International IGR Rectifier

IRF6619

DirectFET™ Power MOSFET ②

Typical values (unless otherwise specified)

V_{DSS}	V_{GS}	$R_{DS(on)}$	$R_{DS(on)}$
20V max	±20V max	1.65mΩ @ 10V	2.2mΩ @ 4.5V

| $Q_{g\ tot}$	Q_{gd}	Q_{gs2}	Q_{rr}	Q_{oss}	$V_{gs(th)}$
38nC	13nC	3.5nC	18nC	22nC	2.0V

- Low Profile (<0.7 mm)
- Dual Sided Cooling Compatible ①
- Ultra Low Package Inductance
- Optimized for High Frequency Switching above 1MHz ①
- Ideal for CPU Core DC-DC Converters
- Optimized for Sync. FET socket of Sync. Buck Converter①
- Low Conduction Losses
- Compatible with existing Surface Mount Techniques ①

MX

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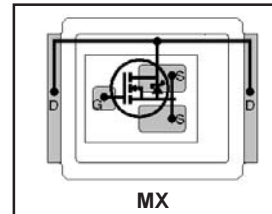
Applicable DirectFET Outline and Substrate Outline (see p.7,8 for details)①

SQ	SX	ST		MQ	**MX**	MT				

Description

The IRF6619 combines the latest HEXFET® Power MOSFET Silicon technology with the advanced DirectFET™ 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, 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%.

The IRF6619 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 IRF6619 has been optimized for parameters that are critical in synchronous buck operating from 12 volt buss converters including Rds(on), gate charge and Cdv/dt-induced turn on immunity. The IRF6619 offers particularly low Rds(on) and high Cdv/dt immunity for synchronous FET applications.

Absolute Maximum Ratings

|	Parameter	Max.	Units
V_{DS}	Drain-to-Source Voltage	20	V
V_{GS}	Gate-to-Source Voltage	±20	
I_D @ T_A = 25°C	Continuous Drain Current, V_{GS} @ 10V ⑥	30	A
I_D @ T_A = 70°C	Continuous Drain Current, V_{GS} @ 10V ⑥	24	
I_D @ T_C = 25°C	Continuous Drain Current, V_{GS} @ 10V ⑨ (Package Limited)	150	
I_{DM}	Pulsed Drain Current ③	240	
$E_{AS\ (Thermally\ limited)}$	Single Pulse Avalanche Energy ④	240	mJ
I_{AR}	Avalanche Current ③	See Fig. 14, 15, 17a, 17b,	A
E_{AR}	Repetitive Avalanche Energy ③		mJ
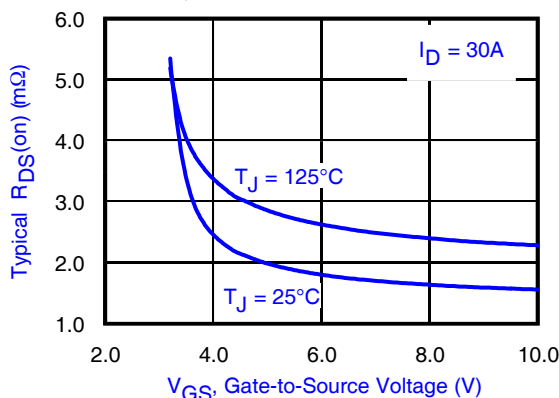
Fig 1. Typical On-Resistance Vs. Gate Voltage
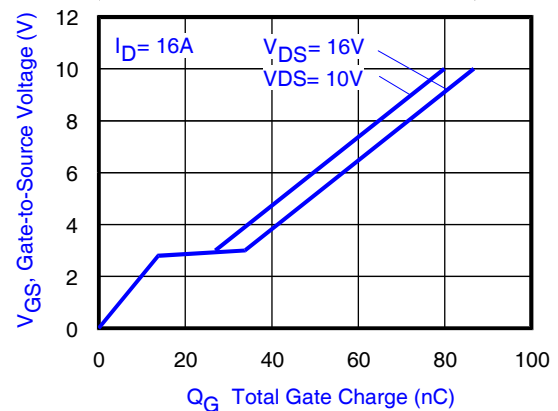
Fig 2. Typical Total Gate Charge vs Gate-to-Source Voltage

Notes:

① Click on this section to link to the appropriate technical paper.
② Click on this section to link to the DirectFET Website.
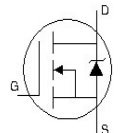③ Repetitive rating; pulse width limited by max. junction temperature.

④ Limited by T_{Jmax}, starting T_J = 25°C, L = 0.86mH, R_G = 25Ω, I_{AS} = 24A, V_{GS} =10V. Part not recommended for use above this value.
⑥ Surface mounted on 1 in. square Cu board, steady state.
⑨ T_C measured with thermocouple mounted to top (Drain) of part.

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Static @ T$_J$ = 25°C (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
BV$_{DSS}$	Drain-to-Source Breakdown Voltage	20	——	——	V	V$_{GS}$ = 0V, I$_D$ = 250µA
∆BV$_{DSS}$/∆T$_J$	Breakdown Voltage Temp. Coefficient	——	14	——	mV/°C	Reference to 25°C, I$_D$ = 1mA
R$_{DS(on)}$	Static Drain-to-Source On-Resistance	——	1.65	2.2	mΩ	V$_{GS}$ = 10V, I$_D$ = 30A ⑤
		——	2.2	3.0		V$_{GS}$ = 4.5V, I$_D$ = 24A ⑤
V$_{GS(th)}$	Gate Threshold Voltage	1.55	——	2.45	V	V$_{DS}$ = V$_{GS}$, I$_D$ = 250µA
∆V$_{GS(th)}$/∆T$_J$	Gate Threshold Voltage Coefficient	——	-5.8	——	mV/°C	
I$_{DSS}$	Drain-to-Source Leakage Current	——	——	1.0	µA	V$_{DS}$ = 16V, V$_{GS}$ = 0V
		——	——	150		V$_{DS}$ = 16V, 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	89	——	——	S	V$_{DS}$ = 10V, I$_D$ = 24A
Q$_g$	Total Gate Charge	——	38	57	nC	V$_{DS}$ = 10V
Q$_{gs1}$	Pre-Vth Gate-to-Source Charge	——	10.2	——		
Q$_{gs2}$	Post-Vth Gate-to-Source Charge	——	3.5	——		V$_{GS}$ = 4.5V
Q$_{gd}$	Gate-to-Drain Charge	——	13.2	——		I$_D$ = 16A
Q$_{godr}$	Gate Charge Overdrive	——	11.1	——		See Fig. 17
Q$_{sw}$	Switch Charge (Q$_{gs2}$ + Q$_{gd}$)	——	16.7	——		
Q$_{oss}$	Output Charge	——	22	——	nC	V$_{DS}$ = 10V, V$_{GS}$ = 0V
R$_G$	Gate Resistance	——	——	2.3	Ω	
t$_{d(on)}$	Turn-On Delay Time	——	21	——		V$_{DD}$ = 16V, V$_{GS}$ = 4.5V ⑤
t$_r$	Rise Time	——	71	——		I$_D$ = 24A
t$_{d(off)}$	Turn-Off Delay Time	——	25	——	ns	Clamped Inductive Load
t$_f$	Fall Time	——	9.3	——		
C$_{iss}$	Input Capacitance	——	5040	——		V$_{GS}$ = 0V
C$_{oss}$	Output Capacitance	——	1580	——	pF	V$_{DS}$ = 10V
C$_{rss}$	Reverse Transfer Capacitance	——	780	——		ƒ = 1.0MHz

Diode Characteristics

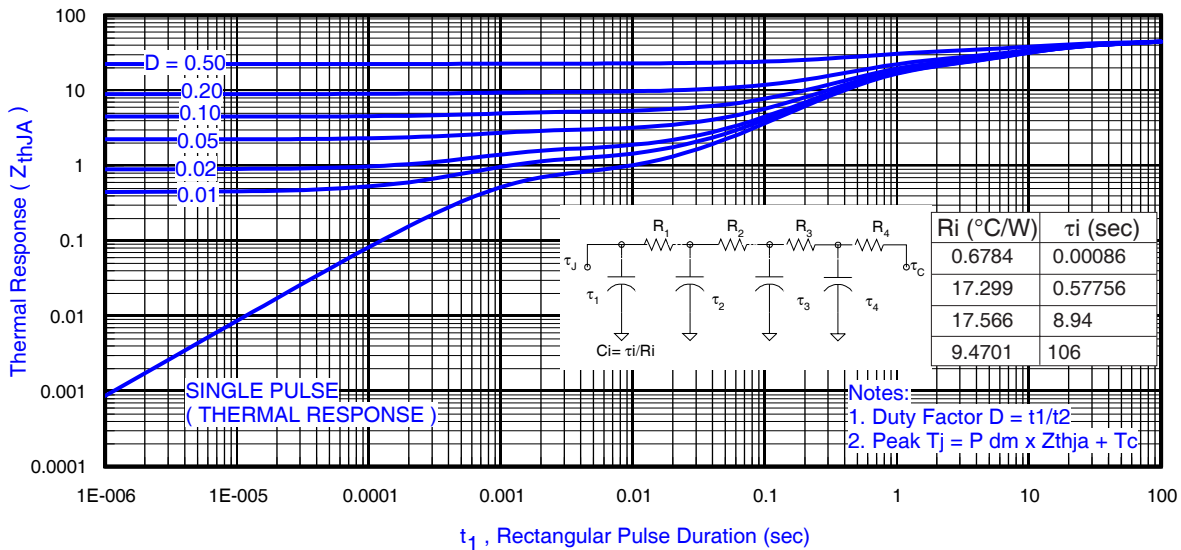|	Parameter	Min.	Typ.	Max.	Units	Conditions
I$_S$	Continuous Source Current (Body Diode)	——	——	30	A	MOSFET symbol showing the integral reverse p-n junction diode.
I$_{SM}$	Pulsed Source Current (Body Diode) ③	——	——	240		
V$_{SD}$	Diode Forward Voltage	——	0.8	1.0	V	T$_J$ = 25°C, I$_S$ = 24A, V$_{GS}$ = 0V ⑤
t$_{rr}$	Reverse Recovery Time	——	29	44	ns	T$_J$ = 25°C, I$_F$ = 24A
Q$_{rr}$	Reverse Recovery Charge	——	18	27	nC	di/dt = 100A/µs ⑤

Notes:

③ Repetitive rating; pulse width limited by max. junction temperature.

⑤ Pulse width ≤ 400µs; duty cycle ≤ 2%.

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Absolute Maximum Ratings

|	Parameter	Max.	Units
P_D @T_A = 25°C	Power Dissipation ⑥	2.8	W
P_D @T_A = 70°C	Power Dissipation ⑥	1.8	
P_D @T_C = 25°C	Power Dissipation ⑨	89	
T_P	Peak Soldering Temperature	270	°C
T_J	Operating Junction and	-40 to + 150	
T_{STG}	Storage Temperature Range		

Thermal Resistance

	Parameter	Typ.	Max.	Units
$R_{\theta JA}$	Junction-to-Ambient ⑥⑩	——	45	
$R_{\theta JA}$	Junction-to-Ambient ⑦⑩	12.5	——	
$R_{\theta JA}$	Junction-to-Ambient ⑧⑩	20	——	°C/W
$R_{\theta JC}$	Junction-to-Case ⑨⑩	——	1.4	
$R_{\theta J\text{-}PCB}$	Junction-to-PCB Mounted	1.0	——	
	Linear Derating Factor ⑥	0.017		W/°C

Ri (°C/W)	τi (sec)
0.6784	0.00086
17.299	0.57756
17.566	8.94
9.4701	106

$Ci = \tau i / Ri$

SINGLE PULSE
(THERMAL RESPONSE)

Notes:
1. Duty Factor D = t1/t2
2. Peak Tj = P dm x Zthja + Tc

**Fig 3.** Maximum Effective Transient Thermal Impedance, Junction-to-Ambient ⑥

Notes:
⑥ Surface mounted on 1 in. square Cu board, steady state.
⑦ Used double sided cooling , mounting pad.
⑧ Mounted on minimum footprint full size board with metalized back and with small clip heatsink.

⑨ T_C measured with thermocouple incontact with top (Drain) of part.
⑩ R_θ is measured at T_J of approximately 90°C.
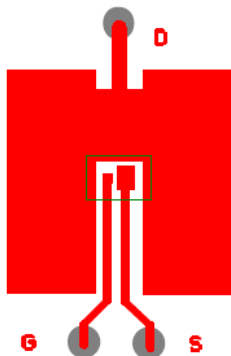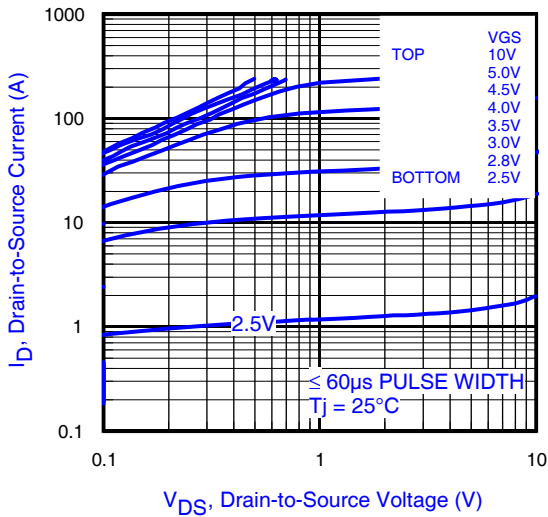

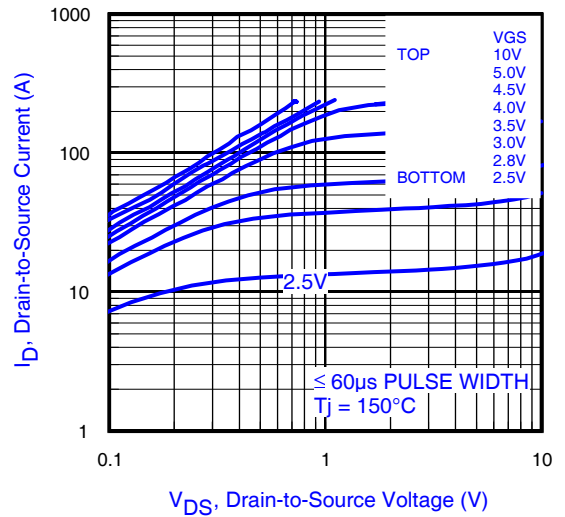⑥ Surface mounted on 1 in. square Cu board (still air).
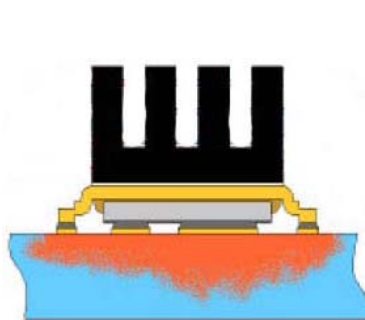
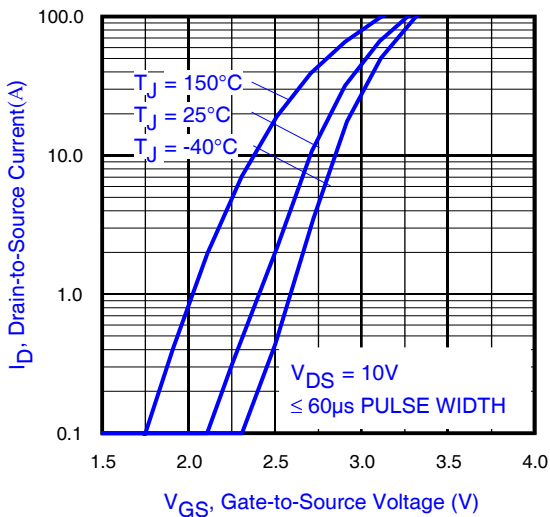⑦ Mounted to a PCB with a thin gap filler and heat sink. (still air)
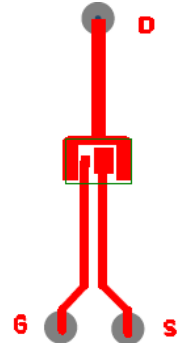
⑧ Mounted on minimum footprint full size board with metalized back and with small clip heatsink (still air)
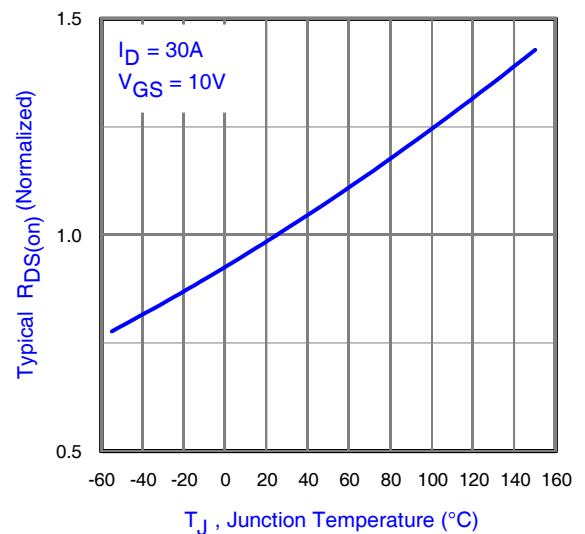
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Fig 4. Typical Output Characteristics
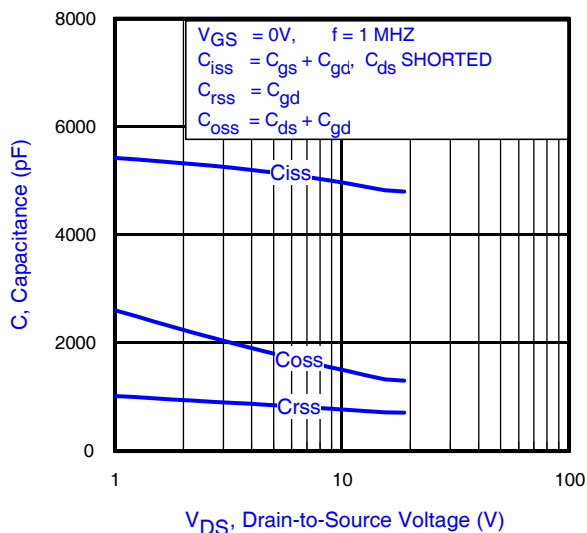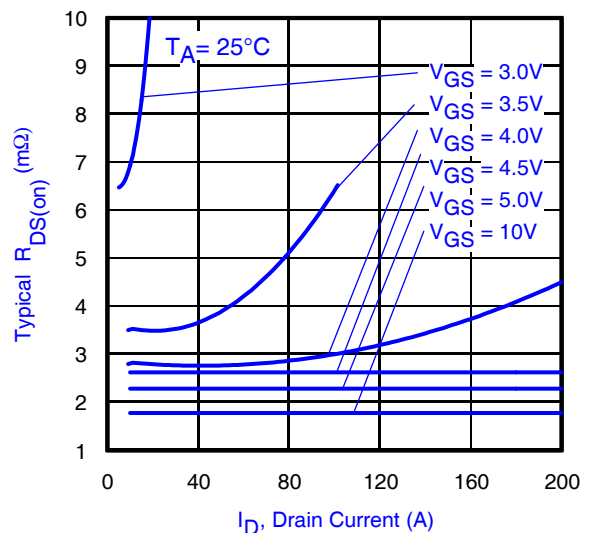

Fig 5. Typical Output Characteristics

Fig 6. Typical Transfer Characteristics

Fig 7. Normalized On-Resistance vs. Temperature

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

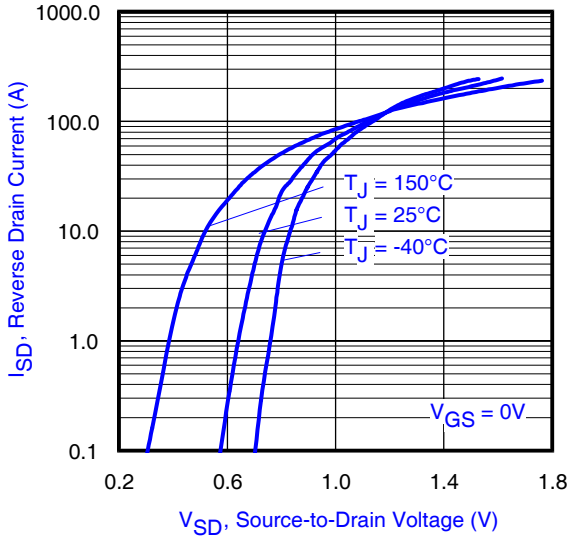**Fig 9.** Typical On-Resistance Vs.
Drain Current and Gate Voltage

4

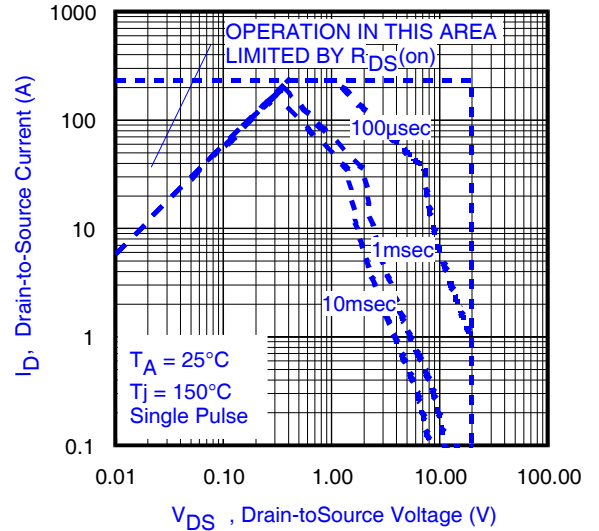**Fig 10.** Typical Source-Drain Diode Forward Voltage
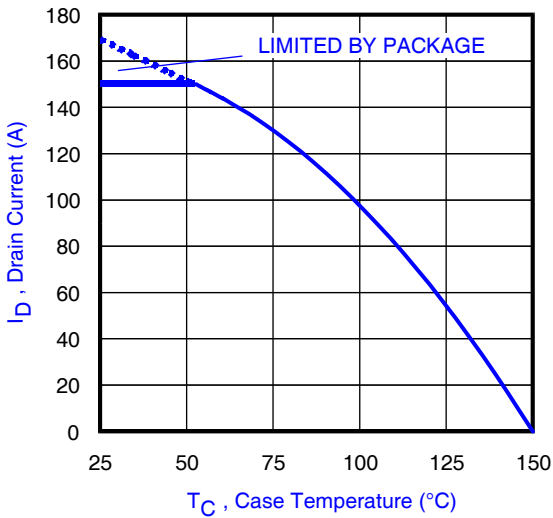

Fig11. Maximum Safe Operating Area

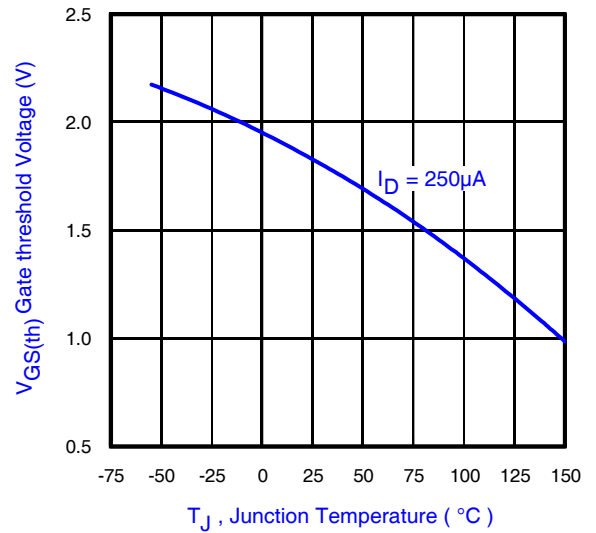**Fig 12.** Maximum Drain Current vs. Case Temperature
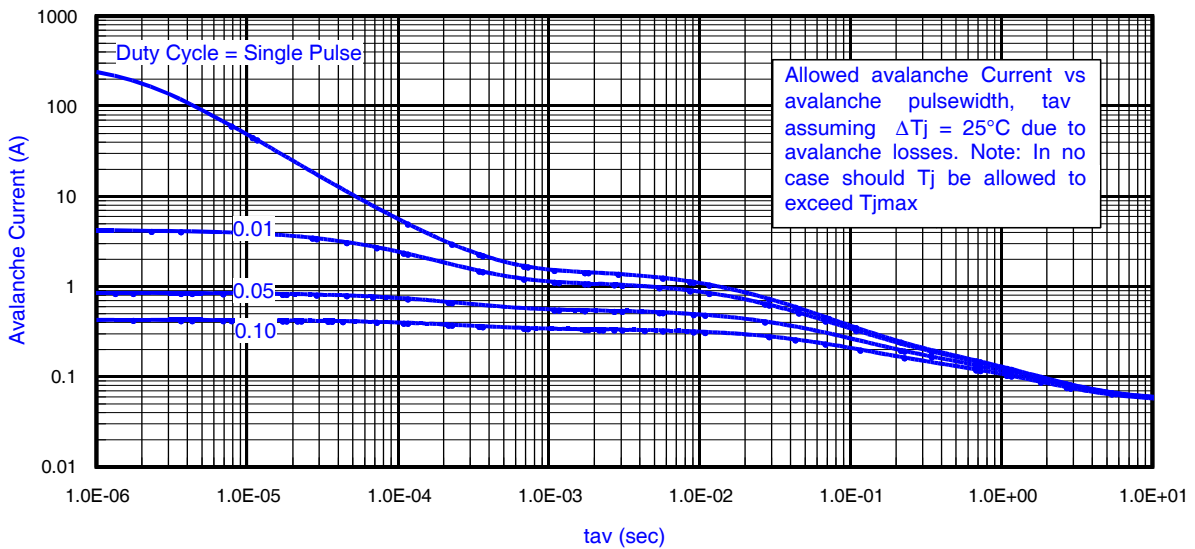

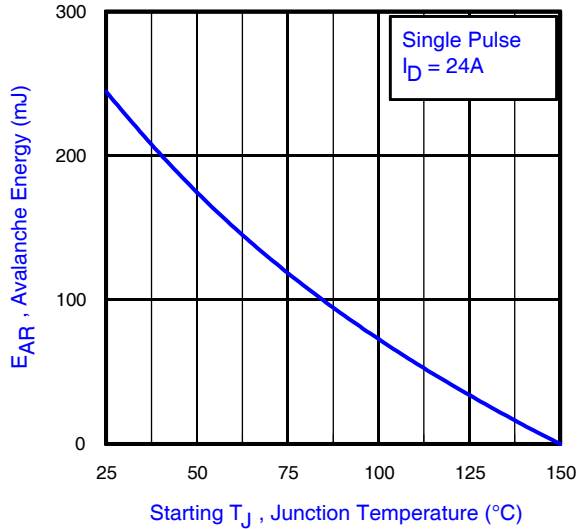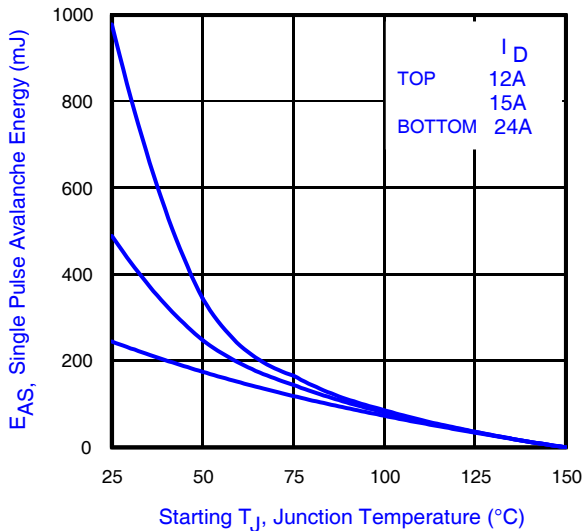**Fig 13.** Typical Threshold Voltage vs. Junction Temperature

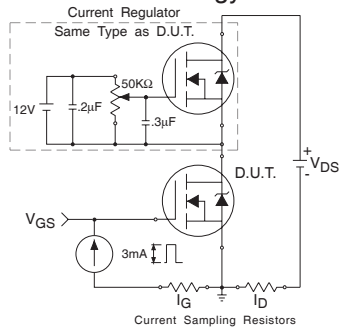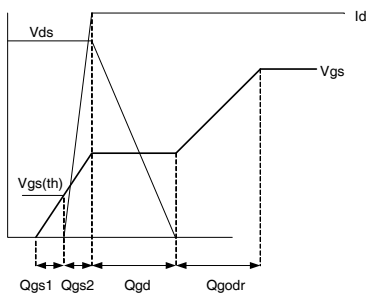**Fig 14.** Typical Avalanche Current vs.Pulsewidth

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Fig 15. Maximum Avalanche Energy vs. Temperature

Starting T_J , Junction Temperature (°C)

E_{AR} , Avalanche Energy (mJ)
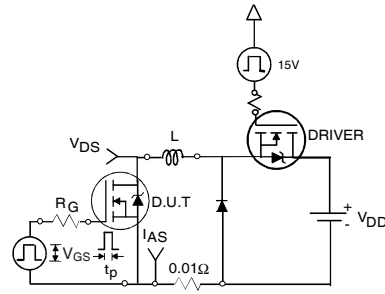
Single Pulse
I_D = 24A

Notes on Repetitive Avalanche Curves , Figures 14, 15:
(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 17a, 17b.
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 = $t_{av} \cdot f$
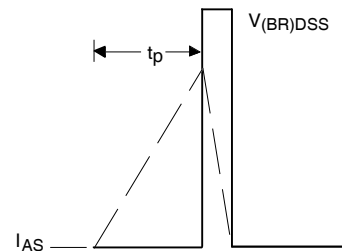 $Z_{thJC}(D, t_{av})$ = Transient thermal resistance, see Figures 3)

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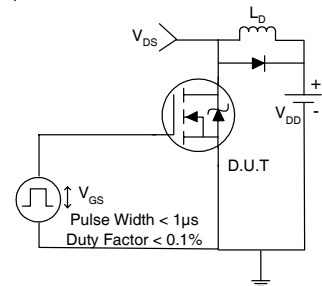$$I_{av} = 2\Delta T / [1.3 \cdot BV \cdot Z_{th}]$$
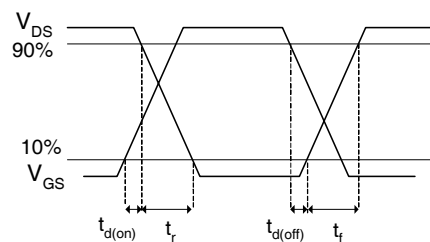$$E_{AS (AR)} = P_{D (ave)} \cdot t_{av}$$

Fig 16. Maximum Avalanche Energy Vs. Drain Current

E_{AS}, Single Pulse Avalanche Energy (mJ)

Starting T_J, Junction Temperature (°C)

I_D
TOP   12A
        15A
BOTTOM 24A

Fig 17a. Unclamped Inductive Test Circuit

Fig 17b. Unclamped Inductive Waveforms

Fig 18a. Gate Charge Test Circuit

Fig 19a. Switching Time Test Circuit

Fig 18b. Gate Charge Waveform

**Fig 19b.** Switching Time Waveforms
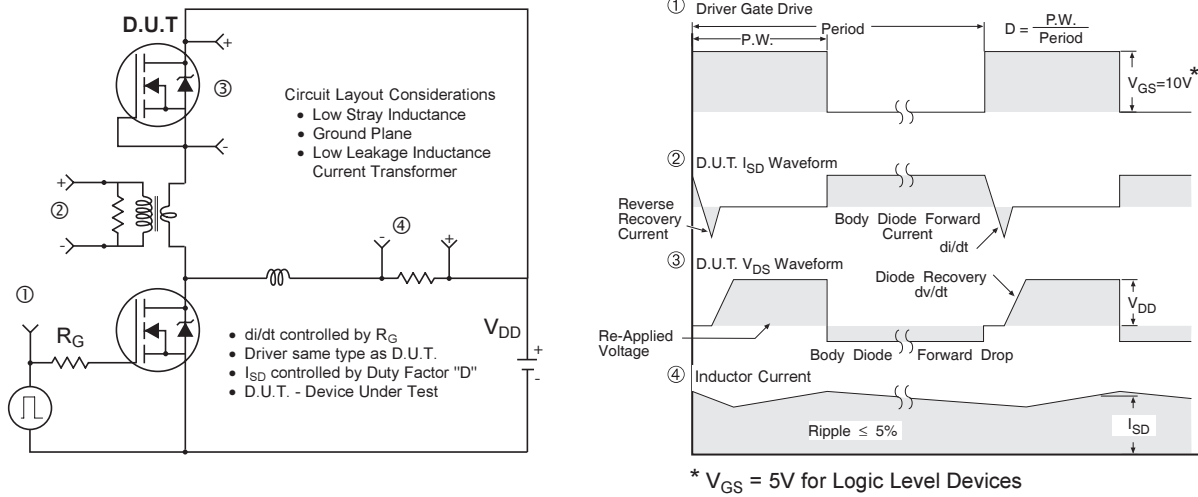
Fig 20. Diode Reverse Recovery Test Circuit for N-Channel
HEXFET® Power MOSFETs

DirectFET™ Substrate and PCB Layout, MX Outline
(Medium Size Can, X-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.

1- Drain
2- Drain
3- Source
4- Source
5- Gate
6- Drain
7- Drain
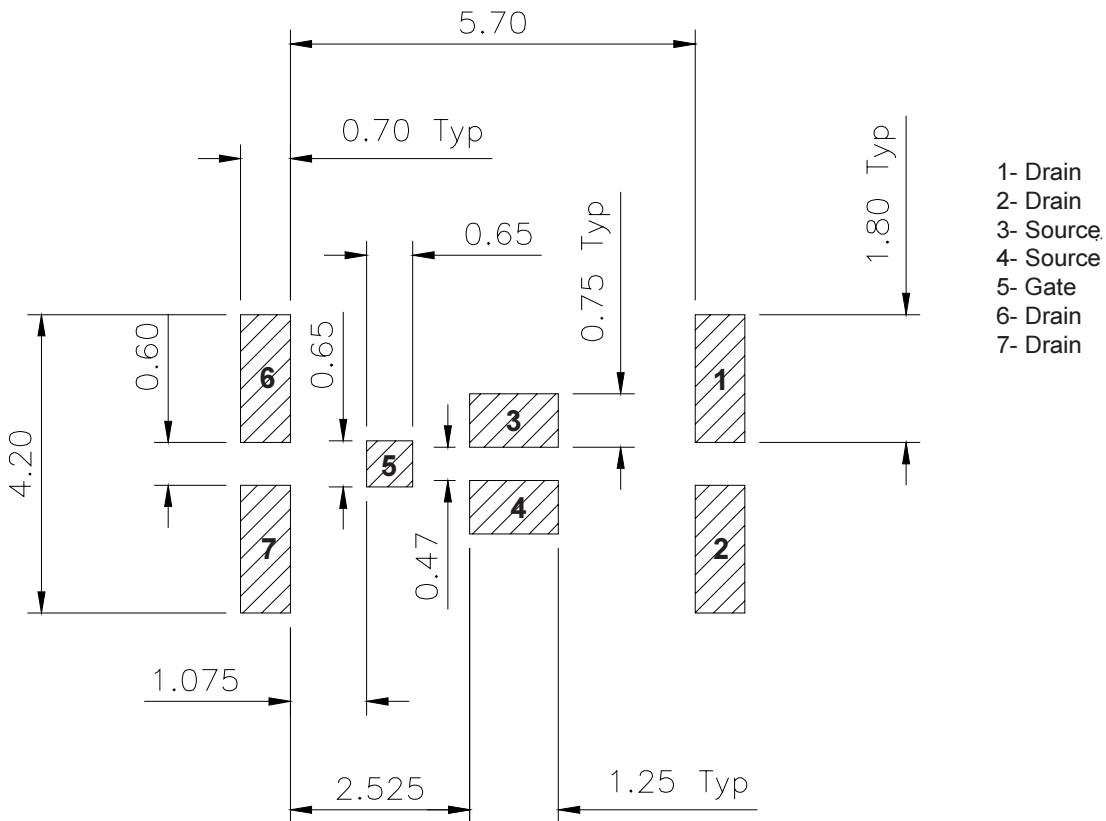
IRF6619

DirectFET™ Outline Dimension, MX Outline
(Medium Size Can, X-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.
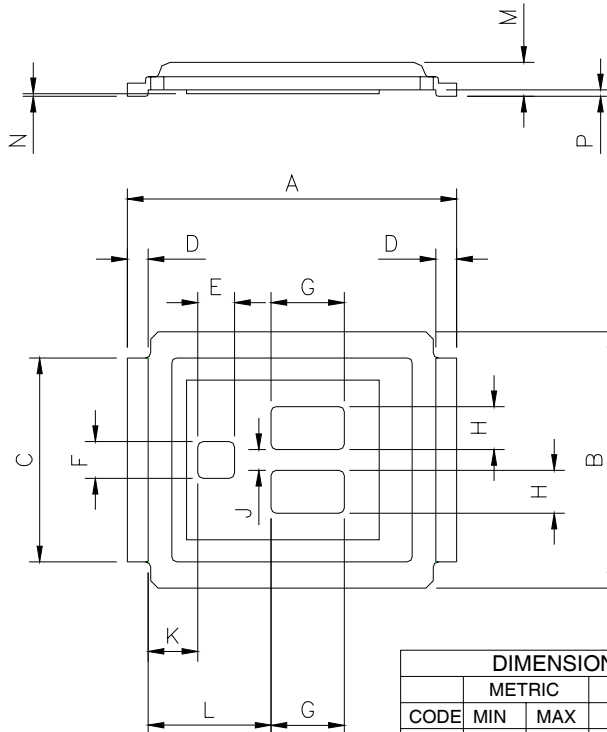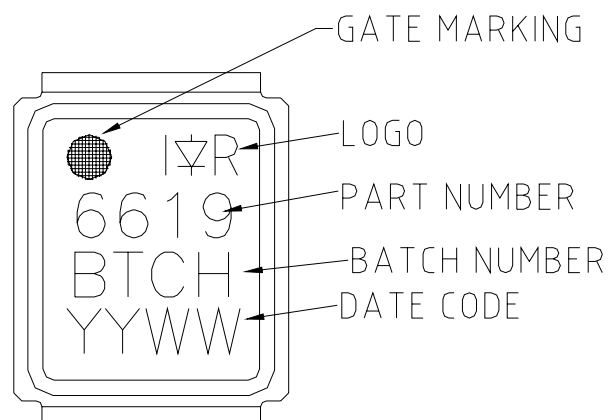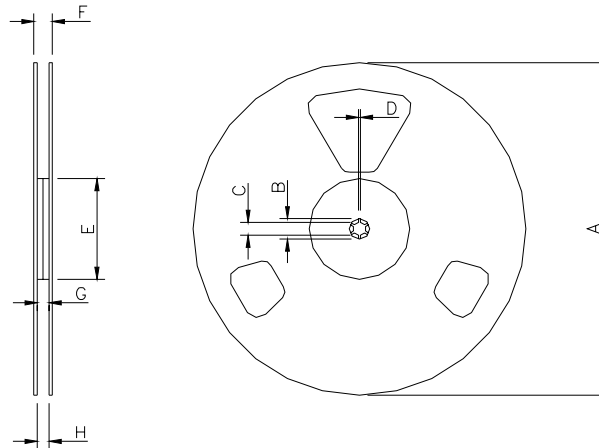
DIMENSIONS				
	METRIC		IMPERIAL	
CODE	MIN	MAX	MAX	MAX
A	6.25	6.35	0.246	0.250
B	4.80	5.05	0.189	0.201
C	3.85	3.95	0.152	0.156
D	0.35	0.45	0.014	0.018
E	0.68	0.72	0.027	0.028
F	0.68	0.72	0.027	0.028
G	1.38	1.42	0.054	0.056
H	0.80	0.84	0.032	0.033
J	0.38	0.42	0.015	0.017
K	0.88	1.01	0.035	0.039
L	2.28	2.41	0.090	0.095
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

GATE MARKING

LOGO

PART NUMBER

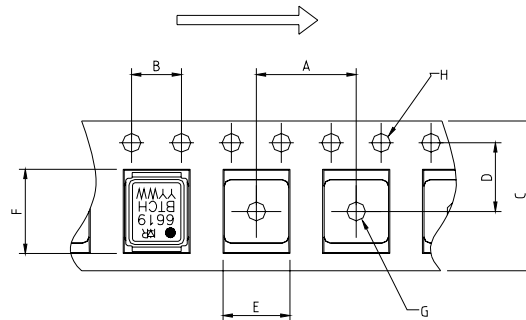BATCH NUMBER

DATE CODE

IƆR
6619
BTCH
YYWW

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

NOTE: Controlling dimensions in mm
Std reel quantity is 4800 parts. (ordered as IRF6619). For 1000 parts on 7" reel,
order   IRF6619TR1

REEL DIMENSIONS							
STANDARD OPTION **(QTY 4800)**				TR1 OPTION **(QTY 1000)**			
	METRIC		IMPERIAL		METRIC		IMPERIAL
			MIN	MAX	MIN	MAX	MIN	MAX
			12.992	N.C	177.77	N.C	6.9	N.C
			0.795	N.C	19.06	N.C	0.75	N.C
			0.504	0.520	13.5	12.8	0.53	0.50
			0.059	N.C	1.5	N.C	0.059	N.C
			3.937	N.C	58.72	N.C	2.31	N.C
			N.C	0.724	N.C	13.50	N.C	0.53
			0.488	0.567	11.9	12.01	0.47	N.C
			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

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.

International **IƏR** Rectifier

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TAC Fax: (310) 252-7903
Visit us at www.irf.com for sales contact information.2/05

www.irf.com

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