PD - 94366A

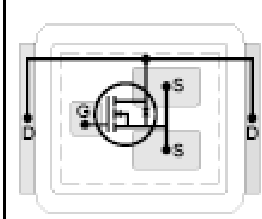
International
IOR Rectifier

IRF6601

DirectFET[TM] 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 exisiting Surface Mount Techniques

V_{DSS}	$R_{DS(on)}$ max	I_D
20V	3.8mΩ@V_{GS} = 10V	26A
	5.0mΩ@V_{GS} = 4.5V	21A



DirectFET™ ISOMETRIC

Description

The IRF6601 combines the latest HEXFET® Power MOSFET Silicon technology with the advanced DirectFET[TM] packaging to achieve the lowest on-state resistance 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 IRF6601 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 IRF6601 has been optimized for parameters that are critical in synchronous buck converters including Rds(on), gate charge and Cdv/dt-induced turn on immunity. The IRF6601 offers particularly low Rds(on) and high Cdv/dt immunity for synchronous FET applications.

Absolute Maximum Ratings

	Parameter	Max.	Units
V_{DS}	Drain- Source Voltage	20	V
I_D @ T_C = 25°C	Continuous Drain Current, V_{GS} @ 10V	85	A
I_D @ T_A = 25°C	Continuous Drain Current, V_{GS} @ 10V	26	
I_D @ T_A = 70°C	Continuous Drain Current, V_{GS} @ 10V	20	
I_{DM}	Pulsed Drain Current ①	200	
P_D @T_A = 25°C	Power Dissipation	3.6	W
P_D @T_A = 70°C	Power Dissipation	2.3	
	Linear Derating Factor	28	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	–––	35	°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	

01/21/02

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 = 100µA
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	–––	0.019	–––	V/°C	Reference to 25°C, I_D = 1mA
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	–––	–––	3.8	mΩ	V_{GS} = 10V, I_D = 26A
		–––	–––	5.0		V_{GS} = 4.5V, I_D = 21A ②
$V_{GS(th)}$	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
		–––	–––	100		V_{DS} = 16V, V_{GS} = 0V, T_J = 70°C
I_{GSS}	Gate-to-Source Forward Leakage	–––	–––	100	nA	V_{GS} = 20 V
	Gate-to-Source Reverse Leakage	–––	–––	-100		V_{GS} = -20 V

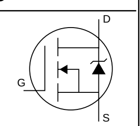
Dynamic @ T_J = 25°C (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
g_{fs}	Forward Transconductance	50	–––	–––	S	V_{DS} = 10 V, I_D = 21 A
Q_g	Total Gate Charge Cont FET	–––	36	54	nC	I_D = 21A
Q_{gs}	Gate-to-Source Charge	–––	11	–––		V_{DS} = 16 V
Q_{gd}	Gate to Drain ("Miller")Charge	–––	12	–––		V_{GS} = 4.5 V,
Q_{oss}	Output Charge	–––	48	–––		V_{DS} = 0 V, V_{GS} = 16V
$t_{d(on)}$	Turn-On Delay Time	–––	16	–––	ns	V_{DD} = 15 V
t_r	Rise Time	–––	140	–––		I_D = 21 A
$t_{d(off)}$	Turn-Off Delay Time	–––	33	–––		R_G = 5.1 Ω
t_f	Fall Time	–––	110	–––		V_{GS} = 4.5 V ②
C_{iss}	Input Capacitance	–––	3440	–––	pF	V_{GS} = 0V
C_{oss}	Output Capacitance	–––	2430	–––		V_{DS} = 10V
C_{rss}	Reverse Transfer Capacitance	–––	380	–––		f = 1.0MHz

Avalanche Characteristics

Symbol	Parameter	Typ.	Max.	Units
E_{AS}	Single Pulse Avalanche Energy⑦	–––	65	mJ
I_{AR}	Avalanche Current①	–––	21	A

Diode Characteristics

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	–––	–––	28	A	MOSFET symbol showing the integral reverse p-n junction diode. 
I_{SM}	Pulsed Source Current (Body Diode) ①	–––	–––	200		
V_{SD}	Diode Forward Voltage	–––	0.83	1.2	V	T_J = 25°C, I_S = 21A, V_{GS} = 0V ②
		–––	0.68	–––		T_J = 125°C, I_S = 21A, V_{GS} = 0V ②
t_{rr}	Reverse Recovery Time	–––	60	90	ns	T_J = 25°C, I_F = 21A, V_R=15 V
Q_{rr}	Reverse Recovery Charge	–––	94	140	nC	di/dt = 100A/µs ②
t_{rr}	Reverse Recovery Time	–––	62	93	ns	T_J = 125°C, I_F = 21A, V_R=15 V
Q_{rr}	Reverse Recovery Charge	–––	88	130	nC	di/dt = 100A/µs ②

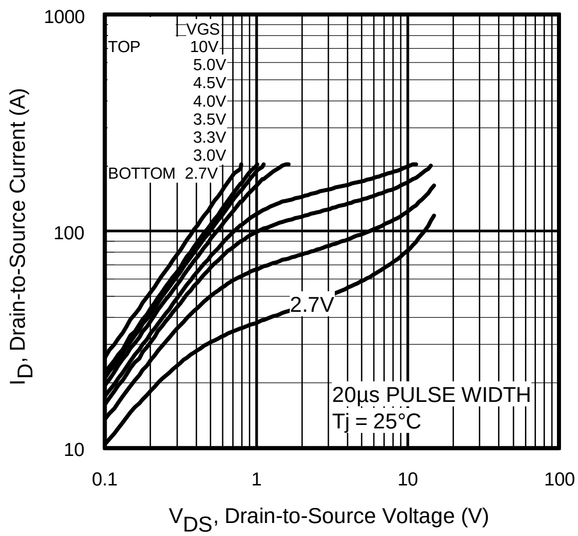


Fig 1. Typical Output Characteristics

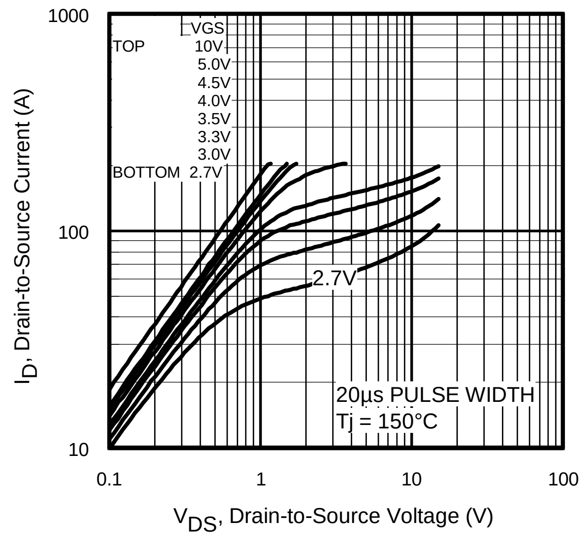


Fig 2. Typical Output Characteristics

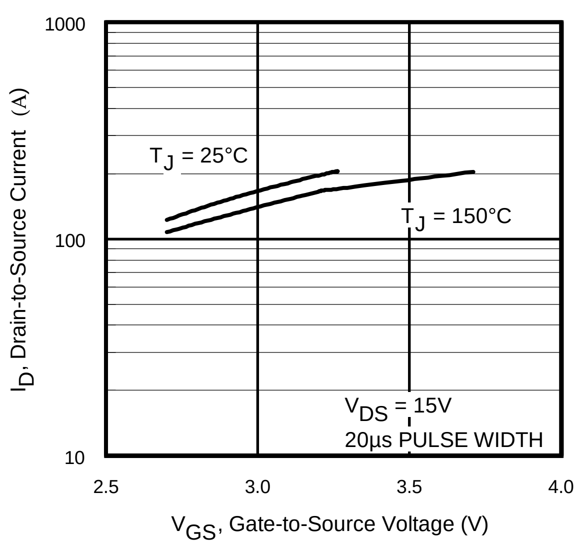


Fig 3. Typical Transfer Characteristics

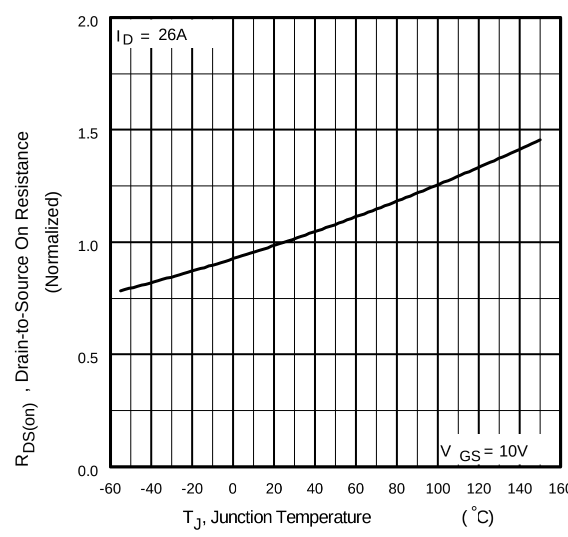


Fig 4. Normalized On-Resistance Vs. Temperature

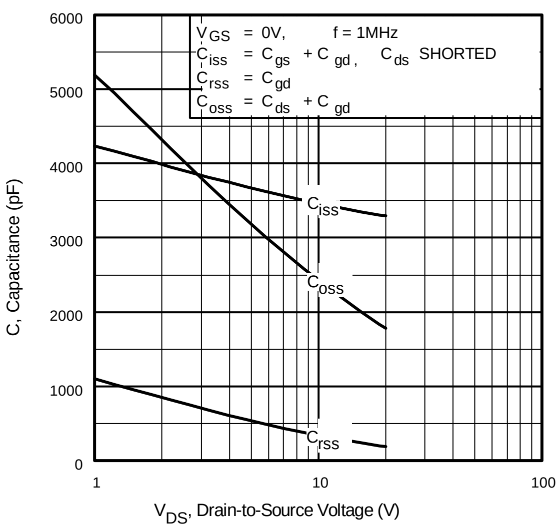


Fig 5. Typical Capacitance Vs. Drain-to-Source Voltage

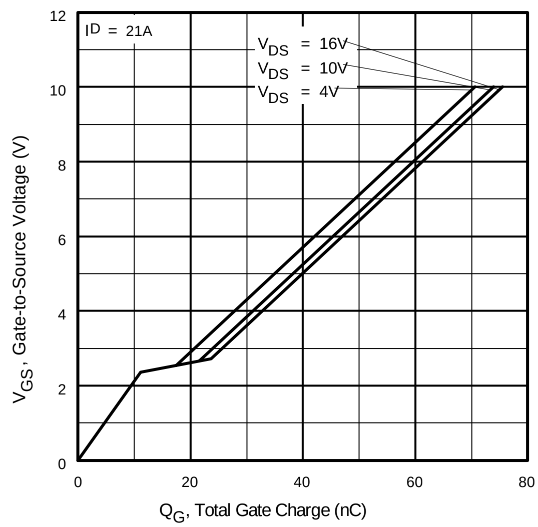


Fig 6. Typical Gate Charge Vs. Gate-to-Source Voltage

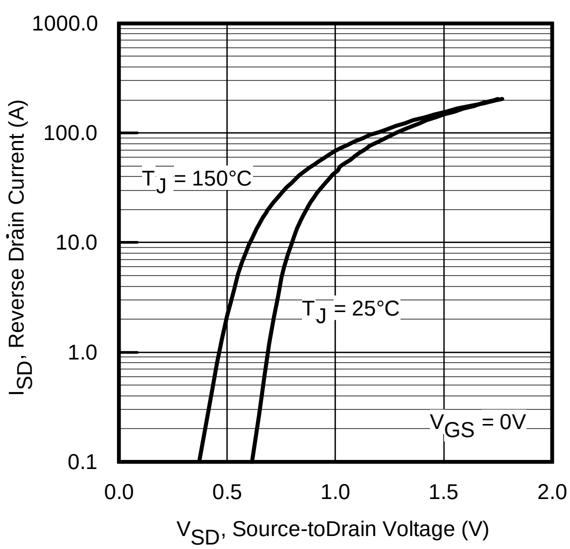


Fig 7. Typical Source-Drain Diode Forward Voltage

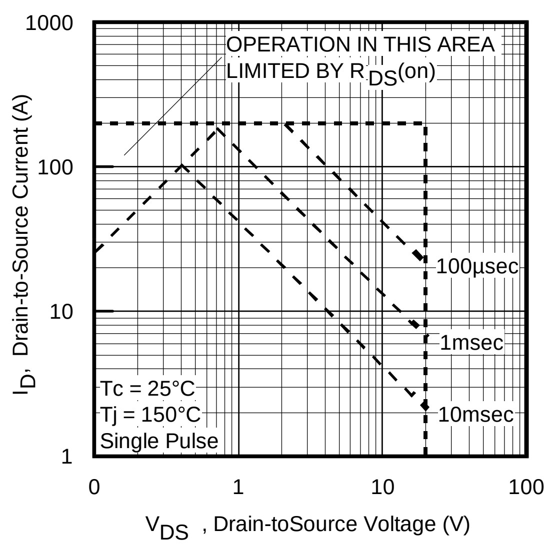


Fig 8. Maximum Safe Operating Area

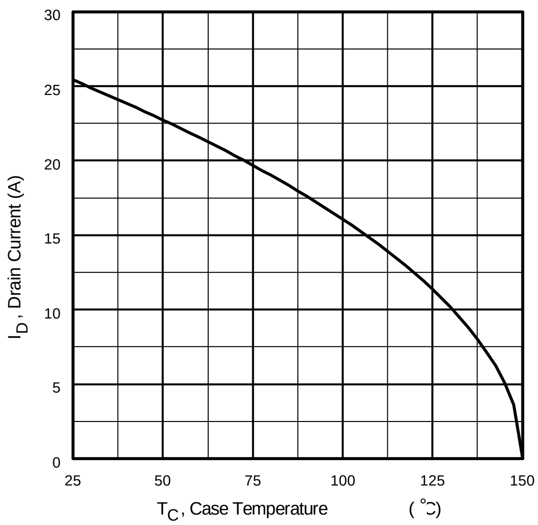


Fig 9. Maximum Drain Current Vs. Ambient Temperature

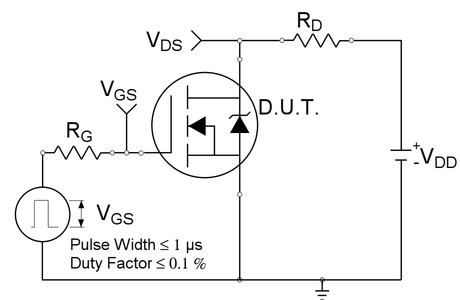


Fig 10a. Switching Time Test Circuit

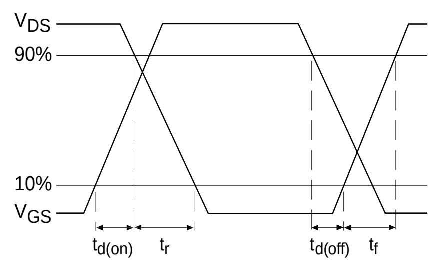


Fig 10b. Switching Time Waveforms

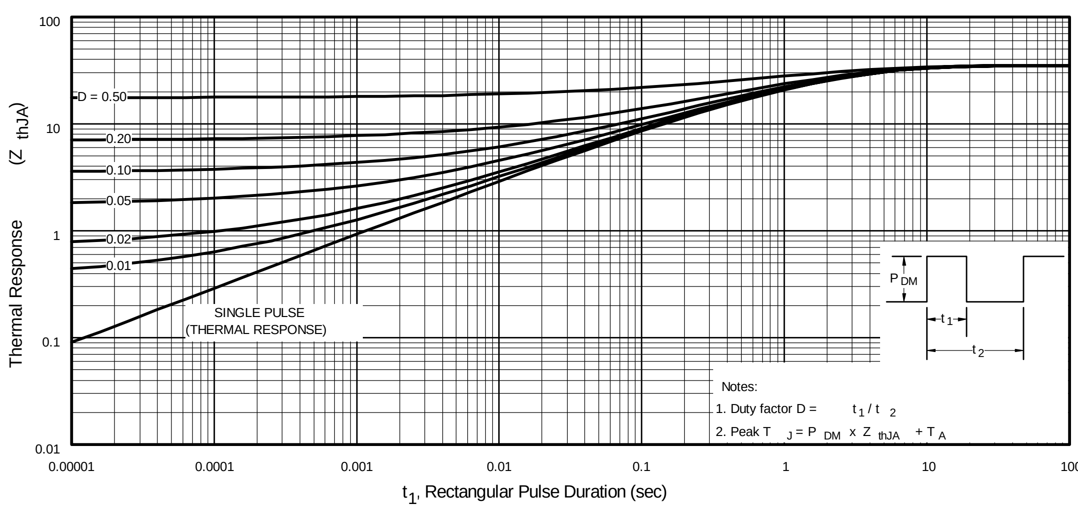


Fig 10. Maximum Effective Transient Thermal Impedance, Junction-to-Ambient

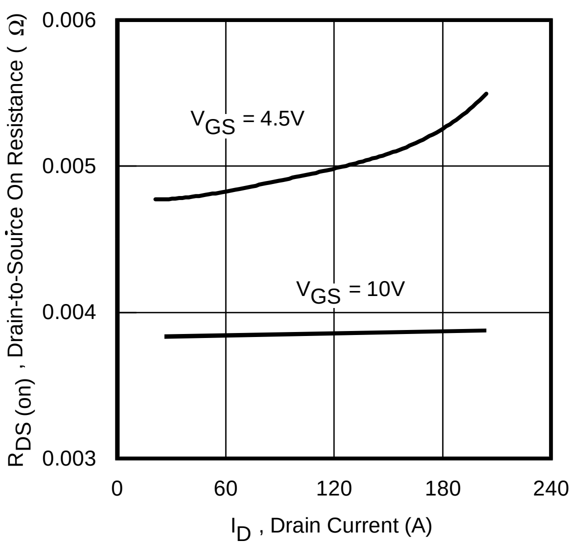


Fig 12. On-Resistance Vs. Drain Current

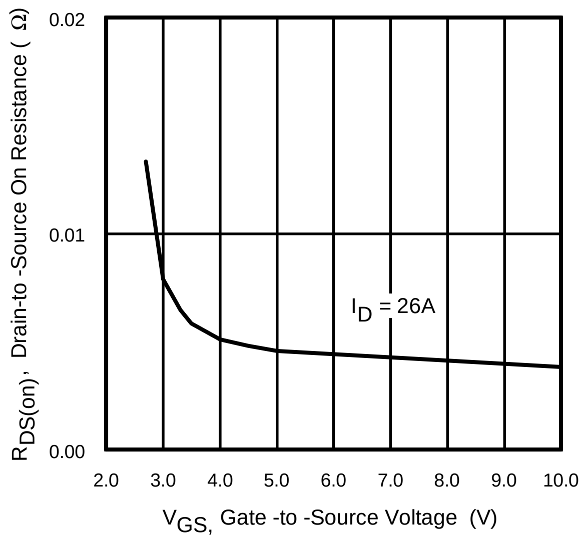


Fig 13. On-Resistance Vs. Gate Voltage

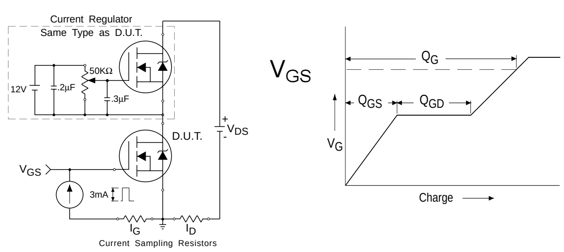
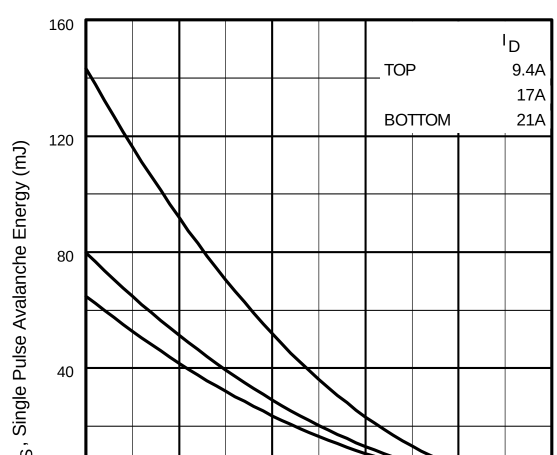
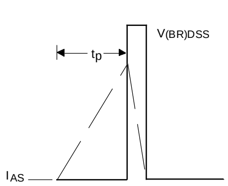


Fig 13a&b. Basic Gate Charge Test Circuit and Waveform





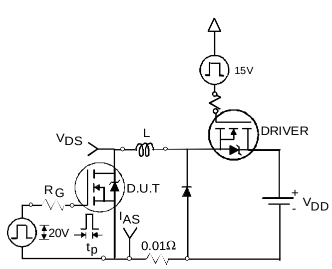
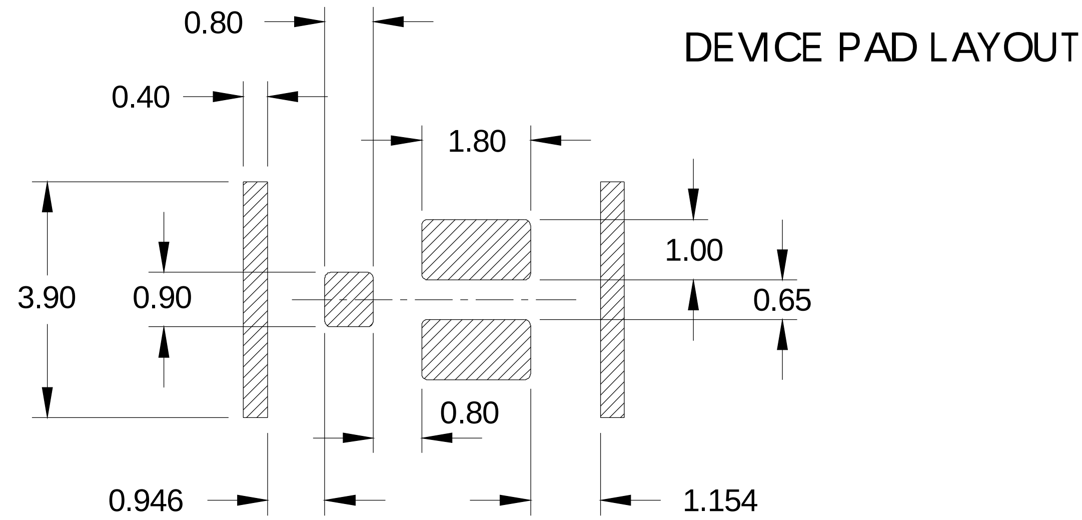
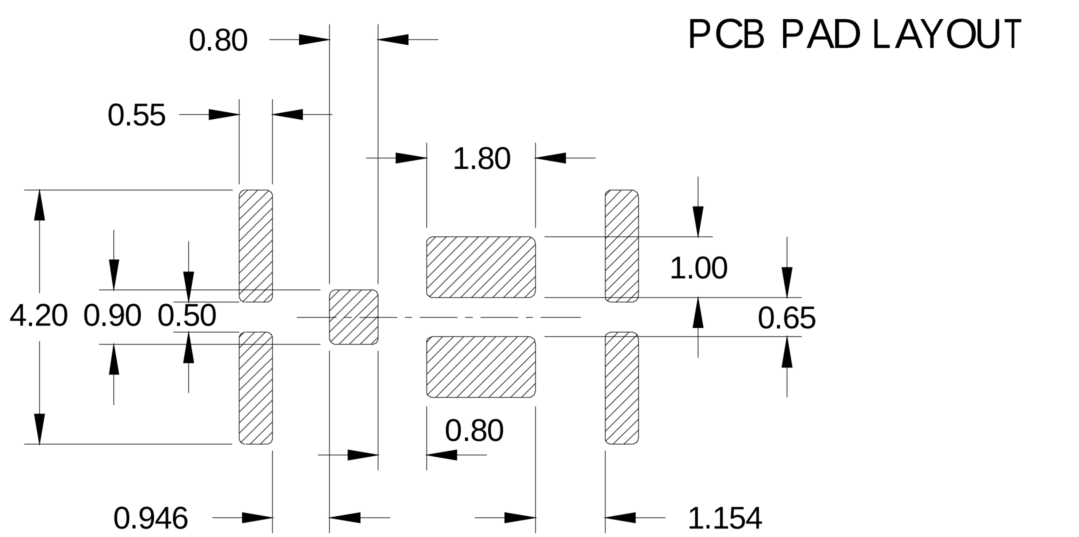


Fig 14a&b. Unclamped Inductive Test circuit and Waveforms

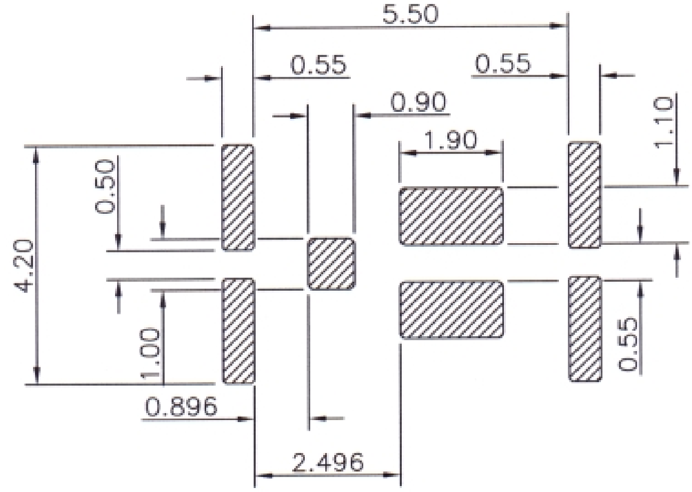
Fig 14c. Maximum Avalanche Energy Vs. Drain Current

DirectFET™ Pad Layout

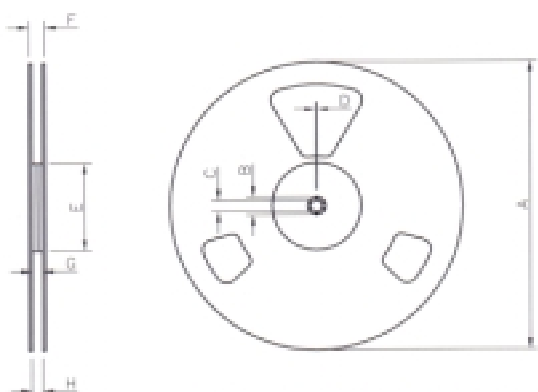




DirectFET™ Board Footprint

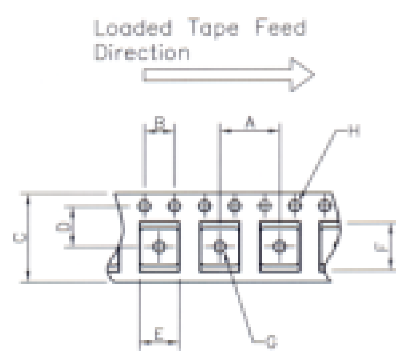


DirectFET™ Tape and Reel Dimension



NOTE: CONTROLLING DIMENSIONS IN MM

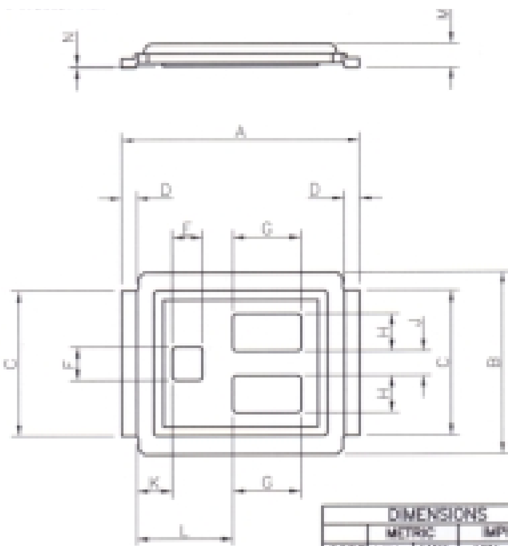
DIMENSIONS				
	METRIC		IMPERIAL	
CODE	MIN	MAX	MIN	MAX
A	330.0	N.C	12.992	N.C
B	20.2	N.C	0.795	N.C
C	12.8	13.2	0.504	0.520
D	1.5	N.C	0.059	N.C
E	100.0	N.C	3.937	N.C
F	N.C	18.4	N.C	0.724
G	12.4	14.4	0.488	0.567
H	11.9	15.4	0.469	0.606



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

DirectFET™ Outline Dimension



NOTE: CONTROLLING
DIMENSIONS ARE IN 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	0.78	0.82	0.031	0.032
F	0.88	0.92	0.035	0.036
G	1.78	1.82	0.070	0.072
H	0.98	1.02	0.039	0.040
J	0.63	0.67	0.025	0.026
K	0.88	1.01	0.035	0.039
L	2.46	2.63	0.097	0.104
M	0.59	0.70	0.023	0.028
N	0.03	0.08	0.001	0.003

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 = 0.30mH, R_G = 25W, I_{AS} = 21A. (See Figure 14)

Data and specifications subject to change without notice.
This product has been designed and qualified for the consumer market.
Qualification Standards can be found on IR's Web site.

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