"High Side Chopper" IGBT SOT-227 (Trench IGBT), 47 A

SOT-227

PRIMARY CHARACTERISTICS	
V_{CES}	1200 V
I_C DC	50 A at 73 °C
$V_{CE(on)}$ typical at 50 A, 25 °C	2.39 V
Package	SOT-227
Circuit configuration	High side chopper

FEATURES

- Trench IGBT technology
- Square RBSOA
- HEXFRED® clamping diode
- Positive $V_{CE(on)}$ temperature coefficient
- Fully isolated package
- Speed 8 kHz to 60 kHz
- 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

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	68	A
		T_C = 80 °C	47	
Pulsed collector current	I_{CM}	T_C = 150 °C, T_p = 6 ms, V_{GE} = 15 V	150	
Clamped inductive load current	I_{LM}		250	
Diode continuous forward current	I_F	T_C = 25 °C	87	
		T_C = 80 °C	59	
Single pulse forward current	I_{FSM}	10 ms sine or 6 ms rectangular pulse, T_J = 25 °C	310	
Gate to emitter voltage	V_{GE}		± 20	V
Power dissipation, IGBT	P_D	T_C = 25 °C	291	W
		T_C = 80 °C	163	
Power dissipation, diode	P_D	T_C = 25 °C	338	
		T_C = 80 °C	190	
RMS 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 mA	1200	-	-	V
Collector to emitter voltage	$V_{CE(on)}$	V_{GE} = 15 V, I_C = 25 A	-	1.95	-	
		V_{GE} = 15 V, I_C = 50 A	-	2.39	2.8	
		V_{GE} = 15 V, I_C = 25 A, T_J = 125 °C	-	2.13	-	
		V_{GE} = 15 V, I_C = 50 A, T_J = 125 °C	-	2.76	-	
Gate threshold voltage	$V_{GE(th)}$	V_{CE} = V_{GE}, I_C = 2 mA	4.6	5.8	7.6	
Temperature coefficient of threshold voltage	$V_{GE(th)}/\Delta T_J$	V_{CE} = V_{GE}, I_C = 2 mA (25 °C to 125 °C)	-	-13	-	mV/°C
Collector to emitter leakage current	I_{CES}	V_{GE} = 0 V, V_{CE} = 1200 V	-	1.7	50	μA
		V_{GE} = 0 V, V_{CE} = 1200 V, T_J = 125 °C	-	26.2	-	
Diode reverse breakdown voltage	V_{BR}	I_R = 1 mA	1200	-	-	V
Diode forward voltage drop	V_{FM}	I_F = 25 A, V_{GE} = 0 V	-	2.11	2.42	V
		I_F = 50 A, V_{GE} = 0 V	-	2.72	-	
		I_F = 25 A, V_{GE} = 0 V, T_J = 125 °C	-	2.04	-	
		I_F = 50 A, V_{GE} = 0 V, T_J = 125 °C	-	2.83	-	
Diode reverse leakage current	I_{RM}	V_R = 1200 V	-	4	50	μA
		T_J = 125 °C, V_R = 1200 V	-	0.8	-	mA
Gate to emitter leakage current	I_{GES}	V_{GE} = ± 20 V	-	-	± 200	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 = 40 A, V_{CC} = 960 V, V_{GE} = 15 V		-	171	-	nC
Gate to emitter charge (turn-on)	Q_{ge}			-	22	-	
Gate to collector charge (turn-on)	Q_{gc}			-	86	-	
Turn-on switching loss	E_{on}	I_C = 50 A, V_{CC} = 600 V, V_{GE} = 15 V, R_g = 4.7 Ω, L = 500 μH, T_J = 25 °C	Energy losses include tail and diode recovery	-	2.7	-	mJ
Turn-off switching loss	E_{off}			-	1.4	-	
Total switching loss	E_{tot}			-	4.1	-	
Turn-on switching loss	E_{on}	I_C = 50 A, V_{CC} = 600 V, V_{GE} = 15 V, R_g = 4.7 Ω, L = 500 μH, T_J = 125 °C		-	4.1	-	
Turn-off switching loss	E_{off}			-	2.3	-	
Total switching loss	E_{tot}			-	6.4	-	
Turn-on delay time	$t_{d(on)}$			-	8	-	ns
Rise time	t_r			-	11	-	
Turn-off delay time	$t_{d(off)}$			-	81	-	
Fall time	t_f			-	179	-	
Reverse bias safe operating area	RBSOA	T_J = 150 °C, I_C = 250 A, R_g = 4.7 Ω, V_{GE} = 15 V to 0 V, V_{CC} = 700 V, V_P = 1200 V		Fullsquare			
Diode reverse recovery time	t_{rr}	I_F = 50 A, dI_F/dt = 200 A/μs, V_R = 200 V		-	129	-	ns
Diode peak reverse current	I_{rr}			-	11	-	A
Diode recovery charge	Q_{rr}			-	710	-	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		-	208	-	ns
Diode peak reverse current	I_{rr}			-	17	-	A
Diode recovery charge	Q_{rr}			-	1768	-	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}		-	-	0.43	°C/W
	Diode			-	-	0.37	
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					

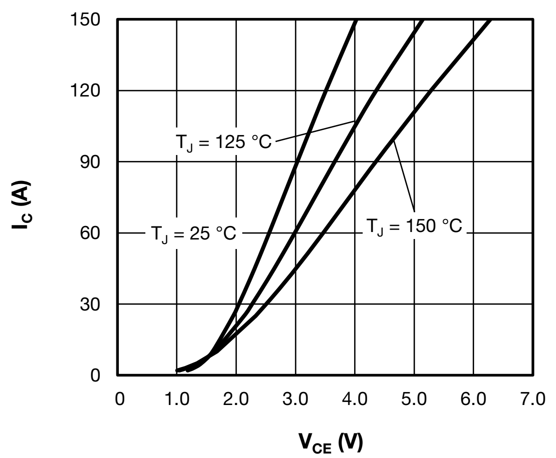


Fig. 1 - Typical Trench IGBT Output Characteristics, V_{GE} = 15 V

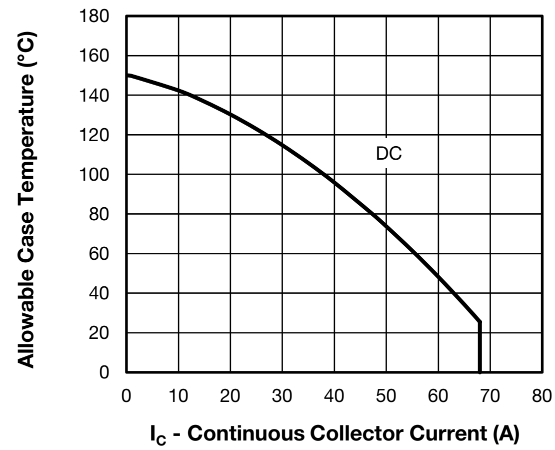


Fig. 3 - Maximum Trench IGBT Continuous Collector Current vs. Case Temperature

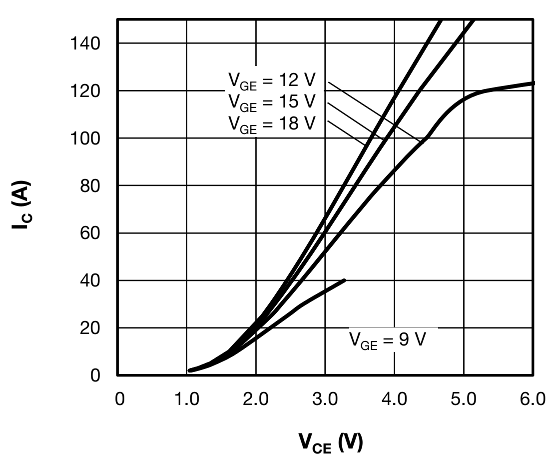


Fig. 2 - Typical Trench IGBT Output Characteristics, T_J = 125 °C

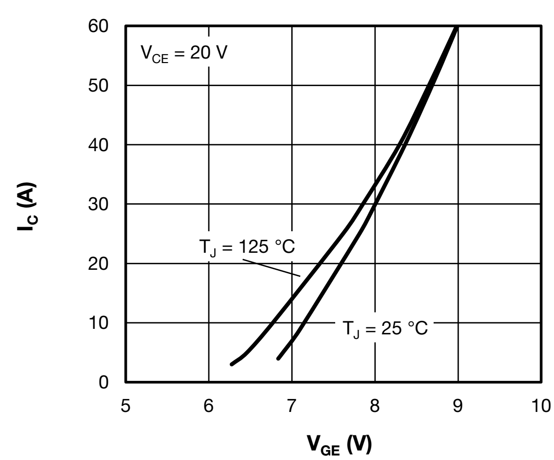


Fig. 4 - Typical Trench IGBT Transfer Characteristic

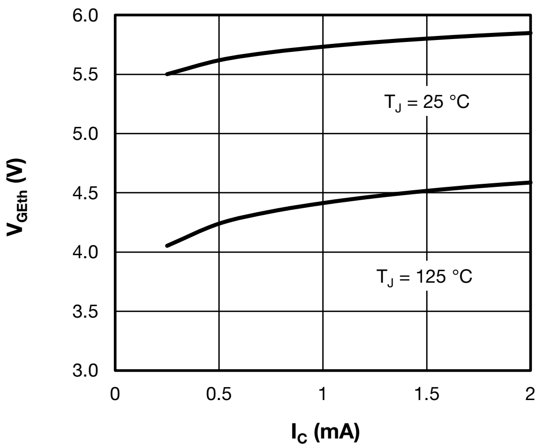


Fig. 5 - Typical Trench IGBT Gate Threshold Voltage

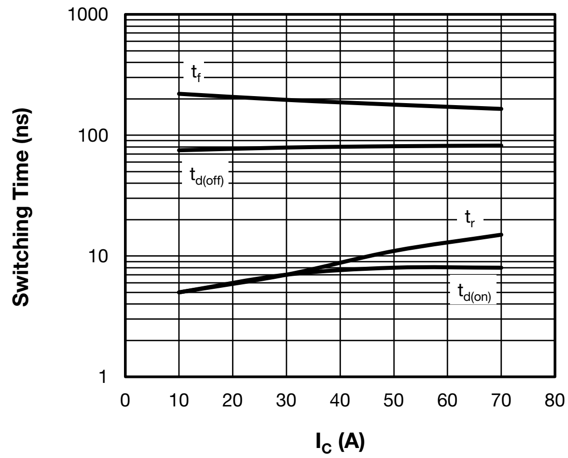


Fig. 8 - Typical Trench IGBT Switching Time vs. I_C
T_J = 125 °C, V_{CC} = 600 V, R_g = 4.7 Ω, V_{GE} = +15 V/-15 V, L = 500 μH

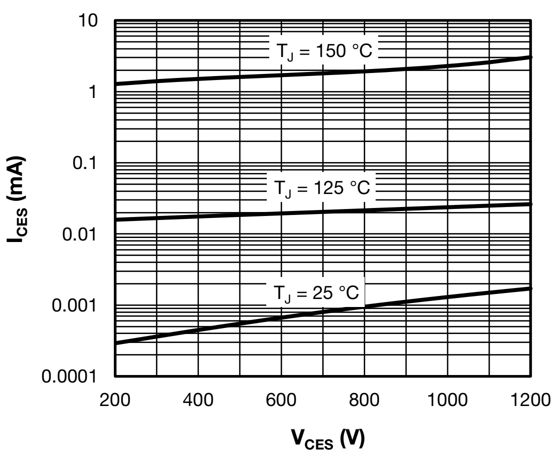


Fig. 6 - Typical Trench IGBT Zero Gate Voltage Collector Current

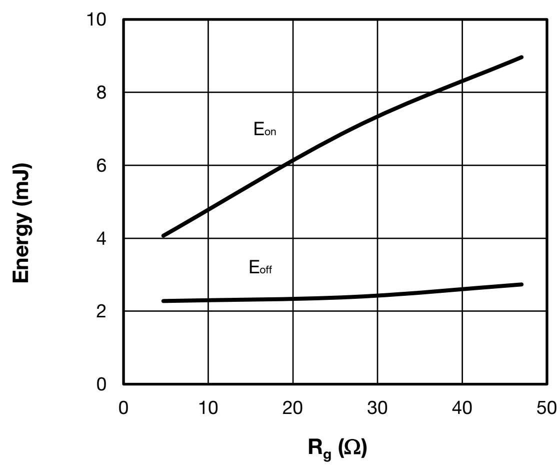


Fig. 9 - Typical Trench IGBT Energy Losses vs. R_g
T_J = 125 °C, V_{CC} = 600 V, I_C = 50 A, V_{GE} = +15 V/-15 V, L = 500 μH

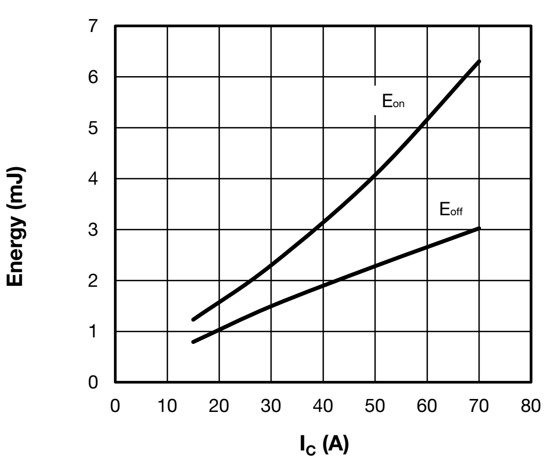


Fig. 7 - Typical Trench IGBT Energy Loss vs. I_C
T_J = 125 °C, V_{CC} = 600 V, R_g = 4.7 Ω, V_{GE} = +15 V/-15 V, L = 500 μH

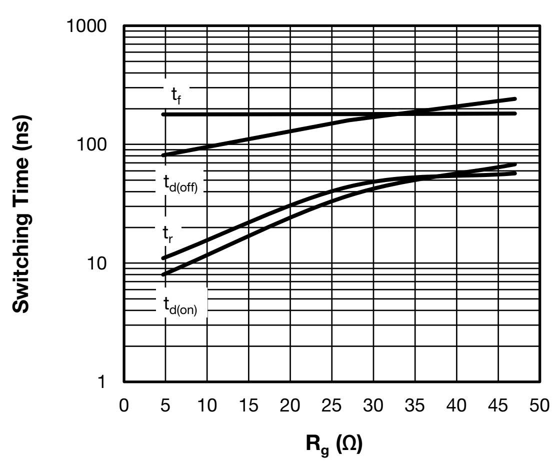


Fig. 10 - Typical Trench IGBT Switching Time vs. R_g
T_J = 125 °C, V_{CC} = 600 V, I_C = 50 A, V_{GE} = +15 V/-15 V, L = 500 μH

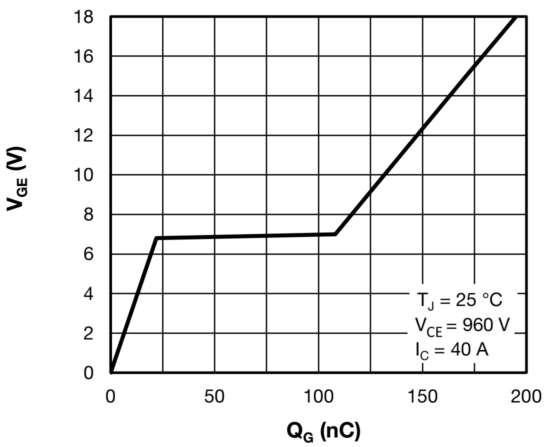


Fig. 11 - Typical Trench IGBT Gate Charge vs. Gate to Emitter Voltage

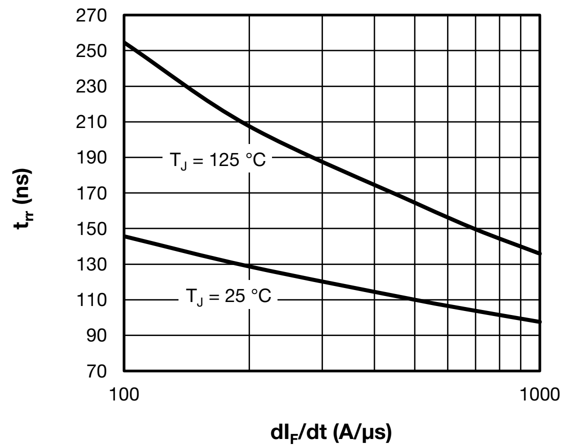


Fig. 14 - Typical Diode Reverse Recovery Time vs. dI_F/dt

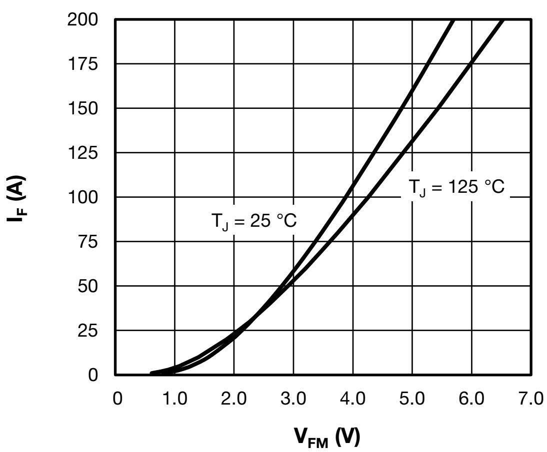


Fig. 12 - Typical Diode Forward Characteristic

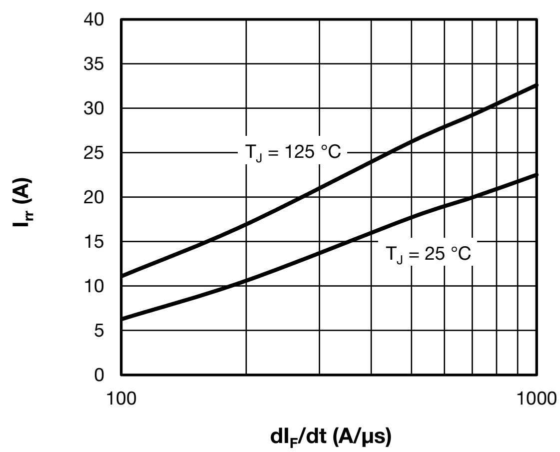


Fig. 15 - Typical Diode Reverse Recovery Current vs. dI_F/dt

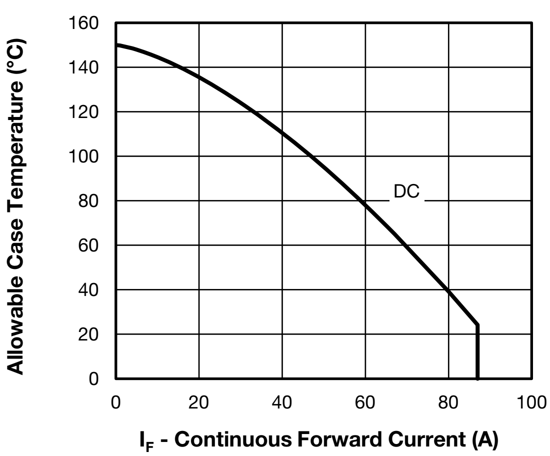


Fig. 13 - Maximum Diode Continuous Forward Current vs. Case Temperature

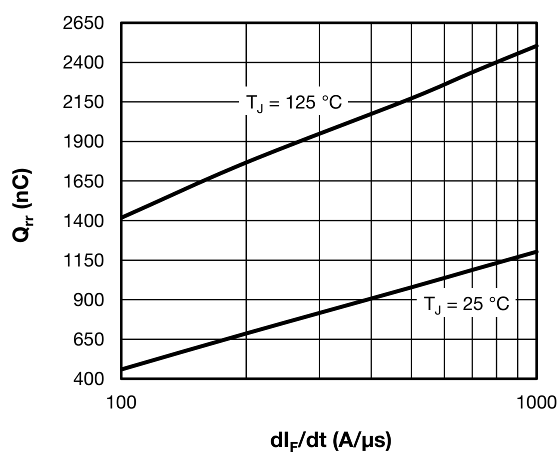


Fig. 16 - Typical Diode Reverse Recovery Charge vs. dI_F/dt

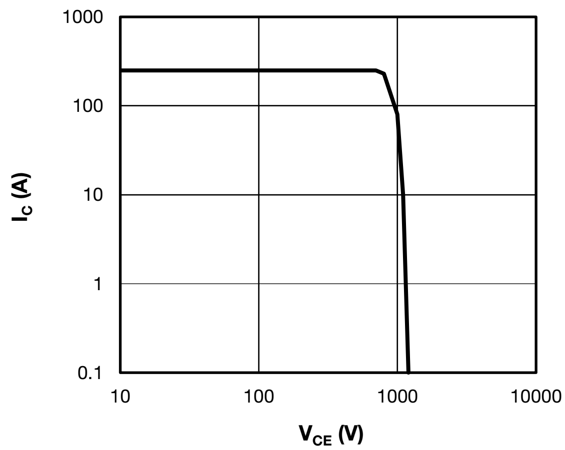


Fig. 17 - Trench IGBT Reverse BIAS SOA
T_J = 150 °C, I_C = 250 A, R_g = 4.7 Ω, V_{GE} = +15 V/ 0 V,
V_{CC} = 700 V, V_p = 1200 V

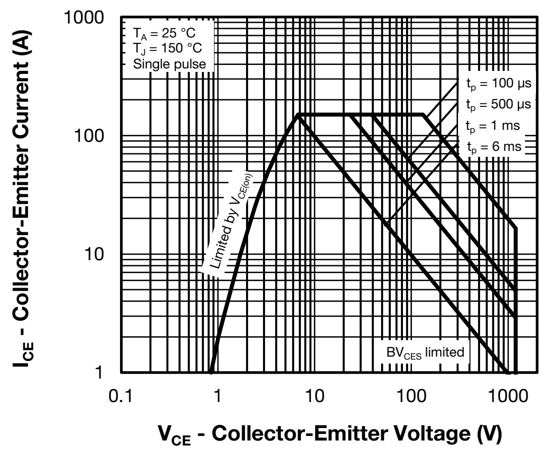


Fig. 18 - Trench IGBT Safe Operating Area

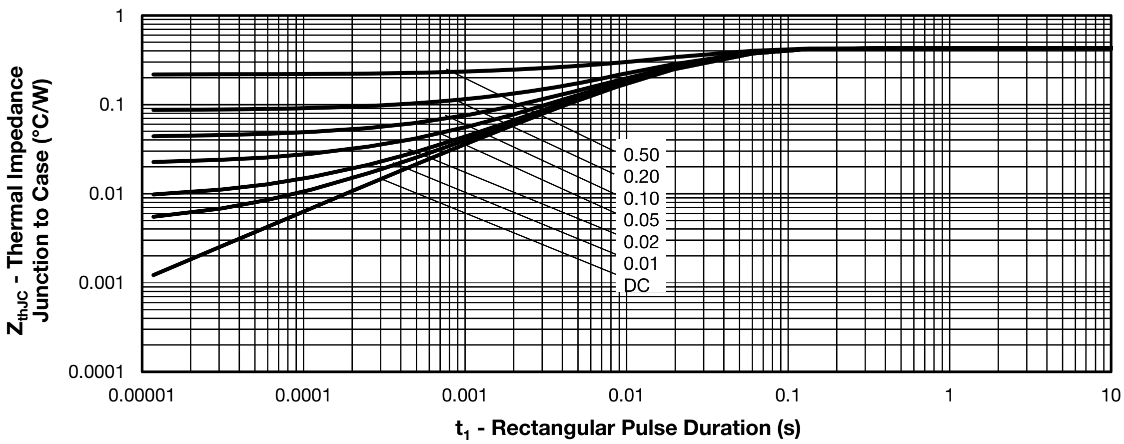


Fig. 19 - Maximum Trench IGBT Thermal Impedance Z_{thJC} Characteristics

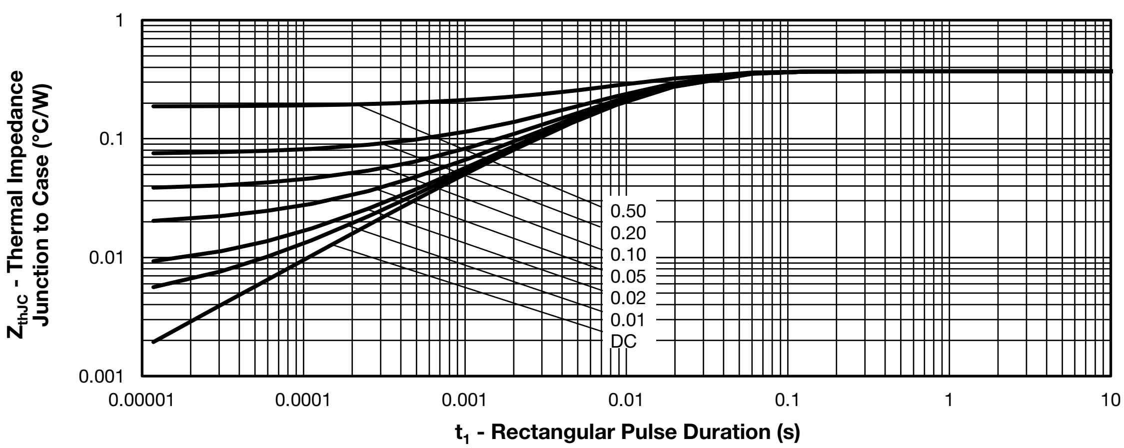
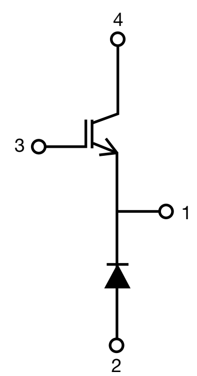
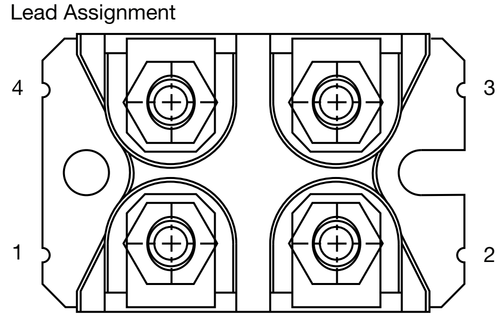


Fig. 20 - Maximum Diode Thermal Impedance Z_{thJC} Characteristics

ORDERING INFORMATION TABLE

Device code	VS-	G	T	55	N	A	120	U	X
	1	2	3	4	5	6	7	8	9

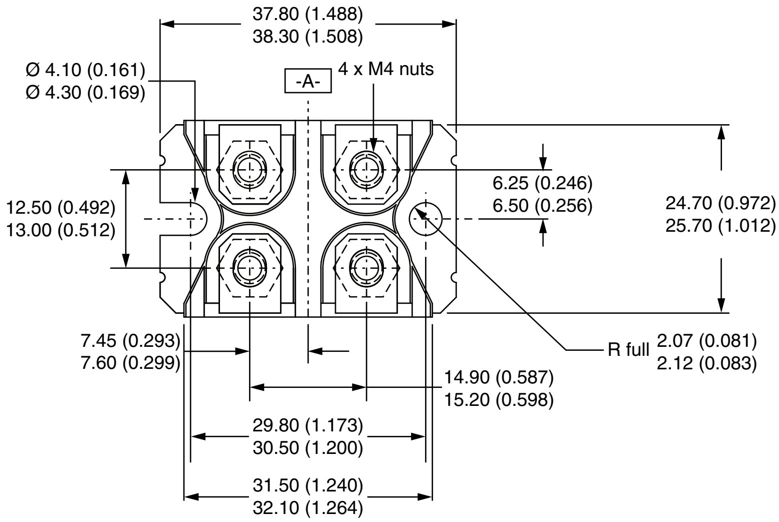
1 - Vishay Semiconductors product
2 - Insulated gate bipolar transistor (IGBT)
3 - T = trench IGBT
4 - Current rating (55 = 55 A)
5 - Circuit configuration (N = high side chopper)
6 - Package indicator (A = SOT-227)
7 - Voltage rating (120 = 1200 V)
8 - Speed/type (U = ultrafast IGBT)
9 - Diode (X = HEXFRED® diode)

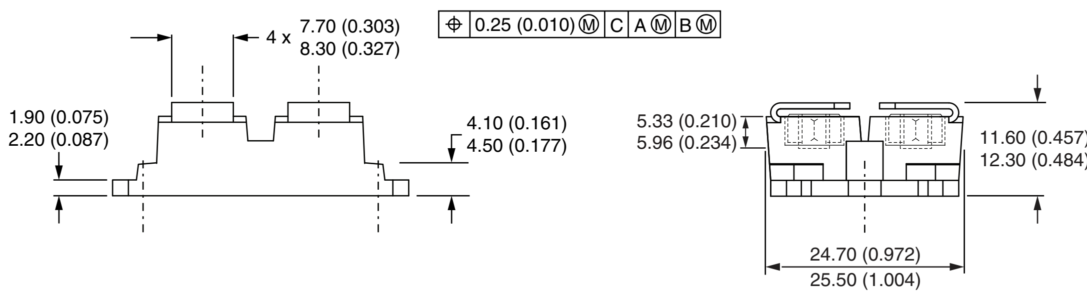
CIRCUIT CONFIGURATION			
CIRCUIT	CIRCUIT CONFIGURATION CODE	CIRCUIT DRAWING	
High side chopper	N		Lead Assignment 

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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