International
IOR Rectifier

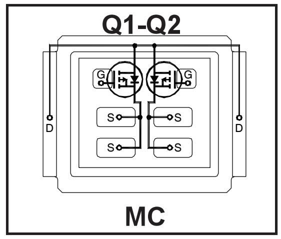
IRF9395MPbF
IRF9395MTRPbF

DirectFET™ dual P-Channel Power MOSFET ②

Typical values (unless otherwise specified)

V_{DSS}	V_{GS}	$R_{DS(on)}$	$R_{DS(on)}$
-30V max	±20V max	5.3mΩ@-10V	9.0mΩ@-4.5V

$Q_{g\,tot}$	Q_{gd}	Q_{gs2}	Q_{rr}	Q_{oss}	$V_{gs(th)}$
32nC	15nC	3.2nC	62nC	23nC	-1.8V




DirectFET™ ISOMETRIC

Applications

- Isolation Switch for Input Power or Battery Application

Features and Benefits

- Environmentaly Friendly Product
- RoHs Compliant Containing no Lead, no Bromide and no Halogen
- Dual Common-Drain P-Channel MOSFETs Provides High Level of Integration and Very Low RDS(on)

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

SQ	SX	ST		MQ	MX	MT	MP	MC		

Description

The IRF9395MTRPbF combines the latest HEXFET® P-Channel 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 0.6 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%.

Orderable part number	Package Type	Standard Pack		Note
		Form	Quantity	
IRF9395MTRPbF	DirectFET Medium Can	Tape and Reel	4800	
IRF9395MTR1PbF	DirectFET Medium Can	Tape and Reel	1000	

Absolute Maximum Ratings

	Parameter	Max.	Units
V_{DS}	Drain-to-Source Voltage	-30	V
V_{GS}	Gate-to-Source Voltage	±20	
I_D @ T_A = 25°C	Continuous Drain Current, V_{GS} @ 10V ③	-14	A
I_D @ T_A = 70°C	Continuous Drain Current, V_{GS} @ 10V ③	-11	
I_D @ T_C = 25°C	Continuous Drain Current, V_{GS} @ 10V ④	-75	
I_{DM}	Pulsed Drain Current ⑤	-110	

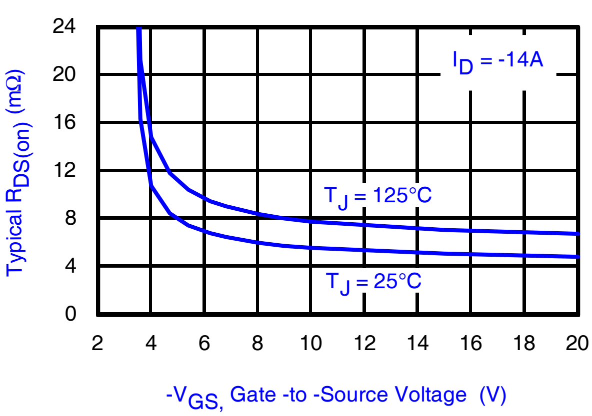


Fig 1. Typical On-Resistance vs. Gate Voltage

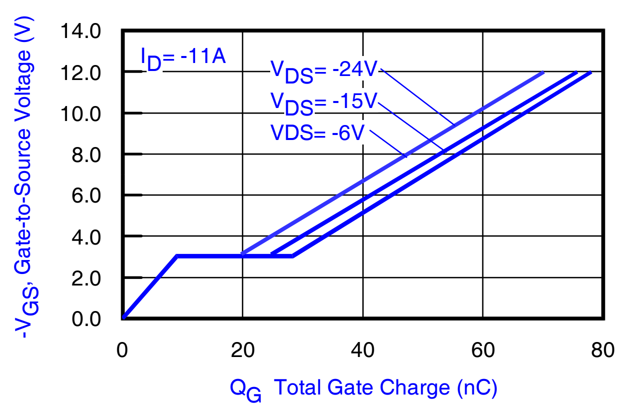


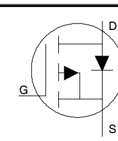
Fig 2. Typical Total Gate Charge vs Gate-to-Source Voltage

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.

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

	Parameter	Min.	Typ.	Max.	Units	Conditions
BV_{DSS}	Drain-to-Source Breakdown Voltage	-30	——	——	V	V_{GS} = 0V, I_D = -250μA
$\Delta BV_{DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	——	0.012	——	mV/°C	Reference to 25°C, I_D = -1.0mA
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	——	5.3	7.0	mΩ	V_{GS} = -10V, I_D = -14A ⑥
		——	9.0	11.9		V_{GS} = -4.5V, I_D = -11 A ⑥
$V_{GS(th)}$	Gate Threshold Voltage	-1.3	-1.8	-2.4	V	V_{DS} = V_{GS}, I_D = -50μA
$\Delta V_{GS(th)}/\Delta T_J$	Gate Threshold Voltage Coefficient	——	-6.1	——	mV/°C	
I_{DSS}	Drain-to-Source Leakage Current	——	——	-1.0	μA	V_{DS} = -24V, V_{GS} = 0V
		——	——	-150		V_{DS} = -24V, 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	40	——	——	S	V_{DS} = -15V, I_D = -11A
Q_g	Total Gate Charge	——	64	——	nC	V_{DS} = -15V, V_{GS} = -10V, I_D = -11A
Q_g	Total Gate Charge	——	32	——		
Q_{gs1}	Pre- Vth Gate-to-Source Charge	——	6.5	——		V_{DS} = -15V
Q_{gs2}	Post -Vth Gate-to-Source Charge	——	3.2	——		V_{GS} = -4.5V
Q_{gd}	Gate-to-Drain Charge	——	15	——		I_D = -11A
Q_{godr}	Gate Charge Overdrive	——	7.3	——		See Fig.15
Q_{sw}	Switch charge (Q_{gs2} + Q_{gd})	——	18.2	——		
Q_{oss}	Output Charge	——	23	——	nC	V_{DS} = -16V, V_{GS} = 0V
R_G	Gate Resistance	——	15	——	Ω	
$t_{d(on)}$	Turn-On Delay Time	——	16	——	ns	V_{DD} = -15V, V_{GS} = -4.5V ⑥
t_r	Rise Time	——	142	——		I_D = -11A
$t_{d(off)}$	Turn-Off Delay Time	——	76	——		R_G = 1.8Ω
t_f	Fall Time	——	121	——		See Fig.17
C_{iss}	Input Capacitance	——	3241	——	pF	V_{GS} = 0V
C_{oss}	Output Capacitance	——	820	——		V_{DS} = -15V
C_{rss}	Reverse Transfer Capacitance	——	466	——		f = 1.0KHz

Diode Characteristics

	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	——	——	-57	A	MOSFET symbol showing the integral reverse p-n junction diode. 
I_{SM}	Pulsed Source Current (Body Diode) ⑤	——	——	-110		
V_{SD}	Diode Forward Voltage	——	——	-1.2	V	T_J = 25°C, I_S = -11A, V_{GS} = 0V ⑥
t_{rr}	Reverse Recovery Time	——	43	65	ns	T_J = 25°C, I_F = -11A, ,V_{DD} = -15V
Q_{rr}	Reverse Recovery Charge	——	62	93	nC	di/dt = 260A/μs ⑥

Notes:

⑥ Pulse width ≤ 400μs; duty cycle ≤ 2%.

Absolute Maximum Ratings

	Parameter	Max.	Units
P_D @T_A = 25°C	Power Dissipation ③	2.1	W
P_D @T_A = 70°C	Power Dissipation ③	1.3	
P_D @T_C = 25°C	Power Dissipation ④	57	
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 ③	——	60	°C/W
$R_{\theta JA}$	Junction-to-Ambient ⑦	12.5	——	
$R_{\theta JA}$	Junction-to-Ambient ⑧	20	——	
$R_{\theta JC}$	Junction-to-Case ④,⑨	——	2.2	
$R_{\theta J\text{-}PCB}$	Junction-to-PCB Mounted	1.0	——	
	Linear Derating Factor ③	0.02		W/°C

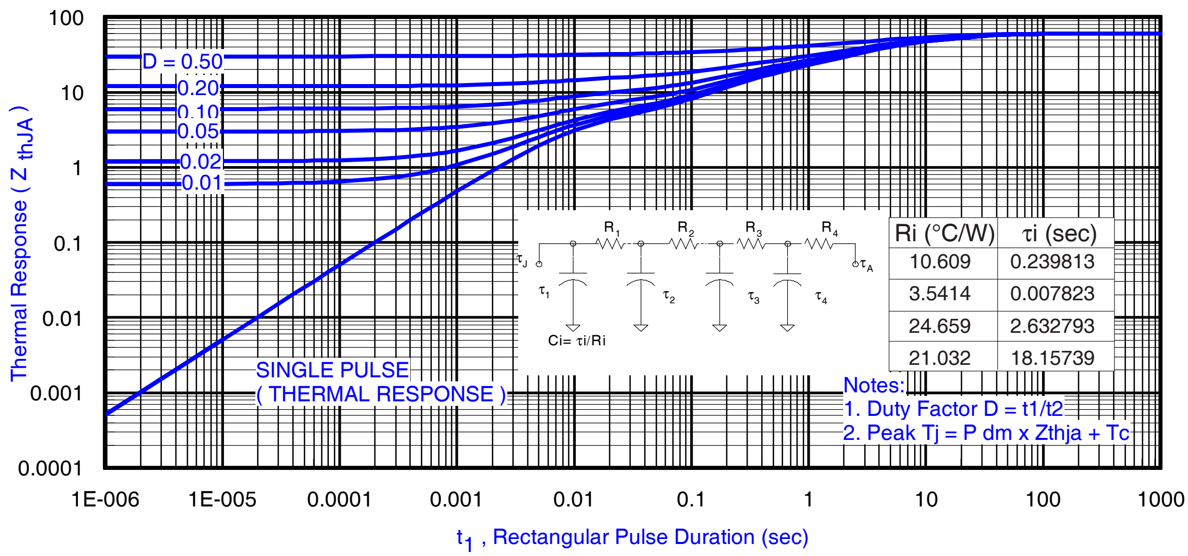


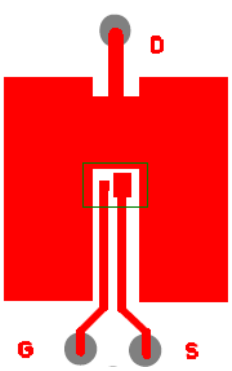
Fig 3. Maximum Effective Transient Thermal Impedance, Junction-to-Ambient ①

Notes:

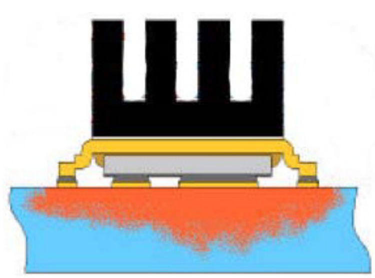
⑦ Used double sided cooling, mounting pad with large heatsink.

⑧ Mounted on minimum footprint full size board with metalized back and with small clip heatsink.

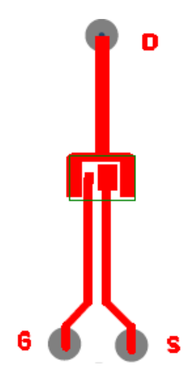
⑨ R_θ is measured at T_J of approximately 90°C.



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)

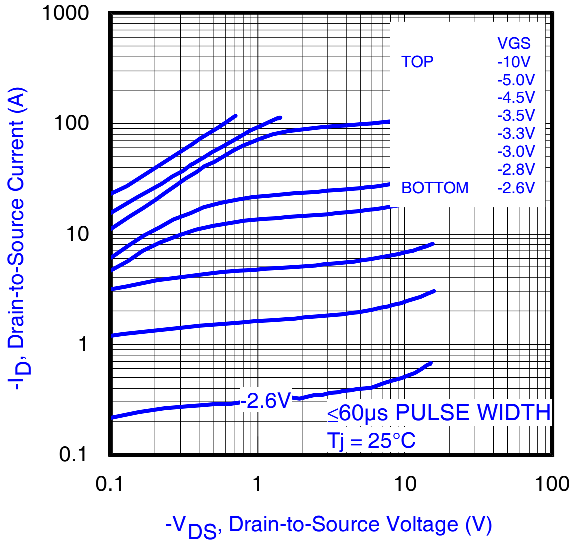


Fig 4. Typical Output Characteristics

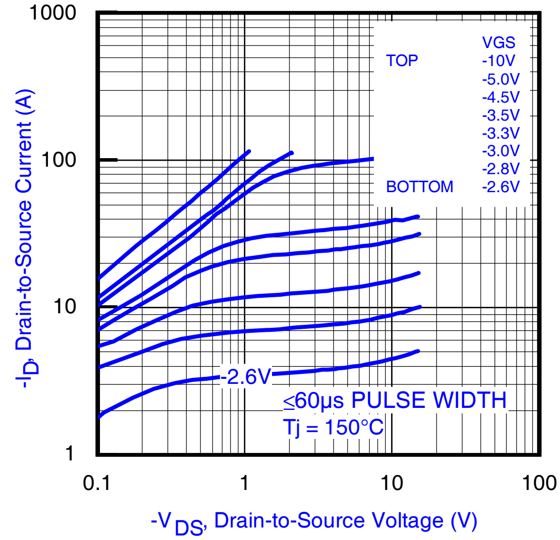


Fig 5. Typical Output Characteristics

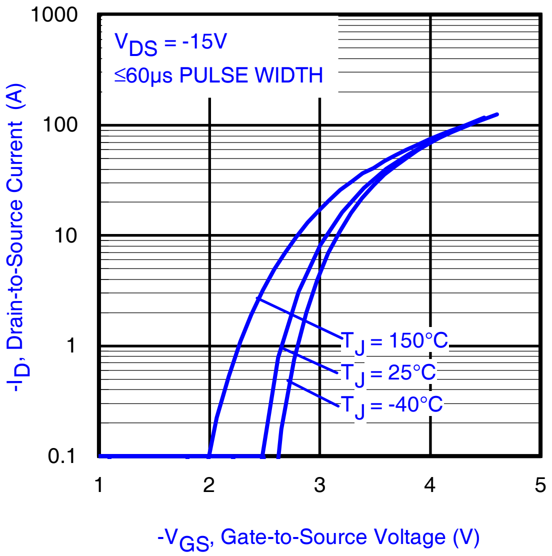


Fig 6. Typical Transfer Characteristics

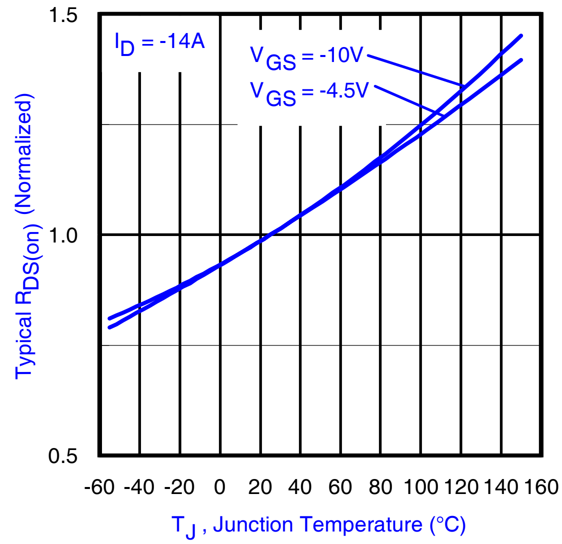


Fig 7. Normalized On-Resistance vs. Temperature

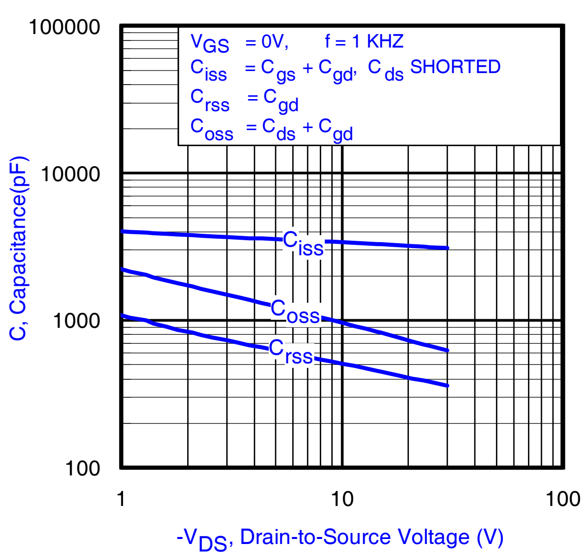


Fig 8. Typical Capacitance vs.Drain-to-Source Voltage

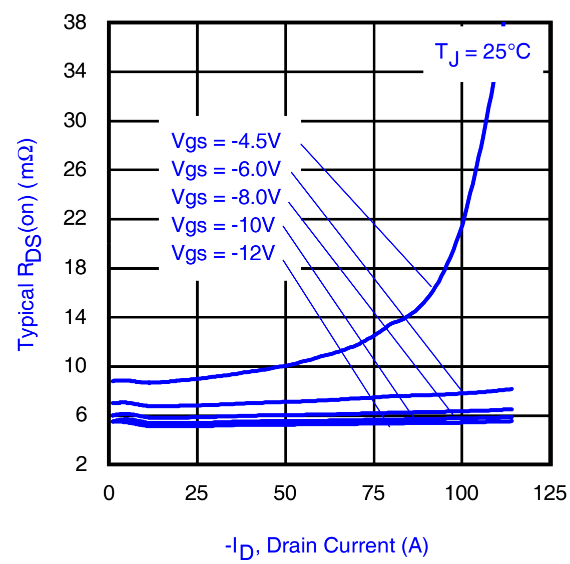


Fig 9. Typical On-Resistance vs. Drain Current and Gate Voltage

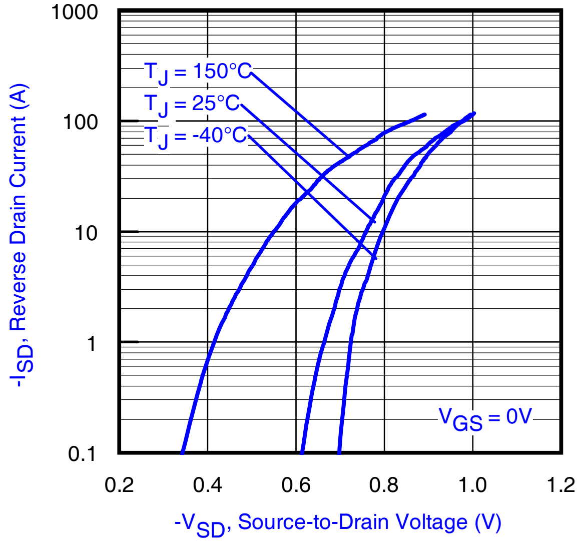


Fig 10. Typical Source-Drain Diode Forward Voltage

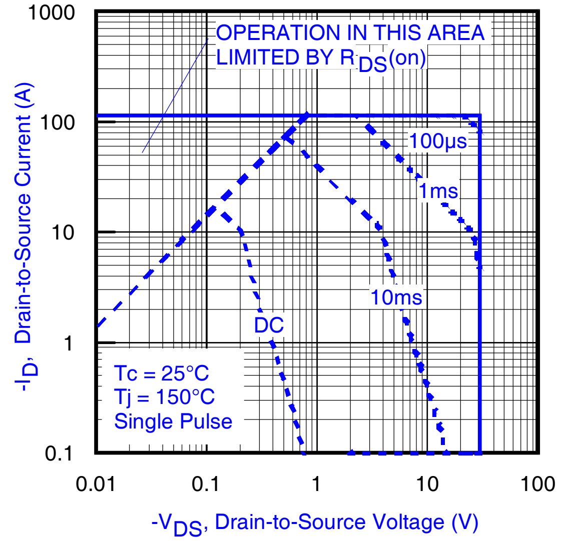


Fig 11. Maximum Safe Operating Area

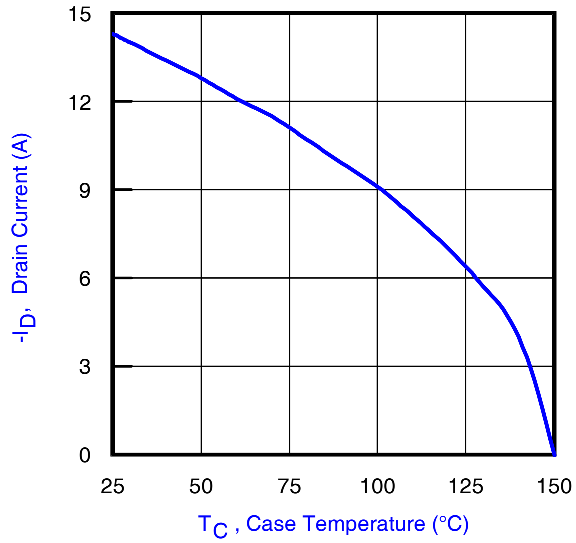


Fig 12. Maximum Drain Current vs. Case Temperature

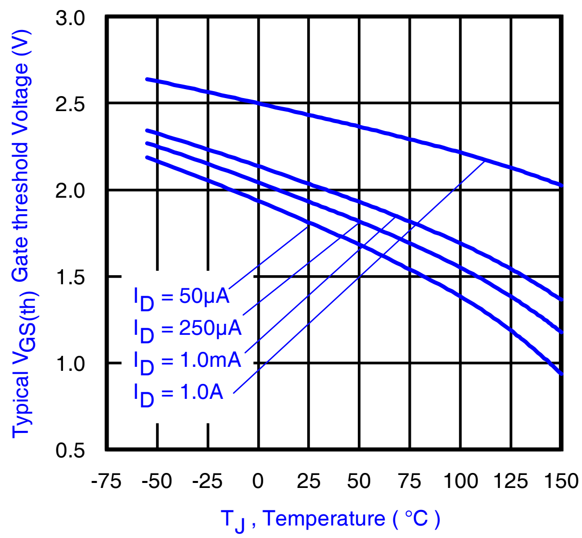


Fig 13. Typical Threshold Voltage vs. Junction Temperature

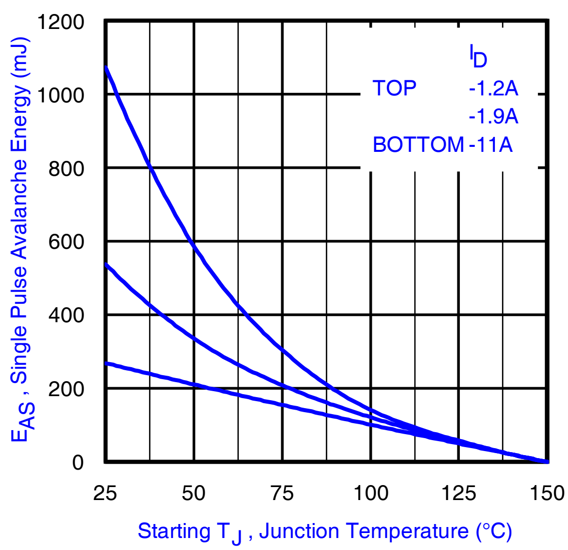


Fig 14. Maximum Avalanche Energy vs. Drain Current

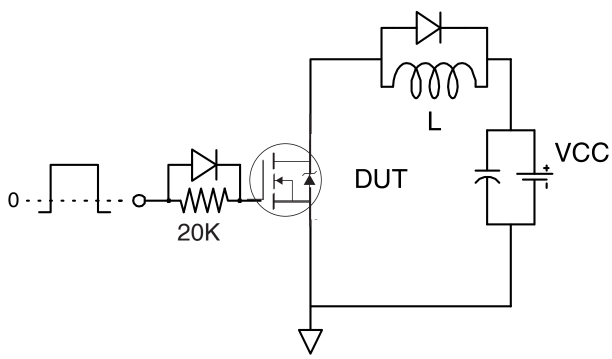


Fig 15a. Gate Charge Test Circuit

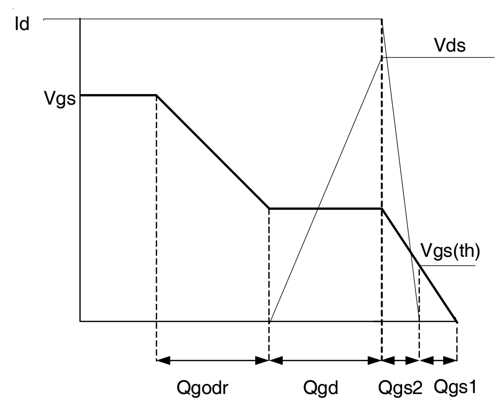


Fig 15b. Gate Charge Waveform

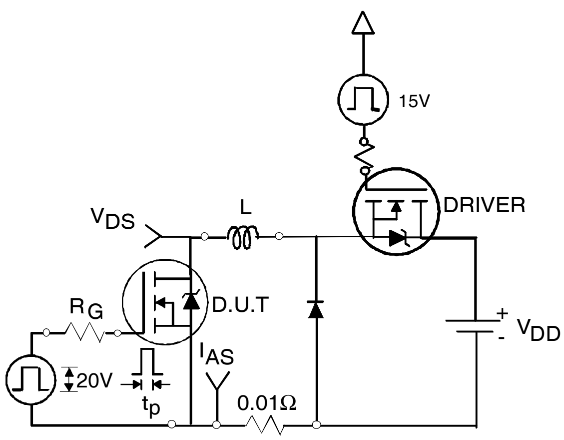


Fig 16a. Unclamped Inductive Test Circuit

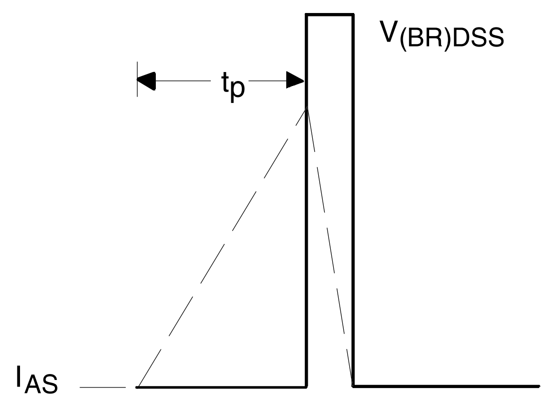


Fig 16b. Unclamped Inductive Waveforms

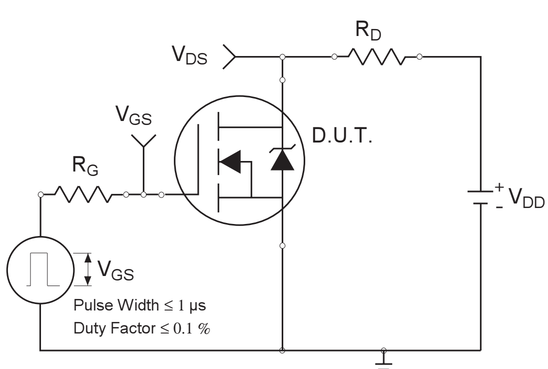


Fig 17a. Switching Time Test Circuit

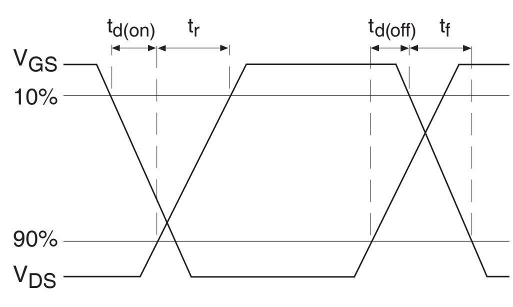


Fig 17b. Switching Time Waveforms

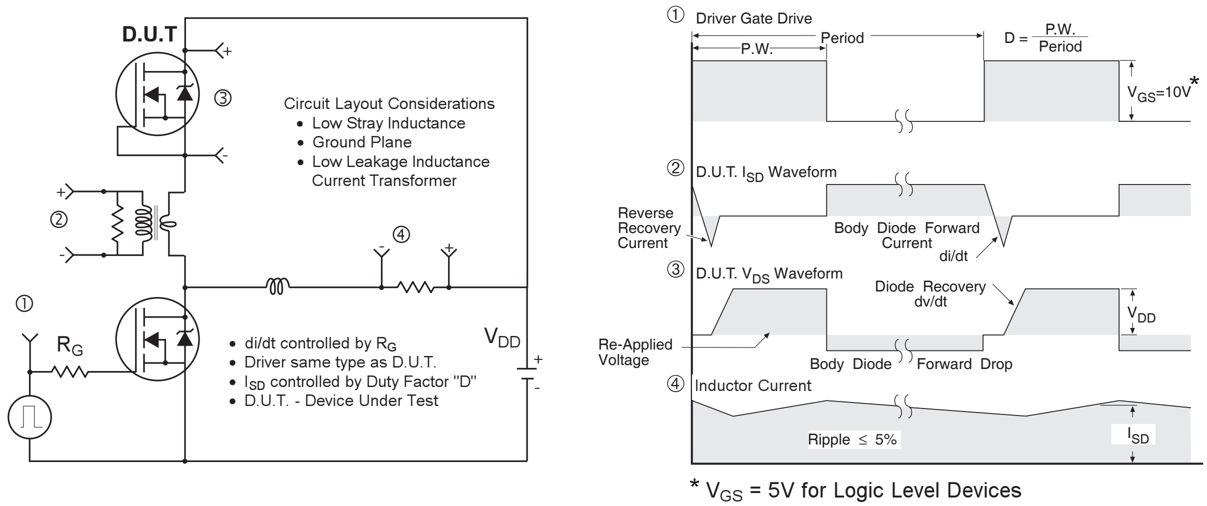
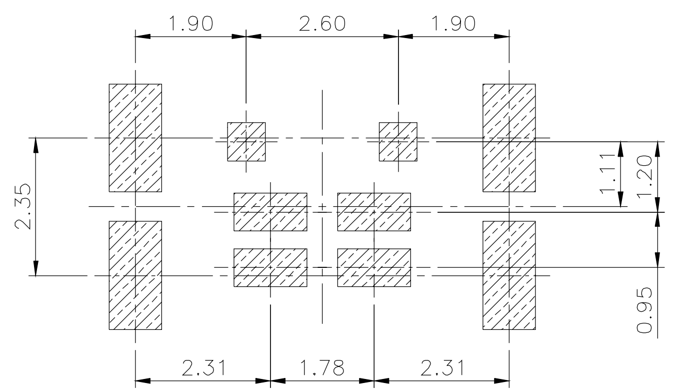


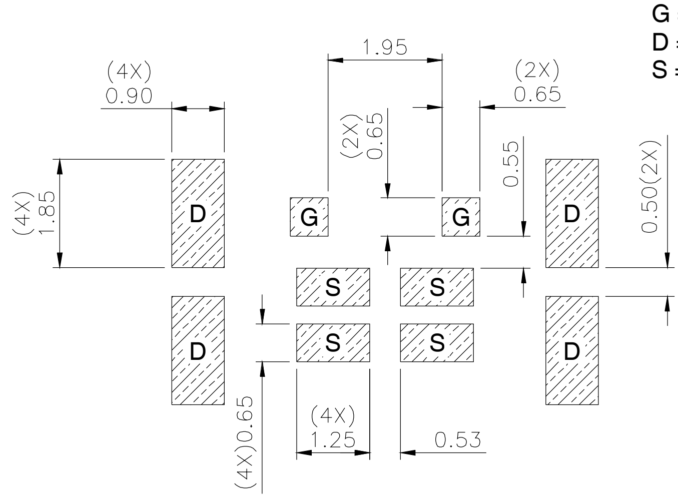
Fig 18. Diode Reverse Recovery Test Circuit for N-Channel HEXFET® Power MOSFETs

DirectFET™ Board Footprint, MC Outline (Medium Size Can, C-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.

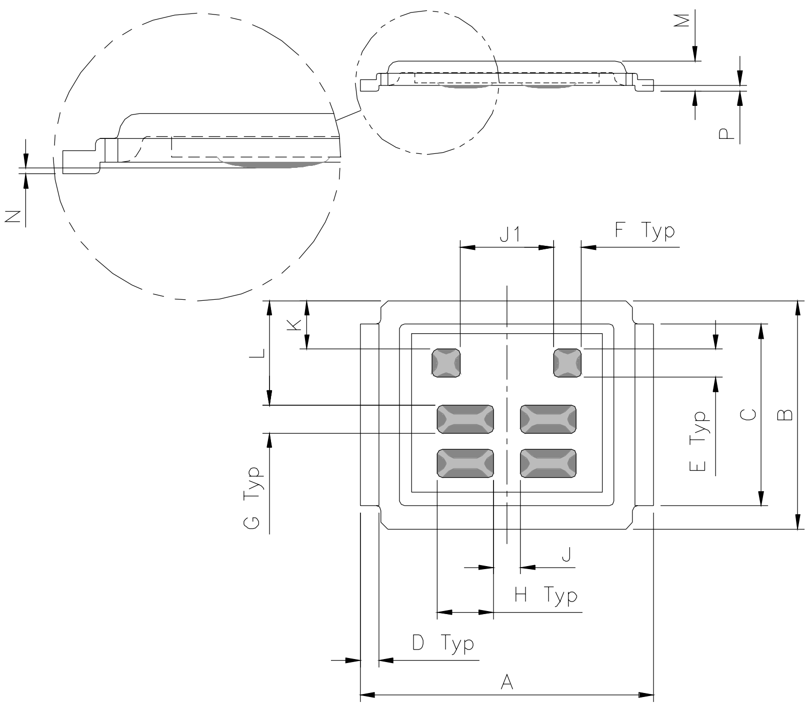


G = GATE
D = DRAIN
S = SOURCE



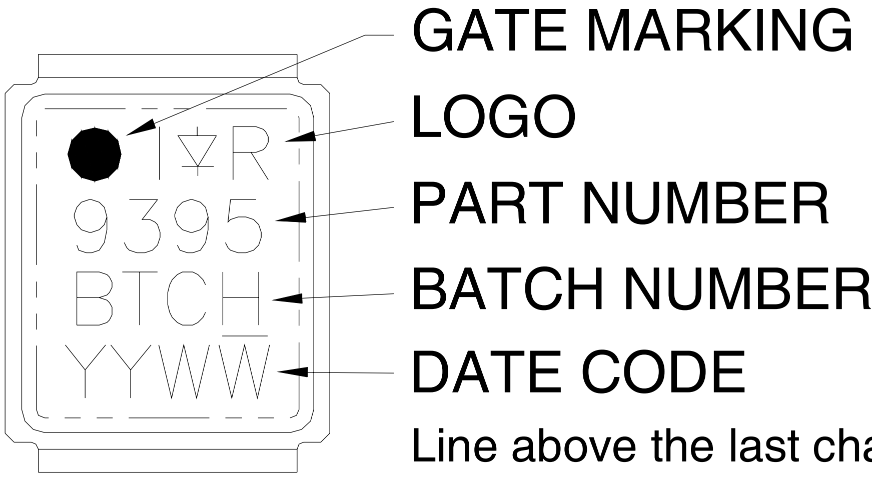
DirectFET™ Outline Dimension, MC Outline
(Medium Size Can, C-Designation).

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



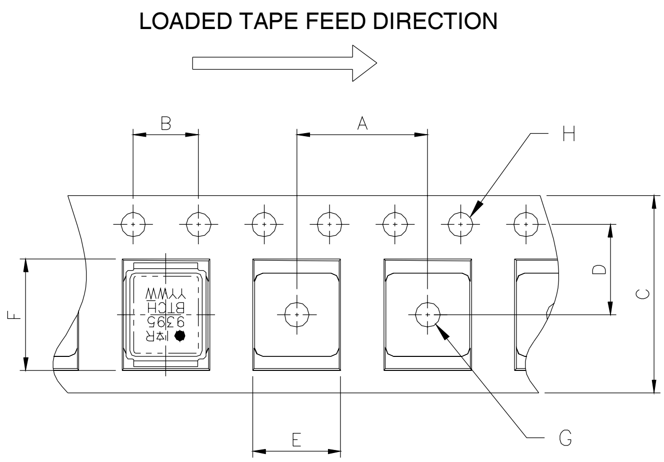
DIMENSIONS				
	METRIC		IMPERIAL	
CODE	MIN	MAX	MIN	MAX
A	6.25	6.35	0.246	0.250
B	4.80	5.05	0.189	0.201
C	3.85	3.95	0.152	0.156
D	0.35	0.45	0.014	0.018
E	0.58	0.62	0.023	0.024
F	0.58	0.62	0.023	0.024
G	0.58	0.62	0.023	0.024
H	1.18	1.22	0.047	0.048
J	0.56	0.60	0.022	0.023
J1	1.98	2.02	0.078	0.079
K	1.02	1.06	0.040	0.041
L	2.22	2.26	0.088	0.089
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

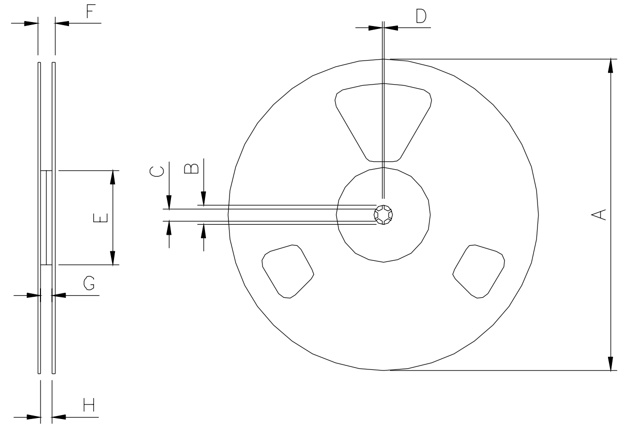
DirectFET™ Part Marking



Line above the last character of the date code indicates "Lead-Free"

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





NOTE: Controlling dimensions in mm
Std reel quantity is 4800 parts. (ordered as IRF9395MTRPBF). For 1000 parts on 7" reel, order IRF9395MTR1PBF

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

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

Qualification Information†

Qualification level	Consumer ††	
	(per JEDEC JESD47F††† guidelines)	
Moisture Sensitivity Level	DirectFET	MSL3 (per JEDEC J-STD-020D†††)
RoHS Compliant	Yes	

† Qualification standards can be found at International Rectifier's web site http://www.irf.com/product-info/reliability

†† Higher qualification ratings may be available should the user have such requirements. Please contact your International Rectifier sales representative for further information: http://www.irf.com/whoto-call/salesrep/

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

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

Data and specifications subject to change without notice.

International
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