Insulated Gate Bipolar Transistor (Ultrafast IGBT), 100 A

SOT-227

FEATURES

- Trench IGBT high speed
- Square RBSOA
- HEXFRED® low Q_{rr}, low switching energy
- Positive $V_{CE(on)}$ temperature coefficient
- 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

BENEFITS

- Designed for increased operating efficiency in power conversion: UPS, SMPS, welding, induction heating
- Easy to assemble and parallel
- Direct mounting on heatsink
- Plug-in compatible with other SOT-227 packages
- Low EMI, requires less snubbing

PRIMARY CHARACTERISTICS	
V_{CES}	1200 V
I_C DC	100 A at 108 °C
$V_{CE(on)}$ typical at 100 A, 25 °C	1.93 V
Speed	8 kHz to 30 kHz
Package	SOT-227
Circuit configuration	Single switch with AP diode

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	187	A
		T_C = 90 °C	123	
Pulsed collector current	I_{CM}		240	
Clamped inductive load current	I_{LM}		250	
Gate to emitter voltage	V_{GE}		± 20	V
Diode continuous forward current	I_F	T_C = 25 °C	97	A
		T_C = 90 °C	61	
Single pulse forward current	I_{FSM}	10 ms sine or 6 ms rectangular pulse, T_J = 25 °C	350	
Power dissipation, IGBT	P_D	T_C = 25 °C	890	W
		T_C = 90 °C	500	
Power dissipation, diode	P_D	T_C = 25 °C	429	
		T_C = 90 °C	194	
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 = 3.8 mA	1200	-	-	V
Collector to emitter voltage	$V_{CE(on)}$	V_{GE} = 15 V, I_C = 100 A	-	1.93	2.55	
		V_{GE} = 15 V, I_C = 100 A, T_J = 125 °C	-	2.26	-	
		V_{GE} = 15 V, I_C = 100 A, T_J = 150 °C	-	2.35	-	
Gate threshold voltage	$V_{GE(th)}$	V_{CE} = V_{GE}, I_C = 3.8 mA	4.5	5.8	7.0	
		V_{CE} = V_{GE}, I_C = 3.8 mA, T_J = 125 °C	-	4.6	-	
Temperature coefficient of threshold voltage	$V_{GE(th)}/\Delta T_J$	V_{CE} = V_{GE}, I_C = 3.8 mA (25 °C to 125 °C)	-	-12	-	mV/°C
Collector to emitter leakage current	I_{CES}	V_{GE} = 0 V, V_{CE} = 1200 V	-	1.0	100	μA
		V_{GE} = 0 V, V_{CE} = 1200 V, T_J = 125 °C	-	0.9	-	mA
		V_{GE} = 0 V, V_{CE} = 1200 V, T_J = 150 °C	-	3.4	-	
Forward voltage drop, diode	V_{FM}	V_{GE} = 0 V, I_F = 80 A	-	2.8	3.5	V
		V_{GE} = 0 V, I_F = 80 A, T_J = 125 °C	-	3.0	-	
		V_{GE} = 0 V, I_F = 80 A, T_J = 150 °C	-	3.0	-	
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**
Total gate charge (turn-on)	Q_g	V_{GE} = -15 V, V_{GE} = +15 V		-	800	-	nC
Input capacitance	C_{ies}	V_{CE} = 25 V, V_{GE} = 0 V*f* = 1 MHz		-	6150	-	pF
Reverse transfer capacitance	C_{res}			-	345	-	
Turn-on switching loss	E_{on}	I_C = 75 A, V_{CC} = 600 V, V_{GE} = 15 V, R_g = 1.0 Ω, L = 500 μH, T_J = 25 °C	Energy losses include tail and diode recovery Diode used HFA16PB120	-	2.2	-	mJ
Turn-off switching loss	E_{off}			-	3.0	-	
Total switching loss	E_{tot}			-	5.2	-	
Turn-on delay time	$t_{d(on)}$			-	131	-	ns
Rise time	t_r			-	55	-	
Turn-off delay time	$t_{d(off)}$			-	244	-	
Fall time	t_f			-	118	-	
Turn-on switching loss	E_{on}	I_C = 75 A, V_{CC} = 600 V, V_{GE} = 15 V, R_g = 1.0 Ω, L = 500 μH, T_J = 125 °C		-	2.9	-	mJ
Turn-off switching loss	E_{off}			-	5.3	-	
Total switching loss	E_{tot}			-	8.2	-	
Turn-on delay time	$t_{d(on)}$			-	147	-	ns
Rise time	t_r			-	61	-	
Turn-off delay time	$t_{d(off)}$			-	358	-	
Fall time	t_f			-	132	-	
Turn-on switching loss	E_{on}	I_C = 100 A, V_{CC} = 600 V, V_{GE} = 15 V, R_g = 1.0 Ω, L = 500 μH, T_J = 25 °C	Energy losses include tail and diode recovery Diode used HFA16PB120	-	3.0	-	mJ
Turn-off switching loss	E_{off}			-	4.0	-	
Total switching loss	E_{tot}			-	7.0	-	
Turn-on delay time	$t_{d(on)}$			-	134	-	ns
Rise time	t_r			-	66	-	
Turn-off delay time	$t_{d(off)}$			-	242	-	
Fall time	t_f			-	108	-	

SWITCHING CHARACTERISTICS (T_J = 25 °C unless otherwise specified)							
PARAMETER	**SYMBOL**	**TEST CONDITIONS**		**MIN.**	**TYP.**	**MAX.**	**UNITS**
Turn-on switching loss	E_{on}	I_C = 100 A, V_{CC} = 600 V, V_{GE} = 15 V, R_g = 1.0 Ω, L = 500 μH, T_J = 125 °C	Energy losses include tail and diode recovery Diode used HFA16PB120	-	3.9	-	mJ
Turn-off switching loss	E_{off}			-	7.1	-	
Total switching loss	E_{tot}			-	11.0	-	
Turn-on delay time	$t_{d(on)}$			-	154	-	ns
Rise time	t_r			-	72	-	
Turn-off delay time	$t_{d(off)}$			-	346	-	
Fall time	t_f			-	120	-	
Reverse bias safe operating area	RBSOA	T_J = 150 °C, I_C = 250 A, R_g = 1.0 Ω, V_{GE} = 15 V to 0 V, V_{CC} = 800 V, V_P = 1200 V, L = 500 μH		Fullsquare			
Short circuit safe operating area	SCSOA	V_{GE} = 15 V, V_{CC} = 800 V, V_{CE} max. = 1200 V, T_{VJ} = 150 °C		-	-	10	μs
Diode reverse recovery time	t_{rr}	I_F = 50 A, dI_F/dt = 200 A/μs, V_R = 400 V		-	183	-	ns
Diode peak reverse current	I_{rr}			-	12	-	A
Diode recovery charge	Q_{rr}			-	1093	-	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		-	278	-	ns
Diode peak reverse current	I_{rr}			-	18.2	-	A
Diode recovery charge	Q_{rr}			-	2541	-	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	IGBT	R_{thJC}		-	-	0.14	°C/W
	Diode			-	-	0.31	
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					

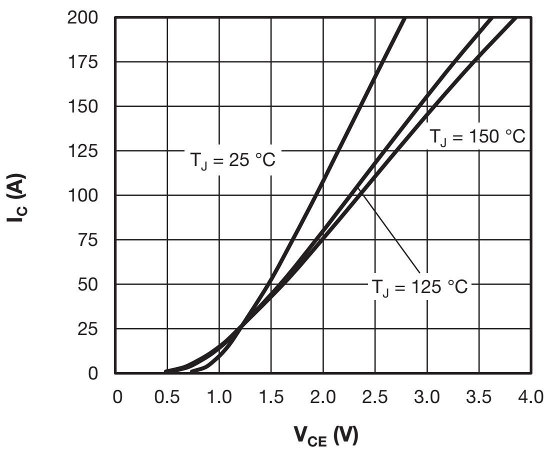


Fig. 1 - Typical IGBT Output Characteristics, V_{GE} = 15 V

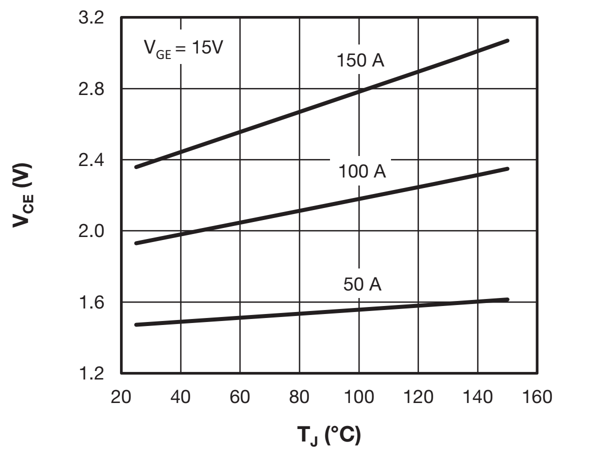


Fig. 4 - Collector to Emitter Voltage vs. Junction Temperature

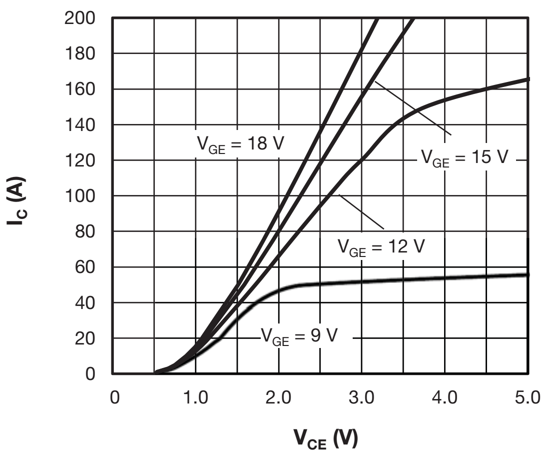


Fig. 2 - Typical IGBT Output Characteristics, T_J = 125 °C

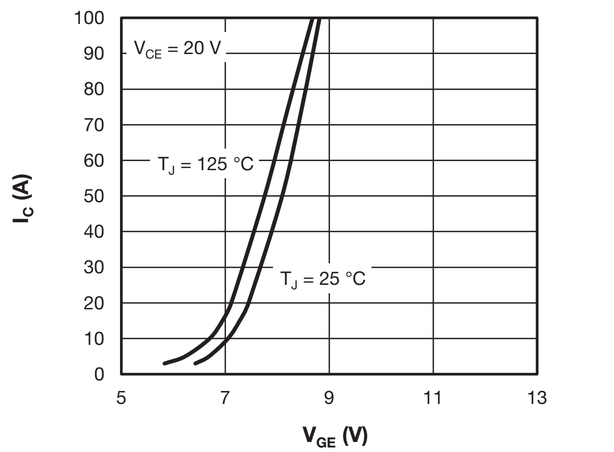


Fig. 5 - Typical IGBT Transfer Characteristics

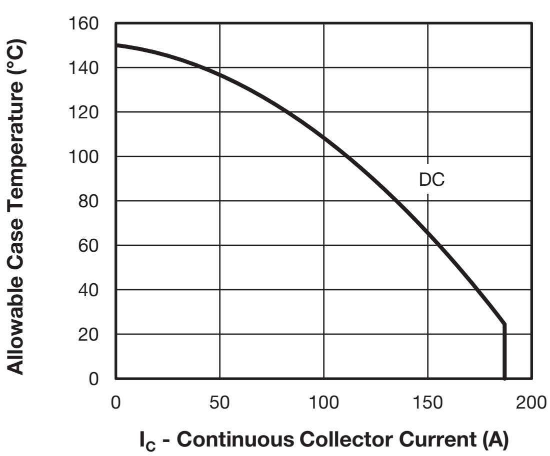


Fig. 3 - Maximum IGBT Continuous Collector Current vs. Case Temperature

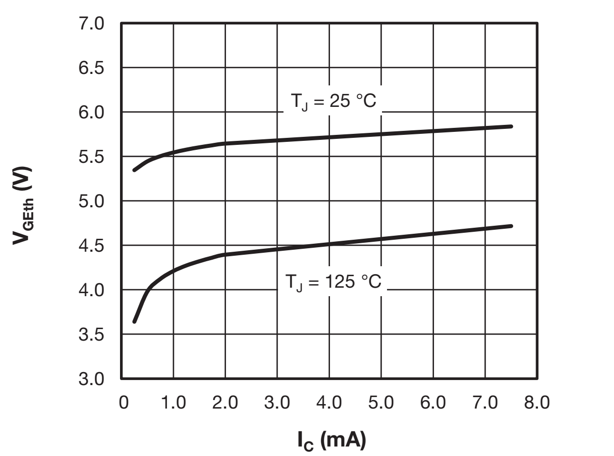


Fig. 6 - Typical IGBT Gate Threshold Voltage

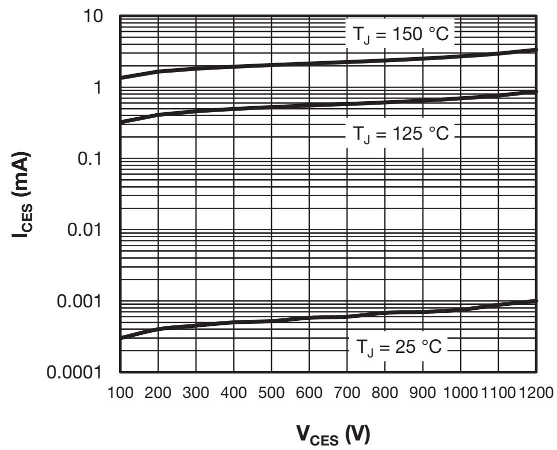


Fig. 7 - Typical IGBT Zero Gate Voltage Collector Current

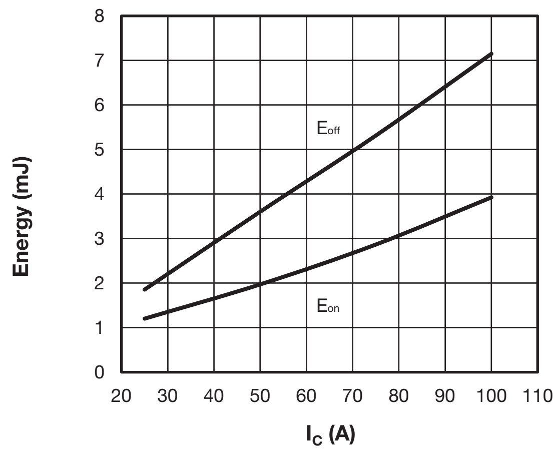


Fig. 10 - Typical IGBT Energy Loss vs. I_C
T_J = 125 °C, V_{CC} = 600 V, R_g = 1.0 Ω, V_{GE} = 15 V, L = 500 μH

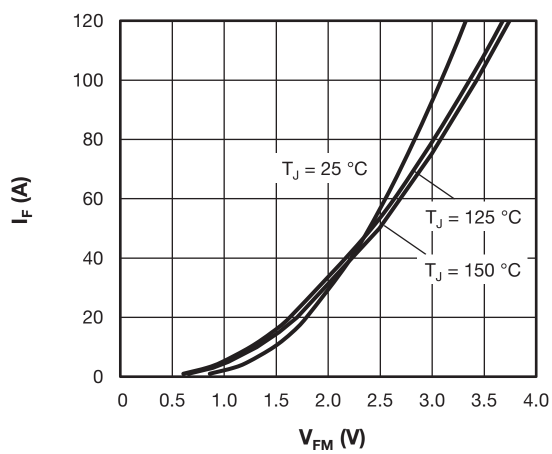


Fig. 8 - Typical Diode Forward Characteristics

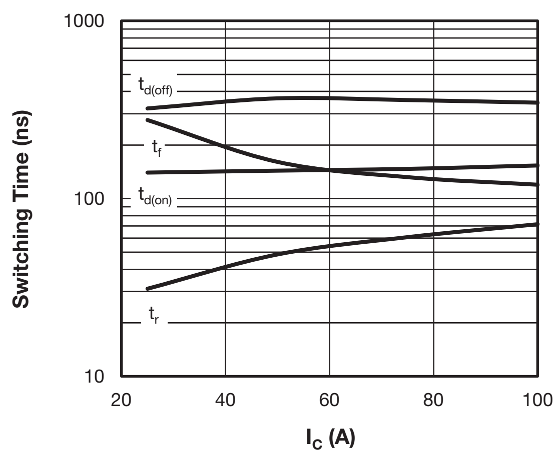


Fig. 11 - Typical IGBT Switching Time vs. I_C
T_J = 125 °C, V_{CC} = 600 V, R_g = 1.0 Ω, V_{GE} = 15 V, L = 500 μH

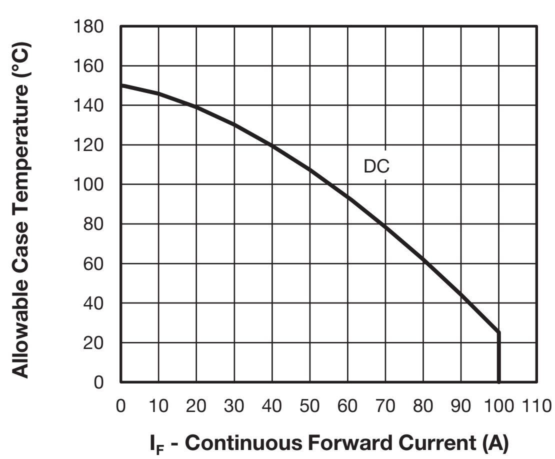


Fig. 9 - Maximum Diode Continuous Forward Current vs. Case Temperature

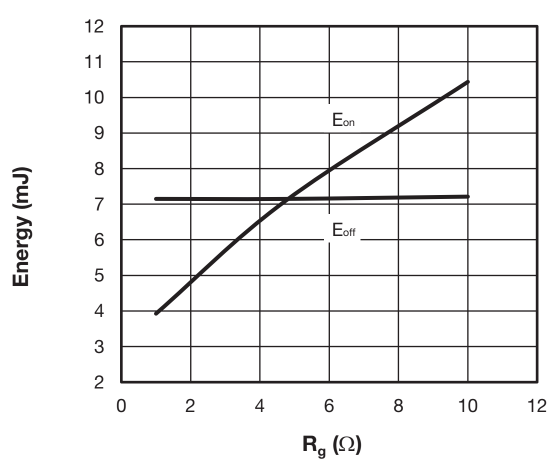


Fig. 12 - Typical IGBT Energy Loss vs. R_g
T_J = 125 °C, V_{CC} = 600 V, I_C = 100 A, V_{GE} = 15 V, L = 500 μH

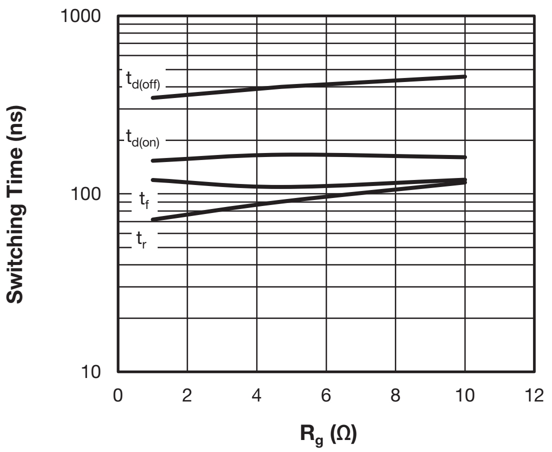


Fig. 13 - Typical IGBT Switching Time vs. R_g
T_J = 125 °C, V_{CC} = 600 V, I_C = 100 A, V_{GE} = 15 V, L = 500 μH

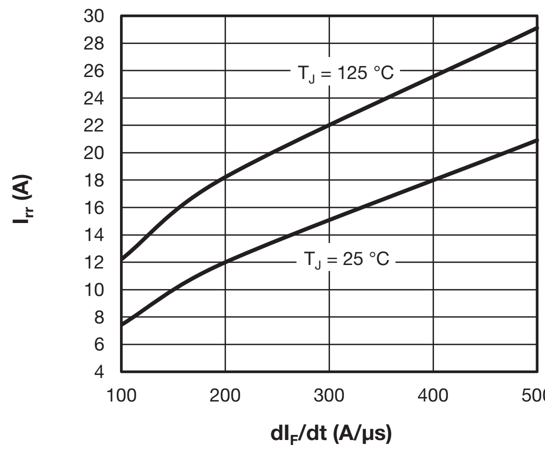


Fig. 15 - Typical Diode Reverse Recovery Current vs. dI_F/dt
V_{rr} = 400 V, I_F = 50 A

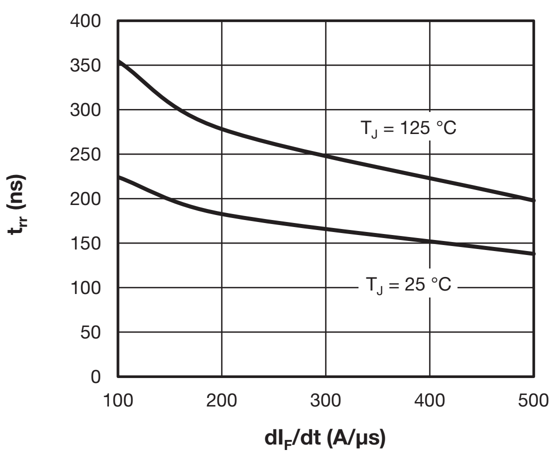


Fig. 14 - Typical Diode Reverse Recovery Time vs. dI_F/dt
V_{rr} = 400 V, I_F = 50 A

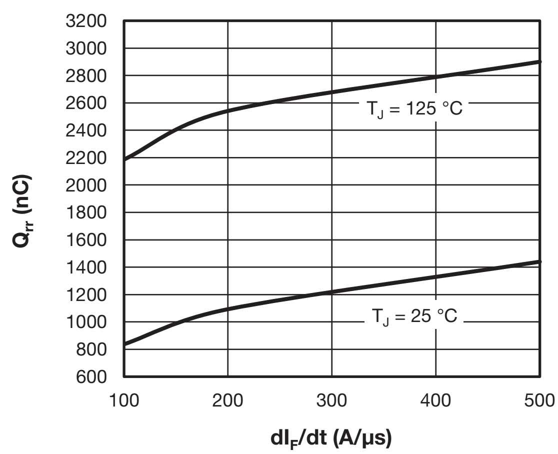


Fig. 16 - Typical Diode Reverse Recovery Charge vs. dI_F/dt
V_{rr} = 400 V, I_F = 50 A

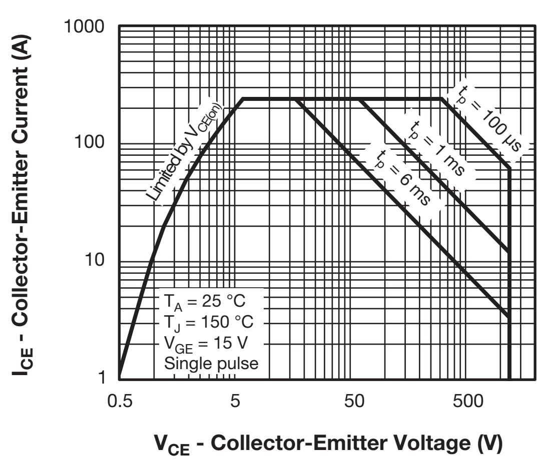


Fig. 17 - IGBT Safe Operating Area

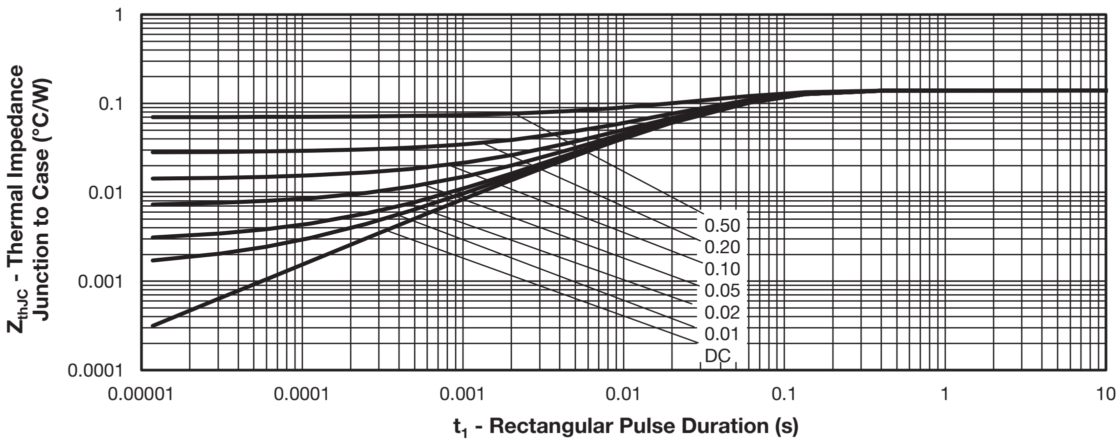


Fig. 18 - Maximum Thermal Impedance Z_{thJC} Characteristics - (IGBT)

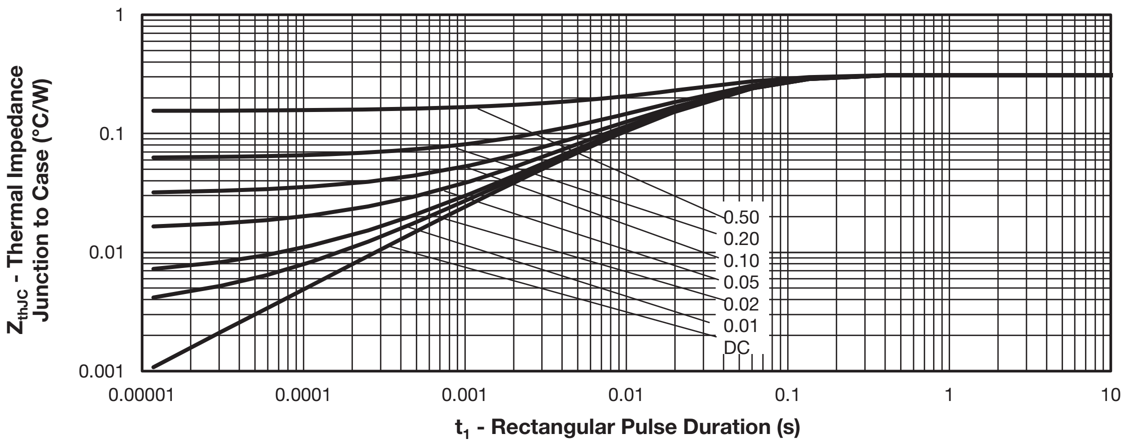


Fig. 19 - Maximum Thermal Impedance Z_{thJC} Characteristics - (Diode)

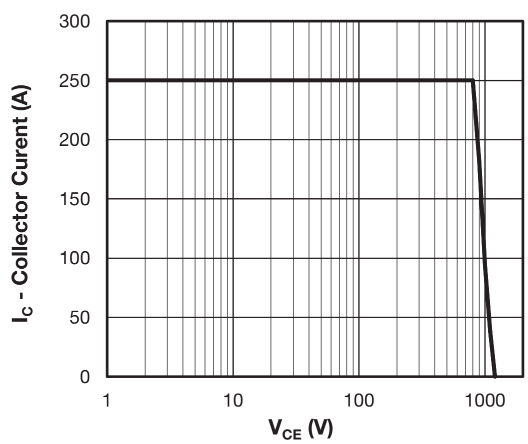


Fig. 20 - IGBT Reverse Bias SOA
V_{GE} = 15 V, T_J = 150°C

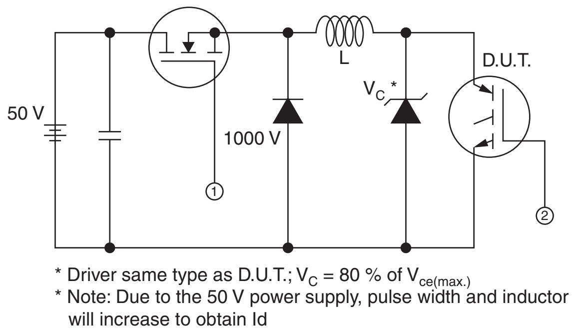


Fig. 21 - Clamped Inductive Load Test Circuit

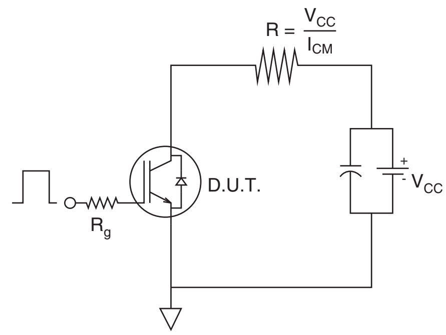


Fig. 22 - Pulsed Collector Current Test Circuit

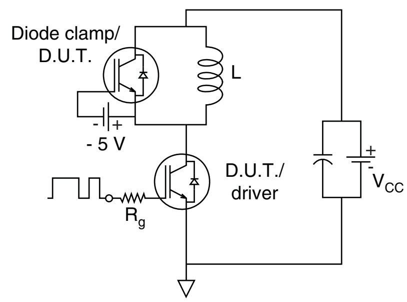


Fig. 23 - Switching Loss Test Circuit

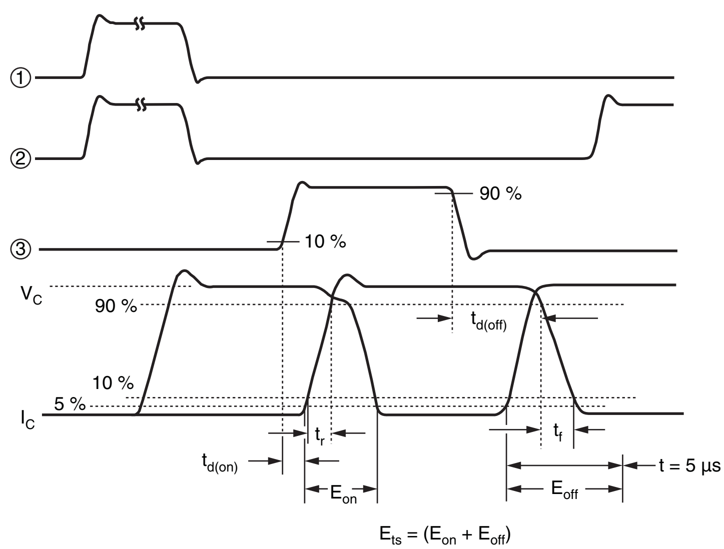
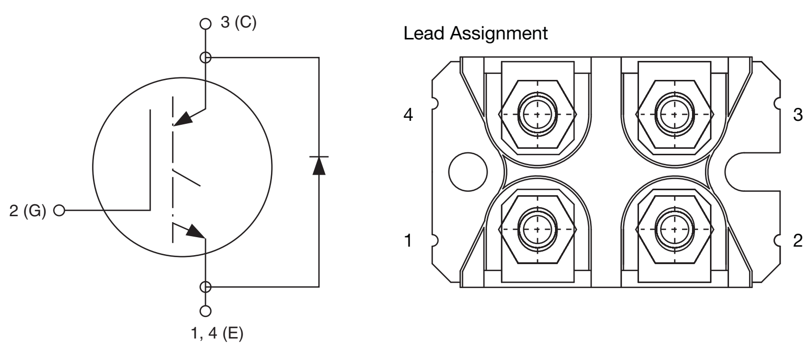


Fig. 24 - Switching Loss Waveforms Test Circuit

ORDERING INFORMATION TABLE

Device code	VS-	G	T	100	D	A	120	UF
	1	2	3	4	5	6	7	8

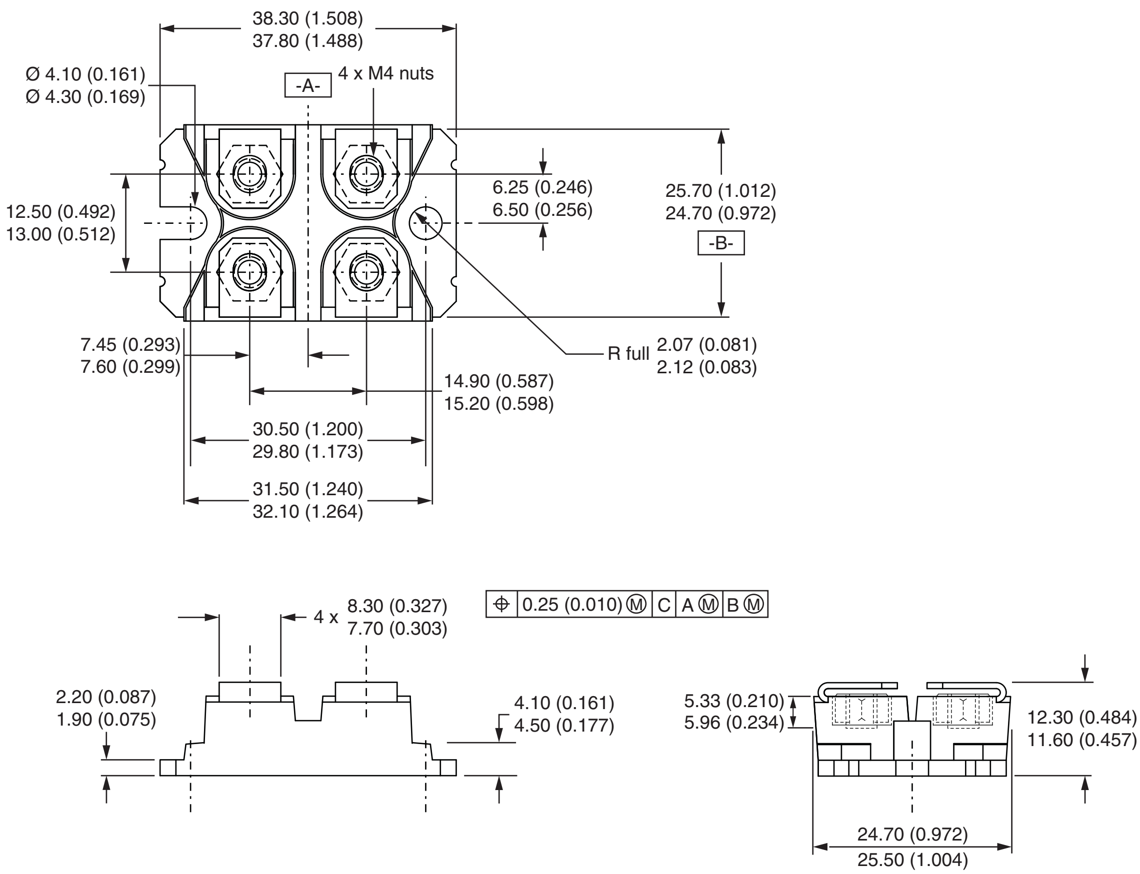
- **1** - Vishay Semiconductors product
- **2** - Insulated Gate Bipolar Transistor (IGBT)
- **3** - Trench IGBT technology
- **4** - Current rating (100 = 100 A)
- **5** - Circuit configuration (D = single switch with antiparallel diode)
- **6** - Package indicator (A = SOT-227)
- **7** - Voltage rating (120 = 1200 V)
- **8** - Speed/type (UF = Trench ultrafast IGBT)

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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- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.

Как с нами связаться

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