

# Power MOSFET

**TO-220AB**


N-Channel MOSFET

## FEATURES

- Dynamic dV/dt rating
- Repetitive avalanche rated
- 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)



**RoHS\***  
Available  
**HALOGEN**  
**FREE**  
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

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)	200	
$R_{DS(on)}$ ( $\Omega$ )	$V_{GS} = 10\text{ V}$	1.5
$Q_g$ max. (nC)	8.2	
$Q_{gs}$ (nC)	1.8	
$Q_{gd}$ (nC)	4.5	
Configuration	Single	

## ORDERING INFORMATION

Package	TO-220AB
Lead (Pb)-free	IRF610PbF
Lead (Pb)-free and halogen-free	IRF610PbF-BE3

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

PARAMETER				SYMBOL	LIMIT	UNIT
Drain-source voltage				V <sub>DS</sub>	200	V
Gate-source voltage				V <sub>GS</sub>	± 20	
Continuous drain current	V <sub>GS</sub> at 10 V	T <sub>C</sub> = 25 °C	I <sub>D</sub>	3.3	A	
		T <sub>C</sub> = 100 °C		2.1		
Pulsed drain current <sup>a</sup>				I <sub>DM</sub>	10	
Linear derating factor					0.29	W/°C
Single pulse avalanche energy <sup>b</sup>				E <sub>AS</sub>	64	mJ
Repetitive avalanche current <sup>a</sup>				I <sub>AR</sub>	3.3	A
Repetitive avalanche energy <sup>a</sup>				E <sub>AR</sub>	3.6	mJ
Maximum power dissipation		T <sub>C</sub> = 25 °C		P <sub>D</sub>	36	W
Peak diode recovery dV/dt <sup>c</sup>				dV/dt	5.0	V/ns
Operating junction and storage temperature range				T <sub>J</sub> , T <sub>stg</sub>	-55 to +150	°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

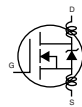

## Notes

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11)
- $V_{DD} = 50\text{ V}$ , starting  $T_J = 25\text{ }^\circ\text{C}$ ,  $L = 8.8\text{ mH}$ ,  $R_g = 25\text{ }\Omega$ ,  $I_{AS} = 3.3\text{ A}$  (see fig. 12)
- $I_{SD} \leq 3.3\text{ A}$ ,  $dI/dt \leq 70\text{ A}/\mu\text{s}$ ,  $V_{DD} \leq V_{DS}$ ,  $T_J \leq 150\text{ }^\circ\text{C}$
- 1.6 mm from case

**THERMAL RESISTANCE RATINGS**

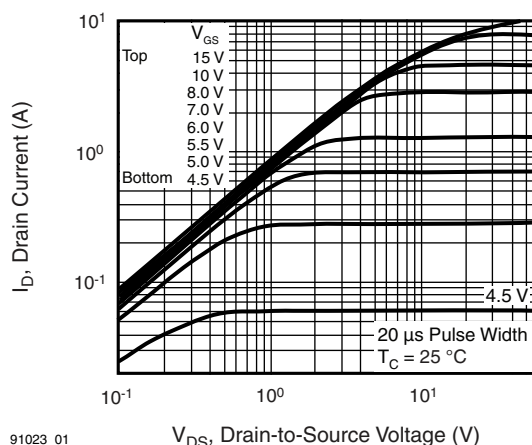
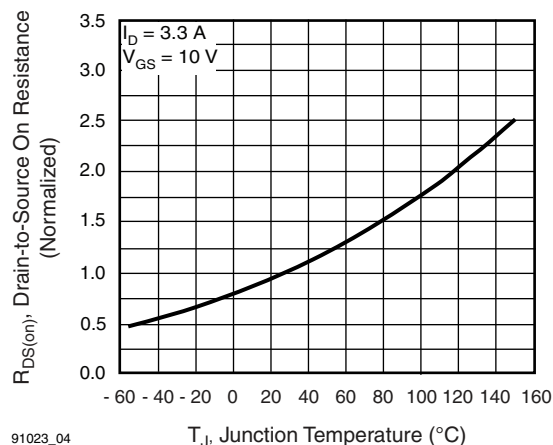
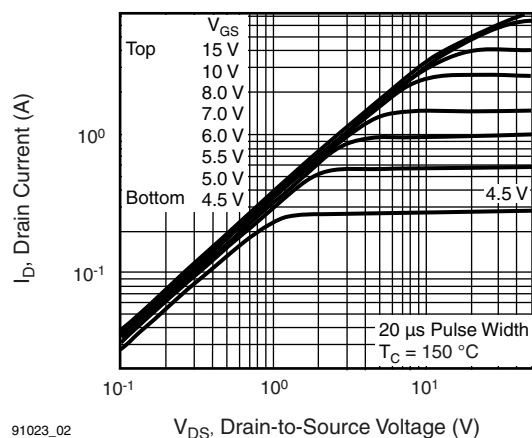
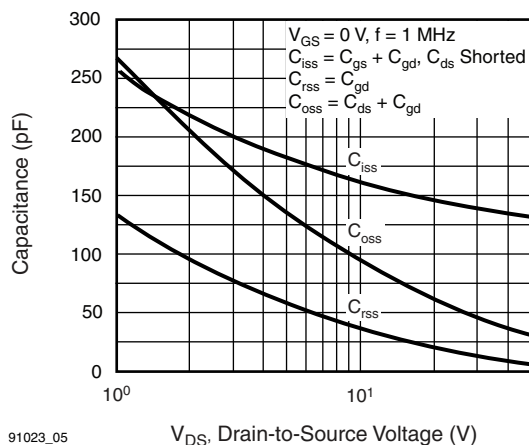
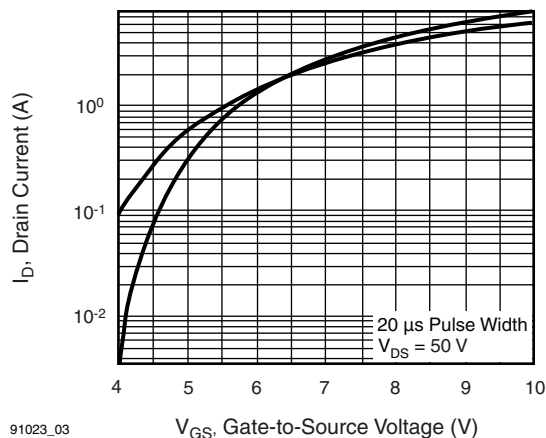
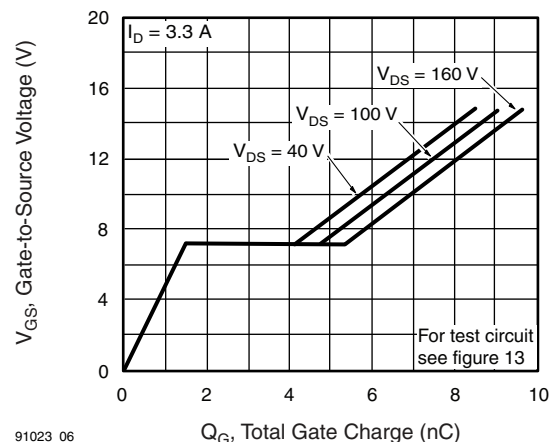
PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum junction-to-ambient	$R_{thJA}$	-	62	°C/W
Case-to-sink, flat, greased surface	$R_{thCS}$	0.50	-	
Maximum junction-to-case (drain)	$R_{thJC}$	-	3.5	

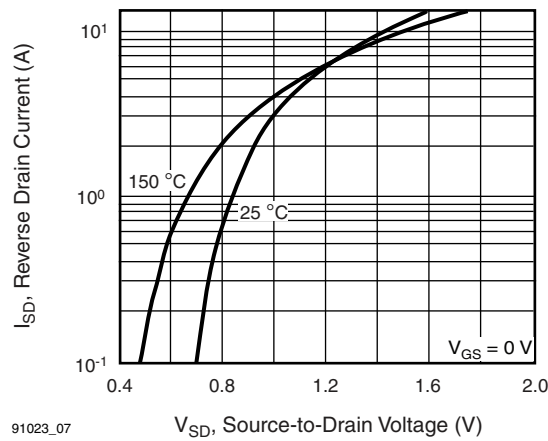
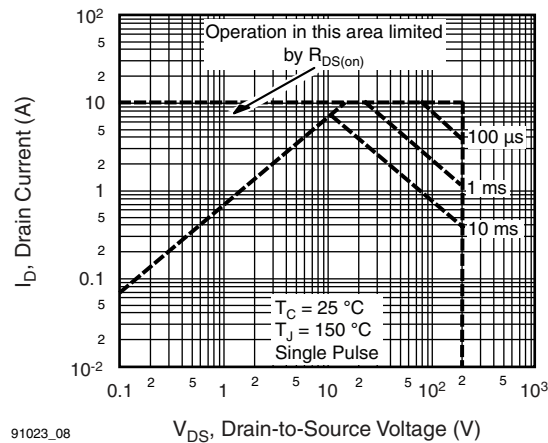
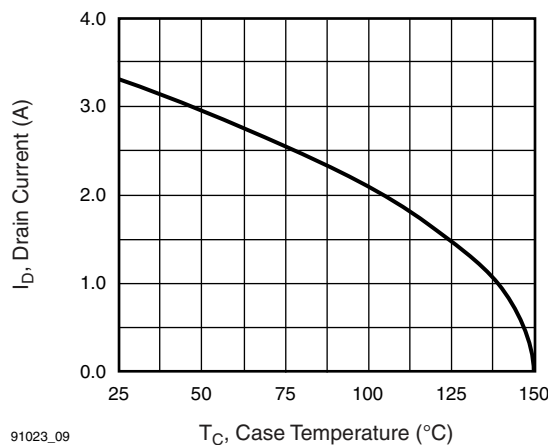
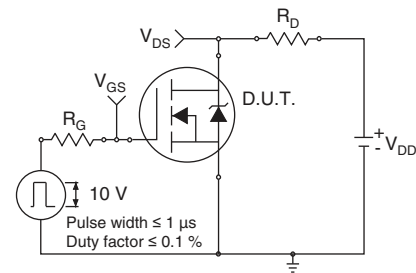
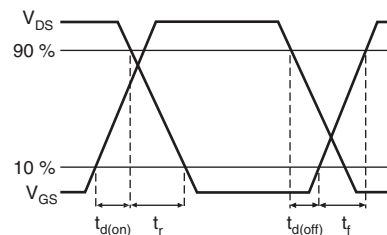
**SPECIFICATIONS** ( $T_J = 25\text{ }^{\circ}\text{C}$ , unless otherwise noted)

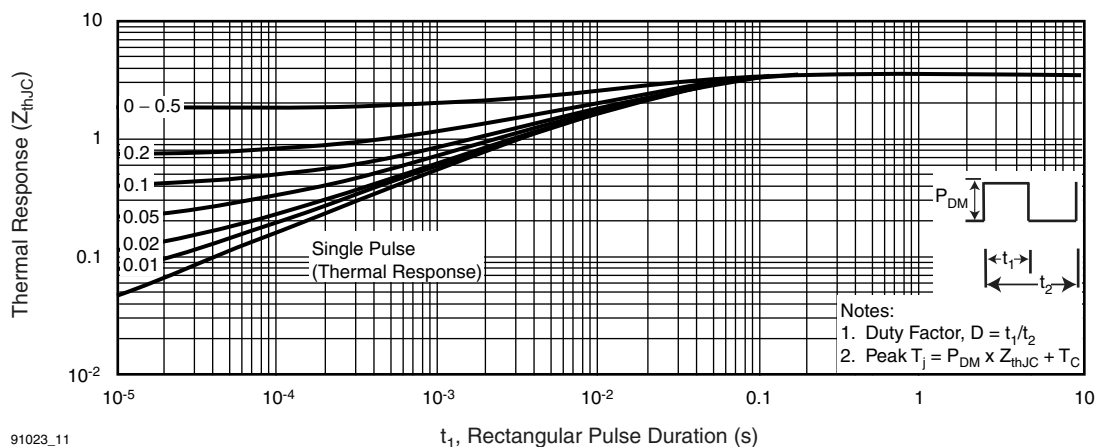
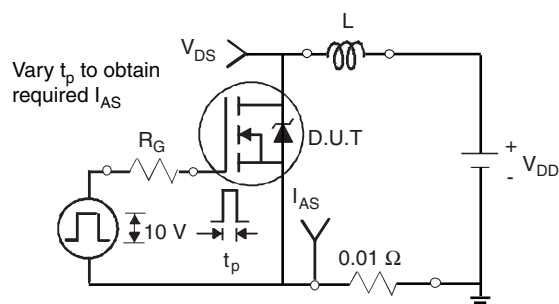
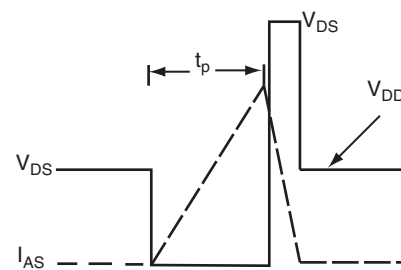
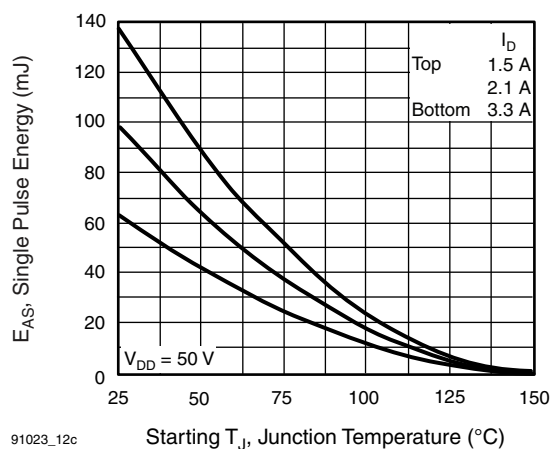
PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
Static							
Drain-source breakdown voltage	$V_{DS}$	$V_{GS} = 0\text{ V}$ , $I_D = 250\text{ }\mu\text{A}$		200	-	-	V
$V_{DS}$ temperature coefficient	$\Delta V_{DS}/T_J$	Reference to $25\text{ }^\circ\text{C}$ , $I_D = 1\text{ mA}$		-	0.30	-	V/ $^\circ\text{C}$
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	$I_{DSS}$	$V_{DS} = 200\text{ V}$ , $V_{GS} = 0\text{ V}$		-	-	25	$\mu\text{A}$
		$V_{DS} = 160\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_J = 125\text{ }^\circ\text{C}$		-	-	250	
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}$	$I_D = 2.0\text{ A}^b$	-	-	1.5	$\Omega$
Forward transconductance	$g_{fs}$	$V_{DS} = 50\text{ V}$ , $I_D = 2.0\text{ A}^b$		0.8	-	-	S
Dynamic							
Input capacitance	$C_{iss}$	$V_{GS} = 0\text{ V}$ , $V_{DS} = 25\text{ V}$ , $f = 1.0\text{ MHz}$ , see fig. 5		-	140	-	pF
Output capacitance	$C_{oss}$			-	53	-	
Reverse transfer capacitance	$C_{rss}$			-	15	-	
Total gate charge	$Q_g$	$V_{GS} = 10\text{ V}$	$I_D = 3.3\text{ A}$ , $V_{DS} = 160\text{ V}$ , see fig. 6 and 13 <sup>b</sup>	-	-	8.2	nC
Gate-source charge	$Q_{gs}$			-	-	1.8	
Gate-drain charge	$Q_{gd}$			-	-	4.5	
Turn-on delay time	$t_{d(on)}$	$V_{DD} = 100\text{ V}$ , $I_D = 3.3\text{ A}$ , $R_g = 24\text{ }\Omega$ , $R_D = 30\text{ }\Omega$ , see fig. 10 <sup>b</sup>		-	8.2	-	ns
Rise time	$t_r$			-	17	-	
Turn-off delay time	$t_{d(off)}$			-	14	-	
Fall time	$t_f$			-	8.9	-	
Gate input resistance	$R_g$	f = 1 MHz, open drain		2.3	-	10.2	$\Omega$
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	-	
Drain-Source Body Diode Characteristics							
Continuous source-drain diode current	$I_S$	MOSFET symbol showing the integral reverse p - n junction diode 		-	-	3.3	A
Pulsed diode forward current <sup>a</sup>	$I_{SM}$			-	-	10	
Body diode voltage	$V_{SD}$	$T_J = 25\text{ }^\circ\text{C}$ , $I_S = 3.3\text{ A}$ , $V_{GS} = 0\text{ V}^b$		-	-	2.0	V
Body diode reverse recovery time	$t_{rr}$	$T_J = 25\text{ }^\circ\text{C}$ , $I_F = 3.3\text{ A}$ , $dI/dt = 100\text{ A}/\mu\text{s}^b$		-	150	310	ns
Body diode reverse recovery charge	$Q_{rr}$			-	0.60	1.4	$\mu\text{C}$
Forward turn-on time	$t_{on}$	Intrinsic turn-on time is negligible (turn-on is dominated by $L_S$ and $L_D$ )					

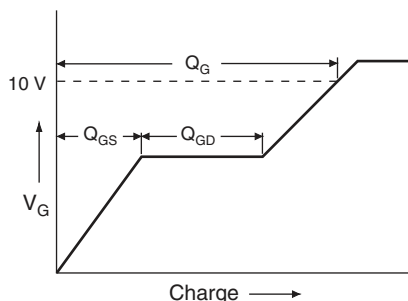
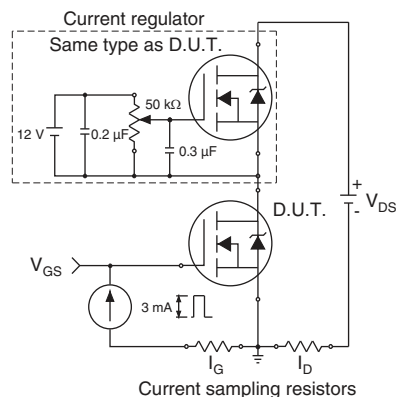
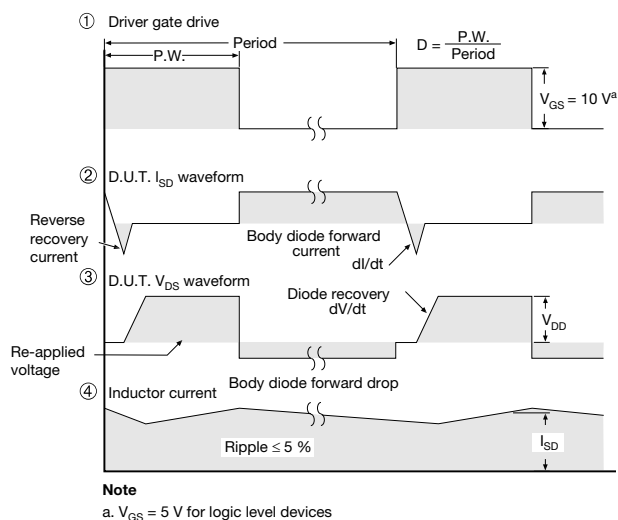
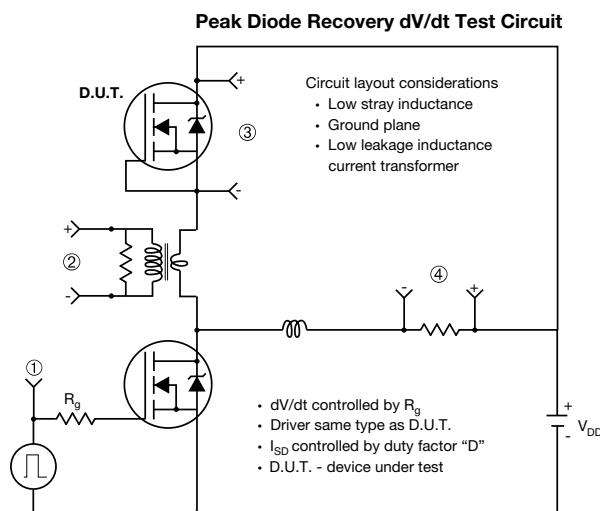
**Notes**

- 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,  $T_C = 25^\circ\text{C}$** 

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

**Fig. 2 - Typical Output Characteristics,  $T_C = 150^\circ\text{C}$** 

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

**Fig. 3 - Typical Transfer Characteristics**

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


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

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

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