

# Power MOSFET

**TO-220AB**


N-Channel MOSFET

## PRODUCT SUMMARY

$V_{DS}$ (V)	60	
$R_{DS(on)}$ ( $\Omega$ )	$V_{GS} = 10\text{ V}$	0.018
$Q_g$ (Max.) (nC)	110	
$Q_{gs}$ (nC)	29	
$Q_{gd}$ (nC)	36	
Configuration	Single	

## FEATURES

- Advanced process technology
- Ultra low on-resistance
- Dynamic  $dV/dt$  rating
- 175 °C operating temperature
- Fast switching
- Fully avalanche rated
- Drop in replacement of the SiHFZ48 for linear / audio applications
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)


**RoHS\***  
Available

## Note

\* This datasheet provides information about parts that are RoHS-compliant and / or parts that are non RoHS-compliant. For example, parts with lead (Pb) terminations are not RoHS-compliant. Please see the information / tables in this datasheet for details

## DESCRIPTION

Advanced power MOSFETs from Vishay utilize advanced processing techniques to achieve extremely low on-resistance per silicon area. This benefit, combined with the fast switching speed and ruggedized device design that Power MOSFETs are well known for, provides the designer with an extremely efficient and reliable device for use in a wide variety of applications.

The TO-220AB package is universally preferred for all commercial-industrial applications at power dissipation levels to approximately 50 W. The low thermal resistance and low package cost of the TO-220AB contribute to its wide acceptance throughout the industry.

## ORDERING INFORMATION

Package	TO-220AB
Lead (Pb)-free	IRFZ48RPbF

## 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	$V_{GS}$	$\pm 20$	
Continuous drain current	$V_{GS}$ at 10 V	$T_C = 25\text{ }^{\circ}\text{C}$	A
		$T_C = 100\text{ }^{\circ}\text{C}$	
Pulsed drain current <sup>a</sup>	$I_{DM}$	290	
Linear derating factor		1.3	W/ $^{\circ}\text{C}$
Single pulse avalanche energy <sup>b</sup>	$E_{AS}$	100	mJ
Repetitive avalanche current <sup>a</sup>	$I_{AR}$	50	A
Repetitive avalanche energy <sup>a</sup>	$E_{AR}$	19	mJ
Maximum power dissipation	$P_D$	190	W
Peak diode recovery $dV/dt$ <sup>c</sup>	$dV/dt$	4.5	V/ns
Operating junction and storage temperature range	$T_J, T_{stg}$	-55 to +175	$^{\circ}\text{C}$
Soldering recommendations (peak temperature) <sup>d</sup>	For 10 s	300 <sup>d</sup>	
Mounting torque	6-32 or M3 screw	10	
		1.1	N · m

## Notes

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11)
- $V_{DD} = 25\text{ V}$ , starting  $T_J = 25\text{ }^{\circ}\text{C}$ ,  $L = 22\text{ }\mu\text{H}$ ,  $R_g = 25\text{ }\Omega$ ,  $I_{AS} = 72\text{ A}$  (see fig. 12)
- $I_{SD} \leq 72\text{ A}$ ,  $dV/dt \leq 200\text{ A/ms}$ ,  $V_{DD} \leq V_{DS}$ ,  $T_J \leq 175\text{ }^{\circ}\text{C}$
- 1.6 mm from case

**THERMAL RESISTANCE RATINGS**

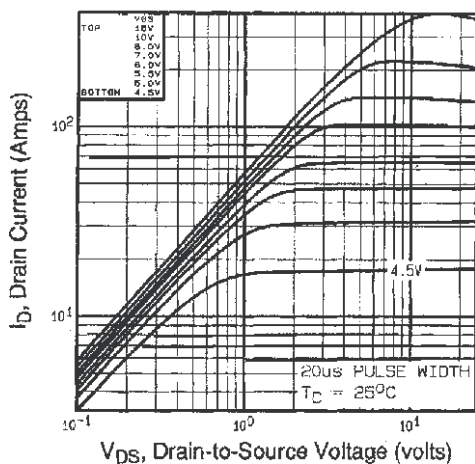
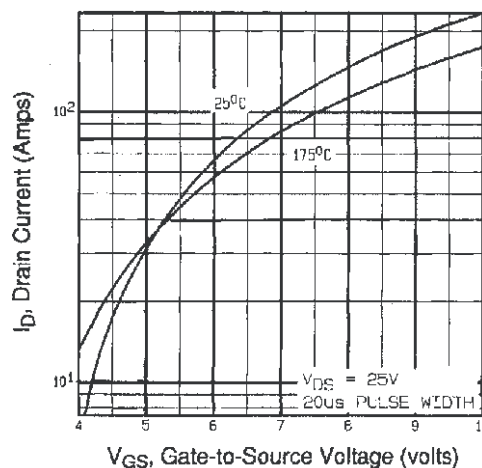
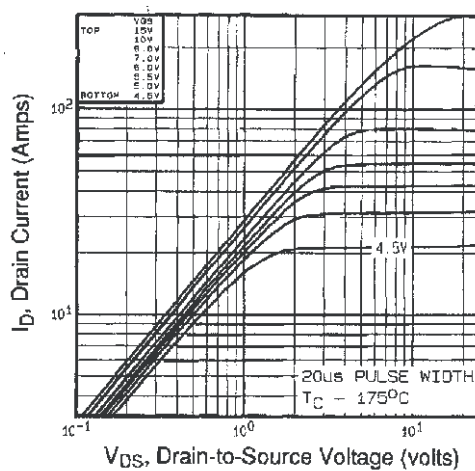
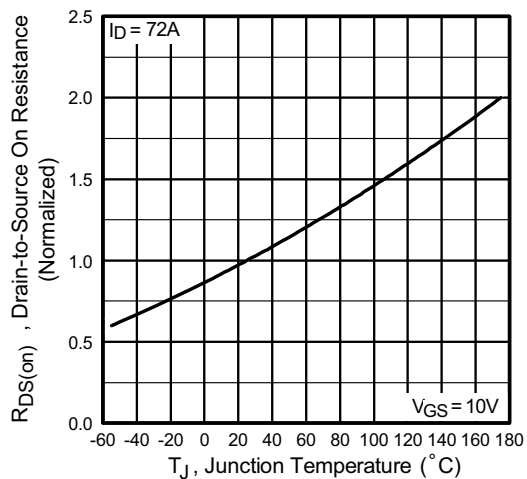
PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum junction-to-ambient	$R_{thJA}$	-	62	°C/W
Case-to-sink, flat, greased surface	$R_{thCS}$	0.50	-	
Maximum junction-to-case (drain)	$R_{thJC}$	-	0.8	

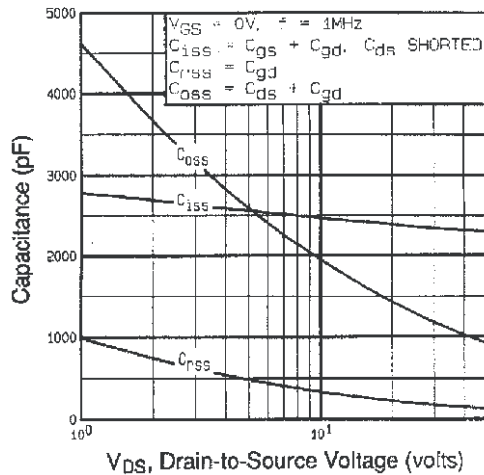
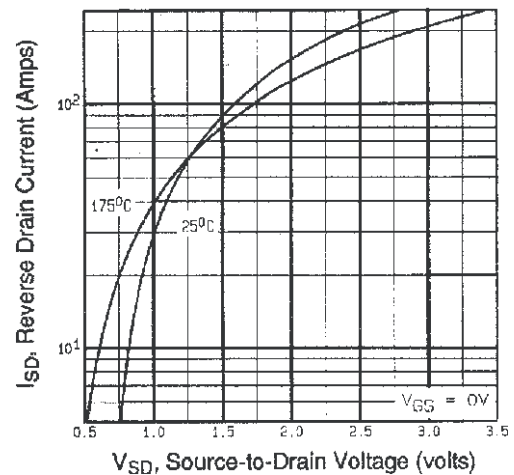
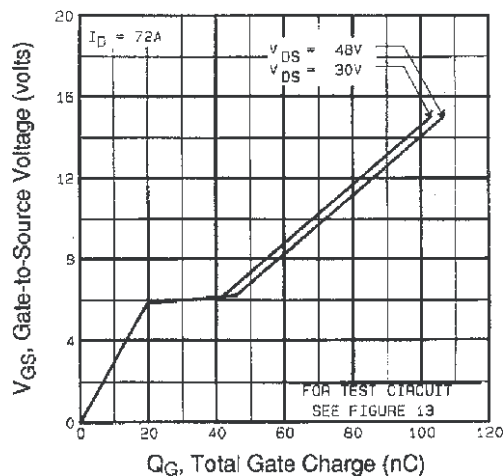
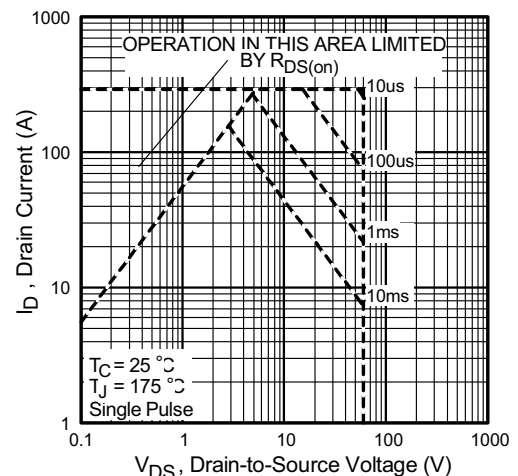
**SPECIFICATIONS** ( $T_J = 25\text{ }^{\circ}\text{C}$ , unless otherwise noted)

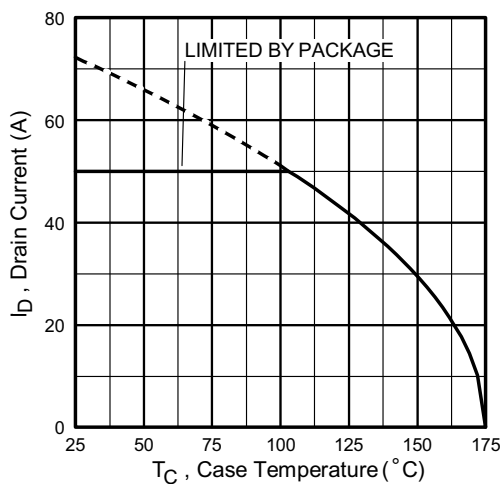
PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
Static							
Drain-source breakdown voltage	V <sub>DS</sub>	V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA		60	-	-	V
V <sub>DS</sub> temperature coefficient	ΔV <sub>DS</sub> /T <sub>J</sub>	Reference to 25 °C, I <sub>D</sub> = 1 mA		-	0.060	-	V/°C
Gate-source threshold voltage	V <sub>GS(th)</sub>	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA		2.0	-	4.0	V
Gate-source leakage	I <sub>GSS</sub>	V <sub>GS</sub> = ± 20		-	-	± 100	nA
Zero gate voltage drain current	I <sub>DSS</sub>	V <sub>DS</sub> = 60 V, V <sub>GS</sub> = 0 V		-	-	25	μA
		V <sub>DS</sub> = 48 V, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 150 °C		-	-	250	
Drain-source on-state resistance	R <sub>DS(on)</sub>	V <sub>GS</sub> = 10 V	I <sub>D</sub> = 43 A <sup>b</sup>	-	-	0.018	Ω
Forward transconductance	g <sub>fs</sub>	V <sub>DS</sub> = 25 V, I <sub>D</sub> = 43 A <sup>b</sup>		27	-	-	S
Dynamic							
Input capacitance	C <sub>iss</sub>	V <sub>GS</sub> = 0 V, V <sub>DS</sub> = 25 V, f = 1.0 MHz, see fig. 5		-	2400	-	pF
Output capacitance	C <sub>oss</sub>			-	1300	-	
Reverse transfer capacitance	C <sub>rss</sub>			-	190	-	
Total gate charge	Q <sub>g</sub>	V <sub>GS</sub> = 10 V	I <sub>D</sub> = 72 A, V <sub>DS</sub> = 48 V, see fig. 6 and 13 <sup>b</sup>	-	-	110	nC
Gate-source charge	Q <sub>gs</sub>			-	-	29	
Gate-drain charge	Q <sub>gd</sub>			-	-	36	
Turn-on delay time	t <sub>d(on)</sub>	V <sub>DD</sub> = 30 V, I <sub>D</sub> = 72 A, R <sub>g</sub> = 9.1 Ω, R <sub>D</sub> = 0.34 Ω, see fig. 10 <sup>b</sup>		-	8.1	-	ns
Rise time	t <sub>r</sub>			-	250	-	
Turn-off delay time	t <sub>d(off)</sub>			-	210	-	
Fall time	t <sub>f</sub>			-	250	-	
Internal drain inductance	L <sub>D</sub>	Between lead, 6 mm (0.25") from package and center of die contact		-	4.5	-	nH
Internal source inductance	L <sub>S</sub>			-	7.5	-	
Drain-Source Body Diode Characteristics							
Continuous source-drain diode current	I <sub>S</sub>	MOSFET symbol showing the integral reverse p - n junction diode		-	-	50	A
Pulsed diode forward current <sup>a</sup>	I <sub>SM</sub>			-	-	290	
Body diode voltage	V <sub>SD</sub>	T <sub>J</sub> = 25 °C, I <sub>S</sub> = 72 A, V <sub>GS</sub> = 0 V <sup>b</sup>		-	-	2.0	V
Body diode reverse recovery time	t <sub>rr</sub>	T <sub>J</sub> = 25 °C, I <sub>F</sub> = 72 A, dI/dt = 100 A/μs <sup>b</sup>		-	120	180	ns
Body diode reverse recovery charge	Q <sub>rr</sub>			-	0.50	0.80	μC
Forward turn-on time	t <sub>on</sub>	Intrinsic turn-on time is negligible (turn-on is dominated by L <sub>S</sub> and L <sub>D</sub> )					

**Notes**

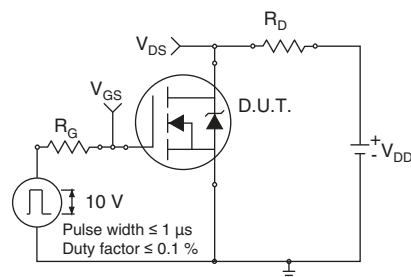
- a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11)  
b. Pulse width  $\leq 300\text{ }\mu\text{s}$ ; duty cycle  $\leq 2\text{ }\%$

**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)

**Fig. 1 - Typical Output Characteristics**

**Fig. 3 - Typical Transfer Characteristics**

**Fig. 2 - Typical Output Characteristics**

**Fig. 4 - Normalized On-Resistance vs. Temperature**

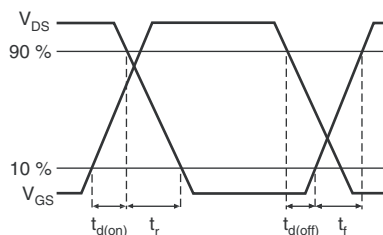

**Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage**

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

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

**Fig. 8 - Maximum Safe Operating Area**



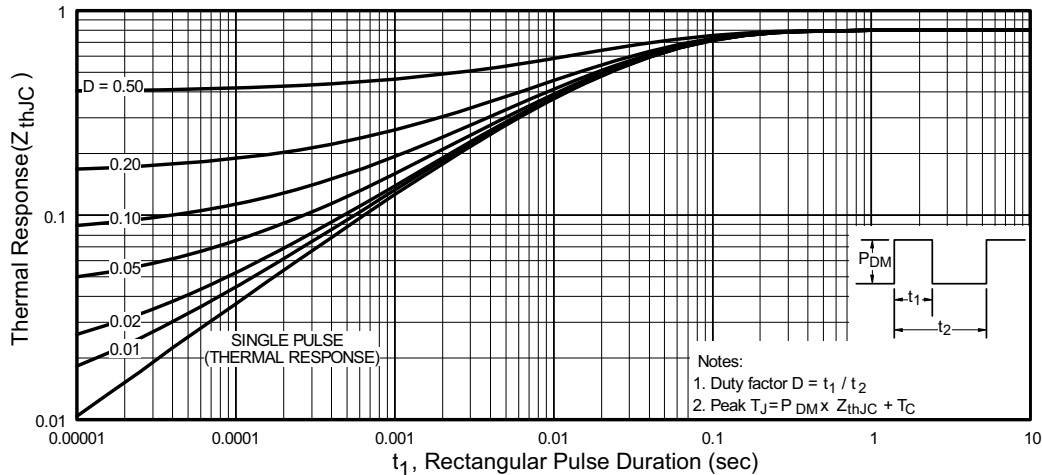
**Fig. 9 - Maximum Drain Current vs. Case Temperature**



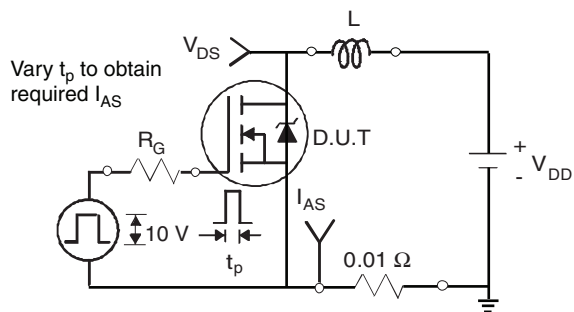
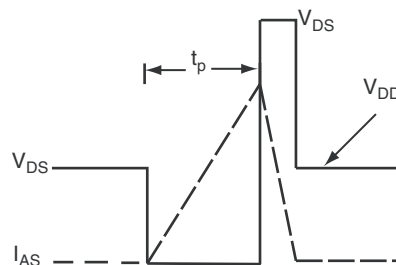
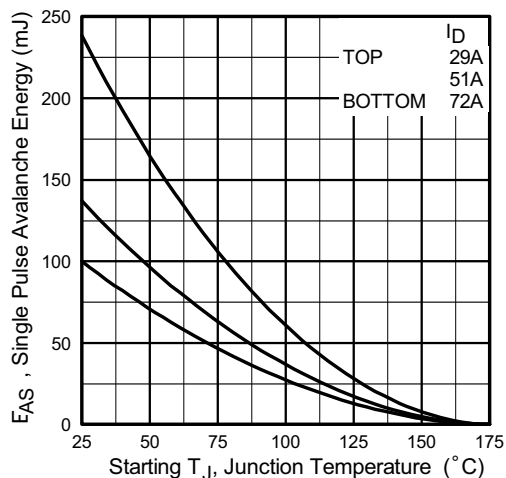
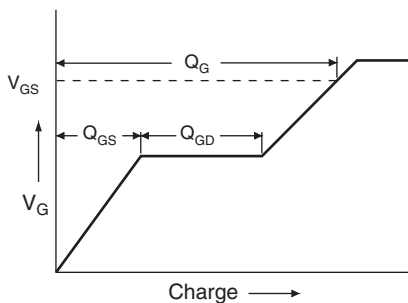
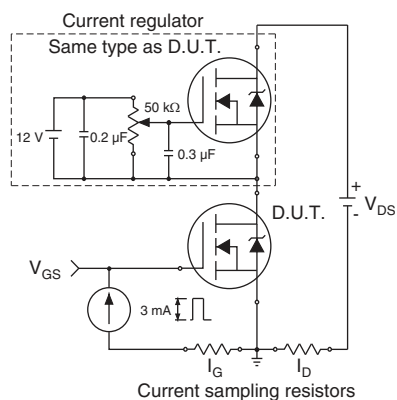
**Fig. 10a - Switching Time Test Circuit**

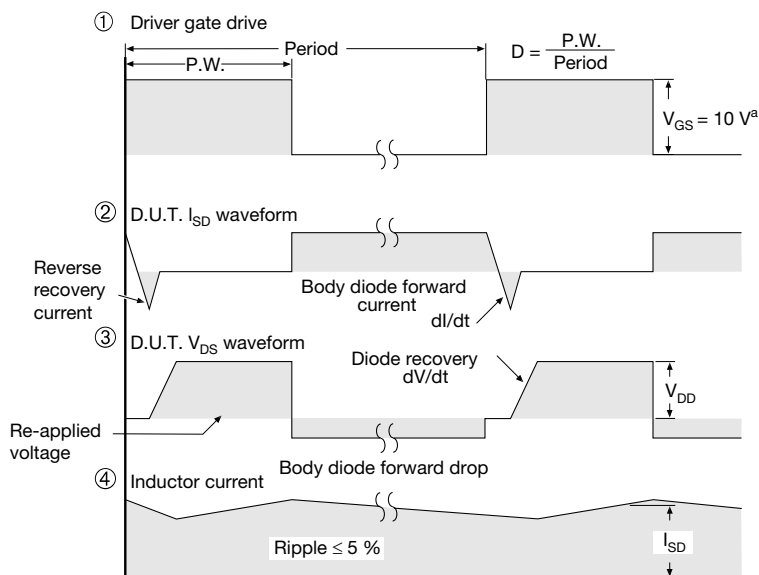
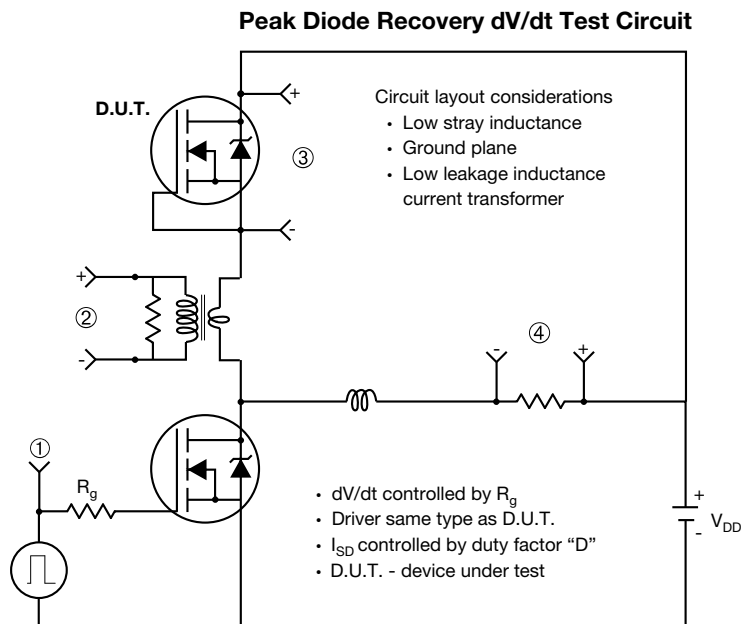


**Fig. 10b - Switching Time Waveforms**



**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**


**Note**

a.  $V_{GS} = 5 V$  for logic level devices

**Fig. 14 - For N-Channel**

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