

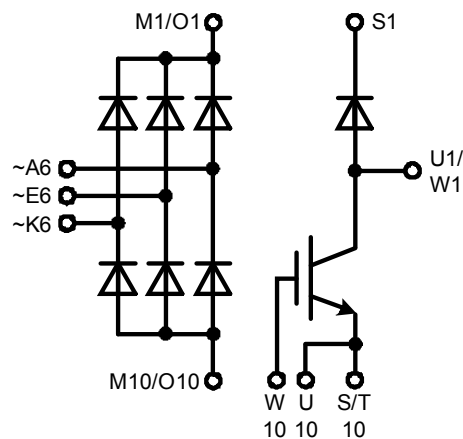
# Standard Rectifier Module

3~ Rectifier	Brake Chopper
$V_{RRM} = 1600\text{ V}$	$V_{CES} = 1200\text{ V}$
$I_{DAV} = 180\text{ A}$	$I_{C25} = 220\text{ A}$
$I_{FSM} = 1100\text{ A}$	$V_{CE(sat)} = 1.95\text{ V}$

## 3~ Rectifier Bridge + Brake Unit

Part number

**VUB160-16NOX**



Backside: isolated



### 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

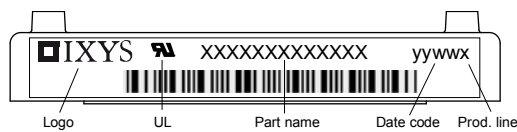
### Package: V2-Pack

- 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	
$V_{RSM}$	max. non-repetitive reverse blocking voltage	$T_{VJ} = 25^{\circ}\text{C}$			1700	V	
$V_{RRM}$	max. repetitive reverse blocking voltage	$T_{VJ} = 25^{\circ}\text{C}$			1600	V	
$I_R$	reverse current	$V_R = 1600\text{ V}$	$T_{VJ} = 25^{\circ}\text{C}$		100	$\mu\text{A}$	
		$V_R = 1600\text{ V}$	$T_{VJ} = 125^{\circ}\text{C}$		2	mA	
$V_F$	forward voltage drop	$I_F = 60\text{ A}$	$T_{VJ} = 25^{\circ}\text{C}$		1.16	V	
		$I_F = 180\text{ A}$			1.55	V	
		$I_F = 60\text{ A}$	$T_{VJ} = 125^{\circ}\text{C}$		1.09	V	
		$I_F = 180\text{ A}$			1.59	V	
$I_{DAV}$	bridge output current	$T_C = 90^{\circ}\text{C}$ rectangular $d = \frac{1}{3}$	$T_{VJ} = 150^{\circ}\text{C}$		180	A	
$V_{FO}$	threshold voltage	} for power loss calculation only	$T_{VJ} = 150^{\circ}\text{C}$		0.81	V	
$r_F$	slope resistance				4.4	m $\Omega$	
$R_{thJC}$	thermal resistance junction to case				0.6	K/W	
$R_{thCH}$	thermal resistance case to heatsink			0.2		K/W	
$P_{tot}$	total power dissipation		$T_C = 25^{\circ}\text{C}$		205	W	
$I_{FSM}$	max. forward surge current	$t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$	$T_{VJ} = 45^{\circ}\text{C}$		1.10	kA	
		$t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$	$V_R = 0\text{ V}$		1.19	kA	
		$t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$	$T_{VJ} = 150^{\circ}\text{C}$		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	$t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$	$T_{VJ} = 45^{\circ}\text{C}$		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	
		$t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$	$T_{VJ} = 150^{\circ}\text{C}$		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	$V_R = 400\text{ V}; f = 1\text{ MHz}$	$T_{VJ} = 25^{\circ}\text{C}$		37	pF	

Brake IGBT				Ratings			
Symbol	Definition	Conditions	min.	typ.	max.	Unit	
$V_{CES}$	collector emitter voltage				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				220	A	
$I_{C80}$					150	A	
$P_{tot}$	total power dissipation				695	W	
$V_{CE(sat)}$	collector emitter saturation voltage	$I_C = 100 \text{ A}; V_{GE} = 15 \text{ V}$			1.95	V	
					2.3	V	
$V_{GE(th)}$	gate emitter threshold voltage	$I_C = 6 \text{ mA}; V_{GE} = V_{CE}$	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	$V_{CE} = 600 \text{ V}; V_{GE} = 15 \text{ V}; I_C = 100 \text{ A}$		470		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			14		mJ	
$E_{off}$	turn-off energy per pulse			16		mJ	
<b>RBSOA</b>	reverse bias safe operating area	$V_{GE} = \pm 15 \text{ V}; R_G = 6.8 \Omega$					
$I_{CM}$		$V_{CEK} = 1200 \text{ V}$			450	A	
<b>SCSOA</b>	short circuit safe operating area						
$t_{SC}$	short circuit duration	$V_{CE} = 900 \text{ V}; V_{GE} = \pm 15 \text{ V}$			10	$\mu\text{s}$	
$I_{SC}$	short circuit current	$R_G = 6.8 \Omega; \text{non-repetitive}$		600		A	
$R_{thJC}$	thermal resistance junction to case				0.18	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	
				1.80		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



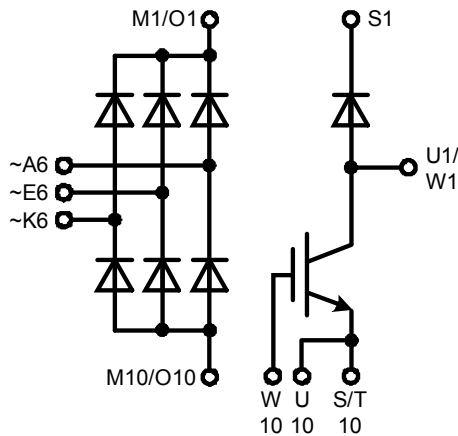
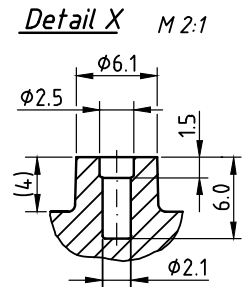
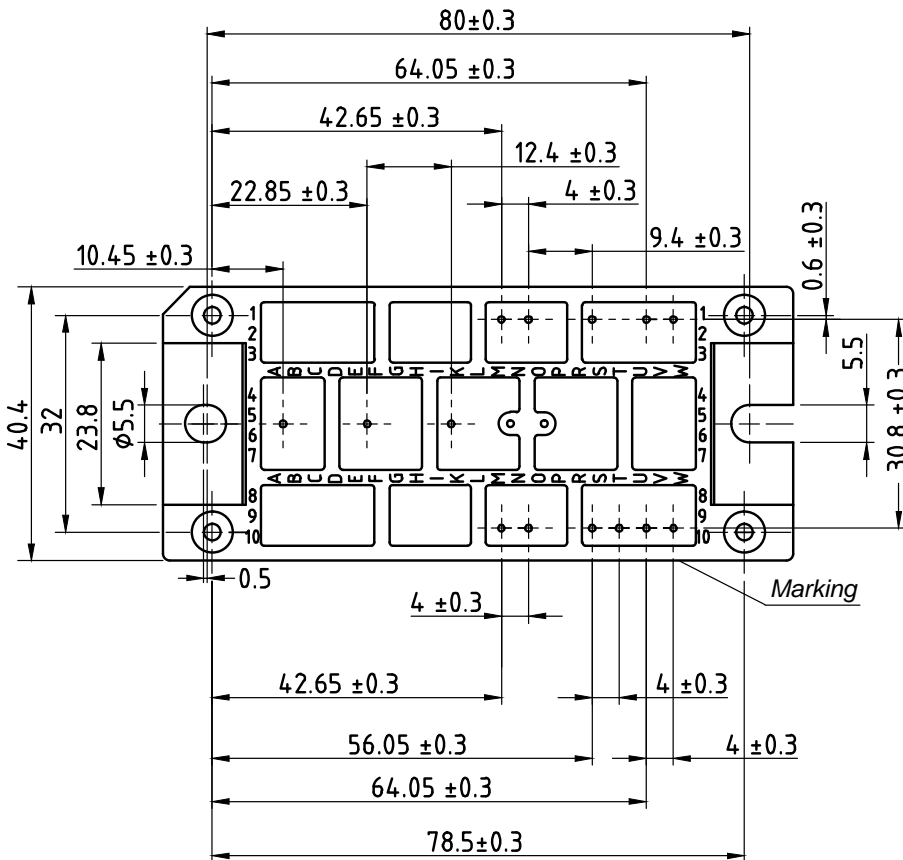
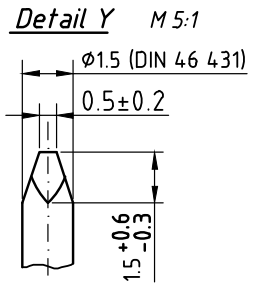
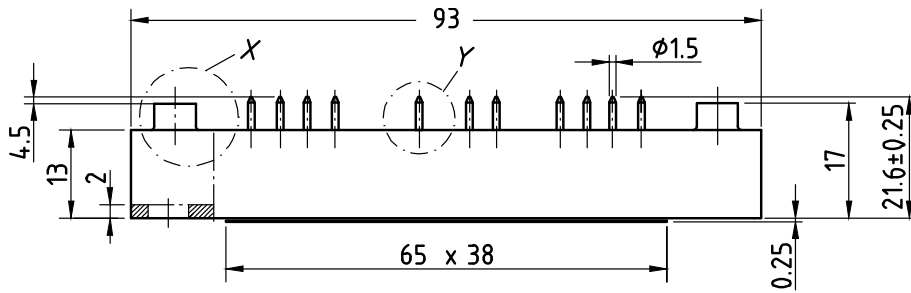
Ordering	Part Number	Marking on Product	Delivery Mode	Quantity	Code No.
Standard	VUB160-16NOX	VUB160-16NOX	Box	6	510141

Similar Part	Package	Voltage class
VUB160-16NOXT	V2-Pack	1600

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

		Rectifier	Brake IGBT	Brake Diode	
	$V_0$				
$V_{0\max}$	threshold voltage	0.81	1.1	1.31	V
$R_{0\max}$	slope resistance *	3.2	13.8	8	mΩ

**Outlines V2-Pack**



Rectifier

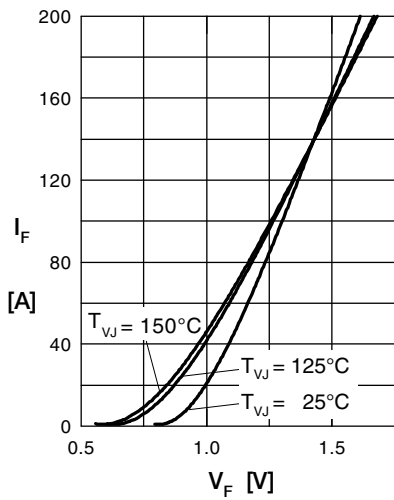


Fig. 1 Forward current vs. voltage drop per diode

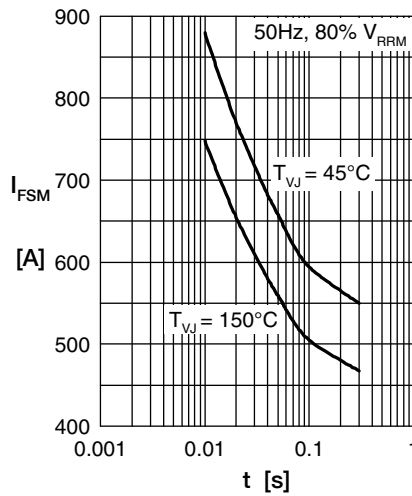


Fig. 2 Surge overload current vs. time per diode

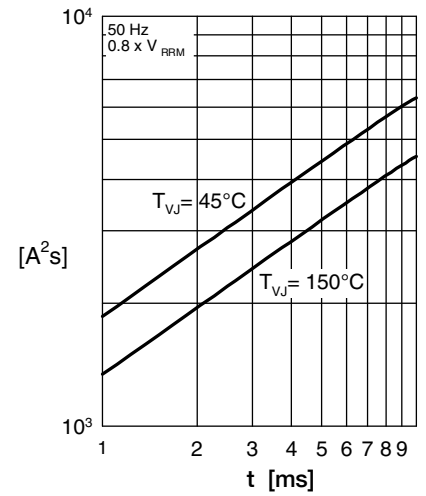


Fig. 3  $I^2t$  vs. time per diode

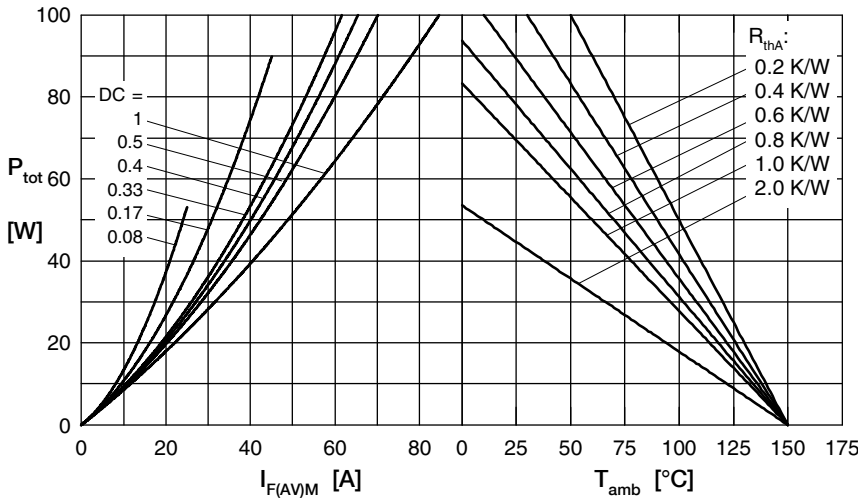


Fig. 4 Power dissipation vs. forward current and ambient temperature per diode

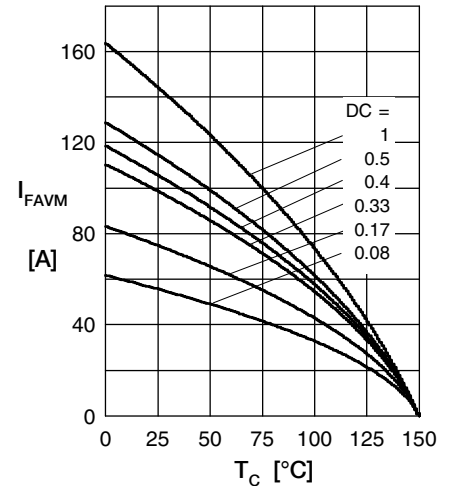


Fig. 5 Max. forward current vs. case temperature per diode

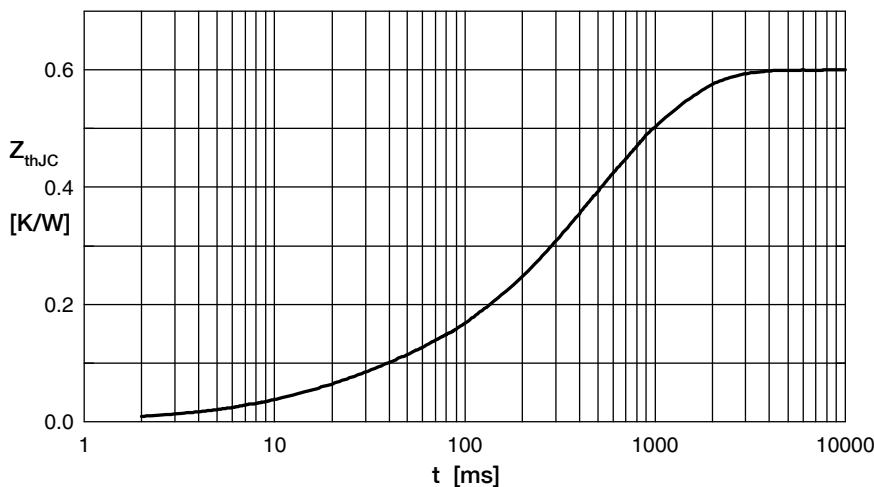


Fig. 6 Transient thermal impedance junction to case vs. time per diode

$R_i$	$t_i$
0.060	0.020
0.003	0.010
0.150	0.225
0.243	0.800
0.144	0.580

**Brake IGBT**

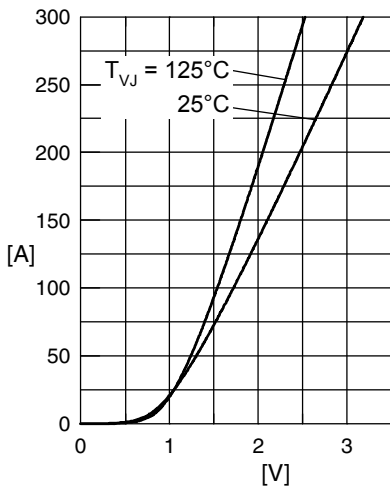


Fig. 1 Typ. output characteristics

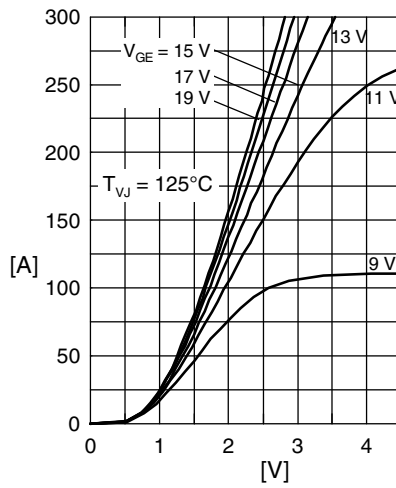


Fig. 2 Typ. output characteristics

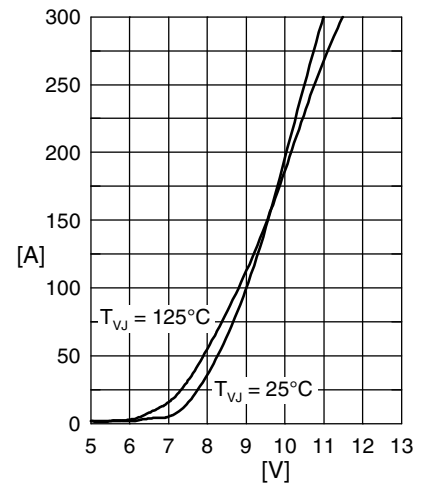


Fig. 3 Typ. transfer characteristics

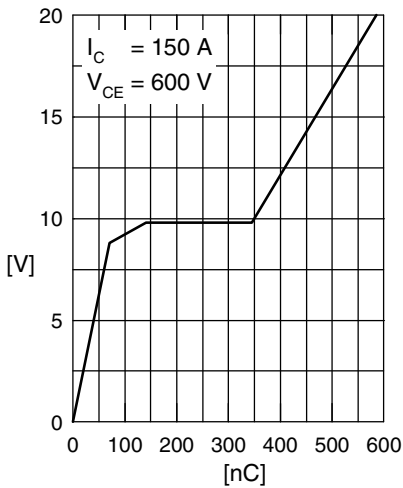


Fig. 4 Dynamic parameters  $Q_r$ ,  $I_{RM}$  versus  $T_{VJ}$

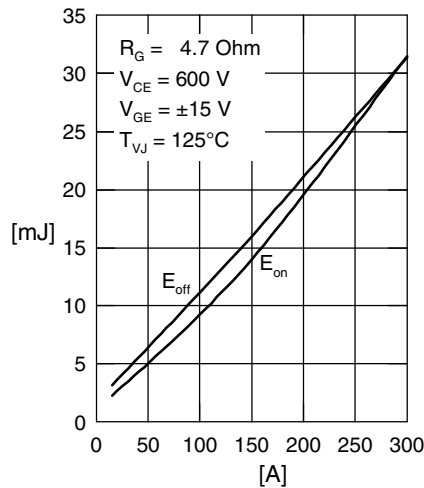


Fig. 5 Typ. recovery time  $t_{tr}$  vs.  $-di_F/dt$

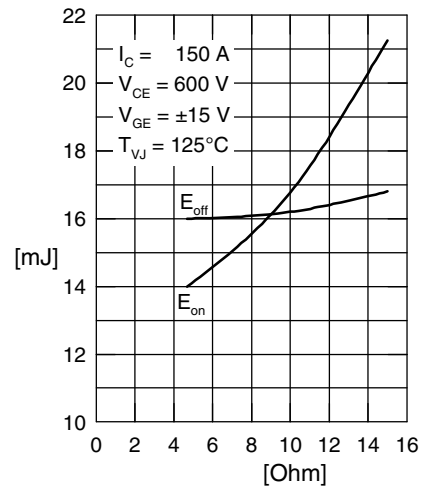


Fig. 6 Typ. peak forward voltage  $V_{FR}$  and  $t_{fr}$  versus  $di_F/dt$

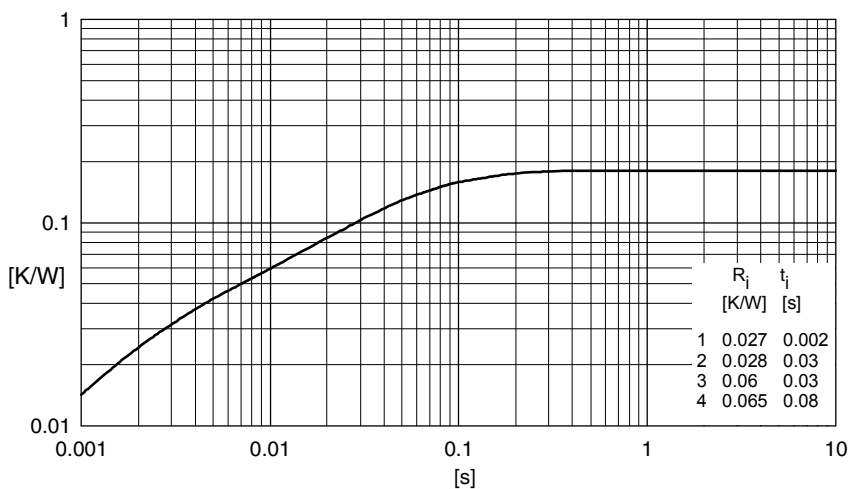


Fig. 7 Transient thermal impedance junction to case

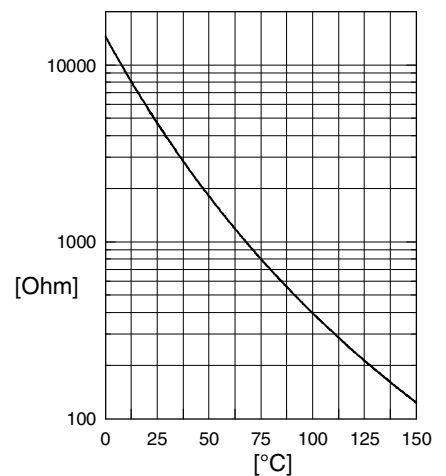


Fig. 8 Typ. thermistor resistance versus temperature

**Brake Diode**

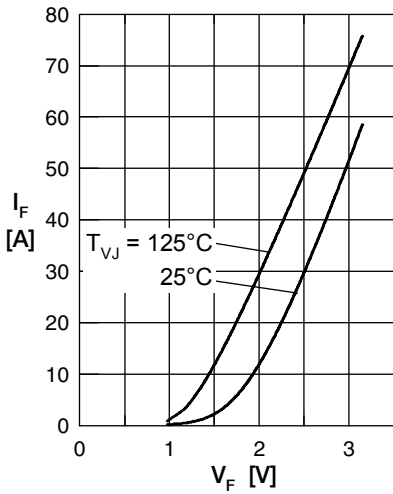


Fig. 1 Forward current  $I_F$  vs.  $V_F$

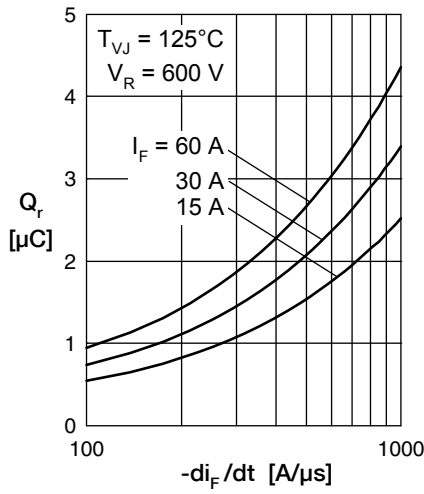


Fig. 2 Typ. reverse recovery charge  $Q_r$  versus  $-di_F/dt$

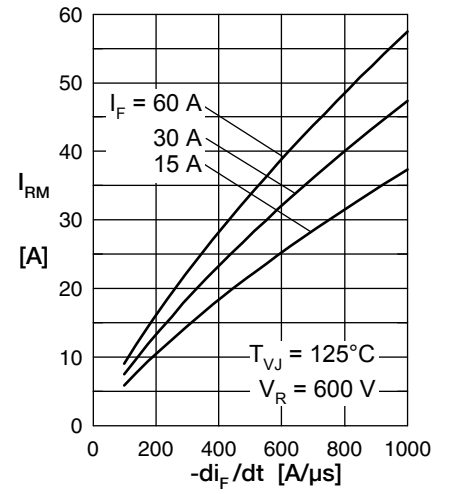


Fig. 3 Typ. peak reverse current  $I_{RM}$  versus  $-di_F/dt$

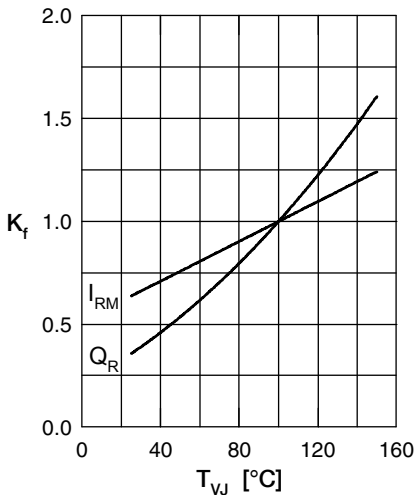


Fig. 4 Dynamic parameters  $Q_r$ ,  $I_{RM}$  versus  $T_{VJ}$

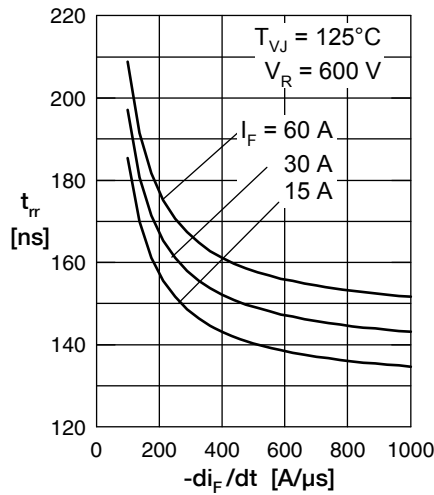


Fig. 5 Typ. recovery time  $t_{rr}$  vs.  $-di_F/dt$

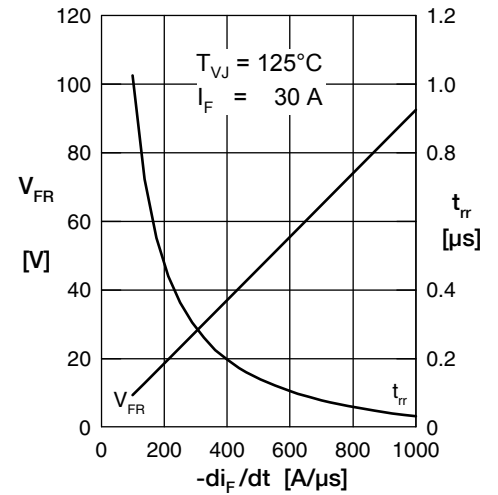


Fig. 6 Typ. peak forward voltage  $V_{FR}$  and  $t_{rr}$  versus  $di_F/dt$

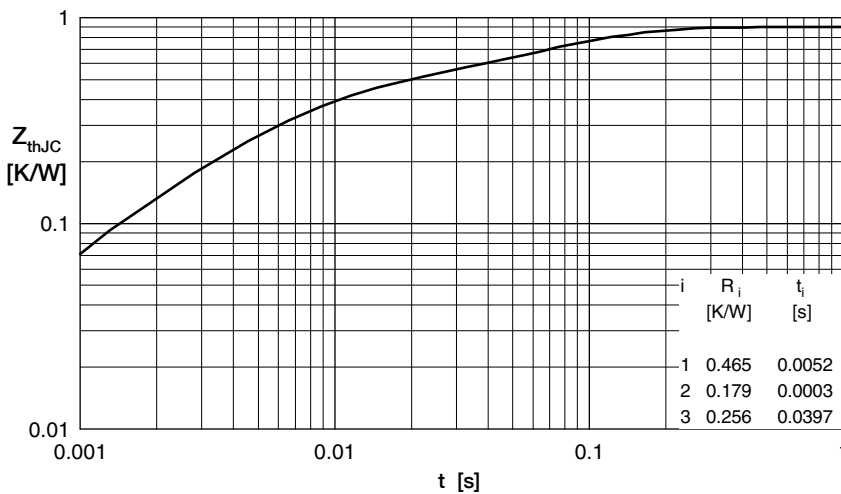


Fig. 7 Transient thermal impedance junction to case