OM02

Optical Mouse Sensor

Data Sheet

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1. General description

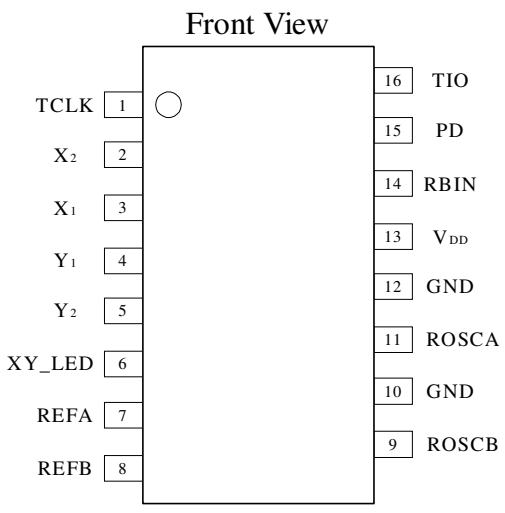
This optical CMOS sensor provides a non-mechanical tracking engine for implementing a computer mouse. On the CMOS IC chip, images are captured, digitized, and then digitally processed. Using an optical navigation technology, the sensor measures changes in position by optically acquiring sequential surface images (frames) and mathematically determining the direction and magnitude of movement. The sensor is mounted in a plastic optical package and is designed to be used with a high intensity LED. Hence, it provides a complete and compact tracking engine. This optical tracking engine has no moving parts and requires no precise optical alignment. Thus, it enables high volume system assembly. It offers a quadrature output mode for interface flexibility. The tracking resolution is specified at 400 counts per inch (cpi) at rates of motion up to 12 inches per second (ips).

2. Features

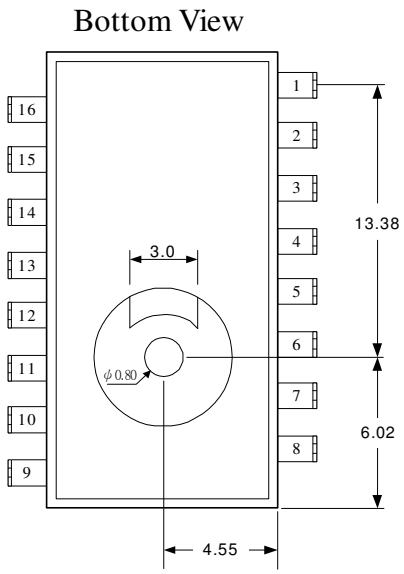
- Superior precision and motion tracking by new optical navigation technology
- Non-mechanical surface-tracking engine
- Complete 2D motion sensor
- Smooth surface navigation
- Single 5.0 volt power supply
- Power down pin (PD) for USB suspend mode operation
- On chip oscillator requiring only an external resistor (No resonator required)
- 16-pin staggered dual inline package (ASDIP-16 / I-DIP-16)
- Hibernation/suspend mode

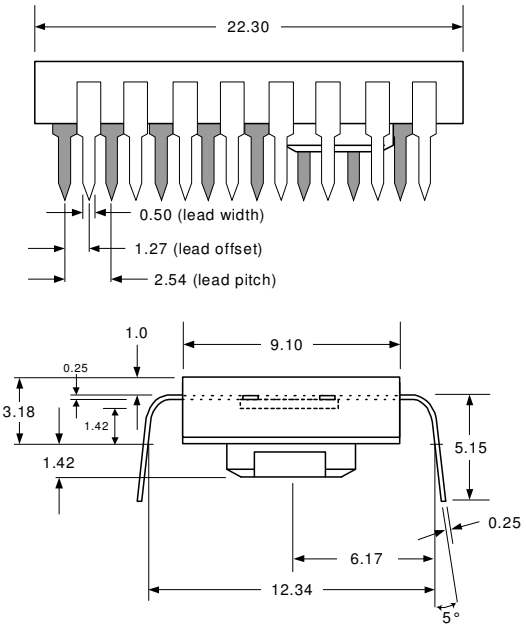
3. Pin configurations (package) and descriptions

(We define as ASDIP-16 and Agilent® define as I-DIP-16 which are 16-pin inter-digitated DIP)



Symbol	I/O	Description
X_1,X_2, Y_1,Y_2	O	△X and △Y axis quadrature outputs
XY_LED	O	LED control
RBIN	-	LED output control
ROSCA, ROSCB	-	On chip oscillator frequency control
V_{DD}	-	5.0 volt DC power supply
GND	-	System ground
REFA, REFB	-	Internal reference
PD	I	Power down pin, active high
TCLK	I	Serial port clock for testing mode
TIO	I/O	Serial data for testing mode

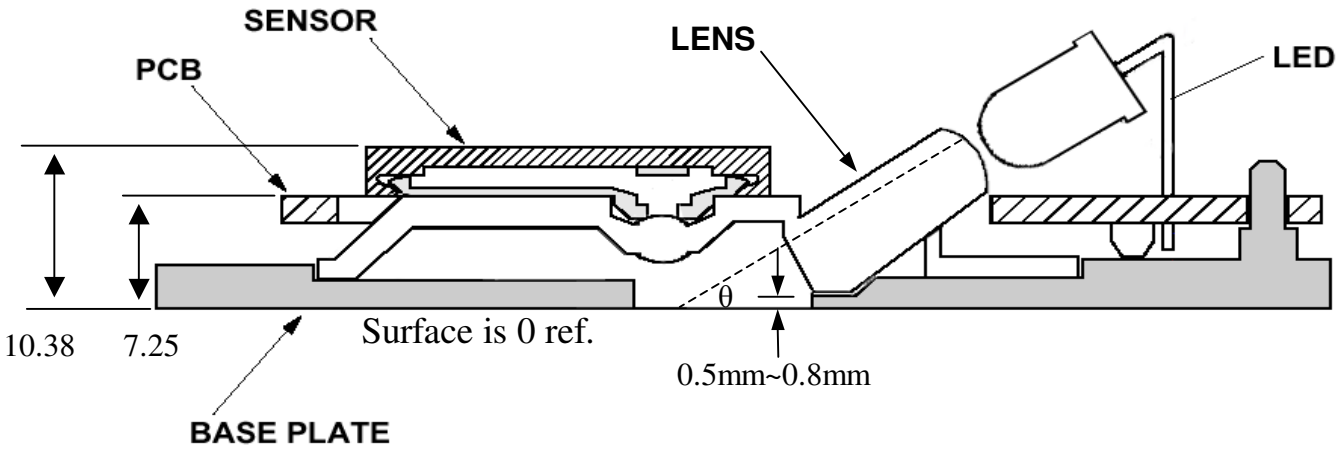




Note:

- Dimension in millimeter.
- Dimension tolerance is +/- 0.1 mm.
- Coplanarity of leads is 0.1 mm.
- Lead pitch tolerance is +/- 0.15 mm.
- Cumulative pitch tolerance is +/- 0.15 mm.
- Angular tolerance is +/- 3º.
- Maximum flash is +0.2 mm.
- Chamfer (25º X 2) on the taper side of the lead.

- Module Structure (Dimension in millimeter)



4. Absolute maximum ratings

Parameter	Symbol	Min.	Max	Unit	Notes
Storage Temperature Range	T_{STR}	-40	85	℃	
Operating Temperature Range	T_{OPR}	0	40	℃	
Lead solder Temperature	-	-	245	℃	For 10 seconds, 1.6mm below seating plane.
Supply Voltage	V_{DD}	4.4	5.5	V	
ESD	-	-	2	KV	All pins, human body model
Input Voltage	-	-0.5	V_{DD} +0.5	V	PD, TIO, TCLK
Angle of incidence	θ	30	45	degree	

5. Electrical characteristics

5-1. Recommended operating conditions

Parameter		Symbol	Min	Typ.	Max.	Unit	Notes
Oscillator Resistor		R_{OSC}	43	51	56	KΩ	
Speed		S	-	16+	-	inches/sec	
Acceleration		A	-	1.0	-	g	
Bin Resistor	Source Current Mode (RBIN tied to V_{DD})	R_1	10	-	191	Ω	For type 1 application Circuit.
	Source Current Mode (RBIN tied to R2 to GND)	R_2	8.2	-	33	KΩ	For type 2 application Circuit.
Distance from Lens Reference Plane to Surface		A	2.1	2.2	2.3	mm	
LED Light onto IC	λ = 639nm	IRR_{INC}	80	-	25,000	mW/m^2	
	λ = 875nm		100	-	30,000		
Unintended External Light onto IC		IRR_{EXT}	-	-	10	mW/m^2	

5-2. DC electrical characteristics

Parameter	Symbol	Min	Typ.	Max.	Unit	Notes
Clock Frequency	F_{CLK}	13	16	19	MHz	
Frame Rate	f_{frame}	1400	1700	2000	frames/sec	
REFA Voltage	V_{REFA}	3.25	3.5	3.75	V	
REFB Voltage	V_{REFB}	-	0	-	V	
ROSCA Voltage	V_{ROSCA}	$0.4*V_{DD}$	$0.5*V_{DD}$	$0.6*V_{DD}$	V	
ROSCB Voltage	V_{ROSCB}	-	V_{DD}	-	V	

DC Supply Current	Mouse Active	I_{DDAVG}	-	-	13	mA	No load on X_1, X_2, Y_1, Y_2. Excluding LED current.
	Standby	I_{DDSB}	-	-	10	mA	
	Power Down	I_{DDPD}	-	-	3.0	mA	
TCLK, TIO, PD	Input Low Voltage	V_{IL}	-	-	0.8	V	
	Input High Voltage	V_{IH}	3	-	-	V	
	Output Low Voltage	V_{OL}	-	-	0.4	V	I_{OL} = 0.5mA
	Output High Voltage	V_{OH}	3.5	-	-	V	I_{OH} = 0.5mA
X_1, X_2, Y_1, Y_2	Output Low Voltage	V_{OL}	-	-	0.4	V	I_{OL} = 0.5mA
	Output High Voltage	V_{OH}	3.5	-	-	V	I_{OH} = 0.5mA
LED Duty Cycle	Mouse Active		-	-	60%		
	Standby		-	-	5%		
	Power Down		-	-	0.20%		
XY_LED Output Current	Low Output Current	I_{LEDL}	-1	0	1	µA	
	High Source Current (RBIN tied to V_{DD})	$I_{LEDHSRC}$	1.5	3.1	6	mA	V_{OH} = 0.6 V
	High Sink Current (RBIN tied to R_2 to GND)	$I_{LEDHSINK}$	Typ. + 35%	-510/R2	Typ. - 35%	mA	$V_{OH} = V_{DD} - 2$ V
	High Sink Current (RBIN short to GND)	$I_{LEDHSINK}$	-1	0	1	µA	R2 < 5KΩ

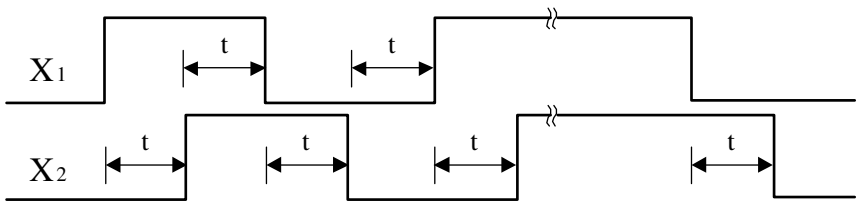
5-3. AC electrical characteristics

Parameter		Symbol	Min	Typ.	Max.	Unit	Notes
Power Down Pulse Width		t_{PDW}	720	-	-	µs	Pulse width to initiate the power down mode.
Power Down from PD↑		t_{PD}	-	600	-	µs	
Power Up from PD↓		t_{PUPD}	-	-	300	ms	When the mouse is fully active again.
Power Up from V_{DD}↑		t_{PU}	-	-	200	ms	
Transient Supply Current		I_{DDT}	-	20	37	mA	
TIO	Rise Time	t_r	-	5	-	ns	C_L = 30 pF
	Fall Time	t_f	-	5	-	ns	C_L = 30 pF
X_1, X_2, Y_1, Y_2	Rise Time	t_r	-	100	-	ns	C_L = 30 pF
	Fall Time	t_f	-	100	-	ns	C_L = 30 pF
XY_LED	Rise Time	t_r	-	100	-	ns	With LED
	Fall Time	t_f	-	100	-	ns	With LED

5-4. Timing and state diagrams

5-4-1. Quadrature Output Waveform

The output signals are two channels quadrature (△X and △Y), which emulates encoder phototransistors. Sensor IC generates △X and △Y relative displacement values that are converted into two channel quadrature signals. The two channel quadrature outputs are 3.5V signals. The △X and △Y counts are used to generate the X1, X2 and Y1, Y2 quadrature signals. The quadrature signals can change at a maximum rate of 25 KHz. The following diagrams show the timing for positive X motion, to the right direction.

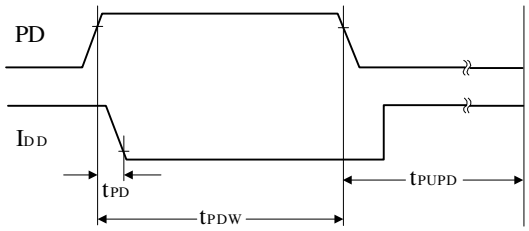


where t = 40us

Example: Quadrature Output Waveform (+X motion)

5-4-2. PD Pin Timing

- Pulse width to initiate the power down mode, t_{PDW} (Power Down Pulse Width) minimum time is 720μs.
- When the mouse is fully active again, t_{PUPD} (Power Up from PD) maximum time is 300ms.



PD Timing Normal Mode

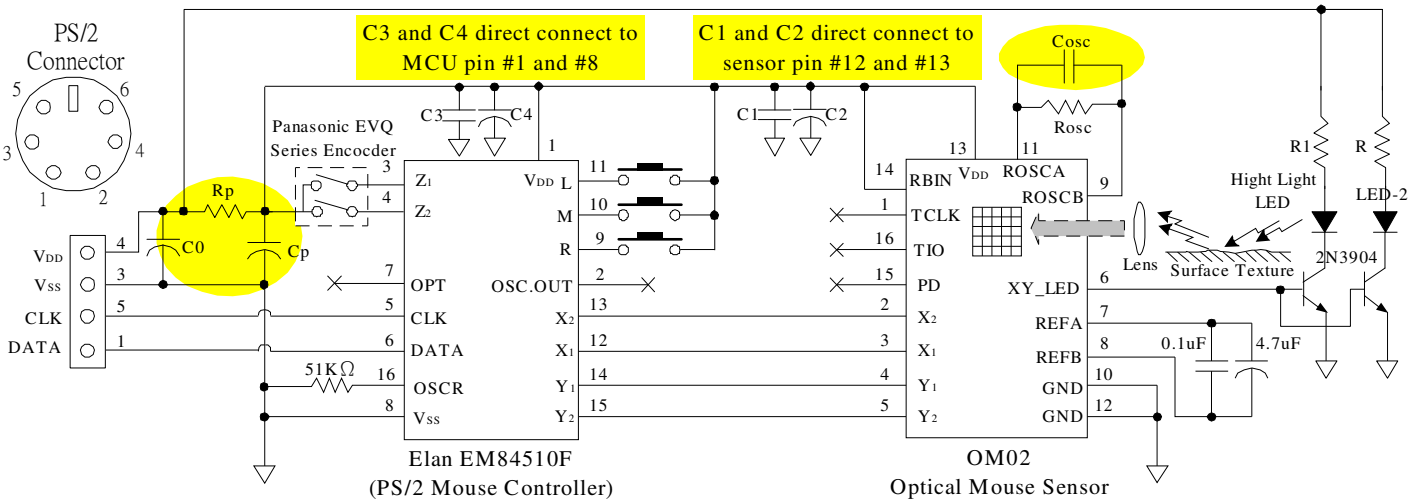
6. Application circuit

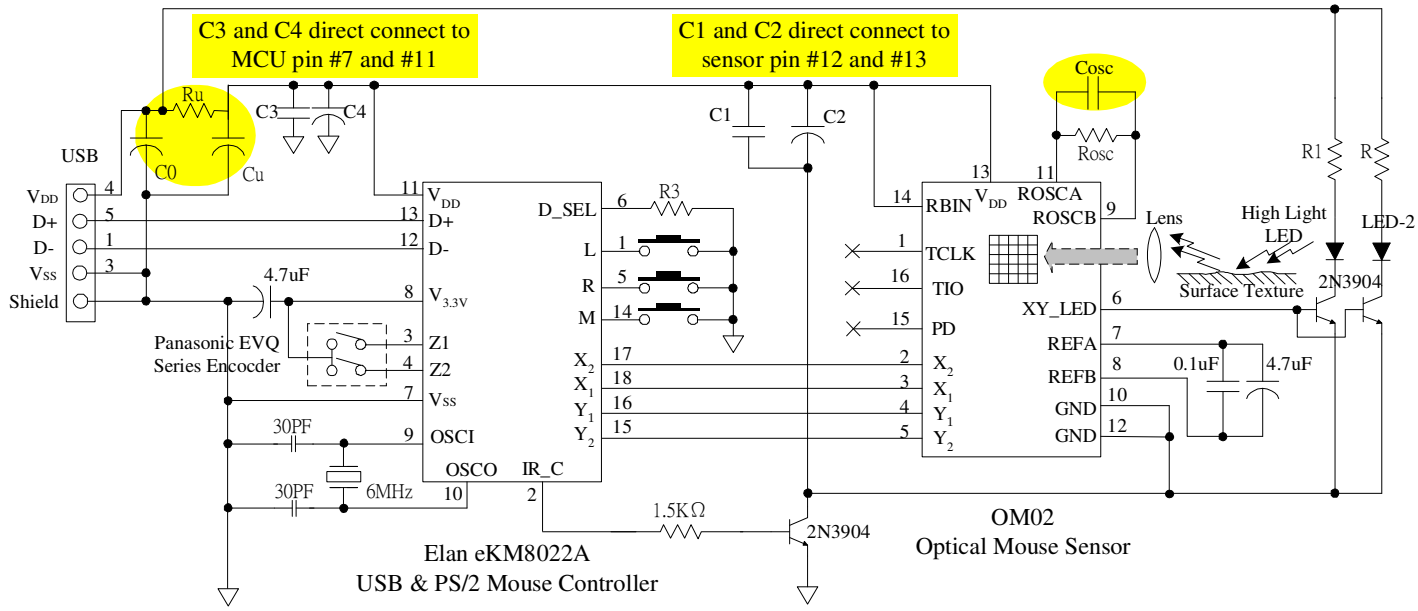
6-1. Application type 1 (Compatible with Agilent® HDNS-2000)

(where Rosc is 51KΩ ; R3 open for 400dpi, short for virtual 800dpi; LED-2 is for shining only)

LED BIN	OPL-130	K/L/M/N	P	Q	R	S	T	U
R1 Value (Ω)	22	10 ~ 69.8	10 ~ 78.7	10 ~ 93.1	10 ~ 113	10 ~ 137	10 ~ 169	10 ~ 191

EFT Level	Rp	Ru	Cosc	C1 & C3	C2	C0 & C4	Cp	Cu
3.0KV Class A	10Ω	10Ω	1nF	0.1uF	100uF	10uF	10uF	22uF
1.2KV Class B	Short					Open		
Don't Care (1.2KV Class C)		Short	Open	Open				





6-2. Application type 2 (Compatible with Agilent® ADNS-2051)

(where Rosc is 51KΩ ; R3 open for 400dpi, short for virtual 800dpi; LED-2 is for shining only)

LED BIN	K/L/M/N/P	Q	R	S	T	U
R2 Value (KΩ)	8.2 ~ 12	8.2 ~ 15	8.2 ~ 18	8.2 ~ 22	8.2 ~ 27	8.2 ~ 33

EFT Level	Rp	Ru	Cosc	C1 & C3	C2	C0 & C4	Cp	Cu
3.0KV Class A	10Ω	10Ω	1nF	0.1uF	100uF	10uF	10uF	22uF
1.2KV Class B	Short					Open		
Don't Care (1.2KV Class C)		Short	Open	Open