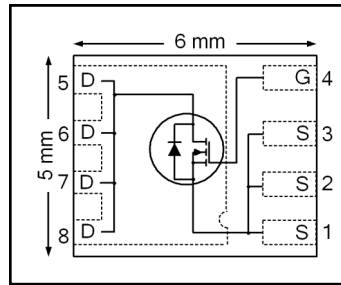


HEXFET® Power MOSFET

**Application**

- Brushed Motor drive applications
- BLDC Motor drive applications
- PWM Inverterized topologies
- Battery powered circuits
- Half-bridge and full-bridge topologies
- Electronic ballast applications
- Synchronous rectifier applications
- Resonant mode power supplies
- OR-ing and redundant power switches
- DC/DC and AC/DC converters



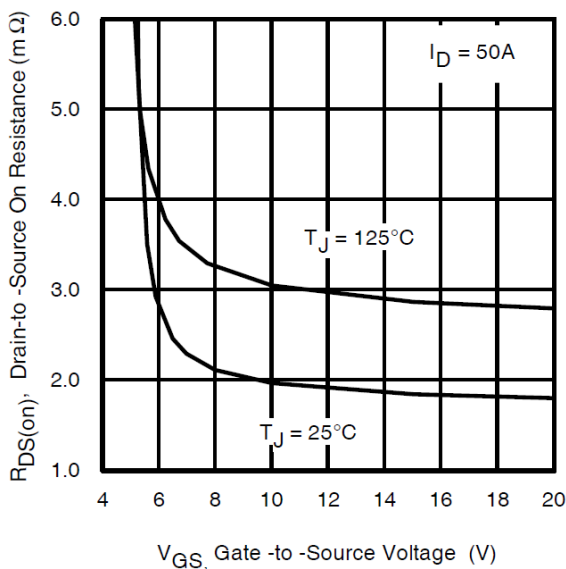
<b>V<sub>DSS</sub></b>	<b>40V</b>
<b>R<sub>DS(on)</sub> typ.</b>	<b>1.8mΩ</b>
	<b>max</b>
<b>I<sub>D</sub></b>	<b>159A</b>



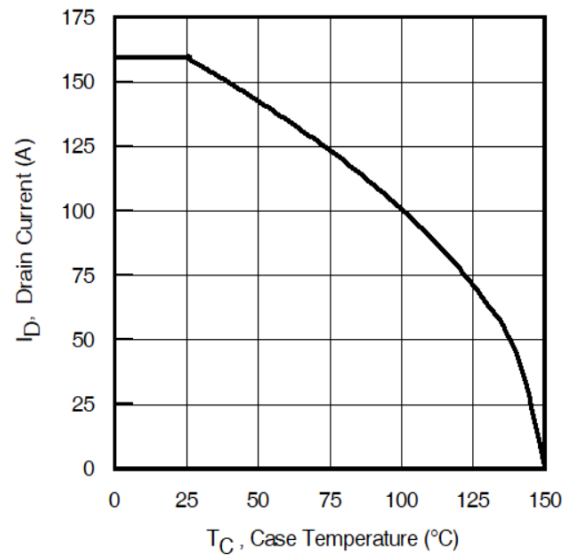
**Benefits**

- Improved Gate, Avalanche and Dynamic dV/dt Ruggedness
- Fully Characterized Capacitance and Avalanche SOA
- Enhanced body diode dV/dt and dI/dt Capability
- RoHS Compliant containing no Lead, no Bromide, and no Halogen

Base part number	Package Type	Standard Pack		Orderable Part Number	Note
		Form	Quantity		
IRFH7440PbF	PQFN 5mm x 6mm	Tape and Reel	4000	IRFH7440TRPbF	
	PQFN 5mm x 6mm	Tape and Reel	400	IRFH7440TR2PbF	EOL notice # 259



**Fig 1.** Typical On-Resistance vs. Gate Voltage



**Fig 2.** Maximum Drain Current vs. Case Temperature

**Absolute Maximum Rating**

Symbol	Parameter	Max.	Units
$I_D @ T_{C(\text{Bottom})} = 25^\circ\text{C}$	Continuous Drain Current, $V_{GS} @ 10\text{V}$ ①	159	A
$I_D @ T_{C(\text{Bottom})} = 100^\circ\text{C}$	Continuous Drain Current, $V_{GS} @ 10\text{V}$ ①	101	
$I_{DM}$	Pulsed Drain Current ②	636	
$P_D @ T_C = 25^\circ\text{C}$	Maximum Power Dissipation	104	W
	Linear Derating Factor	0.83	W/°C
$V_{GS}$	Gate-to-Source Voltage	$\pm 20$	V
dv/dt	Peak Diode Recovery④	3.0	V/ns
$T_J$ $T_{STG}$	Operating Junction and Storage Temperature Range	-55 to + 150	°C

**Avalanche Characteristics**

Symbol	Parameter	Max.	Units
$E_{AS}$ (Thermally limited)	Single Pulse Avalanche Energy ③	121	mJ
$E_{AS}$ (Thermally limited)	Single Pulse Avalanche Energy ⑩	232	
$I_{AR}$	Avalanche Current ②	See Fig 15, 16, 22a, 22b	A
$E_{AR}$	Repetitive Avalanche Energy ②		mJ

**Thermal Resistance**

	Parameter	Typ.	Max.	Units
$R_{\theta JC}$ (Bottom)	Junction-to-Case ⑨	—	1.2	°C/W
$R_{\theta JC}$ (Top)	Junction-to-Case ⑨	—	31	
$R_{\theta JA}$	Junction-to-Ambient ⑧	—	35	
$R_{\theta JA} (<10\text{s})$	Junction-to-Ambient ⑧	—	22	

**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	40	—	—	V	$V_{GS} = 0\text{V}, I_D = 250\mu\text{A}$
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	0.031	—	mV/°C	Reference to $25^\circ\text{C}, I_D = 1.0\text{mA}$
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	1.8	2.4	mΩ	$V_{GS} = 10\text{V}, I_D = 50\text{A}$
		—	2.7	—		$V_{GS} = 6.0\text{V}, I_D = 25\text{A}$
$V_{GS(th)}$	Gate Threshold Voltage	2.2	—	3.9	V	$V_{DS} = V_{GS}, I_D = 100\mu\text{A}$
$I_{DSS}$	Drain-to-Source Leakage Current	—	—	1.0	μA	$V_{DS} = 40\text{V}, V_{GS} = 0\text{V}$
		—	—	150		$V_{DS} = 40\text{V}, V_{GS} = 0\text{V}, T_J = 125^\circ\text{C}$
$I_{GSS}$	Gate-to-Source Forward Leakage	—	—	100	nA	$V_{GS} = 20\text{V}$
	Gate-to-Source Reverse Leakage	—	—	-100		$V_{GS} = -20\text{V}$
$R_G$	Gate Resistance	—	2.6	—	Ω	

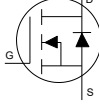
**Notes:**

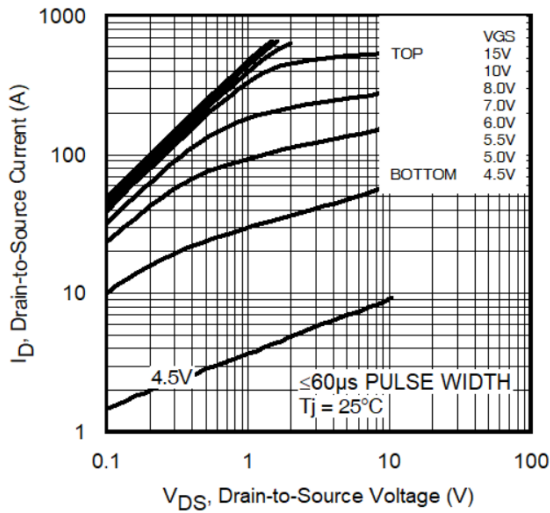
- ① Rating refers to the product only with datasheet specified absolute maximum values, maintaining case temperature at  $25^\circ\text{C}$ . For higher case temperature please refer to Diagram 2. De-rating will be required based on the actual environmental conditions.
- ② Repetitive rating; pulse width limited by max. junction temperature.
- ③ Limited by  $T_{Jmax}$ , starting  $T_J = 25^\circ\text{C}$ ,  $L = 0.097\text{mH}$ ,  $R_G = 50\Omega$ ,  $I_{AS} = 50\text{A}$ ,  $V_{GS} = 10\text{V}$ .
- ④  $I_{SD} \leq 50\text{A}$ ,  $di/dt \leq 1126\text{A}/\mu\text{s}$ ,  $V_{DD} \leq V_{(BR)DSS}$ ,  $T_J \leq 150^\circ\text{C}$ .
- ⑤ Pulse width  $\leq 400\mu\text{s}$ ; duty cycle  $\leq 2\%$ .
- ⑥  $C_{oss}$  eff. (TR) is a fixed capacitance that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to  $80\% V_{DSS}$ .
- ⑦  $C_{oss}$  eff. (ER) is a fixed capacitance that gives the same energy as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to  $80\% V_{DSS}$ .
- ⑧ When mounted on 1 inch square 2 oz copper pad on 1.5 x 1.5 in. board of FR-4 material.
- ⑨  $R_\theta$  is measured at  $T_J$  approximately  $90^\circ\text{C}$ .
- ⑩ Limited by  $T_{Jmax}$ , starting  $T_J = 25^\circ\text{C}$ ,  $L = 1\text{mH}$ ,  $R_G = 50\Omega$ ,  $I_{AS} = 22\text{A}$ ,  $V_{GS} = 10\text{V}$ .

**Dynamic Electrical Characteristics @ T<sub>J</sub> = 25°C (unless otherwise specified)**

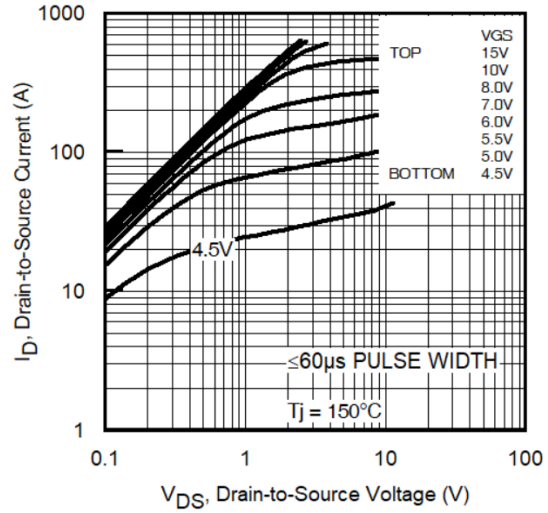
Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
g <sub>fs</sub>	Forward Transconductance	149	—	—	S	V <sub>DS</sub> = 10V, I <sub>D</sub> = 50A
Q <sub>g</sub>	Total Gate Charge	—	92	138	nC	I <sub>D</sub> = 50A V <sub>DS</sub> = 20V V <sub>GS</sub> = 10V ⑤
Q <sub>gs</sub>	Gate-to-Source Charge	—	22	—		
Q <sub>gd</sub>	Gate-to-Drain Charge	—	29	—		
Q <sub>sync</sub>	Total Gate Charge Sync. (Q <sub>g</sub> - Q <sub>gd</sub> )	—	63	—		
t <sub>d(on)</sub>	Turn-On Delay Time	—	12	—	ns	V <sub>DD</sub> = 20V I <sub>D</sub> = 30A R <sub>G</sub> = 2.7Ω V <sub>GS</sub> = 10V ⑤
t <sub>r</sub>	Rise Time	—	45	—		
t <sub>d(off)</sub>	Turn-Off Delay Time	—	53	—		
t <sub>f</sub>	Fall Time	—	42	—		
C <sub>iss</sub>	Input Capacitance	—	4574	—	pF	V <sub>GS</sub> = 0V V <sub>DS</sub> = 25V f = 1.0MHz V <sub>GS</sub> = 0V, V <sub>DS</sub> = 0V to 32V ⑦ V <sub>GS</sub> = 0V, V <sub>DS</sub> = 0V to 32V ⑥
C <sub>oss</sub>	Output Capacitance	—	700	—		
C <sub>rss</sub>	Reverse Transfer Capacitance	—	466	—		
C <sub>oss eff.(ER)</sub>	Effective Output Capacitance (Energy Related)	—	863	—		
C <sub>oss eff.(TR)</sub>	Output Capacitance (Time Related)	—	1229	—		

**Diode Characteristics**

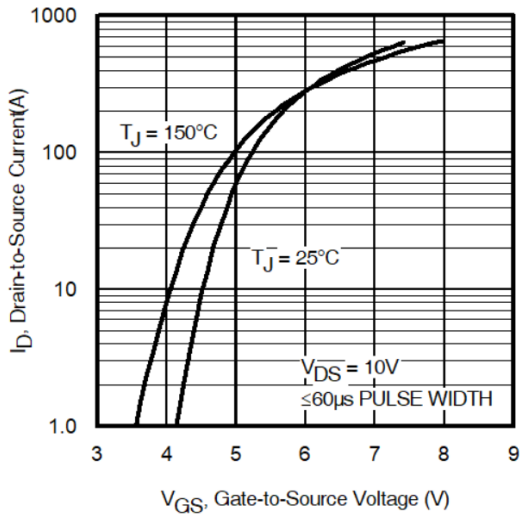
Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
I <sub>S</sub>	Continuous Source Current (Body Diode)	—	—	80	A	MOSFET symbol showing the integral reverse p-n junction diode. 
I <sub>SM</sub>	Pulsed Source Current (Body Diode) ②	—	—	636		
V <sub>SD</sub>	Diode Forward Voltage	—	0.9	1.3	V	T <sub>J</sub> = 25°C, I <sub>S</sub> = 50A, V <sub>GS</sub> = 0V ⑤
t <sub>rr</sub>	Reverse Recovery Time	—	25	—	ns	T <sub>J</sub> = 25°C V <sub>DD</sub> = 34V T <sub>J</sub> = 125°C I <sub>F</sub> = 50A, di/dt = 100A/μs ⑤
Q <sub>rr</sub>		Reverse Recovery Charge	—	16		
I <sub>RRM</sub>	Reverse Recovery Current	—	1.2	—	A	T <sub>J</sub> = 25°C



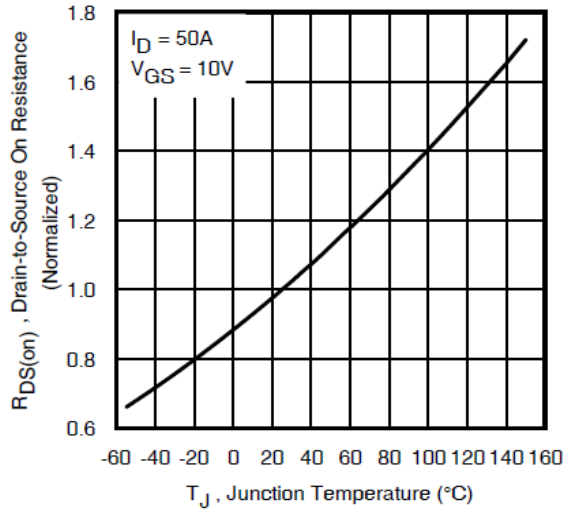
**Fig 3.** Typical Output Characteristics



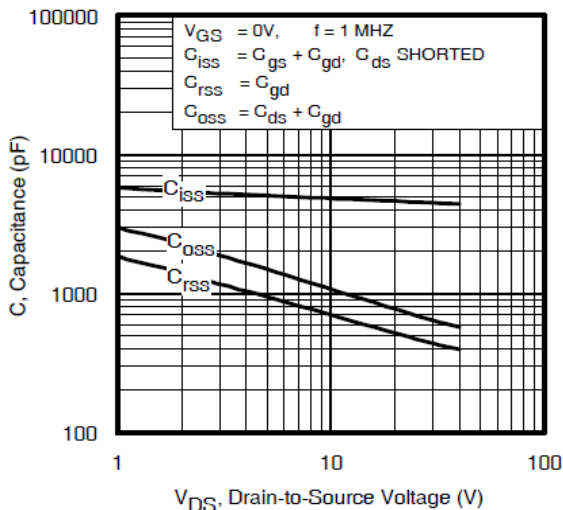
**Fig 4.** Typical Output Characteristics



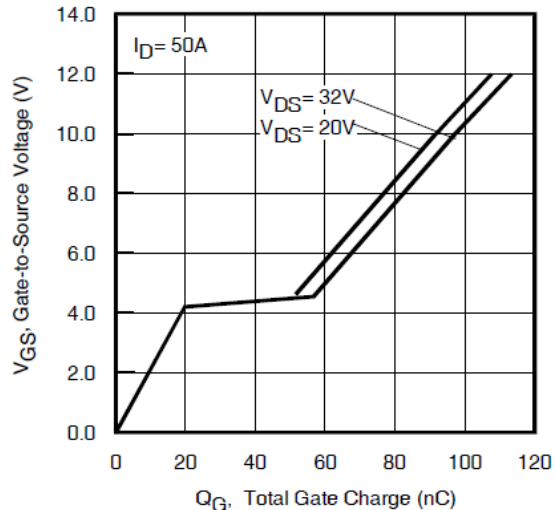
**Fig 5.** Typical Transfer Characteristics



**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

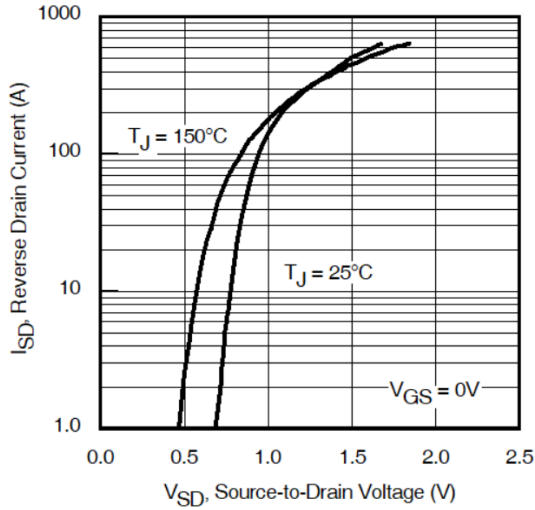


Fig 9. Typical Source-Drain Diode Forward Voltage

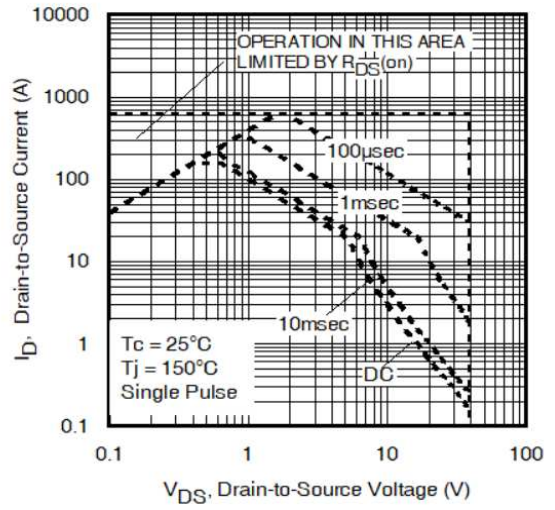


Fig 10. Maximum Safe Operating Area

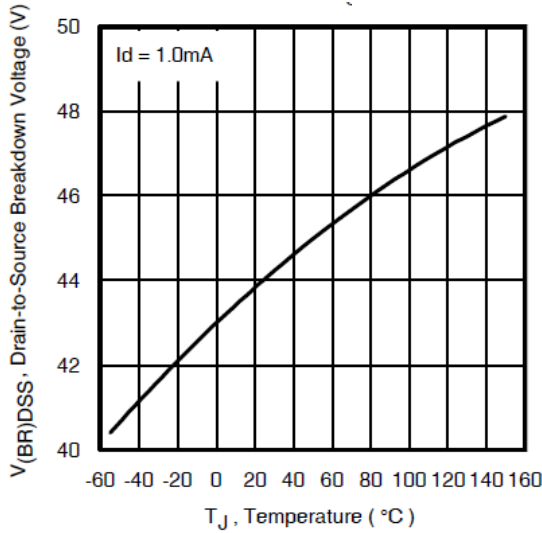


Fig 11. Drain-to-Source Breakdown Voltage

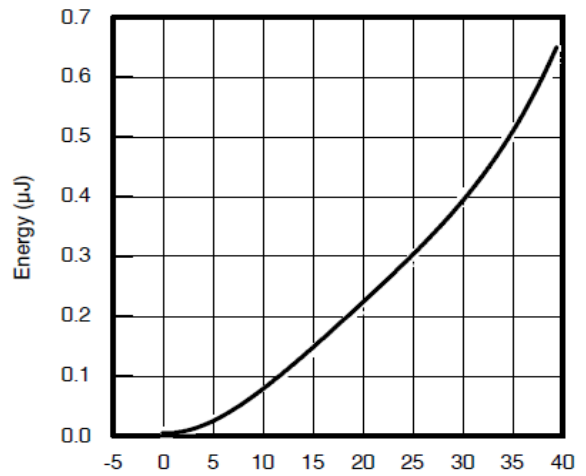


Fig 12. Typical C<sub>oss</sub> Stored Energy

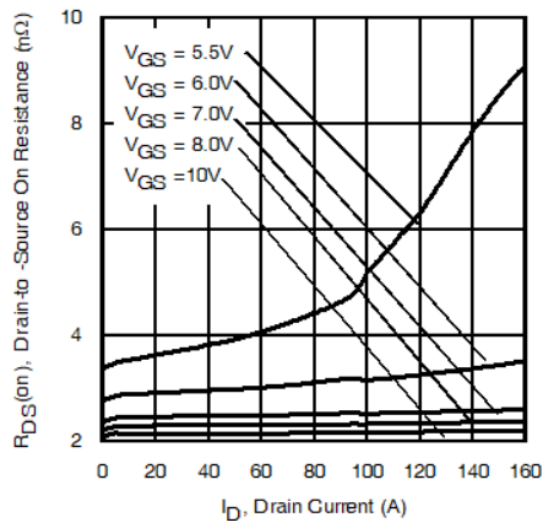


Fig 13. Typical On-Resistance vs. Drain Current

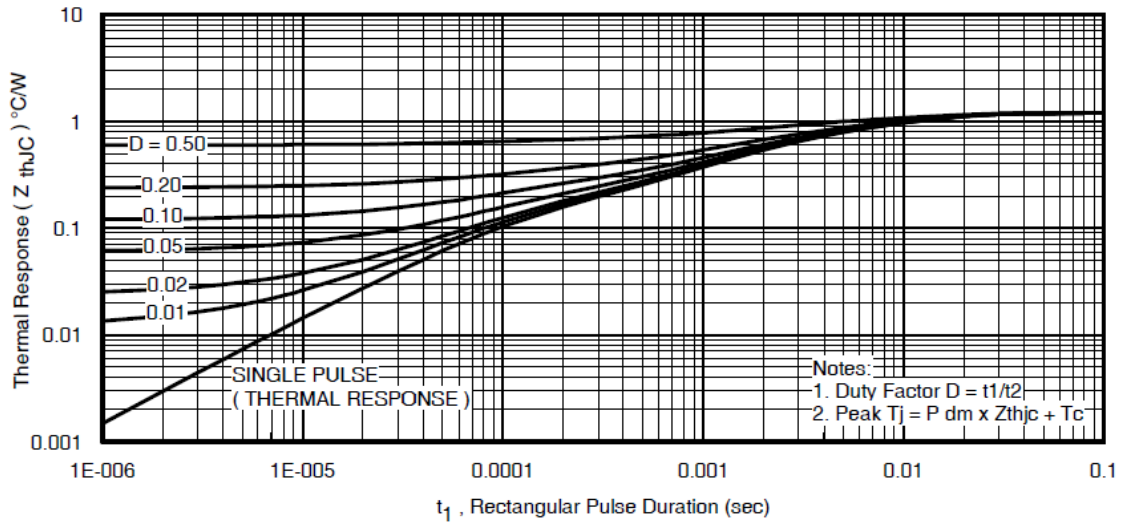


Fig 14. Maximum Effective Transient Thermal Impedance, Junction-to-Case

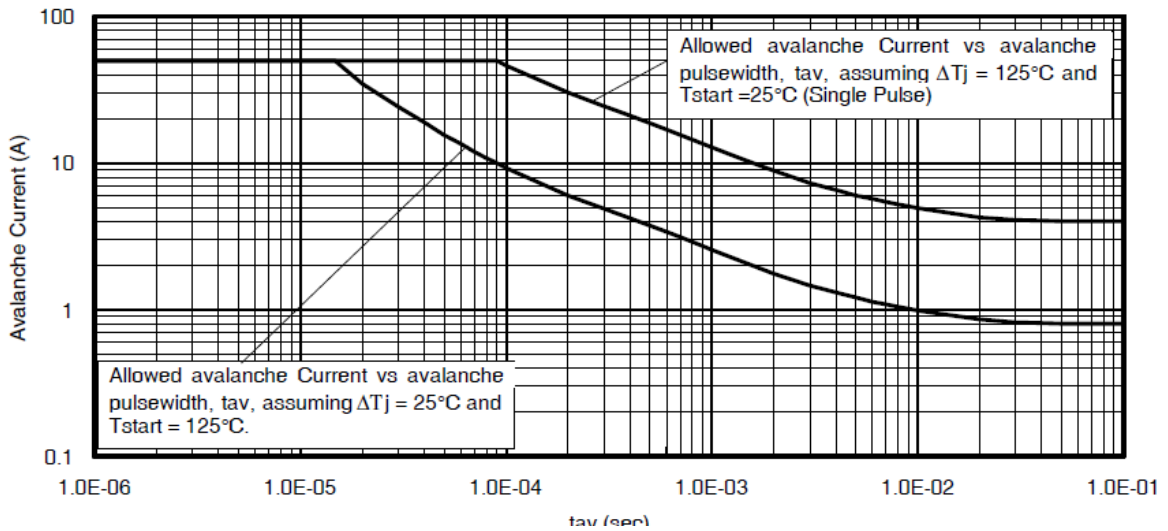


Fig 15. Typical Avalanche Current vs. Pulse Width

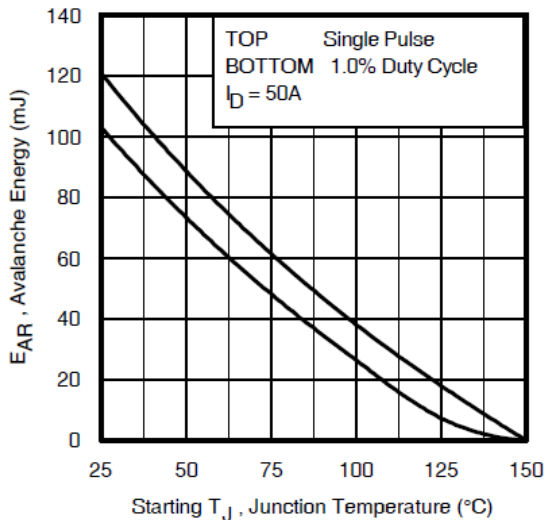


Fig 16. Maximum Avalanche Energy vs. Temperature

**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 22a, 22b.
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.  $\Delta T$  = Allowable rise in junction temperature, not to exceed  $T_{jmax}$  (assumed as 25°C in Figure 14, 16).

$t_{av}$  = Average time in avalanche.

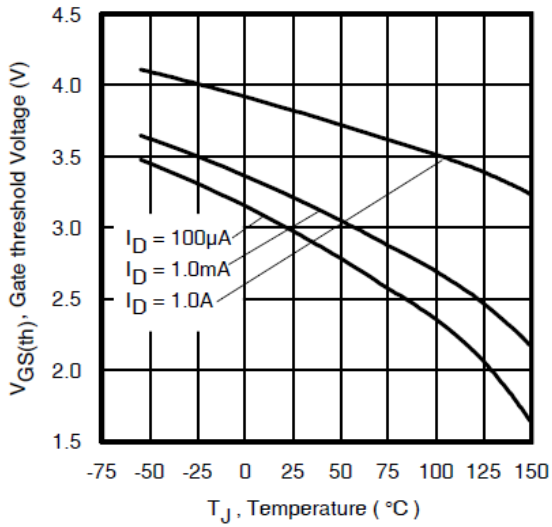
D = Duty cycle in avalanche =  $t_{av} \cdot f$

$Z_{thJC}(D, t_{av})$  = Transient thermal resistance, see Figures 13)

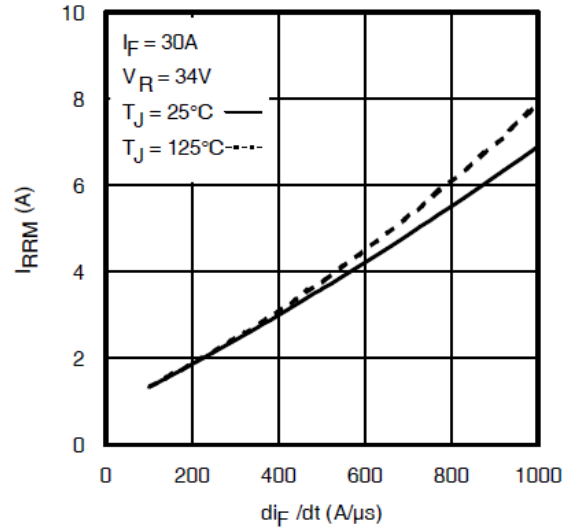
$$P_{D(ave)} = 1/2 ( 1.3 \cdot BV \cdot I_{av} ) = \Delta T / Z_{thJC}$$

$$I_{av} = 2\Delta T / [ 1.3 \cdot BV \cdot Z_{th} ]$$

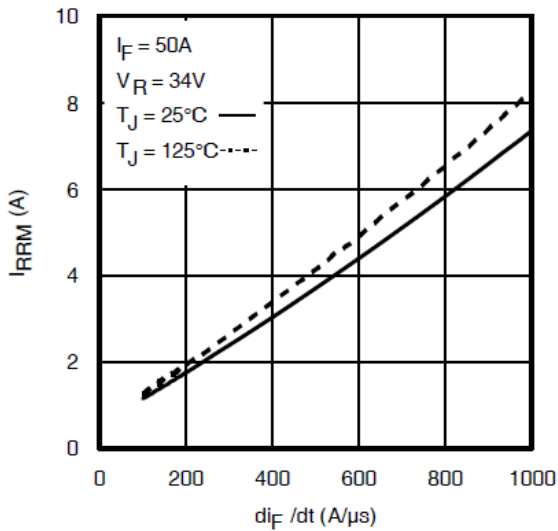
$$E_{AS(AR)} = P_{D(ave)} \cdot t_{av}$$



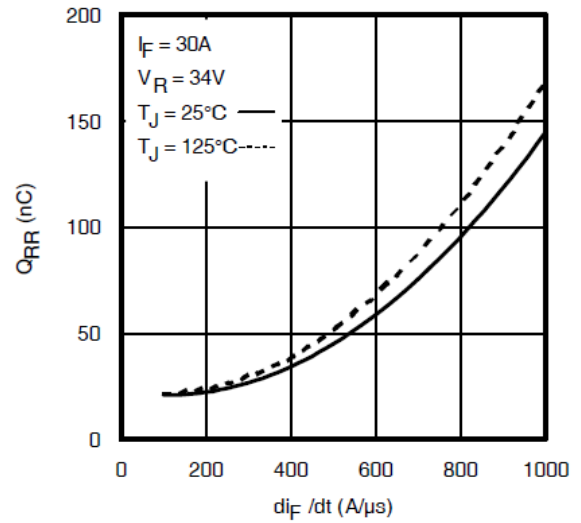
**Fig 17.** Threshold Voltage vs. Temperature



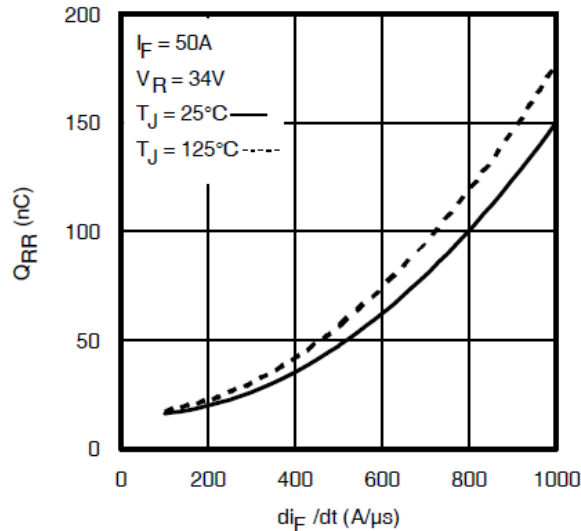
**Fig 18.** Typical Recovery Current vs. dif/dt



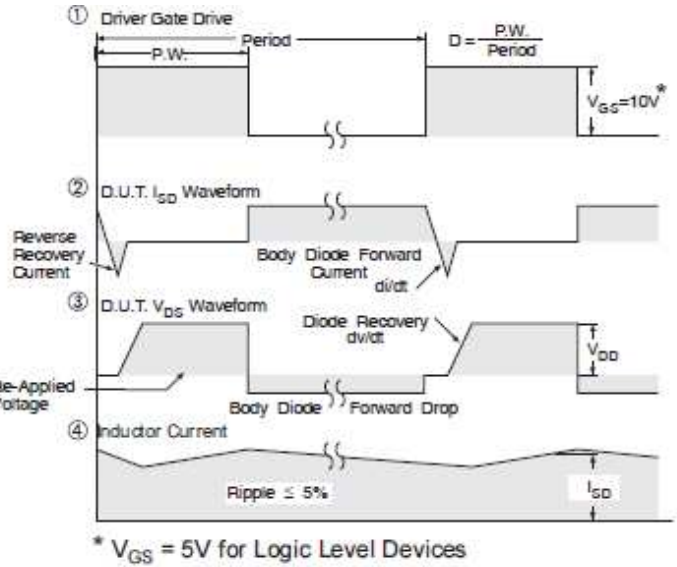
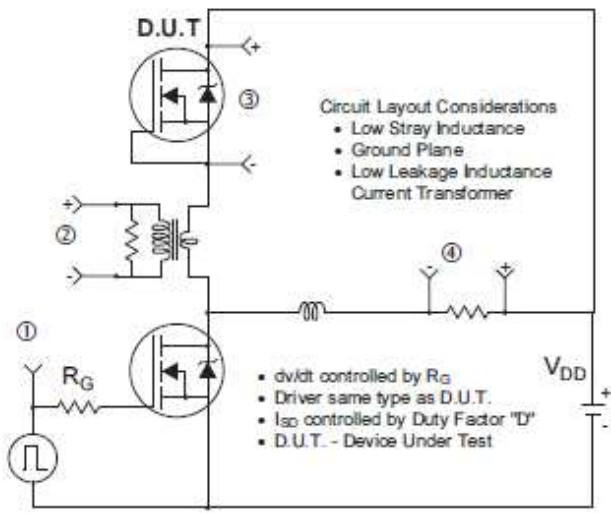
**Fig 19.** Typical Recovery Current vs. dif/dt



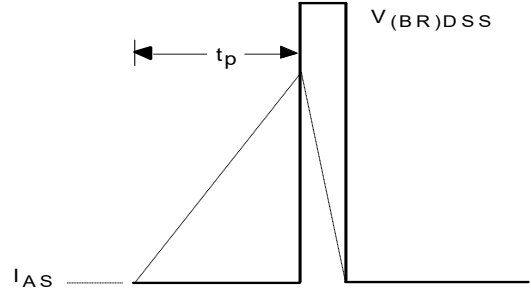
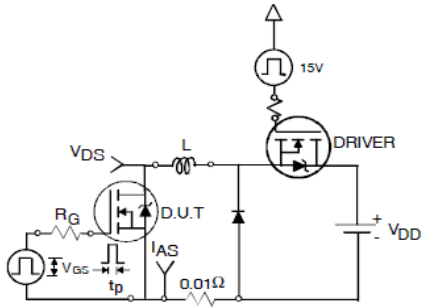
**Fig 20.** Typical Stored Charge vs. dif/dt



**Fig 21.** Typical Stored Charge vs. dif/dt

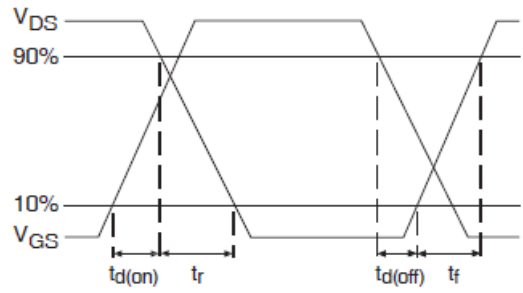
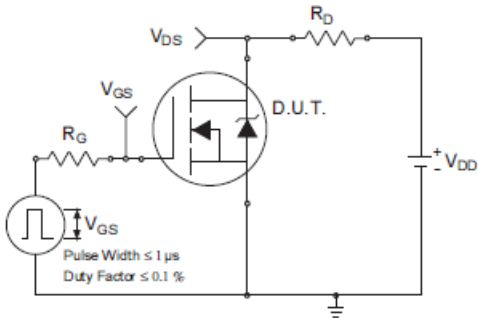


**Fig 22. Peak Diode Recovery dv/dt Test Circuit for N-Channel HEXFET® Power MOSFETs**



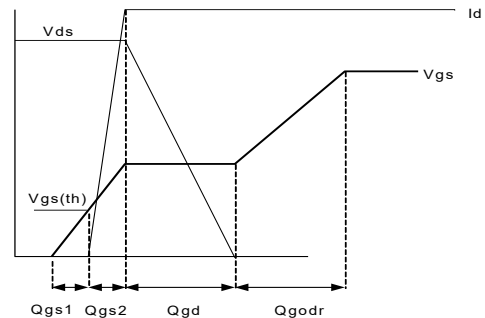
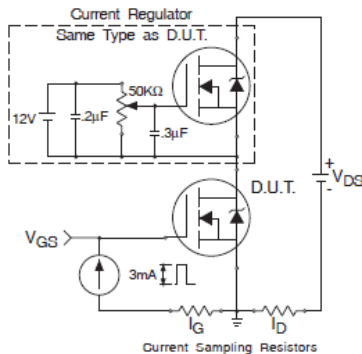
**Fig 23a. Unclamped Inductive Test Circuit**

**Fig 23b. Unclamped Inductive Waveforms**



**Fig 24a. Switching Time Test Circuit**

**Fig 24b. Switching Time Waveforms**

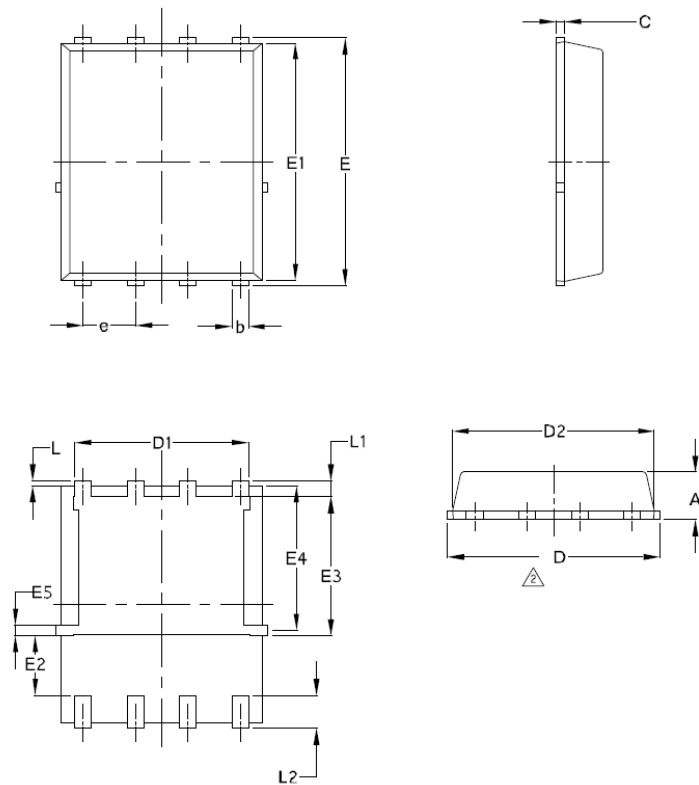


**Fig 25a. Gate Charge Test Circuit**

**Fig 25b. Gate Charge Waveform**

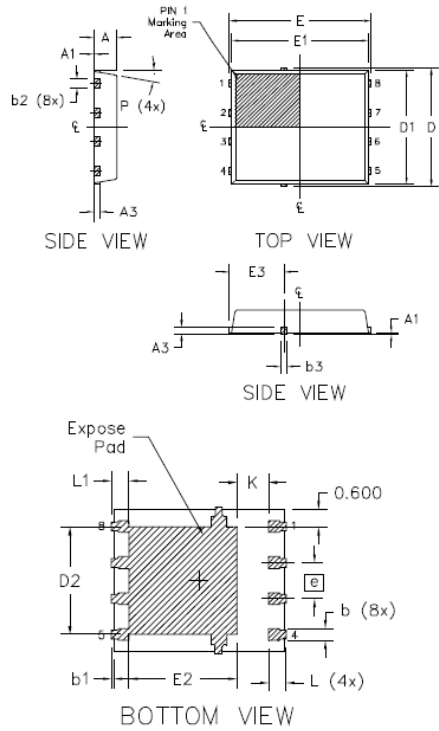


## PQFN 5x6 Outline "E" Package Details



SYMBOL	COMMON			
	MM		INCH	
	MIN.	MAX.	MIN.	MAX.
A	0.90	1.17	0.0354	0.0461
b	0.33	0.48	0.0130	0.0189
C	0.195	0.300	0.0077	0.0118
D	4.80	5.15	0.1890	0.2028
D1	3.91	4.31	0.1539	0.1697
D2	4.80	5.00	0.1890	0.1968
E	5.90	6.15	0.2323	0.2421
E1	5.65	6.00	0.2224	0.2362
E2	1.51	—	0.0594	—
E3	3.32	3.78	0.1307	0.1480
E4	3.42	3.58	0.1346	0.1409
E5	0.18	0.32	0.0071	0.0126
e	1.27 BSC		0.050 BSC	
L	0.05	0.25	0.0020	0.0098
L1	0.38	0.66	0.0150	0.0260
L2	0.51	0.86	0.0201	0.0339
l	0	0.18	0	0.0071

## PQFN 5x6 Outline "G" Package Details



DIM SYMBOL	MILLIMETERS		INCH	
	MIN.	MAX.	MIN.	MAX.
A	0.950	1.050	0.0374	0.0413
A1	0.000	0.050	0.0000	0.0020
A3	0.254 REF		0.0100 REF	
b	0.310	0.510	0.0122	0.0201
b1	0.025	0.125	0.0010	0.0049
b2	0.210	0.410	0.0083	0.0161
b3	0.180	0.450	0.0071	0.0177
D	5.150 BSC		0.2028 BSC	
D1	5.000 BSC		0.1969 BSC	
D2	3.700	3.900	0.1457	0.1535
E	6.150 BSC		0.2421 BSC	
E1	6.000 BSC		0.2362 BSC	
E2	3.560	3.760	0.1402	0.1488
E3	2.270	2.470	0.0894	0.0972
e	1.27 REF		0.050 REF	
K	0.830	1.400	0.0327	0.0551
L	0.510	0.710	0.0201	0.0280
L1	0.510	0.710	0.0201	0.0280
P	10 deg	12 deg	0 deg	12 deg

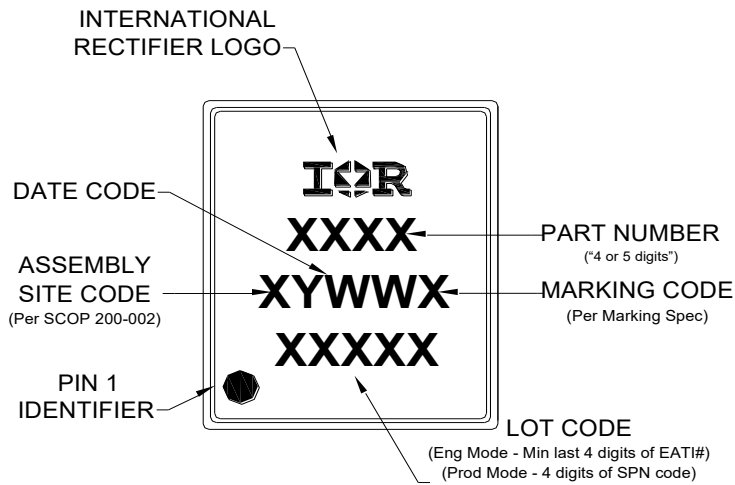
- Note:**
1. Dimensions and tolerancing confirm to ASME Y14.5M-1994
  2. Dimension L represents terminal full back from package edge up to 0.1mm is acceptable
  3. Coplanarity applies to the expose Heat Slug as well as the terminal
  4. Radius on terminal is Optional

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>

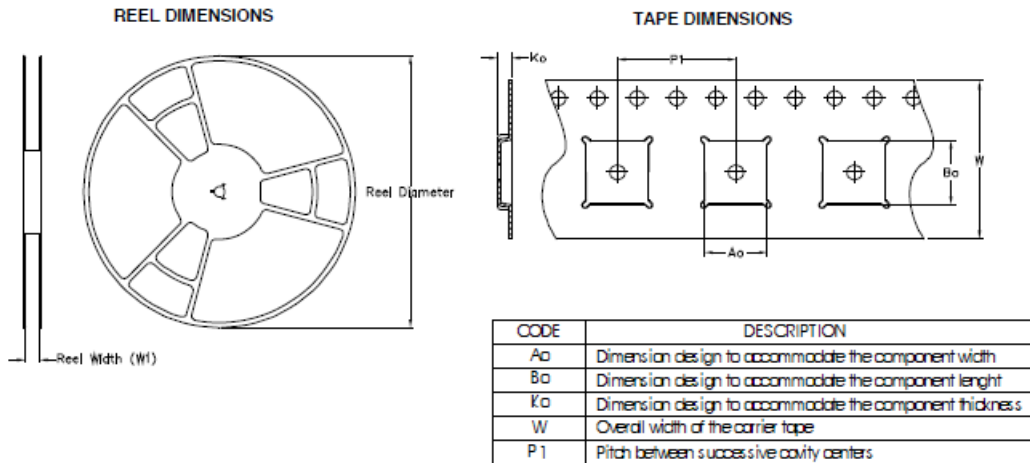
For more information on package inspection techniques, please refer to application note AN-1154:

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

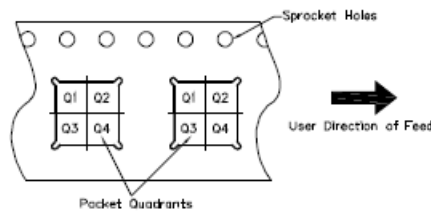
PQFN 5x6 Part Marking



PQFN 5x6 Tape and Reel



QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



Note: All dimension are nominal

Package Type	Reel Diameter (Inch)	QTY	Reel Width W1 (mm)	Ao (mm)	Bo (mm)	Ko (mm)	P1 (mm)	W (mm)	Pin 1 Quadrant
5X6 PQFN	13	4000	12.4	6.300	5.300	1.20	8.00	12	Q1

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

**Qualification Information**

<b>Qualification level</b>	Industrial (per JEDEC JESD47F † guidelines )	
<b>Moisture Sensitivity Level</b>	PQFN 5mm x 6mm	MSL1 (per JEDEC J-STD-020D†)
<b>RoHS Compliant</b>	Yes	

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

**Revision History**

<b>Date</b>	<b>Rev</b>	<b>Comments</b>
01/13/2014	2.1	<ul style="list-style-type: none"> <li>Updated ordering information to reflect the End-Of-Life (EOL) of the mini-reel option (EOL notice #259).</li> <li>Updated data sheet with the new IR corporate template.</li> </ul>
02/19/2015	2.2	<ul style="list-style-type: none"> <li>Updated EAS (L =1mH) = 232mJ on page 2</li> <li>Updated note 10 "Limited by TJmax, starting T<sub>J</sub> = 25°C, L = 1mH, R<sub>G</sub> = 50Ω, I<sub>AS</sub> = 22A, V<sub>GS</sub> =10V". on page 2</li> </ul>
06/2/2015	2.3	<ul style="list-style-type: none"> <li>Updated package outline for "option E" and added package outline for "option G" on page 9.</li> <li>Updated "IFX" logo on page 1 &amp; 11.</li> <li>Updated tape and reel on page 10.</li> </ul>
07/07/2015	2.4	<ul style="list-style-type: none"> <li>Corrected package outline for "option E" on page 9.</li> </ul>
04/16/2020	2.5	<ul style="list-style-type: none"> <li>Updated datasheet based on IFX template.</li> <li>Updated Datasheet based on new current rating and application note :App-AN_1912_PL51_2001_180356</li> </ul>

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**Email: [erratum@infineon.com](mailto:erratum@infineon.com)**

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