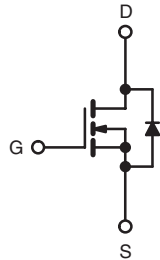
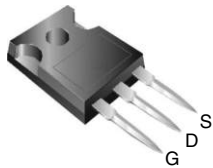


## Power MOSFET

PRODUCT SUMMARY	
$V_{DS}$ (V)	500
$R_{DS(on)}$ ( $\Omega$ )	$V_{GS} = 10\text{ V}$ 0.27
$Q_g$ (Max.) (nC)	105
$Q_{gs}$ (nC)	26
$Q_{gd}$ (nC)	42
Configuration	Single

TO-247



N-Channel MOSFET

### FEATURES

- Low Gate Charge  $Q_g$  Results in Simple Drive Requirement
- Improved Gate, Avalanche and Dynamic  $dV/dt$  Ruggedness
- Fully Characterized Capacitance and Avalanche Voltage and Current
- Effective  $C_{OSS}$  Specified
- Compliant to RoHS Directive 2002/95/EC


**RoHS\***  
COMPLIANT

### APPLICATIONS

- Switch Mode Power Supply (SMPS)
- Uninterruptable Power Supply
- High Speed Power Switching

### TYPICAL SMPS TOPOLOGIES

- Full Bridge
- PFC Boost

ORDERING INFORMATION	
Package	TO-247
Lead (Pb)-free	IRFP460APbF
	SiHFP460A-E3
SnPb	IRFP460A
	SiHFP460A


ABSOLUTE MAXIMUM RATINGS $T_C = 25\text{ }^\circ\text{C}$ , unless otherwise noted				
PARAMETER	SYMBOL	LIMIT	UNIT	
Drain-Source Voltage	$V_{DS}$	500	V	
Gate-Source Voltage	$V_{GS}$	$\pm 30$		
Continuous Drain Current	$V_{GS}$ at 10 V	$T_C = 25\text{ }^\circ\text{C}$	A	
		$T_C = 100\text{ }^\circ\text{C}$		
Pulsed Drain Current <sup>a</sup>	$I_{DM}$	80		
Linear Derating Factor		2.2	$W/^\circ\text{C}$	
Single Pulse Avalanche Energy <sup>b</sup>	$E_{AS}$	960	mJ	
Repetitive Avalanche Current <sup>a</sup>	$I_{AR}$	20	A	
Repetitive Avalanche Energy <sup>a</sup>	$E_{AR}$	28	mJ	
Maximum Power Dissipation	$T_C = 25\text{ }^\circ\text{C}$	$P_D$	280	W
Peak Diode Recovery $dV/dt^c$	$dV/dt$	3.8	V/ns	
Operating Junction and Storage Temperature Range	$T_J, T_{stg}$	- 55 to + 150	$^\circ\text{C}$	
Soldering Recommendations (Peak Temperature)	for 10 s	300 <sup>d</sup>		
Mounting Torque	6-32 or M3 screw	10		lbf · in
		1.1	N · m	

#### Notes

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- Starting  $T_J = 25\text{ }^\circ\text{C}$ ,  $L = 4.3\text{ mH}$ ,  $R_g = 25\text{ }\Omega$ ,  $I_{AS} = 20\text{ A}$  (see fig. 12).
- $I_{SD} \leq 20\text{ A}$ ,  $dI/dt \leq 125\text{ A}/\mu\text{s}$ ,  $V_{DD} \leq V_{DS}$ ,  $T_J \leq 150\text{ }^\circ\text{C}$ .
- 1.6 mm from case.

\* Pb containing terminations are not RoHS compliant, exemptions may apply

THERMAL RESISTANCE RATINGS						
PARAMETER	SYMBOL	TYP.	MAX.	UNIT		
Maximum Junction-to-Ambient	$R_{thJA}$	-	40	°C/W		
Case-to-Sink, Flat, Greased Surface	$R_{thCS}$	0.24	-			
Maximum Junction-to-Case (Drain)	$R_{thJC}$	-	0.45			

SPECIFICATIONS $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
<b>Static</b>						
Drain-Source Breakdown Voltage	$V_{DS}$	$V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$	500	-	-	V
$V_{DS}$ Temperature Coefficient	$\Delta V_{DS}/T_J$	Reference to $25\text{ }^\circ\text{C}, I_D = 1\text{ mA}$	-	0.61	-	V/°C
Gate-Source Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$	2.0	-	4.0	V
Gate-Source Leakage	$I_{GSS}$	$V_{GS} = \pm 30\text{ V}$	-	-	$\pm 100$	nA
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = 500\text{ V}, V_{GS} = 0\text{ V}$	-	-	25	$\mu\text{A}$
		$V_{DS} = 400\text{ V}, V_{GS} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$	-	-	250	
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}, I_D = 12\text{ A}^b$	-	-	0.27	$\Omega$
Forward Transconductance	$g_{fs}$	$V_{DS} = 50\text{ V}, I_D = 12\text{ A}^b$	11	-	-	S
<b>Dynamic</b>						
Input Capacitance	$C_{iss}$	$V_{GS} = 0\text{ V}, V_{DS} = 25\text{ V}, f = 1.0\text{ MHz}$ , see fig. 5	-	3100	-	pF
Output Capacitance	$C_{oss}$		-	480	-	
Reverse Transfer Capacitance	$C_{riss}$		-	18	-	
Output Capacitance	$C_{oss}$	$V_{GS} = 0\text{ V}$	$V_{DS} = 1.0\text{ V}, f = 1.0\text{ MHz}$	4430		pF
Effective Output Capacitance	$C_{oss\text{ eff.}}$		$V_{DS} = 400\text{ V}, f = 1.0\text{ MHz}$	130		
Total Gate Charge	$Q_g$	$V_{GS} = 10\text{ V}, I_D = 20\text{ A}, V_{DS} = 400\text{ V}$ , see fig. 6 and 13 <sup>b</sup>	-	-	105	nC
Gate-Source Charge	$Q_{gs}$		-	-	26	
Gate-Drain Charge	$Q_{gd}$		-	-	42	
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = 250\text{ V}, I_D = 20\text{ A}, R_G = 4.3\text{ }\Omega, R_D = 13\text{ }\Omega$ , see fig. 10 <sup>b</sup>	-	18	-	ns
Rise Time	$t_r$		-	55	-	
Turn-Off Delay Time	$t_{d(off)}$		-	45	-	
Fall Time	$t_f$		-	39	-	
<b>Drain-Source Body Diode Characteristics</b>						
Continuous Source-Drain Diode Current	$I_S$	MOSFET symbol showing the integral reverse p - n junction diode 	-	-	20	A
Pulsed Diode Forward Current <sup>a</sup>	$I_{SM}$		-	-	80	
Body Diode Voltage	$V_{SD}$	$T_J = 25\text{ }^\circ\text{C}, I_S = 20\text{ A}, V_{GS} = 0\text{ V}^b$	-	-	1.8	V
Body Diode Reverse Recovery Time	$t_{rr}$	$T_J = 25\text{ }^\circ\text{C}, I_F = 20\text{ A}, dI/dt = 100\text{ A}/\mu\text{s}^b$	-	480	710	ns
Body Diode Reverse Recovery Charge	$Q_{rr}$		-	5.0	7.5	$\mu\text{C}$
Forward Turn-On Time	$t_{on}$	Intrinsic turn-on time is negligible (turn-on is dominated by $L_S$ and $L_D$ )				

**Notes**

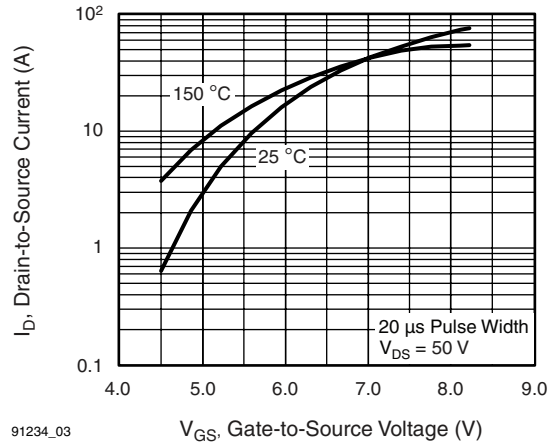
- a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- b. Pulse width  $\leq 300\text{ }\mu\text{s}$ ; duty cycle  $\leq 2\%$ .
- c.  $C_{oss\text{ eff.}}$  is a fixed capacitance that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 % to 80 %  $V_{DS}$ .

## TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



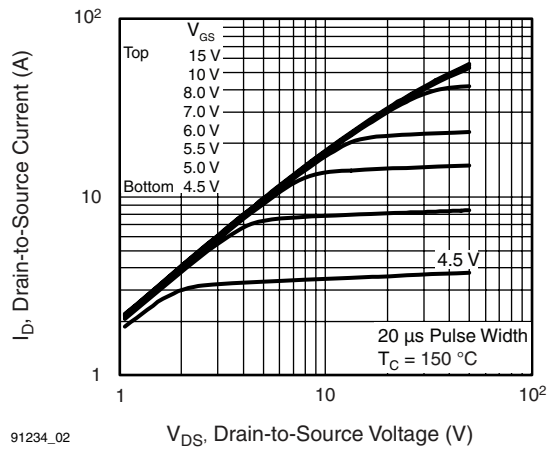
91234\_01

Fig. 1 - Typical Output Characteristics



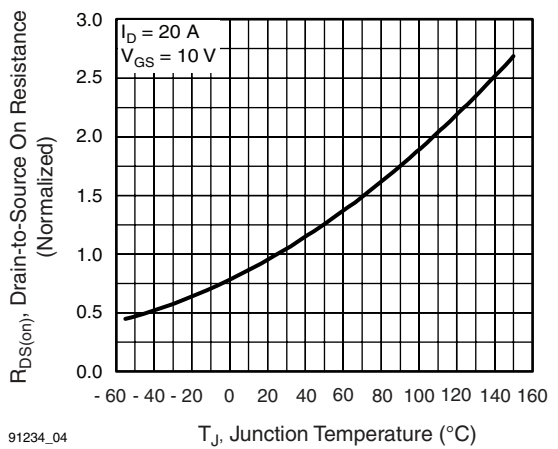
91234\_03

Fig. 3 - Typical Transfer Characteristics



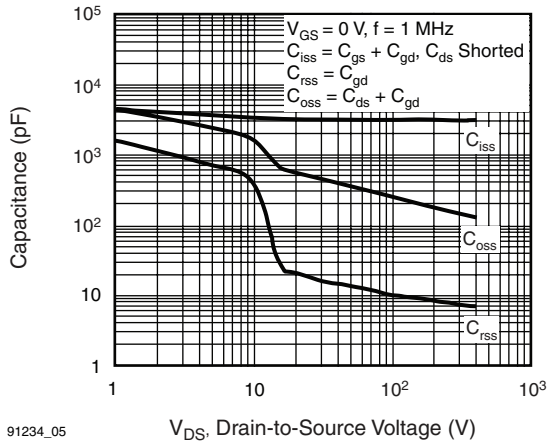
91234\_02

Fig. 2 - Typical Output Characteristics



91234\_04

Fig. 4 - Normalized On-Resistance vs. Temperature



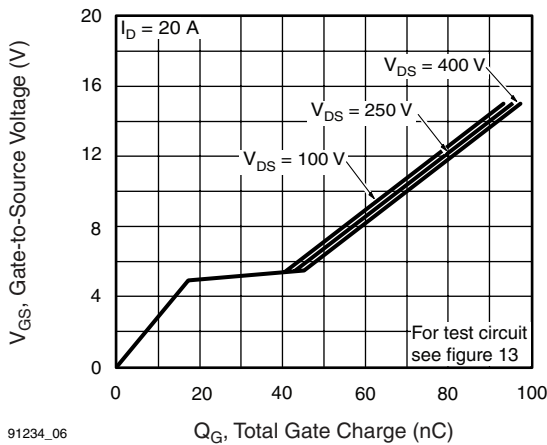
91234\_05

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



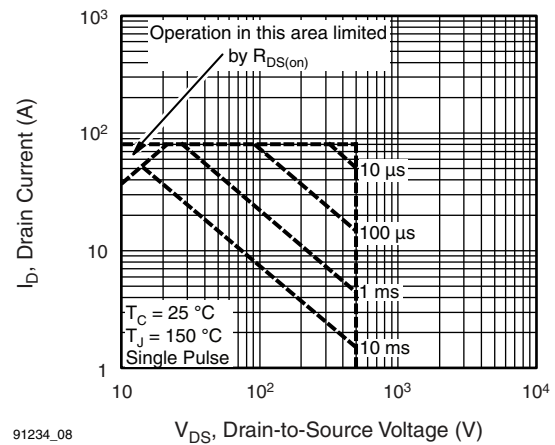
91234\_07

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



91234\_06

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

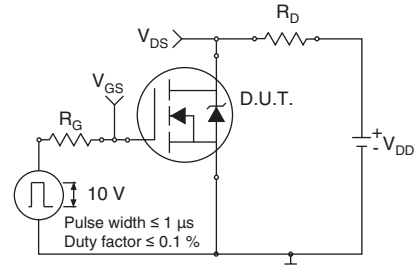


91234\_08

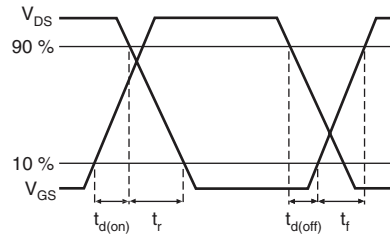
**Fig. 8 - Maximum Safe Operating Area**



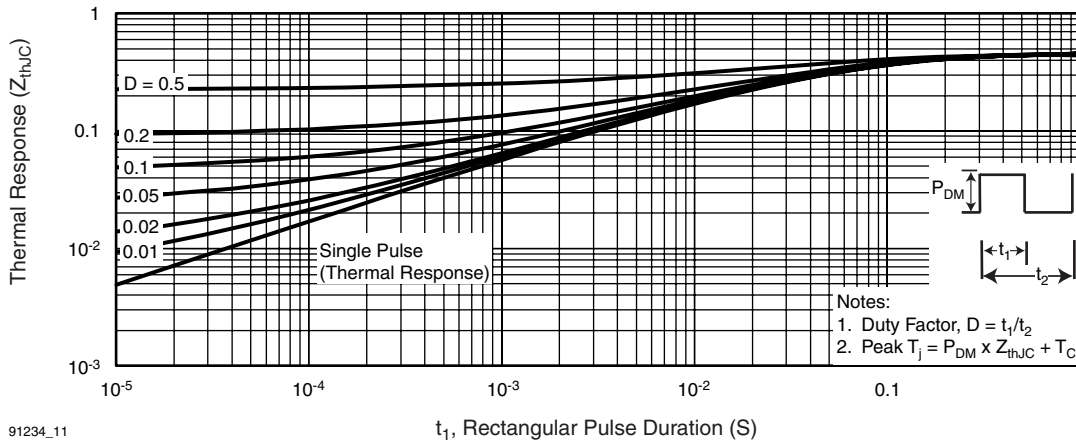
**Fig. 9 - Maximum Drain Current vs. Case Temperature**



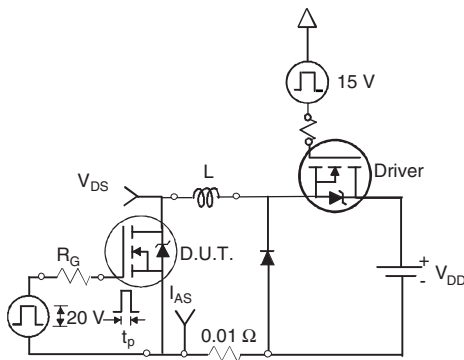
**Fig. 10a - Switching Time Test Circuit**



**Fig. 10b - Switching Time Waveforms**



**Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case**



**Fig. 12a - Unclamped Inductive Test Circuit**



**Fig. 12b - Unclamped Inductive Waveforms**

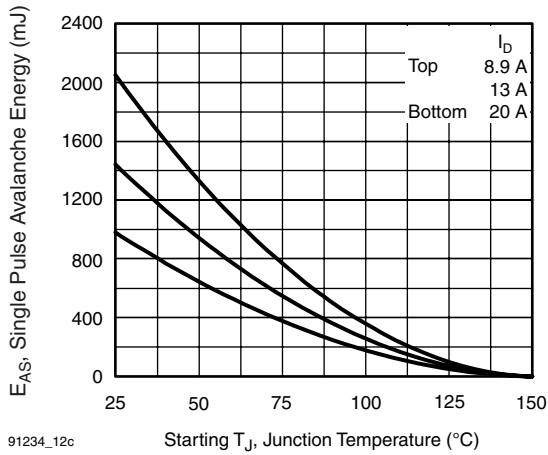


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

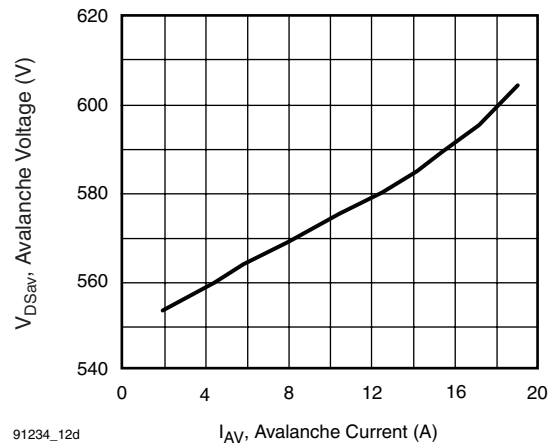


Fig. 12d - Typical Drain-to-Source Voltage vs. Avalanche Current

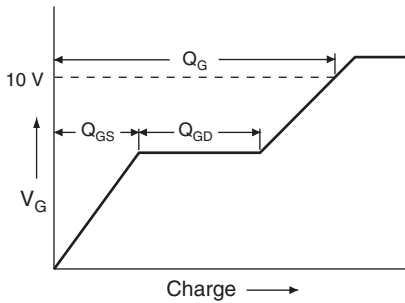


Fig. 13a - Basic Gate Charge Waveform

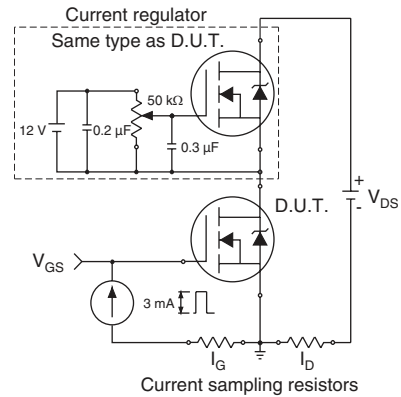


Fig. 13b - Gate Charge Test Circuit

## Peak Diode Recovery $dV/dt$ Test Circuit



**Fig. 14 - For N-Channel**

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# TO-247AC (High Voltage)



DIM.	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	4.58	5.31	0.180	0.209
A1	2.21	2.59	0.087	0.102
A2	1.17	2.49	0.046	0.098
b	0.99	1.40	0.039	0.055
b1	0.99	1.35	0.039	0.053
b2	1.53	2.39	0.060	0.094
b3	1.65	2.37	0.065	0.093
b4	2.42	3.43	0.095	0.135
b5	2.59	3.38	0.102	0.133
c	0.38	0.86	0.015	0.034
c1	0.38	0.76	0.015	0.030
D	19.71	20.82	0.776	0.820
D1	13.08	-	0.515	-

DIM.	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
D2	0.51	1.30	0.020	0.051
E	15.29	15.87	0.602	0.625
E1	13.72	-	0.540	-
e	5.46 BSC		0.215 BSC	
Ø k	0.254		0.010	
L	14.20	16.25	0.559	0.640
L1	3.71	4.29	0.146	0.169
N	7.62 BSC		0.300 BSC	
Ø P	3.51	3.66	0.138	0.144
Ø P1	-	7.39	-	0.291
Q	5.31	5.69	0.209	0.224
R	4.52	5.49	0.178	0.216
S	5.51 BSC		0.217 BSC	

ECN: X13-0103-Rev. D, 01-Jul-13  
DWG: 5971

**Notes**

1. Dimensioning and tolerancing per ASME Y14.5M-1994.
2. Contour of slot optional.
3. Dimension D and E do not include mold flash. Mold flash shall not exceed 0.127 mm (0.005") per side. These dimensions are measured at the outermost extremes of the plastic body.
4. Thermal pad contour optional with dimensions D1 and E1.
5. Lead finish uncontrolled in L1.
6. Ø P to have a maximum draft angle of 1.5 to the top of the part with a maximum hole diameter of 3.91 mm (0.154").
7. Outline conforms to JEDEC outline TO-247 with exception of dimension c.
8. Xian and Mingxin actually photo.







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