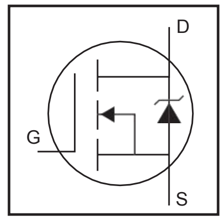
MS4368PBF

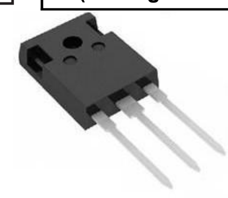
Applications
- High Efficiency Synchronous Rectification in SMPS
- Uninterruptible Power Supply
- High Speed Power Switching
- Hard Switched and High Frequency Circuits

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

HEXFET® Power MOSFET



V_{DSS}		**75V**
$R_{DS(on)}$	typ.	**1.46mΩ**
	max.	**1.85mΩ**
I_{D} (Silicon Limited)		**350A©**
I_{D} (Package Limited)		**195A**



TO247

G	D	S
Gate	Drain	Source

Absolute Maximum Ratings

Symbol	Parameter	Max.	Units
I_D @ T_C = 25°C	Continuous Drain Current, VGS @ 10V (Silicon Limited)	350©	A
I_D @ T_C = 100°C	Continuous Drain Current, V_{GS} @ 10V (Silicon Limited)	250©	
I_D @ T_C = 25°C	Continuous Drain Current, V_{GS} @ 10V (Wire Bond Limited)	195	
I_{DM}	Pulsed Drain Current ᴼ	1280	
P_D @T_C = 25°C	Maximum Power Dissipation	520	W
	Linear Derating Factor	3.4	W/°C
V_{GS}	Gate-to-Source Voltage	± 20	V
dv/dt	Peak Diode Recovery ®	13	V/ns
T_J T_{STG}	Operating Junction and Storage Temperature Range	-55 to + 175	°C
	Soldering Temperature, for 10 seconds (1.6mm from case)	300	
	Mounting torque, 6-32 or M3 screw	10lb·in (1.1N·m)	

Avalanche Characteristics

E_{AS} (Thermally limited)	Single Pulse Avalanche Energy ©	430	mJ
I_{AR}	Avalanche Current ᴼ	See Fig. 14, 15, 22a, 22b	A
E_{AR}	Repetitive Avalanche Energy ᴼ		mJ

Thermal Resistance

Symbol	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case ®	——	0.29	°C/W
$R_{\theta CS}$	Case-to-Sink, Flat Greased Surface	0.24	——	
$R_{\theta JA}$	Junction-to-Ambient ®	——	40	

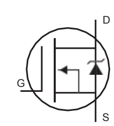
Static @ T_J = 25°C (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	75	——	——	V	V_{GS} = 0V, I_D = 250μA
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	——	0.077	——	V/°C	Reference to 25°C, I_D = 5mA°
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	——	1.46	1.85	mΩ	V_{GS} = 10V, I_D = 195A °
$V_{GS(th)}$	Gate Threshold Voltage	2.0	——	4.0	V	V_{DS} = V_{GS}, I_D = 250μA
I_{DSS}	Drain-to-Source Leakage Current	——	——	20	μA	V_{DS} = 75V, V_{GS} = 0V
		——	——	250		V_{DS} = 75V, V_{GS} = 0V, T_J = 125°C
I_{GSS}	Gate-to-Source Forward Leakage	——	——	100	nA	V_{GS} = 20V
	Gate-to-Source Reverse Leakage	——	——	-100		V_{GS} = -20V

Dynamic @ T_J = 25°C (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
gfs	Forward Transconductance	650	——	——	S	V_{DS} = 50V, I_D = 195A
Q_g	Total Gate Charge	——	380	570	nC	I_D = 195A
Q_{gs}	Gate-to-Source Charge	——	79	——		V_{DS} = 38V
Q_{gd}	Gate-to-Drain ("Miller") Charge	——	105	——		V_{GS} = 10V °
Q_{sync}	Total Gate Charge Sync. (Q_g - Q_{gd})	——	275	——		I_D = 195A, V_{DS} =0V, V_{GS} = 10V
$R_{G(int)}$	Internal Gate Resistance	——	0.80	——	Ω	
$t_{d(on)}$	Turn-On Delay Time	——	43	——	ns	V_{DD} = 49V
t_r	Rise Time	——	220	——		I_D = 195A
$t_{d(off)}$	Turn-Off Delay Time	——	170	——		R_G = 2.7Ω
t_f	Fall Time	——	260	——		V_{GS} = 10V °
C_{iss}	Input Capacitance	——	19230	——	pF	V_{GS} = 0V
C_{oss}	Output Capacitance	——	1670	——		V_{DS} = 50V
C_{rss}	Reverse Transfer Capacitance	——	770	——		f = 100kHz
C_{oss} eff. (ER)	Effective Output Capacitance (Energy Related)°	——	1700	——		V_{GS} = 0V, V_{DS} = 0V to 60V °
C_{oss} eff. (TR)	Effective Output Capacitance (Time Related)®	——	1410	——		V_{GS} = 0V, V_{DS} = 0V to 60V ®

Diode Characteristics

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	——	——	350©	A	MOSFET symbol showing the integral reverse p-n junction diode. 
I_{SM}	Pulsed Source Current (Body Diode) °°	——	——	1280		
V_{SD}	Diode Forward Voltage	——	——	1.3	V	T_J = 25°C, I_S = 195A, V_{GS} = 0V °
t_{rr}	Reverse Recovery Time	——	130	200	ns	T_J = 25°C V_R = 64V,
		——	140	210		T_J = 125°C I_F = 195A
Q_{rr}	Reverse Recovery Charge	——	450	680	nC	T_J = 25°C di/dt = 100A/μs°
		——	530	800		T_J = 125°C
I_{RRM}	Reverse Recovery Current	——	9.1	——	A	T_J = 25°C
t_{on}	Forward Turn-On Time	Intrinsic turn-on time is negligible (turn-on is dominated by LS+LD)				

Notes:

© 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 App Notes (AN-1140).

° Repetitive rating; pulse width limited by max. junction temperature.

© Limited by T_{Jmax}, starting T_J = 25°C, L = 0.022mH R_G = 25Ω, I_{AS} = 195A, V_{GS} =10V. Part not recommended for use above this value.

® $I_{SD} \leq$ 195A, di/dt $\leq$ 1740A/μs, $V_{DD} \leq V_{(BR)DSS}$, $T_J \leq$ 175°C.

° Pulse width $\leq$ 400μs; duty cycle $\leq$ 2%.

® C_{oss} 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}.

° C_{oss} 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}.

When mounted on 1" square PCB (FR-4 or G-10 Material). For recom mended footprint and soldering techniques refer to application note #AN-994.

® R_θ is measured at T_J approximately 90°C.

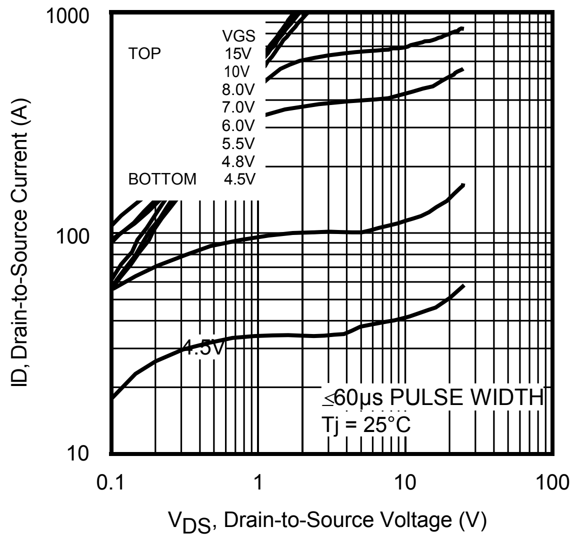


Fig 1. Typical Output Characteristics

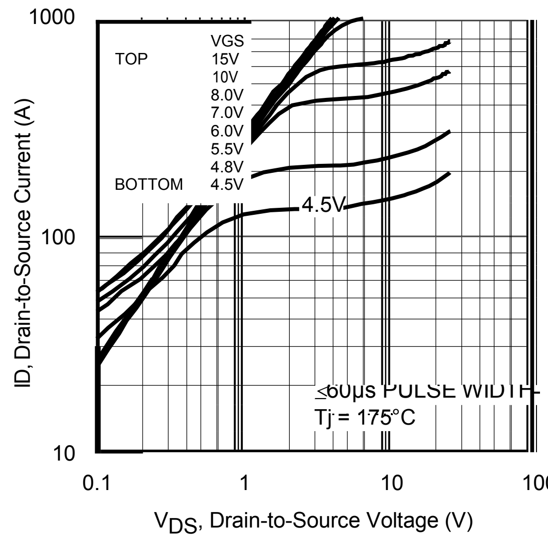


Fig 2. Typical Output Characteristics

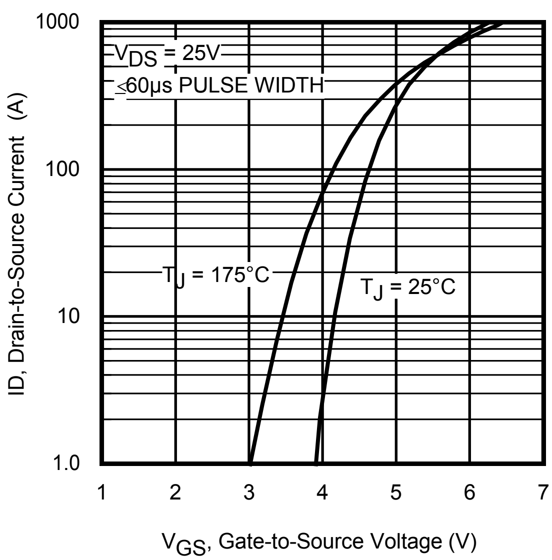


Fig 3. Typical Transfer Characteristics

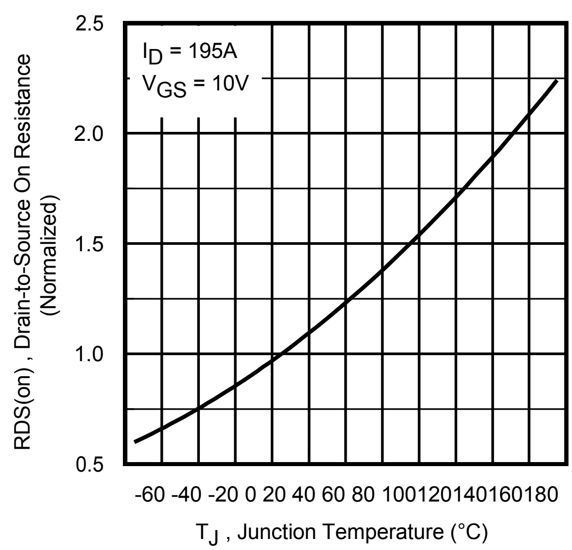


Fig 4. Normalized On-Resistance vs. Temperature

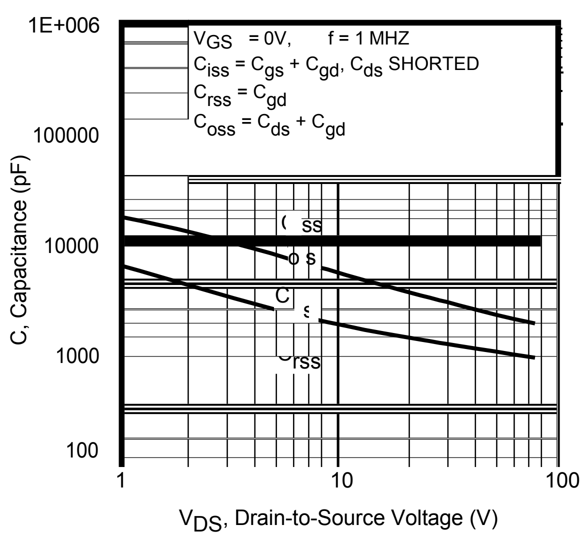


Fig 5. Typical Capacitance vs. Drain-to-Source Voltage

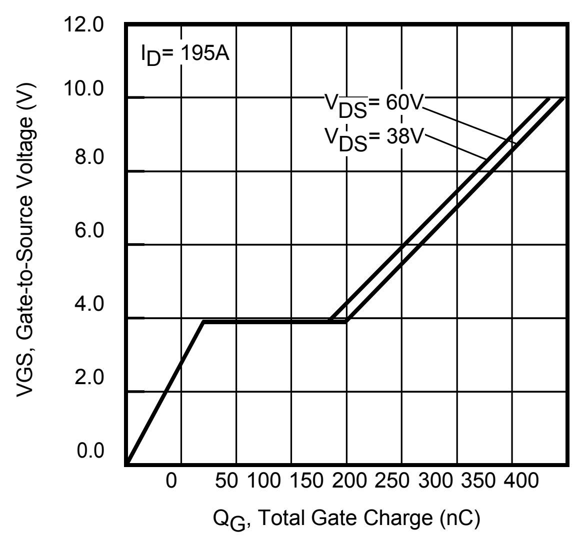


Fig 6. Typical Gate Charge vs. Gate-to-Source Voltage

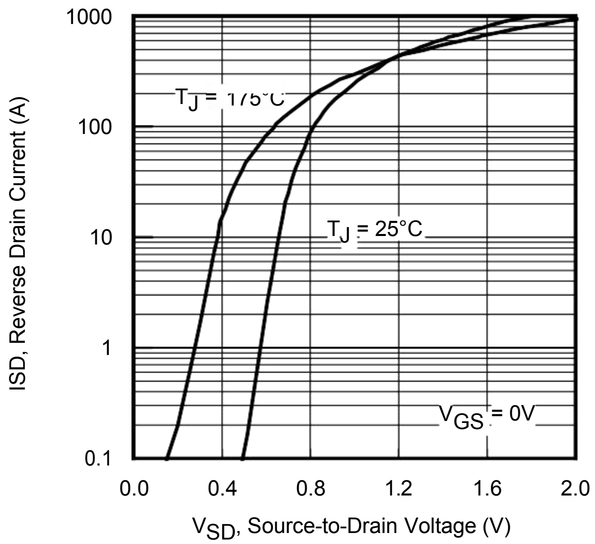


Fig 7. Typical Source-Drain Diode Forward Voltage

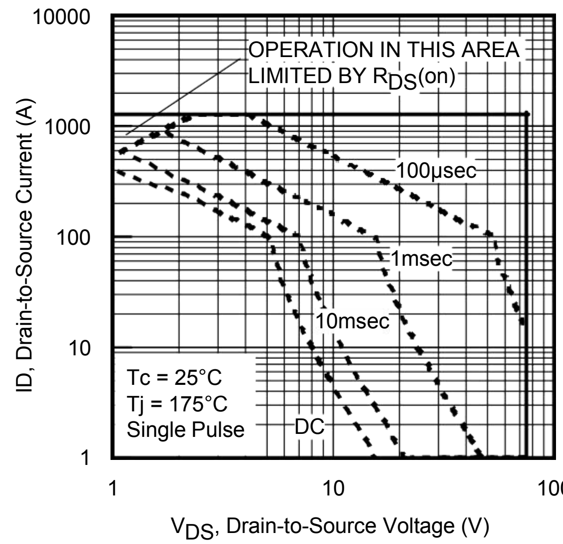


Fig 8. Maximum Safe Operating Area

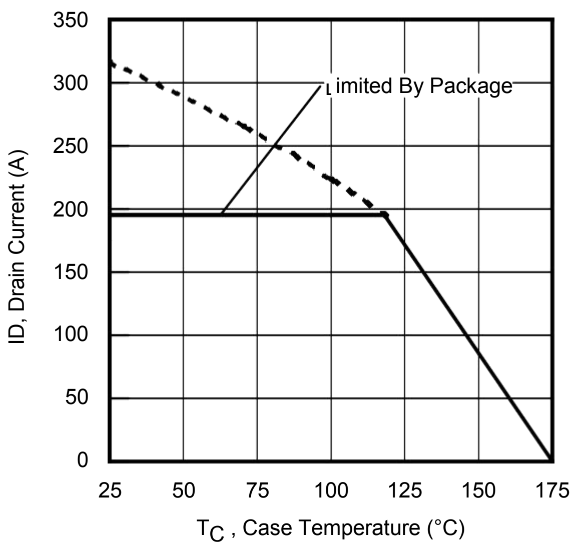


Fig 9. Maximum Drain Current vs. Case Temperature

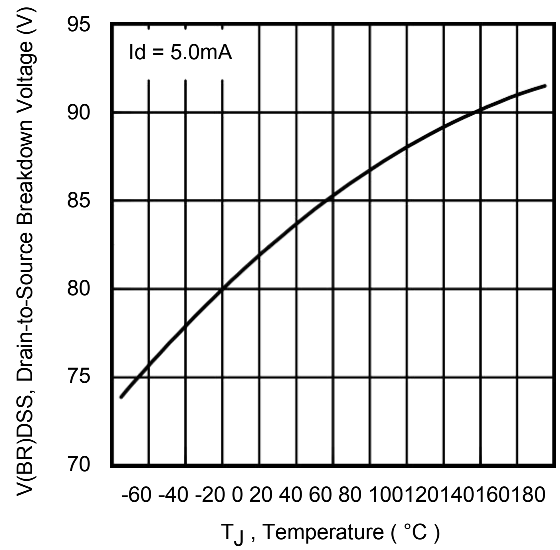


Fig 10. Drain-to-Source Breakdown Voltage

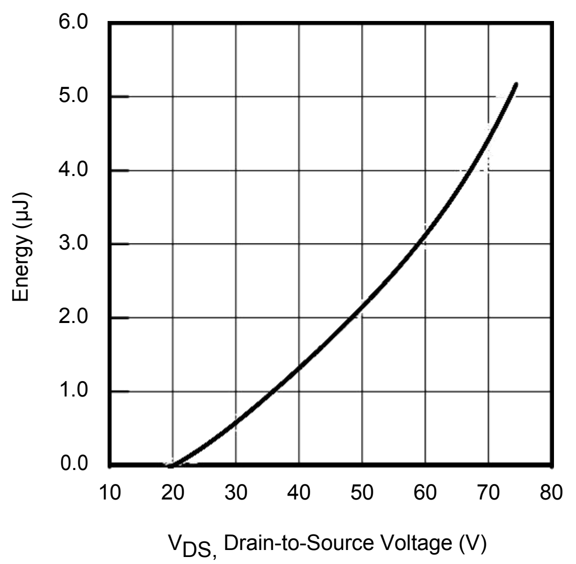


Fig 11. Typical C_{OSS} Stored Energy

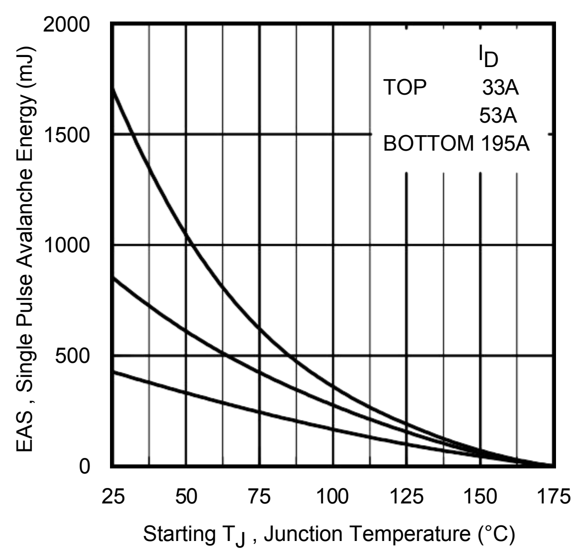


Fig 12. Maximum Avalanche Energy vs. DrainCurrent

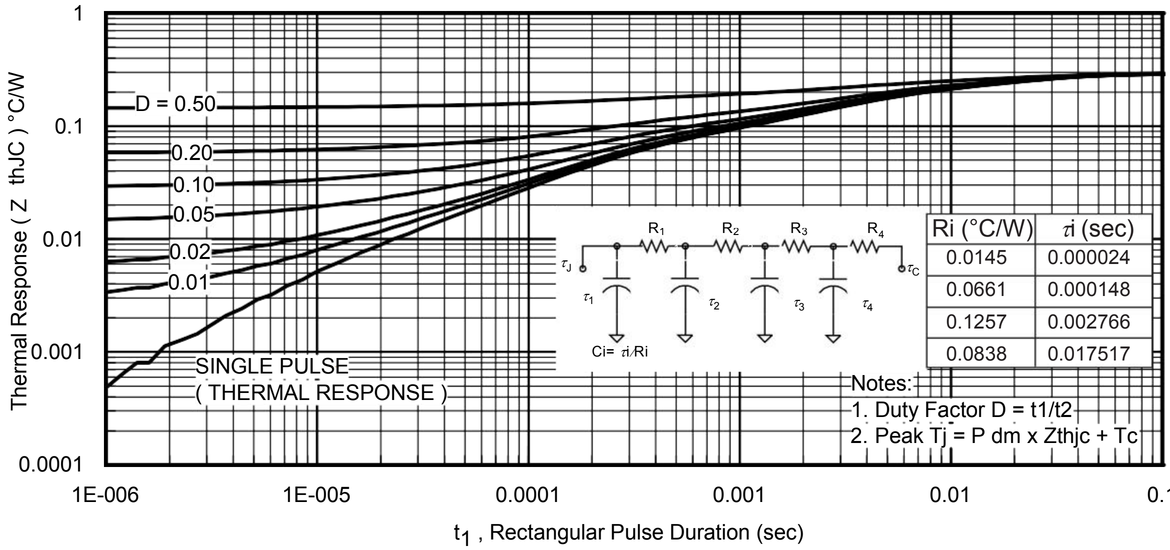


Fig 13. Maximum Effective Transient Thermal Impedance, Junction-to-Case

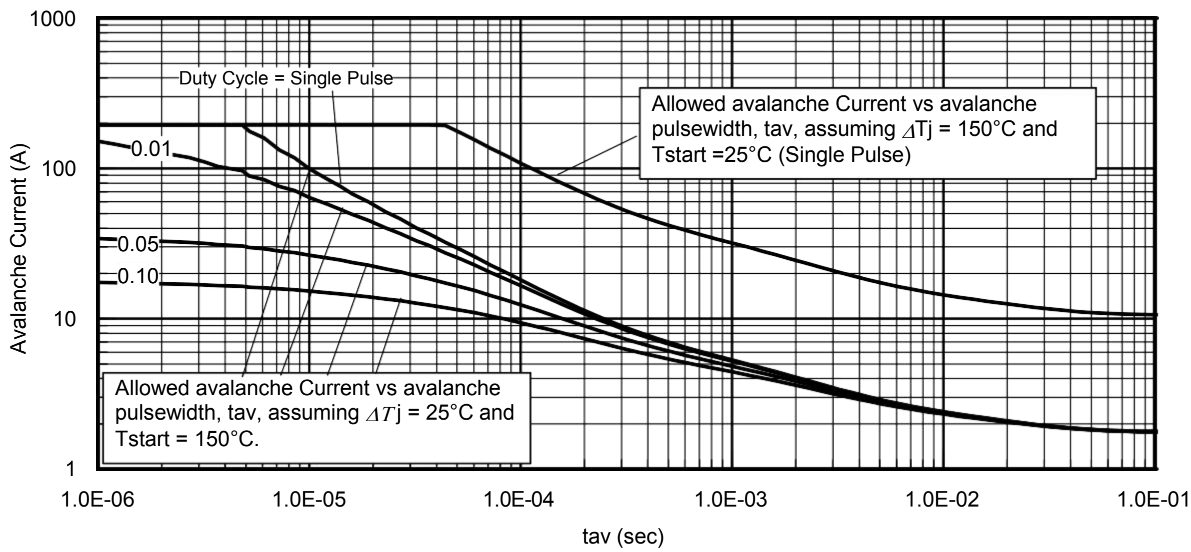


Fig 14. Typical Avalanche Current vs.Pulsewidth

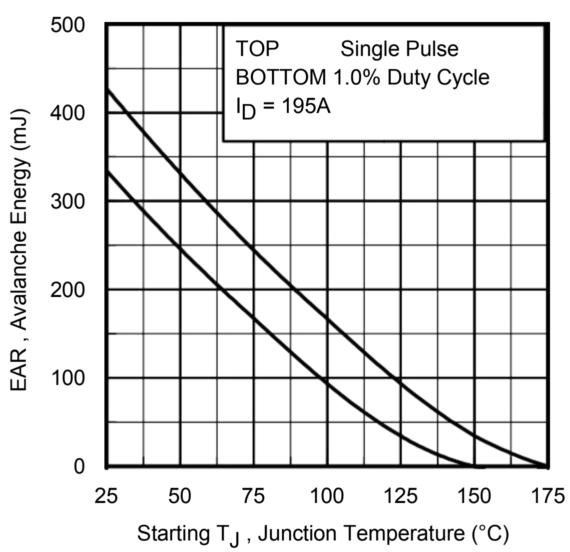


Fig 15. Maximum Avalanche Energy vs. Temperature

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 asT_{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)

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

$$\mathbf{I_{av} = 2\Delta T /\ [1.3 \cdot BV \cdot Z_{th}]}$$

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

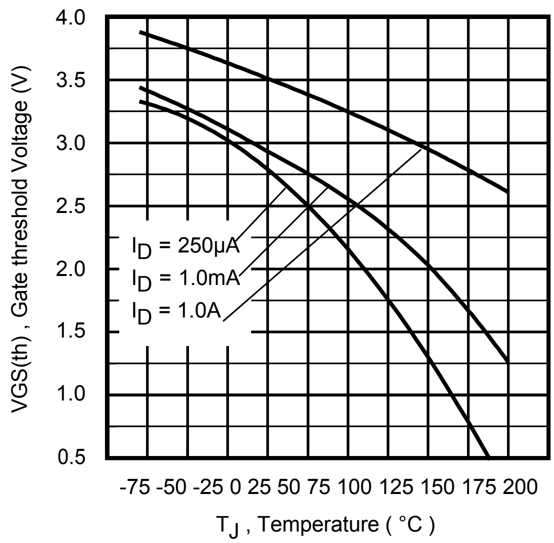


Fig 16. Threshold Voltage vs. Temperature

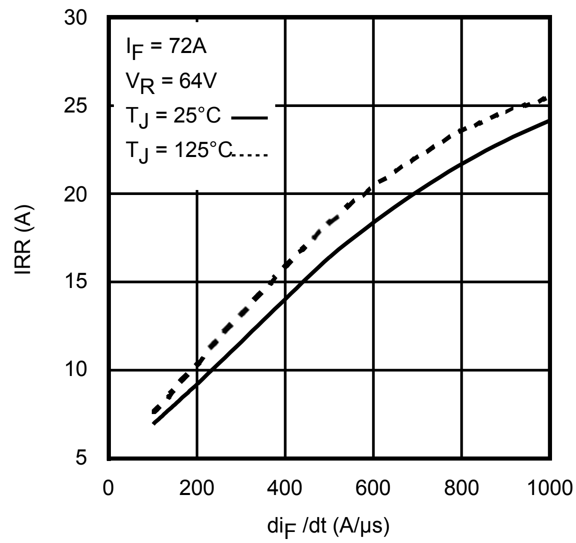


Fig. 17 - Typical Recovery Current vs. di$_f$/dt

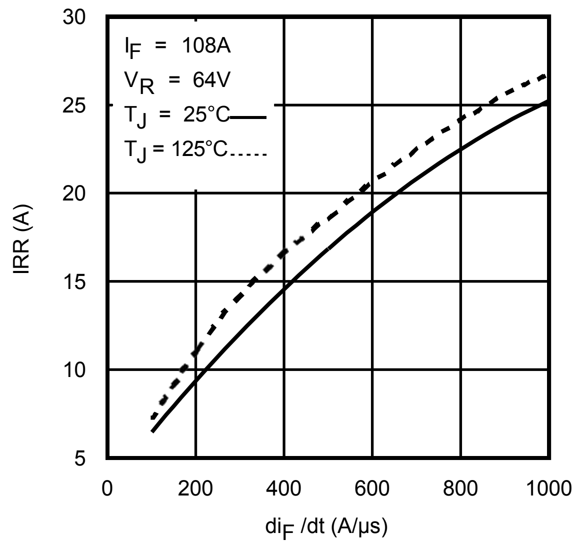


Fig. 18 - Typical Recovery Current vs. di$_f$/dt

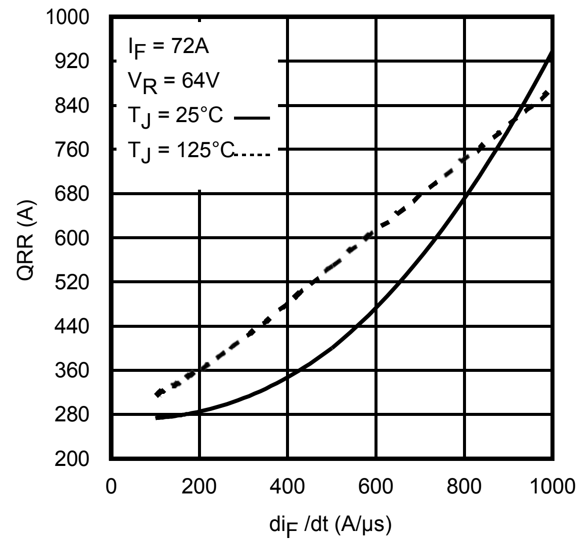


Fig. 19 - Typical Stored Charge vs. di$_f$/dt

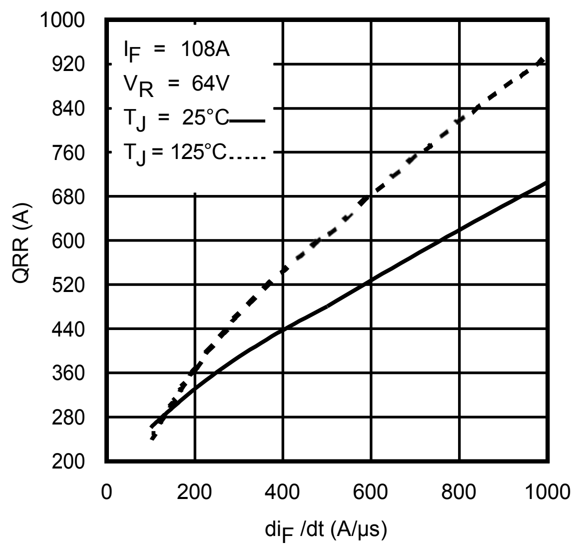
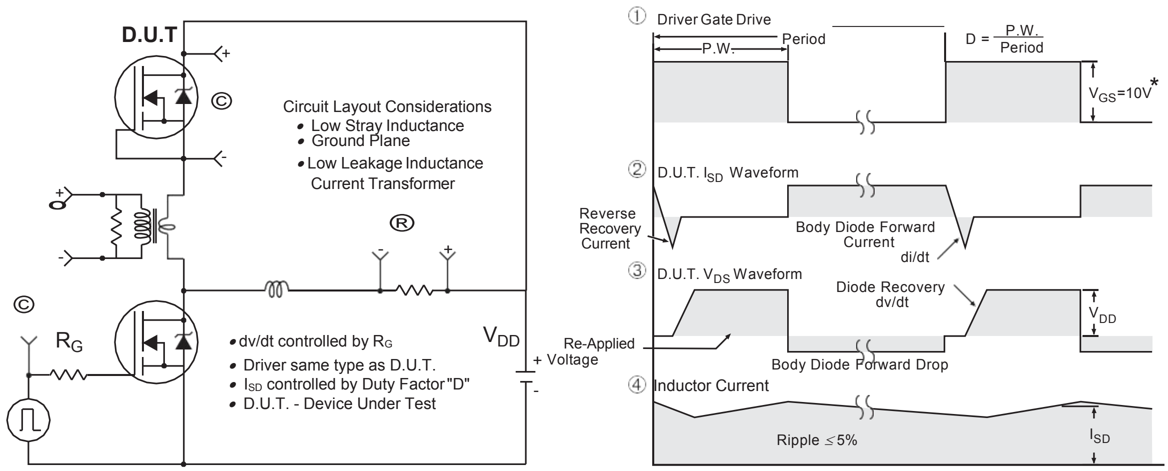


Fig. 20 - Typical Stored Charge vs. di$_f$/dt



* V_{GS} = 5V for Logic Level Devices

Fig 20. Peak Diode Recovery dv/dt Test Circuit for N-Channel HEXFET® Power MOSFETs

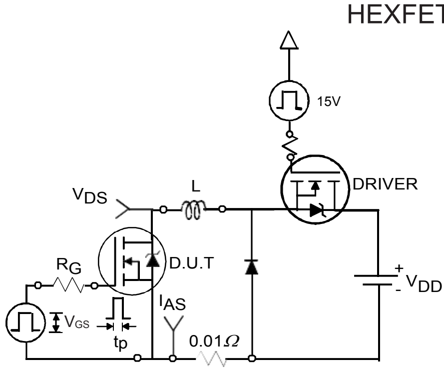


Fig 21a. Unclamped Inductive Test Circuit

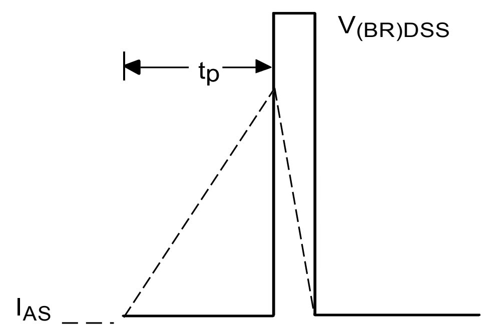


Fig 21b. Unclamped Inductive Waveforms

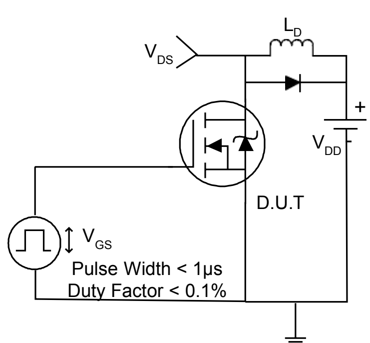


Fig 22a. Switching Time Test Circuit

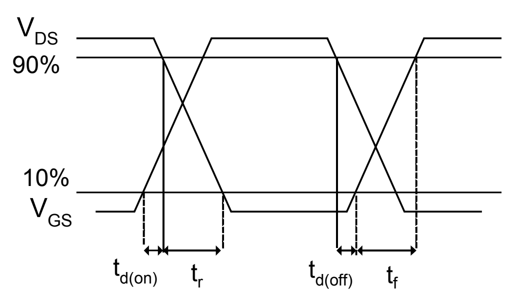
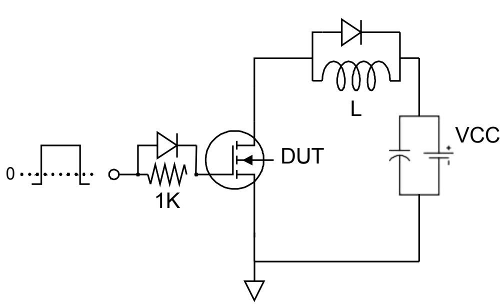


Fig 22b. Switching Time Waveforms



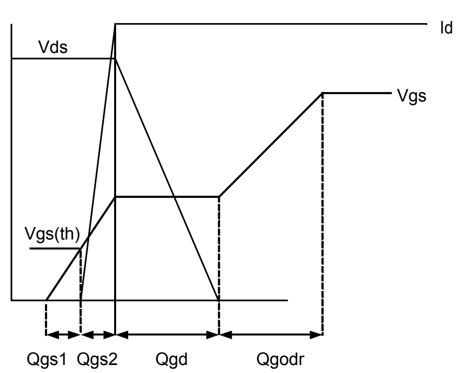
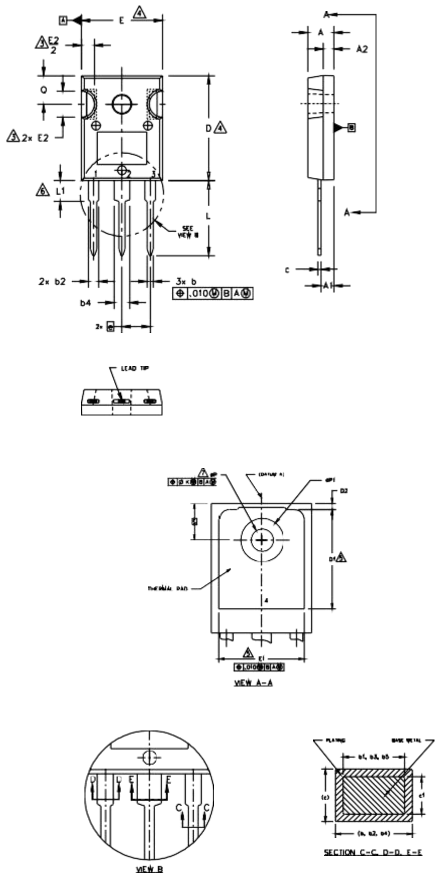


Fig 23a. Gate Charge Test Circuit

Fig 23b. 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