

Automotive E Series Power MOSFET with Fast Body Diode

PRODUCT SUMMARY	
V _{DS} (V) at T _J max.	700
R _{DS(on)} typ. at 25 °C (Ω)	V _{GS} = 10 V 0.045
Q _g typ. (nC)	229
Q _{gs} (nC)	53
Q _{gd} (nC)	91
Configuration	Single

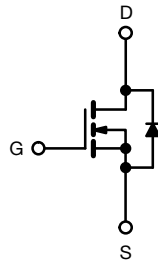
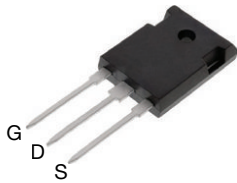
FEATURES

- Fast body diode MOSFET using Automotive Grade E series technology
- Reduced t_{rr}, Q_{rr}, and I_{RRM}
- Low figure-of-merit (FOM) R_{on} x Q_g
- Low input capacitance (C_{iss})
- Low switching losses due to reduced Q_{rr}
- 175 °C operating temperature
- AEC-Q101 qualified
- 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

TO-247AD



N-Channel MOSFET

APPLICATIONS

- Automotive onboard charger
- Automotive DC/DC converter

ORDERING INFORMATION	
Package	TO-247AD
Lead (Pb)-Free and Halogen-Free	SQW61N65EF-GE3


ABSOLUTE MAXIMUM RATINGS (T _C = 25 °C, unless otherwise noted)			
PARAMETER	SYMBOL	LIMIT	UNIT
Drain-Source Voltage	V _{DS}	650	V
Gate-Source Voltage	V _{GS}	± 30	
Continuous Drain Current (T _J = 175 °C)	V _{GS} at 10 V	T _C = 25 °C	A
		T _C = 100 °C	
Pulsed Drain Current ^a	I _{DM}	187	
Linear Derating Factor		4.2	W/°C
Single Pulse Avalanche Energy ^b	E _{AS}	1323	mJ
Maximum Power Dissipation	P _D	625	W
Operating Junction and Storage Temperature Range	T _J , T _{stg}	-55 to +175	°C
Drain-Source Voltage Slope	dV/dt	70	V/ns
Reverse Diode dV/dt ^d		50	
Soldering Recommendations (Peak temperature) ^c	For 10 s	260	°C

Notes

- Repetitive rating; pulse width limited by maximum junction temperature
- V_{DD} = 140 V, starting T_J = 25 °C, L = 73.5 mH, R_g = 25 Ω, I_{AS} = 6 A
- 1.6 mm from case
- I_{SD} ≤ I_D, di/dt = 470 A/μs, starting T_J = 25 °C



THERMAL RESISTANCE RATINGS			
PARAMETER	SYMBOL	LIMIT	UNIT
Maximum Junction-to-Ambient	R_{thJA}	40	°C/W
Maximum Junction-to-Case (Drain)	R_{thJC}	0.24	

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}	$V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$	650	-	-	V	
V_{DS} Temperature Coefficient	$\Delta V_{DS}/T_J$	Reference to $25\text{ }^\circ\text{C}, I_D = 30\text{ mA}$	-	0.77	-	V/°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}	$V_{DS} = 520\text{ V}, V_{GS} = 0\text{ V}$	-	-	1	μA	
		$V_{DS} = 520\text{ V}, V_{GS} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$	-	-	500	μA	
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}, I_D = 32\text{ A}$	-	0.045	0.052	Ω	
Forward Transconductance	g_{fs}	$V_{DS} = 30\text{ V}, I_D = 32\text{ A}$	-	28	-	S	
Dynamic							
Input Capacitance	C_{iss}	$V_{GS} = 0\text{ V}, V_{DS} = 100\text{ V}, f = 1\text{ MHz}$	-	7379	-	pF	
Output Capacitance	C_{oss}		-	310	-		
Reverse Transfer Capacitance	C_{rss}		-	4	-		
Effective Output Capacitance, Energy Related ^a	$C_{o(er)}$		$V_{DS} = 0\text{ V to } 520\text{ V}, V_{GS} = 0\text{ V}$	-	213		-
Effective Output Capacitance, Time Related ^b	$C_{o(tr)}$			-	841		-
Total Gate Charge	Q_g	$V_{GS} = 10\text{ V}, I_D = 32\text{ A}, V_{DS} = 520\text{ V}$	-	229	344	nC	
Gate-Source Charge	Q_{gs}		-	53	-		
Gate-Drain Charge	Q_{gd}		-	91	-		
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = 520\text{ V}, I_D = 32\text{ A}, V_{GS} = 10\text{ V}, R_g = 9.1\text{ }\Omega$	-	65	98	ns	
Rise Time	t_r		-	107	161		
Turn-Off Delay Time	$t_{d(off)}$		-	252	378		
Fall Time	t_f		-	102	153		
Gate Input Resistance	R_g		$f = 1\text{ MHz}, \text{ open drain}$	0.5	1		2
Drain-Source Body Diode Characteristics							
Continuous Source-Drain Diode Current	I_S	MOSFET symbol showing the integral reverse p - n junction diode 	-	-	62	A	
Pulsed Diode Forward Current	I_{SM}		-	-	187		
Diode Forward Voltage	V_{SD}	$T_J = 25\text{ }^\circ\text{C}, I_S = 32\text{ A}, V_{GS} = 0\text{ V}$	-	0.9	1.2	V	
Reverse Recovery Time	t_{rr}	$T_J = 25\text{ }^\circ\text{C}, I_F = I_S = 30.5\text{ A}, di/dt = 100\text{ A}/\mu\text{s}, V_R = 400\text{ V}$	-	204	408	ns	
Reverse Recovery Charge	Q_{rr}		-	1.9	3.8	μC	
Reverse Recovery Current	I_{RRM}		-	18	-	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)

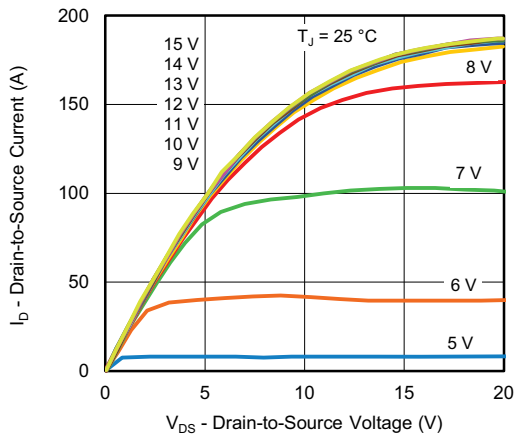


Fig. 1 - Typical Output Characteristics

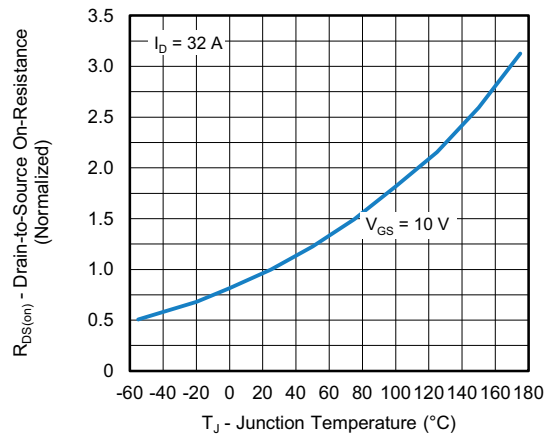


Fig. 4 - Normalized On-Resistance vs. Temperature

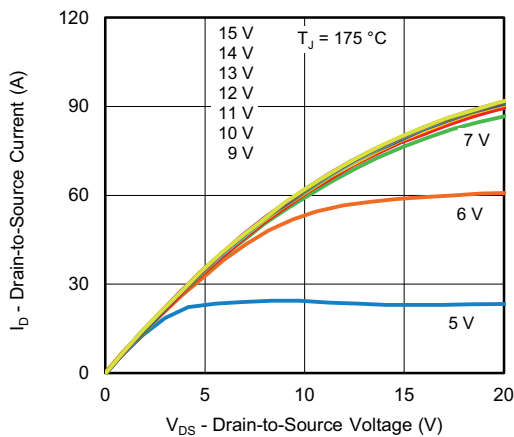


Fig. 2 - Typical Output Characteristics

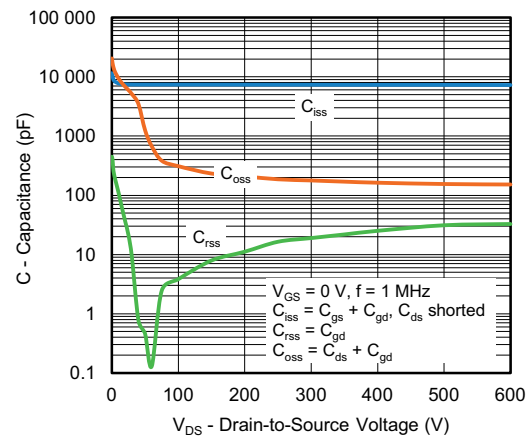


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

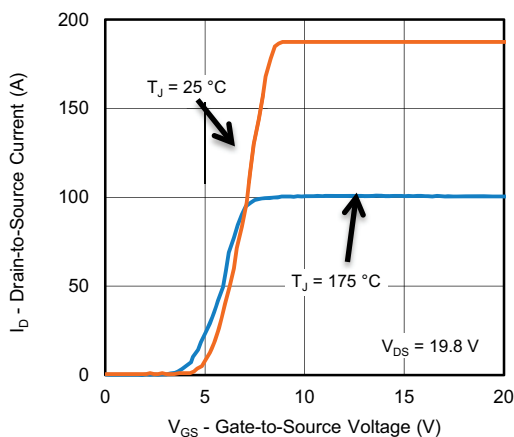


Fig. 3 - Typical Transfer Characteristics

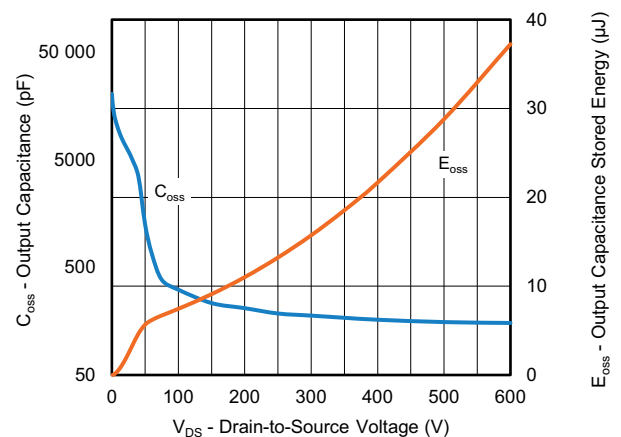


Fig. 6 - C_{oss} and E_{oss} vs. V_{DS}

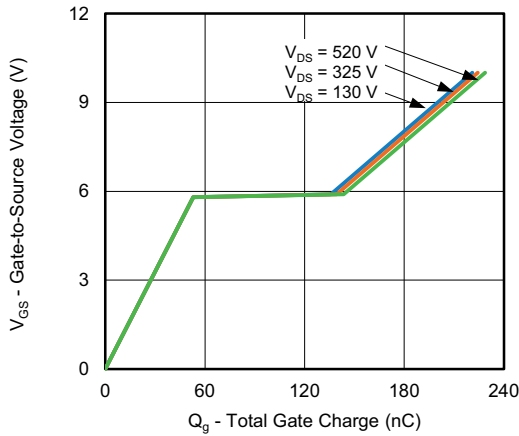


Fig. 7 - Typical Gate Charge vs. Gate-to-Source Voltage

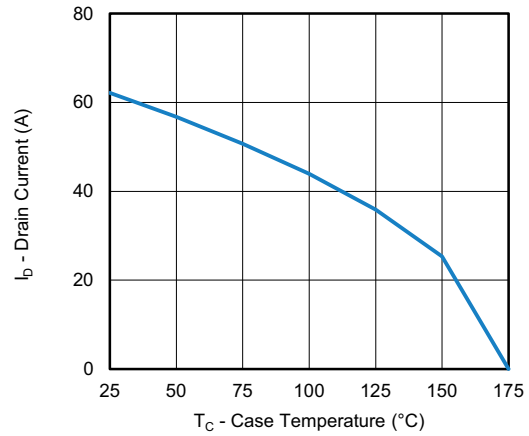


Fig. 10 - Maximum Drain Current vs. Case Temperature

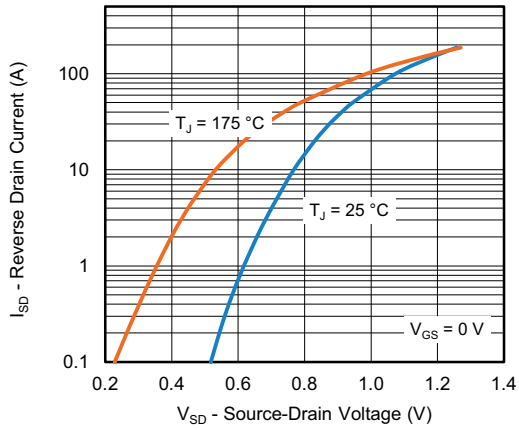


Fig. 8 - Typical Source-Drain Diode Forward Voltage

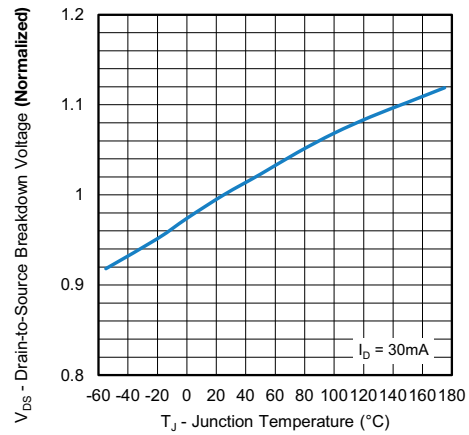


Fig. 11 - Temperature vs. Drain-to-Source Voltage

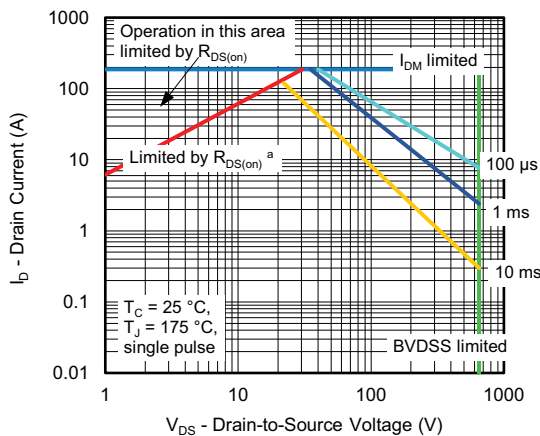


Fig. 9 - Maximum Safe Operating Area

Note

a. $V_{GS} >$ minimum V_{GS} at which $R_{DS(on)}$ is specified

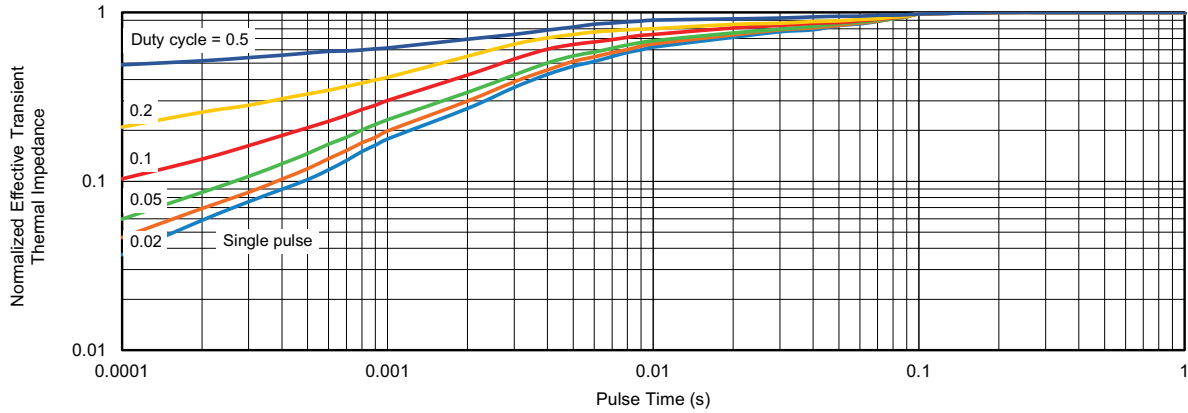


Fig. 12 - Normalized Thermal Transient Impedance, Junction-to-Case

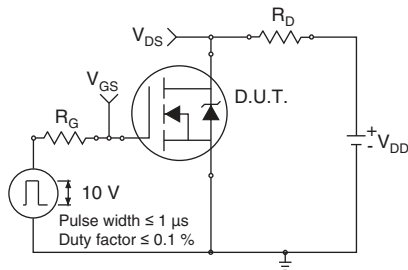


Fig. 13 - Switching Time Test Circuit

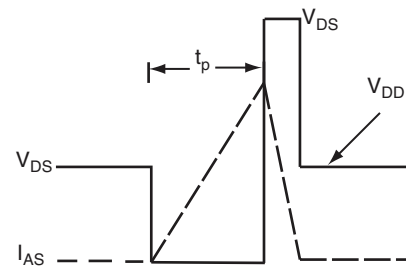


Fig. 16 - Unclamped Inductive Waveforms

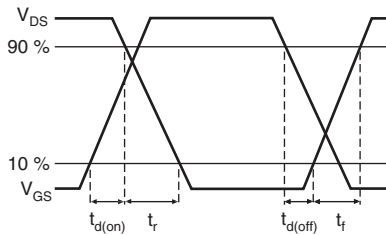


Fig. 14 - Switching Time Waveforms

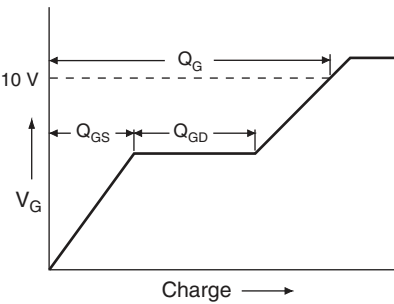


Fig. 17 - Basic Gate Charge Waveform

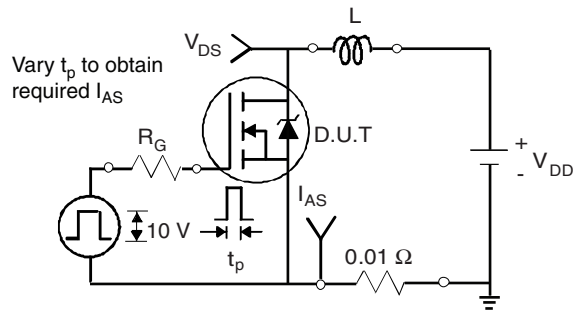


Fig. 15 - Unclamped Inductive Test Circuit

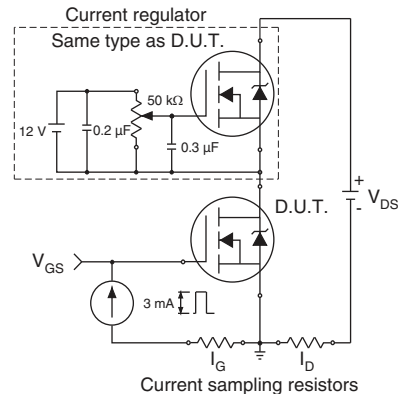


Fig. 18 - Gate Charge Test Circuit

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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