



**THE DATASHEET OF  
VS-GA200SA60SP**



## Insulated Gate Bipolar Transistor Ultralow $V_{CE(on)}$ , 342 A


**SOT-227**
**FEATURES**

- Standard: Optimized for minimum saturation voltage and low speed up to 5 kHz
- Lowest conduction losses available
- Fully isolated package (2500 V<sub>AC</sub>)
- Very low internal inductance (5 nH typical)
- Industry standard outline
- UL approved file E78996
- Compliant to RoHS directive 2002/95/EC
- Designed and qualified for industrial level


**RoHS  
COMPLIANT**

PRODUCT SUMMARY	
$V_{CES}$	600 V
$V_{CE(on)}$ (typical) at 200 A, 25 °C	1.33 V
$I_C$ at $T_C = 97$ °C <sup>(1)</sup>	200 A

**Note**

<sup>(1)</sup> Maximum  $I_{RMS}$  current admitted 100 A to do not exceed the maximum temperature of terminals

**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 breakdown voltage	$V_{CES}$		600	V
Continuous collector current	$I_C$ <sup>(1)</sup>	$T_C = 25$ °C	342	A
		$T_C = 97$ °C	200	
Pulsed collector current	$I_{CM}$	Repetitive rating; $V_{GE} = 20$ V, pulse width limited by maximum junction temperature See fig. 15	400	A
Clamped Inductive load current	$I_{LM}$	$V_{CC} = 80\%$ ( $V_{CES}$ ), $V_{GE} = 20$ V, $L = 10$ $\mu$ H, $R_g = 2.0$ $\Omega$ , See fig. 14	400	
Gate to emitter voltage	$V_{GE}$		$\pm 20$	V
Reverse voltage avalanche energy	$E_{ARV}$	Repetitive rating; pulse width limited by maximum junction temperature	155	mJ
RMS isolation voltage	$V_{ISOL}$	Any terminal to case, $t = 1$ minute	2500	V
Maximum power dissipation	$P_D$	$T_C = 25$ °C	781	W
		$T_C = 100$ °C	312	
Operating junction and storage temperature range	$T_J, T_{Stg}$		- 55 to + 150	°C
Mounting torque		6-32 or M3 screw	12 (1.3)	lbf · in (N · m)

**Note**

<sup>(1)</sup> Maximum  $I_{RMS}$  current admitted 100 A to do not exceed the maximum temperature of terminals

THERMAL AND MECHANICAL SPECIFICATIONS				
PARAMETER	SYMBOL	TYP.	MAX.	UNITS
Junction to case	$R_{thJC}$	-	0.16	°C/W
Case to sink, flat, greased surface	$R_{thCS}$	0.05	-	
Weight of module		30	-	g

<b>ELECTRICAL SPECIFICATIONS</b> ( $T_J = 25\text{ }^\circ\text{C}$ unless otherwise noted)						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Collector to emitter breakdown voltage	$V_{(BR)CES}$	$V_{GE} = 0\text{ V}, I_C = 250\text{ }\mu\text{A}$	600	-	-	V
Emitter to collector breakdown voltage	$V_{(BR)ECS}^{(1)}$	$V_{GE} = 0\text{ V}, I_C = 1.0\text{ A}$	18	-	-	
Temperature coeff. of breakdown voltage	$\Delta V_{(BR)CES}/\Delta T_J$	$V_{GE} = 0\text{ V}, I_C = 1.0\text{ mA}$	-	0.62	-	V/ $^\circ\text{C}$
Collector to emitter saturation voltage	$V_{CE(on)}$	$I_C = 100\text{ A}$	-	1.10	1.3	V
		$I_C = 200\text{ A}$				
		$I_C = 100\text{ A}, T_J = 150\text{ }^\circ\text{C}$				
	$V_{GE} = 15\text{ V}$ See fig. 2, 5	-	1.33	-		
Gate threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}, I_C = 250\text{ }\mu\text{A}$	3.0	-	6.0	
Temperature coeff. of threshold voltage	$\Delta V_{GE(th)}/\Delta T_J$	$V_{CE} = V_{GE}, I_C = 2\text{ mA}$	-	- 10	-	mV/ $^\circ\text{C}$
Forward transconductance	$g_{fe}^{(2)}$	$V_{CE} = 100\text{ V}, I_C = 100\text{ A}$	90	150	-	S
Zero gate voltage collector current	$I_{CES}$	$V_{GE} = 0\text{ V}, V_{CE} = 600\text{ V}$	-	-	1.0	mA
		$V_{GE} = 0\text{ V}, V_{CE} = 10\text{ V}, T_J = 150\text{ }^\circ\text{C}$	-	-	10	
Gate to emitter leakage current	$I_{GES}$	$V_{GE} = \pm 20\text{ V}$	-	-	$\pm 250$	nA

**Notes**(1) Pulse width  $\leq 80\text{ }\mu\text{s}$ ; duty factor  $\leq 0.1\%$ (2) Pulse width 5.0  $\mu\text{s}$ , single shot

<b>SWITCHING CHARACTERISTICS</b> ( $T_J = 25\text{ }^\circ\text{C}$ unless otherwise specified)						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Total gate charge (turn-on)	$Q_g$	$I_C = 100\text{ A}$ $V_{CC} = 400\text{ V}$ $V_{GE} = 15\text{ V}$ ; See fig. 8	-	770	1200	nC
Gate emitter charge (turn-on)	$Q_{ge}$		-	100	150	
Gate collector charge (turn-on)	$Q_{gc}$		-	260	380	
Turn-on delay time	$t_{d(on)}$	$T_J = 25\text{ }^\circ\text{C}$ $I_C = 100\text{ A}$ $V_{CC} = 480\text{ V}$ $V_{GE} = 15\text{ V}$ $R_g = 2.0\text{ }\Omega$	-	78	-	ns
Rise time	$t_r$		-	56	-	
Turn-off delay time	$t_{d(off)}$		-	890	1300	
Fall time	$t_f$		-	390	580	
Turn-on switching loss	$E_{on}$	Energy losses include "tail" See fig. 9, 10, 13	-	0.98	-	mJ
Turn-off switching loss	$E_{off}$		-	17.4	-	
Total switching loss	$E_{ts}$		-	18.4	25.5	
Turn-on delay time	$t_{d(on)}$	$T_J = 150\text{ }^\circ\text{C}$ $I_C = 100\text{ A}, V_{CC} = 480\text{ V}$ $V_{GE} = 15\text{ V}, R_g = 2.0\text{ }\Omega$ Energy losses include "tail" See fig. 10, 11, 13	-	72	-	ns
Rise time	$t_r$		-	60	-	
Turn-off delay time	$t_{d(off)}$		-	1500	-	
Fall time	$t_f$		-	660	-	
Total switching loss	$E_{ts}$		-	35.7	-	
Internal emitter inductance	$L_E$	Between lead, and center of the die contact	-	5.0	-	nH
Input capacitance	$C_{ies}$	$V_{GE} = 0\text{ V}$ $V_{CC} = 30\text{ V}$ $f = 1.0\text{ MHz}$ ; See fig. 7	-	16 250	-	pF
Output capacitance	$C_{oes}$		-	1040	-	
Reverse transfer capacitance	$C_{res}$		-	190	-	

Insulated Gate Bipolar Transistor  
 Ultralow  $V_{CE(on)}$ , 342 A

Vishay Semiconductors

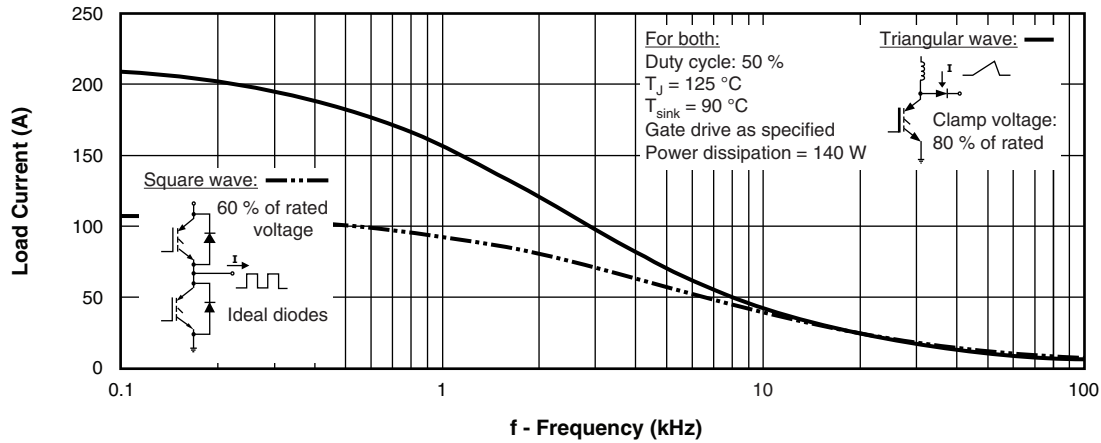
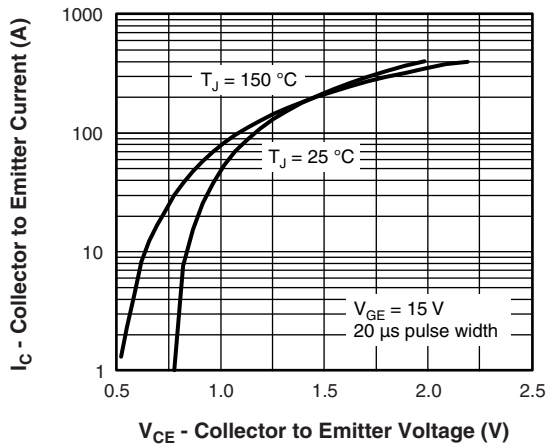

 Fig. 1 - Typical Load Current vs. Frequency  
 (Load Current =  $I_{RMS}$  of Fundamental)


Fig. 2 - Typical Output Characteristics

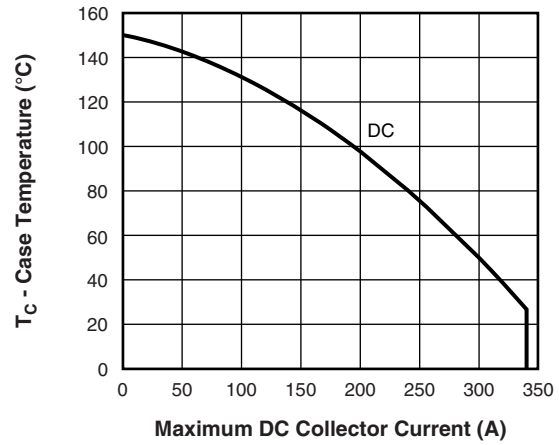


Fig. 4 - Maximum Collector Current vs. Case Temperature

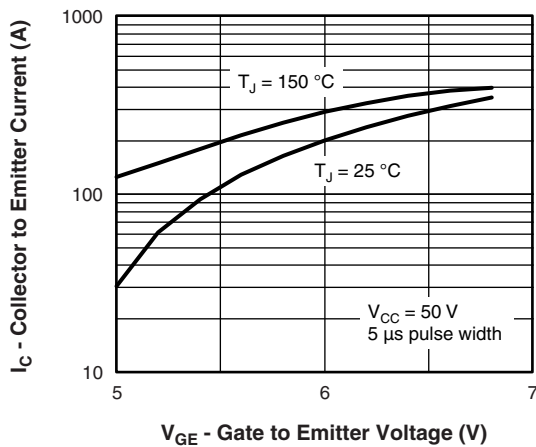


Fig. 3 - Typical Transfer Characteristics

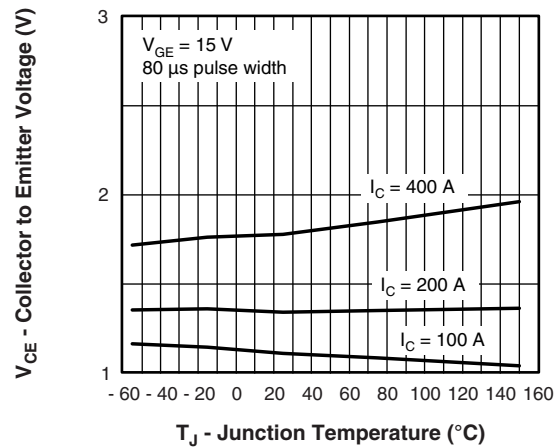


Fig. 5 - Typical Collector to Emitter Voltage vs. Junction Temperature

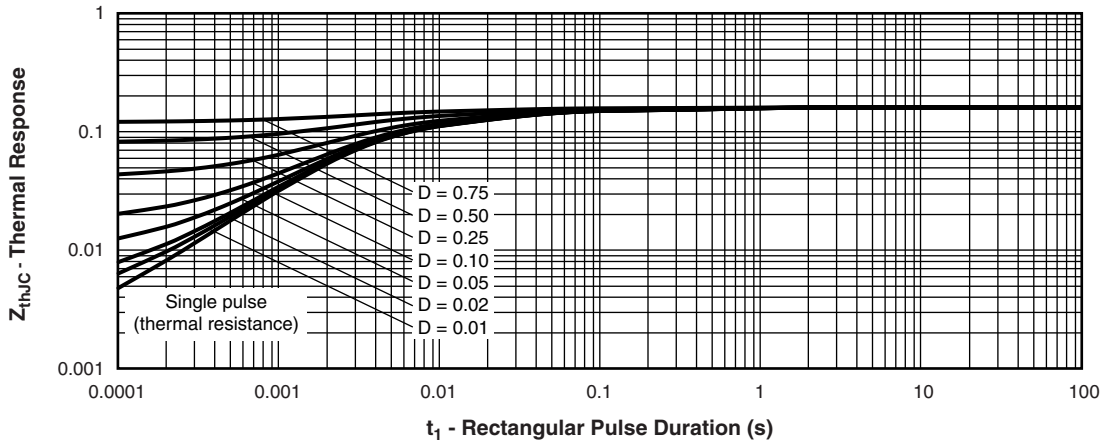


Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction to Case

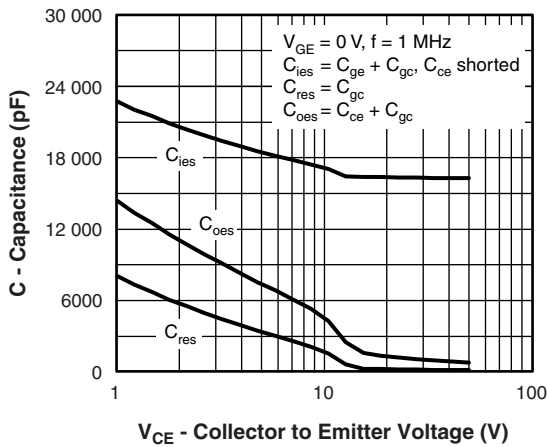


Fig. 7 - Typical Capacitance vs. Collector to Emitter Voltage

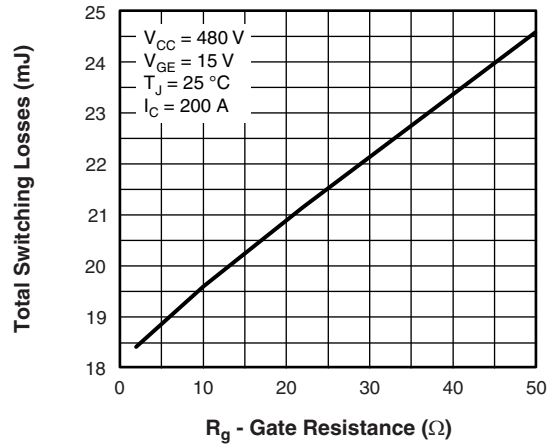


Fig. 9 - Typical Switching Losses vs. Gate Resistance

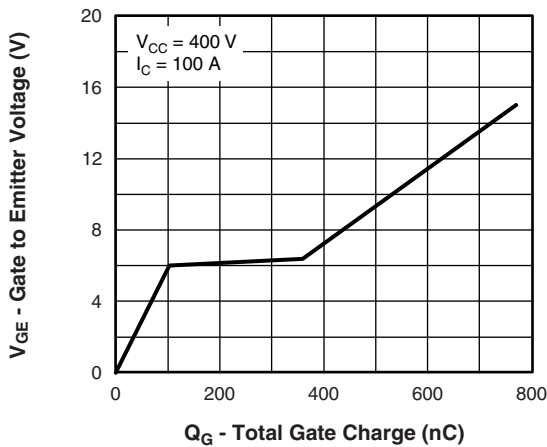


Fig. 8 - Typical Gate Charge vs. Gate to Emitter Voltage

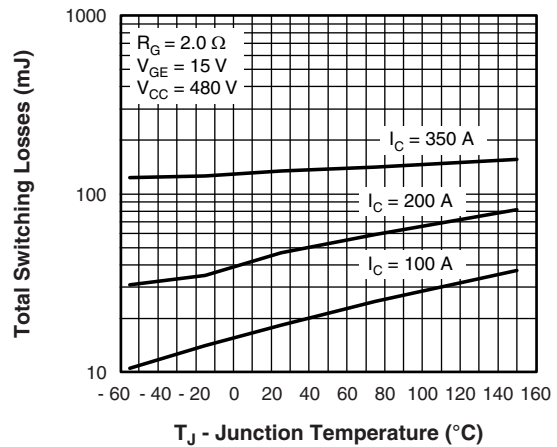


Fig. 10 - Typical Switching Losses vs. Junction Temperature

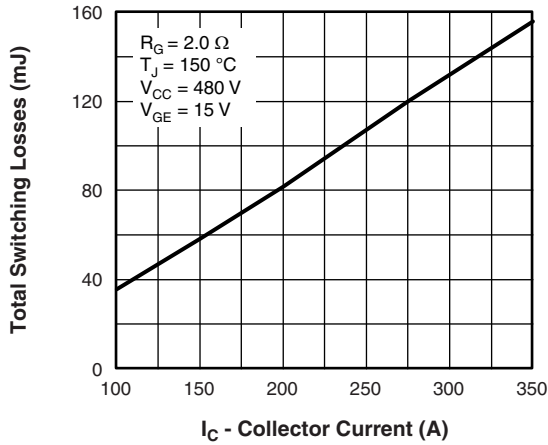
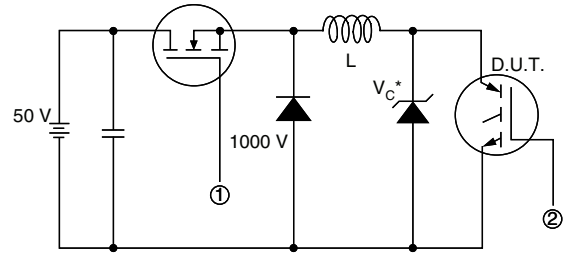


Fig. 11 - Typical Switching Losses vs. Collector Current



\* 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. 13a - Clamped Inductive Load Test Circuit

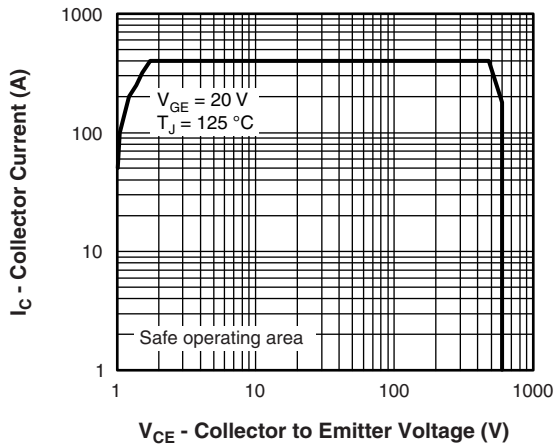


Fig. 12 - Turn-Off SOA

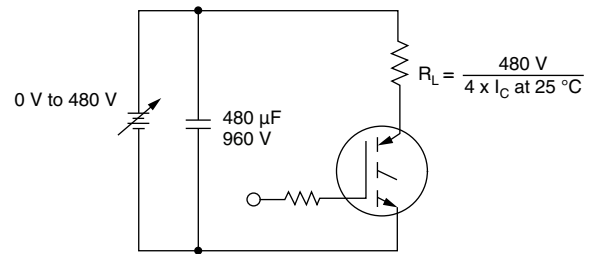
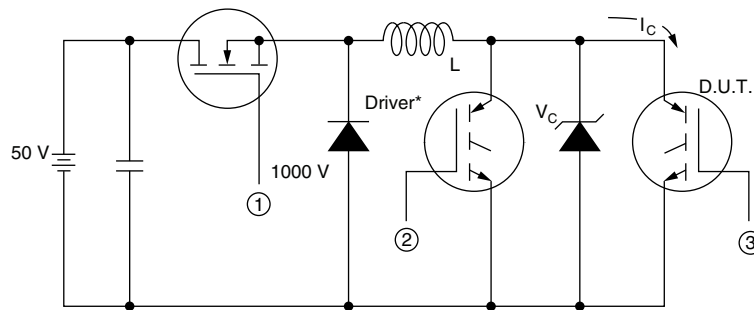


Fig. 13b - Pulsed Collector Current Test Circuit



\* Driver same type as D.U.T.,  $V_C = 480 \text{ V}$

Fig. 14a - Switching Lost Test Circuit

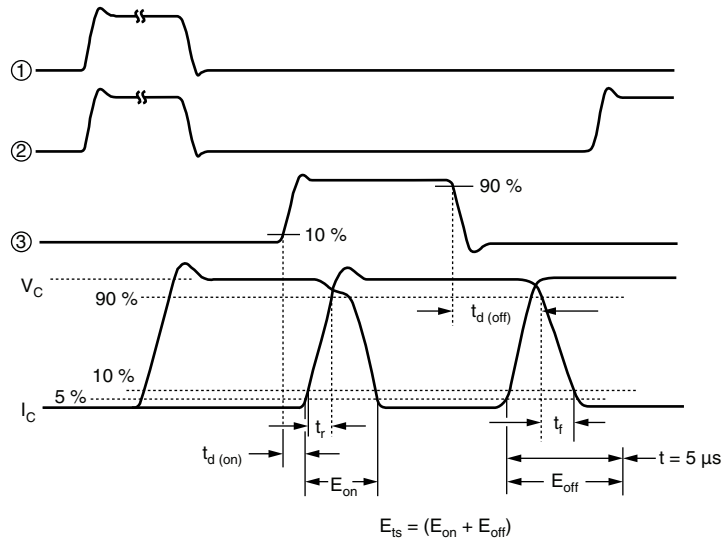


Fig. 14b - Switching Loss Waveforms

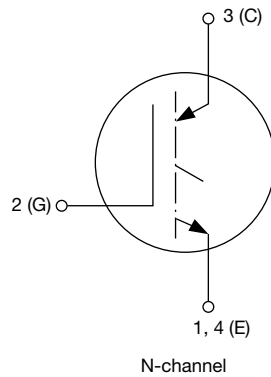
## ORDERING INFORMATION TABLE

Device code	<b>G</b>	<b>A</b>	<b>200</b>	<b>S</b>	<b>A</b>	<b>60</b>	<b>S</b>	<b>P</b>
	①	②	③	④	⑤	⑥	⑦	⑧

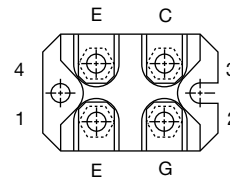
- 1** - Insulated Gate Bipolar Transistor (IGBT)
- 2** - Generation 4, IGBT silicon, DBC construction
- 3** - Current rating (200 = 200 A)
- 4** - Single switch, no diode
- 5** - SOT-227
- 6** - Voltage rating (60 = 600 V)
- 7** - Speed/type (S = Standard speed)
- 8** -
  - None = Standard production
  - P = Lead (Pb)-free



**CIRCUIT CONFIGURATION**



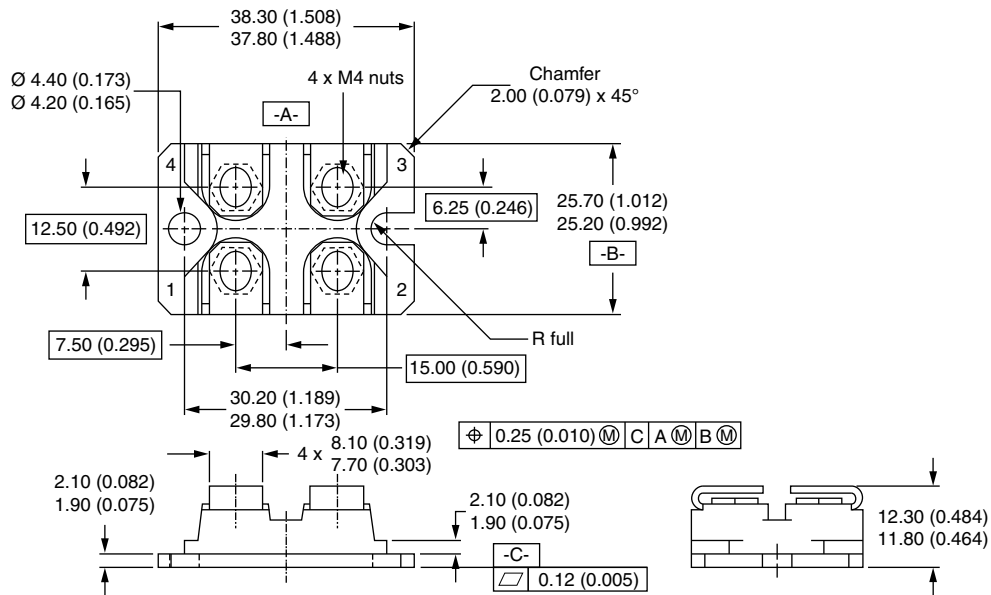
Lead assignment



LINKS TO RELATED DOCUMENTS	
Dimensions	<a href="http://www.vishay.com/doc?95036">www.vishay.com/doc?95036</a>
Packaging information	<a href="http://www.vishay.com/doc?95037">www.vishay.com/doc?95037</a>

## SOT-227

**DIMENSIONS** in millimeters (inches)



### Notes

- Dimensioning and tolerancing per ANSI Y14.5M-1982
- Controlling dimension: millimeter



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