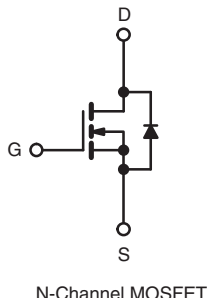
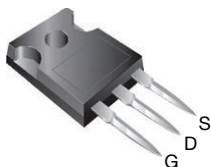


## EF Series Power MOSFET with Fast Body Diode

### PRODUCT SUMMARY

$V_{DS}$ (V) at $T_J$ max.	650	
$R_{DS(on)}$ max. at 25 °C ( $\Omega$ )	$V_{GS} = 10$ V	0.098
$Q_g$ (Max.) (nC)	155	
$Q_{gs}$ (nC)	22	
$Q_{gd}$ (nC)	43	
Configuration	Single	

**TO-247AC**


### FEATURES

- Fast body diode MOSFET using E series technology
- Reduced  $t_{rr}$ ,  $Q_{rr}$ , and  $I_{RRM}$
- 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  
HALOGEN  
**FREE**

### APPLICATIONS

- Telecommunications
  - Server and telecom power supplies
- Lighting
  - High-intensity discharge (HID)
  - Light emitting diodes (LEDs)
- Consumer and computing
  - ATX power supplies
- Industrial
  - Welding
  - Battery chargers
- Renewable energy
  - Solar (PV inverters)
- Switch mode power supplies (SMPS)
  - LLC
  - Phase shifted bridge (ZVS)
  - 3-level inverter
  - AC/DC bridge

### ORDERING INFORMATION

Package	TO-247AC
Lead (Pb)-free and Halogen-free	SiHG33N60EF-GE3

### ABSOLUTE MAXIMUM RATINGS ( $T_C = 25$ °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 ( $f > 1$ Hz)		30	
Continuous Drain Current ( $T_J = 150$ °C)	$I_D$	33	A
		21	
Pulsed Drain Current (Typical) <sup>a</sup>	$I_{DM}$	100	W/°C
Linear Derating Factor		2.2	
Single Pulse Avalanche Energy <sup>b</sup>	$E_{AS}$	691	mJ
Maximum Power Dissipation	$P_D$	278	W
Operating Junction and Storage Temperature Range	$T_J, T_{stg}$	-55 to +150	°C
Drain-Source Voltage Slope	$dV/dt$	70	V/ns
Reverse Diode $dV/dt$ <sup>d</sup>		20	
Soldering Recommendations (Peak Temperature) <sup>c</sup>		300	


#### Notes

- Repetitive rating; pulse width limited by maximum junction temperature.
- $V_{DS} = 50$  V, starting  $T_J = 25$  °C,  $L = 28.2$  mH,  $R_g = 25$   $\Omega$ ,  $I_{AS} = 7$  A.
- 1.6 mm from case.
- $I_{SD} \leq I_D$ ,  $dI/dt = 100$  A/ $\mu$ s, starting  $T_J = 25$  °C.

**THERMAL RESISTANCE RATINGS**

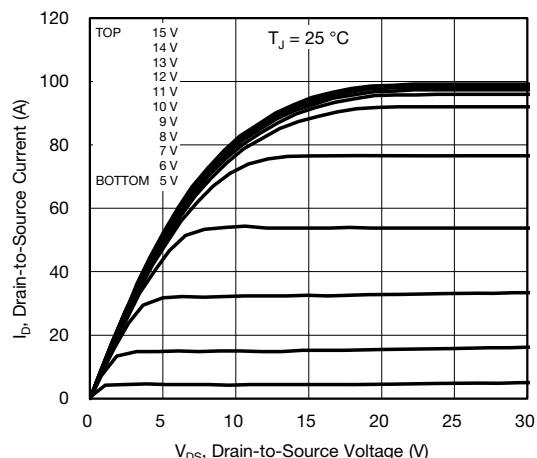
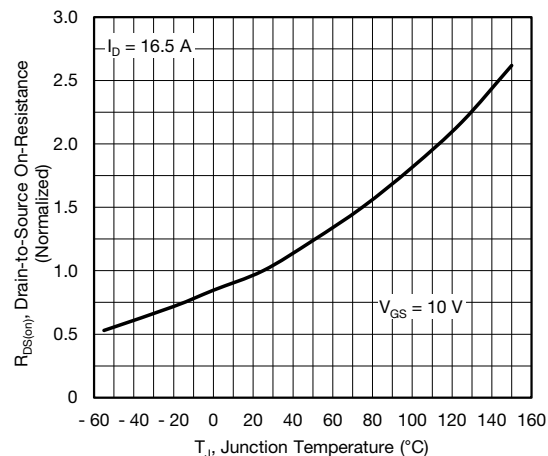
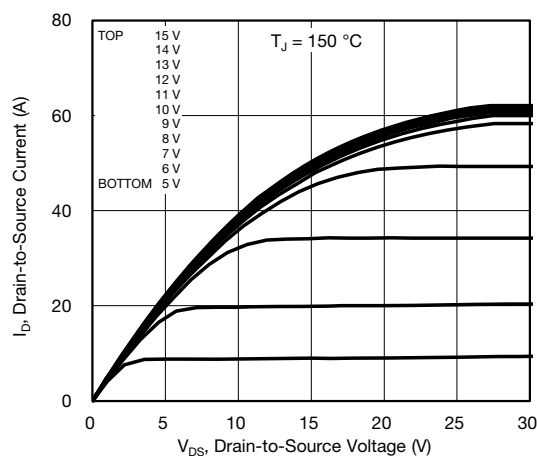
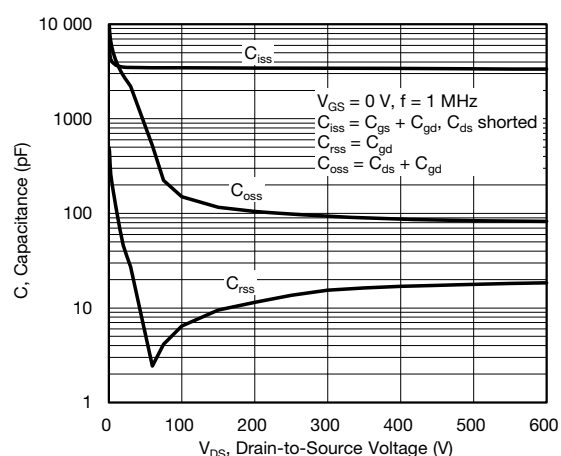
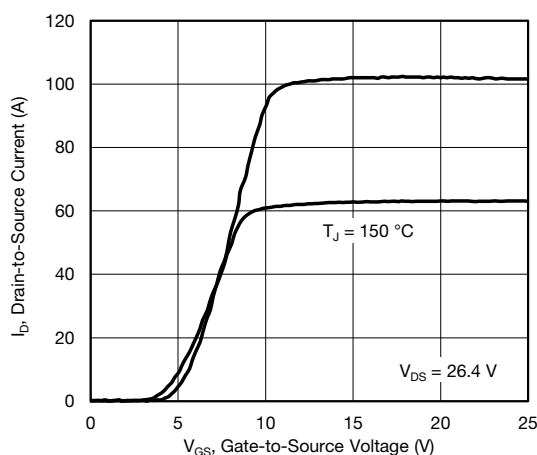
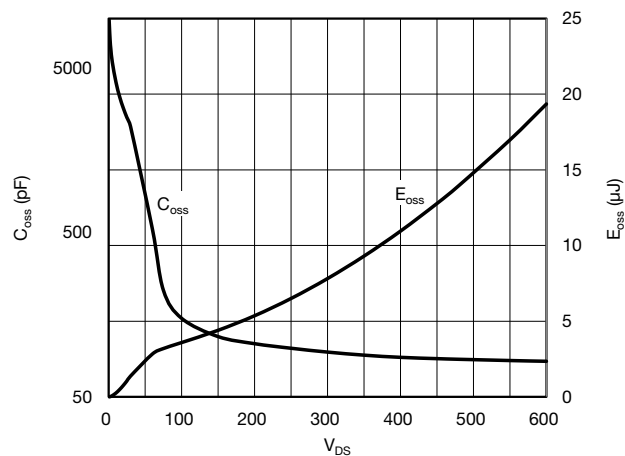
PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum Junction-to-Ambient	$R_{thJA}$	-	40	°C/W
Maximum Junction-to-Case (Drain)	$R_{thJC}$	-	0.45	

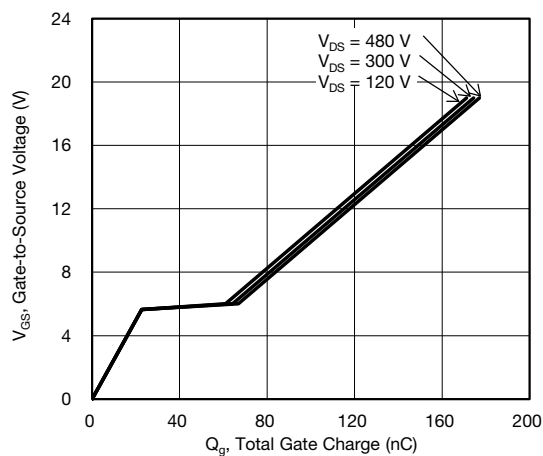
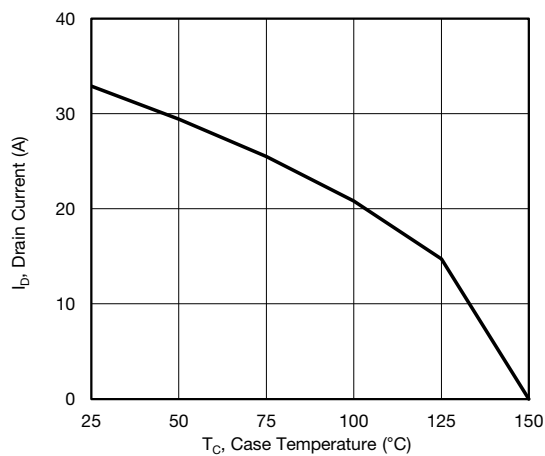
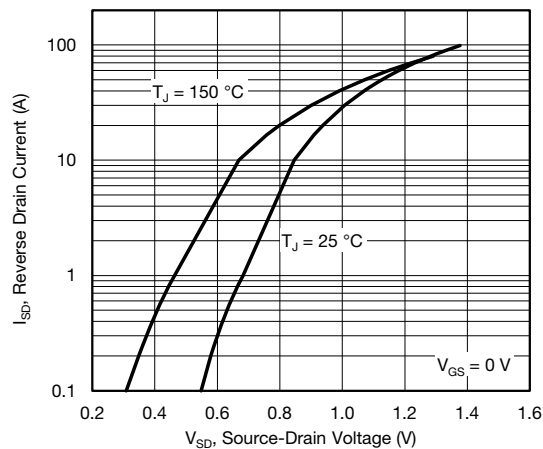
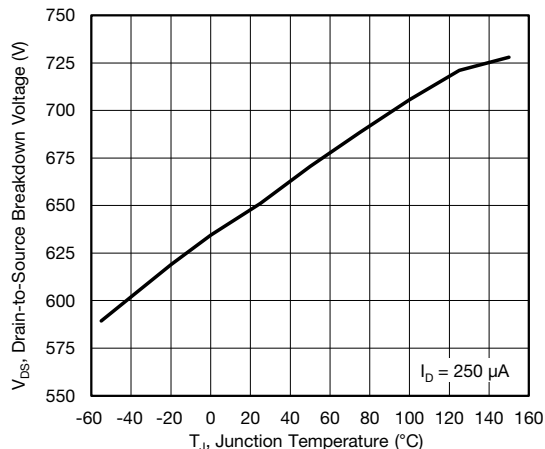
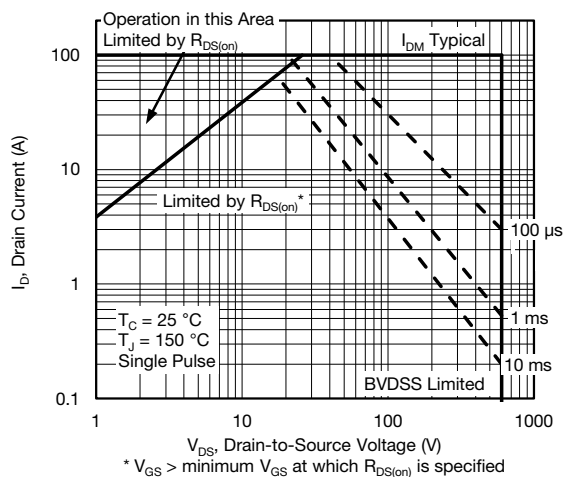
**SPECIFICATIONS** ( $T_J = 25\text{ }^{\circ}\text{C}$ , unless otherwise noted)

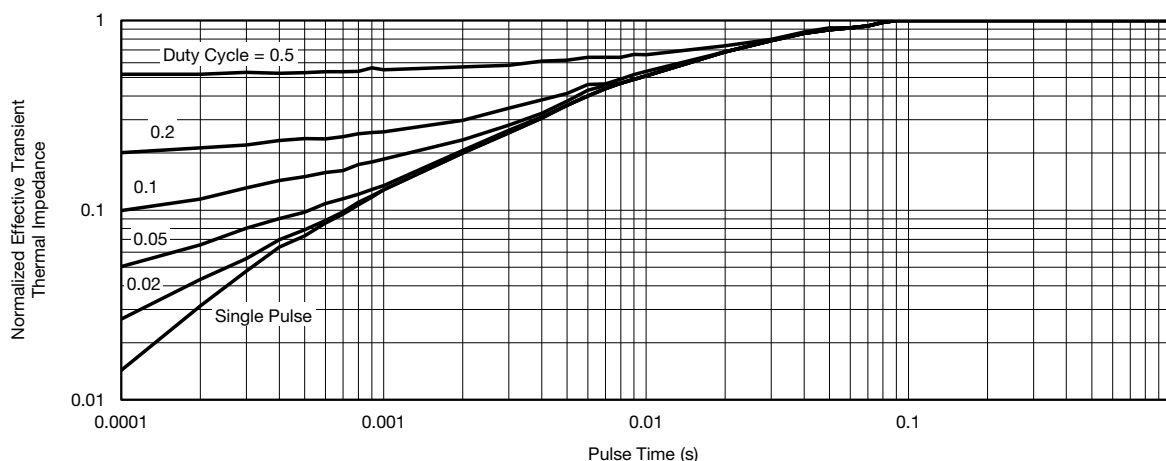
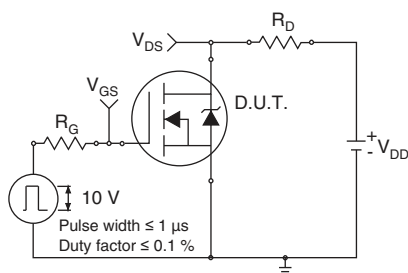
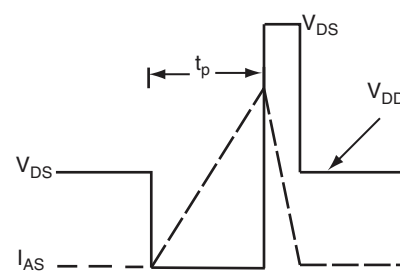
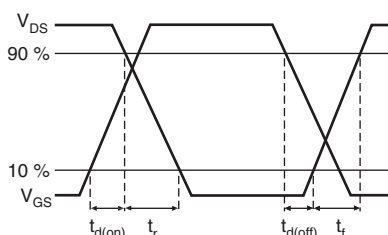
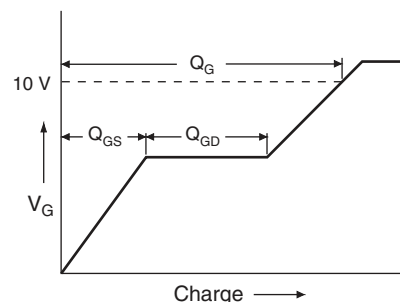
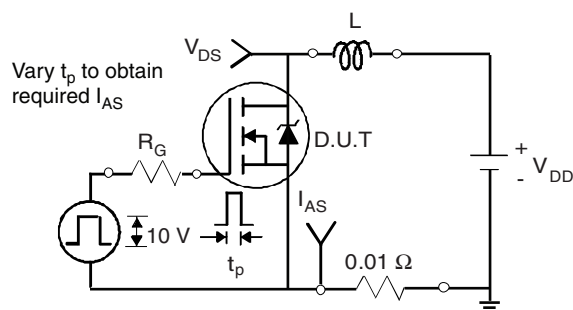
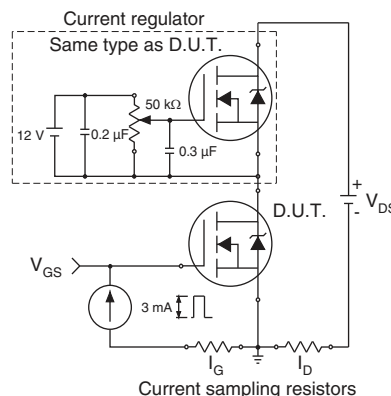
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
<b>Static</b>						
Drain-Source Breakdown Voltage	$V_{DS}$	$V_{GS} = 0\text{ V}$ , $I_D = 250\text{ }\mu\text{A}$	600	-	-	V
$V_{DS}$ Temperature Coefficient	$\Delta V_{DS}/T_J$	Reference to $25\text{ }^{\circ}\text{C}$ , $I_D = 1\text{ mA}$	-	0.72	-	V/ $^{\circ}\text{C}$
Gate-Source Threshold Voltage (N)	$V_{GS(th)}$	$V_{DS} = V_{GS}$ , $I_D = 250\text{ }\mu\text{A}$	2.0	-	4.0	V
Gate-Source Leakage	$I_{GSS}$	$V_{GS} = \pm 20\text{ V}$	-	-	$\pm 100$	nA
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = 480\text{ V}$ , $V_{GS} = 0\text{ V}$	-	-	1	$\mu\text{A}$
		$V_{DS} = 480\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_J = 125\text{ }^{\circ}\text{C}$	-	-	500	
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}$ , $I_D = 16.5\text{ A}$	-	0.085	0.098	$\Omega$
Forward Transconductance <sup>a</sup>	$g_{fs}$	$V_{DS} = 30\text{ V}$ , $I_D = 16.5\text{ A}$	-	12	-	S
<b>Dynamic</b>						
Input Capacitance	$C_{iss}$	$V_{GS} = 0\text{ V}$ , $V_{DS} = 100\text{ V}$ , $f = 1\text{ MHz}$	-	3454	-	pF
Output Capacitance	$C_{oss}$		-	154	-	
Reverse Transfer Capacitance	$C_{rss}$		-	8	-	
Effective Output Capacitance, Energy Related <sup>b</sup>	$C_{o(er)}$	$V_{GS} = 0\text{ V}$ , $V_{DS} = 0\text{ V to } 480\text{ V}$	-	121	-	
Effective Output Capacitance, Time Related <sup>c</sup>	$C_{o(tr)}$		-	437	-	
Total Gate Charge	$Q_g$	$V_{GS} = 10\text{ V}$ , $I_D = 16.5\text{ A}$ , $V_{DS} = 480\text{ V}$	-	103	155	nC
Gate-Source Charge	$Q_{gs}$		-	22	-	
Gate-Drain Charge	$Q_{gd}$		-	43	-	
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = 480\text{ V}$ , $I_D = 16.5\text{ A}$ $R_g = 9.1\text{ }\Omega$ , $V_{GS} = 10\text{ V}$	-	28	56	ns
Rise Time	$t_r$		-	43	86	
Turn-Off Delay Time	$t_{d(off)}$		-	161	242	
Fall Time	$t_f$		-	48	96	
Gate Input Resistance	$R_g$	$f = 1\text{ MHz}$ , open drain	-	0.5	-	$\Omega$
<b>Drain-Source Body Diode Characteristics</b>						
Continuous Source-Drain Diode Current	$I_S$	MOSFET symbol showing the integral reverse p - n junction diode 	-	-	33	A
Pulsed Diode Forward Current	$I_{SM}$		-	100	-	
Diode Forward Voltage	$V_{SD}$	$T_J = 25\text{ }^{\circ}\text{C}$ , $I_S = 16.5\text{ A}$ , $V_{GS} = 0\text{ V}$	-	0.9	1.2	V
Reverse Recovery Time	$t_{rr}$	$T_J = 25\text{ }^{\circ}\text{C}$ , $I_F = I_S = 16.5\text{ A}$ , $dI/dt = 100\text{ A}/\mu\text{s}$ , $V_R = 25\text{ V}$	-	162	324	ns
Reverse Recovery Charge	$Q_{rr}$		-	1.0	2.0	$\mu\text{C}$
Reverse Recovery Current	$I_{RRM}$		-	13	-	A

**Notes**

- a. Repetitive rating; pulse width limited by maximum junction temperature.  
b.  $C_{oss(er)}$  is a fixed capacitance that gives the same energy as  $C_{oss}$  while  $V_{DS}$  is rising from 0 % to 80 %  $V_{DS}$ .  
c.  $C_{oss(tr)}$  is a fixed capacitance that gives the charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 % to 80 %  $V_{DS}$ .

**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 -  $C_{oss}$  and  $E_{oss}$  vs.  $V_{DS}$**


**Fig. 7 - Typical Gate Charge vs. Gate-to-Source Voltage**

**Fig. 10 - Maximum Drain Current vs. Case Temperature**

**Fig. 8 - Typical Source-Drain Diode Forward Voltage**

**Fig. 11 - Typical Drain-to-Source Voltage vs. Temperature**

**Fig. 9 - Maximum Safe Operating Area**


**Fig. 12 - Normalized Thermal Transient Impedance, Junction-to-Case**

**Fig. 13 - Switching Time Test Circuit**

**Fig. 16 - Unclamped Inductive Waveforms**

**Fig. 14 - Switching Time Waveforms**

**Fig. 17 - Basic Gate Charge Waveform**

**Fig. 15 - Unclamped Inductive Test Circuit**

**Fig. 18 - Gate Charge Test Circuit**


**Note**

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

**Fig. 19 - For N-Channel**

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