TDK-InvenSense Motion Sensor IAM-2038x/680x EVB User Guide

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Document Number: AN-000385
Revision: 1.2
Date: 02/08/2024

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1 OVERVIEW

This document describes the Evaluation Board (EVB), dedicated to the evaluation of TDK-InvenSense's 3- and 6-axes motion sensing products of IAM-2038x/680x family. It covers applying the EVB to a larger system and requires the understanding of key signals and circuit functions, hardware jumper settings and port connections.

The EVB provides:

- Digital-output of 3-axis gyroscope or 3-axis accelerometer or 6-axes IMU, with user-programmable full-scale ranges
- On-chip temperature sensor
- On-board voltage controllers allowing different supply levels to the motion sensing device

Data is measured using on-chip ADCs and is transmitted over I²C or SPI interfaces

The EVB may be used by itself utilizing SPI or I²C serial communications interfaces. Alternatively, it may be connected to one of the TDK-InvenSense Controller Board for connectivity to a host computer via USB interface.

The EVB is lead-free and RoHS compliant.

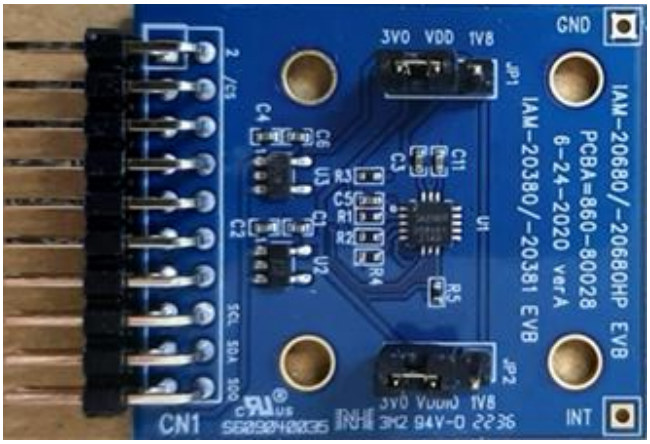

Figure 1. EVB overview

1.1. COMPATIBILITY

EVB can be provided equipped with any of the following TDK-InvenSense Motion Sensors.

Product name	EVB part n.	Temperature grade	Axes configuration
IAM-20380	EV_IAM-20380	3 (-40°C to +85°C)	3 axes (3G)
IAM-20380HT	EV_IAM-20380HT	2 (-40°C to +105°C)	3 axes (3G)
IAM-20381	EV_IAM-20381	3 (-40°C to +85°C)	3 axes (3A)
IAM-20381HT	EV_IAM-20381HT	2 (-40°C to +105°C)	3 axes (3A)
IAM-20680	EV_IAM-20680	3 (-40°C to +85°C)	6 axes (3G, 3A)
IAM-20680HP	EV_IAM-20680HP	2 (-40°C to +105°C)	6 axes (3G, 3A)
IAM-20680HT	EV_IAM-20680HT	2 (-40°C to +105°C)	6 axes (3G, 3A)

Table 1. Products compatibility

1.2. RELATED DOCUMENTS

Please refer to the product specification of the main motion sensor for electrical characteristics, pinout, and applications details. Sensor product specifications can be found at www.invensense.tdk.com. For product specifications for unreleased parts, please contact TDK-InvenSense through the website: https://invensense.tdk.com/smartautomotive-product-details/#contact

2 KEY FUNCTIONS AND PINOUT

The motion sensing EVB is a fully assembled and tested evaluation board, allowing for simple and swift evaluation of the IAM-2038x/680x motion sensor.

The motion sensing device utilizes TDK-InvenSense's proprietary MEMS technology with driven vibrating masses to produce a functionally complete, low-cost motion sensor. The motion processing unit incorporates X-/Y-/Z-axis low-pass filters and an EEPROM for on-chip factory calibration of the sensor. Factory-trimmed scale factors eliminate the need for external active components and end-user calibration. A built-in Proportional-To-Absolute-Temperature (PTAT) sensor provides temperature compensation information. Refer to the product specification document to obtain more details on sensor features.

2.1. I²C/SPI BUS CONNECTIONS

The EVB communicates with a system processor (e.g. TDK-InvenSense controller board) through the custom header using either the I²C or the SPI serial interface. The device always acts as a slave when communicating with the system processor. For details on interface connector, refer to Section 4.

2.2. SCHEMATIC AND BILL OF MATERIAL (BOM)

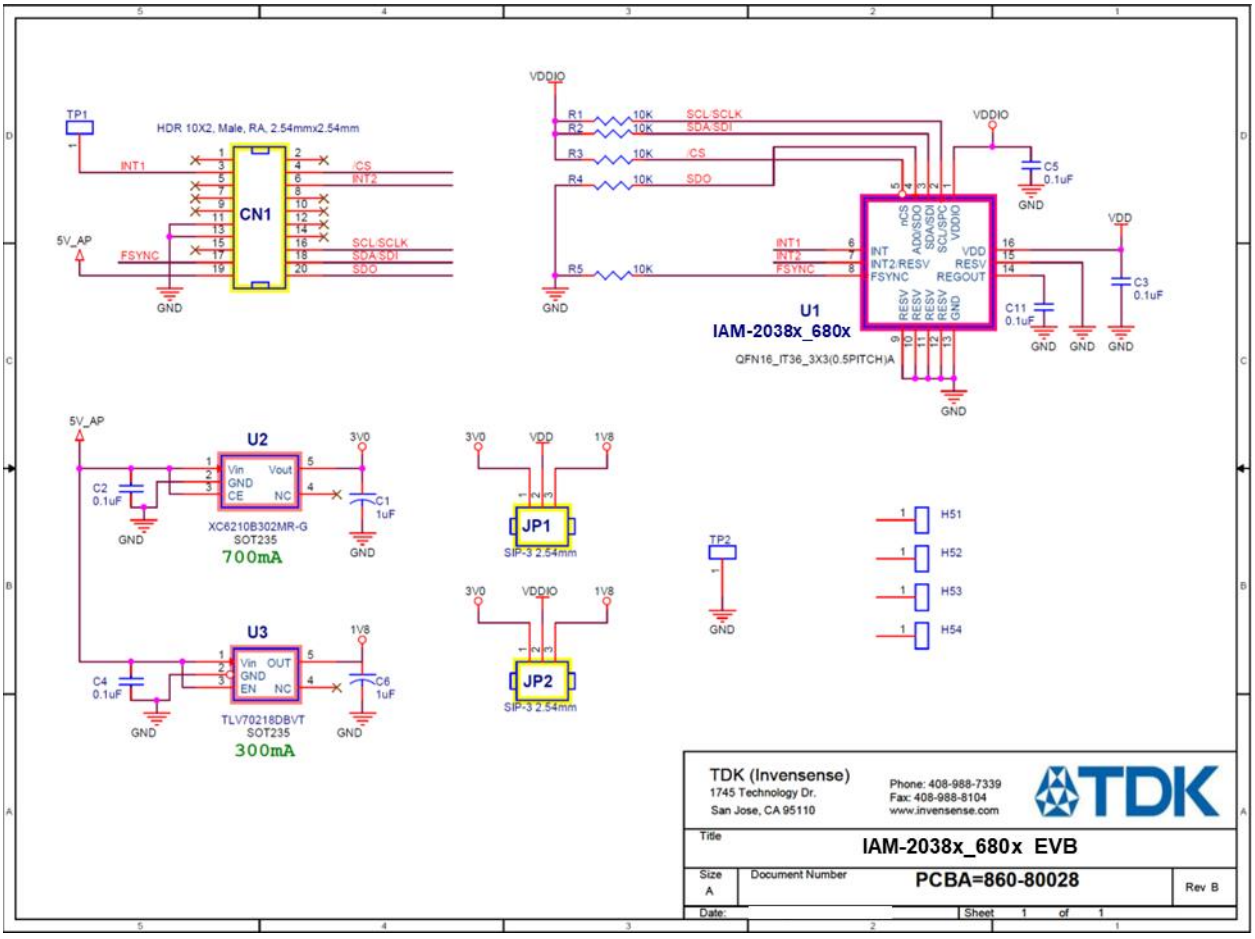

Figure 2. EVB circuit schematic

ITEM	QUANTITY	REFERENCE	PART	PCB FOOTPRINT
1	1	CN1	HDR 10X2, Male, RA, 2.54mmx2.54mm	J100\20DF-VR
5	2	JP1,JP2	SIP-3 2.54mm	sip-3p
2	2	C1,C6	1uF	C0402
3	5	C2,C3,C4,C5,C11	0.1uF	C0402
6	5	R1,R2,R3,R4,R5	10K	R0402
8	1	U1	IAM-20380HT	QFN16_IT36_3X3(0.5PITCH)A
9	1	U2	AP7343DQ-33W5-7	SOT25
10	1	U3	TLV70218DBVT	SOT235
11	2	JP1 pin 1-2, JP2 pin 1-2	Jumper shunt	

Table 2. EVB Bill of Material

3 POWER SUPPLY

Referring to schematic, general power supply to the EVB is provided through connector CN1, pin 19; JP1 and JP2 are 3-pin headers, which allow the user to select between the two on-board LDOs (Low-Voltage Dropout Regulators, U2 and U3) to power the IAM-2038x/680x. Namely, JP1 selects VDD line voltage, while JP2 selects VDDIO line voltage. Available voltages are 1.8V and 3.3V.

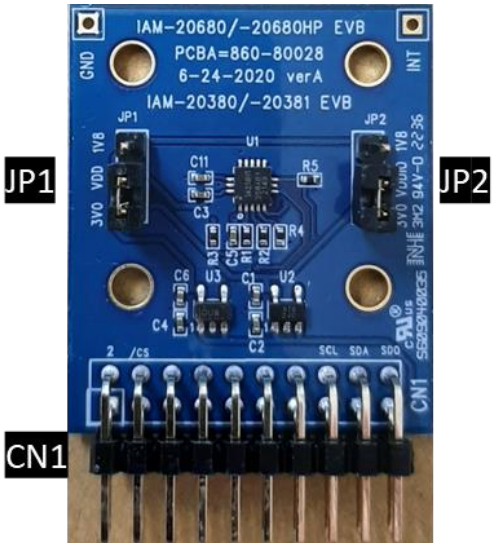

Figure 3. EVB jumpers and connectors

JP1 jumper position	SIGNAL DESCRIPTION
1-2	VDD = 3V (from LDO, VIN > 3.1V, net name 3V0)
2-3	VDD = 1.8V (from LDO, VIN > 3.1V, net name 1V8)
JP2 jumper position	**SIGNAL DESCRIPTION**
1-2	VDDIO = 3V (from LDO, VIN > 3.1V, net name 3V0)
2-3	VDDIO = 1.8V (from LDO, VIN > 3.1V, net name 1V8)

Table 3. Power selection jumpers

To use the on-board LDOs, an external VIN must be provided within the range of 3.1~6.0V to ensure the LDOs work properly.

4 EVB CONNECTOR SIGNALS DESCRIPTION

CN1 PIN NUMBER	CN1 SIGNAL NAME	SIGNAL DESCRIPTION
1, 2, 5, 7, 8, 9, 10, 12, 14, 15	N.C.	N.C. Do not connect to these pins
3	INT1	INT - Interrupt output signal to controller
4	/CS	Not used in I²C mode; active low chip-select pin in SPI mode
6	INT2	INT2 – Additional Interrupt output signal to controller
11, 13	GND	Ground connection
16	SCL_SCLK	SCL/SCLK. I²C or SPI primary serial clock signal
17	FSYNC	FSYNC. Frame synchronization input for camera applications
18	SDA_SDI	SDA/MOSI. I²C primary data or SPI MOSI signal
19	5V_AP	Power. Receive power from TDK-InvenSense Controller board or an external source
20	SDO	AD0/MISO. Lowest (LSB) address bit in I²C mode or SPI MISO signal in SPI mode

Table 4. User interface connector signals (CN1)

4.1. FSYNC LINE

The FSYNC line is intended for use in a camera's image-stabilization system. It is an input from the camera platform to the EVB and is intended to synchronize the motion-sensor serial-bus transfer with the master timing set by the camera system.

4.2. SERIAL BUS LEVELS, SPEED AND TERMINATION

The EVB supports I²C communications up to 400 kHz or SPI communications up to 8 MHz clock rates in both reading and writing operations. The I²C bus open-drain SDA and SCL lines typically need pull-up resistors (10 kΩ) to VDDIO.

5 HOST INTERFACE OPTIONS

The IAM-2038x/680x digital sensor data is directly available on the EVB's header CN1. Alternatively, for connectivity with a host PC, the EVB is designed to be plugged into the **DK-UNIVERSAL-I** board (through CN1 connector). This configuration can be controlled and best exploited using the TDK-InvenSense SmartMotion graphical user interface. The same configuration and capabilities can be obtained using any of the following TDK-InvenSense Development Kits (DK) boards, if already available at customer's: DK-20380HT, DK-20680A, DK-20680HT, DK-20680HP.

5.1. CONNECTION TO THE TDK-INVENSENSE DK BOARD

IAM-2038x/680x can be connected to **DK-UNIVERSAL-I** board via CN1 (Host SPI and I²C) for sensor data read and processing. Following picture shows the complete evaluation system.

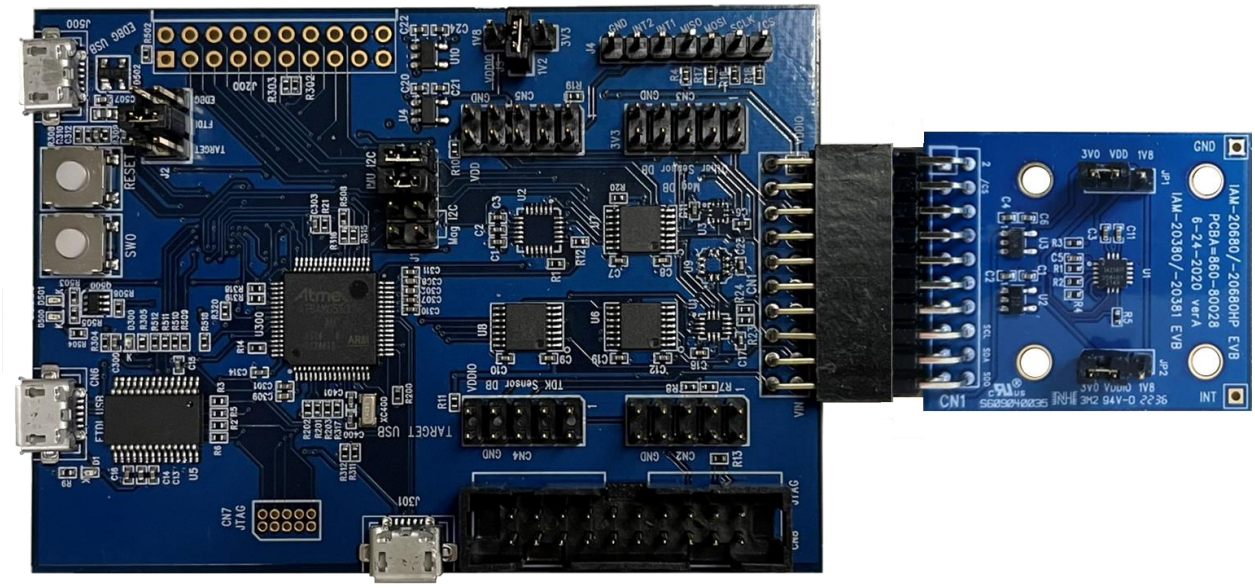

Figure 4. DK-UNIVERSAL-I with EVB

5.2. USE OF THE EVB STAND-ALONE

I²C and SPI signals are available on EVB header CN1. Users may develop their own tools to communicate with the EVB as there is no bus mode selection setting required.

6 SPECIAL INSTRUCTIONS

6.1. ESD SENSITIVITY

The motion sensors can be permanently damaged by electrostatic discharge (ESD). ESD precautions for handling and storage must be taken to avoid damage to the devices. For more informations on this topic, refer to TDK-InvenSense Application Note *AN-IVS-0002A-00 MEMS Motion Handling and Assembly Guide v4.3*

6.2. BOARD LAYOUT AND FOOTPRINT NOTES

The EVB is a 4-layer FR-4 PCB design with the dimensions: 30.5 x 35.5 x 1.6 mm (1200 x 1400 x 62 mil). See Figure 5 for a detailed top and bottom view of the EVB.

Footprints and sensor land patterns were chosen large enough, so they offer ease of use, reliable contact with the sensor, hand-solder and debugging capabilities.

Note that to avoid potential shorting/clearance issues at the corner pins for LGA packages, the land pattern shapes for the individual pins in this design were chosen to be oblong rather than square. The dimensions for the pin pads are 0.225 x 0.7 mm.

Solder mask (also called solder resist is a layer of protective coating for PCB's copper traces, which helps to prevent undesired solder bridges and shorts) dimensions will not be provided as they are dependent upon the manufacturing process and the clearance capabilities of the chosen fabrication house. Contact your PCB vendor to determine the minimum required clearance between pin pads (usually 4 mil to 6 mil or 0.102 mm to 0.152 mm) and traces allowing them enough room to print an adequate solder mask.

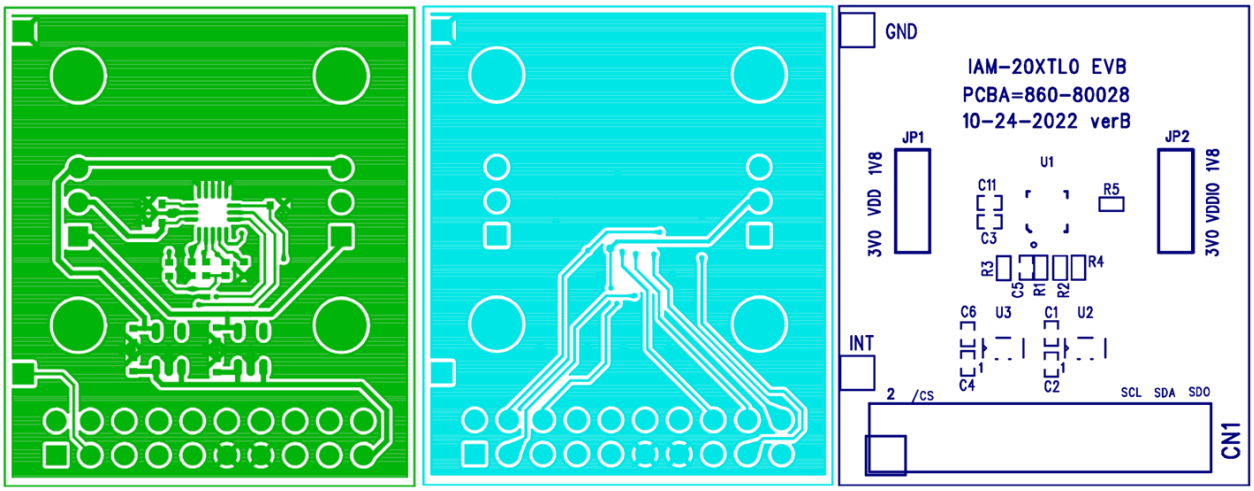

Figure 5. EVB layout: top side, bottom side, components mask (top side)

7 REVISION HISTORY

REVISION DATE	REVISION	DESCRIPTION
11/10/2022	1.0	1st release
11/29/2023	1.1	Title modification Scope extension to all IAM-2038xx and IAM-20680xx products Section 1 reviewed
02/08/2024	1.2	Added Figure 1, schematic typo corrected, Figure 5 corrected. Section 5 reviewed.