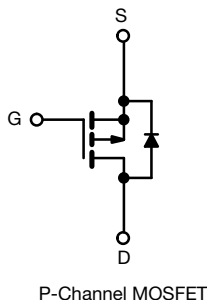
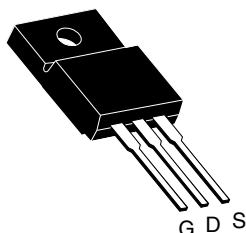


## Power MOSFET

### PRODUCT SUMMARY

V <sub>DS</sub> (V)	-60	
R <sub>DS(on)</sub> (Ω)	V <sub>GS</sub> = -10 V	0.14
Q <sub>g</sub> max. (nC)	34	
Q <sub>gs</sub> (nC)	9.9	
Q <sub>gd</sub> (nC)	16	
Configuration	Single	

### TO-220 FULLPAK



### FEATURES

- Isolated package
- High voltage isolation = 2.5 kV<sub>RMS</sub> (t = 60 s; f = 60 Hz)
- Sink to lead creepage distance = 4.8 mm
- P-channel
- 175 °C operating temperature
- Dynamic dV/dt rating
- Low thermal resistance
- 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

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-220 FULLPAK eliminates the need for additional insulating hardware in commercial-industrial applications. The molding compound used provides a high isolation capability and a low thermal resistance between the tab and external heatsink. This isolation is equivalent to using a 100 micron mica barrier with standard TO-220 product. The FULLPAK is mounted to a heatsink using a single clip or by a single screw fixing.

### ORDERING INFORMATION

Package	TO-220 FULLPAK
Lead (Pb)-free	IRFI9Z34GPbF SiHFI9Z34G-E3
SnPb	IRFI9Z34G SiHFI9Z34G

### ABSOLUTE MAXIMUM RATINGS (T<sub>C</sub> = 25 °C, unless otherwise noted)

PARAMETER	SYMBOL	LIMIT	UNIT
Drain-Source Voltage	V <sub>DS</sub>	-60	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	A
		T <sub>C</sub> = 100 °C	
Pulsed Drain Current <sup>a</sup>	I <sub>DM</sub>	-48	
Linear Derating Factor		0.28	W/°C
Single Pulse Avalanche Energy <sup>b</sup>	E <sub>AS</sub>	370	mJ
Repetitive Avalanche Current <sup>a</sup>	I <sub>AR</sub>	-12	A
Repetitive Avalanche Energy <sup>a</sup>	E <sub>AR</sub>	4.2	mJ
Maximum Power Dissipation	P <sub>D</sub>	42	W
Peak Diode Recovery dV/dt <sup>c</sup>	dV/dt	-4.5	V/ns
Operating Junction and Storage Temperature Range	T <sub>J</sub> , T <sub>stg</sub>	-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

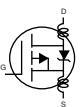

### Notes

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- V<sub>DD</sub> = -25 V, starting T<sub>J</sub> = 25 °C, L = 3.0 mH, R<sub>G</sub> = 25 Ω, I<sub>AS</sub> = -12 A (see fig. 12).
- I<sub>SD</sub> ≤ -12 A, dI/dt ≤ 170 A/μs, V<sub>DD</sub> ≤ V<sub>DS</sub>, T<sub>J</sub> ≤ 175 °C.
- 1.6 mm from case.

**THERMAL RESISTANCE RATINGS**

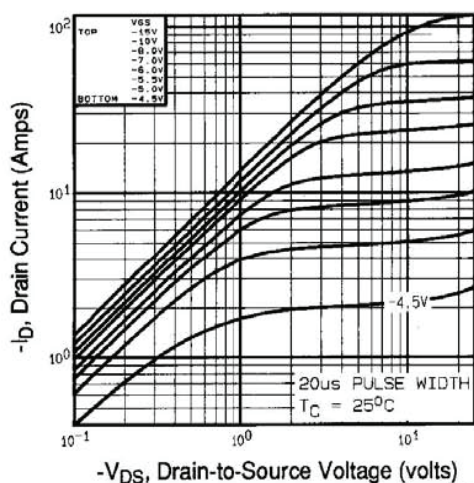
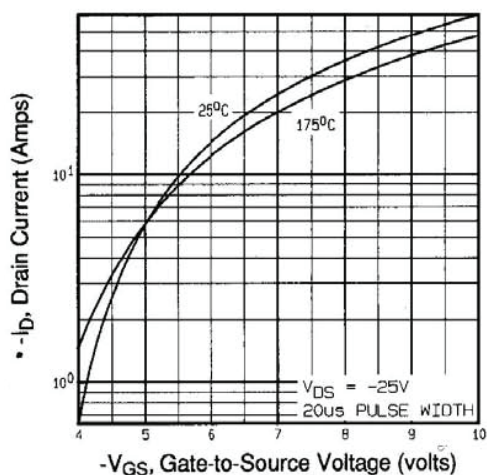
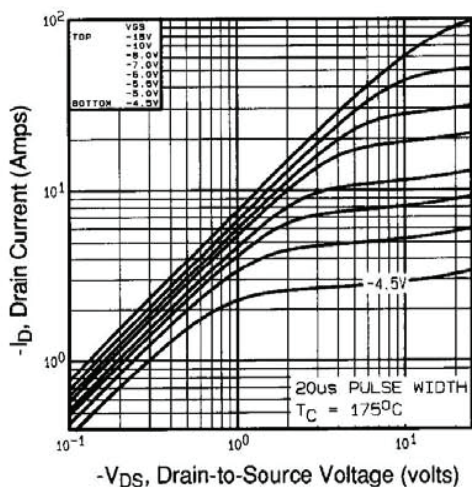
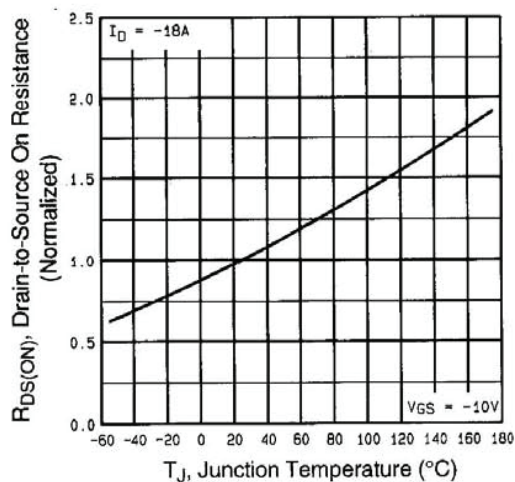
PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum Junction-to-Ambient	$R_{thJA}$	-	65	°C/W
Maximum Junction-to-Case (Drain)	$R_{thJC}$	-	3.6	

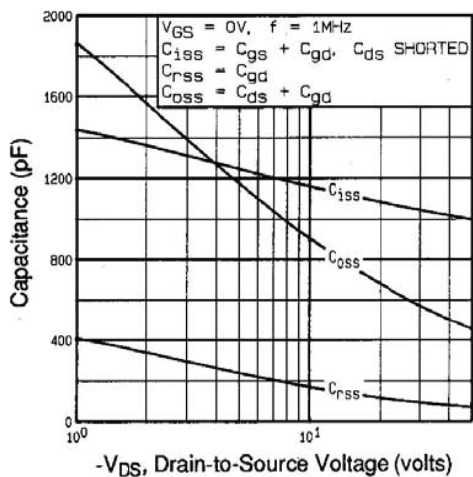
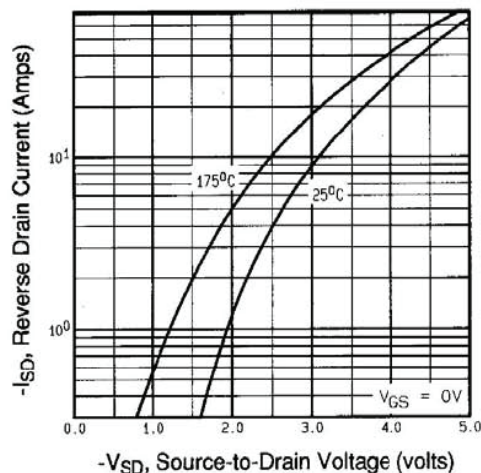
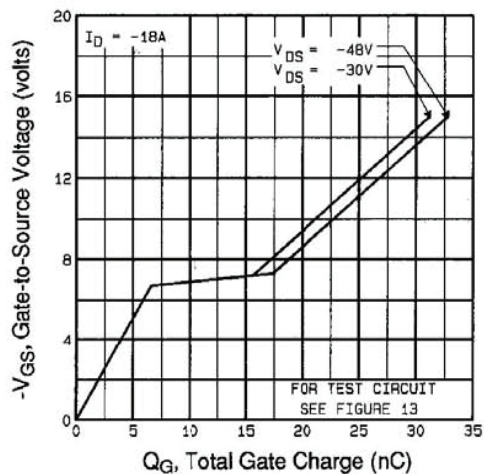
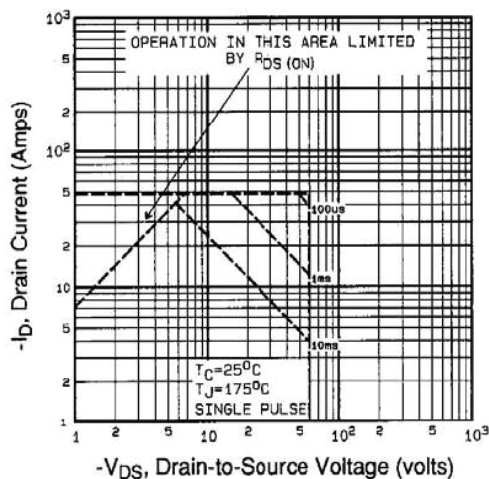
**SPECIFICATIONS** ( $T_J = 25\text{ }^{\circ}\text{C}$ , unless otherwise noted)

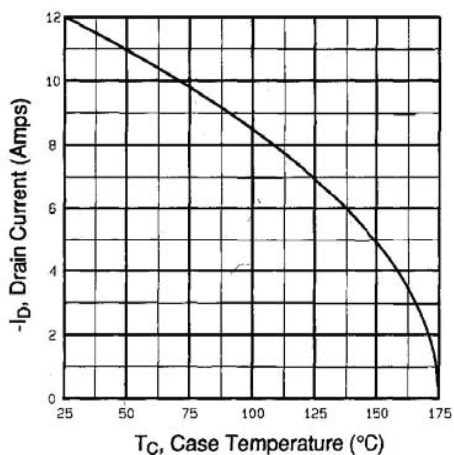
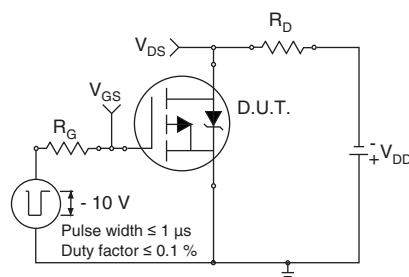
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
<b>Static</b>						
Drain-Source Breakdown Voltage	$V_{DS}$	$V_{GS} = 0\text{ V}$ , $I_D = 250\text{ }\mu\text{A}$	-60	-	-	V
$V_{DS}$ Temperature Coefficient	$\Delta V_{DS}/T_J$	Reference to $25\text{ }^{\circ}\text{C}$ , $I_D = -1\text{ mA}$	-	-0.060	-	V/°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	$I_{DSS}$	$V_{DS} = -60\text{ V}$ , $V_{GS} = 0\text{ V}$	-	-	-100	$\mu\text{A}$
		$V_{DS} = -48\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_J = 150\text{ }^{\circ}\text{C}$	-	-	-500	
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS} = -10\text{ V}$ , $I_D = -7.2\text{ A}^b$	-	-	0.14	$\Omega$
Forward Transconductance	$g_{fs}$	$V_{DS} = -25\text{ V}$ , $I_D = -7.2\text{ A}^b$	5.4	-	-	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	-	1100	-	pF
Output Capacitance	$C_{oss}$		-	620	-	
Reverse Transfer Capacitance	$C_{rss}$		-	100	-	
Drain to Sink Capacitance	$C$	$f = 1.0\text{ MHz}$	-	12	-	
Total Gate Charge	$Q_g$	$V_{GS} = -10\text{ V}$ , $I_D = -18\text{ A}$ , $V_{DS} = -48\text{ V}$ , see fig. 6 and 13 <sup>b</sup>	-	-	34	nC
Gate-Source Charge	$Q_{gs}$		-	-	9.9	
Gate-Drain Charge	$Q_{gd}$		-	-	16	
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = -30\text{ V}$ , $I_D = -18\text{ A}$ , $R_G = 12\text{ }\Omega$ , $R_D = 1.5\text{ }\Omega$ , see fig. 10 <sup>b</sup>	-	18	-	ns
Rise Time	$t_r$		-	120	-	
Turn-Off Delay Time	$t_{d(off)}$		-	20	-	
Fall Time	$t_f$		-	58	-	
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	-	
Gate Input Resistance	$R_g$	$f = 1\text{ MHz}$ , open drain	0.7	-	3.9	$\Omega$
<b>Drain-Source Body Diode Characteristics</b>						
Continuous Source-Drain Diode Current	$I_S$	MOSFET symbol showing the integral reverse p-n junction diode 	-	-	-12	A
Pulsed Diode Forward Current <sup>a</sup>	$I_{SM}$		-	-	-48	
Body Diode Voltage	$V_{SD}$	$T_J = 25\text{ }^{\circ}\text{C}$ , $I_S = -12\text{ A}$ , $V_{GS} = 0\text{ V}^b$	-	-	-6.3	V
Body Diode Reverse Recovery Time	$t_{rr}$	$T_J = 25\text{ }^{\circ}\text{C}$ , $I_F = -18\text{ A}$ , $dI/dt = 100\text{ A}/\mu\text{s}^b$	-	100	200	ns
Body Diode Reverse Recovery Charge	$Q_{rr}$		-	0.28	0.52	$\mu\text{C}$
Forward Turn-On Time	$t_{on}$	Intrinsic turn-on time is negligible (turn-on is dominated by $L_S$ and $L_D$ )				

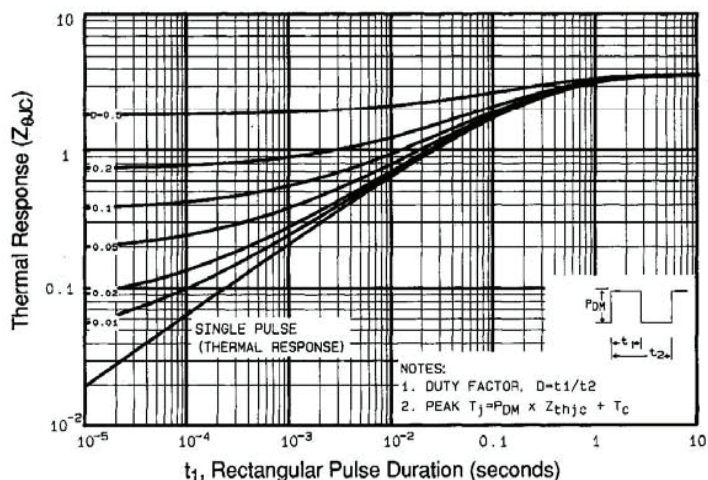
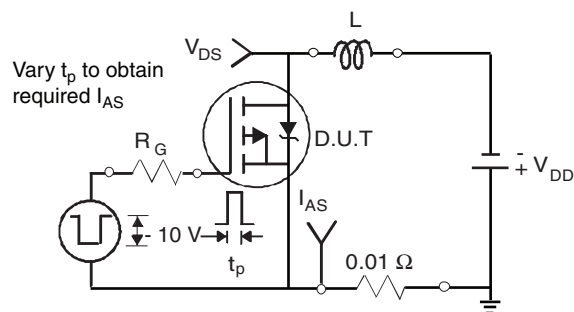
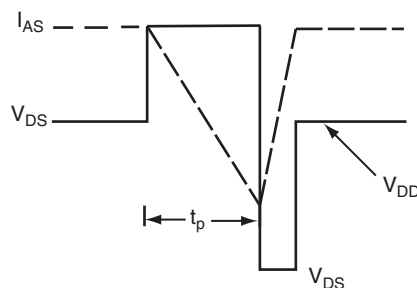
**Notes**

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

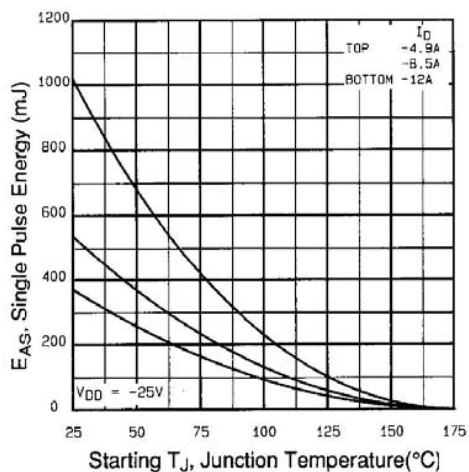
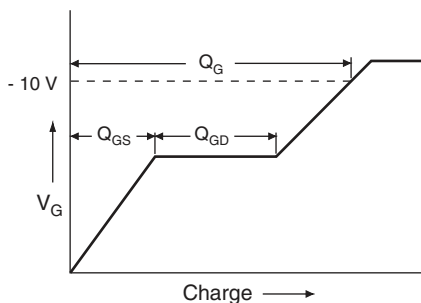
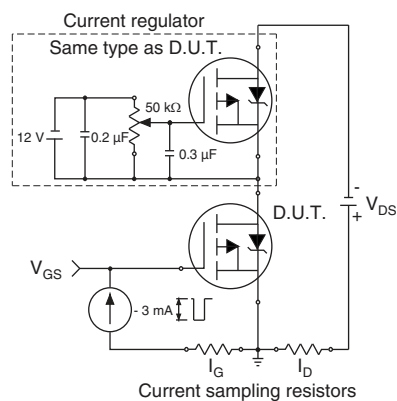
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)

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

**Fig. 3 - Typical Transfer Characteristics**

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

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

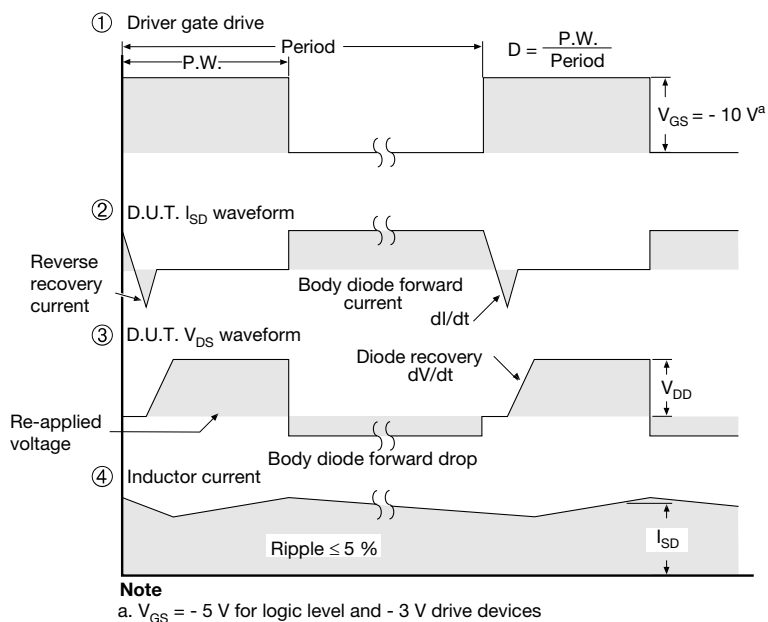
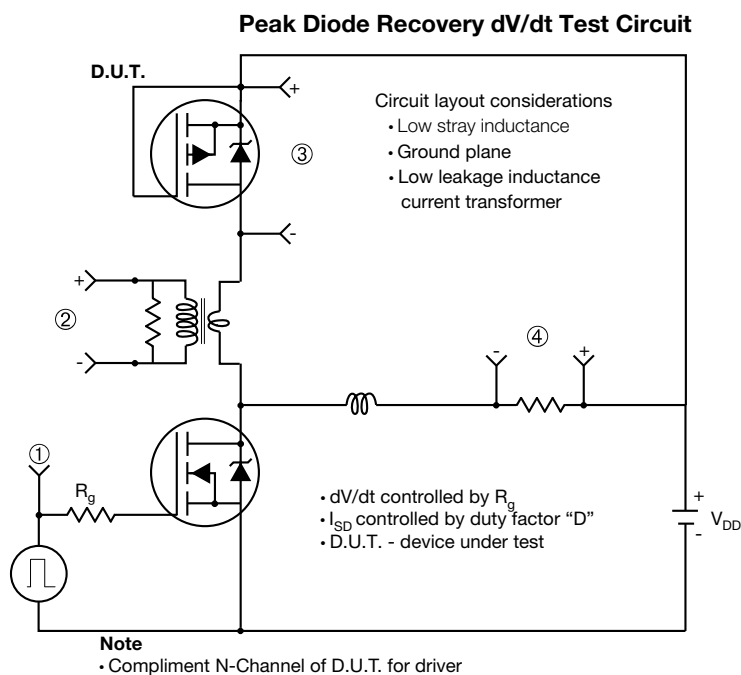

**Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage**

**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**


**Fig. 14 - For P-Channel**

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