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

Proprietary Vishay IGBT Silicon “L Series”

SOT-227

PRODUCT SUMMARY	
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	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

Pb-free
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 °C	380	A
		T_C = 90 °C	239	
Pulsed collector current	I_{CM}		400	
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			-	-	1.3	Nm
Case style		SOT-227				

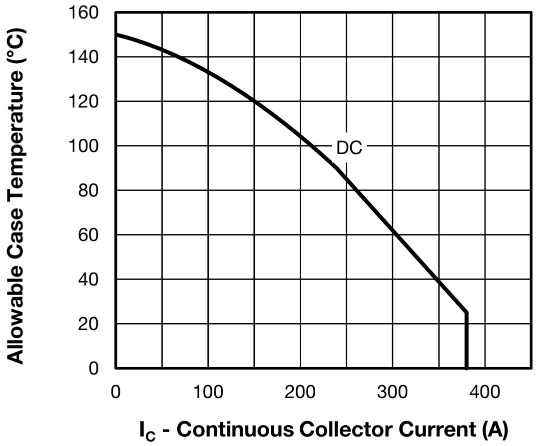


Fig. 1 - Maximum DC IGBT Collector Current vs. Case Temperature

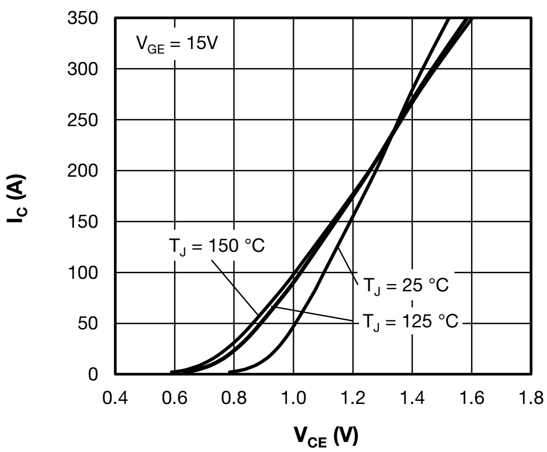


Fig. 2 - Typical IGBT Output Characteristics vs. V_{GE} = 15 V

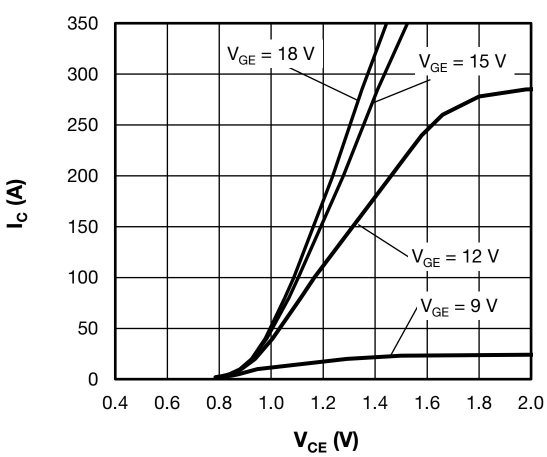


Fig. 3 - Typical Output Characteristics vs. V_{GE} at 25 °C

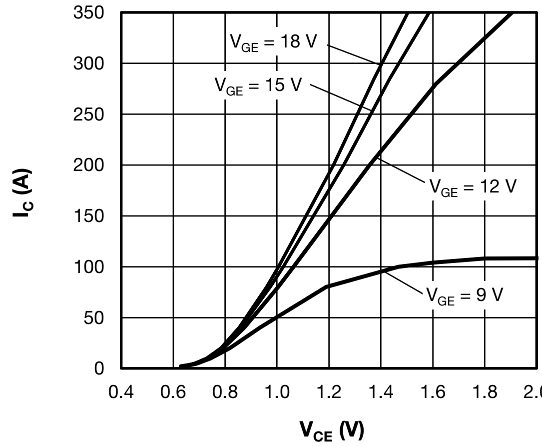


Fig. 4 - Typical Output Characteristics vs. V_{GE} at 125 °C

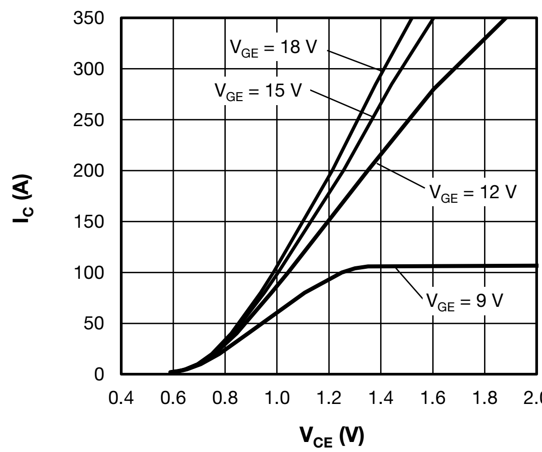


Fig. 5 - Typical Output Characteristics vs. V_{GE} at 150 °C

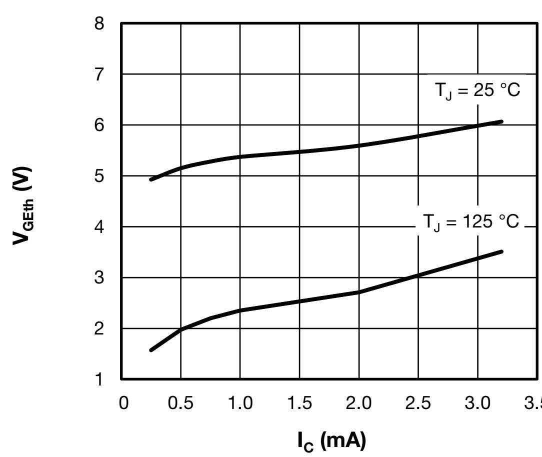


Fig. 6 - Typical Gate Threshold Voltage Characteristics

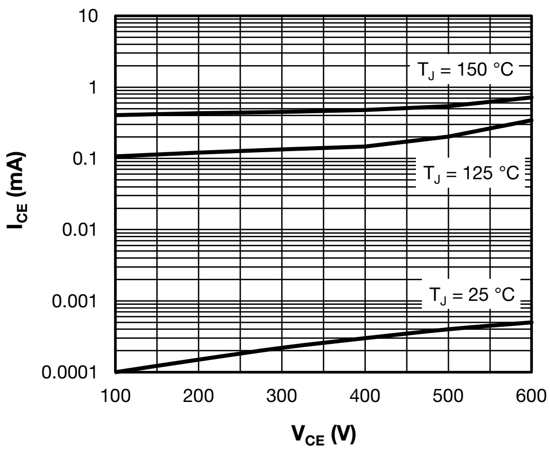


Fig. 7 - Typical Zero Voltage Collector Current

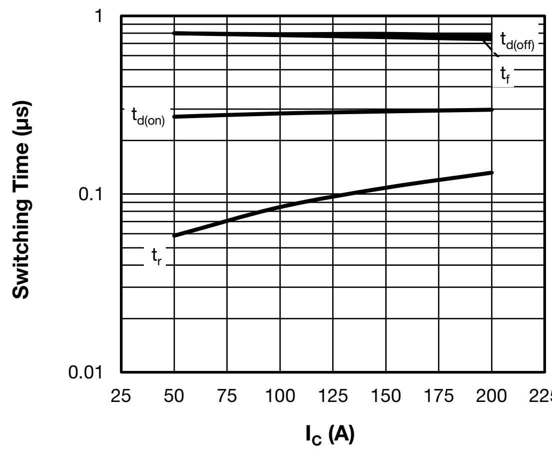


Fig. 10 - Typical IGBT Switching Time vs. I_C
T_J = 125 °C, V_{CC} = 480 V, V_{GE} = 15 V, L = 500 µH, R_g = 5 Ω
Diode used: 60APH06

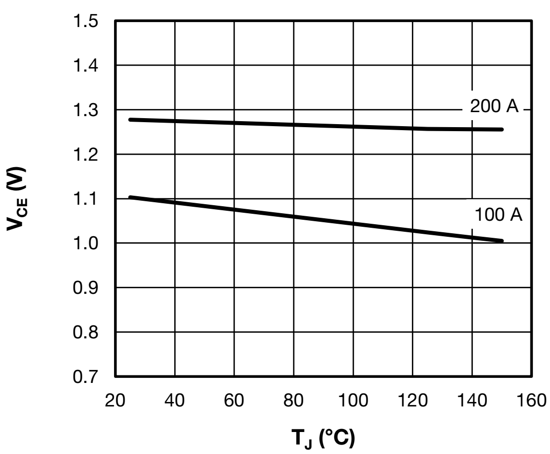


Fig. 8 - Typical V_{CE} vs. Junction Temperature

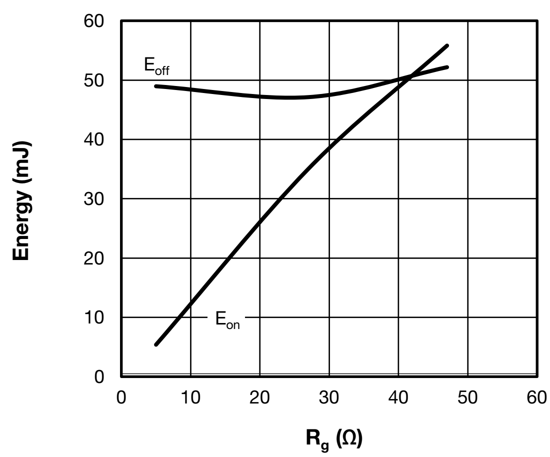


Fig. 11 - Typical IGBT Energy Losses vs. R_g
T_J = 125 °C, I_C = 200 A, V_{CC} = 480 V, V_{GE} = 15 V, L = 500 µH,
R_g = 5 Ω, Diode used: 60APH06

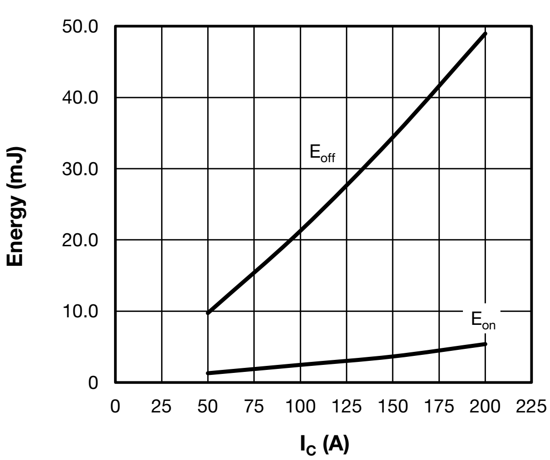


Fig. 9 - Typical IGBT Energy Losses vs. I_C
T_J = 125 °C, V_{CC} = 480 V, V_{GE} = 15 V, L = 500 µH, R_g = 5 Ω
Diode used: 60APH06

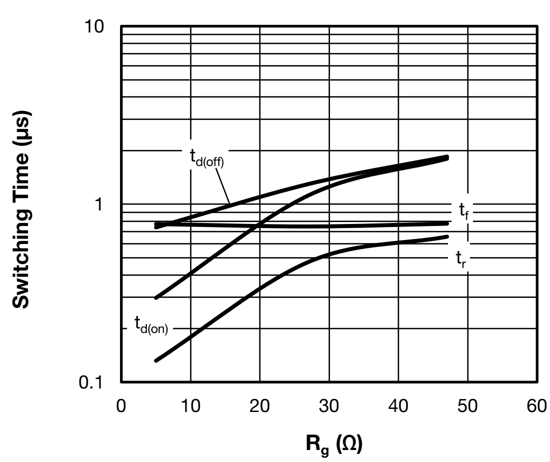


Fig. 12 - Typical IGBT Switching Time vs. R_g
T_J = 125 °C, I_C = 200 A, V_{CC} = 480 V, V_{GE} = 15 V, L = 500 µH,
R_g = 5 Ω, Diode used: 60APH06

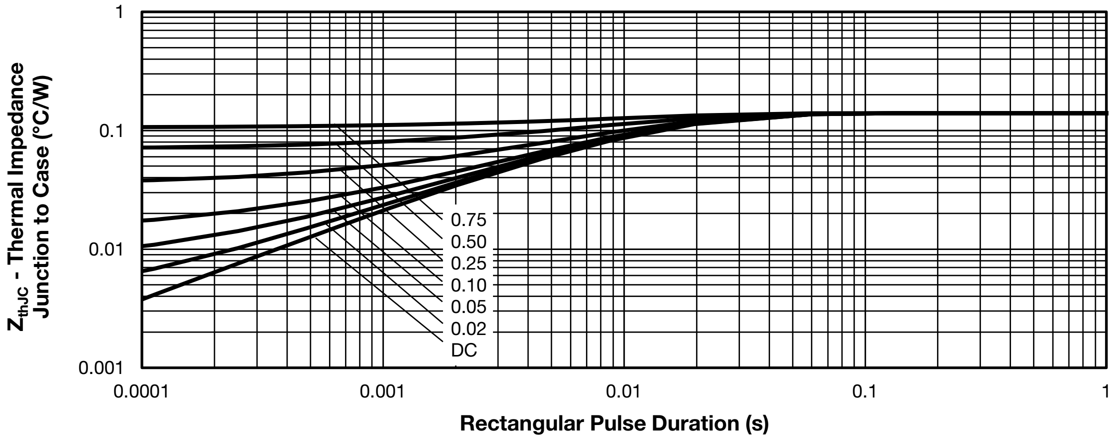


Fig. 13 - Maximum Thermal Impedance Characteristics

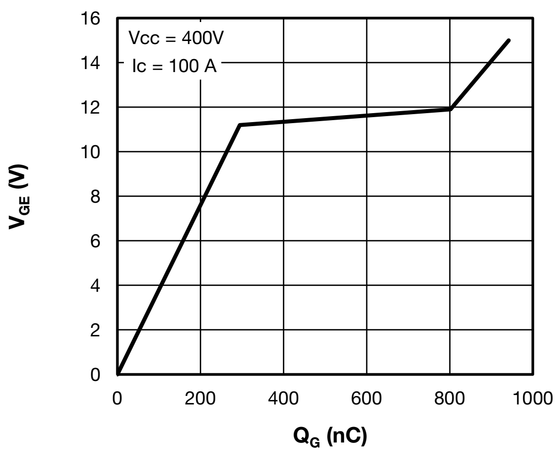


Fig. 14 - Typical Gate Charge vs. Gate Emitter Voltage

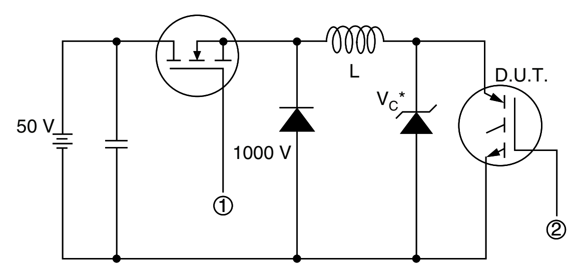


Fig. 16a - Clamped Inductive Load Test Circuit

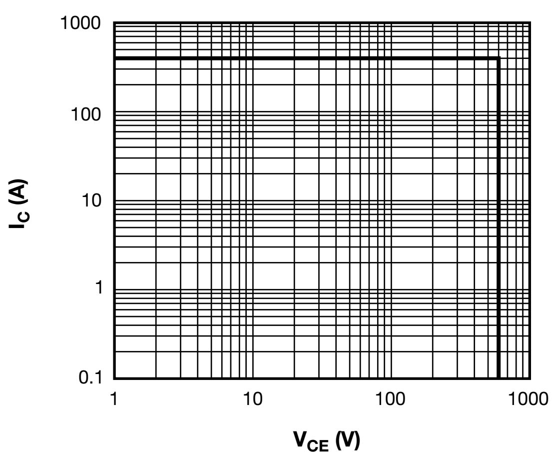


Fig. 15 - Reverse BIAS SOA, T_J = 150 °C, V_{GE} = 15 V

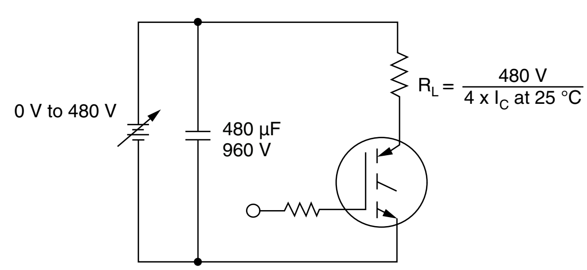
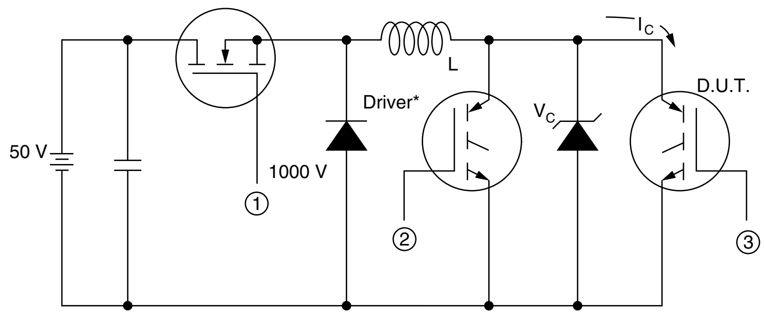
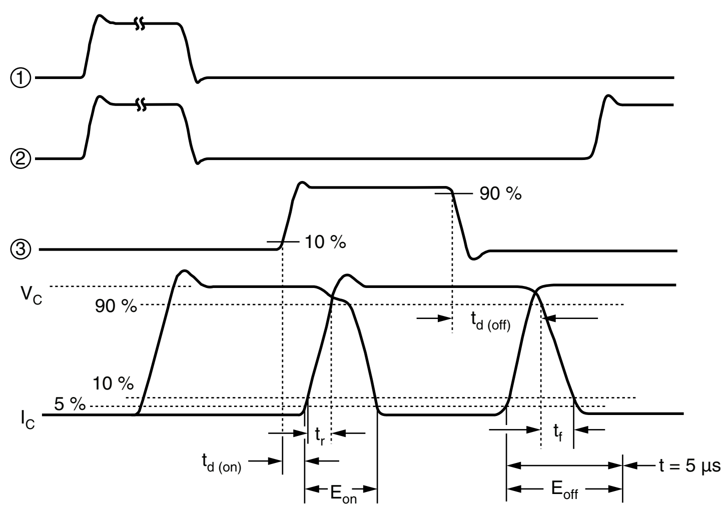


Fig. 16b - Pulsed Collector Current Test Circuit



* 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	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

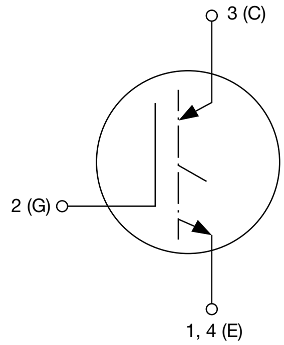
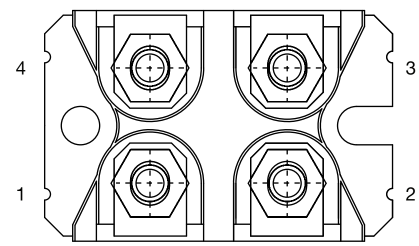
4 - Current rating (250 = 250 A)

5 - Circuit configuration (S = single switch, no diode)

6 - Package indicator (A = SOT-227)

7 - Voltage rating (60 = 600 V)

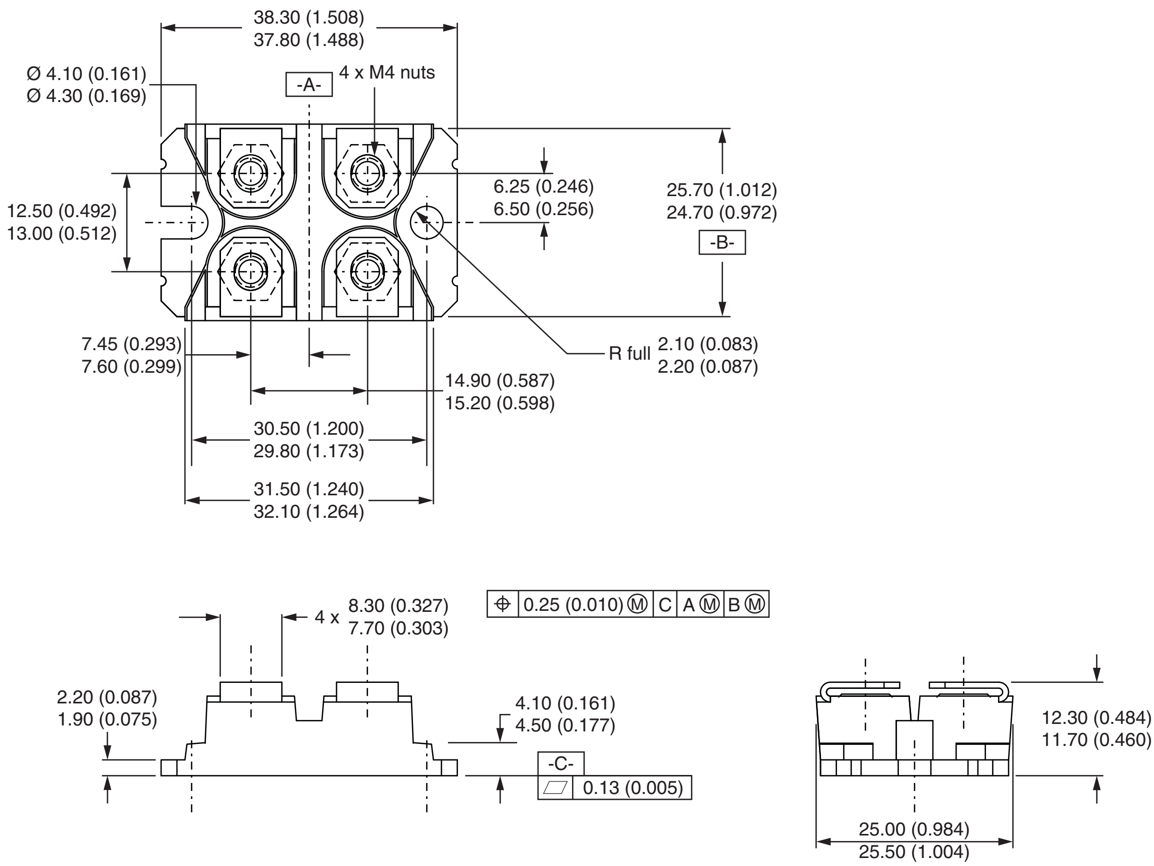
8 - Speed/type (S = standard speed)

CIRCUIT CONFIGURATION		
CIRCUIT	CIRCUIT CONFIGURATION CODE	CIRCUIT DRAWING
Single switch, no diode	S	 Lead Assignment 

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

Disclaimer

ALL PRODUCT, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE.

Vishay Intertechnology, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, "Vishay"), disclaim any and all liability for any errors, inaccuracies or incompleteness contained in any datasheet or in any other disclosure relating to any product.

Vishay makes no warranty, representation or guarantee regarding the suitability of the products for any particular purpose or the continuing production of any product. To the maximum extent permitted by applicable law, Vishay disclaims (i) any and all liability arising out of the application or use of any product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for particular purpose, non-infringement and merchantability.

Statements regarding the suitability of products for certain types of applications are based on Vishay's knowledge of typical requirements that are often placed on Vishay products in generic applications. Such statements are not binding statements about the suitability of products for a particular application. It is the customer's responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application. Parameters provided in datasheets and/or specifications may vary in different applications and performance may vary over time. All operating parameters, including typical parameters, must be validated for each customer application by the customer's technical experts. Product specifications do not expand or otherwise modify Vishay's terms and conditions of purchase, including but not limited to the warranty expressed therein.

Except as expressly indicated in writing, Vishay products are not designed for use in medical, life-saving, or life-sustaining applications or for any other application in which the failure of the Vishay product could result in personal injury or death. Customers using or selling Vishay products not expressly indicated for use in such applications do so at their own risk. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Vishay. Product names and markings noted herein may be trademarks of their respective owners.

Material Category Policy

Vishay Intertechnology, Inc. hereby certifies that all its products that are identified as RoHS-Compliant fulfill the definitions and restrictions defined under Directive 2011/65/EU of The European Parliament and of the Council of June 8, 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (EEE) - recast, unless otherwise specified as non-compliant.

Please note that some Vishay documentation may still make reference to RoHS Directive 2002/95/EC. We confirm that all the products identified as being compliant to Directive 2002/95/EC conform to Directive 2011/65/EU.

Vishay Intertechnology, Inc. hereby certifies that all its products that are identified as Halogen-Free follow Halogen-Free requirements as per JEDEC JS709A standards. Please note that some Vishay documentation may still make reference to the IEC 61249-2-21 definition. We confirm that all the products identified as being compliant to IEC 61249-2-21 conform to JEDEC JS709A standards.