

International **IR** Rectifier

PD - 95016A

IRF7832PbF

HEXFET® Power MOSFET

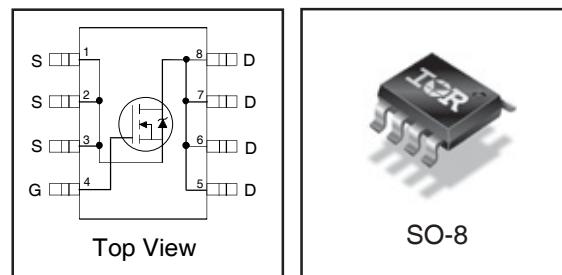
Applications

- Synchronous MOSFET for Notebook Processor Power
- Synchronous Rectifier MOSFET for Isolated DC-DC Converters in Networking Systems
- Lead-Free

V_{DSS}	R_{DS(on)} max	Q_g
30V	4.0mΩ@V_{GS} = 10V	34nC

Benefits

- Very Low R_{DS(on)} at 4.5V V_{GS}
- Ultra-Low Gate Impedance
- Fully Characterized Avalanche Voltage and Current
- 20V V_{GS} Max. Gate Rating
- 100% tested for R_g



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	20	A
I _D @ T _A = 70°C	Continuous Drain Current, V _{GS} @ 10V	16	
I _{DM}	Pulsed Drain Current ①	160	W
P _D @ T _A = 25°C	Power Dissipation	2.5	
P _D @ T _A = 70°C	Power Dissipation	1.6	W/°C
	Linear Derating Factor	0.02	
T _J	Operating Junction and	-55 to + 155	°C
T _{STG}	Storage Temperature Range		

Thermal Resistance

	Parameter	Typ.	Max.	Units
R _{0JL}	Junction-to-Drain Lead	—	20	°C/W
R _{0JA}	Junction-to-Ambient ④	—	50	

Notes ① through ④ are on page 10

www.irf.com

IRF7832PbF

International
Rectifier

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	$V_{\text{GS}} = 0\text{V}$, $I_D = 250\mu\text{A}$
$\Delta \text{BV}_{\text{DSS}}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	0.023	—	V/ $^\circ\text{C}$	Reference to 25°C , $I_D = 1\text{mA}$
$\text{R}_{\text{DS(on)}}$	Static Drain-to-Source On-Resistance	—	3.1	4.0	$\text{m}\Omega$	$V_{\text{GS}} = 10\text{V}$, $I_D = 20\text{A}$ ③
		—	3.7	4.8		$V_{\text{GS}} = 4.5\text{V}$, $I_D = 16\text{A}$ ③
$V_{\text{GS(th)}}$	Gate Threshold Voltage	1.39	—	2.32	V	$V_{\text{DS}} = V_{\text{GS}}$, $I_D = 250\mu\text{A}$
$\Delta V_{\text{GS(th)}}$	Gate Threshold Voltage Coefficient	—	5.7	—	$\text{mV}/^\circ\text{C}$	
I_{DSS}	Drain-to-Source Leakage Current	—	—	1.0	μA	$V_{\text{DS}} = 24\text{V}$, $V_{\text{GS}} = 0\text{V}$
		—	—	150		$V_{\text{DS}} = 24\text{V}$, $V_{\text{GS}} = 0\text{V}$, $T_J = 125^\circ\text{C}$
I_{GSS}	Gate-to-Source Forward Leakage	—	—	100	nA	$V_{\text{GS}} = 20\text{V}$
	Gate-to-Source Reverse Leakage	—	—	-100		$V_{\text{GS}} = -20\text{V}$
g_{fs}	Forward Transconductance	77	—	—	S	$V_{\text{DS}} = 15\text{V}$, $I_D = 16\text{A}$
Q_g	Total Gate Charge	—	34	51	nC	$V_{\text{DS}} = 15\text{V}$ $V_{\text{GS}} = 4.5\text{V}$ $I_D = 16\text{A}$ See Fig. 16
Q_{gs1}	Pre-V _{th} Gate-to-Source Charge	—	8.6	—		
Q_{gs2}	Post-V _{th} Gate-to-Source Charge	—	2.9	—		
Q_{gd}	Gate-to-Drain Charge	—	12	—		
Q_{godr}	Gate Charge Overdrive	—	10.5	—		
Q_{sw}	Switch Charge ($Q_{\text{gs2}} + Q_{\text{gd}}$)	—	14.9	—	ns	$V_{\text{DD}} = 15\text{V}$, $V_{\text{GS}} = 4.5\text{V}$ $I_D = 16\text{A}$ Clamped Inductive Load
Q_{oss}	Output Charge	—	23	—		
R_g	Gate Resistance	—	1.2	2.4		
$t_{\text{d(on)}}$	Turn-On Delay Time	—	12	—		
t_r	Rise Time	—	6.7	—		
$t_{\text{d(off)}}$	Turn-Off Delay Time	—	21	—	pF	$V_{\text{GS}} = 0\text{V}$ $V_{\text{DS}} = 15\text{V}$ $f = 1.0\text{MHz}$
t_f	Fall Time	—	13	—		
C_{iss}	Input Capacitance	—	4310	—		
C_{oss}	Output Capacitance	—	990	—		
C_{rss}	Reverse Transfer Capacitance	—	450	—		

Avalanche Characteristics

	Parameter	Typ.	Max.	Units
E_{AS}	Single Pulse Avalanche Energy ②	—	260	mJ
I_{AR}	Avalanche Current ①	—	16	A

Diode Characteristics

	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	—	—	3.1	A	MOSFET symbol showing the integral reverse p-n junction diode.
I_{SM}	Pulsed Source Current (Body Diode) ①	—	—	160	ns	
V_{SD}	Diode Forward Voltage	—	—	1.0	V	$T_J = 25^\circ\text{C}$, $I_S = 16\text{A}$, $V_{\text{GS}} = 0\text{V}$ ③
t_{rr}	Reverse Recovery Time	—	41	62	ns	$T_J = 25^\circ\text{C}$, $I_F = 16\text{A}$, $V_{\text{DD}} = 10\text{V}$
Q_{rr}	Reverse Recovery Charge	—	39	59	nC	$dI/dt = 100\text{A}/\mu\text{s}$ ③
t_{on}	Forward Turn-On Time	Intrinsic turn-on time is negligible (turn-on is dominated by LS+LD)				

International
IR Rectifier

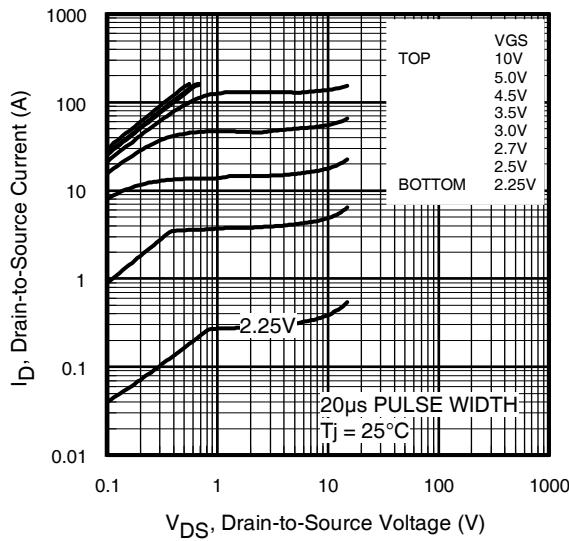


Fig 1. Typical Output Characteristics

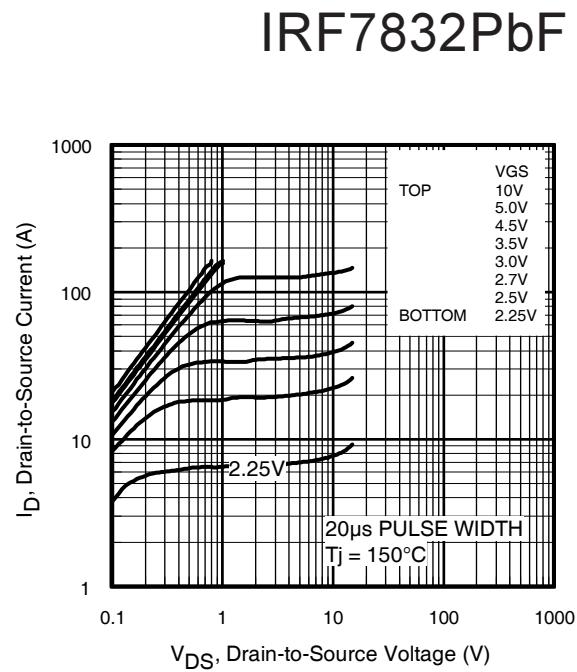


Fig 2. Typical Output Characteristics

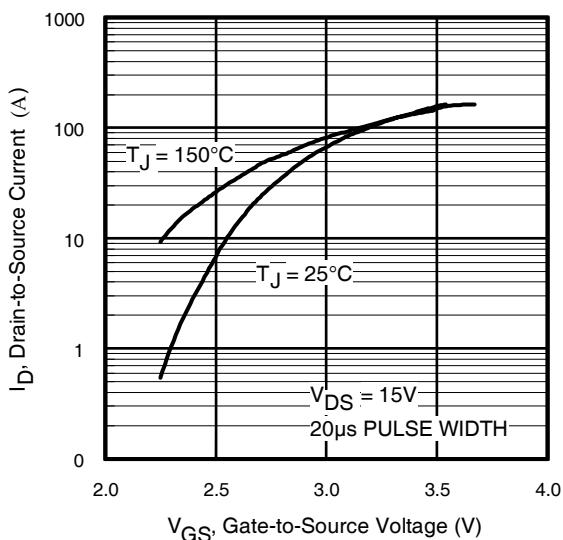


Fig 3. Typical Transfer Characteristics

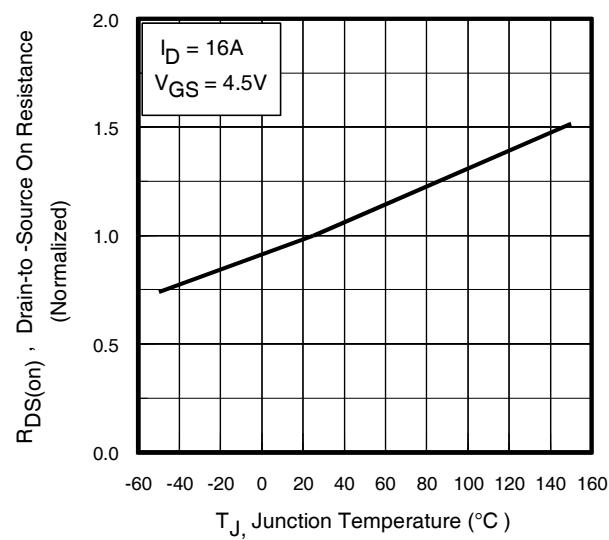


Fig 4. Normalized On-Resistance
Vs. Temperature

IRF7832PbF

International
Rectifier

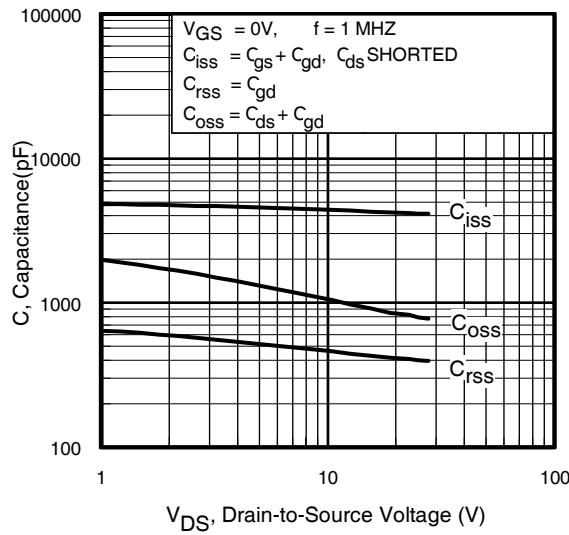


Fig 5. Typical Capacitance Vs.
Drain-to-Source Voltage

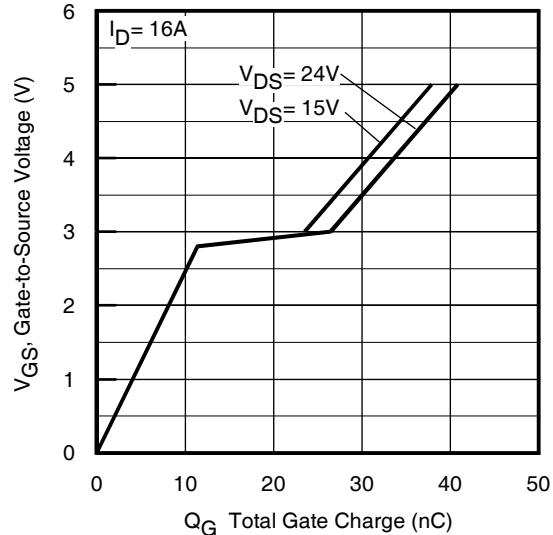


Fig 6. Typical Gate Charge Vs.
Gate-to-Source Voltage

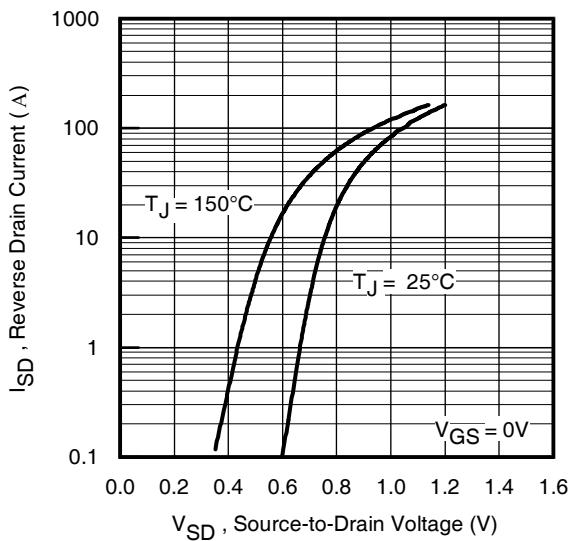


Fig 7. Typical Source-Drain Diode
Forward Voltage

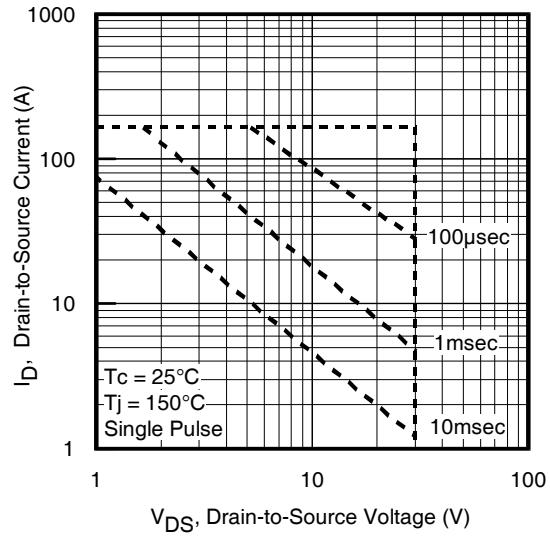


Fig 8. Maximum Safe Operating Area

International
IR Rectifier

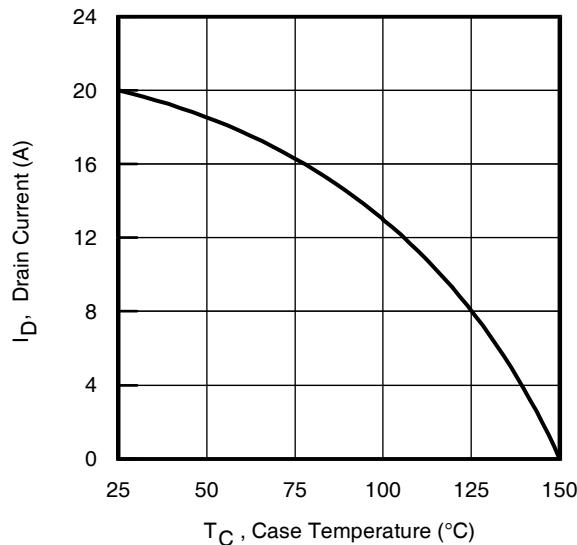


Fig 9. Maximum Drain Current Vs.
Case Temperature

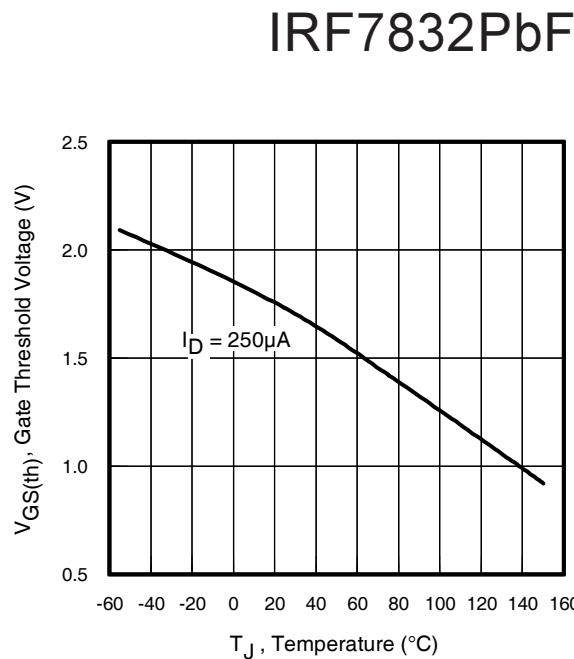


Fig 10. Threshold Voltage Vs. Temperature

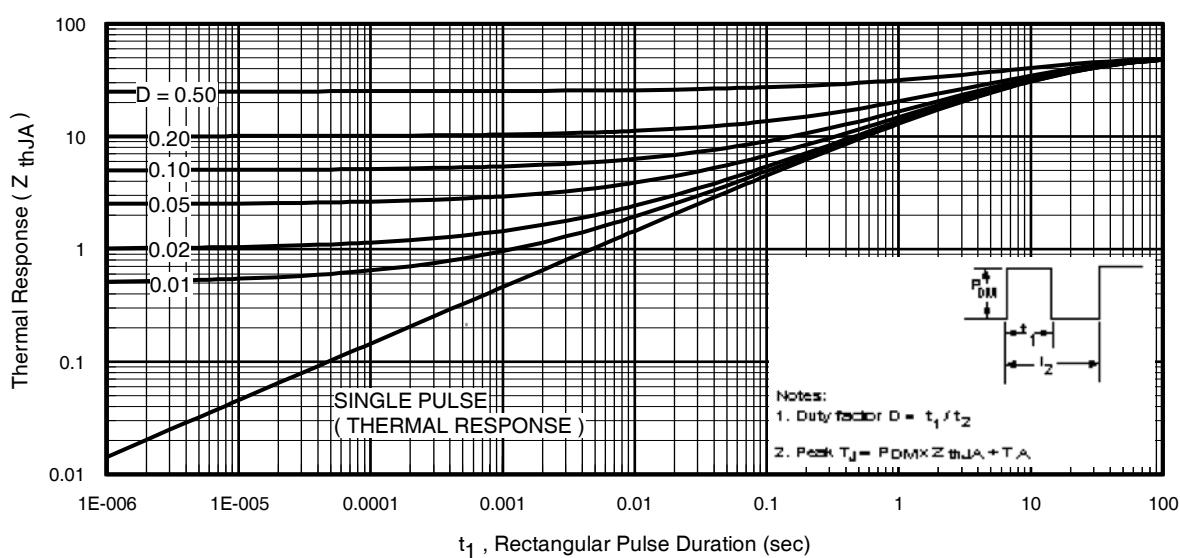


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Ambient

IRF7832PbF

International
Rectifier

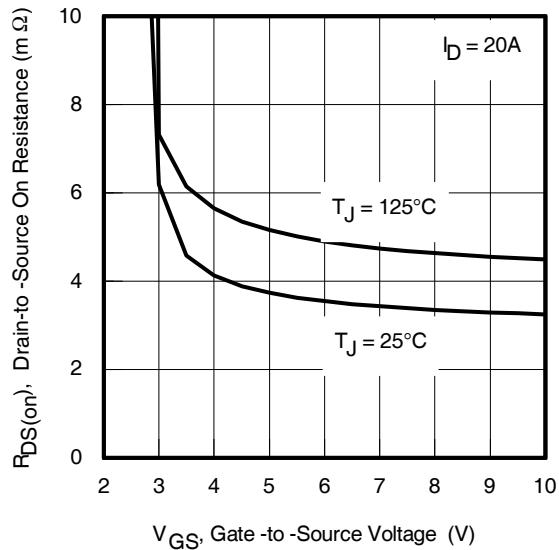


Fig 12. On-Resistance vs. Gate Voltage

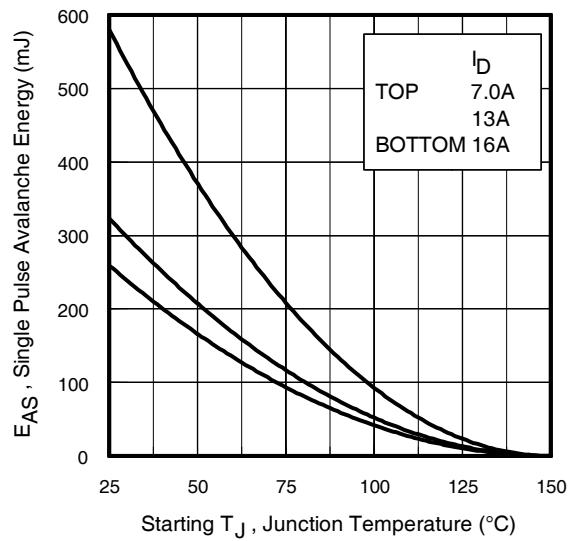


Fig 13. Maximum Avalanche Energy vs. Drain Current

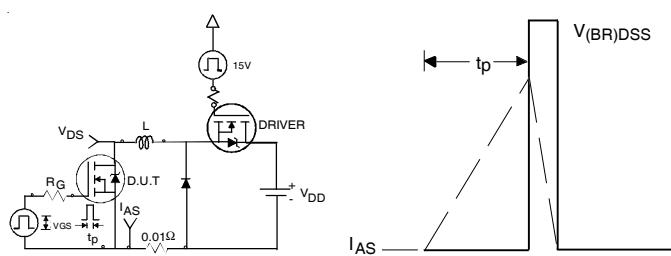


Fig 14. Unclamped Inductive Test Circuit and Waveform

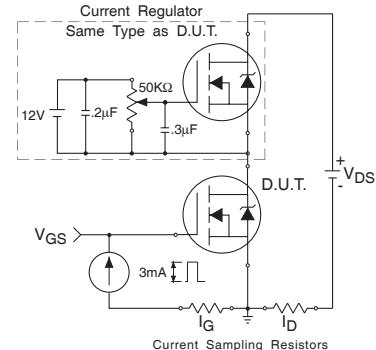


Fig 15. Gate Charge Test Circuit

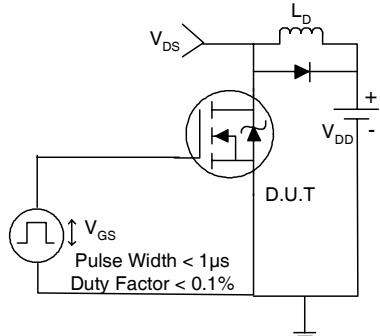


Fig 16. Switching Time Test Circuit

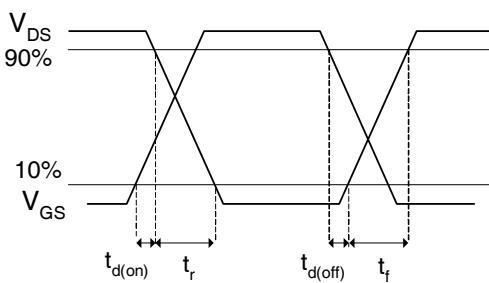


Fig 17. Switching Time Waveforms

www.irf.com

International
IR Rectifier

IRF7832PbF

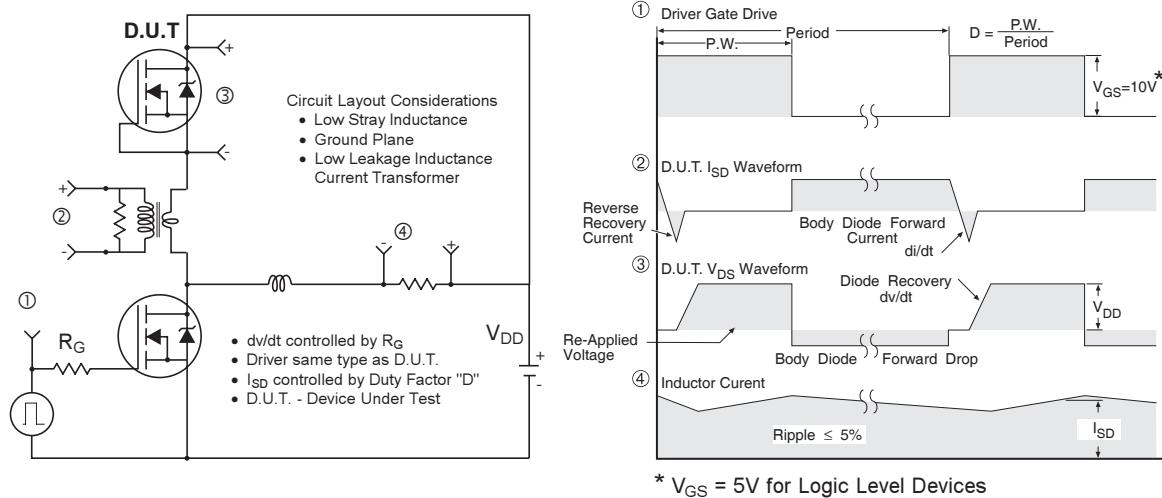


Fig 18. Peak Diode Recovery dv/dt Test Circuit for N-Channel HEXFET® Power MOSFETs

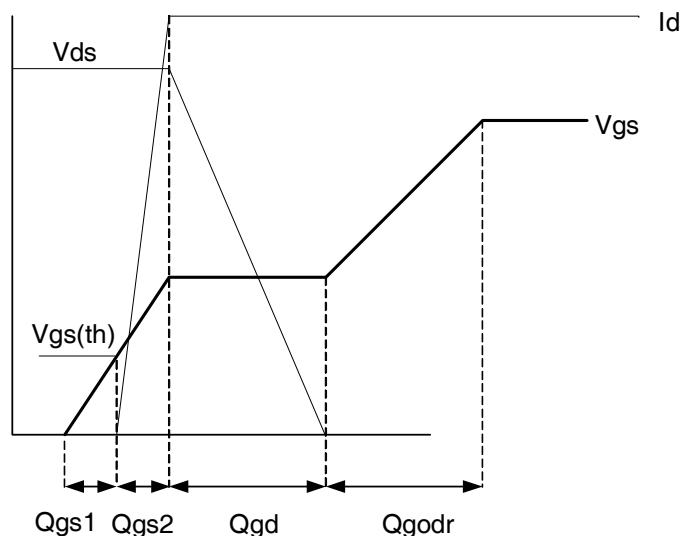


Fig 19. Gate Charge Waveform

IRF7832PbF

International
IR Rectifier

Power MOSFET Selection for Non-Isolated DC/DC Converters

Control FET

Special attention has been given to the power losses in the switching elements of the circuit - Q1 and Q2. Power losses in the high side switch Q1, also called the Control FET, are impacted by the $R_{ds(on)}$ of the MOSFET, but these conduction losses are only about one half of the total losses.

Power losses in the control switch Q1 are given by;

$$P_{loss} = P_{conduction} + P_{switching} + P_{drive} + P_{output}$$

This can be expanded and approximated by;

$$P_{loss} = \left(I_{rms}^2 \times R_{ds(on)} \right) + \left(I \times \frac{Q_{gd}}{i_g} \times V_{in} \times f \right) + \left(I \times \frac{Q_{gs2}}{i_g} \times V_{in} \times f \right) + \left(Q_g \times V_g \times f \right) + \left(\frac{Q_{oss}}{2} \times V_{in} \times f \right)$$

This simplified loss equation includes the terms Q_{gs2} and Q_{oss} which are new to Power MOSFET data sheets.

Q_{gs2} is a sub element of traditional gate-source charge that is included in all MOSFET data sheets. The importance of splitting this gate-source charge into two sub elements, Q_{gs1} and Q_{gs2} , can be seen from Fig 16.

Q_{gs2} indicates the charge that must be supplied by the gate driver between the time that the threshold voltage has been reached and the time the drain current rises to I_{dmax} at which time the drain voltage begins to change. Minimizing Q_{gs2} is a critical factor in reducing switching losses in Q1.

Q_{oss} is the charge that must be supplied to the output capacitance of the MOSFET during every switching cycle. Figure A shows how Q_{oss} is formed by the parallel combination of the voltage dependant (non-linear) capacitance's C_{ds} and C_{dg} when multiplied by the power supply input buss voltage.

Synchronous FET

The power loss equation for Q2 is approximated by;

$$P_{loss} = P_{conduction} + P_{drive} + P_{output}^* \\ P_{loss} = \left(I_{rms}^2 \times R_{ds(on)} \right) + \left(Q_g \times V_g \times f \right) + \left(\frac{Q_{oss}}{2} \times V_{in} \times f \right) + \left(Q_{rr} \times V_{in} \times f \right)$$

*dissipated primarily in Q1.

For the synchronous MOSFET Q2, $R_{ds(on)}$ is an important characteristic; however, once again the importance of gate charge must not be overlooked since it impacts three critical areas. Under light load the MOSFET must still be turned on and off by the control IC so the gate drive losses become much more significant. Secondly, the output charge Q_{oss} and reverse recovery charge Q_{rr} both generate losses that are transferred to Q1 and increase the dissipation in that device. Thirdly, gate charge will impact the MOSFETs' susceptibility to Cdv/dt turn on.

The drain of Q2 is connected to the switching node of the converter and therefore sees transitions between ground and V_{in} . As Q1 turns on and off there is a rate of change of drain voltage dV/dt which is capacitively coupled to the gate of Q2 and can induce a voltage spike on the gate that is sufficient to turn the MOSFET on, resulting in shoot-through current. The ratio of Q_{gd}/Q_{gs1} must be minimized to reduce the potential for Cdv/dt turn on.

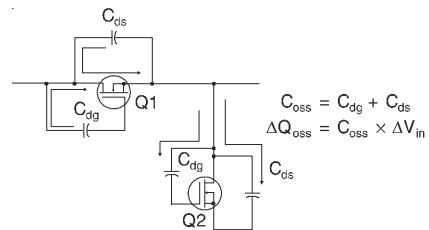
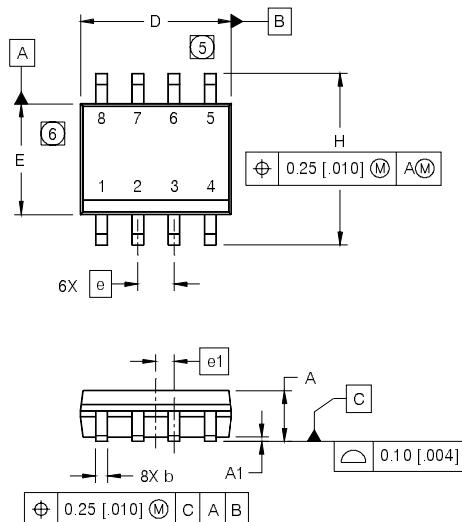


Figure A: Q_{oss} Characteristic

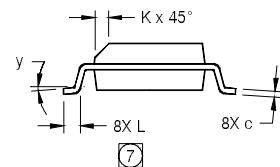
International
IR Rectifier

SO-8 Package Details

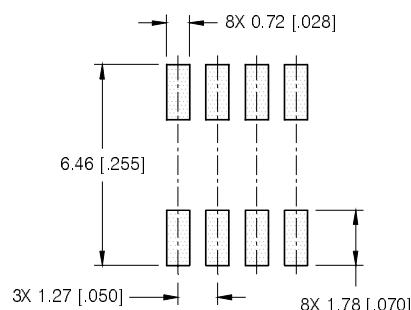


IRF7832PbF

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	.0532	.0688	1.35	1.75
A1	.0040	.0098	0.10	0.25
b	.013	.020	0.33	0.51
c	.0075	.0098	0.19	0.25
D	.189	.1968	4.80	5.00
E	.1497	.1574	3.80	4.00
e	.050	BASIC	1.27	BASIC
e1	.025	BASIC	0.635	BASIC
H	.2284	.2440	5.80	6.20
K	.0099	.0196	0.25	0.50
L	.016	.050	0.40	1.27
y	0°	8°	0°	8°

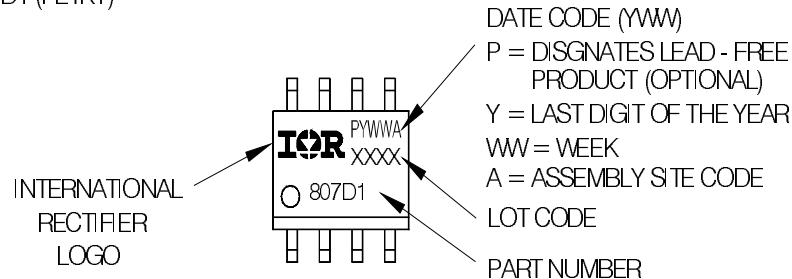


FOOTPRINT



SO-8 Part Marking

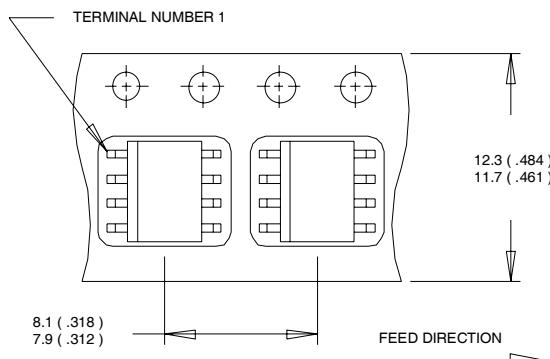
EXAMPLE: THIS IS AN IRF7807D1 (FETKY)



IRF7832PbF

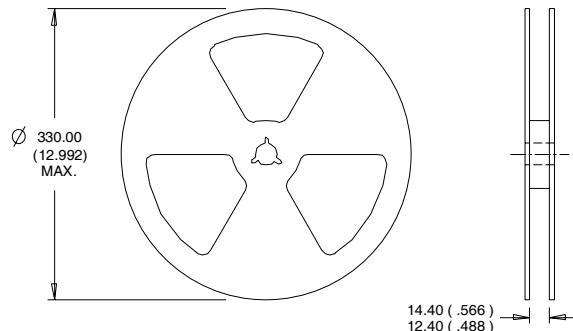
SO-8 Tape and Reel

International
IR Rectifier



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.

Notes:

- ① Repetitive rating; pulse width limited by max. junction temperature.
- ② Starting $T_J = 25^\circ\text{C}$, $L = 2.0\text{mH}$, $R_G = 25\Omega$, $I_{AS} = 16\text{A}$.
- ③ Pulse width $\leq 400\mu\text{s}$; duty cycle $\leq 2\%$.
- ④ When mounted on 1 inch square copper board.

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

International
IR Rectifier

IR WORLD HEADQUARTERS: 233 Kansas St., El Segundo, California 90245, USA Tel: (310) 252-7105

TAC Fax: (310) 252-7903

Visit us at www.irf.com for sales contact information.06/05

www.irf.com

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.