



# MLX92213

## MicroPower & Low-Voltage Hall Effect Latch with Enable

### Features and Benefits

- Operating Voltage from 1.6 to 3.6V
- Latching Output Behavior
- Micropower Consumption  
48uA@3V ; 36uA@1.8V
- Advanced Power Manageability through dedicated "Enable" pin
- Ultra High Sensitivity Hall Sensor
- Push-Pull Output
- Minuature & Ultra Thin CSP package  
(2mm x 1.5mm ; 0.4mm thickness)
- "Green" and "Pb-Free" Compliant Package

### Application Examples

- Battery-operated / Handheld Appliances
- Rotary or Linear Contact-Less Encoders
- Scroll/Jog Wheel, Trackball (Mobile Phones,  
Portable Media Players, Notebooks, Computer  
Mice, Camcorders, Cameras,...)
- Home/Industrial Metering Equipment (Wafer  
Flow Meter)

### Ordering Code

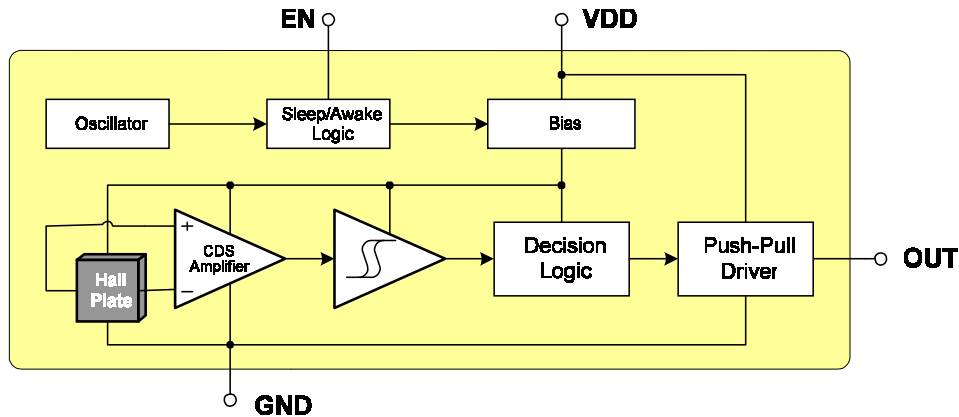
Product Code	Temperature Code	Package Code	Option Code	Packing Form Code
MLX92213	E	LD	AAA-000	RE

#### Legend:

Temperature Code:	E for Temperature Range -40°C to 85°C
Package Code:	LD for UTQFN6
Option Code:	xxx-000: Standard Version
Packing Form:	RE for Reel

Ordering example: MLX92213ELD-AAA-000-RE

### 1 Functional Diagram



### 2 General Description

The MLX92213 Micropower Low-Voltage Latch Hall effect sensor IC is fabricated in mixed signal CMOS technology. It incorporates advanced Correlated Double Sampling (CDS) techniques to provide accurate and stable magnetic switching points.

In order to save power, the internal Timing Logic alternates Awake and Sleep modes, thus significantly reducing the power consumption. The magnetic flux density is periodically evaluated against predefined thresholds. If the flux density is above/below the  $B_{OP}/B_{RP}$  thresholds, then the Output changes its state accordingly. During the Sleep mode the Output is latched in its previous

state. The design has been optimized for applications requiring extended operating lifetime in battery-powered systems. The EN pin adds flexibility by enabling external control of the Micropower Period and Duty Cycle.

The Push-pull Output of the MLX92213 will be latched in Low state in the presence of a sufficiently strong South magnetic field ( $B > B_{OP}$ ) facing the marked side of the package. The Output will be latched in High state in the presence of a sufficiently strong North magnetic field ( $B < B_{RP}$ ).

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### 3 Glossary of Terms

Gauss, milliTesla (mT), Units of magnetic flux density :  
10 Gauss = 1mT

### 4 Absolute Maximum Ratings

Parameter	Symbol	Value	Units
Supply Voltage	V <sub>DD</sub>	5	V
Supply Current	I <sub>DD</sub>	±10	mA
EN Input Voltage	V <sub>IN</sub>	5	V
EN Input Current	I <sub>IN</sub>	±10	mA
Output Voltage	V <sub>OUT</sub>	5	V
Output Current	I <sub>OUT</sub>	±10	mA
Operating Temperature Range	T <sub>A</sub>	-40 to 85	°
Storage Temperature Range	T <sub>S</sub>	-50 to 150	°

Table 1: Absolute maximum ratings

Exceeding the absolute maximum ratings may cause permanent damage. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

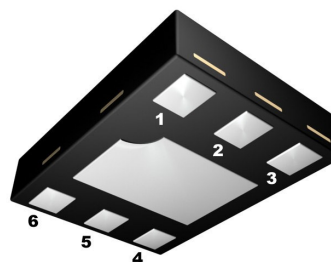
### 5 Pinout

Pin Name	Function	Pin №
VDD	Power Supply	3
GND	Ground	4, E-pad <sup>(2)</sup>
OUT	Push-Pull Output	1
EN	Enable <sup>(1)</sup>	6
NC	Not Connected	2, 5

Table 2: Pin definitions and descriptions

**Note 1:** EN has to be connected to V<sub>DD</sub> when External Micropower Control is not used

**Note 2:** Exposed Pad on LD package is connected to Ground



LD Package

### 6 Output Behavior vs. Magnetic Pole

DC Operating Parameters T<sub>A</sub> = -40°C to 85°C, V<sub>DD</sub> = 1.6V to 3.6V

Parameter	Test Conditions	OUT
South pole	B > B <sub>OP</sub>	Low
North pole	B < B <sub>RP</sub>	High

Table 3: Output behavior versus magnetic pole <sup>(3)</sup>

**Note 3:** The magnetic pole is applied facing the package top

### 7 General Electrical Specifications

Operating Parameters:  $T_A = -40$  to  $85^\circ\text{C}$ ,  $V_{DD} = 1.6\text{V}$  to  $3.6\text{V}$ , unless otherwise specified

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Supply Voltage	$V_{DD}$	Operating	1.6	-	3.6	V
Average Supply Current	$I_{DDav}$	EN = $V_{DD}$ , $V_{DD}=3\text{V}$	-	48	86	$\mu\text{A}$
		EN = $V_{DD}$ , $V_{DD}=1.8\text{V}$	-	36	70	$\mu\text{A}$
Awake Supply Current	$I_{DDaw}$	EN = $V_{DD}$ , $I_{OUT} = 0\text{mA}$	-	-	4	mA
Sleep Supply Current	$I_{DDsl}$	EN = $V_{DD}$ , $I_{OUT} = 0\text{mA}$	-	-	4.5	$\mu\text{A}$
Standby Supply Current	$I_{DDsb}$	EN = 0	-	-	1	$\mu\text{A}$
<b>Output Characteristics</b>						
High Level Output Voltage	$V_{OH}$	$B < B_{RP}$ , $I_{OUT} = -1\text{mA}$	$V_{DD}-0.4$	$V_{DD}-0.2$	-	V
Low Level Output Voltage	$V_{OL}$	$B > B_{OP}$ , $I_{OUT} = 1\text{mA}$	-	0.2	0.4	V
Power-On Output State <sup>(4)</sup>	$V_{PO}$		High			-
<b>Enable Pin Characteristics</b>						
EN Input High Voltage	$V_{IH}$		$0.1 * V_{DD} + 1$	-	-	V
EN Input Low Voltage	$V_{IL}$		-	-	$0.1 * V_{DD} + 0.1$	V
EN Input Current	$I_{IN}$		-1	-	1	$\mu\text{A}$
EN Input Delay	$t_{ID}$		-	-	5	$\mu\text{s}$
EN Pulse Width	$T_{E1}$		5	-	-	$\mu\text{s}$
EN Period	$T_{E2}$		$T_{AW} + 0.1$	-	-	$\mu\text{s}$
<b>Timing Characteristics</b>						
Enable Transition Time <sup>(5)</sup>	$t_{ET}$	Disabled $\rightarrow$ Enabled	-	-	$t_{ID} + T_{AW}$	$\mu\text{s}$
Disable Transition Time <sup>(6)</sup>	$t_{DT}$	Enabled $\rightarrow$ Disabled	-	-	$t_{ID} + T_{AW}$	$\mu\text{s}$
Power-On Time <sup>(7)</sup>	$t_{ON}$	EN = $V_{DD}$	-	31	80	$\mu\text{s}$
		EN = $V_{DD}$ , $T_A=25^\circ\text{C}$ , $V_{DD}=3\text{V}$	-	31	52	$\mu\text{s}$
Awake Time	$T_{AW}$	EN = $V_{DD}$	-	-	60	$\mu\text{s}$
		EN = $V_{DD}$ , $T_A=25^\circ\text{C}$ , $V_{DD}=3\text{V}$	-	27	40	$\mu\text{s}$
		EN = $V_{DD}$ , $T_A=25^\circ\text{C}$ , $V_{DD}=1.8\text{V}$	-	30	45	$\mu\text{s}$
Period	$T_{PER}$	EN = $V_{DD}$	0.70	1.30	1.90	ms
Response Time <sup>(8)</sup>	$t_{RES}$	EN = $V_{DD}$	-	-	$T_{PER}$	ms
Magnetic Signal Frequency	$f_B$	EN = $V_{DD}$	$1 / [ 2 * T_{PER} ]$			Hz

Table 4: Electrical specifications

**Note 4:** Defined Output state after Power-On Time is High until the first BOP threshold is reached ( $B > B_{OP}$ ).

**Note 5:** Enable transition time defined from EN command to the update of the Output driver state (ref. to Diagrams, p.4)

**Note 6:** Disable transition time defined from EN command to entering Standby (ref. to Diagrams, p.4)

**Note 7:** Power-On Time represents the time from reaching  $V_{DD} = 1.6\text{V}$  to the update of the Output driver state

**Note 8:** Response Time is the time from the magnetic field change to the according update of the Output driver state, guaranteed by design

### 8 Magnetic Specifications

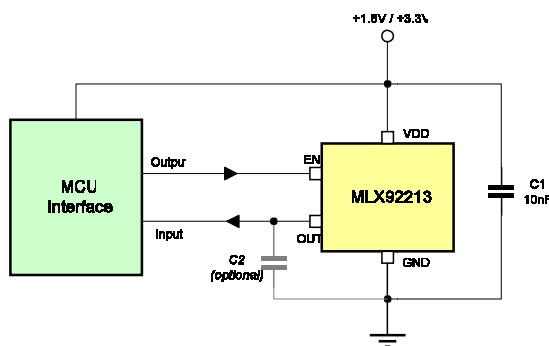
DC Operating Parameters:  $V_{DD} = 1.6V$  to  $3.6V$

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Operating Point	B <sub>OP</sub>	$T_A = 25^\circ C$	0.5	2	4	mT
Release Point	B <sub>RP</sub>		-4	-2	-0.5	mT
Hysteresis	B <sub>HYST</sub>		1.5	4	7	mT
Operating Point	B <sub>OP</sub>	$T_A = -40$ to $85^\circ C$	0.1	2	5	mT
Release Point	B <sub>RP</sub>		-5	-2	-0.1	mT
Hysteresis	B <sub>HYST</sub>		1.5	4	7	mT

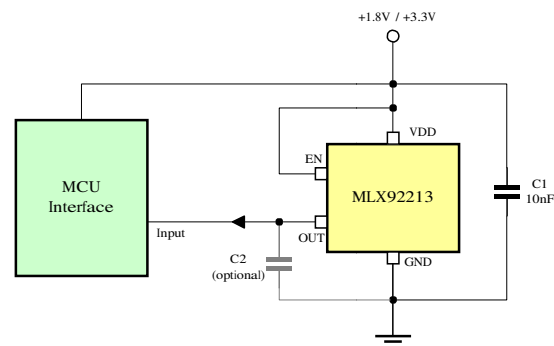
Table 5: Magnetic specifications

### 9 Application Section

#### 9.1 Application Schematics



**Fig.1 – Enhanced Power Management Typical**  
1.8V or 3.3V application with MCU interface reading the OUT signal and driving the EN signal



**Fig.2 – Standard Power Management**  
1.8V or 3.3V application with MCU interface reading the OUT signal with default “Micropower”

#### 9.2 Recommendation / Comments

A bypass capacitor C1 of 10nF is recommended to ensure supply voltage stability in application. It should be placed between the VDD and GND pin, as close as possible to the MLX92213.

The MLX92213 provides a direct push-pull output, hence aiming to reduce external component count like output pull-up resistor or capacitor. The use of the output capacitor C2 connected in parallel to the output is optional. If connected between OUT and GND in such a push-pull configuration, the current sunk by the charge of the capacitor when the output switches from “0” to “1” leads to a small increase of the average current consumption of the whole module (IC + capacitor).

Using small capacitor value C2 (less than 50pF) would avoid having such small increase of the module average current consumption.

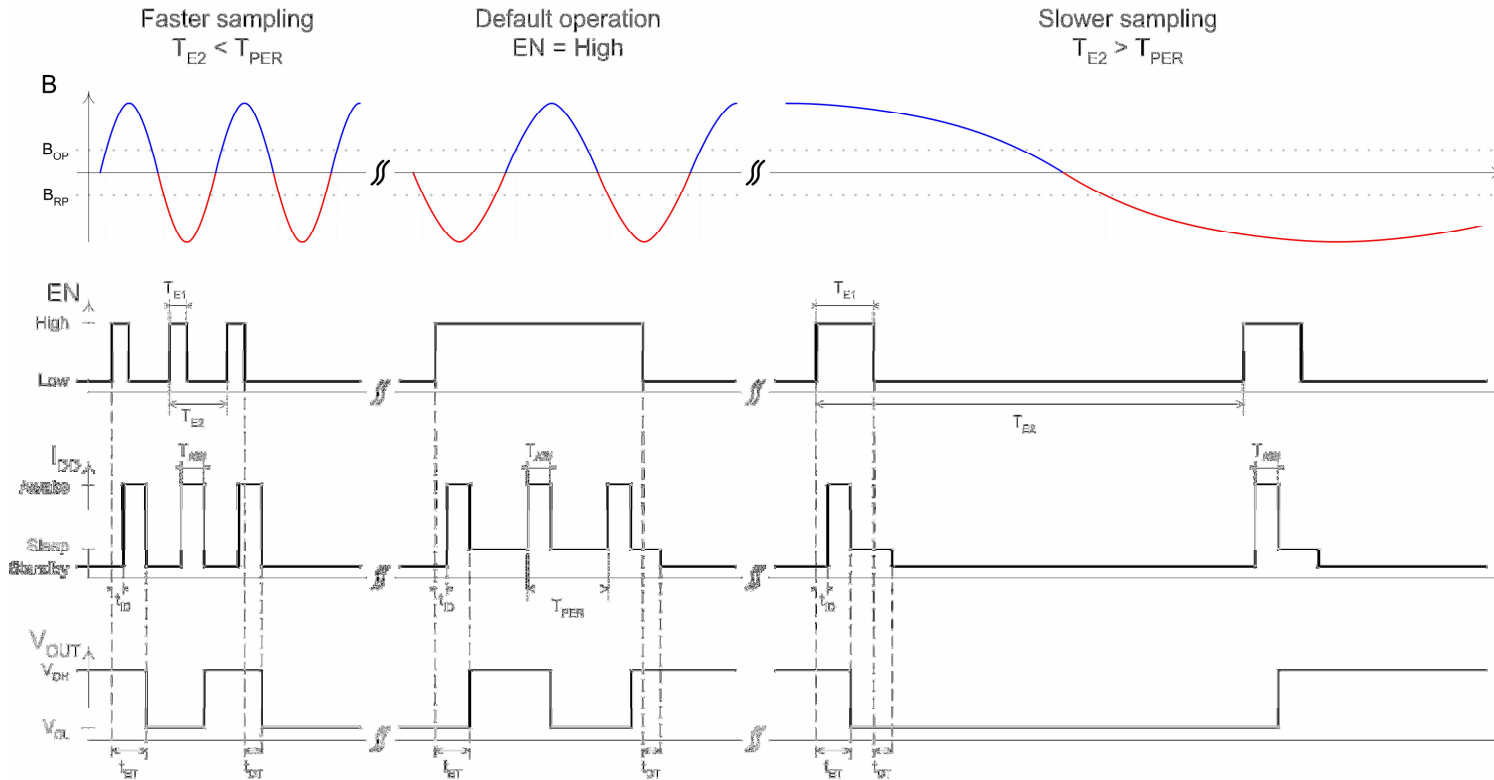
For enhanced power management, the EN (Enable) signal can be driven by an external MCU. It basically allows controlling the state IC and therefore its current consumption according to the application requirements:

- ⊕ Standby mode for minimal current consumption (EN = “0”)
- ⊕ Default Micropower (EN = “1”)
- ⊕ Faster or slower sampling rate through EN signal

For more details on the different mode, please refer to the Principle of Operation section.

For application where standard power management is enough (default “Micropower” mode, Standby unused), the EN pin should be tied to VDD

### 10 Principle of Operation

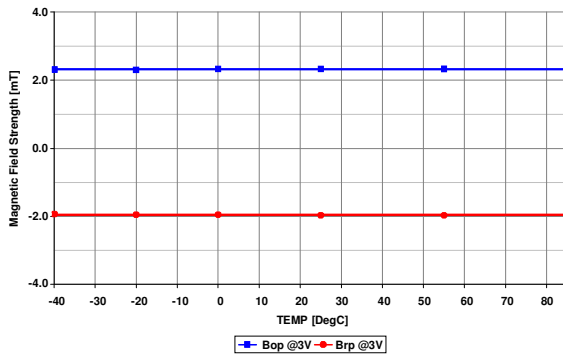


**Note 9:** The diagrams are not-to-scale, for exact values refer to General Electrical Specification

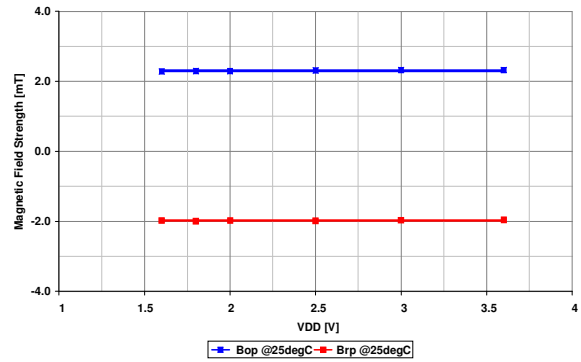
**Note 10:** The Output is assumed to have only a low capacitive load, which results in fast rise / fall times

### 11 Performance Graphs

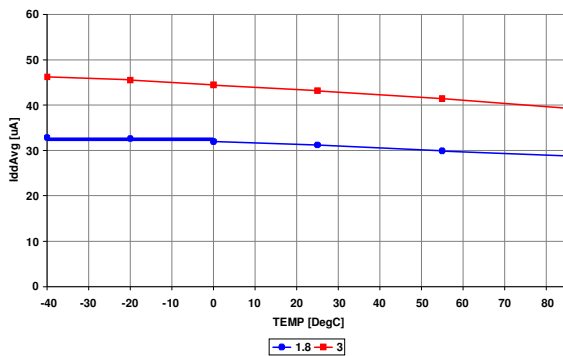
#### 11.1 Magnetic Threshold vs. Temperature



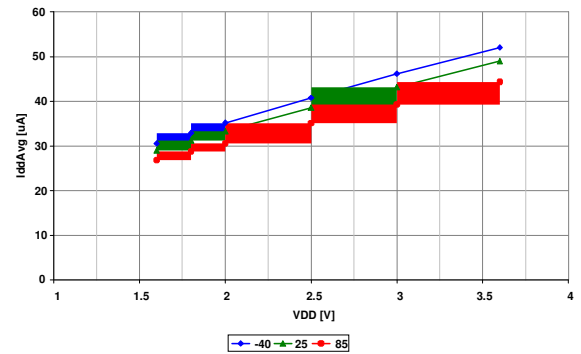
#### 11.2 Magnetic Threshold vs. Supply Voltage



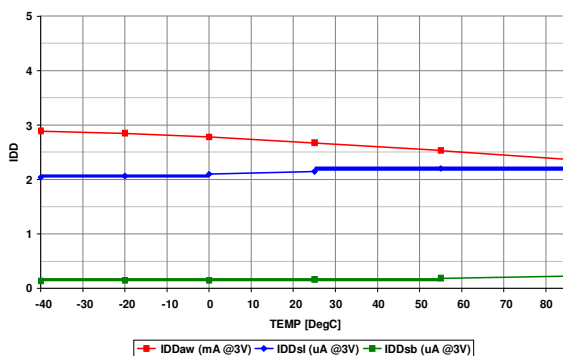
#### 11.3 Average Supply Current vs. Temperature



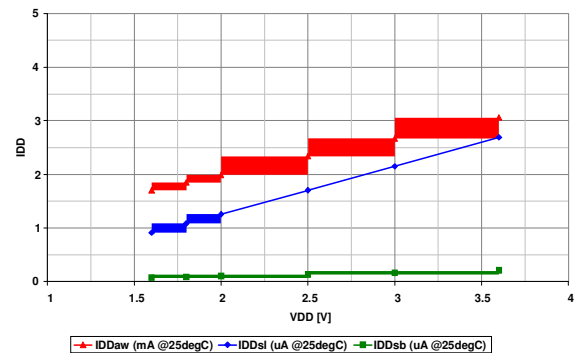
#### 11.4 Average Supply Current vs. Supply Voltage



#### 11.5 Supply Current vs. Temperature



#### 11.6 Supply Current vs. Supply Voltage





## 12 Standard information regarding manufacturability of Melexis products with different soldering processes

Our products are classified and qualified regarding soldering technology, solderability and moisture sensitivity level according to following test methods:

### Reflow Soldering SMD's (Surface Mount Developments)

- IPC/JEDEC J-STD-020  
Moisture/Reflow Sensitivity Classification for Nonhermetic Solid State Surface Mount Devices (classification reflow profiles according to table 5-2)
- EIA/JEDEC JESD22-A113  
Preconditioning of Nonhermetic Surface Mount Devices Prior to Reliability Testing (reflow profiles according to table 2)

### Wave Soldering SMD's (Surface Mount Developments) and THD's (Through Hole Developments)

- EN60749-20  
Resistance of plastic- encapsulated SMD's to combined effect of moisture and soldering heat
- EIA/JEDEC JESD22-B106 and EN60749-15  
Resistance to soldering temperature for through-hole mounted devices

### Iron Soldering THD's (Through Hole Developments)

- EN60749-15  
Resistance to soldering temperature for through-hole mounted devices

### Solderability SMD's (Surface Mount Developments) and THD's (Through Hole Developments)

- EIA/JEDEC JESD22-B102 and EN60749-21  
Solderability

For all soldering technologies deviating from above mentioned standard conditions (regarding peak temperature, temperature gradient, temperature profile etc) additional classification and qualification tests have to be agreed upon with Melexis.

The application of Wave Soldering for SMD's is allowed only after consulting Melexis regarding assurance of adhesive strength between device and board.

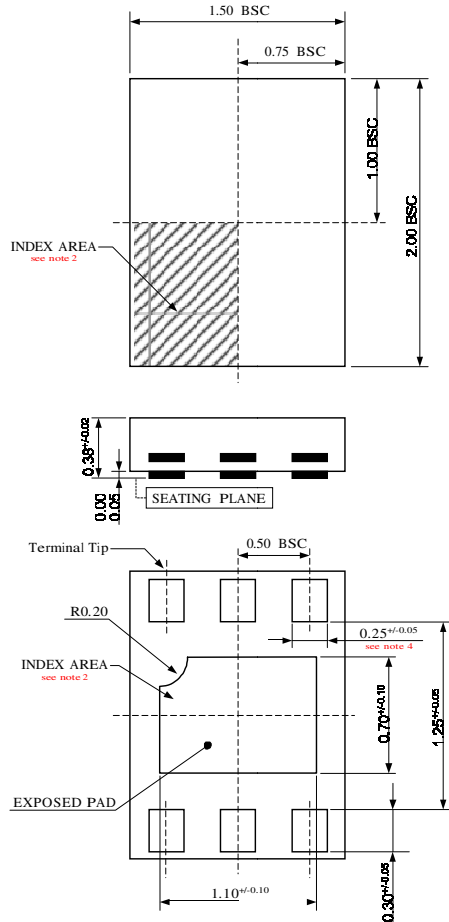
Melexis is contributing to global environmental conservation by promoting **lead free** solutions. For more information on qualifications of **RoHS** compliant products (RoHS = European directive on the Restriction Of the use of certain Hazardous Substances) please visit the quality page on our website:

<http://www.melexis.com/quality.aspx>

## 13 ESD Precautions

Electronic semiconductor products are sensitive to Electro Static Discharge (ESD). Always observe Electro Static Discharge control procedures whenever handling semiconductor products.

### 14 LD Package (UTQFN-6L)



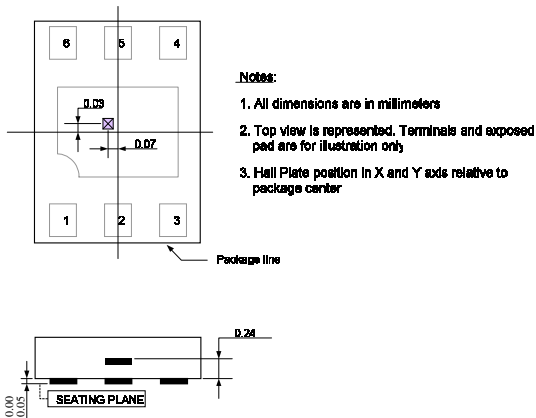
**Notes:**

1. All dimensions are in millimeters.
2. The terminal #1 identifier and terminal numbering convention shall conform JEDEC publication 95 SPP-002. Details of terminal #1 identifier are optional, but must be located within the zone indicated. The terminal #1 identifier may be marked feature.
3. Depopulation is possible in a symmetrical fashion.
4. Pad length applies to metallized terminal and is measured between 0.15mm and 0.30mm from the terminal tip. If the terminal has the optional radius on the other end of the terminal, the pad length should not be measured in that radius area.

**Marking:**

- 1<sup>st</sup> Line : .13  
 ". " (dot) - used to show the 1<sup>st</sup> pin  
 13 - Name of the device (MLX92213)
- 2<sup>nd</sup> Line : YWW  
 Y - Year (last digit)  
 WW - Calendar Week

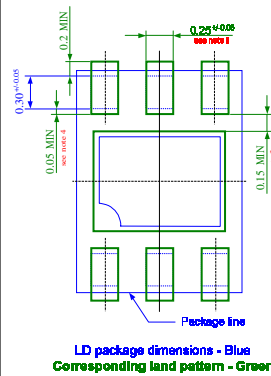
#### Hall plate location



**Notes:**

1. All dimensions are in millimeters
2. Top view is represented. Terminals and exposed pad are for illustration only
3. Hall Plate position in X and Y axis relative to package center

#### Land Pattern



**Notes:**

1. All dimensions are in millimeters
2. Top view is represented. Package pads and outline are for reference.
3. Recommended minimal distance to prevent solder bridging
4. Recommended distance for good solder filletting.
5. Due to lead pitch lower than 0.65mm, pad width should be limited to width of component terminal to reduce risk of solder bridging.
6. To enable thermal and electrical characteristics enhancement, the Exposed Pad must be connected to the PCB substrate with solder
7. Exposed pad land pattern should be extended whenever possible. Therefore, its width is not limited whereas its height should respect the minimal distance as mentioned in note 3
8. Land pattern based on package supplier's specification.

## **15 Disclaimer**

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