

International IR Rectifier

- Advanced Process Technology
- Ultra Low On-Resistance
- Dynamic dv/dt Rating
- 175°C Operating Temperature
- Fast Switching
- Fully Avalanche Rated
- Lead-Free

Description

Seventh Generation HEXFET® Power MOSFETs from International Rectifier utilize advanced processing techniques to achieve extremely low on-resistance per silicon area. This benefit, combined with the fast switching speed and ruggedized device design that HEXFET power MOSFETs are well known for, provides the designer with an extremely efficient and reliable device for use in a wide variety of applications.

The D²Pak is a surface mount power package capable of accommodating die sizes up to HEX-4. It provides the highest power capability and the lowest possible on-resistance in any existing surface mount package. The D²Pak is suitable for high current applications because of its low internal connection resistance and can dissipate up to 2.0W in a typical surface mount application. The through-hole version (IRF1404L) is available for low-profile applications.

Absolute Maximum Ratings

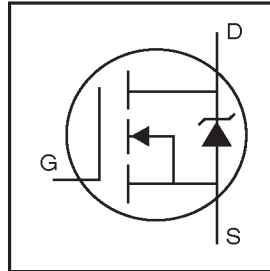
	Parameter	Max.	Units
$I_D @ T_C = 25^\circ\text{C}$	Continuous Drain Current, $V_{GS} @ 10\text{V}$	162 [Ⓒ]	A
$I_D @ T_C = 100^\circ\text{C}$	Continuous Drain Current, $V_{GS} @ 10\text{V}$	115 [Ⓒ]	
I_{DM}	Pulsed Drain Current [Ⓛ] [Ⓜ]	650	
$P_D @ T_A = 25^\circ\text{C}$	Power Dissipation	3.8	W
$P_D @ T_C = 25^\circ\text{C}$	Power Dissipation	200	W
	Linear Derating Factor	1.3	W/°C
V_{GS}	Gate-to-Source Voltage	± 20	V
E_{AS}	Single Pulse Avalanche Energy [Ⓜ]	519	mJ
I_{AR}	Avalanche Current [Ⓛ]	95	A
E_{AR}	Repetitive Avalanche Energy [Ⓛ]	20	mJ
dv/dt	Peak Diode Recovery dv/dt [Ⓛ] [Ⓜ]	5.0	V/ns
T_J	Operating Junction and	-55 to +175	°C
T_{STG}	Storage Temperature Range	-55 to +175	
	Soldering Temperature, for 10 seconds	300 (1.6mm from case)	

Thermal Resistance

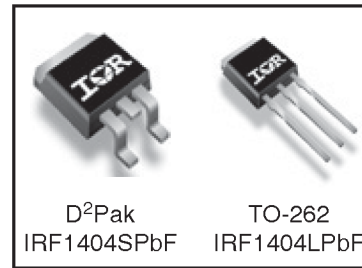
	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case	—	0.75	°C/W
$R_{\theta JA}$	Junction-to-Ambient (PCB mounted, steady-state)*	—	40	

PD-95104

IRF1404SPbF
IRF1404LPbF
HEXFET® Power MOSFET



$V_{DSS} = 40\text{V}$
$R_{DS(on)} = 0.004\Omega$
$I_D = 162\text{A}^{\text{Ⓒ}}$



D²Pak
IRF1404SPbF

TO-262
IRF1404LPbF

IRF1404S/LPbF

International
 Rectifier

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

	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	40	—	—	V	$V_{GS} = 0V, I_D = 250\mu A$
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	0.036	—	V/°C	Reference to $25^\circ\text{C}, I_D = 1mA$
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	0.0035	0.004	Ω	$V_{GS} = 10V, I_D = 95A$ ④
$V_{GS(th)}$	Gate Threshold Voltage	2.0	—	4.0	V	$V_{DS} = 10V, I_D = 250\mu A$
g_{fs}	Forward Transconductance	106	—	—	S	$V_{DS} = 25V, I_D = 60A$ ②
I_{DSS}	Drain-to-Source Leakage Current	—	—	20	μA	$V_{DS} = 40V, V_{GS} = 0V$
		—	—	250		$V_{DS} = 32V, V_{GS} = 0V, T_J = 150^\circ\text{C}$
I_{GSS}	Gate-to-Source Forward Leakage	—	—	200	nA	$V_{GS} = 20V$
	Gate-to-Source Reverse Leakage	—	—	-200		$V_{GS} = -20V$
Q_g	Total Gate Charge	—	160	200	nC	$I_D = 95A$
Q_{gs}	Gate-to-Source Charge	—	35	—		$V_{DS} = 32V$
Q_{gd}	Gate-to-Drain ("Miller") Charge	—	42	60		$V_{GS} = 10V$ ④ ⑦
$t_{d(on)}$	Turn-On Delay Time	—	17	—	ns	$V_{DD} = 20V$
t_r	Rise Time	—	140	—		$I_D = 95A$
$t_{d(off)}$	Turn-Off Delay Time	—	72	—		$R_G = 2.5\Omega$
t_f	Fall Time	—	26	—		$R_D = 0.21\Omega$ ④ ⑦
L_S	Internal Source Inductance	—	7.5	—	nH	Between lead, and center of die contact
C_{iss}	Input Capacitance	—	7360	—	pF	$V_{GS} = 0V$
C_{oss}	Output Capacitance	—	1680	—		$V_{DS} = 25V$
C_{rss}	Reverse Transfer Capacitance	—	240	—		$f = 1.0MHz$, See Fig. 5 ②
C_{oss}	Output Capacitance	—	6630	—		$V_{GS} = 0V, V_{DS} = 1.0V, f = 1.0MHz$
C_{oss}	Output Capacitance	—	1490	—		$V_{GS} = 0V, V_{DS} = 32V, f = 1.0MHz$
$C_{oss\ eff.}$	Effective Output Capacitance ⑤ ⑦	—	1540	—		$V_{GS} = 0V, V_{DS} = 0V$ to $32V$

Source-Drain Ratings and Characteristics

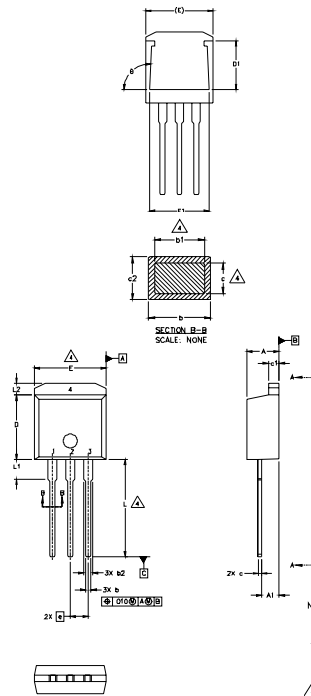
	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	—	—	162 ⑥	A	MOSFET symbol showing the integral reverse p-n junction diode.
I_{SM}	Pulsed Source Current (Body Diode) ①	—	—	650		
V_{SD}	Diode Forward Voltage	—	—	1.3	V	$T_J = 25^\circ\text{C}, I_S = 95A, V_{GS} = 0V$ ④
t_{rr}	Reverse Recovery Time	—	71	110	ns	$T_J = 25^\circ\text{C}, I_F = 95A$
Q_{rr}	Reverse Recovery Charge	—	180	270	nC	$di/dt = 100A/\mu s$ ④ ⑦
t_{on}	Forward Turn-On Time	Intrinsic turn-on time is negligible (turn-on is dominated by $L_S + L_D$)				

Notes:

- ① Repetitive rating; pulse width limited by max. junction temperature. (See fig. 11)
- ② Starting $T_J = 25^\circ\text{C}, L = 0.12mH$
 $R_G = 25\Omega, I_{AS} = 95A$. (See Figure 12)
- ③ $I_{SD} \leq 95A, di/dt \leq 150A/\mu s, V_{DD} \leq V_{(BR)DSS}, T_J \leq 175^\circ\text{C}$
- ④ Pulse width $\leq 300\mu s$; duty cycle $\leq 2\%$.
- ⑤ $C_{oss\ eff.}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS}
- ⑥ Calculated continuous current based on maximum allowable junction temperature. Package limitation current is 75A
- ⑦ Use IRF1404 data and test conditions.

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

TO-262 Package Outline



SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	4.06	4.83	.160	.190	4
A1	2.03	2.92	.080	.115	
b	0.51	0.99	.020	.039	
b1	0.51	0.89	.020	.035	4
b2	1.14	1.40	.045	.055	
c	0.38	0.63	.015	.025	3
c1	1.14	1.40	.045	.055	
c2	0.43	.063	.017	.029	3
D	8.51	9.65	.335	.380	
D1	5.33		.210		3
E	9.65	10.67	.380	.420	
E1	6.22		.245		3
e	2.54 BSC		.100 BSC		
L	13.46	14.09	.530	.555	
L1	3.56	3.71	.140	.146	
L2		1.65		.065	

LEAD ASSIGNMENTS

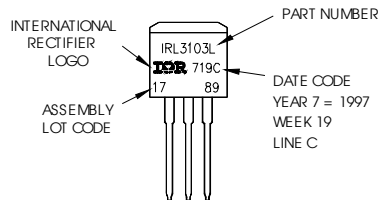
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|------------|--------------|
| HEXFET | IGBT |
| 1.- GATE | 1- GATE |
| 2.- DRAIN | 2- COLLECTOR |
| 3.- SOURCE | 3- EMITTER |
| 4.- DRAIN | |

- NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994
 2. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
 3. DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.127 [0.005"] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY.
 4. DIMENSION b1 AND c1 APPLY TO BASE METAL ONLY.
 5. CONTROLLING DIMENSION: INCH.

TO-262 Part Marking Information

EXAMPLE: THIS IS AN IRL3103L
 LOT CODE 1789
 ASSEMBLED ON WW 19, 1997
 IN THE ASSEMBLY LINE "C"

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



OR

