TDK-InvenSense

DK-42688P-9X
DK-42670P-9X

User Guide

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InvenSense, a TDK Group Company
1745 Technology Drive, San Jose, CA 95110 U.S.A
+1(408) 988–7339
invensense.tdk.com

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1 INTRODUCTION

The purpose of this document is to give an overview of TDK-InvenSense DK-42688P-9X and DK-42670P-9X Reference Design Kits.

Each kit consists of:

- TDK Motion Sensor ICM-42688-P or ICM-42670-P SmartMotion Development kit:
  - DK-42688-P or DK-42670-P
- iSentek Magnetic sensor IST-8306 Daughter board
- MotionLink (Windows Evaluation Software Tool)
- Software (eMD) drivers
- A generic sensor fusion library

The 9-axis sensor data is obtained for evaluation using TDK InvenSense MotionLink software (a Windows GUI). In addition, software drivers (eMD) for both Motion and Magnetic sensors are available for sensor integration into various applications. A generic sensor fusion library running inside kits provides a referencing out-of-box motion tracking solution for applications like Virtual Reality, Augmented Reality, Hearables, Gaming, Wearables, smartphones, tablets, and robotics.

For the latest MotionLink and eMD drivers, please visit the below link:
https://invensense.tdk.com/developers/software-downloads/

2 MOTON SENSORS OVERVIEW

Below table lists a high-level spec and feature comparison of the Motion Sensors used in these kits. For low power applications, ICM-42670-P, and for higher performance applications, ICM-42688-P is recommended, respectively. Please refer to the latest IMU Datasheet for detailed spec.

DEVICE	ICM-42670-P	ICM-42688-P
Key Attribute	Cost-Optimal Lowest power IMU with advanced motion features	Highest Performance 6-axis IMU with advanced motion features and events
Target Market & Applications	Wearables, TWS, Hearables, IoT	Robotics, HMD, High performance IoT, AR, VR
# Axes	6	6
Sensors	Accel + Gyro	Accel + Gyro
Embedded Processor(s)	Advanced Pedometer and Event Detection (APEX)	Advanced Pedometer and Event Detection (APEX)
Embedded Features	Wake on Motion, Freefall Detection, Low-G detection, Pedometer, Tilt Detection, Significant Motion Detection, Independent FIFO ODR	Pedometer, Tilt Detection, Tap Detection, Wake on Motion, Raise to Wake/Sleep, Significant Motion Detection Real Time Clock (RTC) input, 19/18-bit data format in FIFO for Gyro/Accel
Package-Pin	2.5x3x0.76mm, LGA 14-leads	2.5×3×0.91mm, LGA 14-leads
Gyroscope Specs		
FSR (dps)	±250/500/1000/2000	±15.625/31.25/62.5/125/250/500/1000/2000
GYRO ZRO (dps)	±1	±0.5
GYRO Offset Stability TC (dps/C)	±0.015 (-40C to 85C)	±0.005 (0C to 70C)
GYRO Sensitivity Error (%)	±1%	±0.5%
GYRO Sensitivity/temp (%/C)	±0.007 (-40C to 85C)	±0.005 (0C to 70C)
GYRO Cross-Axis Sensitivity (%)	±2%	±1.25%
GYRO Nonlinearity (%)	±0.1%	±0.1%
GYRO Noise (dps/√Hz)	0.007	0.0028
Gyro Output Data Rate (Hz)	12.5Hz to 1.6kHz	12.5Hz to 32kHz
Accelerometer Specs		
FSR (g)	±2/4/8/16	±2/4/8/16
Accel ZGO (mg)	±25	±20
Offset Stability TC (mg/C)	±0.15 (-40C to 85C)	±0.15 (-40C to 85C)
ACCEL Sensitivity Error (%)	±1%	±0.5%
ACCEL Sensitivity/temp (%/C)	±0.01 (-40C to 85C)	±0.005 (-40C to 85C)
ACCEL Cross-Axis Sensitivity (%)	±1%	±1%
ACCEL Nonlinearity (%)	±0.1%	±0.1%
ACCEL Noise (µg/√Hz)	100	XY: 65, Z: 70
ACCEL Output Data Rate (Hz)	1.5625 Hz to 1.6 kHz	1.5625 Hz to 32 kHz
General Specs		
Bus Interface	SPI; I^2C; $I3C^{SM}$	SPI; I^2C; $I3C^{SM}$
FSYNC Support	Yes	Yes
Memory (FIFO)	2.25 Kbytes	2Kbytes
Accel Current LP Mode	9.8 µA (@25Hz)	NA
Gyro Current LN Mode	0.42 mA	0.73 mA
Accel Current LN Mode	0.20 mA	0.28 mA
6-Axis Current LN Mode	0.55 mA	0.88 mA

2.1 SUPPORTED MAGNETOMETER

For 9-Axis solution, TDK recommends IST-8306 Magnetometer. The DK-42688P-9X and DK-42670P-9X Reference Design Kits come with necessary evaluation software and driver for IST-8306, and generic sensor fusion algorithm

The IST-8306 datasheet can be downloaded from TDK InvenSense website.

3 QUICK START PROCEDURE

The DK-42688P-9X and DK-42670P-9X kits are available in our distribution.

1. DK-42688P-9X kit consist of *DK-42688-P* + *DB-IST8306*.
2. DK-42670P-9X kit consist of *DK-42670-P* + *DB-IST8306*.

3.1 SETTING UP SMARTMOTION DEVELOPMENT KIT DK-42688-P OR DK42670-P

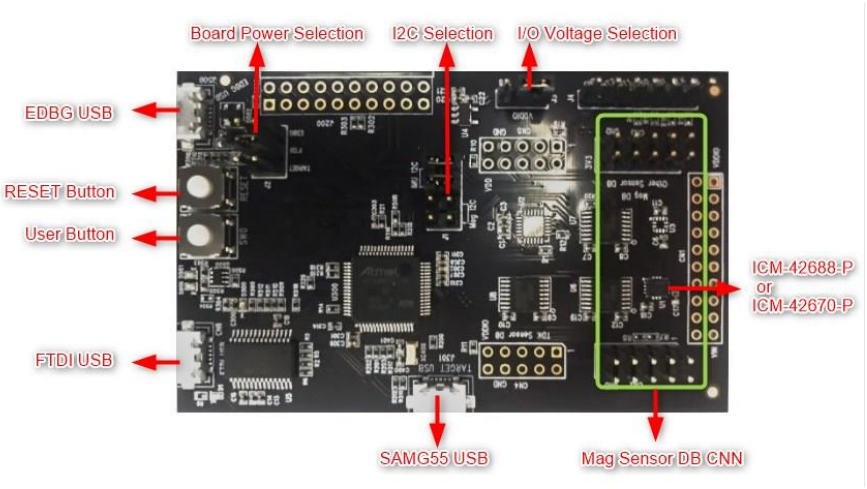

Figure 1. SmartMotion Development Kit (DK) board Ver. G

On the Development Kit board, J1 is used to select input source for SAMG55 master I2C. Ony two at a time jumper shunts are allowed. Refer to the next tables to configure jumpers for the relevant connection.

Reference Name	Jumper	Description
I2C Selection	J1	Default: 1-2 & 3-4 Shorted and 5-6 & 7-8 Opened: Host I2C bus controls all I2C slave devices which include on board IMU, EVB IMU and other sensor daughter board (if the DB's I2C jumper selection is set as UI/AP I2C). 5-6 & 7-8 Shorted and 1-2 & 3-4 Opened: On board IMU and EVB IMU are on the host SPI; and other sensor daughter board is on the host I2C bus. (if the DB's I2C jumper selection is set as AUX I2C)
Board Power Selection	J2	1-2 Shorted: Power from USB connector on J500 (EDBG) Default: 3-4 Shorted: Power from USB connector on CN6 (FTDI) 5-6 Shorted: Power from USB connector on J30 (SAMG55)
I/O Voltage Selection	J3	2-1 Shorted: VDDIO = 3.3V 2-3 Shorted: VDDIO = 1.8V

For more details about DK board usage, refer to AN-000300 SmartMotion Development Platform (Ver. G) Hardware User Guide.

3.2 CONNECTING ISENTEK MAGNETOMETER DAUGHTERBOARD (DB-IST8306)

Top Bottom

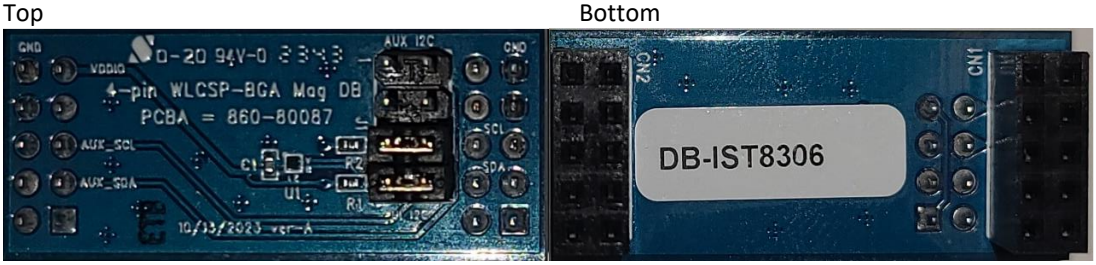

Figure 2. DB-IST8306

The magnetometer daughter boards must be connected on “Mag. Sensor DB CNN,” as follows:

- The connector CN1 on DB-IST8306 must be connected to CN3 on SmartMotion DK board
- The connector CN2 on DB-IST8306 must be connected to CN2 on SmartMotion DK board

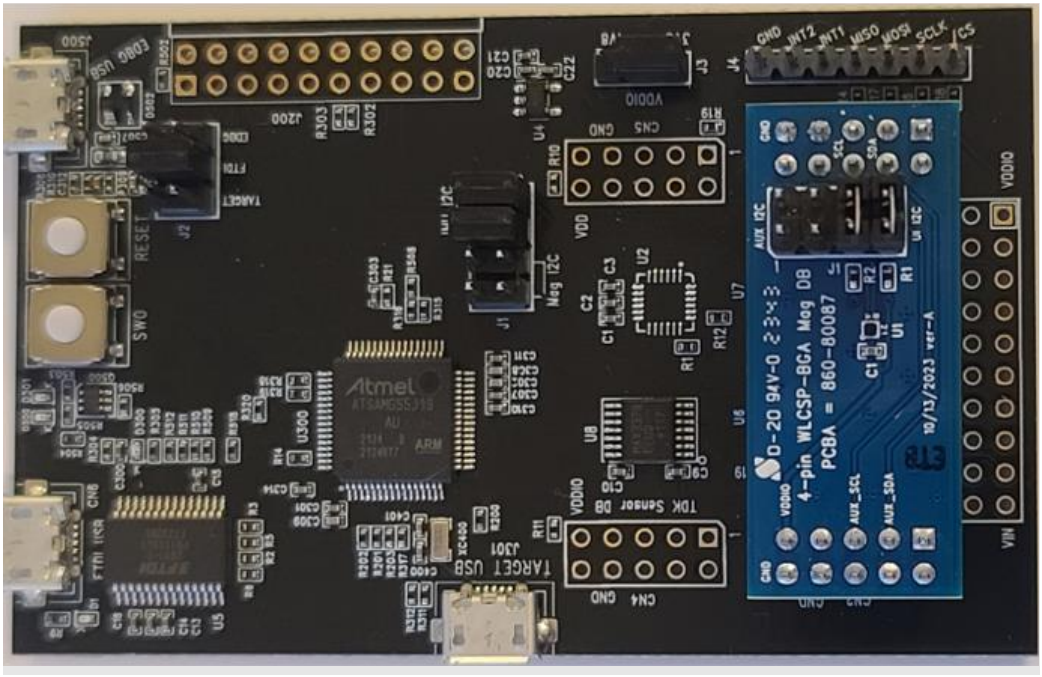

Figure 3. DB-IST8306 installed on DK-42688-P or DK-42670-P

On the magnetometer daughter board, the jumper J1 needs to be configured as shown in Figure 3.

Jumper	Description
J1	1-2 Shorted: NA (Do not short) 3-4 Shorted: NA (Do not short) 5-6 Shorted: UI_SCL active (default) 7-8 Shorted: UI_SDA active (default)

The SmartMotion eMD drivers and IST8306 example drivers that run on the DK boards using the ATMEL/Microchip Studio IDE, can be downloaded from TDK InvenSense website.

3.3 MOTIONLINK SOFTWARE AND EVALUATION PROCEDURE

QuickStart Instructions:

1) Run the latest SmartMotion (e.g., 4.2.14_Ext Installer) and allow it to make changes by clicking on Yes.
2) Click Next when the Select Destination Location window pops up.
3) Select Additional Tasks window will pop up, make sure that the Install FTDI drivers are checked. Then click Next.
4) Click Finish to exit the Setup.
5) SmartMotion icon will appear on your desktop, double click to start the program, then select MotionLink Software.
6) Connect the boards and plug in USB cable from FTDI USB of the DK to the PC.
7) Click on Select and Config button to select ICM42688-P or ICM42670-P (based on the host board) as your connected device to view accelerometer and gyroscope data (Figure 4). To view magnetometer data, select IST8306 (Figure 5).
8) Click on Connect.
9) Click on power button next to ICM42688-P or ICM42670-P or IST8306 which will start data streaming.
10) If you need to find more information user guide is located in selected destination folder.

(Ex. C:\TDK-InvenSense\SmartMotion Platform Ext 4.2.14)

Figure 4. MotionLink configuration of ICM-42688-P to view accel and gyro data

Figure 5. MotionLink Configuration of IST8306 to view magnetometer data

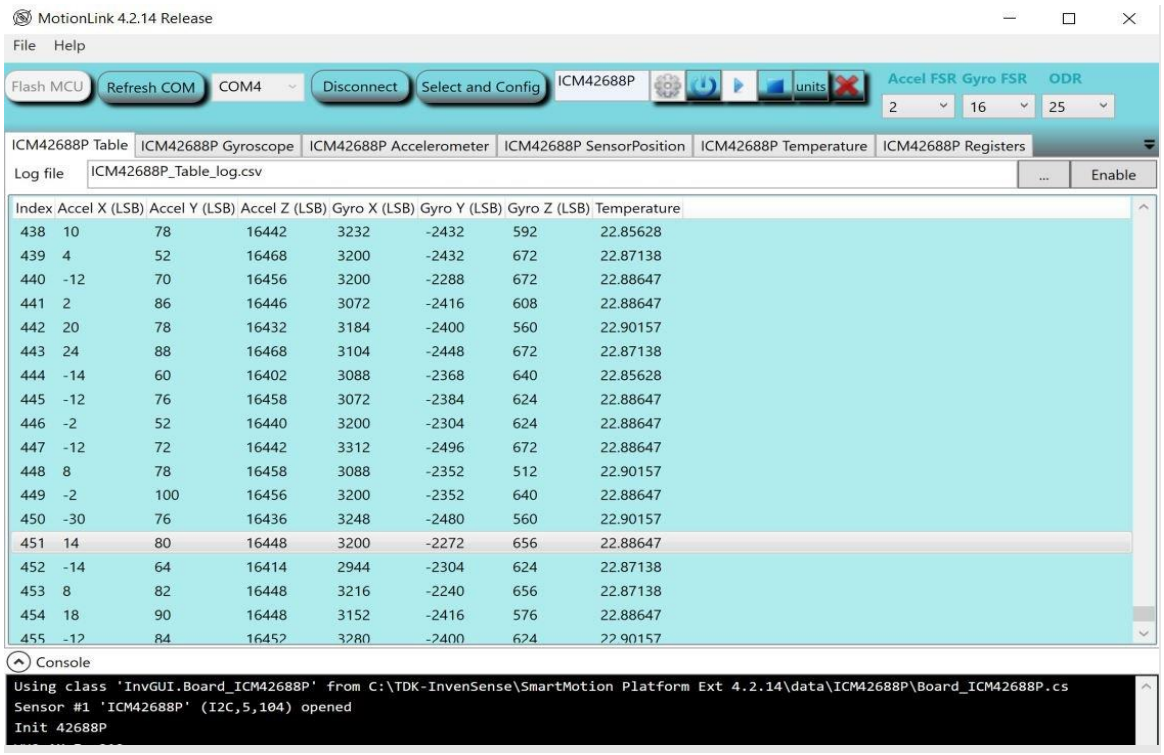

Figure 6. Accel and Gyro data display in MotionLink

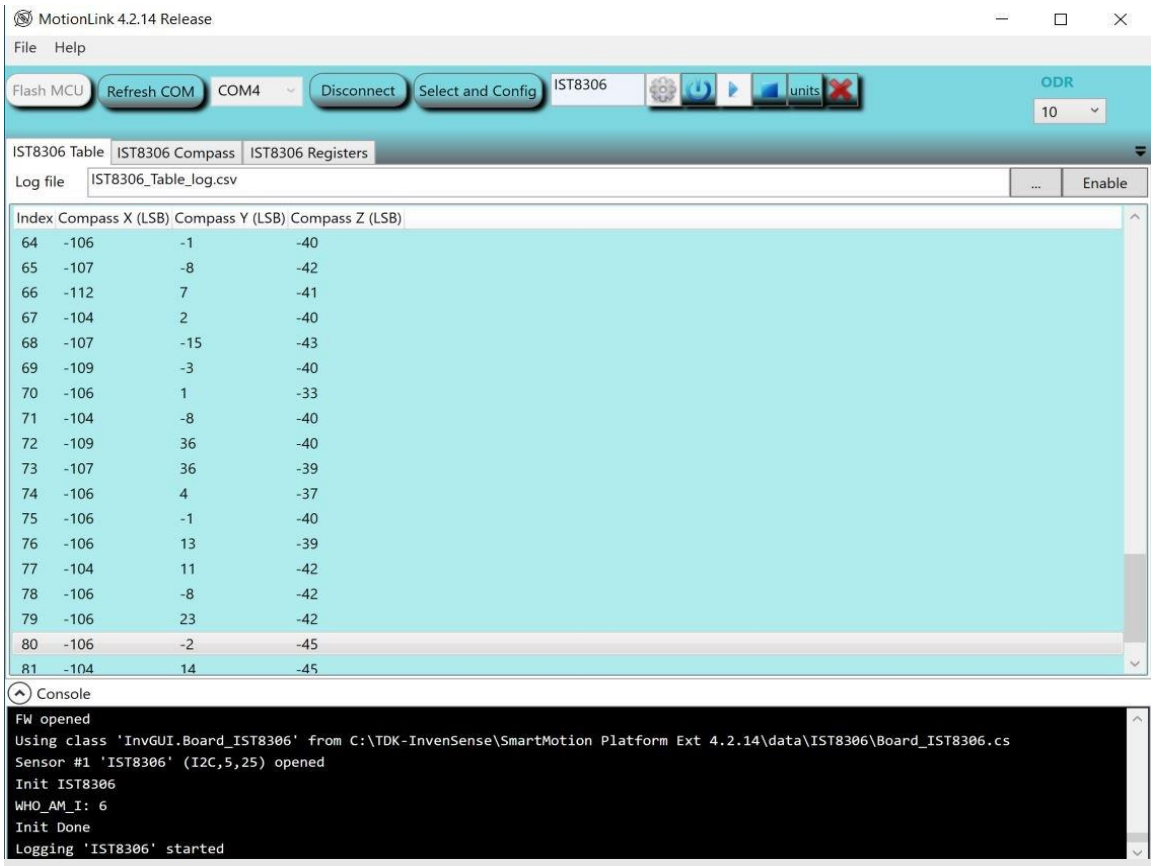

Figure 7. Magnetometer sensor data display in MotionLink

REVISION HISTORY

REVISION DATE	REVISION	DESCRIPTION
02/22/2024	1.0	Initial Draft

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