

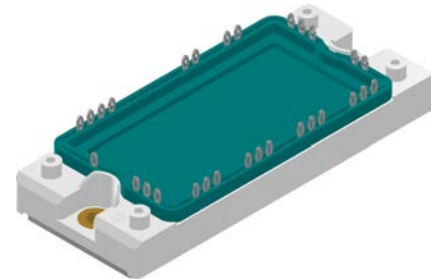
# Standard Rectifier Module

3~ Rectifier	Brake Chopper
$V_{RRM} = 1600\text{ V}$	$V_{CES} = 1200\text{ V}$
$I_{DAV} = 280\text{ A}$	$I_{C25} = 180\text{ A}$
$I_{FSM} = 1500\text{ A}$	$V_{CE(sat)} = 1,7\text{ V}$

## 3~ Rectifier Bridge + Brake Unit + NTC

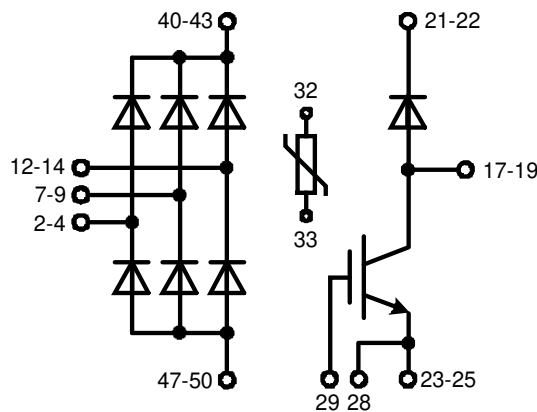
Part number

**MDMA280UB1600PTED**



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  $\mu\text{sec}$ .
  - 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: 4300 V~
- Industry standard outline
- RoHS compliant
- PressFit-Pins for PCB mounting
- Height: 17 mm
- Base plate: Copper internally DCB isolated
- Advanced power cycling
- Phase Change Material available

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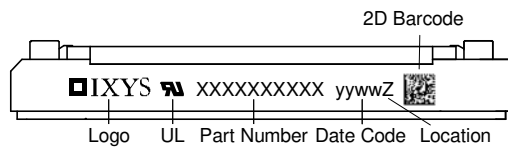
Rectifier				Ratings			
Symbol	Definition	Conditions		min.	typ.	max.	Unit
$V_{RSM}$	max. non-repetitive reverse blocking voltage					1700	V
$V_{RRM}$	max. repetitive reverse blocking voltage					1600	V
$I_R$	reverse current	$V_R = 1600$ V		$T_{VJ} = 25^\circ\text{C}$		100	$\mu\text{A}$
		$V_R = 1600$ V		$T_{VJ} = 150^\circ\text{C}$		2	mA
$V_F$	forward voltage drop	$I_F = 90$ A		$T_{VJ} = 25^\circ\text{C}$		1,23	V
		$I_F = 270$ A				1,75	V
		$I_F = 90$ A		$T_{VJ} = 125^\circ\text{C}$		1,18	V
		$I_F = 270$ A				1,87	V
$I_{DAV}$	bridge output current	$T_C = 85^\circ\text{C}$		$T_{VJ} = 150^\circ\text{C}$		280	A
		rectangular	$d = \frac{1}{3}$				
$V_{FO}$	threshold voltage			$T_{VJ} = 150^\circ\text{C}$		0,80	V
$r_F$	slope resistance					4,1	m $\Omega$
						} for power loss calculation only	
$R_{thJC}$	thermal resistance junction to case					0,35	K/W
$R_{thCH}$	thermal resistance case to heatsink				0,1		K/W
$P_{tot}$	total power dissipation			$T_C = 25^\circ\text{C}$		355	W
$I_{FSM}$	max. forward surge current	$t = 10$ ms; (50 Hz), sine		$T_{VJ} = 45^\circ\text{C}$		1,50	kA
		$t = 8,3$ ms; (60 Hz), sine		$V_R = 0$ V		1,62	kA
		$t = 10$ ms; (50 Hz), sine		$T_{VJ} = 150^\circ\text{C}$		1,28	kA
		$t = 8,3$ ms; (60 Hz), sine		$V_R = 0$ V		1,38	kA
$I^2t$	value for fusing	$t = 10$ ms; (50 Hz), sine		$T_{VJ} = 45^\circ\text{C}$		11,3	kA <sup>2</sup> s
		$t = 8,3$ ms; (60 Hz), sine		$V_R = 0$ V		10,9	kA <sup>2</sup> s
		$t = 10$ ms; (50 Hz), sine		$T_{VJ} = 150^\circ\text{C}$		8,13	kA <sup>2</sup> s
		$t = 8,3$ ms; (60 Hz), sine		$V_R = 0$ V		7,87	kA <sup>2</sup> s
$C_J$	junction capacitance	$V_R = 400$ V; $f = 1$ MHz		$T_{VJ} = 25^\circ\text{C}$		53	pF

Brake IGBT + Diode				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	
$I_{C100}$		$T_C = 100^{\circ}C$			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	$V_{GE} = \pm 15\text{ V}; R_G = 6,8\ \Omega$					
$I_{CM}$		$V_{CEK} = 1200\text{ V}; \text{note } ^1)$			300	A	
<b>SCSOA</b>	short circuit safe operating area	$V_{CEK} = 1200\text{ V}$					
$t_{SC}$	short circuit duration	$V_{CE} = 720\text{ V}; V_{GE} = \pm 15$			10	$\mu s$	
$I_{SC}$	short circuit current	$R_G = 6,8\ \Omega; \text{non-repetitive}$		450		A	
$R_{thJC}$	thermal resistance junction to case				0,25	K/W	
$R_{thCH}$	thermal resistance case to heatsink				0,10	K/W	
<b>Brake Diode</b>							
$V_{RRM}$	max. repetitive reverse voltage				1200	V	
$I_{F25}$	forward current				88	A	
$I_{F100}$					59	A	
$V_F$	forward voltage	$I_F = 60\text{ A}$			2,20	V	
					1,95	V	
$I_R$	reverse current	$V_R = V_{RRM}$			0,1	mA	
					1,2	mA	
$Q_{rr}$	reverse recovery charge	$V_R = 600\text{ V}$ $-di_F/dt = 1200\text{ A}/\mu s$ $I_F = 60\text{ A}; V_{GE} = 0\text{ V}$	$T_{VJ} = 125^{\circ}C$		8	$\mu C$	
$I_{RM}$	max. reverse recovery current				60	A	
$t_{rr}$	reverse recovery time				350	ns	
$E_{rec}$	reverse recovery energy				2,5	mJ	
$R_{thJC}$	thermal resistance junction to case				0,6	K/W	
$R_{thCH}$	thermal resistance case to heatsink				0,1	K/W	

<sup>1)</sup> RBSOA line test conditions for dynamic testing prior to static testing:

470A @ 820V and  $T_C = 150^{\circ}C$  with gate drive +16.5V / -15V,  $R_{G(on)} = 6.8\ \Omega$  and  $R_{G(off)} = 43\ \Omega$ .

Package E2-Pack		Ratings				
Symbol	Definition	Conditions	min.	typ.	max.	Unit
$I_{RMS}$	RMS current	per terminal			30	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 t = 1 minute	4300			V
		50/60 Hz, RMS; $I_{ISOL} \leq 1$ mA	3600			V



### Part description

M = Module  
 D = Diode  
 M = Standard Rectifier  
 A = (up to 1800V)  
 280 = Current Rating [A]  
 UB = 3- Rectifier Bridge + Brake Unit  
 1600 = Reverse Voltage [V]  
 PT = PressFit-Pin, Thermistor  
 ED = E2-Pack  
 - = Hyphen  
 PC = Phase Change Material

Ordering	Ordering Number	Marking on Product	Delivery Mode	Quantity	Code No.
Standard	MDMA280UB1600PTED	MDMA280UB1600PTED	Blister	28	516613
Alternative	MDMA280UB1600PTED-PC	MDMA280UB1600PTED	Blister	28	515416

### Temperature Sensor NTC

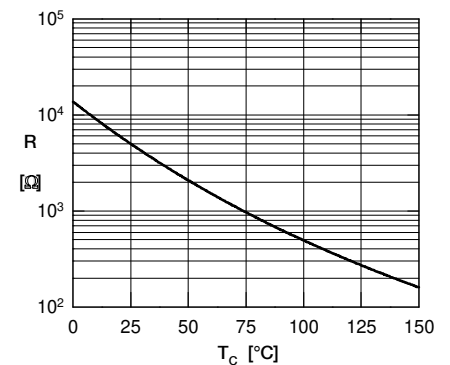
Symbol	Definition	Conditions	min.	typ.	max.	Unit
$R_{25}$	resistance	$T_{VJ} = 25^\circ$	4,85	5	5,15	k $\Omega$
$B_{25/50}$	temperature coefficient			3375		K

### Equivalent Circuits for Simulation

\* on die level

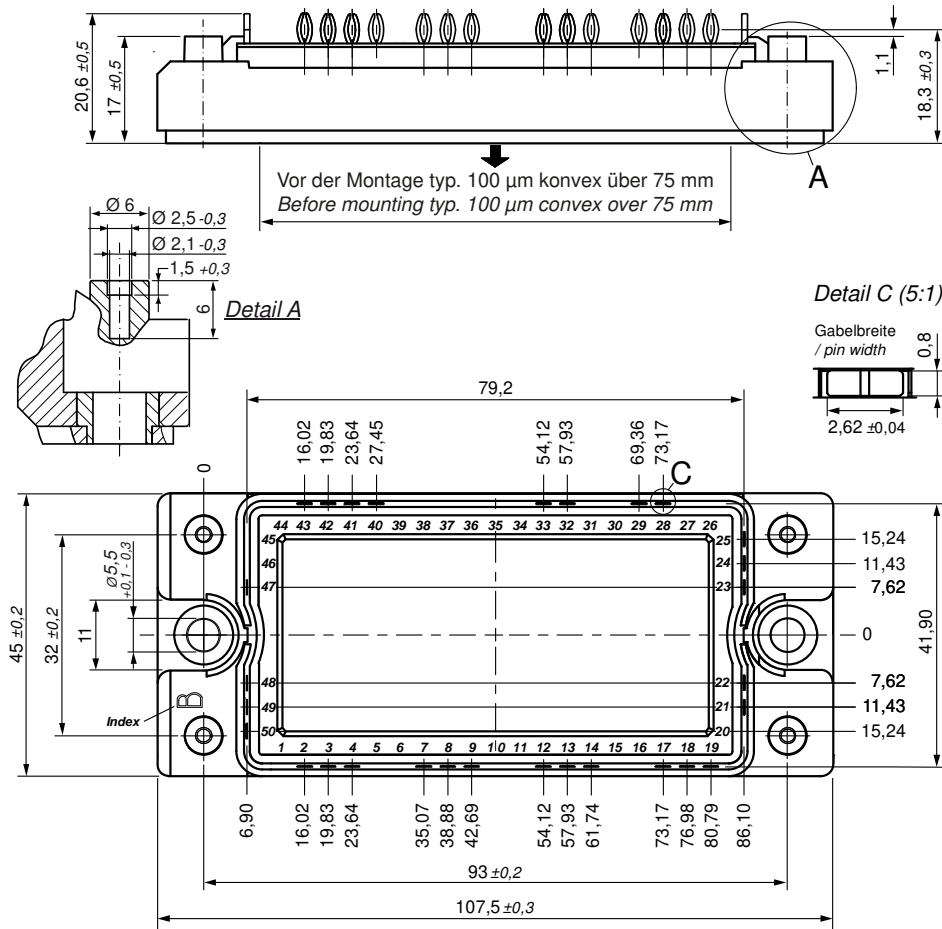
$T_{VJ} = 150^\circ\text{C}$

	Rectifier	Brake Diode	
$V_0$	threshold voltage	1,22	V
$R_0$	slope resistance *	13	m $\Omega$





**Outlines E2-Pack**

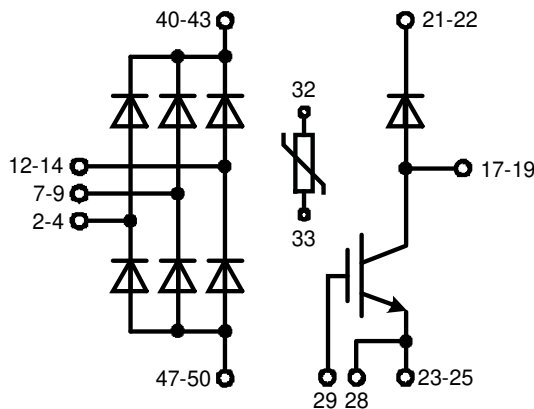


**Bemerkung / Note:**

- Nicht tolerierte 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:  $\oplus 0.1$
- Bohrlochdurchmesser / Diameter of drill:  $\varnothing 2.35$  mm
- Endlochdurchmesser / Diameter of plated holes:  $\varnothing 2.14 - 2.29$  mm (Cu thickness in via typ.  $50 \mu\text{m}$ )
- Beschichtung / Plating: **chem. Sn max.  $15 \mu\text{m}$**
- Einpresskraft / Insert Force: per terminal with a typ. insert speed of  $7$  mm/s: **typ. 90 N**
- Weitere Angaben / Further information: [www.ixys.com](http://www.ixys.com) **Application note IXAN0077**
- Montageanleitung / Mounting instruction: [www.ixys.com](http://www.ixys.com) **Application note IXAN0024**

**Detail A:** PCB-Montage / Mounting on PCB-

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



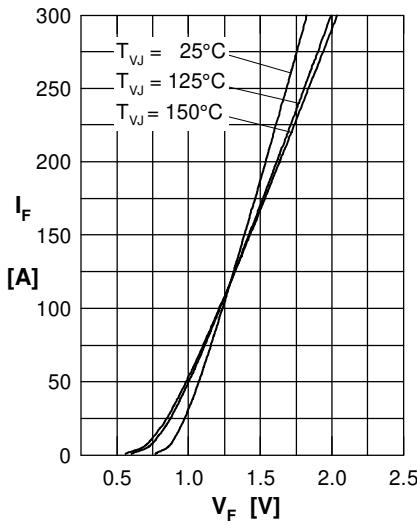
**Rectifier**


Fig. 1 Forward current versus voltage drop per diode

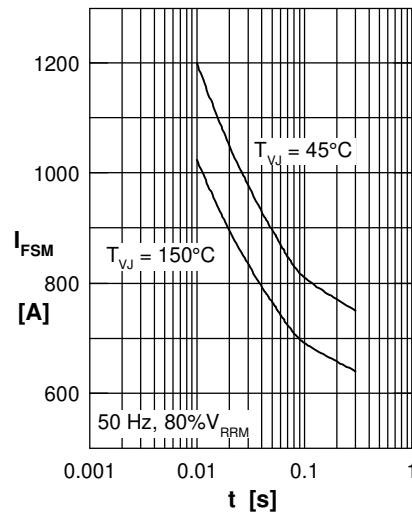


Fig. 2 Surge overload current vs. time per diode

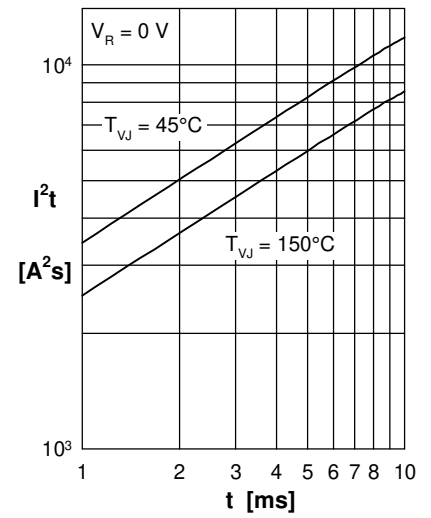
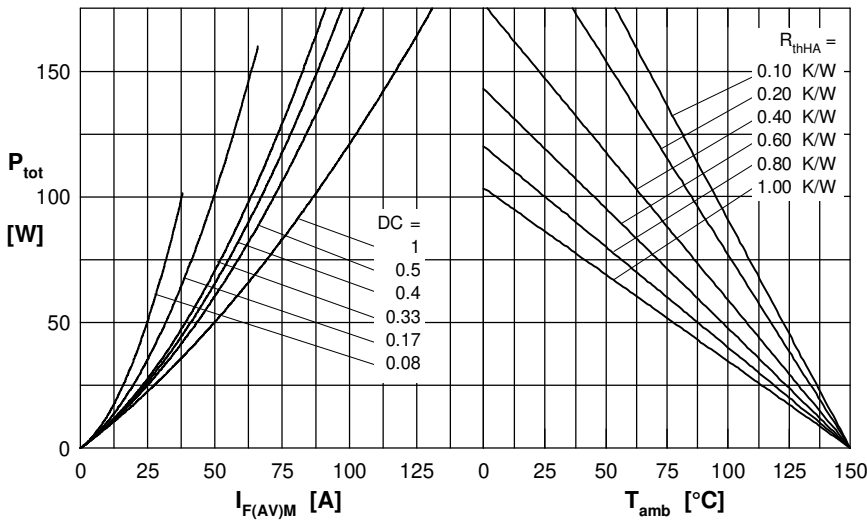

 Fig. 3  $I^2t$  versus time per diode


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

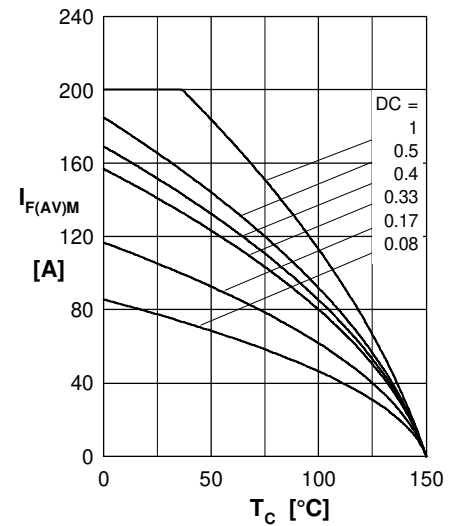


Fig. 5 Max. forward current vs. case temperature per diode

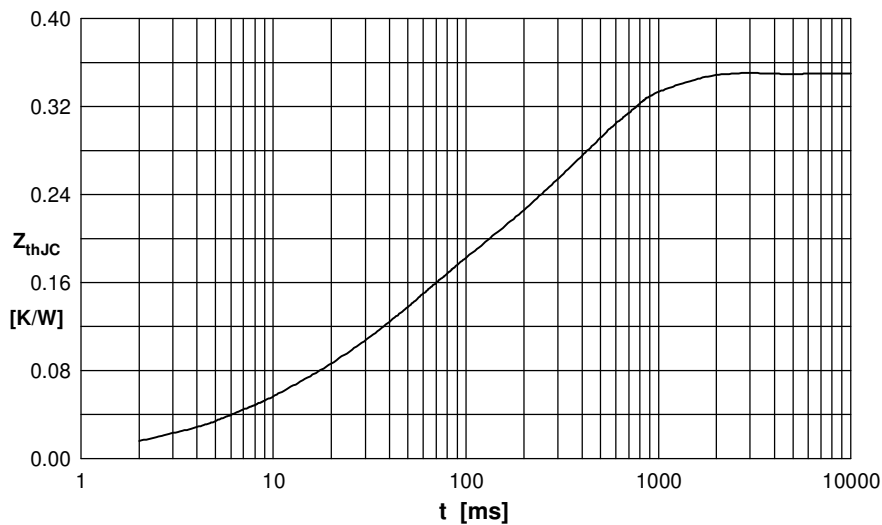


Fig. 6 Transient thermal impedance junction to case vs. time per diode

 Constants for  $Z_{thJC}$  calculation:

i	$R_{thi}$ (K/W)	$t_i$ (s)
1	0.030	0.006
2	0.003	0.007
3	0.114	0.040
4	0.203	0.400

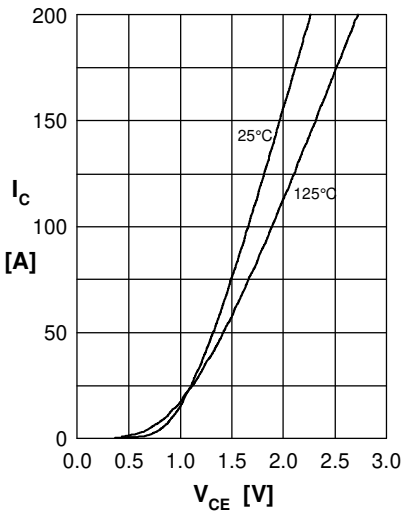
**Brake IGBT + Diode**


Fig.1 Output characteristics IGBT

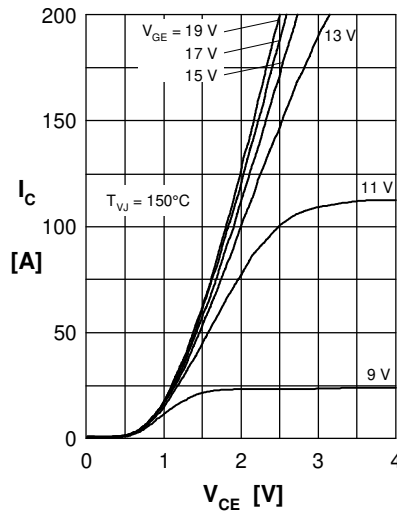


Fig.2 Typ. output characteristics IGBT

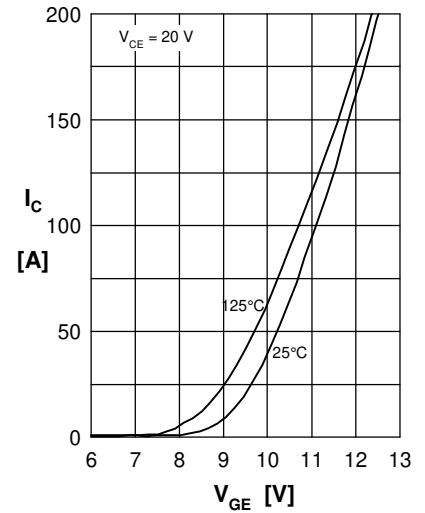


Fig.3 Typ. transfer charact. IGBT

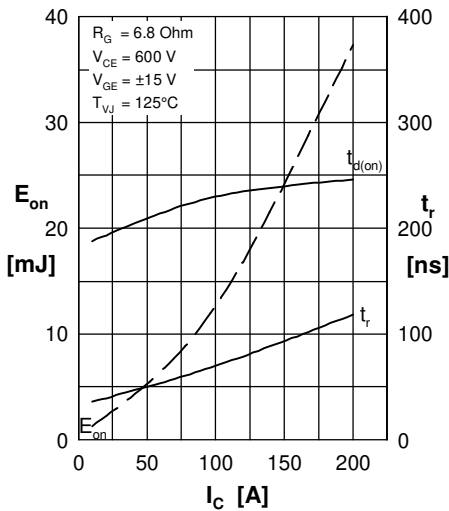


Fig.4 Typ. turn-on energy &amp; switch. times vs. collector current

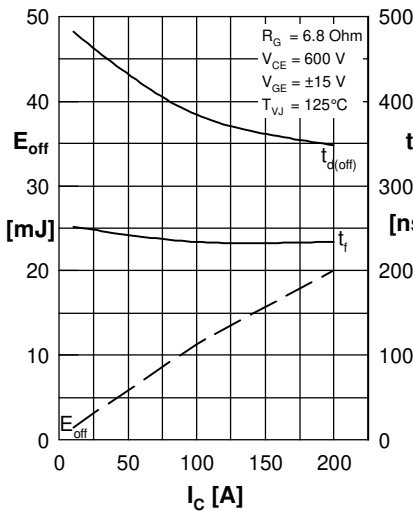


Fig.5 Typ. turn-off energy &amp; switch. times vs. collector current

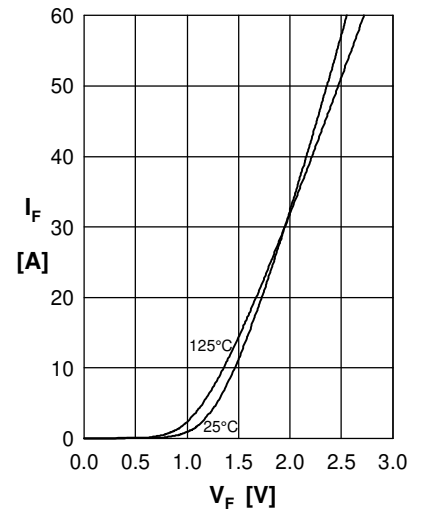
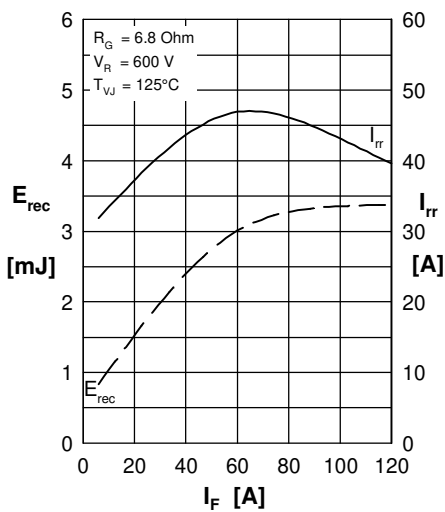

 Fig.6 Typ. forward current versus  $V_F$ 


Fig.7 Typ. reverse recovery characteristics Diode

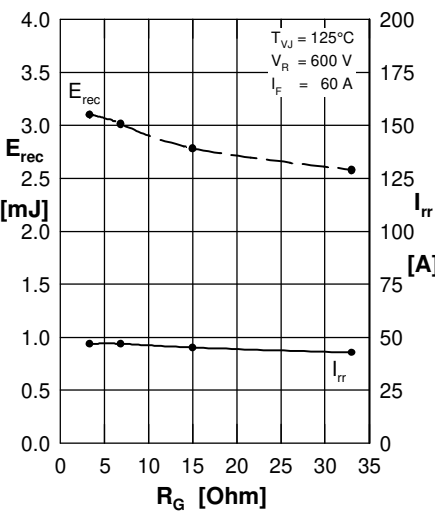


Fig.8 Typ. reverse recovery characteristics Diode

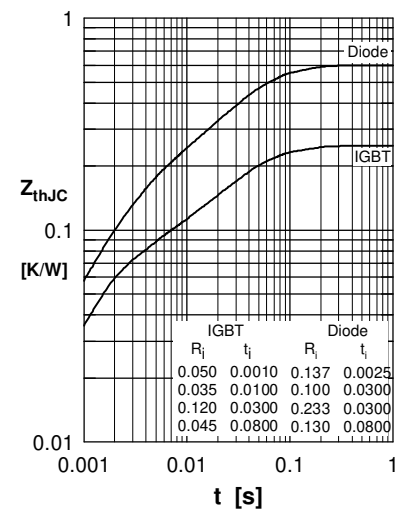


Fig.9 Transient thermal resistance junction to case