

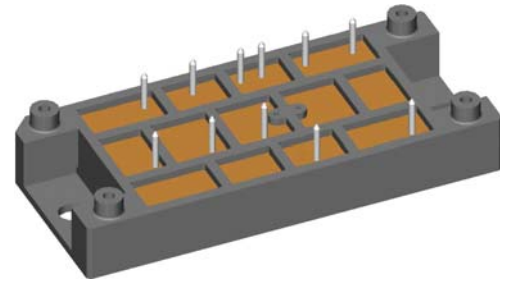
# Thyristor Module

3~ Rectifier	Brake Chopper
$V_{RRM} = 1600\text{ V}$	$V_{CES} = 1200\text{ V}$
$I_{DAV} = 180\text{ A}$	$I_{C25} = 155\text{ A}$
$I_{FSM} = 700\text{ A}$	$V_{CE(sat)} = 2.05\text{ V}$

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

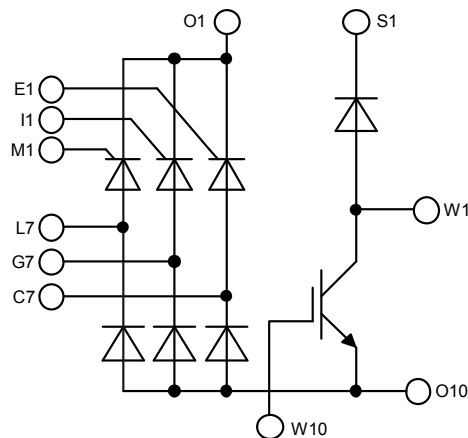
Part number

VVZB120-16ioX



Backside: isolated

E72873



### Features / Advantages:

- Package with DCB ceramic base plate
- Improved temperature and power cycling
- Planar passivated chips
- Very low forward voltage drop
- Very low leakage current

### Applications:

- 3~ Rectifier with brake unit for drive inverters

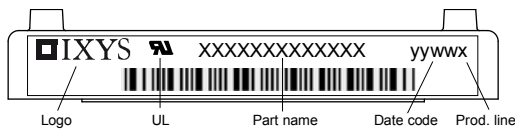
### Package: V2-Pack

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

Rectifier			Ratings			
Symbol	Definition	Conditions	min.	typ.	max.	Unit
$V_{RSM/DSM}$	max. non-repetitive reverse/forward blocking voltage	$T_{VJ} = 25^{\circ}\text{C}$			1700	V
$V_{RRM/DRM}$	max. repetitive reverse/forward blocking voltage	$T_{VJ} = 25^{\circ}\text{C}$			1600	V
$I_{RD}$	reverse current, drain current	$V_{RD} = 1600\text{ V}$	$T_{VJ} = 25^{\circ}\text{C}$		50	$\mu\text{A}$
		$V_{RD} = 1600\text{ V}$	$T_{VJ} = 150^{\circ}\text{C}$		20	mA
$V_T$	forward voltage drop	$I_T = 60\text{ A}$	$T_{VJ} = 25^{\circ}\text{C}$		1.27	V
					1.90	V
		$I_T = 180\text{ A}$	$T_{VJ} = 125^{\circ}\text{C}$		1.25	V
					2.04	V
$I_{DAV}$	bridge output current	$T_C = 85^{\circ}\text{C}$ rectangular $d = 1/3$	$T_{VJ} = 150^{\circ}\text{C}$		180	A
$V_{TO}$	threshold voltage	} for power loss calculation only	$T_{VJ} = 150^{\circ}\text{C}$		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			0.10		K/W
$P_{tot}$	total power dissipation		$T_C = 25^{\circ}\text{C}$		250	W
$I_{TSM}$	max. forward surge current	$t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$	$T_{VJ} = 45^{\circ}\text{C}$		700	A
				$V_R = 0\text{ V}$	755	A
		$t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$	$T_{VJ} = 150^{\circ}\text{C}$		595	A
				$V_R = 0\text{ V}$	645	A
$I^2t$	value for fusing	$t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$	$T_{VJ} = 45^{\circ}\text{C}$		2.45	kA <sup>2</sup> s
				$V_R = 0\text{ V}$	2.37	kA <sup>2</sup> s
		$t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$	$T_{VJ} = 150^{\circ}\text{C}$		1.77	kA <sup>2</sup> s
				$V_R = 0\text{ V}$	1.73	kA <sup>2</sup> s
$C_J$	junction capacitance	$V_R = 400\text{ V}$ $f = 1\text{ MHz}$	$T_{VJ} = 25^{\circ}\text{C}$		54	pF
$P_{GM}$	max. gate power dissipation	$t_p = 30\text{ }\mu\text{s}$	$T_C = 150^{\circ}\text{C}$		10	W
		$t_p = 300\text{ }\mu\text{s}$			5	W
$P_{GAV}$	average gate power dissipation				0.5	W
$(di/dt)_{cr}$	critical rate of rise of current	$T_{VJ} = 150^{\circ}\text{C}; f = 50\text{ Hz}$	repetitive, $I_T = 180\text{ A}$		150	A/ $\mu\text{s}$
				$t_p = 200\text{ }\mu\text{s}; di_G/dt = 0.45\text{ A}/\mu\text{s};$		
				$I_G = 0.45\text{ A}; V_D = 2/3 V_{DRM}$ non-repet., $I_T = 60\text{ A}$		500
$(dv/dt)_{cr}$	critical rate of rise of voltage	$V_D = 2/3 V_{DRM}$	$T_{VJ} = 150^{\circ}\text{C}$		1000	V/ $\mu\text{s}$
				$R_{GK} = \infty$ ; method 1 (linear voltage rise)		
$V_{GT}$	gate trigger voltage	$V_D = 6\text{ V}$	$T_{VJ} = 25^{\circ}\text{C}$		1.5	V
			$T_{VJ} = -40^{\circ}\text{C}$		1.6	V
$I_{GT}$	gate trigger current	$V_D = 6\text{ V}$	$T_{VJ} = 25^{\circ}\text{C}$		95	mA
			$T_{VJ} = -40^{\circ}\text{C}$		200	mA
$V_{GD}$	gate non-trigger voltage	$V_D = 2/3 V_{DRM}$	$T_{VJ} = 150^{\circ}\text{C}$		0.2	V
$I_{GD}$	gate non-trigger current				10	mA
$I_L$	latching current	$t_p = 10\text{ }\mu\text{s}$	$T_{VJ} = 25^{\circ}\text{C}$		450	mA
				$I_G = 0.45\text{ A}; di_G/dt = 0.45\text{ A}/\mu\text{s}$		
$I_H$	holding current	$V_D = 6\text{ V}$ $R_{GK} = \infty$	$T_{VJ} = 25^{\circ}\text{C}$		200	mA
$t_{gd}$	gate controlled delay time	$V_D = 1/2 V_{DRM}$	$T_{VJ} = 25^{\circ}\text{C}$		2	$\mu\text{s}$
				$I_G = 0.45\text{ A}; di_G/dt = 0.45\text{ A}/\mu\text{s}$		
$t_q$	turn-off time	$V_R = 100\text{ V}; I_T = 60\text{ A}; V_D = 2/3 V_{DRM}$	$T_{VJ} = 150^{\circ}\text{C}$		150	$\mu\text{s}$
		$di/dt = 10\text{ A}/\mu\text{s}; dv/dt = 20\text{ V}/\mu\text{s}; t_p = 200\text{ }\mu\text{s}$				

Brake IGBT				Ratings			
Symbol	Definition	Conditions	min.	typ.	max.	Unit	
$V_{CES}$	collector emitter voltage	$T_{VJ} = 25^{\circ}\text{C}$			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	$T_C = 25^{\circ}\text{C}$			155	A	
$I_{C80}$		$T_C = 80^{\circ}\text{C}$			108	A	
$P_{tot}$	total power dissipation	$T_C = 25^{\circ}\text{C}$			500	W	
$V_{CE(sat)}$	collector emitter saturation voltage	$I_C = 100\text{ A}; V_{GE} = 15\text{ V}$			2.05	V	
					2.45	V	
$V_{GE(th)}$	gate emitter threshold voltage	$I_C = 4\text{ mA}; V_{GE} = V_{CE}$	5.4	5.9	6.5	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	$V_{CE} = 600\text{ V}; V_{GE} = 15\text{ V}; I_C = 100\text{ A}$		295		nC	
$t_{d(on)}$	turn-on delay time	inductive load $V_{CE} = 600\text{ V}; I_C = 100\text{ A}$ $V_{GE} = \pm 15\text{ V}; R_G = 6.8\ \Omega$		70		ns	
$t_r$	current rise time			40		ns	
$t_{d(off)}$	turn-off delay time			250		ns	
$t_f$	current fall time			100		ns	
$E_{on}$	turn-on energy per pulse			8.5		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						
$t_{sc}$	short circuit duration	$V_{CE} = 720\text{ V}; V_{GE} = \pm 15\text{ V}$			10	$\mu\text{s}$	
$I_{sc}$	short circuit current	$R_G = 6.8\ \Omega$ ; non-repetitive		400		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	$T_{VJ} = 25^{\circ}\text{C}$			1200	V	
$I_{F25}$	forward current	$T_C = 25^{\circ}\text{C}$			48	A	
$I_{F80}$		$T_C = 80^{\circ}\text{C}$			32	A	
$V_F$	forward voltage	$I_F = 30\text{ A}$			2.75	V	
				1.80		V	
$I_R$	reverse current	$V_R = V_{RRM}$			0.25	mA	
					1	mA	
$Q_{rr}$	reverse recovery charge	$V_R = 600\text{ V}$ $-di_F/dt = 400\text{ A}/\mu\text{s}$ $I_F = 30\text{ A}$		1.8		$\mu\text{C}$	
$I_{RM}$	max. reverse recovery current			23		A	
$t_{rr}$	reverse recovery time			150		ns	
$R_{thJC}$	thermal resistance junction to case				0.9	K/W	
$R_{thCH}$	thermal resistance case to heatsink			0.3		K/W	

Package V2-Pack		Ratings				
Symbol	Definition	Conditions	min.	typ.	max.	Unit
$I_{RMS}$	RMS current	per terminal			100	A
$T_{stg}$	storage temperature		-40		125	°C
$T_{VJ}$	virtual junction temperature		-40		150	°C
<b>Weight</b>				76		g
$M_D$	mounting torque		2		2.5	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 50/60 Hz, RMS; $I_{ISOL} \leq 1$ mA	3000			V



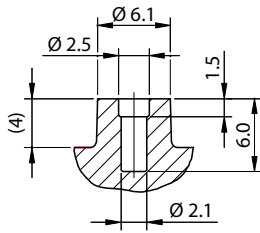
Ordering	Part Number	Marking on Product	Delivery Mode	Quantity	Code No.
Standard	VVZB120-16ioX	VVZB120-16ioX	Box	6	511152

**Equivalent Circuits for Simulation**
*\* on die level*
 $T_{VJ} = 150^\circ\text{C}$ 

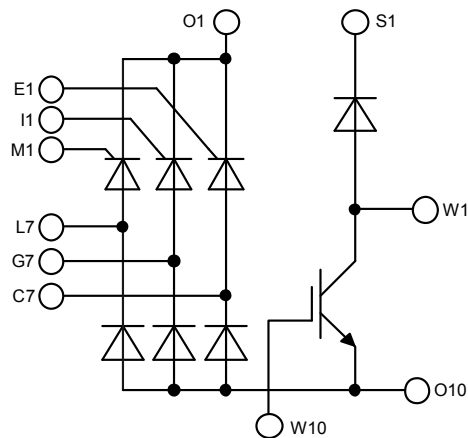
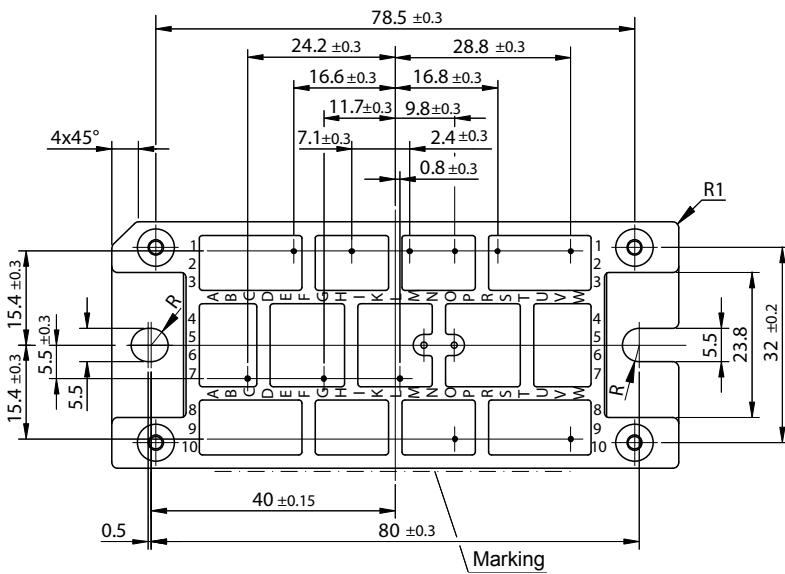
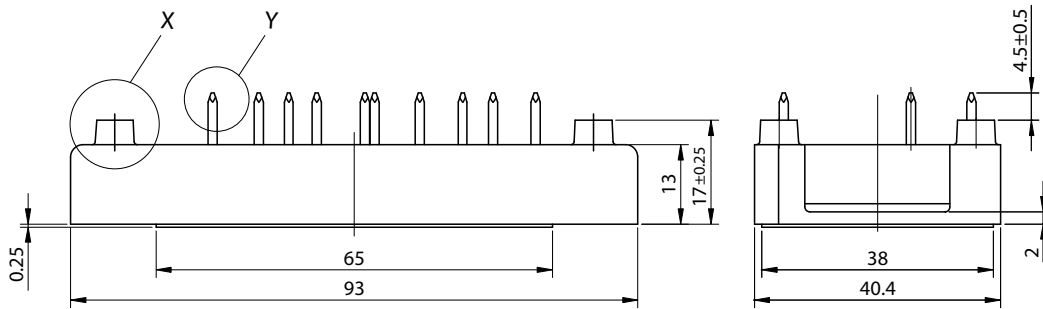
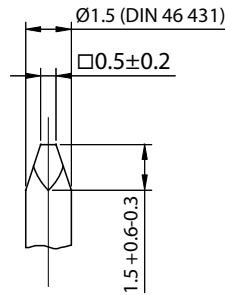
		Thyristor	Brake IGBT	Brake Diode	
$V_{0\max}$	threshold voltage	0.83	1.1	1.31	V
$R_{0\max}$	slope resistance *	3.7	13.8	8	mΩ

## Outlines V2-Pack

Detail X M 2:1



Detail Y M 5:1



## Thyristor

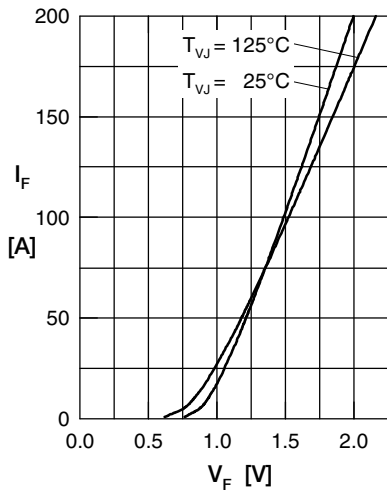


Fig. 1 Forward current vs. voltage drop per thyristor

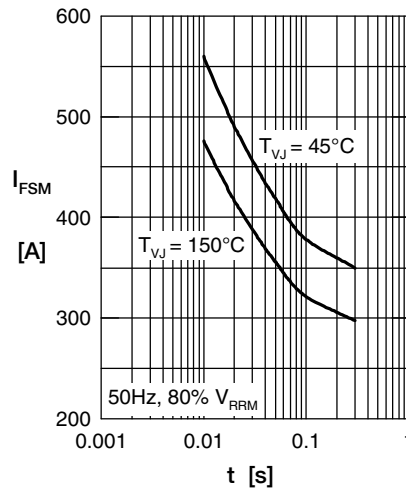


Fig. 2 Surge overload current vs. time per thyristor

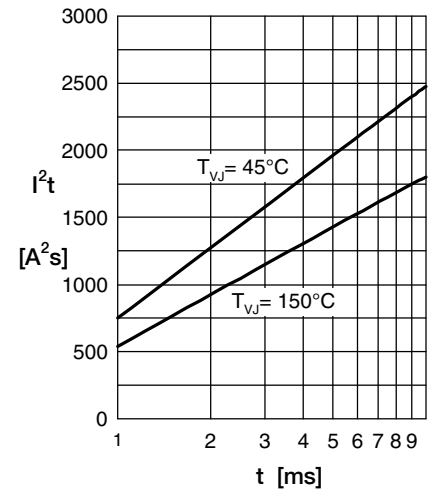


Fig. 3  $I^2t$  vs. time per thyristor

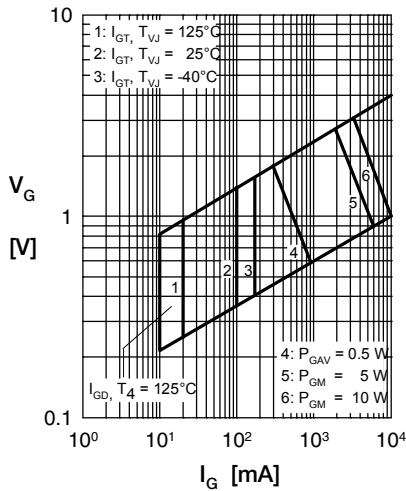


Fig. 4 Gate trigger characteristics

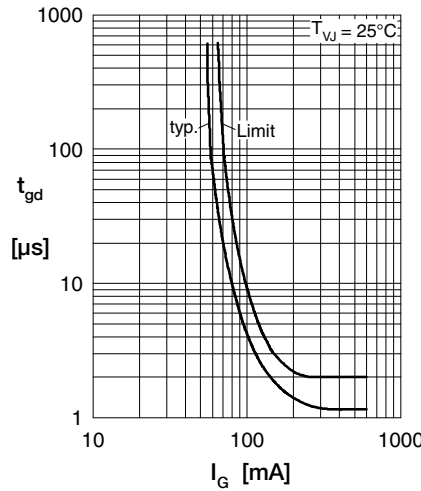


Fig. 5 Gate trigger delay time

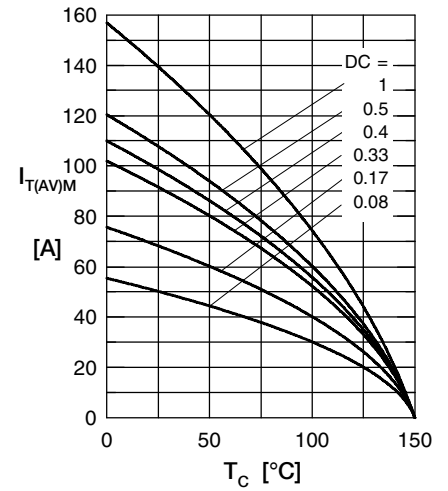


Fig. 5 Max. forward current vs. case temperature per thyristor

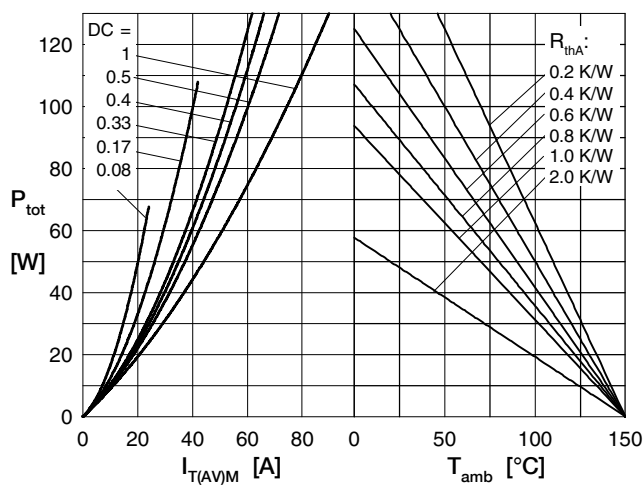


Fig. 4 Power dissipation vs. forward current and ambient temperature per thyristor

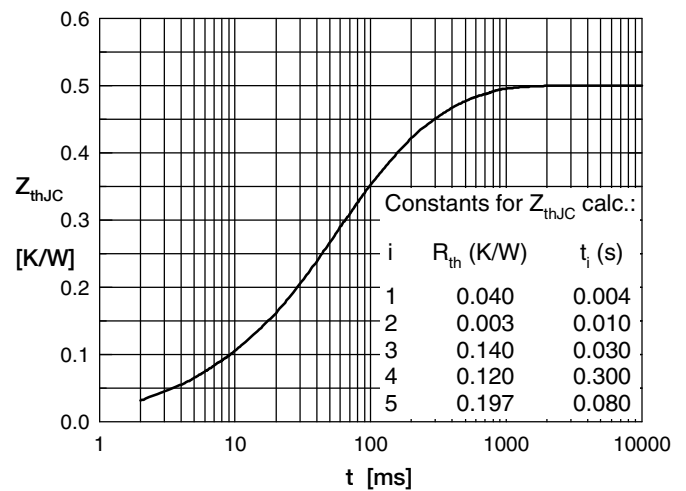


Fig. 6 Transient thermal impedance junction to case vs. time per thyristor

**Brake IGBT**

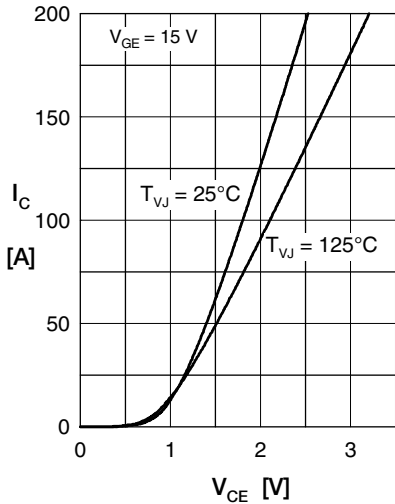


Fig. 1 Typ. output characteristics

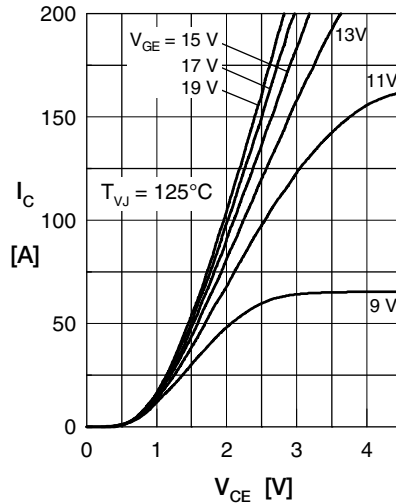


Fig. 2 Typ. output characteristics

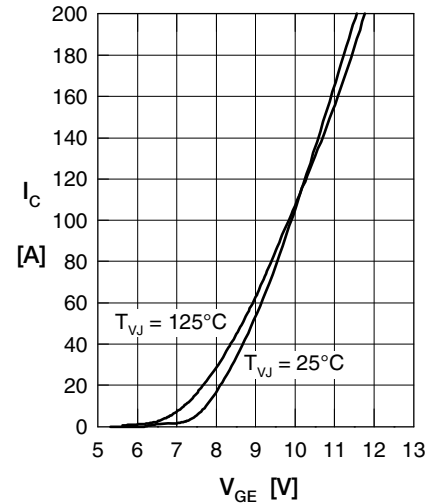


Fig. 3 Typ. transfer characteristics

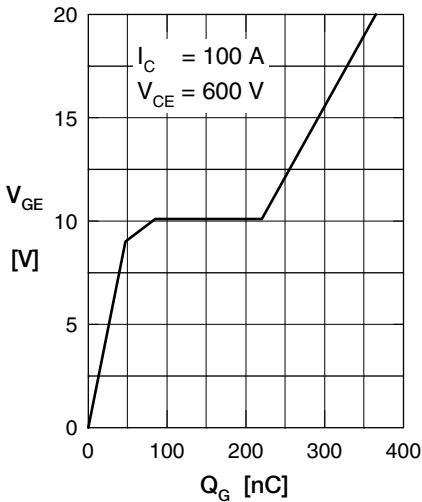


Fig. 4 Typ. turn-on gate charge

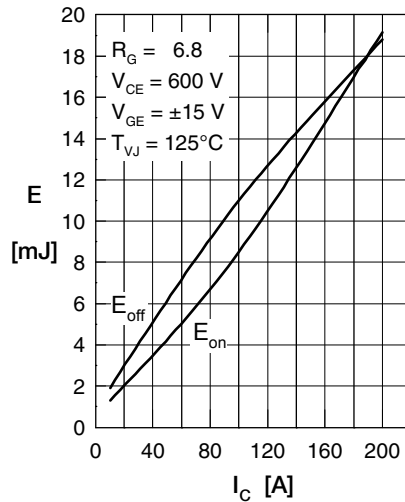


Fig. 5 Typ. switching energy versus collector current

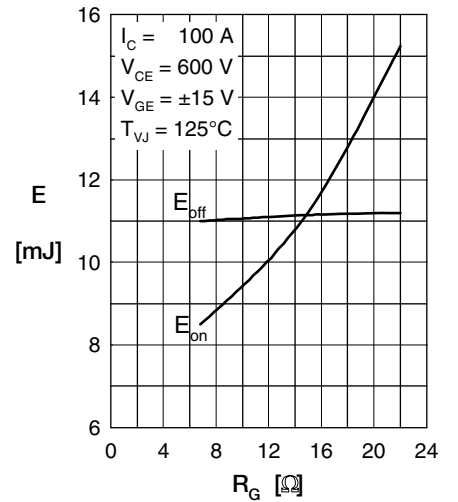


Fig. 6 Typ. switching energy versus gate resistance

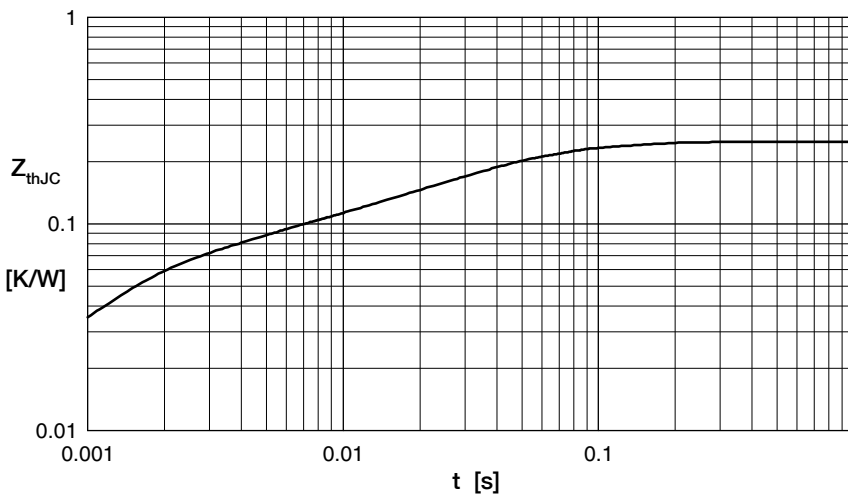


Fig. 7 Typ. transient thermal impedance junction to case

## Brake Diode

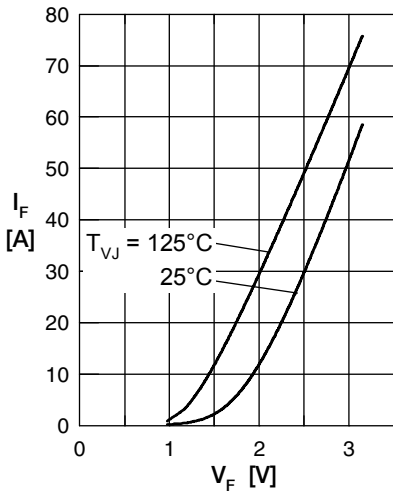


Fig. 1 Forward current  $I_F$  vs.  $V_F$

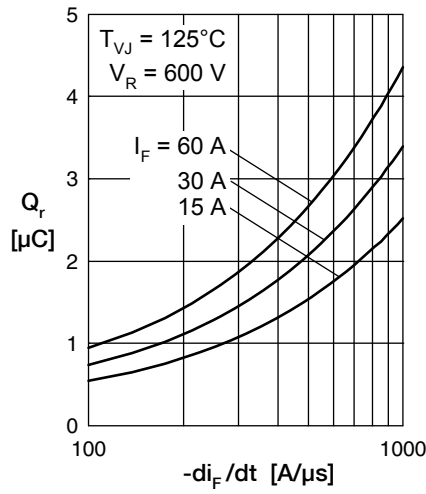


Fig. 2 Typ. reverse recovery charge  $Q_r$  versus  $-di_F/dt$

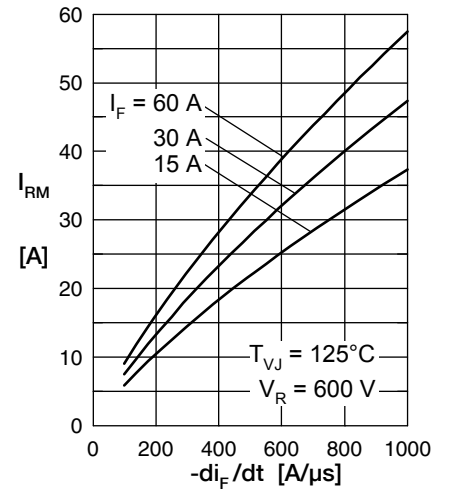


Fig. 3 Typ. peak reverse current  $I_{RM}$  versus  $-di_F/dt$

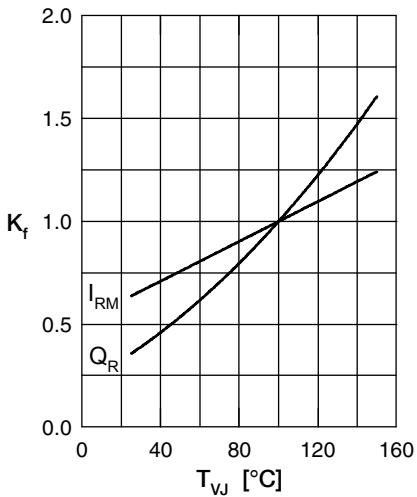


Fig. 4 Dynamic parameters  $Q_r$ ,  $I_{RM}$  versus  $T_{VJ}$

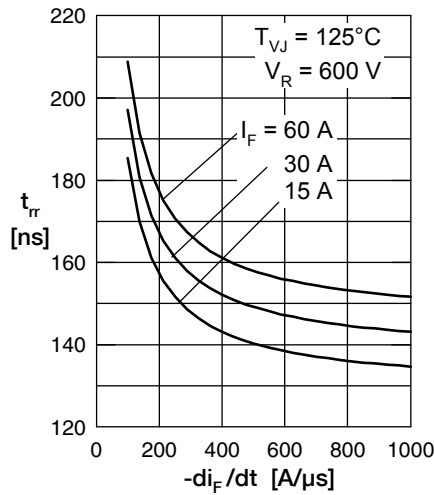


Fig. 5 Typ. recovery time  $t_{rr}$  vs.  $-di_F/dt$

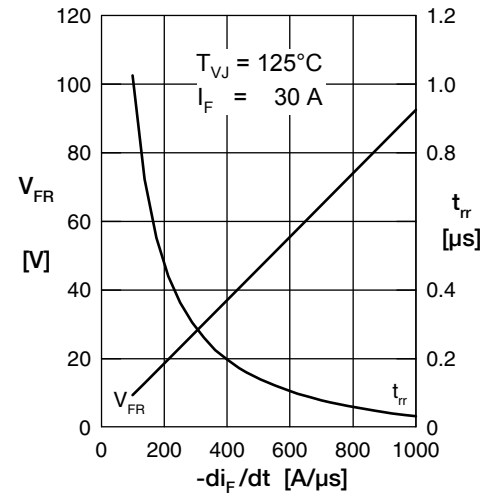


Fig. 6 Typ. peak forward voltage  $V_{FR}$  and  $t_{rr}$  versus  $di_F/dt$

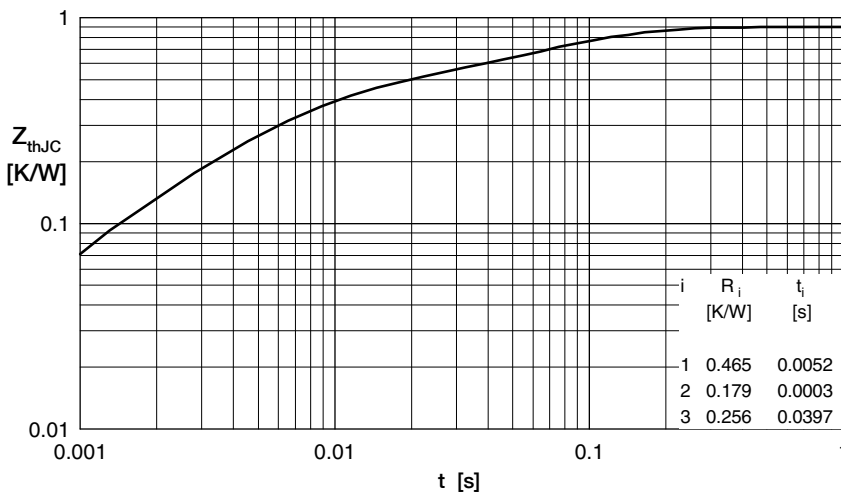


Fig. 7 Transient thermal impedance junction to case



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