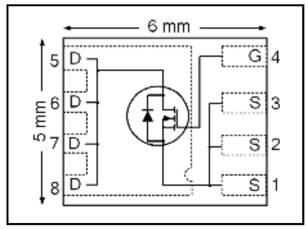
International
IOR Rectifier

StrongIRFET™
IRFH7787PbF

HEXFET® Power MOSFET

Application
- Brushed motor drive applications
- BLDC motor drive applications
- Battery powered circuits
- Half-bridge and full-bridge topologies
- Synchronous rectifier applications
- Resonant mode power supplies
- OR-ing and redundant power switches
- DC/DC and AC/DC converters
- DC/AC inverters



V_{DSS}	75V
$R_{DS(on)}$ typ.	6.6mΩ
max	8.0mΩ
I_D	68A

PQFN 5 x 6 mm

Benefits
- Improved gate, avalanche and dynamic dV/dt ruggedness
- Fully characterized capacitance and avalanche SOA
- Enhanced body diode dV/dt and dI/dt capability
- Lead-free, RoHS compliant

Base part number	Package Type	Standard Pack		Orderable Part Number
		Form	Quantity	
IRFH7787PbF	PQFN 5mm x 6mm	Tape and Reel	4000	IRFH7787TRPbF

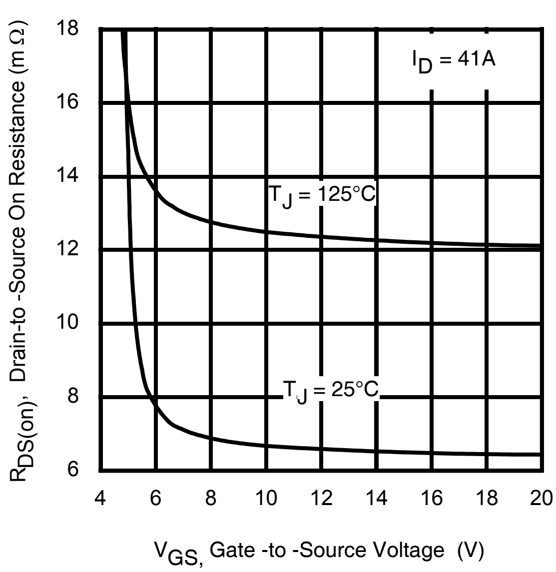


Fig 1. Typical On-Resistance vs. Gate Voltage

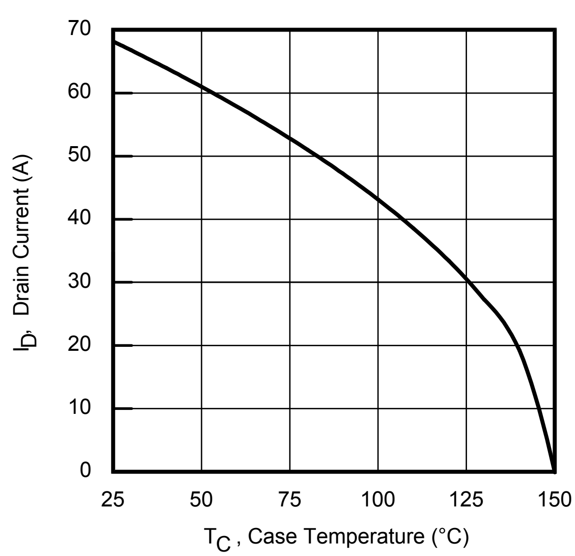


Fig 2. Maximum Drain Current vs. Case Temperature

Absolute Maximum Rating

Symbol	Parameter	Max.	Units
I_D @ T_C = 25°C	Continuous Drain Current, V_{GS} @ 10V	68	A
I_D @ T_C = 100°C	Continuous Drain Current, V_{GS} @ 10V	43	
I_{DM}	Pulsed Drain Current ①	270	
P_D @T_C = 25°C	Maximum Power Dissipation	83	W
	Linear Derating Factor	0.67	W/°C
V_{GS}	Gate-to-Source Voltage	± 20	V
T_J T_{STG}	Operating Junction and Storage Temperature Range	-55 to + 150	°C

Avalanche Characteristics

$E_{AS\ (Thermally\ limited)}$	Single Pulse Avalanche Energy ②	100	mJ
$E_{AS\ (Thermally\ limited)}$	Single Pulse Avalanche Energy ⑧	146	
I_{AR}	Avalanche Current ①	See Fig 15, 16, 23a, 23b	A
E_{AR}	Repetitive Avalanche Energy ①		mJ

Thermal Resistance

Symbol	Parameter	Typ.	Max.	Units
$R_{\theta JC}$ (Bottom)	Junction-to-Case ⑦	——	1.5	°C/W
$R_{\theta JC}$ (Top)	Junction-to-Case ⑦	——	21	
$R_{\theta JA}$	Junction-to-Ambient	——	34	
$R_{\theta JA}$ (<10s)	Junction-to-Ambient	——	22	

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

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	75	——	——	V	V_{GS} = 0V, I_D = 250µA
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	——	60	——	mV/°C	Reference to 25°C, I_D = 1mA
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	——	6.6	8.0	mΩ	V_{GS} = 10V, I_D = 41A
		——	7.5	——		V_{GS} = 6.0V, I_D = 21A
$V_{GS(th)}$	Gate Threshold Voltage	2.1	——	3.7	V	V_{DS} = V_{GS}, I_D = 100µA
I_{DSS}	Drain-to-Source Leakage Current	——	——	1.0	µA	V_{DS} =75 V, V_{GS} = 0V
		——	——	150		V_{DS} =75V,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
R_G	Gate Resistance	——	2.3	——	Ω	

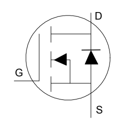
Notes:

① Repetitive rating; pulse width limited by max. junction temperature.
② Limited by T_{Jmax}, starting T_J = 25°C, L = 120µH, R_G = 50Ω, I_{AS} = 41A, V_{GS} =10V.
③ $I_{SD} \leq$ 41A, di/dt $\leq$ 1140A/µs, $V_{DD} \leq V_{(BR)DSS}$, $T_J \leq$ 175°C.
④ Pulse width $\leq$ 400µs; duty cycle $\leq$ 2%.
⑤ C_{oss} eff. (TR) 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 C_{oss} eff. (ER) is a fixed capacitance that gives the same energy as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS}.
⑦ R_θ is measured at T_J approximately 90°C.
⑧ Limited by T_{Jmax}, starting T_J =25°C, L= 1mH, R_G = 50Ω, I_{AS} = 17A, V_{GS} =10V.

Dynamic Electrical Characteristics @ T_J = 25°C (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
gfs	Forward Transconductance	110	——	——	S	V_{DS} = 10V, I_D = 41A
Q_g	Total Gate Charge	——	75	110	nC	I_D = 41A
Q_{gs}	Gate-to-Source Charge	——	18	——		V_{DS} = 38V
Q_{gd}	Gate-to-Drain Charge	——	23	——		V_{GS} = 10V
Q_{sync}	Total Gate Charge Sync. (Qg – Qgd)	——	52	——		
$t_{d(on)}$	Turn-On Delay Time	——	7.3	——	ns	V_{DD} = 38V
t_r	Rise Time	——	16	——		I_D = 41A
$t_{d(off)}$	Turn-Off Delay Time	——	53	——		R_G= 2.7Ω
t_f	Fall Time	——	12	——		V_{GS} = 10V ④
C_{iss}	Input Capacitance	——	4030	——	pF	V_{GS} = 0V
C_{oss}	Output Capacitance	——	330	——		V_{DS} = 25V
C_{rss}	Reverse Transfer Capacitance	——	200	——		*ƒ* = 1.0MHz, See Fig.7
$C_{oss\ eff.(ER)}$	Effective Output Capacitance (Energy Related)	——	290	——		V_{GS} = 0V, VDS = 0V to 60V⑥
$C_{oss\ eff.(TR)}$	Output Capacitance (Time Related)	——	380	——		V_{GS} = 0V, VDS = 0V to 60V⑤

Diode Characteristics

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	——	——	68	A	MOSFET symbol showing the integral reverse p-n junction diode. 
I_{SM}	Pulsed Source Current (Body Diode) ①	——	——	270		
V_{SD}	Diode Forward Voltage	——	——	1.2	V	T_J = 25°C,I_S = 41A,V_{GS} = 0V ④
dv/dt	Peak Diode Recovery dv/dt	——	11	——	V/ns	T_J = 150°C,I_S = 41A,V_{DS} = 75V③
t_{rr}	Reverse Recovery Time	——	29	——	ns	T_J = 25°C V_{DD} = 64V
		——	34	——		T_J = 125°C I_F = 41A,
Q_{rr}	Reverse Recovery Charge	——	30	——	nC	T_J = 25°C di/dt = 100A/μs ④
		——	42	——		T_J = 125°C
I_{RRM}	Reverse Recovery Current	——	1.7	——	A	T_J = 25°C

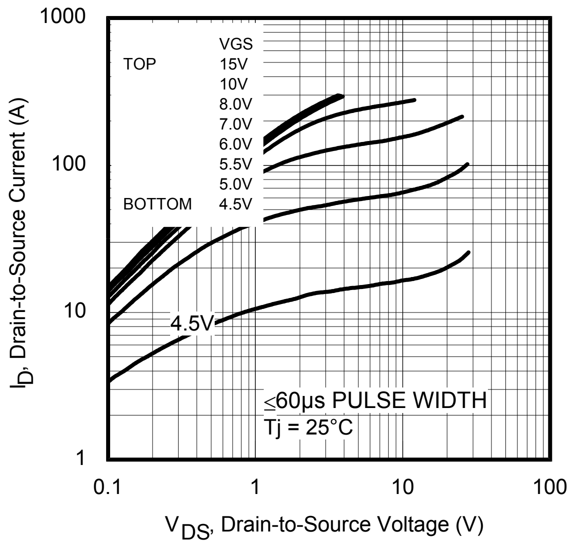


Fig 3. Typical Output Characteristics

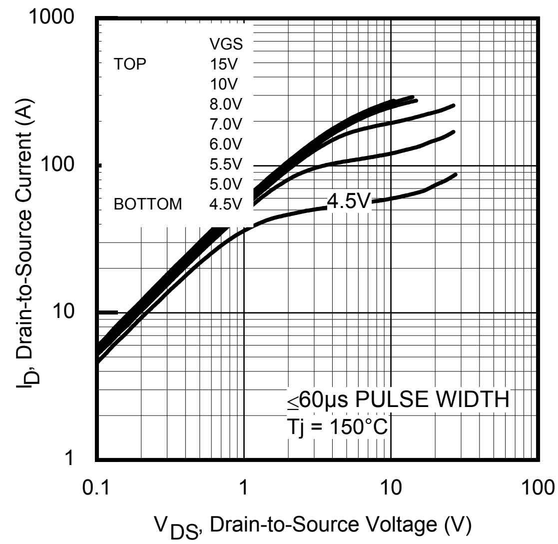


Fig 4. Typical Output Characteristics

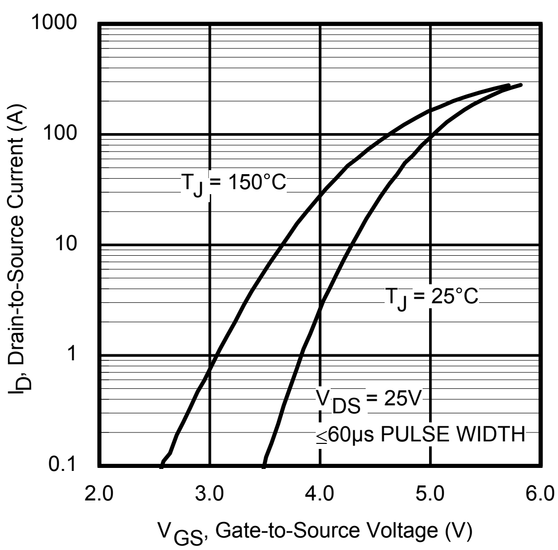


Fig 5. Typical Transfer Characteristics

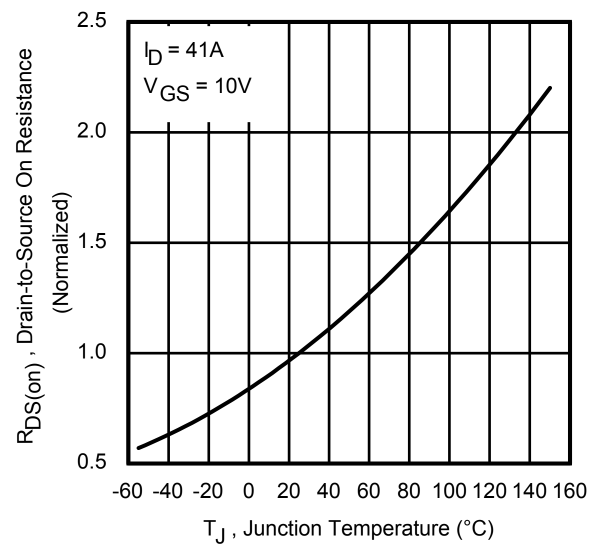


Fig 6. Normalized On-Resistance vs. Temperature

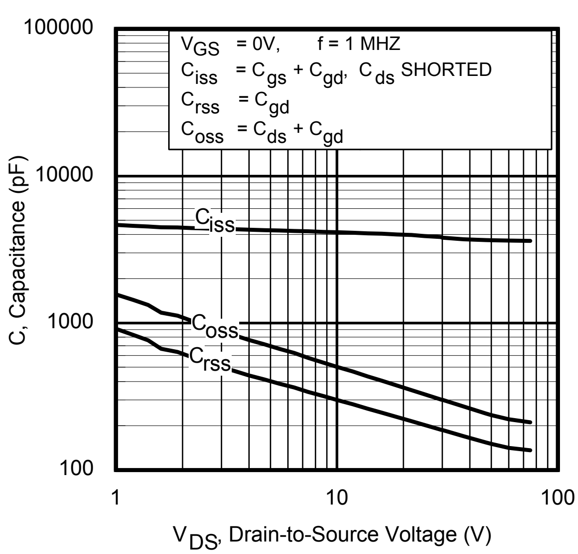


Fig 7. Typical Capacitance vs. Drain-to-Source Voltage

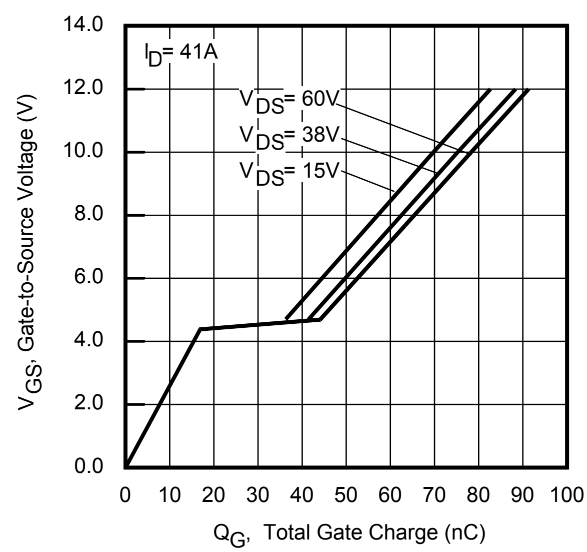


Fig 8. Typical Gate Charge vs.
Gate-to-Source Voltage

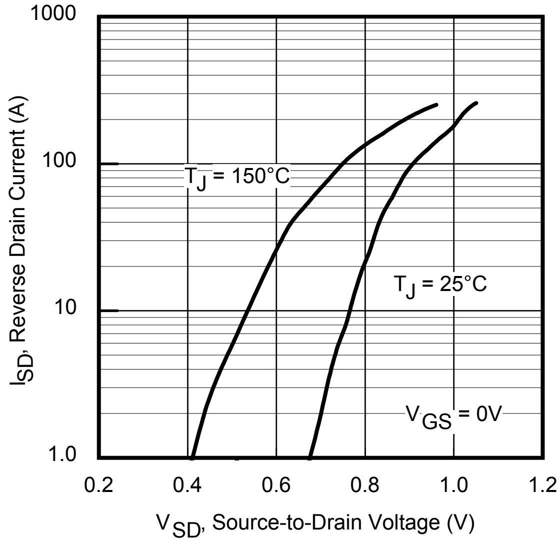


Fig 9. Typical Source-Drain Diode Forward Voltage

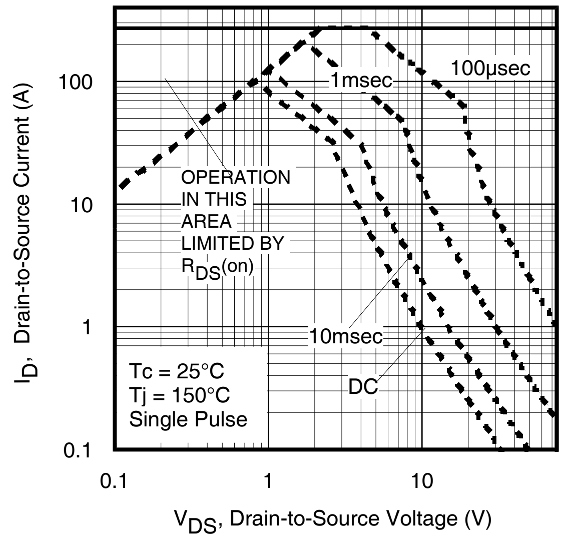


Fig 10. Maximum Safe Operating Area

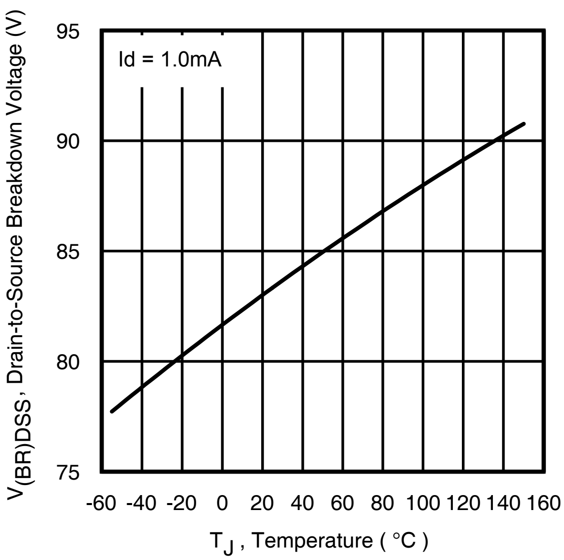


Fig 11. Drain-to-Source Breakdown Voltage

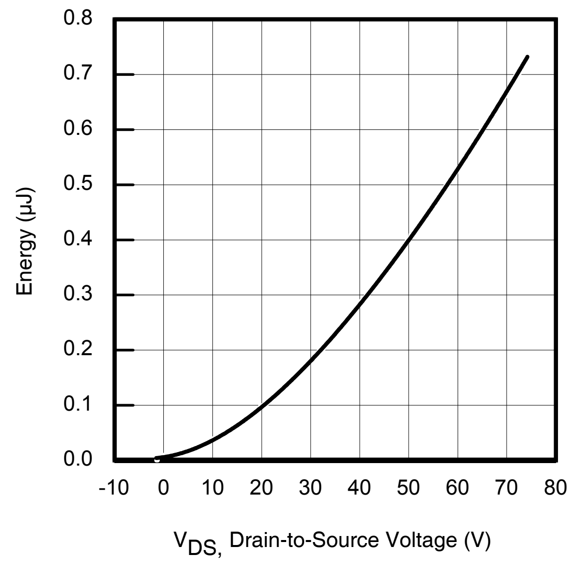


Fig 12. Typical C_{oss} Stored Energy

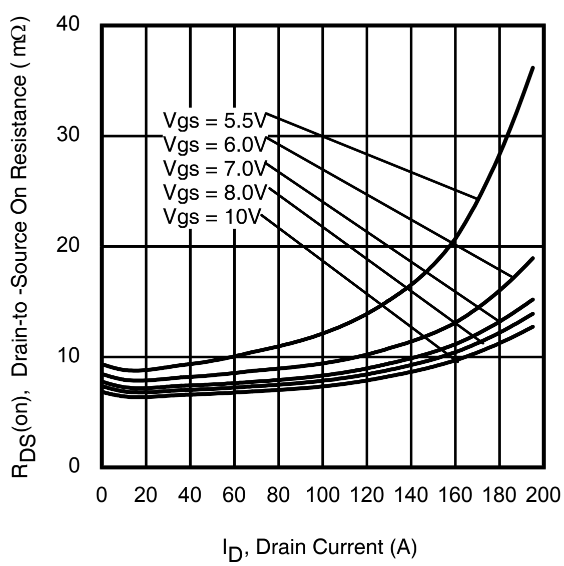


Fig 13. Typical On-Resistance vs. Drain Current

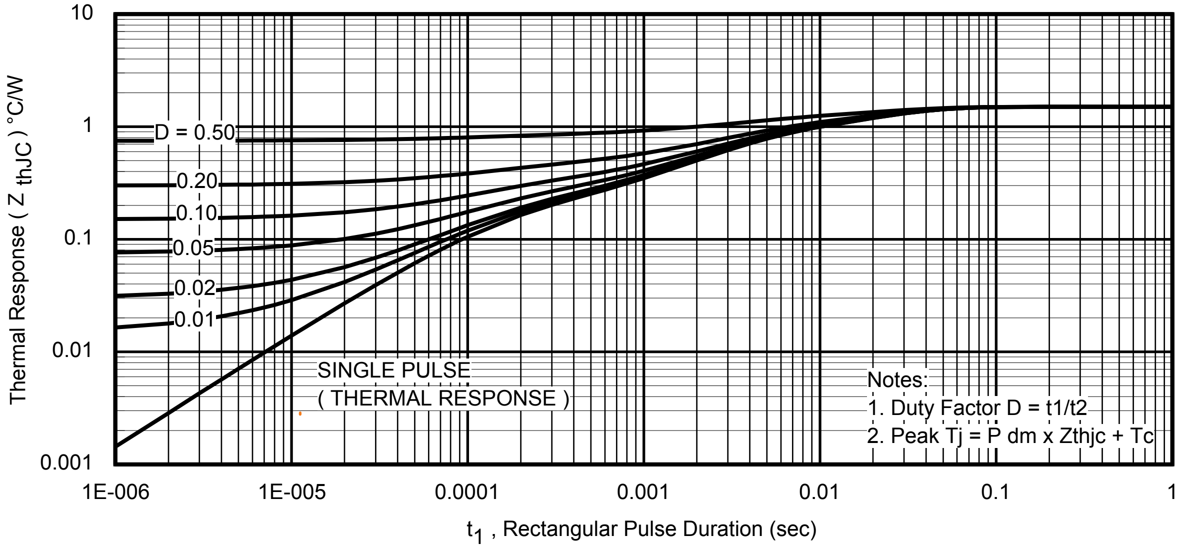


Fig 14. Maximum Effective Transient Thermal Impedance, Junction-to-Case

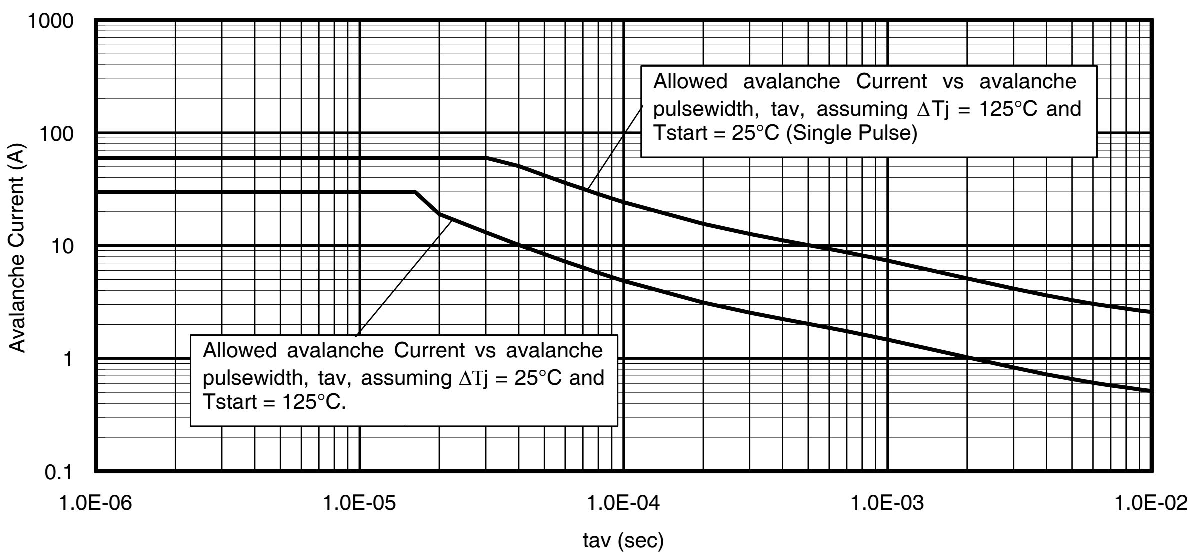


Fig 15. Avalanche Current vs. Pulse Width

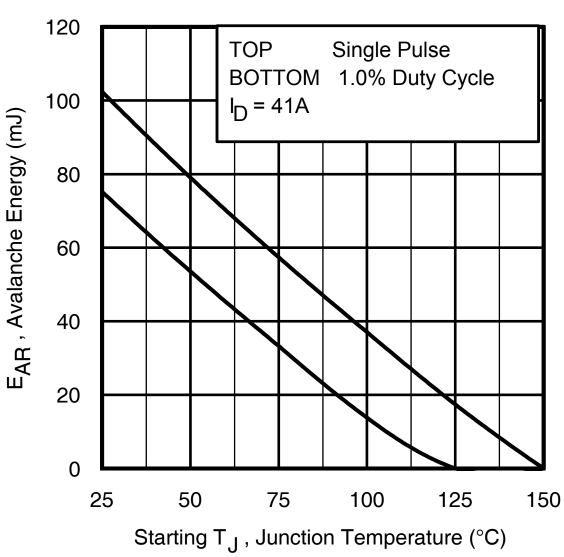


Fig 16. Maximum Avalanche Energy vs. Temperature

Notes on Repetitive Avalanche Curves , Figures 15, 16:
(For further info, see AN-1005 at www.irf.com)

1. Avalanche failures assumption:
   Purely a thermal phenomenon and failure occurs at a temperature far in excess of T_{jmax}. This is validated for every part type.
2. Safe operation in Avalanche is allowed as long as T_{jmax} is not exceeded.
3. Equation below based on circuit and waveforms shown in Figures 23a, 23b.
4. $P_{D\ (ave)}$ = Average power dissipation per single avalanche pulse.
5. BV = Rated breakdown voltage (1.3 factor accounts for voltage increase during avalanche).
6. I_{av} = Allowable avalanche current.
7. ΔT = Allowable rise in junction temperature, not to exceed T_{jmax} (assumed as 25°C in Figure 14, 16).
   t_{av} = Average time in avalanche.
   D = Duty cycle in avalanche = tav ·f
   $Z_{thJC}(D, t_{av})$ = Transient thermal resistance, see Figures 13)
   $PD\ (ave) = 1/2\ (1.3 \cdot BV \cdot I_{av}) = \Delta T / Z_{thJC}$
   $I_{av} = 2\Delta T / [1.3 \cdot BV \cdot Z_{th}]$
   $E_{AS\ (AR)} = P_{D\ (ave)} \cdot t_{av}$

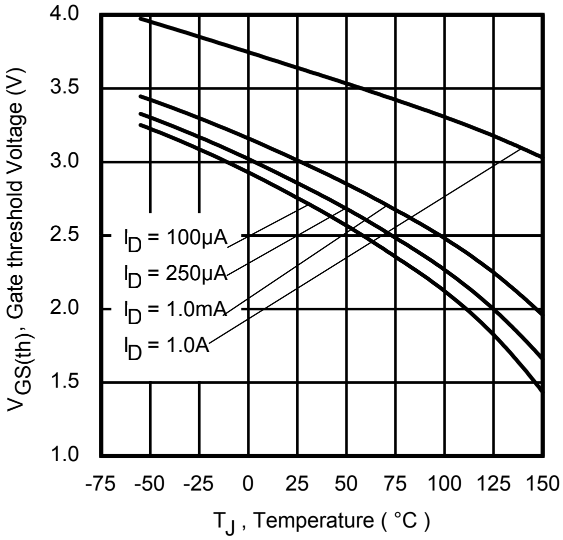


Fig 17. Threshold Voltage vs. Temperature

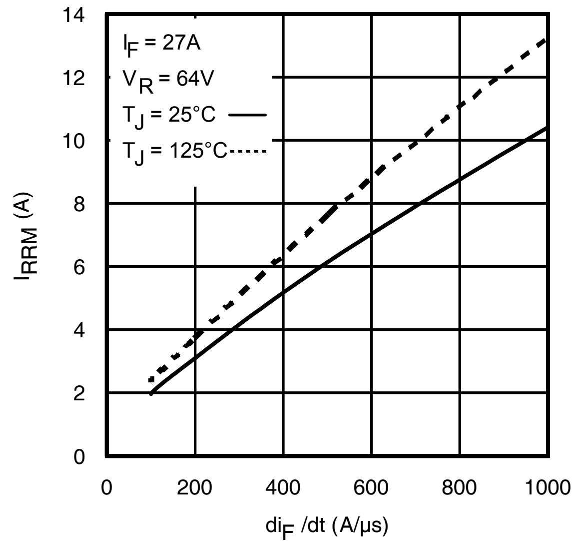


Fig 18. Typical Recovery Current vs. dif/dt

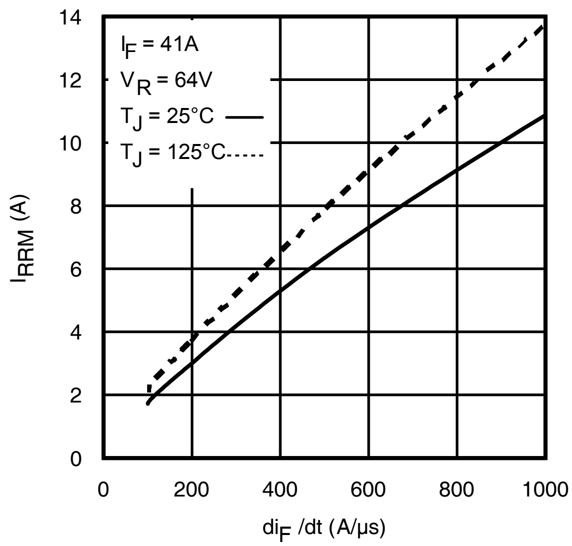


Fig 19. Typical Recovery Current vs. dif/dt

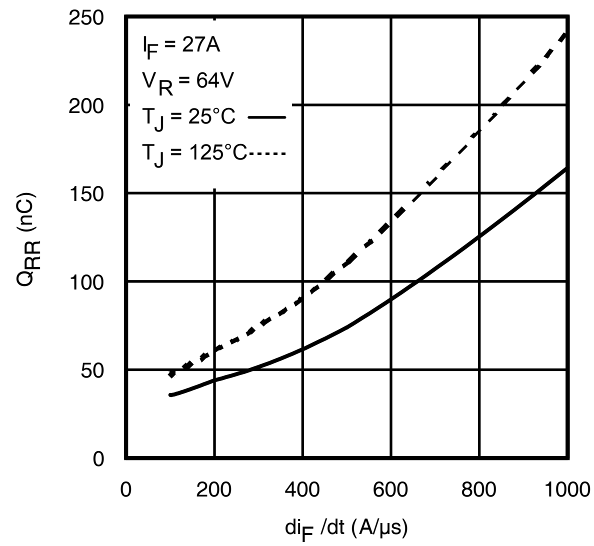


Fig 20. Typical Stored Charge vs. dif/dt

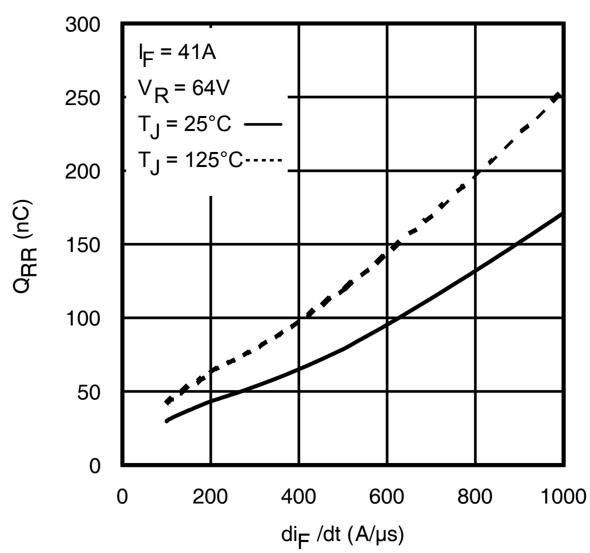


Fig 21. Typical Stored Charge vs. dif/dt

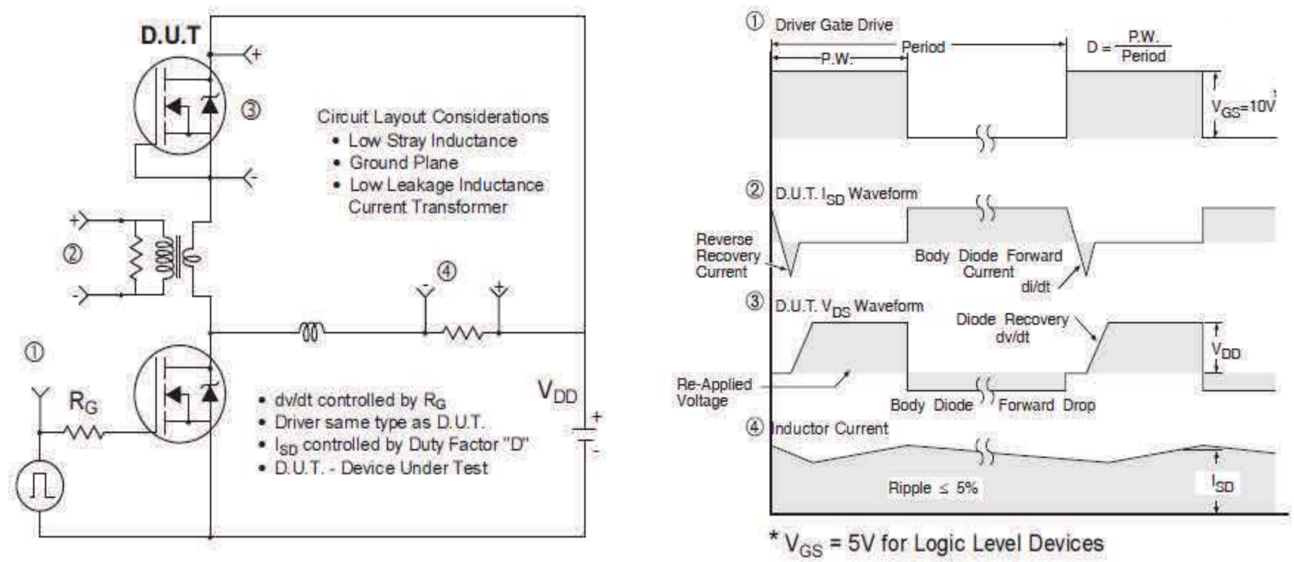


Fig 22. Peak Diode Recovery dv/dt Test Circuit for N-Channel HEXFET® Power MOSFETs

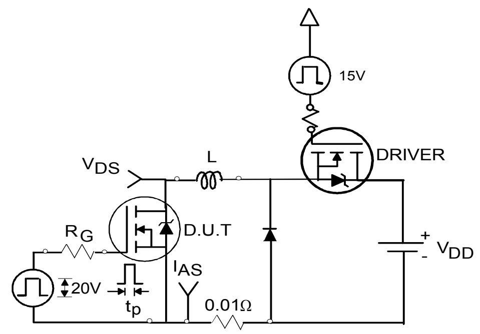


Fig 23a. Unclamped Inductive Test Circuit

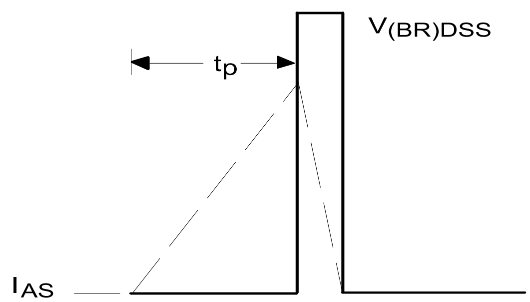


Fig 23b. Unclamped Inductive Waveforms

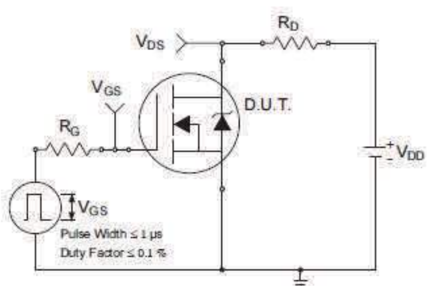


Fig 24a. Switching Time Test Circuit

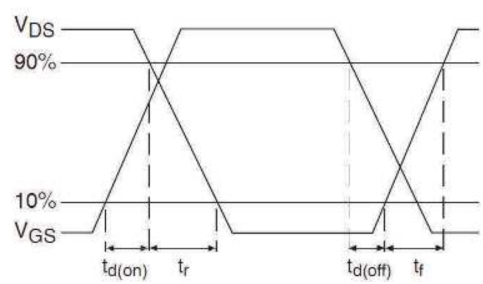


Fig 24b. Switching Time Waveforms

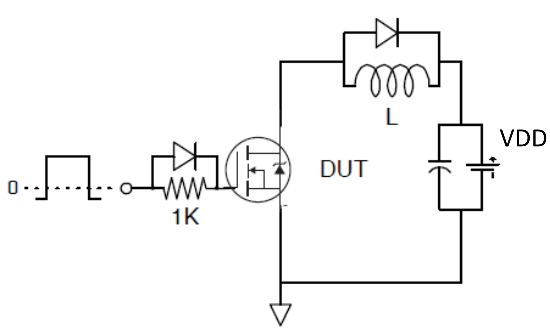


Fig 25a. Gate Charge Test Circuit

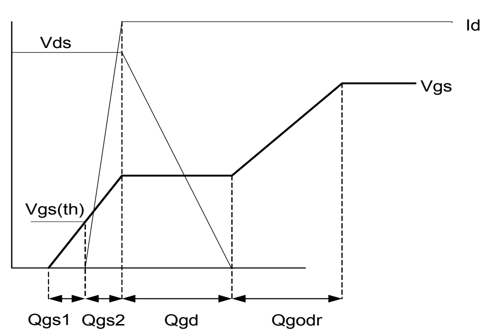
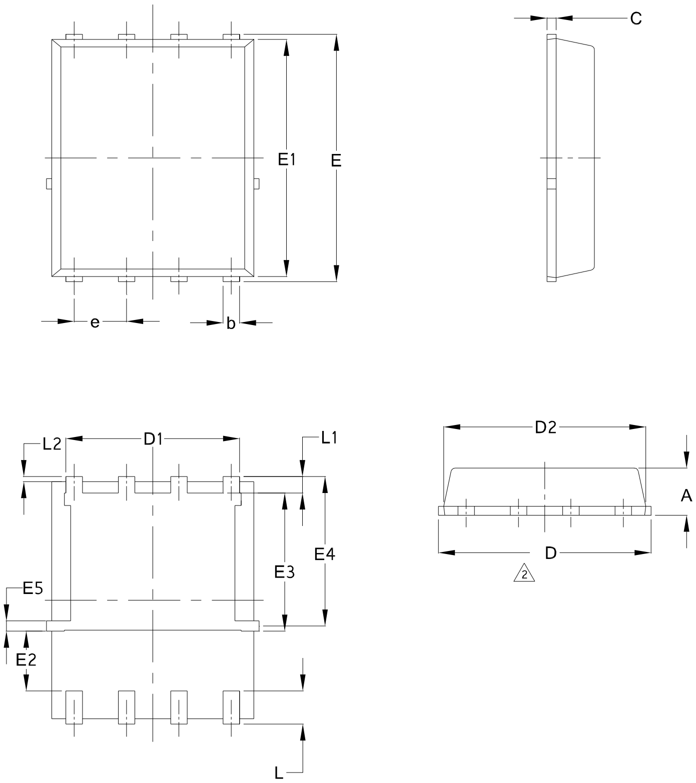


Fig 25b. Gate Charge Waveform

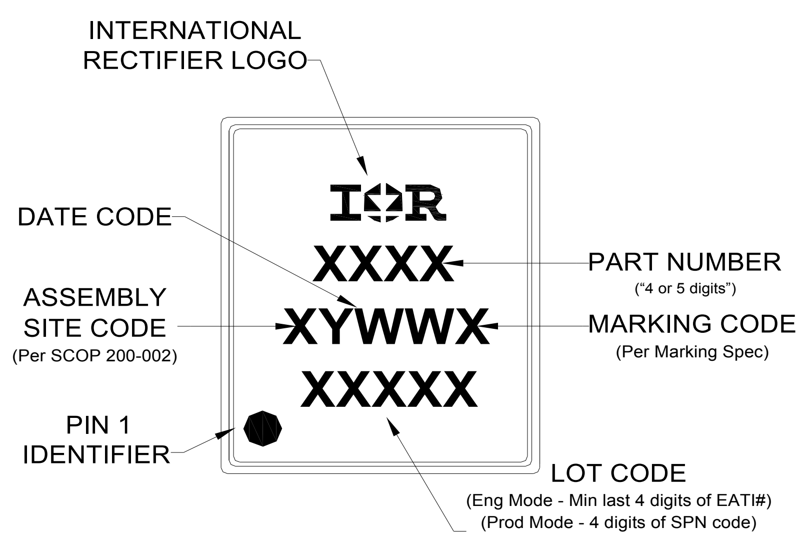
PQFN 5x6 Outline "E" Package Details



SYMBOL	COMMON			
	MM		INCH	
	MIN.	MAX.	MIN.	MAX.
A	0.90	1.17	0.0354	0.0461
b	0.31	0.51	0.0130	0.0189
C	0.195	0.300	0.0077	0.0118
D	4.80	5.25	0.1890	0.2028
D1	3.91	4.31	0.1539	0.1697
D2	4.80	5.10	0.1890	0.1968
E	5.90	6.25	0.2323	0.2421
E1	5.65	6.15	0.2224	0.2362
E2	1.10	—	0.0594	—
E3	3.32	3.78	0.1307	0.1480
E4	3.52	3.72	0.1346	0.1409
E5	0.13	0.32	0.0071	0.0126
e	1.27 BSC		0.050 BSC	
L	0.51	0.86	0.0020	0.0098
L1	0.38	0.71	0.0150	0.0260
L2	0.05	0.25	0.0201	0.0339
I	0	0.18	0	0.0071

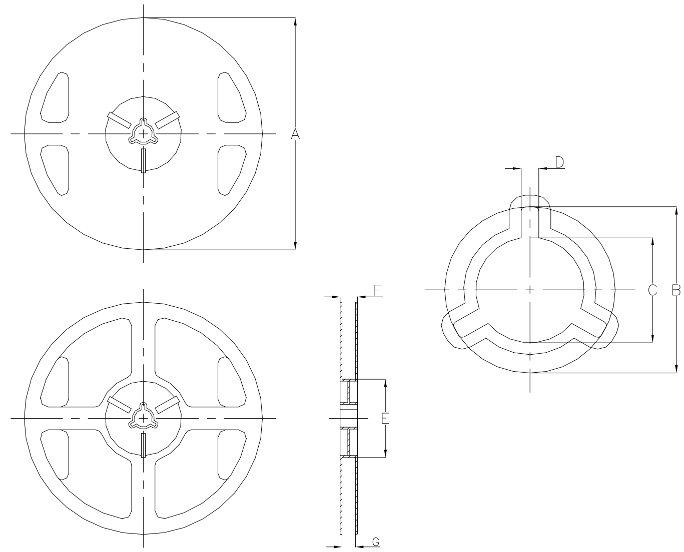
For more information on board mounting, including footprint and stencil recommendation, please refer to application note AN-1136: http://www.irf.com/technical-info/appnotes/an-1136.pdf
For more information on package inspection techniques, please refer to application note AN-1154: http://www.irf.com/technical-info/appnotes/an-1154.pdf

PQFN 5x6 Outline "E" Part Marking



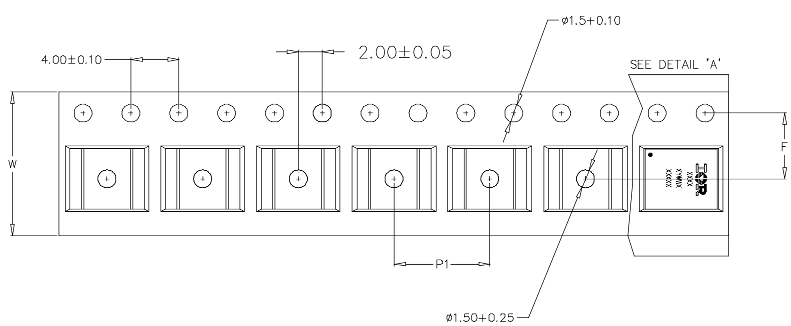
Note: For the most current drawing please refer to IR website at http://www.irf.com/package/

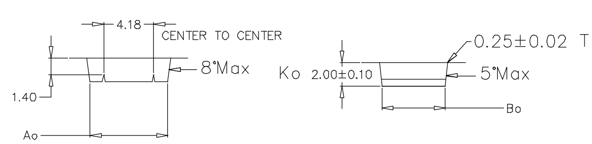
PQFN 5x6 Outline "E" Tape and Reel

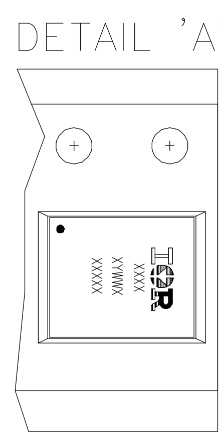


NOTE: Controlling dimensions in mm Std reel quantity is 4000 parts.

REEL DIMENSIONS								
	STANDARD OPTION **(QTY 4000)**				TR1 OPTION **(QTY 400)**			
	METRIC		IMPERIAL		METRIC		IMPERIAL	
CODE	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
A	329.5	330.5	12.972	13.011	177.5	178.5	6.988	7.028
B	20.9	21.5	0.823	0.846	20.9	21.5	0.823	0.846
C	12.8	13.5	0.504	0.532	13.2	13.8	0.520	0.543
D	1.7	2.3	0.067	0.091	1.9	2.3	0.075	0.091
E	97	99	3.819	3.898	65	66	2.350	2.598
F	Ref	17.4			Ref	12		
G	13	14.5	0.512	0.571	13	14.5	0.512	0.571







Ao	6.50 ±0.10
Bo	5.28 ±0.10
F	5.50 ±0.05
P1	8.00 ±0.10
W	12.00 +0.30/−0.10

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 5mm x 6mm	MSL1 (per 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

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

Revision History

Date	Comments
2/19/2015	• Updated $E_{AS\ (L=1mH)}$ = 146mJ on page 2 • Updated note 8 "Limited by T_{Jmax}, starting T_J = 25°C, L = 1mH, R_G = 50Ω, I_{AS} = 17A, V_{GS} =10V" on page 2

International 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/

