“Half Bridge” Low $V_{CE(on)}$ IGBT INT-A-PAK, 200 A

INT-A-PAK IGBT

FEATURES

- Trench IGBT technology
- Gen 4 FRED Pt® technology anti-parallel diodes with ultra soft reverse recovery characteristics
- Very low conduction 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 (AC TIG welding machines)
- Direct mounting to heatsink
- Very low junction to case thermal resistance
- Low EMI

PRIMARY CHARACTERISTICS	
V_{CES}	650 V
I_C DC, T_C = 80 °C	378 A
$V_{CE(on)}$ at 200 A, 25 °C	1.09 V
Chip level $V_{CE(on)}$ at 200 A, 25 °C	0.98 V
Speed	DC to 1 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	476	A
		T_C = 80 °C	378	
Pulsed collector current	I_{CM}	T_C = 175 °C, t_p = 6 ms, V_{GE} = 15 V	810	
Diode continuous forward current	I_F	T_C = 25 °C	57	
		T_C = 80 °C	43	
Maximum non-repetitive peak current	I_{FSM}	10 ms sine or 6 ms rectangular pulse	270	
Peak switching current	I_{LM}		320	
Gate to emitter voltage	V_{GE}		± 20	V
RMS isolation voltage	V_{ISOL}	Any terminal to case, t = 1 min	2500	
Maximum power dissipation	P_D	T_C = 25 °C	1000	W
		T_C = 80 °C	633	
Maximum power dissipation (Diode)	P_D	T_C = 25 °C	150	
		T_C = 80 °C	95	
Operating junction temperature range	T_J		-40 to +175	°C
Storage temperature range	T_{Stg}		-40 to +150	

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 = 800 μA	650	-	-	V
Collector to emitter voltage	$V_{CE(on)}$	V_{GE} = 15 V, I_C = 200 A	-	1.09	1.32	V
		V_{GE} = 15 V, I_C = 400 A	-	1.32	-	V
		V_{GE} = 15 V, I_C = 200 A, T_J = 125 °C	-	1.07	-	V
Gate threshold voltage	$V_{GE(th)}$	V_{CE} = V_{GE}, I_C = 4.0 mA	4.0	4.8	6.0	V
Temperature coefficient of threshold voltage	$\Delta V_{GE(th)}/\Delta T_J$	V_{CE} = V_{GE}, I_C = 4.0 mA, (25 °C to 125 °C)	-	-14.8	-	mV/°C
Forward transconductance	g_{fe}	V_{CE} = 20 V, I_C = 100 A	-	455	-	S
Transfer characteristics	V_{GE}	V_{CE} = 20 V, I_C = 200 A	-	6.65	-	V
Collector to emitter leakage current	I_{CES}	V_{GE} = 0 V, V_{CE} = 650 V	-	0.5	200	μA
		V_{GE} = 0 V, V_{CE} = 650 V, T_J = 125 °C	-	0.17	-	mA
Diode forward voltage drop	V_{FM}	I_C = 50 A, V_{GE} = 0 V	-	2.0	2.9	V
		I_C = 50 A, V_{GE} = 0 V, T_J = 125 °C	-	1.6	-	V
Gate to emitter leakage current	I_{GES}	V_{GE} = ± 20 V	-	-	± 480	nA

SWITCHING CHARACTERISTICS (T_J = 25 °C unless otherwise specified)						
PARAMETER	**SYMBOL**	**TEST CONDITIONS**	**MIN.**	**TYP.**	**MAX.**	**UNITS**
Total gate charge	Q_g	I_C = 200 A, V_{CC} = 520 V V_{GE} = 15 V	-	1763	-	nC
Gate to emitter charge	Q_{ge}		-	301	-	nC
Gate to collector charge	Q_{gc}		-	509	-	nC
Turn-on switching energy	E_{on}	I_C = 200 A, V_{CC} = 325 V, V_{GE} = 15 V, L = 500 μH R_g = 4.7 Ω, T_J = 25 °C	-	1.1	-	mJ
Turn-off switching energy	E_{off}		-	9.7	-	mJ
Total switching energy	E_{ts}		-	10.8	-	mJ
Turn-on delay time	$t_{d(on)}$		-	60	-	ns
Rise time	t_r		-	60	-	ns
Turn-off delay time	$t_{d(off)}$		-	520	-	ns
Fall time	t_f		-	57	-	ns
Turn-on switching energy	E_{on}	I_C = 200 A, V_{CC} = 325 V, V_{GE} = 15 V, L = 500 μH R_g = 4.7 Ω, T_J = 125 °C	-	1.1	-	mJ
Turn-off switching energy	E_{off}		-	13.7	-	mJ
Total switching energy	E_{ts}		-	14.8	-	mJ
Turn-on delay time	$t_{d(on)}$		-	60	-	ns
Rise time	t_r		-	61	-	ns
Turn-off delay time	$t_{d(off)}$		-	580	-	ns
Fall time	t_f		-	137	-	ns
Reverse bias safe operating area	RBSOA	T_J = 175 °C, I_C = 320 A, V_{CC} = 325 V, V_p = 650 V, R_g = 4.7 Ω, V_{GE} = 15 V to 0 V, L = 500 μH	Fullsquare			
Diode reverse recovery time	t_{rr}	I_F = 50 A, dI_F/dt = 500 A/μs, V_{rr} = 200 V, T_J = 125 °C	-	79	-	ns
Diode peak reverse current	I_{rr}		-	10.5	-	A
Diode recovery charge	Q_{rr}		-	409	-	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	-	141	-	ns
Diode peak reverse current	I_{rr}		-	19	-	A
Diode recovery charge	Q_{rr}		-	1336	-	nC

THERMAL AND MECHANICAL SPECIFICATIONS						
PARAMETER		**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNITS**
Operating junction temperature range		T_J	-40	-	175	°C
Storage temperature range		T_{Stg}	-40	-	150	°C
Junction to case	per switch	R_{thJC}	-	-	0.15	°C/W
	per diode		-	-	1.0	°C/W
Case to sink per module		R_{thCS}	-	0.1	-	°C/W
Mounting torque	case to heatsink		-	-	4	Nm
	case to terminal 1, 2, 3		-	-	3	Nm
Weight			-	185	-	g

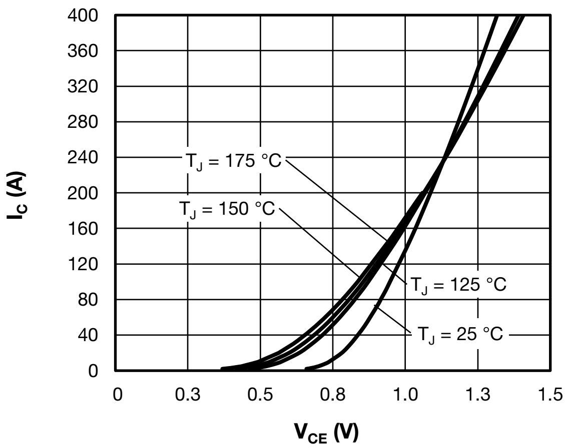


Fig. 1 - Typical Trench IGBT Output Characteristics, V_{GE} = 15 V

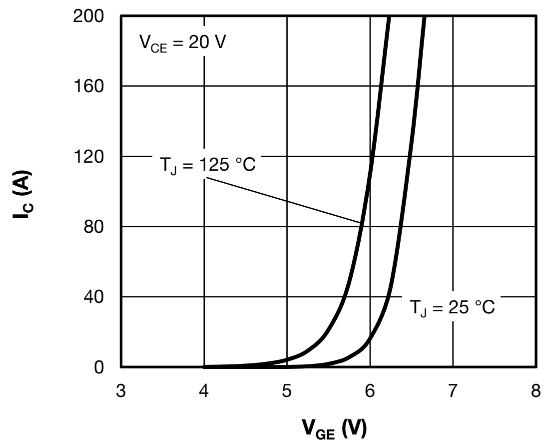


Fig. 4 - Typical Trench IGBT Transfer Characteristics

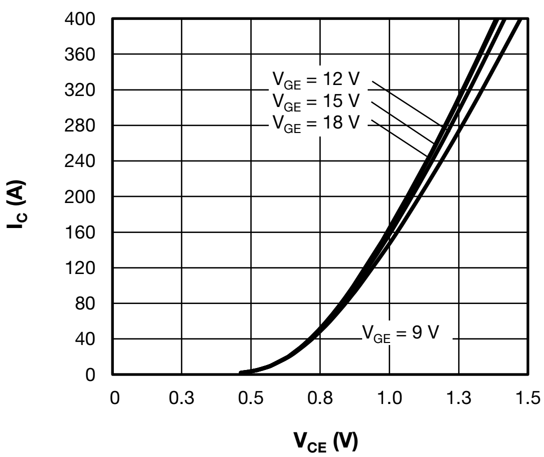


Fig. 2 - Typical Trench IGBT Output Characteristics, T_J = 125 °C

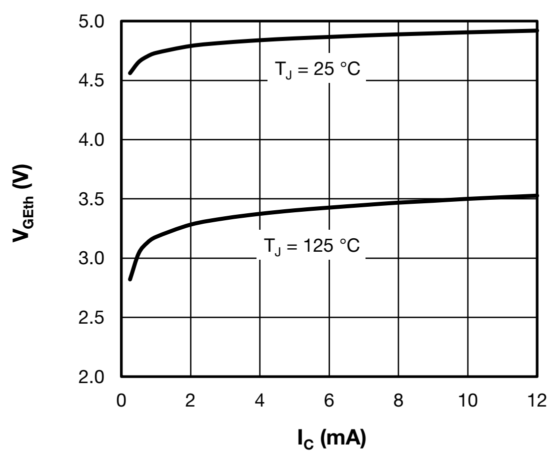


Fig. 5 - Typical Trench IGBT Gate Threshold Voltage

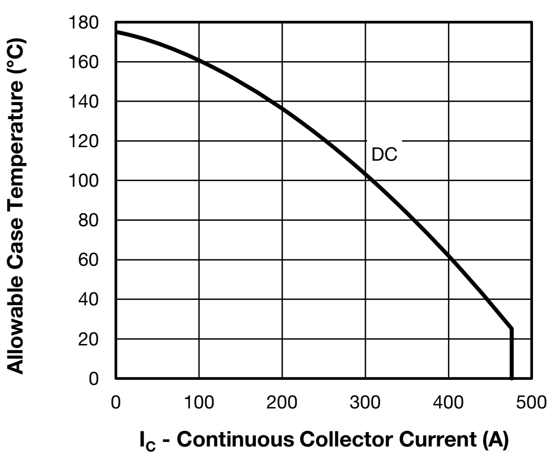


Fig. 3 - Maximum Trench IGBT Continuous Collector Current vs. Case Temperature

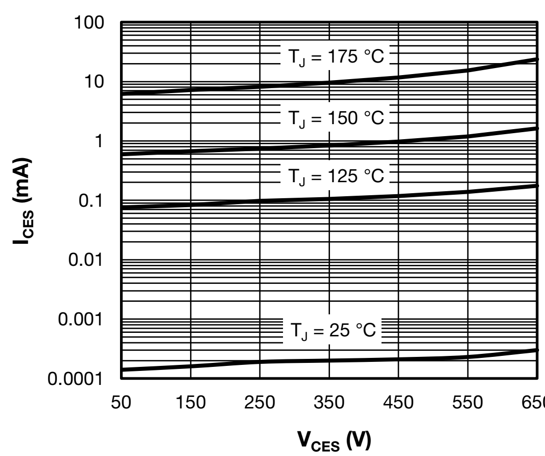


Fig. 6 - Typical Trench IGBT Zero Gate Voltage Collector Current

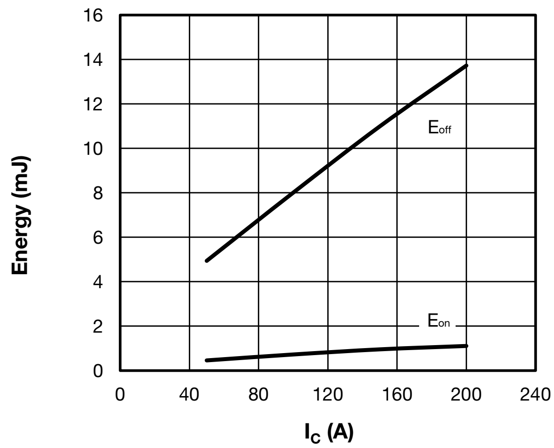


Fig. 7 - Typical Trench IGBT Energy Loss vs. I_C (with Antiparallel Diode)
T_J = 125 °C, V_{CC} = 325 V, R_g = 4.7 Ω, V_{GE} = +15 V / -15 V, L = 500 μH

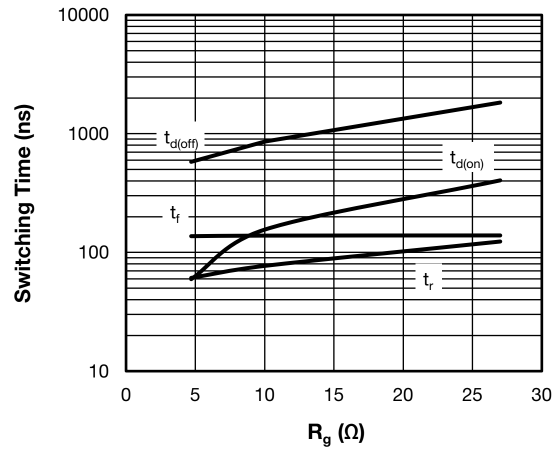


Fig. 10 - Typical Trench IGBT Switching Time vs. R_g (with Antiparallel Diode)
T_J = 125 °C, V_{CC} = 325 V, I_C = 200 A, V_{GE} = +15 V / -15 V, L = 500 μH

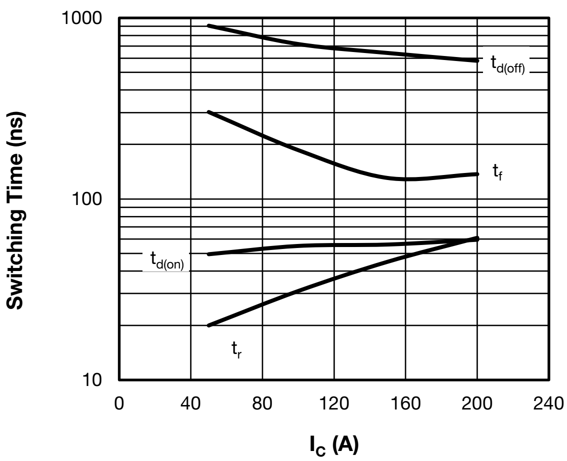


Fig. 8 - Typical Trench IGBT Switching Time vs. I_C (with Antiparallel Diode)
T_J = 125 °C, V_{CC} = 325 V, R_g = 4.7 Ω, V_{GE} = +15 V / -15 V, L = 500 μH

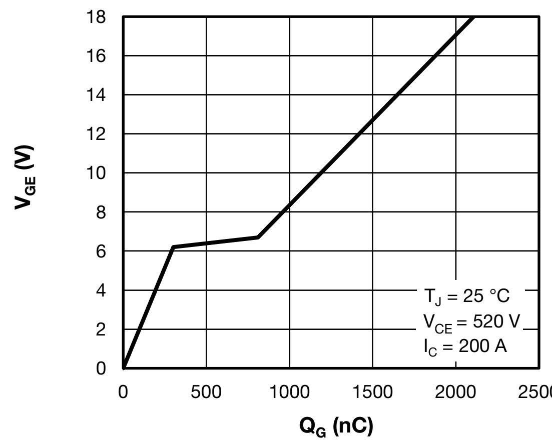


Fig. 11 - Typical Trench IGBT Gate Charge vs. Gate to Collector Voltage

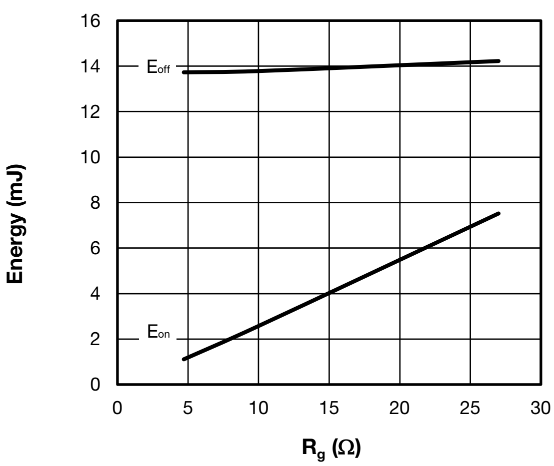


Fig. 9 - Typical Trench IGBT Energy Loss vs. R_g (with Antiparallel Diode)
T_J = 125 °C, V_{CC} = 325 V, I_C = 200 A, V_{GE} = +15 V / -15 V, L = 500 μH

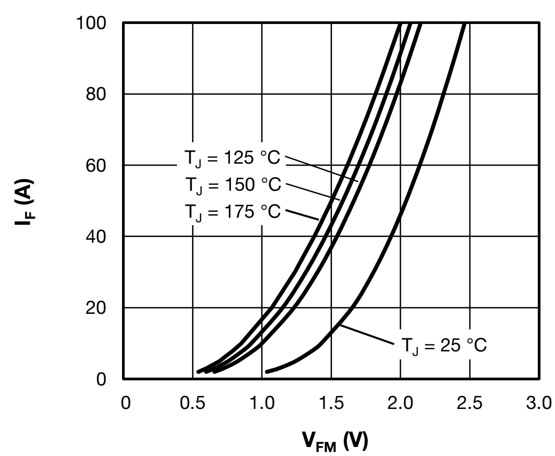


Fig. 12 - Typical Antiparallel Diode Forward Characteristics

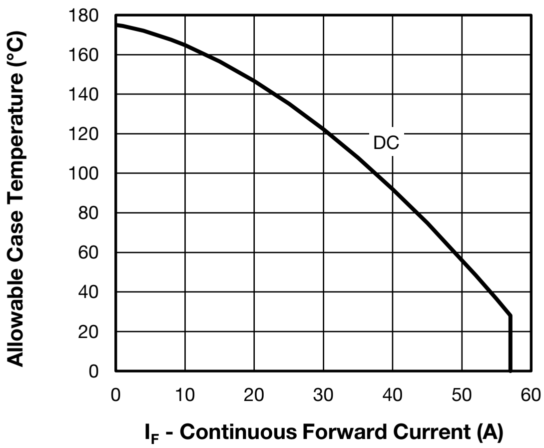


Fig. 13 - Maximum Antiparallel Diode Continuous Forward Current vs. Case Temperature

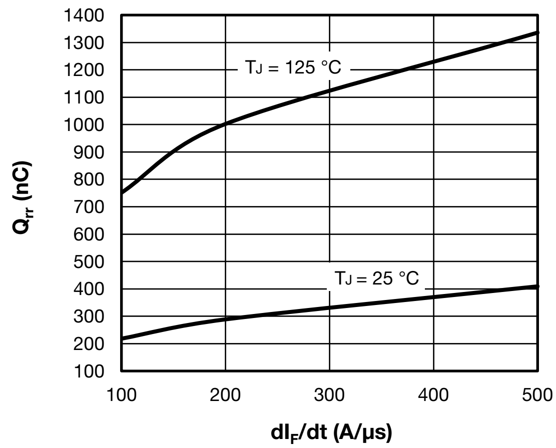


Fig. 16 - Typical Antiparallel Diode Reverse Recovery Charge vs. dI_Fdt
I_F = 50 A, V_{CC} = 200 V

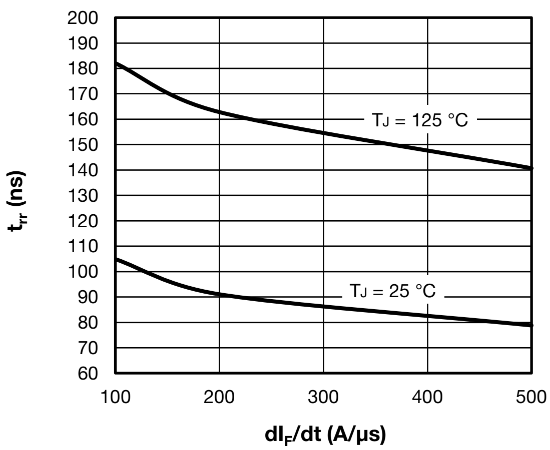


Fig. 14 - Typical Antiparallel Diode Reverse Recovery Time vs. dI_Fdt
I_F = 50 A, V_{CC} = 200 V

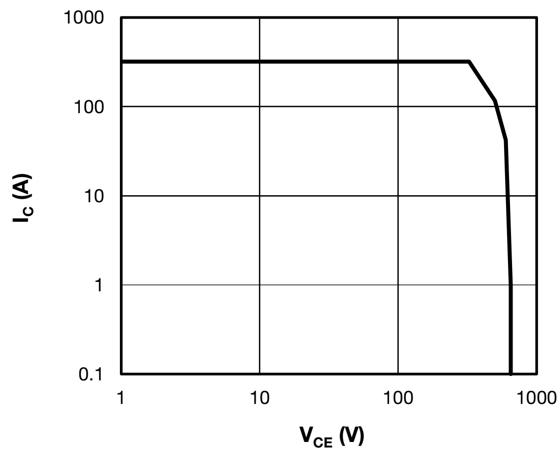


Fig. 17 - Trench IGBT Reverse BIAS SOA
T_J = 175 °C, I_C = 320 A, R_g = 4.7 Ω, V_{GE} = +15 V / 0 V, V_{CC} = 325 V, V_p = 650 V

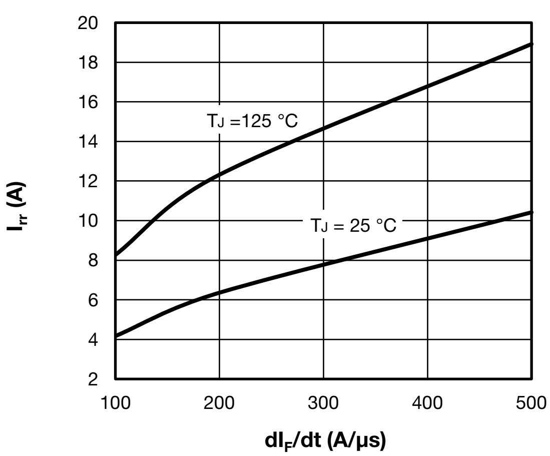


Fig. 15 - Typical Antiparallel Diode Reverse Recovery Current vs. dI_Fdt
I_F = 50 A, V_{CC} = 200 V

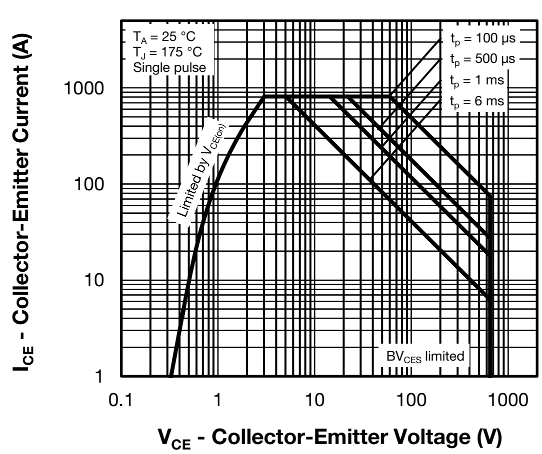


Fig. 18 - Trench IGBT Safe Operating Area

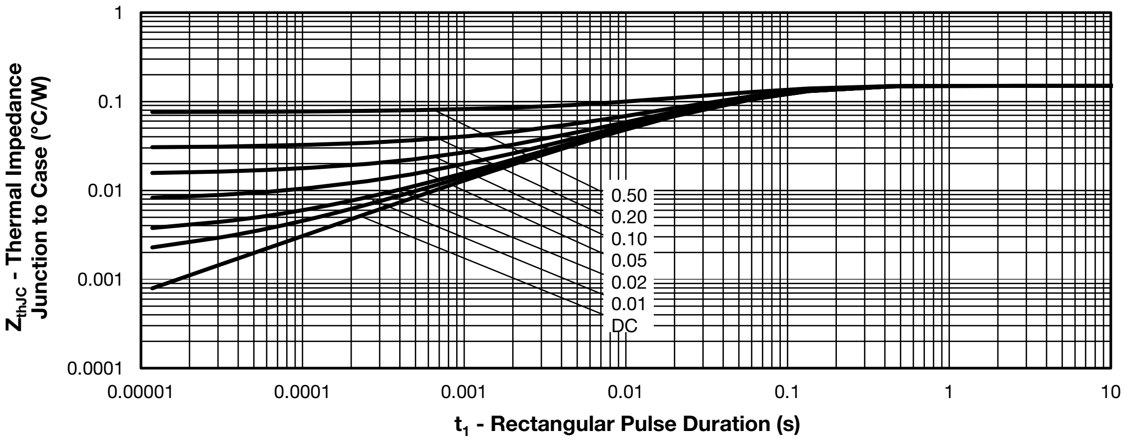


Fig. 19 - Maximum Trench IGBT Thermal Impedance Z_{thJC} Characteristics

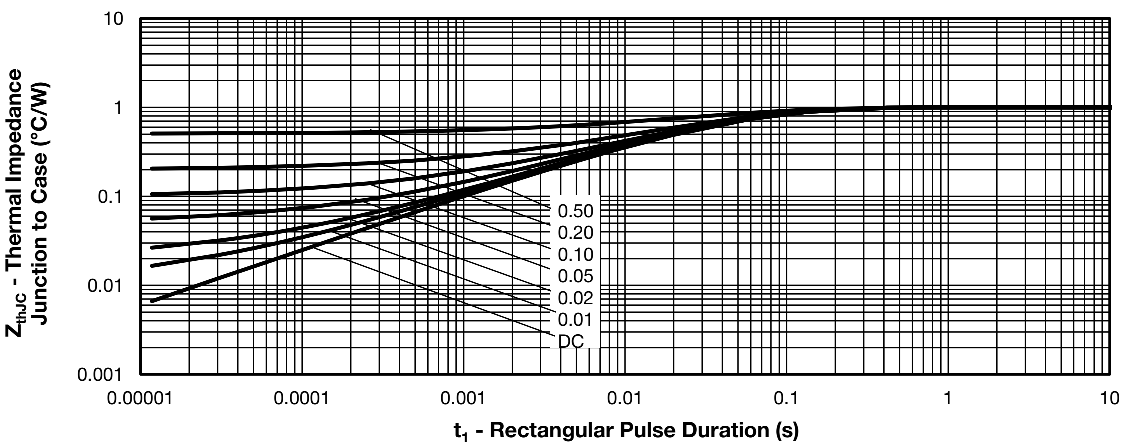


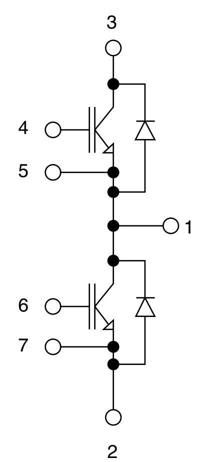
Fig. 20 - Maximum Antiparallel Diode Thermal Impedance Z_{thJC} Characteristics

ORDERING INFORMATION TABLE

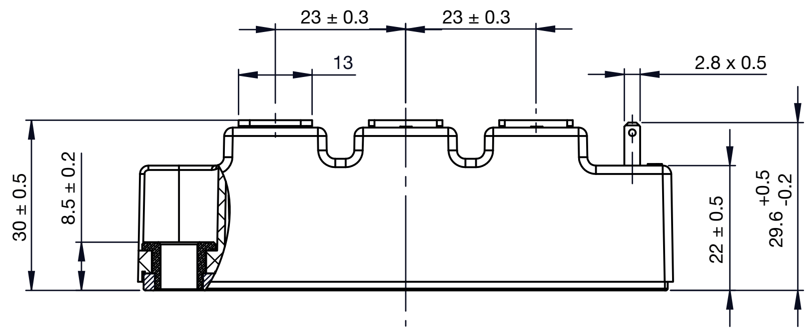
Device code	VS-	G	T	200	T	S	065	S
	1	2	3	4	5	6	7	8

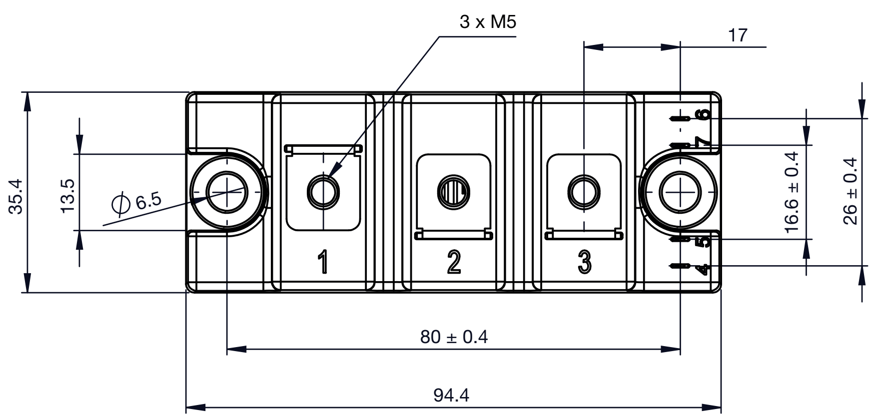
1	-	Vishay Semiconductors product
2	-	Insulated Gate Bipolar Transistor (IGBT)
3	-	T = trench IGBT
4	-	Current rating (200 = 200 A)
5	-	Circuit configuration (T = half bridge)
6	-	Package indicator (S = INT-A-PAK IGBT)
7	-	Voltage rating (065 = 650 V)
8	-	Speed type = (S = standard speed IGBT)

CIRCUIT CONFIGURATION



DIMENSIONS in millimeters (inches)





General tolerance ± 0.5 mm

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