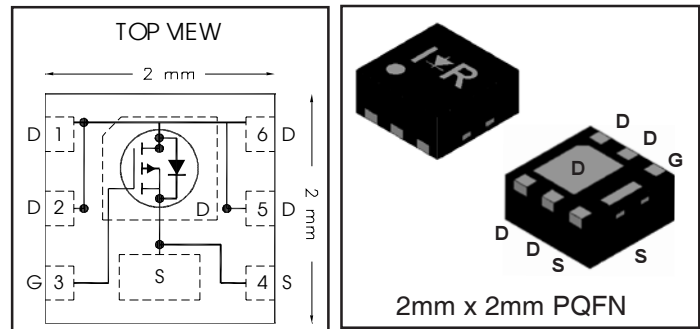


# IRFHS9301PbF

HEXFET® Power MOSFET

$V_{DS}$	<b>-30</b>	<b>V</b>
$V_{GS\ max}$	<b>±20</b>	<b>V</b>
$R_{DS(on)\ max}$ (@ $V_{GS} = -10V$ )	<b>37</b>	<b>mΩ</b>
$Q_g$ (typical)	<b>13</b>	<b>nC</b>
$I_D$ (@ $T_C = 25^\circ C$ )	<b>-8.5</b> ②	<b>A</b>



## Applications

- Charge and Discharge Switch for Battery Application
- System/load switch

## Features and Benefits

### Features

Low $R_{DS(on)}$ ( $\leq 37m\Omega$ )
Low Thermal Resistance to PCB ( $\leq 13^\circ C/W$ )
Low Profile ( $\leq 1.0\ mm$ )
Compatible with Existing Surface Mount Techniques
RoHS Compliant Containing no Lead, no Bromide and no Halogen
MSL1, Consumer Qualification

### Benefits

Lower Conduction Losses
Enable better thermal dissipation
Increased Power Density
Easier Manufacturing
Environmentally Friendlier
Increased Reliability

results in

Orderable part number	Package Type	Standard Pack		Note
		Form	Quantity	
IRFHS9301TRPBF	PQFN 2mm x 2mm	Tape and Reel	4000	
IRFHS9301TR2PBF	PQFN 2mm x 2mm	Tape and Reel	400	

## Absolute Maximum Ratings

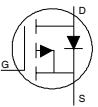
	Parameter	Max.	Units
$V_{DS}$	Drain-to-Source Voltage	-30	V
$V_{GS}$	Gate-to-Source Voltage	± 20	
$I_D @ T_A = 25^\circ C$	Continuous Drain Current, $V_{GS} @ -10V$	-6.0	A
$I_D @ T_A = 70^\circ C$	Continuous Drain Current, $V_{GS} @ -10V$	-4.8	
$I_D @ T_C = 25^\circ C$	Continuous Drain Current, $V_{GS} @ -10V$	-13	
$I_D @ T_C = 70^\circ C$	Continuous Drain Current, $V_{GS} @ -10V$	-10	
$I_D @ T_C = 25^\circ C$	Continuous Drain Current, $V_{GS} @ 10V$ (Package Limited)	-8.5	
$I_{DM}$	Pulsed Drain Current ①	-52	
$P_D @ T_A = 25^\circ C$	Power Dissipation ④	2.1	W
$P_D @ T_A = 70^\circ C$	Power Dissipation ④	1.3	
	Linear Derating Factor	0.02	W/°C
$T_J$	Operating Junction and	-55 to + 150	°C
$T_{STG}$	Storage Temperature Range		

Notes ① through ⑤ are on page 2

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

	Parameter	Min.	Typ.	Max.	Units	Conditions
$BV_{DSS}$	Drain-to-Source Breakdown Voltage	-30	—	—	V	$V_{GS} = 0V, I_D = -250\mu A$
$\Delta BV_{DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	0.02	—	V/°C	Reference to $25^\circ\text{C}, I_D = -1mA$
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	30	37	mΩ	$V_{GS} = -10V, I_D = -7.8A$ ③
		—	52	65		$V_{GS} = -4.5V, I_D = -6.2A$ ③
$V_{GS(th)}$	Gate Threshold Voltage	-1.3	-1.8	-2.4	V	$V_{DS} = V_{GS}, I_D = -25\mu A$
$\Delta V_{GS(th)}$	Gate Threshold Voltage Coefficient	—	-4.8	—	mV/°C	
$I_{DSS}$	Drain-to-Source Leakage Current	—	—	-1.0	μA	$V_{DS} = -24V, V_{GS} = 0V$
		—	—	-150		$V_{DS} = -24V, V_{GS} = 0V, T_J = 125^\circ\text{C}$
$I_{GSS}$	Gate-to-Source Forward Leakage	—	—	-100	nA	$V_{GS} = -20V$
	Gate-to-Source Reverse Leakage	—	—	100		$V_{GS} = 20V$
$g_{fs}$	Forward Transconductance	9.3	—	—	S	$V_{DS} = -10V, I_D = -7.8A$
$Q_g$	Total Gate Charge	—	6.9	—	nC	$V_{DS} = -15V, V_{GS} = -4.5V, I_D = -7.8A$
$Q_g$	Total Gate Charge	—	13	—	nC	$V_{GS} = -10V$
$Q_{gs}$	Gate-to-Source Charge	—	2.1	—		$V_{DS} = -15V$
$Q_{gd}$	Gate-to-Drain Charge	—	3.9	—		$I_D = -7.8A$
$R_G$	Gate Resistance	—	17	—	Ω	
$t_{d(on)}$	Turn-On Delay Time	—	12	—	ns	$V_{DD} = -15V, V_{GS} = -4.5V$ ③
$t_r$	Rise Time	—	80	—		$I_D = -7.8A$
$t_{d(off)}$	Turn-Off Delay Time	—	13	—		$R_G = 2.0\Omega$
$t_f$	Fall Time	—	25	—		See Figs. 19a & 19b
$C_{iss}$	Input Capacitance	—	580	—	pF	$V_{GS} = 0V$
$C_{oss}$	Output Capacitance	—	125	—		$V_{DS} = -25V$
$C_{rss}$	Reverse Transfer Capacitance	—	79	—		$f = 1.0KHz$

## Diode Characteristics

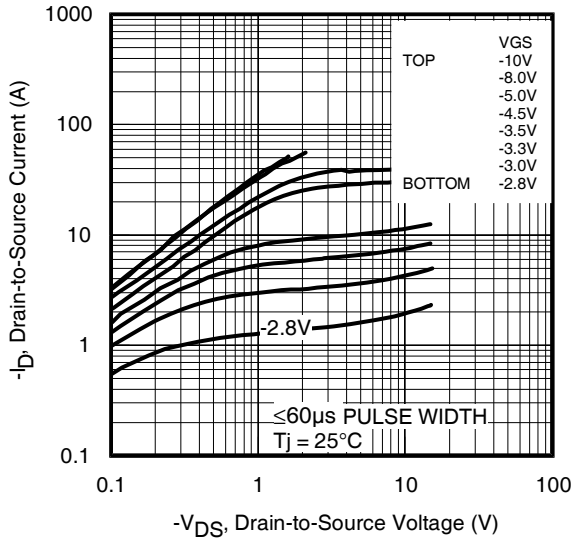
	Parameter	Min.	Typ.	Max.	Units	Conditions
$I_S$	Continuous Source Current (Body Diode)	—	—	-8.5②	A	MOSFET symbol showing the integral reverse p-n junction diode. 
$I_{SM}$	Pulsed Source Current (Body Diode) ①	—	—	-52		
$V_{SD}$	Diode Forward Voltage	—	—	-1.2	V	$T_J = 25^\circ\text{C}, I_S = -7.8A, V_{GS} = 0V$ ③
$t_{rr}$	Reverse Recovery Time	—	30	45	ns	$T_J = 25^\circ\text{C}, I_F = -7.8A, V_{DD} = -15V$
$Q_{rr}$	Reverse Recovery Charge	—	110	170	nC	$di/dt = 280/\mu s$ ③

## Thermal Resistance

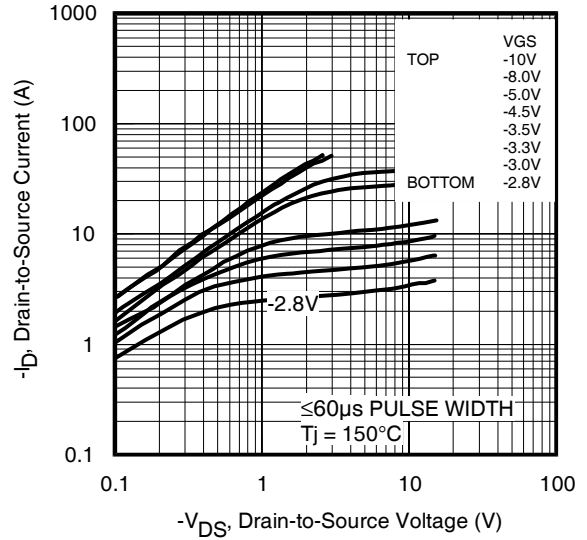
	Parameter	Typ.	Max.	Units
$R_{\theta JC}$ (Bottom)	Junction-to-Case ⑤	—	13	°C/W
$R_{\theta JC}$ (Top)	Junction-to-Case ⑤	—	90	
$R_{\theta JA}$	Junction-to-Ambient ④	—	60	
$R_{\theta JA}$	Junction-to-Ambient ( $t < 10s$ ) ④	—	42	

### Notes:

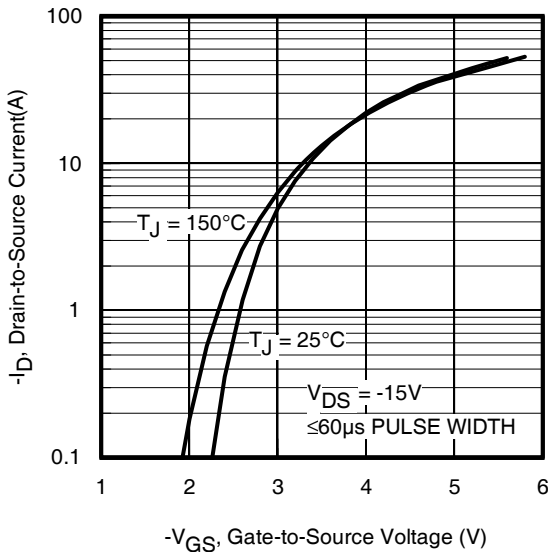
- ① Repetitive rating; pulse width limited by max. junction temperature.
- ② Current limited by package.
- ③ Pulse width  $\leq 400\mu s$ ; duty cycle  $\leq 2\%$ .
- ④ When mounted on 1 inch square copper board.
- ⑤  $R_{\theta}$  is measured at  $T_J$  of approximately  $90^\circ\text{C}$ .



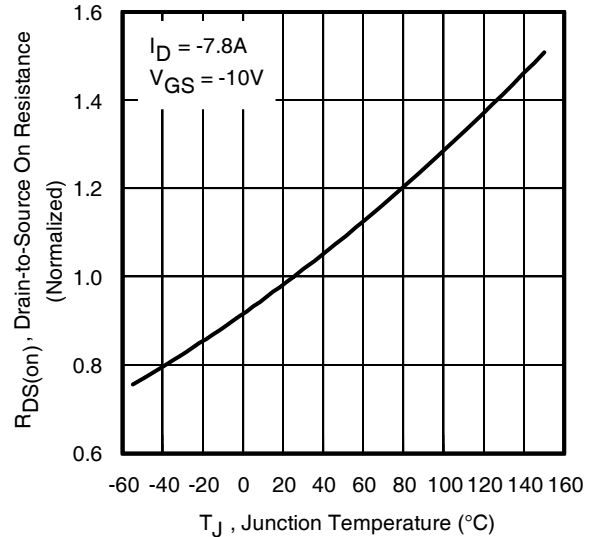
**Fig 1.** Typical Output Characteristics



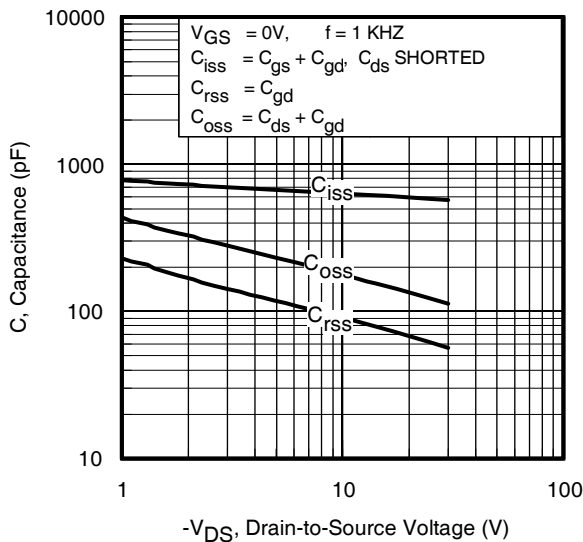
**Fig 2.** Typical Output Characteristics



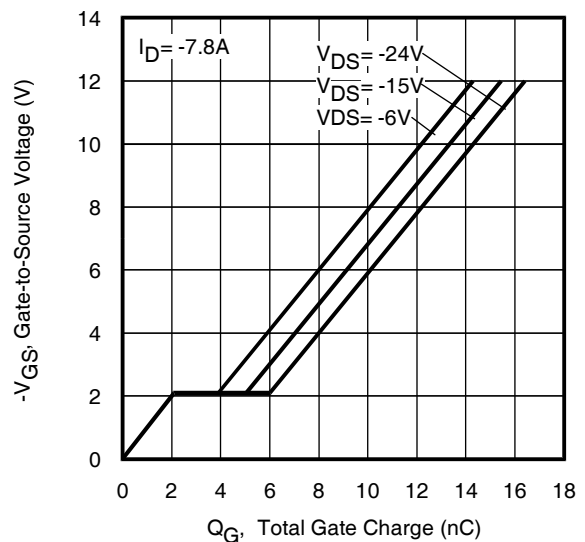
**Fig 3.** Typical Transfer Characteristics



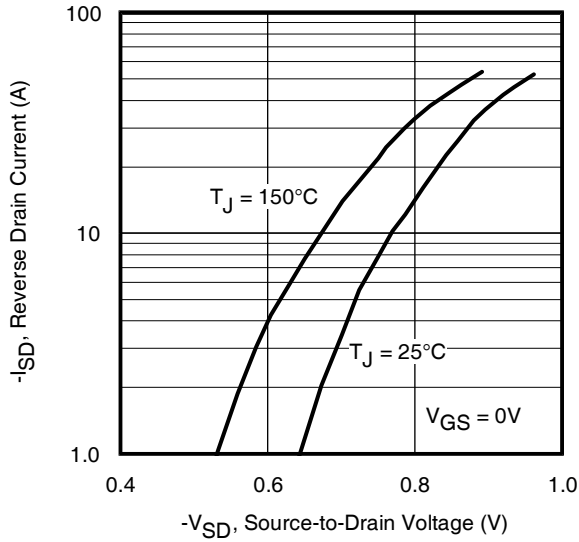
**Fig 4.** Normalized On-Resistance vs. Temperature



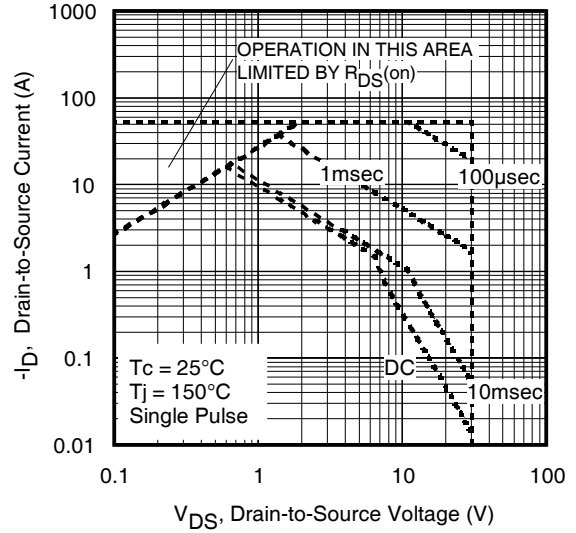
**Fig 5.** Typical Capacitance vs. Drain-to-Source Voltage  
[www.irf.com](http://www.irf.com)



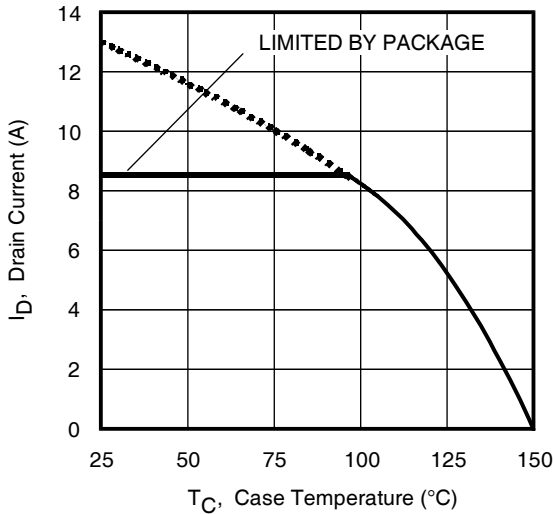
**Fig 6.** Typical Gate Charge vs. Gate-to-Source Voltage



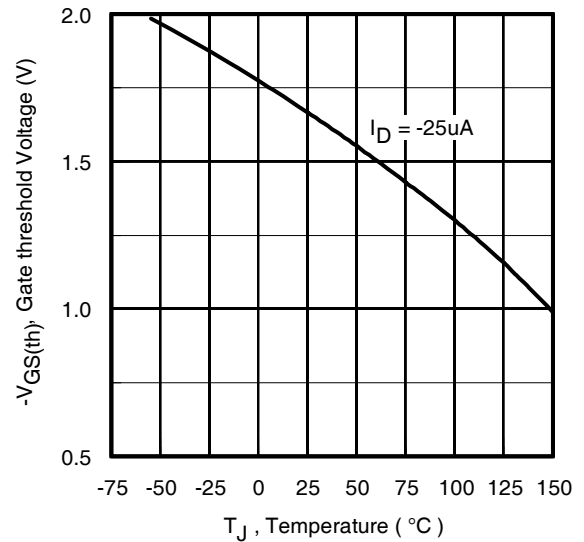
**Fig 7.** Typical Source-Drain Diode Forward Voltage



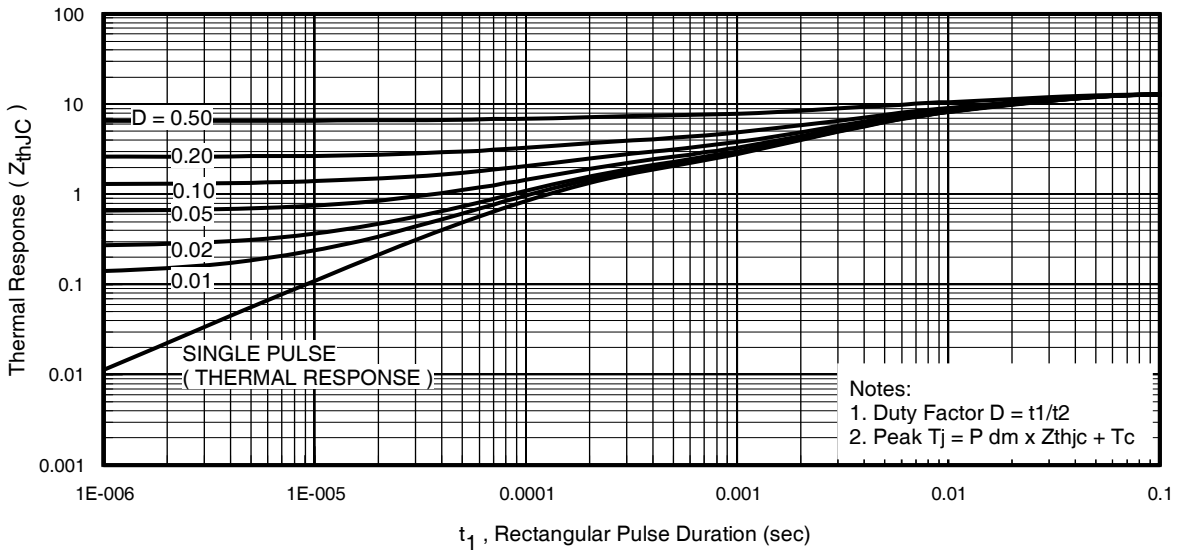
**Fig 8.** Maximum Safe Operating Area



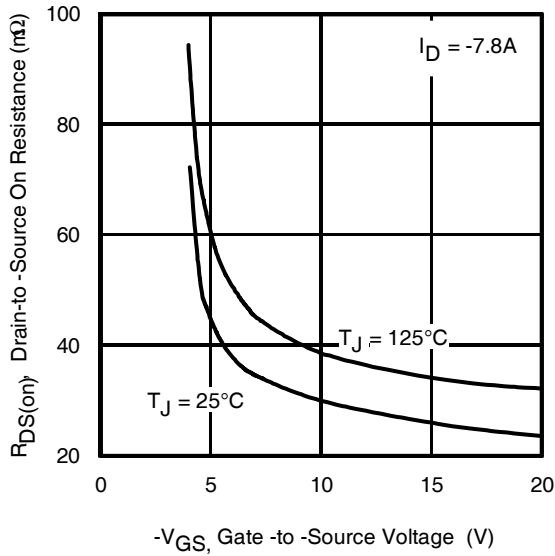
**Fig 9.** Maximum Drain Current vs. Case Temperature



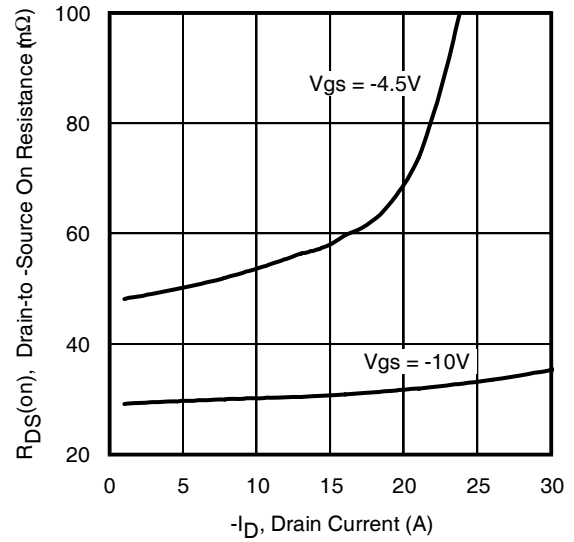
**Fig 10.** Threshold Voltage vs. Temperature



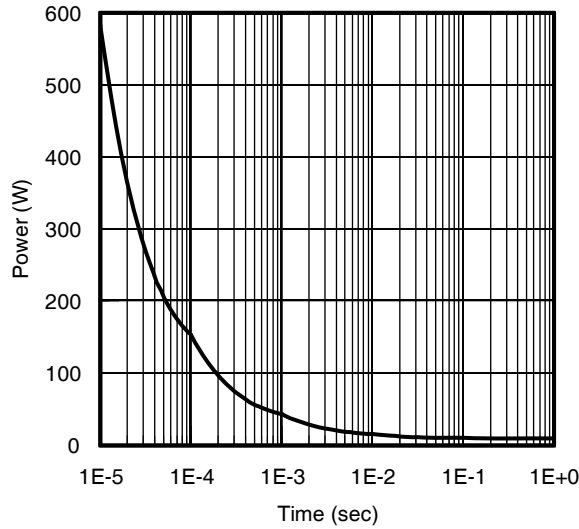
**Fig 11.** Maximum Effective Transient Thermal Impedance, Junction-to-Case



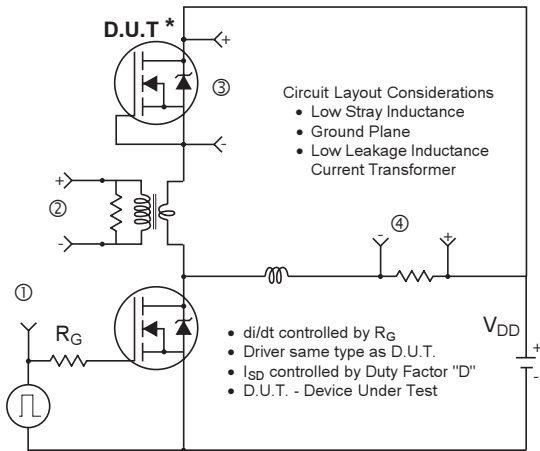
**Fig 12.** On-Resistance vs. Gate Voltage



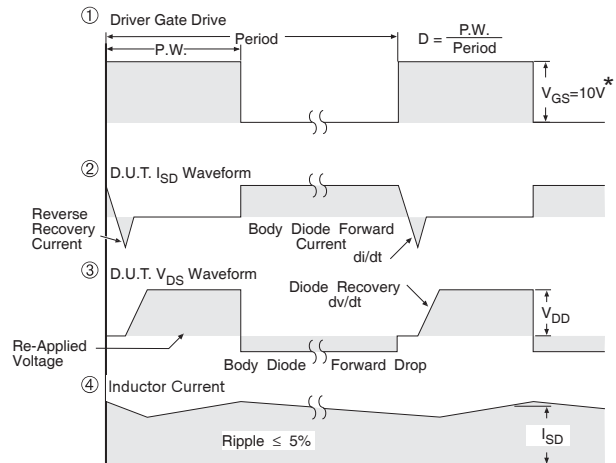
**Fig 13.** Typical On-Resistance vs. Drain Current



**Fig 14.** Typical Power vs. Time

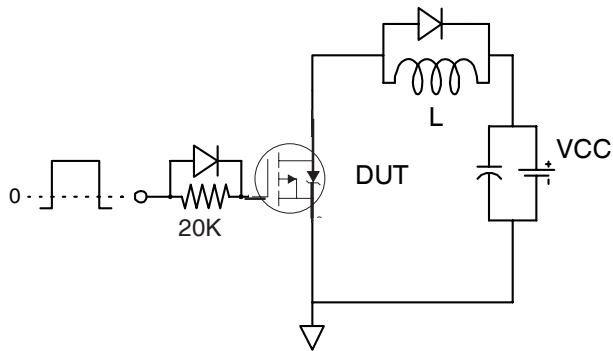


\* Reverse Polarity of D.U.T. for P-Channel

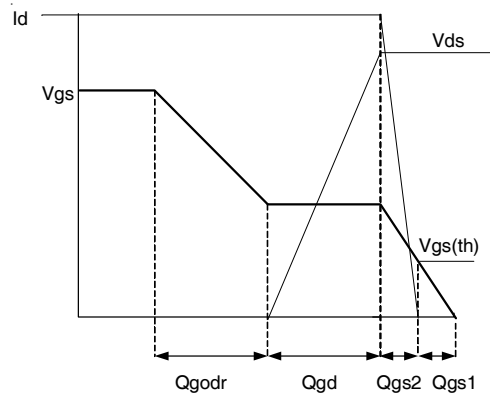


\*  $V_{GS} = 5V$  for Logic Level Devices

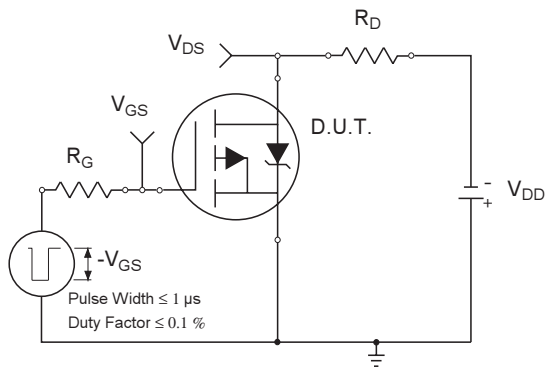
**Fig 15.** Diode Reverse Recovery Test Circuit for P-Channel HEXFET® Power MOSFETs



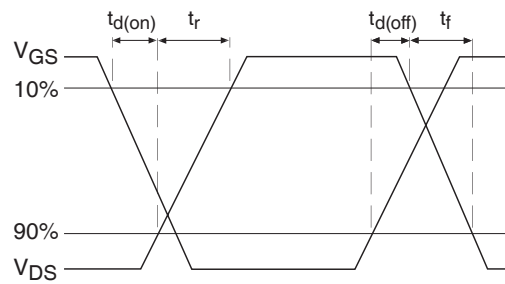
**Fig 16a.** Gate Charge Test Circuit



**Fig 16b.** Gate Charge Waveform

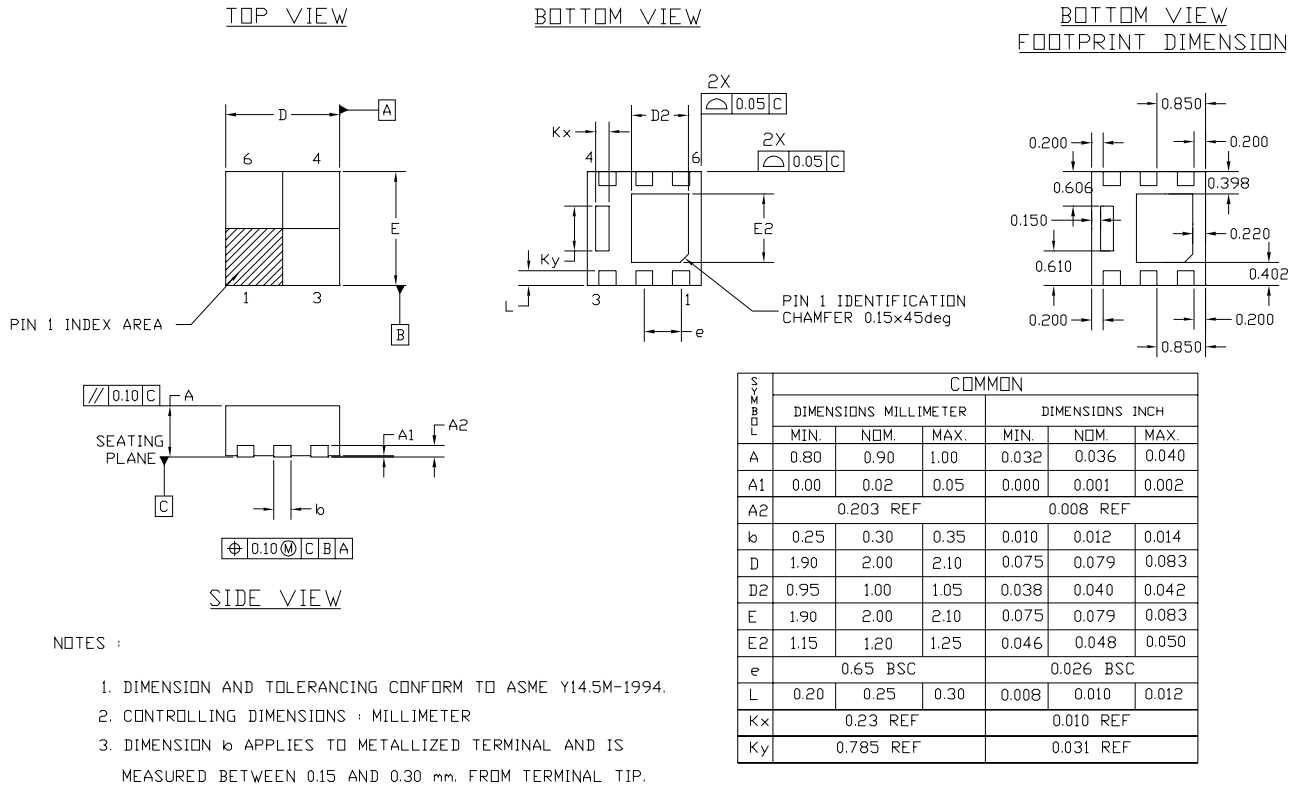


**Fig 17a.** Switching Time Test Circuit

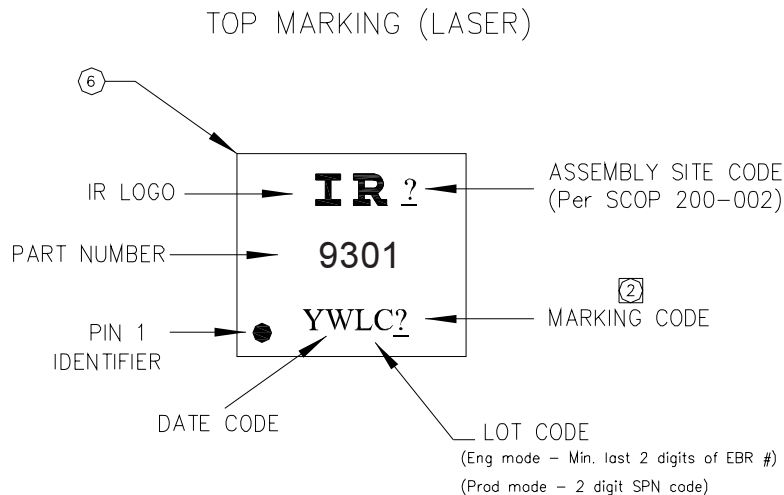


**Fig 17b.** Switching Time Waveforms

## PQFN Package Details



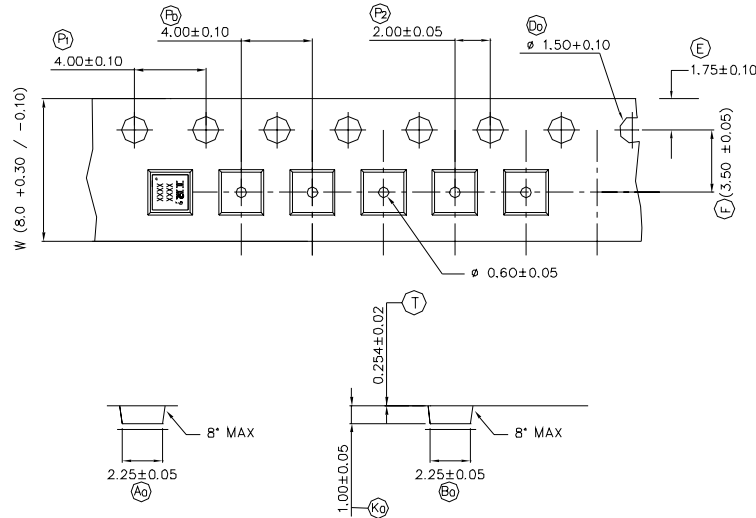
## PQFN Part Marking



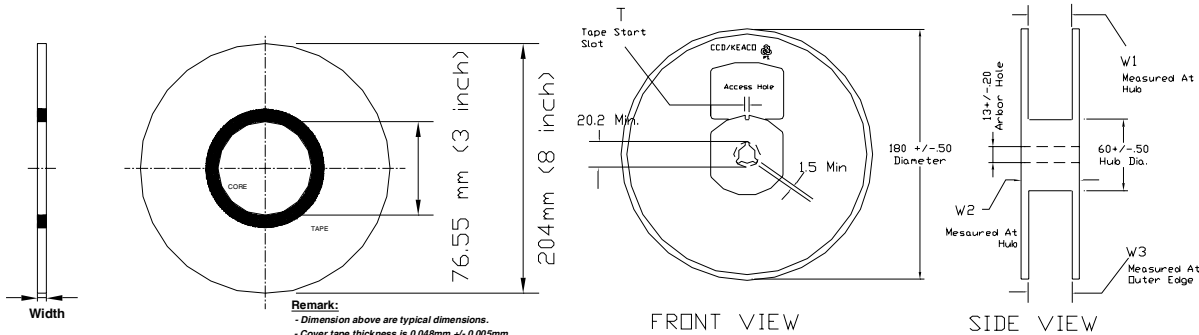
Note: For the most current drawing please refer to IR website at: <http://www.irf.com/package/>

# IRFHS9301TR/TR2PbF

## PQFN Tape and Reel



NOTE: The Surface Resistivity is  $10^4 - 10^5$  OHM/SQ



**Remark:**  
- Dimension above are typical dimensions.  
- Cover tape thickness is 0.048mm +/- 0.005mm.  
- Surface resistivity  $10E5 < R_s < 10E9$ .

COVER TAPE (WIDTH)	TOLERANCE
5.4mm	+/- 0.1 mm
9.5mm	+/- 0.1 mm

TAPE WIDTH	T	W1	W2	W3	PART NO
8 MM	3 ± 0.50	84 <sup>+</sup> 1.5 <sup>-</sup> 0.0	14.4 Max	7.50 Min 10.9 Max	91386-1
12 MM	5 ± 0.50	12.4 <sup>+</sup> 2.0 <sup>-</sup> 0.0	18.4 Max	11.9 Min 15.4 Max	91386-2

Note: Surface resistivity is  $\geq 1 \times 10^5$  but  $< 1 \times 10^{12}$  ohm/sq.

### Qualification information<sup>†</sup>

Qualification level	Consumer <sup>††</sup> (per JEDEC JESD47F <sup>†††</sup> guidelines)	
Moisture Sensitivity Level	PQFN 2mm x 2mm	MSL1 (per IPC/JEDEC J-STD-020D <sup>†††</sup> )
RoHS compliant	Yes	

<sup>†</sup> Qualification standards can be found at International Rectifier's web site

<http://www.irf.com/product-info/reliability>

<sup>††</sup> Higher qualification ratings may be available should the user have such requirements.

Please contact your International Rectifier sales representative for further information:

<http://www.irf.com/whoto-call/salesrep/>

<sup>†††</sup> Applicable version of JEDEC standard at the time of product release.

Data and specifications subject to change without notice.