

Insulated Gate Bipolar Transistor (Ultrafast IGBT), 106 A


SOT-227

FEATURES

- Trench IGBT technology
- Square RBSOA
- Positive $V_{CE(on)}$ temperature coefficient
- 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}	1200 V
I_C DC	106 A at 90 °C
$V_{CE(on)}$ typical at 75 A, 25 °C	2.17 V
Speed	8 kHz to 30 kHz
Package	SOT-227
Circuit configuration	Single switch no diode

BENEFITS

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

ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	TEST CONDITIONS	MAX.	UNITS
Collector to emitter voltage	V_{CES}		1200	V
Continuous collector current	I_C	$T_C = 25$ °C	169	A
		$T_C = 90$ °C	106	
Pulsed collector current	I_{CM}	$T_J = 150$ °C, $t_p = 6$ ms, $V_{GE} = 15$ V	350	
Clamped inductive load current	I_{LM}		250	
Gate to emitter voltage	V_{GE}		± 20	V
Power dissipation	P_D	$T_C = 25$ °C	781	W
		$T_C = 90$ °C	375	
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, $I_C = 4$ mA	1200	-	-	V
Collector to emitter voltage	$V_{CE(on)}$	$V_{GE} = 15$ V, $I_C = 75$ A	-	2.17	2.60	
		$V_{GE} = 15$ V, $I_C = 75$ A, $T_J = 125$ °C	-	2.44	-	
		$V_{GE} = 15$ V, $I_C = 75$ A, $T_J = 150$ °C	-	2.49	-	
Gate threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$, $I_C = 4$ mA	4.6	5.9	7.6	
		$V_{CE} = V_{GE}$, $I_C = 4$ mA, $T_J = 125$ °C	-	4.63	-	
Temperature coefficient of threshold voltage	$V_{GE(th)}/\Delta T_J$	$V_{CE} = V_{GE}$, $I_C = 4$ mA (25 °C to 125 °C)	-	-13	-	mV/°C
Collector to emitter leakage current	I_{CES}	$V_{GE} = 0$ V, $V_{CE} = 1200$ V	-	0.9	100	μ A
		$V_{GE} = 0$ V, $V_{CE} = 1200$ V, $T_J = 125$ °C	-	750	-	
		$V_{GE} = 0$ V, $V_{CE} = 1200$ V, $T_J = 150$ °C	-	2.7	-	mA
Gate to emitter leakage current	I_{GES}	$V_{GE} = \pm 20$ 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 = 90 A, V _{CC} = 960 V, V _{GE} = 15 V		-	307	-	nC		
Gate to emitter charge (turn-on)	Q _{ge}			-	33	-			
Gate to collector charge (turn-on)	Q _{gc}			-	160	-			
Turn-on switching loss	E _{on}	I _C = 75 A, V _{CC} = 600 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 HFA16PB120	-	2.15	-	mJ		
Turn-off switching loss	E _{off}			-	2.59	-			
Total switching loss	E _{tot}			-	4.74	-			
Turn-on delay time	t _{d(on)}			-	36	-	ns		
Rise time	t _r			-	26	-			
Turn-off delay time	t _{d(off)}			-	116	-			
Fall time	t _f			-	82	-			
Turn-on switching loss	E _{on}			I _C = 75 A, V _{CC} = 600 V, V _{GE} = 15 V, R _g = 5 Ω, L = 500 μH, T _J = 125 °C		-	2.23	-	mJ
Turn-off switching loss	E _{off}					-	3.87	-	
Total switching loss	E _{tot}					-	6.1	-	
Turn-on delay time	t _{d(on)}	-	34			-	ns		
Rise time	t _r	-	27			-			
Turn-off delay time	t _{d(off)}	-	123			-			
Fall time	t _f	-	147			-			
Reverse bias safe operating area	RBSOA	T _J = 150 °C, I _C = 250, R _g = 4.7 Ω, V _{GE} = 15 V to 0 V, V _{CC} = 800 V, V _P = 1200 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	$^{\circ}\text{C}$
Junction to case	R_{thJC}		-	-	0.16	$^{\circ}\text{C/W}$
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				

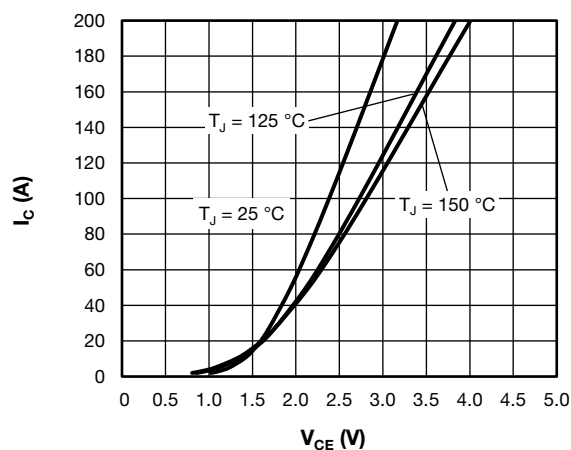
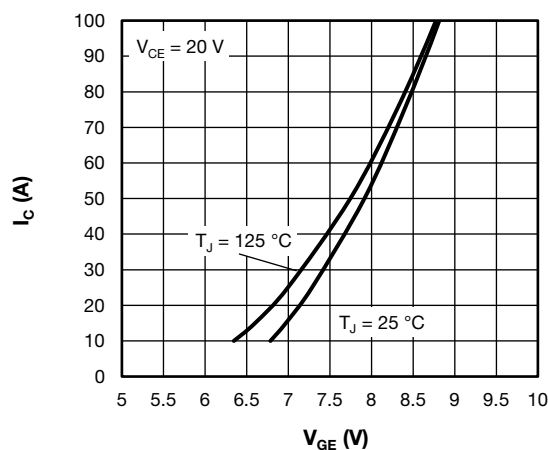

Fig. 1 - Typical Trench IGBT Output Characteristics, $V_{GE} = 15\text{ V}$


Fig. 4 - Typical Trench IGBT Transfer Characteristics

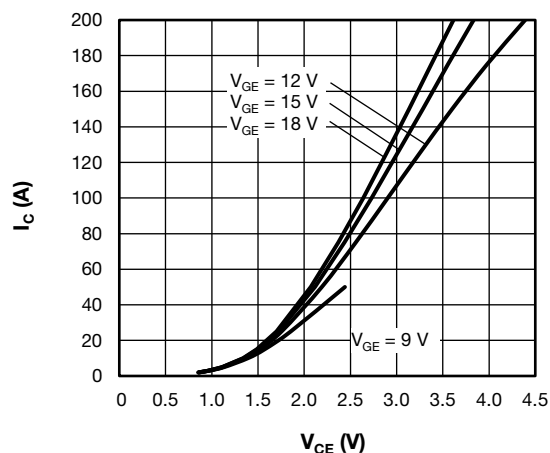
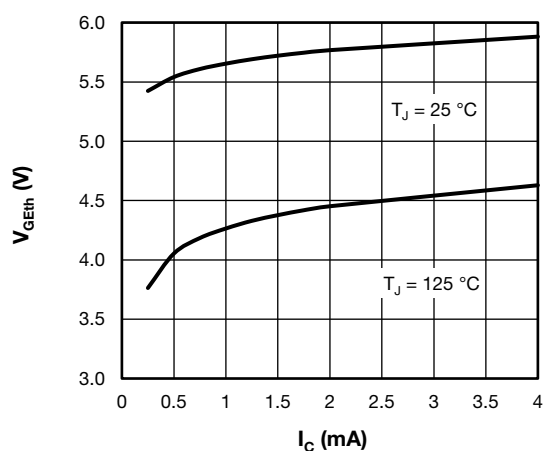

Fig. 2 - Typical Trench IGBT Output Characteristics, $T_J = 125\text{ °C}$


Fig. 5 - Typical Trench IGBT Gate Threshold Voltage

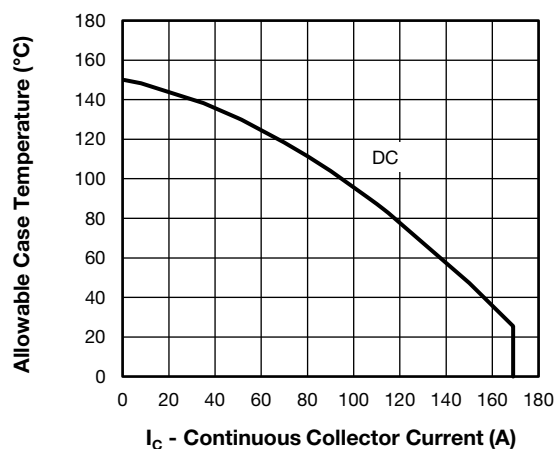


Fig. 3 - Maximum Trench IGBT Continuous Collector Current vs. Case Temperature

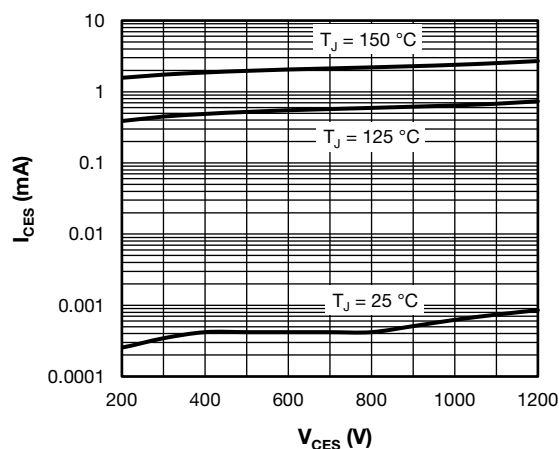


Fig. 6 - Typical Trench IGBT Zero Gate Voltage Collector Current

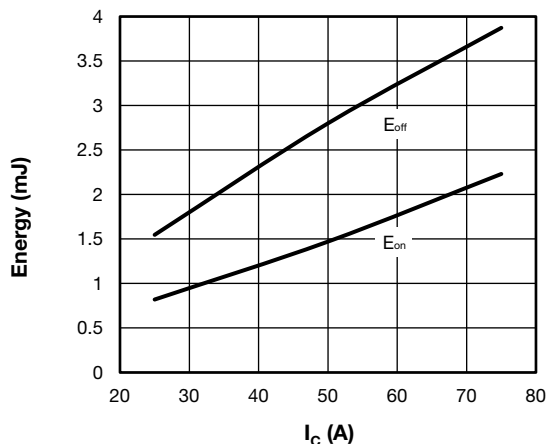


Fig. 7 - Typical Trench IGBT Energy Loss vs. I_C
 $T_J = 125^\circ\text{C}$, $V_{CC} = 600\text{ V}$, $R_g = 4.7\ \Omega$, $V_{GE} = +15\text{ V}/-15\text{ V}$, $L = 500\ \mu\text{H}$

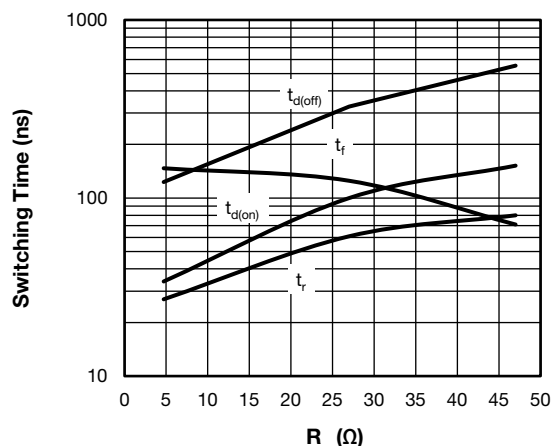


Fig. 10 - Typical Trench IGBT Switching Time vs. R_g
 $T_J = 125^\circ\text{C}$, $V_{CC} = 600\text{ V}$, $I_C = 75\text{ A}$, $V_{GE} = +15\text{ V}/-15\text{ V}$, $L = 500\ \mu\text{H}$

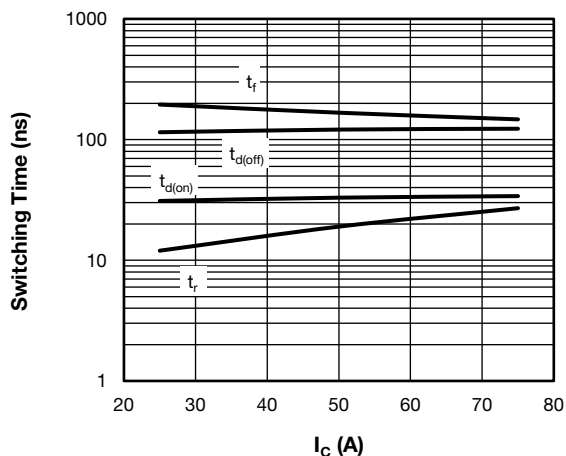


Fig. 8 - Typical Trench IGBT Switching Time vs. I_C
 $T_J = 125^\circ\text{C}$, $V_{CC} = 600\text{ V}$, $R_g = 4.7\ \Omega$, $V_{GE} = +15\text{ V}/-15\text{ V}$, $L = 500\ \mu\text{H}$

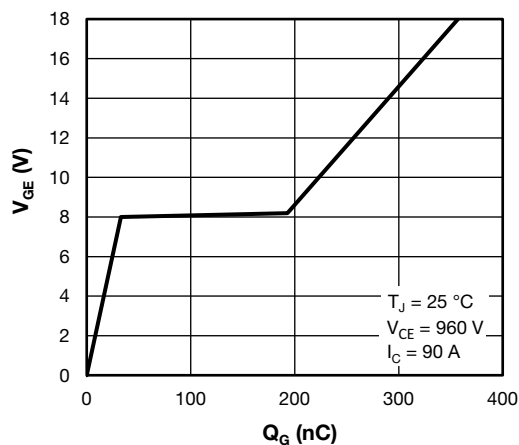


Fig. 11 - Typical Trench IGBT Gate Charge vs. Gate to Emitter Voltage
 $T_J = 25^\circ\text{C}$, $V_{CE} = 960\text{ V}$, $I_C = 90\text{ A}$

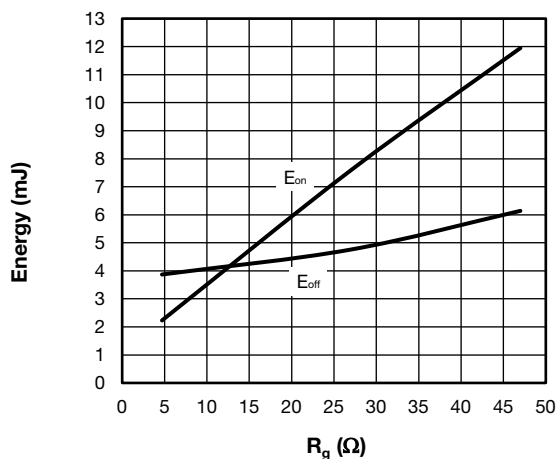


Fig. 9 - Typical Trench IGBT Energy Loss vs. R_g
 $T_J = 125^\circ\text{C}$, $V_{CC} = 600\text{ V}$, $I_C = 75\text{ A}$, $V_{GE} = +15\text{ V}/-15\text{ V}$, $L = 500\ \mu\text{H}$

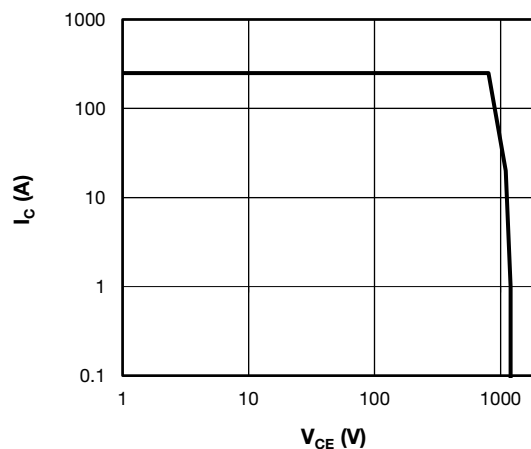


Fig. 12 - Trench IGBT Reverse BIAS SOA
 $T_J = 150^\circ\text{C}$, $I_C = 250\text{ A}$, $R_g = 4.7\ \Omega$, $V_{GE} = +15\text{ V}/0\text{ V}$, $V_{CC} = 800\text{ V}$, $V_p = 1200\text{ V}$

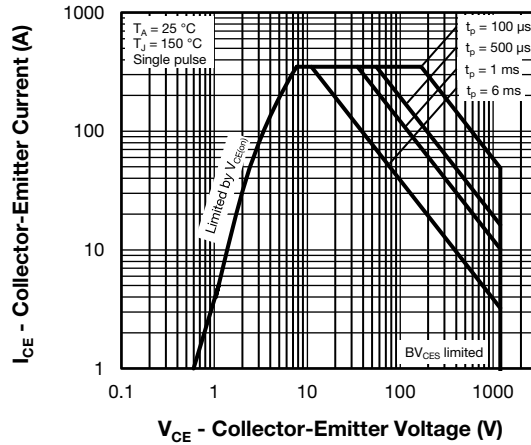
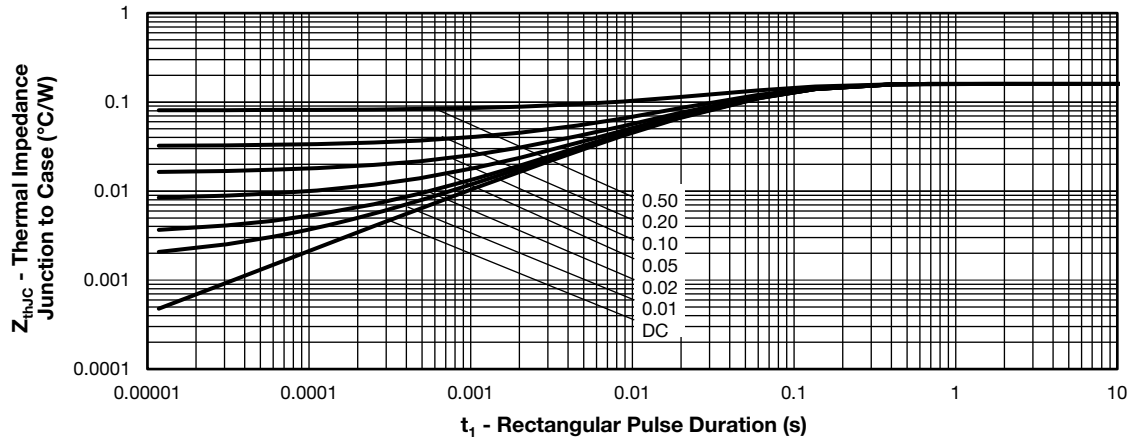
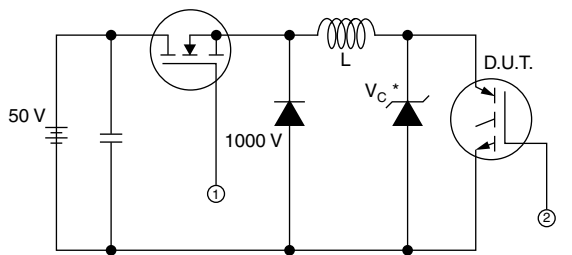


Fig. 13 - Trench IGBT Safe Operating Area


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



* 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 I_d

Fig. 15 - Clamped Inductive Load Test Circuit

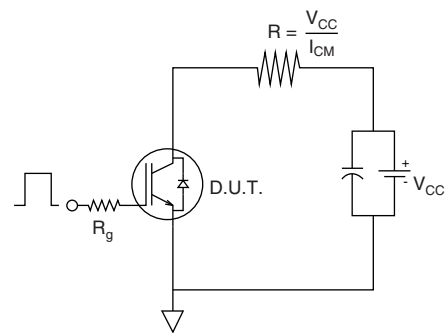


Fig. 16 - Pulsed Collector Current Test Circuit

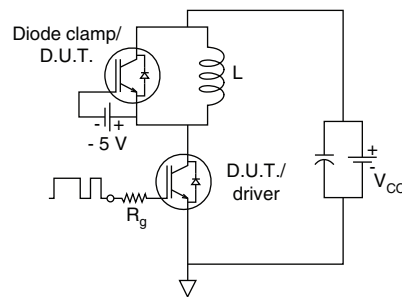


Fig. 17 - Switching Loss Test Circuit

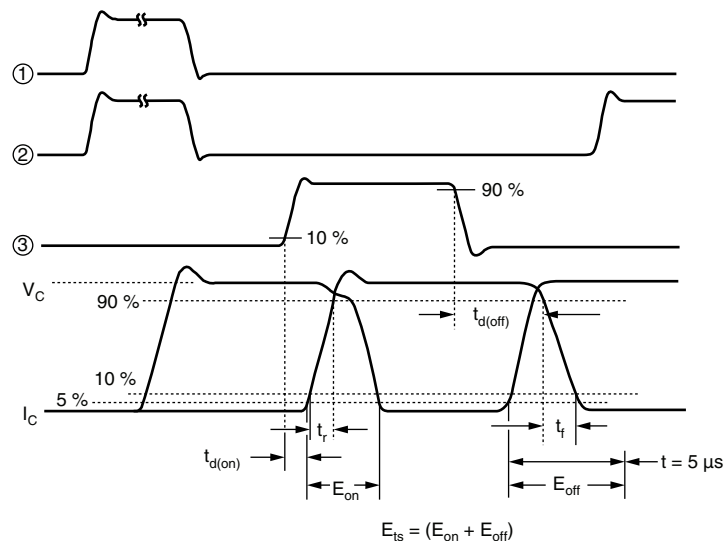
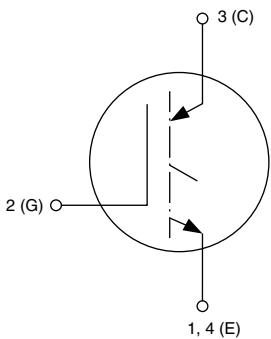
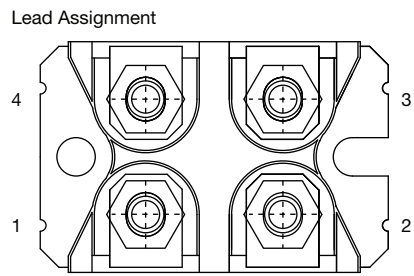


Fig. 18 - Switching Loss Waveforms Test Circuit

ORDERING INFORMATION TABLE

Device code	VS-	G	T	90	S	A	120	U
	1	2	3	4	5	6	7	8

1	- Vishay Semiconductors product
2	- Insulated gate bipolar transistor (IGBT)
3	- T = Trench IGBT
4	- Current rating (90 = 90 A)
5	- Circuit configuration (S = single switch no diode)
6	- Package indicator (A = SOT-227)
7	- Voltage rating (120 = 1200 V)
8	- Speed/type (U = ultrafast IGBT)

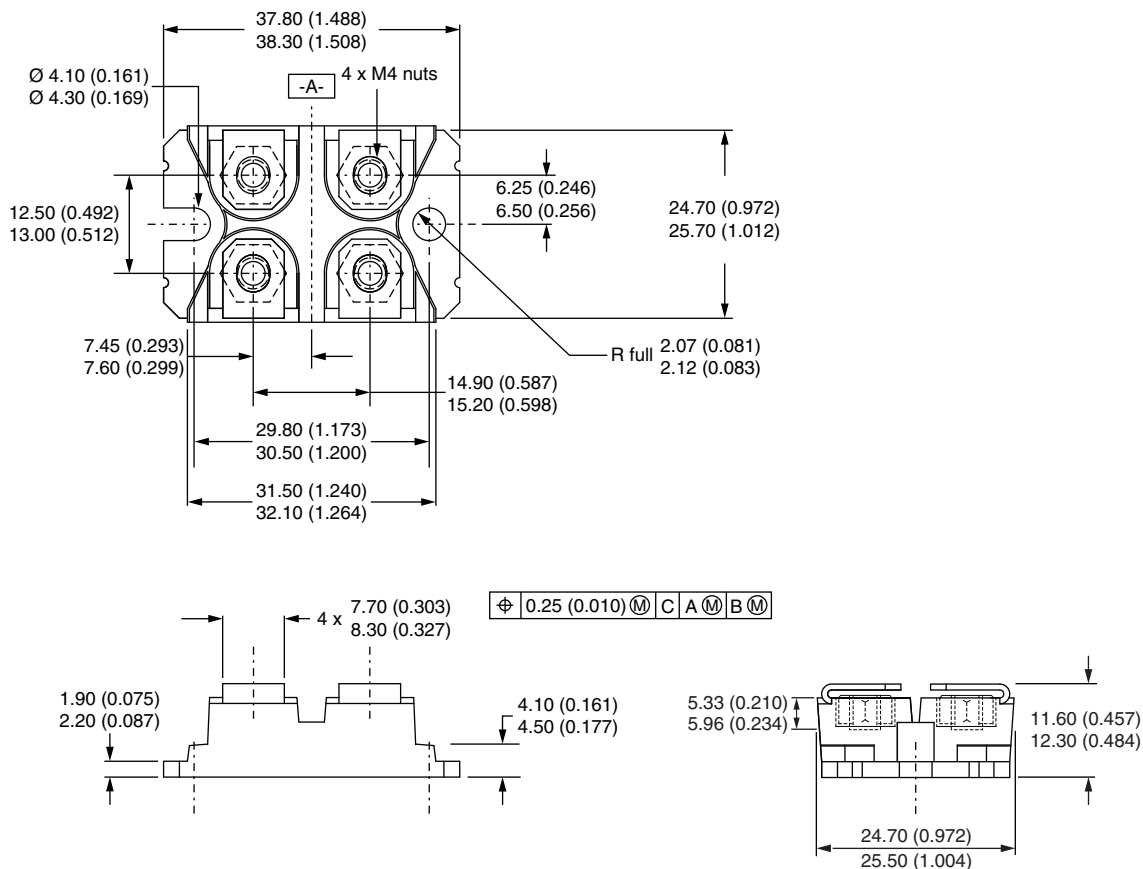
CIRCUIT CONFIGURATION		
CIRCUIT	CIRCUIT CONFIGURATION CODE	CIRCUIT DRAWING
Single switch no diode	S	 

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)





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