

# ON Semiconductor

## Is Now

The logo for onsemi, featuring the word "onsemi" in a dark teal, lowercase, sans-serif font. The letter "i" is stylized with a white dot and a teal vertical bar. A small orange triangle is positioned above the top right of the "i". A trademark symbol (TM) is located to the right of the logo.

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ON Semiconductor®

# FDD6N50 / FDU6N50

## N-Channel UniFET™ MOSFET

500 V, 6 A, 900 mΩ

### Features

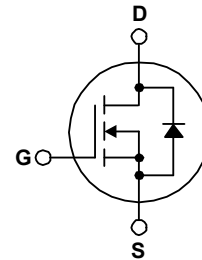
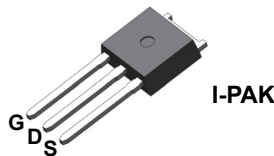
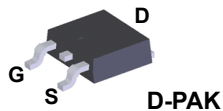
- $R_{DS(on)} = 900\text{ m}\Omega$  (Max.) @  $V_{GS} = 10\text{ V}$ ,  $I_D = 3\text{ A}$
- Low Gate Charge (Typ. 12.8 nC)
- Low  $C_{rss}$  (Typ. 9 pF)
- 100% Avalanche Tested
- Improved dv/dt Capability

### Applications

- LCD/LED/PDP TV
- Lighting
- Uninterruptible Power Supply
- AC-DC Power Supply

### Description

UniFET™ MOSFET is ON Semiconductor's high voltage MOSFET family based on planar stripe and DMOS technology. This MOSFET is tailored to reduce on-state resistance, and to provide better switching performance and higher avalanche energy strength. This device family is suitable for switching power converter applications such as power factor correction (PFC), flat panel display (FPD) TV power, ATX and electronic lamp ballasts.



### Absolute Maximum Ratings $T_C = 25^\circ\text{C}$ unless otherwise noted.

Symbol	Parameter		FDD6N50TM / FDD6N50TM-WS / FDU6N50TU	Unit
$V_{DSS}$	Drain-Source Voltage		500	V
$I_D$	Drain Current	- Continuous ( $T_C = 25^\circ\text{C}$ ) - Continuous ( $T_C = 100^\circ\text{C}$ )	6 3.8	A A
$I_{DM}$	Drain Current	- Pulsed (Note 1)	24	A
$V_{GSS}$	Gate-Source voltage		$\pm 30$	V
$E_{AS}$	Single Pulsed Avalanche Energy	(Note 2)	270	mJ
$I_{AR}$	Avalanche Current	(Note 1)	6	A
$E_{AR}$	Repetitive Avalanche Energy	(Note 1)	8.9	mJ
dv/dt	Peak Diode Recovery dv/dt	(Note 3)	4.5	V/ns
$P_D$	Power Dissipation	( $T_C = 25^\circ\text{C}$ ) - Derate Above $25^\circ\text{C}$	89 0.71	W W/ $^\circ\text{C}$
$T_J, T_{STG}$	Operating and Storage Temperature Range		-55 to +150	$^\circ\text{C}$
$T_L$	Maximum Lead Temperature for Soldering, 1/8" from Case for 5 Seconds		300	$^\circ\text{C}$

### Thermal Characteristics

Symbol	Parameter	FDD6N50TM / FDD6N50TM-WS / FDU6N50TU	Unit
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case, Max.	1.4	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient, Max.	83	

## Package Marking and Ordering Information

Part Number	Top Mark	Package	Packing Method	Reel Size	Tape Width	Quantity
FDD6N50TM	FDD6N50	DPAK	Tape and Reel	330 mm	16 mm	2500 units
FDD6N50TM-WS	FDD6N50S	DPAK	Tape and Reel	330 mm	16 mm	2500 units
FDU6N50TU	FDU6N50	IPAK	Tube	N/A	N/A	75 units

## Electrical Characteristics $T_C = 25^\circ\text{C}$ unless otherwise noted.

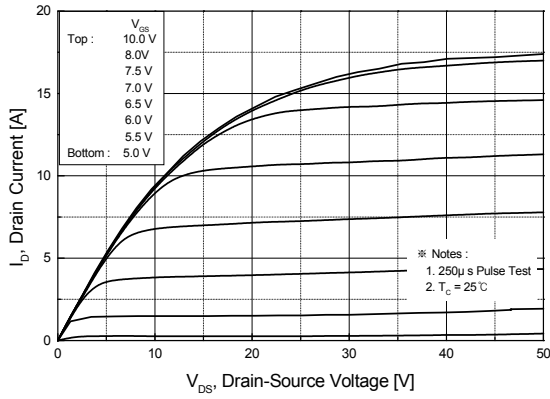
Symbol	Parameter	Conditions	Min.	Typ.	Max	Unit
<b>Off Characteristics</b>						
$BV_{DSS}$	Drain-Source Breakdown Voltage	$V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}$	500	--	--	V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = 250\ \mu\text{A}$ , Referenced to $25^\circ\text{C}$	--	0.5	--	$\text{V}/^\circ\text{C}$
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 500\text{ V}, V_{GS} = 0\text{ V}$ $V_{DS} = 400\text{ V}, T_C = 125^\circ\text{C}$	--	--	1 10	$\mu\text{A}$ $\mu\text{A}$
$I_{GSSF}$	Gate-Body Leakage Current, Forward	$V_{GS} = 30\text{ V}, V_{DS} = 0\text{ V}$	--	--	100	nA
$I_{GSSR}$	Gate-Body Leakage Current, Reverse	$V_{GS} = -30\text{ V}, V_{DS} = 0\text{ V}$	--	--	-100	nA
<b>On Characteristics</b>						
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 250\ \mu\text{A}$	3.0	--	5.0	V
$R_{DS(on)}$	Static Drain-Source On-Resistance	$V_{GS} = 10\text{ V}, I_D = 3\text{ A}$	--	0.76	0.9	$\Omega$
$g_{FS}$	Forward Transconductance	$V_{DS} = 40\text{ V}, I_D = 3\text{ A}$	--	2.5	--	S
<b>Dynamic Characteristics</b>						
$C_{ISS}$	Input Capacitance	$V_{DS} = 25\text{ V}, V_{GS} = 0\text{ V},$ $f = 1.0\text{ MHz}$	--	720	940	pF
$C_{OSS}$	Output Capacitance		--	95	190	pF
$C_{RSS}$	Reverse Transfer Capacitance		--	9	13.5	pF
<b>Switching Characteristics</b>						
$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 250\text{ V}, I_D = 6\text{ A},$ $V_{GS} = 10\text{ V}, R_G = 25\ \Omega$	--	6	20	ns
$t_r$	Turn-On Rise Time		--	55	120	ns
$t_{d(off)}$	Turn-Off Delay Time		--	25	60	ns
$t_f$	Turn-Off Fall Time		(Note 4)	--	35	80
$Q_g$	Total Gate Charge	$V_{DS} = 400\text{ V}, I_D = 6\text{ A},$ $V_{GS} = 10\text{ V}$	--	12.8	16.6	nC
$Q_{gs}$	Gate-Source Charge		--	3.7	--	nC
$Q_{gd}$	Gate-Drain Charge		(Note 4)	--	5.8	--
<b>Drain-Source Diode Characteristics and Maximum Ratings</b>						
$I_S$	Maximum Continuous Drain-Source Diode Forward Current		--	--	6	A
$I_{SM}$	Maximum Pulsed Drain-Source Diode Forward Current		--	--	24	A
$V_{SD}$	Drain-Source Diode Forward Voltage	$V_{GS} = 0\text{ V}, I_S = 6\text{ A}$	--	--	1.4	V
$t_{rr}$	Reverse Recovery Time	$V_{GS} = 0\text{ V}, I_S = 6\text{ A},$ $di_F/dt = 100\text{ A}/\mu\text{s}$	--	275	--	ns
$Q_{rr}$	Reverse Recovery Charge		--	1.7	--	$\mu\text{C}$

### Notes:

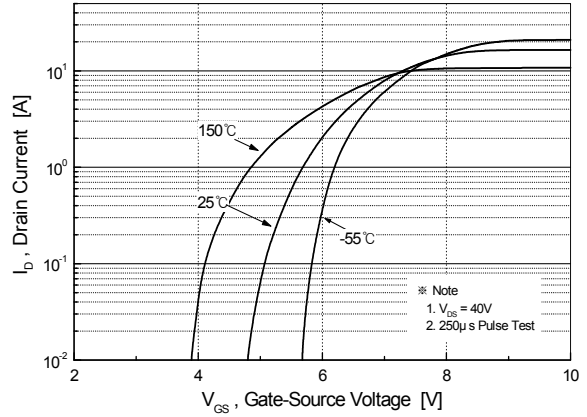
1. Repetitive rating: pulse-width limited by maximum junction temperature.
2.  $I_{AS} = 6\text{ A}, V_{DD} = 50\text{ V}, L = 13.5\text{ mH}, R_G = 25\ \Omega$ , starting  $T_J = 25^\circ\text{C}$ .
3.  $I_{SD} \leq 6\text{ A}, di/dt \leq 200\text{ A}/\mu\text{s}, V_{DD} \leq BV_{DSS}$ , starting  $T_J = 25^\circ\text{C}$ .
4. Essentially independent of operating temperature typical characteristics.

## Typical Performance Characteristics

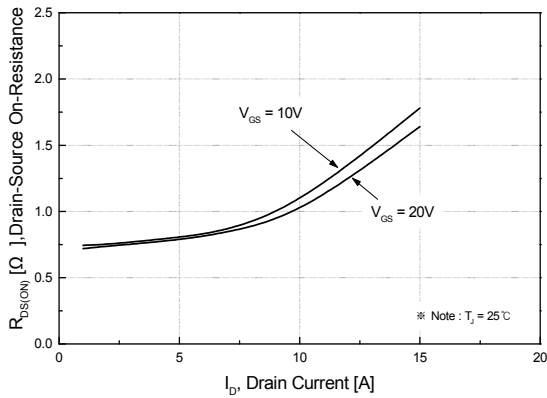
**Figure 1. On-Region Characteristics**



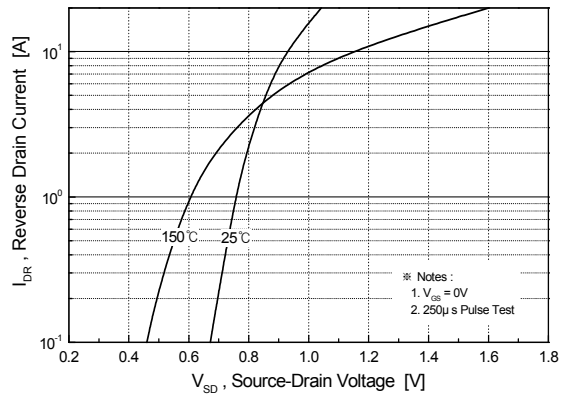
**Figure 2. Transfer Characteristics**



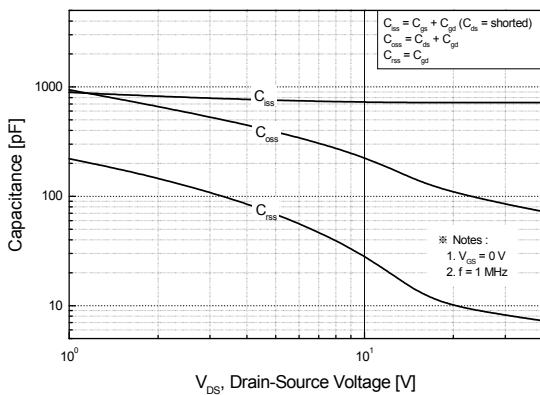
**Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage**



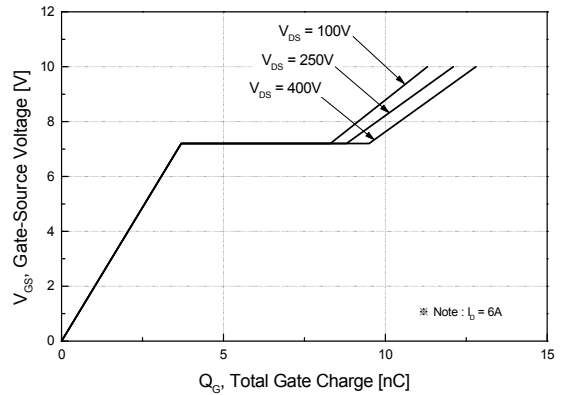
**Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature**



**Figure 5. Capacitance Characteristics**

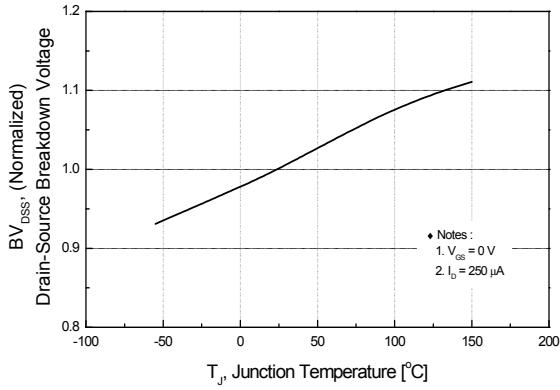


**Figure 6. Gate Charge Characteristics**

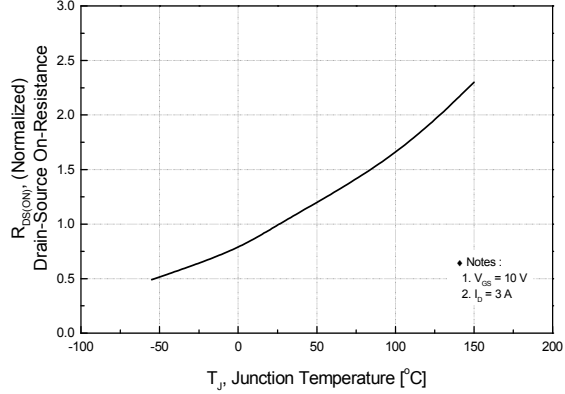


**Typical Performance Characteristics (Continued)**

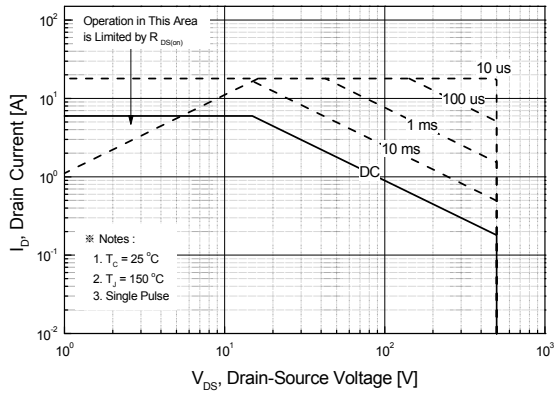
**Figure 7. Breakdown Voltage Variation vs. Temperature**



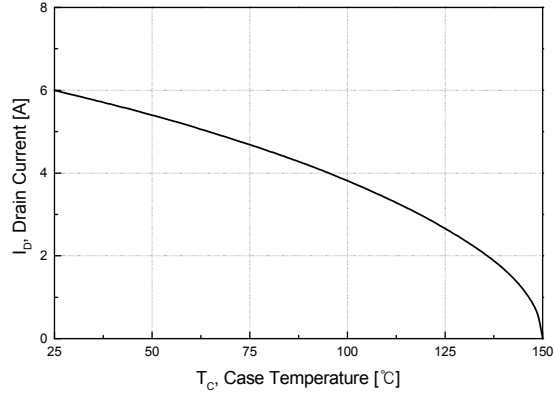
**Figure 8. On-Resistance Variation vs. Temperature**



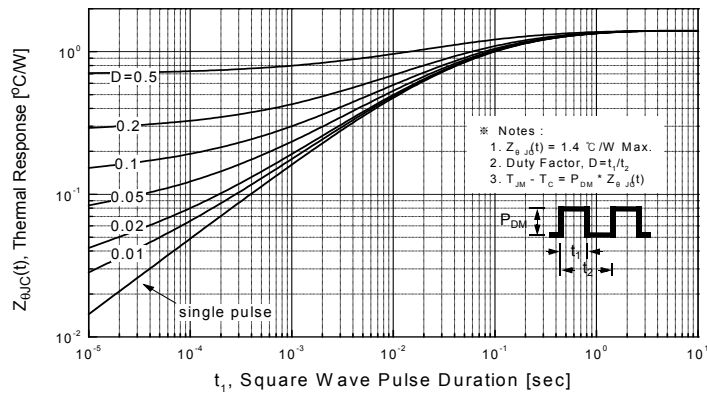
**Figure 9. Maximum Safe Operating Area**



**Figure 10. Maximum Drain Current vs. Case Temperature**



**Figure 11. Transient Thermal Response Curve**



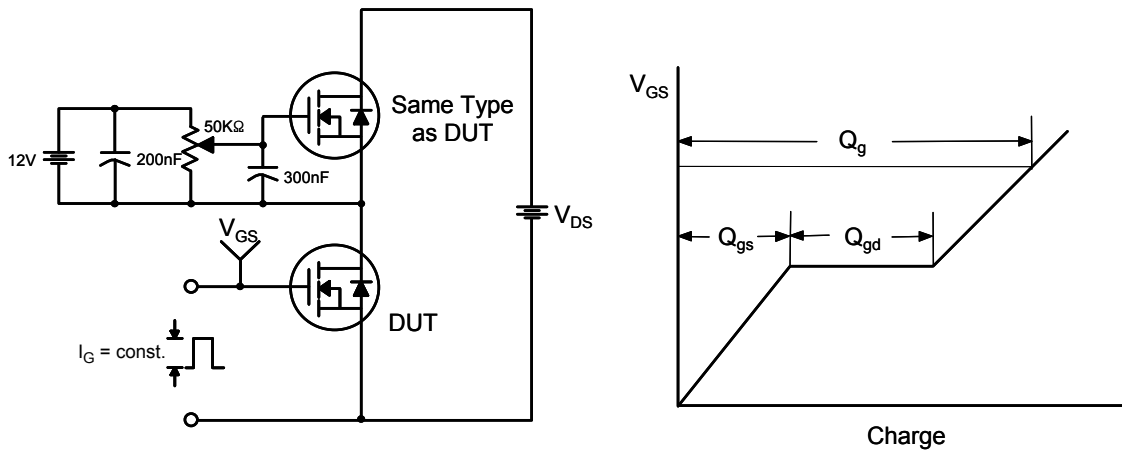


Figure 12. Gate Charge Test Circuit & Waveform

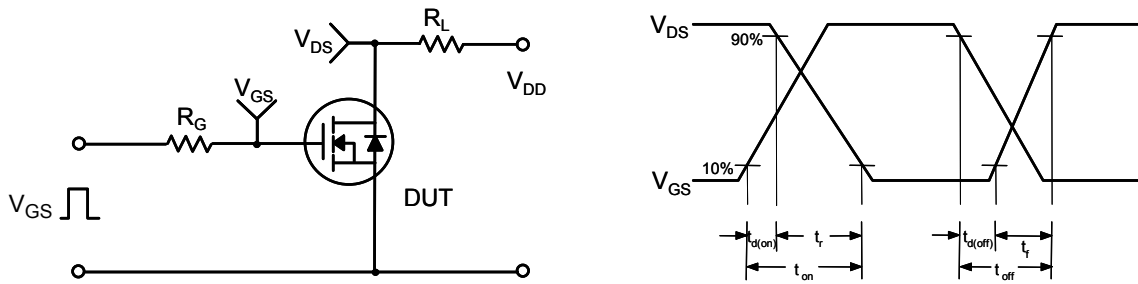


Figure 13. Resistive Switching Test Circuit & Waveforms



Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms

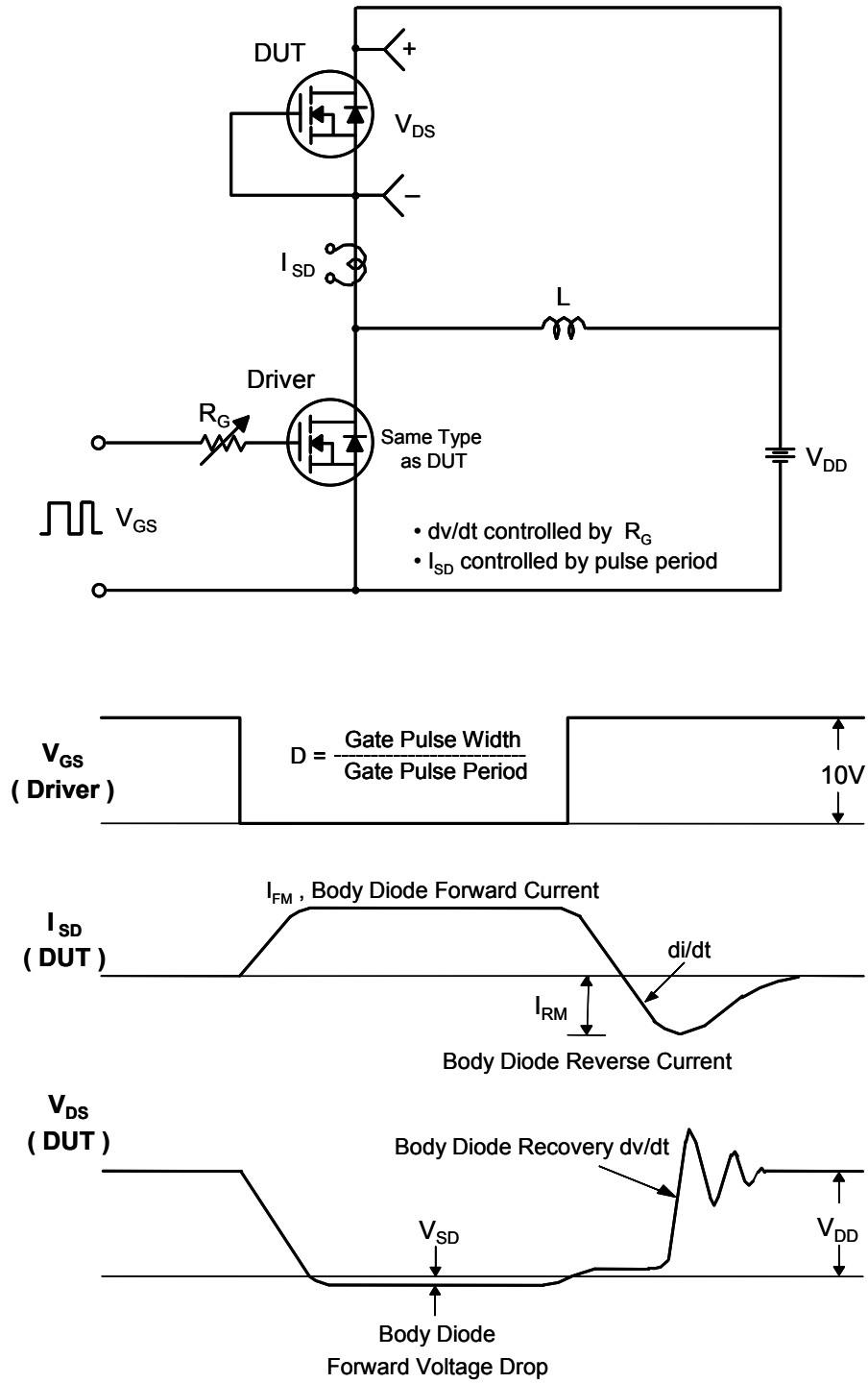


Figure 15. Peak Diode Recovery  $dv/dt$  Test Circuit & Waveforms

## Mechanical Dimensions



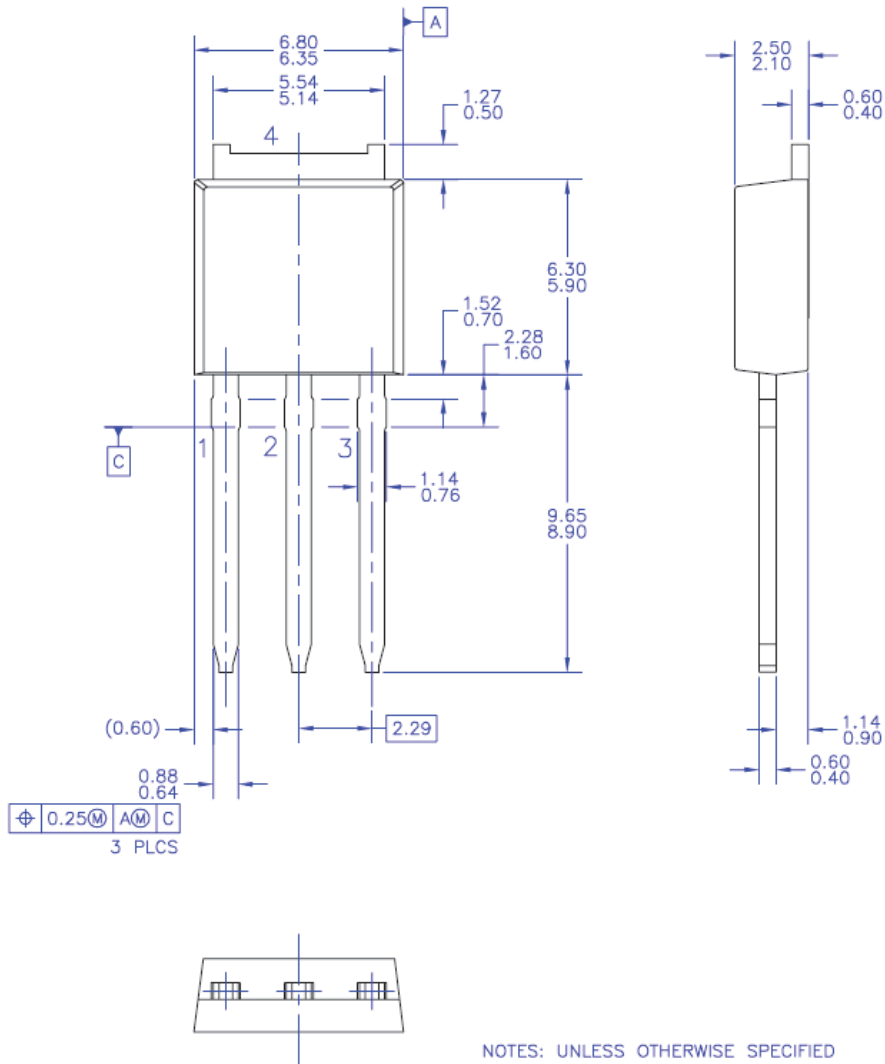
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  - B) ALL DIMENSIONS ARE IN MILLIMETERS.
  - C) DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994.
  - D) HEAT SINK TOP EDGE COULD BE IN CHAMFERED CORNERS OR EDGE PROTRUSION.
  - E) PRESENCE OF TRIMMED CENTER LEAD IS OPTIONAL.
  - F) DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR EXTRUSIONS.
  - G) LAND PATTERN RECOMMENDATION IS BASED ON IPC7351A STD TO220P1003X238-3N.
  - H) DRAWING NUMBER AND REVISION: MKT-T0252A03REV8

**Figure 16. TO252 (D-PAK), Molded, 3-Lead, Option AA&AB**

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- C) DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994.

**Figure 17. TO-251 (I-PAK), Molded, 3-Lead, Option AA**

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