

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.

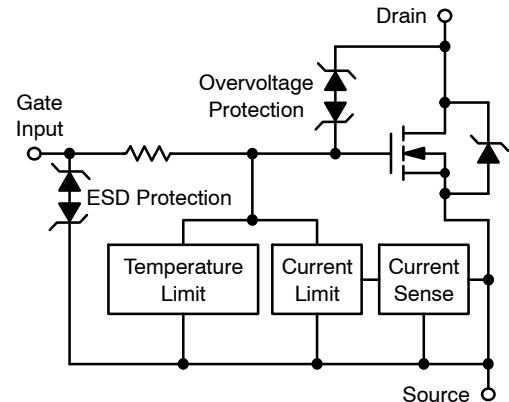
Features

- 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

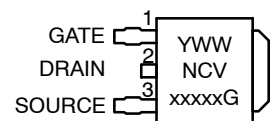
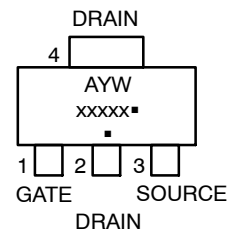
Typical Applications

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

| V _{DSS} (Clamped) | R _{DS(on)} TYP | I _D MAX (Limited) |
|-------------------------------|-------------------------|---------------------------------|
| 42 V | 53 mΩ @ 10 V | 15 A |



MARKING DIAGRAM



A = Assembly Location
Y = Year
W, WW = Work Week
xxxxx = 8403A or 8403B
G or ■ = Pb-Free Package

(Note: Microdot may be in either location)

ORDERING INFORMATION

See detailed ordering and shipping information page 10 of this data sheet.

NOTE: Some of the devices on this data sheet have been **DISCONTINUED**. Please refer to the table on page 10.

NCV8403A, NCV8403B

MAXIMUM RATINGS ($T_J = 25^\circ\text{C}$ unless otherwise noted)

| Rating | Symbol | Value | Unit |
|--|---|--------------------|--------------------|
| Drain-to-Source Voltage Internally Clamped | V_{DSS} | 42 | Vdc |
| Gate-to-Source Voltage | V_{GS} | ± 14 | Vdc |
| Drain Current Continuous | I_{D} | Internally Limited | |
| Total Power Dissipation – SOT-223 Version @ $T_A = 25^\circ\text{C}$ (Note 1) @ $T_A = 25^\circ\text{C}$ (Note 2) | P_{D} | 1.13 1.56 | W |
| Total Power Dissipation – DPAK Version @ $T_A = 25^\circ\text{C}$ (Note 1) @ $T_A = 25^\circ\text{C}$ (Note 2) | | 1.32 2.5 | |
| Thermal Resistance – SOT-223 Version Junction-to-Soldering Point Junction-to-Ambient (Note 1) Junction-to-Ambient (Note 2) | $R_{\theta\text{JS}}$ $R_{\theta\text{JA}}$ $R_{\theta\text{JA}}$ | 12 110 80 | $^\circ\text{C/W}$ |
| Thermal Resistance – DPAK Version Junction-to-Soldering Point Junction-to-Ambient (Note 1) Junction-to-Ambient (Note 2) | | 2.5 95 50 | |
| Single Pulse Inductive Load Switching Energy ($V_{\text{DD}} = 25\text{ Vdc}$, $V_{\text{GS}} = 5.0\text{ V}$, $I_{\text{L}} = 2.8\text{ A}$, $L = 120\text{ mH}$, $R_{\text{G}} = 25\ \Omega$) | E_{AS} | 470 | mJ |
| | | | |
| Load Dump Voltage ($V_{\text{GS}} = 0$ and 10 V , $R_{\text{I}} = 2.0\ \Omega$, $R_{\text{L}} = 4.5\ \Omega$, $t_{\text{d}} = 400\text{ ms}$) | V_{LD} | 55 | V |
| Operating Junction Temperature | T_{J} | -40 to 150 | $^\circ\text{C}$ |
| Storage Temperature | T_{stg} | -55 to 150 | $^\circ\text{C}$ |

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.

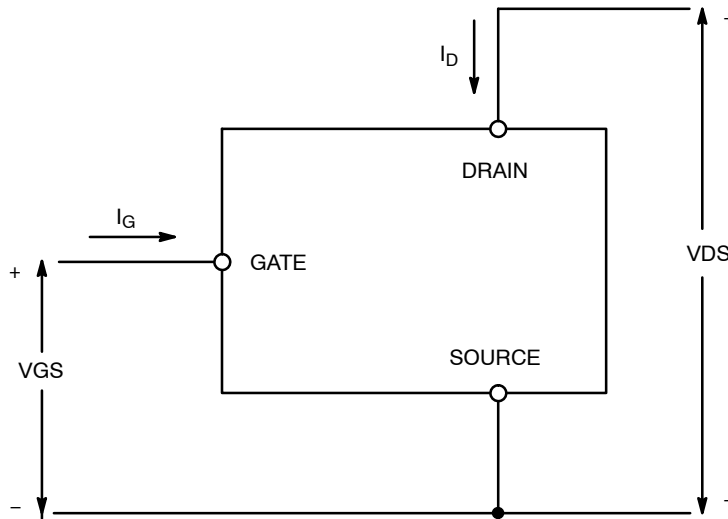


Figure 1. Voltage and Current Convention

NCV8403A, NCV8403B

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

| Characteristic | Symbol | Min | Typ | Max | Unit |
|---|----------------------|----------|------------|----------|------------|
| OFF CHARACTERISTICS | | | | | |
| Drain-to-Source Clamped Breakdown Voltage (V _{GS} = 0 Vdc, I _D = 250 μAdc) (V _{GS} = 0 Vdc, I _D = 250 μAdc, T _J = -40°C to 150°C) (Note 3) | V _{(BR)DSS} | 42 40 | 46 45 | 51 51 | Vdc Vdc |
| Zero Gate Voltage Drain Current (V _{DS} = 32 Vdc, V _{GS} = 0 Vdc) (V _{DS} = 32 Vdc, V _{GS} = 0 Vdc, T _J = 150°C) (Note 3) | I _{DSS} | - - | 0.6 2.5 | 5.0 - | μAdc |
| Gate Input Current (V _{GS} = 5.0 Vdc, V _{DS} = 0 Vdc) | I _{GSS} | - | 50 | 125 | μAdc |

ON CHARACTERISTICS

| | | | | | |
|---|---------------------|----------|------------|-----------|--------------|
| Gate Threshold Voltage (V _{DS} = V _{GS} , I _D = 1.2 mAdc) Threshold Temperature Coefficient (Negative) | V _{GS(th)} | 1.0 - | 1.7 5.0 | 2.2 - | Vdc mV/°C |
| Static Drain-to-Source On-Resistance (Note 4) (V _{GS} = 10 Vdc, I _D = 3.0 Adc, T _J @ 25°C) (V _{GS} = 10 Vdc, I _D = 3.0 Adc, T _J @ 150°C) (Note 3) | R _{DS(on)} | - - | 53 95 | 68 123 | mΩ |
| Static Drain-to-Source On-Resistance (Note 4) (V _{GS} = 5.0 Vdc, I _D = 3.0 Adc, T _J @ 25°C) (V _{GS} = 5.0 Vdc, I _D = 3.0 Adc, T _J @ 150°C) (Note 3) | R _{DS(on)} | - - | 63 105 | 76 135 | mΩ |
| Source-Drain Forward On Voltage (I _S = 7.0 A, V _{GS} = 0 V) | V _{SD} | - | 0.95 | 1.1 | V |

SWITCHING CHARACTERISTICS (Note 3)

| | | | | | |
|---|--|-------------------------------------|------|--|------|
| Turn-ON Time (10% V _{IN} to 90% I _D) | V _{IN} = 0 V to 5 V, V _{DD} = 25 V I _D = 1.0 A, Ext R _G = 2.5 Ω | t _{ON} | 44 | | μs |
| Turn-OFF Time (90% V _{IN} to 10% I _D) | | t _{OFF} | 84 | | |
| Turn-ON Time (10% V _{IN} to 90% I _D) | V _{IN} = 0 V to 10 V, V _{DD} = 25 V, I _D = 1.0 A, Ext R _G = 2.5 Ω | t _{ON} | 15 | | μs |
| Turn-OFF Time (90% V _{IN} to 10% I _D) | | t _{OFF} | 116 | | |
| Slew-Rate ON (20% V _{DS} to 50% V _{DS}) | V _{in} = 0 to 10 V, V _{DD} = 12 V, R _L = 4.7 Ω | -dV _{DS} /dt _{ON} | 2.43 | | V/μs |
| Slew-Rate OFF (80% V _{DS} to 50% V _{DS}) | | dV _{DS} /dt _{OFF} | 0.83 | | |

SELF PROTECTION CHARACTERISTICS (T_J = 25°C unless otherwise noted) (Note 5)

| | | | | | | |
|------------------------------|---|-----------------------|-----------|----------|----------|-----|
| Current Limit | V _{GS} = 5.0 V, V _{DS} = 10 V V _{GS} = 5.0 V, T _J = 150°C (Notes 3, 6) | I _{LIM} | 10 5.0 | 15 10 | 20 15 | Adc |
| Current Limit | V _{GS} = 10 V, V _{DS} = 10 V V _{GS} = 10 V, T _J = 150°C (Notes 3, 6) | I _{LIM} | 12 8.0 | 17 13 | 22 18 | Adc |
| Temperature Limit (Turn-off) | V _{GS} = 5.0 Vdc (Notes 3, 6) | T _{LIM(off)} | 150 | 175 | 200 | °C |
| Thermal Hysteresis | V _{GS} = 5.0 Vdc | ΔT _{LIM(on)} | - | 15 | - | °C |
| Temperature Limit (Turn-off) | V _{GS} = 10 Vdc (Notes 3, 6) | T _{LIM(off)} | 150 | 165 | 185 | °C |
| Thermal Hysteresis | V _{GS} = 10 Vdc | ΔT _{LIM(on)} | - | 15 | - | °C |

GATE INPUT CHARACTERISTICS (Note 3)

| | | | | | | |
|--|--|------------------|--|------|--|----|
| Device ON Gate Input Current | V _{GS} = 5 V I _D = 1.0 A | I _{GON} | | 50 | | μA |
| | V _{GS} = 10 V I _D = 1.0 A | | | 400 | | |
| Current Limit Gate Input Current | V _{GS} = 5 V, V _{DS} = 10 V | I _{GCL} | | 0.1 | | mA |
| | V _{GS} = 10 V, V _{DS} = 10 V | | | 0.6 | | |
| Thermal Limit Fault Gate Input Current | V _{GS} = 5 V, V _{DS} = 10 V | I _{GTL} | | 0.45 | | mA |
| | V _{GS} = 10 V, V _{DS} = 10 V | | | 1.5 | | |

ESD ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise noted) (Note 3)

| | | | | | | |
|-------------------------------------|------------------------|-----|------|---|---|---|
| Electro-Static Discharge Capability | Human Body Model (HBM) | ESD | 4000 | - | - | V |
| Electro-Static Discharge Capability | Machine Model (MM) | ESD | 400 | - | - | V |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

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.

6. Refer to Application Note AND8202/D for dependence of protection features on gate voltage.

TYPICAL PERFORMANCE CURVES

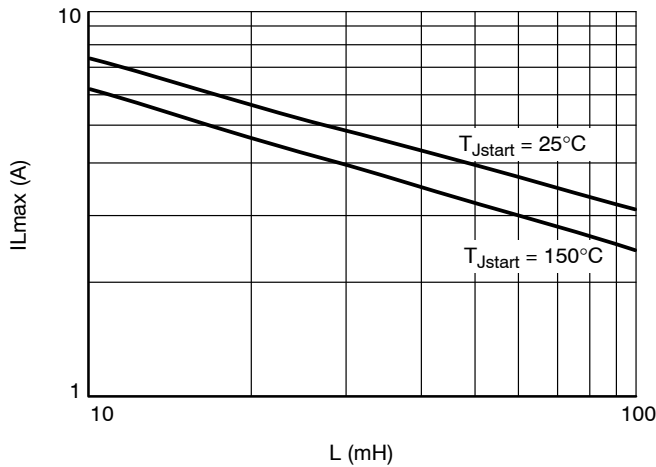


Figure 2. Single Pulse Maximum Switch-off Current vs. Load Inductance

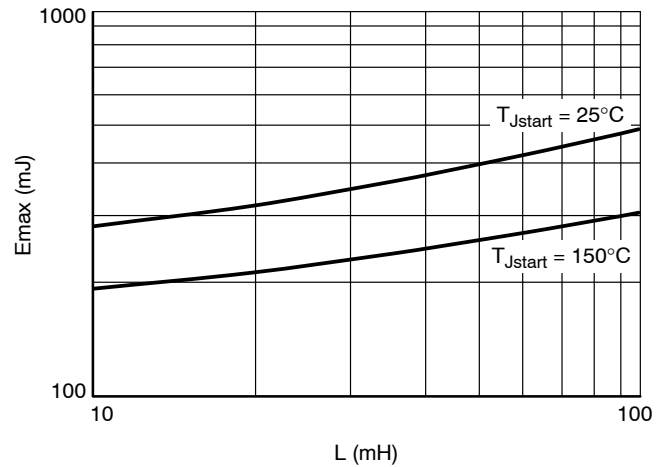


Figure 3. Single-Pulse Maximum Switching Energy vs. Load Inductance

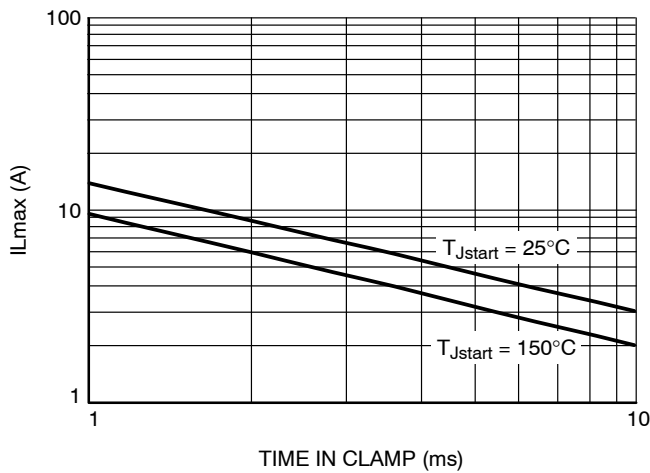


Figure 4. Single Pulse Maximum Inductive Switch-off Current vs. Time in Clamp

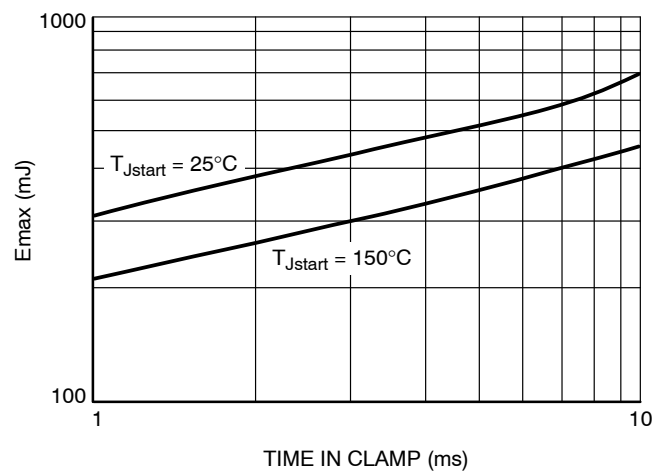


Figure 5. Single-Pulse Maximum Inductive Switching Energy vs. Time in Clamp

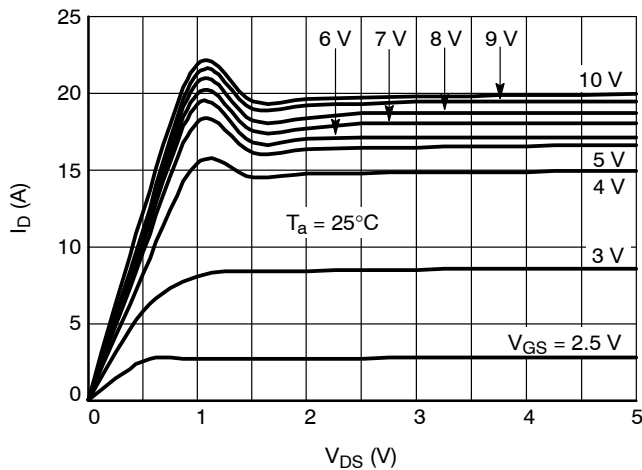


Figure 6. On-state Output Characteristics

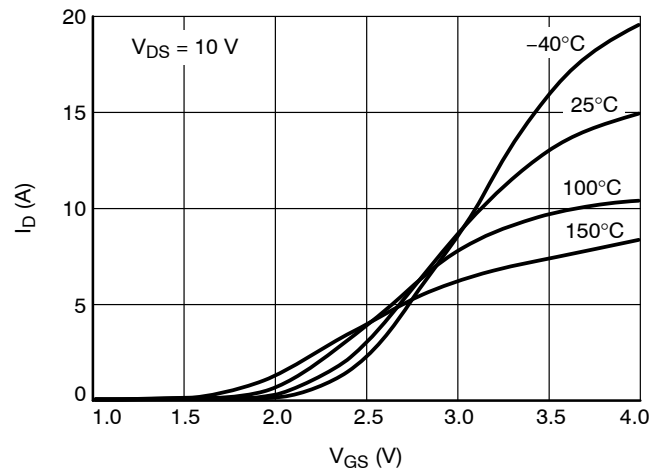


Figure 7. Transfer Characteristics

TYPICAL PERFORMANCE CURVES

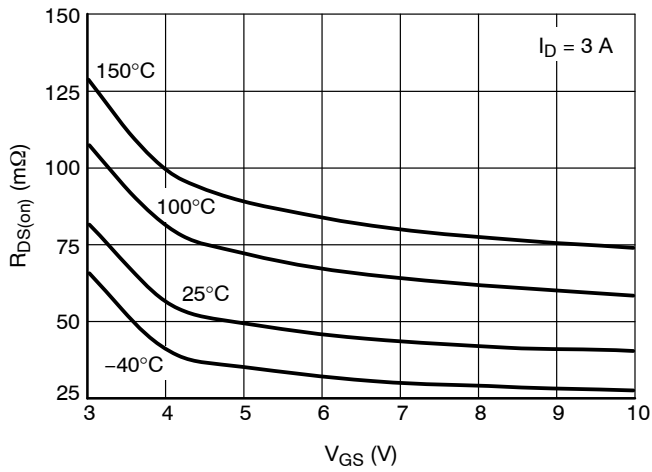


Figure 8. $R_{DS(on)}$ vs. Gate-Source Voltage

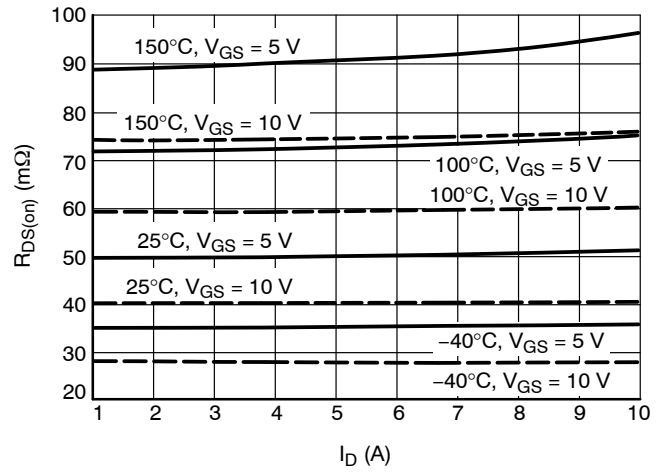


Figure 9. $R_{DS(on)}$ vs. Drain Current

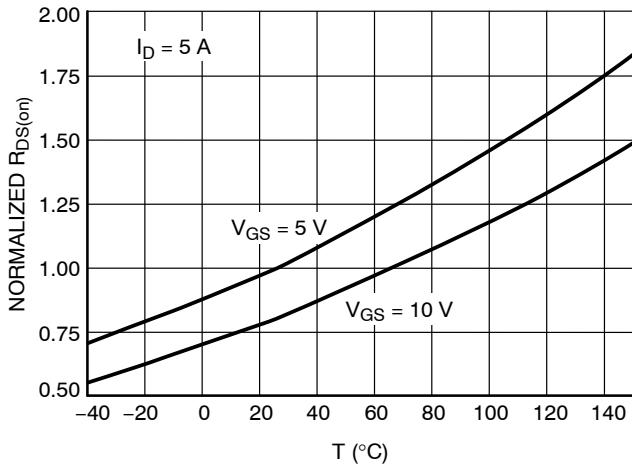


Figure 10. Normalized $R_{DS(on)}$ vs. Temperature

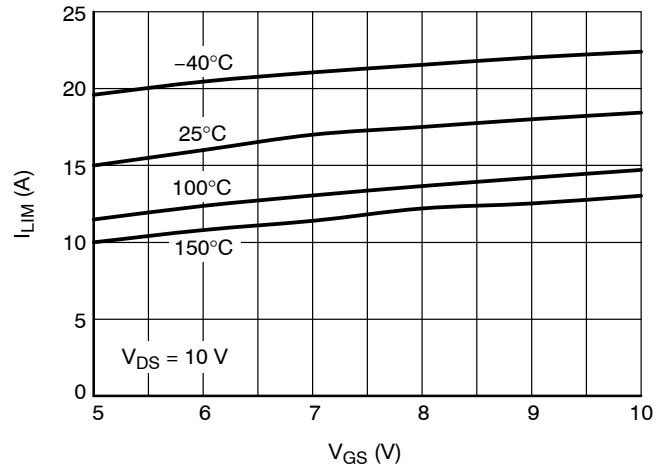


Figure 11. Current Limit vs. Gate-Source Voltage

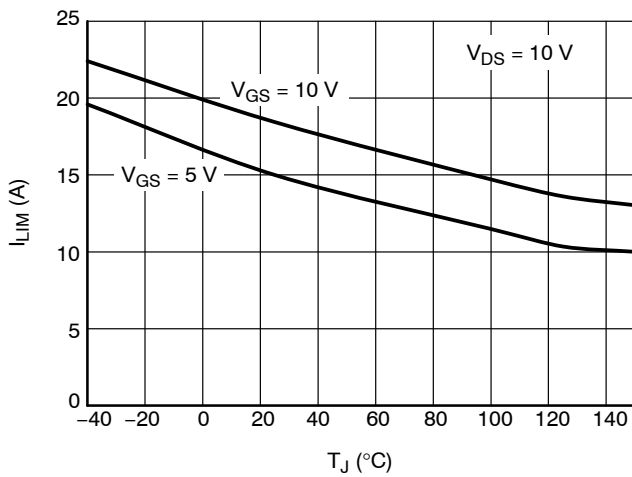


Figure 12. Current Limit vs. Junction Temperature

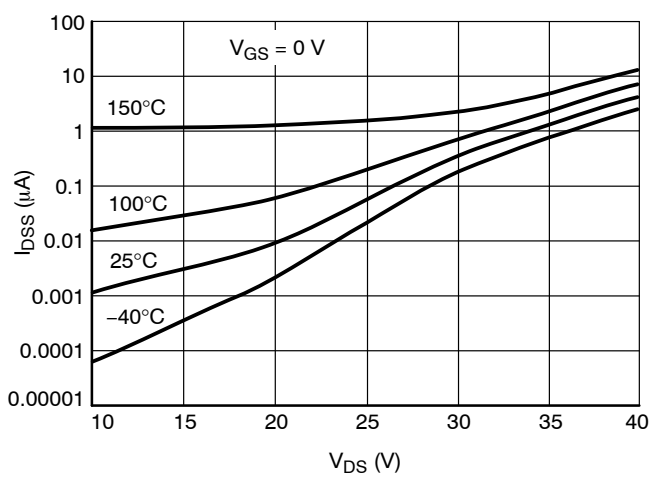


Figure 13. Drain-to-Source Leakage Current

TYPICAL PERFORMANCE CURVES

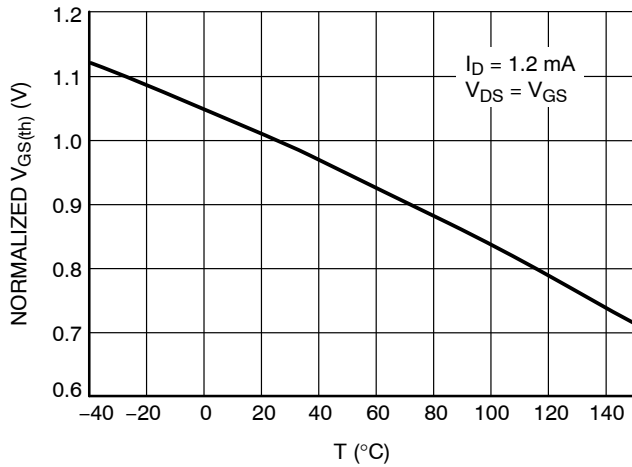


Figure 14. Normalized Threshold Voltage vs. Temperature

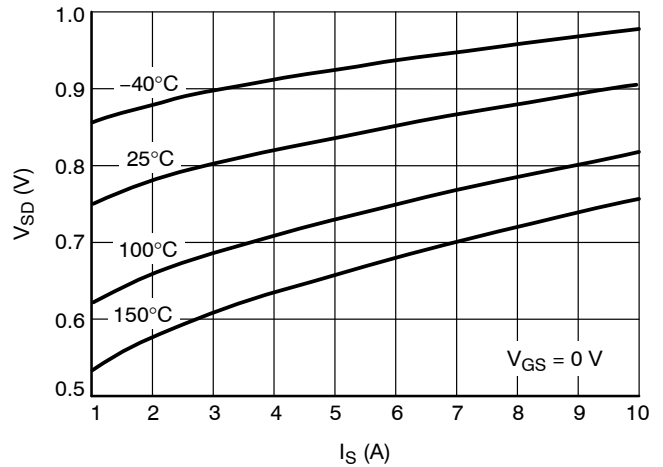


Figure 15. Source-Drain Diode Forward Characteristics

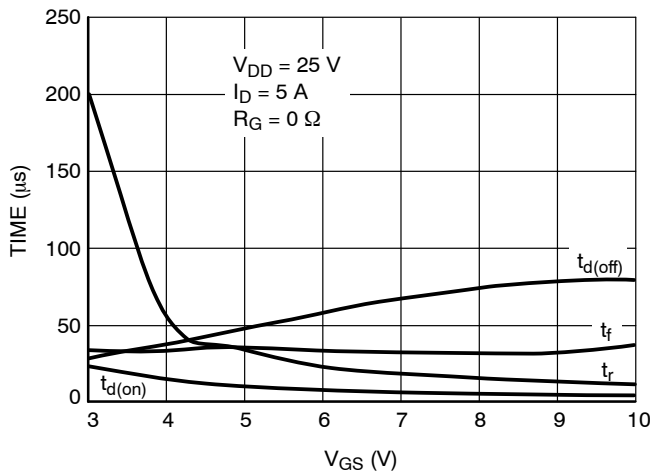


Figure 16. Resistive Load Switching Time vs. Gate-Source Voltage

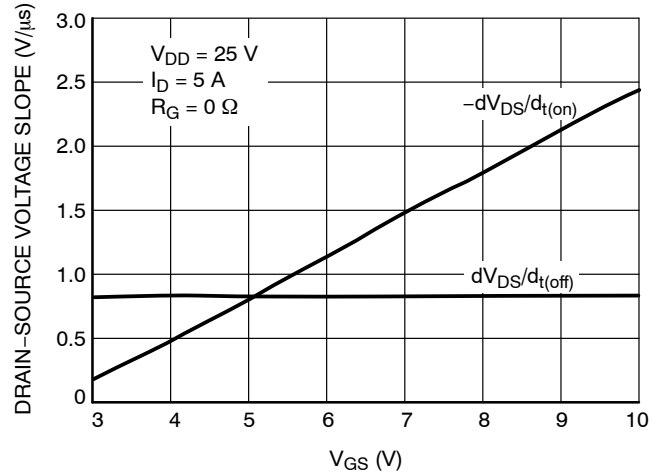


Figure 17. Resistive Load Switching Drain-Source Voltage Slope vs. Gate-Source Voltage

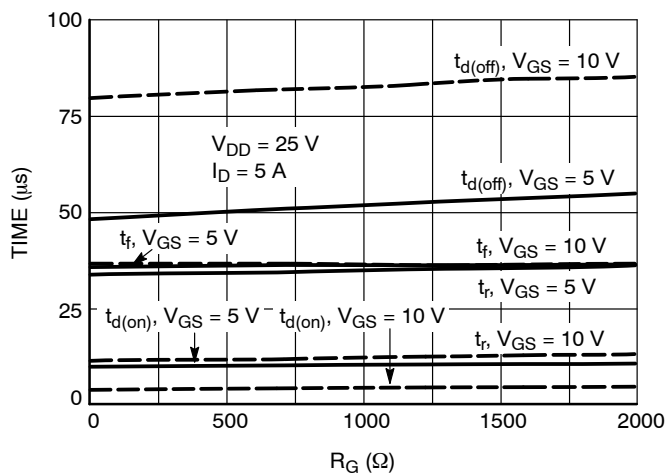


Figure 18. Resistive Load Switching Time vs. Gate Resistance

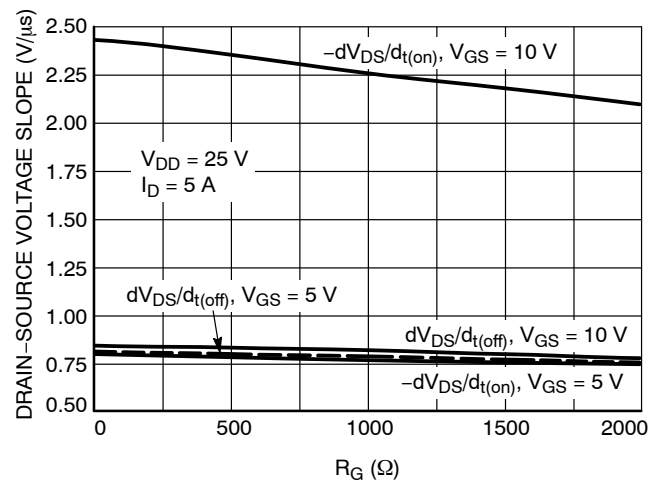


Figure 19. Drain-Source Voltage Slope during Turn On and Turn Off vs. Gate Resistance

TYPICAL PERFORMANCE CURVES

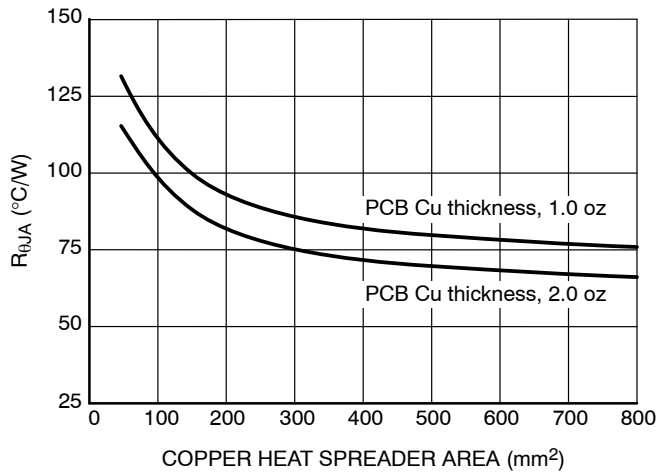


Figure 20. $R_{\theta JA}$ vs. Copper Area – SOT-223

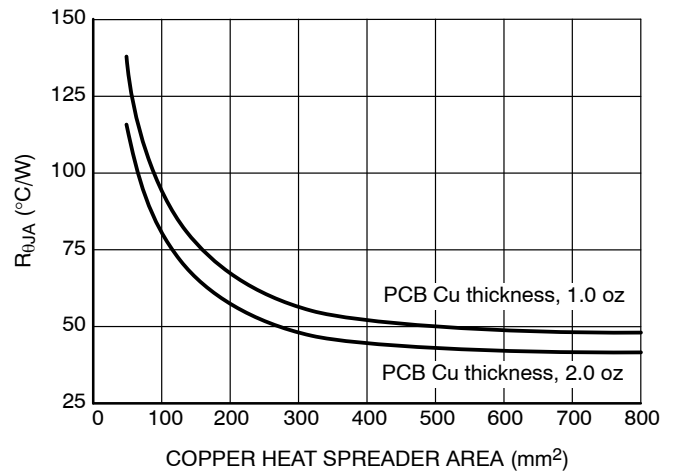


Figure 21. $R_{\theta JA}$ vs. Copper Area – DPAK

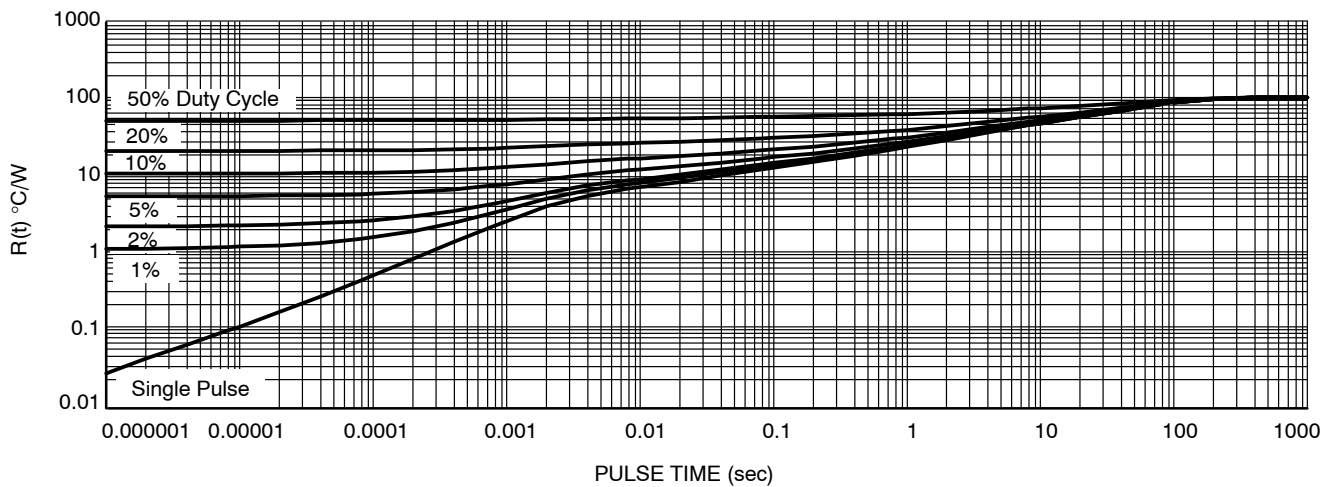


Figure 22. Transient Thermal Resistance – SOT-223 Version

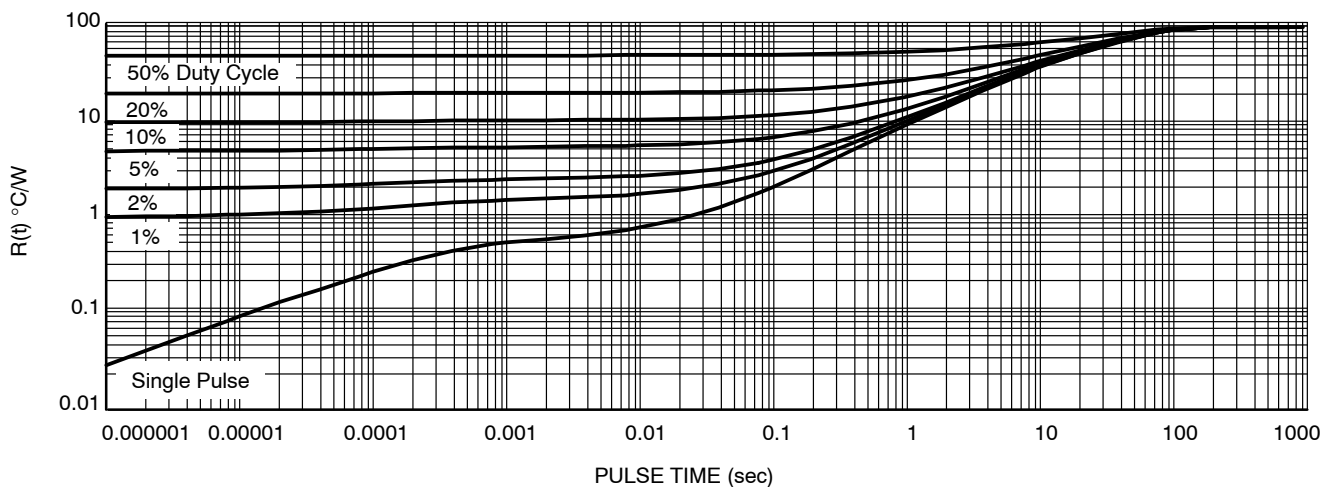


Figure 23. Transient Thermal Resistance – DPAK Version

NCV8403A, NCV8403B

TEST CIRCUITS AND WAVEFORMS

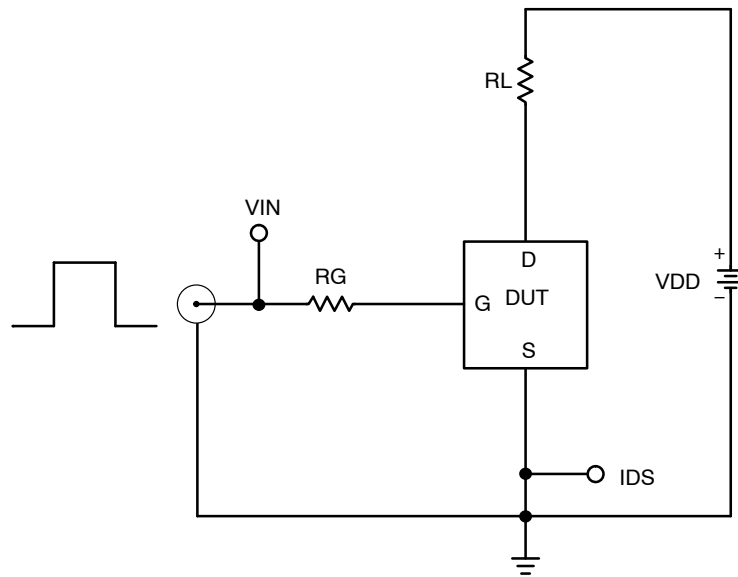


Figure 24. Resistive Load Switching Test Circuit

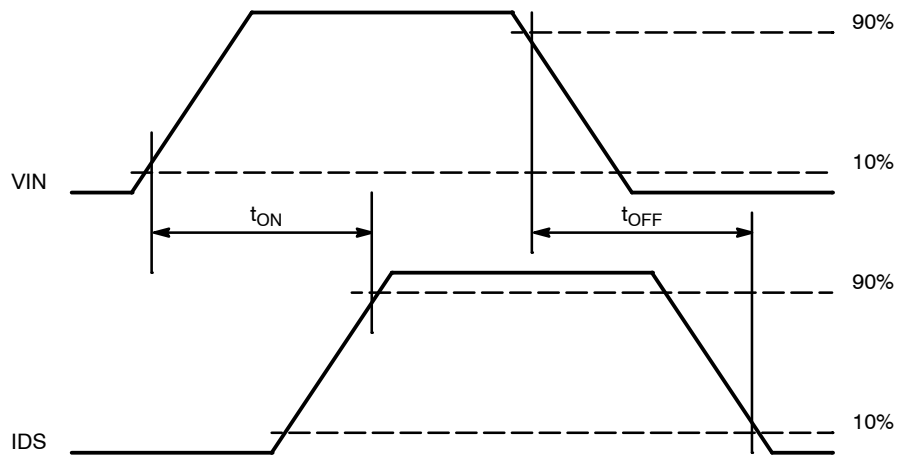


Figure 25. Resistive Load Switching Waveforms

TEST CIRCUITS AND WAVEFORMS

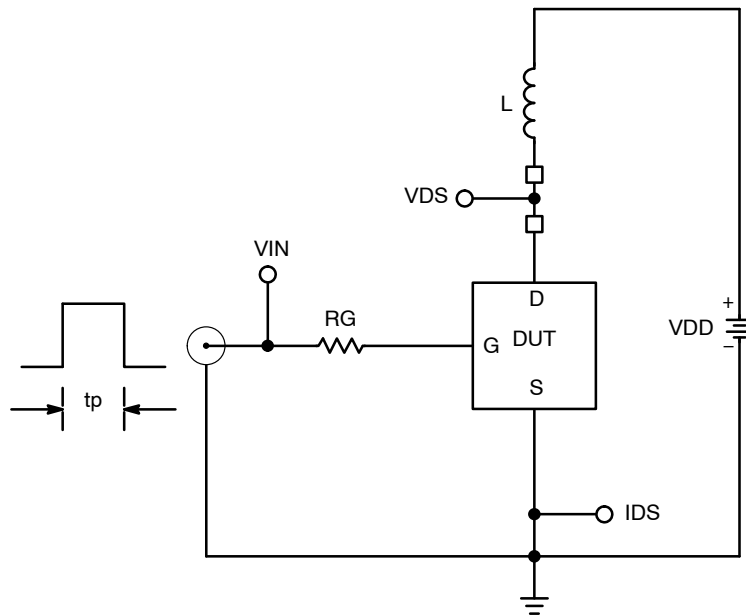


Figure 26. Inductive Load Switching Test Circuit

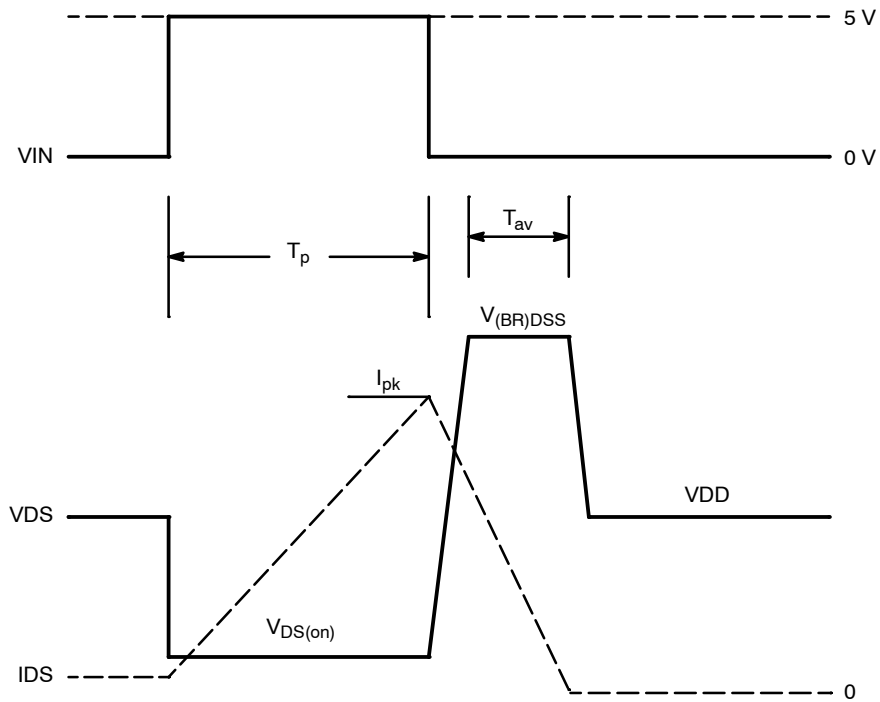


Figure 27. Inductive Load Switching Waveforms

NCV8403A, NCV8403B

ORDERING INFORMATION

| Device | Package | Shipping† |
|---------------|----------------------|--------------------|
| NCV8403ASTT1G | SOT-223 (Pb-Free) | 1000 / Tape & Reel |
| NCV8403ASTT3G | SOT-223 (Pb-Free) | 4000 / Tape & Reel |
| NCV8403BDTRKG | DPAK (Pb-Free) | 2500 / Tape & Reel |

DISCONTINUED (Note 7)

| | | |
|---------------|-------------------|--------------------|
| NCV8403ADTRKG | 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 Specifications Brochure, BRD8011/D.

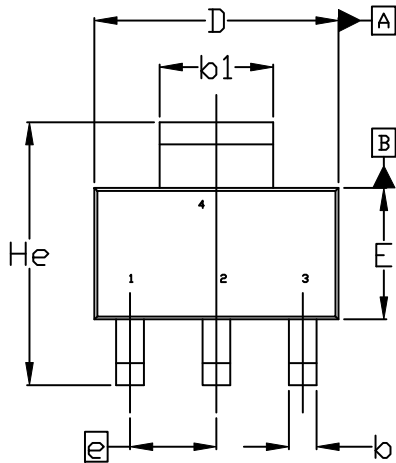
7. **DISCONTINUED:** This device is not recommended for new design. Please contact your **onsemi** representative for information. The most current information on this device may be available on www.onsemi.com.



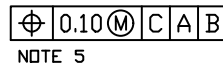
SCALE 1:1

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

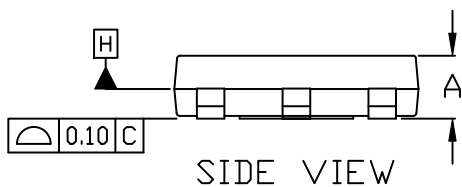
DATE 02 OCT 2018



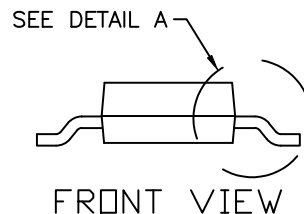
TOP VIEW



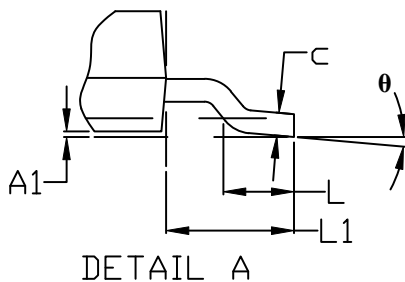
NOTE 5



SIDE VIEW



FRONT VIEW

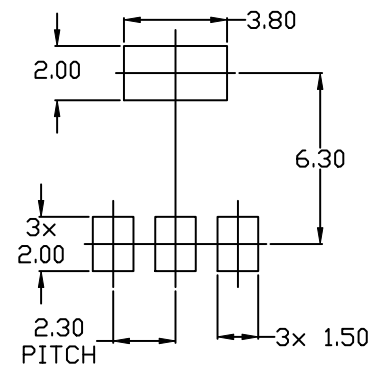


DETAIL A

NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
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.

| MILLIMETERS | | | |
|-------------|----------|------|------|
| DIM | MIN. | NOM. | MAX. |
| A | 1.50 | 1.63 | 1.75 |
| A1 | 0.02 | 0.06 | 0.10 |
| b | 0.60 | 0.75 | 0.89 |
| b1 | 2.90 | 3.06 | 3.20 |
| c | 0.24 | 0.29 | 0.35 |
| D | 6.30 | 6.50 | 6.70 |
| E | 3.30 | 3.50 | 3.70 |
| e | 2.30 BSC | | |
| L | 0.20 | --- | --- |
| L1 | 1.50 | 1.75 | 2.00 |
| He | 6.70 | 7.00 | 7.30 |
| θ | 0° | --- | 10° |


RECOMMENDED MOUNTING
FOOTPRINT

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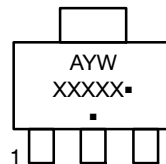
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SOT-223 (TO-261)
CASE 318E-04
ISSUE R

DATE 02 OCT 2018

| | | | | |
|--|---|---|---|---|
| STYLE 1: PIN 1. BASE 2. COLLECTOR 3. EMITTER 4. COLLECTOR | STYLE 2: PIN 1. ANODE 2. CATHODE 3. NC 4. CATHODE | STYLE 3: PIN 1. GATE 2. DRAIN 3. SOURCE 4. DRAIN | STYLE 4: PIN 1. SOURCE 2. DRAIN 3. GATE 4. DRAIN | STYLE 5: PIN 1. DRAIN 2. GATE 3. SOURCE 4. GATE |
| STYLE 6: PIN 1. RETURN 2. INPUT 3. OUTPUT 4. INPUT | STYLE 7: PIN 1. ANODE 1 2. CATHODE 3. ANODE 2 4. CATHODE | STYLE 8: CANCELLED | STYLE 9: PIN 1. INPUT 2. GROUND 3. LOGIC 4. GROUND | STYLE 10: PIN 1. CATHODE 2. ANODE 3. GATE 4. ANODE |
| STYLE 11: PIN 1. MT 1 2. MT 2 3. GATE 4. MT 2 | STYLE 12: PIN 1. INPUT 2. OUTPUT 3. NC 4. OUTPUT | STYLE 13: PIN 1. GATE 2. COLLECTOR 3. EMITTER 4. COLLECTOR | | |

**GENERIC
MARKING DIAGRAM***

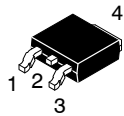


A = Assembly Location
 Y = Year
 W = Work Week
 XXXXX = Specific Device Code
 ■ = Pb-Free Package

(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.

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| DESCRIPTION: | SOT-223 (TO-261) | PAGE 2 OF 2 |

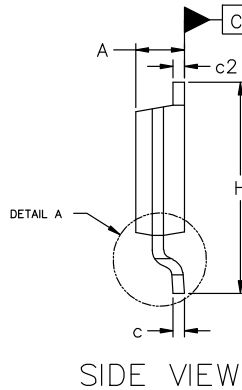
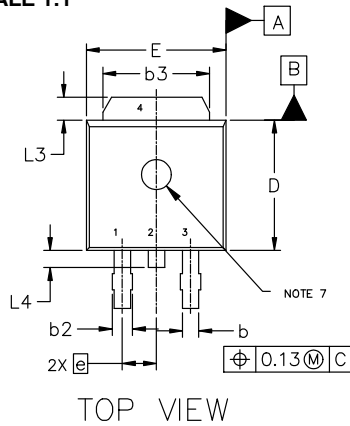
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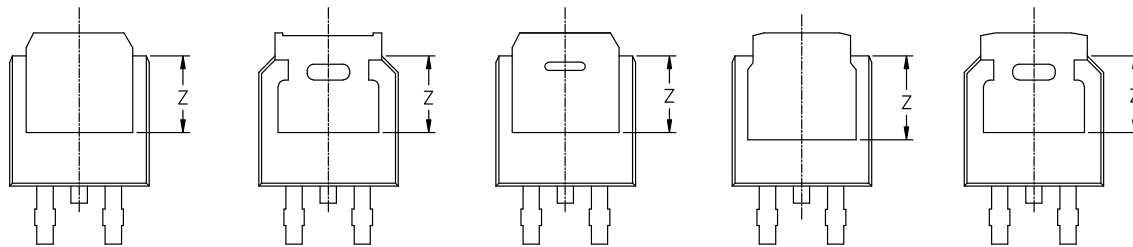
DPAK3 6.10x6.54x2.28, 2.29P
CASE 369C
ISSUE J

DATE 12 AUG 2025

SCALE 1:1

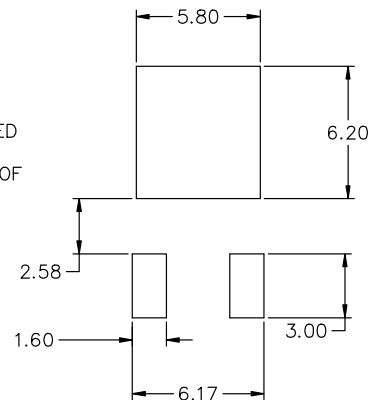
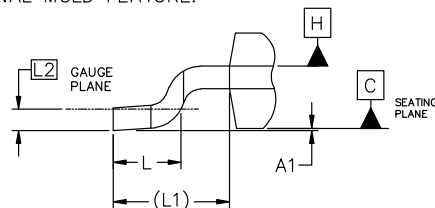


| MILLIMETERS | | | |
|-------------|----------|------|-------|
| DIM | MIN | NOM | MAX |
| A | 2.18 | 2.28 | 2.38 |
| A1 | 0.00 | --- | 0.13 |
| b | 0.63 | 0.76 | 0.89 |
| b2 | 0.72 | 0.93 | 1.14 |
| b3 | 4.57 | 5.02 | 5.46 |
| c | 0.46 | 0.54 | 0.61 |
| c2 | 0.46 | 0.54 | 0.61 |
| D | 5.97 | 6.10 | 6.22 |
| E | 6.35 | 6.54 | 6.73 |
| e | 2.29 BSC | | |
| H | 9.40 | 9.91 | 10.41 |
| L | 1.40 | 1.59 | 1.78 |
| L1 | 2.90 REF | | |
| L2 | 0.51 BSC | | |
| L3 | 0.89 | --- | 1.27 |
| L4 | --- | --- | 1.01 |
| Z | 3.93 | --- | --- |



NOTES:

1. DIMENSIONING AND TOLERANCING ASME Y14.5M, 2018.
2. CONTROLLING DIMENSION: MILLIMETERS.
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 0.15mm 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.



RECOMMENDED MOUNTING FOOTPRINT*

*FOR ADDITIONAL INFORMATION ON OUR PB-FREE STRATEGY AND SOLDERING DETAILS, PLEASE DOWNLOAD THE ONSEMI SOLDERING AND MOUNTING TECHNIQUES REFERENCE MANUAL, SOLDERRM/D.

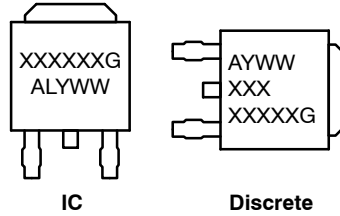
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DPAK3 6.10x6.54x2.28, 2.29P
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ISSUE J

DATE 12 AUG 2025

**GENERIC
MARKING DIAGRAM***



XXXXXX = Device Code
A = Assembly Location
L = Wafer Lot
Y = Year
WW = Work Week
G = Pb-Free Package

*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.

| | | | | |
|---|---|--|--|---|
| STYLE 1: PIN 1. BASE 2. COLLECTOR 3. EMITTER 4. COLLECTOR | STYLE 2: PIN 1. GATE 2. DRAIN 3. SOURCE 4. DRAIN | STYLE 3: PIN 1. ANODE 2. CATHODE 3. ANODE 4. CATHODE | STYLE 4: PIN 1. CATHODE 2. ANODE 3. GATE 4. ANODE | STYLE 5: PIN 1. GATE 2. ANODE 3. CATHODE 4. ANODE |
| STYLE 6: PIN 1. MT1 2. MT2 3. GATE 4. MT2 | STYLE 7: PIN 1. GATE 2. COLLECTOR 3. EMITTER 4. COLLECTOR | STYLE 8: PIN 1. N/C 2. CATHODE 3. ANODE 4. CATHODE | STYLE 9: PIN 1. ANODE 2. CATHODE 3. RESISTOR ADJUST 4. CATHODE | STYLE 10: PIN 1. CATHODE 2. ANODE 3. CATHODE 4. ANODE |

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