# International IƏR Rectifier

IRF6613

HEXFET® Power MOSFET

- Application Specific MOSFETs
- Ideal for Synchronous Rectification in Isolated
  DC-DC Converters
- Low Conduction Losses
- Low Switching Losses
- Low Profile (<0.7 mm)
- Dual Sided Cooling Compatible
- Compatible with existing Surface Mount Techniques

V_{DSS}	$R_{DS(on)}$ max	Qg(typ.)
40V	3.4mΩ @ V_{GS} = 10V	42nC
	4.1mΩ @ V_{GS} = 4.5V	

MT

DirectFET™ ISOMETRIC
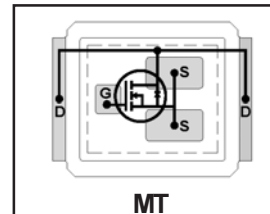
Applicable DirectFET Outline and Substrate Outline (see p.8,9 for details)

SQ	SX	ST		MQ	MX	**MT**				

Description

The IRF6613 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 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 IRF6613 balances both low resistance and low charge along with ultra low package inductance to reduce both conduction and switching losses. The reduced total losses make this product ideal for high efficiency DC-DC converters that power the latest generation of processors operating at higher frequencies. The IRF6613 has been optimized for parameters that are critical in synchronous buck converters including Rds(on), gate charge and Cdv/dt-induced turn on immunity. The IRF6613 offers particularly low Rds(on) and high Cdv/dt immunity for synchronous FET applications.

Absolute Maximum Ratings

	Parameter	Max.	Units
V_{DS}	Drain-to-Source Voltage	40	V
V_{GS}	Gate-to-Source Voltage	±20	
I_D @ T_C = 25°C	Continuous Drain Current, V_{GS} @ 10V	150	
I_D @ T_A = 25°C	Continuous Drain Current, V_{GS} @ 10V	23	A
I_D @ T_A = 70°C	Continuous Drain Current, V_{GS} @ 10V	18	
I_{DM}	Pulsed Drain Current ①	180	
P_D @ T_C = 25°C	Power Dissipation	89	
P_D @ T_A = 25°C	Power Dissipation ⑤	2.8	
P_D @ T_A = 70°C	Power Dissipation ⑤	1.8	W
E_{AS}	Single Pulse Avalanche Energy②	200	mJ
I_{AR}	Avalanche Current ①	18	A
	Linear Derating Factor ④	0.022	W/°C
T_J	Operating Junction and	-40 to + 150	°C
T_{STG}	Storage Temperature Range		

Thermal Resistance

	Parameter	Typ.	Max.	Units
$R_{\theta JA}$	Junction-to-Ambient ④⑧	——	45	
$R_{\theta JA}$	Junction-to-Ambient ⑤⑧	12.5	——	
$R_{\theta JA}$	Junction-to-Ambient ⑥⑧	20	——	°C/W
$R_{\theta JC}$	Junction-to-Case ⑦⑧	——	1.4	
$R_{\theta J-PCB}$	Junction-to-PCB Mounted	1.0	——	

Notes ① through ⑧ are on page 2

IRF6613

International **IGR** Rectifier

Static @ T$_J$ = 25°C (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
BV$_{DSS}$	Drain-to-Source Breakdown Voltage	40	——	——	V	V$_{GS}$ = 0V, I$_D$ = 250µA
ΔBV$_{DSS}$/ΔT$_J$	Breakdown Voltage Temp. Coefficient	——	38	——	mV/°C	Reference to 25°C, I$_D$ = 1mA
R$_{DS(on)}$	Static Drain-to-Source On-Resistance	——	2.6	3.4	mΩ	V$_{GS}$ = 10V, I$_D$ = 23A ③
		——	3.1	4.1		V$_{GS}$ = 4.5V, I$_D$ = 18A ③
V$_{GS(th)}$	Gate Threshold Voltage	1.35	——	2.25	V	V$_{DS}$ = V$_{GS}$, I$_D$ = 250µA
ΔV$_{GS(th)}$/ΔT$_J$	Gate Threshold Voltage Coefficient	——	-5.8	——	mV/°C	
I$_{DSS}$	Drain-to-Source Leakage Current	——	——	1.0	µA	V$_{DS}$ = 32V, V$_{GS}$ = 0V
		——	——	150		V$_{DS}$ = 32V, 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	93	——	——	S	V$_{DS}$ = 15V, I$_D$ = 18A
Q$_g$	Total Gate Charge	——	42	63		
Q$_{gs1}$	Pre-Vth Gate-to-Source Charge	——	11.5	——		V$_{DS}$ = 20V
Q$_{gs2}$	Post-Vth Gate-to-Source Charge	——	3.3	——	nC	V$_{GS}$ = 4.5V
Q$_{gd}$	Gate-to-Drain Charge	——	12.6	——		I$_D$ = 18A
Q$_{godr}$	Gate Charge Overdrive	——	14.6	——		See Fig. 6 and 16
Q$_{sw}$	Switch Charge (Q$_{gs2}$ + Q$_{gd}$)	——	15.9	——		
Q$_{oss}$	Output Charge	——	22	——	nC	V$_{DS}$ = 16V, V$_{GS}$ = 0V
t$_{d(on)}$	Turn-On Delay Time	——	18	——		V$_{DD}$ = 16V, V$_{GS}$ = 4.5V ③
t$_r$	Rise Time	——	47	——		I$_D$ = 18A
t$_{d(off)}$	Turn-Off Delay Time	——	27	——	ns	Clamped Inductive Load
t$_f$	Fall Time	——	4.9	——		
C$_{iss}$	Input Capacitance	——	5950	——		V$_{GS}$ = 0V
C$_{oss}$	Output Capacitance	——	990	——	pF	V$_{DS}$ = 15V
C$_{rss}$	Reverse Transfer Capacitance	——	460	——		f = 1.0MHz

Diode Characteristics

	Parameter	Min.	Typ.	Max.	Units	Conditions	
I$_S$	Continuous Source Current (Body Diode)	——	——	3.5	A	MOSFET symbol showing the integral reverse p-n junction diode.	
I$_{SM}$	Pulsed Source Current (Body Diode) ①	——	——	180			
V$_{SD}$	Diode Forward Voltage	——	——	1.0	V	T$_J$ = 25°C, I$_S$ = 18A, V$_{GS}$ = 0V ③	
t$_{rr}$	Reverse Recovery Time	——	38	57	ns	T$_J$ = 25°C, I$_F$ = 18A	
Q$_{rr}$	Reverse Recovery Charge	——	42	63	nC	di/dt = 100A/µs ③	
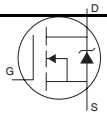
Notes:

① Repetitive rating; pulse width limited by max. junction temperature.

② Starting T$_J$ = 25°C, L = 1.2mH, R$_G$ = 25Ω, I$_{AS}$ = 18A.

③ Pulse width ≤ 400µs; duty cycle ≤ 2%.

④ Surface mounted on 1 in. square Cu board.

⑤ Used double sided cooling, mounting pad.

⑥ Mounted on minimum footprint full size board with metalized back and with small clip heatsink.

⑦ T$_C$ measured with thermal couple mounted to top (Drain) of part.

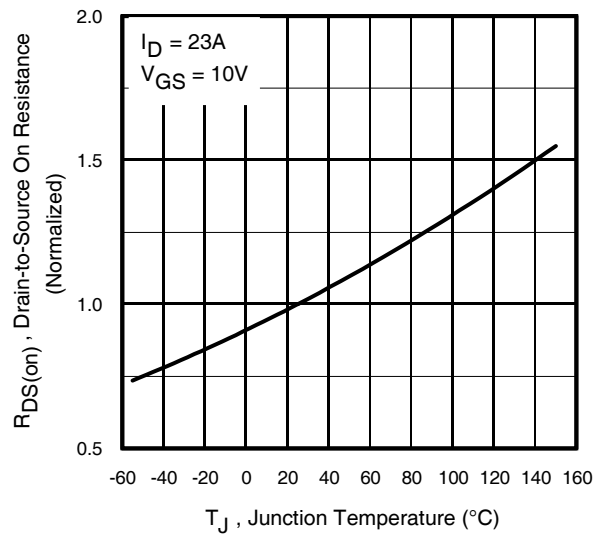⑧ R$_θ$ is measured at T$_J$ of approximately 90°C.
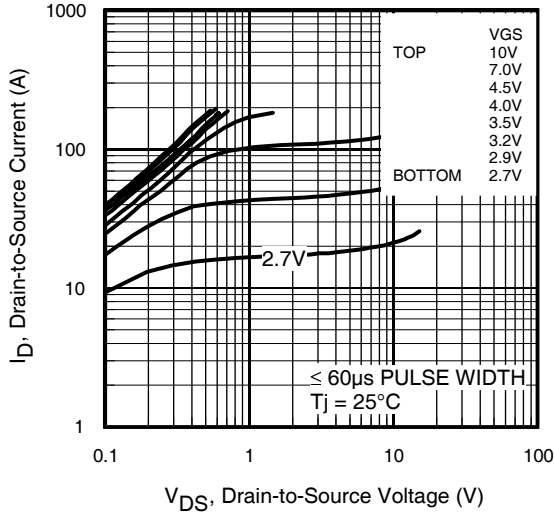
www.irf.com

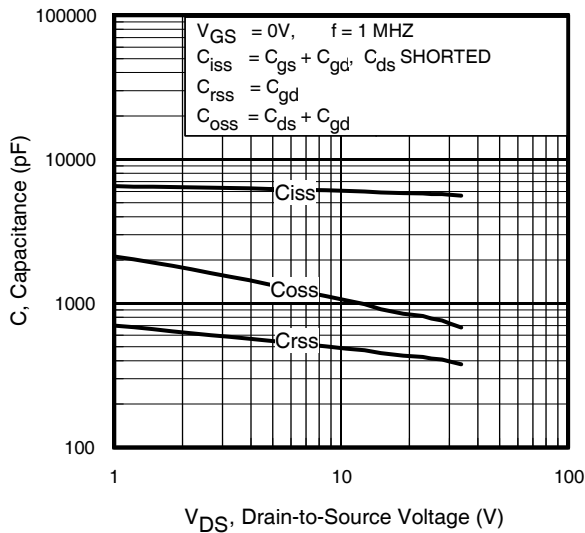**Fig 1.** Typical Output Characteristics
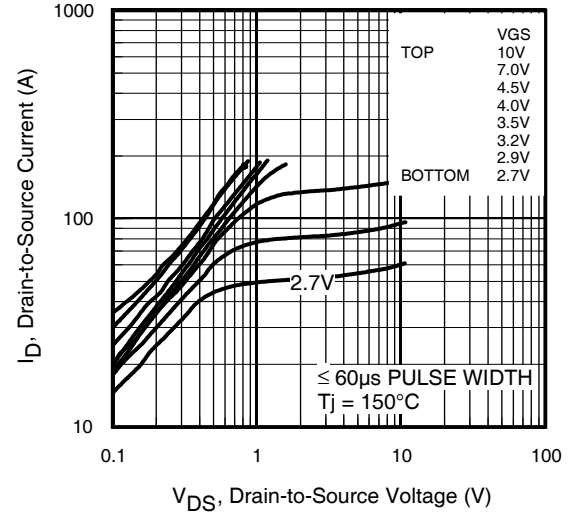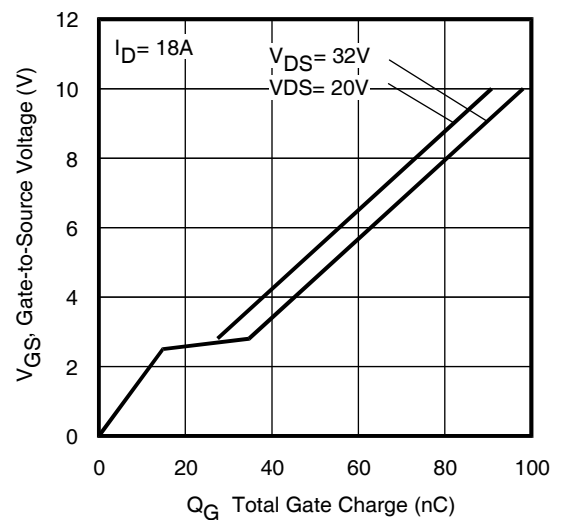

Fig 2. Typical Output Characteristics
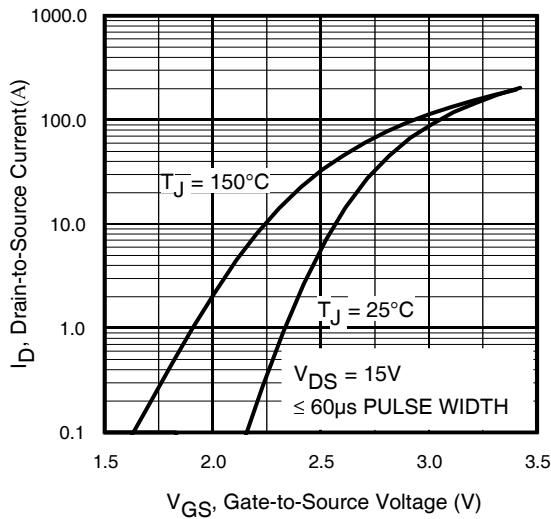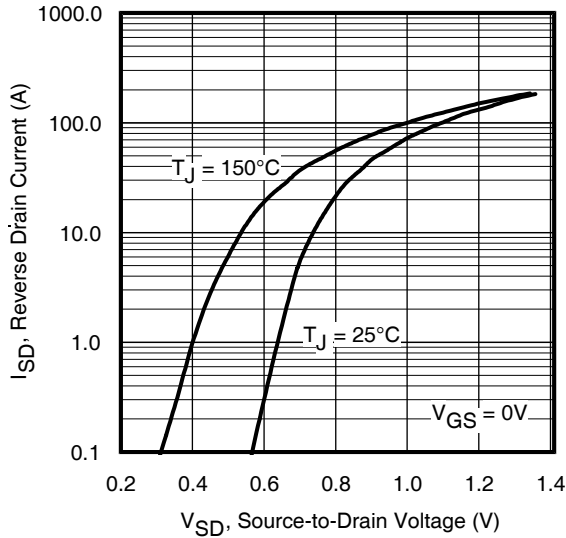

Fig 3. Typical Transfer Characteristics
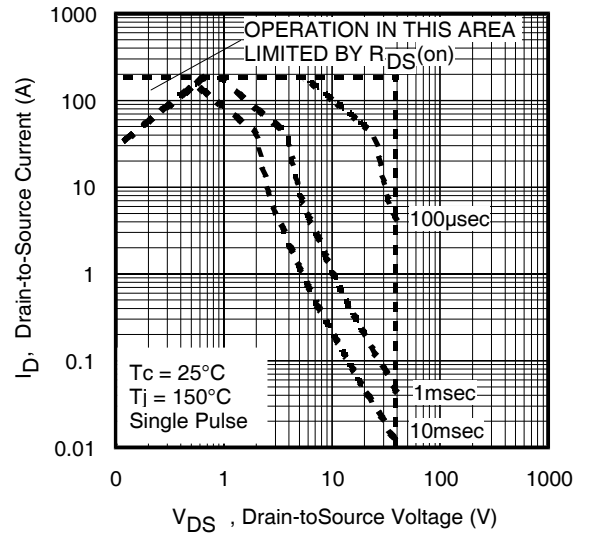

Fig 4. Normalized On-Resistance vs. Temperature

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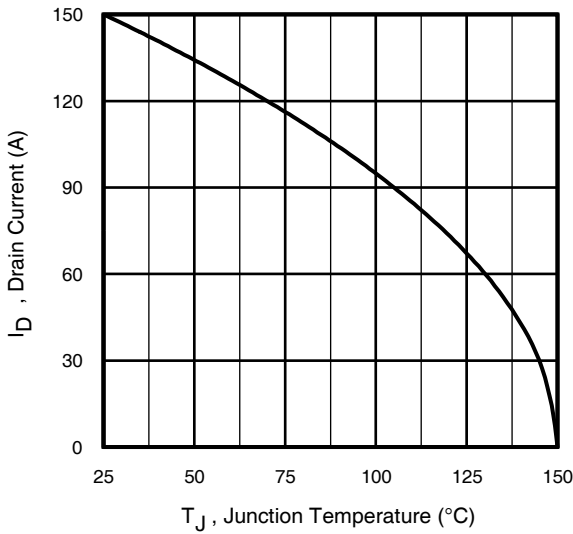

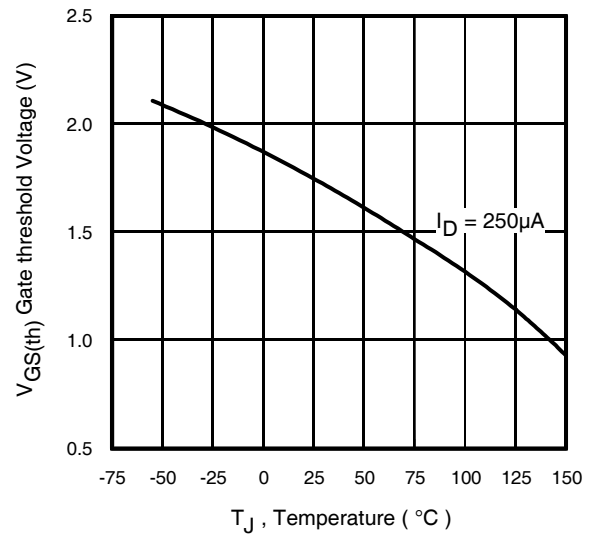**Fig 6.** Typical Gate Charge vs.Gate-to-Source Voltage

IRF6613
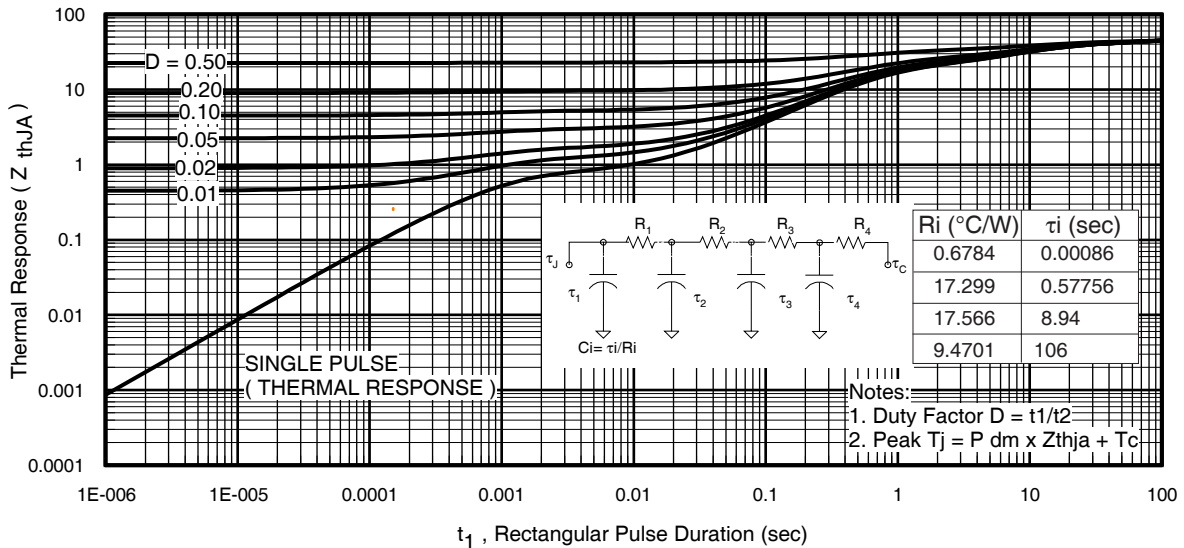
Fig 7. Typical Source-Drain Diode Forward Voltage

Fig 8. Maximum Safe Operating Area

Fig 9. Maximum Drain Current vs. Case Temperature

Fig 10. Threshold Voltage vs. Temperature

Ri (°C/W)	τi (sec)
0.6784	0.00086
17.299	0.57756
17.566	8.94
9.4701	106

Notes:
1. Duty Factor D = t1/t2
2. Peak Tj = P dm x Zthja + Tc

Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Ambient
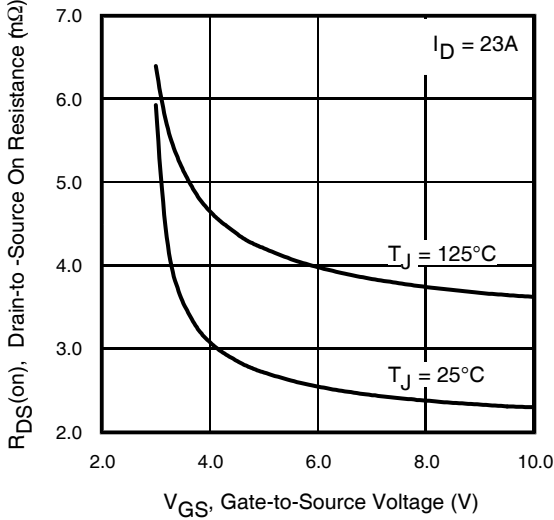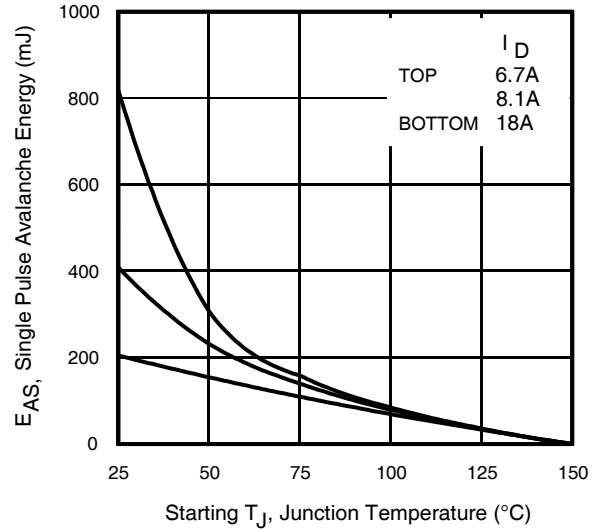
Fig 12. On-Resistance Vs. Gate Voltage
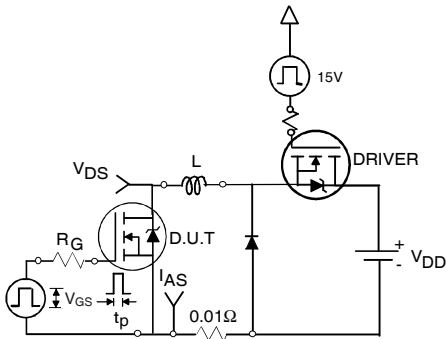

Fig 13c. Maximum Avalanche Energy Vs. Drain Current

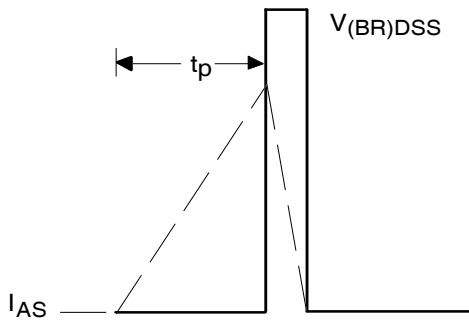**Fig 13a.** Unclamped Inductive Test Circuit

Fig 14a. Switching Time Test Circuit
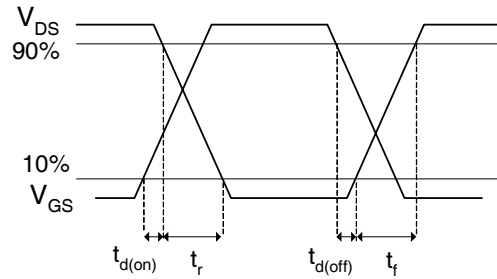

Fig 13b. Unclamped Inductive Waveforms
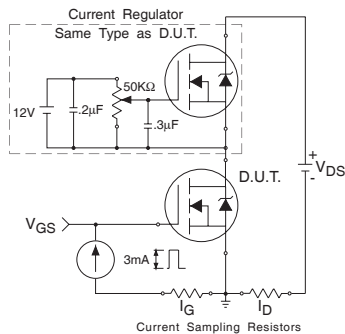

Fig 14b. Switching Time Waveforms

Fig 15. Gate Charge Test Circuit
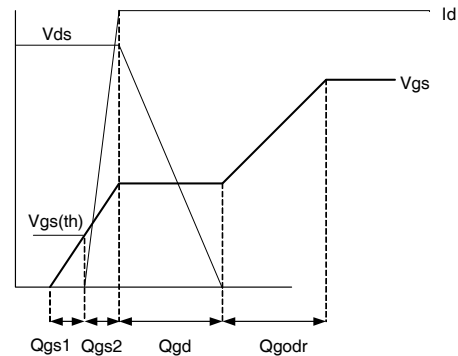
Fig 16. Gate Charge Waveform
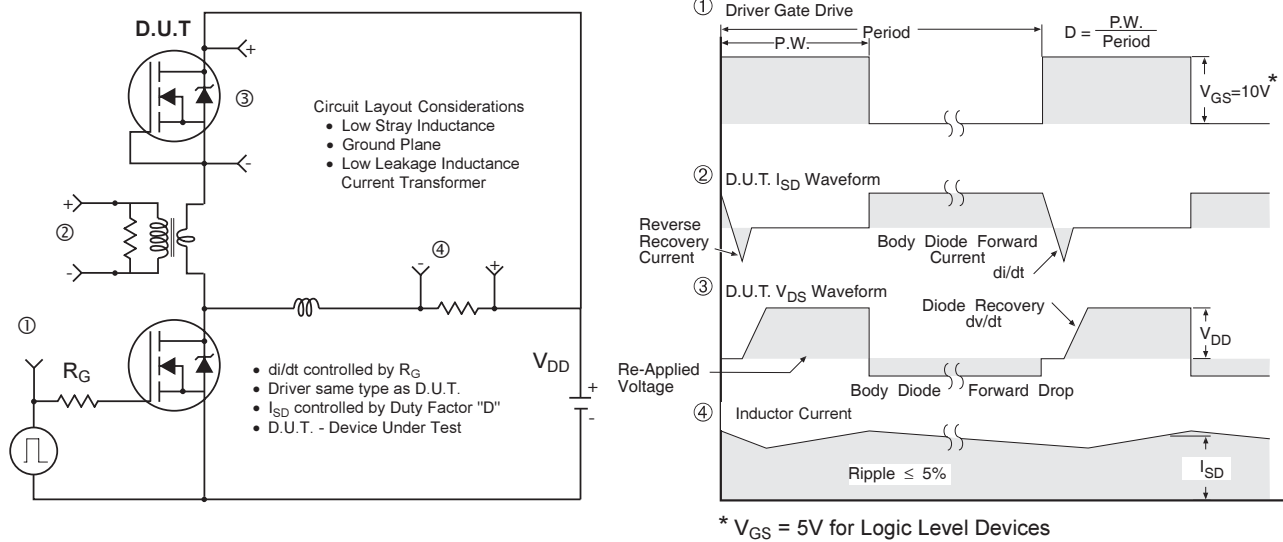
**Fig 17.** Diode Reverse Recovery Test Circuit for N-Channel HEXFET® Power MOSFETs

DirectFET™ Substrate and PCB Layout, MT Outline (Medium Size Can, T-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.

1- Drain
2- Drain
3- Source
4- Source
5- Gate
6- Drain
7- Drain
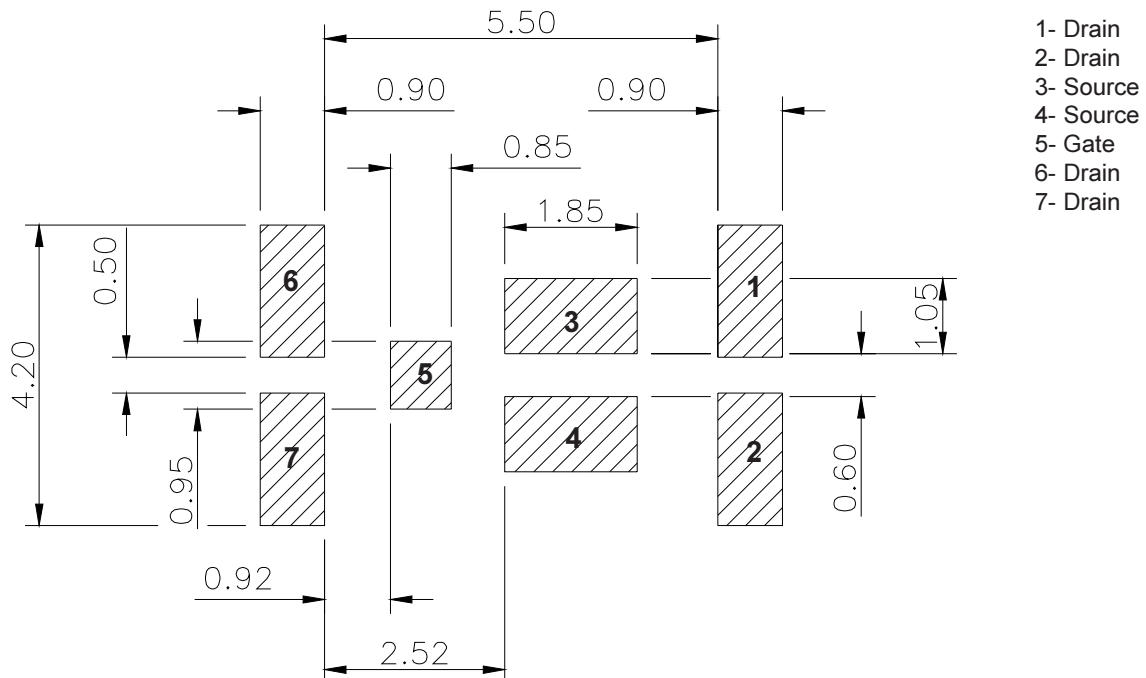
DirectFET™ Outline Dimension, MT Outline
(Medium Size Can, T-Designation).

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: CONTROLLING
DIMENSIONS ARE IN MM
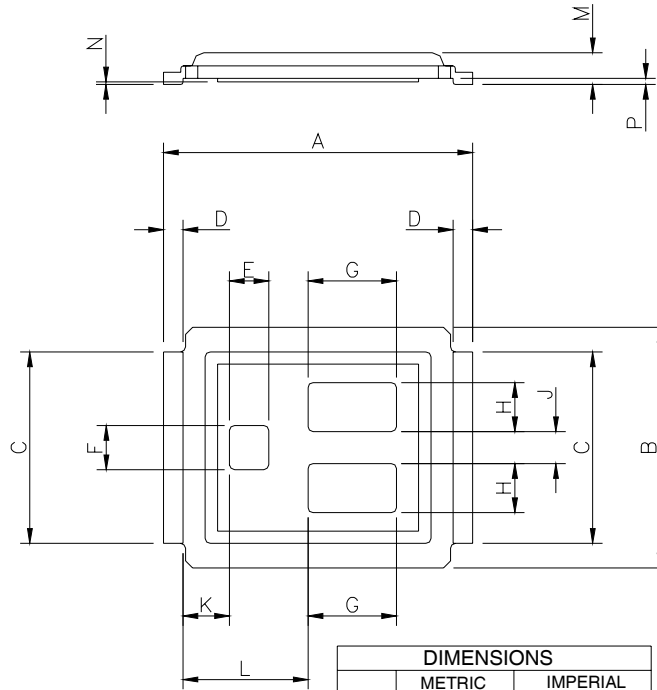
	DIMENSIONS			
	METRIC		IMPERIAL	
CODE	MIN	MAX	MIN	MAX
A	6.25	6.35	0.246	0.250
B	4.80	5.05	0.189	0.199
C	3.85	3.95	0.152	0.156
D	0.35	0.45	0.014	0.018
E	0.78	0.82	0.031	0.032
F	0.88	0.92	0.035	0.036
G	1.78	1.82	0.070	0.072
H	0.98	1.02	0.039	0.040
J	0.63	0.67	0.025	0.026
K	O.88	1.01	0.035	0.039
L	2.46	2.63	0.097	0.104
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
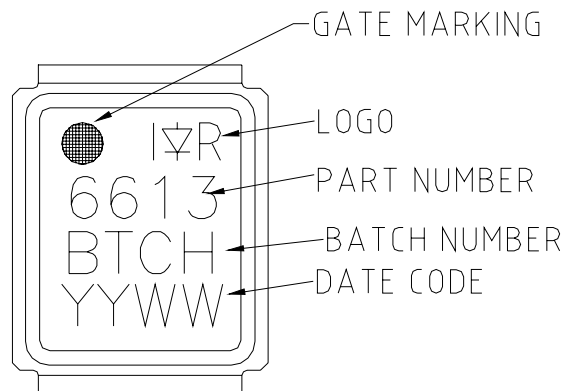
DirectFET™ Tape & Reel Dimension (Showing component orientation).
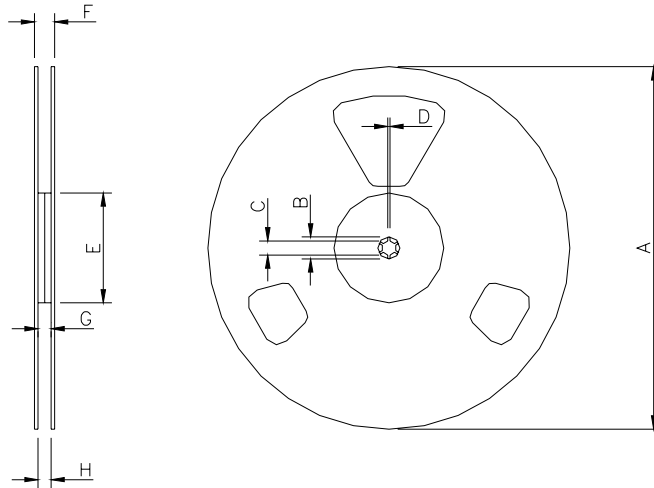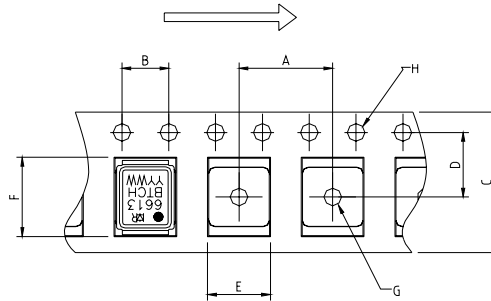

NOTE: Controlling dimensions in mm
Std reel quantity is 4800 parts. (ordered as IRF6613). For 1000 parts on 7" reel, order   IRF6613TR1

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

LOADED TAPE FEED DIRECTION

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
IΘR Rectifier

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