

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


**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 ($T_J = 25\text{ }^\circ\text{C}$ unless otherwise specified)						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Collector to emitter breakdown voltage	$V_{BR(CES)}$	$V_{GE} = 0\text{ V}, I_C = 2.0\text{ mA}$	600	-	-	V
Collector to emitter voltage	$V_{CE(on)}$	$V_{GE} = 15\text{ V}, I_C = 80\text{ A}$	-	1.83	2.45	
		$V_{GE} = 15\text{ V}, I_C = 80\text{ A}, T_J = 125\text{ }^\circ\text{C}$	-	2.12	-	
		$V_{GE} = 15\text{ V}, I_C = 80\text{ A}, T_J = 150\text{ }^\circ\text{C}$	-	2.2	-	
Gate threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}, I_C = 1.0\text{ mA}$	4.6	5.6	7.5	
Temperature coefficient of threshold voltage	$\Delta V_{GE(th)}/\Delta T_J$	$V_{CE} = V_{GE}, I_C = 1.0\text{ mA}$ (25 °C to 150 °C)	-	-18.8	-	mV/°C
Collector to emitter leakage current	I_{CES}	$V_{GE} = 0\text{ V}, V_{CE} = 600\text{ V}$	-	0.2	100	µA
		$V_{GE} = 0\text{ V}, V_{CE} = 600\text{ V}, T_J = 125\text{ }^\circ\text{C}$	-	51	-	
		$V_{GE} = 0\text{ V}, V_{CE} = 600\text{ V}, T_J = 150\text{ }^\circ\text{C}$	-	259	-	
Forward voltage drop, diode	V_{FM}	$I_F = 80\text{ A}, V_{GE} = 0\text{ V}$	-	1.92	3.15	V
		$I_F = 80\text{ A}, V_{GE} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$	-	1.61	-	
		$I_F = 80\text{ A}, V_{GE} = 0\text{ V}, T_J = 150\text{ }^\circ\text{C}$	-	1.54	-	
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		
Input capacitance	C_{iss}	$V_{GE} = 0\text{ V}, V_{CE} = 25\text{ V}, f = 1.0\text{ MHz}$	-	10 800	-	pF		
Output capacitance	C_{oss}		-	390	-			
Reverse transfer capacitance	C_{rss}		-	220	-			
Total gate charge (turn-on)	Q_g	$I_C = 80\text{ A}, V_{CC} = 480\text{ V}, V_{GE} = 15\text{ V}$	-	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}	$I_C = 80\text{ A}, V_{CC} = 300\text{ V}, V_{GE} = 15\text{ V}, R_g = 27\text{ }\Omega, L = 500\text{ }\mu\text{H}, T_J = 25\text{ }^\circ\text{C}$	-	1.95	-	mJ		
Turn-off switching loss	E_{off}		-	1.25	-			
Total switching loss	E_{tot}		-	3.2	-			
Turn-on delay time	$t_{d(on)}$		Energy losses include tail and diode recovery.	-	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}	$I_C = 80\text{ A}, V_{CC} = 300\text{ V}, V_{GE} = 15\text{ V}, R_g = 27\text{ }\Omega, L = 500\text{ }\mu\text{H}, T_J = 125\text{ }^\circ\text{C}$	-	2.3	-	mJ		
Turn-off switching loss	E_{off}		-	1.43	-			
Total switching loss	E_{tot}		-	3.73	-			
Turn-on delay time	$t_{d(on)}$		Energy losses include tail and diode recovery.	-	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}	$I_F = 50\text{ A}, dI_F/dt = 200\text{ A}/\mu\text{s}, V_R = 200\text{ V}$	-	69	-	ns		
Diode peak reverse current	I_{rr}		-	4.9	-	A		
Diode recovery charge	Q_{rr}		-	169	-	nC		
Diode reverse recovery time	t_{rr}	$I_F = 50\text{ A}, dI_F/dt = 200\text{ A}/\mu\text{s}, V_R = 200\text{ V}, T_J = 125\text{ }^\circ\text{C}$	-	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 Diode	R_{thJC}	-	-	0.33	°C/W
			-	-	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					

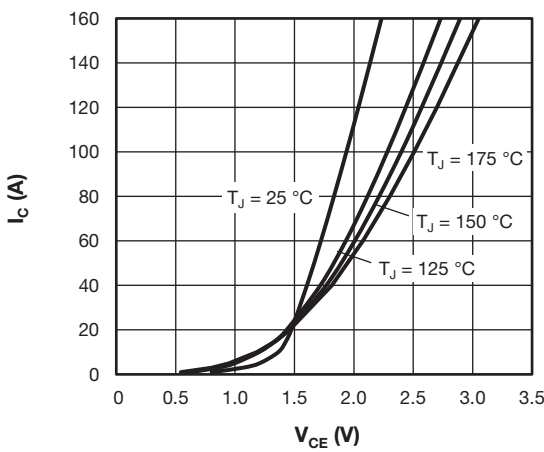


Fig. 1 - Typical IGBT Output Characteristics, $V_{GE} = 15V$

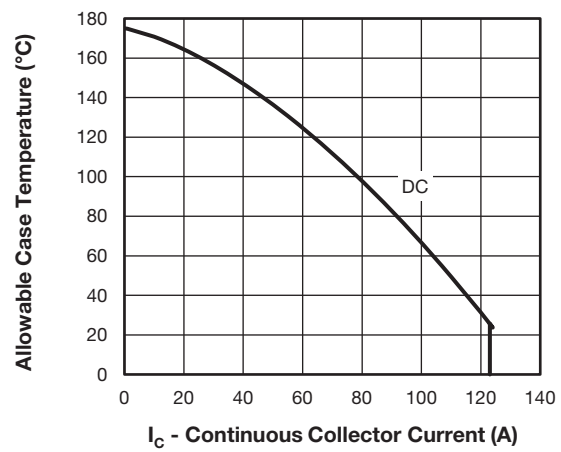


Fig. 3 - Maximum IGBT Continuous Collector Current vs. Case Temperature

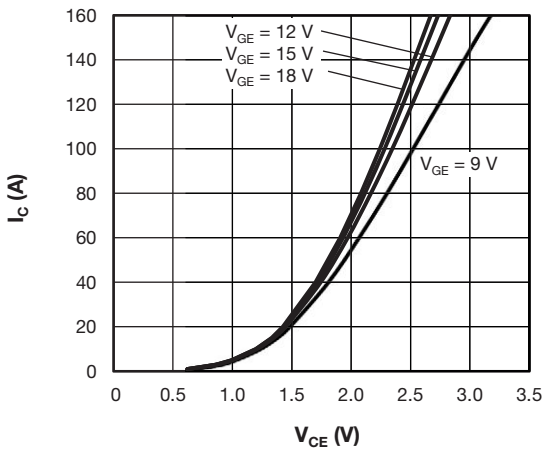


Fig. 2 - Typical IGBT Output Characteristics, $T_J = 125^\circ C$

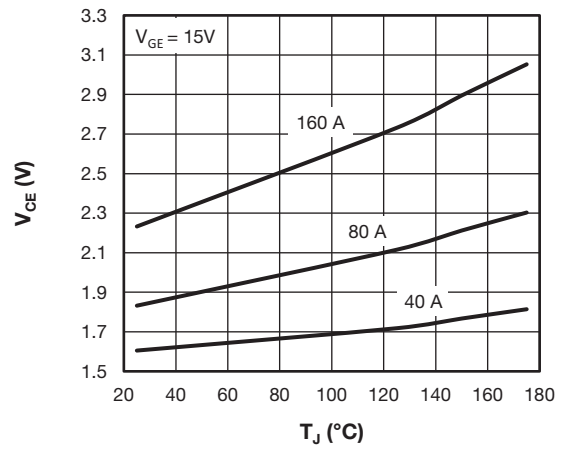


Fig. 4 - Collector to Emitter Voltage vs. Junction Temperature

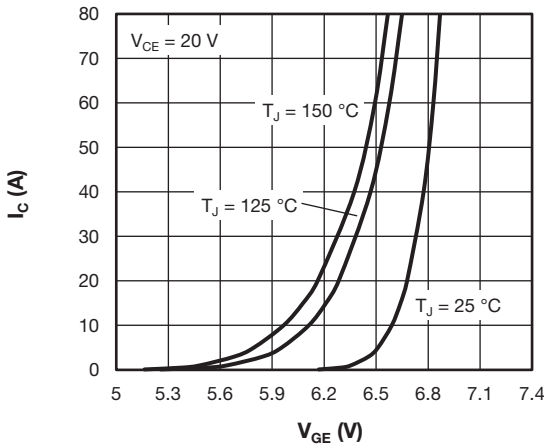


Fig. 5 - Typical IGBT Transfer Characteristics

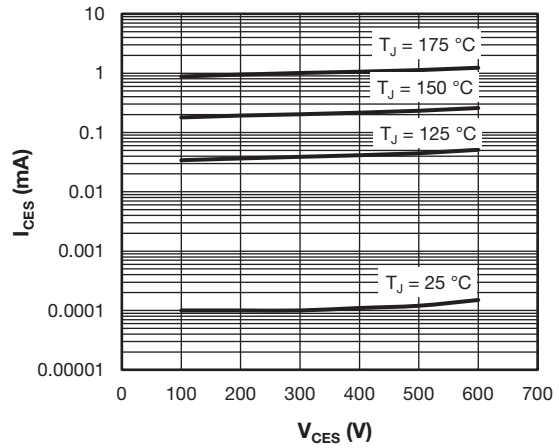


Fig. 8 - Typical IGBT Zero Gate Voltage Collector Current

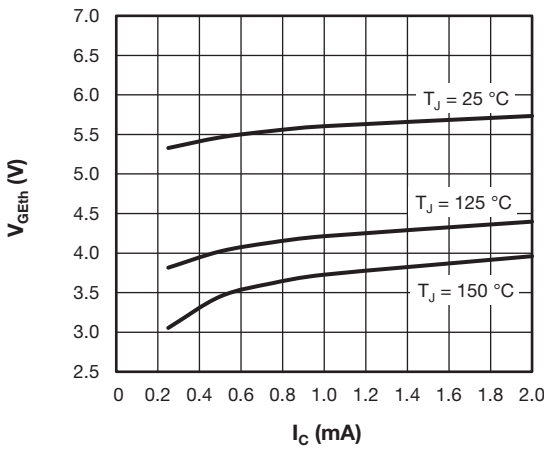


Fig. 6 - Typical IGBT Gate Threshold Voltage

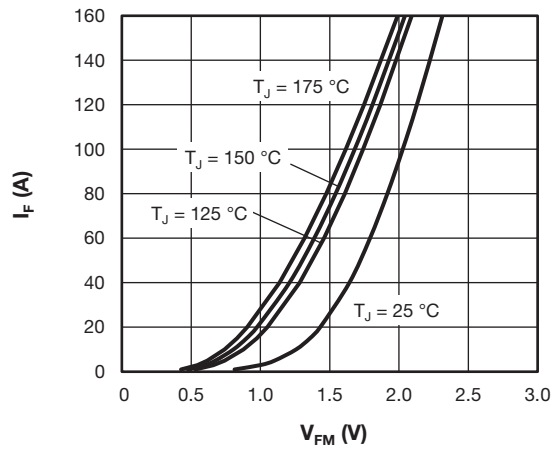


Fig. 9 - Typical Diode Forward Characteristics

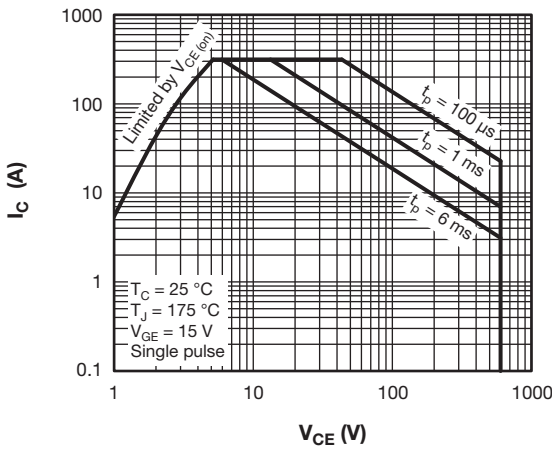


Fig. 7 - IGBT Safe Operating Area

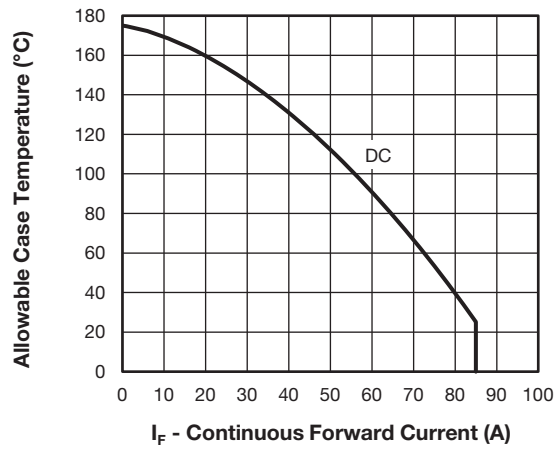


Fig. 10 - Maximum Diode Continuous Forward Current vs. Case Temperature

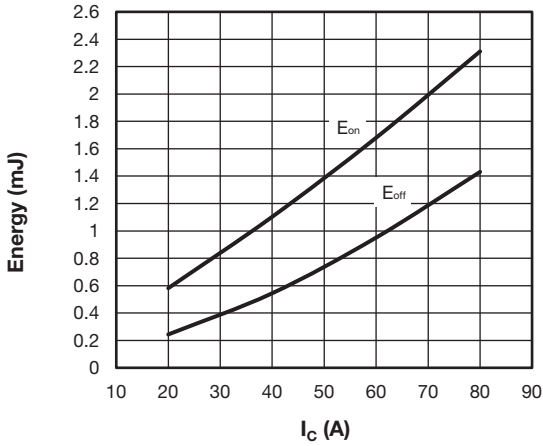


Fig. 11 - Typical IGBT Energy Loss vs. I_C
 $T_J = 125\text{ }^\circ\text{C}$, $V_{CC} = 300\text{ V}$, $R_g = 27\text{ }\Omega$, $V_{GE} = 15\text{ V}$, $L = 500\text{ }\mu\text{H}$

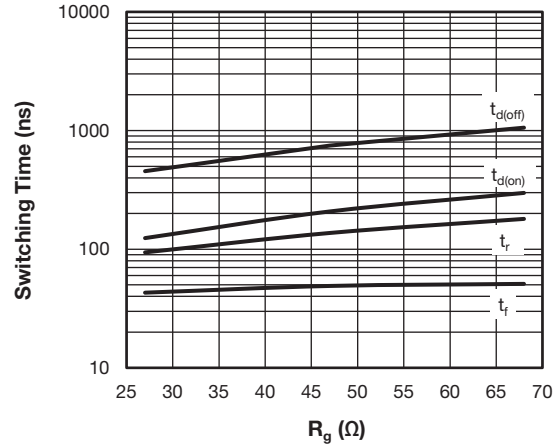


Fig. 14 - Typical IGBT Switching Time vs. R_g
 $T_J = 125\text{ }^\circ\text{C}$, $V_{CC} = 300\text{ V}$, $I_C = 80\text{ A}$, $V_{GE} = 15\text{ V}$, $L = 500\text{ }\mu\text{H}$

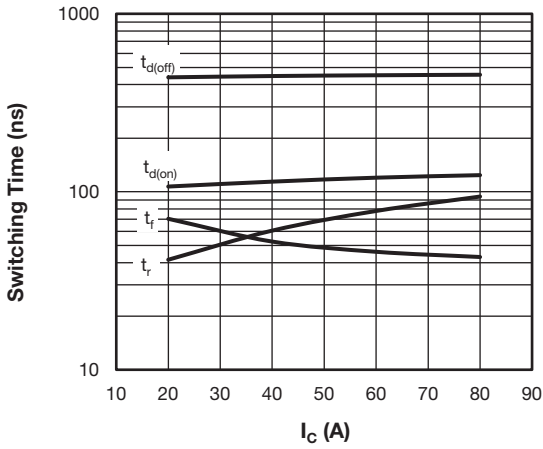


Fig. 12 - Typical IGBT Switching Time vs. I_C
 $T_J = 125\text{ }^\circ\text{C}$, $V_{CC} = 300\text{ V}$, $R_g = 27\text{ }\Omega$, $V_{GE} = 15\text{ V}$, $L = 500\text{ }\mu\text{H}$

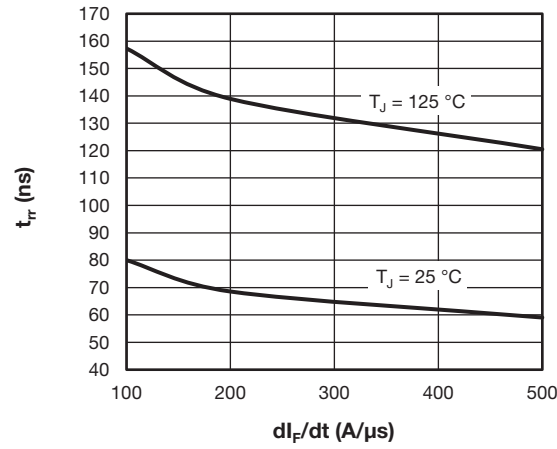


Fig. 15 - Typical t_{rr} Diode vs. di_F/dt
 $V_{rr} = 200\text{ V}$, $I_F = 50\text{ A}$

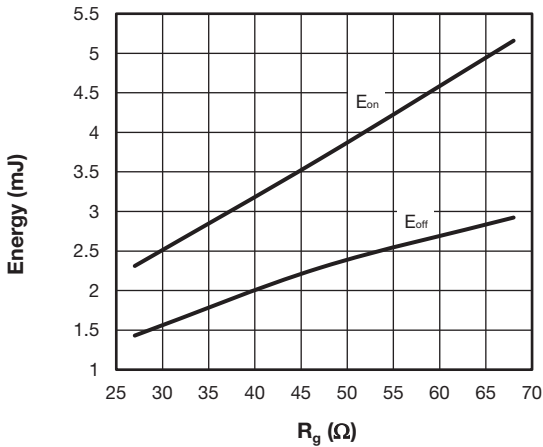


Fig. 13 - Typical IGBT Energy Loss vs. R_g
 $T_J = 125\text{ }^\circ\text{C}$, $V_{CC} = 300\text{ V}$, $I_C = 80\text{ A}$, $V_{GE} = 15\text{ V}$, $L = 500\text{ }\mu\text{H}$

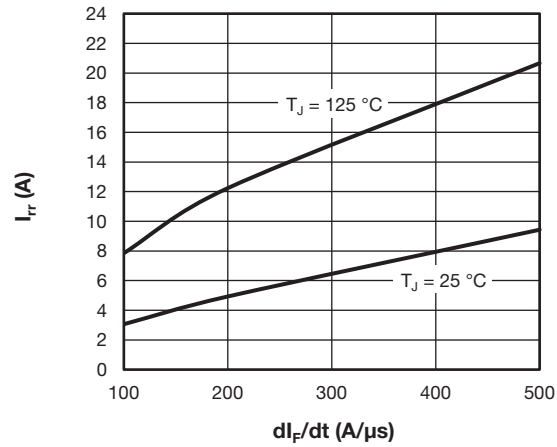


Fig. 16 - Typical I_{rr} Diode vs. di_F/dt
 $V_{rr} = 200\text{ V}$, $I_F = 50\text{ A}$

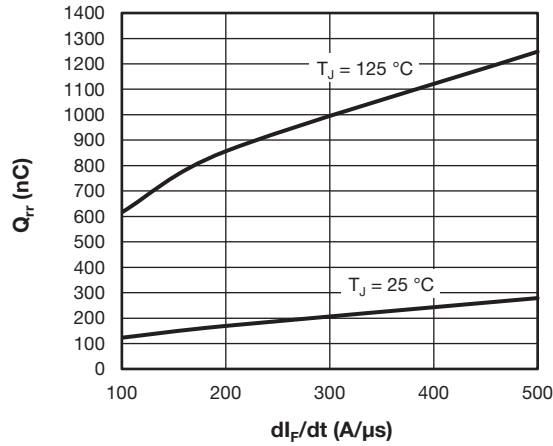


Fig. 17 - Typical Diode Reverse Recovery Charge vs. di_F/dt
 $V_{rr} = 200\text{ V}$, $I_F = 50\text{ A}$

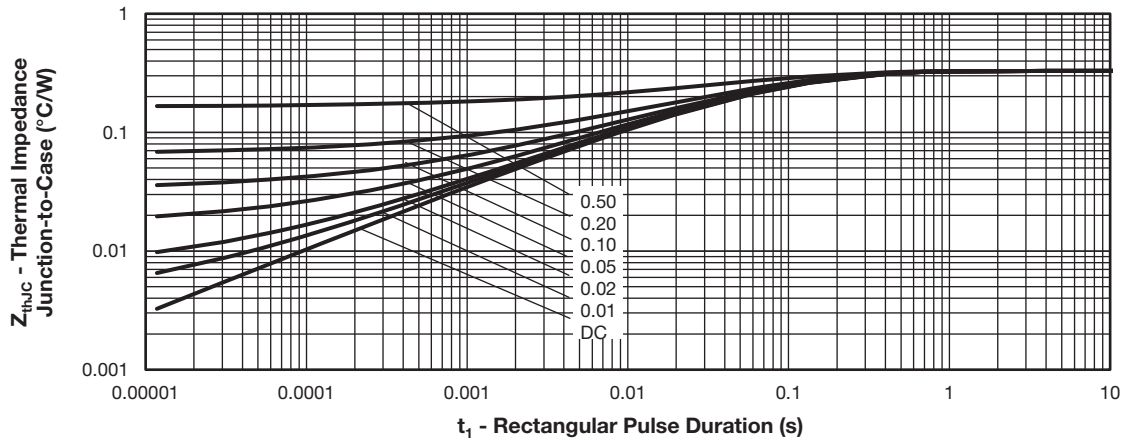


Fig. 18 - Maximum Thermal Impedance Z_{thJC} Characteristics, IGBT

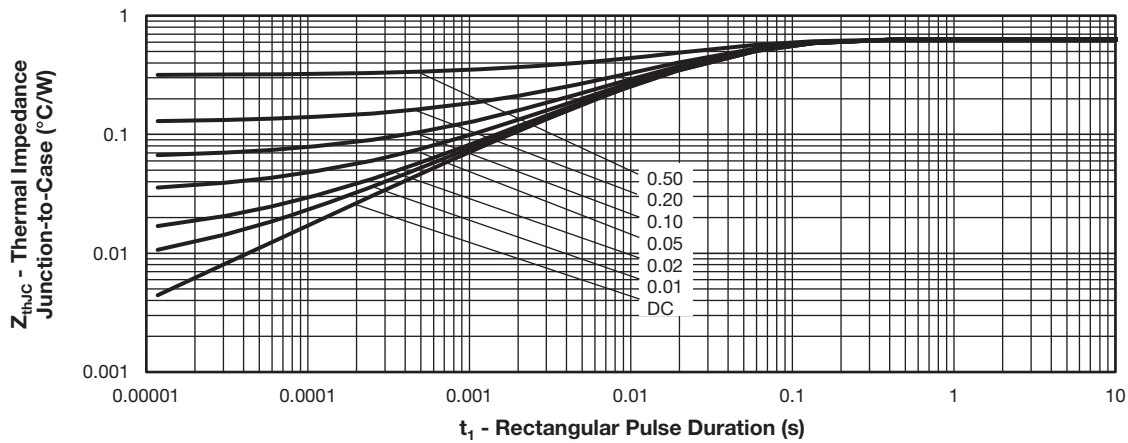


Fig. 19 - Maximum Thermal Impedance Z_{thJC} Characteristics, Diode

ORDERING INFORMATION TABLE

Device code	VS-	G	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	<div style="display: inline-block; vertical-align: middle; margin-left: 20px;"> <p>Lead Assignment</p> </div>

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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