INT-A-PAK, Half Bridge - Trench IGBT, 200 A

INT-A-PAK

FEATURES

- Trench IGBT
- Very low $V_{CE(on)}$
- Positive $V_{CE(on)}$ temperature coefficient
- FRED Pt® anti-parallel diode low Q_{rr} and low switching energy
- Industry and standard package
- T_J = 175 °C
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

RoHS COMPLIANT

BENEFITS

- Benchmark efficiency for UPS and welding application
- Rugged transient performance
- Direct mounting on heatsink
- Very low junction to case thermal resistance

PRIMARY CHARACTERISTICS	
V_{CES}	650 V
I_C (DC) at T_C = 59°C	150 A
$V_{CE(on)}$ (typical) at I_C = 200 A, T_J = 25 °C	1.90 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	177	A
			T_C = 80 °C	132	
Pulsed collector current		I_{CM}	T_J = 175 °C, t_p = 6 ms, V_{GE} = 15 V	570	
Clamped inductive load current		I_{LM}		600	
Diode continuous forward current		I_F	T_C = 25 °C	138	
			T_C = 80 °C	103	
Maximum non-repetitive peak current		I_{FSM}	10 ms sine or 6 ms rectangular pulse, T_J = 25 °C	700	
Gate to emitter voltage		V_{GE}		± 20	V
Maximum power dissipation	IGBT	P_D	T_C = 25 °C	429	W
			T_C = 80 °C	271	
	Diode		T_C = 25 °C	288	
			T_C = 80 °C	183	
RMS isolation voltage		V_{ISOL}	T_J = 25 °C, f = 50 Hz, t = 1 s	3500	V
Operating junction temperature range		T_J		-40 to +175	°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	-	1.49	-	
		V_{GE} = 15 V, I_C = 200 A	-	1.90	2.12	
		V_{GE} = 15 V, I_C = 100 A, T_J = 125 °C	-	1.62	-	
		V_{GE} = 15 V, I_C = 200 A, T_J = 125 °C	-	2.20	-	
Gate threshold voltage	$V_{GE(th)}$	V_{CE} = V_{GE}, I_C = 2.0 mA	2.9	4.0	5.3	
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	-	200	-	S
Transfer characteristics	V_{GE}	V_{CE} = 20 V, I_C = 200 A	-	6.6	-	V
Collector to emitter leakage current	I_{CES}	V_{GE} = 0 V, V_{CE} = 650 V	-	0.3	200	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	-	1.75	-	V
		I_{FM} = 200 A	-	2.08	3.04	
		I_{FM} = 100 A, T_J = 125 °C	-	1.41	-	
		I_{FM} = 200 A, T_J = 125 °C	-	1.80	-	
Gate to emitter leakage current	I_{GES}	V_{GE} = ± 20 V	-	-	200	nA

SWITCHING CHARACTERISTICS						
PARAMETER	**SYMBOL**	**TEST CONDITIONS**	**MIN.**	**TYP.**	**MAX.**	**UNITS**
Total gate charge (turn-on)	Q_g	I_C = 200 A	-	476	-	nC
Gate to emitter charge (turn-on)	Q_{ge}	V_{CC} = 520 V	-	61	-	
Gate to collector (turn-on)	Q_{gc}	V_{GE} = 15 V	-	128	-	
Turn-on switching loss	E_{on}	V_{CC} = 325 V, I_C = 200 A, R_g = 4.7 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 switching loss	E_{on}	V_{CC} = 325 V, I_C = 200 A, R_g = 4.7 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 = 600 A, R_g = 27 Ω, V_{CC} = 400 V, V_p = 650 V, V_{GE} = 15 V to 0 V, T_J = 175 °C				
ANTI-PARALLEL DIODE						
Diode reverse recovery time	t_{rr}	I_F = 50 A, dI_F/dt = 500 A/μs V_{rr} = 200 V, T_J = 25 °C	-	73	-	ns
Diode peak reverse current	I_{rr}		-	13	-	A
Diode recovery charge	Q_{rr}		-	465	-	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	-	125	
Junction to case per leg	IGBT	R_{thJC}		-	-	0.35	°C/W
	Diode			-	-	0.52	
Case to sink per module (conductive grease applied)		R_{thCS}		-	0.05	-	
Mounting torque	Power terminal screw: M5			2.5	-	5.0	Nm
	Mounting screw: M6			3.0	-	5.0	
Weight				-	150	-	g

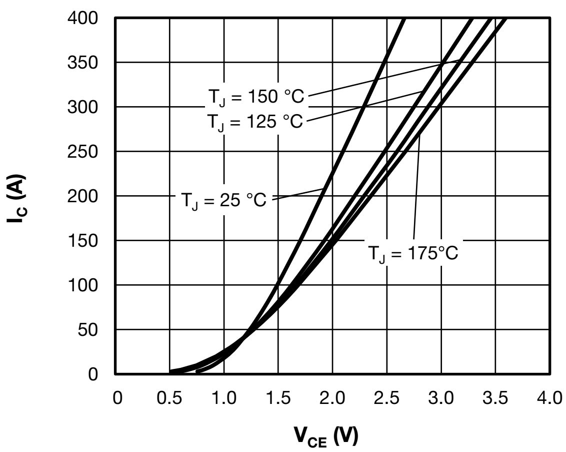


Fig. 1 - Typical IGBT Output Characteristics, V_{GE} = 15 V

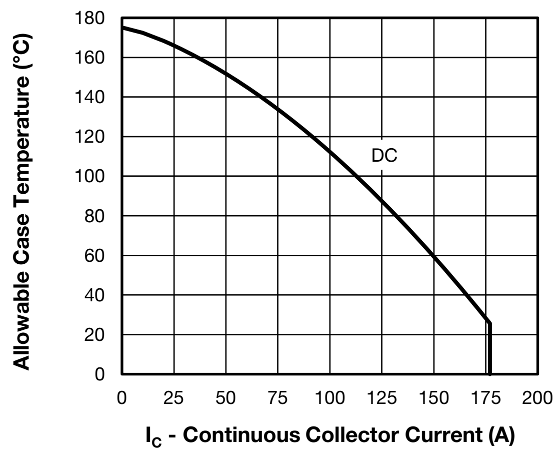


Fig. 3 - Maximum IGBT Continuous Collector Current vs. Case Temperature

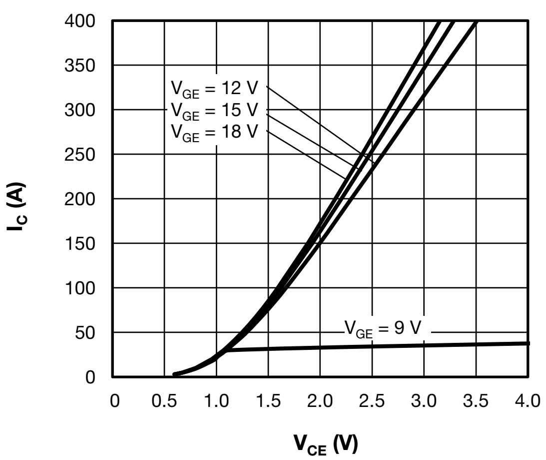


Fig. 2 - Typical IGBT Output Characteristics, T_J = 125 °C

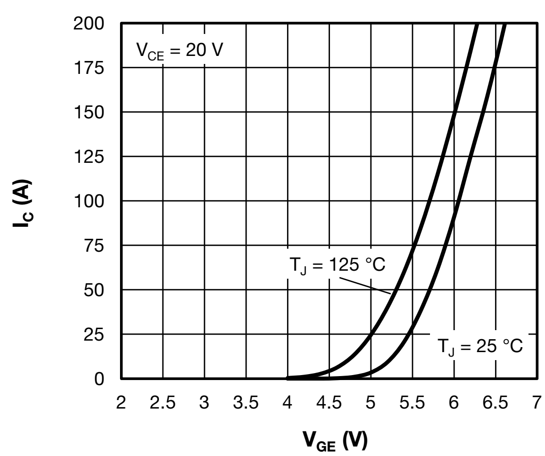


Fig. 4 - Typical IGBT Transfer Characteristics

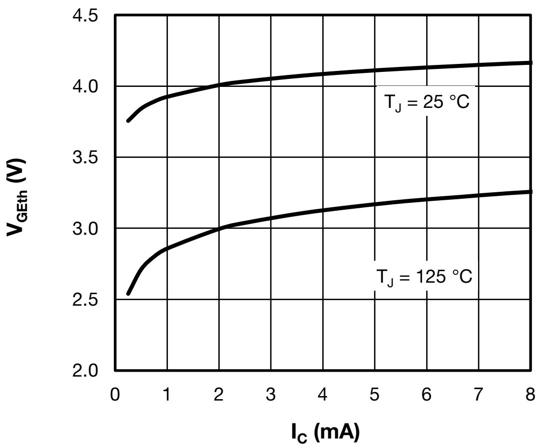


Fig. 5 - Typical IGBT Threshold Voltage

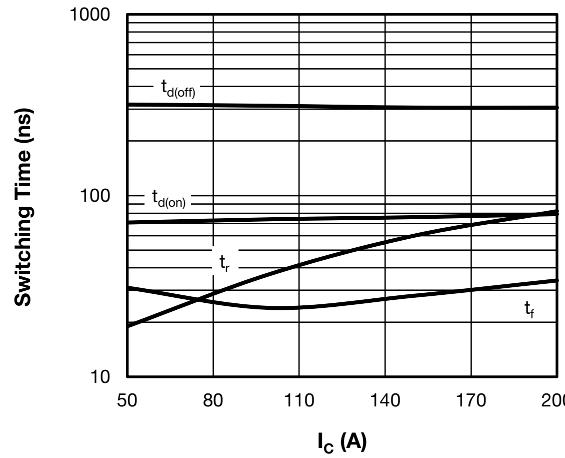


Fig. 8 - Typical Trench IGBT Switching Time vs. I_C
(with Antiparallel Diode)
T_J = 125 °C, V_{CC} = 300 V, R_g = 4.7 Ω, V_{GE} = +15 V / -15 V, L = 500 µH

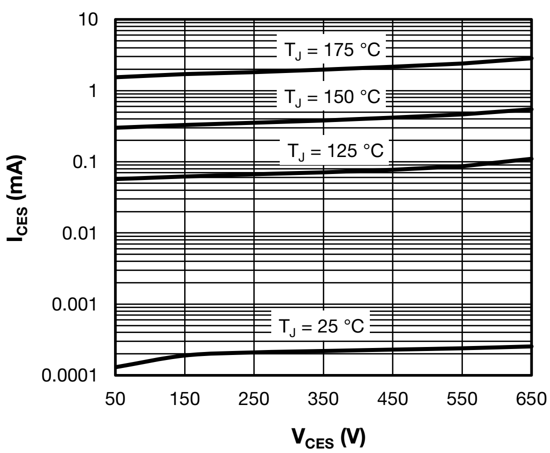


Fig. 6 - Typical IGBT Zero Gate Voltage Collector Current

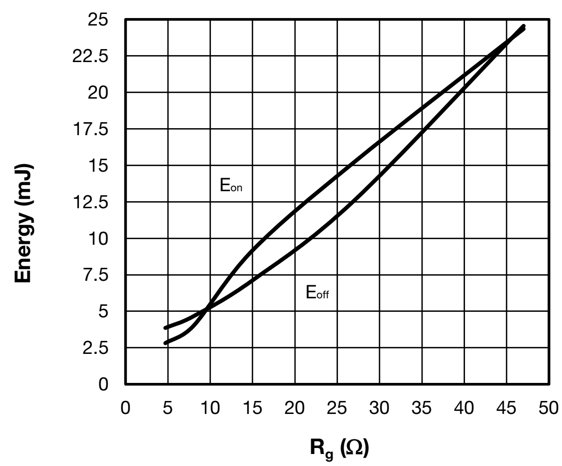


Fig. 9 - Typical Trench IGBT Energy Loss vs. R_g
(with Antiparallel Diode)
T_J = 125 °C, V_{CC} = 300 V, I_C = 200 A, V_{GE} = +15 V / -15 V, L = 500 µH

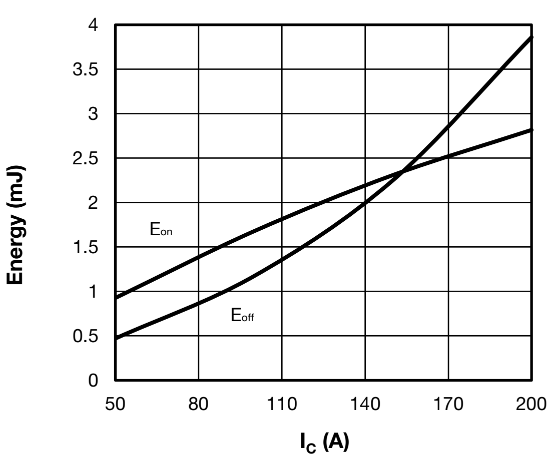


Fig. 7 - Typical Trench IGBT Energy Loss vs. I_C
(with Antiparallel Diode)
T_J = 125 °C, V_{CC} = 300 V, R_g = 4.7 Ω, V_{GE} = +15 V / -15 V, L = 500 µH

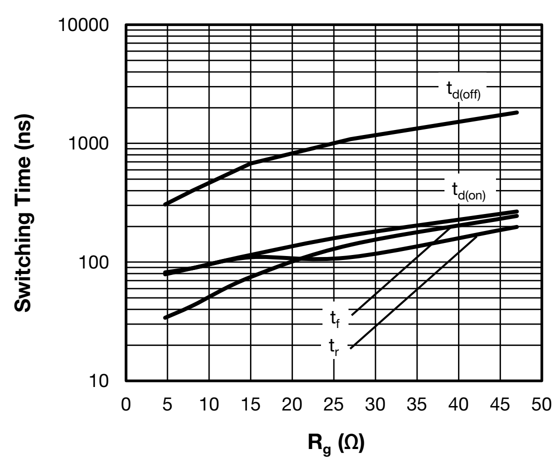


Fig. 10 - Typical Trench IGBT Switching Time vs. R_g
(with Antiparallel Diode)
T_J = 125 °C, V_{CC} = 300 V, I_C = 200 A, V_{GE} = +15 V / -15 V,
L = 500 µH

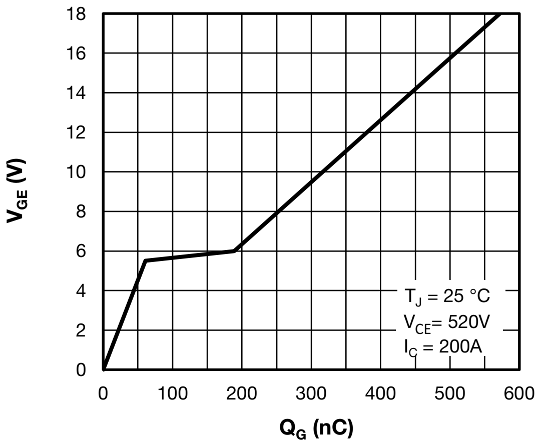


Fig. 11 - Typical Trench IGBT Gate Charge vs. Gate to Emitter Voltage

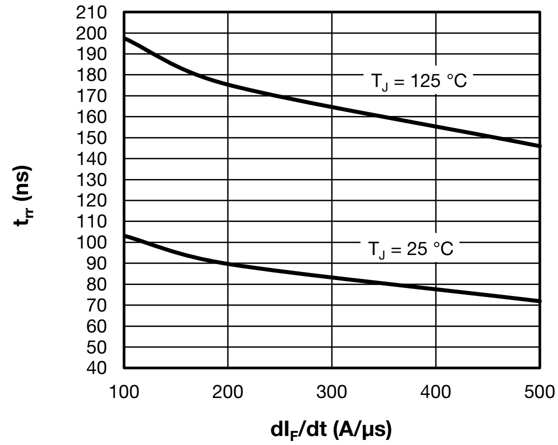


Fig. 14 - Typical Diode Reverse Recovery Time vs. dI_F/dt
V_{rr} = 200 V, I_F = 50 A

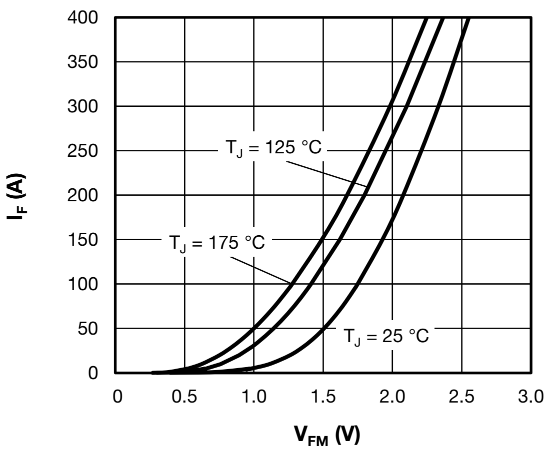


Fig. 12 - Typical IGBT Switching Time vs. I_C

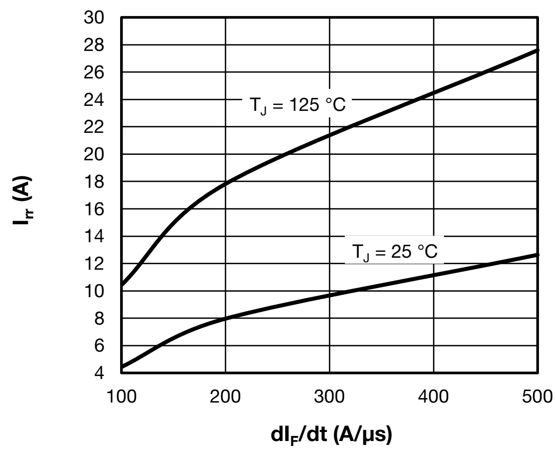


Fig. 15 - Typical Diode Reverse Recovery Current vs. dI_F/dt
V_{rr} = 200 V, I_F = 50 A

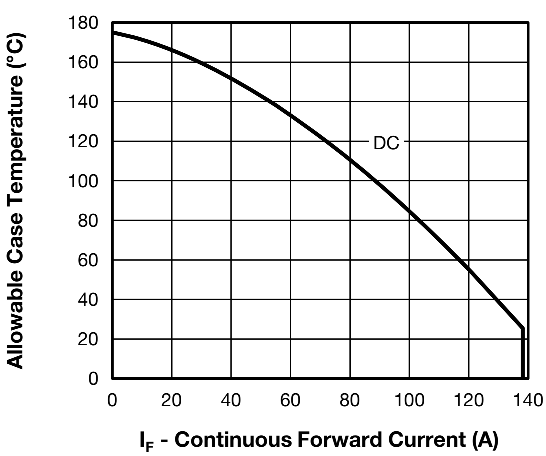


Fig. 13 - Maximum Diode Continuous Forward Current vs. Case Temperature

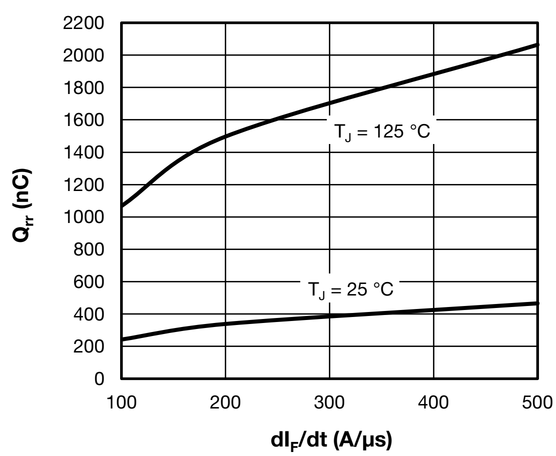


Fig. 16 - Typical Diode Reverse Recovery Current vs. dI_F/dt
V_{rr} = 200 V, I_F = 50 A

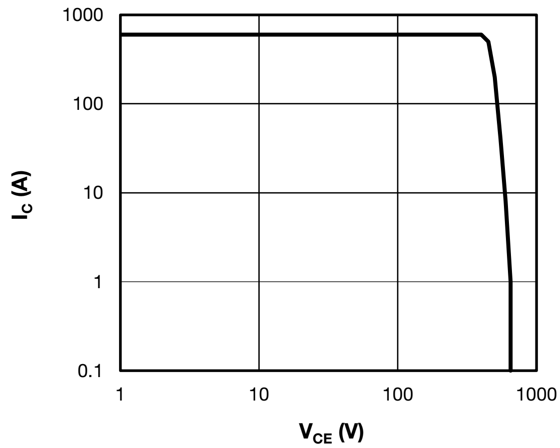


Fig. 17 - Typical Trench IGBT Reverse BIAS SOA
T_J = 175 °C, I_C = 600 A, R_g = 27 Ω, V_{GE} = +15 V / 0 V, V_{CC} = 400 V, V_p = 650 V

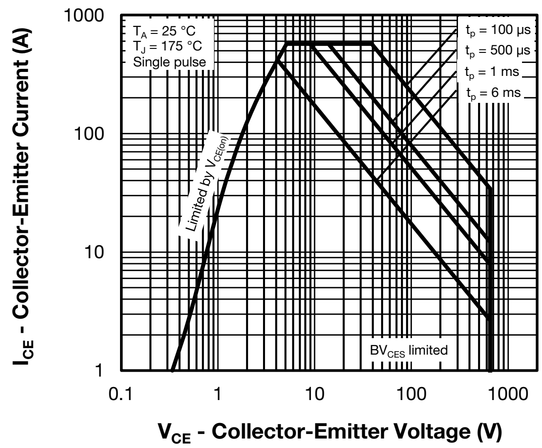


Fig. 18 - Trench IGBT safe Operating Area

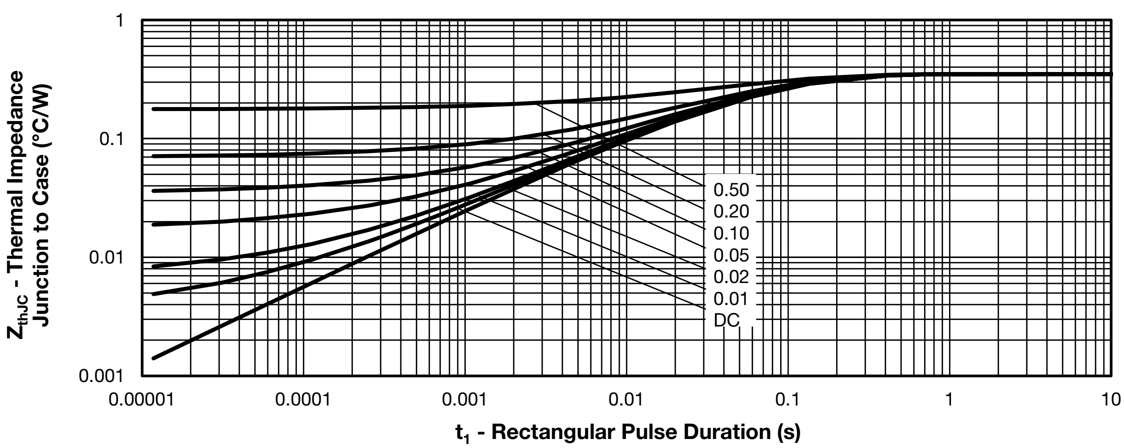


Fig. 19 - Maximum Trench IGBT Thermal Impedance Z_{thJC} Characteristics

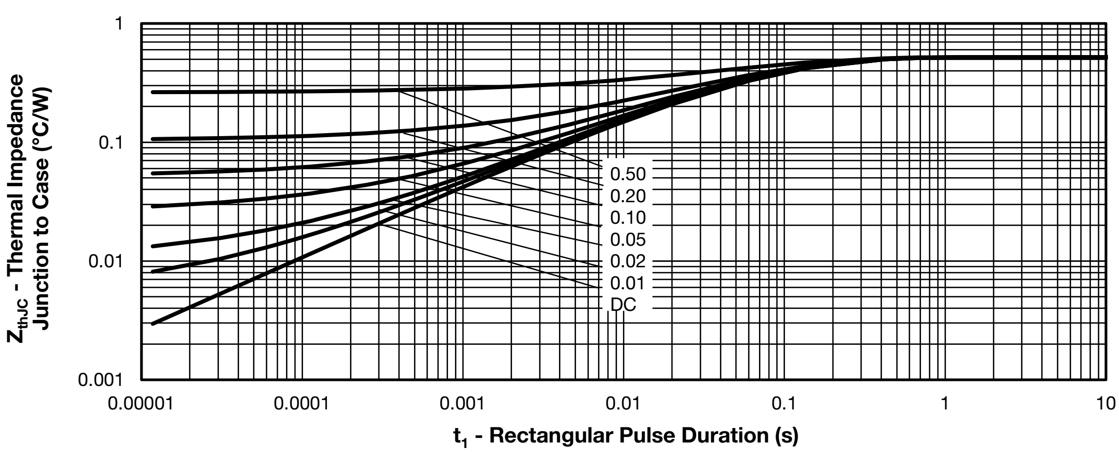
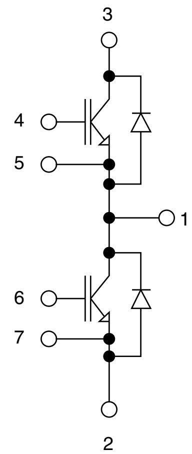


Fig. 20 - Maximum Diode Thermal Impedance Z_{thJC} Characteristics

CIRCUIT CONFIGURATION

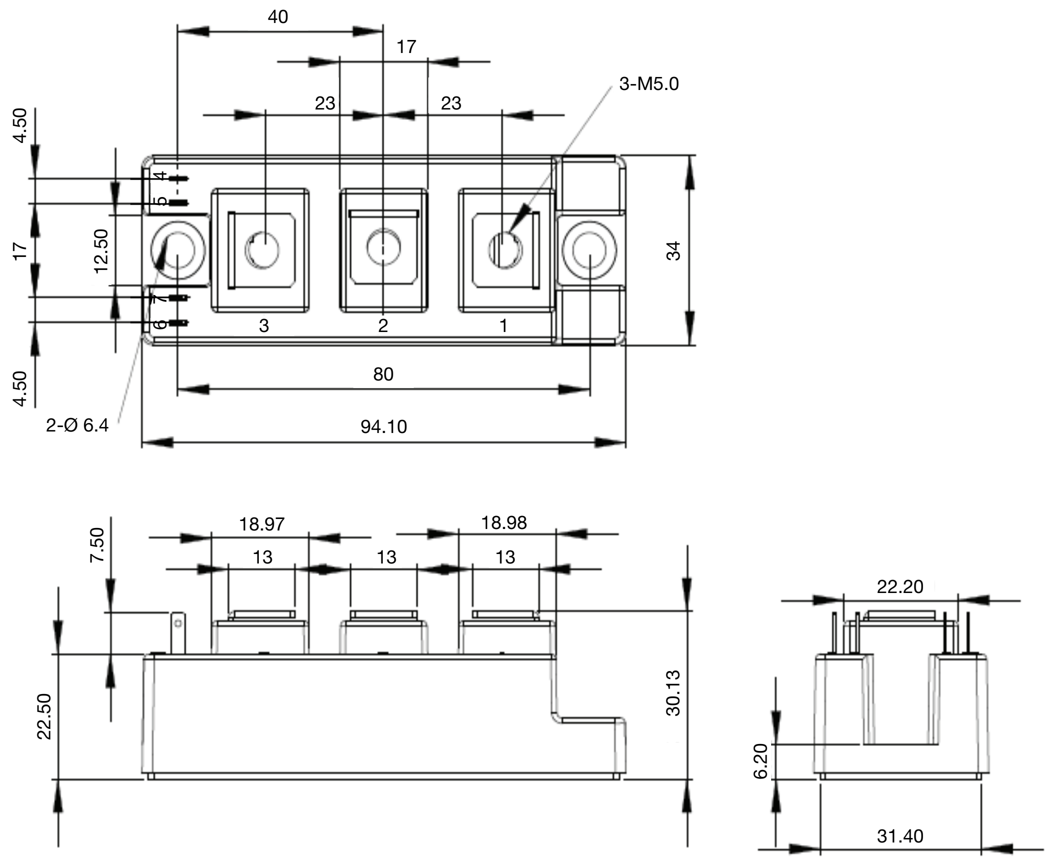


ORDERING INFORMATION TABLE

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

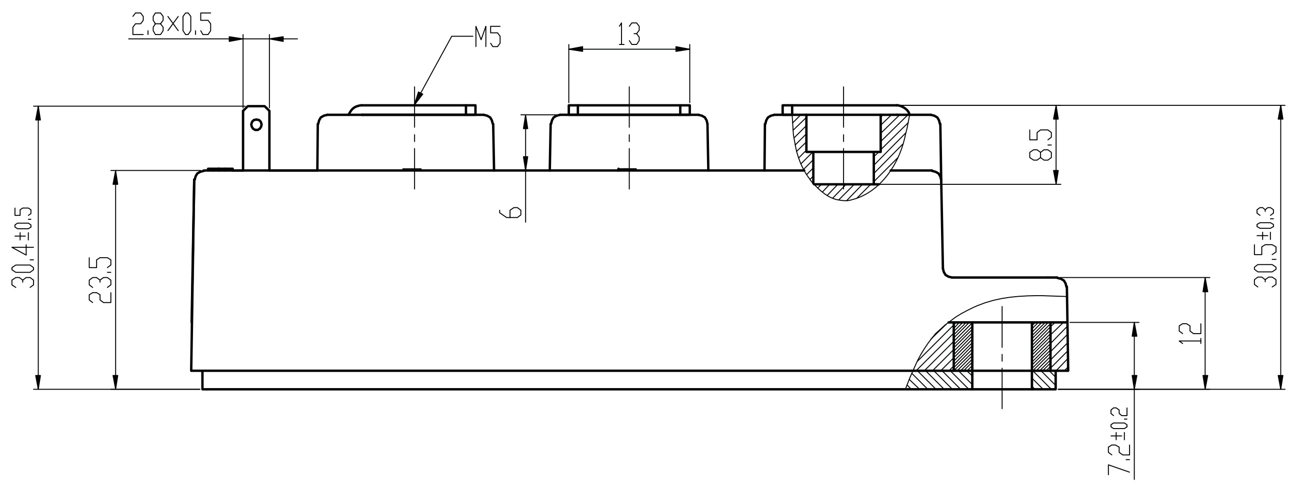
1 - Vishay Semiconductors product
2 - Insulated gate bipolar transistor (IGBT)
3 - T = trench IGBT
4 - Current rating (200 = 200 A)
5 - Circuit configuration (T = half bridge)
6 - Package indicator (P = INT-A-PAK IGBT)
7 - Voltage rating (065 = 650 V)
8 - Speed/type (U = ultrafast)

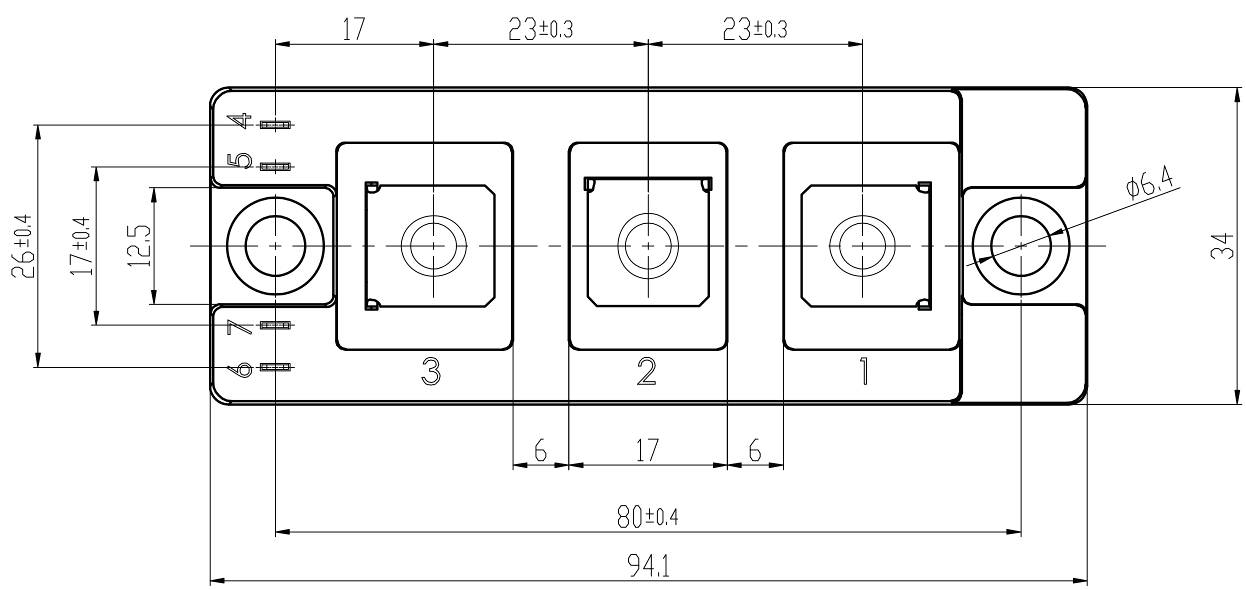
DIMENSIONS in millimeters



INT-A-PAK

DIMENSIONS in millimeters (inches)





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