IST8303
3D Magnetometer Sensor

Datasheet

Table of Contents

1 General Description

The iSentek IST8303 is a 3-axis digital magnetometer sensor. It is an integrated chip with 3-axis magnetic sensors and controller ASIC. IST8303 provides an I2C digital output with fast mode up to 400kHz. The compact form factor is easy to surface mount for high-volume design and production.

Features

- Single chip 3-axis magnetic sensor
- I2C slave, Fast mode up to 400kHz
- Small form factor, 1.6x1.6x1.0mm, 12-pin BGA package
- Wide magnetic field range +/- 1600uT
- 14 bits data output
- Auto zero drift for anti magnetic interference
- Low power consumption
- Best performance/cost solution

Applications

Digital Compass
GPS/pedestrian Navigation
Augmented Reality Applications
Magnetometer

2 Block Diagram, Package Dimension and Application Circuit

2.1 Block diagram

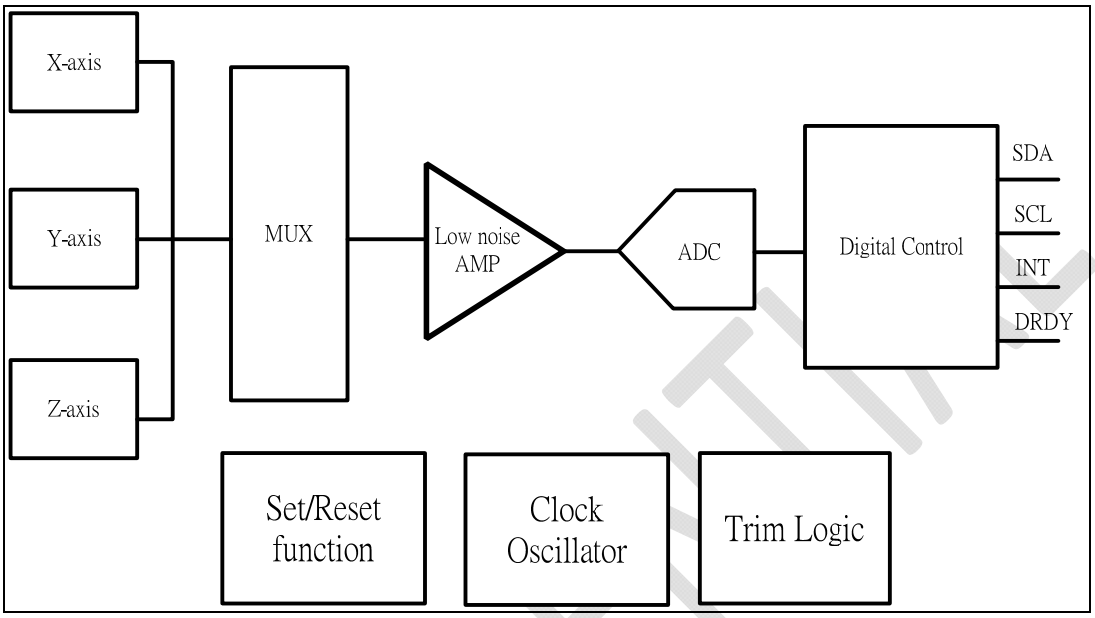
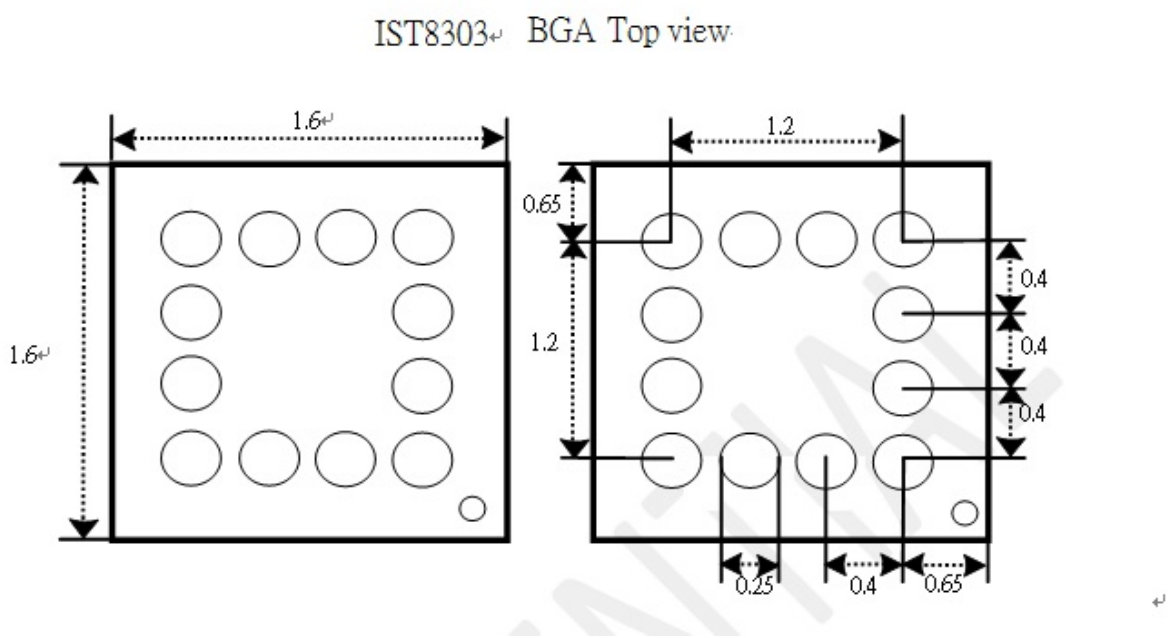
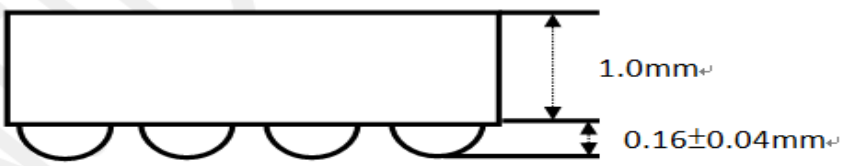


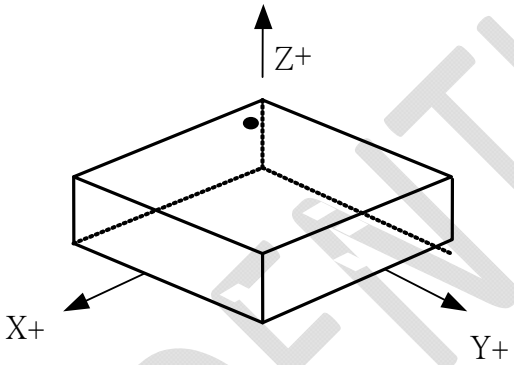
Figure 2-1 Block Diagram

2.2 Package Dimensions and Pin Description



IST8303 BGA Side View





Top view

Pin	Name	Function
1	DRDY	Data ready
2	NC	Not use
3	SCL	I2C serial clock
4	SDA	I2C serial data
5	NC	Not use
6	DVDD	Power for I/O, 1.72~3.6
7	RSTN	Reset
8	C1	Set/Reset Function
9	CAD1	I2C Slave Address
10	CAD0	I2C Slave Address
11	VSS	GND
12	AVDD	Analog Power , 1.72~3.6V

2.3 Application Circuit

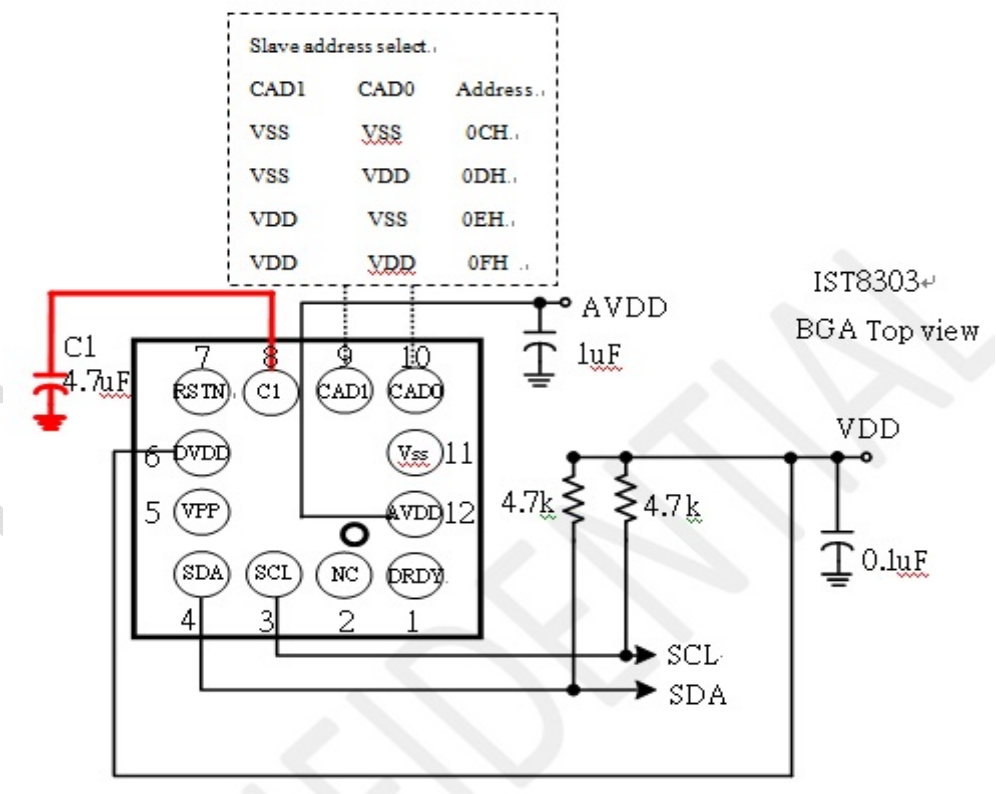


Figure 2-2 Application circuit

3 Operational Modes and Functional Descriptions

3.1 Operation modes

IST8303 has following operation modes:
(1) Stand-By Mode
(2) Single Measurement Mode
(3) Continuous Measurement Mode

3.1.1 Stand-By Mode

In Stand-By mode, all internal circuit is turned off. All register can be accessed in Stand-By Mode. Data stored in Read/Write registers are remained. Register can be reset by soft reset.

3.1.1 Single Measurement Mode

In Single Measurement mode, the measured data stored to data registers. Then, IST8303 transits to stand-by mode automatically. On transition to stand-by mode, Control register 1(CNTL1[3:0]) turns to “0000”. At the same time, DRDY bit in STAT1 turns to “1”. This called “data ready”. When any of measurement data register or STAT2 register is read, DRDY bit turns to “0”.

3.1.1 Continuous Measurement Mode

When continuous measurement mode is set, sensor is measured periodically at different frequency. The measured data is stored in data registers and wait for the measurement period finish. When the next measurement timing comes, IST8303 automatically starts measurement again.

3.2 Interrupt function

Interrupt function is used for detect the extraordinary external magnetic field occur. When the measured output value is exceeding 16 Gauss, the INT register is enabled. INT register can be found in STAT2.

3.3 DRDY function

DRDY function is used to detect when the output data was updated. The DRDY pin is enabled to notice the data ready output. DRDY is changed to low after reading data in the output register.

3.4 IST8303 Read Process

(1) Read STAT1 register

- Polling STAT1 register bit 0

- DRDY: shows data ready or not

0: no data ready

1: data ready

- DOR: shows if any data has been skipped before the current data or not.

0: no skipped data

1: Skipped data

(2) Read Measurement Data

Read Register 0x03h~0x08h for X, Y and Z axis data. When data reading starts, DRDY bit and DOR bit turns to "0"

4 Electrical Specifications

4.1 Extreme Rating

For E compass

Parameter	Symbol	Limits	Unit
Storage Temperature	TSTG	-40 to +125	°C
Operating Temperature	TOPR	-20 to +85	°C
Analog Power Input Voltage	AVDD	+1.72 to +3.6	V
I/O Power Voltage	DVDD	+1.72 to +3.6	V
Digital Input Voltage	VIN	-0.3 to DVDD+0.3	V
Electrostatic Discharge Voltage*[1]	VESD	-2000 to 2000	V
Latch Up Current	ALU	-100 to 100	mA

4.2 Recommended Operating Conditions

Parameter	Symbol	Min.	Typ.	Max.	Unit
Operating Temperature	TOPR	-20		+85	°C
Analog Power Input Voltage	AVDD	1.72	2.8	3.6	V
Digital Input Power Voltage	DVDD	1.72	1.80	3.6	V

4.3 Electrical Specifications

(Operating conditions: Ta=+25℃; AVDD=3.0V; VDDIO=1.8V; 1μF ceramic capacitors tied closely to VO and GND respectively.)

Parameter	Symbol	Conditions	Min.	Typ.	Max	Unit

Operating current	IDD3A	Full operation, at 0.5 sps 1 sps 8 sps 10 sps 20sps 50 sps 100sps 200 sps		 18 20 72 80 140 320 600 1200		uA
Standby current	ISTB			10		uA
Output data rate (ODR)	ODR		8		200	Hz
Input low voltage	VIL		0		VDDIO *30%	V
Input high voltage	VIH		VDDIO *70%		VDDIO	V
Output low voltage	VOL	IOL= +4mA	0		VDDIO *20%	V
Output high voltage	VOH	IOH= -100uA (Except SCL and SDA)	VDDIO *80%		VDDIO	V

4.4 Magnetic Sensor Specifications

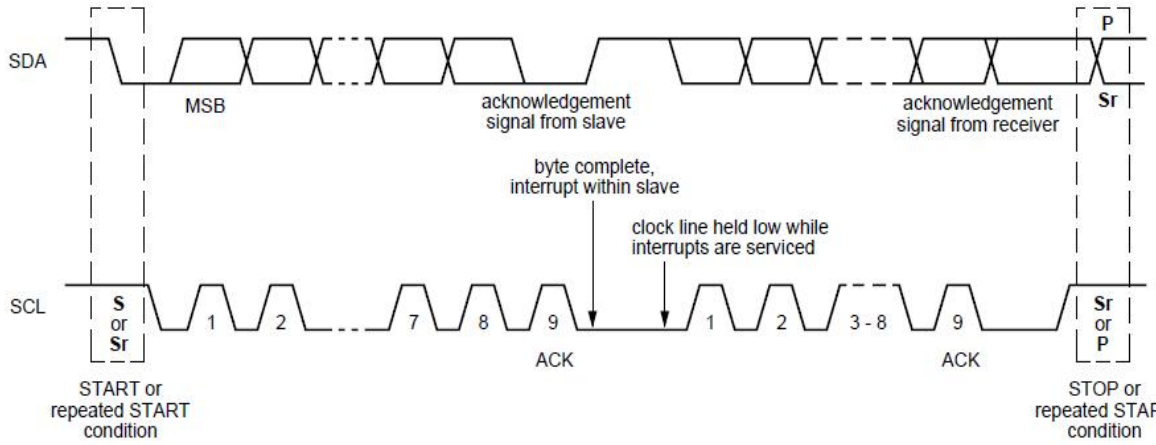
(Operating conditions: Ta=+25℃; AVDD=2.8V; VDDIO=2.8V; 4.7μF ceramic capacitors tied closely to C1 and GND respectively.)

Parameter	Symbol	Conditions	Min.	Typ.	Max	Unit
Dynamic Range	Mdr			±16		gauss
Linearity	Lin	within ±3gauss		1		%FS
Resolution	Reso			3		mG/LSB
Zero Guass Drift	ZGD			± 3		mG
Hystersis	HS			0.1		%FS

5 Digital Interface and Register

5.1 I2C interface

The interface for IST8303 follows the standard I2C definition guidelines with some additional protocol definitions. IST8303 support standard speed (100KHz) and fast speed (400KHz). Pull-up resistors (both in SDA and SCK lines) must be pulled up to 3.3K. The default I2C slave address is 0xE.



5.2 I2C Read Operation

Single Byte Read:

SA	Slave Address+ RW	ACK	Reg Address	ACK	SP	Slave Address+RW	ACK	DATA	NA	ST

Figure 5-2-1 I2C Single Byte Read Operation

ACK: acknowledge, NA: not acknowledge, SA: START Condition, SP: Repeat Start Condition, ST: STOP Condition

■ :Slave to Master □:Master to Slave

Multiple Byte Reads:

SA	Slave Address+ RW	ACK	Reg Address	ACK	SP	Slave Address+RW	ACK	DATA	ACK	DATA	NA	ST

Figure 5-2-2 I2C Multiple Byte Read Operation

ACK: acknowledge, NA: not acknowledge, SA: START Condition, SP: Repeat Start Condition, ST: STOP Condition

■:Slave to Master □:Master to Slave

5.3 I2C Write Operation

Single Byte Write:

SA	Slave Address +RW	ACK	Reg Address	ACK	DATA	ACK	ST

Figure 5-3-1 I2C Single Byte write Operation

ACK: acknowledge, NA: not acknowledge, SA: START Condition, SP: Repeat Start Condition, ST: STOP Condition
■:Slave to Master □:Master to Slave

Multiple Byte Writes:

SA	Slave Address +RW	ACK	Reg Adderss	ACK	DATA	ACK	DATA	NA	ST

Figure 5-3-2 I2C Multiple Byte write Operation

ACK: acknowledge, NA: not acknowledge, SA: START Condition, SP: Repeat Start Condition, ST: STOP Condition
■:Slave to Master □:Master to Slave

5.4 Register

5.4.1 Customer Defined Register

Register name	Typ	I2C Addr	Size (bit)	Info
Who I am	R	00h	8	Device ID
More Info	R	01h	8	Information
Status Register 1	R	02h	8	Data Status
Output Value X_L	R	03h	8	Low byte for X-axis data
Output Value X_H	R	04h	8	High byte for X-axis data
Output Value Y_L	R	05h	8	Low byte for Y-axis data
Output Value Y_H	R	06h	8	High byte for Y-axis data
Output Value Z_L	R	07h	8	Low byte for Z-axis data
Output Value Z_H	R	08h	8	High byte for Z-axis data
Status Register 2	R	09h	8	Data Status
Control Register 1	R/W	0Ah	8	Chip Control setting 1
Control Register 2	R/W	0Bh	8	Chip Control setting 2
Output Value T_L	R	1Ch	8	Low byte for Temperature data
Output Value T_H	R	1Dh	8	High byte for Temperature data

Table 5.1 Control/Status Register Map defined by Customer

5.4.2 Who I Am Register

WLA(0x00)			
Bit	Description	Attr	Default
7:0	Device ID	R	TBD

This Register provides device ID information

5.4.3 More Info Register

INFO(0x01)			
Bit	Description	Attr	Default
7:0	More Information	R	TBD

This Register provides extra information about IST8303

5.4.4 Status Register 1

STAT1 (0x02)			
Bit	Description	Attr	Default
7:2	Reserved		
1	DOR: Turns to 1 when data has been skipped. Bit is release after any output data register read 0: no data overrun 1: data overrun	R	0
0	DRDY: Data ready pin 0: no data ready 1: data is ready This status bit is following physical signal appearance, expect the polarity control (refer to DRP bit in CNTL2 register) If data ready function enable bit is not set (refer to DREN bit in CNTL2 register), this bit is zero	R	0

5.4.4 Output data registers

The output register 0x03h~0x08h contain X, Y, Z Axis measurement data. Measurement data is stored in two's complement.

DATAXL(0x03)			
Bit	Description	Attr	Default
7:0	Low Byte of X-axis data	R	

DATAXH(0x04)			
Bit	Description	Attr	Default
7:0	High Byte of X-axis data	R	

DATAYL(0x05)			
Bit	Description	Attr	Default
7:0	Low Byte of Y-axis data	R	

DATAYH(0x06)			
Bit	Description	Attr	Default
7:0	High Byte of Y-axis data	R	

DATAZL(0x07)			
Bit	Description	Attr	Default
7:0	Low Byte of Z-axis data	R	

DATAZH(0x08)			
Bit	Description	Attr	Default
7:0	High Byte of Z-axis data	R	

5.4.5 Status register 2

This Register Control the ADC output resolution and also has INT register for customer use.

STAT2(0x09)			
Bit	Description	Attr	Default
7	Reserved		
6	Reserved Reserved	R	0
5	Reserved	R	0
4	Reserved	R	0
3	INT : Interrupt bit. When interrupt event occurs, this bit will set to 1	R	0
2	Reserved	R	0
1	Reserved	R	0
0	Reserved	R	0

5.4.6 Control setting register 1

Controls and adjusts main parameter.

CNTL1(0x0A)			
Bit	Description	Attr	Default
7:4	Reserved		
3:0	Mode: Operating mode setting 0: Stand-By mode 1: Single measurement mode 2: Continuous measurement mode with ODR 8Hz 3: Continuous measurement mode with ODR 10Hz 4: Reserved 5: Continuous measurement mode with ODR 20Hz 6: Continuous measurement mode with ODR 100Hz 7: Continuous measurement mode with ODR 50Hz 8: Reserved 9: Continuous measurement mode with ODR 0.5Hz 10: Continuous measurement mode with ODR 1Hz 11: Continuous measurement mode with ODR 200Hz	R/W	0

	12~15: Reserved		

5.4.7 Control setting register 2

Controls and adjusts main parameter set.

CNTL2(0x0B)			
Bit	Description	Attr	Default
7:4	Reserved		
3	DREN : Data ready function enable: 0:disable 1:enable Master switch for DRDY output pin	R/W	1
2	DRP: DRDY signal active 0: Low 1: High	R/W	1
1	Reserved		
0	SRST: Soft reset, perform the same routine as POR 0: no action 1: start immediately POR routine This bit set to zero after POR routine	R/W	0

5.4.9 Temperature sensor output register

Output Data Register use 2's complement format

DATATL(0x1C)			
Bit	Description	Attr	Default
7:0	Low Byte of Temperature data	R	0

DATATH(0x1D)			
Bit	Description	Attr	Default
7:0	High Byte of Temperature data	R	0