

IRFS531-VB Datasheet

N-Channel 60 V (D-S) MOSFET

PRODUCT SUMMARY

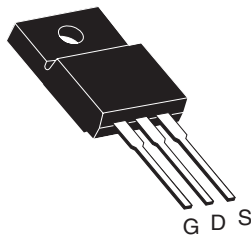
V_{DS} (V)	60	
$R_{DS(on)}$ (Ω)	$V_{GS} = 10\text{ V}$	0.027
Q_g (Max.) (nC)	95	
Q_{gs} (nC)	27	
Q_{gd} (nC)	46	
Configuration	Single	

FEATURES

- Isolated Package
- High Voltage Isolation = 2.5 kV_{RMS} (t = 60 s; f = 60 Hz)
- Sink to Lead Creepage Distance = 4.8 mm
- 175 °C Operating Temperature
- Dynamic dV/dt Rating
- Low Thermal Resistance
- Lead (Pb)-free Available



TO-220 FULLPAK



N-Channel MOSFET

ABSOLUTE MAXIMUM RATINGS $T_C = 25\text{ }^{\circ}\text{C}$, unless otherwise noted

PARAMETER			SYMBOL	LIMIT	UNIT
Drain-Source Voltage			V _{DS}	60	V
Gate-Source Voltage			V _{GS}	± 20	
Continuous Drain Current	V _{GS} at 10 V	T _C = 25 °C	I _D	45	A
		T _C = 100 °C		30	
Pulsed Drain Current ^a			I _{DM}	220	
Linear Derating Factor				0.32	W/°C
Single Pulse Avalanche Energy ^b			E _{AS}	100	mJ
Maximum Power Dissipation	T _C = 25 °C		P _D	52	W
Peak Diode Recovery dV/dt ^c			dV/dt	4.5	V/ns
Operating Junction and Storage Temperature Range			T _J , T _{stg}	- 55 to + 175	°C
Soldering Recommendations (Peak Temperature)	for 10 s			300 ^d	
Mounting Torque	6-32 or M3 screw			10	lbf · in
				1.1	N · m

Notes

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- $V_{DD} = 25\text{ V}$, starting $T_J = 25\text{ }^{\circ}\text{C}$, $L = 129\text{ }\mu\text{H}$, $R_G = 25\text{ }\Omega$, $I_{AS} = 30\text{ A}$ (see fig. 12).
- $I_{SD} \leq 52\text{ A}$, $dI/dt \leq 250\text{ A}/\mu\text{s}$, $V_{DD} \leq V_{DS}$, $T_J \leq 175\text{ }^{\circ}\text{C}$.
- 1.6 mm from case.

THERMAL RESISTANCE RATINGS

PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum Junction-to-Ambient	R_{thJA}	-	65	°C/W
Maximum Junction-to-Case (Drain)	R_{thJC}	-	3.1	

SPECIFICATIONS $T_J = 25\text{ }^{\circ}\text{C}$, unless otherwise noted

PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
Static							
Drain-Source Breakdown Voltage	V _{DS}	V _{GS} = 0 V, I _D = 250 μA		60	-	-	V
V _{DS} Temperature Coefficient	ΔV _{DS} /T _J	Reference to 25 °C, I _D = 1 mA		-	0.060	-	V/°C
Gate-Source Threshold Voltage	V _{GS(th)}	V _{DS} = V _{GS} , I _D = 250 μA		1.0	-	3.0	V
Gate-Source Leakage	I _{GSS}	V _{GS} = ± 20 V		-	-	± 100	nA
Zero Gate Voltage Drain Current	I _{DSS}	V _{DS} = 60 V, V _{GS} = 0 V		-	-	25	μA
		V _{DS} = 48 V, V _{GS} = 0 V, T _J = 150 °C		-	-	250	
Drain-Source On-State Resistance	R _{DS(on)}	V _{GS} = 10 V	I _D = 18 A ^b	-	0.027	-	Ω
Forward Transconductance	g _{fs}	V _{DS} = 25 V, I _D = 18 A ^b		15	-	-	S
Dynamic							
Input Capacitance	C _{iss}	V _{GS} = 0 V, V _{DS} = 25 V, f = 1.0 MHz, see fig. 5		-	1500	-	pF
Output Capacitance	C _{oss}			-	720	-	
Reverse Transfer Capacitance	C _{rss}			-	100	-	
Drain to Sink Capacitance	C	f = 1.0 MHz		-	12	-	
Total Gate Charge	Q _g	V _{GS} = 10 V	I _D = 52 A, V _{DS} = 48 V, see fig. 6 and 13 ^b	-	-	95	nC
Gate-Source Charge	Q _{gs}			-	-	27	
Gate-Drain Charge	Q _{gd}			-	-	46	
Turn-On Delay Time	t _{d(on)}	V _{DD} = 30 V, I _D = 52 A, R _G = 9.1 Ω, R _D = 0.54 Ω, see fig. 10 ^b		-	19	-	ns
Rise Time	t _r			-	120	-	
Turn-Off Delay Time	t _{d(off)}			-	55	-	
Fall Time	t _f			-	86	-	
Internal Drain Inductance	L _D	Between lead, 6 mm (0.25") from package and center of die contact		-	4.5	-	nH
Internal Source Inductance	L _S			-	7.5	-	
Drain-Source Body Diode Characteristics							
Continuous Source-Drain Diode Current	I _S	MOSFET symbol showing the integral reverse p - n junction diode		-	-	45	A
Pulsed Diode Forward Current ^a	I _{SM}			-	-	120	
Body Diode Voltage	V _{SD}	T _J = 25 °C, I _S = 30 A, V _{GS} = 0 V ^b		-	-	2.5	V
Body Diode Reverse Recovery Time	t _{rr}	T _J = 25 °C, I _F = 52 A, dI/dt = 100 A/μs ^b		-	140	300	ns
Body Diode Reverse Recovery Charge	Q _{rr}			-	1.2	2.8	μC
Forward Turn-On Time	t _{on}	Intrinsic turn-on time is negligible (turn-on is dominated by L _S and L _D)					

Notes

a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).

b. Pulse width $\leq 300\text{ }\mu\text{s}$; duty cycle $\leq 2\%$.

TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted

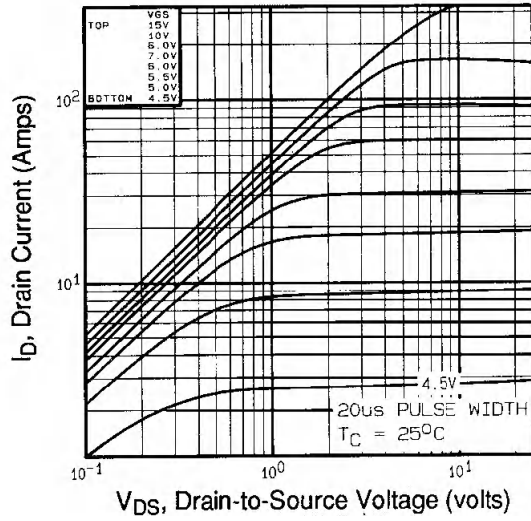


Fig. 1 - Typical Output Characteristics, $T_C = 25^\circ\text{C}$

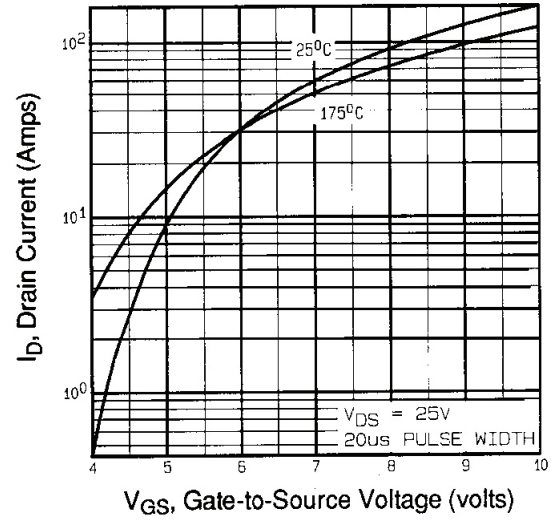


Fig. 3 - Typical Transfer Characteristics



Fig. 2 - Typical Output Characteristics, $T_C = 175^\circ\text{C}$

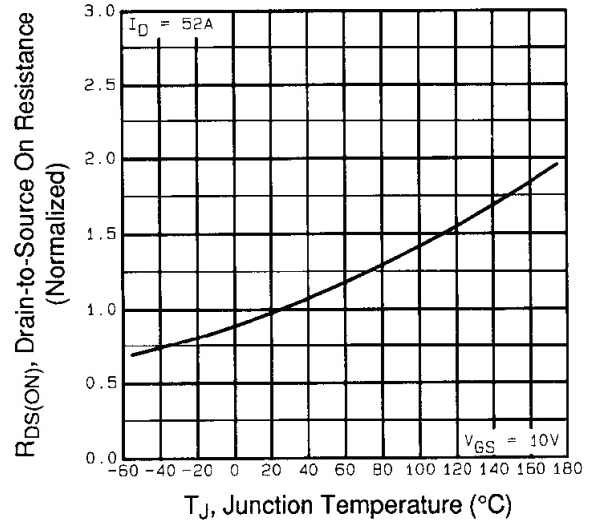


Fig. 4 - Normalized On-Resistance vs. Temperature



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

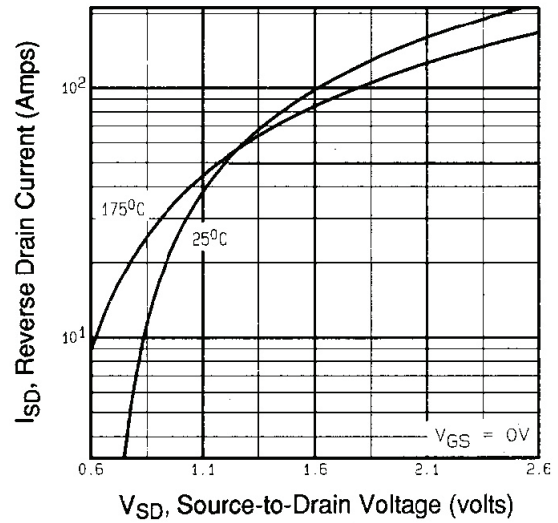


Fig. 7 - Typical Source-Drain Diode Forward Voltage



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



Fig. 8 - Maximum Safe Operating Area

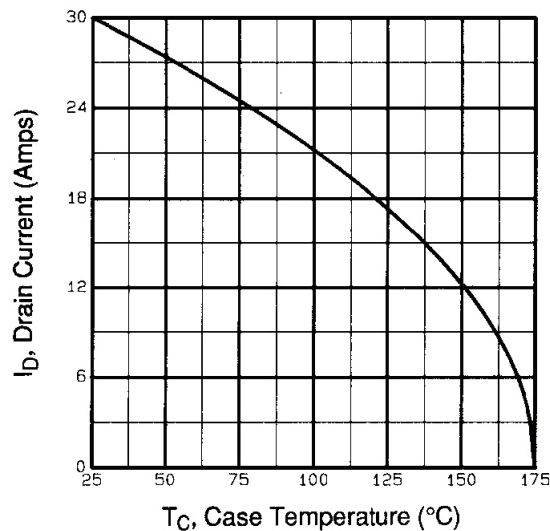


Fig. 9 - Maximum Drain Current vs. Case Temperature

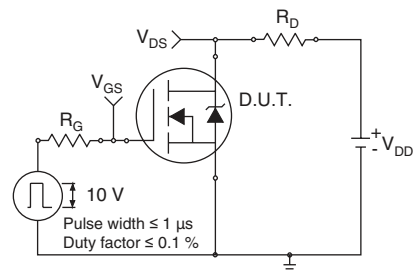


Fig. 10a - Switching Time Test Circuit

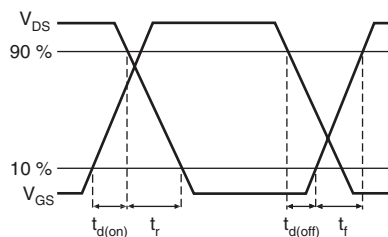


Fig. 10b - Switching Time Waveforms

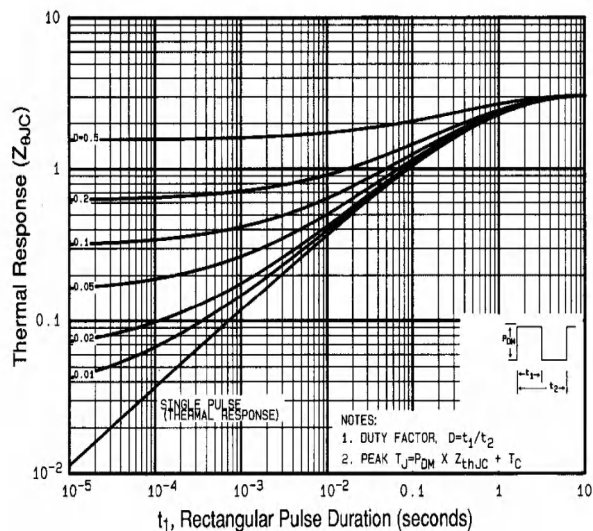


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

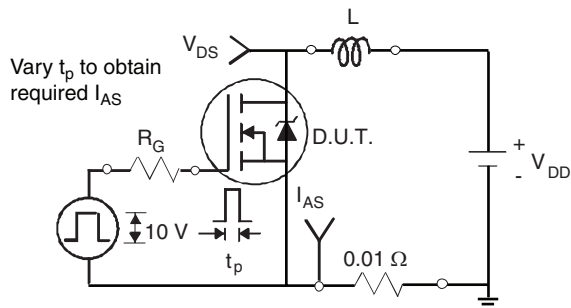


Fig. 12a - Unclamped Inductive Test Circuit

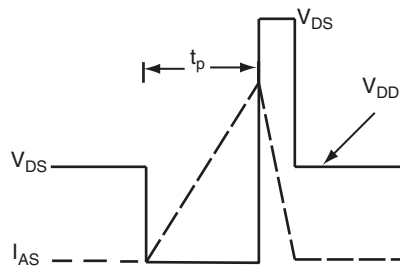


Fig. 12b - Unclamped Inductive Waveforms

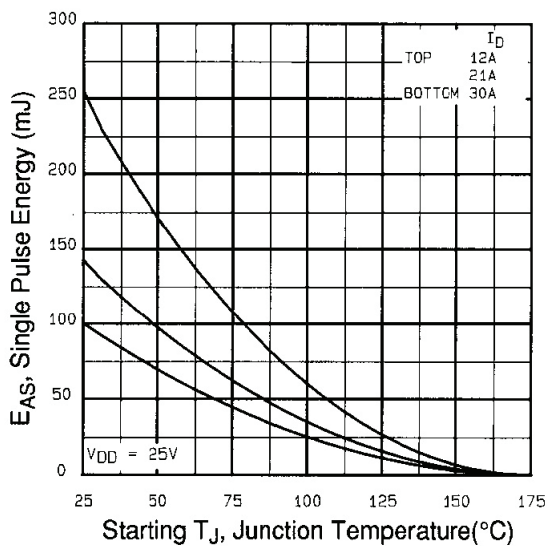


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

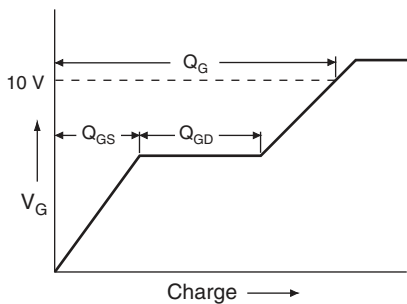


Fig. 13a - Basic Gate Charge Waveform

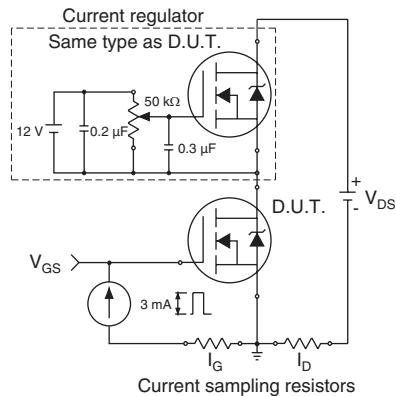
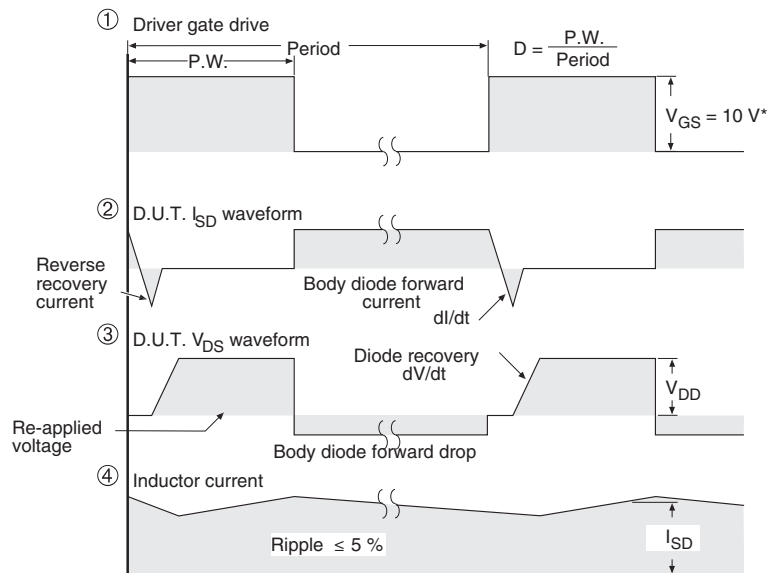


Fig. 13b - Gate Charge Test Circuit

Peak Diode Recovery dV/dt Test Circuit



* $V_{GS} = 5\text{ V}$ for logic level devices

Fig. 14 - For N-Channel

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