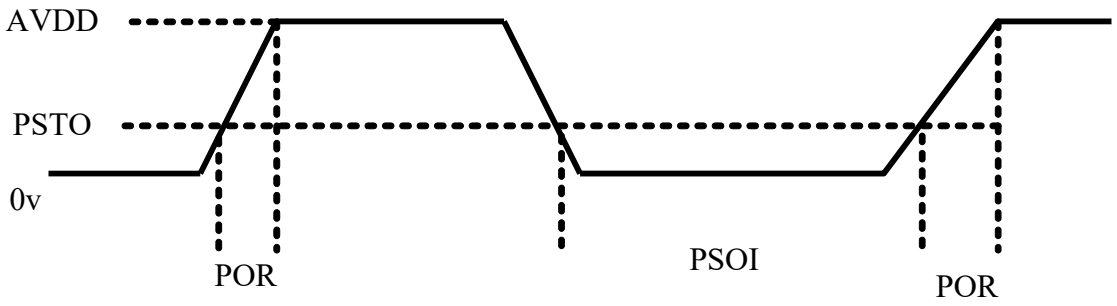
3.4. Magnetic Sensor Specifications

(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		±1000		μT
Linearity	LIN			0.5		%FS
Resolution	RES			0.3		μT/LSB
Sensitivity	SEN			3.3		LSB/μT
Zero Gauss Offset	ZGD			±0.3		μT
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		μT/°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-L transits to Standby mode.

4. Technology Overview

4.1. AMR Technology

iSentek's patented magnetometer IST8315-L 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-L 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

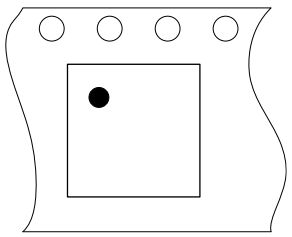
AMR sensing resistors consist of permalloy thin film and metallization. Permalloy is a soft magnetic material. Irreversible magnetic rotation may occur when the strength of external magnetic field exceeds half of the anisotropy field of the sensing resistor, resulting in angular error induced by offset. To solve this issue, a magnetic setting mechanism has been introduced in IST8315-L. A magnetic field is generated within IST8315-L to align the magnetization of AMR sensing resistors before every measurement. This auto-zeroing mechanism ensures the stability of the IST8315-L's angular accuracy throughout the operation.

4.5. Cross-Axis Calibration

Cross-axis calibration is performed in production using a Helmholtz coil. The correction matrix is stored into OTP memory. By default, the correction matrix is applied and thus the correction is enabled, so that the sensor orientation alignment error is within ±3°.
Optionally, the cross-axis correction can be disabled and the uncorrected measured values can be directly bypassed into accessible output registers (DATAXL, DATAXH, …) by appropriate configuration of register 0x40.
Its recommended to use the same OSR for ZX-axis and Y-axis when operating the sensor in default mode with enabled cross-axis correction to avoid unwanted errors by AC-magnetic fields.

5. Packing Information

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



6. Ordering Information

Order Number	Package Type	Packaging	Marking Information
IST8315-L	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.

7. Legal Disclaimer

7.1. Warranty and Liability Disclaimer

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7.3. 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.

Revision History

Revision Version	Date	Description
1.0	March 2nd, 2021	Initial release
1.1	March 14th, 2023	Added green compliance statement (Page 4); corrected pin orientation in the application circuit diagram (Page 7); removed contact phone number (Page 26)
1.2	June 5th, 2023	Updated application circuit figure: Added an extra line from SDA to DVDD. (Page 7)
1.3	January 3rd, 2025	Added packing information (Page 23); added Moisture Sensitivity Level (MSL): 3 (Page 23)
1.4	September 11th, 2025	Fixed single measurement mode logic value (Page 9); added self-test flow (Page 10); added typical operating current table (Page 14); added 5.5. Cross-Axis Calibration (Page 16); edited Register table (Page 19); added IIR filter description in Control Setting Register 1 (Page 22); added 6.4.11. Control Setting Register 4 (Page 24).
1.5	April 23rd, 2026	Edited figure 5 (Page 7)