

E Series Power MOSFET

Thin-Lead TO-220 FULLPAK


N-Channel MOSFET

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


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	
$R_{DS(on)}$ typ. (Ω) at 25 °C	$V_{GS} = 10$ V	0.156
Q_g max. (nC)	96	
Q_{gs} (nC)	12	
Q_{gd} (nC)	25	
Configuration	Single	

ORDERING INFORMATION

Package	Thin-Lead TO-220 FULLPAK
Lead (Pb)-free	SiHA22N60AE-E3
Lead (Pb)-free and halogen-free	SiHA22N60AE-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}	± 30	
Continuous drain current ($T_J = 150$ °C) ^e	V_{GS} at 10 V	$T_C = 25$ °C	8
		$T_C = 100$ °C	5
Pulsed drain current ^a	I_{DM}	49	A
Linear derating factor		0.26	W/°C
Single pulse avalanche energy ^b	E_{AS}	204	mJ
Maximum power dissipation	P_D	33	W
Operating junction and storage temperature range	T_J, T_{stg}	-55 to +150	°C
Drain-source voltage slope	dV/dt	$T_J = 125$ °C	70
Reverse diode dV/dt ^d		31	
Soldering recommendations (peak temperature) ^c	For 10 s	300	°C
Mounting torque	M3 screw	0.6	Nm

Notes

- Repetitive rating; pulse width limited by maximum junction temperature
- $V_{DD} = 140$ V, starting $T_J = 25$ °C, $L = 28.2$ mH, $R_g = 25$ Ω , $I_{AS} = 3.8$ A
- 1.6 mm from case
- $I_{SD} \leq I_D$, $dI/dt = 100$ A/ μ s, starting $T_J = 25$ °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}	-	3.8	

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	ΔV _{DS} /T _J	Reference to 25 °C, I _D = 250 μA		-	0.72	-	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 = 11 A	-	0.156	0.180	Ω
Forward transconductance	g _{fs}	V _{DS} = 30 V, I _D = 11 A		-	4.8	-	S
Dynamic							
Input capacitance	C _{iss}	V _{GS} = 0 V, V _{DS} = 100 V, f = 1 MHz		-	1451	-	pF
Output capacitance	C _{oss}			-	73	-	
Reverse transfer capacitance	C _{rss}			-	5	-	
Effective output capacitance, energy related ^a	C _{o(er)}			-	50	-	
Effective output capacitance, time related ^b	C _{o(tr)}	V _{DS} = 0 V to 480 V, V _{GS} = 0 V		-	258	-	
Total gate charge	Q _g	V _{GS} = 10 V	I _D = 11 A, V _{DS} = 480 V	-	48	96	nC
Gate-source charge	Q _{gs}			-	12	-	
Gate-drain charge	Q _{gd}			-	25	-	
Turn-on delay time	t _{d(on)}	V _{DD} = 480 V, I _D = 11 A, V _{GS} = 10 V, R _g = 9.1 Ω		-	19	38	ns
Rise time	t _r			-	33	66	
Turn-off delay time	t _{d(off)}			-	45	90	
Fall time	t _f			-	21	42	
Gate input resistance	R _g			f = 1 MHz, open drain		0.3	
Drain-Source Body Diode Characteristics							
Continuous source-drain diode current	I _S	MOSFET symbol showing the integral reverse p - n junction diode 		-	-	20	A
Pulsed diode forward current	I _{SM}			-	-	49	
Diode forward voltage	V _{SD}	T _J = 25 °C, I _S = 11 A, V _{GS} = 0 V		-	-	1.2	V
Reverse recovery Time	t _{rr}	T _J = 25 °C, I _F = I _S = 11 A, dI/dt = 100 A/μs, V _R = 25 V		-	319	638	ns
Reverse recovery charge	Q _{rr}			-	4.9	9.8	μC
Reverse recovery current	I _{RRM}			-	28	-	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)

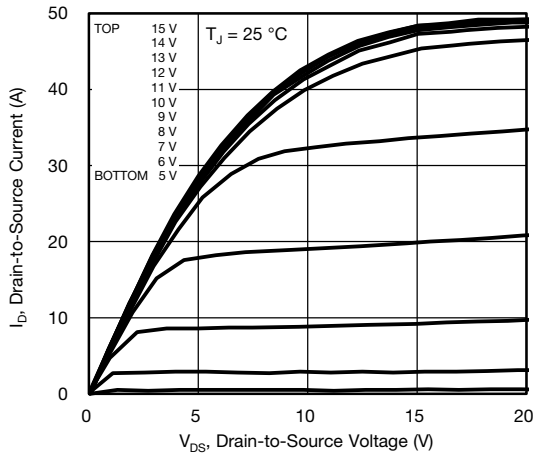


Fig. 1 - Typical Output Characteristics

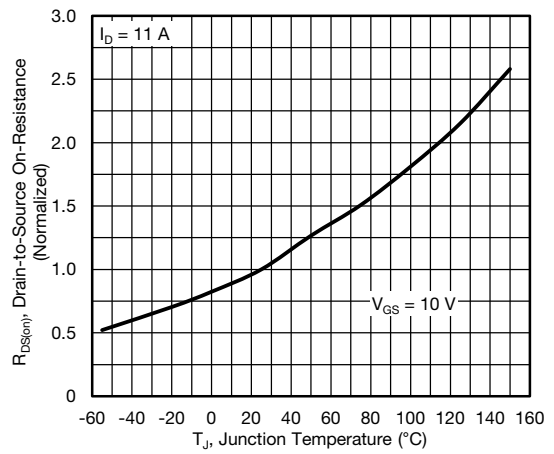


Fig. 4 - Normalized On-Resistance vs. Temperature

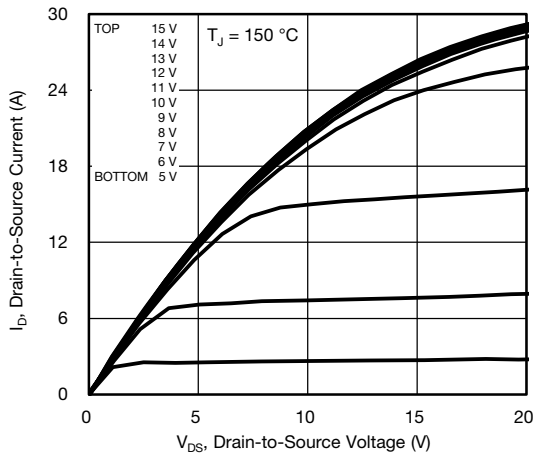


Fig. 2 - Typical Output Characteristics

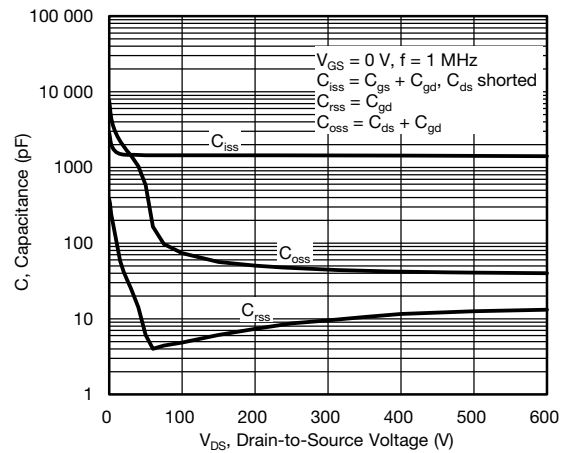


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

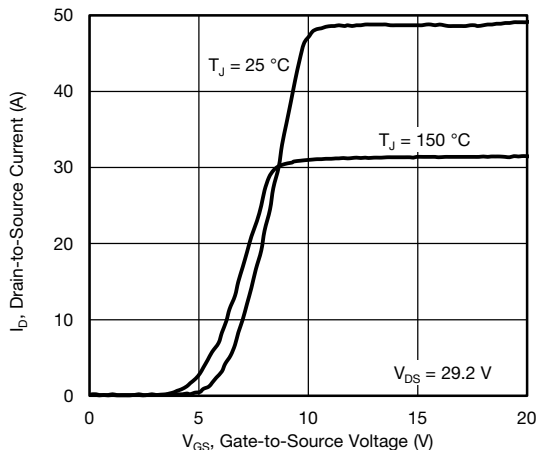


Fig. 3 - Typical Transfer Characteristics

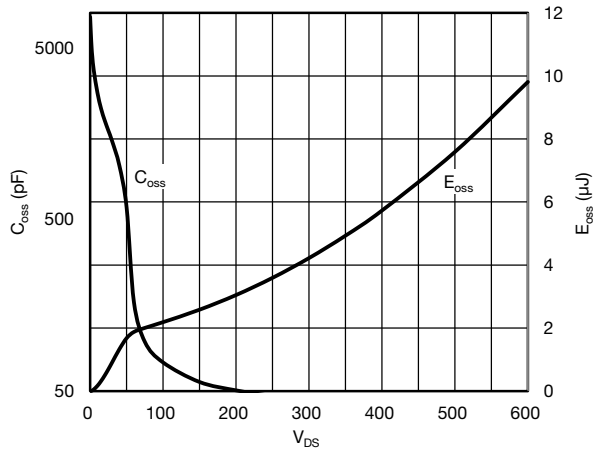


Fig. 6 - C_{oss} and E_{oss} vs. V_{ds}



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

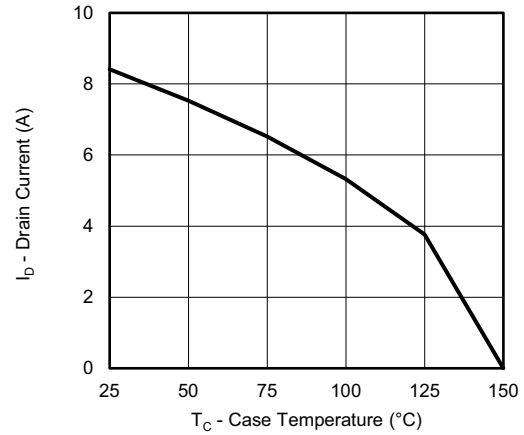


Fig. 10 - Maximum Drain Current vs. Case Temperature

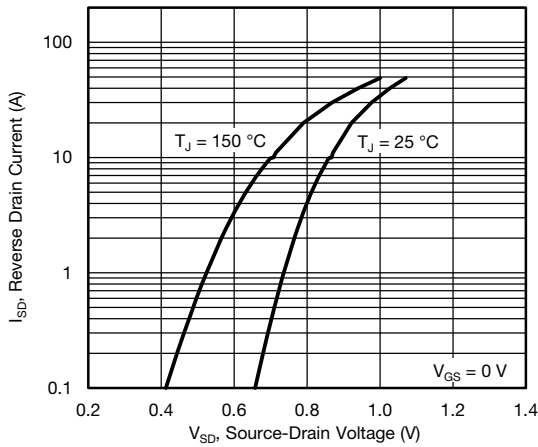


Fig. 8 - Typical Source-Drain Diode Forward Voltage

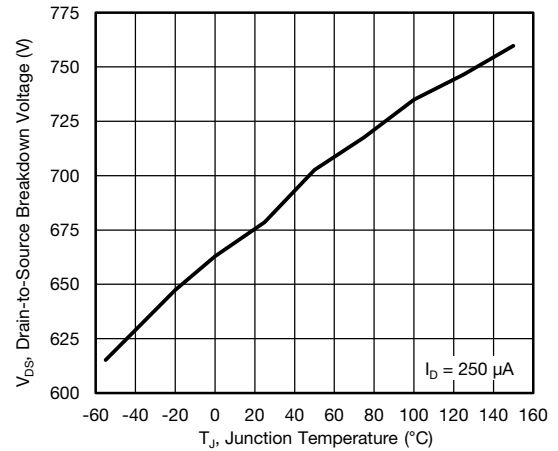


Fig. 11 - Temperature vs. Drain-to-Source Voltage

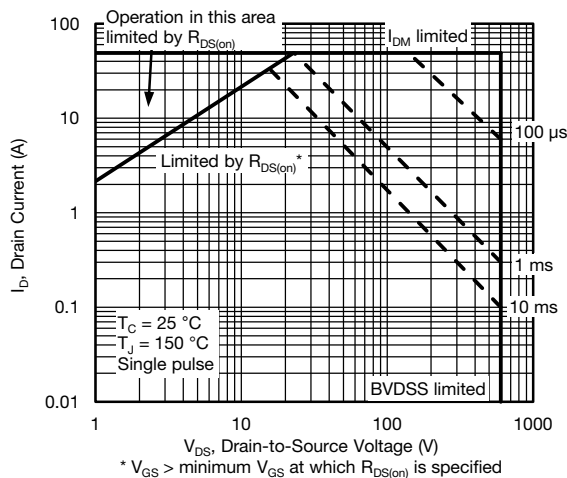


Fig. 9 - Maximum Safe Operating Area

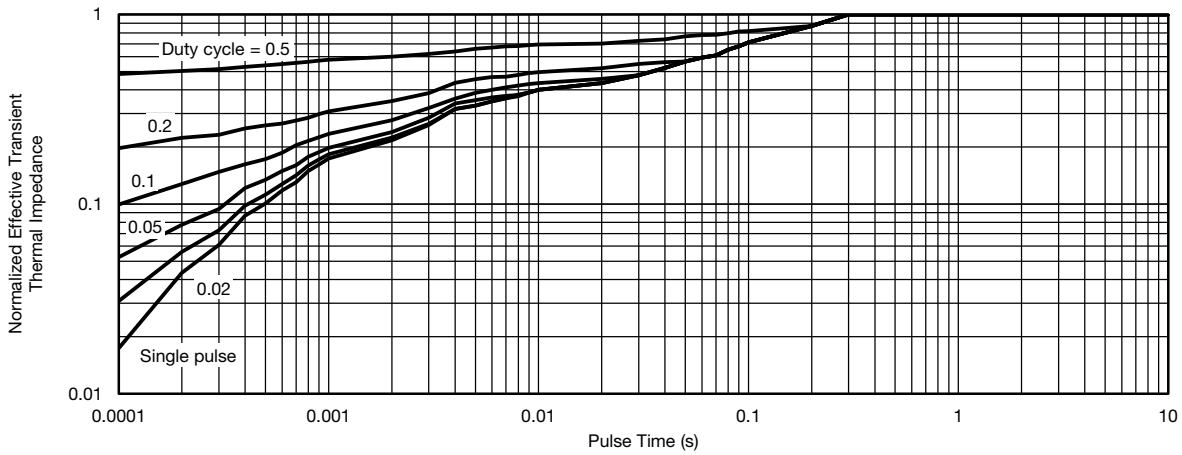


Fig. 12 - Normalized Thermal Transient Impedance, Junction-to-Case



Fig. 13 - Switching Time Test Circuit

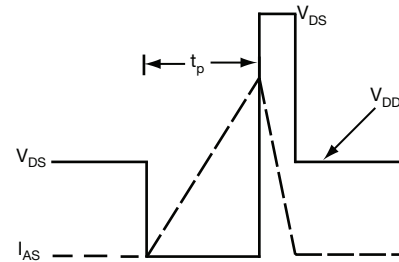


Fig. 16 - Unclamped Inductive Waveforms

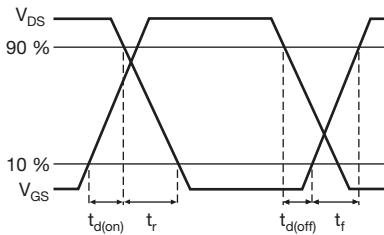


Fig. 14 - Switching Time Waveforms

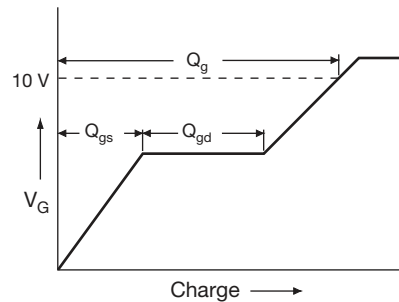


Fig. 17 - Basic Gate Charge Waveform

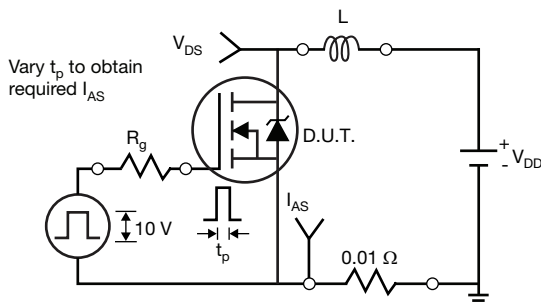


Fig. 15 - Unclamped Inductive Test Circuit

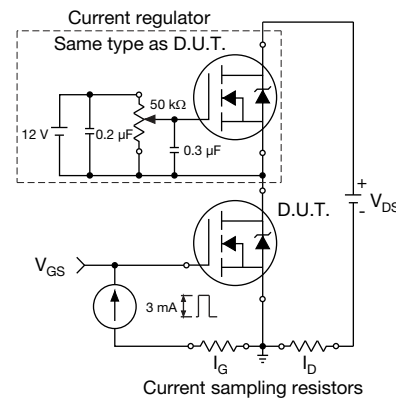


Fig. 18 - Gate Charge Test Circuit

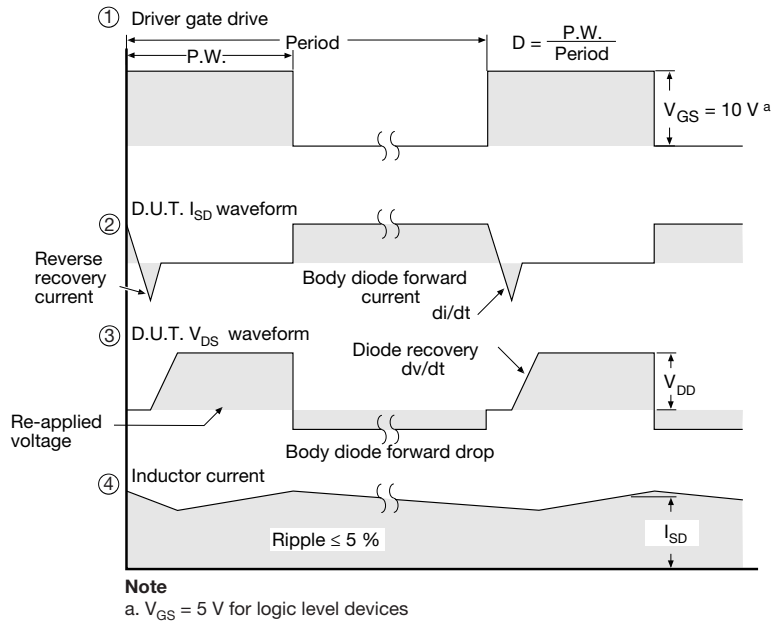
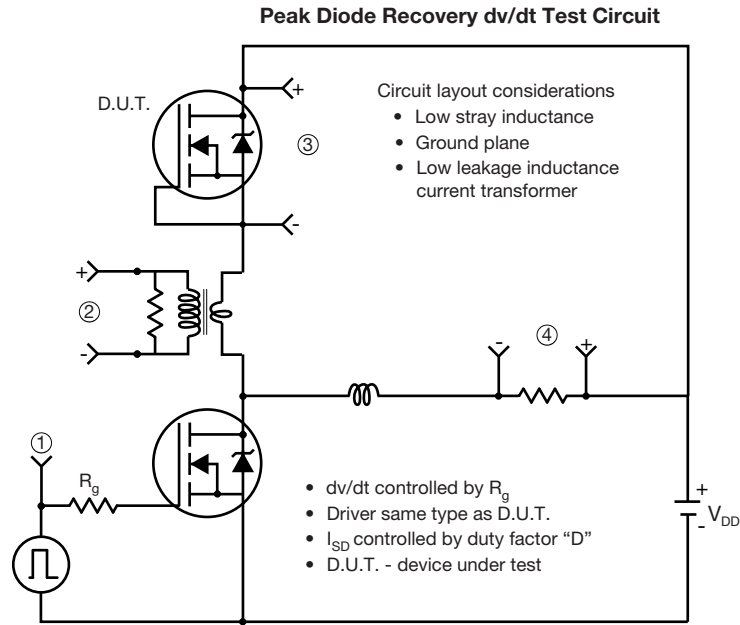


Fig. 19 - For N-Channel

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TO-220 FULLPAK Thin Lead



SYMBOL	DIMENSIONS			
	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	4.30	4.70	0.169	0.185
A1	2.50	2.90	0.098	0.114
A2	2.40	2.80	0.094	0.110
b	0.60	0.80	0.024	0.031
b2	0.60	0.90	0.024	0.035
c	-	0.60	-	0.024
D	8.30	8.70	0.327	0.342
d1	14.70	15.30	0.579	0.602
d2	2.90	3.10	0.114	0.122
d3	3.30	3.70	0.130	0.146
E	9.70	10.30	0.382	0.406
e	2.50	2.70	0.098	0.106
L	13.40	13.80	0.528	0.543
L1	1.00	2.80	0.039	0.110
Ø P	3.00	3.40	0.118	0.134

ECN: E20-0684-Rev. D, 28-Dec-2020
DWG: 6021



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