

# MOSFET – P-Channel, POWERTRENCH®

60 V

**FDD5614P**

## General Description

This 60 V P-Channel MOSFET uses onsemi's high voltage POWERTRENCH process. It has been optimized for power management applications.

## Features

- -15 A, -60 V
  - ♦  $R_{DS(ON)} = 100\text{ m}\Omega$  at  $V_{GS} = -10\text{ V}$
  - ♦  $R_{DS(ON)} = 130\text{ m}\Omega$  at  $V_{GS} = -4.5\text{ V}$
- Fast Switching Speed
- High Performance Trench Technology for Extremely Low  $R_{DS(ON)}$
- High Power and Current Handling Capability
- This is a Pb-Free Device

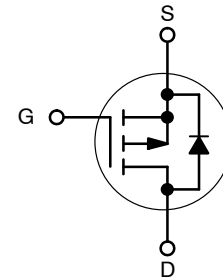
## Applications

- DC/DC Converter
- Power Management
- Load Switch

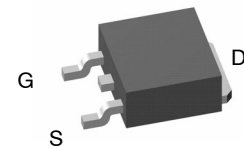
## ABSOLUTE MAXIMUM RATINGS ( $T_A = 25^\circ\text{C}$ unless otherwise noted)

| Symbol         | Parameter  | Ratings          | Unit             |
|----------------|--|------------------|------------------|
| $V_{DS}$       | Drain-Source Voltage   | -60              | V                |
| $V_{GS}$       | Gate-Source Voltage  | $\pm 20$         | V                |
| $I_D$          | Drain Current<br>– Continuous (Note 3)<br>– Pulsed (Note 1a)                 | -15<br>-45       | A                |
| $P_D$          | Power Dissipation for Single Operation<br>(Note 1)<br>(Note 1a)<br>(Note 1b) | 42<br>3.8<br>1.6 | W                |
| $T_J, T_{STG}$ | Operating and Storage Junction Temperature Range                             | -55 to +175      | $^\circ\text{C}$ |

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.

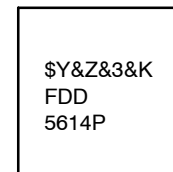


P-Channel MOSFET



DPAK3 (TO-252 3 LD)  
CASE 369AS

## MARKING DIAGRAM



FDD5614P = Specific Device Code  
 \$Y = onsemi Logo  
 &Z = Assembly Plant Code  
 &3 = 3-Digit Date Code  
 &K = 2-Digits Lot Run Traceability Code

## ORDERING INFORMATION

| Device   | Package               | Shipping <sup>†</sup> |
|----------|-----------------------|-----------------------|
| FDD5614P | TO-252-3<br>(Pb-Free) | 2500 /<br>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 Specification Brochure, BRD8011/D.

**THERMAL CHARACTERISTICS**

| Symbol          | Parameter   | Ratings | Unit                        |
|-----------------|---|---------|-----------------------------|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case (Note 1)     | 3.5     | $^{\circ}\text{C}/\text{W}$ |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient (Note 1a) | 40      | $^{\circ}\text{C}/\text{W}$ |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient (Note 1b) | 96      | $^{\circ}\text{C}/\text{W}$ |

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

| Symbol | Parameter | Condition | Min | Typ | Max | Unit |
|--------|-----------|-----------|-----|-----|-----|------|
|--------|-----------|-----------|-----|-----|-----|------|

**DRAIN-SOURCE AVALANCHE RATINGS** (Note 1)

|           |  |   |   |   |      |    |
|-----------|--|---|---|---|------|----|
| $W_{DSS}$ | Single Pulse Drain-Source Avalanche Energy | $V_{DD} = -30\text{ V}$ , $I_D = -4.5\text{ A}$ | – | – | 90   | mJ |
| $I_{AR}$  | Maximum Drain-Source Avalanche Current     |   | – | – | –4.5 | A  |

**OFF CHARACTERISTICS**

|   |   |  |     |     |      |                              |
|---|---|--|-----|-----|------|------------------------------|
| $B_{V_{DSS}}$                           | Drain-Source Breakdown Voltage            | $V_{GS} = 0\text{ V}$ , $I_D = -250\text{ }\mu\text{A}$              | –60 | –   | –    | V                            |
| $\frac{\Delta B_{V_{DSS}}}{\Delta T_J}$ | Breakdown Voltage Temperature Coefficient | $I_D = -250\text{ }\mu\text{A}$ , Referenced to $25^{\circ}\text{C}$ | –   | –49 | –    | $\text{mV}/^{\circ}\text{C}$ |
| $I_{DSS}$                               | Zero Gate Voltage Drain Current           | $V_{DS} = -48\text{ V}$ , $V_{GS} = 0\text{ V}$                      | –   | –   | –1   | $\mu\text{A}$                |
| $I_{GSSF}$                              | Gate-Body Leakage, Forward                | $V_{GS} = 20\text{ V}$ , $V_{DS} = 0\text{ V}$                       | –   | –   | 100  | nA                           |
| $I_{GSSR}$                              | Gate-Body Leakage, Reverse                | $V_{GS} = -20\text{ V}$ , $V_{DS} = 0\text{ V}$                      | –   | –   | –100 | nA                           |

**ON CHARACTERISTICS** (Note 2)

|  |  |   |     |      |     |                              |
|--|--|---|-----|------|-----|------------------------------|
| $V_{GS(th)}$                           | Gate to Threshold Voltage                      | $V_{DS} = V_{GS}$ , $I_D = -250\text{ }\mu\text{A}$                           | –1  | –1.6 | –3  | V                            |
| $\frac{\Delta V_{GS(th)}}{\Delta T_J}$ | Gate Threshold Voltage Temperature Coefficient | $I_D = -250\text{ }\mu\text{A}$ , Referenced to $25^{\circ}\text{C}$          | –   | 4    | –   | $\text{mV}/^{\circ}\text{C}$ |
| $R_{DS(on)}$                           | Static Drain-Source On-Resistance              | $V_{GS} = -10\text{ V}$ , $I_D = -4.5\text{ A}$                               | –   | 76   | 100 | $\text{m}\Omega$             |
|  |  | $V_{GS} = -4.5\text{ V}$ , $I_D = -3.9\text{ A}$                              | –   | 99   | 130 |                              |
|  |  | $V_{GS} = -10\text{ V}$ , $I_D = -4.5\text{ A}$ , $T_J = 125^{\circ}\text{C}$ | –   | 137  | 185 |                              |
| $I_{D(on)}$                            | On-State Drain Current                         | $V_{GS} = -10\text{ V}$ , $V_{DS} = -5\text{ V}$                              | –20 | –    | –   | A                            |
| $g_{FS}$                               | Forward Transconductance                       | $V_{DS} = -5\text{ V}$ , $I_D = -3\text{ A}$                                  | –   | 8    | –   | S                            |

**DYNAMIC CHARACTERISTICS**

|           |                              |  |   |     |   |    |
|-----------|------------------------------|--|---|-----|---|----|
| $C_{iss}$ | Input Capacitance            | $V_{DS} = -30\text{ V}$ , $V_{GS} = 0\text{ V}$ , $f = 1\text{ MHz}$ | – | 759 | – | pF |
| $C_{oss}$ | Output Capacitance           |  | – | 90  | – | pF |
| $C_{rss}$ | Reverse Transfer Capacitance |  | – | 39  | – | pF |

**SWITCHING CHARACTERISTICS**

|              |                     |  |   |     |    |    |
|--------------|---------------------|--|---|-----|----|----|
| $t_{d(on)}$  | Turn-On Delay Time  | $V_{DD} = -30\text{ V}$ , $I_D = -1\text{ A}$ ,<br>$V_{GS} = -10\text{ V}$ , $R_{GEN} = 6\text{ }\Omega$ | – | 7   | 14 | ns |
| $t_r$        | Turn-On Rise Time   |  | – | 10  | 20 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time |  | – | 19  | 34 | ns |
| $t_f$        | Turn-Off Fall Time  |  | – | 12  | 22 | ns |
| $Q_g$        | Total Gate Charge   | $V_{DS} = -30\text{ V}$ , $I_D = -4.5\text{ A}$ ,<br>$V_{GS} = -10\text{ V}$                             | – | 15  | 24 | nC |
| $Q_{gs}$     | Gate-Source Charge  |  | – | 2.5 | –  | nC |
| $Q_{gd}$     | Gate-Drain Charge   |  | – | 3.0 | –  | nC |

# FDD5614P

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

| Symbol | Parameter | Condition | Min | Typ | Max | Unit |
|--------|-----------|-----------|-----|-----|-----|------|
|--------|-----------|-----------|-----|-----|-----|------|

### DRAIN-SOURCE AVELANCHE RATINGS

|          |   |  |   |      |      |   |
|----------|---|--|---|------|------|---|
| $I_S$    | Maximum Continuous Drain-Source Diode Forward Current |  | – | –    | –3.2 | A |
| $V_{SD}$ | Drain-Source Diode Forward Voltage                    | $V_{GS} = 0\text{ V}$ , $I_S = -3.2\text{ A}$ (Note 2) | – | –0.8 | –1.2 | V |

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.

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



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

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

- 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  $V_{GS} = 10\text{ V}$ . Package current limitation is 21 A.

TYPICAL CHARACTERISTICS

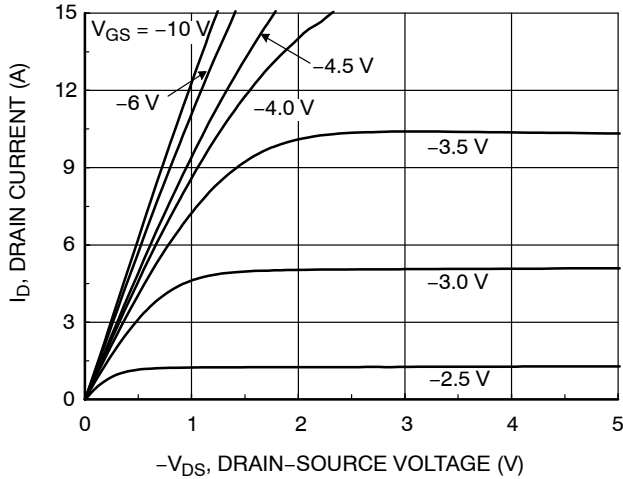


Figure 1. On-Region Characteristics

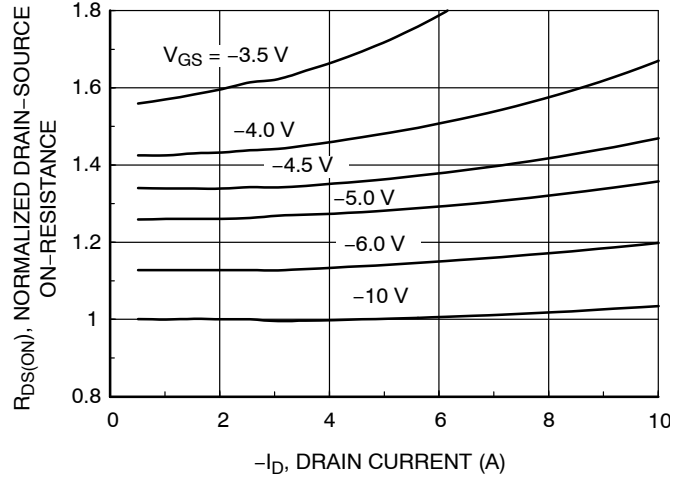


Figure 2. On-Resistance Variation with Drain Current and Gate Voltage

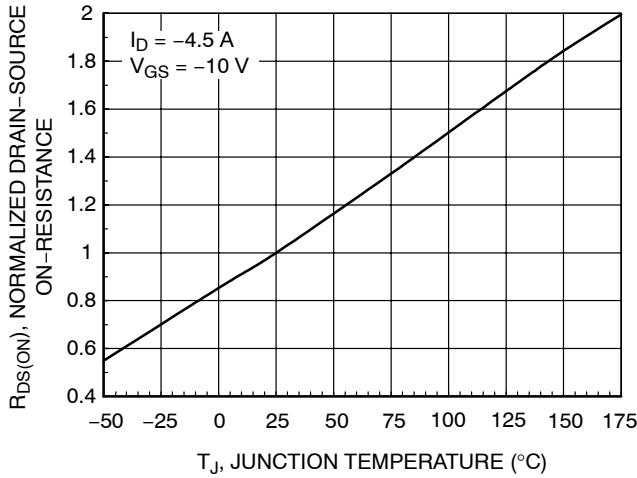


Figure 3. On-Resistance Variation with Temperature

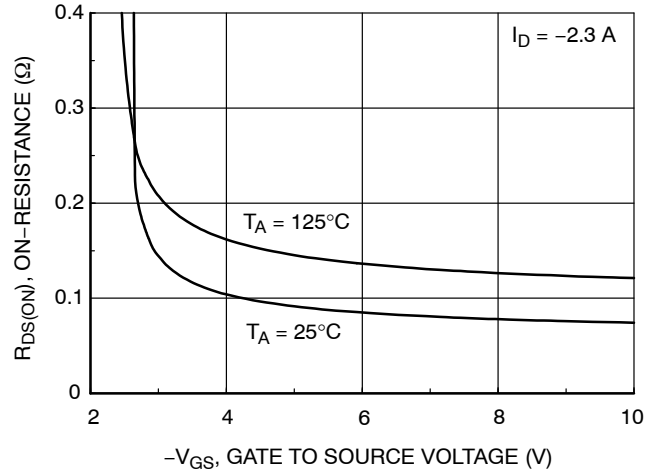


Figure 4. On-Resistance Variation with Gate-to-Source Voltage

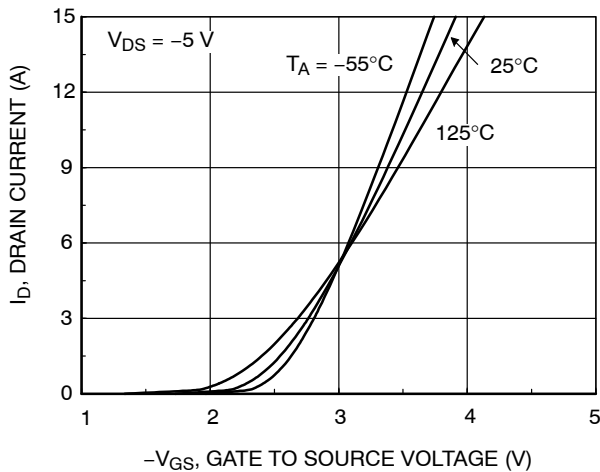


Figure 5. Transfer Characteristics

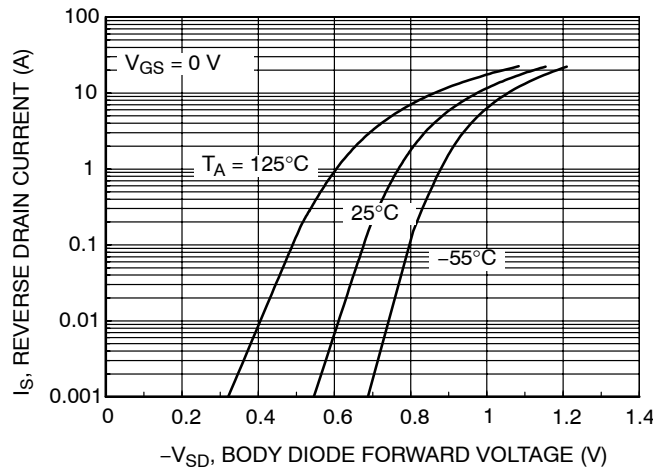


Figure 6. Body Diode Forward Voltage Variation with Source Current and Temperature

TYPICAL CHARACTERISTICS (continued)

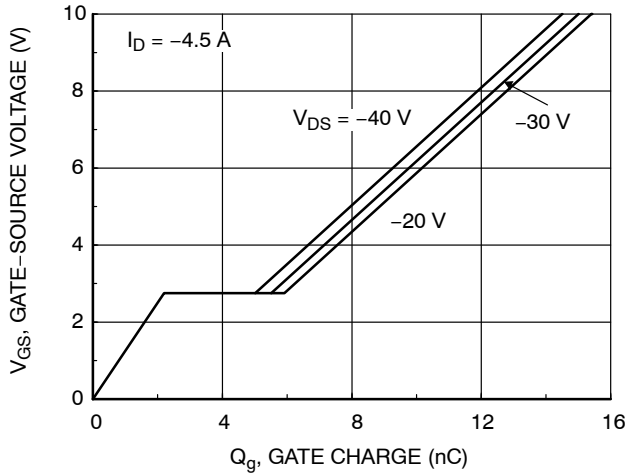


Figure 7. Gate Charge Characteristics

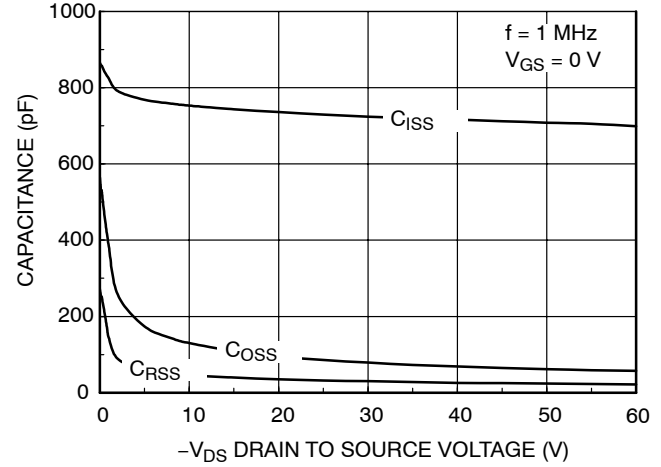


Figure 8. Capacitance Characteristics

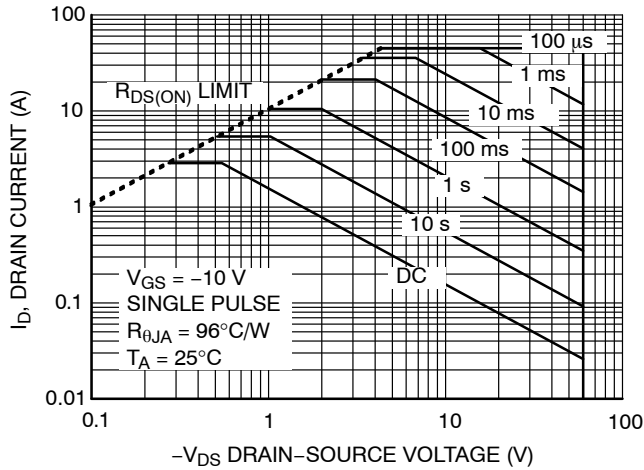


Figure 9. Maximum Safe Operating Area

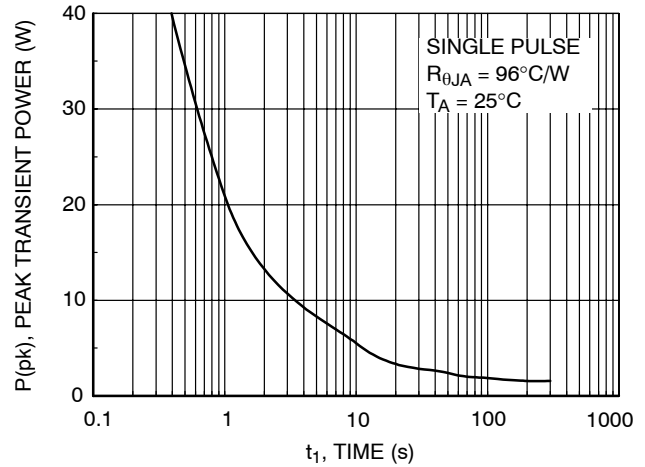
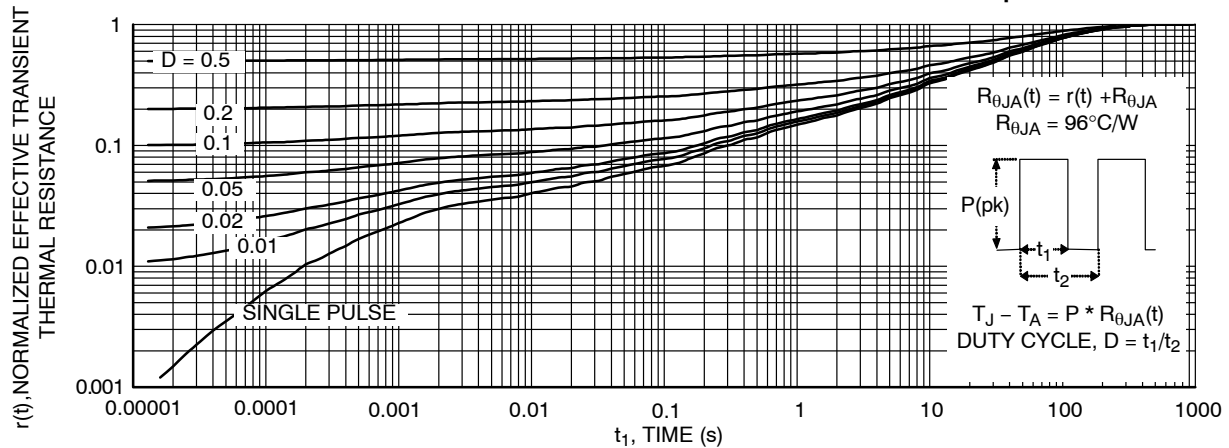


Figure 10. Single Pulse Maximum Power Dissipation



Thermal characterization performed using the conditions described in Note 1b.  
Transient thermal response will change depending on the circuit board design.

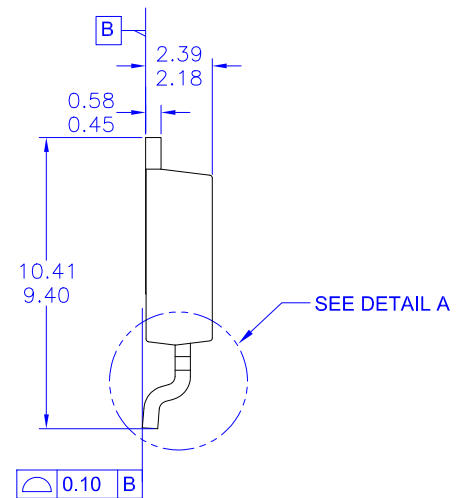
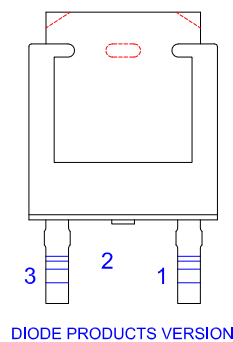
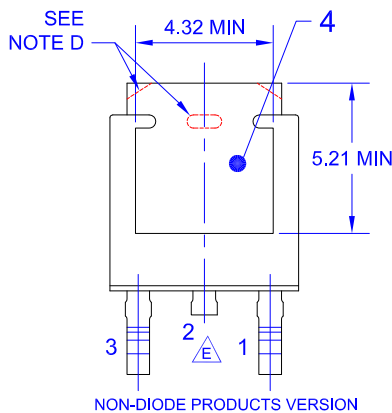
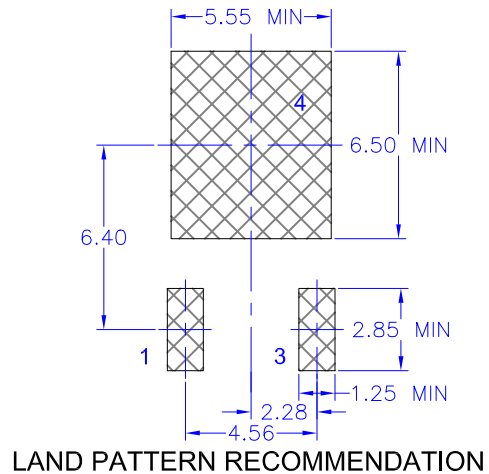
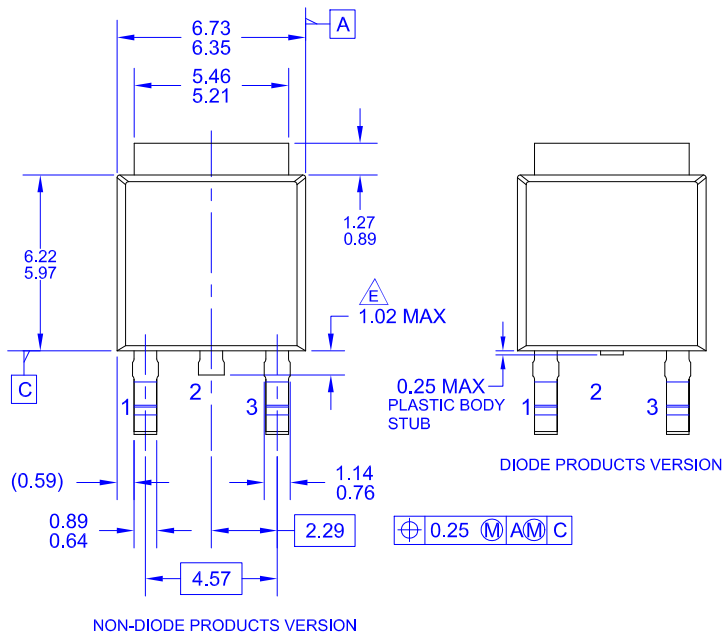
Figure 11. Transient Thermal Response Curve

### DPAK3 (TO-252 3 LD)

#### CASE 369AS

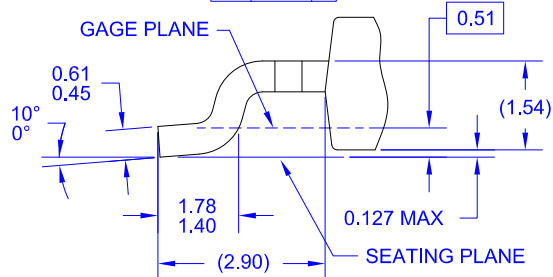
#### ISSUE O

DATE 30 SEP 2016



#### NOTES: UNLESS OTHERWISE SPECIFIED

- A) THIS PACKAGE CONFORMS TO JEDEC, TO-252, ISSUE C, VARIATION AA.
- B) ALL DIMENSIONS ARE IN MILLIMETERS.
- C) DIMENSIONING AND TOLERANCING PER ASME Y14.5M-2009.
- D) SUPPLIER DEPENDENT MOLD LOCKING HOLES OR CHAMFERED CORNERS OR EDGE PROTRUSION.
- E) TRIMMED CENTER LEAD IS PRESENT ONLY FOR DIODE PRODUCTS
- F) DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR EXTRUSIONS.
- G) LAND PATTERN RECOMMENDATION IS BASED ON IPC7351A STD TO228P991X239-3N.



|                         |                            |   |
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