

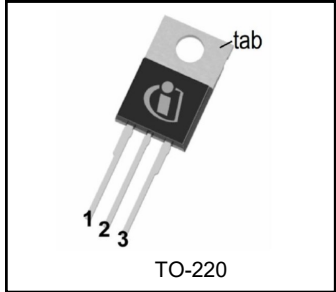
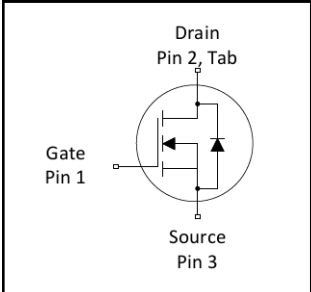
$V_{(BR)DSS}$	55V
$R_{DS(on)}$ max.	5.3m Ω
I_D	169A ^⑥

Typical Applications

- Industrial motor drive

Features

- Advanced Process Technology
- Ultra Low On-Resistance
- Dynamic dv/dt Rating
- 175°C Operating Temperature
- Fast Switching
- Fully Avalanche Rated
- Lead-Free



G	D	S
Gate	Drain	Source

Description

This Stripe Planar design of HEXFET Power MOSFETs utilizes the latest processing techniques to achieve extremely low on-resistance per silicon area. Additional features of this HEXFET power MOSFET are a 175°C junction operating temperature, fast switching speed and improved repetitive avalanche rating. These benefits combine to make this design an extremely efficient and reliable device for use in a wide variety of applications.

Base part number	Package Type	Standard Pack		Orderable Part Number
		Form	Quantity	
IRF1405PbF	TO-220	Tube	50	IRF1405PbF

Absolute Maximum Rating

Symbol	Parameter	Max.	Units
I_D @ $T_C = 25^\circ\text{C}$	Continuous Drain Current, V_{GS} @ 10V	169 ^⑥	A
I_D @ $T_C = 100^\circ\text{C}$	Continuous Drain Current, V_{GS} @ 10V	118 ^⑥	
I_{DM}	Pulsed Drain Current ^①	680	
P_D @ $T_C = 25^\circ\text{C}$	Maximum Power Dissipation	330	W
	Linear Derating Factor	2.2	W/ $^\circ\text{C}$
V_{GS}	Gate-to-Source Voltage	± 20	V
E_{AS}	Single Pulse Avalanche Energy ^②	560	mJ
I_{AR}	Avalanche Current	See Fig. 12a,12b,15,16	A
E_{AR}	Repetitive Avalanche Energy ^⑦		mJ
dv/dt	Peak Diode Recovery dv/dt ^③	5.0	V/ns
T_J	Operating Junction and	-55 to + 175	$^\circ\text{C}$
T_{STG}	Storage Temperature Range		
	Soldering Temperature, for 10 seconds (1.6mm from case)	300	
	Mounting torque, 6-32 or M3 screw	10 lbf•in (1.1N•m)	

Thermal Resistance

Symbol	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case	—	0.45	$^\circ\text{C/W}$
$R_{\theta CS}$	Case-to-Sink, Flat, Greased Surface	0.50	—	
$R_{\theta JA}$	Junction-to-Ambient	—	62	

Static @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	55	—	—	V	$V_{GS} = 0V, I_D = 250\mu A$
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	0.057	—	V/ $^\circ\text{C}$	Reference to 25°C , $I_D = 1\text{mA}$
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	4.6	5.3	m Ω	$V_{GS} = 10V, I_D = 101A$ ④
$V_{GS(th)}$	Gate Threshold Voltage	2.0	—	4.0	V	$V_{DS} = V_{GS}, I_D = 250\mu A$
g_{fs}	Forward Trans conductance	69	—	—	S	$V_{DS} = 25V, I_D = 101A$ ④
I_{DSS}	Drain-to-Source Leakage Current	—	—	20	μA	$V_{DS} = 55V, V_{GS} = 0V$
		—	—	250		$V_{DS} = 44V, V_{GS} = 0V, T_J = 150^\circ\text{C}$
I_{GSS}	Gate-to-Source Forward Leakage	—	—	200	nA	$V_{GS} = 20V$
	Gate-to-Source Reverse Leakage	—	—	-200		$V_{GS} = -20V$

Dynamic Electrical Characteristics @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

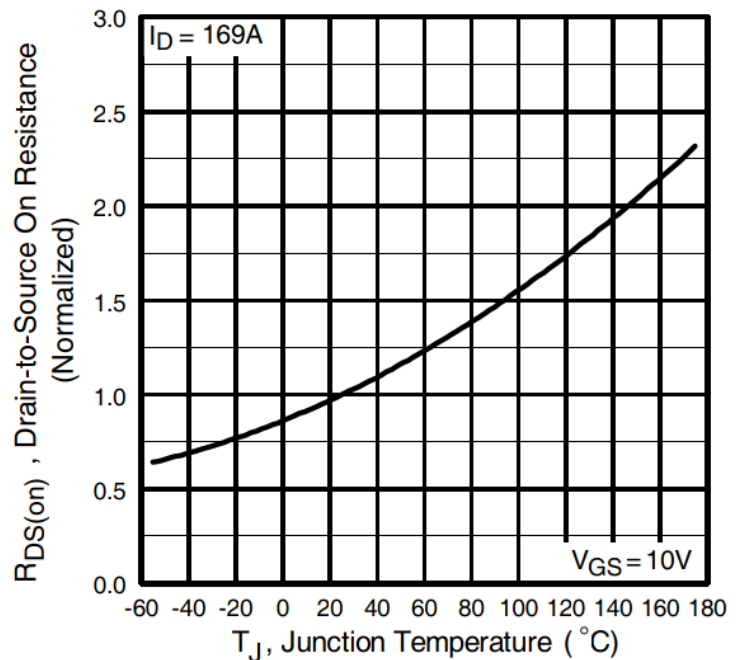
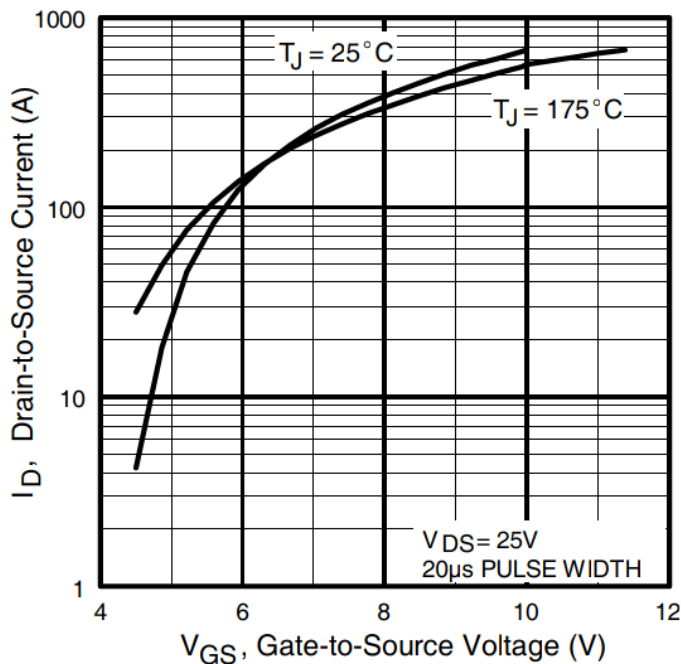
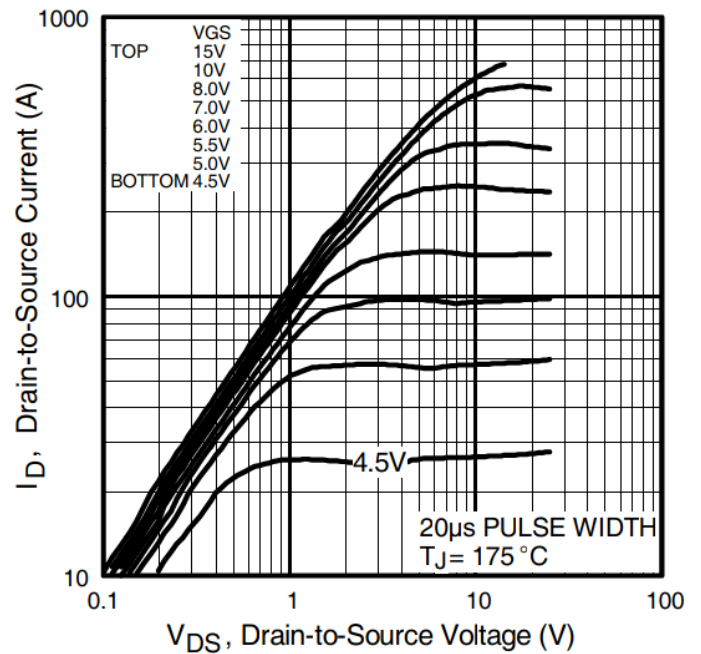
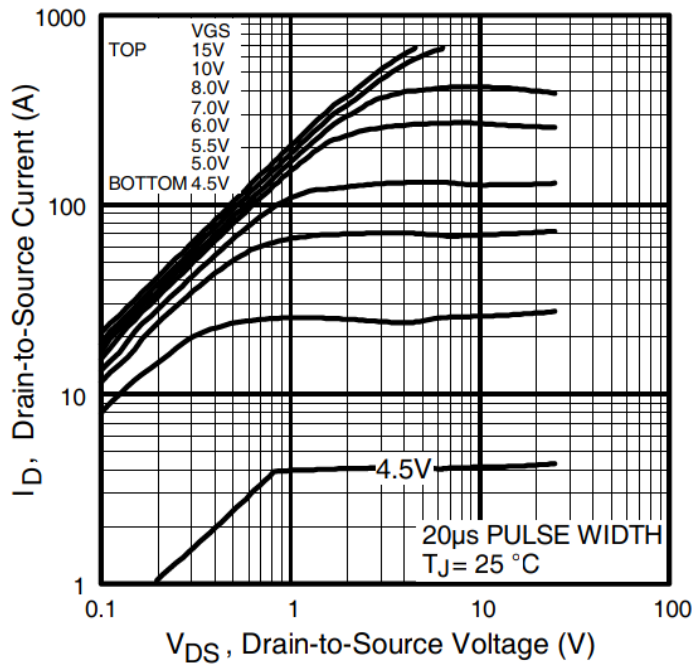
Q_g	Total Gate Charge	—	170	260	nC	$I_D = 101A$
Q_{gs}	Gate-to-Source Charge	—	44	66		$V_{DS} = 44V$
Q_{gd}	Gate-to-Drain Charge	—	62	93		$V_{GS} = 10V$ ④
$t_{d(on)}$	Turn-On Delay Time	—	13	—	ns	$V_{DD} = 38V$
t_r	Rise Time	—	190	—		$I_D = 101A$
$t_{d(off)}$	Turn-Off Delay Time	—	130	—		$R_G = 1.1\Omega$
t_f	Fall Time	—	110	—		$V_{GS} = 10V$ ④
L_D	Internal Drain Inductance	—	4.5	—	nH	Between lead, 6mm (0.25in.) from package and center of die contact
L_S	Internal Source Inductance	—	7.5	—		
C_{iss}	Input Capacitance	—	5480	—	pF	$V_{GS} = 0V$
C_{oss}	Output Capacitance	—	1210	—		$V_{DS} = 25V$
C_{rss}	Reverse Transfer Capacitance	—	280	—		$f = 1.0\text{MHz}$, See Fig.5
C_{oss}	Output Capacitance	—	5210	—		$V_{GS} = 0V, V_{DS} = 1.0V, f = 1.0\text{MHz}$
C_{oss}	Output Capacitance	—	900	—		$V_{GS} = 0V, V_{DS} = 44V, f = 1.0\text{MHz}$
$C_{oss \text{ eff.}}$	Effective Output Capacitance	—	1500	—		$V_{GS} = 0V, V_{DS} = 0V \text{ to } 44V$

Diode Characteristics

	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	—	—	169⑥	A	MOSFET symbol showing the integral reverse p-n junction diode.
I_{SM}	Pulsed Source Current (Body Diode) ①	—	—	680		
V_{SD}	Diode Forward Voltage	—	—	1.3	V	$T_J = 25^\circ\text{C}, I_S = 101A, V_{GS} = 0V$ ④
t_{rr}	Reverse Recovery Time	—	88	130	ns	$T_J = 25^\circ\text{C}, I_F = 101A$
Q_{rr}	Reverse Recovery Charge	—	250	380	nC	$di/dt = 100A/\mu s$ ④

Notes:

- ① Repetitive rating; pulse width limited by max. junction temperature. (See fig. 11).
- ② Starting $T_J = 25^\circ\text{C}$, $L = 0.11\text{mH}$, $R_G = 25\Omega$, $I_{AS} = 101A$. (See fig. 12)
- ③ $I_{SD} \leq 101A$, $di/dt \leq 210A/\mu s$, $V_{DD} \leq V_{(BR)DSS}$, $T_J \leq 175^\circ\text{C}$.
- ④ Pulse width $\leq 400\mu s$; duty cycle $\leq 2\%$.
- ⑤ $C_{oss \text{ eff.}}$ 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 Calculated continuous current based on maximum allowable junction temperature. Package limitation current is 75A.
- ⑦ Limited by T_{Jmax} , see Fig.12a, 12b, 15, 16 for typical repetitive avalanche performance.



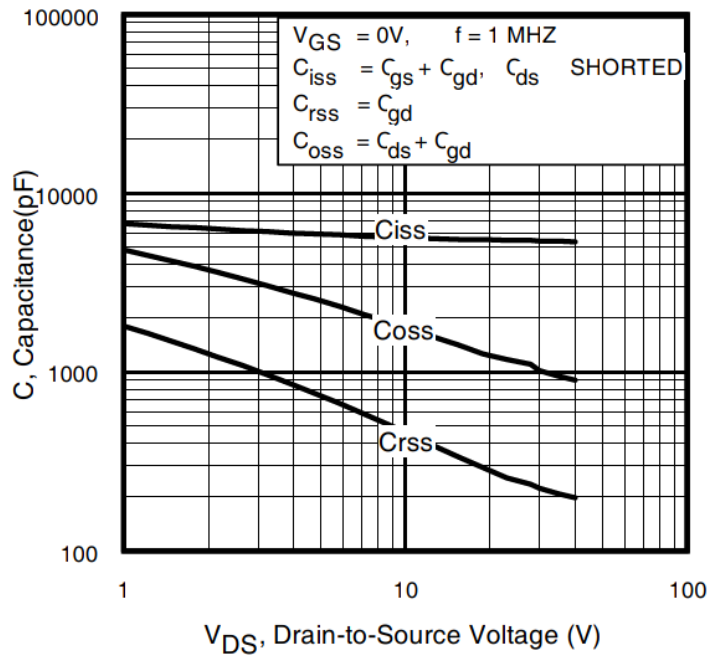


Fig 5. Typical Capacitance vs. Drain-to-Source Voltage

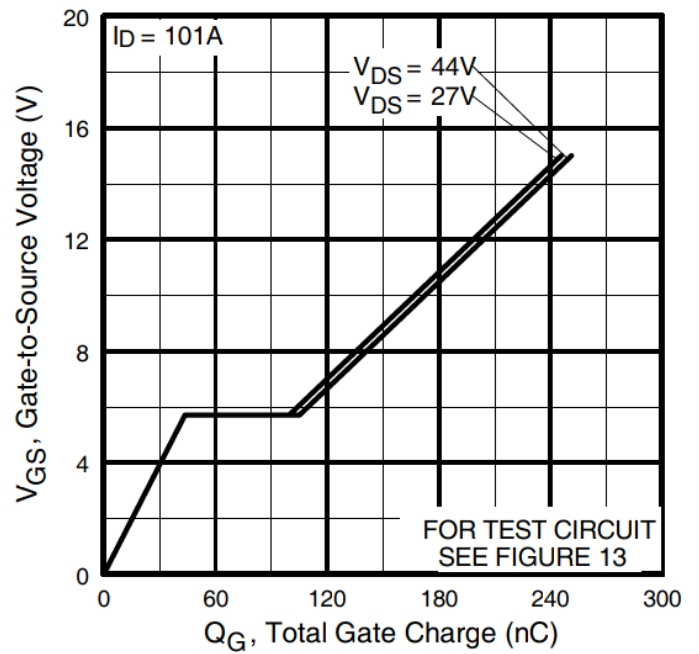


Fig 6. Typical Gate Charge vs. Gate-to-Source Voltage

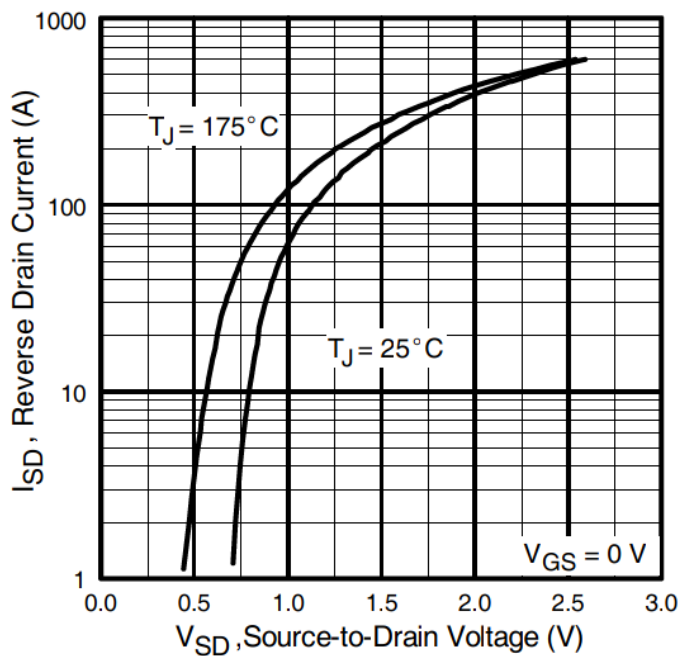


Fig. 7 Typical Source-to-Drain Diode Forward Voltage

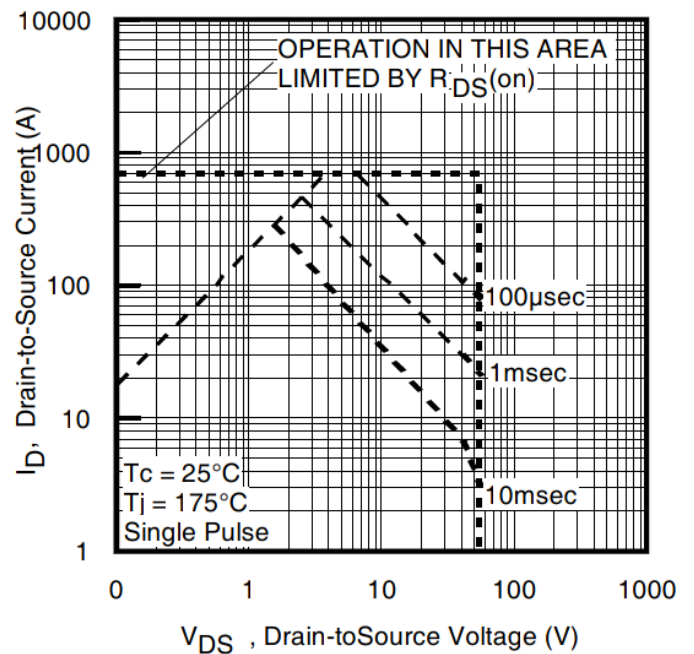


Fig 8. Maximum Safe Operating Area

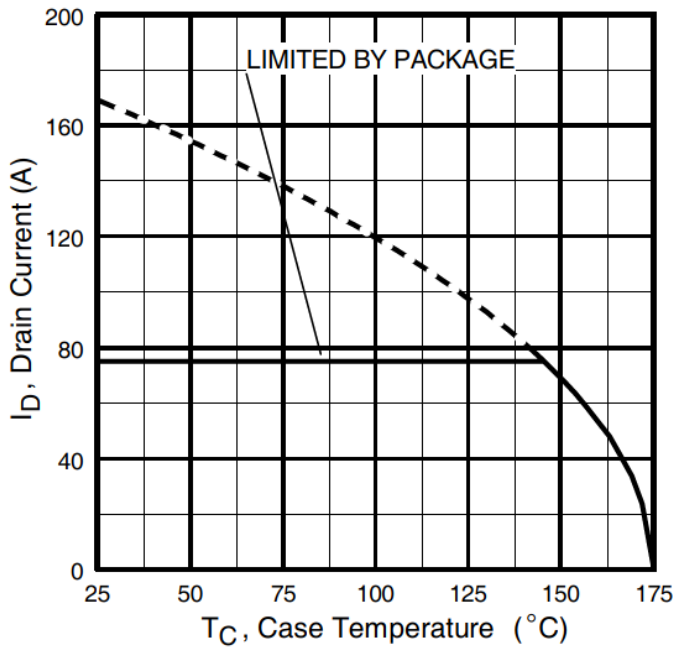


Fig 9. Maximum Drain Current vs. Case Temperature

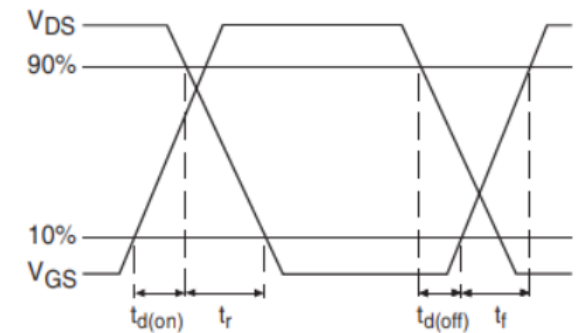
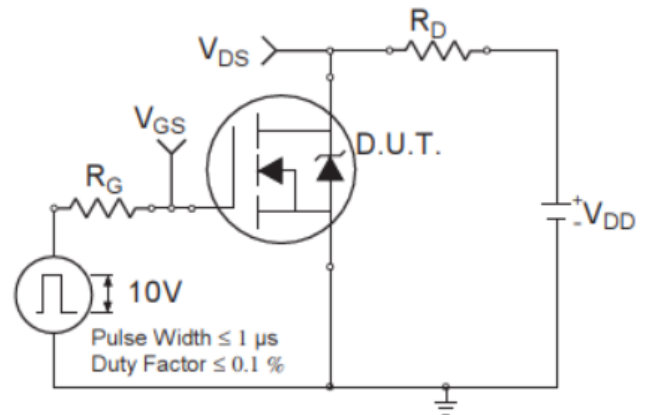


Fig 10b. Switching Time Waveforms

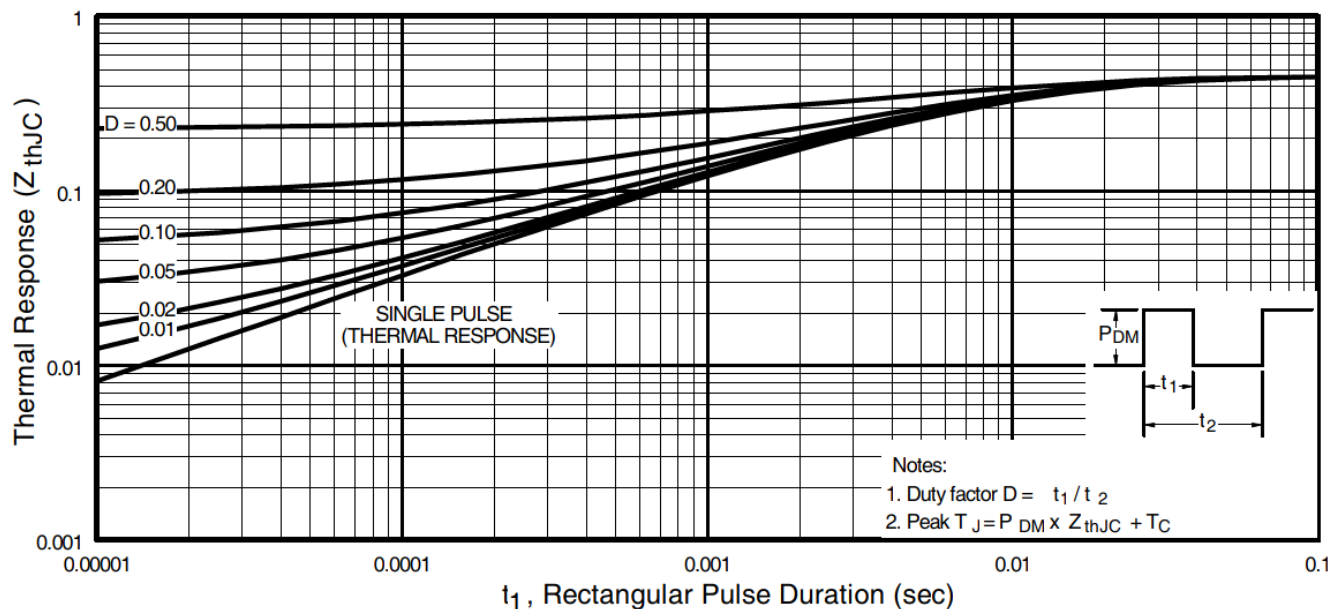


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case

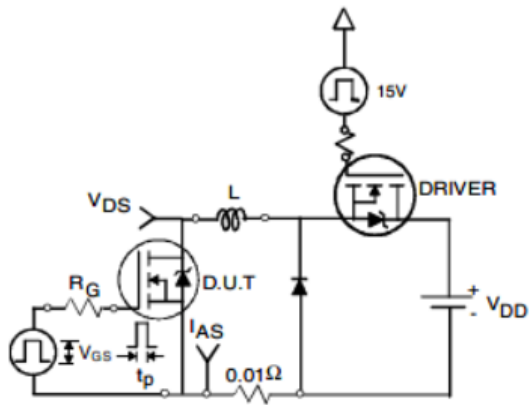


Fig. 12a. Unclamped Inductive Test Circuit

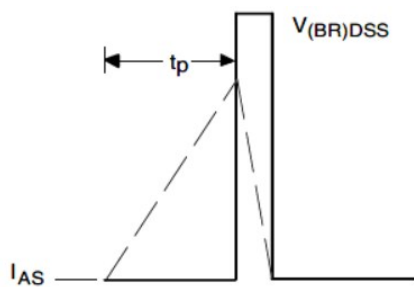


Fig. 12b. Unclamped Inductive Waveforms

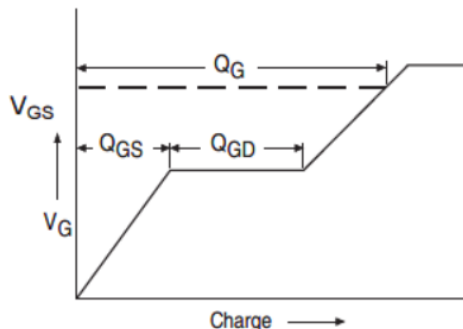


Fig 13a. Basic Gate Charge Waveform

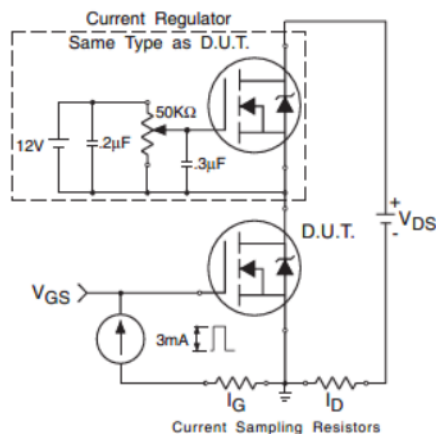


Fig 13b. Gate Charge Test Circuit

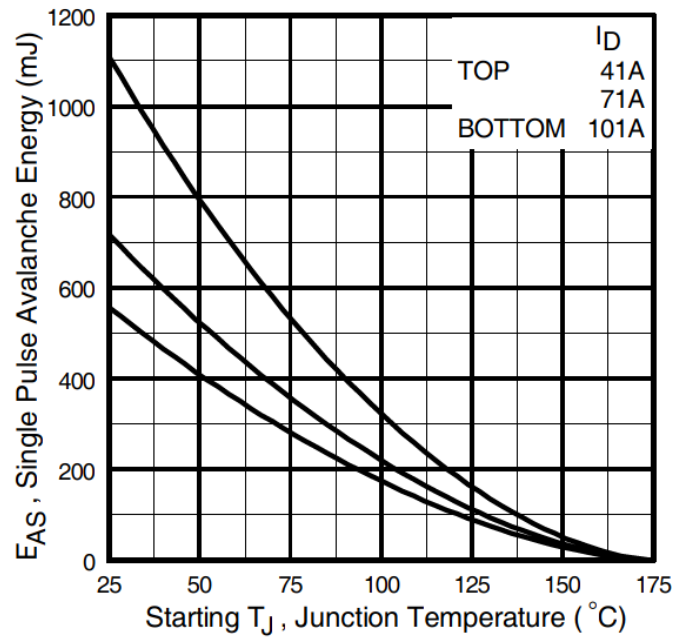


Fig 12c. Maximum Avalanche Energy vs. Drain Current

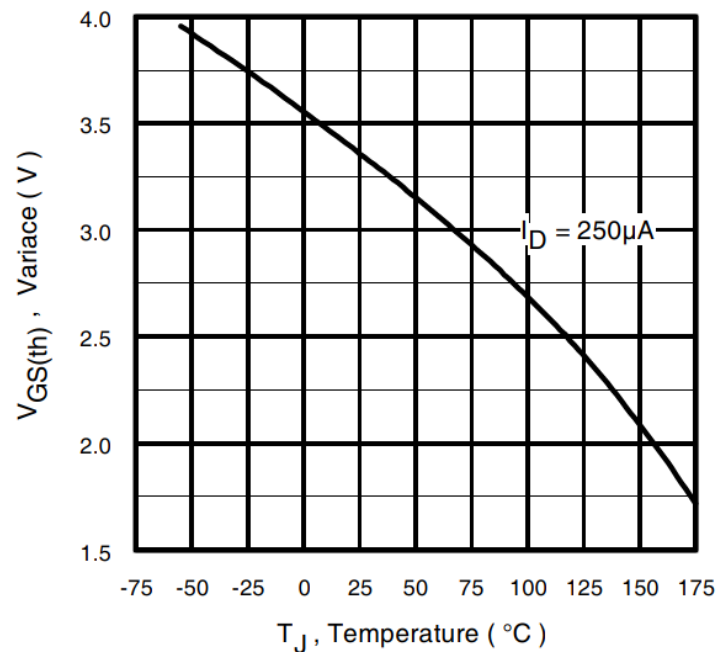


Fig. 14 Threshold Voltage vs. Temperature

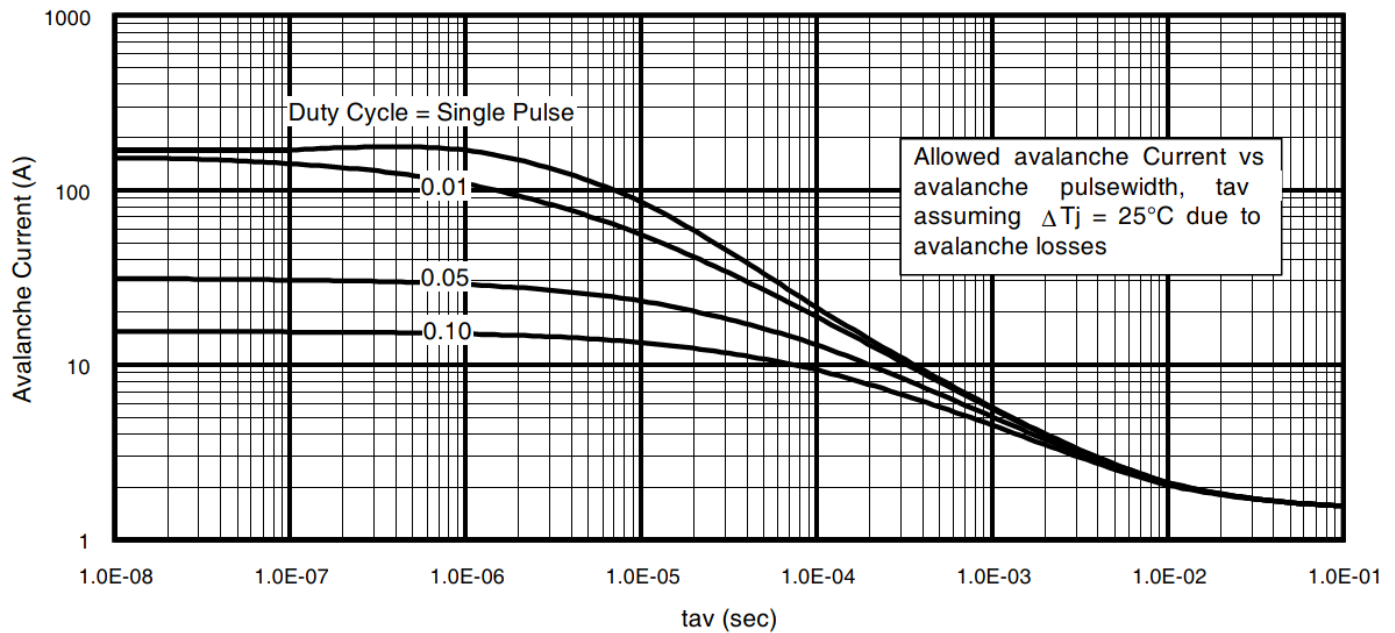


Fig 15. Typical Avalanche Current vs. Pulse Width

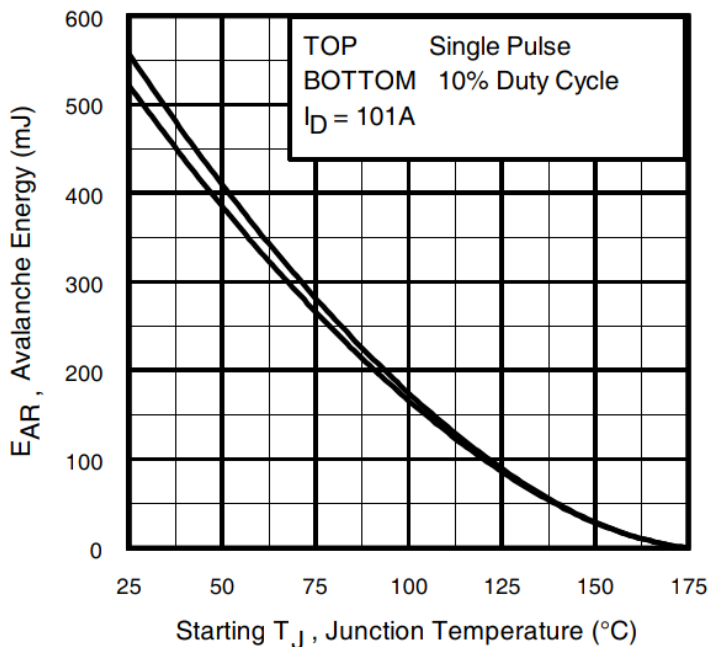


Fig 16. Maximum Avalanche Energy vs. Temperature

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 12a, 12b.
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 15, 16).

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 14)

$$P_{D(ave)} = 1/2 (1.3 \cdot BV \cdot I_{av}) = \Delta T / Z_{thJC}$$

$$I_{av} = 2\Delta T / [1.3 \cdot BV \cdot Z_{thJC}]$$

$$E_{AS(AR)} = P_{D(ave)} \cdot t_{av}$$

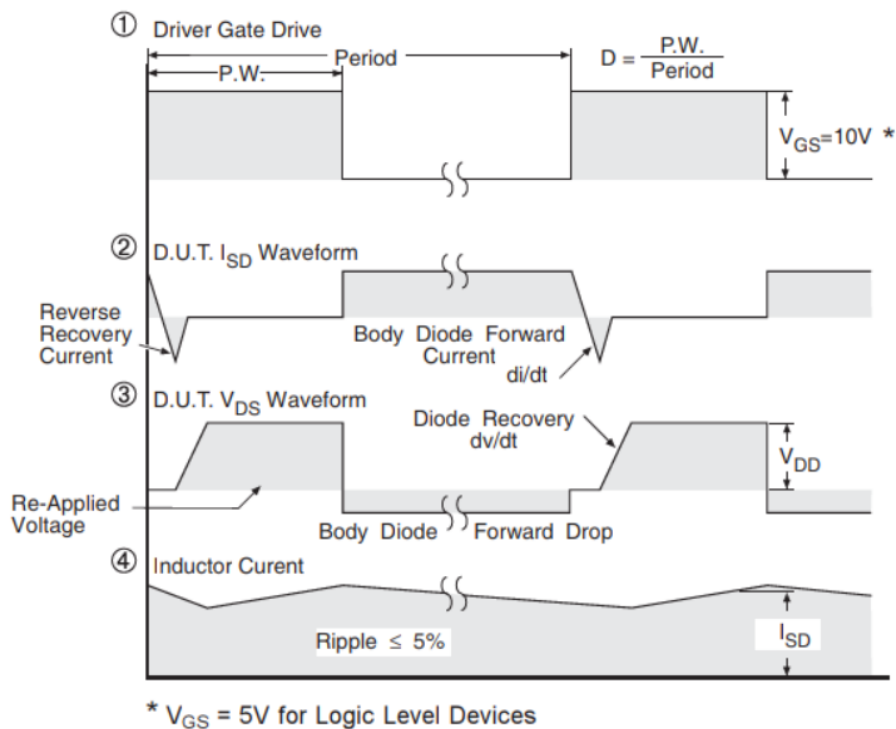
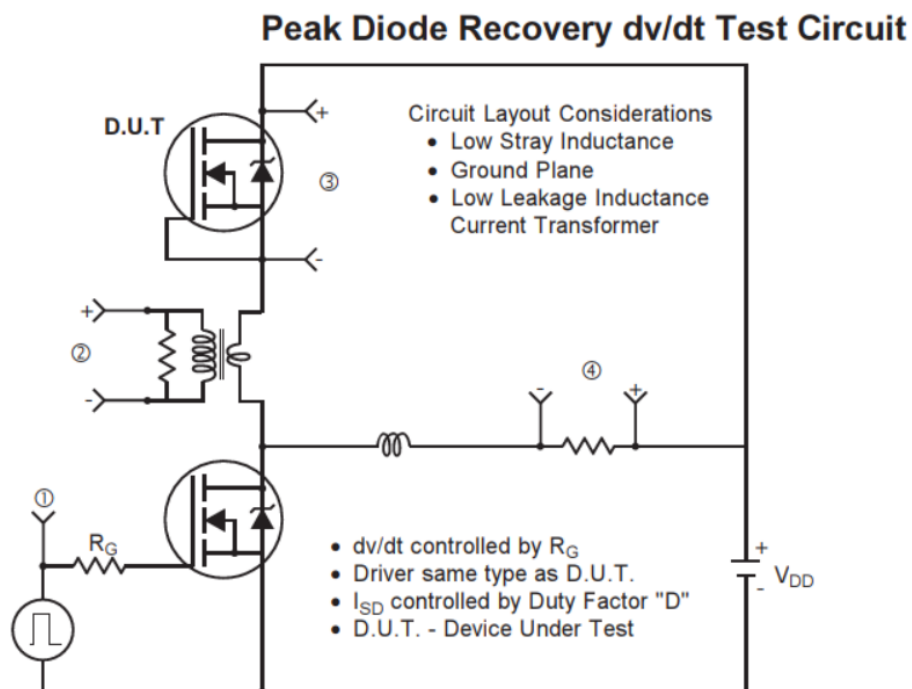
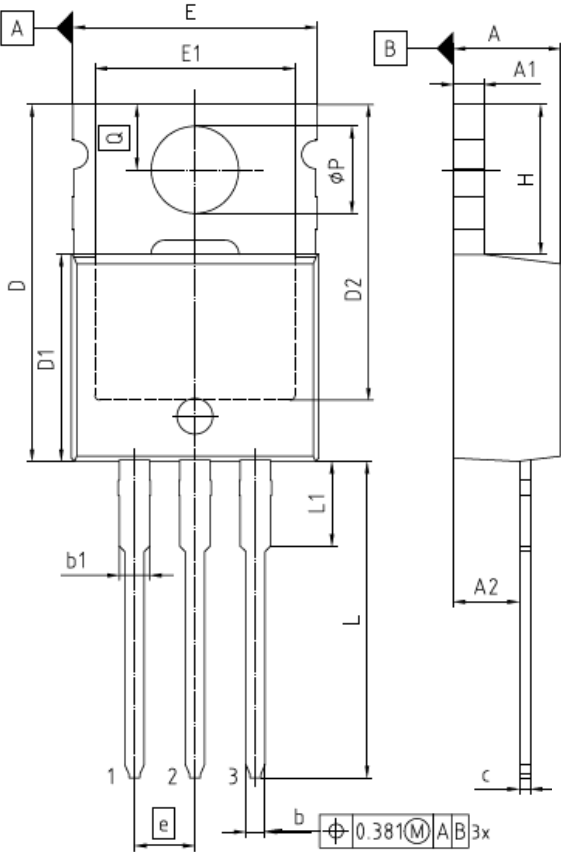


Fig 17. Peak Diode Recovery dv/dt Test Circuit for N-Channel
HEXFET® Power MOSFETs

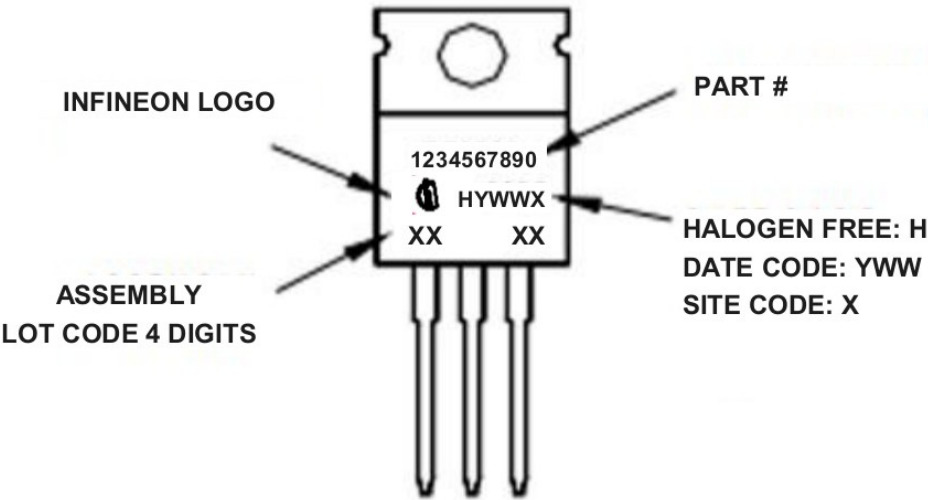
TO-220 Package Outline (Dimensions are shown in millimeters (inches))



NOTES:
DIMENSIONS DO NOT INCLUDE MOLD FLASH, PROTRUSION OR GATE BURRS
GATE BURRS ARE LESS THAN 0.5 mm

PACKAGE - GROUP NUMBER: PG-TO220-3-U05		
DIMENSIONS	MILLIMETERS	
	MIN.	MAX.
A	3.56	4.83
A1	1.14	1.40
A2	2.03	2.92
b	0.38	1.01
b1	1.14	1.78
c	0.36	0.61
D	14.22	16.51
D1	8.38	9.20
D2	11.68	12.88
E	9.65	10.67
E1	6.86	8.89
e	2.54	
N	3	
H	5.84	6.86
L	12.70	14.73
L1	3.56	4.06
øP	3.54	4.08
Q	2.54	3.42

TO-220 Part Marking Information



TO-220 packages are not recommended for Surface Mount Application.

Revision History

Date	Rev.	Comments
2026-07-20	2.1	- Update datasheet to Infineon format - Updated Package Outline and Part marking –page 9 - Added disclaimer on last page.

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