

PAW3805EK-CJV1: Track-On-Glass Mouse Chip

General Description

The PixArt PAW3805EK-CJV1 is an optical chip which is optimized for infrared (IR) LED based wireless mouse application. It has high accuracy navigation ability that enables navigation virtually on any flat surface, including the transparent glass. The low power architecture and automatic power management make it suitable for power-sensitive application such as a wireless mouse. PAW3805EK-CJV1 is capable of high-speed motion detection up to the velocity of 40 inches/sec and 10g on non-glass surfaces, 20 inches/sec and acceleration of 5g on glass surface. In addition, it has an on-chip oscillator and a built-in programmable LED current driver. In order to achieve the best tracking performance, it is recommended to match the chip with L029-LSI optical lens.

Key Features

- Integrated package with optical chip and light source
- Virtually track on any flat surface, including glass
- Ultra-low power consumption
- Interface : 3-wire SPI (NCS, SCLK, SDIO)
- 16-bit motion data length for X-movement and Y-movement
- Resolution up to 3000cpi with ~26cpi per step
- Motion detection interrupt output
- Built-in Low Power Timer (LPT) for Sleep1/ Sleep2/ Sleep3 mode
- Programmable downshift time and sampling time during sleep modes
- Adaptive frame rate control for power saving during moving at different speeds
- Programmable LED Current Source (5-bits with 1.2mA/step) to provide LED with constant current

Applications

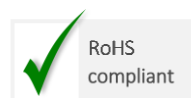
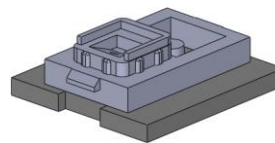
- Wireless mouse applications
- Optical navigation systems

Key Parameters

Parameter	Value
Supply Voltage (V)	2 VDD Voltage Segments: High segment: 2.1 - 3.3V Low segment: 1.7 - 1.9V VLED : 1.7-3.3V (for IR LED)
Interface	3-wire SPI (NCS, SCLK, SDIO)
Light Source	Infrared 850nm wavelength
Companion Lens	L029-LSI
Tracking Speed (ips)	Up to 40 on non-glass surfaces Up to 20 on glass surface
Acceleration (g)	Non-Glass surfaces: 10 (max.) Glass surface: 5 (max.)
Resolution (cpi)	Up to 3000 (~26 per step)
Operating Current @ VDD = 3.3V, on glass surface	Run : 2.5 mA Sleep1 : 500 μ A Sleep2 : 80 μ A Sleep3 : 40 μ A Power down : 15 μ A
Package Dimension L x W x H (mm)	10.7 x 9.8 x 3.67

Ordering Information

Part Number	Package Type
PAW3805EK-CJV1	LGA 12-pin
L029-LSI	Trim Lens



For any additional inquiries, please contact us at <http://www.pixart.com/contact.asp>

Contents

PAW3805EK-CJV1: Track-On-Glass Mouse Chip 1

 General Description 1

 Key Features..... 1

 Applications..... 1

 Key Parameters 1

 Ordering Information 1

List of Figures..... 3

List of Tables 3

1.0 Introduction..... 4

 1.1 Overview 4

 1.2 Terminology 5

 1.3 Signal Description 5

2.0 Operating Specifications 6

 2.1 Absolute Maximum Ratings..... 6

 2.2 Recommended Operating Conditions 6

 2.3 DC Characteristics..... 7

 2.4 AC Characteristics..... 7

3.0 Mechanical Specifications 8

 3.1 Mechanical Dimension 8

 3.2 Mechanical Assembly Drawings 9

4.0 Design Reference 10

 4.1 Reference Application Schematics 10

5.0 Registers 11

 5.1 Registers Summary 11

Document Revision History 12

List of Figures

Figure 1. Chip Architecture Functional Block Diagram..... 4

Figure 2. Pinout Configuration..... 5

Figure 3. Chip Package Outline and PCB Cutout Drawings..... 8

Figure 4. 2D Assembly of Chip, Lens, PCB and Base Plate 9

Figure 5. Exploded 3D Assembly View of Chip, Lens, PCB and Base Plate 9

Figure 6. Application Circuit for Low Voltage Segment..... 10

Figure 7. Application Circuit for High Voltage Segment 10

List of Tables

Table 1. Signal Pins Description 5

Table 2. Absolute Maximum Ratings..... 6

Table 3. Recommended Operating Conditions 6

Table 4. DC Electrical Specifications..... 7

Table 5. AC Electrical Specifications..... 7

Table 6. Registers List..... 11

1.0 Introduction

1.1 Overview

PAW3805EK-CJV1 is a high performance and ultralow power CMOS-processed optical image chip with integrated digital image process circuits. It is based on an optical navigation technology which measures changes in position by optically acquiring sequential surface images (frames) and mathematically determining the speed, the direction and the magnitude of motion. The movement Delta_X and Delta_Y information are available in registers which are accessible through 3-wire SPI serial interface. A host controller reads and translates the data from the SPI interface into RF signals before sending them to the host PC.

PAW3805EK-CJV1 is designed to work on glass (including the transparent glass) with thickness of at least 4mm. Most glass surfaces provide enough microscopic features to enable motion tracking. It will not work on the glass which is perfectly clean and virtually scratch-free. The minimum requirements for PAW3805EK-CJV1 to work reliably on glass is there must be at least 44 features/mm² at the minimum of 5µm width and 2µm depth. Basically, PAW3805EK-CJV1 is able to virtually navigate on any flat surfaces.

The Figure 1 below shows the architecture block diagram of the chip. Refer to the subsequent chapters for detailed information on the functionality of the different interface blocks. This datasheet describes the electrical characteristics, switching characteristics, introduction to different functions and the register settings of PAW3805EK-CJV1.

Note: Throughout this document PAW3805EK-CJV1 is referred to as the chip.

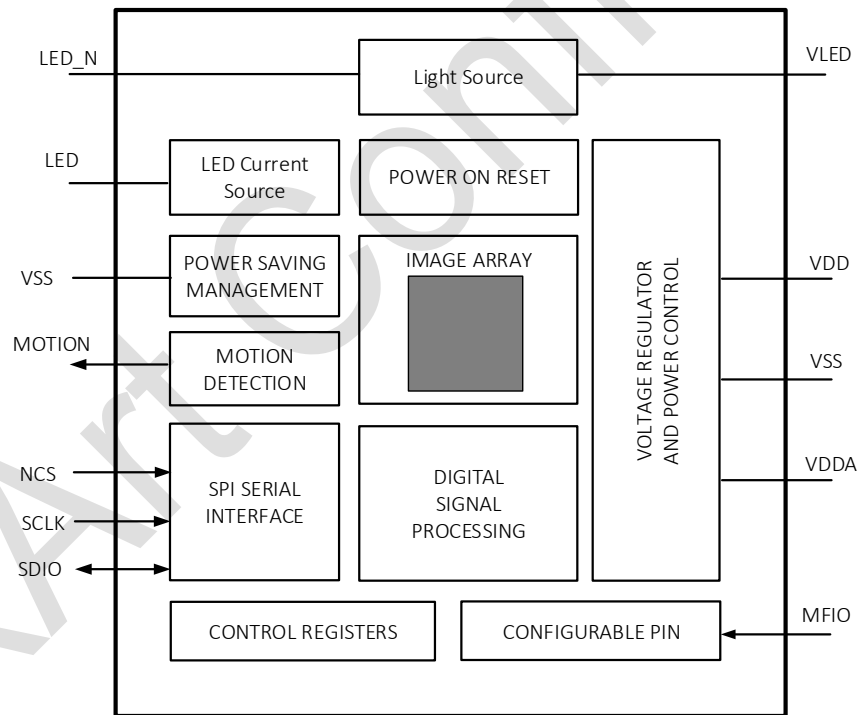


Figure 1. Chip Architecture Functional Block Diagram

1.2 Terminology

Term	Description
IPS	Inches per Second
FPS	Frame per Second
TOG	Track on Glass
CPI	Counts per Inch
SPI	Serial Peripheral Interface
LGA	Land Grid Array

1.3 Signal Description

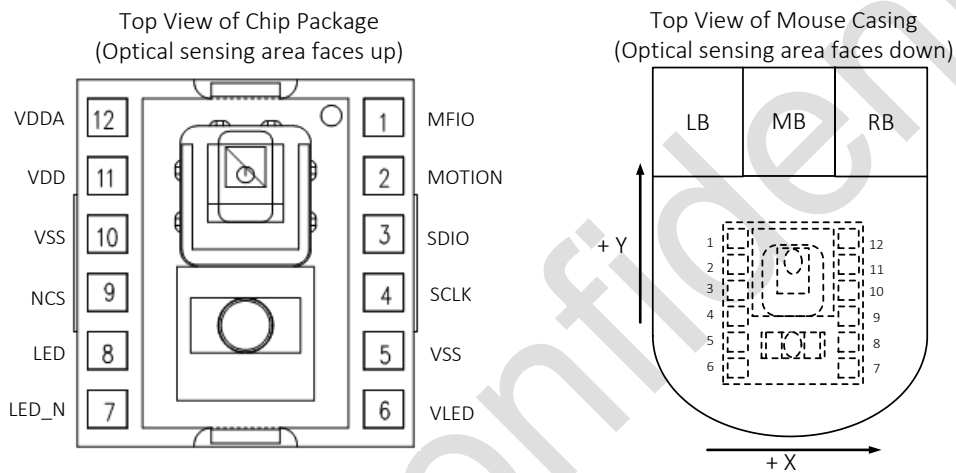


Figure 2. Pinout Configuration

Table 1. Signal Pins Description

Pin No.	Signal Name	Type	Description
1	MFIO	IN	Multi-functional I/O pin (can be programmed to the functions below): <ul style="list-style-type: none"> ▪ RST (Reset): Active high to reset the whole chip ▪ QB (Quick-Burst): To quickly read out motion data ▪ PD (Power Down): Active high to force the chip enter power down mode ▪ NF (Null Function) : Power-up default
2	MOTION	OUT	Motion detection output (active low)
3	SDIO	I/O	Bi-direction I/O for 3-wire SPI
4	SCLK	IN	Clock input for 3-wire SPI
5	VSS	GND	Chip ground
6	VLED	PWR	Power supply input for LED (1.7 – 3.3V power for IR LED)
7	LED_N	PWR	LED Cathode, should be connected to LED pin
8	LED	PWR	LED control pin, should be connected to LED_N pin
9	NCS	IN	NCS: chip select pin (active low) in SPI mode
10	VSS	GND	Chip ground
11	VDD	PWR	Power supply input
12	VDDA	PWR	High voltage segment (VDD: 2.1V ~ 3.3V): VDDA is 1.8V regulator output and should connect a 1uF capacitor to ground Low voltage segment (VDD: 1.7V ~ 1.9V): VDDA should connect to VDD directly

2.0 Operating Specifications

2.1 Absolute Maximum Ratings

Table 2. Absolute Maximum Ratings

Parameters	Symbol	Min.	Max.	Unit	Notes
DC Supply Voltage	V_{DC}	-0.3	3.9	V	High Voltage Segment
		-0.2	2.3	V	Low Voltage Segment
I/O Voltage	V_{IO}	-0.3	V_{DC}	V	All I/O pin
ESD	ESD_{HBM}		2	kV	Class 2 on all pins, as per human body model JESD22-A114E with 15 sec zap interval.

Notes:

- At room temperature.
- Maximum Ratings are those values beyond which damage to the device may occur.
- Exposure to these conditions or conditions beyond those indicated may adversely affect device reliability. Functional operation under absolute maximum-rated conditions is not implied.
- Functional operation should be restricted to the Recommended Operating Conditions.

2.2 Recommended Operating Conditions

Table 3. Recommended Operating Conditions

Description	Symbol	Min.	Typ.	Max.	Unit	Notes
Operating Temperature	T_A	0	25	40	°C	
Storage Temperature	T_{STG}	-40	-	85	°C	
Power Supply Voltage	VDD	1.7	1.8	1.9	V	High Voltage Segment
		2.1	2.7	3.3	V	Low Voltage Segment
	VLED	1.7	1.8	3.3		LED Power
Supply Noise (peak to peak)	V_{pp}	-	-	100	mV	Peak to peak voltage within 100KHz – 80MHz
SPI Clock Frequency	SCLK	-	-	2	MHz	
Tracking Speed	SP	0	-	40	IPS	@ non-glass surfaces
				20		@ glass surface
Tracking Acceleration	AC	0	-	10	g	@ non-glass surfaces
				5		@ glass surface

Note: PixArt does not guarantee the performance if the operating temperature is beyond the specified limit.

2.3 DC Characteristics

Table 4. DC Electrical Specifications

Parameters	Symbol	Min.	Typ.	Max.	Unit	Conditions
Power Consumption on glass surface	I_{DDNM}	-	2.5	-	mA	Run mode current. Based on 85% weighting for speed ≤ 5 ips and 15% weighting for speed > 5 ips
	I_{DDs1}	-	500	-	μA	Sleep1 current, based on 8ms sampling period.
	I_{DDs2}	-	80	-	μA	Sleep2 current, based on 128ms sampling period
	I_{DDs3}	-	40	-	μA	Sleep3 current, based on 512ms sampling period
	I_{DDPD}	-	15	-	μA	Power down current
I/O Input High Voltage	V_{IH}	$0.7 * V_{DD}$	-	-	V	
I/O Input Low Voltage	V_{IL}	-	-	$0.3 * V_{DD}$	V	
I/O Output High Voltage	V_{OH}	$V_{DD} - 0.4$	-	-	V	@ $I_{OH} = 2mA$
I/O Output Low Voltage	V_{OL}	-	-	0.4	V	@ $I_{OL} = 2mA$

Notes: All the parameters are tested under operating conditions: $V_{DD} = 3.3V$ (including LED current), $T_A = 25^\circ C$

2.4 AC Characteristics

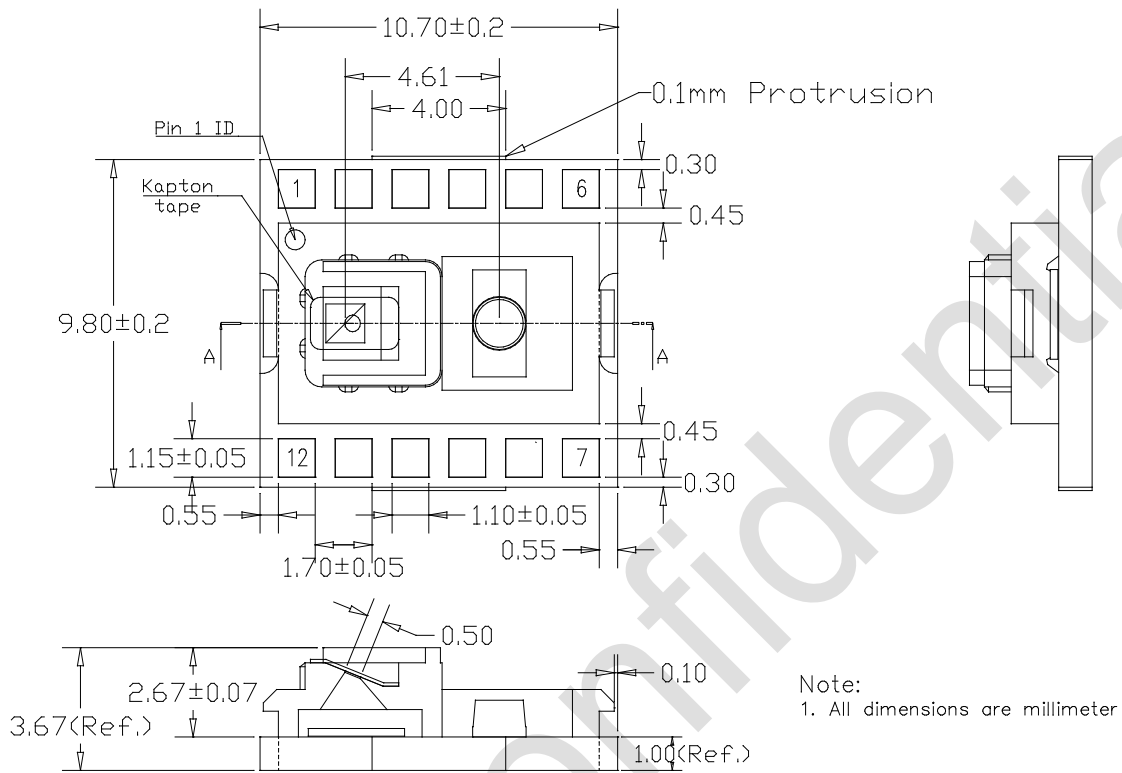
Table 5. AC Electrical Specifications

Parameters	Symbol	Min.	Typ.	Max.	Unit	Conditions
QB(Quick Burst) high pulse time	QB_{HIGH}	2	-	-	μs	
RST(Reset) high pulse time	RST_{HIGH}	500	-	-	μs	
3-wire SPI Speed	F_{SPI}	-	-	2	MHz	

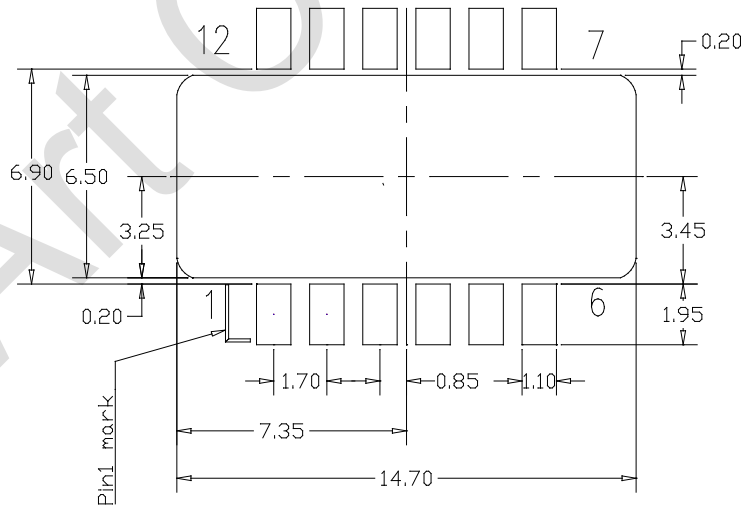
Note: All the parameters are tested under operating conditions: $V_{DD} = 3.3V$, $T_A = 25^\circ C$

3.0 Mechanical Specifications

3.1 Mechanical Dimension



X-Section A-A



Unit: mm ; Tolerance: +/−0.05mm
PCB Cutout / Footprint Drawing

Figure 3. Chip Package Outline and PCB Cutout Drawings

3.2 Mechanical Assembly Drawings

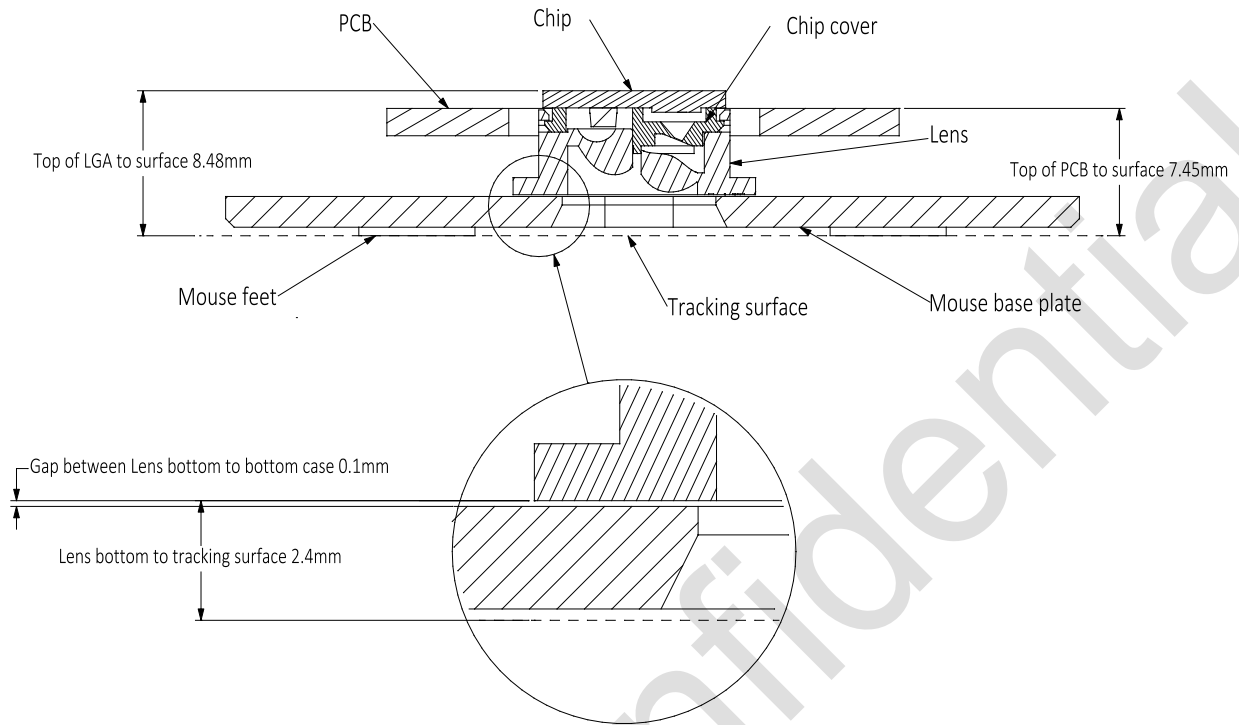


Figure 4. 2D Assembly of Chip, Lens, PCB and Base Plate

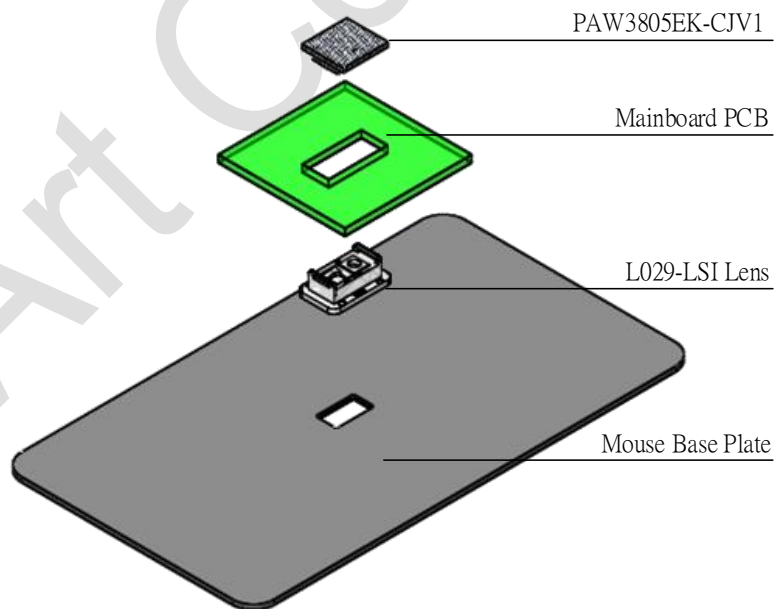


Figure 5. Exploded 3D Assembly View of Chip, Lens, PCB and Base Plate

4.0 Design Reference

4.1 Reference Application Schematics

The chip only supports simplified 3-wire SPI slave mode, while some host controllers may only support standard 4-wire SPI master mode. In this case, users can connect the host controller to the chip using the method shown below to communicate with each other. Take note that the 3.3K ohm resistor is for reference only and the resistance may have to be modified according to different I/O capability as per the specification of the host controllers.

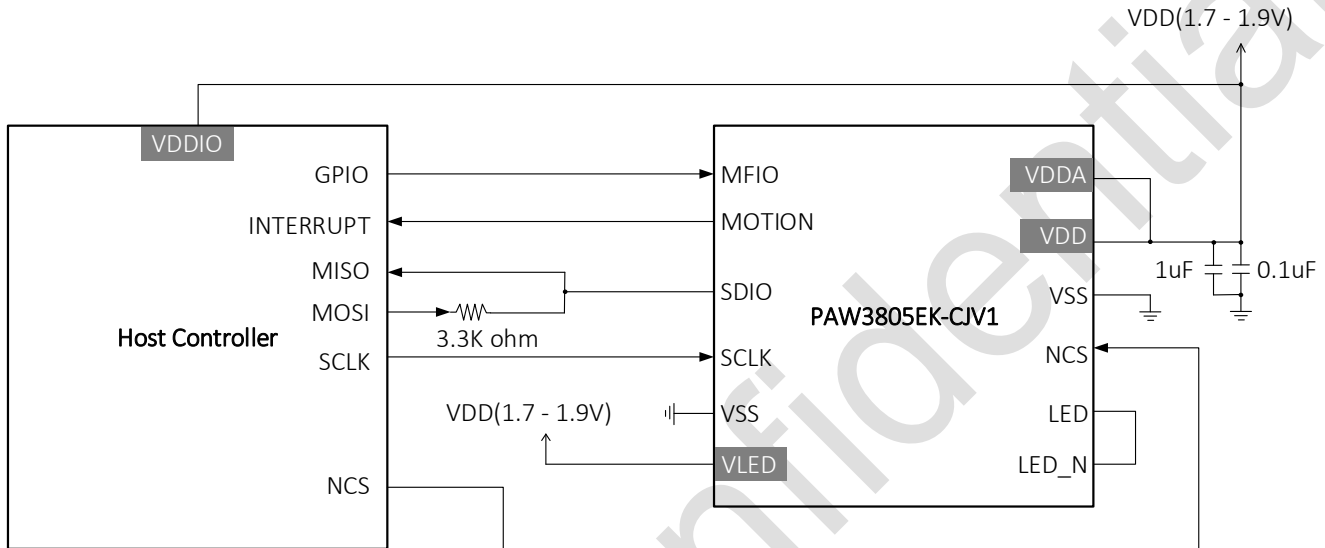


Figure 6. Application Circuit for Low Voltage Segment

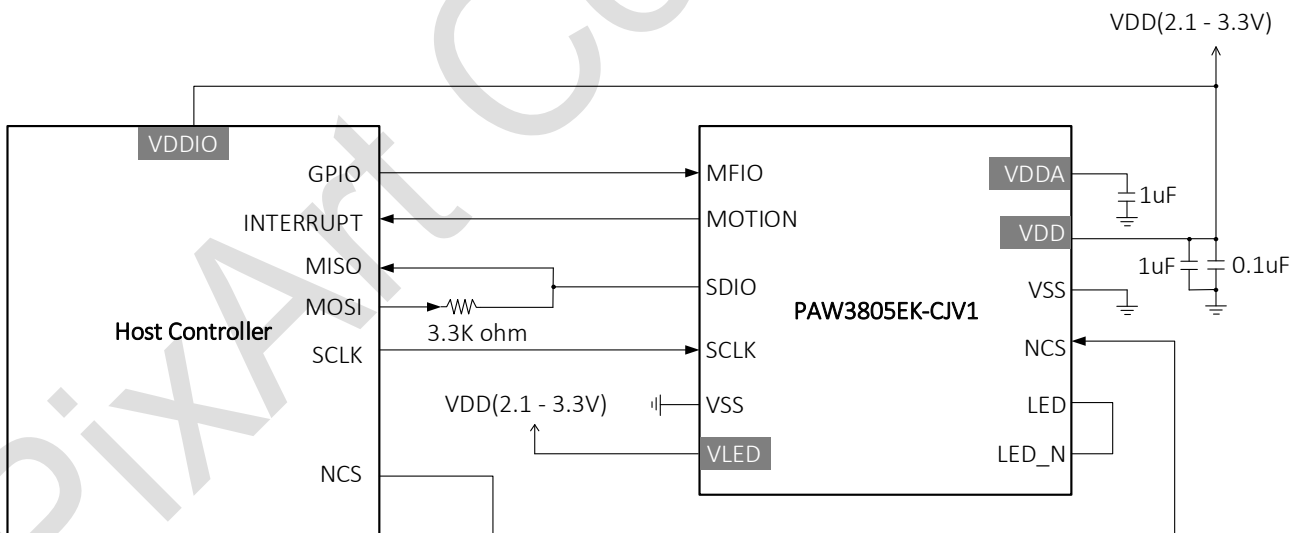


Figure 7. Application Circuit for High Voltage Segment

5.0 Registers

5.1 Registers Summary

Table 6. Registers List

Address	Register Name	Access	Reset	Brief Description
0x00	Product_ID1	R	0x31	Product Identifier [11:4]
0x01	Product_ID2	R	0x61	Upper 4 bits for Product Identifier, PID [3:0] Lower 4 bits for Product Version, VID [3:0]
0x02	Motion_Status	R	-	Motion Status information
0x03	Delta_X_Lo	R	-	Eight bits 2's complement number for X-movement data in 8-bit movement data format
0x04	Delta_Y_Lo	R	-	Eight bits 2's complement number for Y-movement data in 8-bit movement data format
0x05	Operation_Mode	R/W	0xB8	Operation mode selection
0x06	Configuration	R/W	0x10	Software power down and reset
0x09	Write_Protect	R/W	0x00	Write Protect to avoid missed-writing registers
0x0A	Sleep1	R/W	0x77	Sleep1 configuration
0x0B	Sleep2	R/W	0x10	Sleep2 configuration
0x0C	Sleep3	R/W	0x70	Sleep3 configuration
0x0D	CPI_X	R/W	0x27	CPI resolution setting for X-direction
0x0E	CPI_Y	R/W	0x2B	CPI resolution setting for Y-direction
0x11	Delta_X_Hi	R/W	-	High Byte of X-movement for 16-bit 2's complement data format. X-movement[15:0] = {Delta_X_Hi[7:0], Delta_X_Lo[7:0]}
0x12	Delta_Y_Hi	R/W	-	High Byte of Y-movement for 16-bit 2's complement data format. Y-movement[15:0] = {Delta_Y_Hi[7:0], Delta_Y_Lo[7:0]}
0x13	IQ	R	-	Image Quality[7:0]
0x15	Shutter	R	-	Shutter value[7:0]
0x19	Orientation	R/W	0x14	Chip orientation selection
0x26	MFIO_Config	R/W	0x34	Configuration the function of MFIO pin
0x51	LED_Current	R/W	0x0E	LED current source program
0x61	Frame_Avg	R	-	Average brightness of a frame

Document Revision History

Revision Number	Date	Description
0.8	17 Mar 2016	New creation
0.9	13 Apr 2016	1. Removed TBD on the operation current 2. Modified the descriptions of register CPI_X and CPI_Y 3. Change the drawings of Mechanical Dimension 4. Fixed some typos
1.0	09 May 2016	1. Modified the current of Sleep1, Sleep2 and Sleep3 2. Modified parameter $T_{PREP-RD}$ min. value in Table 6 from 10us to 250ns
1.1	30 Dec 2016	Added PCB cutout and footprints drawings in Section 3.1
1.2	05 Apr 2017	Modified the dimensions in Figure 3
1.3	27 Jun 2017	No content change, update revision number to match Product Datasheet version