

Insulated Gate Bipolar Transistor (Ultrafast Speed IGBT), 100 A



SOT-227

PRIMARY CHARACTERISTICS

V_{CES}	600 V
$V_{CE(on)}$ (typical)	1.92 V
V_{GE}	15 V
I_C	100 A
Speed	8 kHz to 30 kHz
Package	SOT-227
Circuit configuration	Single switch no diode

FEATURES

- Ultrafast: optimized for minimum saturation voltage and speed up to 30 kHz in hard switching, > 200 kHz in resonant mode
- Very low conduction and switching losses
- Fully isolate package (2500 V_{AC}/RMS)
- Very low internal inductance (≤ 5 nH typical)
- Industry standard outline
- UL approved file E78996 
- Designed and qualified for industrial level
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912


RoHS
COMPLIANT

BENEFITS

- Designed for increased operating efficiency in power conversion: UPS, SMPS, welding, induction heating
- Lower overall losses available at frequencies = 20 kHz
- Easy to assemble and parallel
- Direct mounting to heatsink
- Lower EMI, requires less snubbing
- 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	$T_C = 25^\circ\text{C}$	200	A
		$T_C = 100^\circ\text{C}$	100	
Pulsed collector current	I_{CM}		400	
Clamped inductive load current	I_{LM}	$V_{CC} = 80\% (V_{CES})$, $V_{GE} = 20$ V, $L = 10$ μH , $R_g = 2.0$ Ω , see fig. 13a	400	
Gate to emitter voltage	V_{GE}		± 20	V
Reverse voltage avalanche energy	E_{ARV}	Repetitive rating; pulse width limited by maximum junction temperature	160	mJ
RMS isolation voltage	V_{ISOL}	Any terminal to case, $t = 1$ min	2500	V
Maximum power dissipation	P_D	$T_C = 25^\circ\text{C}$	500	W
		$T_C = 100^\circ\text{C}$	200	
Operating junction and storage temperature range	T_J, T_{Stg}		-55 to +150	$^\circ\text{C}$
Mounting torque		6-32 or M3 screw	1.3 (12)	Nm (lbf.in)

THERMAL AND MECHANICAL SPECIFICATIONS

PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Junction and storage temperature range	T_J, T_{Stg}		-55	-	150	$^\circ\text{C}/\text{W}$
Thermal resistance, junction to case	R_{thJC}		-	-	0.25	
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			

**ELECTRICAL SPECIFICATIONS** ($T_J = 25\text{ }^{\circ}\text{C}$ unless otherwise specified)

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	$V_{(BR)ECS}$	$V_{GE} = 0\text{ V}$, $I_C = 1.0\text{ A}$ Pulse width $\leq 80\text{ }\mu\text{s}$; duty factor $\leq 0.1\%$	18	-	-	
Temperature coefficient of breakdown voltage	$\Delta V_{(BR)CES}/\Delta T_J$	$V_{GE} = 0\text{ V}$, $I_C = 10\text{ mA}$	-	0.38	-	V/ $^{\circ}\text{C}$
Collector to emitter saturation voltage	$V_{CE(on)}$	$I_C = 100\text{ A}$	-	1.60	1.9	V
		$I_C = 200\text{ A}$	-	1.92	-	
		$I_C = 100\text{ A}$, $T_J = 150\text{ }^{\circ}\text{C}$	-	1.54	-	
Gate threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$, $I_C = 250\text{ }\mu\text{A}$	3.0	-	6.0	
Temperature coefficient of threshold voltage	$\Delta V_{GE(th)}/\Delta T_J$	$V_{CE} = V_{GE}$, $I_C = 2.0\text{ mA}$	-	-11	-	mV/ $^{\circ}\text{C}$
Forward transconductance	g_{fe}	$V_{CE} = 100\text{ V}$, $I_C = 100\text{ A}$ Pulse width $5.0\text{ }\mu\text{s}$, single shot	79	-	-	S
Zero gate voltage collector current	I_{CES}	$V_{GE} = 0\text{ V}$, $V_{CE} = 600\text{ V}$	-	-	1.0	mA
		$V_{GE} = 0\text{ V}$, $V_{CE} = 600\text{ V}$, $T_J = 150\text{ }^{\circ}\text{C}$	-	-	10	
Gate to emitter leakage current	I_{GES}	$V_{GE} = \pm 20\text{ V}$	-	-	± 250	nA

SWITCHING CHARACTERISTICS ($T_J = 25\text{ }^{\circ}\text{C}$ 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	$t_{d(on)}$	$T_J = 25\text{ }^{\circ}\text{C}$ $I_C = 100\text{ A}$ $V_{CC} = 480\text{ V}$ $V_{GE} = 15\text{ V}$ $R_g = 2.0\text{ }\Omega$ Energy losses include "tail" See fig. 9, 10, 14	-	54	-	ns
Rise time	t_r		-	79	-	
Turn-off delay time	$t_{d(off)}$		-	130	200	
Fall time	t_f		-	300	450	
Turn-on switching loss	E_{on}	See fig. 9, 10, 14	-	0.98	-	mJ
Turn-off switching loss	E_{off}		-	3.48	-	
Total switching loss	E_{ts}		-	4.46	7.6	
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, 14	-	56	-	ns
Rise time	t_r		-	75	-	
Turn-off delay time	$t_{d(off)}$		-	160	-	
Fall time	t_f		-	460	-	
Total switching loss	E_{ts}		-	7.24	-	mJ
Internal emitter inductance	L_E	Measured 5 mm from package	-	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	-	16 500	-	pF
Output capacitance	C_{oes}		-	1000	-	
Reverse transfer capacitance	C_{res}		-	200	-	

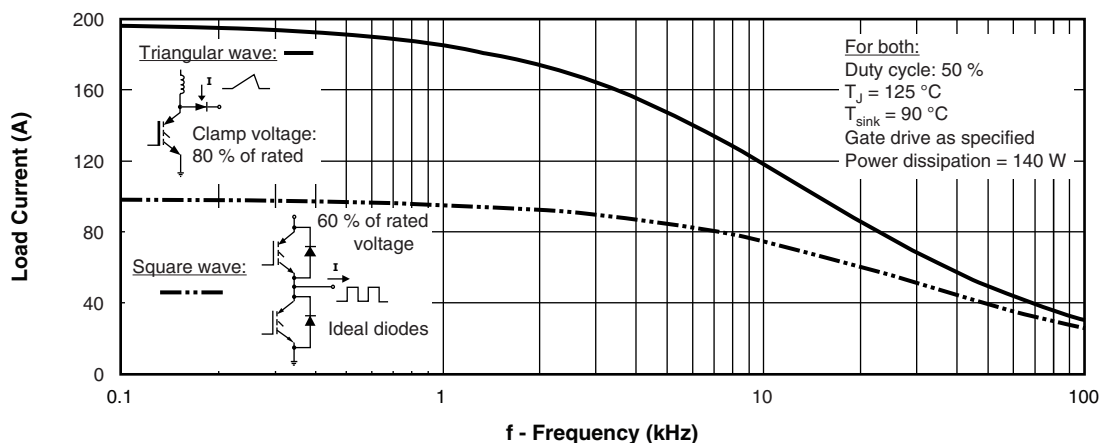


Fig. 1 - Typical Load Current vs. Frequency
(Load Current = I_{RMS} of Fundamental)

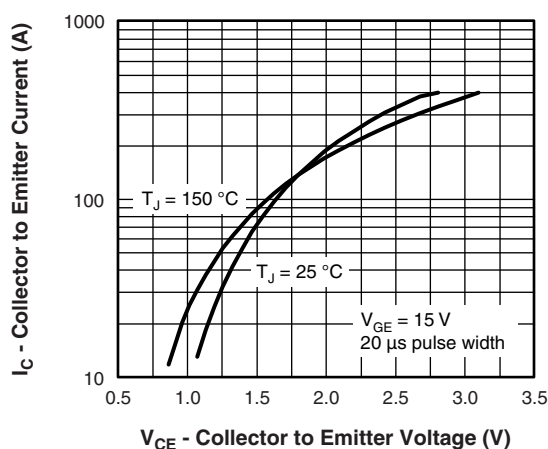


Fig. 2 - Typical Output Characteristics

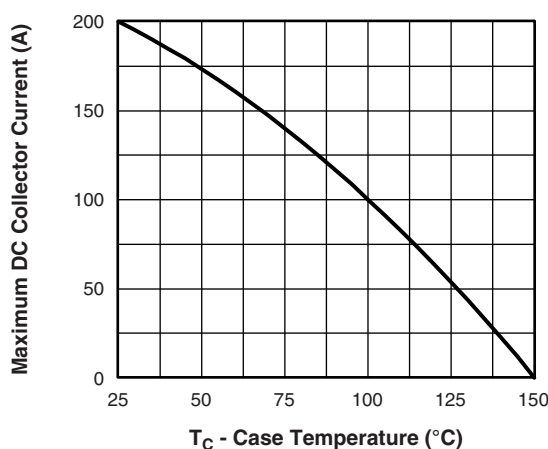


Fig. 4 - Maximum Collector Current vs. Case Temperature

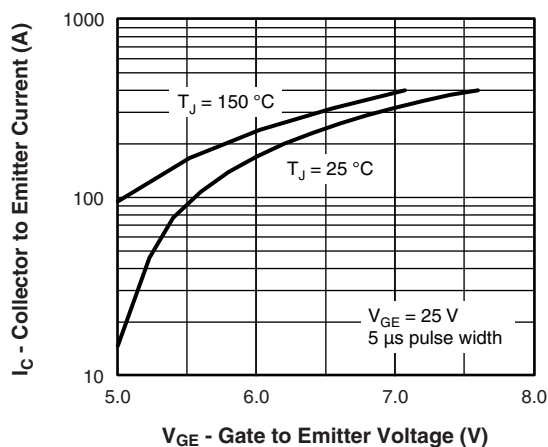


Fig. 3 - Typical Transfer Characteristics

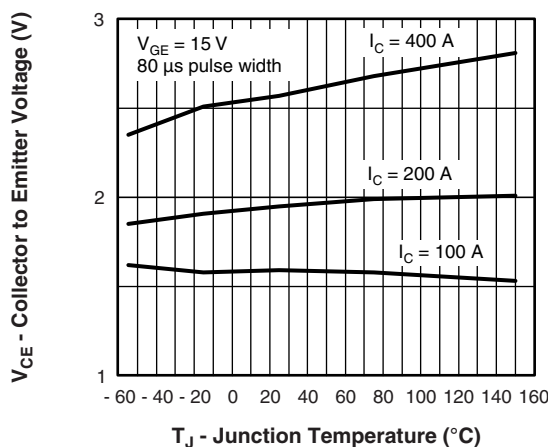


Fig. 5 - Typical Collector to Emitter Voltage vs. Junction Temperature

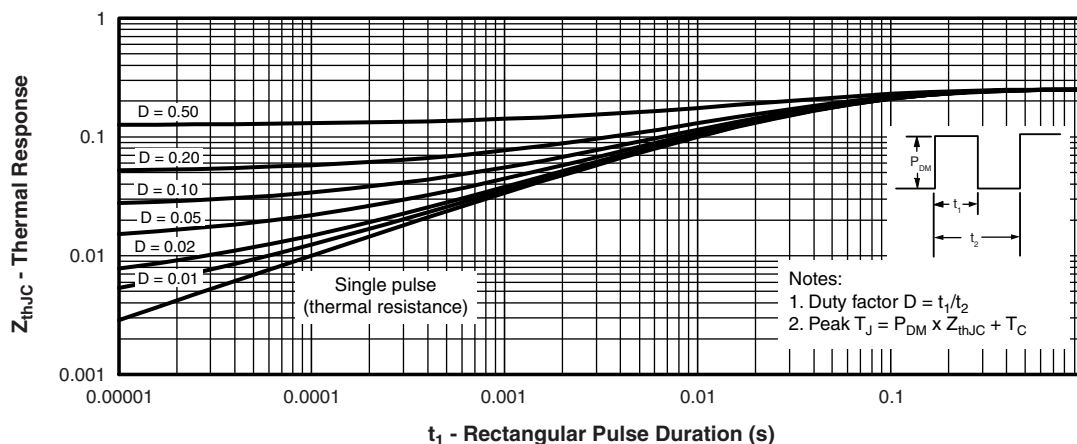


Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction to Case

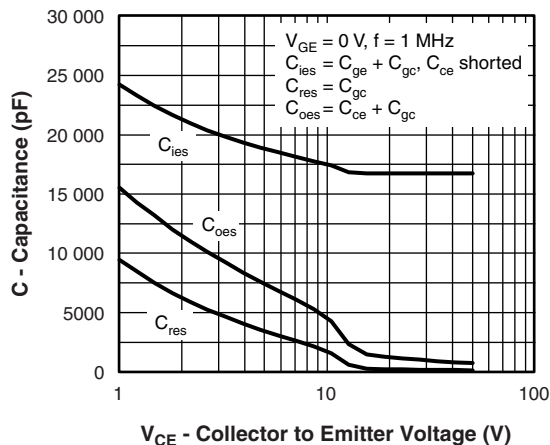


Fig. 7 - Typical Capacitance vs. Collector to Emitter Voltage

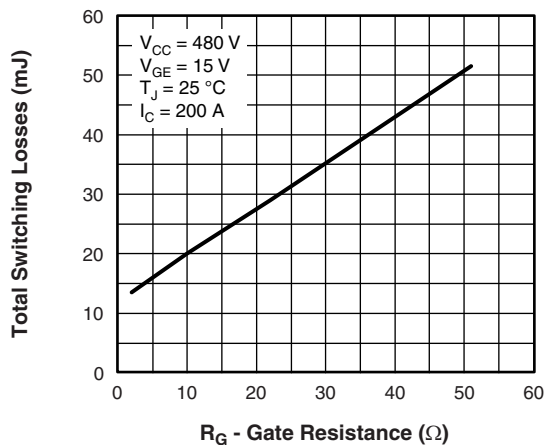


Fig. 9 - Typical Switching Losses vs. Gate Resistance

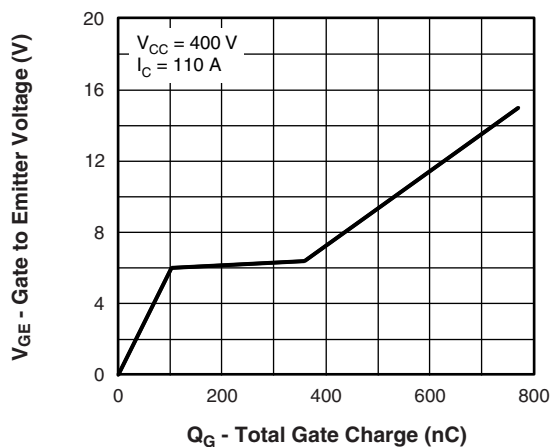


Fig. 8 - Typical Gate Charge vs. Gate to Emitter Voltage

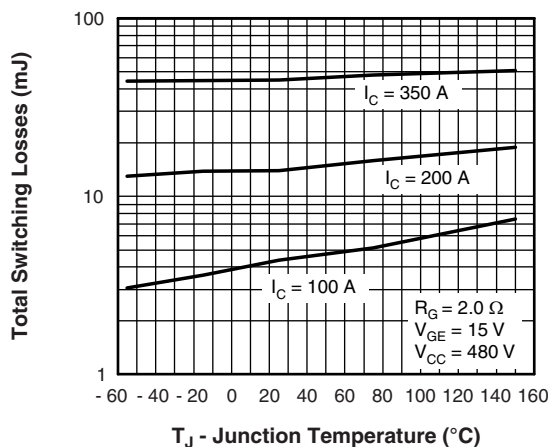


Fig. 10 - Typical Switching Losses vs. Junction Temperature

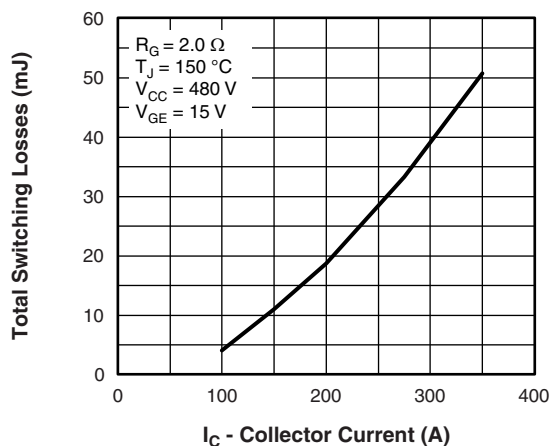


Fig. 11 - Typical Switching Losses vs. Collector Current

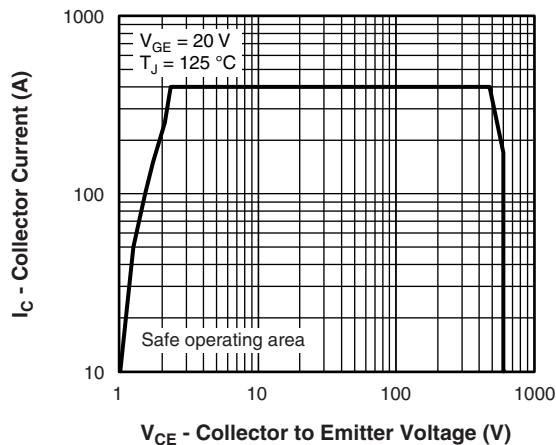
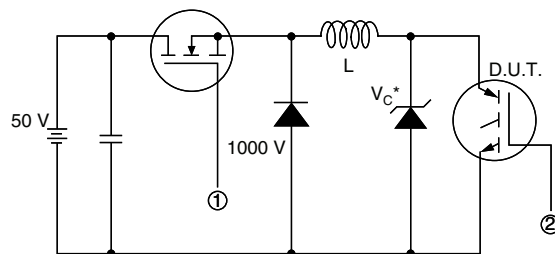


Fig. 12 - Turn-Off SOA



* Driver same type as D.U.T.; $V_C = 80 \, \%$ of $V_{CE} \, (\text{max})$

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

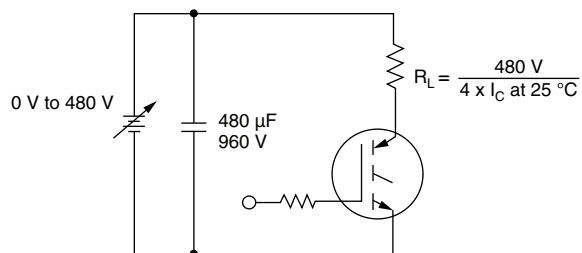
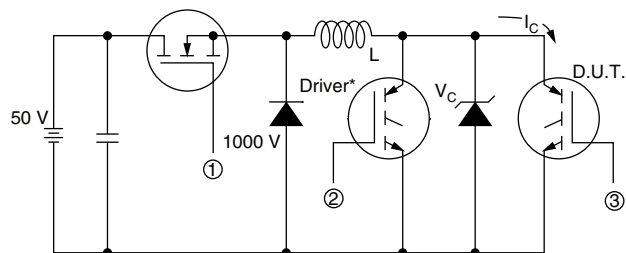


Fig. 13b - Pulsed Collector Current Test Circuit



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

Fig. 14a - Switching Loss Test Circuit

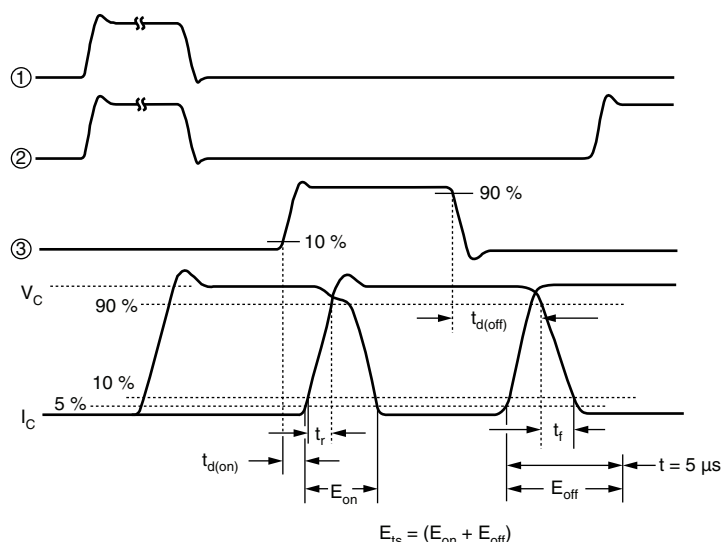
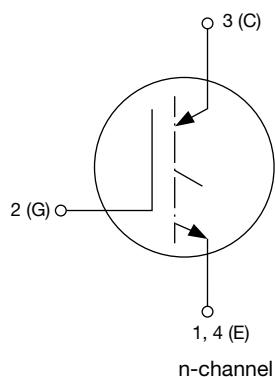


Fig. 14b - Switching Loss Waveforms

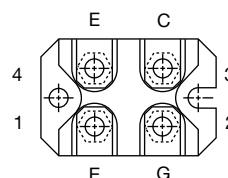
ORDERING INFORMATION TABLE

Device code	VS-	G	A	200	S	A	60	U	P
	1	2	3	4	5	6	7	8	9

- | | | |
|---|---|--|
| 1 | - | Vishay Semiconductors product |
| 2 | - | Insulated gate bipolar transistor (IGBT) |
| 3 | - | Generation 4, IGBT silicon, DBC construction |
| 4 | - | Current rating (200 = 200 A) |
| 5 | - | Single switch no diode |
| 6 | - | SOT-227 |
| 7 | - | Voltage rating (60 = 600 V) |
| 8 | - | Speed/type (U = ultrafast) |
| 9 | - | <ul style="list-style-type: none"> • None = standard production • P = lead (Pb)-free |

CIRCUIT CONFIGURATION


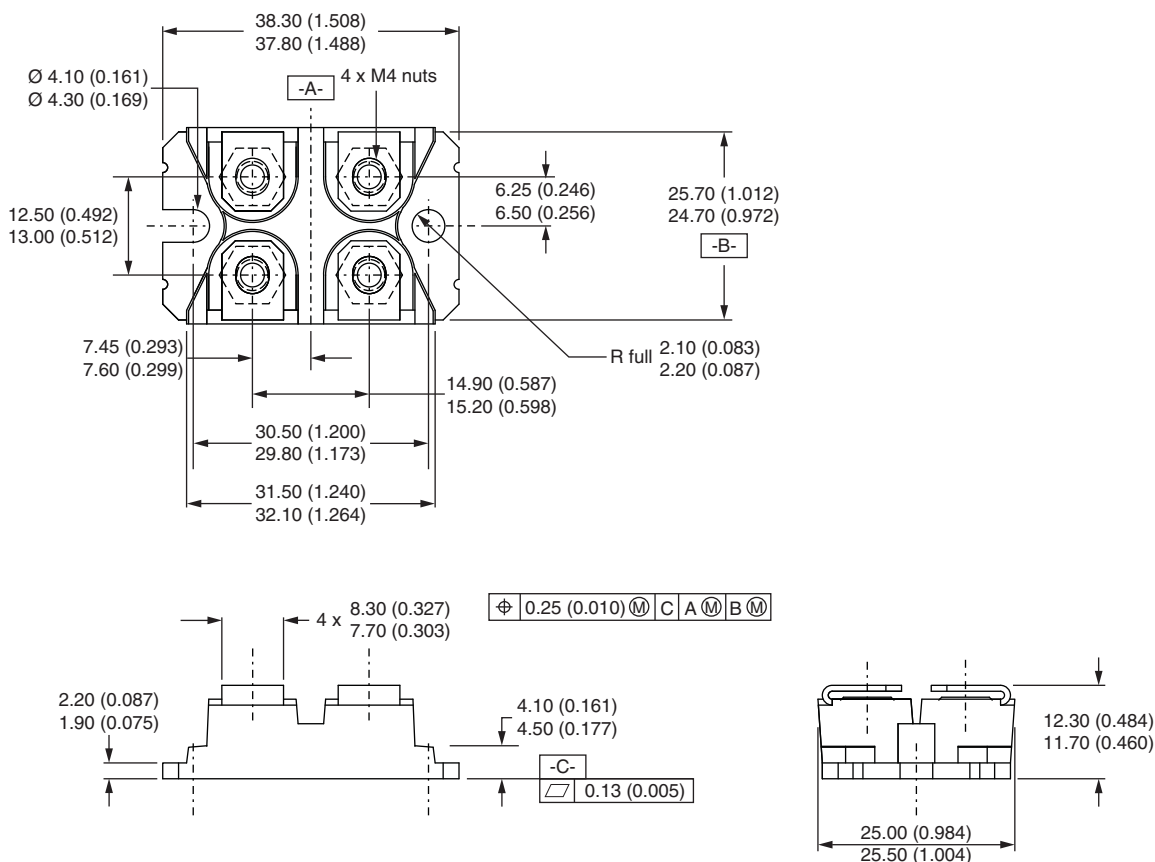
Lead assignment


LINKS TO RELATED DOCUMENTS

Dimensions	www.vishay.com/doc?95425
Packaging information	www.vishay.com/doc?95423

SOT-227 Generation II

DIMENSIONS in millimeters (inches)



Note

- Controlling dimension: millimeter



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