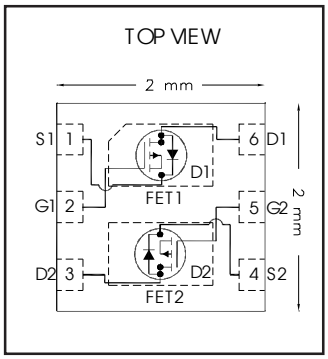
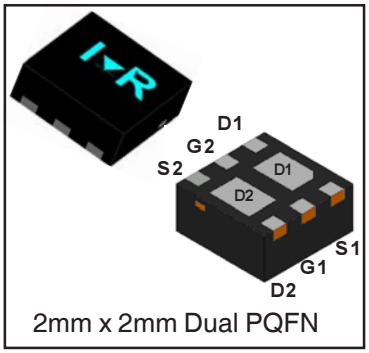
IRFHS9351PbF

HEXFET® Power MOSFET

V_{DS}	-30	V
$V_{GS\ max}$	±20	V
$R_{DS(on)\ max}$ ($@V_{GS}$ = -10V)	170	mΩ
I_D ($@T_C$ = 25°C)	-3.4②	A





2mm x 2mm Dual PQFN

Applications

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

Features and Benefits

Features		Benefits
Low R_{DSon} (≤ 170mΩ)		Lower Conduction Losses
Low Thermal Resistance to PCB (≤ 19°C/W)		Enable better thermal dissipation
Low Profile (≤ 1.0 mm)	results in	Increased Power Density
Compatible with Existing Surface Mount Techniques		Easier Manufacturing
RoHS Compliant Containing no Lead, no Bromide and no Halogen		Environmentally Friendlier
MSL1, Industrial Qualification		Increased Reliability

Orderable part number	Package Type	Standard Pack		Note
		Form	Quantity	
IRFHS9351TRPBF	PQFN 2mm x 2mm	Tape and Reel	4000	
~~IRFHS9351TR2PBF~~	~~PQFN 2mm x 2mm~~	~~Tape and Reel~~	~~400~~	EOL notice # 259

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°C	Continuous Drain Current, V_{GS} @ -10V	-2.3	A
I_D @ T_A = 70°C	Continuous Drain Current, V_{GS} @ -10V	-1.5	
I_D @ T_C = 25°C	Continuous Drain Current, V_{GS} @ -10V	-5.1②	
I_D @ T_C = 70°C	Continuous Drain Current, V_{GS} @ -10V	-4.1②	
I_D @ T_C = 25°C	Continuous Drain Current, V_{GS} @ 10V (Package Limited)	-3.4②	
I_{DM}	Pulsed Drain Current ①	-20	
P_D @T_A = 25°C	Power Dissipation ④	1.4	W
P_D @ T_A = 70°C	Power Dissipation ④	0.9	
	Linear Derating Factor	0.01	W/°C
T_J T_{STG}	Operating Junction and Storage Temperature Range	-55 to + 150	°C

Notes ① through ⑥ are on page 2

Static @ T_J = 25°C (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
BV_{DSS}	Drain-to-Source Breakdown Voltage	-30	—	—	V	V_{GS} = 0V, I_D = -250µA
V_{DSS}/T_J	Breakdown Voltage Temp. Coefficient	—	0.02	—	V/°C	Reference to 25°C, I_D = -1mA
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	135	170	m	V_{GS} = -10V, I_D = -3.1A ③
		—	235	290		V_{GS} = -4.5V, I_D = -2.5A ③
$V_{GS(th)}$	Gate Threshold Voltage	-1.3	-1.8	-2.4	V	V_{DS} = V_{GS}, I_D = -10µA
$V_{GS(th)}$	Gate Threshold Voltage Coefficient	—	-4.6	—	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°C
I_{GSS}	Gate-to-Source Forward Leakage	—	—	-100	nA	V_{GS} = -20V
	Gate-to-Source Reverse Leakage	—	—	100		V_{GS} = 20V
gfs	Forward Transconductance	2.4	—	—	S	V_{DS} = -10V, I_D = -3.1A
Q_g	Total Gate Charge ⑥	—	1.9	—	nC	V_{DS} = -15V, V_{GS} = -4.5V, I_D = - 3.1A
Q_g	Total Gate Charge ⑥	—	3.7	—	nC	V_{GS} = -10V
Q_{gs}	Gate-to-Source Charge ⑥	—	0.6	—		V_{DS} = -15V
Q_{gd}	Gate-to-Drain Charge ⑥	—	1.1	—		I_D = -3.1A
R_G	Gate Resistance ⑥	—	17	—		
$t_{d(on)}$	Turn-On Delay Time	—	8.3	—	ns	V_{DD} = -15V, V_{GS} = -4.5V ③
t_r	Rise Time	—	30	—		I_D = -3.1A
$t_{d(off)}$	Turn-Off Delay Time	—	6.3	—		R_G = 1.8
t_f	Fall Time	—	7.9	—		See Figs. 19a & 19b
C_{iss}	Input Capacitance	—	160	—	pF	V_{GS} = 0V
C_{oss}	Output Capacitance	—	39	—		V_{DS} = -25V
C_{rss}	Reverse Transfer Capacitance	—	26	—		f = 1.0KHz

Diode Characteristics

	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	—	—	-5.1	A	MOSFET symbol showing the integral reverse p-n junction diode.
I_{SM}	Pulsed Source Current (Body Diode) ①	—	—	-20		
V_{SD}	Diode Forward Voltage	—	—	-1.2	V	T_J = 25°C, I_S = -3.1A, V_{GS} = 0V ③
t_{rr}	Reverse Recovery Time	—	20	30	ns	T_J = 25°C, I_F = -3.1A, V_{DD} = -15V
Q_{rr}	Reverse Recovery Charge	—	42	63	nC	di/dt = 370/µs ③

Thermal Resistance

	Parameter	Typ.	Max.	Units
R_{JC} (Bottom)	Junction-to-Case ⑤	—	19	°C/W
R_{JC} (Top)	Junction-to-Case ⑤	—	170	
R_{JA}	Junction-to-Ambient ④		90	
R_{JA}	Junction-to-Ambient (t<10s) ④	—	75	

Notes:

① Repetitive rating; pulse width limited by max. junction temperature.

② Current limited by package. .

③ Pulse width ≤ 400µs; duty cycle ≤ 2%.

④ When mounted on 1 inch square copper board.

⑤ R_θ is measured at T_J of approximately 90°C.

⑥ For DESIGN AID ONLY, not subject to production testing.

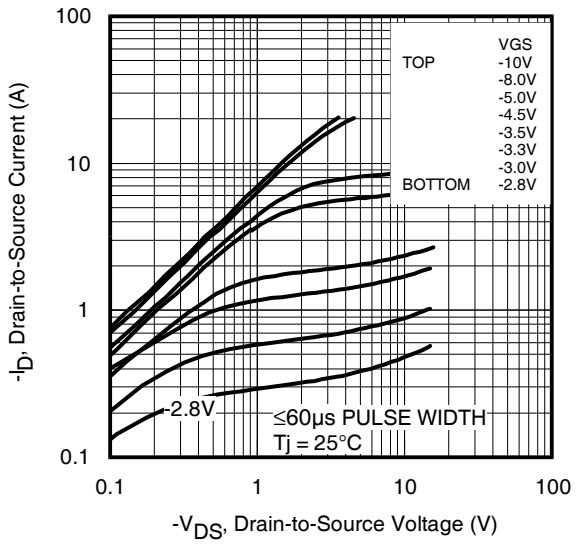


Fig 1. Typical Output Characteristics

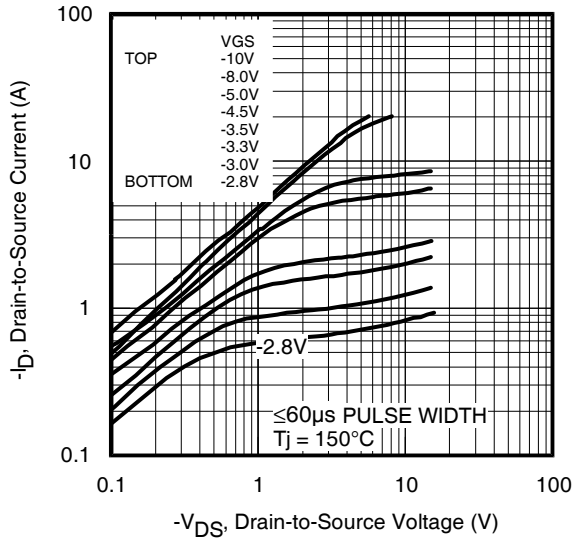


Fig 2. Typical Output Characteristics

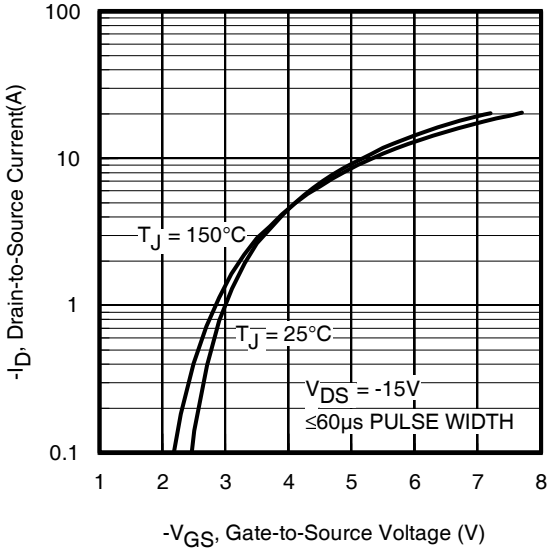


Fig 3. Typical Transfer Characteristics

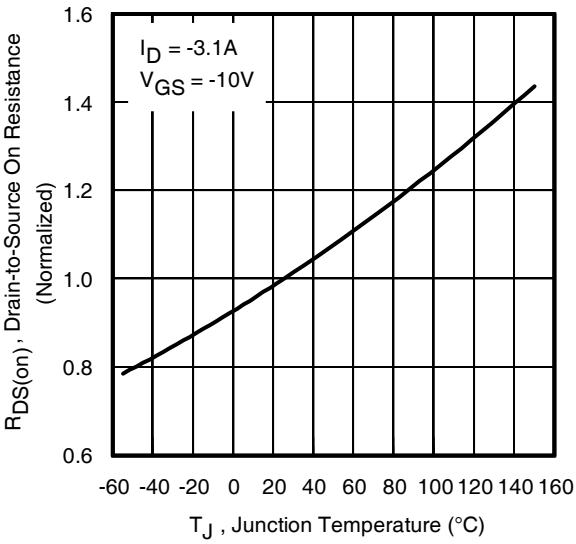


Fig 4. Normalized On-Resistance vs. Temperature

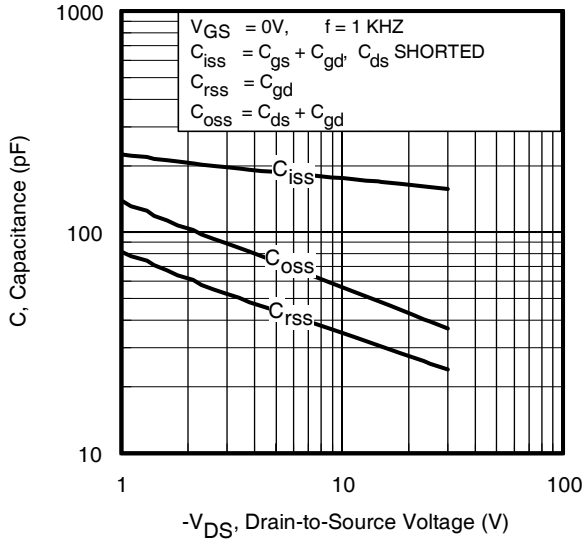


Fig 5. Typical Capacitance vs.Drain-to-Source Voltage

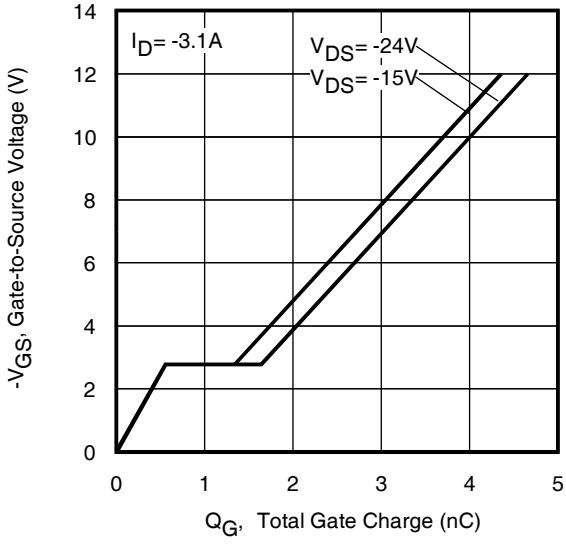


Fig 6. Typical Gate Charge vs.Gate-to-Source Voltage

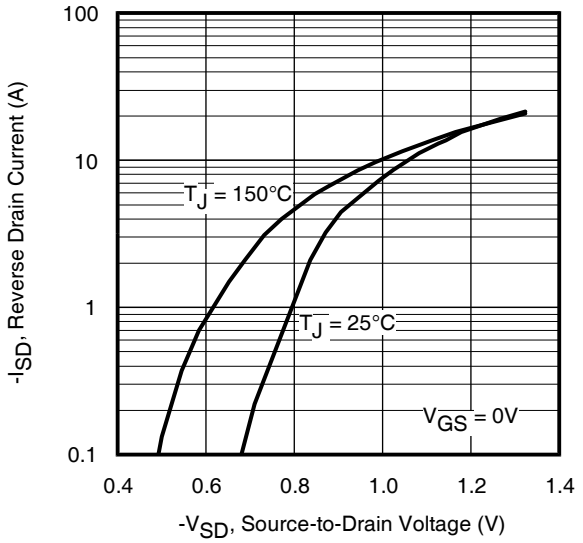


Fig 7. Typical Source-Drain Diode Forward Voltage

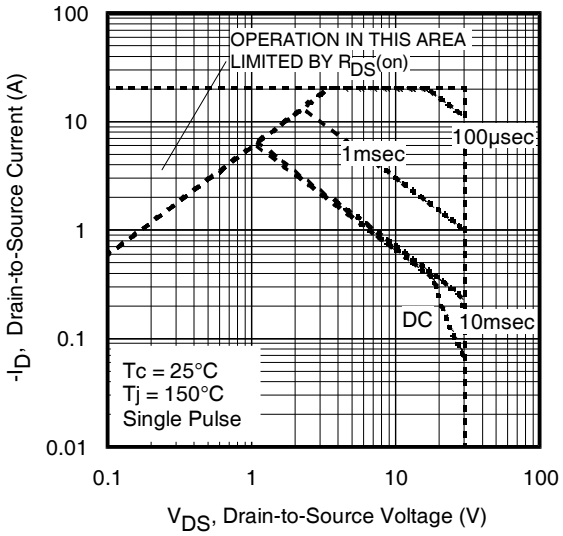


Fig 8. Maximum Safe Operating Area

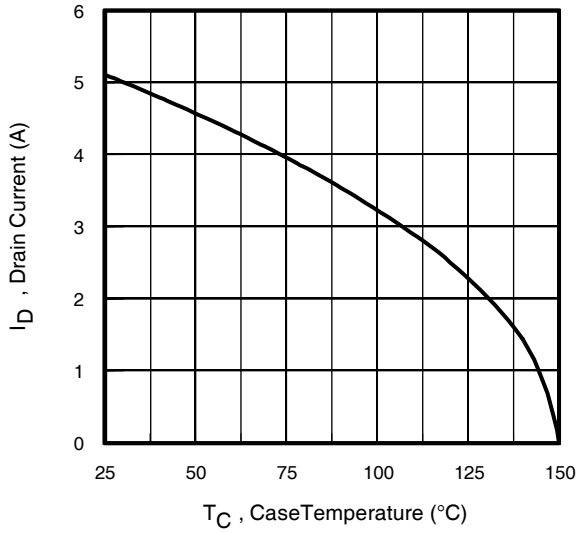


Fig 9. Maximum Drain Current vs. Case Temperature

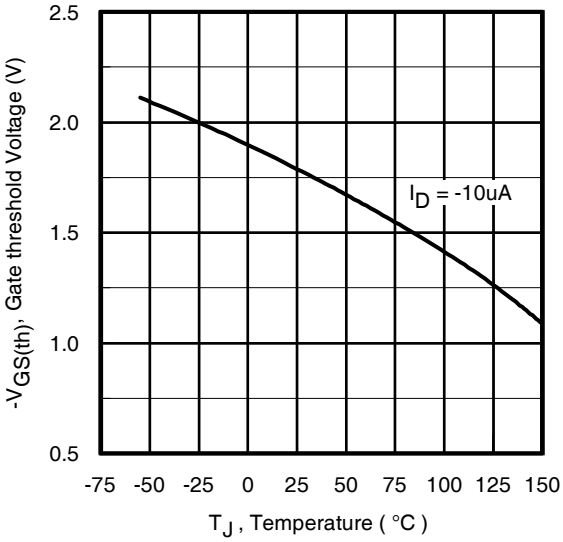


Fig 10. Threshold Voltage vs. Temperature

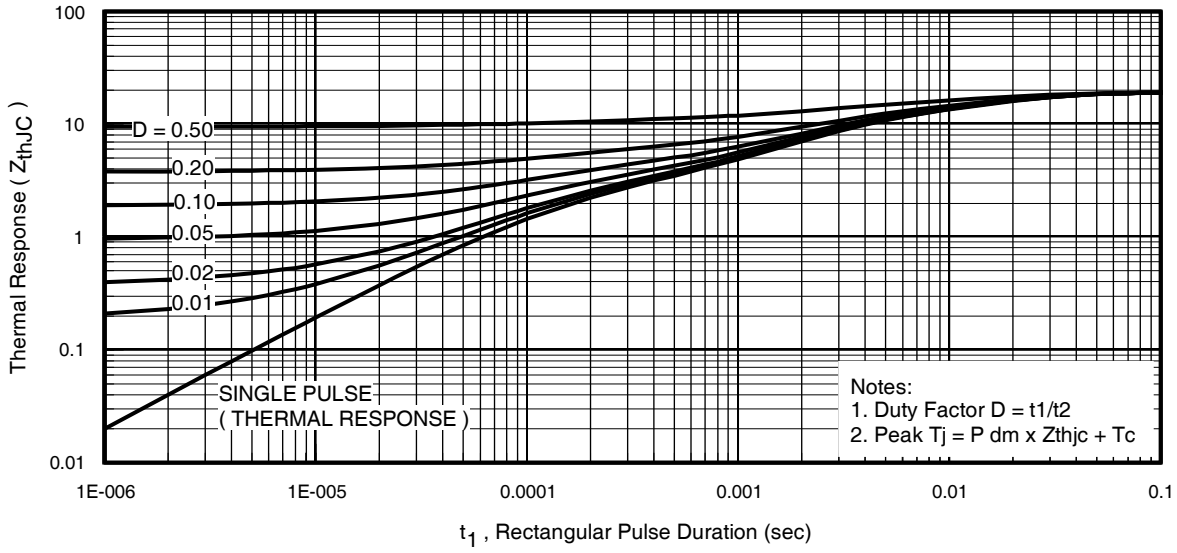


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case

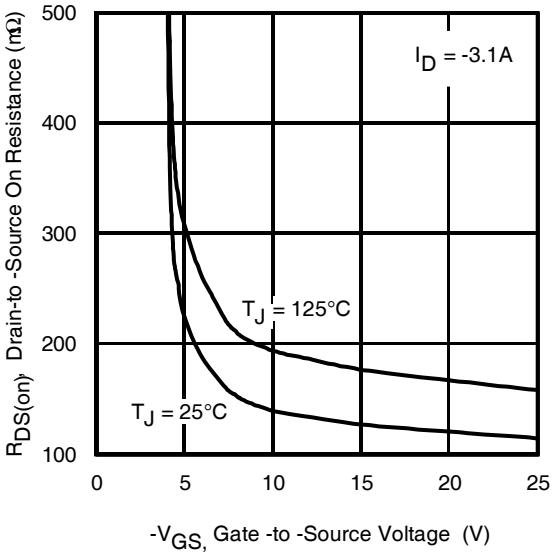


Fig 12. On-Resistance vs. Gate Voltage

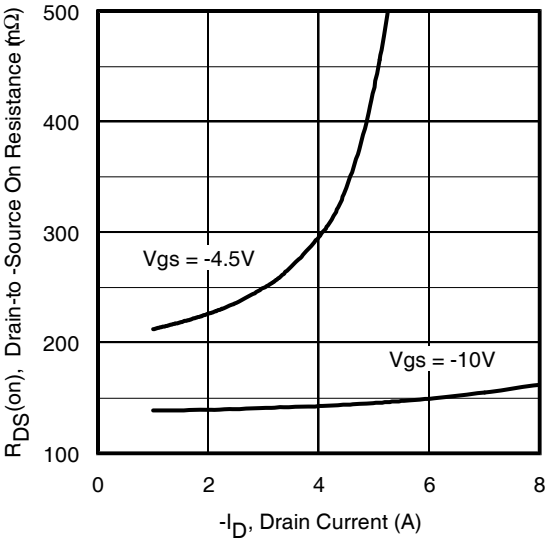


Fig 13. Typical On-Resistance vs. Drain Current

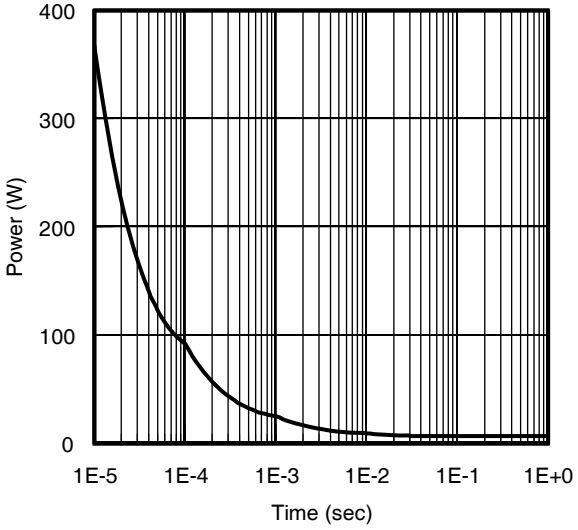


Fig 14. Typical Power vs. Time

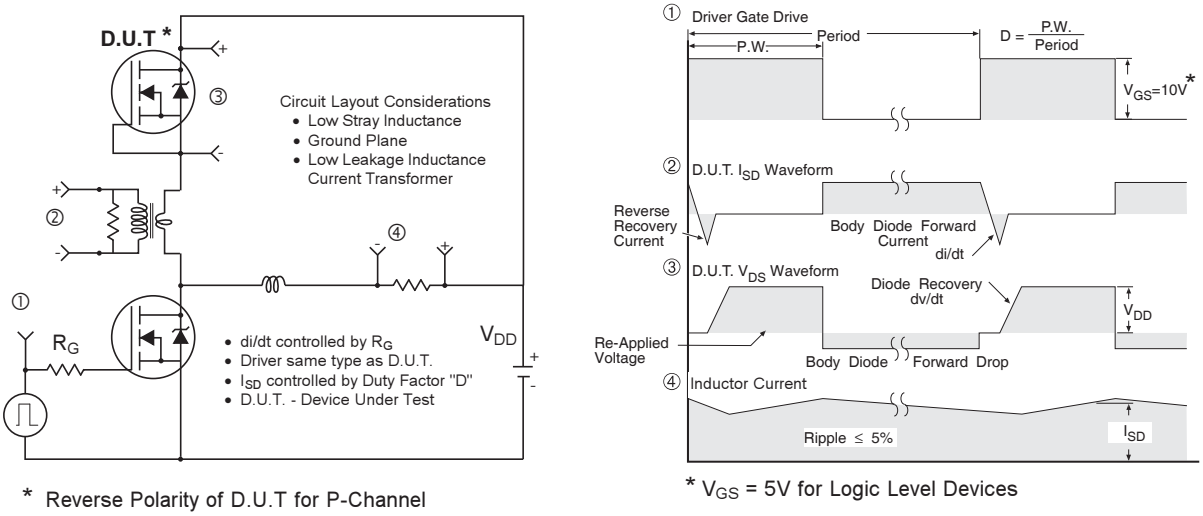


Fig 15. Diode Reverse Recovery Test Circuit for P-Channel HEXFET® Power MOSFETs

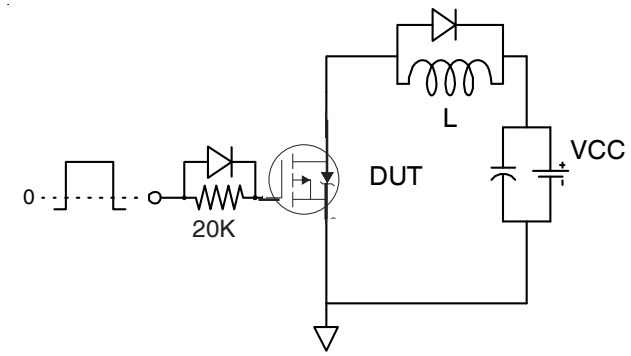


Fig 16a. Gate Charge Test Circuit

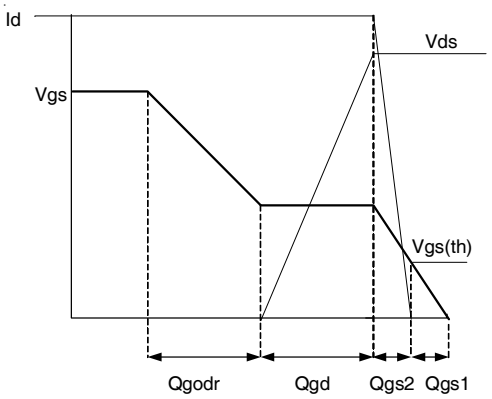


Fig 16b. Gate Charge Waveform

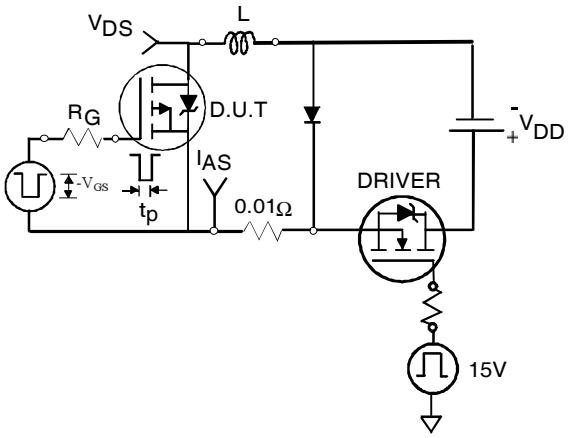


Fig 17a. Unclamped Inductive Test Circuit

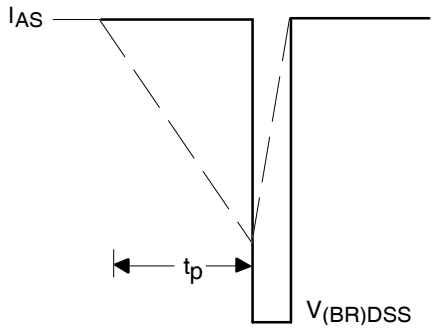


Fig 17b. Unclamped Inductive Waveforms

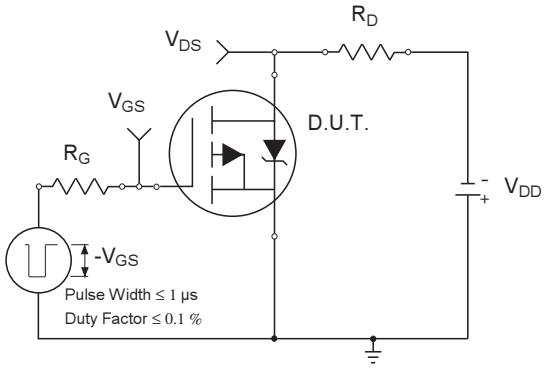


Fig 18a. Switching Time Test Circuit

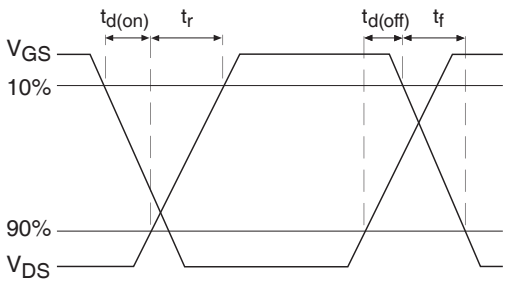
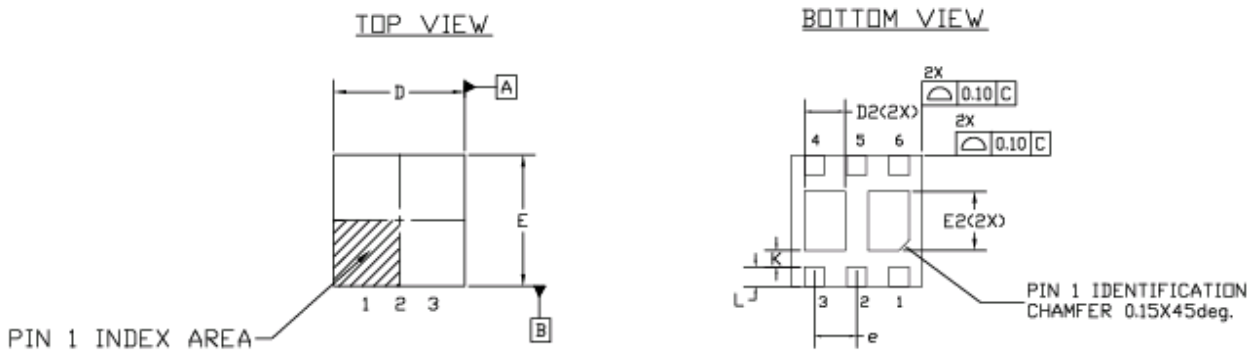
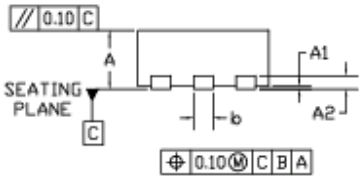


Fig 18b. Switching Time Waveforms

PQFN Package Details



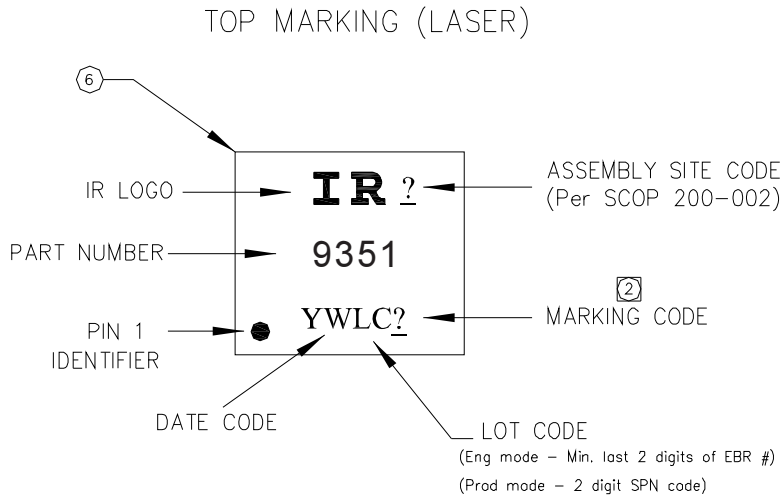


SYMBOL	COMMON					
	DIMENSIONS MILLIMETER			DIMENSIONS INCH		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.80	0.90	1.00	0.032	0.036	0.040
A1	0.00	0.02	0.05	0.000	0.001	0.002
A2	0.203 REF			0.008 REF		
b	0.25	0.30	0.35	0.010	0.012	0.014
D	1.90	2.00	2.10	0.075	0.079	0.083
D2	0.575	0.625	0.675	0.023	0.025	0.027
E	1.90	2.00	2.10	0.075	0.079	0.083
E2	0.85	0.90	0.95	0.034	0.036	0.038
e	0.65 BSC			0.026 BSC		
L	0.25	0.30	0.35	0.010	0.012	0.014
K	0.25	–	–	0.010	–	–

NOTES :

1. DIMENSION AND TOLERANCING CONFORM TO ASME Y14.5M-1994.
2. CONTROLLING DIMENSIONS : MILLIMETER. CONVERTED INCH DIMENSION ARE NOT NECESSARILY EXACT.

PQFN Part Marking



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

PQFN Tape and Reel

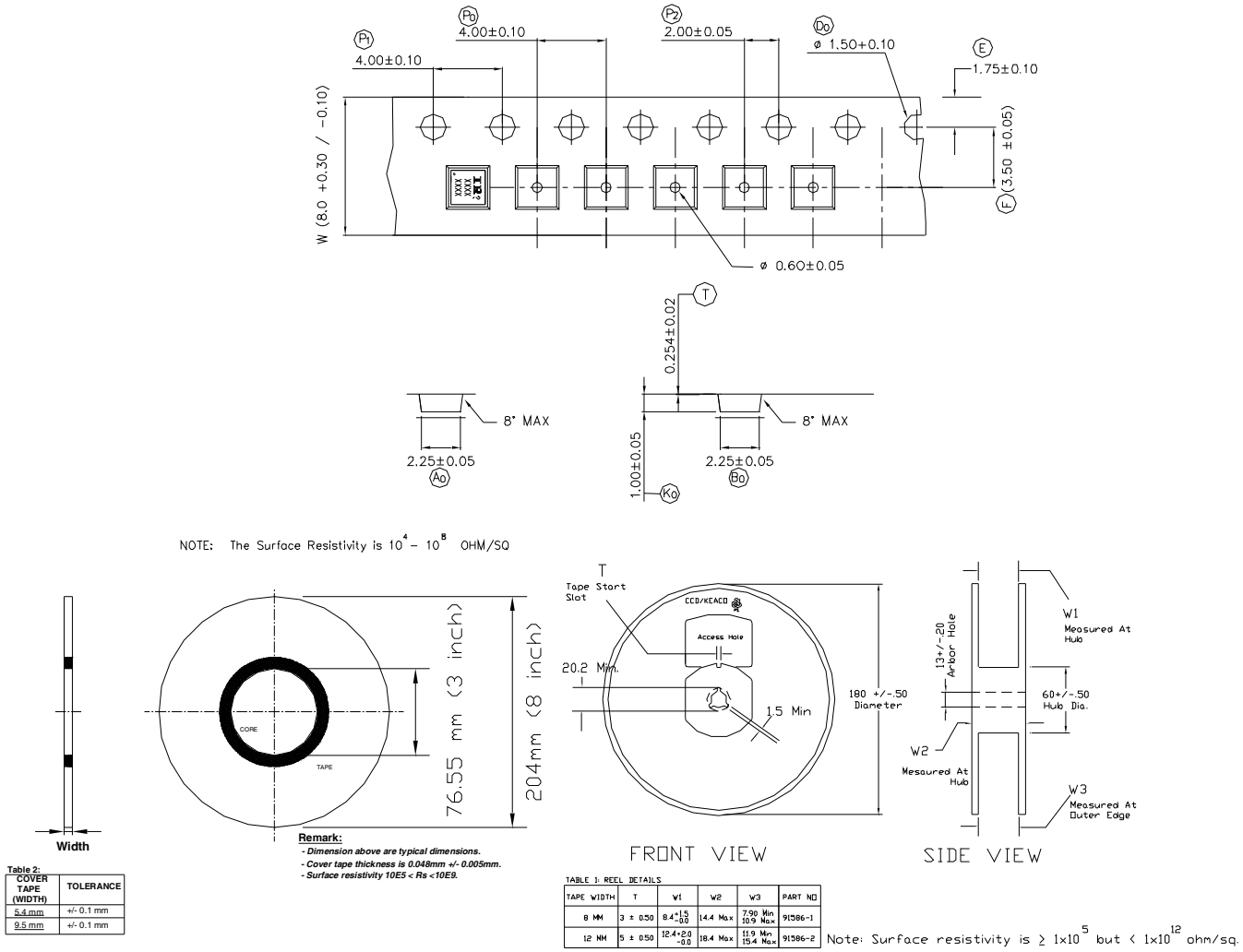


Table 2:

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

TABLE 1: REEL DETAILS

TAPE WIDTH	T	W1	W2	W3	PART NO
8 MM	3 ± 0.50	8.4 +1.5 −0.0	14.4 Max	7.90 Min 10.9 Max	91586-1
12 MM	5 ± 0.50	12.4 +2.0 −0.0	18.4 Max	11.9 Min 15.4 Max	91586-2

Note: Surface resistivity is ≥ $1x10^5$ but < $1x10^{12}$ ohm/sq.

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

Qualification information†

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

† Qualification standards can be found at International Rectifier's web site http://www.irf.com/product-info/reliability

†† 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/

††† Applicable version of JEDEC standard at the time of product release.

Revision History

Date	Comment
5/13/2014	• Updated ordering information to reflect the End-Of-life (EOL) of the mini-reel option (EOL notice #259) • Updated data sheet based on corporate template.
5/21/2014	• Updated qual level from "Consumer" to "Industrial" on page 1 & 9.

International
IOR Rectifier

IR WORLD HEADQUARTERS: 101 N. Sepulveda Blvd., El Segundo, California 90245, USA
To contact International Rectifier, please visit http://www.irf.com/whoto-call/

IMPORTANT NOTICE

The information given in this document shall in no event be regarded as a guarantee of conditions or characteristics ("Beschaffenheitsgarantie") .

With respect to any examples, hints or any typical values stated herein and/or any information regarding the application of the product, Infineon Technologies hereby disclaims any and all warranties and liabilities of any kind, including without limitation warranties of non-infringement of intellectual property rights of any third party.

In addition, any information given in this document is subject to customer's compliance with its obligations stated in this document and any applicable legal requirements, norms and standards concerning customer's products and any use of the product of Infineon Technologies in customer's applications.

The data contained in this document is exclusively intended for technically trained staff. It is the responsibility of customer's technical departments to evaluate the suitability of the product for the intended application and the completeness of the product information given in this document with respect to such application.

For further information on the product, technology, delivery terms and conditions and prices please contact your nearest Infineon Technologies office (**www.infineon.com**).

WARNINGS

Due to technical requirements products may contain dangerous substances. For information on the types in question please contact your nearest Infineon Technologies office.

Except as otherwise explicitly approved by Infineon Technologies in a written document signed by authorized representatives of Infineon Technologies, Infineon Technologies' products may not be used in any applications where a failure of the product or any consequences of the use thereof can reasonably be expected to result in personal injury.