# NCV8408

## Self-Protected Low Side Driver with Temperature and Current Limit

### 42 V, 10 A, Single N−Channel, DPAK

NCV8408 is a single channel protected Low-Side Smart Discrete device. The protection features include overcurrent, overtemperature, ESD and integrated Drain-to-Gate clamping for overvoltage protection. Thermal protection includes a latch which can be reset by toggling the input. This device is suitable for harsh automotive environments.

### Features
- Short Circuit Protection
- Thermal Shutdown with Latched Reset
- Gate Input Current Flag During Latched Fault Condition
- Overvoltage Protection
- Integrated Clamp for Inductive Switching
- ESD Protection
- dV/dt Robustness
- Analog Drive Capability (Logic Level Input)
- NCV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC−Q100 Qualified and PPAP Capable
- These Devices are Pb−Free and are RoHS Compliant
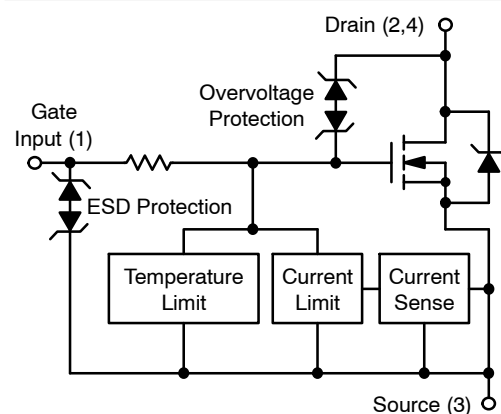
### Typical Applications
- Switch a Variety of Resistive, Inductive and Capacitive Loads
- Can Replace Electromechanical Relays and Discrete Circuits
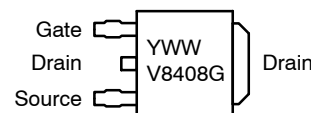- Automotive / Industrial

## ON Semiconductor®

**http://onsemi.com**

| $V_{DSS}$ (Clamped) | $R_{DS(on)}$ TYP | $I_D$ MAX (Limited) |
|---|---|---|
| 42 V | 55 mΩ @ 5 V | 10 A |



DPAK
CASE 369C
STYLE 2

**MARKING DIAGRAM**



Y    = Year
WW  = Work Week
V8408 = Specific Device Code
G    = Pb−Free Package

### ORDERING INFORMATION

| Device | Package | Shipping[†] |
|---|---|---|
| NCV8408DTRKG | DPAK (Pb−Free) | 2500/Tape & Reel |

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specification Brochure, BRD8011/D.

# NCV8408

**MAXIMUM RATINGS** ($T_J$ = 25°C unless otherwise noted)

| Rating | Symbol | Value | Unit |
|---|---|---|---|
| Drain−to−Source Voltage Internally Clamped | $V_{DSS}$ | 42 | Vdc |
| Drain−to−Gate Voltage Internally Clamped        ($R_{GS}$ = 1.0 MΩ) | $V_{DGR}$ | 42 | V |
| Gate−to−Source Voltage | $V_{GS}$ | ±14 | Vdc |
| Continuous Drain Current | $I_D$ | Internally Limited | |
| Total Power Dissipation<br>    @ $T_A$ = 25°C (Note 1)<br>    @ $T_A$ = 25°C (Note 2) | $P_D$ | <br>1.8<br>2.3 | W |
| Thermal Resistance<br>    Junction−to−Ambient Steady State (Note 1)<br>    Junction−to−Ambient Steady State (Note 2)<br>    Junction−to−Tab Steady State (Note 3) | <br>$R_{\theta JA}$<br>$R_{\theta JA}$<br>$R_{\theta JT}$ | <br>70<br>55<br>2.1 | °C/W |
| Single Pulse Inductive Load Switching Energy<br>    ($V_{DD}$ = 20 Vdc, $V_{GS}$ = 5.0 V, $I_L$ = 8.0 A) | $E_{AS}$ | 140 | mJ |
| Load Dump Voltage ($V_{GS}$ = 0 and 10 V, $R_I$ = 2.0 Ω, $R_L$ = 4.5 Ω, $t_d$ = 400 ms) | $V_{LD}$ | 63 | V |
| Operating Junction Temperature | $T_J$ | −40 to 150 | °C |
| Storage Temperature | $T_{stg}$ | −55 to 150 | °C |

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.
1. Surface−mounted onto minimum pad FR4 PCB (1 oz Cu, 0.06" thick).
2. Surface−mounted onto 2″ square FR4 PCB,  (1″ square, 1 oz Cu, 0.06" thick).
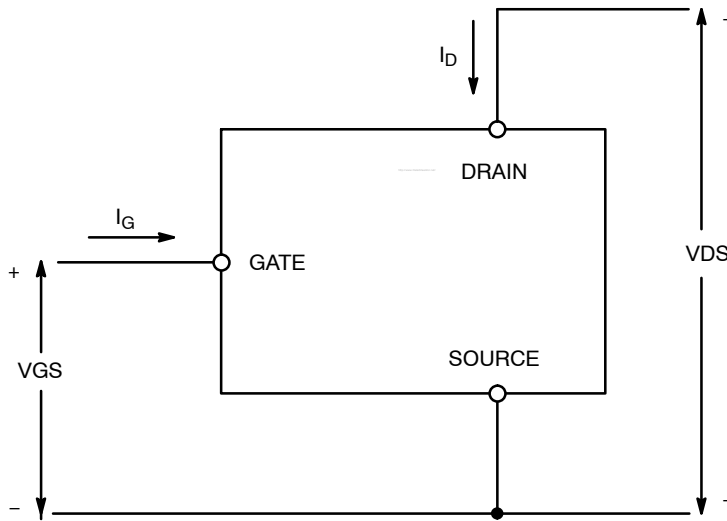3. Surface−mounted onto minimum pad FR4 PCB (2 oz Cu, 0.06" thick).



**Figure 1. Voltage and Current Convention**

**MOSFET ELECTRICAL CHARACTERISTICS** ($T_J$ = 25°C unless otherwise noted)

| Characteristic | Test Conditions | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | | | |
| Drain–to–Source Clamped Breakdown Voltage (Note 4)<br>($V_{GS}$ = 0 V, $I_D$ = 10 mA, $T_J$ = 25°C)<br>($V_{GS}$ = 0 V, $I_D$ = 10 mA, $T_J$ = 150°C) (Note 6)<br>($V_{GS}$ = 0 V, $I_D$ = 10 mA, $T_J$ = –40°C) (Note 6) | | $V_{(BR)DSS}$ | 42<br>40<br>43 | 46<br>45<br>47 | 51<br>51<br>51 | V |
| Zero Gate Voltage Drain Current<br>($V_{GS}$ = 0 V, $V_{DS}$ = 32 V, $T_J$ = 25°C)<br>($V_{GS}$ = 0 V, $V_{DS}$ = 32 V, $T_J$ = 150°C) (Note 6) | | $I_{DSS}$ | –<br>– | 0.6<br>2.5 | 5.0<br>10 | μA |
| **INPUT CHARACTERISTICS** (Note 4) | | | | | | |
| Gate Input Current – Normal Operation | ($V_{GS}$ = 5.0 V) | $I_{GSSF}$ | – | 25 | 50 | μA |
| Gate Input Current – Protection Latched | ($V_{GS}$ = 5.0 V) (Note 6) | $I_{GSSL}$ | – | 440 | – | μA |
| Gate Threshold Voltage | ($V_{GS}$ = $V_{DS}$, $I_D$ = 1 mA) | $V_{GS(th)}$ | 1.0 | 1.7 | 2.2 | V |
| Gate Threshold Temperature Coefficient | | $V_{GS(th)}/T_J$ | – | 5.0 | – | –mV/°C |
| Latched Reset Voltage | (Note 6) | $V_{LR}$ | 0.8 | 1.4 | 1.9 | V |
| Latched Reset Time | ($V_{GS}$ = 5.0 V to $V_{GS}$ < 1 V) (Note 6) | $t_{LR}$ | 10 | 40 | 100 | μs |
| Internal Gate Input Resistance | | | – | 25.5 | – | kΩ |
| **ON CHARACTERISTICS** (Note 4) | | | | | | |
| Static Drain–to–Source On–Resistance<br>($V_{GS}$ = 5.0 V, $I_D$ = 3.0 A, $T_J$ @ 25°C)<br>($V_{GS}$ = 5.0 V, $I_D$ = 3.0 A, $T_J$ @ 150°C) (Note 6) | | $R_{DS(on)}$ | –<br>– | 55<br>100 | 60<br>120 | mΩ |
| Source–Drain Forward On Voltage | ($V_{GS}$ = 0 V, $I_S$ = 7.0 A) | $V_{SD}$ | – | 0.95 | – | V |
| **SWITCHING CHARACTERISTICS** (Note 6) | | | | | | |
| Turn–ON Delay Time | | $t_{d(ON)}$ | | 10 | 20 | μs |
| Rise Time (10% $I_D$ to 90% $I_D$) | | $t_r$ | | 20 | 40 | |
| Turn–OFF Delay Time | $V_{GS}$ = 5 V, $V_{DS}$ = 13 V<br>$R_L$ = 4 Ω, –40°C < $T_J$ < 150°C | $t_{d(OFF)}$ | | 30 | 60 | |
| Fall Time (90% $I_D$ to 10% $I_D$) | | $t_f$ | | 20 | 40 | |
| Slew–Rate ON (90% $V_D$ to 10% $V_D$) | | $-dV_{DS}/dt_{ON}$ | | 0.5 | | V/μs |
| Slew–Rate OFF (10% $V_D$ to 90% $V_D$) | | $dV_{DS}/dt_{OFF}$ | | 0.5 | | |
| **SELF PROTECTION CHARACTERISTICS** ($T_J$ = 25°C unless otherwise noted) (Note 5) | | | | | | |
| Current Limit<br>$V_{GS}$ = 5.0 V, $V_{DS}$ = 10 V, $T_J$ @ 25°C<br>$V_{GS}$ = 5.0 V, $V_{DS}$ = 10 V, $T_J$ = 150°C (Note 6)<br>$V_{GS}$ = 5.0 V, $V_{DS}$ = 10 V, $T_J$ = –40°C (Note 6) | | $I_{LIM}$ | 8<br>8<br>8 | 13<br>–<br>– | 16<br>18<br>16 | A |
| Temperature Limit (Turn–off) | $V_{GS}$ = 5.0 V<br>$V_{GS}$ = 10 V | $T_{LIM(off)}$ | 150<br>150 | 175<br>165 | 200<br>185 | °C |
| **ESD ELECTRICAL CHARACTERISTICS** ($T_J$ = 25°C unless otherwise noted) | | | | | | |
| Electro–Static Discharge Capability | Human Body Model (HBM) | ESD | 4000 | – | – | V |
| Electro–Static Discharge Capability | Machine Model (MM) | ESD | 400 | – | – | V |

4. Pulse Test: Pulse Width = 300 μs, Duty Cycle = 2%.
5. Fault conditions are viewed as beyond the normal operating range of the part.
6. Not subject to production testing.
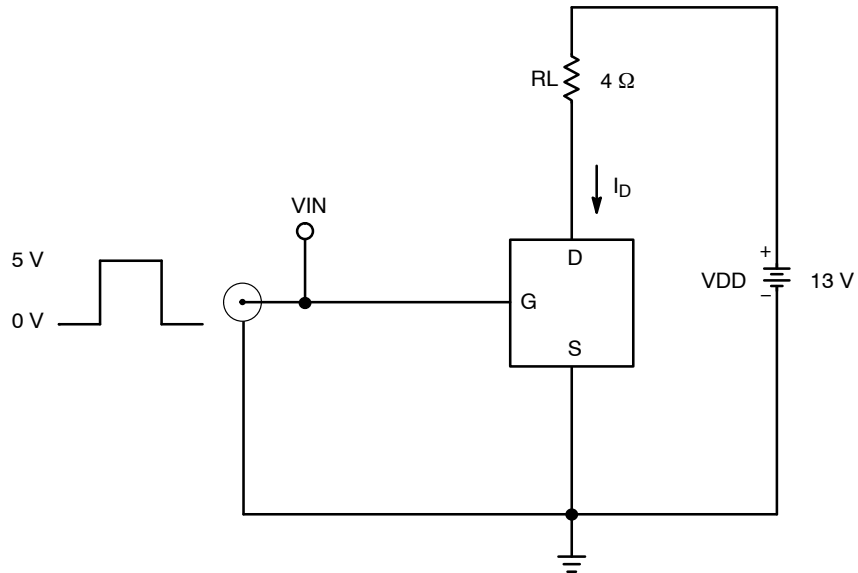
## TEST CIRCUITS AND WAVEFORMS

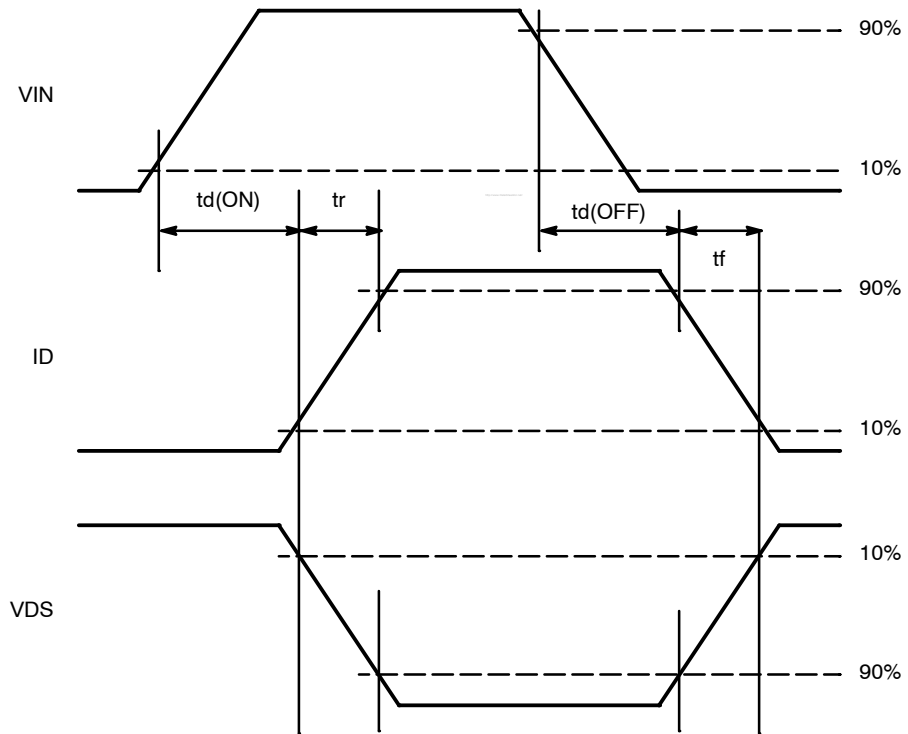**Figure 2. Resistive Load Switching Test Circuit**

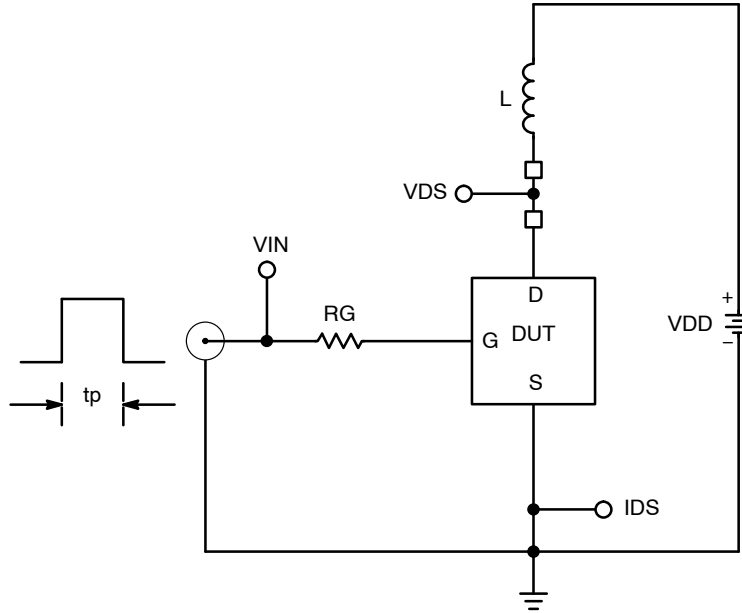**Figure 3. Resistive Load Switching Waveforms**

## TEST CIRCUITS AND WAVEFORMS

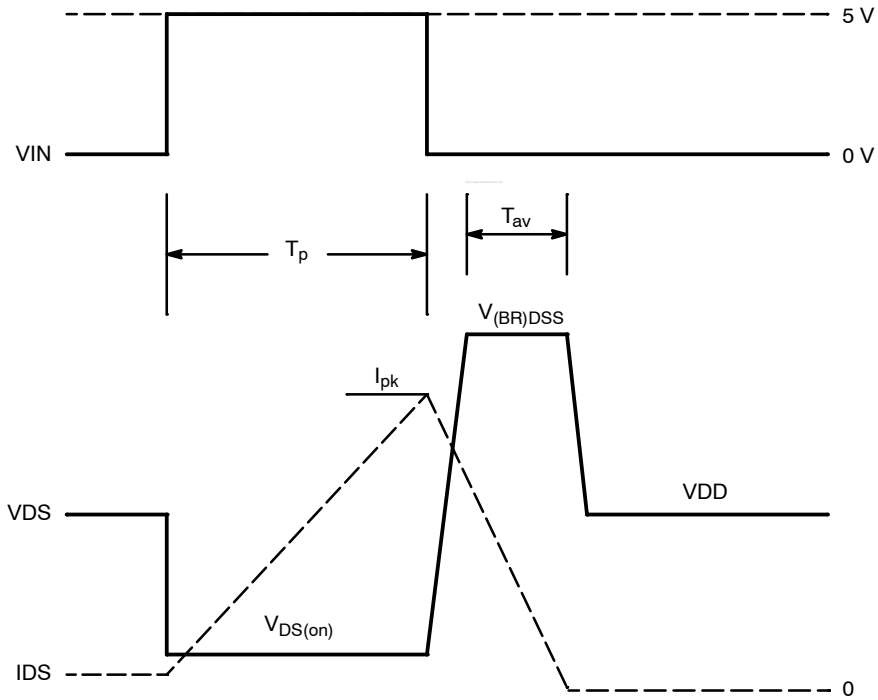**Figure 4. Inductive Load Switching Test Circuit**

**Figure 5. Inductive Load Switching Waveforms**
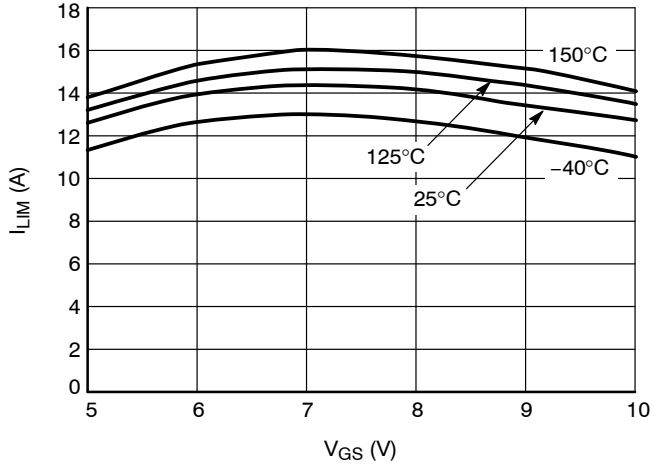
## TYPICAL CHARACTERISTICS



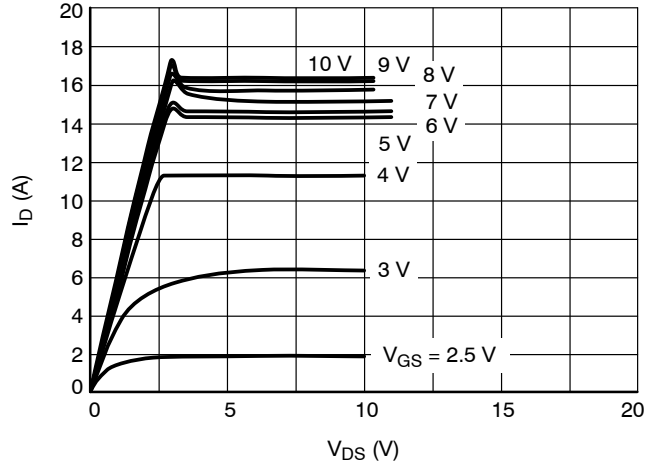**Figure 6. Current Limit vs. Gate Voltage**
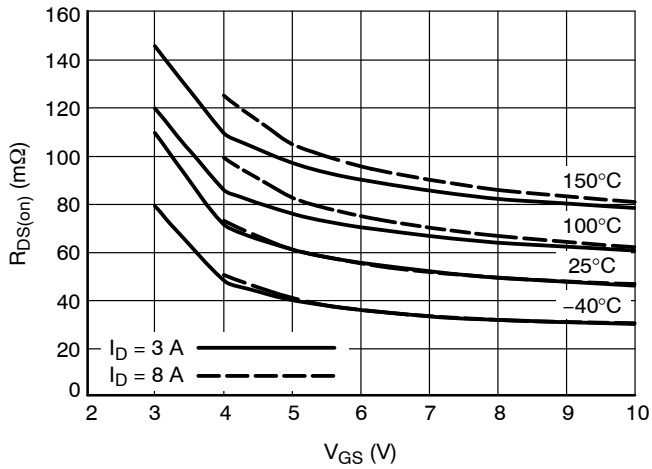


**Figure 7. Drain Current vs. Drain Voltage**
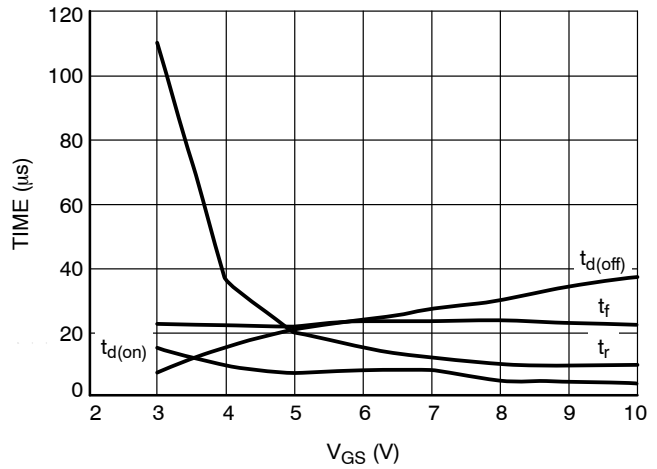


**Figure 8. R$_{DS(on)}$ vs. Gate Voltage**



**Figure 9. Resistive Switching**

## PACKAGE DIMENSIONS

**DPAK (SINGLE GAUGE)**
CASE 369C
ISSUE D
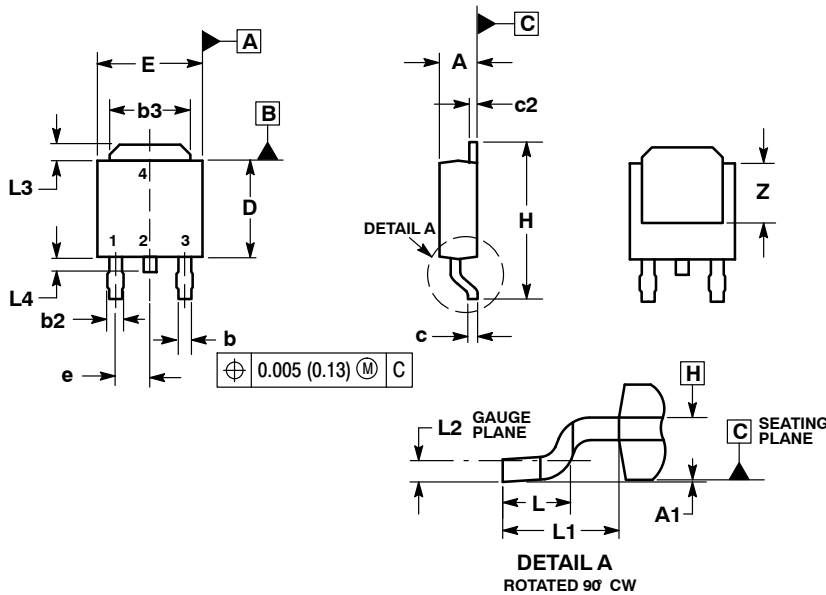
NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: INCHES.
3. THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSIONS b3, L3 and Z.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR BURRS. MOLD FLASH, PROTRUSIONS, OR GATE BURRS SHALL NOT EXCEED 0.006 INCHES PER SIDE.
5. DIMENSIONS D AND E ARE DETERMINED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY.
6. DATUMS A AND B ARE DETERMINED AT DATUM PLANE H.



**DETAIL A**
**ROTATED 90° CW**

| DIM | INCHES | | MILLIMETERS | |
|-----|--------|--------|-------------|--------|
|     | MIN | MAX | MIN | MAX |
| A | 0.086 | 0.094 | 2.18 | 2.38 |
| A1 | 0.000 | 0.005 | 0.00 | 0.13 |
| b | 0.025 | 0.035 | 0.63 | 0.89 |
| b2 | 0.030 | 0.045 | 0.76 | 1.14 |
| b3 | 0.180 | 0.215 | 4.57 | 5.46 |
| c | 0.018 | 0.024 | 0.46 | 0.61 |
| c2 | 0.018 | 0.024 | 0.46 | 0.61 |
| D | 0.235 | 0.245 | 5.97 | 6.22 |
| E | 0.250 | 0.265 | 6.35 | 6.73 |
| e | 0.090 BSC | | 2.29 BSC | |
| H | 0.370 | 0.410 | 9.40 | 10.41 |
| L | 0.055 | 0.070 | 1.40 | 1.78 |
| L1 | 0.108 REF | | 2.74 REF | |
| L2 | 0.020 BSC | | 0.51 BSC | |
| L3 | 0.035 | 0.050 | 0.89 | 1.27 |
| L4 | --- | 0.040 | --- | 1.01 |
| Z | 0.155 | --- | 3.93 | --- |

STYLE 2:
PIN 1. GATE
    2. DRAIN
    3. SOURCE
    4. DRAIN

**SOLDERING FOOTPRINT***
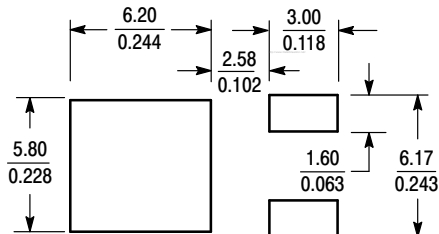


SCALE 3:1  $\left(\dfrac{mm}{inches}\right)$

*For additional information on our Pb–Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.