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–Q101 Qualified and PPAP Capable
• These Devices are Pb–Free, Halogen Free/BFR 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

PRODUCT SUMMARY

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Characteristics</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>V_{OV}</td>
<td>Overvoltage Protection</td>
<td>41</td>
<td>V</td>
</tr>
<tr>
<td>V_D</td>
<td>Operation Voltage</td>
<td>5 – 34</td>
<td>V</td>
</tr>
<tr>
<td>R_{ON}</td>
<td>On–State Resistance</td>
<td>200</td>
<td>mΩ</td>
</tr>
<tr>
<td>I_{ILIM}</td>
<td>Output Current Limit</td>
<td>1.0</td>
<td>A</td>
</tr>
</tbody>
</table>

V8452 = Device Code
A = Assembly Location
Y = Year
W = Work Week
* = Pb–Free Package
(Note: Microdot may be in either location)

www.onsemi.com

MARKING DIAGRAM

SOT–223 (TO–261)
CASE 318E

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

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October, 2018 – Rev. 6
Publication Order Number: NCV8452/D
Figure 1. Block Diagram

PACKAGE PIN DESCRIPTION

<table>
<thead>
<tr>
<th>Pin #</th>
<th>Symbol</th>
<th>Description</th>
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<tbody>
<tr>
<td>1</td>
<td>OUT</td>
<td>Output</td>
</tr>
<tr>
<td>2</td>
<td>GND</td>
<td>Ground</td>
</tr>
<tr>
<td>3</td>
<td>IN</td>
<td>Logic Level Input</td>
</tr>
<tr>
<td>4</td>
<td>VD</td>
<td>Supply Voltage</td>
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</table>

Figure 2. Voltage and Current Definition
# MAXIMUM RATINGS

<table>
<thead>
<tr>
<th>Rating</th>
<th>Symbol</th>
<th>Value</th>
<th>Unit</th>
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</thead>
<tbody>
<tr>
<td>DC Supply Voltage</td>
<td>$V_D$</td>
<td>40</td>
<td>V</td>
</tr>
<tr>
<td>Peak Transient Input Voltage (Load Dump 37.5 V, $V_D = 13.5$ V, ISO7637−2 pulse5) (Note 1)</td>
<td>$V_{peak}$</td>
<td>51</td>
<td>V</td>
</tr>
<tr>
<td>Input Voltage</td>
<td>$V_{IN}$</td>
<td>−5 to $V_D$</td>
<td>V</td>
</tr>
<tr>
<td>Input Current</td>
<td>$I_{IN}$</td>
<td>±5 mA</td>
<td></td>
</tr>
<tr>
<td>Output Current</td>
<td>$I_{OUT}$</td>
<td>Internally Limited</td>
<td>A</td>
</tr>
<tr>
<td>Power Dissipation</td>
<td>$P_D$</td>
<td>1.19 W</td>
<td>1.76 W</td>
</tr>
<tr>
<td>Electrostatic Discharge (Note 1) (HBM Model 100 pF / 1500 Ω)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input</td>
<td>±1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output</td>
<td>±5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$V_D$</td>
<td>±5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single Pulse Inductive Load Switch Off Energy (Note 1) (L = 4.55 H, $V_D = 13.5$ V; $I_L = 0.5$ A, $T_{Jstart} = 25$°C)</td>
<td>$E_{AS}$</td>
<td>0.8 J</td>
<td></td>
</tr>
<tr>
<td>Operating Junction Temperature</td>
<td>$T_J$</td>
<td>−40 to +150 °C</td>
<td></td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>$T_{storage}$</td>
<td>−55 to +150 °C</td>
<td></td>
</tr>
</tbody>
</table>

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

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.
4. 1 in square pad size, FR−4, 1 oz Cu.

# THERMAL RESISTANCE RATINGS

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Max Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal Resistance (Note 5)</td>
<td>$R_{HJS}$</td>
<td>10</td>
<td>°C/W</td>
</tr>
<tr>
<td>Junction-to-Soldering Point</td>
<td>$R_{HJA}$</td>
<td>105</td>
<td>°C/W</td>
</tr>
<tr>
<td>Junction-to-Ambient (Note 6)</td>
<td>$R_{HJA}$</td>
<td>71</td>
<td>°C/W</td>
</tr>
</tbody>
</table>

5. Reverse Output current has to be limited by the load to stay within absolute maximum ratings and thermal performance.
7. 1 in square pad size, FR−4, 1 oz Cu.
### ELECTRICAL CHARACTERISTICS \((V_D = 13.5 \, V; \, -40^\circ C < T_J < 150^\circ C \text{ unless otherwise specified})\)

<table>
<thead>
<tr>
<th>Rating</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Supply Voltage</td>
<td>(V_D)</td>
<td></td>
<td>5 – 34 (V)</td>
</tr>
<tr>
<td>Undervoltage Shutdown</td>
<td>(V_{UV})</td>
<td></td>
<td>2.5 – 5.5 (V)</td>
</tr>
<tr>
<td>Undervoltage Restart</td>
<td>(V_{UV(\text{res})})</td>
<td></td>
<td>6.0 – 6.0 (V)</td>
</tr>
<tr>
<td>Undervoltage Hysteresis</td>
<td>(V_{UV(hyst)})</td>
<td></td>
<td>0.3 – 0.3 (V)</td>
</tr>
<tr>
<td>Overvoltage Shutdown</td>
<td>(V_{OV})</td>
<td></td>
<td>34 – 42 (V)</td>
</tr>
<tr>
<td>Overvoltage Restart</td>
<td>(V_{OV(\text{res})})</td>
<td></td>
<td>33 – 33 (V)</td>
</tr>
<tr>
<td>On-state Resistance</td>
<td>(R_{ON})</td>
<td>(I_{\text{OUT}} = 0.5 , A, , V_{\text{IN}} = 5 , V, , T_J = 25^\circ , C)</td>
<td>160 – 160 (m\Omega)</td>
</tr>
<tr>
<td>Standby Current</td>
<td>(I_{\text{D(\text{off})}})</td>
<td>(V_{\text{IN}} = V_{\text{OUT}} = 0 , V)</td>
<td>12 – 25 (\mu\text{A})</td>
</tr>
<tr>
<td>Active Ground Current</td>
<td>(I_{\text{GND(on)}})</td>
<td>(V_{\text{IN}} = 5 , V)</td>
<td>1 – 1.8 (\text{mA})</td>
</tr>
<tr>
<td>Output Leakage Current</td>
<td>(I_{\text{OUT(\text{off})}})</td>
<td>(V_{\text{IN}} = 0 , V)</td>
<td>2 – 2 (\mu\text{A})</td>
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</table>

#### INPUT CHARACTERISTICS

<table>
<thead>
<tr>
<th></th>
<th>Symbol</th>
<th>Conditions</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Voltage – Low</td>
<td>(V_{\text{IN(low)}})</td>
<td></td>
<td>0.8 – 0.8 (V)</td>
</tr>
<tr>
<td>Input Voltage – High</td>
<td>(V_{\text{IN(high)}})</td>
<td></td>
<td>2.2 – 2.2 (V)</td>
</tr>
<tr>
<td>Off State Input Current</td>
<td>(I_{\text{IN(\text{off})}})</td>
<td>(V_{\text{IN}} = 0.7 , V)</td>
<td>10 – 10 (\mu\text{A})</td>
</tr>
<tr>
<td>On State Input Current</td>
<td>(I_{\text{IN(on)}})</td>
<td>(V_{\text{IN}} = 5.0 , V)</td>
<td>10 – 10 (\mu\text{A})</td>
</tr>
<tr>
<td>Input Threshold Hysteresis</td>
<td>(V_{\text{IN(hyst)}})</td>
<td></td>
<td>0.3 – 0.3 (V)</td>
</tr>
<tr>
<td>Input Resistance</td>
<td>(R_I)</td>
<td>1.5 – 2.8 – 3.5 (k\Omega)</td>
<td>1.5 – 2.8 – 3.5 (k\Omega)</td>
</tr>
</tbody>
</table>

#### SWITCHING CHARACTERISTICS

<table>
<thead>
<tr>
<th></th>
<th>Symbol</th>
<th>Conditions</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turn–On Time</td>
<td>(t_{\text{on}})</td>
<td>to 90% (V_{\text{OUT}}), (R_L = 24 , \Omega)</td>
<td>60 – 60 (\mu\text{s})</td>
</tr>
<tr>
<td>Turn–Off Time</td>
<td>(t_{\text{off}})</td>
<td>to 10% (V_{\text{OUT}}), (R_L = 24 , \Omega)</td>
<td>60 – 60 (\mu\text{s})</td>
</tr>
<tr>
<td>Slew Rate On</td>
<td>(dV_{\text{OUT}}/dt_{\text{on}})</td>
<td>10% to 30% (V_{\text{OUT}}), (R_L = 24 , \Omega)</td>
<td>1 – 4 (V/\mu\text{s})</td>
</tr>
<tr>
<td>Slew Rate Off</td>
<td>(dV_{\text{OUT}}/dt_{\text{off}})</td>
<td>70% to 40% (V_{\text{OUT}}), (R_L = 24 , \Omega)</td>
<td>1 – 4 (V/\mu\text{s})</td>
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</table>

#### REVERSE BATTERY (Note 8)

<table>
<thead>
<tr>
<th></th>
<th>Symbol</th>
<th>Requires a 150 (\Omega) Resistor in GND Connection</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Reverse Battery</td>
<td>(-V_D)</td>
<td></td>
<td>32 – 32 (V)</td>
</tr>
<tr>
<td>Forward Voltage</td>
<td>(V_F)</td>
<td>(T_J = 150^\circ , C)</td>
<td>0.6 – 0.6 (V)</td>
</tr>
</tbody>
</table>

#### PROTECTION FUNCTIONS (Note 9)

<table>
<thead>
<tr>
<th></th>
<th>Symbol</th>
<th>Conditions</th>
<th>Value</th>
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<tr>
<td>Temperature Shutdown</td>
<td>(T_{SD})</td>
<td></td>
<td>150 – 150 (^\circ , C)</td>
</tr>
<tr>
<td>Temperature Shutdown Hysteresis (Note 8)</td>
<td>(T_{SD(hyst)})</td>
<td></td>
<td>10 – 10 (^\circ , C)</td>
</tr>
<tr>
<td>Overvoltage Protection</td>
<td>(V_{OV})</td>
<td>(I_D = 4 , mA)</td>
<td>41 – 41 (V)</td>
</tr>
<tr>
<td>Switch Off Output Clamp Voltage</td>
<td>(V_{CLAMP})</td>
<td>(I_D = 4 , mA, , V_{\text{IN}} = 0 , V)</td>
<td>(V_D - 41)</td>
</tr>
<tr>
<td>Output Current Limit Initial Peak</td>
<td>(I_{\text{LIM}})</td>
<td>(V_D = 20 , V, , T_J = 25^\circ , C) (\text{or} , -40^\circ , C , \text{to} , 150^\circ , C)</td>
<td>1.0 – 1.0 (A)</td>
</tr>
</tbody>
</table>

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**

- $\frac{dV_{OUT}}{dt}$ vs. $T_J$ ($^\circ$C)
- $V_{OUT} = 13.5$ V
- $V_{OUT} = 5$ V
- $V_{OUT} = 35$ V

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

- $-V_D$ vs. $I_{IGND}$ (A)
- $V_D = 13.5$ V
- $V_D = 13.5$ V
- $R_L = 24$ Ω
- $V_D = 35$ V

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

- $I_{OUT}$ vs. $V_{OUT}$
- $V_D = 13.5$ V
- $R_L = 0$ Ω
- $V_D = 5$ V
- $V_D = 13.5$ V

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

- $I_L$ vs. $L$ (mH)
- $V_D = 13.5$ V
- $R_L = 0$ Ω
- $T_{Jstart} = 25$ °C
- $T_{Jstart} = 150$ °C

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

- $E_{AS}$ (mJ) vs. $L$ (mH)
- $V_D = 13.5$ V
- $R_L = 0$ Ω
- $T_{Jstart} = 25$ °C
- $T_{Jstart} = 150$ °C

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

- $T_{shut}$ (ms) vs. $V_D$ (V)
- $R_L = 0$ Ω
- No heatsink attached
- $T_{Jstart} = 25$ °C
- $T_{Jstart} = 150$ °C
- $T_{Jstart} = -40$ °C
Figure 40. Initial Short-Circuit Shutdown Time vs. Starting Junction Temperature

![Graph showing SHUTDOWN TIME (ms) vs. T_Jstart (°C)](image)

- V_D = 13.5 V
- V_D = 24 V
- V_D = 34 V
- R_L = 0 Ω
- No heatsink attached

Figure 41. Junction-to-Ambient Thermal Resistance vs. Copper Area

![Graph showing RthJA (°C/W) vs. COPPER HEAT SPREADER AREA (mm²)](image)

- V_D = 13.5 V
- V_D = 24 V
- V_D = 34 V
- R_L = 0/C0087

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

![Graph showing Z(t)JA (°C/W) vs. PULSE TIME (sec)](image)

- Duty Cycle = 0.5
- Single Pulse

ORDERING INFORMATION

<table>
<thead>
<tr>
<th>Device</th>
<th>Package</th>
<th>Shipping†</th>
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<tbody>
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<td>NCV8452STT1G</td>
<td>SOT–223 (Pb–Free)</td>
<td>1000 / Tape &amp; Reel</td>
</tr>
<tr>
<td>NCV8452STT3G</td>
<td>SOT–223 (Pb–Free)</td>
<td>4000 / Tape &amp; Reel</td>
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</table>

†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.
MECHANICAL CASE OUTLINE
PACKAGE DIMENSIONS

SOT-223 (TO-261)
CASE 318E-04
ISSUE R

DATE 02 OCT 2018

NOTES:
2. CONTROLLING DIMENSION MILLIMETERS
3. DIMENSIONS D & E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH, PROTRUSIONS OR GATE BURRS SHALL NOT EXCEED 0.200MM PER SIDE.
4. DATUMS A AND B ARE DETERMINED AT DATUM H.
5. A1 IS DEFINED AS THE VERTICAL DISTANCE FROM THE SEATING PLANE TO THE LOWEST POINT OF THE PACKAGE BODY.
6. POSITIONAL TOLERANCE APPLIES TO DIMENSIONS b AND b1.

<table>
<thead>
<tr>
<th>MILLIMETERS</th>
<th>DIM</th>
<th>MIN.</th>
<th>NOM.</th>
<th>MAX.</th>
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<tbody>
<tr>
<td>A</td>
<td>1.50</td>
<td>1.63</td>
<td>1.75</td>
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</tr>
<tr>
<td>A1</td>
<td>0.02</td>
<td>0.06</td>
<td>0.10</td>
<td></td>
</tr>
<tr>
<td>b</td>
<td>0.60</td>
<td>0.75</td>
<td>0.89</td>
<td></td>
</tr>
<tr>
<td>b1</td>
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<td>3.06</td>
<td>3.20</td>
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</tr>
<tr>
<td>c</td>
<td>0.24</td>
<td>0.29</td>
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</tr>
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<td>D</td>
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<td>6.70</td>
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<td>E</td>
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<td>6.30</td>
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<td></td>
<td>3x</td>
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<td>2.30 PITCH</td>
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<td>1.50</td>
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</tbody>
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DOCUMENT NUMBER: 98ASB42680B
DESCRIPTION: SOT-223 (TO-261)

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Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.

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www.onsemi.com
**SOT–223 (TO–261)**

CASE 318E–04

ISSUE R

DATE 02 OCT 2018

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**STYLE 1:**
1. BASE
2. COLLECTOR
3. EMITTER
4. COLLECTOR

**STYLE 2:**
1. ANODE
2. CATHODE
3. NC
4. CATHODE

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

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

**STYLE 5:**
1. DRAIN
2. GATE
3. SOURCE
4. DRAIN

**STYLE 6:**
1. RETURN
2. INPUT
3. OUTPUT
4. INPUT

**STYLE 7:**
1. ANODE 1
2. CATHODE
3. ANODE 2
4. CATHODE

**STYLE 8:**
1. INPUT
2. GROUND
3. LOGIC
4. GROUND

**STYLE 9:**
1. INPUT
2. GROUND
3. LOGIC
4. GROUND

**STYLE 10:**
1. CATHODE
2. ANODE
3. GATE
4. ANODE

**STYLE 11:**
1. MT 1
2. MT 2
3. GATE
4. MT 2

**STYLE 12:**
1. INPUT
2. OUTPUT
3. NC
4. OUTPUT

**STYLE 13:**
1. GATE
2. COLLECTOR
3. EMITTER
4. COLLECTOR

---

**GENERIC MARKING DIAGRAM**

```
/  |
/  |
+---
```

**A** = Assembly Location

**Y** = Year

**W** = Work Week

**XXXXX** = Specific Device Code

*= Pb–Free Package

(Note: Microdot may be in either location)

*This information is generic. Please refer to device data sheet for actual part marking. Pb–Free indicator, “G” or microdot “•”, may or may not be present. Some products may not follow the Generic Marking.*