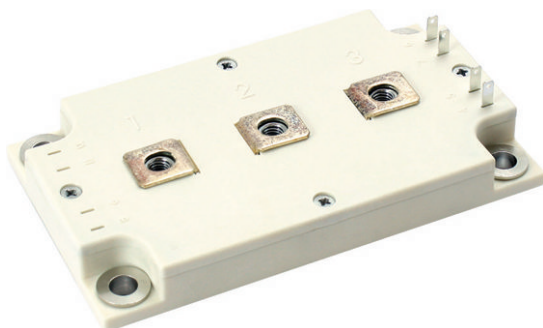


Dual INT-A-PAK Low Profile “Half Bridge” (Standard Speed IGBT), 400 A



Dual INT-A-PAK Low Profile

FEATURES

- TrenchStop IGBT technology
- Standard: optimized for hard switching speed
- Low $V_{CE(on)}$
- Square RBSOA
- Gen 4 FRED Pt[®] dices technology
- Industry standard package
- 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

PRIMARY CHARACTERISTICS

V_{CES}	600 V
I_C DC at $T_C = 114\text{ °C}$	400 A
$V_{CE(on)}$ (typical) at 400 A, 25 °C	1.14 V
Speed	DC to 1 kHz
Package	Dual INT-A-PAK low profile
Circuit configuration	Half bridge

BENEFITS

- Increased operating efficiency
- Performance optimized as output inverter stage for TIG welding machines
- Direct mounting on heatsink
- Very low junction to case thermal resistance

ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	TEST CONDITIONS	MAX.	UNITS
Collector to emitter voltage	V_{CES}		600	V
Continuous collector current	$I_C^{(1)}$	$T_C = 25\text{ °C}$	711	A
		$T_C = 80\text{ °C}$	532	
Pulsed collector current	I_{CM}	$T_C = 175\text{ °C}$, $t_p = 6\text{ ms}$, $V_{GE} = 15\text{ V}$	1100	
Clamped inductive load current	I_{LM}		900	
Diode continuous forward current	I_F	$T_C = 25\text{ °C}$	260	
		$T_C = 80\text{ °C}$	192	
Gate to emitter voltage	V_{GE}		± 20	V
Maximum power dissipation (IGBT)	P_D	$T_C = 25\text{ °C}$	1364	W
		$T_C = 80\text{ °C}$	864	
Maximum power dissipation (Diode)	P_D	$T_C = 25\text{ °C}$	441	W
		$T_C = 80\text{ °C}$	279	
RMS isolation voltage	V_{ISOL}	Any terminal to case ($V_{RMS} t = 1\text{ s}$, $T_J = 25\text{ °C}$)	3500	V

Note

(1) Maximum continuous collector current must be limited to 500 A to do not exceed the maximum temperature of terminals

**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	$V_{BR(CES)}$	$V_{GE} = 0\text{ V}$, $I_C = 1.2\text{ mA}$	600	-	-	V
Collector to emitter voltage	$V_{CE(on)}$	$V_{GE} = 15\text{ V}$, $I_C = 400\text{ A}$	-	1.14	1.40	
		$V_{GE} = 15\text{ V}$, $I_C = 400\text{ A}$, $T_J = 125\text{ }^{\circ}\text{C}$	-	1.13	-	
Gate threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$, $I_C = 6\text{ mA}$	3.8	4.7	6.3	mA
Collector to emitter leakage current	I_{CES}	$V_{GE} = 0\text{ V}$, $V_{CE} = 600\text{ V}$	-	0.002	0.3	
		$V_{GE} = 0\text{ V}$, $V_{CE} = 600\text{ V}$, $T_J = 125\text{ }^{\circ}\text{C}$	-	1.1	-	
Diode forward voltage drop	V_{FM}	$I_{FM} = 400\text{ A}$	-	1.65	2.26	V
		$I_{FM} = 400\text{ A}$, $T_J = 125\text{ }^{\circ}\text{C}$	-	1.58	-	
Gate to emitter leakage current	I_{GES}	$V_{GE} = \pm 20\text{ V}$	-	-	± 200	nA

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

PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Total gate charge (turn-on)	Q_g	$I_C = 75\text{ A}$, $V_{CC} = 520\text{ V}$, $V_{GE} = 15\text{ V}$	-	2791	-	nC
Gate-to-emitter charge (turn-on)	Q_{ge}		-	428	-	
Gate-to-collector charge (turn-on)	Q_{gc}		-	711	-	
Turn-on switching loss	E_{on}	$I_C = 400\text{ A}$, $V_{CC} = 300\text{ V}$, $V_{GE} = 15\text{ V}$, $R_g = 1.5\text{ }\Omega$, $L = 500\text{ }\mu\text{H}$, $T_J = 25\text{ }^{\circ}\text{C}$	-	2.5	-	mJ
Turn-off switching loss	E_{off}		-	20.7	-	
Total switching loss	E_{tot}		-	23.2	-	
Turn-on switching loss	E_{on}	$I_C = 400\text{ A}$, $V_{CC} = 300\text{ V}$, $V_{GE} = 15\text{ V}$, $R_g = 1.5\text{ }\Omega$, $L = 500\text{ }\mu\text{H}$, $T_J = 125\text{ }^{\circ}\text{C}$	-	2.2	-	
Turn-off switching loss	E_{off}		-	27.6	-	
Total switching loss	E_{tot}		-	29.8	-	
Turn-on delay time	$t_{d(on)}$		-	24	-	ns
Rise time	t_r		-	104	-	
Turn-off delay time	$t_{d(off)}$		-	506	-	
Fall time	t_f		-	167	-	
Reverse bias safe operating area	RBSOA	$T_J = 175\text{ }^{\circ}\text{C}$, $I_C = 900\text{ A}$, $V_{CC} = 300\text{ V}$, $V_p = 600\text{ V}$, $R_g = 27\text{ }\Omega$, $V_{GE} = 15\text{ V to } -5\text{ V}$, $L = 500\text{ }\mu\text{H}$	Fullsquare			
Diode reverse recovery time	t_{rr}	$I_F = 50\text{ A}$, $dI_F/dt = 500\text{ A}/\mu\text{s}$, $V_{CC} = 200\text{ V}$, $T_J = 25\text{ }^{\circ}\text{C}$	-	152	-	ns
Diode peak reverse current	I_{rr}		-	24	-	A
Diode recovery charge	Q_{rr}		-	1.82	-	μC
Diode reverse recovery time	t_{rr}	$I_F = 50\text{ A}$, $dI_F/dt = 500\text{ A}/\mu\text{s}$, $V_{CC} = 200\text{ V}$, $T_J = 125\text{ }^{\circ}\text{C}$	-	200	-	ns
Diode peak reverse current	I_{rr}		-	39	-	A
Diode recovery charge	Q_{rr}		-	3.94	-	μC

THERMAL AND MECHANICAL SPECIFICATIONS

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS
Operating junction and storage temperature range	T_J , T_{Stg}	-40	-	175	$^{\circ}\text{C}$
Junction to case per leg	IGBT	-	-	0.11	$^{\circ}\text{C}/\text{W}$
	Diode	-	-	0.34	
Case to sink per module	R_{thCS}	-	0.05	-	
Mounting torque	case to heatsink: M6 screw	4	-	6	Nm
	case to terminal 1, 2, 3: M5 screw	2	-	5	
Weight		-	270	-	g

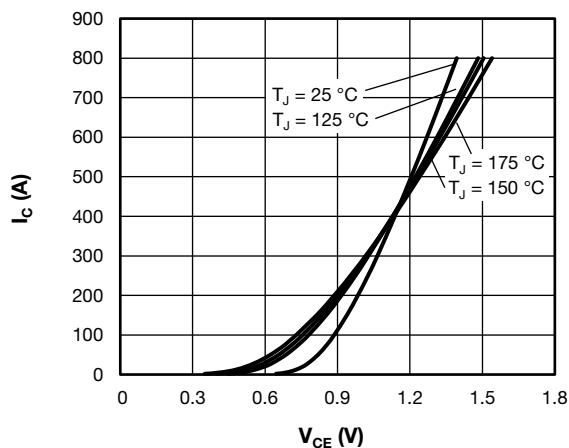


Fig. 1 - Typical Q1 to Q2 IGBT Output Characteristics, $V_{GE} = 15\text{ V}$

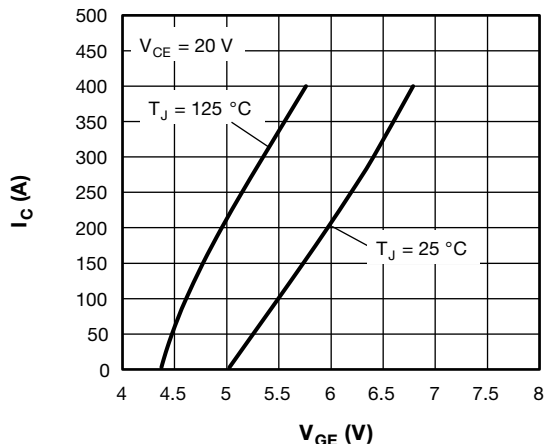


Fig. 4 - Typical Q1 to Q2 IGBT Transfer Characteristics

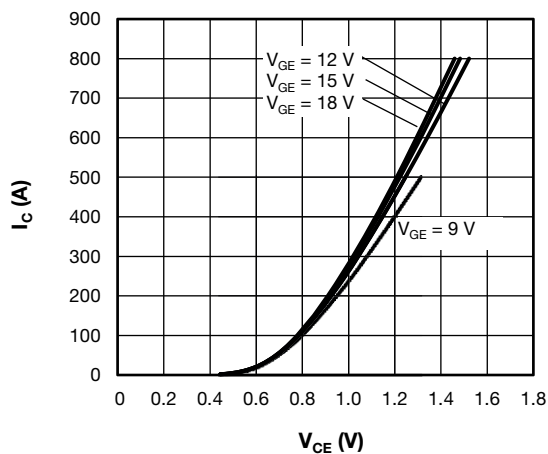


Fig. 2 - Typical Q1 to Q2 IGBT Output Characteristics, $T_J = 125\text{ °C}$

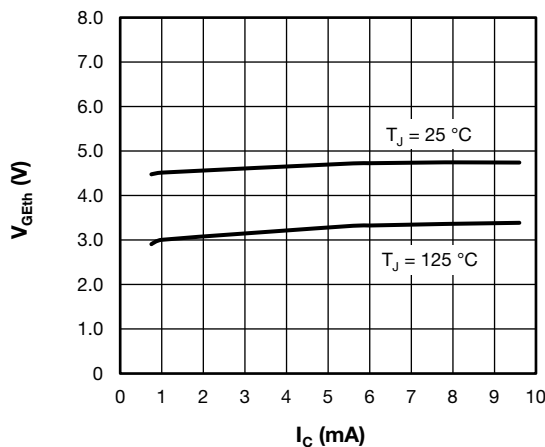


Fig. 5 - Typical Q1 to Q2 IGBT Gate Threshold Voltage

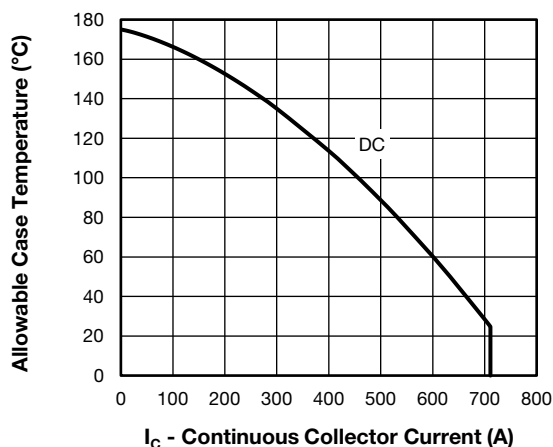


Fig. 3 - Maximum Q1 to Q2 IGBT Continuous Collector Current vs. Case Temperature

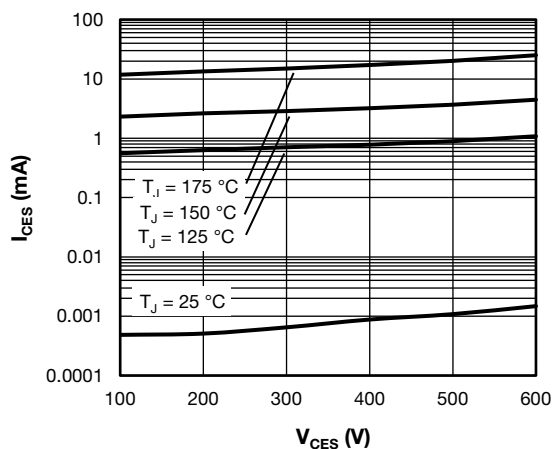


Fig. 6 - Typical Q1 to Q2 IGBT Zero Gate Voltage Collector Current

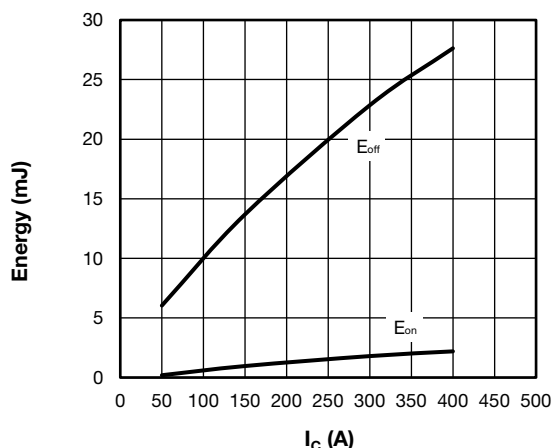


Fig. 7 - Typical Q1 to Q2 IGBT
Energy Loss vs. I_C (with D1 to D2 Antiparallel Diode)
 $T_J = 125^\circ\text{C}$, $V_{CC} = 300\text{ V}$, $R_g = 1.5\ \Omega$, $V_{GE} = +15\text{ V}/-15\text{ V}$, $L = 500\ \mu\text{H}$

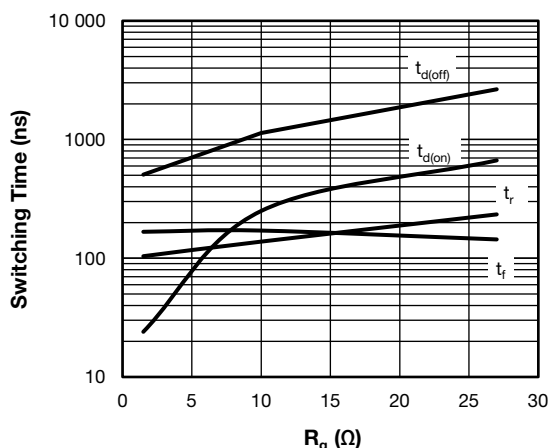


Fig. 10 - Typical Q1 to Q2 IGBT
Switching Time vs. R_g (with D1 to D2 Antiparallel Diode)
 $T_J = 125^\circ\text{C}$, $V_{CC} = 300\text{ V}$, $I_C = 400\text{ A}$, $V_{GE} = +15\text{ V}/-15\text{ V}$, $L = 500\ \mu\text{H}$

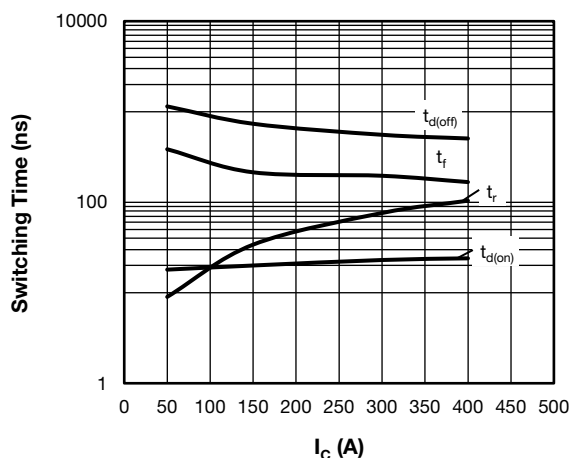


Fig. 8 - Typical Q1 to Q2 IGBT
Switching Time vs. I_C (with D1 to D2 Antiparallel Diode)
 $T_J = 125^\circ\text{C}$, $V_{CC} = 300\text{ V}$, $R_g = 1.5\ \Omega$, $V_{GE} = +15\text{ V}/-15\text{ V}$, $L = 500\ \mu\text{H}$

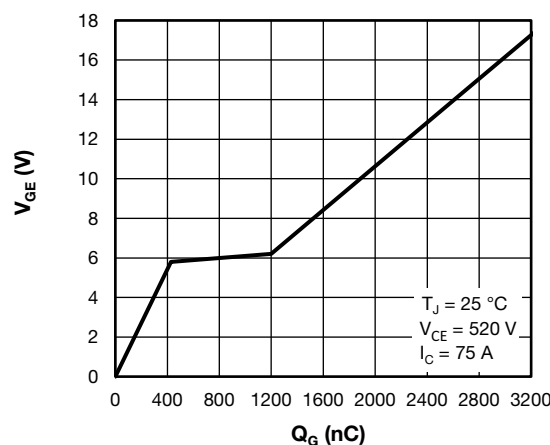


Fig. 11 - Typical Q1 to Q2 IGBT
Gate Charge vs. Gate to Emitter Voltage

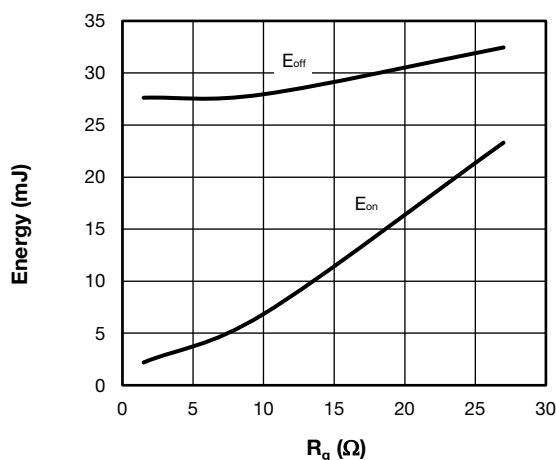


Fig. 9 - Typical Q1 to Q2 IGBT
Energy Loss vs. R_g (with D1 to D2 Antiparallel Diode)
 $T_J = 125^\circ\text{C}$, $V_{CC} = 300\text{ V}$, $I_C = 400\text{ A}$, $V_{GE} = +15\text{ V}/-15\text{ V}$, $L = 500\ \mu\text{H}$

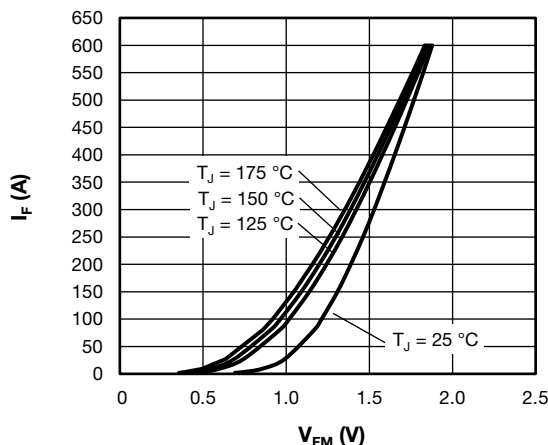


Fig. 12 - Typical D1 to D2 Antiparallel Diode
Forward Characteristics

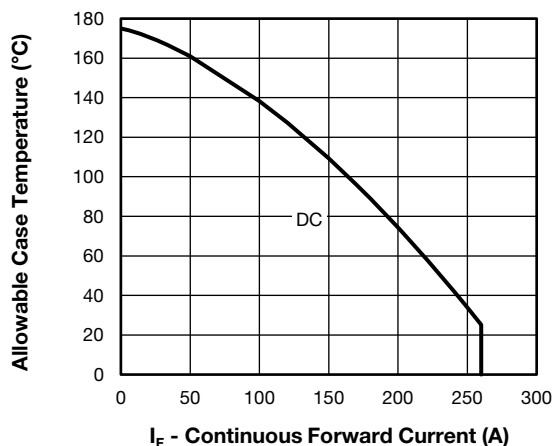


Fig. 13 - Maximum D1 to D2 Antiparallel Diode Continuous Forward Current vs. Case Temperature

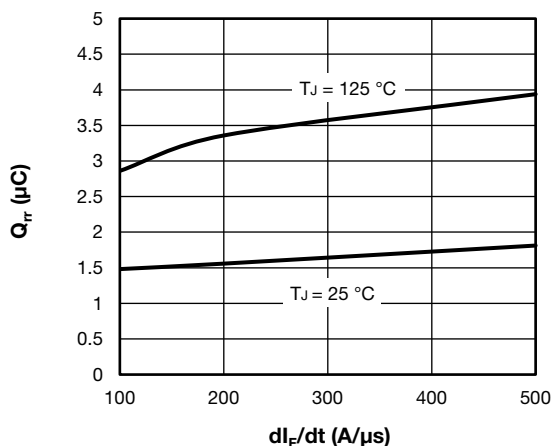


Fig. 16 - Typical D1 to D2 Antiparallel Diode Reverse Recovery Charge vs. dI_F/dt , $V_{CC} = 200\text{ V}$, $I_F = 50\text{ A}$

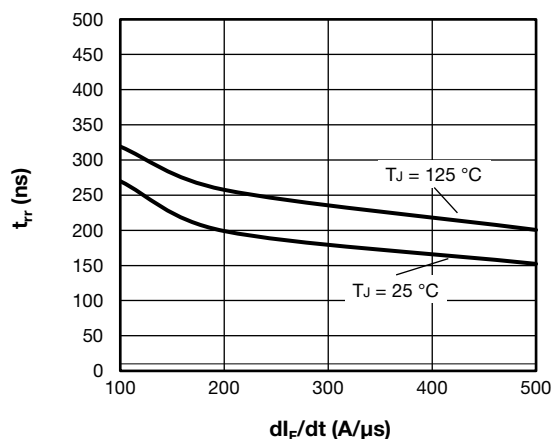


Fig. 14 - Typical D1 to D2 Antiparallel Diode Reverse Recovery Time vs. dI_F/dt , $V_{CC} = 200\text{ V}$, $I_F = 50\text{ A}$

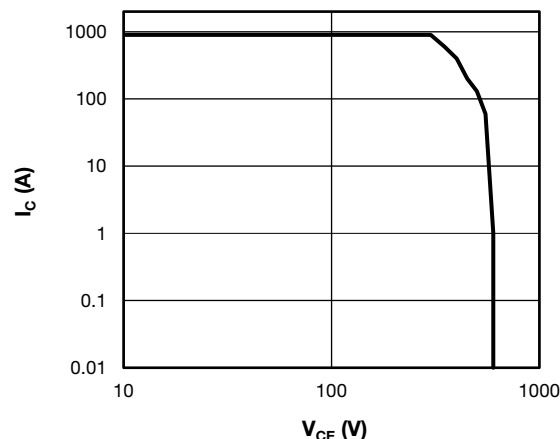


Fig. 17 - Q1 to Q2 IGBT Reverse BIAS SOA
 $T_J = 175^\circ\text{C}$, $I_C = 900\text{ A}$, $R_g = 27\Omega$, $V_{GE} = +15\text{ V} / -5\text{ V}$, $V_{CC} = 300\text{ V}$, $V_p = 600\text{ V}$

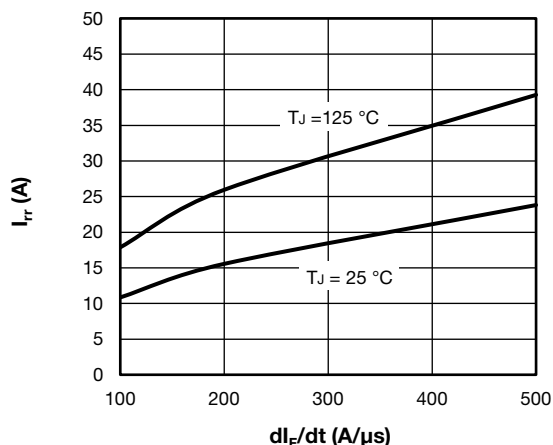


Fig. 15 - Typical D1 to D2 Antiparallel Diode Reverse Recovery Current vs. dI_F/dt , $V_{CC} = 200\text{ V}$, $I_F = 50\text{ A}$

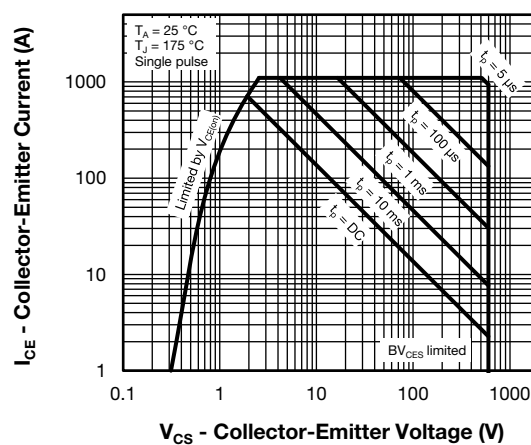


Fig. 18 - Q1 to Q2 IGBT Safe Operating Area

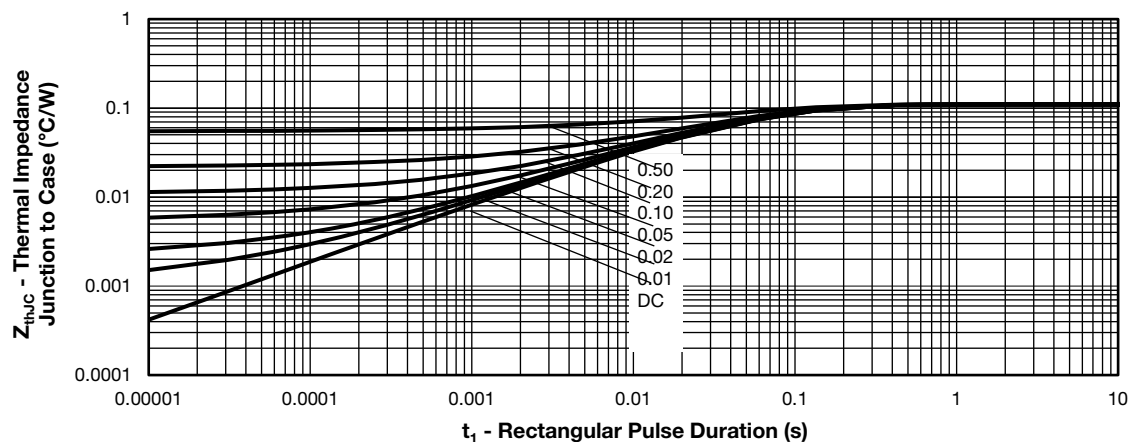


Fig. 19 - Maximum Thermal Impedance Z_{thJC} Characteristics - (Q1 to Q2 IGBT)

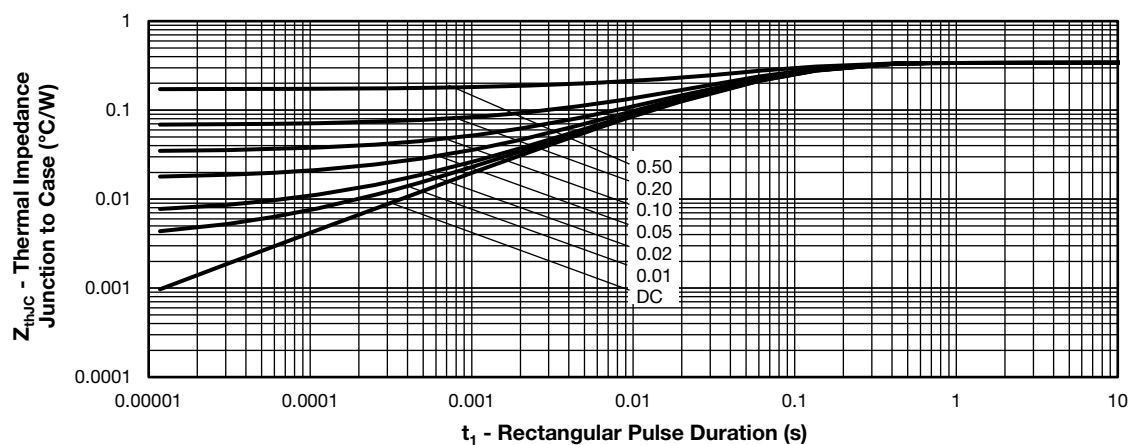


Fig. 20 - Maximum Thermal Impedance Z_{thJC} Characteristics - (D1 to D2 Antiparallel Diode)

ORDERING INFORMATION TABLE

Device code

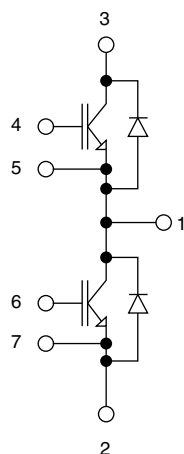
G	T	400	T	D	60	S
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1 2 3 4 5 6 7

- 1 - Insulated gate bipolar transistor (IGBT)
- 2 - T = Trench IGBT technology
- 3 - Current rating (400 = 400 A)
- 4 - Circuit configuration (T = half-bridge)
- 5 - Package indicator (D = dual INT-A-PAK low profile)
- 6 - Voltage rating (60 = 600 V)
- 7 - Speed / type (S = standard speed IGBT)



CIRCUIT CONFIGURATION

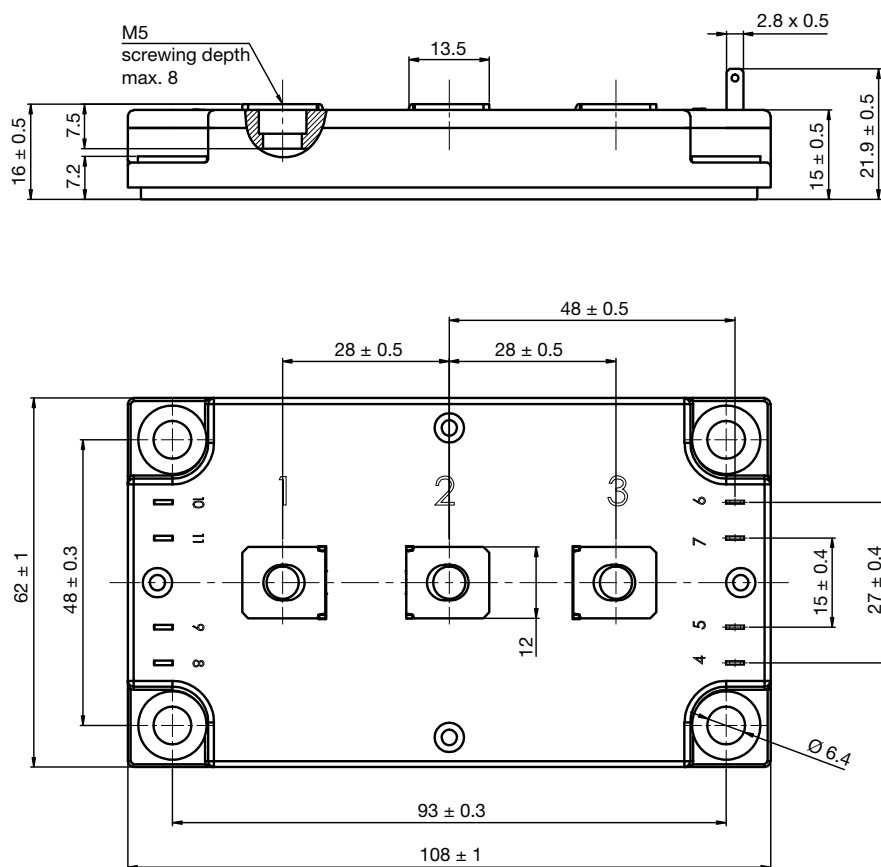


LINKS TO RELATED DOCUMENTS

Dimensions	www.vishay.com/doc?95435
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Dual INT-A-PAK Low Profile

DIMENSIONS in millimeters





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