

# MMFT2N25E



## Product Preview

# High Energy Power FET N-Channel Enhancement-Mode Silicon Gate

ON Semiconductor®

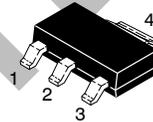
<http://onsemi.com>

**POWER FET**  
**2.0 AMPERES, 250 VOLTS**

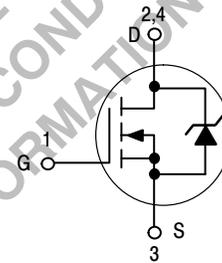
$R_{DS(on)} = 3.5 \Omega$

This advanced high voltage MOSFET is designed to withstand high energy in the avalanche mode and switch efficiently. This new high energy device also offers a drain-to-source diode with fast recovery time. Designed for high voltage, high speed switching applications such as power supplies, PWM motor controls and other inductive loads, the avalanche energy capability is specified to eliminate the guesswork in designs where inductive loads are switched and offer additional safety margin against unexpected voltage transients.

- Avalanche Energy Capability Specified at Elevated Temperature
- Internal Source-to-Drain Diode Designed to Replace External Zener Transient Suppressor – Absorbs High Energy in the Avalanche Mode
- Source-to-Drain Diode Recovery Time Comparable to Discrete Fast Recovery Diode



CASE 318E-04, STYLE 3  
TO-261AA



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

Rating	Symbol	Value	Unit
Drain-to-Source Voltage	$V_{DSS}$	250	Vdc
Drain-to-Gate Voltage, $R_{GS} = 1.0 \text{ m}\Omega$	$V_{DGR}$	250	Vdc
Gate-to-Source Voltage — Continuous	$V_{GS}$	$\pm 20$	Vdc
Gate-to-Source Voltage — Single Pulse ( $t_p \leq 50 \mu\text{s}$ )	$V_{GSM}$	$\pm 40$	Vdc
Drain Current — Continuous @ $T_C = 25^\circ\text{C}$	$I_D$	2.0	Adc
— Continuous @ $T_C = 100^\circ\text{C}$	$I_D$	0.6	
— Single Pulse ( $t_p \leq 10 \mu\text{s}$ )	$I_{DM}$	7.0	Apk
Total Power Dissipation @ $T_C = 25^\circ\text{C}$	$P_D$	0.77	Watts
Derate above $25^\circ\text{C}$		6.2	mW/ $^\circ\text{C}$
Total $P_D$ @ $T_A = 25^\circ\text{C}$ mounted on 1" Sq. Drain Pad on FR-4 Bd. Material		1.0	Watts
Total $P_D$ @ $T_A = 25^\circ\text{C}$ mounted on 0.7" Sq. Drain Pad on FR-4 Bd. Material		1.2	
Total $P_D$ @ $T_A = 25^\circ\text{C}$ mounted on min. Drain Pad on FR-4 Bd. Material		0.8	
Operating and Storage Temperature Range	$T_J, T_{stg}$	-55 to 150	$^\circ\text{C}$

### UNCLAMPED DRAIN-TO-SOURCE AVALANCHE CHARACTERISTICS ( $T_J < 150^\circ\text{C}$ )

Single Pulse Drain-to-Source Avalanche Energy — Starting $T_J = 25^\circ\text{C}$ ( $V_{DD} = 80 \text{ V}$ , $V_{GS} = 10 \text{ V}$ , Peak $I_L = 4.0 \text{ Apk}$ , $L = 3.0 \text{ mH}$ , $R_G = 25 \Omega$ )	$E_{AS}$	26	mJ
--	----------	----	----

### THERMAL CHARACTERISTICS

— Junction-to-Ambient on 1" Sq. Drain Pad on FR-4 Bd. Material	$R_{\theta JA}$	90	$^\circ\text{C}/\text{W}$
— Junction-to-Ambient on 0.7" Sq. Drain Pad on FR-4 Bd. Material		103	
— Junction-to-Ambient on min. Drain Pad on FR-4 Bd. Material		162	
Maximum Lead Temperature for Soldering Purposes, 1/8" from case for 10 seconds	$T_L$	260	$^\circ\text{C}$

This document contains information on a product under development. ON Semiconductor reserves the right to change or discontinue this product without notice.

# MMFT2N25E

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

Characteristic	Symbol	Min	Typ	Max	Unit
----------------	--------	-----	-----	-----	------

### OFF CHARACTERISTICS

Drain-to-Source Breakdown Voltage (V <sub>GS</sub> = 0, I <sub>D</sub> = 0.25 mA) Temperature Coefficient (Positive)	BV <sub>DSS</sub>	250 —	— 324	— —	Vdc V/°C
Zero Gate Voltage Drain Current (V <sub>DS</sub> = 250 V, V <sub>GS</sub> = 0) (V <sub>DS</sub> = 250 V, V <sub>GS</sub> = 0, T <sub>J</sub> = 125°C)	I <sub>DSS</sub>	— —	— —	10 100	μAdc
Gate-Body Leakage Current (V <sub>GS</sub> = ±20 V, V <sub>DS</sub> = 0)	I <sub>GSS</sub>	—	—	100	nAdc

### ON CHARACTERISTICS (1)

Gate Threshold Voltage (V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 0.25 mA) Threshold Temperature Coefficient (Negative)	V <sub>GS(th)</sub>	2.0 —	2.8 5.7	4.0 —	Vdc mV/°C
Static Drain-to-Source On-Resistance (V <sub>GS</sub> = 10 V, I <sub>D</sub> = 1.0 Adc)	R <sub>DS(on)</sub>	—	2.1	3.5	Ohms
Drain-to-Source On-Voltage (V <sub>GS</sub> = 10 V, I <sub>D</sub> = 2.0 A) (V <sub>GS</sub> = 10 V, I <sub>D</sub> = 1.0 A, T <sub>J</sub> = 125°C)	V <sub>DS(on)</sub>	— —	— —	8.40 7.35	Vdc
Forward Transconductance (V <sub>DS</sub> = 8.0 V, I <sub>D</sub> = 2.0 Adc)	g <sub>FS</sub>	0.44	1.2	—	mhos

### DYNAMIC CHARACTERISTICS

Input Capacitance	(V <sub>DS</sub> = 25 V, V <sub>GS</sub> = 0, f = 1.0 MHz)	C <sub>iSS</sub>	—	137	190	pF
Output Capacitance		C <sub>oSS</sub>	—	30	40	
Transfer Capacitance		C <sub>rSS</sub>	—	7.0	10	

### SWITCHING CHARACTERISTICS (1)

Turn-On Delay Time	(V <sub>DS</sub> = 125 V, I <sub>D</sub> = 2.0 A, R <sub>G</sub> = 9.1 Ohms, V <sub>GS</sub> = 10 V)	t <sub>d(on)</sub>	—	9.2	20	ns
Rise Time		t <sub>r</sub>	—	6.6	10	
Turn-Off Delay Time		t <sub>d(off)</sub>	—	13	30	
Fall Time		t <sub>f</sub>	—	8.5	20	
Gate Charge	(V <sub>DS</sub> = 200 V, I <sub>D</sub> = 2.0 A, V <sub>GS</sub> = 10 V)	Q <sub>T</sub>	—	4.7	10	nC
		Q <sub>1</sub>	—	1.3	—	
		Q <sub>2</sub>	—	3.2	—	
		Q <sub>3</sub>	—	2.3	—	

### SOURCE-DRAIN DIODE CHARACTERISTICS

Forward On-Voltage	I <sub>S</sub> = 2.0 A, V <sub>GS</sub> = 0 V	V <sub>SD</sub>	—	0.94	2.0	Vdc
	I <sub>S</sub> = 2.0 A, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 125°C	V <sub>SD</sub>	—	0.83	—	
Reverse Recovery Time	(I <sub>S</sub> = 2.0 A, di <sub>S</sub> /dt = 100 A/μs)	t <sub>rr</sub>	—	104	—	nS
		t <sub>a</sub>	—	63	—	
		t <sub>b</sub>	—	41	—	
Reverse Recovery Stored Charge		q <sub>rr</sub>	—	0.365	—	

(1) Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2%.

# MMFT2N25E

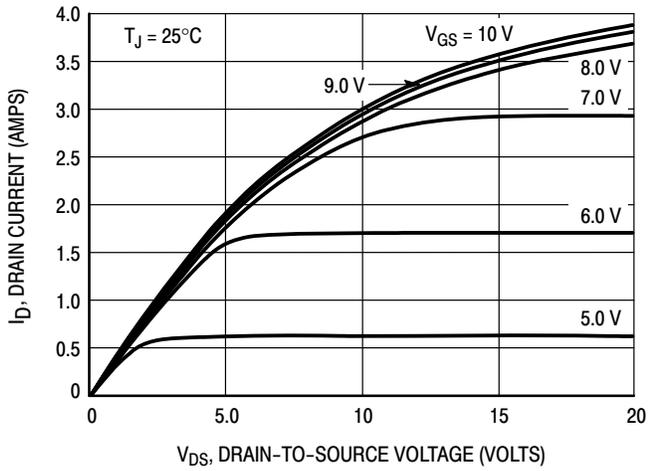


Figure 1. On-Region Characteristics

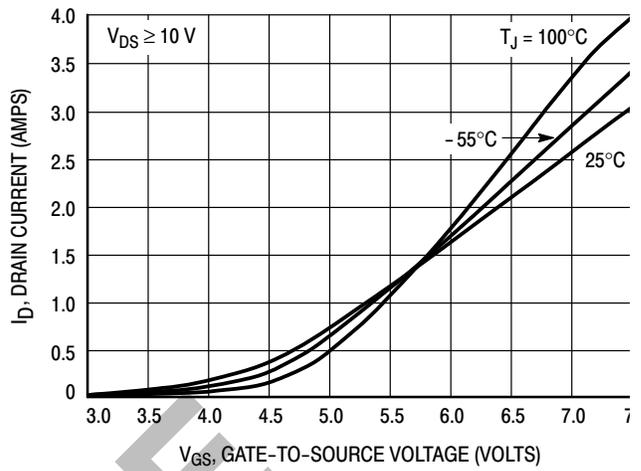


Figure 2. Transfer Characteristics

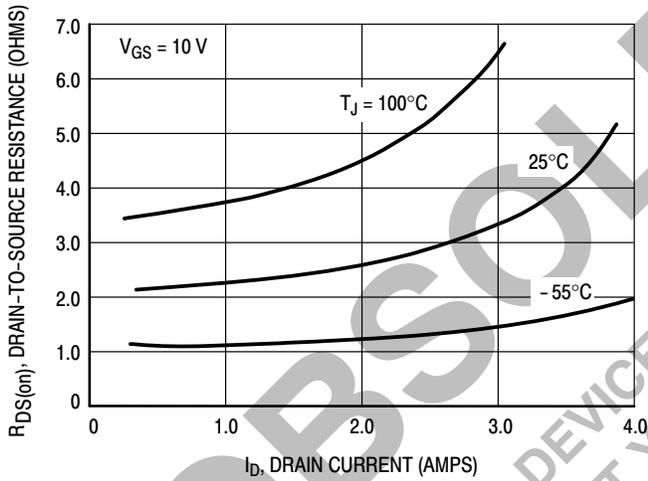


Figure 3. On-Resistance versus Drain Current and Temperature

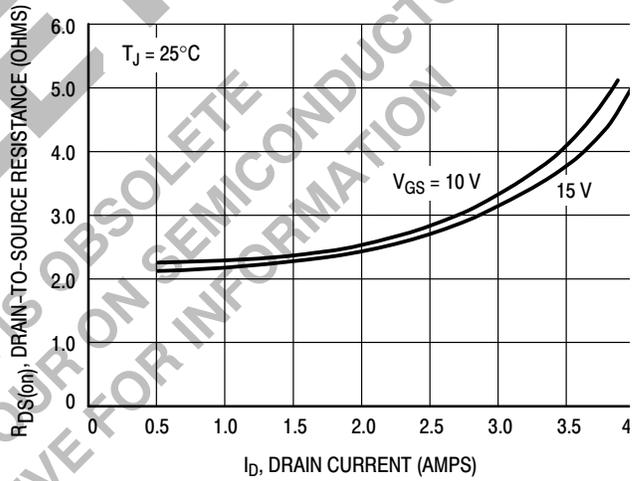


Figure 4. On-Resistance versus Drain Current and Gate Voltage

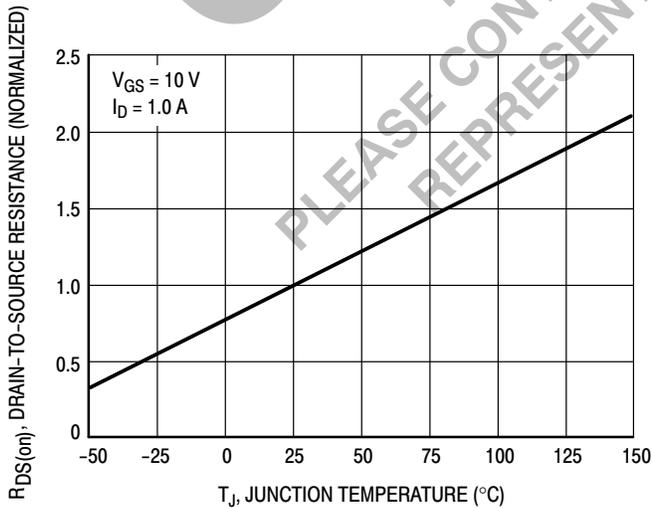


Figure 5. On-Resistance Variation versus Temperature

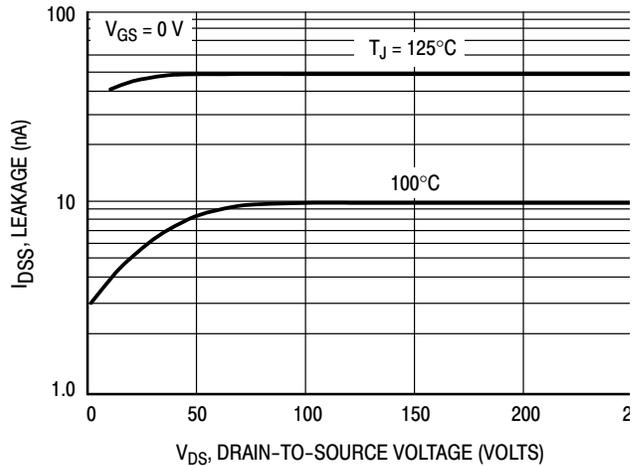


Figure 6. Drain-to-Source Leakage Current versus Voltage

# MMFT2N25E

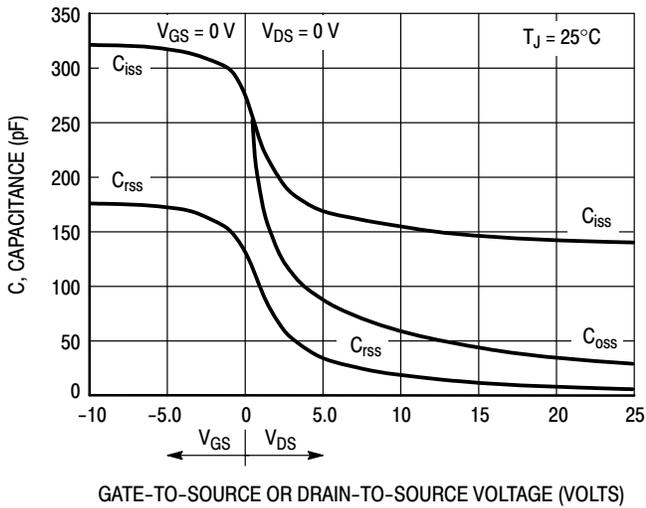


Figure 7. Capacitance Variation

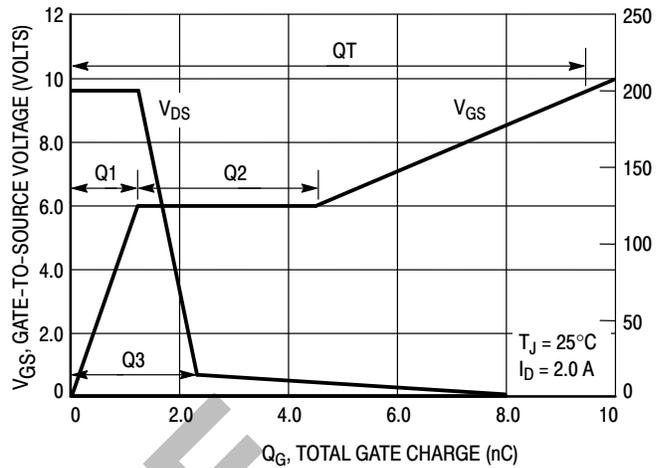


Figure 8. Gate-to-Source and Drain-to-Source Voltage versus Total Charge

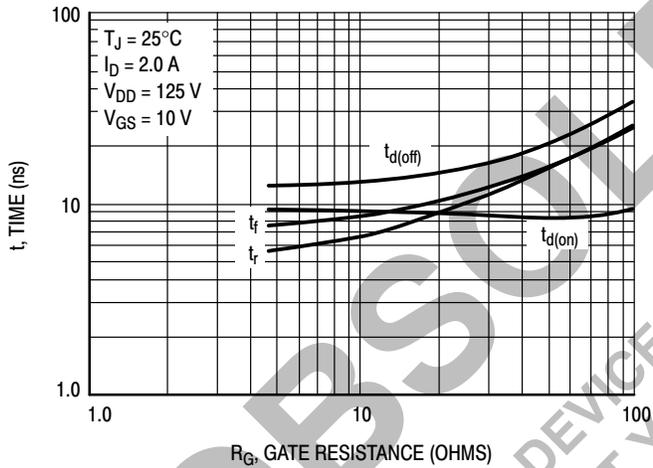


Figure 9. Resistive Switching Time Variation versus Gate Resistance

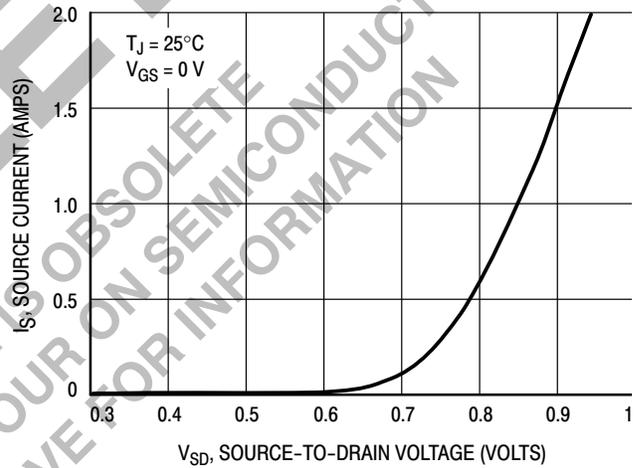


Figure 10. Diode Forward Voltage versus Current

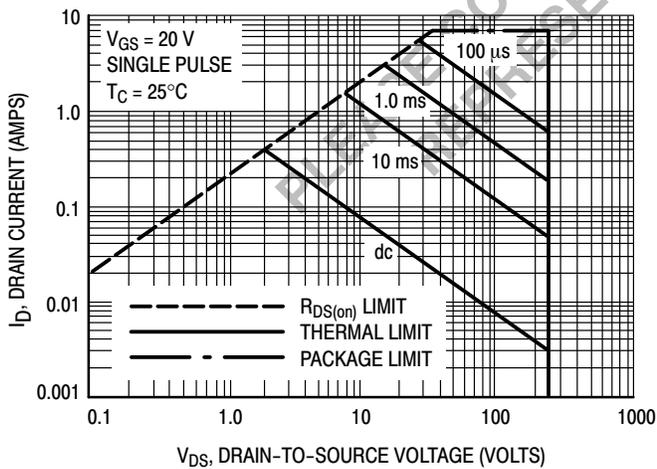


Figure 11. Maximum Rated Forward Biased Safe Operating Area

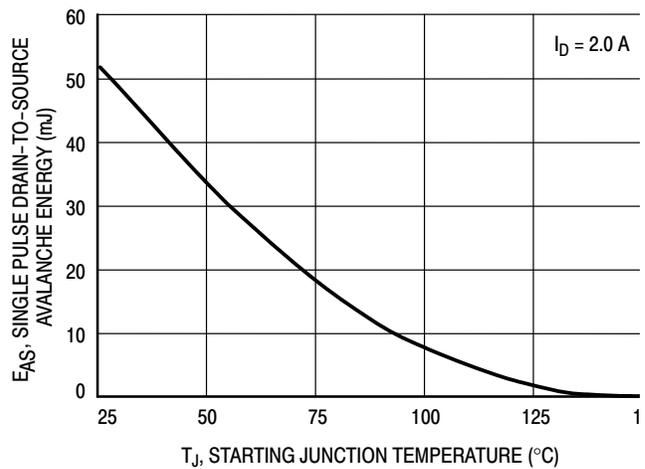


Figure 12. Maximum Avalanche Energy versus Starting Junction Temperature

# MMFT2N25E

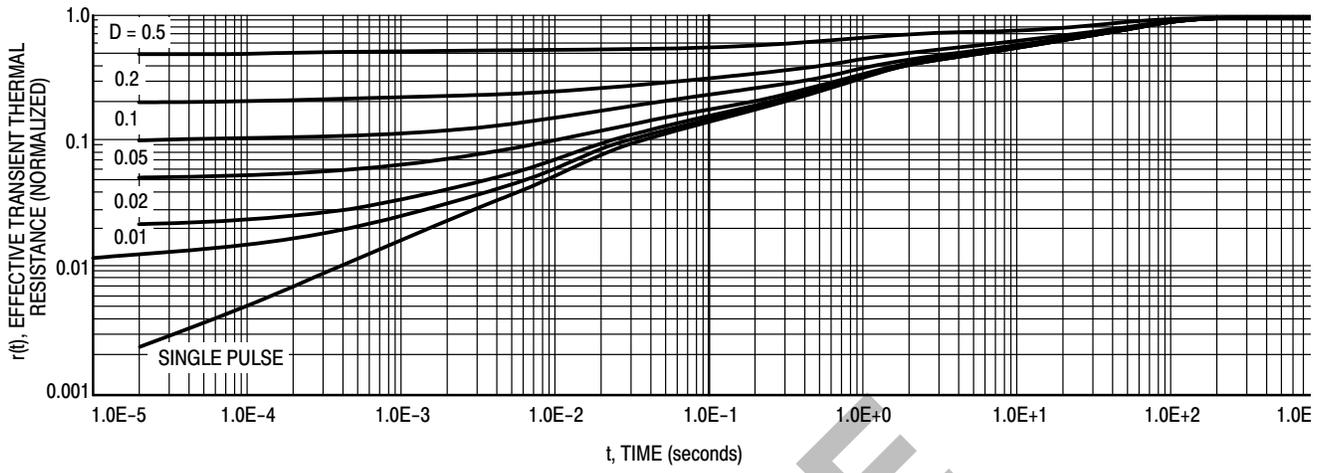


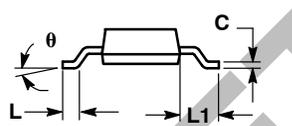
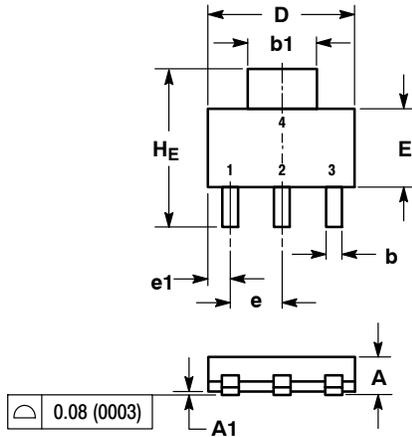
Figure 13. Thermal Response

**OBSOLETE**  
THIS DEVICE IS OBSOLETE  
PLEASE CONTACT YOUR ON SEMICONDUCTOR  
REPRESENTATIVE FOR INFORMATION

# MMFT2N25E

## PACKAGE DIMENSIONS

SOT-223 (TO-261)  
CASE 318E-04  
ISSUE N

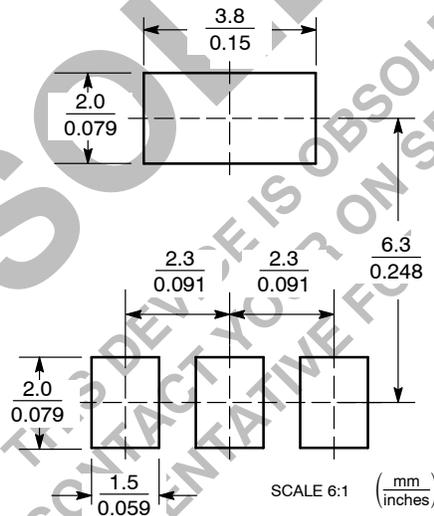


NOTES:  
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.  
2. CONTROLLING DIMENSION: INCH

DIM	MILLIMETERS			INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	1.50	1.63	1.75	0.060	0.064	0.068
A1	0.02	0.06	0.10	0.001	0.002	0.004
b	0.60	0.75	0.89	0.024	0.030	0.035
b1	2.90	3.06	3.20	0.115	0.121	0.126
c	0.24	0.29	0.35	0.009	0.012	0.014
D	6.30	6.50	6.70	0.249	0.256	0.263
E	3.30	3.50	3.70	0.130	0.138	0.145
e	2.20	2.30	2.40	0.087	0.091	0.094
e1	0.85	0.94	1.05	0.033	0.037	0.041
L	0.20	---	---	0.008	---	---
L1	1.50	1.75	2.00	0.060	0.069	0.078
He	6.70	7.00	7.30	0.264	0.276	0.287
θ	0°	-	10°	0°	-	10°

STYLE 3:  
PIN 1. GATE  
2. DRAIN  
3. SOURCE  
4. DRAIN

### SOLDERING 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.

ON Semiconductor and are registered trademarks of Semiconductor Components Industries, LLC (SCILLC). SCILLC owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of SCILLC's product/patent coverage may be accessed at [www.onsemi.com/site/pdf/Patent-Marking.pdf](http://www.onsemi.com/site/pdf/Patent-Marking.pdf). SCILLC reserves the right to make changes without further notice to any products herein. SCILLC makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does SCILLC 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. "Typical" parameters which may be provided in SCILLC 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. SCILLC does not convey any license under its patent rights nor the rights of others. SCILLC products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the SCILLC product could create a situation where personal injury or death may occur. Should Buyer purchase or use SCILLC products for any such unintended or unauthorized application, Buyer shall indemnify and hold SCILLC 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 SCILLC was negligent regarding the design or manufacture of the part. SCILLC is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

### PUBLICATION ORDERING INFORMATION

**LITERATURE FULFILLMENT:**  
Literature Distribution Center for ON Semiconductor  
P.O. Box 5163, Denver, Colorado 80217 USA  
Phone: 303-675-2175 or 800-344-3860 Toll Free USA/Canada  
Fax: 303-675-2176 or 800-344-3867 Toll Free USA/Canada  
Email: [orderlit@onsemi.com](mailto:orderlit@onsemi.com)

**N. American Technical Support:** 800-282-9855 Toll Free  
USA/Canada  
**Europe, Middle East and Africa Technical Support:**  
Phone: 421 33 790 2910  
**Japan Customer Focus Center**  
Phone: 81-3-5817-1050

**ON Semiconductor Website:** [www.onsemi.com](http://www.onsemi.com)  
**Order Literature:** <http://www.onsemi.com/orderlit>  
For additional information, please contact your local Sales Representative