Insulated Gate Bipolar Transistor Ultralow $V_{CE(on)}$, 250 A

SOT-227

PRIMARY CHARACTERISTICS	
V_{CES}	600 V
$V_{CE(on)}$ (typical) at 200 A, 25 °C	1.33 V
I_C at T_C = 90 °C	250 A
Speed	DC to 1 kHz
Package	SOT-227
Circuit configuration	Single switch no diode

FEATURES

- Standard: optimized for minimum saturation voltage and low speed
- Lowest conduction losses available
- Fully isolated package (2500 V_{AC})
- Very low internal inductance (5 nH typical)
- Industry standard outline
- Designed and qualified for industrial level
- UL approved file E78996
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Pb-free
RoHS COMPLIANT

BENEFITS

- Designed for increased operating efficiency in power conversion: UPS, SMPS, TIG welding, induction heating
- Easy to assemble and parallel
- Direct mounting to heatsink
- Plug-in compatible with other SOT-227 packages

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	400	A
		T_C = 90 °C	250	
Pulsed collector current	I_{CM}	Repetitive rating; V_{GE} = 20 V, pulse width limited by maximum junction temperature	400	
Clamped Inductive load current	I_{LM}	V_{CC} = 80 % (V_{CES}), V_{GE} = 20 V, L = 10 μH, R_g = 2.0 Ω	400	
Gate to emitter voltage	V_{GE}		± 20	V
Power dissipation	P_D	T_C = 25 °C	961	W
		T_C = 90 °C	462	
Isolation voltage	V_{ISOL}	Any terminal to case, t = 1 min	2500	V

THERMAL AND MECHANICAL SPECIFICATIONS

PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Junction and storage temperature range	T_J, T_{Stg}		-40	-	150	°C
Thermal resistance junction to case	R_{thJC}		-	-	0.13	°C/W
Thermal resistance 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	-	-	1.8 (15.9)	Nm (lbf.in)
Case style	SOT-227					

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ELECTRICAL SPECIFICATIONS (T_J = 25 °C unless otherwise noted)							
PARAMETER	**SYMBOL**	**TEST CONDITIONS**		**MIN.**	**TYP.**	**MAX.**	**UNITS**
Collector to emitter breakdown voltage	$V_{(BR)CES}$	V_{GE} = 0 V, I_C = 1 mA		600	-	-	V
Emitter to collector breakdown voltage	$V_{(BR)ECS}$ (1)	V_{GE} = 0 V, I_C = 1.0 A		18	-	-	
Collector to emitter voltage	$V_{CE(on)}$	I_C = 100 A	V_{GE} = 15 V	-	1.10	1.3	
		I_C = 200 A		-	1.33	1.66	
		I_C = 100 A, T_J = 125 °C		-	1.02	-	
		I_C = 200 A, T_J = 125 °C		-	1.32	-	
		I_C = 100 A, T_J = 150 °C		-	1.02	-	
		I_C = 200 A, T_J = 150 °C		-	1.33	-	
Gate threshold voltage	$V_{GE(th)}$	V_{CE} = V_{GE}, I_C = 250 μA		3.0	4.5	6.0	
		V_{CE} = V_{GE}, I_C = 250 μA, T_J = 125 °C		-	3.1	-	
Temperature coefficient of threshold voltage	$\Delta V_{GE(th)}/\Delta T_J$	V_{CE} = V_{GE}, I_C = 1 mA, 25 °C to 125 °C		-	-12	-	mV/°C
Collector to emitter leakage current	I_{CES}	V_{GE} = 0 V, V_{CE} = 600 V		-	20	1000	μA
		V_{GE} = 0 V, V_{CE} = 600 V, T_J = 125 °C		-	0.2	-	mA
		V_{GE} = 0 V, V_{CE} = 600 V, T_J = 150 °C		-	0.6	10	
Gate to emitter leakage current	I_{GES}	V_{GE} = ± 20 V		-	-	± 250	nA

Note

(1) Pulse width ≤ 80 μs; duty factor ≤ 0.1 %

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} = 600 V, V_{GE} = 15 V		-	770	1200	nC
Gate-to-emitter charge (turn-on)	Q_{ge}			-	100	150	
Gate-to-collector charge (turn-on)	Q_{gc}			-	260	380	
Turn-on switching loss	E_{on}	T_J = 25 °C I_C = 100 A V_{CC} = 480 V V_{GE} = 15 V R_g = 5.0 Ω L = 500 μH	Energy losses include tail and diode recovery. Diode used 60APH06	-	0.55	-	mJ
Turn-off switching loss	E_{off}			-	25	-	
Total switching loss	E_{tot}			-	25.5	-	
Turn-on delay time	$t_{d(on)}$			-	267	-	ns
Rise time	t_r			-	42	-	
Turn-off delay time	$t_{d(off)}$			-	310	-	
Fall time	t_f			-	450	-	
Turn-on switching loss	E_{on}	T_J = 125 °C I_C = 100 A V_{CC} = 480 V V_{GE} = 15 V R_g = 5.0 Ω L = 500 μH		-	0.67	-	mJ
Turn-off switching loss	E_{off}			-	43.0	-	
Total switching loss	E_{tot}			-	43.7	-	
Turn-on delay time	$t_{d(on)}$			-	275	-	ns
Rise time	t_r			-	50	-	
Turn-off delay time	$t_{d(off)}$			-	350	-	
Fall time	t_f			-	700	-	
Internal emitter inductance	L_E	Between lead and center of die contact		-	5.0	-	nH
Input capacitance	C_{ies}	V_{GE} = 0 V, V_{CC} = 30 V, f = 1.0 MHz		-	16 250	-	pF
Output capacitance	C_{oes}			-	1040	-	
Reverse transfer capacitance	C_{res}			-	190	-	

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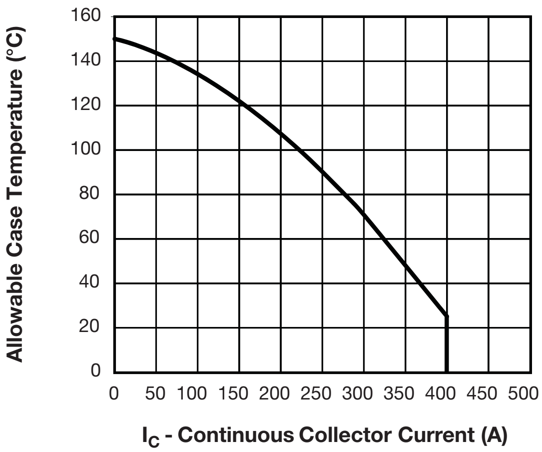

Fig. 1 - Maximum DC IGBT Collector Current vs. Case Temperature

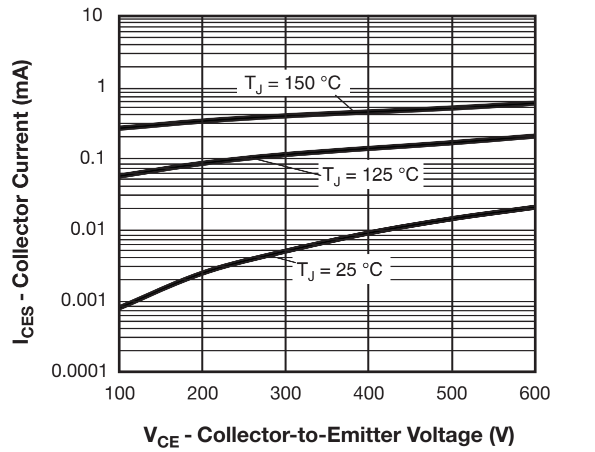

Fig. 4 - Typical IGBT Zero Gate Voltage Collector Current

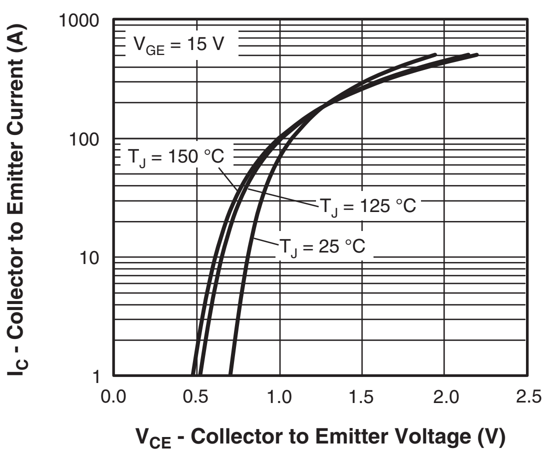

Fig. 2 - Typical Collector to Emitter Current Output Characteristics

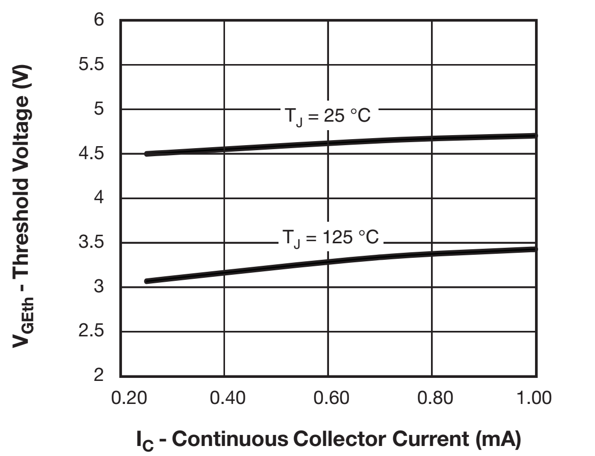

Fig. 5 - Typical IGBT Threshold Voltage

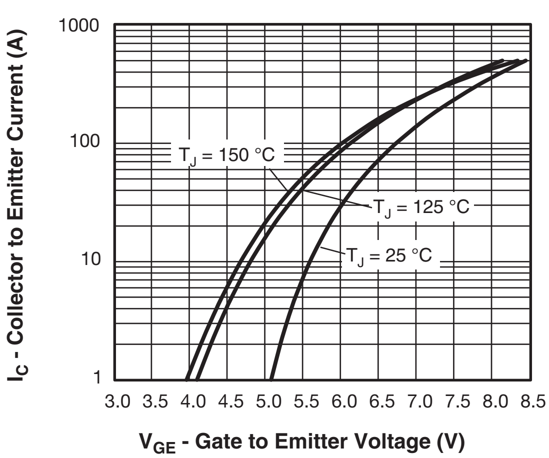

Fig. 3 - Typical IGBT Transfer Characteristics

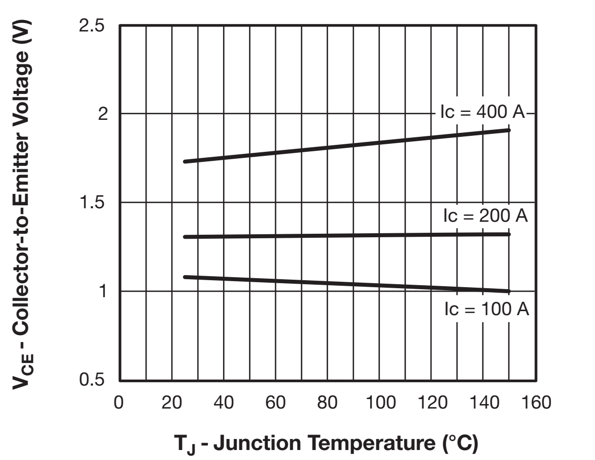

Fig. 6 - Typical IGBT Collector to Emitter Voltage vs. Junction Temperature, V_{GE} = 15 V

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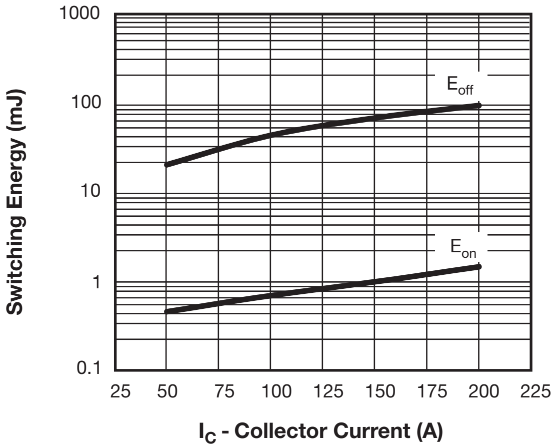

Fig. 7 - Typical IGBT Energy Losses vs. I_C, T_J = 125 °C, V_{CC} = 480 V, V_{GE} = 15 V, L = 500 μH, R_g = 5 Ω, Diode used: 60APH06

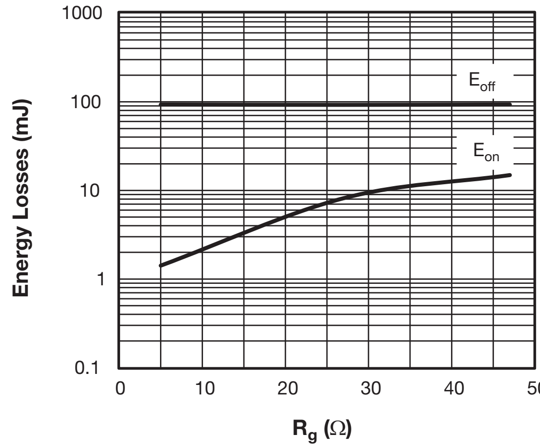

Fig. 9 - Typical IGBT Energy Losses vs. R_g, T_J = 125 °C, I_C = 200 A, V_{CC} = 480 V, V_{GE} = 15 V, L = 500 μH, Diode used: 60APH06

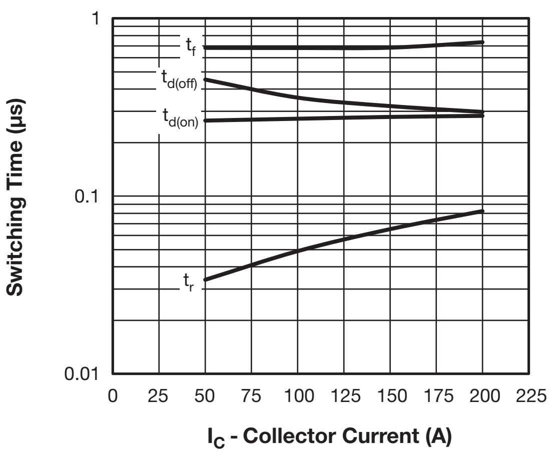

Fig. 8 - Typical IGBT Switching Time vs. I_C, T_J = 125 °C, V_{CC} = 480 V, V_{GE} = 15 V, L = 500 μH, R_g = 5 Ω, Diode used: 60APH06

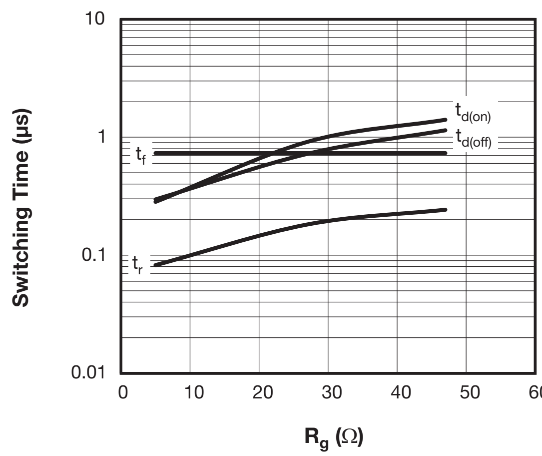

Fig. 10 - Typical IGBT Switching Time vs. R_g, T_J = 125 °C, I_C = 200 A, V_{CC} = 480 V, V_{GE} = 15 V, L = 500 μH, Diode used: 60APH06

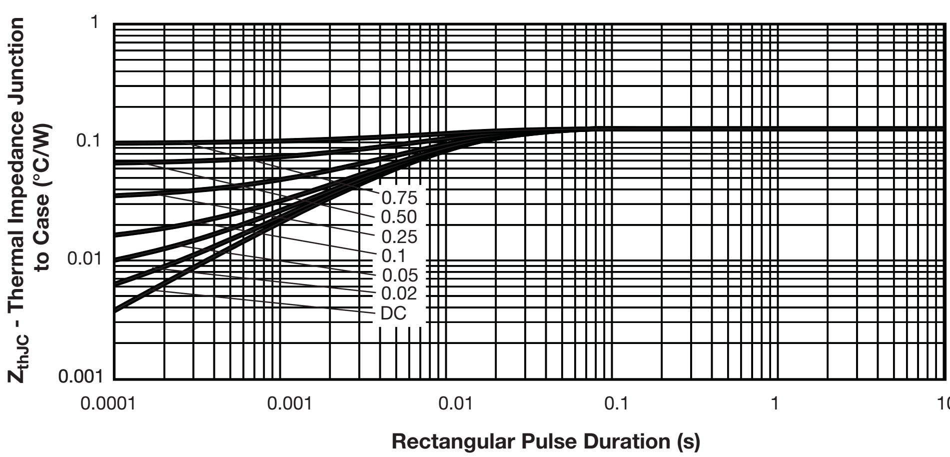

Fig. 11 - Maximum Thermal Impedance Z_{thJC} Characteristics

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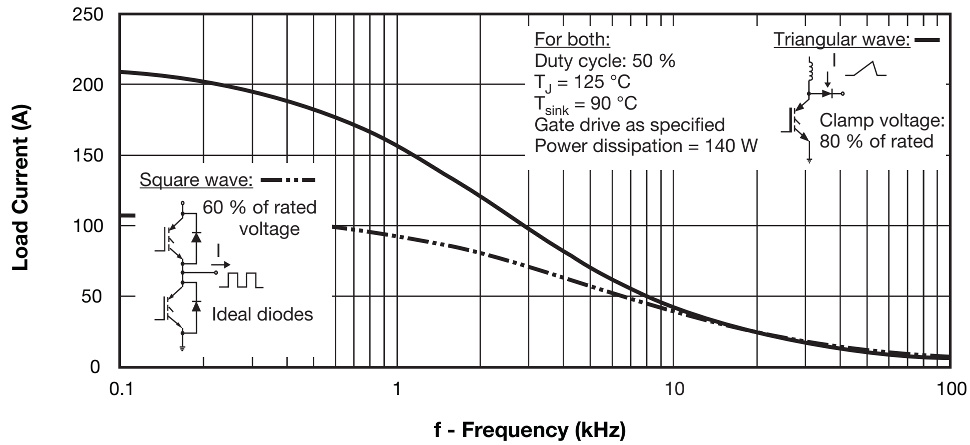

Fig. 12 - Typical Load Current vs. Frequency (Load Current = I_{RMS} of Fundamental)

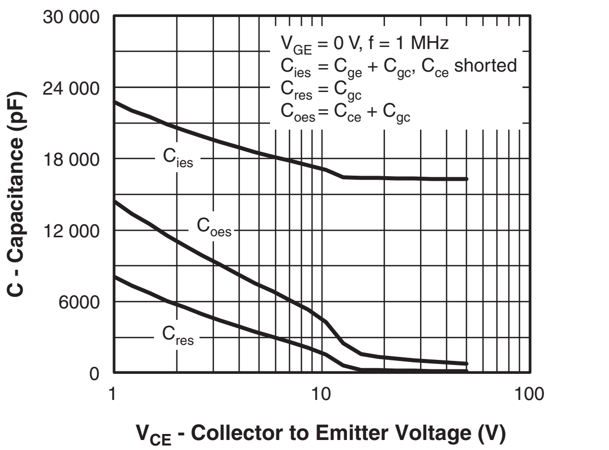

Fig. 13 - Typical Capacitance vs. Collector to Emitter Voltage

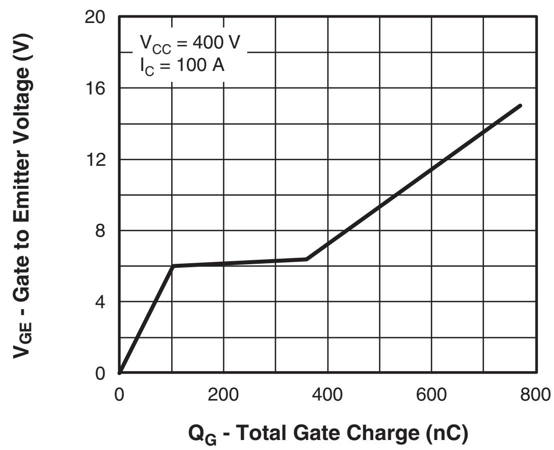

Fig. 14 - Typical Gate Charge vs. Gate to Emitter Voltage

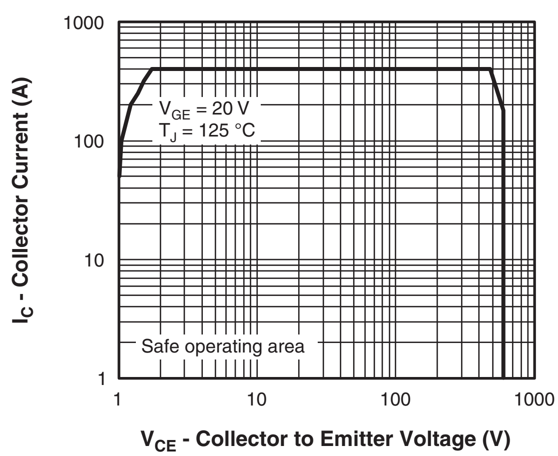

Fig. 15 - Turn-Off SOA

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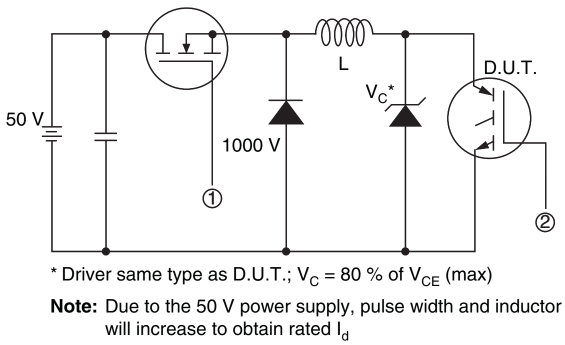

Fig. 16a - Clamped Inductive Load Test Circuit

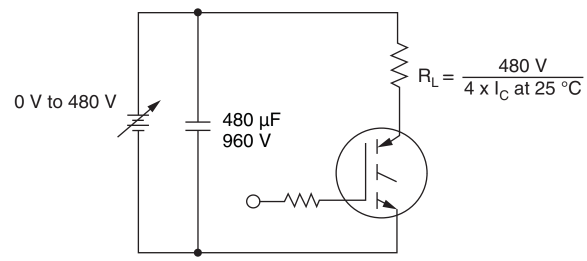

Fig. 16b - Pulsed Collector Current Test Circuit

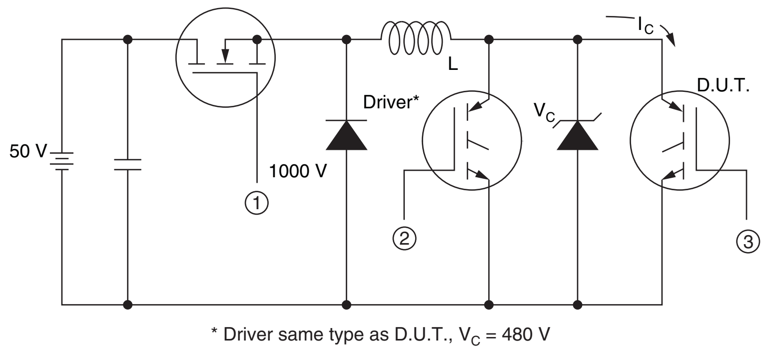

Fig. 17a - Switching Lost Test Circuit

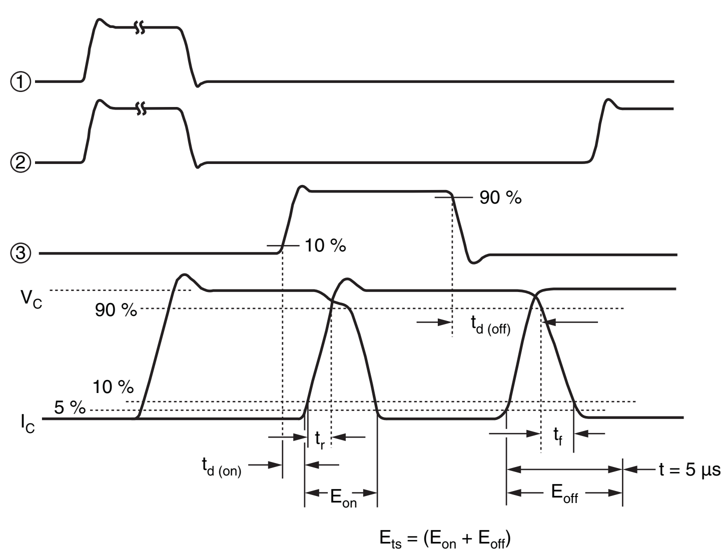

Fig. 17b - Switching Loss Waveforms

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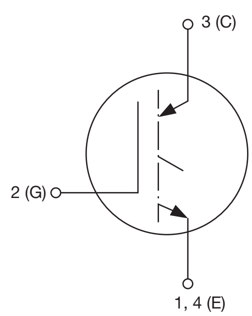
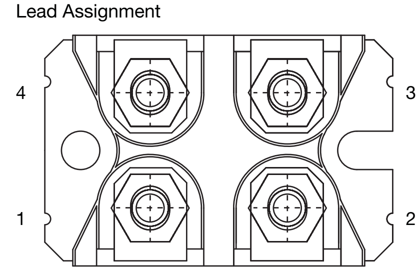
ORDERING INFORMATION TABLE

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

- **1** - Vishay Semiconductors product
- **2** - Insulated gate bipolar transistor (IGBT)
- **3** - Gen 4, IGBT silicon
- **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	 N-channel Lead Assignment 

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

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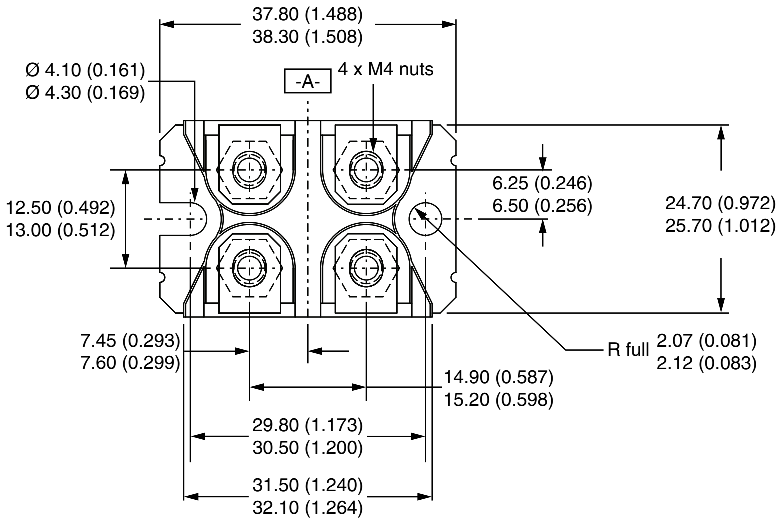
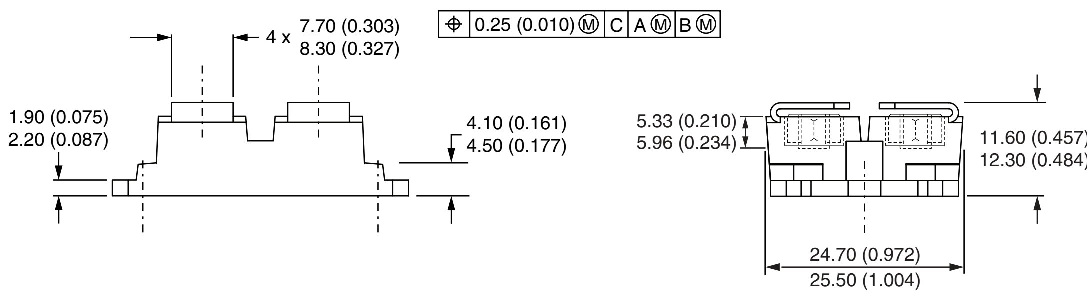
SOT-227 Generation 2

DIMENSIONS in millimeters (inches)





Note

- Controlling dimension: millimeter

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