

SOT-227 Power Module

Single Switch - Power MOSFET, 220 A


SOT-227

FEATURES

- Enhanced body diode dV/dt and dI_F/dt capability
- Improved gate avalanche and dynamic dV/dt ruggedness
- Fully characterized capacitance and avalanche SOA
- Fully isolated package
- Easy to use and parallel
- Low on-resistance
- Simple drive requirements
- UL approved file E78996 
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912


RoHS
COMPLIANT

APPLICATIONS

- High efficiency synchronous rectification SMPS
- Uninterruptible power supply
- High speed power switching
- Hard switched and high frequency circuits

DESCRIPTION

This generation of 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 400 W to 700 W. The low thermal resistance of the SOT-227 contribute to its wide acceptance throughout the industry.

PRODUCT SUMMARY	
V_{DSS}	200 V
$R_{DS(on)}$	0.0048 Ω
I_D	220 A
Type	Modules - MOSFET
Package	SOT-227

ABSOLUTE MAXIMUM RATINGS				
PARAMETER	SYMBOL	TEST CONDITIONS	MAX.	UNITS
MOSFET				
Drain to source voltage	V_{DSS}		200	V
Continuous drain current at V_{GS} 10 V	$I_D^{(1)}$	$T_C = 25\text{ }^\circ\text{C}$	220	A
		$T_C = 100\text{ }^\circ\text{C}$	158	
Pulsed drain current	$I_{DM}^{(2)}$		520	
Power dissipation	P_D	$T_C = 25\text{ }^\circ\text{C}$	789	W
		$T_C = 100\text{ }^\circ\text{C}$	395	
Gate to source voltage	V_{GS}		± 30	V
Single pulse avalanche energy	$E_{AS}^{(3)}$		1200	mJ
Avalanche current	$I_{AR}^{(4)}$		70	A
Repetitive avalanche energy	$E_{AR}^{(4)}$		600	mJ
MODULE				
Operating junction temperature range	T_J		-55 to +175	$^\circ\text{C}$
Operating storage temperature range	T_{Stg}		-55 to +175	
Insulation withstand voltage (AC-RMS)	V_{ISOL}		2.5	kV

Notes

- Maximum continuous drain current at V_{GS} 10 V must be limited to 100 A to do not exceed the maximum temperature of power terminals.
- Repetitive rating; pulse width limited by maximum junction temperature.
- Limited by T_J max., starting $T_J = 25\text{ }^\circ\text{C}$, $L = 0.23\text{ mH}$, $R_g = 25\text{ }\Omega$, $I_{AS} = 102\text{ A}$, $V_{GS} = 10\text{ V}$. Part not recommended for use above this value.
- Repetitive rating; pulse width limited by maximum junction temperature starting $T_J = 25\text{ }^\circ\text{C}$, $L = 0.23\text{ mH}$, $R_g = 25\text{ }\Omega$, $V_{GS} = 10\text{ V}$, duty cycle 1 %.

**THERMAL - MECHANICAL SPECIFICATIONS**

PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Junction and storage temperature range	T_J, T_{Stg}		-55	-	175	°C
Junction to case	R_{thJC}		-	-	0.19	°C/W
Case to heatsink	R_{thCS}	Flat, greased surface	-	0.05	-	
Weight			-	30	-	g
Mounting torque		Torque to terminal	-	-	1.1 (9.7)	Nm (lbf.in)
		Torque to heatsink	-	-	1.3 (11.5)	Nm (lbf.in)
Case style			SOT-227			

ELECTRICAL CHARACTERISTICS ($T_J = 25\text{ °C}$ unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Drain to source breakdown voltage	$V_{(BR)DSS}$	$V_{GS} = 0\text{ V}, I_D = 1.0\text{ mA}$	200	-	-	V
Breakdown voltage temperature coefficient	$\Delta V_{(BR)DSS}/\Delta T_J$	Reference to 25 °C , $I_D = 1.0\text{ mA}$	-	0.21	-	V/°C
Static drain to source on-resistance	$R_{DS(on)}^{(1)}$	$V_{GS} = 10\text{ V}, I_D = 150\text{ A}$	-	4.8	7.0	mΩ
Gate threshold voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 500\text{ μA}$	3	4	5.1	V
		$V_{DS} = V_{GS}, I_D = 500\text{ μA}, T_J = 125\text{ °C}$	-	2.5	-	
Forward transconductance	g_{fs}	$V_{DS} = 20\text{ V}, I_D = 150\text{ A}$	-	385	-	S
Gate resistance, internal	R_g		-	2	-	Ω
Drain to source leakage current	I_{DSS}	$V_{DS} = 200\text{ V}, V_{GS} = 0\text{ V}$	-	1	50	μA
		$V_{DS} = 200\text{ V}, V_{GS} = 0\text{ V}, T_J = 125\text{ °C}$	-	40	1000	
		$V_{DS} = 200\text{ V}, V_{GS} = 0\text{ V}, T_J = 175\text{ °C}$	-	2	10	mA
Gate to source forward leakage	I_{GSS}	$V_{GS} = 20\text{ V}$	-	-	250	nA
Gate to source reverse leakage		$V_{GS} = -20\text{ V}$	-	-	-250	
Total gate charge	Q_g	$I_D = 150\text{ A},$ $V_{DS} = 100\text{ V},$ $V_{GS} = 10\text{ V},$ see fig.15 and fig.19 ⁽¹⁾	-	350	-	nC
Gate to source charge	Q_{gs}		-	120	-	
Gate to drain ("Miller") charge	Q_{gd}		-	110	-	
Turn-on delay time	$t_{d(on)}$	$V_{DD} = 120\text{ V},$ $I_D = 150\text{ A},$ $R_g = 5\text{ Ω},$ $L = 500\text{ μH},$ diode used: 20CZU02	-	360	-	ns
Rise time	t_r		-	245	-	
Turn-off delay time	$t_{d(off)}$		-	205	-	
Fall time	t_f		-	220	-	
Turn-on delay time	$t_{d(on)}$	$V_{DD} = 120\text{ V},$ $I_D = 150\text{ A},$ $R_g = 5\text{ Ω},$ $L = 500\text{ μH},$ $T_J = 125\text{ °C},$ diode used: 20CZU02	-	350	-	ns
Rise time	t_r		-	243	-	
Turn-off delay time	$t_{d(off)}$		-	210	-	
Fall time	t_f		-	175	-	
Internal source inductance	L_S	Between lead, and center of die contact	-	5	-	nH
Input capacitance	C_{iss}	$V_{GS} = 0\text{ V},$ $V_{DS} = 50\text{ V},$ $f = 1.0\text{ MHz},$ see fig.14	-	21 000	-	pF
Output capacitance	C_{oss}		-	1600	-	
Reverse transfer capacitance	C_{rss}		-	320	-	
Drain to case capacitance	C_{d-cs}	$V_{GS} = 0\text{ V}, (G-S \text{ shortened}); f = 1\text{ MHz}$	-	43	-	

SOURCE-DRAIN RATINGS AND CHARACTERISTICS ($T_J = 25\text{ }^{\circ}\text{C}$ unless otherwise specified)						
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	-	-	220	A
Pulsed source current (body diode)	$I_{SM}^{(1)}$		-	-	520	
Diode forward voltage	$V_{SD}^{(2)}$	$T_J = 25\text{ }^{\circ}\text{C}$, $I_S = 150\text{ A}$, $V_{GS} = 0\text{ V}$	-	0.87	1.0	V
		$T_J = 125\text{ }^{\circ}\text{C}$, $I_S = 150\text{ A}$, $V_{GS} = 0\text{ V}$	-	0.75	-	
		$T_J = 175\text{ }^{\circ}\text{C}$, $I_S = 150\text{ A}$, $V_{GS} = 0\text{ V}$	-	0.70	-	
Reverse recovery time	t_{rr}	$T_J = 25\text{ }^{\circ}\text{C}$, $I_F = 50\text{ A}$, $dI_F/dt = 100\text{ A}/\mu\text{s}$, $V_R = 100\text{ V}^{(2)}$	-	170	-	ns
Reverse recovery current	I_{rr}		-	12	-	A
Reverse recovery charge	Q_{rr}		-	1060	-	nC
Reverse recovery time	t_{rr}	$T_J = 125\text{ }^{\circ}\text{C}$, $I_F = 50\text{ A}$, $dI_F/dt = 100\text{ A}/\mu\text{s}$, $V_R = 100\text{ V}^{(2)}$	-	200	-	ns
Reverse recovery current	I_{rr}		-	15	-	A
Reverse recovery charge	Q_{rr}		-	1550	-	nC
Forward turn-on time	t_{on}	Intrinsic turn-on time is negligible (turn-on is dominated by LS + LD)				

Notes

- (1) Repetitive rating; pulse width limited by maximum junction temperature.
(2) Pulse width $\leq 300\text{ }\mu\text{s}$, duty cycle $\leq 2\%$

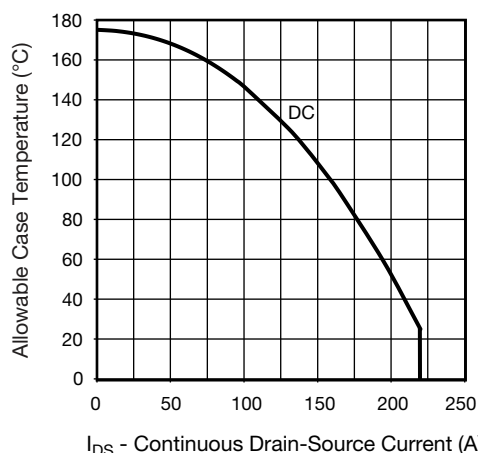


Fig. 1 - Maximum DC MOSFET Drain-Source Current vs. Case Temperature

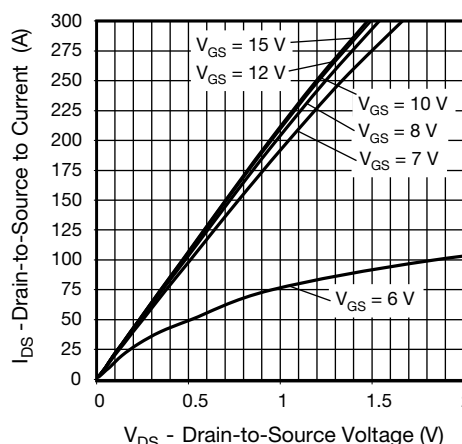


Fig. 3 - Typical Drain-to-Source Current Output Characteristics, at $T_J = 25\text{ }^{\circ}\text{C}$

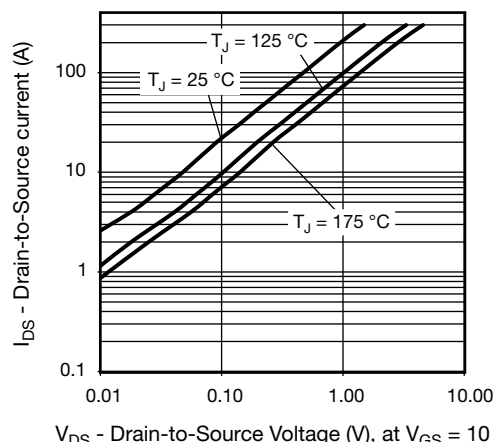


Fig. 2 - Typical Drain-to-Source Current Output Characteristics, $V_{GS} = 10\text{ V}$

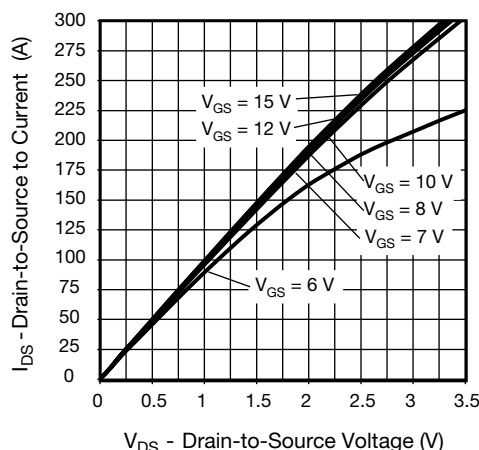


Fig. 4 - Typical Drain-to-Source Current Output Characteristics, at $T_J = 125\text{ }^{\circ}\text{C}$

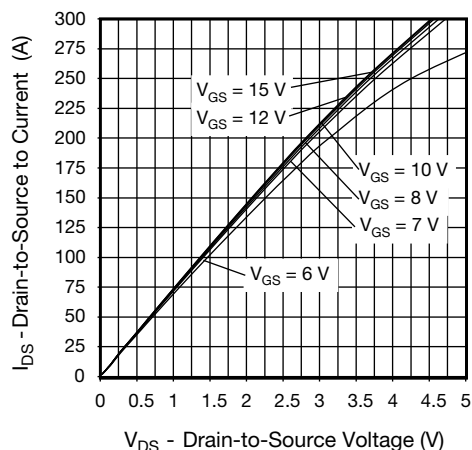


Fig. 5 - Typical Drain-to-Source Current Output Characteristics, at $T_J = 175\text{ }^{\circ}\text{C}$

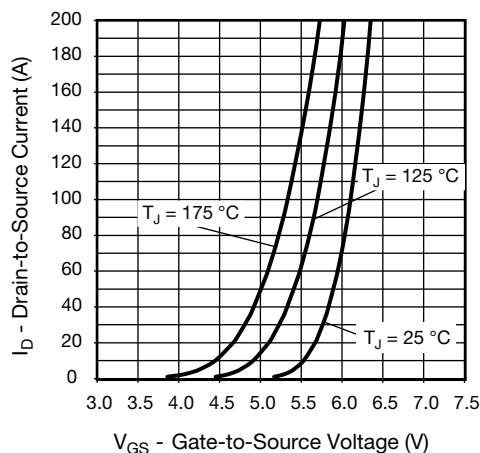


Fig. 8 - Typical MOSFET Transfer Characteristics

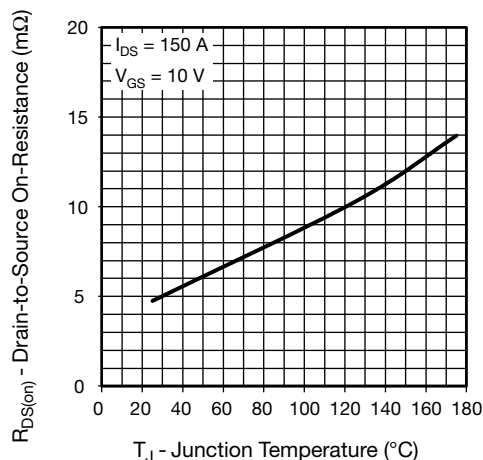


Fig. 6 - Typical Drain-to-Source On-Resistance vs. Temperature

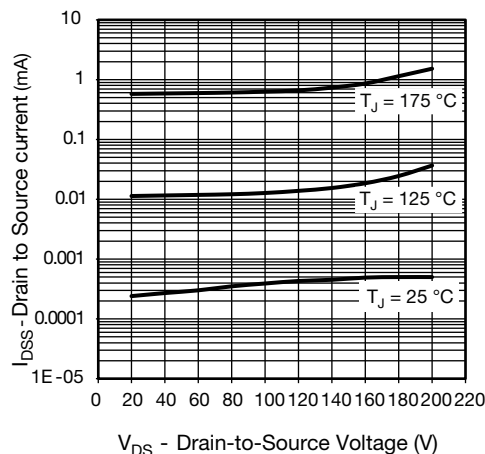


Fig. 9 - Typical MOSFET Zero Gate Voltage Drain Current

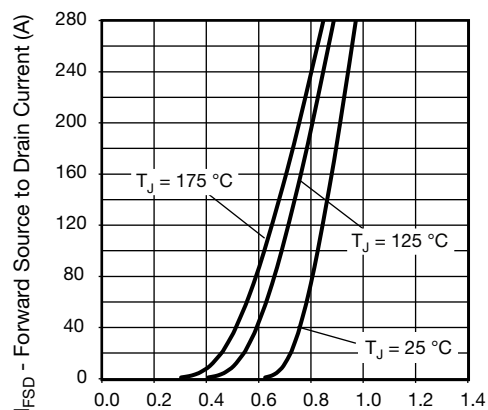


Fig. 7 - Typical Body Diode Forward Voltage Drop Characteristics

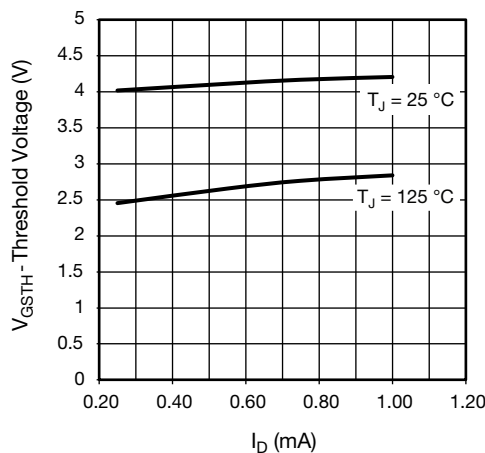


Fig. 10 - Typical MOSFET Threshold Voltage

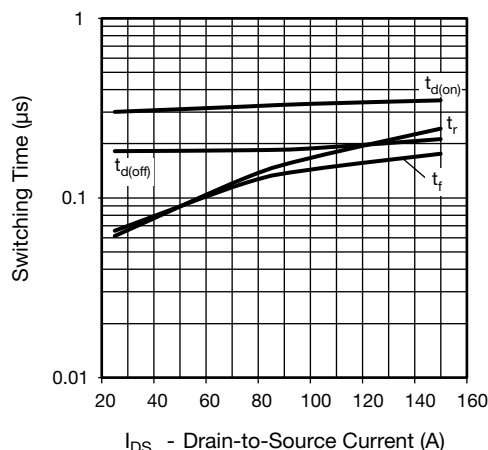


Fig. 11 - Typical MOSFET Switching Time vs. I_{DS} ,
 $T_J = 125^\circ\text{C}$, $V_{DD} = 120\text{ V}$, $V_{GS} = 10\text{ V}$, $L = 500\text{ }\mu\text{H}$, $R_g = 5\text{ }\Omega$
 Diode Used: 20CZU02

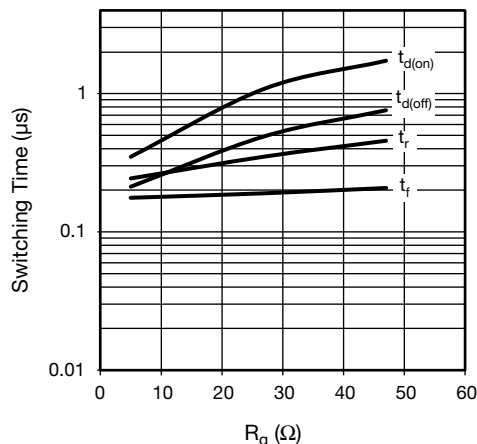


Fig. 12 - Typical MOSFET Switching Time vs. R_g ,
 $T_J = 125^\circ\text{C}$, $I_{DS} = 150\text{ A}$, $V_{DD} = 120\text{ V}$, $V_{GS} = 10\text{ V}$, $L = 500\text{ }\mu\text{H}$
 Diode Used: 20CZU02

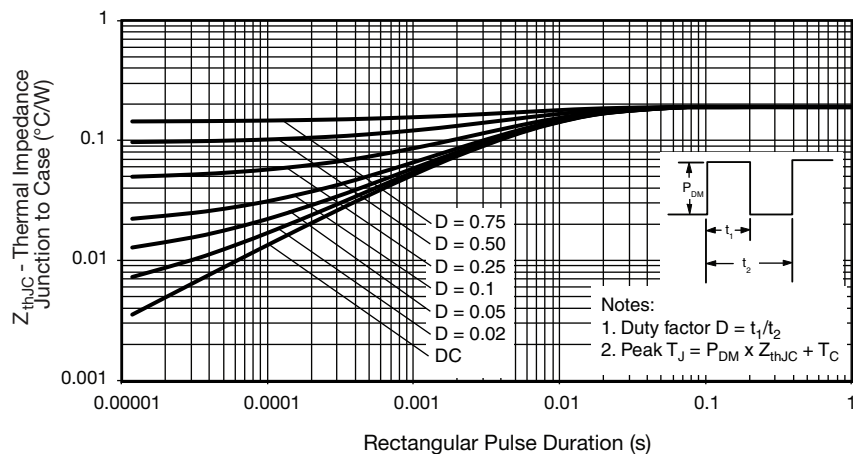


Fig. 13 - Maximum Thermal Impedance Z_{thJC} Characteristics, MOSFET

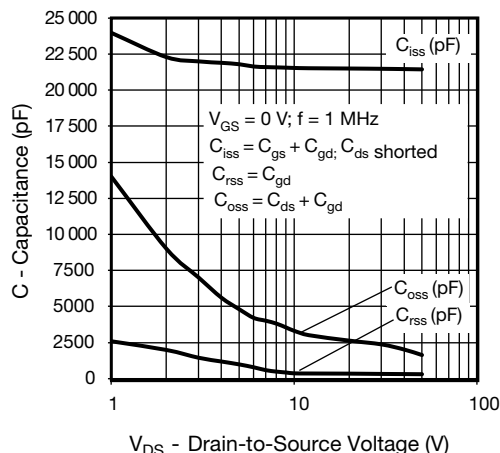


Fig. 14 - Typical Capacitance vs. Drain-to-Source Voltage

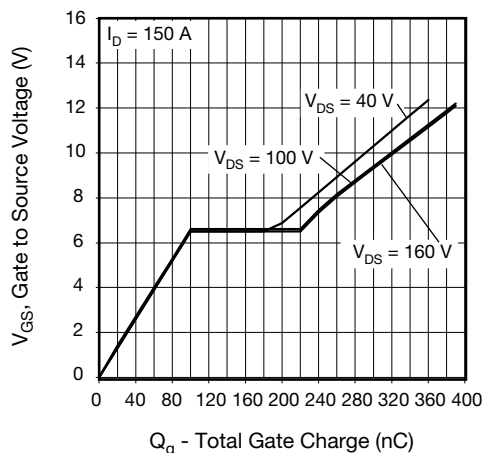


Fig. 15 - Typical Gate Charge vs. Gate-to-Source Voltage

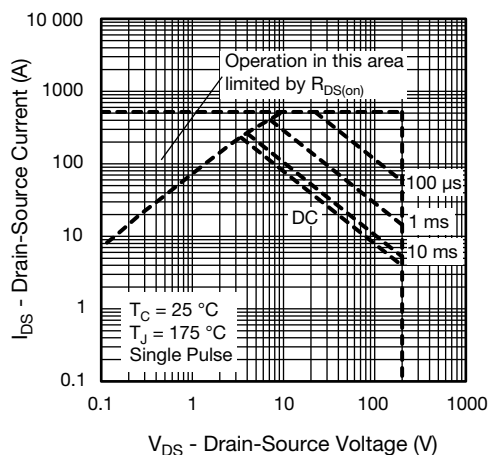


Fig. 16 - Maximum Safe Operating Area

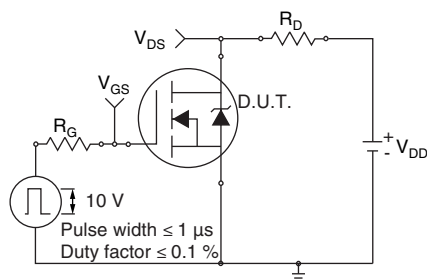


Fig. 17 a - Switching Time Test Circuit

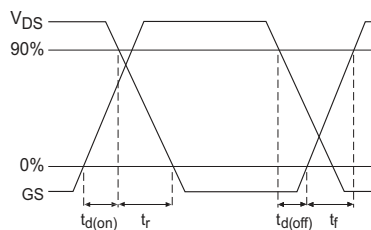
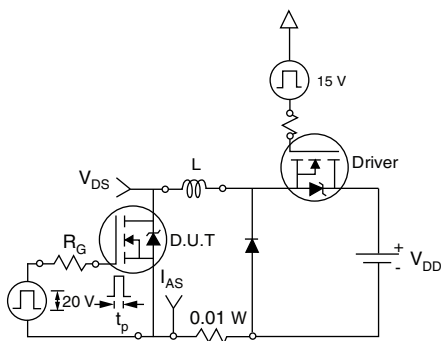


Fig. 17 b - Switching Time Waveform



18 a - Unclamped Inductive Test Circuit

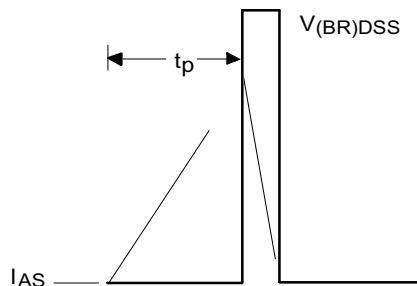


Fig. 18 b - Unclamped Inductive Waveform

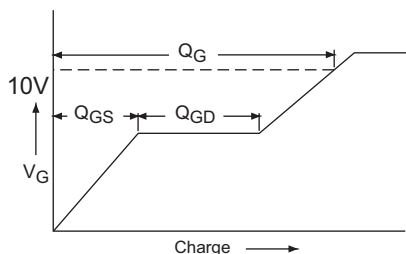


Fig. 19 a - Basic Gate Charge Waveform

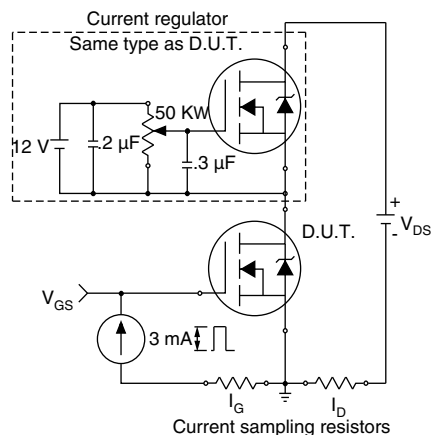


Fig. 19 b - Gate Charge Test Circuit

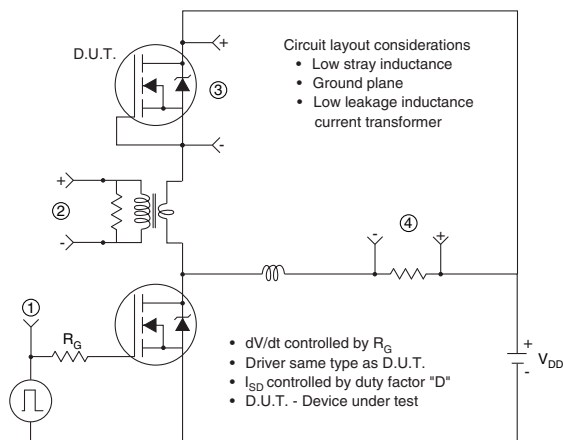
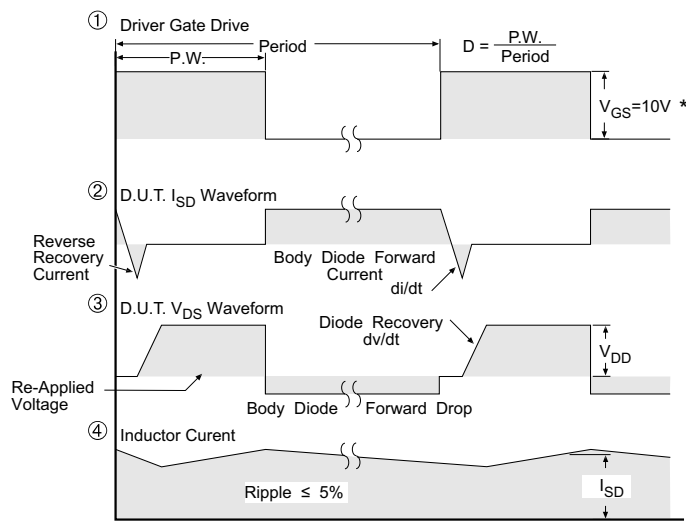


Fig. 19 c - Peak Diode Recovery dV/dt Test Circuit

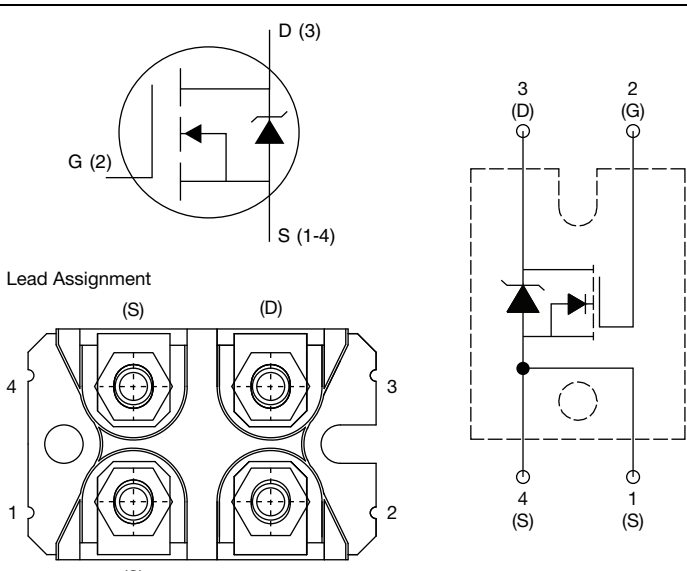


* $V_{GS} = 5V$ for Logic Level Devices

Fig. 20 - For N-Channel Power MOSFETs

ORDERING INFORMATION TABLE

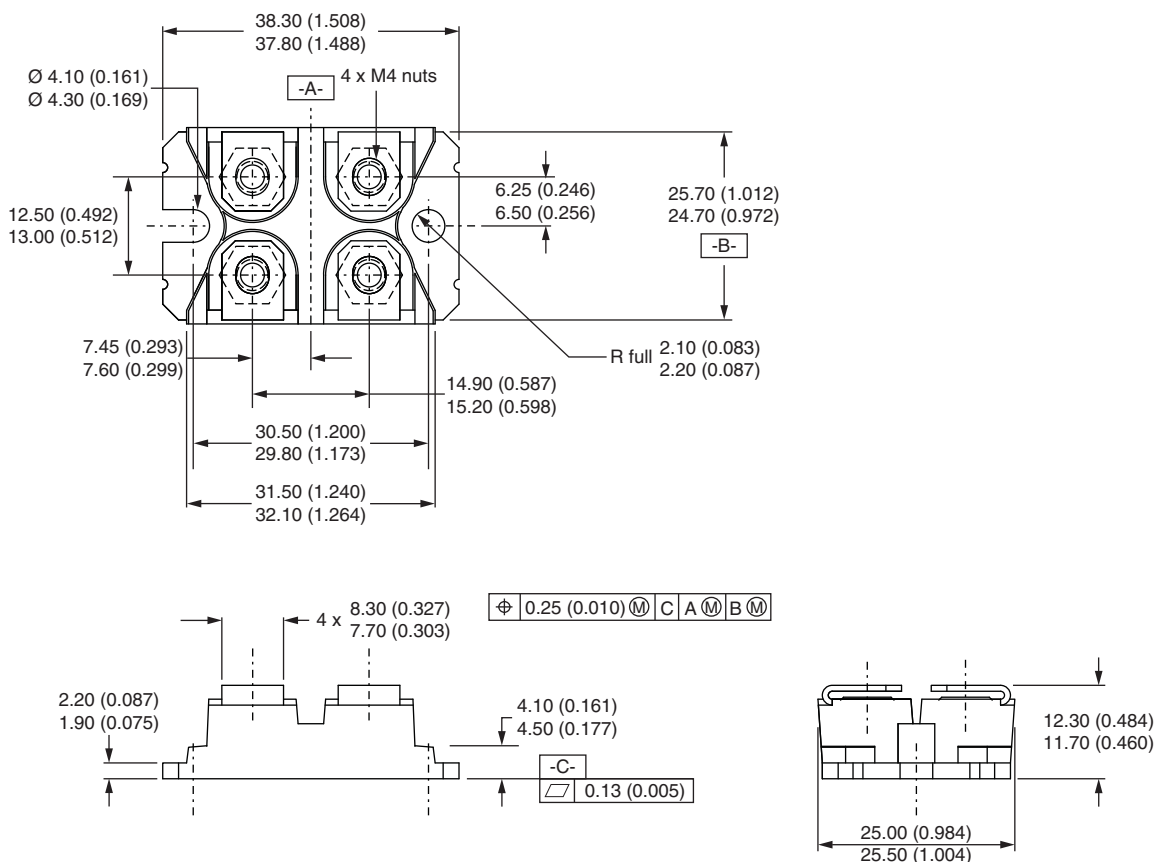
Device code	VS-	F	C	220	S	A	20
	1	2	3	4	5	6	7
1	-	Vishay Semiconductors product					
2	-	MOSFET module					
3	-	MOSFET die generation					
4	-	Current rating (220 = 220 A)					
5	-	S = single switch					
6	-	Package indicator SOT-227					
7	-	Voltage rating (20 = 200 V)					

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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