DK-45605 & DK-45686

SmartMotion Development Platform (Ver. I)

Hardware User Guide

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1 OVERVIEW

The TDK SmartMotion Platform Ver. I is a comprehensive development system for TDK InvenSense Motion Sensor devices. The platform designed around the Microchip SAMG55 MCU can be used by customers for rapid evaluation and development of InvenSense sensor-based solutions. The platform integrates an on-board Embedded Debugger so external tools are not required to program or debug with the SAMG55 MCU. Each InvenSense motion sensor has its own unique development kit. Their DK numbers are listed in this document.

The SmartMotion platform comes with the necessary software including InvenSense MotionLink, a GUI based development tool and embedded Motion Drivers (eMD) for InvenSense motion sensors.

Embedded Motion Drivers (eMD) consist of a set of APIs to configure various aspects of the platform including motion sensor parameters such as full-scale range (FSR), output data rate (ODR) signal redirection to dedicated pin, sensors low pass filter cutoff or alarm bits check.

MotionLink is a GUI based development tool included with the platform. It can be used to capture and visualize the sensor data from the motion sensor.

The platform supports Atmel Studio and is compatible with Microchip Xplained Pro Extension boards. Xplained Pro extension series evaluation kits offer additional peripherals to extend the features of the board and ease the development of customer designs.

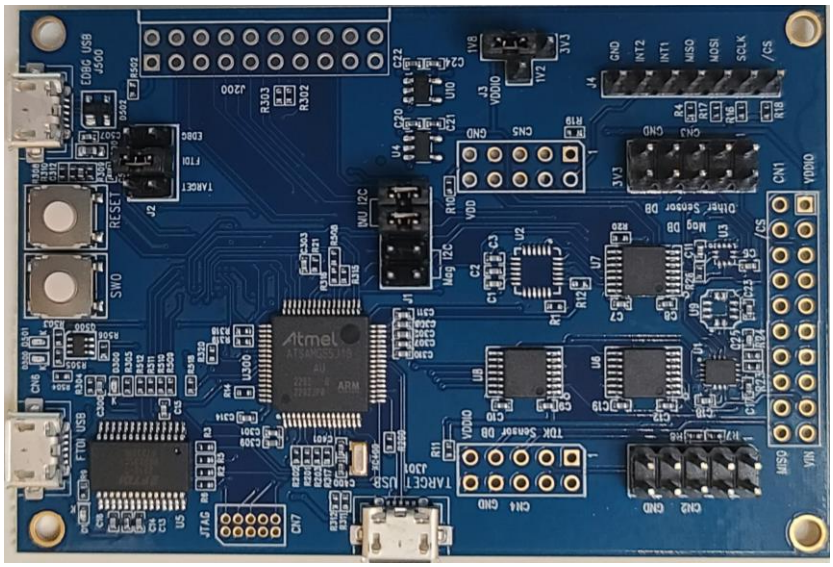


Figure 1. SmartMotion Platform (Ver. I) Development Kit

2 INTRODUCTION

2.1. FEATURES OVERVIEW

- Integrated TDK InvenSense motion sensor
- Support for a magnetic sensor with plug in daughter boards (DB)
- Microchip SAMG55 microcontroller with 512 KB Flash
- On-board Embedded debugger (EDBG) for Programming and debugging
- Built in FTDI USB to UART interface for fast motion sensor data transfer
- USB Connectors for host interface to software debug and data logging
- Board Power Supply through USB

2.2. PLATFORM OVERVIEW

The TDK SmartMotion Platform Ver. I is a hardware unit for TDK sensor product evaluation and algorithm software development. The platform offers support for many different application developments.

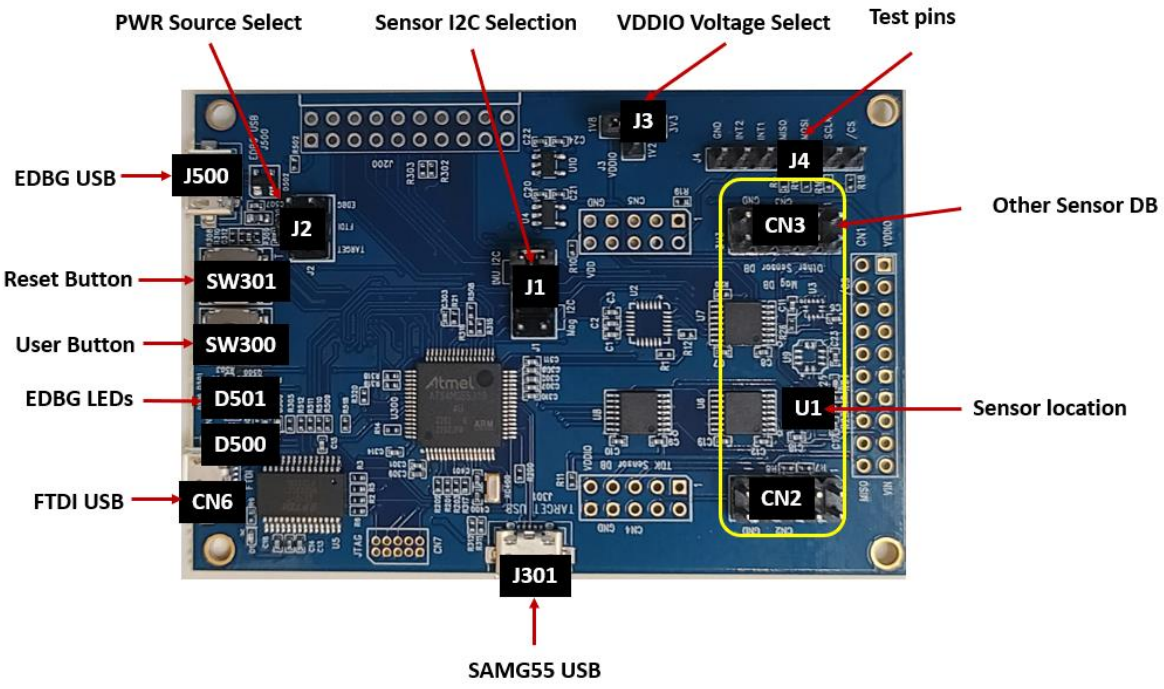


Figure 2. The SmartMotion Platform Overview

2.3. HARDWARE USER GUIDE

The TDK SmartMotion Platform Ver. I is compatible with Microchip's SAM G55 Xplained Pro. The link to the Atmel Xplained Pro user guide is here:

http://www.atmel.com/Images/Atmel-42389-SAM-G55-Xplained-Pro_User-Guide.pdf

3 SENSORS AND DEVELOPMENT KITS

The TDK SmartMotion Platform Ver. I support multiple types of TDK IMUs and pressure sensors. The Development

Kits (DKs) based on this SmartMotion Platform Ver. I are listed in Table 1 below.

Important Note:

The DK boards are intended for basic sensor product evaluation and software development at Room Temperature. These boards are NOT designed to be used at any other temperature. For sensor evaluation or characterization at temperature range specified in the product datasheet, please obtain an Evaluation Board (EVB) from your TDK FAE or sales contact.

#	DK PART NUMBER	SUPPORTED SENSOR	SMT IN
1	DK-45605	ICM-45605	U1
2	DK-45686	ICM-45686	U1

Table 1. Sensors and DKs

3.1. DK-45605

The DK-45605 is the development kit (DK) for TDK IMU ICM-45605.

The ICM-45605 is a high performance 6-axis MEMS MotionTracking device. It has a configurable host interface that supports I3C^{SM}, I^{2}C and SPI serial communication, and an I^{2}C master mode interface for connection to external sensors. The device features up to 8Kbytes FIFO and 2 programmable interrupts.

Please refer to the ICM-45605 datasheet for the sensor details.

3.2. DK-45686

The DK-45686 is the development kit (DK) for TDK IMU ICM-45686.

The ICM-45686 is a high-performance dual interface (UI + AUX) 6-axis MEMS MotionTracking device. It has a configurable host interface that supports I3C^{SM}, I^{2}C and SPI serial communication, and an AUX interface that supports SPI slave mode for connection to OIS controllers or I^{2}C master mode for connection to external sensors. The device features up to 8Kbytes FIFO and 2 programmable interrupts.

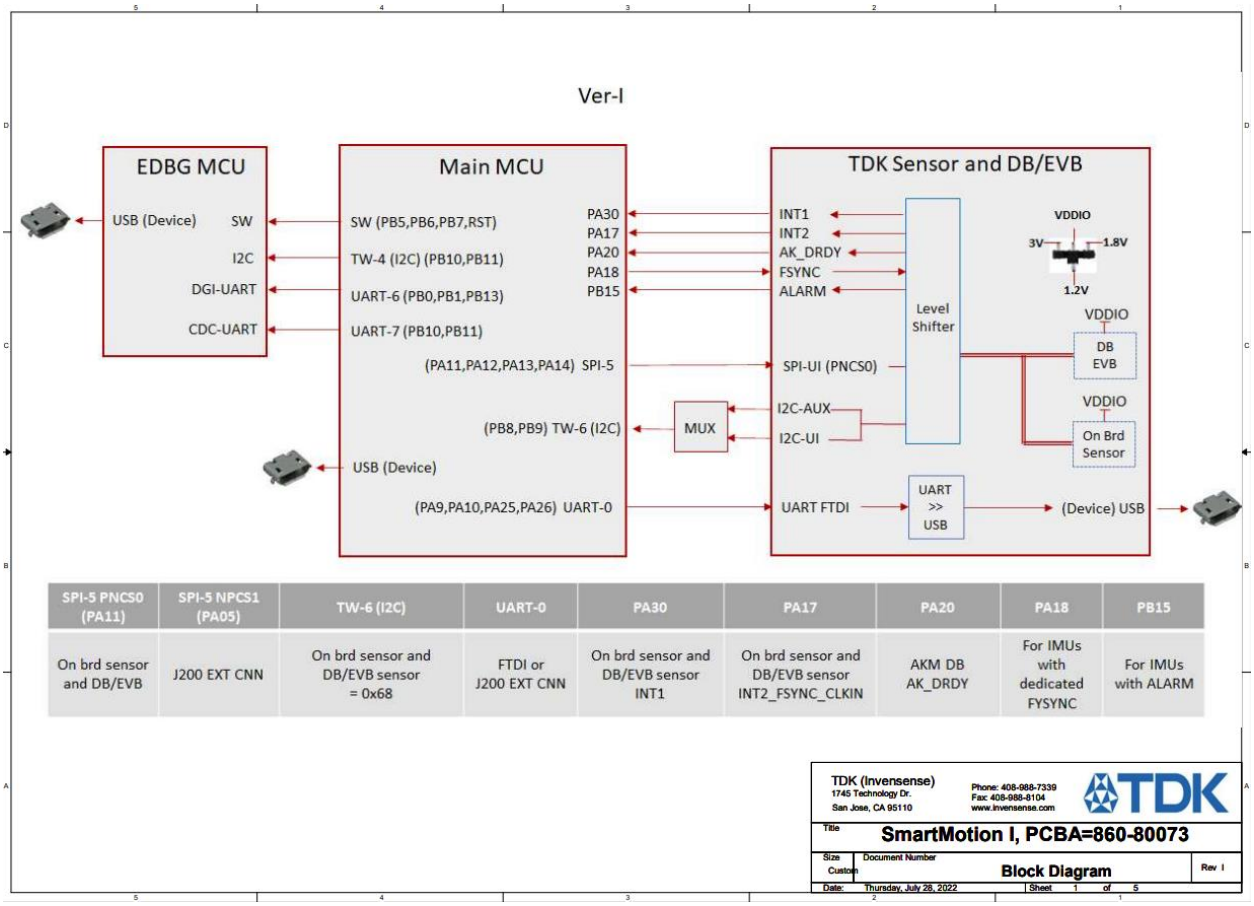
Please refer to the ICM-45686 datasheet for the sensor details.

4 THE SMARTMOTION SYSTEM DESIGN

This section is a system design overview and addresses MCU SAMG55 resource allocation.

4.1. SYSTEM BLOCK DIAGRAM

On board EDBG MCU AT32UC3A4256HHB-C1UR allows user to do main MCU SAMG55 debug, trace, and programming without using external tools. Figure 3 shows the system block diagram.



SPI-5 PNCS0 (PA11)	SPI-5 NPCS1 (PA05)	TW-6 (I2C)	UART-0	PA30	PA17	PA20	PA18	PB15
On brd sensor and DB/EVB	J200 EXT CNN	On brd sensor and DB/EVB sensor = 0x68	FTDI or J200 EXT CNN	On brd sensor and DB/EVB sensor INT1	On brd sensor and DB/EVB sensor INT2_FSYNC_CLKIN	AKM DB AK_DRDY	For IMUs with dedicated FYSYNC	For IMUs with ALARM

Figure 3. System Block Diagram

4.2. MAIN MCU SAMG55 RESOURCE ALLOCATION

SAMG55 RESOURCE	USAGE
UART 0 (PA9/10/25/26)	The UART0 is connected to FTDI input by default. In the use case of Extension-1 on J200, the UART0 to FTDI connection can be disconnected through jumper J3.
TW6 (I2C) (PB8/9)	Master I^2C lines for external sensor connected through CN2.
SPI5 (PA11/12/13/14)	The SPI5 master is connected to TDK IMU sensor. On board IMU sensor /CS = PNCS0
GPIO (INTs) PA17/18/20/30 and PB15	The GPIOs are used for sensor interrupt inputs and other intelligent functions. Refer to the table in Figure 3.
TW4 (I2C)	The master I^2C communicates with EDBG MCU slave I^2C.
UART6	The UART6 is used for EDBG DGI-UART interface.
UART7	The UART7 is used for EDBG CDC-UART interface.

Table 2. SAMG55 Resource Allocation

4.3. CONNECTORS

TDK SmartMotion Platform Ver. I connector and header reference names and descriptions.

CONNECTOR NAME	CONNECTOR REF #	CONNECTOR FUNCTION DESCRIPTIONS
Other Sensor DB	CN2/CN3	Daughter board connector for Mag sensor. I²C interface only
FTDI USB	CN6	USB connector for FTDI USB to serial UART interface
EDBG LEDs	D500/D501	EDBG LEDs. D500 is green and D501 is yellow
Sensor I²C Selection	J1	Select host I²C connections, for IMU sensor and other sensors
PWR Source Select	J2	Board power source selection
VDDIO Voltage Select	J3	Selects voltage level between 3.3V, 1.8V and 1.2V for VDDIO
Test pins	J4	Digital signal test pins
SAMG55 USB	J301	MCU SAM G55 USB connector
EDBG USB	J500	EDBG MCU USB connector
User Button	SW300	User Button is connected to MCU GPIO, function is defined by the user
Reset Button	SW301	RESET Button: Hardware Reset for the Target MCU and EDBG MCU

Table 3. Connectors

4.4. JUMPER SETTINGS

JUMPER	DESCRIPTION
J1	The J1 is used to select which sensor will be connected to the SAMG55 master I2C. Only two jumper shunts are allowed. Jumper shunts on pin 1/2 and 3/4: IMU Sensor primary I2C is connected to SAMG55 I2C master Jumper shunts on pin 5/6 and 7/8: Other Sensor I2C is connected to SAMG55 I2C master. In this configuration TDK IMU Sensor is connected to SAMG55 SPI master.
J2	The J2 is for board power source selection. Only one jumper shunt is allowed. Jumper shunt on pin 1/2: board power is from EDBG USB on J500 Jumper shunt on pin 3/4: board power is from FTDI USB on CN6 Jumper shunt on pin 5/6: board power is from SAMG55 USB on J30
J3	J3 is for system VDDIO level selection. Jumper shunts on pin-1/2: VDDIO=3V3 Jumper shunts on pin-3/2: VDDIO=1V8 Jumper shunts on pin-4/2: VDDIO=1V2
J4	J4 have digital signals as test points. Pin-1: SPI /CS Pin-2: SPI SCLK, I2C SCL Pin-3: SPI MOSI, I2C SDA Pin-4: SPI MISO, I2C AD0 Pin-5: INT1 Pin-6: INT2 Pin-7: GND

Table 4. Jumper Setting

5 SCHEMATICS AND BOARD PCB

5.1. SCHEMATICS

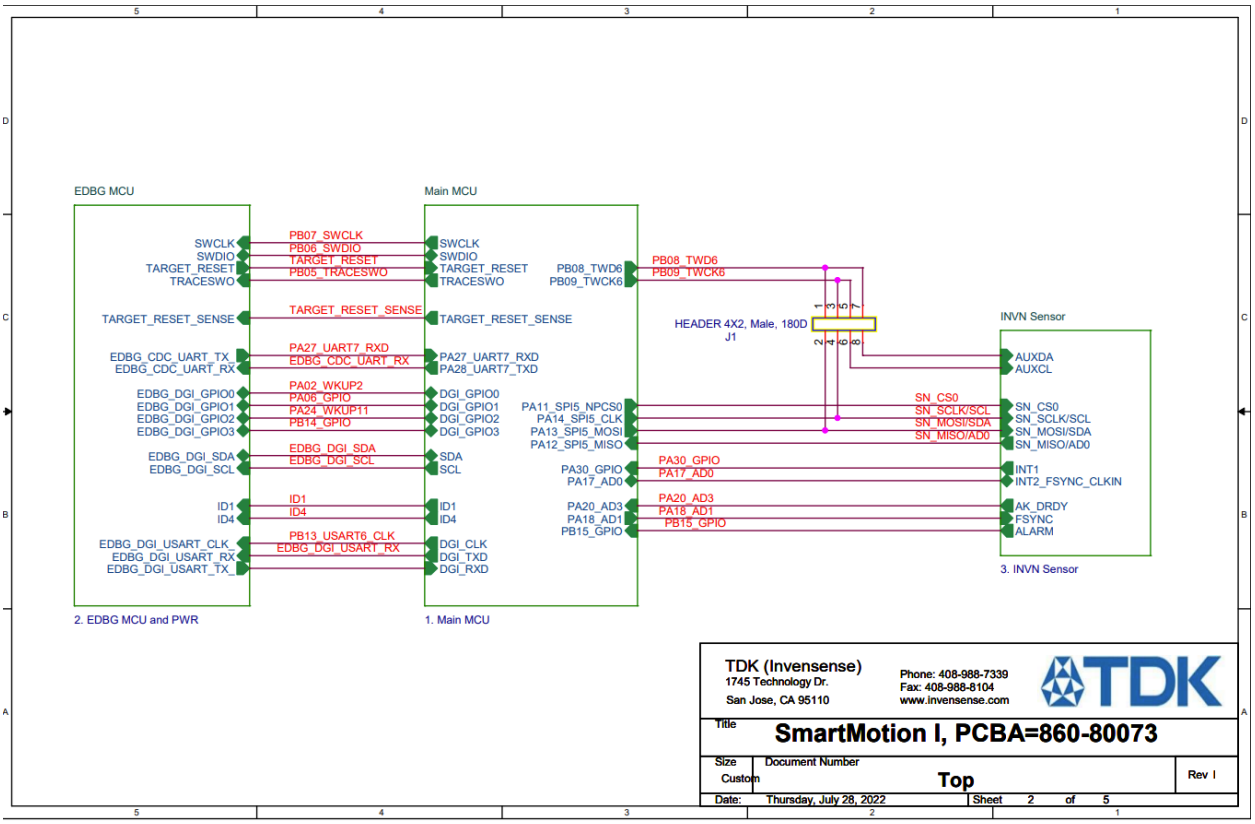


Figure 4. Block Diagram

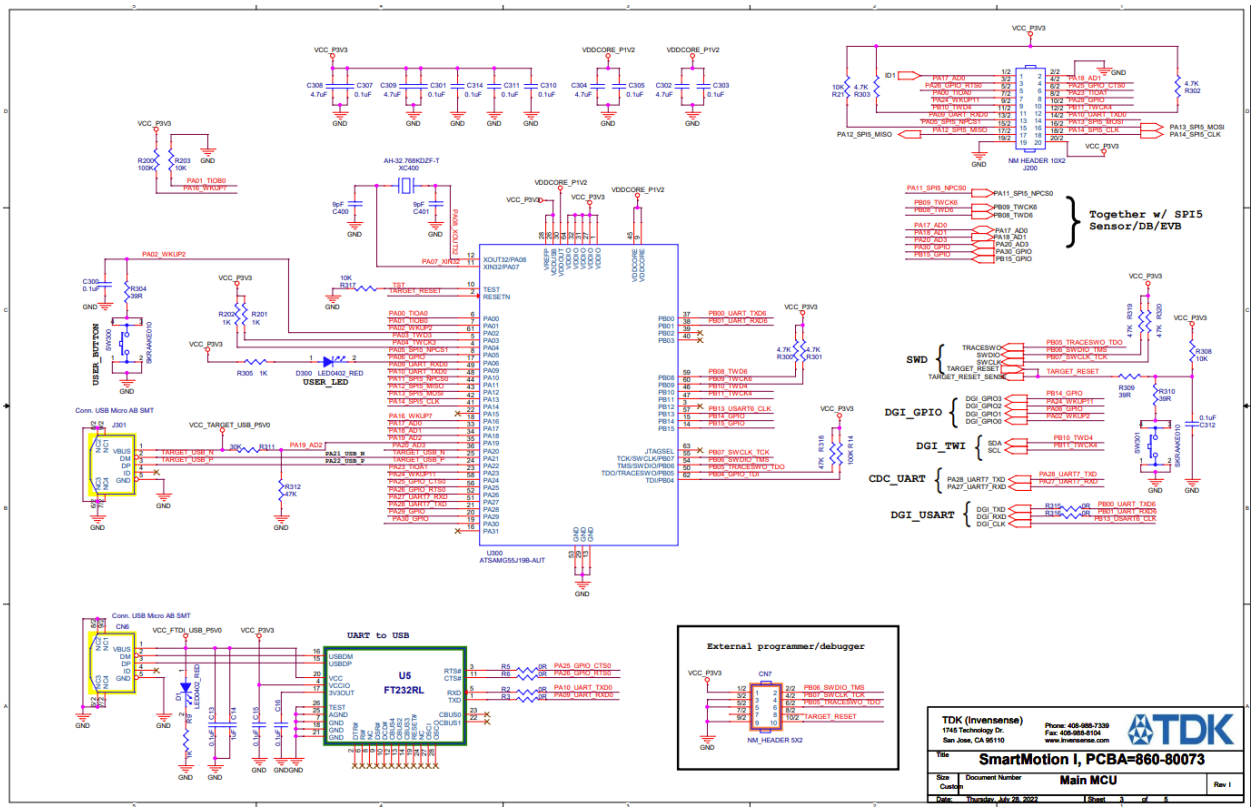


Figure 5. Main MCU

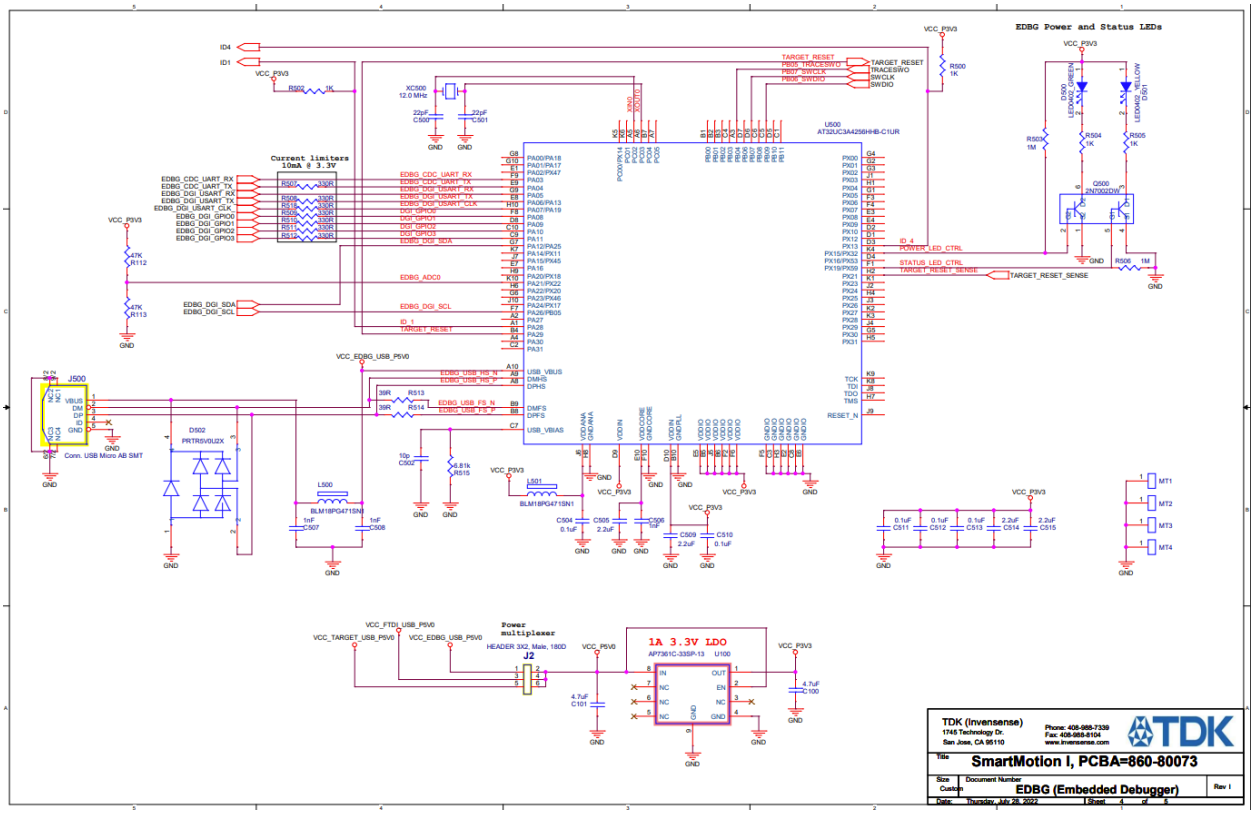


Figure 6. Embedded Debugger

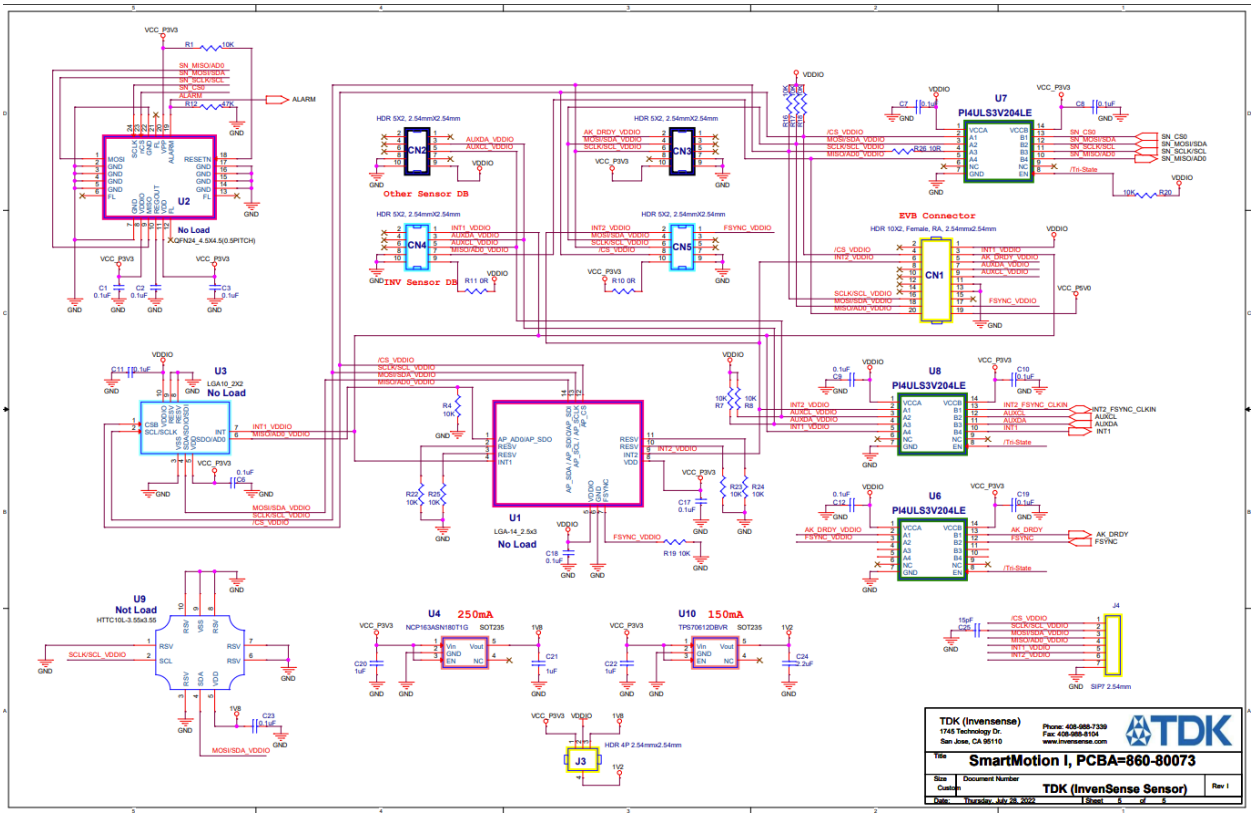


Figure 7. Sensors, DB and EVB connectors

5.2. BOARD PCB

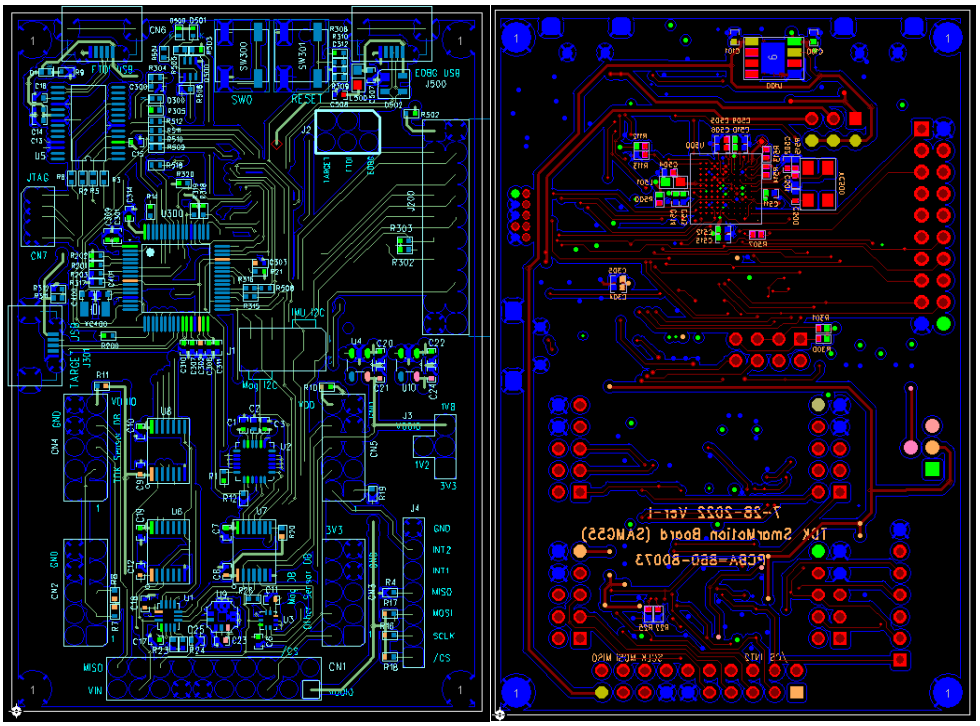


Figure 8. Ver. I PCB Top view (left) and Bottom view (right)

6 REVISION HISTORY

REVISION DATE	REVISION	DESCRIPTION
7/26/2024	1.0	Initial Release

7 DECLARATION DISCLAIMER

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