International IΩR Rectifier

IRF6611

DirectFET™ Power MOSFET ②

Typical values (unless otherwise specified)

V_{DSS}	V_{GS}	$R_{DS(on)}$	$R_{DS(on)}$
30V max	±20V max	2.0mΩ @ 10V	2.6mΩ @ 4.5V

$Q_{g\ tot}$	Q_{gd}	Q_{gs2}	Q_{rr}	Q_{oss}	$V_{gs(th)}$
37nC	12nC	3.3nC	16nC	23nC	1.7V

- RoHS compliant containing no lead or bromide ①
- 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 SyncFET Socket of Sync. Buck Converter①
- Low Conduction Losses
- Compatible with Existing Surface Mount Techniques ①

MX

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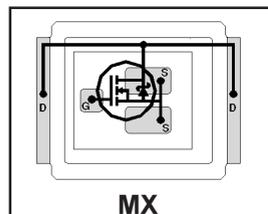
Applicable DirectFET Outline and Substrate Outline (see p.7,8 for details)①

SQ	SX	ST		MQ	**MX**	MT				

Description

The IRF6611 combines the latest HEXFET® power MOSFET silicon technology with 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 IRF6611 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 IRF6611 has been optimized for parameters that are critical in synchronous buck operating from 12 volt bus converters including $R_{DS(on)}$, gate charge and Cdv/dt-induced turn on immunity. The IRF6611 offers particularly low $R_{DS(on)}$ and high Cdv/dt immunity for synchronous FET applications.

Absolute Maximum Ratings

|	Parameter	Max.	Units
V_{DS}	Drain-to-Source Voltage	30	V
V_{GS}	Gate-to-Source Voltage	±20	
I_D @ T_A = 25°C	Continuous Drain Current, V_{GS} @ 10V ⑥	32	
I_D @ T_A = 70°C	Continuous Drain Current, V_{GS} @ 10V ⑥	26	A
I_D @ T_C = 25°C	Continuous Drain Current, V_{GS} @ 10V ⑨	150	
I_{DM}	Pulsed Drain Current ③	220	
E_{AS}	Single Pulse Avalanche Energy ④	310	mJ
I_{AR}	Avalanche Current ③	22	A
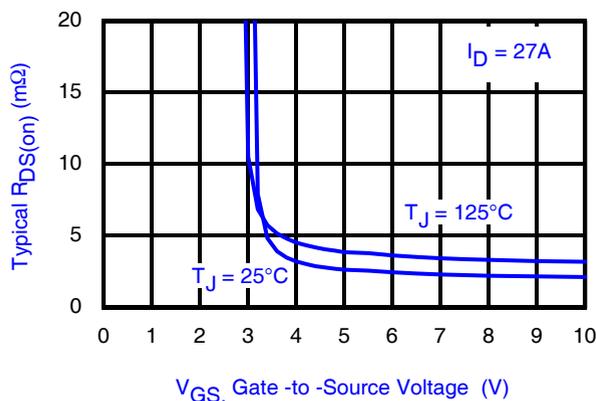
Fig 1. Typical On-Resistance vs. Gate Voltage
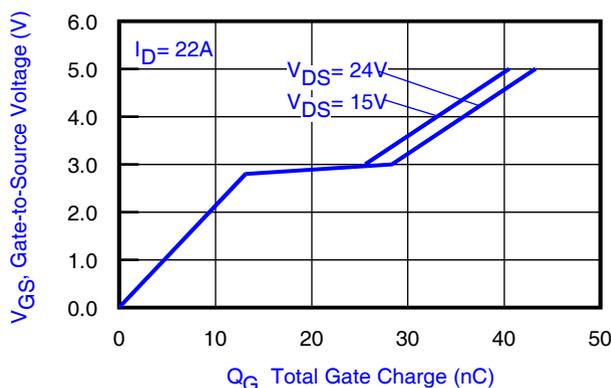

Fig 2. Typical On-Resistance vs. Gate Voltage

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

④ Starting T_J = 25°C, L = 0.91mH, R_G = 25Ω, I_{AS} = 22A.
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	30	——	——	V	$V_{GS} = 0V$, $I_D = 250µA$
$\Delta BV_{DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	——	23	——	mV/°C	Reference to 25°C, $I_D = 1mA$
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	——	2.0	2.6	mΩ	$V_{GS} = 10V$, $I_D = 27A$ ⑤
		——	2.6	3.4		$V_{GS} = 4.5V$, $I_D = 22A$ ⑤
$V_{GS(th)}$	Gate Threshold Voltage	1.35	——	2.25	V	$V_{DS} = V_{GS}$, $I_D = 250µA$
$\Delta V_{GS(th)}/\Delta T_J$	Gate Threshold Voltage Coefficient	——	-6.7	——	mV/°C	
I_{DSS}	Drain-to-Source Leakage Current	——	——	1.0	µA	$V_{DS} = 24V$, $V_{GS} = 0V$
		——	——	150		$V_{DS} = 24V$, $V_{GS} = 0V$, $T_J = 125°C$
I_{GSS}	Gate-to-Source Forward Leakage	——	——	100	nA	$V_{GS} = 20V$
	Gate-to-Source Reverse Leakage	——	——	-100		$V_{GS} = -20V$
gfs	Forward Transconductance	100	——	——	S	$V_{DS} = 15V$, $I_D = 22A$
Q_g	Total Gate Charge	——	37	56		
Q_{gs1}	Pre-Vth Gate-to-Source Charge	——	9.8	——		$V_{DS} = 15V$
Q_{gs2}	Post-Vth Gate-to-Source Charge	——	3.3	——	nC	$V_{GS} = 4.5V$
Q_{gd}	Gate-to-Drain Charge	——	12.5			$I_D = 22A$
Q_{godr}	Gate Charge Overdrive	——	11.4	——		See Fig. 15
Q_{sw}	Switch Charge ($Q_{gs2} + Q_{gd}$)	——	15.8	——		
Q_{oss}	Output Charge	——	23	——	nC	$V_{DS} = 16V$, $V_{GS} = 0V$
R_G	Gate Resistance	——	——	2.3	Ω	
$t_{d(on)}$	Turn-On Delay Time	——	18	——		$V_{DD} = 16V$, $V_{GS} = 4.5V$ ⑤
t_r	Rise Time	——	57	——		$I_D = 22A$
$t_{d(off)}$	Turn-Off Delay Time	——	24	——	ns	Clamped Inductive Load
t_f	Fall Time	——	6.5	——		
C_{iss}	Input Capacitance	——	4860	——		$V_{GS} = 0V$
C_{oss}	Output Capacitance	——	1030	——	pF	$V_{DS} = 15V$
C_{rss}	Reverse Transfer Capacitance	——	480	——		$f = 1.0MHz$

Diode Characteristics

	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	——	——	110	A	MOSFET symbol showing the integral reverse p-n junction diode.
I_{SM}	Pulsed Source Current (Body Diode) ③	——	——	220		
V_{SD}	Diode Forward Voltage	——	——	1.0	V	$T_J = 25°C$, $I_S = 22A$, $V_{GS} = 0V$ ⑤
t_{rr}	Reverse Recovery Time	——	24	36	ns	$T_J = 25°C$, $I_F = 22A$
Q_{rr}	Reverse Recovery Charge	——	16	24	nC	$di/dt = 100A/µs$ ⑤
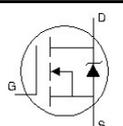
Notes:

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	3.9	W
P_D @T_A = 70°C	Power Dissipation ⑥	2.5	
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	——	32	
$R_{\theta JA}$	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 ⑤	0.031		W/°C

Ri (°C/W)	τi (sec)
1.8310	0.000686
16.033	0.786140
14.139	28
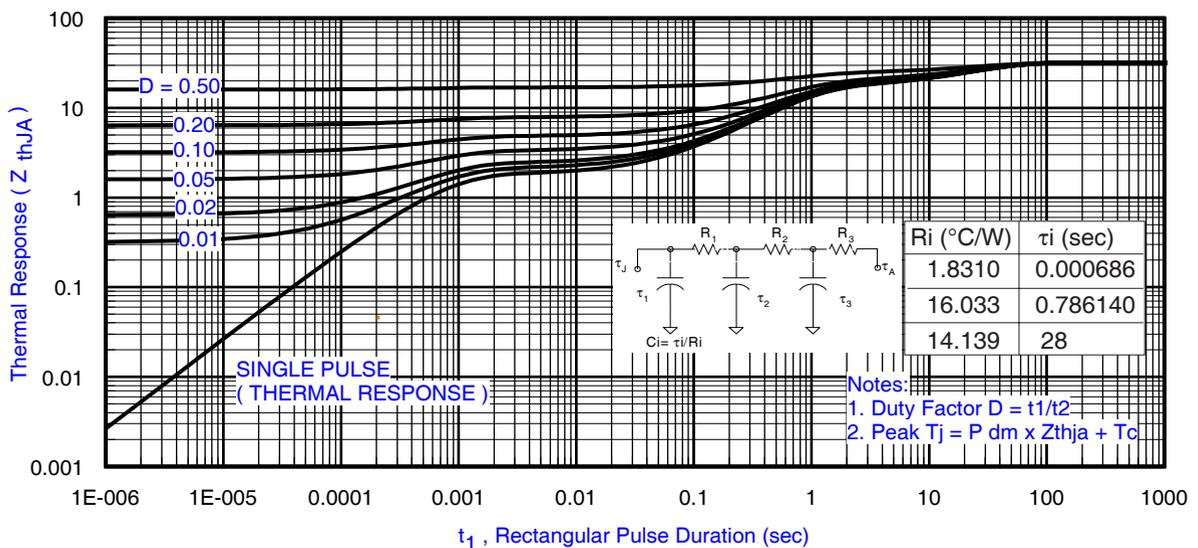
Fig 3. Maximum Effective Transient Thermal Impedance, Junction-to-Ambient

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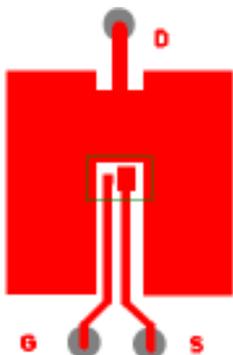
⑥ Surface mounted on 1 in. square Cu board (still air).
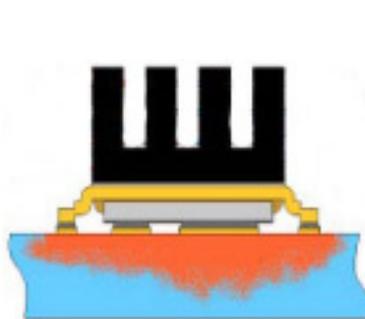
⑦ Mounted to a PCB with a thin gap filler and heat sink. (still air)
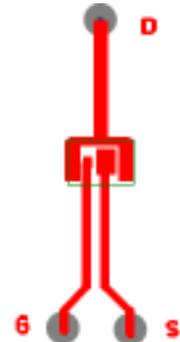
⑧ Mounted on minimum footprint full size board with metalized back and with small clip heatsink (still air)

IRF6611
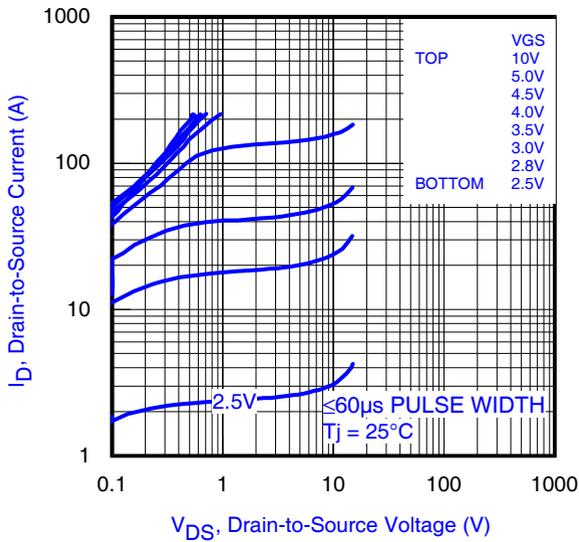
Fig 4. Typical Output Characteristics
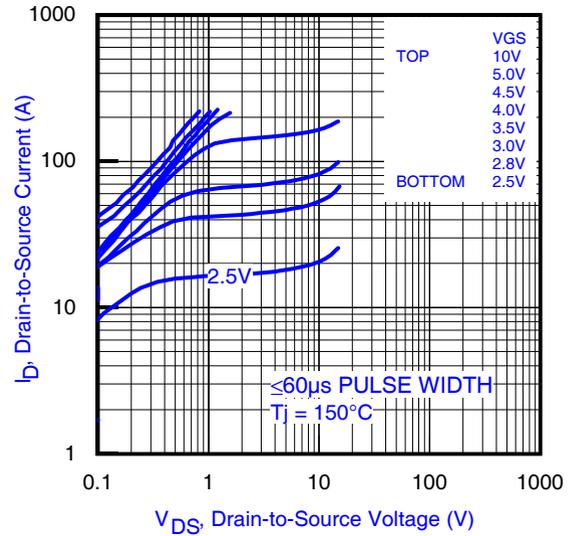
Fig 5. Typical Output Characteristics
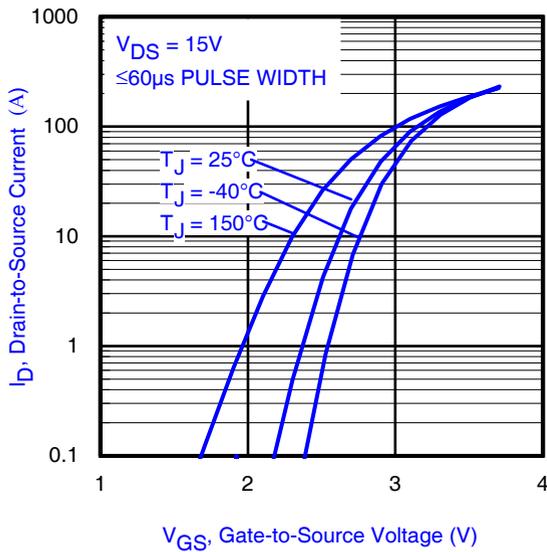
Fig 6. Typical Transfer Characteristics
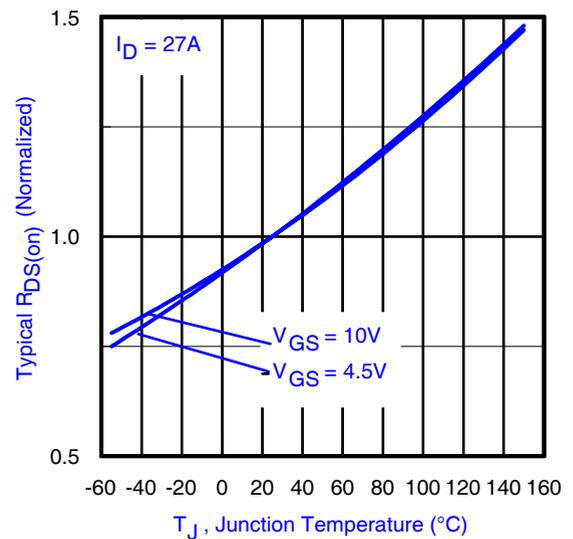

Fig 7. Normalized On-Resistance vs. Temperature
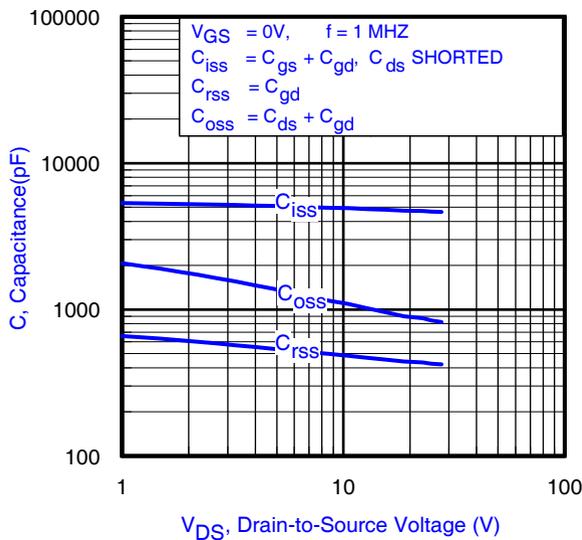
Fig 8. Typical Capacitance vs.Drain-to-Source Voltage
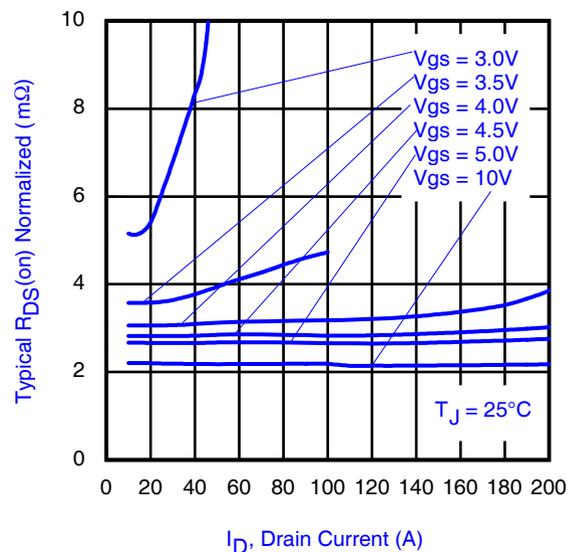
Fig 9. Normalized Typical On-Resistance vs. Drain Current and Gate Voltage

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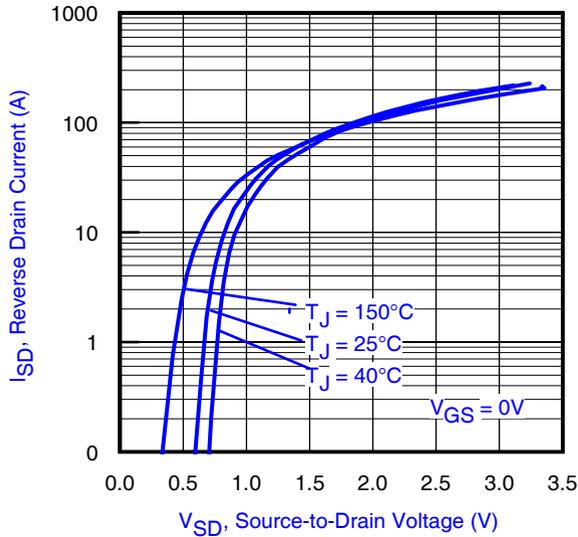
Fig 10. Typical Source-Drain Diode Forward Voltage
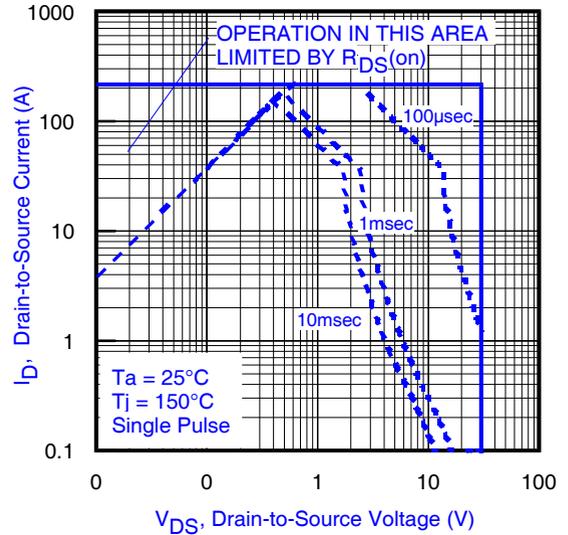
Fig11. Maximum Safe Operating Area
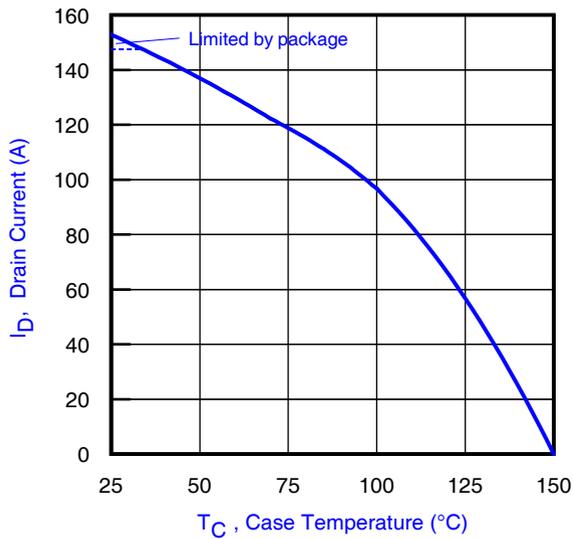

Fig 12. Maximum Drain Current vs. Case Temperature
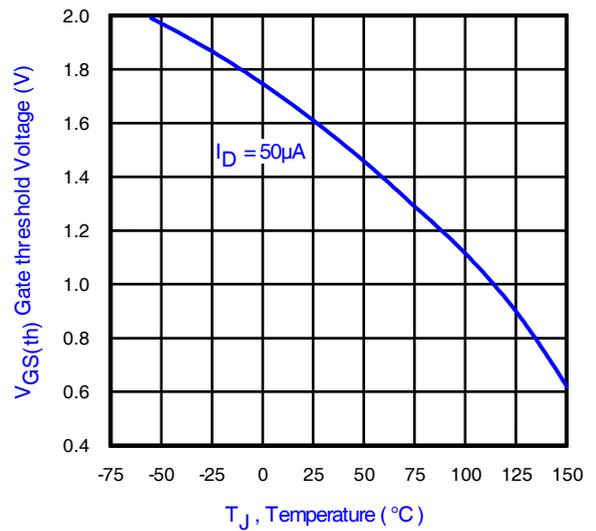
Fig 13. Threshold Voltage vs. Temperature
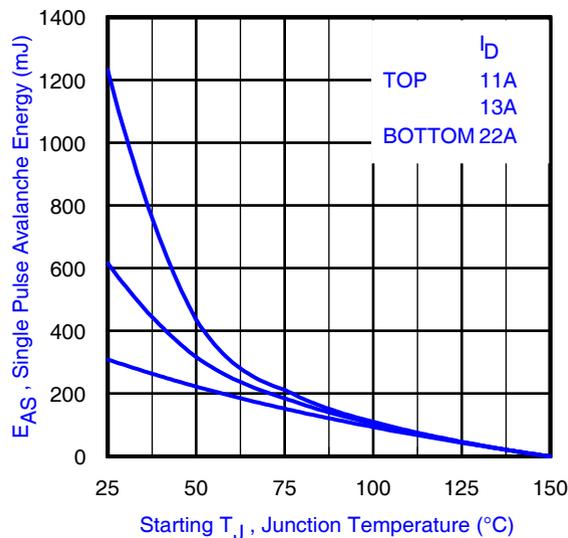

**Fig 14.** Maximum Avalanche Energy vs. Drain Current

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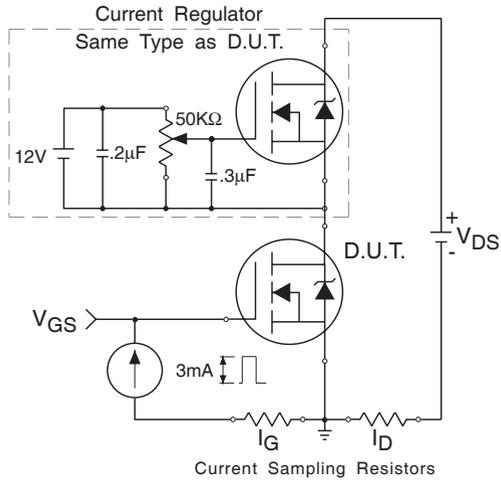
Fig 15a. Gate Charge Test Circuit
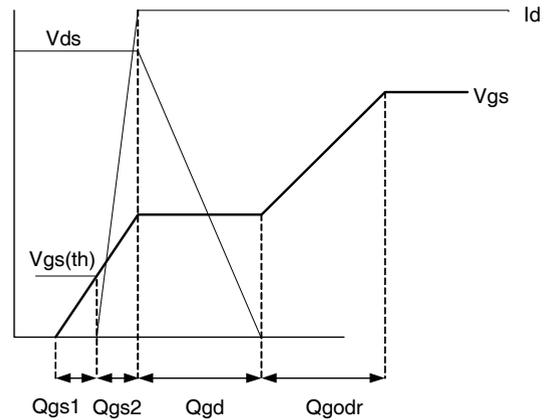

Fig 15b. Gate Charge Waveform
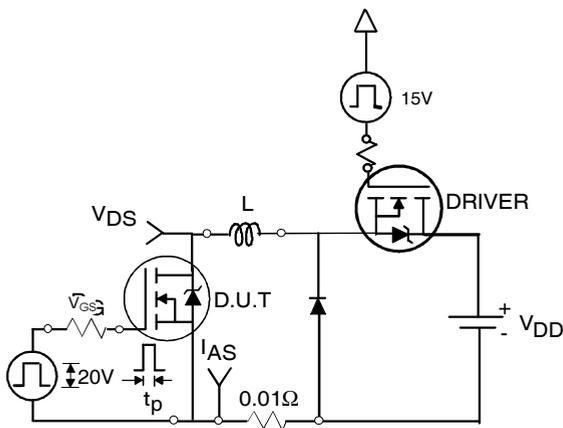
Fig 16a. Unclamped Inductive Test Circuit
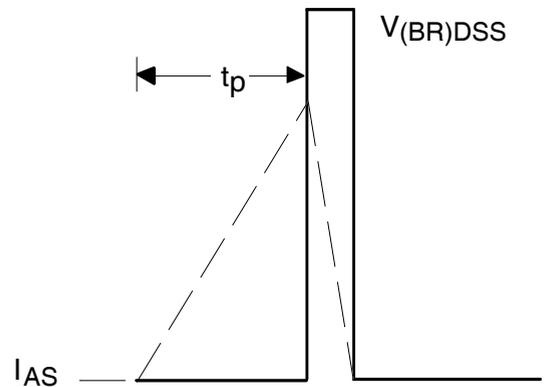
Fig 16b. Unclamped Inductive Waveforms
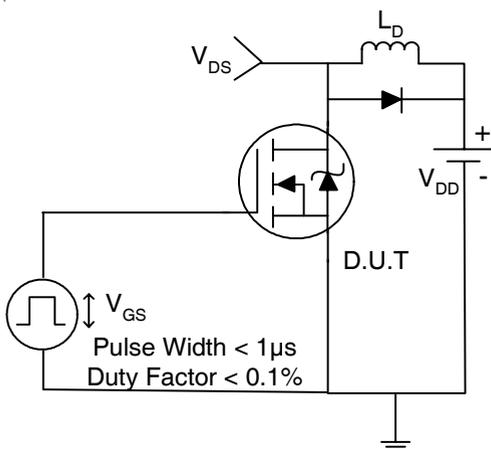
Fig 17a. Switching Time Test Circuit
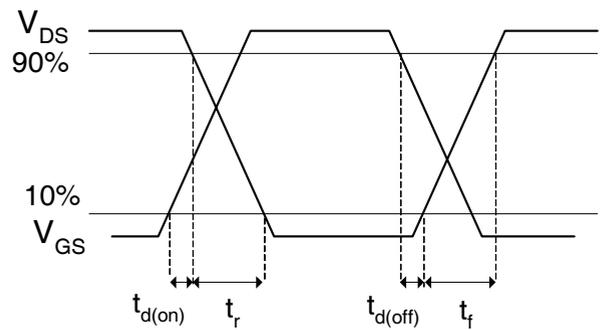
**Fig 17b.** Switching Time Waveforms
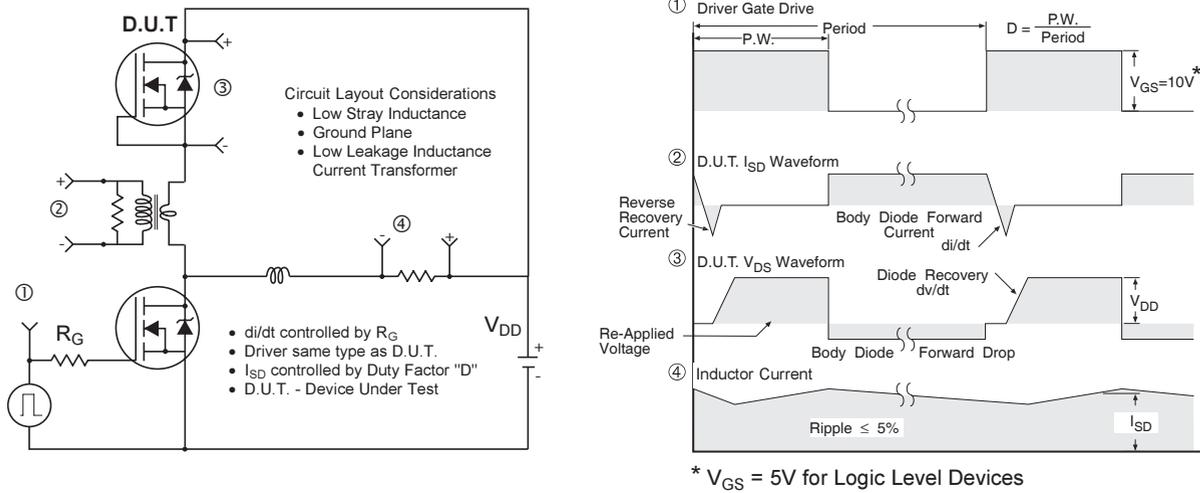
Fig 18. Diode Reverse Recovery Test Circuit for N-Channel HEXFET® Power MOSFETs

DirectFET™ Substrate and PCB Layout, MX Outline ③ (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.

G = GATE
D = DRAIN
S = SOURCE
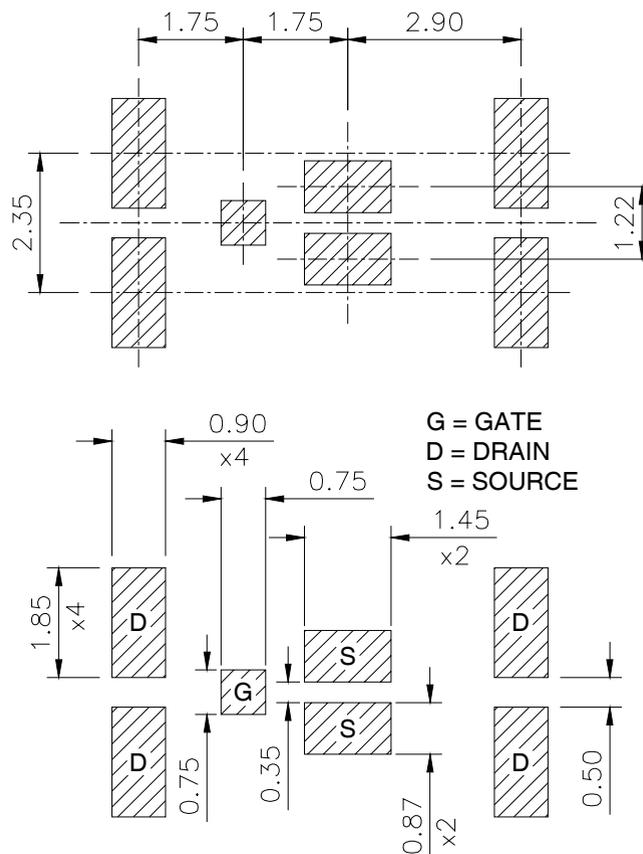
IRF6611

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.
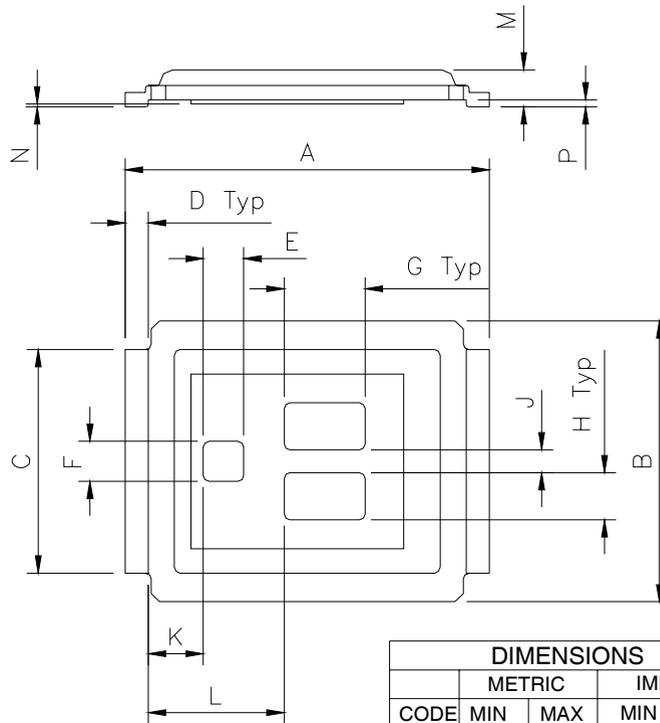

DIMENSIONS				
	METRIC		IMPERIAL	
CODE	MIN	MAX	MIN	MAX
A	6.25	6.35	0.246	0.250
B	4.80	5.05	0.189	0.201
C	3.85	3.95	0.152	0.156
D	0.35	0.45	0.014	0.018
E	0.68	0.72	0.027	0.028
F	0.68	0.72	0.027	0.028
G	1.38	1.42	0.054	0.056
H	0.80	0.84	0.032	0.033
J	0.38	0.42	0.015	0.017
K	0.88	1.01	0.035	0.039
L	2.28	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

## International IR Rectifier
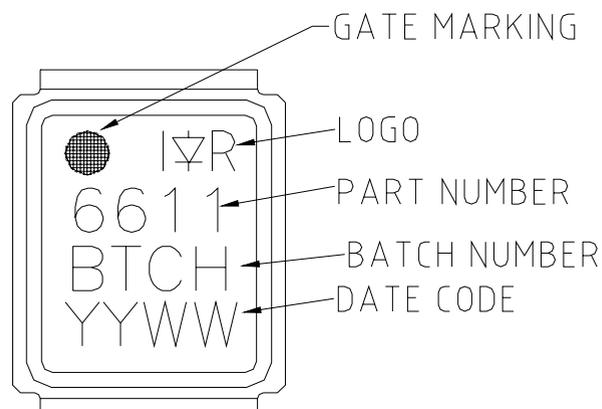
DirectFET™ Tape & Reel Dimension (Showing component orientation).
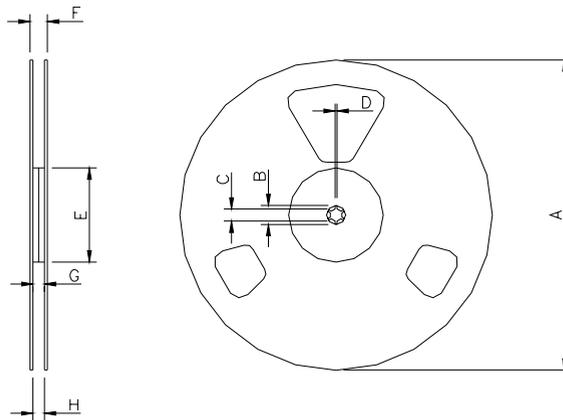
NOTE: Controlling dimensions in mm
Std reel quantity is 4800 parts. (ordered as IRF6611). For 1000 parts on 7" reel,
order   IRF6611TR1

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
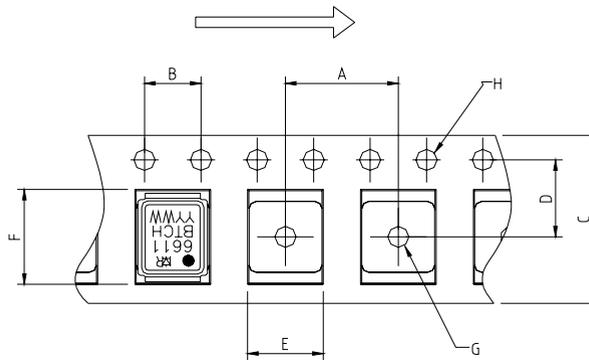
NOTE: CONTROLLING
DIMENSIONS IN MM

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

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 IR Rectifier

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