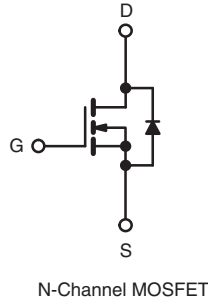
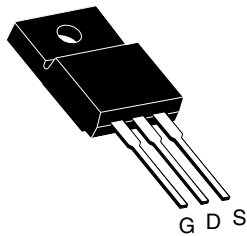


## E Series Power MOSFET

PRODUCT SUMMARY	
$V_{DS}$ (V) at $T_J$ max.	650
$R_{DS(on)}$ max. at 25 °C ( $\Omega$ )	$V_{GS} = 10\text{ V}$   0.28
$Q_g$ max. (nC)	76
$Q_{gs}$ (nC)	11
$Q_{gd}$ (nC)	17
Configuration	Single

**TO-220 FULLPAK**

**FEATURES**

- Low Figure-of-Merit (FOM)  $R_{on} \times Q_g$
- Low Input Capacitance ( $C_{iss}$ )
- Reduced Switching and Conduction Losses
- Ultra Low Gate Charge ( $Q_g$ )
- Avalanche Energy Rated (UIS)
- Material categorization: For definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)


**RoHS\***  
COMPLIANT

**Note**

\* Lead (Pb)-containing terminations are not RoHS-compliant. Exemptions may apply.

**APPLICATIONS**

- Server and Telecom Power Supplies
- Switch Mode Power Supplies (SMPS)
- Power Factor Correction Power Supplies (PFC)
- Lighting
  - High-Intensity Discharge (HID)
  - Fluorescent Ballast Lighting
- Industrial
  - Welding
  - Induction Heating
  - Motor Drives
  - Battery Chargers
  - Renewable Energy
  - Solar (PV Inverters)

**ORDERING INFORMATION**

Package	TO-220 FULLPAK
Lead (Pb)-free	SiHF15N60E-E3

**ABSOLUTE MAXIMUM RATINGS** ( $T_C = 25\text{ °C}$ , unless otherwise noted)


PARAMETER	SYMBOL	LIMIT	UNIT
Drain-Source Voltage	$V_{DS}$	600	V
Gate-Source Voltage	$V_{GS}$	$\pm 20$	
Gate-Source Voltage AC ( $f > 1\text{ Hz}$ )		30	
Continuous Drain Current ( $T_J = 150\text{ °C}$ ) <sup>e</sup>	$V_{GS}$ at 10 V	$T_C = 25\text{ °C}$	A
		$T_C = 100\text{ °C}$	
Pulsed Drain Current <sup>a</sup>	$I_{DM}$	39	
Linear Derating Factor		0.27	W/°C
Single Pulse Avalanche Energy <sup>b</sup>	$E_{AS}$	102	mJ
Maximum Power Dissipation	$P_D$	34	W
Operating Junction and Storage Temperature Range	$T_J, T_{stg}$	- 55 to + 150	°C
Drain-Source Voltage Slope	$dV/dt$	$T_J = 125\text{ °C}$	V/ns
Reverse Diode $dV/dt$ <sup>d</sup>		7.7	
Soldering Recommendations (Peak Temperature)	for 10 s	300°	°C

**Notes**

- Repetitive rating; pulse width limited by maximum junction temperature.
- $V_{DD} = 50\text{ V}$ , starting  $T_J = 25\text{ °C}$ ,  $L = 11.6\text{ mH}$ ,  $R_g = 25\text{ }\Omega$ ,  $I_{AS} = 4.2\text{ A}$ .
- 1.6 mm from case.
- $I_{SD} \leq I_D$ ,  $dI/dt = 100\text{ A}/\mu\text{s}$ , starting  $T_J = 25\text{ °C}$ .
- Limited by maximum junction temperature.



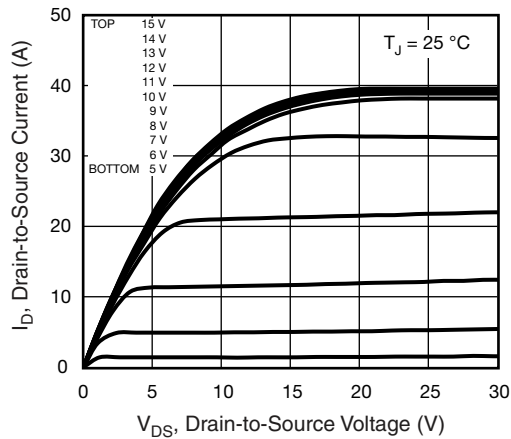
THERMAL RESISTANCE RATINGS				
PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum Junction-to-Ambient	$R_{thJA}$	-	65	°C/W
Maximum Junction-to-Case (Drain)	$R_{thJC}$	-	3.7	

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	$V_{DS}$	$V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$		600	-	-	V
$V_{DS}$ Temperature Coefficient	$\Delta V_{DS}/T_J$	Reference to $25\text{ }^\circ\text{C}$ , $I_D = 1\text{ mA}$		-	0.71	-	V/°C
Gate-Source Threshold Voltage (N)	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$		2	-	4	V
Gate-Source Leakage	$I_{GSS}$	$V_{GS} = \pm 20\text{ V}$		-	-	$\pm 100$	nA
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = 600\text{ V}, V_{GS} = 0\text{ V}$		-	-	1	$\mu\text{A}$
		$V_{DS} = 480\text{ V}, V_{GS} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$		-	-	10	
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}$	$I_D = 8\text{ A}$	-	0.23	0.28	$\Omega$
Forward Transconductance	$g_{fs}$	$V_{DS} = 30\text{ V}, I_D = 8\text{ A}$		-	4.6	-	S
<b>Dynamic</b>							
Input Capacitance	$C_{iss}$	$V_{GS} = 0\text{ V}, V_{DS} = 100\text{ V}, f = 1\text{ MHz}$		-	1350	-	$\mu\text{F}$
Output Capacitance	$C_{oss}$			-	70	-	
Reverse Transfer Capacitance	$C_{rss}$			-	5	-	
Effective Output Capacitance, Energy Related <sup>a</sup>	$C_{o(er)}$	$V_{DS} = 0\text{ V to } 480\text{ V}, V_{GS} = 0\text{ V}$		-	53	-	$\mu\text{F}$
Effective Output Capacitance, Time Related <sup>b</sup>	$C_{o(tr)}$			-	177	-	
Total Gate Charge	$Q_g$	$V_{GS} = 10\text{ V}$	$I_D = 8\text{ A}, V_{DS} = 480\text{ V}$	-	38	76	nC
Gate-Source Charge	$Q_{gs}$			-	11	-	
Gate-Drain Charge	$Q_{gd}$			-	17	-	
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = 480\text{ V}, I_D = 8\text{ A}, V_{GS} = 10\text{ V}, R_g = 9.1\text{ }\Omega$		-	17	34	ns
Rise Time	$t_r$			-	51	77	
Turn-Off Delay Time	$t_{d(off)}$			-	35	70	
Fall Time	$t_f$			-	33	66	
Gate Input Resistance	$R_g$	$f = 1\text{ MHz}, \text{open drain}$		-	0.86	-	$\Omega$
<b>Drain-Source Body Diode Characteristics</b>							
Continuous Source-Drain Diode Current	$I_S$	MOSFET symbol showing the integral reverse p - n junction diode 		-	-	15	A
Pulsed Diode Forward Current	$I_{SM}$			-	-	60	
Diode Forward Voltage	$V_{SD}$	$T_J = 25\text{ }^\circ\text{C}, I_S = 8\text{ A}, V_{GS} = 0\text{ V}$		-	-	1.2	V
Reverse Recovery Time	$t_{rr}$	$T_J = 25\text{ }^\circ\text{C}, I_F = I_S = 8\text{ A}, dI/dt = 100\text{ A}/\mu\text{s}, V_R = 20\text{ V}$		-	410	-	ns
Reverse Recovery Charge	$Q_{rr}$			-	5.4	-	$\mu\text{C}$
Reverse Recovery Current	$I_{RRM}$			-	21	-	A

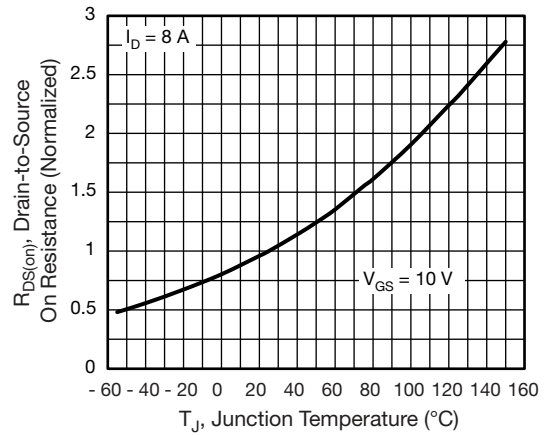
**Notes**

- a.  $C_{oss(er)}$  is a fixed capacitance that gives the same energy as  $C_{oss}$  while  $V_{DS}$  is rising from 0 % to 80 %  $V_{DSS}$ .
- b.  $C_{oss(tr)}$  is a fixed capacitance that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 % to 80 %  $V_{DSS}$ .

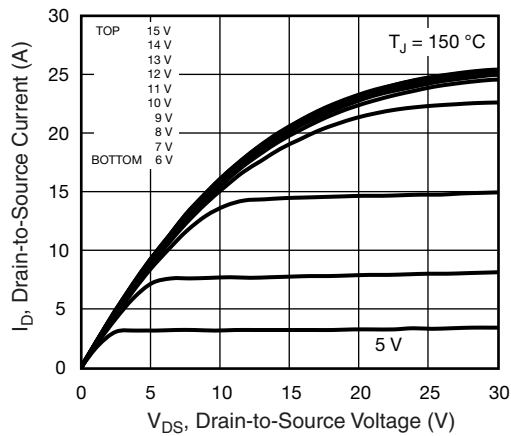
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



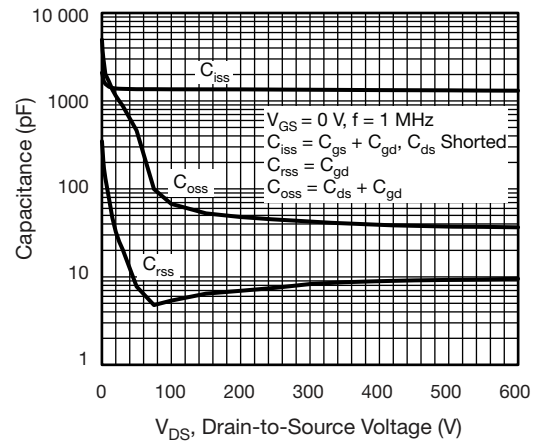
**Fig. 1 - Typical Output Characteristics**



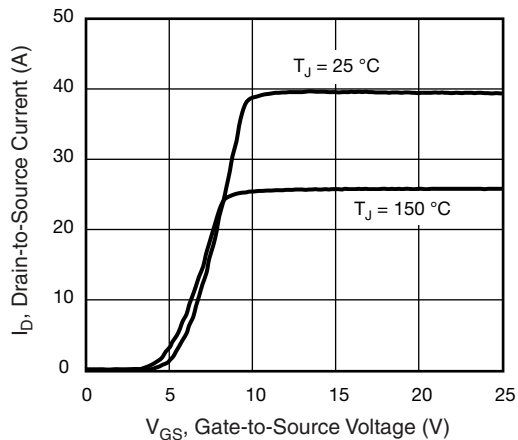
**Fig. 4 - Normalized On-Resistance vs. Temperature**



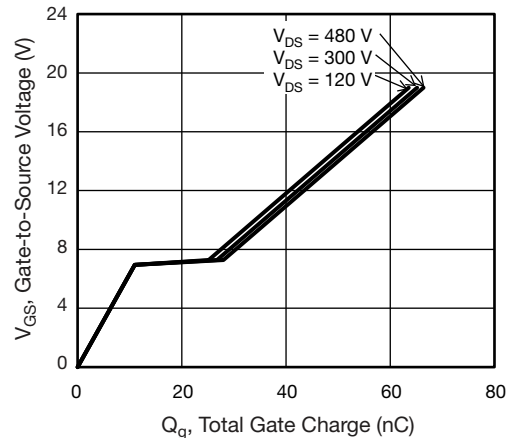
**Fig. 2 - Typical Output Characteristics**



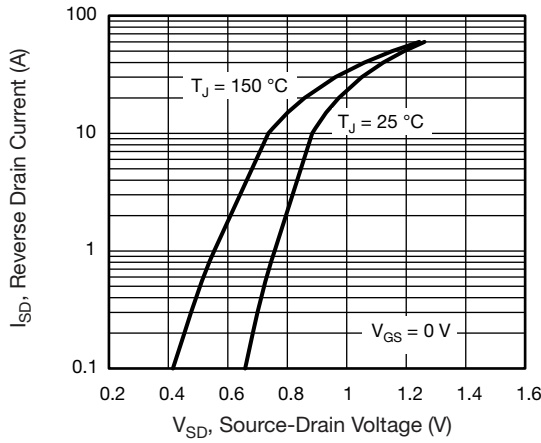
**Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage**



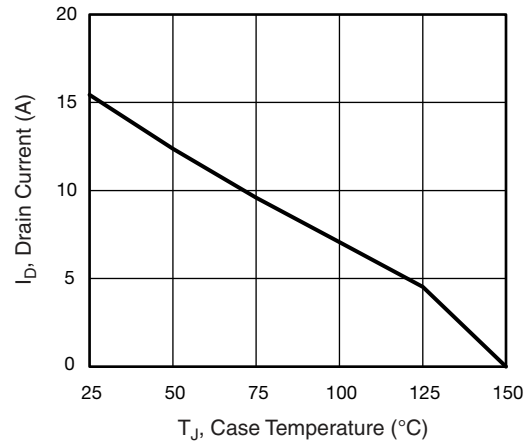
**Fig. 3 - Typical Transfer Characteristics**



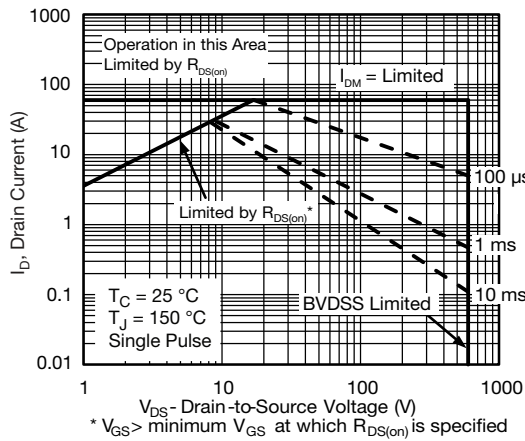
**Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage**



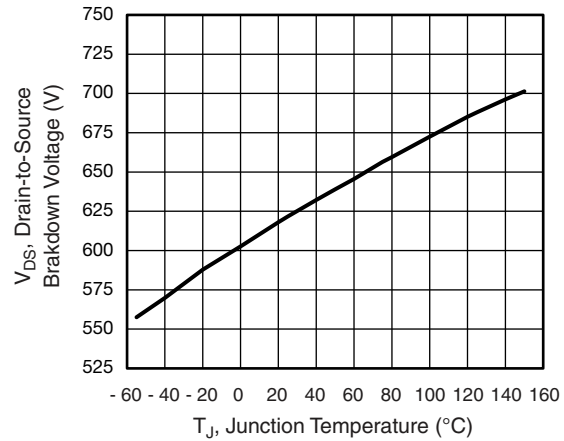
**Fig. 7 - Typical Source-Drain Diode Forward Voltage**



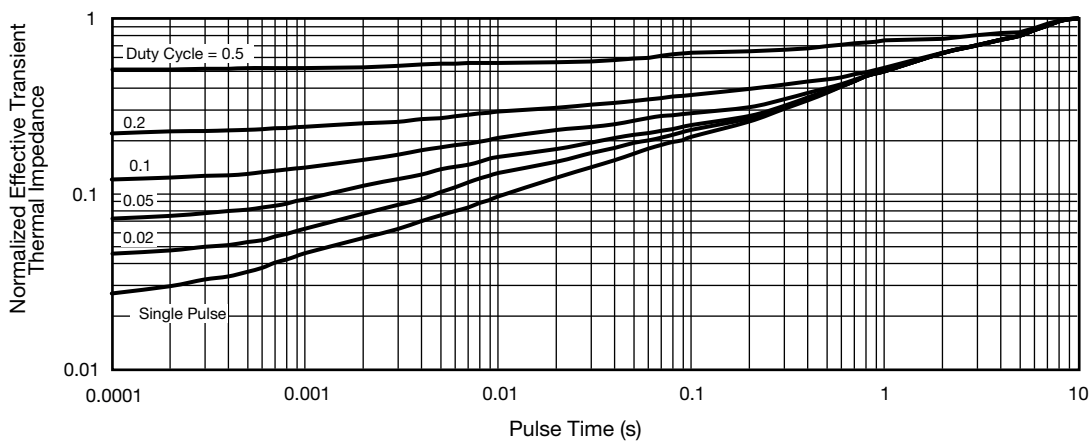
**Fig. 9 - Maximum Drain Current vs. Case Temperature**



**Fig. 8 - Maximum Safe Operating Area**



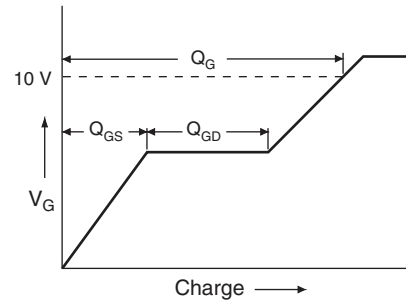
**Fig. 10 - Temperature vs. Drain-to-Source Voltage**



**Fig. 11 - Normalized Thermal Transient Impedance, Junction-to-Case**



**Fig. 12 - Switching Time Test Circuit**



**Fig. 16 - Basic Gate Charge Waveform**



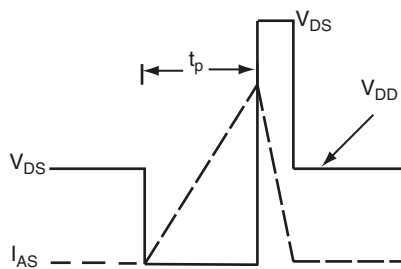
**Fig. 13 - Switching Time Waveforms**



**Fig. 17 - Gate Charge Test Circuit**



**Fig. 14 - Unclamped Inductive Test Circuit**



**Fig. 15 - Unclamped Inductive Waveforms**



**Note**

a.  $V_{GS} = 5 V$  for logic level devices

**Fig. 18 - For N-Channel**

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