International
IOR Rectifier

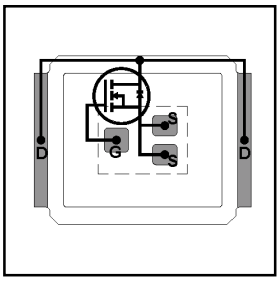
PD - 94363A

IRF6602

DirectFET™ Power MOSFET

- Application Specific MOSFETs
- Ideal for CPU Core DC-DC Converters
- Low Conduction Losses
- Low Switching Losses
- Low Profile (<0.7 mm)
- Dual Sided Cooling Compatible
- Compatible with existing Surface Mount Techniques

V_{DSS}	$R_{DS(on)}$ max	I_D
20V	13mΩ@V_{GS} = 10V	11A
	19mΩ@V_{GS} = 4.5V	8.8A



DirectFET™ ISOMETRIC

Description

The IRF6602 combines the latest HEXFET® Power MOSFET Silicon technology with the advanced DirectFET™ packaging to achieve the lowest on-state resistance charge product in a package that has the footprint of an 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. The DirectFET package allows dual sided cooling to maximize thermal transfer in power systems, IMPROVING previous best thermal resistance by 80%.

The IRF6602 balances both low resistance and low charge along with ultra low package inductance to reduce both conduction and switching losses. The reduced total losses make this product ideal for high efficiency DC-DC converters that power the latest generation of processors operating at higher frequencies. The IRF6602 has been optimized for parameters that are critical in synchronous buck converters including Rds(on) and gate charge to minimize losses in the control FET socket.

Absolute Maximum Ratings

	Parameter	Max.	Units
V_{DS}	Drain- Source Voltage	20	V
I_D @ T_C = 25°C	Continuous Drain Current, V_{GS} @ 4.5V	11	A
I_D @ T_C = 70°C	Continuous Drain Current, V_{GS} @ 4.5V	8.8	
I_{DM}	Pulsed Drain Current ①	88	
P_D @T_C = 25°C	Power Dissipation	2.3	W
P_D @T_C = 70°C	Power Dissipation	1.5	
	Linear Derating Factor	18	mW/°C
V_{GS}	Gate-to-Source Voltage	± 20	V
T_J, T_{STG}	Junction and Storage Temperature Range	-55 to + 150	°C

Thermal Resistance

Symbol	Parameter	Typ.	Max.	Units
$R_{\theta JA}$	Junction-to-Ambient③	—	55	°C/W
$R_{\theta JA}$	Junction-to-Ambient④	12.5	—	
$R_{\theta JA}$	Junction-to-Ambient⑤	20	—	
$R_{\theta JC}$	Junction-to-Case⑥	3.0	—	
$R_{\theta J\text{-}PCB}$	Junction-to-PCB mounted	1.0	—	

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

	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	20	—	—	V	V_{GS} = 0V, I_D = 250µA
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	0.022	—	V/°C	Reference to 25°C, I_D = 1mA
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	10	13	mΩ	V_{GS} = 10V, I_D = 11A ③
		—	14	19		V_{GS} = 4.5V, I_D = 8.8A ③
$V_{GS(th)}$	Gate Threshold Voltage	1.0	—	3.0	V	V_{DS} = V_{GS}, I_D = 250µA
I_{DSS}	Drain-to-Source Leakage Current	—	—	20	µA	V_{DS} = 16V, V_{GS} = 0V
		—	—	125		V_{DS} = 16V, V_{GS} = 0V, T_J = 125°C
I_{GSS}	Gate-to-Source Forward Leakage	—	—	200	nA	V_{GS} = 20V
	Gate-to-Source Reverse Leakage	—	—	-200		V_{GS} = -20V

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

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
g_{fs}	Forward Transconductance	20	—	—	S	V_{DS} = 10V, I_D = 8.8A
Q_g	Total Gate Charge Cont FET	—	13	20	nC	V_{GS} = 5.0V, V_{DS} = 10V, I_D = 8.8A
Q_g	Total Gate Charge Sync FET	—	11	—		V_{GS} = 5.0V, V_{DS} < 100mV
Q_{gs1}	Pre-Vth Gate-Source Charge	—	3.5	—		V_{DS} = 16V, I_D = 8.8A
Q_{gs2}	Post-Vth Gate-Source Charge	—	1.3	—		
Q_{gd}	Gate to Drain Charge	—	4.8	—		
Q_{sw}	Switch Charge (Q_{gs2} + Q_{gd})	—	6.1	—		
Q_{oss}	Output Charge	—	19	—		V_{DS} = 16V, V_{GS} = 0V
$t_{d(on)}$	Turn-On Delay Time	—	11	—	ns	V_{DD} = 15V
t_r	Rise Time	—	58	—		I_D = 8.8A
$t_{d(off)}$	Turn-Off Delay Time	—	15	—		R_G = 1.8Ω
t_f	Fall Time	—	5.5	—		V_{GS} = 4.5V ③
C_{iss}	Input Capacitance	—	1420	—	pF	V_{GS} = 0V
C_{oss}	Output Capacitance	—	960	—		V_{DS} = 10V
C_{rss}	Reverse Transfer Capacitance	—	100	—		f = 1.0MHz

Avalanche Characteristics

Symbol	Parameter	Typ.	Max.	Units
E_{AS}	Single Pulse Avalanche Energy②	—	97	mJ
I_{AR}	Avalanche Current①	—	8.8	A

Diode Characteristics

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	—	—	11	A	MOSFET symbol showing the integral reverse p-n junction diode.
I_{SM}	Pulsed Source Current (Body Diode) ①	—	—	88		
V_{SD}	Diode Forward Voltage	—	0.83	1.2	V	T_J = 25°C, I_S = 8.8A, V_{GS} = 0V ③
		—	0.65	—		T_J = 125°C, I_S = 8.8A, V_{GS} = 0V ③
t_{rr}	Reverse Recovery Time	—	42	62	ns	T_J = 25°C, I_F = 8.8A, V_R=15V
Q_{rr}	Reverse Recovery Charge	—	51	77	nC	di/dt = 100A/µs ③
t_{rr}	Reverse Recovery Time	—	43	64	ns	T_J = 125°C, I_F = 8.8A, V_R=15V
Q_{rr}	Reverse Recovery Charge	—	55	82	nC	di/dt = 100A/µs ③

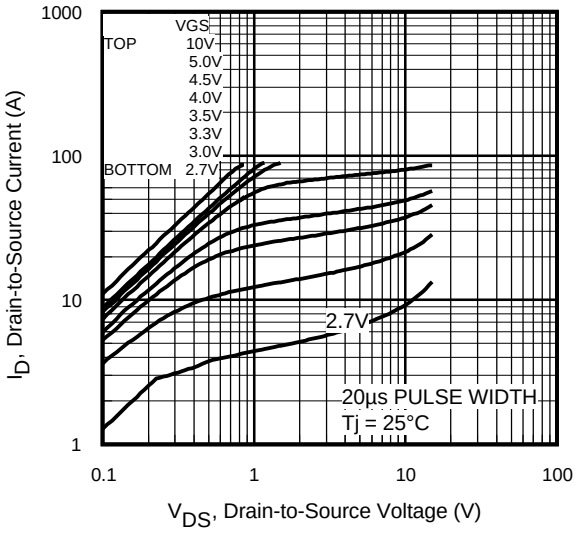


Fig 1. Typical Output Characteristics

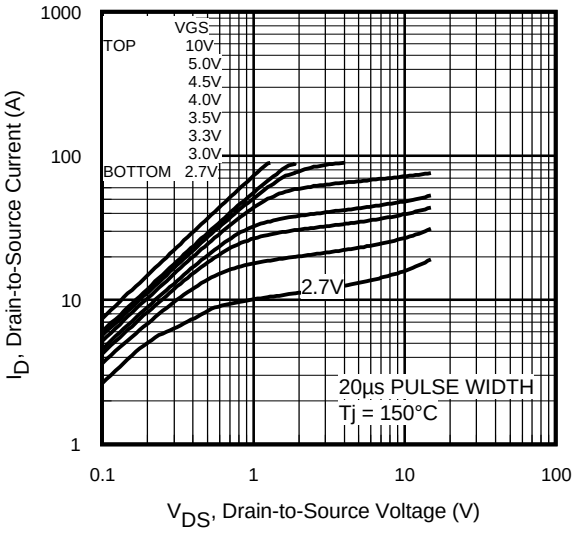


Fig 2. Typical Output Characteristics

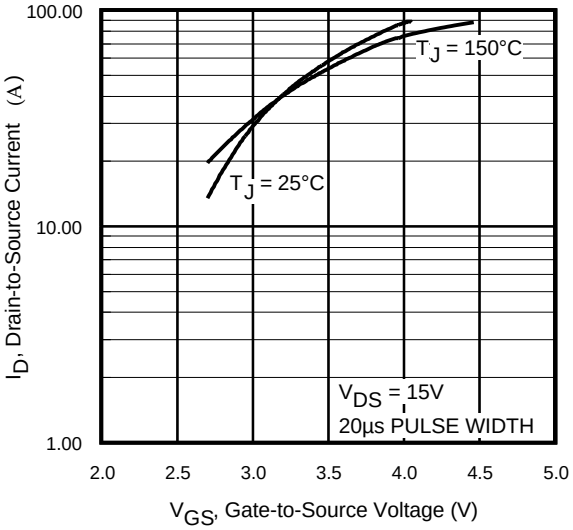


Fig 3. Typical Transfer Characteristics

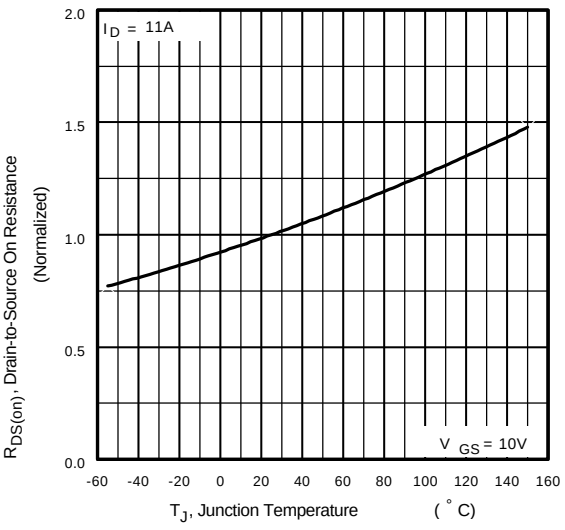


Fig 4. Normalized On-Resistance Vs. Temperature

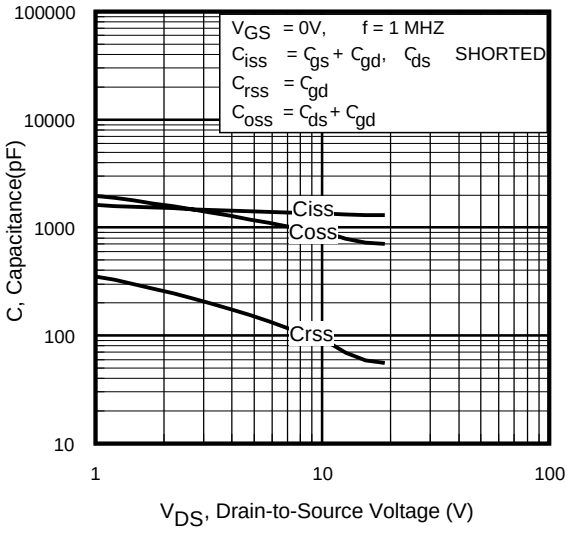


Fig 5. Typical Capacitance Vs. Drain-to-Source Voltage

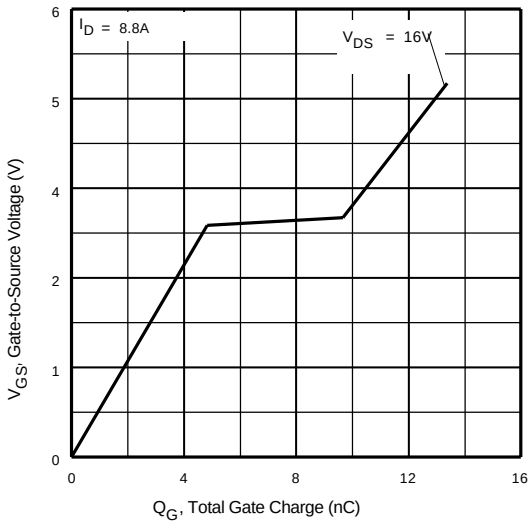


Fig 6. Typical Gate Charge Vs. Gate-to-Source Voltage

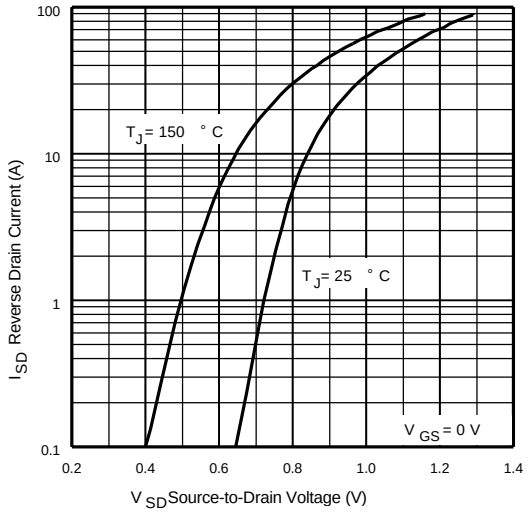


Fig 7. Typical Source-Drain Diode Forward Voltage

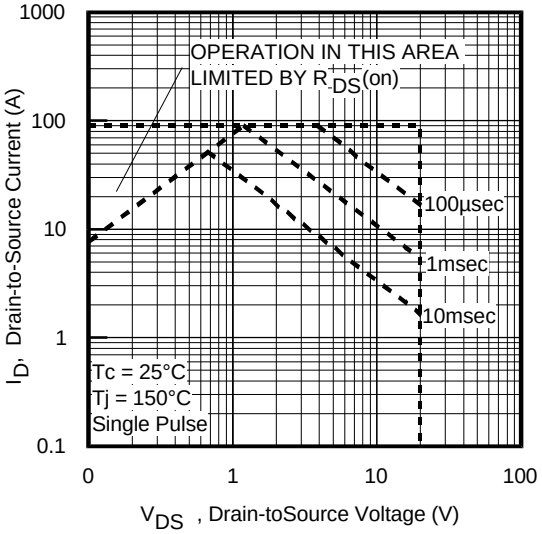


Fig 8. Maximum Safe Operating Area

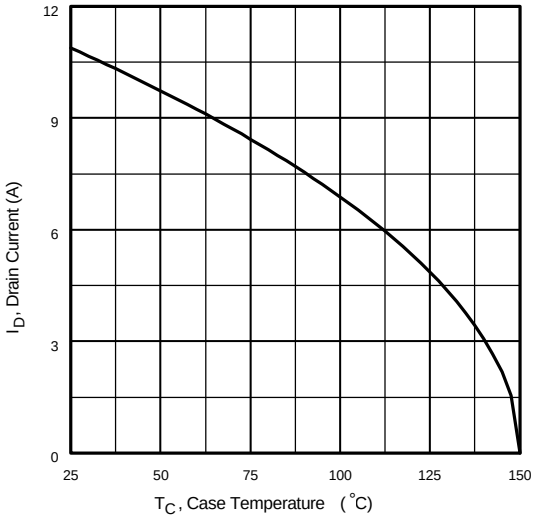


Fig 9. Maximum Drain Current Vs. Ambient Temperature

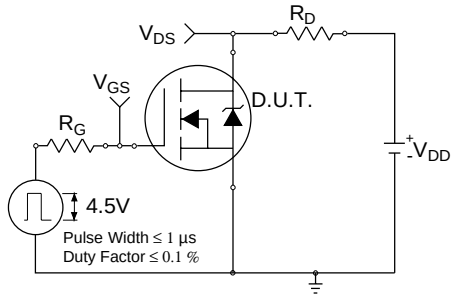


Fig 10a. Switching Time Test Circuit

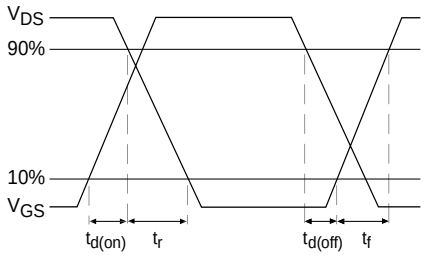


Fig 10b. Switching Time Waveforms

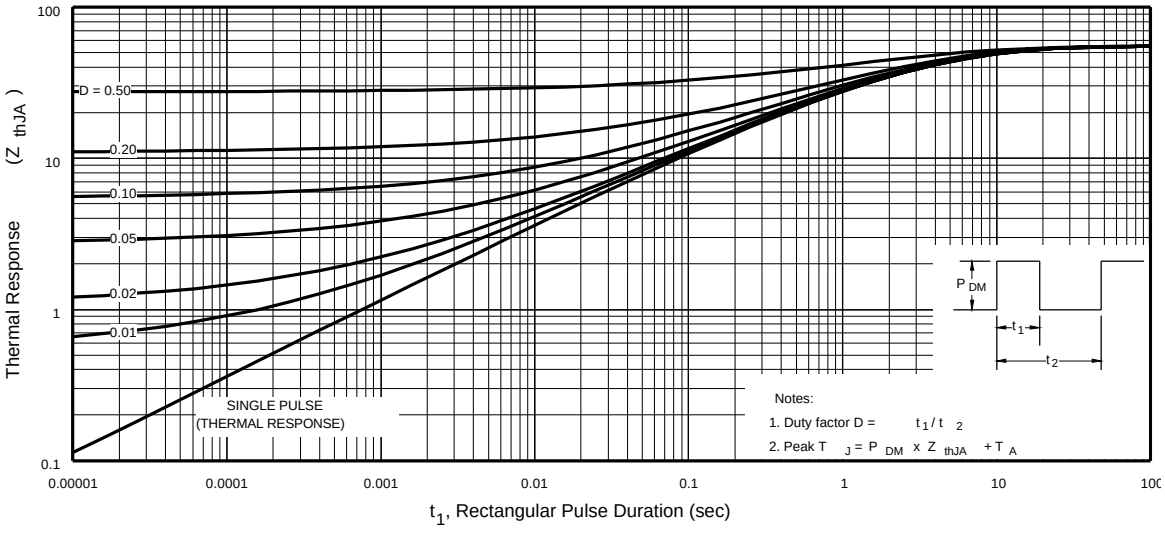


Fig 10. Maximum Effective Transient Thermal Impedance, Junction-to-Case

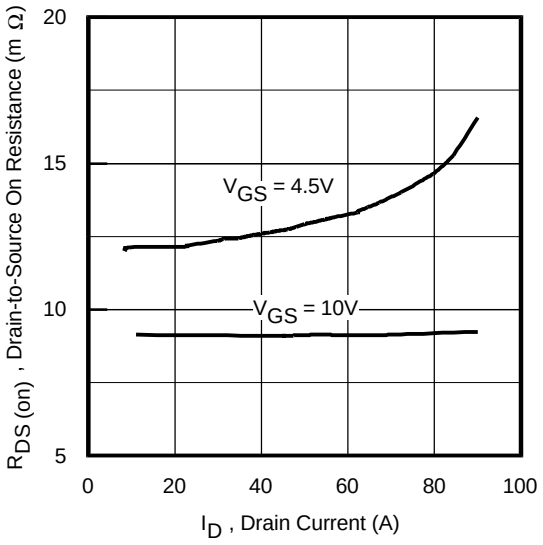


Fig 12. On-Resistance Vs. Drain Current

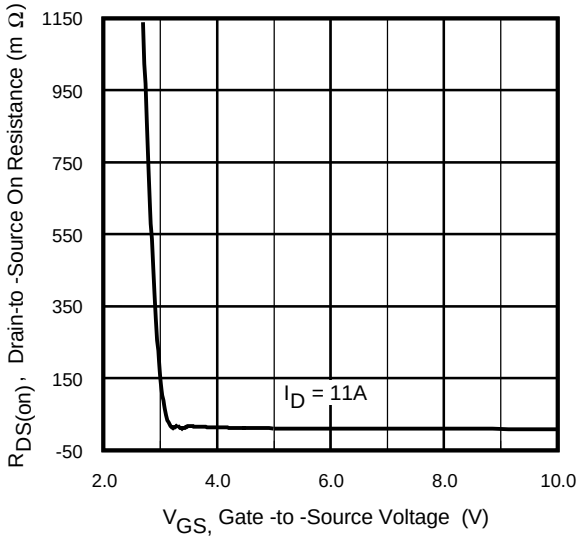


Fig 13. On-Resistance Vs. Gate Voltage

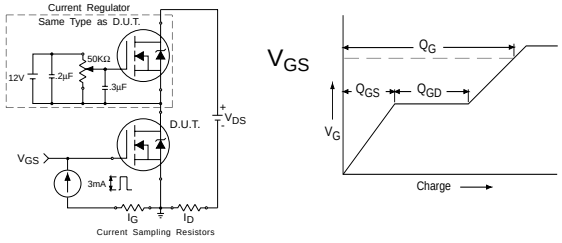


Fig 13a&b. Basic Gate Charge Test Circuit and Waveform

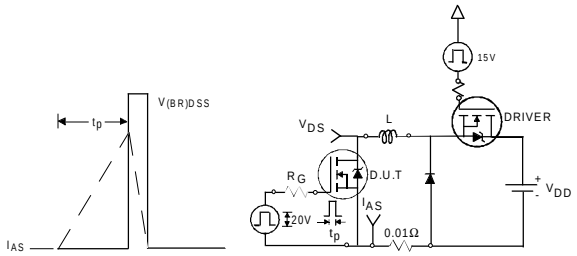


Fig 14a&b. Unclamped Inductive Test circuit and Waveforms

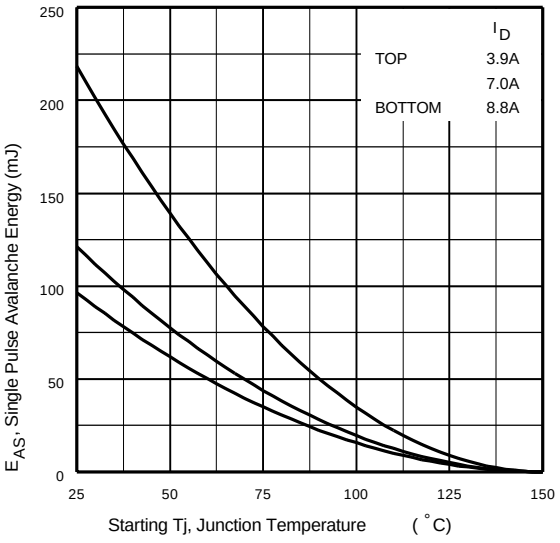
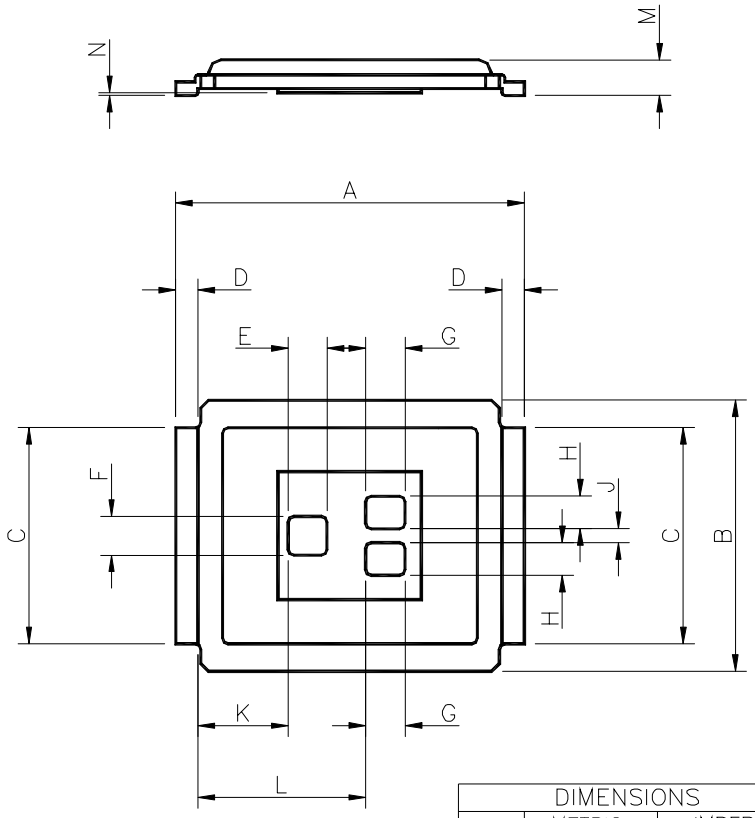


Fig 14c. Maximum Avalanche Energy Vs. Drain Current

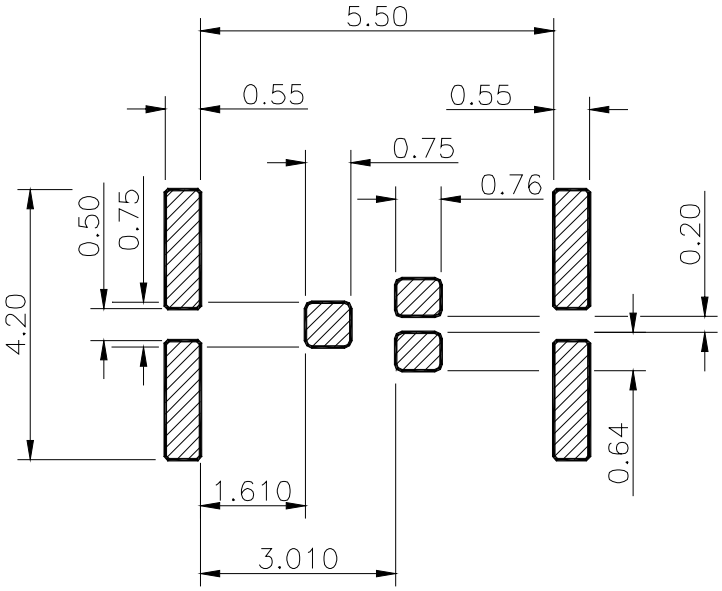
DirectFET™ Outline Dimension



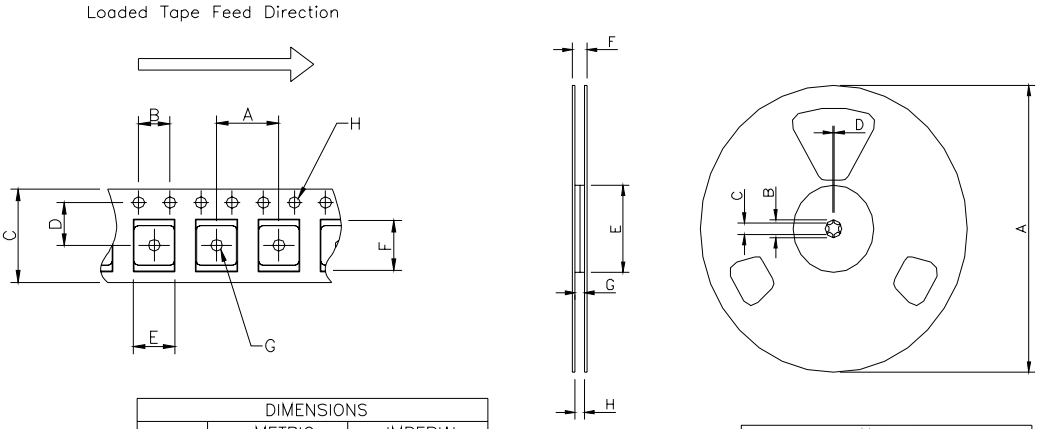
E: Controlling dimensions
n mm

DIMENSIONS				
	METRIC		IMPERIAL	
CODE	MIN	MAX	MIN	MAX
A	6.25	6.35	0.246	0.250
B	4.80	5.05	0.189	0.201
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	0.69	0.73	0.027	0.029
H	0.57	0.61	0.022	0.024
J	0.23	0.27	0.009	0.011
K	1.57	1.70	0.062	0.067
L	2.95	3.12	0.116	0.123
M	0.59	0.70	0.023	0.028
N	0.03	0.08	0.001	0.003

DirectFET™ PCB Footprint



DirectFET™ Tape and Reel Dimension



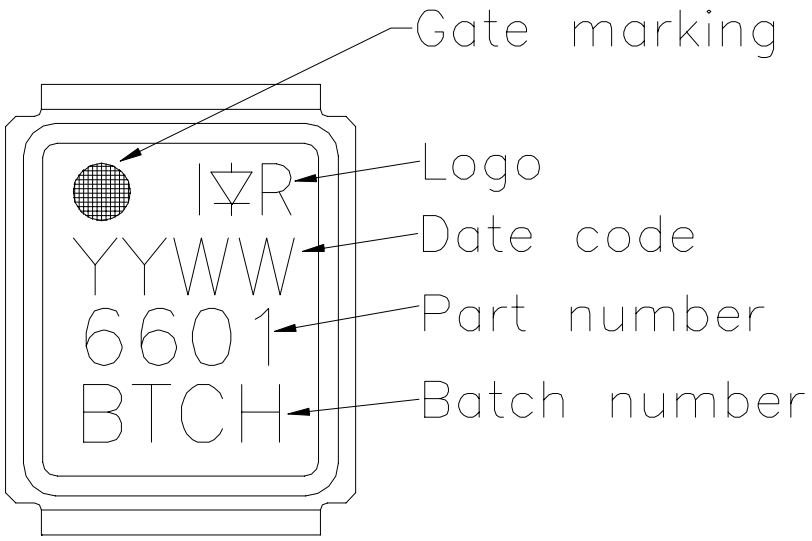
Note: Controlling dimensions in mm

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: Controlling dimensions are in mm

DIMENSIONS				
	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

DirectFET™ Part Marking



Notes:

① Repetitive rating; pulse width limited by max. junction temperature.
② Pulse width ≤ 400µs; duty cycle ≤ 2%.
③ Surface mounted on 1 in square Cu board.
④ Used double sided cooling, mounting pad.
⑤ Mounted on minimum footprint full size board with metalized back and with small clip heatsink.
⑥ T_C measured with thermal couple mounted to top (Drain) of part.
② Starting T_J = 25°C, L = 2.5mH, R_G = 25Ω, I_{AS} = 8.8A. (See Figure 14)

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