

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
- $T_J = 175\text{ °C}$
- 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 $T_C = 59\text{ °C}$	150 A
$V_{CE(on)}$ (typical) at $I_C = 200\text{ A}$, $T_J = 25\text{ °C}$	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	$T_C = 25\text{ °C}$	177	A
		$T_C = 80\text{ °C}$	132	
Pulsed collector current	I_{CM}	$T_J = 175\text{ °C}$, $t_p = 6\text{ ms}$, $V_{GE} = 15\text{ V}$	570	
Clamped inductive load current	I_{LM}		600	
Diode continuous forward current	I_F	$T_C = 25\text{ °C}$	138	
		$T_C = 80\text{ °C}$	103	
Maximum non-repetitive peak current	I_{FSM}	10 ms sine or 6 ms rectangular pulse, $T_J = 25\text{ °C}$	700	
Gate to emitter voltage	V_{GE}		± 20	V
Maximum power dissipation	IGBT	$T_C = 25\text{ °C}$	429	W
		$T_C = 80\text{ °C}$	271	
	Diode	$T_C = 25\text{ °C}$	288	
		$T_C = 80\text{ °C}$	183	
RMS isolation voltage	V_{ISOL}	$T_J = 25\text{ °C}$, $f = 50\text{ Hz}$, $t = 1\text{ s}$	3500	V
Operating junction temperature range	T_J		-40 to +175	°C



ELECTRICAL SPECIFICATIONS ($T_J = 25\text{ }^\circ\text{C}$ unless otherwise noted)						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Collector to emitter breakdown voltage	$V_{(BR)CES}$	$V_{GE} = 0\text{ V}, I_C = 400\text{ }\mu\text{A}$	650	-	-	V
Collector to emitter voltage	$V_{CE(on)}$	$V_{GE} = 15\text{ V}, I_C = 100\text{ A}$	-	1.49	-	
		$V_{GE} = 15\text{ V}, I_C = 200\text{ A}$	-	1.90	2.12	
		$V_{GE} = 15\text{ V}, I_C = 100\text{ A}, T_J = 125\text{ }^\circ\text{C}$	-	1.62	-	
		$V_{GE} = 15\text{ V}, I_C = 200\text{ A}, T_J = 125\text{ }^\circ\text{C}$	-	2.20	-	
Gate threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}, I_C = 2.0\text{ mA}$	2.9	4.0	5.3	
Temperature coefficient of threshold voltage	$\Delta V_{GE(th)}/\Delta T_J$	$V_{CE} = V_{GE}, I_C = 2.0\text{ mA}$ ($25\text{ }^\circ\text{C}$ to $125\text{ }^\circ\text{C}$)	-	-10	-	mV/ $^\circ\text{C}$
Forward transconductance	g_{fe}	$V_{CE} = 20\text{ V}, I_C = 200\text{ A}$	-	200	-	S
Transfer characteristics	V_{GE}	$V_{CE} = 20\text{ V}, I_C = 200\text{ A}$	-	6.6	-	V
Collector to emitter leakage current	I_{CES}	$V_{GE} = 0\text{ V}, V_{CE} = 650\text{ V}$	-	0.3	200	μA
		$V_{GE} = 0\text{ V}, V_{CE} = 650\text{ V}, T_J = 125\text{ }^\circ\text{C}$	-	0.1	-	mA
Diode forward voltage drop	V_{FM}	$I_{FM} = 100\text{ A}$	-	1.75	-	V
		$I_{FM} = 200\text{ A}$	-	2.08	3.04	
		$I_{FM} = 100\text{ A}, T_J = 125\text{ }^\circ\text{C}$	-	1.41	-	
		$I_{FM} = 200\text{ A}, T_J = 125\text{ }^\circ\text{C}$	-	1.80	-	
Gate to emitter leakage current	I_{GES}	$V_{GE} = \pm 20\text{ V}$	-	-	200	nA

SWITCHING CHARACTERISTICS						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Total gate charge (turn-on)	Q_g	$I_C = 200\text{ A}$	-	476	-	nC
Gate to emitter charge (turn-on)	Q_{ge}	$V_{CC} = 520\text{ V}$	-	61	-	
Gate to collector (turn-on)	Q_{gc}	$V_{GE} = 15\text{ V}$	-	128	-	
Turn-on switching loss	E_{on}	$V_{CC} = 325\text{ V}, I_C = 200\text{ A}, R_g = 4.7\text{ }\Omega,$ $L = 500\text{ }\mu\text{H}, V_{GE} = 15\text{ V}$	-	2.34	-	mJ
Turn-off switching loss	E_{off}		-	3.77	-	
Total switching loss	E_{tot}		-	6.11	-	
Turn-on switching loss	E_{on}	$V_{CC} = 325\text{ V}, I_C = 200\text{ A}, R_g = 4.7\text{ }\Omega,$ $L = 500\text{ }\mu\text{H}, V_{GE} = 15\text{ V},$ $T_J = 125\text{ }^\circ\text{C}$	-	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	$I_C = 600\text{ A}, R_g = 27\text{ }\Omega, V_{CC} = 400\text{ V},$ $V_p = 650\text{ V}, V_{GE} = 15\text{ V to } 0\text{ V}, T_J = 175\text{ }^\circ\text{C}$				
ANTI-PARALLEL DIODE						
Diode reverse recovery time	t_{rr}	$I_F = 50\text{ A}, di_F/dt = 500\text{ A}/\mu\text{s}$ $V_{rr} = 200\text{ V}, T_J = 25\text{ }^\circ\text{C}$	-	73	-	ns
Diode peak reverse current	I_{rr}		-	13	-	A
Diode recovery charge	Q_{rr}		-	465	-	nC
Diode reverse recovery time	t_{rr}	$I_F = 50\text{ A}, di_F/dt = 500\text{ A}/\mu\text{s}$ $V_{rr} = 200\text{ V}, T_J = 125\text{ }^\circ\text{C}$	-	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	$^{\circ}\text{C}$
Storage temperature range	T_{Stg}		-40	-	125	$^{\circ}\text{C}$
Junction to case per leg	IGBT		-	-	0.35	$^{\circ}\text{C}/\text{W}$
	Diode					
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

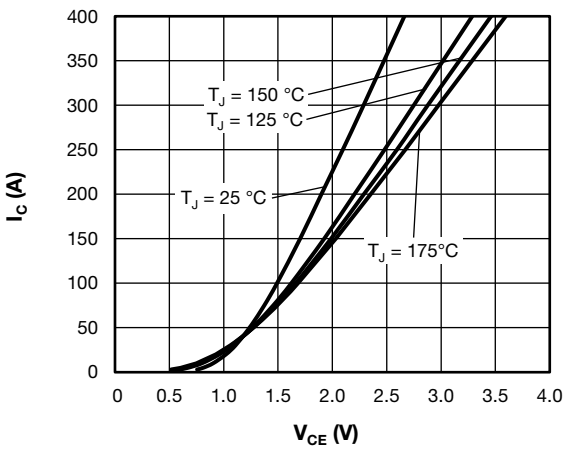


Fig. 1 - Typical IGBT Output Characteristics, $V_{GE} = 15\text{ V}$

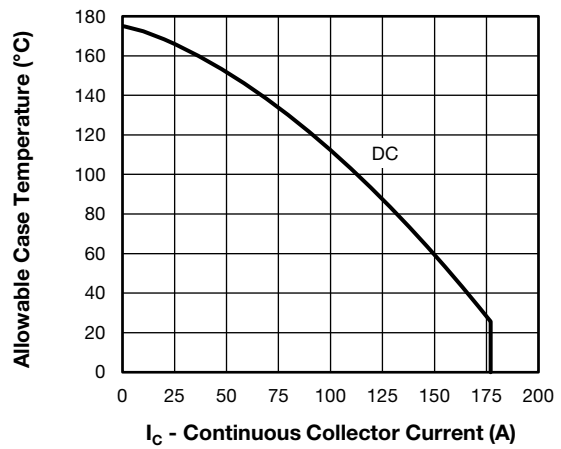


Fig. 3 - Maximum IGBT Continuous Collector Current vs. Case Temperature

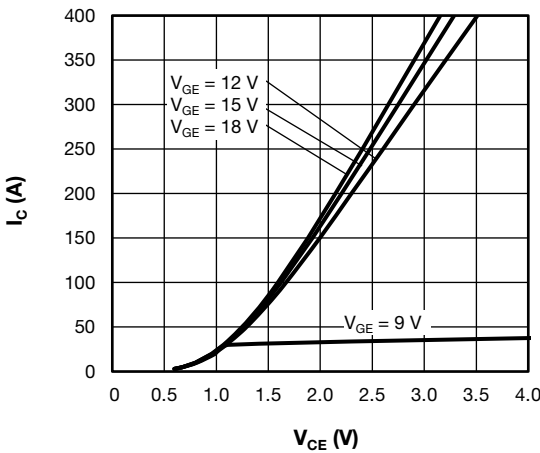


Fig. 2 - Typical IGBT Output Characteristics, $T_J = 125\text{ }^{\circ}\text{C}$

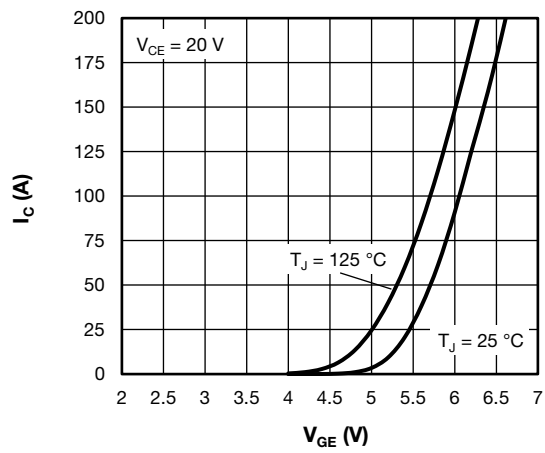


Fig. 4 - Typical IGBT Transfer Characteristics

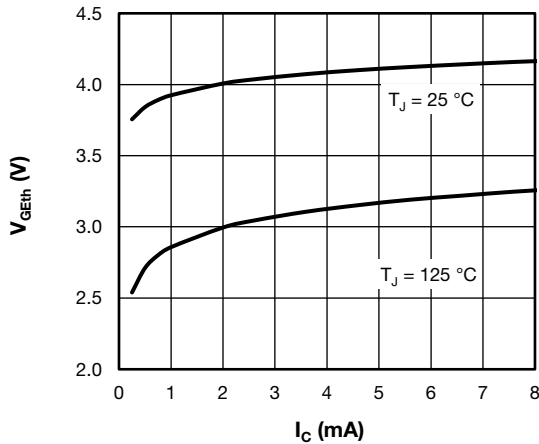


Fig. 5 - Typical IGBT Threshold Voltage

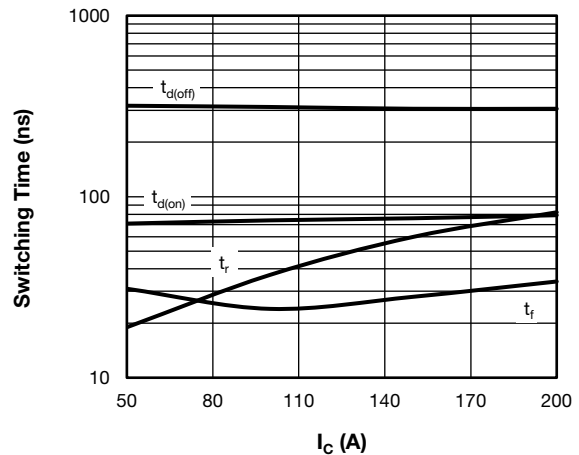


Fig. 8 - Typical Trench IGBT Switching Time vs. I_C (with Antiparallel Diode)

$T_J = 125\text{ }^\circ\text{C}$, $V_{CC} = 300\text{ V}$, $R_g = 4.7\ \Omega$, $V_{GE} = +15\text{ V} / -15\text{ V}$, $L = 500\ \mu\text{H}$

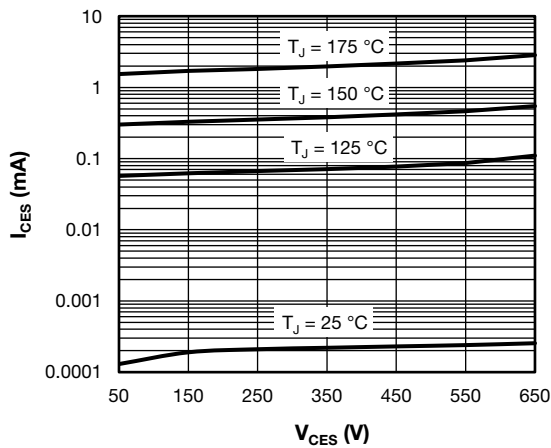


Fig. 6 - Typical IGBT Zero Gate Voltage Collector Current

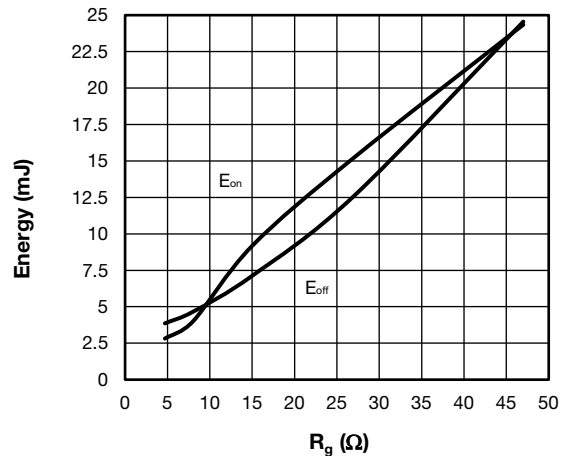


Fig. 9 - Typical Trench IGBT Energy Loss vs. R_g (with Antiparallel Diode)

$T_J = 125\text{ }^\circ\text{C}$, $V_{CC} = 300\text{ V}$, $I_C = 200\text{ A}$, $V_{GE} = +15\text{ V} / -15\text{ V}$, $L = 500\ \mu\text{H}$

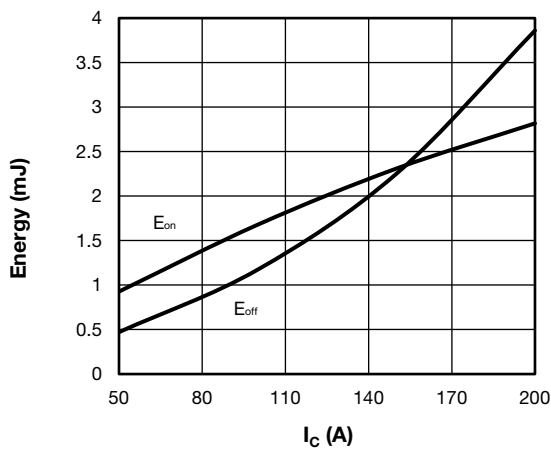


Fig. 7 - Typical Trench IGBT Energy Loss vs. I_C (with Antiparallel Diode)

$T_J = 125\text{ }^\circ\text{C}$, $V_{CC} = 300\text{ V}$, $R_g = 4.7\ \Omega$, $V_{GE} = +15\text{ V} / -15\text{ V}$, $L = 500\ \mu\text{H}$

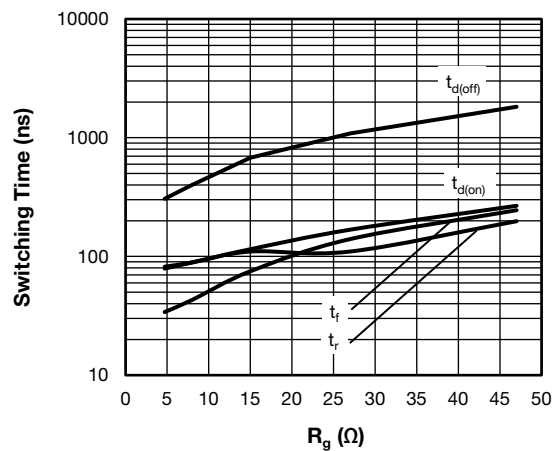


Fig. 10 - Typical Trench IGBT Switching Time vs. R_g (with Antiparallel Diode)

$T_J = 125\text{ }^\circ\text{C}$, $V_{CC} = 300\text{ V}$, $I_C = 200\text{ A}$, $V_{GE} = +15\text{ V} / -15\text{ V}$, $L = 500\ \mu\text{H}$

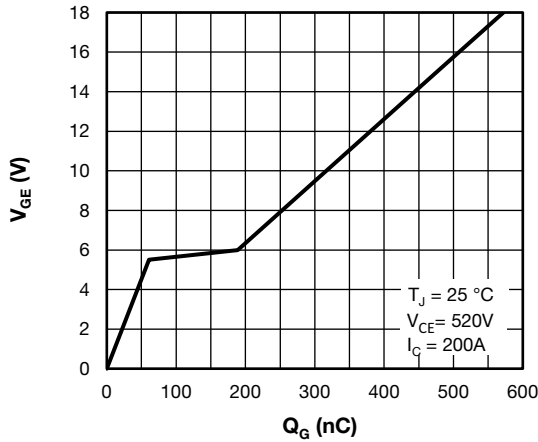


Fig. 11 - Typical Trench IGBT Gate Charge vs. Gate to Emitter Voltage

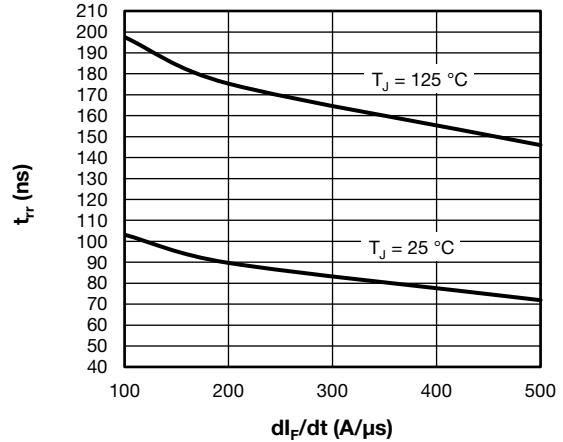


Fig. 14 - Typical Diode Reverse Recovery Time vs. dI_F/dt
 $V_{rr} = 200\text{ V}$, $I_F = 50\text{ A}$

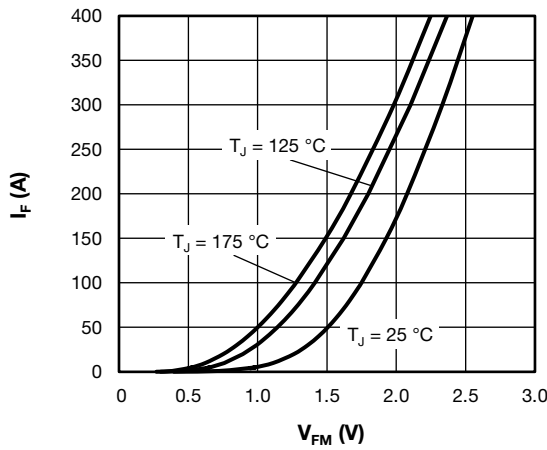


Fig. 12 - Typical IGBT Switching Time vs. I_C

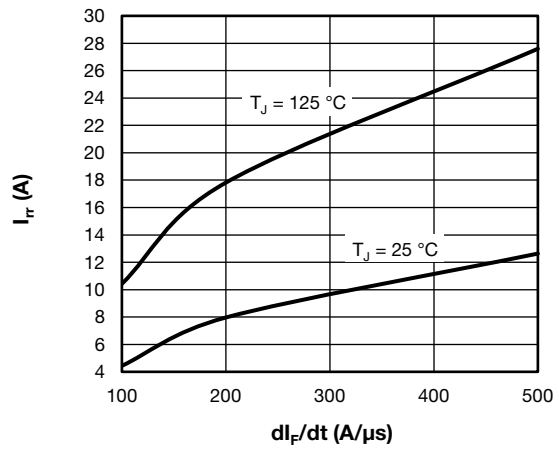


Fig. 15 - Typical Diode Reverse Recovery Current vs. dI_F/dt
 $V_{rr} = 200\text{ V}$, $I_F = 50\text{ A}$

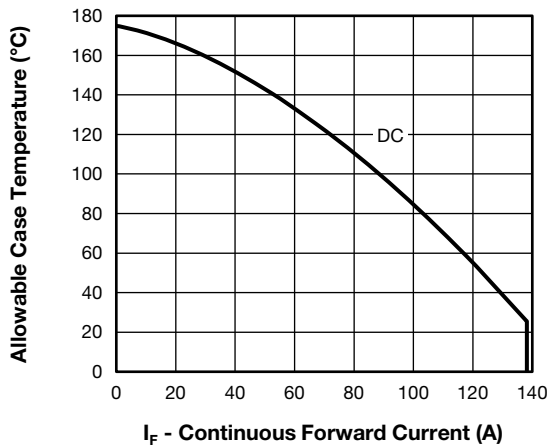


Fig. 13 - Maximum Diode Continuous Forward Current vs. Case Temperature

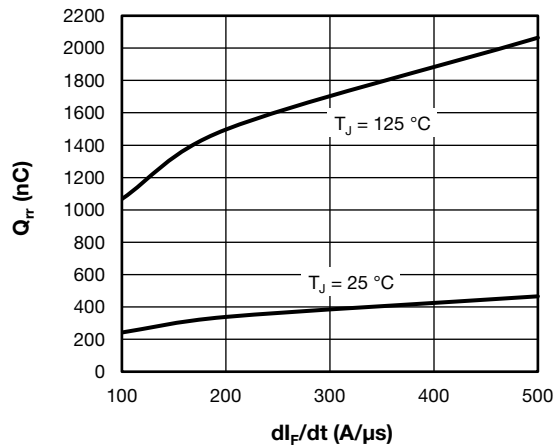


Fig. 16 - Typical Diode Reverse Recovery Current vs. dI_F/dt
 $V_{rr} = 200\text{ V}$, $I_F = 50\text{ A}$

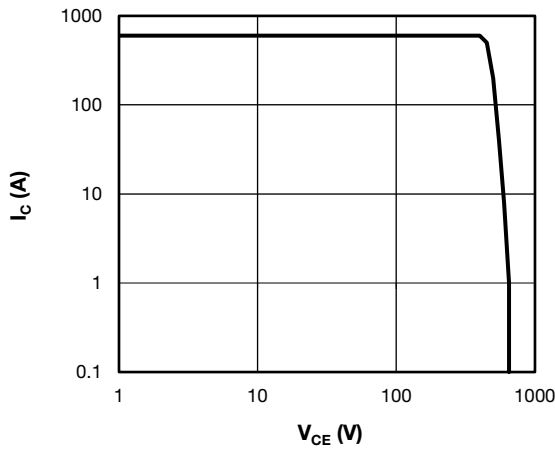


Fig. 17 - Typical Trench IGBT Reverse BIAS SOA
 $T_J = 175\text{ }^\circ\text{C}$, $I_C = 600\text{ A}$, $R_{\theta} = 27\text{ }\Omega$, $V_{GE} = +15\text{ V} / 0\text{ V}$, $V_{CC} = 400\text{ V}$,
 $V_p = 650\text{ V}$

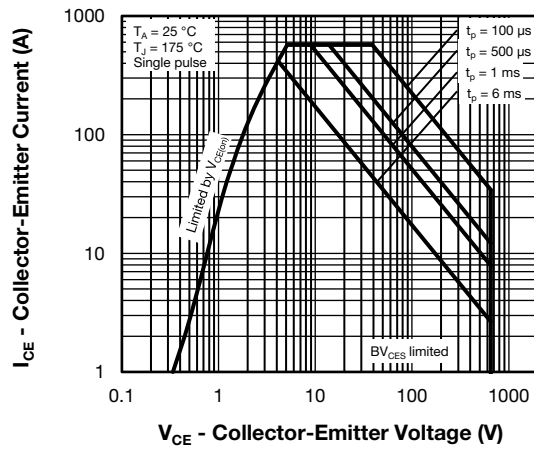


Fig. 18 - Trench IGBT safe Operating Area

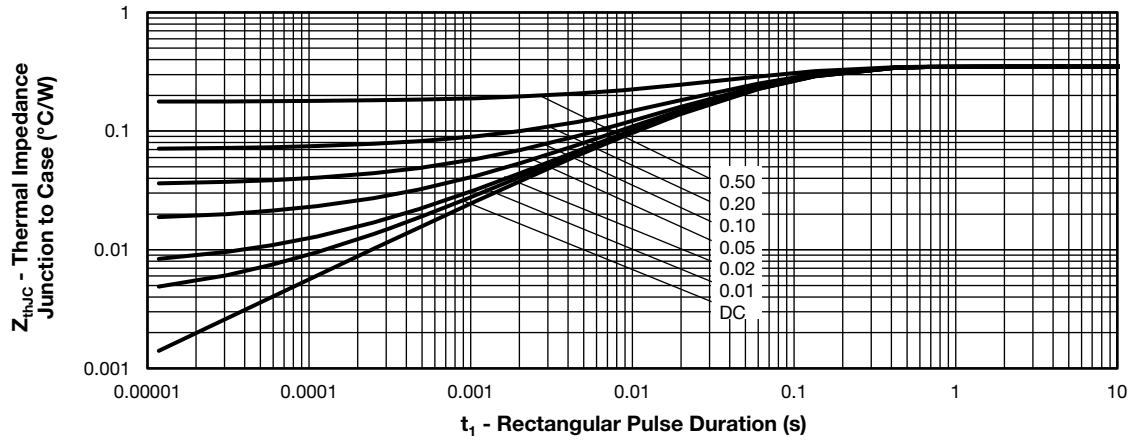


Fig. 19 - Maximum Trench IGBT Thermal Impedance Z_{thJC} Characteristics

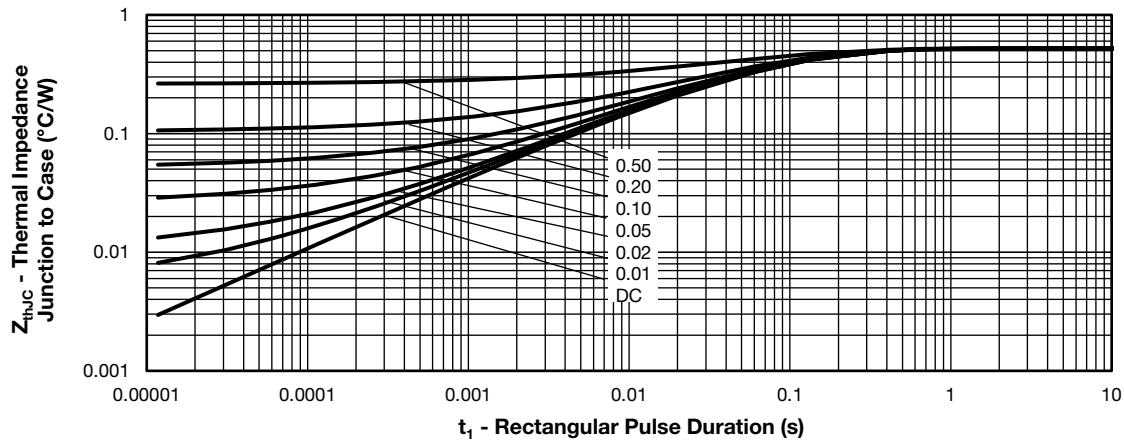
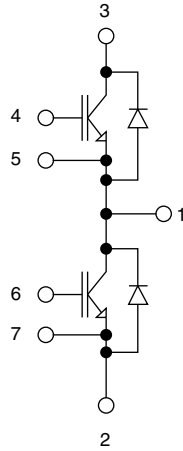


Fig. 20 - Maximum Diode Thermal Impedance Z_{thJC} Characteristics

CIRCUIT CONFIGURATION

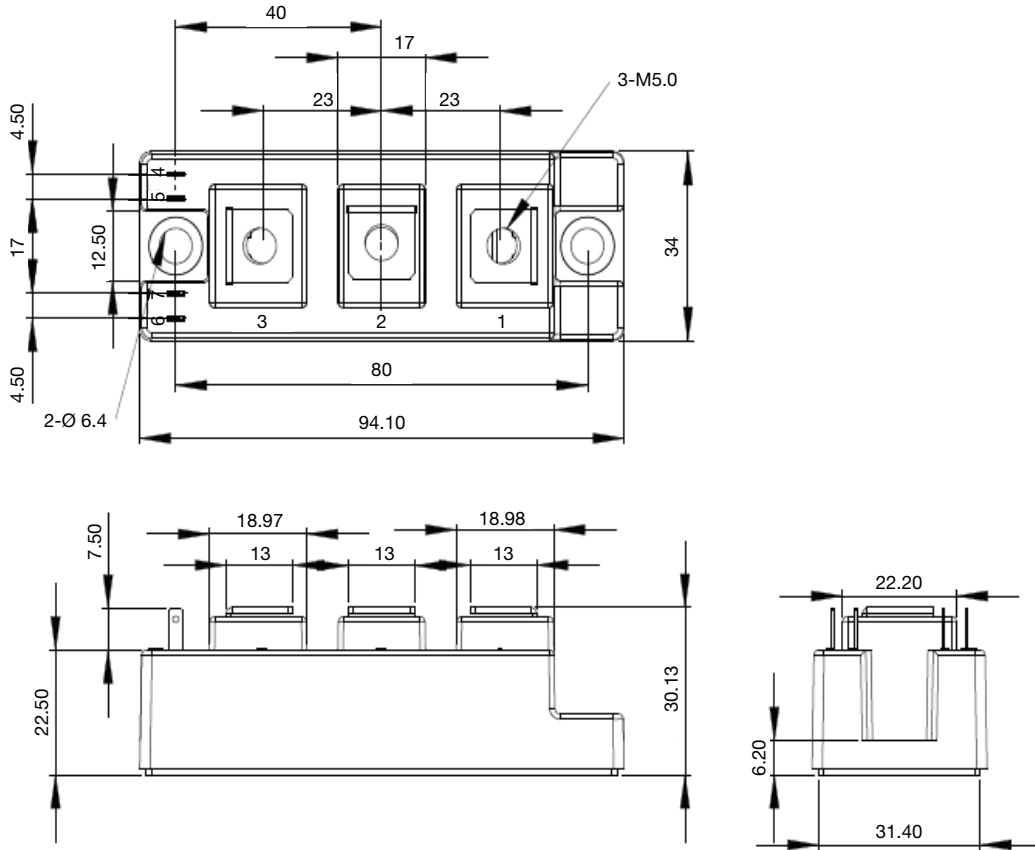


ORDERING INFORMATION TABLE

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)			



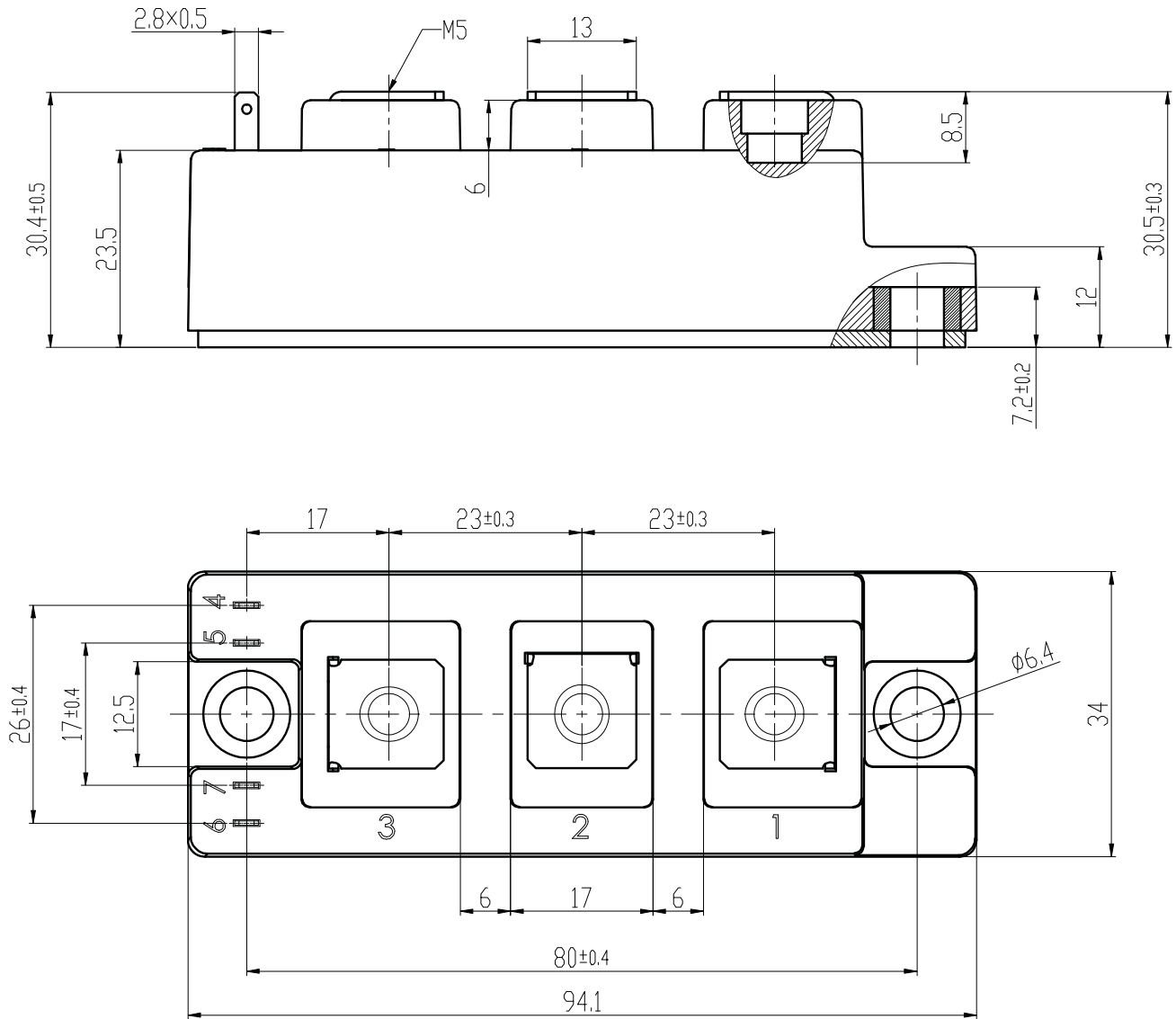
DIMENSIONS in millimeters





INT-A-PAK

DIMENSIONS in millimeters (inches)





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