

RS2596

150KHz, 3A PWM Buck DC/DC Converter

General Description

The RS2596 is Monolithic IC that design for a step-down DC/DC Converter, and own the ability of driving a 3A load without additional transistor component.

The output version included 3.3V, 5V, 12V and an adjustable type. It operates at a switching frequency of 150KHz thus allowing smaller sized filter components than what would be needed with lower frequency switching regulators. Other features include a guaranteed $\pm 4\%$ tolerance on output voltage under specified input voltage and output load conditions, and $\pm 15\%$ on the oscillator frequency. Regarding protected function, thermal shutdown is to prevent over temperature operating from damage, and current limit is against over current operating of the output switch.

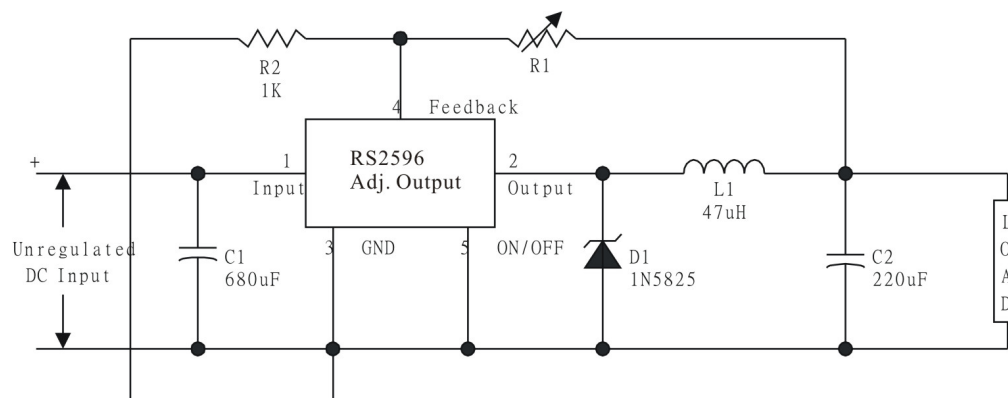
Features

- 3.3V, 5V, 12V and adjustable
- Adjustable version output voltage range: 1.23-37V
- $\pm 4\%$ max over line and load conditions
- 150KHz $\pm 15\%$ fixed switching frequency
- TTL shutdown capability
- Operating voltage can be up to 40V
- Output load current: 3A
- TO220-5 and TO263-5 packages
- Low power standby mode
- Thermal-shunt down and current-limit protection
- Built-in switching a transistor on chip, requires only 4 external components

Applications

- Simple High-efficiency step-down regulator
- Positive to negative converter
- On-card switching regulators

Application Circuits



Adjustable Output Voltage Versions

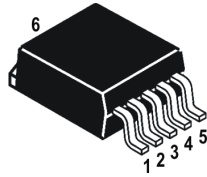


This integrated circuit can be damaged by ESD. Orister Corporation recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

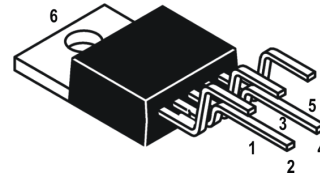
ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

Pin Assignments

TO-263-5



TO-220-5



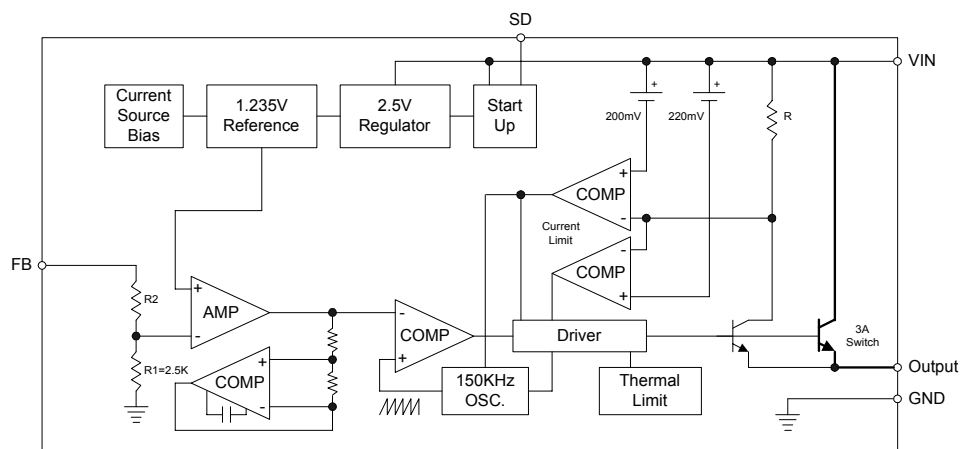
| PACKAGE | PIN | SYMBOL | DESCRIPTION |
|----------|------|--------|--------------------------------------|
| TO-263-5 | 1 | VIN | Regulator Input Pin |
| | 2 | VOUT | Regulator Output Pin |
| | 3, 6 | GND | Ground Pin |
| | 4 | FB | Output Voltage Feed Back Control Pin |
| | 5 | SD | ON/OFF Shutdown Pin |

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Ordering Information

| DEVICE | DEVICE CODE |
|---------------|--|
| RS2596-XX Y Z | <p>XX is nominal output voltage (for example, AD=ADJ, 33 = 3.3V, 50 = 5.0V, 12 = 12V). Y is package designator : U : TO-263-5 E : TO-220-5 Z is Lead Free designator : P: Commercial Standard, Lead (Pb) Free and Phosphorous (P) Free Package G: Green (Halogen Free with Commercial Standard)</p> |

Block Diagram



Absolute Maximum Ratings ^(Note1)

| Parameter | Symbol | Value | Unit |
|--------------------------------------|-----------|--------------------|------|
| Supply Voltage | V_{CC} | 40 | V |
| On/Off Pin Input Voltage | V_{SD} | -0.3~+25 | V |
| Feedback Pin Voltage | V_{FB} | -0.3~+25 | V |
| Output Voltage to Ground | V_{OUT} | -1 | V |
| Power Dissipation | P_D | Internally Limited | W |
| Operating Temperature | T_{opr} | 0~+70 | °C |
| Storage Temperature | T_{stg} | -65~+150 | °C |
| Operating Junction Temperature Range | T_J | -40~+125 | °C |
| Operating Voltage | V_{OP} | +4.5~+40 | V |

Electrical Characteristics (Continued)

Specifications with boldface type apply over for full operating temperature range, the other type are for $T_J=25^{\circ}\text{C}$ ^(Note 2)

| Part No. | Parameter | Symbol | Conditions | Min. | Typ. (Note3) | Max. (Note4) | Unit |
|-------------|-------------------|-----------|--|-----------------------|-----------------|-----------------------|------|
| RS2596-3.3V | Output Voltage | V_{OUT} | $5V \leq V_{IN} \leq 40V, 0.2A \leq I_{LOAD} \leq 3A$ | 3.168 3.135 | 3.3 | 3.342 3.465 | V |
| | Efficiency | η | $V_{IN}=12V, I_{LOAD}=3A$ | - | 72 | - | % |
| RS2596-5.0V | Output Voltage | V_{OUT} | $7V \leq V_{IN} \leq 40V, 0.2A \leq I_{LOAD} \leq 3A$ | 4.800 4.750 | 5.0 | 5.200 5.250 | V |
| | Efficiency | η | $V_{IN}=12V, I_{LOAD}=3A$ | - | 79 | - | % |
| RS2596-12V | Output Voltage | V_{OUT} | $15V \leq V_{IN} \leq 40V, 0.2A \leq I_{LOAD} \leq 3A$ | 11.52 11.40 | 12.0 | 12.48 12.60 | V |
| | Efficiency | η | $V_{IN}=25V, I_{LOAD}=3A$ | - | 90 | - | % |
| RS2596-ADJ | Reference Voltage | V_{FB} | $4.5V \leq V_{IN} \leq 40V, 0.2A \leq I_{LOAD} \leq 3A$ V_{OUT} programmed for 3V | 1.193 | 1.230 | 1.267 1.280 | V |
| | Efficiency | η | $V_{IN}=12V, I_{LOAD}=3A$ | - | 72 | - | % |

All Output Voltage Versions Electrical Characteristics

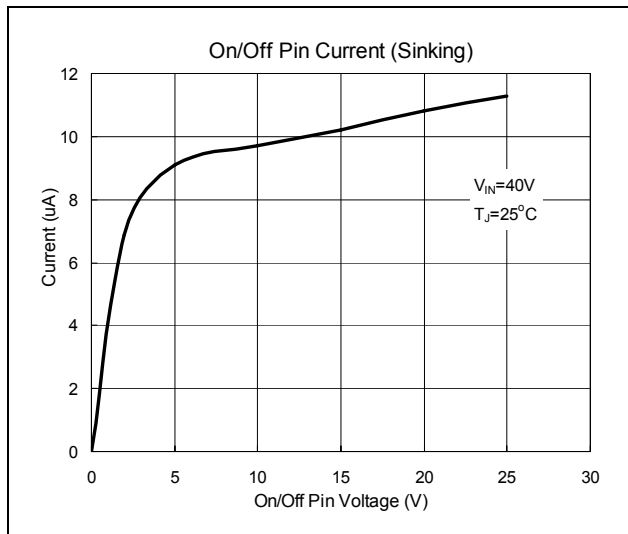
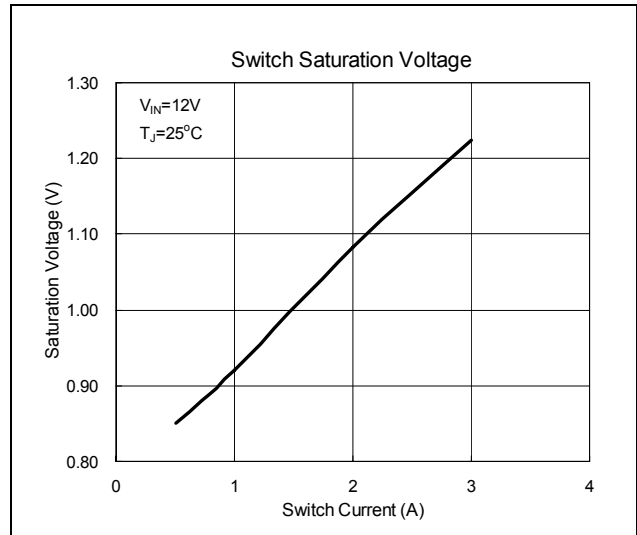
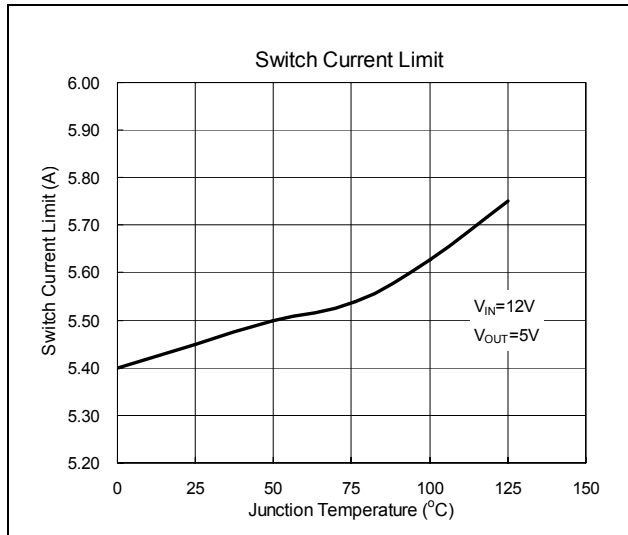
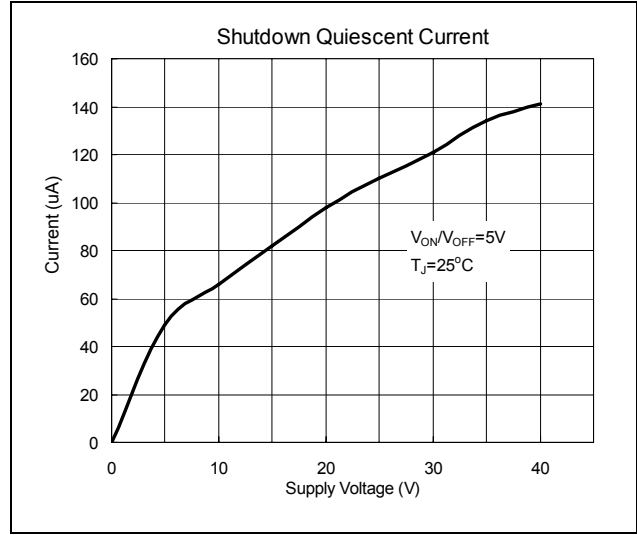
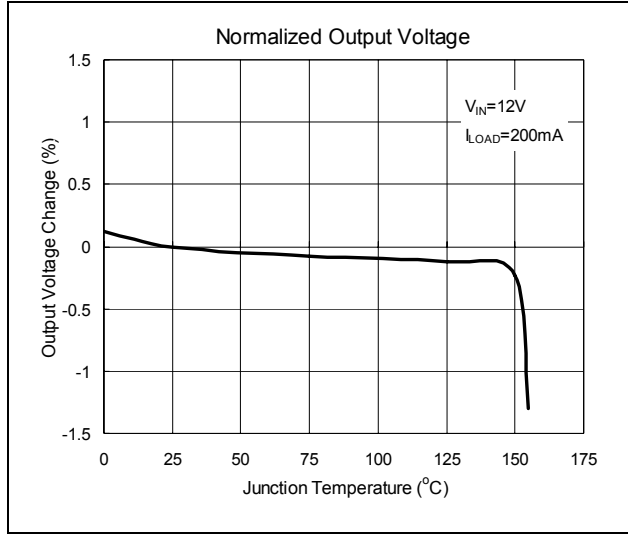
Specifications with **boldface type** apply over for full operating temperature range, the other type are for $T_J=25^{\circ}\text{C}$
(Unless otherwise specified, $V_{IN}=12\text{V}$ for the 3.3V, 5V, and adjustable version and $V_{IN}=24\text{V}$ for the 12V version, $I_{LOAD}=500\text{mA}$)

| Parameter | Symbol | Test Condition | Min. | Typ. | Max. | Unit | | |
|---|----------------------------|---|---------------------|----------|------------|---------------|---|----------------------|
| Device Parameters | | | | | | | | |
| Feedback Bias Current | I_b | Adjustable Version Only, $V_{FB}=1.3\text{V}$ | - | 40 | 50 100 | nA | | |
| Oscillator Frequency | f_o | (Note 5) | 127 110 | 150 | 173 173 | KHz | | |
| Saturation Voltage | V_{SAT} | $I_{OUT}=3\text{A}$ (Note 6,7) | - | 1.16 | 1.4 1.5 | V | | |
| Max. Duty Cycle (ON) Min. Duty Cycle (OFF) | DC | (Note 7) (Note 8) | - | 100 0 | - | % | | |
| Current Limit | I_{CL} | Peak Current (Note 6,7) | 3.6 | - | 5.5 6.9 | A | | |
| Output Leakage Current | I_L | Output=0V (Note 6,8) | - | - | 50 | μA | | |
| Quiescent Current | I_Q | (Note 8) | - | 5 | 30 | mA | | |
| Standby Quiescent Current | I_{STBY} | ON/OFF pin=5V (Note 9) | - | 85 | 200 300 | μA | | |
| Thermal Resistance | θ_{JC} | TO220-5L | Junction to Case | | - | 2.5 | - | $^{\circ}\text{C/W}$ |
| | | TO263-5L | | | - | 3.5 | - | |
| | θ_{JA} (Note 10) | TO220-5L | Junction to ambient | | - | 28 | - | $^{\circ}\text{C/W}$ |
| | | TO263-5L | | | - | 30 | - | |
| ON/OFF Control | | | | | | | | |
| ON/OFF Pin Logic Input Threshold Voltage | V_{IH} | Low (Regulator ON) | - | 1.4 | 0.6 | V | | |
| | V_{IL} | High (Regulator OFF) | 2.0 | | - | | | |
| ON/OFF Pin Input Current | I_{IH} | $V_{LOGIC}=2.5\text{V}$ (Regulator OFF) | - | 6 | 15 | μA | | |
| | I_{IL} | $V_{LOGIC}=0.5\text{V}$ (Regulator ON) | - | 0.02 | 5 | | | |

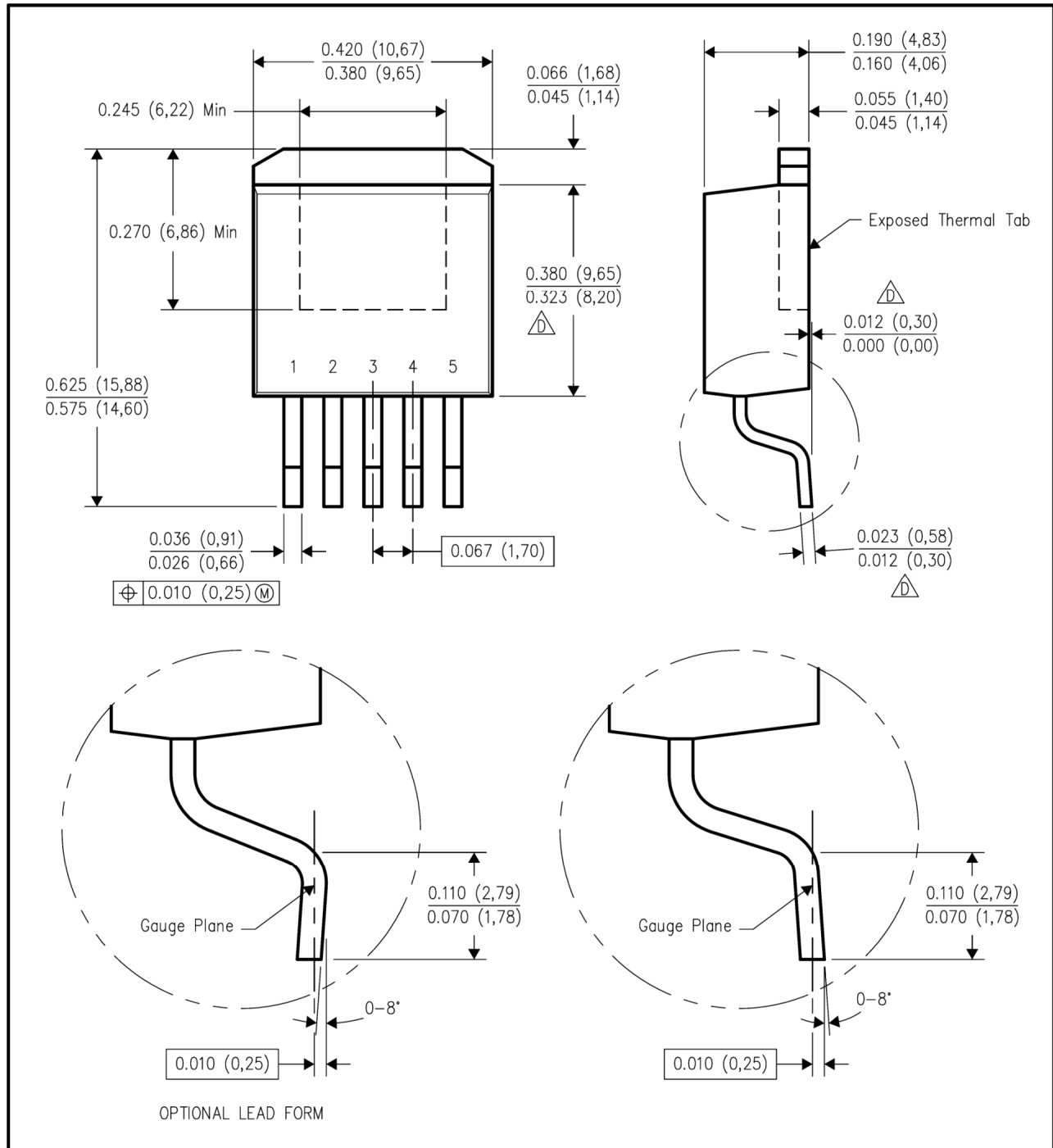
NOTE:

- Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is intended to be functional, but do not guarantee specific performance limits. For guaranteed specifications and test conditions, see the Electrical Characteristics.
- External components such as the catch diode, inductor, input and output capacitors, and voltage programming resistors can affect switching regulator system performance.
- Typical numbers are at 25°C and represent the most likely norm.
- All limits guaranteed at room temperature (standard type face) and at temperature extremes (bold type face). All room temperature limits are 100% production tested. All limits at temperature extremes are guaranteed via correlation using standard Statistical Quality Control (SQC) methods. All limits are used to calculate Average Outgoing Quality Level (AOQL).
- The switching frequency is reduced when the second stage current limit is activated.
- No diode, inductor or capacitor connected to output pin.
- Feedback pin removed from output and connected to 0V to force the output transistor switch ON.
- Feedback pin removed from output and connected to 12V for the 3.3V, 5V, ADJ. version, and 15V for the 12V version, to force the output transistor switch OFF.
- $V_{IN}=40\text{V}$.
- Junction to ambient thermal resistance. (With copper area of approximately 3in^2)

Characteristics Curve



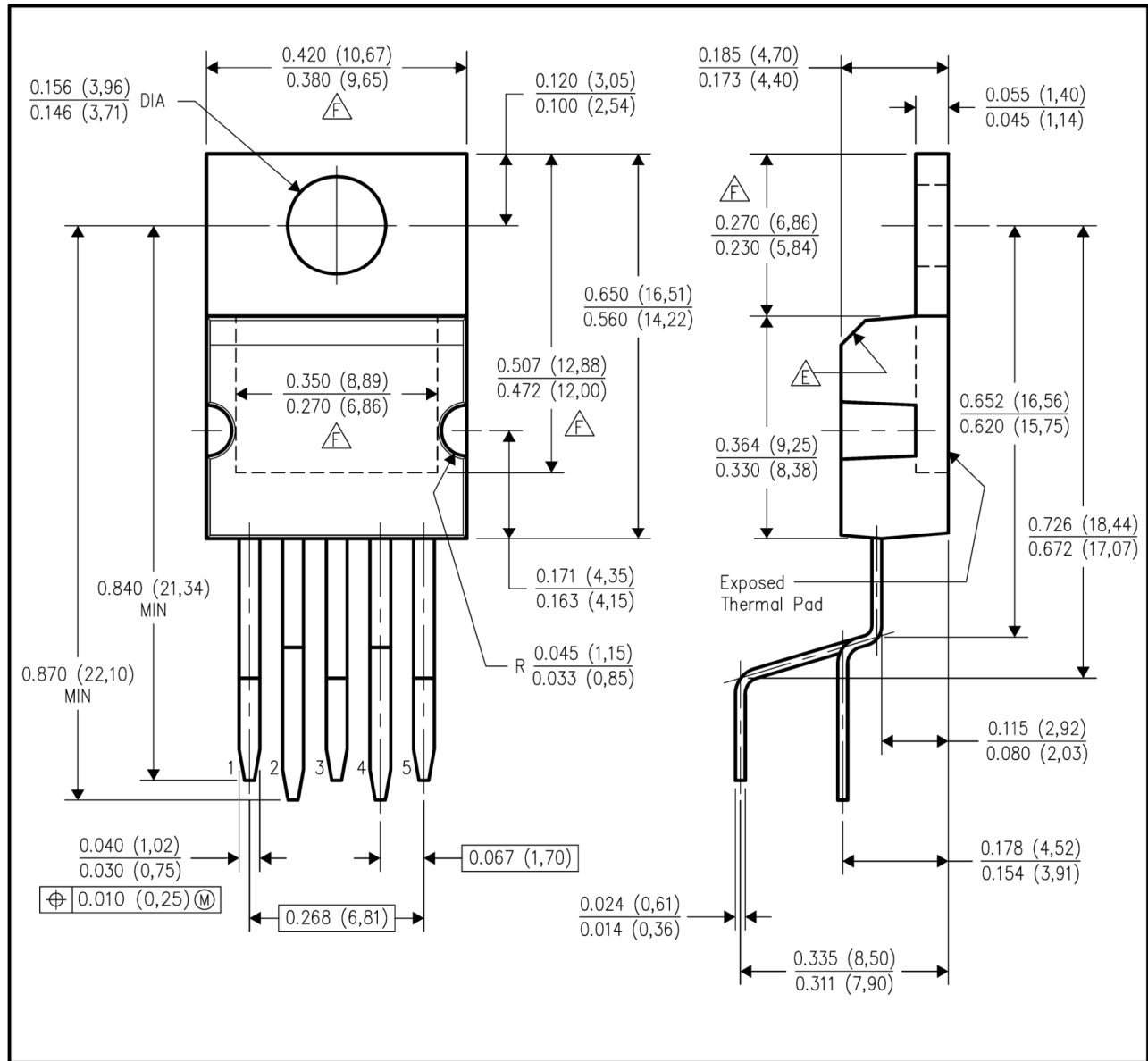
TO-263-5 Dimension



NOTES:

- All linear dimensions are in inches (millimeters).
- This drawing is subject to change without notice.
- Body dimensions do not include mold flash or protrusion. Mold flash or protrusion not to exceed 0.005 (0.13) per side.
- Falls within JEDEC TO-263 variation BA. Except minimum lead thickness, maximum seating height, and minimum body length.

TO-220-5 Dimension

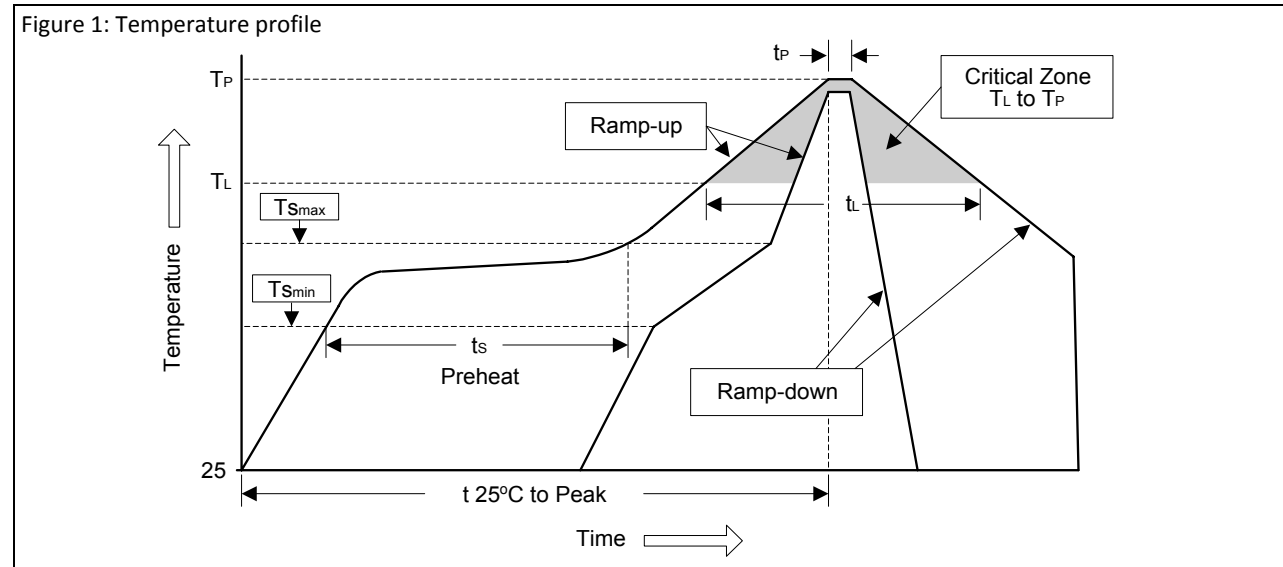


NOTES:

- A. All linear dimensions are in inches (millimeters).
- B. This drawing is subject to change without notice.
- C. All lead dimensions apply before solder dip.
- D. The center lead is in electrical contact with the tab.
- E. The chamfer is optional.
- F. Thermal pad contour optional within these dimensions.

Soldering Methods for Orister's Products

1. Storage environment: Temperature=10°C~35°C Humidity=65%±15%
2. Reflow soldering of surface-mount devices



| Profile Feature | Sn-Pb Eutectic Assembly | Pb-Free Assembly |
|--|-------------------------|------------------|
| Average ramp-up rate (T_L to T_P) | <3°C/sec | <3°C/sec |
| Preheat | | |
| - Temperature Min (T_{Smin}) | 100°C | 150°C |
| - Temperature Max (T_{Smax}) | 150°C | 200°C |
| - Time (min to max) (t_s) | 60~120 sec | 60~180 sec |
| T_{Smax} to T_L | | |
| - Ramp-up Rate | <3°C/sec | <3°C/sec |
| Time maintained above: | | |
| - Temperature (T_L) | 183°C | 217°C |
| - Time (t_L) | 60~150 sec | 60~150 sec |
| Peak Temperature (T_P) | 240°C +0/-5°C | 260°C +0/-5°C |
| Time within 5°C of actual Peak Temperature (t_p) | 10~30 sec | 20~40 sec |
| Ramp-down Rate | <6°C/sec | <6°C/sec |
| Time 25°C to Peak Temperature | <6 minutes | <8 minutes |

3. Flow (wave) soldering (solder dipping)

| Products | Peak temperature | Dipping time |
|------------------|------------------|--------------|
| Pb devices. | 245°C ±5°C | 5sec ±1sec |
| Pb-Free devices. | 260°C +0/-5°C | 5sec ±1sec |

Important Notice:

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