

## Power MOSFET



N-Channel MOSFET

### FEATURES

- Dynamic dV/dt rating
- Repetitive avalanche rated
- 175 °C operating temperature
- Fast switching
- Ease of paralleling
- Simple drive requirements
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



### 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

Third generation power MOSFETs from Vishay provide the designer with the best combination of fast switching, ruggedized device design, low on-resistance and cost-effectiveness.

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.

### PRODUCT SUMMARY

$V_{DS}$ (V)	100	
$R_{DS(on)}$ ( $\Omega$ )	$V_{GS} = 10$ V	0.54
$Q_g$ max. (nC)	8.3	
$Q_{gs}$ (nC)	2.3	
$Q_{gd}$ (nC)	3.8	
Configuration	Single	

### ORDERING INFORMATION

Package	TO-220AB
Lead (Pb)-free	IRF510PbF
Lead (Pb)-free and halogen-free	IRF510PbF-BE3



### ABSOLUTE MAXIMUM RATINGS ( $T_C = 25$ °C, unless otherwise noted)

PARAMETER	SYMBOL	LIMIT	UNIT	
Drain-source voltage	$V_{DS}$	100	V	
Gate-source voltage	$V_{GS}$	$\pm 20$		
Continuous drain current	$V_{GS}$ at 10 V	$T_C = 25$ °C	A	
		$T_C = 100$ °C		
Pulsed drain current <sup>a</sup>	$I_{DM}$	20		
Linear derating factor		0.29	W/°C	
Single pulse avalanche energy <sup>b</sup>	$E_{AS}$	75	mJ	
Repetitive avalanche current <sup>a</sup>	$I_{AR}$	5.6	A	
Repetitive avalanche energy <sup>a</sup>	$E_{AR}$	4.3	mJ	
Maximum power dissipation	$T_C = 25$ °C	$P_D$	43	W
Peak diode recovery dV/dt <sup>c</sup>	dV/dt	5.5	V/ns	
Operating junction and storage temperature range	$T_J, T_{stg}$	-55 to +175	°C	
Soldering recommendations (peak temperature) <sup>d</sup>	For 10 s	300		
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)
- $V_{DD} = 25$  V, starting  $T_J = 25$  °C,  $L = 4.8$  mH,  $R_g = 25$   $\Omega$ ,  $I_{AS} = 5.6$  A (see fig. 12)
- $I_{SD} \leq 5.6$  A,  $dI/dt \leq 75$  A/ $\mu$ s,  $V_{DD} \leq V_{DS}$ ,  $T_J \leq 175$  °C
- 1.6 mm from case

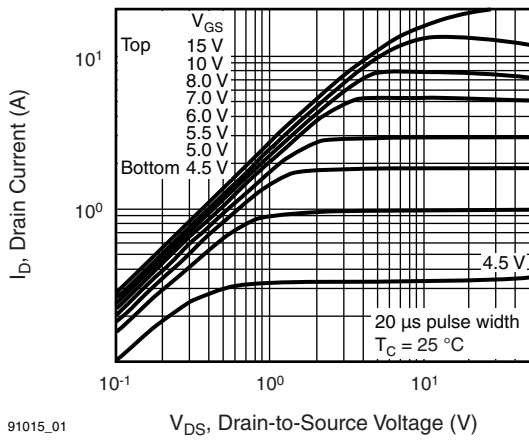
THERMAL RESISTANCE RATINGS				
PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum junction-to-ambient	$R_{thJA}$	-	62	°C/W
Case-to-sink, flat, greased surface	$R_{thCS}$	0.50	-	
Maximum junction-to-case (drain)	$R_{thJC}$	-	3.5	

SPECIFICATIONS ( $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted)						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
<b>Static</b>						
Drain-source breakdown voltage	$V_{DS}$	$V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$	100	-	-	V
$V_{DS}$ temperature coefficient	$\Delta V_{DS}/T_J$	Reference to $25\text{ }^\circ\text{C}$ , $I_D = 1\text{ mA}$	-	0.12	-	V/°C
Gate-source threshold voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$	2.0	-	4.0	V
Gate-source leakage	$I_{GSS}$	$V_{GS} = \pm 20\text{ V}$	-	-	$\pm 100$	nA
Zero gate voltage drain current	$I_{DSS}$	$V_{DS} = 100\text{ V}, V_{GS} = 0\text{ V}$	-	-	25	$\mu\text{A}$
		$V_{DS} = 80\text{ V}, V_{GS} = 0\text{ V}, T_J = 150\text{ }^\circ\text{C}$	-	-	250	
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}$   $I_D = 3.4\text{ A}^b$	-	-	0.54	$\Omega$
Forward transconductance	$g_{fs}$	$V_{DS} = 50\text{ V}, I_D = 3.4\text{ A}^b$	1.3	-	-	S
<b>Dynamic</b>						
Input capacitance	$C_{iss}$	$V_{GS} = 0\text{ V},$ $V_{DS} = 25\text{ V},$ $f = 1.0\text{ MHz}$ , see fig. 5	-	180	-	pF
Output capacitance	$C_{oss}$		-	81	-	
Reverse transfer capacitance	$C_{rfs}$		-	15	-	
Total gate charge	$Q_g$	$V_{GS} = 10\text{ V}$   $I_D = 5.6\text{ A}, V_{DS} = 80\text{ V}$ $V_{DS} = 10\text{ V},$ see fig. 6 and fig. 13 <sup>b</sup>	-	-	8.3	nC
Gate-source charge	$Q_{gs}$		-	-	2.3	
Gate-drain charge	$Q_{gd}$		-	-	3.8	
Turn-on delay time	$t_{d(on)}$	$V_{DD} = 50\text{ V}, I_D = 5.6\text{ A}$ $R_g = 24\text{ }\Omega, R_D = 8.4\text{ }\Omega$ , see fig. 10 <sup>b</sup>	-	6.9	-	ns
Rise time	$t_r$		-	16	-	
Turn-off delay time	$t_{d(off)}$		-	15	-	
Fall time	$t_f$		-	9.4	-	
Gate input resistance	$R_g$	$f = 1\text{ MHz}$ , open drain	2.5	-	11.6	$\Omega$
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	-	
<b>Drain-Source Body Diode Characteristics</b>						
Continuous source-drain diode current	$I_S$	MOSFET symbol showing the integral reverse p - n junction diode 	-	-	5.6	A
Pulsed diode forward current <sup>a</sup>	$I_{SM}$		-	-	20	
Body diode voltage	$V_{SD}$	$T_J = 25\text{ }^\circ\text{C}, I_S = 5.6\text{ A}, V_{GS} = 0\text{ V}^b$	-	-	2.5	V
Body diode reverse recovery time	$t_{rr}$	$T_J = 25\text{ }^\circ\text{C}, I_F = 5.6\text{ A}, dI/dt = 100\text{ A}/\mu\text{s}^b$	-	100	200	ns
Body diode reverse recovery charge	$Q_{rr}$		-	0.44	0.88	$\mu\text{C}$
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  $\leq 2\%$

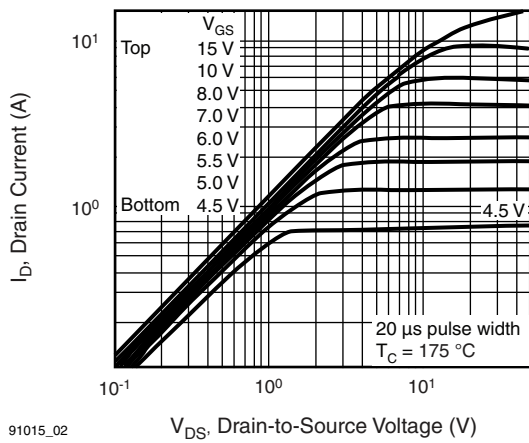
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



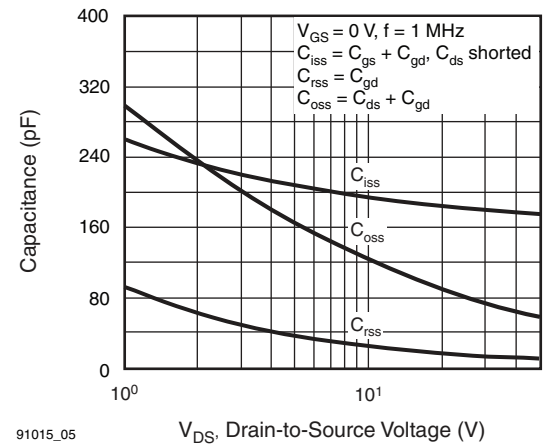
**Fig. 1 - Typical Output Characteristics,  $T_C = 25\text{ }^\circ\text{C}$**



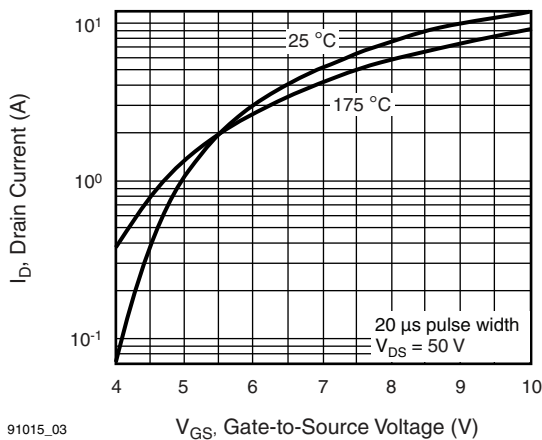
**Fig. 4 - Normalized On-Resistance vs. Temperature**



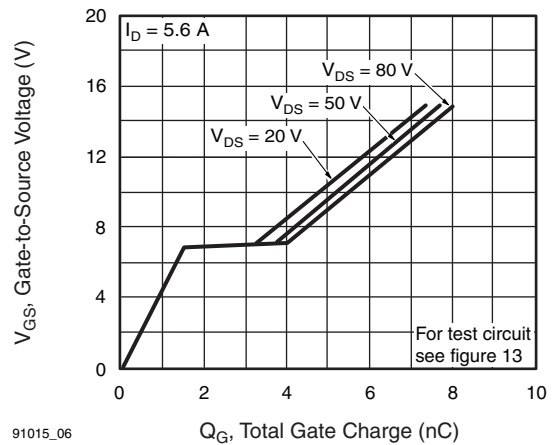
**Fig. 2 - Typical Output Characteristics,  $T_C = 175\text{ }^\circ\text{C}$**



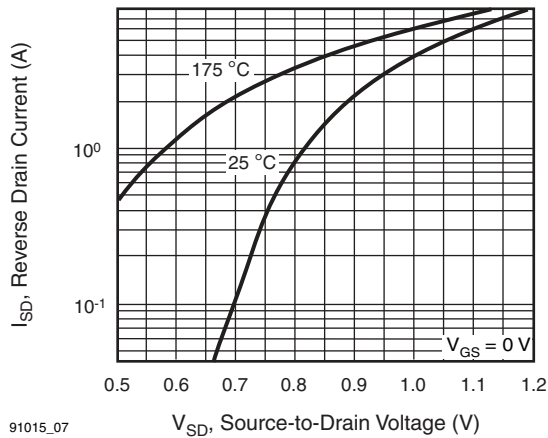
**Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage**



**Fig. 3 - Typical Transfer Characteristics**

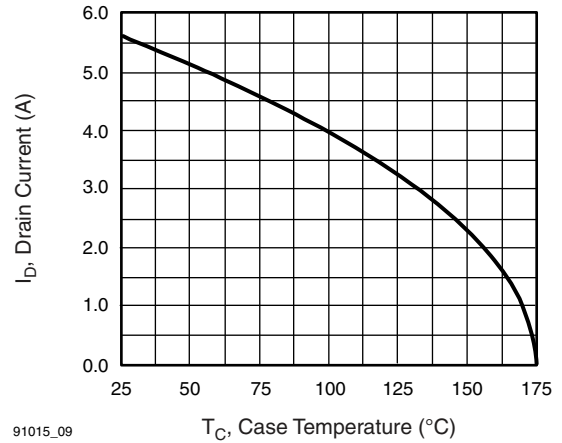


**Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage**



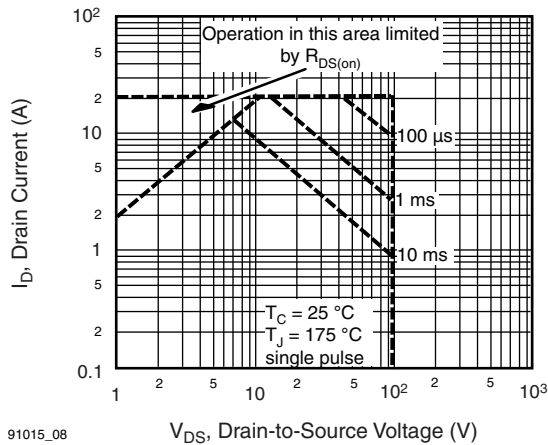
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Fig. 7 - Typical Source-Drain Diode Forward Voltage



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Fig. 9 - Maximum Drain Current vs. Case Temperature



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Fig. 8 - Maximum Safe Operating Area

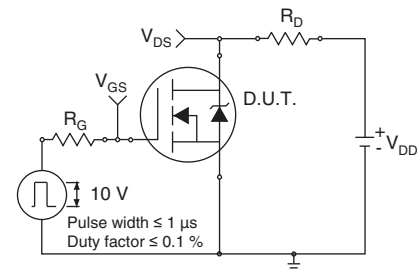


Fig. 10a - Switching Time Test Circuit

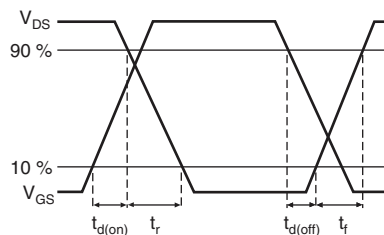
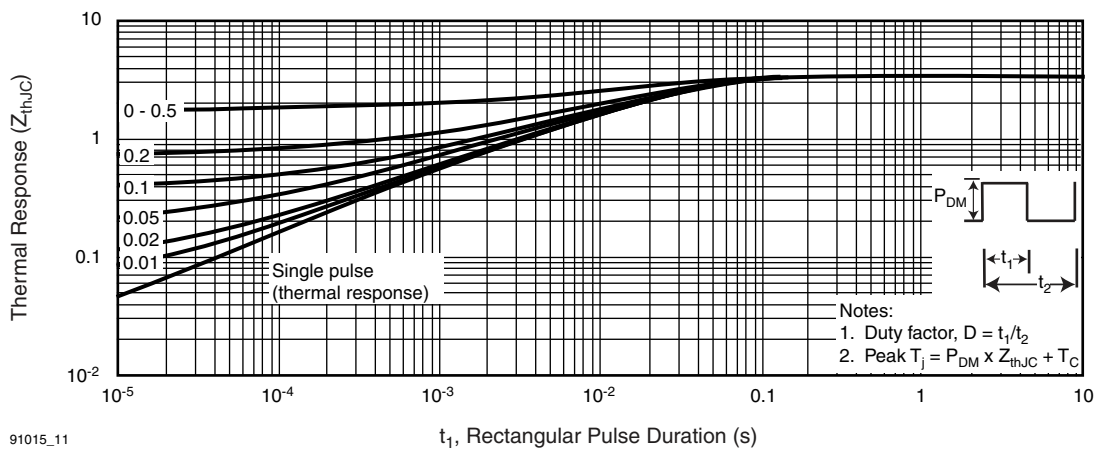


Fig. 10b - Switching Time Waveforms



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

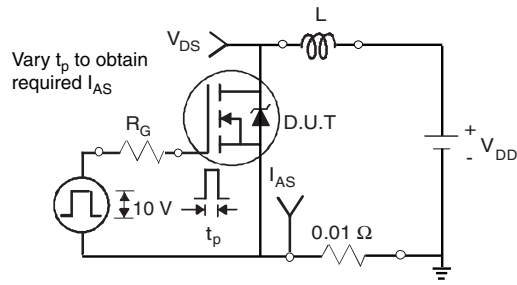


Fig. 12a - Unclamped Inductive Test Circuit



Fig. 13a - Basic Gate Charge Waveform



Fig. 12b - Unclamped Inductive Waveforms

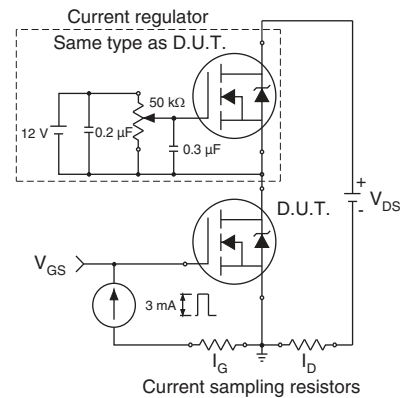


Fig. 13b - Gate Charge Test Circuit

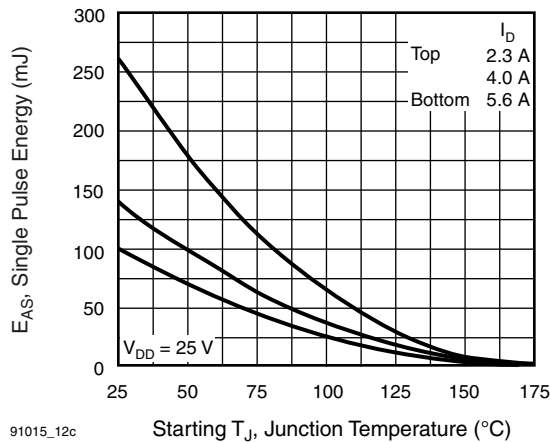
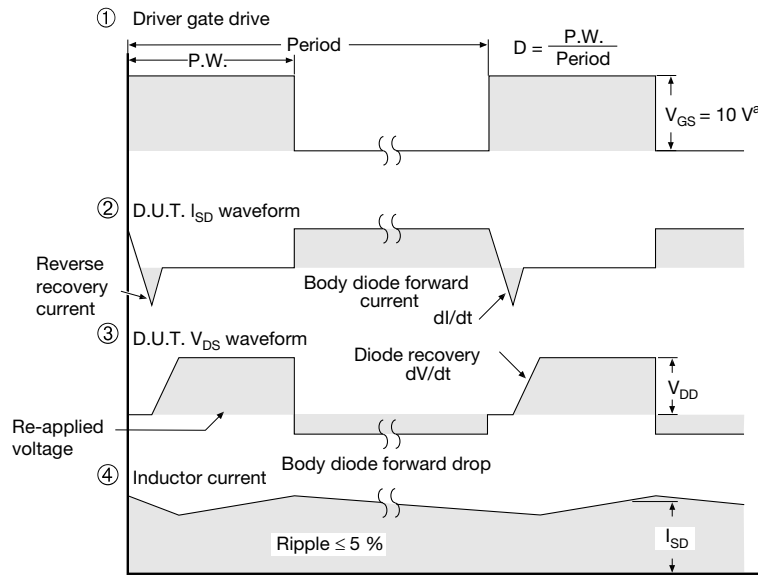
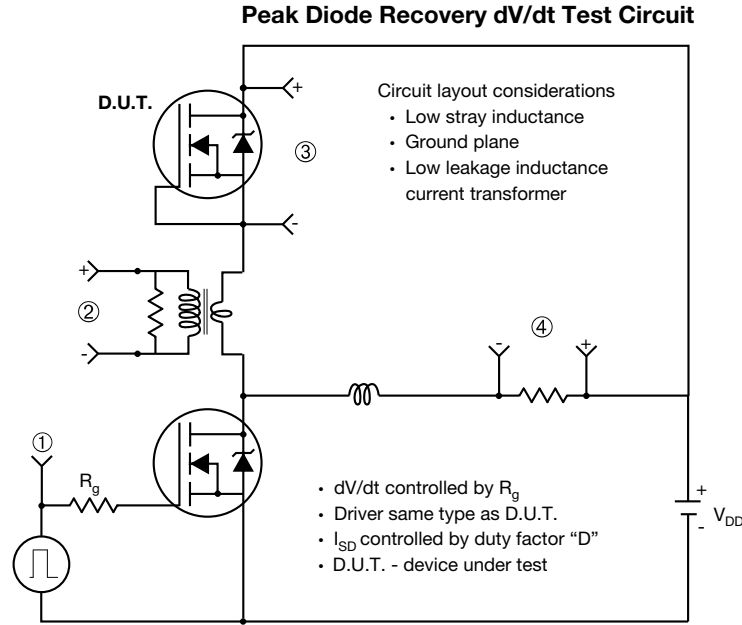


Fig. 12c - Maximum Avalanche Energy vs. Drain Current



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

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

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