

## Half Bridge, 600 A, DIAP IGBT Power Module (Trench Field Stop IGBT)



Dual INT-A-PAK

### 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
- 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

$V_{CES}$	600 V
$I_C$ DC at $T_C = 71\text{ }^\circ\text{C}$	600 A
$V_{CE(on)}$ (typical) at 600 A, 25 °C	1.29 V
Speed	DC to 1 kHz
Package	Dual INT-A-PAK
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	$I_C^{(1)}$	$T_C = 25\text{ }^\circ\text{C}$	755	A
		$T_C = 80\text{ }^\circ\text{C}$	565	
Pulsed collector current	$I_{CM}$	$T_C = 175\text{ }^\circ\text{C}$ , $t_p = 6\text{ ms}$ , $V_{GE} = 15\text{ V}$	1000	
Clamped inductive load current	$I_{LM}$		n/a	
Diode continuous forward current	$I_F$	$T_C = 25\text{ }^\circ\text{C}$	272	
		$T_C = 80\text{ }^\circ\text{C}$	202	
Gate to emitter voltage	$V_{GE}$		$\pm 20$	V
Maximum power dissipation (IGBT)	$P_D$	$T_C = 25\text{ }^\circ\text{C}$	1364	W
		$T_C = 80\text{ }^\circ\text{C}$	864	
Maximum power dissipation (Diode)	$P_D$	$T_C = 25\text{ }^\circ\text{C}$	468	W
		$T_C = 80\text{ }^\circ\text{C}$	297	
RMS isolation voltage	$V_{ISOL}$	Any terminal to case ( $V_{RMS}$ $t = 1\text{ s}$ , $T_J = 25\text{ }^\circ\text{C}$ )	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	$V_{CE(on)}$	$V_{GE} = 15\text{ V}$ , $I_C = 600\text{ A}$	-	1.29	1.64	
		$V_{GE} = 15\text{ V}$ , $I_C = 600\text{ A}$ , $T_J = 125\text{ }^{\circ}\text{C}$	-	1.36	-	
Gate threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$ , $I_C = 6\text{ mA}$	3.8	4.8	6.3	
Collector to emitter leakage current	$I_{CES}$	$V_{GE} = 0\text{ V}$ , $V_{CE} = 600\text{ V}$	-	0.3	200	$\mu\text{A}$
		$V_{GE} = 0\text{ V}$ , $V_{CE} = 600\text{ V}$ , $T_J = 125\text{ }^{\circ}\text{C}$	-	280	-	
Diode forward voltage drop	$V_{FM}$	$I_{FM} = 400\text{ A}$	-	1.66	2.3	V
		$I_{FM} = 400\text{ A}$ , $T_J = 125\text{ }^{\circ}\text{C}$	-	1.57	-	
Gate to emitter leakage current	$I_{GES}$	$V_{GE} = \pm 20\text{ V}$	-	-	$\pm 200$	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)	$Q_g$	$I_C = 75\text{ A}$ , $V_{CC} = 520\text{ V}$ , $V_{GE} = 15\text{ V}$	-	2665	-	nC
Gate-to-emitter charge (turn-on)	$Q_{ge}$		-	445	-	
Gate-to-collector charge (turn-on)	$Q_{gc}$		-	750	-	
Turn-on switching loss	$E_{on}$	$I_C = 600\text{ A}$ , $V_{CC} = 300\text{ V}$ , $V_{GE} = 15\text{ V}$ , $R_g = 27\text{ }\Omega$ , $L = 500\text{ }\mu\text{H}$ , $T_J = 25\text{ }^{\circ}\text{C}$	-	75	-	mJ
Turn-off switching loss	$E_{off}$		-	72	-	
Total switching loss	$E_{tot}$		-	147	-	
Turn-on switching loss	$E_{on}$	$I_C = 600\text{ A}$ , $V_{CC} = 300\text{ V}$ , $V_{GE} = 15\text{ V}$ , $R_g = 27\text{ }\Omega$ , $L = 500\text{ }\mu\text{H}$ , $T_J = 125\text{ }^{\circ}\text{C}$	-	39	-	
Turn-off switching loss	$E_{off}$		-	53	-	
Total switching loss	$E_{tot}$		-	92	-	
Turn-on delay time	$t_{d(on)}$		-	580	-	ns
Rise time	$t_r$		-	290	-	
Turn-off delay time	$t_{d(off)}$		-	2540	-	
Fall time	$t_f$		-	130	-	
Reverse bias safe operating area	RBSOA	$T_J = 175\text{ }^{\circ}\text{C}$ , $I_C = \text{n/a}$ , $V_{CC} = 300\text{ V}$ , $V_p = 600\text{ V}$ , $R_g = 27\text{ }\Omega$ , $V_{GE} = 15\text{ V to } -5\text{ V}$ , $L = 500\text{ }\mu\text{H}$	n/a			
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	-	$\mu\text{C}$
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	-	$\mu\text{C}$

**THERMAL AND MECHANICAL SPECIFICATIONS**

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS
Operating junction temperature range	$T_J$	-40	-	175	$^{\circ}\text{C}$
Storage temperature range	$T_{Stg}$	-40	-	150	$^{\circ}\text{C}$
Junction to case per leg	IGBT	-	-	0.11	$^{\circ}\text{C/W}$
	Diode	-	-	0.32	
Case to sink per module	$R_{thCS}$	-	0.05	-	
Mounting torque	case to heatsink: M6 screw	2.5	-	5	Nm
	case to terminal 1, 2, 3: M6 screw	3	-	5	
Weight		-	270	-	g

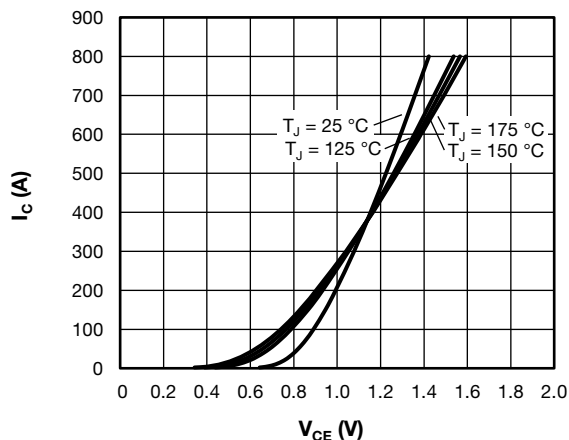
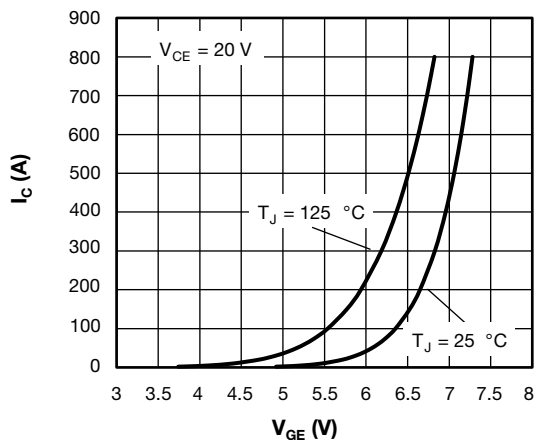

Fig. 1 - Typical Q1 to Q2 IGBT Output Characteristics,  $V_{GE} = 15\text{ V}$ 


Fig. 4 - Typical Q1 to Q2 IGBT Transfer Characteristics

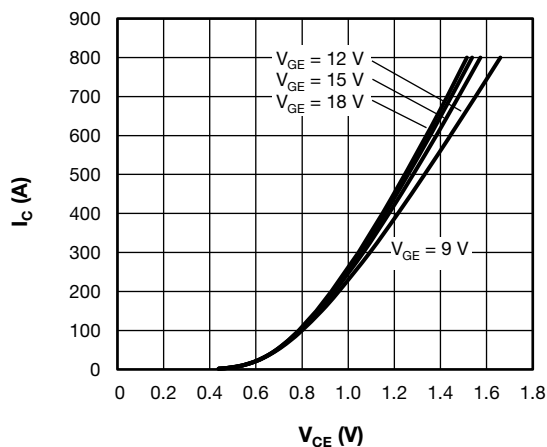
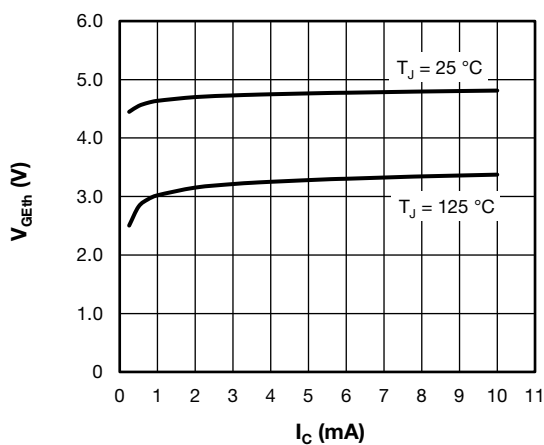

Fig. 2 - Typical Q1 to Q2 IGBT Output Characteristics,  $T_J = 125\text{ °C}$ 


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

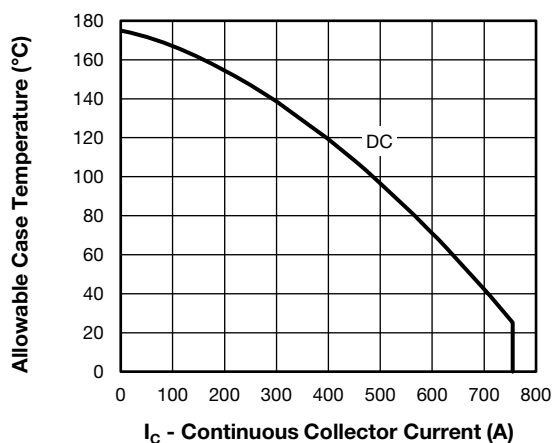


Fig. 3 - Maximum Q1 to Q2 IGBT Continuous Collector Current vs. Case Temperature

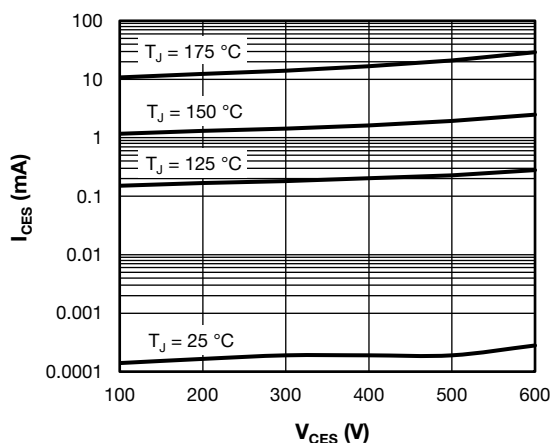


Fig. 6 - Typical Q1 to Q2 IGBT Zero Gate Voltage Collector Current

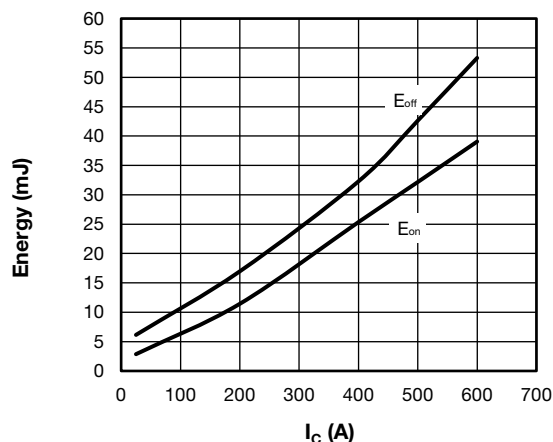


Fig. 7 - Typical Q1 to Q2 IGBT Energy Loss vs.  $I_C$   
(with D1 to D2 Antiparallel Diode)  
 $T_J = 125^\circ\text{C}$ ,  $V_{CC} = 300\text{ V}$ ,  $R_g = 27\ \Omega$ ,  $V_{GE} = +15\text{ V}/-15\text{ V}$ ,  $L = 500\ \mu\text{H}$

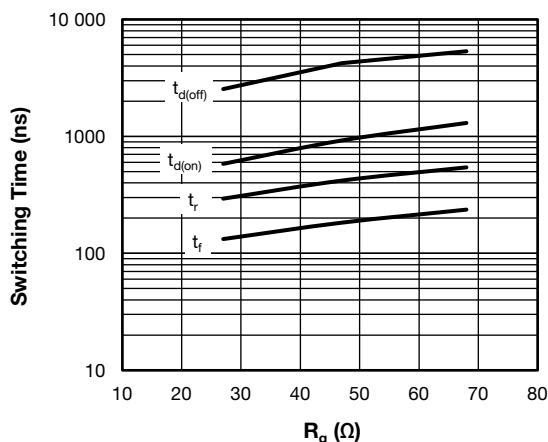


Fig. 10 - Typical Q1 to Q2 IGBT Switching Time vs.  $R_g$   
(with D1 to D2 Antiparallel Diode)  
 $T_J = 125^\circ\text{C}$ ,  $V_{CC} = 300\text{ V}$ ,  $I_C = 600\text{ A}$ ,  $V_{GE} = +15\text{ V}/-15\text{ V}$ ,  $L = 500\ \mu\text{H}$

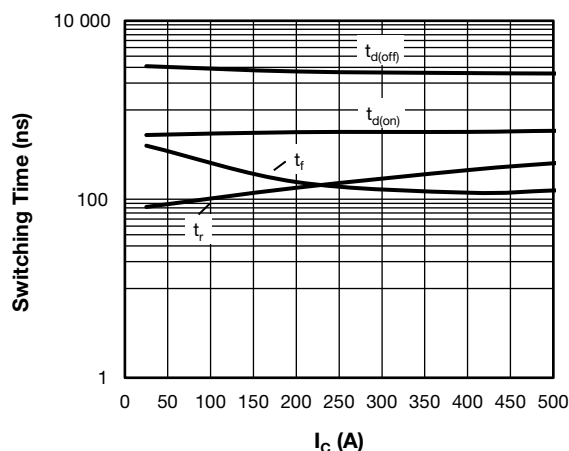


Fig. 8 - Typical Q1 to Q2 IGBT Switching Time vs.  $I_C$   
(with D1 to D2 Antiparallel Diode)  
 $T_J = 125^\circ\text{C}$ ,  $V_{CC} = 300\text{ V}$ ,  $R_g = 27\ \Omega$ ,  $V_{GE} = +15\text{ V}/-15\text{ V}$ ,  $L = 500\ \mu\text{H}$

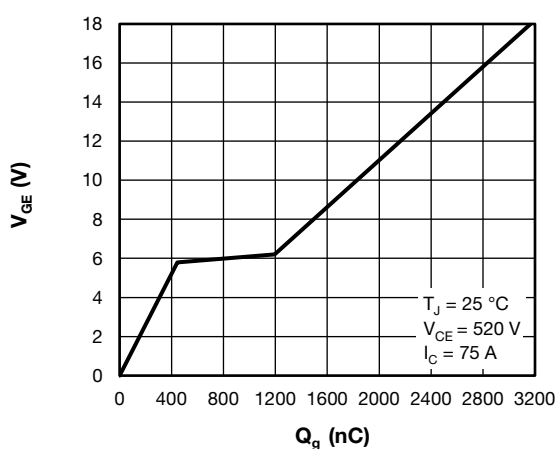


Fig. 11 - Typical Q1 to Q2 IGBT  
Gate Charge vs. Gate to Source Voltage

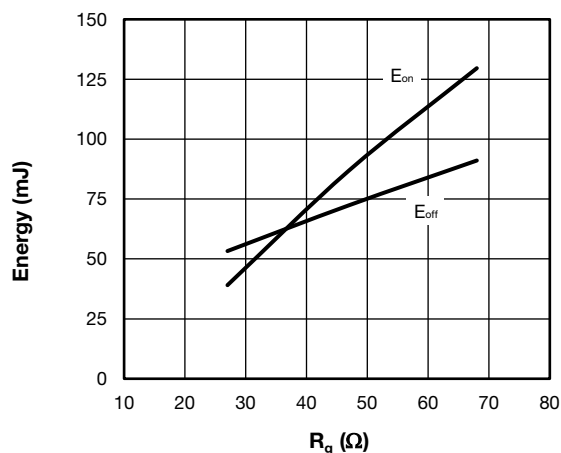


Fig. 9 - Typical Q1 to Q2 IGBT Energy Loss vs.  $R_g$   
(with D1 to D2 Antiparallel Diode)  
 $T_J = 125^\circ\text{C}$ ,  $V_{CC} = 300\text{ V}$ ,  $I_C = 600\text{ A}$ ,  $V_{GE} = +15\text{ V}/-15\text{ V}$ ,  $L = 500\ \mu\text{H}$

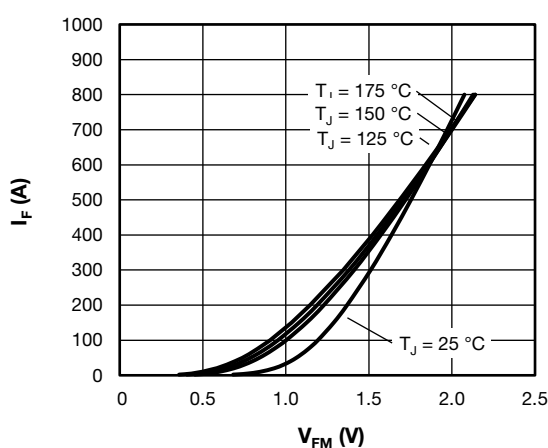


Fig. 12 - Typical D1 to D2  
Antiparallel Diode Forward Characteristics

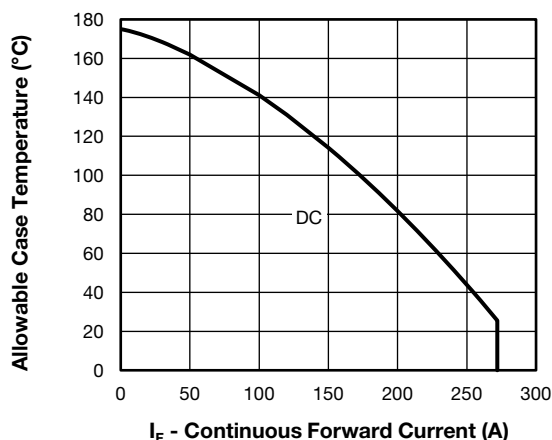


Fig. 13 - Maximum D1 to D2 Antiparallel Diode Continuous Forward Current vs. Case Temperature

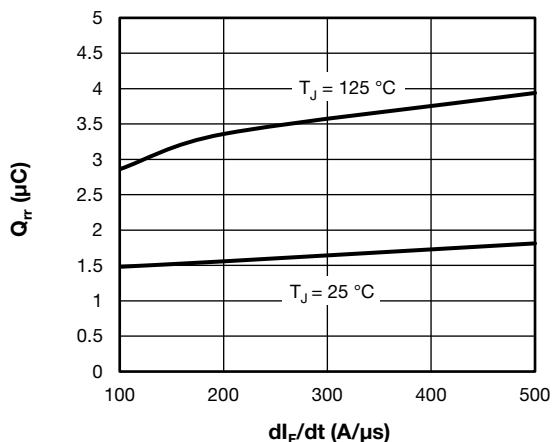


Fig. 16 - Typical D1 to D2 Antiparallel Diode Reverse Recovery Charge vs.  $dI_F/dt$   
 $V_{rr} = 200\text{ V}$ ,  $I_F = 50\text{ A}$

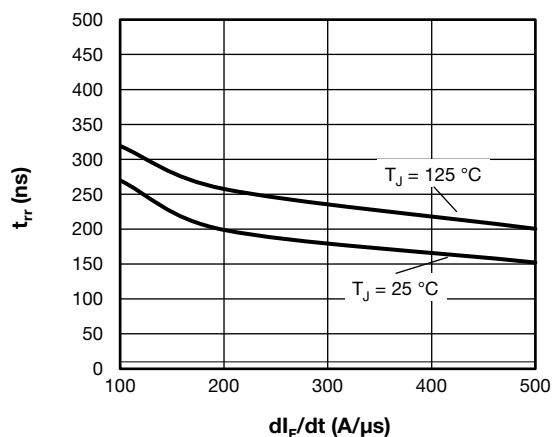


Fig. 14 - Typical D1 to D2 Antiparallel Diode Reverse Recovery Time vs.  $dI_F/dt$   
 $V_{rr} = 200\text{ V}$ ,  $I_F = 50\text{ A}$

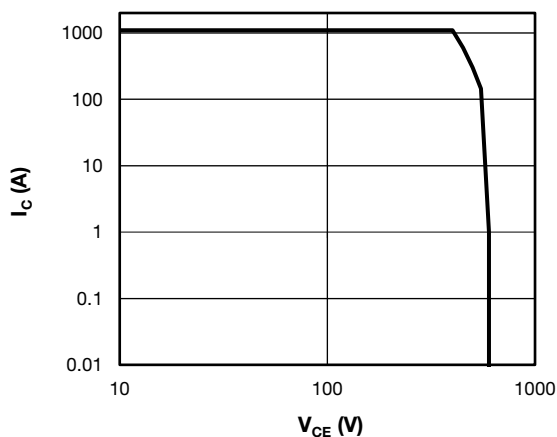


Fig. 17 - Q1 to Q2 IGBT Reverse BIAS SOA  $T_J = 175^\circ\text{C}$ ,  $V_{GE} = 15\text{ V}$   
 $T_J = 175^\circ\text{C}$ ,  $I_C = 1100\text{ A}$ ,  $R_g = 27\ \Omega$ ,  $V_{GE} = +15\text{ V}/0\text{ V}$ ,  $V_{CC} = 400\text{ V}$ ,  
 $V_p = 600\text{ V}$

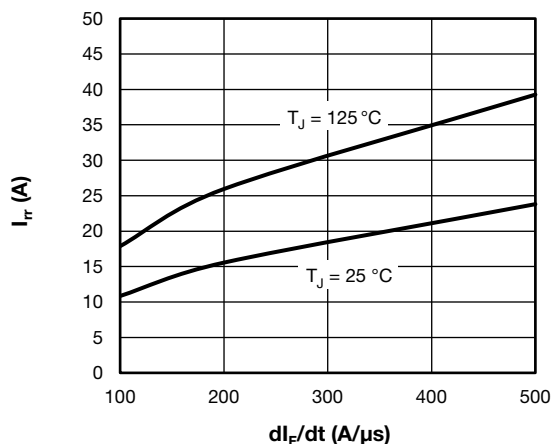


Fig. 15 - Typical D1 to D2 Antiparallel Diode Reverse Recovery Current vs.  $dI_F/dt$   
 $V_{rr} = 200\text{ V}$ ,  $I_F = 50\text{ A}$

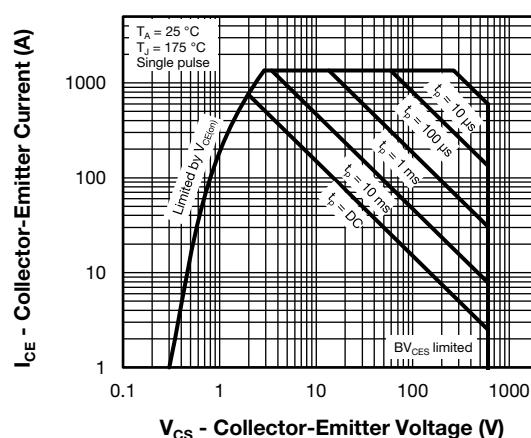
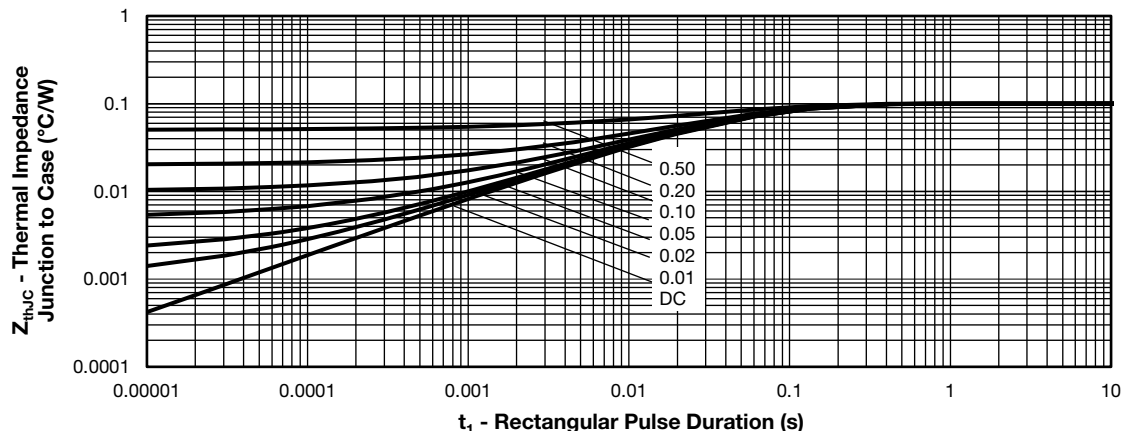
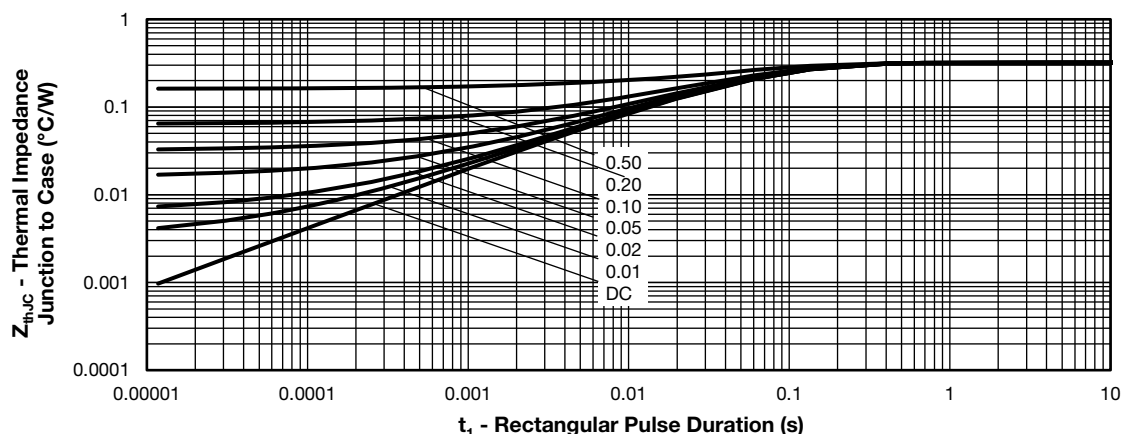
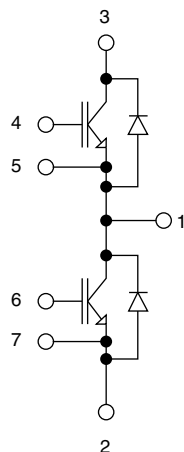


Fig. 18 - Q1 to Q2 IGBT Safe Operating Area

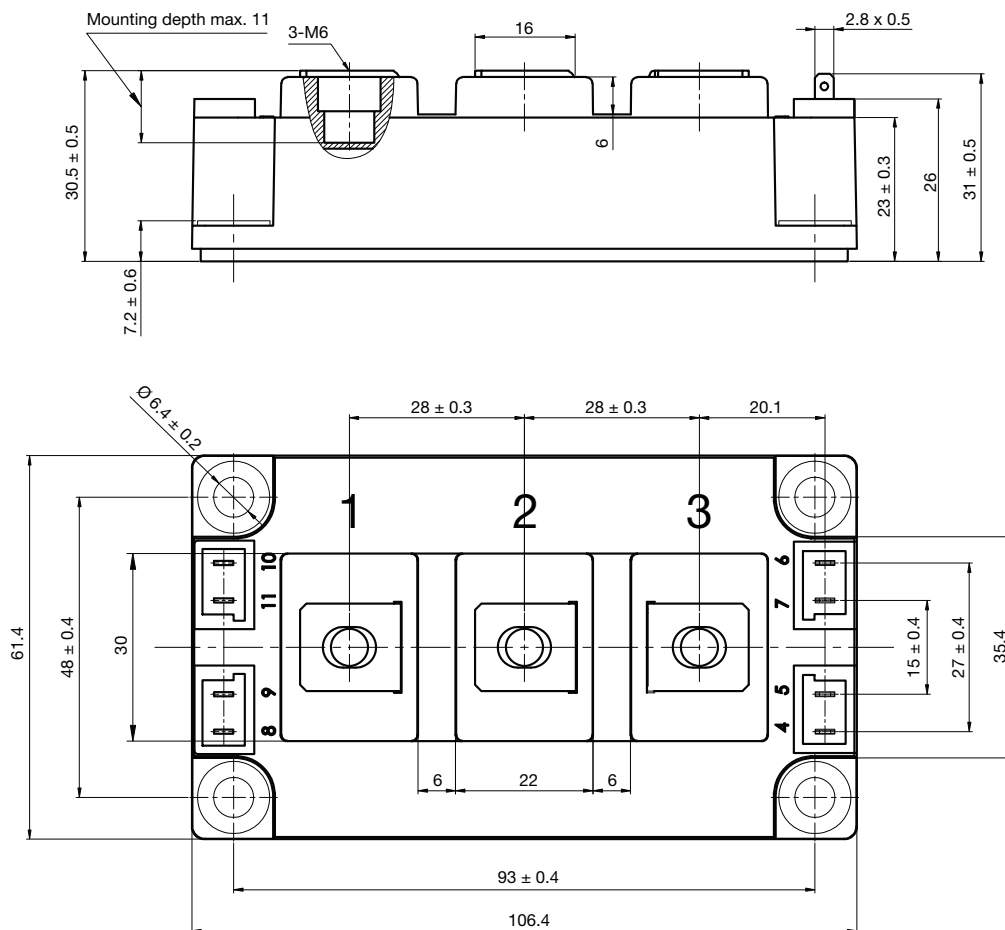

Fig. 19 - Maximum Thermal Impedance  $Z_{thJC}$  Characteristics - (Q1 to Q2 PT IGBT)

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

## ORDERING INFORMATION TABLE

Device code	G	T	600	T	H	060	S
	①	②	③	④	⑤	⑥	⑦
①	-	Insulated gate bipolar transistor (IGBT)					
②	-	T = Trench IGBT technology					
③	-	Current rating (600 = 600 A)					
④	-	Circuit configuration (T = half-bridge)					
⑤	-	Package indicator (H = dual INT-A-PAK)					
⑥	-	Voltage rating (060 = 600 V)					
⑦	-	Speed / type (S = standard speed IGBT)					

**CIRCUIT CONFIGURATION**


LINKS TO RELATED DOCUMENTS	
Dimensions	<a href="http://www.vishay.com/doc?95435">www.vishay.com/doc?95435</a>
Application Note	<a href="http://www.vishay.com/doc?95553">www.vishay.com/doc?95553</a>

**DIMENSIONS** in millimeters




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