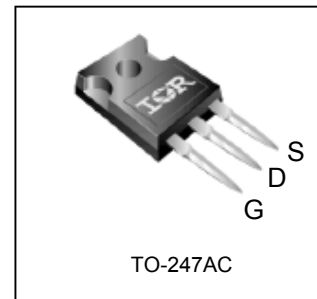
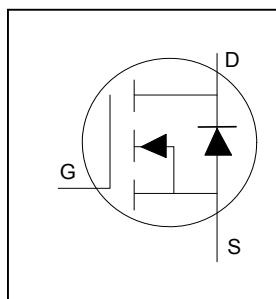


V_{DS}	60V
$R_{DS(on)}$ typ.	2.1mΩ
max.	2.5mΩ
I_D (Silicon Limited)	270A^①
I_D (Package Limited)	195A



G	D	S
Gate	Drain	Source

Applications

- High Efficiency Synchronous Rectification in SMPS
- Uninterruptible Power Supply
- High Speed Power Switching
- Hard Switched and High Frequency Circuits

Benefits

- Improved Gate, Avalanche and Dynamic dV/dt Ruggedness
- Fully Characterized Capacitance and Avalanche SOA
- Enhanced body diode dV/dt and dI/dt Capability
- Lead-Free

Base Part Number	Package Type	Standard Pack		Orderable Part Number
		Form	Quantity	
IRFP3006PbF	TO-247	Tube	25	IRFP3006PbF

Absolute Maximum Ratings

Symbol	Parameter	Max.	Units
I_D @ $T_C = 25^\circ\text{C}$	Continuous Drain Current, V_{GS} @ 10V (Silicon Limited)	270 ^①	A
I_D @ $T_C = 100^\circ\text{C}$	Continuous Drain Current, V_{GS} @ 10V (Silicon Limited)	190 ^①	
I_D @ $T_C = 25^\circ\text{C}$	Continuous Drain Current, V_{GS} @ 10V (Wire Bond Limited)	195	
I_{DM}	Pulsed Drain Current ^②	1080	
P_D @ $T_C = 25^\circ\text{C}$	Maximum Power Dissipation	375	W
	Linear Derating Factor	2.5	W/ $^\circ\text{C}$
V_{GS}	Gate-to-Source Voltage	± 20	V
dv/dt	Peak Diode Recovery ^④	10	V/ns
T_J	Operating Junction and	-55 to + 175	$^\circ\text{C}$
T_{STG}	Storage Temperature Range		
	Soldering Temperature, for 10 seconds (1.6mm from case)	300	
	Mounting torque, 6-32 or M3 screw	10lbf.in (1.1N.m)	

Avalanche Characteristics

E_{AS} (Thermally limited)	Single Pulse Avalanche Energy ^③	320	mJ
I_{AR}	Avalanche Current ^②	See Fig. 14, 15, 22a, 22b	A
E_{AR}	Repetitive Avalanche Energy ^⑤		mJ

Thermal Resistance

Symbol	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case ^⑧	—	0.4	$^\circ\text{C/W}$
$R_{\theta CS}$	Case-to-Sink, Flat Greased Surface	0.24	—	
$R_{\theta JA}$	Junction-to-Ambient	—	40	

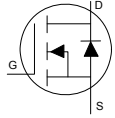
Static @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	60	—	—	V	$V_{GS} = 0V, I_D = 250\mu A$
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	0.07	—	V/ $^\circ\text{C}$	Reference to 25°C , $I_D = 5mA$ ②
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	2.1	2.5	m Ω	$V_{GS} = 10V, I_D = 170A$ ⑤
$V_{GS(th)}$	Gate Threshold Voltage	2.0	—	4.0	V	$V_{DS} = V_{GS}, I_D = 250\mu A$
I_{DSS}	Drain-to-Source Leakage Current	—	—	20	μA	$V_{DS} = 60V, V_{GS} = 0V$
		—	—	250		$V_{DS} = 60V, V_{GS} = 0V, T_J = 125^\circ\text{C}$
I_{GSS}	Gate-to-Source Forward Leakage	—	—	100	nA	$V_{GS} = 20V$
	Gate-to-Source Reverse Leakage	—	—	-100		$V_{GS} = -20V$
R_G	Internal Gate Resistance	—	2.0	—	Ω	

Dynamic @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

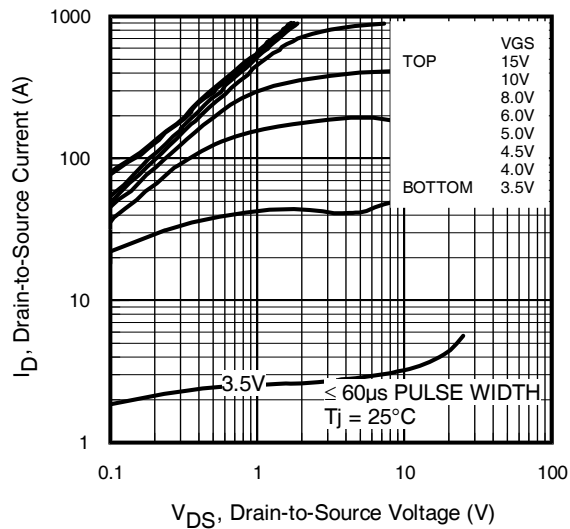
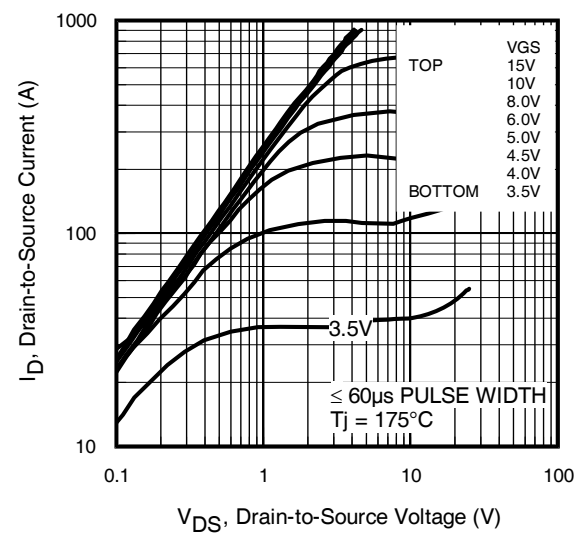
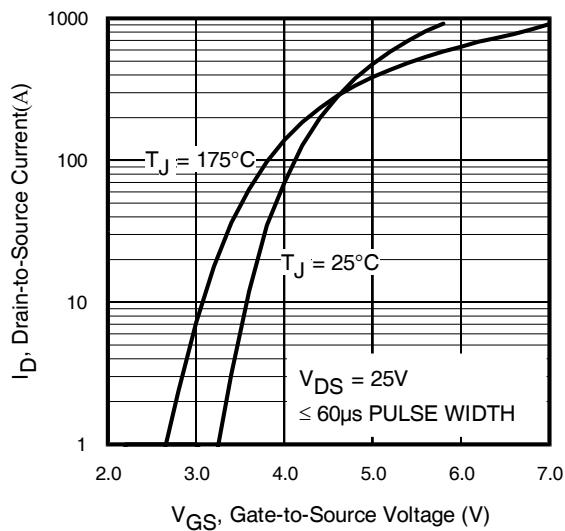
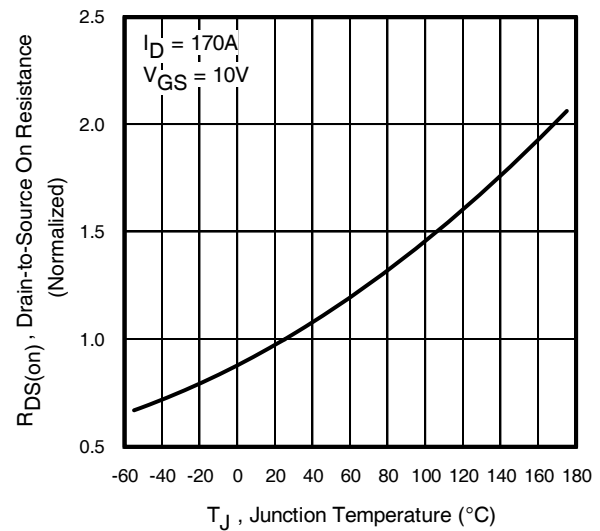
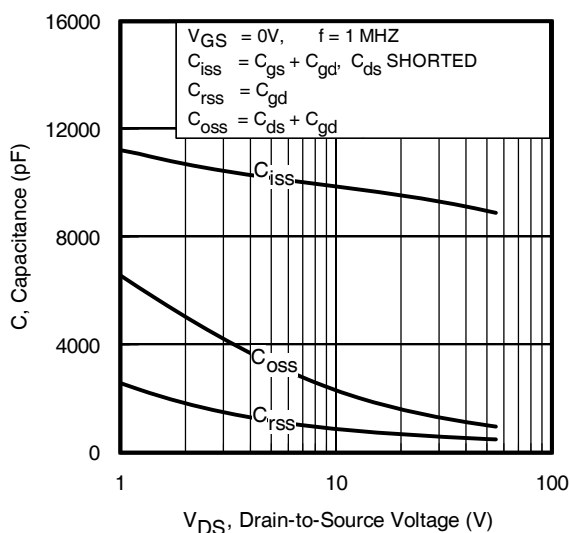
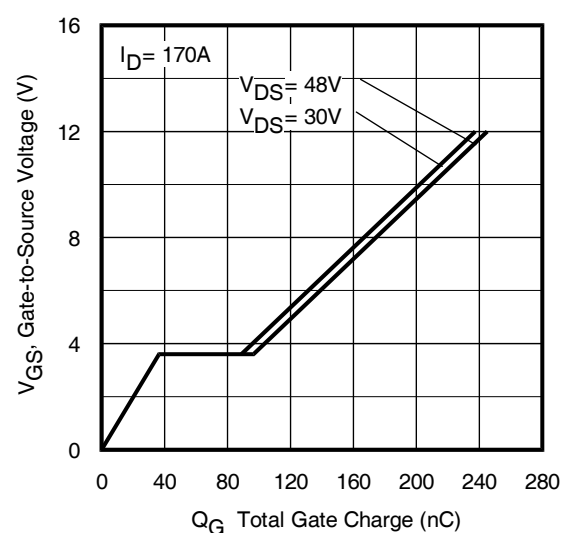
Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
gfs	Forward Transconductance	280	—	—	S	$V_{DS} = 25V, I_D = 170A$
Q_g	Total Gate Charge	—	200	300	nC	$I_D = 170A$
Q_{gs}	Gate-to-Source Charge	—	37	—		$V_{DS} = 30V$
Q_{gd}	Gate-to-Drain ("Miller") Charge	—	60	—		$V_{GS} = 10V$ ⑤
Q_{sync}	Total Gate Charge Sync. ($Q_g - Q_{gd}$)	—	140	—		$I_D = 170A, V_{DS} = 0V, V_{GS} = 10V$
$t_{d(on)}$	Turn-On Delay Time	—	16	—	ns	$V_{DD} = 39V$
t_r	Rise Time	—	182	—		$I_D = 170A$
$t_{d(off)}$	Turn-Off Delay Time	—	118	—		$R_G = 2.7\Omega$
t_f	Fall Time	—	189	—		$V_{GS} = 10V$ ⑤
C_{iss}	Input Capacitance	—	8970	—	pF	$V_{GS} = 0V$
C_{oss}	Output Capacitance	—	1020	—		$V_{DS} = 50V$
C_{rss}	Reverse Transfer Capacitance	—	534	—		$f = 1.0\text{ MHz}$, See Fig. 5
$C_{oss\text{ eff. (ER)}}$	Effective Output Capacitance (Energy Related)	—	1480	—		$V_{GS} = 0V, V_{DS} = 0V\text{ to }48V$ ⑦ See Fig. 11
$C_{oss\text{ eff. (TR)}}$	Effective Output Capacitance (Time Related)	—	1920	—		$V_{GS} = 0V, V_{DS} = 0V\text{ to }48V$ ⑥

Diode Characteristics

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	—	—	257①	A	MOSFET symbol showing the integral reverse p-n junction diode. 
I_{SM}	Pulsed Source Current (Body Diode) ②	—	—	1028		
V_{SD}	Diode Forward Voltage	—	—	1.3	V	$T_J = 25^\circ\text{C}, I_S = 170A, V_{GS} = 0V$ ④
t_{rr}	Reverse Recovery Time	—	44	—	ns	$T_J = 25^\circ\text{C}$
		—	48	—		$T_J = 125^\circ\text{C}$
Q_{rr}	Reverse Recovery Charge	—	63	—	nC	$T_J = 25^\circ\text{C}$
		—	77	—		$T_J = 125^\circ\text{C}$
I_{RRM}	Reverse Recovery Current	—	2.4	—	A	$T_J = 25^\circ\text{C}$ $V_R = 51V, I_F = 170A, di/dt = 100A/\mu s$ ⑤

Notes:

- ① Calculated continuous current based on maximum allowable junction temperature. Bond wire current limit is 195A. Note that current limitations arising from heating of the device leads may occur with some lead mounting arrangements. (Refer to AN-1140)
- ② Repetitive rating; pulse width limited by max. Junction temperature.
- ③ Limited by T_{Jmax} , starting $T_J = 25^\circ\text{C}$, $L = 0.022mH$, $R_G = 50\Omega$, $I_{AS} = 170A, V_{GS} = 10V$. Part not Recommended for use above this value.
- ④ $I_{SD} \leq 170A, di/dt \leq 1360A/\mu s, V_{DD} \leq V_{(BR)DSS}, T_J \leq 175^\circ\text{C}$.
- ⑤ Pulse width $\leq 400\mu s$; duty cycle $\leq 2\%$.
- ⑥ $C_{oss\text{ eff. (TR)}}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS} .
- ⑦ $C_{oss\text{ eff. (ER)}}$ is a fixed capacitance that gives the same energy as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS} .
- ⑧ R_θ is measured at T_J approximately 90°C .
- * All spec data and curves based on (TO-220 Pak -IRFP3006PbF) Datasheet.


Fig 1. Typical Output Characteristics

Fig 2. Typical Output Characteristics

Fig 3. Typical Transfer Characteristics

Fig 4. Normalized On-Resistance vs. Temperature

Fig 5. Typical Capacitance vs. Drain-to-Source Voltage

Fig 6. Typical Gate Charge vs. Gate-to-Source Voltage

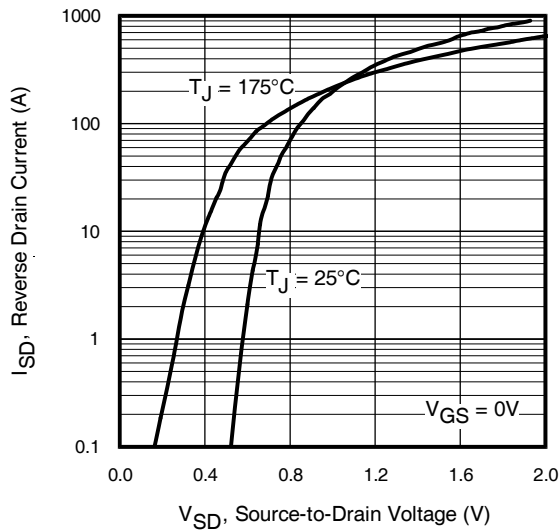


Fig 7. Typical Source-to-Drain Diode Forward Voltage

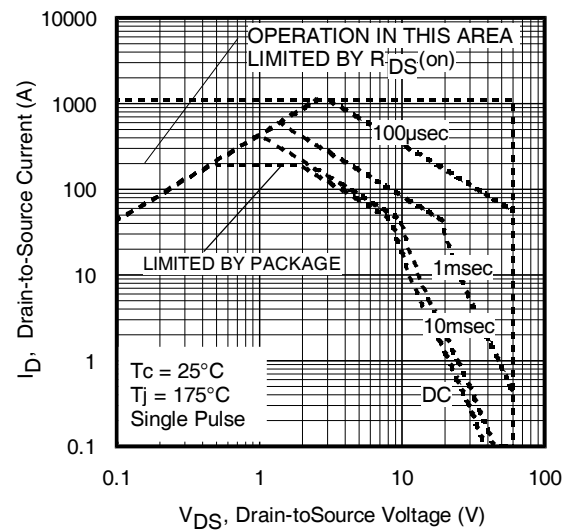


Fig 8. Maximum Safe Operating Area

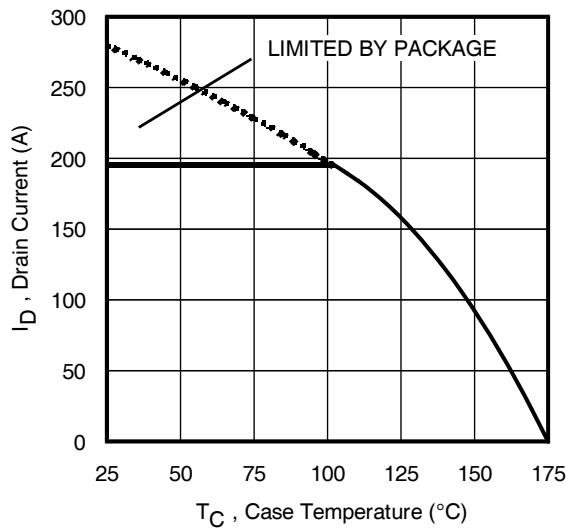


Fig 9. Maximum Drain Current vs. Case Temperature

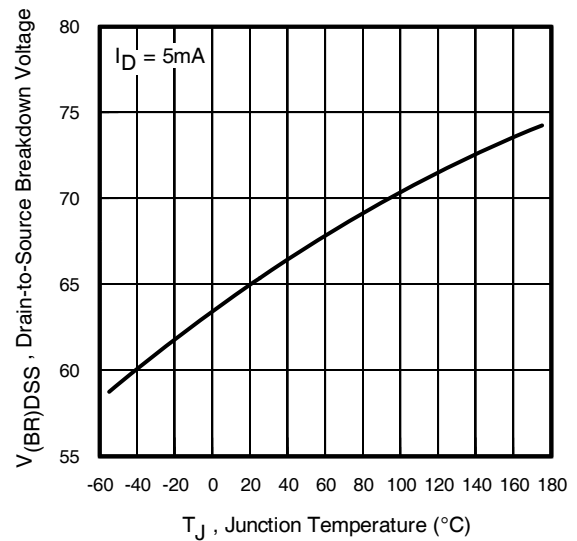


Fig 10. Drain-to-Source Breakdown Voltage

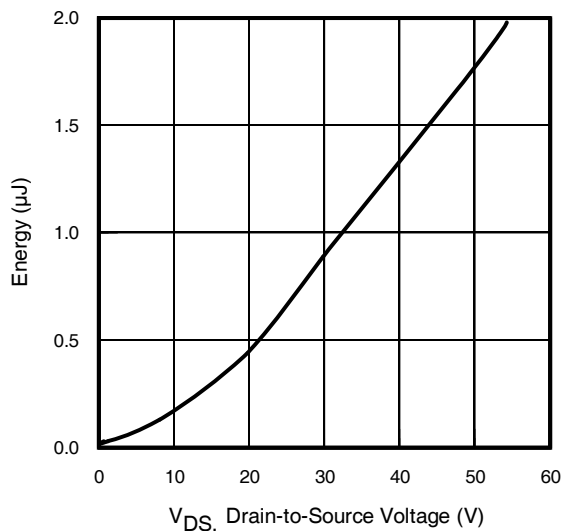


Fig 11. Typical C_{oss} Stored Energy

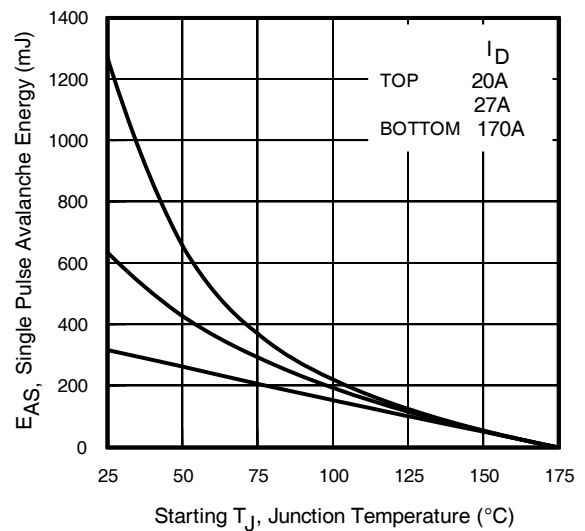


Fig 12. Maximum Avalanche Energy vs. Drain Current

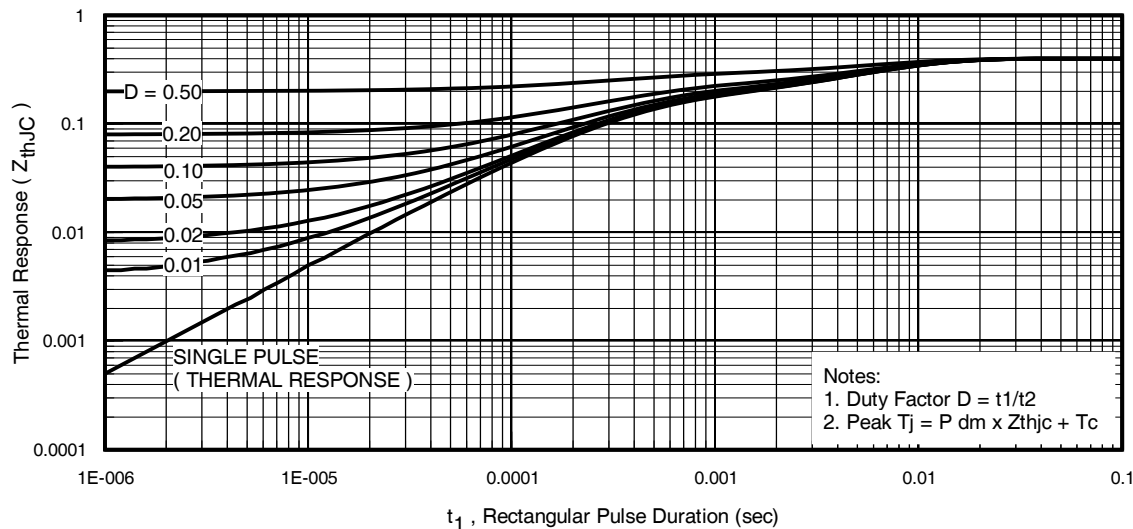


Fig 13. Maximum Effective Transient Thermal Impedance, Junction-to-Case

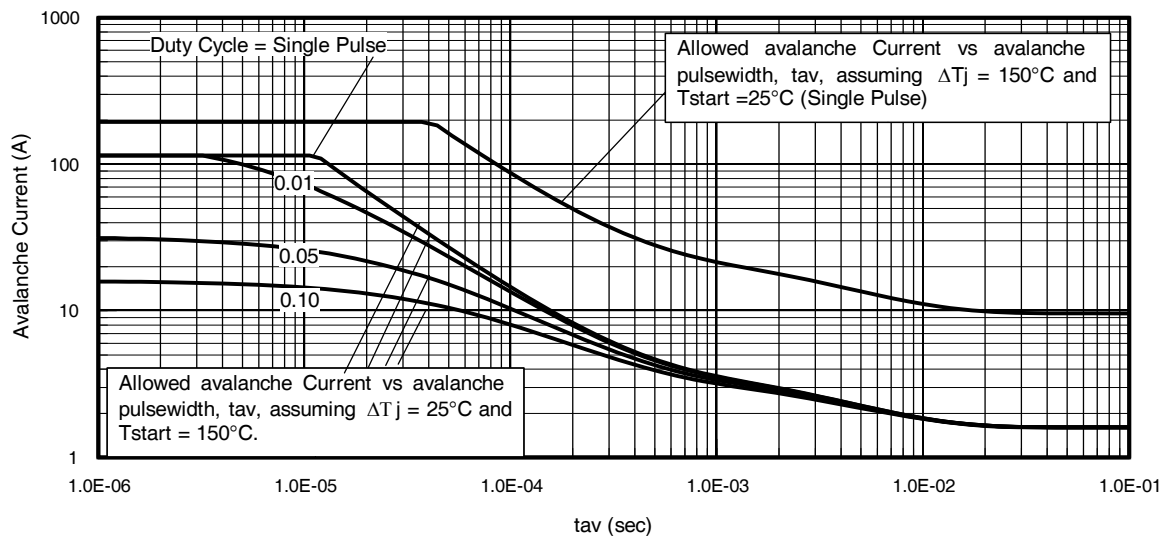


Fig 14. Typical Avalanche Current vs. Pulsewidth

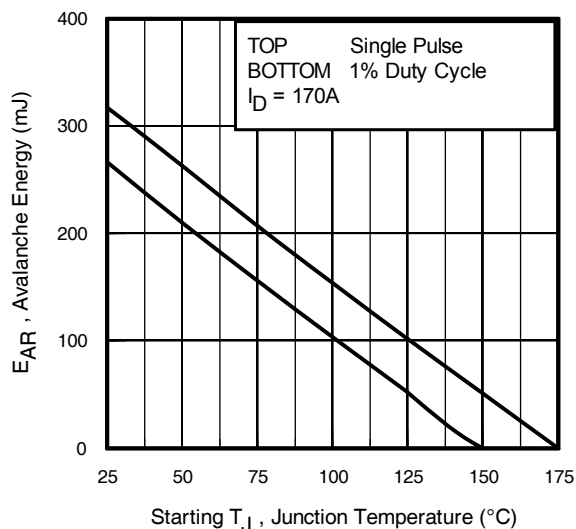


Fig 15. Maximum Avalanche Energy vs. Temperature

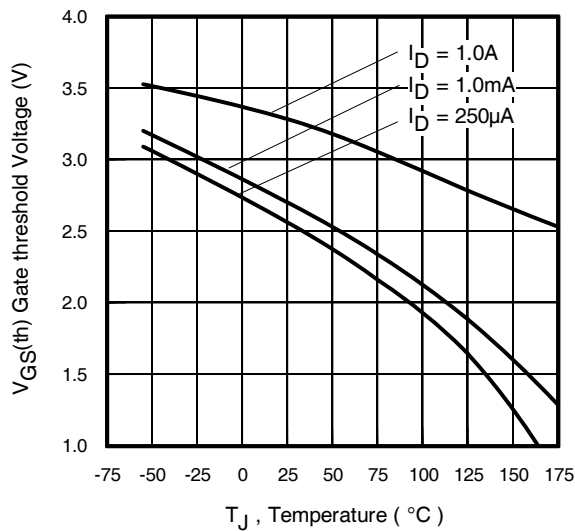
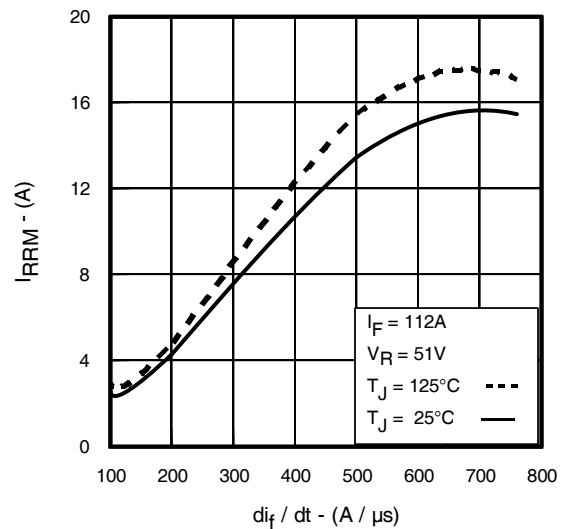
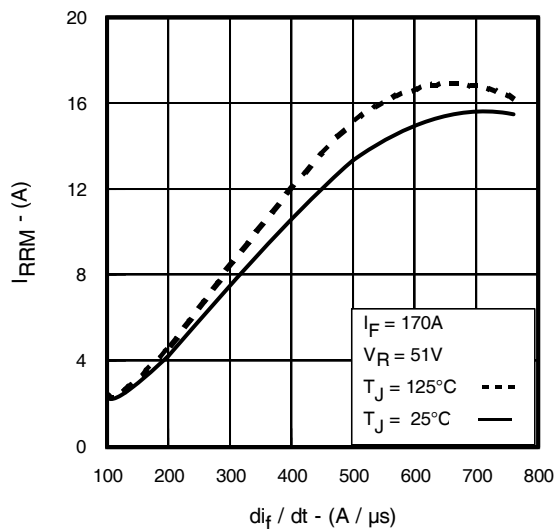
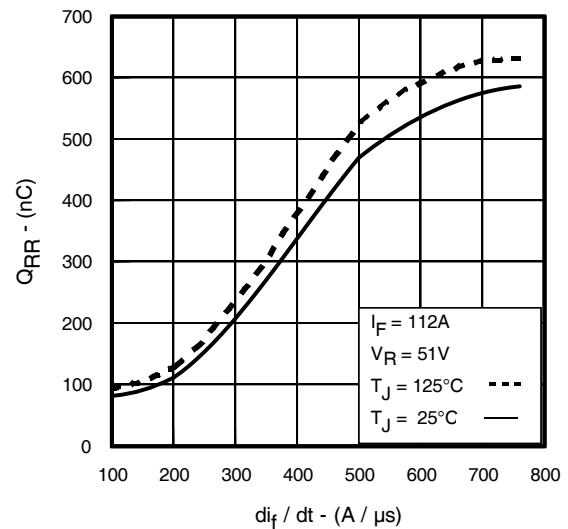
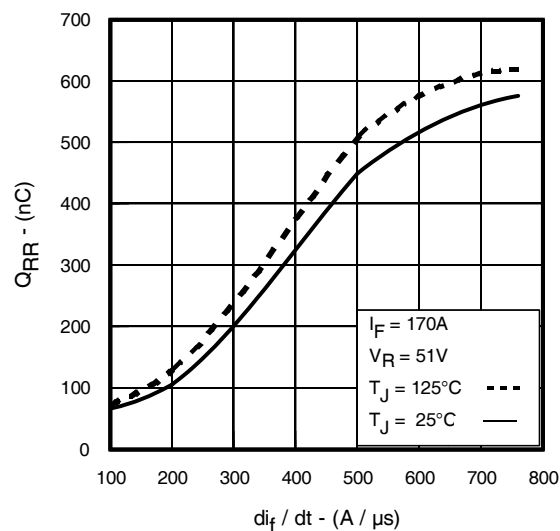
Notes on Repetitive Avalanche Curves , Figures 14, 15:
(For further info, see AN-1005 at www.irf.com)

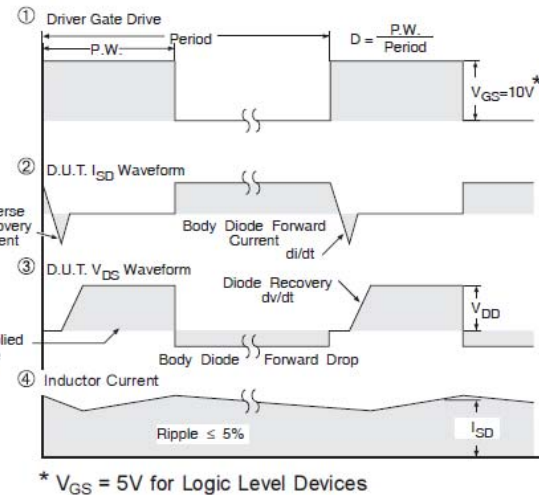
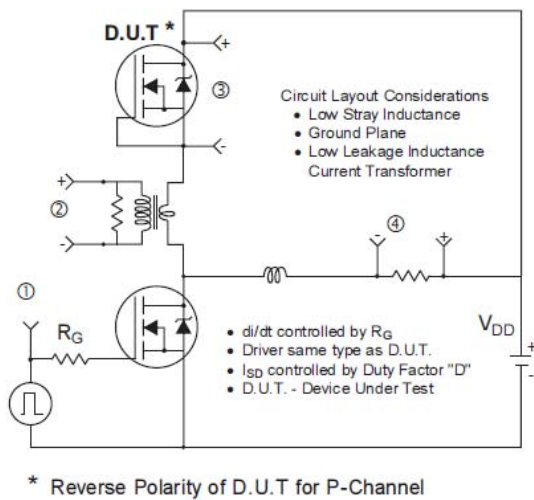
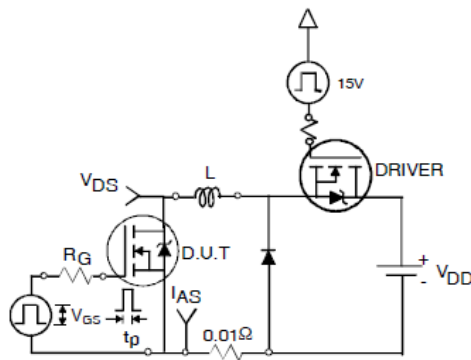
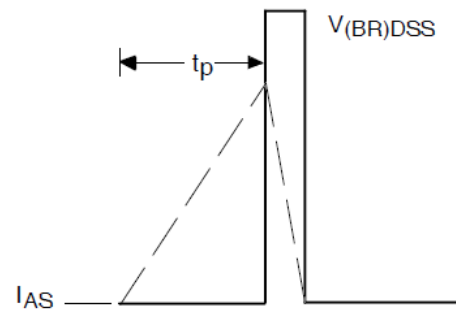
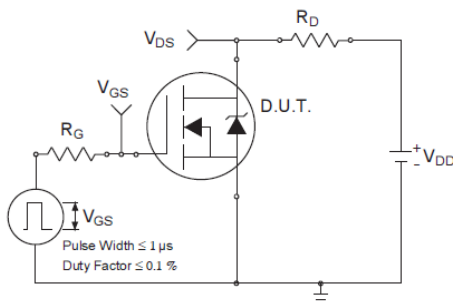
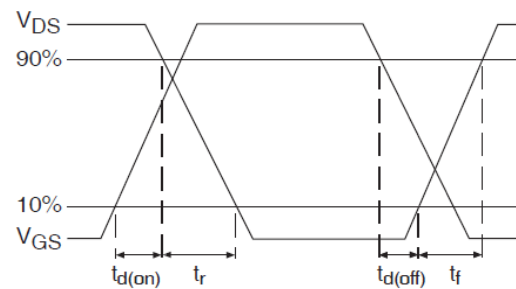
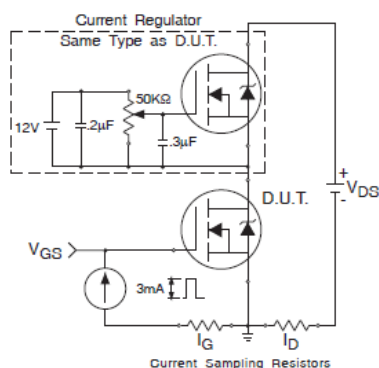
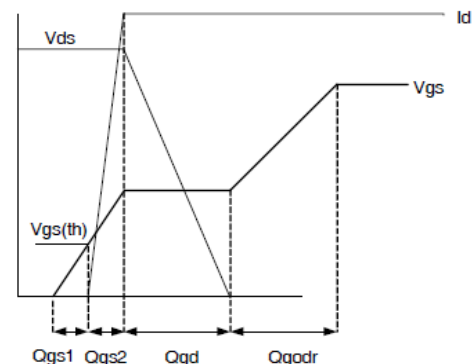
1. Avalanche failures assumption:
Purely a thermal phenomenon and failure occurs at a temperature far in excess of T_{jmax} . This is validated for every part type.
2. Safe operation in Avalanche is allowed as long as T_{jmax} is not exceeded.
3. Equation below based on circuit and waveforms shown in Figures 16a, 16b.
4. $P_{D(ave)}$ = Average power dissipation per single avalanche pulse.
5. BV = Rated breakdown voltage (1.3 factor accounts for voltage increase during avalanche).
6. I_{av} = Allowable avalanche current.
7. ΔT = Allowable rise in junction temperature, not to exceed T_{jmax} (assumed as 25°C in Figure 14, 15).
 t_{av} = Average time in avalanche.
 D = Duty cycle in avalanche = $t_{av} \cdot f$
 $Z_{thJC}(D, t_{av})$ = Transient thermal resistance, see Figures 13)

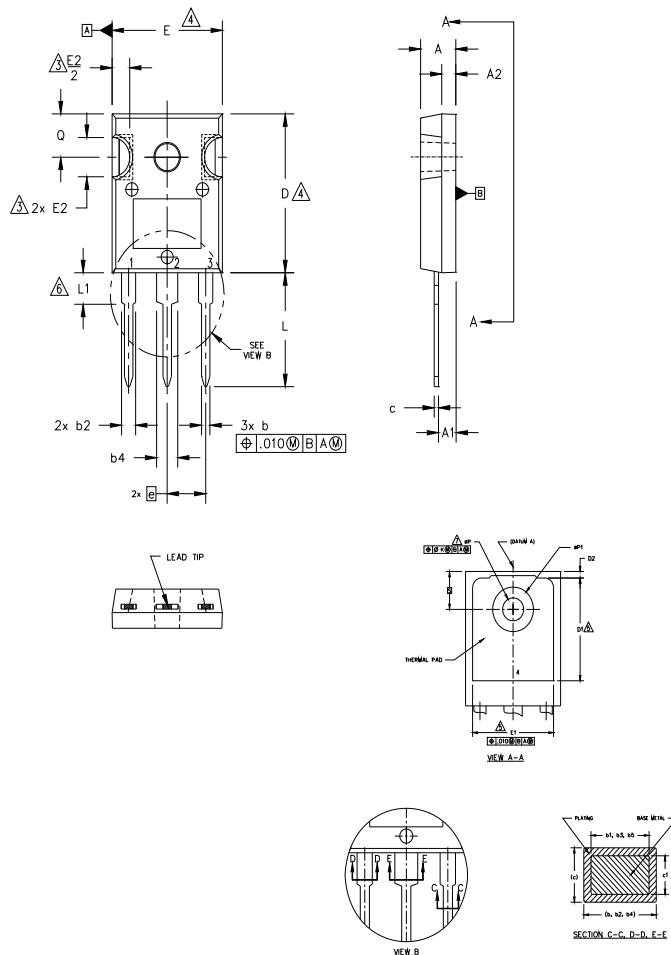
$$P_{D(ave)} = \frac{1}{2} (1.3 \cdot BV \cdot I_{av}) = \frac{\Delta T}{Z_{thJC}}$$

$$I_{av} = \frac{2\Delta T}{[1.3 \cdot BV \cdot Z_{thJC}]}$$

$$E_{AS(AR)} = P_{D(ave)} \cdot t_{av}$$


Fig. 16 Threshold Voltage vs. Temperature

Fig. 17 Typical Recovery Current vs. di_f/dt

Fig 18. Typical Recovery Current vs. di_f/dt

Fig 19. Typical Stored Charge vs. di_f/dt

Fig 20. Typical Stored Charge vs. di_f/dt


Fig 21. Peak Diode Recovery dv/dt Test Circuit for N-Channel HEXFET® Power MOSFETs

Fig 22a. Unclamped Inductive Test Circuit

Fig 22b. Unclamped Inductive Waveforms

Fig 23a. Switching Time Test Circuit

Fig 23b. Switching Time Waveforms

Fig 24a. Gate Charge Test Circuit

Fig 24b. Gate Charge Waveform

TO-247AC Package Outline (Dimensions are shown in millimeters (inches))

NOTES:

1. DIMENSIONING AND TOLERANCING AS PER ASME Y14.5M 1994.
2. DIMENSIONS ARE SHOWN IN INCHES.
3. CONTOUR OF SLOT OPTIONAL.
4. DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED .005" (0.127) PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY.
5. THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSIONS D1 & E1.
6. LEAD FINISH UNCONTROLLED IN L1.
7. ØP TO HAVE A MAXIMUM DRAFT ANGLE OF 1.5 ° TO THE TOP OF THE PART WITH A MAXIMUM HOLE DIAMETER OF .154 INCH.
8. OUTLINE CONFORMS TO JEDEC OUTLINE TO-247AC .

SYMBOL	DIMENSIONS				NOTES
	INCHES		MILLIMETERS		
	MIN.	MAX.	MIN.	MAX.	
A	.183	.209	4.65	5.31	
A1	.087	.102	2.21	2.59	
A2	.059	.098	1.50	2.49	
b	.039	.055	0.99	1.40	
b1	.039	.053	0.99	1.35	
b2	.065	.094	1.65	2.39	
b3	.065	.092	1.65	2.34	
b4	.102	.135	2.59	3.43	
b5	.102	.133	2.59	3.38	
c	.015	.035	0.38	0.89	
c1	.015	.033	0.38	0.84	
D	.776	.815	19.71	20.70	4
D1	.515	—	13.08	—	5
D2	.020	.053	0.51	1.35	
E	.602	.625	15.29	15.87	4
E1	.530	—	13.46	—	
E2	.178	.216	4.52	5.49	
e	.215 BSC		5.46 BSC		
Øk	.010		0.25		
L	.559	.634	14.20	16.10	
L1	.146	.169	3.71	4.29	
ØP	.140	.144	3.56	3.66	
ØP1	—	.291	—	7.39	
Q	.209	.224	5.31	5.69	
S	.217 BSC		5.51 BSC		

LEAD ASSIGNMENTS
HEXFET

- 1.- GATE
- 2.- DRAIN
- 3.- SOURCE
- 4.- DRAIN

IGBTs, CoPACK

- 1.- GATE
- 2.- COLLECTOR
- 3.- EMITTER
- 4.- COLLECTOR

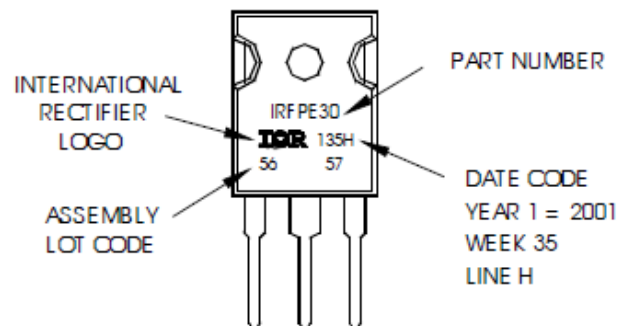
DIODES

- 1.- ANODE/OPEN
- 2.- CATHODE
- 3.- ANODE

TO-247AC Part Marking Information

EXAMPLE: THIS IS AN IRFPE3D
WITH ASSEMBLY
LOT CODE 5657
ASSEMBLED ON WW 35, 2001
IN THE ASSEMBLY LINE "H"

Note: "P" in assembly line position
indicates "Lead-Free"



TO-247AC package is not recommended for Surface Mount Application.

TO-247AC package is not recommended for Surface Mount Application.

Note: For the most current drawing please refer to IR website at <http://www.irf.com/package/>

Qualification information[†]

Qualification level	Industrial (per JEDEC JESD47F) ^{††}	
Moisture Sensitivity Level	TO-247AC	N/A
RoHS compliant	Yes	

† Qualification standards can be found at International Rectifier's web site <http://www.irf.com/product-info/reliability>

†† Applicable version of JEDEC standard at the time of product release.

International
 Rectifier

IR WORLD HEADQUARTERS: 101N Sepulveda Blvd, El Segundo, California 90245, USA

To contact International Rectifier, please visit <http://www.irf.com/whoto-call/>