

Linear Adjustable Constant Current LED Driver HM7136A/HM7136B

General Description

The HM7136A is a constant current regulator for driving LEDs with low quiescent current and low dropout voltage. The current is adjustable from 10mA to 1A with an external resistor.

The HM7136 is only a controller, and must be connected to an external NMOS. HM7136B is an external transistor, is suitable for applications requiring a high output current. The output current of HM7136B can be adjusted by external DC control voltage or PWM control.

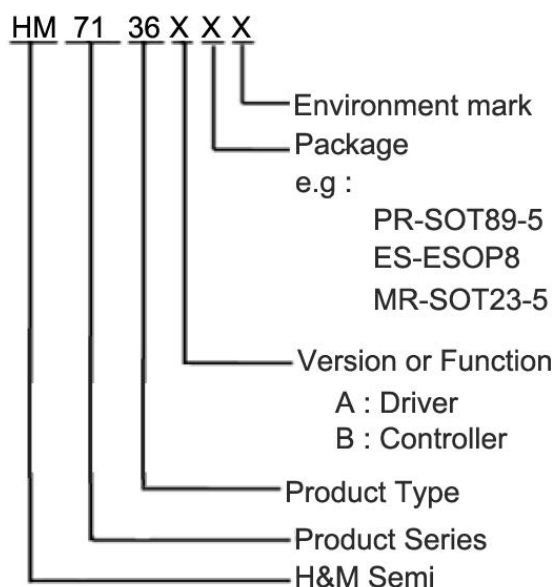
Only one external resistor is required to achieve a constant current LED driver. Soft start, thermal protection and low voltage protection are also provided.

The driver pin EXT is provided for current and voltage extension. Adding an external NMOS or NPN transistor to this pin can extend current and voltage range.

Features

- HM7136B is only a controller, and must be connected to an external NMOS.
- The output current of HM7136B is adjustable
- Sink current: 10mA to 1A adjustable with an external resistor
- Current and voltage range extendable by adding an external NMOS or NPN transistor
- Power supply voltage: 2.7-18V
- Low drop out voltage: 50mV@1A
- Low quiescent current: 80uA
- Thermal Shutdown protection: 165°C
- Soft start
- Low voltage protection: 2.5V
- Package: HM7136A: SOT89-5, ESOP8
HM7136B: SOT23-5

Selection Guide

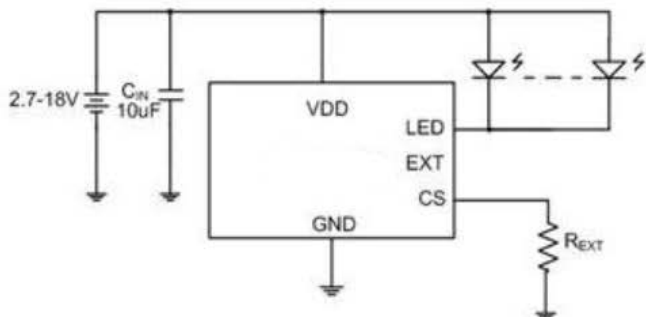


Typical Application

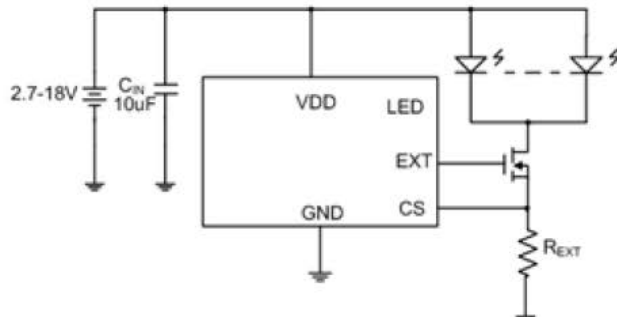
- Power Led driver and controller

HM7136A

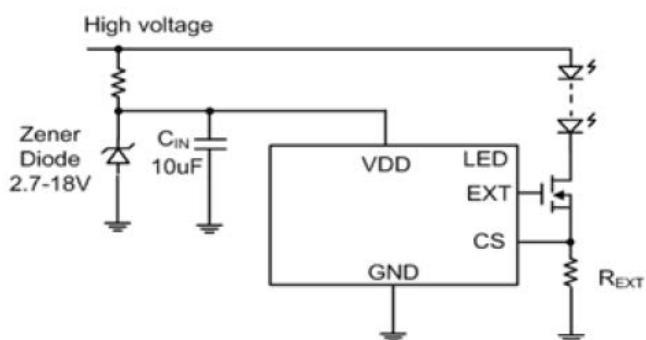
Low Voltage And Light Load (Under 1A)



Low Voltage And Heavy Load (Exceed 1A)

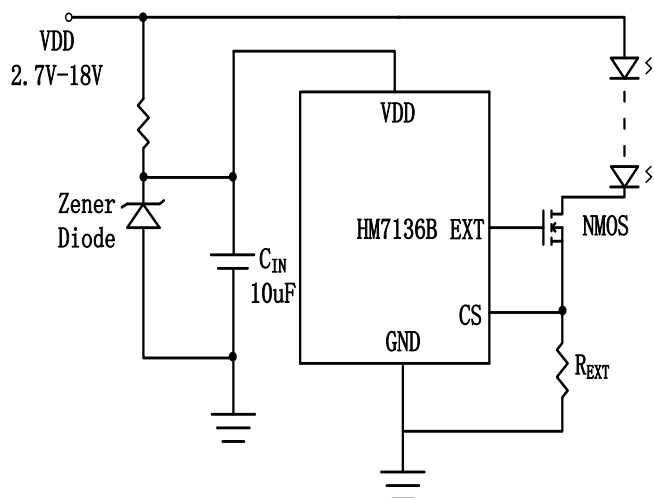


High Voltage Application

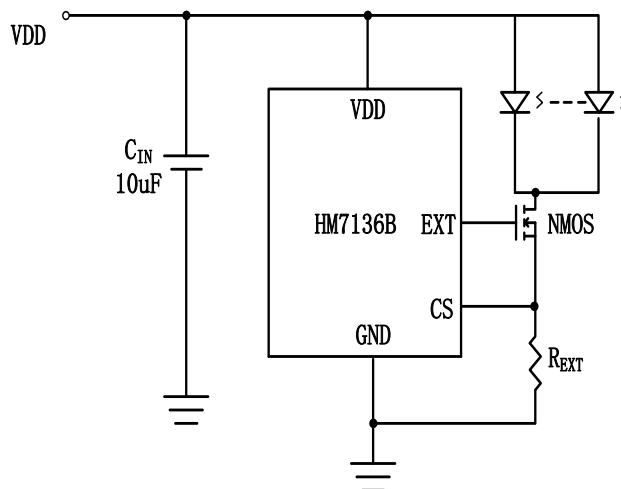


HM7136B

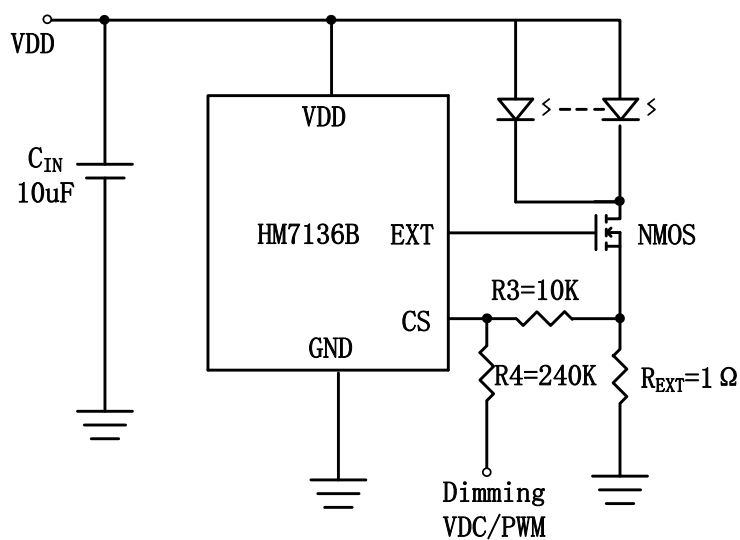
Low Voltage Application



High Voltage Application



Adjustable Output Current Application

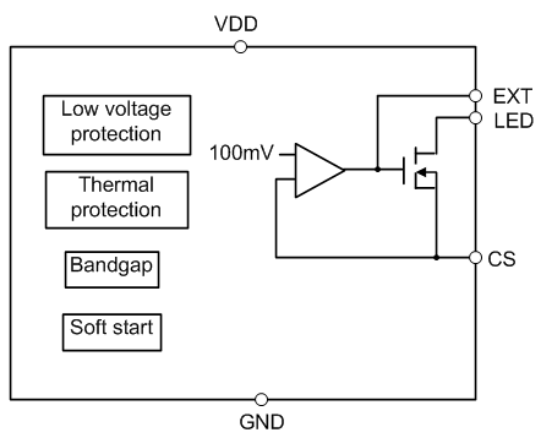


R_{EXT} Resistor Value selection:

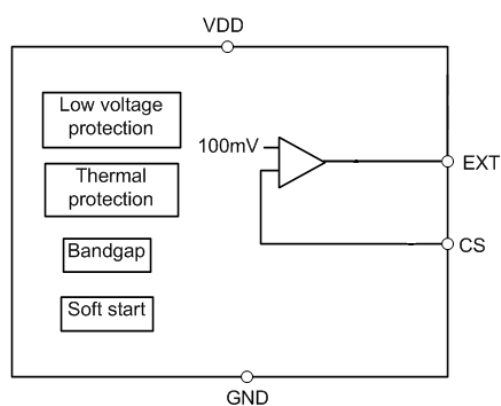
| R _{EXT} (Ω) | I _{LED} (mA) |
|-----------------------|-----------------------|
| 10 | 10 |
| 1 | 100 |
| 0.286 | 350 |
| 0.1 | 1000 |

$$I_{LED} = \frac{V_{CS}}{R_{EXT}}$$

Block Diagram



HM7136A



HM7136B

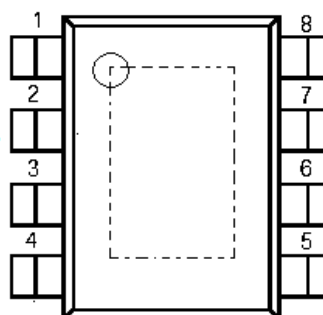
Pin Configuration



SOT23-5(only for HM7136B)



SOT89-5



ESOP8

Pin Assignment

HM7136A

| Pin Number | | Pin Name | Functions |
|------------|---------|----------|--------------------------------|
| ESOP8 | SOT89-5 | | |
| 2 | 1 | CS | Output current detection |
| 1 | 2 | D(LED) | The negative input feet of LED |
| 3 | 3 | VDD | Power Input |
| 5 | 4 | GND | Ground |
| 7 | 5 | EXT | Driving external NMOS |
| 4,6,8 | | NC | No connection |

HM7136B

| Pin Number | Pin Name | Functions |
|------------|----------|--------------------------|
| SOT23-5 | | |
| 1 | NC | NC |
| 2 | GND | Ground |
| 3 | VDD | Power Input |
| 4 | CS | Output current detection |
| 5 | EXT | Driving external NMOS |

Absolute Maximum Ratings

| Parameter | Symbol | Ratings | Units |
|-------------------|-------------------|-----------------------------------|-------|
| Input Voltage | V_{DD} | 18 | V |
| Voltage on LED,CS | V_{LED}, V_{CS} | $-0.3 \sim V_{DD} + 0.3$ | V |
| Voltage on EXT | V_{EXT} | 6 | V |
| Output Current | I_{OUT} | 1.5 | A |
| Power Dissipation | SOT89-5 | 500 | mW |
| | | 1300 (PCB mounted) ^(*) | |

| | ESOP8 | P_D | 2000 | mW ($T=25^{\circ}\text{C}$) |
|--|---------|-----------|------------------------------|----------------------------------|
| | | | 2000 (PCB mounted) (*1) | |
| | SOT23-5 | P_D | 300 | |
| Operating Temperature Range | | T_{OPR} | $-40 \sim +125$ | $^{\circ}\text{C}$ |
| Storage Temperature Range | | T_{STG} | $-40 \sim +150$ | $^{\circ}\text{C}$ |
| Lead Temperature | | | 260°C , 4sec | |
| ESD(ESD voltage for human body model) | | V_{ESD} | 2000 | V |

*1:The power dissipation figure shown in PCB mounted. Please refer to page8-9 for details.

Electrical Characteristics

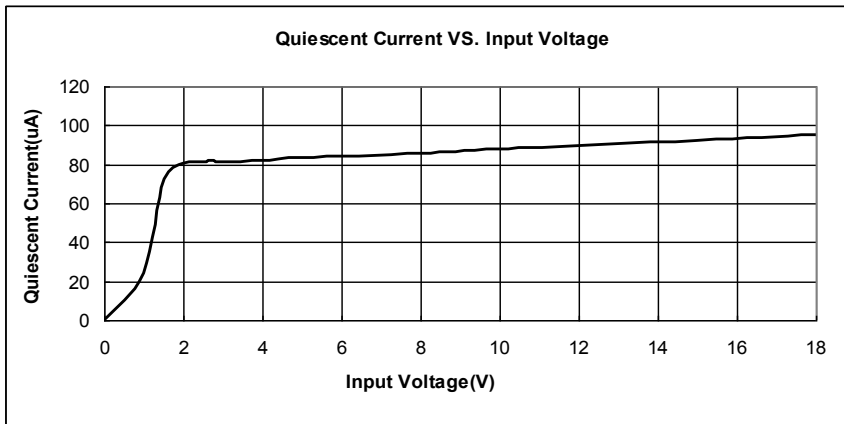
HM7136A/HM7136B

($V_{DD}=3.6\text{V}$, $T_a=25^{\circ}\text{C}$, unless otherwise noted)

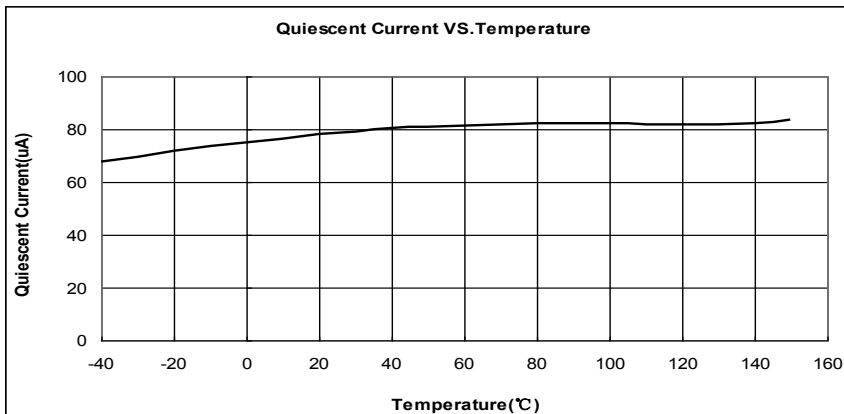
| Parameter | Symbol | Conditions | Min. | Typ. | Max. | Units |
|-----------------------------|--------------------------|--|------|------|------|--------------------|
| Sink Current | I_{sink} | $V_{DD}=3.6\text{V}$ | 10 | | 1000 | mA |
| Input Voltage | V_{DD} | $I_{\text{sink}}=1\text{A}$ | 2.7 | | 18 | V |
| CS Voltage | V_{CS} | | 95 | 100 | 105 | mV |
| Sink current accuracy | $\Delta I_{LED}/I_{LED}$ | $I_{\text{sink}}=1\text{A}$ | -5 | -2.5 | 5 | % |
| Load Regulation | LDR | $V_{LED}=0.2\text{V to }3\text{V}$ $V_{DD}=3.6\text{V}$ | | 0.1 | 2 | mA/V |
| Line Regulation | LNR | $V_{LED}=3\text{V}$ $3.6\text{V} \leq V_{DD} \leq 18\text{V}$ | | 0.4 | 2 | mA/V |
| Output dropout voltage | V drop | $V_{DD}=3.6\text{V}$, $V_{LED}=0.5\text{V}$ | | 50 | 100 | mV |
| Quiescent Current | I_{SS} | $V_{DD}=3.6\text{V}$ | | 80 | 100 | uA |
| Low Voltage Protection | | | 2.3 | 2.5 | 2.7 | V |
| Low voltage hysteresis | V_{hys} | | | 0.15 | | V |
| Maximal EXT Voltage | V_{EXT} | $V_{DD}=5.0\text{V}$, $V_{CS}=0\text{V}$ | 2.5 | 3.6 | 4.5 | V |
| Thermal Shutdown protection | T_{sd} | | | 165 | | $^{\circ}\text{C}$ |

Type Characteristics

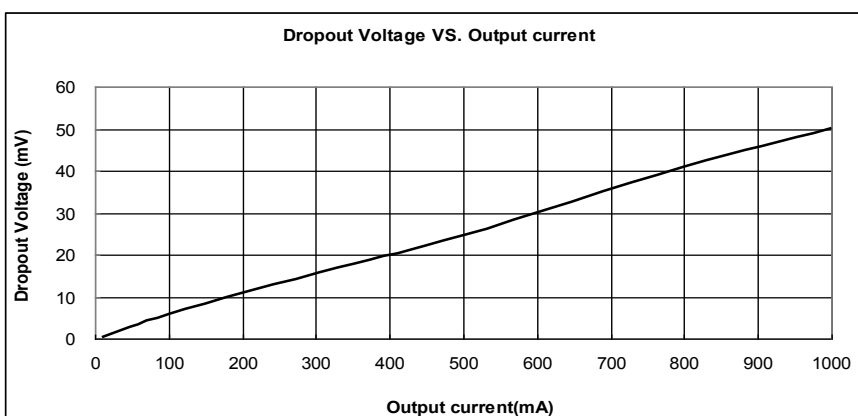
- (1) Quiescent Current VS. Input Voltage (No external component)



- (2) Quiescent Current VS. Temperature ($V_{DD}=3.6V$)



- (3) Dropout Voltage VS. Output Current ($V_{DD}=3.6V$)



Adjustment of the ME7136B output current

1 Output current adjustment by external DC control voltage

The Dimming pin can be driven by an external dc voltage (V_{DC}), as shown, to adjust the output current to a value below the nominal average value defined by R_{EXT} . $V_{REF}=0.1V$.

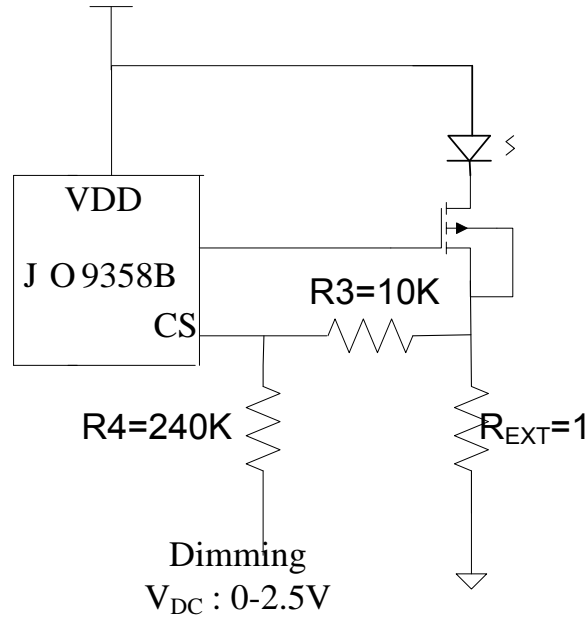


Figure 1. Dimming Control Using a DC Voltage

$$R4:R3=24:1$$

The average output current is given by:

$$I_{LED} = \frac{V_{REF} - \frac{R3 \times (V_{DC} - V_{REF})}{R4}}{R_{EXT}} \quad (0 \leq V_{DC} \leq 2.5V)$$

$$I_{LED} = 0 \quad (2.5 \leq V_{DC} \leq V_{DD})$$

2 Output current adjustment by PWM control

A Pulse Width Modulated (PWM) signal with duty cycle PWM can be applied to the Dimming pin, as shown below, to adjust the output current to a value below the nominal average value set by resistor R_{EXT} . $V_{REF}=0.1V$.

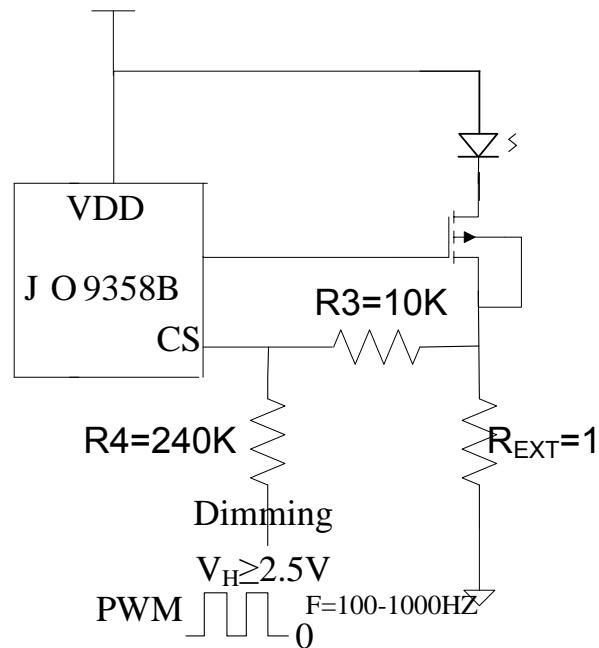


Figure 2. Dimming Control Using a PWM Signal

$R4:R3=24:1$

The average output current is given by:

$$I_{LED} = \frac{V_{REF} - \frac{R3 \times (2.5 \times Duty - V_{REF})}{R4}}{R_{EXT}}$$

($2.5 \leq V_{PWM} \leq V_{DD}$ & $0 \leq Duty \leq 100\%$)

PWM dimming provides reduced brightness by modulating the LED's forward current between 0% and 100%. The LED brightness is controlled by adjusting the relative ratios of the on time to the off time. A 25% brightness level is achieved by turning the LED on at full current for 25% of one cycle. To ensure this switching process between on and off state is invisible by human eyes, the switching frequency must be greater than 100 Hz. Above 100 Hz, the human eyes average the on and off times, seeing only an effective brightness that is proportional to the LED's on-time duty cycle. The advantage of PWM dimming is that the forward current is always constant, therefore the LED color does not vary with brightness as it does with analog dimming. Pulsing the current provides precise brightness control while preserving the color purity. The best dimming frequency of HM7136B is 100Hz to 1kHz.

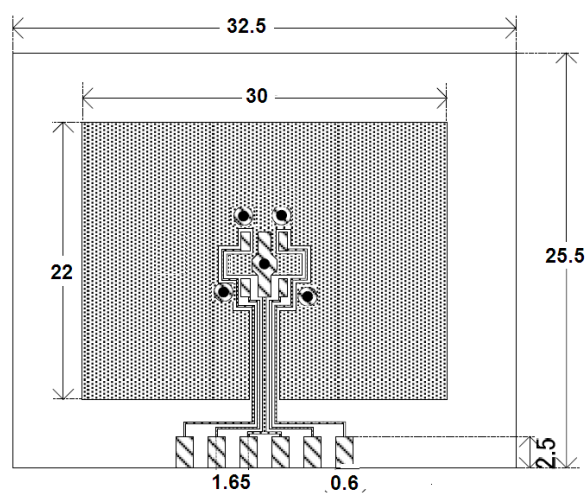
Power dissipation

● SOT89-5 power dissipation

The power dissipation data for the SOT89-5 is shown as below. The value of power dissipation varies with the mount board conditions. Please use this data as the reference data taken in the following condions.

1. Measurement condition

Condition: Mount on a board
Ambient: Natural convection
Soldering: Lead(pb) free
Board: Dimensions 30*35mm (1050mm² in one side)
Copper(Cu) traces occupy 50% of the board
Area in top and back faces
Material: Glass Epoxy (FR-4)
Thickness: 1.6mm
Through-hole: 5*0.8 Diameter

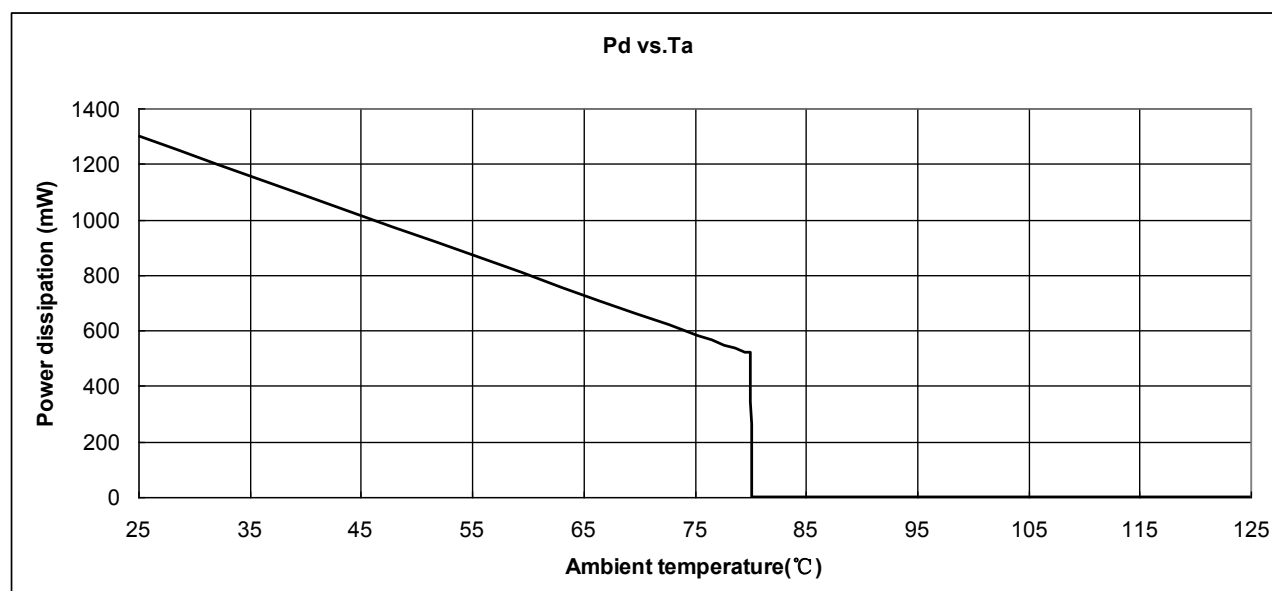


Evaluation Board(Unit:mm)

2. Power dissipation vs. Ambient temperature

Board Mount (T_j max=125 °C)

| Ambient Temperature(°C) | Power Dissipation(mW) | Thermal Resistance(°C/W) |
|-------------------------|-----------------------|--------------------------|
| 25 | 1300 | 76.92 |
| 85 | 520 | |

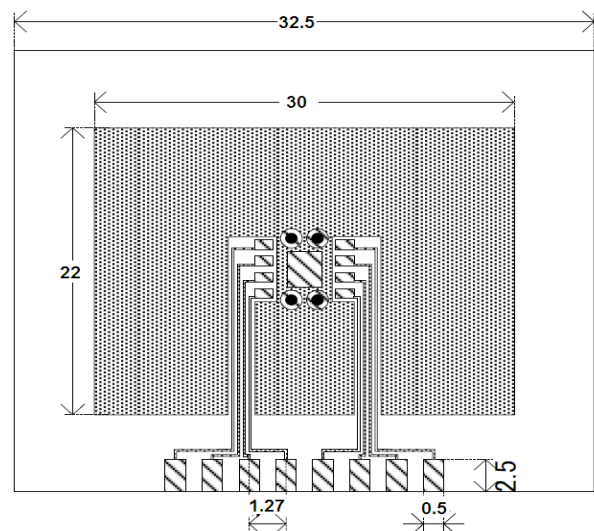


● ESOP8 power dissipation

The power dissipation data for the ESOP8 is shown as below. The value of power dissipation varies with the mount board conditions. Please use this data as the reference data taken in the following condions.

3. Measurement condition

Condition: Mount on a board
Ambient: Natural convection
Soldering: Lead(pb) free
Board: Dimensions 30*35mm (1050mm² in one side)
Copper(Cu) traces occupy 50% of the board
Area in top and back faces
Material: Glass Epoxy (FR-4)
Thickness: 1.6mm
Through-hole: 4*0.8 Diameter

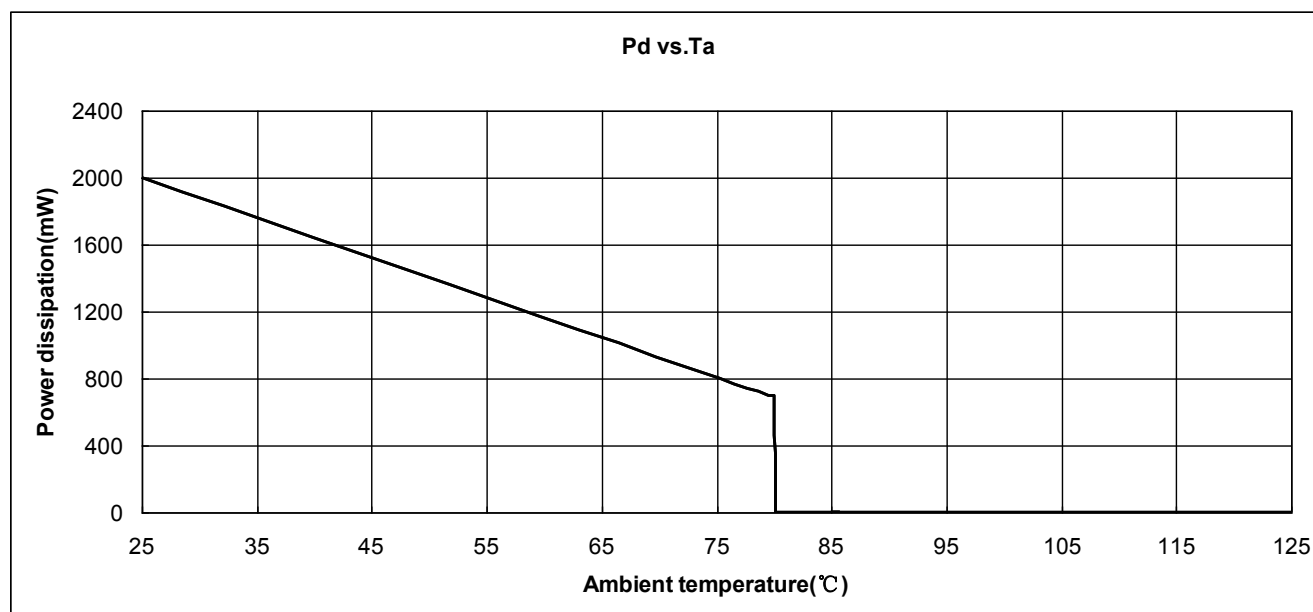


4. Power dissipation vs. Ambient temperature

Board Mount ($T_j \text{ max} = 125^\circ\text{C}$)

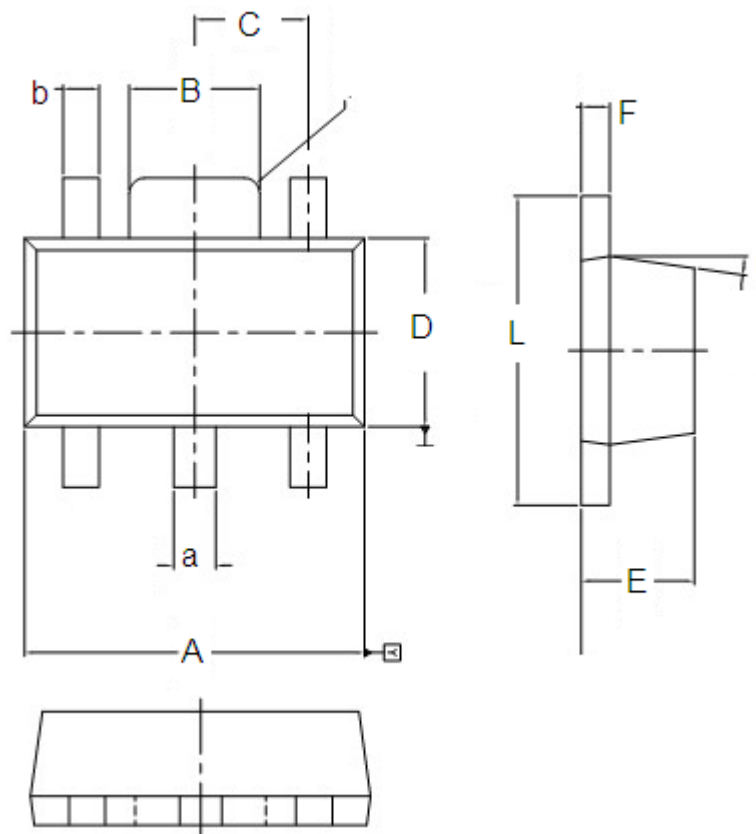
Evaluation Board(Unit:mm)

| Ambient Temperature($^\circ\text{C}$) | Power Dissipation(mW) | Thermal Resistance($^\circ\text{C}/\text{W}$) |
|---|-----------------------|---|
| 25 | 2000 | 66.67 |
| 85 | 700 | |



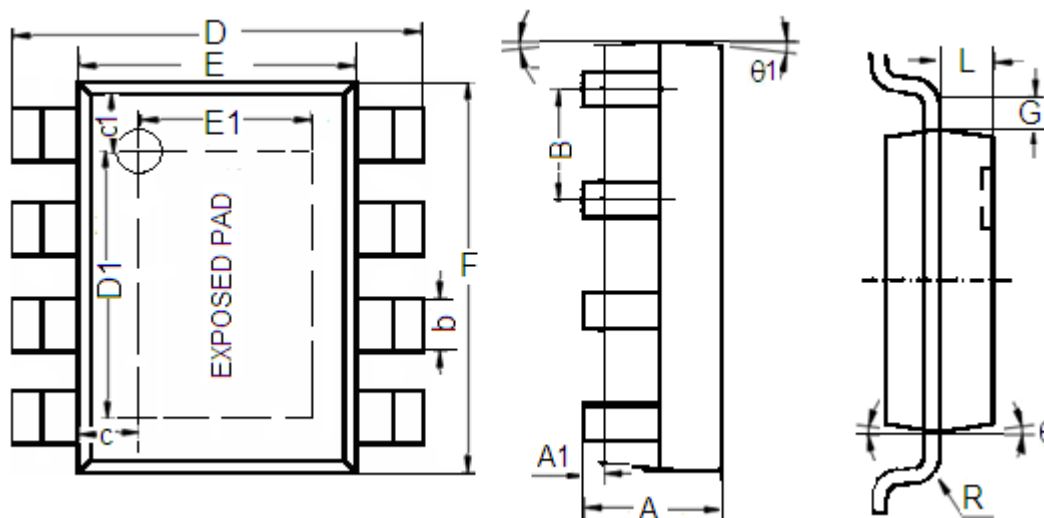
Packaging Information

- Packaging Type: SOT89-5



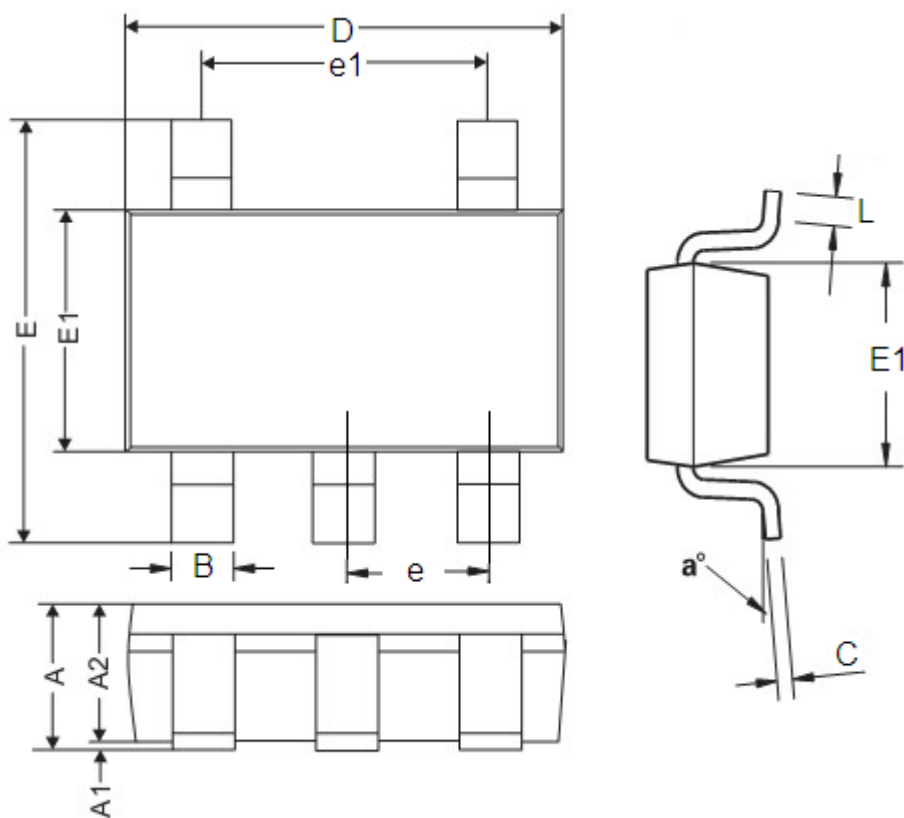
| DIM | Millimeters | | Inches | |
|-----|---------------------|------|---------------------|-------|
| | Min | Max | Min | Max |
| A | 4.4 | 4.6 | 0.173 | 0.181 |
| a | 0.5 | 0.62 | 0.02 | 0.024 |
| B | 1.63 | 1.83 | 0.064 | 0.072 |
| b | 0.44 | 0.54 | 0.017 | 0.021 |
| C | Type:1.5 | | Type:0.059 | |
| D | 2.4 | 2.6 | 0.094 | 0.102 |
| E | 1.4 | 1.6 | 0.054 | 0.063 |
| F | 0.35 | 0.43 | 0.013 | 0.017 |
| L | 3.95 | 4.25 | 0.155 | 0.167 |
| r | Type:8 ⁰ | | Type:8 ⁰ | |

● Packaging Type: SOP8-PP



| Character | Dimension (mm) | | Dimension (Inches) | |
|-----------|----------------|-------|--------------------|-------|
| | Min | Max | Min | Max |
| A | 1.350 | 1.750 | 0.053 | 0.069 |
| A1 | 0.1 | 0.3 | 0.004 | 0.012 |
| B | 1.27(Typ.) | | 0.05(Typ.) | |
| b | 0.330 | 0.510 | 0.013 | 0.020 |
| c | 0.9(Typ.) | | 0.035(Typ.) | |
| c1 | 1.0(Typ.) | | 0.039(Typ.) | |
| D | 5.8 | 6.2 | 0.228 | 0.244 |
| D1 | 3.202 | 3.402 | 0.126 | 0.134 |
| E | 3.800 | 4.000 | 0.150 | 0.157 |
| E1 | 2.313 | 2.513 | 0.091 | 0.099 |
| F | 4.7 | 5.1 | 0.185 | 0.201 |
| L | 0.675 | 0.725 | 0.027 | 0.029 |
| G | 0.32(Typ.) | | 0.013(Typ.) | |
| R | 0.15(Typ.) | | 0.006(Typ.) | |
| θ1 | 7° | | 7° | |
| θ | 8° | | 8° | |

Package type:SOT23-5 Unit:mm(inch)



| DIM | Millimeters | | Inches | |
|-----|-------------|------|-----------|--------|
| | Min | Max | Min | Max |
| A | 0.9 | 1.45 | 0.0354 | 0.0570 |
| A1 | 0 | 0.15 | 0 | 0.0059 |
| A2 | 0.9 | 1.3 | 0.0354 | 0.0511 |
| B | 0.2 | 0.5 | 0.0078 | 0.0196 |
| C | 0.09 | 0.26 | 0.0035 | 0.0102 |
| D | 2.7 | 3.10 | 0.1062 | 0.1220 |
| E | 2.2 | 3.2 | 0.0866 | 0.1181 |
| E1 | 1.30 | 1.80 | 0.0511 | 0.0708 |
| e | 0.95REF | | 0.0374REF | |
| e1 | 1.90REF | | 0.0748REF | |
| L | 0.10 | 0.60 | 0.0039 | 0.0236 |
| a° | 0° | 30° | 0° | 30° |