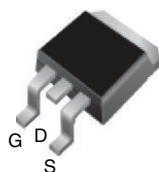


EF Series Power MOSFET With Fast Body Diode

D²PAK (TO-263)


N-Channel MOSFET

FEATURES

- A specific on resistance ($m\Omega\text{-cm}^2$) reduction of 25 %
- Low figure-of-merit (FOM) $R_{\text{on}} \times Q_g$
- 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


RoHS
COMPLIANT
HALOGEN
FREE

PRODUCT SUMMARY

V_{DS} (V) at T_J max.	650	
$R_{\text{DS(on)}}$ typ. (Ω) at 25 °C	$V_{\text{GS}} = 10 \text{ V}$	0.084
Q_g max. (nC)	134	
Q_{gs} (nC)	16	
Q_{gd} (nC)	48	
Configuration	Single	

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	D ² PAK (TO-263)
Lead (Pb)-free and halogen-free	SiHB35N60EF-GE3
Tape and reel	SiHB35N60EF-T1-GE3 SiHB35N60EF-T5-GE3

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

PARAMETER	SYMBOL	LIMIT	UNIT
Drain-source voltage	V_{DS}	600	V
Gate-source voltage	V_{GS}	± 30	
Continuous drain current ($T_J = 150 \text{ }^\circ\text{C}$)	V_{GS} at 10 V	$T_C = 25 \text{ }^\circ\text{C}$	A
		$T_C = 100 \text{ }^\circ\text{C}$	
Pulsed drain current ^a	I_{DM}	80	
Linear derating factor		2.0	W/ $^\circ\text{C}$
Single pulse avalanche energy ^b	E_{AS}	298	mJ
Maximum power dissipation	P_D	250	W
Operating junction and storage temperature range	T_J, T_{stg}	-55 to +150	$^\circ\text{C}$
Drain-source voltage slope	dv/dt	100	V/ns
Reverse diode dv/dt ^d		50	
Soldering recommendations (peak temperature) ^c	For 10 s	260	$^\circ\text{C}$

Notes

- Repetitive rating; pulse width limited by maximum junction temperature
- $V_{\text{DD}} = 140 \text{ V}$, starting $T_J = 25 \text{ }^\circ\text{C}$, $L = 28.2 \text{ mH}$, $R_g = 25 \text{ } \Omega$, $I_{\text{AS}} = 4.6 \text{ A}$
- 1.6 mm from case
- $I_{\text{SD}} = 17 \text{ A}$, $di/dt = 300 \text{ A}/\mu\text{s}$, starting $T_J = 25 \text{ }^\circ\text{C}$

**THERMAL RESISTANCE RATINGS**

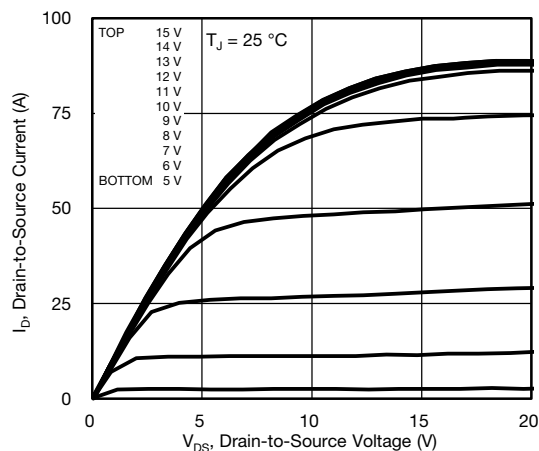
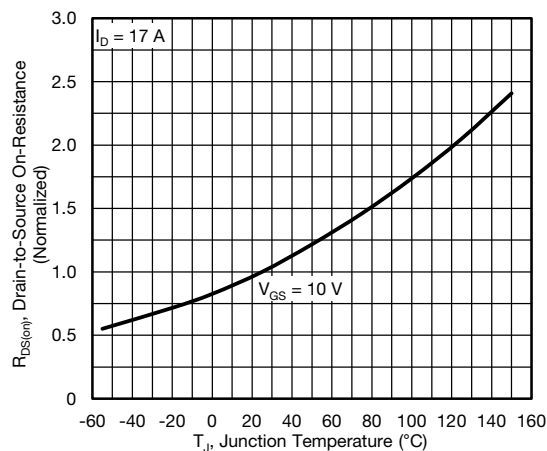
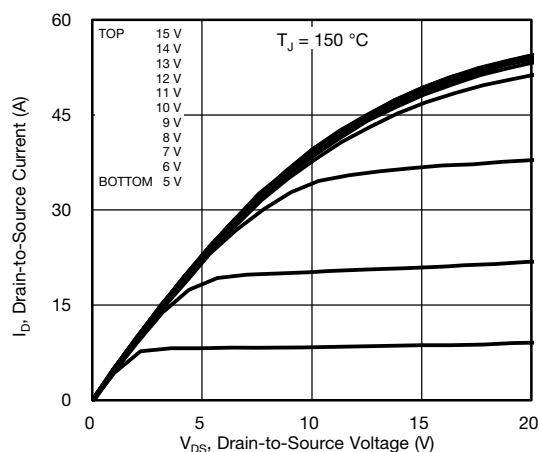
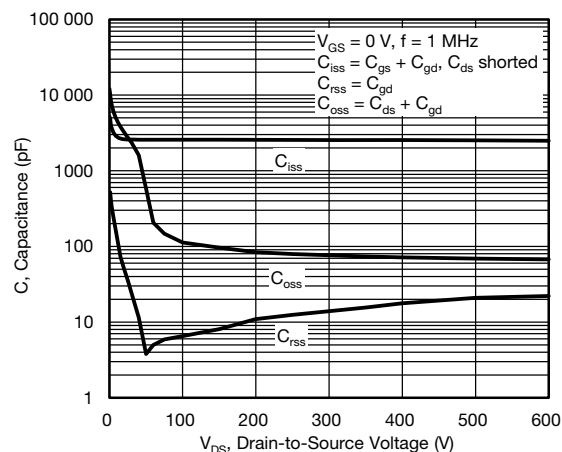
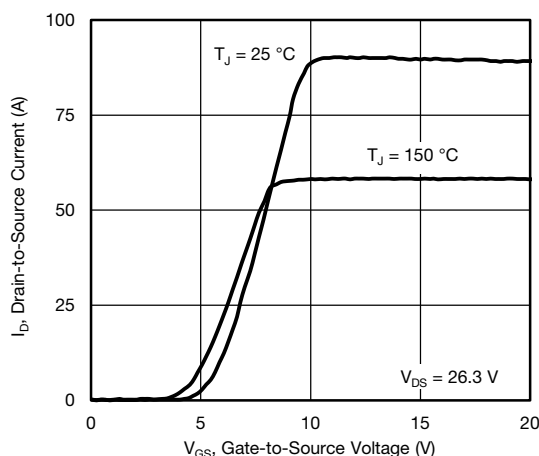
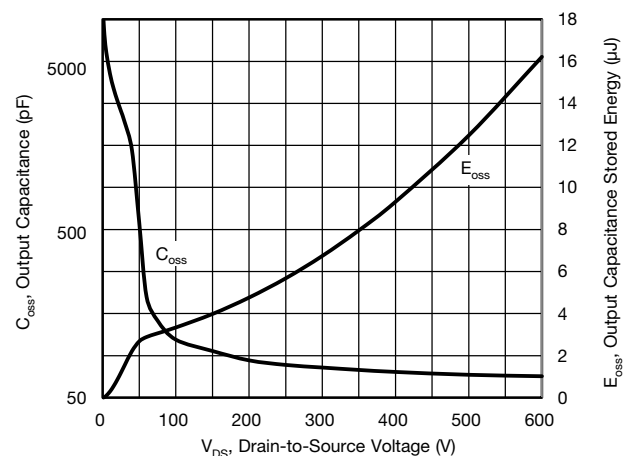
PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum junction-to-ambient	R_{thJA}	-	62	°C/W
Maximum junction-to-case (drain)	R_{thJC}	-	0.5	

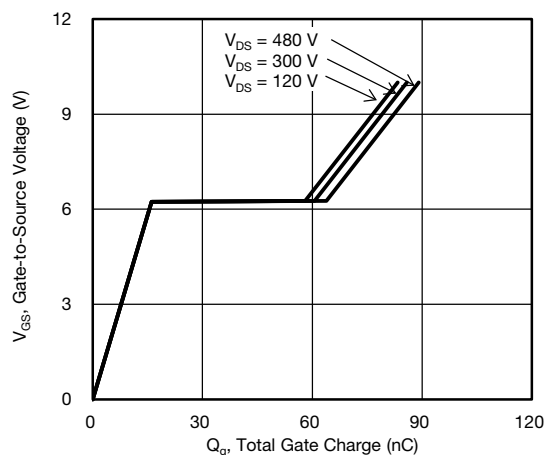
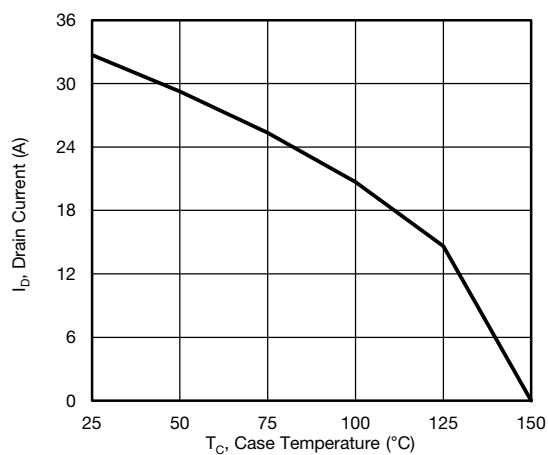
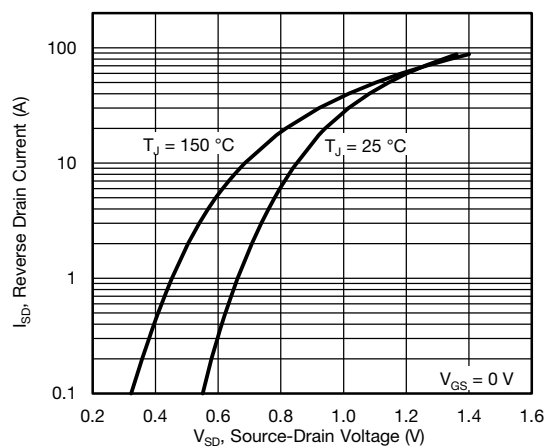
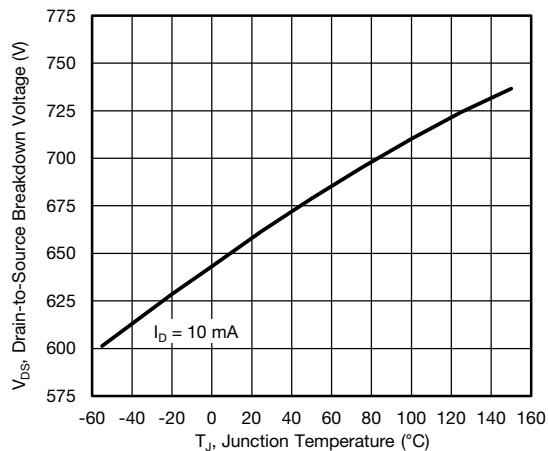
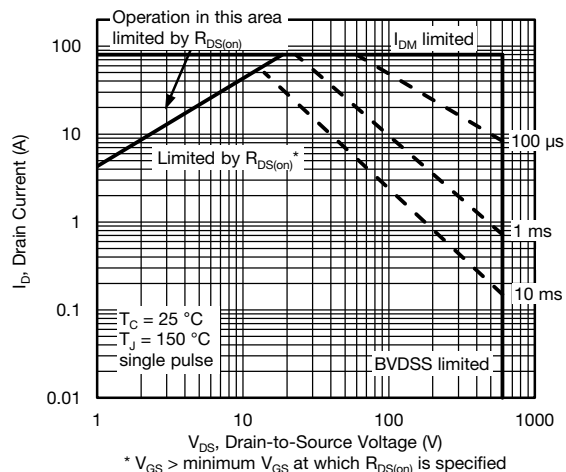
SPECIFICATIONS ($T_J = 25\text{ }^{\circ}\text{C}$, unless otherwise noted)

PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
Static							
Drain-source breakdown voltage	V_{DS}	$V_{GS} = 0\text{ V}$, $I_D = 250\text{ }\mu\text{A}$		600	-	-	V
V_{DS} temperature coefficient	$\Delta V_{DS}/T_J$	Reference to $25\text{ }^{\circ}\text{C}$, $I_D = 10\text{ mA}$		-	0.66	-	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}	$V_{GS} = \pm 20\text{ V}$		-	-	± 100	nA
		$V_{GS} = \pm 30\text{ V}$		-	-	± 1	μA
Zero gate voltage drain current	I_{DSS}	$V_{DS} = 480\text{ V}$, $V_{GS} = 0\text{ V}$		-	-	1	μA
		$V_{DS} = 480\text{ V}$, $V_{GS} = 0\text{ V}$, $T_J = 125\text{ }^{\circ}\text{C}$		-	-	500	
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}$	$I_D = 17\text{ A}$	-	0.084	0.097	Ω
Forward transconductance ^a	g_{fs}	$V_{DS} = 30\text{ V}$, $I_D = 17\text{ A}$		-	8	-	S
Dynamic							
Input capacitance	C_{iss}	$V_{GS} = 0\text{ V}$, $V_{DS} = 100\text{ V}$, $f = 1\text{ MHz}$		-	2568	-	pF
Output capacitance	C_{oss}			-	113	-	
Reverse transfer capacitance	C_{rss}			-	7	-	
Effective output capacitance, energy related ^a	$C_{o(er)}$	$V_{DS} = 0\text{ V to } 480\text{ V}$, $V_{GS} = 0\text{ V}$		-	81	-	
Effective output capacitance, time related ^b	$C_{o(tr)}$			-	421	-	
Total gate charge	Q_g	$V_{GS} = 10\text{ V}$	$I_D = 17\text{ A}$, $V_{DS} = 480\text{ V}$	-	89	134	nC
Gate-source charge	Q_{gs}			-	16	-	
Gate-drain charge	Q_{gd}			-	48	-	
Turn-on delay time	$t_{d(on)}$	$V_{DD} = 480\text{ V}$, $I_D = 17\text{ A}$, $V_{GS} = 10\text{ V}$, $R_g = 9.1\text{ }\Omega$		-	28	56	ns
Rise time	t_r			-	85	170	
Turn-off delay time	$t_{d(off)}$			-	96	192	
Fall time	t_f			-	61	122	
Gate input resistance	R_g	$f = 1\text{ MHz}$, open drain		0.2	0.5	1.0	Ω
Drain-Source Body Diode Characteristics							
Continuous source-drain diode current	I_S	MOSFET symbol showing the integral reverse p - n junction diode 		-	-	32	A
Pulsed diode forward current	I_{SM}			-	-	80	
Diode forward voltage	V_{SD}	$T_J = 25\text{ }^{\circ}\text{C}$, $I_S = 17\text{ A}$, $V_{GS} = 0\text{ V}$		-	-	1.2	V
Reverse recovery time	t_{rr}	$T_J = 25\text{ }^{\circ}\text{C}$, $I_F = I_S = 17\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_R = 400\text{ V}$		-	150	300	ns
Reverse recovery charge	Q_{rr}			-	1.1	2.2	μC
Reverse recovery current	I_{RRM}			-	14	-	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 - 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 - Temperature vs. Drain-to-Source Voltage

Fig. 9 - Maximum Safe Operating Area

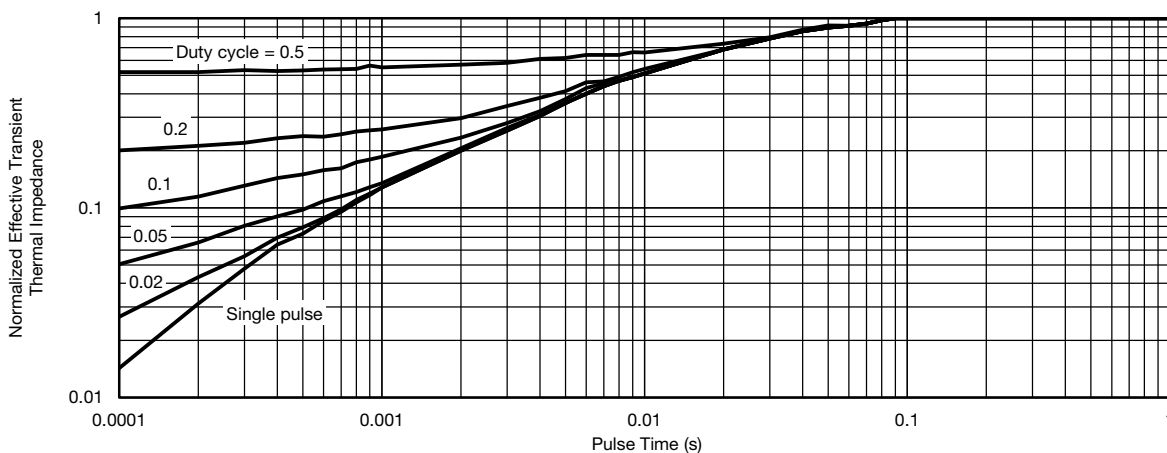

Fig. 12 - Normalized Transient Thermal Impedance, Junction-to-Case

Fig. 13 - Switching Time Test Circuit

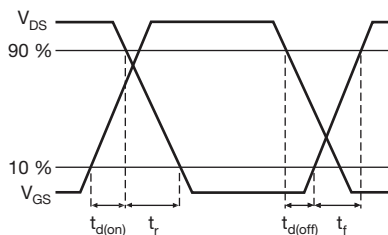
Fig. 16 - Unclamped Inductive Waveforms

Fig. 14 - Switching Time Waveforms

Fig. 17 - Basic Gate Charge Waveform

Fig. 15 - Unclamped Inductive Test Circuit

Fig. 18 - Gate Charge Test Circuit



Fig. 19 - For N-Channel

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	MILLIMETERS		INCHES	
DIM.	MIN.	MAX.	MIN.	MAX.
D1	6.86	-	0.270	-
E	9.65	10.67	0.380	0.420
E1	6.22	-	0.245	-
e	2.54 BSC		0.100 BSC	
H	14.61	15.88	0.575	0.625
L	1.78	2.79	0.070	0.110
L1	-	1.65	-	0.066
L2	-	1.78	-	0.070
L3	0.25 BSC		0.010 BSC	
L4	4.78	5.28	0.188	0.208

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RECOMMENDED MINIMUM PADS FOR D²PAK: 3-Lead



Recommended Minimum Pads
Dimensions in Inches/(mm)

[Return to Index](#)



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