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

SOT-227

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

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

Note

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

ABSOLUTE MAXIMUM RATINGS				
PARAMETER	**SYMBOL**	**TEST CONDITIONS**	**MAX.**	**UNITS**
Collector to emitter voltage	V_{CES}		600	V
Continuous collector current	I_C (1)	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

Note

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

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	-	-	1.3 (11.5)	Nm (lbf.in)
Case style	SOT-227					

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

Notes

(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	-	

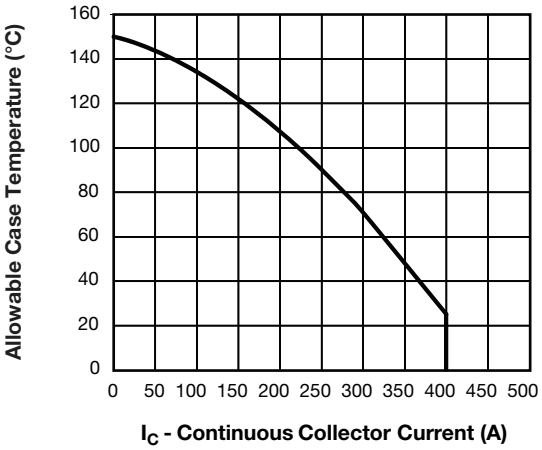


Fig. 1 - Maximum DC IGBT Collector Current vs. Case Temperature

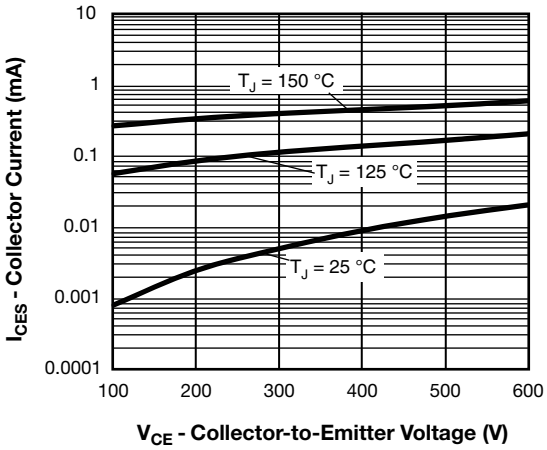


Fig. 4 - Typical IGBT Zero Gate Voltage Collector Current

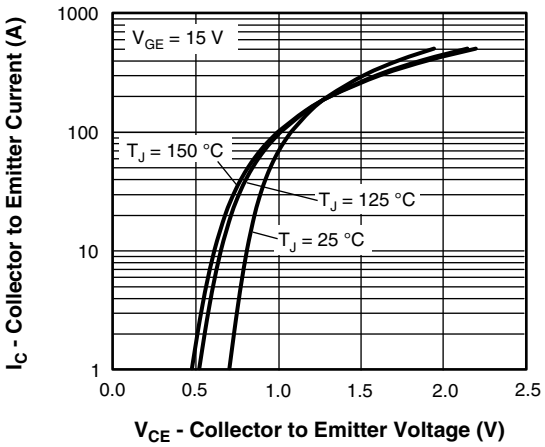


Fig. 2 - Typical Collector to Emitter Current Output Characteristics

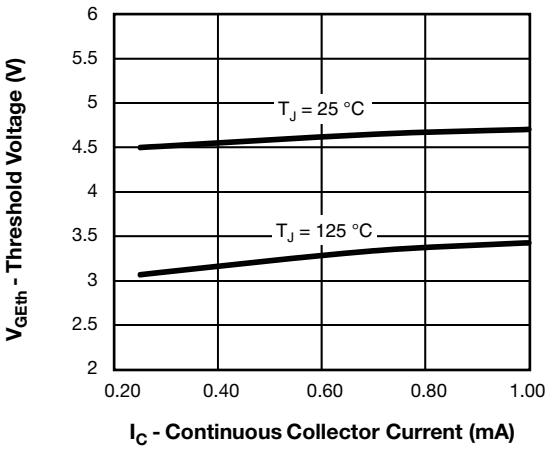


Fig. 5 - Typical IGBT Threshold Voltage

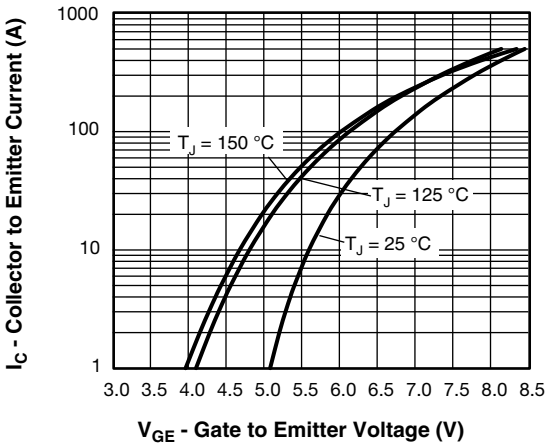


Fig. 3 - Typical IGBT Transfer Characteristics

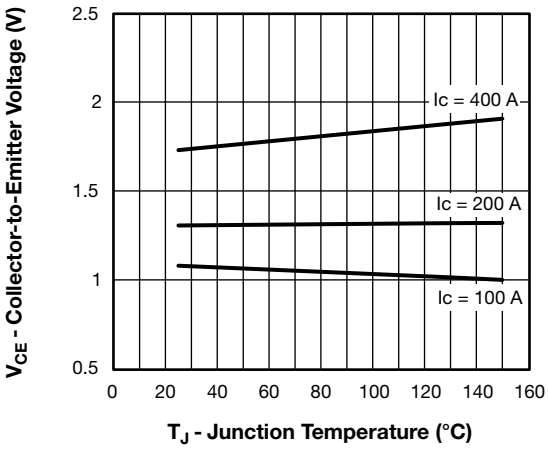


Fig. 6 - Typical IGBT Collector to Emitter Voltage vs. Junction Temperature, V_{GE} = 15 V

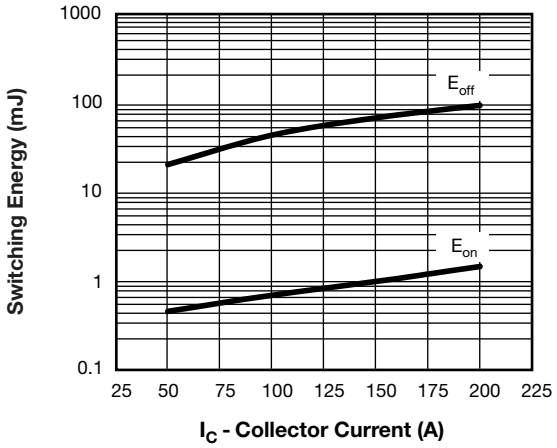


Fig. 7 - Typical IGBT Energy Losses vs. I_C, T_J = 125 °C,
V_{CC} = 480 V, V_{GE} = 15 V, L = 500 µH, R_g = 5 Ω,
Diode used: 60APH06

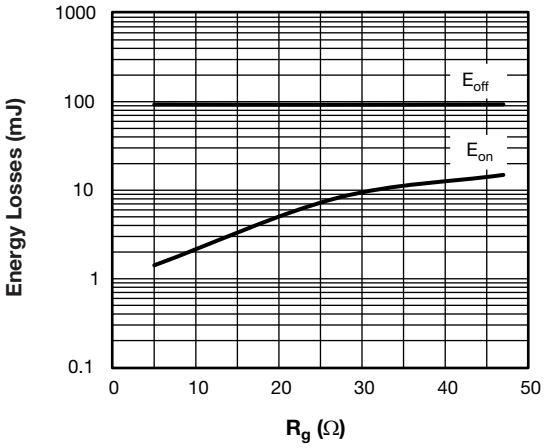


Fig. 9 - Typical IGBT Energy Losses vs. R_g,
T_J = 125 °C, I_C = 200 A, V_{CC} = 480 V, V_{GE} = 15 V, L = 500 µH,
Diode used: 60APH06

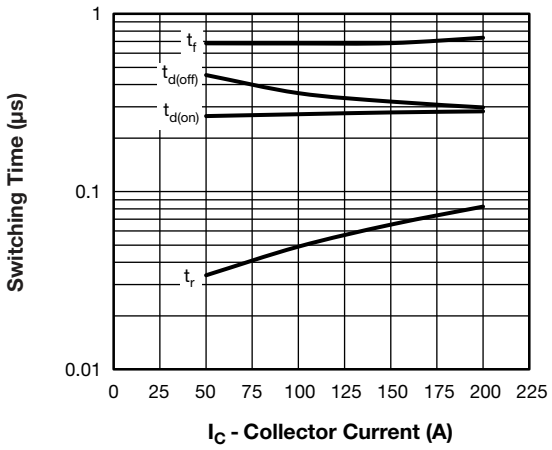


Fig. 8 - Typical IGBT Switching Time vs. I_C,
T_J = 125 °C, V_{CC} = 480 V, V_{GE} = 15 V, L = 500 µH, R_g = 5 Ω,
Diode used: 60APH06

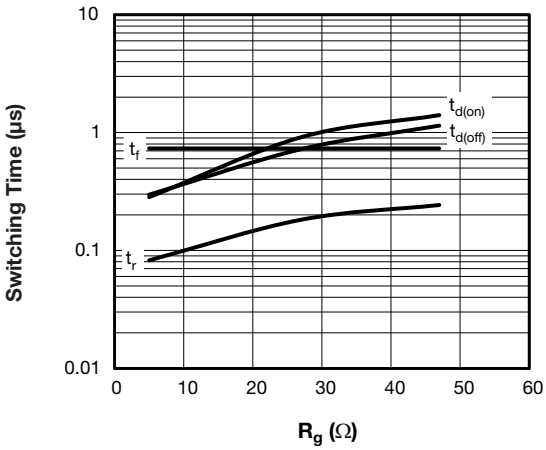


Fig. 10 - Typical IGBT Switching Time vs. R_g,
T_J = 125 °C, I_C = 200 A, V_{CC} = 480 V, V_{GE} = 15 V, L = 500 µH,
Diode used: 60APH06

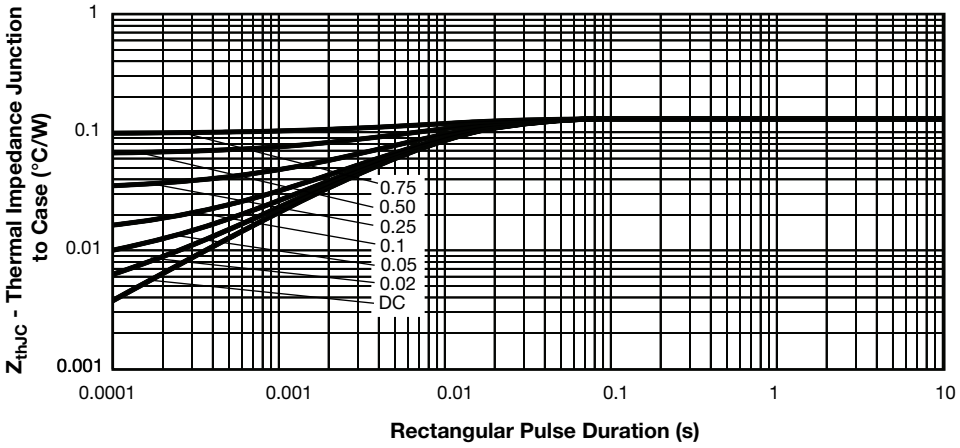


Fig. 11 - Maximum Thermal Impedance Z_{thJC} Characteristics

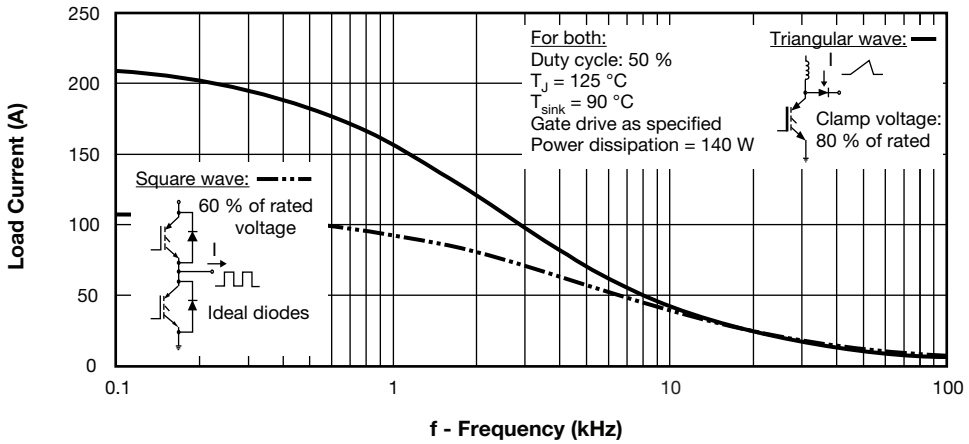


Fig. 12 - Typical Load Current vs. Frequency (Load Current = I_{RMS} of Fundamental)

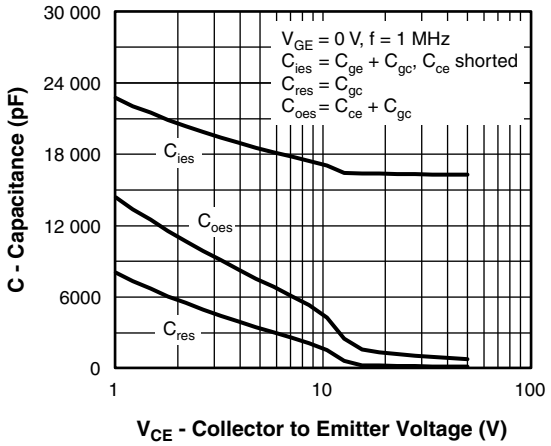


Fig. 13 - Typical Capacitance vs. Collector to Emitter Voltage

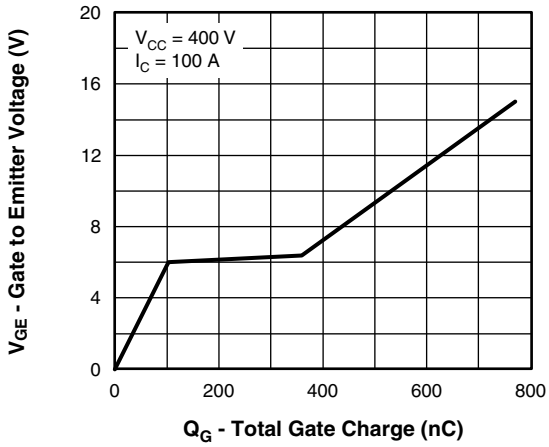


Fig. 14 - Typical Gate Charge vs. Gate to Emitter Voltage

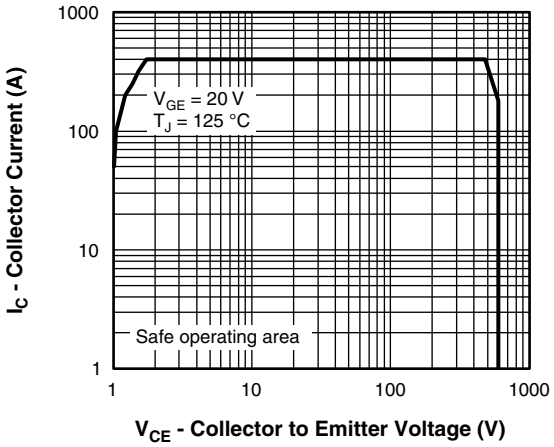
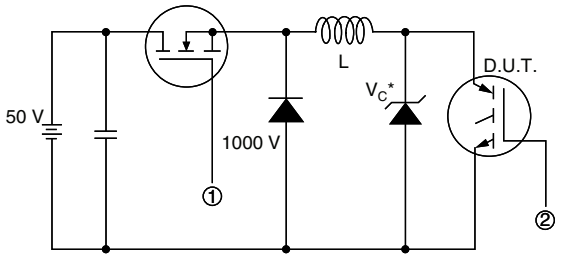


Fig. 15 - Turn-Off SOA



* 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. 16a - Clamped Inductive Load Test Circuit

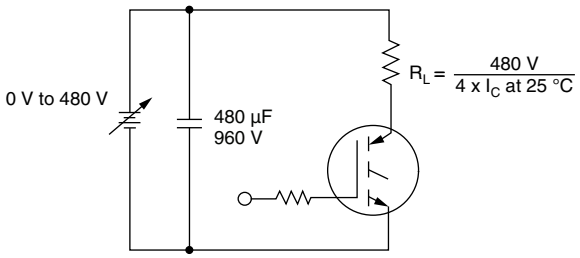
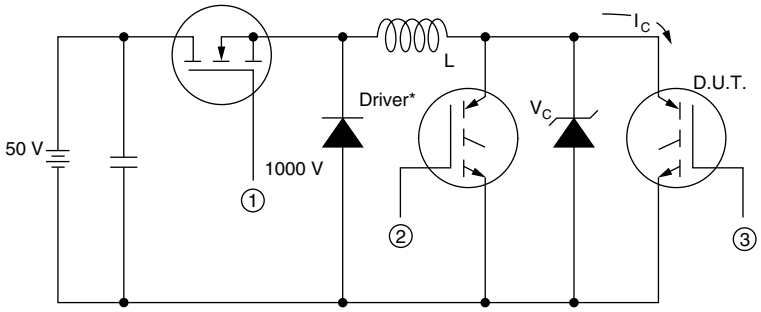
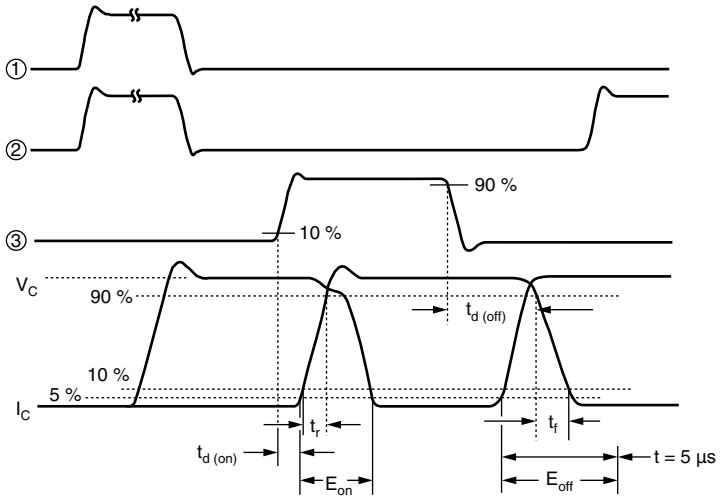


Fig. 16b - Pulsed Collector Current Test Circuit



* Driver same type as D.U.T., V_C = 480 V

Fig. 17a - Switching Lost Test Circuit



$E_{ts} = (E_{on} + E_{off})$

Fig. 17b - Switching Loss Waveforms

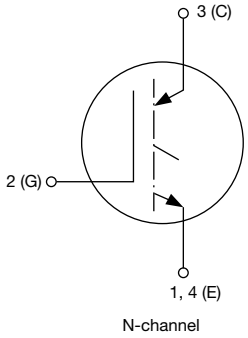
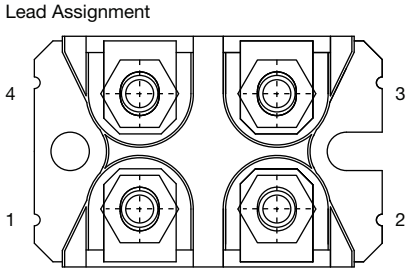
ORDERING INFORMATION TABLE

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, without antiparallel diode)
- 6 - Package indicator (A = SOT-227)
- 7 - Voltage rating (60 = 600 V)
- 8 - Speed/type (S = standard speed)

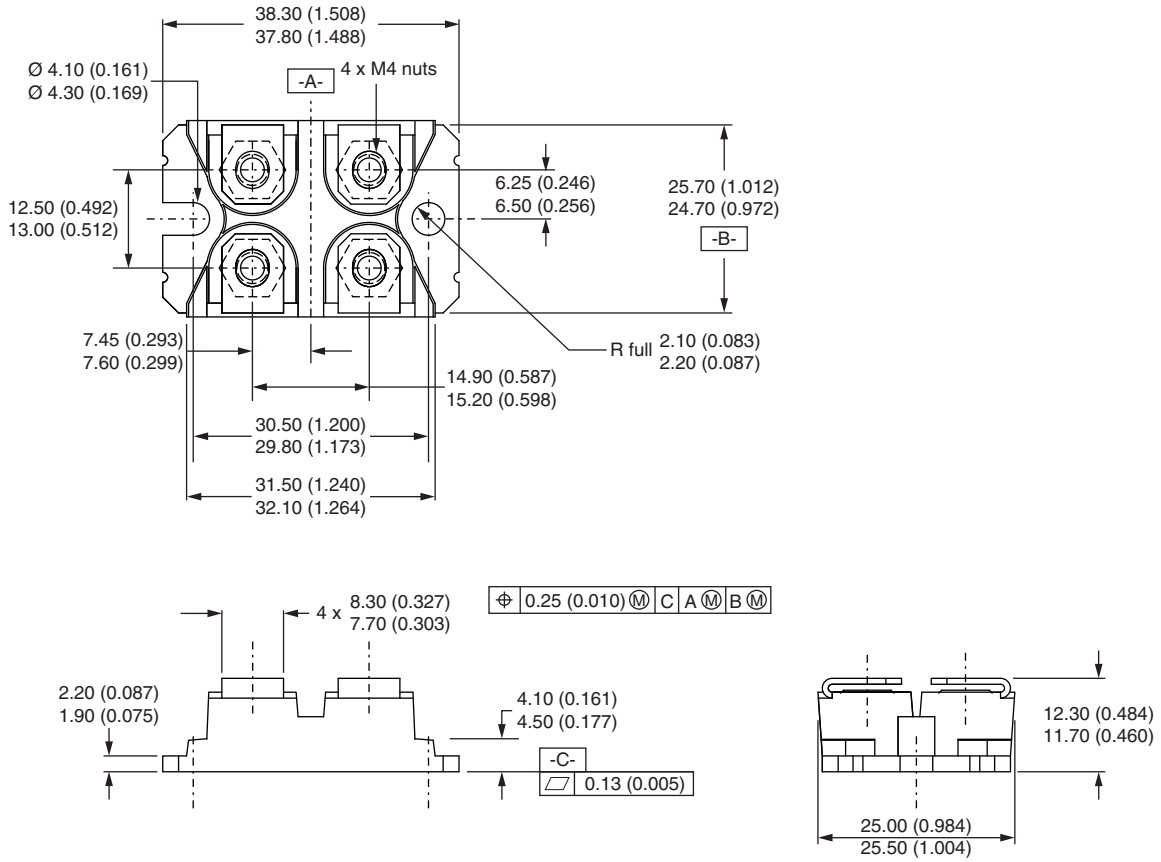
CIRCUIT CONFIGURATION

CIRCUIT	CIRCUIT CONFIGURATION CODE	CIRCUIT DRAWING
Single switch, no antiparallel diode	S	 N-channel 

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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