Insulated Gate Bipolar Transistor (Trench IGBT), 600 V, 80 A

SOT-227

FEATURES

- High speed trench gate field-stop IGBT positive temperature coefficient
- T_J maximum = 175 °C
- FRED Pt® anti-parallel diodes with ultrasoft reverse recovery
- 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

PRIMARY CHARACTERISTICS	
V_{CES}	600 V
I_C DC	80 A at T_C = 97 °C
$V_{CE(on)}$ typical at 80 A, 25 °C	1.83 V
$I_{F\ (DC)}$	56 A at T_C = 100 °C
Speed	8 kHz to 30 kHz
Package	SOT-227
Circuit configuration	Single switch with AP diode

BENEFITS

- Designed for increased operating efficiency in power conversion: UPS, SMPS, welding, induction heating
- Easy to assemble and safe paralleling
- 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 °C	123	A
		T_C = 90 °C	85	
Pulsed collector current	I_{CM}		315	
Diode continuous forward current	I_F	T_C = 25 °C	85	
		T_C = 90 °C	60	
Gate-to-emitter voltage	V_{GE}		± 20	V
Power dissipation, IGBT	P_D	T_C = 25 °C	454	W
		T_C = 90 °C	258	
Power dissipation, diode	P_D	T_C = 25 °C	238	
		T_C = 90 °C	135	
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 = 2.0 mA	600	-	-	V
Collector to emitter voltage	$V_{CE(on)}$	V_{GE} = 15 V, I_C = 80 A	-	1.83	2.45	
		V_{GE} = 15 V, I_C = 80 A, T_J = 125 °C	-	2.12	-	
		V_{GE} = 15 V, I_C = 80 A, T_J = 150°C	-	2.2	-	
Gate threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$, I_C = 1.0 mA	4.6	5.6	7.5	
Temperature coefficient of threshold voltage	$\Delta V_{GE(th)}/\Delta T_J$	$V_{CE} = V_{GE}$, I_C = 1.0 mA (25 °C to 150 °C)	-	-18.8	-	mV/°C
Collector to emitter leakage current	I_{CES}	V_{GE} = 0 V, V_{CE} = 600 V	-	0.2	100	μA
		V_{GE} = 0 V, V_{CE} = 600 V, T_J = 125 °C	-	51	-	
		V_{GE} = 0 V, V_{CE} = 600 V, T_J = 150 °C	-	259	-	
Forward voltage drop, diode	V_{FM}	I_F = 80 A, V_{GE} = 0 V	-	1.92	3.15	V
		I_F = 80 A, V_{GE} = 0 V, T_J = 125 °C	-	1.61	-	
		I_F = 80 A, V_{GE} = 0 V, T_J = 150 °C	-	1.54	-	
Gate to emitter leakage current	I_{GES}	V_{GE} = ± 20 V	-	-	± 250	nA

SWITCHING CHARACTERISTICS (T_J = 25 °C unless otherwise specified)							
PARAMETER	**SYMBOL**	**TEST CONDITIONS**		**MIN.**	**TYP.**	**MAX.**	**UNITS**
Input capacitance	C_{iss}	V_{GE} = 0 V, V_{CE} = 25 V, f = 1.0 MHz		-	10 800	-	pF
Output capacitance	C_{oss}			-	390	-	
Reverse transfer capacitance	C_{rss}			-	220	-	
Total gate charge (turn-on)	Q_g	I_C = 80 A, V_{CC} = 480 V, V_{GE} = 15 V		-	448	-	nC
Gate to emitter charge (turn-on)	Q_{ge}			-	76	-	
Gate to collector charge (turn-on)	Q_{gc}			-	184	-	
Turn-on switching loss	E_{on}	I_C = 80 A, V_{CC} = 300 V, V_{GE} = 15 V, R_g = 27 Ω, L = 500 μH, T_J = 25 °C	Energy losses include tail and diode recovery.	-	1.95	-	mJ
Turn-off switching loss	E_{off}			-	1.25	-	
Total switching loss	E_{tot}			-	3.2	-	
Turn-on delay time	$t_{d(on)}$			-	120	-	ns
Rise time	t_r			-	90	-	
Turn-off delay time	$t_{d(off)}$			-	442	-	
Fall time	t_f			-	35	-	
Turn-on switching loss	E_{on}	I_C = 80 A, V_{CC} = 300 V, V_{GE} = 15 V, R_g = 27 Ω, L = 500 μH, T_J = 125 °C		-	2.3	-	mJ
Turn-off switching loss	E_{off}			-	1.43	-	
Total switching loss	E_{tot}			-	3.73	-	
Turn-on delay time	$t_{d(on)}$			-	124	-	ns
Rise time	t_r			-	94	-	
Turn-off delay time	$t_{d(off)}$			-	455	-	
Fall time	t_f			-	43	-	
Diode reverse recovery time	t_{rr}	I_F = 50 A, dI_F/dt = 200 A/μs, V_R = 200 V		-	69	-	ns
Diode peak reverse current	I_{rr}			-	4.9	-	A
Diode recovery charge	Q_{rr}			-	169	-	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		-	139	-	ns
Diode peak reverse current	I_{rr}			-	12.2	-	A
Diode recovery charge	Q_{rr}			-	856	-	nC

THERMAL AND MECHANICAL SPECIFICATIONS							
PARAMETER		**SYMBOL**	**TEST CONDITIONS**	**MIN.**	**TYP.**	**MAX.**	**UNITS**
Junction temperature range		T_J		-40	-	175	°C
Storage temperature range		T_{Stg}		-40	-	150	°C
Junction-to-case	IGBT	R_{thJC}		-	-	0.33	°C/W
	Diode			-	-	0.63	
Case-to-heatsink		R_{thCS}	Flat, greased surface	-	0.1	-	
Weight				-	30	-	g
Mounting torque			Torque to terminal	-	-	1.1 (9.7)	Nm (lbf. in)
			Torque to heatsink	-	-	1.3 (11.5)	Nm (lbf. in)
Case style		SOT-227					

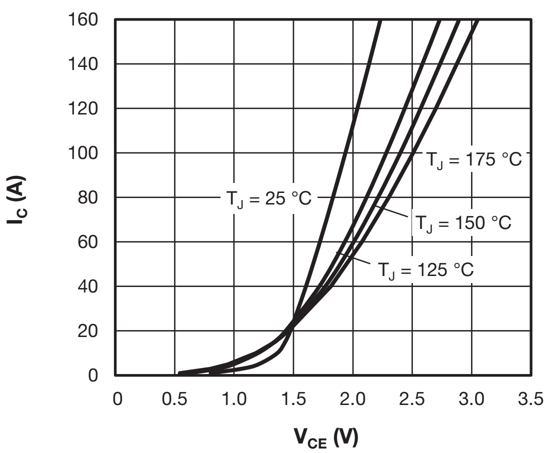


Fig. 1 - Typical IGBT Output Characteristics, V_{GE} = 15 V

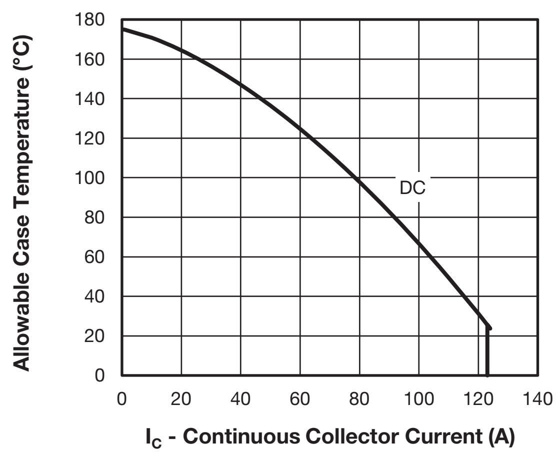


Fig. 3 - Maximum IGBT Continuous Collector Current vs. Case Temperature

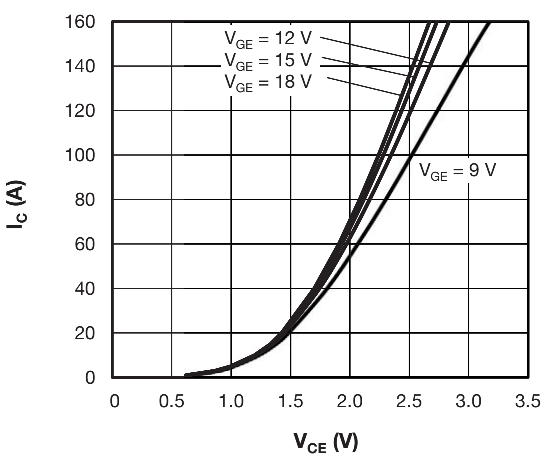


Fig. 2 - Typical IGBT Output Characteristics, T_J = 125 °C

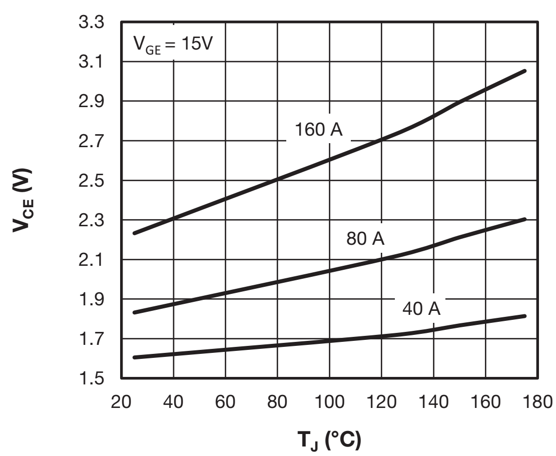


Fig. 4 - Collector to Emitter Voltage vs. Junction Temperature

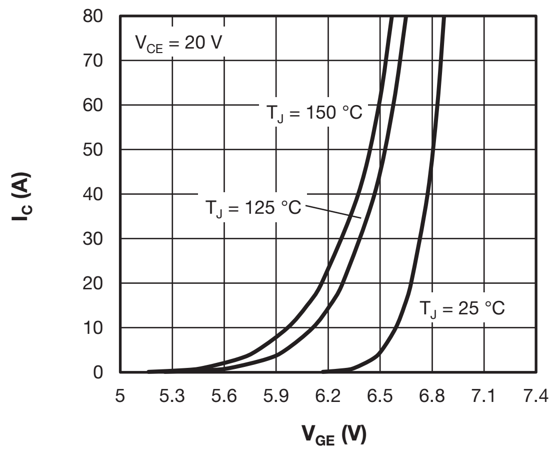


Fig. 5 - Typical IGBT Transfer Characteristics

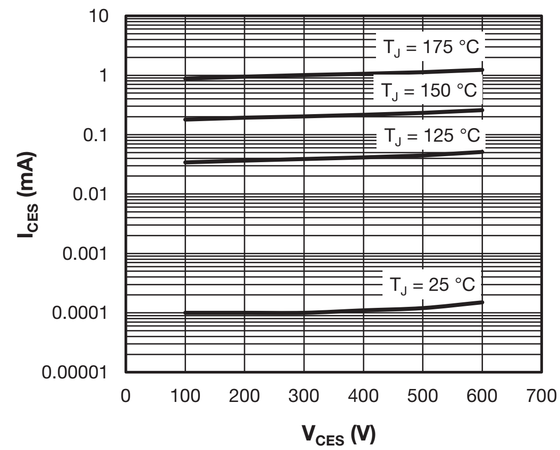


Fig. 8 - Typical IGBT Zero Gate Voltage Collector Current

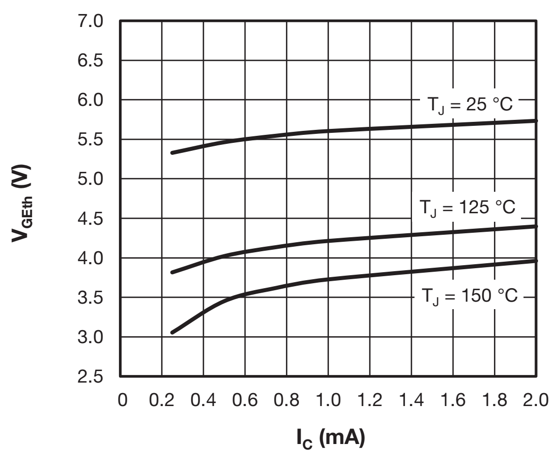


Fig. 6 - Typical IGBT Gate Threshold Voltage

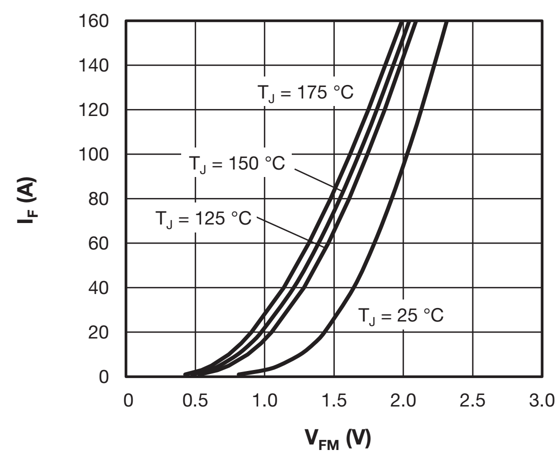


Fig. 9 - Typical Diode Forward Characteristics

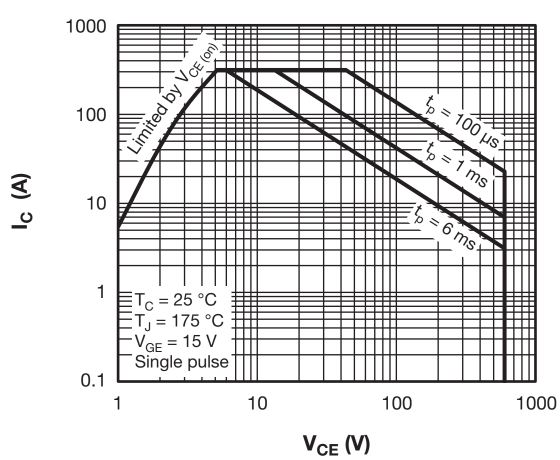


Fig. 7 - IGBT Safe Operating Area

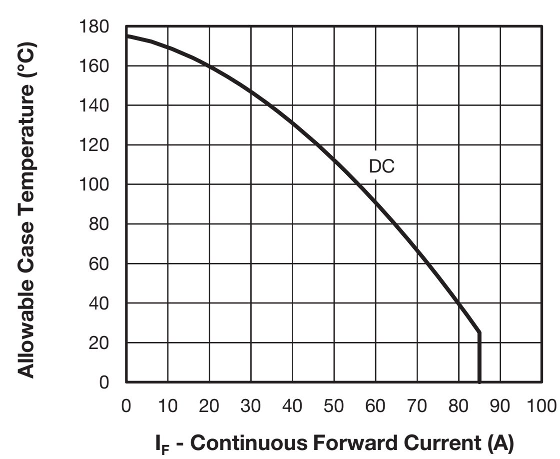


Fig. 10 - Maximum Diode Continuous Forward Current vs. Case Temperature

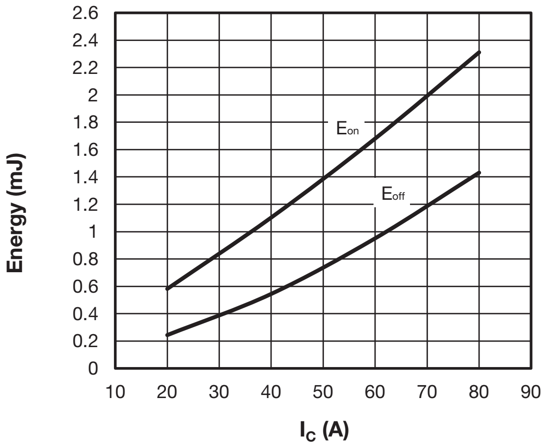


Fig. 11 - Typical IGBT Energy Loss vs. I_C
T_J = 125 °C, V_{CC} = 300 V, R_g = 27 Ω, V_{GE} = 15 V, L = 500 µH

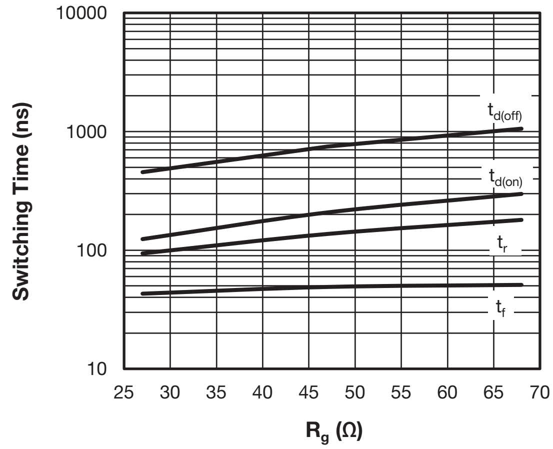


Fig. 14 - Typical IGBT Switching Time vs. R_g
T_J = 125 °C, V_{CC} = 300 V, I_C = 80 A, V_{GE} = 15 V, L = 500 µH

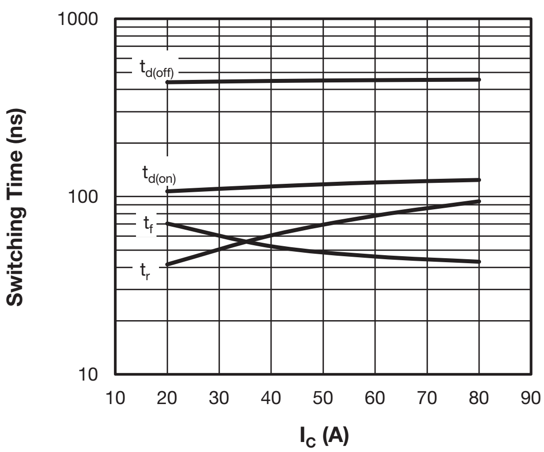


Fig. 12 - Typical IGBT Switching Time vs. I_C
T_J = 125 °C, V_{CC} = 300 V, R_g = 27 Ω, V_{GE} = 15 V, L = 500 µH

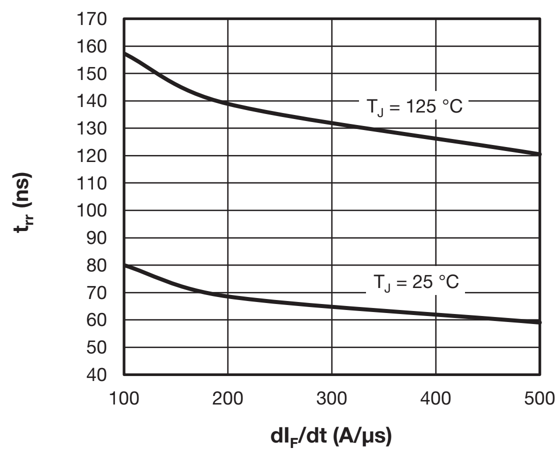


Fig. 15 - Typical t_{rr} Diode vs. dI_F/dt
V_{rr} = 200 V, I_F = 50 A

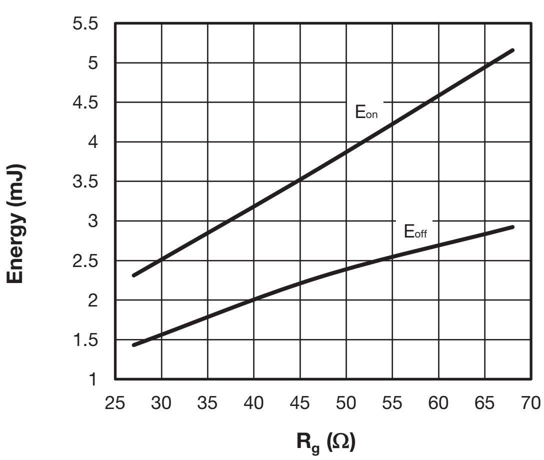


Fig. 13 - Typical IGBT Energy Loss vs. R_g
T_J = 125 °C, V_{CC} = 300 V, I_C = 80 A, V_{GE} = 15 V, L = 500 µH

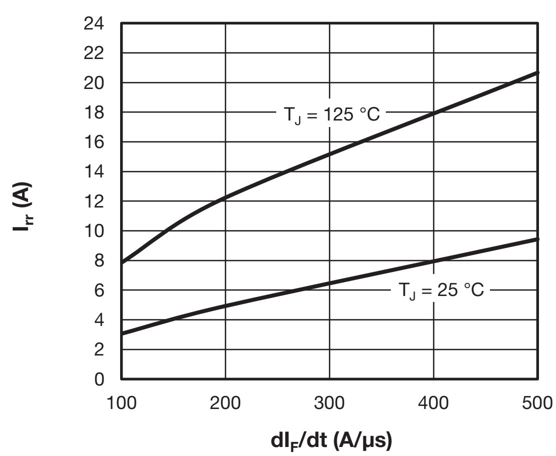


Fig. 16 - Typical I_{rr} Diode vs. dI_F/dt
V_{rr} = 200 V, I_F = 50 A

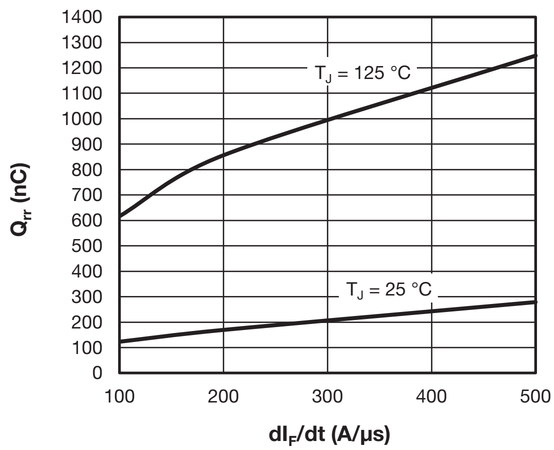


Fig. 17 - Typical Diode Reverse Recovery Charge vs. dI_F/dt
V_{rr} = 200 V, I_F = 50 A

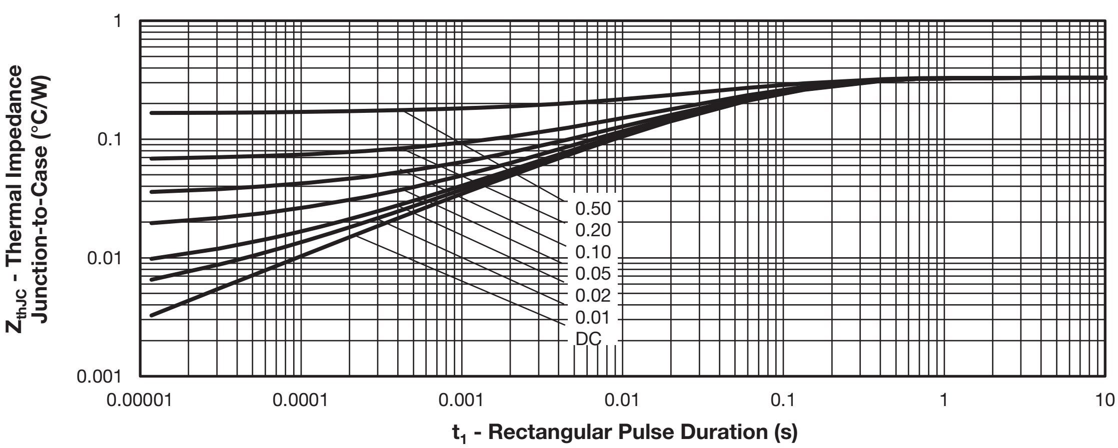


Fig. 18 - Maximum Thermal Impedance Z_{thJC} Characteristics, IGBT

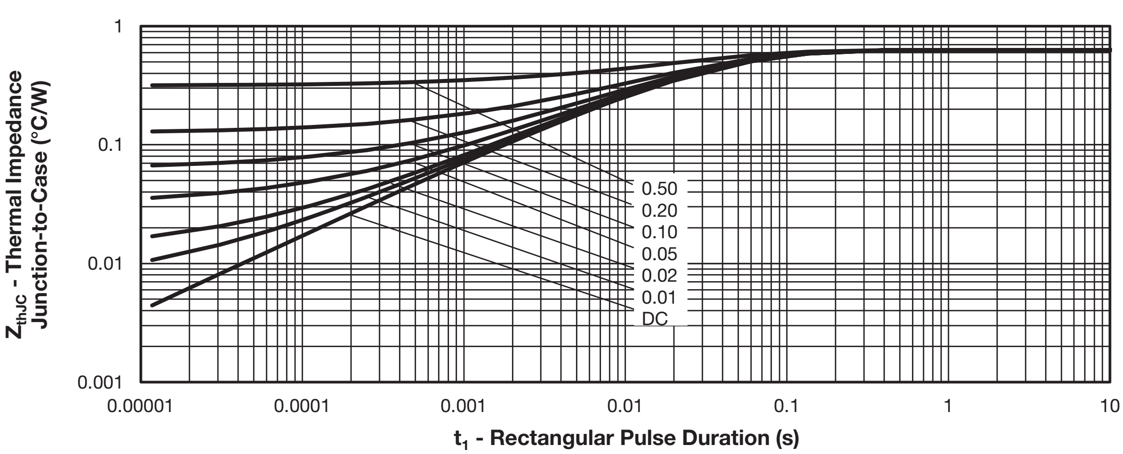
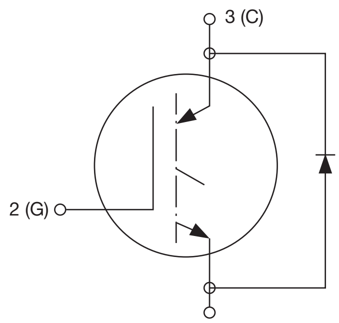
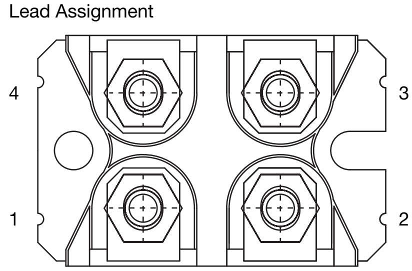


Fig. 19 - Maximum Thermal Impedance Z_{thJC} Characteristics, Diode

ORDERING INFORMATION TABLE

Device code	VS-	G	T	80	D	A	60	U
	1	2	3	4	5	6	7	8

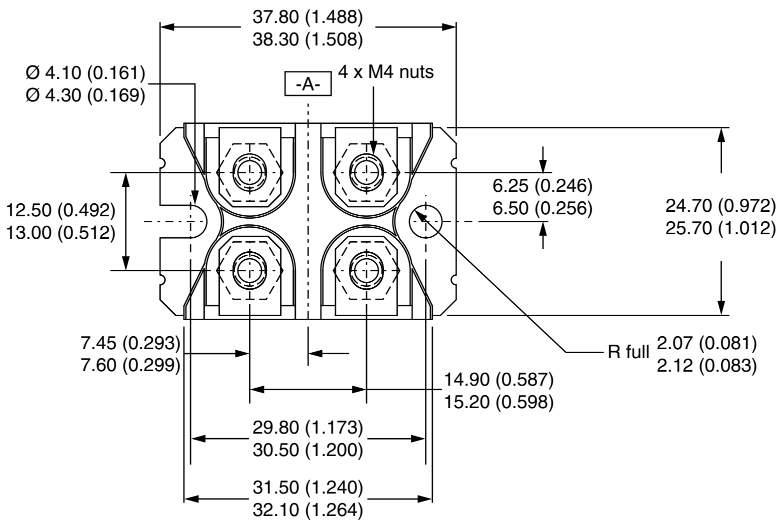
1 - Vishay Semiconductors product
2 - Insulated gate bipolar transistor (IGBT)
3 - T = trench IGBT
4 - Current rating (80 = 80 A)
5 - Circuit configuration (D = single switch with antiparallel diode)
6 - Package indicator (A = SOT-227)
7 - Voltage rating (60 = 600 V)
8 - Speed / type (U = ultrafast IGBT)

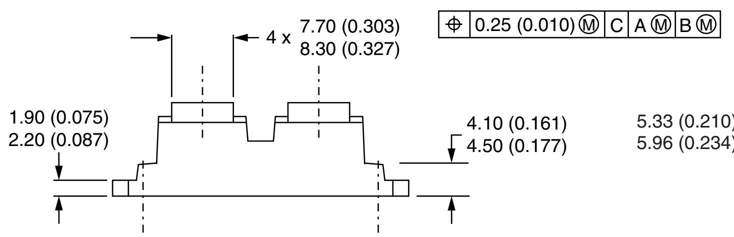
CIRCUIT CONFIGURATION		
CIRCUIT	CIRCUIT CONFIGURATION CODE	CIRCUIT DRAWING
Single switch with AP diode	D	 Lead Assignment 

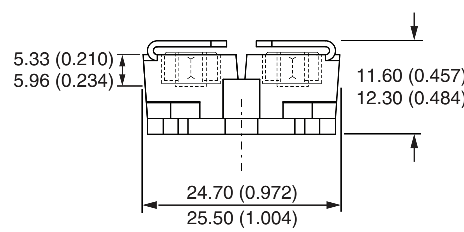
LINKS TO RELATED DOCUMENTS	
Dimensions	www.vishay.com/doc?95423
Packaging information	www.vishay.com/doc?95425

SOT-227 Generation 2

DIMENSIONS in millimeters (inches)







Note

- Controlling dimension: millimeter

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