PAW3502 USB OPTICAL MOUSE SINGLE CHIP

General Description

The PAW3502 is a CMOS process optical mouse sensor single chip with USB interface that serves as a non-mechanical motion estimation engine for implementing a computer mouse.

Features

- **USB interface**
- **Single power supply**
- **Optical motion estimation technology**
- **Complete 2-D motion sensor**
- **Accurate motion estimation over a wide range of surfaces**
- **High speed motion detection up to 28 inches/sec**
- **Power saving mode during times of no movement**
- **Supports three buttons (R, M, L) and three axes (X, Y, Z) output**
- **Z-axis support mechanical input (Z/2)**
- **USB spec.**
  - **Complete Universal Serial Bus specs V1.1 compatibility**
  - **Complete USB HID specs V1.1 compatibility**
  - **Integrated USB transceiver and 1.5Mbps USB serial interface engine**

Key Specification

Power Supply	**Wide operating supply range 4.25V ~ 5.5V**
Interface	**USB**
Optical Lens	**1:1**
System Clock	**24.000 MHz**
Speed	**28 inches/sec**
Acceleration	**20g**
Resolution	**400/800/1000/1200 CPI**
Frame Rate	**3000 frames/sec**
Operating Current	**10mA @Mouse moving (Normal) 5mA @Mouse not moving (Sleep) 480uA @USB suspend (Suspend)**
Package	**Shrunk DIP14**

Ordering Information

Part Number	CPI
PAW3502DL	800
PAW3502DL-TD	400
PAW3502DL-TK	1200

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1. Pin Configuration

1.1 Pin Description

Pin #	Name	Type	Definition
1	OSCIN	IN	Oscillator input, connected to resonator or resistor
2	BL	IN	Button left key input, normal pull-high (50k), press connect to low
3	LED	OUT	LED control
4	VDDQ	BYPASS	I/O voltage reference
5	VSS	GND	Chip ground
6	VDD5V	PWR	Chip power VDD, 5.0V
7	VDDA	BYPASS	Analog voltage reference
8	D+	I/O	USB D+
9	D-	I/O	USB D-
10	BR	IN	Button right key input, normal pull-high (50k), press connect to low
11	BM	IN	Button middle key input, normal pull-high (50k), press connect to low
12	Z2	IN	Z axis, support mechanical scroller input
13	Z1	IN	Z axis, support mechanical scroller input
14	OSCOUT	OUT	Oscillator output, connected to resonator

1.2 Pin Assignment

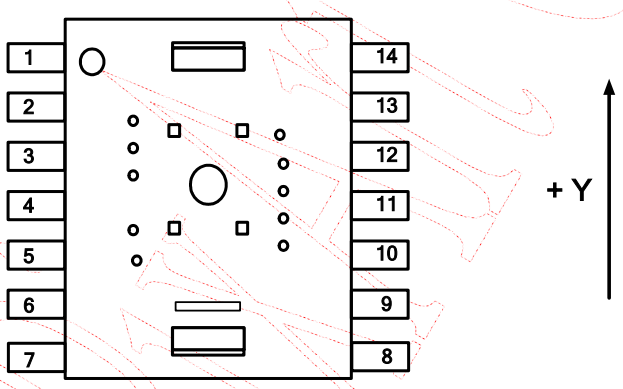


Figure 1. Top View Pinout

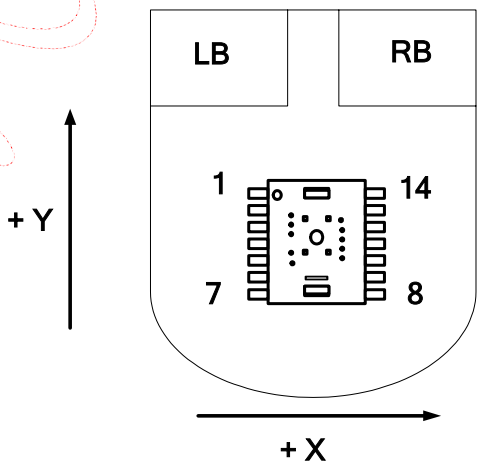


Figure 2. Top View of Mouse

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2. Block Diagram and Operation

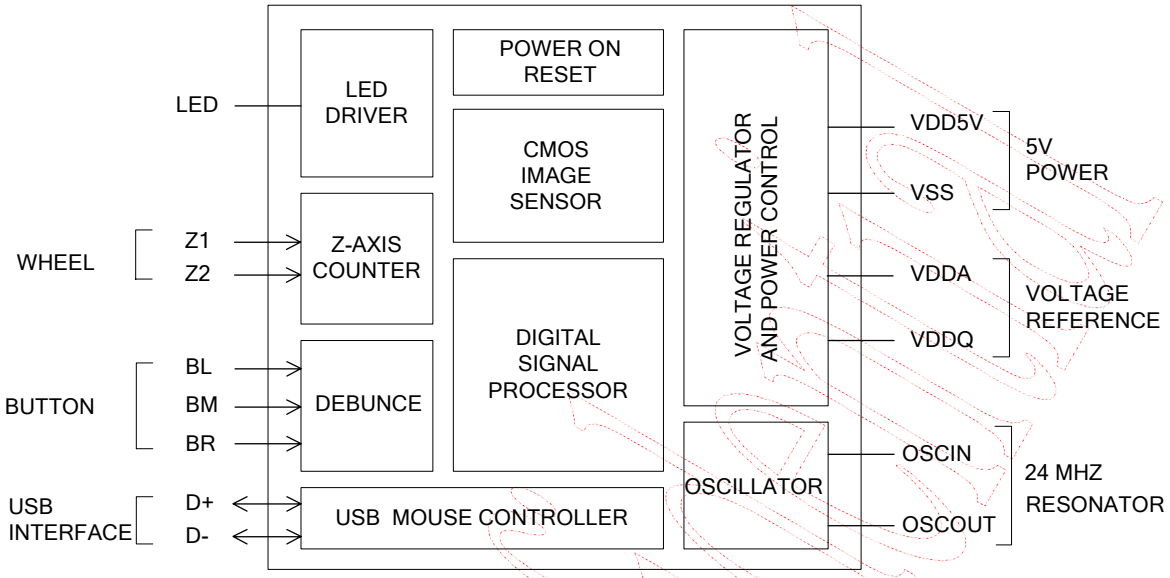


Figure 3. Block Diagram

The PAW3502 supports X, Y, Z three axes, and L, R, M three buttons under USB mode. It is a CMOS process optical mouse sensor single chip with USB interface that serves as a non-mechanical motion estimation engine for implementing a computer mouse.

The PAW3502 is in a 14-pin optical package and comes with the resolution of 400/800/1000/1200 counts per inch (CPI) and the rate of motion up to 28 inches per second. It includes USB interface so that no mouse controller is needed to interface through USB. The PAW3502 can receive command and echo status or data format, both complete Universal Serial Bus® spec V1.1 and USB HID spec V1.1 compatibility. It is also a cost effective solution to support USB Mouse.

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3. Specifications

3.1 Absolute Maximum Ratings

Exposure to absolute maximum rating may affect device reliability.

Symbol	Parameter	Min.	Max.	Unit	Notes
T_{STG}	Storage Temperature	-40	85	°C	
TA	Operating Temperature	-15	55	°C	
	Lead Solder Temp		260	°C	For 10 seconds, 1.6 mm below seating plane.
ESD			2	kV	All pins, human body model MIL 883 Method 3015
V_{DC}	DC Supply Voltage	-0.5	5.5	V	
V_{IN}	DC Input Voltage	-0.5	5.5	V	All I/O pin

3.2 Recommend Operating Condition

Symbol	Parameter	Min.	Typ.	Max.	Unit	Notes
T_A	Operating Temperature	0		40	°C	
V_{DD}	Power Supply Voltage	4.25	5.0	5.5	V	
V_N	Supply Noise			100	mV	Peak to peak within 0 - 80 MHz
Z	Distance from Lens Reference Plane to Surface	2.3	2.4	2.5	mm	Refer to Figure 4.
R	Resolution	400		1200	CPI	
A	Acceleration			20	g	
F_{CLK}	Clock Frequency		24		MHz	
FR	Frame Rate		3000		frames/sec	
S	Speed	0		28	inches/sec	28 inches/sec @400CPI 20 inches/sec @800CPI 16 inches/sec @1000CPI 13 inches/sec @1200CPI

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4. Z and 2D Assembly

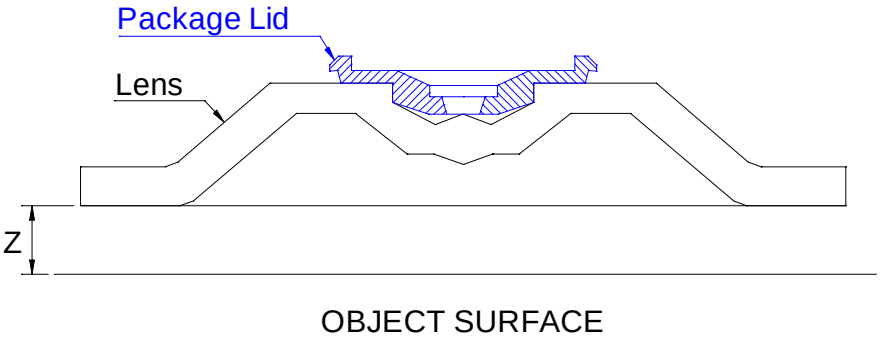


Figure 4. Distance from Lens Reference Plane to Surface

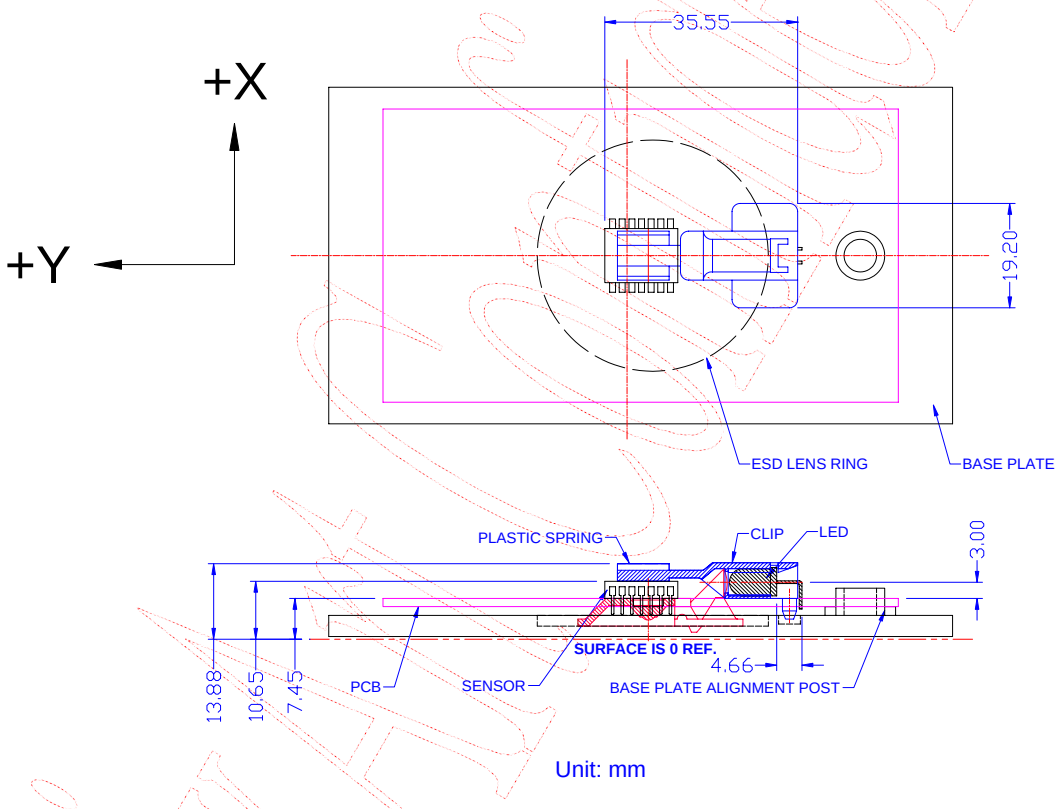


Figure 5. 2D Assembly

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5. USB Interface

5.1 USB Command Set Description (USB Descriptor)

The USB HOST detects USB mouse device plug-in and assigns a new unique address to the USB mouse device, then asking USB mouse device for information about the device description, configuration description, and assigning a configuration value for USB mouse device during enumeration period. After enumeration, the USB mouse device is able to transfer motion and button value to the USB host.

Descriptor Type	Byte	Byte	Byte	Byte	Byte	Byte	Byte	Byte
Device Descriptor (18 bytes)	12	01	10	01	00	00	00	08
	3A	09	10	25	00	01	01	02
	00	01						
Configuration Descriptor (9 bytes)	09	02	22	00	01	01	04	A0
	32							
Interface Descriptor (9 bytes)	09	04	00	00	01	03	01	02
	00							
Human Interface Device Descriptor (9 bytes)	09	21	10	01	00	01	22	3E
	00							
Endpoint Descriptor (7 bytes)	07	05	81	03	04	00	0A	
Human Interface Device Report Descriptor (62 bytes, 3D3B)	05	01	09	02	A1	01	05	09
	19	01	29	03	15	00	25	01
	95	03	75	01	81	02	95	01
	75	05	81	03	05	01	09	01
	A1	00	09	30	09	31	15	81
	25	7F	75	08	95	02	81	06
	C0	09	38	15	81	25	7F	75
	08	95	01	81	06	C0		

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5.2 USB Data Report Format

The USB report has two data formats, depending on boot or report protocol is selected. One kind of data format is the boot protocol used in legacy environment as 5.2.1. The other kind of data format is USB report protocol format which includes Z-wheel movement data in the fourth byte as 5.2.2. The Z-wheel is moved forward the fourth byte data is 01H, the Z-wheel is moved backward the fourth byte data is FFH, and the Z-wheel is idle the fourth byte data is 00H.

5.2.1 USB Boot Protocol for Legacy Operation

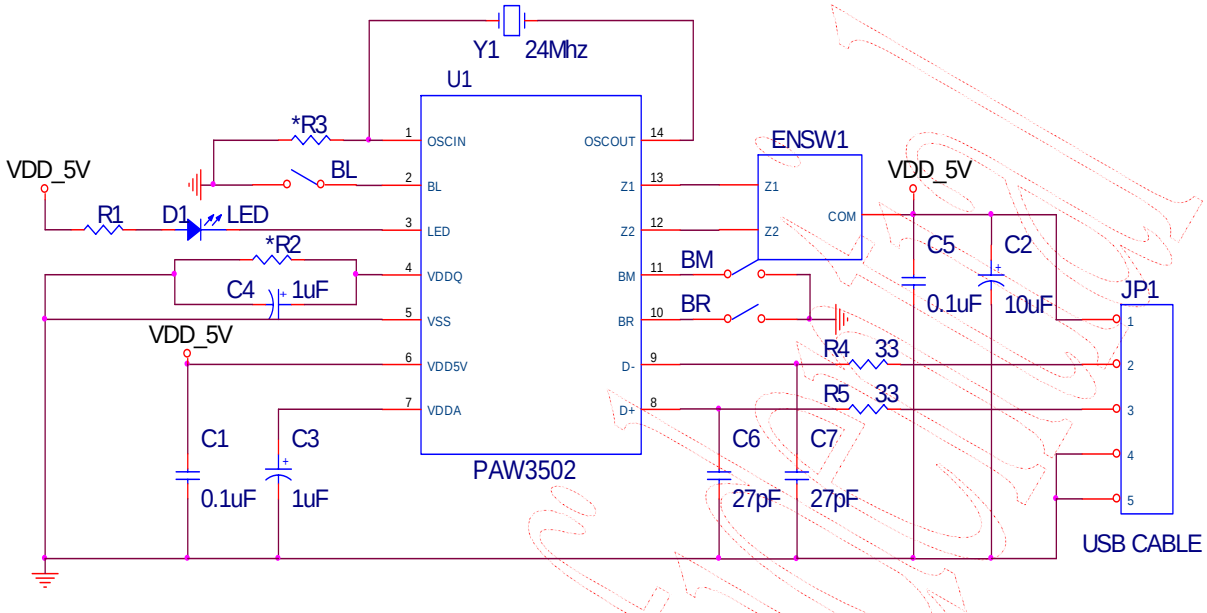
Byte	Bit	Symbol	Description
1	0	BL	1 = Left button pressed
	1	BR	1 = Right button pressed
	2	BM	1 = Middle button pressed
	3 ~ 7	NC	Reserved
2	0 - 7	X0 ~ X7	X data (D0 - D7). A positive value indicates motion to the right; a negative value indicates motion to the left. Bit 0 = LSB.
3	0 - 7	Y0 ~ Y7	Y data (D0 - D7). A positive value indicates device motion upward; a negative value indicates motion downward. Bit 0 = LSB.

5.2.2 USB Report Protocol

Byte	Bit	Symbol	Description
1	0	BL	1 = Left button pressed
	1	BR	1 = Right button pressed
	2	BM	1 = Middle button pressed
	3	B4	Reserved
	4	B5	Reserved
	5 ~ 7	NC	Reserved
2	0 - 7	X0 ~ X7	X data (D0 - D7). A positive value indicates motion to the right; a negative value indicates motion to the left. Bit 0 = LSB.
3	0 - 7	Y0 ~ Y7	Y data (D0 - D7). A positive value indicates device motion upward; a negative value indicates motion downward. Bit 0 = LSB.
4	0 - 7	Z0 ~ Z7	Z-wheel motion data (D0 - D7). A positive value indicates device motion downward; a negative value indicates motion upward. The Z0 - Z7 limit value is ±7. Bit 0 = LSB.

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6. Referencing Application Circuit



Note: *R2 and *R3 are reserved for future use.

Figure 6. Application Circuit for PAW3502

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7. Package Information

7.1 Package Outline Drawing

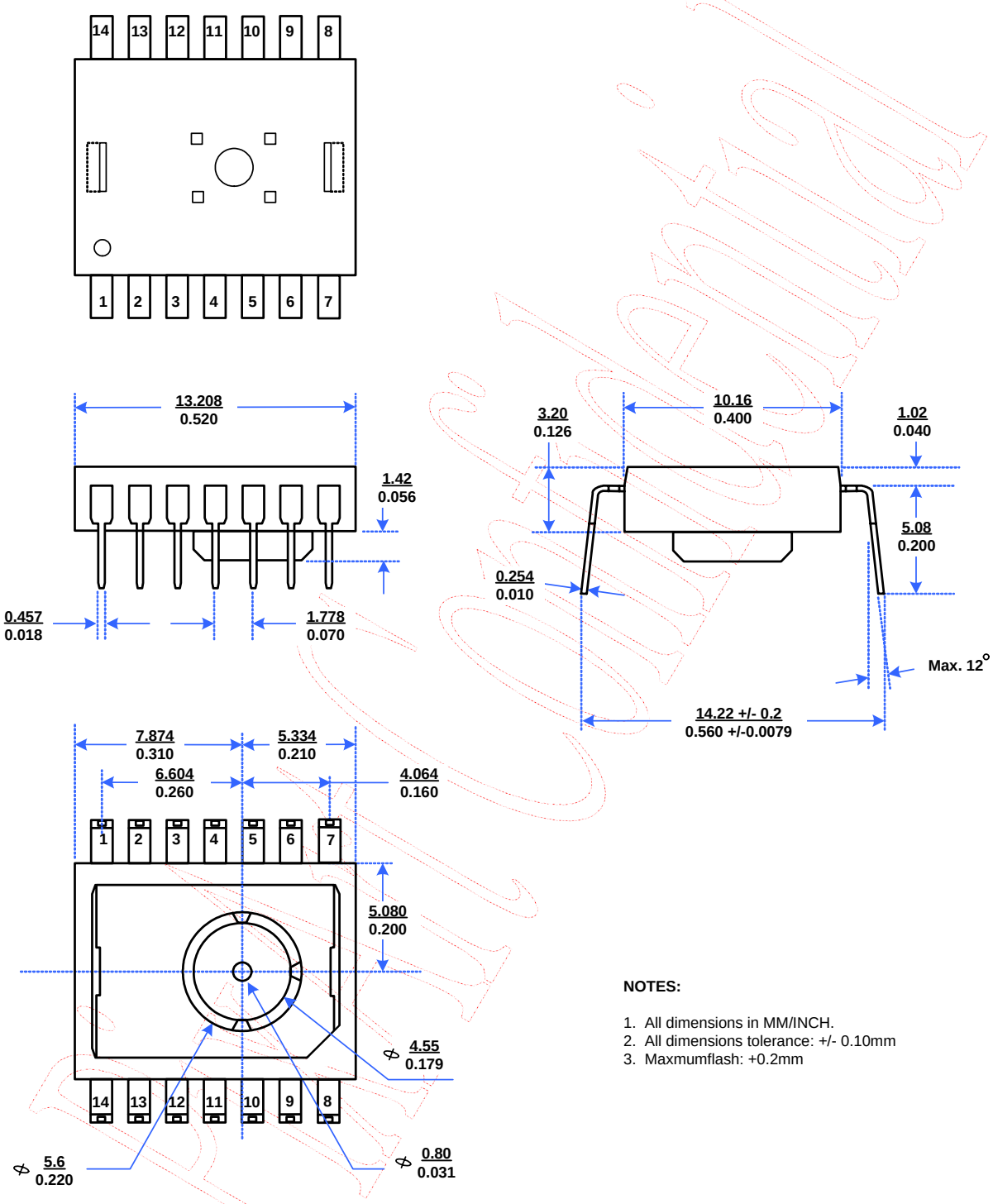
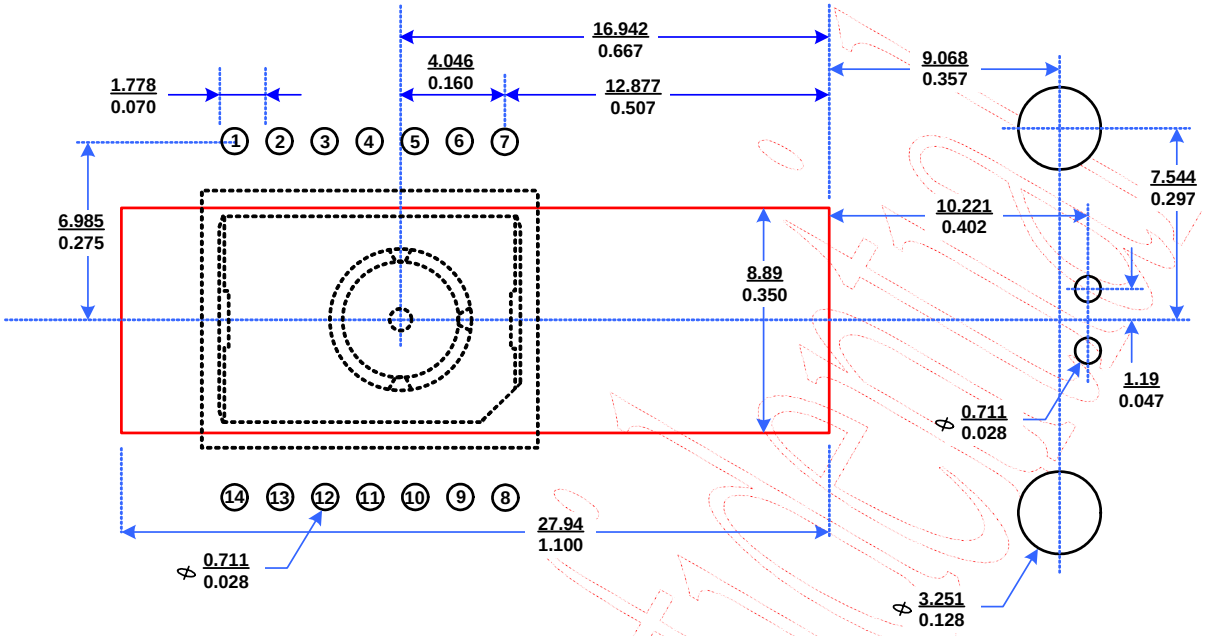


Figure 7. Package Outline Drawing

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7.2 Recommended PCB Mechanical Cutouts and Spacing



All Dimension : mm/inch

Back Side

Figure 8. Recommended PCB Mechanical Cutouts and Spacing

8. Update History

Version	Update	Date
V0.1	Creation, Preliminary 1st version	10/11/2006
V0.2	Modify Referencing Application Circuit	12/28/2006

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