Insulated Gate Bipolar Transistor (Ultrafast IGBT), 90 A

SOT-227

FEATURES

- NPT Gen 5 IGBT technology
- 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

PRIMARY CHARACTERISTICS	
V_{CES}	1200 V
I_C DC	90 A at 90 °C
$V_{CE(on)}$ typical at 75 A, 25 °C	3.3 V
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 on heatsink
- Plug-in compatible with other SOT-227 packages
- 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	149	A
		T_C = 90 °C	90	
Pulsed collector current	I_{CM}		200	
Clamped inductive load current	I_{LM}		200	
Diode continuous forward current	I_F	T_C = 25 °C	76	
		T_C = 90 °C	46	
Gate to emitter voltage	V_{GE}		± 20	V
Power dissipation, IGBT	P_D	T_C = 25 °C	862	W
		T_C = 90 °C	414	
Power dissipation, diode	P_D	T_C = 25 °C	357	
		T_C = 90 °C	171	
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 = 250 μA	1200	-	-	V
Collector to emitter voltage	$V_{CE(on)}$	V_{GE} = 15 V, I_C = 75 A	-	3.3	3.8	
		V_{GE} = 15 V, I_C = 75 A, T_J = 125 °C	-	3.6	3.9	
		V_{GE} = 15 V, I_C = 75 A, T_J = 150 °C	-	3.7	-	
Gate threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$, I_C = 250 μA	4	5	6	
		$V_{CE} = V_{GE}$, I_C = 250 μA, T_J = 125 °C	-	3.2	-	
Temperature coefficient of threshold voltage	$V_{GE(th)}/\Delta T_J$	$V_{CE} = V_{GE}$, I_C = 1 mA (25 °C to 125 °C)	-	-12	-	mV/°C
Collector to emitter leakage current	I_{CES}	V_{GE} = 0 V, V_{CE} = 1200 V	-	7	250	μA
		V_{GE} = 0 V, V_{CE} = 1200 V, T_J = 125 °C	-	1.4	10	mA
		V_{GE} = 0 V, V_{CE} = 1200 V, T_J = 150 °C	-	6.5	20	
Forward voltage drop, diode	V_{FM}	V_{GE} = 0 V, I_F = 75 A	-	3.4	5.0	V
		V_{GE} = 0 V, I_F = 75 A, T_J = 125 °C	-	3.2	5.2	
		V_{GE} = 0 V, I_F = 75 A, T_J = 150 °C	-	3.05	-	
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**
Total gate charge (turn-on)	Q_g	I_C = 50 A, V_{CC} = 600 V, V_{GE} = 15 V		-	690	-	nC
Gate to emitter charge (turn-on)	Q_{ge}			-	65	-	
Gate to collector charge (turn-on)	Q_{gc}			-	250	-	
Turn-on switching loss	E_{on}	I_C = 75 A, V_{CC} = 600 V, V_{GE} = 15 V, R_g = 5 Ω, L = 500 μH, T_J = 25 °C	Energy losses include tail and diode recovery Diode used HFA16PB120	-	1.2	-	mJ
Turn-off switching loss	E_{off}			-	2.1	-	
Total switching loss	E_{tot}			-	3.3	-	
Turn-on delay time	$t_{d(on)}$			-	250	-	ns
Rise time	t_r			-	38	-	
Turn-off delay time	$t_{d(off)}$			-	280	-	
Fall time	t_f			-	90	-	
Turn-on switching loss	E_{on}	I_C = 75 A, V_{CC} = 600 V, V_{GE} = 15 V, R_g = 5 Ω, L = 500 μH, T_J = 125 °C		-	1.7	-	mJ
Turn-off switching loss	E_{off}			-	4.08	-	
Total switching loss	E_{tot}			-	5.78	-	
Turn-on delay time	$t_{d(on)}$			-	245	-	ns
Rise time	t_r			-	48	-	
Turn-off delay time	$t_{d(off)}$			-	280	-	
Fall time	t_f			-	140	-	
Reverse bias safe operating area	RBSOA	T_J = 150 °C, I_C = 200 A, R_g = 22 Ω, V_{GE} = 15 V to 0 V, V_{CC} = 900 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 = 200 V		-	140	-	ns
Diode peak reverse current	I_{rr}			-	13	-	A
Diode recovery charge	Q_{rr}			-	860	-	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		-	210	-	ns
Diode peak reverse current	I_{rr}			-	19	-	A
Diode recovery charge	Q_{rr}			-	1880	-	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}		-	-	0.145	°C/W
	Diode			-	-	0.35	
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					

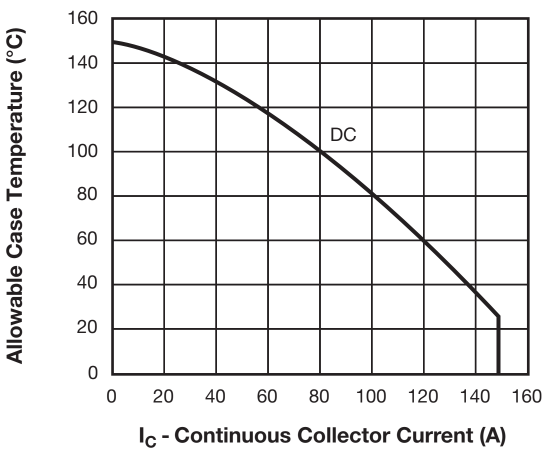


Fig. 1 - Maximum DC IGBT Collector Current vs. Case Temperature

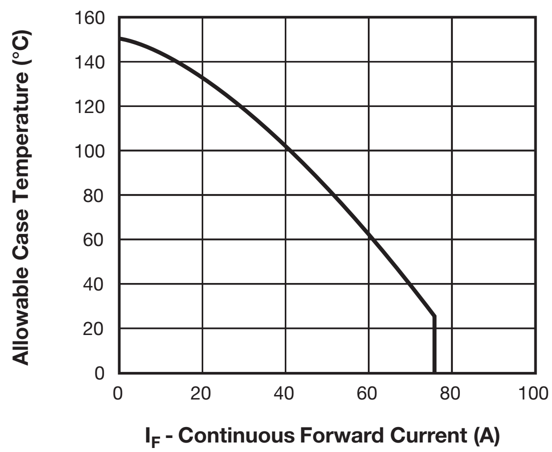


Fig. 3 - Allowable Forward Current vs. Case Temperature Diode Leg

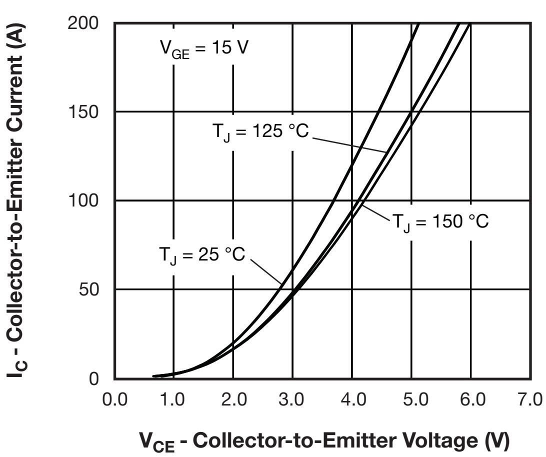


Fig. 2 - Typical Collector to Emitter Current Output Characteristics of IGBT

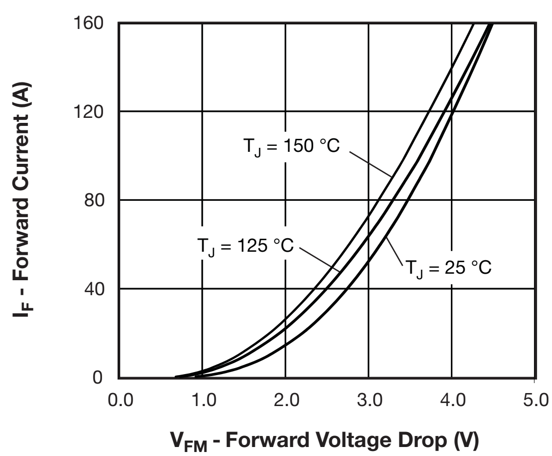


Fig. 4 - Typical Diode Forward Voltage Drop Characteristics

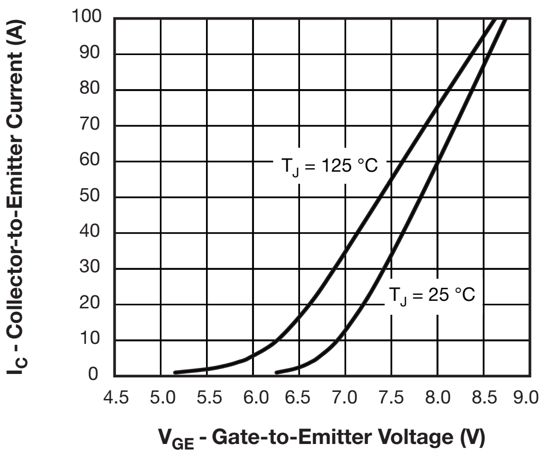


Fig. 5 - Typical IGBT Transfer Characteristics

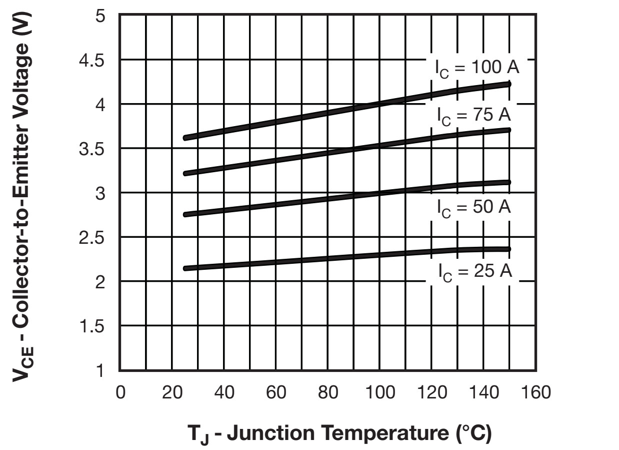


Fig. 8 - Typical IGBT Collector to Emitter Voltage vs. Junction Temperature, V_{GE} = 15 V

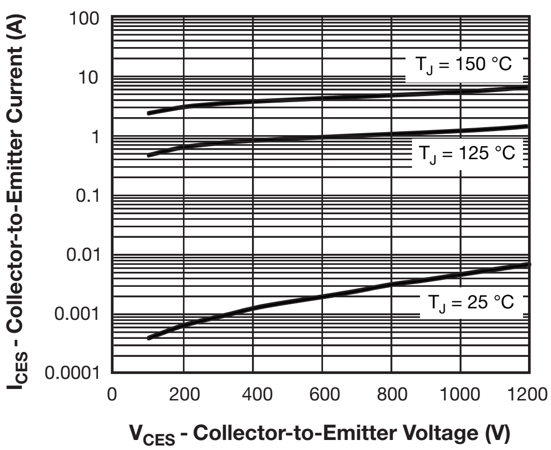


Fig. 6 - Typical IGBT Zero Gate Voltage Collector Current

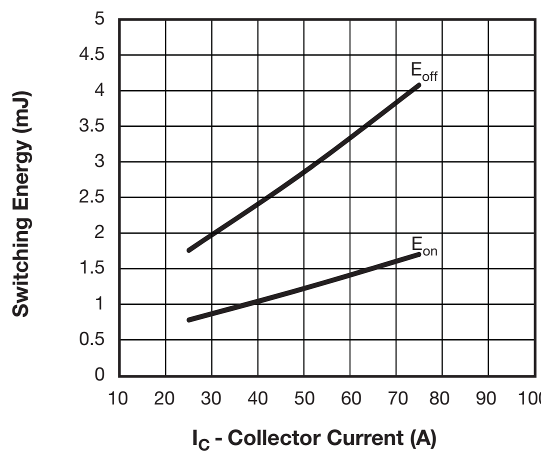


Fig. 9 - Typical IGBT Energy Losses vs. I_C
T_J = 125 °C, L = 500 µH, V_{CC} = 600 V,
R_g = 5 Ω, V_{GE} = 15 V, Diode used HFA16PB120

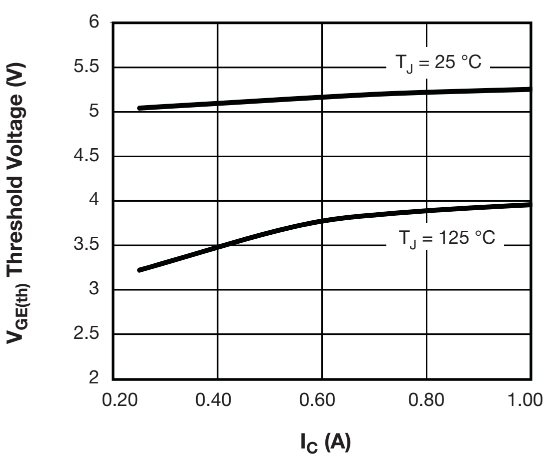


Fig. 7 - Typical IGBT Threshold Voltage

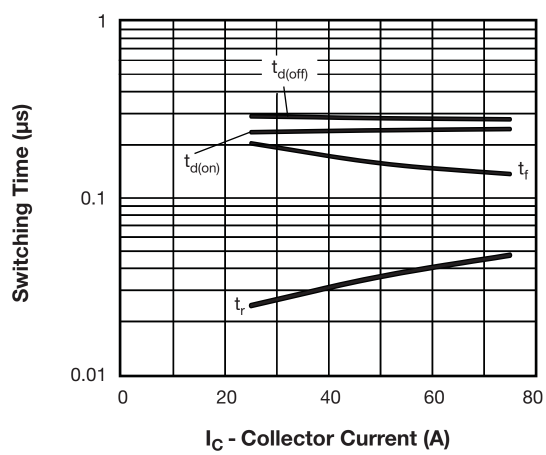


Fig. 10 - Typical IGBT Switching Time vs. I_C
T_J = 125 °C, L = 500 µH, V_{CC} = 600 V,
R_g = 5 Ω, V_{GE} = 15 V, Diode used HFA16PB120

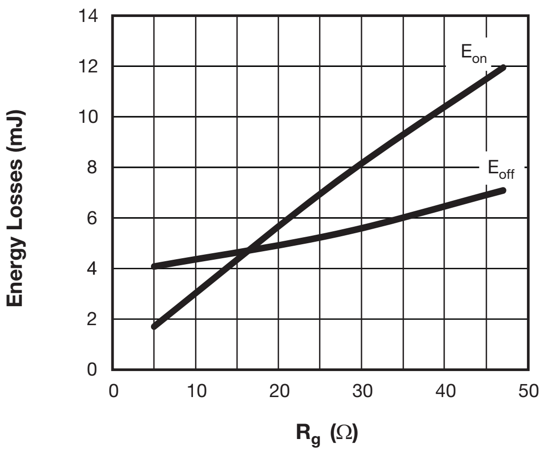


Fig. 11 - Typical IGBT Energy Loss vs. R_g,
T_J = 125 °C, I_C = 75 A, L = 500 µH,
V_{CC} = 600 V, V_{GE} = 15 V, Diode used HFA16PB120

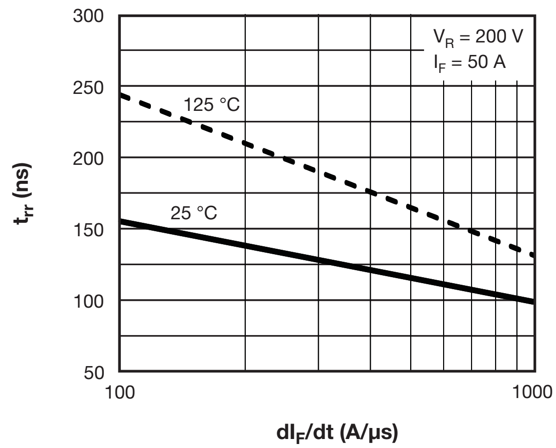


Fig. 13 - Typical t_{rr} Diode vs. dI_F/dt
V_{RR} = 200 V, I_F = 50 A

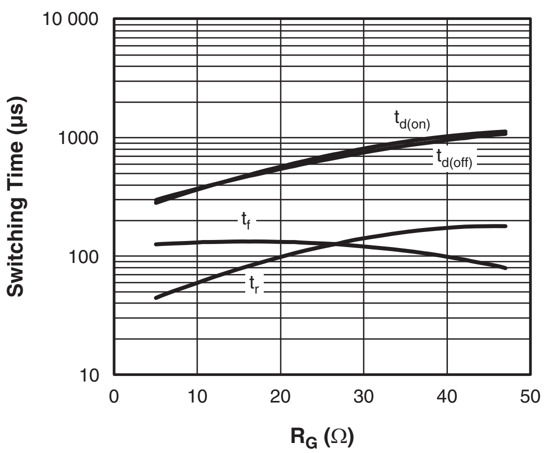


Fig. 12 - Typical IGBT Switching Time vs. R_g
T_J = 125 °C, L = 500 µH, V_{CC} = 600 V,
R_g = 5 Ω, V_{GE} = 15 V

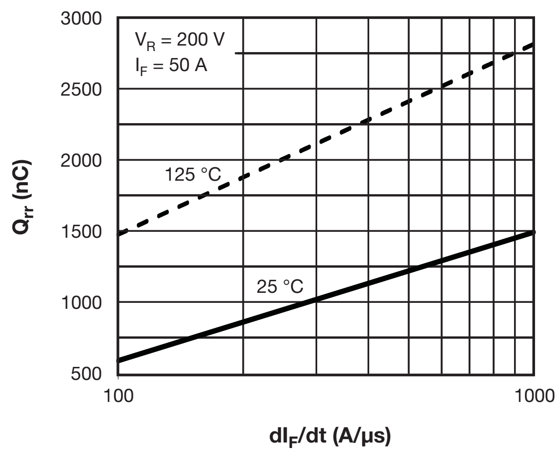


Fig. 14 - Stored Charge vs. dI_F/dt of Diode

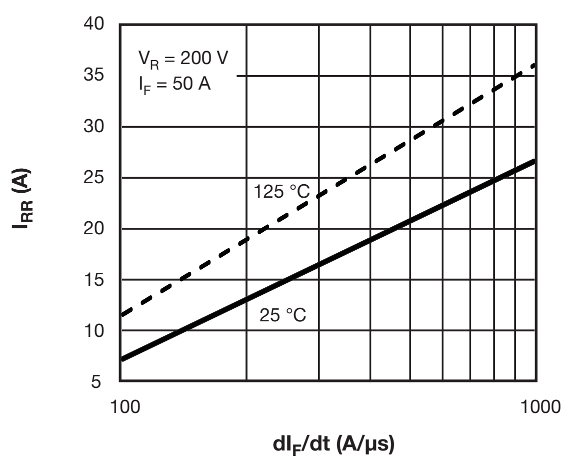


Fig. 15 - Typical Reverse Recovery Current vs. dI_F/dt of Diode

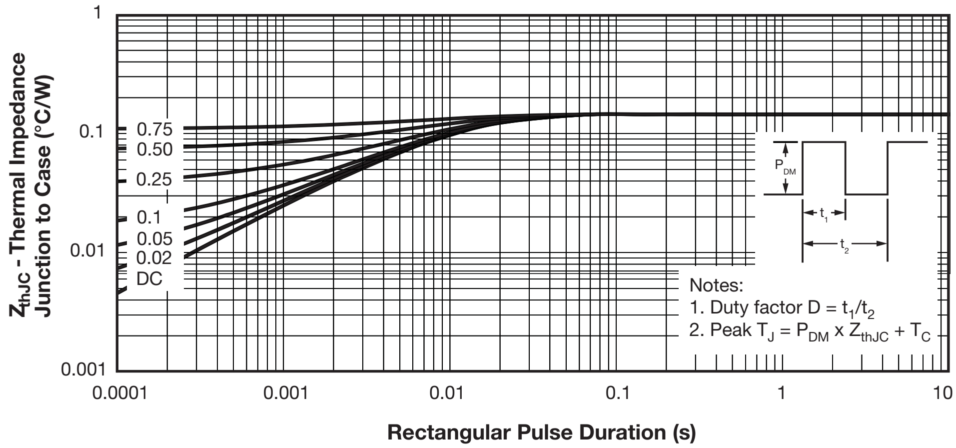


Fig. 16 - Maximum Thermal Impedance Z_{thJC} Characteristics (IGBT)

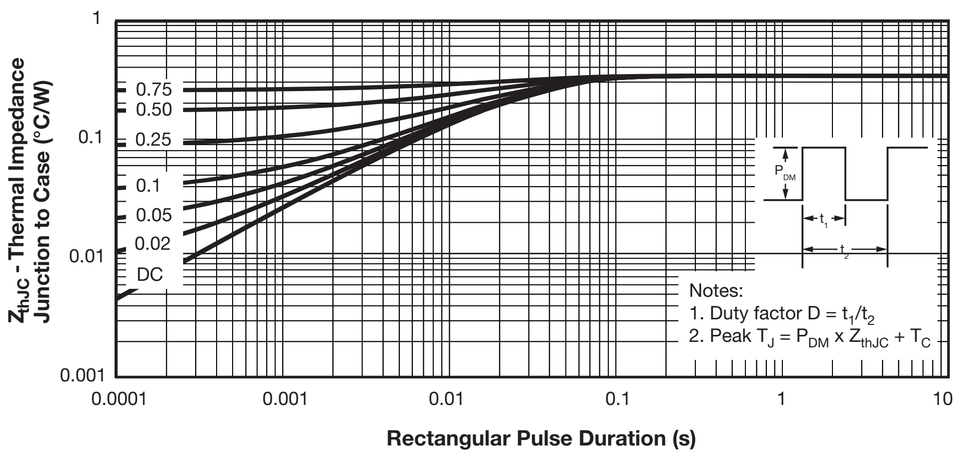


Fig. 17 - Maximum Thermal Impedance Z_{thJC} Characteristics (Diode)

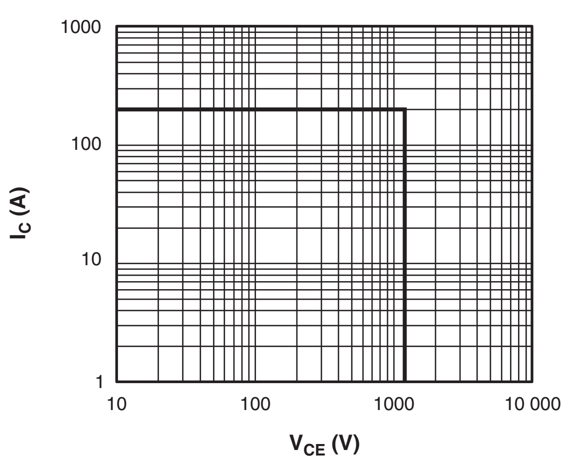
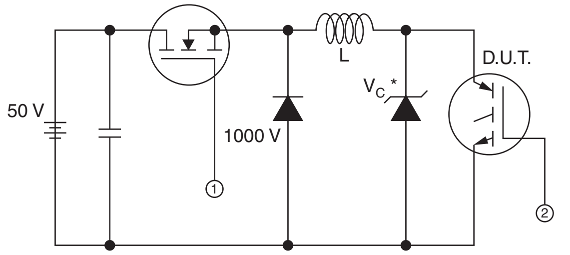


Fig. 18 - IGBT Reverse Bias SOA, TJ = 150 °C, V_{GE} = 15 V,



* Driver same type as D.U.T.; V_C = 80 % of $V_{ce(max.)}$
* Note: Due to the 50 V power supply, pulse width and inductor will increase to obtain Id

Fig. 19a - Clamped Inductive Load Test Circuit

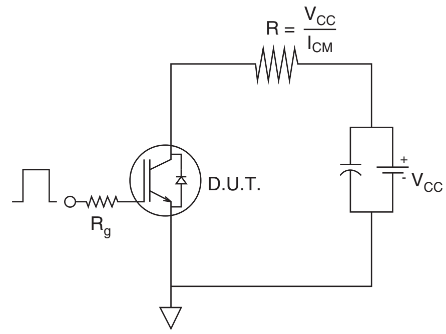


Fig. 19b - Pulsed Collector Current Test Circuit

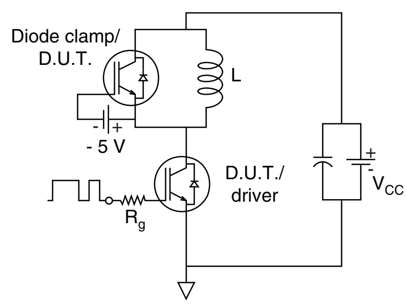


Fig. 20a - Switching Loss Test Circuit

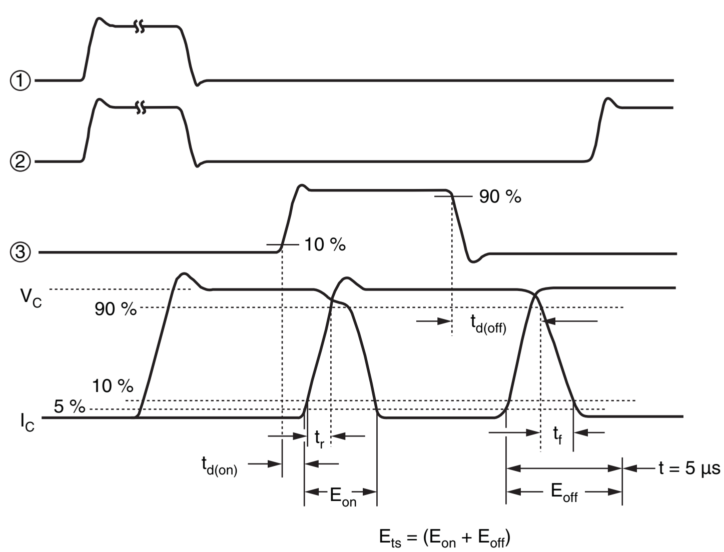
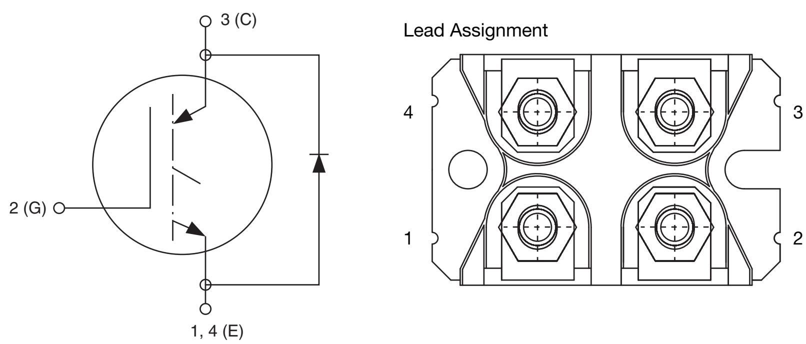


Fig. 20b - Switching Loss Waveforms Test Circuit

ORDERING INFORMATION TABLE

Device code	VS-	G	B	90	D	A	120	U
	1	2	3	4	5	6	7	8

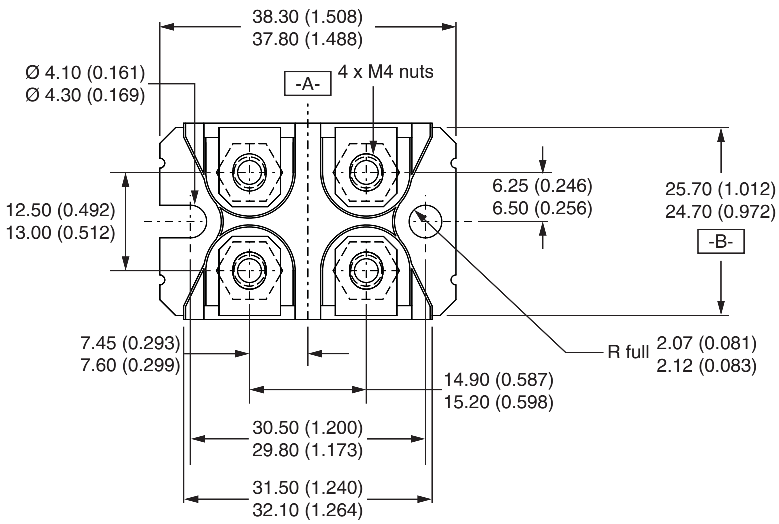
1 - Vishay Semiconductors product
2 - Insulated gate bipolar transistor (IGBT)
3 - B = IGBT Gen 5
4 - Current rating (90 = 90 A)
5 - Circuit configuration (D = single switch with AP diode)
6 - Package indicator (A = SOT-227)
7 - Voltage rating (120 = 1200 V)
8 - Speed/type (U = ultrafast IGBT)

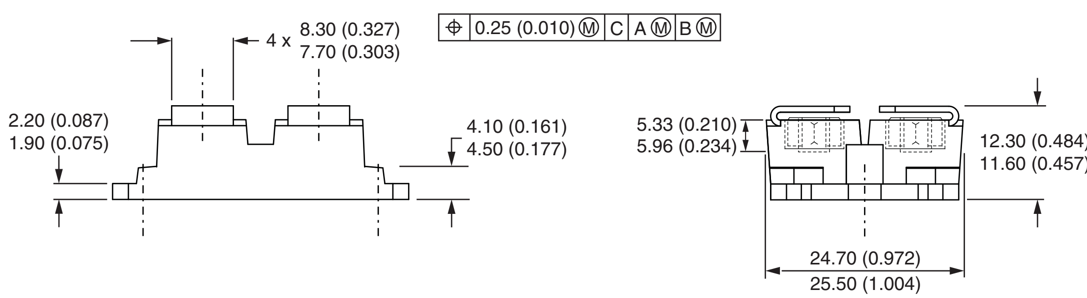
CIRCUIT CONFIGURATION		
CIRCUIT	CIRCUIT CONFIGURATION CODE	CIRCUIT DRAWING
Single switch with AP diode	D	

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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