NTGD4167C

MOSFET – POWER, Dual, Complementary, TSOP-6
30 V, +2.9/-2.2 A

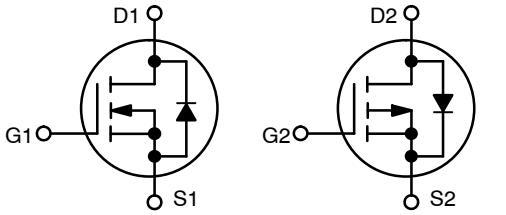
ON Semiconductor®

http://onsemi.com

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

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



N−CHANNEL MOSFET **P−CHANNEL MOSFET**

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

Parameter			Symbol	Value	Unit
Drain−to−Source Voltage			V_{DSS}	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°C	I_D	2.6	A
		T_A = 85°C		1.9	
	t ≤ 5 s	T_A = 25°C		2.9	
P−Channel Continuous Drain Current (Note 1)	Steady State	T_A = 25°C	I_D	−1.9	A
		T_A = 85°C		−1.4	
	t ≤ 5 s	T_A = 25°C		−2.2	
Power Dissipation (Note 1)	Steady State	T_A = 25°C	P_D	0.9	W
	t ≤ 5 s			1.1	
Pulsed Drain Current	N−Ch	t_p = 10 μs	I_{DM}	8.6	A
	P−Ch			−6.3	
Operating Junction and Storage Temperature			T_J, T_{STG}	−55 to 150	°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	°C

THERMAL RESISTANCE RATINGS

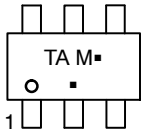
Parameter	Symbol	Value	Unit
Junction−to−Ambient − Steady State (Note 1)	$R_{\theta JA}$	140	°C/W
Junction−to−Ambient − t ≤ 5 s (Note 1)	$R_{\theta JA}$	110	°C/W

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

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

TSOP−6
CASE 318G
STYLE 13

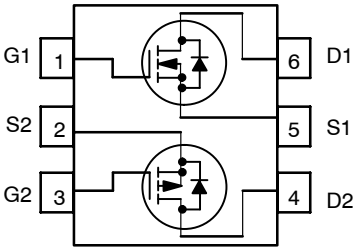
MARKING DIAGRAM



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 the package dimensions section on page 9 of this data sheet.

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		
SWITCHING CHARACTERISTICS (Note 3)								
Turn−On Delay Time	$t_{d(ON)}$	N	V_{GS} = 4.5 V, V_{DD} = 15 V, I_D = 1.0 A, R_G = 6.0 Ω			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 V, V_{DD} = −15 V, I_D = −1.0 A, R_G = 6.0 Ω			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 ≤ 300 μs, duty cycle ≤ 2%.

3. Switching characteristics are independent of operating junction temperatures.

ELECTRICAL CHARACTERISTICS (T_J = 25°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

N−CHANNEL TYPICAL CHARACTERISTICS

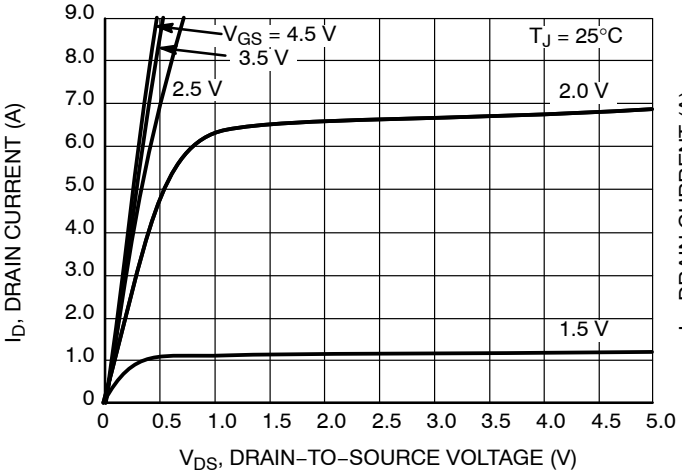


Figure 1. On−Region Characteristics

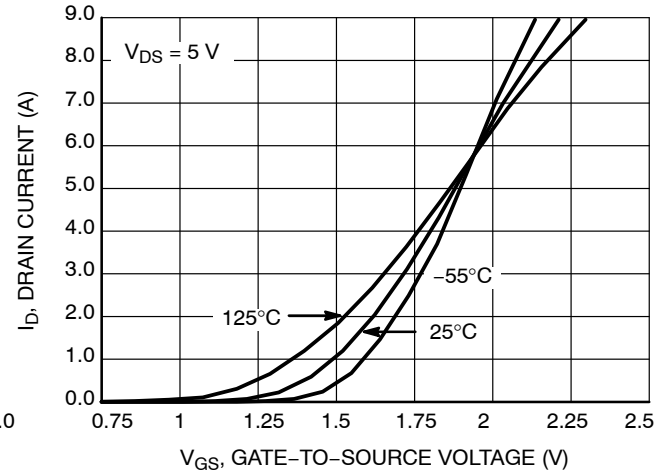


Figure 2. Transfer Characteristics

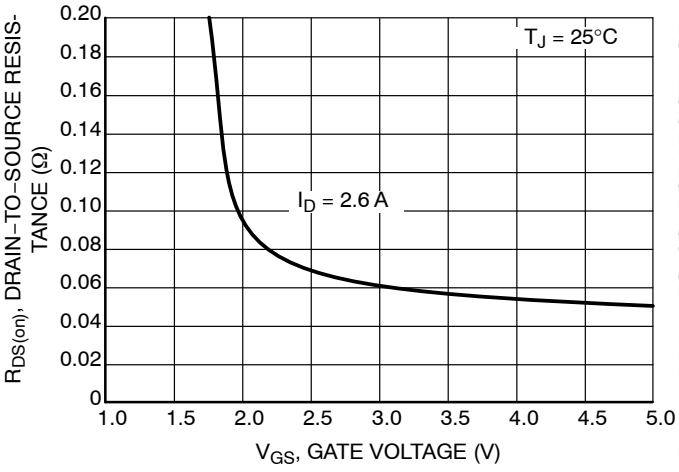


Figure 3. On−Region vs. Gate−To−Source Voltage

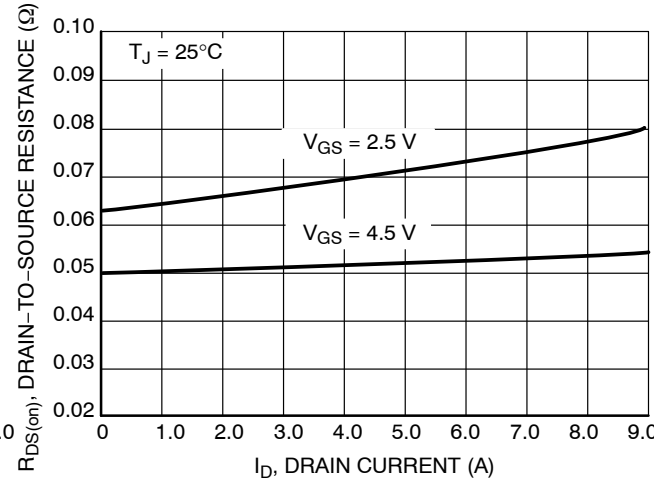


Figure 4. On−Resistance vs. Drain Current and Temperature

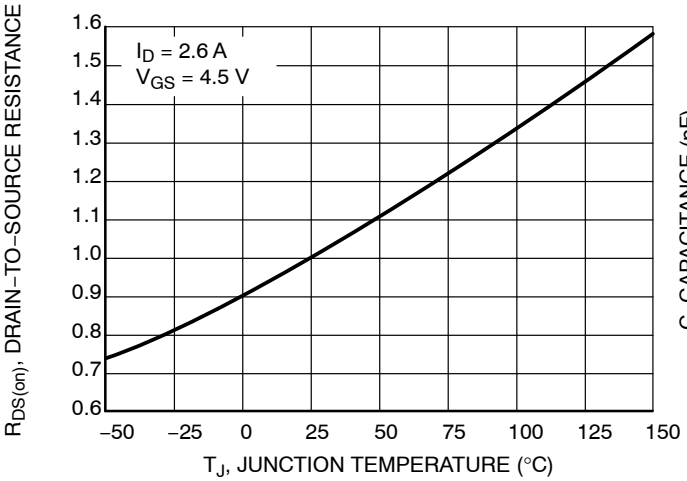


Figure 5. On−Resistance Variation with Temperature

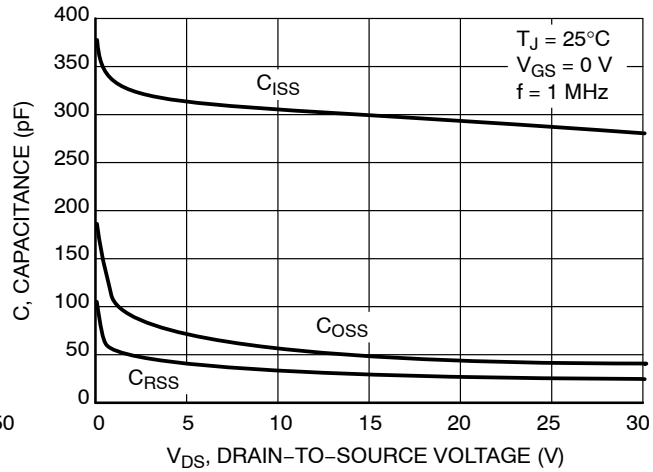


Figure 6. Capacitance Variation

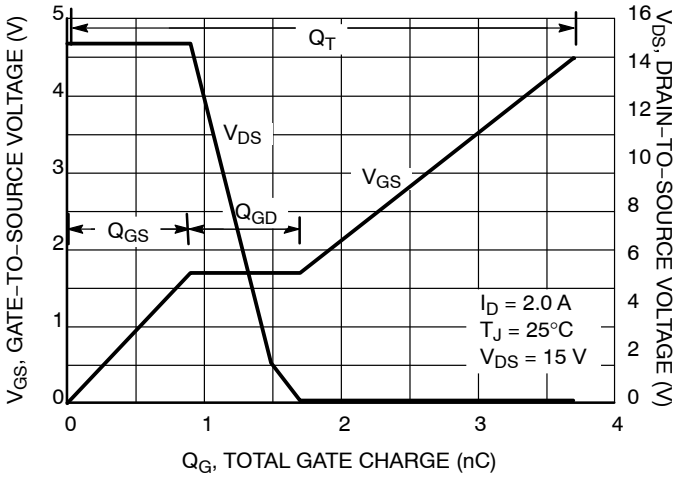


Figure 7. Gate−to−Source and Drain−to−Source Voltage versus Total Charge

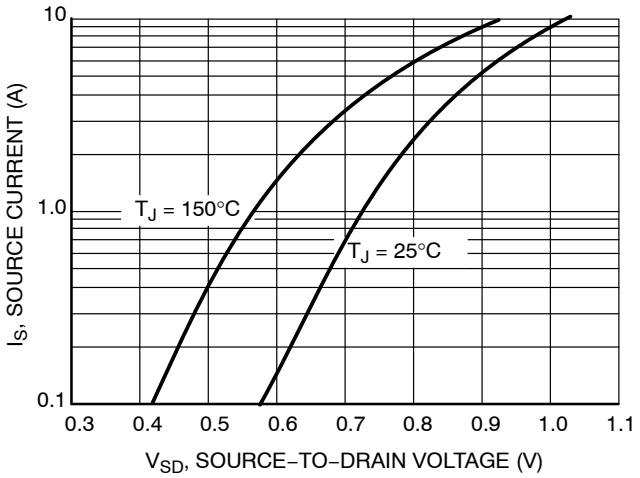


Figure 8. Diode Forward Voltage versus Current

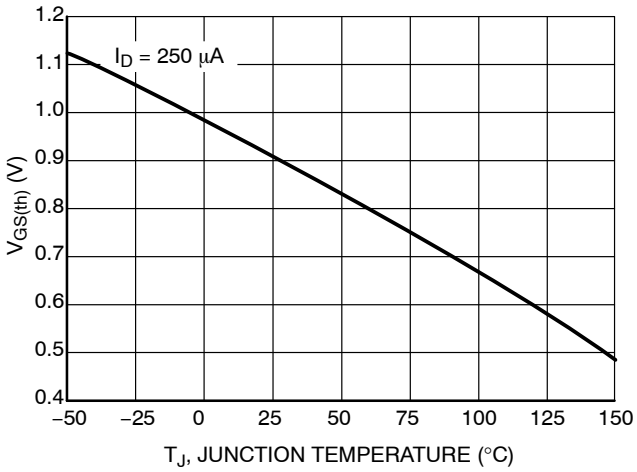


Figure 9. Threshold Voltage

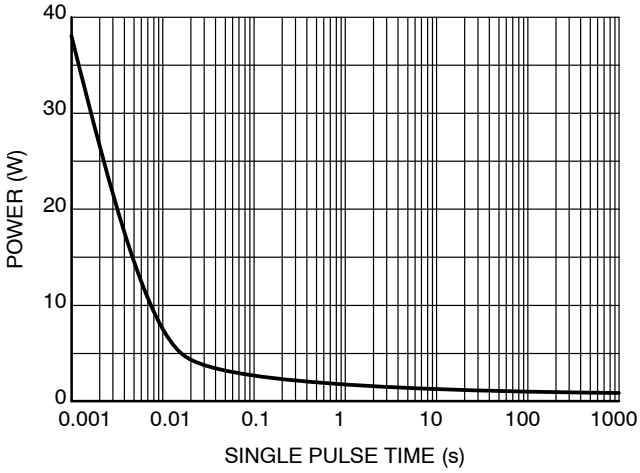


Figure 10. Single Pulse Maximum Power Dissipation

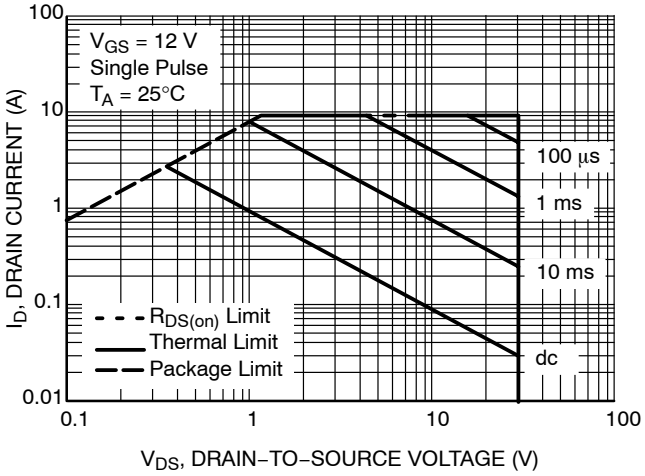


Figure 11. Maximum Rated Forward Biased Safe Operating Area

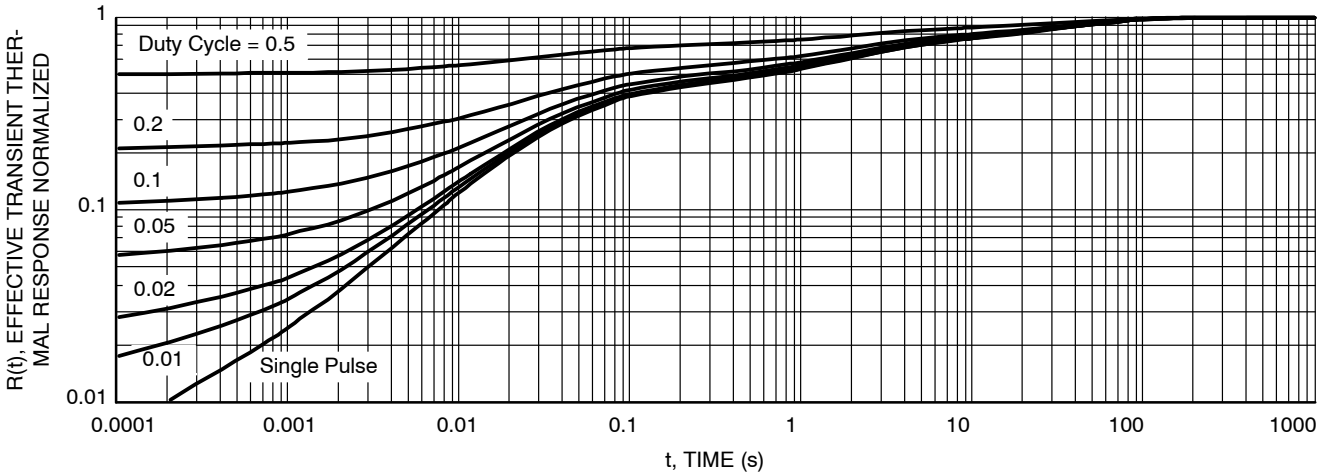


Figure 12. FET Thermal Response

P−CHANNEL TYPICAL CHARACTERISTICS

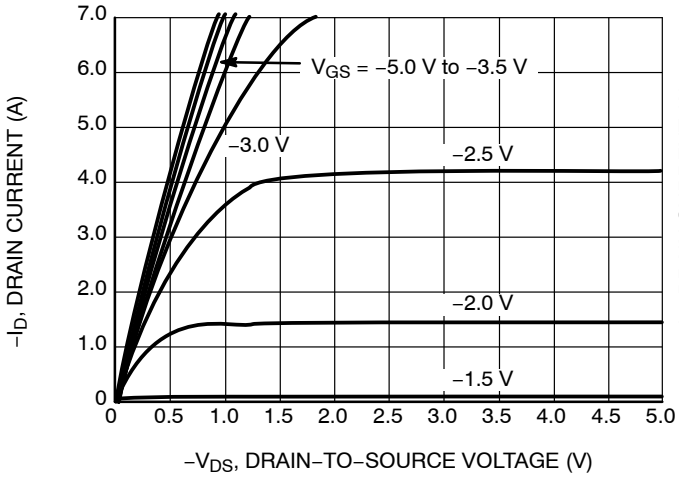


Figure 13. On−Region Characteristics

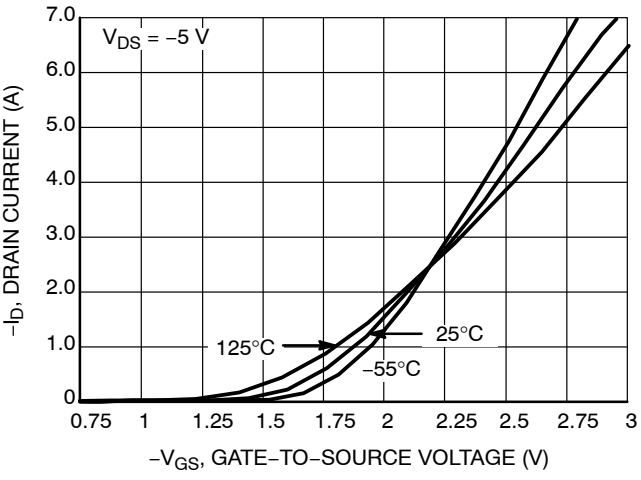


Figure 14. Transfer Characteristics

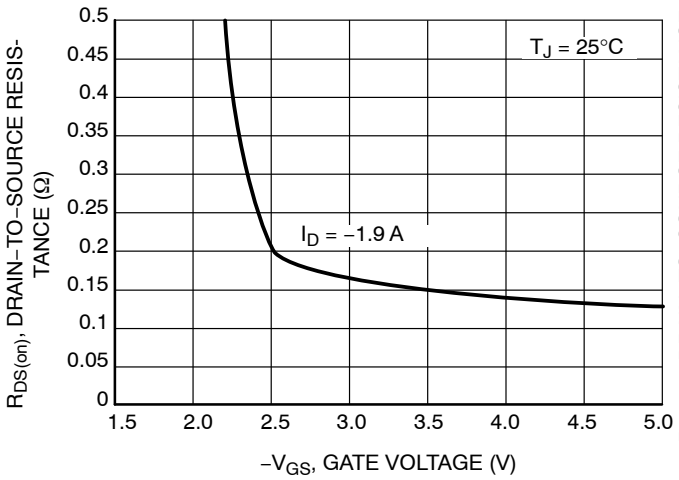


Figure 15. On−Region vs. Gate−To−Source Voltage

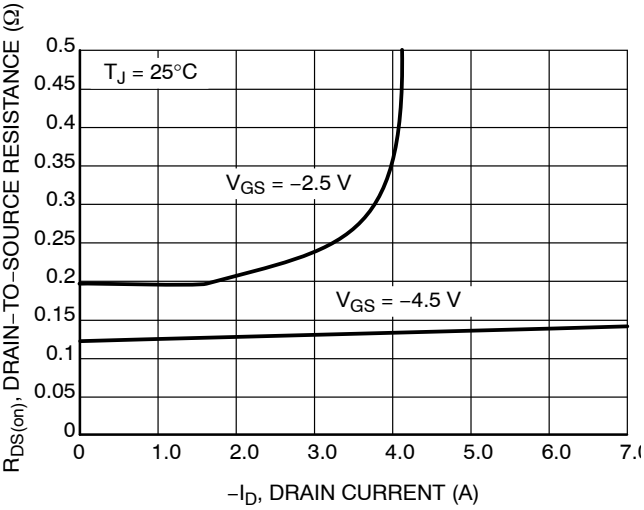


Figure 16. On−Resistance vs. Drain Current and Temperature

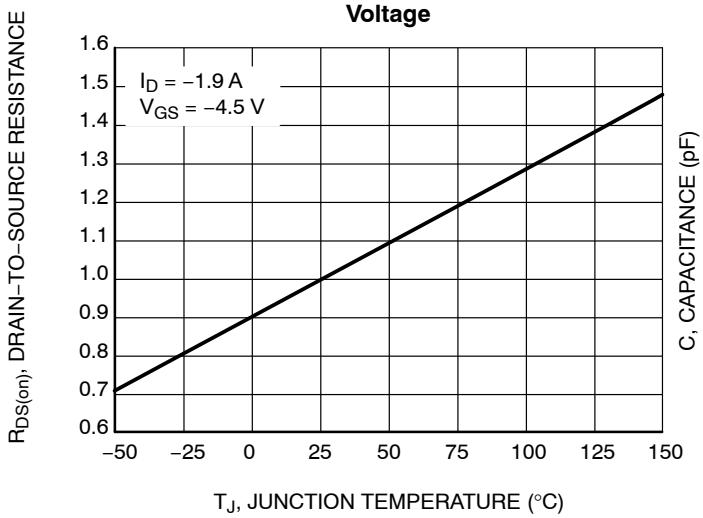


Figure 17. On−Resistance Variation with Temperature

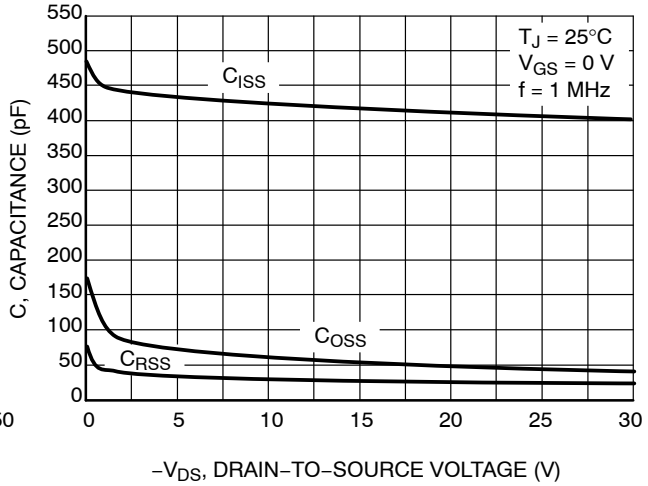


Figure 18. Capacitance Variation

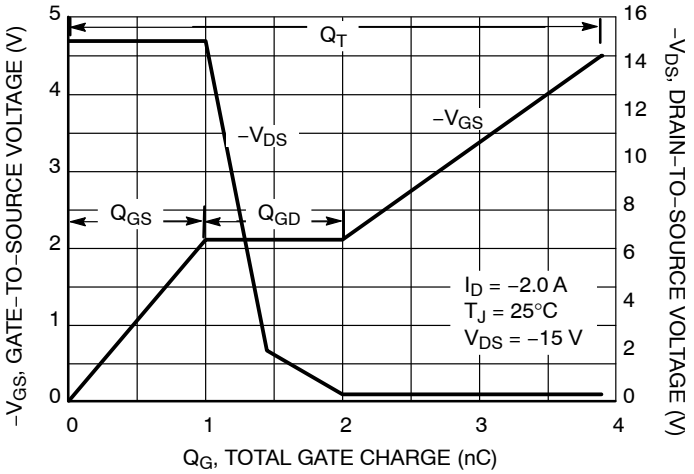


Figure 19. Gate−to−Source and Drain−to−Source Voltage versus Total Charge

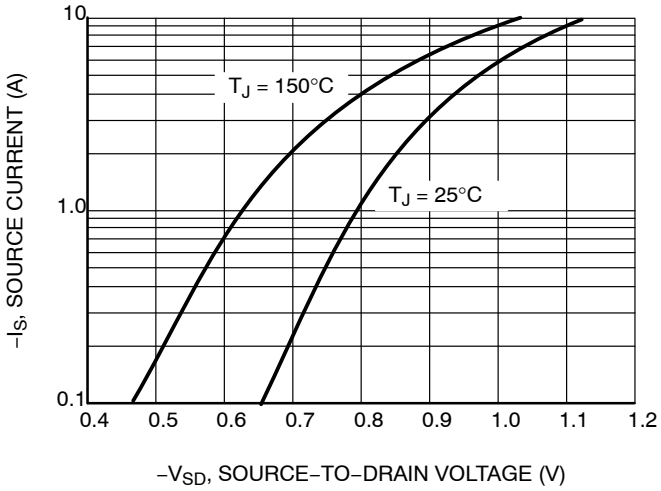


Figure 20. Diode Forward Voltage versus Current

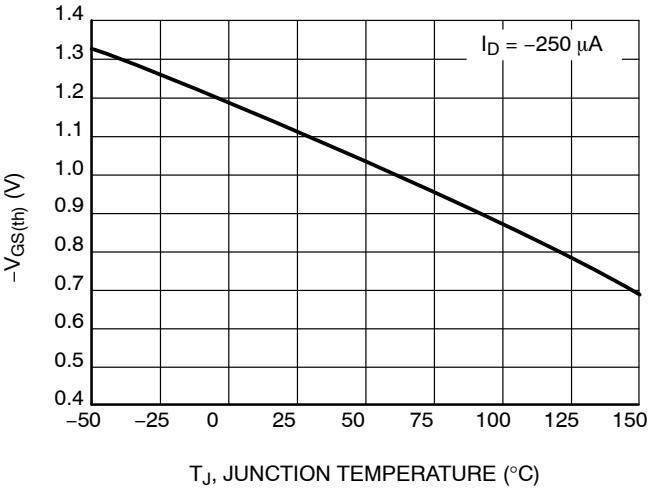


Figure 21. Threshold Voltage

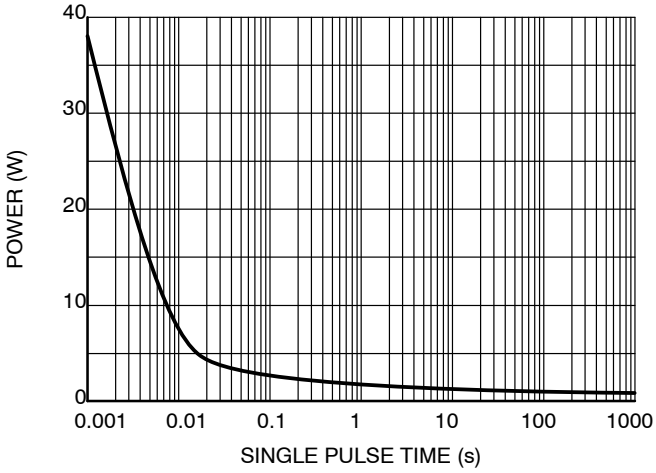


Figure 22. Single Pulse Maximum Power Dissipation

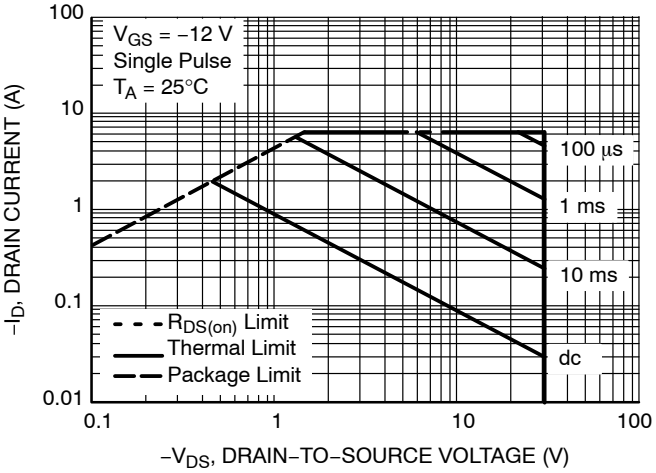


Figure 23. Maximum Rated Forward Biased Safe Operating Area

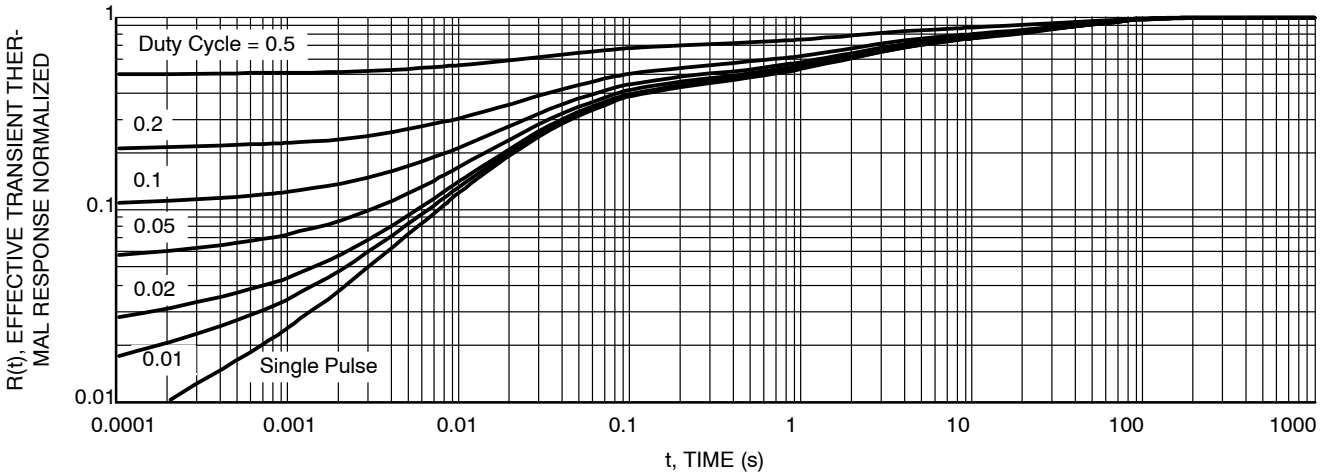


Figure 24. FET Thermal Response

ORDERING INFORMATION

Device	Package	Shipping†
NTGD4167CT1G	TSOP6 (Pb−Free)	3000 / Tape & Reel

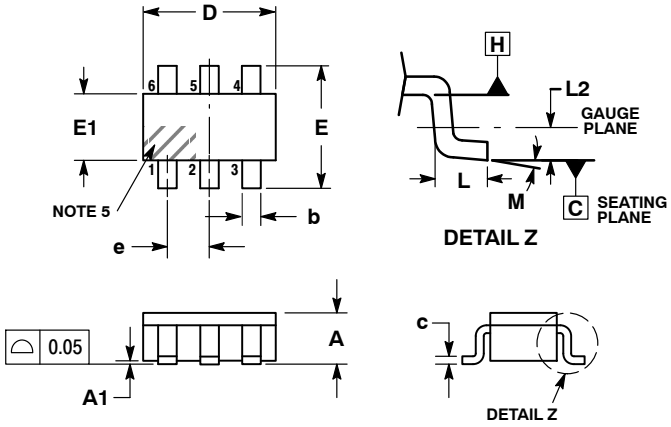
†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

MECHANICAL CASE OUTLINE
PACKAGE DIMENSIONS

SCALE 2:1

TSOP−6
CASE 318G−02
ISSUE V

DATE 12 JUN 2012



NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
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 ONE 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
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°

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

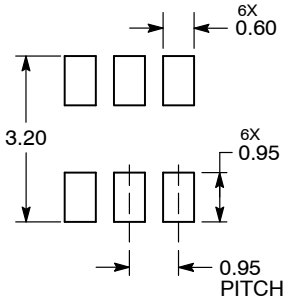
STYLE 14:
PIN 1. ANODE
2. SOURCE
3. GATE
4. CATHODE/DRAIN
5. CATHODE/DRAIN
6. CATHODE/DRAIN

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

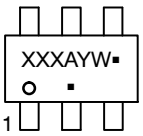
RECOMMENDED SOLDERING FOOTPRINT*



DIMENSIONS: MILLIMETERS

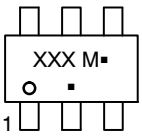
*For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

GENERIC MARKING DIAGRAM*



IC

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



STANDARD

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.

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