"Half Bridge" High Speed IGBT INT-A-PAK, 200 A

INT-A-PAK IGBT

FEATURES

- Trench IGBT technology
- Gen 4 FRED Pt® anti-parallel diodes with ultra soft reverse recovery characteristics
- Very low switching losses
- Al_2O_3 DBC
- UL approved file E78996
- Designed for industrial level
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Pb-free
RoHS COMPLIANT

BENEFITS

- Optimized for high current inverter stages
- Direct mounting on heatsink
- Very low junction to case thermal resistance
- Low EMI

PRIMARY CHARACTERISTICS	
V_{CES}	650 V
I_C (DC) at T_C = 80 °C	144 A
$V_{CE(on)}$ (typical) at I_C = 200 A, T_J = 25 °C	1.83 V
Chip level $V_{CE(on)}$ at 200 A, 25 °C	1.70 V
Speed	8 kHz to 30 kHz
Package	INT-A-PAK
Circuit configuration	Half bridge

ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	TEST CONDITIONS	MAX.	UNITS
Collector to emitter voltage	V_{CES}		650	V
Continuous collector current	I_C	T_C = 25 °C	193	A
		T_C = 80 °C	144	
Pulsed collector current	I_{CM}	T_J = 175 °C, t_p = 6 ms, V_{GE} = 15 V	450	
Clamped inductive load current	I_{LM}		405	
Diode continuous forward current	I_F	T_C = 25 °C	144	
		T_C = 80 °C	108	
Maximum non-repetitive peak current	I_{FSM}	10 ms sine or 6 ms rectangular pulse	1080	
Gate to emitter voltage	V_{GE}		± 20	V
Maximum power dissipation (IGBT)	P_D	T_C = 25 °C	517	W
		T_C = 80 °C	328	
Maximum power dissipation (Diode)	P_D	T_C = 25 °C	366	
		T_C = 80 °C	232	
RMS isolation voltage	V_{ISOL}	Any terminal to case, t = 1 min	2500	V
Operating junction temperature range	T_J		-40 to +175	°C
Storage temperature range	T_{STG}		-40 to +150	°C

ELECTRICAL SPECIFICATIONS (T_J = 25 °C unless otherwise noted)						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Collector to emitter breakdown voltage	$V_{(BR)CES}$	V_{GE} = 0 V, I_C = 400 μA	650	-	-	V
Collector to emitter voltage	$V_{CE(on)}$	V_{GE} = 15 V, I_C = 100 A	-	1.46	-	
		V_{GE} = 15 V, I_C = 200 A	-	1.83	2.3	
		V_{GE} = 15 V, I_C = 100 A, T_J = 125 °C	-	1.59	-	
		V_{GE} = 15 V, I_C = 200 A, T_J = 125 °C	-	2.13	-	
Gate threshold voltage	$V_{GE(th)}$	V_{CE} = V_{GE}, I_C = 2.0 mA	3	3.9	5	
Temperature coefficient of threshold voltage	$\Delta V_{GE(th)}/\Delta T_J$	V_{CE} = V_{GE}, I_C = 2.0 mA (25 °C to 125 °C)	-	-10	-	mV/°C
Forward transconductance	g_{fe}	V_{CE} = 20 V, I_C = 200 A	-	238	-	S
Transfer characteristics	V_{GE}	V_{CE} = 20 V, I_C = 200 A	-	6.3	-	V
Collector to emitter leakage current	I_{CES}	V_{GE} = 0 V, V_{CE} = 650 V	-	0.2	100	μA
		V_{GE} = 0 V, V_{CE} = 650 V, T_J = 125 °C	-	0.1	-	mA
Diode forward voltage drop	V_{FM}	I_{FM} = 100 A	-	1.73	2.5	V
		I_{FM} = 200 A	-	2.05	-	
		I_{FM} = 100 A, T_J = 125 °C	-	1.37	-	
		I_{FM} = 200 A, T_J = 125 °C	-	1.75	-	
Gate to emitter leakage current	I_{GES}	V_{GE} = ± 20 V	-	-	240	nA

SWITCHING CHARACTERISTICS						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Total gate charge (turn-on)	Q_g	I_C = 200 A V_{CC} = 520 V V_{GE} = 15 V	-	488	-	nC
Gate to emitter charge (turn-on)	Q_{ge}		-	58	-	
Gate to collector (turn-on)	Q_{gc}		-	137	-	
Turn-on switching loss	E_{on}	V_{CC} = 325 V, I_C = 200 A, R_g = 27 Ω, L = 500 μH, V_{GE} = ±15 V	-	2.34	-	mJ
Turn-off switching loss	E_{off}		-	3.77	-	
Total switching loss	E_{tot}		-	6.11	-	
Turn-on delay time	$t_{d(on)}$		-	111	-	ns
Rise time	t_r		-	120	-	
Turn-off delay time	$t_{d(off)}$		-	454	-	
Fall time	t_f		-	64	-	
Turn-on switching loss	E_{on}	V_{CC} = 325 V, I_C = 200 A, R_g = 27 Ω, L = 500 μH, V_{GE} = ±15 V T_J = 125 °C	-	2.82	-	mJ
Turn-off switching loss	E_{off}		-	3.86	-	
Total switching loss	E_{tot}		-	6.68	-	
Turn-on delay time	$t_{d(on)}$		-	79	-	ns
Rise time	t_r		-	82	-	
Turn-off delay time	$t_{d(off)}$		-	306	-	
Fall time	t_f		-	34	-	
Reverse bias safe operating area	RBSOA	I_C = 405 A, R_g = 27 Ω, V_{CC} = 325 V, V_p = 650 V, V_{GE} = 15 V to -5 V, T_J = 175 °C	Fullsquare			
Diode reverse recovery time	t_{rr}	I_F = 50 A, dI_F/dt = 500 A/μs V_{rr} = 200 V, T_J = 25 °C	-	72	-	ns
Diode peak reverse current	I_{rr}		-	13	-	A
Diode recovery charge	Q_{rr}		-	466	-	nC
Diode reverse recovery time	t_{rr}	I_F = 50 A, dI_F/dt = 500 A/μs V_{rr} = 200 V, T_J = 125 °C	-	146	-	ns
Diode peak reverse current	I_{rr}		-	28	-	A
Diode recovery charge	Q_{rr}		-	2064	-	nC

THERMAL AND MECHANICAL SPECIFICATIONS							
PARAMETER		SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Operating junction temperature range		T_J		-40	-	175	°C
Storage temperature range		T_{Stg}		-40	-	150	
Junction to case per leg	IGBT	R_{thJC}		-	-	0.29	°C/W
	Diode			-	-	0.41	
Case to sink per module (conductive grease applied)		R_{thCS}		-	0.05	-	
Mounting torque	case to heatsink			-	-	4	Nm
	case to terminal 1, 2, 3			-	-	3	
Weight				-	150	-	g

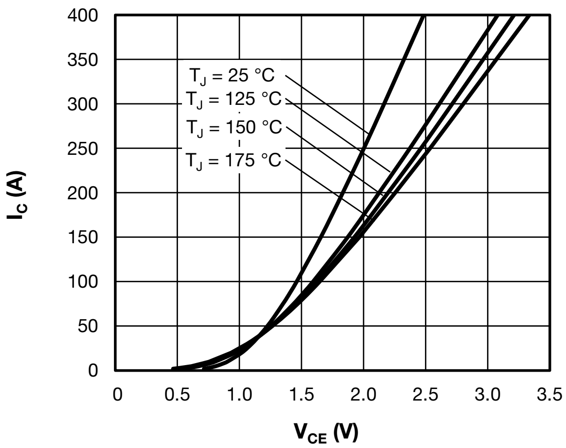


Fig. 1 - Typical Trench IGBT Output Characteristics, V_{GE} = 15 V

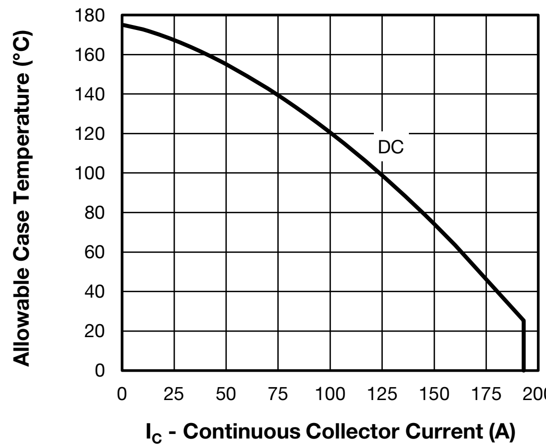


Fig. 3 - Maximum Trench IGBT Continuous Collector Current vs. Case Temperature

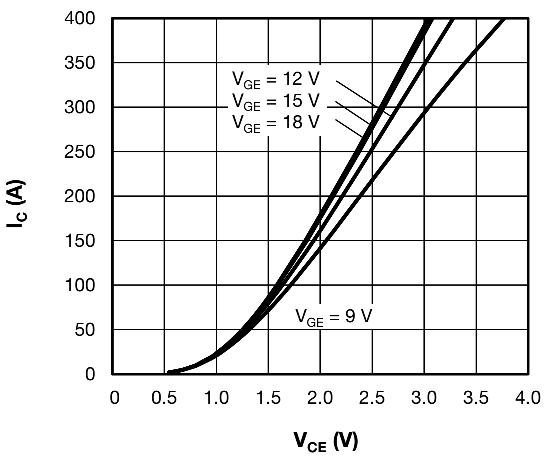


Fig. 2 - Typical Trench IGBT Output Characteristics, T_J = 125 °C

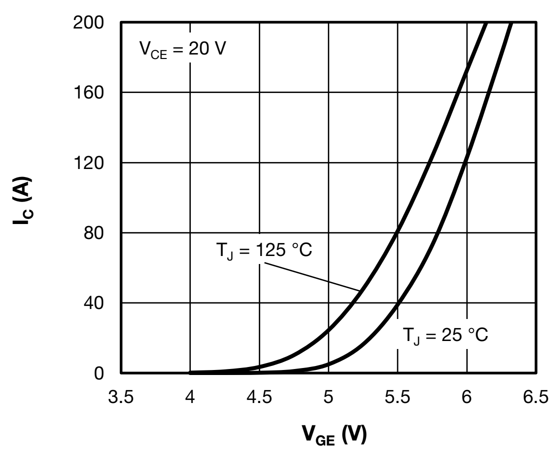


Fig. 4 - Typical Trench IGBT Transfer Characteristics

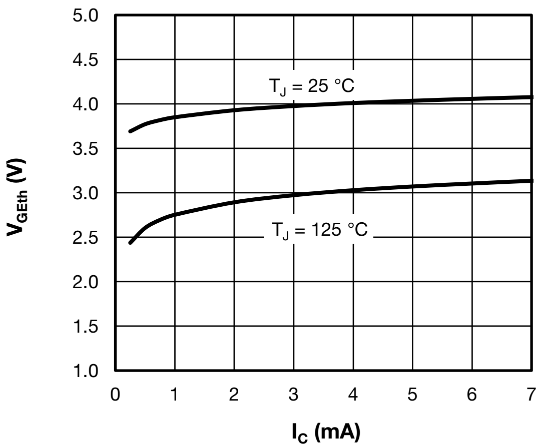


Fig. 5 - Typical Trench IGBT Gate Threshold Voltage

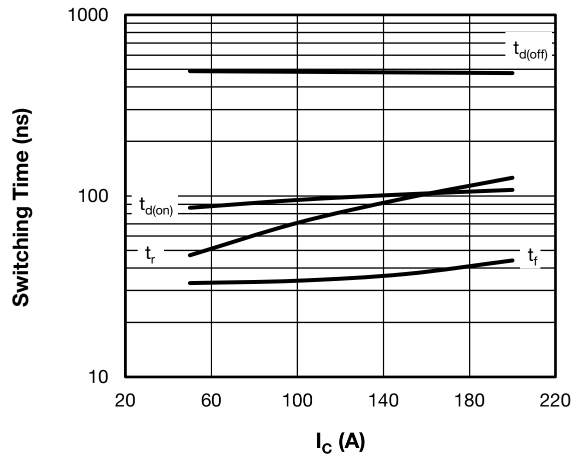


Fig. 8 - Typical Trench IGBT Switching Time vs. I_C
(with Antiparallel Diode)
T_J = 125 °C, V_{CC} = 325 V, R_g = 27 Ω, V_{GE} = +15 V/-15 V, L = 500 μH

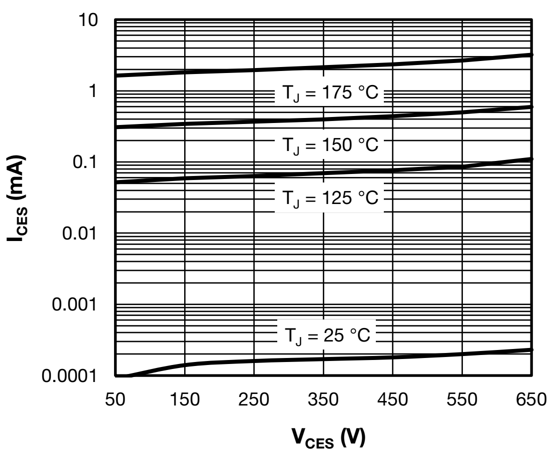


Fig. 6 - Typical Trench IGBT Zero Gate Voltage Collector Current

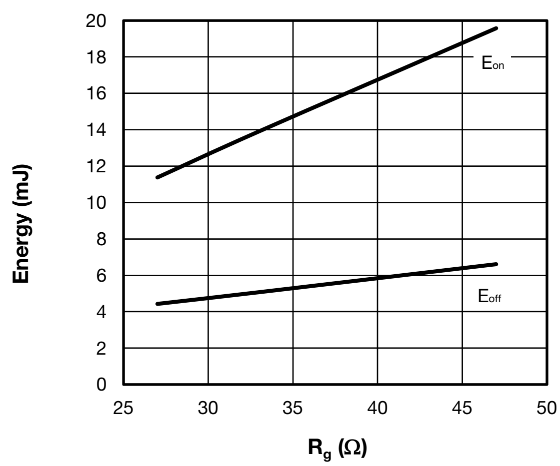


Fig. 9 - Typical Trench IGBT Energy Loss vs. R_g
(with Antiparallel Diode)
T_J = 125 °C, V_{CC} = 325 V, I_C = 200 A, V_{GE} = +15 V/-15 V, L = 500 μH

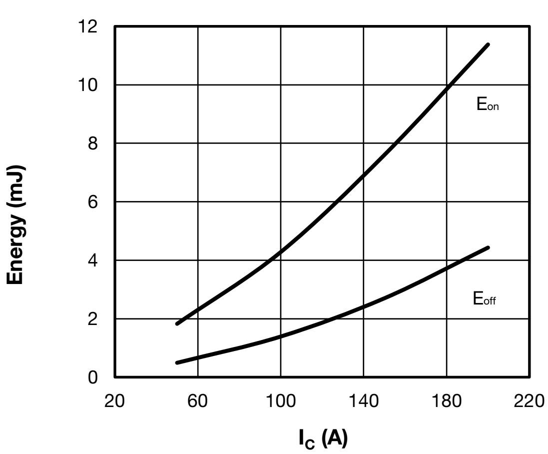


Fig. 7 - Typical Trench IGBT Energy Loss vs. I_C
(with Antiparallel Diode)
T_J = 125 °C, V_{CC} = 325 V, R_g = 27 Ω, V_{GE} = +15 V/-15 V, L = 500 μH

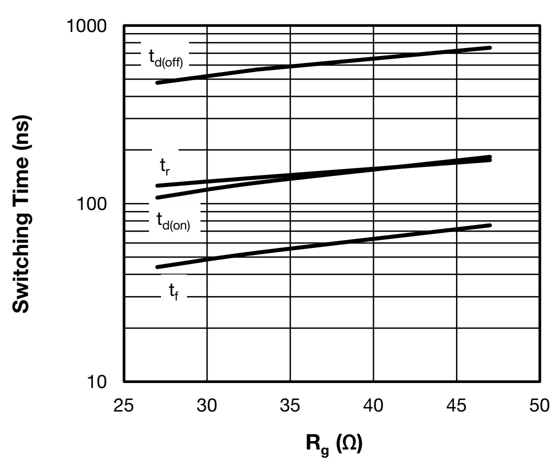


Fig. 10 - Typical Trench IGBT Switching Time vs. R_g
(with Antiparallel Diode)
T_J = 125 °C, V_{CC} = 325 V, I_C = 200 A, V_{GE} = +15 V/-15 V, L = 500 μH

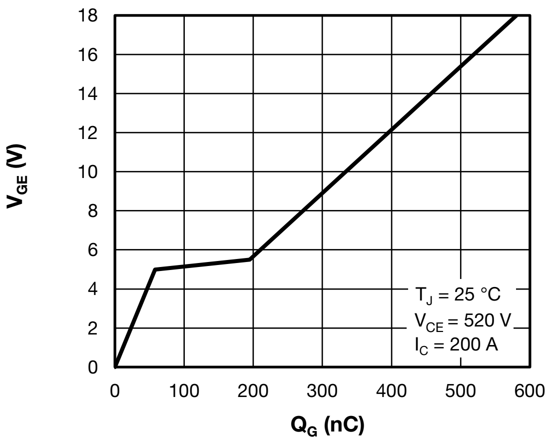


Fig. 11 - Typical Trench IGBT Gate Charge vs. Gate to Collector Voltage

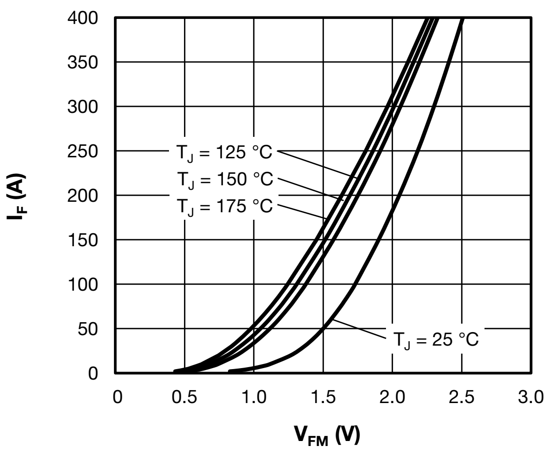


Fig. 12 - Typical Antiparallel Diode Forward Characteristics

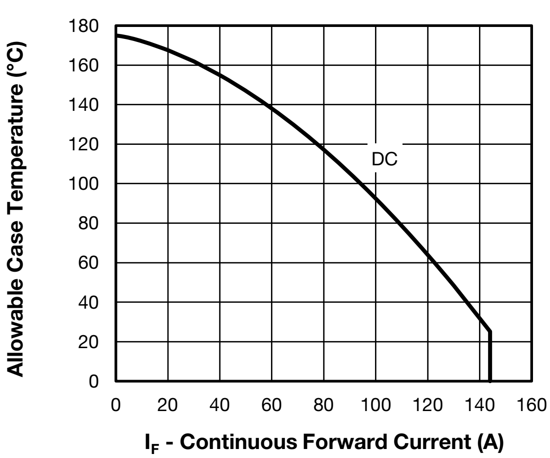


Fig. 13 - Maximum Antiparallel Diode Continuous Forward Current vs. Case Temperature

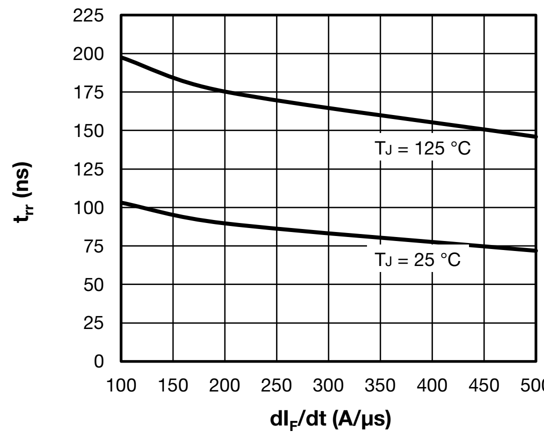


Fig. 14 - Typical Antiparallel Diode Reverse Recovery Time vs. $dI_F dt$
I_F = 50 A, V_{CC} = 200 V

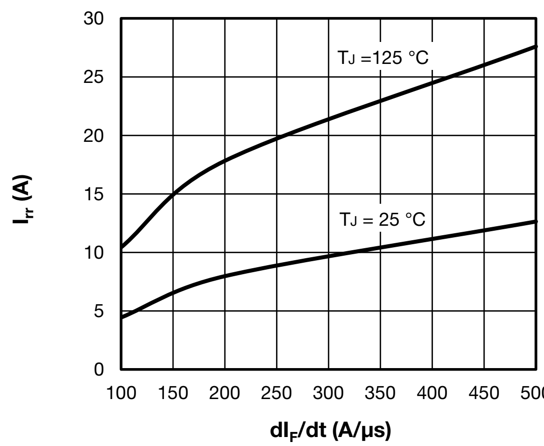


Fig. 15 - Typical Antiparallel Diode Reverse Recovery Current vs. $dI_F dt$
I_F = 50 A, V_{CC} = 200 V

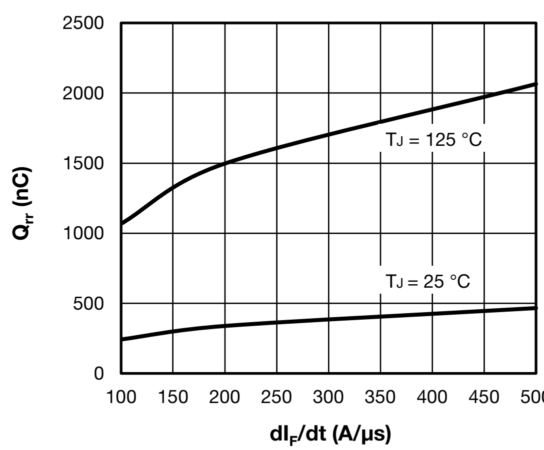


Fig. 16 - Typical Antiparallel Diode Reverse Recovery Charge vs. $dI_F dt$
I_F = 50 A, V_{CC} = 200 V

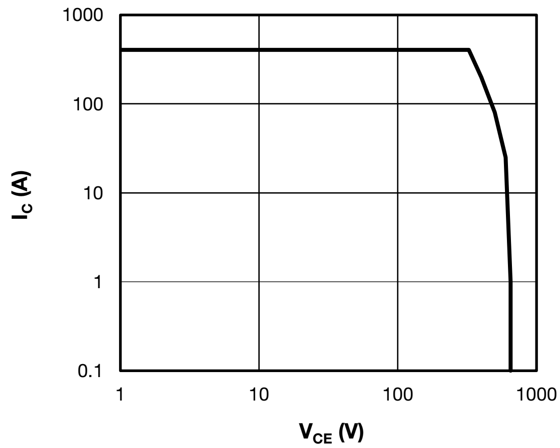


Fig. 17 - Trench IGBT Reverse BIAS SOA
T_J = 175 °C, I_C = 405 A, R_g = 27 Ω, V_{GE} = +15 V/-5 V, V_{CC} = 325 V, V_p = 650 V

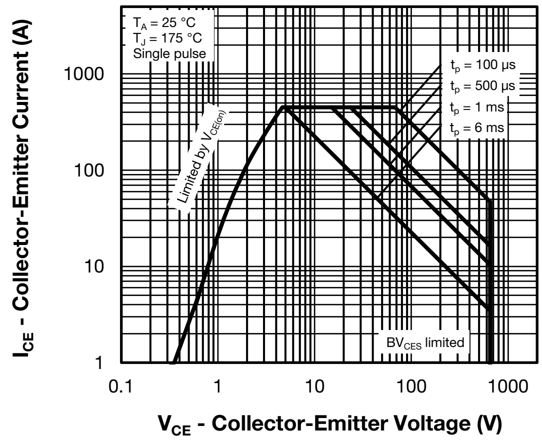


Fig. 18 - Trench IGBT Safe Operating Area

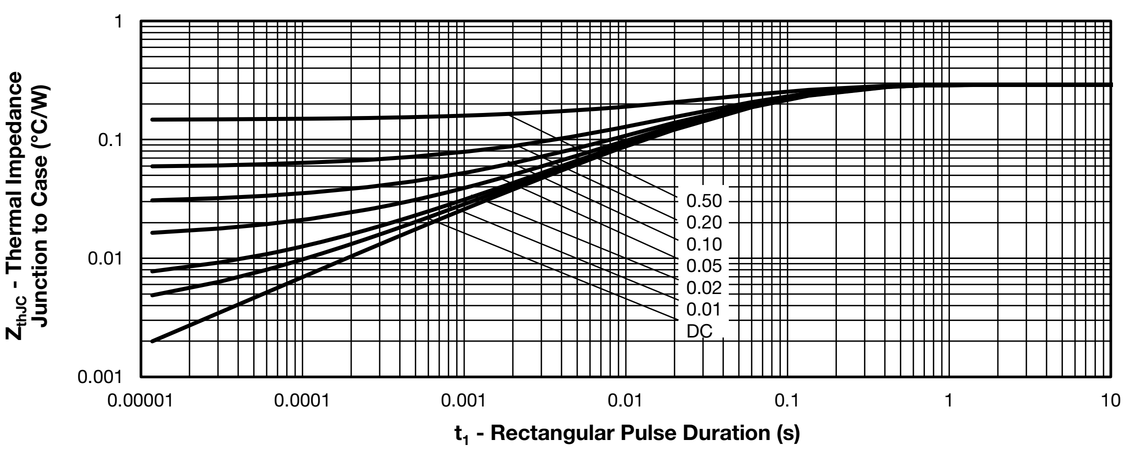


Fig. 19 - Maximum Trench IGBT Thermal Impedance Z_{thJC} Characteristics

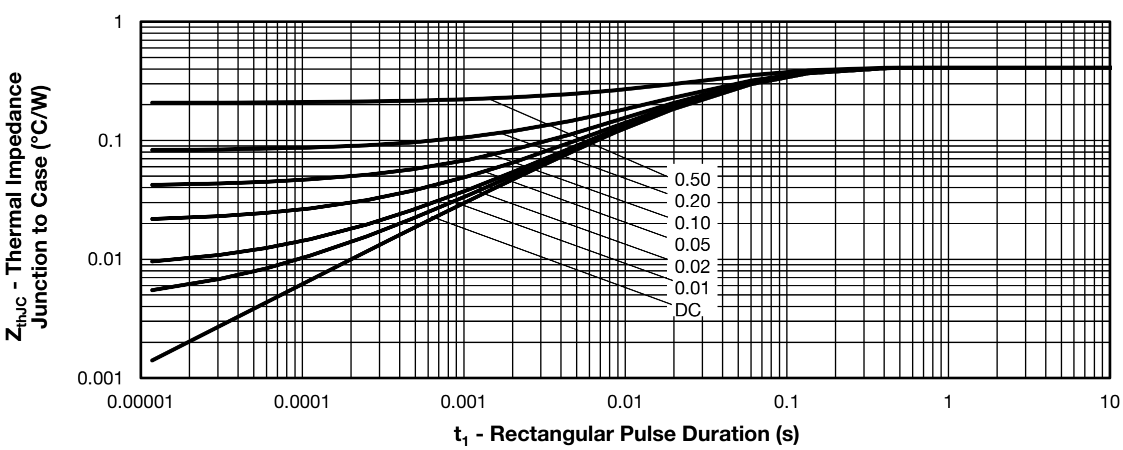


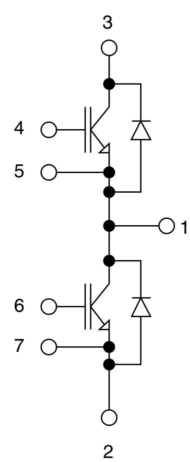
Fig. 20 - Maximum Antiparallel Diode Thermal Impedance Z_{thJC} Characteristics

ORDERING INFORMATION TABLE

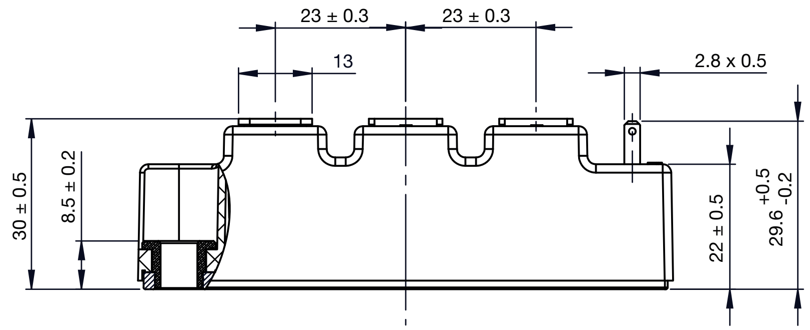
Device code	VS-	G	T	200	T	S	065	N
	1	2	3	4	5	6	7	8

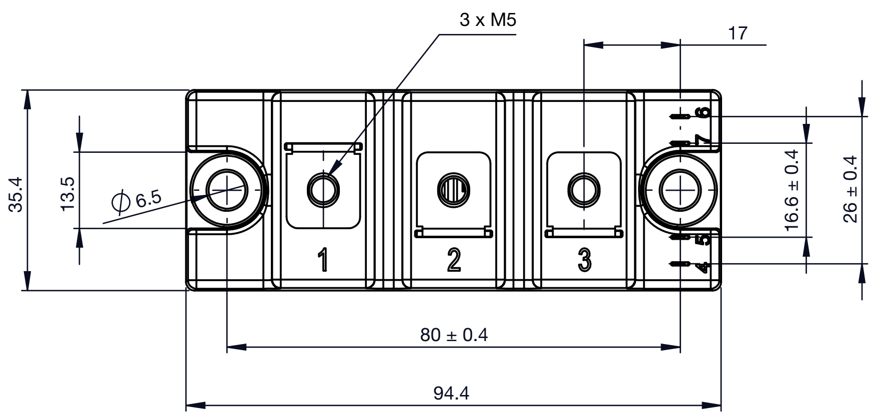
1	-	Vishay Semiconductors product
2	-	Insulated gate bipolar transistor (IGBT)
3	-	T = trench IGBT
4	-	Current rating (200 = 200 A)
5	-	Circuit configuration (T = half bridge)
6	-	Package indicator (S = INT-A-PAK IGBT)
7	-	Voltage rating (065 = 650 V)
8	-	Speed/type (N = ultrafast IGBT)

CIRCUIT CONFIGURATION



DIMENSIONS in millimeters





General tolerance ± 0.5 mm

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