

General Description

The TD1507 is a easy to use adjustable step-down (buck) switch-mode voltage regulators. The device is available in an adjustable output version. It is capable of driving a 2.5A load with excellent line and load regulation.

Requiring a minimum number of external components, the regulator is simple to use and include internal frequency compensation, and a fixed-frequency oscillator.

The output voltage is guaranteed to $\pm 3\%$ tolerance under specified input voltage and output load conditions. The oscillator frequency is guaranteed to $\pm 15\%$. External shutdown is included, featuring typically 80 μA standby current. Self protection features include a two stage frequency reducing current limit for the output switch and an over temperature shutdown for complete protection under fault conditions.

The TD1507 is available in TO252-5L package.

Features

- Adjustable output version
- Output adjustable from 1.23v to 34V
- Fixed 150KHz frequency internal oscillator
- Guaranteed 2.5A output load current
- Input voltage range up to 36V
- Low power standby mode, I_Q typically 70 μA
- TTL shutdown capability
- Excellent line and load regulation
- High efficiency
- Thermal shutdown and current limit protection
- Available in TO252-5L package

Applications

- Simple High-efficiency step-down regulator
- On-card switching regulators
- Positive to negative converter
- LCD monitor and LCD TV
- DVD recorder and PDP TV
- Battery charger
- Step-down to 3.3V for microprocessors

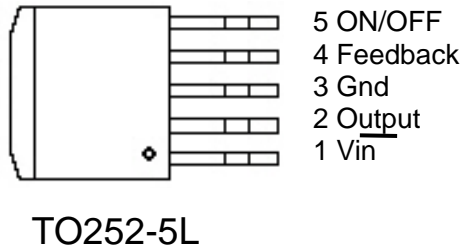
Package Types



Figure 1. Package Types of TD1507

2.5A 150KHZ PWM Buck DC/DC Converter **TD1507**

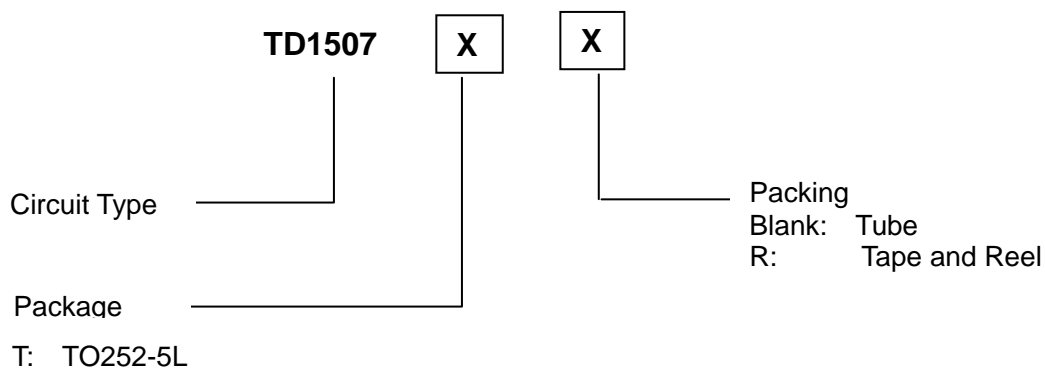
Pin Assignments



Pin Descriptions

| Name | Description |
|----------|--|
| Vin | Input supply voltage |
| Output | Switching output |
| Gnd | Ground |
| Feedback | Output voltage feedback |
| ON/OFF | ON/OFF shutdown Active is "Low" or floating |

Ordering Information



Functional Block Diagram

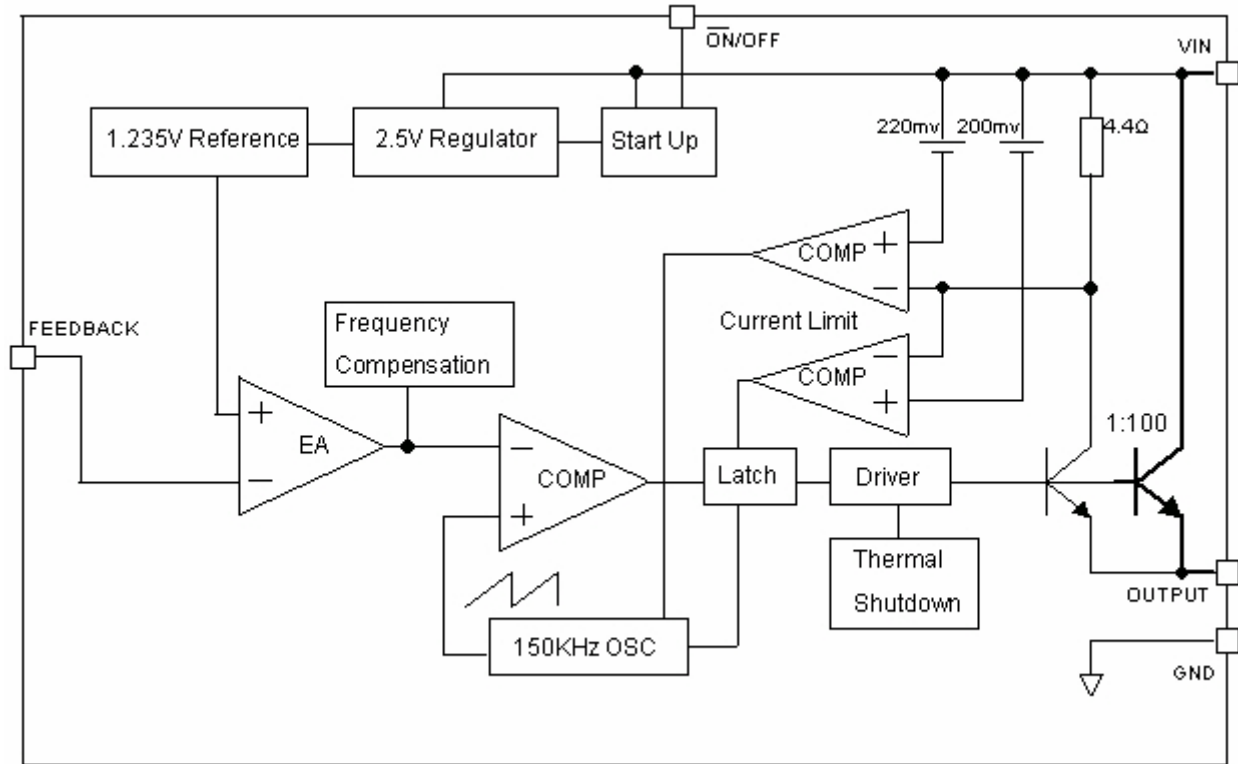


Figure 2. Functional Block Diagram of TD1507

Typical Application

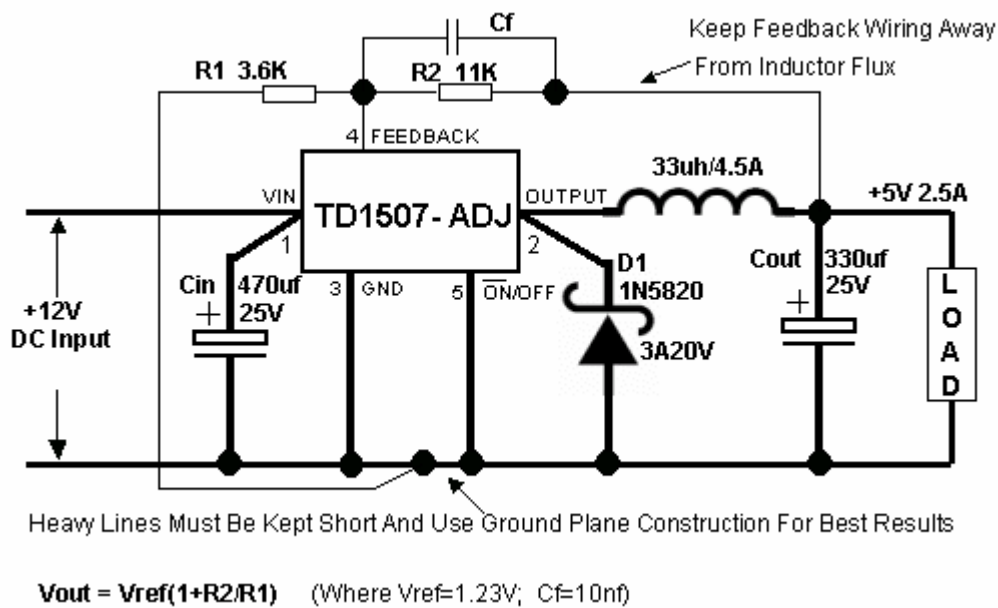


Figure 3. Typical Application of TD1507

2.5A 150KHZ PWM Buck DC/DC Converter

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Absolute Maximum Ratings

Note1: Stresses greater than those listed under Maximum Ratings may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operation is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

| Parameter | Value | Unit |
|---|----------------------|------|
| Supply Voltage V_{in} | -0.3 to 40 | V |
| Feedback VFB pin voltage | -0.3 to $V_{in}+0.3$ | V |
| ON/OFF Pin voltage | -0.3 to $V_{in}+0.3$ | V |
| Output pin voltage | -0.3 to $V_{in}+0.3$ | V |
| Output Voltage to Ground (Steady State) | -1 | V |
| Power Dissipation | Internally limited | W |
| Operating Temperature Range | -40 to +125 | °C |
| Storage Temperature | -65 to +150 | °C |
| Lead Temperature (Soldering, 10 sec) | 200 | °C |
| ESD(HM) | 2000 | V |

Electrical Characteristics

Unless otherwise specified, $V_{in} = 12V$. $I_{load} = 0.5A$, $T_a = 25^{\circ}C$.

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|----------------------|--|----------------------------------|------------|------|-----------------|------|
| I_b | Feedback bias current | $V_{FB}=1.3V$ | | 10 | 50/ 100 | nA |
| I_Q | Quiescent current | $V_{FB}=12V$ force driver off | | 5 | 10 | mA |
| I_{STBY} | Standby quiescent current | ON/OFF=5V, $V_{IN}=36V$ | | 70 | 150 | uA |
| F_{OSC} | Oscillator frequency | | 127 | 150 | 173 | KHz |
| V_{SAT} | Saturation voltage | $I_{OUT}=2A$ | | 1.10 | 1.4/ 1.5 | V |
| I_{CL} | Current Limit | Peak Current ($V_{FB}=0V$) | | 4.5 | 5.5/ 6.5 | A |
| I_L | Output leakage current | Output=0V ($V_{FB}=12V$) | | | 50 | uA |
| | Output leakage current | Output=-1V ($V_{IN}=36V$) | | 2 | 30 | mA |
| V_{IL} V_{IH} | ON/OFF pin logic input Threshold voltage | Low (Regulator ON) | | 1.3 | 0.6 | V |
| | | High (Regulator OFF) | 2.0 | 1.3 | | V |
| I_H | ON/OFF pin input current | $V_{LOGIC}=2.5V$ (Regulator OFF) | | 5 | 15 | uA |

2.5A 150KHZ PWM Buck DC/DC Converter

TD1507

| | | | | | | |
|---------------|--|--|------------------------|------|------------------------|---------------|
| I_L | | $V_{LOGIC}=0.5V(\text{Regulator ON})$ | | 0.02 | 5 | μA |
| θ_{JC} | Thermal Resistance Junction to Case | TO252-5L | | 10 | | $^{\circ}C/W$ |
| θ_{JA} | Thermal Resistance Junction to Ambient (Note1) | TO252-5L | | 50 | | $^{\circ}C/W$ |
| TD1507 ADJ | Vfb: Output Voltage | $11V \leq V_{IN} \leq 36V, 0.2A \leq I_{LOAD} \leq 3A, V_{OUT}$ for 9V | 1.193/ 1.180 | 1.23 | 1.267/ 1.280 | V |
| | η : Efficiency | $V_{IN}=12V, V_{OUT}=9V, I_{LOAD}=3A$ | | 88 | | % |

Specifications with **boldface type** are for full operating temperature range, the other type are for $T_J=25^{\circ}C$.

Note1: Thermal resistance with copper area of approximately 3 in².

Typical Performance Characteristics

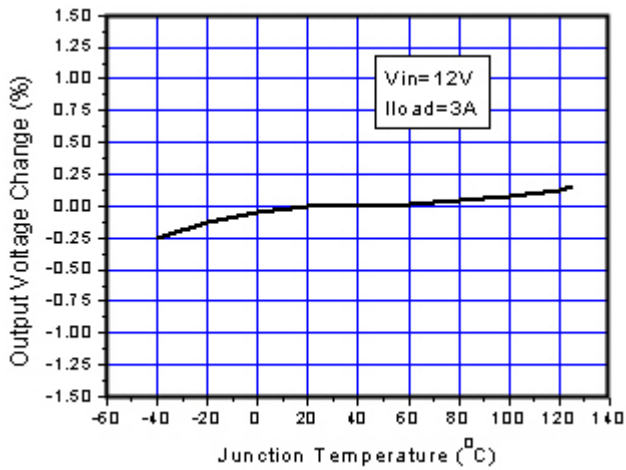


Figure 4. Output Voltage vs. Temperature

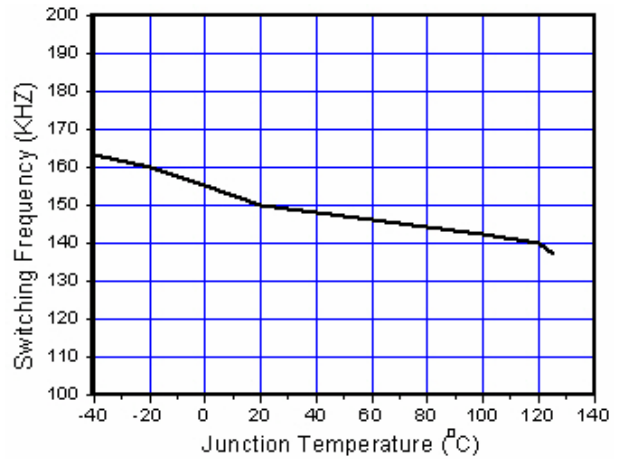


Figure 5. Switching Frequency vs. Temperature

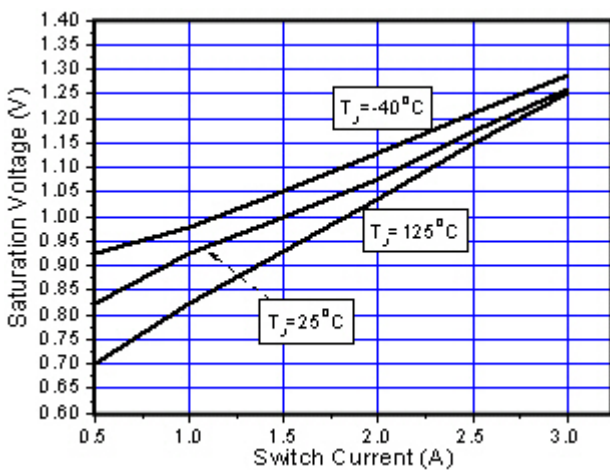


Figure 6. Output Saturation Characteristics

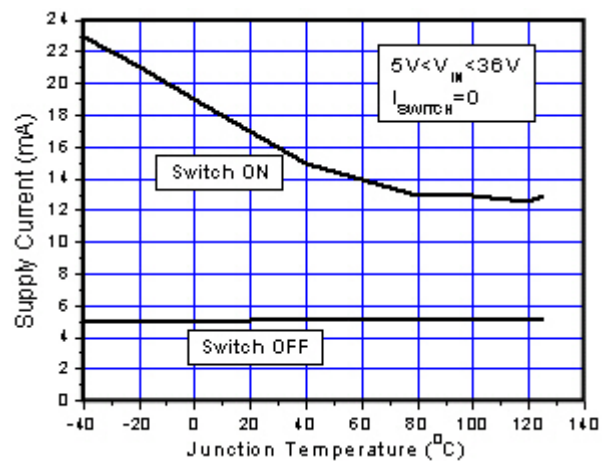


Figure 7. Quiescent Current vs. Temperature

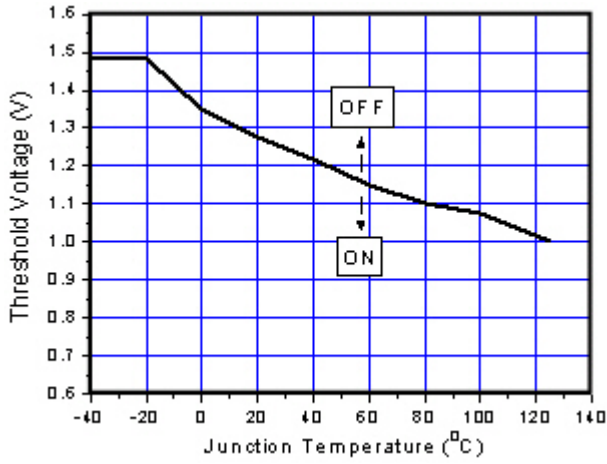


Figure 8. ON/OFF Pin Voltage

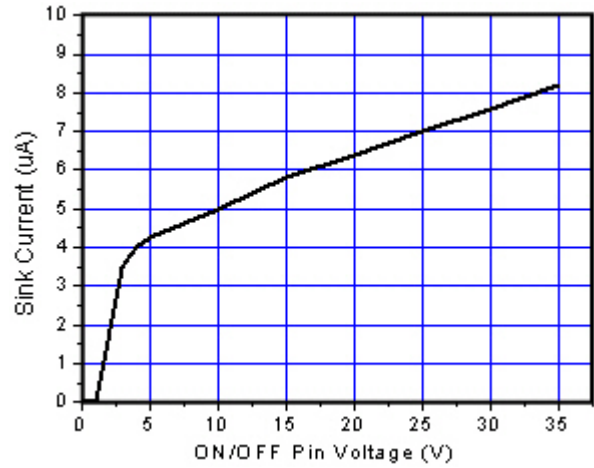


Figure 9. ON/OFF Pin Sink Current

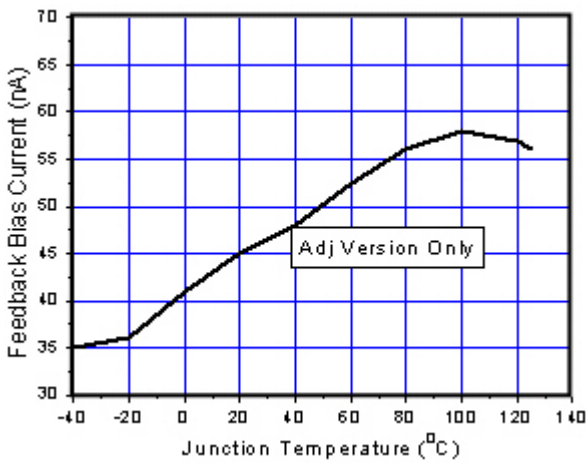
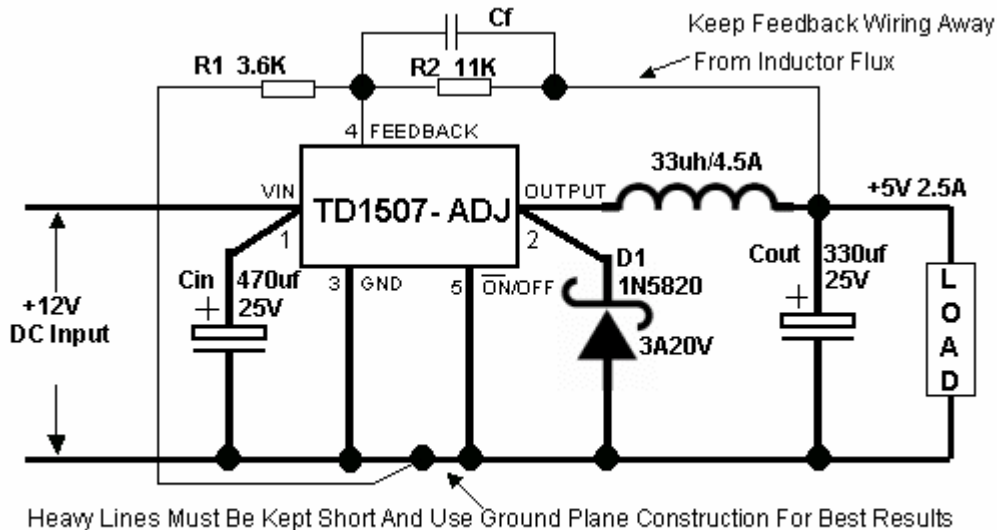


Figure 10. Output Saturation Characteristics

Typical Application Circuit



$V_{out} = V_{ref}(1+R2/R1)$ (Where $V_{ref}=1.23V$; $C_f=10nf$)

Figure 11. Typical Application of TD1507

| Vout | R1 | R2 | Cf (Operational) |
|------|------|------|------------------|
| 3.3V | 1.6K | 2.7K | 33nf |
| 5V | 3.6K | 11K | 10nf |
| 9V | 6.8K | 43K | 1.5nf |
| 12V | 1.5K | 13K | 1nf |

Table 1. Vout VS. R1, R2, Cf Select Table

| Output Voltage | Input Voltage | Inductor (L1) | Output Capacitor (Cout) |
|----------------|---------------|---------------|---------------------------|
| | | | Through Hole Electrolytic |
| 3.3V | 6V ~ 18V | 47uh | 470uf/25V |
| | 6V ~36V | 68uh | 560uf/25V |
| 5V | 8V ~ 18V | 33uh | 330uf/25V |
| | 8V ~36V | 47uh | 470uf/25V |
| 9V | 12V ~18V | 47uh | 330uf/25V |
| | 12V ~36V | 47uh | 470uf/25V |
| 12V | 15V ~ 18V | 47uh | 220uf/25V |
| | 15V ~36V | 47uh | 330uf/25V |

Table 2. Typical Application Buck Regulator Design Procedure

Function Description

Pin Functions

+V_{IN}

This is the positive input supply for the IC switching regulator. A suitable input bypass capacitor must be present at this pin to minimize voltage transients and to supply the switching currents needed by the regulator

Ground

Circuit ground.

Output

Internal switch. The voltage at this pin switches between $(+V_{IN} - V_{SAT})$ and approximately $-0.5V$, with a duty cycle of approximately V_{OUT} / V_{IN} . To minimize coupling to sensitive circuitry, the PC board copper area connected to this pin should be kept a minimum.

Feedback

Senses the regulated output voltage to complete the feedback loop.

ON/OFF

Allows the switching regulator circuit to be shutdown using logic level signals thus dropping the total input supply current to approximately 80uA. Pulling this pin below a threshold voltage of approximately 1.3V turns the regulator on, and pulling this pin above 1.3V (up to a maximum of 25V) shuts the regulator down. If this shutdown feature is not needed, the ON /OFF pin can be wired to the ground pin or it can be left open, in either case the regulator will be in the ON condition.

Thermal Considerations

The TD1507 is available in TO252-5L package.

The TO252 package needs a heat sink under most conditions. The size of the heatsink depends on the input voltage, the output voltage, the load current and the ambient temperature. The TD1507 junction temperature rises above ambient temperature for a 2.5A load and different input and output voltages. The data for these curves was taken with the TD1507 (TO252

package) operating as a buck switching regulator in an ambient temperature of 25°C (still air). These temperature rise numbers are all approximate and there are many factors that can affect these temperatures. Higher ambient temperatures require more heat sinking.

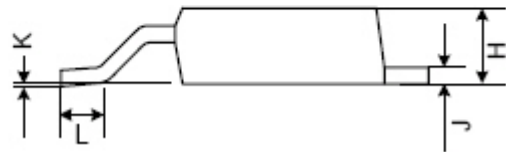
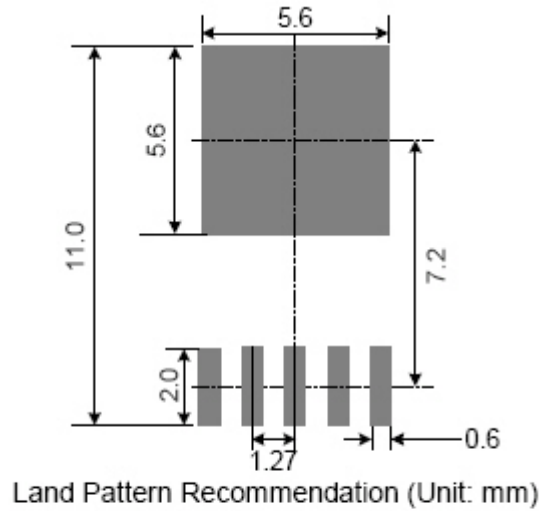
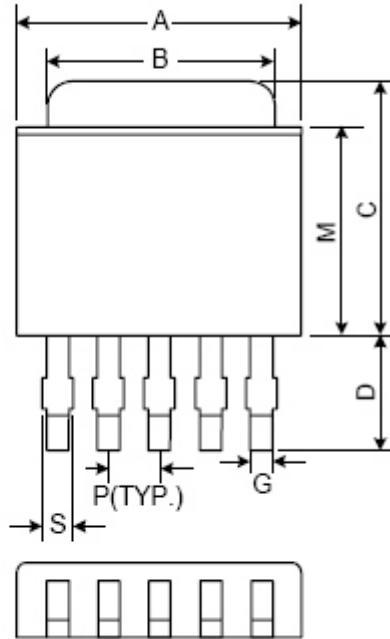
The TO252 surface mount package tab is designed to be soldered to the copper on a printed circuit board. The copper and the board are the heat sink for this package and the other heat producing components, such as the catch diode and inductor. The PC board copper area that the package is soldered to should be at least 0.4 in², and ideally should have 2 or more square inches of 2 oz. Additional copper area improves the thermal characteristics, but with copper areas greater than approximately 6 in², only small improvements in heat dissipation are realized. If further thermal improvements are needed, double sided, multilayer PC board with large copper areas and/or airflow are recommended.

The TD1507 (TO252 package) junction temperature rise above ambient temperature with a 2.5A load for various input and output voltages. This data was taken with the circuit operating as a buck switching regulator with all components mounted on a PC board to simulate the junction temperature under actual operating conditions. This curve can be used for a quick check for the approximate junction temperature for various conditions, but be aware that there are many factors that can affect the junction temperature. When load currents higher than 2.5A are used, double sided or multilayer PC boards with large copper areas and/or airflow might be needed, especially for high ambient temperatures and high output voltages.

For the best thermal performance, wide copper traces and generous amounts of printed circuit board copper should be used in the board layout. (Once exception to this is the output (switch) pin, which should not have large areas of copper.) Large areas of copper provide the best transfer of heat (lower thermal resistance) to the surrounding air, and moving air lowers the thermal resistance even further.

Package Information

Package Type: TO252-5L



| Symbol | Dimensions In Millimeters | | | Dimensions In Inches | | |
|--------|---------------------------|------|------|----------------------|-------|-------|
| | Min. | Nom. | Max. | Min. | Nom. | Max. |
| A | 6.35 | 6.60 | 6.85 | 0.250 | 0.260 | 0.270 |
| B | 5.20 | 5.35 | 5.50 | 0.205 | 0.211 | 0.217 |
| C | 6.80 | 7.00 | 7.30 | 0.268 | 0.276 | 0.287 |
| D | 2.20 | 2.50 | 2.80 | 0.087 | 0.098 | 0.110 |
| P | 1.27 REF. | | | 0.050 REF. | | |
| S | 0.50 | 0.65 | 0.80 | 0.020 | 0.026 | 0.031 |
| G | 0.40 | 0.50 | 0.63 | 0.016 | 0.020 | 0.025 |
| H | 2.20 | 2.30 | 2.40 | 0.087 | 0.091 | 0.094 |
| J | 0.45 | 0.52 | 0.58 | 0.018 | 0.020 | 0.023 |
| K | 0.00 | 0.08 | 0.15 | 0.000 | 0.003 | 0.006 |
| L | 0.90 | 1.20 | 1.63 | 0.035 | 0.047 | 0.064 |
| M | 5.40 | 5.80 | 6.20 | 0.213 | 0.228 | 0.244 |

Design Notes