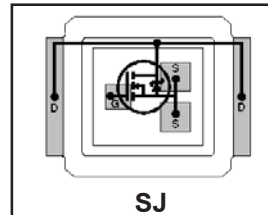


DirectFET™ Power MOSFET ②

Typical values (unless otherwise specified)

V_{DS}	V_{GS}	$R_{DS(on)}$
100V max	$\pm 20V$ max	28m Ω @ 10V
$Q_{g\ tot}$	Q_{gd}	$V_{gs(th)}$
14nC	4.8nC	4.0V



- RoHS Compliant, Halogen-Free ②
- Lead-Free (Qualified up to 260°C Reflow) ①
- Application Specific MOSFETs
- Ideal for High Performance Isolated Converter Primary Switch Socket
- Optimized for Synchronous Rectification
- Low Conduction Losses
- High Cdv/dt Immunity
- Low Profile (<0.7mm)
- Dual Sided Cooling Compatible ①
- Compatible with existing Surface Mount Techniques ①

Applicable DirectFET Outline and Substrate Outline (see p.7,8 for details) ①

SH	SJ	SP		MZ	MN					
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Description

The IRF6645PbF combines the latest HEXFET® Power MOSFET Silicon technology with the advanced DirectFET™ packaging to achieve the lowest on-state resistance in a package that has the footprint of an Micro8 and only 0.7 mm profile. The DirectFET package is compatible with existing layout geometries used in power applications, PCB assembly equipment and vapor phase, infra-red or convection soldering techniques, when application note AN-1035 is followed regarding the manufacturing methods and processes. The DirectFET package allows dual sided cooling to maximize thermal transfer in power systems, improving previous best thermal resistance by 80%.

The IRF6645PbF is optimized for primary side bridge topologies in isolated DC-DC applications, for wide range universal input Telecom applications (36V - 75V), and for secondary side synchronous rectification in regulated DC-DC topologies. The reduced total losses in the device coupled with the high level of thermal performance enables high efficiency and low temperatures, which are key for system reliability improvements, and makes this device ideal for high performance isolated DC-DC converters.

Absolute Maximum Ratings

	Parameter	Max.	Units
V_{DS}	Drain-to-Source Voltage	100	V
V_{GS}	Gate-to-Source Voltage	± 20	
I_D @ $T_A = 25^\circ C$	Continuous Drain Current, V_{GS} @ 10V ③	5.7	A
I_D @ $T_A = 70^\circ C$	Continuous Drain Current, V_{GS} @ 10V ③	4.5	
I_D @ $T_C = 25^\circ C$	Continuous Drain Current, V_{GS} @ 10V ④	25	
I_{DM}	Pulsed Drain Current ⑤	45	
E_{AS}	Single Pulse Avalanche Energy ⑥	29	mJ
I_{AR}	Avalanche Current ⑤	3.4	A

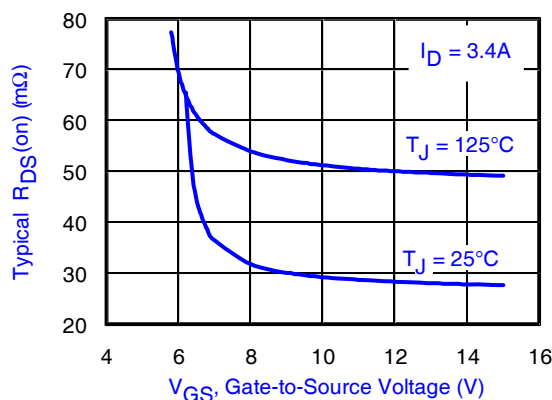


Fig 1. Typical On-Resistance vs. Gate Voltage

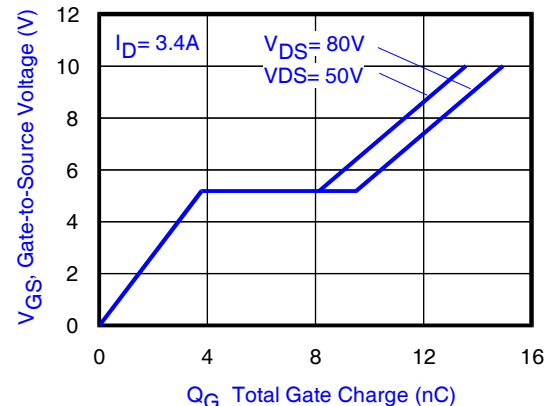


Fig 2. Typical Total Gate Charge vs. Gate-to-Source Voltage

Notes:

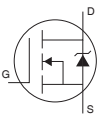
- ① Click on this section to link to the appropriate technical paper.
- ② Click on this section to link to the DirectFET Website.
- ③ Surface mounted on 1 in. square Cu board, steady state.

- ④ T_C measured with thermocouple mounted to top (Drain) of part.
- ⑤ Repetitive rating; pulse width limited by max. junction temperature.
- ⑥ Starting $T_J = 25^\circ C$, $L = 5.0mH$, $R_G = 25\Omega$, $I_{AS} = 3.4A$.

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

	Parameter	Min.	Typ.	Max.	Units	Conditions
BV_{DSS}	Drain-to-Source Breakdown Voltage	100	—	—	V	$V_{GS} = 0V, I_D = 250\mu A$
$\Delta BV_{DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	0.12	—	V/ $^\circ\text{C}$	Reference to $25^\circ\text{C}, I_D = 1\text{mA}$
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	28	35	m Ω	$V_{GS} = 10V, I_D = 5.7A$ ⑦
$V_{GS(th)}$	Gate Threshold Voltage	3.0	—	4.9	V	$V_{DS} = V_{GS}, I_D = 50\mu A$
$\Delta V_{GS(th)}/\Delta T_J$	Gate Threshold Voltage Coefficient	—	-12	—	mV/ $^\circ\text{C}$	
I_{DSS}	Drain-to-Source Leakage Current	—	—	20	μA	$V_{DS} = 100V, V_{GS} = 0V$
		—	—	250		$V_{DS} = 80V, V_{GS} = 0V, T_J = 125^\circ\text{C}$
I_{GSS}	Gate-to-Source Forward Leakage	—	—	100	nA	$V_{GS} = 20V$
	Gate-to-Source Reverse Leakage	—	—	-100		$V_{GS} = -20V$
gfs	Forward Transconductance	7.4	—	—	S	$V_{DS} = 10V, I_D = 3.4A$
Q_g	Total Gate Charge	—	14	20	nC	$V_{DS} = 50V$ $V_{GS} = 10V$ $I_D = 3.4A$ See Fig. 15
Q_{gs1}	Pre-Vth Gate-to-Source Charge	—	3.1	—		
Q_{gs2}	Post-Vth Gate-to-Source Charge	—	0.8	—		
Q_{gd}	Gate-to-Drain Charge	—	4.8	7.2		
Q_{godr}	Gate Charge Overdrive	—	5.3	—		
Q_{sw}	Switch Charge ($Q_{gs2} + Q_{gd}$)	—	5.6	—		
Q_{oss}	Output Charge	—	7.2	—	nC	$V_{DS} = 16V, V_{GS} = 0V$
R_G	Gate Resistance	—	1.0	—	Ω	
$t_{d(on)}$	Turn-On Delay Time	—	9.2	—	ns	$V_{DD} = 50V, V_{GS} = 10V$ ⑦ $I_D = 3.4A$ $R_G = 6.2\Omega$
t_r	Rise Time	—	5.0	—		
$t_{d(off)}$	Turn-Off Delay Time	—	18	—		
t_f	Fall Time	—	5.1	—		
C_{iss}	Input Capacitance	—	890	—	pF	$V_{GS} = 0V$ $V_{DS} = 25V$ $f = 1.0\text{MHz}$
C_{oss}	Output Capacitance	—	180	—		
C_{rss}	Reverse Transfer Capacitance	—	40	—		
C_{oss}	Output Capacitance	—	870	—		$V_{GS} = 0V, V_{DS} = 1.0V, f = 1.0\text{MHz}$
C_{oss}	Output Capacitance	—	100	—		$V_{GS} = 0V, V_{DS} = 80V, f = 1.0\text{MHz}$

Diode Characteristics

	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	—	—	25	A	MOSFET symbol showing the integral reverse p-n junction diode. 
I_{SM}	Pulsed Source Current (Body Diode) ⑤	—	—	45		
V_{SD}	Diode Forward Voltage	—	—	1.3	V	$T_J = 25^\circ\text{C}, I_S = 3.4A, V_{GS} = 0V$ ⑦
t_{rr}	Reverse Recovery Time	—	31	47	ns	$T_J = 25^\circ\text{C}, I_F = 3.4A, V_{DD} = 50V$
Q_{rr}	Reverse Recovery Charge	—	40	60	nC	$di/dt = 100A/\mu s$ ①

Notes:

⑤ Repetitive rating; pulse width limited by max. junction temperature.

 ⑦ Pulse width $\leq 400\mu s$; duty cycle $\leq 2\%$.

Absolute Maximum Ratings

	Parameter	Max.	Units
$P_D @ T_A = 25^\circ\text{C}$	Power Dissipation ③	2.2	W
$P_D @ T_A = 70^\circ\text{C}$	Power Dissipation ③	1.4	
$P_D @ T_C = 25^\circ\text{C}$	Power Dissipation ④	42	
T_P	Peak Soldering Temperature	270	$^\circ\text{C}$
T_J	Operating Junction and	-40 to + 150	
T_{STG}	Storage Temperature Range		

Thermal Resistance

	Parameter	Typ.	Max.	Units
$R_{\theta JA}$	Junction-to-Ambient ③ ⑩	—	58	$^\circ\text{C/W}$
$R_{\theta JA}$	Junction-to-Ambient ⑤ ⑩	12.5	—	
$R_{\theta JA}$	Junction-to-Ambient ③ ⑩	20	—	
$R_{\theta JC}$	Junction-to-Case ④ ⑩	—	3.0	
$R_{\theta J-PCB}$	Junction-to-PCB Mounted	1.0	—	

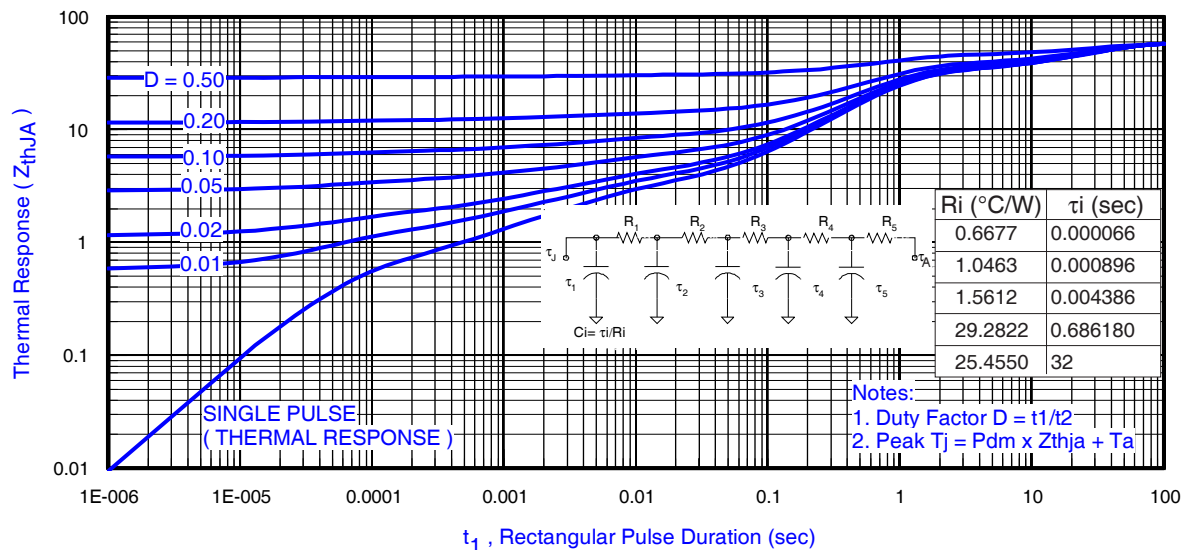
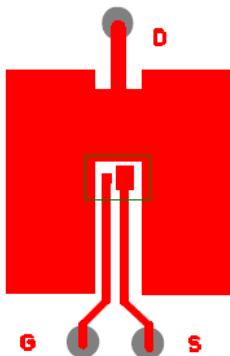


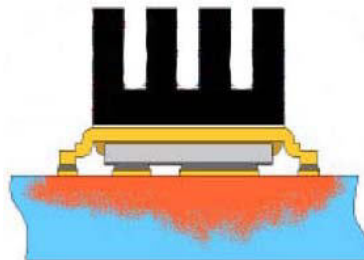
Fig 3. Maximum Effective Transient Thermal Impedance, Junction-to-Ambient ①

Notes:

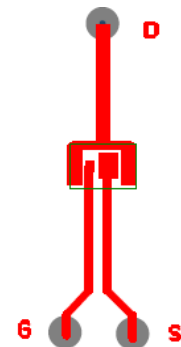
- ③ Surface mounted on 1 in. square Cu board, steady state.
- ④ T_C measured with thermocouple incontact with top (Drain) of part.
- ⑤ Used double sided cooling, mounting pad with large heatsink.
- ⑥ Mounted on minimum footprint full size board with metalized back and with small clip heatsink.
- ⑦ R_{θ} is measured at T_J of approximately 90°C .



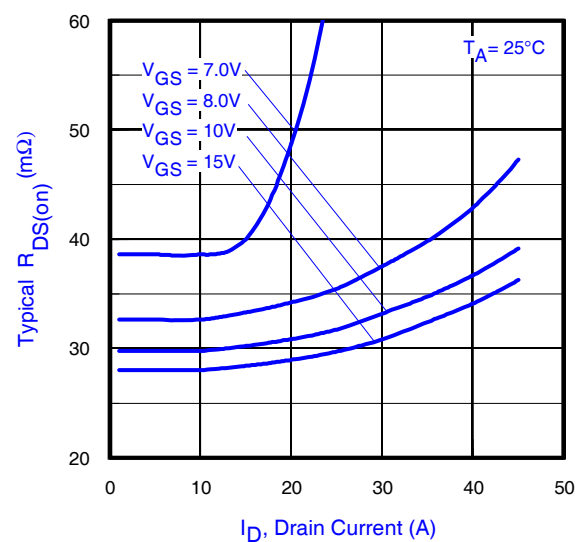
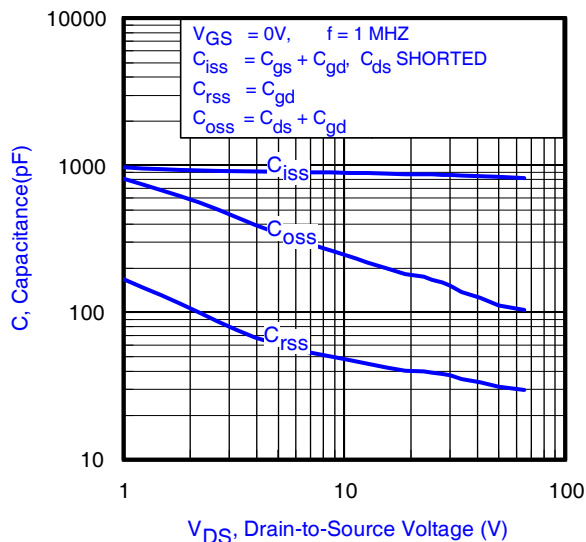
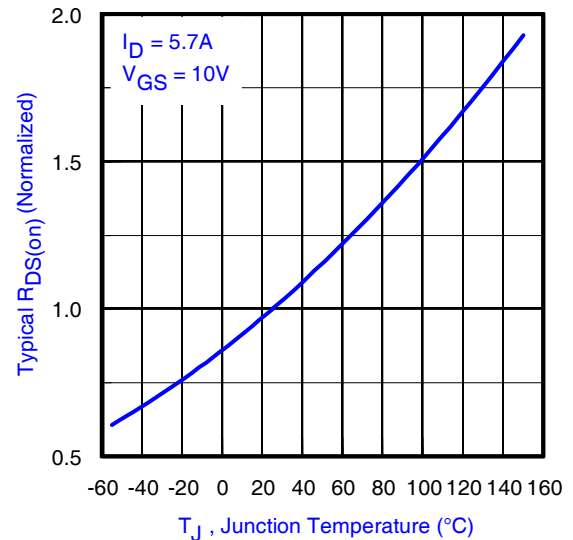
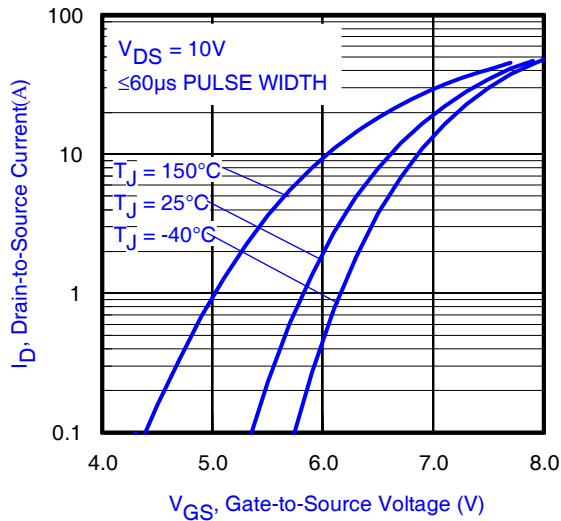
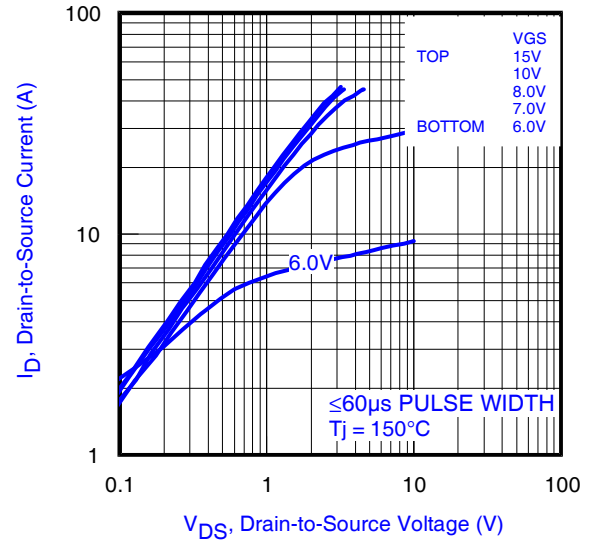
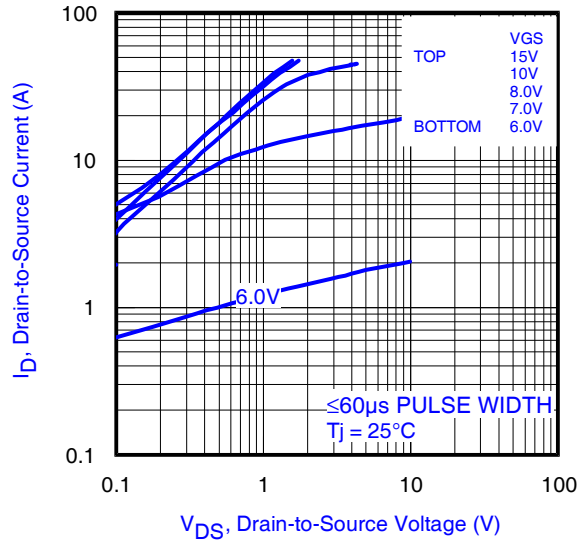
③ Surface mounted on 1 in. square Cu board (still air).

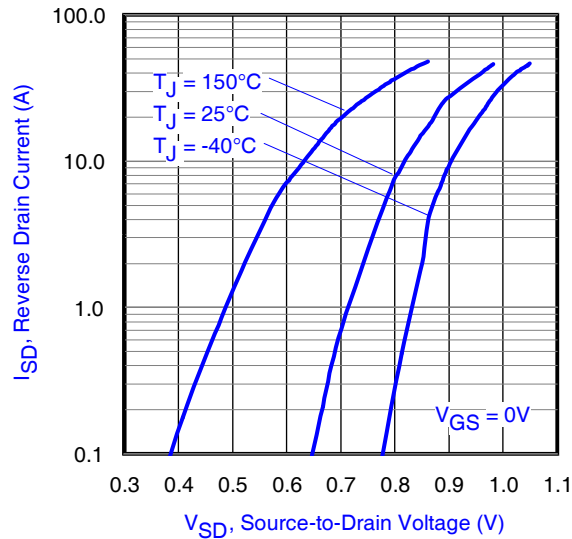
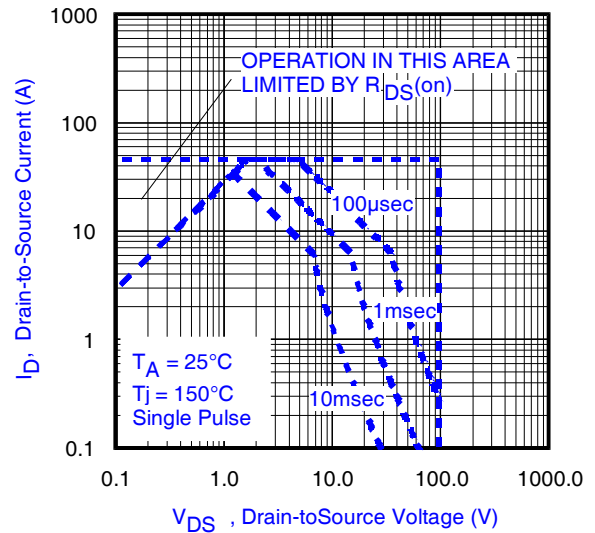
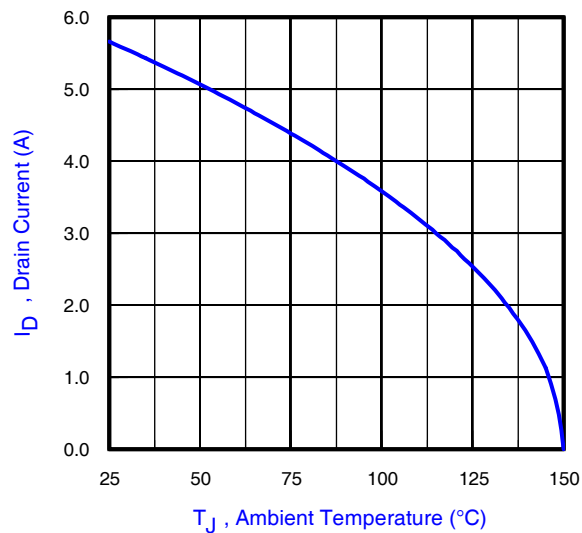
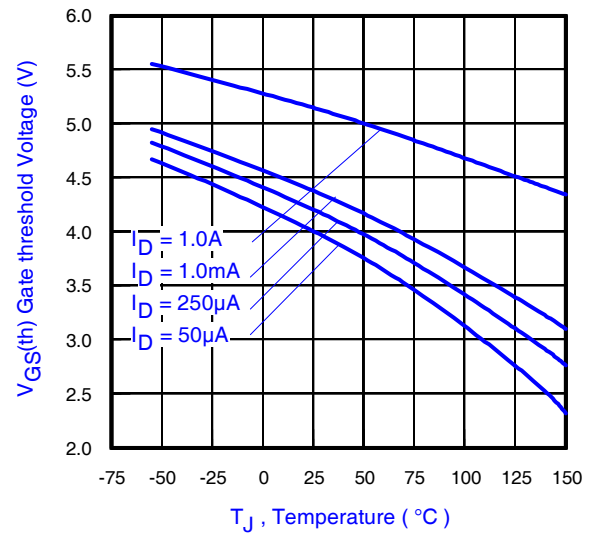
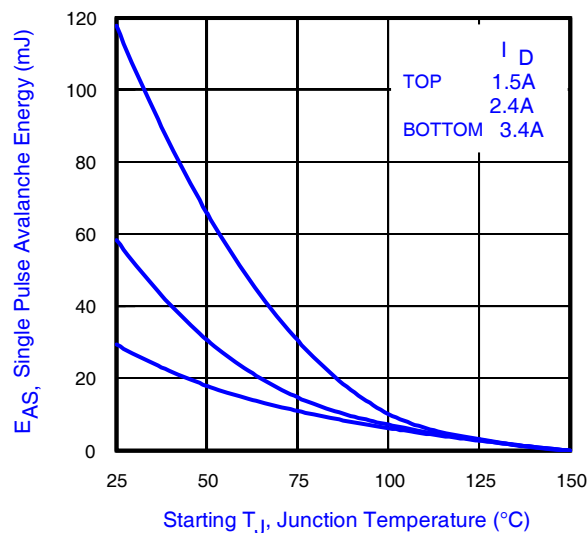


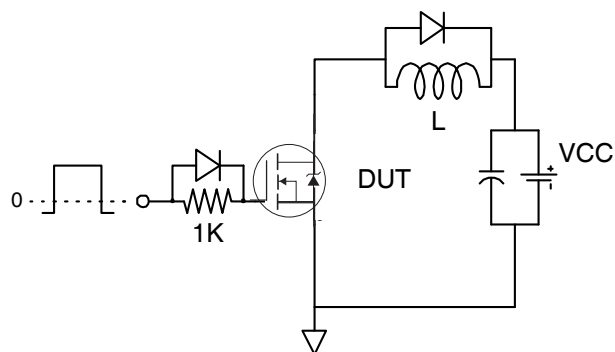
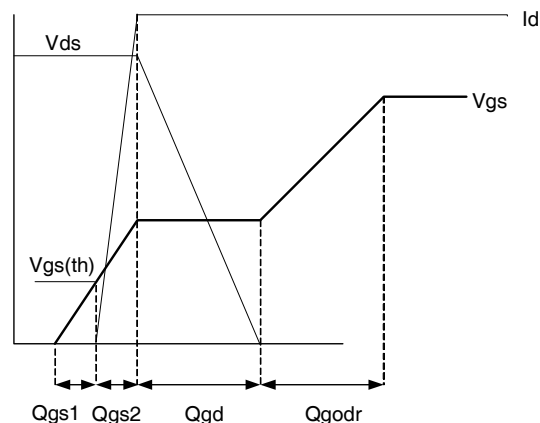
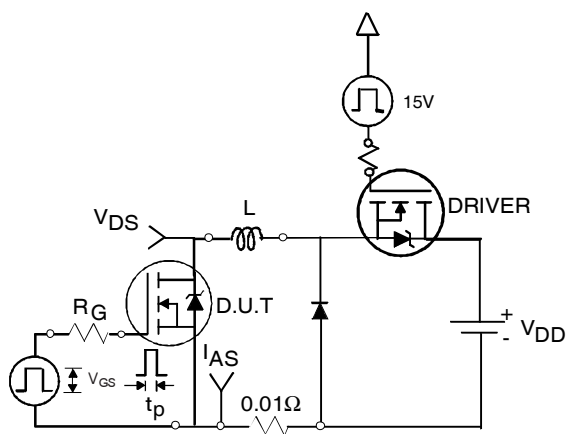
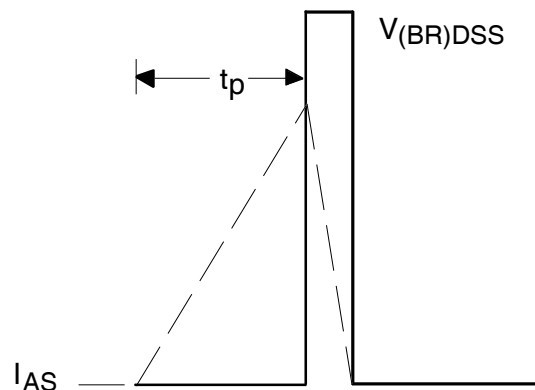
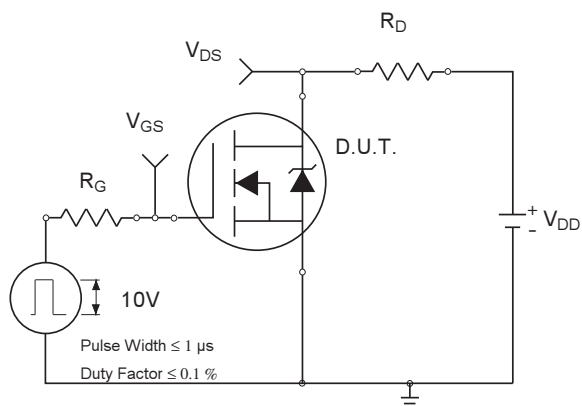
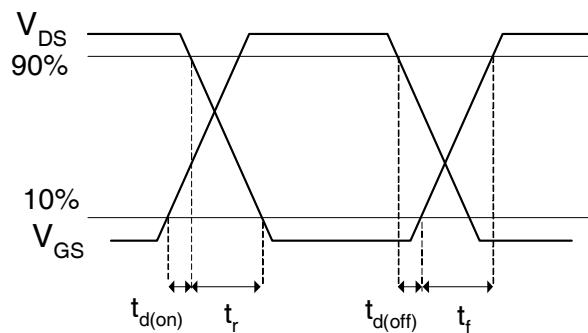
⑥ Mounted to a PCB with small clip heatsink (still air)



⑦ Mounted on minimum footprint full size board with metalized back and with small clip heatsink (still air)




Fig 10. Typical Source-Drain Diode Forward Voltage

Fig11. Maximum Safe Operating Area

Fig 12. Maximum Drain Current vs. Ambient Temperature

Fig 13. Typical Threshold Voltage vs. Junction Temperature

Fig 14. Maximum Avalanche Energy vs. Drain Current


Fig 15a. Gate Charge Test Circuit

Fig 15b. Gate Charge Waveform

Fig 16b. Unclamped Inductive Test Circuit

Fig 16c. Unclamped Inductive Waveforms

Fig 17a. Switching Time Test Circuit

Fig 17b. Switching Time Waveforms

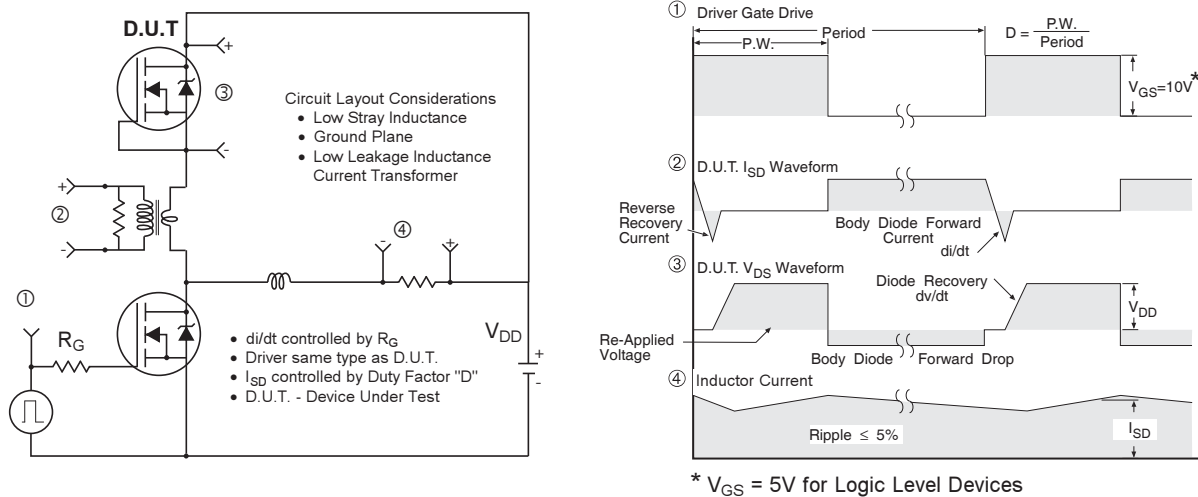
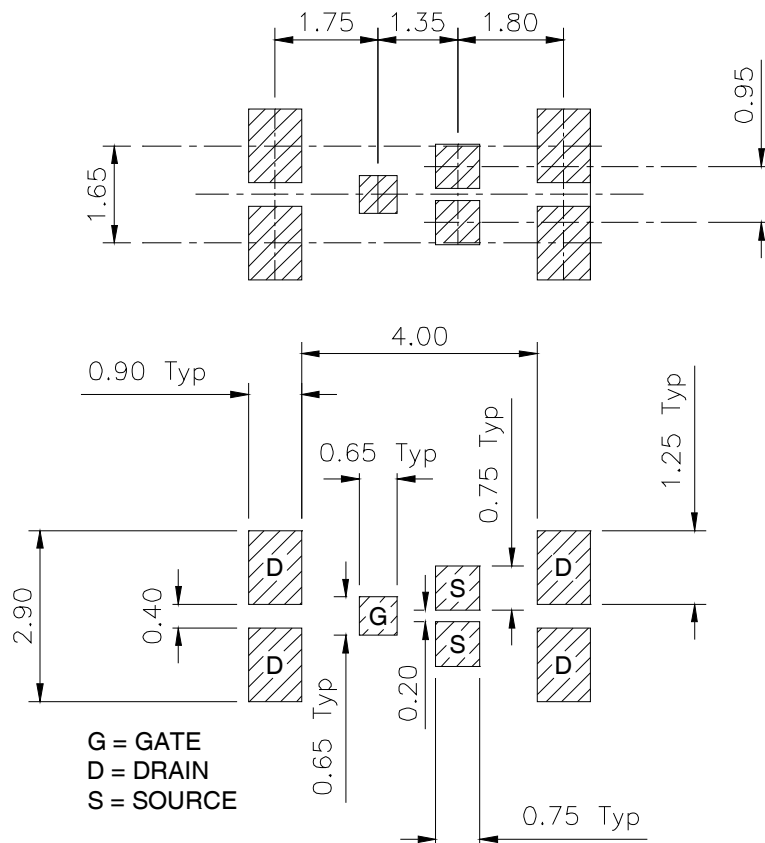


Fig 18. Diode Reverse Recovery Test Circuit for N-Channel HEXFET® Power MOSFETs

DirectFET™ Substrate and PCB Layout, SJ Outline (Small Size Can, J-Designation).

Please see DirectFET application note [AN-1035](#) for all details regarding the assembly of DirectFET.

This includes all recommendations for stencil and substrate designs.

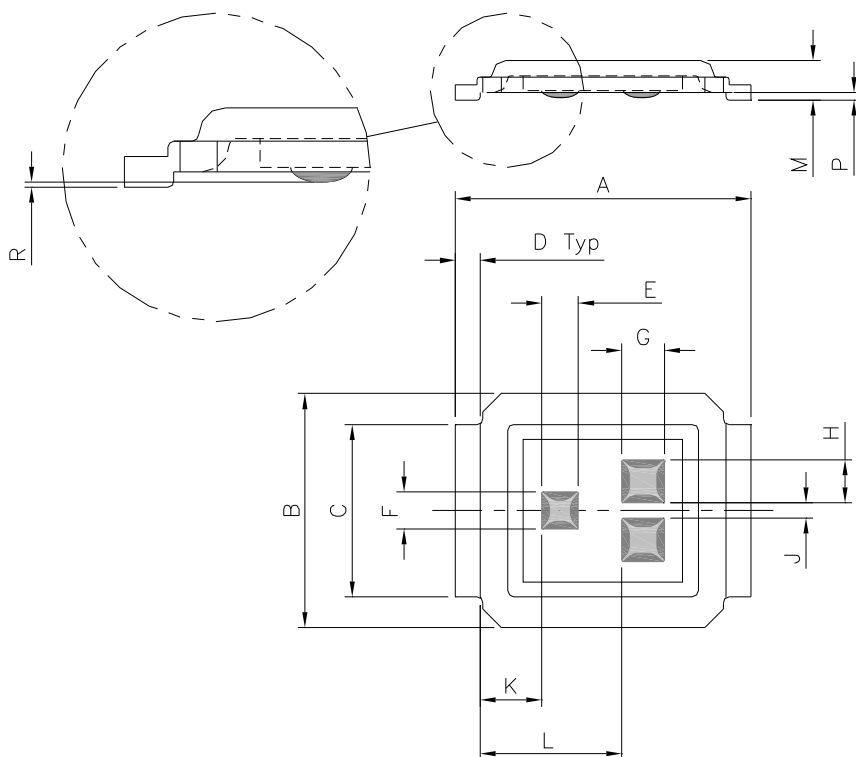


Note: For the most current drawing please refer to IR website at <http://www.irf.com/package>

DirectFET™ Outline Dimension, SJ Outline (Small Size Can, J-Designation).

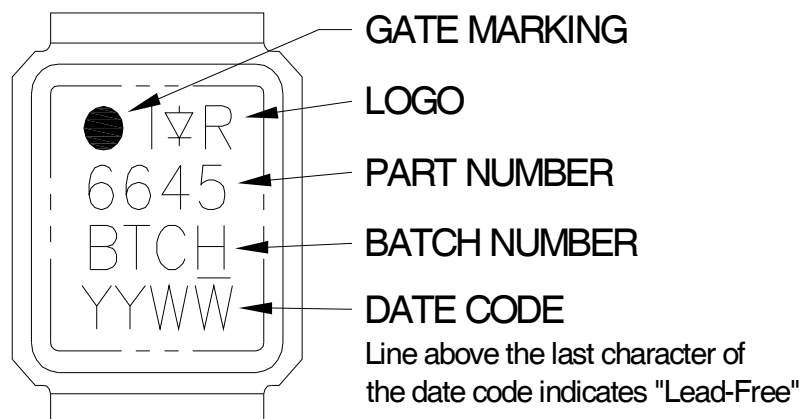
Please see DirectFET application note [AN-1035](#) for all details regarding the assembly of DirectFET.

This includes all recommendations for stencil and substrate designs.



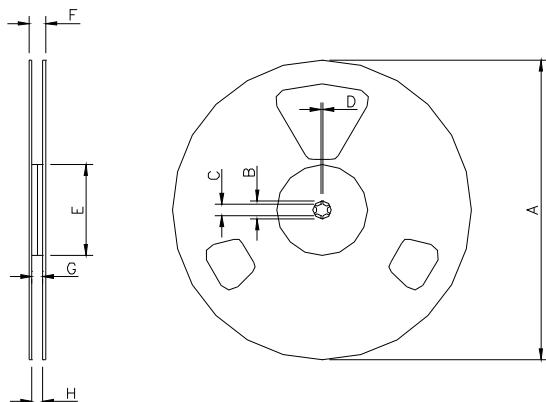
CODE	METRIC		IMPERIAL	
	MIN	MAX	MIN	MAX
A	4.75	4.85	0.187	0.191
B	3.70	3.95	0.146	0.156
C	2.75	2.85	0.108	0.112
D	0.35	0.45	0.014	0.018
E	0.58	0.62	0.023	0.024
F	0.58	0.62	0.023	0.024
G	0.68	0.72	0.027	0.028
H	0.68	0.72	0.027	0.028
J	0.23	0.27	0.009	0.010
K	0.95	1.05	0.037	0.041
L	2.25	2.35	0.089	0.093
M	0.59	0.70	0.023	0.028
P	0.08	0.17	0.003	0.007
R	0.020	0.080	0.0008	0.0031

DirectFET™ Part Marking



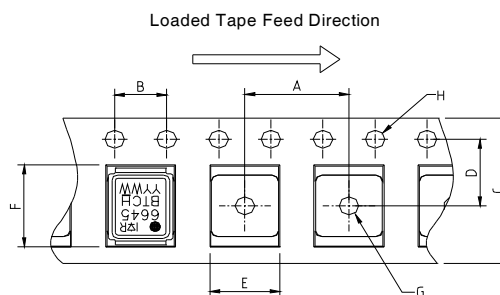
Note: For the most current drawing please refer to IR website at <http://www.irf.com/package>

DirectFET™ Tape & Reel Dimension (Showing component orientation).



NOTE: Controlling dimensions in mm
Std reel quantity is 4800 parts. (ordered as IRF6645TRPbF). For 1000 parts on 7" reel, order IRF6645TR1PbF

REEL DIMENSIONS								
STANDARD OPTION (QTY 4800)					TR1 OPTION (QTY 1000)			
	METRIC		IMPERIAL		METRIC		IMPERIAL	
CODE	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
A	330.0	N.C	12.992	N.C	177.77	N.C	6.9	N.C
B	20.2	N.C	0.795	N.C	19.06	N.C	0.75	N.C
C	12.8	13.2	0.504	0.520	13.5	12.8	0.53	0.50
D	1.5	N.C	0.059	N.C	1.5	N.C	0.059	N.C
E	100.0	N.C	3.937	N.C	58.72	N.C	2.31	N.C
F	N.C	18.4	N.C	0.724	N.C	13.50	N.C	0.53
G	12.4	14.4	0.488	0.567	11.9	12.01	0.47	N.C
H	11.9	15.4	0.469	0.606	11.9	12.01	0.47	N.C



DIMENSIONS				
CODE	METRIC		IMPERIAL	
	MIN	MAX	MIN	MAX
A	7.90	8.10	0.311	0.319
B	3.90	4.10	0.154	0.161
C	11.90	12.30	0.469	0.484
D	5.45	5.55	0.215	0.219
E	4.00	4.20	0.158	0.165
F	5.00	5.20	0.197	0.205
G	1.50	N.C	0.059	N.C
H	1.50	1.60	0.059	0.063

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

Revision History

Date	Comments
12/10/2012	Updated package outline, on page 8.
2/26/2013	Updated P _D @ T _A = 25C from 3W to 2.2W, on page 3.

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

International
IR Rectifier

IR WORLD HEADQUARTERS: 101N Sepulveda Blvd, El Segundo, California 90245, USA

To contact International Rectifier, please visit <http://www.irf.com/whoto-call/>

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