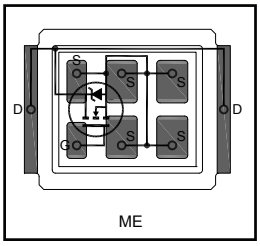
International
IOR Rectifier

StrongIRFET™
IRF7780MTRPbF

DirectFET® N-Channel Power MOSFET

Application
- Brushed Motor drive applications
- BLDC Motor drive applications
- Battery powered circuits
- Half-bridge and full-bridge topologies
- Synchronous rectifier applications
- Resonant mode power supplies
- OR-ing and redundant power switches
- DC/DC and AC/DC converters
- DC/AC Inverters

V_{DSS}	75V
$R_{DS(on)}$ typ.	4.5mΩ
max	5.7mΩ
I_D	89A



ME


DirectFET® ISOMETRIC

Benefits
- Improved Gate, Avalanche and Dynamic dv/dt Ruggedness
- Fully Characterized Capacitance and Avalanche SOA
- Enhanced body diode dv/dt and di/dt Capability
- Lead-Free, RoHS Compliant

Base part number	Package Type	Standard Pack		Orderable Part Number
		Form	Quantity	
IRF7780MPbF	DirectFET® ME	Tape and Reel	4800	IRF7780MTRPbF

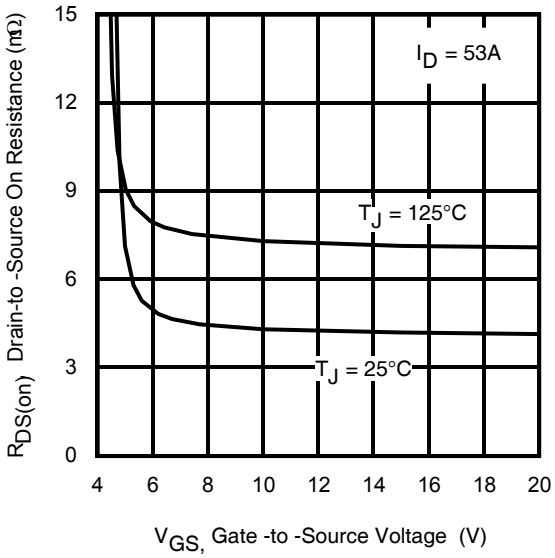


Fig 1. Typical On-Resistance vs. Gate Voltage

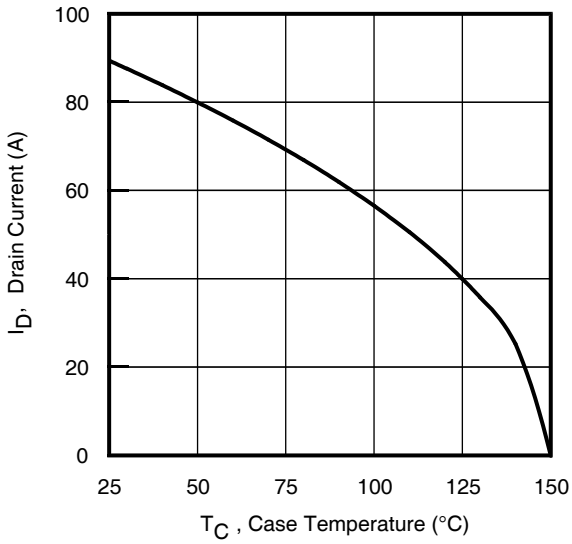


Fig 2. Maximum Drain Current vs. Case Temperature

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Absolute Maximum Ratings

Symbol	Parameter	Max.	Units
I_D @ T_C = 25°C	Continuous Drain Current, V_{GS} @ 10V	89	A
I_D @ T_C = 100°C	Continuous Drain Current, V_{GS} @ 10V	57	
I_{DM}	Pulsed Drain Current ①	356	
P_D @T_C = 25°C	Maximum Power Dissipation	96	W
	Linear Derating Factor	0.77	W/°C
V_{GS}	Gate-to-Source Voltage	± 20	V
T_J T_{STG}	Operating Junction and Storage Temperature Range	-55 to + 150	°C

Avalanche Characteristics

$E_{AS\ (Thermally\ limited)}$	Single Pulse Avalanche Energy ②	82	mJ
$E_{AS\ (Thermally\ limited)}$	Single Pulse Avalanche Energy ⑨	133	
I_{AR}	Avalanche Current ①	See Fig.15,16, 23a, 23b	A
E_{AR}	Repetitive Avalanche Energy ①		mJ

Thermal Resistance

Symbol	Parameter	Typ.	Max.	Units
$R_{\theta JA}$	Junction-to-Ambient ❶	–––	45	°C/W
$R_{\theta JA}$	Junction-to-Ambient ❸	12.5	–––	
$R_{\theta JA}$	Junction-to-Ambient ❷	20	–––	
$R_{\theta JC}$	Junction-to-Case ❹⑧	–––	1.3	
$R_{\theta J\text{-}PCB}$	Junction-to-PCB Mounted	0.75	–––	

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

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	75	–––	–––	V	V_{GS} = 0V, I_D = 250µA
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	–––	53	–––	mV/°C	Reference to 25°C, I_D = 1.0mA①
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	–––	4.5	5.7	mΩ	V_{GS} = 10V, I_D = 53A ④
		–––	5.2	–––		V_{GS} = 6.0V, I_D = 27A ④
$V_{GS(th)}$	Gate Threshold Voltage	2.1	–––	3.7	V	V_{DS} = V_{GS}, I_D = 150µA
I_{DSS}	Drain-to-Source Leakage Current	–––	–––	1.0	µA	V_{DS} = 75V, V_{GS} = 0V
		–––	–––	150		V_{DS} = 75V, 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
R_G	Internal Gate Resistance	–––	0.8	–––	Ω	

Notes:

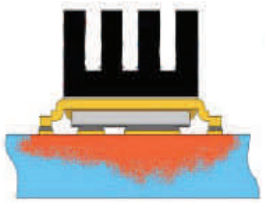
❷ Mounted on minimum footprint full size board with metalized back and with small clip heatsink.

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

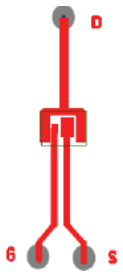
❹ TC measured with thermocouple mounted to top (Drain) of part.



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



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



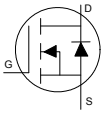
❷ Mounted on minimum footprint full size board with metalized back and with small clip heatsink (still air)

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

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
gfs	Forward Transconductance	154	—	—	S	V_{DS} = 10V, I_D = 53A
Q_g	Total Gate Charge	—	124	186	nC	I_D = 53A
Q_{gs}	Gate-to-Source Charge	—	29	—		V_{DS} = 38V
Q_{gd}	Gate-to-Drain ("Miller") Charge	—	38	—		V_{GS} = 10V ④
Q_{sync}	Total Gate Charge Sync. (Q_g - Q_{gd})	—	86	—		
$t_{d(on)}$	Turn-On Delay Time	—	18	—	ns	V_{DD} = 38V
t_r	Rise Time	—	26	—		I_D = 30A
$t_{d(off)}$	Turn-Off Delay Time	—	60	—		R_G = 2.7Ω
t_f	Fall Time	—	26	—		V_{GS} = 10V ④
C_{iss}	Input Capacitance	—	6504	—	pF	V_{GS} = 0V
C_{oss}	Output Capacitance	—	547	—		V_{DS} = 25V
C_{rss}	Reverse Transfer Capacitance	—	334	—		f = 1.0MHz
C_{oss} eff. (ER)	Effective Output Capacitance (Energy Related)	—	498	—		V_{GS} = 0V, V_{DS} = 0V to 60V ⑥
C_{oss} eff. (TR)	Effective Output Capacitance (Time Related)	—	630	—		V_{GS} = 0V, V_{DS} = 0V to 60V ⑤

Diode Characteristics

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	—	—	89	A	MOSFET symbol showing the integral reverse p-n junction diode. 
I_{SM}	Pulsed Source Current (Body Diode) ①	—	—	356		
V_{SD}	Diode Forward Voltage	—	—	1.2	V	T_J= 25°C,I_S = 53A, V_{GS} = 0V④
dv/dt	Peak Diode Recovery ③	—	12	—	V/ns	T_J =150°C,I_S = 53A, V_{DS} = 75V
t_{rr}	Reverse Recovery Time	—	35	—	ns	T_J = 25° C V_R = 64V,
		—	38	—		T_J = 125°C I_F = 53A
Q_{rr}	Reverse Recovery Charge	—	45	—	nC	T_J = 25°C di/dt = 100A/µs ④
		—	58	—		T_J = 125°C
I_{RRM}	Reverse Recovery Current	—	2.2	—	A	T_J = 25°C

Notes:

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

② Limited by $T_J$max, starting T_J = 25°C, L = 0.058mH, R_G = 50Ω, I_{AS} = 53A, V_{GS} =10V.

③ I_{SD} ≤ 53A, di/dt ≤ 1580A/µs, V_{DD} ≤ $V_{(BR)DSS}$, T_J ≤ 150°C.

④ Pulse width ≤ 400µs; duty cycle ≤ 2%.

⑤ C_{oss} eff. (TR) is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS}.

⑥ C_{oss} eff. (ER) is a fixed capacitance that gives the same energy as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS}.

⑦ When mounted on 1" square PCB (FR-4 or G-10 Material). For recommended footprint and soldering techniques refer to application note # AN-994. http://www.irf.com/technical-info/appnotes/an-994.pdf

⑧ R_θ is measured at T_J approximately 90°C.

⑨ Limited by T_{Jmax}, starting T_J = 25°C, L = 1mH, R_G = 50Ω, I_{AS} = 16A, V_{GS} =10V.

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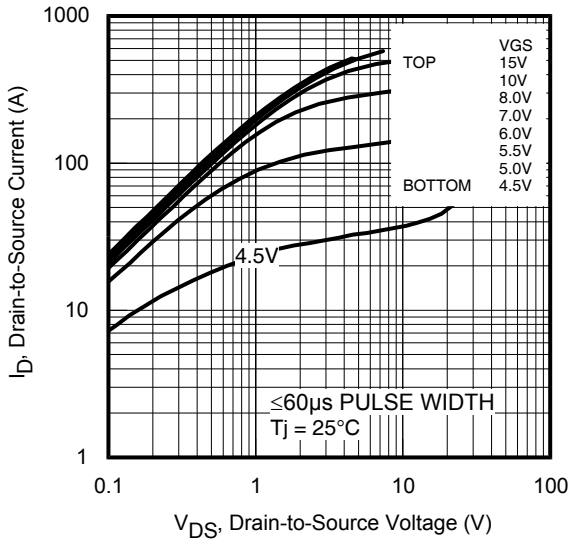


Fig 3. Typical Output Characteristics

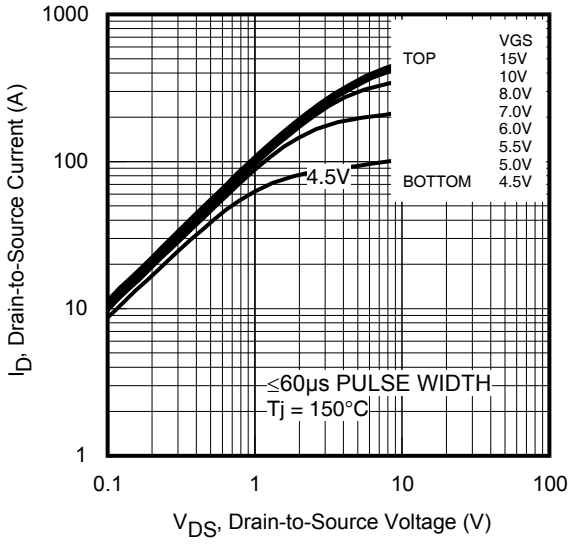


Fig 4. Typical Output Characteristics

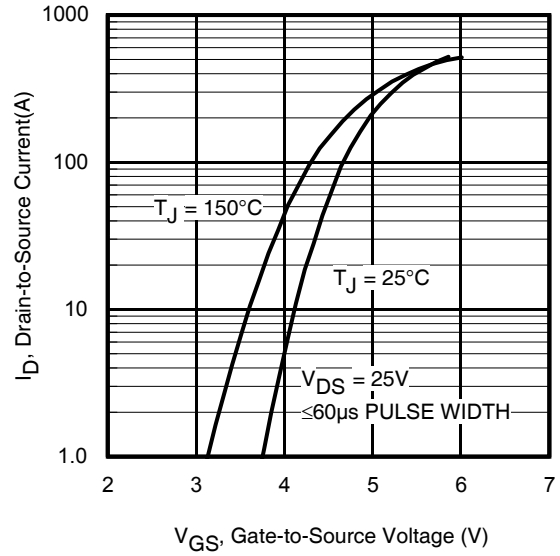


Fig 5. Typical Transfer Characteristics

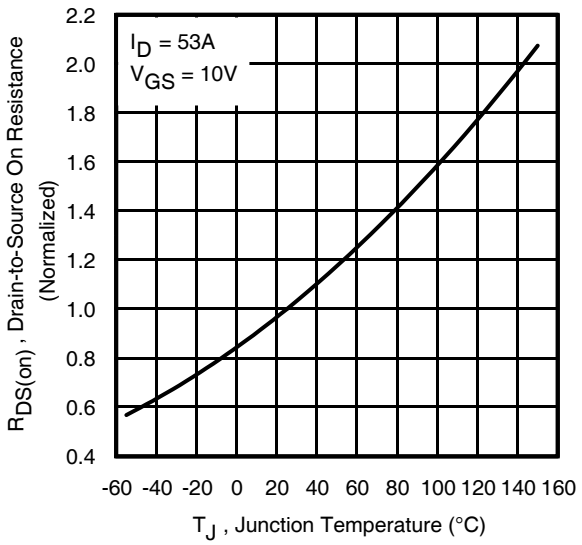


Fig 6. Normalized On-Resistance vs. Temperature

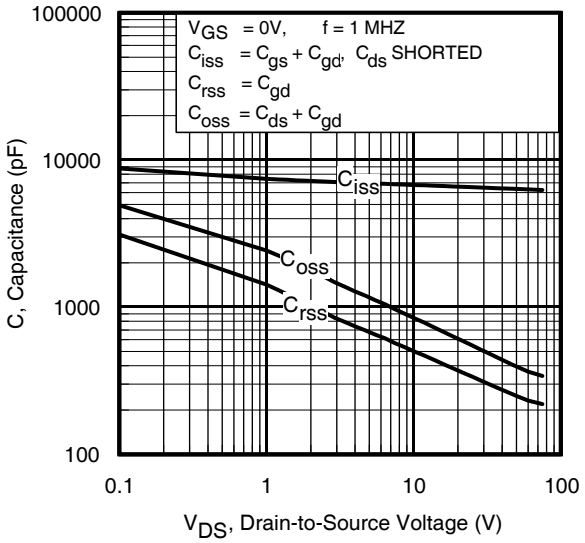


Fig 7. Typical Capacitance vs. Drain-to-Source Voltage

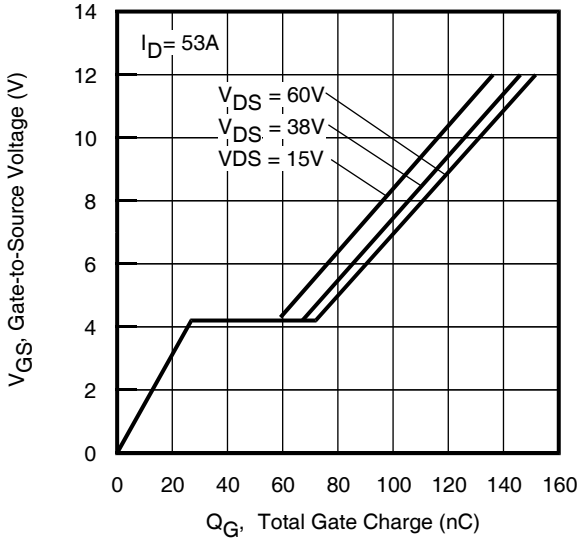


Fig 8. Typical Gate Charge vs. Gate-to-Source Voltage

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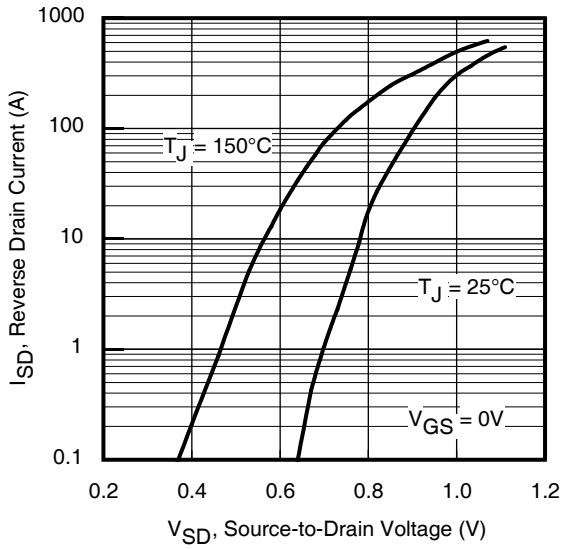


Fig 9. Typical Source-Drain Diode Forward Voltage

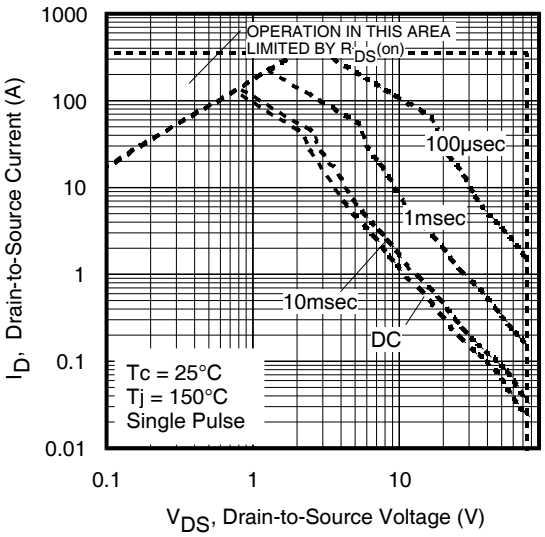


Fig 10. Maximum Safe Operating Area

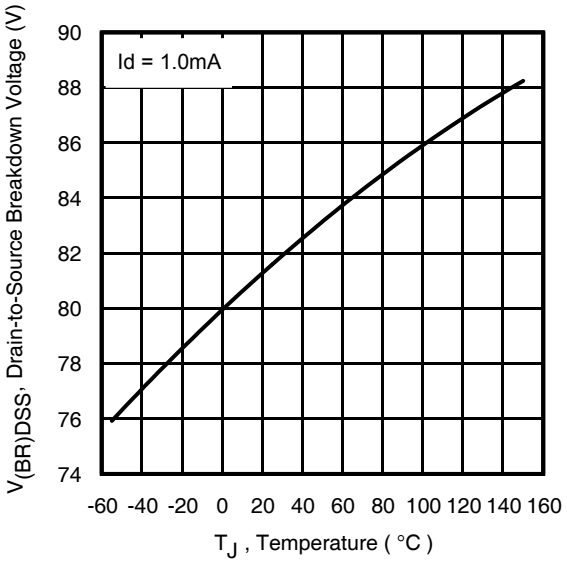


Fig 11. Drain-to-Source Breakdown Voltage

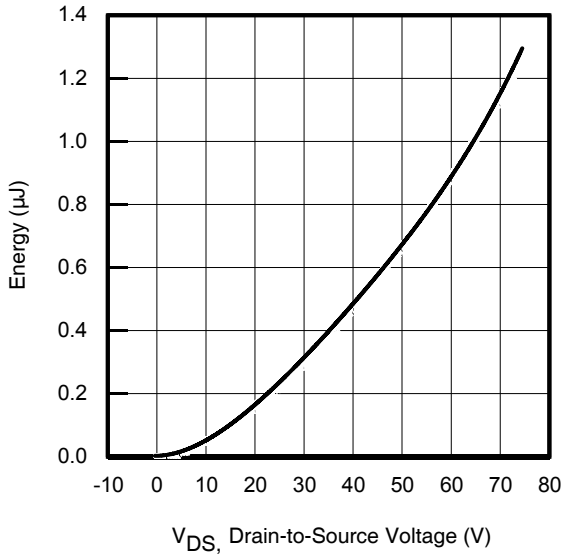


Fig 12. Typical C_{oss} Stored Energy

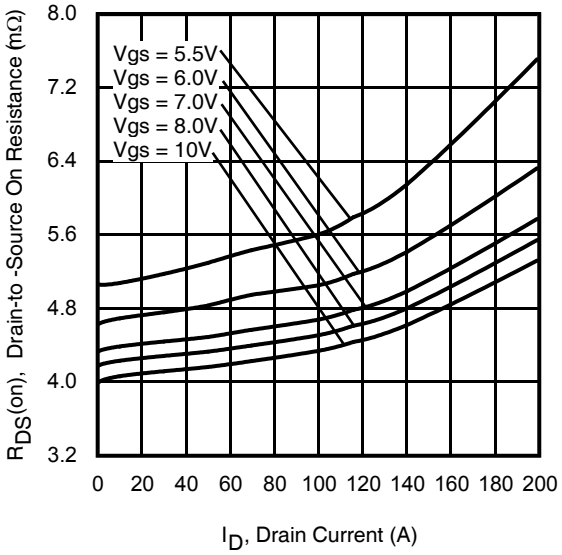


Fig 13. Typical On-Resistance vs. Drain Current

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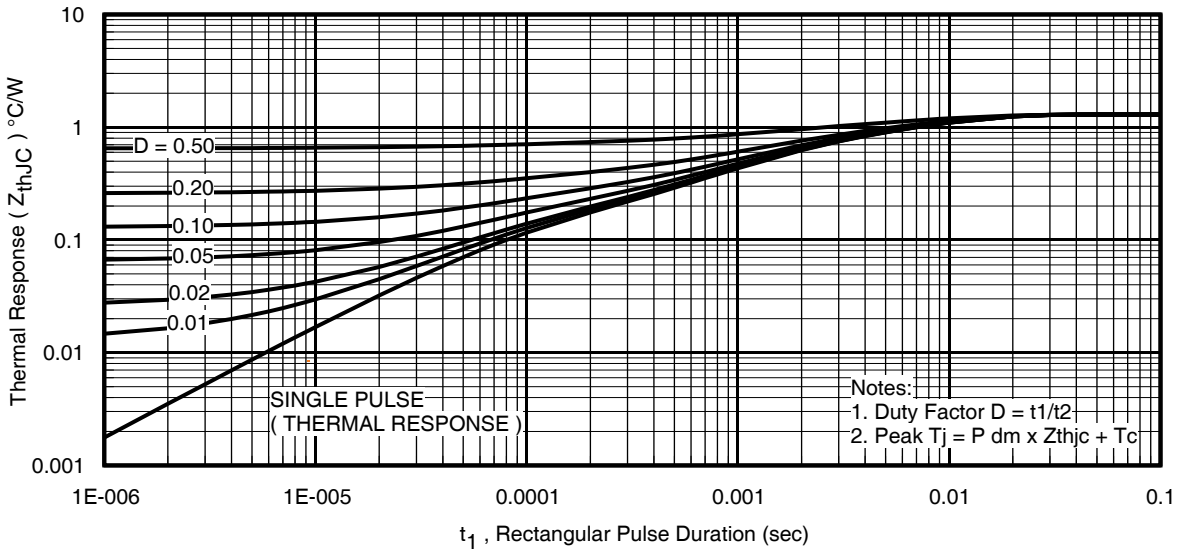


Fig 14. Maximum Effective Transient Thermal Impedance, Junction-to-Case

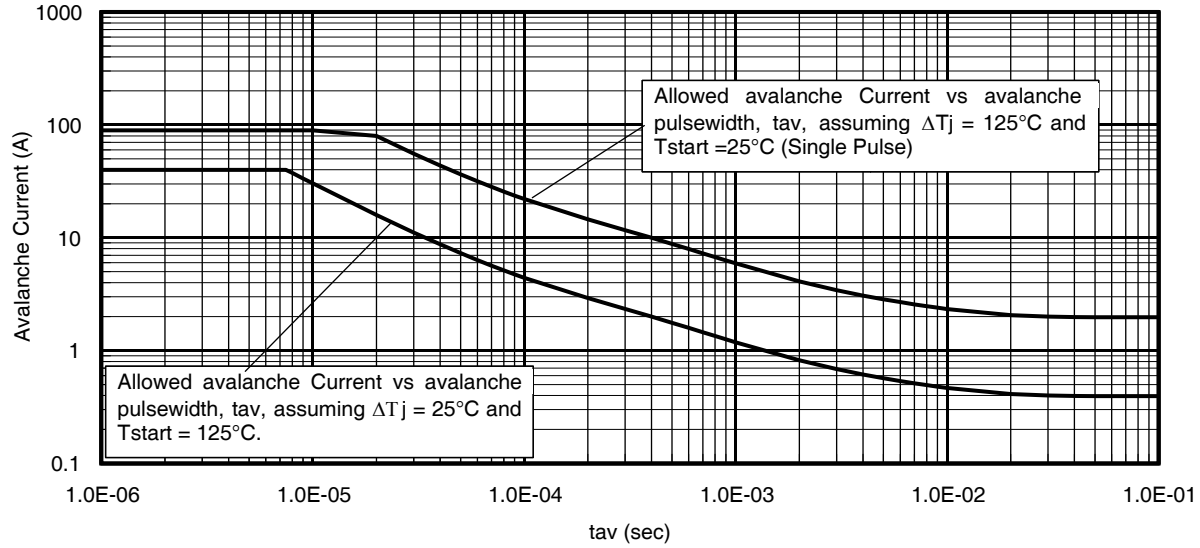


Fig 15. Avalanche Current vs. Pulse Width

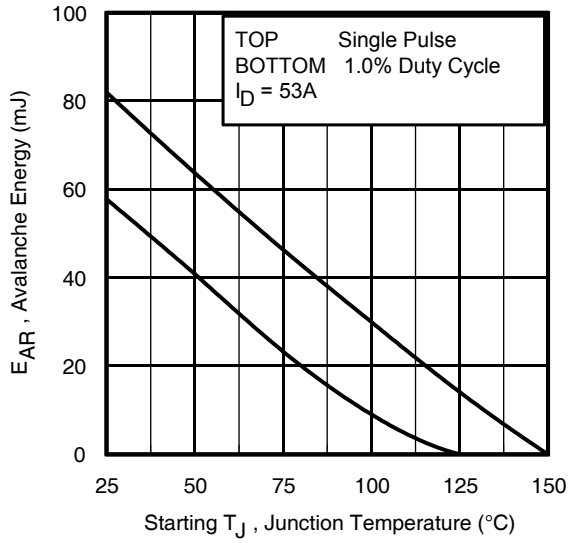


Fig 16. Maximum Avalanche Energy vs. Temperature

Notes on Repetitive Avalanche Curves , Figures 15, 16:
(For further info, see AN-1005 at www.irf.com)

1.Avalanche failures assumption:
Purely a thermal phenomenon and failure occurs at a temperature far in excess of T_{jmax}. This is validated for every part type.

2. Safe operation in Avalanche is allowed as long asT_{jmax} is not exceeded.

3. Equation below based on circuit and waveforms shown in Figures 23a, 23b.

4. $P_{D\ (ave)}$ = Average power dissipation per single avalanche pulse.

5. BV = Rated breakdown voltage (1.3 factor accounts for voltage increase during avalanche).

6. I_{av} = Allowable avalanche current.

7. ΔT = Allowable rise in junction temperature, not to exceed T_{jmax} (assumed as 25°C in Figure 14, 15).

t_{av} = Average time in avalanche.

D = Duty cycle in avalanche = tav ·f

$Z_{thJC}(D, t_{av})$ = Transient thermal resistance, see Figures 13)

PD (ave) = 1/2 (1.3·BV·I_{av}) = ΔT/ Z_{thJC}

I_{av} = 2ΔT/ [1.3·BV·Z_{th}]

$E_{AS\ (AR)}$ = $P_{D\ (ave)}$·t_{av}

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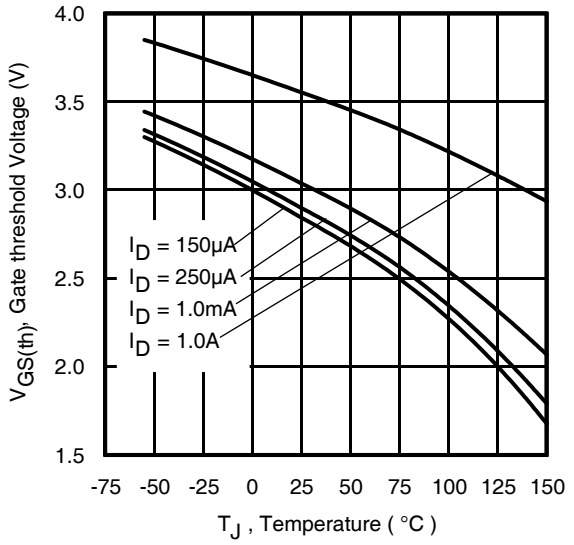


Fig 17. Threshold Voltage vs. Temperature

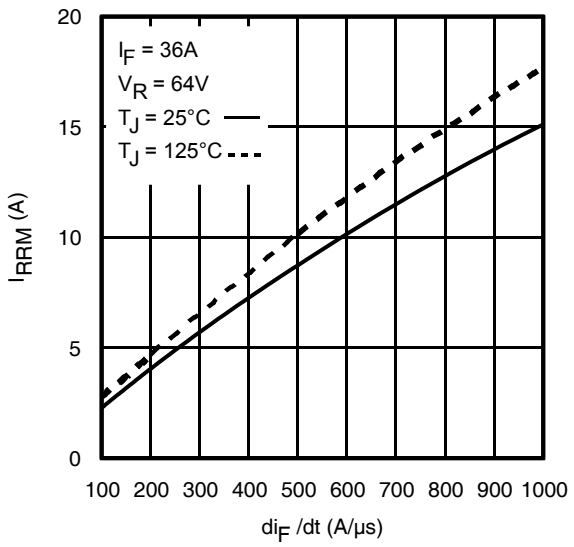


Fig 18. Typical Recovery Current vs. dif/dt

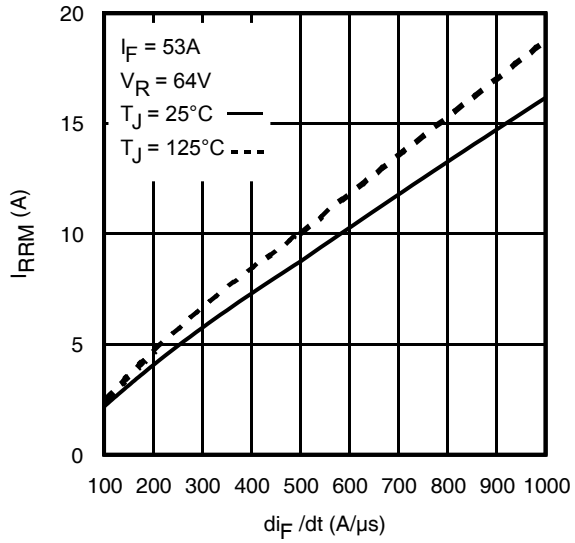


Fig 19. Typical Recovery Current vs. dif/dt

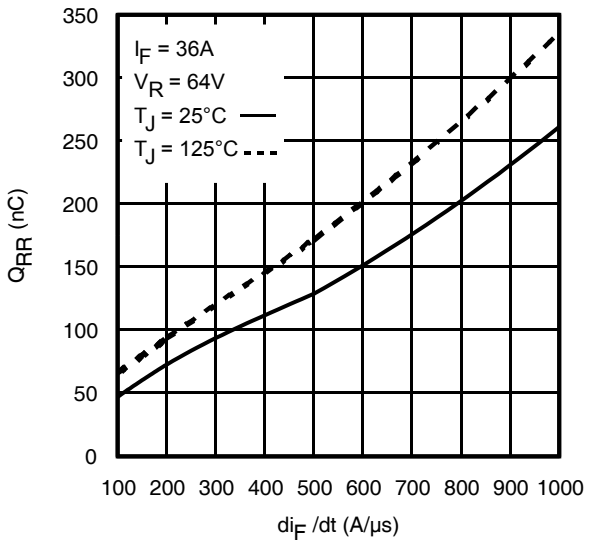


Fig 20. Typical Stored Charge vs. dif/dt

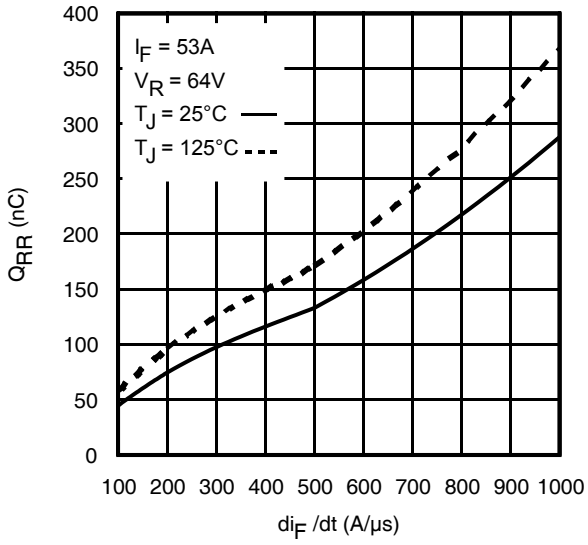


Fig 21. Typical Stored Charge vs. dif/dt

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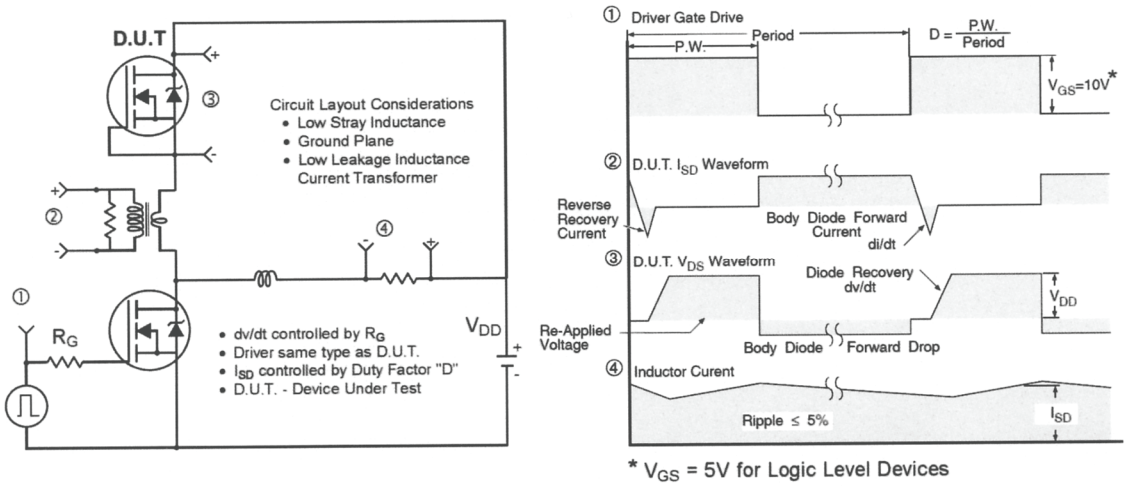


Fig 22. Peak Diode Recovery dv/dt Test Circuit for N-Channel HEXFET® Power MOSFETs

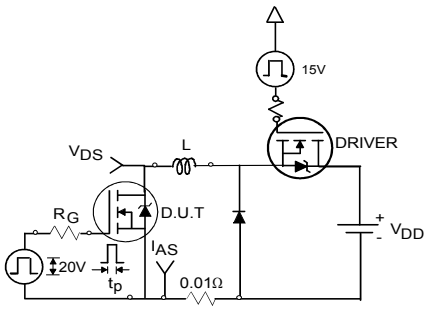


Fig 23a. Unclamped Inductive Test Circuit

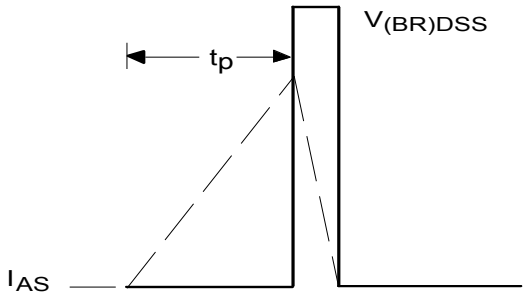


Fig 23b. Unclamped Inductive Waveforms

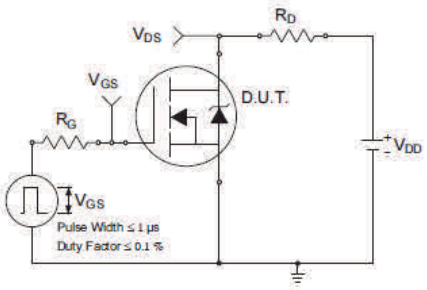


Fig 24a. Switching Time Test Circuit

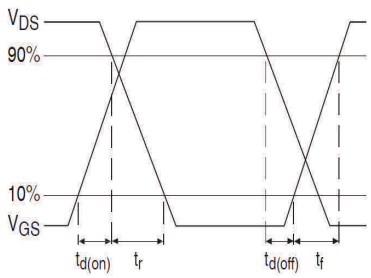


Fig 24b. Switching Time Waveforms

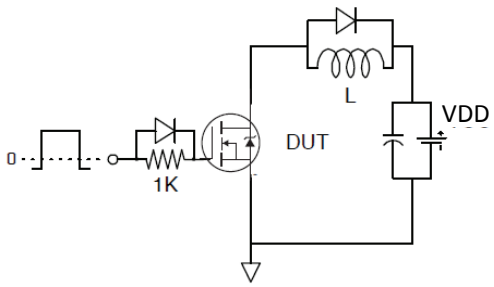


Fig 25a. Gate Charge Test Circuit

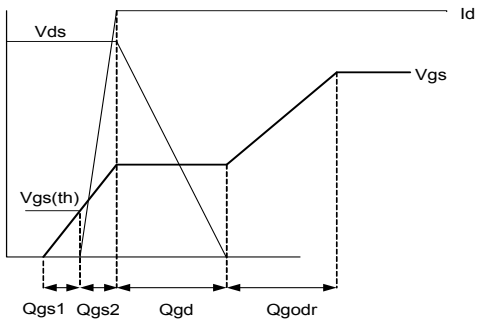
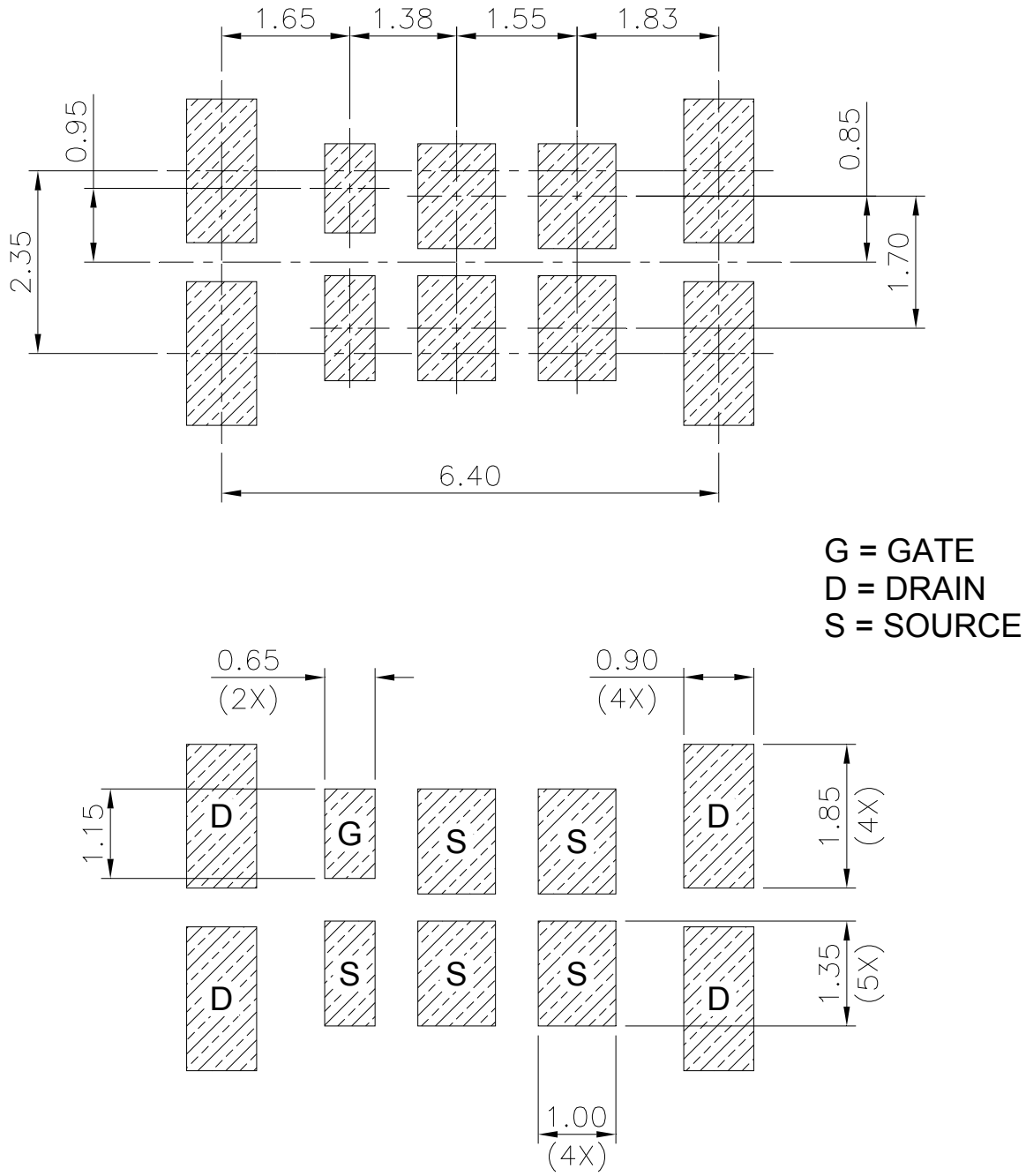


Fig 25b. Gate Charge Waveform

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DirectFET® Board Footprint, ME Outline
(Medium Size Can, E-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.

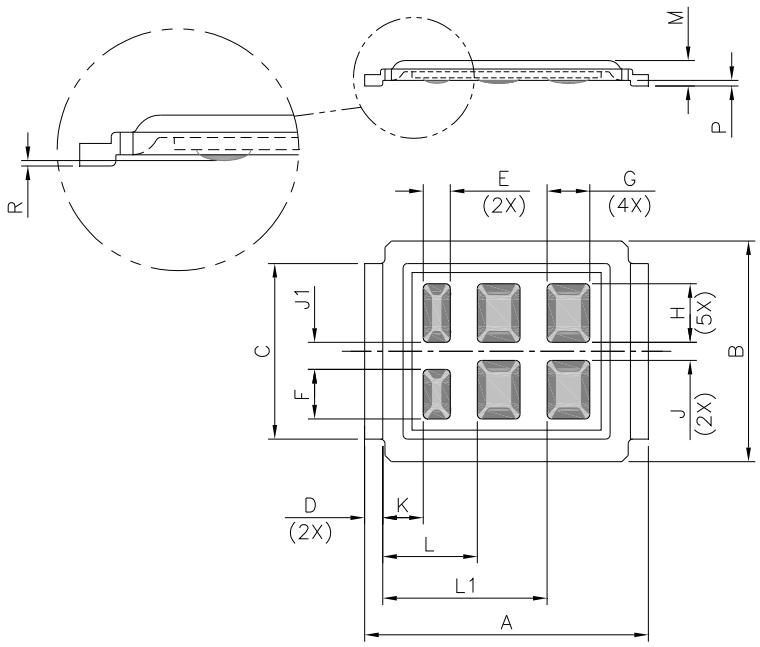


Note: For the most current drawing please refer to IR website at http://www.irf.com/package/

 © 2015 International Rectifier

DirectFET® Outline Dimension, ME Outline
(Medium Size Can, E-Designation)

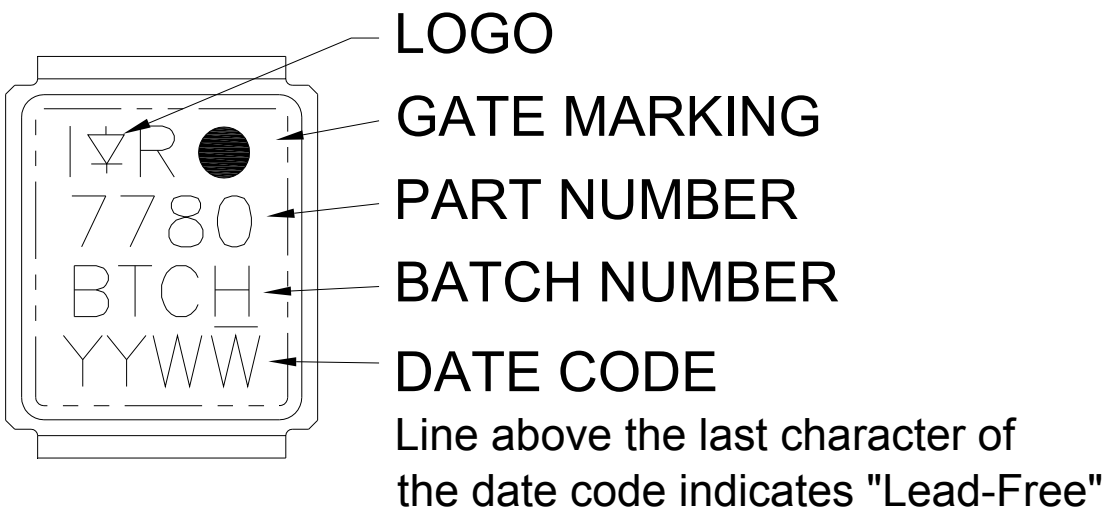
Please see DirectFET® application note AN-1035 for all details regarding the assembly of DirectFET®. This includes all recommendations for stencil and substrate designs.



DIMENSIONS				
	METRIC		IMPERIAL	
CODE	MIN	MAX	MIN	MAX
A	6.25	6.35	0.246	0.250
B	4.80	5.05	0.189	0.199
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	1.08	1.12	0.043	0.044
G	0.93	0.97	0.037	0.038
H	1.28	1.32	0.050	0.052
J	0.38	0.42	0.015	0.017
J1	0.58	0.62	0.023	0.024
K	0.88	0.92	0.035	0.036
L	2.08	2.12	0.082	0.083
L1	3.63	3.67	0.143	0.144
M	0.535	0.595	0.021	0.023
R	0.02	0.08	0.0008	0.0031
P	0.08	0.17	0.003	0.007

Dimensions are shown in millimeters (inches)

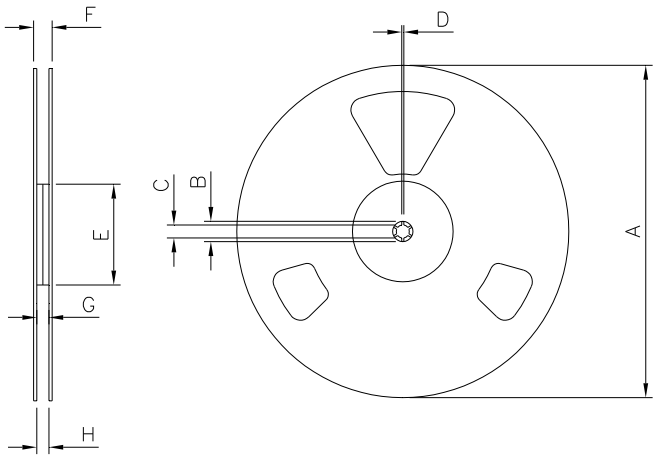
DirectFET® Part Marking



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

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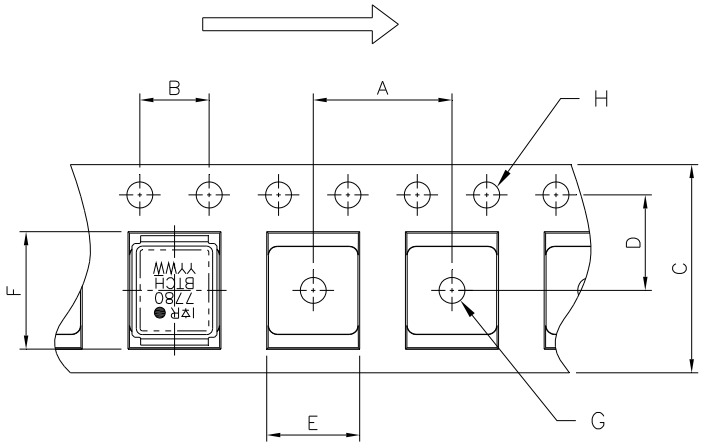
DirectFET® Tape & Reel Dimension (Showing component orientation).



NOTE: Controlling dimensions in mm
Std reel quantity is 4800 parts. (ordered as IRF7780MTRPBF). For 1000 parts on 7" reel, order IRF7780MTR1PBF

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

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

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Qualification Information†

Qualification Level	Industrial * (per JEDEC JESD47F†† guidelines)	
Moisture Sensitivity Level	DFET 1.5	MSL1 (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

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

* Industrial qualification standards except autoclave test conditions.

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IR WORLD HEADQUARTERS: 101 N. Sepulveda Blvd., El Segundo, California 90245, USA

To contact International Rectifier, please visit http://www.irf.com/whoto-call/

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