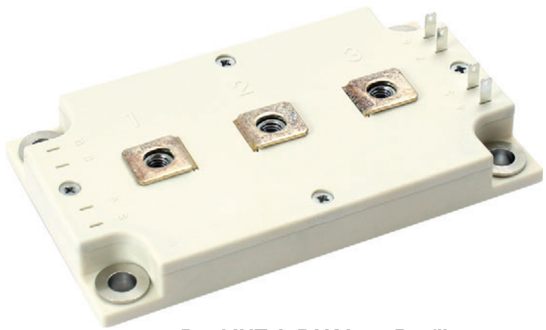
Dual INT-A-PAK Low Profile “Half Bridge” (Trench PT IGBT), 400 A

Proprietary Vishay IGBT Silicon “L Series”



Dual INT-A-PAK Low Profile

PRODUCT SUMMARY	
V_{CES}	600 V
I_C DC at T_C = 103 °C	400 A
$V_{CE(on)}$ (typical) at 400 A, 25 °C	1.30 V
Speed	DC to 1 kHz
Package	DIAP low profile
Circuit	Half bridge

FEATURES

RoHS
COMPLIANT

- Trench PT IGBT technology
- 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

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 °C	758	A
		T_C = 80 °C	525	
Pulsed collector current	I_{CM}		n/a	
Clamped inductive load current	I_{LM}		n/a	
Diode continuous forward current	I_F	T_C = 25 °C	219	
		T_C = 80 °C	145	
Gate to emitter voltage	V_{GE}		± 20	V
Maximum power dissipation (IGBT)	P_D	T_C = 25 °C	1563	W
		T_C = 80 °C	875	
RMS isolation voltage	V_{ISOL}	Any terminal to case (V_{RMS} t = 1 s, T_J = 25 °C)	3500	V
Operating junction and storage temperature range	T_J, T_{STG}		-40 to +150	°C

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 °C unless otherwise specified)						
PARAMETER	**SYMBOL**	**TEST CONDITIONS**	**MIN.**	**TYP.**	**MAX.**	**UNITS**
Collector to emitter breakdown voltage	$V_{BR(CES)}$	V_{GE} = 0 V, I_C = 500 μA	600	-	-	V
Collector to emitter voltage	$V_{CE(on)}$	V_{GE} = 15 V, I_C = 200 A	-	1.13	1.24	
		V_{GE} = 15 V, I_C = 400 A	-	1.30	1.52	
		V_{GE} = 15 V, I_C = 200 A, T_J = 125 °C	-	1.03	-	
		V_{GE} = 15 V, I_C = 400 A, T_J = 125 °C	-	1.26	-	
Gate threshold voltage	$V_{GE(th)}$	V_{CE} = V_{GE}, I_C = 9.6 mA	4.9	5.9	8.8	
		V_{CE} = V_{GE}, I_C = 9.6 mA, T_J = 125 °C	-	3.2	-	
Temperature coefficient of threshold voltage	$\Delta V_{GE(th)}/\Delta T$	V_{CE} = V_{GE}, I_C = 9.6 mA, (25 °C to 125 °C)	-	-27	-	mV/°C
Forward transconductance	g_{fe}	V_{CE} = 20 V, I_C = 50 A	-	74	-	S
Transfer characteristics	V_{GE}	V_{CE} = 20 V, I_C = 400 A	-	10.7	-	V
Collector to emitter leakage current	I_{CES}	V_{GE} = 0 V, V_{CE} = 600 V	-	5	200	μA
		V_{GE} = 0 V, V_{CE} = 600 V, T_J = 125 °C	-	1.5	-	mA
Diode forward voltage drop	V_{FM}	I_{FM} = 200 A	-	1.42	1.55	V
		I_{FM} = 400 A	-	1.76	1.98	
		I_{FM} = 200 A, T_J = 125 °C	-	1.43	-	
		I_{FM} = 400 A, T_J = 125 °C	-	1.88	-	
Gate to emitter leakage current	I_{GES}	V_{GE} = ± 20 V	-	-	± 750	nA

SWITCHING CHARACTERISTICS (T_J = 25 °C unless otherwise specified)						
PARAMETER	**SYMBOL**	**TEST CONDITIONS**	**MIN.**	**TYP.**	**MAX.**	**UNITS**
Turn-on switching energy	E_{on}	I_C = 400 A, V_{CC} = 300 V, V_{GE} = 15 V, R_g = 1.5 Ω, L = 500 μH, T_J = 25 °C	-	6.3	-	mJ
Turn-off switching energy	E_{off}		-	45	-	
Total switching energy	E_{tot}		-	51.3	-	
Turn-on delay time	$t_{d(on)}$		-	633	-	ns
Rise time	t_r		-	254	-	
Turn-off delay time	$t_{d(off)}$		-	715	-	
Fall time	t_f		-	490	-	
Turn-on switching loss	E_{on}	I_C = 400 A, V_{CC} = 300 V, V_{GE} = 15 V, R_g = 1.5 Ω, L = 500 μH, T_J = 125 °C	-	7.2	-	mJ
Turn-off switching loss	E_{off}		-	74	-	
Total switching loss	E_{tot}		-	81.2	-	
Turn-on delay time	$t_{d(on)}$		-	595	-	ns
Rise time	t_r		-	250	-	
Turn-off delay time	$t_{d(off)}$		-	950	-	
Fall time	t_f		-	865	-	
Reverse bias safe operating area	RBSOA	T_J = 150 °C, I_C = n/a, V_{CC} = 300 V V_P = 600 V, R_g = 1.5 Ω, V_{GE} = 15 V to 0 V, L = 500 μH	Fullsquare			
Diode reverse recovery time	t_{rr}	I_F = 400 A, R_g = 1.5 Ω, V_{CC} = 300 V, T_J = 25 °C	-	123	-	ns
Diode peak reverse current	I_{rr}		-	107	-	A
Diode recovery charge	Q_{rr}		-	8.1	-	μC
Diode reverse recovery time	t_{rr}	I_F = 400 A, R_g = 1.5 Ω, V_{CC} = 300 V, T_J = 125 °C	-	167	-	ns
Diode peak reverse current	I_{rr}		-	140	-	A
Diode recovery charge	Q_{rr}		-	14.7	-	μC

THERMAL AND MECHANICAL SPECIFICATIONS						
PARAMETER		SYMBOL	MIN.	TYP.	MAX.	UNITS
Operating junction and storage temperature range		T_J, T_{Stg}	-40	-	150	°C
Junction to case per leg	IGBT	R_{thJC}	-	-	0.08	°C/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	-	4	
Weight			-	270	-	g

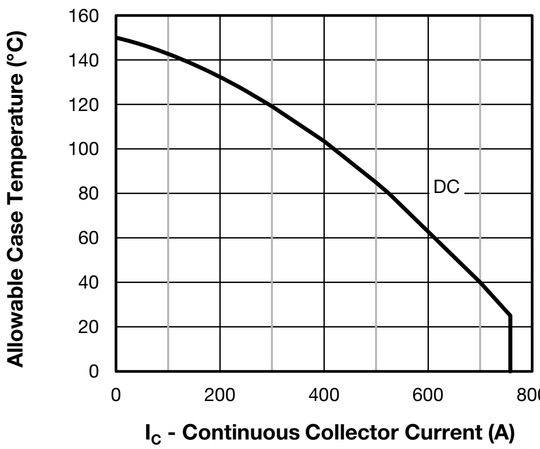


Fig. 1 - Maximum IGBT Continuous Collector Current vs. Case Temperature

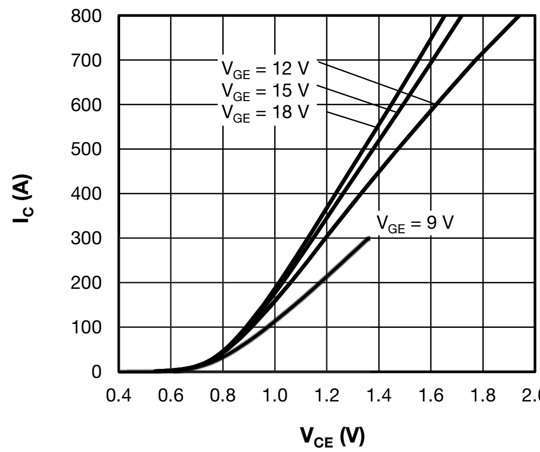


Fig. 3 - Typical IGBT Output Characteristics, T_J = 125 °C

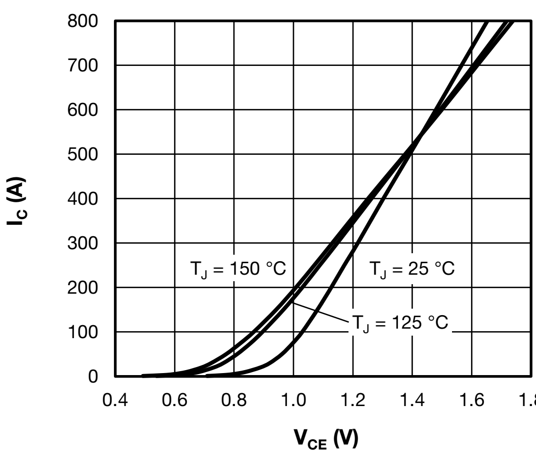


Fig. 2 - Typical IGBT Output Characteristics, V_{GE} = 15 V

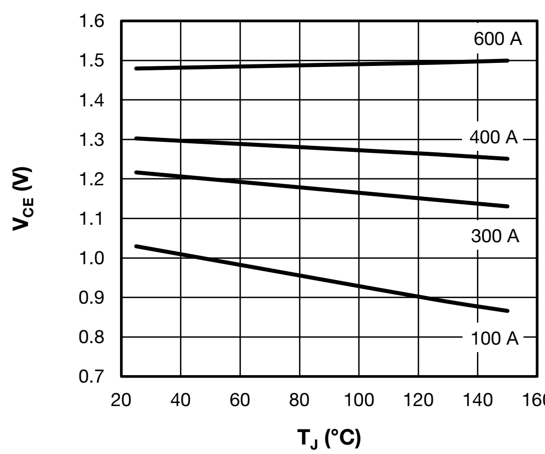


Fig. 4 - Collector to Emitter Voltage vs. Junction Temperature

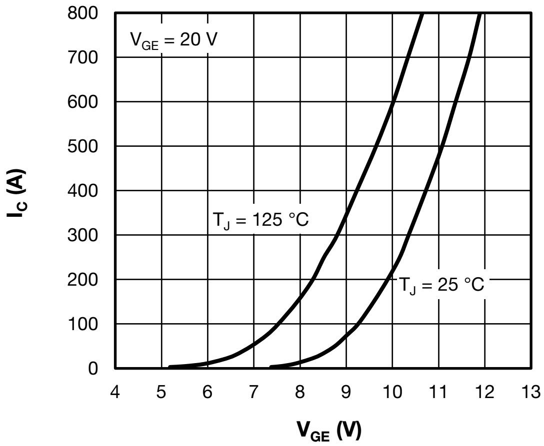


Fig. 5 - Typical IGBT Transfer Characteristics

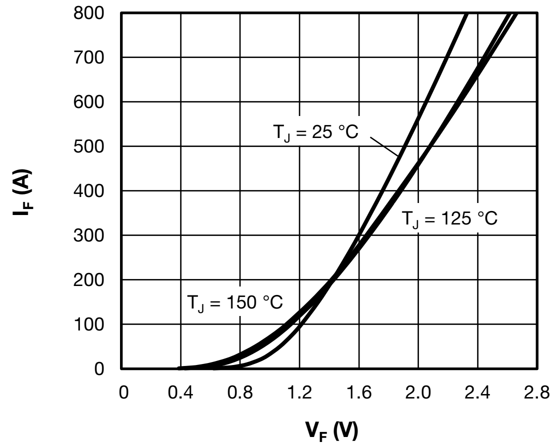


Fig. 8 - Typical Diode Forward Characteristics

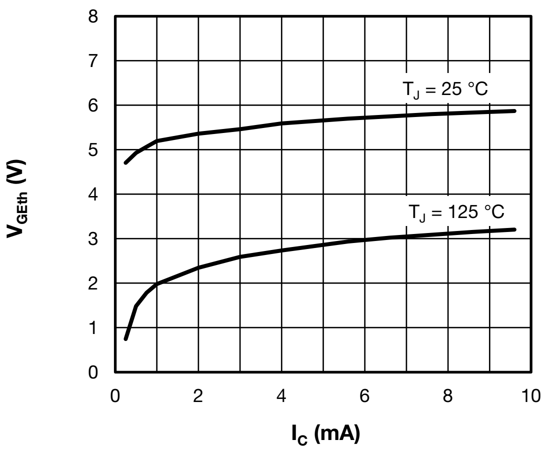


Fig. 6 - Typical IGBT Gate Threshold Voltage

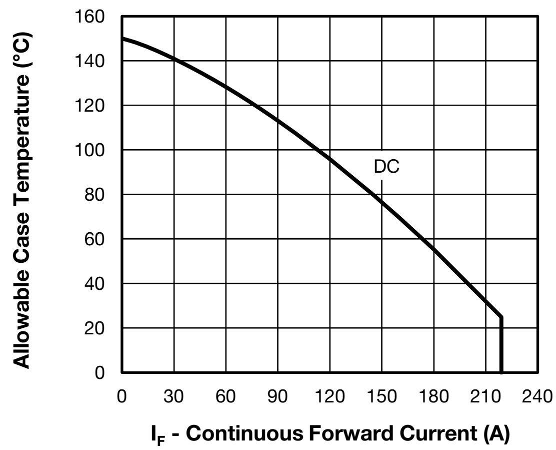


Fig. 9 - Maximum Diode Continuous Forward Current vs. Case Temperature

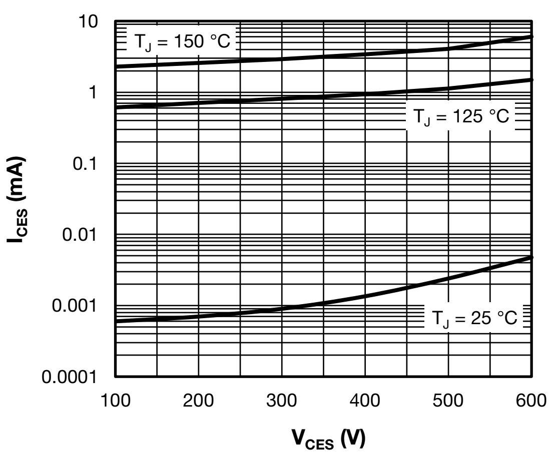


Fig. 7 - Typical IGBT Zero Gate Voltage Collector Current

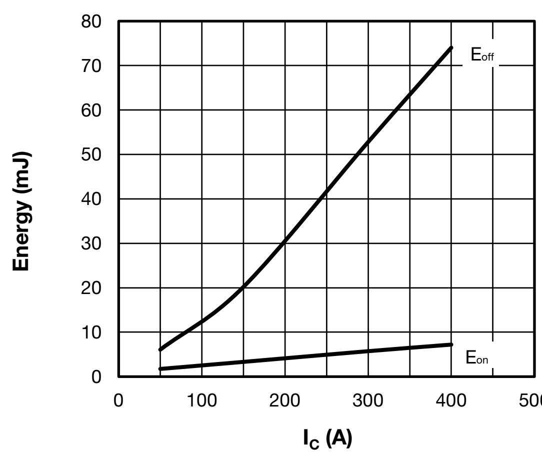


Fig. 10 - Typical IGBT Energy Loss vs. I_C
T_J = 125 °C, V_{CC} = 300 V, R_g = 1.5 Ω, V_{GE} = 15 V, L = 500 μH

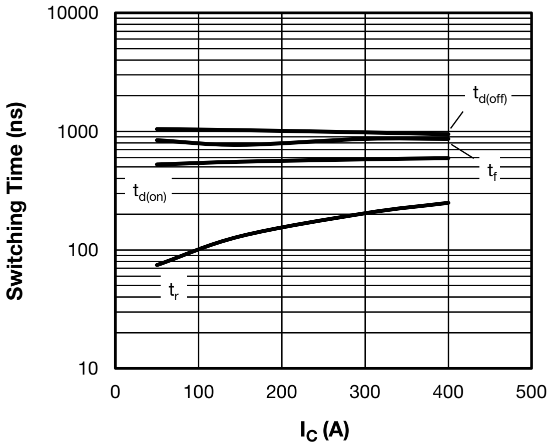


Fig. 11 - Typical IGBT Switching Time vs. I_C
T_J = 125 °C, V_{CC} = 300 V, R_g = 1.5 Ω, V_{GE} = 15 V, L = 500 μH

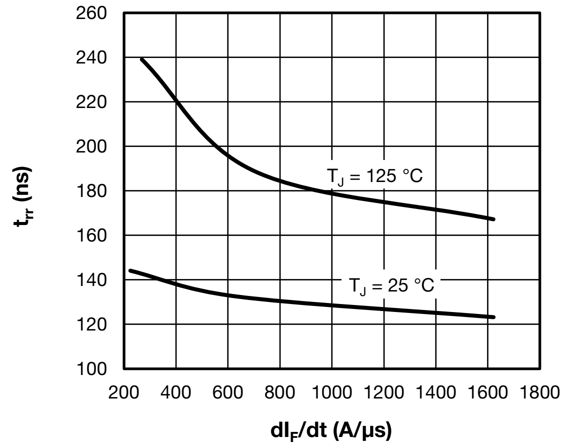


Fig. 14 - Typical Diode Reverse Recovery Time vs. dI_F/dt
V_{CC} = 300 V, I_F = 400 A

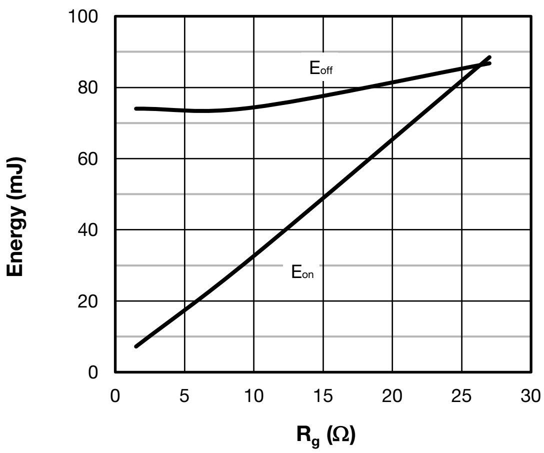


Fig. 12 - Typical IGBT Energy Loss vs. R_g
T_J = 125 °C, V_{CC} = 300 V, I_C = 400 A, V_{GE} = 15 V, L = 500 μH

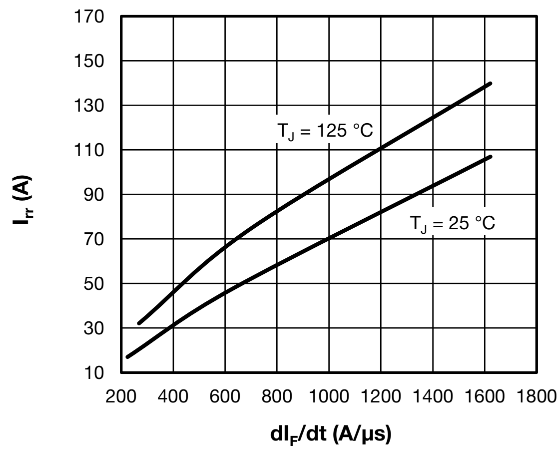


Fig. 15 - Typical Diode Reverse Recovery Current vs. dI_F/dt
V_{CC} = 300 V, I_F = 400 A

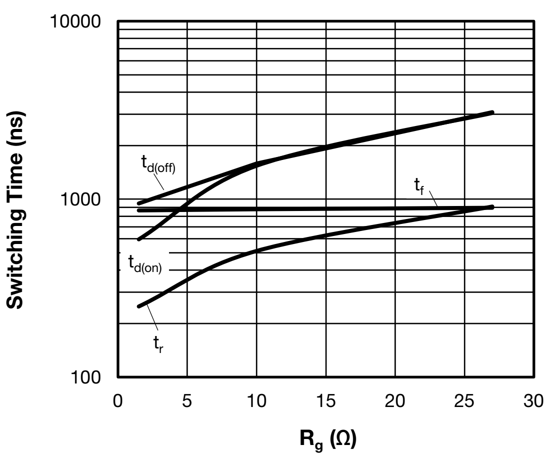


Fig. 13 - Typical IGBT Switching Time vs. R_g
T_J = 125 °C, V_{CC} = 300 V, I_C = 400 A, V_{GE} = 15 V, L = 500 μH

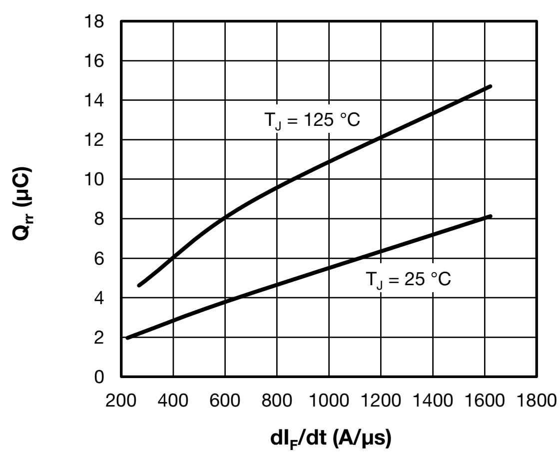


Fig. 16 - Typical Diode Reverse Recovery Charge vs. dI_F/dt
V_{CC} = 300 V, I_F = 400 A

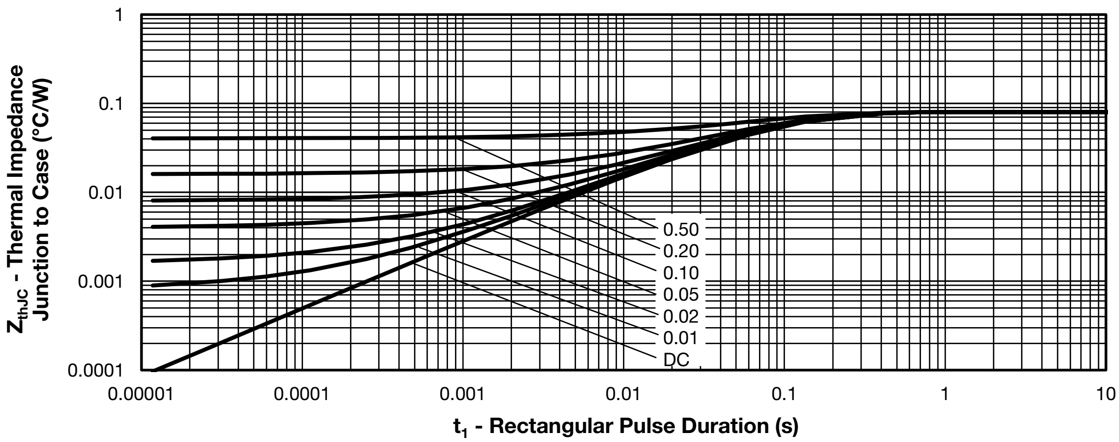


Fig. 17 - Maximum Thermal Impedance Z_{thJC} Characteristics - (IGBT)

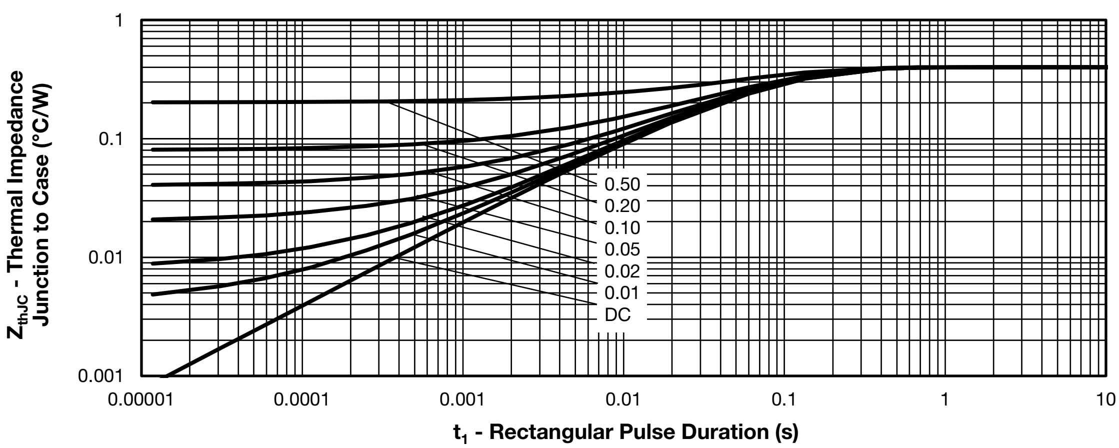


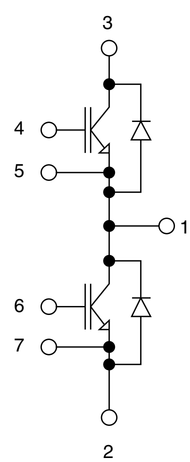
Fig. 18 - Maximum Thermal Impedance Z_{thJC} Characteristics - (Diode)

ORDERING INFORMATION TABLE

Device code	VS-	G	P	400	T	D	60	S
	1	2	3	4	5	6	7	8

1 - Vishay Semiconductors product
2 - Insulated gate bipolar transistor (IGBT)
3 - P = trench PT IGBT technology
4 - Current rating (400 = 400 A)
5 - Circuit configuration (T = Half bridge)
6 - Package indicator (D = Dual INT-A-PAK low profile)
7 - Voltage rating (60 = 600 V)
8 - Speed / type (S = standard speed IGBT)

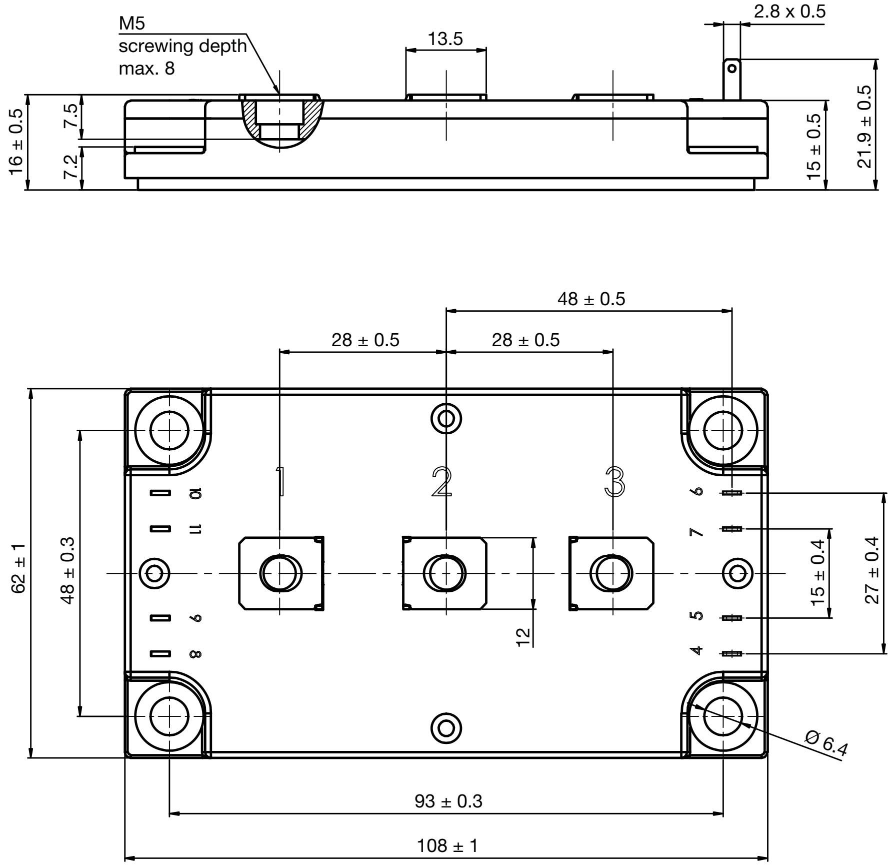
CIRCUIT CONFIGURATION



LINKS TO RELATED DOCUMENTS	
Dimensions	www.vishay.com/doc?95435

Dual INT-A-PAK Low Profile

DIMENSIONS in millimeters



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