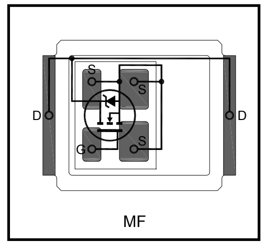
DirectFET™ N-Channel Power MOSFET

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}	40V
$R_{DS(on)}$ typ.	1.4mΩ
max	1.85mΩ
I_D (Silicon Limited)	159A



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	
IRF40DM229	DirectFET™ MF	Tape and Reel	4800	IRF40DM229

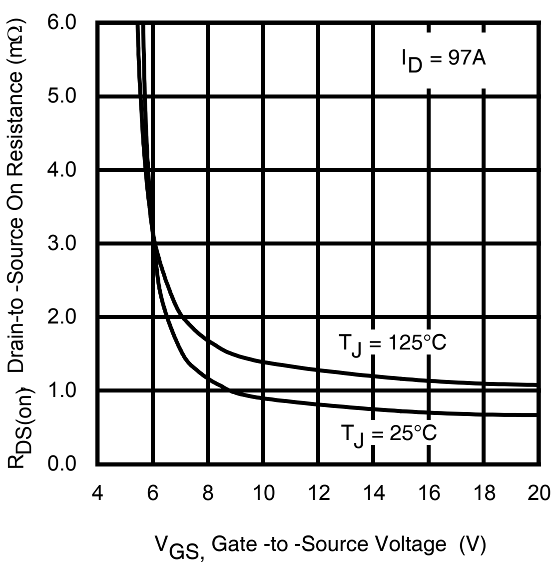


Fig 1. Typical On-Resistance vs. Gate Voltage

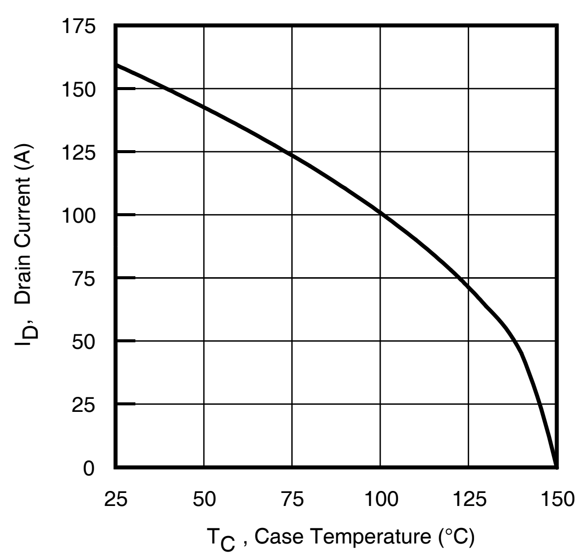


Fig 2. Maximum Drain Current vs. Case Temperature

Absolute Maximum Ratings

Symbol	Parameter	Max.	Units
I_D @ T_C = 25°C	Continuous Drain Current, V_{GS} @ 10V (Silicon Limited)	159	A
I_D @ T_C = 100°C	Continuous Drain Current, V_{GS} @ 10V (Silicon Limited)	101	
I_{DM}	Pulsed Drain Current ①	636	
P_D @T_C = 25°C	Maximum Power Dissipation	83	W
	Linear Derating Factor	0.67	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	72	mJ
$E_{AS\ (Thermally\ limited)}$	Single Pulse Avalanche Energy ⑩	169	
$E_{AS\ (tested)}$	Single Pulse Avalanche Energy Tested Value ⑨	195	
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	——	1.5	
$R_{\theta J\text{-}PCB}$	Junction-to-PCB Mounted	1.0	——	

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

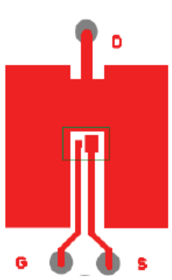
Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	40	——	——	V	V_{GS} = 0V, I_D = 250μA
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	——	32	——	mV/°C	Reference to 25°C, I_D = 1.0mA①
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	——	1.4	1.85	mΩ	V_{GS} = 10V, I_D = 97A ④
		——	3.0	——		V_{GS} = 6.0V, I_D = 49A ④
$V_{GS(th)}$	Gate Threshold Voltage	2.2	2.8	3.9	V	V_{DS} = V_{GS}, I_D = 100μA
I_{DSS}	Drain-to-Source Leakage Current	——	——	1.0	μA	V_{DS} = 40V, V_{GS} = 0V
		——	——	150		V_{DS} = 40V, 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	——	1.0	——	Ω	

Notes:

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

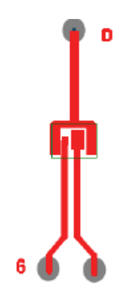
❸ Used double sided cooling , mounting pad with large heatsink.

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



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

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

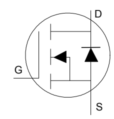


❷ Mounted on minimum footprint full size board with metalized back and with small clip heatsink (still air)

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

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
gfs	Forward Transconductance	87	——	——	S	V_{DS} = 10V, I_D = 97A
Q_g	Total Gate Charge	——	107	161	nC	I_D = 97A
Q_{gs}	Gate-to-Source Charge	——	30	——		V_{DS} =20V
Q_{gd}	Gate-to-Drain ("Miller") Charge	——	39	——		V_{GS} = 10V ④
Q_{sync}	Total Gate Charge Sync. (Q_g - Q_{gd})	——	68	——		
$t_{d(on)}$	Turn-On Delay Time	——	16	——	ns	V_{DD} = 20V
t_r	Rise Time	——	66	——		I_D = 30A
$t_{d(off)}$	Turn-Off Delay Time	——	54	——		R_G = 2.7Ω
t_f	Fall Time	——	54	——		V_{GS} = 10V ④
C_{iss}	Input Capacitance	——	5317	——	pF	V_{GS} = 0V
C_{oss}	Output Capacitance	——	866	——		V_{DS} = 25V
C_{rss}	Reverse Transfer Capacitance	——	575	——		*ƒ* = 1.0MHz
C_{oss} eff. (ER)	Effective Output Capacitance (Energy Related)	——	1037	——		V_{GS} = 0V, V_{DS} = 0V to 32V ⑥
C_{oss} eff. (TR)	Effective Output Capacitance (Time Related)	——	1237	——		V_{GS} = 0V, V_{DS} = 0V to 32V ⑤

Diode Characteristics

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	——	——	83	A	MOSFET symbol showing the integral reverse p-n junction diode. 
I_{SM}	Pulsed Source Current (Body Diode) ①	——	——	636		
V_{SD}	Diode Forward Voltage	——	——	1.2	V	T_J= 25°C,I_S = 97A, V_{GS} = 0V④
dv/dt	Peak Diode Recovery ③	——	3.2	——	V/ns	T_J =150°C,I_S = 97A,V_{DS} = 40V
t_{rr}	Reverse Recovery Time	——	26	——	ns	T_J = 25° C V_R = 34V
		——	27	——		T_J = 125°C I_F = 97A
Q_{rr}	Reverse Recovery Charge	——	24	——	nC	T_J = 25°C di/dt = 100A/μs ④
		——	23	——		T_J = 125°C
I_{RRM}	Reverse Recovery Current	——	1.2	——	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 = 0.015mH R_G = 50Ω, I_{AS} = 97A, V_{GS} =10V.

③ I_{SD} ≤ 97A, di/dt ≤ 862A/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 This value determined from sample failure population, starting T_J = 25°C, L= 0.015mH, R_G = 50Ω, I_{AS} = 97A, V_{GS} =10V.

⑩ Limited by $T_J$max, starting T_J = 25°C, L = 1mH R_G = 50Ω, I_{AS} = 18A, V_{GS} =10V.

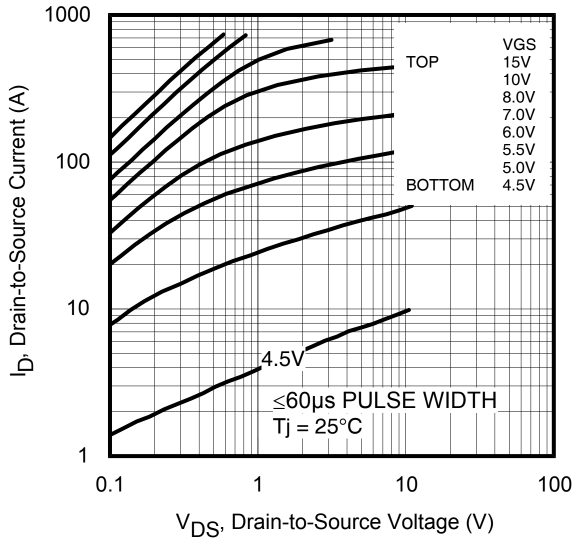


Fig 3. Typical Output Characteristics

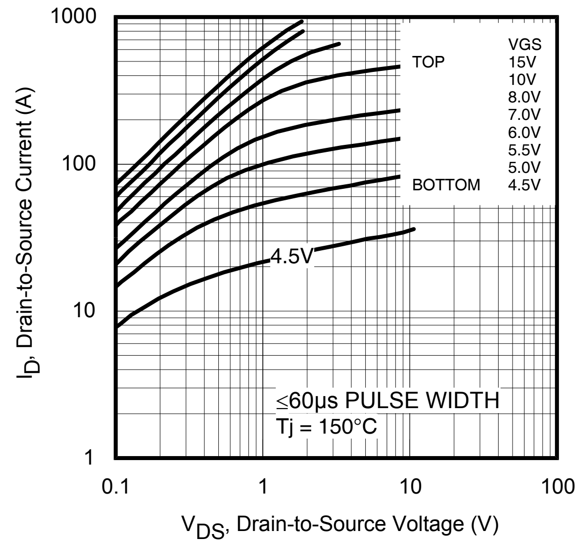


Fig 4. Typical Output Characteristics

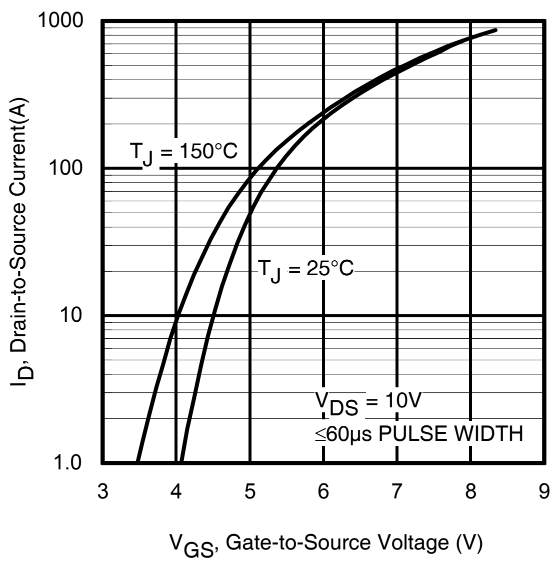


Fig 5. Typical Transfer Characteristics

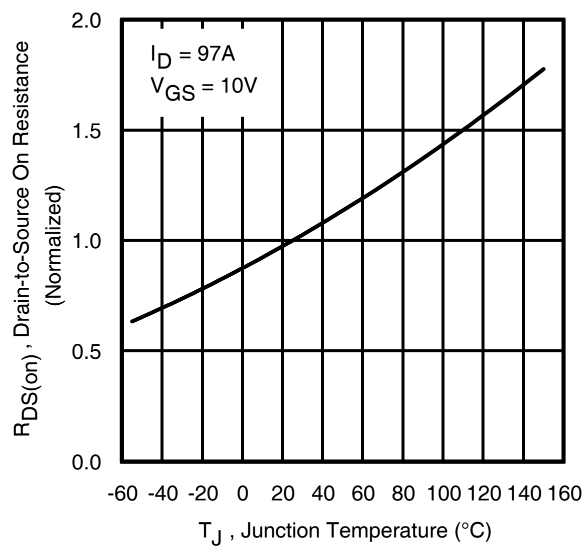


Fig 6. Normalized On-Resistance vs. Temperature

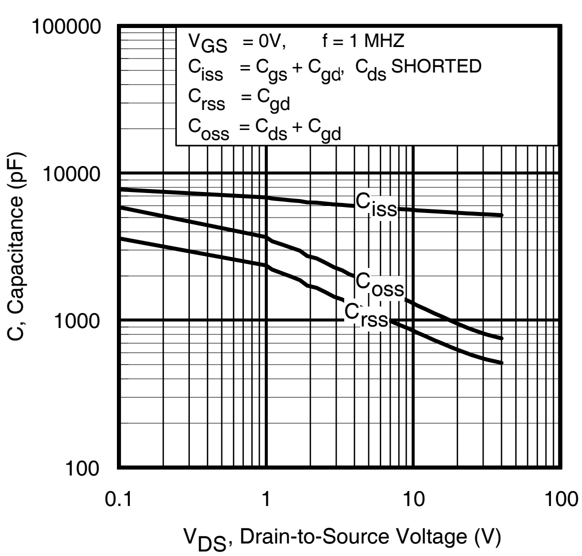


Fig 7. Typical Capacitance vs. Drain-to-Source Voltage

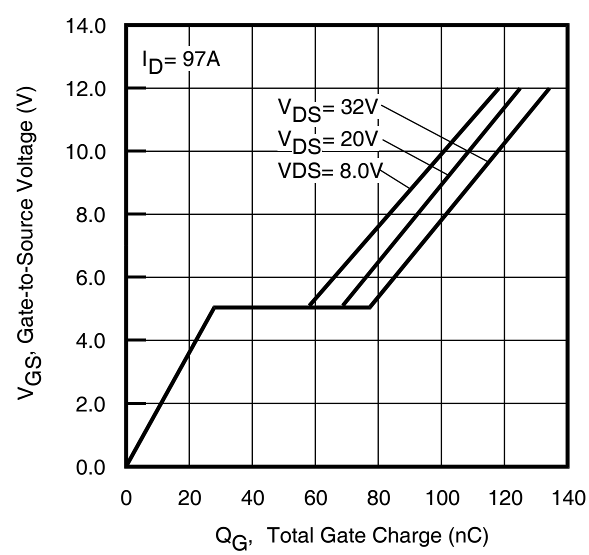


Fig 8. Typical Gate Charge vs. Gate-to-Source Voltage

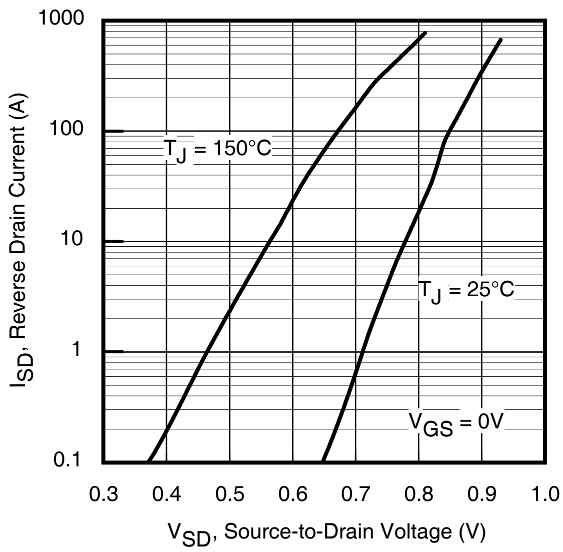


Fig 9. Typical Source-Drain Diode Forward Voltage

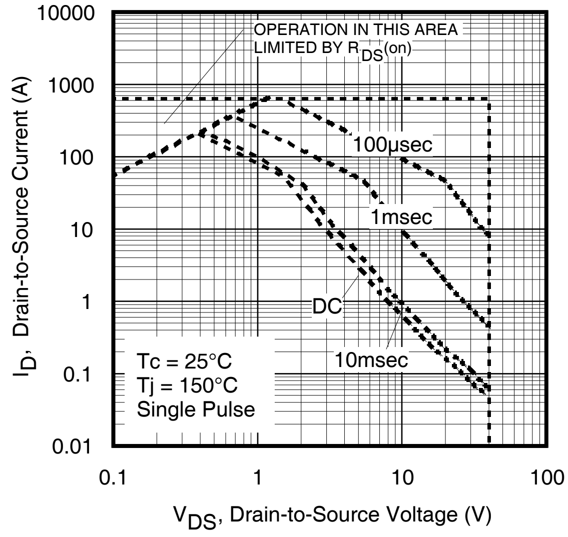


Fig 10. Maximum Safe Operating Area

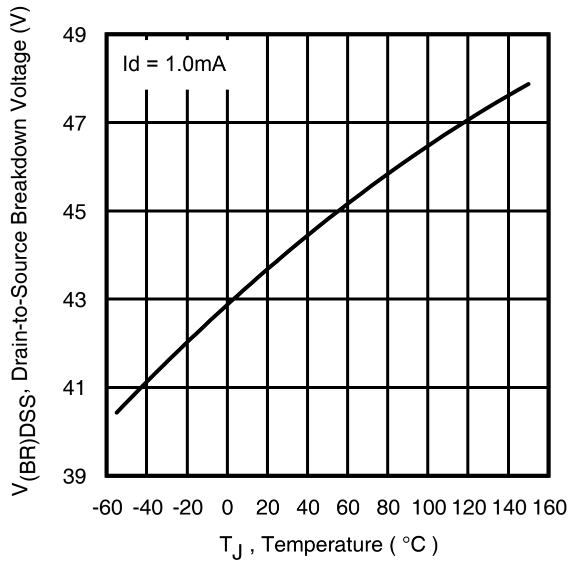


Fig 11. Drain-to-Source Breakdown Voltage

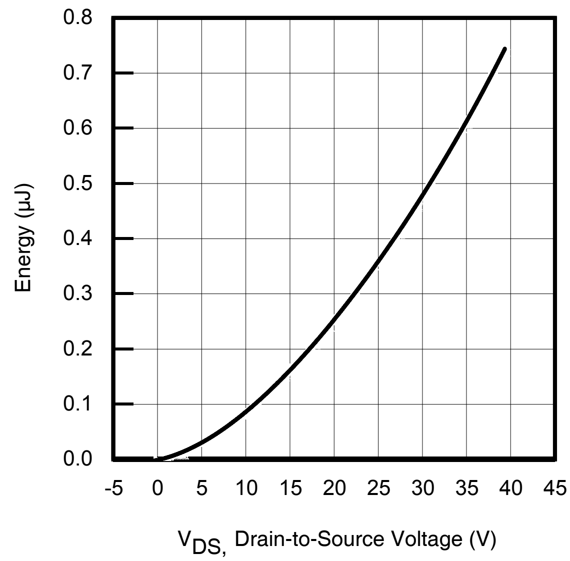


Fig 12. Typical C_{oss} Stored Energy

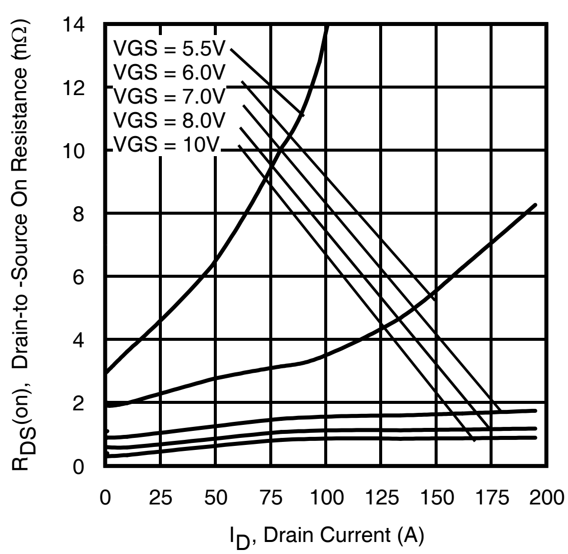


Fig 13. Typical On-Resistance vs. Drain Current

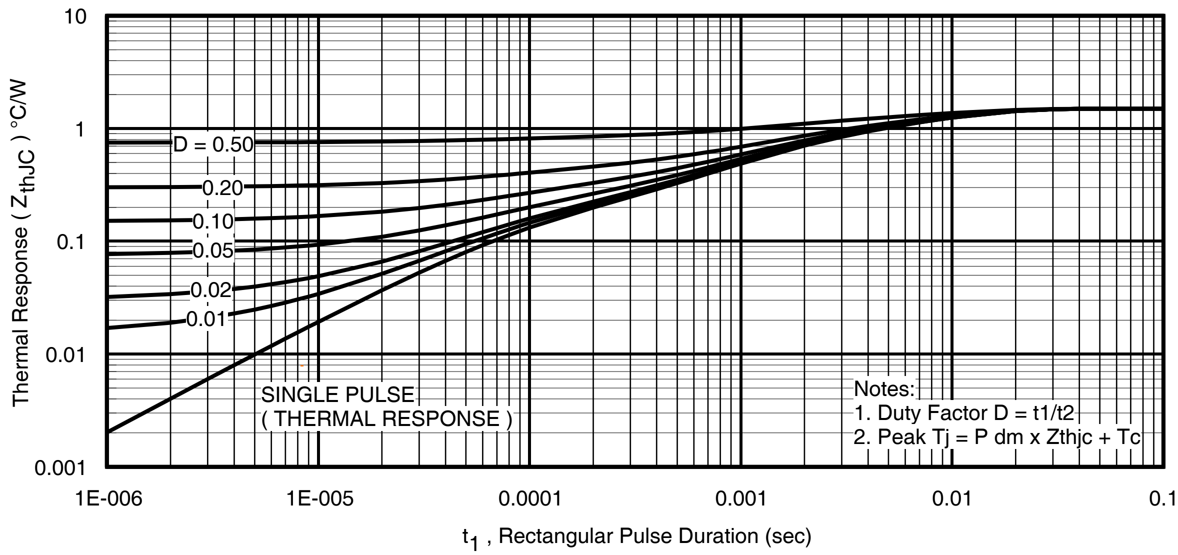


Fig 14. Maximum Effective Transient Thermal Impedance, Junction-to-Case

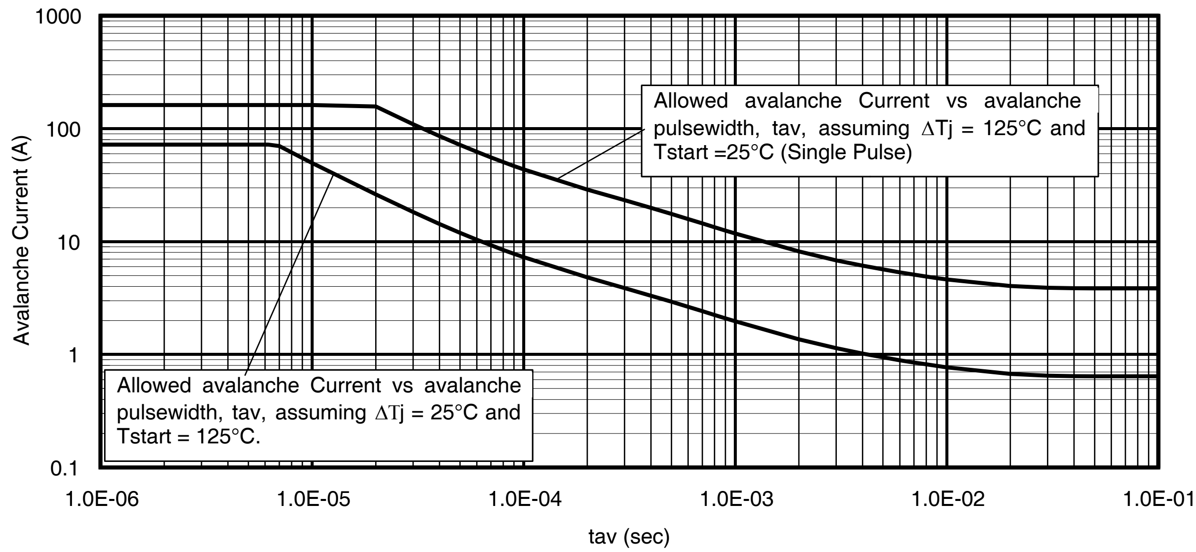


Fig 15. Avalanche Current vs. Pulse Width

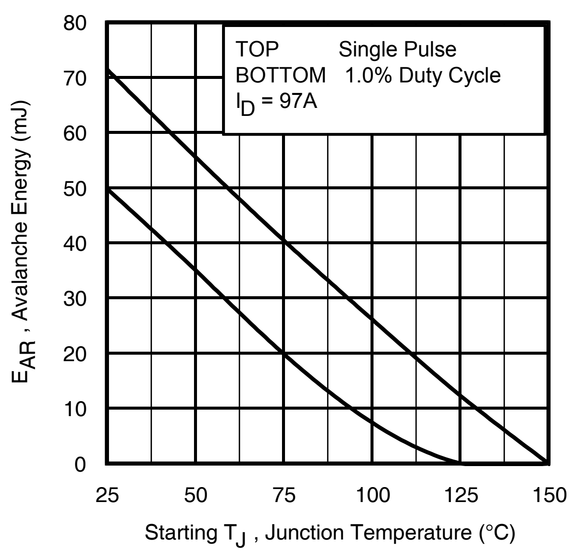


Fig 16. Maximum Avalanche Energy vs. Temperature

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 as T_{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)

$$PD\ (ave) = 1/2\ (1.3 \cdot BV \cdot I_{av}) = \Delta T / Z_{thJC}$$
$$I_{av} = 2\Delta T / [1.3 \cdot BV \cdot Z_{th}]$$
$$E_{AS\ (AR)} = P_{D\ (ave)} \cdot t_{av}$$

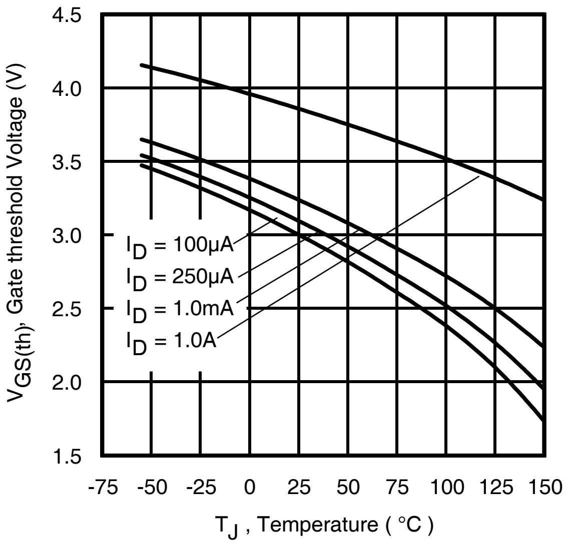


Fig 17. Threshold Voltage vs. Temperature

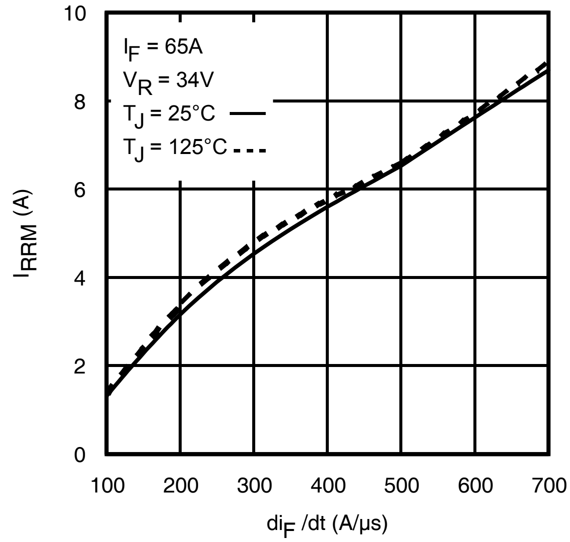


Fig 18. Typical Recovery Current vs. dif/dt

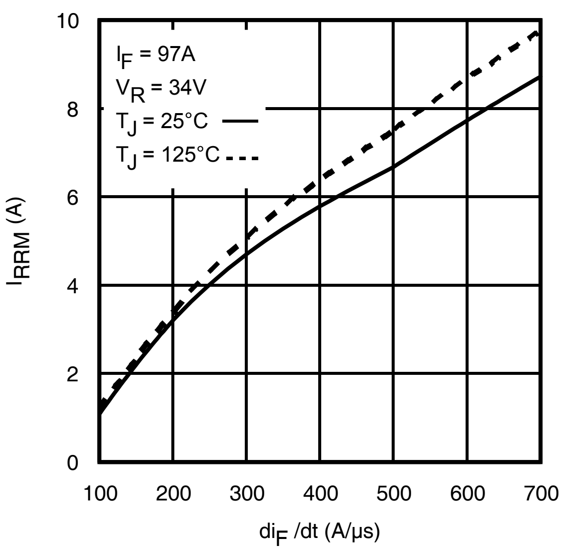


Fig 19. Typical Recovery Current vs. dif/dt

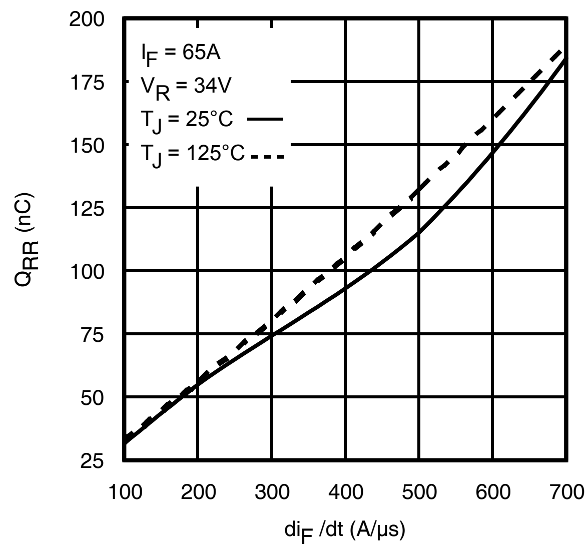


Fig 20. Typical Stored Charge vs. dif/dt

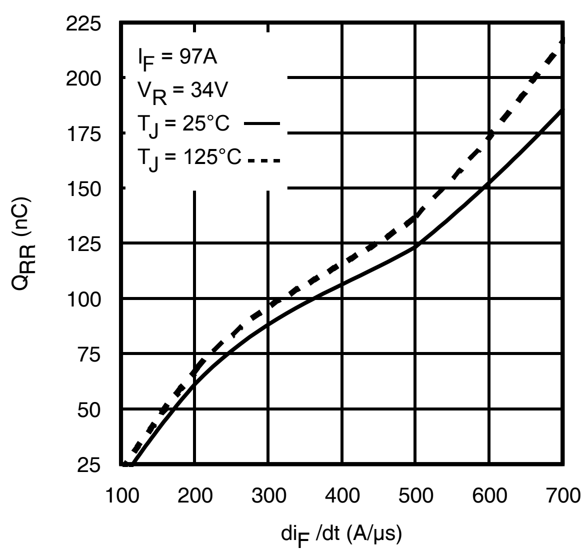


Fig 21. Typical Stored Charge vs. dif/dt

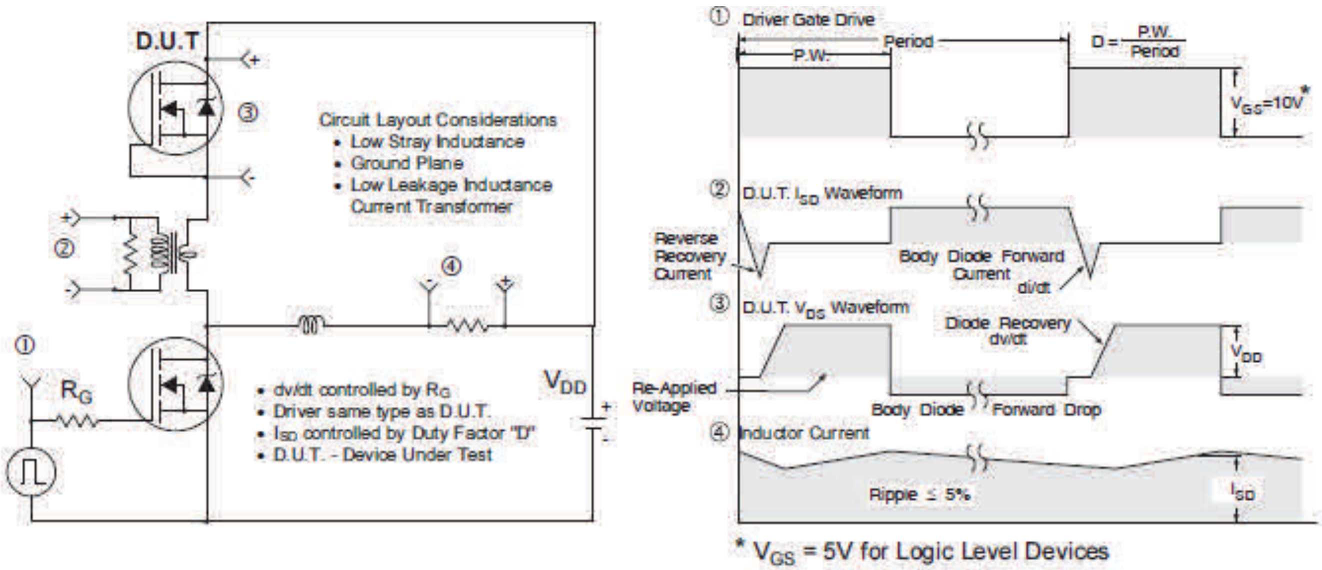


Fig 22. Peak Diode Recovery dv/dt Test Circuit for N-Channel HEXFET® Power MOSFETs

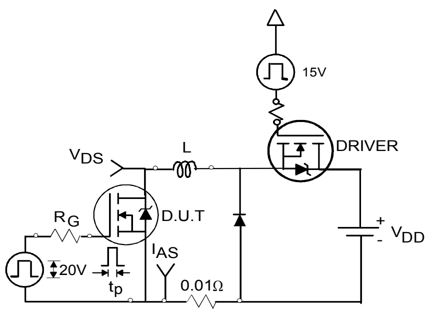


Fig 23a. Unclamped Inductive Test Circuit

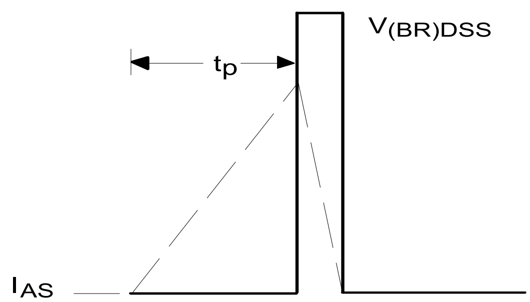


Fig 23b. Unclamped Inductive Waveforms

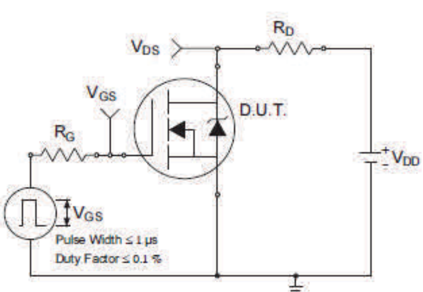


Fig 24a. Switching Time Test Circuit

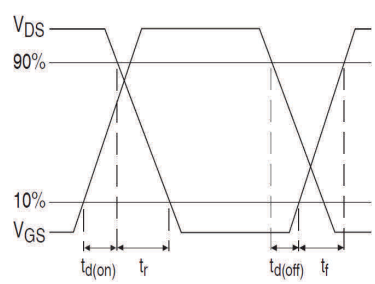


Fig 24b. Switching Time Waveforms

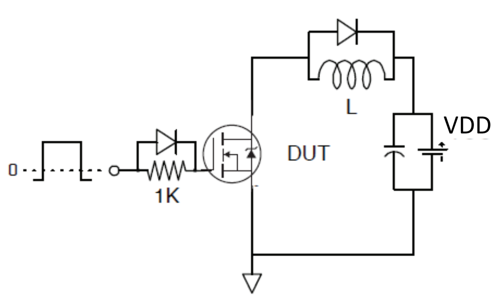


Fig 25a. Gate Charge Test Circuit

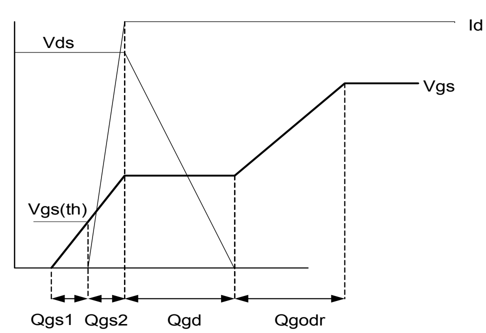
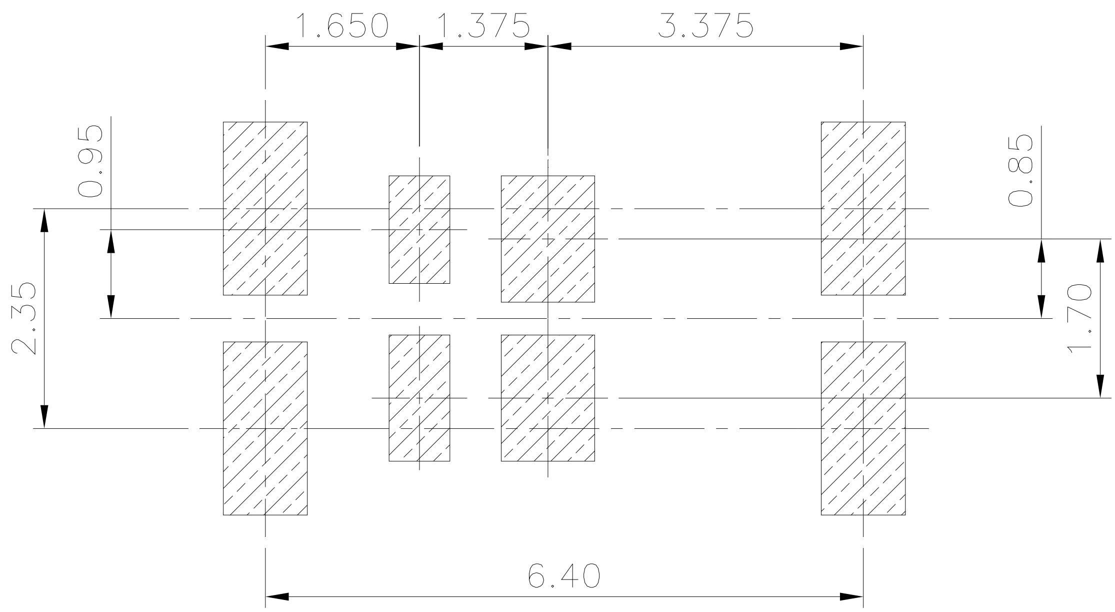


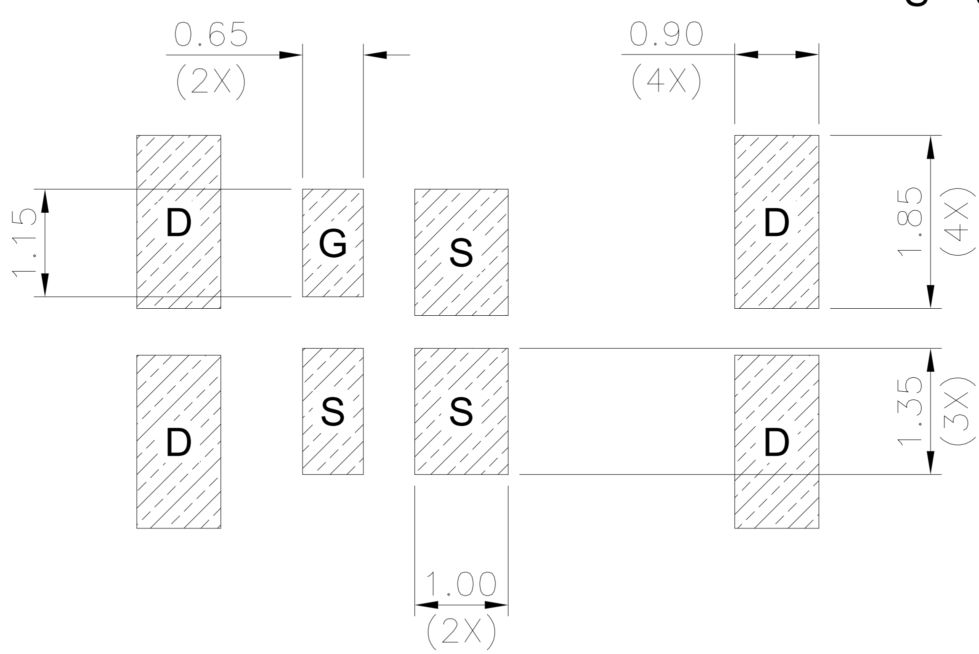
Fig 25b. Gate Charge Waveform

DirectFET™ Board Footprint, MF 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.



G = GATE
D = DRAIN
S = SOURCE

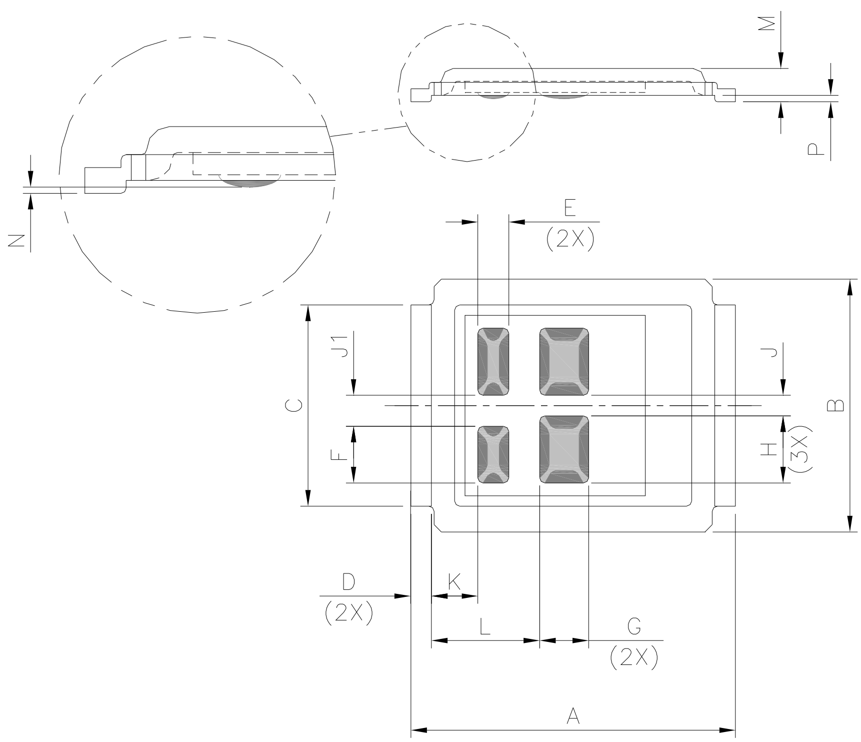


Note: For the most current drawing please refer to IR website at http://www.irf.com/package/

DirectFET™ Outline Dimension, MF Outline

(Medium Size Can, E-Designation)

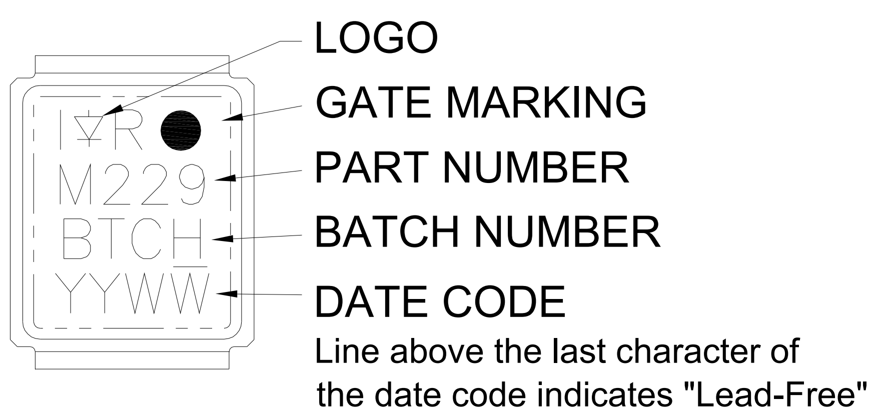
Please see DirectFET™ application note AN-1035 for all details regarding the assembly of DirectFET™. This includes all recommendations for stencil and substrate designs.



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	0.835	0.965	0.033	0.038
L	2.035	2.165	0.080	0.085
M	0.59	0.70	0.023	0.028
N	0.02	0.08	0.0008	0.003
P	0.08	0.17	0.003	0.007

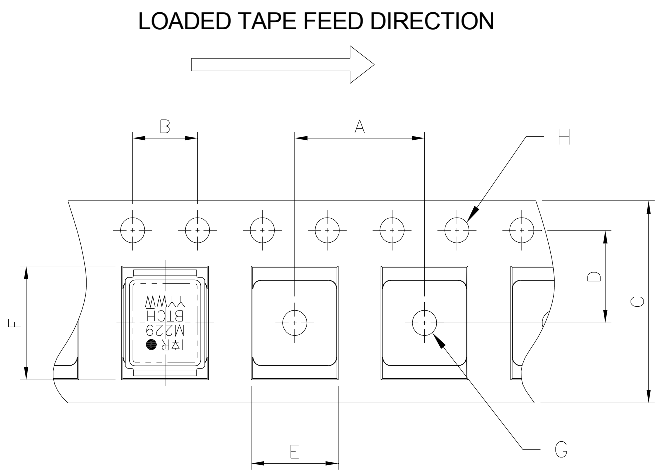
Dimensions are shown in millimeters (inches)

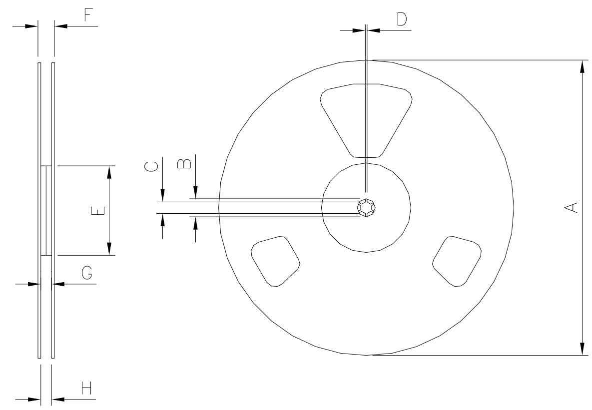
DirectFET™ Part Marking



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

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





NOTE: Controlling dimensions in mm
Std reel quantity is 4800 parts. Ordered as IRF40DM229.

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)**				
	METRIC		IMPERIAL	
CODE	MIN	MAX	MIN	MAX
A	330.0	N.C	12.992	N.C
B	20.2	N.C	0.795	N.C
C	12.8	13.2	0.504	0.520
D	1.5	N.C	0.059	N.C
E	100.0	N.C	3.937	N.C
F	N.C	18.4	N.C	0.724
G	12.4	14.4	0.488	0.567
H	11.9	15.4	0.469	0.606

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

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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Компания «ЭлектроПласт» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов;
- Поставка более 17-ти миллионов наименований электронных компонентов;
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
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- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits,General Dynamics и др.);

Помимо этого, одним из направлений компании «ЭлектроПласт» является направление «Источники питания». Мы предлагаем Вам помощь Конструкторского отдела:

- Подбор оптимального решения, техническое обоснование при выборе компонента;
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.

Как с нами связаться

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