

“Half Bridge” Low $V_{CE(on)}$ IGBT INT-A-PAK, 150 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


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, $T_C = 80\text{ }^\circ\text{C}$	280 A
Terminal level $V_{CE(on)}$ at 150 A, $25\text{ }^\circ\text{C}$	1.07 V
Chip level $V_{CE(on)}$ at 150 A, $25\text{ }^\circ\text{C}$	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	$T_C = 25\text{ }^\circ\text{C}$	372	A
		$T_C = 80\text{ }^\circ\text{C}$	280	
Pulsed collector current	I_{CM}	$T_C = 175\text{ }^\circ\text{C}$, $t_p = 6\text{ ms}$, $V_{GE} = 15\text{ V}$	750	
Peak switching current	I_{LM}		320	
Diode continuous forward current	I_F	$T_C = 25\text{ }^\circ\text{C}$	57	
		$T_C = 80\text{ }^\circ\text{C}$	43	
Maximum non-repetitive peak current	I_{FSM}	10 ms sine or 6 ms rectangular pulse	270	
Gate to emitter voltage	V_{GE}		± 20	V
RMS isolation voltage	V_{ISOL}	Any terminal to case, $t = 1\text{ min}$	2500	
Maximum power dissipation (IGBT)	P_D	$T_C = 25\text{ }^\circ\text{C}$	789	W
		$T_C = 80\text{ }^\circ\text{C}$	500	
Maximum power dissipation (Diode)	P_D	$T_C = 25\text{ }^\circ\text{C}$	150	W
		$T_C = 80\text{ }^\circ\text{C}$	95	
Operating junction temperature range	T_J		-40 to +175	$^\circ\text{C}$
Storage temperature range	T_{Stg}		-40 to +150	

**ELECTRICAL SPECIFICATIONS** ($T_J = 25\text{ }^{\circ}\text{C}$ unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Collector to emitter breakdown voltage	$V_{BR(CES)}$	$V_{GE} = 0\text{ V}$, $I_C = 600\text{ }\mu\text{A}$	650	-	-	
Collector to emitter voltage	$V_{CE(on)}$	$V_{GE} = 15\text{ V}$, $I_C = 150\text{ A}$	-	1.07	1.32	V
		$V_{GE} = 15\text{ V}$, $I_C = 300\text{ A}$	-	1.29	-	
		$V_{GE} = 15\text{ V}$, $I_C = 150\text{ A}$, $T_J = 125\text{ }^{\circ}\text{C}$	-	1.05	-	
		$V_{CE} = V_{GE}$, $I_C = 3.0\text{ mA}$	4	4.5	6	
Gate threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$, $I_C = 3.0\text{ mA}$	4	4.5	6	
Temperature coefficient of threshold voltage	$\Delta V_{GE(th)}/\Delta T_J$	$V_{CE} = V_{GE}$, $I_C = 3.0\text{ mA}$, ($25\text{ }^{\circ}\text{C}$ to $125\text{ }^{\circ}\text{C}$)	-	-15	-	mV/ $^{\circ}\text{C}$
Forward transconductance	g_{fe}	$V_{CE} = 20\text{ V}$, $I_C = 150\text{ A}$	-	400	-	S
Transfer characteristics	V_{GE}	$V_{CE} = 20\text{ V}$, $I_C = 150\text{ A}$	-	6.4	-	V
Collector to emitter leakage current	I_{CES}	$V_{GE} = 0\text{ V}$, $V_{CE} = 650\text{ V}$	-	0.28	150	μA
		$V_{GE} = 0\text{ V}$, $V_{CE} = 650\text{ V}$, $T_J = 125\text{ }^{\circ}\text{C}$	-	0.13	-	mA
Diode forward voltage drop	V_{FM}	$I_C = 50\text{ A}$, $V_{GE} = 0\text{ V}$	-	2.0	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}	$V_{GE} = \pm 20\text{ V}$	-	-	± 360	nA

SWITCHING CHARACTERISTICS ($T_J = 25\text{ }^{\circ}\text{C}$ unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Total gate charge	Q_g	$I_C = 150\text{ A}$, $V_{CC} = 520\text{ V}$ $V_{GE} = 15\text{ V}$	-	1408	-	nC
Gate to emitter charge	Q_{ge}		-	216	-	
Gate to collector charge	Q_{gc}		-	391	-	
Turn-on switching energy	E_{on}	$I_C = 150\text{ A}$, $V_{CC} = 325\text{ V}$, $V_{GE} = 15\text{ V}$, $L = 500\text{ }\mu\text{H}$ $R_g = 4.7\text{ }\Omega$, $T_J = 25\text{ }^{\circ}\text{C}$	-	0.7	-	mJ
Turn-off switching energy	E_{off}		-	7.2	-	
Total switching energy	E_{ts}		-	7.9	-	
Turn-on delay time	$t_{d(on)}$		-	37	-	ns
Rise time	t_r		-	41	-	
Turn-off delay time	$t_{d(off)}$		-	459	-	
Fall time	t_f	$I_C = 150\text{ A}$, $V_{CC} = 325\text{ V}$, $V_{GE} = 15\text{ V}$, $L = 500\text{ }\mu\text{H}$ $R_g = 4.7\text{ }\Omega$, $T_J = 125\text{ }^{\circ}\text{C}$	-	67	-	mJ
Turn-on switching energy	E_{on}		-	0.7	-	
Turn-off switching energy	E_{off}		-	10.3	-	
Total switching energy	E_{ts}		-	11	-	
Turn-on delay time	$t_{d(on)}$		-	36	-	ns
Rise time	t_r		-	42	-	
Turn-off delay time	$t_{d(off)}$		-	515	-	
Fall time	t_f		-	150	-	
Reverse bias safe operating area	RBSOA	$T_J = 175\text{ }^{\circ}\text{C}$, $I_C = 320\text{ A}$, $V_{CC} = 325\text{ V}$, $V_p = 650\text{ V}$, $R_g = 4.7\text{ }\Omega$, $V_{GE} = 15\text{ V}$ to 0 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

**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	
Junction to case per switch per diode	R_{thJC}	-	-	0.19	°C/W
		-	-	1.0	
Case to sink per module	R_{thCS}	-	0.1	-	
Mounting torque case to heatsink case to terminal 1, 2, 3		-	-	4	Nm
		-	-	3	
Weight		-	185	-	g

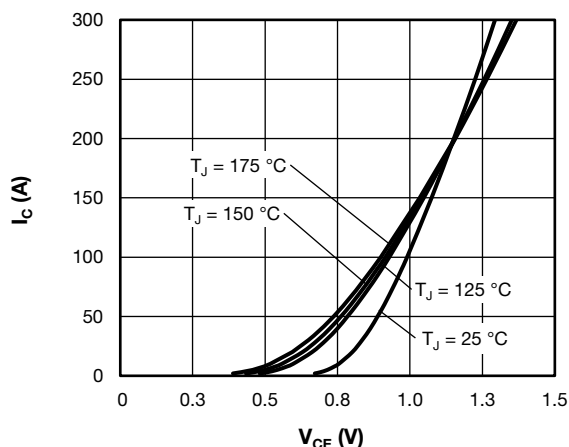
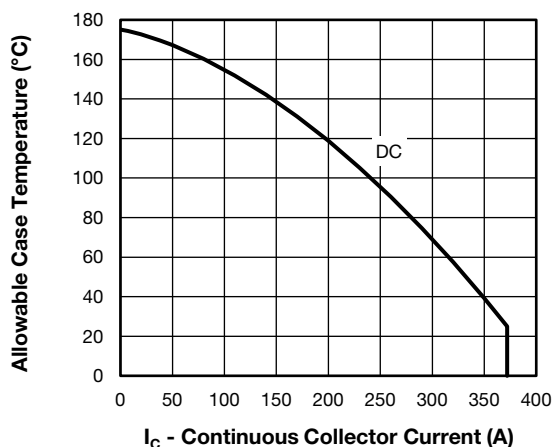
Fig. 1 - Typical Trench IGBT Output Characteristics, $V_{GE} = 15\text{ V}$ 

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

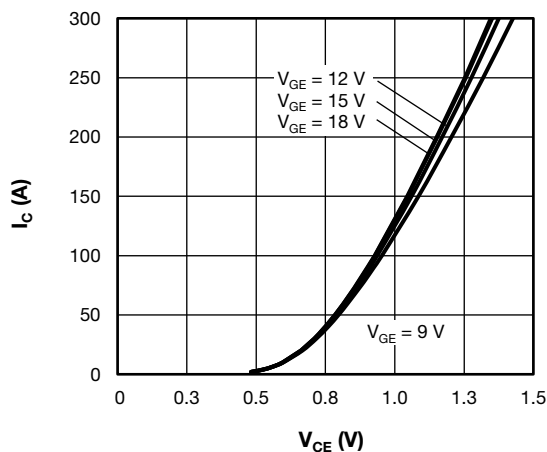
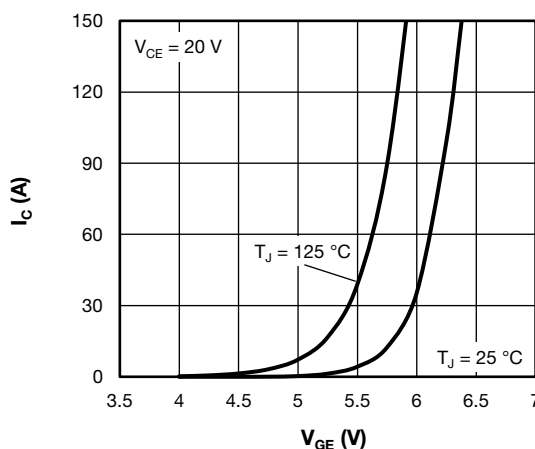
Fig. 2 - Typical Trench IGBT Output Characteristics, $T_J = 125\text{ °C}$ 

Fig. 4 - Typical Trench IGBT Transfer Characteristics

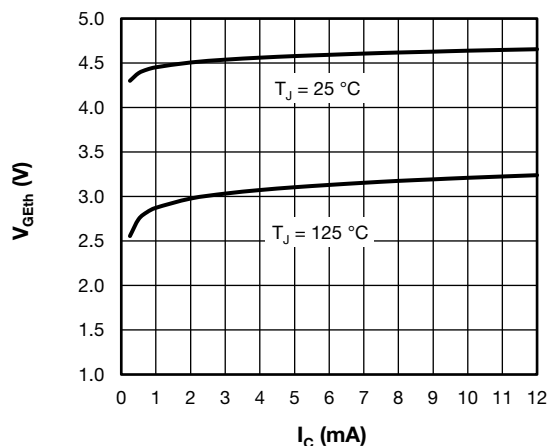
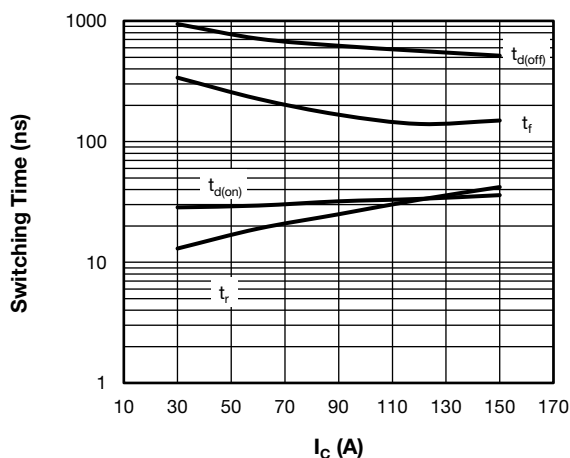


Fig. 5 - Typical Trench IGBT Gate Threshold Voltage


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

$T_J = 125^\circ\text{C}$, $V_{CC} = 325\text{V}$, $R_g = 4.7\ \Omega$, $V_{GE} = +15\text{V} / -15\text{V}$, $L = 500\ \mu\text{H}$

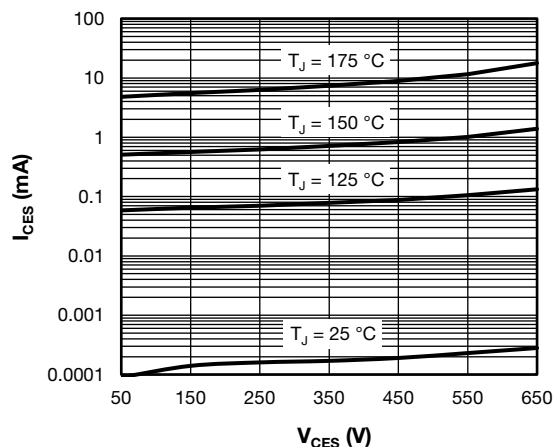
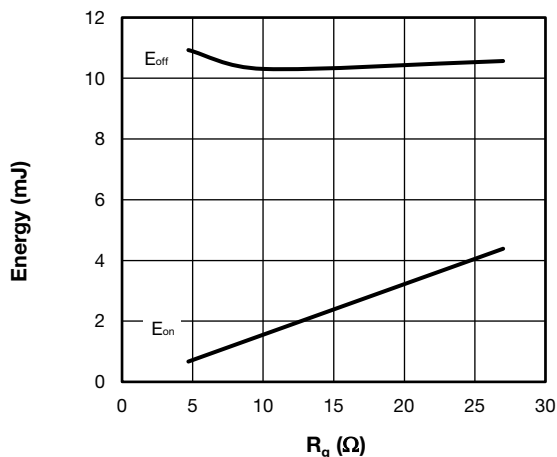
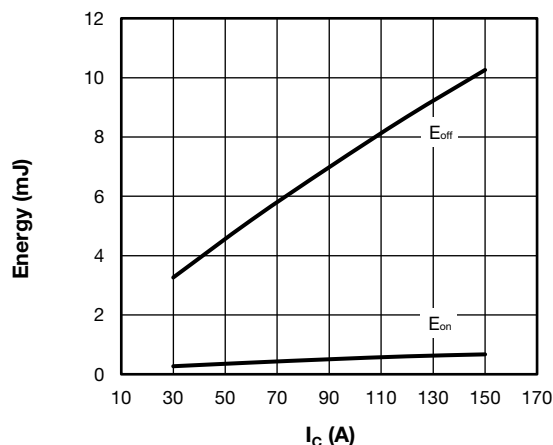


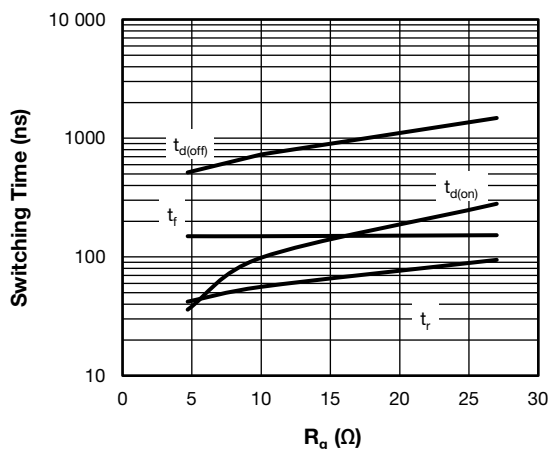
Fig. 6 - Typical Trench IGBT Zero Gate Voltage Collector Current


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

$T_J = 125^\circ\text{C}$, $V_{CC} = 325\text{V}$, $I_C = 150\text{A}$, $V_{GE} = +15\text{V} / -15\text{V}$, $L = 500\ \mu\text{H}$


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

$T_J = 125^\circ\text{C}$, $V_{CC} = 325\text{V}$, $R_g = 4.7\ \Omega$, $V_{GE} = +15\text{V} / -15\text{V}$, $L = 500\ \mu\text{H}$


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

$T_J = 125^\circ\text{C}$, $V_{CC} = 325\text{V}$, $I_C = 150\text{A}$, $V_{GE} = +15\text{V} / -15\text{V}$, $L = 500\ \mu\text{H}$

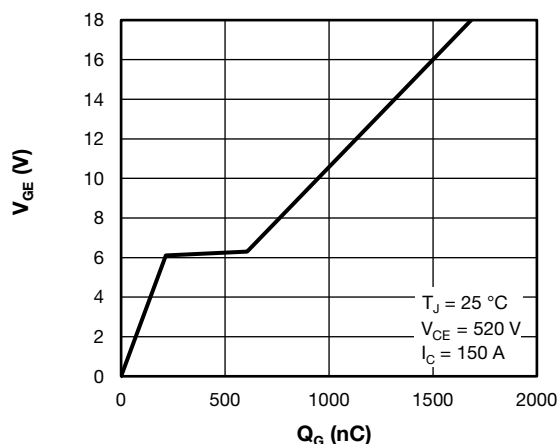


Fig. 11 - Typical Trench IGBT Gate Charge vs. Gate to Collector Voltage

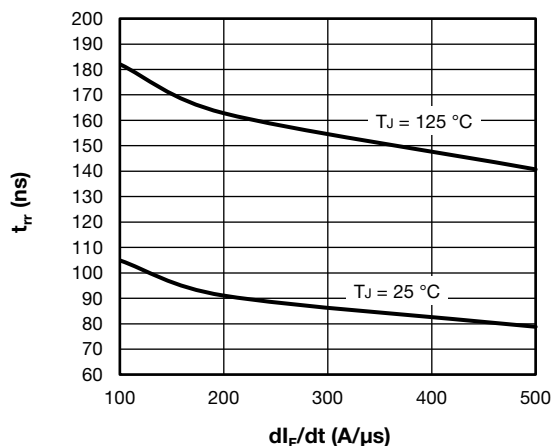


Fig. 14 - Typical Antiparallel Diode Reverse Recovery Time vs. dI_F/dt
 $I_F = 50 \text{ A}$, $V_{CC} = 200 \text{ V}$

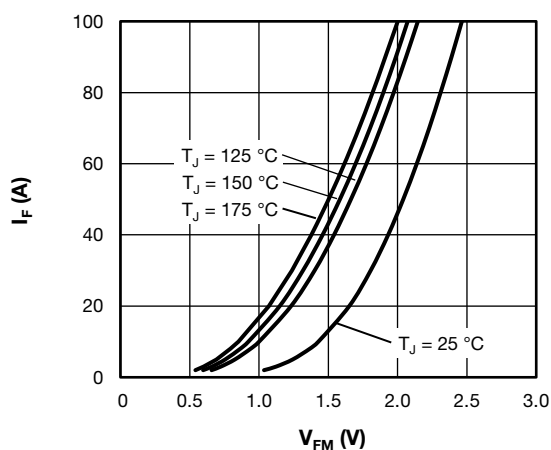


Fig. 12 - Typical Antiparallel Diode Forward Characteristics

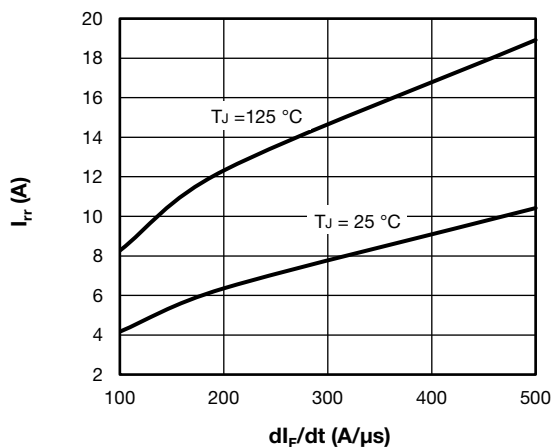


Fig. 15 - Typical Antiparallel Diode Reverse Recovery Current vs. dI_F/dt
 $I_F = 50 \text{ A}$, $V_{CC} = 200 \text{ V}$

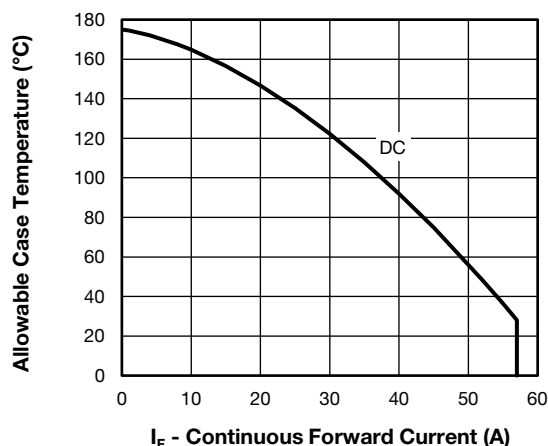


Fig. 13 - Maximum Antiparallel Diode Continuous Forward Current vs. Case Temperature

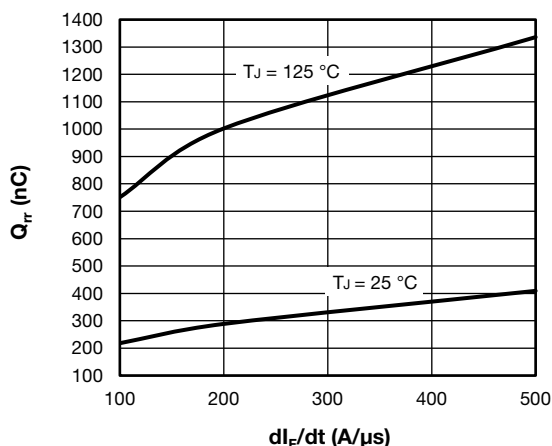


Fig. 16 - Typical Antiparallel Diode Reverse Recovery Charge vs. dI_F/dt
 $I_F = 50 \text{ A}$, $V_{CC} = 200 \text{ V}$

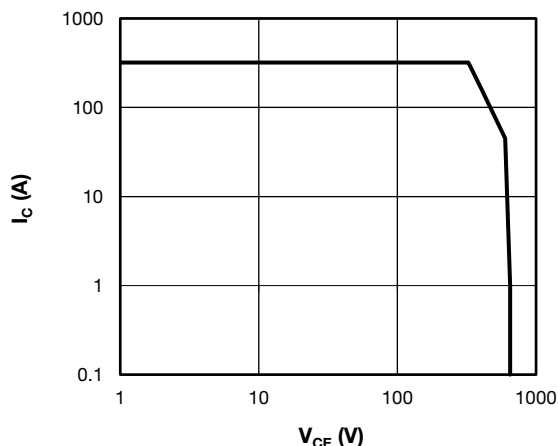


Fig. 17 - Trench IGBT Reverse BIAS SOA
 $T_J = 175^\circ\text{C}$, $I_C = 320\text{ A}$, $R_g = 4.7\ \Omega$, $V_{GE} = +15\text{ V/0 V}$, $V_{CC} = 325\text{ V}$,
 $V_p = 650\text{ V}$

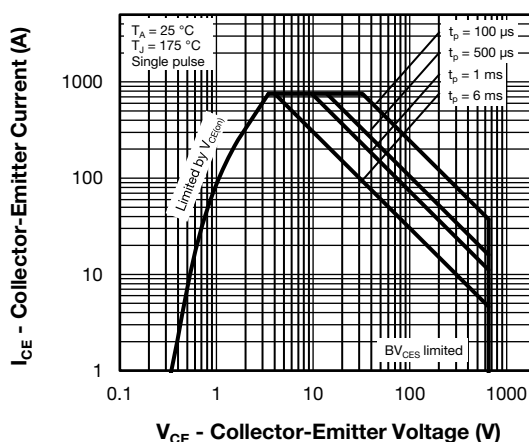


Fig. 18 - Trench IGBT Safe Operating Area

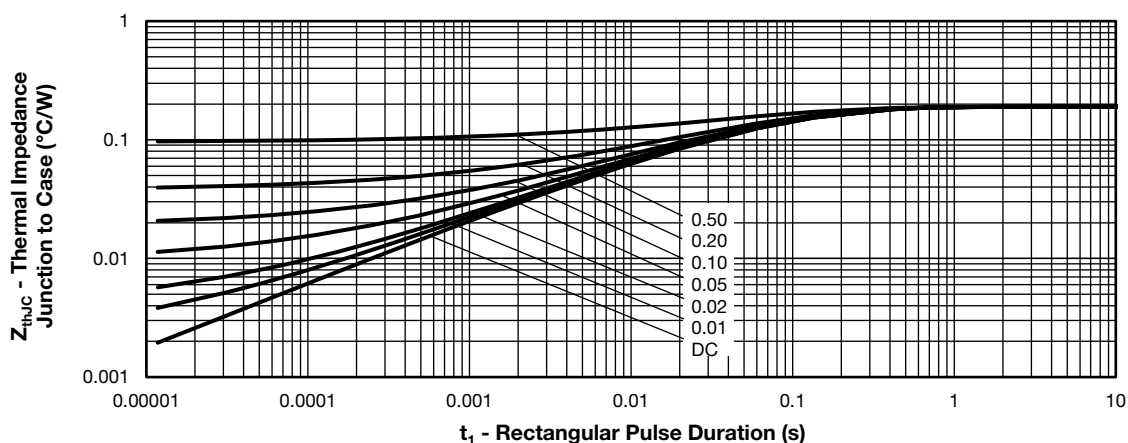


Fig. 19 - Maximum Trench IGBT Thermal Impedance Z_{thJC} Characteristics

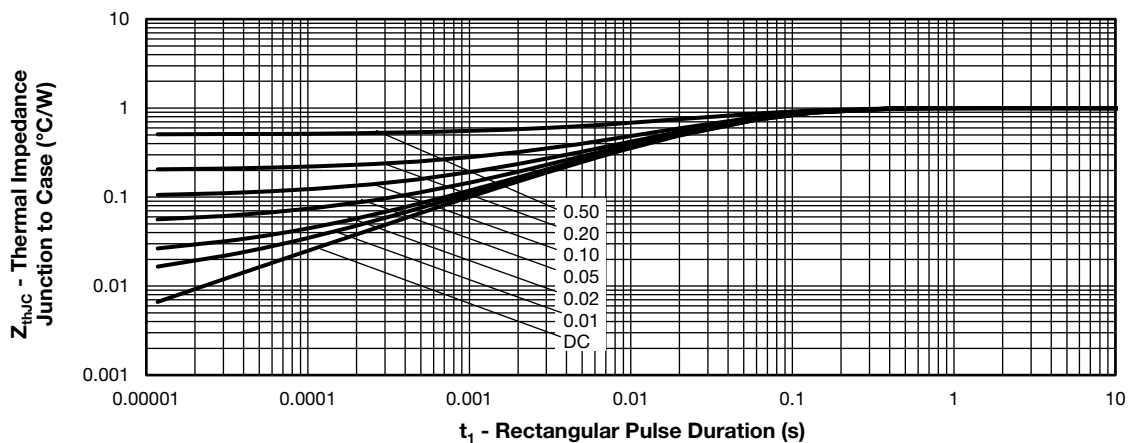


Fig. 20 - Maximum Antiparallel Diode Thermal Impedance Z_{thJC} Characteristics

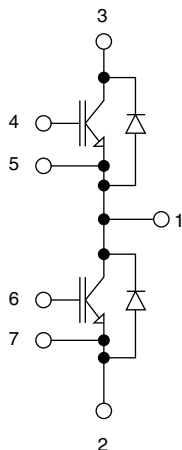


ORDERING INFORMATION TABLE

Device code	VS-	G	T	150	T	S	065	S
	1	2	3	4	5	6	7	8

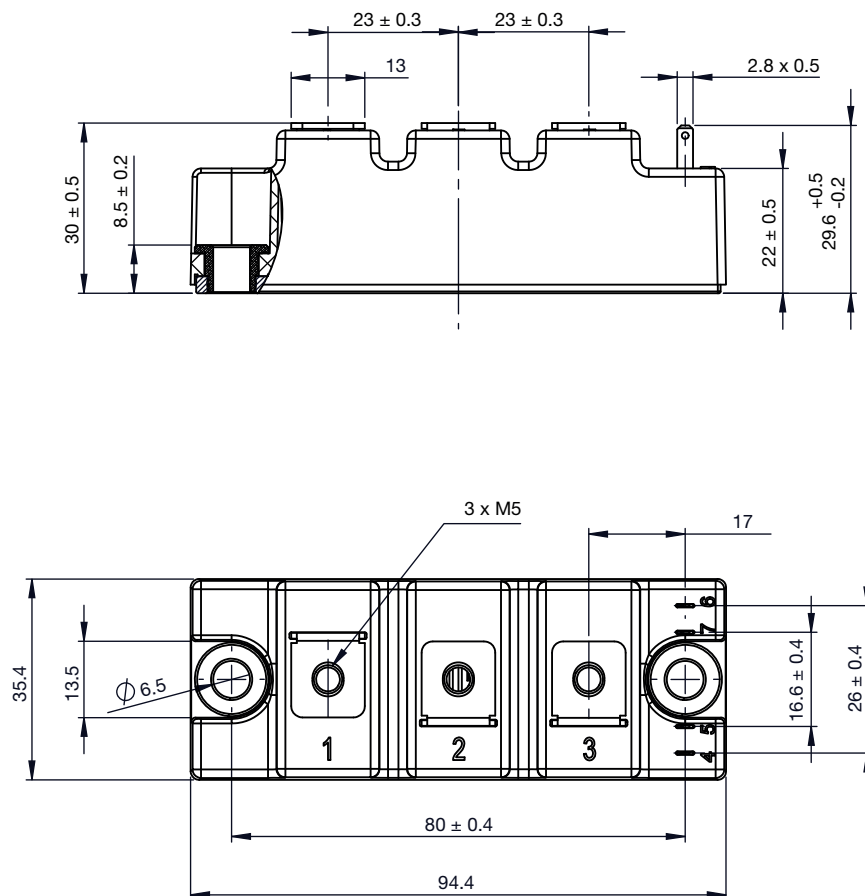
- | | | |
|----------|---|--|
| 1 | - | Vishay Semiconductors product |
| 2 | - | Insulated Gate Bipolar Transistor (IGBT) |
| 3 | - | T = trench IGBT |
| 4 | - | Current rating (150 = 150 A) |
| 5 | - | Circuit configuration (T = half bridge) |
| 6 | - | Package indicator (S = INT-A-PAK IGBT) |
| 7 | - | 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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