

# MMFT2N25E

## Product Preview

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

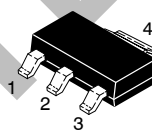


ON Semiconductor®

<http://onsemi.com>

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

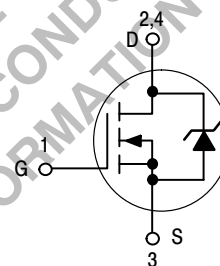
$R_{DS(on)} = 3.5 \Omega$



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

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



#### 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 @ $T_C = 25^\circ\text{C}$<br>— Continuous @ $T_C = 100^\circ\text{C}$<br>— Single Pulse ( $t_p \leq 10 \mu\text{s}$ )                                                                                                                                                                                                                      | $I_D$<br>$I_D$<br>$I_{DM}$ | 2.0<br>0.6<br>7.0                | Adc<br>Adc<br>Apk                                        |
| Total Power Dissipation @ $T_C = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$<br>Total $P_D$ @ $T_A = 25^\circ\text{C}$ mounted on 1" Sq. Drain Pad on FR-4 Bd. Material<br>Total $P_D$ @ $T_A = 25^\circ\text{C}$ mounted on 0.7" Sq. Drain Pad on FR-4 Bd. Material<br>Total $P_D$ @ $T_A = 25^\circ\text{C}$ mounted on min. Drain Pad on FR-4 Bd. Material | $P_D$                      | 0.77<br>6.2<br>1.0<br>1.2<br>0.8 | Watts<br>mW/ $^\circ\text{C}$<br>Watts<br>Watts<br>Watts |
| 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 $T_J = 25^\circ\text{C}$<br>( $V_{DD} = 80 \text{ V}$ , $V_{GS} = 10 \text{ V}$ , 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<br>— Junction-to-Ambient on 0.7" Sq. Drain Pad on FR-4 Bd. Material<br>— Junction-to-Ambient on min. Drain Pad on FR-4 Bd. Material | $R_{\theta JA}$ | 90<br>103<br>162 | $^\circ\text{C/W}$ |
| 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.

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

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

### OFF CHARACTERISTICS

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

### ON CHARACTERISTICS (1)

|                                                                                                                                                            |                     |          |            |              |              |
|------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|----------|------------|--------------|--------------|
| Gate Threshold Voltage<br>(V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 0.25 mA)<br>Threshold Temperature Coefficient (Negative)                   | V <sub>GS(th)</sub> | 2.0<br>— | 2.8<br>5.7 | 4.0<br>—     | Vdc<br>mV/°C |
| Static Drain-to-Source On-Resistance<br>(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<br>(V <sub>GS</sub> = 10 V, I <sub>D</sub> = 2.0 A)<br>(V <sub>GS</sub> = 10 V, I <sub>D</sub> = 1.0 A, T <sub>J</sub> = 125°C) | V <sub>DS(on)</sub> | —<br>—   | —<br>—     | 8.40<br>7.35 | Vdc          |
| Forward Transconductance<br>(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,<br>V <sub>GS</sub> = 0,<br>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,<br>I <sub>D</sub> = 2.0 A,<br>R <sub>G</sub> = 9.1 Ohms,<br>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,<br>I <sub>D</sub> = 2.0 A,<br>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,<br>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 | —   | μC  |

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

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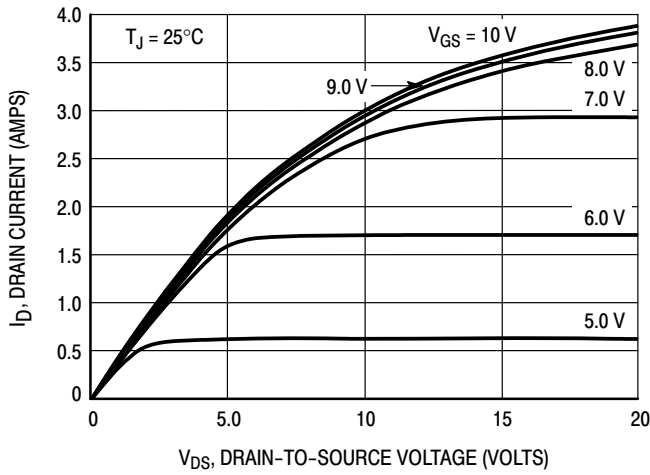


Figure 1. On-Region Characteristics

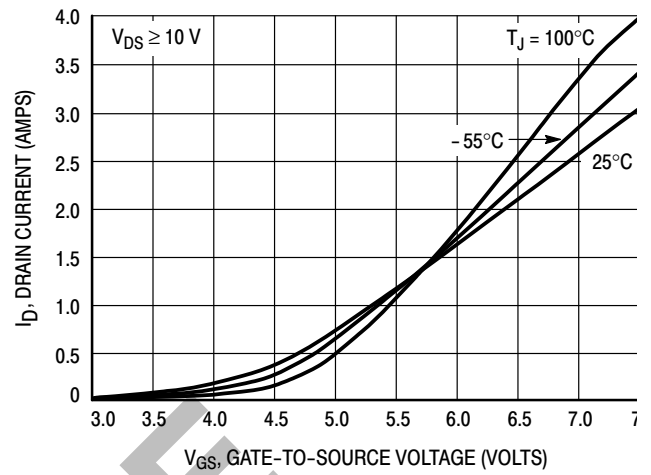


Figure 2. Transfer Characteristics

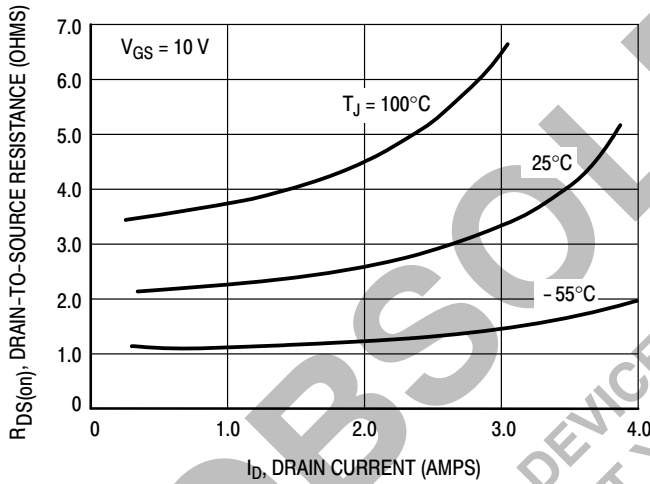


Figure 3. On-Resistance versus Drain Current and Temperature

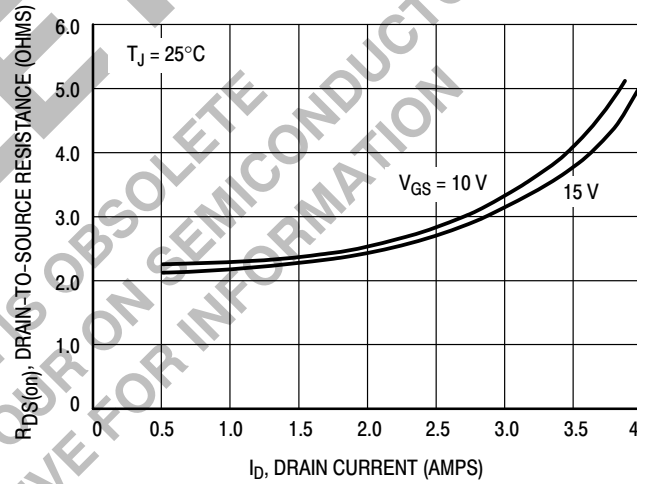


Figure 4. On-Resistance versus Drain Current and Gate Voltage

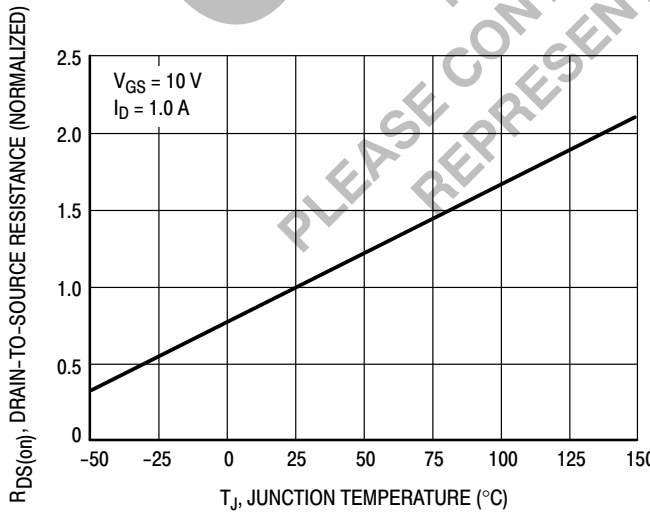


Figure 5. On-Resistance Variation versus Temperature

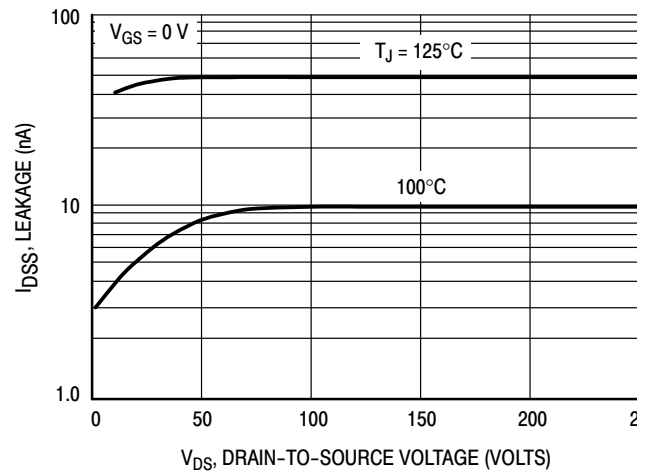


Figure 6. Drain-to-Source Leakage Current versus Voltage

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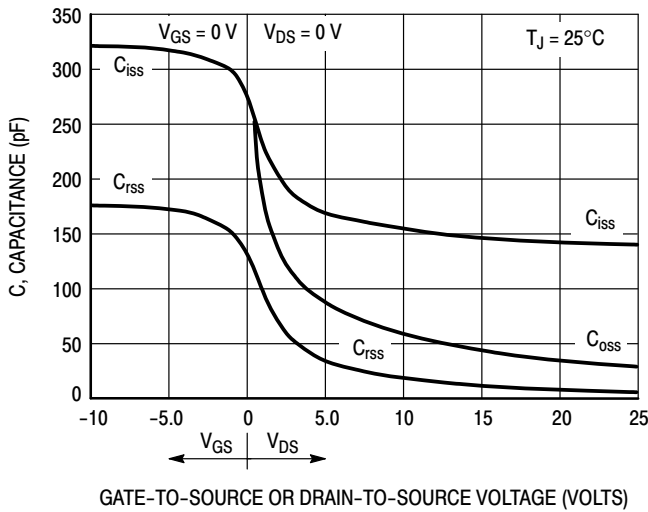


Figure 7. Capacitance Variation

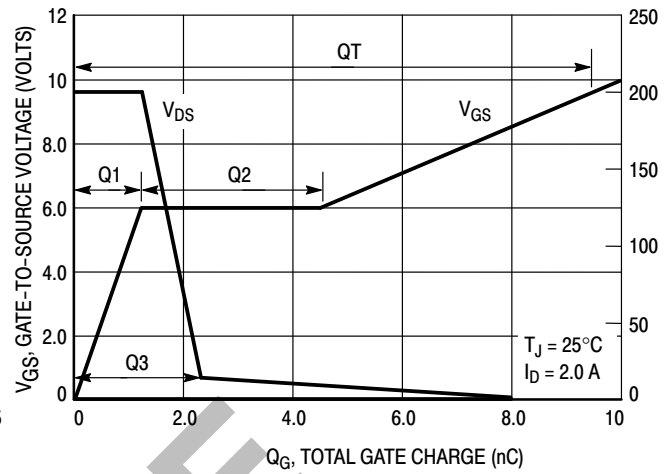


Figure 8. Gate-to-Source and Drain-to-Source Voltage versus Total Charge

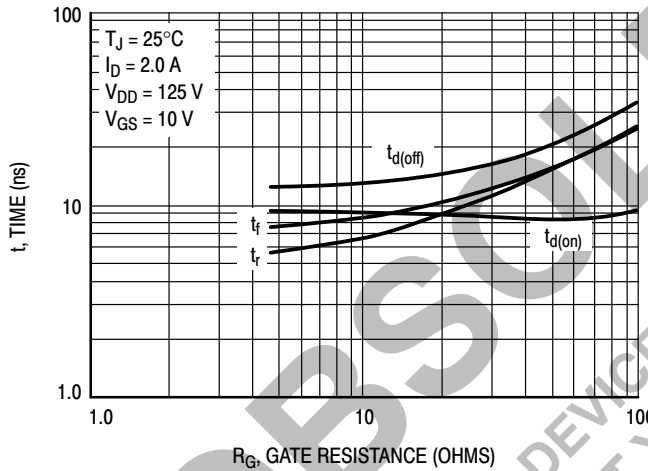


Figure 9. Resistive Switching Time Variation versus Gate Resistance

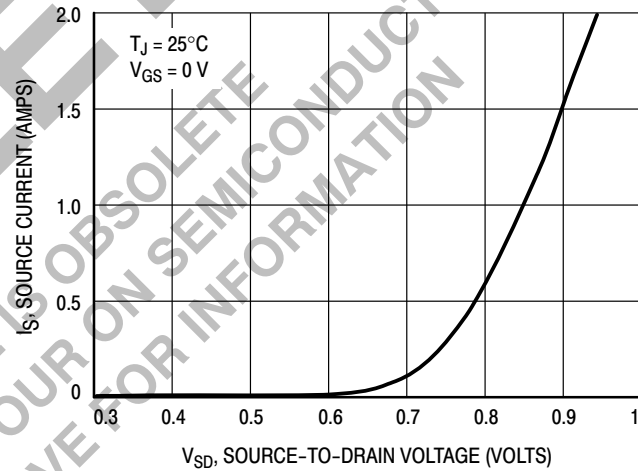


Figure 10. Diode Forward Voltage versus Current

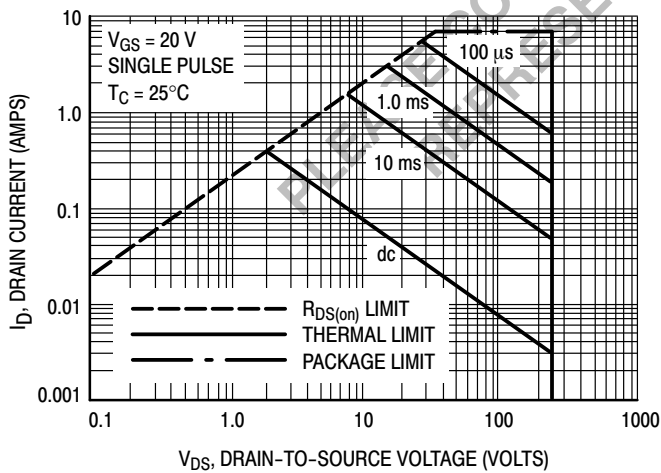


Figure 11. Maximum Rated Forward Biased Safe Operating Area

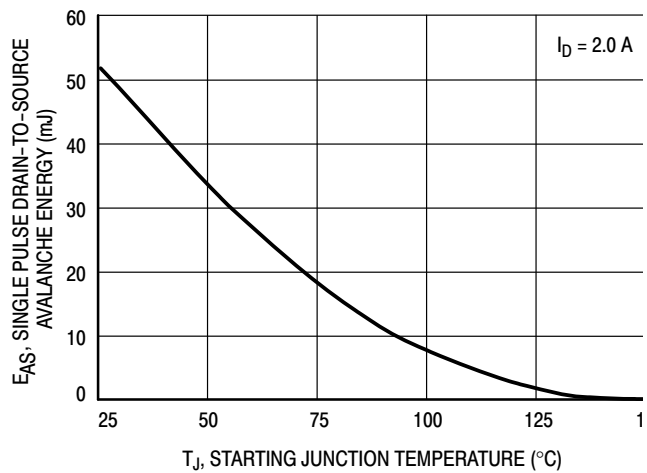


Figure 12. Maximum Avalanche Energy versus Starting Junction Temperature

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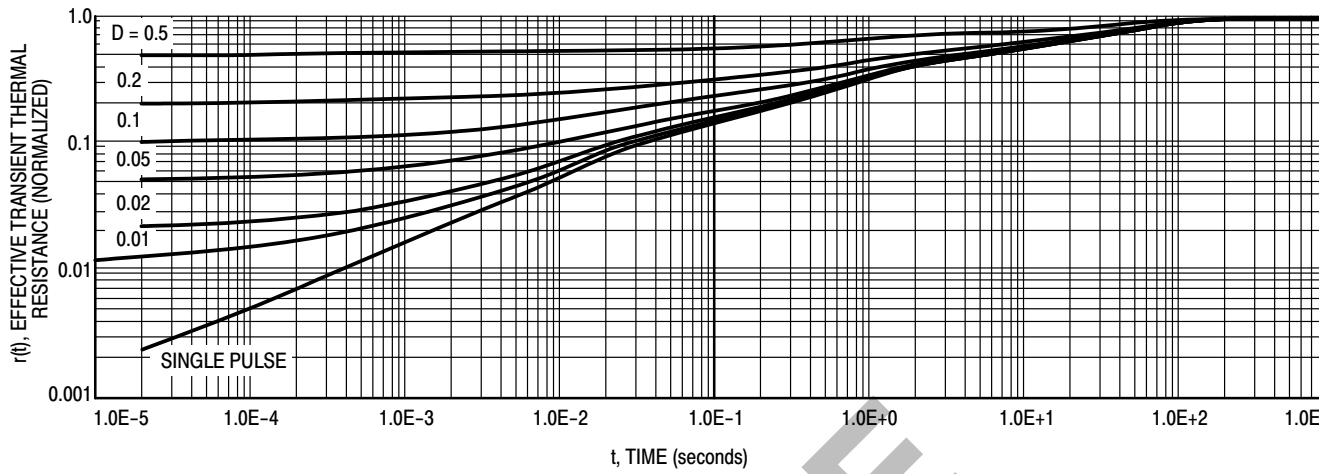


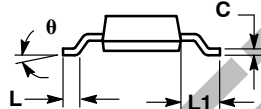
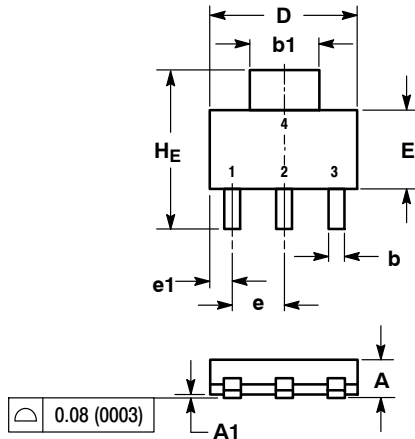
Figure 13. Thermal Response

**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

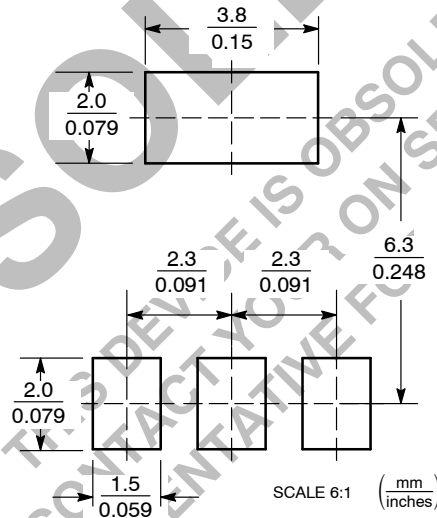


NOTES:  
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.  
2. CONTROLLING DIMENSION: INCH.

| 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 |
| theta | 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.

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