

“Low Side Chopper” IGBT SOT-227 (Warp 2 Speed IGBT), 70 A



SOT-227

PRIMARY CHARACTERISTICS

V_{CES}	600 V
I_C DC	70 A at 87 °C
$V_{CE(on)}$ typical at 70 A, 25 °C	2.31 V
I_F DC	70 A at 86 °C
Package	SOT-227
Circuit configuration	Low side chopper

FEATURES

- NPT warp 2 speed IGBT technology with positive temperature coefficient
- Higher switching frequency up to 150 kHz
- Square RBSOA
- Low $V_{CE(on)}$
- FRED Pt® hyperfast rectifier
- 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

BENEFITS

- Designed for increased operating efficiency in power conversion: UPS, SMPS, welding, induction heating
- Easy to assemble and parallel
- Direct mounting to heatsink
- Plug-in compatible with other SOT-227 packages
- Lower conduction losses and switching 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	$T_C = 25\text{ °C}$	109	A
		$T_C = 80\text{ °C}$	75	
Pulsed collector current	I_{CM}		120	
Clamped inductive load current	I_{LM}		120	
Diode continuous forward current	I_F	$T_C = 25\text{ °C}$	113	
		$T_C = 80\text{ °C}$	75	
Single pulse forward current	I_{FSM}	10 ms sine or 6 ms rectangular pulse, $T_J = 25\text{ °C}$	390	
Gate to emitter voltage	V_{GE}		± 20	V
Power dissipation, IGBT	P_D	$T_C = 25\text{ °C}$	447	W
		$T_C = 80\text{ °C}$	250	
Power dissipation, diode	P_D	$T_C = 25\text{ °C}$	236	
		$T_C = 80\text{ °C}$	132	
RMS isolation voltage	V_{ISOL}	Any terminal to case, $t = 1\text{ min}$	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 = 1 mA	600	-	-	V
Collector to emitter voltage	V _{CE(on)}	V _{GE} = 15 V, I _C = 35 A	-	1.73	2.0	
		V _{GE} = 15 V, I _C = 70 A	-	2.31	-	
		V _{GE} = 15 V, I _C = 35 A, T _J = 125 °C	-	2.14	-	
		V _{GE} = 15 V, I _C = 70 A, T _J = 125 °C	-	3.0	-	
Gate threshold voltage	V _{GE(th)}	V _{CE} = V _{GE} , I _C = 500 μA	2.7	4.5	5.4	
Temperature coefficient of threshold voltage	ΔV _{GE(th)} /ΔT _J	V _{CE} = V _{GE} , I _C = 1 mA (25 °C to 125 °C)	-	-10.8	-	mV/°C
Collector to emitter leakage current	I _{CES}	V _{GE} = 0 V, V _{CE} = 600 V	-	5	50	μA
		V _{GE} = 0 V, V _{CE} = 600 V, T _J = 125 °C	-	0.17	-	mA
Diode reverse breakdown voltage	V _{BR}	I _R = 1 mA	600	-	-	V
Diode forward voltage drop	V _{FM}	I _F = 35 A, V _{GE} = 0 V	-	1.67	2.33	V
		I _F = 70 A, V _{GE} = 0 V	-	1.96	-	
		I _F = 35 A, V _{GE} = 0 V, T _J = 125 °C	-	1.23	-	
		I _F = 70 A, V _{GE} = 0 V, T _J = 125 °C	-	1.55	-	
Diode reverse leakage current	I _{RM}	V _R = 600 V	-	0.1	50	μA
		T _J = 125 °C, V _R = 600 V	-	0.04	-	mA
Gate to emitter leakage current	I _{GES}	V _{GE} = ± 20 V	-	-	± 200	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 = 50 A, V _{CC} = 400 V, V _{GE} = 15 V		-	320	-	nC	
Gate to emitter charge (turn-on)	Q _{ge}			-	42	-		
Gate to collector charge (turn-on)	Q _{gc}			-	110	-		
Turn-on switching loss	E _{on}	I _C = 70 A, V _{CC} = 300 V, V _{GE} = 15 V, R _g = 4.7 Ω, L = 500 μH, T _J = 25 °C	Energy losses include tail and diode recovery	-	0.33	-	mJ	
Turn-off switching loss	E _{off}			-	0.46	-		
Total switching loss	E _{tot}			-	0.79	-		
Turn-on switching loss	E _{on}	I _C = 70 A, V _{CC} = 300 V, V _{GE} = 15 V, R _g = 4.7 Ω, L = 500 μH, T _J = 125 °C		-	0.51	-		
Turn-off switching loss	E _{off}			-	0.56	-		
Total switching loss	E _{tot}			-	1.07	-		
Turn-on delay time	t _{d(on)}			-	166	-	ns	
Rise time	t _r	-		44	-			
Turn-off delay time	t _{d(off)}	-		188	-			
Fall time	t _f	-		53	-			
Reverse bias safe operating area	RBSOA	T _J = 150 °C, I _C = 120 A, R _g = 22 Ω, V _{GE} = 15 V to 0 V, V _{CC} = 400 V, V _P = 600 V		Fullsquare				
Diode reverse recovery time	t _{rr}	I _F = 50 A, dI _F /dt = 200 A/μs, V _R = 200 V		-	64	-	ns	
Diode peak reverse current	I _{rr}			-	4.5	-	A	
Diode recovery charge	Q _{rr}			-	144	-	nC	
Diode reverse recovery time	t _{rr}	I _F = 50 A, dI _F /dt = 200 A/μs, V _R = 200 V, T _J = 125 °C		-	136	-	ns	
Diode peak reverse current	I _{rr}			-	12	-	A	
Diode recovery charge	Q _{rr}			-	807	-	nC	



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}	IGBT	-	-	0.28	°C/W
			-	-	0.53	
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				

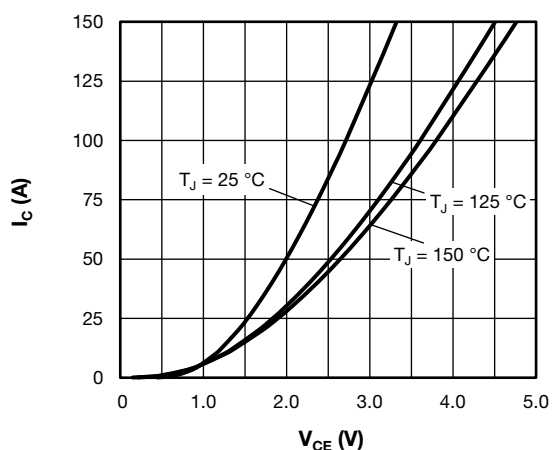
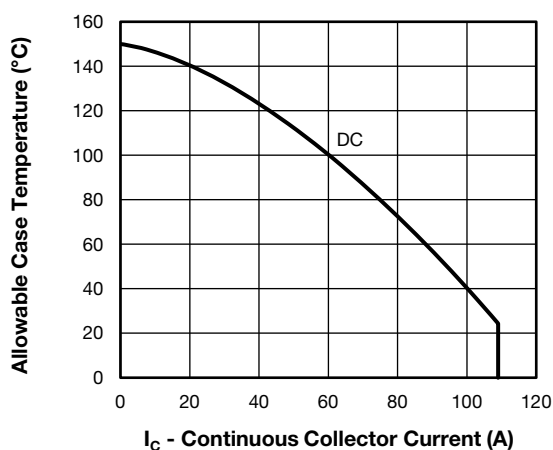
Fig. 1 - Typical IGBT Output Characteristics, $V_{GE} = 15$ V

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

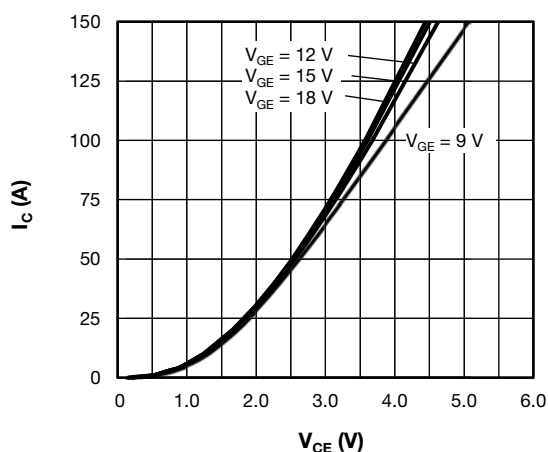
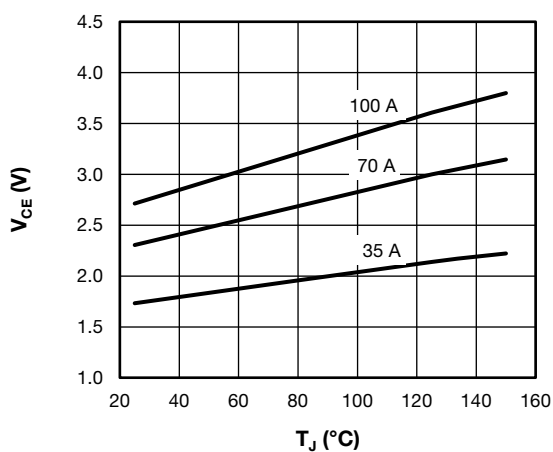
Fig. 2 - Typical IGBT Output Characteristics, $T_J = 125$ °C

Fig. 4 - Collector to Emitter Voltage vs. Junction Temperature

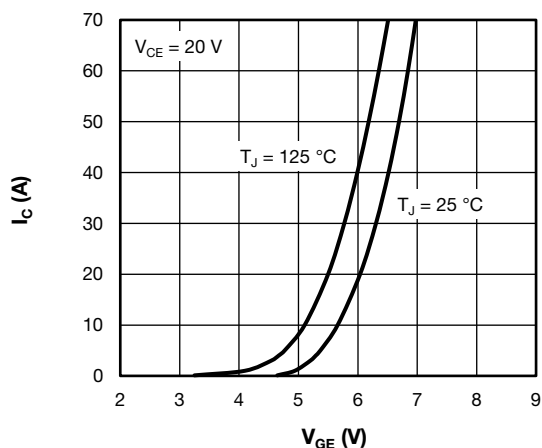


Fig. 5 - Typical IGBT Transfer Characteristics

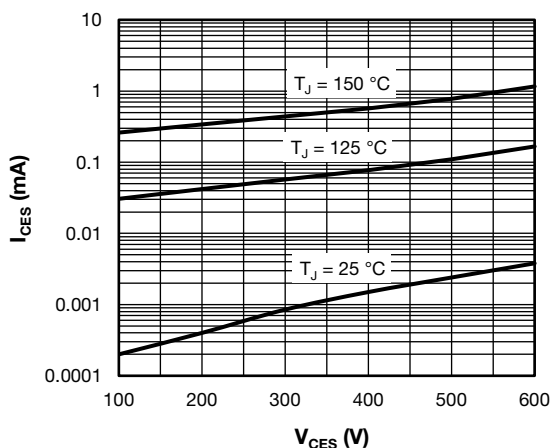


Fig. 8 - Typical IGBT Zero Gate Voltage Collector Current

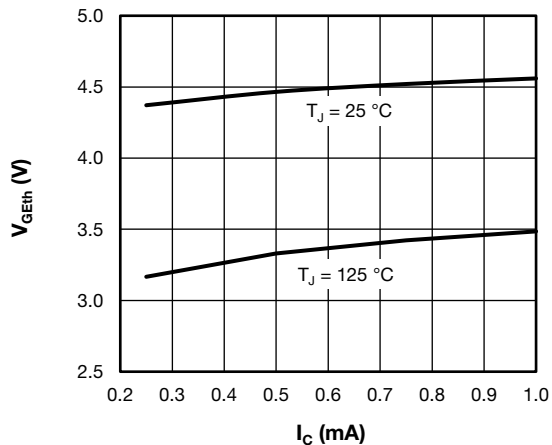


Fig. 6 - Typical IGBT Gate Threshold Voltage

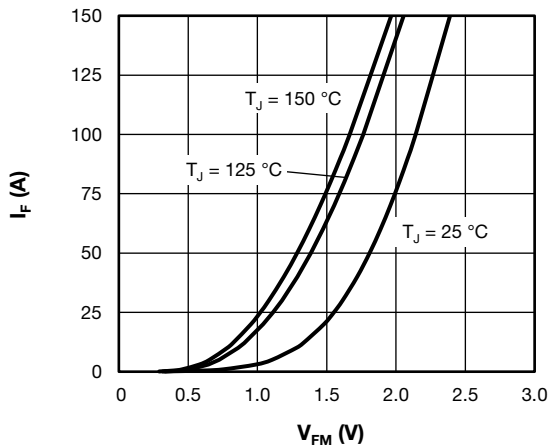


Fig. 9 - Typical Diode Forward Characteristics

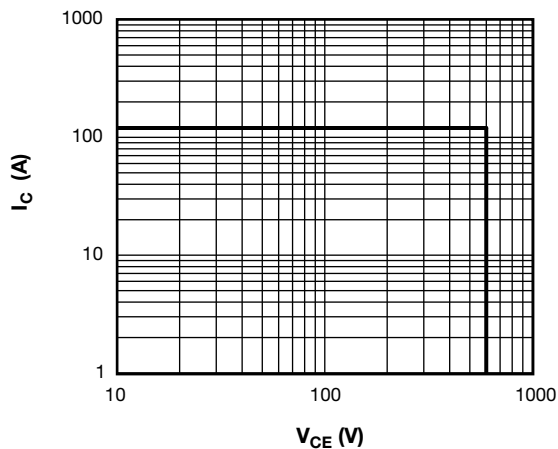


Fig. 7 - IGBT Reverse BIAS SOA,
T_J = 150 °C, V_{GE} = 15 V

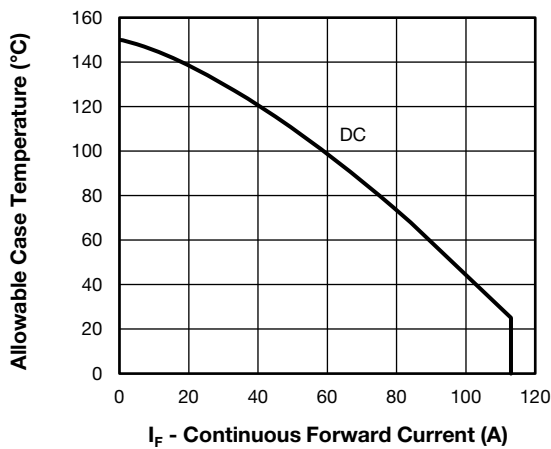


Fig. 10 - Maximum Diode Continuous Forward Current vs.
Case Temperature

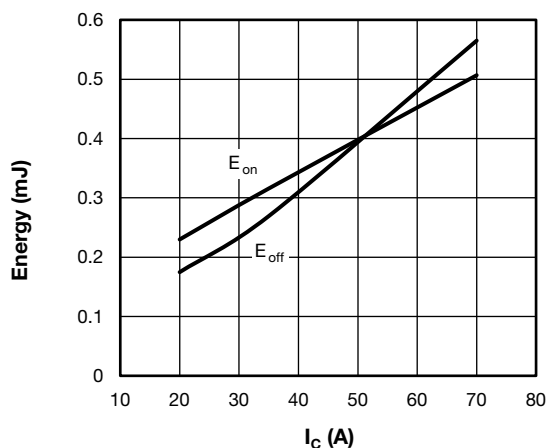


Fig. 11 - Typical IGBT Energy Loss vs. I_C
 $T_J = 125^\circ\text{C}$, $V_{CC} = 300\text{ V}$, $R_g = 4.7\ \Omega$, $V_{GE} = 15\text{ V}$, $L = 500\ \mu\text{H}$

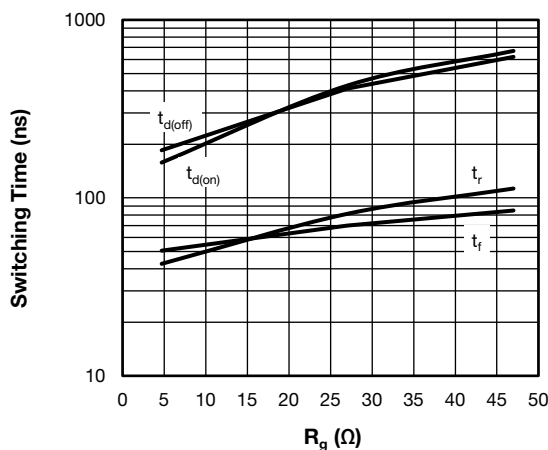


Fig. 14 - Typical IGBT Switching Time vs. R_g
 $T_J = 125^\circ\text{C}$, $V_{CC} = 300\text{ V}$, $I_C = 70\text{ A}$, $V_{GE} = 15\text{ V}$, $L = 500\ \mu\text{H}$

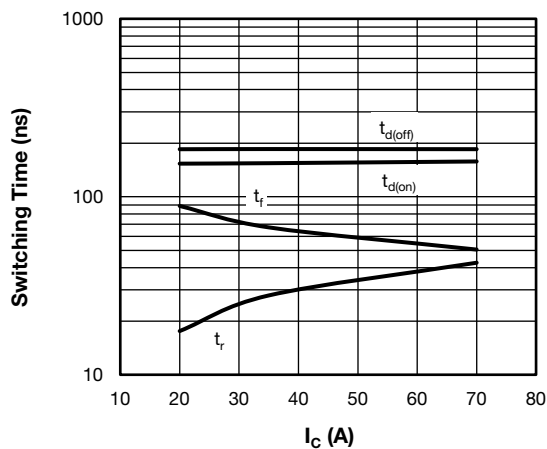


Fig. 12 - Typical IGBT Switching Time vs. I_C
 $T_J = 125^\circ\text{C}$, $V_{CC} = 300\text{ V}$, $R_g = 4.7\ \Omega$, $V_{GE} = 15\text{ V}$, $L = 500\ \mu\text{H}$

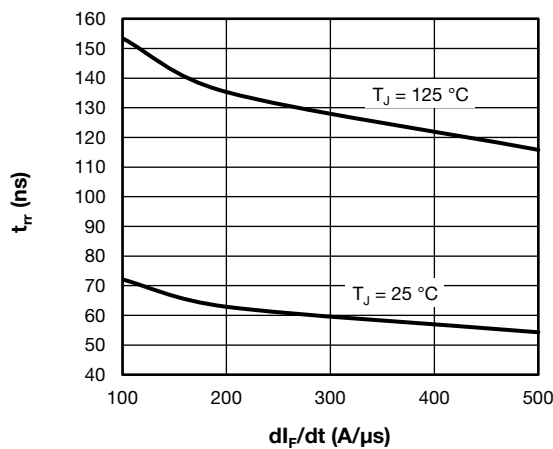


Fig. 15 - Typical Diode Reverse Recovery Time vs. dI_F/dt
 $V_{rr} = 200\text{ V}$, $I_F = 50\text{ A}$

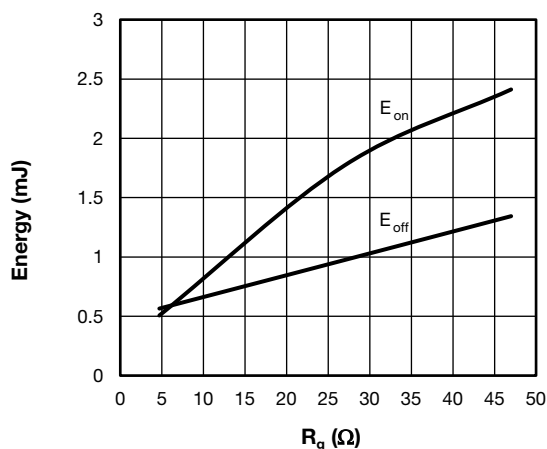


Fig. 13 - Typical IGBT Energy Loss vs. R_g
 $T_J = 125^\circ\text{C}$, $V_{CC} = 300\text{ V}$, $I_C = 70\text{ A}$, $V_{GE} = 15\text{ V}$, $L = 500\ \mu\text{H}$

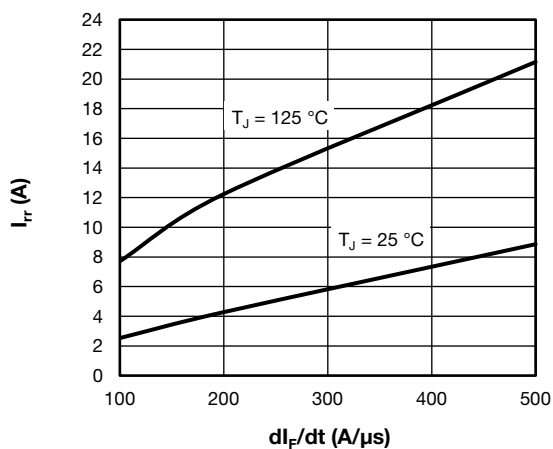


Fig. 16 - Typical Diode Reverse Recovery Current vs. dI_F/dt
 $V_{rr} = 200\text{ V}$, $I_F = 50\text{ A}$

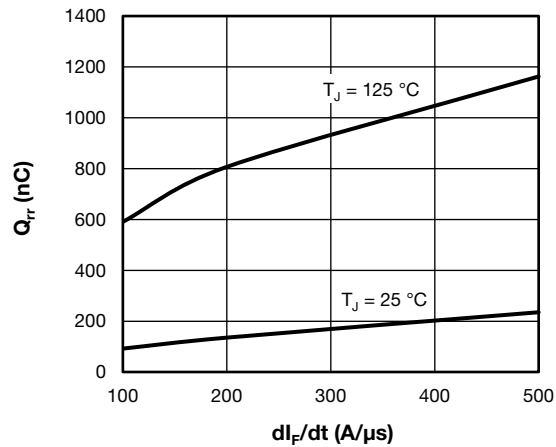


Fig. 17 - Typical Diode Reverse Recovery Charge vs. di_F/dt
 $V_{rr} = 200\text{ V}$, $I_F = 50\text{ A}$

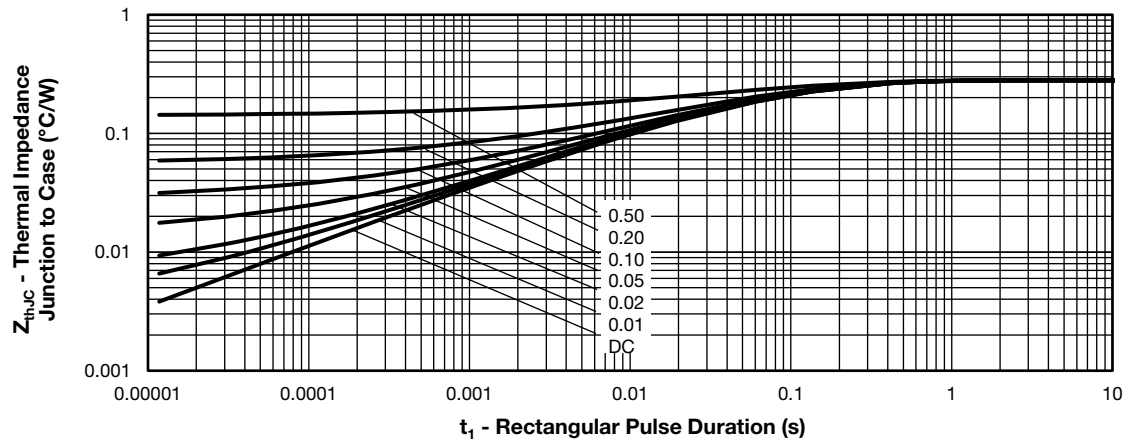


Fig. 18 - Maximum Thermal Impedance Z_{thJC} Characteristics (IGBT)

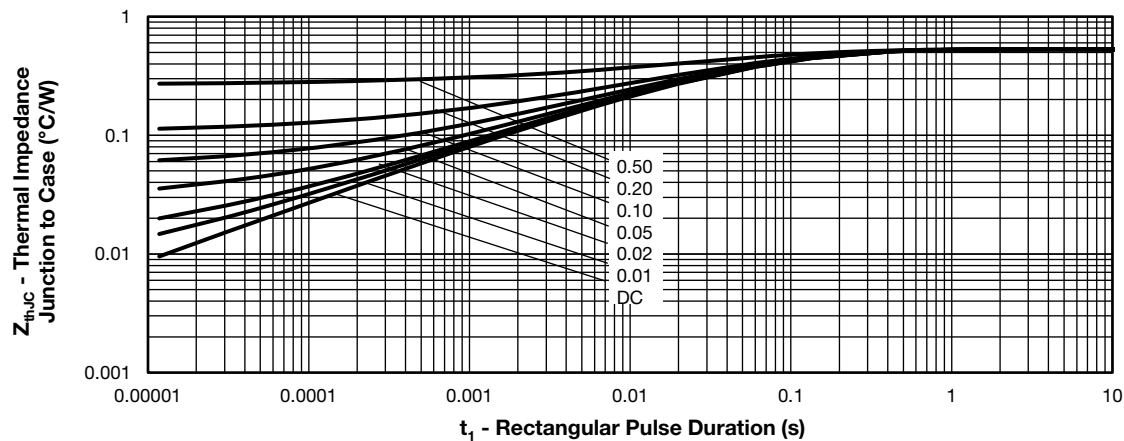
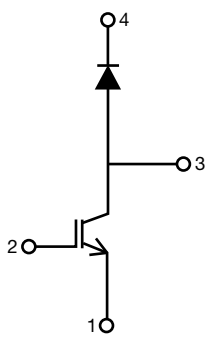
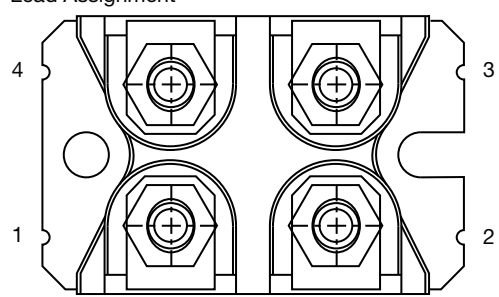


Fig. 19 - Maximum Thermal Impedance Z_{thJC} Characteristics (Diode)

ORDERING INFORMATION TABLE

Device code	VS-	G	B	75	L	A	60	U	F
	1	2	3	4	5	6	7	8	9

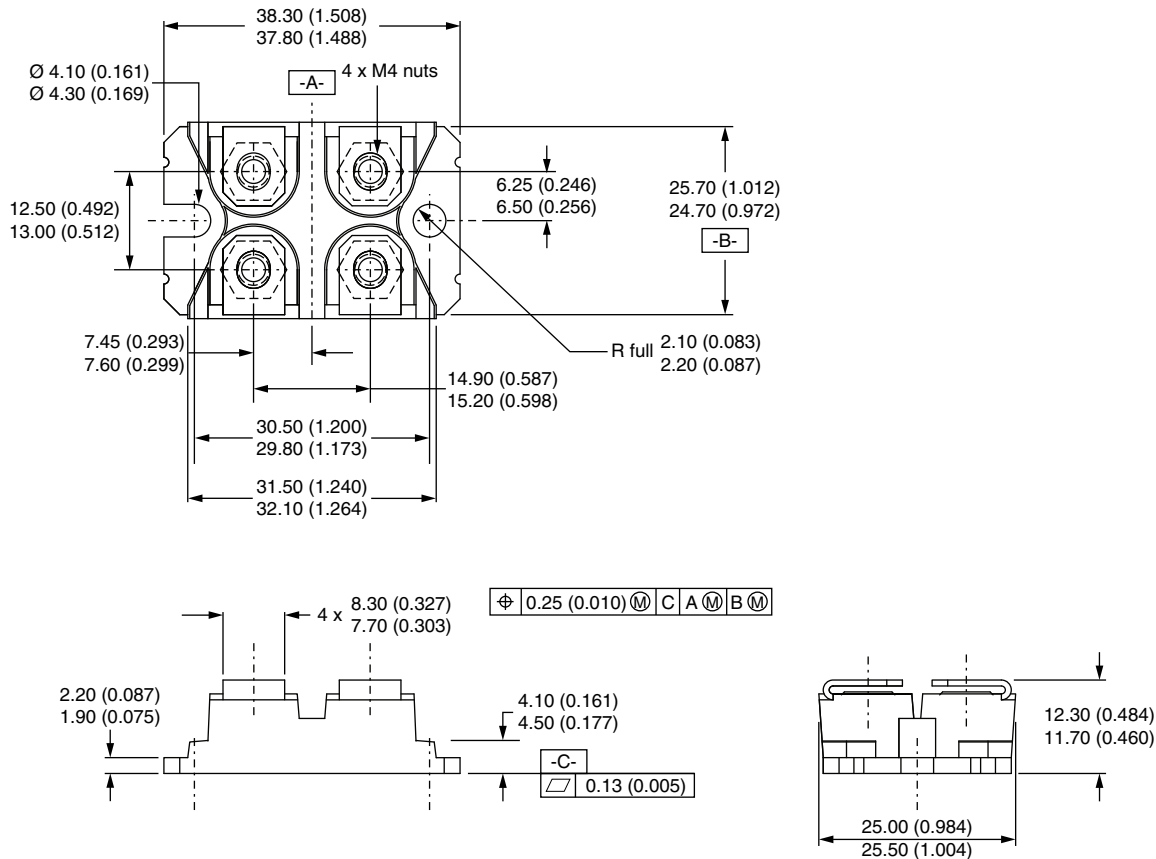
- | | |
|---|--|
| 1 | - Vishay Semiconductors product |
| 2 | - Insulated gate bipolar transistor (IGBT) |
| 3 | - B = IGBT Gen 5 |
| 4 | - Current rating (75 = 70 A) |
| 5 | - Circuit configuration (L = low side chopper) |
| 6 | - Package indicator (A = SOT-227) |
| 7 | - Voltage rating (60 = 600 V) |
| 8 | - Speed/type (U = ultrafast IGBT) |
| 9 | - Diode (F = FRED Pt [®] diode) |

CIRCUIT CONFIGURATION			
CIRCUIT	CIRCUIT CONFIGURATION CODE	CIRCUIT DRAWING	
Low side chopper	L		Lead Assignment 

LINKS TO RELATED DOCUMENTS	
Dimensions	www.vishay.com/doc?95423
Packaging information	www.vishay.com/doc?95425



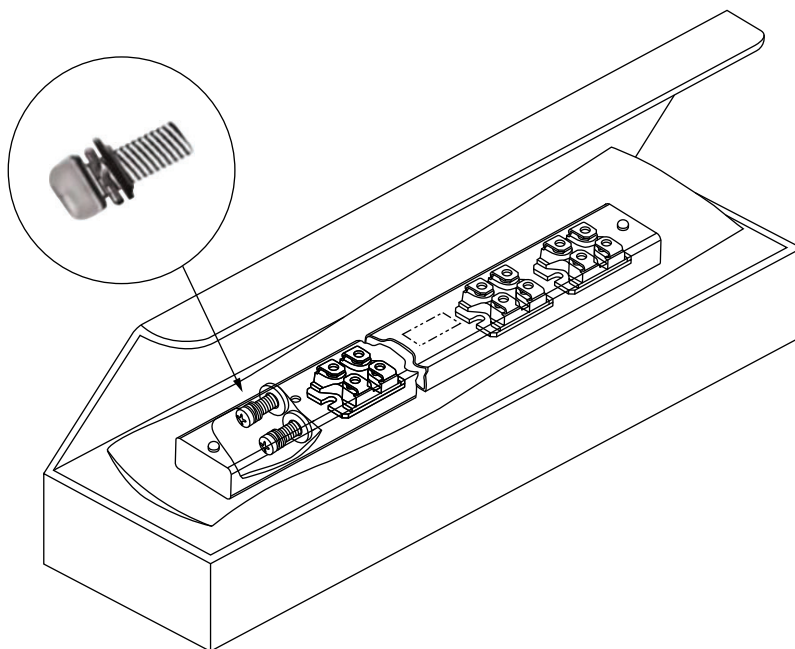
DIMENSIONS in millimeters (inches)



Note

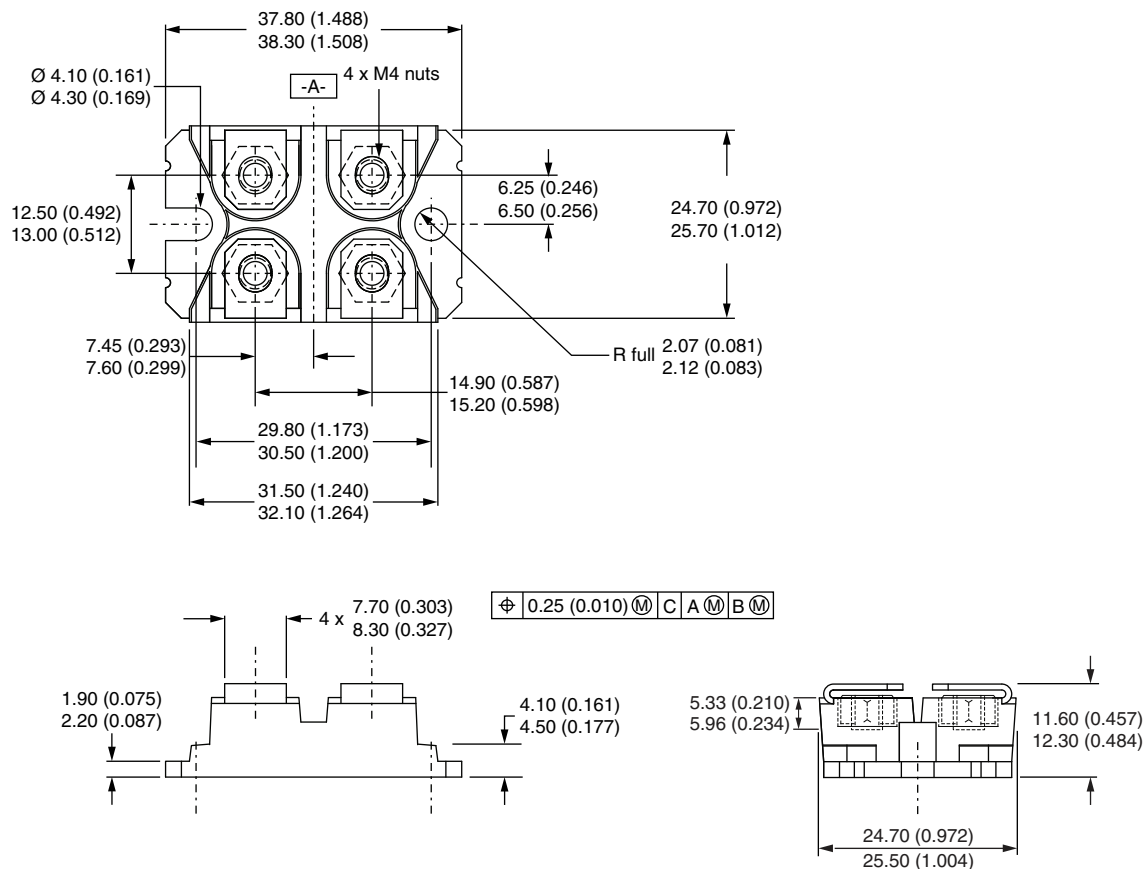
- Controlling dimension: millimeter

PACKAGING INFORMATION



SOT-227 Generation 2

DIMENSIONS in millimeters (inches)



Note

- Controlling dimension: millimeter



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