Power MOSFET, 40 A

SOT-227

PRODUCT SUMMARY	
V_{DSS}	500 V
$R_{DS(on)}$	0.106 Ω
I_D	40 A
Type	Modules - MOSFET
Package	SOT-227

FEATURES

- Fully isolated package
- Easy to use and parallel
- Low on-resistance
- Dynamic dV/dt rating
- Fully avalanche rated
- Simple drive requirements
- Low drain to case capacitance
- Low internal inductance
- UL approved file E78996
- Designed for industrial level
- Material categorization: For definitions of compliance please see www.vishay.com/doc?99912

Pb-free
RoHS
COMPLIANT

DESCRIPTION

Third Generation Power MOSFETs from Vishay Semiconductors provide the designer with the best combination of fast switching, ruggedized device design, low on-resistance and cost-effectiveness.

The SOT-227 package is universally preferred for all commercial-industrial applications at power dissipation levels to approximately 500 W. The low thermal resistance of the SOT-227 contribute to its wide acceptance throughout the industry.

ABSOLUTE MAXIMUM RATINGS				
PARAMETER	**SYMBOL**	**TEST CONDITIONS**	**MAX.**	**UNITS**
Continuous drain current at V_{GS} 10 V	I_D	T_C = 25 °C	40	A
		T_C = 90 °C	29	
Pulsed drain current	I_{DM} (1)		150	
Power dissipation	P_D	T_C = 25 °C	543	W
		T_C = 90 °C	261	
Gate to source voltage	V_{GS}		± 20	V
Single pulse avalanche energy	E_{AS} (2)		400	mJ
Repetitive avalanche current	I_{AR} (1)		13	A
Repetitive avalanche energy	E_{AR} (1)		42	mJ
Peak diode recovery dV/dt	dV/dt (3)		10	V/ns
Operating junction and storage temperature range	T_J, T_{Stg}		- 55 to + 150	°C
Insulation withstand voltage (AC-RMS)	V_{ISO}		2.5	kV
Mounting torque		M4 screw, on terminals and heatsink	1.3	Nm

Notes

(1) Repetitive rating; pulse width limited by maximum junction temperature (see fig. 18)

(2) Starting T_J = 25 °C, L = 500 μH, R_g = 2.4 Ω, I_{AS} = 40 A (see fig. 18)

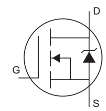
(3) $I_{SD} \leq 40$ A, $dI_F/dt \leq 200$ A/μs, $V_{DD} \leq V_{(BR)DSS}$, $T_J \leq 150$ °C

THERMAL - MECHANICAL SPECIFICATIONS						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Junction and storage temperature range	T_J, T_{Stg}		- 55	-	150	°C
Junction to case	R_{thJC}		-	-	0.23	°C/W
Case to heatsink	R_{thCS}	Flat, greased surface	-	0.05	-	
Weight			-	30	-	g
Mounting torque			-	-	1.3	Nm
Case style			SOT-227			

ELECTRICAL CHARACTERISTCS (T_J = 25 °C unless otherwise noted)						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Drain to source breakdown voltage	$V_{(BR)DSS}$	V_{GS} = 0 V, I_D = 1.0 mA	500	-	-	V
Breakdown voltage temperature coefficient	$\Delta V_{(BR)DSS}/\Delta T_J$	Reference to 25 °C, I_D = 1 mA	-	0.65	-	V/°C
Static drain to source on-resistance	$R_{DS(on)}$ (1)	V_{GS} = 10 V, I_D = 23 A	-	106	130	mΩ
Gate threshold voltage	$V_{GS(th)}$	V_{DS} = V_{GS}, I_D = 250 μA	2	3	4	V
		V_{DS} = V_{GS}, I_D = 250 μA, T_J = 125 °C	-	1.9	-	
Forward transconductance	g_{fs}	V_{DS} = 50 V, I_D = 23 A	-	29	-	S
Drain to source leakage current	I_{DSS}	V_{DS} = 500 V, V_{GS} = 0 V	-	0.5	50	μA
		V_{DS} = 500 V, V_{GS} = 0 V, T_J = 125 °C	-	30	500	
		V_{DS} = 500 V, V_{GS} = 0 V, T_J = 150 °C	-	0.2	3	mA
Gate to source forward leakage	I_{GSS}	V_{GS} = 20 V	-	-	200	nA
Gate to source reverse leakage		V_{GS} = - 20 V	-	-	- 200	
Total gate charge	Q_g	I_D = 38 A V_{DS} = 400 V V_{GS} = 10 V; see fig. 15 and 19 (1)	-	280	420	nC
Gate to source charge	Q_{gs}		-	37	55	
Gate to drain ("Miller") charge	Q_{gd}		-	150	220	
Turn-on delay time	$t_{d(on)}$	V_{DD} = 250 V, I_D = 40 A, R_g = 2.4 Ω, L = 500 μH, diode used: 60APH06	-	143	-	ns
Rise time	t_r		-	33	-	
Turn-off delay time	$t_{d(off)}$		-	107	-	
Fall time	t_f		-	36	-	
Turn-on delay time	$t_{d(on)}$	V_{DD} = 250 V, I_D = 40 A, R_g = 2.4 Ω, L = 500 μH, T_J = 125 °C, diode used: 60APH06	-	145	-	ns
Rise time	t_r		-	35	-	
Turn-off delay time	$t_{d(off)}$		-	110	-	
Fall time	t_f		-	40	-	
Internal source inductance	L_S	Between lead, and center of die contact	-	5	-	nH
Input capacitance	C_{iss}	V_{GS} = 0 V V_{DS} = 25 V f = 1.0 MHz, see fig. 14	-	6900	-	pF
Output capacitance	C_{oss}		-	1600	-	
Reverse transfer capacitance	C_{rss}		-	580	-	

Note

(1) Pulse width ≤ 300 μs, duty cycle ≤ 2 %

SOURCE-DRAIN RATINGS AND CHARACTERISTICS						
PARAMETER	**SYMBOL**	**TEST CONDITIONS**	**MIN.**	**TYP.**	**MAX.**	**UNITS**
Continuous source current (body diode)	I_S	MOSFET symbol showing the integral reverse p-n junction diode. 	-	-	38	A
Pulsed source current (body diode)	I_{SM} (1)		-	-	150	
Diode forward voltage	V_{SD} (2)	T_J = 25 °C, I_S = 38 A, V_{GS} = 0 V	-	0.9	1.31	V
		T_J = 125 °C, I_S = 38 A, V_{GS} = 0 V	-	0.75	-	
Reverse recovery time	t_{rr}	T_J = 25 °C, I_F = 40 A; dI_F/dt = 100 A/μs (2)	-	560	-	ns
Reverse recovery current	I_{rr}		-	40	-	A
Reverse recovery charge	Q_{rr}		-	11	-	μC
Reverse recovery time	t_{rr}	T_J = 25 °C, I_F = 40 A; dI_F/dt = 100 A/μs (2)	-	680	-	ns
Reverse recovery current	I_{rr}		-	47	-	A
Reverse recovery charge	Q_{rr}		-	16	-	μC
Forward turn-on time	t_{on}	Intrinsic turn-on time is negligible (turn-on is dominated by $L_S + L_D$)				

Notes

(1) Repetitive rating; pulse width limited by maximum junction temperature (see fig. 18)

(2) Pulse width ≤ 300 μs, duty cycle ≤ 2 %

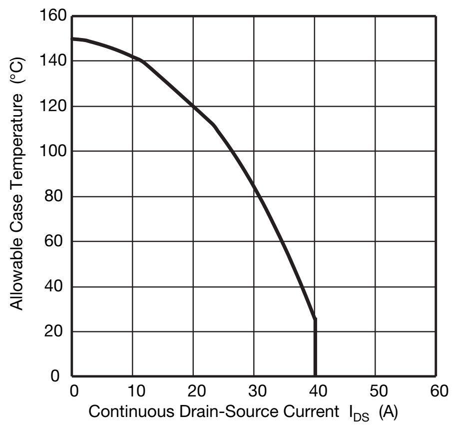


Fig. 1 - Maximum DC MOSFET Drain-Source Current vs. Case Temperature

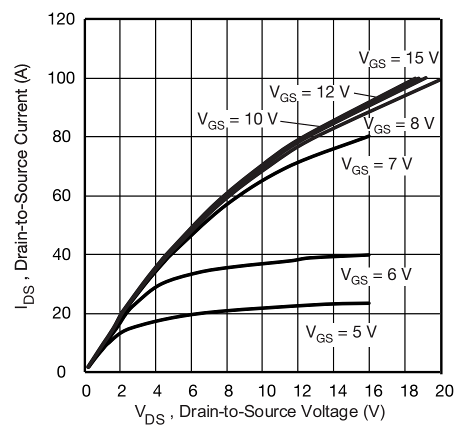


Fig. 3 - Typical Drain-to-Source Current Output Characteristics at T_J = 25 °C

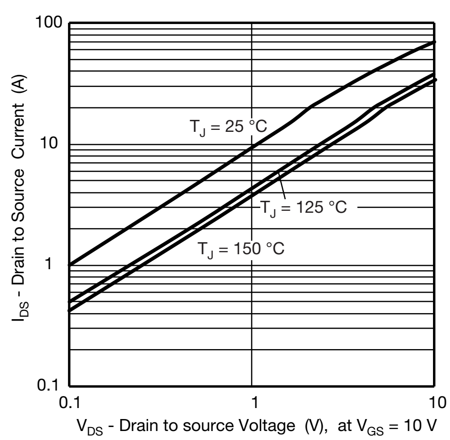


Fig. 2 - Typical Drain-to-Source Current Output Characteristics; V_{GS} = 10 V

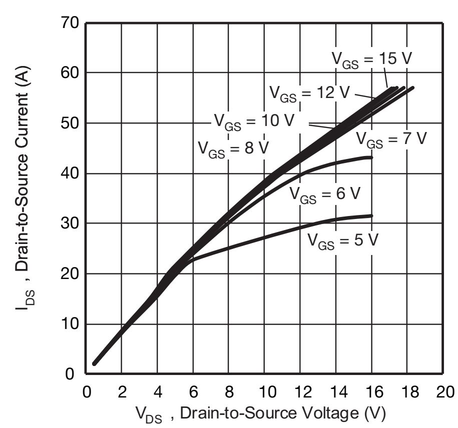


Fig. 4 - Typical Drain-to-Source Current Output Characteristics at T_J = 125 °C

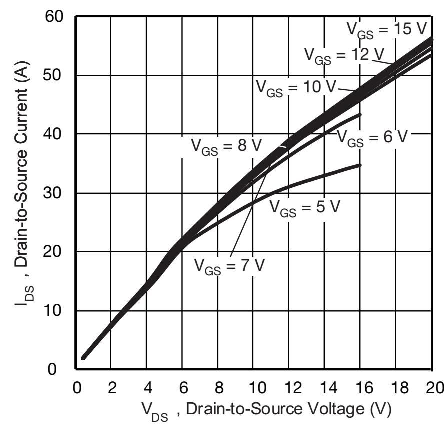


Fig. 5 - Typical Drain-to-Source Current Output Characteristics at T_J = 150 °C

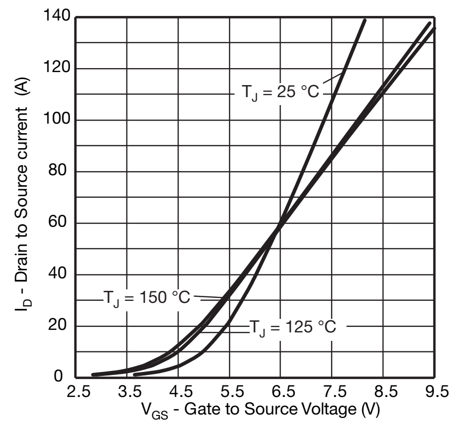


Fig. 8 - Typical MOSFET Transfer Characteristics

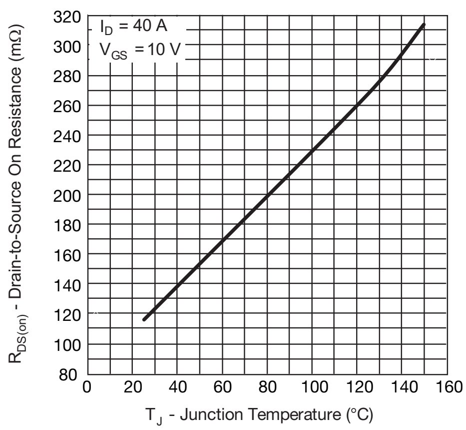


Fig. 6 - Normalized On-Resistance vs. Temperature

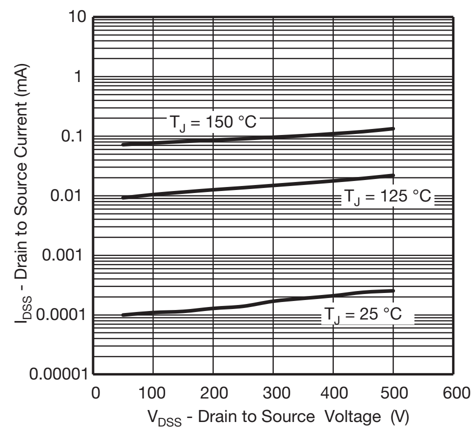


Fig. 9 - Typical MOSFET Zero Gate Voltage Drain Current

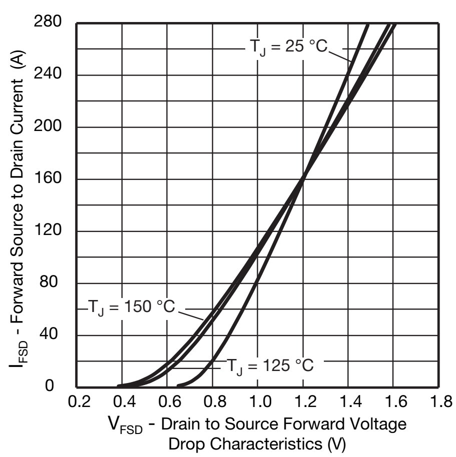


Fig. 7 - Typical Body Diode Forward Voltage Drop Characeristics

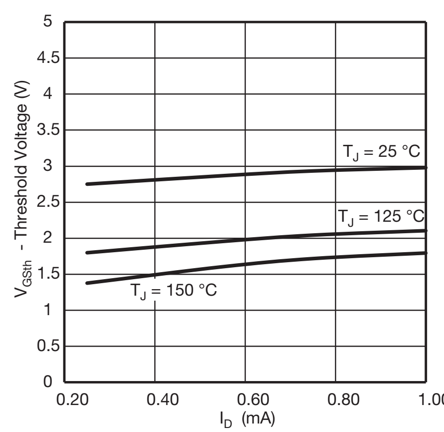


Fig. 10 - Typical MOSFET Threshold Voltage

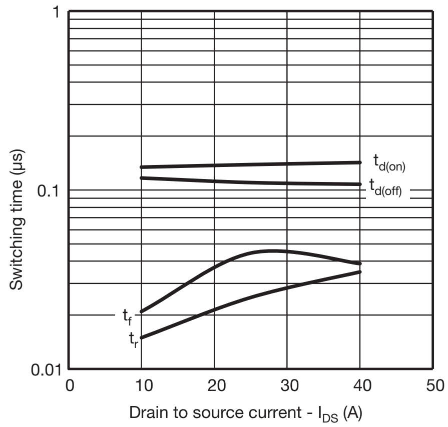


Fig. 11 - Typical MOSFET Switching Time vs. I_{DS}, T_J = 125 °C, V_{DD} = 250 V, V_{GS} = 10 V, L = 500 µH, R_G = 2.4 Ω
Diode used 60APH06

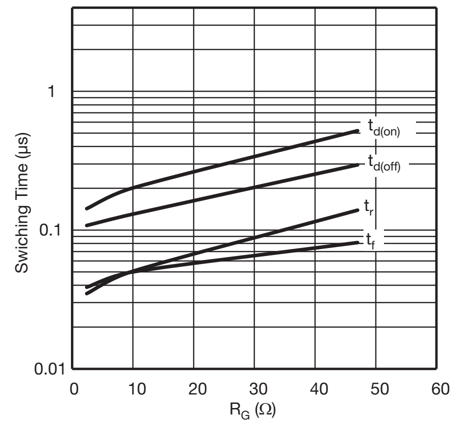


Fig. 12 - Typical MOSFET Switching Time vs. R_G, T_J = 125 °C, I_{DS} = 40 A , V_{DD} = 250 V, V_{GS} = 10 V, L = 500 µH
Diode used 60APH06

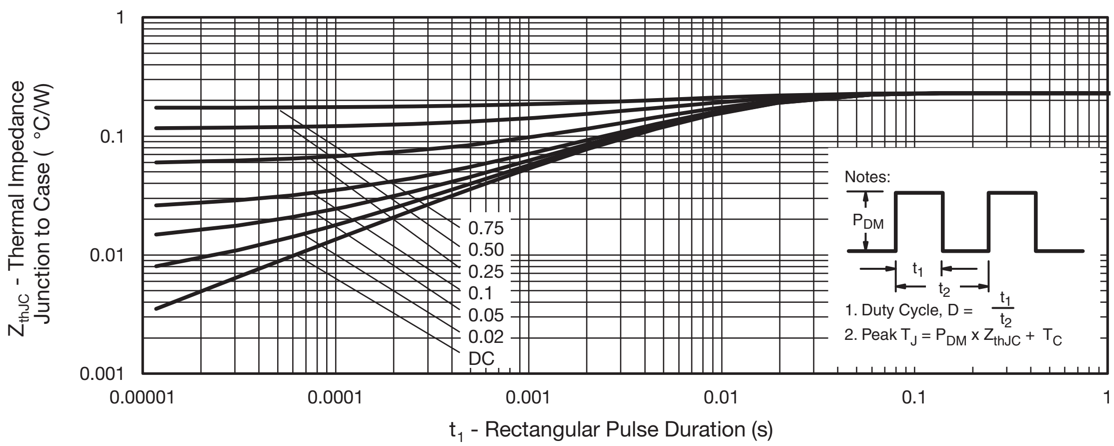


Fig. 13 - Maximum Thermal Impedance Z_{thJC} Characteristics, MOSFET

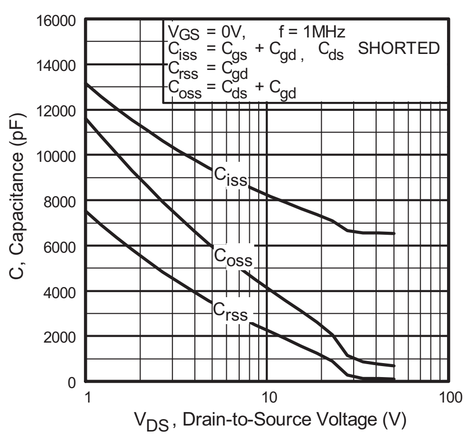


Fig. 14 - Typical Capacitance vs. Drain to Source Voltage

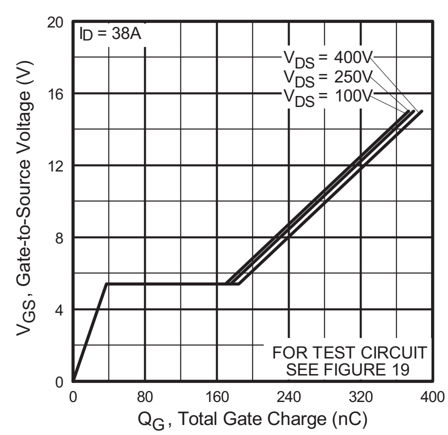


Fig. 15 - Typical Gate Charge vs. Gate to Source Voltage

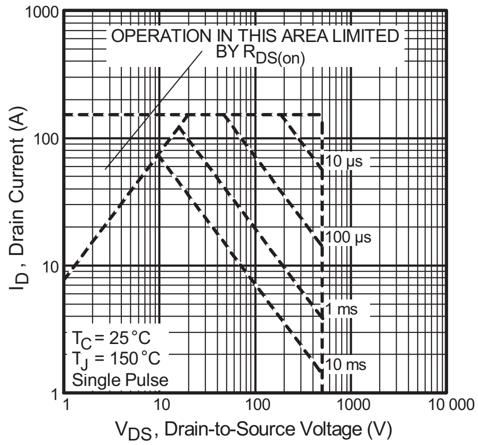


Fig. 16 - Maximum Safe Operating Area

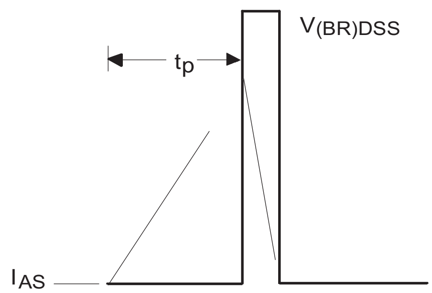


Fig. 20 - Unclamped Inductive Waveforms

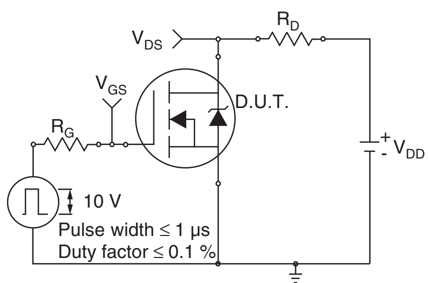


Fig. 17 - Switching Time Test Circuit

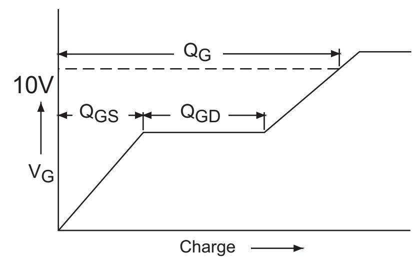


Fig. 21 - Basic Gate Charge Waveform

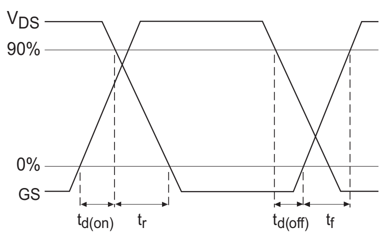


Fig. 18 - Switching Time Waveforms

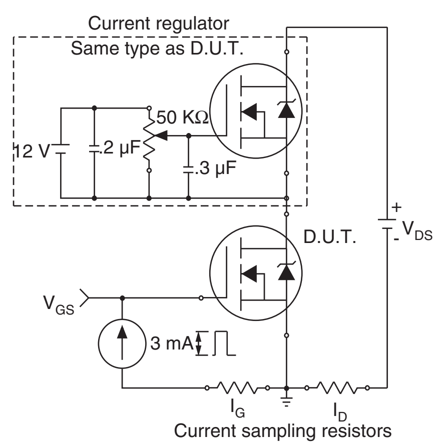


Fig. 22 - Gate Charge Test Circuit

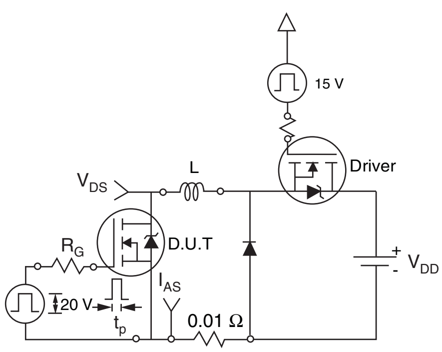


Fig. 19 - Unclamped Inductive Test Circuit

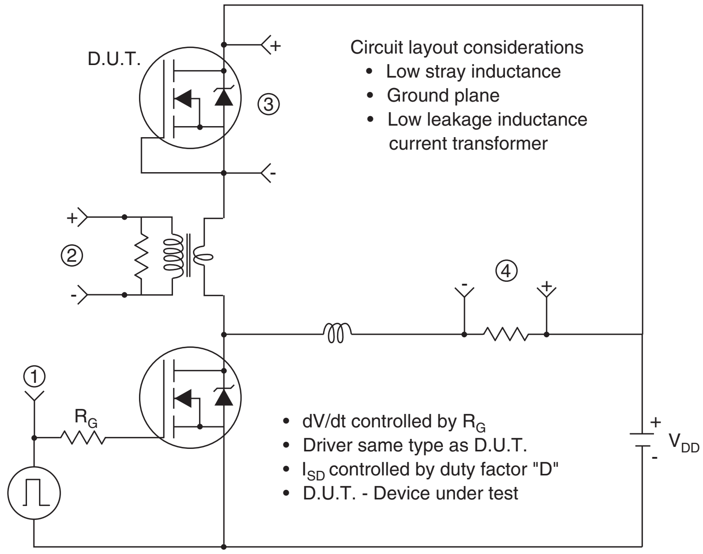


Fig. 23 - Peak Diode Recovery dV/dt Test Circuit

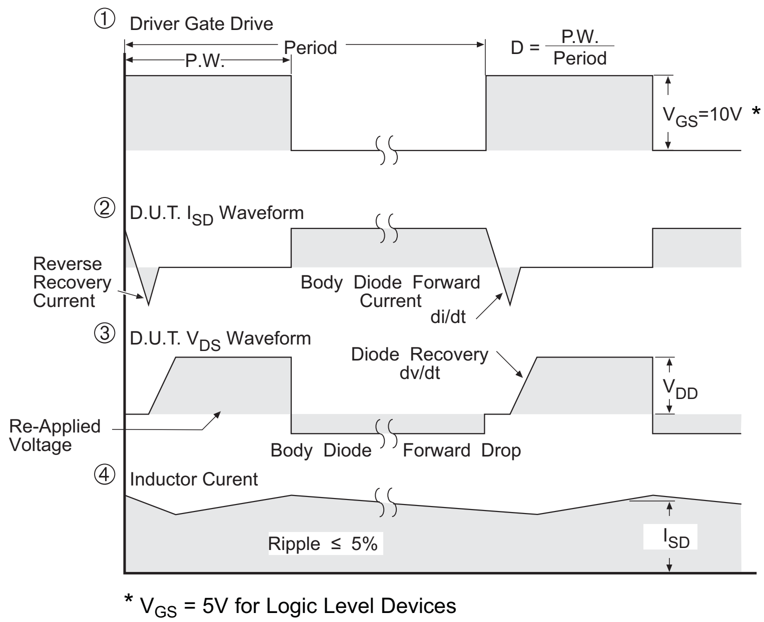
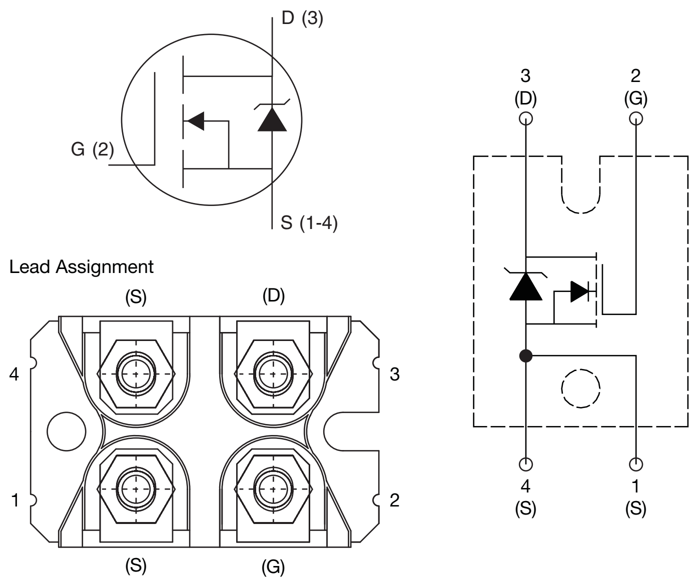


Fig. 24 - For N-Channel Power MOSFETs

ORDERING INFORMATION TABLE

Device code	VS-	F	A	40	S	A	50	LC
	1	2	3	4	5	6	7	8

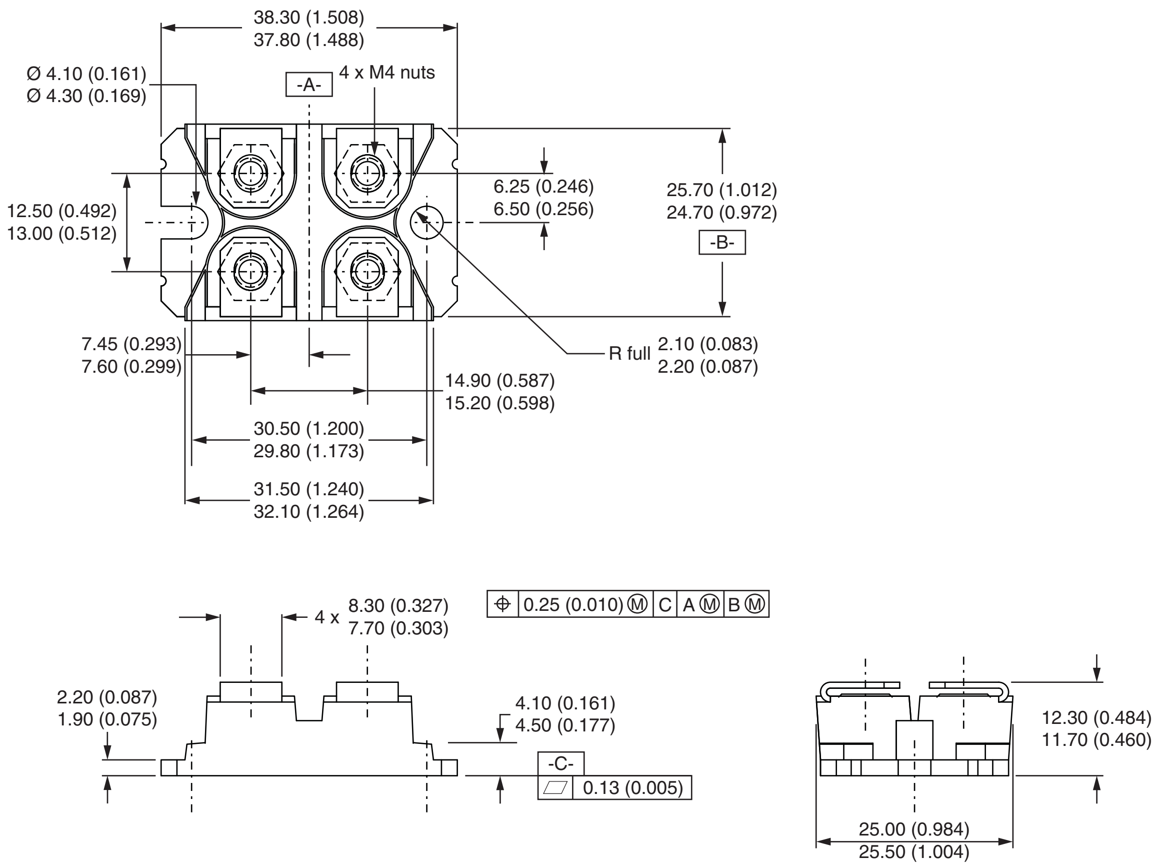
1	-	Vishay Semiconductors product
2	-	Power MOSFET
3	-	A = Generation 3, MOSFET silicon die
4	-	Current rating (40 = 40 A)
5	-	Single switch
6	-	Package indicator (SOT-227)
7	-	Voltage rating (50 = 500 V)
8	-	LC = Low charge

CIRCUIT CONFIGURATION		
CIRCUIT	**CIRCUIT CONFIGURATION CODE**	**CIRCUIT DRAWING**
Single switch	S	

LINKS TO RELATED DOCUMENTS	
Dimensions	www.vishay.com/doc?95423
Packaging information	www.vishay.com/doc?95425

SOT-227 Generation II

DIMENSIONS in millimeters (inches)



Note

- Controlling dimension: millimeter

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