# International Rectifier

# Generation V Technology

- Ultra Low On-Resistance
- Dual N and P Channel MOSFET
- Surface Mount
- Very Low Gate Charge and Switching Losses
- Fully Avalanche Rated
- Lead-Free

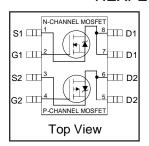
#### Description

Fifth Generation HEXFETs 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 SO-8 has been modified through a customized leadframe for enhanced thermal characteristics and multiple-die capability making it ideal in a variety of power applications. With these improvements, multiple devices can be used in an application with dramatically reduced board space. The package is designed for vapor phase, infra red, or wave soldering techniques.

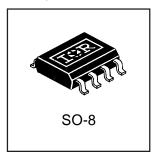
# IRF9952PbF

**HEXFET® Power MOSFET** 



	N-Ch	P-Ch		
V <sub>DSS</sub>	30V	-30V		
R <sub>DS(on)</sub>	0.10Ω	0.25Ω		

Recommended upgrade: IRF7309 or IRF7319 Lower profile/smaller equivalent: IRF7509



		Symbol	Maximum		Units	
			N-Channel	P-Channel		
Drain-Source Voltage		V <sub>DS</sub>	30		V	
Gate-Source Voltage		V <sub>GS</sub>	± 20		V	
Continuous Drain Current®	T <sub>A</sub> = 25°C		3.5	-2.3		
Continuous Drain Current	$T_A = 70$ °C	- I <sub>D</sub>	2.8	-1.8	A	
Pulsed Drain Current		I <sub>DM</sub>	16	-10	^	
Continuous Source Current (Diode Conduction)		Is	1.7	-1.3		
Maximum Power Dissipation ⑤	T <sub>A</sub> = 25°C	- P <sub>D</sub>	2.0		W	
Maximum Fower Dissipation	T <sub>A</sub> = 70°C	LD LD	1.3			
Single Pulse Avalanche Energy	<u>'</u>	E <sub>AS</sub>	44	57	mJ	
Avalanche Current		I <sub>AR</sub>	2.0	-1.3	Α	
Repetitive Avalanche Energy		E <sub>AR</sub>	0.25		mJ	
Peak Diode Recovery dv/dt ⊘		dv/dt	5.0	-5.0	V/ ns	
Junction and Storage Temperature Range		T <sub>J,</sub> T <sub>STG</sub>	-55 to + 150 ℃			

### **Thermal Resistance Ratings**

Parameter	Symbol	Limit	Units
Maximum Junction-to-Ambient ⑤	$R_{\theta JA}$	62.5	°C/W

# IRF9952PbF

# Electrical Characteristics @ T<sub>J</sub> = 25°C (unless otherwise specified)

Parameter			Тур.	Max.	Units	Conditions	
Drain-to-Source Breakdown Voltage			_	_	\/	$V_{GS} = 0V, I_D = 250\mu A$	
Brain-to-Gourde Breakdown Voltage			_	_	v	$V_{GS} = 0V, I_D = -250\mu A$	
Breakdown Voltage Temp, Coefficient		_			V//°C	Reference to 25°C, I <sub>D</sub> = 1mA	
Broakdoviii Voltago Toliip. Goolilololii	P-Ch	_	0.015	_	V/ C	Reference to 25°C, I <sub>D</sub> = -1mA	
	N-Ch	_				V <sub>GS</sub> = 10V, I <sub>D</sub> = 2.2A ④	
Static Drain-to-Source On-Resistance	14-011	_				V <sub>GS</sub> = 4.5V, I <sub>D</sub> = 1.0A ④	
	P-Ch	—				V <sub>GS</sub> = -10V, I <sub>D</sub> = -1.0A ④	
		_	0.290	0.400		$V_{GS} = -4.5V, I_D = -0.50A$ ④	
Gate Threshold Voltage				_		$V_{DS} = V_{GS}, I_{D} = 250 \mu A$	
Cate Impendia Fenage		_	_	_	_ v	$V_{DS} = V_{GS}, I_{D} = -250 \mu A$	
Forward Transconductance		_	_	_		V <sub>DS</sub> = 15V, I <sub>D</sub> = 3.5A ⊕	
T OTTIGLE THE TOTAL OF THE TOTA	_		2.4	_		$V_{DS} = -15V, I_D = -2.3A$ (4)	
				2.0		V <sub>DS</sub> = 24V, V <sub>GS</sub> = 0V	
Drain-to-Source Leakage Current						$V_{DS} = -24V, V_{GS} = 0V$	
Ziam to Jourso Zounago Jamoin			_		μΛ	$V_{DS} = 24V, V_{GS} = 0V, T_{J} = 125^{\circ}C$	
			_			$V_{DS} = -24V, V_{GS} = 0V, T_{J} = 125^{\circ}C$	
Gate-to-Source Forward Leakage	_		_	±100	nA	V <sub>GS</sub> = ±20V	
Total Gate Charge		_	6.9	14		N-Channel	
g-		_				$I_D = 1.8A, V_{DS} = 10V, V_{GS} = 10V$	
Gate-to-Source Charge					nC	1D = 1.0A, VDS = 10V, VGS = 10V	
g-		_	_		110	P-Channel	
Gate-to-Drain ("Miller") Charge						I <sub>D</sub> = -2.3A, V <sub>DS</sub> = -10V, V <sub>GS</sub> = -10V	
, , ,			_			.b _167 i, 165 101 i 165	
Turn-On Delay Time						N-Channel	
,			_			$V_{DD} = 10V$ , $I_D = 1.0A$ , $R_G = 6.0\Omega$ ,	
Rise Time			_			$R_D = 10\Omega$	
		_	_		ns	4	
Turn-Off Delay Time						P-Channel	
						$V_{DD} = -10V$ , $I_{D} = -1.0A$ , $R_{G} = 6.0\Omega$ ,	
Fall Time						$R_D = 10\Omega$	
				14		N. Ohannad	
Input Capacitance						N-Channel	
			_			$V_{GS} = 0V, V_{DS} = 15V, f = 1.0MHz$	
Output Capacitance					рr	P-Channel	
			61			V <sub>GS</sub> = 0V, V <sub>DS</sub> = -15V, <i>f</i> = 1.0MHz	
l .	N-Ch						
	Drain-to-Source Breakdown Voltage Breakdown Voltage Temp. Coefficient Static Drain-to-Source On-Resistance Gate Threshold Voltage Forward Transconductance  Drain-to-Source Leakage Current  Gate-to-Source Forward Leakage Total Gate Charge Gate-to-Drain ("Miller") Charge  Turn-On Delay Time Rise Time  Turn-Off Delay Time Fall Time Input Capacitance	Drain-to-Source Breakdown Voltage					

### **Source-Drain Ratings and Characteristics**

	Parameter		Min.	Тур.	Max.	Units	Conditions
		N-Ch	_	_	1.7		
IS	Continuous Source Current (Body Diode)	P-Ch	_	_	-1.3	Α	
	D   10 0 1/D   D: 1\0	N-Ch	_	_	16	^	
I <sub>SM</sub>	Pulsed Source Current (Body Diode) ①	P-Ch	_	_	16		
.,		N-Ch	_	0.82	1.2	V	$T_J = 25$ °C, $I_S = 1.25A$ , $V_{GS} = 0V$ ③
$V_{SD}$	Diode Forward Voltage	P-Ch	_	-0.82	-1.2	1 "	$T_J = 25^{\circ}C$ , $I_S = -1.25A$ , $V_{GS} = 0V$ ③
		N-Ch	_	27	53	ns	N-Channel
τ <sub>rr</sub>	Reverse Recovery Time	P-Ch	_	27	54	113	$T_J = 25$ °C, $I_F = 1.25$ A, $di/dt = 100$ A/ $\mu$ s
	D	N-Ch	_	28	57	nC	P-Channel 4
$Q_{rr}$	Reverse Recovery Charge	P-Ch	_	31	62		$T_J = 25$ °C, $I_F = -1.25$ A, $di/dt = 100$ A/ $\mu$ s

#### Notes:

① Repetitive rating; pulse width limited by max. junction temperature. ( See fig. 23 )

- 4 Pulse width  $\leq 300 \mu s$ ; duty cycle  $\leq 2\%$ .
- ② N-Channel  $I_{SD} \le 2.0$ A, di/dt  $\le 100$ A/ $\mu$ s,  $V_{DD} \le V_{(BR)DSS}$ ,  $T_J \le 150$ °C P-Channel  $I_{SD} \le -1.3$ A, di/dt  $\le 84$ A/ $\mu$ s,  $V_{DD} \le V_{(BR)DSS}$ ,  $T_J \le 150$ °C

- ③ N-Channel Starting T $_J$  = 25°C, L = 22mH R $_G$  = 25 $\Omega$ , I $_{AS}$  = 2.0A. (See Figure 12) P-Channel Starting T $_J$  = 25°C, L = 67mH R $_G$  = 25 $\Omega$ , I $_{AS}$  = -1.3A.
  - 2

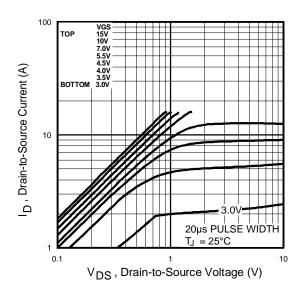


Fig 1. Typical Output Characteristics

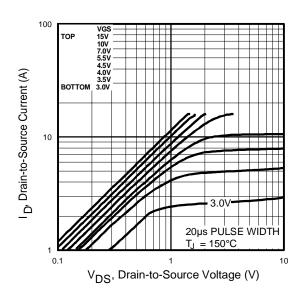


Fig 2. Typical Output Characteristics

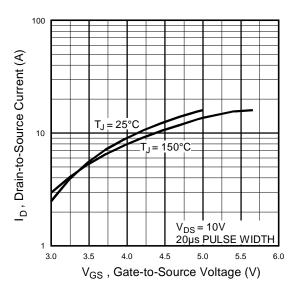


Fig 3. Typical Transfer Characteristics

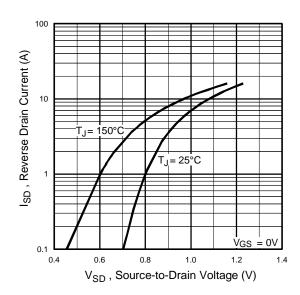
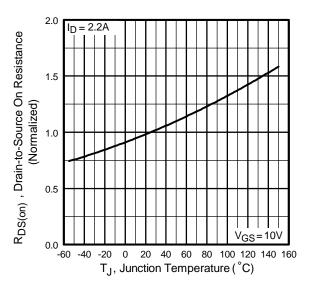


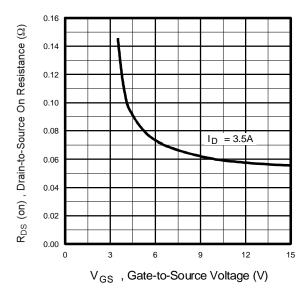
Fig 4. Typical Source-Drain Diode Forward Voltage

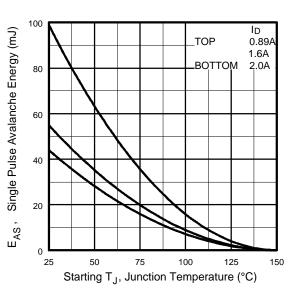


0.12 0.12 0.10 V<sub>GS</sub> = 4.5V 0.00 V<sub>GS</sub> = 10V 0.06 0.04 0 2 4 6 8 10 12 I<sub>D</sub>, Drain Current (A)

**Fig 5.** Normalized On-Resistance Vs. Temperature

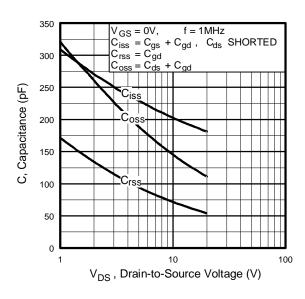
**Fig 6.** Typical On-Resistance Vs. Drain Current

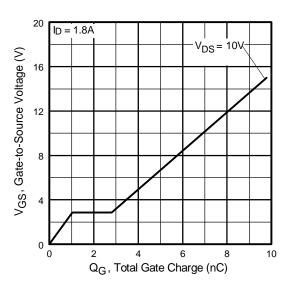




**Fig 7.** Typical On-Resistance Vs. Gate Voltage

Fig 8. Maximum Avalanche Energy
Vs. Drain Current
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**Fig 9.** Typical Capacitance Vs. Drain-to-Source Voltage

**Fig 10.** Typical Gate Charge Vs. Gate-to-Source Voltage

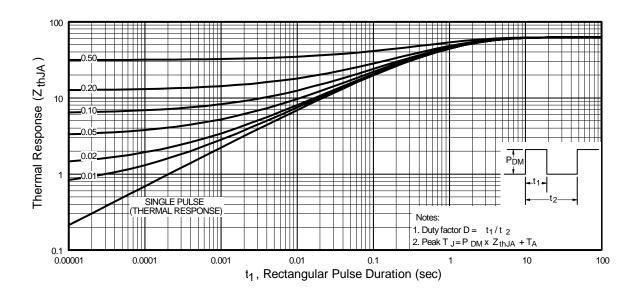


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Ambient

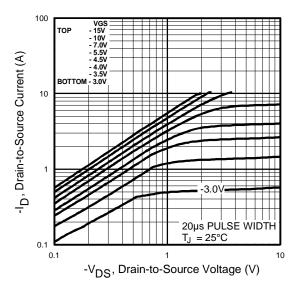


Fig 12. Typical Output Characteristics

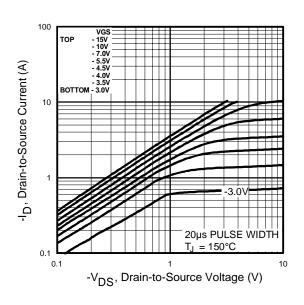


Fig 13. Typical Output Characteristics

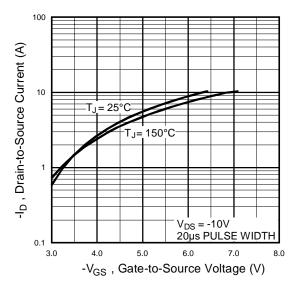


Fig 14. Typical Transfer Characteristics

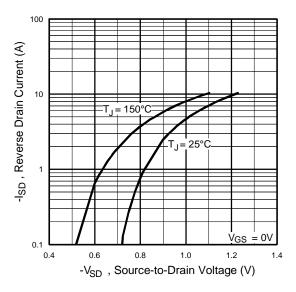
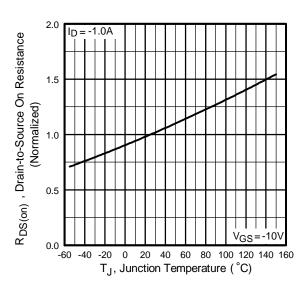
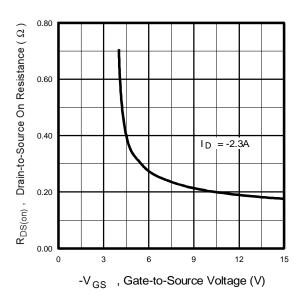


Fig 15. Typical Source-Drain Diode Forward Voltage



**Fig 16.** Normalized On-Resistance Vs. Temperature

Fig 17. Typical On-Resistance Vs. Drain Current



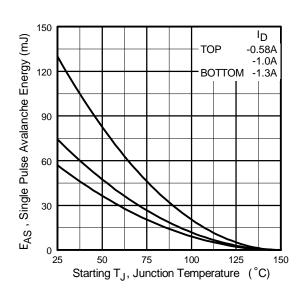


Fig 18. Typical On-Resistance Vs. Gate Voltage

Fig 19. Maximum Avalanche Energy Vs. Drain Current

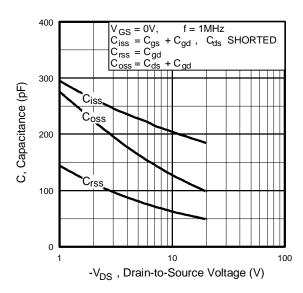


Fig 20. Typical Capacitance Vs.
Drain-to-Source Voltage

**Fig 21.** Typical Gate Charge Vs. Gate-to-Source Voltage

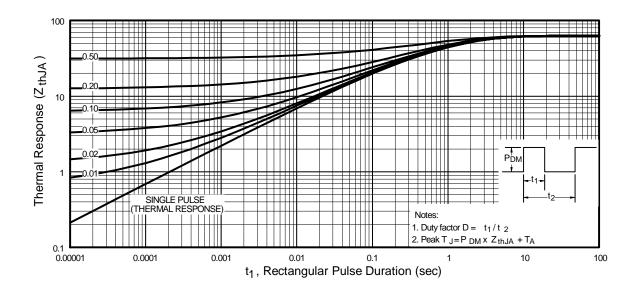


Fig 22. Maximum Effective Transient Thermal Impedance, Junction-to-Ambient

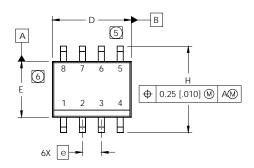
International

TOR Rectifier

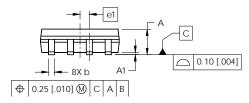
# IRF9952PbF

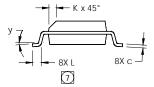
# **SO-8 Package Outline**

Dimensions are shown in millimeters (inches)



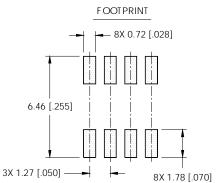
DIM	INC	HES	MILLIMETERS			
DIIVI	MIN	MAX	MIN	MAX		
Α	.0532	.0688	1.35	1.75		
A1	.0040	.0098	0.10	0.25		
b	.013	.020	0.33	0.51		
С	.0075	.0098	0.19	0.25		
D	.189	.1968	4.80	5.00		
Ε	.1497	.1574	3.80	4.00		
е	.050 B	ASIC	1.27 BASIC			
e1	.025 B	ASIC	0.635 BASIC			
Н	.2284	.2440	5.80	6.20		
K	.0099	.0196	0.25	0.50		
L	.016	.050	0.40	1.27		
У	0°	8°	0°	8°		





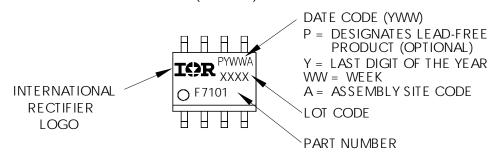
#### NOTES:

- 1. DIMENSIONING & TOLERANCING PER ASME Y14.5M-1994.
- 2. CONTROLLING DIMENSION: MILLIMETER
- 3. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
- 4. OUTLINE CONFORMS TO JEDEC OUTLINE MS-012AA.
- (5) DIMENSION DOES NOT INCLUDE MOLD PROTRUSIONS. MOLD PROTRUSIONS NOT TO EXCEED 0.15 [.006].
- (6) DIMENSION DOES NOT INCLUDE MOLD PROTRUSIONS. MOLD PROTRUSIONS NOT TO EXCEED 0.25 [.010].
- (7) DIMENSION IS THE LENGTH OF LEAD FOR SOLDERING TO A SUBSTRATE.



# **SO-8 Part Marking**

EXAMPLE: THIS IS AN IRF7101 (MOSFET)

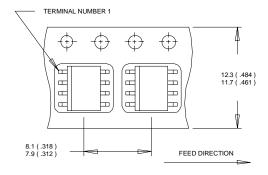


# IRF9952PbF

International IOR Rectifier

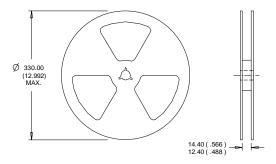
## **SO-8 Tape and Reel**

Dimensions are shown in millimeters (inches)



#### NOTES:

- 1. CONTROLLING DIMENSION : MILLIMETER.
  2. ALL DIMENSIONS ARE SHOWN IN MILLIMETERS(INCHES).
  3. OUTLINE CONFORMS TO EIA-481 & EIA-541.



- NOTES:
  1. CONTROLLING DIMENSION: MILLIMETER.
  2. OUTLINE CONFORMS TO EIA-481 & EIA-541.

Data and specifications subject to change without notice. This product has been designed and qualified for the Consumer market. Qualifications Standards can be found on IR's Web site.



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