Self-Protected Low Side Driver with Temperature and Current Limit
42 V, 14 A, Single N-Channel

NCV8403A, NCV8403B

NCV8403A/B is a three terminal protected Low-Side Smart Discrete device. The protection features include overcurrent, overtemperature, ESD and integrated Drain-to-Gate clamping for overvoltage protection. This device offers protection and is suitable for harsh automotive environments.

Features
• Short Circuit Protection
• Thermal Shutdown with Automatic Restart
• Over Voltage 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−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

<table>
<thead>
<tr>
<th>$V_{DSS}$ (Clamped)</th>
<th>$R_{DS(ON)}$ TYP</th>
<th>$I_{D}$ MAX (Limited)</th>
</tr>
</thead>
<tbody>
<tr>
<td>42 V</td>
<td>53 mΩ @ 10 V</td>
<td>15 A</td>
</tr>
</tbody>
</table>

MARKING DIAGRAM

ORDERING INFORMATION
See detailed ordering and shipping information in the package dimensions section on page 10 of this data sheet.
### MAXIMUM RATINGS (TJ = 25°C unless otherwise noted)

<table>
<thead>
<tr>
<th>Rating</th>
<th>Symbol</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drain-to-Source Voltage Internally Clamped</td>
<td>V_DSS</td>
<td>42</td>
<td>Vdc</td>
</tr>
<tr>
<td>Gate-to-Source Voltage</td>
<td>V_GS</td>
<td>±14</td>
<td>Vdc</td>
</tr>
<tr>
<td>Drain Current Continuous</td>
<td>I_D</td>
<td>Internally Limited</td>
<td></td>
</tr>
<tr>
<td>Total Power Dissipation – SOT–223 Version</td>
<td>P_D</td>
<td>1.13</td>
<td>W</td>
</tr>
<tr>
<td>@ TA = 25°C (Note 1)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ TA = 25°C (Note 2)</td>
<td></td>
<td>1.56</td>
<td></td>
</tr>
<tr>
<td>Total Power Dissipation – DPAK Version</td>
<td></td>
<td>1.32</td>
<td>W</td>
</tr>
<tr>
<td>@ TA = 25°C (Note 1)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ TA = 25°C (Note 2)</td>
<td></td>
<td>2.5</td>
<td></td>
</tr>
<tr>
<td>Thermal Resistance – SOT–223 Version</td>
<td>R_UJS</td>
<td>12</td>
<td>°C/W</td>
</tr>
<tr>
<td>Junction-to-Soldering Point</td>
<td>R_UJA</td>
<td>110</td>
<td></td>
</tr>
<tr>
<td>Junction-to-Ambient (Note 1)</td>
<td>R_UJA</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td>Junction-to-Ambient (Note 2)</td>
<td>R_UJS</td>
<td>2.5</td>
<td></td>
</tr>
<tr>
<td>Thermal Resistance – DPAK Version</td>
<td>R_UJS</td>
<td>2.5</td>
<td></td>
</tr>
<tr>
<td>Junction-to-Soldering Point</td>
<td>R_UJA</td>
<td>95</td>
<td></td>
</tr>
<tr>
<td>Junction-to-Ambient (Note 1)</td>
<td>R_UJA</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Junction-to-Ambient (Note 2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single Pulse Inductive Load Switching Energy</td>
<td>E_AS</td>
<td>470</td>
<td>mJ</td>
</tr>
<tr>
<td>(V_DD = 25 Vdc, V_GS = 5.0 V, I_L = 2.8 A, L = 120 mH, R_G = 25 Ω)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Load Dump Voltage (V_GS = 0 and 10 V, R_I = 2.0 Ω, R_L = 4.5 Ω, I_D = 400 ms)</td>
<td>V_LD</td>
<td>55</td>
<td>V</td>
</tr>
<tr>
<td>Operating Junction Temperature</td>
<td>T_J</td>
<td>–40 to 150</td>
<td>°C</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>T_stg</td>
<td>–55 to 150</td>
<td>°C</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. Surface mounted onto minimum pad size (0.412” square) FR4 PCB, 1 oz cu.
2. Mounted onto 1” square pad size (1.127” square) FR4 PCB, 1 oz cu.

![Figure 1. Voltage and Current Convention](image-url)
## MOSFET ELECTRICAL CHARACTERISTICS

(T<sub>J</sub> = 25°C unless otherwise noted)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Symbol</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>OFF CHARACTERISTICS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drain-to-Source Clamped Breakdown Voltage</td>
<td>V&lt;sub&gt;BRDSS&lt;/sub&gt;</td>
<td>42</td>
<td>46</td>
<td>51</td>
<td>V&lt;sub&gt;d&lt;/sub&gt;c</td>
</tr>
<tr>
<td>Zero Gate Voltage Drain Current</td>
<td>I&lt;sub&gt;DSS&lt;/sub&gt;</td>
<td>–</td>
<td>0.6</td>
<td>5.0</td>
<td>µA&lt;sub&gt;d&lt;/sub&gt;c</td>
</tr>
<tr>
<td>Gate Input Current</td>
<td>I&lt;sub&gt;GSS&lt;/sub&gt;</td>
<td>–</td>
<td>50</td>
<td>125</td>
<td>µA&lt;sub&gt;d&lt;/sub&gt;c</td>
</tr>
<tr>
<td><strong>ON CHARACTERISTICS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gate Threshold Voltage</td>
<td>V&lt;sub&gt;GS(th)&lt;/sub&gt;</td>
<td>1.0</td>
<td>1.7</td>
<td>2.2</td>
<td>V&lt;sub&gt;d&lt;/sub&gt;c</td>
</tr>
<tr>
<td>Source-Drain Forward On Voltage</td>
<td>V&lt;sub&gt;SD&lt;/sub&gt;</td>
<td>–</td>
<td>0.95</td>
<td>1.1</td>
<td>V</td>
</tr>
<tr>
<td><strong>SWITCHING CHARACTERISTICS</strong> (Note 3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turn-ON Time (10% V&lt;sub&gt;IN&lt;/sub&gt; to 90% I&lt;sub&gt;D&lt;/sub&gt;)</td>
<td>t&lt;sub&gt;ON&lt;/sub&gt;</td>
<td>44</td>
<td></td>
<td>µs</td>
<td></td>
</tr>
<tr>
<td>Turn-OFF Time (90% V&lt;sub&gt;IN&lt;/sub&gt; to 10% I&lt;sub&gt;D&lt;/sub&gt;)</td>
<td>t&lt;sub&gt;OFF&lt;/sub&gt;</td>
<td>84</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turn-ON Time (10% V&lt;sub&gt;IN&lt;/sub&gt; to 90% I&lt;sub&gt;D&lt;/sub&gt;)</td>
<td>I&lt;sub&gt;ON&lt;/sub&gt;</td>
<td>15</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turn-OFF Time (90% V&lt;sub&gt;IN&lt;/sub&gt; to 10% I&lt;sub&gt;D&lt;/sub&gt;)</td>
<td>I&lt;sub&gt;OFF&lt;/sub&gt;</td>
<td>116</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slew-Rate ON (20% V&lt;sub&gt;DS&lt;/sub&gt; to 50% V&lt;sub&gt;DS&lt;/sub&gt;)</td>
<td>dV&lt;sub&gt;DS&lt;/sub&gt;/d&lt;sub&gt;TON&lt;/sub&gt;</td>
<td>2.43</td>
<td></td>
<td>V/µs</td>
<td></td>
</tr>
<tr>
<td>Slew-Rate OFF (80% V&lt;sub&gt;DS&lt;/sub&gt; to 50% V&lt;sub&gt;DS&lt;/sub&gt;)</td>
<td>dV&lt;sub&gt;DS&lt;/sub&gt;/d&lt;sub&gt;OFF&lt;/sub&gt;</td>
<td>0.83</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SELF PROTECTION CHARACTERISTICS</strong> (T&lt;sub&gt;J&lt;/sub&gt; = 25°C unless otherwise noted) (Note 5)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current Limit</td>
<td>I&lt;sub&gt;LIM&lt;/sub&gt;</td>
<td>10</td>
<td>15</td>
<td>20</td>
<td>A&lt;sub&gt;d&lt;/sub&gt;c</td>
</tr>
<tr>
<td>Temperature Limit (Turn-off)</td>
<td>T&lt;sub&gt;LIM(off)&lt;/sub&gt;</td>
<td>150</td>
<td>175</td>
<td>200</td>
<td>°C</td>
</tr>
<tr>
<td>Thermal Hysteresis</td>
<td>ΔT&lt;sub&gt;LIM(on)&lt;/sub&gt;</td>
<td>–</td>
<td>15</td>
<td>–</td>
<td>°C</td>
</tr>
<tr>
<td>Temperature Limit (Turn-off)</td>
<td>T&lt;sub&gt;LIM(on)&lt;/sub&gt;</td>
<td>150</td>
<td>165</td>
<td>185</td>
<td>°C</td>
</tr>
<tr>
<td>Thermal Hysteresis</td>
<td>ΔT&lt;sub&gt;LIM(on)&lt;/sub&gt;</td>
<td>–</td>
<td>15</td>
<td>–</td>
<td>°C</td>
</tr>
<tr>
<td><strong>GATE INPUT CHARACTERISTICS</strong> (Note 3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Device ON Gate Input Current</td>
<td>I&lt;sub&gt;GON&lt;/sub&gt;</td>
<td>–</td>
<td>50</td>
<td></td>
<td>µA</td>
</tr>
<tr>
<td>Current Limit Gate Input Current</td>
<td>I&lt;sub&gt;GCL&lt;/sub&gt;</td>
<td>0.1</td>
<td></td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td>Thermal Limit Fault Gate Input Current</td>
<td>I&lt;sub&gt;GTL&lt;/sub&gt;</td>
<td>0.45</td>
<td></td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td><strong>ESD ELECTRICAL CHARACTERISTICS</strong> (T&lt;sub&gt;J&lt;/sub&gt; = 25°C unless otherwise noted) (Note 3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electro–Static Discharge Capability</td>
<td>ESD</td>
<td>4000</td>
<td>–</td>
<td>–</td>
<td>V</td>
</tr>
</tbody>
</table>

3. Not subject to production testing.
4. Pulse Test: Pulse Width = 300 µs, Duty Cycle = 2%.
5. Fault conditions are viewed as beyond the normal operating range of the part.
TYPICAL PERFORMANCE CURVES

Figure 2. Single Pulse Maximum Switch–off Current vs. Load Inductance

Figure 3. Single–Pulse Maximum Switching Energy vs. Load Inductance

Figure 4. Single Pulse Maximum Inductive Switch–off Current vs. Time in Clamp

Figure 5. Single–Pulse Maximum Inductive Switching Energy vs. Time in Clamp

Figure 6. On–state Output Characteristics

Figure 7. Transfer Characteristics
NCV8403A, NCV8403B

TYPICAL PERFORMANCE CURVES

Figure 8. R\text{DS(on)} vs. Gate–Source Voltage

Figure 9. R\text{DS(on)} vs. Drain Current

Figure 10. Normalized R\text{DS(on)} vs. Temperature

Figure 11. Current Limit vs. Gate–Source Voltage

Figure 12. Current Limit vs. Junction Temperature

Figure 13. Drain–to–Source Leakage Current
NCV8403A, NCV8403B
TYPICAL PERFORMANCE CURVES

Figure 14. Normalized Threshold Voltage vs. Temperature

**Figure 15. Source–Drain Diode Forward Characteristics**

**Figure 16. Resistive Load Switching Time vs. Gate–Source Voltage**

**Figure 17. Resistive Load Switching Drain–Source Voltage Slope vs. Gate–Source Voltage**

**Figure 18. Resistive Load Switching Time vs. Gate Resistance**

**Figure 19. Drain–Source Voltage Slope during Turn On and Turn Off vs. Gate Resistance**

www.onsemi.com
**NCV8403A, NCV8403B**

**TYPICAL PERFORMANCE CURVES**

**Figure 20.** $R_{thA}$ vs. Copper Area – SOT–223

**Figure 21.** $R_{thA}$ vs. Copper Area – DPAK

**Figure 22.** Transient Thermal Resistance – SOT–223 Version

**Figure 23.** Transient Thermal Resistance – DPAK Version
TEST CIRCUITS AND WAVEFORMS

Figure 24. Resistive Load Switching Test Circuit

Figure 25. Resistive Load Switching Waveforms
TEST CIRCUITS AND WAVEFORMS

Figure 26. Inductive Load Switching Test Circuit

Figure 27. Inductive Load Switching Waveforms
## ORDERING INFORMATION

<table>
<thead>
<tr>
<th>Device</th>
<th>Package</th>
<th>Shipping†</th>
</tr>
</thead>
<tbody>
<tr>
<td>NCV8403ASTT1G</td>
<td>SOT−223 (Pb−Free)</td>
<td>1000 / Tape &amp; Reel</td>
</tr>
<tr>
<td>NCV8403ASTT3G</td>
<td>SOT−223 (Pb−Free)</td>
<td>4000 / Tape &amp; Reel</td>
</tr>
<tr>
<td>NCV8403ADTRKG</td>
<td>DPAK (Pb−Free)</td>
<td>2500 / Tape &amp; Reel</td>
</tr>
<tr>
<td>NCV8403BDTRKG</td>
<td>DPAK (Pb−Free)</td>
<td>2500 / Tape &amp; Reel</td>
</tr>
</tbody>
</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. AI 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></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>DIM</td>
<td>MIN.</td>
<td>NOM.</td>
<td>MAX.</td>
</tr>
<tr>
<td>A</td>
<td>1.50</td>
<td>1.63</td>
<td>1.75</td>
</tr>
<tr>
<td>A1</td>
<td>0.02</td>
<td>0.06</td>
<td>0.10</td>
</tr>
<tr>
<td>b</td>
<td>0.60</td>
<td>0.75</td>
<td>0.89</td>
</tr>
<tr>
<td>b1</td>
<td>2.90</td>
<td>3.06</td>
<td>3.20</td>
</tr>
<tr>
<td>c</td>
<td>0.24</td>
<td>0.29</td>
<td>0.35</td>
</tr>
<tr>
<td>D</td>
<td>6.30</td>
<td>6.50</td>
<td>6.70</td>
</tr>
<tr>
<td>E</td>
<td>3.30</td>
<td>3.50</td>
<td>3.70</td>
</tr>
<tr>
<td>e</td>
<td>2.30</td>
<td></td>
<td>BSC</td>
</tr>
<tr>
<td>L</td>
<td>0.20</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>L1</td>
<td>1.50</td>
<td>1.75</td>
<td>2.00</td>
</tr>
<tr>
<td>He</td>
<td>6.70</td>
<td>7.00</td>
<td>7.30</td>
</tr>
<tr>
<td>θ</td>
<td>0°</td>
<td>---</td>
<td>10°</td>
</tr>
</tbody>
</table>

**RECOMMENDED MOUNTING FOOTPRINT**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2.00</td>
<td>3.80</td>
</tr>
<tr>
<td>6.30</td>
<td></td>
</tr>
</tbody>
</table>

**DOCUMENT NUMBER:** 98ASB42680B  
**DESCRIPTION:** SOT-223 (TO-261)  
**PAGE 1 OF 2**

© Semiconductor Components Industries, LLC, 2018  
www.onsemi.com
**GENERIC MARKING DIAGRAM**

```
 AYW
 XXXXX -
```

(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.*
### DPAK (SINGLE GAUGE)

**CASE 369C**
**ISSUE G**
**DATE 31 MAY 2023**

**NOTES:**

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 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.
7. OPTIONAL MOLD FEATURE.

### GENERIC MARKING DIAGRAM*

<table>
<thead>
<tr>
<th>IC</th>
<th>Discrete</th>
</tr>
</thead>
<tbody>
<tr>
<td>XXXXXX</td>
<td>AYYW</td>
</tr>
<tr>
<td>ALYWW</td>
<td>XXX</td>
</tr>
<tr>
<td>XXXXXG</td>
<td>XXXXXG</td>
</tr>
</tbody>
</table>

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

**SCALE 1:1**

**TOP VIEW**

**SIDE VIEW**

**BOTTOM VIEW**

**ALTERNATE CONSTRUCTIONS**

**DETAIL A**

**ROTATED 90° CW**

**Recommended Mounting Footprint**

**Not for additional information on our Pb−Free strategy and soldering details, please reference the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SMDRM.**

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

**STYLE 2:**
1. STYLE 3:
2. BASE
3. SOURCE
4. BASE

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

**STYLE 4:**
1. STYLE 5:
2. ANODE
3. CATHODE
4. ANODE

**STYLE 5:**
1. STYLE 6:
2. GATE
3. ANODE
4. GATE

**STYLE 6:**
1. STYLE 7:
2. MT1
3. EMITTER
4. MT1

**STYLE 7:**
1. STYLE 8:
2. MT2
3. CATHODE
4. MT2

**STYLE 8:**
1. STYLE 9:
2. CATHODE
3. RESISTOR ADJUST
4. CATHODE

**STYLE 9:**
1. STYLE 10:
2. ANODE
3. CATHODE
4. ANODE

**STYLE 10:**
1. **TABLE OF PROPERTIES**

<table>
<thead>
<tr>
<th>EPD</th>
<th>INCHES</th>
<th>MILLIMETERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0.086</td>
<td>0.2176</td>
</tr>
<tr>
<td>A1</td>
<td>0.000</td>
<td>0.0000</td>
</tr>
<tr>
<td>b1</td>
<td>0.025</td>
<td>0.0635</td>
</tr>
<tr>
<td>b2</td>
<td>0.025</td>
<td>0.0635</td>
</tr>
<tr>
<td>b3</td>
<td>0.180</td>
<td>4.5720</td>
</tr>
<tr>
<td>c</td>
<td>0.018</td>
<td>0.4572</td>
</tr>
<tr>
<td>c2</td>
<td>0.018</td>
<td>0.4572</td>
</tr>
<tr>
<td>B</td>
<td>0.235</td>
<td>5.9780</td>
</tr>
<tr>
<td>e</td>
<td>0.250</td>
<td>5.4920</td>
</tr>
<tr>
<td>H</td>
<td>0.170</td>
<td>4.5720</td>
</tr>
<tr>
<td>L</td>
<td>0.025</td>
<td>0.0635</td>
</tr>
<tr>
<td>P</td>
<td>0.040</td>
<td>1.0160</td>
</tr>
<tr>
<td>L3</td>
<td>0.035</td>
<td>0.8378</td>
</tr>
<tr>
<td>Z</td>
<td>0.095</td>
<td>2.4130</td>
</tr>
</tbody>
</table>

**DISCLAIMER:**

© Semiconductor Components Industries, LLC, 2018 www.onsemi.com

onsemi and ON Semiconductor are trademarks of Semiconductor Components Industries, LLC dba onsemi or its subsidiaries in the United States and/or other countries. onsemi reserves the right to make changes without further notice to any products herein. onsemi makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does onsemi assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation, special, consequential or incidental damages. onsemi does not convey any license under its patent rights nor the rights of others.