GMC303 Tri-Axial Digital Geomagnetic Sensor

General Introduction

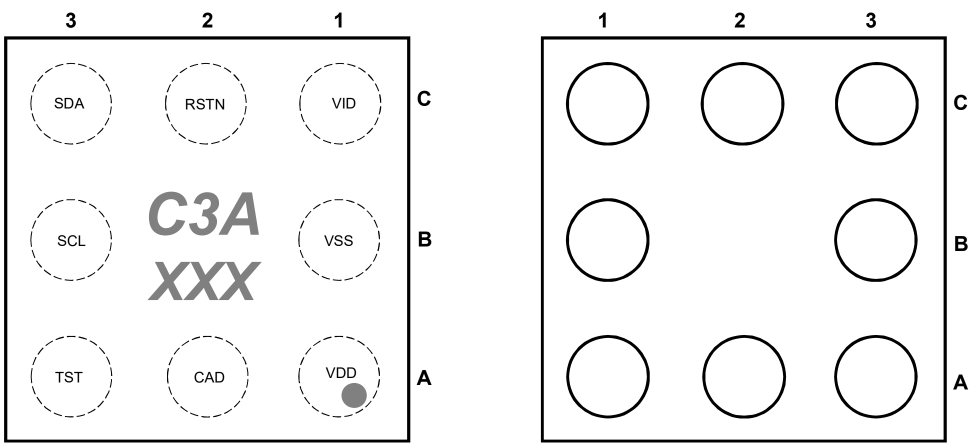
GMC303 is a low-power digital geomagnetic sensor for consumer e-compass applications. A highly sensitive Hall-effect magnetic sensor is directly integrated with the signal conditioning IC in a monolithic wafer process. The 8-pin wafer level chip scale package (WL-CSP) measures only 1.2×1.2×0.5mm^3. This small package size dramatically increases the design flexibility to developers of compact mobile devices. GMC303 can work harmoniously with the 3-axis digital accelerometer like GMEMS's GMA303 for directional information. The magnetometer detects the terrestrial magnetism to be compensated by the tilt angle determined from the accelerometer for providing precise navigation heading. GMEMS can provide further software and hardware support for such fusion application.

Features

- 3-axis geomagnetic sensor for consumer e-compass application
- Built-in 14-bit ADC with sensitivity 0.6μT/LSB
- Extended dynamic range of ±4914uT gives extra large room for the sensor placement
- I2C digital interface supporting standard, fast and high-speed mode
- Operation voltage: +2.5V ~ +3.6V; IO interface voltage: +1.65V ~ +3.6V
- Power consumption:
  - Continuous measurement: typical 650uA@10Hz ODR / 3.0mA@100HZ ODR
  - Power down current < 1uA
- Various operation modes including power-down, single and continuous measurement
- Self-test function with internal magnetic source
- 8-pin WL-CSP package. Footprint: 1.2mm × 1.2mm, height: 0.5mm.
- RoHS compliance

Applications

Navigation heading, gaming, augmented reality and LBS applications, smart user interface



Top View   Bottom View

Specifications

Table 1: Pin Descriptions

Pin#	Name	Description
A1	VDD	Core circuit power supply in
B1	VSS	Ground pin
C1	VID	Digital interface power supply in
C2	RSTN	Reset pin Reset IC when set to “L”
C3	SDA	I2C data pin Input: Schmidt trigger Output: open drain
B3	SCL	I2C clock pin Input: Schmidt trigger
A3	TST	Test pin Pulled down by 100kΩ internal resistor. Keep unconnected.
A2	CAD	Slave address selection input pin Connect to VSS or VDD

Table 2: Operating Range

Parameter	Symbol	Min.	Typ.	Max.	Unit
Operation voltage	VDD	2.5	3.0	3.6	V
IO voltage	VID	1.65	—	VDD	V
Operating range	Ta	-30	—	+85	°C

Table 3: Absolute Maximum Rating

Parameter	Symbol	Min.	Max.	Unit
Power supply voltage	VDD, VID	-0.3	4.3	V
Signal input voltage	VIS	-0.3	VDD/VID + 0.3	V
Signal input current	IIS	—	±10	mA
Storage temperature	TST	-40	+125	°C

Table 4: Magnetic Characteristics

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
X, Y, Z Digital output	DBW		—	14	—	bits
Measurement time	TMEAS	Time for single x, y and z axis measurement	—	—	9.9	ms
Magnetic field resolution	BRES		—	0.6	—	uT/LSB
Magnetic field range	BRAN		-4914	—	+4914	uT

Table 5: DC Characteristics

Parameter	Symbol	Pin	Note	Min.	Typ.	Max.	Unit
Input high level voltage	VIH	RSTN		0.7×VID	—	VID+0.3	V
		SCL SDA		0.7×VID	—	VID+0.3	
		TST CAD		0.7×VDD	—	VDD+0.3	
Input low level voltage	VIL	RSTN SCL SDA		-0.3	—	0.3×VID	V
		TST CAD		-0.3	—	0.3×VDD	V
Input current	IIN	RSTN SCL SDA	Vin=VSS or VID	-10	—	10	uA
		CAD	Vin=VSS or VDD				
		TST	Vin = VDD				
Input hysteresis voltage	VHYS	SCL	VID>2V	5%VID	—	—	V
		SDA	VID<2V	10%VID	—	—	
Output low level voltage	VOL	SDA	IOL≦3mA, VID>2V	—	—	0.4	V
			IOL≦3mA, VID<2V	—	—	20%VID	
Current consumption	IDD1	VDD VID	Power-down mode VDD=VID=3V RSTN="L"	—	1	—	uA
	IDD2		During magnetic sensor is operating	—	3	—	mA
	IDD3		During self-test mode	—	5	—	mA

Table 6: AC Characteristics

Parameter	Symbol	Pin	Description	Min.	Typ.	Max.	Unit
Supply voltage rise time	TRISE	VDD VID	From VOFF to VDD/VID	—	—	50	ms
Initialization time	TINIT		From time VDD reaches its level to time the IC completes entering the power-down mode by POR circuits	—	—	10	ms
Supply of voltage	VOFF	VDD VID	VDD/VID voltage to ensure the POR circuits to restart	—	—	0.2	V
Supply volt. off duration	TOFF	VDD VID	Duration of supply off voltage to ensure the POR circuits to restart	100	—	—	us
ON time difference between VDD and VID	TVDON	VDD VID	ON timing difference between VDD and VID	0	—	—	us
OFF time difference between VDD and VID	TVDOFF	VDD VID	OFF timing difference between VDD and VID	0	—	—	us
Reset pulse width	TRST	RSTN	Reset pulse width	5	—	—	us

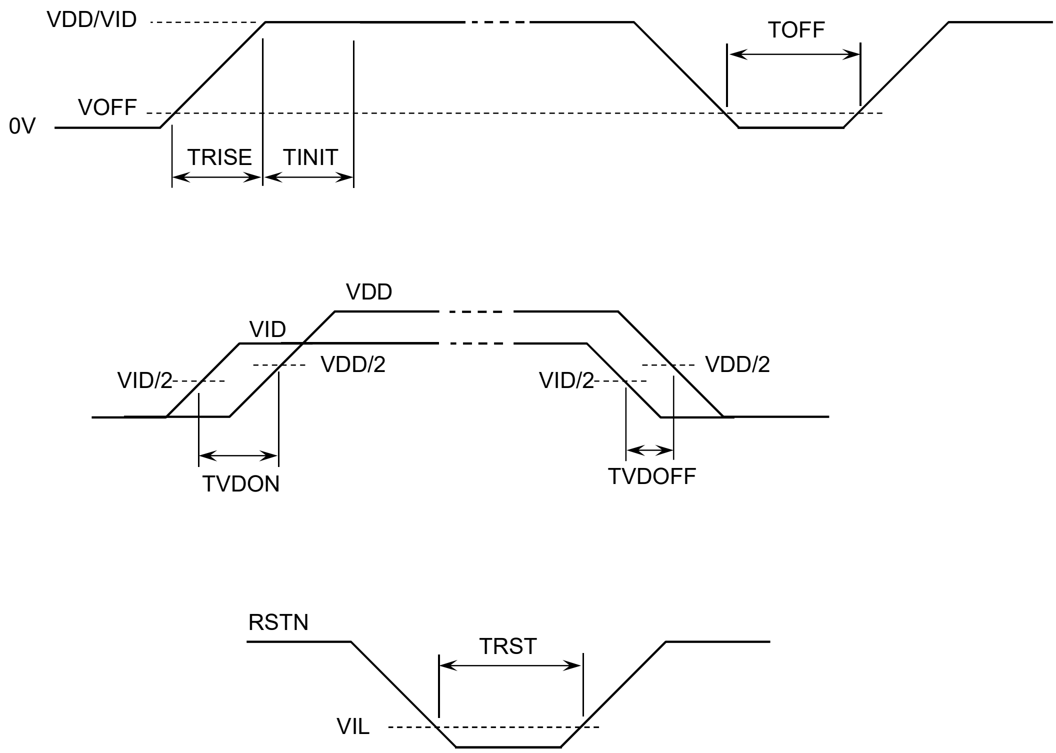


Figure 1: AC Characteristics

Block Diagram and Connection

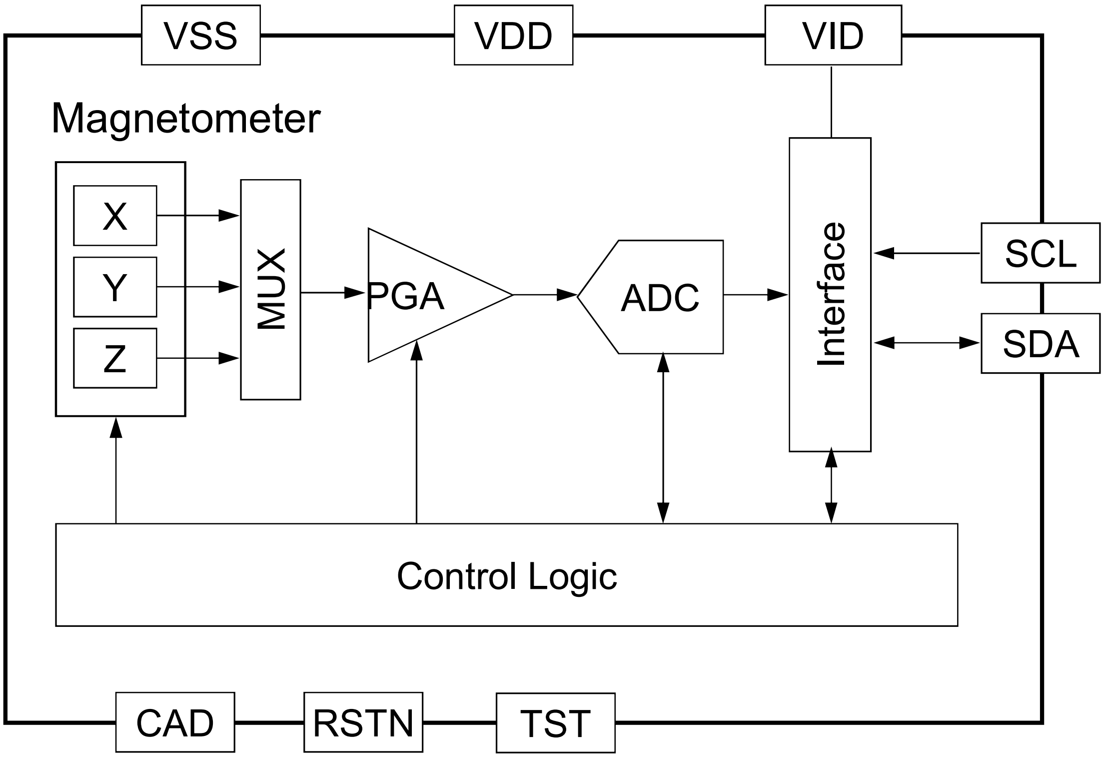


Figure 2: GMC303 Block Diagram

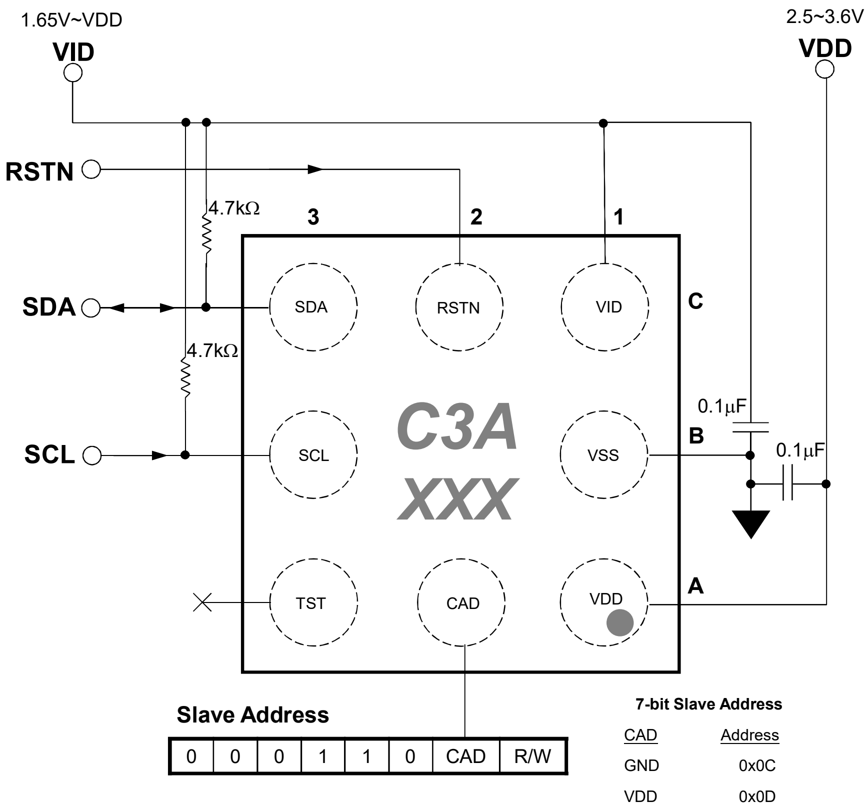


Figure 3: GMC303 I2C Connection Example

Functional Description

Power States

When VDD and VID are turned on from VDD=OFF (0V) and VID=OFF (0V), all registers in GMC303 are initialized to default values by POR circuit and GMC303 transists to power-down mode.

All the states in the table below can be set, except the transition from state 2 to state 3 and the transition from state 3 to state 2 are prohibited.

Table 7: Power States

State	VDD	VID	Power State
1	OFF (0V)	OFF (0V)	OFF (0V) It doesn't affect external interface. Digital input pins other than SCL and SDA pin should be fixed to "L" (0V).
2	OFF (0V)	1.65~3.6V	OFF (0V) It doesn't affect external interface.
3	2.5~3.6V	OFF (0V)	OFF (0V) It doesn't affect external interface. Digital input pins other than SCL and SDA pin should be fixed to "L" (0V).
4	2.5~3.6V	1.65V~VDD	ON

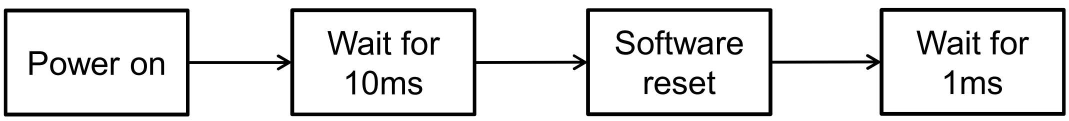
Reset Functions

When the power state is set to ON, make sure VID is always no more than VDD. Power-on reset circuit (POR) will be active until VDD reaches the effective operation voltage, about 1.4V as taken from the design reference. After the POR circuit deactivate, all registers will be initialized to default values and then GMC303 transits to power-down mode.

GMC303 has three types of reset as summarized below.

- Power-on reset (POR): When VDD rise is detected, POR circuit kicks in to reset GMC303.
- Reset pin (RSTN): GMC303 is reset when RSTN is "L". Connect RSTN to VID if this feature is not used.
- Software reset: GMC303 is reset by setting SRST bit. And the fuse ROM value will be automatically loaded.

Power on Sequence



Operation Modes

GMC303 has the following eight operation modes, which can be set by the MODE[4:0] bits.

1. Power-down mode: MODE[4:0] = "00h"
   - When power is turned ON, sensor is put in power-down mode..
   - Return to power-down mode before changing operation mode.
2. Single measurement mode: MODE[4:0] = "01h"
   - Sensor will take one-time measurement and returns to power-down mode automatically.
3. Continuous measurement mode 1: MODE[4:0] = "02h"
   - Sensor will take periodic measurement at 10Hz ODR.
4. Continuous measurement mode 2: MODE[4:0] = "04h"
   - Sensor will take periodic measurement at 20Hz ODR.
5. Continuous measurement mode 3: MODE[4:0] = "06h"
   - Sensor will take periodic measurement at 50Hz ODR.
6. Continuous measurement mode 4: MODE[4:0] = "08h"
   - Sensor will take periodic measurement at 100Hz ODR.
7. Self-test mode: MODE[4:0] = "10h"
   - Sensor will activate self-test and output the result before automatically returning to power-down mode.
8. Fuse ROM access mode: MODE[4:0] = "1Fh"
   - Download all data from Fuse ROM to registers automatically.

When power is turned ON, MODE[4:0] is reset to "00h" and GMC303 is in power-down mode. When a specified value is set to MODE[4:0], GMC303 transits to the specified mode and starts operation. If user wants to change operation mode, user needs to return to power-down mode and wait at least for at 100us (TWAIT) before setting another mode. An operation mode transition is shown below.

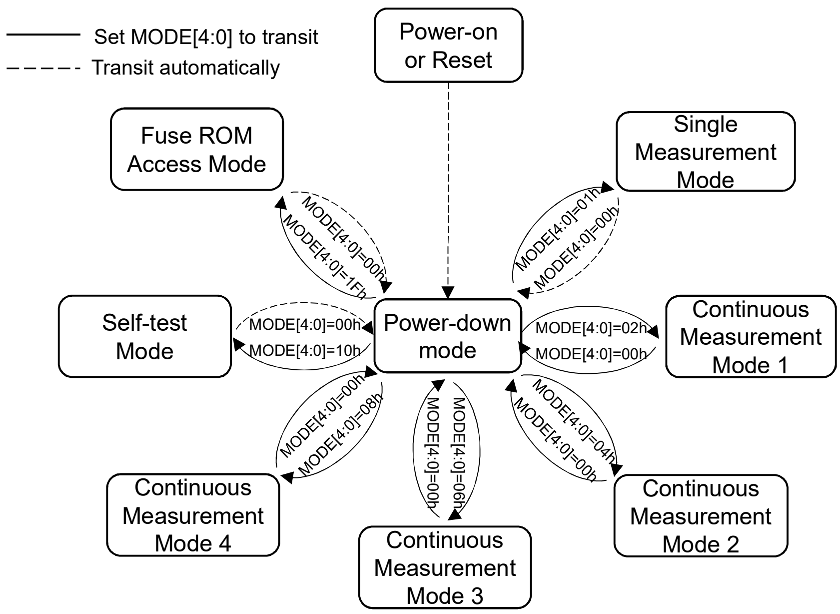


Figure 4: GMC303 State Transition Diagram

User Registers

User Register Map

Table 8: User Register Map Table

Addr.	Name	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0	Access	Default
00h	CMPID	CMPID[7:0]								R	0x48
01h	DEVID	DEVID[7:0]								R	0x05
02h	INFO1	INFO1[7:0]								R	0x00
03h	INFO2	INFO2[7:0]								R	0x00
10h	ST1	HSM	0	0	0	0	0	DOR	DRDY	R	NA
11h	HXL	HX[7:0]								R	NA
12h	HXH	HX[15:8]								R	NA
13h	HYL	HY[7:0]								R	NA
14h	HYH	HY[15:8]								R	NA
15h	HZL	HZ[7:0]								R	NA
16h	HZH	HZ[15:8]								R	NA
17h	TMPS	Reserved								R	0x00
18h	ST2	0	0	0	0	HOFL	0	0	0	R	NA
30h	CNTL1	Reserved								R/W	—
31h	CNTL2	0	0	0	MODE[4:0]					R/W	NA
32h	CNTL3	0	0	0	0	0	0	0	SRST	R/W	NA
33h	TS1	Reserved								R/W	—
60h	ASAX	COEFX[7:0]								R	NA
61h	ASAY	COEFY[7:0]								R	NA
62h	ASAZ	COEFZ[7:0]								R	NA

Description of Registers

Register 00h & 01h: Product Identification Registers

Addr.	Name	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0	Access	Default
00h	CMPID	CMPID[7:0]								R	0x48
01h	DEVID	DEVID[7:0]								R	0x05

CMPID and DEVID are product identification registers and are fixed to 0x48 and 0x05 respectively.

Register 02h & 03h: Information Registers

Addr.	Name	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0	Access	Default
02h	INFO1	INFO1[7:0]								R	0x00
03h	INFO2	INFO2[7:0]								R	0x00

INFO1 and INFO2 are information registers storing miscellaneous device information.

Register 10h: Status Register 1

Addr.	Name	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0	Access	Default
10h	ST1	HSM	0	0	0	0	0	DOR	DRDY	R	NA

DRDY is the magnetic measurement data ready bit. Bit set represents measurement results are ready to read. DRDY will be cleared when any of the data registers (HX to TMPS) or ST2 register is read. The measured data is stored to the data registers (HX to HZ) and DRDY bit is set when the measurement period complete, as illustrated in the Figure 5.

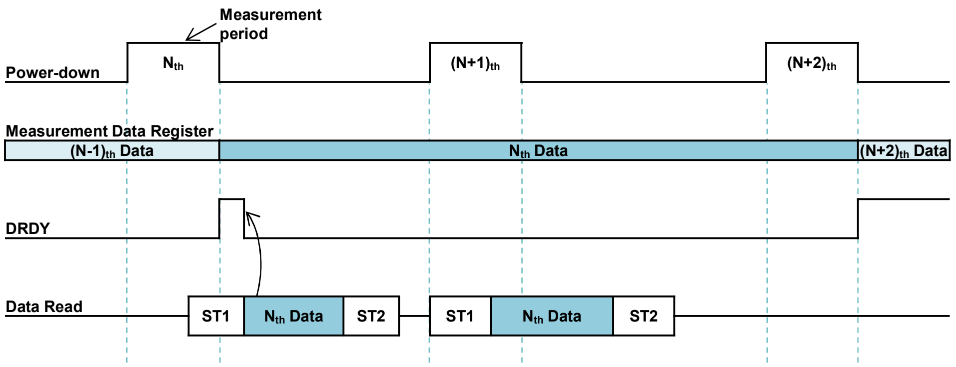


Figure 5: DRDY bit and measurement data read

DOR is the data over-run/skip bit. Bit set represent magnetic measurement data is over-run or skipped. DOR will be cleared when any of the data registers (HX to TMPS) or ST2 register is read. As illustrated in the Figure 6, when N_{th} data is not read before the $(N+1)_{th}$ measurement complete, the DOR bit is set, indicating the Nth data is over-run by the $(N+1)_{th}$ measurement result.

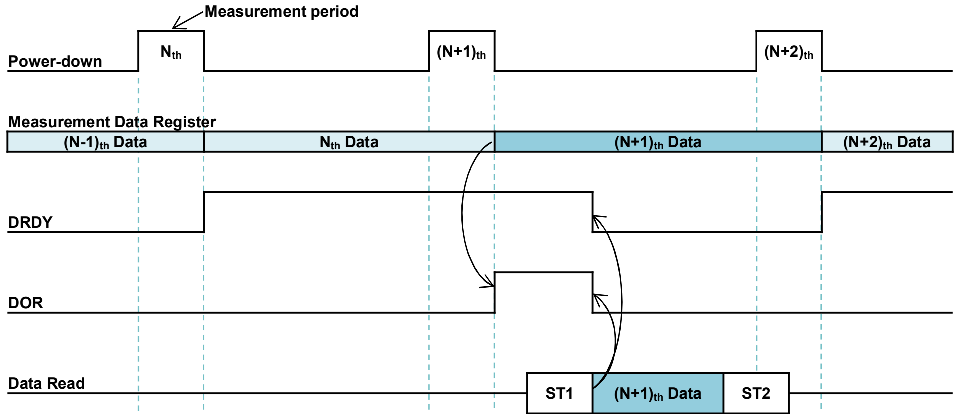


Figure 6: DOR bit and data over-run

However if the data read start right after N_{th} measurement complete but does not manage to finish before $(N+1)_{th}$ measurement end, N_{th} measurement data is protected from being over-run by the $(N+1)_{th}$ data. In such case the DRDY will not be set after the complete of $(N+1)_{th}$ measurement because data registers are protected from being updated. Instead the DOR will be set to indicate the $(N+1)_{th}$ data is skipped, as illustrated in the Figure 7.

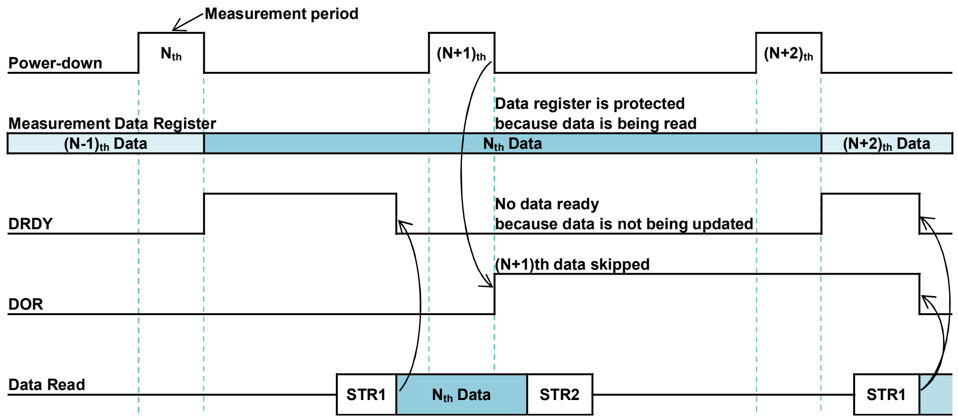


Figure 7: DOR bit and data skip

HSM is the I2C high-speed mode (Hs-mode) bit. Bit set represents I2C is in the high-speed mode. Otherwise I2C is in the standard or fast mode.

Register 11h to 16h: Magnetic Measurement Data Registers

Addr.	Name	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0	Access	Default
11h	HXL	HX[7:0]								R	NA
12h	HXH	HX[15:8]								R	NA
13h	HYL	HY[7:0]								R	NA
14h	HYH	HY[15:8]								R	NA

15h	HZL	HZ[7:0]	R	NA
16h	HZH	HZ[15:8]	R	NA

HX[15:0], HY[15:0] and HZ[15:0] are magnetic measurement data registers of X-/Y-/Z-axis respectively. When measurement period complete, measured data is stored to these magnetic measurement data registers using two's complement format. Measurement range for each axis is from -8190 to +8190.

Measurement Data (each axis)[15:0]		Magnetic Flux Density (uT)
Two's complement (Hex)	Decimal	
1FFE	8190	4914 (max)
…	…	…
0001	1	0.6
0000	0	0
FFFF	-1	-0.6
…	…	…
E002	-8190	-4914 (min)

Register 18h: Status Register 2

Addr.	Name	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0	Access	Default
18h	ST2	0	0	0	0	HOFL	0	0	0	R	NA

HOFL is the magnetic sensor overflow bit. Bit set means magnetic sensor overflow occurs. GMC303 limits the sum of absolute values of each axis to 4914uT, i.e. $\|X\|+\|Y\|+\|Z\|<4914\text{uT}$. Even the measurement data registers are not saturated, magnetic sensor may overflow. In such case the measurement data is not correct and the HOFL bit will be set. HOFL bit can be cleared by reading ST2 (18h) register, or when next measurement period starts.

Register 31h: Control Register 2

Addr.	Name	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0	Access	Default
31h	CNTL2	0	0	0	MODE[4:0]					R/W	NA

MODE[4:0] set the following operation modes. Other settings are prohibited.

- MODE[4:0]=00h: Power-down mode
- MODE[4:0]=01h: Single measurement mode
- MODE[4:0]=02h: Continuous measurement mode 1
- MODE[4:0]=04h: Continuous measurement mode 2
- MODE[4:0]=06h: Continuous measurement mode 3
- MODE[4:0]=08h: Continuous measurement mode 4
- MODE[4:0]=10h: Self-test mode

- MODE[4:0]=1Fh: Fuse ROM access mode

Power-down Mode

Set MODE[4:0] to 00h to enter power-down mode. All internal circuits are turned off, but all registers remain accessible and register values are retained. GMC303 will automatically enter power-down mode after power-on or by RSTN or SRST reset, as shown in the Figure 4.

Single Measurement Mode

GMC303 will make a single measurement once and automatically transit to the power-down mode every time when entering the single measurement mode by setting MODE[4:0]=01h. Measurement data is then stored to the measurement data registers (HX to HZ) and DRDY bit set. The measurement result is available to access anytime before another measurement starts. Depending on the timing, the current result may be over-run by the next measurement, Figure 8, or the next measurement data is skipped, Figure 9.

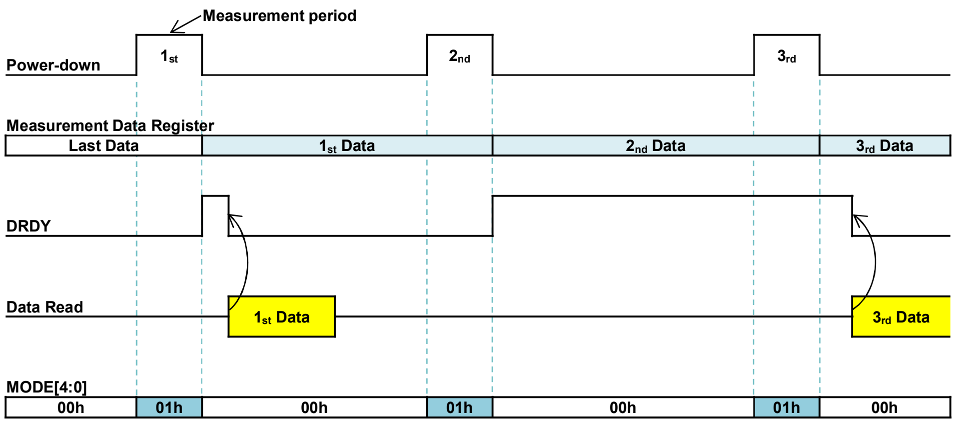


Figure 8: Single measurement and data over-run

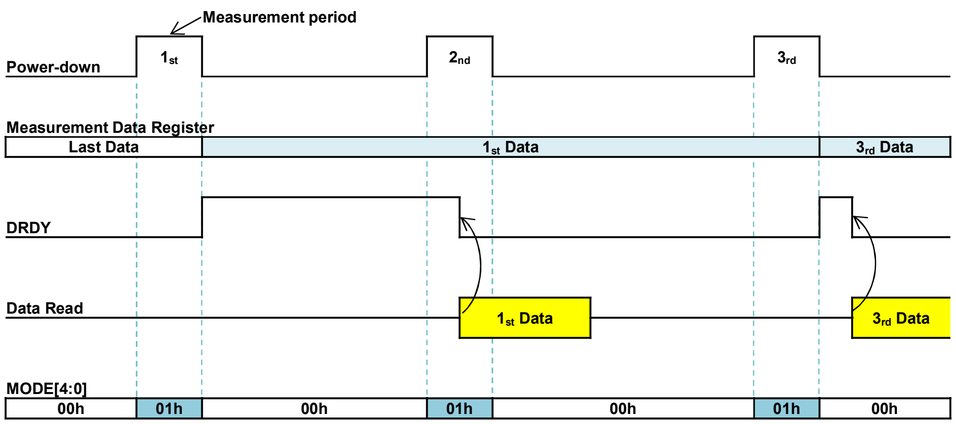


Figure 9: Single measurement and data skip

Continuous Measurement Mode

When put into the continuous measurement mode by setting MODE[4:0]=02h/04/06h/08h, GMC303 will make periodic data measurement with four ODR options of 10/20/50/100Hz respectively. The measurement data will be stored to the measurement data registers (HX to HZ) after the current measurement is finished, and DRDY bit is set accordingly. All circuit except the OSC is turned off intermittently until next measurement due. DRDY bit can be cleared by reading any of the data registers (HX to TMPS) or ST2 register. The timing of normal continuous mode is illustrated in the Figure 10.

To switch between operation mode, user needs to return to power-down mode by setting MODE[4:0]=00h and then set to another operation mode, as shown in the Figure 4.

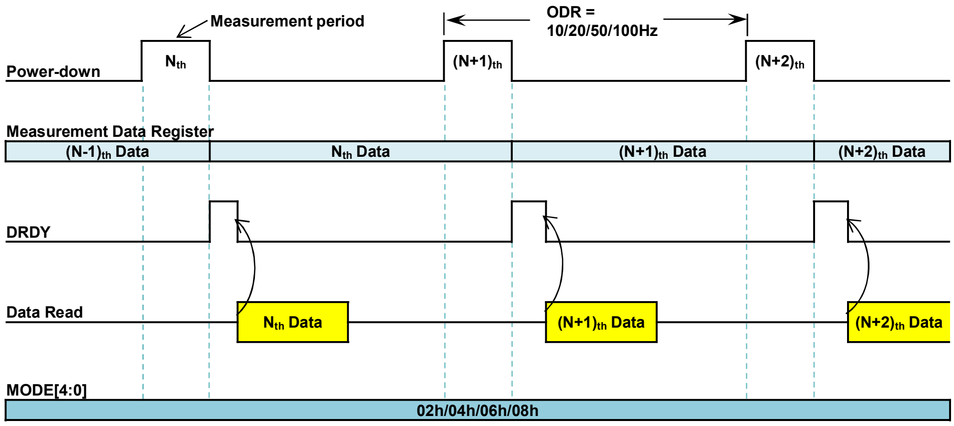


Figure 10: Normal continuous measurement mode

Self-test Mode

Self-test mode is used to check if the magnetic sensor is working normally. GMC303 will start the self-test sequence when setting MODE[4:0]=10h, and automatically transits to power-down mode when complete. At first the built-in internal magnetic source will generate a magnetic field for measurement. After the measurement process is finished, the measurement data is stored in the measurement data registers (HX to HZ) and set the DRDY bit. User can access the measurement result for judgment with the same procedure as the single measurement mode. When the reading is in the range of the following table, GMC303 is working normally.

	HX[15:0]	HY[15:0]	HZ[15:0]
Criteria	-40<HX<40	-40<HY<40	-320<HZ<-80

Fuse ROM Access Mode

GMC303 has fuse ROM for storing calibration data. When MODE[4:0] is set to 1Fh, all magnetic coefficient data of fuse ROM is read. After reading fuse ROM is finished, operation mode returns to power-down mode automatically.

Register 32h: Control Register 3

Addr.	Name	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0	Access	Default
32h	CNTL3	0	0	0	0	0	0	0	SRST	R/W	NA

SRST is the soft reset bit. When set, all registers are reset to default values. After reset, SRST bit is cleared automatically.

Register 60h~62h: Magnetic Coefficient Registers

Addr.	Name	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0	Access	Default
60h	ASAX	COEFX[7:0]								R	NA
61h	ASAY	COEFY[7:0]								R	NA
62h	ASAZ	COEFZ[7:0]								R	NA

ASAX, ASAY and ASAZ are magnetic sensor sensitivity coefficient value for X-, Y- and Z-axis respectively. The coefficient is used for the sensitivity adjustment by the following equation:

$$H_{adj} = H \times \left(\frac{ASA}{128} + 1 \right)$$

where

H : the measuremet data read out from the measurement data registers

ASA : the sensitivity adjustment value

H_{adj} : the adjusted measurement data

Digital Interface

I2C Interface General Description

The I2C interface is compliant with standard, fast and high-speed I2C standard. The devices support the 7-bit control functions and SDA and SCL facilitate communication between GMC303 and master with clock rates up to 3.4MHz.

The 7-bit device slave address can be selected by the CAD pin as summarized in the below table.

CAD	7-bit Slave Address
1'b0	0x0C
1'b1	0x0D

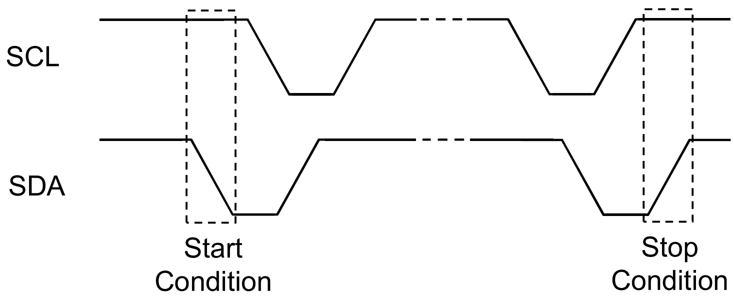
The I2C bus takes master clock through SCL pin and exchanges serial data via SDA. SDA is a bidirectional (input/output) connection. Both are open-drain connection and must be connected externally to VID via a pull-up resistor. The I2C interface supports multiple read and write. When using multiple read/write, the internal I2C address pointer will automatically increase by 1 for the next access.

I2C Access Format: Standard and Fast Mode

One data bit is transferred for each SCL cycle. The SDA must not change level when the SCL is high. The level changes in SDA while SCL is high are reserved control signals. The SDA and SCL remain high when I2C bus is idle.

Data transfer begins by bus master indicating a start condition (ST) of a falling edge on SDA when SCL is high. The master terminates transmission and frees the bus by issuing a STOP condition (SP). Stop condition is a rising edge on SDA while SCL is high. The bus remains active if a repeated START (SR) condition is generated instead of a STOP condition. Figure 11 illustrates the START and STOP condition.

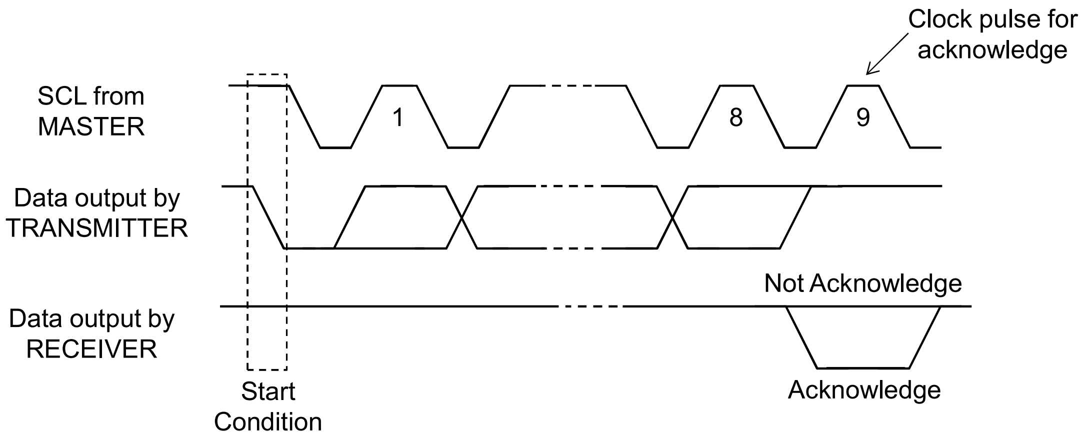
Figure 11: I2C START and STOP condition



After a start condition (ST), the 7-bit slave address + RW bit must be sent by master. If the slave address does not match with GMC303, there is no acknowledge and the following data transfer will not affect GMC303. If the slave address corresponds to GMC303, it will acknowledge by pulling SDA to low and the SDA line should be let free by bus master to enable the data transfer. The master should let the SDA high (no pull down) and generate a high SCL pulse for

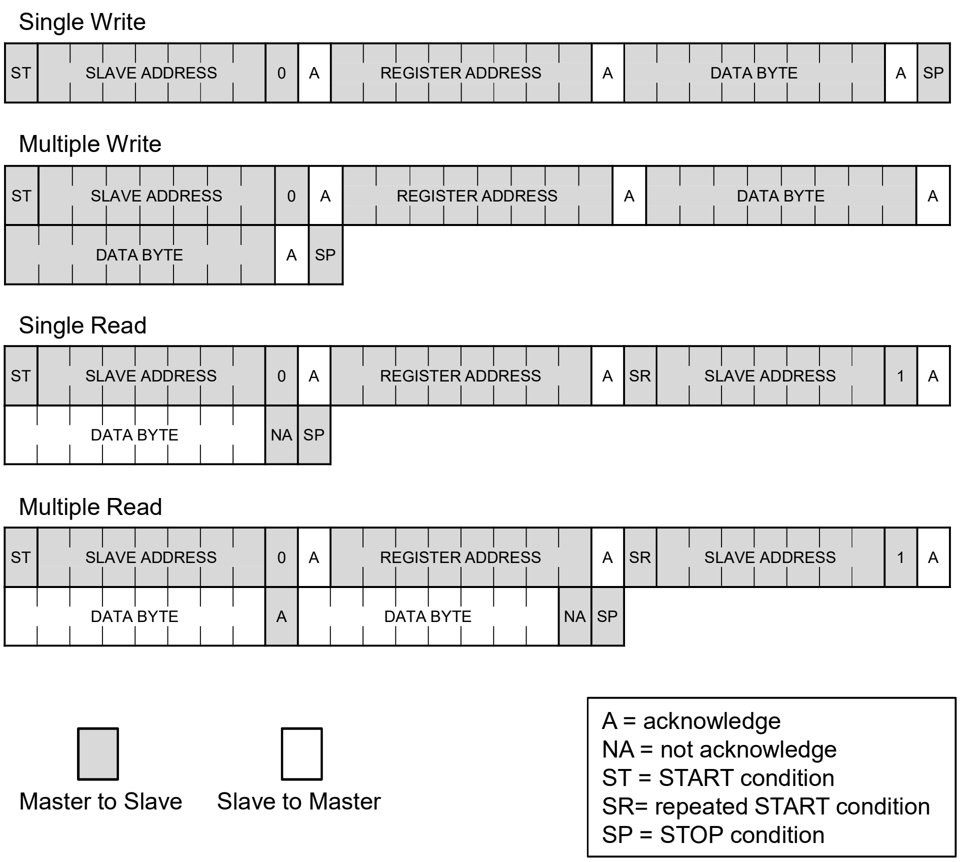
GMC303 acknowledge. Figure 12 illustrates the acknowledge signal sequence.

Figure 12: Acknowledge signal sequence



A write to GMC303 includes transmission of a START condition, the slave address with R/W bit=1'b0, one byte of data to specify the register address to write, subsequent one or more bytes of data, and finally a STOP condition. "Single Write" and "Multiple Write" in Figure 13 illustrates the frame format of single and multiple write to GMC303 respectively.

Figure 13: I2C access format: standard and fast mode



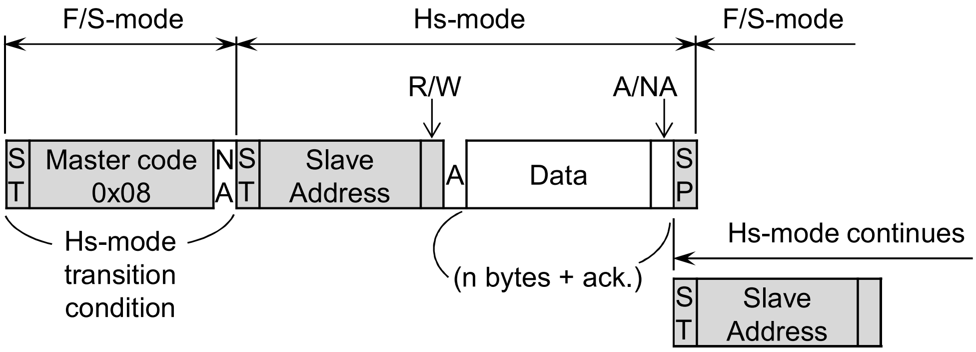
A read from GMC303 starts with transmission of a START condition, the slave address with R/W bit=1'b0, and one byte of data to specify the register address to read. A repeated START condition and the slave address with R/W bit=1'b1 are transmitted subsequently. The slave address with R/W bit=1'b1 initiates a read operation. GMC303 acknowledge receipt of the read operation command by pulling SDA low during the 9th SCL clock and begin transmitting the contents starting from the specified register address. The master must acknowledge all correctly received bytes except the last byte. The final byte must be followed by a not acknowledge from the master and the STOP condition. "Single Read" and "Multiple Read" in Figure 13 illustrates the frame format for reading single or multiple byte from GMC303.

I2C Access Format: High-Speed Mode

GMC303 supports the I2C high-speed mode (Hs-mode). Hs-mode can only be initiated after the Hs-mode transition condition is met. The Hs-code transition condition is communicated under Fast/Standard-mode beginning with START (ST) condition, then the 8-bit master code and finally not-acknowledge (NA) bit, as shown in the Figure 14.

After the master sends master code to GMC303, GMC303 responses with not-acknowledge (NA) and switch over to circuit ready for Hs-mode communication. From next START (ST) condition GMC303 can start communicating at the Hs-mode. The STOP (SP) condition will make GMC303 end the Hs-mode and switch back to Fast/Standard-mode.

Figure 14: Data transfer format in Hs-mode



I2C Specifications

Table 9: I2C Timing Specification: Standard Mode

Parameter	Symbol	Minimum	Typical	Maximum	Unit
SCL clock frequency	f_{SCL}	—	—	100	kHz
Clock low period	t_{LOW}	4.7	—	—	µs
Clock high period	t_{HIGH}	4	—	—	µs
Start hold time	$t_{HD.STA}$	4	—	—	µs
Start setup time	$t_{SU.STA}$	4.7	—	—	µs
Data-in hold time	$t_{HD.DAT}$	0	—	—	µs
Data-in setup time	$t_{SU.DAT}$	250	—	—	ns
Stop setup time	$t_{SU.STO}$	4	—	—	µs
Rise time	t_r	—	—	1	µs
Fall time	t_f	—	—	0.3	µs

Table 10: I2C Timing Specification: Fast Mode

Parameter	Symbol	Minimum	Typical	Maximum	Unit
SCL clock frequency	f_{SCL}	—	—	400	kHz
Clock low period	t_{LOW}	1.3	—	—	µs
Clock high period	t_{HIGH}	0.6	—	—	µs
Bus free to new start	t_{BUF}	1.3	—	—	µs
Start hold time	$t_{HD.STA}$	0.6	—	—	µs
Start setup time	$t_{SU.STA}$	0.6	—	—	µs
Data-in hold time	$t_{HD.DAT}$	0	—	—	µs
Data-in setup time	$t_{SU.DAT}$	100	—	—	ns
Stop setup time	$t_{SU.STO}$	0.6	—	—	µs
Rise time	t_r	—	—	0.3	µs
Fall time	t_f	—	—	0.3	µs
Spike width	t_{SP}	—	—	50	µs

Figure 15: I2C Timing Diagram: Standard and Fast Mode

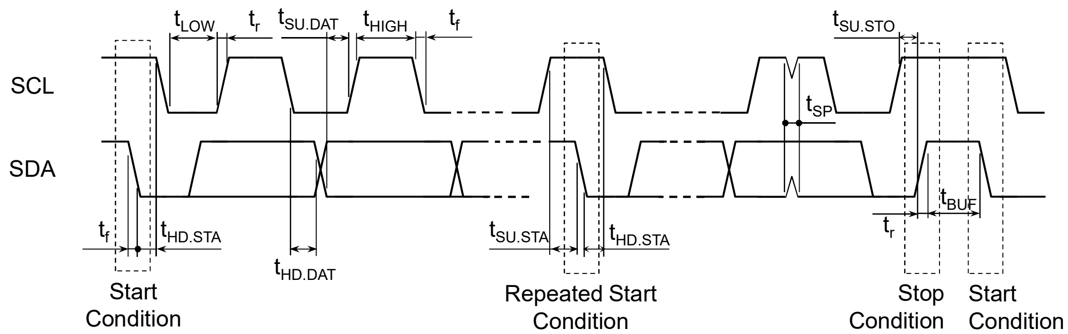
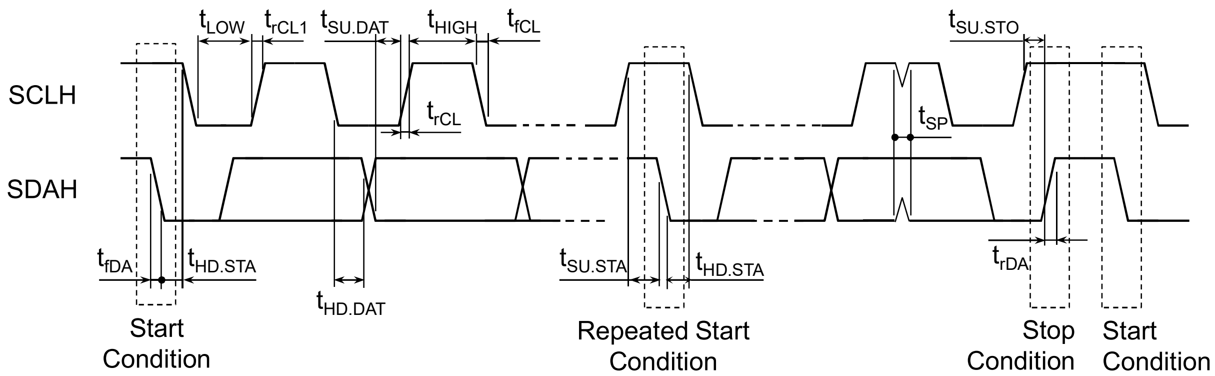


Table 11: I2C Timing Specification: Fast Mode

Parameter	Symbol	Minimum	Typical	Maximum	Unit
SCLH clock frequency	f_{SCLH}	—	—	3.4	MHz
Clock low period	t_{LOW}	220	—	—	ns
Clock high period	t_{HIGH}	110	—	—	ns
Start hold time	$t_{HD.STA}$	160	—	—	ns
Start setup time	$t_{SU.STA}$	160	—	—	ns
Data-in hold time	$t_{HD.DAT}$	0	—	—	ns
Data-in setup time	$t_{SU.DAT}$	10	—	—	ns
Stop setup time	$t_{SU.STO}$	160	—	—	ns
Rise time of SCLH	t_{rCL}	10	—	40	ns
Rise time of SCLH after a repeated START condition and acknowledge bit	t_{rCL1}	10	—	80	ns
Rise time of SDAH	t_{rDA}	10	—	80	ns
Fall time of SCLH	t_{fCL}	—	—	40	ns
Fall time of SDAH	t_{fDA}	—	—	80	ns
Spike width	t_{SP}	—	—	10	ns

Figure 16: I2C Timing Diagram: High-speed Mode



Package

Outline Dimension

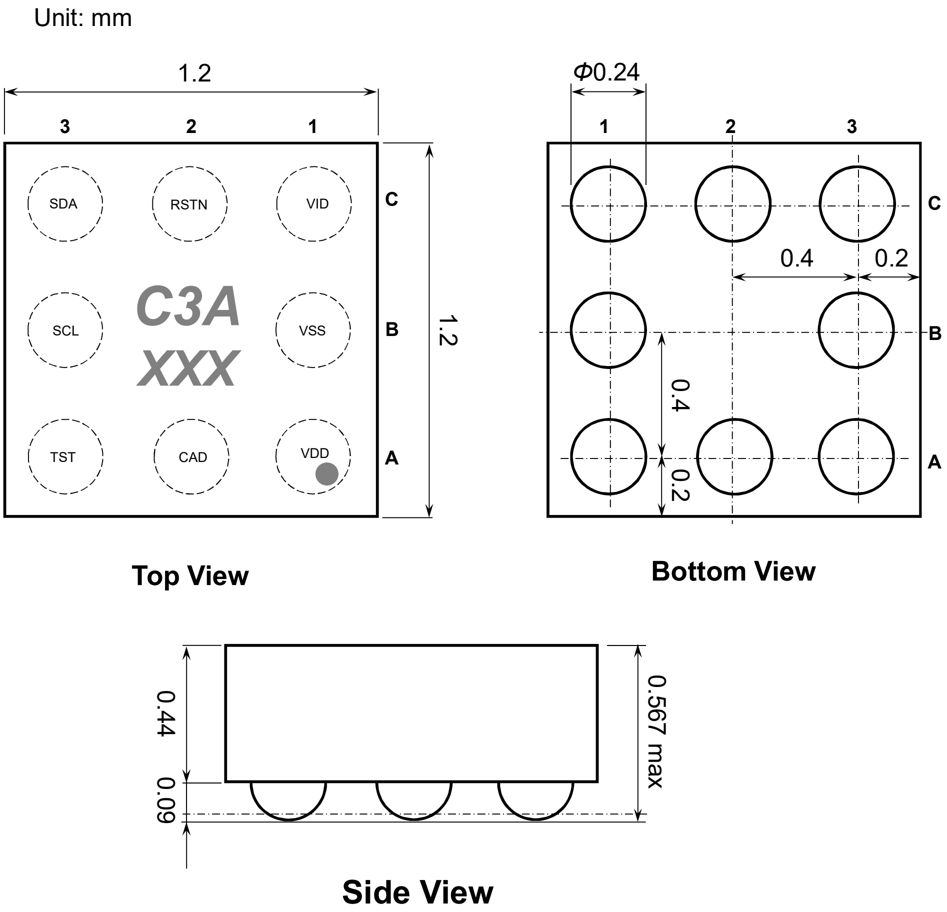


Figure 17: Package Outline Dimension

Axes Orientation

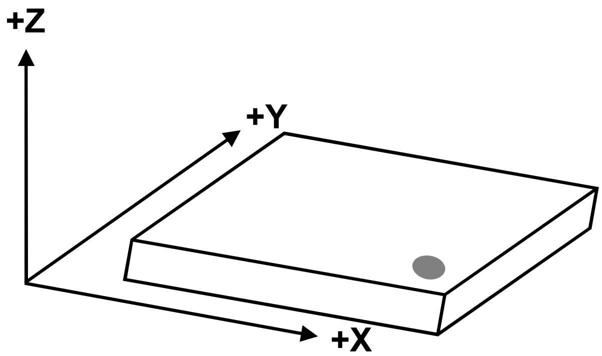


Figure 18: GMC303 Axes Orientation

RoHS Compliance

GMEMS WLCSP sensors are compliant with Restrictions on Hazardous Substances (RoHS), having halide-free molding compound (green) and lead-free terminations. Reflow profiles applicable to those processes can be used successfully for soldering the devices.

Recommended PCB Foot Print Layout

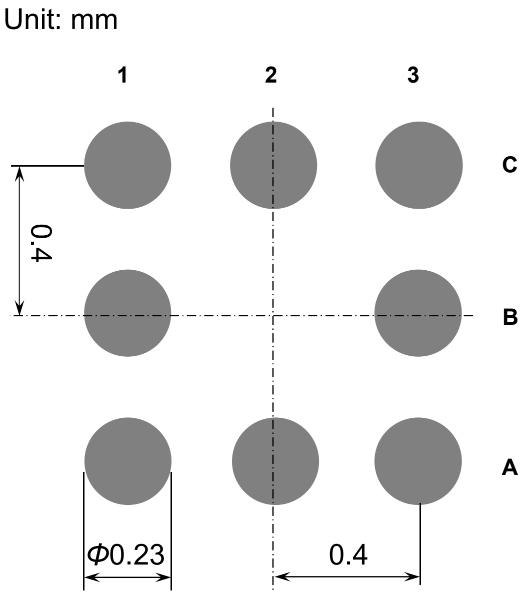


Figure 19: Layout Recommendation for PCB Land Pad

Moisture Sensitivity Level

GMC303 package MSL rating is Level 3.

Tape Specification

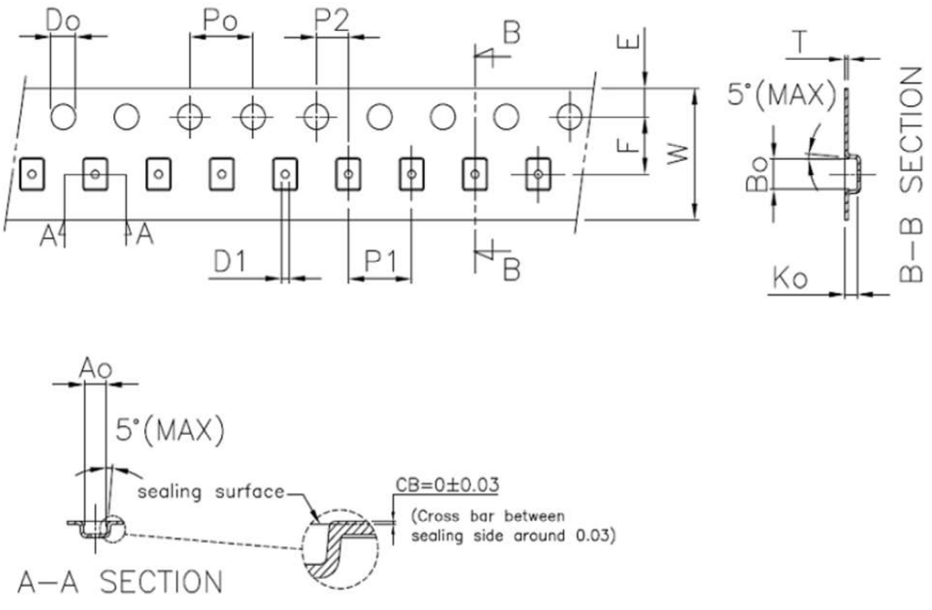


Figure 20: Tape Outline Drawing

Table 12: Tape Dimension

Symbol	Dimension (mm)
A_0	1.38±0.05
B_0	1.38±0.05
K_0	0.7±0.05
P_0	4.0±0.1
P_1	4.0±0.1
P_2	2.0±0.05
T	0.25±0.03
E	1.75±0.1
F	3.5±0.05
D_0	1.5+ 0.1/-0
D_1	0.5±0.05
W	8.0±0.3

Pin1 Orientation

GMC303 devices are reeled so that Pin1 is orientated with the direction of feed and sprocket holes as illustrated in the Figure 21.

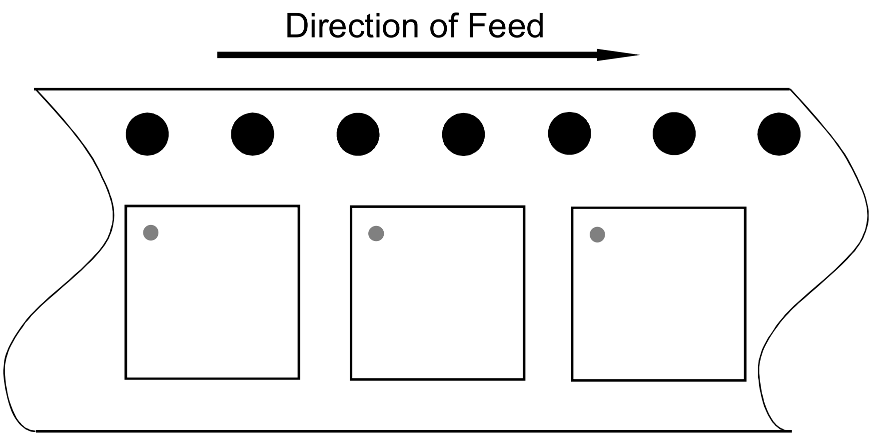


Figure 21: Pin1 Orientation

Document History and Modification

Revision No.	Description	Date
V1.0	Formal release with updated package information	2015/8/11
V1.1	● Update reset functions and power on sequence ● Update self-test criteria ● Various typo corrections	2015/8/20
V1.2	Correct Fig. 3 CAD connect to GND or VDD	2016/3/3
V1.3	Update T&R Pin1 orientation	2016/8/30