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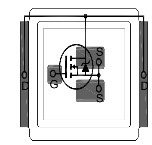
HEXFET® Power MOSFET plus Schottky Diode②

- RoHs Compliant Containing No Lead and Bromide ②
- Integrated Monolithic Schottky Diode
- Low Profile (<0.7 mm)
- Dual Sided Cooling Compatible ①
- Low Package Inductance
- Optimized for High Frequency Switching
- Ideal for CPU Core DC-DC Converters
- Optimized for Sync. FET socket of Sync. Buck Converter
- Low Conduction and Switching Losses
- Compatible with existing Surface Mount Techniques ①
- 100% Rg tested
- Footprint compatible to DirectFET

Typical values (unless specified)

V_{DSS}	V_{GS}	$R_{DS(on)}$	$R_{DS(on)}$
25V min	±16V max	0.9mΩ @ 10V	1.4mΩ @ 4.5V

$Q_{g\ tot}$	Q_{gd}	Q_{gs2}	Q_{rr}	Q_{oss}	$V_{gs(th)}$
31nC	10nC	3.0nC	58nC	33nC	1.6V


MX


DirectFET™ ISOMETRIC

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

SQ	SX	ST		MQ	MX	MT	MP			

Description

The IRF6894MPbF 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 a 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. 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 IRF6894MPbF balances industry leading on-state resistance while minimizing gate charge along with low gate resistance to reduce both conduction and switching losses. This part contains an integrated Schottky diode to reduce the Qrr of the body drain diode further reducing the losses in a Synchronous Buck circuit. The reduced losses make this product ideal for high frequency/high efficiency DC-DC converters that power high current loads such as the latest generation of microprocessors. The IRF6894MPbF has been optimized for parameters that are critical in synchronous buck converter's Sync FET sockets.

Base part number	Package Type	Standard Pack		Orderable Part Number
		Form	Quantity	
IRF6894MTRPbF	DirectFET® Medium Can	Tape and Reel	4800	IRF6894MTRPbF

Absolute Maximum Ratings

	Parameter	Max.	Units
V_{DS}	Drain-to-Source Voltage	25	V
V_{GS}	Gate-to-Source Voltage	±16	
I_D @ T_A = 25°C	Continuous Drain Current, V_{GS} @ 10V (Silicon Limited)④	37	A
I_D @ T_A = 70°C	Continuous Drain Current, V_{GS} @ 10V (Silicon Limited)④	29	
I_D @ T_C = 25°C	Continuous Drain Current, V_{GS} @ 10V (Silicon Limited)③	163	
I_{DM}	Pulsed Drain Current⑤	296	
E_{AS}	Single Pulse Avalanche Energy ⑥	540	mJ
I_{AR}	Avalanche Current ⑥	30	A

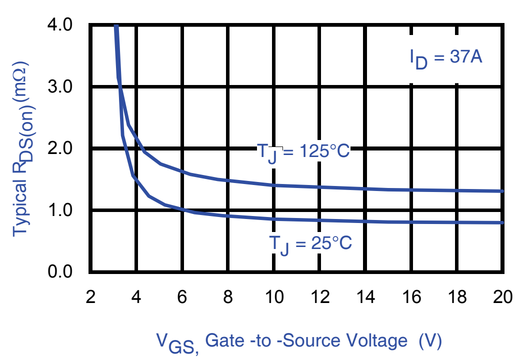


Fig 1. Typical On-Resistance vs. Gate Voltage

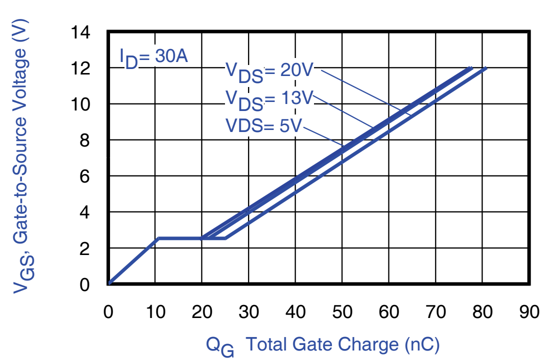


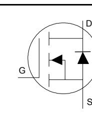
Fig 2. Typical Total Gate Charge vs. Gate-to-Source Voltage

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 TC measured with thermocouple mounted to top (Drain) of part.
⑤ Repetitive rating; pulse width limited by max. junction temperature.
⑥ Starting T_J = 25°C, L = 1.2mH, R_G = 50Ω, I_{AS} = 30A.

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

	Parameter	Min.	Typ.	Max.	Units	Conditions
BV_{DSS}	Drain-to-Source Breakdown Voltage	25	—	—	V	V_{GS} = 0V, I_D = 1.0mA
$\Delta BV_{DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	0.02	—	V/°C	I_D = 10mA (25°C-125°C)
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	0.9	1.3	mΩ	V_{GS} = 10V, I_D = 37A ⑦
		—	1.4	1.8		V_{GS} = 4.5V, I_D = 30A ⑦
$V_{GS(th)}$	Gate Threshold Voltage	1.1	1.6	2.1	V	V_{DS} = V_{GS}, I_D = 100μA
$\Delta V_{GS(th)}/\Delta T_J$	Gate Threshold Voltage Temp. Coefficient	—	-3.8	—	mV/°C	V_{DS} = V_{GS}, I_D = 10mA
I_{DSS}	Drain-to-Source Leakage Current	—	—	500	μA	V_{DS} = 20 V, V_{GS} = 0V
I_{GSS}	Gate-to-Source Forward Leakage	—	—	100	nA	V_{GS} = 16V
	Gate-to-Source Reverse Leakage	—	—	-100		V_{GS} = -16V
gfs	Forward Transconductance	193	—	—	S	V_{DS} = 13V, I_D = 30A
Q_g	Total Gate Charge	—	31	47	nC	V_{DS} = 13V
Q_{gs1}	Pre– Vth Gate-to-Source Charge	—	8.1	—		V_{GS} = 4.5V
Q_{gs2}	Post– Vth Gate-to-Source Charge	—	3.0	—		I_D = 30A
Q_{gd}	Gate-to-Drain Charge	—	10	—		See Fig 15
Q_{godr}	Gate Charge Overdrive	—	10	—		
Q_{sw}	Switch Charge ($Q_{gs2} + Q_{gd}$)	—	13	—		
Q_{oss}	Output Charge	—	33	—	nC	V_{DS} = 16V, V_{GS} = 0V
R_G	Gate Resistance	—	0.2	—	Ω	
$t_{d(on)}$	Turn-On Delay Time	—	17	—	ns	V_{DD} = 13V, V_{GS} = 4.5V⑦
t_r	Rise Time	—	47	—		I_D = 30A
$t_{d(off)}$	Turn-Off Delay Time	—	23	—		R_G= 1.8Ω
t_f	Fall Time	—	13	—		See Fig 17
C_{iss}	Input Capacitance	—	4232	—	pF	V_{GS} = 0V
C_{oss}	Output Capacitance	—	1260	—		V_{DS} = 13V
C_{rss}	Reverse Transfer Capacitance	—	255	—		f = 1.0MHz

Diode Characteristics

	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	—	—	37	A	MOSFET symbol showing the integral reverse p-n junction diode. 
I_{SM}	Pulsed Source Current (Body Diode) ⑤	—	—	296		
V_{SD}	Diode Forward Voltage	—	—	0.75	V	T_J = 25°C, I_S = 30A, V_{GS} = 0V ⑦
t_{rr}	Reverse Recovery Time	—	28	42	ns	T_J = 25°C, I_F = 30A
Q_{rr}	Reverse Recovery Charge	—	58	87	nC	di/dt = 320A/μs ⑦

Notes:
⑤ Repetitive rating; pulse width limited by max. junction temperature.
⑦ Pulse width ≤ 400μs; duty cycle ≤ 2%.

Absolute Maximum Ratings

Symbol	Parameter	Max.	Units
P_D @T_A = 25°C	Power Dissipation ③④	2.8	W
P_D @T_A = 70°C	Power Dissipation ③④	1.8	
P_D @T_C = 25°C	Power Dissipation ④	54	
T_P	Peak Soldering Temperature	270	°C
T_J T_{STG}	Operating Junction and Storage Temperature Range	-40 to + 150	

Thermal Resistance

Symbol	Parameter	Typ.	Max.	Units
$R_{\theta JA}$	Junction-to-Ambient ③	——	45	°C/W
$R_{\theta JA}$	Junction-to-Ambient ⑧	12.5	——	
$R_{\theta JA}$	Junction-to-Ambient ⑨	20	——	
$R_{\theta JC}$	Junction-to-Can ④⑩	——	2.3	
$R_{\theta JA-PCB}$	Junction-to-PCB Mounted	1.0	——	
	Linear Derating Factor ③	0.022		W/°C

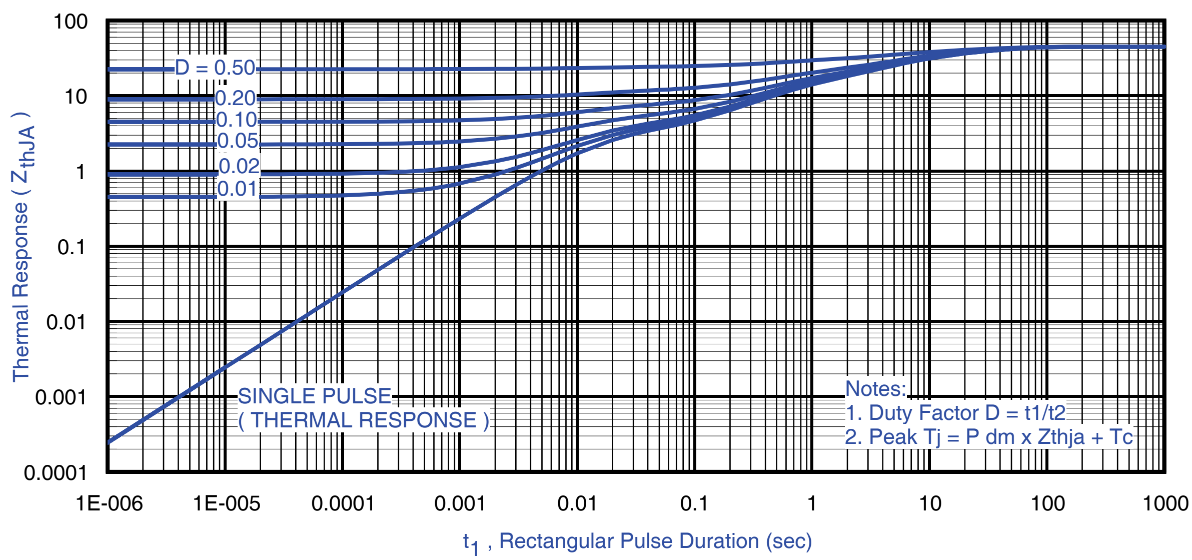
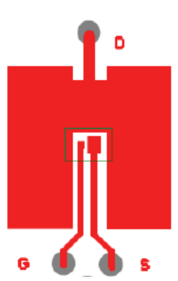


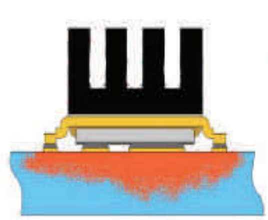
Fig 3. Maximum Effective Transient Thermal Impedance, Junction-to-Ambient③

Notes:

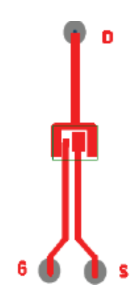
③ Surface mounted on 1 in. square Cu board, steady state.
④ T_C measured with thermocouple incontact with top (Drain) of part.
⑧ Used double sided cooling, mounting pad with large heatsink.
⑨ Mounted on minimum footprint full size board with metalized back and with small clip heatsink.
⑩ R_θ is measured at T_J of approximately 90°C.



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



⑨ Mounted to a PCB with small clip heatsink (still air)



⑨ Mounted on minimum footprint full size board with metalized back and with small clip heatsink (still air)

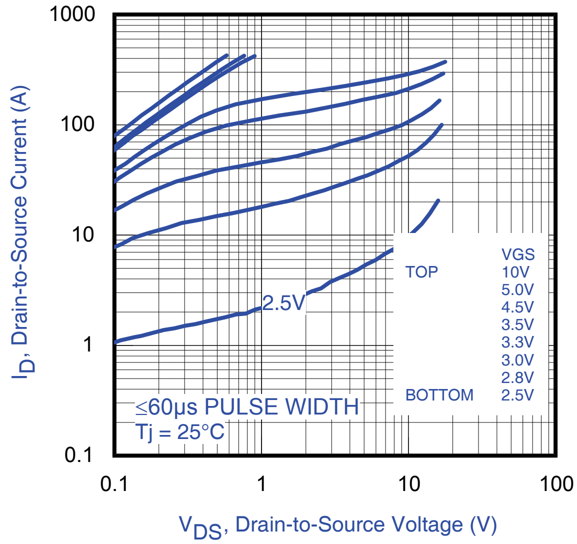


Fig 4. Typical Output Characteristics

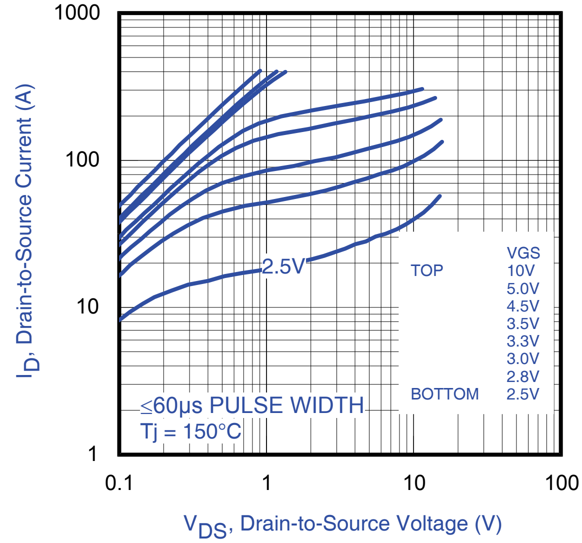


Fig 5. Typical Output Characteristics

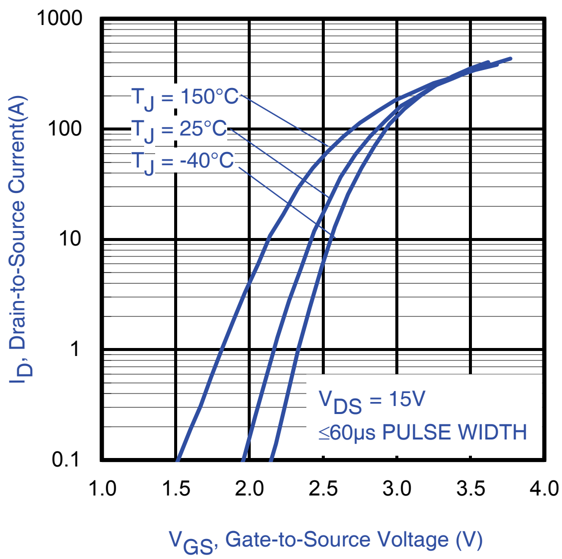


Fig 6. Typical Transfer Characteristics

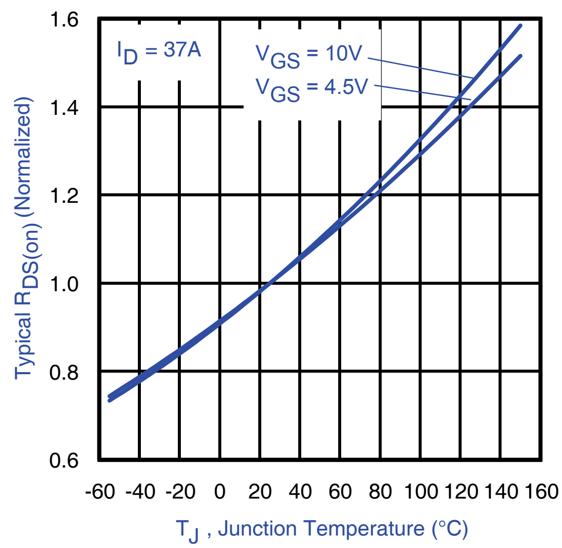


Fig 7. Normalized On-Resistance vs. Temperature

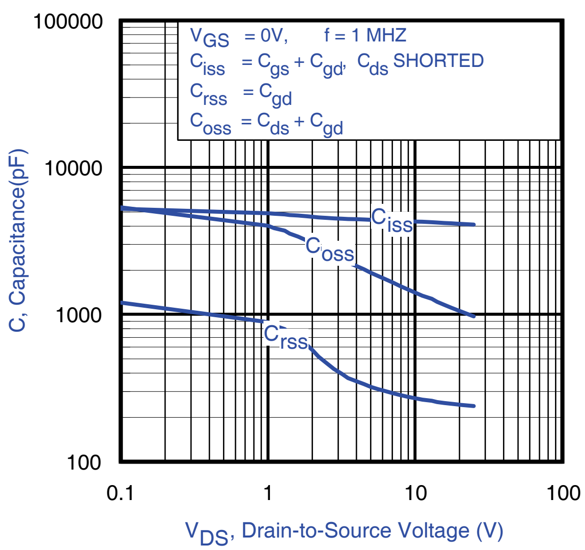


Fig 8. Typical Capacitance vs. Drain-to-Source Voltage

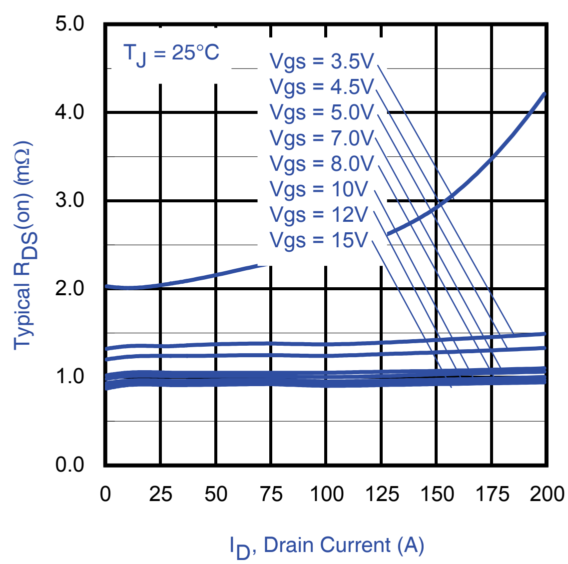


Fig 9. Typical On-Resistance vs. Drain Current and Gate Voltage

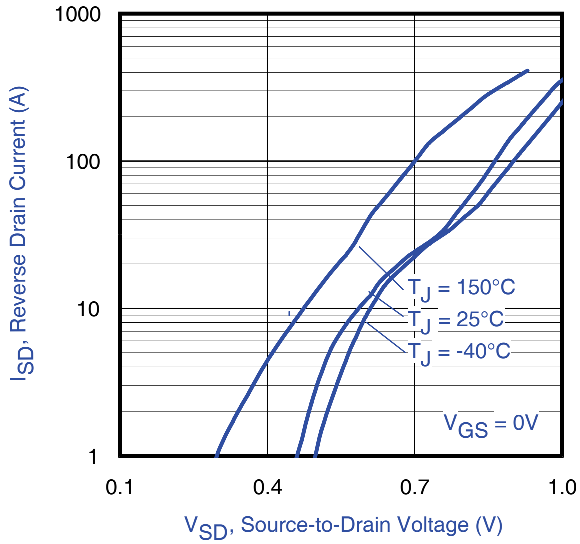


Fig 10. Typical Source-Drain Diode Forward Voltage

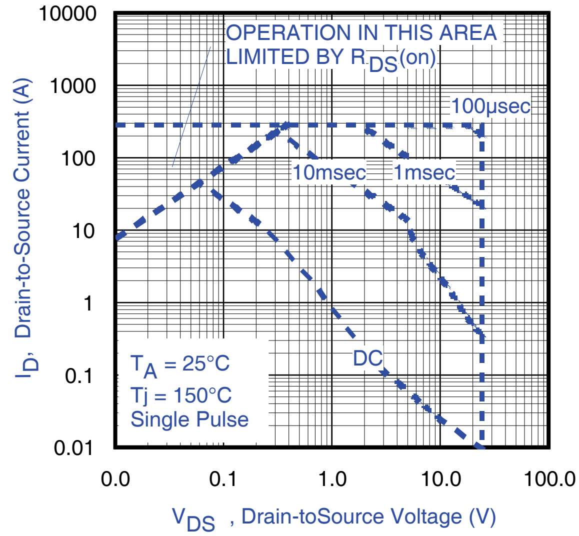


Fig 11. Maximum Safe Operating Area

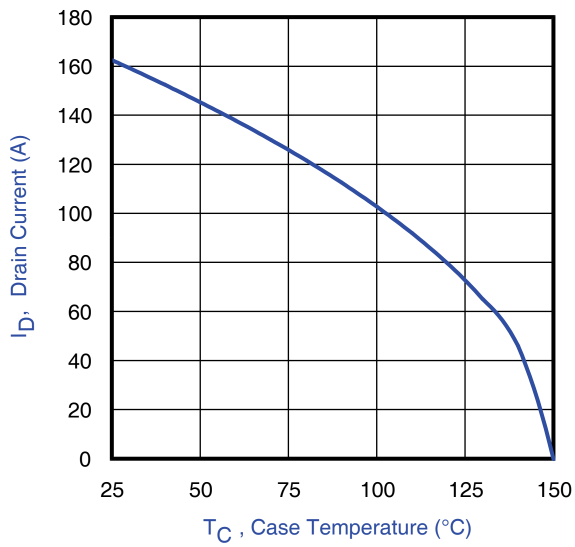


Fig 12. Maximum Drain Current vs. Case Temperature

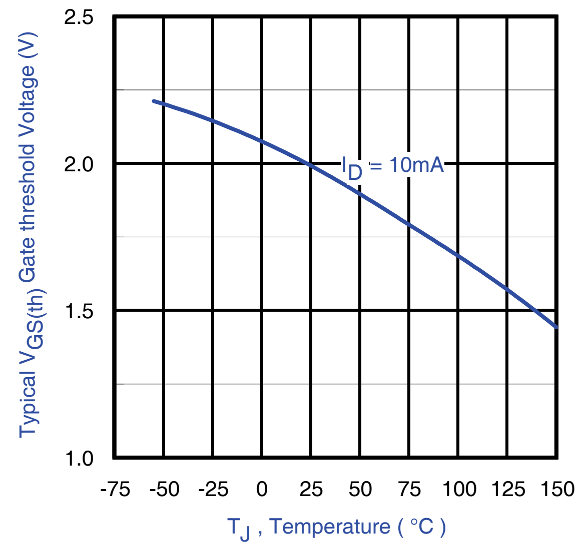


Fig 13. Typical Threshold Voltage vs. Junction Temperature

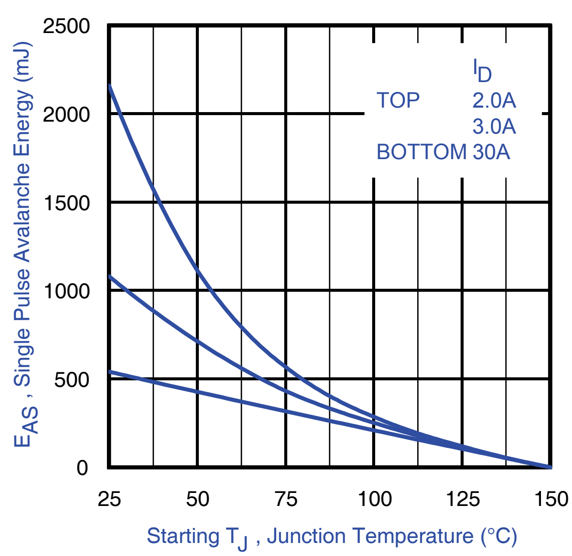


Fig 14. Maximum Avalanche Energy vs. Drain Current

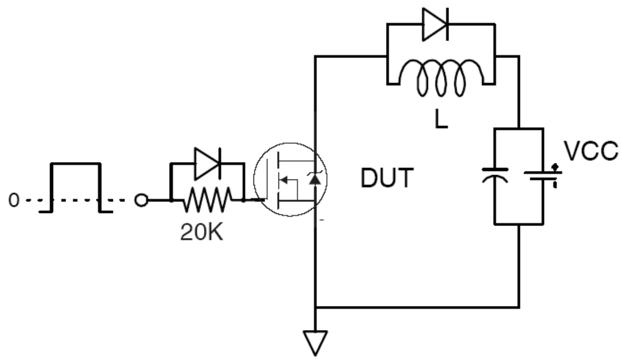


Fig 15a. Gate Charge Test Circuit

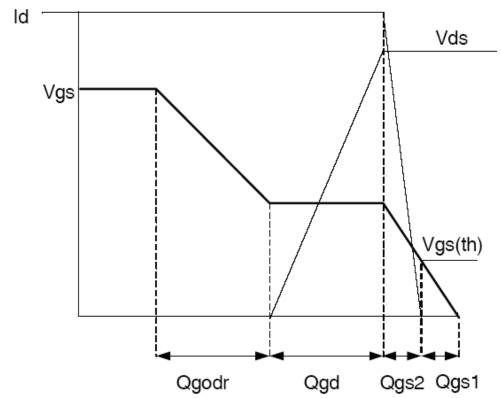


Fig 15b. Gate Charge Waveform

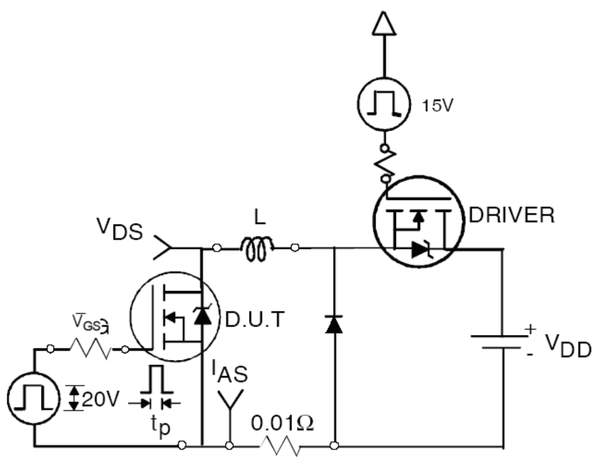


Fig 16a. Unclamped Inductive Test Circuit

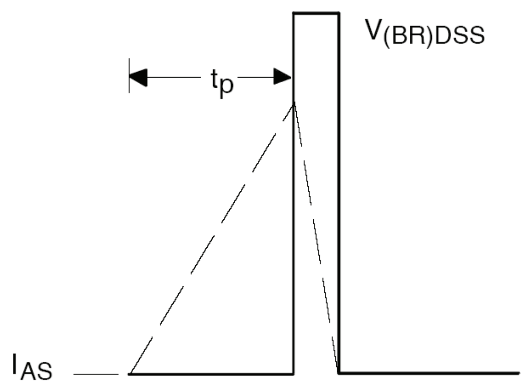


Fig 16b. Unclamped Inductive Waveforms

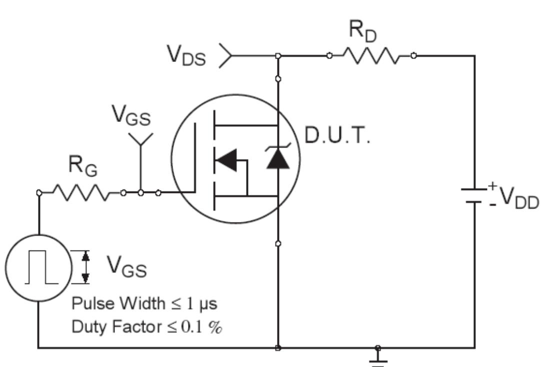


Fig 17a. Switching Time Test Circuit

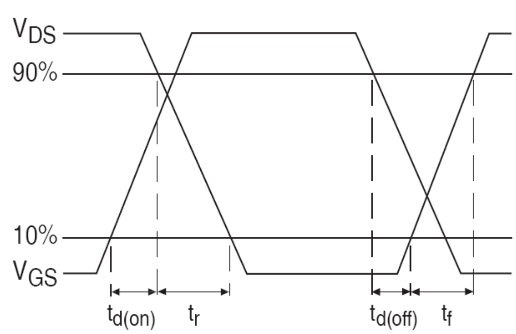


Fig 17b. Switching Time Waveforms

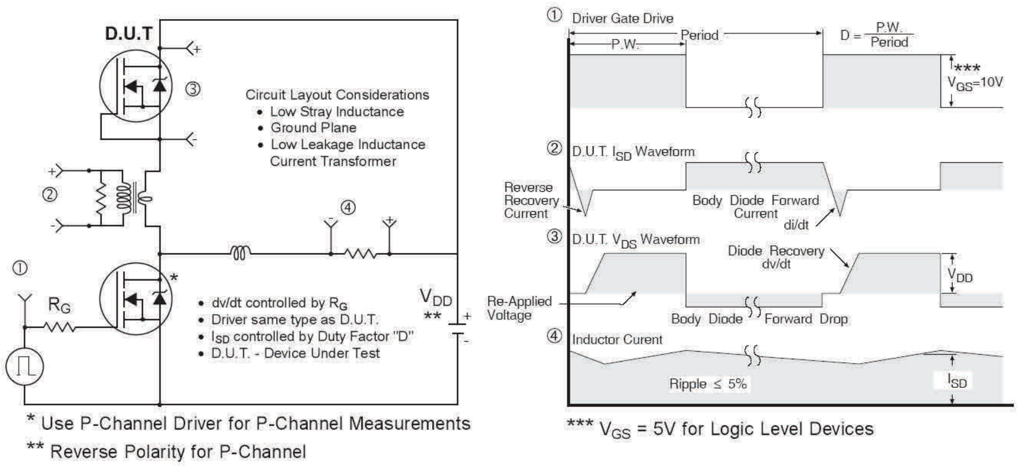
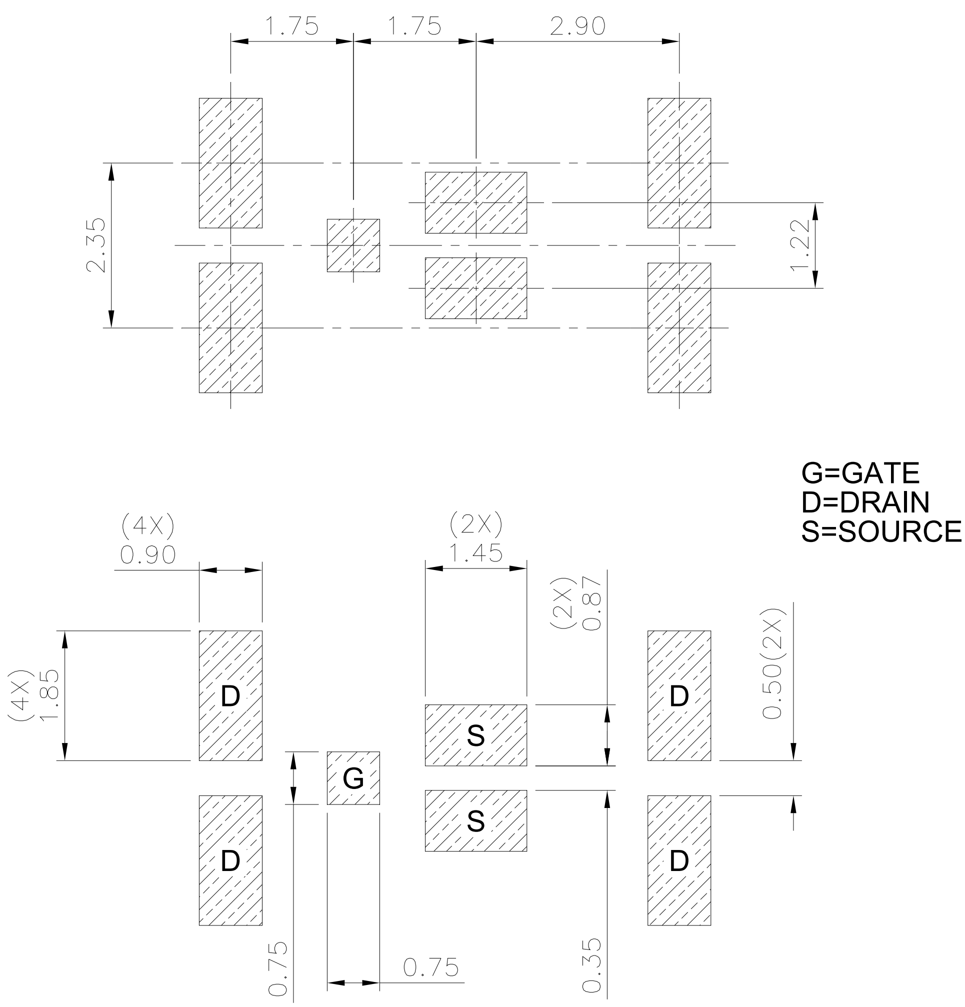


Fig 18. Diode Reverse Recovery Test Circuit for HEXFET® Power MOSFETs

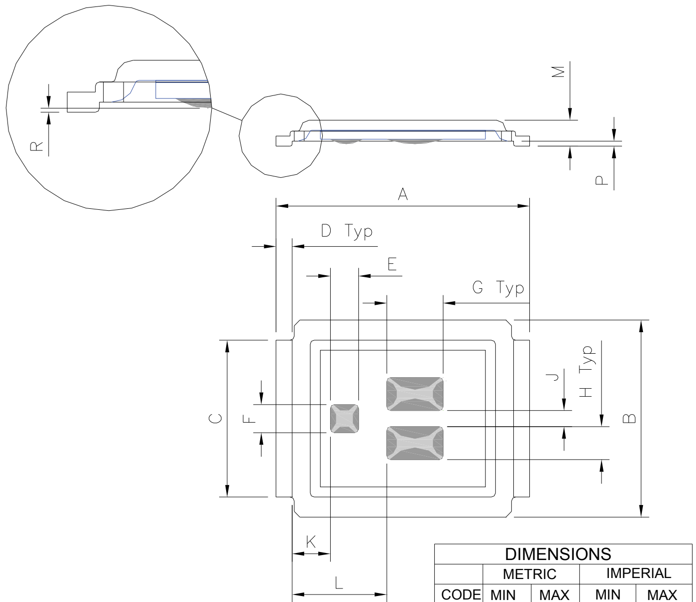
DirectFET™ Board Footprint, MX Outline
(Medium Size Can, X-Designation).
Please see DirectFET™ application note AN-1035 for all details regarding the assembly of DirectFET™.
This includes all recommendations for stencil and substrate designs.



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

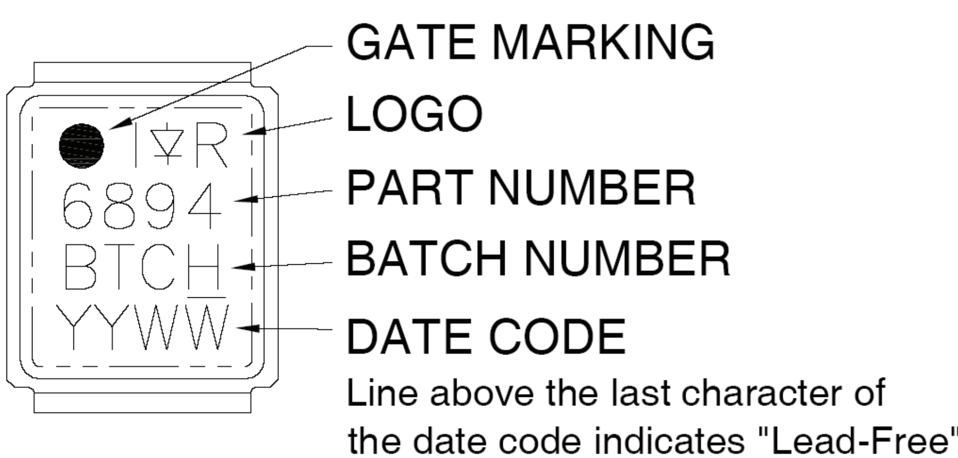
DirectFET™ Outline Dimension, MX Outline
(Medium Size Can, X-Designation).

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



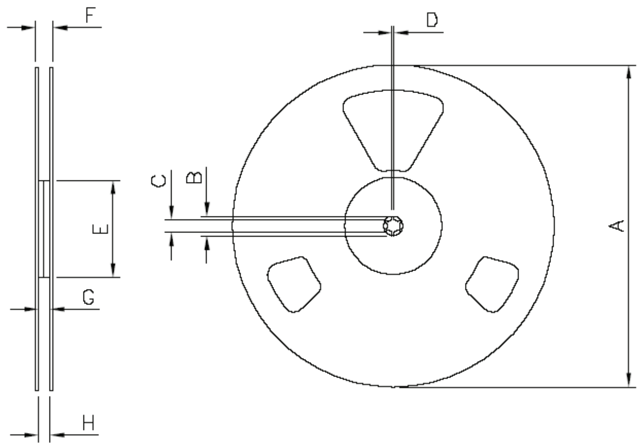
DIMENSIONS				
	METRIC		IMPERIAL	
CODE	MIN	MAX	MIN	MAX
A	6.25	6.35	0.246	0.250
B	4.80	5.05	0.189	0.201
C	3.85	3.95	0.152	0.156
D	0.35	0.45	0.014	0.018
E	0.68	0.72	0.027	0.028
F	0.68	0.72	0.027	0.028
G	1.38	1.42	0.054	0.056
H	0.80	0.84	0.032	0.033
J	0.38	0.42	0.015	0.017
K	0.88	1.01	0.035	0.039
L	2.28	2.41	0.090	0.095
M	0.535	0.595	0.021	0.023
R	0.020	0.080	0.001	0.003
P	0.08	0.17	0.003	0.007

DirectFET™ Part Marking



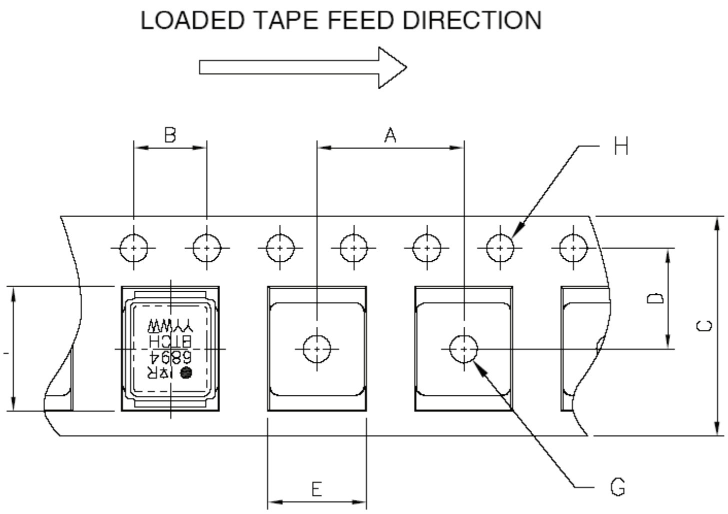
Note: For the most current drawing please refer to website at http://www.irf.com/package/

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



NOTE: Controlling dimensions in mm
Std reel quantity is 4800 parts. (ordered as IRF6894MTRPBF). For 1000 parts on 7" reel, order IRF6894MTR1PBF

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

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

Qualification Information

Qualification Level	Industrial†	
Moisture Sensitivity Level	DirectFET™ Medium Can	MSL1 (per JEDEC J-STD-020D†)
RoHS Compliant	Yes	

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

Revision History

Date	Comment
10/13/2016	• Changed datasheet with "Infineon" logo –all pages. • Changed Rth from "60°C/W" to "45°C/W" –page 3 • Changed ID @ TA 25C/70C from "32A/25A" to "37A/29A" –page 1 & 2. • Changed Fig.1 to Fig.15 –page 1 to 9. • Added disclaimer on last page.

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