# SPECIFICATION FOR APPROVAL

CUSTOMER              :

PRODUCT TYPE         :     1616 3-Axis Electronic Compass

TXC P/N              :     PM13100001

REVISION             :     S1

CUSTOMER P/N         :

PM / SALES           :

DATE                 :

CUSTOMER SIGNATURE & DATE

                     :

(1) TXC requires one copy returned with signature and title of authorized individual that signifies acceptance of the attached specifications.

(2) Orders received and accepted by TXC after return of signed copy of specification will be produced per these specifications.

(3) Any changes to these specifications must be agreed upon by both parties and new revision of the Product Specification Sheet will be issued.

(4) Any issuance of purchase order prior to consigning back the Approval page of "Specification Sheets" from customers will be regarded as the agreement on the contents of these specifications.

Attachment(s):
[V] 1. Product Specification Sheet
[ ] 2. Testing Report(Electrical & Temperature)
[ ] 3. Reliability Report

**RoHS Compliant**

# PRODUCT SPECIFICATION SHEET

CUSTOMER            :

PRODUCT TYPE        :     1616 3-Axis Electronic Compass

TXC P/N             :     PM13100001

REVISION            :     S1

| PE/RD | QA | MFG |
|-------|-----|------|
|       |     |      |

NOTE:

(1) The green product standard set by TXC is based upon the international standards. Related information is publicly described on the TXC's Website, and updated regularly. The document is compliant with the latest green product quality system directives at the time.

(2) Revision "Sx" is for engineering samples only. PE/RD's approval required.

(3) Revision "Ax" is production ready.  PE, QA and MFG's approval required.

**RoHS Compliant**

**TXC CORPORATION**

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| Rev | Revise page | Revise contents | Date | Ref.No. | Reviser |
|---|---|---|---|---|---|
| S1 | NA | Initial release | 2015/04/15 | NA | Andy Juan |
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PRODUCT TYPE: 1616 3-Axis Electronic Compass    P/N : PM13100001    REVISION :    S1

## ■ GENERAL DESCRIPTION

TXC PM13100001 is a 3-axis digital magnetometer. It is an integrated chip with 3-axis magnetic sensors and control ASIC. TXC PM13100001 provides an I2C digital output with fast mode up to 400kHz. The compact form factor is easy for surface mount therefore is suitable for high-volume design and production.

## ■ FEATURES

Single chip 3-axis magnetic sensor

I2C slave, Fast Mode up to 400kHz

Small form factor, 1.6x1.6x1.16mm, 11-pin BGA package

Wide magnetic field range of ±16 gauss

14 bits data output

Zero drift after anti-magnetic interference

Low power consumption
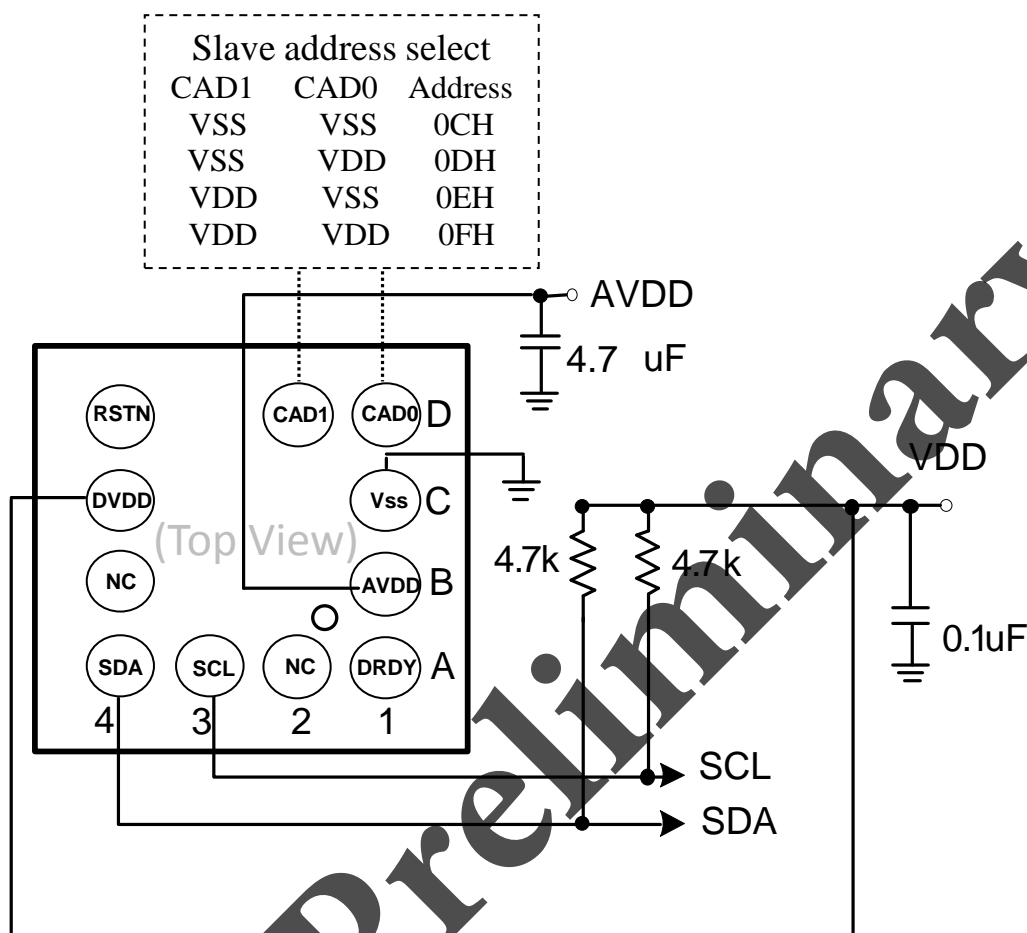
Best performance/cost solution

## ■ APPLICATION

Digital Compass

GPS/Pedestrian Navigation

Augmented Reality Applications

Magnetometer

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## ■ TYPICAL APPLICATION CIRCUIT

Slave address select

| CAD1 | CAD0 | Address |
|------|------|---------|
| VSS | VSS | 0CH |
| VSS | VDD | 0DH |
| VDD | VSS | 0EH |
| VDD | VDD | 0FH |



## ■ FUNCTIONAL PIN DESCRIPTION

| PIN NO. | PIN NAME | DESCRIPTION |
|---------|----------|-------------|
| A1 | DRDY | Data ready |
| A2 | NC | Not use |
| A3 | SCL | I2C serial clock |
| A4 | SDA | I2C serial data |
| B1 | AVDD | Analog supply voltage, 1.8~2.8V |
| B4 | NC | Not use |
| C1 | VSS | GND |
| C4 | DVDD | Digital supply voltage, 1.72~3.6V |
| D1 | CAD0 | I2C slave Address |
| D2 | CAD1 | I2C slave Address |
| D4 | RSTN | Reset |

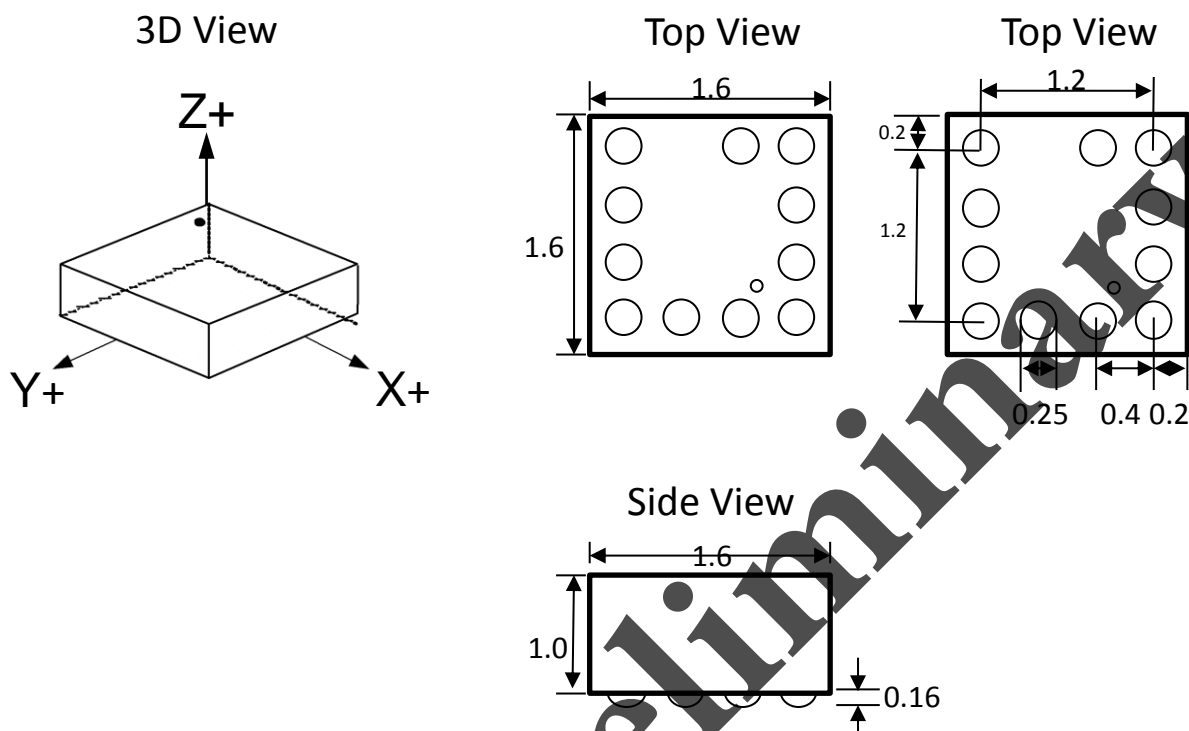PRODUCT TYPE:　　1616 3-Axis Electronic Compass　　P/N : PM13100001　　REVISION :　　S1
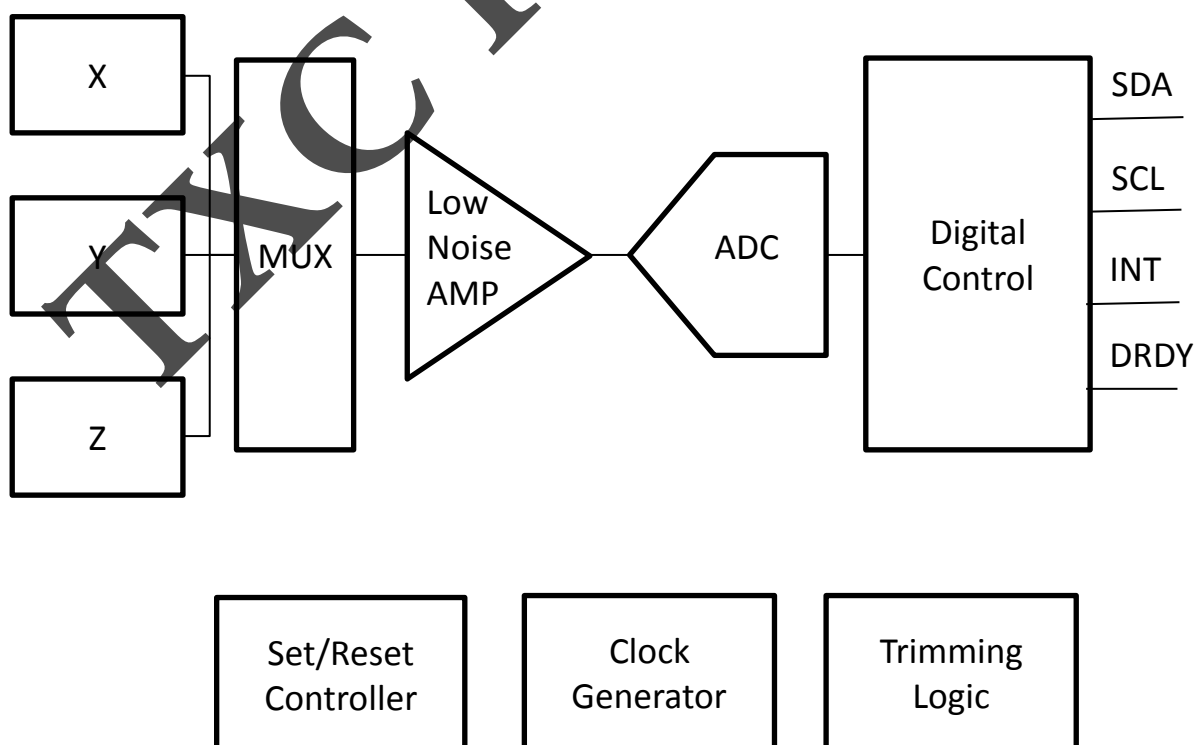
## ■ DIMENSIONS

Unit : mm

Tolerance : ±0.1mm

### 3D View



Z+

Y+　　　　X+

### Top View

1.6

1.6

### Top View

1.2

0.2

1.2

0.25　　0.4　0.2

### Side View

1.6

1.0

0.16

## ■ FUNCTIONAL BLOCK DIAGRAM



X

Y → MUX → Low Noise AMP → ADC → Digital Control → SDA, SCL, INT, DRDY

Z

Set/Reset Controller

Clock Generator

Trimming Logic

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## ■ FUNCTIONAL DESCRIPTION

### Operation modes

PM13100001 has following operation modes:
  (1) Stand-By Mode
  (2) Single Measurement Mode
  (3) Continuous Measurement Mode

### Stand-By Mode

In Stand-By Mode, all internal circuits are off. All registers can be accessed in Stand-By Mode. Data stored in Read/Write registers remains as last state. Registers can be reset by soft reset.

### Single Measurement Mode

In Single Measurement Mode, the measured data are stored to data registers then IST8304 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 register turns to "1". This is called "data ready". When any of the measurement data registers or STAT2 register is read, DRDY bit turns to "0".

### Continuous Measurement Mode

When Continuous Measurement Mode is set, sensor is measured periodically at different frequencies. The measured data is stored in data registers and wait for the measurement period finish. When the next measurement timing comes, PM13100001 automatically starts to measure again.

### Interrupt Function

Interrupt function is used when there is a huge external magnetic field in the surrounding. When the absolute sum of measured 3-axis output value exceeds 16 gauss, the INT flag is activated. The INT flag can be found in STAT2 register.

### DRDY Function

DRDY function is used when the output data is updated. The DRDY pin is used to monitor the data ready output. DRDY is changed to low after reading data from the output register.

■ **FUNCTIONAL DESCRIPTION**

**PM13100001 Read Process**

(1) Read STAT1 register:
- Polling STAT1 register bit 0
- DRDY: shows if the data is ready or not
0: no data ready
1: data ready
- DOR: shows if any data has been skipped before the current data
0: no skipped data
1: data skipped.
(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".

■ **Digital Interface and Registers**

**I2C Interface**

  The interface of IST8304 follows the standard I2C definition guidelines with some additional protocol definitions. IST8304 supports standard speed (100kHz) and fast speed (400kHz). Pull-up resistors of 4.7kohm for both SDA and SCK lines should be used. The default I2C slave address is 0xE.
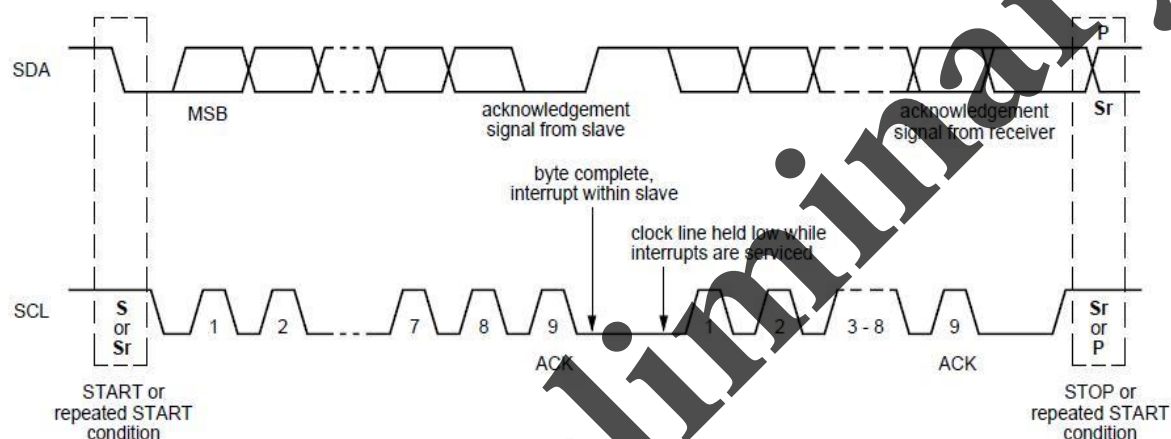


**I2C Read Operation**

**I2C Single Byte Read Operation**

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

ACK: Acknowledge, NA: Not Acknowledge, SA: START Condition, SP: Repeat Start Condition, ST: STOP Condition

▨ Slave to Master    ☐ Master to Slave

**I2C Multiple Byte Read Operation**

| SA | Slave Address + RW | ACK | Reg Address | ACK | SP | Slave Address + RW | ACK | DAT A | ACK | DAT A | NA | ST |
|----|--------------------|-----|-------------|-----|----|--------------------|-----|-------|-----|-------|----|----|
|    |                    |     |             |     |    |                    |     |       |     |       |    |    |

ACK: Acknowledge, NA: Not Acknowledge, SA: START Condition, SP: Repeat Start Condition, ST: STOP Condition

▨ Slave to Master    ☐ Master to Slave

■ **Digital Interface and Registers**

## I2C Write Operation

## I2C Single Byte Write Operation

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

ACK: Acknowledge, NA: Not Acknowledge, SA: START Condition, SP: Repeat Start Condition, ST: STOP Condition
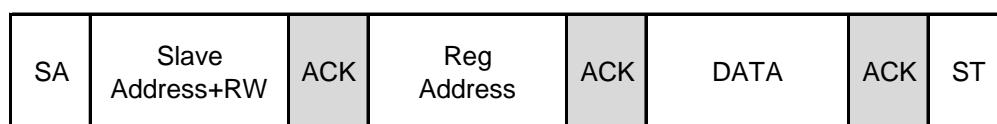
  Slave to Master     Master to Slave

## I$^2$C Multiple Byte Write Operation

| SA | Slave Address + RW | ACK | Reg Address | ACK | DATA | ACK | DATA | NA | ST |
|----|--------------------|-----|-------------|-----|------|-----|------|-----|-----|

ACK: Acknowledge, NA: Not Acknowledge, SA: START Condition, SP: Repeat Start Condition, ST: STOP Condition

  Slave to Master     Master to Slave

PRODUCT TYPE: 1616 3-Axis Electronic Compass    P/N : PM13100001    REVISION :    S1

■ **Digital Interface and Registers**

**Register**

**Customer Defined Registers**

| Register name | Typ | Register Addr | Size (bit) | Info |
|---|---|---|---|---|
| Who am I | 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 |

**Who am I Register**

| WLA(0 x 00) | | | |
|---|---|---|---|
| Bit | Description | Attr | Default |
| 7:0 | Device ID | R | TBD |

This Register provides device ID information

■ **Digital Interface and Registers**

## More Info Register

| INFO(0 x 01) | | | |
|---|---|---|---|
| Bit | Description | Attr | Default |
| 7:0 | More Information | R | TBD |

This Register provides extra information about PM13100001

## Status Register 1

| STAT1(0 x 02) | | | |
|---|---|---|---|
| Bit | Description | Attr | Default |
| 7:2 | Reserved | | |
| 1 | DOR: Turns to 1 when data has been skipped. Bit is released after any output data register read<br>0: no data overrun<br>1: data overrun | R | 0 |
| 0 | DRDY: Data ready pin<br>0: no data ready<br>1: data is ready<br>This status bit follows physical signal appearance, expect the polarity control (refer to DRP bit in CNTL2 register)<br>If data ready function enable bit is not set (refer to DREN bit in CNTL2 register), this bit is zero | R | 0 |

■ **Digital Interface and Registers**

**Output Data Registers**

The Output Registers (from 0x03h~0x08h) contain X, Y and Z axis measurement data.
Measurement data are stored in 2's complement format.

| 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 | - |

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■ **Digital Interface and Registers**

**Status register 2**

In this register, there is an INT flag for customer use.

| STAT2(0 x 09) | | | |
|---|---|---|---|
| Bit | Description | Attr | Default |
| 7 | Reserved | | |
| 6 | Reserved | | |
| 5 | Reserved | | |
| 4 | Reserved | | |
| 3 | INT : Interrupt bit. When interrupt event occurs, this bit will be set to 1 | R | 0 |
| 2 | Reserved | | |
| 1 | Reserved | | |
| 0 | Reserved | | |

**Control setting register 1**

This Register controls and adjusts the main parameters.

| CNTL1(0x0A) | | | |
|---|---|---|---|
| Bit | Description | Attr | Default |
| 7:4 | Reserved | | |
| 3:0 | Mode: Operating mode setting<br>0: Stand-By mode<br>1: Single measurement mode<br>2: Continuous measurement mode with ODR 8Hz<br>3: Continuous measurement mode with ODR 10Hz<br>4: Reserved<br>5: Continuous measurement mode with ODR 20Hz<br>6: Continuous measurement mode with ODR 100Hz<br>7: Continuous measurement mode with ODR 50Hz<br>8: Reserved<br>9: Continuous measurement mode with ODR 0.5Hz<br>10: Continuous measurement mode with ODR 1Hz<br>11: Continuous measurement mode with ODR 200Hz<br>12~15: Reserved | R/W | 0 |

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■ **Digital Interface and Registers**

## Control setting register 2

This Register controls and adjusts the main parameters.

| CNTL2(0x0B) | | | |
|---|---|---|---|
| Bit | Description | Attr | Default |
| 7:4 | Reserved | | |
| 3 | DREN : Data ready enable control:<br>0: disable<br>1: enable<br>Master switch for DRDY output pin | R/W | 1 |
| 2 | DRP: DRDY pin polarity control<br>0: active low<br>1: active high | R/W | 1 |
| 1 | Reserved | | |
| 0 | SRST: Soft reset, perform the same routine as POR<br>0: no action<br>1: start immediately POR routine<br>This bit will be set to zero after POR routine | R/W | 0 |

## Temperature Sensor Output Registers

The Output Data Registers 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 |

■ **ELECTRICAL CHARACTERISTICS**

**Extreme Rating**

| Parameter | Symbol | Limits | Unit |
|---|---|---|---|
| Storage Temperature | TSTG | -40 to +125 | ℃ |
| Operating Temperature | TOPR | -40 to +85 | ℃ |
| Analog Supply Voltage | AVDD | -0.5 to +2.8 | 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 | -350 to 350 | V |

**1. Human Body Model (HBM)  2. Machine Model (MM)**

**Recommended Operating Conditions**

| Parameter | Symbol | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| Operating Temperature | TOPR | -40 | | +85 | ℃ |
| Analog Supply Voltage | AVDD | 1.8 | 2.3 | 2.8 | V |
| Digital Supply Voltage | DVDD | 1.72 | 1.8 | 3.6 | V |

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## ■ ELECTRICAL CHARACTERISTICS

### Electrical Specifications

(Operating conditions: Ta=+25℃; AVDD=2.3V; DVDD=1.8V; 4.7μF ceramic capacitors tied closely to AVDD and GND respectively.)

| Parameter | Symbol | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Operating current | IDD3A | Full operation, at<br>0.5 sps<br>1 sps<br>8 sps<br>10 sps<br>20 sps<br>50 sps<br>100 sps<br>200 sps | | 18<br>20<br>72<br>80<br>140<br>320<br>600<br>1200 | | uA |
| Standby Current | ISTB | | | 10 | | uA |
| Output Data Rate (ODR) | ODR | | 0.5 | | 200 | 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 |

### Magnetic Sensor Specifications

(Operating conditions: Ta=+25℃; AVDD=2.3V; DVDD=1.8V; 4.7μF ceramic capacitors tied closely to AVDD and GND respectively. )

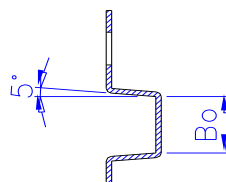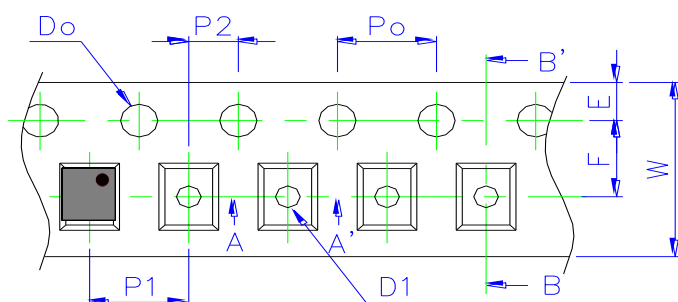| Parameter | Symbol | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Dynamic Range | MDR | | | ±16 | | Gauss |
| Linearity | Lin | within ±3 gauss | | 1 | | %FS |
| Resolution | RESO | | | 3 | | mG/LSB |
| Zero Gauss Drift | ZGD | | | ±3 | | mG |
| Hysteresis | HS | | | 0.1 | | %FS |

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## ■ PACKING :
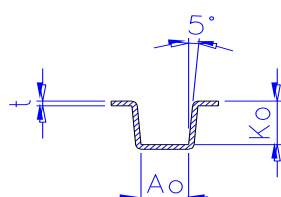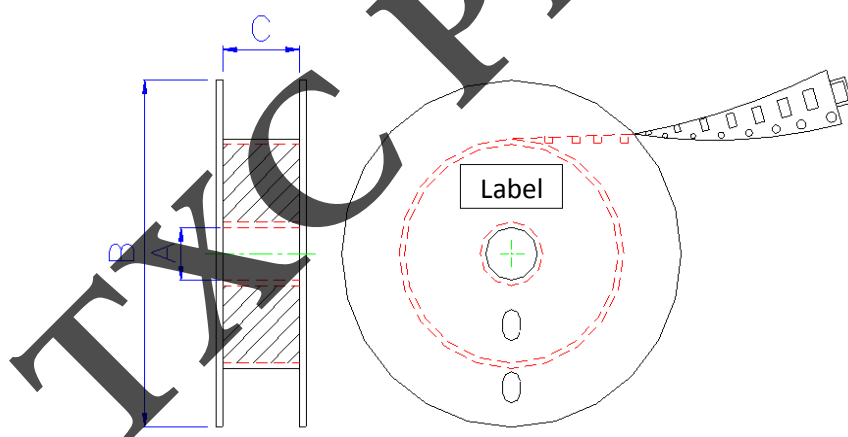


| DIMENSIONS (mm) | W | E | F | D0 | D1 | P0 | P1 | P2 | A0 | B0 | K0 | t |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 8.00 | 1.75 | 3.50 | 1.50 | 0.60 | 4.00 | 4.00 | 2.00 | 1.85 | 1.85 | 1.40 | 0.25 |



Label

| DIMENSIONS (mm) | A | B | C | |
|---|---|---|---|---|
| | 77.00 | 500.00 | 123.00 | Standard Reel Quantity is 3,000 pcs per reel |

Issue date: 02.20 '14  VER.F