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	1.16 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	359	A
		T_C = 90 °C	250	
Pulsed collector current	I_{CM}	T_C = 175 °C, t_p = 6 ms, V_{GE} = 15 V	945	
Clamped Inductive load current	I_{LM}		250	
Gate to emitter voltage	V_{GE}		± 20	V
Power dissipation	P_D	T_C = 25 °C	750	W
		T_C = 90 °C	425	
Isolation voltage	V_{ISOL}	Any terminal to case, t = 1 min	2500	V

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 = 0.4 mA		600	-	-	V
Collector to emitter voltage	$V_{CE(on)}$	I_C = 100 A	V_{GE} = 15 V	-	1.01	1.16	
		I_C = 200 A		-	1.16	-	
		I_C = 100 A, T_J = 125 °C		-	0.96	-	
		I_C = 200 A, T_J = 125 °C		-	1.18	-	
		I_C = 100 A, T_J = 150 °C		-	0.95	-	
		I_C = 200 A, T_J = 150 °C		-	1.18	-	
Gate threshold voltage	$V_{GE(th)}$	V_{CE} = V_{GE}, I_C = 2 mA		3.8	4.9	6.3	
		V_{CE} = V_{GE}, I_C = 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 = 2 mA, 25 °C to 125 °C		-	-14	-	mV/°C
Collector to emitter leakage current	I_{CES}	V_{GE} = 0 V, V_{CE} = 600 V		-	0.2	100	μA
		V_{GE} = 0 V, V_{CE} = 600 V, T_J = 125 °C		-	51	-	
		V_{GE} = 0 V, V_{CE} = 600 V, T_J = 150 °C		-	508	-	
Gate to emitter leakage current	I_{GES}	V_{GE} = ± 20 V		-	-	± 250	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 = 75 A, V_{CC} = 520 V, V_{GE} = 15 V		-	909	-	nC
Gate-to-emitter charge (turn-on)	Q_{ge}			-	139	-	
Gate-to-collector charge (turn-on)	Q_{gc}			-	249	-	
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 UFL330FA60	-	1.61	-	mJ
Turn-off switching loss	E_{off}			-	6.65	-	
Total switching loss	E_{tot}			-	8.26	-	
Turn-on delay time	$t_{d(on)}$			-	469	-	ns
Rise time	t_r			-	36	-	
Turn-off delay time	$t_{d(off)}$			-	539	-	
Fall time	t_f			-	109	-	
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		-	2.03	-	mJ
Turn-off switching loss	E_{off}			-	9.65	-	
Total switching loss	E_{tot}			-	11.68	-	
Turn-on delay time	$t_{d(on)}$			-	498	-	ns
Rise time	t_r			-	43	-	
Turn-off delay time	$t_{d(off)}$			-	640	-	
Fall time	t_f			-	128	-	
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} = 25 V, f = 1.0 MHz		-	24 200	-	pF
Output capacitance	C_{oes}			-	300	-	
Reverse transfer capacitance	C_{res}			-	84	-	
Reverse bias safe operating area	RBSOA	T_J = 175 °C, I_C = 250 A, R_g = 5.0 Ω, V_{GE} = 15 V to 0 V, V_{CC} = 400 V, V_p = 600 V		Fullsquare			

THERMAL AND MECHANICAL SPECIFICATIONS							
PARAMETER	**SYMBOL**	**TEST CONDITIONS**	**MIN.**	**TYP.**	**MAX.**	**UNITS**
Junction and storage temperature range	T_J, T_{Stg}		-40	-	175	°C
Thermal resistance junction to case	R_{thJC}		-	-	0.2	°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					

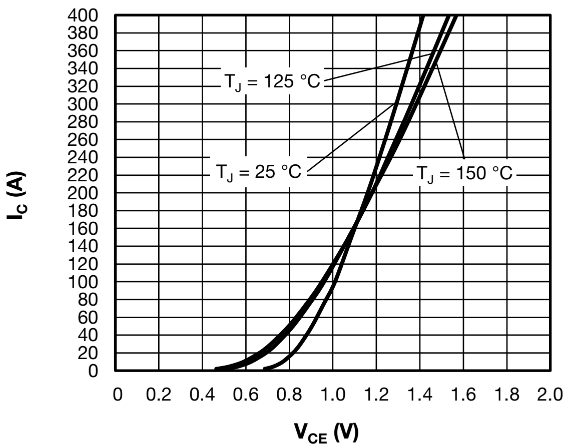


Fig. 1 - Typical Trench IGBT Output Characteristics, V_{GE} = 15 V

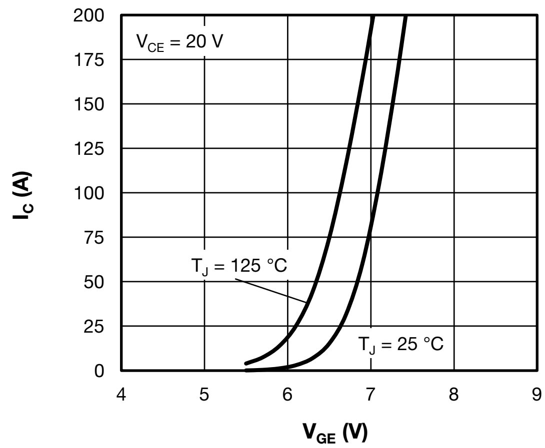


Fig. 4 - Typical Trench IGBT Transfer Characteristics

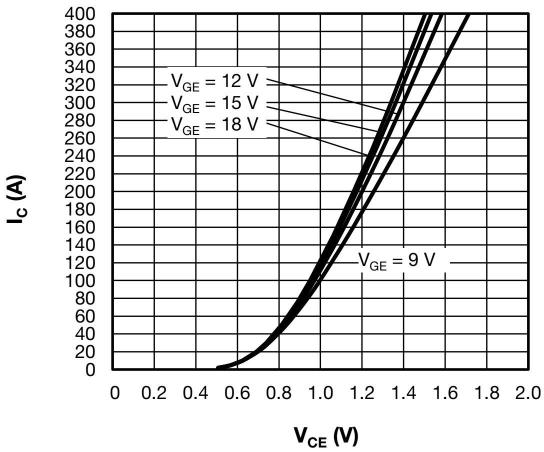


Fig. 2 - Typical Trench IGBT Output Characteristics, T_J = 125 °C

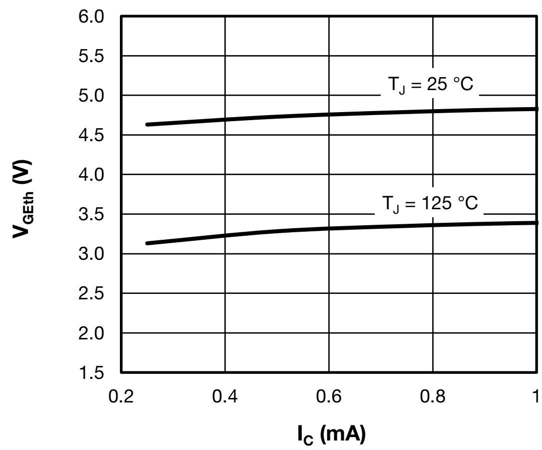


Fig. 5 - Typical Trench IGBT Gate Threshold Voltage

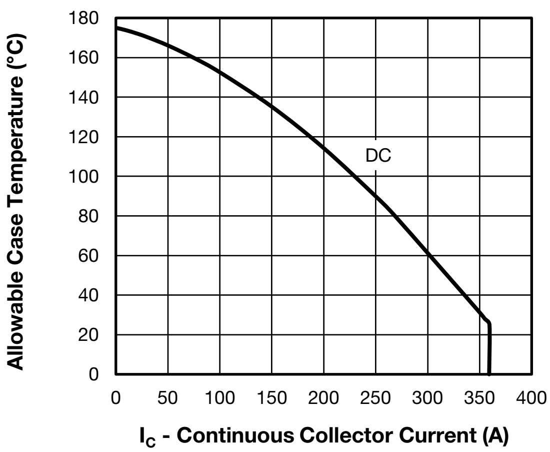


Fig. 3 - Typical Trench IGBT
Continuous Collector Current vs. Case Temperature

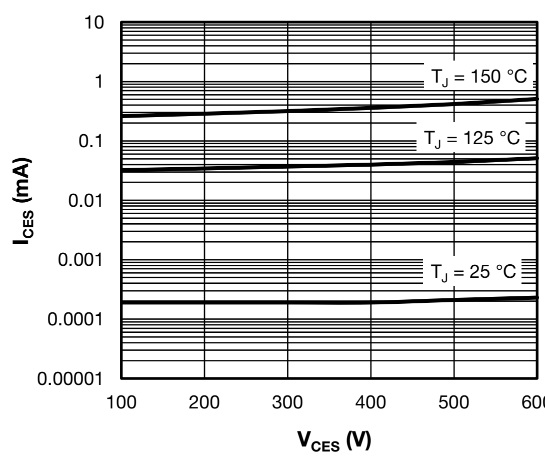


Fig. 6 - Typical Trench IGBT Zero Gate Voltage Collector Current

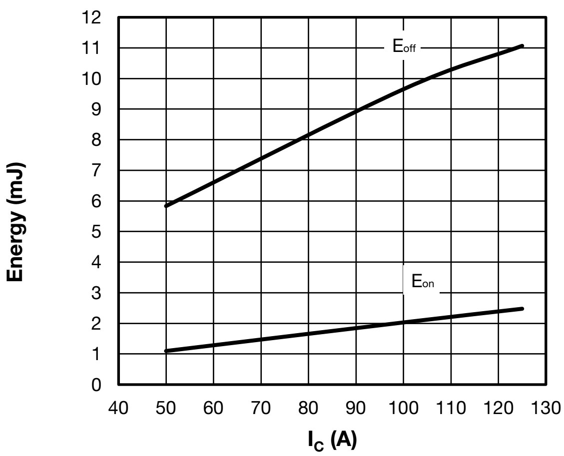


Fig. 7 - Typical Trench IGBT Energy Loss vs. I_C
T_J = 125 °C, V_{CC} = 480 V, R_g = 5 Ω, V_{GE} = +15 V/-15 V, L = 500 μH

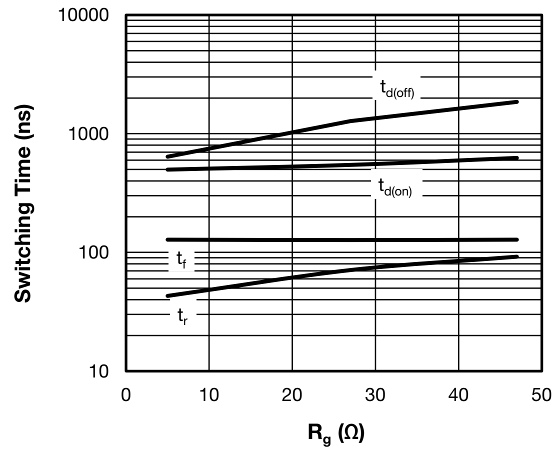


Fig. 10 - Typical Trench IGBT Switching Time vs. R_g
T_J = 125 °C, V_{CC} = 480 V, I_C = 100 A, V_{GE} = +15 V/-15 V, L = 500 μH

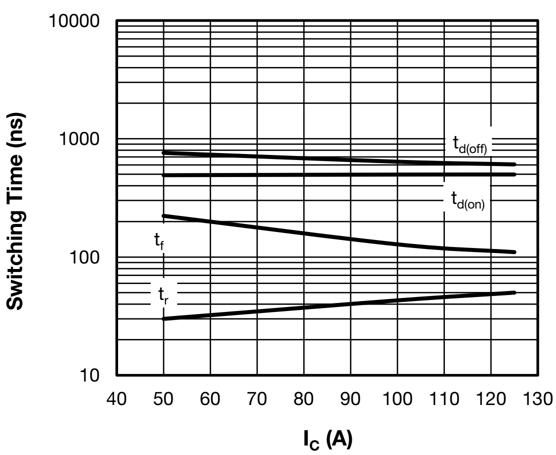


Fig. 8 - Typical Trench IGBT Switching Time vs. I_C
T_J = 125 °C, V_{CC} = 480 V, R_g = 5 Ω, V_{GE} = +15 V/-15 V, L = 500 μH

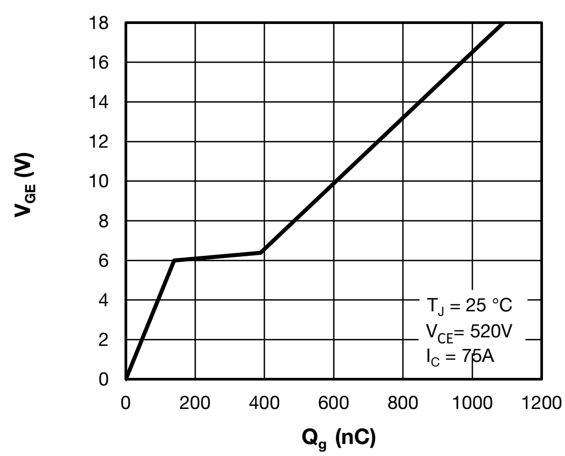


Fig. 11 - Typical Trench IGBT
Gate Charge vs. Gate to Emitter Voltage

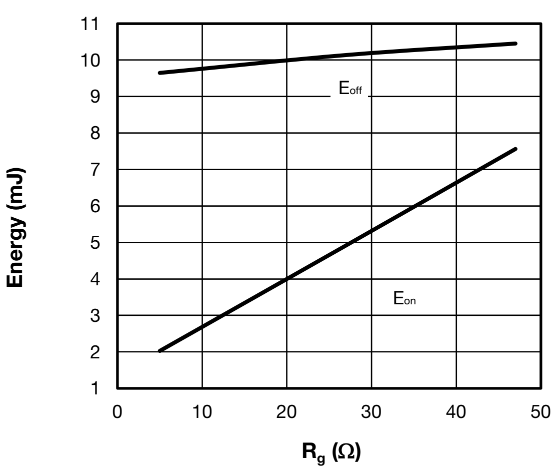


Fig. 9 - Typical Trench IGBT Energy Loss vs. R_g
T_J = 125 °C, V_{CC} = 480 V, I_C = 100 A, V_{GE} = +15 V/-15 V, L = 500 μH

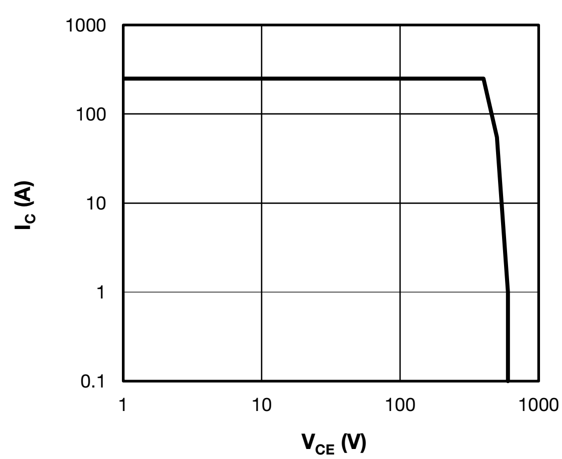


Fig. 12 - Typical Trench IGBT Reverse BIAS SOA
T_J = 175 °C, I_C = 250 A, R_g = 4.7 Ω, V_{GE} = +15 V/0 V,
V_{CC} = 400 V, V_p = 600 V

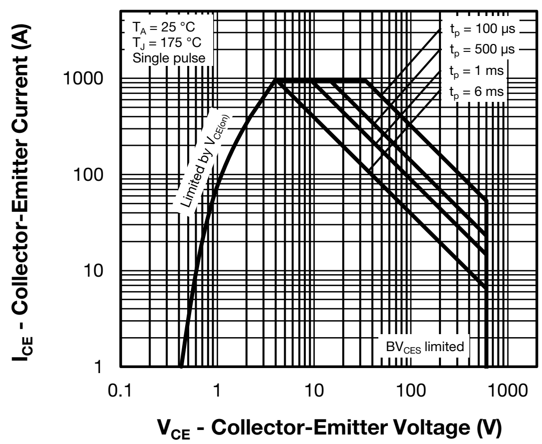


Fig. 13 - Typical Trench IGBT Safe Operating Area

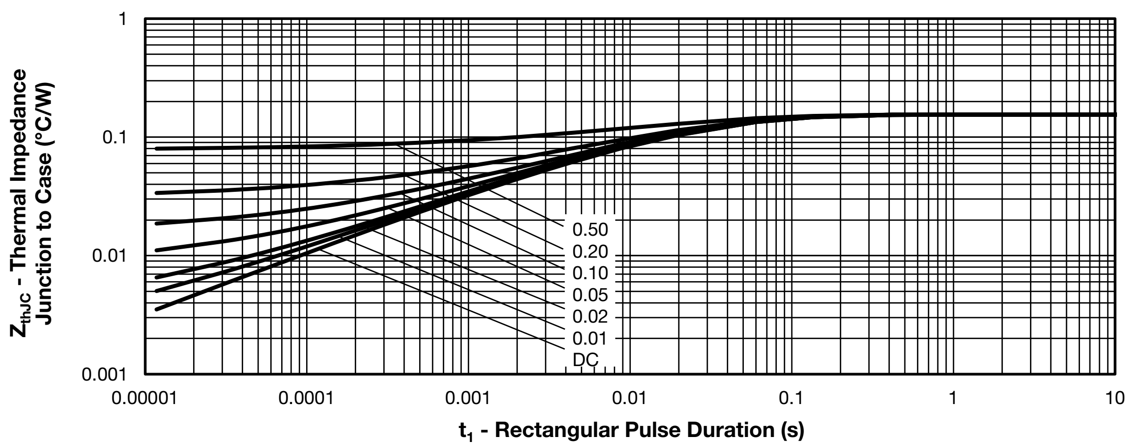


Fig. 14 - Maximum Thermal Impedance Z_{thJC} Characteristics

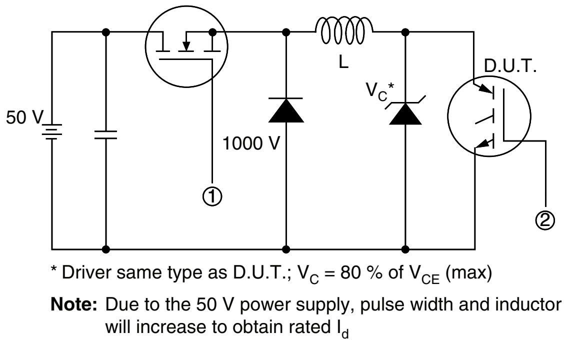


Fig. 15 - Clamped Inductive Load Test Circuit

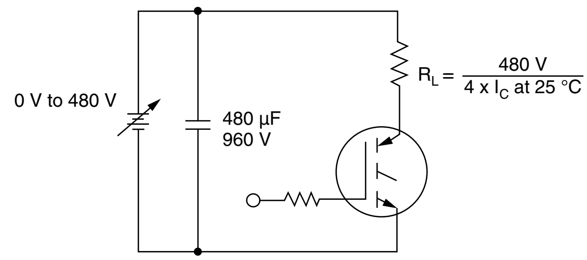


Fig. 16 - Pulsed Collector Current Test Circuit

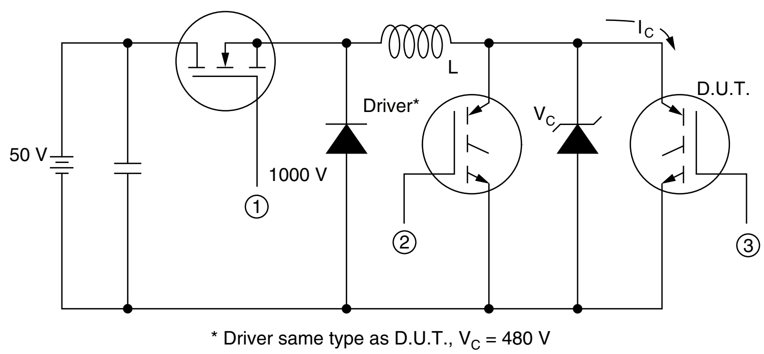


Fig. 17 - Switching Lost Test Circuit

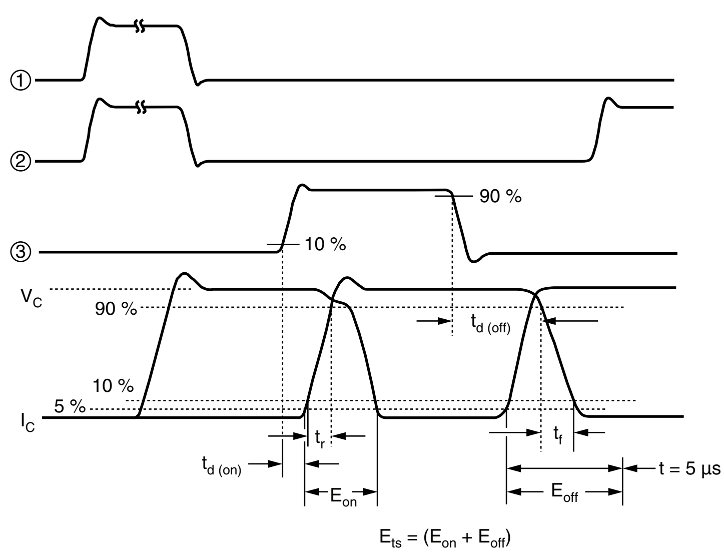
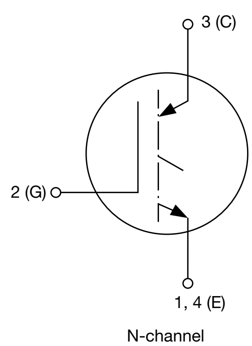
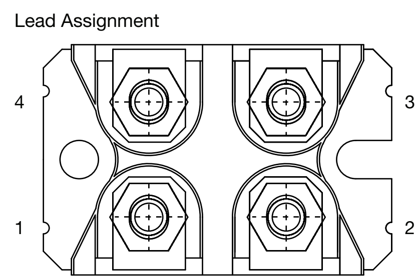


Fig. 18 - Switching Loss Waveforms

ORDERING INFORMATION TABLE

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

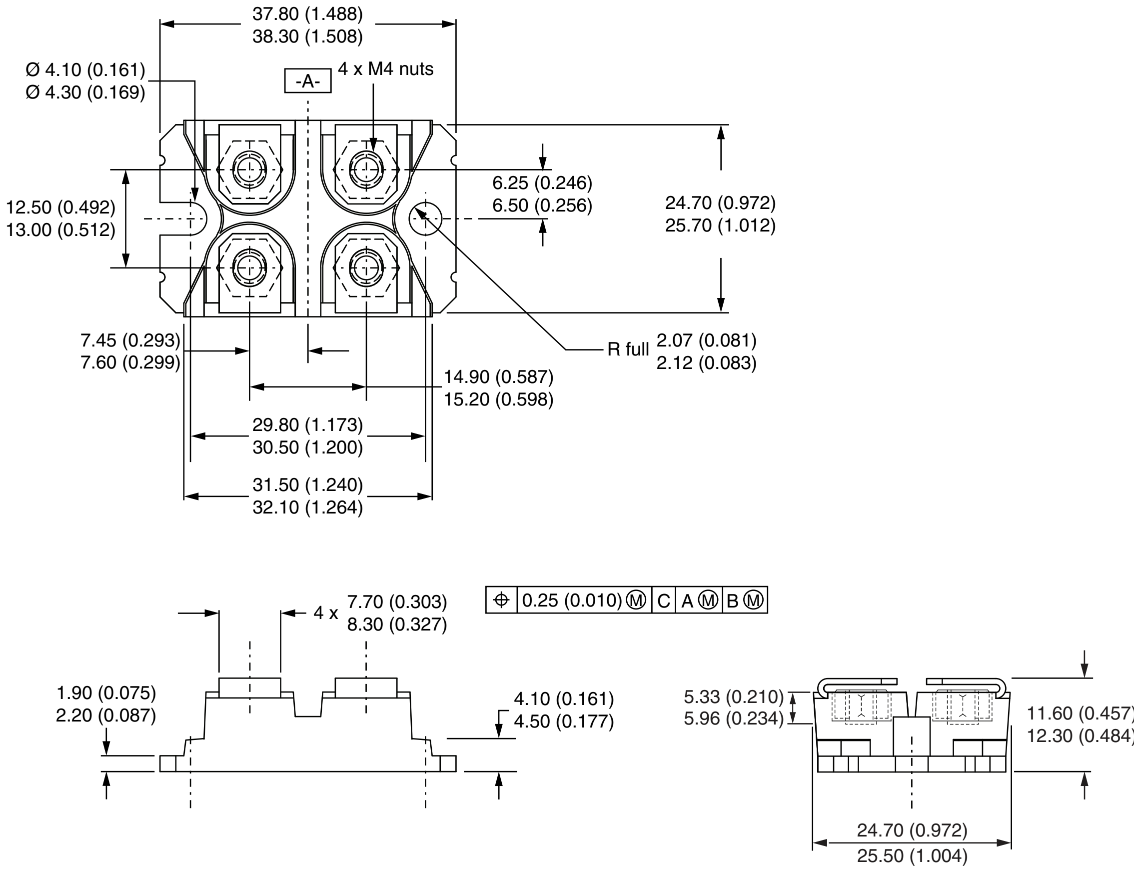
1 - Vishay Semiconductors product
2 - Insulated gate bipolar transistor (IGBT)
3 - Trench IGBT silicon
4 - Current rating (250 = 250 A)
5 - Circuit configuration (S = single switch no diode)
6 - Package indicator (A = SOT-227)
7 - Voltage rating (60 = 600 V)
8 - Speed/type (S = standard speed)

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

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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