

## HEXFET<sup>®</sup> POWER MOSFET

## IRFN054 N-CHANNEL

### 60 Volt, 0.020Ω HEXFET

HEXFET technology is the key to International Rectifier's advanced line of power MOSFET transistors. The efficient geometry achieves very low on-state resistance combined with high transconductance.

HEXFET transistors also feature all of the well-established advantages of MOSFETs, such as voltage control, very fast switching, ease of paralleling and electrical parameter temperature stability. They are well-suited for applications such as switching power supplies, motor controls, inverters, choppers, audio amplifiers, and high energy pulse circuits.

The Surface Mount Device (SMD-1) package represents another step in the continual evolution of surface mount technology. The SMD-1 will give designers the extra flexibility they need to increase circuit board density. International Rectifier has engineered the SMD-1 package to meet the specific needs of the power market by increasing the size of the termination pads, thereby enhancing thermal and electrical performance.

### Product Summary

Part Number	BV <sub>DSS</sub>	R <sub>DS(on)</sub>	I <sub>D</sub>
IRFN054	60V	0.020Ω	55A*

### Features:

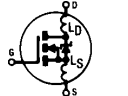
- Avalanche Energy Rating
- Dynamic dv/dt Rating
- Simple Drive Requirements
- Ease of Paralleling
- Hermetically Sealed
- Surface Mount
- Light-weight

### Absolute Maximum Ratings

	Parameter	IRFN054	Units
I <sub>D</sub> @ V <sub>GS</sub> = 10V, T <sub>C</sub> = 25°C	Continuous Drain Current	55*	A
I <sub>D</sub> @ V <sub>GS</sub> = 10V, T <sub>C</sub> = 100°C	Continuous Drain Current	40	
I <sub>DM</sub>	Pulsed Drain Current ①	256	
P <sub>D</sub> @ T <sub>C</sub> = 25°C	Max. Power Dissipation	150	W
	Linear Derating Factor	1.2	W/K ⑤
V <sub>GS</sub>	Gate-to-Source Voltage	±20	V
E <sub>AS</sub>	Single Pulse Avalanche Energy ②	480	mJ
I <sub>AR</sub>	Avalanche Current ①	55	A
E <sub>AR</sub>	Repetitive Avalanche Energy ①	15	mJ
dv/dt	Peak Diode Recovery dv/dt ③	4.5	V/ns
T <sub>J</sub>	Operating Junction	-55 to 150	°C
T <sub>STG</sub>	Storage Temperature Range		
	Package Mounting Surface Temperature		
	Weight	2.6 (typical)	g

# IRFN054 Device

## Electrical Characteristics @ Tj = 25°C (Unless Otherwise Specified)

	Parameter	Min.	Typ.	Max.	Units	Test Conditions
$BV_{DSS}$	Drain-to-Source Breakdown Voltage	60	—	—	V	$V_{GS} = 0V, I_D = 1.0 \text{ mA}$
$\Delta BV_{DSS}/\Delta T_J$	Temperature Coefficient of Breakdown Voltage	—	0.68	—	V/°C	Reference to 25°C, $I_D = 1.0 \text{ mA}$
RDS(on)	Static Drain-to-Source	—	—	0.020	$\Omega$	$V_{GS} = 10V, I_D = 40A \text{ ④}$
	On-State Resistance	—	—	0.031		
$V_{GS(th)}$	Gate Threshold Voltage	2.0	—	4.0	V	$V_{DS} = V_{GS}, I_D = 250\mu A$
$g_{fs}$	Forward Transconductance	20	—	—	S (r)	$V_{DS} > 15V, I_{DS} = 40A \text{ ④}$
IDSS	Zero Gate Voltage Drain Current	—	—	25	$\mu A$	$V_{DS} = 0.8 \times \text{Max Rating}, V_{GS} = 0V$
		—	—	250		
IGSS	Gate-to-Source Leakage Forward	—	—	100	nA	$V_{GS} = 20V$
IGSS	Gate-to-Source Leakage Reverse	—	—	-100	nA	$V_{GS} = -20V$
Qg	Total Gate Charge	39	—	88	nC	$V_{GS} = 10V, I_D = 55A$ $V_{DS} = \text{Max. Rating} \times 0.5$ see figures 6 and 13
Qgs	Gate-to-Source Charge	20	—	45		
Qgd	Gate-to-Drain ("Miller") Charge	34	—	105		
td(on)	Turn-On Delay Time	—	—	33	ns	$V_{DD} = 30V, I_D = 55A,$ $R_G = 2.35\Omega, V_{GS} = 10V$  see figure 10
tr	Rise Time	—	—	180		
td(off)	Turn-Off Delay Time	—	—	100		
tf	Fall Time	—	—	100		
LD	Internal Drain Inductance	—	2.0	—	nH	<p>Measured from the drain lead, 6mm (0.25 in.) from package to center of die.</p> <p>Modified MOSFET symbol showing the internal inductances.</p> 
LS	Internal Source Inductance	—	4.1	—		
Ciss	Input Capacitance	—	1660	—	pF	$V_{GS} = 0V, V_{DS} = 25V$ $f = 1.0 \text{ MHz}$ see figure 5
Coss	Output Capacitance	—	2000	—		
Crss	Reverse Transfer Capacitance	—	340	—		

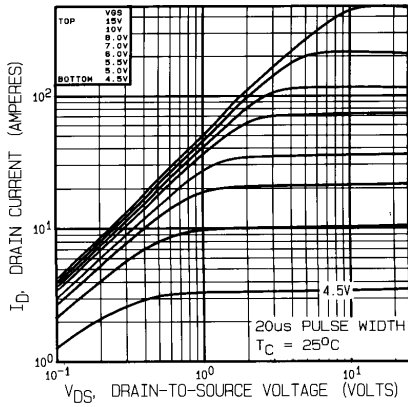
## Source-Drain Diode Ratings and Characteristics

	Parameter	Min.	Typ.	Max.	Units	Test Conditions
IS	Continuous Source Current (Body Diode)	—	—	55	A	Modified MOSFET symbol showing the integral reverse p-n junction rectifier.
ISM	Pulse Source Current (Body Diode) ①	—	—	256		
VSD	Diode Forward Voltage	—	—	2.5	V	$T_j = 25^\circ C, I_S = 55A, V_{GS} = 0V \text{ ④}$
trr	Reverse Recovery Time	—	—	280	ns	$T_j = 25^\circ C, I_F = 55A, di/dt \leq 100A/\mu s$ $V_{DD} \leq 50V \text{ ④}$
QRR	Reverse Recovery Charge	—	—	2.2	$\mu C$	
ton	Forward Turn-On Time	Intrinsic turn-on time is negligible. Turn-on speed is substantially controlled by LS + LD.				

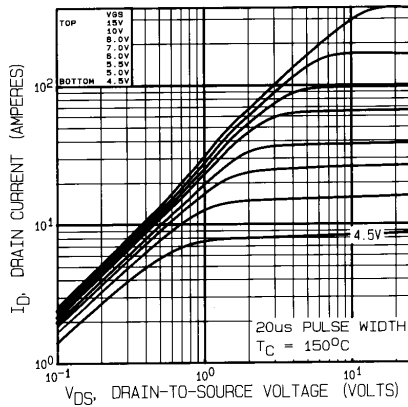
## Thermal Resistance

	Parameter	Min.	Typ.	Max.	Units	Test Conditions
RthJC	Junction-to-Case	—	—	0.83	K/W	Soldered to a copper clad PC board
RthJ-PCB	Junction-to-PC Board	—	TBD	—		

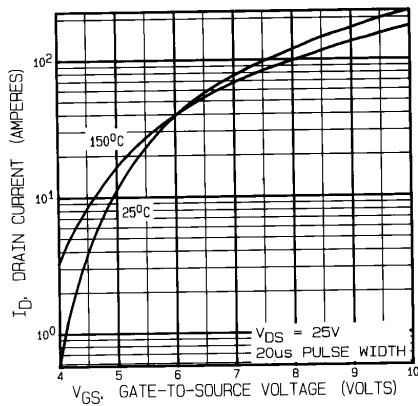
# IRFN054 Device



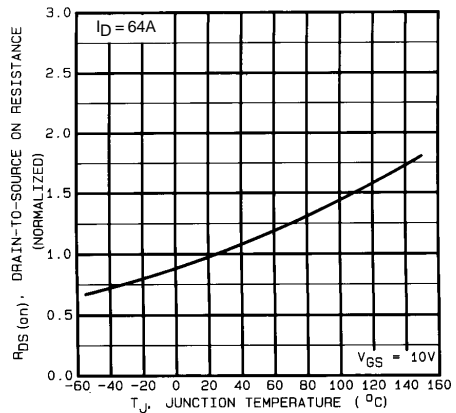
**Fig. 1 — Typical Output Characteristics**  
 $T_C = 25^\circ\text{C}$



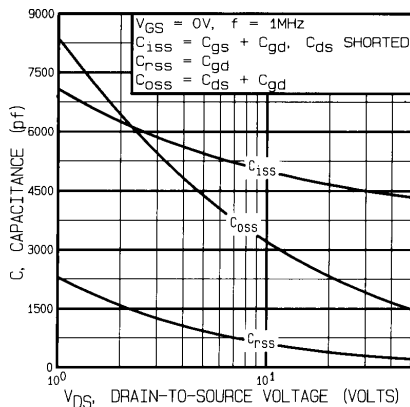
**Fig. 2 — Typical Output Characteristics**  
 $T_C = 150^\circ\text{C}$



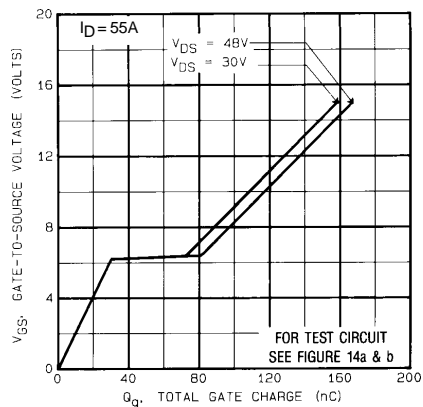
**Fig. 3 — Typical Transfer Characteristics**



**Fig. 4 — Normalized On-Resistance Vs. Temperature**

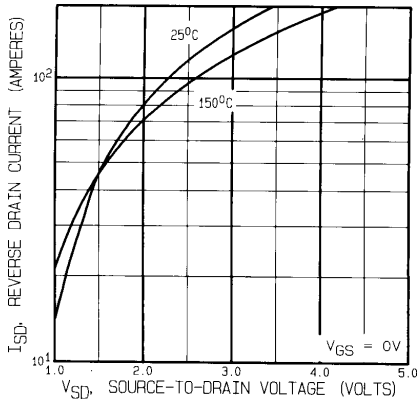


**Fig. 5 — Typical Capacitance Vs. Drain-to-Source Voltage**

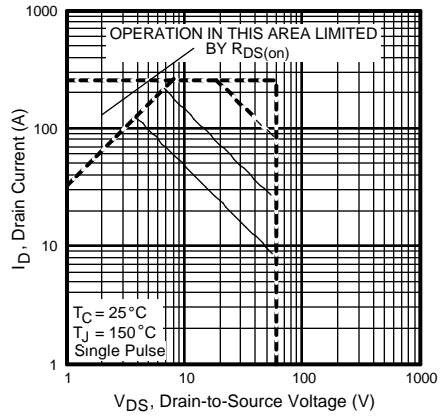


**Fig. 6 — Typical Gate Charge Vs. Gate-to-Source Voltage**

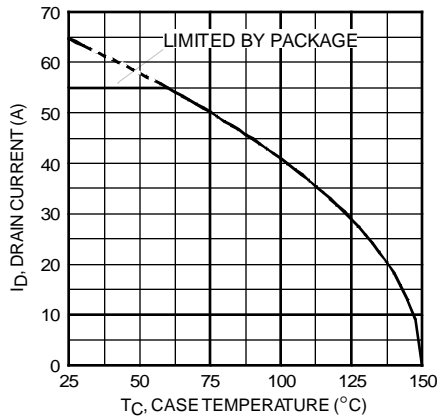
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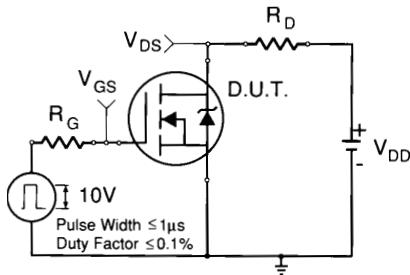
**Fig. 7 — Typical Source-to-Drain Diode Forward Voltage**



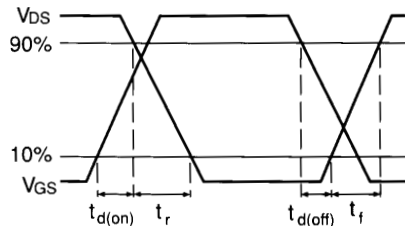
**Fig. 8 — Maximum Safe Operating Area**



**Fig. 9 — Maximum Drain Current Vs. Case Temperature**



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



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

# IRFN054 Device

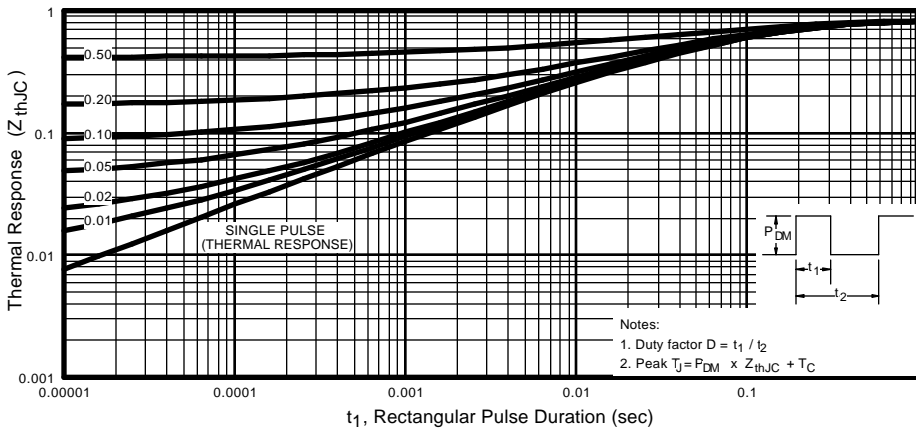


Fig. 11 — Maximum Effective Transient Thermal Impedance, Junction-to-Case Vs. Pulse Duration

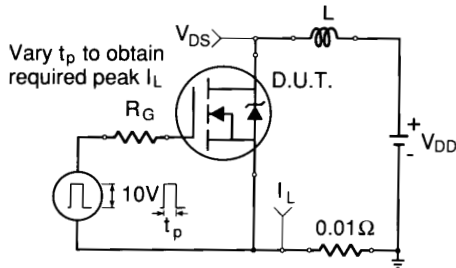


Fig. 12a — Unclamped Inductive Test Circuit

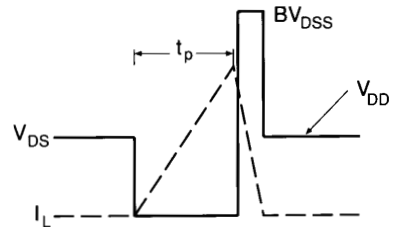


Fig. 12b — Unclamped Inductive Waveforms

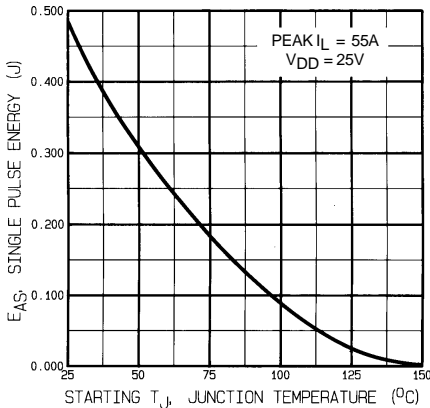


Fig. 12c — Max. Avalanche Energy vs. Current

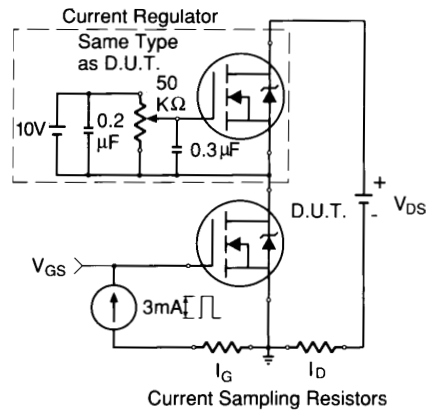


Fig. 13a — Gate Charge Test Circuit

# IRFN054 Device

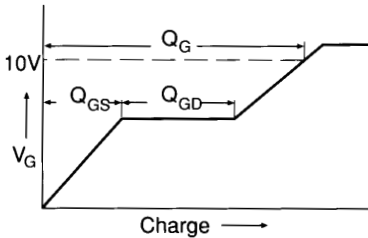
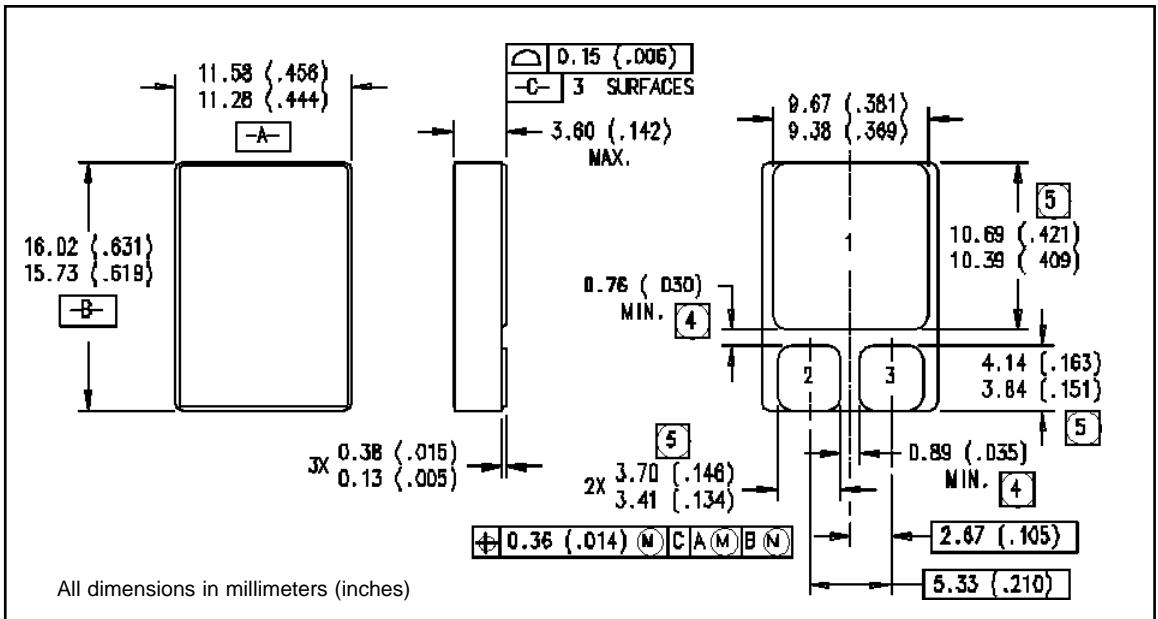


Fig. 13b — Basic Gate Charge Waveform

- ① Repetitive Rating; Pulse width limited by maximum junction temperature. (see figure 11)
- ② @  $V_{DD} = 25V$ , Starting  $T_J = 25^\circ C$ ,  
 $EAS = [0.5 * L * (I_L^2) * [BV_{DSS}/(BV_{DSS}-V_{DD})]$   
 Peak  $I_L = 55A$ ,  $V_{GS} = 10V$ ,  $25 \leq R_G \leq 200\Omega$
- ③  $I_{SD} \leq 55A$ ,  $di/dt \leq 200A/\mu s$ ,  
 $V_{DD} \leq BV_{DSS}$ ,  $T_J \leq 150^\circ C$
- ④ Pulse width  $\leq 300 \mu s$ ; Duty Cycle  $\leq 2\%$
- ⑤  $K/W = ^\circ C/W$   
 $W/K = W/^\circ C$

## Case Outline and Dimensions — SMD-1



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**IR** Rectifier

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<http://www.irf.com/> Data and specifications subject to change without notice. 9/96