

MOSFET - POWER, Dual, Complementary, TSOP-6

30 V, +2.9/-2.2 A

NTGD4167C

Features

- Complementary N-Channel and P-Channel MOSFET
- Small Size (3 x 3 mm) Dual TSOP-6 Package
- Leading Edge Trench Technology for Low On Resistance
- Reduced Gate Charge to Improve Switching Response
- Independently Connected Devices to Provide Design Flexibility
- This is a Pb-Free Device

Applications

- DC-DC Conversion Circuits
- Load/Power Switching with Level Shift

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

Parameter			Symbol	Value	Unit
Drain-to-Source Voltage			V_{DS}	30	V
Gate-to-Source Voltage (N-Ch & P-Ch)			V_{GS}	± 12	V
N-Channel Continuous Drain Current (Note 1)	Steady State	$T_A = 25^\circ\text{C}$	I_D	2.6	A
		$T_A = 85^\circ\text{C}$		1.9	
	$t \leq 5\text{ s}$	$T_A = 25^\circ\text{C}$		2.9	
P-Channel Continuous Drain Current (Note 1)	Steady State	$T_A = 25^\circ\text{C}$	I_D	-1.9	A
		$T_A = 85^\circ\text{C}$		-1.4	
	$t \leq 5\text{ s}$	$T_A = 25^\circ\text{C}$		-2.2	
Power Dissipation (Note 1)	Steady State	$T_A = 25^\circ\text{C}$	P_D	0.9	W
	$t \leq 5\text{ s}$			1.1	
Pulsed Drain Current	N-Ch	$t_p = 10\text{ }\mu\text{s}$	I_{DM}	8.6	A
	P-Ch			-6.3	
Operating Junction and Storage Temperature			T_J, T_{STG}	-55 to 150	$^\circ\text{C}$
Source Current (Body Diode)			I_S	± 0.9	A
Lead Temperature for Soldering Purposes (1/8" from case for 10 s)			T_L	260	$^\circ\text{C}$

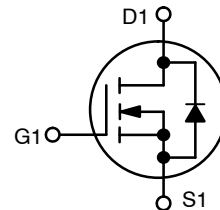
THERMAL RESISTANCE RATINGS

Parameter	Symbol	Value	Unit
Junction-to-Ambient – Steady State (Note 1)	$R_{\theta JA}$	140	$^\circ\text{C/W}$
Junction-to-Ambient – $t \leq 5\text{ s}$ (Note 1)	$R_{\theta JA}$	110	$^\circ\text{C/W}$

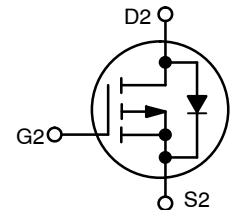
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. Surface Mounted on FR4 Board using 1 in sq pad size (Cu area = 1.127 in sq [1 oz] including traces).

$V_{(BR)DS}$	$R_{DS(on)}$ MAX	I_D MAX (Note 1)
N-Ch 30 V	90 m Ω @ 4.5 V	2.6 A
	125 m Ω @ 2.5 V	2.2 A
P-Ch -30 V	170 m Ω @ -4.5 V	-1.9 A
	300 m Ω @ -2.5 V	-1.0 A



N-CHANNEL MOSFET

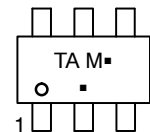


P-CHANNEL MOSFET



TSOP-6
CASE 318G
STYLE 13

MARKING DIAGRAM



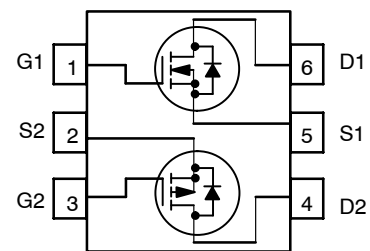
TA = Specific Device Code

M = Date Code

■ = Pb-Free Package

(Note: Microdot may be in either location)

PIN CONNECTION



(Top View)

ORDERING INFORMATION

See detailed ordering and shipping information in on page 9 of this data sheet.

NTGD4167C

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

Parameter	Symbol	N/P	Test Conditions	Min	Typ	Max	Unit
OFF CHARACTERISTICS							
Drain-to-Source Breakdown Voltage	V _{(BR)DSS}	N	V _{GS} = 0 V	I _D = 250 μA	30		V
		P		I _D = -250 μA	-30		
Drain-to-Source Breakdown Voltage Temperature Coefficient	V _{(BR)DSS} /T _J	N				21.4	mV/°C
		P				22.2	
Zero Gate Voltage Drain Current	I _{DSS}	N	V _{GS} = 0 V, V _{DS} = 24 V	T _J = 25 °C		1.0	μA
		P	V _{GS} = 0 V, V _{DS} = -24 V			-1.0	
		N	V _{GS} = 0 V, V _{DS} = 24 V	T _J = 85 °C		10	
		P	V _{GS} = 0 V, V _{DS} = -24 V			-10	
Gate-to-Source Leakage Current	I _{GSS}	N	V _{DS} = 0 V, V _{GS} = ±12 V			±100	nA
		P	V _{DS} = 0 V, V _{GS} = ±12 V			±100	

ON CHARACTERISTICS (Note 2)

Gate Threshold Voltage	V _{GS(TH)}	N	V _{GS} = V _{DS}	I _D = 250 μA	0.5	0.9	1.5	V
		P		I _D = -250 μA	-0.5	-1.1	-1.5	
Drain-to-Source On Resistance	R _{DS(on)}	N	V _{GS} = 4.5 V, I _D = 2.6 A			52	90	mΩ
			V _{GS} = 2.5 V, I _D = 2.2 A			67	125	
		P	V _{GS} = -4.5 V, I _D = -1.9 A			130	170	
			V _{GS} = -2.5 V, I _D = -1.0 A			202	300	
Forward Transconductance	g _{FS}	N	V _{DS} = 15 V, I _D = 2.6 A			2.6		S
		P	V _{DS} = -15 V, I _D = -1.9 A			2.6		

CHARGES AND CAPACITANCES

Input Capacitance	C _{ISS}	N	f = 1 MHz, V _{GS} = 0 V	V _{DS} = 15 V		295		pF
Output Capacitance	C _{OSS}					48		
Reverse Transfer Capacitance	C _{RSS}					27		
Input Capacitance	C _{ISS}	P		V _{DS} = -15 V		419		
Output Capacitance	C _{OSS}					51		
Reverse Transfer Capacitance	C _{RSS}					26		
Total Gate Charge	Q _{G(TOT)}	N	V _{GS} = 4.5 V, V _{DS} = 15 V, I _D = 2.0 A		3.7	5.5	nC	
Threshold Gate Charge	Q _{G(TH)}				0.6			
Gate-to-Source Gate Charge	Q _{GS}				0.9			
Gate-to-Drain “Miller” Charge	Q _{GD}				0.8			
Total Gate Charge	Q _{G(TOT)}	P	V _{GS} = -4.5 V, V _{DS} = -15 V, I _D = -2.0 A		3.9	6.0		
Threshold Gate Charge	Q _{G(TH)}				0.6			
Gate-to-Source Gate Charge	Q _{GS}				1.0			
Gate-to-Drain “Miller” Charge	Q _{GD}				1.0			

NTGD4167C

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

Parameter	Symbol	N/P	Test Conditions	Min	Typ	Max	Unit
SWITCHING CHARACTERISTICS (Note 3)							
Turn-On Delay Time	$t_{d(ON)}$	N	$V_{GS} = 4.5\text{ V}, V_{DD} = 15\text{ V},$ $I_D = 1.0\text{ A}, R_G = 6.0\text{ }\Omega$		7.0		ns
Rise Time	t_r				4.0		
Turn-Off Delay Time	$t_{d(OFF)}$				14		
Fall Time	t_f				2.0		
Turn-On Delay Time	$t_{d(ON)}$	P	$V_{GS} = -4.5\text{ V}, V_{DD} = -15\text{ V},$ $I_D = -1.0\text{ A}, R_G = 6.0\text{ }\Omega$		8.0		
Rise Time	t_r				8.0		
Turn-Off Delay Time	$t_{d(OFF)}$				22		
Fall Time	t_f				8.0		

2. Pulse Test: pulse width $\leq 300\text{ }\mu\text{s}$, duty cycle $\leq 2\%$.
3. Switching characteristics are independent of operating junction temperatures.

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

Parameter	Symbol	N/P	Test Conditions	Min	Typ	Max	Unit	
DRAIN-SOURCE DIODE CHARACTERISTICS								
Forward Diode Voltage	V _{SD}	N	V _{GS} = 0 V, T _J = 25 °C	I _S = 0.9 A		0.7	1.2	V
		P		I _S = -0.9 A		-0.8	-1.2	
Reverse Recovery Time	t _{RR}	N	V _{GS} = 0 V, dI _S / dt = 100 A/μs, I _S = 0.9 A		8.0		ns	
Charge Time	t _a				5.0			
Discharge Time	t _b				3.0			
Reverse Recovery Charge	Q _{RR}				3.0		nC	
Reverse Recovery Time	t _{RR}	P	V _{GS} = 0 V, dI _S / dt = 100 A/μs, I _S = -0.9 A		12		ns	
Charge Time	t _a				10			
Discharge Time	t _b				2.0			
Reverse Recovery Charge	Q _{RR}				7.0		nC	

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.

N-CHANNEL TYPICAL CHARACTERISTICS

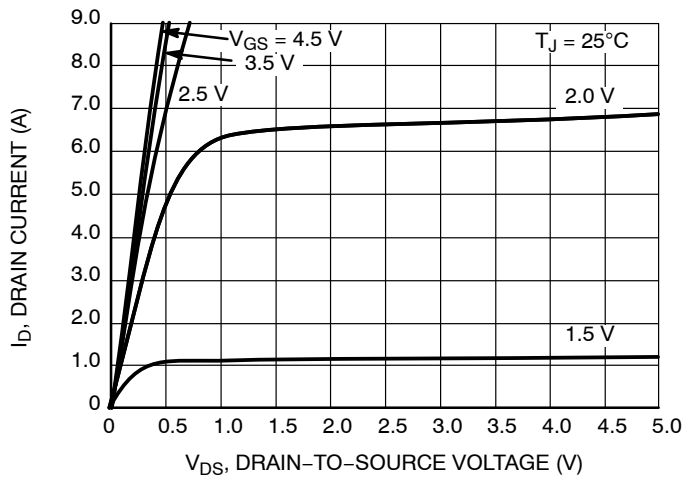


Figure 1. On-Region Characteristics

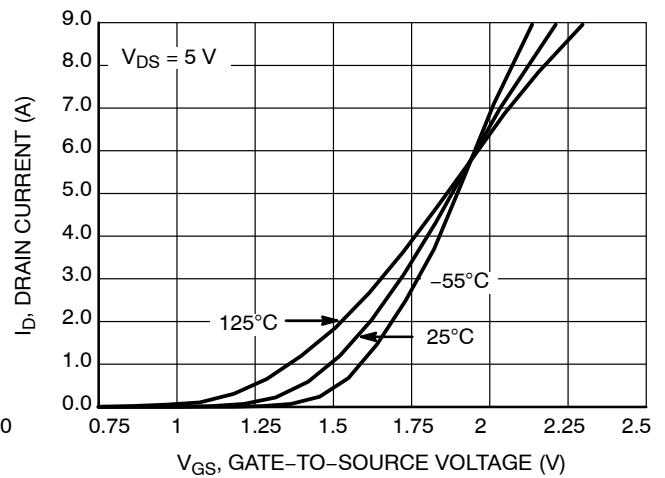


Figure 2. Transfer Characteristics

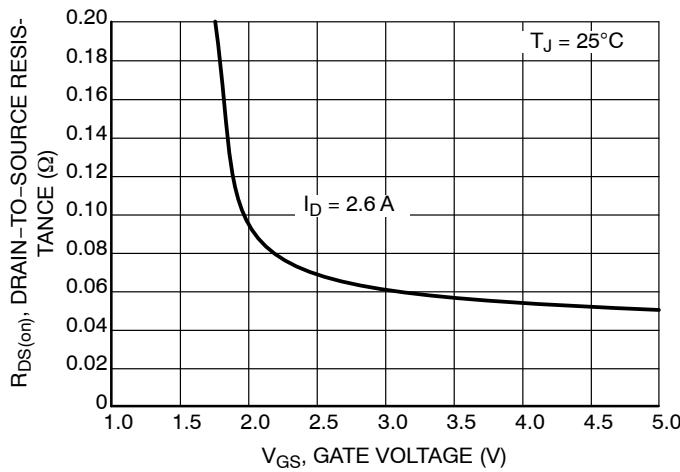


Figure 3. On-Region vs. Gate-To-Source Voltage

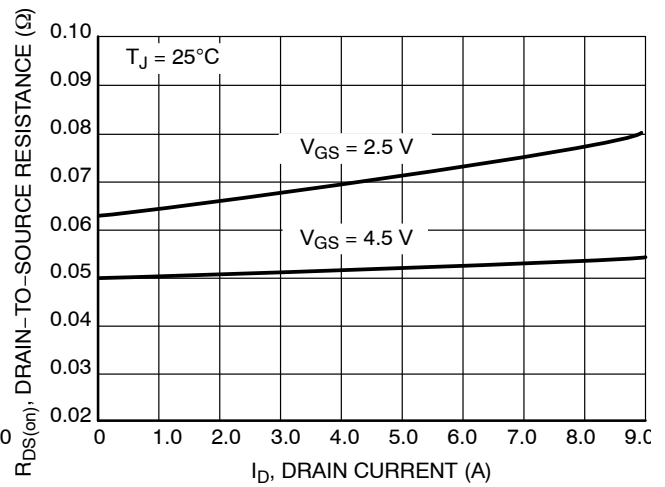


Figure 4. On-Resistance vs. Drain Current and Temperature

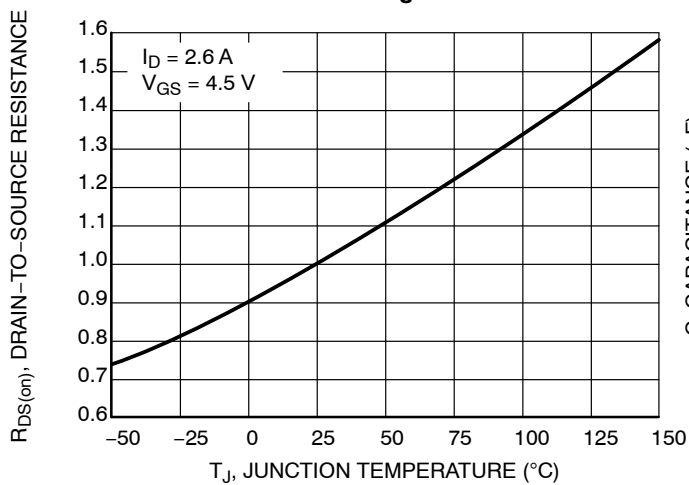


Figure 5. On-Resistance Variation with Temperature

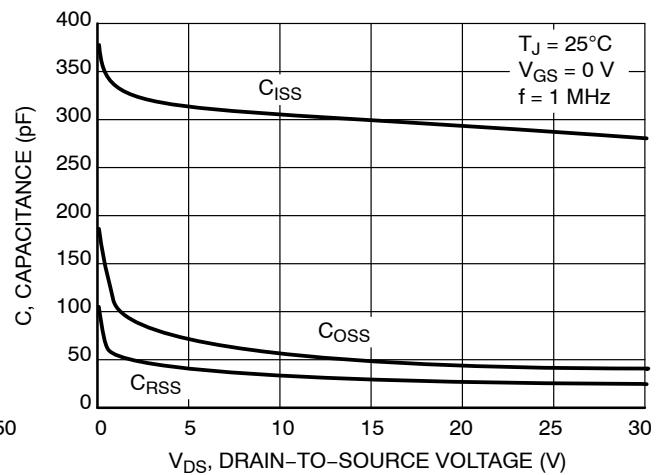


Figure 6. Capacitance Variation

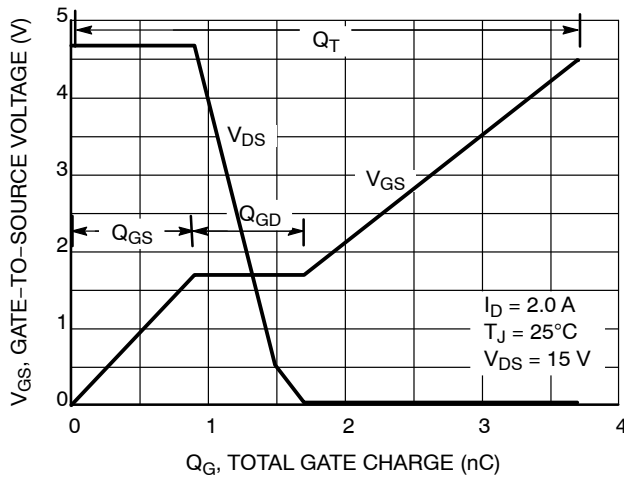


Figure 7. Gate-to-Source and Drain-to-Source Voltage versus Total Charge

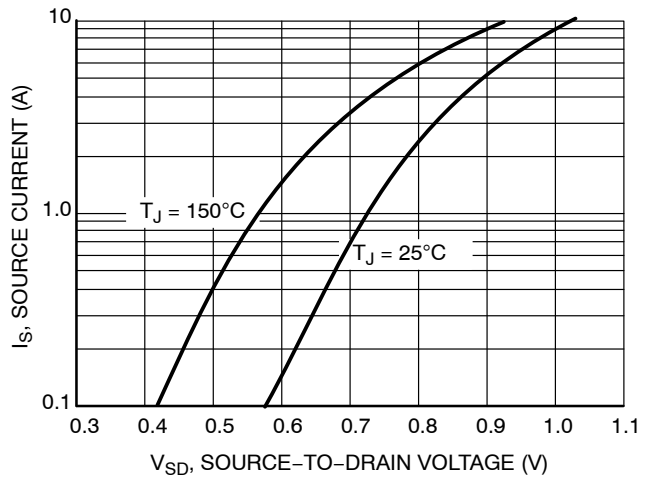


Figure 8. Diode Forward Voltage versus Current

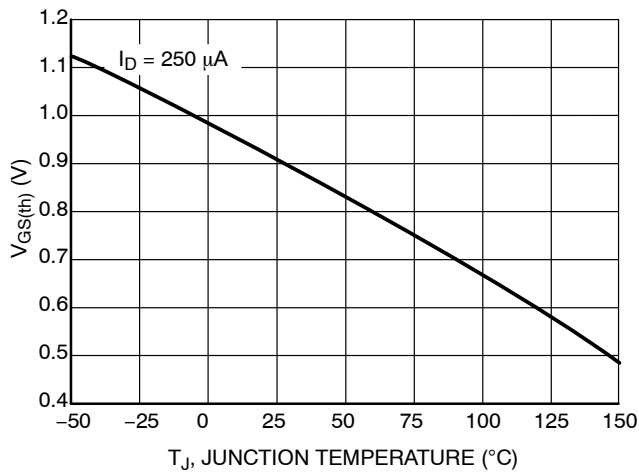


Figure 9. Threshold Voltage

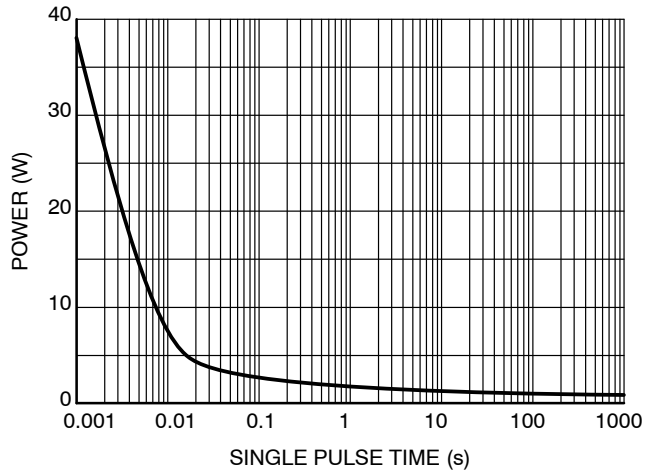


Figure 10. Single Pulse Maximum Power Dissipation

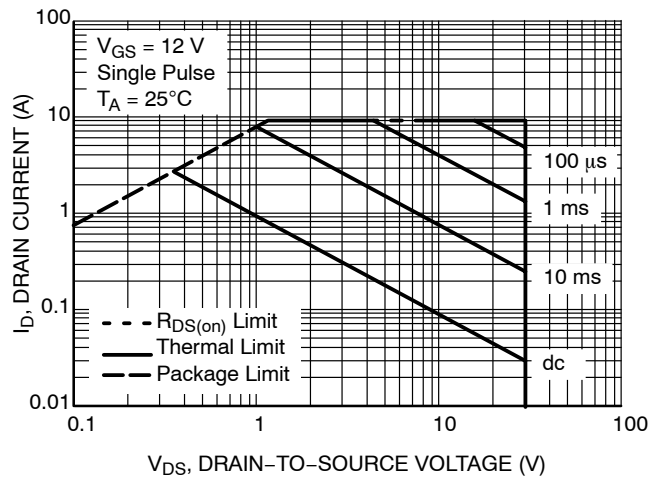


Figure 11. Maximum Rated Forward Biased Safe Operating Area

NTGD4167C

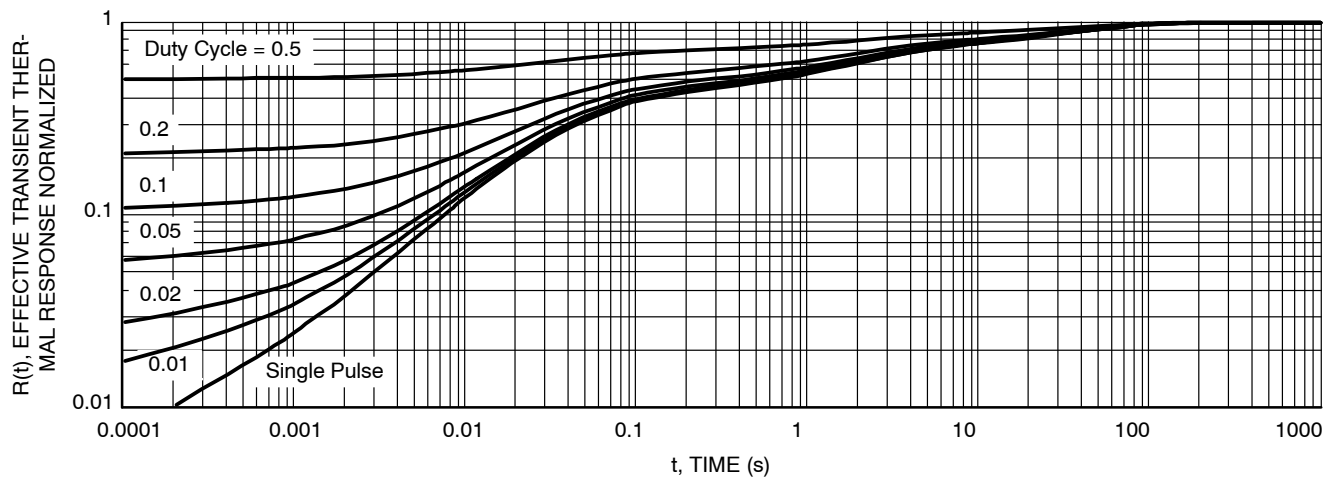


Figure 12. FET Thermal Response

P-CHANNEL TYPICAL CHARACTERISTICS

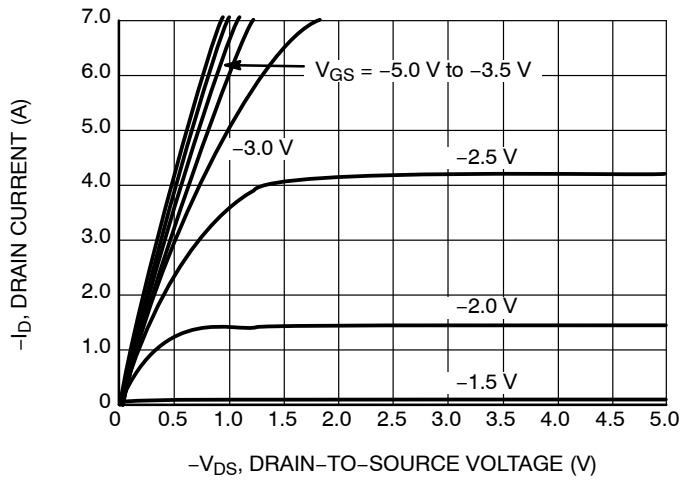


Figure 13. On-Region Characteristics

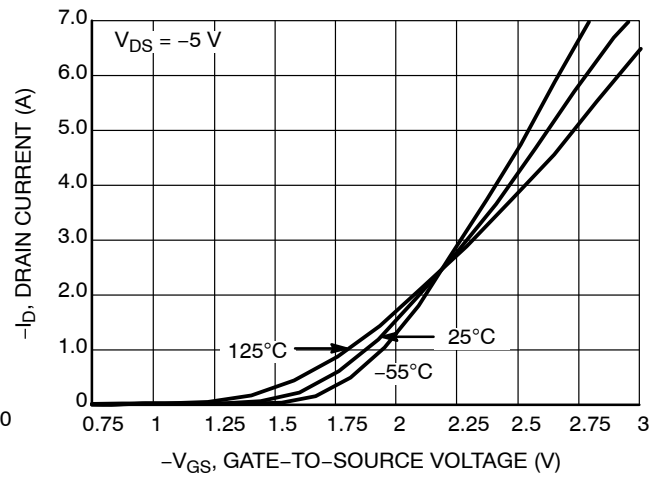


Figure 14. Transfer Characteristics

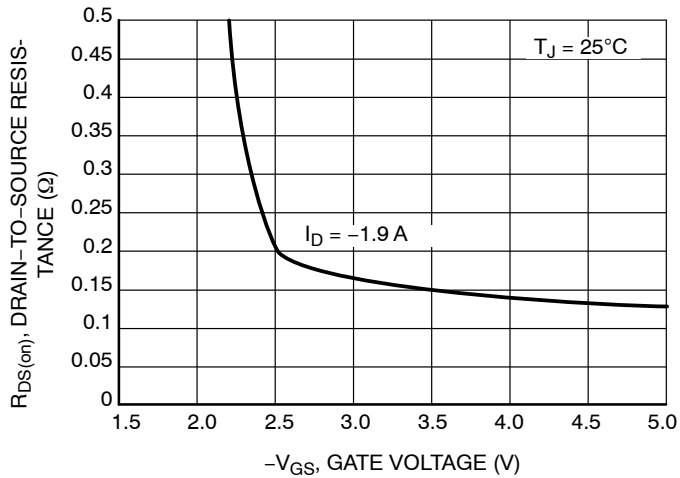


Figure 15. On-Region vs. Gate-To-Source Voltage

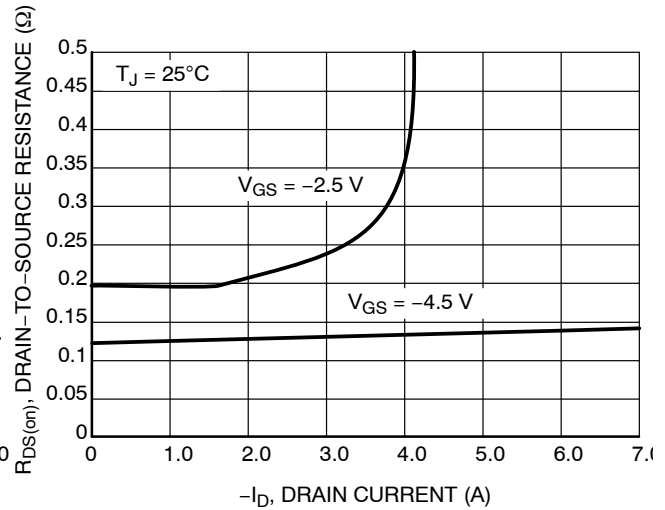


Figure 16. On-Resistance vs. Drain Current and Temperature

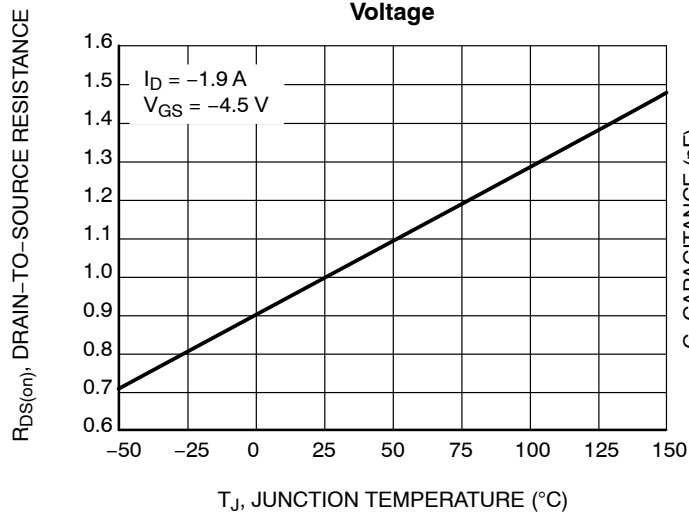


Figure 17. On-Resistance Variation with Temperature

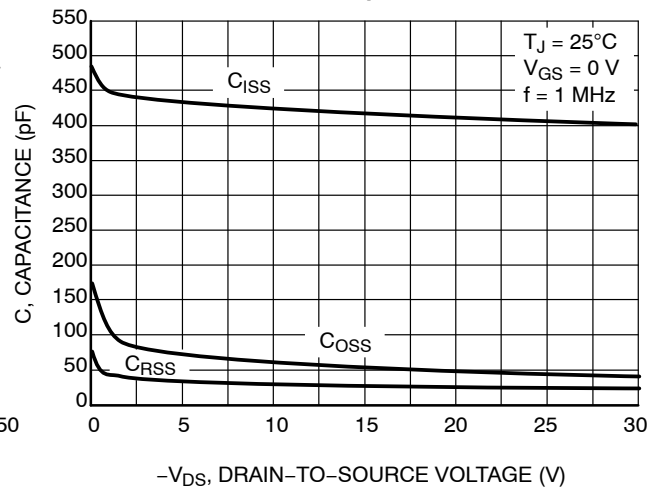


Figure 18. Capacitance Variation

NTGD4167C

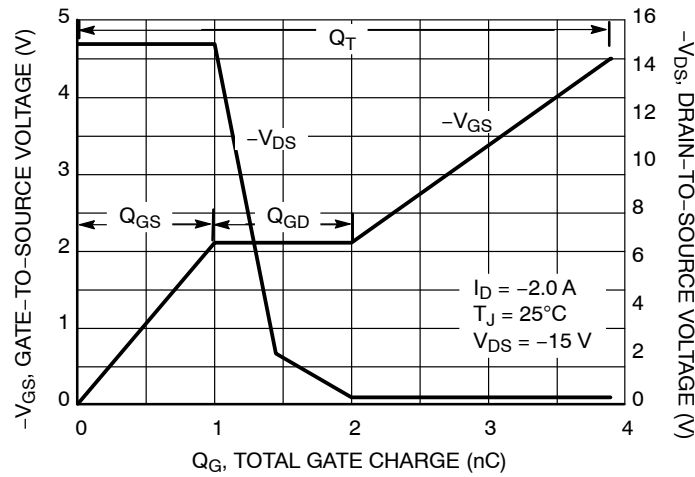


Figure 19. Gate-to-Source and Drain-to-Source Voltage versus Total Charge

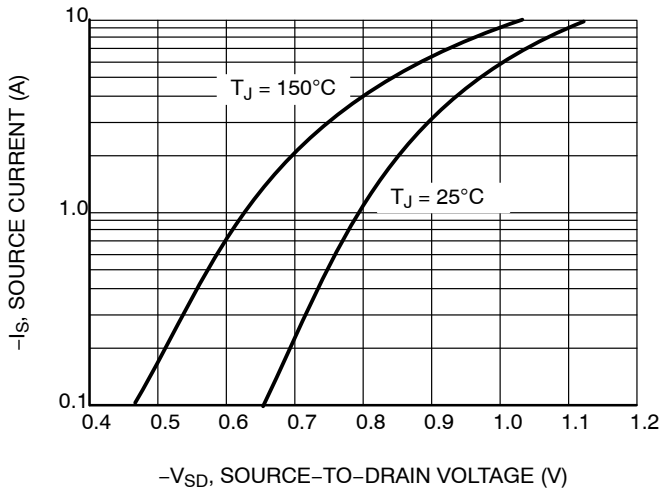


Figure 20. Diode Forward Voltage versus Current

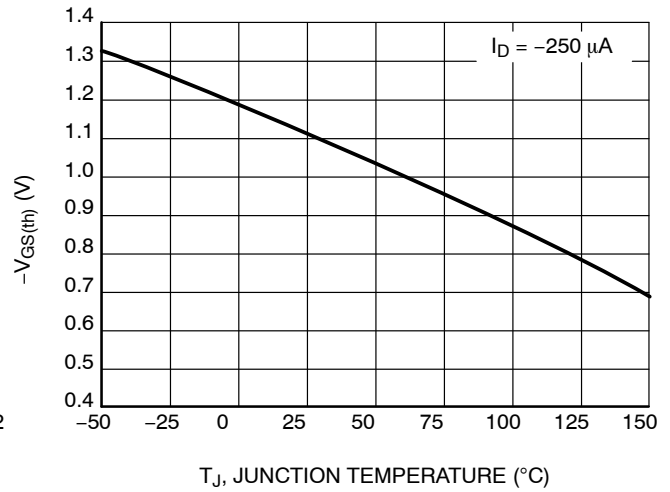


Figure 21. Threshold Voltage

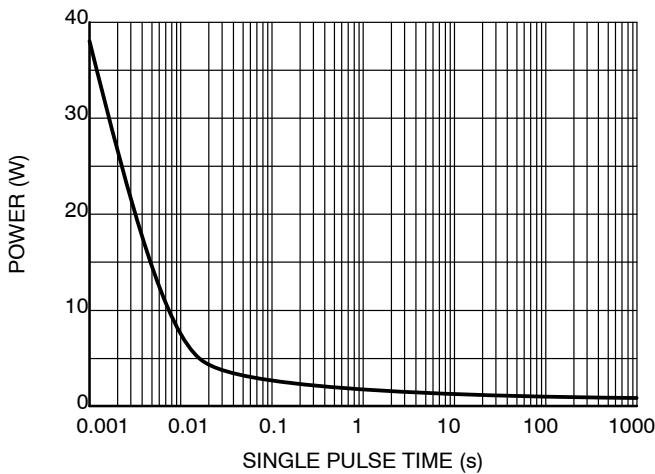


Figure 22. Single Pulse Maximum Power Dissipation

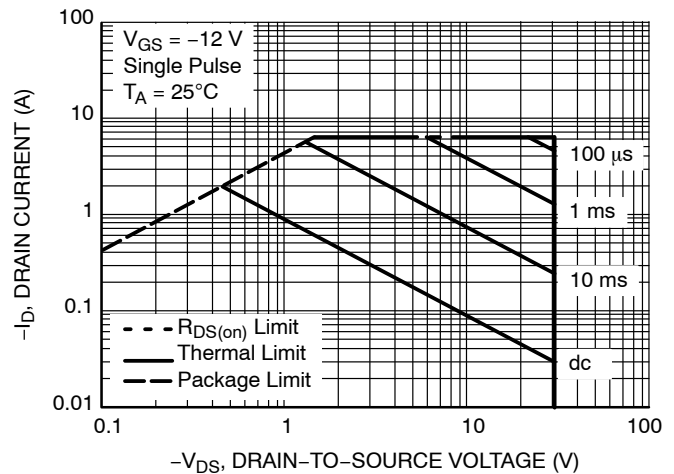
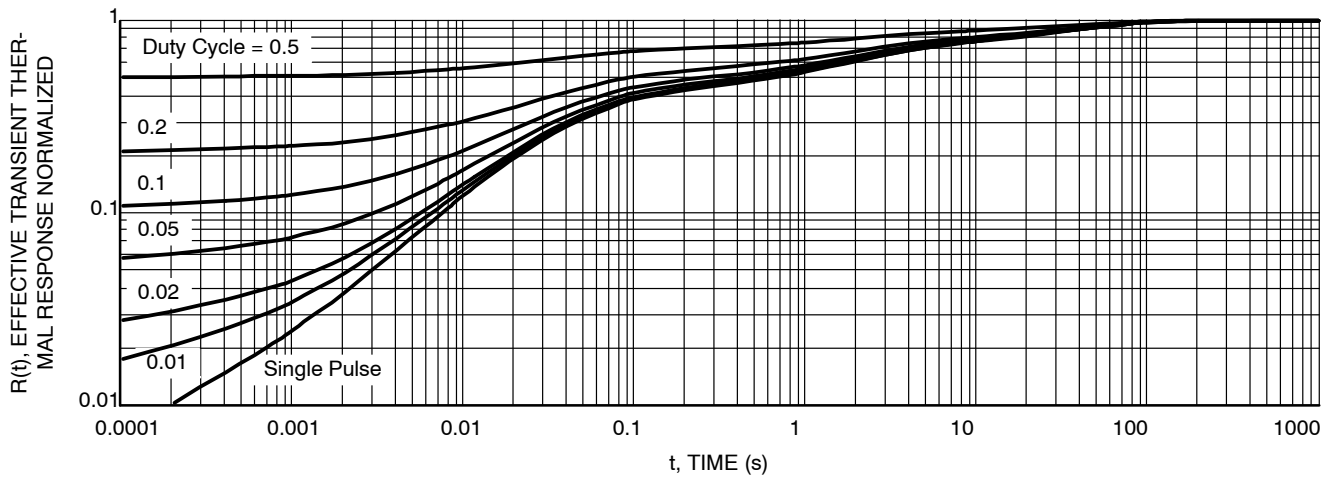


Figure 23. Maximum Rated Forward Biased Safe Operating Area

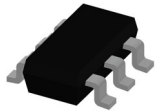
NTGD4167C



ORDERING INFORMATION

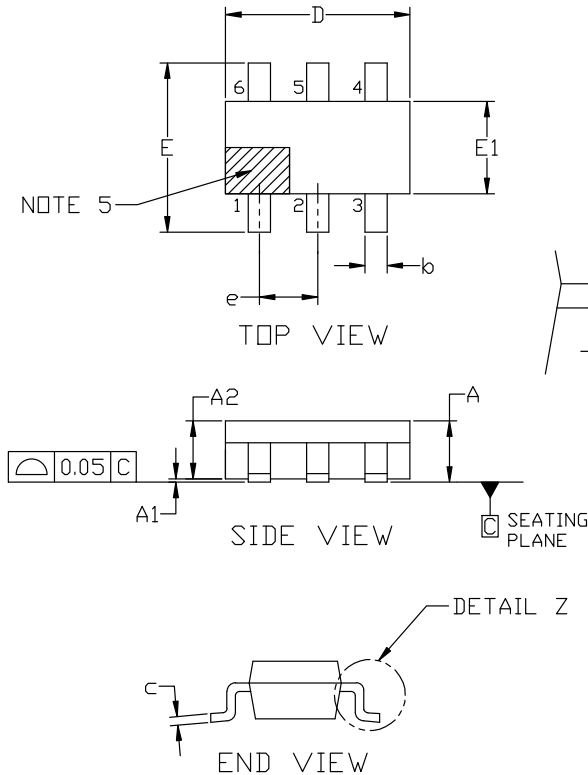
Device	Package	Shipping [†]
NTGD4167CT1G	TSOP6 (Pb-Free)	3000 / Tape & Reel

[†]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.



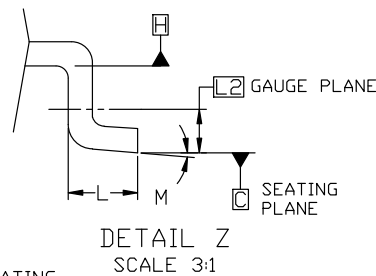
TSOP-6 3.00x1.50x0.90, 0.95P
CASE 318G
ISSUE W

DATE 26 FEB 2024

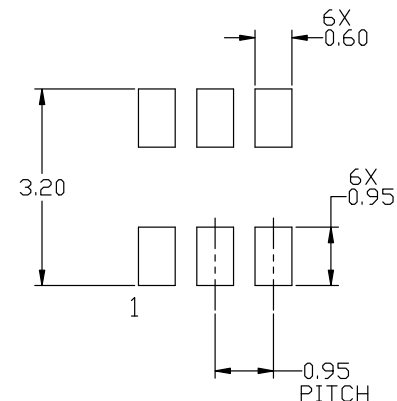


NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2018.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. DIMENSIONS D AND E1 DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS. MOLD FLASH, PROTRUSIONS, OR GATE BURRS SHALL NOT EXCEED 0.15 PER SIDE. DIMENSIONS D AND E1 ARE DETERMINED AT DATUM H.
5. PIN 1 INDICATOR MUST BE LOCATED IN THE INDICATED ZONE



MILLIMETERS			
DIM	MIN	NOM	MAX
A	0.90	1.00	1.10
A1	0.01	0.06	0.10
A2	0.80	0.90	1.00
b	0.25	0.38	0.50
c	0.10	0.18	0.26
D	2.90	3.00	3.10
E	2.50	2.75	3.00
E1	1.30	1.50	1.70
e	0.85	0.95	1.05
L	0.20	0.40	0.60
L2	0.25 BSC		
M	0°	---	10°



RECOMMENDED MOUNTING 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.

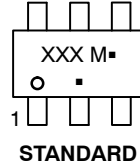
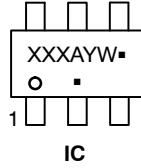
DOCUMENT NUMBER:	98ASB14888C	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
DESCRIPTION:	TSOP-6 3.00x1.50x0.90, 0.95P	PAGE 1 OF 2

onsemi and onsemi 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.

TSOP-6 3.00x1.50x0.90, 0.95P
CASE 318G
ISSUE W

DATE 26 FEB 2024

GENERIC
MARKING DIAGRAM*



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

XXX = Specific Device Code
M = Date Code
■ = 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. DRAIN 2. DRAIN 3. GATE 4. SOURCE 5. DRAIN 6. DRAIN	STYLE 2: PIN 1. EMITTER 2 2. BASE 1 3. COLLECTOR 1 4. EMITTER 1 5. BASE 2 6. COLLECTOR 2	STYLE 3: PIN 1. ENABLE 2. N/C 3. R BOOST 4. Vz 5. V in 6. V out	STYLE 4: PIN 1. N/C 2. V in 3. NOT USED 4. GROUND 5. ENABLE 6. LOAD	STYLE 5: PIN 1. EMITTER 2 2. BASE 2 3. COLLECTOR 1 4. EMITTER 1 5. BASE 1 6. COLLECTOR 2	STYLE 6: PIN 1. COLLECTOR 2. COLLECTOR 3. BASE 4. EMITTER 5. COLLECTOR 6. COLLECTOR
STYLE 7: PIN 1. COLLECTOR 2. COLLECTOR 3. BASE 4. N/C 5. COLLECTOR 6. EMITTER	STYLE 8: PIN 1. Vbus 2. D(in) 3. D(in)+ 4. D(out)+ 5. D(out) 6. GND	STYLE 9: PIN 1. LOW VOLTAGE GATE 2. DRAIN 3. SOURCE 4. DRAIN 5. DRAIN 6. HIGH VOLTAGE GATE	STYLE 10: PIN 1. D(OUT)+ 2. GND 3. D(OUT)- 4. D(IN)- 5. VBUS 6. D(IN)+	STYLE 11: PIN 1. SOURCE 1 2. DRAIN 2 3. DRAIN 2 4. SOURCE 2 5. GATE 1 6. DRAIN 1/GATE 2	STYLE 12: PIN 1. I/O 2. GROUND 3. I/O 4. I/O 5. VCC 6. I/O
STYLE 13: PIN 1. GATE 1 2. SOURCE 2 3. GATE 2 4. DRAIN 2 5. SOURCE 1 6. DRAIN 1	STYLE 14: PIN 1. ANODE 2. SOURCE 3. GATE 4. CATHODE/DRAIN 5. CATHODE/DRAIN 6. CATHODE/DRAIN	STYLE 15: PIN 1. ANODE 2. SOURCE 3. GATE 4. DRAIN 5. N/C 6. CATHODE	STYLE 16: PIN 1. ANODE/CATHODE 2. BASE 3. EMITTER 4. COLLECTOR 5. ANODE 6. CATHODE	STYLE 17: PIN 1. EMITTER 2. BASE 3. ANODE/CATHODE 4. ANODE 5. CATHODE 6. COLLECTOR	

DOCUMENT NUMBER:	98ASB14888C	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
DESCRIPTION:	TSOP-6 3.00x1.50x0.90, 0.95P	PAGE 2 OF 2

onsemi and onsemi 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.

onsemi, **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**'s 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.

ADDITIONAL INFORMATION

TECHNICAL PUBLICATIONS:

Technical Library: www.onsemi.com/design/resources/technical-documentation
onsemi Website: www.onsemi.com

ONLINE SUPPORT: www.onsemi.com/support

For additional information, please contact your local Sales Representative at
www.onsemi.com/support/sales