

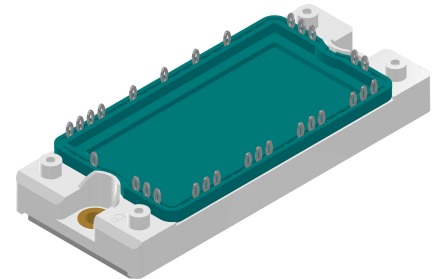
# High Voltage Thyristor Module

3~ Rectifier	Brake Chopper
$V_{RRM} = 2200\text{ V}$	$V_{CES} = 1700\text{ V}$
$I_{DAV} = 120\text{ A}$	$I_{C25} = 113\text{ A}$
$I_{FSM} = 500\text{ A}$	$V_{CE(sat)} = 2.5\text{ V}$

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

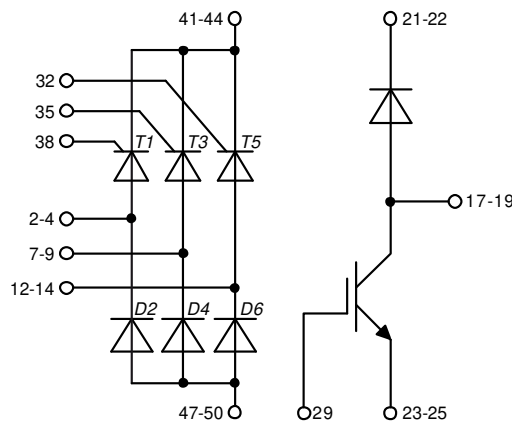
Part number

**MCNA120UI2200PED**



Backside: isolated

 E72873



## Features / Advantages:

- Thyristor/Standard Rectifier for line frequency
- Planar passivated chips
- Long-term stability
- Low forward voltage drop
- Copper base plate with Direct Copper Bonded Al<sub>2</sub>O<sub>3</sub>-ceramic
- Improved temperature and power cycling

## Applications:

- 3~ Rectifier with brake unit for drive inverters

## Package: E2-Pack

- Isolation Voltage: 3600 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

## 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	$T_{VJ} = 25^{\circ}C$			2300	V
$V_{RRM/DRM}$	max. repetitive reverse/forward blocking voltage	$T_{VJ} = 25^{\circ}C$			2200	V
$I_{RD}$	reverse current, drain current	$V_{R/D} = 2200 V$	$T_{VJ} = 25^{\circ}C$		50	$\mu A$
		$V_{R/D} = 2200 V$	$T_{VJ} = 125^{\circ}C$		10	mA
$V_T$	forward voltage drop	$I_T = 40 A$	$T_{VJ} = 25^{\circ}C$		1.33	V
		$I_T = 120 A$			2.05	V
		$I_T = 40 A$	$T_{VJ} = 125^{\circ}C$		1.36	V
		$I_T = 120 A$			2.38	V
$I_{DAV}$	bridge output current	$T_C = 80^{\circ}C$ rectangular $d = 1/3$	$T_{VJ} = 150^{\circ}C$		120	A
$V_{T0}$	threshold voltage	} for power loss calculation only	$T_{VJ} = 150^{\circ}C$		0.83	V
$r_T$	slope resistance				13.6	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	$t = 10 ms; (50 Hz), sine$	$T_{VJ} = 45^{\circ}C$		500	A
		$t = 8,3 ms; (60 Hz), sine$	$V_R = 0 V$		540	A
		$t = 10 ms; (50 Hz), sine$	$T_{VJ} = 150^{\circ}C$		425	A
		$t = 8,3 ms; (60 Hz), sine$	$V_R = 0 V$		460	A
$I^2t$	value for fusing	$t = 10 ms; (50 Hz), sine$	$T_{VJ} = 45^{\circ}C$		1.25	kA <sup>2</sup> s
		$t = 8,3 ms; (60 Hz), sine$	$V_R = 0 V$		1.22	kA <sup>2</sup> s
		$t = 10 ms; (50 Hz), sine$	$T_{VJ} = 150^{\circ}C$		905	A <sup>2</sup> s
		$t = 8,3 ms; (60 Hz), sine$	$V_R = 0 V$		880	A <sup>2</sup> s
$C_J$	junction capacitance	$V_R = 700 V$ $f = 1 MHz$	$T_{VJ} = 25^{\circ}C$		13	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, $I_T = 120 A$			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., $I_T = 40 A$			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	$V_D = 6 V$	$T_{VJ} = 25^{\circ}C$		70	mA
			$T_{VJ} = -40^{\circ}C$		150	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	$t_p = 10 \mu s$	$T_{VJ} = 25^{\circ}C$		150	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	$V_D = 1/2 V_{DRM}$ $I_G = 0.45 A; di_G/dt = 0.45 A/\mu s$	$T_{VJ} = 25^{\circ}C$		2	$\mu s$
$t_q$	turn-off time	$V_R = 100 V; I_T = 40 A; V = 2/3 V_{DRM}$ $di/dt = 10 A/\mu s$ $dv/dt = 20 V/\mu s$ $t_p = 200 \mu s$	$T_{VJ} = 125^{\circ}C$	500		$\mu s$



Brake IGBT + Diode				Ratings			
Symbol	Definition	Conditions	min.	typ.	max.	Unit	
$V_{CES}$	collector emitter voltage	$T_{VJ} = 25^{\circ}C$			1700	V	
$V_{GES}$	max. DC gate voltage				$\pm 20$	V	
$V_{GEM}$	max. transient gate emitter voltage				$\pm 30$	V	
$I_{C25}$	collector current	$T_C = 25^{\circ}C$			113	A	
$I_{C80}$		$T_C = 80^{\circ}C$			80	A	
$P_{tot}$	total power dissipation	$T_C = 25^{\circ}C$			445	W	
$V_{CE(sat)}$	collector emitter saturation voltage	$I_C = 75\text{ A}; V_{GE} = 15\text{ V}$			2.5	2.93	V
					3	V	
$V_{GE(th)}$	gate emitter threshold voltage	$I_C = 3\text{ mA}; V_{GE} = V_{CE}$	5.2	5.8	6.4	V	
$I_{CES}$	collector emitter leakage current	$V_{CE} = V_{CES}; V_{GE} = 0\text{ V}$			0.6	5	mA
						mA	
$I_{GES}$	gate emitter leakage current	$V_{GE} = \pm 20\text{ V}$			400	nA	
$Q_{G(on)}$	total gate charge	$V_{CE} = 900\text{ V}; V_{GE} = 15\text{ V}; I_C = 75\text{ A}$		850		nC	
$t_{d(on)}$	turn-on delay time	inductive load $V_{CE} = 900\text{ V}; I_C = 75\text{ A}$ $V_{GE} = \pm 15\text{ V}; R_G = 18\ \Omega$		270		ns	
$t_r$	current rise time		$T_{VJ} = 125^{\circ}C$		100		ns
$t_{d(off)}$	turn-off delay time				700		ns
$t_f$	current fall time				430		ns
$E_{on}$	turn-on energy per pulse				34		mJ
$E_{off}$	turn-off energy per pulse				17.5		mJ
<b>RBSOA</b>	reverse bias safe operating area	$V_{GE} = \pm 15\text{ V}; R_G = 18\ \Omega$					
$I_{CM}$		$V_{CEK} = 1700\text{ V}$			150	A	
<b>SCSOA</b>	short circuit safe operating area	$V_{CEK} = 1700\text{ V}$					
$t_{SC}$	short circuit duration	$V_{CE} = 720\text{ V}; V_{GE} = \pm 15$			10	$\mu s$	
$I_{SC}$	short circuit current	$R_G = 18\ \Omega$ ; non-repetitive		280		A	
$R_{thJC}$	thermal resistance junction to case				0.28	K/W	
$R_{thCH}$	thermal resistance case to heatsink			0.1		K/W	
<b>Brake Diode</b>							
$V_{RRM}$	max. repetitive reverse voltage	$T_{VJ} = 25^{\circ}C$			1700	V	
$I_{F25}$	forward current	$T_C = 25^{\circ}C$			75	A	
$I_{F80}$		$T_C = 80^{\circ}C$			50	A	
$V_F$	forward voltage	$I_F = 60\text{ A}$			2.45	V	
					2.20	V	
$I_R$	reverse current	$V_R = V_{RRM}$			0.1	1	mA
						mA	
$Q_{rr}$	reverse recovery charge	$V_R = 900\text{ V}$ $-di_f/dt = 600\text{ A}/\mu s$ $I_F = 60\text{ A}; V_{GE} = 0\text{ V}$		20		$\mu C$	
$I_{RM}$	max. reverse recovery current		$T_{VJ} = 125^{\circ}C$		46		A
$t_{rr}$	reverse recovery time				1300		ns
$E_{rec}$	reverse recovery energy				10.5		mJ
$R_{thJC}$	thermal resistance junction to case				0.65	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			40	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	3600 3000			V V
		50/60 Hz, RMS; $I_{ISOL} \leq 1$ mA				



### Part description

M = Module  
 C = Thyristor (SCR)  
 N = High Voltage Thyristor  
 A = (>= 2000V)  
 120 = Current Rating [A]  
 UI = 3- Rectifier Bridge, half-controlled (high-side) + Brake Unit  
 2200 = Reverse Voltage [V]  
 P = PressFit-Pin  
 ED = E2-Pack  
 - = Hyphen  
 PC = Phase Change Material

Ordering	Ordering Number	Marking on Product	Delivery Mode	Quantity	Code No.
Standard	MCNA120UI2200PED	MCNA120UI2200PED	Blister	28	521435
Alternative	MCNA120UI2200PED-PC	MCNA120UI2200PED	Blister	28	521428

### Equivalent Circuits for Simulation

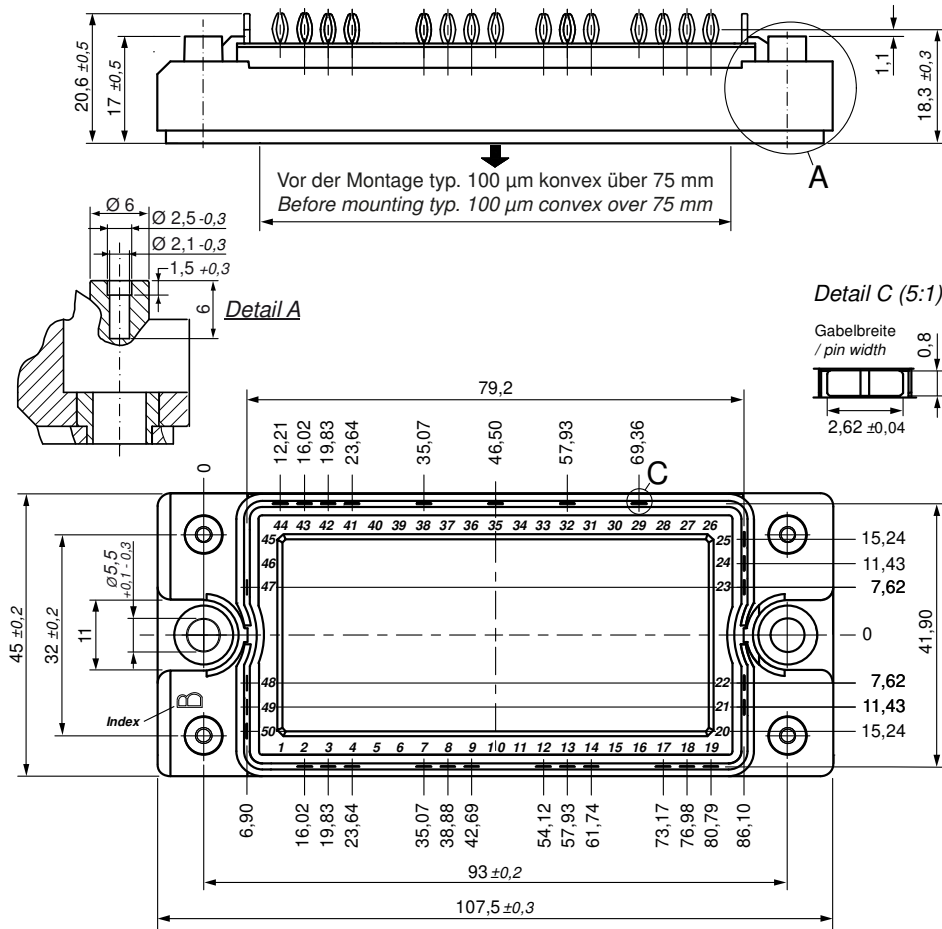
\* on die level

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

		Thyristor	Brake IGBT +	Brake Diode	
$V_0$	threshold voltage	0.83	1.17	1.34	V
$R_0$	slope resistance *	10.5	25	15.2	mΩ



**Outlines E2-Pack**

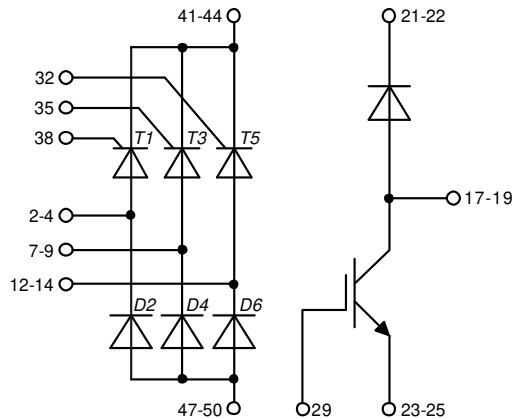


**Bemerkung / Note:**

- 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 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<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**



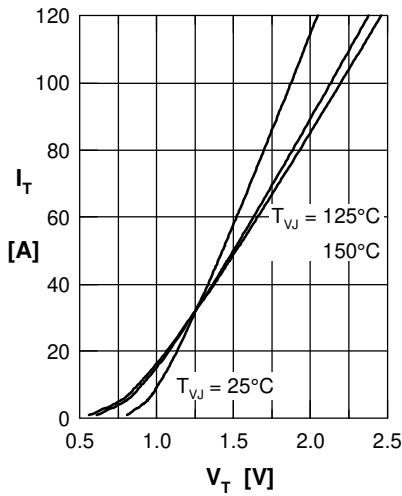
**Thyristor**


Fig. 1 Forward characteristics

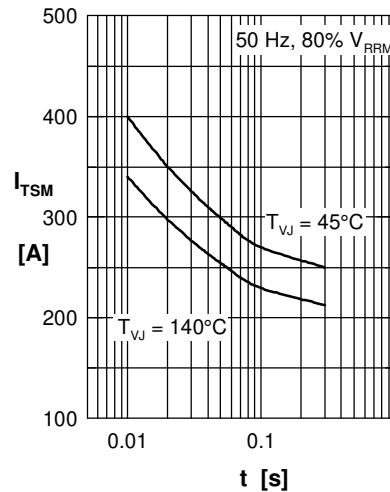
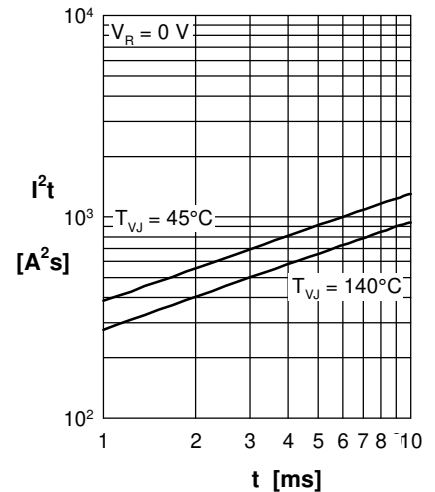
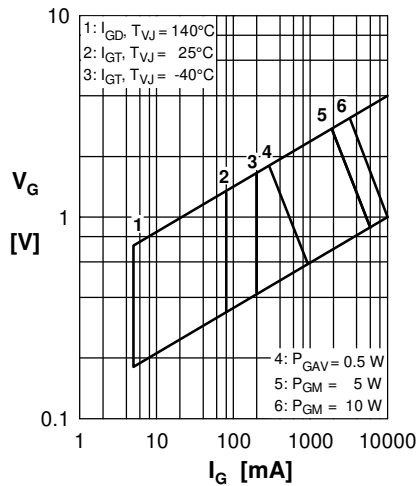

 Fig. 2 Surge overload current  
 $I_{TSM}$ : crest value,  $t$ : duration

 Fig. 3  $I^2t$  versus time (1-10 s)


Fig. 4 Gate voltage &amp; gate current

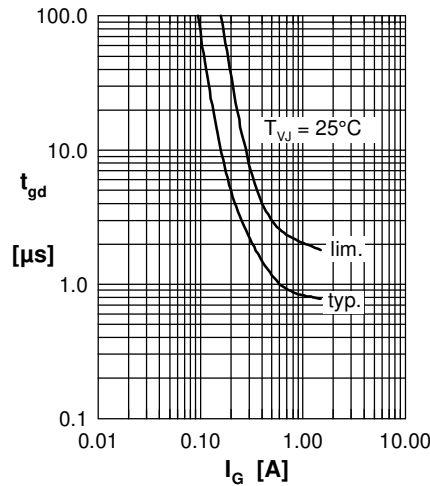
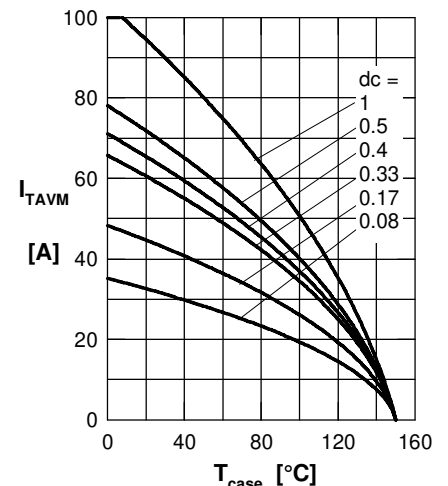

 Fig. 5 Gate controlled delay time  $t_{gd}$ 


Fig. 6 Max. forward current at case temperature

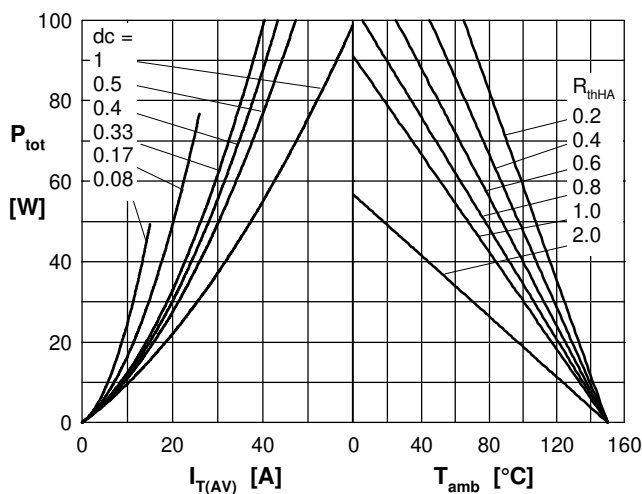
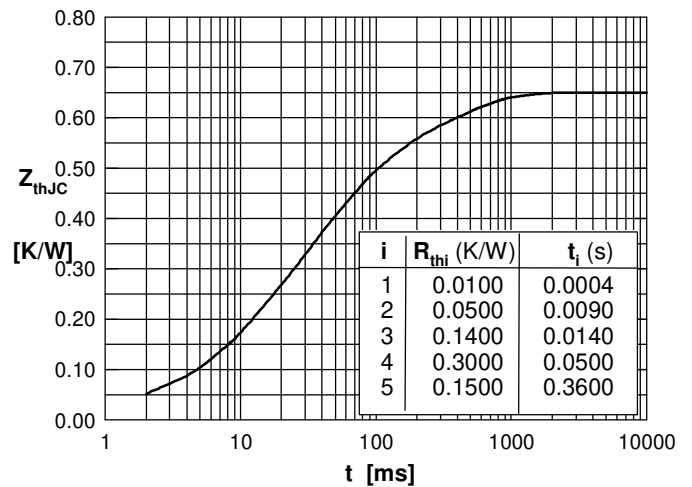

 Fig. 7a Power dissipation versus direct output current  
 Fig. 7b and ambient temperature


Fig. 8 Transient thermal impedance junction to case

## Brake IGBT + Diode

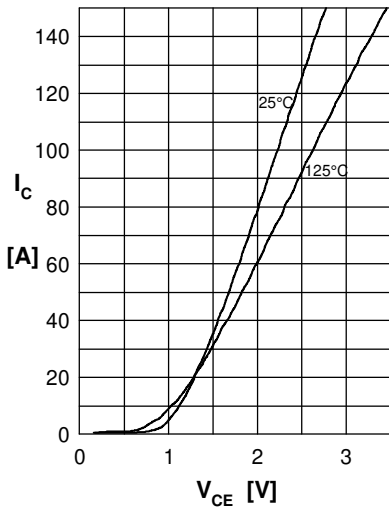


Fig.1 Output characteristics IGBT

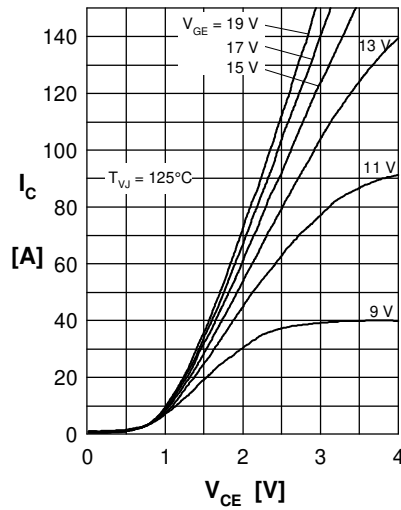


Fig.2 Typ. output characteristics IGBT

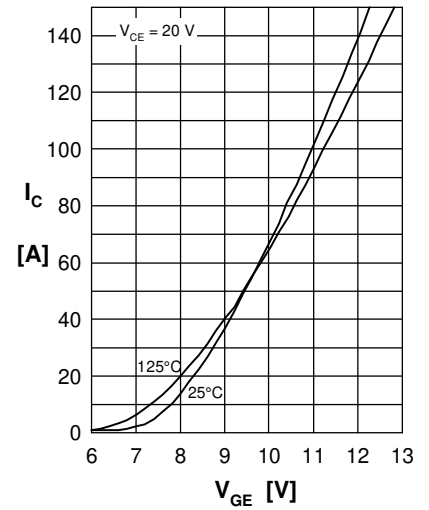


Fig.3 Typ. transfer charact. IGBT

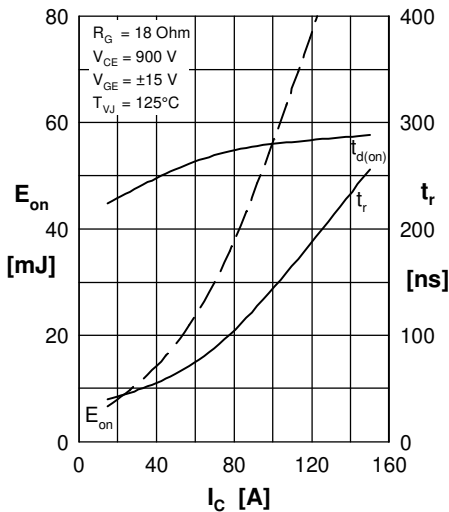


Fig.4 Typ. turn-on energy & switch. times vs. collector current

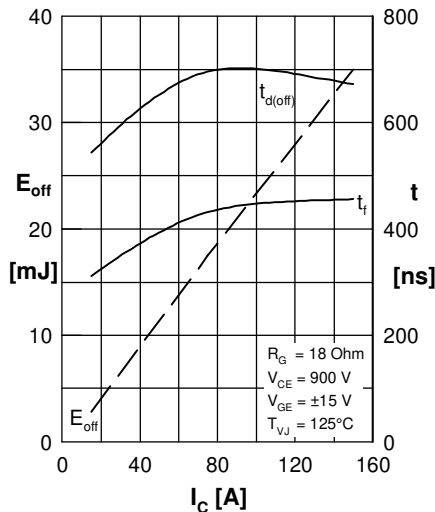


Fig.5 Typ. turn-off energy & switch. times vs. collector current

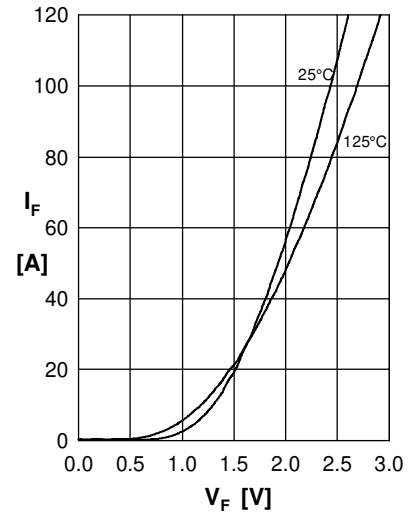


Fig.6 Typ. forward characteristics Diode

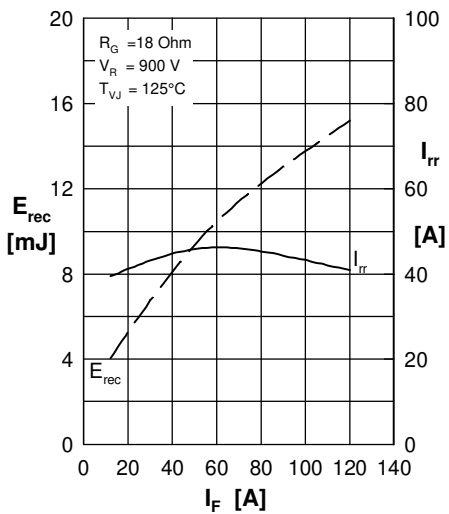


Fig.7 Typ. reverse recovery characteristics Diode

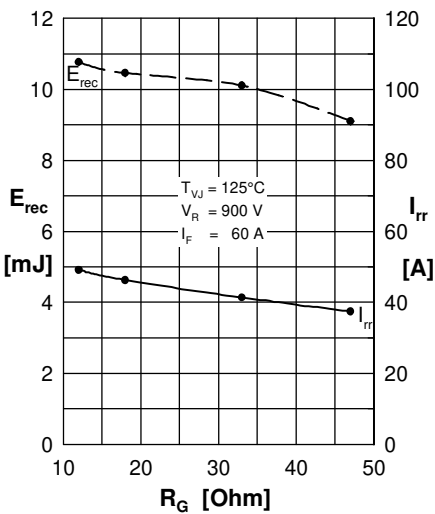


Fig.8 reverse recovery characteristics Diode

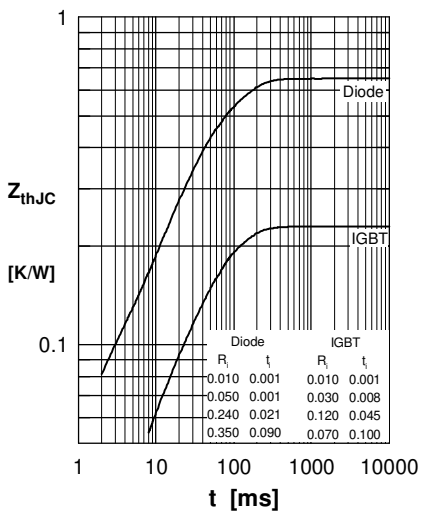


Fig.9 Transient thermal resistance junction to case