ON Semiconductor

Is Now

onsemi™

To learn more about onsemi™, please visit our website at www.onsemi.com

onsemi and onsemi. and other names, marks, and brands are registered and/or common law trademarks of Semiconductor Components Industries, LLC dba "**onsemi**" or its affiliates and/or subsidiaries in the United States and/or other countries. **onsemi** owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of **onsemi** product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. **onsemi** reserves the right to make changes at any time to any products or information herein, without notice. The information herein is provided "as-is" and **onsemi** makes no warranty, representation or guarantee regarding the accuracy of the information, product features, availability, functionality, or 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. Buyer is responsible for its products and applications using **onsemi** products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by **onsemi**. "Typical" parameters which may be provided in **onsemi** data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. **onsemi** does not convey any license under any of its intellectual property rights nor the rights of others. **onsemi** products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use **onsemi** products for any such unintended or unauthorized application, Buyer shall indemnify and hold **onsemi** and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that **onsemi** was negligent regarding the design or manufacture of the part. **onsemi** is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner. Other names and brands may be claimed as the property of others.

Downloaded from Arrow.com.

Self-Protected Low Side Driver with Temperature and Current Limit

65 V, 7.0 A, Single N−Channel

NCV8406A, NCV8406B

NCV8406A/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)
- These Devices are Faster than the Rest of the NCV Devices
- 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

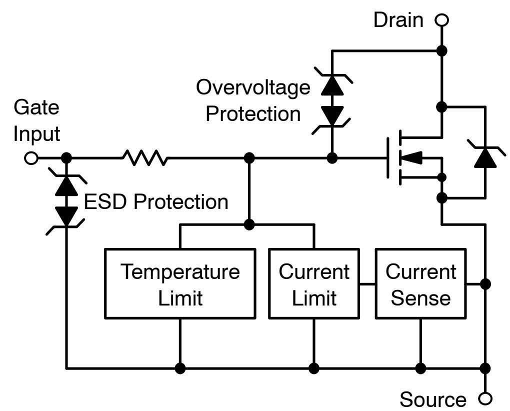
Typical Applications

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

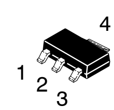
ON Semiconductor®

www.onsemi.com

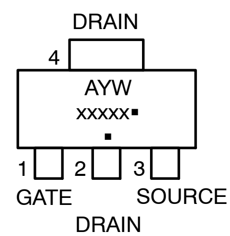
V_{DSS} (Clamped)	$R_{DS(on)}$ TYP	I_D TYP (Limited)
65 V	210 mΩ	7.0 A

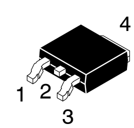


MARKING DIAGRAM

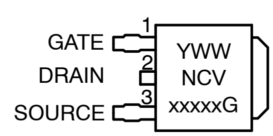


SOT−223
CASE 318E
STYLE 3





DPAK
CASE 369C



A = Assembly Location
Y = Year
W, WW = Work Week
xxxxx = 8406A or 8406B
G or ▪ = 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 10 of this data sheet.

© Semiconductor Components Industries, LLC, 2017

Downloaded from Arrow.com.

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

Rating		Symbol	Value	Unit
Drain−to−Source Voltage Internally Clamped		V_{DSS}	60	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°C (Note 1) @ T_A = 25°C (Note 2)		P_D	 1.25 1.81	W
Total Power Dissipation − DPAK Version @ T_A = 25°C (Note 1) @ T_A = 25°C (Note 2)		P_D	 1.31 2.31	W
Thermal Resistance − SOT−223 Version Junction−to−Soldering Point Junction−to−Ambient (Note 1) Junction−to−Ambient (Note 2)		 $R_{\theta JS}$ $R_{\theta JA}$ $R_{\theta JA}$	 7.0 100 69	°C/W
Thermal Resistance − DPAK Version Junction−to−Soldering Point Junction−to−Ambient (Note 1) Junction−to−Ambient (Note 2)		 $R_{\theta JS}$ $R_{\theta JA}$ $R_{\theta JA}$	 1.0 95 54	°C/W
Single Pulse Inductive Load Switching Energy (Starting T_J = 25°C, V_{DD} = 50 Vdc, V_{GS} = 5.0 Vdc, I_L = 2.1 Apk, L = 50 mH, R_G = 25 Ω)		E_{AS}	110	mJ
Load Dump Voltage (V_{GS} = 0 and 10 V, R_I = 2 Ω, R_L = 7 Ω, t_d = 400 ms)		V_{LD}	75	V
Operating Junction Temperature Range		T_J	−40 to 150	°C
Storage Temperature Range		T_{stg}	−55 to 150	°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 (100 sq/mm) FR4 PCB, 1 oz cu.
2. Mounted onto 1″ square pad size (700 sq/mm) FR4 PCB, 1 oz cu.

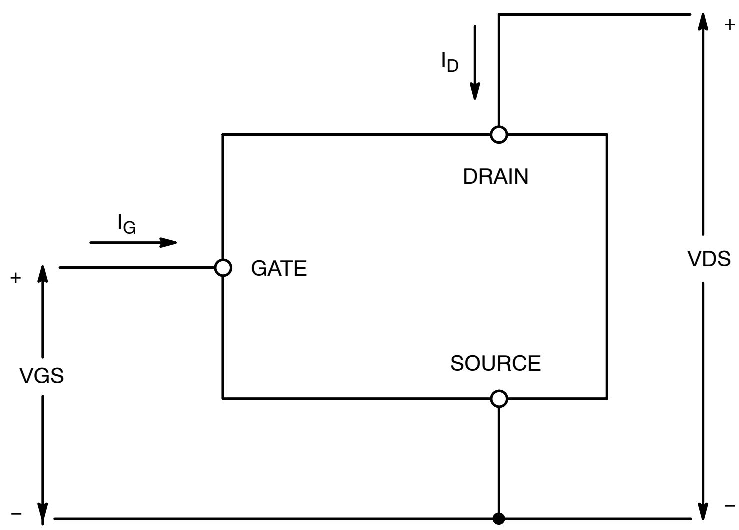


Figure 1. Voltage and Current Convention

Downloaded from Arrow.com.

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 V, I_D = 2 mA)	$V_{(BR)DSS}$	60	65	70	V
Zero Gate Voltage Drain Current (V_{DS} = 52 V, V_{GS} = 0 V)	I_{DSS}	−	22	100	μA
Gate Input Current (V_{GS} = 5.0 V, V_{DS} = 0 V)	I_{GSS}	−	30	100	μA
ON CHARACTERISTICS					
Gate Threshold Voltage (V_{DS} = V_{GS}, I_D = 150 μA) Threshold Temperature Coefficient	$V_{GS(th)}$	1.2 −	1.66 4.0	2.0 −	V −mV/°C
Static Drain−to−Source On−Resistance (Note 3) (V_{GS} = 10 V, I_D = 2.0 A, T_J @ 25°C)	$R_{DS(on)}$	−	185	210	mΩ
Static Drain−to−Source On−Resistance (Note 3) (V_{GS} = 5.0 V, I_D = 2.0 A, T_J @ 25°C) (V_{GS} = 5.0 V, I_D = 2.0 A, T_J @ 150°C)	$R_{DS(on)}$	− −	210 445	240 520	mΩ
Source−Drain Forward On Voltage (I_S = 7.0 A, V_{GS} = 0 V)	V_{SD}	−	0.9	1.1	V

SWITCHING CHARACTERISTICS (Note 6)

Characteristic	Test Conditions	Symbol	Min	Typ	Max	Unit
Turn−on Delay Time	R_L = 6.6 Ω, V_{in} = 0 to 10 V, V_{DD} = 13.8 V, I_D = 2.0 A, 10% V_{in} to 10% I_D	$td_{(on)}$	−	127	−	ns
Turn−on Rise Time	R_L = 6.6 Ω, V_{in} = 0 to 10 V, V_{DD} = 13.8 V, I_D = 2.0 A, 10% I_D to 90% I_D	t_{rise}	−	486	−	ns
Turn−off Delay Time	R_L = 6.6 Ω, V_{in} = 0 to 10 V, V_{DD} = 13.8 V, I_D = 2.0 A, 90% V_{in} to 90% I_D	$td_{(off)}$	−	1600	−	ns
Turn−off Fall Time	R_L = 6.6 Ω, V_{in} = 0 to 10 V, V_{DD} = 13.8 V, I_D = 2.0 A, 90% I_D to 10% I_D	t_{fall}	−	692	−	ns
Slew Rate ON	R_L = 6.6 Ω, V_{in} = 0 to 10 V, V_{DD} = 13.8 V, I_D = 2.0 A, 70% to 50% V_{DD}	dV_{DS}/dT_{on}	−	79	−	V/μs
Slew Rate OFF	R_L = 6.6 Ω, V_{in} = 0 to 10 V, V_{DD} = 13.8 V, I_D = 2.0 A, 50% to 70% V_{DD}	dV_{DS}/dT_{off}	−	27	−	V/μs

SELF PROTECTION CHARACTERISTICS (Note 4)

Characteristic	Test Conditions	Symbol	Min	Typ	Max	Unit
Current Limit	V_{DS} = 10 V, V_{GS} = 5.0 V, T_J = 25°C (Note 5) V_{DS} = 10 V, V_{GS} = 5.0 V, T_J = 150°C (Notes 5, 6) V_{DS} = 10 V, V_{GS} = 10 V, T_J = 25°C (Notes 5)	I_{LIM}	5.0 3.5 6.5	7.0 4.5 8.5	9.5 6.0 10.5	A
Temperature Limit (Turn−off)	V_{GS} = 5.0 V (Note 6)	$T_{LIM(off)}$	150	180	200	°C
Thermal Hysteresis	V_{GS} = 5.0 V	$\Delta T_{LIM(on)}$	−	10	−	°C
Temperature Limit (Turn−off)	V_{GS} = 10 V (Note 6)	$T_{LIM(off)}$	150	180	200	°C
Thermal Hysteresis	V_{GS} = 10 V	$\Delta T_{LIM(on)}$	−	20	−	°C
Input Current during Thermal Fault	V_{DS} = 0 V, V_{GS} = 5.0 V, T_J = T_J > $T_{(fault)}$ (Note 6) V_{DS} = 0 V, V_{GS} = 10 V, T_J = T_J > $T_{(fault)}$ (Note 6)	$I_{g(fault)}$	− −	5.9 12.3	−	mA

ESD ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	Min	Typ	Max	Unit
Electro−Static Discharge Capability Human Body Model (HBM) Machine Model (MM)	ESD	6000 500	− −	− −	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. Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2%.
4. Fault conditions are viewed as beyond the normal operating range of the part.
5. Current limit measured at 380 μs after gate pulse.
6. Not subject to production test.

Downloaded from Arrow.com.

TYPICAL PERFORMANCE CURVES

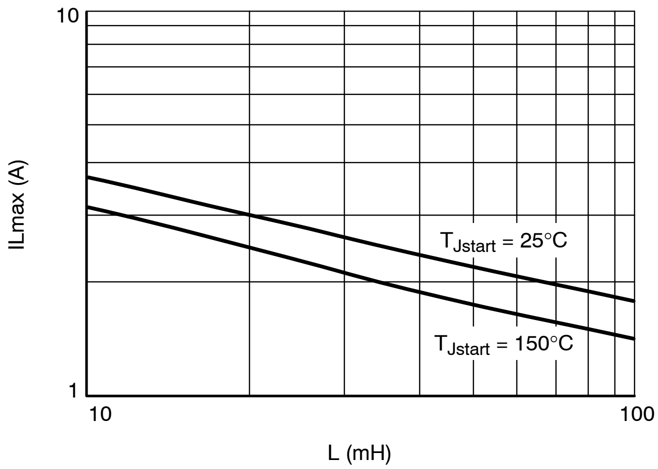


Figure 2. Single Pulse Maximum Switch−off Current vs. Load Inductance

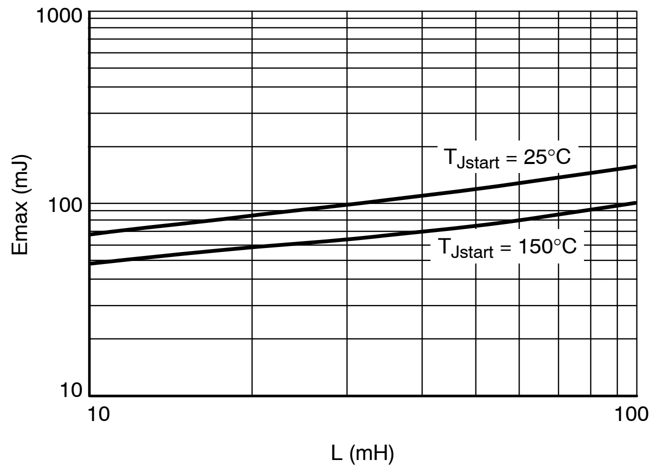


Figure 3. Single−Pulse Maximum Switching Energy vs. Load Inductance

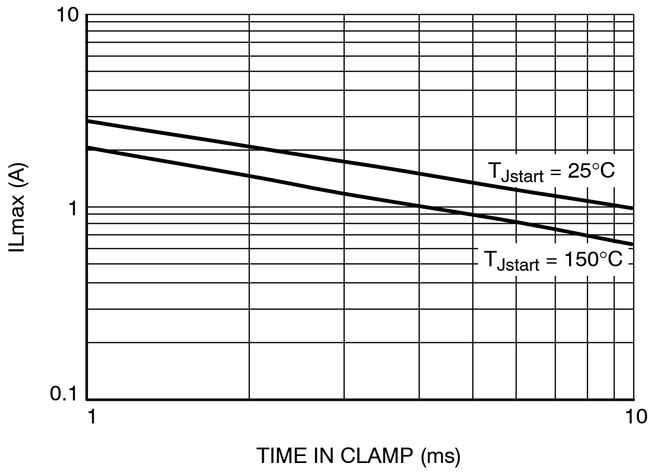


Figure 4. Single Pulse Maximum Inductive Switch−off Current vs. Time in Clamp

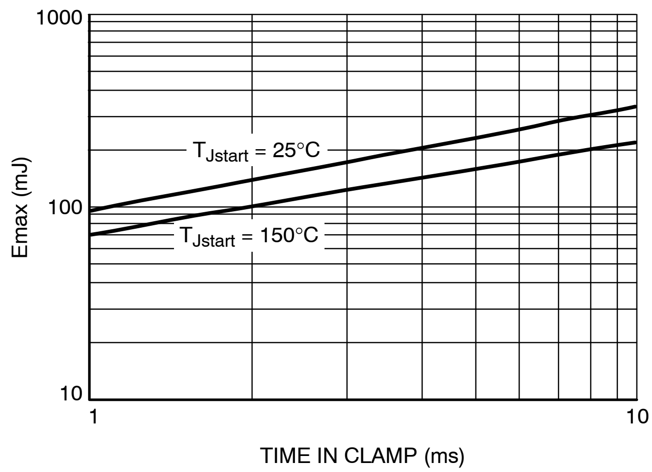


Figure 5. Single−Pulse Maximum Inductive Switching Energy vs. Time in Clamp

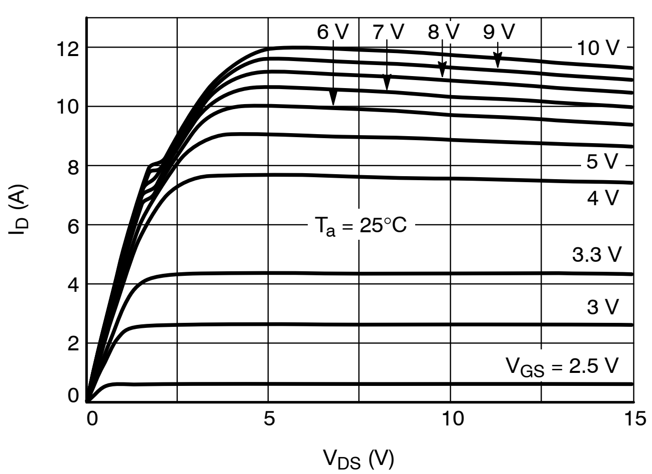


Figure 6. On−state Output Characteristics

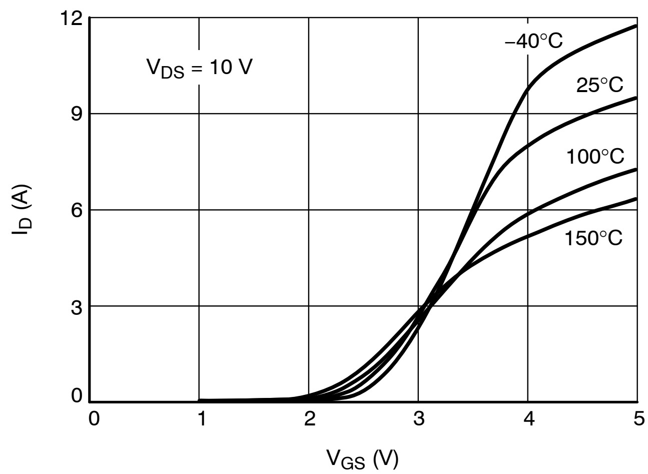


Figure 7. Transfer Characteristics

Downloaded from Arrow.com.

TYPICAL PERFORMANCE CURVES

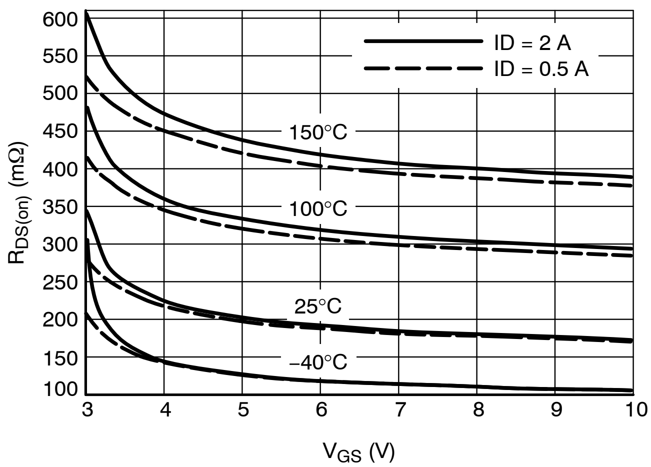


Figure 8. $R_{DS(on)}$ vs. Gate−Source Voltage

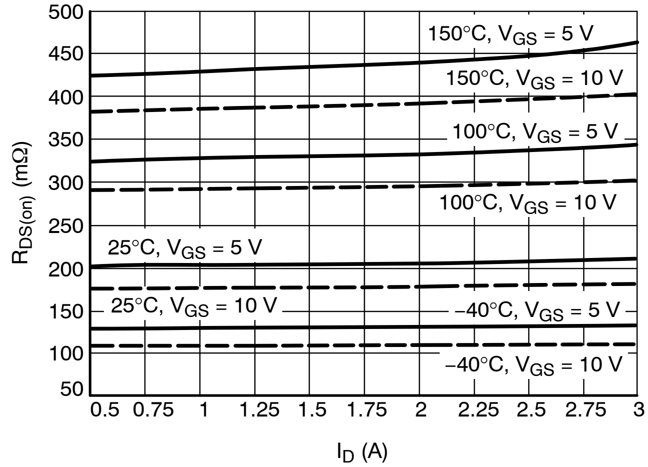


Figure 9. $R_{DS(on)}$ vs. Drain Current

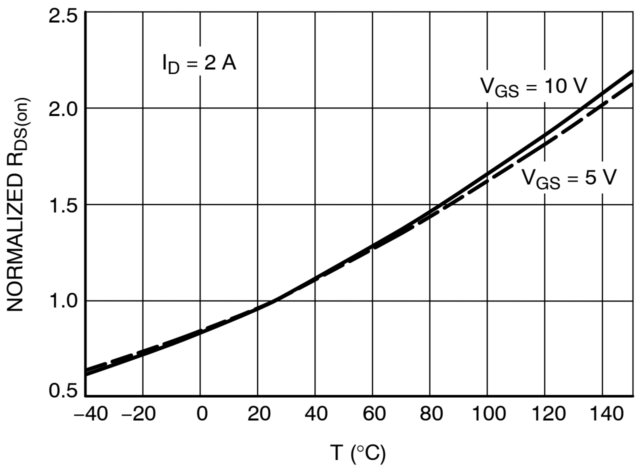


Figure 10. Normalized $R_{DS(on)}$ vs. Temperature

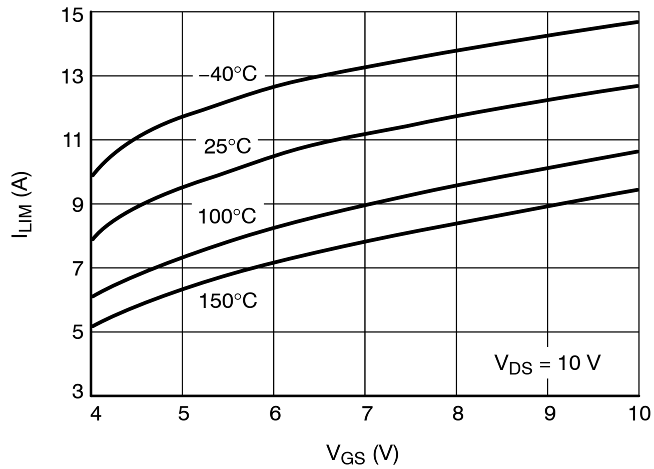


Figure 11. Current Limit vs. Gate−Source Voltage

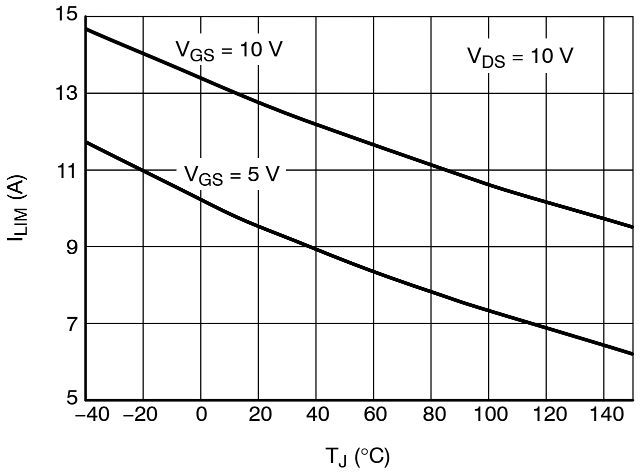


Figure 12. Current Limit vs. Junction Temperature

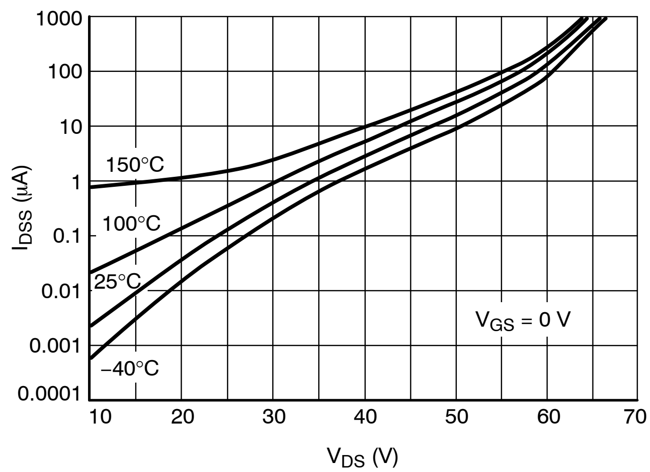


Figure 13. Drain−to−Source Leakage Current

Downloaded from Arrow.com.

TYPICAL PERFORMANCE CURVES

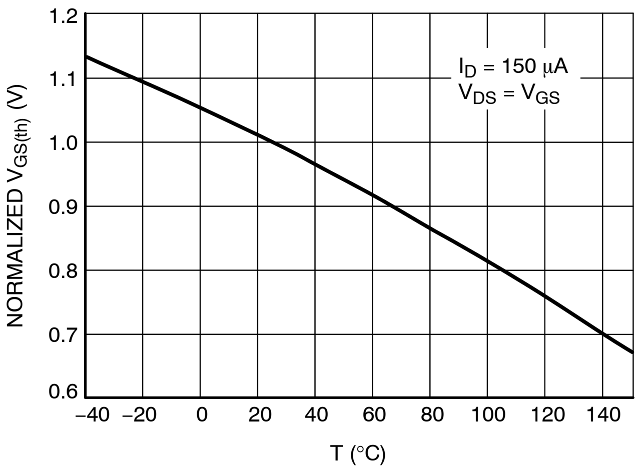


Figure 14. Normalized Threshold Voltage vs. Temperature

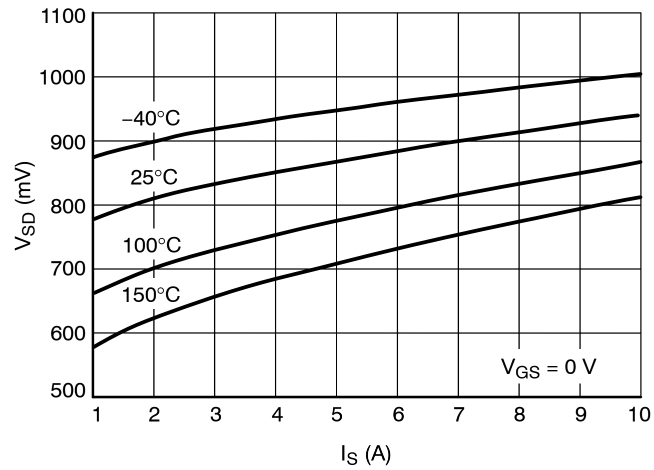


Figure 15. Source−Drain Diode Forward Characteristics

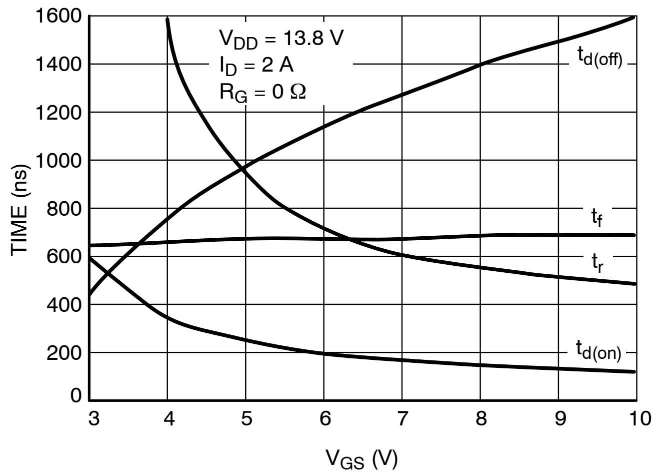


Figure 16. Resistive Load Switching Time vs. Gate−Source Voltage

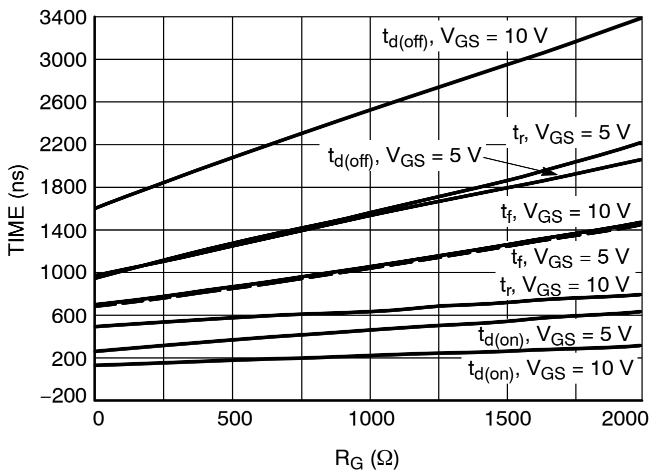


Figure 17. Resistive Load Switching Time vs. Gate Resistance

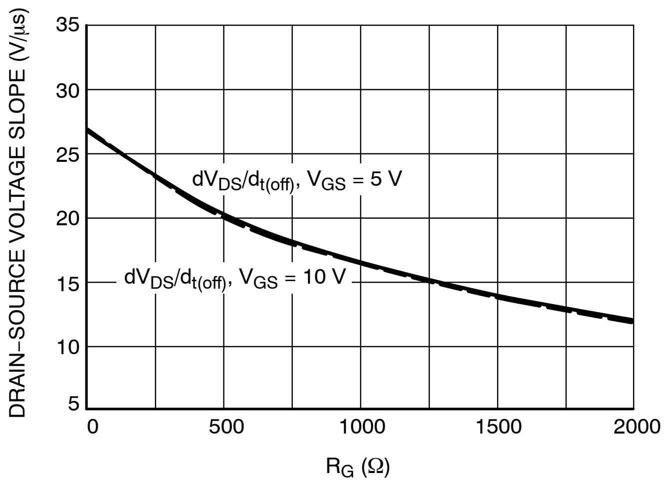


Figure 18. Drain−Source Voltage Slope during Turn On and Turn Off vs. Gate Resistance

Downloaded from Arrow.com.

TYPICAL PERFORMANCE CURVES

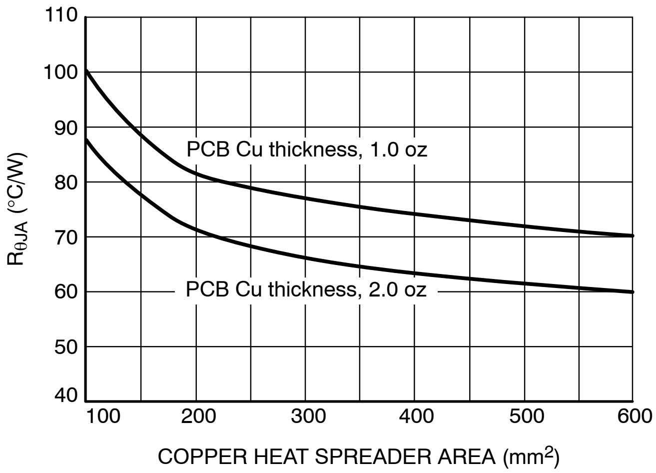


Figure 19. $R_{\theta JA}$ vs. Copper Area − SOT−223

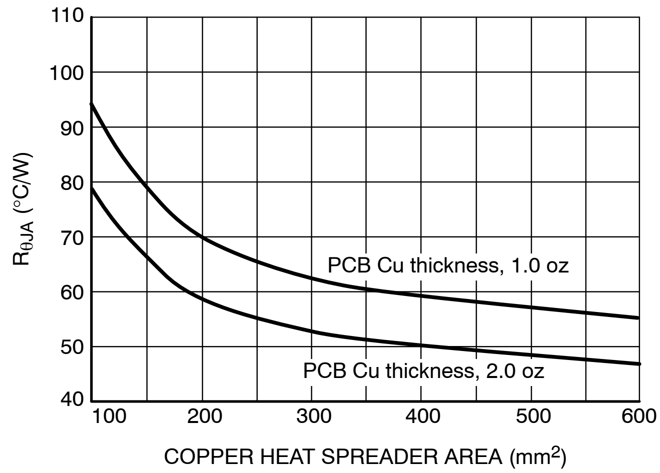


Figure 20. $R_{\theta JA}$ vs. Copper Area − DPAK

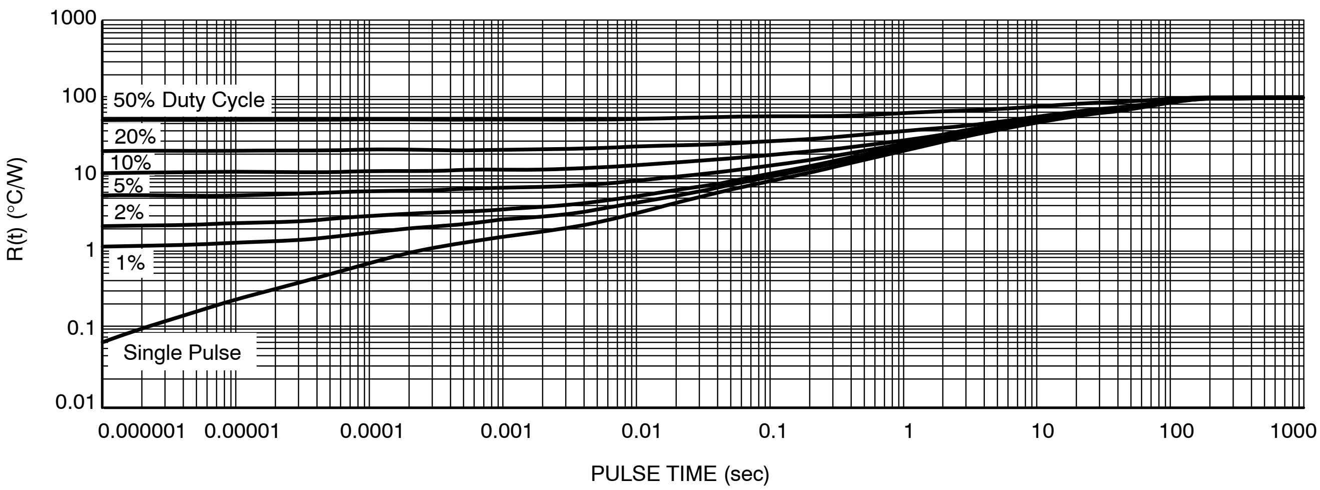


Figure 21. Transient Thermal Resistance − SOT−223 Version

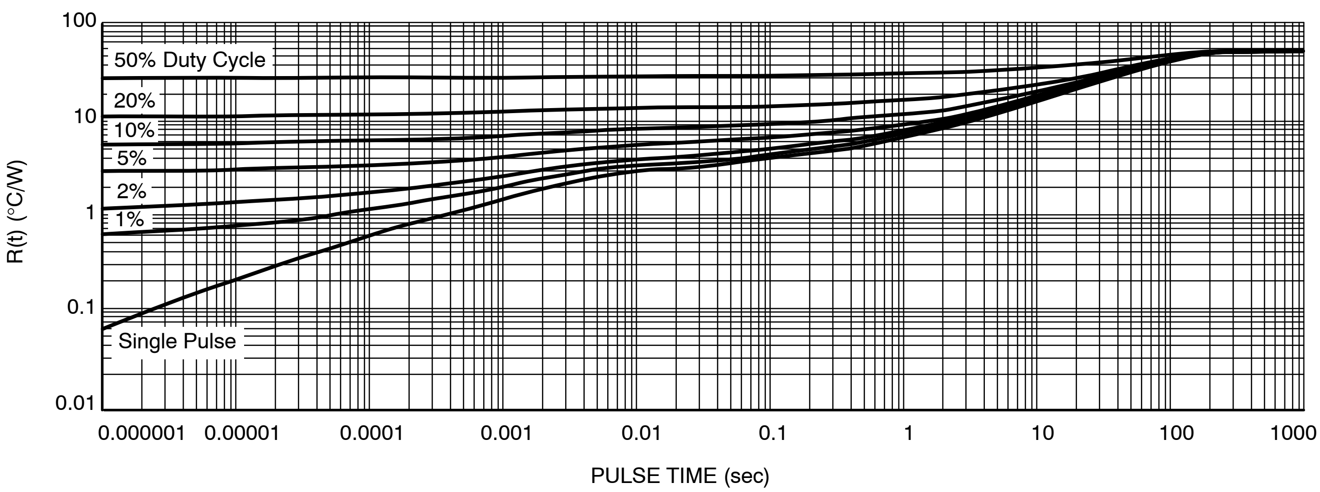


Figure 22. Transient Thermal Resistance − DPAK Version

Downloaded from Arrow.com.

TEST CIRCUITS AND WAVEFORMS

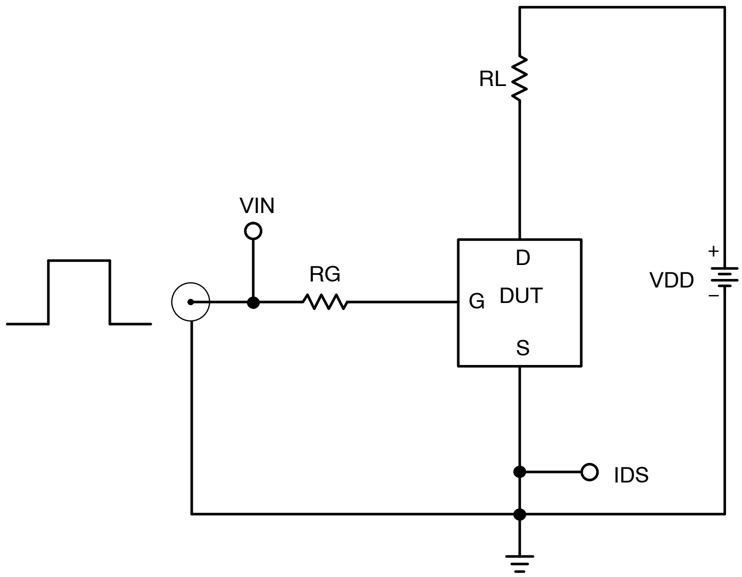


Figure 23. Resistive Load Switching Test Circuit

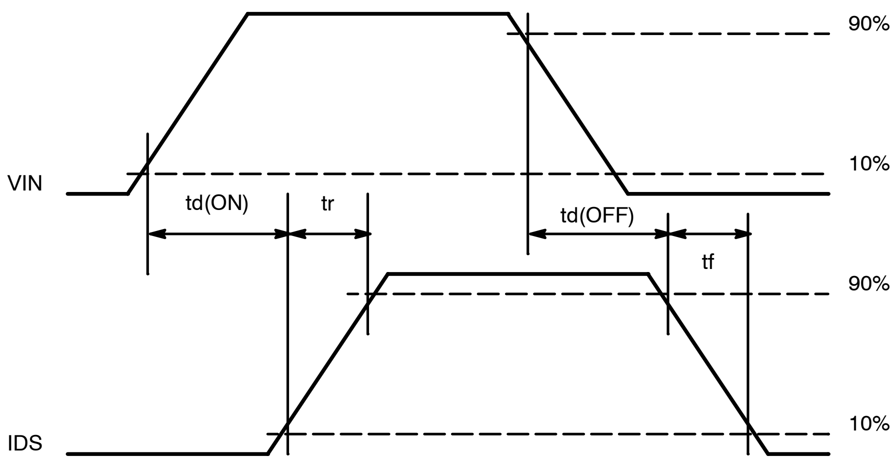


Figure 24. Resistive Load Switching Waveforms

Downloaded from Arrow.com.

TEST CIRCUITS AND WAVEFORMS

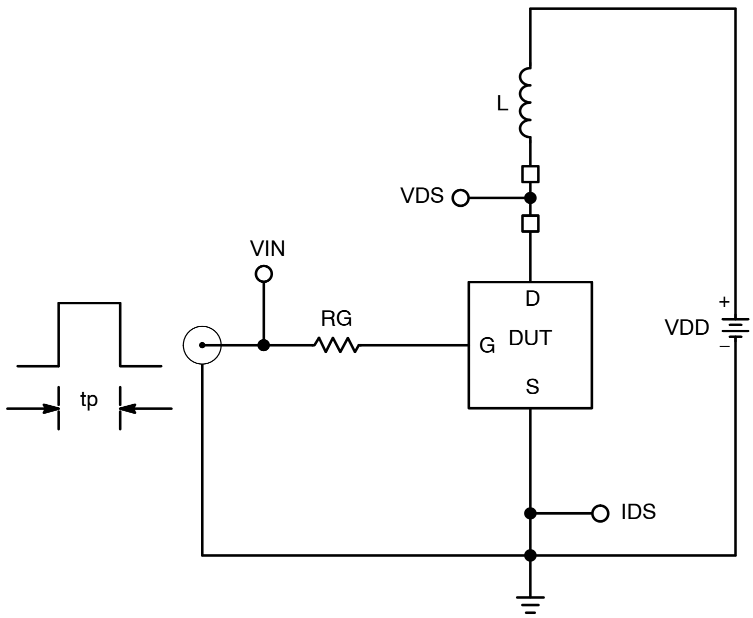


Figure 25. Inductive Load Switching Test Circuit

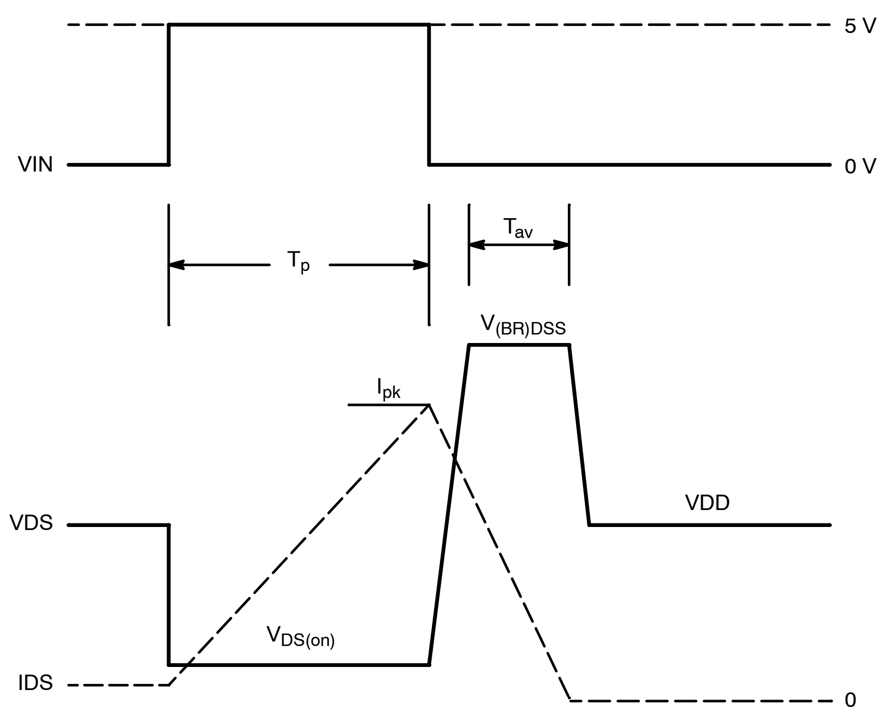


Figure 26. Inductive Load Switching Waveforms

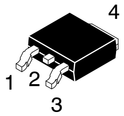
Downloaded from Arrow.com.

ORDERING INFORMATION

Device	Package	Shipping†
NCV8406ASTT1G	SOT−223 (Pb−Free)	1000 / Tape & Reel
NCV8406ASTT3G	SOT−223 (Pb−Free)	4000 / Tape & Reel
NCV8406ADTRKG	DPAK (Pb−Free)	2500 / Tape & Reel
NCV8406BDTRKG	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.

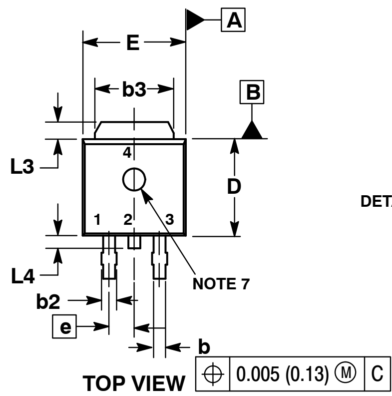
Downloaded from Arrow.com.



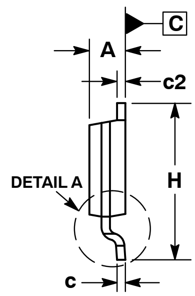
SCALE 1:1

DPAK (SINGLE GAUGE)
CASE 369C
ISSUE F

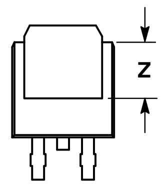
DATE 21 JUL 2015



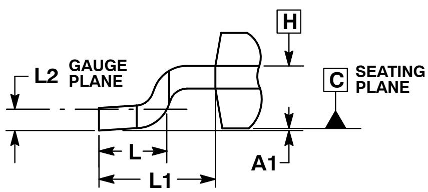
TOP VIEW



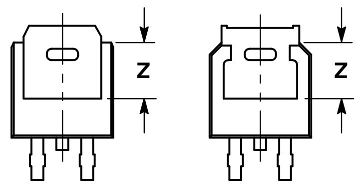
SIDE VIEW



BOTTOM VIEW



DETAIL A
ROTATED 90° CW



BOTTOM VIEW
ALTERNATE CONSTRUCTIONS

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.
7. OPTIONAL MOLD FEATURE.

	INCHES		MILLIMETERS	
DIM	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	0.028	0.045	0.72	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	0.114 REF		2.90 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 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

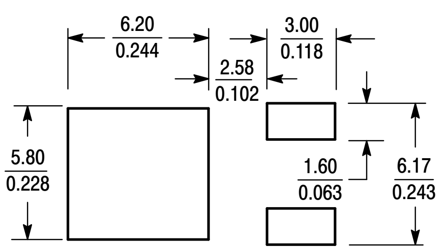
STYLE 7:
PIN 1. GATE
2. COLLECTOR
3. EMITTER
4. COLLECTOR

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

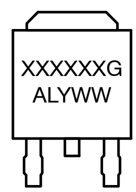
SOLDERING FOOTPRINT*



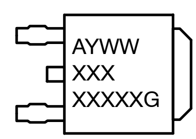
SCALE 3:1 (mm / inches)

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

GENERIC MARKING DIAGRAM*



IC



Discrete

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.

DOCUMENT NUMBER:	98AON10527D	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped “CONTROLLED COPY” in red.
DESCRIPTION:	DPAK (SINGLE GAUGE)	PAGE 1 OF 1

ON Semiconductor and ON are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor 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. ON Semiconductor does not convey any license under its patent rights nor the rights of others.

Downloaded from Arrow.com.

ON Semiconductor and ON are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of ON Semiconductor's product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent−Marking.pdf. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor 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. Buyer is responsible for its products and applications using ON Semiconductor products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by ON Semiconductor. "Typical" parameters which may be provided in ON Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. ON Semiconductor does not convey any license under its patent rights nor the rights of others. ON Semiconductor products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use ON Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold ON Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that ON Semiconductor was negligent regarding the design or manufacture of the part. ON Semiconductor is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:
Email Requests to: orderlit@onsemi.com

ON Semiconductor Website: www.onsemi.com

TECHNICAL SUPPORT
North American Technical Support:
Voice Mail: 1 800−282−9855 Toll Free USA/Canada
Phone: 011 421 33 790 2910

Europe, Middle East and Africa Technical Support:
Phone: 00421 33 790 2910
For additional information, please contact your local Sales Representative

◊

Downloaded from Arrow.com.