

IST8309

3D Magnetometer

with Programmable

Switch

Datasheet

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1. General Description

iSentek IST8309 is a 3D digital linear hall sensor to measure magnetic flux intensity. It is an IC device that contains magnetic sensors and control ASIC with a 16-bit ADC output. IST8309 provides an I²C digital output with a fast mode up to 400 kHz. Wide dynamic range operation, high resolution, and compact form factor features make it the best candidate for smartphone, wearable, and IoT devices.

Features

- Single-chip 3-axis linear Hall sensor with digital output
- 3-axis programmable magnetic switch functionality
- INTB pin for event notification (magnetic switch, DRDY, overflow)
- Compact form factor: 1.29 × 0.99 × 0.53 mm³ (5-pin WLCSP-BGA package)
- Operating supply voltage: VDD: 1.7V to 3.6V; VID: 1.2V to VDD
- I2C interface: Supports fast mode up to 400 kHz
- Dual selectable slave addresses
- High dynamic range: Up to ±30 mT
- High resolution: Up to 2.5 μT/LSB
- Absolute 360° angle output
- High output data rate: Up to 1 kHz
- Operating temperature range: -30°C to 85°C
- Integrated oscillator for internal clock source
- Built-in power-on reset (POR) circuit
- Compliance: RoHS, HF, and TSCA

Applications

- Magnetometer for external magnetic detection
- Displacement detection
- Foldable device angle detection
- Angle sensor application
- Joystick and gaming controller

2. Block Diagram, Package Details, Pin Configurations, and Application Considerations

Considerations

2.1. Block Diagram

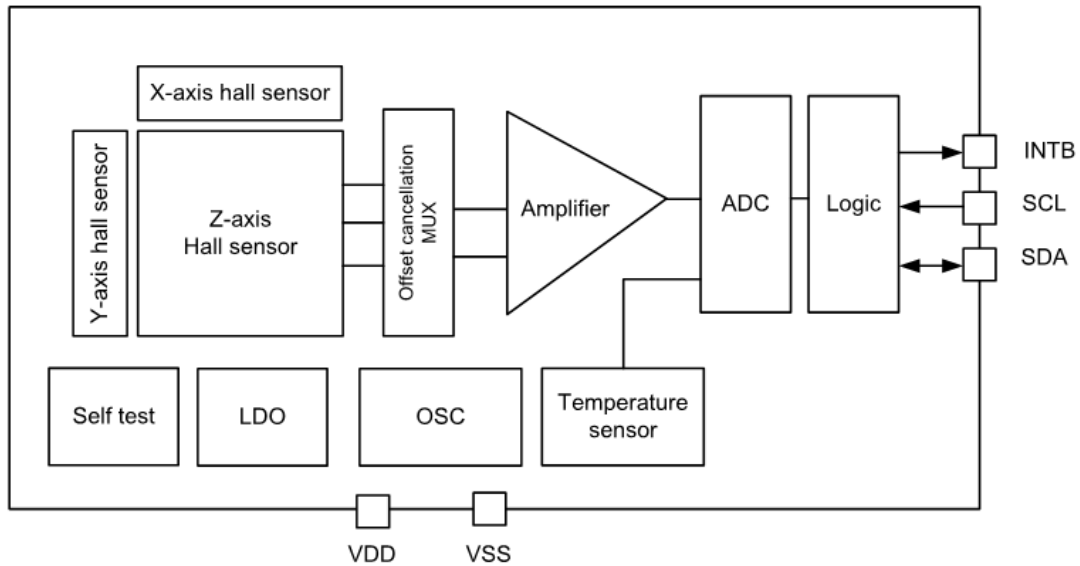


Figure 1. Block Diagram

2.2. Package Dimensions

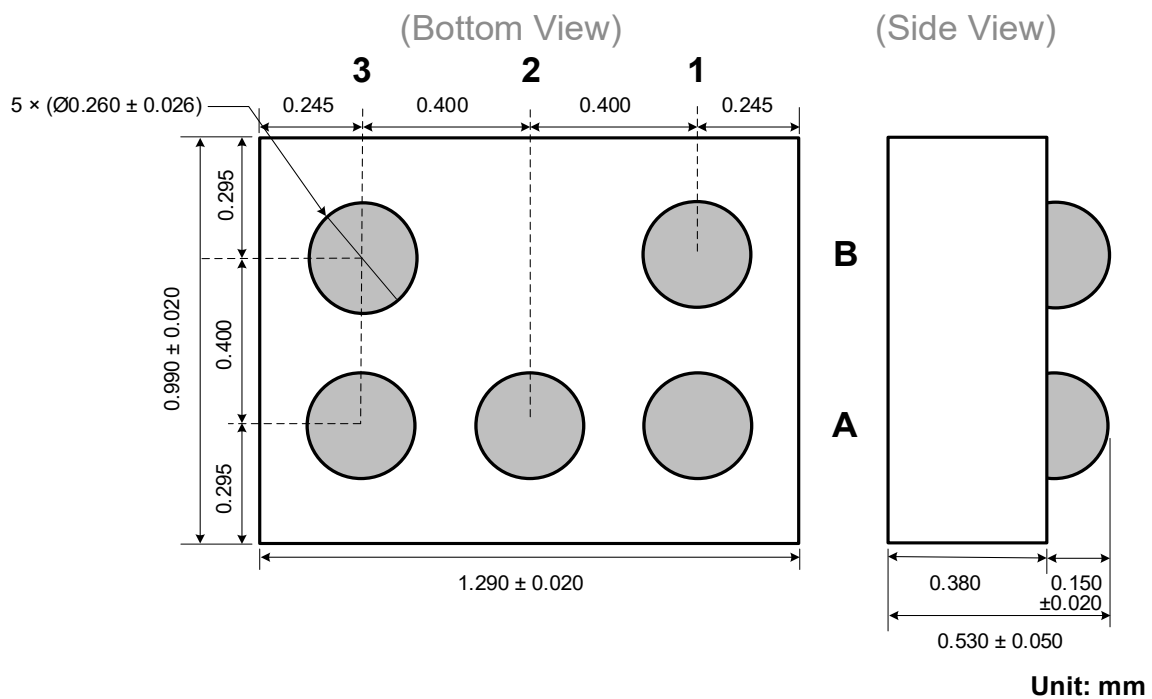


Figure 2. Package Dimensions

2.3. Location of Hall Sensing Elements

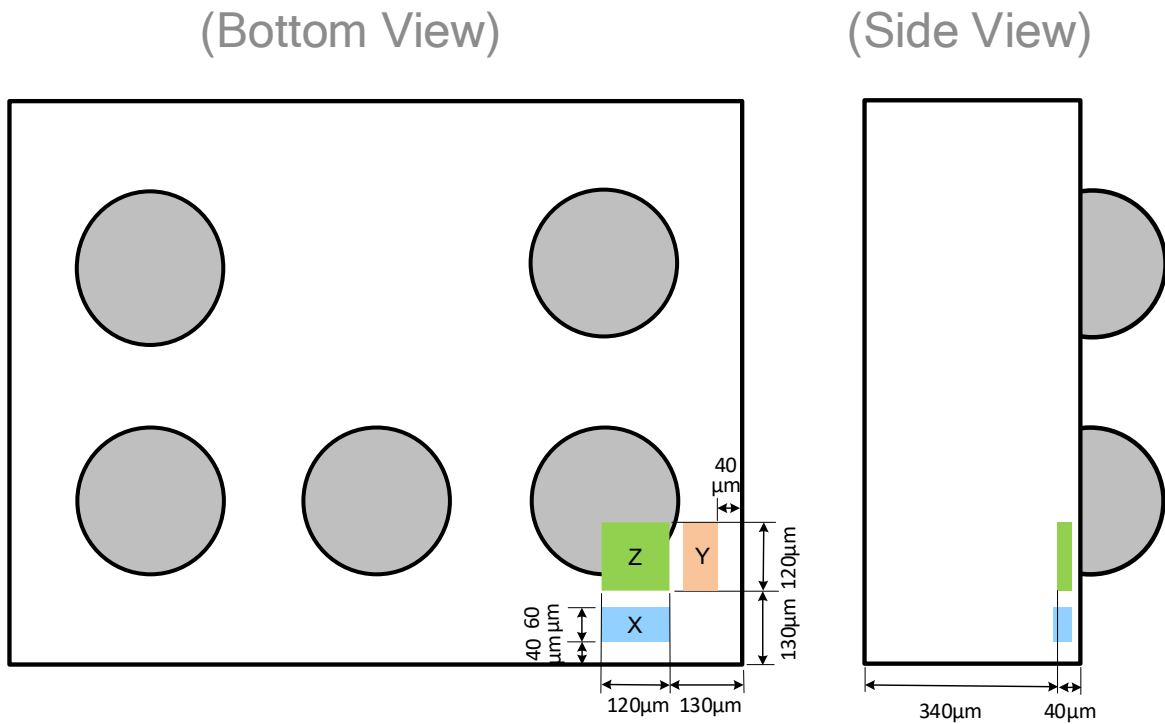
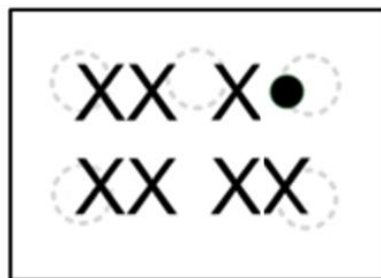


Figure 3. Sensing Element Positions

2.4. Marking

Date code $X_1X_2X_3$ ●
 Product code $X_4X_5X_6X_7$
 X_1 : Year
 X_2X_3 : Week
 $X_4X_5X_6X_7$: Product code



IST8309 TOP View

2.5. Magnetic Field Direction

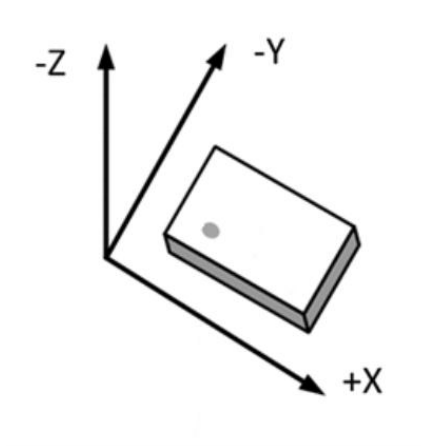
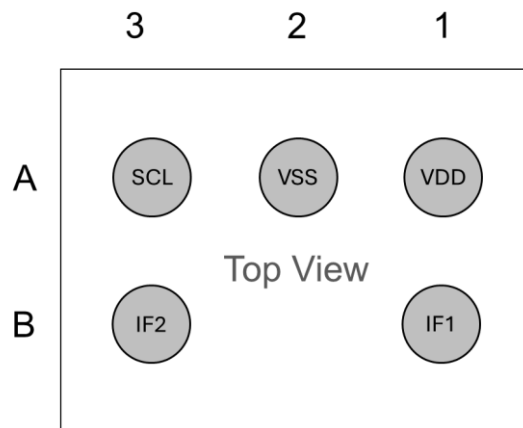


Figure 4. Magnetic Field Direction

2.6. Pin Configurations and Application Circuit



Case 1. Slave Address = 0x18

	Symbol	Function name	Type	Function
A1	VDD	VDD	Power	Power supply
A2	VSS	VSS	Power	Ground
A3	SCL	SCL	Input	I ² C clock
B1	IF1	INTB	Output	Open-drain interrupt output
B3	IF2	SDA	I/O	I ² C data

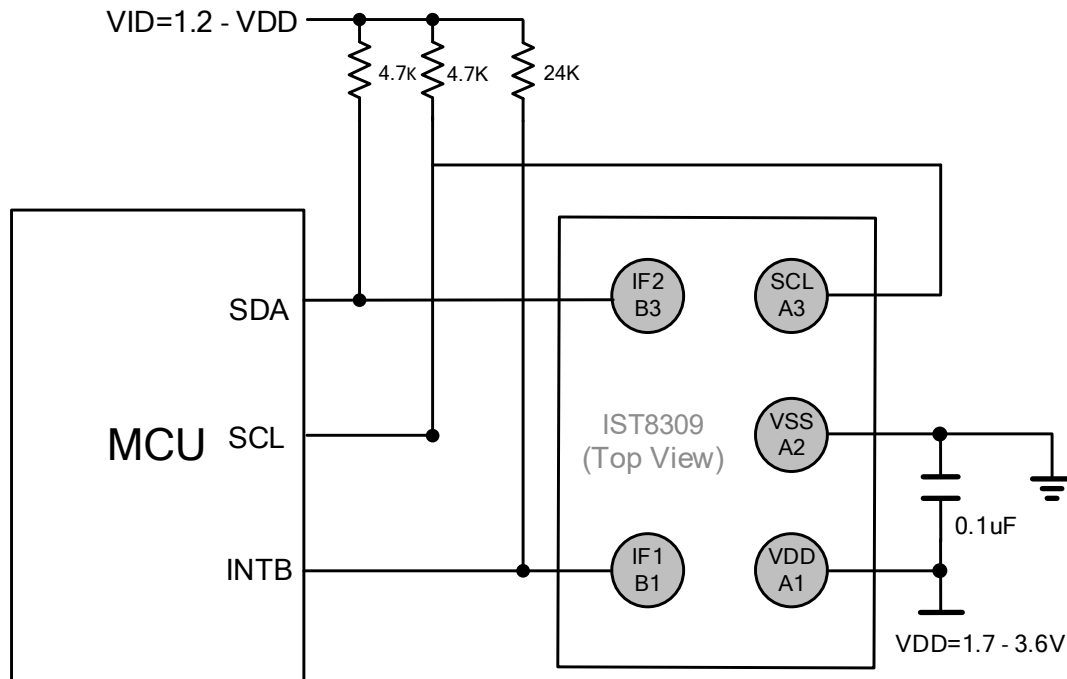


Figure 5. Application Circuit

Note:

1. VID must be powered up no later than VDD.
2. **Resistor Selection:** A 24 kΩ resistor is recommended. Alternatives ranging from 16 kΩ to 100 kΩ may be used, depending on customer preference and design requirements. Higher resistance values are beneficial for power saving.

Case 2. Slave Address = 0x19

	Symbol	Function name	Type	Function
A1	VDD	VDD	Power	Power supply
A2	VSS	VSS	Power	Ground
A3	SCL	SCL	Input	I ² C clock
B1	IF1	SDA	I/O	I ² C data
B3	IF2	INTB	Output	Open-drain interrupt output

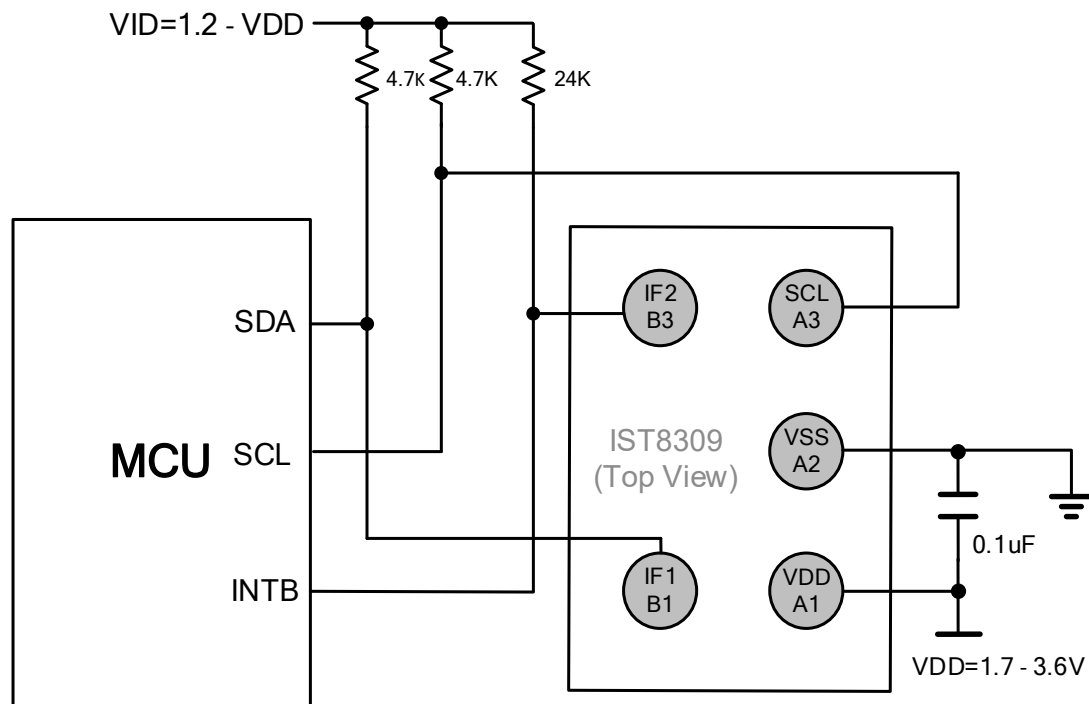


Figure 6. Application Circuit

Note:

1. VID must be powered up no later than VDD.
2. **Resistor Selection:** A 24 kΩ resistor is recommended. Alternatives ranging from 16 kΩ to 100 kΩ may be used, depending on customer preference and design requirements. Higher resistance values are beneficial for power saving.

Case 3. Dual IST8309

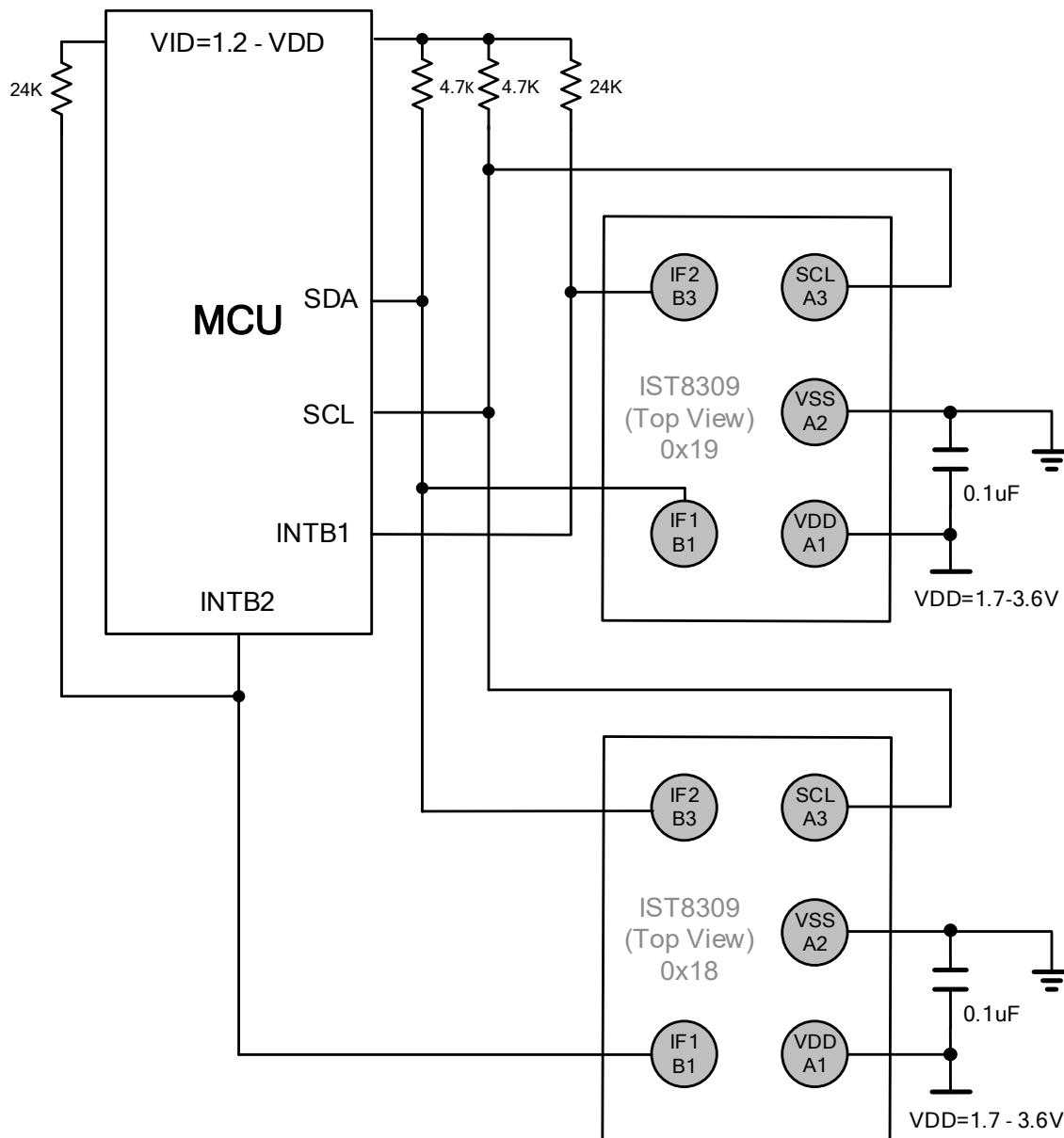


Figure 7. Application Circuit

Note:

1. VID must be powered up no later than VDD.
2. **Resistor Selection:** A 24 kΩ resistor is recommended. Alternatives ranging from 16 kΩ to 100 kΩ may be used, depending on customer preference and design requirements. Higher resistance values are beneficial for power saving.

2.7. Slave Address Detection

1. The slave address, either **0x18** or **0x19**, is determined by the pull-up resistors of SDA, SCL, and INT.
2. Pull-up resistor **MUST** be:

- 4.7 kΩ on **SDA** and **SCL**.
 - 24 kΩ on **INT**
3. The I²C “**SDA**” and interrupt “**INT**” schematics are **different** between 0x18 and 0x19.
- When the slave address is set to **0x18**:
 “**SDA**” will be **IF2** (B3 Pin)
 “**INT**” will be **IF1** (B1 Pin)
 - When the slave address is set to **0x19**:
 “**SDA**” will be **IF1** (B1 Pin)
 “**INT**” will be **IF2** (B3 Pin)

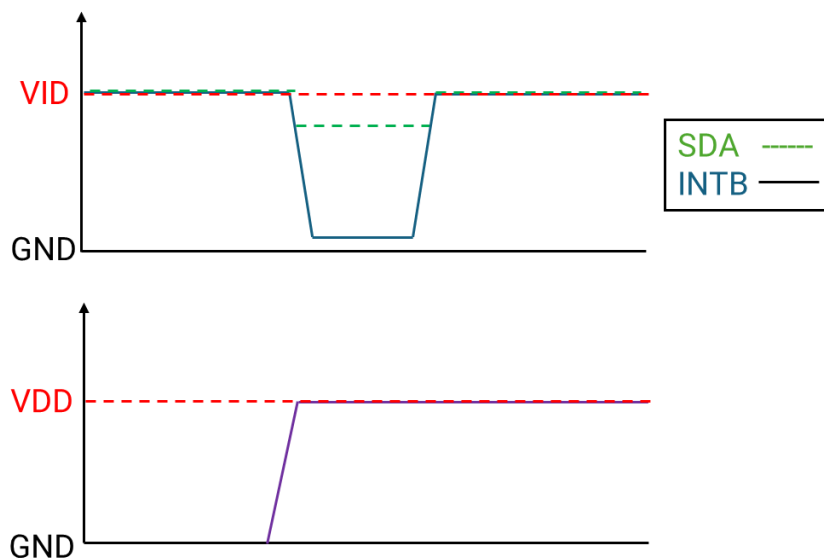
2.8. MCU and Platform Baseband Application

1. External pull-up resistors on SDA, SCL, and INT are required.
 2. Disconnect any internal pull-up resistors within the MCU or Platform Baseband.
 3. Set the GPIO mode connected to the INT to either FLOATING MODE or INPUT MODE at power-on
 4. Set the mode of I²C IO for SDA and SCL to OPEN DRAIN MODE.
- ***DO NOT ACCESS SDA, SCL, AND INT WHILE POWER-ON*****
5. The startup sequence should be completed within 1 ms after power-on before beginning any I²C communication operations.

2.9. Startup Sequence and Voltage Requirements

(1) VID is applied before VDD

The power-up of VDD triggers the address detection mechanism. During this process, SDA remains high relative to INTB until the detection is completed.

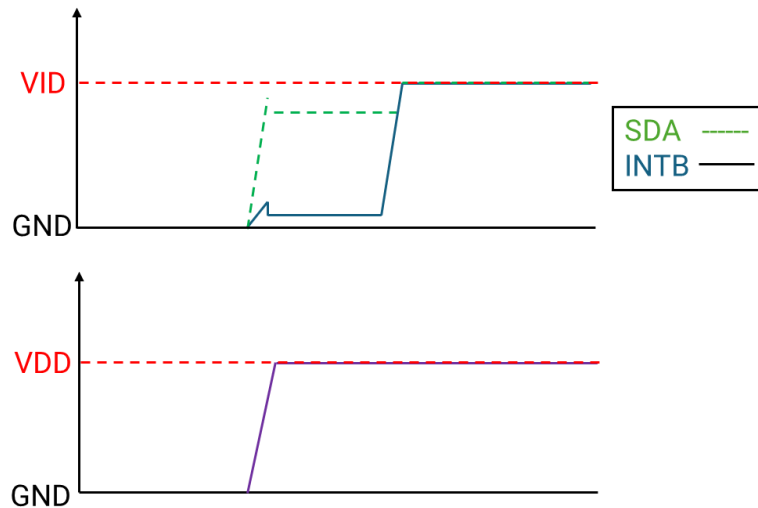


Notes:

- VID voltage must be less than or equal to VDD voltage.
- SDA, SCL, and INTB must all operate at the same VID voltage.

(2) VDD and VID Applied Simultaneously

The power-up of VDD triggers the address detection mechanism. During this process, SDA remains high relative to INTB until the detection is completed.



Notes:

- VID voltage must be less than or equal to VDD voltage.
- SDA, SCL, and INTB must all operate at the same VID voltage.

2.10. CSP Packaging and Light Exposure Effects

IST8309 uses a WLCSP (Wafer-Level Chip Scale Package) for minimal footprint and optimized assembly cost. Unlike fully encapsulated packages, the CSP structure applies an opaque coating only on the backside of the die. The active front side remains exposed, making the device susceptible to photoelectric effects caused by incident light.

Photo-Induced Effects: Exposure to visible or infrared light can generate electron-hole pairs within the exposed silicon.

This may cause:

- Increased leakage currents via surface or substrate conduction.
- Threshold voltage shifts or unstable behavior in MOSFET circuits.
- Elevated quiescent current or reduced signal stability, particularly in low-power operation modes.

Design Recommendations:

- **Light-Blocking Enclosure:** Ensure that system-level mechanical design prevents direct illumination of the chip surface.

- **Optional Opaque Coating:** Application of an additional opaque layer after assembly can provide supplementary protection against light-induced effects.

Improper light shielding may result in abnormal current consumption and performance drift under illumination.

3. Electrical Specifications

3.1. Absolute Maximum Ratings

Parameter	Symbol	Limits	Unit
Storage Temperature	TCG	-40 to 125	°C
Power Supply Voltage	VDD	-0.3 to 4.0	V
Electrostatic Discharge Voltage* ¹	VESD_HBM	-2000 to 2000	V
Electrostatic Discharge Voltage* ²	VESD_CDM	-1000 to 1000	V
Reflow Classification	JESD22-A113 with 260°C Peak Temperature		

If the device is used in conditions exceeding these limits, it may malfunction permanently. Performance cannot be assured when these limits are exceeded.

1. Human Body Model (HBM)
2. Charge Device Model (CDM)

3.2. Recommended Operating Conditions

Parameter	Symbol	Min.	Typ.	Max.	Unit
Operating Temperature	TA	-30		85	°C
Power Supply Voltage	VDD	1.7	3.3	3.6	V

3.3. Electrical Specifications

Operating conditions: TA = 25 °C; VDD = 3.3 V.

Parameter	Symbol	Pin	Conditions	Min.	Typ.	Max.	Unit
Current Consumption	IDD	VDD	10 Hz sampling		50		µA
Standby Consumption	CUP	VDD	Standby mode		2		µA
Input current	IAN	SCL, IF1, IF2	GND or VDD	-10		10	µA
Input Low Voltage	VIL	SCL, IF1, IF2		-0.3		0.42	V
Input High Voltage	VIA	SCL, IF1, IF2		0.89		VDD	V
Output Low Voltage	VOL	IF1, IF2				0.3	V

IST8309



Hysteresis Input	VHS	SCL, IF1, IF2		0.2			V
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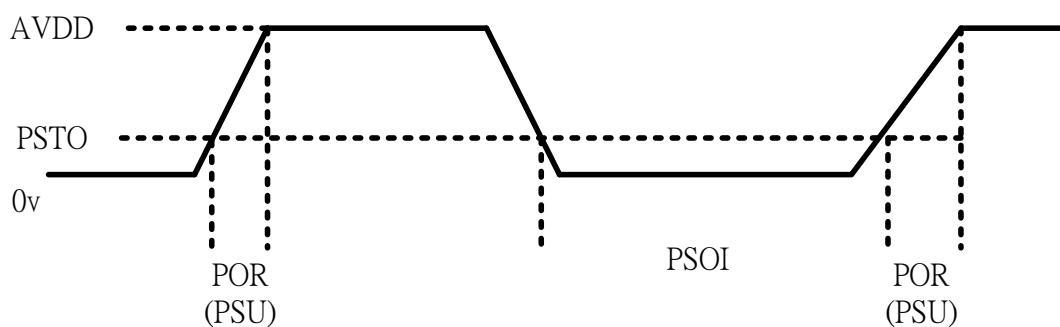
3.4. Magnetic Sensor Specifications

Operating conditions: TA = 25 °C; VDD = 3.3 V.

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Dynamic Range	DR		±26 ±180 ^{*1}	±30 ±210 ^{*1}	±35 ±245 ^{*1}	mT
Resolution	RES	16-bit setting	2.17 ±13.1 ^{*1}	2.5 17.5 ^{*1}	2.94 ±22.9 ^{*1}	uT/LSB
Zero-Field Offset	BOF		-1	0	1	mT

^{*1} **High Dynamic Range Mode:** Guaranteed by design; not subject to testing.

3.5. Power-On Reset (POR) Specifications



PSTO: Power Supply Turn Off voltage
 PSOI: Power Supply Turn Off Interval
 POR: Power On Reset
 PSU: Power Supply Rise Time^{*1}

PSTO: max=0.1volt
 PSOI: min=30ms
 POR: max:1ms

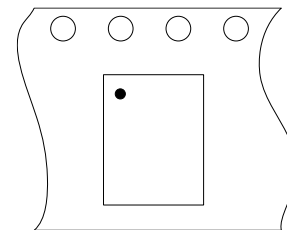
^{*1} The power on reset time is equal to the power supply rise time (max:1ms).

When the POR circuit detects an increase in VDD value, it resets all internal circuits and initializes all registers. After being reset, IST8309 transits to Standby Mode.

4. Packing Information

Reel tape with round hole facing up, with Pin 1 positioned at the top left.

Moisture Sensitivity Level (MSL): 1



5. Ordering Information

Order Number	Package Type	Packaging	Temperature Range	Marking Information
IST8309	WLCSP – 5 pins	Tape and Reel: 5k pieces per reel	-30 to 85°C	X ₁ X ₂ X ₃ ● X ₄ X ₅ X ₆ X ₇ X ₁ : Year X ₂ X ₃ : Week X ₄ X ₅ X ₆ X ₇ : Product code

For further information about iSentek's Magnetic Sensors, please send an email to sales@isentek.com visit our website at www.isentek.com.

6. Legal disclaimer

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