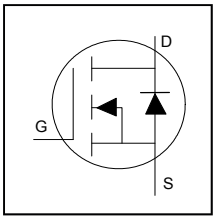
HEXFET® Power MOSFET

Applications

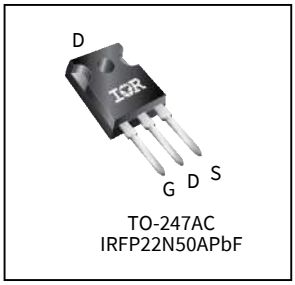
- Switch Mode Power Supply (SMPS)
- Uninterruptable Power Supply
- High speed power switching



V_{DSS}	500V
$R_{DS(on)\ max}$	0.23Ω
$I_{D\ (Silicon\ Limited)}$	22A

Benefits

- Low Gate Charge Qg results in Simple Drive Requirement
- Improved Gate, Avalanche and dynamic dv/dt Ruggedness
- Fully Characterized Capacitance and Avalanche Voltage and Current
- Lead-Free



TO-247AC
IRFP22N50APbF

Halogen-Free RoHS

G	D	S
Gate	Drain	Source

Base part number	Package Type	Standard Pack		Orderable Part Number
		Form	Quantity	
IRFP22N50APbF	TO-247AC	Tube	25	IRFP22N50APbF

Typical SMPS Topologies

- Full Bridge Converters
- Power Factor Correction Boost

Table of Contents

1 Parameters

Table1 Key performance parameters

Parameter	Values	Units
V_{DS}	500	V
$R_{DS(on)\ max}$	0.23	Ω
I_D	22	A

2 Maximum ratings and thermal characteristics

Table 2 Maximum ratings (at T_J=25°C, unless otherwise specified)

Parameter	Symbol	Conditions	Values	Unit
Continuous Drain Current	I_D	T_C = 25°C, V_{GS} @ 10V	22	A
Continuous Drain Current	I_D	T_C = 100°C, V_{GS} @ 10V	14	
Pulsed Drain Current ①	I_{DM}	T_C = 25°C	88	
Maximum Power Dissipation	P_D	T_C = 25°C	277	W
Linear Derating Factor		T_C = 25°C	2.2	W/°C
Gate-to-Source Voltage	V_{GS}	-	± 30	V
Operating Junction and Storage Temperature Range	T_J T_{STG}	-	-55 to + 150	°C
Soldering Temperature, for 10 seconds (1.6mm from case)	-	-	300	
Mounting Torque, 6-32 or M3 Screw	-	-	10 lbf·in (1.1 N·m)	-

Table 3 Thermal characteristics

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Junction-to-Case ⑤	$R_{\theta JC}$	T_J approximately 90°C	-	-	0.45	°C/W
Case-to-Sink, Flat Greased Surface	$R_{\theta CS}$	-	-	0.24	-	
Junction-to-Ambient	$R_{\theta JA}$	-	-	-	40	

Table 4 Avalanche characteristics

Parameter	Symbol	Values	Unit
Single Pulse Avalanche Energy ②	$E_{AS\ (Thermally\ limited)}$	1180	mJ
Avalanche Current ①	I_{AR}	22	A
Repetitive Avalanche Energy ①	E_{AR}	28	mJ

Notes:

① *Repetitive rating; pulse width limited by max. junction temperature. (See Figure 12).*

② *Starting T_J = 25°C, L = 4.87mH, R_G = 25Ω, I_{AS} = 22A. (See Figure 10).*

③ *$I_{SD} \leq$ 22A, di/dt ≤ 190A/µs, $V_{DD} \leq V_{(BR)DSS}$, $T_J \leq$ 150°C.*

④ *Pulse width ≤300µs; duty cycle ≤2%.*

⑤ *R_θ is measured at T_J approximately 90°C.*

⑥ *C_{oss} eff. is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS}*

3 Electrical characteristics

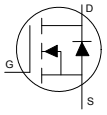
Table 5 Static characteristics

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Drain-to-Source Breakdown Voltage	$V_{(BR)DSS}$	V_{GS} = 0V, I_D = 250µA	500	-	-	V
Breakdown Voltage Temp. Coefficient	$\Delta V_{(BR)DSS}/\Delta T_J$	Reference to 25°C, I_D = 1mA	-	0.55	-	V/°C
Static Drain-to-Source On-Resistance	$R_{DS(on)}$	V_{GS} = 10V, I_D = 13A	-	-	0.23	Ω
Gate Threshold Voltage	$V_{GS(th)}$	V_{DS} = V_{GS}, I_D = 250µA	2.0	-	4.0	V
Drain-to-Source Leakage Current	I_{DSS}	V_{DS} =500V, V_{GS} =0V	-	-	25	µA
		V_{DS} =400V,V_{GS} = 0V,T_J =125°C	-	-	250	
Gate-to-Source Forward Leakage	I_{GSS}	V_{GS} = 30V	-	-	100	nA
Gate-to-Source Reverse Leakage	I_{GSS}	V_{GS} = -30V	-	-	-100	

Table 6 Dynamic characteristics

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Forward Trans conductance	gfs	V_{DS} = 50V, I_D = 13A	12	-	-	S
Total Gate Charge	Q_g	I_D = 22A V_{DS} = 400V V_{GS} = 10V See Fig.6 and 13	-	-	120	nC
Gate-to-Source Charge	Q_{gs}		-	-	32	
Gate-to-Drain Charge	Q_{gd}		-	-	52	
Turn-On Delay Time	$t_{d(on)}$	V_{DD} = 250V I_D = 22A R_G = 4.3Ω R_D = 11Ω, See Fig.10	-	26	-	ns
Rise Time	t_r		-	94	-	
Turn-Off Delay Time	$t_{d(off)}$		-	47	-	
Fall Time	t_f		-	47	-	
Input Capacitance	C_{iss}	V_{GS} = 0V V_{DS} = 25V f = 1.0MHz, See Fig.5	-	3450	-	pF
Output Capacitance	C_{oss}		-	513	-	
Reverse Transfer Capacitance	C_{rss}		-	27	-	
Output Capacitance	C_{oss}	V_{GS} = 0V, V_{DS} = 1V, f = 1.0MHz	-	4935	-	
Output Capacitance	C_{oss}	V_{GS} = 0V, V_{DS} = 400V, f = 1.0MHz	-	137	-	
Effective Output Capacitance	C_{oss} eff.	V_{GS} = 0V, V_{DS} = 0V to 400V ⑥	-	264	-	

Table 7 Reverse Diode

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Continuous Source Current (Body Diode)	I_S	MOSFET symbol showing the integral reverse p-n junction diode. 	-	-	22	A
Pulsed Source Current (Body Diode) ①	I_{SM}		-	-	88	
Diode Forward Voltage	V_{SD}	T_J = 25°C, I_S = 22A,V_{GS} = 0V ④	-	-	1.5	V
Peak Diode Recovery dv/dt ③	dv/dt	T_J = 150°C, I_S = 22A,V_{DS} = 500V	-	-	4.8	V/ns
Reverse Recovery Time	t_{rr}	T_J = 25°C I_F = 22A, di/dt = 100A/µs ④	-	570	850	ns
Reverse Recovery Charge	Q_{rr}	T_J = 25°C	-	6.1	9.2	µC
Forward Turn-On Time	t_{on}	Intrinsic turn-on time is negligible (turn-on is dominated by L_S +L_D)				

4 Electrical characteristic diagrams

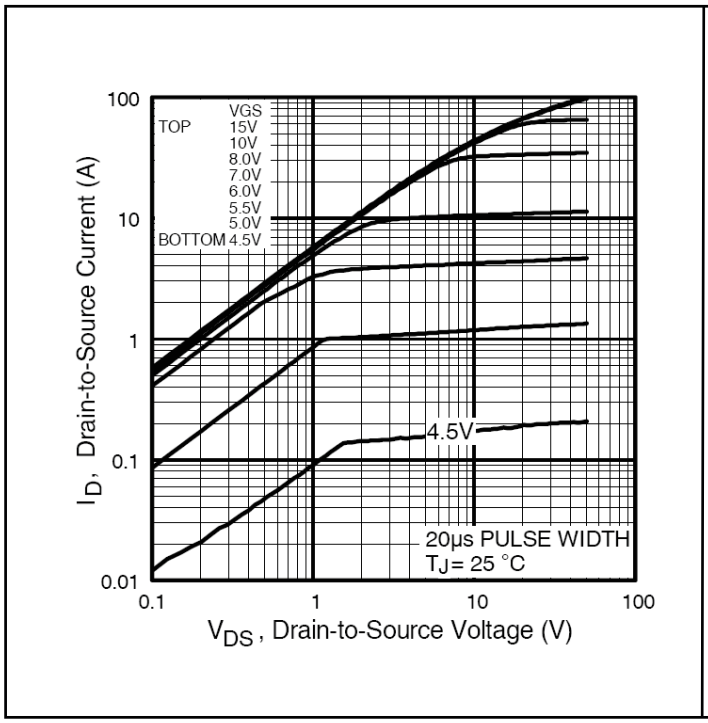


Figure 1 Typical Output Characteristics, T_c = 25°C

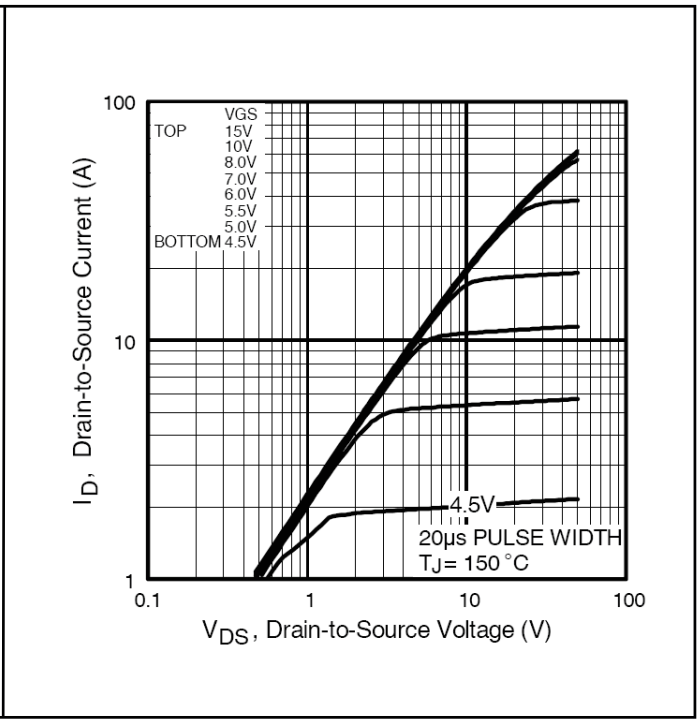


Figure 2 Typical Output Characteristics, T_c = 150°C

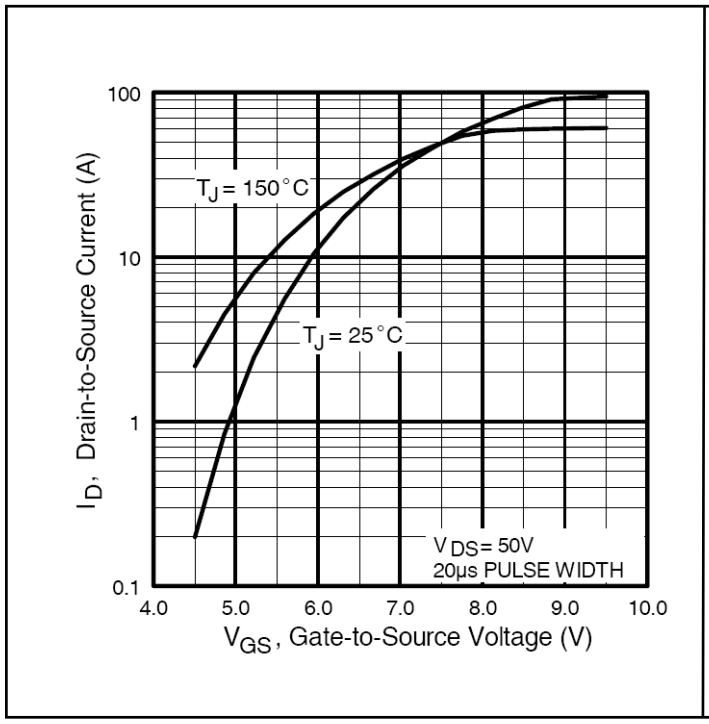


Figure 3 Typical Transfer Characteristics

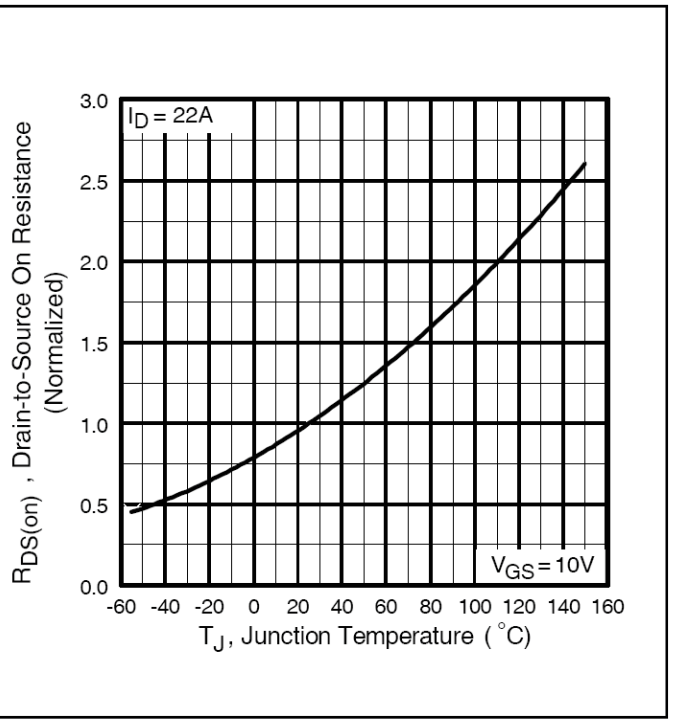


Figure 4 Normalized On-Resistance vs. Temperature

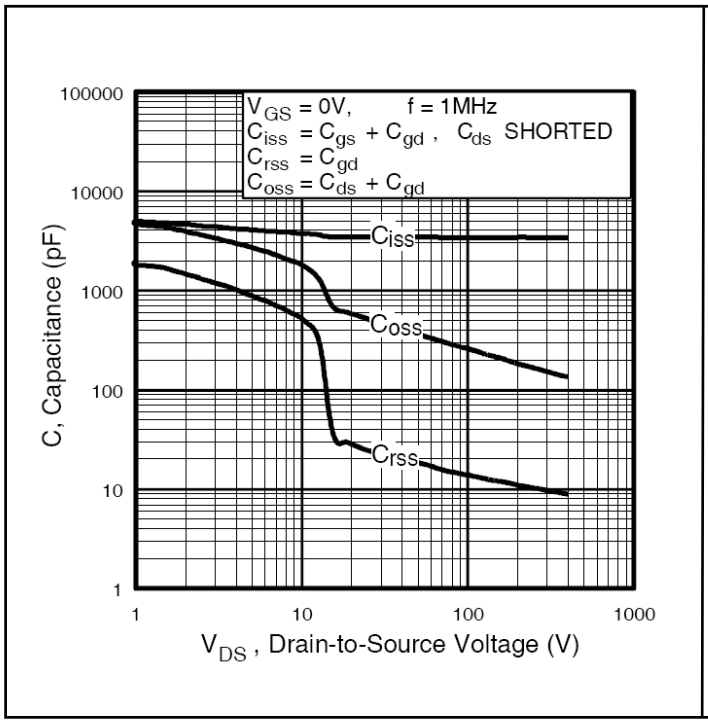


Figure 5 Typical Capacitance vs. Drain-to-Source Voltage

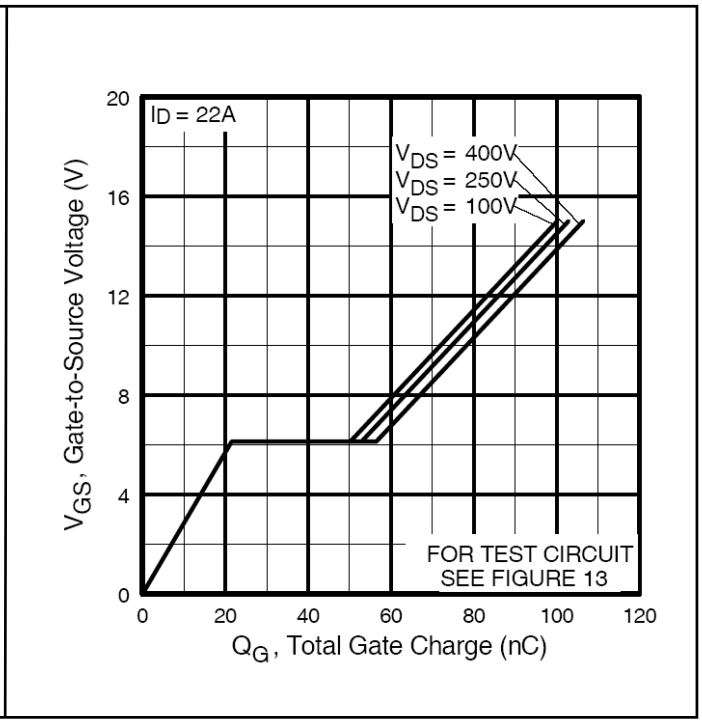


Figure 6 Typical Gate Charge vs. Gate-to-Source Voltage

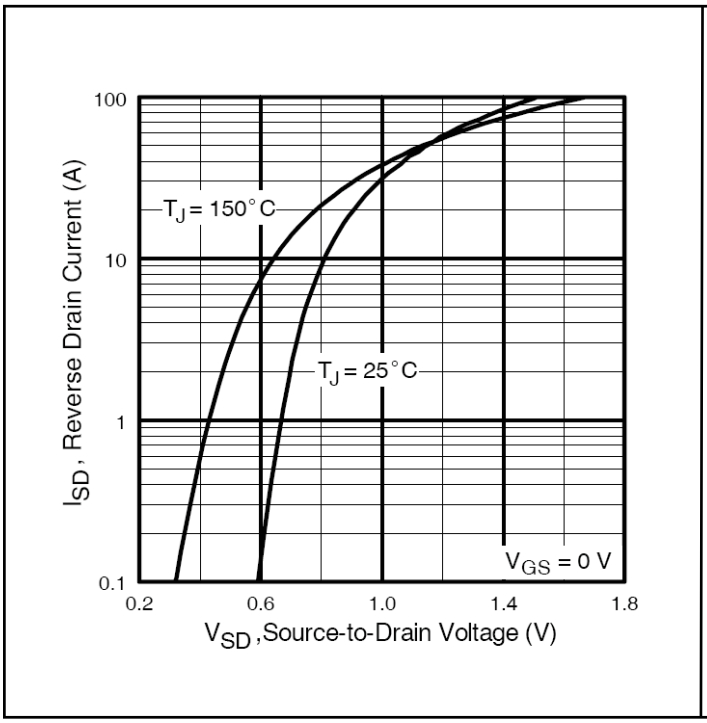


Figure 7 Typical Source-Drain Diode Forward Voltage

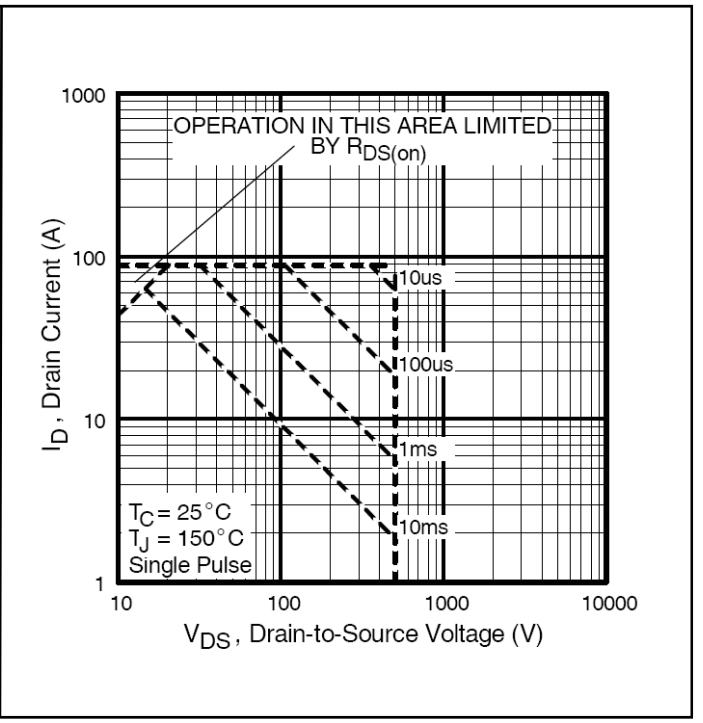


Figure 8 Maximum Safe Operating Area

Electrical characteristic diagrams

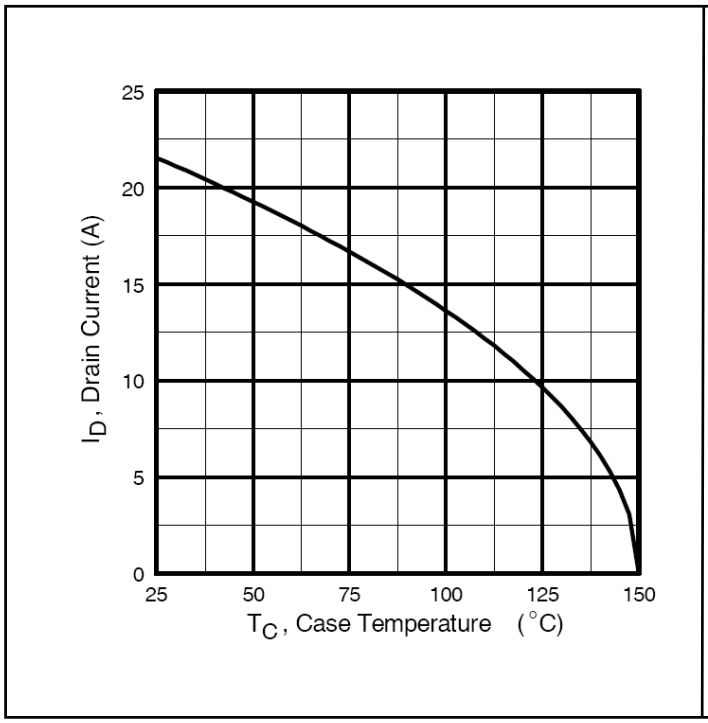


Figure 9 Maximum Drain Current vs. Case Temperature

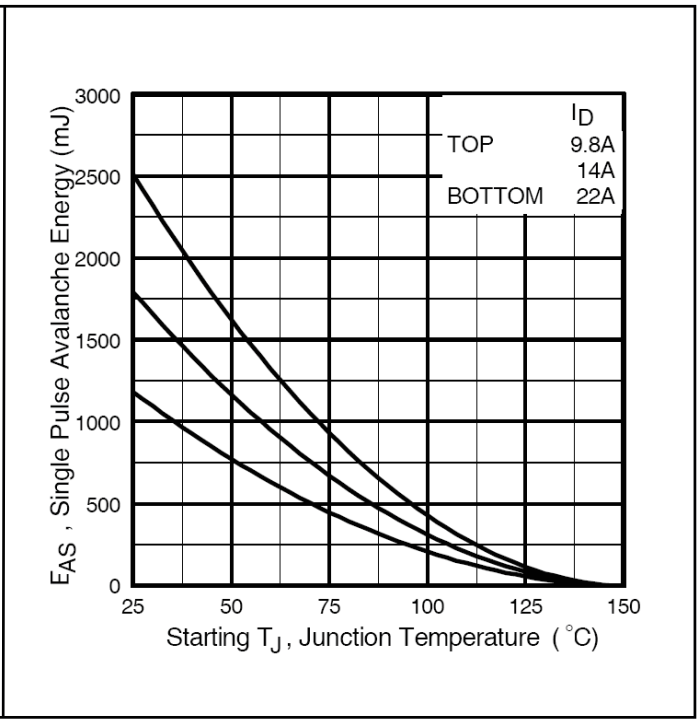


Figure 10 Maximum Avalanche Energy vs. Temperature

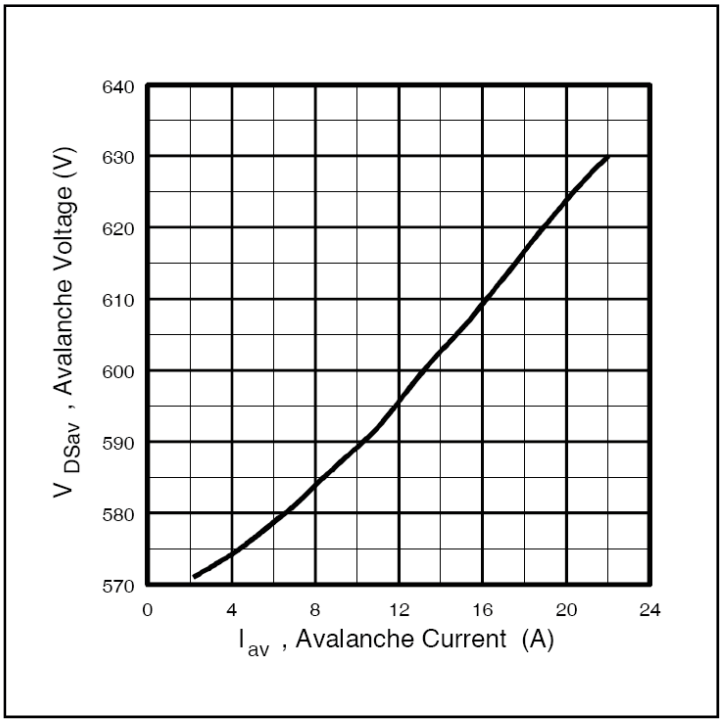


Figure 11 Typical Drain-to-Source Voltage vs. Avalanche Current

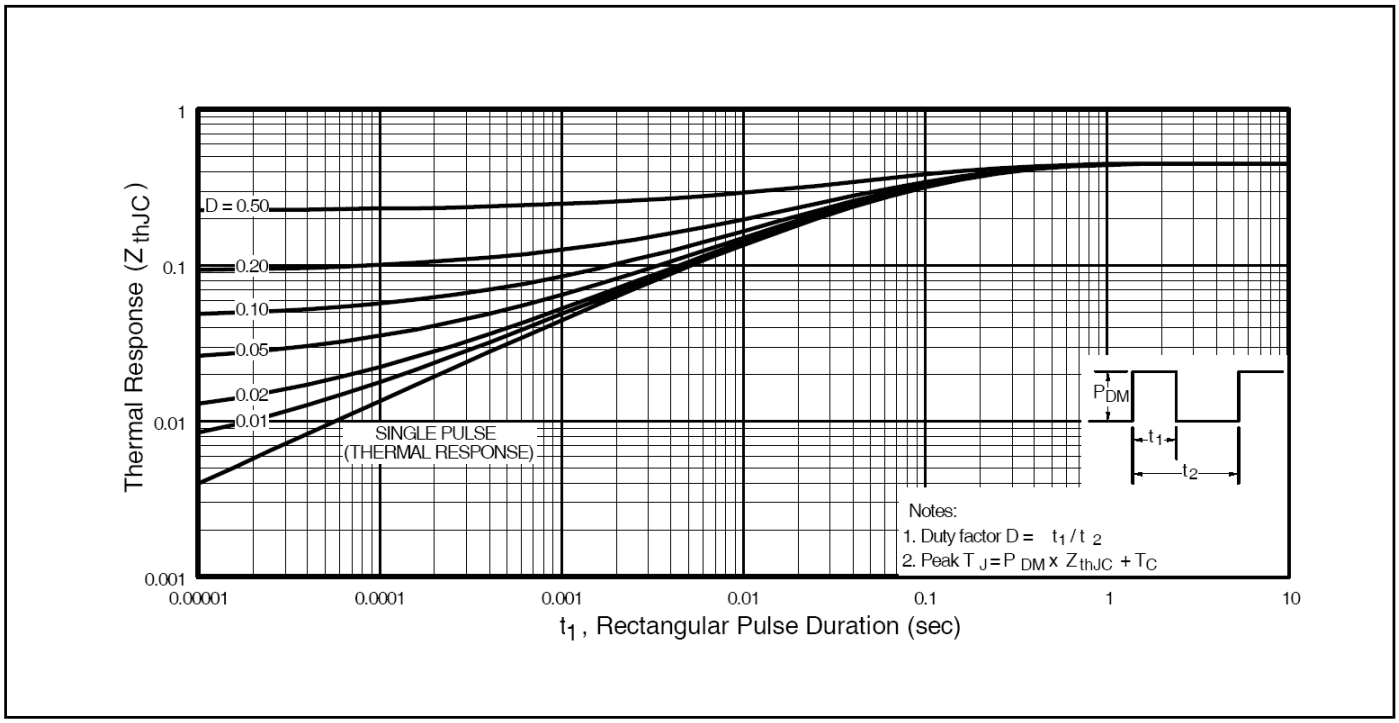


Figure 12 Maximum Effective Transient Thermal Impedance, Junction-to-Case

Electrical characteristic diagrams

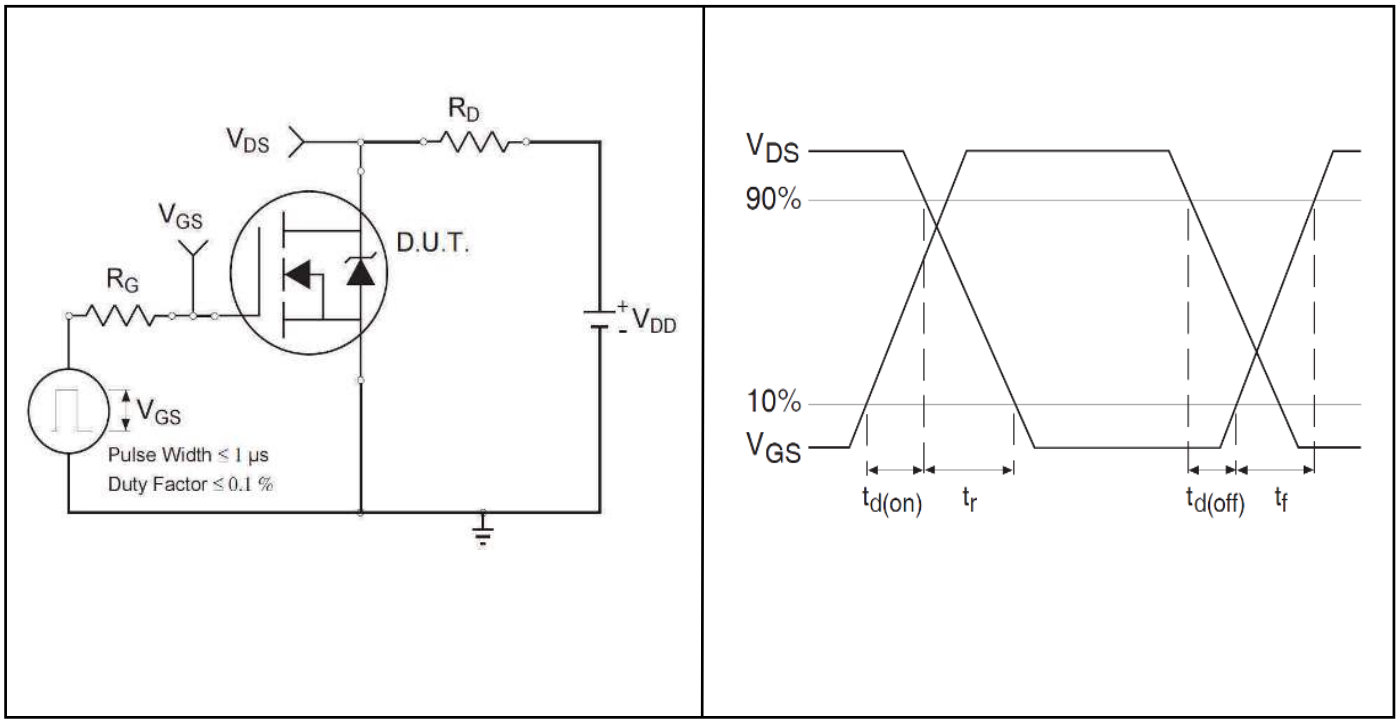


Figure 13a Switching Time Test Circuit

Figure 13b Switching Time Waveforms

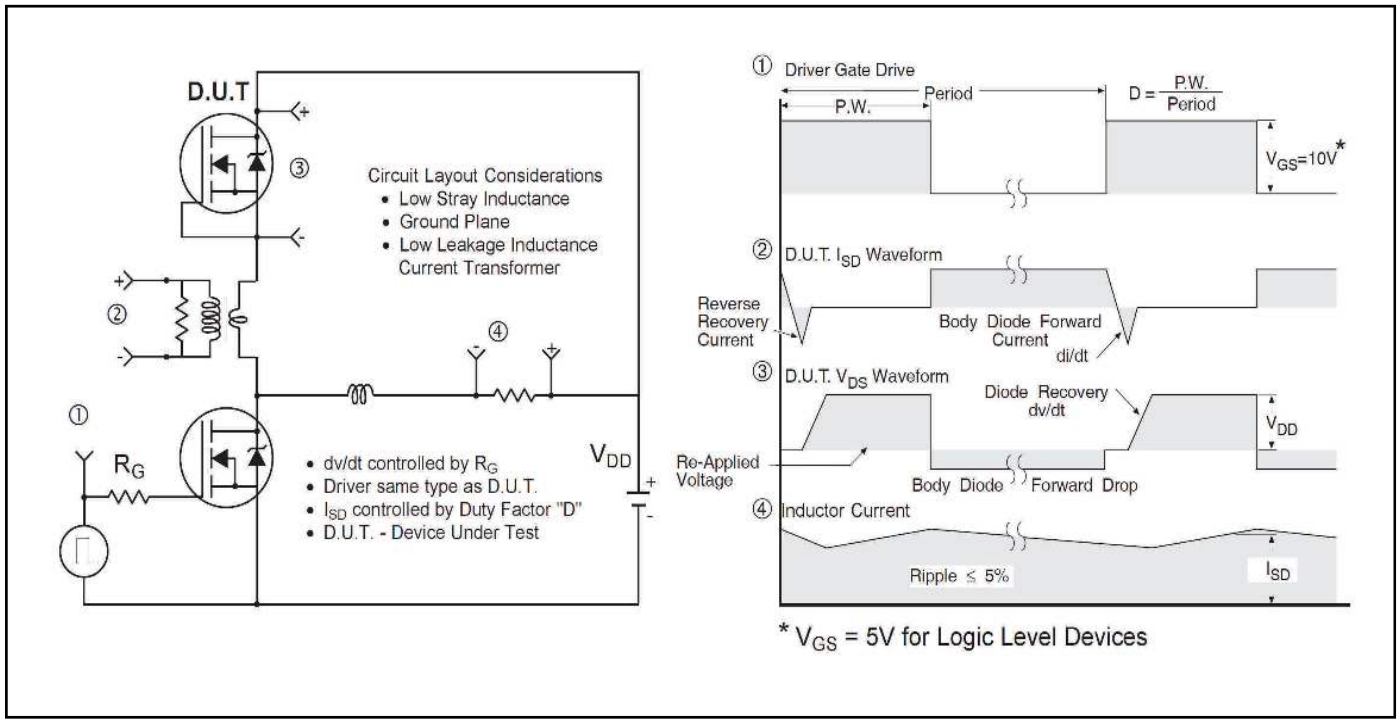


Figure 14 Peak Diode Recovery dv/dt Test Circuit for N-Channel HEXFET™ Power MOSFETs

Electrical characteristic diagrams

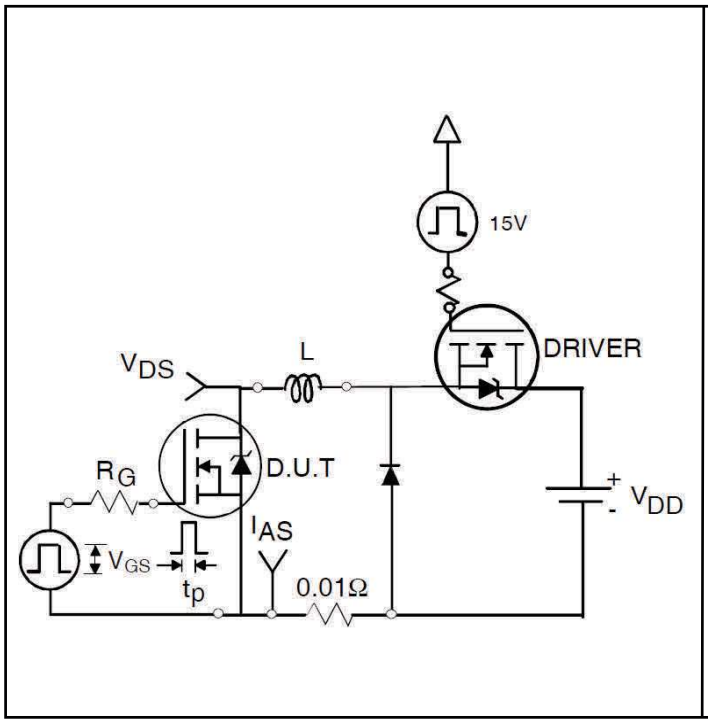


Figure 15a Unclamped Inductive Test Circuit

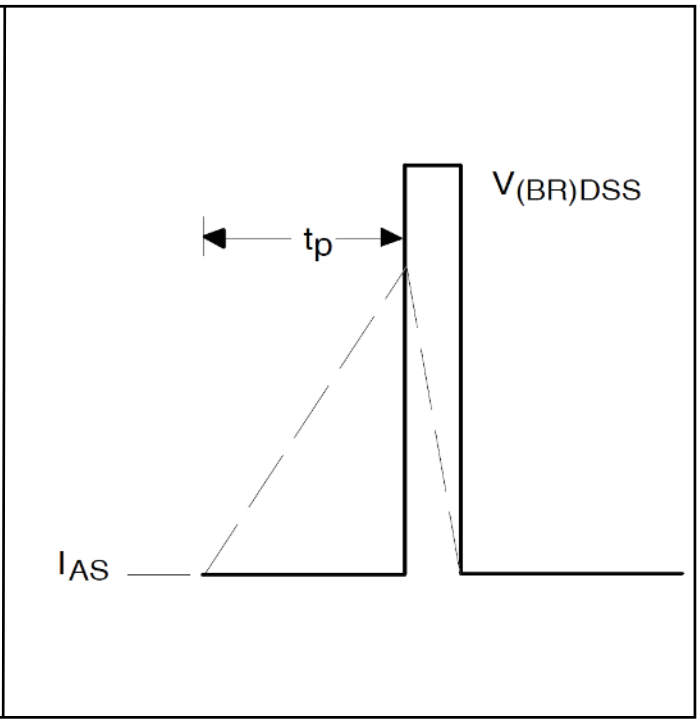


Figure 15b Unclamped Inductive Waveforms

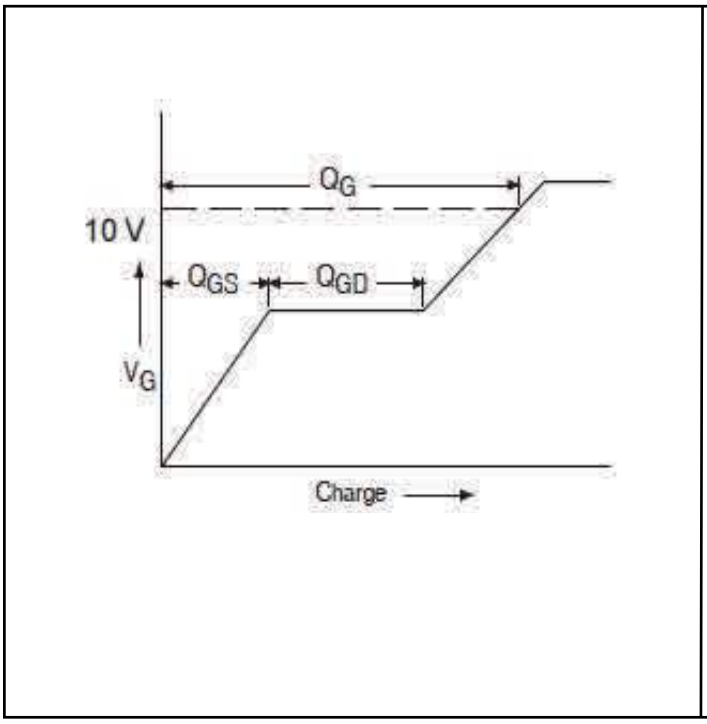


Figure 16a Gate Charge Waveform

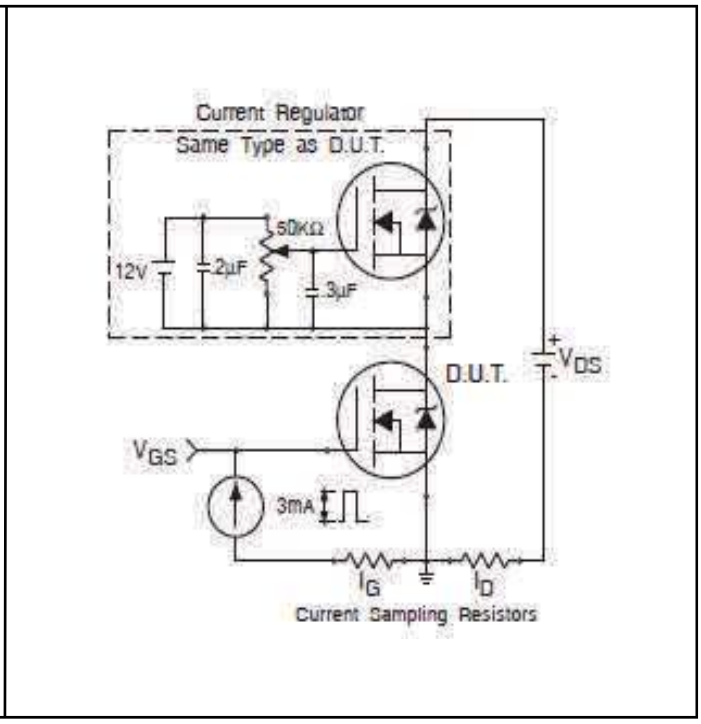
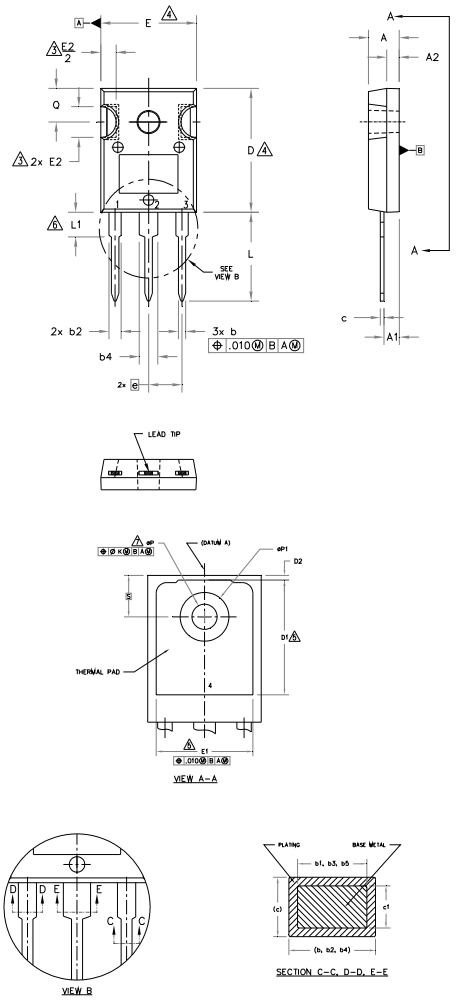


Figure 16b Gate Charge Test Circuit

5 Package Information

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

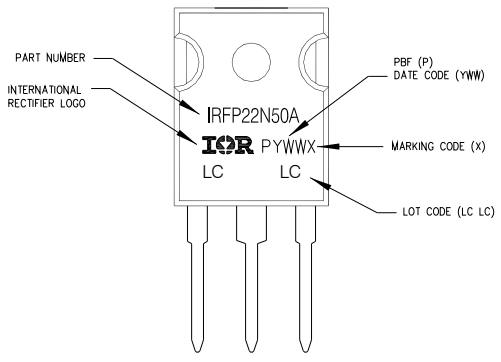
IGBTs, CoPACK

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

DIODES

1.– ANODE/OPEN
2.– CATHODE
3.– ANODE

TO-247AC Part Marking Information



TOP MARKING

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

6 Qualification Information

Qualification Information

Qualification Level	Industrial (per JEDEC JESD47F) †	
Moisture Sensitivity Level	TO-247AC	N/A
RoHS Compliant	Yes	

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

Revision History

Major changes since the last revision

Page or Reference	Revision	Date	Description of changes
All pages	2.0	2018-07-10	• First release data sheet.

Edition 2015-05-06
Published by
Infineon Technologies AG
81726 Munich, Germany

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Document reference

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