

## Power MOSFET

PRODUCT SUMMARY		
$V_{DS}$ (V)	- 200	
$R_{DS(on)}$ ( $\Omega$ )	$V_{GS} = -10$ V	0.50
$Q_g$ (Max.) (nC)	44	
$Q_{gs}$ (nC)	7.1	
$Q_{gd}$ (nC)	27	
Configuration	Single	

### 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
- Dynamic dV/dt Rating
- Low Thermal Resistance
- Lead (Pb)-free Available



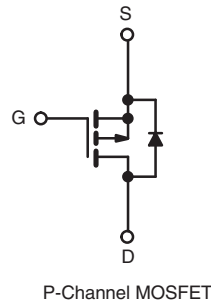
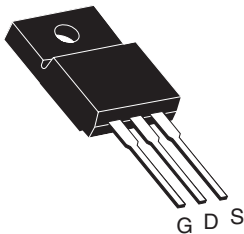
Available  
**RoHS\***  
COMPLIANT

### 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.

TO-220 FULLPAK



ORDERING INFORMATION	
Package	TO-220 FULLPAK
Lead (Pb)-free	IRFI9640GPbF
	SiHFI9640G-E3
SnPb	IRFI9640G
	SiHFI9640G

ABSOLUTE MAXIMUM RATINGS $T_C = 25$ °C, unless otherwise noted				
PARAMETER	SYMBOL	LIMIT	UNIT	
Drain-Source Voltage	$V_{DS}$	- 200	V	
Gate-Source Voltage	$V_{GS}$	$\pm 20$		
Continuous Drain Current	$V_{GS}$ at - 10 V	$T_C = 25$ °C	- 6.1	A
		$T_C = 100$ °C	- 3.9	
Pulsed Drain Current <sup>a</sup>	$I_{DM}$	- 24		
Linear Derating Factor		0.32	W/°C	
Single Pulse Avalanche Energy <sup>b</sup>	$E_{AS}$	650	mJ	
Repetitive Avalanche Current <sup>a</sup>	$I_{AR}$	- 6.1	A	
Repetitive Avalanche Energy <sup>a</sup>	$E_{AR}$	4.0	mJ	
Maximum Power Dissipation	$T_C = 25$ °C	$P_D$	40	W
Peak Diode Recovery dV/dt <sup>c</sup>		dV/dt	- 5.0	V/ns
Operating Junction and Storage Temperature Range	$T_J, T_{stg}$		- 55 to + 150	°C
Soldering Recommendations (Peak Temperature)	for 10 s		300 <sup>d</sup>	
Mounting Torque	6-32 or M3 screw		10	lbf · in
			1.1	N · m

#### Notes

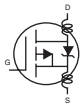
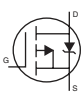
- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- $V_{DD} = -50$  V, starting  $T_J = 25$  °C, L = 26 mH,  $R_G = 25$   $\Omega$ ,  $I_{AS} = -6.1$  A (see fig. 12).
- $I_{SD} \leq -11$  A,  $dI/dt \leq 150$  A/ $\mu$ s,  $V_{DD} \leq V_{DS}$ ,  $T_J \leq 150$  °C.
- 1.6 mm from case.

\* Pb containing terminations are not RoHS compliant, exemptions may apply

**THERMAL RESISTANCE RATINGS**

PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum Junction-to-Ambient	$R_{thJA}$	-	65	°C/W
Maximum Junction-to-Case (Drain)	$R_{thJC}$	-	3.1	

**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	$V_{DS}$	$V_{GS} = 0\text{ V}$ , $I_D = -250\text{ }\mu\text{A}$	-200	-	-	V
$V_{DS}$ Temperature Coefficient	$\Delta V_{DS}/T_J$	Reference to $25\text{ }^\circ\text{C}$ , $I_D = -1\text{ mA}$	-	-0.22	-	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	$I_{DSS}$	$V_{DS} = -200\text{ V}$ , $V_{GS} = 0\text{ V}$	-	-	-100	$\mu\text{A}$
		$V_{DS} = -160\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_J = 125\text{ }^\circ\text{C}$	-	-	-500	
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS} = -10\text{ V}$ , $I_D = -3.7\text{ A}^b$	-	-	0.50	$\Omega$
Forward Transconductance	$g_{fs}$	$V_{DS} = -50\text{ V}$ , $I_D = -3.7\text{ A}^b$	3.4	-	-	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	-	1200	-	pF
Output Capacitance	$C_{oss}$		-	370	-	
Reverse Transfer Capacitance	$C_{rss}$		-	80	-	
Drain to Sink Capacitance	$C$	$f = 1.0\text{ MHz}$	-	12	-	
Total Gate Charge	$Q_g$	$V_{GS} = -10\text{ V}$ , $I_D = -11\text{ A}$ , $V_{DS} = -160\text{ V}$ , see fig. 6 and 13 <sup>b</sup>	-	-	44	nC
Gate-Source Charge	$Q_{GS}$		-	-	7.1	
Gate-Drain Charge	$Q_{GD}$		-	-	27	
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = -100\text{ V}$ , $I_D = -11\text{ A}$ , $R_G = 9.1\text{ }\Omega$ , $R_D = 8.6\text{ }\Omega$ , see fig. 10 <sup>b</sup>	-	14	-	ns
Rise Time	$t_r$		-	43	-	
Turn-Off Delay Time	$t_{d(off)}$		-	39	-	
Fall Time	$t_f$		-	38	-	
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	-	-	-6.1	A
Pulsed Diode Forward Current <sup>a</sup>	$I_{SM}$		-	-	-24	
Body Diode Voltage	$V_{SD}$	$T_J = 25\text{ }^\circ\text{C}$ , $I_S = -6.1\text{ A}$ , $V_{GS} = 0\text{ V}^b$	-	-	-5.0	V
Body Diode Reverse Recovery Time	$t_{rr}$	$T_J = 25\text{ }^\circ\text{C}$ , $I_F = -11\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}^b$	-	250	300	ns
Body Diode Reverse Recovery Charge	$Q_{rr}$		-	2.9	3.6	$\mu\text{C}$
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

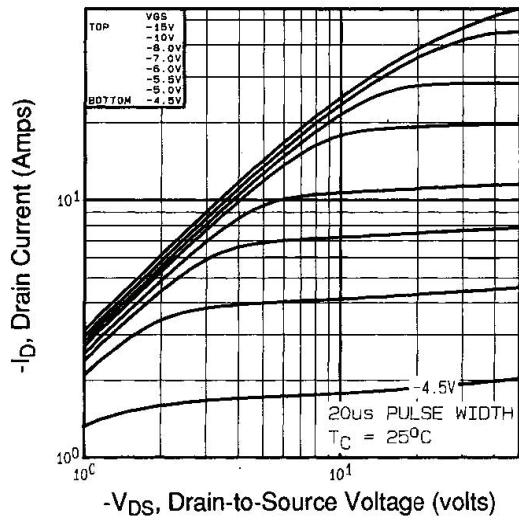


Fig. 1 - Typical Output Characteristics,  $T_C = 25^\circ\text{C}$

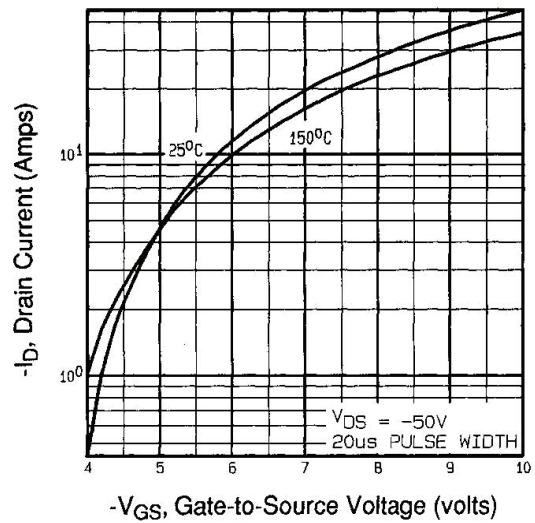


Fig. 3 - Typical Transfer Characteristics

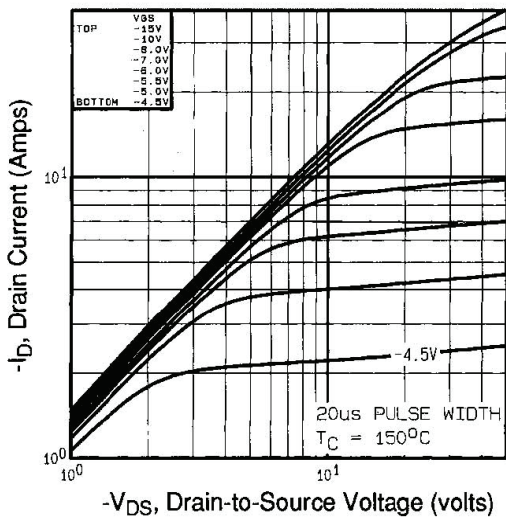


Fig. 2 - Typical Output Characteristics,  $T_C = 150^\circ\text{C}$

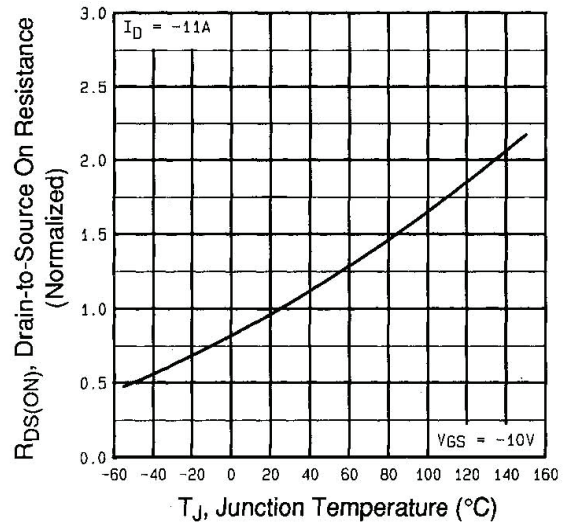


Fig. 4 - Normalized On-Resistance vs. Temperature

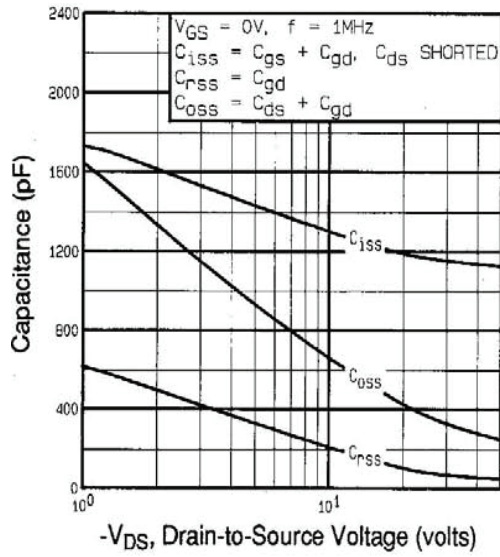


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

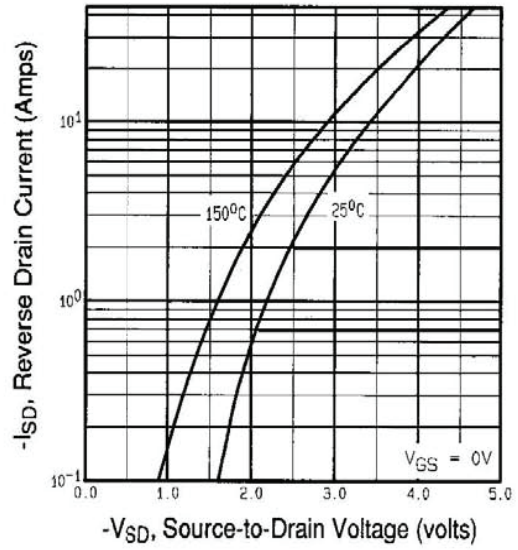


Fig. 7 - Typical Source-Drain Diode Forward Voltage

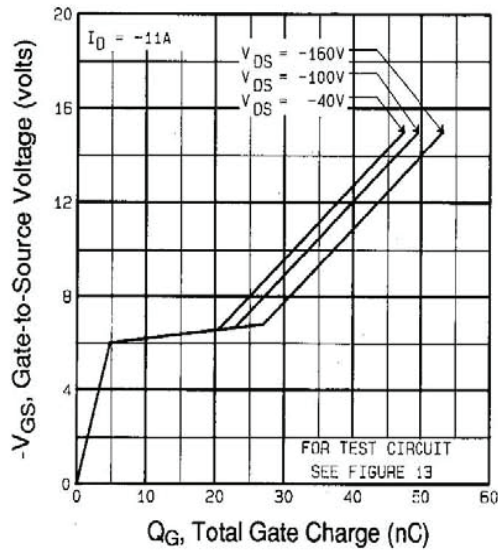


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

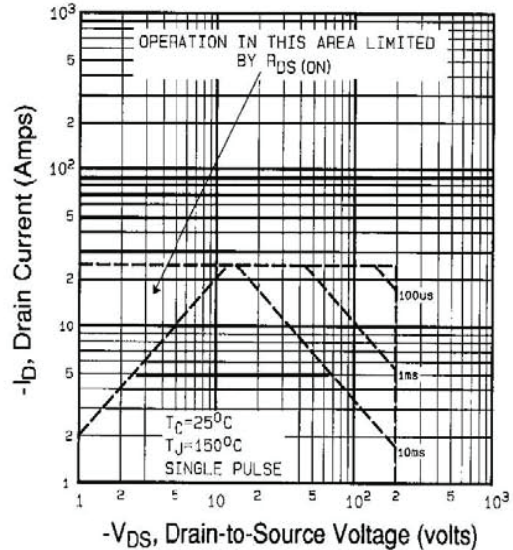


Fig. 8 - Maximum Safe Operating Area

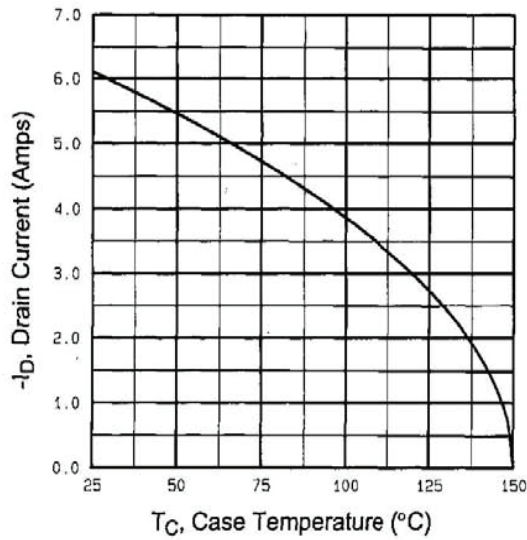


Fig. 9 - Maximum Drain Current vs. Case Temperature



Fig. 10a - Switching Time Test Circuit

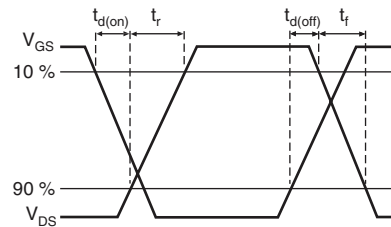


Fig. 10b - Switching Time Waveforms

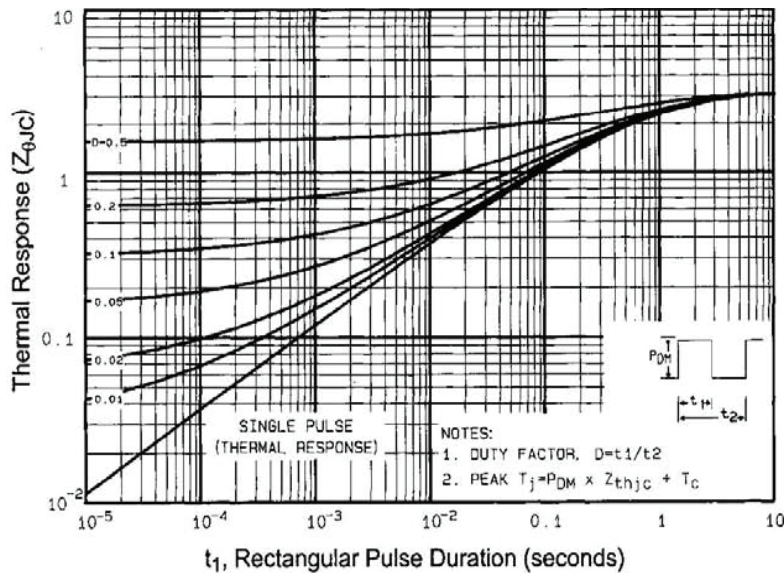


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

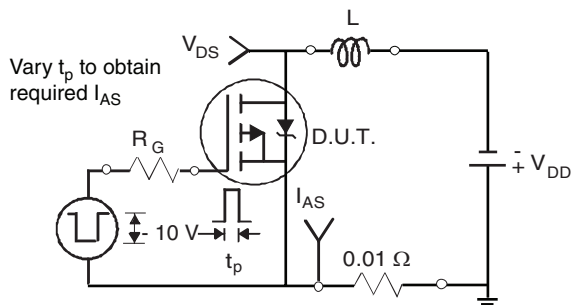


Fig. 12a - Unclamped Inductive Test Circuit

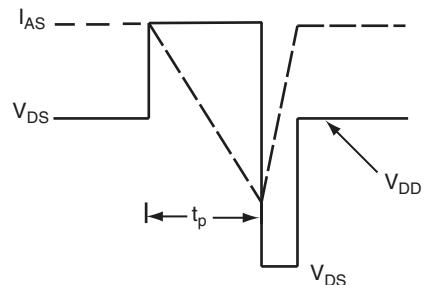


Fig. 12b - Unclamped Inductive Waveforms

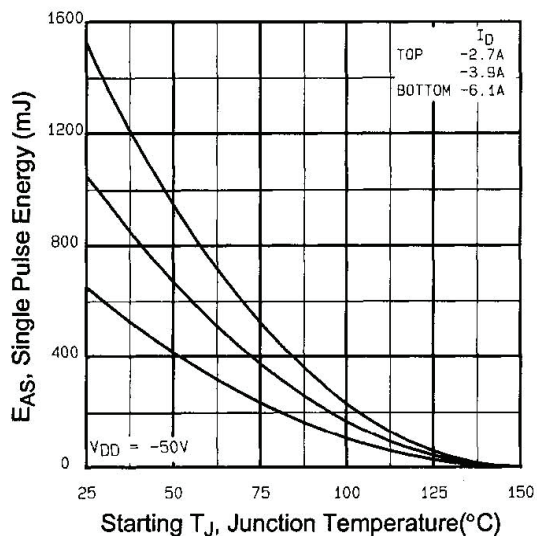


Fig. 12c - Maximum Avalanche Energy vs. Drain Current



Fig. 13a - Basic Gate Charge Waveform

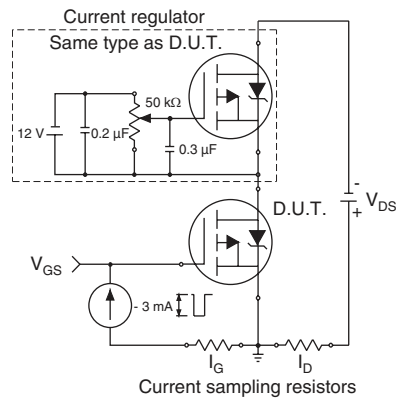
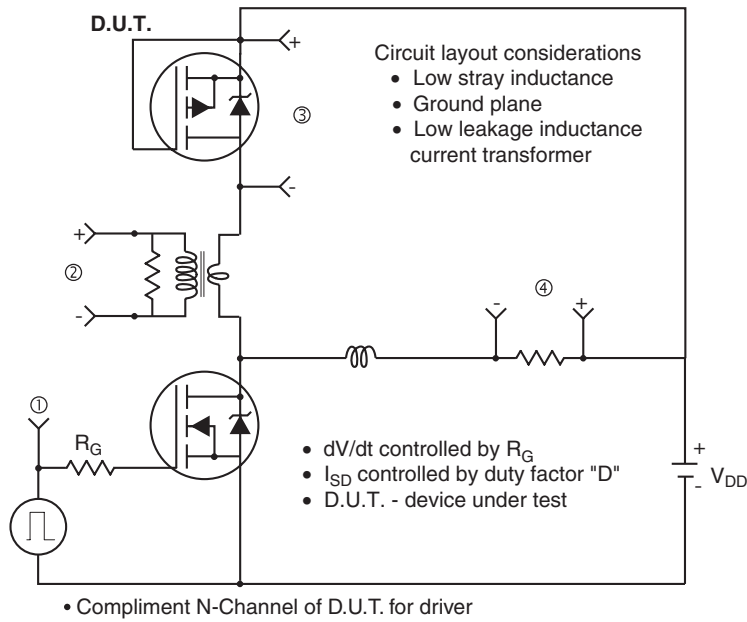


Fig. 13b - Gate Charge Test Circuit

## Peak Diode Recovery dV/dt Test Circuit



\*  $V_{GS} = -5V$  for logic level and  $-3V$  drive devices

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

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