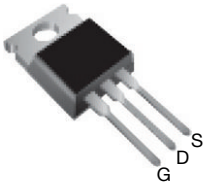
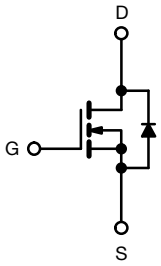
E Series Power MOSFET

TO-220AB





N-Channel MOSFET

FEATURES

- Low figure-of-merit (FOM) R_{on} x 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 Available

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)

PRODUCT SUMMARY		
V_{DS} (V) at T_J max.	650	
$R_{DS(on)}$ max. (Ω) at 25 °C	V_{GS} = 10 V	0.28
Q_g max. (nC)	78	
Q_{gs} (nC)	9	
Q_{gd} (nC)	17	
Configuration	Single	

ORDERING INFORMATION	
Package	TO-220AB
Lead (Pb)-free	SiHP15N60E-E3
Lead (Pb)-free and halogen-free	SiHP15N60E-BE3 [a]
	SiHP15N60E-GE3

Note

a. "-BE3" denotes alternate manufacturing location

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}	± 30	
Continuous drain current (T_J = 150 °C)	V_{GS} at 10 V	T_C = 25 °C	I_D	15	A
		T_C = 100 °C		9.6	
Pulsed drain current [a]			I_{DM}	39	
Linear derating factor				1.4	W/°C
Single pulse avalanche energy [b]			E_{AS}	102	mJ
Maximum power dissipation			P_D	180	W
Operating junction and storage temperature range			T_J, T_{stg}	-55 to +150	°C
Drain-source voltage slope	V_{DS} = 0 V to 80 % V_{DS}		dV/dt	70	V/ns
Reverse diode dV/dt [d]				7.7	
Soldering recommendations (peak temperature) [c]	For 10 s			300	°C

Notes

a. Repetitive rating; pulse width limited by maximum junction temperature
b. V_{DD} = 50 V, starting T_J = 25 °C, L = 11.6 mH, R_g = 25 Ω, I_{AS} = 4.2 A
c. 1.6 mm from case
d. $I_{SD} \leq I_D$, dI/dt = 100 A/µs, starting T_J = 25 °C

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THERMAL RESISTANCE RATINGS

PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum junction-to-ambient	R_{thJA}	-	62	°C/W
Maximum junction-to-case (drain)	R_{thJC}	-	0.7	

SPECIFICATIONS (T_J = 25 °C, unless otherwise noted)

PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
Static							
Drain-source breakdown voltage	V_{DS}	V_{GS} = 0 V, I_D = 250 µA		600	-	-	V
V_{DS} temperature coefficient	$\Delta V_{DS}/T_J$	Reference to 25 °C, I_D = 1 mA		-	0.71	-	V/°C
Gate-source threshold Voltage (N)	$V_{GS(th)}$	V_{DS} = V_{GS}, I_D = 250 µA		2	-	4	V
Gate-source leakage	I_{GSS}	V_{GS} = ± 20 V		-	-	± 100	nA
		V_{GS} = ± 30 V		-	-	± 1	µA
Zero gate voltage drain current	I_{DSS}	V_{DS} = 600 V, V_{GS} = 0 V		-	-	1	µA
		V_{DS} = 480 V, V_{GS} = 0 V, T_J = 125 °C		-	-	10	
Drain-source on-state resistance	$R_{DS(on)}$	V_{GS} = 10 V	I_D = 8 A	-	0.23	0.28	Ω
Forward transconductance	g_{fs}	V_{DS} = 30 V, I_D = 8 A		-	4.6	-	S
Dynamic							
Input capacitance	C_{iss}	V_{GS} = 0 V, V_{DS} = 100 V, f = 1 MHz		-	1350	-	pF
Output capacitance	C_{oss}			-	70	-	
Reverse transfer capacitance	C_{rss}			-	5	-	
Effective output capacitance, energy related [a]	$C_{o(er)}$	V_{DS} = 0 V to 480 V, V_{GS} = 0 V		-	53	-	
Effective output capacitance, time related [b]	$C_{o(tr)}$			-	177	-	
Total gate charge	Q_g	V_{GS} = 10 V	I_D = 8 A, V_{DS} = 480 V	-	39	78	nC
Gate-source charge	Q_{gs}			-	11	-	
Gate-drain charge	Q_{gd}			-	17	-	
Turn-on delay time	$t_{d(on)}$	V_{DD} = 480 V, I_D = 8 A, V_{GS} = 10 V, R_g = 9.1 Ω		-	16	32	ns
Rise time	t_r			-	26	52	
Turn-off delay time	$t_{d(off)}$			-	41	82	
Fall time	t_f			-	22	44	
Gate input resistance	R_g	f = 1 MHz, open drain		0.3	0.86	1.7	Ω
Drain-Source Body Diode Characteristics							
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 °C, I_S = 8 A, V_{GS} = 0 V		-	1.0	1.2	V
Reverse recovery time	t_{rr}	T_J = 25 °C, I_F = I_S = 8 A, dI/dt = 100 A/µs, V_R = 25 V		-	302	604	ns
Reverse recovery charge	Q_{rr}			-	4.0	8	µC
Reverse recovery current	I_{RRM}			-	24	-	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}

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TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

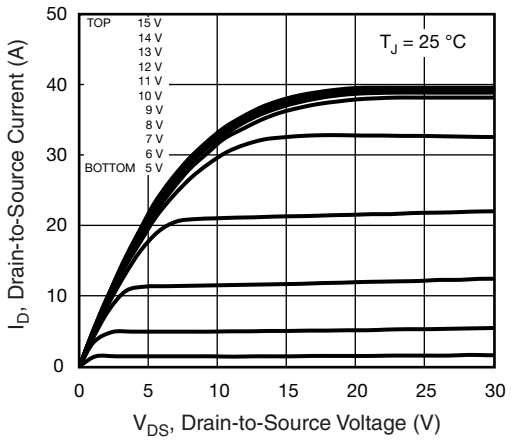

Fig. 1 - Typical Output Characteristics

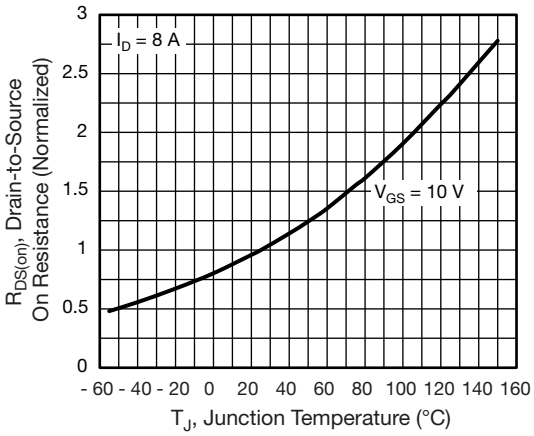

Fig. 4 - Normalized On-Resistance vs. Temperature

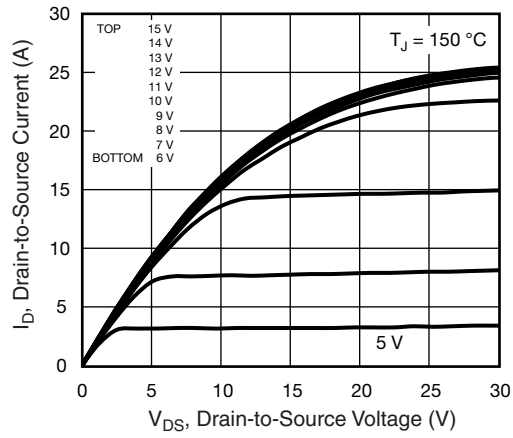

Fig. 2 - Typical Output Characteristics

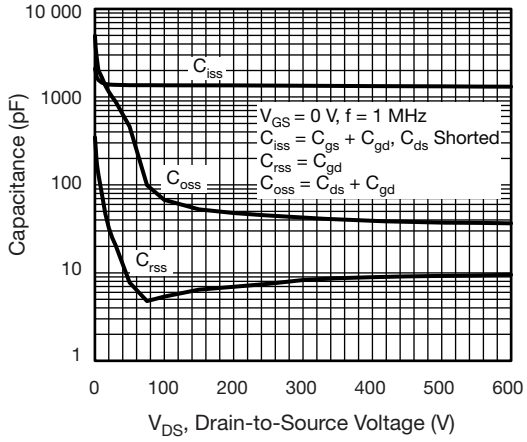

Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

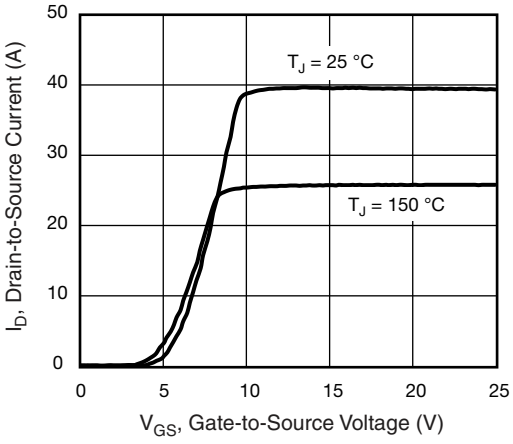

Fig. 3 - Typical Transfer Characteristics

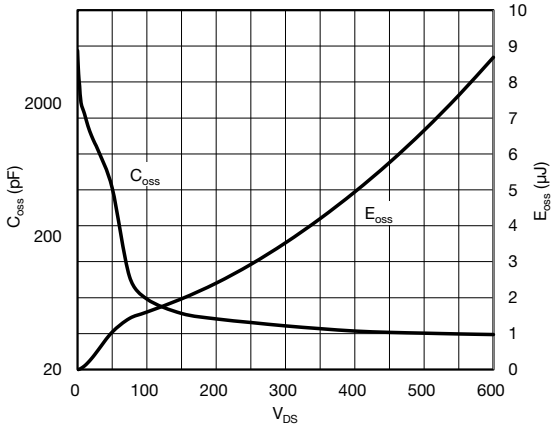

Fig. 6 - C_{oss} and E_{oss} vs. V_{DS}

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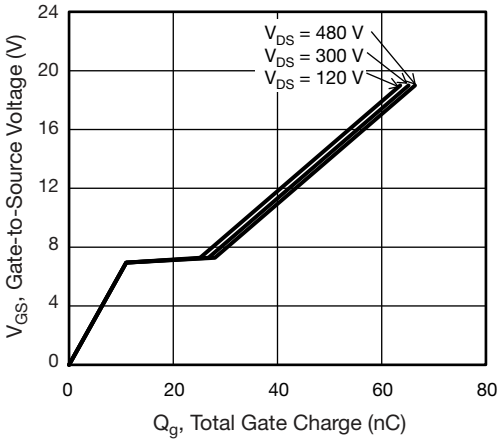

Fig. 7 - Typical Gate Charge vs. Gate-to-Source Voltage

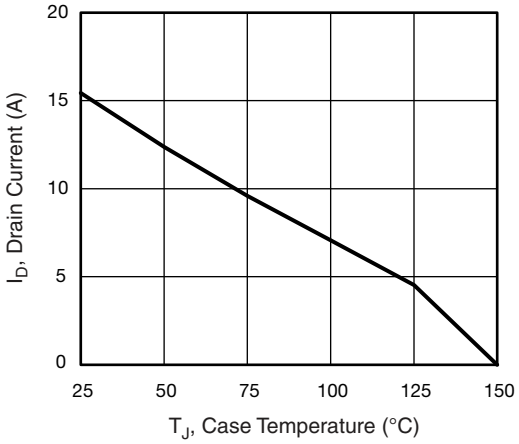

Fig. 10 - Maximum Drain Current vs. Case Temperature

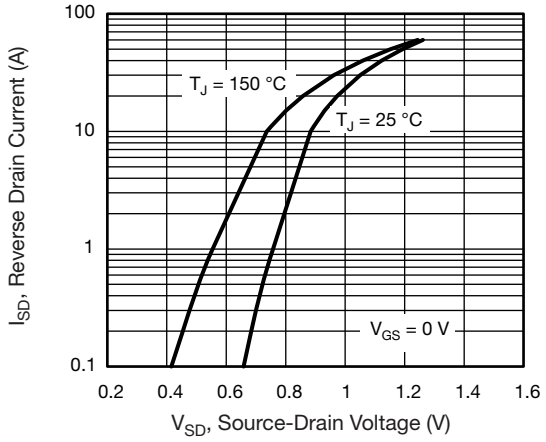

Fig. 8 - Typical Source-Drain Diode Forward Voltage

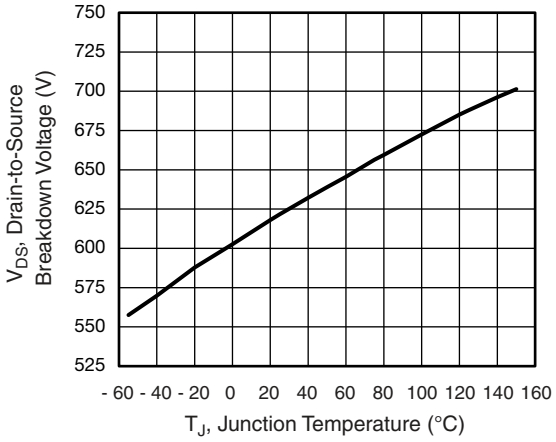

Fig. 11 - Temperature vs. Drain-to-Source Voltage

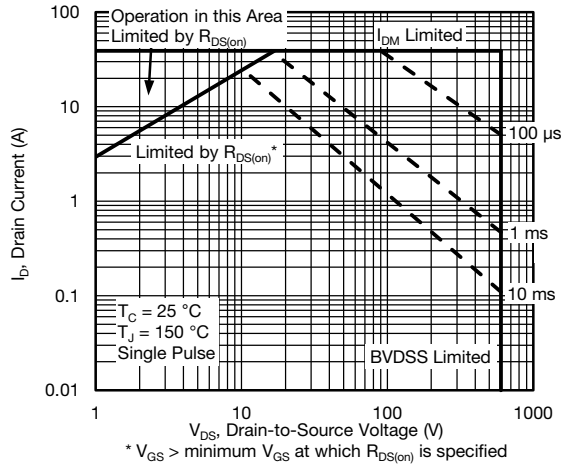

Fig. 9 - Maximum Safe Operating Area

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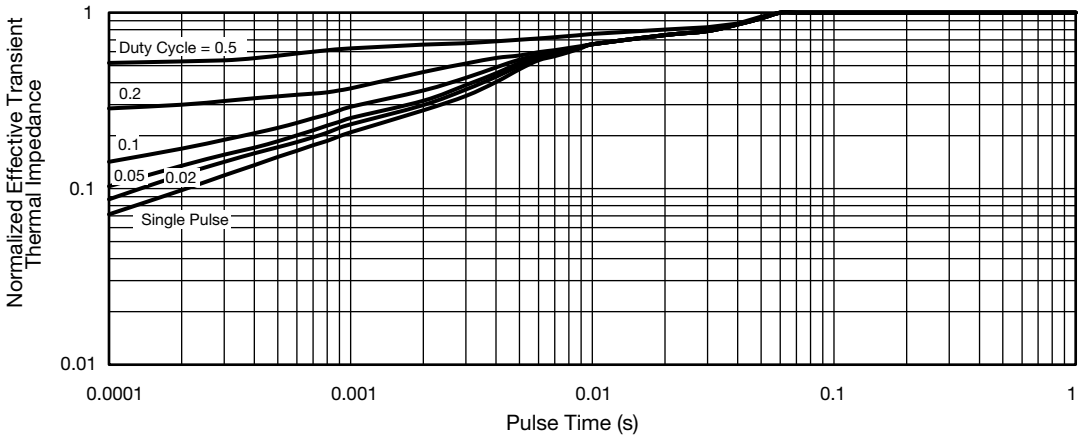

Fig. 12 - Normalized Thermal Transient Impedance, Junction-to-Case

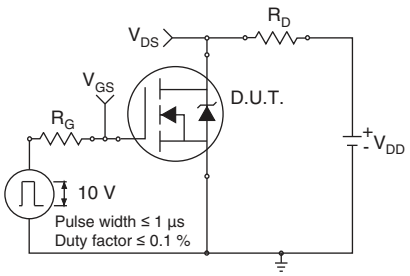

Fig. 13 - Switching Time Test Circuit

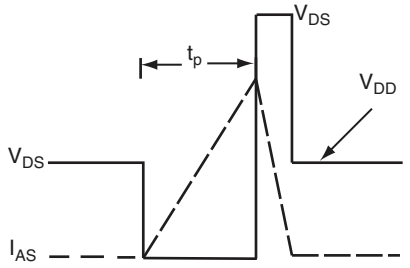

Fig. 16 - Unclamped Inductive Waveforms

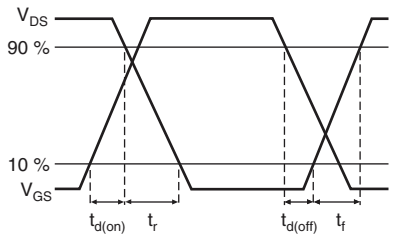

Fig. 14 - Switching Time Waveforms

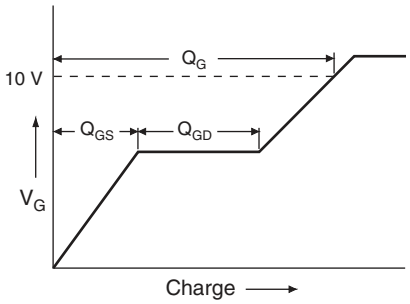

Fig. 17 - Basic Gate Charge Waveform

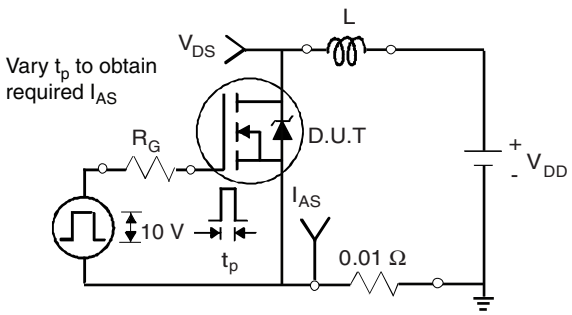

Fig. 15 - Unclamped Inductive Test Circuit

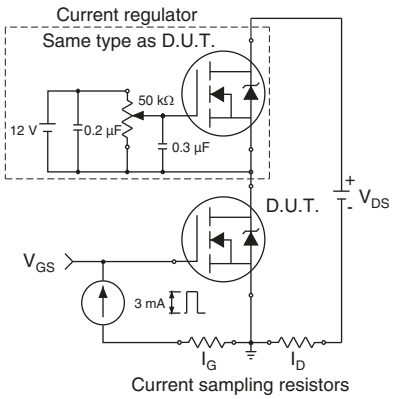

Fig. 18 - Gate Charge Test Circuit

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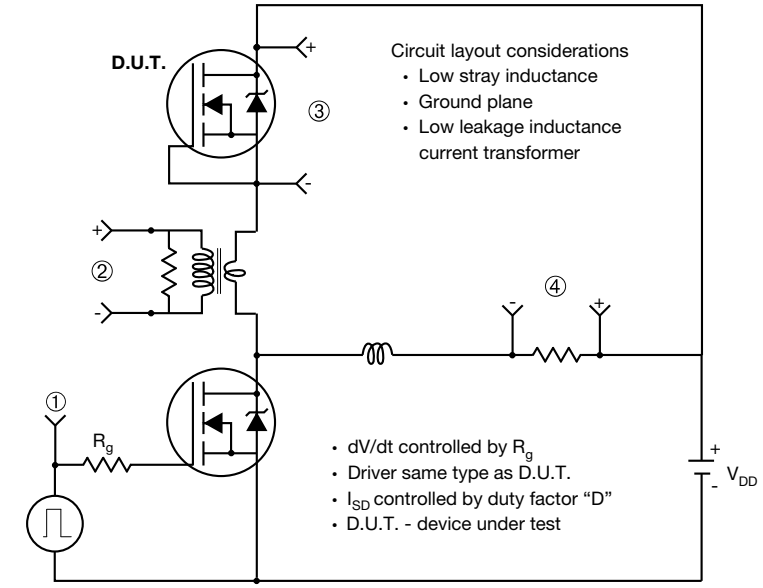
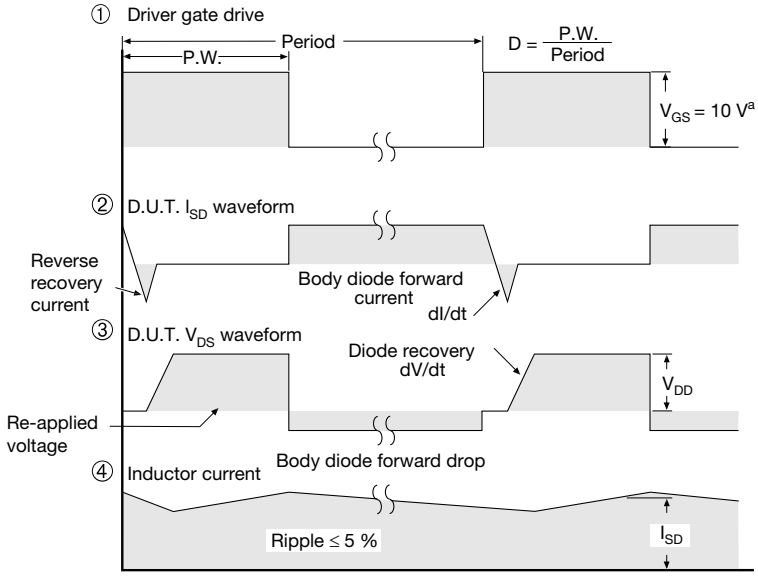
Peak Diode Recovery dV/dt Test Circuit





Note

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

Fig. 19 - For N-Channel

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