Insulated Gate Bipolar Transistor (Trench IGBT), 180 A

SOT-227

FEATURES

- 1200 V trench and field stop technology
- Low switching losses
- Positive temperature coefficient
- Easy paralleling
- Square RBSOA
- 10 μs short circuit capability
- HEXFRED® antiparallel diodes with ultrasoft reverse recovery
- T_J maximum = 150 °C
- 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}	1200 V
$I_{C(DC)}$	185 A at 90 °C
$V_{CE(on)}$ typical at 100 A, 25 °C	1.55 V
$I_{F(DC)}$	32 A at 90 °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 parallel
- Direct mounting to heatsink
- Plug-in compatible with other SOT-227 packages
- Very low $V_{CE(on)}$
- Low EMI, requires less snubbing

ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	TEST CONDITIONS	MAX.	UNITS
Collector to emitter voltage	V_{CES}		1200	V
Continuous collector current	I_C	T_C = 25 °C	281	A
		T_C = 90 °C	185	
Pulsed collector current	I_{CM}		390	
Clamped inductive load current	I_{LM}		450	
Gate to emitter voltage	V_{GE}		± 20	V
Diode continuous forward current	I_F	T_C = 25 °C	51	A
		T_C = 90 °C	32	
Single pulse forward current	I_{FSM}	10 ms sine or 6 ms rectangular pulse, T_J = 25 °C	185	
Power dissipation, IGBT	P_D	T_C = 25 °C	1087	W
		T_C = 90 °C	522	
Power dissipation, diode	P_D	T_C = 25 °C	216	
		T_C = 90 °C	103	
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 = 5.7 mA	1200	-	-	V
Collector to emitter voltage	$V_{CE(on)}$	V_{GE} = 15 V, I_C = 100 A	-	1.55	2.05	
		V_{GE} = 15 V, I_C = 100 A, T_J = 125 °C	-	1.71	-	
		V_{GE} = 15 V, I_C = 100 A, T_J = 150 °C	-	1.76	-	
Gate threshold voltage	$V_{GE(th)}$	V_{CE} = V_{GE}, I_C = 5.7 mA	4.75	5.8	7.0	
		V_{CE} = V_{GE}, I_C = 5.7 mA, T_J = 125 °C	-	4.7	-	
Temperature coefficient of threshold voltage	$\Delta V_{GE(th)}/\Delta T_J$	V_{CE} = V_{GE}, I_C = 5.7 mA (25 °C to 125 °C)	-	-11.4	-	mV/°C
Transfer characteristics	V_{GE}	V_{DS} = 20 V, I_D = 100 A	-	8.5	-	V
Collector to emitter leakage current	I_{CES}	V_{GE} = 0 V, V_{CE} = 1200 V	-	0.6	100	µA
		V_{GE} = 0 V, V_{CE} = 1200 V, T_J = 125 °C	-	0.4	-	mA
		V_{GE} = 0 V, V_{CE} = 1200 V, T_J = 150 °C	-	1.6	-	
Forward voltage drop, diode	V_{FM}	I_F = 40 A, V_{GE} = 0 V	-	3.0	3.5	V
		I_F = 40 A, V_{GE} = 0 V, T_J = 125 °C	-	3.2	-	
		I_F = 40 A, V_{GE} = 0 V, T_J = 150 °C	-	3.2	-	
Gate to emitter leakage current	I_{GES}	V_{GE} = ± 20 V	-	-	± 220	nA

SWITCHING CHARACTERISTICS (T_J = 25 °C unless otherwise specified)							
PARAMETER	**SYMBOL**	**TEST CONDITIONS**		**MIN.**	**TYP.**	**MAX.**	**UNITS**
Input capacitance	C_{ies}	V_{CE} = 25 V, V_{GE} = 0 V, f = 1 MHz, T_J = 25 °C		-	9350	-	pF
Reverse transfer capacitance	C_{res}			-	350	-	
Turn-on switching loss	E_{on}	I_C = 100 A, V_{CC} = 720 V, V_{GE} = 15 V, R_g = 1.0 Ω, L = 500 µH, T_J = 25 °C	Energy losses include tail and diode recovery	-	4.4	-	mJ
Turn-off switching loss	E_{off}			-	7.3	-	
Total switching loss	E_{tot}			-	11.7	-	
Turn-on delay time	$t_{d(on)}$			-	192	-	ns
Rise time	t_r			-	59	-	
Turn-off delay time	$t_{d(off)}$			-	334	-	
Fall time	t_f			-	137	-	
Turn-on switching loss	E_{on}	I_C = 100 A, V_{CC} = 720 V, V_{GE} = 15 V, R_g = 1.0 Ω, L = 500 µH, T_J = 125 °C		-	5.7	-	mJ
Turn-off switching loss	E_{off}			-	11.6	-	
Total switching loss	E_{tot}			-	17.3	-	
Turn-on delay time	$t_{d(on)}$			-	200	-	ns
Rise time	t_r			-	62	-	
Turn-off delay time	$t_{d(off)}$			-	485	-	
Fall time	t_f			-	138	-	
Reverse bias safe operating area	RBSOA	T_J = 150 °C, I_C = 450 A, R_g = 1.0 Ω, V_{GE} = 15 V to 0 V, V_{CC} = 600 V, V_P = 1200 V, L = 500 µH		Fullsquare			
Diode reverse recovery time	t_{rr}	I_F = 50 A, dI_F/dt = 200 A/µs, V_R = 400 V		-	163	-	ns
Diode peak reverse current	I_{rr}			-	10.4	-	A
Diode recovery charge	Q_{rr}			-	851	-	nC
Diode reverse recovery time	t_{rr}	I_F = 50 A, dI_F/dt = 200 A/µs, V_R = 400 V, T_J = 125 °C		-	225	-	ns
Diode peak reverse current	I_{rr}			-	14.9	-	A
Diode recovery charge	Q_{rr}			-	1698	-	nC
Short circuit safe operating area	SCSOA	T_J = 150 °C, V_{GE} = 15 V to 0 V, V_{CC} = 800 V, V_p = 1200 V		10			µs

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	IGBT	R_{thJC}		-	-	0.115	°C/W
	Diode			-	-	0.57	
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	-	-	1.3 (11.5)	Nm (lbf. in)
Case style		SOT-227					

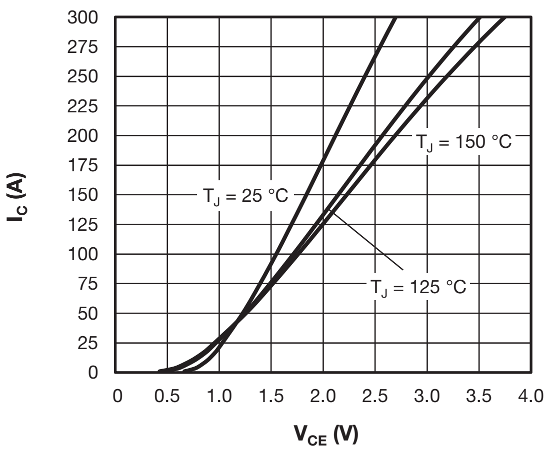


Fig. 1 - Typical IGBT Output Characteristics, V_{GE} = 15 V

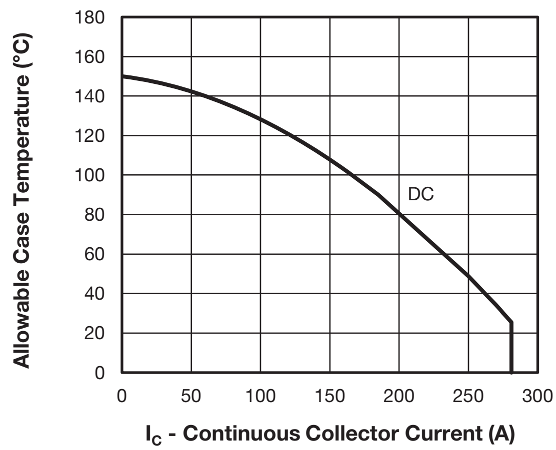


Fig. 3 - Maximum IGBT Continuous Collector Current vs. Case Temperature

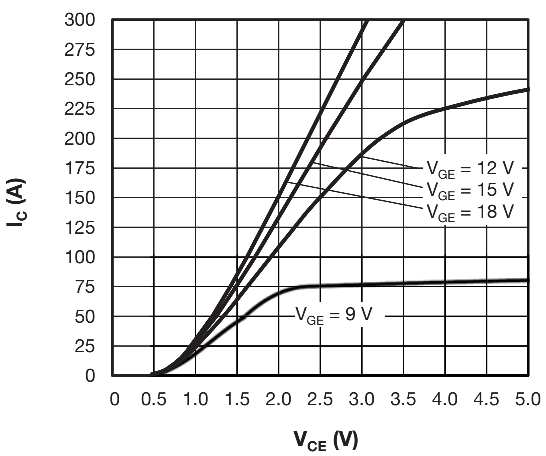


Fig. 2 - Typical IGBT Output Characteristics, T_J = 125 °C

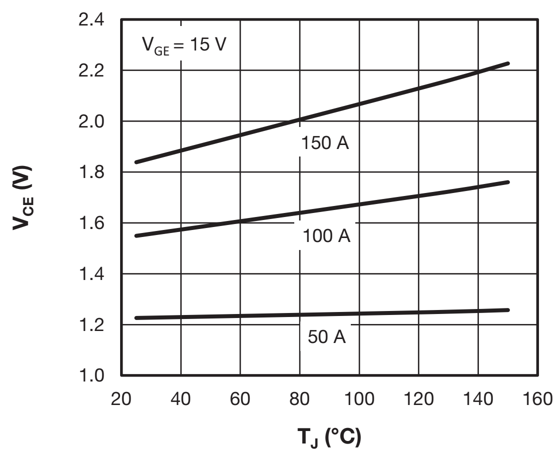


Fig. 4 - Collector to Emitter Voltage vs. Junction Temperature

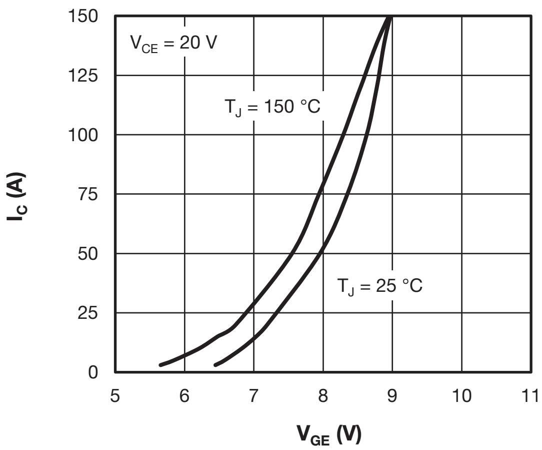


Fig. 5 - Typical IGBT Transfer Characteristics

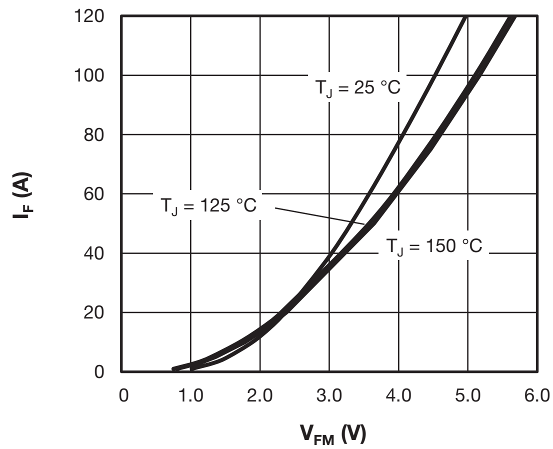


Fig. 8 - Typical Diode Forward Characteristics

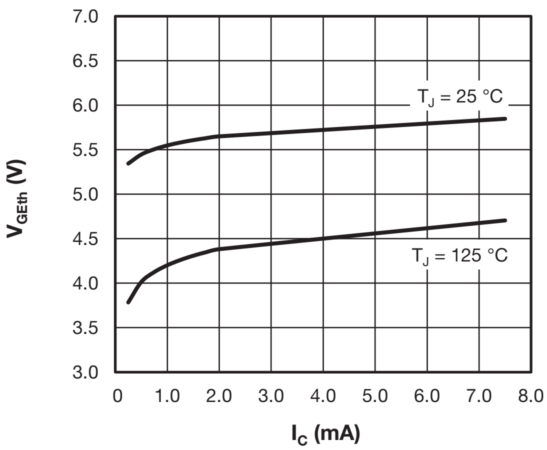


Fig. 6 - Typical IGBT Gate Threshold Voltage

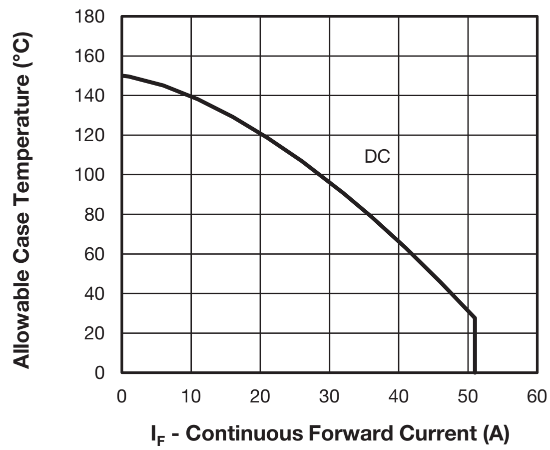


Fig. 9 - Maximum Diode Continuous Forward Current vs. Case Temperature

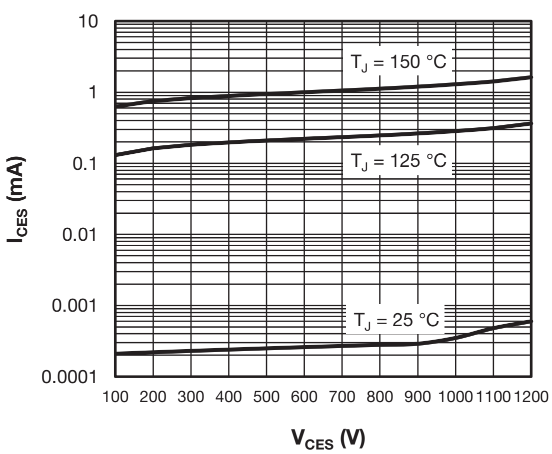


Fig. 7 - Typical IGBT Zero Gate Voltage Collector Current

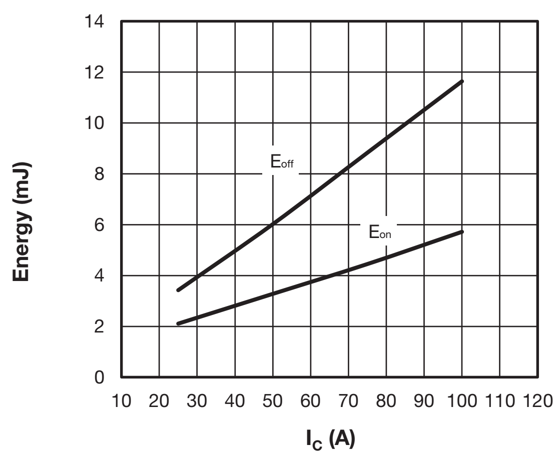


Fig. 10 - Typical IGBT Energy Loss vs. I_C
T_J = 125 °C, V_{CC} = 720 V, R_g = 1.0 Ω, V_{GE} = 15 V, L = 500 μH

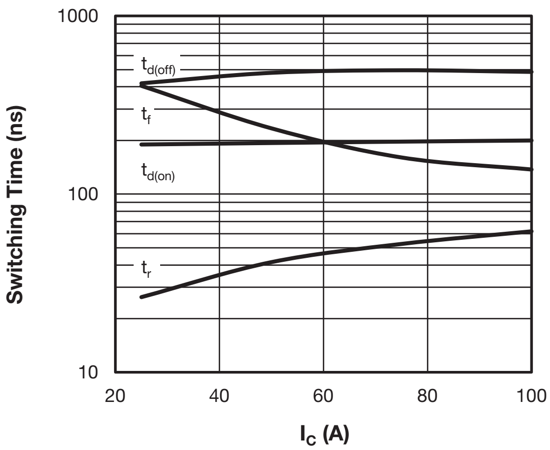


Fig. 11 - Typical IGBT Switching Time vs. I_C
T_J = 125 °C, V_{CC} = 720 V, R_g = 1.0 Ω,, V_{GE} = 15 V, L = 500 µH

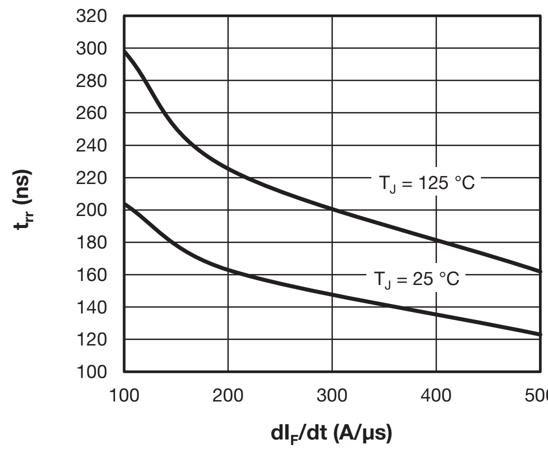


Fig. 14 - Typical Diode Reverse Recovery Time vs. dI_F/dt
V_{rr} = 400 V, I_F = 50 A

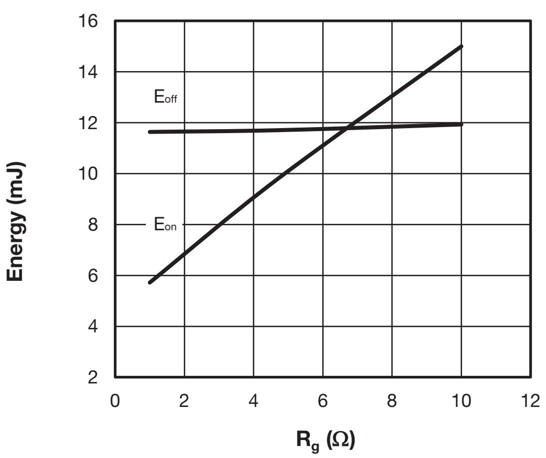


Fig. 12 - Typical IGBT Energy Loss vs. R_g
T_J = 125 °C, V_{CC} = 720 V, I_C = 100 A, V_{GE} = 15 V, L = 500 µH

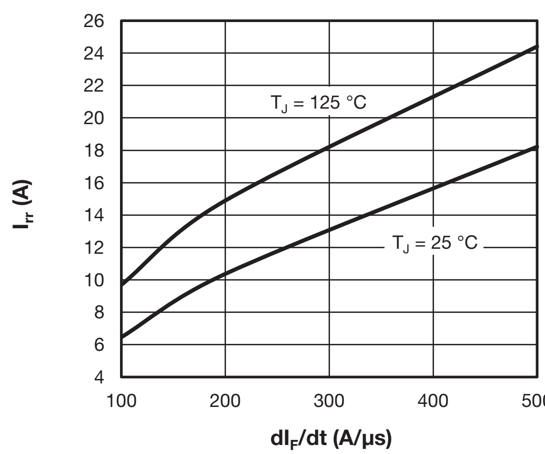


Fig. 15 - Typical Diode Reverse Recovery Current vs. dI_F/dt
V_{rr} = 400 V, I_F = 50 A

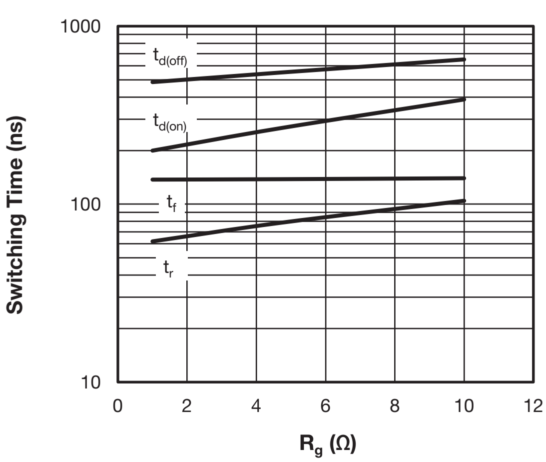


Fig. 13 - Typical IGBT Switching Time vs. R_g
T_J = 125 °C, V_{CC} = 720 V, I_C = 100 A, V_{GE} = 15 V, L = 500 µH

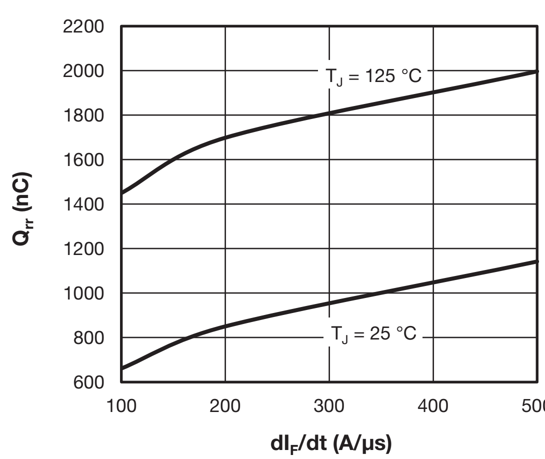


Fig. 16 - Typical Diode Reverse Recovery Charge vs. dI_F/dt
V_{rr} = 400 V, I_F = 50 A

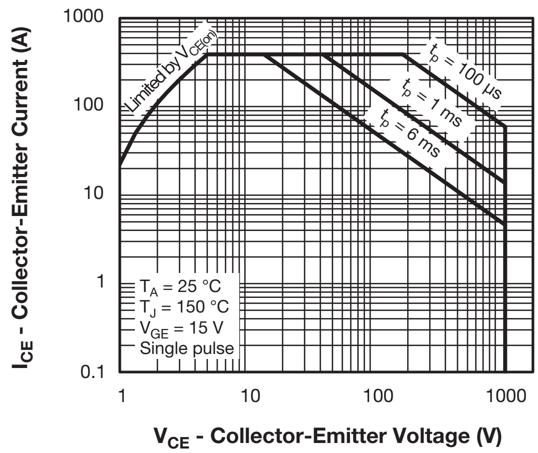


Fig. 17 - IGBT Safe Operating Area

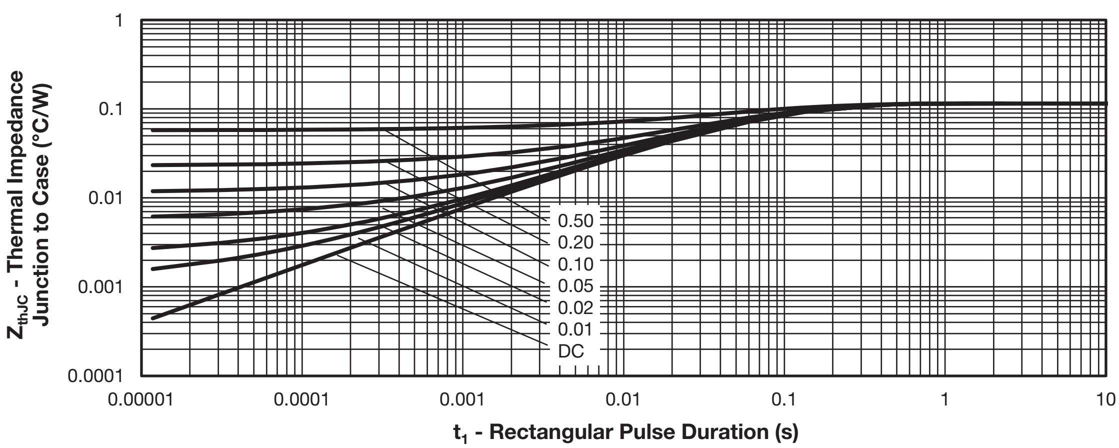


Fig. 18 - Maximum Thermal Impedance Z_{thJC} Characteristics - (IGBT)

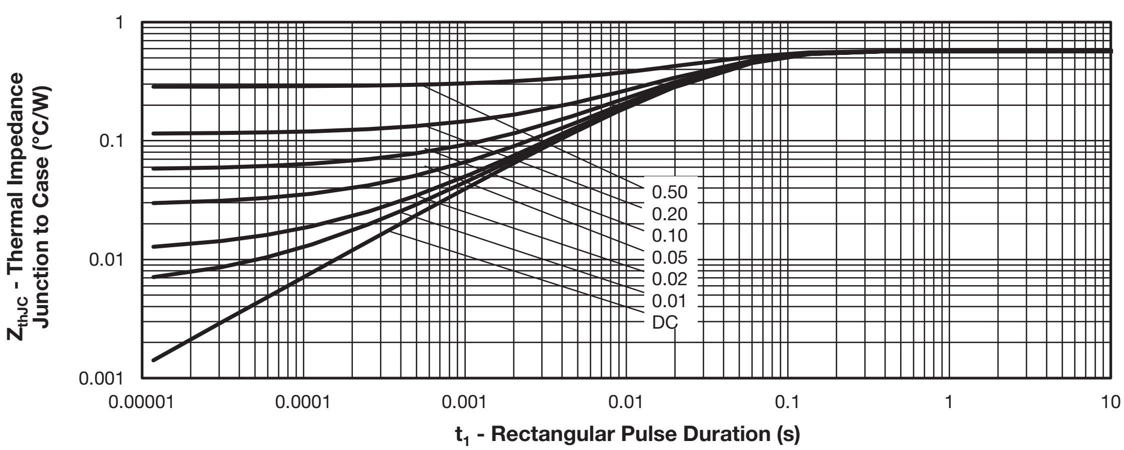


Fig. 19 - Maximum Thermal Impedance Z_{thJC} Characteristics - (Diode)

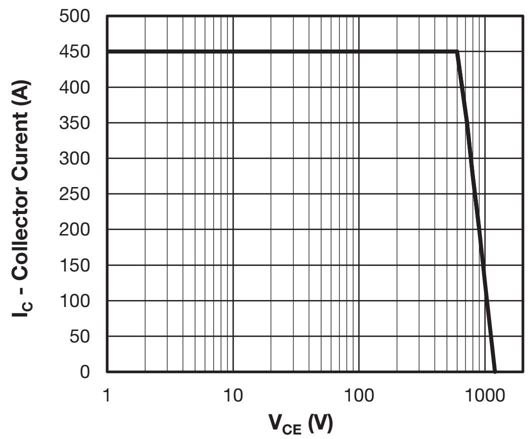


Fig. 20 - IGBT Reverse Bias SOA
V_{GE} = 15 V, T_J = 150 °C

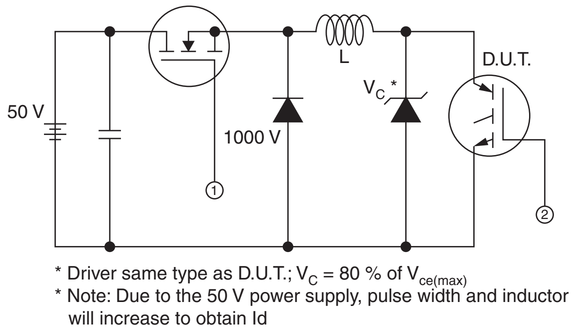


Fig. 21 - Clamped Inductive Load Test Circuit

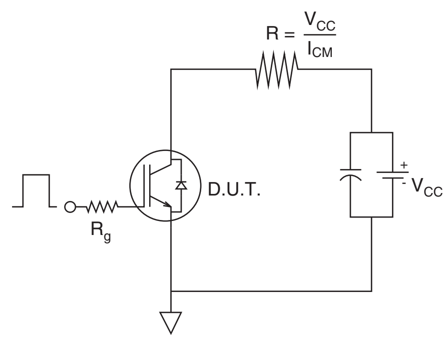


Fig. 22 - Pulsed Collector Current Test Circuit

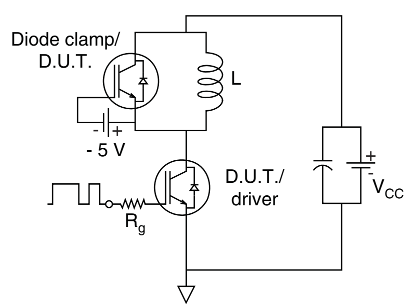
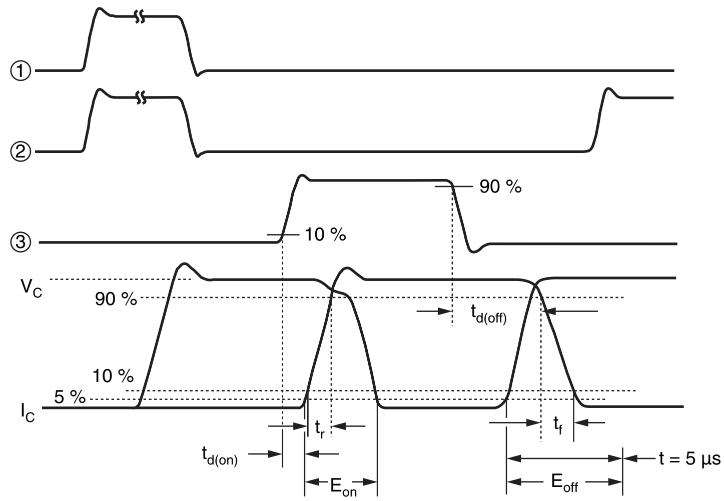


Fig. 23 - Switching Loss Test Circuit



$E_{ts} = (E_{on} + E_{off})$

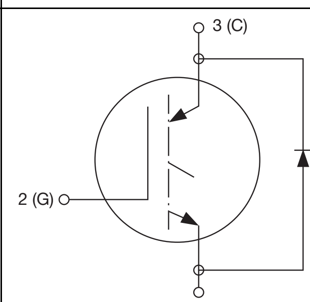
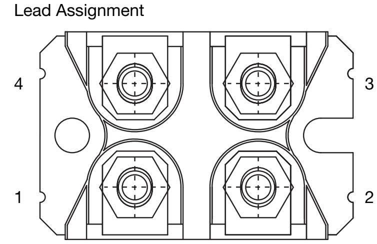
Fig. 24 - Switching Loss Waveforms Test Circuit

ORDERING INFORMATION TABLE

Device code	VS-	G	T	180	D	A	120	U
	1	2	3	4	5	6	7	8

1	-	Vishay Semiconductors product
2	-	Insulated gate bipolar transistor (IGBT)
3	-	Trench IGBT technology
4	-	Current rating (180 = 180 A)
5	-	Circuit configuration (D = single switch with antiparallel diode)
6	-	Package indicator (A = SOT-227)
7	-	Voltage rating (120 = 1200 V)
8	-	Speed/type (U = ultrafast)

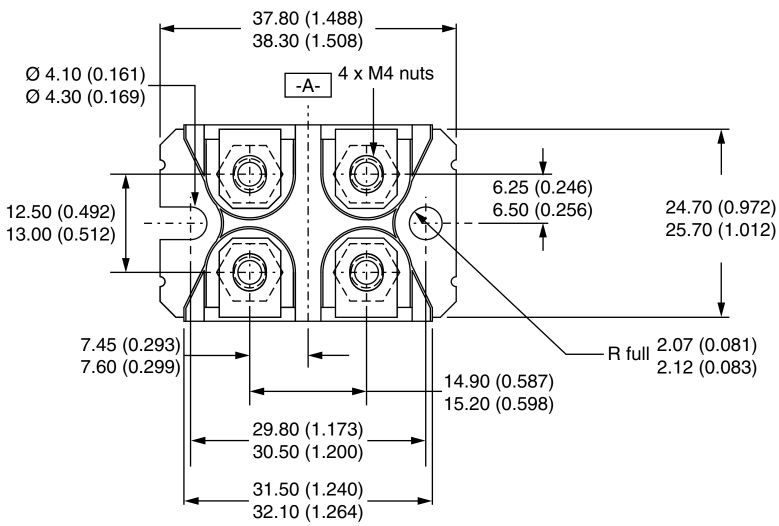
CIRCUIT CONFIGURATION

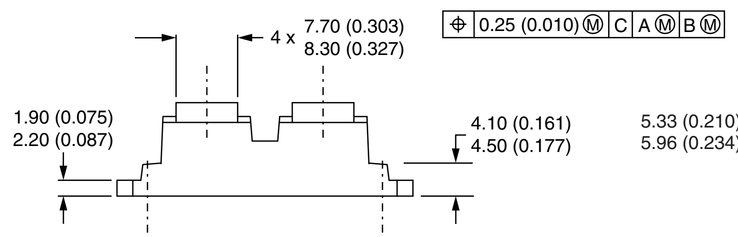
CIRCUIT	CIRCUIT CONFIGURATION CODE	CIRCUIT DRAWING
Single switch with AP diode	D	 

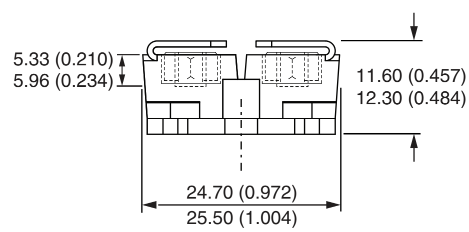
LINKS TO RELATED DOCUMENTS	
Dimensions	www.vishay.com/doc?95423
Packaging information	www.vishay.com/doc?95425

SOT-227 Generation 2

DIMENSIONS in millimeters (inches)







Note

- Controlling dimension: millimeter

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