

# NTGS4111P, NVGS4111P

## MOSFET – Power, Single, P-Channel, TSOP-6

**-30 V, -4.7 A**

### Features

- Leading -30 V Trench Process for Low  $R_{DS(on)}$
- Low Profile Package Suitable for Portable Applications
- Surface Mount TSOP-6 Package Saves Board Space
- Improved Efficiency for Battery Applications
- NV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q101 Qualified and PPAP Capable
- Pb-Free Package is Available

### Applications

- Battery Management and Switching
- Load Switching
- Battery Protection

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

Rating		Symbol	Value	Unit	
Drain-to-Source Voltage		$V_{DS}$	-30	V	
Gate-to-Source Voltage		$V_{GS}$	$\pm 20$	V	
Continuous Drain Current (Note 1)	Steady State	$T_A = 25^\circ\text{C}$	$I_D$	-3.7	A
			$T_A = 85^\circ\text{C}$	-2.7	
	$t \leq 5\text{ s}$	$T_A = 25^\circ\text{C}$		-4.7	
Power Dissipation (Note 1)	Steady State	$T_A = 25^\circ\text{C}$	$P_D$	1.25	W
			$t \leq 5\text{ s}$	2.0	
Continuous Drain Current (Note 2)	Steady State	$T_A = 25^\circ\text{C}$	$I_D$	-2.6	A
			$T_A = 85^\circ\text{C}$	-1.9	
		$T_A = 25^\circ\text{C}$	$P_D$	0.63	W
Pulsed Drain Current	$t_p = 10\ \mu\text{s}$	$I_{DM}$	-15	A	
Operating Junction and Storage Temperature		$T_J, T_{STG}$	-55 to 150	$^\circ\text{C}$	
Source Current (Body Diode)		$I_S$	-1.7	A	
Lead Temperature for Soldering Purposes (1/8" from case for 10 s)		$T_L$	260	$^\circ\text{C}$	

### THERMAL RESISTANCE RATINGS

Rating	Symbol	Max	Unit
Junction-to-Ambient – Steady State (Note 1)	$R_{\theta JA}$	100	$^\circ\text{C}/\text{W}$
Junction-to-Ambient – $t \leq 5\text{ s}$ (Note 1)	$R_{\theta JA}$	62.5	
Junction-to-Ambient – Steady State (Note 2)	$R_{\theta JA}$	200	

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).

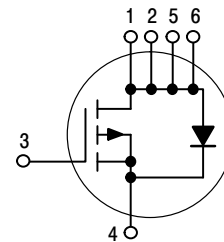


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$V_{(BR)DSS}$	$R_{DS(on)}$ TYP	$I_D$ MAX
-30 V	38 m $\Omega$ @ -10 V	-4.7 A
	68 m $\Omega$ @ -4.5 V	

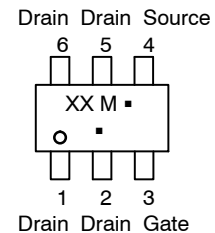
### P-Channel



### MARKING DIAGRAM & PIN ASSIGNMENT



**TSOP-6  
CASE 318G  
STYLE 1**



- XX = Specific Device Code
- M = Date Code\*
- = Pb-Free Package

(Note: Microdot may be in either location)  
\*Date Code orientation may vary depending upon manufacturing location.

### ORDERING INFORMATION

See detailed ordering and shipping information on page 6 of this data sheet.

## NTGS4111P, NVGS4111P

2. Surface-mounted on FR4 board using the minimum recommended pad size (Cu area = 0.006 in sq).

# NTGS4111P, NVGS4111P

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

Characteristic	Symbol	Test Condition	Min	Typ	Max	Unit
<b>OFF CHARACTERISTICS</b>						
Drain-to-Source Breakdown Voltage	V <sub>(BR)DSS</sub>	V <sub>GS</sub> = 0 V, I <sub>D</sub> = -250 μA	-30			V
Drain-to-Source Breakdown Voltage Temperature Coefficient	V <sub>(BR)DSS</sub> /T <sub>J</sub>			-17		mV/°C
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>GS</sub> = 0 V, V <sub>DS</sub> = -24 V	T <sub>J</sub> = 25°C		-1.0	μA
			T <sub>J</sub> = 125°C		-100	
Gate-to-Source Leakage Current	I <sub>GSS</sub>	V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ±20 V			±100	nA

## ON CHARACTERISTICS (Note 3)

Gate Threshold Voltage	V <sub>GS(TH)</sub>	V <sub>GS</sub> = V <sub>DS</sub> , I <sub>D</sub> = -250 μA	-1.0		-3.0	V
Negative Threshold Temperature Coefficient	V <sub>GS(TH)</sub> /T <sub>J</sub>			5.0		mV/°C
Drain-to-Source On Resistance	R <sub>DS(on)</sub>	V <sub>GS</sub> = -10 V, I <sub>D</sub> = -3.7 A		38	60	mΩ
		V <sub>GS</sub> = -4.5 V, I <sub>D</sub> = -2.7 A		68	110	
Forward Transconductance	g <sub>FS</sub>	V <sub>DS</sub> = -10 V, I <sub>D</sub> = -3.7 A		6.0		S

## CHARGES, CAPACITANCES AND GATE RESISTANCE

Input Capacitance	C <sub>ISS</sub>	V <sub>GS</sub> = 0 V, f = 1.0 MHz, V <sub>DS</sub> = -15 V		750		pF
Output Capacitance	C <sub>OSS</sub>			140		
Reverse Transfer Capacitance	C <sub>RSS</sub>			105		
Total Gate Charge	Q <sub>G(TOT)</sub>	V <sub>GS</sub> = -10 V, V <sub>DD</sub> = -15 V, I <sub>D</sub> = -3.7 A		15.25	32	nC
Threshold Gate Charge	Q <sub>G(TH)</sub>			0.8		
Gate-to-Source Charge	Q <sub>GS</sub>			2.6		
Gate-to-Drain Charge	Q <sub>GD</sub>			3.4		

## SWITCHING CHARACTERISTICS, V<sub>GS</sub> = -10 V (Note 4)

Turn-On Delay Time	t <sub>d(ON)</sub>	V <sub>GS</sub> = -10 V, V <sub>DD</sub> = -15 V, I <sub>D</sub> = -1.0 A, R <sub>G</sub> = 6.0 Ω		9.0	17	ns
Rise Time	t <sub>r</sub>			9.0	18	
Turn-Off Delay Time	t <sub>d(OFF)</sub>			38	85	
Fall Time	t <sub>f</sub>			22	45	

## SWITCHING CHARACTERISTICS, V<sub>GS</sub> = -4.5 V (Note 4)

Turn-On Delay Time	t <sub>d(ON)</sub>	V <sub>GS</sub> = -4.5 V, V <sub>DD</sub> = -15 V, I <sub>D</sub> = -1.0 A, R <sub>G</sub> = 6.0 Ω		11	20	ns
Rise Time	t <sub>r</sub>			15	28	
Turn-Off Delay Time	t <sub>d(OFF)</sub>			28	56	
Fall Time	t <sub>f</sub>			22	50	

## DRAIN - SOURCE DIODE CHARACTERISTICS

Characteristic	Symbol	Test Condition	Min	Typ	Max	Unit
Forward Diode Voltage	V <sub>DS</sub>	V <sub>GS</sub> = 0 V, I <sub>S</sub> = -1.0 A	T <sub>J</sub> = 25°C	-0.76	-1.2	V
			T <sub>J</sub> = 125°C	-0.60		
Reverse Recovery Time	t <sub>RR</sub>	V <sub>GS</sub> = 0 V dI <sub>S</sub> /dt = 100 A/μs, I <sub>S</sub> = -1.0 A		17	40	ns
Charge Time	t <sub>a</sub>			9.0		
Discharge Time	t <sub>b</sub>			8.0		
Reverse Recovery Charge	Q <sub>RR</sub>			8.0		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.

3. Pulse Test: pulse width ≤ 300 μs, duty cycle ≤ 2%.

4. Switching characteristics are independent of operating junction temperatures.

# NTGS4111P, NVGS4111P

## TYPICAL PERFORMANCE CURVES ( $T_J = 25^\circ\text{C}$ unless otherwise noted)

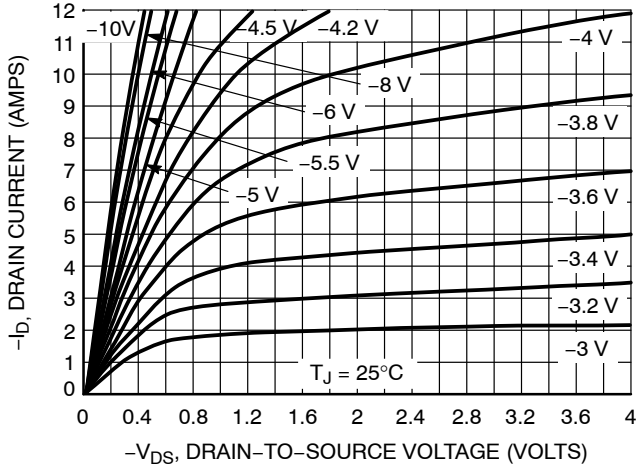


Figure 1. On-Region Characteristics

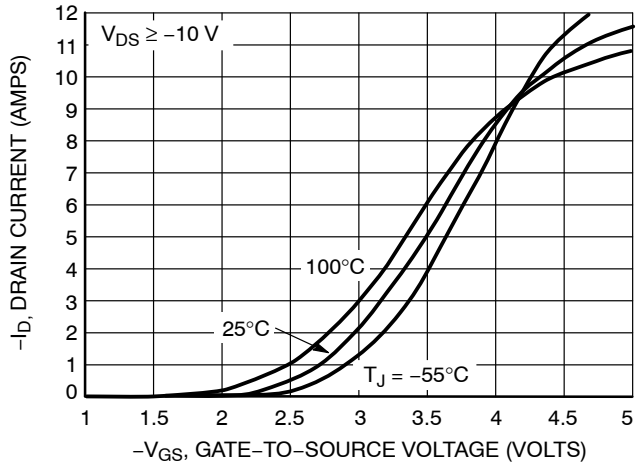


Figure 2. Transfer Characteristics

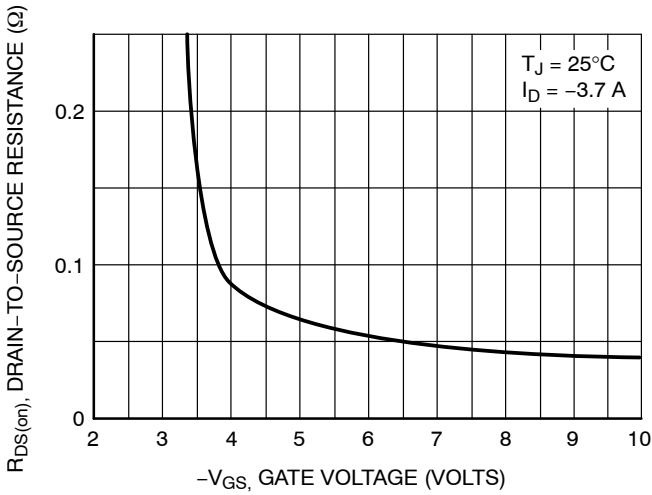


Figure 3. On-Resistance vs. Gate-to-Source Voltage

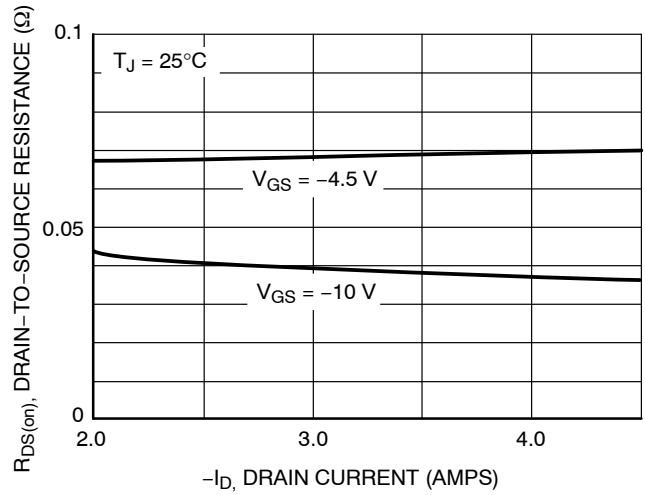


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

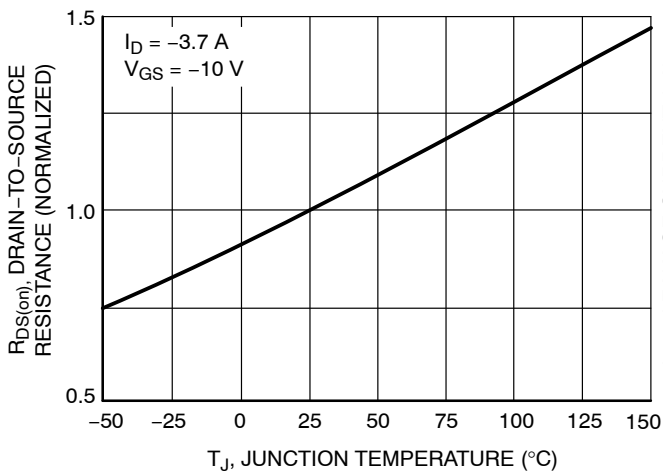


Figure 5. On-Resistance Variation with Temperature

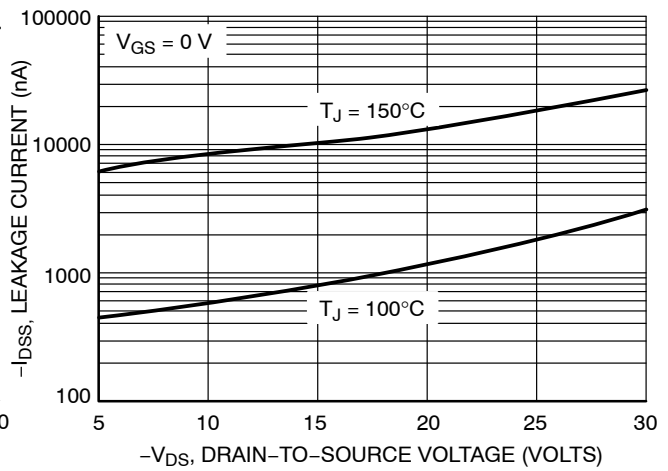


Figure 6. Drain-to-Source Leakage Current vs. Voltage

# NTGS4111P, NVGS4111P

## TYPICAL PERFORMANCE CURVES ( $T_J = 25^\circ\text{C}$ unless otherwise noted)

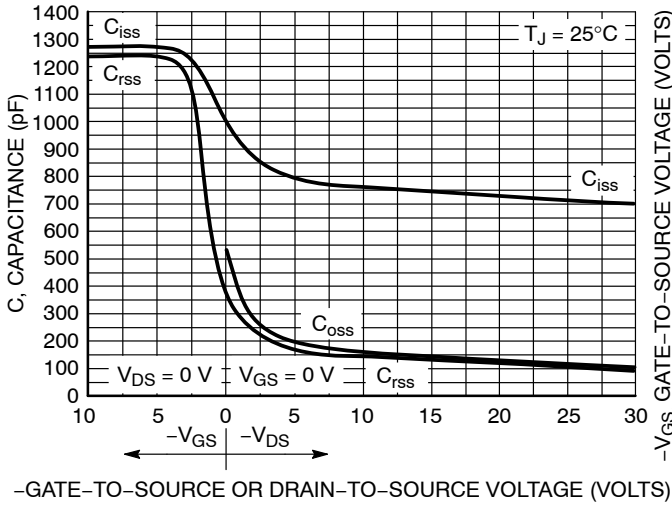


Figure 7. Capacitance Variation

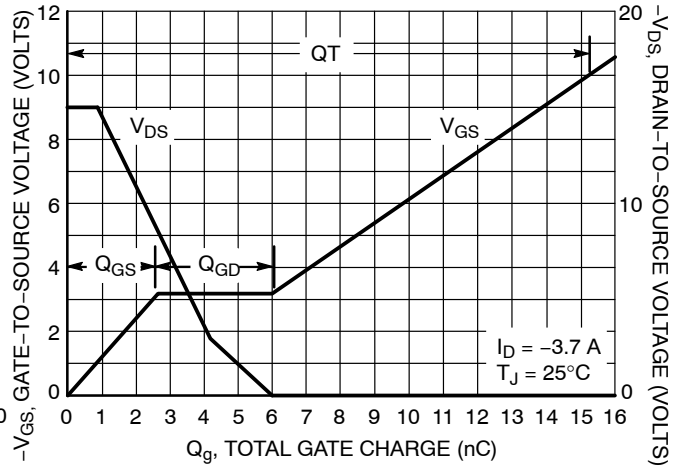


Figure 8. Gate-to-Source Voltage vs. Total Gate Charge

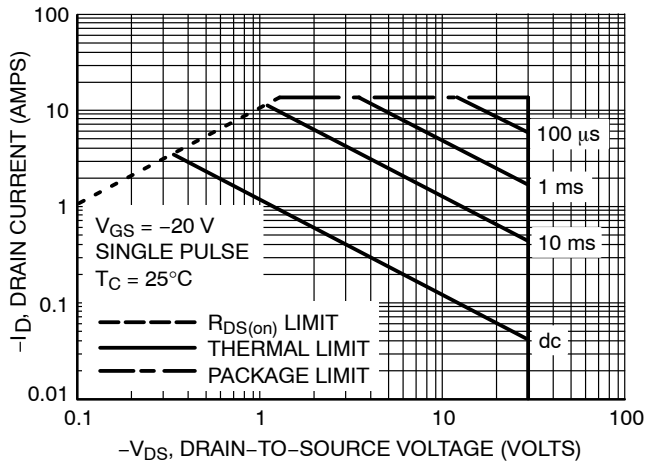


Figure 9. Maximum Rated Forward Biased Safe Operating Area

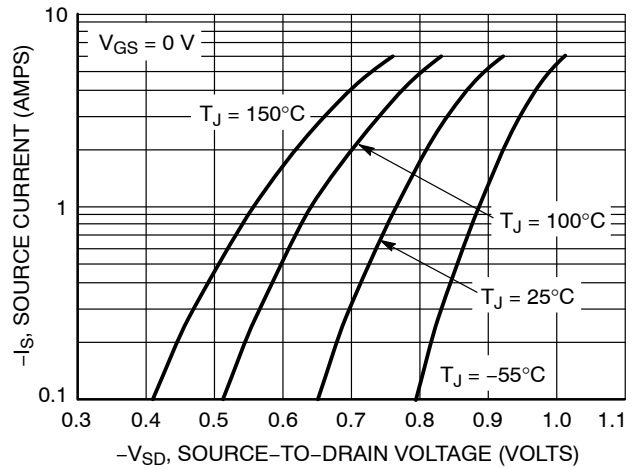


Figure 10. Diode Forward Voltage vs. Current

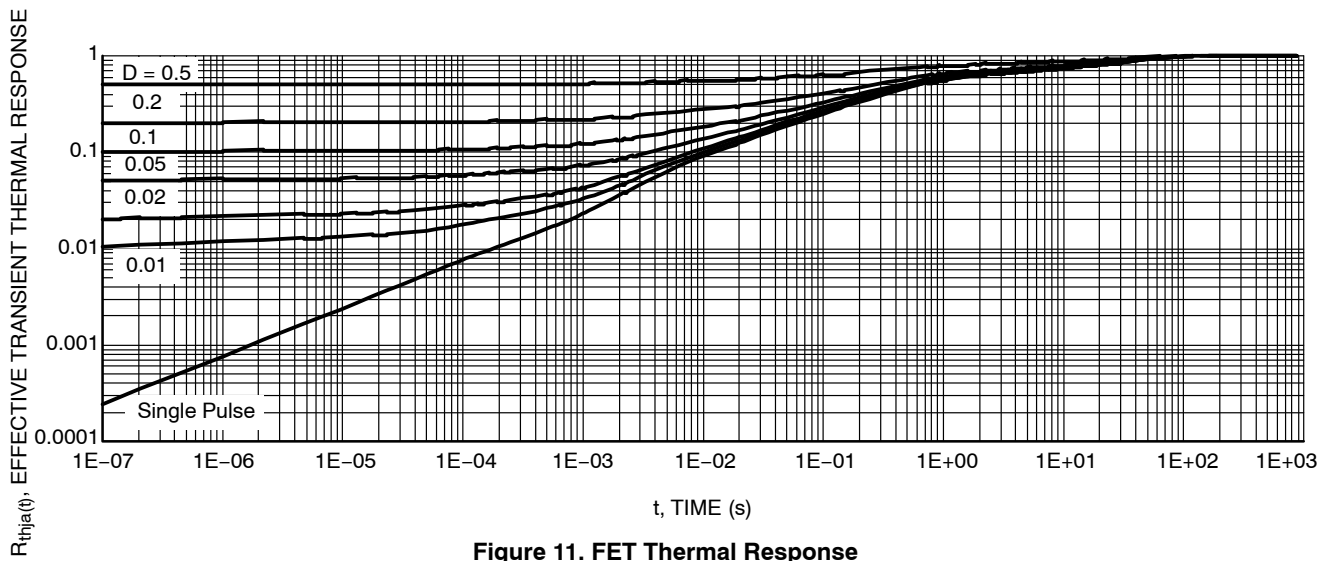


Figure 11. FET Thermal Response

# NTGS4111P, NVGS4111P

**Table 1. ORDERING INFORMATION**

<b>Part Number</b>	<b>Marking (XX)</b>	<b>Package</b>	<b>Shipping<sup>†</sup></b>
NTGS4111PT1	TG	SC-88	3000 / Tape & Reel
NTGS4111PT1G	TG	SC-88 (Pb-Free)	3000 / Tape & Reel
NVGS4111PT1G	VTG	SC-88 (Pb-Free)	3000 / Tape & Reel

<sup>†</sup>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



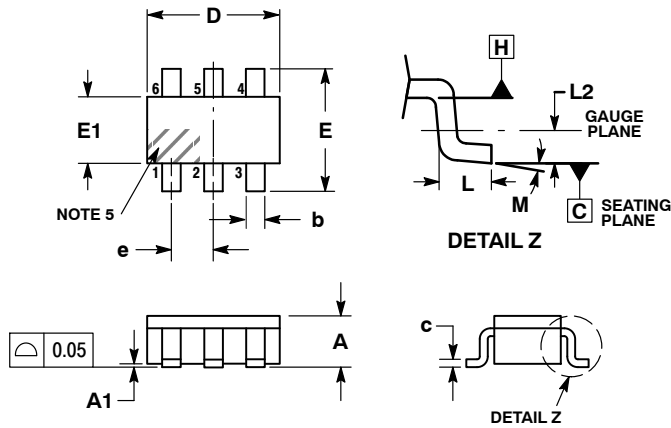
SCALE 2:1

### TSOP-6

#### CASE 318G-02

#### ISSUE V

DATE 12 JUN 2012



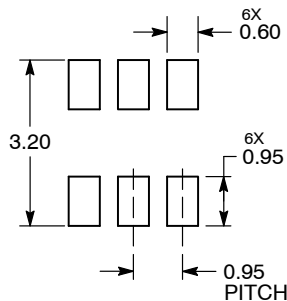
NOTES:

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.

DIM	MILLIMETERS		
	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°

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

### 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

STANDARD

- |  |   |
|--|---|
| <p>XXX = Specific Device Code</p> <p>A = Assembly Location</p> <p>Y = Year</p> <p>W = Work Week</p> <p>▪ = Pb-Free Package</p> | <p>XXX = Specific Device Code</p> <p>M = Date Code</p> <p>▪ = Pb-Free Package</p> |
|--|---|

\*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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