

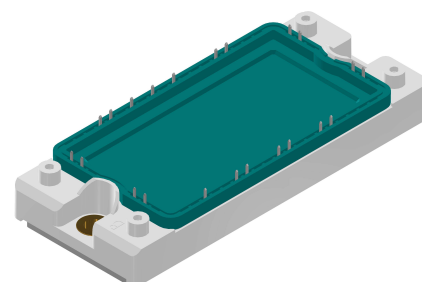
Thyristor Module

3~ Rectifier	Brake Chopper
$V_{RRM} = 1600 \text{ V}$	$V_{CES} = 1200 \text{ V}$
$I_{DAV} = 150 \text{ A}$	$I_{C25} = 120 \text{ A}$
$I_{FSM} = 700 \text{ A}$	$V_{CE(sat)} = 1.8 \text{ V}$

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

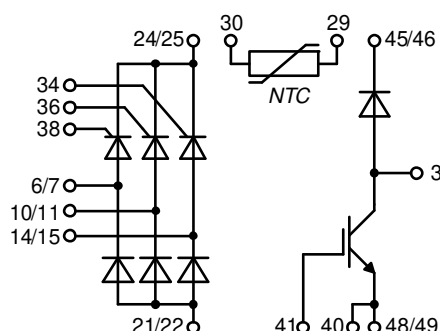
Part number

VVZB135-16ioXT



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

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

Disclaimer Notice

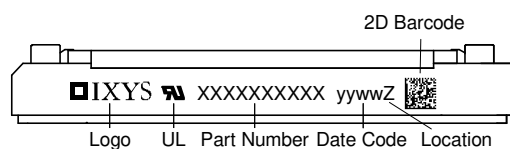
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Rectifier				Ratings			
Symbol	Definition	Conditions		min.	typ.	max.	Unit
$V_{RSM/DSM}$	max. non-repetitive reverse/forward blocking voltage	$T_{VJ} = 25^{\circ}\text{C}$				1700	V
$V_{RRM/DRM}$	max. repetitive reverse/forward blocking voltage	$T_{VJ} = 25^{\circ}\text{C}$				1600	V
$I_{R/D}$	reverse current, drain current	$V_{R/D} = 1600\text{ V}$	$T_{VJ} = 25^{\circ}\text{C}$			100	μA
		$V_{R/D} = 1600\text{ V}$	$T_{VJ} = 150^{\circ}\text{C}$			20	mA
V_T	forward voltage drop	$I_T = 50\text{ A}$	$T_{VJ} = 25^{\circ}\text{C}$			1.32	V
		$I_T = 150\text{ A}$				1.92	V
		$I_T = 50\text{ A}$	$T_{VJ} = 125^{\circ}\text{C}$			1.26	V
		$I_T = 150\text{ A}$				1.96	V
I_{DAV}	bridge output current	$T_C = 85^{\circ}\text{C}$ rectangular $d = \frac{1}{3}$	$T_{VJ} = 150^{\circ}\text{C}$			150	A
V_{T0}	threshold voltage	} for power loss calculation only	$T_{VJ} = 150^{\circ}\text{C}$			0.88	V
r_T	slope resistance					7.3	m Ω
R_{thJC}	thermal resistance junction to case					0.65	K/W
R_{thCH}	thermal resistance case to heatsink				0.1		K/W
P_{tot}	total power dissipation		$T_C = 25^{\circ}\text{C}$			190	W
I_{TSM}	max. forward surge current	$t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$	$T_{VJ} = 45^{\circ}\text{C}$			700	A
		$t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$	$V_R = 0\text{ V}$			755	A
		$t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$	$T_{VJ} = 150^{\circ}\text{C}$			595	A
		$t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$	$V_R = 0\text{ V}$			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 ² s
		$t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$	$V_R = 0\text{ V}$			2.37	kA ² s
		$t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$	$T_{VJ} = 150^{\circ}\text{C}$			1.77	kA ² s
		$t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$	$V_R = 0\text{ V}$			1.73	kA ² s
C_J	junction capacitance	$V_R = 400\text{ V}$ $f = 1\text{ MHz}$	$T_{VJ} = 25^{\circ}\text{C}$		32		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, $I_T = 150\text{ A}$				150	A/ μs
		$t_p = 200\text{ }\mu\text{s}; di_G/dt = 0.45\text{ A}/\mu\text{s};$ $I_G = 0.45\text{ A}; V = \frac{2}{3} V_{DRM}$ non-repet., $I_T = 50\text{ A}$				500	A/ μs
$(dv/dt)_{cr}$	critical rate of rise of voltage	$V = \frac{2}{3} V_{DRM}$ $R_{GK} = \infty$; method 1 (linear voltage rise)	$T_{VJ} = 150^{\circ}\text{C}$			1000	V/ μs
V_{GT}	gate trigger voltage	$V_D = 6\text{ V}$	$T_{VJ} = 25^{\circ}\text{C}$			1.4	V
			$T_{VJ} = -40^{\circ}\text{C}$			1.6	V
I_{GT}	gate trigger current	$V_D = 6\text{ V}$	$T_{VJ} = 25^{\circ}\text{C}$			80	mA
			$T_{VJ} = -40^{\circ}\text{C}$			200	mA
V_{GD}	gate non-trigger voltage	$V_D = \frac{2}{3} V_{DRM}$	$T_{VJ} = 150^{\circ}\text{C}$			0.2	V
I_{GD}	gate non-trigger current					5	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	$V_D = 6\text{ V}$ $R_{GK} = \infty$	$T_{VJ} = 25^{\circ}\text{C}$			100	mA
t_{gd}	gate controlled delay time	$V_D = \frac{1}{2} V_{DRM}$	$T_{VJ} = 25^{\circ}\text{C}$			2	μs
		$I_G = 0.45\text{ A}; di_G/dt = 0.45\text{ A}/\mu\text{s}$					
t_q	turn-off time	$V_R = 100\text{ V}; I_T = 50\text{ A}; V = \frac{2}{3} V_{DRM}$ $di/dt = 10\text{ A}/\mu\text{s}$ $dv/dt = 20\text{ V}/\mu\text{s}$ $t_p = 200\text{ }\mu\text{s}$	$T_{VJ} = 125^{\circ}\text{C}$		150		μs

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					± 20	V
V_{GEM}	max. transient gate emitter voltage					± 30	V
I_{C25}	collector current	$T_C = 25^{\circ}\text{C}$				120	A
I_{C80}		$T_C = 80^{\circ}\text{C}$				84	A
P_{tot}	total power dissipation	$T_C = 25^{\circ}\text{C}$				390	W
$V_{CE(sat)}$	collector emitter saturation voltage	$I_C = 75 \text{ A}; V_{GE} = 15 \text{ V}$	$T_{VJ} = 25^{\circ}\text{C}$		1.8	2.1	V
			$T_{VJ} = 125^{\circ}\text{C}$		2.1		V
$V_{GE(th)}$	gate emitter threshold voltage	$I_C = 3 \text{ mA}; V_{GE} = V_{CE}$	$T_{VJ} = 25^{\circ}\text{C}$	5.5	6.0	6.5	V
I_{CES}	collector emitter leakage current	$V_{CE} = V_{CES}; V_{GE} = 0 \text{ V}$	$T_{VJ} = 25^{\circ}\text{C}$			0.2	mA
			$T_{VJ} = 125^{\circ}\text{C}$		0.6		mA
I_{GES}	gate emitter leakage current	$V_{GE} = \pm 20 \text{ V}$				500	nA
$Q_{G(on)}$	total gate charge	$V_{CE} = 600 \text{ V}; V_{GE} = 15 \text{ V}; I_C = 75 \text{ A}$			230		nC
$t_{d(on)}$	turn-on delay time	inductive load $V_{CE} = 600 \text{ V}; I_C = 75 \text{ A}$ $V_{GE} = \pm 15 \text{ V}; R_G = 10 \Omega$	$T_{VJ} = 125^{\circ}\text{C}$		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				6.8		mJ
E_{off}	turn-off energy per pulse				8.3		mJ
RBSOA	reverse bias safe operating area	$V_{GE} = \pm 15 \text{ V}; R_G = 10 \Omega$	$T_{VJ} = 125^{\circ}\text{C}$				
I_{CM}		$V_{CEK} = 1200 \text{ V}$				225	A
SCSOA	short circuit safe operating area	$V_{CEK} = 1200 \text{ V}$					
t_{SC}	short circuit duration	$V_{CE} = 900 \text{ V}; V_{GE} = \pm 15$	$T_{VJ} = 125^{\circ}\text{C}$			10	μs
I_{SC}	short circuit current	$R_G = 10 \Omega$; non-repetitive			300		A
R_{thJC}	thermal resistance junction to case					0.32	K/W
R_{thCH}	thermal resistance case to heatsink				0.15		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	$I_F = 30 \text{ A}$	$T_{VJ} = 25^{\circ}\text{C}$			2.75	V
			$T_{VJ} = 125^{\circ}\text{C}$		1.99		V
I_R	reverse current	$V_R = V_{RRM}$	$T_{VJ} = 25^{\circ}\text{C}$			0.25	mA
			$T_{VJ} = 125^{\circ}\text{C}$			1	mA
Q_{rr}	reverse recovery charge	$V_R = 600 \text{ V}$ $-di_F/dt = 400 \text{ A}/\mu\text{s}$ $I_F = 30 \text{ A}; V_{GE} = 0 \text{ V}$	$T_{VJ} = 125^{\circ}\text{C}$		1.8		μC
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 E2-Pack				Ratings			
Symbol	Definition	Conditions		min.	typ.	max.	Unit
I _{RMS}	RMS current	per terminal				50	A
T _{VJ}	virtual junction temperature			-40		150	°C
T _{op}	operation temperature			-40		125	°C
T _{stg}	storage temperature			-40		125	°C
Weight					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	50/60 Hz, RMS; I _{ISOL} ≤ 1 mA	3600			V
		t = 1 minute		3000			V



Ordering	Ordering Number	Marking on Product	Delivery Mode	Quantity	Code No.
Standard	VVZB135-16IOXT	VVZB135-16IOXT	Box	6	510134

Temperature Sensor NTC

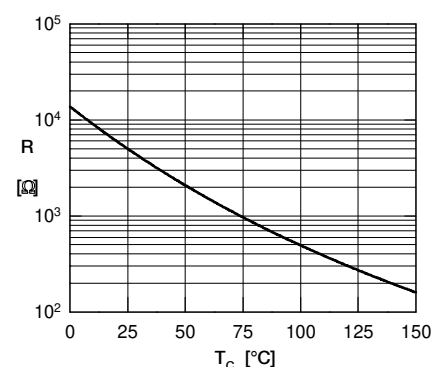
Symbol	Definition	Conditions	min.	typ.	max.	Unit
R_{25}	resistance	$T_{VJ} = 25^\circ$	4.75	5	5.25	k Ω
$B_{25/50}$	temperature coefficient			3375		K

Equivalent Circuits for Simulation

* on die level

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

		Thyristor	Brake IGBT	Brake Diode	
V_0	threshold voltage	0.88	1.1	1.31	V
R_0	slope resistance *	4.1	17.9	8	m Ω



Typ. NTC resistance vs. temperature

Technical drawing of a rectangular component, likely a sensor or actuator, showing dimensions and details.

Top View Dimensions:

- Overall width: $107,5 \pm 0,3$
- Overall height: $45 \pm 0,2$
- Inner width: $79,2$
- Inner height: $32 \pm 0,2$
- Distance from top edge to first row of holes: $20,6 \pm 0,5$
- Distance between rows of holes: $17 \pm 0,5$
- Distance from bottom edge to last row of holes: $3,5 \pm 0,5$

Side View Dimensions:

- Overall height: $41,90$
- Distance from bottom edge to first row of holes: 11
- Distance between rows of holes: $11,43$
- Distance from top edge to last row of holes: $15,24$

Details:

- Detail A:** Shows a cross-section of a hole with diameter $\varnothing 6$ and a depth of $1,5 \pm 0,3$. The hole is located in a plate with a thickness of 6 .
- Detail B:** Shows a cross-section of a hole with diameter $\varnothing 5,5$ and a depth of $+0,1 - 0,3$. The hole is located in a plate with a thickness of 11 .
- Detail C:** Shows a cross-section of a hole with diameter $\varnothing 2,5 - 0,3$ and a depth of $1,2 \pm 0,05$. The hole is located in a plate with a thickness of $0,8 \pm 0,2$.
- Detail D:** Shows a cross-section of a hole with diameter $\varnothing 2,1 - 0,3$ and a depth of $1,5 \pm 0,3$. The hole is located in a plate with a thickness of 6 .

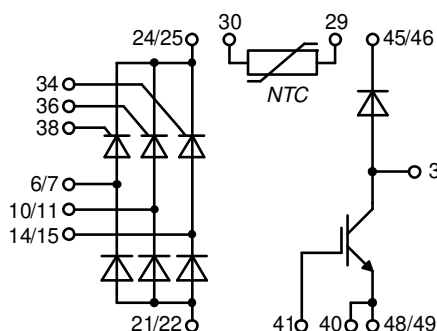
Other Dimensions:

- Distance from left edge to first row of holes: $19,83$
- Distance from left edge to second row of holes: $31,26$
- Distance from left edge to third row of holes: $35,07$
- Distance from left edge to fourth row of holes: $46,50$
- Distance from left edge to fifth row of holes: $50,31$
- Distance from left edge to sixth row of holes: $61,74$
- Distance from left edge to seventh row of holes: $65,55$
- Distance from right edge to seventh row of holes: $65,55$
- Distance from right edge to sixth row of holes: $61,74$
- Distance from right edge to fifth row of holes: $50,31$
- Distance from right edge to fourth row of holes: $46,50$
- Distance from right edge to third row of holes: $35,07$
- Distance from right edge to second row of holes: $31,26$
- Distance from right edge to first row of holes: $19,83$

Notes:

- Vor der Montage typ. $100 \mu\text{m}$ konvex über 75 mm
- Before mounting typ. $100 \mu\text{m}$ convex over 75 mm

- Empfohlenes Drehmoment / *Recommended mounting torque*: **1.5 Nm**



Thyristor

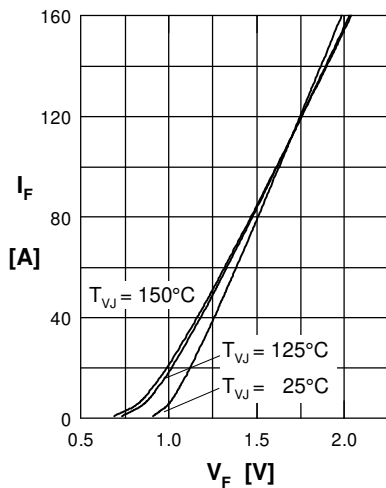


Fig. 1 Forward current vs. voltage drop per thyristor

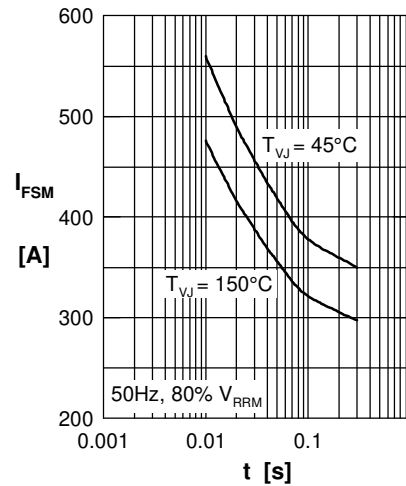


Fig. 2 Surge overload current vs. time per thyristor

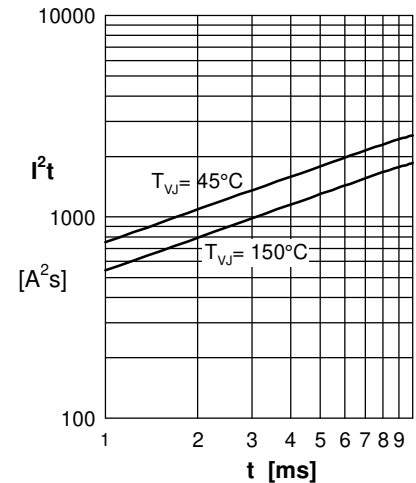


Fig. 3 I^2t vs. time per thyristor

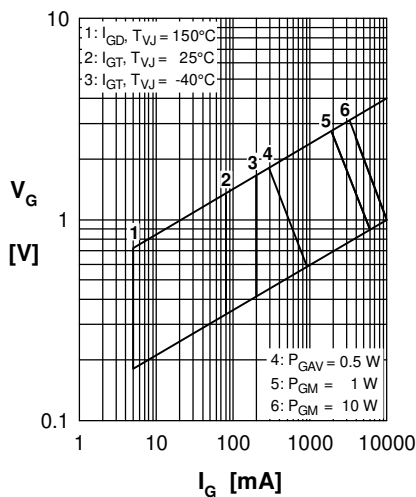


Fig. 4 Gate trigger characteristics

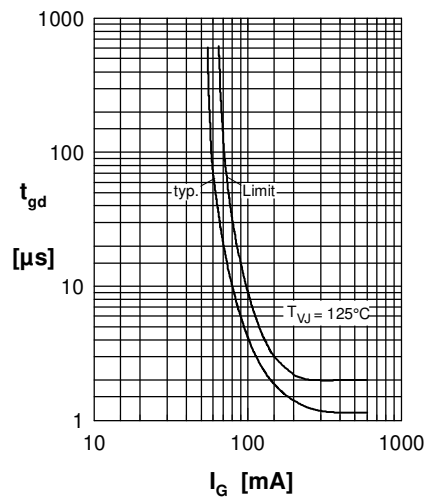


Fig. 5 Gate controlled delay time

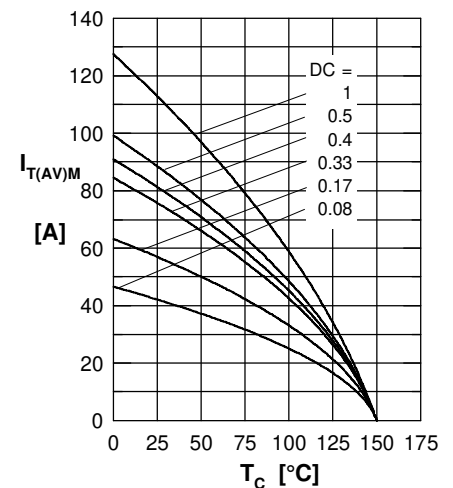


Fig. 5 Max. forward current vs. case temperature per thyristor

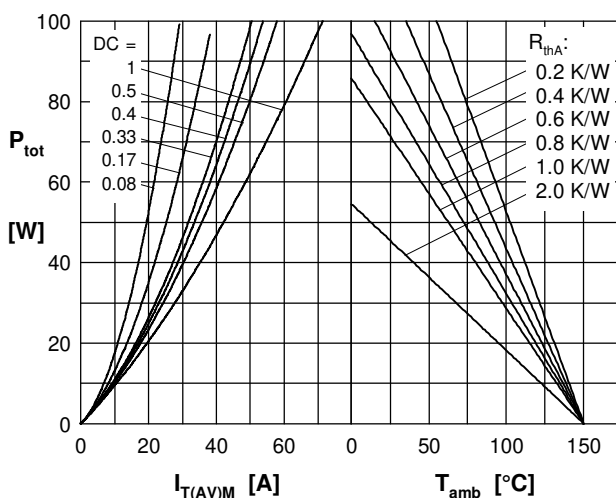


Fig. 4 Power dissipation vs. forward current and ambient temperature per thyristor

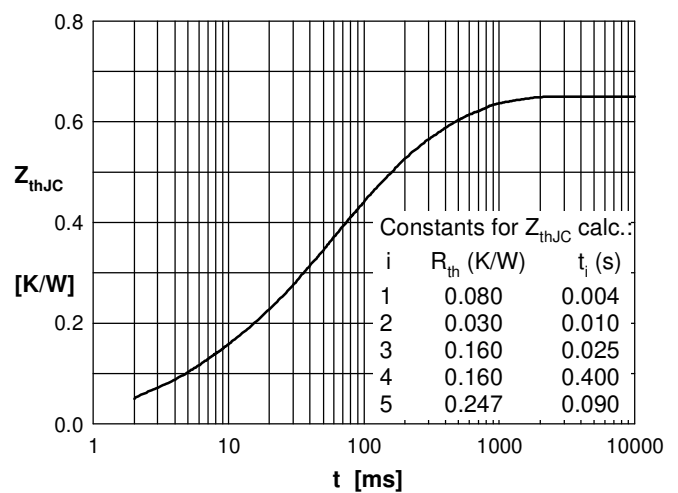


Fig. 6 Transient thermal impedance junction to case vs. time per thyristor

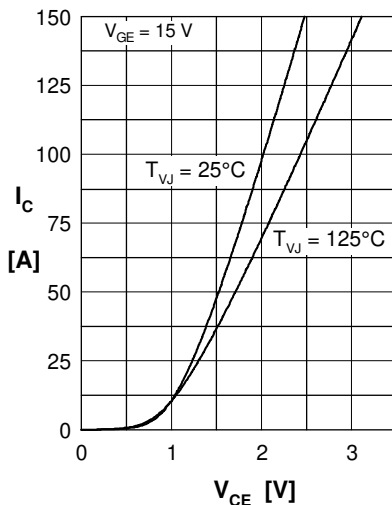
Brake IGBT


Fig. 1 Typ. output characteristics

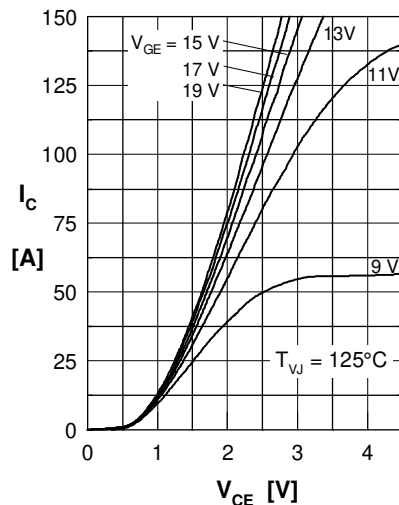


Fig. 2 Typ. output characteristics

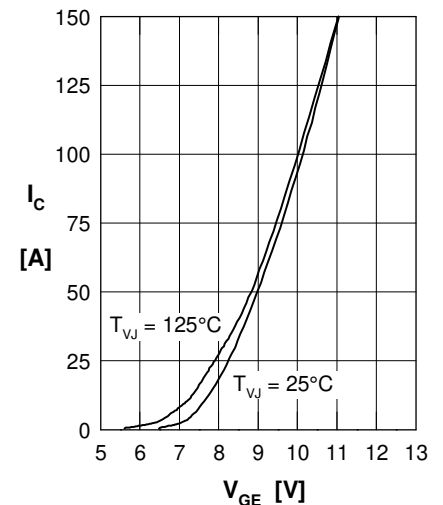


Fig. 3 Typ. transfer characteristics

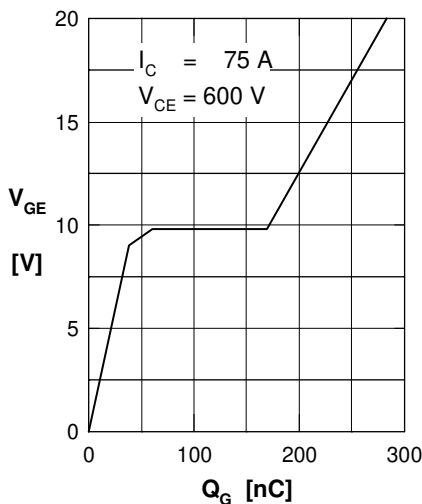


Fig. 4 Typ. turn-on gate charge

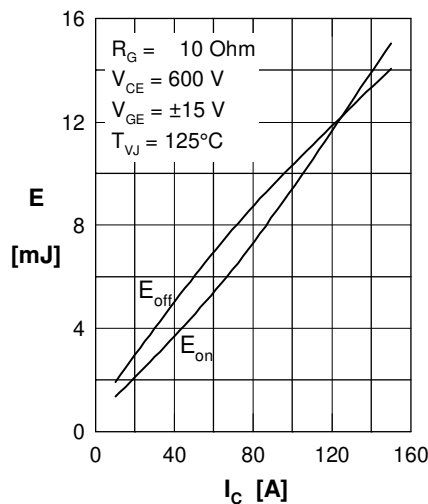


Fig. 5 Typ. switching energy versus collector current

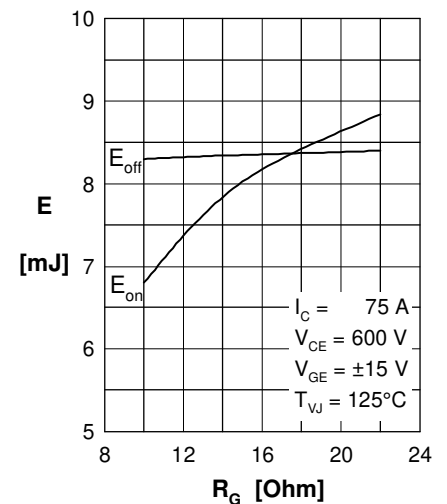


Fig. 6 Typ. switching energy versus gate resistance

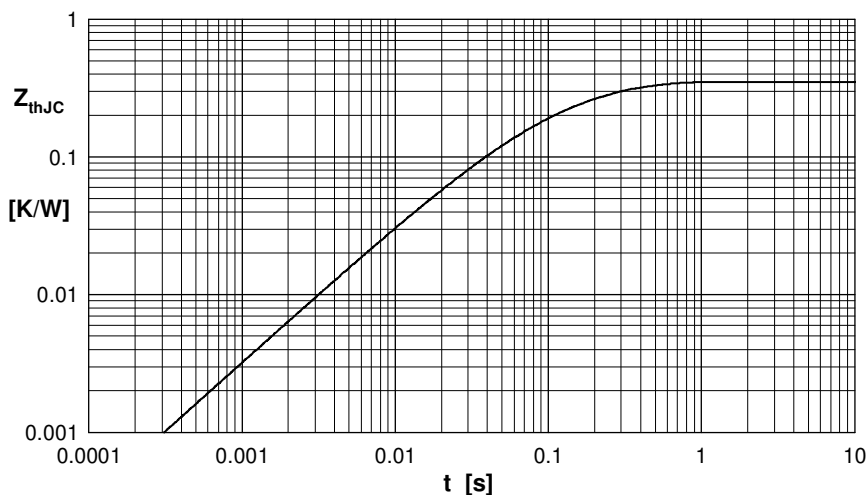


Fig. 7 Typ. transient thermal impedance junction to case

Brake Diode

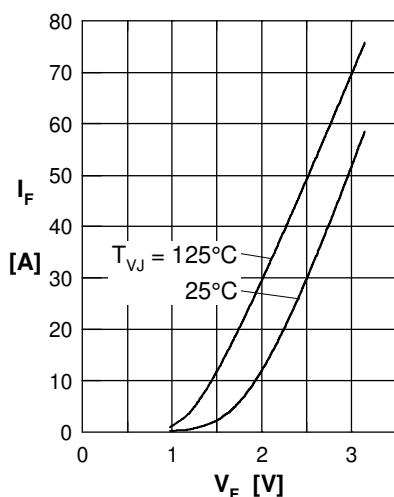


Fig. 1 Forward current I_F vs. V_F

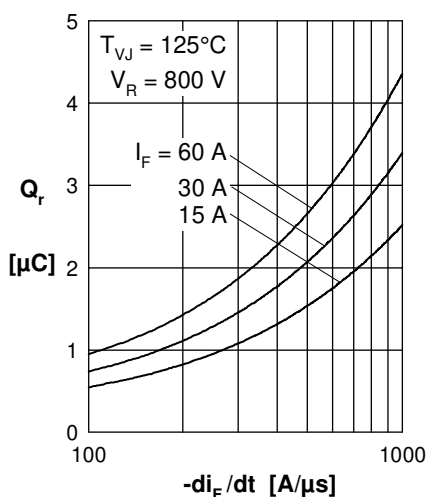


Fig. 2 Typ. reverse recovery charge Q_r versus $-di_F/dt$

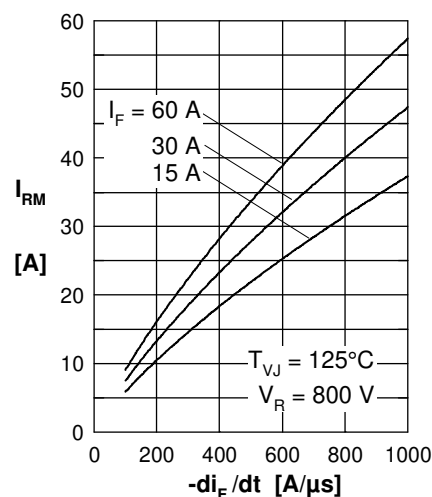


Fig. 3 Typ. peak reverse current I_{RM} versus $-di_F/dt$

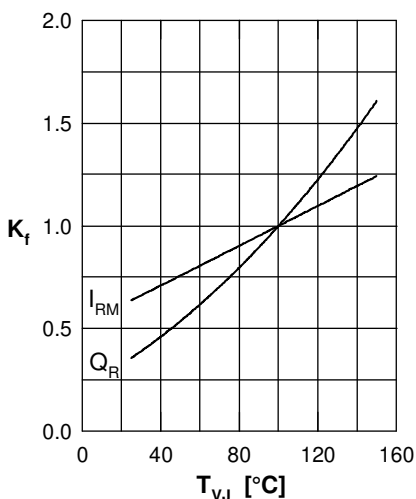


Fig. 4 Dynamic parameters Q_r , I_{RM} versus T_{VJ}

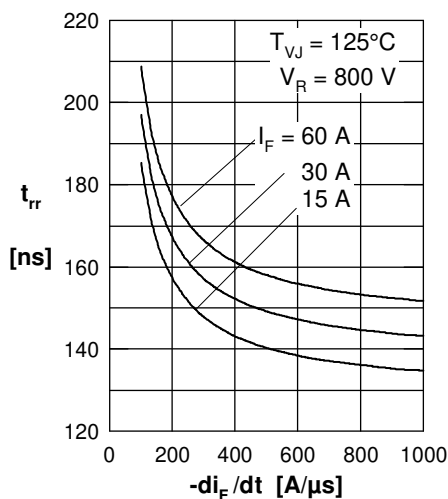


Fig. 5 Typ. recovery time t_{rr} versus $-di_F/dt$

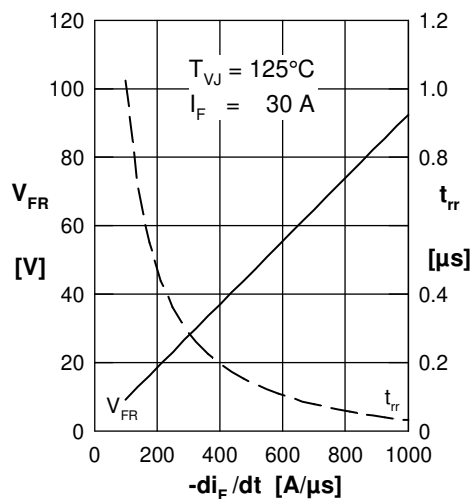


Fig. 6 Typ. peak forward voltage V_{FR} and t_{rr} versus di_F/dt

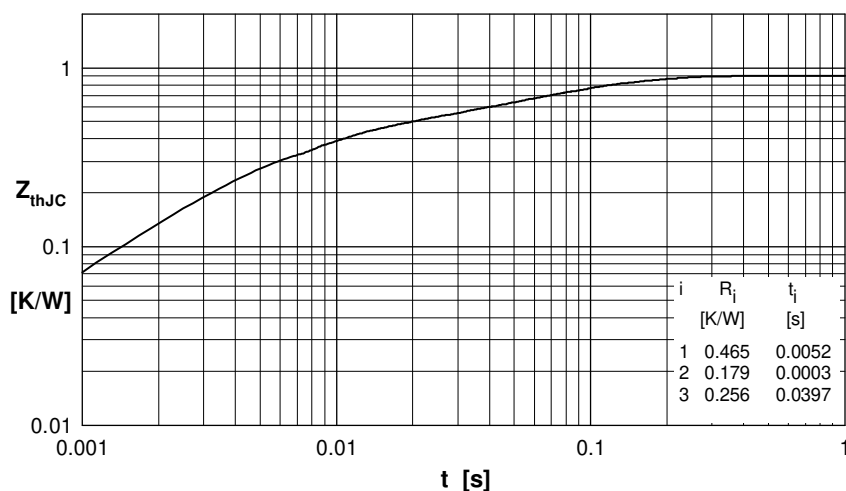


Fig. 7 Transient thermal impedance junction to case