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 (≤ 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

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}		± 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 μA	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	μA
		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} = ± 20 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	-	
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	-	mJ
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	°C
Junction to case	R_{thJC}		-	-	0.14	°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				

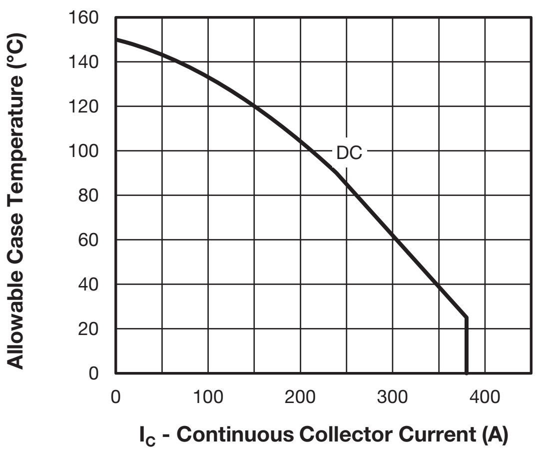


Fig. 1 - Maximum DC IGBT Collector Current vs. Case Temperature

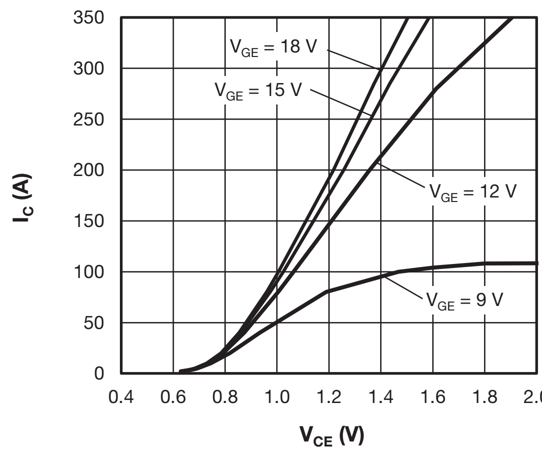


Fig. 4 - Typical Output Characteristics vs. V_{GE} at 125 °C

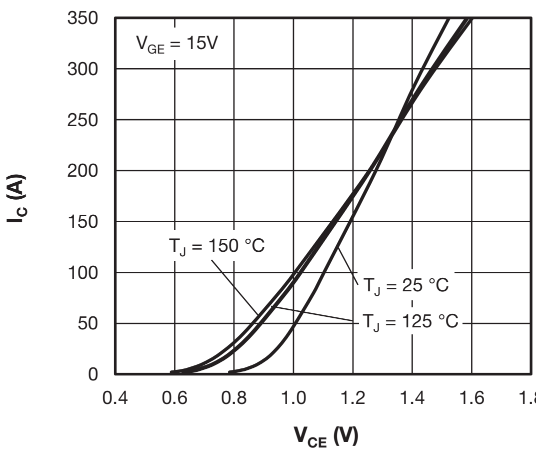


Fig. 2 - Typical IGBT Output Characteristics vs. V_{GE} = 15 V

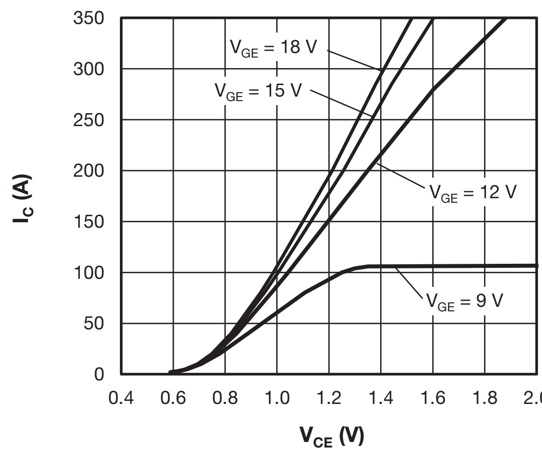


Fig. 5 - Typical Output Characteristics vs. V_{GE} at 150 °C

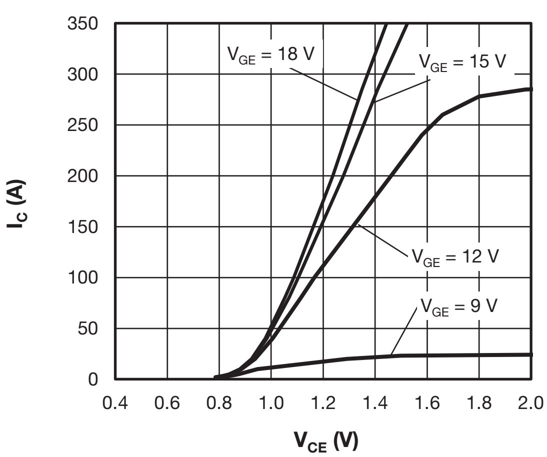


Fig. 3 - Typical Output Characteristics vs. V_{GE} at 25 °C

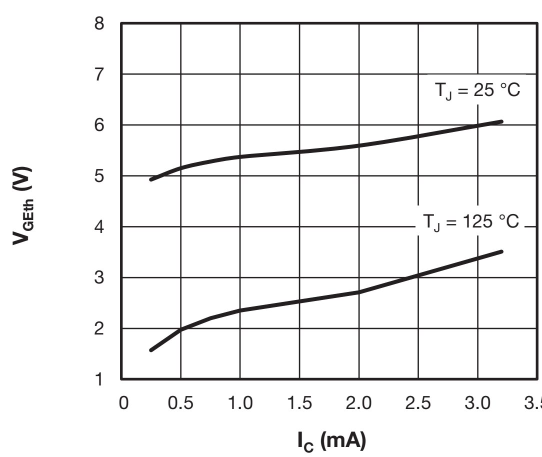


Fig. 6 - Typical Gate Threshold Voltage Characteristics

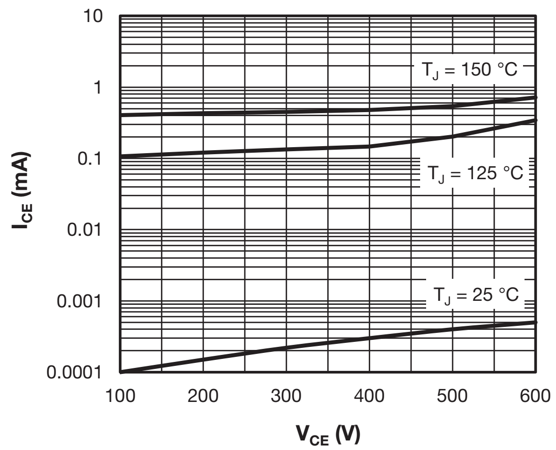


Fig. 7 - Typical Zero Voltage Collector Current

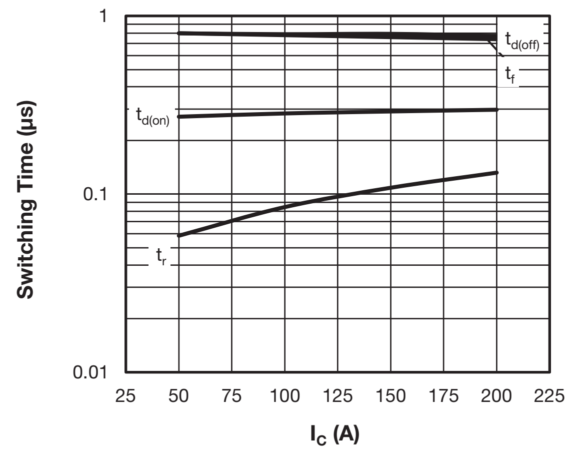


Fig. 10 - Typical IGBT Switching Time vs. I_C
T_J = 125 °C, V_{CC} = 480 V, V_{GE} = 15 V, L = 500 µH, R_g = 5 Ω
Diode used: 60APH06

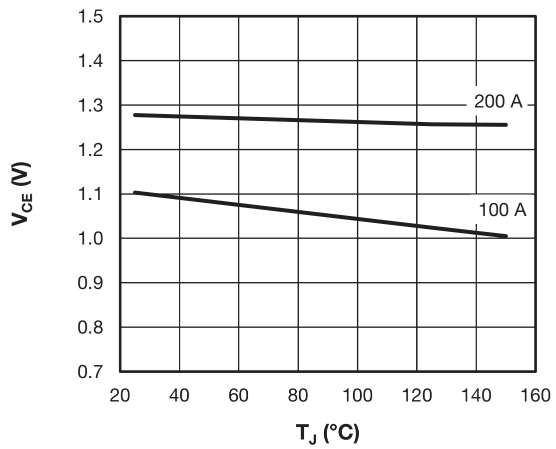


Fig. 8 - Typical V_{CE} vs. Junction Temperature

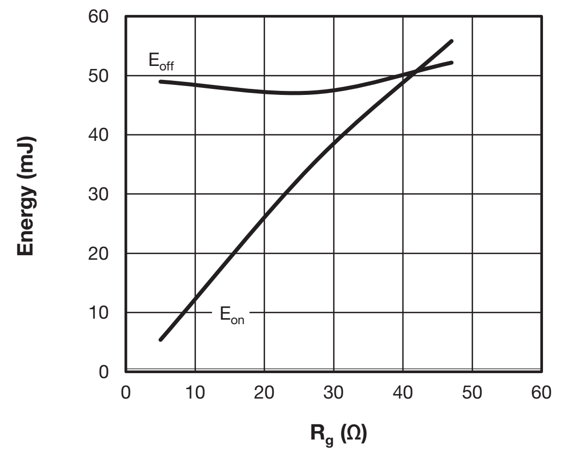


Fig. 11 - Typical IGBT Energy Losses vs. R_g
T_J = 125 °C, I_C = 200 A, V_{CC} = 480 V, V_{GE} = 15 V, L = 500 µH,
R_g = 5 Ω, Diode used: 60APH06

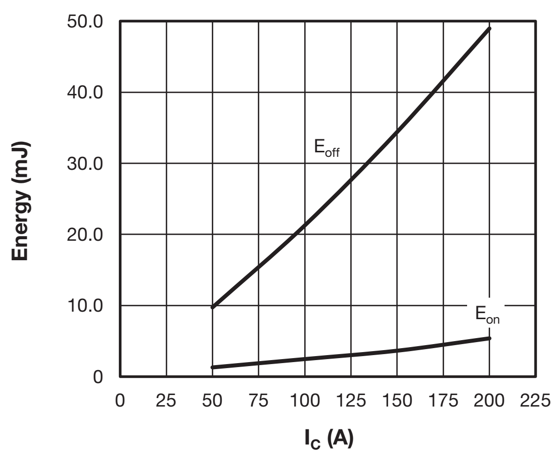


Fig. 9 - Typical IGBT Energy Losses vs. I_C
T_J = 125 °C, V_{CC} = 480 V, V_{GE} = 15 V, L = 500 µH, R_g = 5 Ω
Diode used: 60APH06

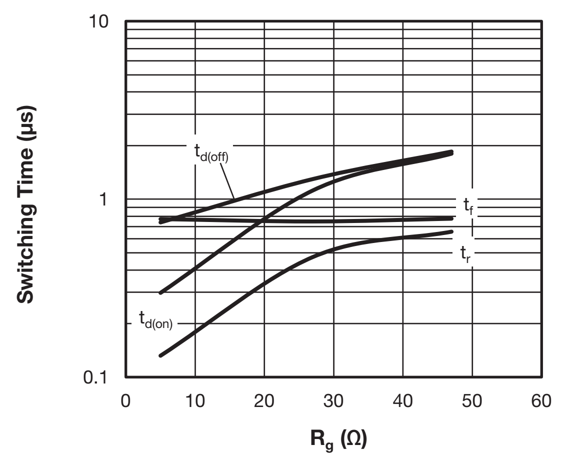


Fig. 12 - Typical IGBT Switching Time vs. R_g
T_J = 125 °C, I_C = 200 A, V_{CC} = 480 V, V_{GE} = 15 V, L = 500 µH,
R_g = 5 Ω, Diode used: 60APH06

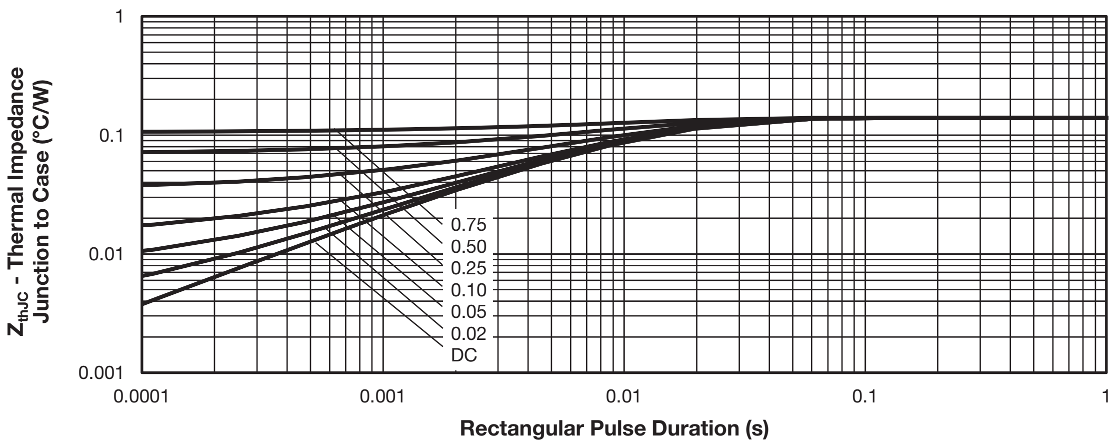


Fig. 13 - Maximum Thermal Impedance Characteristics

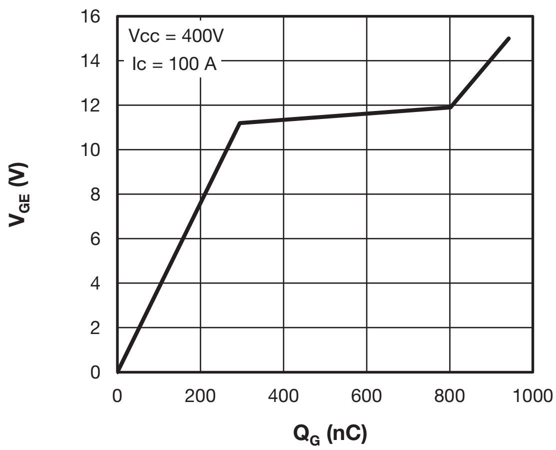
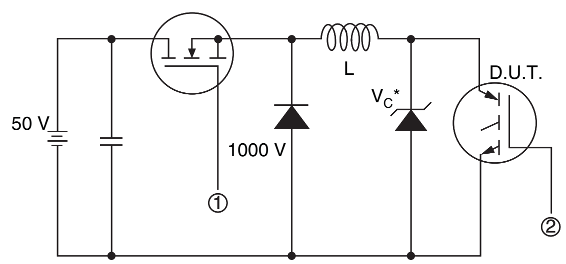


Fig. 14 - Typical Gate Charge vs. Gate Emitter Voltage



* 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

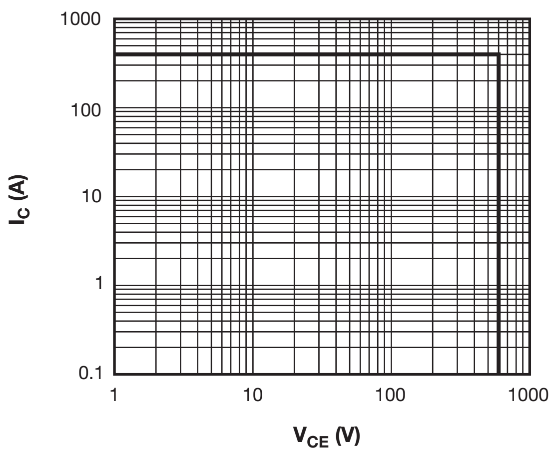


Fig. 15 - Reverse BIAS SOA, T_J = 150 °C, V_{GE} = 15 V

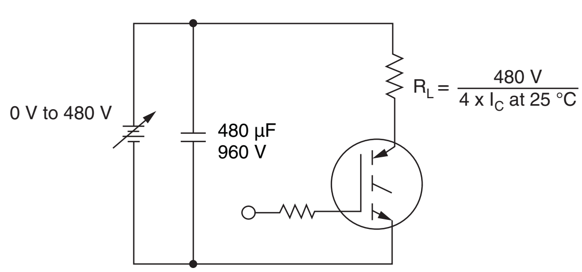


Fig. 17 - Pulsed Collector Current Test Circuit

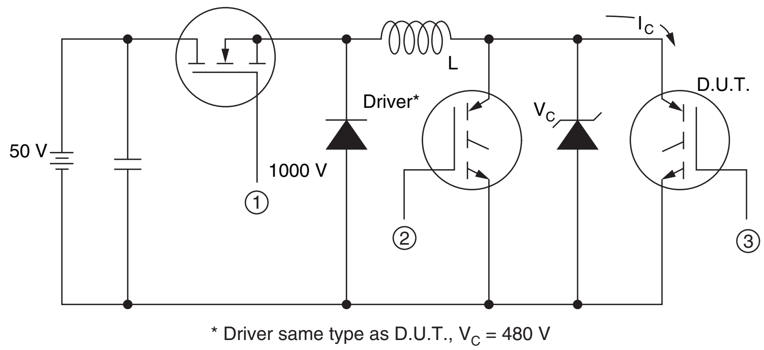


Fig. 18 - Switching Lost Test Circuit

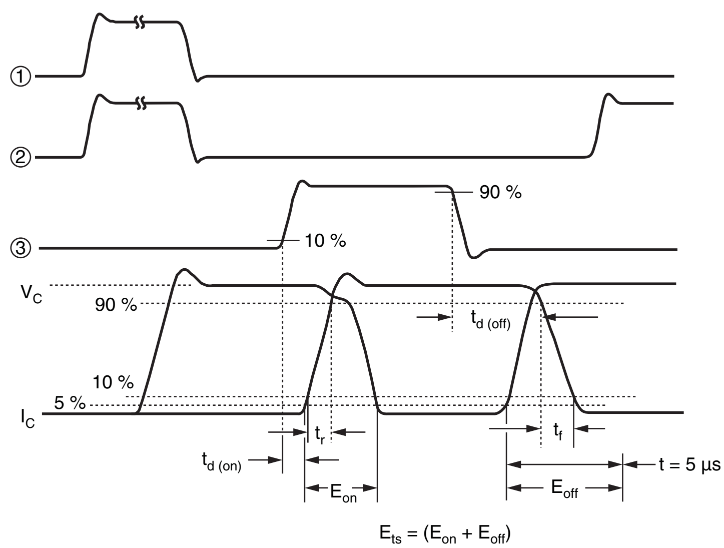
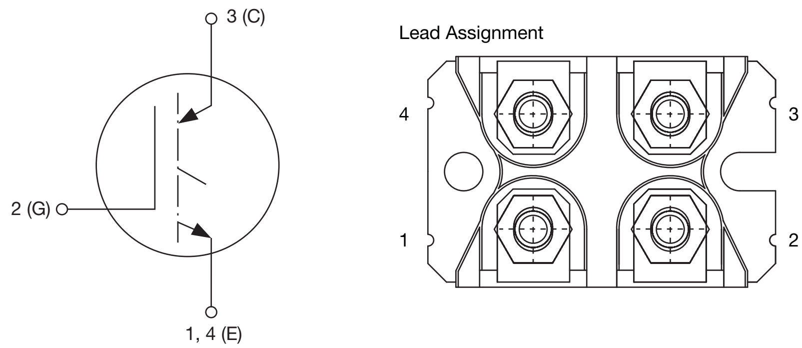


Fig. 19 - Switching Loss Waveforms

ORDERING INFORMATION TABLE

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

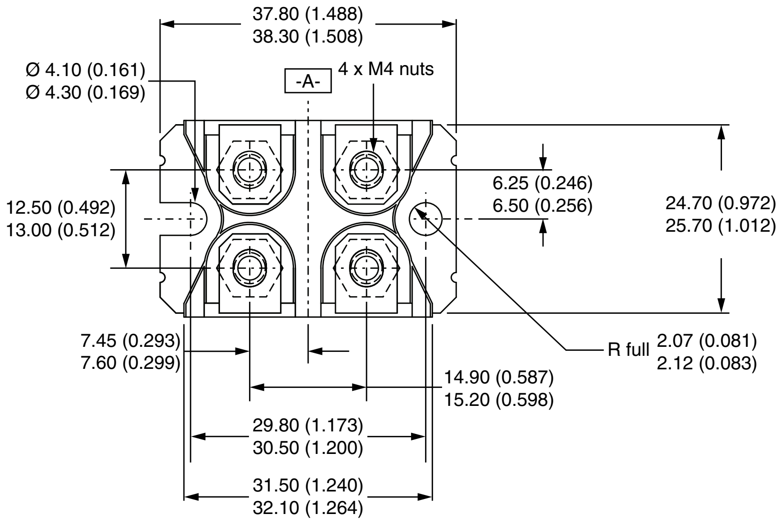
1	-	Vishay Semiconductors product
2	-	Insulated gate bipolar transistor (IGBT)
3	-	P = trench PT IGBT
4	-	Current rating (250 = 250 A)
5	-	Circuit configuration (S = single switch, no diode)
6	-	Package indicator (A = SOT-227)
7	-	Voltage rating (60 = 600 V)
8	-	Speed/type (S = standard speed)

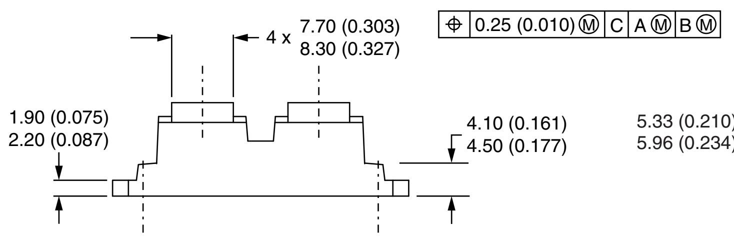
CIRCUIT CONFIGURATION		
CIRCUIT	**CIRCUIT CONFIGURATION CODE**	**CIRCUIT DRAWING**
Single switch no diode	S	

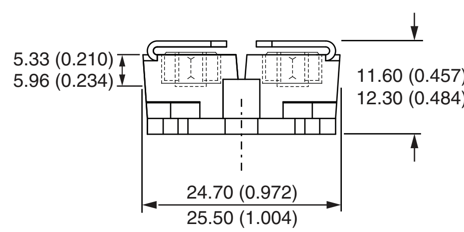
LINKS TO RELATED DOCUMENTS	
Dimensions	www.vishay.com/doc?95423
Packaging information	www.vishay.com/doc?95425

SOT-227 Generation 2

DIMENSIONS in millimeters (inches)







Note

- Controlling dimension: millimeter

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