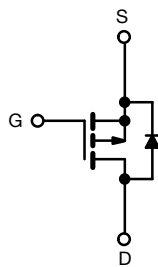
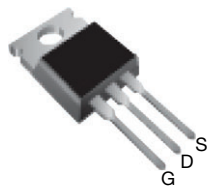


Power MOSFET

TO-220AB


P-Channel MOSFET

FEATURES

- Dynamic dV/dt rating
- Repetitive avalanche rated
- P-channel
- 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


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

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)	-60	
R _{DS(on)} (Ω)	V _{GS} = -10 V	0.50
Q _g max. (nC)	12	
Q _{gs} (nC)	3.8	
Q _{gd} (nC)	5.1	
Configuration	Single	

ORDERING INFORMATION

Package	TO-220AB
Lead (Pb)-free	IRF9Z14PbF
Lead (Pb)-free and halogen-free	IRF9Z14PbF-BE3

ABSOLUTE MAXIMUM RATINGS (T_C = 25 °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	A
		T _C = 100 °C	
Pulsed drain current ^a	I _{DM}	-27	
Linear derating factor		0.29	W/°C
Single pulse avalanche energy ^b	E _{AS}	140	mJ
Repetitive avalanche current ^a	I _{AR}	-6.7	A
Repetitive avalanche energy ^a	E _{AR}	4.3	mJ
Maximum power dissipation	P _D	43	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) ^d	For 10 s	300	
Mounting torque	6-32 or M3 screw	10 1.1	

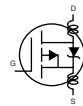
Notes

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11)
- V_{DD} = -25 V, starting T_J = 25 °C, L = 3.6 mH, R_g = 25 Ω, I_{AS} = -6.7 A (see fig. 12)
- I_{SD} ≤ -6.7 A, dI/dt ≤ 90 A/μs, V_{DD} ≤ V_{DS}, T_J ≤ 175 °C
- 1.6 mm from case

THERMAL RESISTANCE RATINGS

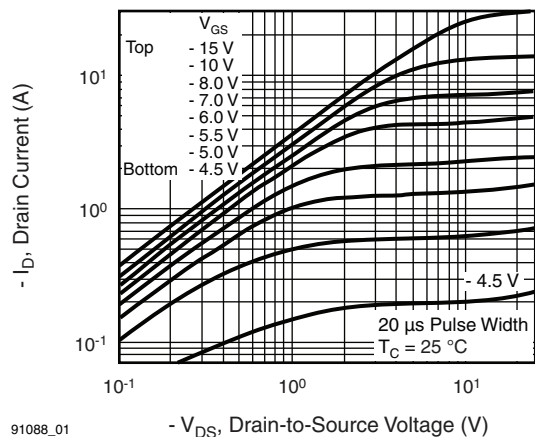
PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum junction-to-ambient	R_{thJA}	-	62	°C/W
Case-to-sink, flat, greased surface	R_{thCS}	0.50	-	
Maximum junction-to-case (drain)	R_{thJC}	-	3.5	

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

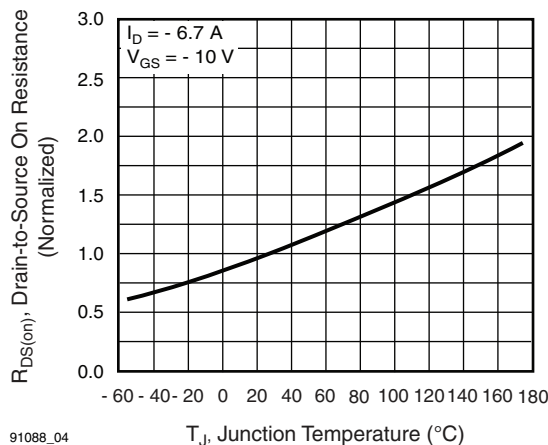
PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
Static							
Drain-source breakdown voltage	V_{DS}	$V_{GS} = 0\text{ V}$, $I_D = -250\text{ }\mu\text{A}$		-60	-	-	V
V_{DS} temperature coefficient	$\Delta V_{DS}/T_J$	Reference to $25\text{ }^{\circ}\text{C}$, $I_D = -1\text{ mA}$		-	-0.060	-	V/ $^{\circ}\text{C}$
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}	$V_{GS} = \pm 20\text{ V}$		-	-	± 100	nA
Zero gate voltage drain current	I_{DSS}	$V_{DS} = -60\text{ V}$, $V_{GS} = 0\text{ V}$		-	-	-100	μA
		$V_{DS} = -48\text{ V}$, $V_{GS} = 0\text{ V}$, $T_J = 150\text{ }^{\circ}\text{C}$		-	-	-500	
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS} = -10\text{ V}$	$I_D = -4.0\text{ A}^b$	-	-	0.50	Ω
Forward transconductance	g_{fs}	$V_{DS} = -25\text{ V}$, $I_D = -4.0\text{ A}^b$		1.4	-	-	S
Dynamic							
Input capacitance	C_{iss}	$V_{GS} = 0\text{ V}$, $V_{DS} = -25\text{ V}$, $f = 1.0\text{ MHz}$, see fig. 5		-	270	-	pF
Output capacitance	C_{oss}			-	170	-	
Reverse transfer capacitance	C_{rss}			-	31	-	
Total gate charge	Q_g	$V_{GS} = -10\text{ V}$	$I_D = -6.7\text{ A}$, $V_{DS} = -48\text{ V}$, see fig. 6 and 13 ^b	-	-	12	nC
Gate-source charge	Q_{gs}			-	-	3.8	
Gate-drain charge	Q_{gd}			-	-	5.1	
Turn-on delay time	$t_{d(on)}$	$V_{DD} = -30\text{ V}$, $I_D = -6.7\text{ A}$, $R_g = 24\text{ }\Omega$, $R_D = 4.0\text{ }\Omega$, see fig. 10 ^b		-	11	-	ns
Rise time	t_r			-	63	-	
Turn-off delay time	$t_{d(off)}$			-	10	-	
Fall time	t_f			-	31	-	
Gate input resistance	R_g	$f = 1\text{ MHz}$, open drain		1.4	-	8.7	Ω
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 		-	-	-6.7	A
Pulsed diode forward current ^a	I_{SM}			-	-	-27	
Body diode voltage	V_{SD}	$T_J = 25\text{ }^{\circ}\text{C}$, $I_S = -6.7\text{ A}$, $V_{GS} = 0\text{ V}^b$		-	-	-5.5	V
Body diode reverse recovery time	t_{rr}	$T_J = 25\text{ }^{\circ}\text{C}$, $I_F = -6.7\text{ A}$, $dI/dt = 100\text{ A}/\mu\text{s}^b$		-	80	160	ns
Body diode reverse recovery charge	Q_{rr}			-	0.096	0.19	μC
Forward turn-on time	t_{on}	Intrinsic turn-on time is negligible (turn-on is dominated by L_S and L_D)					

Notes

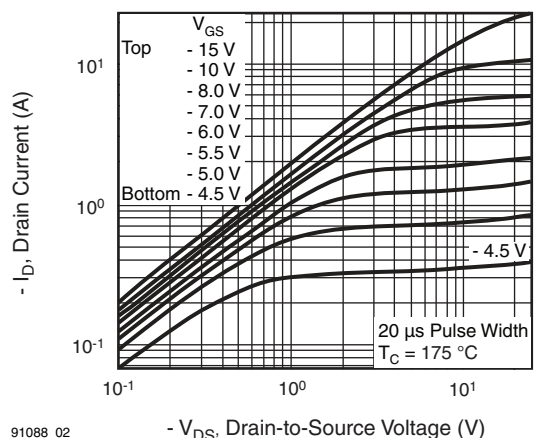
- a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11)
b. Pulse width $\leq 300\text{ }\mu\text{s}$; duty cycle $\leq 2\%$

TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)


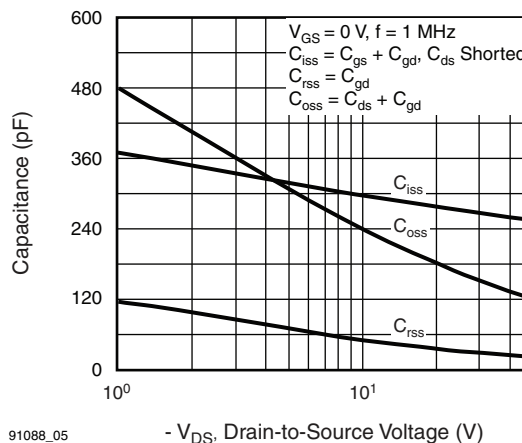
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Fig. 1 - Typical Output Characteristics, $T_C = 25^\circ\text{C}$


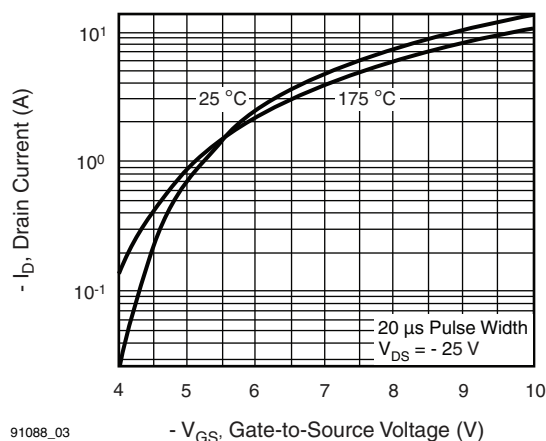
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Fig. 4 - Normalized On-Resistance vs. Temperature


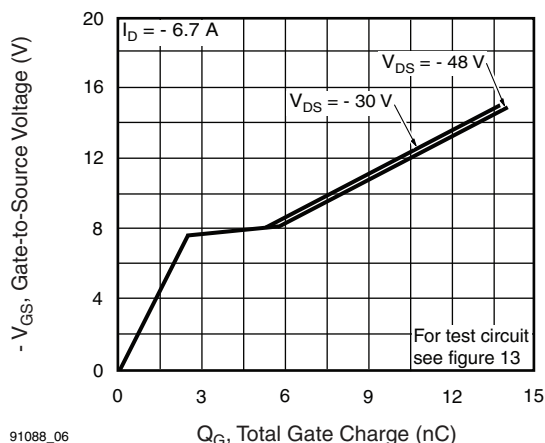
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Fig. 2 - Typical Output Characteristics, $T_C = 175^\circ\text{C}$


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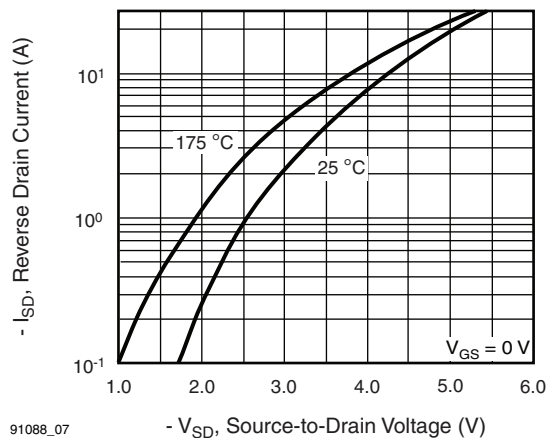
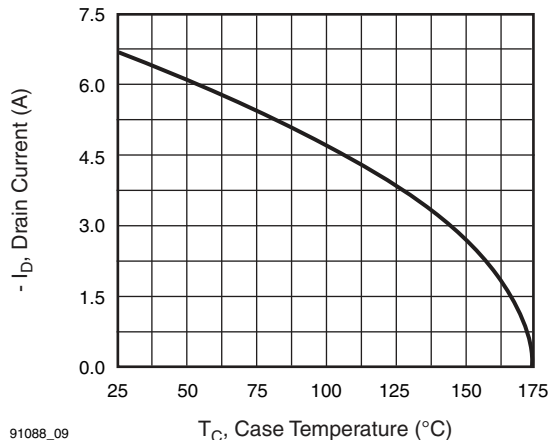
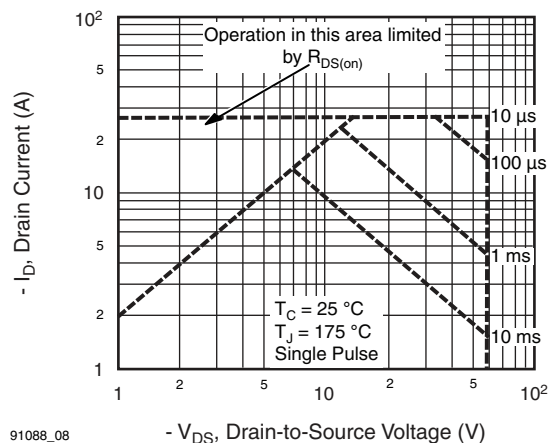
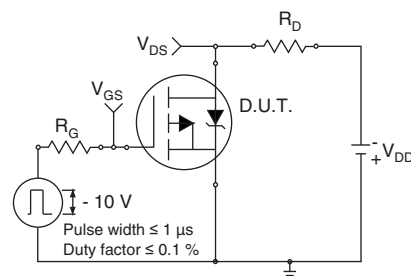
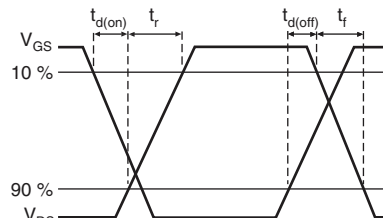
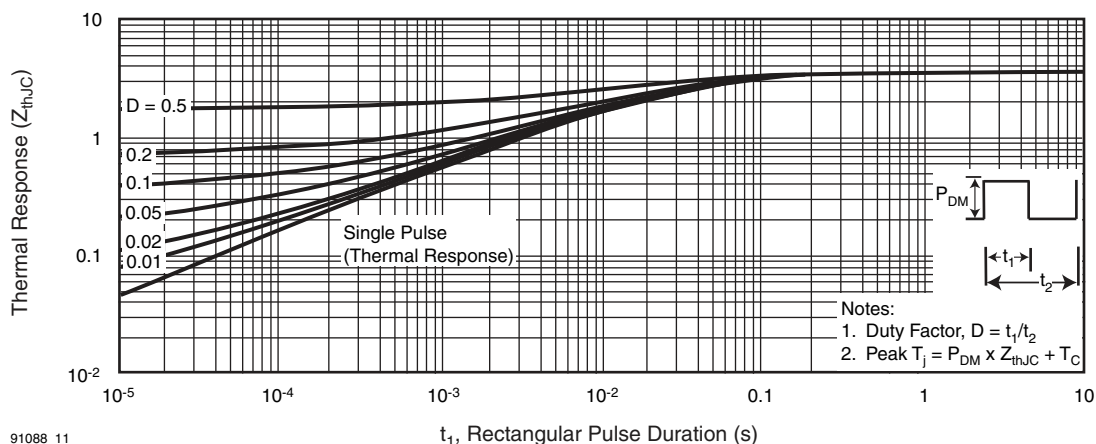
Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage


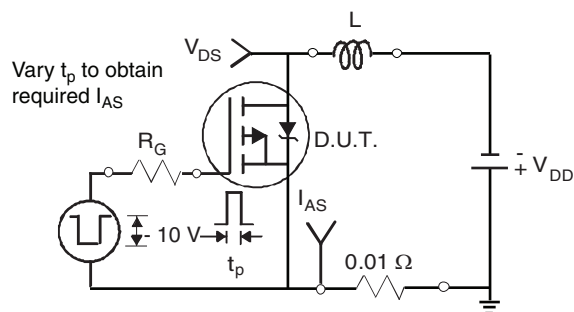
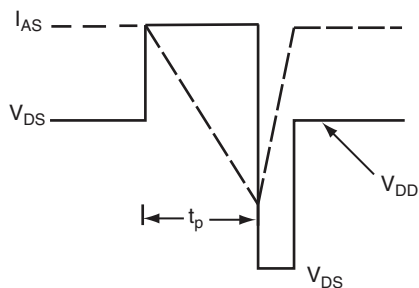
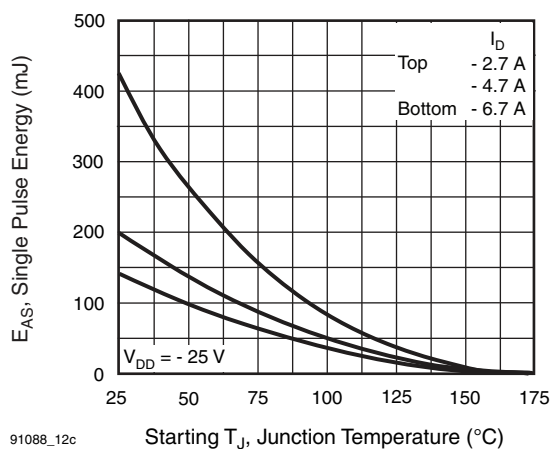
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Fig. 3 - Typical Transfer Characteristics


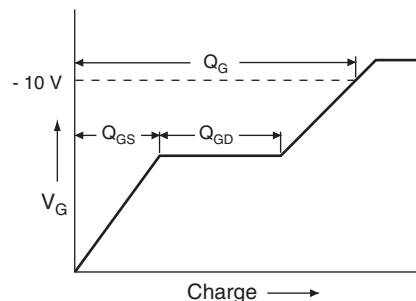
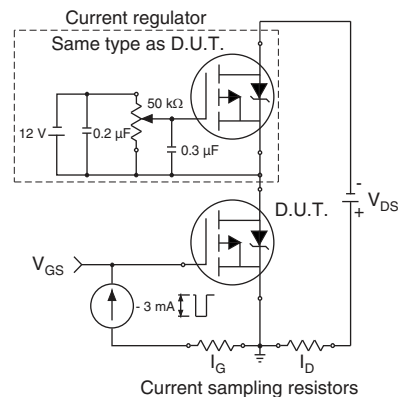
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Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage


Fig. 7 - Typical Source-Drain Diode Forward Voltage

Fig. 9 - Maximum Drain Current vs. Case Temperature

Fig. 8 - Maximum Safe Operating Area

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


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

Fig. 13a - Basic Gate Charge Waveform

Fig. 13b - Gate Charge Test Circuit

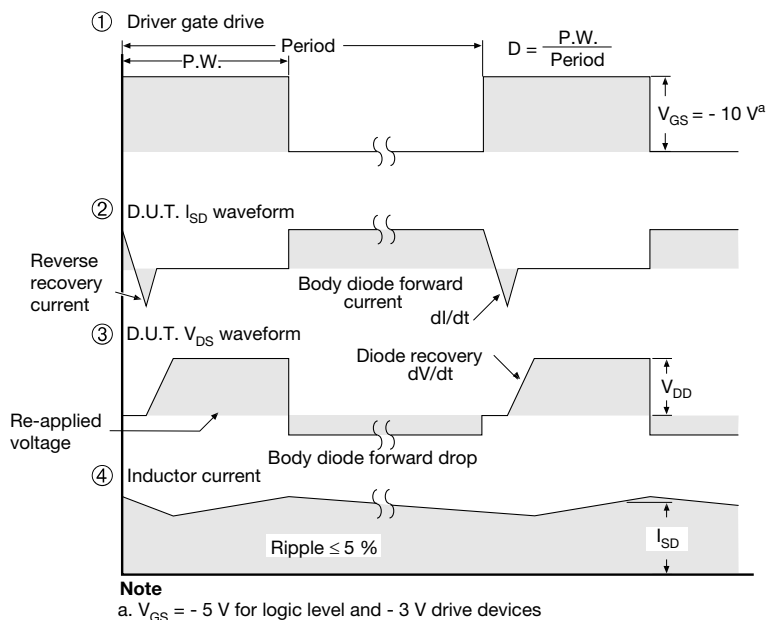
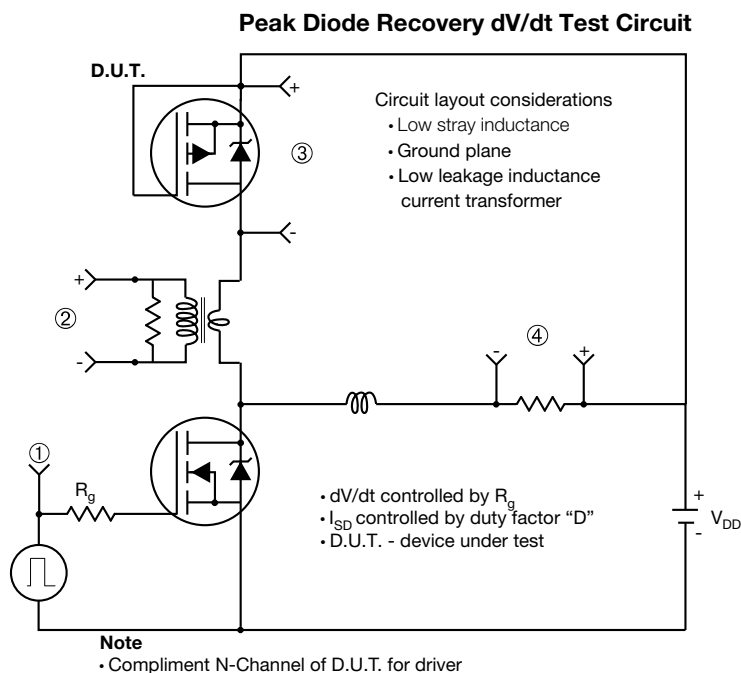


Fig. 14 - For P-Channel

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