# NCV8452

# Self Protected High Side Driver with Temperature Shutdown and Current Limit

The NCV8452 is a fully protected High−Side driver that can be used to switch a wide variety of loads, such as bulbs, solenoids and other activators. The device is internally protected from an overload condition by an active current limit and thermal shutdown.

### Features

- Short Circuit Protection
- Thermal Shutdown with Automatic Restart
- CMOS (3 V/5 V) Compatible Control Input
- Overvoltage Protection and Shutdown
- Output Voltage Clamp for Inductive Switching
- Under Voltage Shutdown
- Loss of Ground Protection
- ESD Protection
- Reverse Battery Protection (with external resistor)
- Very Low Standby Current
- NCV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC−Q100 Qualified and PPAP Capable
- These are Pb−Free Devices

### Typical Applications

- Switch a Variety of Resistive, Inductive and Capacitive Loads
- Can Replace Electromechanical Relays and Discrete Circuits
- Automotive / Industrial

**PRODUCT SUMMARY**

| Symbol | Characteristics | Value | Unit |
|---|---|---|---|
| $V_{OV}$ | Overvoltage Protection | 41 | V |
| $V_D$ | Operation Voltage | 5 – 34 | V |
| $R_{ON}$ | On−State Resistance | 200 | mΩ |
| $I_{ILIM}$ | Output Current Limit | 1.0 | A |

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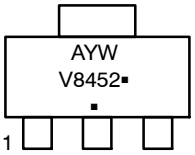
**MARKING DIAGRAM**

**SOT−223**
**(TO−261)**
**CASE 318E**




V8452 = Device Code
A = Assembly Location
Y = Year
W = Work Week
▪ = Pb−Free Package

(Note: Microdot may be in either location)

**ORDERING INFORMATION**

See detailed ordering and shipping information in the package dimensions section on page 12 of this data sheet.

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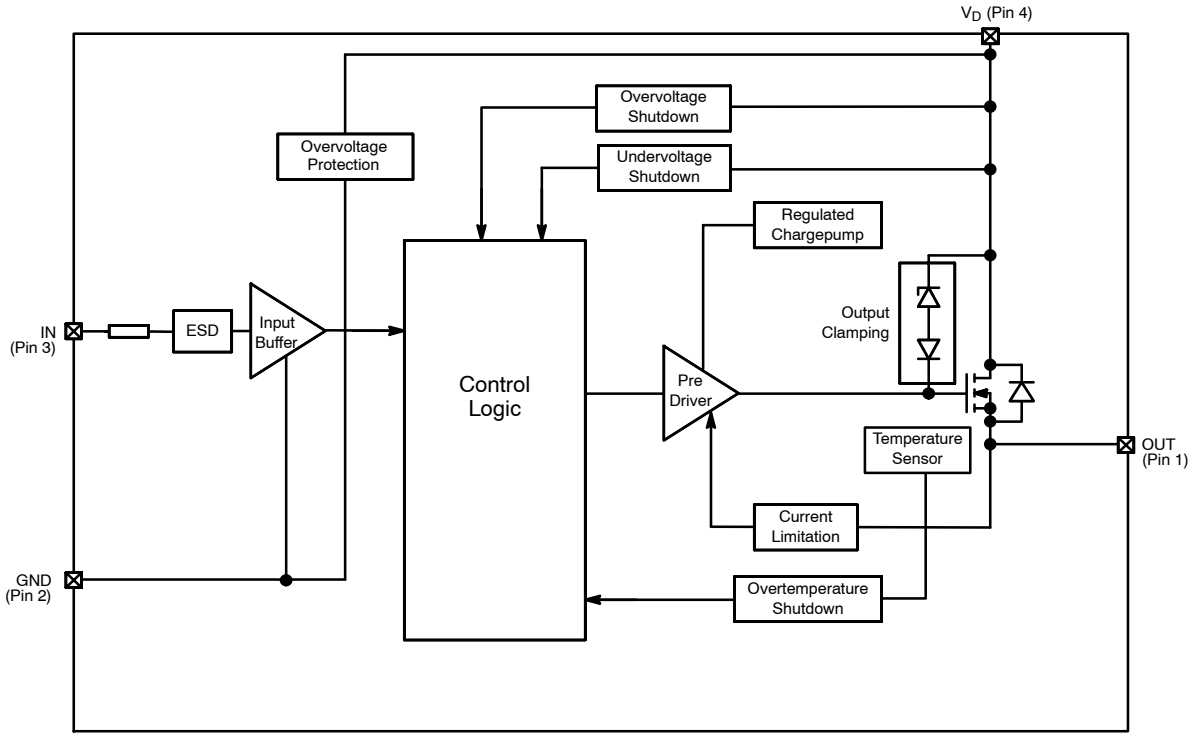



**Figure 1. Block Diagram**

**PACKAGE PIN DESCRIPTION**

| Pin # | Symbol | Description |
|---|---|---|
| 1 | OUT | Output |
| 2 | GND | Ground |
| 3 | IN | Logic Level Input |
| 4 | $V_D$ | Supply Voltage |

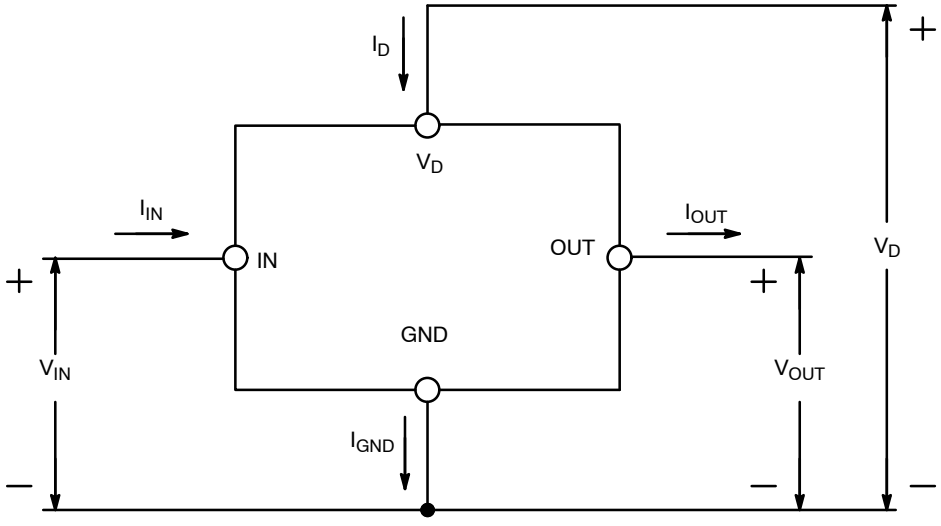



**Figure 2. Voltage and Current Definition**

## MAXIMUM RATINGS

| Rating | Symbol | Value | Unit |
|---|---|---|---|
| DC Supply Voltage | $V_D$ | 40 | V |
| Peak Transient Input Voltage<br>(Load Dump 46 V, $V_D$ = 14 V, ISO7637−2 pulse5) (Note 1) | $V_{peak}$ | 60 | V |
| Input Voltage | $V_{IN}$ | −5 to $V_D$ | V |
| Input Current | $I_{IN}$ | ±5 | mA |
| Output Current | $I_{OUT}$ | Internally Limited | A |
| Power Dissipation<br>@$T_A$ = 25°C (Note 3)<br>@$T_A$ = 25°C (Note 4) | $P_D$ | <br>1.19<br>1.76 | W |
| Electrostatic Discharge (Note 1)<br>(HBM Model 100 pF / 1500 Ω)<br>Input<br>Output<br>$V_D$ | | <br><br>±1<br>±5<br>±5 | kV |
| Single Pulse Inductive Load Switch Off Energy (Note 1)<br>(L = 4.55 H, $V_D$ = 13.5 V; $I_L$ = 0.5 A, $T_{Jstart}$ = 25°C) | $E_{AS}$ | 0.8 | J |
| Operating Junction Temperature | $T_J$ | −40 to +150 | °C |
| Storage Temperature | $T_{storage}$ | −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. Not subjected to production testing
2. Reverse Output current has to be limited by the load to stay within absolute maximum ratings and thermal performance.
3. Minimum pad.
4. 1 in square pad size, FR−4, 1 oz Cu.

## THERMAL RESISTANCE RATINGS

| Parameter | Symbol | Max Value | Unit |
|---|---|---|---|
| Thermal Resistance (Note 5)<br>Junction−to−Lead<br>Junction−to−Ambient (Note 6)<br>Junction−to−Ambient (Note 7) | <br>$R_{thJL}$<br>$R_{thJA}$<br>$R_{thJA}$ | <br>10<br>105<br>71 | <br>°C/W<br>°C/W<br>°C/W |

5. Reverse Output current has to be limited by the load to stay within absolute maximum ratings and thermal performance.
6. Minimum pad.
7. 1 in square pad size, FR−4, 1 oz Cu.

**ELECTRICAL CHARACTERISTICS** ($V_D$ = 13.5 V; −40°C < $T_J$ < 150°C unless otherwise specified)

| Rating | Symbol | Conditions | Value | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min | Typ | Max | |
| Operating Supply Voltage | $V_D$ | | 5 | – | 34 | V |
| Undervoltage Shutdown | $V_{UV}$ | | 2.5 | | 5.5 | V |
| Undervoltage Restart | $V_{UV(res)}$ | | | | 6.0 | V |
| Undervoltage Hysteresis | $V_{UV(hyst)}$ | | | 0.3 | | |
| Overvoltage Shutdown | $V_{OV}$ | | 34 | | 42 | V |
| Overvoltage Restart | $V_{OV(res)}$ | | 33 | | | |
| On−state Resistance | $R_{ON}$ | $I_{OUT}$ = 0.5 A, $V_{IN}$ = 5 V, $T_J$ = 25°C<br>$I_{OUT}$ = 0.5 A, $V_{IN}$ = 5 V, $T_J$ = 150°C | | 160<br>– | 200<br>400 | mΩ |
| Standby Current | $I_{D(off)}$ | $V_{IN}$ = $V_{OUT}$ = 0 V | | 12 | 25 | μA |
| Active Ground Current | $I_{GND(on)}$ | $V_{IN}$ = 5 V | | 1 | 1.8 | mA |
| Output Leakage Current | $I_{OUT(off)}$ | $V_{IN}$ = 0 V | | | 2 | μA |
| **INPUT CHARACTERISTICS** | | | | | | |
| Input Voltage − Low | $V_{IN(low)}$ | | | | 0.8 | V |
| Input Voltage − High | $V_{IN(high)}$ | | 2.2 | | | V |
| Off State Input Current | $I_{IN(off)}$ | $V_{IN}$ = 0.7 V | | | 10 | μA |
| On State Input Current | $I_{IN(on)}$ | $V_{IN}$ = 5.0 V | | | 10 | μA |
| Input Threshold Hysteresis | $V_{IN(hyst)}$ | | | 0.3 | | V |
| Input Resistance | $R_I$ | | 1.5 | 2.8 | 3.5 | kΩ |
| **SWITCHING CHARACTERISTICS** | | | | | | |
| Turn−On Time | $t_{on}$ | to 90% $V_{OUT}$, $R_L$ = 24 Ω | | 60 | 120 | μs |
| Turn−Off Time | $t_{off}$ | to 10% $V_{OUT}$, $R_L$ = 24 Ω | | 60 | 120 | μs |
| Slew Rate On | $dV_{OUT}/dt_{on}$ | 10% to 30% $V_{OUT}$, $R_L$ = 24 Ω | | 1 | 4 | V / μs |
| Slew Rate Off | $dV_{OUT}/dt_{off}$ | 70% to 40% $V_{OUT}$, $R_L$ = 24 Ω | | 1 | 4 | V / μs |
| **REVERSE BATTERY** (Note 8) | | | | | | |
| Reverse Battery | $-V_D$ | Requires a 150 Ω Resistor in GND Connection | | | 32 | V |
| Forward Voltage | $V_F$ | $T_J$ = 150°C | | 0.6 | | V |
| **PROTECTION FUNCTIONS** (Note 9) | | | | | | |
| Temperature Shutdown (Note 8) | TSD | | 150 | 175 | 200 | °C |
| Temperature Shutdown Hysteresis (Note 8) | $TSD_{(hyst)}$ | | | 10 | | °C |
| Overvoltage Protection | $V_{OV}$ | $I_D$ = 4 mA | 41 | | | V |
| Switch Off Output Clamp Voltage | $V_{CLAMP}$ | $I_D$ = 4 mA, $V_{IN}$ = 0 V | $V_D$ − 41 | $V_D$ − 47 | | V |
| Output Current Limit Initial Peak | $I_{LIM}$ | $V_D$ = 20 V, $T_J$ = 25°C<br>$T_J$ = −40°C to150°C | 1.0 | 1.8<br>– | 3 | A |

8. Not subjected to production testing
9. To ensure long term reliability under heavy overload or short circuit conditions, protection and related diagnostic signals must be used together with a proper hardware/software strategy. If the devices operates under abnormal conditions this hardware/software solutions must limit the duration and number of activation cycles.

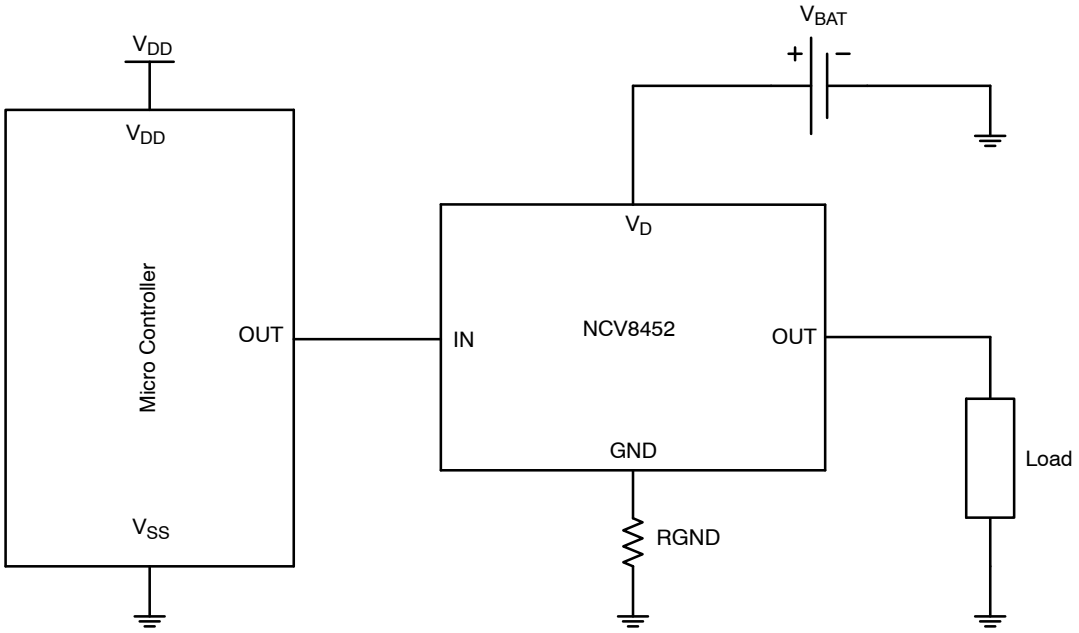



**Figure 3. Application Diagram**

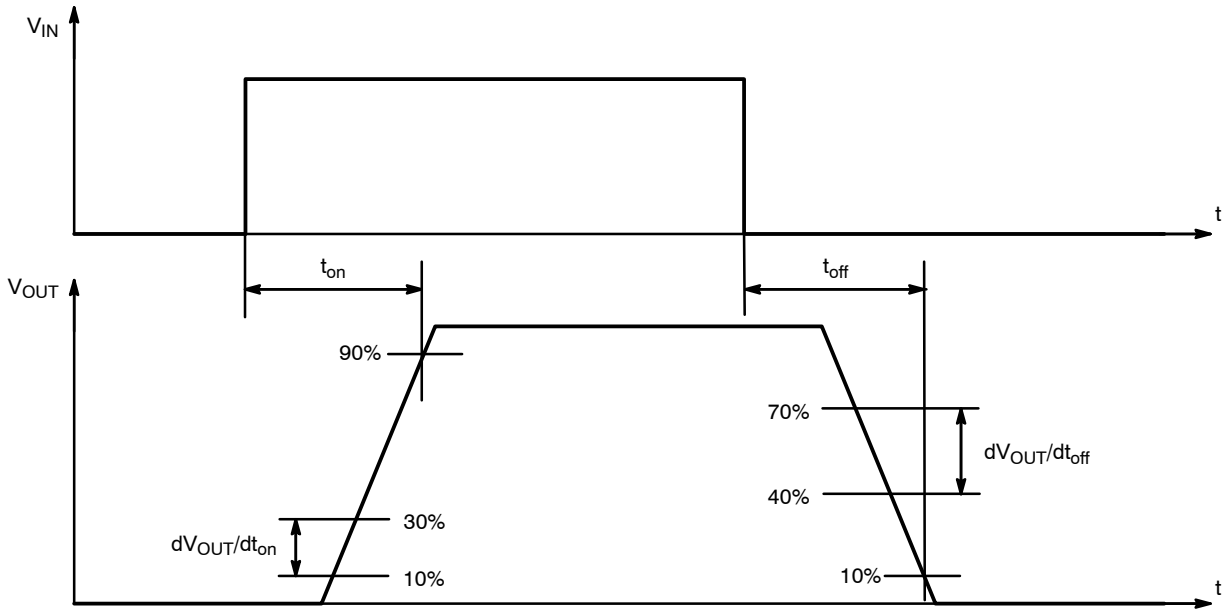



**Figure 4. Resistive Load Switching Waveform**

## TYPICAL CHARACTERISTIC CURVES

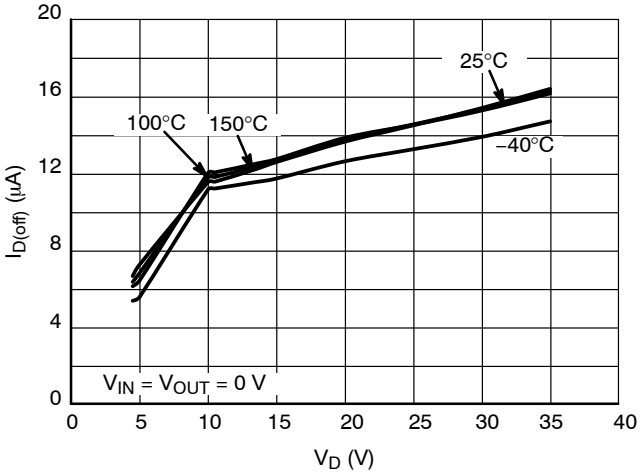



**Figure 5. Standby Current vs. Supply Voltage**

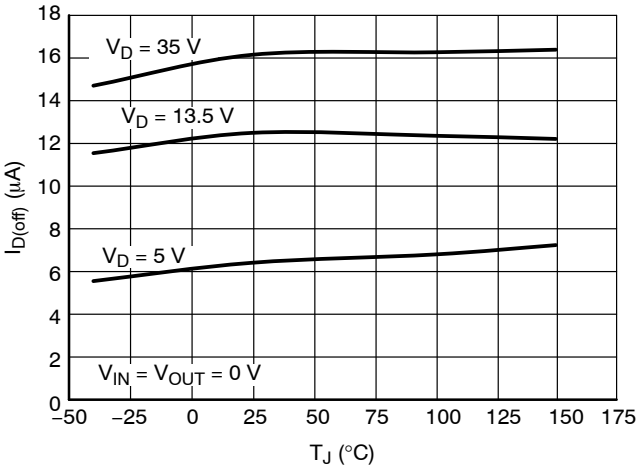



**Figure 6. Standby Current vs. Junction Temperature**

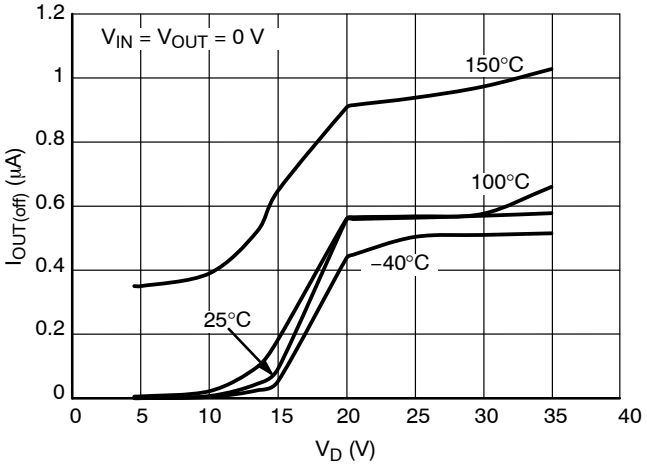



**Figure 7. Output Leakage Current vs. Supply Voltage**

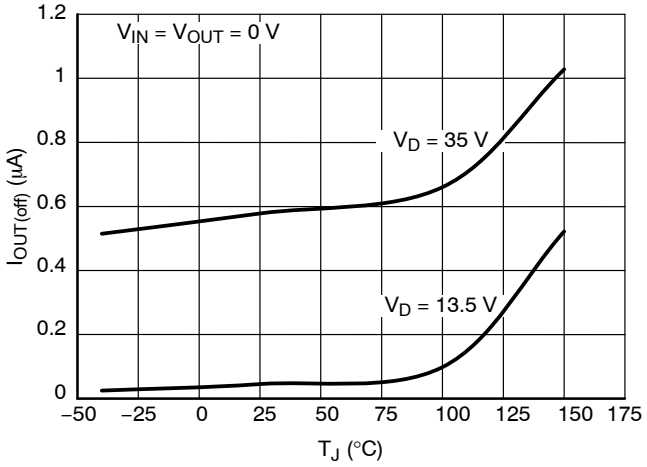



**Figure 8. Output Leakage Current vs. Junction Temperature**

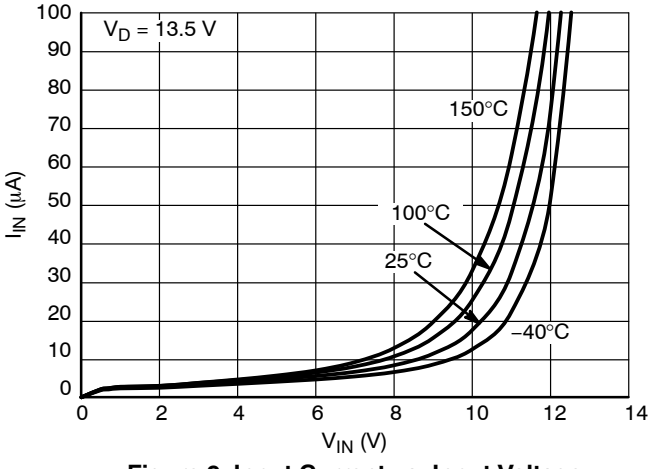



**Figure 9. Input Current vs. Input Voltage**

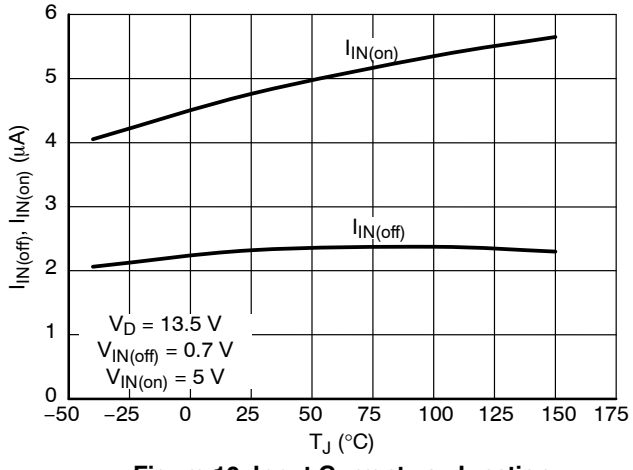



**Figure 10. Input Current vs. Junction Temperature**

## TYPICAL CHARACTERISTIC CURVES

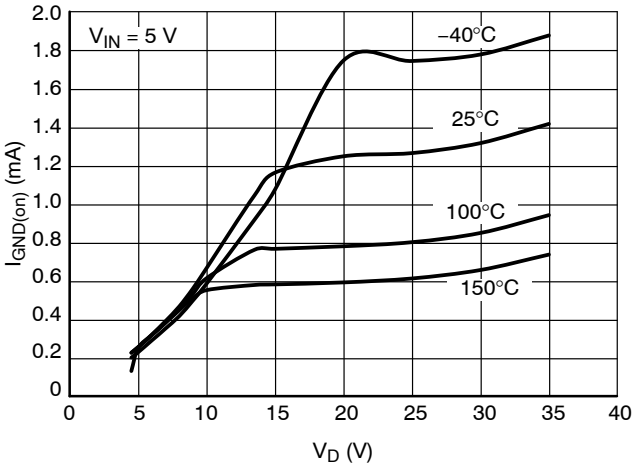



**Figure 11. Active Ground Current vs. Supply Voltage**

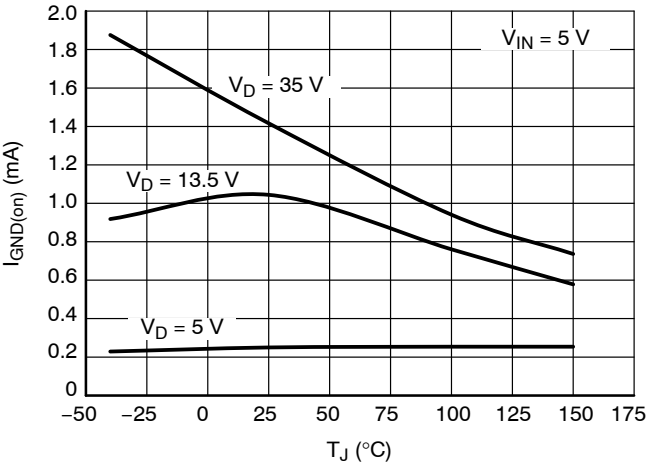



**Figure 12. Active Ground Current vs. Junction Temperature**

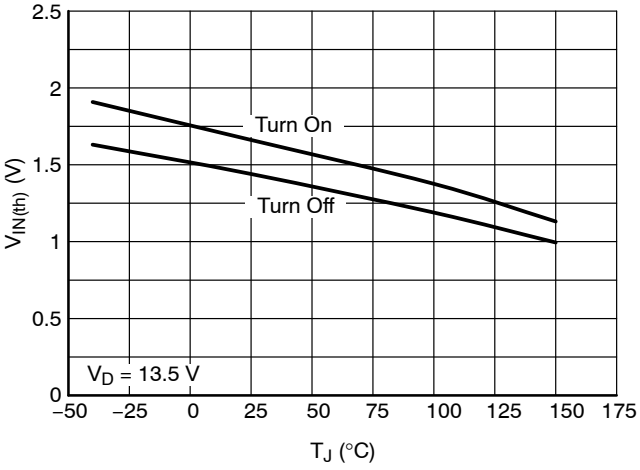



**Figure 13. Input Threshold Voltage vs. Junction Temperature**

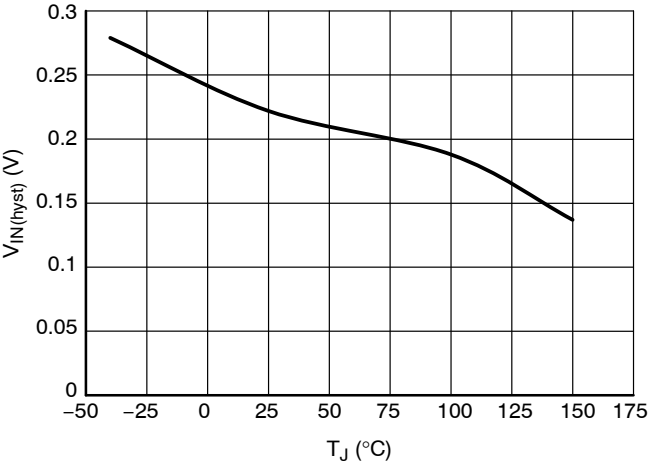



**Figure 14. Input Threshold Hysteresis vs. Junction Temperature**

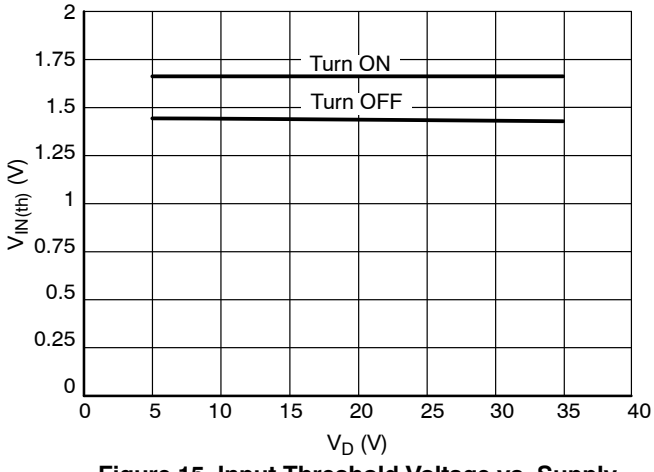



**Figure 15. Input Threshold Voltage vs. Supply Voltage**

## TYPICAL CHARACTERISTIC CURVES

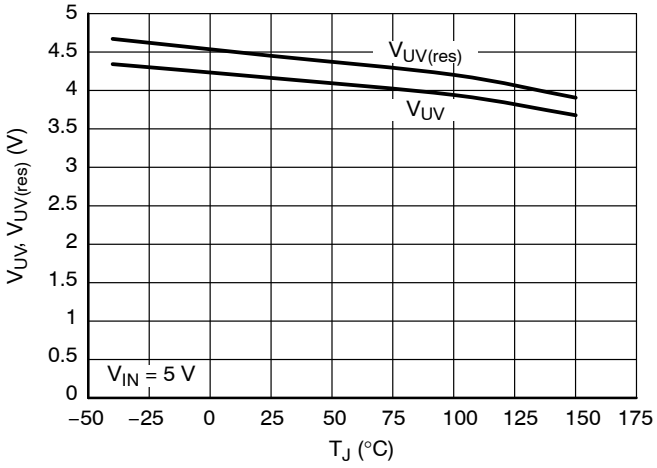



**Figure 16. Under Voltage Shutdown and Restart vs. Junction Temperature**

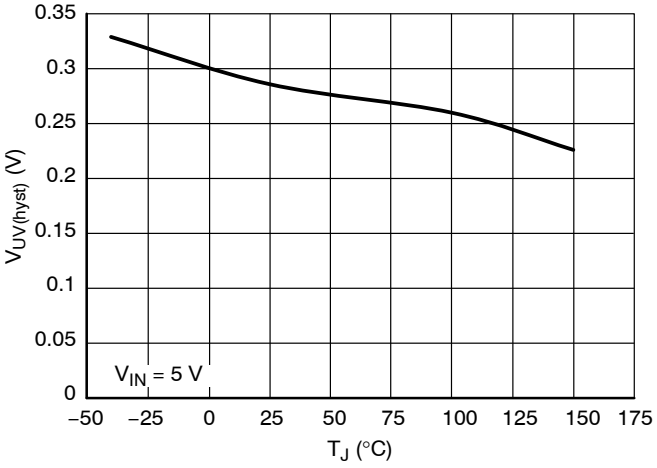



**Figure 17. Under Voltage Shutdown Hysteresis vs. Junction Temperature**

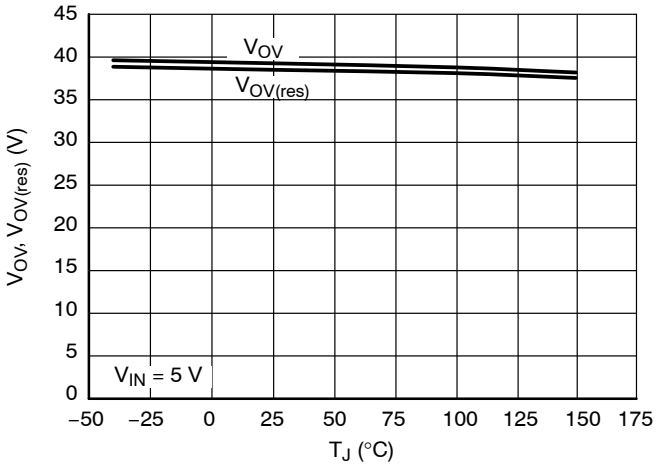



**Figure 18. Over Voltage Shutdown vs. Junction Temperature**

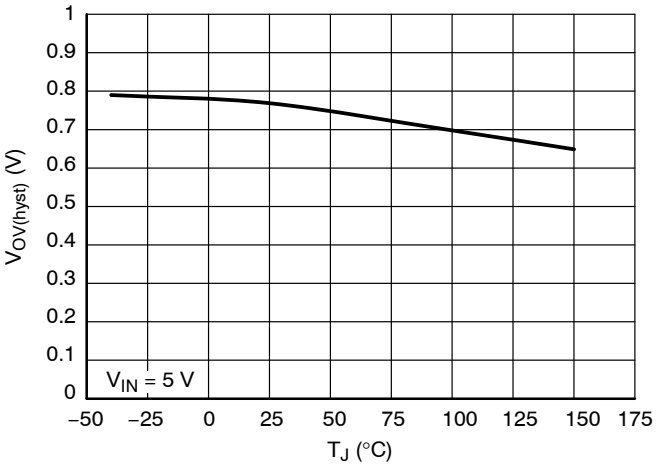



**Figure 19. Over Voltage Shutdown Hysteresis vs. Junction Temperature**

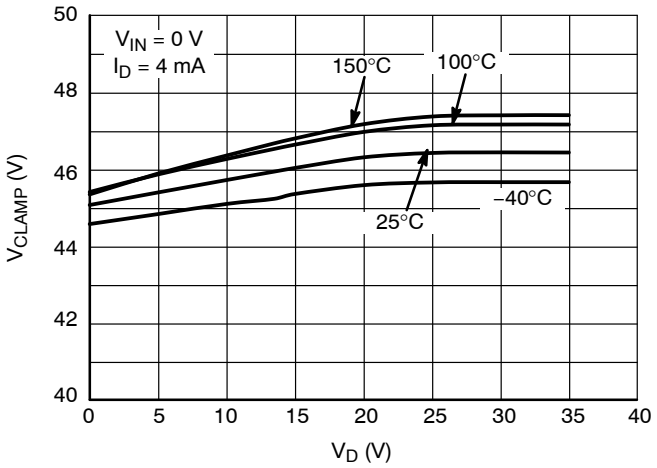



**Figure 20. Output Clamp Voltage vs. Supply Voltage**

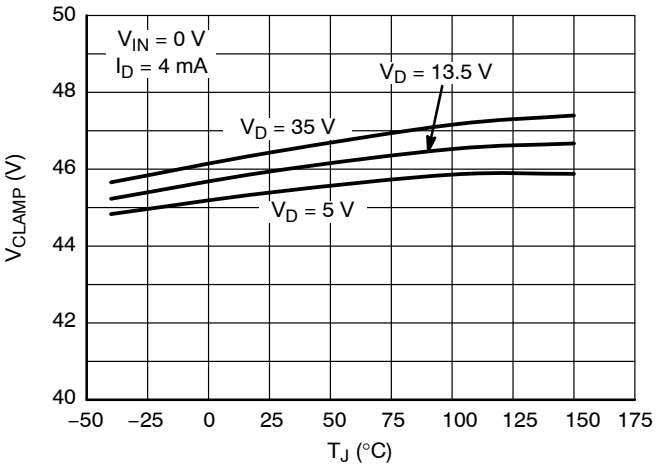



**Figure 21. Output Clamp Voltage vs. Junction Temperature**

## TYPICAL CHARACTERISTIC CURVES

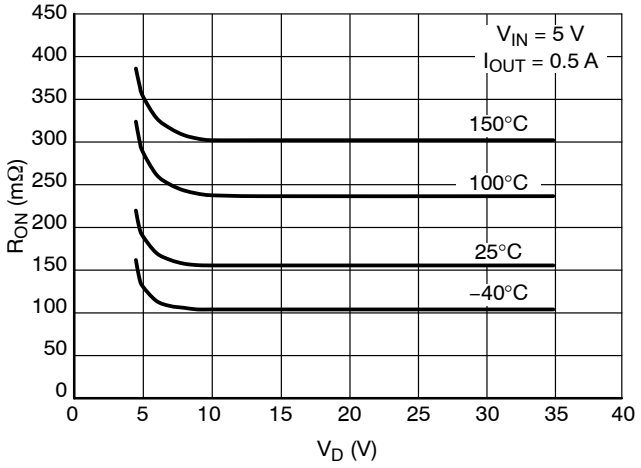



**Figure 22. On−state Resistance vs. Supply Voltage**

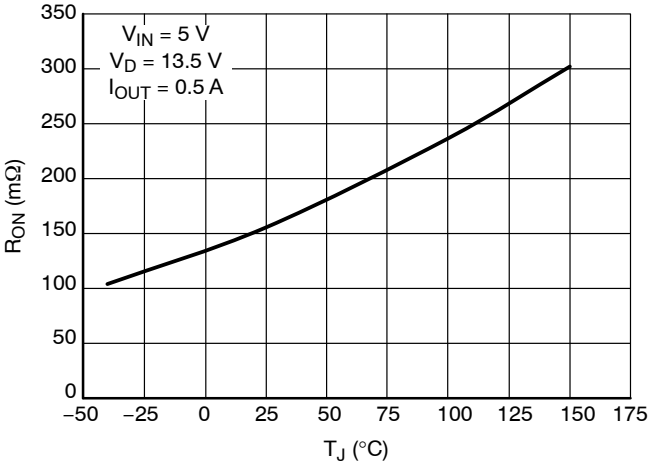



**Figure 23. On−state Resistance vs. Junction Temperature**

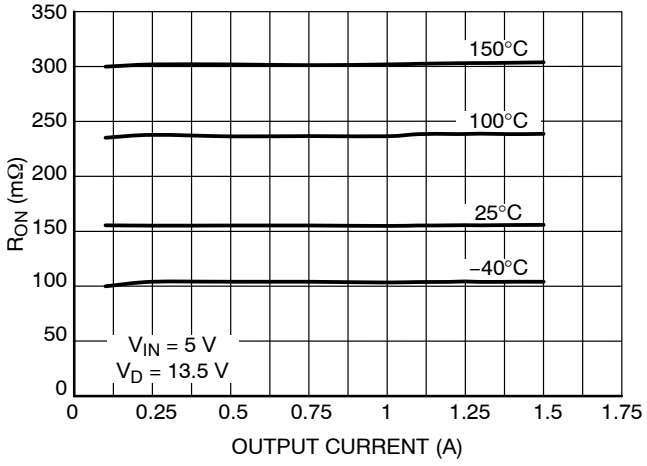



**Figure 24. On−state Resistance vs. Output Current**

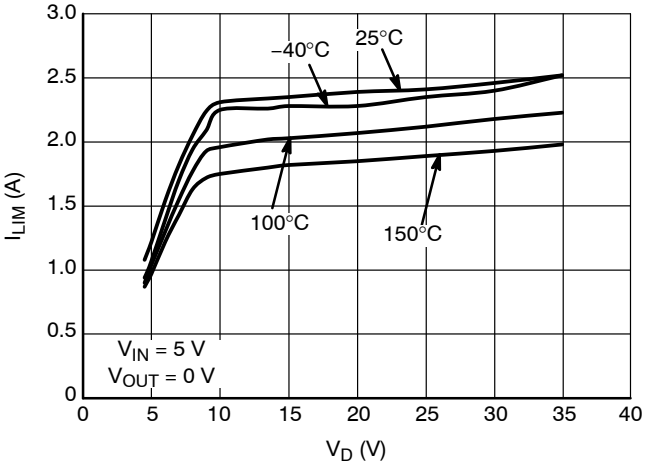



**Figure 25. Current Limit vs. Supply Voltage**

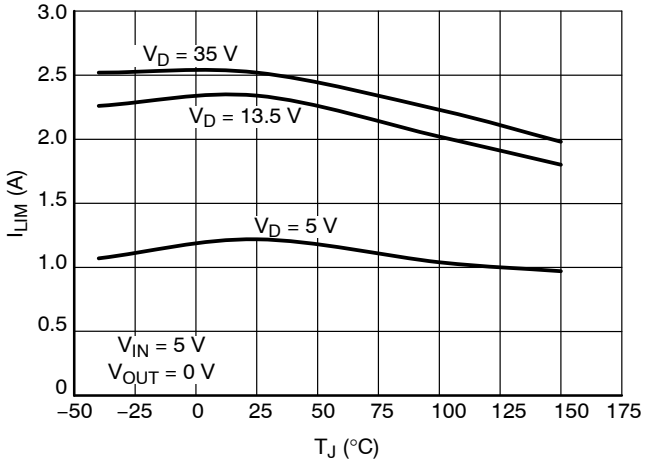



**Figure 26. Current Limit vs. Junction Temperature**

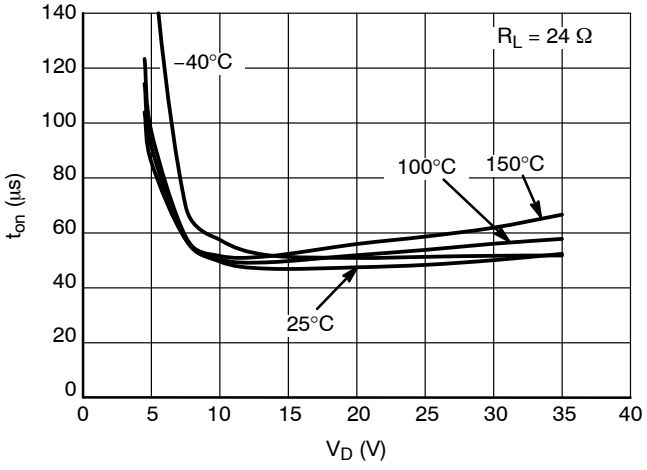



**Figure 27. Turn−On Time vs. Supply Voltage**

## TYPICAL CHARACTERISTIC CURVES

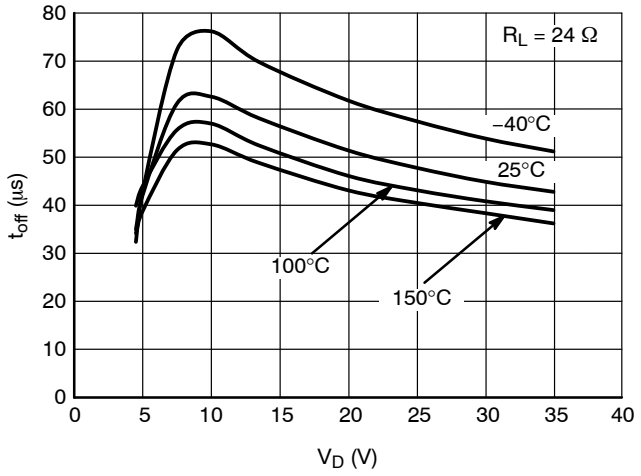



**Figure 28. Turn−Off Time vs. Supply Voltage**

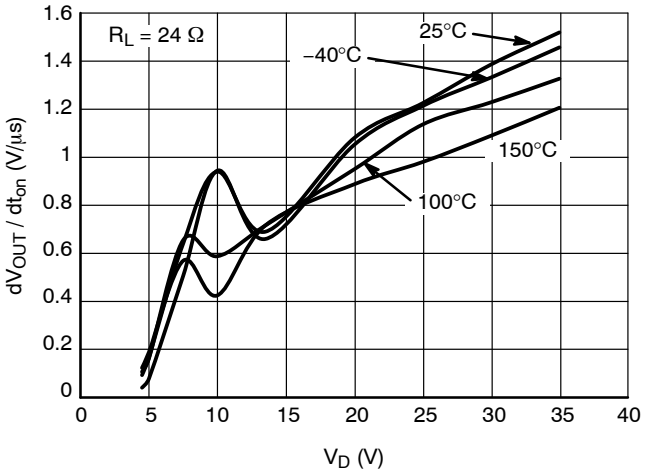



**Figure 29. Slew Rate On vs. Supply Voltage**

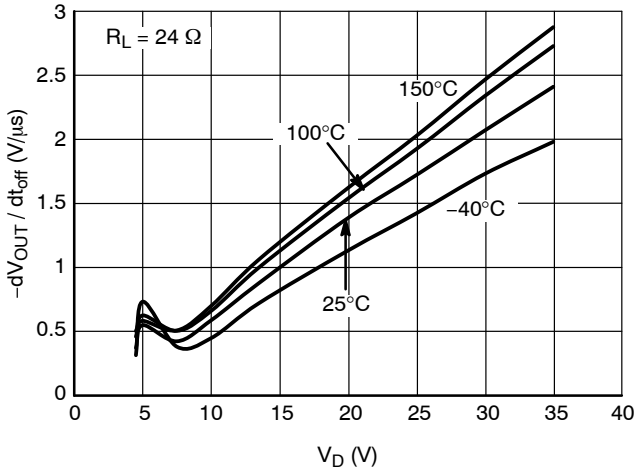



**Figure 30. Slew Rate Off vs. Supply Voltage**

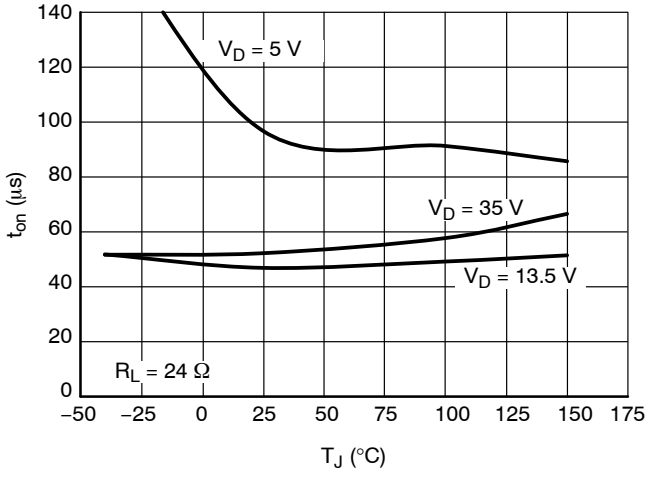



**Figure 31. Turn−On vs. Junction Temperature**

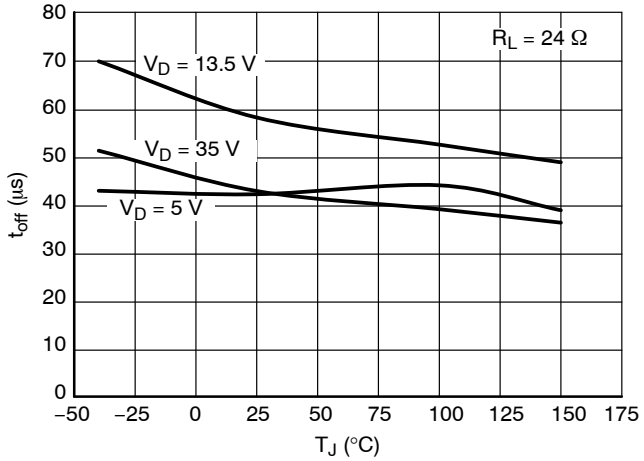



**Figure 32. Turn−Off Time vs. Junction Temperature**

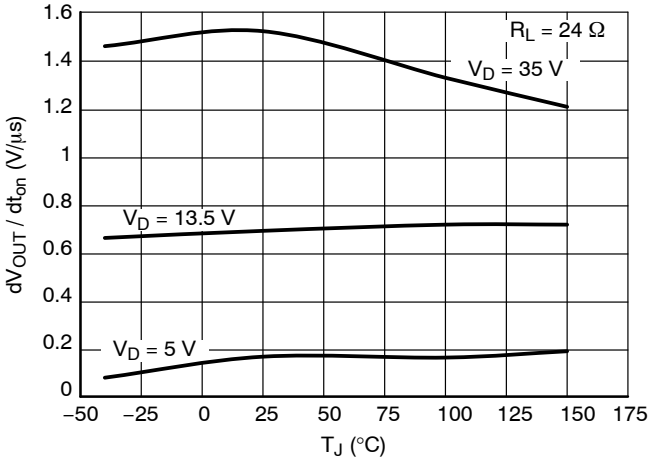



**Figure 33. Slew Rate On vs. Junction Temperature**

## TYPICAL CHARACTERISTIC CURVES

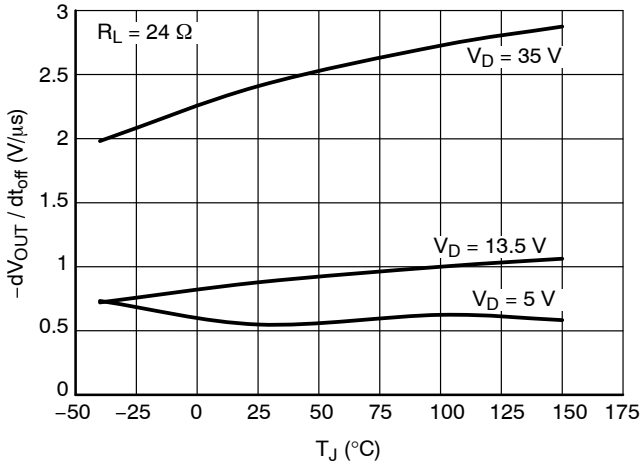



**Figure 34. Slew Rate Off vs. Junction Temperature**

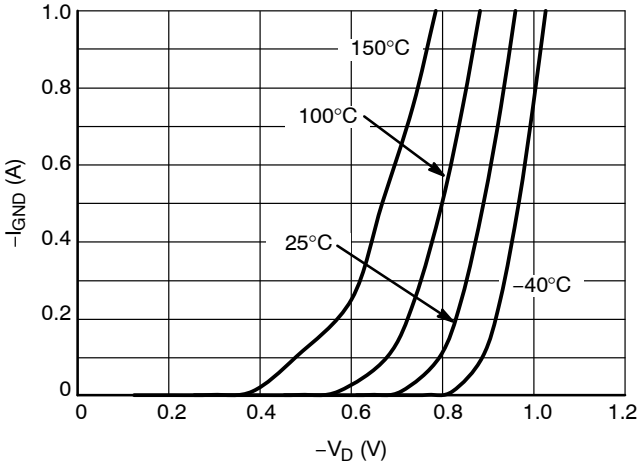



**Figure 35. Supply−to−Ground Reverse Characteristics**

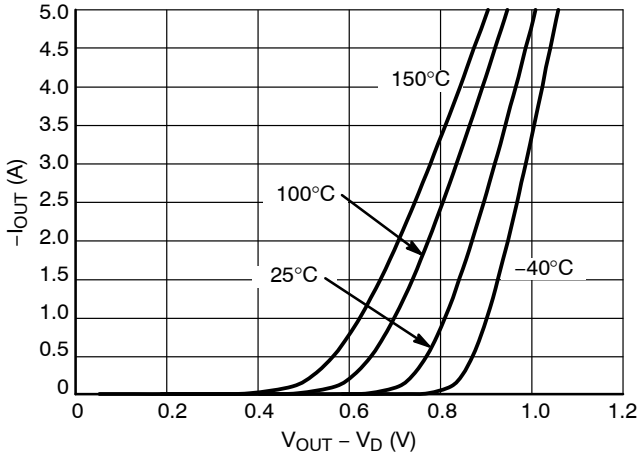



**Figure 36. Power FET Body Forward Characteristics**

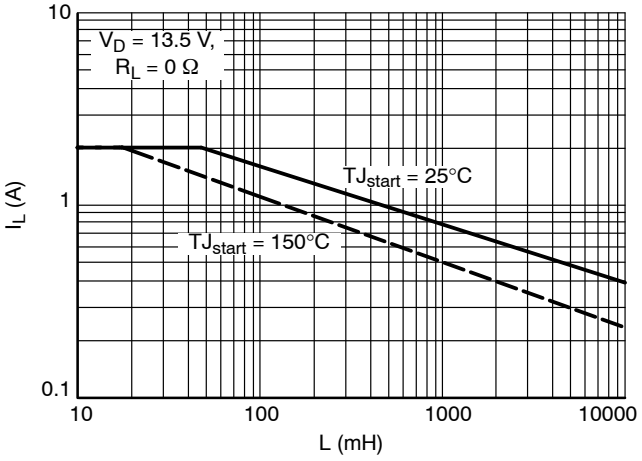



**Figure 37. Single Pulse Maximum Switch Off Current vs. Load Inductance**

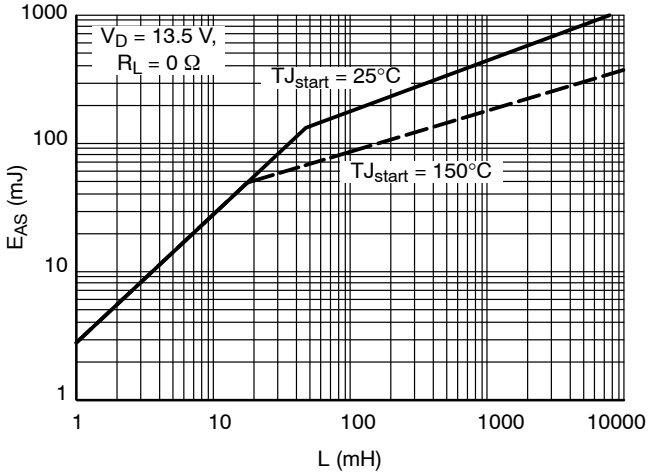



**Figure 38. Single Pulse Maximum Switch Off Energy vs. Load Inductance**

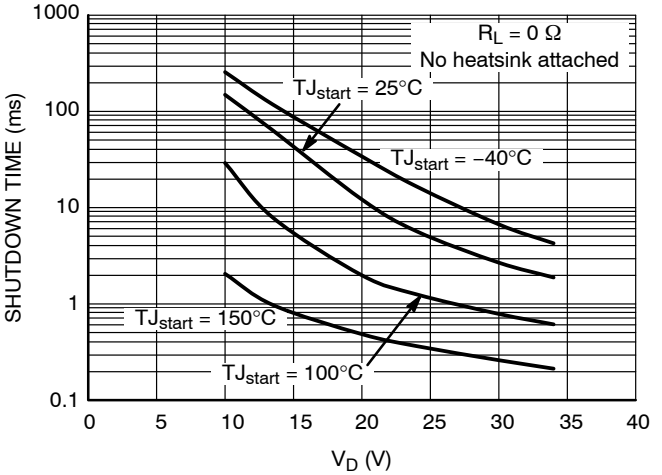



**Figure 39. Initial Short−Circuit Shutdown Time vs. Supply Voltage**

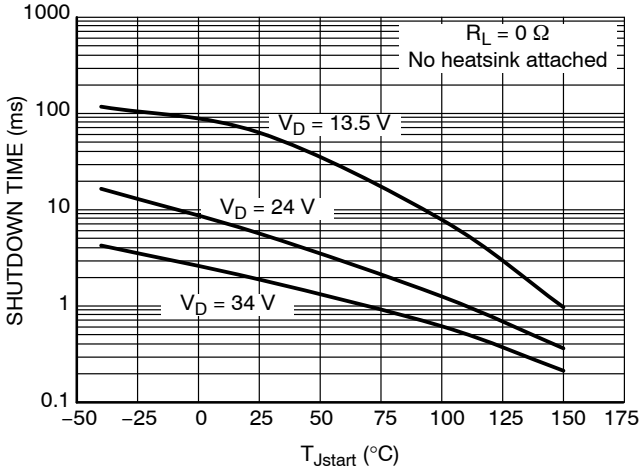



**Figure 40. Initial Short−Circuit Shutdown Time vs. Starting Junction Temperature**

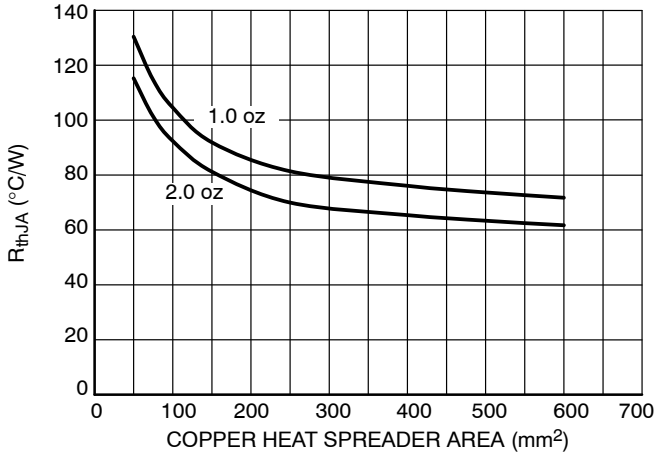



**Figure 41. Junction−to−Ambient Thermal Resistance vs. Copper Area**

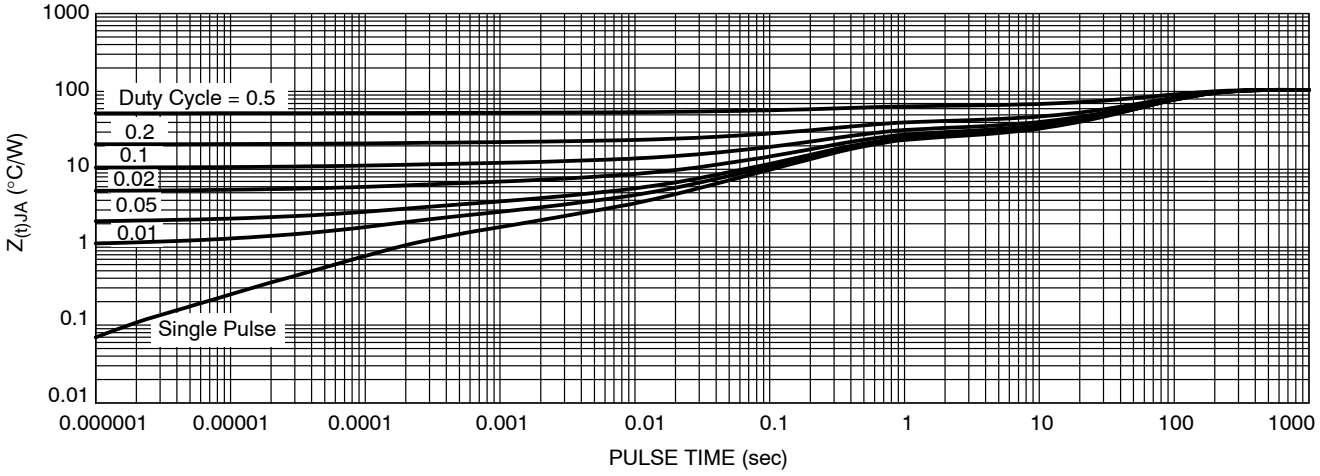



**Figure 42. Junction−to−Ambient Transient Thermal Impedance (minimum pad size)**

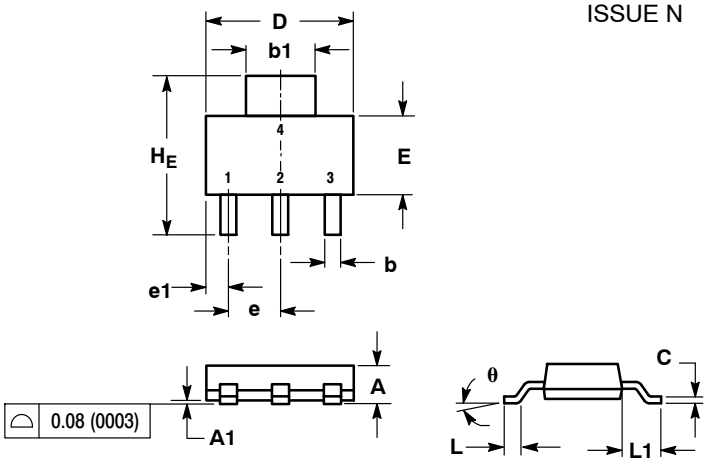
## ORDERING INFORMATION

| Device | Package | Shipping† |
|---|---|---|
| NCV8452STT1G | SOT−223 (Pb−Free) | 1000 / Tape & Reel |
| NCV8452STT3G | SOT−223 (Pb−Free) | 4000 / Tape & Reel |

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

## PACKAGE DIMENSIONS

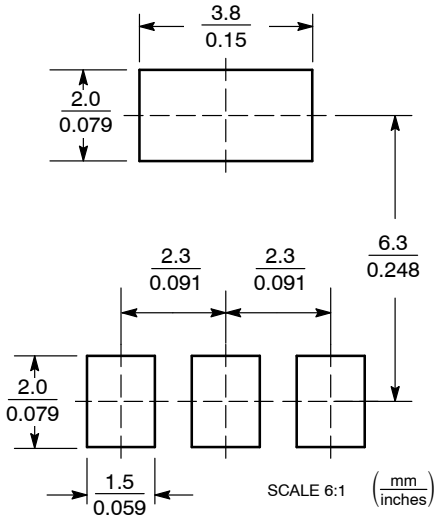
**SOT−223 (TO−261)**
CASE 318E−04
ISSUE N




NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: INCH.

| | MILLIMETERS | | | INCHES | | |
|---|---|---|---|---|---|---|
| DIM | MIN | NOM | MAX | MIN | NOM | MAX |
| A | 1.50 | 1.63 | 1.75 | 0.060 | 0.064 | 0.068 |
| A1 | 0.02 | 0.06 | 0.10 | 0.001 | 0.002 | 0.004 |
| b | 0.60 | 0.75 | 0.89 | 0.024 | 0.030 | 0.035 |
| b1 | 2.90 | 3.06 | 3.20 | 0.115 | 0.121 | 0.126 |
| c | 0.24 | 0.29 | 0.35 | 0.009 | 0.012 | 0.014 |
| D | 6.30 | 6.50 | 6.70 | 0.249 | 0.256 | 0.263 |
| E | 3.30 | 3.50 | 3.70 | 0.130 | 0.138 | 0.145 |
| e | 2.20 | 2.30 | 2.40 | 0.087 | 0.091 | 0.094 |
| e1 | 0.85 | 0.94 | 1.05 | 0.033 | 0.037 | 0.041 |
| L | 0.20 | −−− | −−− | 0.008 | −−− | −−− |
| L1 | 1.50 | 1.75 | 2.00 | 0.060 | 0.069 | 0.078 |
| $H_E$ | 6.70 | 7.00 | 7.30 | 0.264 | 0.276 | 0.287 |
| θ | 0° | – | 10° | 0° | – | 10° |

### SOLDERING FOOTPRINT*




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

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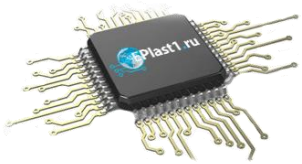
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.

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