

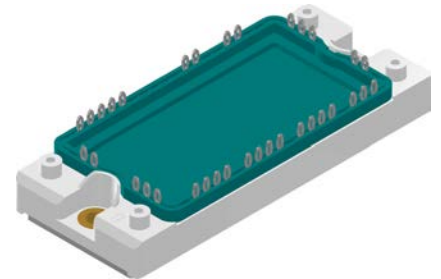
# Standard Rectifier Module

3~ Rectifier	Brake Chopper
$V_{RRM} = 1600 \text{ V}$	$V_{CES} = 1200 \text{ V}$
$I_{DAV} = 450 \text{ A}$	$I_{C25} = 250 \text{ A}$
$I_{FSM} = 2400 \text{ A}$	$V_{CE(sat)} = 1,7 \text{ V}$

## 3~ Rectifier Bridge + Brake Unit + NTC

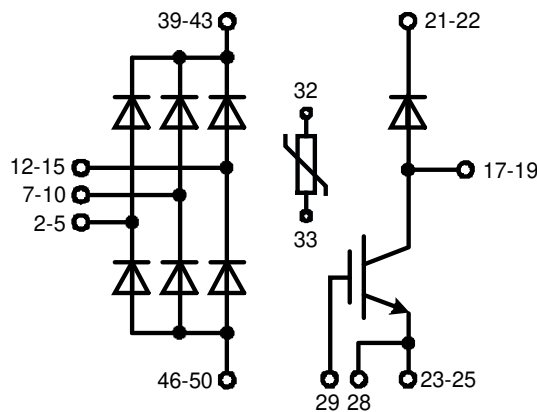
Part number

**MDMA450UB1600PTED**



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 Features:

- very low  $E_{off}$
- reduced  $V_{ce(sat)}$
- $T_{jmax} = 175^{\circ}\text{C}$
- reduced  $R_{th}$
- very low gate charge
- easy paralleling
- square RBSOA @ 3x  $I_{nom}$

### 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

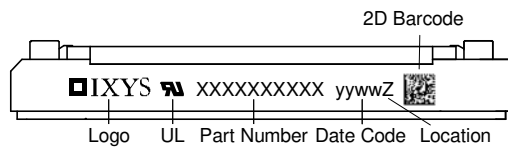
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Rectifier				Ratings			
Symbol	Definition	Conditions		min.	typ.	max.	Unit
$V_{RSM}$	max. non-repetitive reverse blocking voltage					1700	V
$V_{RRM}$	max. repetitive reverse blocking voltage					1600	V
$I_R$	reverse current	$V_R = 1600$ V		$T_{VJ} = 25^\circ\text{C}$		100	$\mu\text{A}$
		$V_R = 1600$ V		$T_{VJ} = 150^\circ\text{C}$		3	mA
$V_F$	forward voltage drop	$I_F = 150$ A		$T_{VJ} = 25^\circ\text{C}$		1,26	V
		$I_F = 450$ A				1,81	V
		$I_F = 150$ A		$T_{VJ} = 125^\circ\text{C}$		1,23	V
		$I_F = 450$ A				1,99	V
$I_{DAV}$	bridge output current	$T_C = 85^\circ\text{C}$		$T_{VJ} = 150^\circ\text{C}$		450	A
		rectangular	$d = \frac{1}{3}$				
$V_{FO}$	threshold voltage			$T_{VJ} = 150^\circ\text{C}$		0,82	V
$r_F$	slope resistance					2,7	m $\Omega$
						} for power loss calculation only	
$R_{thJC}$	thermal resistance junction to case					0,2	K/W
$R_{thCH}$	thermal resistance case to heatsink				0,1		K/W
$P_{tot}$	total power dissipation			$T_C = 25^\circ\text{C}$		625	W
$I_{FSM}$	max. forward surge current	$t = 10$ ms; (50 Hz), sine		$T_{VJ} = 45^\circ\text{C}$		2,40	kA
		$t = 8,3$ ms; (60 Hz), sine		$V_R = 0$ V		2,59	kA
		$t = 10$ ms; (50 Hz), sine		$T_{VJ} = 150^\circ\text{C}$		2,04	kA
		$t = 8,3$ ms; (60 Hz), sine		$V_R = 0$ V		2,21	kA
$I^2t$	value for fusing	$t = 10$ ms; (50 Hz), sine		$T_{VJ} = 45^\circ\text{C}$		28,8	kA <sup>2</sup> s
		$t = 8,3$ ms; (60 Hz), sine		$V_R = 0$ V		27,9	kA <sup>2</sup> s
		$t = 10$ ms; (50 Hz), sine		$T_{VJ} = 150^\circ\text{C}$		20,8	kA <sup>2</sup> s
		$t = 8,3$ ms; (60 Hz), sine		$V_R = 0$ V		20,2	kA <sup>2</sup> s
$C_J$	junction capacitance	$V_R = 400$ V; $f = 1$ MHz		$T_{VJ} = 25^\circ\text{C}$		91	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	$T_C = 25^{\circ}C$			250	A	
$I_{C80}$		$T_C = 80^{\circ}C$			175	A	
$P_{tot}$	total power dissipation	$T_C = 25^{\circ}C$			780	W	
$V_{CE(sat)}$	collector emitter saturation voltage	$I_C = 150\text{ A}; V_{GE} = 15\text{ V}$			1,7	V	
					1,9	V	
$V_{GE(th)}$	gate emitter threshold voltage	$I_C = 6\text{ mA}; V_{GE} = V_{CE}$	6	6,8	7,5	V	
$I_{CES}$	collector emitter leakage current	$V_{CE} = V_{CES}; V_{GE} = 0\text{ V}$			0,1	mA	
				1		mA	
$I_{GES}$	gate emitter leakage current	$V_{GE} = \pm 20\text{ V}$			500	nA	
$Q_{G(on)}$	total gate charge	$V_{CE} = 600\text{ V}; V_{GE} = 15\text{ V}; I_C = 150\text{ A}$		510		nC	
$t_{d(on)}$	turn-on delay time	inductive load $V_{CE} = 600\text{ V}; I_C = 150\text{ A}$ $V_{GE} = \pm 15\text{ V}; R_G = 4,7\ \Omega$	$T_{VJ} = 125^{\circ}C$	280		ns	
$t_r$	current rise time			80		ns	
$t_{d(off)}$	turn-off delay time			440		ns	
$t_f$	current fall time			230		ns	
$E_{on}$	turn-on energy per pulse			26		mJ	
$E_{off}$	turn-off energy per pulse			15		mJ	
<b>RBSOA</b>	reverse bias safe operating area	$V_{GE} = \pm 15\text{ V}; R_G = 4,7\ \Omega$					
$I_{CM}$		$V_{CEK} = 1200\text{ V}$			450	A	
<b>SCSOA</b>	short circuit safe operating area	$V_{CEK} = 1200\text{ V}$					
$t_{SC}$	short circuit duration	$V_{CE} = 900\text{ V}; V_{GE} = \pm 15$	$T_{VJ} = 125^{\circ}C$		10	$\mu s$	
$I_{SC}$	short circuit current	$R_G = 4,7\ \Omega$ ; non-repetitive		600		A	
$R_{thJC}$	thermal resistance junction to case				0,16	K/W	
$R_{thCH}$	thermal resistance case to heatsink				0,10	K/W	
<b>Brake Diode</b>							
$V_{RRM}$	max. repetitive reverse voltage		$T_{VJ} = 25^{\circ}C$		1200	V	
$I_{F25}$	forward current		$T_C = 25^{\circ}C$		135	A	
$I_{F80}$			$T_C = 80^{\circ}C$		90	A	
$V_F$	forward voltage	$I_F = 100\text{ A}$	$T_{VJ} = 25^{\circ}C$		2,20	V	
			$T_{VJ} = 125^{\circ}C$	1,95		V	
$I_R$	reverse current	$V_R = V_{RRM}$	$T_{VJ} = 25^{\circ}C$		0,1	mA	
			$T_{VJ} = 125^{\circ}C$		1,2	mA	
$Q_{rr}$	reverse recovery charge	$V_R = 600\text{ V}$ $-di_F/dt = 1600\text{ A}/\mu s$ $I_F = 100\text{ A}; V_{GE} = 0\text{ V}$	$T_{VJ} = 125^{\circ}C$	12,5		$\mu C$	
$I_{RM}$	max. reverse recovery current			100		A	
$t_{rr}$	reverse recovery time			350		ns	
$E_{rec}$	reverse recovery energy			4		mJ	
$R_{thJC}$	thermal resistance junction to case				0,4	K/W	
$R_{thCH}$	thermal resistance case to heatsink				0,1	K/W	

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)  
 450 = 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	MDMA450UB1600PTED	MDMA450UB1600PTED	Blister	28	517598
Alternative	MDMA450UB1600PTED-PC	MDMA450UB1600PTED	Blister	28	517605

### Temperature Sensor NTC

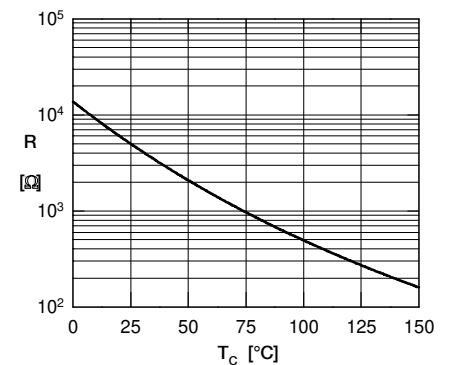
Symbol	Definition	Conditions	min.	typ.	max.	Unit
$R_{25}$	resistance	$T_{VJ} = 25^\circ$	4,85	5	5,15	k $\Omega$
$B_{25/50}$	temperature coefficient			3375		K

### Equivalent Circuits for Simulation

\* on die level

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

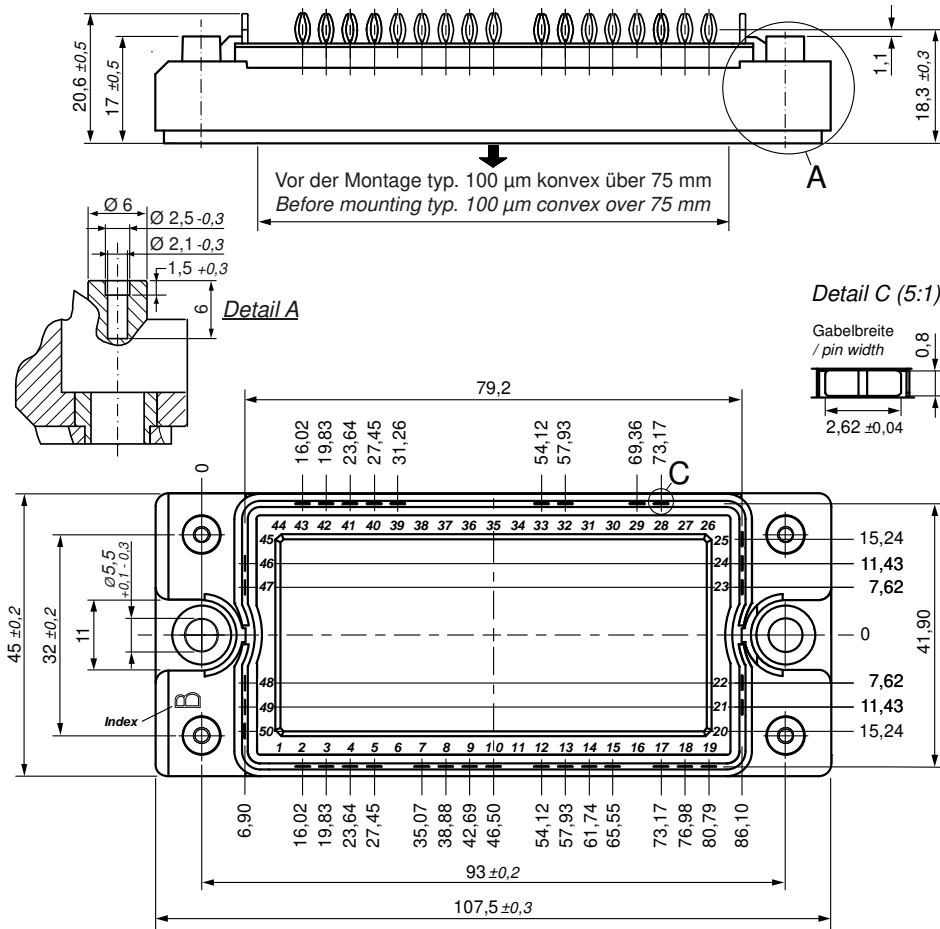
		Rectifier	Brake IGBT +	Brake Diode	
$V_0$	threshold voltage	0,82	1,1	1,25	V
$R_0$	slope resistance *	1,2	9,2	8,5	m $\Omega$



Typ. NTC resistance vs. temperature



**Outlines E2-Pack**

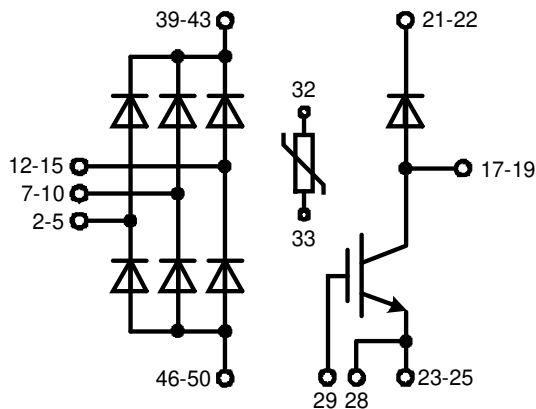


**Bemerkung / Note:**

- 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: **Ø 2.35 mm**
- Endlochdurchmesser / Diameter of plated holes: **Ø 2.14 - 2.29 mm** (Cu thickness in via typ. 50 µm)
- Beschichtung / Plating: **chem. Sn max. 15 µm**
- 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**



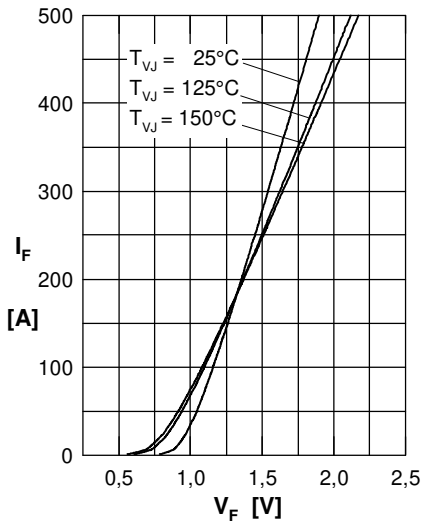
**Rectifier**


Fig. 1 Forward current versus voltage drop per diode

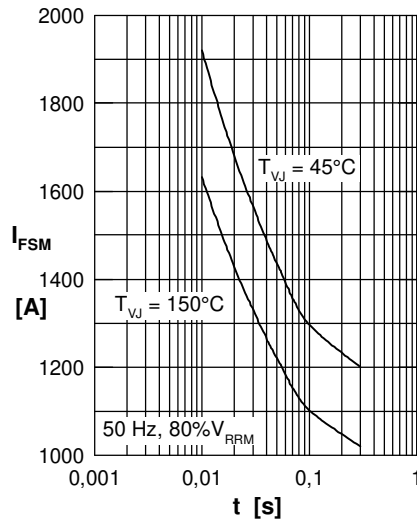


Fig. 2 Surge overload current vs. time per diode

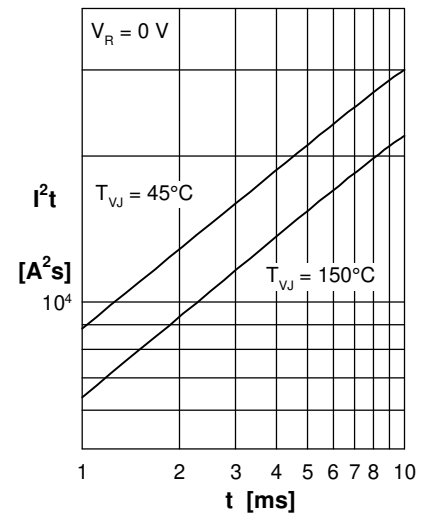
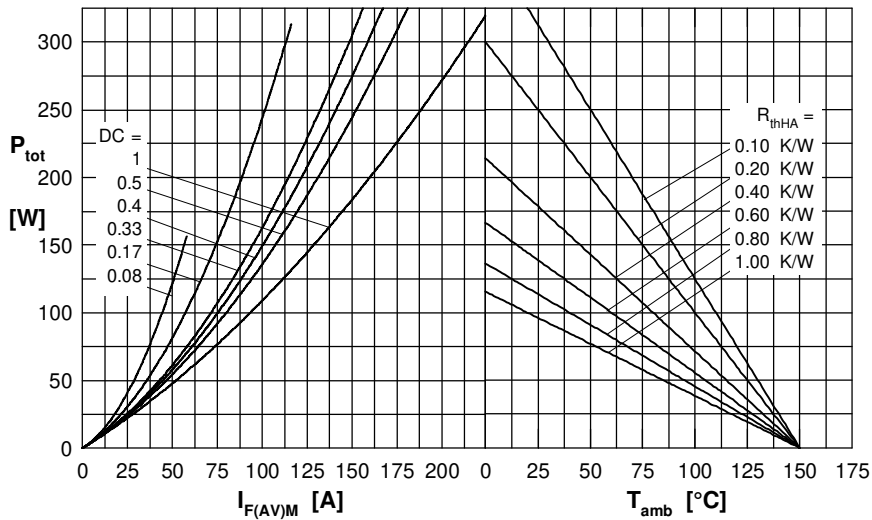

 Fig. 3  $I^2t$  versus time per diode


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

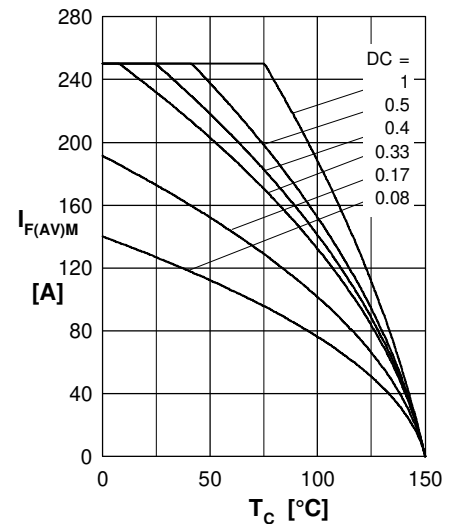


Fig. 5 Max. forward current vs. case temperature per diode

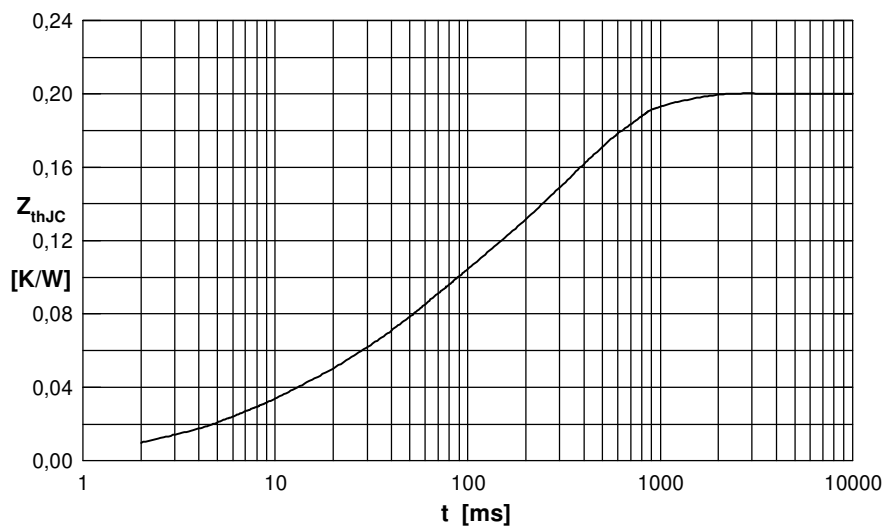


Fig. 6 Transient thermal impedance junction to case vs. time per diode

 Constants for  $Z_{thJC}$  calculation:

i	$R_{thi}$ (K/W)	$t_i$ (s)
1	0.020	0.006
2	0.003	0.007
3	0.057	0.042
4	0.120	0.350

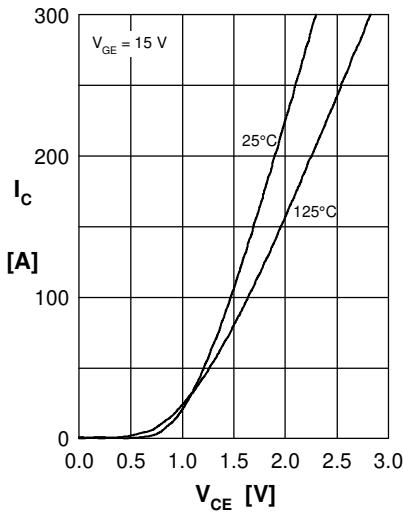
**Brake IGBT + Diode**


Fig.1 Output characteristics IGBT

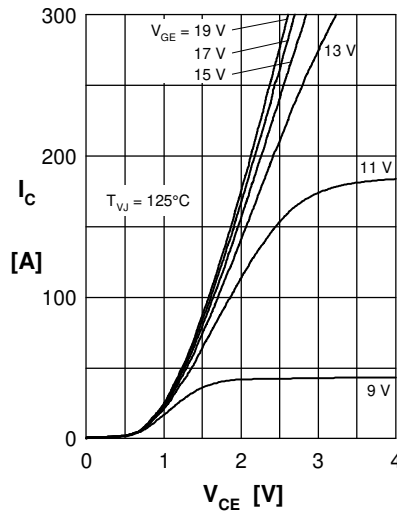


Fig.2 Typ. output characteristics IGBT

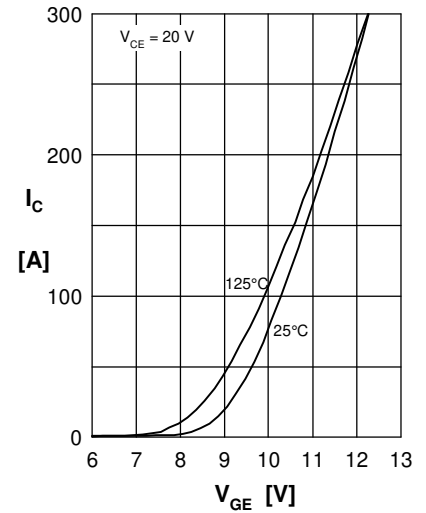


Fig. 3 Typ. transfer charact. IGBT

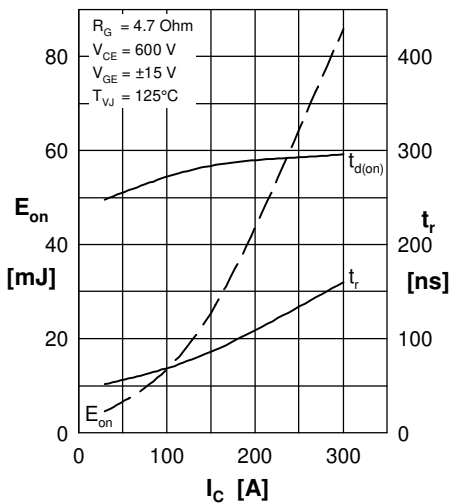


Fig. 4 Typ. turn-on energy &amp; switch. times vs. collector current

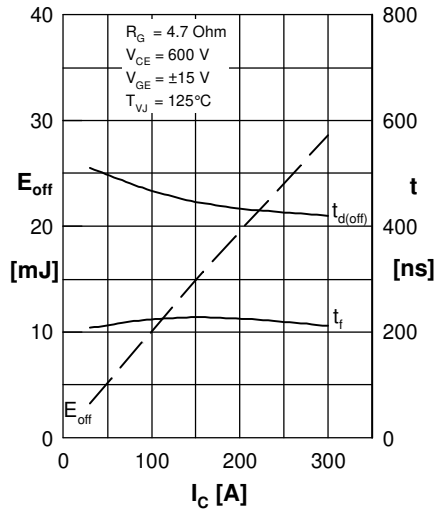


Fig. 5 Typ. turn-off energy &amp; switch. times vs. collector current

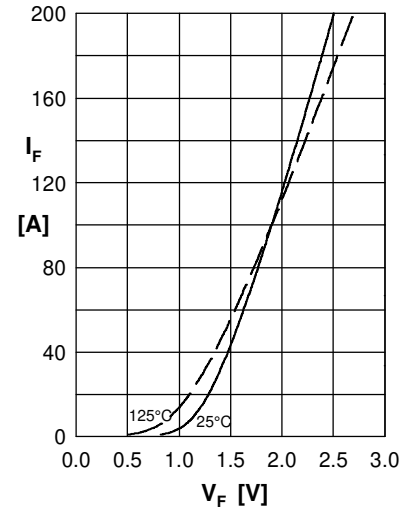


Fig. 6 Typ. forward characteristics Diode

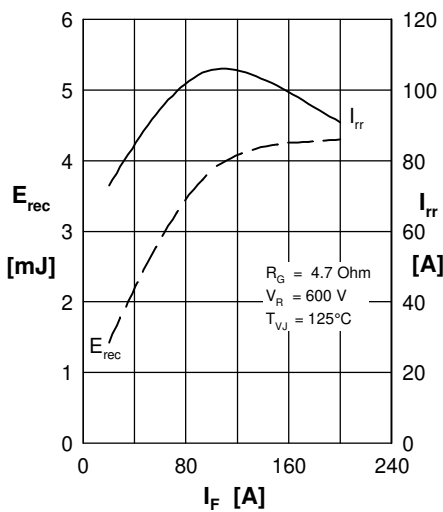


Fig. 7 Typ. reverse recovery characteristics Diode

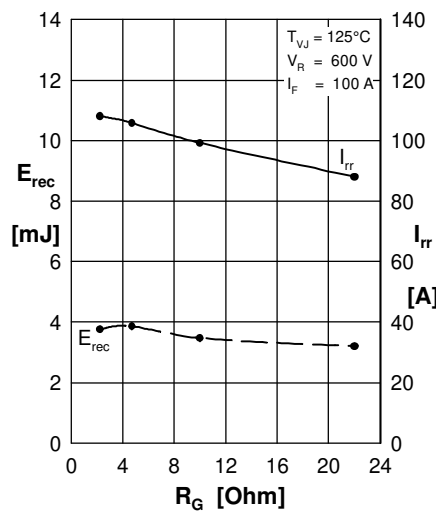


Fig. 8 Typ. reverse recovery characteristics Diode

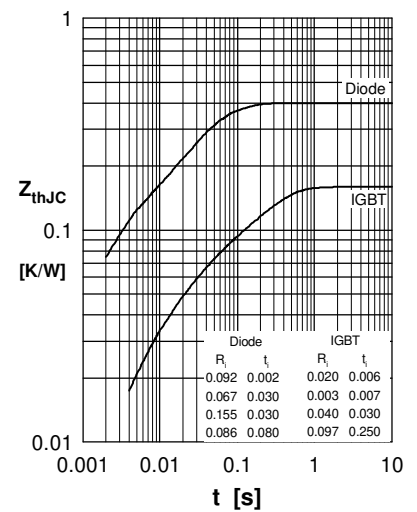


Fig. 9 Transient thermal resistance junction to case