

# IRFPS40N60K

HEXFET® Power MOSFET

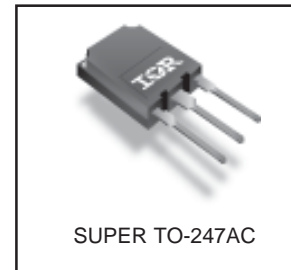
## Applications

- Hard Switching Primary or PFC Switch
- Switch Mode Power Supply (SMPS)
- Uninterruptible Power Supply
- High Speed Power Switching
- Motor Drive

$V_{DSS}$	$R_{DS(on)}$ typ.	$I_D$
600V	0.110 $\Omega$	40A

## Benefits

- 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
- Enhanced Body Diode  $dv/dt$  Capability



## Absolute Maximum Ratings

	Parameter	Max.	Units
$I_D$ @ $T_C = 25^\circ\text{C}$	Continuous Drain Current, $V_{GS}$ @ 10V	40	A
$I_D$ @ $T_C = 100^\circ\text{C}$	Continuous Drain Current, $V_{GS}$ @ 10V	24	
$I_{DM}$	Pulsed Drain Current ①	160	
$P_D$ @ $T_C = 25^\circ\text{C}$	Power Dissipation	570	W
	Linear Derating Factor	4.5	W/ $^\circ\text{C}$
$V_{GS}$	Gate-to-Source Voltage	$\pm 30$	V
$dv/dt$	Peak Diode Recovery $dv/dt$ ③	7.5	V/ns
$T_J$ $T_{STG}$	Operating Junction and Storage Temperature Range	-55 to + 150	$^\circ\text{C}$
	Soldering Temperature, for 10 seconds (1.6mm from case )	300	

## Avalanche Characteristics

Symbol	Parameter	Typ.	Max.	Units
$E_{AS}$	Single Pulse Avalanche Energy②	—	600	mJ
$I_{AR}$	Avalanche Current①	—	40	A
$E_{AR}$	Repetitive Avalanche Energy①	—	57	mJ

## Thermal Resistance

Symbol	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case④	—	0.22	$^\circ\text{C}/\text{W}$
$R_{\theta CS}$	Case-to-Sink, Flat, Greased Surface	0.24	—	
$R_{\theta JA}$	Junction-to-Ambient④	—	40	

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International  
IR Rectifier

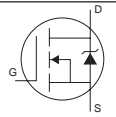
## Static @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	600	—	—	V	$V_{GS} = 0V, I_D = 250\mu A$
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	0.63	—	V/ $^\circ\text{C}$	Reference to $25^\circ\text{C}, I_D = 1\text{mA}$ ⓐ
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	0.110	0.130	$\Omega$	$V_{GS} = 10V, I_D = 24A$ ④
$V_{GS(th)}$	Gate Threshold Voltage	3.0	—	5.0	V	$V_{DS} = V_{GS}, I_D = 250\mu A$
$I_{DSS}$	Drain-to-Source Leakage Current	—	—	50	$\mu A$	$V_{DS} = 600V, V_{GS} = 0V$
		—	—	250		$V_{DS} = 480V, V_{GS} = 0V, T_J = 125^\circ\text{C}$
$I_{GSS}$	Gate-to-Source Forward Leakage	—	—	100	nA	$V_{GS} = 30V$
	Gate-to-Source Reverse Leakage	—	—	-100		$V_{GS} = -30V$

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

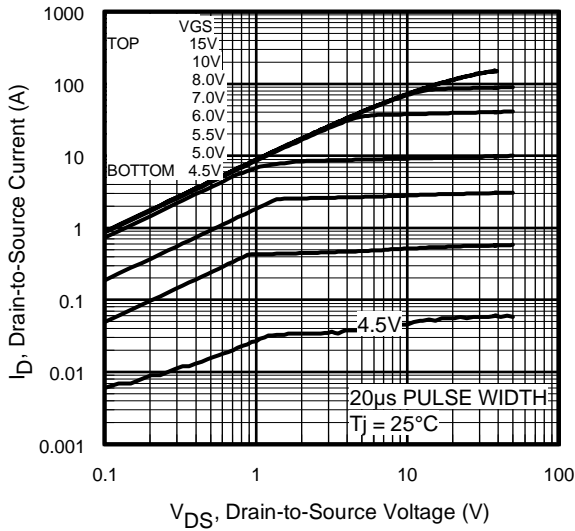
Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
$g_{fs}$	Forward Transconductance	21	—	—	S	$V_{DS} = 50V, I_D = 24A$
$Q_g$	Total Gate Charge	—	—	330	nC	$I_D = 38A$
$Q_{gs}$	Gate-to-Source Charge	—	—	84		$V_{DS} = 480V$
$Q_{gd}$	Gate-to-Drain ("Miller") Charge	—	—	150		$V_{GS} = 10V$ , See Fig. 6 and 13 ④
$t_{d(on)}$	Turn-On Delay Time	—	47	—	ns	$V_{DD} = 300V$
$t_r$	Rise Time	—	110	—		$I_D = 38A$
$t_{d(off)}$	Turn-Off Delay Time	—	97	—		$R_G = 4.3\Omega$
$t_f$	Fall Time	—	60	—		$V_{GS} = 10V$ , See Fig. 10 ④
$C_{iss}$	Input Capacitance	—	7970	—	pF	$V_{GS} = 0V$
$C_{oss}$	Output Capacitance	—	750	—		$V_{DS} = 25V$
$C_{riss}$	Reverse Transfer Capacitance	—	75	—		$f = 1.0\text{MHz}$ , See Fig. 5
$C_{oss}$	Output Capacitance	—	9440	—		$V_{GS} = 0V, V_{DS} = 1.0V, f = 1.0\text{MHz}$
$C_{oss}$	Output Capacitance	—	200	—		$V_{GS} = 0V, V_{DS} = 480V, f = 1.0\text{MHz}$
$C_{oss \text{ eff.}}$	Effective Output Capacitance	—	260	—		$V_{GS} = 0V, V_{DS} = 0V \text{ to } 480V$ ⑤

## Diode Characteristics

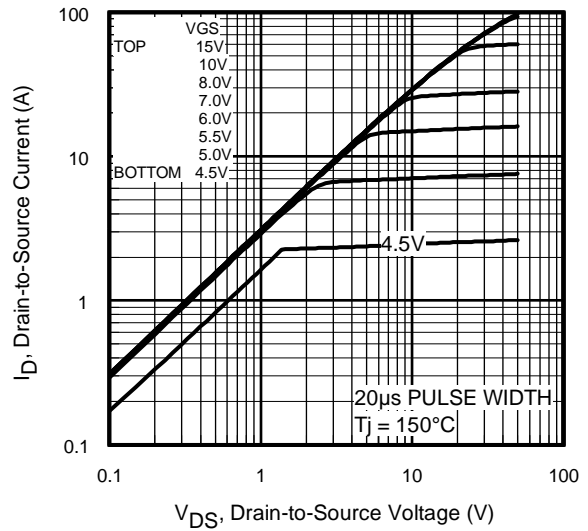
Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
$I_S$	Continuous Source Current (Body Diode)	—	—	40	A	MOSFET symbol showing the integral reverse p-n junction diode. 
$I_{SM}$	Pulsed Source Current (Body Diode) ①	—	—	160		
$V_{SD}$	Diode Forward Voltage	—	—	1.5	V	$T_J = 25^\circ\text{C}, I_S = 38A, V_{GS} = 0V$ ④
$t_{rr}$	Reverse Recovery Time	—	630	950	ns	$T_J = 25^\circ\text{C}$
		—	730	1090		$T_J = 125^\circ\text{C}$
$Q_{rr}$	Reverse Recovery Charge	—	14	20	$\mu\text{C}$	$T_J = 25^\circ\text{C}$
		—	17	25		$T_J = 125^\circ\text{C}$
$I_{RRM}$	Reverse Recovery Current	—	39	58	A	$T_J = 25^\circ\text{C}$
$t_{on}$	Forward Turn-On Time	Intrinsic turn-on time is negligible (turn-on is dominated by $L_S+L_D$ )				

### Notes:

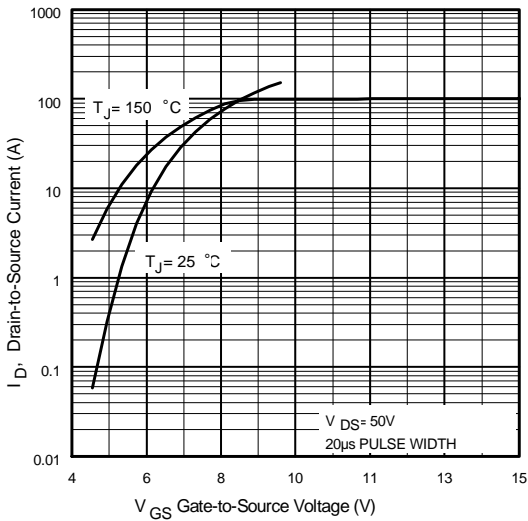
- ① Repetitive rating; pulse width limited by max. junction temperature. (See Fig. 11)
- ② Starting  $T_J = 25^\circ\text{C}$ ,  $L = 0.84\text{mH}$ ,  $R_G = 25\Omega$ ,  $I_{AS} = 38A$ , (See Figure 12a)
- ③  $I_{SD} \leq 38A$ ,  $di/dt \leq 224A/\mu\text{s}$ ,  $V_{DD} \leq V_{(BR)DSS}$ ,  $T_J \leq 150^\circ\text{C}$
- ④ Pulse width  $\leq 300\mu\text{s}$ ; duty cycle  $\leq 2\%$ .
- ⑤  $C_{oss \text{ eff.}}$  is a fixed capacitance that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 80%  $V_{DSS}$
- ⑥  $R_\theta$  is measured at  $T_J$  approximately  $90^\circ\text{C}$



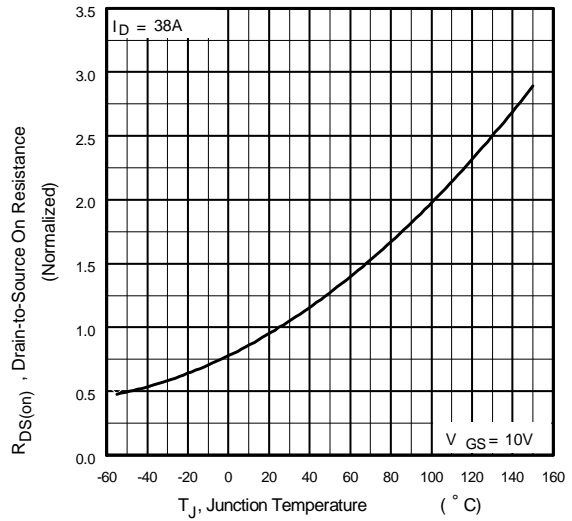
**Fig 1.** Typical Output Characteristics



**Fig 2.** Typical Output Characteristics

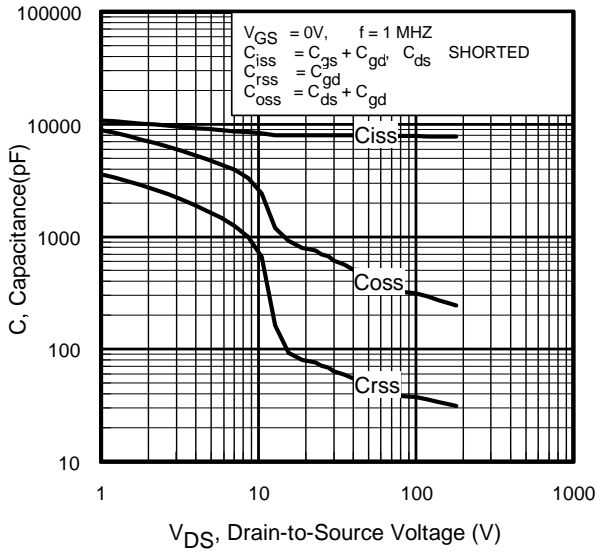


**Fig 3.** Typical Transfer Characteristics

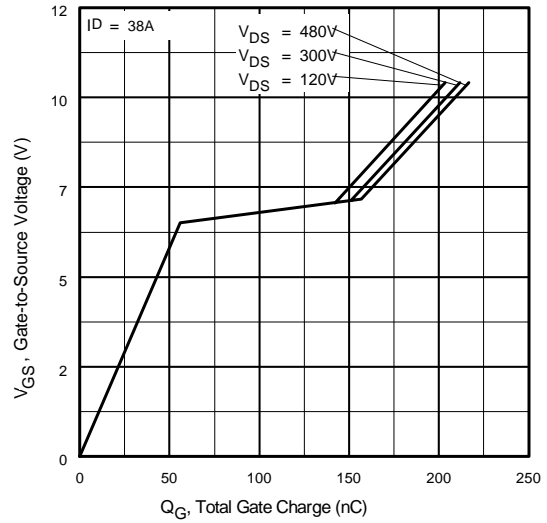


**Fig 4.** Normalized On-Resistance Vs. Temperature

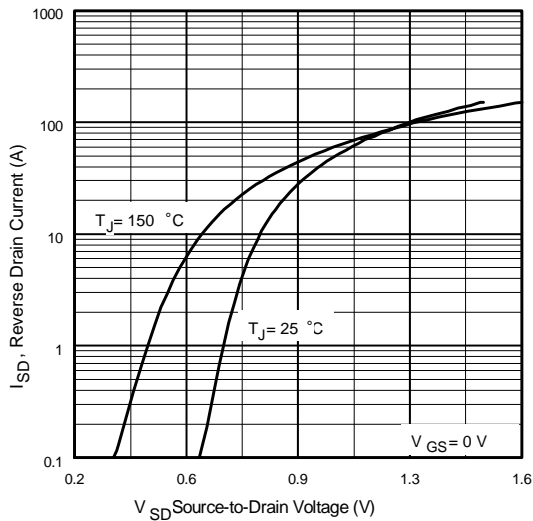
# IRFPS40N60K



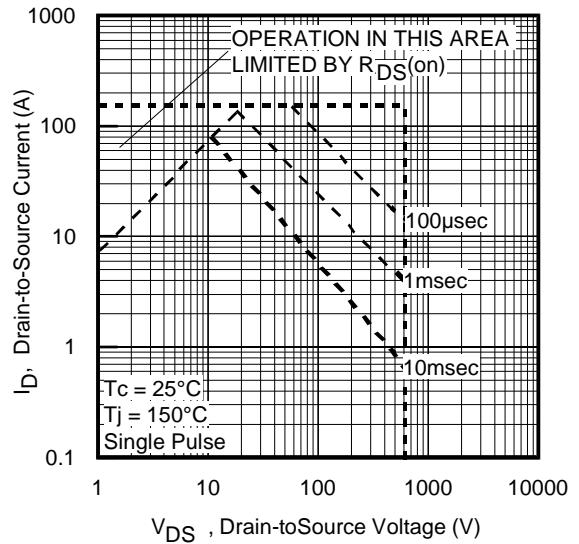
**Fig 5.** Typical Capacitance Vs. Drain-to-Source Voltage



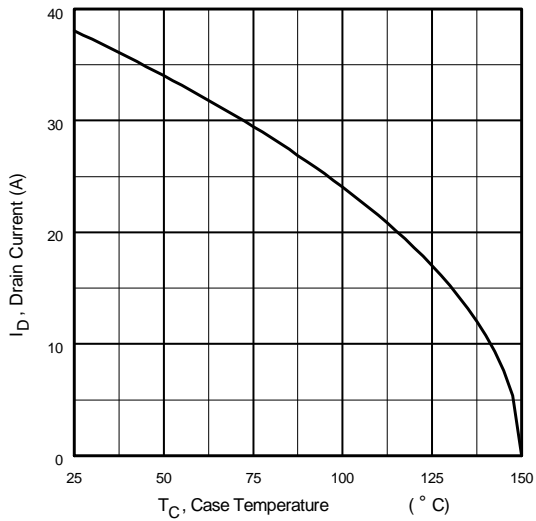
**Fig 6.** Typical Gate Charge Vs. Gate-to-Source Voltage



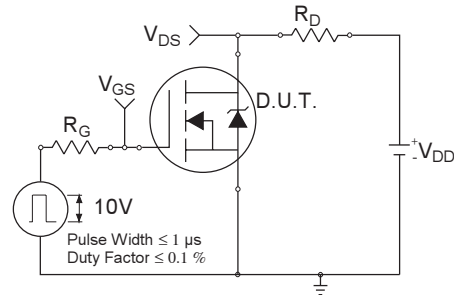
**Fig 7.** Typical Source-Drain Diode Forward Voltage



**Fig 8.** Maximum Safe Operating Area



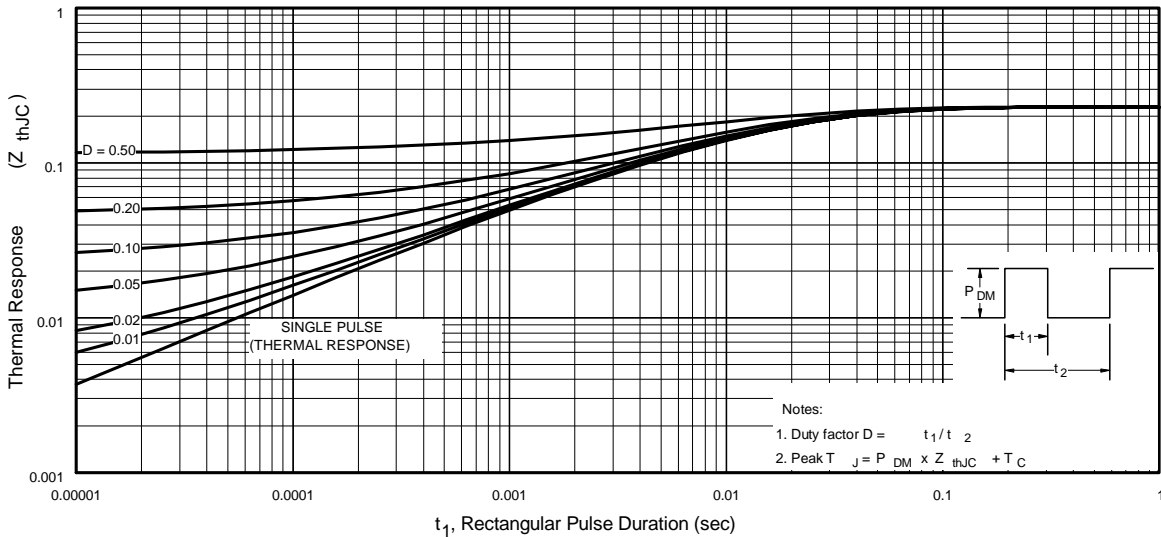
**Fig 9.** Maximum Drain Current Vs. Case Temperature



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



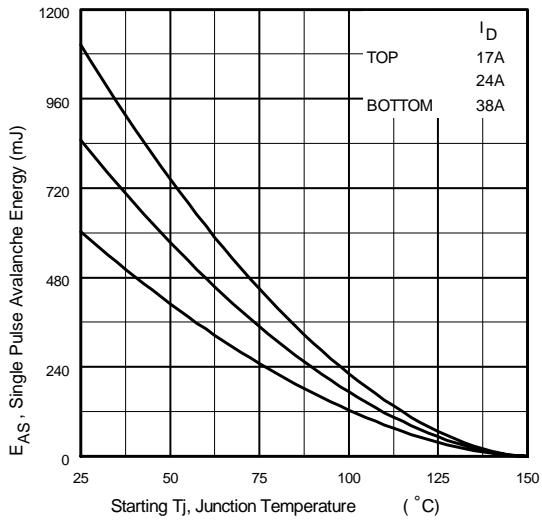
**Fig 10b.** Switching Time Waveforms



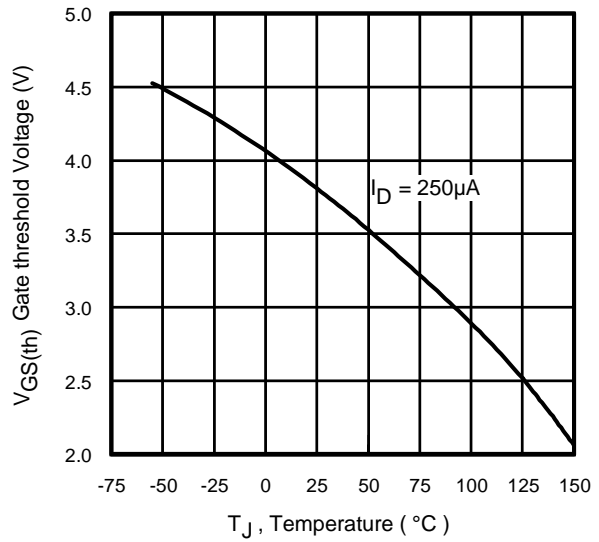
**Fig 11.** Maximum Effective Transient Thermal Impedance, Junction-to-Case

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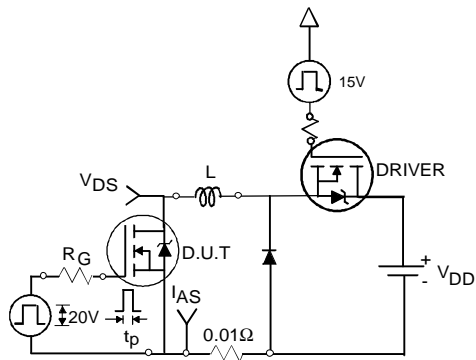
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**IR** Rectifier



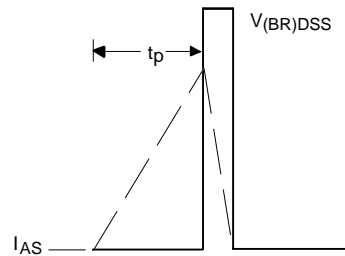
**Fig 12a.** Maximum Avalanche Energy Vs. Drain Current



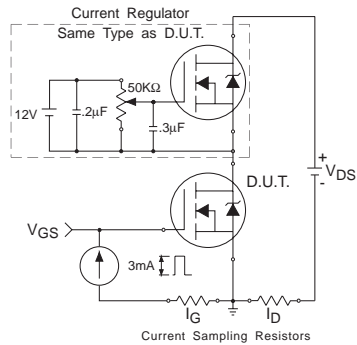
**Fig 14.** Threshold Voltage Vs. Temperature



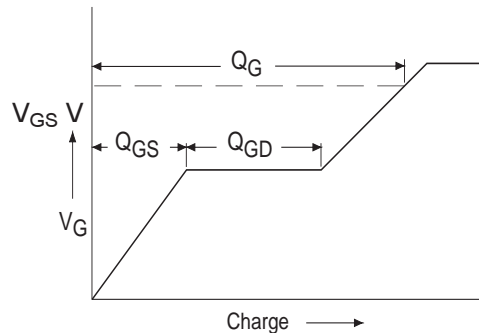
**Fig 12b.** Unclamped Inductive Test Circuit



**Fig 12c.** Unclamped Inductive Waveforms



**Fig 13a.** Gate Charge Test Circuit



**Fig 13b.** Basic Gate Charge Waveform

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## Peak Diode Recovery dv/dt Test Circuit



\*  $V_{GS} = 5V$  for Logic Level Devices

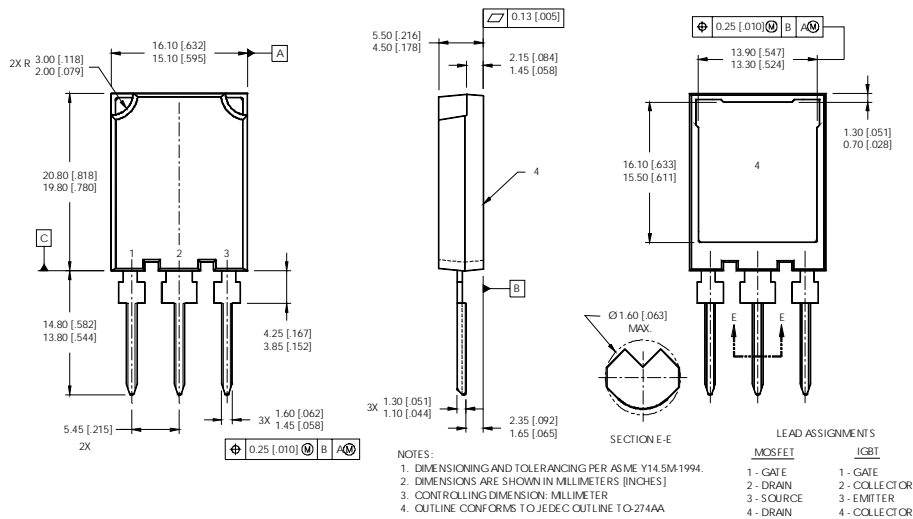
**Fig 14.** For N-Channel HEXFET® Power MOSFETs

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## SUPER TO-247AC Package Outline

Dimensions are shown in millimeters (inches)

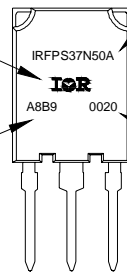


## Super-247™ Part Marking Information

EXAMPLE: THIS IS AN IRFPS37N50A WITH  
ASSEMBLY LOT CODE A8B9

INTERNATIONAL RECTIFIER  
LOGO

ASSEMBLY LOT CODE



PART NUMBER

DATE CODE  
(YYWW)  
YY = YEAR  
WW = WEEK

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

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**IR** Rectifier

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