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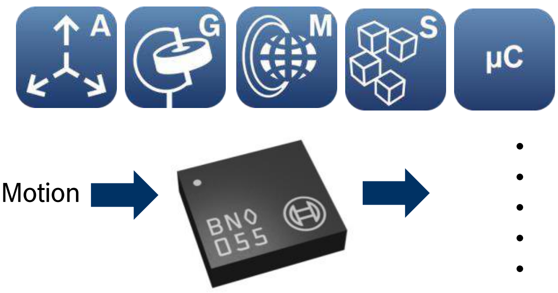
Data sheet

BNO055
Intelligent 9-axis absolute orientation sensor

Bosch Sensortec

BOSCH
Invented for life

User Motion



- Quaternion
- Linear Acceleration
- Rotation
- Gravity
- Robust Heading

BNO055: data sheet

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BNO055

INTELLIGENT ABSOLUTE ORIENTATION SENSOR, 9-AXIS SENSOR FUSION ALL-IN-ONE WINDOWS 8.x COMPLIANT SENSOR HUB

Basic Description

Key features:

• Outputs fused sensor data	Quaternion, Euler angles, Rotation vector, Linear acceleration, Gravity, Heading
• 3 sensors in one device	an advanced triaxial 16bit gyroscope, a versatile, leading edge triaxial 14bit accelerometer and a full performance geomagnetic sensor
• Small package	LGA package 28 pins Footprint 3.8 x 5.2 mm², height 1.13 mm²
• Power Management	Intelligent Power Management: normal, low power and suspend mode available
• Common voltage supplies	V_{DD} voltage range: 2.4V to 3.6V
• Digital interface	HID-I2C (Windows 8 compatible), I²C, UART V_{DDIO} voltage range: 1.7V to 3.6V
• Consumer electronics suite	MSL1, RoHS compliant, halogen-free Operating temperature: -40°C ... +85°C

Key features of integrated sensors:

Accelerometer features

• Programmable functionality	Acceleration ranges ±2g/±4g/±8g/±16g Low-pass filter bandwidths 1kHz - <8Hz Operation modes: - Normal - Suspend - Low power - Standby - Deep suspend
• On-chip interrupt controller	Motion-triggered interrupt-signal generation for - any-motion (slope) detection - slow or no motion recognition - high-g detection

Gyroscope features

- Programmable functionality
  Ranges switchable from ±125°/s to ±2000°/s
  Low-pass filter bandwidths 523Hz - 12Hz
  Operation modes:
  - Normal
  - Fast power up
  - Deep suspend
  - Suspend
  - Advanced power save
- On-chip interrupt controller
  Motion-triggered interrupt-signal generation for
  - any-motion (slope) detection
  - high rate

Magnetometer features

- Flexible functionality
  Magnetic field range typical ±1300μT (x-, y-axis); ±2500μT (z-axis)
  Magnetic field resolution of ~0.3μT
  Operating modes:
  - Low power
  - Regular
  - Enhanced regular
  - High Accuracy
  Power modes:
  - Normal
  - Sleep
  - Suspend
  - Force

Typical applications

- Navigation
- Robotics
- Fitness and well-being
- Augmented reality
- Context awareness
- Tablets and ultra-books

General description

The BNO055 is a System in Package (SiP), integrating a triaxial 14-bit accelerometer, a triaxial 16-bit gyroscope with a range of ±2000 degrees per second, a triaxial geomagnetic sensor and a 32-bit cortex M0+ microcontroller running Bosch Sensortec sensor fusion software, in a single package.

The corresponding chip-sets are integrated into one single 28-pin LGA 3.8mm x 5.2mm x 1.1 mm housing. For optimum system integration the BNO055 is equipped with digital bi-directional I^2C and UART interfaces. The I^2C interface can be programmed to run with the HID-I2C protocol turning the BNO055 into a plug-and-play sensor hub solution for devices running the Windows 8.0 or 8.1 operating system.

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Specification

If not stated otherwise, the given values are over lifetime and full performance temperature and voltage ranges, minimum/maximum values are ±3 sigma.

1.1 Electrical specification

Table 0-1: Electrical parameter specification

OPERATING CONDITIONS BNO055						
Parameter	**Symbol**	**Condition**	**Min**	**Typ**	**Max**	**Unit**
Supply Voltage (only Sensors)	V_{DD}	--	2.4	--	3.6	V
Supply Voltage (µC and I/O Domain)	V_{DDIO}	--	1.7	--	3.6	V
Voltage Input Low Level (UART, I2C)	V_{DDIO_VIL}	V_{DDIO} = 1.7-2.7V	--	--	0.25 V_{DDIO}	V
		V_{DDIO} = 2.7-3.6V	--	--	0.3 V_{DDIO}	V
Voltage Input High Level (UART, I2C)	V_{DDIO_VIH}	V_{DDIO} = 1.7-2.7V	0.7 V_{DDIO}	--	--	V
		V_{DDIO} = 2.7-3.6V	0.55 V_{DDIO}	--	--	V
Voltage Output Low Level (UART, I2C)	V_{DDIO_VOL}	V_{DDIO} > 3V , I_{OL} =20mA	--	0.1 V_{DDIO}	0.2 V_{DDIO}	V
Voltage Output High Level (UART, I2C)	V_{DDIO_VOH}	V_{DDIO} > 3V , I_{OH} =10mA	0.8 V_{DDIO}	0.9 V_{DDIO}	--	V
POR Voltage threshold on VDDIO-IN rising	V_{DDIO_POT+}	V_{DDIO} falls at 1V/ms or slower	--	1.45	--	V
POR Voltage threshold on VDDIO-IN falling	V_{DDIO_POT-}		--	0.99	--	V
Operating Temperature	T_A	--	-40	--	+85	°C
Total supply current normal mode at T_A (9DOF @100Hz output data rate)	I_{DD} + I_{DDIO}	V_{DD} = 3V, V_{DDIO} = 2.5V	--	--	12.3	mA
Total supply current Low power mode at T_A	I_{DD_LPM}	V_{DD} = 3V, V_{DDIO} = 2.5V	0.33	2.72#		mA
Total supply current suspend mode at T_A	I_{DD_SuM}	V_{DD} = 3V, V_{DDIO} = 2.5V	--	--	0.04*	mA

80% suspend mode and 20% normal mode with 9DOF @100Hz output data rate
* using I2C as communication protocol

1.2 Electrical and physical characteristics, measurement performance

Table 0-2: Electrical characteristics BNO055

Parameter	Symbol	Condition	Min	Typ	Max	Unit
OPERATING CONDITIONS BNO055						
Parameter	**Symbol**	**Condition**	**Min**	**Typ**	**Max**	**Unit**
Start-Up time	T_{Sup}	From Off to configuration mode		400		ms
POR time	T_{POR}	From Reset to Config mode		650		ms
Data Rate	DR	s. Par. Fusion Output data rates				
Data rate tolerance 9DOF @100Hz output data rate (if internal oscillator is used)	DR_{tol}			±1		%
OPERATING CONDITIONS ACCELEROMETER						
Parameter	**Symbol**	**Condition**	**Min**	**Typ**	**Max**	**Units**
Acceleration Range	g_{FS2g}	Selectable via serial digital interface		±2		g
	g_{FS4g}			±4		g
	g_{FS8g}			±8		g
	g_{FS16g}			±16		g
OUTPUT SIGNAL ACCELEROMETER (ACCELEROMETER ONLY MODE)						
Parameter	**Symbol**	**Condition**	**Min**	**Typ**	**Max**	**Units**
Sensitivity	S	All g_{FSXg} Values, T_A=25°C		1		LSB/mg
Sensitivity tolerance	S_{tol}	Ta=25°C, g_{FS2g}		±1	±4	%
Sensitivity Temperature Drift	TCS	g_{FS2g}, Nominal V_{DD} supplies, Temp operating conditions		±0.03		%/K
Sensitivity Supply Volt. Drift	S_{VDD}	g_{FS2g}, T_A=25°C, $V_{DD\_min} \leq V_{DD} \leq V_{DD\_max}$		0.065	0.2	%/V
Zero-g Offset (x,y.z)	Off_{xyz}	g_{FS2g}, T_A=25°C, nominal V_{DD} supplies, over life-time	-150	±80	+150	mg
Zero-g Offset Temperature Drift	TCO	g_{FS2g}, Nominal V_{DD} supplies		±1	+/-3.5	mg/K
Zero-g Offset Supply Volt. Drift	Off_{VDD}	g_{FS2g}, T_A=25°C, $V_{DD\_min} \leq V_{DD} \leq V_{DD\_max}$		1.5	2.5	mg/V
Bandwidth	bw_8	2nd order filter, bandwidth programmable		8		Hz
	bw_{16}			16		Hz
	bw_{31}			31		Hz
	bw_{63}			63		Hz
	bw_{125}			125		Hz
	bw_{250}			250		Hz
	bw_{500}			500		Hz
	bw_{1000}			1,000		Hz

Nonlinearity	NL	best fit straight line, g_{FS2g}		0.5	2	%FS
Output Noise Density	n_{rms}	g_{FS2g}, T_A=25°C Nominal V_{DD} supplies Normal mode		150	190	µg/√Hz

Mechanical Characteristics Accelerometer

Parameter	Symbol	Condition	Min	Typ	Max	Units
Cross Axis Sensitivity	CAS	relative contribution between any two of the three axes		1	2	%
Alignment Error	E_A	relative to package outline		0.5	2	°

Operating Conditions Gyroscope

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Rate Range	R_{FS125}	Selectable via serial digital interface		125		°/s
	R_{FS250}			250		°/s
	R_{FS500}			500		°/s
	R_{FS1000}			1,000		°/s
	R_{FS2000}			2,000		°/s

Output Signal Gyroscope (Gyro Only Mode)

Sensitivity via register Map	S	Ta=25°C		16.0 900		LSB/°/s rad/s
Sensitivity tolerance	S_{tol}	Ta=25°C, R_{FS2000}	--	±1	±3	%
Sensitivity Change over Temperature	TCS	Nominal V_{DD} supplies -40°C ≤ T_A ≤ +85°C R_{FS2000}		±0.03	±0.07	%/K
Sensitivity Supply Volt. Drift	S_{VDD}	T_A=25°C, V_{DD_min} ≤ V_{DD} ≤ V_{DD_max}		<0.4		%/V
Nonlinearity	NL	best fit straight line R_{FS1000}, R_{FS2000}		±0.05	±0.2	%FS
Zero-rate Offset	Off Ω_x Ω_y and Ω_z	Nominal V_{DD} supplies T_A=25°C, Slow and fast offset cancellation off	-3	±1	+3	°/s
Zero-Ω Offset Change over Temperature	TCO	Nominal V_{DD} supplies -40°C ≤ T_A ≤ +85°C R_{FS2000}		±0.015	±0.03	°/s per K
Zero-Ω Offset Supply Volt. Drift	$Off\Omega_{VDD}$	T_A=25°C, V_{DD_min} ≤ V_{DD} ≤ V_{DD_max}		0.1		°/s /V
Output Noise	n_{rms}	rms, BW=47Hz (@ 0.014°/s/√Hz)		0.1	0.3	°/s

Bandwidth BW	f_{-3dB}			523 230 116 64 47 32 23 12		Hz
MECHANICAL CHARACTERISTICS GYROSCOPE						
Cross Axis Sensitivity	CAS	Sensitivity to stimuli in non-sense-direction		±1	±3	%

OPERATING CONDITIONS MAGNETOMETER (MAGNETOMETER ONLY MODE)

Parameter	Symbol	Condition	Min	Typ	Max	Units
Magnetic field range[1]	Brg,xy	TA=25°C	±1200	±1300		µT
	Brg,z		±2000	±2500		µT
Magnetometer heading accuracy[2]	As heading	30µT horizontal geomagnetic field component, TA=25°C			±2.5	deg

MAGNETOMETER OUTPUT SIGNAL

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Device Resolution	$D_{res,m}$	T_A=25°C		0.3		µT
Gain error[3]	$G_{err,m}$	After API compensation T_A=25°C Nominal V_{DD} supplies		±5	±8	%
Sensitivity Temperature Drift	TCS_m	After API compensation -40°C ≤ T_A ≤ +85°C Nominal V_{DD} supplies		±0.01	±0.03	%/K
Zero-B offset	OFF_m	T_A=25°C		±40		µT
Zero-B offset[4]	$OFF_{m,cal}$	After calibration in fusion mode -40°C ≤ T_A ≤ +85°C		±2		µT
Zero-B offset Temperature Drift	TCO_m	-40°C ≤ T_A ≤ +85°C		±0.23	±0.37	µT/K
Full-scale Nonlinearity	$NL_{m,\ FS}$	best fit straight line			1	%FS

[1] Full linear measurement range considering sensor offsets.
[2] The heading accuracy depends on hardware and software. A fully calibrated sensor and ideal tilt compensation are assumed.
[3] Definition: *gain error = ((measured field after API compensation) / (applied field))* – 1
[4] Magnetic zero-B offset assuming calibration in fusion mode. Typical value after applying calibration movements containing various device orientations (typical device usage).

Output Noise	$n_{rms,lp,m,xy}$	Low power preset x, y-axis, T_A=25°C Nominal V_{DD} supplies		1.0		µT
	$n_{rms,lp,m,z}$	Low power preset z-axis, T_A=25°C Nominal V_{DD} supplies		1.4		µT
	$n_{rms,rg,m}$	Regular preset T_A=25°C Nominal V_{DD} supplies		0.6		µT
	$n_{rms,eh,m}$	Enhanced regular preset T_A=25°C Nominal V_{DD} supplies		0.5		µT
	$n_{rms,ha,m}$	High accuracy preset T_A=25°C Nominal V_{DD} supplies		0.3		µT
Power Supply Rejection Rate	$PSRR_m$	T_A=25°C Nominal V_{DD} supplies		±0.5		µT/V

2. Absolute Maximum Ratings

Table 2-1: Absolute maximum ratings (preliminary target values)

Parameter	Symbol	Condition	Min	Max	Units
Voltage at Supply Pin	V_{DD} Pin		-0.3	4.2	V
	V_{DDIO} Pin		-0.3	3.6	V
Voltage at any Logic Pin	$V_{non\text{-}supply}$ Pin		-0.3	V_{DDIO}+0.3	V
Passive Storage Temp. Range	Trps	≤ 65% rel. H.	-50	+150	°C
Mechanical Shock	$MechShock_{200µs}$	Duration ≤ 200µs		10,000	g
	$MechShock_{1ms}$	Duration ≤ 1.0ms		2,000	g
	$MechShock_{freefall}$	Free fall onto hard surfaces		1.8	m
ESD	ESD_{HBM}	HBM, at any Pin		2	kV
	ESD_{CDM}	CDM		500	V
	ESD_{MM}	MM		200	V

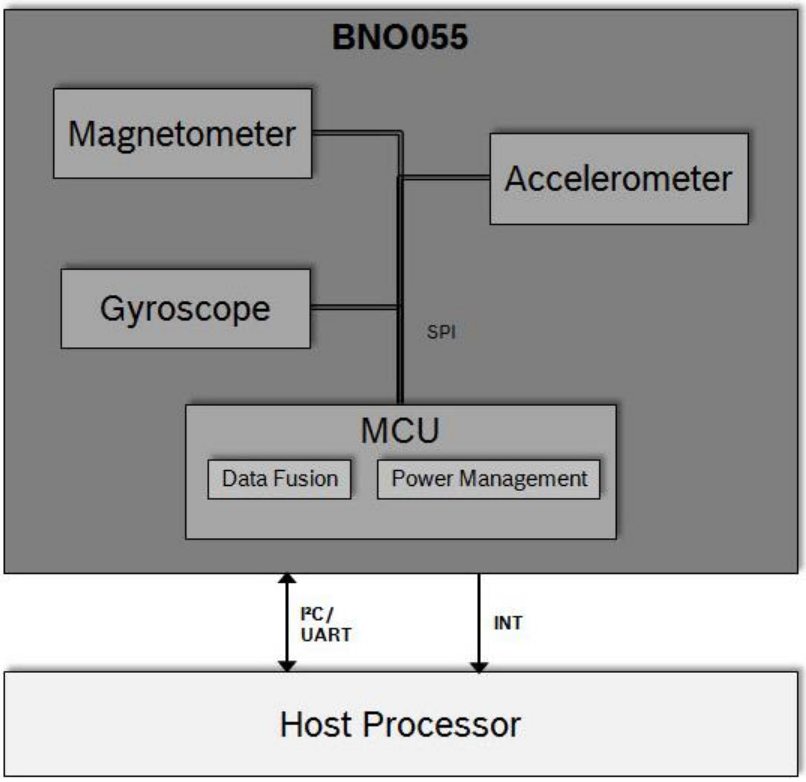
Note:
Stress above these limits may cause damage to the device. Exceeding the specified electrical limits may affect the device reliability or cause malfunction.

3. Functional Description

3.1 Architecture

The following figure shows the basic building blocks of the BNO055 device.

Figure 1: system architecture



3.2 Power management

The BNO055 has two distinct power supply pins:

- V_{DD} is the main power supply for the internal sensors
- V_{DDIO} is a separate power supply pin used for the supply of the µC and the digital interfaces

For the switching sequence of power supply V_{DD} and V_{DDIO} it is mandatory that V_{DD} is powered on and driven to the specified level before or at the same time as V_{DDIO} is powered ON. Otherwise there are no limitations on the voltage levels of both pins relative to each other, as long as they are used within the specified operating range.

The sensor features a power-on reset (POR), initializing the register map with the default values and starting in CONFIG mode. The POR is executed at every power on and can also be triggered either by applying a low signal to the nRESET pin for at least 20ns or by setting the RST_SYS bit in the SYS_TRIGGER register.

The BNO055 can be configured to run in one of the following power modes: normal mode, low power mode, and suspend mode. These power modes are described in more detail in section Power Modes

Power Modes

The BNO055 support three different power modes: Normal mode, Low Power Mode, and Suspend mode.

The power mode can be selected by writing to the PWR_MODE register as defined in the table below. As default at start-up the BNO055 will run in Normal mode.

Table 3-1: power modes selection

Parameter	Value	[Reg Addr]: Reg Value
Power Mode	Normal Mode	[PWR_MODE]: xxxxxx00b
	Low Power Mode	[PWR_MODE]: xxxxxx01b
	Suspend Mode	[PWR_MODE]: xxxxxx10b

3.2.1 Normal Mode

In normal mode all sensors required for the selected operating mode (see section 3.3) are always switched ON. The register map and the internal peripherals of the MCU are always operative in this mode.

3.2.2 Low Power Mode

If no activity (i.e. no motion) is detected for a configurable duration (default 5 seconds), the BNO055 enters the low power mode. In this mode only the accelerometer is active. Once motion is detected (i.e. the accelerometer signals an any-motion interrupt), the system is woken up and normal mode is entered. The following settings are possible.

Table 3-2: Low power modes - Interrupts

Description	Parameter	Value	Reg Value	Restriction
Entering to sleep: NO Motion Interrupt	Detection Type	No Motion	[ACC_NM_SET] : xxxxxxx1b	n/a
		Detection Axis	[ACC_INT_Settings] : bit4-bit2	Shares common bit with Any Motion interrupt axis selection
	Params	Duration	[ACC_NM_SET] : bit6-bit1	n/a
		Threshold	[ACC_NM_THRE] : bit7-bit0	n/a

Description	Parameter	Value	Reg Value
Waking up: Any Motion Interrupt	Detection Type	Detection Axis	[ACC_INT_Settings] : bit4-bit2
	Params	Duration	[ACC_INT_Settings] : bit1-bit0
		Threshold	[ACC_AM_THRES] : bit7-bit0

Additionally, the interrupt pins can also be configured to provide HW interrupt to the host.

The BNO055 is by default configured to have optimum values for entering into sleep and waking up. To restore these values, trigger system reset by setting RST_SYS bit in SYS_TRIGGER register.

There are some limitations to achieve the low power mode performance:

- Only No and Any motion interrupts are applicable and High-G and slow motion interrupts are not applicable in low power mode.
- Low power mode is not applicable where accelerometer is not employed.

3.2.3 Suspend Mode

In suspend mode the system is paused and all the sensors and the microcontroller are put into sleep mode. No values in the register map will be updated in this mode. To exit from suspend mode the mode should be changed by writing to the PWR_MODE register (see Table 3-1).

3.3 Operation Modes

The BNO055 provides a variety of output signals, which can be chosen by selecting the appropriate operation mode. The table below lists the different modes and the available sensor signals.

Table 3-3: Operating modes overview

Operating Mode		**Available sensor signals**			**Fusion Data**	
		Accel	**Mag**	**Gyro**	**Relative orientation**	**Absolute orientation**
	CONFIGMODE	-	-	-	-	-
Non-fusionmodes	ACCONLY	X	-	-	-	-
	MAGONLY	-	X	-	-	-
	GYROONLY	-	-	X	-	-
	ACCMAG	X	X	-	-	-
	ACCGYRO	X	-	X	-	-
	MAGGYRO	-	X	X	-	-
	AMG	X	X	X	-	-
Fusion modes	IMU	X	-	X	X	-
	COMPASS	X	X	-	-	X
	M4G	X	X		X	-
	NDOF_FMC_OFF	X	X	X	-	X
	NDOF	X	X	X	-	X

The default operation mode after power-on is CONFIGMODE.

When the user changes to another operation mode, the sensors which are required in that particular sensor mode are powered, while the sensors whose signals are not required are set to suspend mode.

The BNO055 sets the following default settings for the sensors. The user can overwrite these settings in the register map when in CONFIGMODE.

Table 3-4: Default sensor settings

Sensor	Range	Bandwidth
Accelerometer	4G	62.5 Hz
Magnetometer	NA	10 Hz
Gyroscope	2000 dps	32 Hz

In any mode, the sensor data are available in the data register based on the unit selected. The axis of the data is configured based on the axis-remap register configuration.

The operating mode can be selected by writing to the OPR_MODE register, possible register values and the corresponding operating modes are shown in the table below.

Table 3-5: operating modes selection

Parameter	Value	[Reg Addr]: Reg Value
CONFIG MODE	CONFIGMODE	[OPR_MODE]: xxxx0000b
Non-Fusion Mode	ACCONLY	[OPR_MODE]: xxxx0001b
	MAGONLY	[OPR_MODE]: xxxx0010b
	GYROONLY	[OPR_MODE]: xxxx0011b
	ACCMAG	[OPR_MODE]: xxxx0100b
	ACCGYRO	[OPR_MODE]: xxxx0101b
	MAGGYRO	[OPR_MODE]: xxxx0110b
	AMG	[OPR_MODE]: xxxx0111b
Fusion Mode	IMU	[OPR_MODE]: xxxx1000b
	COMPASS	[OPR_MODE]: xxxx1001b
	M4G	[OPR_MODE]: xxxx1010b
	NDOF_FMC_OFF	[OPR_MODE]: xxxx1011b
	NDOF	[OPR_MODE]: xxxx1100b

Table 3-6 below shows the time required to switch between CONFIGMODE and the other operating modes.

Table 3-6: Operating mode switching time

From	To	Switching time
CONFIGMODE	Any operation mode	7ms
Any operation mode	CONFIGMODE	19ms

3.3.1 Config Mode

This mode is used to configure BNO, wherein all output data is reset to zero and sensor fusion is halted. This is the only mode in which all the writable register map entries can be changed. (Exceptions from this rule are the interrupt registers (INT and INT_MSK) and the operation mode register (OPR_MODE), which can be modified in any operation mode.)

As being said, this mode is the default operation mode after power-on or RESET. Any other mode must be chosen to be able to read any sensor data.

3.3.2 Non-Fusion Modes

3.3.2.1 ACCONLY

If the application requires only raw accelerometer data, this mode can be chosen. In this mode the other sensors (magnetometer, gyro) are suspended to lower the power consumption. In this mode, the BNO055 behaves like a stand-alone acceleration sensor.

3.3.2.1 MAGONLY

In MAGONLY mode, the BNO055 behaves like a stand-alone magnetometer, with acceleration sensor and gyroscope being suspended.

3.3.2.2 GYROONLY

In GYROONLY mode, the BNO055 behaves like a stand-alone gyroscope, with acceleration sensor and magnetometer being suspended.

3.3.2.3 ACCMAG

Both accelerometer and magnetometer are switched on, the user can read the data from these two sensors.

3.3.2.4 ACCGYRO

Both accelerometer and gyroscope are switched on; the user can read the data from these two sensors.

3.3.2.5 MAGGYRO

Both magnetometer and gyroscope are switched on, the user can read the data from these two sensors.

3.3.2.6 AMG (ACC-MAG-GYRO)

All three sensors accelerometer, magnetometer and gyroscope are switched on.

3.3.3 Fusion modes

Sensor fusion modes are meant to calculate measures describing the orientation of the device in space. It can be distinguished between non-absolute or relative orientation and absolute orientation. Absolute orientation means orientation of the sensor with respect to the earth and its magnetic field. In other words, absolute orientation sensor fusion modes calculate the direction of the magnetic north pole.
In non-absolute or relative orientation modes, the heading of the sensor can vary depending on how the sensor is placed initially.

All fusion modes provide the heading of the sensor as quaternion data or in Euler angles (roll, pitch and yaw angle). The acceleration sensor is both exposed to the gravity force and to accelerations applied to the sensor due to movement. In fusion modes it is possible to separate the two acceleration sources, and thus the sensor fusion data provides separately linear acceleration (i.e. acceleration that is applied due to movement) and the gravity vector.

3.3.3.1 IMU (Inertial Measurement Unit)

In the IMU mode the relative orientation of the BNO055 in space is calculated from the accelerometer and gyroscope data. The calculation is fast (i.e. high output data rate).

3.3.3.2 COMPASS

The COMPASS mode is intended to measure the magnetic earth field and calculate the geographic direction.
The earth magnetic field is a vector with the horizontal components x,y and the vertical z component. It depends on the position on the globe and natural iron occurrence. For heading calculation (direction of compass pointer) only the horizontal components x and y are used. Therefore the vector components of the earth magnetic field must be transformed in the horizontal plane, which requires the knowledge of the direction of the gravity vector. To summarize, the heading can only be calculated when considering gravity and magnetic field at the same time.

However, the measurement accuracy depends on the stability of the surrounding magnetic field. Furthermore, since the earth magnetic field is usually much smaller than the magnetic fields that occur around and inside electronic devices, the compass mode requires calibration (see chapter 3.10)

3.3.3.3 M4G (Magnet for Gyroscope)

The M4G mode is similar to the IMU mode, but instead of using the gyroscope signal to detect rotation, the changing orientation of the magnetometer in the magnetic field is used. Since the magnetometer has much lower power consumption than the gyroscope, this mode is less power consuming in comparison to the IMU mode. There are no drift effects in this mode which are inherent to the gyroscope.

However, as for compass mode, the measurement accuracy depends on the stability of the surrounding magnetic field.
For this mode no magnetometer calibration is required and also not available.

3.3.3.4 NDOF_FMC_OFF

This fusion mode is same as NDOF mode, but with the Fast Magnetometer Calibration turned 'OFF'.

3.3.3.5 NDOF

This is a fusion mode with 9 degrees of freedom where the fused absolute orientation data is calculated from accelerometer, gyroscope and the magnetometer. The advantages of combining all three sensors are a fast calculation, resulting in high output data rate, and high robustness from magnetic field distortions. In this mode the Fast Magnetometer calibration is turned ON and thereby resulting in quick calibration of the magnetometer and higher output data accuracy. The current consumption is slightly higher in comparison to the NDOF_FMC_OFF fusion mode.

3.4 Axis remap

The device mounting position should not limit the data output of the BNO055 device. The axis of the device can be re-configured to the new reference axis.

Axis configuration byte: Register Address: **AXIS_MAP_CONFIG**

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Reserved		Remapped Z axis value		Remapped Y axis value		Remapped X axis value	

There are two bits are used to configure the axis remap which will define in the following way,

Value	Axis Representation
00	X - Axis
01	Y - Axis
10	Z- Axis
11	Invalid

Also, when user try to configure the same axis to two or more then BNO055 will take this as invalid condition and previous configuration will be restored in the register map. The default value is: X Axis = X, Y Axis = Y and Z Axis = Z (AXIS_REMAP_CONFIG = 0x24).

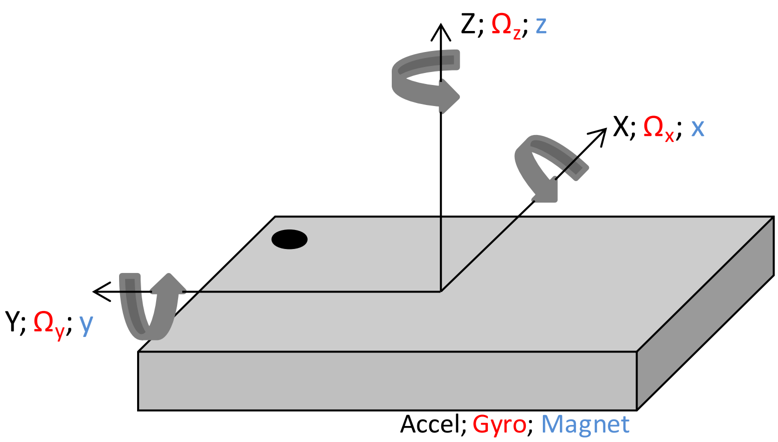
Axis sign configuration byte: Register Address: **AXIS_MAP_SIGN**

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Reserved					Remapped X axis sign	Remapped Y axis sign	Remapped Z axis sign

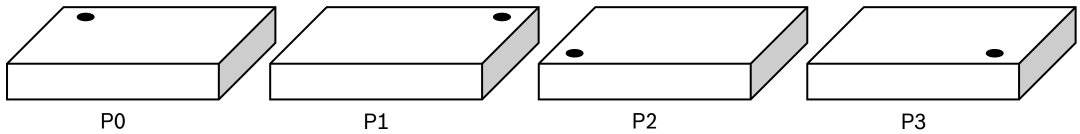
Value	Sign
0	Positive
1	Negative

The default value is 0x00.

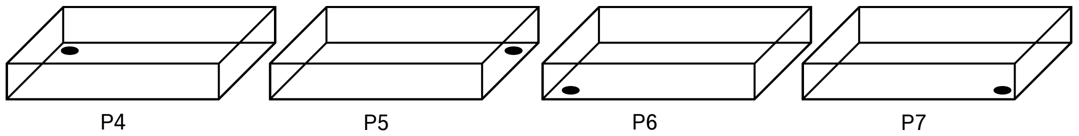
The default values correspond to the following coordinate system



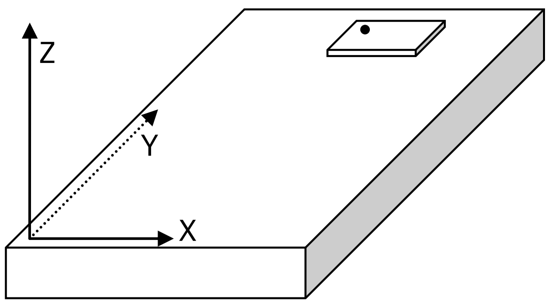
Some example placement for axis vs. register settings:



TOP VIEW



BOTTOM VIEW



P0

For the above described placements, following would be the axis configuration parameters.

Placement	AXIS_REMAP_CONFIG	AXIS_REMAP_SIGN
P0	0x21	0x04
P1 (default)	0x24	0x00
P2	0x24	0x06
P3	0x21	0x02
P4	0x24	0x03
P5	0x21	0x01
P6	0x21	0x07
P7	0x24	0x05