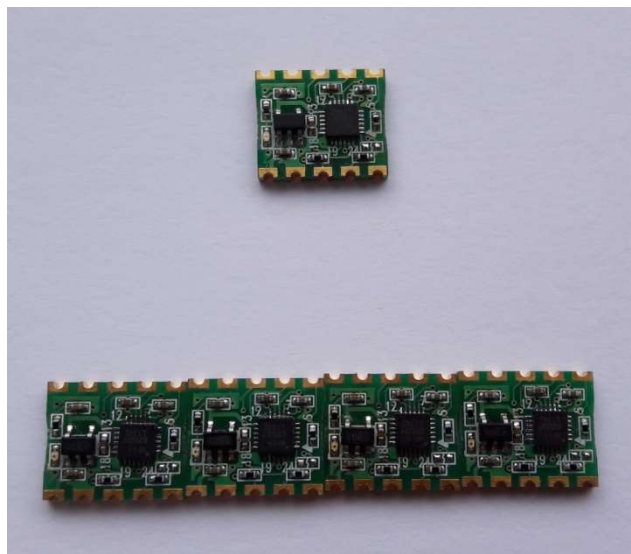


# OSTSen-20649 User Guide



**Ver 1.0**

**Onsystemech**

## 1. OSTSen-20649 Overview

OSTSen-20649 is a motion tracking module, which is based on InvenSense ICM-206490. The ICM-20649 is a world's first wide-range 6-axis MEMS MotionTracking device for sports and high impact applications. Many of today's wearable and sports solutions, which analyze the motion of a user's golf or tennis swings, soccer ball kicks, or basketball activities, require higher than currently available  $\pm 2000$  dps (degrees per second) FSR for gyroscope and  $\pm 16g$  FSR for accelerometer to better insure that critical data is not lost at the point of high impact or high speed rotation. The ICM-20649 6-axis inertial sensor offers the smallest size, lowest profile and lowest power in conjunction with industry leading high FSR.

With an extended FSR range of  $\pm 4000$  dps gyroscope and  $\pm 30g$  for accelerometer, the ICM-20649 enable precise analysis of contact spots applications providing continuous motion sensor data before, during and after impact providing more accurate feedback.

The ICM-20649 is the world's first wide-range 6-axis MotionTracking device for Sports and other High Impact applications. It is available in a 3x3x0.9mm 24-pin QFN package.

## 2. Application

- Sports
- Wearable Sensors
- High Impact Applications

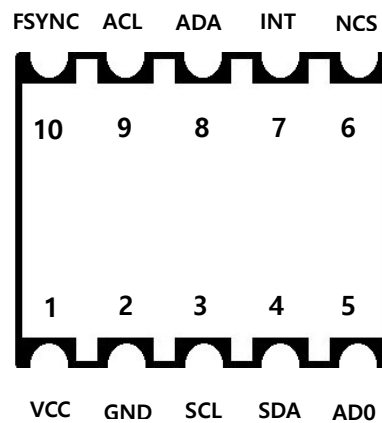
## 3. Features of ICM-20649

- 3-Axis gyroscope with programmable FSR of  $\pm 500$  dps ,  $\pm 100$  dps,  $\pm 2000$  dps, and  $\pm 4000$  dps
- 3-Axis accelerometer with programmable FSR of  $\pm 4g$ ,  $\pm 8g$ ,  $\pm 16g$ , and  $\pm 30g$
- Use-programmable interrupts
- Wake-on-motion interrupt for low power operation of applications processor
- 512-byte FIFO buffer enables the applications processor to read the data in bursts
- On-Chip 16-bit ADCs and Programmable Filters
- DMP Enables
  - SMD. Step Count, Step Detect, Activity Classifier, RV, GRV
  - Calibration of accel/gyro/compass
- Host interface: 7 MHz SPI or 400kHz I2C
- Digital-output temperature sensor
- VDD operating range of 1.7V to 3.6V
- MEMS structure hermetically sealed and bonded at wafer level
- RoHS and Green compliant

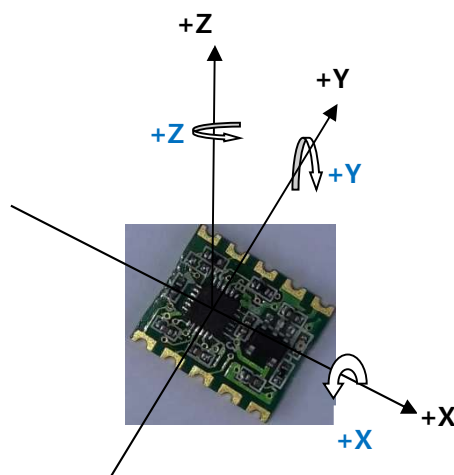
#### 4. Application Information

##### 4.1 Module Pin Out and Signal Description

Pin Number	Pin Name	Pin Description
1	VCC	Power supply voltage
2	GND	Power supply ground
3	SCL	I2C serial clock(SCL); SPI serial clock(SCLK)
4	SDA	I2C serial data(SDA); SPI serial data input(SDI)
5	AD0	I2C Slave Address LSB (AD0); SPI serial data output(SDO)
6	NCS	Chip select (SPI mode only)
7	INT	Interrupt digital output (totem pole or open-drain)
8	ADA	Auxiliary I2C master serial data
9	ACL	Auxiliary I2C master serial clock
10	FSYNC	Frame synchronization digital input. Connect to GND if unused



< TopView >



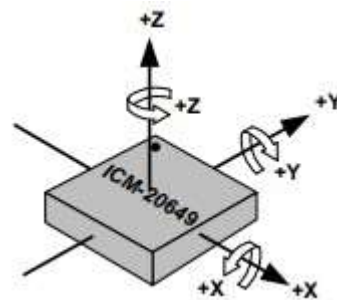
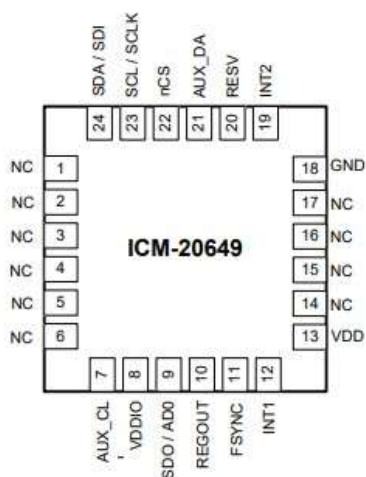
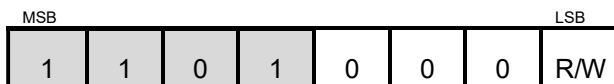
**Orientation of Axes of Sensitivity  
 and Polarity of Rotation  
 for Accel & Gyro**

## 4.2 ICM-20649 Pin out and Signal Description

Pin Number	Pin Name	Pin Description
1	NC	No connect pin. Do not connect
7	AUX_CL	I2C master serial clock for connecting to external sensors
8	VDDIO	Digital I/O supply voltage
9	AD0/SDO	I2C Slave Address LSB (AD0); SPI serial data output(SDO)
10	REGOUT	Regulator filter capacitor connection
11	FSYNC	Frame synchronization digital input. Connect to GND if unused
12	INT1	Interrupt1
13	VDD	Power supply voltage
18	GND	Power supply ground
19	INT2	Interrupt2
20	RESV	Reserved. Connect to GND
21	AUX_DA	I2C master serial data, for connecting to external sensors
22	nCS	Chip select (SPI mode only)
23	SCL/SCLK	I2C serial clock(SCL); SPI serial clock(SCLK)
24	SDA/SDI	I2C serial data(SDA); SPI serial data input(SDI)
2~6, 14~17	NC	No connect pin. Do not connect

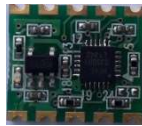
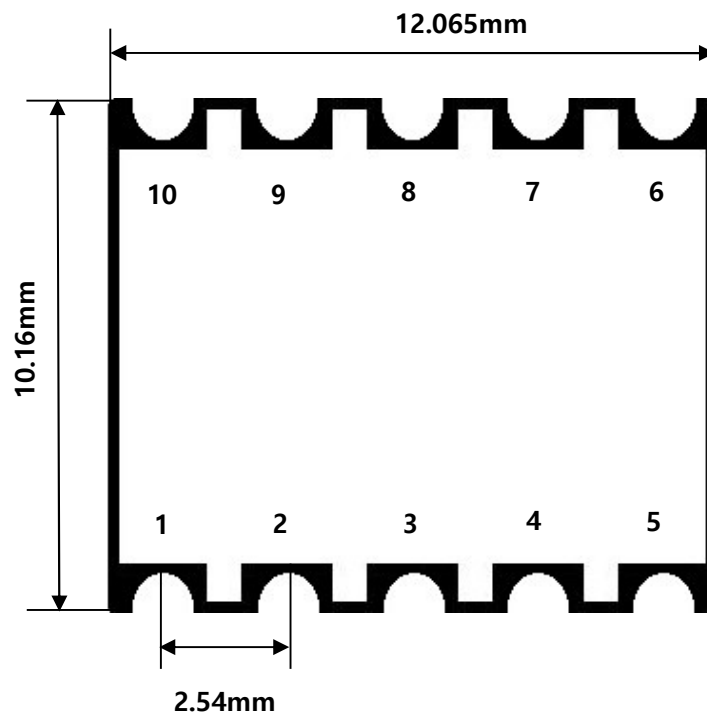
- **ICM-20649 I2C 7bit device address: 0x69 ( in module : AD0 is HIGH )**  
**0x68 ( in module : AD0 is LOW )**

In case, 7bit device address is 0x68:



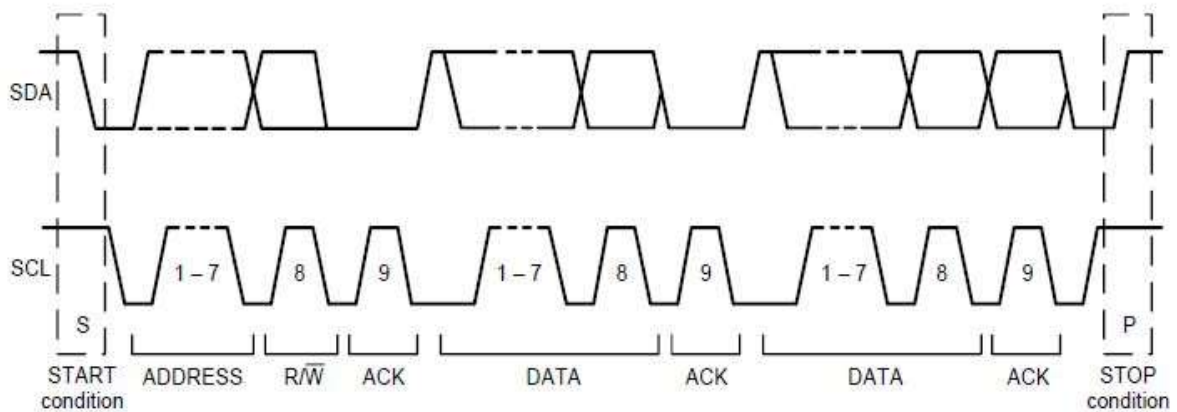
Orientation of Axes of Sensitivity and Polarity of Rotation for Accel & Gyro

## 5. Module Dimension



< OSTSen-20649 module >

## 6. I2C Communications



### Single-Byte Write Sequence

Master	S	AD+W		RA		DATA		P
Slave			ACK		ACK		ACK	

### Burst Write Sequence

Master	S	AD+W		RA		DATA		DATA		P
Slave			ACK		ACK		ACK		ACK	

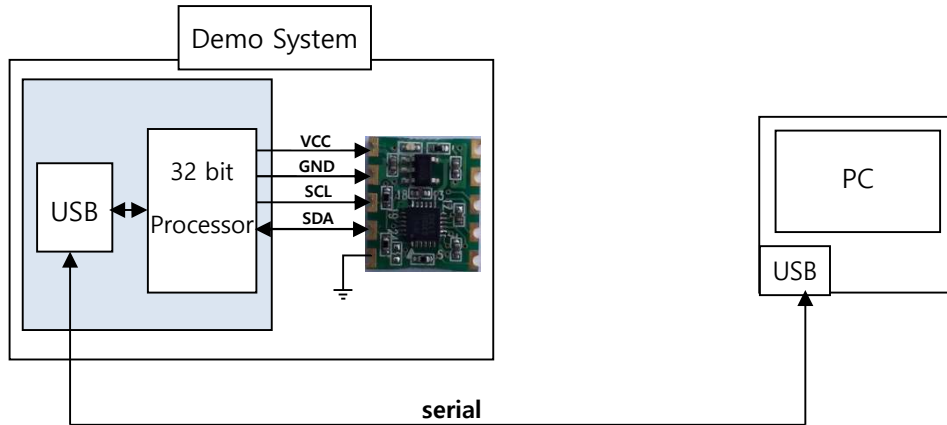
### Single-Byte Read Sequence

Master	S	AD+W		RA		S	AD+R			NACK	P
Slave			ACK		ACK			ACK	DATA		

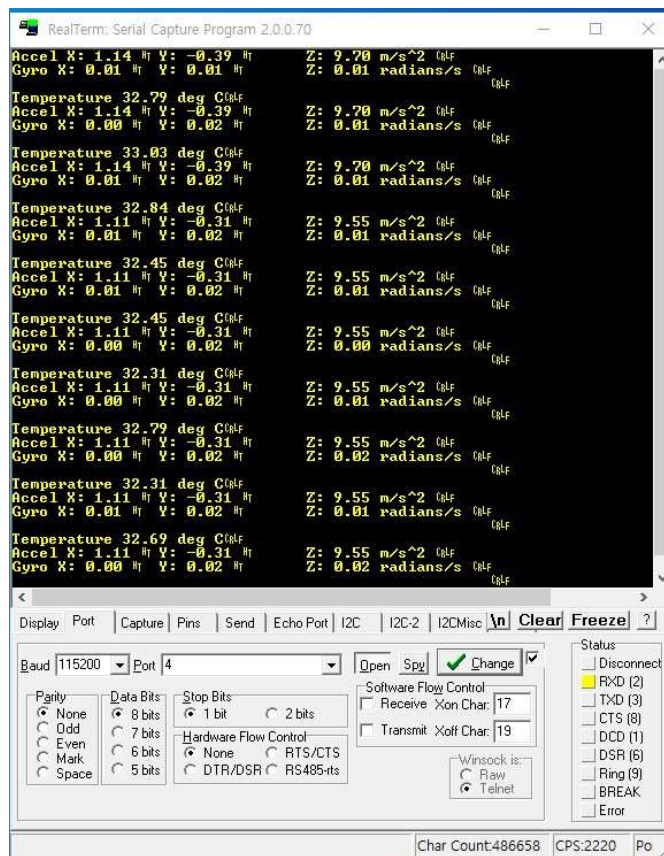
### Burst Read Sequence

Master	S	AD+W		RA		S	AD+R			ACK		NACK	P
Slave			ACK		ACK			ACK	DATA		DATA		

## 7. Demo System



### OSTSen-20649 Data Display on PC



## 8. Reference

- 1) <https://invensense.tdk.com/products/motion-tracking/6-axis/icm-20649/>
  - 2) <https://invensense.tdk.com/wp-content/uploads/2017/07/DS-000179-ICM-20648-v1.2-TYP.pdf>
  - 3) [https://github.com/adafruit/Adafruit\\_ICM20X](https://github.com/adafruit/Adafruit_ICM20X)
  - 4) <https://www.arduino.cc/reference/en/libraries/adafruit-icm20649/>
- If you need some information or have some questions about OSTSen-20649, contact [ostsen@naver.com](mailto:ostsen@naver.com).