

# Field Effect Transistor - Dual, N-Channel, Enhancement Mode

## NDC7002N

### General Description

These dual N-Channel enhancement mode power field effect transistors are produced using onsemi's proprietary, high cell density, DMOS technology. This very high density process has been designed to minimize on-state resistance, provide rugged and reliable performance and fast switching. These devices is particularly suited for low voltage applications requiring a low current high side switch.

### Features

- 0.51 A, 50 V,  $R_{DS(ON)} = 2 \Omega @ V_{GS} = 10 \text{ V}$
- High Density Cell Design for Low  $R_{DS(ON)}$
- Proprietary SUPERSOT™ -6 Package Design Using Copper Lead Frame for Superior Thermal and Electrical Capabilities
- High Saturation Current
- This is a Pb-Free Device

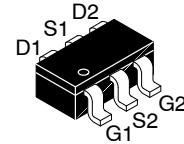
### ABSOLUTE MAXIMUM RATINGS ( $T_A = 25^\circ\text{C}$ unless otherwise noted)

Symbol	Parameter	Ratings	Unit
$V_{DS}$	Drain-Source Voltage	50	V
$V_{GSS}$	Gate-Source Voltage	20	V
$I_D$	Drain Current – Continuous (Note 1a) – Pulsed	0.51 1.5	A
$P_D$	Power Dissipation (Note 1a) (Note 1b) (Note 1c)	0.96 0.9 0.7	W
$T_J, T_{STG}$	Operating and Storage Temperature Range	-55 to +150	$^\circ\text{C}$

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.

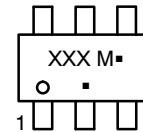
### THERMAL CHARACTERISTICS

Symbol	Parameter	Ratings	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case (Note 1)	60	$^\circ\text{C/W}$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient (Note 1a)	130	



TSOT23 6-Lead  
CASE 419BL

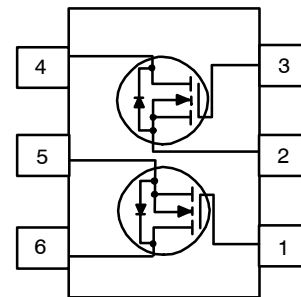
### MARKING DIAGRAM



XXX = Specific Device Code  
M = Date Code  
▪ = Pb-Free Package

(Note: Microdot may be in either location)

### PINOUT



SOT-6 (SUPERSOT™ -6)

### ORDERING INFORMATION

Device	Package	Shipping†
NDC7002N	TSOT-23-6 (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 Specification Brochure, BRD8011/D.

# NDC7002N

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

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

BV <sub>DSS</sub>	Drain-Source Breakdown Voltage	I <sub>D</sub> = 250 μA, V <sub>GS</sub> = 0 V	50			V
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	V <sub>DS</sub> = 40 V, V <sub>GS</sub> = 0 V T <sub>J</sub> = 125°C			1 500	μA
I <sub>GSSF</sub>	Gate-Body Leakage, Forward	V <sub>GS</sub> = 20 V, V <sub>DS</sub> = 0 V			100	nA
I <sub>GSSR</sub>	Gate-Body Leakage, Reverse	V <sub>GS</sub> = -20 V, V <sub>DS</sub> = 0 V			-100	nA

### ON CHARACTERISTICS (Note 2)

V <sub>GS(th)</sub>	Gate Threshold Voltage	V <sub>GS</sub> = V <sub>DS</sub> , I <sub>D</sub> = 250 μA T <sub>J</sub> = 125°C	1 0.8	1.9 1.5	2.5 2.2	V
R <sub>DS(on)</sub>	Static Drain-Source On-Resistance	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 0.51 A T <sub>J</sub> = 125°C		1 1.7	2 3.5	Ω
		V <sub>GS</sub> = 4.5 V, I <sub>D</sub> = 0.35 A		1.6	4	
I <sub>D(on)</sub>	On-State Drain Current	V <sub>GS</sub> = 10 V, V <sub>DS</sub> = 10 V	1.5			A
g <sub>FS</sub>	Forward Transconductance	V <sub>DS</sub> = 10 V, I <sub>D</sub> = 0.51 A		400		mS

### DYNAMIC CHARACTERISTICS

C <sub>iss</sub>	Input Capacitance	V <sub>DS</sub> = 25 V, V <sub>GS</sub> = 0 V, f = 1.0 MHz		20		pF
C <sub>oss</sub>	Output Capacitance			13		pF
C <sub>rss</sub>	Reverse Transfer Capacitance			5		pF

### SWITCHING CHARACTERISTICS (Note 2)

t <sub>d(on)</sub>	Turn-On Delay Time	V <sub>DD</sub> = 25 V, I <sub>D</sub> = 0.25 A, V <sub>GS</sub> = 10 V, R <sub>GEN</sub> = 25 Ω		6	20	ns
t <sub>r</sub>	Turn-On Time			6	20	
t <sub>d(off)</sub>	Turn-Off Delay Time			11	20	
t <sub>f</sub>	Turn-Off Fall Time			5	20	
Q <sub>g</sub>	Total Gate Charge	V <sub>DS</sub> = 25 V, I <sub>D</sub> = 0.51 A, V <sub>GS</sub> = 10 V		1		nC
Q <sub>gs</sub>	Gate-Source Charge			0.19		nC
Q <sub>gd</sub>	Gate to Drain Charge			0.33		nC

### DRAIN-SOURCE DIODE CHARACTERISTICS

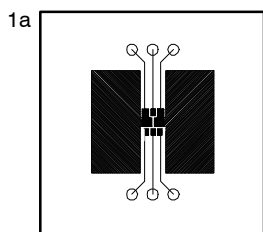
I <sub>S</sub>	Maximum Continuous Source Current				0.51	A
I <sub>SM</sub>	Maximum Pulse Source Current (Note 2)				1.5	A
V <sub>SD</sub>	Drain–Source Diode Forward Voltage	V <sub>GS</sub> = 0 V, I <sub>S</sub> = 0.51 A (Note 2)		0.8	1.2	V

1. R<sub>θJA</sub> 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<sub>θJC</sub> is guaranteed by design while R<sub>θCA</sub> is determined by the user's board design.

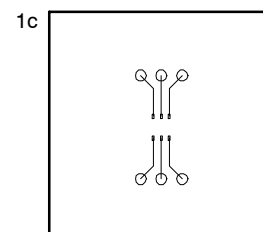
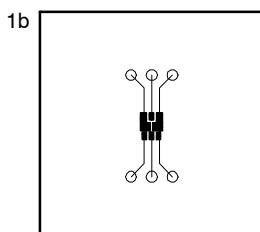
$$P_D(t) = \frac{T_J - T_A}{R_{\theta JA}(t)} = \frac{T_J - T_A}{R_{\theta JC} + R_{\theta CA}(t)} = I_D^2(t) \times R_{DS(on)}@T_J$$

Typical R<sub>θJA</sub> for single device operation using the board layouts shown below on 4.5" x 5" FR-4 PCB in a still air environment:

- 130°C/W when mounted on a 0.125 in<sup>2</sup> pad of 2oz copper.
- 140°C/W when mounted on a 0.005 in<sup>2</sup> pad of 2oz copper.
- 180°C/W when mounted on a 0.0015 in<sup>2</sup> pad of 2oz copper.



Scale 1:1 on letter size paper



2. Pulse Test: Pulse Width ≤ 300 μs, Duty cycle ≤ 2.0 %.

# TYPICAL ELECTRICAL CHARACTERISTICS

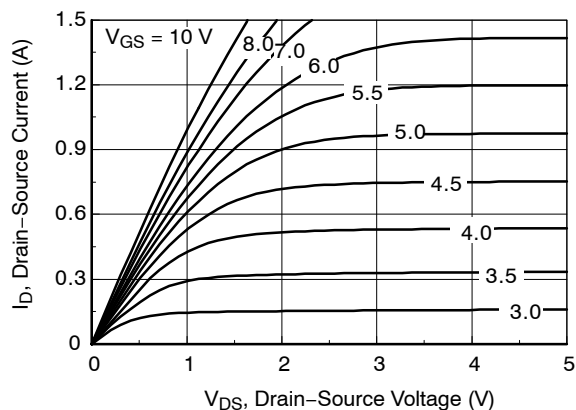


Figure 1. On-Region Characteristics

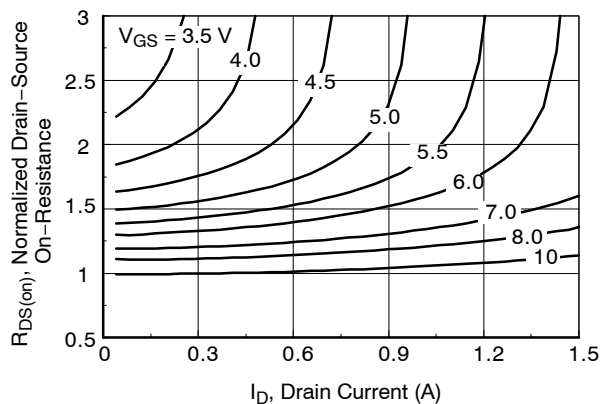


Figure 2. On-Resistance Variation with Gate Voltage and Current

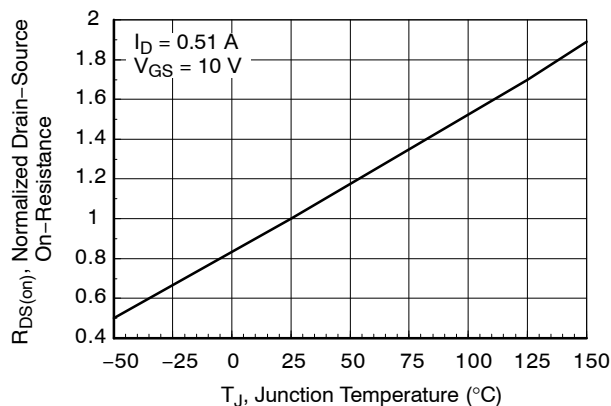


Figure 3. On-Resistance Variation with Temperature

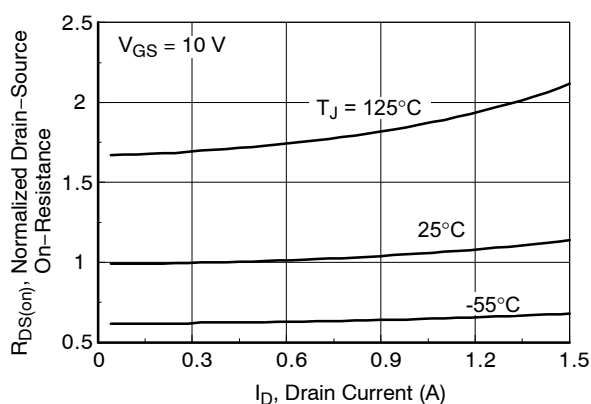


Figure 4. On-Resistance vs Variation with Drain Current and Temperature

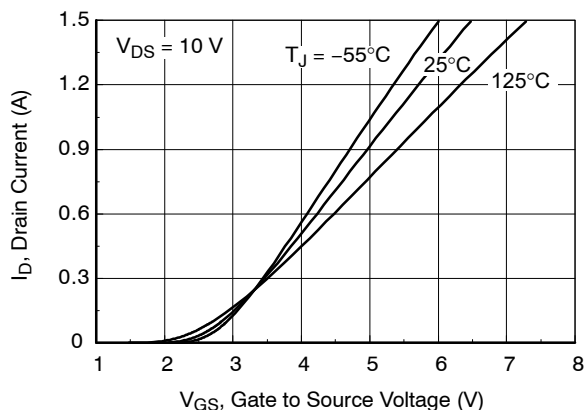


Figure 5. Transfer Characteristics

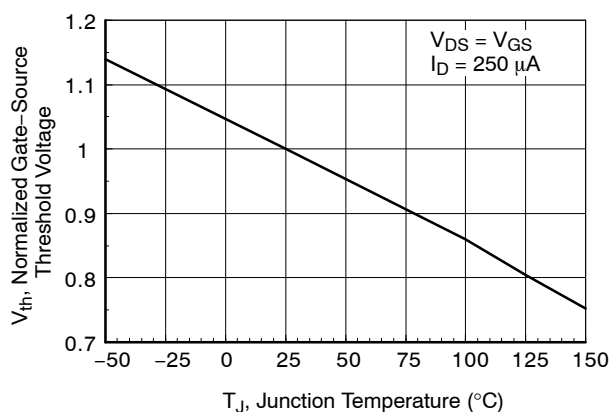


Figure 6. Gate Threshold Variation with Temperature

TYPICAL ELECTRICAL CHARACTERISTICS (continued)

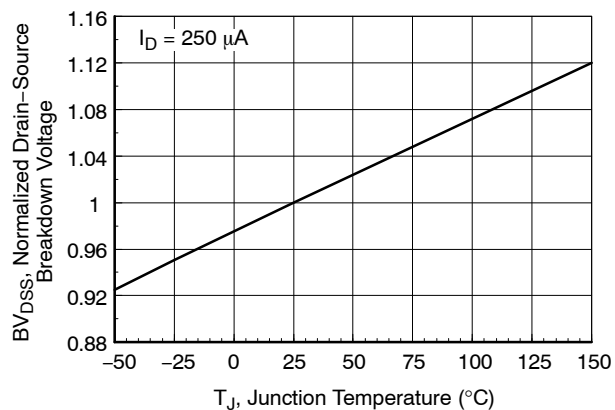


Figure 7. Breakdown Voltage Variation with Temperature

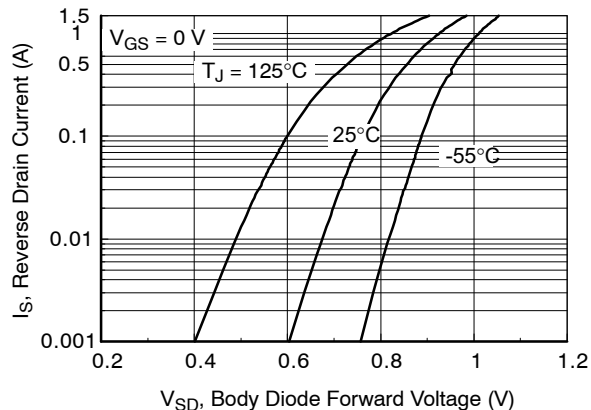


Figure 8. Body Diode Forward Voltage Variation with Current and Temperature

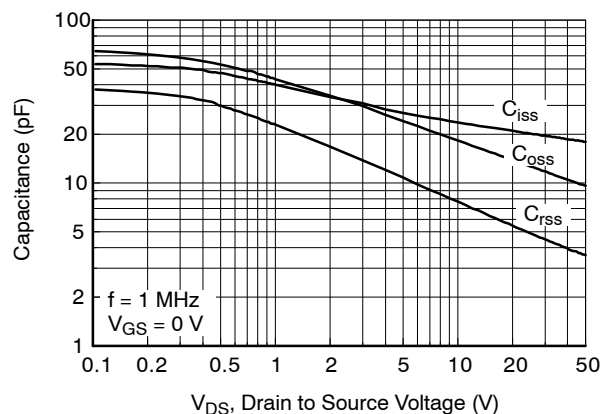


Figure 9. Capacitance Characteristics

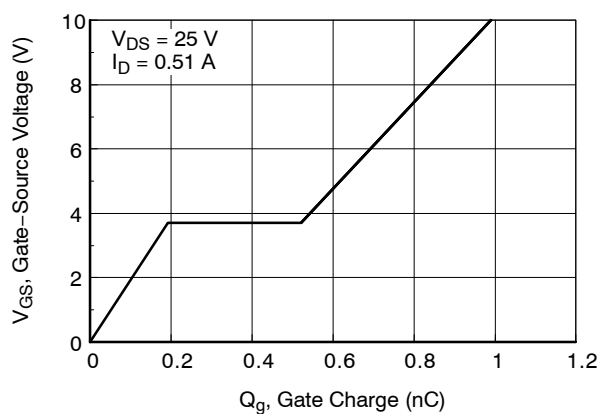


Figure 10. Gate Charge Characteristics

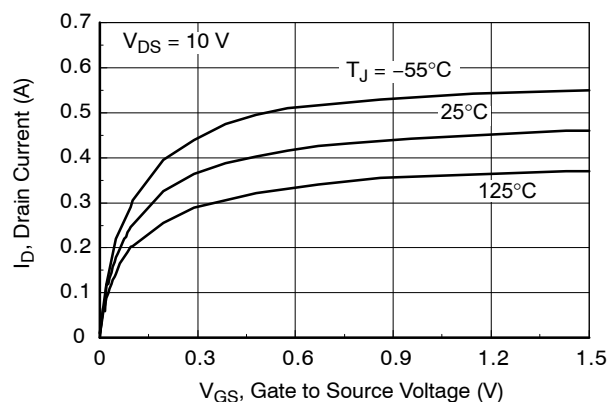
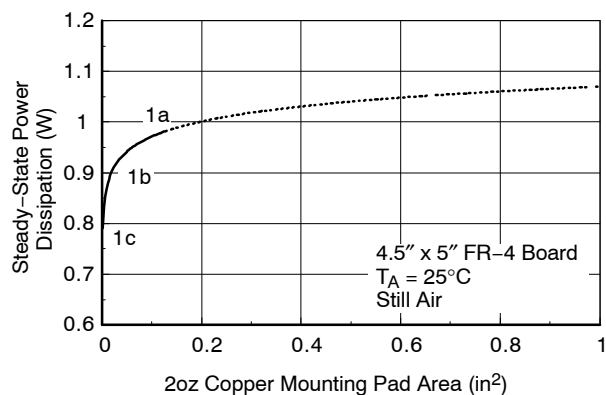
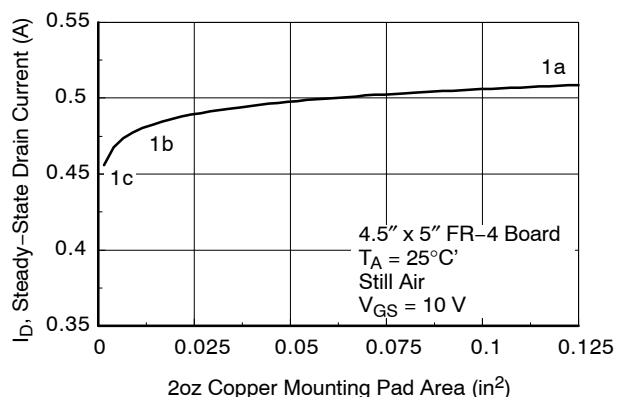


Figure 11. Transconductance Variation with Drain Current and Temperature

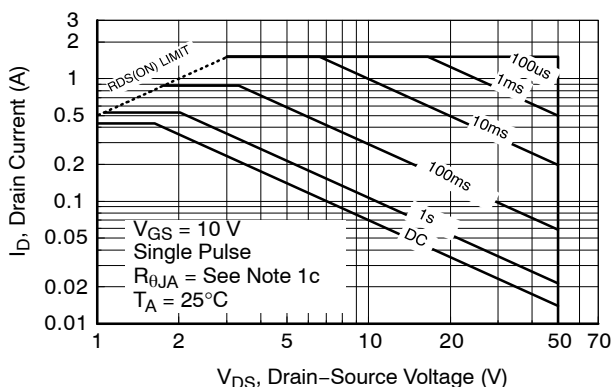
## TYPICAL THERMAL CHARACTERISTICS



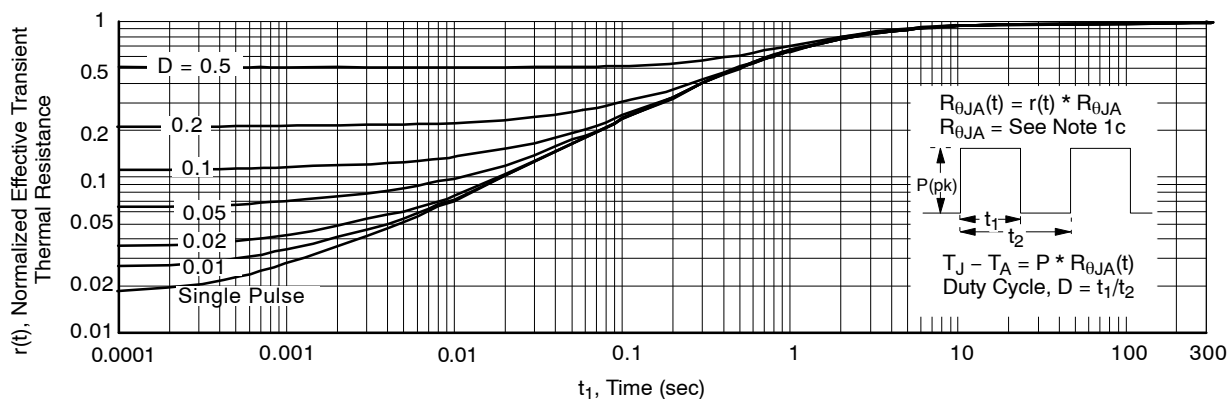
**Figure 12. SOT-6 Dual Package Maximum Steady-State Power Dissipation versus Copper Mounting Pad Area**



**Figure 13. Maximum Steady-State Drain Current versus Copper Mounting Pad Area**



**Figure 14. Maximum Safe Operating Area**



**Figure 15. Transient Thermal Response Curve**

(Note: Thermal characterization performed using the conditions described in note 1c. Transient thermal response will change depending on the circuit board design.)

# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

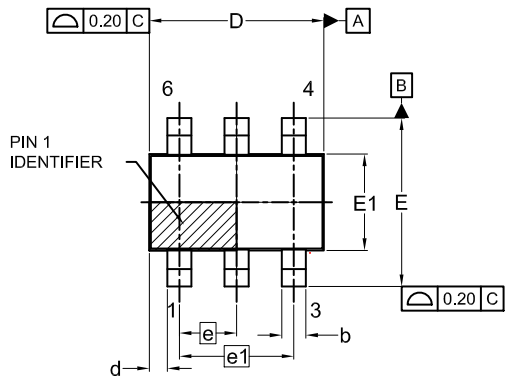
ON Semiconductor®



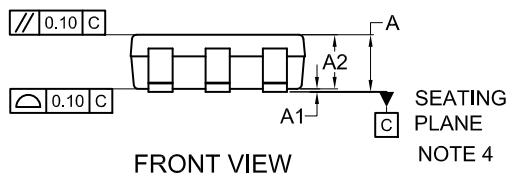
SCALE 2:1

### TSOT23 6-Lead CASE 419BL ISSUE A

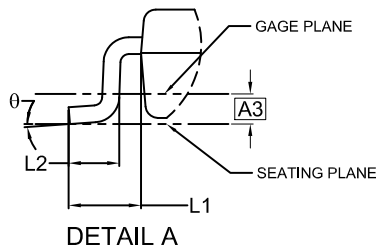
DATE 31 AUG 2020



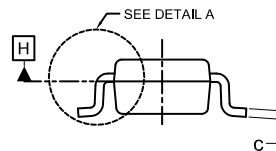
TOP VIEW



FRONT VIEW

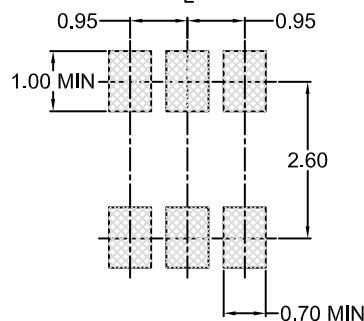


DETAIL A



SIDE VIEW

SYMM



### LAND PATTERN RECOMMENDATION

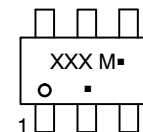
\*FOR ADDITIONAL INFORMATION ON OUR  
Pb-FREE STRATEGY AND SOLDERING DETAILS,  
PLEASE DOWNLOAD THE ON SEMICONDUCTOR  
SOLDERING AND MOUNTING TECHNIQUES  
REFERENCE MANUAL, SOLDERRM/D.

### NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
2. CONTROLLING DIMENSION: MILLIMETERS
3. DIMENSIONS D AND E1 DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS. MOLD FLASH, PROTRUSIONS OR GATE BURRS SHALL NOT EXCEED 0.25MM PER END. DIMENSIONS D AND E1 ARE DETERMINED AT DATUM H.
4. SEATING PLANE IS DEFINED BY THE TERMINALS. "A1" IS DEFINED AS THE DISTANCE FROM THE SEATING PLANE TO THE LOWEST POINT ON THE PACKAGE BODY.

DIM	MILLIMETERS		
	MIN.	NOM.	MAX.
A	0.90	1.00	1.10
A1	0.00	0.05	0.10
A2	0.70	0.85	1.00
A3	0.25 BSC		
b	0.25	0.38	0.50
c	0.10	0.18	0.26
D	2.80	2.95	3.10
d	0.30 REF		
E	2.50	2.75	3.00
E1	1.30	1.50	1.70
e	0.95 BSC		
e1	1.90 BSC		
L1	0.60 REF		
L2	0.20	0.40	0.60
Θ	0°	—	10°

### GENERIC MARKING DIAGRAM\*



XXX = Specific Device Code

M = Date Code

▪ = Pb-Free Package

(Note: Microdot may be in either location)

\*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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