

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

Proprietary Vishay IGBT Silicon "L Series"



SOT-227

PRIMARY CHARACTERISTICS

V_{CES}	600 V
I_C DC ⁽¹⁾	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

Note

⁽¹⁾ Maximum continuous collector current 100 A to do not exceed the maximum temperature of terminals

FEATURES

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


RoHS
COMPLIANT

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	$T_C = 25\text{ °C}$	380	A
		$T_C = 90\text{ °C}$	239	
Pulsed collector current	I_{CM}		600	
Clamped inductive load current	I_{LM}		400	
Gate-to-emitter voltage	V_{GE}		± 20	V
Power dissipation, IGBT	P_D	$T_C = 25\text{ °C}$	893	W
		$T_C = 90\text{ °C}$	429	
Isolation voltage	V_{ISOL}	Any terminal to case, $t = 1$ min	2500	V

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

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

SWITCHING CHARACTERISTICS (T _J = 25 °C unless otherwise specified)							
PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNITS
Total gate charge (turn-on)	Q _g	I _C = 100 A, V _{CC} = 400 V, V _{GE} = 15 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 A, V _{CC} = 480 V, V _{GE} = 15 V, R _g = 5 Ω, L = 500 μH, T _J = 25 °C	Energy losses include tail and diode recovery. diode used 60APH06	-	2.2	-	mJ
Turn-off switching loss	E _{off}			-	11	-	
Total switching loss	E _{tot}			-	13.2	-	
Turn-on delay time	t _{d(on)}			-	300	-	ns
Rise time	t _r			-	85	-	
Turn-off delay time	t _{d(off)}			-	515	-	
Fall time	t _f			-	450	-	mJ
Turn-on switching loss	E _{on}	I _C = 100 A, V _{CC} = 480 V, V _{GE} = 15 V, R _g = 5 Ω, L = 500 μH, T _J = 125 °C		-	2.6	-	
Turn-off switching loss	E _{off}			-	21.5	-	
Total switching loss	E _{tot}			-	24.1	-	
Turn-on delay time	t _{d(on)}			-	285	-	ns
Rise time	t _r			-	85	-	
Turn-off delay time	t _{d(off)}			-	785	-	
Fall time	t _f			-	790	-	
Reverse bias safe operating area	RBSOA	T _J = 150 °C, I _C = 400, R _g = 5 Ω, V _{GE} = 15 V to 0 V, V _{CC} = 480 V, V _P = 600 V, L = 500 μH		Fullsquare			

THERMAL AND MECHANICAL SPECIFICATIONS						
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				

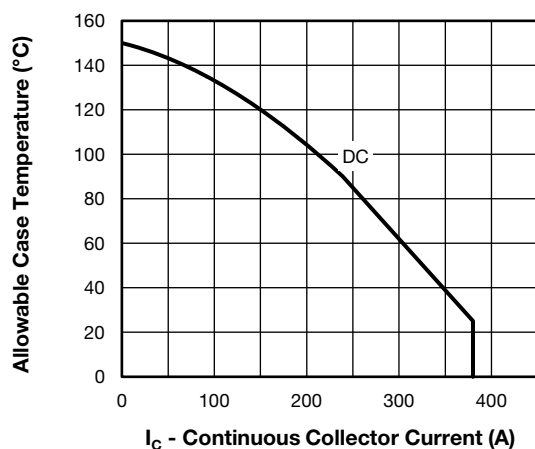
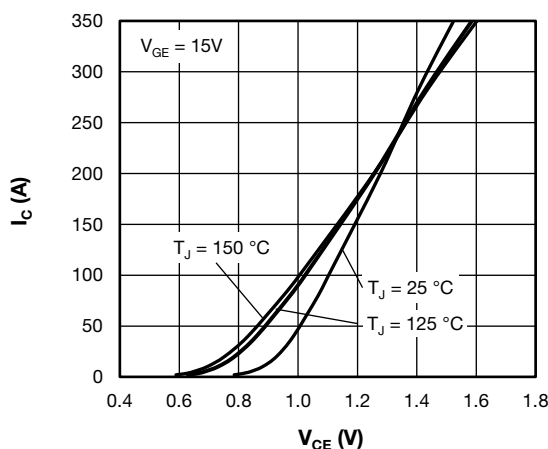


Fig. 1 - Maximum DC IGBT Collector Current vs. Case Temperature


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

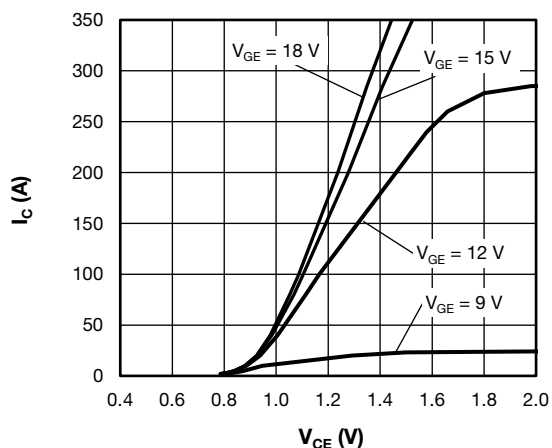


Fig. 3 - Typical Output Characteristics vs. V_{GE} at 25°C

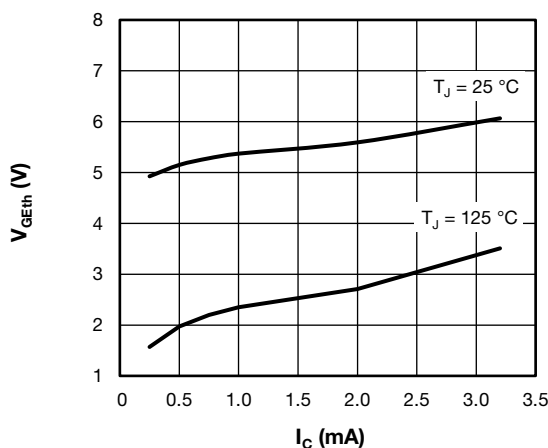


Fig. 6 - Typical Gate Threshold Voltage Characteristics

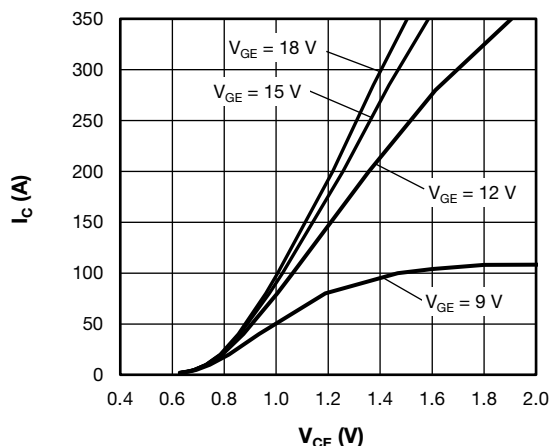


Fig. 4 - Typical Output Characteristics vs. V_{GE} at 125°C

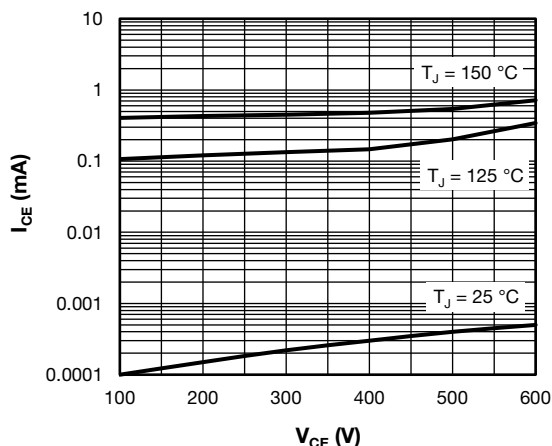


Fig. 7 - Typical Zero Voltage Collector Current

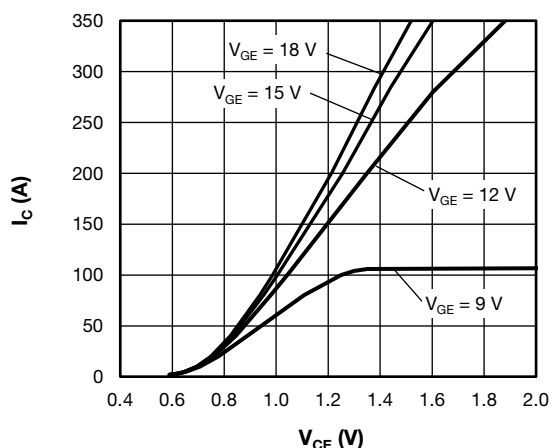


Fig. 5 - Typical Output Characteristics vs. V_{GE} at 150°C

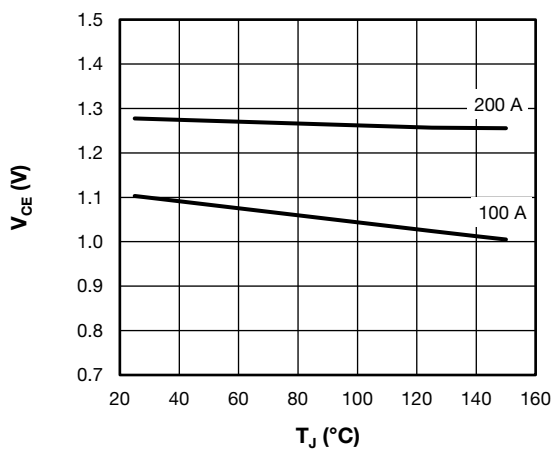


Fig. 8 - Typical V_{CE} vs. Junction Temperature

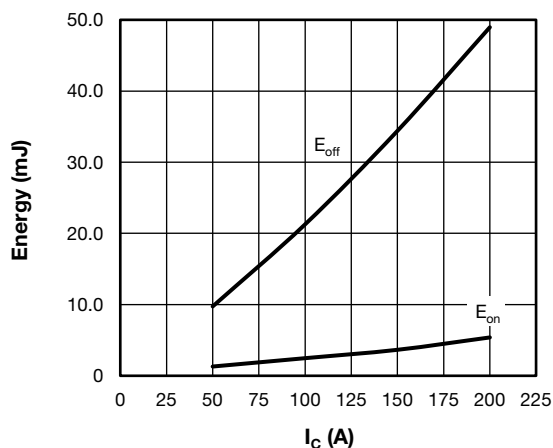


Fig. 9 - Typical IGBT Energy Losses vs. I_C
 $T_J = 125^\circ\text{C}$, $V_{CC} = 480\text{ V}$, $V_{GE} = 15\text{ V}$, $L = 500\text{ }\mu\text{H}$, $R_g = 5\text{ }\Omega$
 Diode used: 60APH06

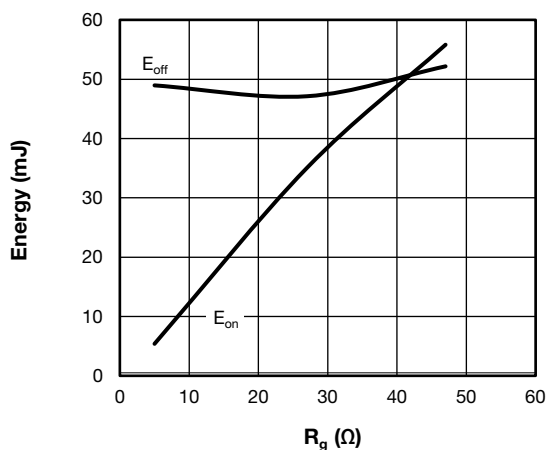


Fig. 11 - Typical IGBT Energy Losses vs. R_g
 $T_J = 125^\circ\text{C}$, $I_C = 200\text{ A}$, $V_{CC} = 480\text{ V}$, $V_{GE} = 15\text{ V}$, $L = 500\text{ }\mu\text{H}$,
 $R_g = 5\text{ }\Omega$, Diode used: 60APH06

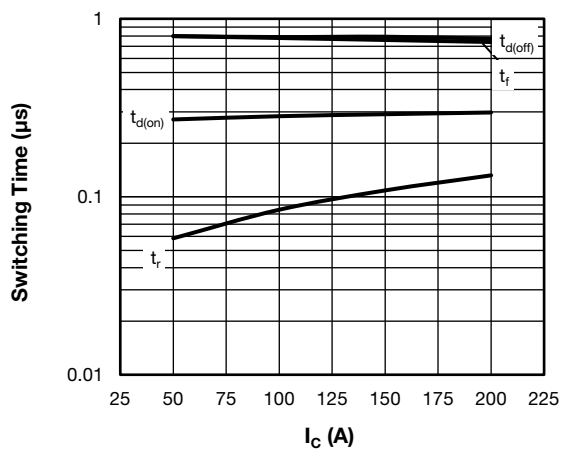


Fig. 10 - Typical IGBT Switching Time vs. I_C
 $T_J = 125^\circ\text{C}$, $V_{CC} = 480\text{ V}$, $V_{GE} = 15\text{ V}$, $L = 500\text{ }\mu\text{H}$, $R_g = 5\text{ }\Omega$
 Diode used: 60APH06

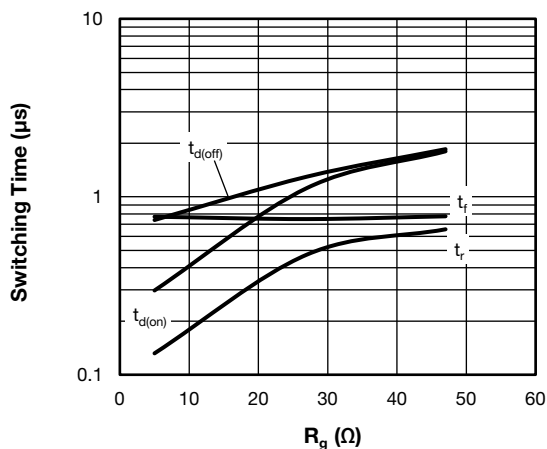


Fig. 12 - Typical IGBT Switching Time vs. R_g
 $T_J = 125^\circ\text{C}$, $I_C = 200\text{ A}$, $V_{CC} = 480\text{ V}$, $V_{GE} = 15\text{ V}$, $L = 500\text{ }\mu\text{H}$,
 $R_g = 5\text{ }\Omega$, Diode used: 60APH06

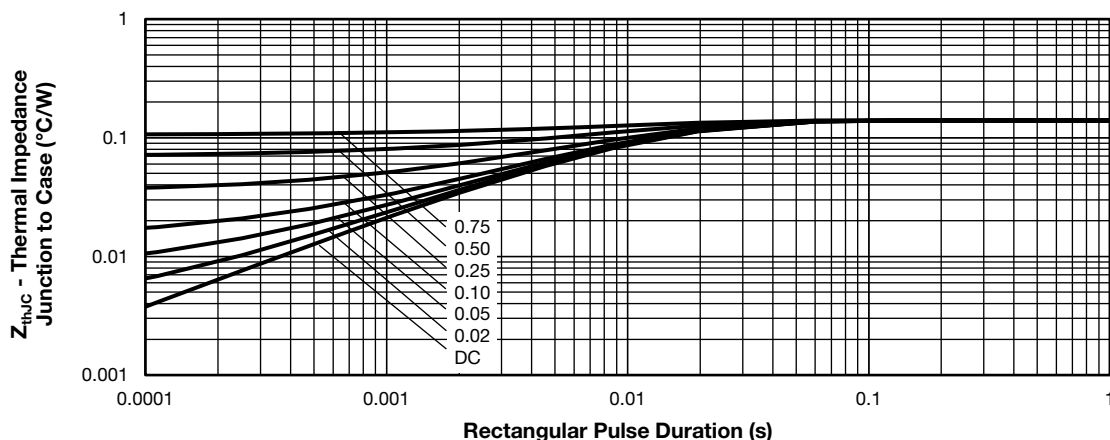


Fig. 13 - Maximum Thermal Impedance Characteristics

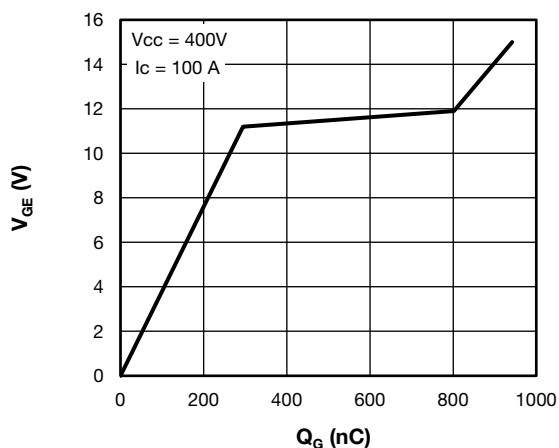
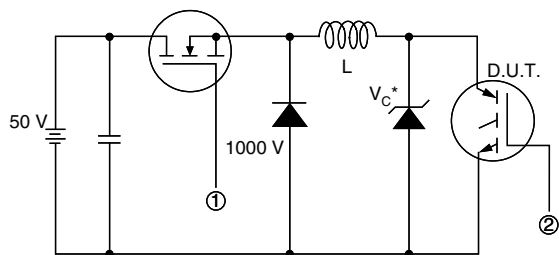


Fig. 14 - Typical Gate Charge vs. Gate Emitter Voltage



* 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

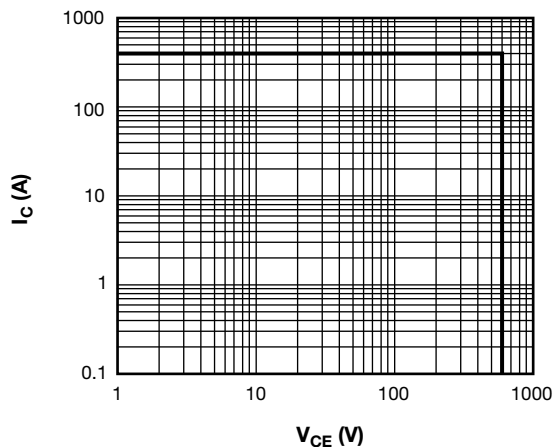


Fig. 15 - Reverse BIAS SOA, $T_J = 150\text{ }^{\circ}\text{C}$, $V_{GE} = 15\text{ V}$

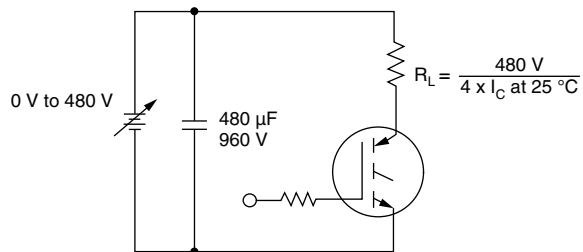
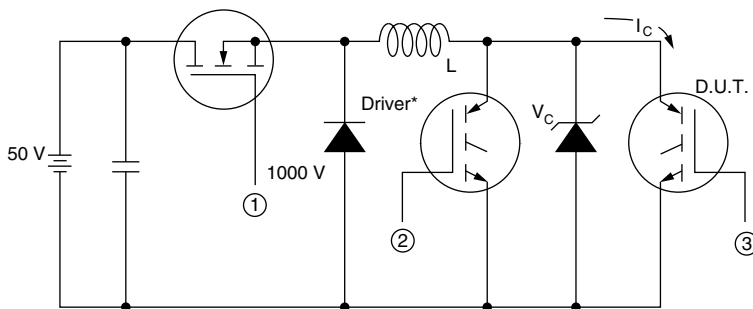


Fig. 17 - Pulsed Collector Current Test Circuit



* Driver same type as D.U.T., $V_C = 480\text{ V}$

Fig. 18 - Switching Lost Test Circuit

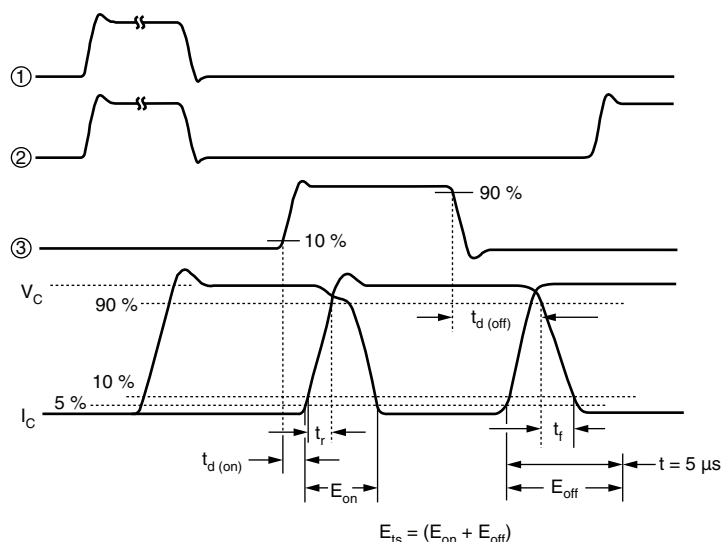


Fig. 19 - Switching Loss Waveforms

ORDERING INFORMATION TABLE

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

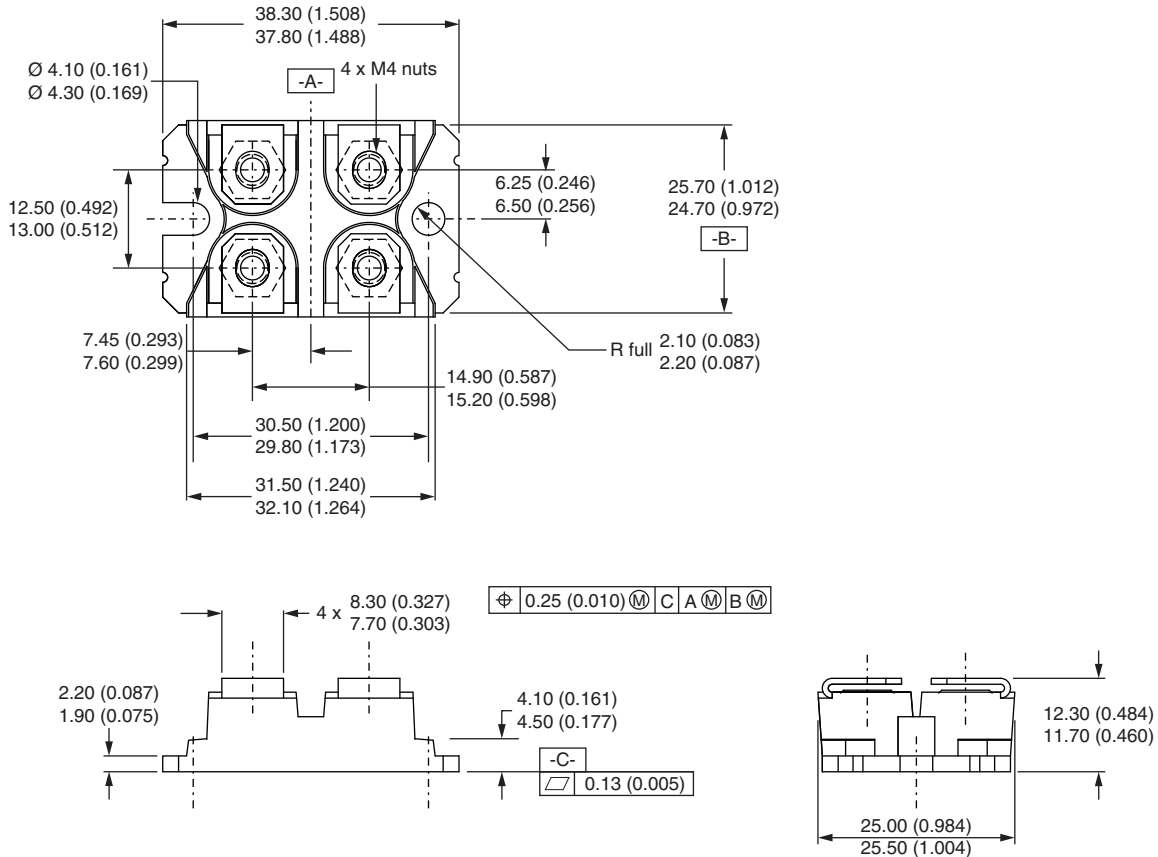
- 1 - Vishay Semiconductors product
- 2 - Insulated gate bipolar transistor (IGBT)
- 3 - P = trench PT IGBT
- 4 - Current rating (250 = 250 A)
- 5 - Circuit configuration (S = single switch, no diode)
- 6 - Package indicator (A = SOT-227)
- 7 - Voltage rating (60 = 600 V)
- 8 - Speed/type (S = standard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

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

LINKS TO RELATED DOCUMENTS	
Dimensions	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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