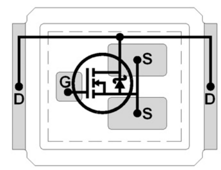
IRF6691

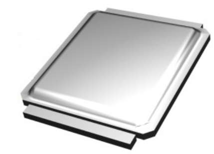
HEXFET® Power MOSFET plus Schottky Diode

- Application Specific MOSFETs
- Integrates Monolithic Trench Schottky Diode
- Ideal for CPU Core DC-DC Converters
- Low Conduction Losses
- Low Reverse Recovery Losses
- Low Switching Losses
- Low Reverse Recovery Charge and Low Vf
- Low Profile (<0.7 mm)
- Dual Sided Cooling Compatible
- Compatible with existing Surface Mount Techniques

V_{DSS}	$R_{DS(on)}$ max	Qg(typ.)
20V	2.5mΩ@V_{GS} = 4.5V	47nC
	1.8mΩ@V_{GS} = 10V	



MT


DirectFET™ ISOMETRIC

Applicable DirectFET Package/Layout Pad (see p.8,9 for details)

SQ	SX	ST		MQ	MX	MT				

Description

The IRF6691 combines IR's industry leading DirectFET package technology with the latest monolithic die technology, which integrates MOSFET plus free-wheeling Schottky diode. 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 IRF6691 is characterized with reduced on resistance ($R_{DS(on)}$), reverse recovery charge (Q_{rr}) and source to drain voltage (V_{SD}) to reduce conduction, reverse recovery and deadtime losses. These reduced total losses along with high Cdv/dt immunity make this product ideal for high efficiency DC-DC converters that power the latest generation of processors operating at higher frequencies. The IRF6691 has been optimized for parameters that are critical for synchronous MOSFET sockets operating in 12 volt buss converters.

Absolute Maximum Ratings

	Parameter	Max.	Units
V_{DS}	Drain-to-Source Voltage	20	V
V_{GS}	Gate-to-Source Voltage	±12	
I_D @ T_C = 25°C	Continuous Drain Current, V_{GS} @ 10V	180	A
I_D @ T_A = 25°C	Continuous Drain Current, V_{GS} @ 10V	32	
I_D @ T_A = 70°C	Continuous Drain Current, V_{GS} @ 10V	26	
I_{DM}	Pulsed Drain Current ①	260	
P_D @T_A = 25°C	Power Dissipation ⑤	2.8	W
P_D @T_A = 70°C	Power Dissipation ⑤	1.8	
P_D @T_C = 25°C	Power Dissipation	89	
	Linear Derating Factor	0.022	W/°C
T_J T_{STG}	Operating Junction and Storage Temperature Range	-40 to + 150	°C

Thermal Resistance

	Parameter	Typ.	Max.	Units
$R_{θJA}$	Junction-to-Ambient ④⑧	–––	45	°C/W
$R_{θJA}$	Junction-to-Ambient ⑤⑧	12.5	–––	
$R_{θJA}$	Junction-to-Ambient ⑥⑧	20	–––	
$R_{θJC}$	Junction-to-Case ⑦⑧	–––	1.4	
$R_{θJ-PCB}$	Junction-to-PCB Mounted	1.0	–––	

Notes ① through ⑧ are on page 10

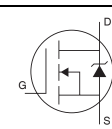
Static @ T_J = 25°C (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
BV_{DSS}	Drain-to-Source Breakdown Voltage	20	——	——	V	V_{GS} = 0V, I_D = 1.0mA
$\Delta BV_{DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	——	12	——	mV/°C	Reference to 25°C, I_D = 10mA
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	——	1.8	2.5	mΩ	V_{GS} = 4.5V, I_D = 12A ③
		——	1.2	1.8		V_{GS} = 10V, I_D = 15A ③
$V_{GS(th)}$	Gate Threshold Voltage	1.6	——	2.5	V	V_{DS} = V_{GS}, I_D = 250μA
$\Delta V_{GS(th)}/\Delta T_J$	Gate Threshold Voltage Coefficient	——	-4.1	——	mV/°C	I_D = 10mA, reference to 25°C
I_{DSS}	Drain-to-Source Leakage Current	——	——	1.4	mA	V_{DS} = 20V, V_{GS} = 0V
		——	——	500	μA	V_{DS} = 16V, V_{GS} = 0V
		——	——	5	mA	V_{DS} = 16V, V_{GS} = 0V, T_J = 125°C
I_{GSS}	Gate-to-Source Forward Leakage	——	——	100	nA	V_{GS} = 12V
	Gate-to-Source Reverse Leakage	——	——	-100		V_{GS} = -12V
gfs	Forward Transconductance	110	——	——	S	V_{DS} = 10V, I_D = 26A
Q_g	Total Gate Charge	——	47	71	nC	
Q_{gs1}	Pre-Vth Gate-to-Source Charge	——	14	——		V_{DS} = 10V
Q_{gs2}	Post-Vth Gate-to-Source Charge	——	4.4	——		V_{GS} = 4.5V
Q_{gd}	Gate-to-Drain Charge	——	15	——		I_D = 17A
Q_{godr}	Gate Charge Overdrive	——	14	——		See Fig. 17
Q_{sw}	Switch Charge (Q_{gs2} + Q_{gd})	——	19	——		
Q_{oss}	Output Charge	——	30	——	nC	V_{DS} = 10V, V_{GS} = 0V
R_G	Gate Resistance	——	0.60	1.5	Ω	
$t_{d(on)}$	Turn-On Delay Time	——	23	——	ns	V_{DD} = 16V, V_{GS} = 4.5V ③
t_r	Rise Time	——	95	——		I_D = 26A
$t_{d(off)}$	Turn-Off Delay Time	——	25	——		Clamped Inductive Load
t_f	Fall Time	——	10	——		
C_{iss}	Input Capacitance	——	6580	——	pF	V_{GS} = 0V
C_{oss}	Output Capacitance	——	2070	——		V_{DS} = 10V
C_{rss}	Reverse Transfer Capacitance	——	840	——		ƒ = 1.0MHz

Avalanche Characteristics

	Parameter	Typ.	Max.	Units
E_{AS}	Single Pulse Avalanche Energy②	——	230	mJ
I_{AR}	Avalanche Current ①	——	26	A

Diode Characteristics

	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	——	——	32	A	MOSFET symbol showing the integral reverse p-n junction diode. 
I_{SM}	Pulsed Source Current (Body Diode) ①	——	——	260		
V_{SD}	Diode Forward Voltage	——	——	0.65	V	T_J = 25°C, I_S = 25A, V_{GS} = 0V ③
t_{rr}	Reverse Recovery Time	——	32	48	ns	T_J = 25°C, I_F = 25A
Q_{rr}	Reverse Recovery Charge	——	26	39	nC	di/dt = 100A/μs ③

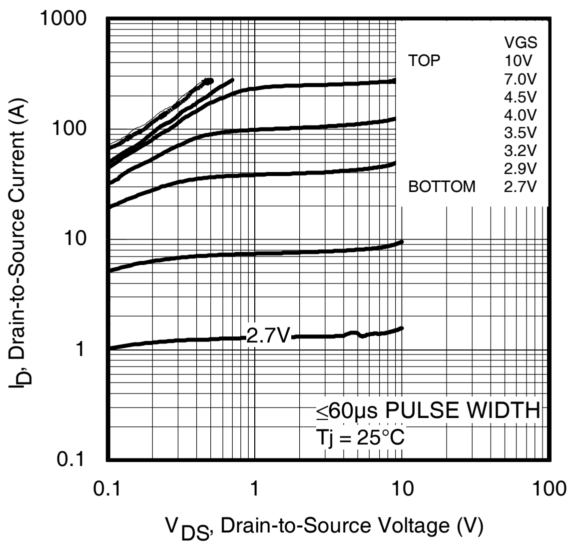


Fig 1. Typical Output Characteristics

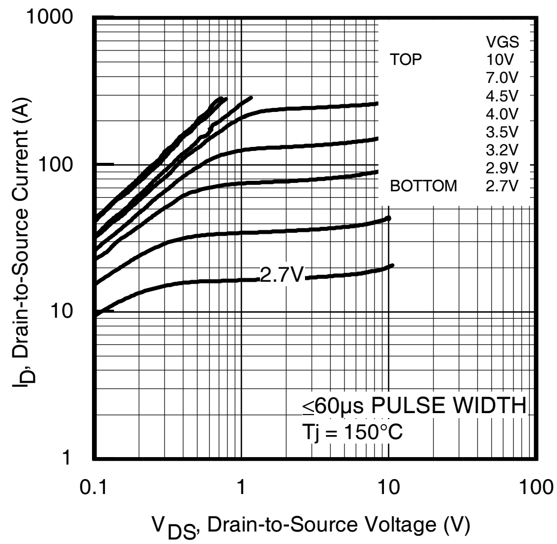


Fig 2. Typical Output Characteristics

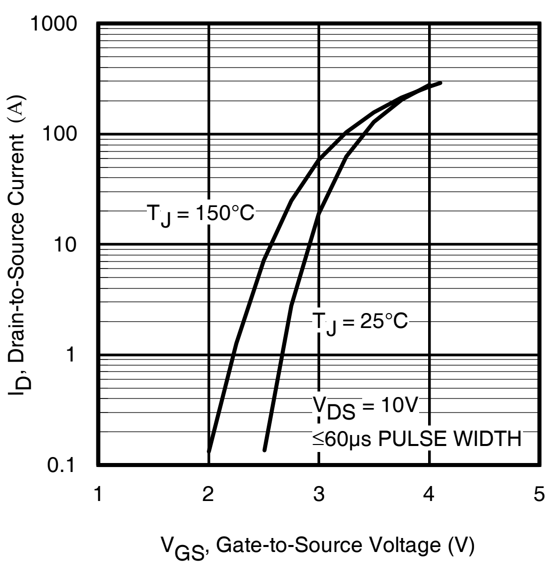


Fig 3. Typical Transfer Characteristics

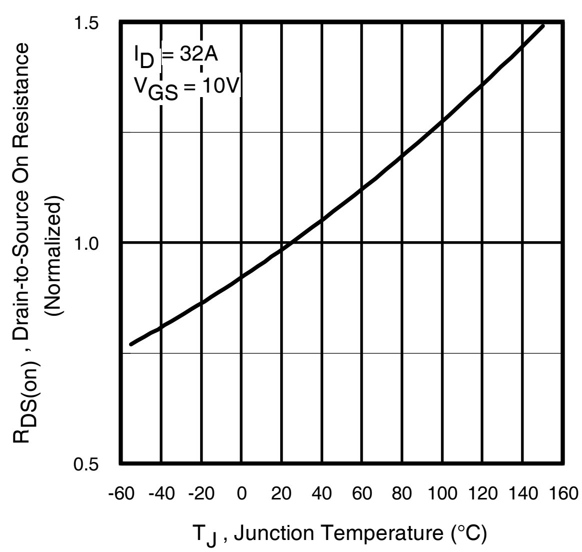


Fig 4. Normalized On-Resistance vs. Temperature

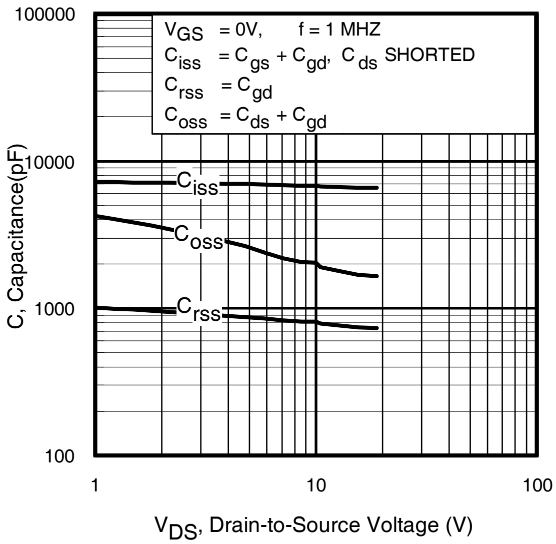


Fig 5. Typical Capacitance vs. Drain-to-Source Voltage

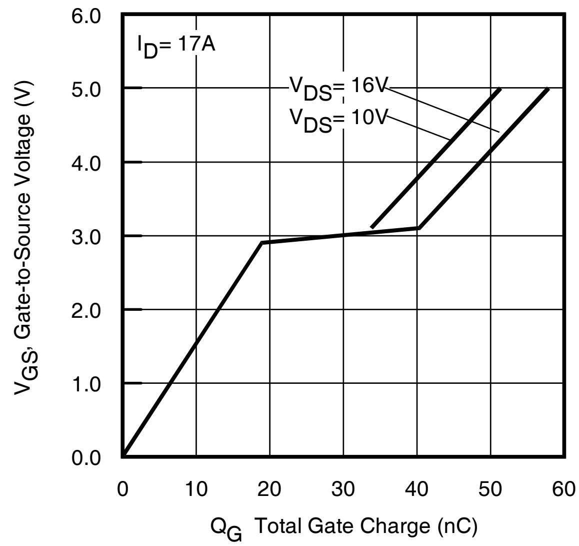


Fig 6. Typical Gate Charge vs. Gate-to-Source Voltage

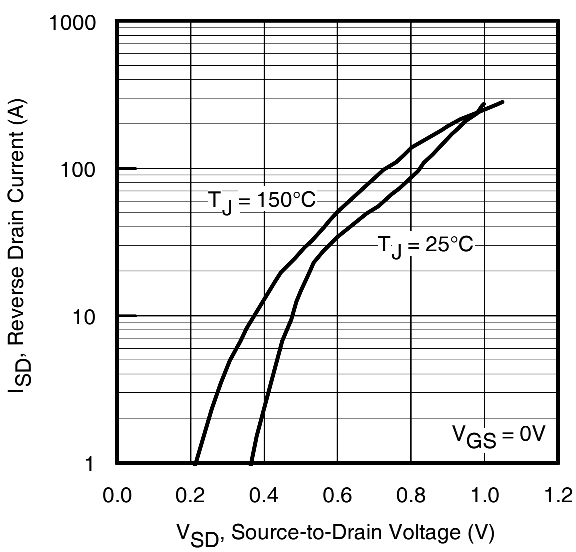


Fig 7. Typical Source-Drain Diode Forward Voltage

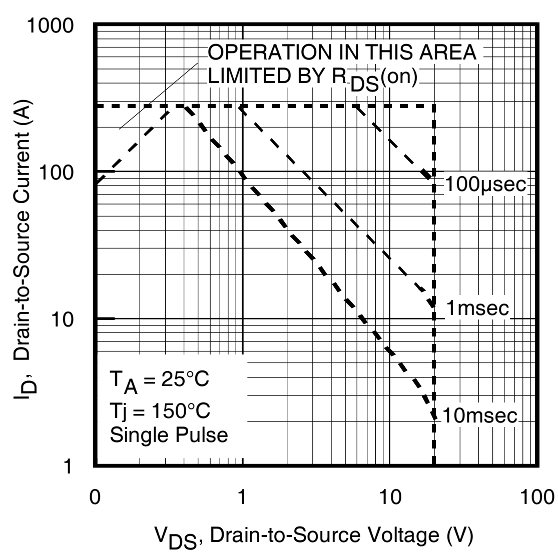


Fig 8. Maximum Safe Operating Area

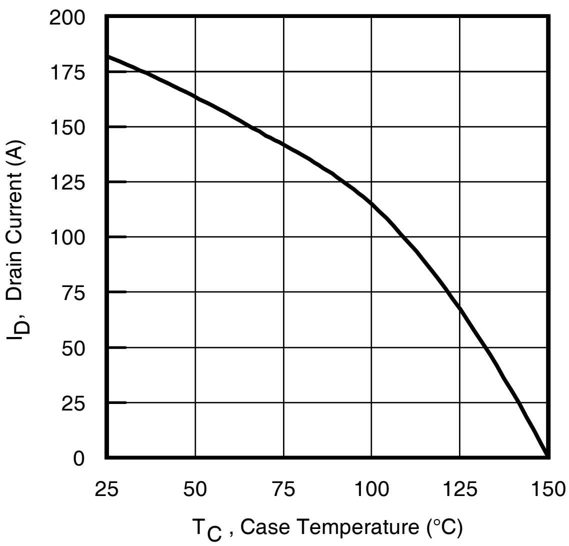


Fig 9. Maximum Drain Current vs. Case Temperature

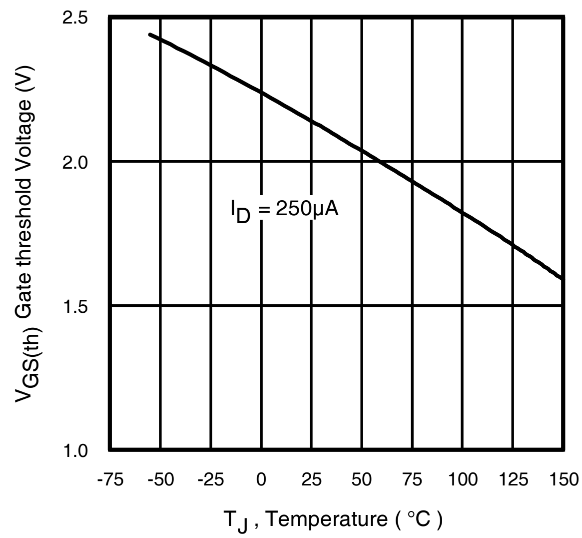


Fig 10. Threshold Voltage vs. Temperature

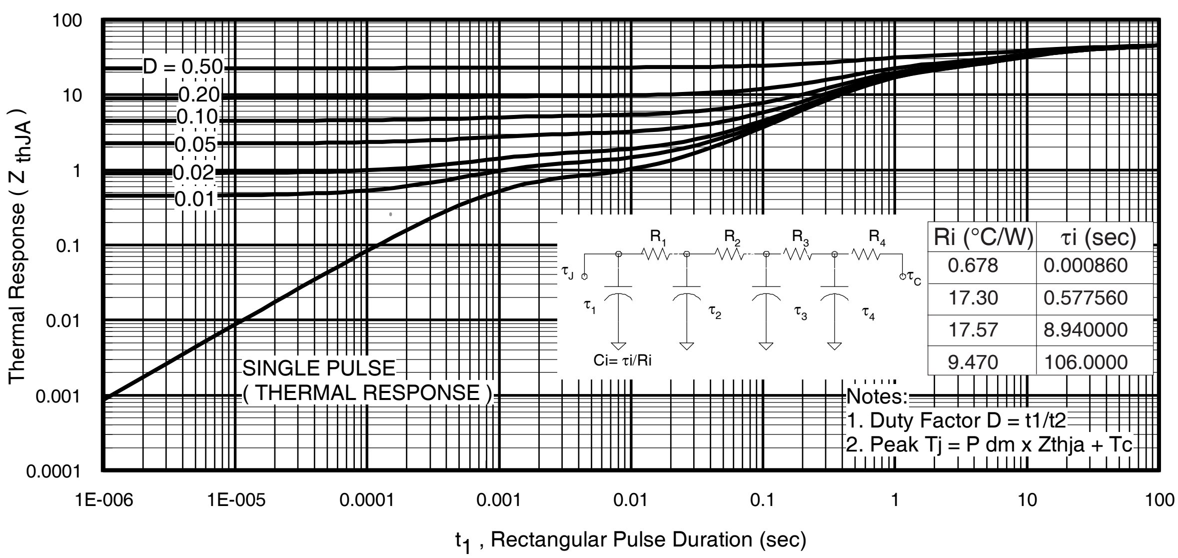


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Ambient

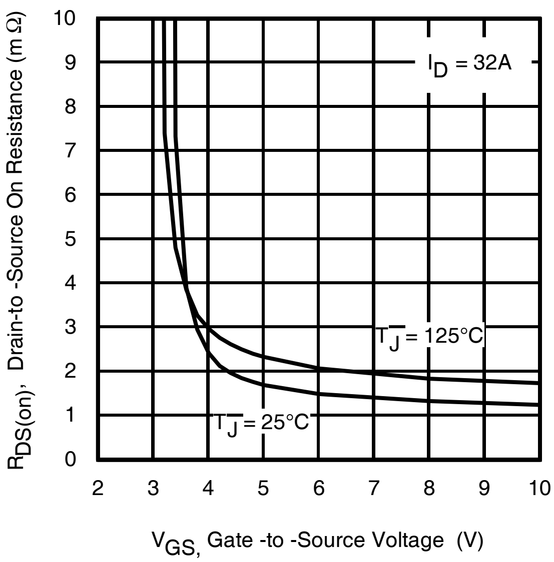


Fig 12. On-Resistance vs. Gate Voltage

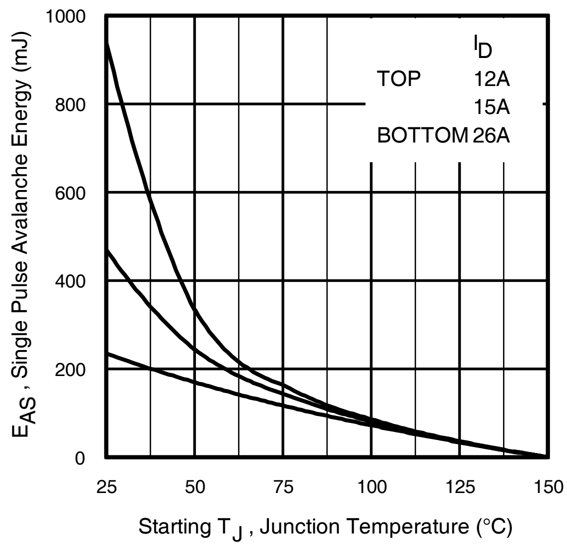


Fig 13c. Maximum Avalanche Energy vs. Drain Current

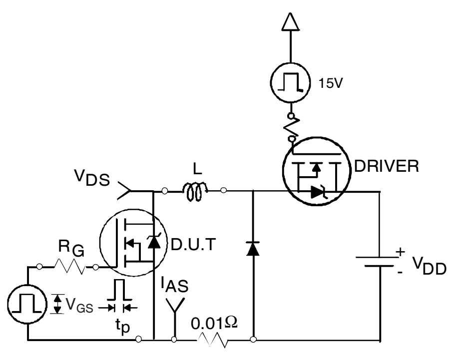


Fig 13a. Unclamped Inductive Test Circuit

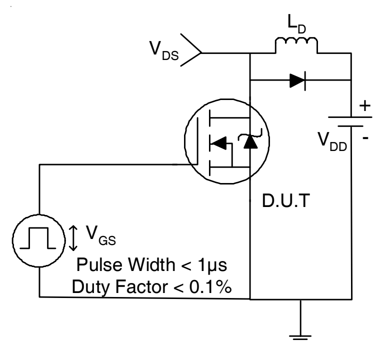


Fig 14a. Switching Time Test Circuit

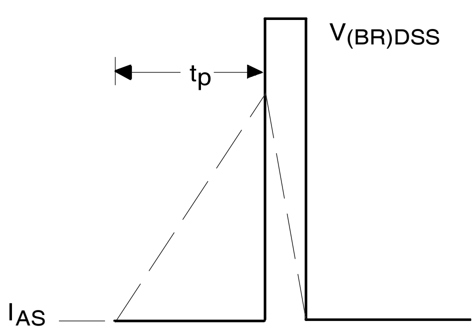


Fig 13b. Unclamped Inductive Waveforms

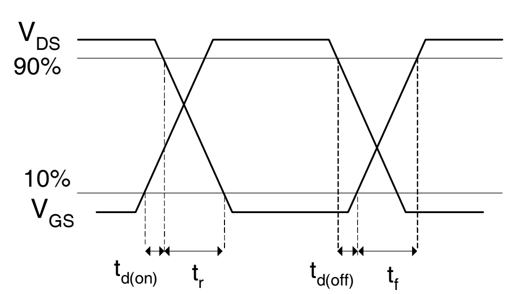
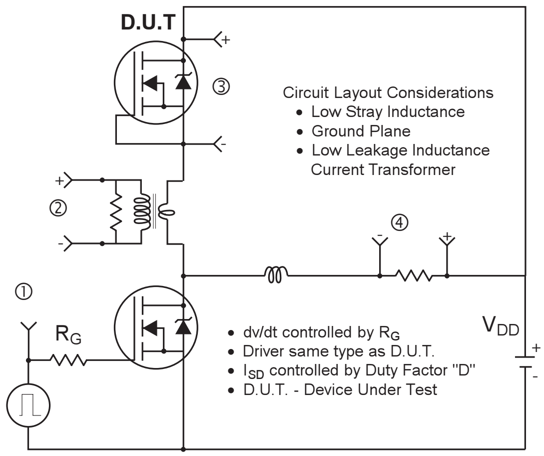


Fig 14b. Switching Time Waveforms



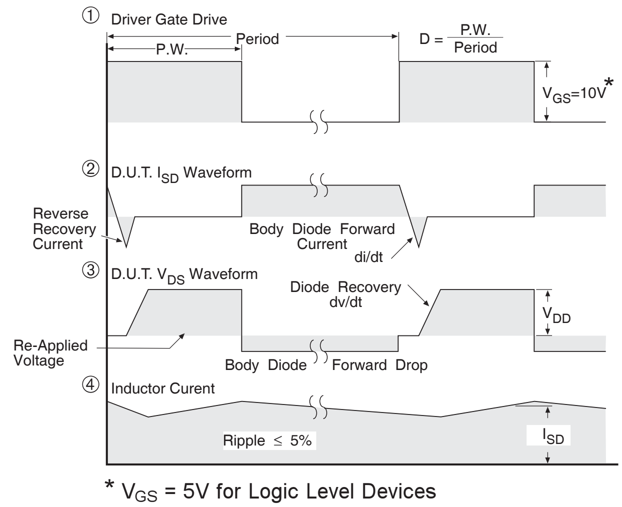


Fig 15. Peak Diode Recovery dv/dt Test Circuit for N-Channel HEXFET® Power MOSFETs

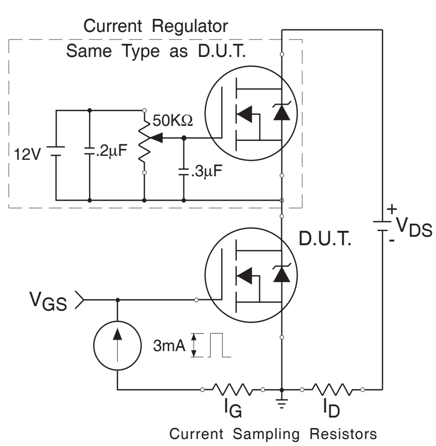


Fig 16. Gate Charge Test Circuit

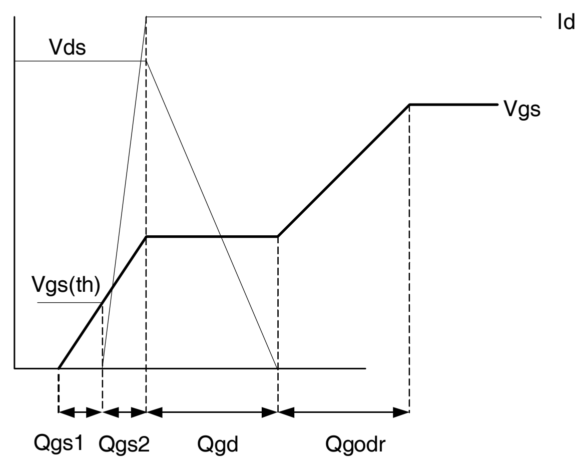
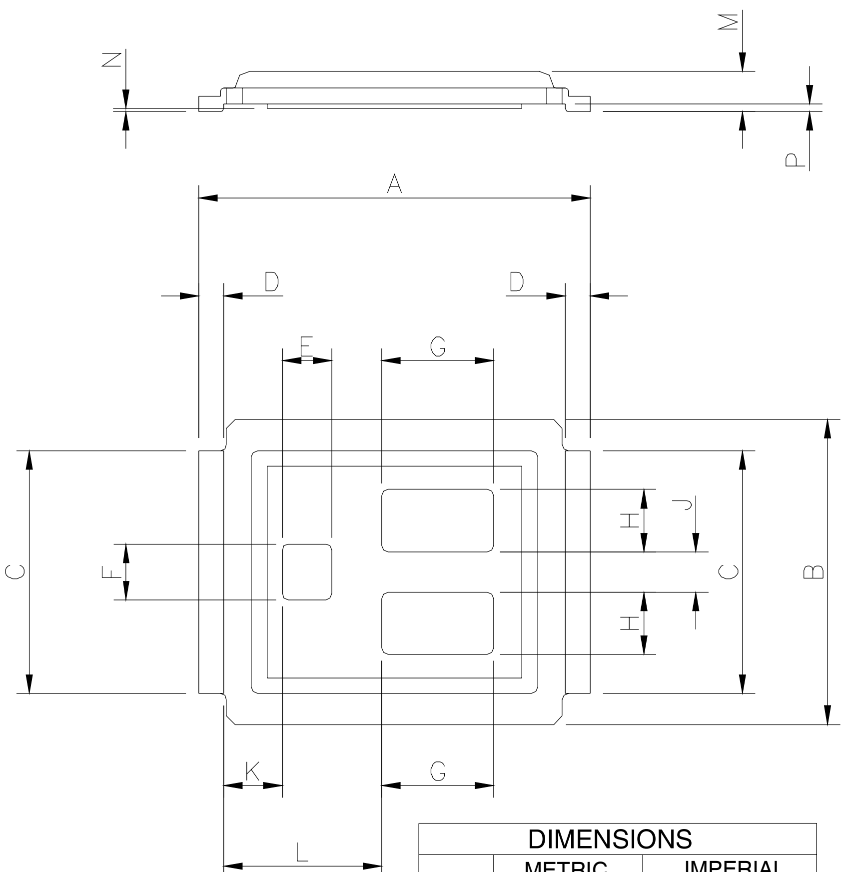


Fig 17. Gate Charge Waveform

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.

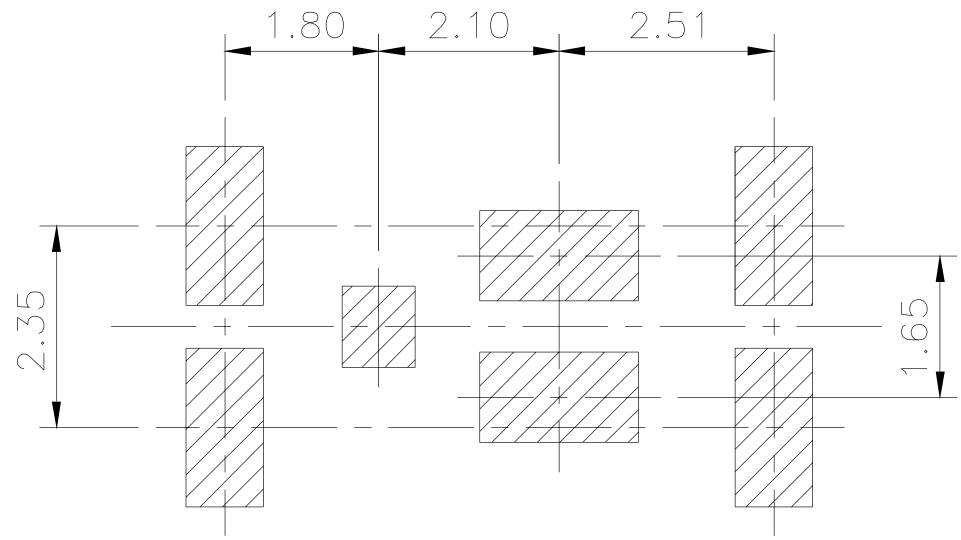


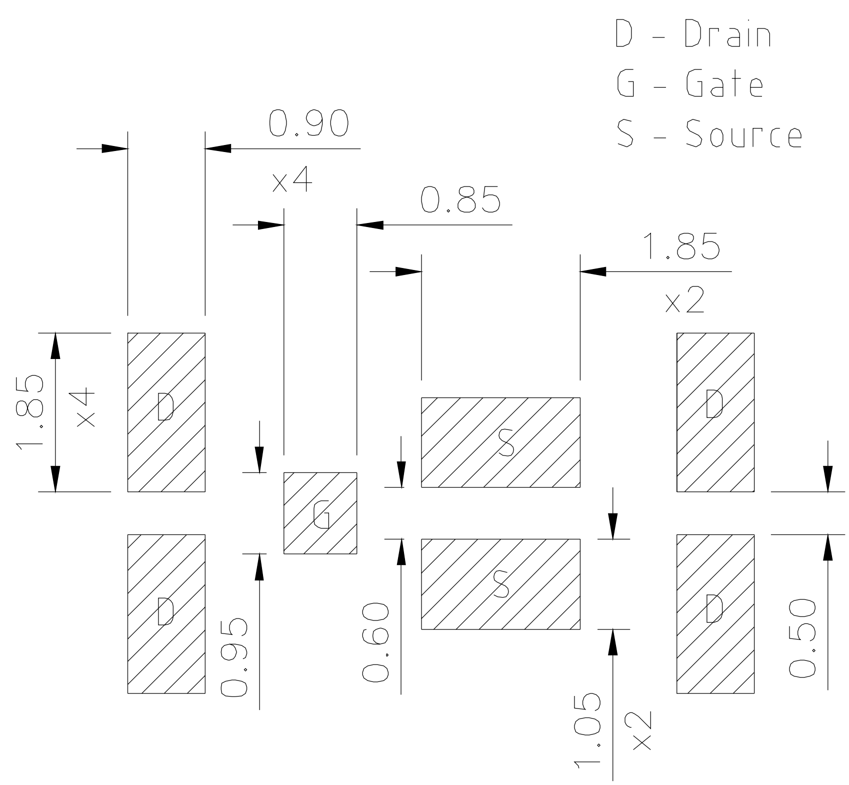
NOTE: CONTROLLING DIMENSIONS ARE IN MM

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

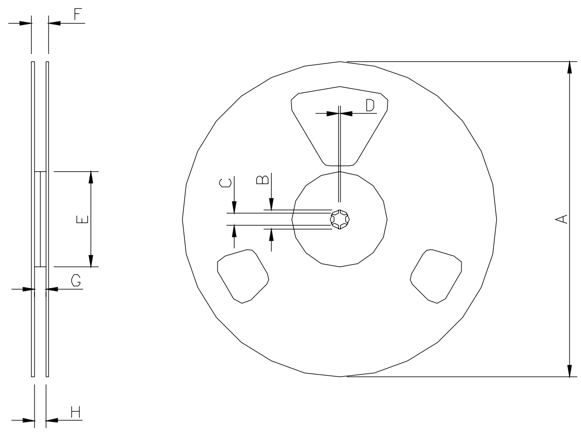
DirectFET™ Board Footprint, MT Outline
(Medium Size Can, T-Designation).

Please see DirectFET application note AN-1035 for all details regarding the assembly of DirectFET.
This includes all recommendations for stencil and substrate designs.



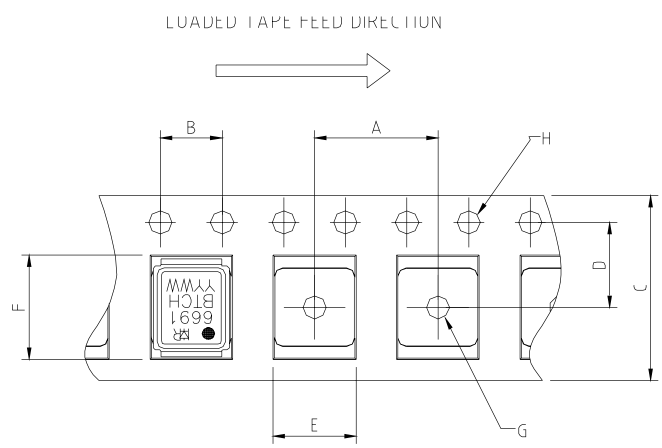


DirectFET™ Tape & Reel Dimension (Showing component orientation).



NOTE: Controlling dimensions in mm
Std reel quantity is 4800 parts. (ordered as IRF6691). For 1000 parts on 7" reel, order IRF6691TR1

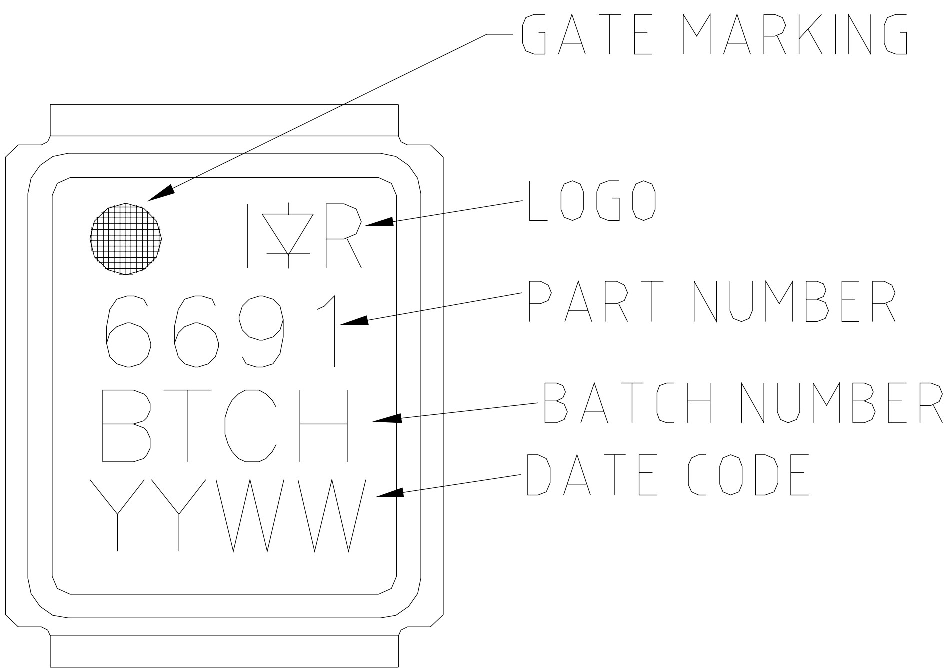
REEL DIMENSIONS								
	STANDARD OPTION **(QTY 4800)**				TR1 OPTION **(QTY 1000)**			
	METRIC		IMPERIAL		METRIC		IMPERIAL	
CODE	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
A	330.0	N.C	12.992	N.C	177.77	N.C	6.9	N.C
B	20.2	N.C	0.795	N.C	19.06	N.C	0.75	N.C
C	12.8	13.2	0.504	0.520	13.5	12.8	0.53	0.50
D	1.5	N.C	0.059	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

DirectFET™ Part Marking



Notes:

① Repetitive rating; pulse width limited by max. junction temperature.
② Starting $T_J = 25°C$, L = 0.72mH, $R_G = 25\Omega$, $I_{AS} = 26A$.
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.

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