OPTICAL MOUSE SENSOR IC

ATA2188

Datasheet

Version 0.3

@Lab ATA2188

Optical Mouse Sensors

Datasheet

INTRODUCTION

Description

The ATA2188 is an optical sensor with capability of replacing current track ball mouse of computer system. How the most common optical sensor for mouse works today is: The sensor captures "snapshots" of the work surface at 1,700 times per second, calculates ±3-pixel movement per frame, and produce 5,100 pixel movements per second with internal 6MHz oscillator. With internal 12MHz oscillator, the sensor captures snapshots of the work surface at 3,400 times per second, calculates ± 3-pixel movement per frame, and produce 10,200 pixel movements per second.

However, the key difference in ATA2188 from other optical sensors is that it is designed based on a system level architecture so that it can eliminate side parts resulting in saving extra manufacturing costs. Additionally, PS/2 interface is included within ATA2188 so that no MCU is needed to interface through PS/2. ATA2188 also tolerates all different magnitudes of movement so that the sensor can be used for design purpose where accuracy is the most important factor as well as for gaming purpose where speed would be the critical factor.

The sensor is in a 12-pin optical DIP type and comes with the default resolution of 600 or 800 counts per inch (CPI) and the speed of motion is up to either 12.75 inches per second running at 6MHz or 25 inches per second at 12MHz (“fast”).

Patented Eye Protection Technology

Since the optical mice sense the movement through capturing the movement of the surface on which LED/Laser light is shed. The stronger the light and the higher the density of light, one can realize an optical mouse with higher and better performance. However, facing the light (LED/Laser) source directly with one’s eyes causes dazzling eyes which may last long for someone with sensitive eyes,

especially for children. In the worst case, this direct eye contact may be a reason of loss/reduction of eyesight.

ATLab's eye protection mouse sensors – including ATA2188E - are using a patented "Eye Protection" technology, automatically TURNS OFF the light source when user lifts the mouse off the surface and hence it can protect eyes from the harmful light. There are two operational modes in this mouse: i) under the bright environment, when you lift the mouse to a certain distance from the surface, the light source is automatically turned off, whereas ii) under the darker environment, after reaching a certain distance from the surface, the light source gets weakened and blinking weakly.

Features

- Single 5.0 volt power supply
- Low operation current
- On chip LED drive TR
- 6MHz/12MHz selectable internal oscillator included (No additional OSC needed)
- PS/2 interface included (No additional MCU needed)
- Complete 2-D motion sensor
- Eye protection function included (ATA2188E)
- High speed motion detection
- Optical navigation technology
- Proprietary enhanced navigation accuracy over a wide variety of surfaces
- 3 Button (Left, Middle, Right) and Scrolling Wheel application
- No mechanical parts
- No precision optical alignment
- High reliability
- Power Conservation Mode during times of no movement (No Motion).
- 600CPI / 800CPI

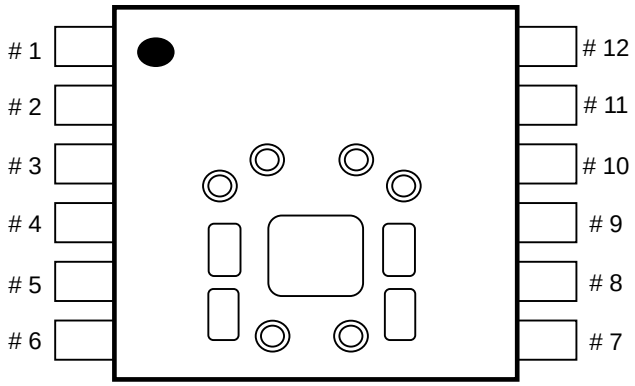
Applications

- Mice for desktop PC's, Workstations, and notebook PC's
- Trackballs
- Integrated input devices

Order Information

Order Code	Power Supply Voltage	Function	
		Eye Protection	CPI
ATA2188AF	Vcc= 5.0V	×	600 CPI
ATA2188EF	Vcc= 5.0V	○	
ATA2188FF	Vcc= 5.0V	×	800 CPI
ATA2188EFF	Vcc= 5.0V	○	

12ADIP PKG Top View



Pin out

Pin	Name	Description
1	**XY_LED**	LED On/Off (O)
2	**VDD**	Power
3	**RESETB**	Reset active low (I)
4	**VSS**	Ground
5	**PS2_CL**	PS/2 Clock (I/O)
6	**PS2_DA**	PS/2 Data (I/O)
7	**LB_SW**	Left Button (I)
8	**Z_A**	Wheel A (I)
9	**MB_SW**	Middle Button (I)
10	**Z_B**	Wheel B (I)
11	**RB_SW**	Right Button (I)
12	**OSC**	Oscillator selection (I) (“H” or “open”: 12MHz, “L”: 6MHz)

Note: Pin assignments can be altered without notice

ELECTRICAL CHARACTERISTICS

Parameter	Symbol	Unit	Min.	Typ.	Max.	Note
Absolute Maximum Ratings						
Storage Temperature	Tstg	°C	–20		70	
Operating Temperature	Topr	°C	0		50	
Supply Voltage	Vdd	V	–		7.0	
Input Voltage	Vin	V	Vss–0.3		Vdd+0.3	
ESD	-	V	200			All pins, machine model
			2000			All pins, human body model
Recommended Operating Conditions						
Operating Temperature	Topr	°C	0	25	40	
Supply Voltage	Vdd	V	4.5	5.0	5.5	
Power Supply Rise Time	Vrt	msec	-	50	100	
Distance from lens reference plane to surface	D	mm	2.2	2.3	2.4	
Speed	S	Inch/sec	-	-	12.75 25.0	At 6MHz At 12MHz
AC Electrical Specification (Recommended operating conditions: Temp=25°C, Vdd=5.0V, and CLK=6MHz)						
Internal Clock Frequency	Fclk	MHz	-	6 12	-	Pin 12 (OSC)= low Pin 12 (OSC)= high or open
PS/2 Motion Report Rate		reports /sec	-	100	-	See PS/2 Timing Diagrams
PS/2 Data Transition Delay after PS/2_CLK rising edge	T2	msec	-	-	-	See PS/2 Timing Diagrams
Motion Scale Factor		counts /inch	-	800	-	
Response Time	Trsp1	msec	8.7	10.9	13.1	Movement to data in no motion mode
Power-Up Delay		msec	-	600	-	
DC Electrical Specification (Recommended operating conditions: Temp=25C and Vdd=5.0V)						
Supply Current1 (in Motion)	Idd1	mA	- -	11.0 17.0	15.0 24.0	At 6MHz, exclude LED At 12MHz, exclude LED
Supply Current2 (No Motion)	Idd2	mA	- -	5.5 7.0	7.5 10.0	At 6MHz, exclude LED At 12MHz, exclude LED
Input Low Voltage	V_{IL}	V	-	-	0.8	
Input High Voltage	V_{IH}	V	2.0	-	-	
Output Low Voltage (LED)	V_{OLL}	V	-	0.3	0.5	
XY-LED Current (LED)	I_{LED}	mA				

OPERATIONS

Theory of Operation

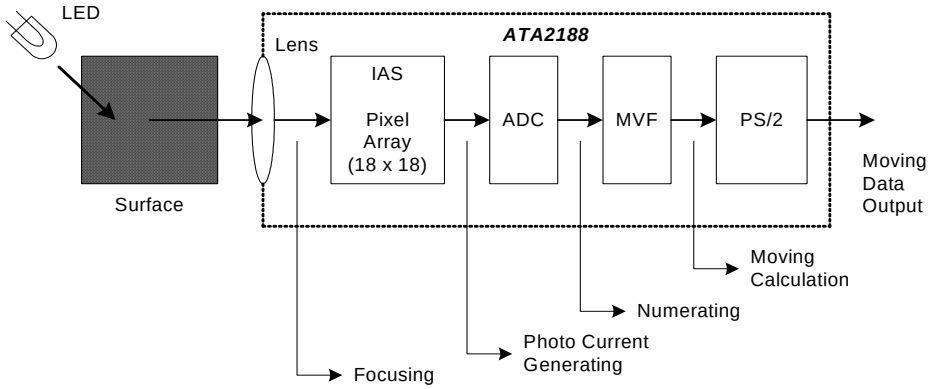


Figure 1 - Operational block diagram

ATA2188 is based on Optical Navigation Technology. It contains an Image Acquisition System (IAS) and a Motion Vector Finding Processor (MVFP).

The IAS acquires microscopic surface images via the lens and illumination system provided by other parts. These images are processed by the MVF processor to determine the direction and distance of motion. The MVF processor generates Δx and Δy, relative displacement values that are converted into signals in PS/2 format.

No Motion Mode

Once power is up, it requires 600 msec to be stabilized in Motion mode. In order to minimize the power consumption, when there is no motion in the sensor, ATA2188 turns into No-Motion mode.

When there is no motion for one second (default time period) in Motion mode, ATA2188 turns into No-Motion mode. In No-Motion mode, ATA2188 wakes up every 10.9 msec for one report time and compares with the previous wake-up in order to check whether there is any movement.

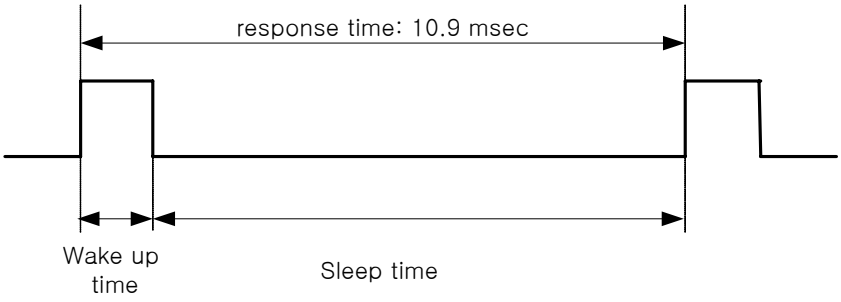


Figure 2 - Timing diagram in No-Motion mode

PS/2 Command Set

Command (Hex.)	Description	Response
FF	Enter reset mode	FA AA 00
FE	Resend the last data packet to the host NN = last packet (1byte or some bytes)	FA NN
F6	Set default	FA
F5	Disable data reporting	FA
F4	Enable data reporting	FA
F3	Set sample rate (reports/second) NN = {0A, 14, 28, 3C, 50, 64, C8}	FA NN FA
F2	Get device ID NN(Device ID) = 00(without wheel), 03(with wheel)	FA NN
F0	Set remote mode	FA
EE	Set wrap mode	FA
EC	Reset wrap mode and the mouse enters previous mode	FA
EB	Read data in the remote mode Data Packet = See Table1	FA Data Packet
EA	Set stream mode	FA
E9	Status request Status Packet = See Table2	FA Status Packet
E8	Set resolution (counts/mm) NN = {00, 01, 02, 03}	FA NN FA
E7	Set scaling 2:1	FA
E6	Set scaling 1:1	FA

[1] Data Packet

Device ID = 00

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 1	Y overflow	X overflow	Y sign	X sign	Always 1	Middle Btn	Right Btn	Left Btn
Byte 2	X Movement							
Byte 3	Y Movement							

Device ID = 03

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 1	Y overflow	X overflow	Y sign	X sign	Always 1	Middle Btn	Right Btn	Left Btn
Byte 2	X Movement							
Byte 3	Y Movement							
Byte 4	Z Movement (Wheel Movement)							

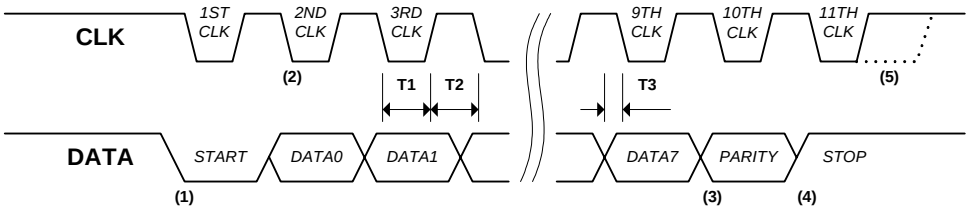
[2] Status Packet

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 1	Always 0	Mode	Enable	Scaling	Always 0	Left Btn	Middle Btn	Right Btn
Byte 2	Resolution							
Byte 3	Sample Rate							

NOTES : Mode = '1' if remote mode is enabled,
'0' if stream mode is enabled.

PS/2 Mode Output Waveforms

[1] Timing Diagram for Data Sent from ATA2188



(1) The mouse checks the clock (CLK) signal when it has the data to transmit. If this line is set "high", the mouse starts transmitting data from start bit (always 0).

(2) The host reads data at falling edge of clock signal.

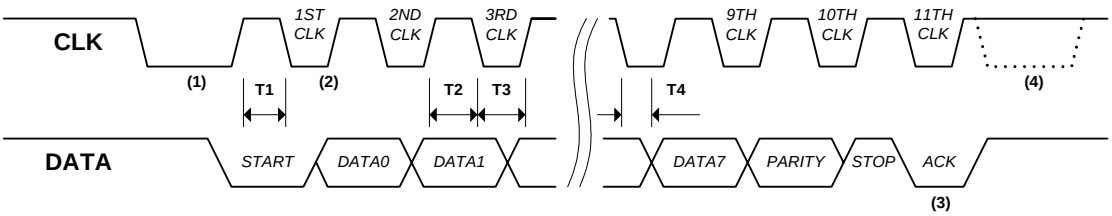
(3) The parity bit is odd parity.

(4) The stop bit is always high.

(5) The host can hold the clock signal low to inhibit next transition.

Parameters	Description	Min. Time	Max. Time
T1	Duration of clock low	TBD	TBD
T2	Duration of clock high	TBD	TBD
T3	Time from data transition to falling edge of the clock	TBD	TBD

[2] Timing Diagram for Data received by ATA2188



(1) The host pulls clock signal low to inhibit the mouse, when it has the data to transmit.

(2) The mouse reads data at rising edge of clock signal.

(3) The ACK bit is changed when the clock signal is high.

(4) The host can pull the clock line low to inhibit the mouse.

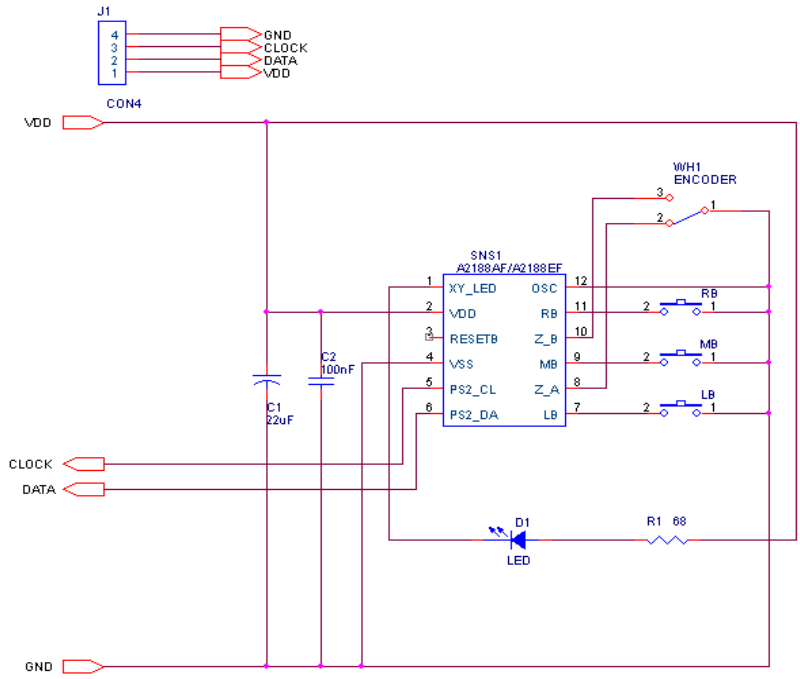
Parameters	Description	Min. Time	Max. Time
T1	Duration of clock high in the start bit	TBD	TBD
T2	Duration of clock high	TBD	TBD
T3	Duration of clock low	TBD	TBD
T4	Time from falling edge of the clock to data transition	TBD	TBD

TYPICAL APPLICATION

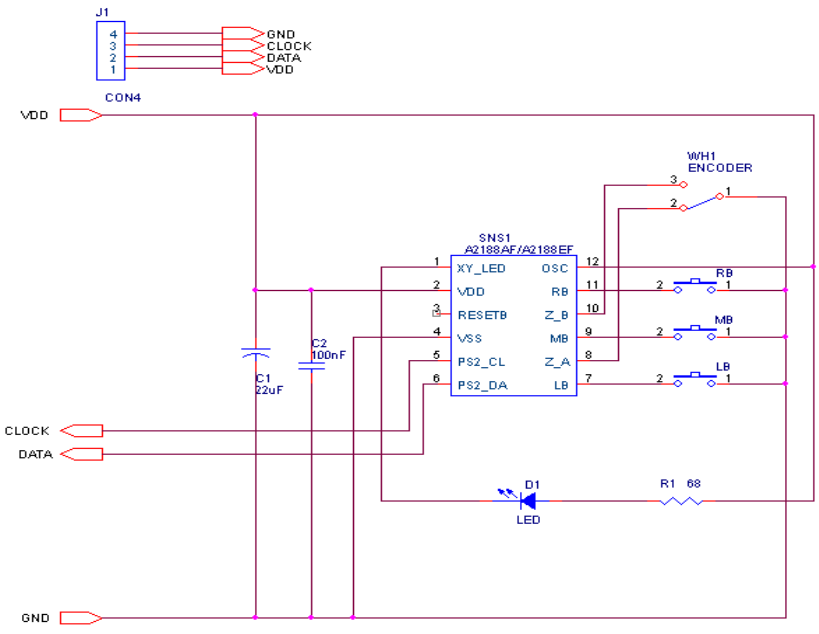
The following diagram shows a typical application of ATA2188AF/EF/FF/EFF.

(The value of passive components can be changed without notice)

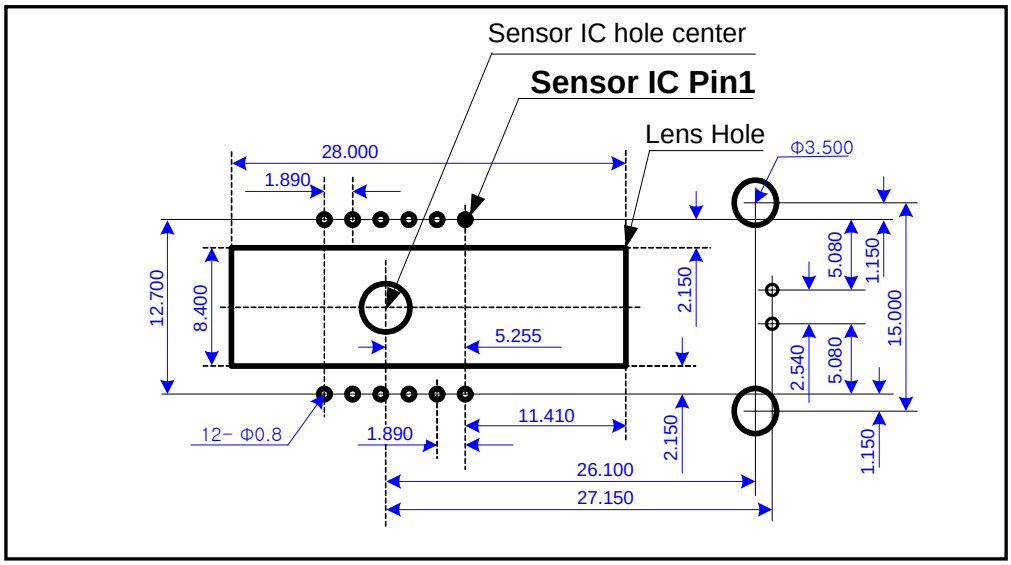
■ ***Typical Applications 1 - 5,100 pixels movement/sec (running at 6MHz)***



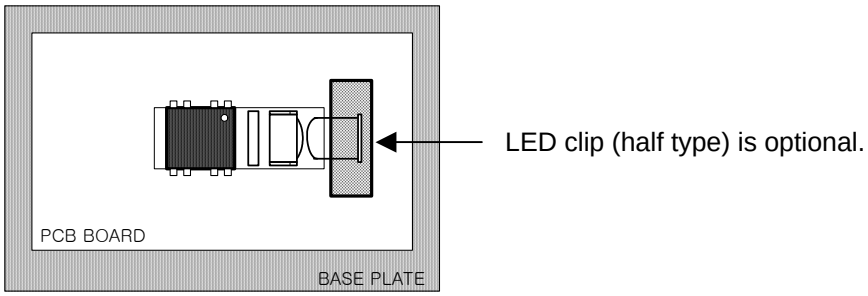
■ ***Typical Applications 2- 10,200 pixels movement/sec (running at 12MHz)***

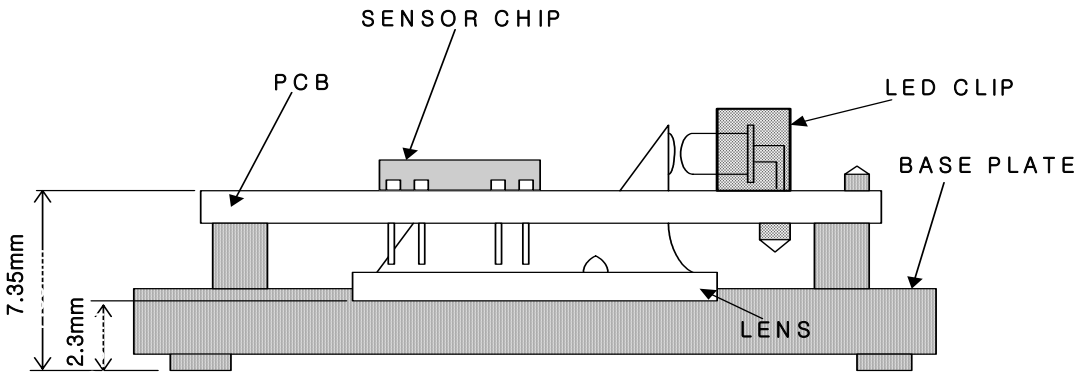


Recommended PCB Mechanical Drawing (Unit: mm)



Assembly Drawing (Unit: mm)

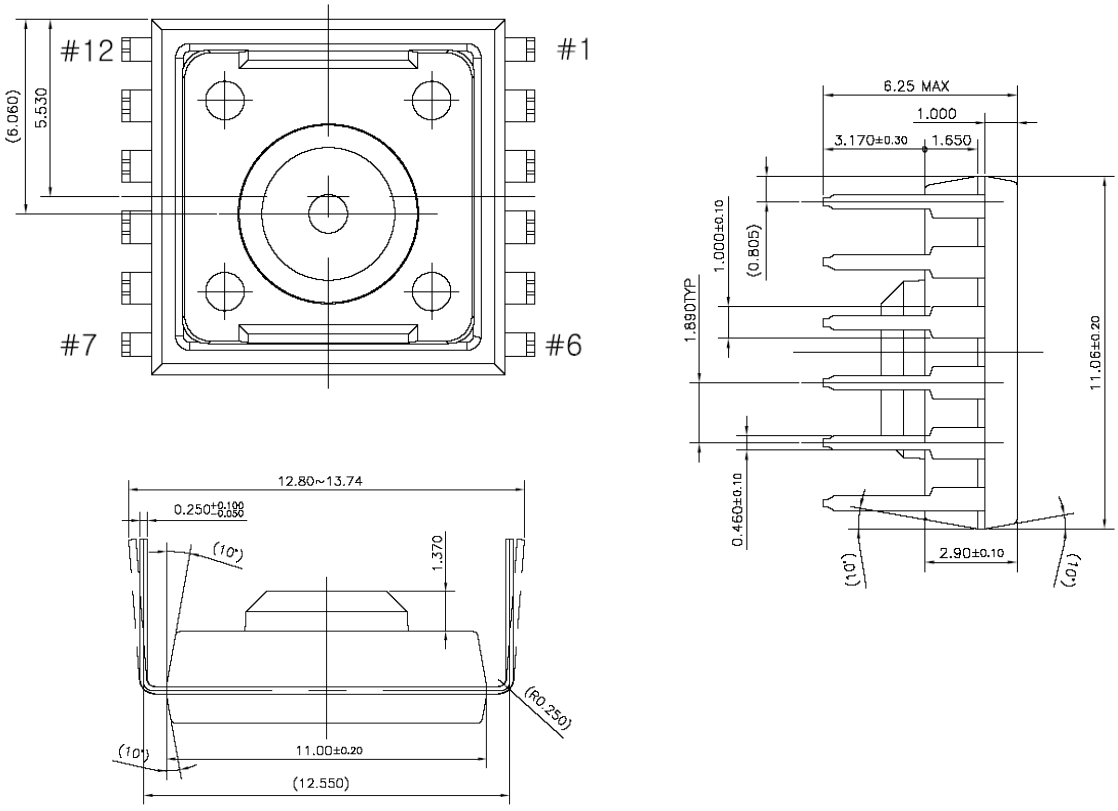




The maximum performance of optical mouse set can be achieved from applying the distances shown above. Lens to surface distance tolerance is ±0.1mm

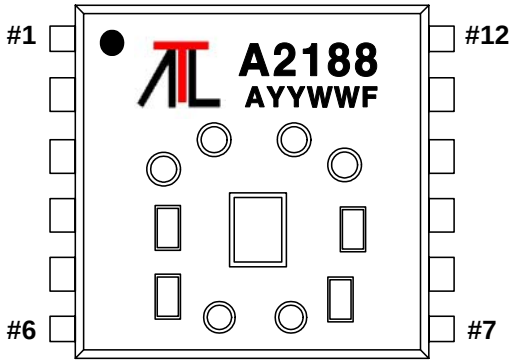
ATA2188 Series Package Dimension (Unit: mm)

Package Outline Drawing

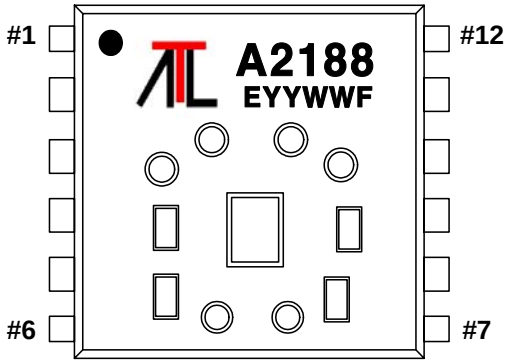


Marking Information

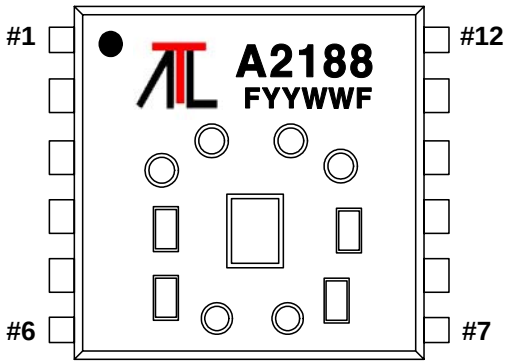
ATA2188AF



ATA2188EF



ATA2188FF



ATA2188EFF