


## “Half Bridge” High Speed IGBT INT-A-PAK, 100 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 switching losses
- Al<sub>2</sub>O<sub>3</sub> DBC
- UL approved file E78996 
- Designed for industrial level
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)


**RoHS  
COMPLIANT**

PRIMARY CHARACTERISTICS	
V <sub>CES</sub>	650 V
I <sub>C</sub> DC, T <sub>C</sub> = 80 °C	72 A
V <sub>CE(on)</sub> at 100 A, 25 °C	1.82 V
Chip level V <sub>CE(on)</sub> at 100 A, 25 °C	1.70 V
Speed	8 kHz to 30 kHz
Package	INT-A-PAK
Circuit configuration	Half bridge

**BENEFITS**

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

ABSOLUTE MAXIMUM RATINGS				
PARAMETER	SYMBOL	TEST CONDITIONS	MAX.	UNITS
Collector to emitter voltage	V <sub>CES</sub>		650	V
Continuous collector current	I <sub>C</sub>	T <sub>C</sub> = 25 °C	96	A
		T <sub>C</sub> = 80 °C	72	
Pulsed collector current	I <sub>CM</sub>	T <sub>C</sub> = 175 °C, t <sub>p</sub> = 6 ms, V <sub>GE</sub> = 15 V	240	
Peak switching current	I <sub>LM</sub>		140	
Diode continuous forward current	I <sub>F</sub>	T <sub>C</sub> = 25 °C	57	
		T <sub>C</sub> = 80 °C	43	
Maximum non-repetitive peak current	I <sub>FSM</sub>	10 ms sine or 6 ms rectangular pulse, T <sub>J</sub> = 25 °C	270	
Gate to emitter voltage	V <sub>GE</sub>		± 20	V
RMS isolation voltage	V <sub>ISOL</sub>	Any terminal to case, t = 1 min	2500	
Maximum power dissipation	P <sub>D</sub>	T <sub>C</sub> = 25 °C	259	W
		T <sub>C</sub> = 80 °C	164	
Maximum power dissipation (Diode)	P <sub>D</sub>	T <sub>C</sub> = 25 °C	150	W
		T <sub>C</sub> = 80 °C	95	
Operating junction temperature range	T <sub>J</sub>		-40 to +175	°C
Storage temperature range	T <sub>Stg</sub>		-40 to +150	



<b>ELECTRICAL SPECIFICATIONS</b> ( $T_J = 25\text{ }^\circ\text{C}$ unless otherwise specified)						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Collector to emitter breakdown voltage	$V_{BR(CEs)}$	$V_{GE} = 0\text{ V}, I_C = 200\text{ }\mu\text{A}$	650	-	-	V
Collector to emitter voltage	$V_{CE(on)}$	$V_{GE} = 15\text{ V}, I_C = 50\text{ A}$	-	1.46	-	
		$V_{GE} = 15\text{ V}, I_C = 100\text{ A}$	-	1.82	2.3	
		$V_{GE} = 15\text{ V}, I_C = 100\text{ A}, T_J = 125\text{ }^\circ\text{C}$	-	2.12	-	
Gate threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}, I_C = 1\text{ mA}$	3	4.0	5	
Temperature coefficient of threshold voltage	$\Delta V_{GE(th)}/\Delta T_J$	$V_{CE} = V_{GE}, I_C = 1\text{ mA}, (25\text{ }^\circ\text{C to } 125\text{ }^\circ\text{C})$	-	-11	-	mV/ $^\circ\text{C}$
Forward transconductance	$g_{fe}$	$V_{CE} = 20\text{ V}, I_C = 100\text{ A}$	-	132	-	S
Transfer characteristics	$V_{GE}$	$V_{CE} = 20\text{ V}, I_C = 100\text{ A}$	-	6.46	-	V
Collector to emitter leakage current	$I_{CES}$	$V_{GE} = 0\text{ V}, V_{CE} = 650\text{ V}$	-	0.5	50	$\mu\text{A}$
		$V_{GE} = 0\text{ V}, V_{CE} = 650\text{ V}, T_J = 125\text{ }^\circ\text{C}$	-	7	-	
Diode forward voltage drop	$V_{FM}$	$I_C = 50\text{ A}, V_{GE} = 0\text{ V}$	-	2.02	2.9	V
		$I_C = 50\text{ A}, V_{GE} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$	-	1.6	-	
Gate to emitter leakage current	$I_{GES}$	$V_{GE} = \pm 20\text{ V}$	-	-	$\pm 120$	nA

<b>SWITCHING CHARACTERISTICS</b> ( $T_J = 25\text{ }^\circ\text{C}$ unless otherwise specified)						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Total gate charge	$Q_g$	$I_C = 75\text{ A},$ $V_{CC} = 520\text{ V}$ $V_{GE} = 15\text{ V}$	-	236	-	nC
Gate to emitter charge	$Q_{ge}$		-	31	-	
Gate to collector charge	$Q_{gc}$		-	65	-	
Turn-on switching energy	$E_{on}$	$I_C = 100\text{ A},$ $V_{CC} = 325\text{ V},$ $V_{GE} = 15\text{ V}, L = 500\text{ }\mu\text{H}$ $R_g = 22\text{ }\Omega,$ $T_J = 25\text{ }^\circ\text{C}$	-	3.1	-	mJ
Turn-off switching energy	$E_{off}$		-	0.94	-	
Total switching energy	$E_{ts}$		-	4.04	-	
Turn-on delay time	$t_{d(on)}$		ns	-	39	-
Rise time	$t_r$			-	55	-
Turn-off delay time	$t_{d(off)}$			-	200	-
Fall time	$t_f$	-		25	-	
Turn-on switching energy	$E_{on}$	$I_C = 100\text{ A},$ $V_{CC} = 325\text{ V},$ $V_{GE} = 15\text{ V}, L = 500\text{ }\mu\text{H}$ $R_g = 22\text{ }\Omega,$ $T_J = 125\text{ }^\circ\text{C}$		-	3.2	-
Turn-off switching energy	$E_{off}$		-	1.0	-	
Total switching energy	$E_{ts}$		-	4.2	-	
Turn-on delay time	$t_{d(on)}$		ns	-	36	-
Rise time	$t_r$			-	58	-
Turn-off delay time	$t_{d(off)}$			-	210	-
Fall time	$t_f$	-		23	-	
Reverse bias safe operating area	RBSOA	$T_J = 175\text{ }^\circ\text{C}, I_C = 140\text{ A}, V_{CC} = 325\text{ V},$ $V_p = 650\text{ V}, R_g = 22\text{ }\Omega,$ $V_{GE} = 15\text{ V to } -5\text{ V}, L = 500\text{ }\mu\text{H}$	Fullsquare			
Diode reverse recovery time	$t_{rr}$	$I_F = 50\text{ A},$ $di_F/dt = 500\text{ A}/\mu\text{s},$ $V_{rr} = 200\text{ V}$	-	79	-	ns
Diode peak reverse current	$I_{rr}$		-	10.5	-	A
Diode recovery charge	$Q_{rr}$		-	409	-	nC
Diode reverse recovery time	$t_{rr}$	$I_F = 50\text{ A},$ $di_F/dt = 500\text{ A}/\mu\text{s},$ $V_{rr} = 200\text{ V}, T_J = 125\text{ }^\circ\text{C}$	-	141	-	ns
Diode peak reverse current	$I_{rr}$		-	19	-	A
Diode recovery charge	$Q_{rr}$		-	1336	-	nC

<b>THERMAL AND MECHANICAL SPECIFICATIONS</b>						
PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	
Operating junction temperature range	$T_J$	-40	-	175	$^\circ\text{C}$	
Storage temperature range	$T_{Stg}$	-40	-	150		
Junction to case	per switch	$R_{thJC}$	-	-	0.58	$^\circ\text{C}/\text{W}$
	per diode		-	-	1.0	
Case to sink per module	$R_{thCS}$	-	0.1	-		
Mounting torque	case to heatsink	-	-	4	Nm	
	case to terminal 1, 2, 3	-	-	3		
Weight		-	185	-	g	

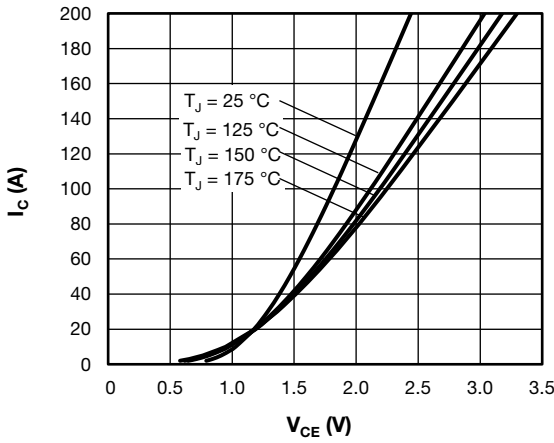


Fig. 1 - Typical Trench IGBT Output Characteristics,  $V_{GE} = 15\text{ V}$

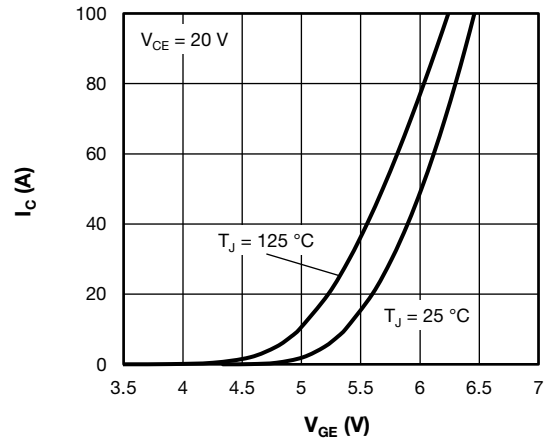


Fig. 4 - Typical Trench IGBT Transfer Characteristics

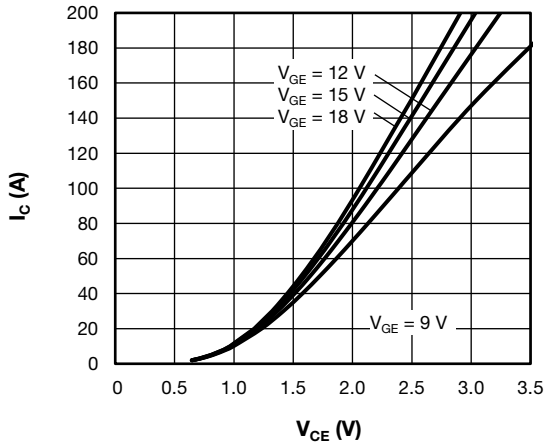


Fig. 2 - Typical Trench IGBT Output Characteristics,  $T_J = 125\text{ °C}$

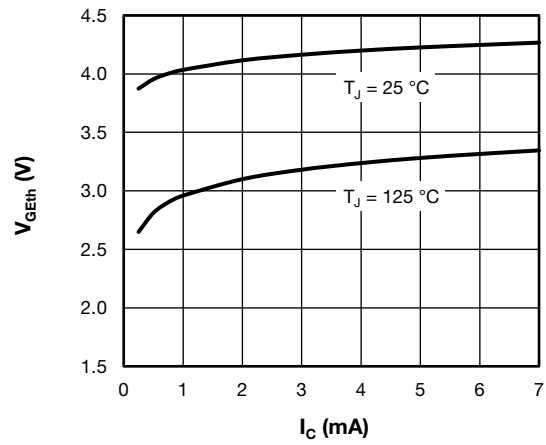


Fig. 5 - Typical Trench IGBT Gate Threshold Voltage

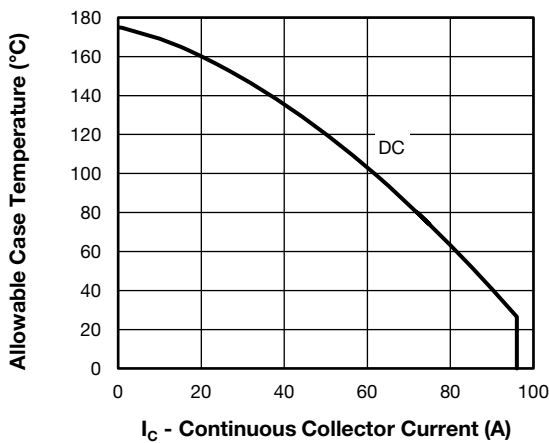


Fig. 3 - Maximum Trench IGBT Continuous Collector Current vs. Case Temperature

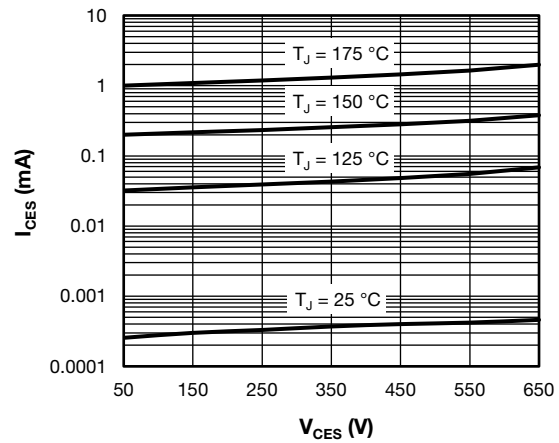


Fig. 6 - Typical Trench IGBT Zero Gate Voltage Collector Current

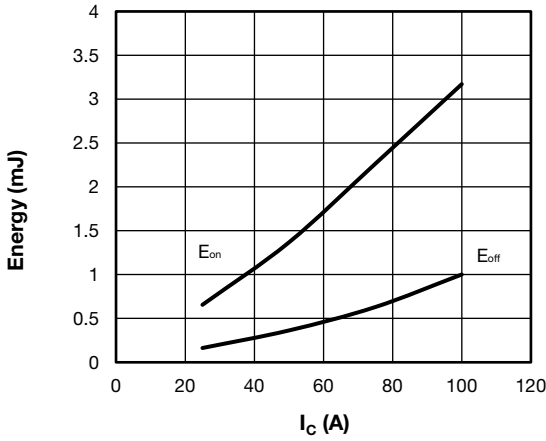


Fig. 7 - Typical Trench IGBT Energy Loss vs.  $I_C$  (with Antiparallel Diode)

$T_J = 125\text{ }^\circ\text{C}$ ,  $V_{CC} = 325\text{ V}$ ,  $R_g = 22\ \Omega$ ,  $V_{GE} = +15\text{ V}/-15\text{ V}$ ,  $L = 500\ \mu\text{H}$

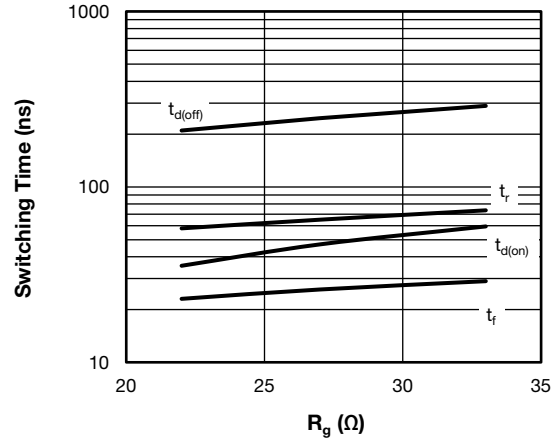


Fig. 10 - Typical Trench IGBT Switching Time vs.  $R_g$  (with Antiparallel Diode)

$T_J = 125\text{ }^\circ\text{C}$ ,  $V_{CC} = 325\text{ V}$ ,  $I_C = 100\text{ A}$ ,  $V_{GE} = +15\text{ V}/-15\text{ V}$ ,  $L = 500\ \mu\text{H}$

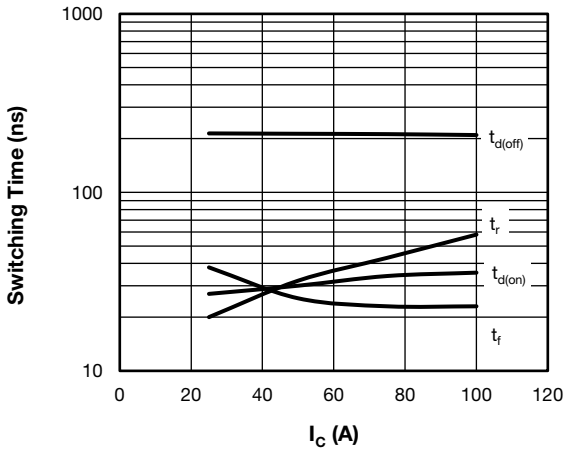


Fig. 8 - Typical Trench IGBT Switching Time vs.  $I_C$  (with Antiparallel Diode)

$T_J = 125\text{ }^\circ\text{C}$ ,  $V_{CC} = 325\text{ V}$ ,  $R_g = 22\ \Omega$ ,  $V_{GE} = +15\text{ V}/-15\text{ V}$ ,  $L = 500\ \mu\text{H}$

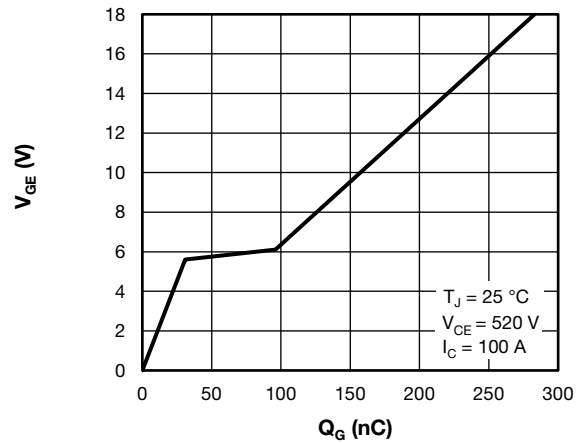


Fig. 11 - Typical Trench IGBT Gate Charge vs. Gate to Collector Voltage

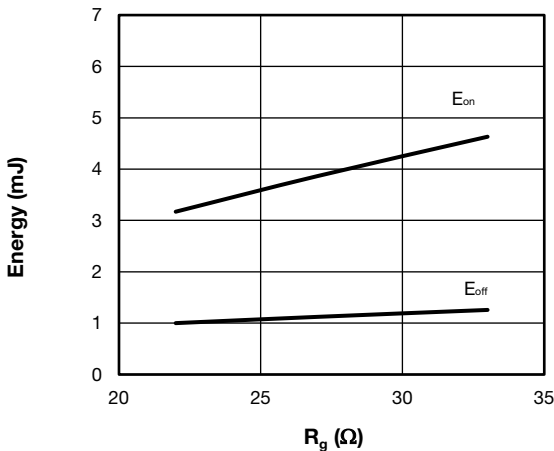


Fig. 9 - Typical Trench IGBT Energy Loss vs.  $R_g$  (with Antiparallel Diode)

$T_J = 125\text{ }^\circ\text{C}$ ,  $V_{CC} = 325\text{ V}$ ,  $I_C = 100\text{ A}$ ,  $V_{GE} = +15\text{ V}/-15\text{ V}$ ,  $L = 500\ \mu\text{H}$

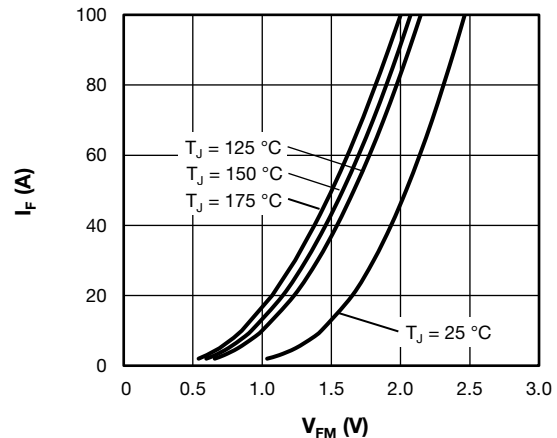


Fig. 12 - Typical Antiparallel Diode Forward Characteristics

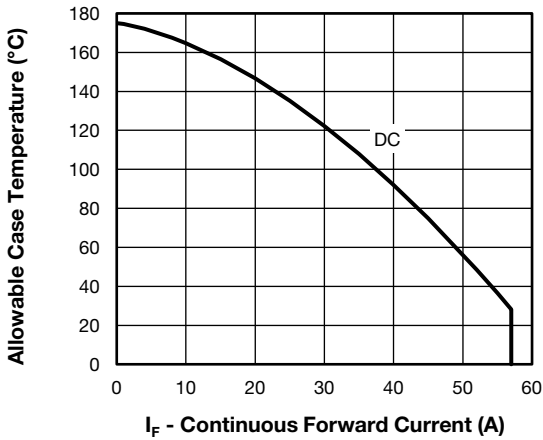


Fig. 13 - Maximum Antiparallel Diode Continuous Forward Current vs. Case Temperature

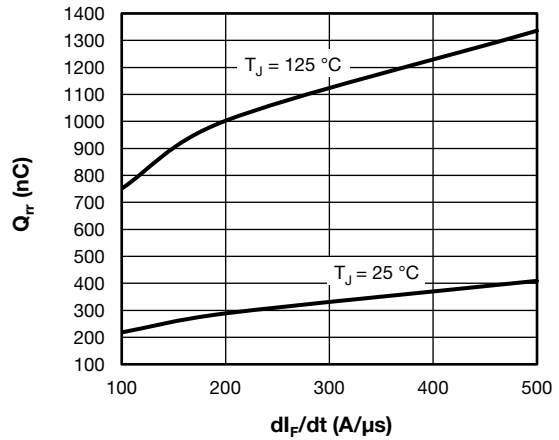


Fig. 16 - Typical Antiparallel Diode Reverse Recovery Charge vs.  $dI_F/dt$   
 $I_F = 50 \text{ A}, V_{CC} = 200 \text{ V}$

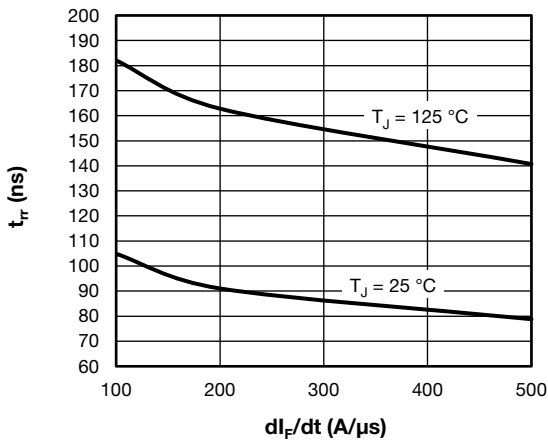


Fig. 14 - Typical Antiparallel Diode Reverse Recovery Time vs.  $dI_F/dt$   
 $I_F = 50 \text{ A}, V_{CC} = 200 \text{ V}$

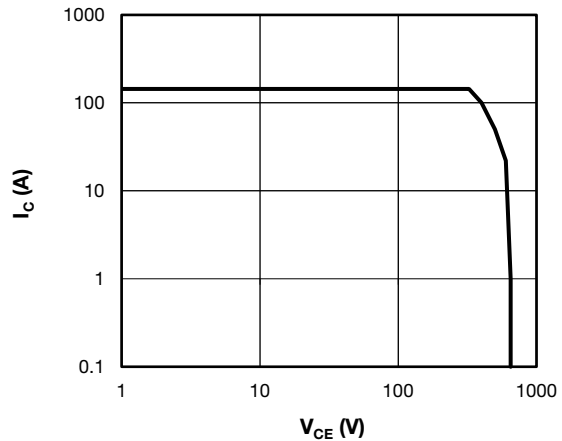


Fig. 17 - Trench IGBT Reverse BIAS SOA  
 $T_J = 175 \text{ °C}, I_C = 140 \text{ A}, R_g = 22 \text{ } \Omega, V_{GE} = +15 \text{ V}/-5 \text{ V}, V_{CC} = 325 \text{ V}, V_p = 650 \text{ V}$

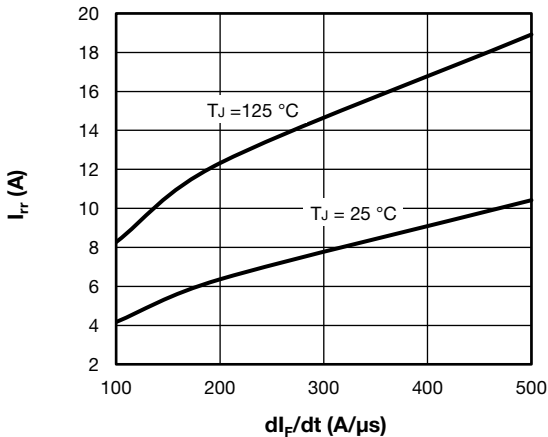


Fig. 15 - Typical Antiparallel Diode Reverse Recovery Current vs.  $dI_F/dt$   
 $I_F = 50 \text{ A}, V_{CC} = 200 \text{ V}$

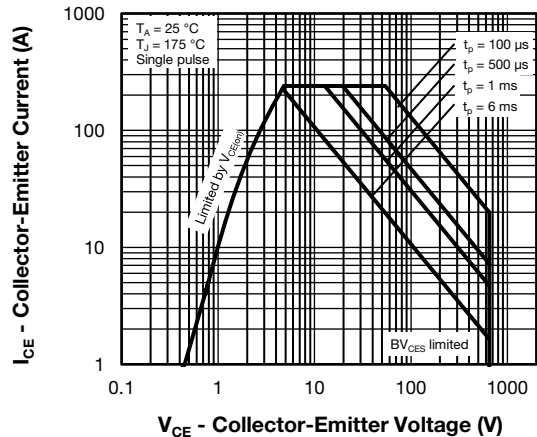


Fig. 18 - Trench IGBT Safe Operating Area

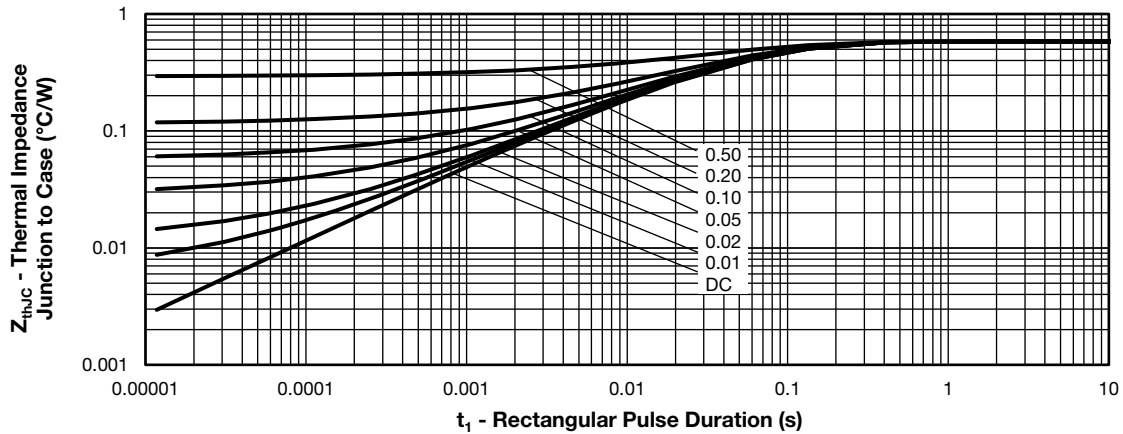


Fig. 19 - Maximum Trench IGBT Thermal Impedance  $Z_{thJC}$  Characteristics

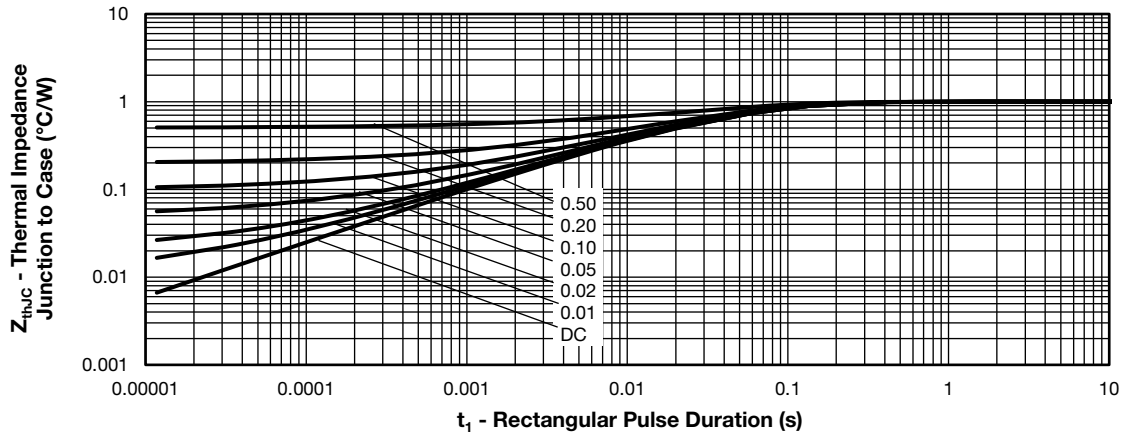


Fig. 20 - Maximum Antiparallel Diode Thermal Impedance  $Z_{thJC}$  Characteristics

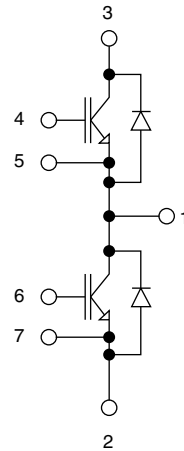
**ORDERING INFORMATION TABLE**

Device code	<b>VS-</b>	<b>GT</b>	<b>100</b>	<b>T</b>	<b>S</b>	<b>065</b>	<b>N</b>
	①	②	③	④	⑤	⑥	⑦

- 1** - Vishay Semiconductors product
- 2** - IGBT die technology (GT = trench)
- 3** - Current rating (100 = 100 A)
- 4** - Circuit configuration (T = half bridge)
- 5** - Package indicator (S = INT-A-PAK)
- 6** - Voltage code (065 = 650 V)
- 7** - Speed/type (N = ultrafast IGBT)



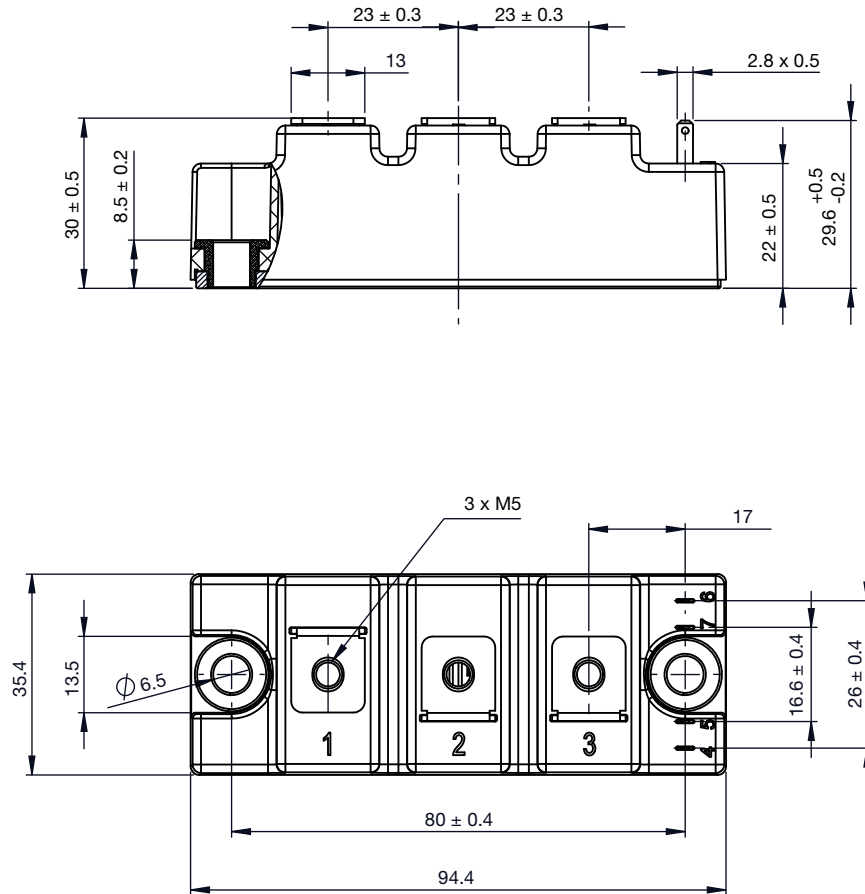
**CIRCUIT CONFIGURATION**



LINKS TO RELATED DOCUMENTS	
Dimensions	<a href="http://www.vishay.com/doc?95173">www.vishay.com/doc?95173</a>



**DIMENSIONS** in millimeters (inches)



General tolerance  $\pm 0.5$  mm





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