



ON Semiconductor®

FDP050AN06A0 / FDB050AN06A0

N-Channel PowerTrench® MOSFET

60 V, 80 A, 5 mΩ

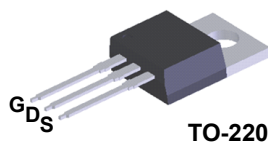
Features

- $R_{DS(on)} = 4.3 \text{ m}\Omega$ (Typ.) @ $V_{GS} = 10 \text{ V}$, $I_D = 80 \text{ A}$
- $Q_{G(tot)} = 61 \text{ nC}$ (Typ.) @ $V_{GS} = 10 \text{ V}$
- Low Miller Charge
- Low Q_{rr} Body Diode
- UIS Capability (Single Pulse and Repetitive Pulse)

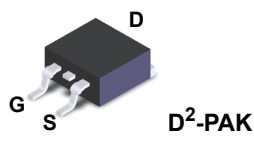
Formerly developmental type 82575

Applications

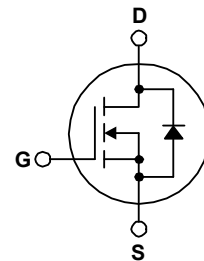
- Synchronous Rectification for ATX / Server / Telecom PSU
- Battery Protection Circuit
- Motor drives and Uninterruptible Power Supplies



TO-220



D²-PAK



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

Symbol	Parameter	FDP050AN06A0 FDB050AN06A0	Unit
V_{DSS}	Drain to Source Voltage	60	V
V_{GS}	Gate to Source Voltage	± 20	V
I_D	Drain Current		
	Continuous ($T_C < 135^\circ\text{C}$, $V_{GS} = 10\text{V}$)	80	A
	Continuous ($T_A = 25^\circ\text{C}$, $V_{GS} = 10\text{V}$, $R_{\theta JA} = 43^\circ\text{C/W}$)	18	A
	Pulsed	Figure 4	A
E_{AS}	Single Pulse Avalanche Energy (Note 1)	470	mJ
P_D	Power dissipation	245	W
	Derate above 25°C	1.63	W/ $^\circ\text{C}$
T_J, T_{STG}	Operating and Storage Temperature	-55 to 175	$^\circ\text{C}$

Thermal Characteristics

$R_{\theta JC}$	Thermal Resistance Junction to Case, Max. TO-220, D²-PAK	0.61	$^\circ\text{C/W}$
$R_{\theta JA}$	Thermal Resistance Junction to Ambient, Max. TO-220, D²-PAK (Note 2)	62	$^\circ\text{C/W}$
$R_{\theta JA}$	Thermal Resistance Junction to Ambient D²-PAK, Max. 1in² copper pad area	43	$^\circ\text{C/W}$

Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FDB050AN06A0	FDB050AN06A0	D ² -PAK	330 mm	24 mm	800 units
FDP050AN06A0	FDP050AN06A0	TO-220	Tube	N/A	50 units

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

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
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Off Characteristics

B_{VDSS}	Drain to Source Breakdown Voltage	$I_D = 250\mu\text{A}$, $V_{GS} = 0\text{V}$	60	-	-	V
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 50\text{V}$ $V_{GS} = 0\text{V}$ $T_C = 150^\circ\text{C}$	-	-	1 250	μA
I_{GSS}	Gate to Source Leakage Current	$V_{GS} = \pm 20\text{V}$	-	-	± 100	nA

On Characteristics

$V_{GS(TH)}$	Gate to Source Threshold Voltage	$V_{GS} = V_{DS}$, $I_D = 250\mu\text{A}$	2	-	4	V
$r_{DS(ON)}$	Drain to Source On Resistance	$I_D = 80\text{A}$, $V_{GS} = 10\text{V}$	-	0.0043	0.005	Ω
		$I_D = 40\text{A}$, $V_{GS} = 6\text{V}$	-	0.007	0.011	
		$I_D = 80\text{A}$, $V_{GS} = 10\text{V}$, $T_J = 175^\circ\text{C}$	-	0.0085	0.010	

Dynamic Characteristics

C_{ISS}	Input Capacitance	$V_{DS} = 25\text{V}$, $V_{GS} = 0\text{V}$, $f = 1\text{MHz}$	-	3900	-	pF
C_{OSS}	Output Capacitance		-	750	-	pF
C_{RSS}	Reverse Transfer Capacitance		-	270	-	pF
$Q_{g(TOT)}$	Total Gate Charge at 10V	$V_{GS} = 0\text{V}$ to 10V	$V_{DD} = 30\text{V}$ $I_D = 80\text{A}$ $I_g = 1.0\text{mA}$	61	80	nC
$Q_{g(TH)}$	Threshold Gate Charge	$V_{GS} = 0\text{V}$ to 2V		8	11	nC
Q_{gs}	Gate to Source Gate Charge			24	-	nC
Q_{gs2}	Gate Charge Threshold to Plateau			16	-	nC
Q_{gd}	Gate to Drain "Miller" Charge			15	-	nC

Switching Characteristics ($V_{GS} = 10\text{V}$)

t_{ON}	Turn-On Time	$V_{DD} = 30\text{V}$, $I_D = 80\text{A}$ $V_{GS} = 10\text{V}$, $R_{GS} = 4.3\Omega$	-	-	264	ns
$t_{d(ON)}$	Turn-On Delay Time		-	16	-	ns
t_r	Rise Time		-	160	-	ns
$t_{d(OFF)}$	Turn-Off Delay Time		-	28	-	ns
t_f	Fall Time		-	29	-	ns
t_{OFF}	Turn-Off Time		-	-	86	ns

Drain-Source Diode Characteristics

V_{SD}	Source to Drain Diode Voltage	$I_{SD} = 80\text{A}$	-	-	1.25	V
		$I_{SD} = 40\text{A}$	-	-	1.0	V
t_{rr}	Reverse Recovery Time	$I_{SD} = 75\text{A}$, $dI_{SD}/dt = 100\text{A}/\mu\text{s}$	-	-	34	ns
Q_{RR}	Reverse Recovered Charge	$I_{SD} = 75\text{A}$, $dI_{SD}/dt = 100\text{A}/\mu\text{s}$	-	-	25	nC

Notes:

1: Starting $T_J = 25^\circ\text{C}$, $L = 229\mu\text{H}$, $I_{AS} = 64\text{A}$.

2: Pulse width = 100s.

Typical Characteristics $T_C = 25^\circ\text{C}$ unless otherwise noted

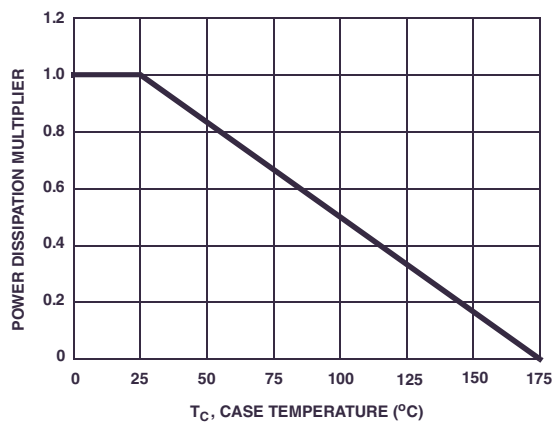


Figure 1. Normalized Power Dissipation vs Ambient Temperature

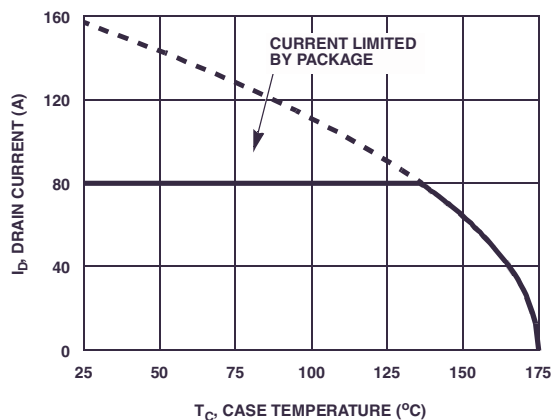


Figure 2. Maximum Continuous Drain Current vs Case Temperature

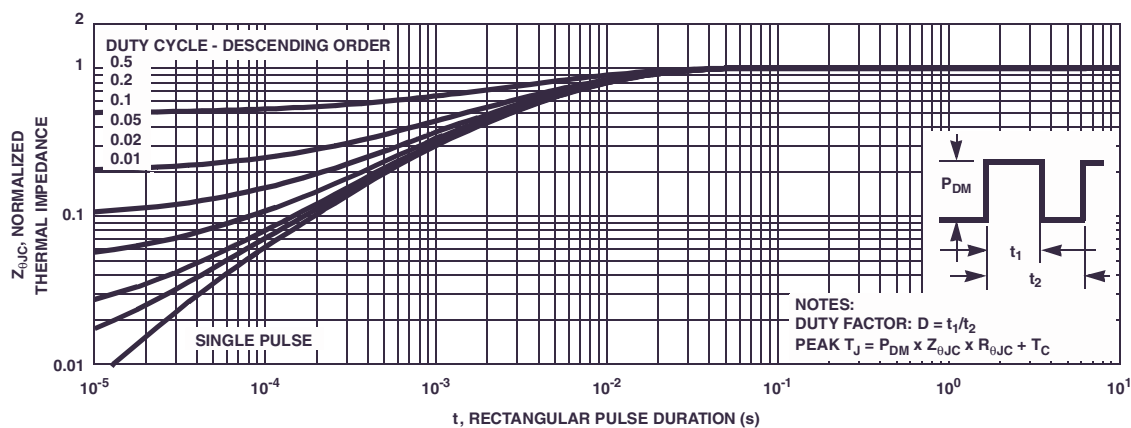


Figure 3. Normalized Maximum Transient Thermal Impedance

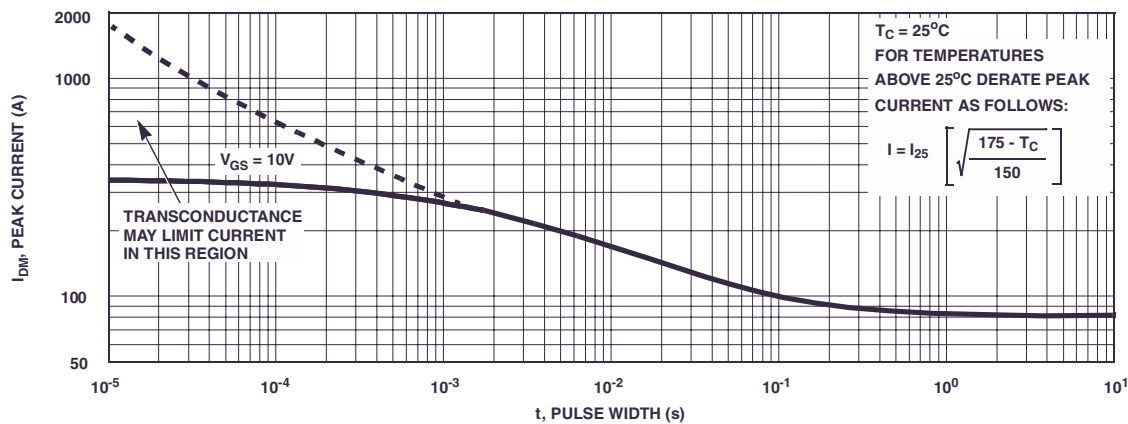


Figure 4. Peak Current Capability

Typical Characteristics $T_C = 25^\circ\text{C}$ unless otherwise noted

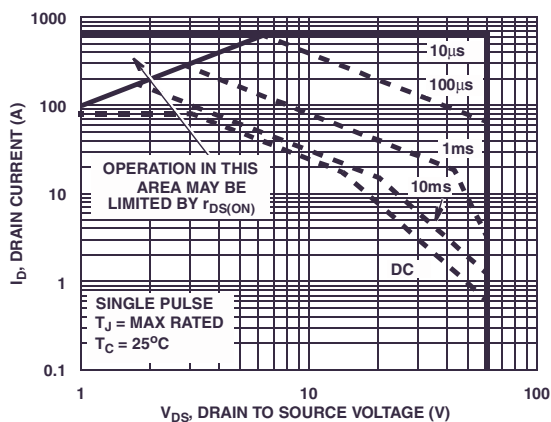
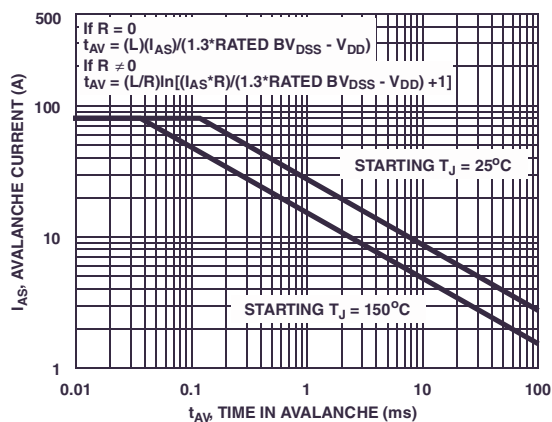


Figure 5. Forward Bias Safe Operating Area



NOTE: Refer to ON Semiconductor Application Notes AN7514 and AN7515

Figure 6. Unclamped Inductive Switching Capability

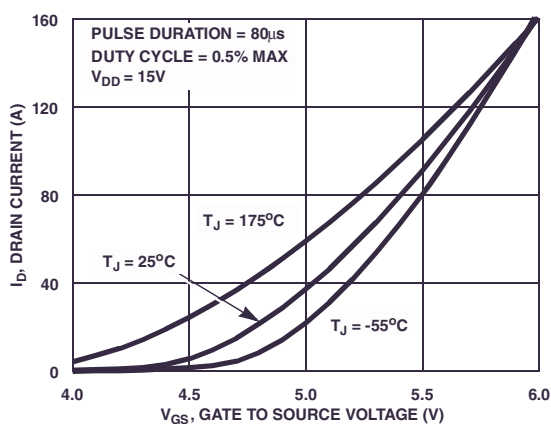


Figure 7. Transfer Characteristics

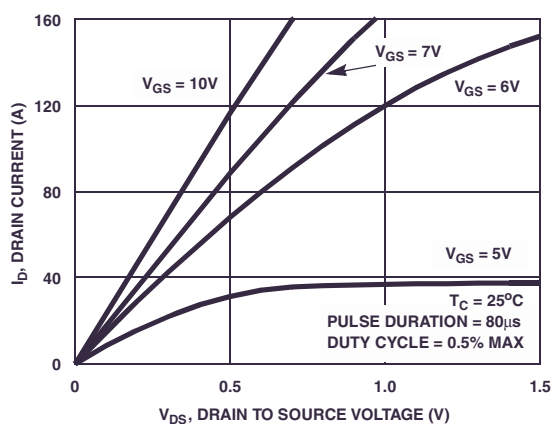


Figure 8. Saturation Characteristics

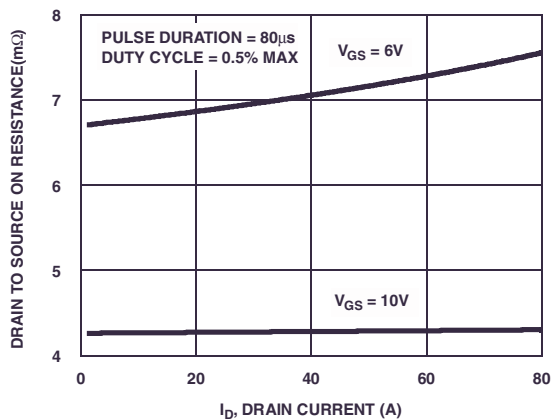


Figure 9. Drain to Source On Resistance vs Drain Current

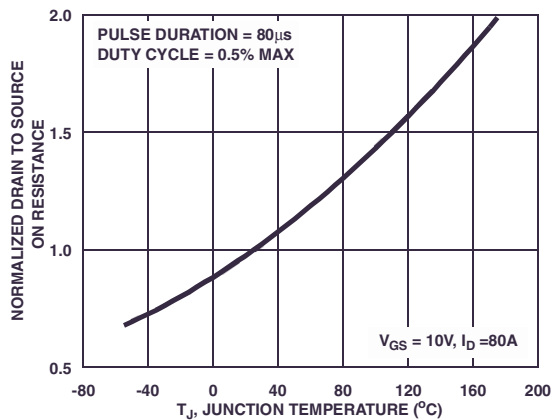


Figure 10. Normalized Drain to Source On Resistance vs Junction Temperature

Typical Characteristics $T_C = 25^\circ\text{C}$ unless otherwise noted

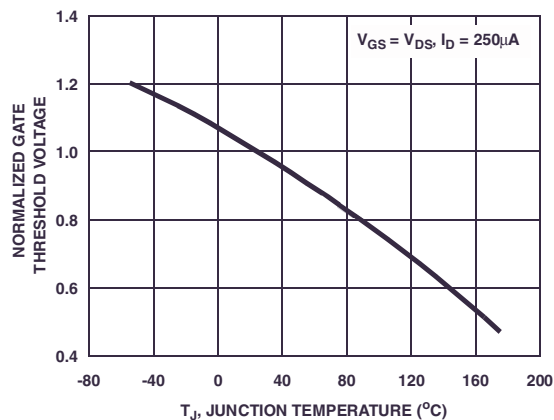


Figure 11. Normalized Gate Threshold Voltage vs Junction Temperature

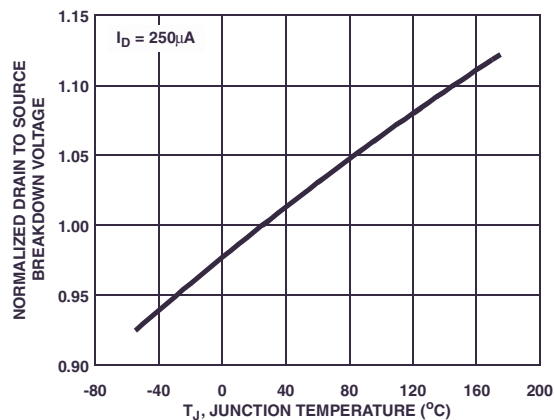


Figure 12. Normalized Drain to Source Breakdown Voltage vs Junction Temperature

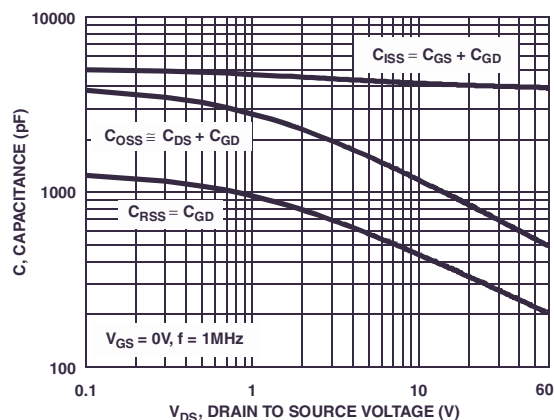


Figure 13. Capacitance vs Drain to Source Voltage

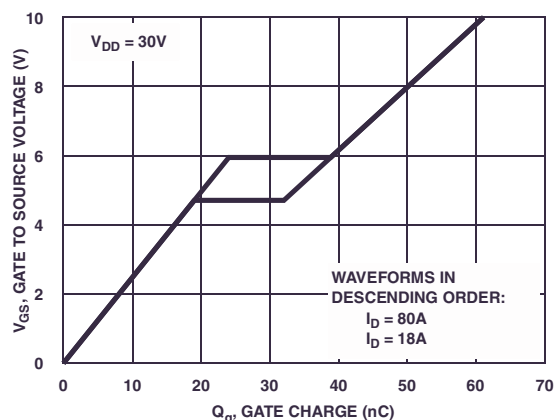


Figure 14. Gate Charge Waveforms for Constant Gate Current

Test Circuits and Waveforms

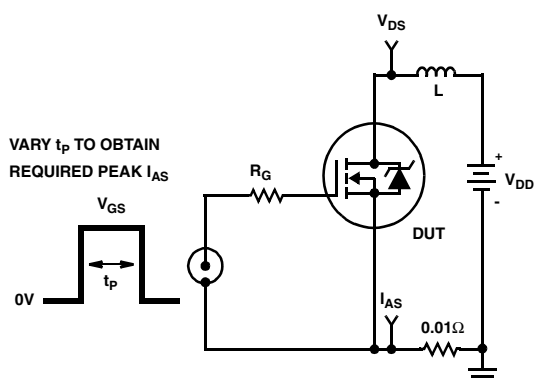


Figure 15. Unclamped Energy Test Circuit

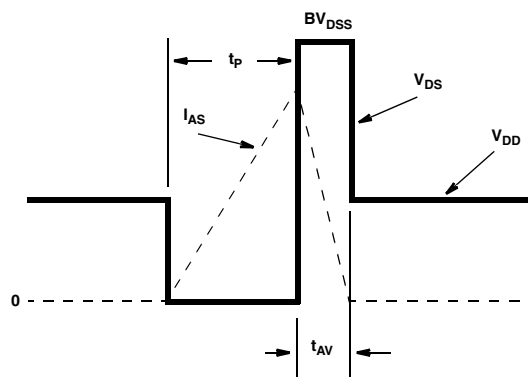


Figure 16. Unclamped Energy Waveforms

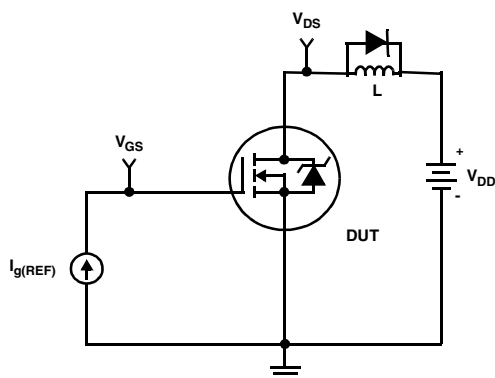


Figure 17. Gate Charge Test Circuit

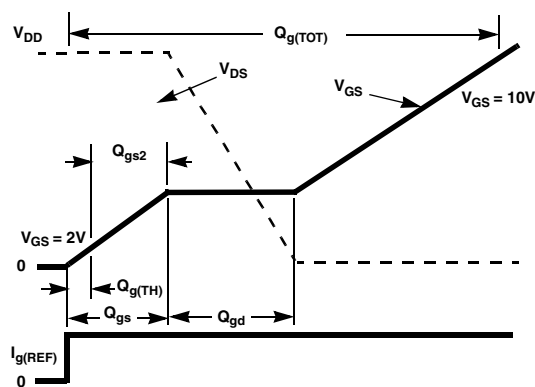


Figure 18. Gate Charge Waveforms

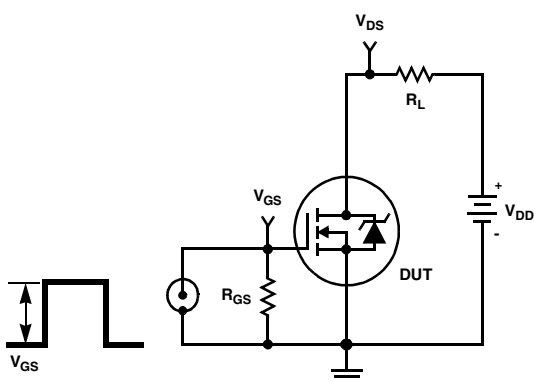


Figure 19. Switching Time Test Circuit

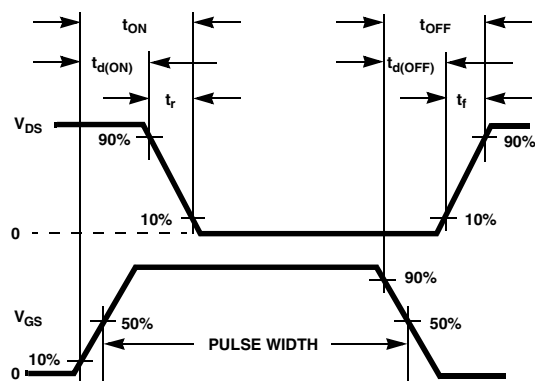


Figure 20. Switching Time Waveforms

Thermal Resistance vs. Mounting Pad Area

The maximum rated junction temperature, T_{JM} , and the thermal resistance of the heat dissipating path determines the maximum allowable device power dissipation, P_{DM} , in an application. Therefore the application's ambient temperature, T_A ($^{\circ}\text{C}$), and thermal resistance $R_{\theta JA}$ ($^{\circ}\text{C}/\text{W}$) must be reviewed to ensure that T_{JM} is never exceeded. Equation 1 mathematically represents the relationship and serves as the basis for establishing the rating of the part.

$$P_{DM} = \frac{(T_{JM} - T_A)}{R_{\theta JA}} \quad (\text{EQ. 1})$$

In using surface mount devices such as the TO-263 package, the environment in which it is applied will have a significant influence on the part's current and maximum power dissipation ratings. Precise determination of P_{DM} is complex and influenced by many factors:

1. Mounting pad area onto which the device is attached and whether there is copper on one side or both sides of the board.
2. The number of copper layers and the thickness of the board.
3. The use of external heat sinks.
4. The use of thermal vias.
5. Air flow and board orientation.
6. For non steady state applications, the pulse width, the duty cycle and the transient thermal response of the part, the board and the environment they are in.

ON Semiconductor provides thermal information to assist the designer's preliminary application evaluation. Figure 21

defines the $R_{\theta JA}$ for the device as a function of the top copper (component side) area. This is for a horizontally positioned FR-4 board with 1oz copper after 1000 seconds of steady state power with no air flow. This graph provides the necessary information for calculation of the steady state junction temperature or power dissipation. Pulse applications can be evaluated using the ON Semiconductor device Spice thermal model or manually utilizing the normalized maximum transient thermal impedance curve.

Thermal resistances corresponding to other copper areas can be obtained from Figure 21 or by calculation using Equation 2 or 3. Equation 2 is used for copper area defined in inches square and equation 3 is for area in centimeters square. The area, in square inches or square centimeters is the top copper area including the gate and source pads.

$$R_{\theta JA} = 26.51 + \frac{19.84}{(0.262 + \text{Area})} \quad (\text{EQ. 2})$$

Area in Inches Squared

$$R_{\theta JA} = 26.51 + \frac{128}{(1.69 + \text{Area})} \quad (\text{EQ. 3})$$

Area in Centimeters Squared

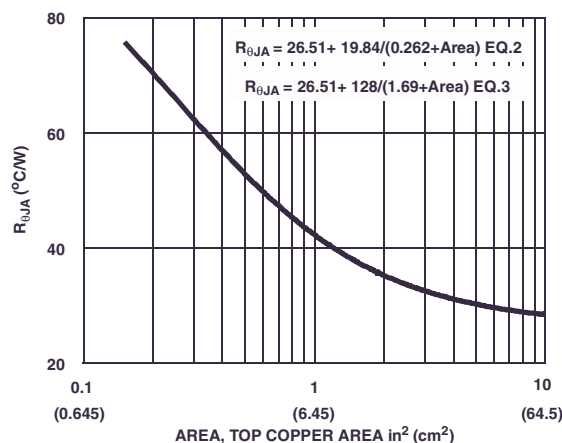


Figure 21. Thermal Resistance vs Mounting Pad Area

SPICE Thermal Model

REV 23 February 2003

FDB050AN06A0T

CTHERM1 TH 6 5e-3
 CTHERM2 6 5 1.3e-2
 CTHERM3 5 4 1.4e-2
 CTHERM4 4 3 1.9e-2
 CTHERM5 3 2 4.7e-2
 CTHERM6 2 TL 9e-2

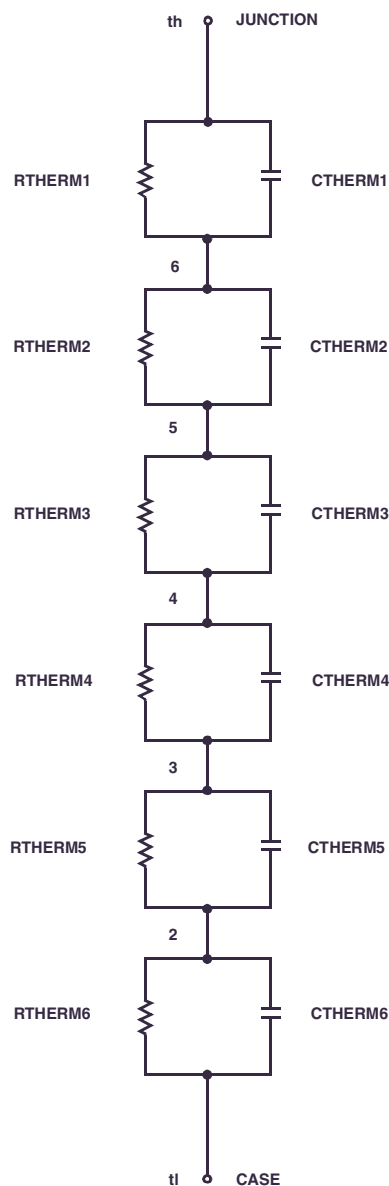
RTHERM1 TH 6 1e-2
 RTHERM2 6 5 3.1e-2
 RTHERM3 5 4 4.5e-2
 RTHERM4 4 3 1.2e-1
 RTHERM5 3 2 1.3e-1
 RTHERM6 2 TL 1.52e-1

SABER Thermal Model

SABER thermal model FDB050AN06A0T
 template thermal_model th tl
 thermal_c th, tl

```
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  ctherm.ctherm1 th 6 =5e-3
  ctherm.ctherm2 6 5 =1.3e-2
  ctherm.ctherm3 5 4 =1.4e-2
  ctherm.ctherm4 4 3 =1.9e-2
  ctherm.ctherm5 3 2 =4.7e-2
  ctherm.ctherm6 2 tl =9e-2
```

```
rtherm.rtherm1 th 6 =1e-2
rtherm.rtherm2 6 5 =3.1e-2
rtherm.rtherm3 5 4 =4.5e-2
rtherm.rtherm4 4 3 =1.2e-1
rtherm.rtherm5 3 2 =1.3e-1
rtherm.rtherm6 2 tl =1.52e-1
}
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Mechanical Dimensions

TO-220 3L

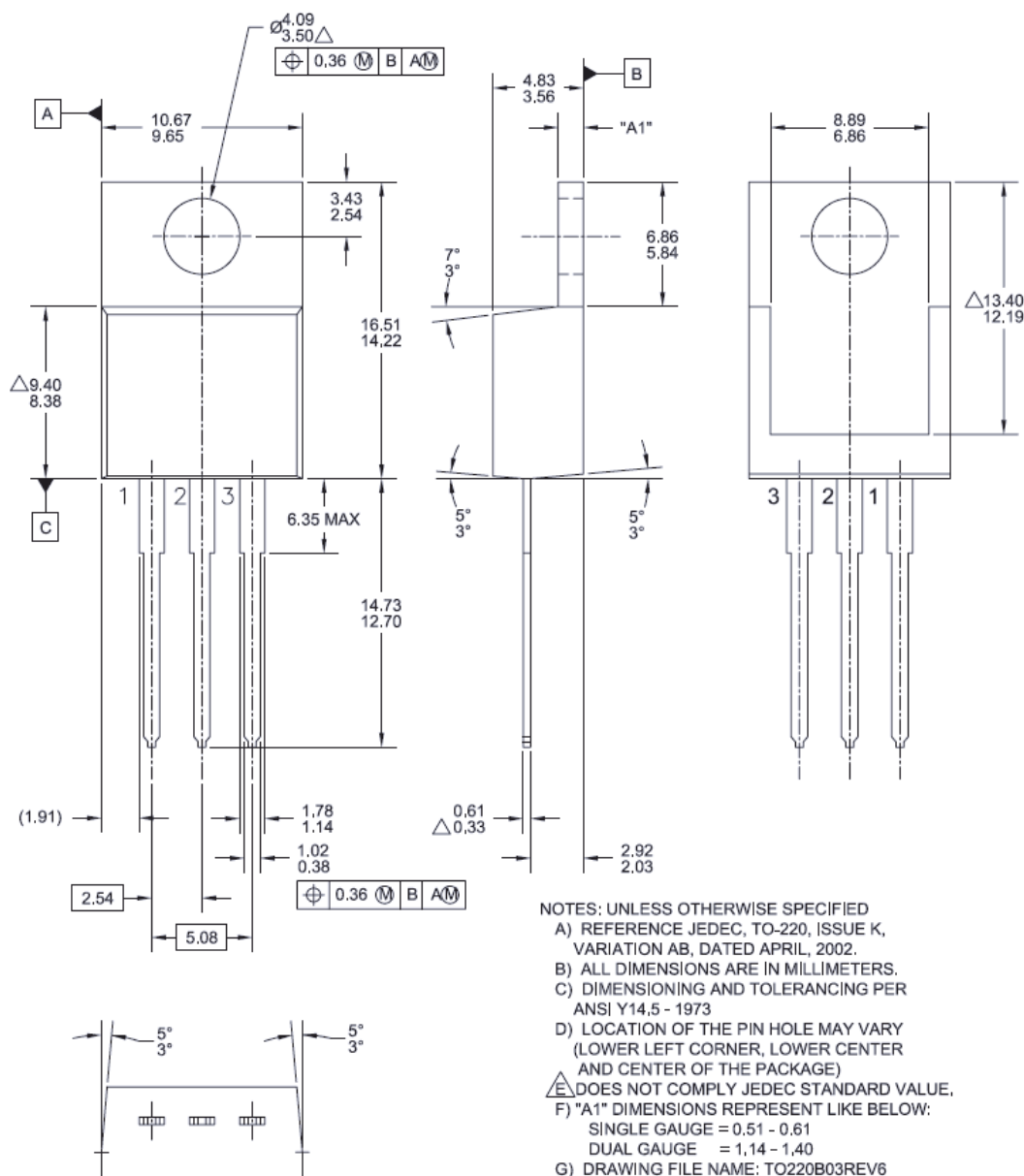


Figure 22. TO-220, Molded, 3Lead, Jedec Variation AB

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Dimension in Millimeters

Mechanical Dimensions

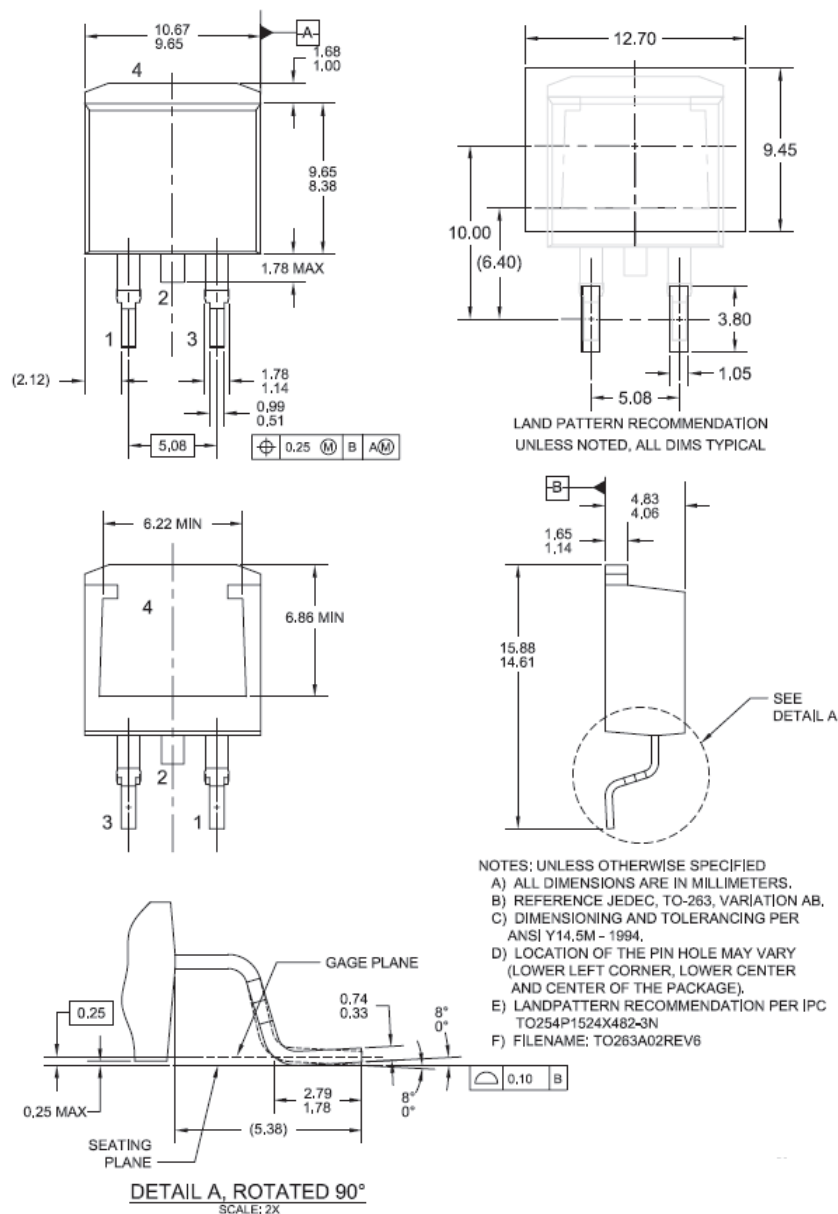
TO-263 2L (D²PAK)

Figure 23. 2LD, TO263, Surface Mount

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Dimension in Millimeters

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