

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



Dual INT-A-PAK Low Profile

FEATURES

- Gen 4 IGBT technology
- Standard: optimized for hard switching speed
- Low $V_{CE(on)}$
- Square RBSOA
- HEXFRED® antiparallel diode with ultrasoft reverse recovery characteristics
- 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 $T_C = 25\text{ }^{\circ}\text{C}$	750 A
$V_{CE(on)}$ (typical) at 400 A, $25\text{ }^{\circ}\text{C}$	1.24 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	$I_C^{(1)}$	$T_C = 25\text{ }^{\circ}\text{C}$	750	A
		$T_C = 80\text{ }^{\circ}\text{C}$	525	
Pulsed collector current	I_{CM}		1000	
Clamped inductive load current	I_{LM}		1000	
Diode continuous forward current	I_F	$T_C = 25\text{ }^{\circ}\text{C}$	219	
		$T_C = 80\text{ }^{\circ}\text{C}$	145	
Gate to emitter voltage	V_{GE}		± 20	V
Maximum power dissipation (IGBT)	P_D	$T_C = 25\text{ }^{\circ}\text{C}$	1563	W
		$T_C = 80\text{ }^{\circ}\text{C}$	875	
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)

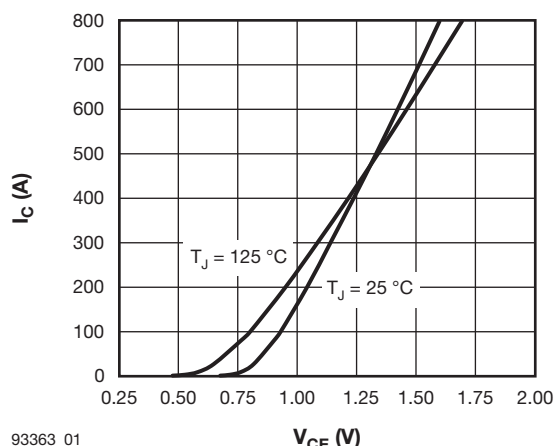
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Collector to emitter breakdown voltage	$V_{BR(CES)}$	$V_{GE} = 0\text{ V}$, $I_C = 500\text{ }\mu\text{A}$	600	-	-	V
Collector to emitter voltage	$V_{CE(on)}$	$V_{GE} = 15\text{ V}$, $I_C = 300\text{ A}$	-	1.14	1.35	
		$V_{GE} = 15\text{ V}$, $I_C = 400\text{ A}$	-	1.24	1.52	
		$V_{GE} = 15\text{ V}$, $I_C = 300\text{ A}$, $T_J = 125\text{ }^{\circ}\text{C}$	-	1.08	1.29	
		$V_{GE} = 15\text{ V}$, $I_C = 400\text{ A}$, $T_J = 125\text{ }^{\circ}\text{C}$	-	1.21	1.5	
Gate threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$, $I_C = 250\text{ }\mu\text{A}$	3.0	4.6	6.3	mA
Collector to emitter leakage current	I_{CES}	$V_{GE} = 0\text{ V}$, $V_{CE} = 600\text{ V}$	-	0.075	1	
		$V_{GE} = 0\text{ V}$, $V_{CE} = 600\text{ V}$, $T_J = 125\text{ }^{\circ}\text{C}$	-	1.8	10	V
Diode forward voltage drop	V_{FM}	$I_{FM} = 300\text{ A}$	-	1.48	1.75	
		$I_{FM} = 400\text{ A}$	-	1.63	1.98	
		$I_{FM} = 300\text{ A}$, $T_J = 125\text{ }^{\circ}\text{C}$	-	1.50	1.77	
		$I_{FM} = 400\text{ A}$, $T_J = 125\text{ }^{\circ}\text{C}$	-	1.70	2.04	
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
Turn-on switching loss	E_{on}	$I_C = 400\text{ A}$, $V_{CC} = 360\text{ V}$, $V_{GE} = 15\text{ V}$, $R_g = 1.5\text{ }\Omega$, $L = 500\text{ }\mu\text{H}$, $T_J = 25\text{ }^{\circ}\text{C}$	-	8.5	-	mJ
Turn-off switching loss	E_{off}		-	113	-	
Total switching loss	E_{tot}		-	121.5	-	
Turn-on switching loss	E_{on}	$I_C = 400\text{ A}$, $V_{CC} = 360\text{ V}$, $V_{GE} = 15\text{ V}$, $R_g = 1.5\text{ }\Omega$, $L = 500\text{ }\mu\text{H}$, $T_J = 125\text{ }^{\circ}\text{C}$	-	21	-	ns
Turn-off switching loss	E_{off}		-	163	-	
Total switching loss	E_{tot}		-	184	-	
Turn-on delay time	$t_{d(on)}$		-	532	-	
Rise time	t_r		-	377	-	
Turn-off delay time	$t_{d(off)}$		-	496	-	
Fall time	t_f		-	1303	-	
Reverse bias safe operating area	RBSOA	$T_J = 150\text{ }^{\circ}\text{C}$, $I_C = 1000\text{ A}$, $V_{CC} = 400\text{ V}$, $V_P = 600\text{ V}$, $R_g = 22\text{ }\Omega$, $V_{GE} = 15\text{ V}$ to 0 V , $L = 500\text{ }\mu\text{H}$	Fullsquare			
Diode reverse recovery time	t_{rr}	$I_F = 300\text{ A}$, $di_F/dt = 500\text{ A}/\mu\text{s}$, $V_{CC} = 400\text{ V}$, $T_J = 25\text{ }^{\circ}\text{C}$	-	150	179	ns
Diode peak reverse current	I_{rr}		-	43	59	A
Diode recovery charge	Q_{rr}		-	3.9	6.3	μC
Diode reverse recovery time	t_{rr}	$I_F = 300\text{ A}$, $di_F/dt = 500\text{ A}/\mu\text{s}$, $V_{CC} = 400\text{ V}$, $T_J = 125\text{ }^{\circ}\text{C}$	-	236	265	ns
Diode peak reverse current	I_{rr}		-	64	80	A
Diode recovery charge	Q_{rr}		-	8.6	11.1	μC

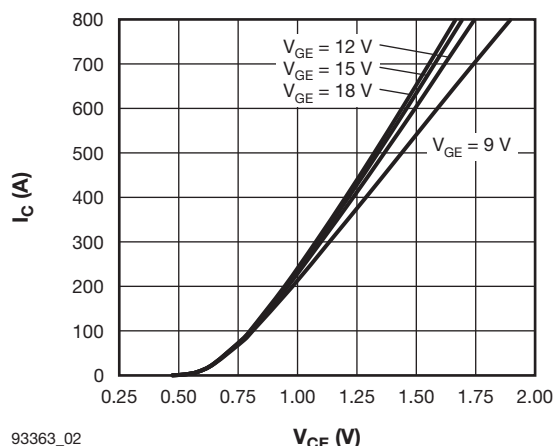
THERMAL AND MECHANICAL SPECIFICATIONS

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS
Operating junction and storage temperature range	T_J , T_{Stg}	-40	-	150	$^{\circ}\text{C}$
Junction to case per leg	IGBT	-	-	0.08	$^{\circ}\text{C}/\text{W}$
	Diode	-	-	0.4	
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



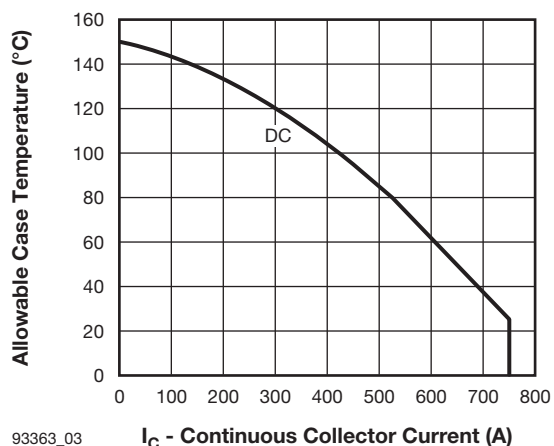
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Fig. 1 - Typical Output Characteristics,
 $T_J = 25^\circ\text{C}$, $V_{GE} = 15\text{ V}$



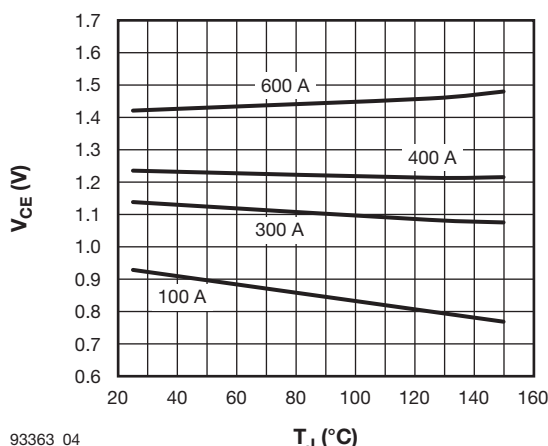
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Fig. 2 - Typical Output Characteristics,
 $T_J = 125^\circ\text{C}$



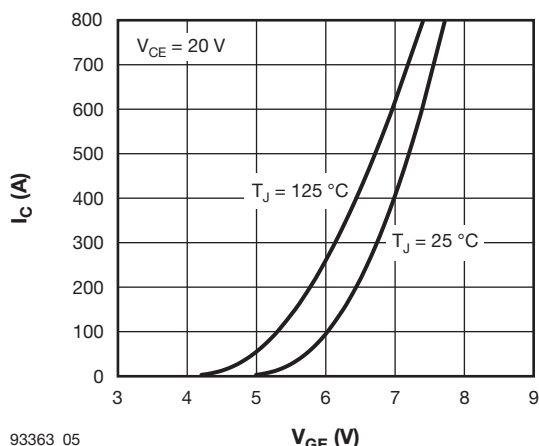
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Fig. 3 - Maximum DC IGBT Collector Current vs.
Case Temperature



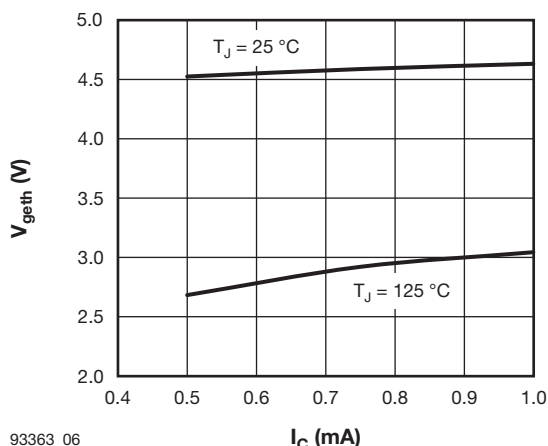
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Fig. 4 - Typical IGBT Collector to Emitter Voltage vs.
Junction Temperature,
 $V_{GE} = 15\text{ V}$



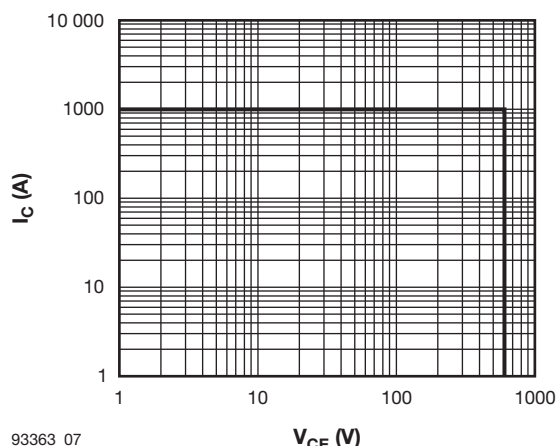
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Fig. 5 - Typical IGBT Transfer Characteristics



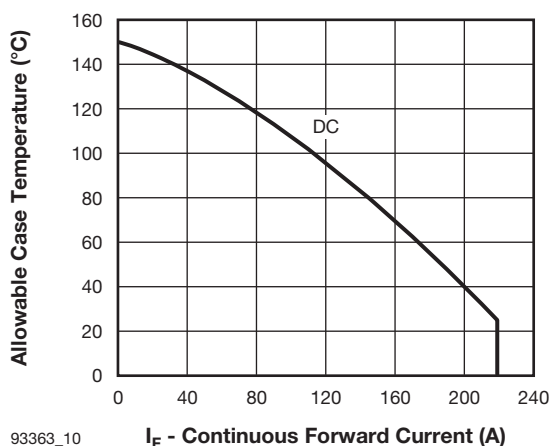
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Fig. 6 - Typical IGBT Gate Threshold Voltage



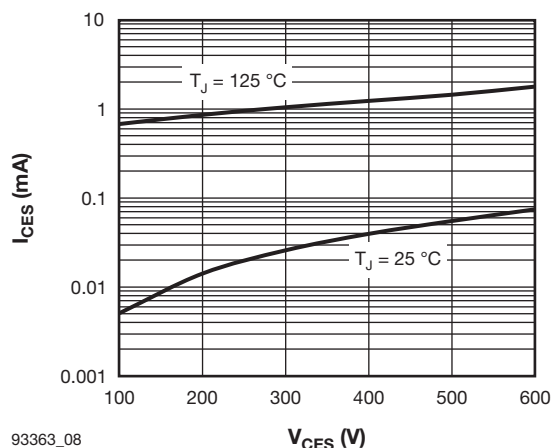
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Fig. 7 - IGBT Reverse Bias SOA,
 $T_J = 150^\circ\text{C}$, $V_{GE} = 15\text{ V}$, $R_g = 22\ \Omega$



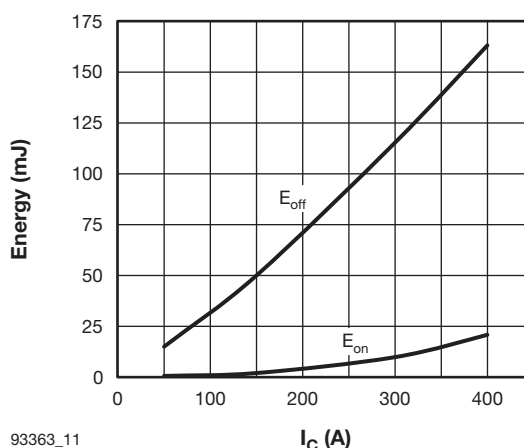
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Fig. 10 - Maximum DC Forward Current vs. Case Temperature



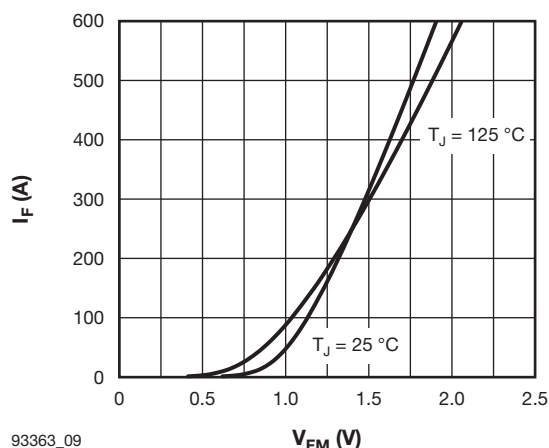
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Fig. 8 - Typical IGBT Zero Gate Voltage Collector Current



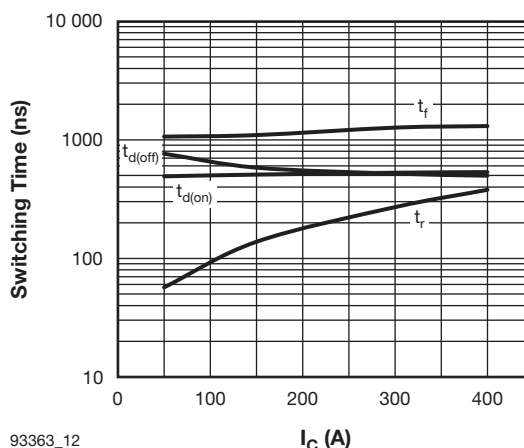
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Fig. 11 - Typical IGBT Energy Loss vs. I_C ,
 $T_J = 125^\circ\text{C}$, $V_{CC} = 360\text{ V}$, $R_g = 1.5\ \Omega$,
 $V_{GE} = 15\text{ V}$, $L = 500\ \mu\text{H}$



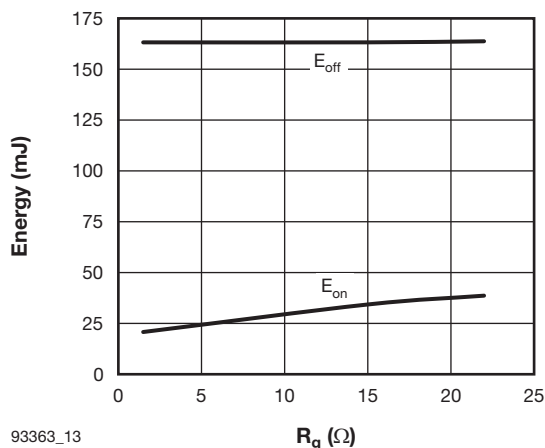
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Fig. 9 - Typical Diode Forward Characteristics



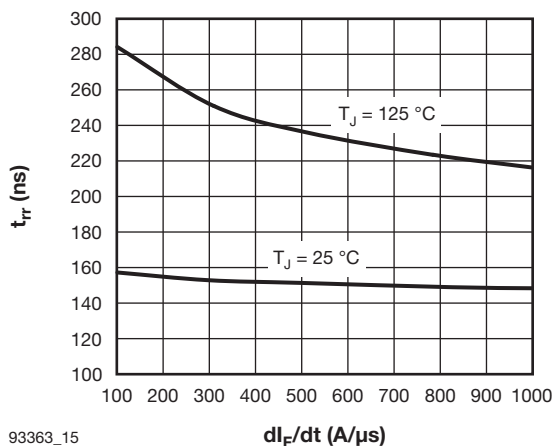
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Fig. 12 - Typical IGBT Switching Time vs. I_C ,
 $T_J = 125^\circ\text{C}$, $V_{CC} = 360\text{ V}$, $R_g = 1.5\ \Omega$,
 $V_{GE} = 15\text{ V}$, $L = 500\ \mu\text{H}$



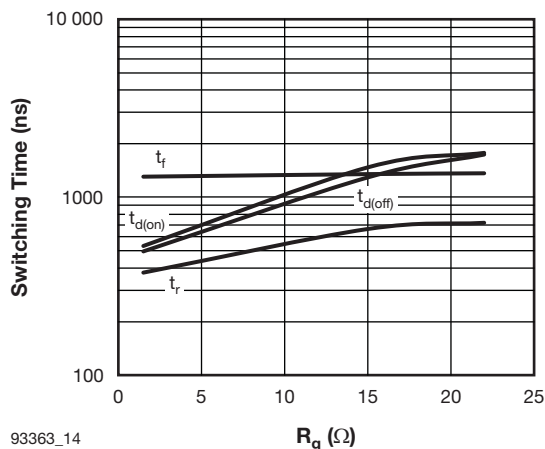
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Fig. 13 - Typical IGBT Energy Loss vs. R_g ,
 $T_J = 125^\circ\text{C}$, $I_C = 400\text{ A}$, $V_{CC} = 360\text{ V}$,
 $V_{GE} = 15\text{ V}$, $L = 500\text{ }\mu\text{H}$



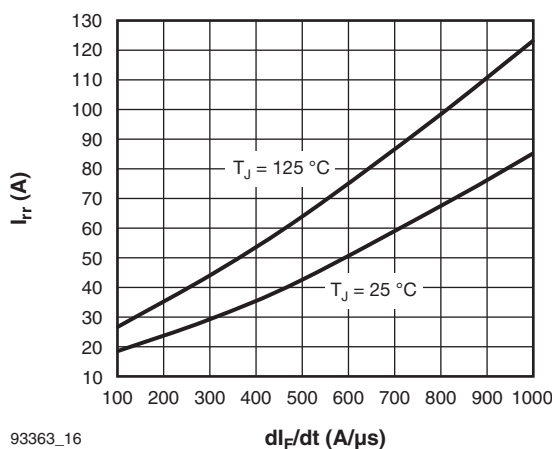
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Fig. 15 - Typical Reverse Recovery Time vs. dI_F/dt ,
 $V_{CC} = 400\text{ V}$, $I_F = 300\text{ A}$



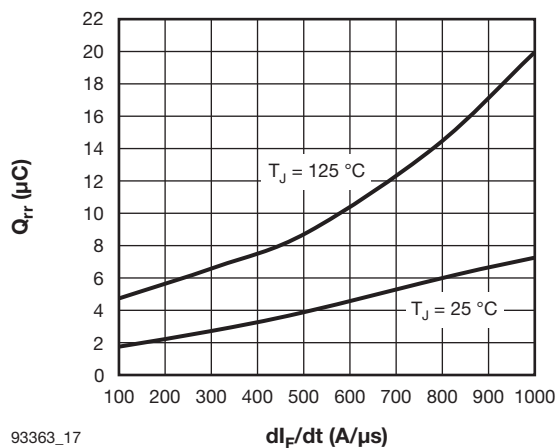
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Fig. 14 - Typical IGBT Switching Time vs. R_g ,
 $T_J = 125^\circ\text{C}$, $I_C = 400\text{ A}$, $V_{CC} = 360\text{ V}$,
 $V_{GE} = 15\text{ V}$, $L = 500\text{ }\mu\text{H}$



93363_16

Fig. 16 - Typical Reverse Recovery Current vs. dI_F/dt ,
 $V_{CC} = 400\text{ V}$, $I_F = 300\text{ A}$



93363_17

Fig. 17 - Typical Reverse Recovery Charge vs. dI_F/dt ,
 $V_{CC} = 400\text{ V}$, $I_F = 300\text{ A}$

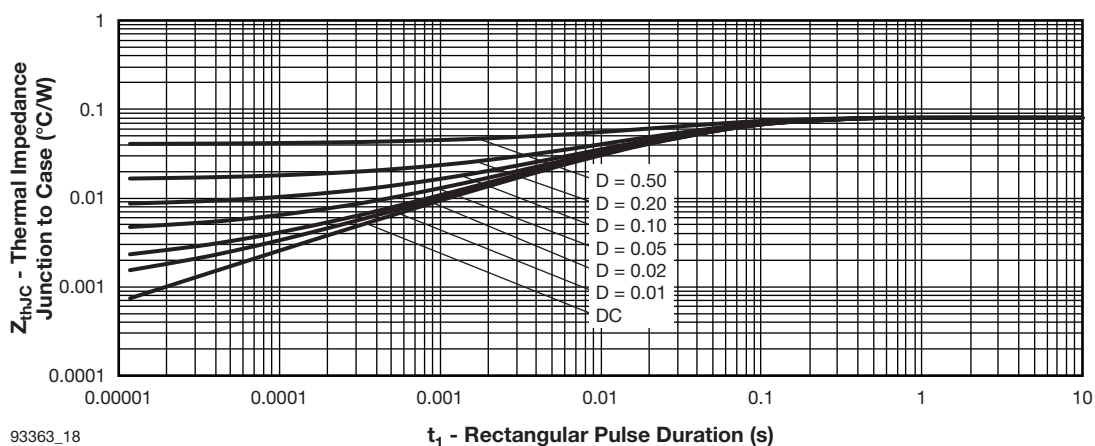


Fig. 18 - Maximum Thermal Impedance Z_{thJC} Characteristics (IGBT)

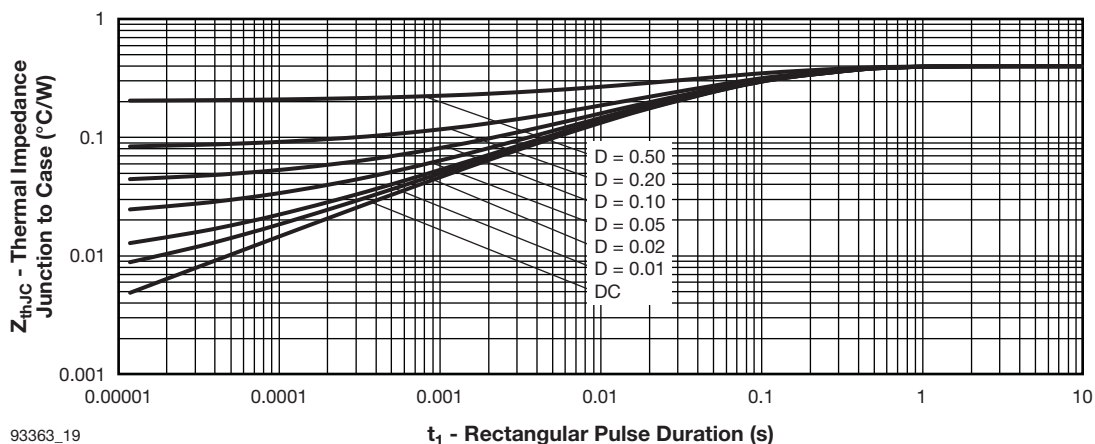


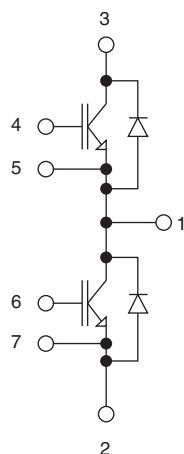
Fig. 19 - Maximum Thermal Impedance Z_{thJC} Characteristics (Diode)

ORDERING INFORMATION TABLE

Device code	G	A	400	T	D	60	S
	①	②	③	④	⑤	⑥	⑦
①	- Insulated gate bipolar transistor (IGBT)						
②	- A = Gen 4 IGBT						
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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