

# FDD6685

## 30 V P-Channel POWERTRENCH<sup>®</sup> MOSFET

### General Description

This P-Channel MOSFET is a rugged gate version of ON Semiconductor's advanced POWERTRENCH process. It has been optimized for power management applications requiring a wide range of gate drive voltage ratings (4.5 V – 2.5V).

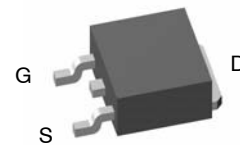
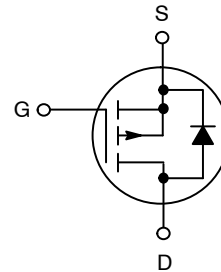
### Features

- -40 A, -30 V
  - ◆  $R_{DS(ON)} = 20\text{ m}\Omega @ V_{GS} = -10\text{ V}$
  - ◆  $R_{DS(ON)} = 30\text{ m}\Omega @ V_{GS} = -4.5\text{ V}$
- Fast Switching Speed
- High Performance Trench Technology for Extremely Low  $R_{DS(ON)}$
- High Power and Current Handling Capability
- Qualified to AEC Q101
- This Device is Pb-Free and are RoHS Compliant



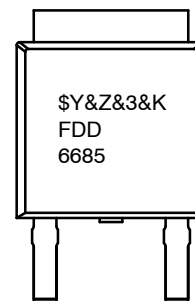
**ON Semiconductor<sup>®</sup>**

[www.onsemi.com](http://www.onsemi.com)



**DPAK3 (TO-252 3 LD)  
CASE 369AS**

### MARKING DIAGRAM



\$Y	= ON Semiconductor Logo
&Z	= Assembly Plant Code
&3	= Numeric Date Code
&K	= Lot Code
FDD6685	= Specific Device Code

### ORDERING INFORMATION

See detailed ordering and shipping information on page 2 of this data sheet.

# FDD6685

## ABSOLUTE MAXIMUM RATINGS (T<sub>A</sub> = 25°C, Unless otherwise noted)

Symbol	Parameter	Ratings	Units
V <sub>DSS</sub>	Drain–Source Voltage	–30	V
V <sub>GSS</sub>	Gate–Source Voltage	±25	V
I <sub>D</sub>	Continuous Drain Current	@T <sub>C</sub> = 25°C (Note 5)	–40
		@T <sub>A</sub> = 25°C (Note 3a)	–11
		Pulsed, PW ≤ 100 μs (Note 3b)	–100
P <sub>D</sub>	Power Dissipation for Single Operation	(Note 3)	52
		(Note 3a)	3.8
		(Note 3b)	1.6
T <sub>J</sub> , T <sub>STG</sub>	Operating and Storage Junction Temperature Range	–55 to +175	°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.

## THERMAL CHARACTERISTICS

Symbol	Parameter	Ratings	Unit
R <sub>θJC</sub>	Thermal Resistance, Junction–to–Case (Note 3)	2.9	°C/W
R <sub>θJA</sub>	Thermal Resistance, Junction–to–Ambient (Note 3a)	40	°C/W
R <sub>θJA</sub>	Thermal Resistance, Junction–to–Ambient (Note 3b)	96	°C/W

- This product has been designed to meet the extreme test conditions and environment demanded by the automotive industry. For a copy of the requirements, see AEC Q101 at <http://www.aecouncil.com/>
- All ON Semiconductor products are manufactured, assembled and tested under ISO9000 and QS9000 quality systems certification.

## PACKAGE MARKING AND ORDERING INFORMATION

Part Number	Device	Reel Size	Tape Width	Quantity
FDD6685	FDD6685	13"	16 mm	2500 Units

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

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
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### DRAIN–SOURCE AVALANCHE RATINGS (NOTE 4)

E <sub>AS</sub>	Single Pulse Drain–Source Avalanche Energy	I <sub>D</sub> = –11 A		42		mJ
I <sub>AS</sub>	Maximum Drain–Source Avalanche Current			–11		A

### OFF CHARACTERISTICS

BV <sub>DSS</sub>	Drain–Source Breakdown Voltage	V <sub>GS</sub> = 0 V, I <sub>D</sub> = –250 μA	–30			V
ΔBV <sub>DSS</sub> / ΔT <sub>J</sub>	Breakdown Voltage Temperature Coefficient	I <sub>D</sub> = –250 μA, Referenced to 25°C		–24		mV/°C
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	V <sub>DS</sub> = –24 V, V <sub>GS</sub> = 0 V			–1	μA
I <sub>GSS</sub>	Gate–Body Leakage	V <sub>GS</sub> = ±25V, V <sub>DS</sub> = 0 V			±100	nA

### ON CHARACTERISTICS

V <sub>GS(th)</sub>	Gate Threshold Voltage	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = –250 μA	–1	–1.8	–3	V
ΔV <sub>GS(th)</sub> / ΔT <sub>J</sub>	Gate Threshold Voltage Temperature Coefficient	I <sub>D</sub> = –250 μA, Referenced to 25°C		5		mV/°C
R <sub>DS(on)</sub>	Static Drain–Source On–Resistance	V <sub>GS</sub> = –10 V, I <sub>D</sub> = –11 A		14	20	mΩ
		V <sub>GS</sub> = –4.5 V, I <sub>D</sub> = –9 A		21	30	
		V <sub>GS</sub> = –10 V, I <sub>D</sub> = –11 A, T <sub>J</sub> = 125°C		20		

# FDD6685

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

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
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### ON CHARACTERISTICS

$I_{D(on)}$	On-State Drain Current	$V_{GS} = -10\text{ V}, V_{DS} = -5\text{ V}$	-20			A
$g_{FS}$	Forward Transconductance	$V_{DS} = -5\text{ V}, I_D = -11\text{ A}$		26		S

### DYNAMIC CHARACTERISTICS

$C_{iss}$	Input Capacitance	$V_{DS} = -15\text{ V}, V_{GS} = 0\text{ V}, f = 1.0\text{ MHz}$		1715		pF
$C_{oss}$	Output Capacitance			440		pF
$C_{rss}$	Reverse Transfer Capacitance			225		pF
$R_G$	Gate Resistance	$V_{GS} = 15\text{ mV}, f = 1.0\text{ MHz}$		3.6		$\Omega$

### SWITCHING CHARACTERISTICS

$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = -15\text{ V}, I_D = -11\text{ A}, V_{GS} = -10\text{ V}, R_{GEN} = 6\ \Omega$		17	31	ns
$t_r$	Turn-On Rise Time			11	21	ns
$t_{d(off)}$	Turn-Off Delay Time			43	68	ns
$t_f$	Turn-Off Fall Time			21	34	ns
$Q_g$	Total Gate Charge	$V_{DS} = -15\text{ V}, I_D = -11\text{ A}, V_{GS} = -5\text{ V}$		17	24	nC
$Q_{gs}$	Gate-Source Charge			9		nC
$Q_{gd}$	Gate-Drain Charge			4		nC

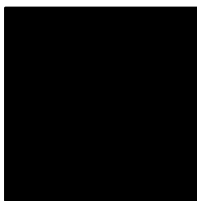
### DRAIN-SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS

$V_{SD}$	Drain-Source Diode Forward Voltage	$V_{GS} = 0\text{ V}, I_S = -3.2\text{ A}$ (Note 4)		-0.8	-1.2	V
$T_{rr}$	Diode Reverse Recovery Time	$I_F = -11\text{ A}, diF/dt = 100\text{ A}/\mu\text{s}$		26		ns
$Q_{rr}$	Diode Reverse Recovery Charge			13		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.

#### NOTES:

3.  $R_{\theta JA}$  is the sum of the junction-to-case and case-to-ambient thermal resistance where the case thermal reference is defined as the solder mounting surface of the drain pins.  $R_{\theta JC}$  is guaranteed by design while  $R_{\theta CA}$  is determined by the user's board design.



- a)  $R_{\theta JA} = 40^\circ\text{C}/\text{W}$  when mounted on  
■  $1\text{ in}^2$  pad of 2 oz copper



- b)  $R_{\theta JA} = 96^\circ\text{C}/\text{W}$  when mounted on  
■ a minimum pad

4. Pulse Test: Pulse Width < 300  $\mu\text{s}$ , Duty Cycle < 2.0%

5. Maximum current is calculated as:
- $$\sqrt{\frac{P_D}{R_{DS(on)}}}$$

where  $P_D$  is maximum power dissipation at  $T_C = 25^\circ\text{C}$  and  $R_{DS(on)}$  is at  $T_{J(max)}$  and  $V_{GS} = 10\text{ V}$ .

6. Starting  $T_J = 25^\circ\text{C}$ ,  $L = 0.69\text{ mH}$ ,  $I_{AS} = -11\text{ A}$

TYPICAL CHARACTERISTICS

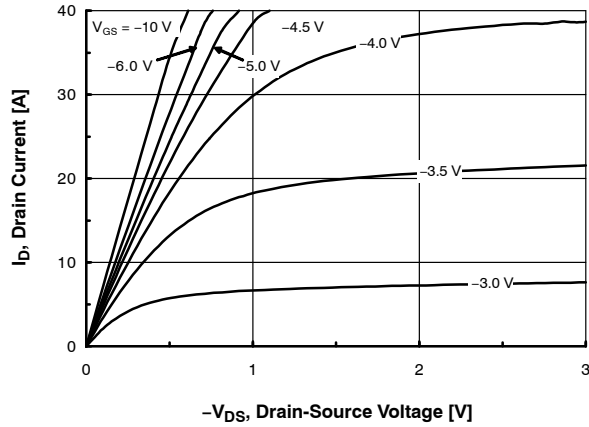


Figure 1. On-Region Characteristics

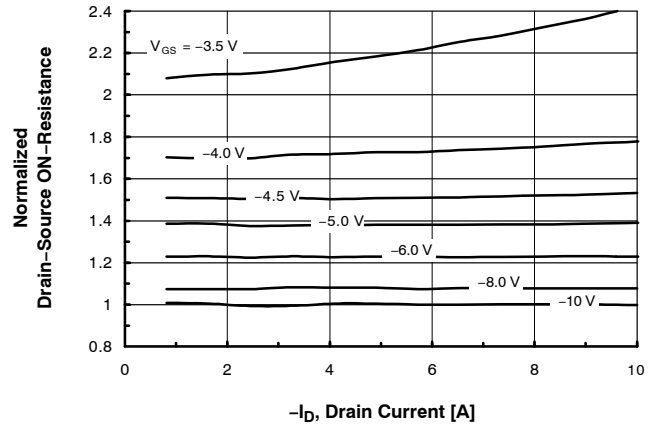


Figure 2. On-Resistance Variation with Drain Current and Gate Voltage

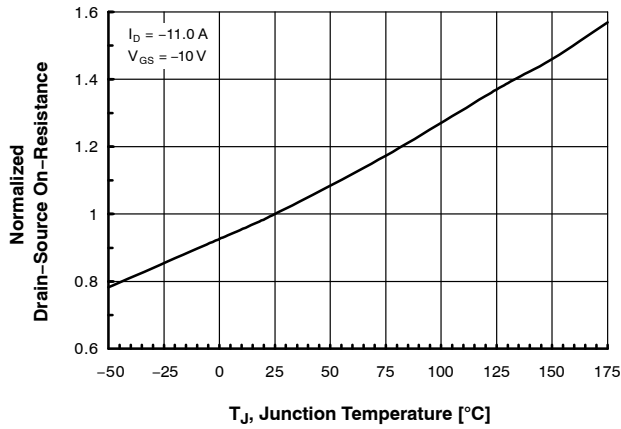


Figure 3. On-Resistance Variation with Temperature

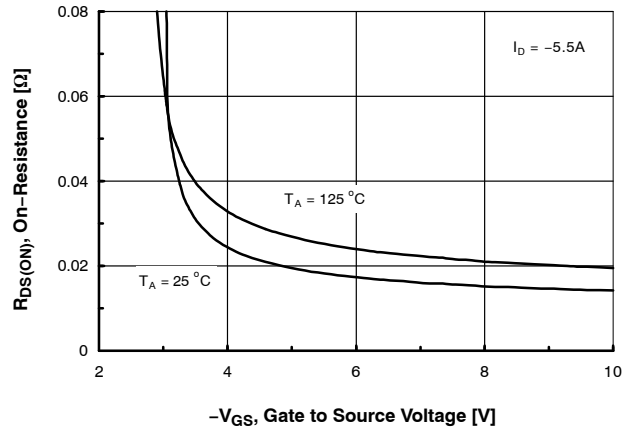


Figure 4. On-Resistance Variation with Gate-to-Source Voltage

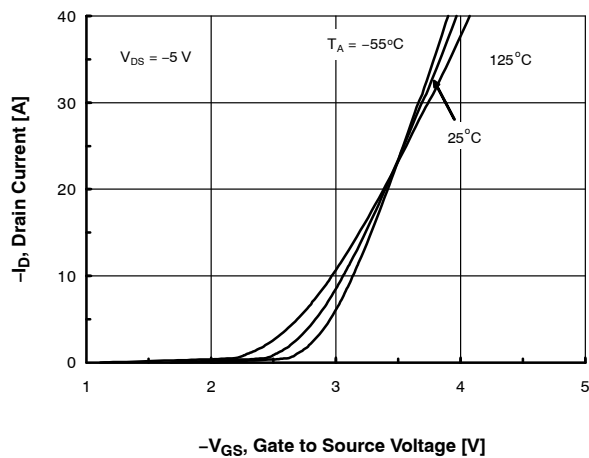


Figure 5. Transfer Characteristics

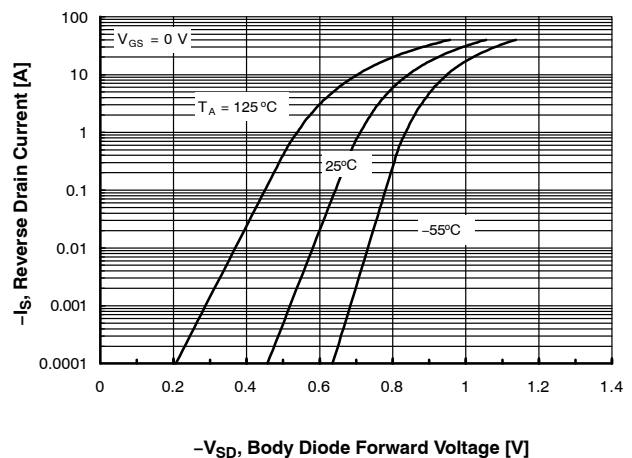


Figure 6. Body Diode Forward Voltage Variation with Source Current and Temperature

TYPICAL CHARACTERISTICS (continued)

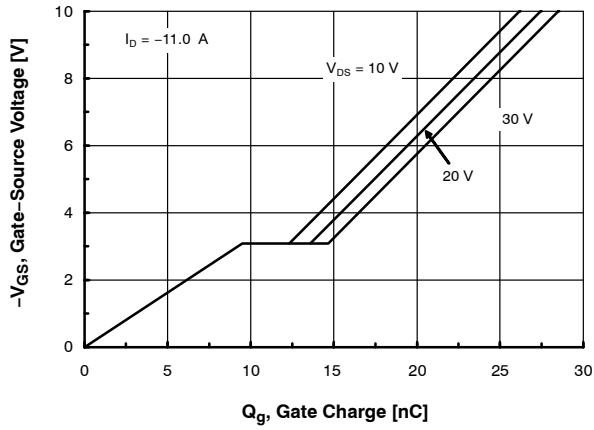


Figure 7. Gate Charge Characteristics

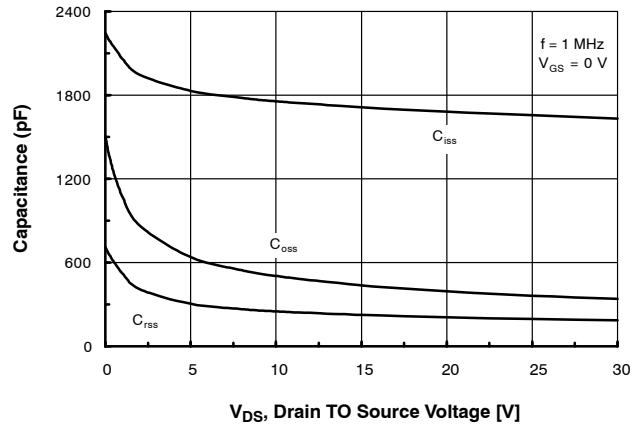


Figure 8. Capacitance Characteristics

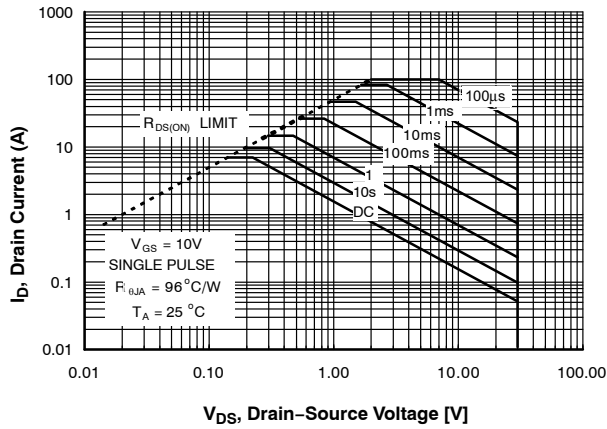


Figure 9. Maximum Safe Operating Area

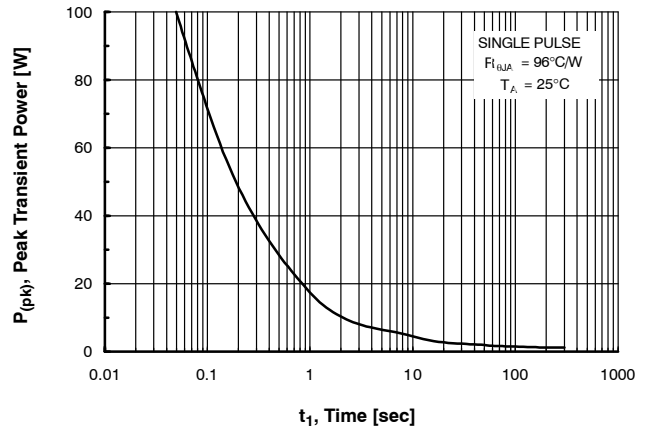


Figure 10. Single Pulse Minimum Power Dissipation

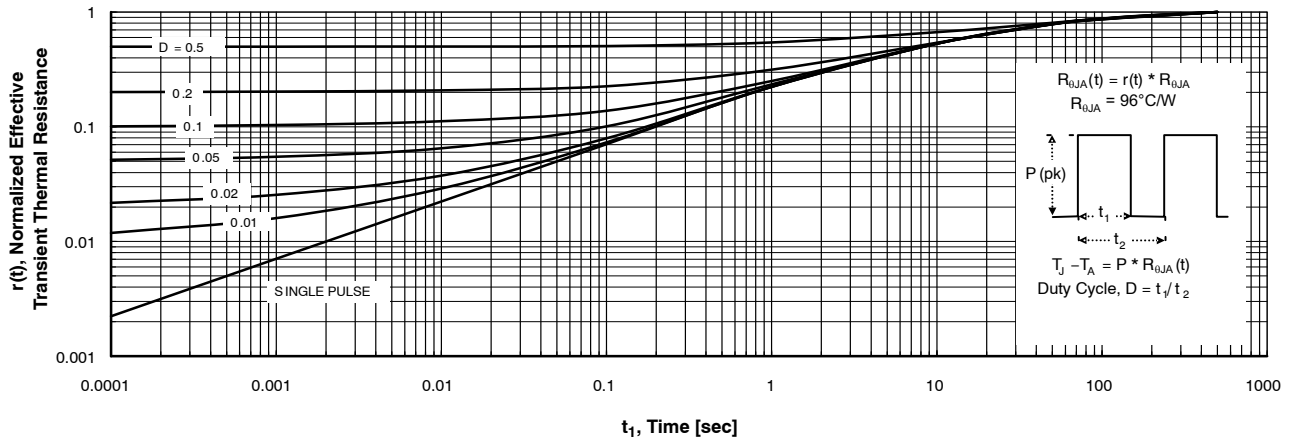


Figure 11. Transient Thermal Response Curve

NOTES:

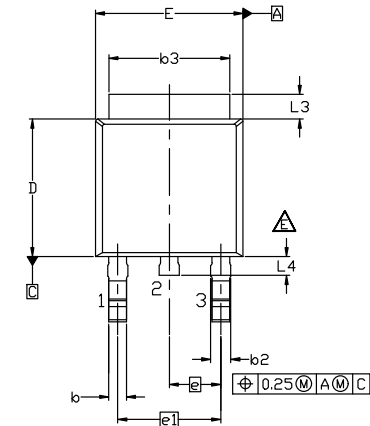
- 7. Thermal characterization performed using the conditions described in Note 3b.
- 8. Transient thermal response will change depending on the circuit board design.

# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS

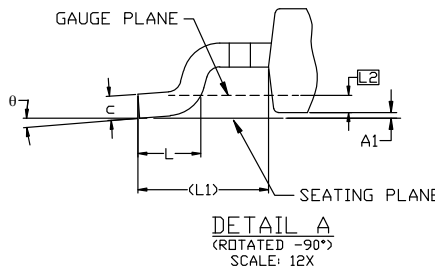
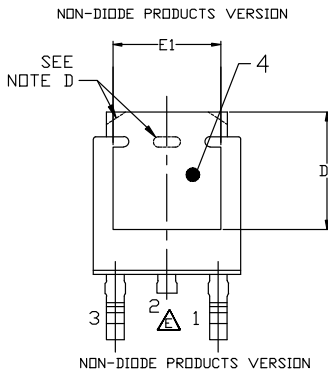


## DPAK3 6.10x6.54x2.29, 4.57P CASE 369AS ISSUE B

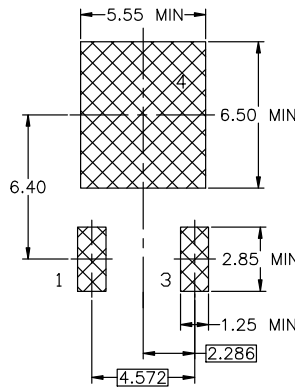
DATE 20 DEC 2023



- NOTES: UNLESS OTHERWISE SPECIFIED
- A) THIS PACKAGE CONFORMS TO JEDEC, TO-252, ISSUE F, VARIATION AA.
  - B) ALL DIMENSIONS ARE IN MILLIMETERS.
  - C) DIMENSIONING AND TOLERANCING PER ASME Y14.5M-2018.
  - D) SUPPLIER DEPENDENT MOLD LOCKING HOLES OR CHAMFERED CORNERS OR EDGE PROTRUSION.
  - E) FOR DIODE PRODUCTS, L4 IS 0.25 MM MAX PLASTIC BODY STUB WITHOUT CENTER LEAD.
  - F) DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR EXTRUSIONS.
  - G) LAND PATTERN RECOMMENDATION IS BASED ON IPC7351A STD TD228P991X239-3N.



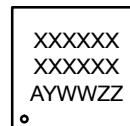
DIM	MILLIMETERS		
	MIN.	NOM.	MAX.
A	2.18	2.29	2.39
A1	0.00	-	0.127
b	0.64	0.77	0.89
b2	0.76	0.95	1.14
b3	5.21	5.34	5.46
c	0.45	0.53	0.61
c2	0.45	0.52	0.58
D	5.97	6.10	6.22
D1	5.21	---	---
E	6.35	6.54	6.73
E1	4.32	---	---
e	2.286 BSC		
e1	4.572 BSC		
H	9.40	9.91	10.41
L	1.40	1.59	1.78
L1	2.90 REF		
L2	0.51 BSC		
L3	0.89	1.08	1.27
L4	---	---	1.02
theta	0°	---	10°



### LAND PATTERN RECOMMENDATION

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

### GENERIC MARKING DIAGRAM\*



\*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.

XXXX = Specific Device Code  
 A = Assembly Location  
 Y = Year  
 WW = Work Week  
 ZZ = Assembly Lot Code

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