

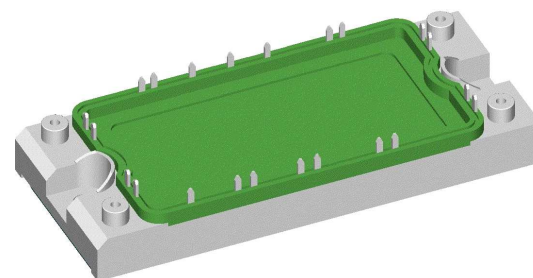
# Thyristor Module

3~ Rectifier	Brake Chopper
$V_{RRM} = 1600$	$V_{CES} = 1200$
$I_{DAV} = 180$	$I_{C25} = 180$
$I_{FSM} = 1100$	$V_{CE(sat)} = 1.7$

3~ Rectifier Bridge, half-controlled (high-side) + Brake Unit + NTC

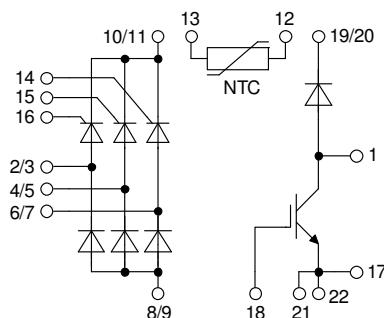
Part number

**VVZB170-16ioXT**



Backside: isolated

E72873



## Features / Advantages:

- Package with DCB ceramic
- Improved temperature and power cycling
- Planar passivated chips
- Very low forward voltage drop
- Very low leakage current
- NTC
- X2PT - 2nd generation Xtreme light Punch Through
- Rugged X2PT design results in:
  - short circuit rated for 10  $\mu$ sec.
  - very low gate charge
  - low EMI
  - square RBSOA @ 2x  $I_c$
- Thin wafer technology combined with X2PT design results in a competitive low  $V_{CE(sat)}$  and low thermal resistance

## Applications:

- 3~ Rectifier with brake unit for drive inverters

## Package: E2-Pack

- Isolation Voltage: 3600 V~
- Industry standard outline
- RoHS compliant
- Soldering pins for PCB mounting
- Height: 17 mm
- Base plate: DCB ceramic
- Reduced weight
- Advanced power cycling

## Terms Conditions of usage:

The data contained in this product data sheet is exclusively intended for technically trained staff. The user will have to evaluate the suitability of the product for the intended application and the completeness of the product data with respect to his application. The specifications of our components may not be considered as an assurance of component characteristics. The information in the valid application- and assembly notes must be considered. Should you require product information in excess of the data given in this product data sheet or which concerns the specific application of your product, please contact your local sales office.

Due to technical requirements our product may contain dangerous substances. For information on the types in question please contact your local sales office.

Should you intend to use the product in aviation, in health or life endangering or life support applications, please notify. For any such application we urgently recommend

- to perform joint risk and quality assessments;

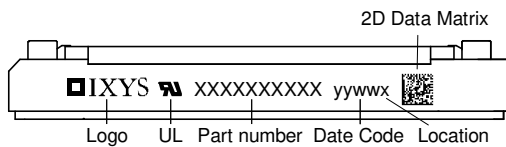
- the conclusion of quality agreements;

- to establish joint measures of an ongoing product survey, and that we may make delivery dependent on the realization of any such measures.

Rectifier			Ratings			
Symbol	Definition	Conditions	min.	typ.	max.	Unit
$V_{RSM/DSM}$	max. non-repetitive reverse/forward blocking voltage	$T_{VJ} = 25^{\circ}C$			1700	V
$V_{RRM/DRM}$	max. repetitive reverse/forward blocking voltage	$T_{VJ} = 25^{\circ}C$			1600	V
$I_{RD}$	reverse current, drain current	$V_{R/D} = 1600\text{ V}$	$T_{VJ} = 25^{\circ}C$		50	$\mu A$
		$V_{R/D} = 1600\text{ V}$	$T_{VJ} = 150^{\circ}C$		20	mA
$V_T$	forward voltage drop	$I_T = 60\text{ A}$	$T_{VJ} = 25^{\circ}C$		1.27	V
		$I_T = 180\text{ A}$			1.90	V
		$I_T = 60\text{ A}$	$T_{VJ} = 125^{\circ}C$		1.25	V
		$I_T = 180\text{ A}$			2.04	V
$I_{DAV}$	bridge output current	$T_C = 85^{\circ}C$ rectangular $d = 1/3$	$T_{VJ} = 150^{\circ}C$		180	A
$V_{T0}$	threshold voltage	} for power loss calculation only	$T_{VJ} = 150^{\circ}C$		0.83	V
$r_T$	slope resistance				6.9	m $\Omega$
$R_{thJC}$	thermal resistance junction to case				0.5	K/W
$R_{thCH}$	thermal resistance case to heatsink			0.100		K/W
$P_{tot}$	total power dissipation		$T_C = 25^{\circ}C$		250	W
$I_{TSM}$	max. forward surge current	$t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$	$T_{VJ} = 45^{\circ}C$		1.10	kA
		$t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$	$V_R = 0\text{ V}$		1.19	kA
		$t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$	$T_{VJ} = 150^{\circ}C$		935	A
		$t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$	$V_R = 0\text{ V}$		1.01	kA
$I^2t$	value for fusing	$t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$	$T_{VJ} = 45^{\circ}C$		6.05	kA <sup>2</sup> s
		$t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$	$V_R = 0\text{ V}$		5.89	kA <sup>2</sup> s
		$t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$	$T_{VJ} = 150^{\circ}C$		4.37	kA <sup>2</sup> s
		$t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$	$V_R = 0\text{ V}$		4.25	kA <sup>2</sup> s
$C_J$	junction capacitance	$V_R = 400\text{ V}$ $f = 1\text{ MHz}$	$T_{VJ} = 25^{\circ}C$		54	pF
$P_{GM}$	max. gate power dissipation	$t_p = 30\text{ }\mu s$	$T_C = 150^{\circ}C$		10	W
		$t_p = 300\text{ }\mu s$			5	W
$P_{GAV}$	average gate power dissipation				0.5	W
$(di/dt)_{cr}$	critical rate of rise of current	$T_{VJ} = 150^{\circ}C; f = 50\text{ Hz}$ repetitive, $I_T = 180\text{ A}$			150	A/ $\mu s$
		$t_p = 200\text{ }\mu s; di_G/dt = 0.45\text{ A}/\mu s;$ $I_G = 0.45\text{ A}; V = 2/3 V_{DRM}$ non-repet., $I_T = 60\text{ A}$			500	A/ $\mu s$
$(dv/dt)_{cr}$	critical rate of rise of voltage	$V = 2/3 V_{DRM}$ $R_{GK} = \infty; \text{ method 1 (linear voltage rise)}$	$T_{VJ} = 150^{\circ}C$		1000	V/ $\mu s$
$V_{GT}$	gate trigger voltage	$V_D = 6\text{ V}$	$T_{VJ} = 25^{\circ}C$		1.5	V
			$T_{VJ} = -40^{\circ}C$		1.6	V
$I_{GT}$	gate trigger current	$V_D = 6\text{ V}$	$T_{VJ} = 25^{\circ}C$		95	mA
			$T_{VJ} = -40^{\circ}C$		200	mA
$V_{GD}$	gate non-trigger voltage	$V_D = 2/3 V_{DRM}$	$T_{VJ} = 150^{\circ}C$		0.2	V
$I_{GD}$	gate non-trigger current				10	mA
$I_L$	latching current	$t_p = 10\text{ }\mu s$	$T_{VJ} = 25^{\circ}C$		450	mA
		$I_G = 0.45\text{ A}; di_G/dt = 0.45\text{ A}/\mu s$				
$I_H$	holding current	$V_D = 6\text{ V}$ $R_{GK} = \infty$	$T_{VJ} = 25^{\circ}C$		200	mA
$t_{gd}$	gate controlled delay time	$V_D = 1/2 V_{DRM}$ $I_G = 0.45\text{ A}; di_G/dt = 0.45\text{ A}/\mu s$	$T_{VJ} = 25^{\circ}C$		2	$\mu s$
$t_q$	turn-off time	$V_R = 100\text{ V}; I_T = 60\text{ A}; V = 2/3 V_{DRM}$ $di/dt = 10\text{ A}/\mu s$ $dv/dt = 20\text{ V}/\mu s$ $t_p = 200\text{ }\mu s$	$T_{VJ} = 125^{\circ}C$		150	$\mu s$

Brake IGBT				Ratings			
Symbol	Definition	Conditions	min.	typ.	max.	Unit	
$V_{CES}$	collector emitter voltage	$T_{VJ} = 25^{\circ}C$			1200	V	
$V_{GES}$	max. DC gate voltage				$\pm 20$	V	
$V_{GEM}$	max. transient gate emitter voltage				$\pm 30$	V	
$I_{C25}$	collector current	$T_C = 25^{\circ}C$			180	A	
$I_{C80}$		$T_C = 80^{\circ}C$			140	A	
$P_{tot}$	total power dissipation	$T_C = 25^{\circ}C$			500	W	
$V_{CE(sat)}$	collector emitter saturation voltage	$I_C = 100\text{ A}; V_{GE} = 15\text{ V}$			1.7	V	
					1.9	V	
$V_{GE(th)}$	gate emitter threshold voltage	$I_C = 4\text{ mA}; V_{GE} = V_{CE}$	6	6.8	7.5	V	
$I_{CES}$	collector emitter leakage current	$V_{CE} = V_{CES}; V_{GE} = 0\text{ V}$			0.1	mA	
					0.1	mA	
$I_{GES}$	gate emitter leakage current	$V_{GE} = \pm 20\text{ V}$			500	nA	
$Q_{G(on)}$	total gate charge	$V_{CE} = 600\text{ V}; V_{GE} = 15\text{ V}; I_C = 100\text{ A}$		340		nC	
$t_{d(on)}$	turn-on delay time	inductive load $V_{CE} = 600\text{ V}; I_C = 100\text{ A}$ $V_{GE} = \pm 15\text{ V}; R_G = 6.8\ \Omega$	$T_{VJ} = 125^{\circ}C$		230	ns	
$t_r$	current rise time				70	ns	
$t_{d(off)}$	turn-off delay time				380	ns	
$t_f$	current fall time				230	ns	
$E_{on}$	turn-on energy per pulse				12.5	mJ	
$E_{off}$	turn-off energy per pulse				11.5	mJ	
<b>RBSOA</b>	reverse bias safe operating area	$V_{GE} = \pm 15\text{ V}; R_G = 6.8\ \Omega$					
$I_{CM}$		$V_{CEK} = 1200\text{ V}$			300	A	
<b>SCSOA</b>	short circuit safe operating area	$V_{CEK} = 1200\text{ V}$					
$t_{SC}$	short circuit duration	$V_{CE} = 720\text{ V}; V_{GE} = \pm 15\text{ V}$			10	$\mu s$	
$I_{SC}$	short circuit current	$R_G = 6.8\ \Omega$ ; non-repetitive		450		A	
$R_{thJC}$	thermal resistance junction to case				0.25	K/W	
$R_{thCH}$	thermal resistance case to heatsink			0.10		K/W	
Brake Diode							
$V_{RRM}$	max. repetitive reverse voltage				1200	V	
$I_{F25}$	forward current				48	A	
$I_{F80}$					32	A	
$V_F$	forward voltage	$I_F = 30\text{ A}$			2.75	V	
					1.60	V	
$I_R$	reverse current	$V_R = V_{RRM}$			0.25	mA	
					1	mA	
$Q_{rr}$	reverse recovery charge	$V_R = 600\text{ V}$ $-di_f/dt = 1000\text{ A}/\mu s$ $I_F = 30\text{ A}$	$T_{VJ} = 125^{\circ}C$		5.2	$\mu C$	
$I_{RM}$	max. reverse recovery current				50	A	
$t_{rr}$	reverse recovery time				300	ns	
$E_{rec}$	reverse recovery energy				1.9	mJ	
$R_{thJC}$	thermal resistance junction to case				0.9	K/W	
$R_{thCH}$	thermal resistance case to heatsink			0.3		K/W	

Package E2-Pack			Ratings			
Symbol	Definition	Conditions	min.	typ.	max.	Unit
$I_{RMS}$	RMS current	per terminal			200	A
$T_{VJ}$	virtual junction temperature		-40		150	°C
$T_{op}$	operation temperature		-40		125	°C
$T_{stg}$	storage temperature		-40		125	°C
<b>Weight</b>				176		g
$M_D$	mounting torque		3		6	Nm
$d_{Spp/App}$	creepage distance on surface / striking distance through air	terminal to terminal	6.0			mm
$d_{Spb/Apb}$		terminal to backside	12.0			mm
$V_{ISOL}$	isolation voltage	t = 1 second	3600			V
		t = 1 minute	3000			V



Ordering	Ordering Number	Marking on Product	Delivery Mode	Quantity	Code No.
Standard	VVZB170-16ioXT	VVZB170-16ioXT	Box	6	510482

### Temperature Sensor NTC

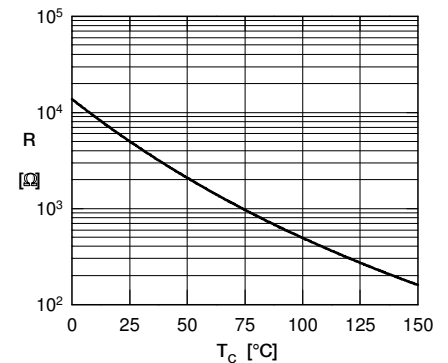
Symbol	Definition	Conditions	min.	typ.	max.	Unit
$R_{25}$	resistance	$T_{VJ} = 25^\circ$	4.75	5	5.25	k $\Omega$
$B_{25/50}$	temperature coefficient			3375		K

### Equivalent Circuits for Simulation

\* on die level

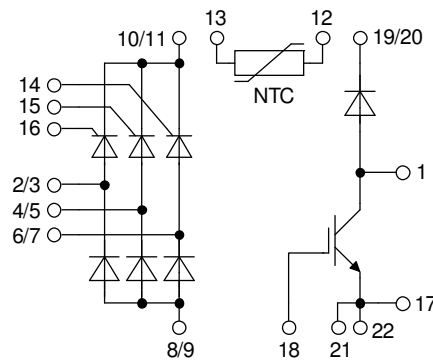
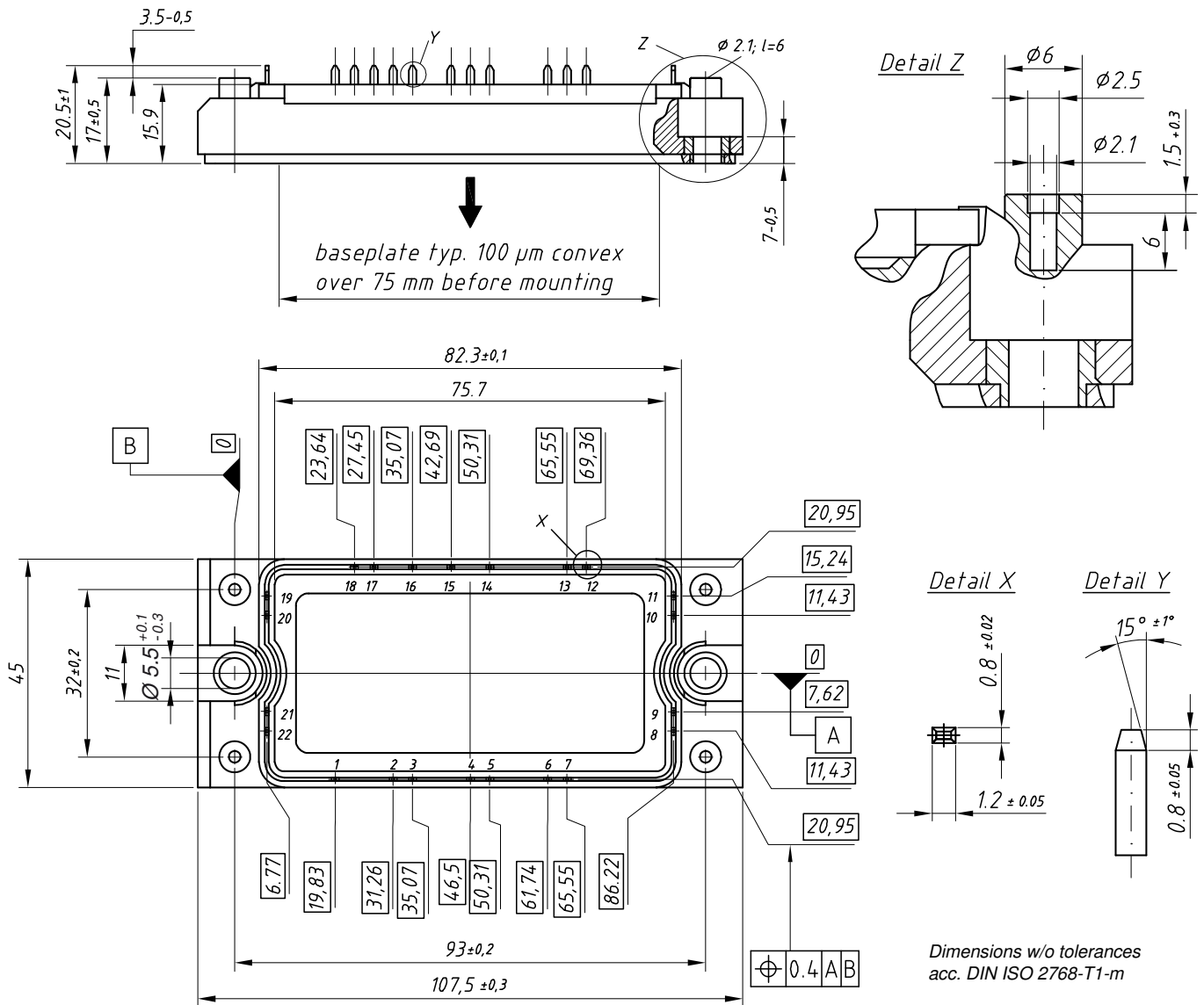
$T_{VJ} = 150^\circ\text{C}$

	Thyristor	Brake Diode	
$V_{0\max}$	threshold voltage	0.83	V
$R_{0\max}$	slope resistance *	3.7	m $\Omega$



Typ. NTC resistance vs. temperature

## Outlines E2-Pack



## Thyristor

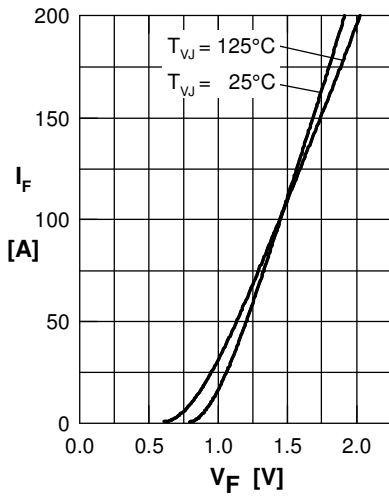


Fig. 1 Forward current vs. voltage drop per diode

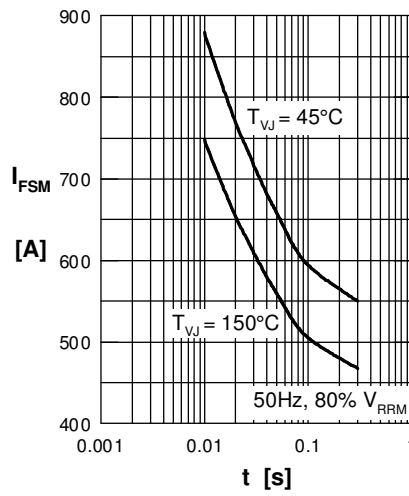


Fig. 2 Surge overload current vs. time per diode

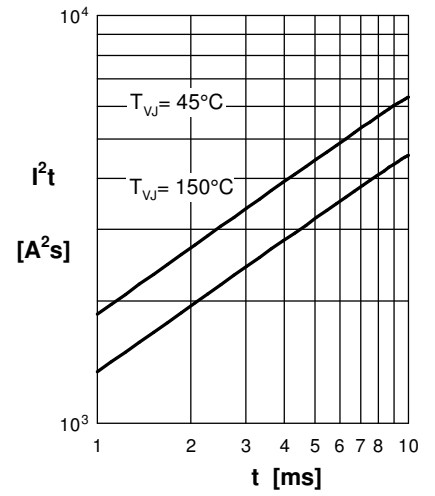


Fig. 3  $I^2t$  vs. time per diode

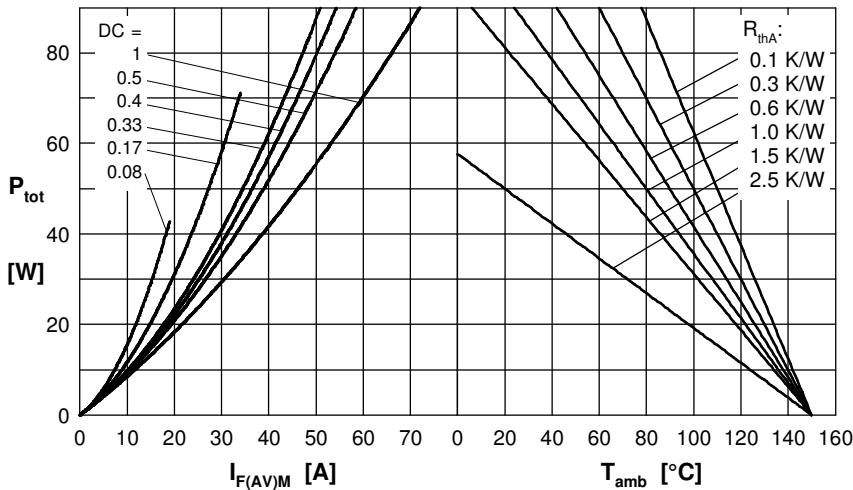


Fig. 4 Power dissipation vs. forward current and ambient temperature per diode

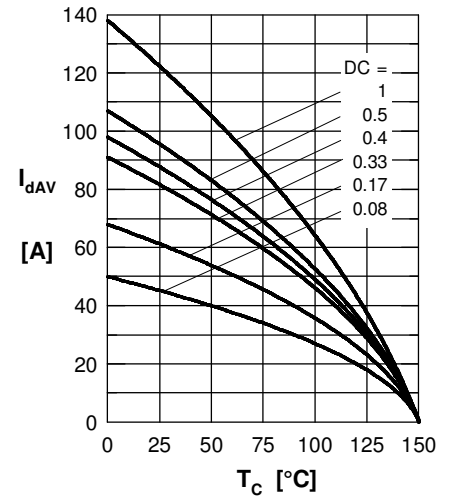


Fig. 5 Max. forward current vs. case temperature per diode

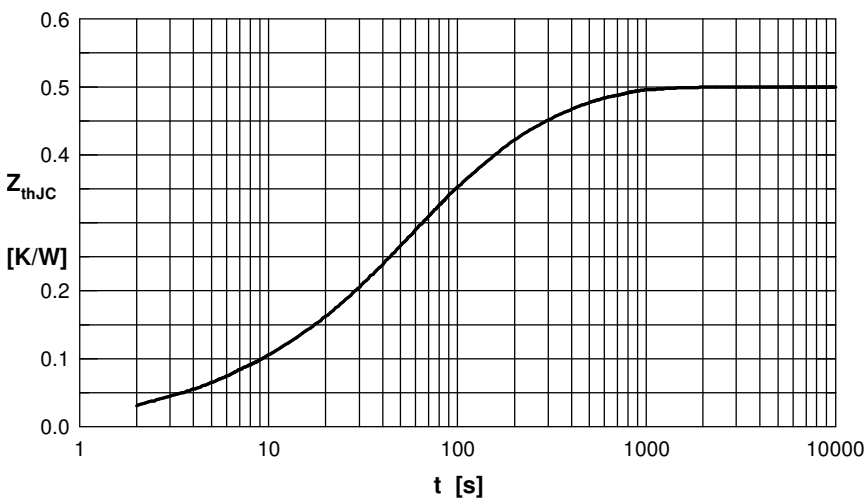


Fig. 6 Transient thermal impedance junction to case vs. time per diode

Constants for  $Z_{thJC}$  calculation:

i	$R_{th}$ (K/W)	$t_i$ (s)
1	0.040	0.004
2	0.003	0.010
3	0.140	0.030
4	0.120	0.300
5	0.197	0.080

## Brake Diode

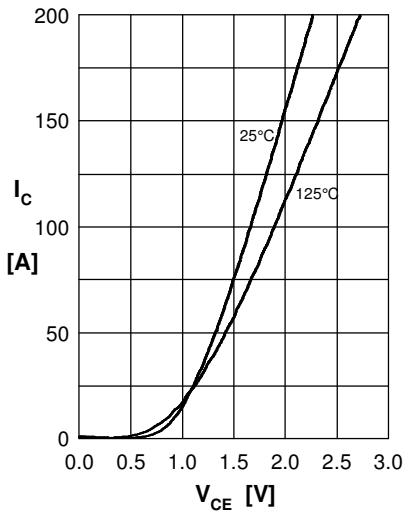


Fig.1 Output characteristics IGBT

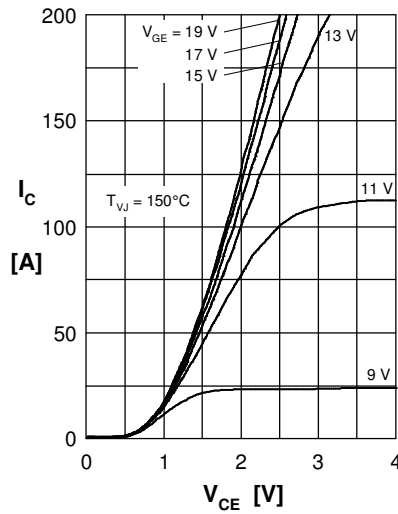


Fig.2 Typ. output characteristics IGBT

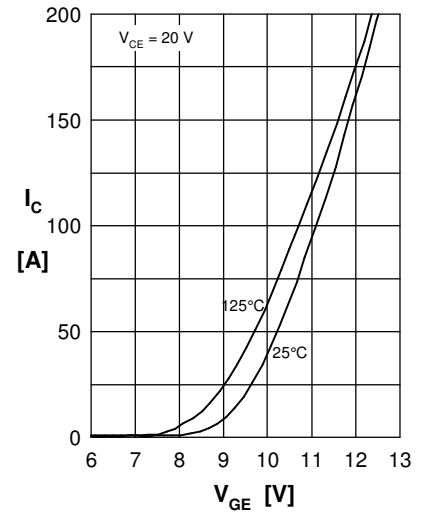


Fig.3 Typ. transfer charact. IGBT

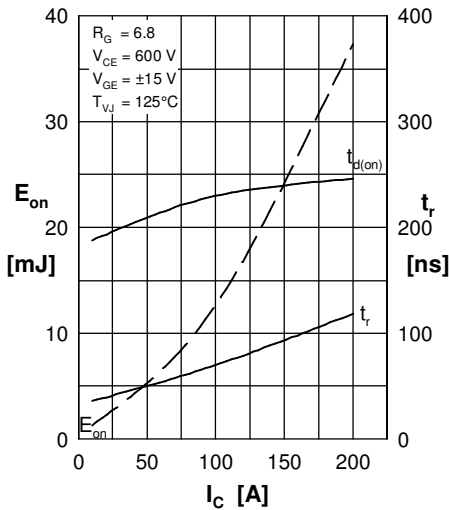


Fig.4 Typ. turn-on energy & switch. times vs. collector current

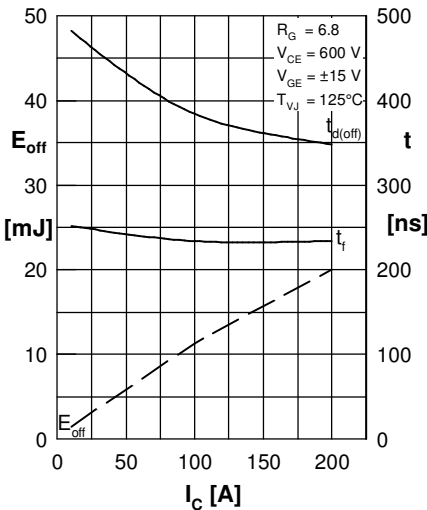


Fig.5 Typ. turn-off energy & switch. times vs. collector current

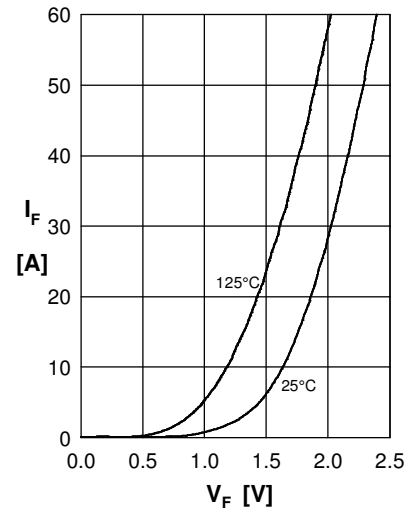


Fig.6 Typ. forward characteristics Diode

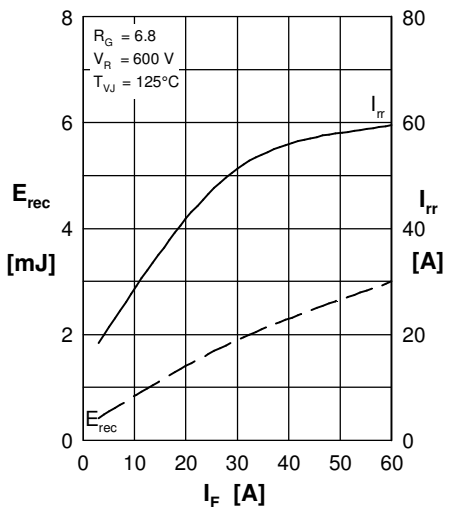


Fig.7 Typ. reverse recovery characteristics Diode

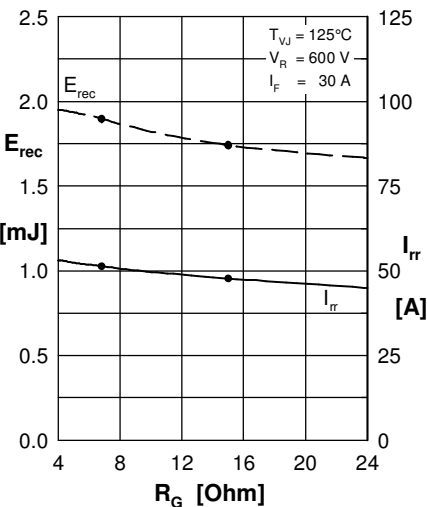


Fig.8 Typ. reverse recovery characteristics Diode

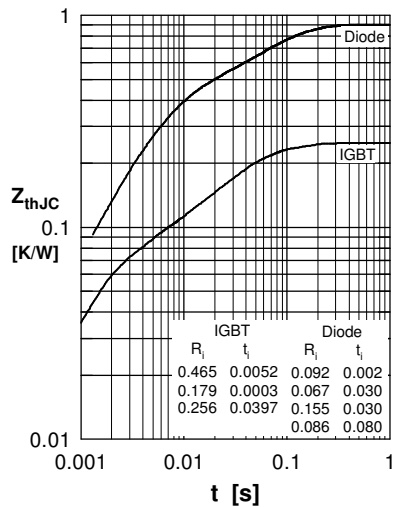


Fig.9 Transient thermal resistance junction to case