High Voltage, High Efficiency, Constant Current PWM Buck Controller for LED Lighting

General Description

The RT8458D is a PWM controller with an internal high side gate driver. Because of the Buck topology, the input voltage for the Buck system is only limited by the voltage rating of the external MOSFET. It is used for step down converters by well controlling the external MOSFET and regulating a constant output current. The output duty cycle of the RT8458D can be up to 100% for wider input voltage application.

The RT8458D also features a 160kHz fixed frequency oscillator, an internal \(-220mV\) precision reference, and a PWM comparator with latching logic. The accurate output LED current is achieved by an averaging current feedback loop and the LED current dimming can be easily controlled via the ACTL pin. The RT8458D also has multiple features to protect the controller from fault conditions, including Under Voltage Lockout (UVLO), Over Current Protection (OCP) and Over Voltage Protection (OVP). Additionally, to ensure the system reliability, the RT8458D is built with the thermal protection function.

The RT8458D is housed in a TSOT-23-6 package. Thus, the components in the whole LED driver system can be made very compact.

Features

- Low Cost and Efficient Buck Converter Solution
- Input Voltage Depends On External MOSFET
- Programmable Constant LED Current
- Dimmable LED Current by ACTL
- 100% Maximum Duty Cycle
- 160kHz Fixed Switching Frequency
- Output LED String Open Protection
- Output LED String Short Protection
- Output LED String Over Current Protection
- Built-in Thermal Protection
- TSOT-23-6 Package
- RoHS Compliant and Halogen Free

Applications

- E27, PAR30, Offline LED Lights

Marking Information

13= : Product Code
DNN : Date Code

Simplified Application Circuit
## Functional Pin Description

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Pin Name</th>
<th>Pin Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>VCC</td>
<td>Supply Voltage Input of the chip. For good bypass, a ceramic capacitor near the VCC pin is required.</td>
</tr>
<tr>
<td>2</td>
<td>GND</td>
<td>Ground of the Chip.</td>
</tr>
<tr>
<td>3</td>
<td>GATE</td>
<td>Gate Driver Output for External MOSFET Switch.</td>
</tr>
<tr>
<td>4</td>
<td>ACTL</td>
<td>Analog Dimming Control Input. The effective dimming range is between 0.1V to 1.2V. If ( V_{ACTL} ) is greater than 1.2V, the ACTL dimming signal high is internally clamped around 1.3V. If dimming is not used, a pull up resistor or a voltage holding capacitor between ACTL and GND pins should be used.</td>
</tr>
<tr>
<td>5</td>
<td>VC</td>
<td>PWM Loop Compensation Node.</td>
</tr>
<tr>
<td>6</td>
<td>SENSE</td>
<td>LED Current Sense Input. The typical sensing threshold is (-220)mV between the SENSE and GND pin.</td>
</tr>
</tbody>
</table>

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**Ordering Information**

- **Package Type:** J6 : TSOT-23-6
- **Lead Plating System:** G : Green (Halogen Free and Pb Free)

**Note:**

Richtek products are:

- RoHS compliant and compatible with the current requirements of IPC/JEDEC J-STD-020.
- Suitable for use in SnPb or Pb-free soldering processes.

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**Pin Configurations**

(TOP VIEW)

<table>
<thead>
<tr>
<th>SENSE</th>
<th>VC</th>
<th>ACTL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>VCC</td>
<td>GND</td>
<td>GATE</td>
</tr>
</tbody>
</table>

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Function Block Diagram

**Operation**

The RT8458D is a PWM Buck current mode controller with an integrated high side gate driver. The start-up voltage of RT8458D is around 10V. Once VCC is above the start-up voltage, the RT8458D will maintain operation until VCC drops below 8V.

The RT8458D's main control loop consists of a 160kHz fixed frequency oscillator, an internal −220mV precision current sense threshold OPAMP (OP1), and a PWM comparator (CCOMP) with latching logic. In normal operation, the GATE turns high when the gate driver is set by the oscillator (OSC). The lower the average of the sensed current is below the loop-regulated −220mV threshold, the higher the VC pin voltage (OP1 output) will go high. Higher the VC voltage means longer the GATE turn-on period. The GATE of RT8458D can turn on up to 100% duty. The GATE turns low until the current comparator (CCOMP) resets the gate driver. The GATE will be set high again by OSC and the next switching cycle repeats.

The adjustment of the regulated sense current threshold (dimming) can be achieved by varying ACTL pin voltage. The typical range of ACTL voltage adjustment is between 0.1V and 1.2V.

The RT8458D is equipped with protection from several fault conditions, including input voltage Under Voltage Lockout (UVLO), Over Current Protection (OCP) and VIN/VOUT Over Voltage Protection (OVP). Additionally, to ensure the system reliability, the RT8458D is built with internal thermal protection function.
Absolute Maximum Ratings  (Note 1)

- Supply Input Voltage, VCC -------------------------------------------------------- -0.3V to 40V
- GATE Voltage (Note 8) ---------------------------------------------------------- -0.3V to 16V
- ACTL Voltage (Note 6) ----------------------------------------------------------- -0.3V to 8V
- VC Voltage ----------------------------------------------------------------------- -0.3V to 6V
- SENSE Voltage ------------------------------------------------------------------- -1V to 0.3V
- Power Dissipation, P_D @ T_A = 25°C
  TSOT-23-6 ----------------------------------------------------------------------- 0.392W
- Package Thermal Resistance (Note 2)
  TSOT-23-6, θJA ------------------------------------------------------------------- 255°C/W
  TSOT-23-6, θJC ------------------------------------------------------------------- 135°C/W
- Junction Temperature ------------------------------------------------------------- 150°C
- Lead Temperature (Soldering, 10 sec.) --------------------------------------------- 260°C
- Storage Temperature Range ------------------------------------------------------- -65°C to 150°C
- ESD Susceptibility (Note 3)
  HBM (Human Body Model) ---------------------------------------------------------- 2kV
  MM (Machine Model) ---------------------------------------------------------------- 200V

Recommended Operating Conditions  (Note 4)

- Supply Input Voltage, VCC -------------------------------------------------------- 10V to 31V
- Junction Temperature Range ------------------------------------------------------ -40°C to 125°C

Electrical Characteristics  
(VCC = 24V, T_A = 25°C, unless otherwise specified)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Test Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Start-Up Voltage</td>
<td>V_CC_ST</td>
<td></td>
<td>--</td>
<td>10</td>
<td>12</td>
<td>V</td>
</tr>
<tr>
<td>Minimum Operation Voltage</td>
<td>V_CC(MIN)</td>
<td>After Start-Up</td>
<td>--</td>
<td>8</td>
<td>9</td>
<td>V</td>
</tr>
<tr>
<td>Maximum Startup Current in</td>
<td>I_ST(MAX)</td>
<td>VCC Hiccup Operation</td>
<td>--</td>
<td>250</td>
<td>300</td>
<td>μA</td>
</tr>
<tr>
<td>VCC Hiccup Operation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input Supply Current</td>
<td>I_CC</td>
<td>After Start-Up, V_CC = 24V</td>
<td>--</td>
<td>2</td>
<td>5</td>
<td>mA</td>
</tr>
<tr>
<td>Input Shutdown Current</td>
<td>I_QC</td>
<td>Before Start-Up, V_CC = 5V</td>
<td>--</td>
<td>1</td>
<td>5</td>
<td>μA</td>
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</table>

Oscillator

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Test Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switching Frequency</td>
<td>f_SW</td>
<td></td>
<td>120</td>
<td>160</td>
<td>200</td>
<td>kHz</td>
</tr>
<tr>
<td>Maximum Duty in Transient</td>
<td>D_MAX(TR)</td>
<td>V_C = 3V</td>
<td>--</td>
<td>--</td>
<td>100</td>
<td>%</td>
</tr>
<tr>
<td>Operation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum Duty in Steady State</td>
<td>D_MAX</td>
<td></td>
<td>--</td>
<td>88</td>
<td>--</td>
<td>%</td>
</tr>
<tr>
<td>Operation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blanking Time</td>
<td>t_BLANK</td>
<td>(Note 7)</td>
<td>--</td>
<td>300</td>
<td>--</td>
<td>ns</td>
</tr>
<tr>
<td>Minimum Off Time</td>
<td>t_OFF(MIN)</td>
<td>(Note 7)</td>
<td>--</td>
<td>600</td>
<td>--</td>
<td>ns</td>
</tr>
</tbody>
</table>
### Notes

1. Stresses beyond those listed "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions may affect device reliability.

2. $\theta_{JA}$ is measured at $T_A = 25^\circ C$ on a low effective thermal conductivity single-layer test board per JEDEC 51-3. $\theta_{JC}$ is measured at the exposed pad of the package.

3. Devices are ESD sensitive. Handling precaution is recommended.

4. The device is not guaranteed to function outside its operating conditions.

5. The RT8458D achieves precise LED average current with a current feedback loop to sense the average LED current, in the deep discontinuous mode operation especially when a small inductor is used, small current offset might occur due to current waveform distortion of the nature of the discontinuous operation. This offset current is consistent over production.

6. If a 1MΩ resistor is connected between the control input and ACTL pin, the control input voltage can be up to 36V.

7. Guaranteed by design, not subjected to production test.

8. The GATE voltage is internally clamped and varies with operating conditions.

### Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Test Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
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<tr>
<td>Current Sense Amplifier</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current Sense Voltage</td>
<td>$V_{SENSE}$</td>
<td>(Note 5)</td>
<td>$-213$</td>
<td>$-220$</td>
<td>$-227$</td>
<td>mV</td>
</tr>
<tr>
<td>Sense Input Current</td>
<td>$I_{SENSE}$</td>
<td>(Note 7)</td>
<td>--</td>
<td>11</td>
<td>--</td>
<td>$\mu$A</td>
</tr>
<tr>
<td>VC Sourcing Current</td>
<td>$I_{VC_{Source}}$</td>
<td>$V_{SENSE} = -150mV$</td>
<td>(Note 7)</td>
<td>--</td>
<td>20</td>
<td>--</td>
</tr>
<tr>
<td>VC Sinking Current</td>
<td>$I_{VC_{Sink}}$</td>
<td>$V_{SENSE} = -250mV$</td>
<td>(Note 7)</td>
<td>--</td>
<td>180</td>
<td>--</td>
</tr>
<tr>
<td>VC Threshold for PWM Switch Off</td>
<td>$V_{VC}$</td>
<td></td>
<td>1.15</td>
<td>1.25</td>
<td>1.35</td>
<td>V</td>
</tr>
<tr>
<td>GATE Driver Output</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GATE Pin Maximum Voltage</td>
<td>$V_{GATE}$</td>
<td>No Load at GATE Pin</td>
<td>--</td>
<td>10</td>
<td>16</td>
<td>V</td>
</tr>
<tr>
<td>GATE Voltage High</td>
<td>$V_{GATE_H}$</td>
<td>$I_{GATE} = -50mA$</td>
<td>8</td>
<td>9.7</td>
<td>11.5</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$I_{GATE} = -100\mu$A</td>
<td>8.5</td>
<td>10</td>
<td>12</td>
<td>V</td>
</tr>
<tr>
<td>GATE Voltage Low</td>
<td>$V_{GATE_L}$</td>
<td>$I_{GATE} = 50mA$</td>
<td>0.01</td>
<td>0.75</td>
<td>1.2</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$I_{GATE} = 100\mu$A</td>
<td>0.01</td>
<td>0.5</td>
<td>1.2</td>
<td>V</td>
</tr>
<tr>
<td>GATE Drive Rise Time</td>
<td></td>
<td>1nF Load at GATE</td>
<td>--</td>
<td>60</td>
<td>150</td>
<td>ns</td>
</tr>
<tr>
<td>GATE Driver Fall Time</td>
<td></td>
<td>1nF Load at GATE</td>
<td>--</td>
<td>30</td>
<td>100</td>
<td>ns</td>
</tr>
<tr>
<td>GATE Drive Source Peak Current</td>
<td></td>
<td>1nF Load at GATE</td>
<td>--</td>
<td>0.2</td>
<td>0.5</td>
<td>A</td>
</tr>
<tr>
<td>GATE Driver Sink Peak Current</td>
<td></td>
<td>1nF Load at GATE</td>
<td>--</td>
<td>0.5</td>
<td>0.8</td>
<td>A</td>
</tr>
<tr>
<td>LED Dimming</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Analog Dimming ACTL Pin Input Current</td>
<td>$I_{ACTL}$</td>
<td>$V_{ACTL} = 1.2V$</td>
<td>--</td>
<td>1</td>
<td>5</td>
<td>$\mu$A</td>
</tr>
<tr>
<td>LED Current On Threshold at ACTL</td>
<td>$V_{ACTL_{On}}$</td>
<td></td>
<td>--</td>
<td>1.2</td>
<td>1.3</td>
<td>V</td>
</tr>
<tr>
<td>LED Current Off Threshold at ACTL</td>
<td>$V_{ACTL_{Off}}$</td>
<td></td>
<td>--</td>
<td>0.1</td>
<td>0.2</td>
<td>V</td>
</tr>
<tr>
<td>OVP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Over Voltage Protection</td>
<td>$V_{OVP}$</td>
<td>VCC Pin</td>
<td>32</td>
<td>35</td>
<td>38</td>
<td>V</td>
</tr>
<tr>
<td>Thermal Protection</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thermal Shutdown Temperature</td>
<td>$T_{SD}$</td>
<td></td>
<td>--</td>
<td>150</td>
<td>--</td>
<td>$^\circ$C</td>
</tr>
</tbody>
</table>
Typical Application Circuit

- **VIN**: 50V
- **VOUT**: 30V
- **IOUT**: 350mA

Component Values:
- CIN: 10µF/100V
- COUT: 220µF/50V
- L1: 200µH
- D1: SK36C
- D2: 1N4148
- ZD1: Short

Resistors:
- RVC: 10k
- RVC2: 3.3nF
- RVC1: 1nF
- RVCC: 180k
- RACTL: 1M
- RO: 0.63
- RG: 0R

Capacitors:
- 4.7µF
- 10µF/100V
- 10k
- 1nF

Optional Components:
- Q1
- RG
- ZD1

Diagram shows the connection between various components, including feedback and sink nodes.
Application Information

The RT8458D is a high efficiency PWM Buck LED controller for high brightness LED application. Its high side gate driver is used to control the Buck converter via an external MOSFET and regulate the constant output current. The RT8458D can achieve high accurate LED output current via the average current feedback loop control. The internal sense voltage (~220mV typ.) is used to set the average output current. The oscillator's frequency is fixed at 160kHz to get better switching performance. Once the average current is set by the external resistor, Rs, the output LED current can be dimmed by varying the ACTL voltage.

Under Voltage Lockout (UVLO)
The RT8458D includes a UVLO feature with 2V hysteresis. The GATE terminal turns on when VIN rises over 10V (typ.). The GATE terminal turns off when VIN falls below 8V (typ.).

Setting Average Output Current
The output current that flows through the LED string is set by an external resistor, Rs, which is connected between the GND and SENSE pins. With ACTL pin voltage greater than 1.2V, the relationship between output current, IOUT, and Rs is shown below:

\[ I_{OUT} = \frac{0.22}{R_s} \text{ (A)} \]

Analog Dimming Control
The ACTL terminal is driven by an external voltage, VACTL, to adjust the output current to an average value set by Rs. The voltage range for VACTL to adjust the output current is from 0.1V to 1.2V. For VACTL between 0.1V to 1.2V, the output current value will be determined by the following formula:

\[ I_{OUT_{avg}} = (0.22V / R_s) \times \frac{V_{ACTL} - 0.1}{1.1} \]

Start-Up Resistor
Start-up resistor should be chosen not to exceed the maximum start-up current. Otherwise, the RT8458D may latch low and will never start. The maximum start-up current is VIN / RVCC.

VCC Supplied from Auxiliary Winding
Auxiliary winding can be added to the main step-down converter with coupled inductor. Because the diode voltage drop and the RT8458D controller regulate the output current, the inductor's voltage drop is also relatively constant during the OFF time. To remain output average current, the main inductor should be in continuous current conduction throughout the step-down load range.
Three functions are needed to set the value of the main inductor: the voltage across the inductor, the operating frequency, and the inductor's current ripple. These functions will ensure that adequate energy is stored in the inductor together. The Auxiliary output voltage $V_{\text{Aux}}$ to VCC is given by:

$$V_{\text{Aux}} = \frac{N_2}{N_1} (V_{\text{Out}} + V_{D1}) - V_{D2}$$

$N_2 =$ primary turns and $N_2 =$ secondary turns.

The $V_{\text{Aux}}$ design value should be set below 31V for RT8458D OVP limitation in normal operation. This output in Figure 1 is independent of input voltage changes, as $D_2$ is ON when the MOSFET OFF. For a given inductor value, secondary power at the auxiliary output is limited by the onset of discontinuous current in the main primary loop.

To use Auxiliary output to supply the VCC, the Minimum load is required to place a resistor as load at the output. If $V_{\text{In}} >$ output LED forward voltage, the leakage current ($\sim 2mA$) which is RT8458D operating Current will pass through the output LED. To avoid this leakage current pass through LED, place a resistor between LED+ and LED−. The resistor value is ($V_{\text{Out}} / 2mA$) and the consume power is about ($V_{\text{Out}} x 2mA$).

**Input Capacitor Selection**

The input capacitor supplies the peak current to the inductor and flattens the current ripple on the input. The low ESR condition is required to avoid increasing power loss. The ceramic capacitor is recommended due to its excellent high frequency characteristic and low ESR. For maximum stability over the entire operating temperature range, capacitors with better dielectric are suggested.

For most of the RT8458D applications, a 10μF ceramic capacitor is sufficient. Use of X7R type ceramic capacitors is recommended. Lower operating frequencies will require proportionately higher capacitor values.

Thus, a 10μF / 100V electrolytic capacitor can be chosen in this case due to its low ESR.

**Inductor Selection**

The inductor value and operating frequency determine the ripple current according to a specific input and output voltage. The ripple current, $\Delta I_L$, increases with higher $V_{\text{In}}$ and decreases with higher inductance, as shown in equation below:

$$\Delta I_L = \frac{V_{\text{Out}}}{T_x L} \times \left[1 - \frac{V_{\text{Out}}}{V_{\text{In}}}\right]$$

To optimize the ripple current, the RT8458D operates the Buck converter in BCM (Boundary-Condition Mode). The largest ripple current will occur at the highest $V_{\text{In}}$. To guarantee that the ripple current stays below the specified value, the inductor value should be chosen according to the following equation:

$$L = \frac{V_{\text{Out}} \times T_S \times (1-D)}{2 \times I_{\text{Out}}}$$

where $D$ is the duty cycle and $T_S$ is the switching period.

**Forward Diode Selection**

The Schottky diode, with their low forward voltage drop and fast switching speed, is necessary for the RT8458D applications. In addition, power dissipation, reverse voltage rating and pulsating peak current are also important parameters for the Schottky diode selection. Choose a suitable Schottky diode with reverse voltage rating greater than the maximum output voltage. The diode's average current rating must exceed the average output current. The diode conducts current only when the power switch is turned off (typically less than 50% duty cycle). If using the PWM feature for dimming, it is important to consider diode leakage, which increases with temperature, from the output during the PWM low interval. Therefore, a Schottky diode with sufficiently low leakage current is suggested.

**MOSFET Selection**

For applications operating at high input or output voltages, the power N-MOSFET switch is typically chosen for drain voltage, $V_{DS}$, rating and low gate charge. Consideration of switch on-resistance, $R_{DS(ON)}$, is usually secondary because switching losses dominate power loss.
Output Capacitor Selection
The selection of $C_{OUT}$ is determined by the required ESR to minimize output voltage ripple. Moreover, the amount of bulk capacitance is also a key for $C_{OUT}$ selection to ensure that the control loop is stable. Loop stability can be checked by viewing the load transient response. The output voltage ripple, $\Delta V_{OUT}$, is determined by:

$$\Delta V_{OUT} \leq \Delta I_L \left[ \frac{1}{8f_{OSC}C_{OUT}} \right] \text{ESR}$$

where $f_{OSC}$ is the switching frequency and $\Delta I_L$ is the inductor ripple current. The output voltage ripple will be the highest at the maximum input voltage since $\Delta I_L$ increases with input voltage. Multiple capacitors placed in parallel may be needed to meet the ESR and RMS current handling requirement. Dry tantalum, special polymer, aluminum electrolytic and ceramic capacitors are all common selections and available in surface mount packages. Tantalum capacitors have the highest capacitance density, but it is important to only use ones that pass the surge test for use in switching power supplies. Special polymer capacitors offer very low ESR value, but with the trade-off of lower capacitance density. Aluminum electrolytic capacitors have significantly higher ESR, but still can be used in cost-sensitive applications for ripple current rating and long term reliability considerations.

Thermal Protection
A thermal protection feature is included to protect the RT8458D from excessive heat damage. When the junction temperature exceeds a threshold of 150°C, the thermal protection will turn off the GATE terminal.

Soldering Process of Pb-free Package Plating
To meet the current RoHS requirements, pure tin is selected to provide forward and backward compatibility with both the current industry standard SnPb-based soldering processes and higher temperature Pb-free processes. In the whole Pb-free soldering processes, pure tin is required with a maximum 260°C (<10s) for proper soldering on board, referring to J-STD-020 for more information.

Thermal Considerations
For continuous operation, do not exceed absolute maximum junction temperature. The maximum power dissipation depends on the thermal resistance of the IC package, PCB layout, rate of surrounding airflow, and difference between junction and ambient temperature. The maximum power dissipation can be calculated by the following formula:

$$P_{D(MAX)} = (T_{J(MAX)} - T_A) / \theta_{JA}$$

where $T_{J(MAX)}$ is the maximum junction temperature, $T_A$ is the ambient temperature, and $\theta_{JA}$ is the junction to ambient thermal resistance.

For recommended operating condition specifications, the maximum junction temperature is 125°C. The junction to ambient thermal resistance, $\theta_{JA}$, is layout dependent. For TSOT-23-6 package, the thermal resistance, $\theta_{JA}$, is 255°C/W on a standard JEDEC 51-3 single-layer thermal test board. The maximum power dissipation at $T_A = 25°C$ can be calculated by the following formula:

$$P_{D(MAX)} = (125°C - 25°C) / (255°C/W) = 0.392W$$

The maximum power dissipation depends on the operating ambient temperature for fixed $T_{J(MAX)}$ and thermal resistance, $\theta_{JA}$. The derating curve in Figure 2 allows the designer to see the effect of rising ambient temperature on the maximum power dissipation.

![Figure 2. Derating Curve of Maximum Power Dissipation](image-url)
Layout Considerations
For best performance of the RT8458D, the following layout guidelines should be strictly followed.

- The hold up capacitor, \( C_{VCC} \), must be placed as close as possible to the VCC pin.
- The output capacitor, \( C_{OUT} \), must be placed as close as possible to the LED terminal.
- The power GND should be connected to a strong ground plane.
- \( R_S \) should be connected between the GND pin and SENSE pin.
- Keep the main current traces as short and wide as possible.
- Place L1, Q1, \( R_S \), and D1 as close to each other as possible.

![Figure 3. PCB Layout Guide](image-url)

- Place the capacitor \( C_{VCC} \) as close as possible to the VCC pin.
- Narrow trace to avoid the switching noise.
- Place the output capacitor \( C_{OUT} \) as close as possible to LED terminal.
Outline Dimension

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Dimensions In Millimeters</th>
<th>Dimensions In Inches</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Min</td>
<td>Max</td>
</tr>
<tr>
<td>A</td>
<td>0.700</td>
<td>1.000</td>
</tr>
<tr>
<td>A1</td>
<td>0.000</td>
<td>0.100</td>
</tr>
<tr>
<td>B</td>
<td>1.397</td>
<td>1.803</td>
</tr>
<tr>
<td>b</td>
<td>0.300</td>
<td>0.559</td>
</tr>
<tr>
<td>C</td>
<td>2.591</td>
<td>3.000</td>
</tr>
<tr>
<td>D</td>
<td>2.692</td>
<td>3.099</td>
</tr>
<tr>
<td>e</td>
<td>0.838</td>
<td>1.041</td>
</tr>
<tr>
<td>H</td>
<td>0.080</td>
<td>0.254</td>
</tr>
<tr>
<td>L</td>
<td>0.300</td>
<td>0.610</td>
</tr>
</tbody>
</table>

TSOT-23-6 Surface Mount Package

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