International
IOR Rectifier

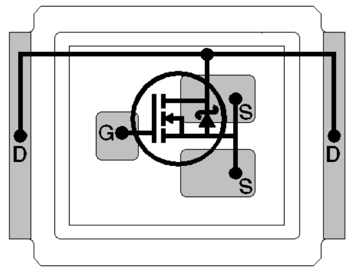
IRF6648

DirectFET™ Power MOSFET ②

- RoHs Compliant Containing No Lead and Bromide ①
- Low Profile (<0.7 mm)
- Dual Sided Cooling Compatible ①
- Ultra Low Package Inductance
- Optimized for High Frequency Switching ①
- Optimized for Synchronous Rectification for 5V to 12V outputs
- Ideal for 24V input Primary Side Forward Converters
- Low Conduction Losses
- Compatible with Existing Surface Mount Techniques ①

Typical values (unless otherwise specified)

V_{DSS}	V_{GS}	$R_{DS(on)}$	$Q_{g\ tot}$	Q_{gd}
60V max	±20V max	5.5mΩ@ 10V	36nC	14nC



MN

DirectFET™
ISOMETRIC

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

SH	SJ	SP		MZ	MN					

Description

The IRF6648 combines the latest HEXFET® power MOSFET silicon technology with advanced DirectFET™ packaging to achieve the lowest on-state resistance in a package that has the footprint of an SO-8 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 IRF6648 is an optimized switch for use in synchronous rectification circuits with 5-12Vout, and is also ideal for use as a primary side switch in 24Vin forward converters. 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	60	V
V_{GS}	Gate-to-Source Voltage	±20	
I_D @ T_C = 25°C	Continuous Drain Current, V_{GS} @ 10V ④	86	A
I_D @ T_C = 70°C	Continuous Drain Current, V_{GS} @ 10V ④	69	
I_{DM}	Pulsed Drain Current ③	260	
I_S @ T_C = 25°C	Continuous Source Current (Body Diode) ④	81	
I_S @ T_C = 70°C	Continuous Source Current (Body Diode) ④	52	
I_{SM}	Pulsed Source Current (Body Diode)③	260	

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 Repetitive rating; pulse width limited by max. junction temperature.
④ T_C measured with thermocouple mounted to top (Drain) of part.

02/28/06

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

	Parameter	Min.	Typ.	Max.	Units	Conditions
BV_{DSS}	Drain-to-Source Breakdown Voltage	60	——	——	V	V_{GS} = 0V, I_D = 250μA
$\Delta BV_{DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	——	0.076	——	V/°C	Reference to 25°C, I_D = 1mA
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	——	5.5	7.0	mΩ	V_{GS} = 10V, I_D = 17A ⑤
$V_{GS(th)}$	Gate Threshold Voltage	3.0	4.0	4.9	V	V_{DS} = V_{GS}, I_D = 150μA
$\Delta V_{GS(th)}/\Delta T_J$	Gate Threshold Voltage Coefficient	——	-11	——	mV/°C	
I_{DSS}	Drain-to-Source Leakage Current	——	——	20	μA	V_{DS} = 60V, V_{GS} = 0V
		——	——	250		V_{DS} = 48V, 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	31	——	——	S	V_{DS} = 10V, I_D = 17A
Q_g	Total Gate Charge	——	36	50	nC	
Q_{gs1}	Pre-Vth Gate-to-Source Charge	——	7.5	——		V_{DS} = 30V
Q_{gs2}	Post-Vth Gate-to-Source Charge	——	2.7	——		V_{GS} = 10V
Q_{gd}	Gate-to-Drain Charge	——	14	21		I_D = 17A
Q_{godr}	Gate Charge Overdrive	——	12	——		See Fig. 14
Q_{sw}	Switch Charge (Q_{gs2} + Q_{gd})	——	17	——		
Q_{oss}	Output Charge	——	21	——	nC	V_{DS} = 16V, V_{GS} = 0V
$R_{G\ (Internal)}$	Gate Resistance	——	1.0	——	Ω	
$t_{d(on)}$	Turn-On Delay Time	——	16	——	ns	V_{DD} = 30V, V_{GS} = 10V ⑤
t_r	Rise Time	——	29	——		I_D = 17A
$t_{d(off)}$	Turn-Off Delay Time	——	28	——		R_G= 6.2Ω
t_f	Fall Time	——	13	——		See Fig. 16
C_{iss}	Input Capacitance	——	2120	——	pF	V_{GS} = 0V
C_{oss}	Output Capacitance	——	600	——		V_{DS} = 25V
C_{rss}	Reverse Transfer Capacitance	——	170	——		f = 1.0MHz
C_{oss}	Output Capacitance	——	2450	——		V_{GS} = 0V, V_{DS} = 1.0V, f=1.0MHz
C_{oss}	Output Capacitance	——	440	——		V_{GS} = 0V, V_{DS} = 48V, f=1.0MHz

Avalanche Characteristics

	Parameter	Min.	Typ.	Max.	Units	Conditions
E_{AS}	Single Pulse Avalanche Energy	——	——	47	mJ	T_J = 25°C, I_S = 34A, R_G = 25Ω L = 0.082mH. See Fig. 13

Diode Characteristics

	Parameter	Min.	Typ.	Max.	Units	Conditions
V_{SD}	Diode Forward Voltage	——	——	1.3	V	T_J = 25°C, I_S = 17A, V_{GS} = 0V ⑤
t_{rr}	Reverse Recovery Time	——	31	47	ns	T_J = 25°C, I_F = 17A, V_{DD} = 30V
Q_{rr}	Reverse Recovery Charge	——	37	56	nC	di/dt = 100A/μs ⑤

Notes:

⑤ Pulse width ≤ 400μs; duty cycle ≤ 2%.

Absolute Maximum Ratings

	Parameter	Max.	Units
P_D @T_A = 25°C	Power Dissipation ⑥	2.8	W
P_D @T_A = 70°C	Power Dissipation ⑥	1.8	
P_D @T_C = 25°C	Power Dissipation ④	89	
T_P	Peak Soldering Temperature	270	°C
T_J T_{STG}	Operating Junction and Storage Temperature Range	-40 to + 150	

Thermal Resistance

	Parameter	Typ.	Max.	Units
$R_{\theta JA}$	Junction-to-Ambient ⑥⑧	——	45	°C/W
$R_{\theta JA}$	Junction-to-Ambient ⑦⑧	12.5	——	
$R_{\theta JC}$	Junction-to-Case ④⑧	——	1.4	
$R_{\theta J\text{-}PCB}$	Junction-to-PCB Mounted	1.0	——	

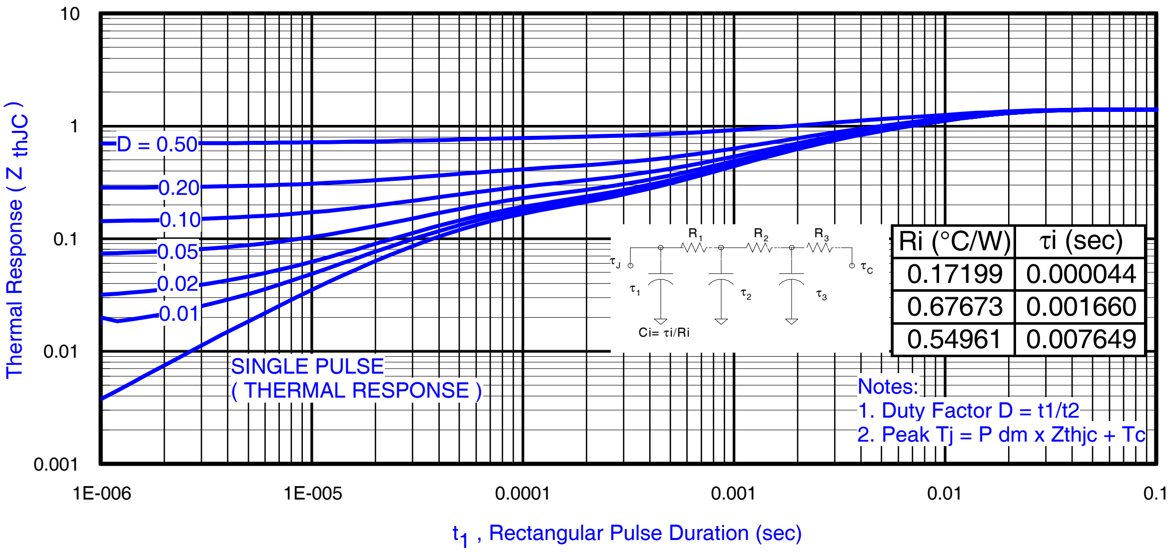


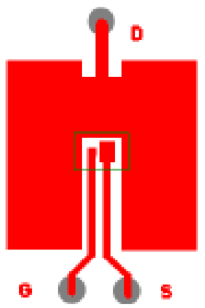
Fig 1. Maximum Effective Transient Thermal Impedance, Junction-to-Case ①

Notes:

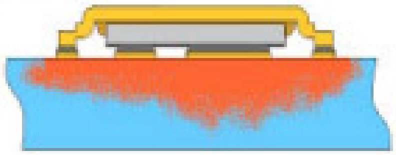
⑥ Surface mounted on 1 in. square Cu, steady state (still air).

⑦ Used double sided cooling, mounted on 1 in. square Cu board PCB with small clip heatsink (still air).

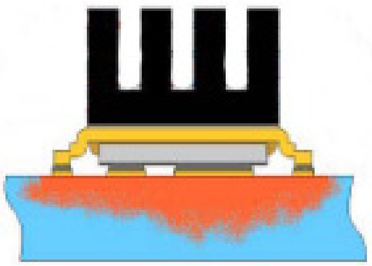
⑧ R_θ is measured at T_J of approximately 90°C.



Note ⑥



Note ⑥



Note ⑦

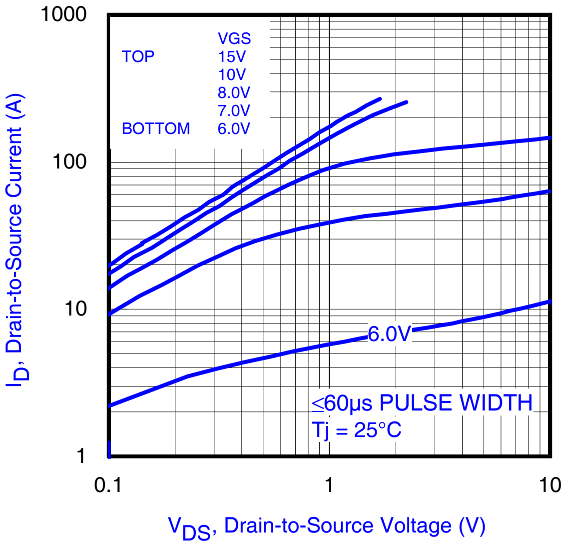


Fig 2. Typical Output Characteristics

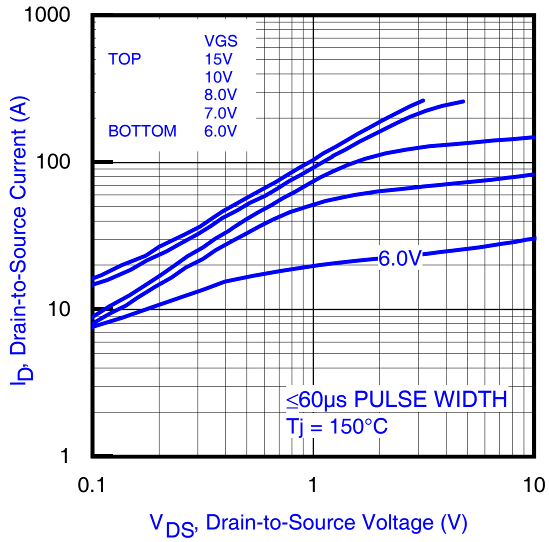


Fig 3. Typical Output Characteristics

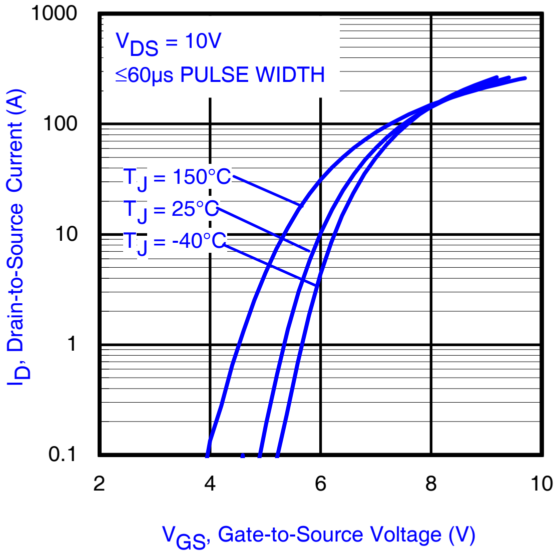


Fig 4. Typical Transfer Characteristics

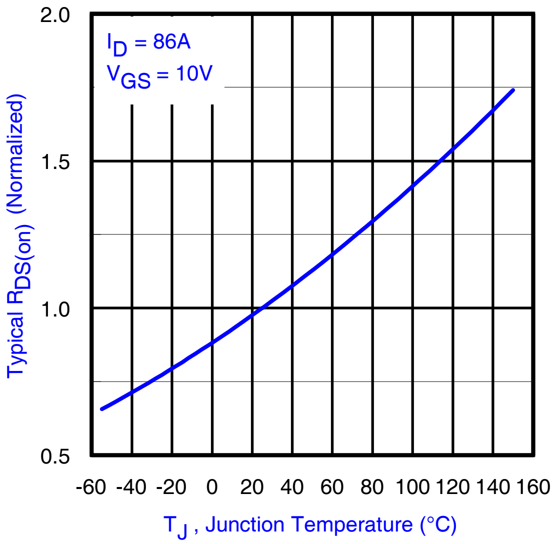


Fig 5. Normalized On-Resistance vs. Temperature

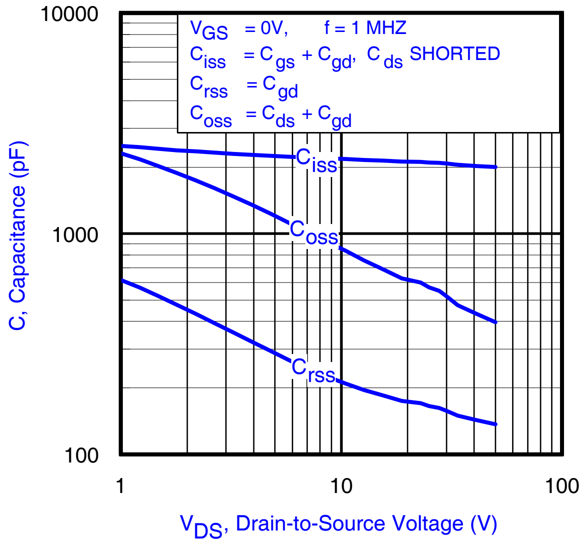


Fig 6. Typical Capacitance vs.Drain-to-Source Voltage

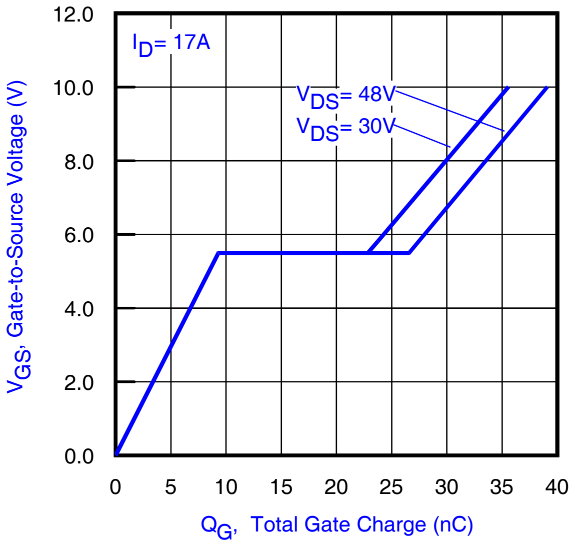


Fig 7. Typical Total Gate Charge vs Gate-to-Source Voltage

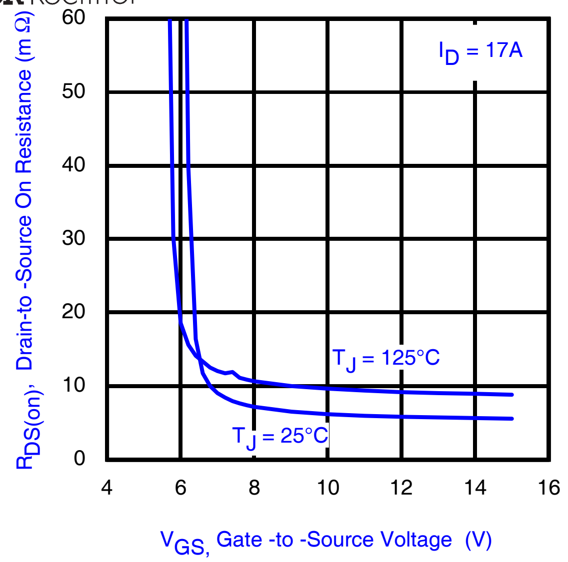


Fig 8. Typical On-Resistance vs. Gate Voltage

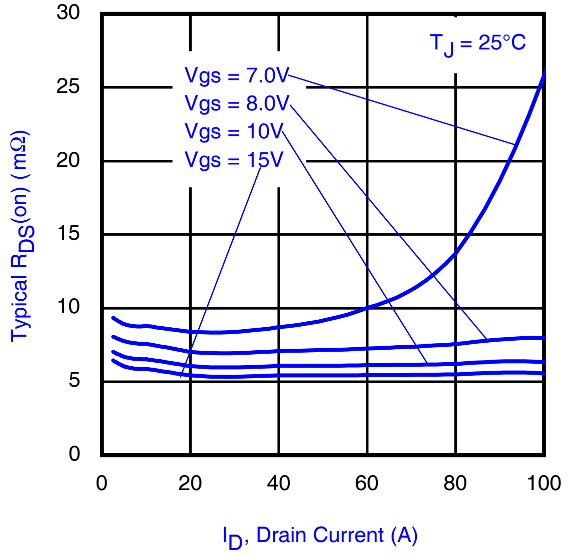


Fig 9. Typical On-Resistance vs. Drain Current

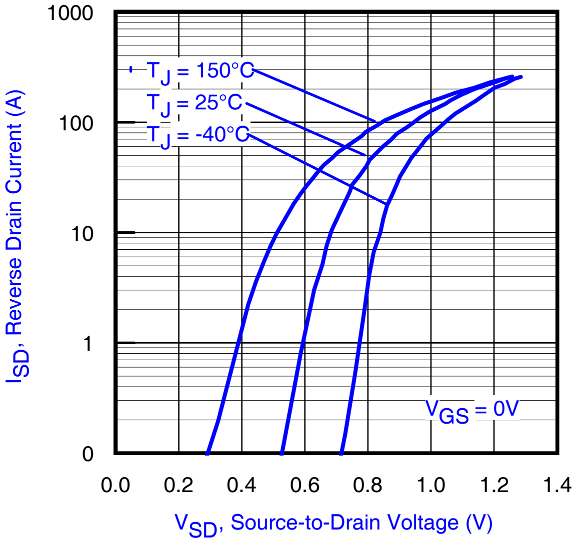


Fig 10. Typical Source-Drain Diode Forward Voltage

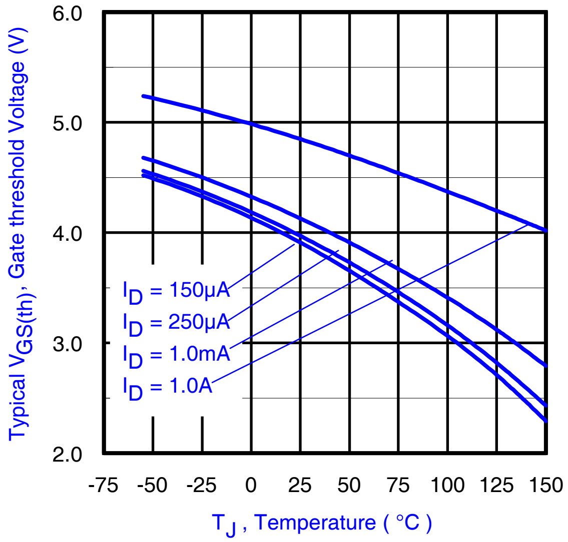


Fig 11. Typical Threshold Voltage vs. Junction Temperature

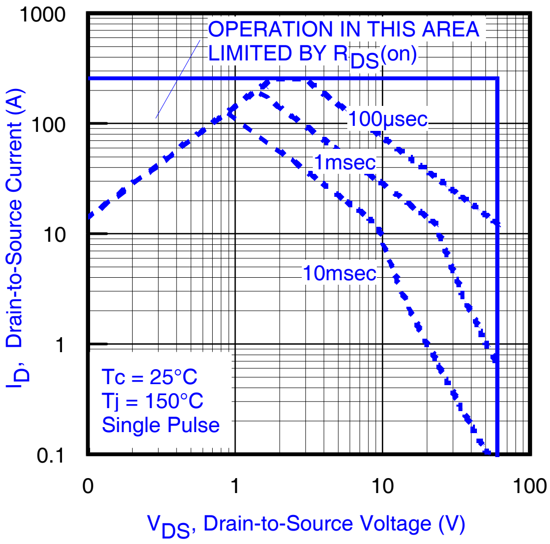


Fig12. Maximum Safe Operating Area

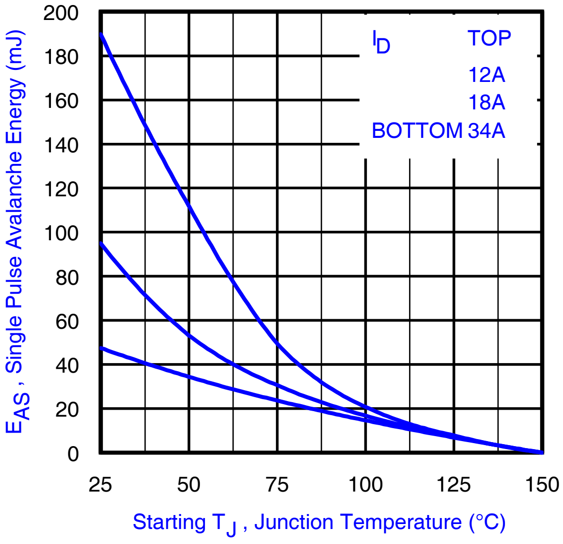


Fig 13. Maximum Avalanche Energy vs. Drain Current

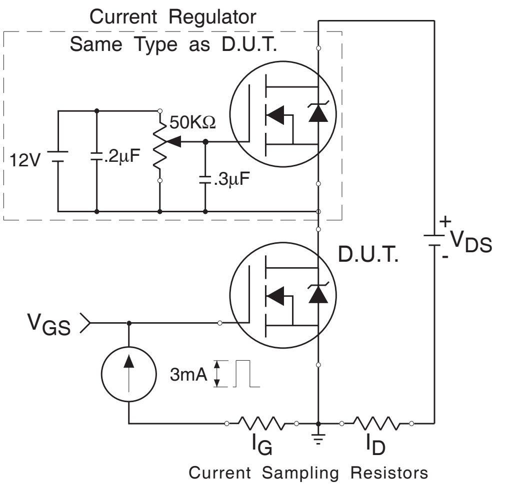


Fig 14a. Gate Charge Test Circuit

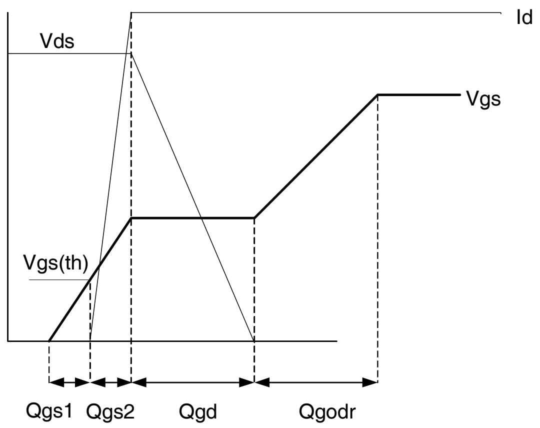


Fig 14b. Gate Charge Waveform

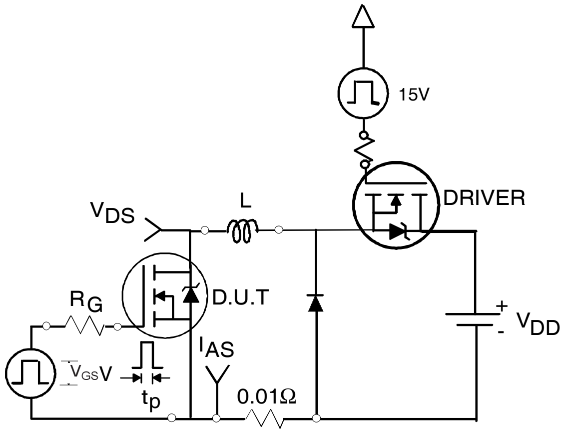


Fig 15a. Unclamped Inductive Test Circuit

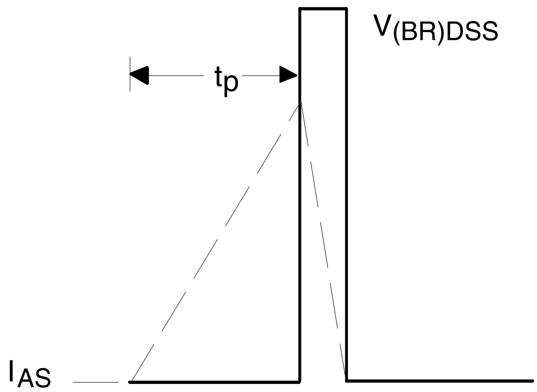


Fig 15b. Unclamped Inductive Waveforms

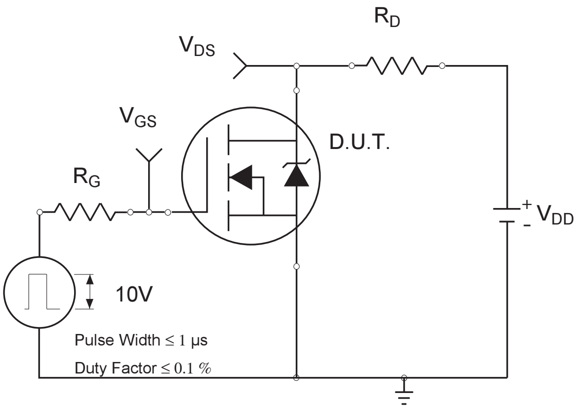


Fig 16a. Switching Time Test Circuit

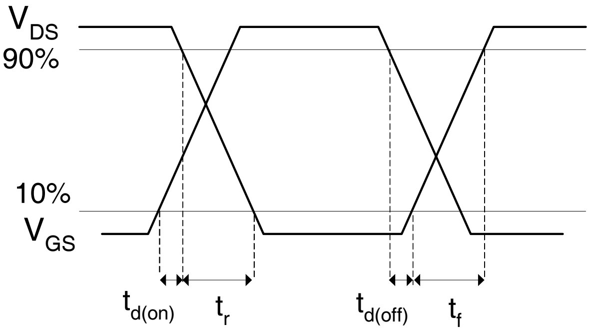
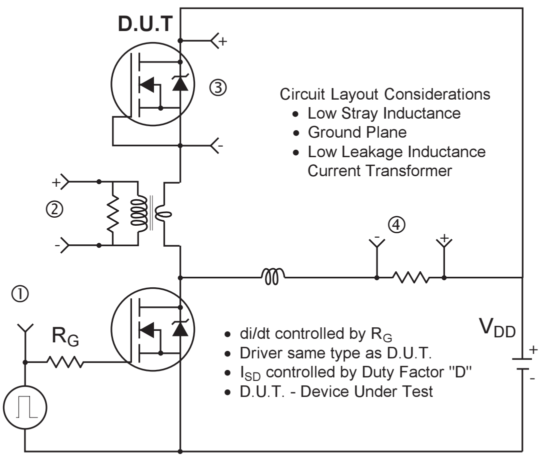


Fig 16b. Switching Time Waveforms



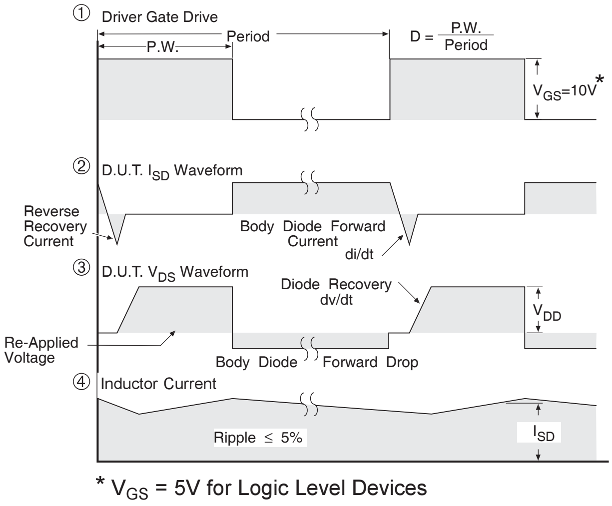
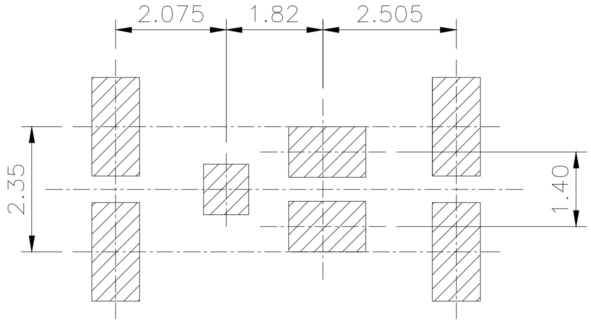


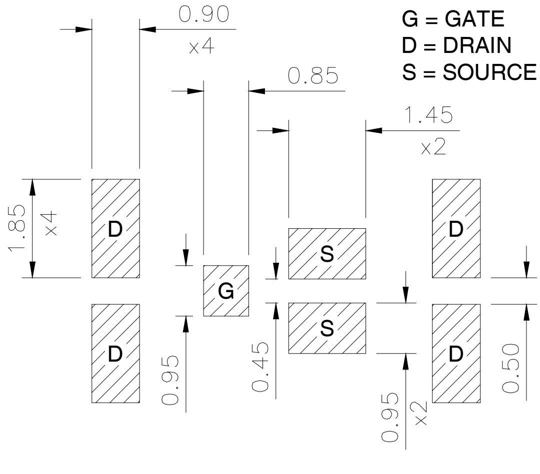
Fig 17. Diode Reverse Recovery Test Circuit for N-Channel HEXFET® Power MOSFETs

DirectFET™ Substrate and PCB Layout, MN Outline (Medium Size Can, N-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.

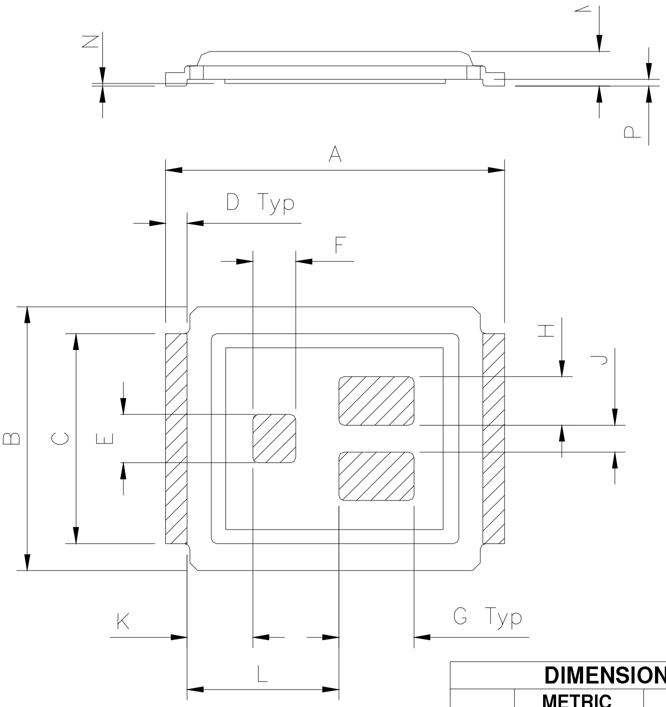




DirectFET™ Outline Dimension, MN Outline
(Medium Size Can, N-Designation).

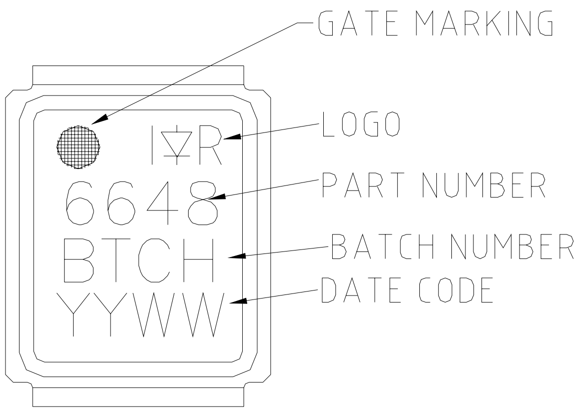
Please see DirectFET application note AN-1035 for all details regarding the assembly of DirectFET.

This includes all recommendations for stencil and substrate designs.

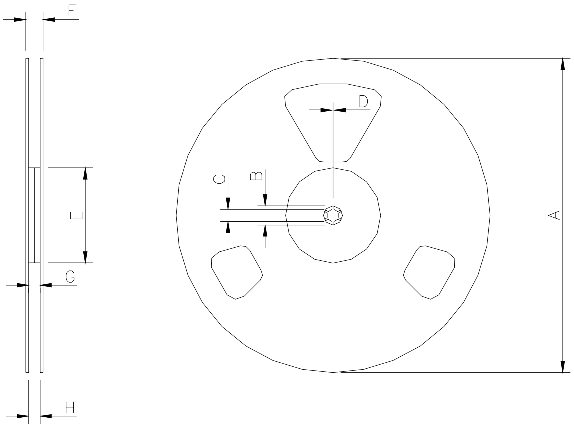


DIMENSIONS				
	METRIC		IMPERIAL	
CODE	MIN	MAX	MIN	MAX
A	6.25	6.35	0.246	0.250
B	4.80	5.05	0.189	0.201
C	3.85	3.95	0.152	0.156
D	0.35	0.45	0.014	0.018
E	0.88	0.92	0.034	0.036
F	0.78	0.82	0.031	0.032
G	1.38	1.42	0.054	0.056
H	0.88	0.92	0.034	0.036
J	0.48	0.52	0.019	0.020
K	1.16	1.29	0.046	0.051
L	2.74	2.91	0.109	0.115
M	0.59	0.70	0.023	0.028
N	0.03	0.08	0.001	0.003
P	0.08	0.17	0.003	0.007

DirectFET™ Part Marking

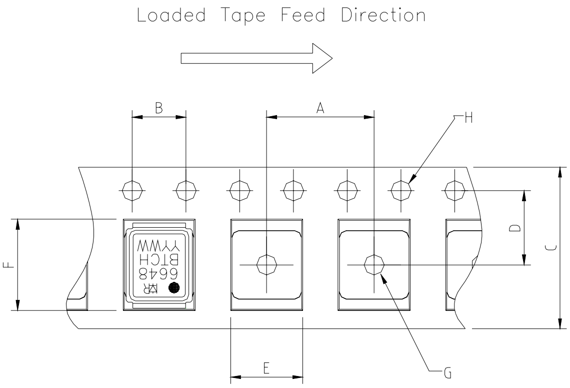


DirectFET™ Tape & Reel Dimension (Showing component orientation).



NOTE: Controlling dimensions in mm
Std reel quantity is 4800 parts. (ordered as IRF6648). For 1000 parts on 7" reel, order IRF6648TR1

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



NOTE: CONTROLLING DIMENSIONS IN MM

DIMENSIONS				
	METRIC		IMPERIAL	
CODE	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	5.10	5.30	0.201	0.209
F	6.50	6.70	0.256	0.264
G	1.50	N.C	0.059	N.C
H	1.50	1.60	0.059	0.063

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
IOR 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.02/06

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