




# Insulated Gate Bipolar Transistor Trench PT IGBT, 600 V, 250 A

Proprietary Vishay IGBT Silicon "L Series"



SOT-227

### FEATURES

- Standard speed Trench PT IGBT
- Fully isolated package
- Very low internal inductance ( $\leq 5$  nH typical)
- Industry standard outline
- UL approved file E78996 
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



RoHS COMPLIANT

PRIMARY CHARACTERISTICS	
$V_{CES}$	600 V
$I_C$ DC	239 A at 90 °C
$V_{CE(on)}$ typical at 100 A, 25 °C	1.10 V
Speed	DC to 1 kHz
Package	SOT-227
Circuit configuration	Single switch no diode

### BENEFITS

- Optimized for high current inverter stages (AC TIG welding machine)
- Direct mounting to heatsink
- Plug-in compatible with other SOT-227 packages
- Lower conduction losses
- Low EMI, requires less snubbing

ABSOLUTE MAXIMUM RATINGS				
PARAMETER	SYMBOL	TEST CONDITIONS	MAX.	UNITS
Collector to emitter voltage	$V_{CES}$		600	V
Continuous collector current	$I_C$	$T_C = 25$ °C	380	A
		$T_C = 90$ °C	239	
Pulsed collector current	$I_{CM}$		600	
Clamped inductive load current	$I_{LM}$		400	
Gate-to-emitter voltage	$V_{GE}$		$\pm 20$	V
Power dissipation, IGBT	$P_D$	$T_C = 25$ °C	893	W
		$T_C = 90$ °C	429	
Isolation voltage	$V_{ISOL}$	Any terminal to case, $t = 1$ min	2500	V

ELECTRICAL SPECIFICATIONS ( $T_J = 25$ °C unless otherwise specified)						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Collector to emitter breakdown voltage	$V_{BR(CES)}$	$V_{GE} = 0$ V, $I_C = 250$ $\mu$ A	600	-	-	V
Collector to emitter voltage	$V_{CE(on)}$	$V_{GE} = 15$ V, $I_C = 100$ A	-	1.10	1.30	
		$V_{GE} = 15$ V, $I_C = 100$ A, $T_J = 125$ °C	-	1.03	-	
		$V_{GE} = 15$ V, $I_C = 100$ A, $T_J = 150$ °C	-	1.0	-	
Gate threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$ , $I_C = 3.2$ mA	4.1	6.1	8.1	
		$V_{CE} = V_{GE}$ , $I_C = 3.2$ mA, $T_J = 125$ °C	-	3.5	-	
Temperature coefficient of threshold voltage	$\Delta V_{GE(th)}/\Delta T_J$	$V_{CE} = V_{GE}$ , $I_C = 3.2$ mA, (25 °C to 125 °C)	-	-26	-	mV/°C
Collector to emitter leakage current	$I_{CES}$	$V_{GE} = 0$ V, $V_{CE} = 600$ V	-	1.0	100	$\mu$ A
		$V_{GE} = 0$ V, $V_{CE} = 600$ V, $T_J = 125$ °C	-	350	-	
		$V_{GE} = 0$ V, $V_{CE} = 600$ V, $T_J = 150$ °C	-	700	-	
Gate to emitter leakage current	$I_{GES}$	$V_{GE} = \pm 20$ V	-	-	$\pm 350$	nA



<b>SWITCHING CHARACTERISTICS</b> ( $T_J = 25\text{ }^\circ\text{C}$ unless otherwise specified)									
PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNITS		
Total gate charge (turn-on)	$Q_g$	$I_C = 100\text{ A}, V_{CC} = 400\text{ V}, V_{GE} = 15\text{ V}$		-	942	-	nC		
Gate to emitter charge (turn-on)	$Q_{ge}$			-	295	-			
Gate to collector charge (turn-on)	$Q_{gc}$			-	802	-			
Turn-on switching loss	$E_{on}$	$I_C = 100\text{ A}, V_{CC} = 480\text{ V}, V_{GE} = 15\text{ V}, R_g = 5\text{ }\Omega, L = 500\text{ }\mu\text{H}, T_J = 25\text{ }^\circ\text{C}$		-	2.2	-	mJ		
Turn-off switching loss	$E_{off}$			-	11	-			
Total switching loss	$E_{tot}$			-	13.2	-			
Turn-on delay time	$t_{d(on)}$			Energy losses include tail and diode recovery. diode used 60APH06		-	300	-	ns
Rise time	$t_r$					-	85	-	
Turn-off delay time	$t_{d(off)}$					-	515	-	
Fall time	$t_f$	-	450			-			
Turn-on switching loss	$E_{on}$	-	2.6			-			
Turn-off switching loss	$E_{off}$	$I_C = 100\text{ A}, V_{CC} = 480\text{ V}, V_{GE} = 15\text{ V}, R_g = 5\text{ }\Omega, L = 500\text{ }\mu\text{H}, T_J = 125\text{ }^\circ\text{C}$		-	21.5	-	mJ		
Total switching loss	$E_{tot}$			-	24.1	-			
Turn-on delay time	$t_{d(on)}$			-	285	-			
Rise time	$t_r$			-	85	-	ns		
Turn-off delay time	$t_{d(off)}$			-	785	-			
Fall time	$t_f$			-	790	-			
Reverse bias safe operating area	RBSOA	$T_J = 150\text{ }^\circ\text{C}, I_C = 400, R_g = 5\text{ }\Omega, V_{GE} = 15\text{ V to } 0\text{ V}, V_{CC} = 480\text{ V}, V_P = 600\text{ V}, L = 500\text{ }\mu\text{H}$		Fullsquare					

<b>THERMAL AND MECHANICAL SPECIFICATIONS</b>						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Junction and storage temperature range	$T_J, T_{Stg}$		-40	-	150	$^\circ\text{C}$
Junction to case	$R_{thJC}$		-	-	0.14	$^\circ\text{C/W}$
Case to heatsink	$R_{thCS}$	Flat, greased surface	-	0.1	-	
Weight			-	30	-	g
Mounting torque		Torque to terminal	-	-	1.1 (9.7)	Nm (lbf.in)
		Torque to heatsink	-	-	1.8 (15.9)	Nm (lbf.in)
Case style		SOT-227				

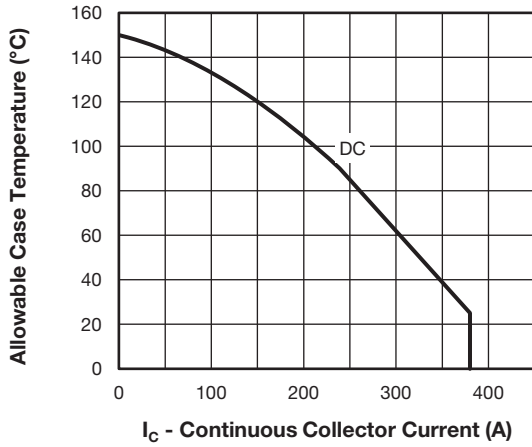


Fig. 1 - Maximum DC IGBT Collector Current vs. Case Temperature

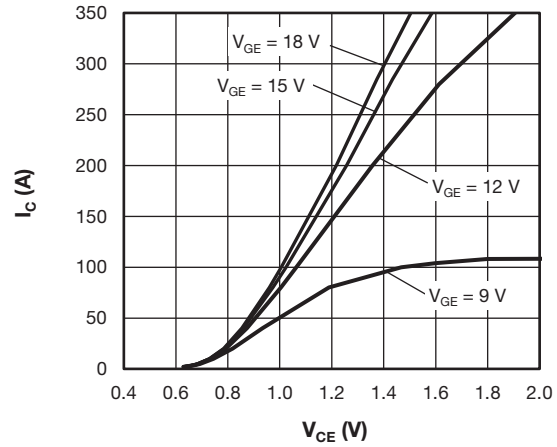


Fig. 4 - Typical Output Characteristics vs.  $V_{GE}$  at 125 °C

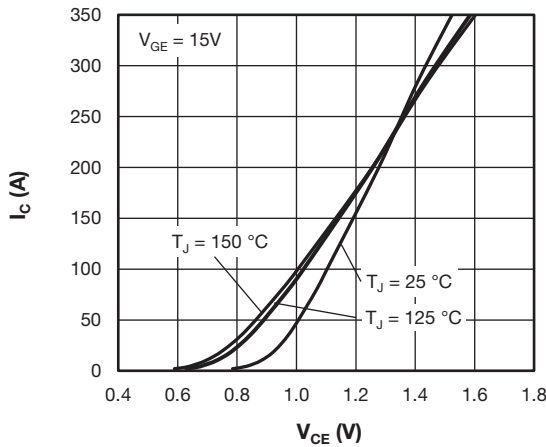


Fig. 2 - Typical IGBT Output Characteristics vs.  $V_{GE} = 15 V$

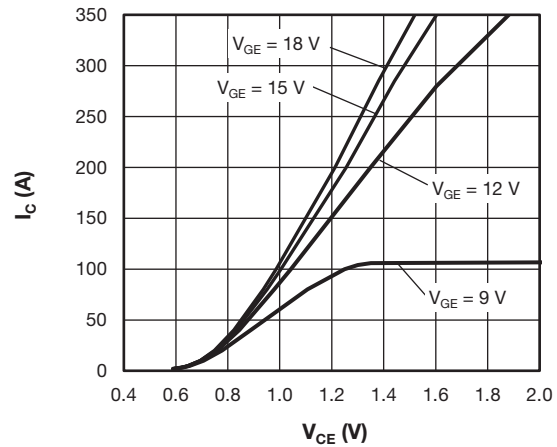


Fig. 5 - Typical Output Characteristics vs.  $V_{GE}$  at 150 °C

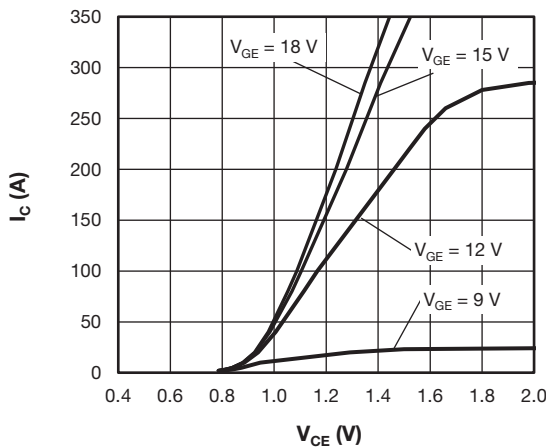


Fig. 3 - Typical Output Characteristics vs.  $V_{GE}$  at 25 °C

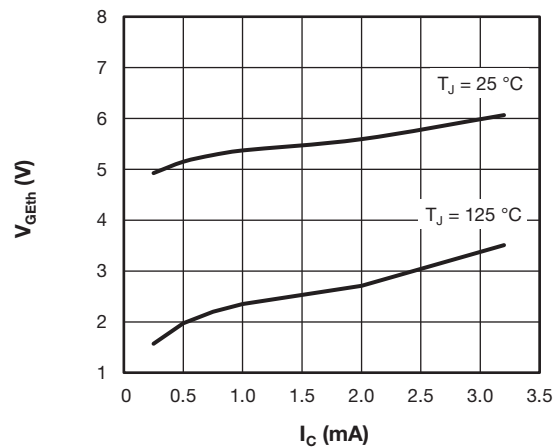


Fig. 6 - Typical Gate Threshold Voltage Characteristics

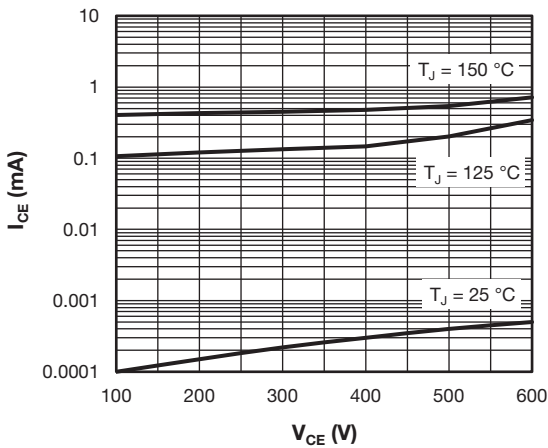


Fig. 7 - Typical Zero Voltage Collector Current

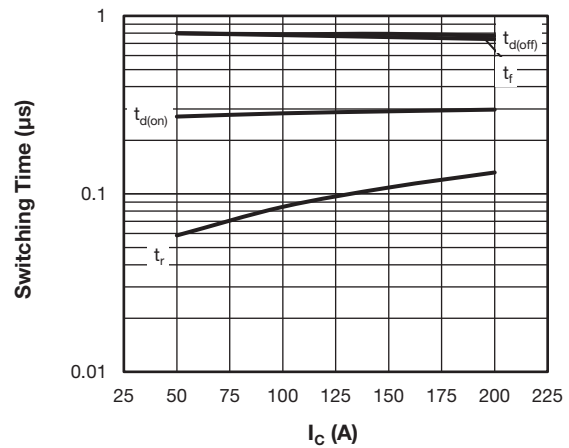


Fig. 10 - Typical IGBT Switching Time vs.  $I_C$   
 $T_J = 125\text{ °C}$ ,  $V_{CC} = 480\text{ V}$ ,  $V_{GE} = 15\text{ V}$ ,  $L = 500\text{ μH}$ ,  $R_g = 5\text{ Ω}$   
 Diode used: 60APH06

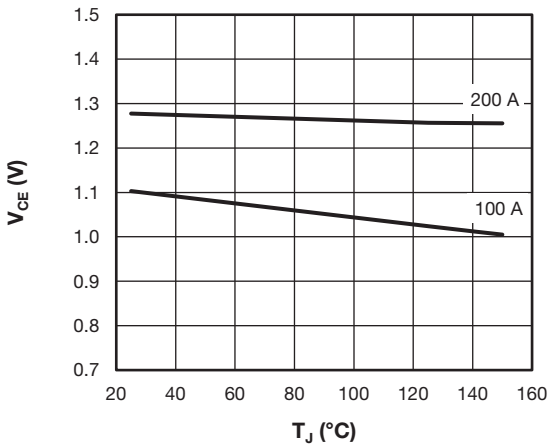


Fig. 8 - Typical  $V_{CE}$  vs. Junction Temperature

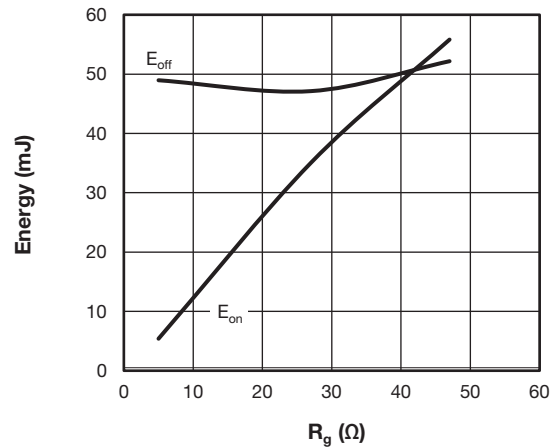


Fig. 11 - Typical IGBT Energy Losses vs.  $R_g$   
 $T_J = 125\text{ °C}$ ,  $I_C = 200\text{ A}$ ,  $V_{CC} = 480\text{ V}$ ,  $V_{GE} = 15\text{ V}$ ,  $L = 500\text{ μH}$ ,  
 $R_g = 5\text{ Ω}$ , Diode used: 60APH06

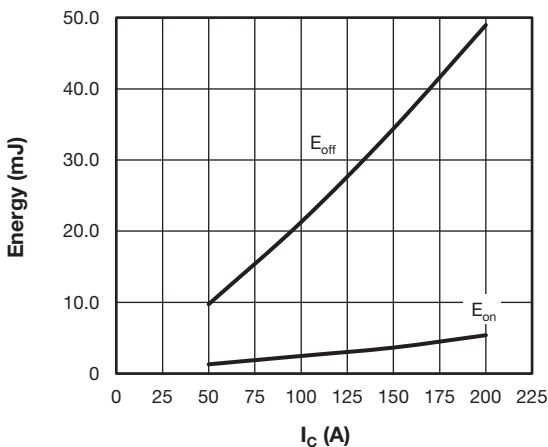


Fig. 9 - Typical IGBT Energy Losses vs.  $I_C$   
 $T_J = 125\text{ °C}$ ,  $V_{CC} = 480\text{ V}$ ,  $V_{GE} = 15\text{ V}$ ,  $L = 500\text{ μH}$ ,  $R_g = 5\text{ Ω}$   
 Diode used: 60APH06

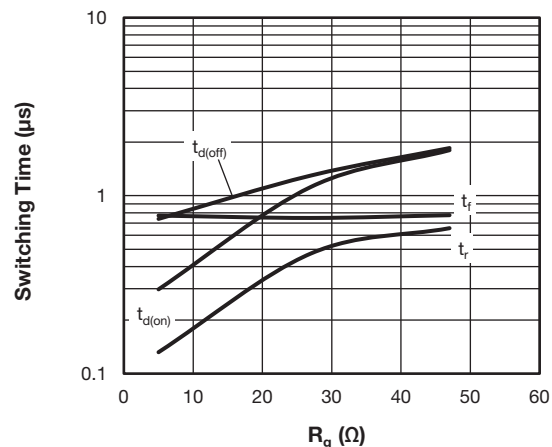


Fig. 12 - Typical IGBT Switching Time vs.  $R_g$   
 $T_J = 125\text{ °C}$ ,  $I_C = 200\text{ A}$ ,  $V_{CC} = 480\text{ V}$ ,  $V_{GE} = 15\text{ V}$ ,  $L = 500\text{ μH}$ ,  
 $R_g = 5\text{ Ω}$ , Diode used: 60APH06

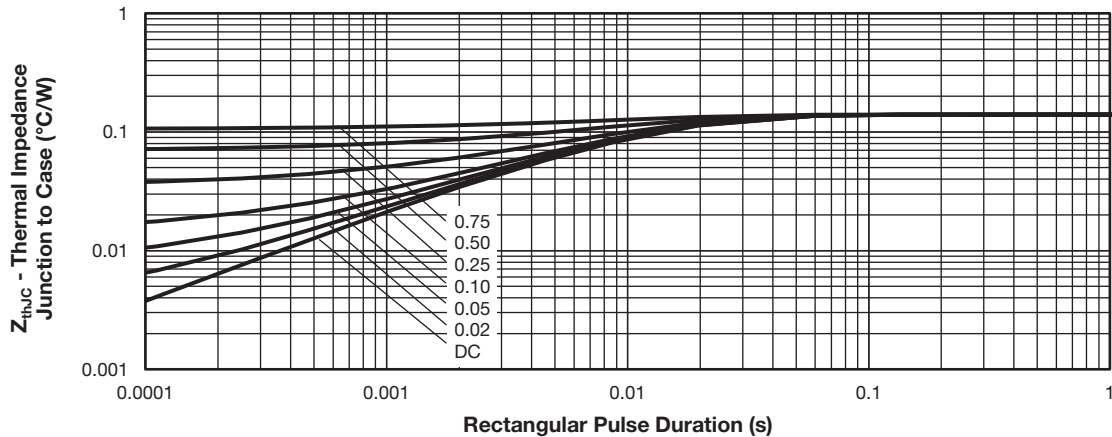


Fig. 13 - Maximum Thermal Impedance Characteristics

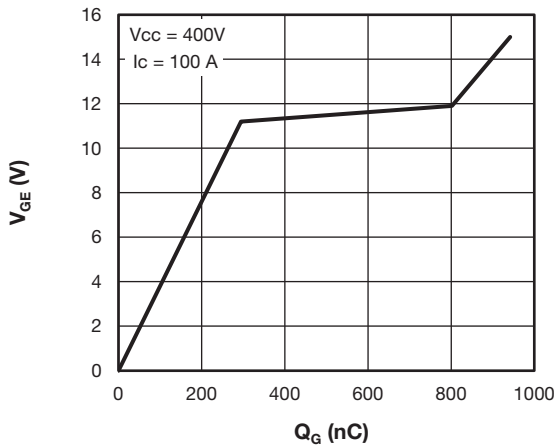
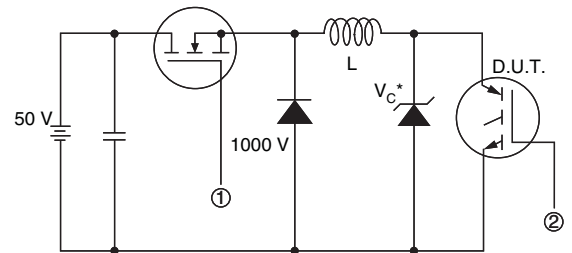


Fig. 14 - Typical Gate Charge vs. Gate Emitter Voltage



\* Driver same type as D.U.T.;  $V_C = 80\%$  of  $V_{CE}$  (max)  
**Note:** Due to the 50 V power supply, pulse width and inductor will increase to obtain rated  $I_d$

Fig. 16 - Clamped Inductive Load Test Circuit

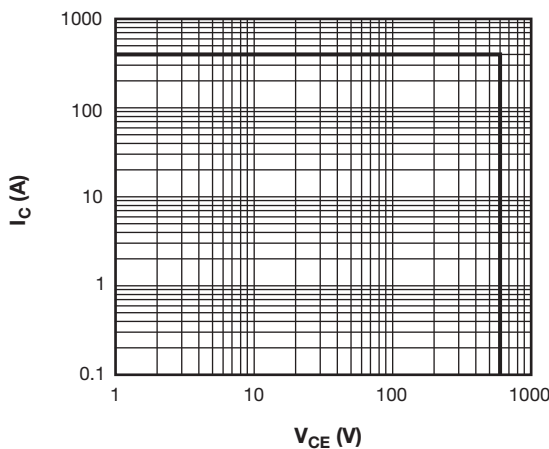


Fig. 15 - Reverse BIAS SOA,  $T_J = 150^{\circ}C$ ,  $V_{GE} = 15V$

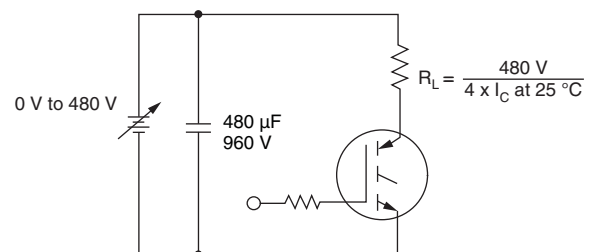


Fig. 17 - Pulsed Collector Current Test Circuit

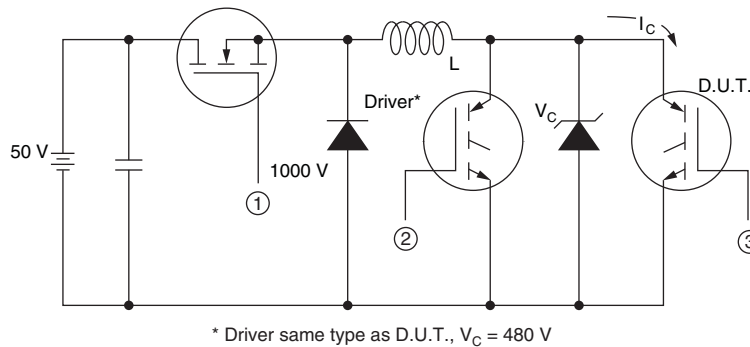


Fig. 18 - Switching Lost Test Circuit

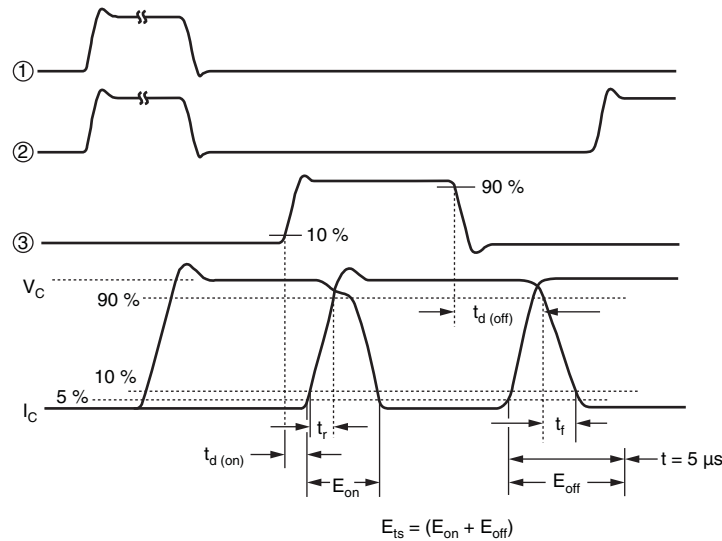


Fig. 19 - Switching Loss Waveforms

**ORDERING INFORMATION TABLE**

Device code	<b>VS-</b>	<b>G</b>	<b>P</b>	<b>250</b>	<b>S</b>	<b>A</b>	<b>60</b>	<b>S</b>
	①	②	③	④	⑤	⑥	⑦	⑧

- 1** - Vishay Semiconductors product
- 2** - Insulated gate bipolar transistor (IGBT)
- 3** - P = trench PT IGBT
- 4** - Current rating (250 = 250 A)
- 5** - Circuit configuration (S = single switch, no diode)
- 6** - Package indicator (A = SOT-227)
- 7** - Voltage rating (60 = 600 V)
- 8** - Speed/type (S = standard speed)



CIRCUIT CONFIGURATION		
CIRCUIT	CIRCUIT CONFIGURATION CODE	CIRCUIT DRAWING
Single switch no diode	S	

LINKS TO RELATED DOCUMENTS	
Dimensions	<a href="http://www.vishay.com/doc?95423">www.vishay.com/doc?95423</a>
Packaging information	<a href="http://www.vishay.com/doc?95425">www.vishay.com/doc?95425</a>



## SOT-227 Generation 2

**DIMENSIONS** in millimeters (inches)



**Note**

- Controlling dimension: millimeter





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