



ON Semiconductor®

# FGD3N60LSD IGBT

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## Features

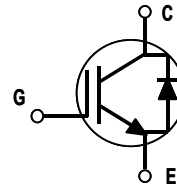
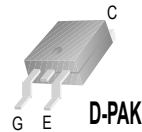
- High Current Capability
- Very Low Saturation Voltage :  $V_{CE(sat)} = 1.2\text{ V @ } I_C = 3\text{ A}$
- High Input Impedance

## Applications

- HID Lamp Applications
- Piezo Fuel Injection Applications

## Description

ON Semiconductor's Insulated Gate Bipolar Transistors (IGBTs) provide very low conduction losses. The device is designed for applications where very low On-Voltage Drop is a required feature.



## Absolute Maximum Ratings

Symbol	Description	FGD3N60LSD	Units
$V_{CES}$	Collector-Emitter Voltage	600	V
$V_{GES}$	Gate-Emitter Voltage	$\pm 25$	V
$I_C$	Collector Current @ $T_C = 25^\circ\text{C}$	6	A
	Collector Current @ $T_C = 100^\circ\text{C}$	3	A
$I_{CM(1)}$	Pulsed Collector Current (1)	25	A
$I_F$	Diode Continuous Forward Current @ $T_C = 100^\circ\text{C}$	3	A
$I_{FM}$	Diode Maximum Forward Current	25	A
$P_D$	Maximum Power Dissipation @ $T_C = 25^\circ\text{C}$	40	W
	Derating Factor	0.32	W/°C
$T_J$	Operating Junction Temperature	-55 to +150	°C
$T_{stg}$	Storage Temperature Range	-55 to +150	°C
$T_L$	Maximum Lead Temp. for Soldering Purposes, 1/8" from Case for 5 Seconds	250	°C

Notes :

(1) Repetitive rating : Pulse width limited by max. junction temperature

## Thermal Characteristics

Symbol	Parameter	Typ.	Max.	Units
$R_{\theta JC}$ (IGBT)	Thermal Resistance, Junction-to-Case	--	3.1	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient (PCB Mount) (2)	--	100	°C/W

Notes :

(2) Mounted on 1" square PCB (FR4 or G-10 Material)

## Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FGD3N60LSD	FGD3N60LSDTM	D-PAK	380mm	16mm	2500

## Electrical Characteristics of the IGBT T<sub>C</sub> = 25°C unless otherwise noted

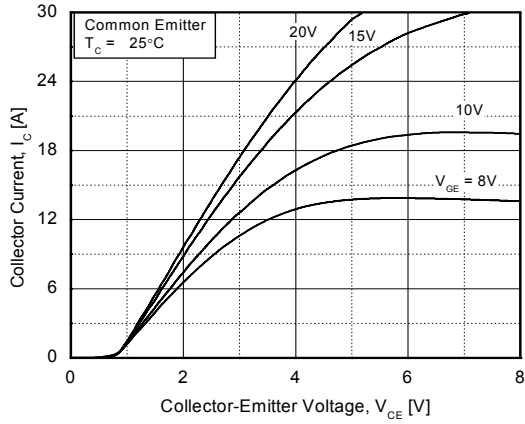
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
<b>Off Characteristics</b>						
$BV_{CES}$	Collector-Emitter Breakdown Voltage	$V_{GE} = 0V, I_C = 250\mu A$	600	--	--	V
$\frac{\Delta BV_{CES}}{\Delta T_J}$	Temperature Coefficient of Breakdown Voltage	$V_{GE} = 0V, I_C = 1mA$	--	0.6	--	V/°C
$I_{CES}$	Collector Cut-Off Current	$V_{CE} = V_{CES}, V_{GE} = 0V$	--	--	250	$\mu A$
$I_{GES}$	G-E Leakage Current	$V_{GE} = V_{GES}, V_{CE} = 0V$	--	--	$\pm 100$	nA
<b>On Characteristics</b>						
$V_{GE(th)}$	G-E Threshold Voltage	$I_C = 3mA, V_{CE} = V_{GE}$	2.5	3.2	5.0	V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	$I_C = 3A, V_{GE} = 10V$	--	1.2	1.5	V
		$I_C = 6A, V_{GE} = 10V$	--	1.8	--	V
<b>Dynamic Characteristics</b>						
$C_{ies}$	Input Capacitance	$V_{CE} = 25V, V_{GE} = 0V,$ $f = 1MHz$	--	185	--	pF
$C_{oes}$	Output Capacitance		--	20	--	pF
$C_{res}$	Reverse Transfer Capacitance		--	5.5	--	pF
<b>Switching Characteristics</b>						
$t_{d(on)}$	Turn-On Delay Time	$V_{CC} = 480V, I_C = 3A,$ $R_G = 470\Omega, V_{GE} = 10V,$ Inductive Load, $T_C = 25^\circ C$	--	40	--	ns
$t_r$	Rise Time		--	40	--	ns
$t_{d(off)}$	Turn-Off Delay Time		--	600	--	ns
$t_f$	Fall Time		--	600	--	ns
$E_{on}$	Turn-On Switching Loss		--	250	--	$\mu J$
$E_{off}$	Turn-Off Switching Loss		--	1.00	--	mJ
$E_{ts}$	Total Switching Loss		--	1.25	--	mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC} = 480V, I_C = 3A,$ $R_G = 470\Omega, V_{GE} = 10V,$ Inductive Load, $T_C = 125^\circ C$	--	40	--	ns
$t_r$	Rise Time		--	45	--	ns
$t_{d(off)}$	Turn-Off Delay Time		--	620	--	ns
$t_f$	Fall Time		--	800	--	ns
$E_{on}$	Turn-On Switching Loss		--	300	--	$\mu J$
$E_{off}$	Turn-Off Switching Loss		--	1.9	--	mJ
$E_{ts}$	Total Switching Loss		--	2.2	--	mJ
$Q_g$	Total Gate Charge	$V_{CE} = 480V, I_C = 3A,$ $V_{GE} = 10V$	--	12.5	--	nC
$Q_{ge}$	Gate-Emitter Charge		--	2.8	--	nC
$Q_{gc}$	Gate-Collector Charge		--	4.9	--	nC
$L_e$	Internal Emitter Inductance	Measured 5mm from PKG	--	7.5	--	nH

**Electrical Characteristics of DIODE**  $T_C = 25^\circ\text{C}$  unless otherwise noted

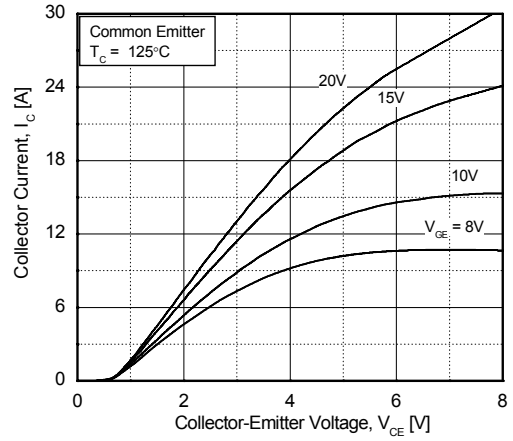
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units	
$V_{FM}$	Diode Forward Voltage	$I_F = 3A$	$T_C = 25^\circ\text{C}$	--	1.5	1.9	V
			$T_C = 100^\circ\text{C}$	--	1.55	--	
$t_{rr}$	Diode Reverse Recovery Time	$I_F = 3A,$ $di/dt = 100A/us$ $V_R = 200V$	$T_C = 25^\circ\text{C}$	--	234	--	ns
			$T_C = 100^\circ\text{C}$	--	--	--	
$I_{rr}$	Diode Peak Reverse Recovery Current	$I_F = 3A,$ $di/dt = 100A/us$ $V_R = 200V$	$T_C = 25^\circ\text{C}$	--	2.64	--	A
			$T_C = 100^\circ\text{C}$	--	--	--	
$Q_{rr}$	Diode Reverse Recovery Charge	$I_F = 3A,$ $di/dt = 100A/us$ $V_R = 200V$	$T_C = 25^\circ\text{C}$	--	309	--	nC
			$T_C = 100^\circ\text{C}$	--	--	--	

## Typical Performance Characteristics

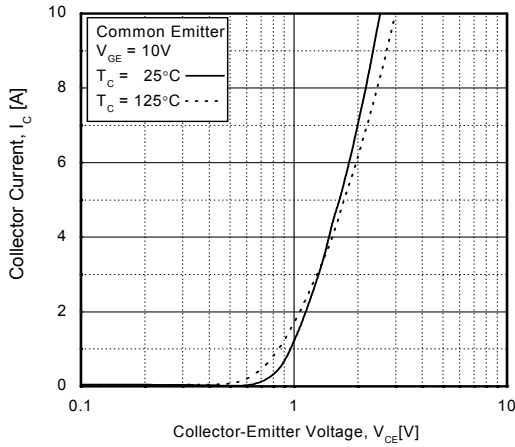
**Figure 1. Typical Output Characteristics**



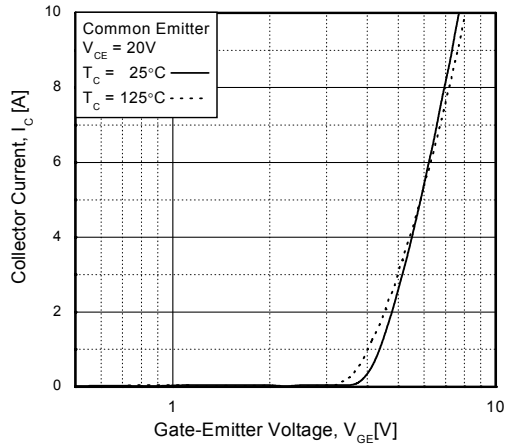
**Figure 2. Typical Output Characteristics**



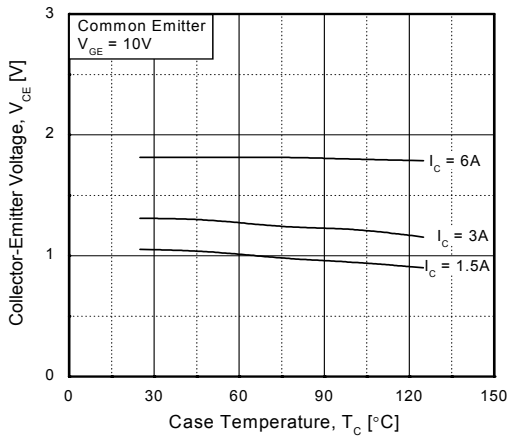
**Figure 3. Typical Output Characteristics**



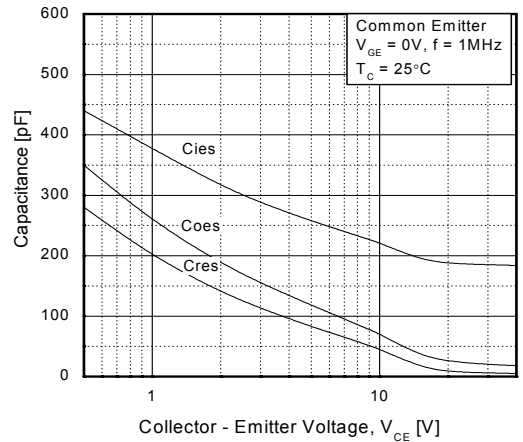
**Figure 4. Transfer Characteristics**



**Figure 5. Saturation Voltage vs. Case**

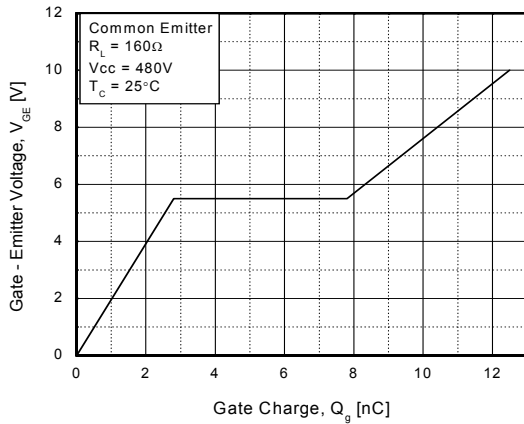


**Figure 6. Capacitance Characteristics**

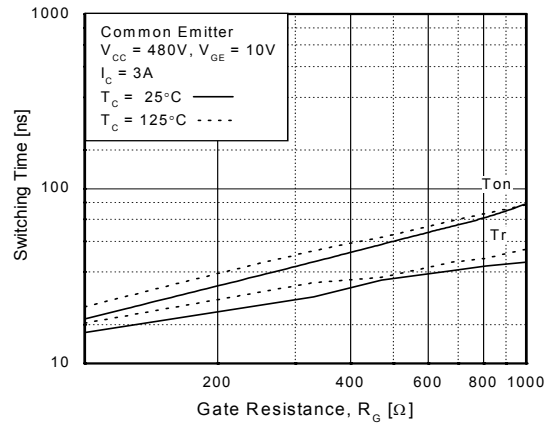


## Typical Performance Characteristics (Continued)

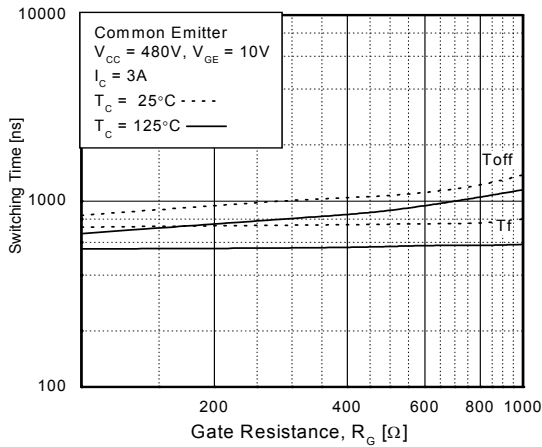
**Figure 7. Gate Charge**



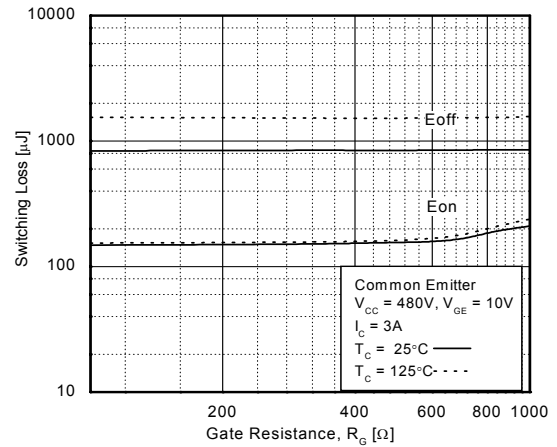
**Figure 8. Turn-On Characteristics vs. Gate Resistance**



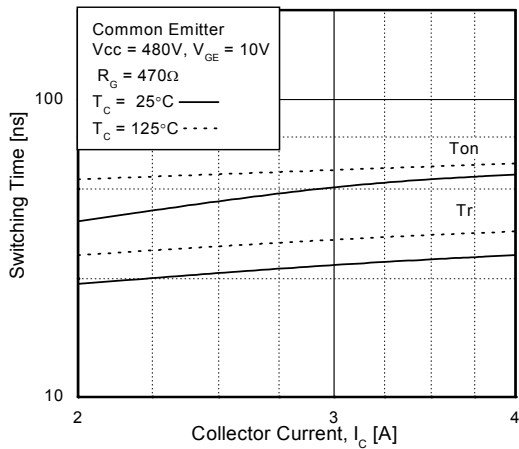
**Figure 9. Turn-Off Characteristics vs. Gate Resistance**



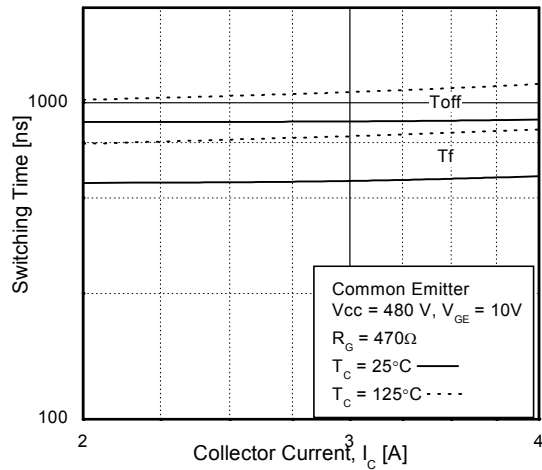
**Figure 10. Switching Loss vs. Gate Resistance**



**Figure 11. Turn-On Characteristics vs. Collector Current**

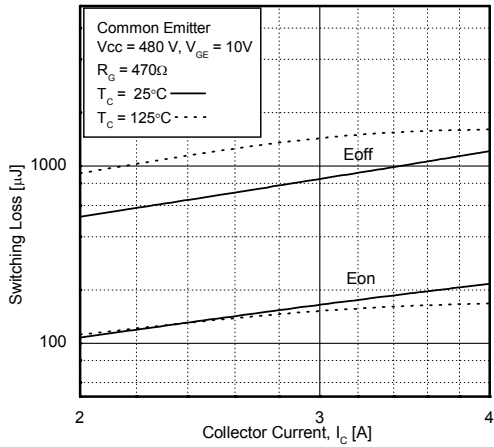


**Figure 12. Turn-Off Characteristics vs. Collector Current**

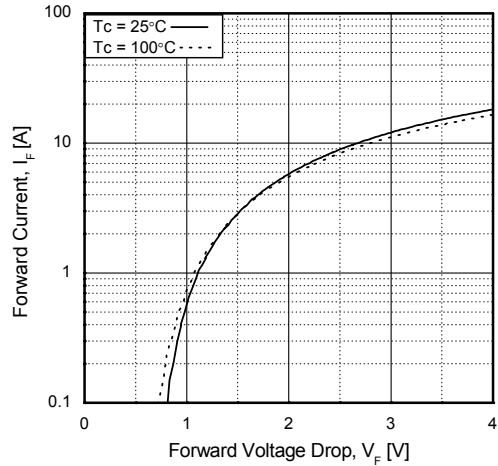


**Typical Performance Characteristics** (Continued)

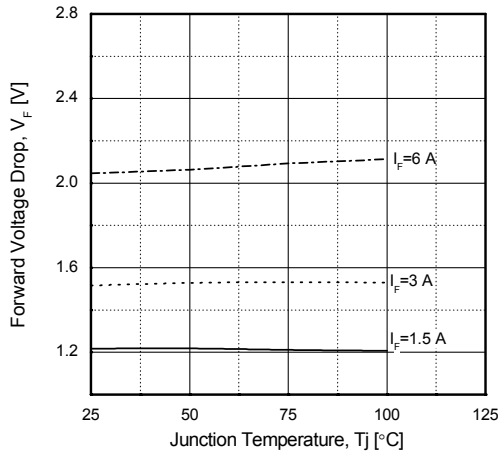
**Figure 13. Switching Loss vs. Collector Current**



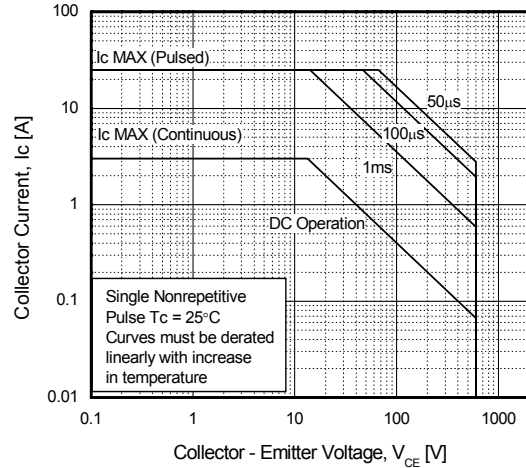
**Figure 14. Forward Characteristics**



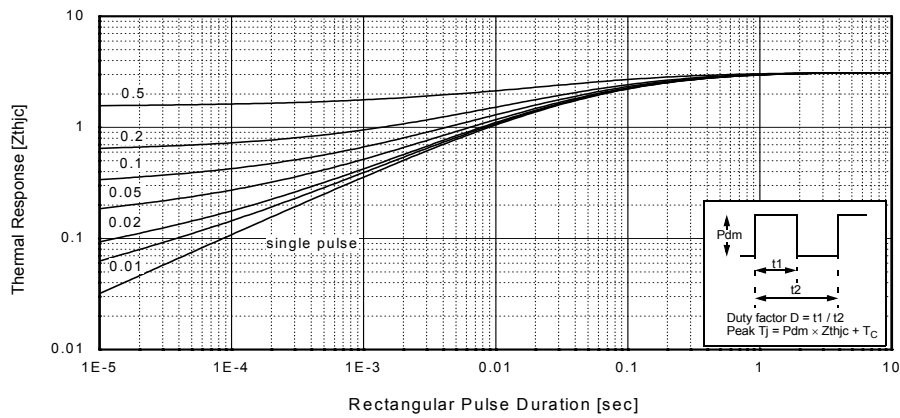
**Figure 15. Forward Voltage Drop Vs Tj**



**Figure 16. SOA Characteristics**

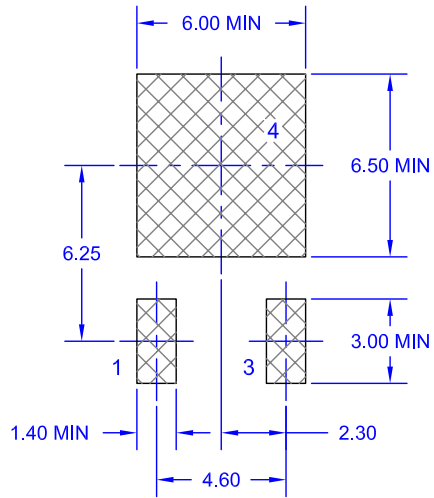
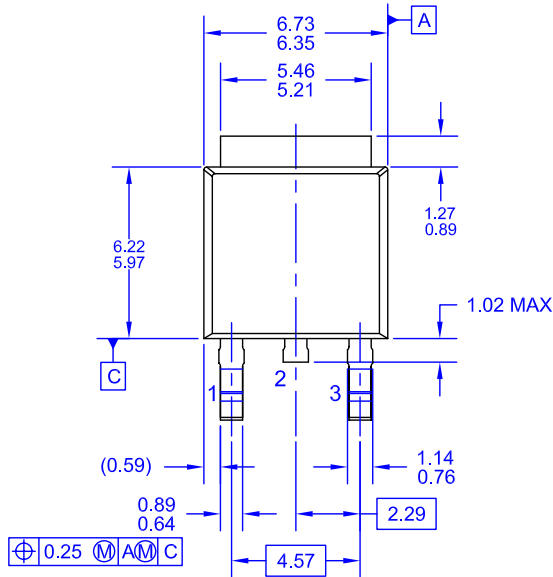


**Figure 17. Transient Thermal Impedance of IGBT**

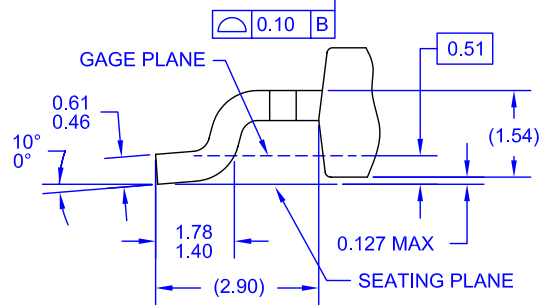
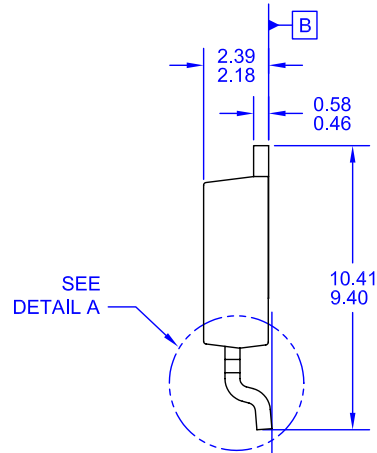
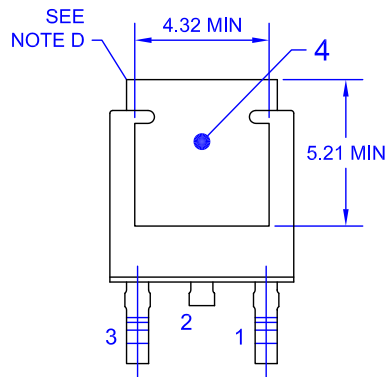


# Mechanical Dimensions

## D-PAK



LAND PATTERN RECOMMENDATION



- 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-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 BURSS, MOLD FLASH AND TIE BAR EXTRUSIONS.
  - G) LAND PATTERN RECOMMENDATION IS BASED ON IPC7351A STD TO220P1003X238-3N.
  - H) DRAWING NUMBER AND REVISION: MKT-TO252A03REV8

Dimensions in Millimeters

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