

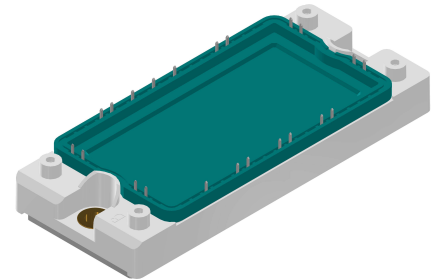
# Thyristor Module

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

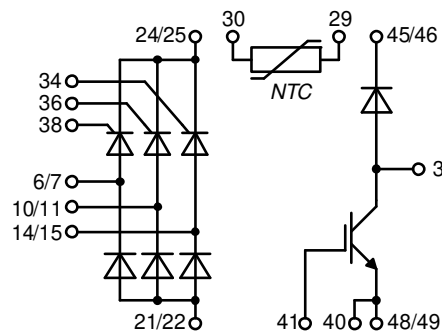
Part number

**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

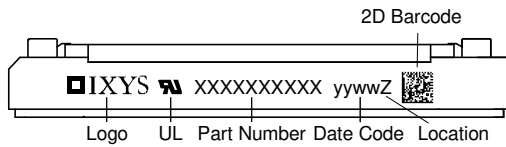
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Rectifier			Ratings			
Symbol	Definition	Conditions	min.	typ.	max.	Unit
$V_{RSM/DSM}$	max. non-repetitive reverse/forward blocking voltage	$T_{VJ} = 25^{\circ}C$			1700	V
$V_{RRM/DRM}$	max. repetitive reverse/forward blocking voltage	$T_{VJ} = 25^{\circ}C$			1600	V
$I_{RD}$	reverse current, drain current	$V_{R/D} = 1600 V$	$T_{VJ} = 25^{\circ}C$		100	$\mu A$
		$V_{R/D} = 1600 V$	$T_{VJ} = 150^{\circ}C$		20	mA
$V_T$	forward voltage drop	$I_T = 50 A$	$T_{VJ} = 25^{\circ}C$		1.32	V
		$I_T = 150 A$			1.92	V
		$I_T = 50 A$	$T_{VJ} = 125^{\circ}C$		1.26	V
		$I_T = 150 A$			1.96	V
$I_{DAV}$	bridge output current	$T_C = 85^{\circ}C$ rectangular $d = 1/3$	$T_{VJ} = 150^{\circ}C$		150	A
$V_{T0}$	threshold voltage	} for power loss calculation only	$T_{VJ} = 150^{\circ}C$		0.88	V
$r_T$	slope resistance				7.3	m $\Omega$
$R_{thJC}$	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		$T_C = 25^{\circ}C$		190	W
$I_{TSM}$	max. forward surge current	$t = 10 ms; (50 Hz), sine$	$T_{VJ} = 45^{\circ}C$		700	A
		$t = 8,3 ms; (60 Hz), sine$	$V_R = 0 V$		755	A
		$t = 10 ms; (50 Hz), sine$	$T_{VJ} = 150^{\circ}C$		595	A
		$t = 8,3 ms; (60 Hz), sine$	$V_R = 0 V$		645	A
$I^2t$	value for fusing	$t = 10 ms; (50 Hz), sine$	$T_{VJ} = 45^{\circ}C$		2.45	kA <sup>2</sup> s
		$t = 8,3 ms; (60 Hz), sine$	$V_R = 0 V$		2.37	kA <sup>2</sup> s
		$t = 10 ms; (50 Hz), sine$	$T_{VJ} = 150^{\circ}C$		1.77	kA <sup>2</sup> s
		$t = 8,3 ms; (60 Hz), sine$	$V_R = 0 V$		1.73	kA <sup>2</sup> s
$C_J$	junction capacitance	$V_R = 400 V f = 1 MHz$	$T_{VJ} = 25^{\circ}C$		32	pF
$P_{GM}$	max. gate power dissipation	$t_p = 30 \mu s$	$T_C = 150^{\circ}C$		10	W
		$t_p = 300 \mu s$			5	W
$P_{GAV}$	average gate power dissipation				0.5	W
$(di/dt)_{cr}$	critical rate of rise of current	$T_{VJ} = 150^{\circ}C; f = 50 Hz$ repetitive, $I_T = 150 A$			150	A/ $\mu s$
		$t_p = 200 \mu s; di_G/dt = 0.45 A/\mu s;$ $I_G = 0.45 A; V = 2/3 V_{DRM}$ non-repet., $I_T = 50 A$			500	A/ $\mu s$
$(dv/dt)_{cr}$	critical rate of rise of voltage	$V = 2/3 V_{DRM}$ $R_{GK} = \infty; method 1 (linear voltage rise)$	$T_{VJ} = 150^{\circ}C$		1000	V/ $\mu s$
$V_{GT}$	gate trigger voltage	$V_D = 6 V$	$T_{VJ} = 25^{\circ}C$		1.4	V
			$T_{VJ} = -40^{\circ}C$		1.6	V
$I_{GT}$	gate trigger current	$V_D = 6 V$	$T_{VJ} = 25^{\circ}C$		80	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				5	mA
$I_L$	latching current	$t_p = 10 \mu s$	$T_{VJ} = 25^{\circ}C$		450	mA
		$I_G = 0.45 A; di_G/dt = 0.45 A/\mu s$				
$I_H$	holding current	$V_D = 6 V R_{GK} = \infty$	$T_{VJ} = 25^{\circ}C$		100	mA
$t_{gd}$	gate controlled delay time	$V_D = 1/2 V_{DRM}$	$T_{VJ} = 25^{\circ}C$		2	$\mu s$
		$I_G = 0.45 A; di_G/dt = 0.45 A/\mu s$				
$t_q$	turn-off time	$V_R = 100 V; I_T = 50 A; V = 2/3 V_{DRM}$ $di/dt = 10 A/\mu s dv/dt = 20 V/\mu s t_p = 200 \mu s$	$T_{VJ} = 125^{\circ}C$		150	$\mu s$

Brake IGBT				Ratings					
Symbol	Definition	Conditions	min.	typ.	max.	Unit			
$V_{CES}$	collector emitter voltage	$T_{VJ} = 25^{\circ}\text{C}$			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	$T_C = 25^{\circ}\text{C}$			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	$I_C = 75\text{ A}; V_{GE} = 15\text{ V}$			1.8	V			
					2.1	V			
$V_{GE(th)}$	gate emitter threshold voltage	$I_C = 3\text{ mA}; V_{GE} = V_{CE}$	5.5	6.0	6.5	V			
$I_{CES}$	collector emitter leakage current	$V_{CE} = V_{CES}; V_{GE} = 0\text{ V}$			0.2	mA			
					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 $V_{CE} = 600\text{ V}; I_C = 75\text{ A}$ $V_{GE} = \pm 15\text{ V}; R_G = 10\ \Omega$							
$t_r$	current rise time						$T_{VJ} = 125^{\circ}\text{C}$	70	ns
$t_{d(off)}$	turn-off delay time						40	ns	
$t_f$	current fall time						250	ns	
$E_{on}$	turn-on energy per pulse						100	ns	
$E_{off}$	turn-off energy per pulse						6.8	mJ	
$E_{off}$		8.3	mJ						
<b>RBSOA</b>	reverse bias safe operating area	$V_{GE} = \pm 15\text{ V}; R_G = 10\ \Omega$							
$I_{CM}$		$V_{CEK} = 1200\text{ V}$			225	A			
<b>SCSOA</b>	short circuit safe operating area	$V_{CEK} = 1200\text{ V}$							
$t_{SC}$	short circuit duration	$V_{CE} = 900\text{ V}; V_{GE} = \pm 15$			10	$\mu\text{s}$			
$I_{SC}$	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				1200	V			
$I_{F25}$	forward current				48	A			
$I_{F80}$					32	A			
$V_F$	forward voltage	$I_F = 30\text{ A}$			2.75	V			
					1.99	V			
$I_R$	reverse current	$V_R = V_{RRM}$			0.25	mA			
					1	mA			
$Q_{rr}$	reverse recovery charge	$V_R = 600\text{ V}$ $-di_f/dt = 400\text{ A}/\mu\text{s}$ $I_F = 30\text{ A}; V_{GE} = 0\text{ V}$							
$I_{RM}$	max. reverse recovery current						$T_{VJ} = 125^{\circ}\text{C}$	1.8	$\mu\text{C}$
$t_{rr}$	reverse recovery time						23	A	
$R_{thJC}$	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
<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 50/60 Hz, RMS; $I_{ISOL} \leq 1$ 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**

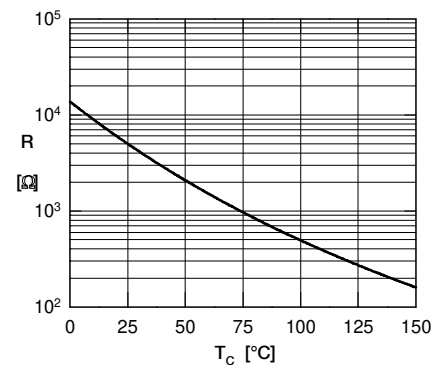
Symbol	Definition	Conditions	min.	typ.	max.	Unit
$R_{25}$	resistance	$T_{VJ} = 25^\circ$	4.75	5	5.25	k $\Omega$
$B_{25/50}$	temperature coefficient			3375		K

**Equivalent Circuits for Simulation**

\* on die level

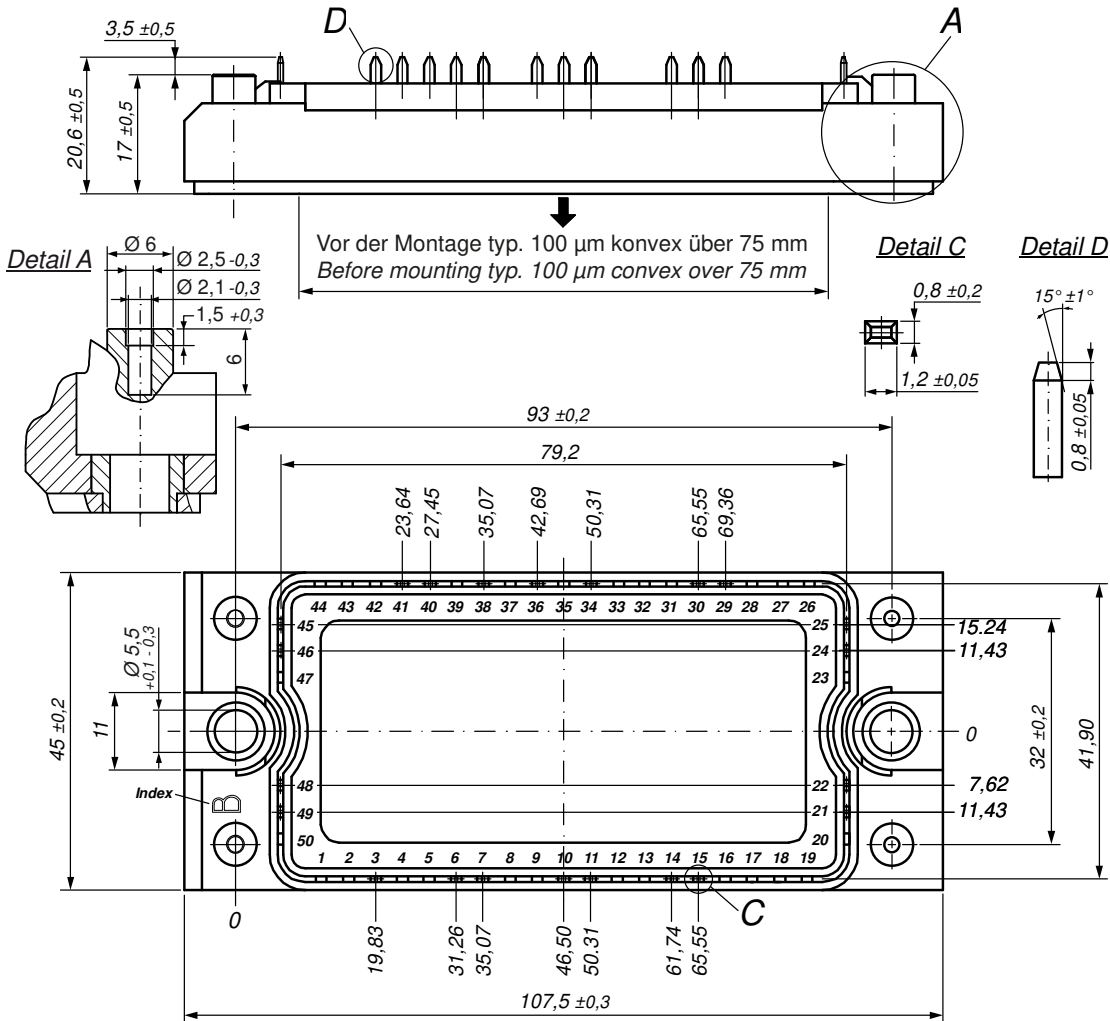
$T_{VJ} = 150^\circ\text{C}$

	Thyristor	Brake IGBT	Brake Diode	
$V_0$	0.88	1.1	1.31	V
$R_0$	4.1	17.9	8	m $\Omega$





**Outlines E2-Pack**

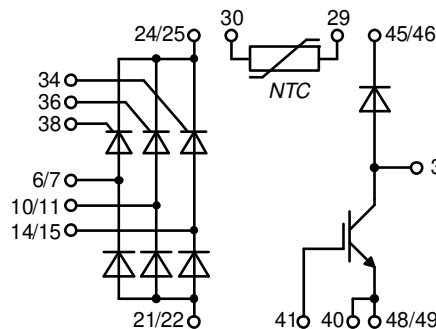


**Bemerkung / Note:**

- Nichttolerierete Maße nach / Measure without tolerances according DIN ISO 2768-T1-m
- PCB-Lochmuster / PCB hole pattern: **see pin position**
- Toleranz Pin-Position und PCB-Lochmuster / Tolerance of pin position and PCB hole pattern:  $\oplus 0,1$
- Montageanleitung / Mounting instruction: [www.ixys.com](http://www.ixys.com) **Application note IXAN0024**

**Detail A:** PCB-Montage / Mounting on PCB <sup>L</sup>

- Empfohlene, selbstschneidende Schraube / Recommended, self-tapping screw: **EJOT PT®** (Größe / size: **K25**) <sup>L</sup>
- Max. Schraubenlänge / Max. screw length: **PCB-Dicke / thickness + 6 mm** (max. Lochtiefe / hole depth) <sup>L</sup>
- Empfohlenes Drehmoment / Recommended mounting torque: **1.5 Nm**



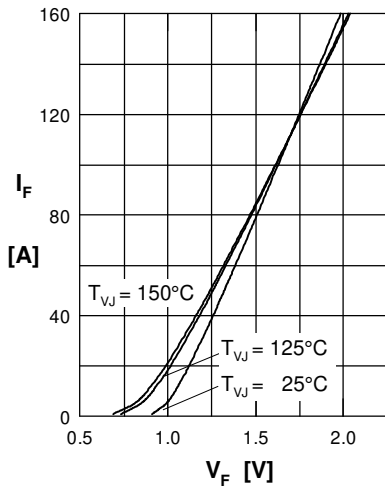
**Thyristor**


Fig. 1 Forward current vs. voltage drop per thyristor

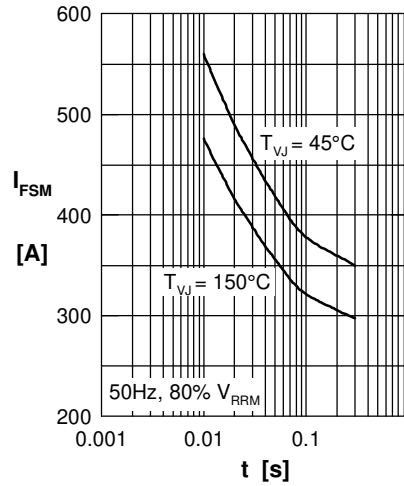


Fig. 2 Surge overload current vs. time per thyristor

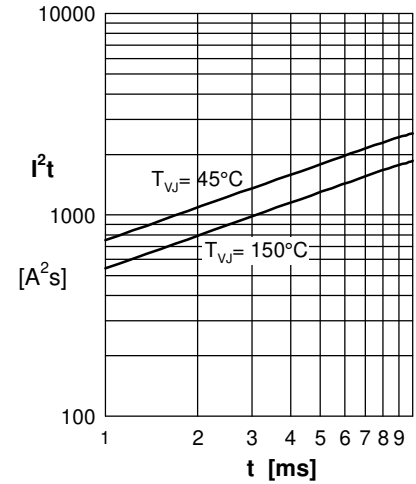
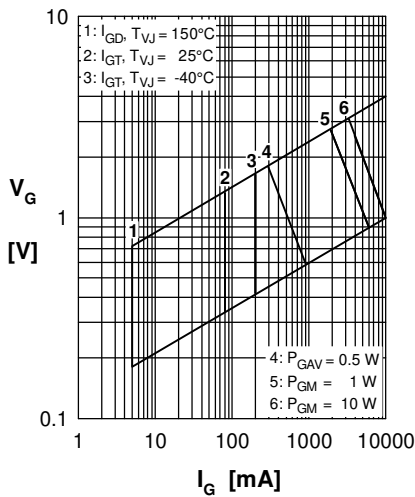

 Fig. 3  $I^2t$  vs. time per thyristor


Fig. 4 Gate trigger characteristics

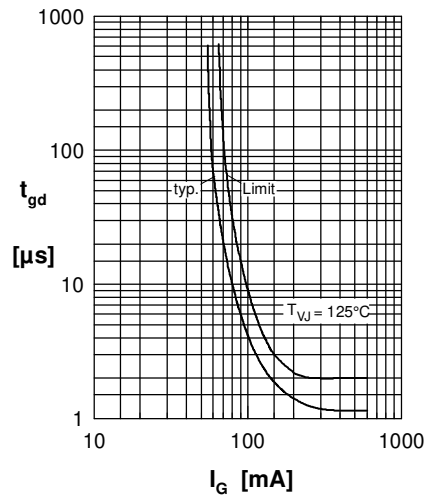


Fig. 5 Gate controlled delay time

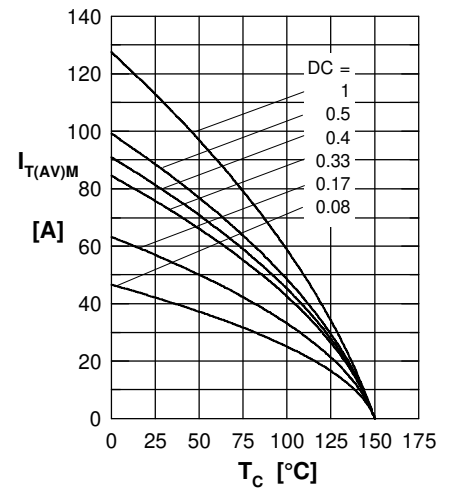


Fig. 5 Max. forward current vs. case temperature per thyristor

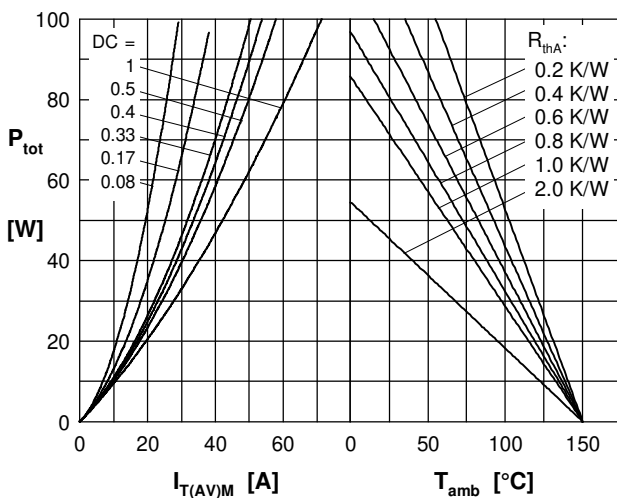


Fig. 4 Power dissipation vs. forward current and ambient temperature per thyristor

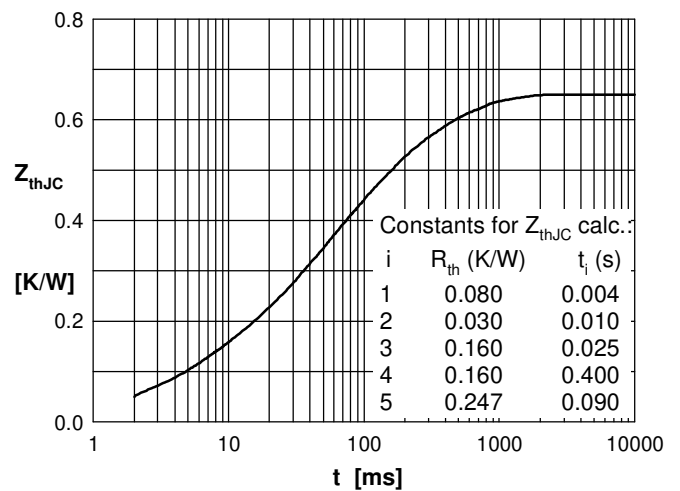


Fig. 6 Transient thermal impedance junction to case vs. time per thyristor

**Brake IGBT**

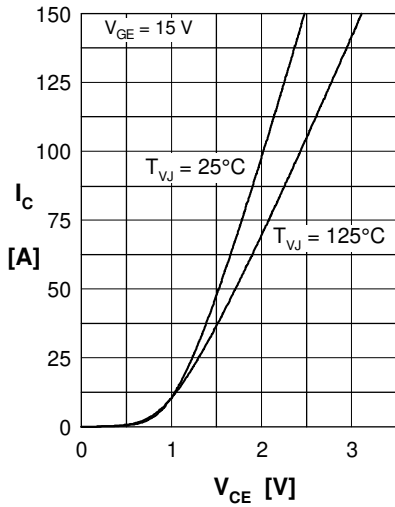


Fig. 1 Typ. output characteristics

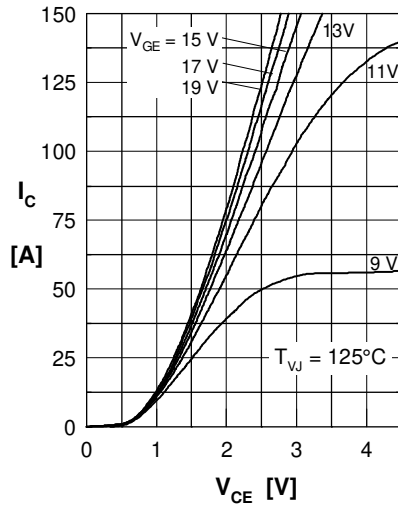


Fig. 2 Typ. output characteristics

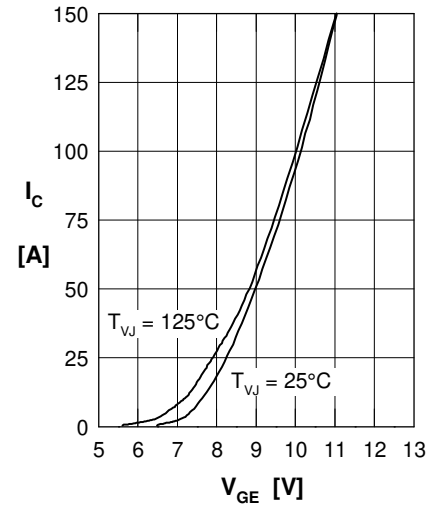


Fig. 3 Typ. transfer characteristics

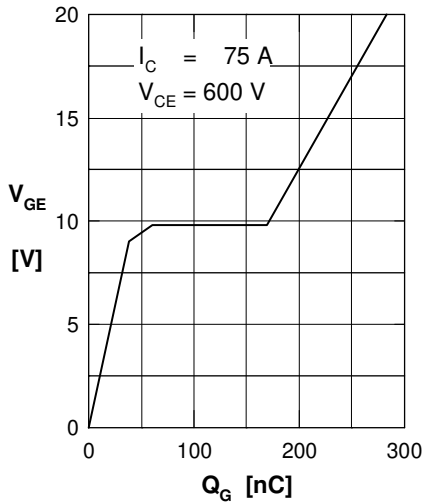


Fig. 4 Typ. turn-on gate charge

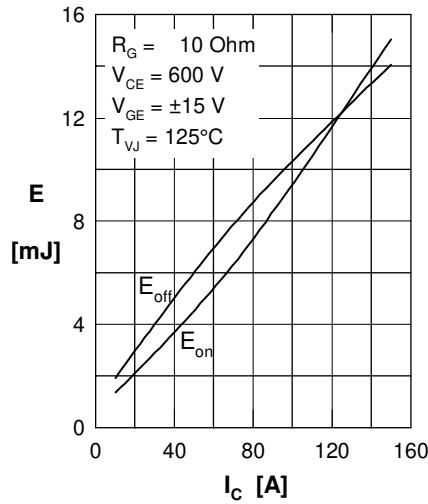


Fig. 5 Typ. switching energy versus collector current

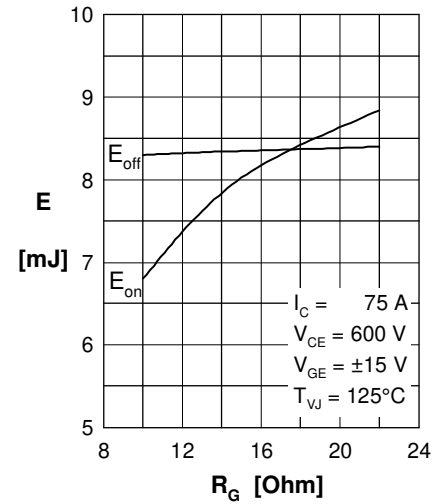


Fig. 6 Typ. switching energy versus gate resistance

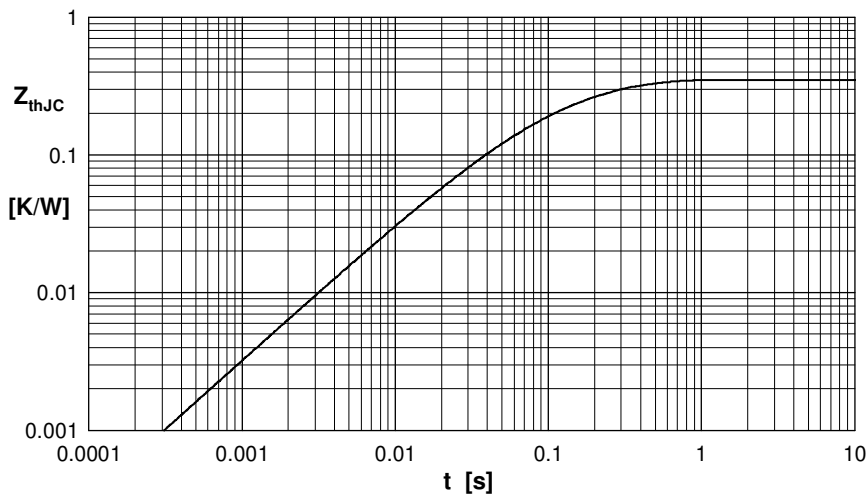


Fig. 7 Typ. transient thermal impedance junction to case

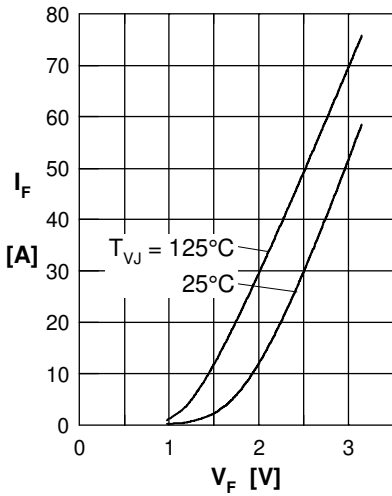
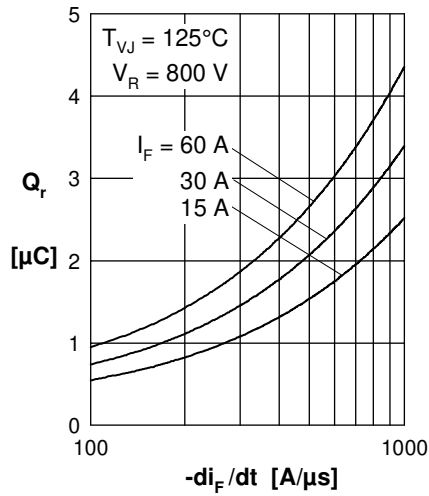
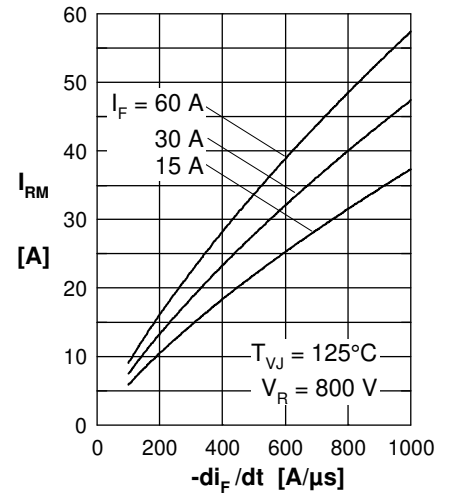
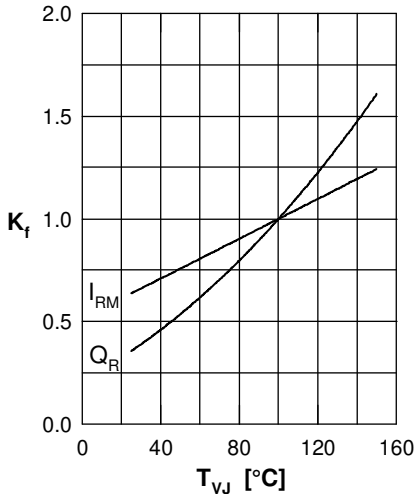
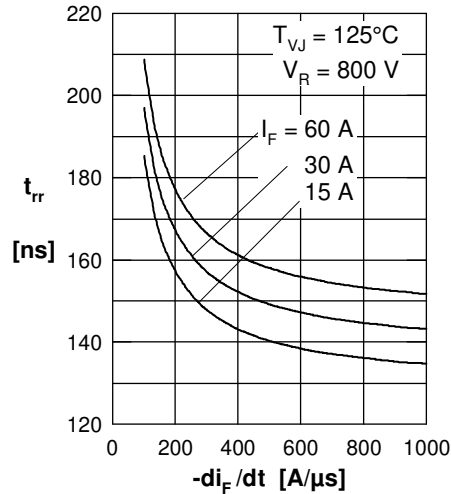
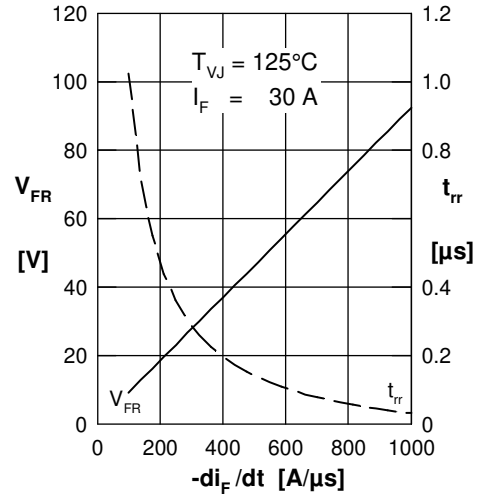
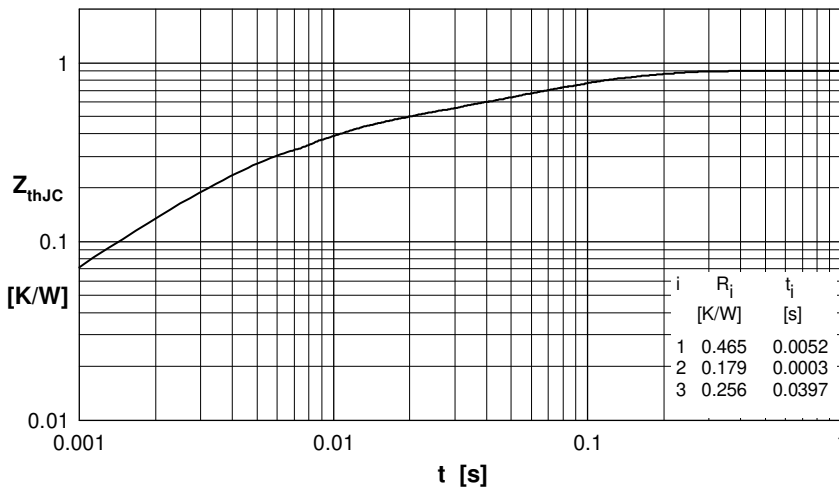
**Brake Diode**

 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