

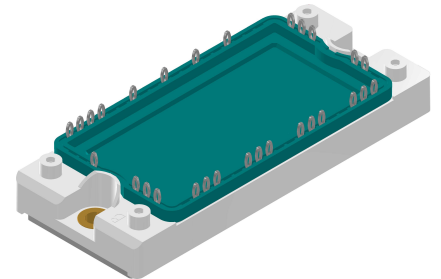
# Thyristor Module

3~ Rectifier	Brake Chopper
$V_{RRM} = 1600 \text{ V}$	$V_{CES} = 1200 \text{ V}$
$I_{DAV} = 240 \text{ A}$	$I_{C25} = 180 \text{ A}$
$I_{FSM} = 1500 \text{ A}$	$V_{CE(sat)} = 1.7 \text{ V}$

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

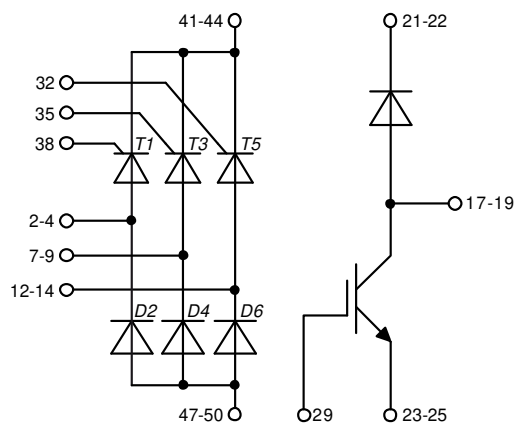
Part number

**MCMA240UI1600PED**



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
- 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: 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

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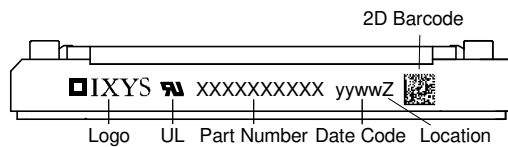


Rectifier				Ratings			
Symbol	Definition	Conditions	min.	typ.	max.	Unit	
$V_{RSM/DSM}$	max. non-repetitive reverse/forward blocking voltage	$T_{VJ} = 25^{\circ}C$			1700	V	
$V_{RRM/DRM}$	max. repetitive reverse/forward blocking voltage	$T_{VJ} = 25^{\circ}C$			1600	V	
$I_{RD}$	reverse current, drain 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	$I_T = 80 A$	$T_{VJ} = 25^{\circ}C$		1.27	V	
		$I_T = 240 A$			1.89	V	
		$I_T = 80 A$	$T_{VJ} = 125^{\circ}C$		1.26	V	
		$I_T = 240 A$			2.05	V	
$I_{DAV}$	bridge output current	$T_C = 80^{\circ}C$ rectangular $d = 120^{\circ}$	$T_{VJ} = 150^{\circ}C$		240	A	
$V_{T0}$	threshold voltage	} for power loss calculation only	$T_{VJ} = 150^{\circ}C$		0.83	V	
$r_T$	slope resistance				5.3	m $\Omega$	
$R_{thJC}$	thermal resistance junction to case				0.4	K/W	
$R_{thCH}$	thermal resistance case to heatsink			0.1		K/W	
$P_{tot}$	total power dissipation		$T_C = 25^{\circ}C$		312	W	
$I_{TSM}$	max. forward surge current	$t = 10 ms; (50 Hz), sine$	$T_{VJ} = 45^{\circ}C$		1.50	kA	
		$t = 8,3 ms; (60 Hz), sine$	$V_R = 0 V$		1.62	kA	
		$t = 10 ms; (50 Hz), sine$	$T_{VJ} = 150^{\circ}C$		1.28	kA	
		$t = 8,3 ms; (60 Hz), sine$	$V_R = 0 V$		1.38	kA	
$I^2t$	value for fusing	$t = 10 ms; (50 Hz), sine$	$T_{VJ} = 45^{\circ}C$		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	
		$t = 10 ms; (50 Hz), sine$	$T_{VJ} = 150^{\circ}C$		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	$V_R = 400 V f = 1 MHz$	$T_{VJ} = 25^{\circ}C$		74	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, $I_T = 240 A$			150	A/ $\mu s$	
		$t_p = 200 \mu s; di_G/dt = 0.45 A/\mu s;$ $I_G = 0.45 A; V = \frac{2}{3} V_{DRM}$ non-repet., $I_T = 80 A$			500	A/ $\mu s$	
$(dv/dt)_{cr}$	critical rate of rise of voltage	$V = \frac{2}{3} V_{DRM}$ $R_{GK} = \infty; method 1 (linear voltage rise)$	$T_{VJ} = 150^{\circ}C$		1000	V/ $\mu s$	
$V_{GT}$	gate trigger voltage	$V_D = 6 V$	$T_{VJ} = 25^{\circ}C$		1.5	V	
			$T_{VJ} = -40^{\circ}C$		1.6	V	
$I_{GT}$	gate trigger current	$V_D = 6 V$	$T_{VJ} = 25^{\circ}C$		95	mA	
			$T_{VJ} = -40^{\circ}C$		200	mA	
$V_{GD}$	gate non-trigger voltage	$V_D = \frac{2}{3} V_{DRM}$	$T_{VJ} = 150^{\circ}C$		0.2	V	
$I_{GD}$	gate non-trigger current				10	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	$V_D = 6 V R_{GK} = \infty$	$T_{VJ} = 25^{\circ}C$		200	mA	
$t_{gd}$	gate controlled delay time	$V_D = \frac{1}{2} V_{DRM}$ $I_G = 0.45 A; di_G/dt = 0.45 A/\mu s$	$T_{VJ} = 25^{\circ}C$		2	$\mu s$	
$t_q$	turn-off time	$V_R = 100 V; I_T = 80 A; V = \frac{2}{3} V_{DRM}$ $di/dt = 10 A/\mu s dv/dt = 20 V/\mu s t_p = 200 \mu s$	$T_{VJ} = 125^{\circ}C$	150		$\mu s$	



Brake IGBT + Diode				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				180	A	
$I_{C80}$					140	A	
$P_{tot}$	total power dissipation				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 $V_{CE} = 600 \text{ V}; I_C = 100 \text{ A}$ $V_{GE} = \pm 15 \text{ V}; R_G = 6.8 \Omega$		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	$V_{GE} = \pm 15 \text{ V}; R_G = 6.8 \Omega$					
$I_{CM}$		$V_{CEK} = 1200 \text{ V}$			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	$\mu\text{s}$	
$I_{SC}$	short circuit current	$R_G = 6.8 \Omega$ ; 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	
$I_{F80}$					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	$V_R = 600 \text{ V}$ $-di_f/dt = 900 \text{ A}/\mu\text{s}$ $I_F = 60 \text{ A}; V_{GE} = 0 \text{ V}$		9.6		$\mu\text{C}$	
$I_{RM}$	max. reverse recovery current			47		A	
$t_{rr}$	reverse recovery time			450		ns	
$E_{rec}$	reverse recovery energy			3		mJ	
$R_{thJC}$	thermal resistance junction to case				0.6	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			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
$d_{Spb/Appb}$		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)  
 M = Thyristor  
 A = (up to 1800V)  
 240 = Current Rating [A]  
 UI = 3- Rectifier Bridge, half-controlled (high-side) + Brake Unit  
 1600 = Reverse Voltage [V]  
 P = PressFit-Pin  
 ED = E2-Pack  
 - = Hyphen  
 PC = Phase Change Material

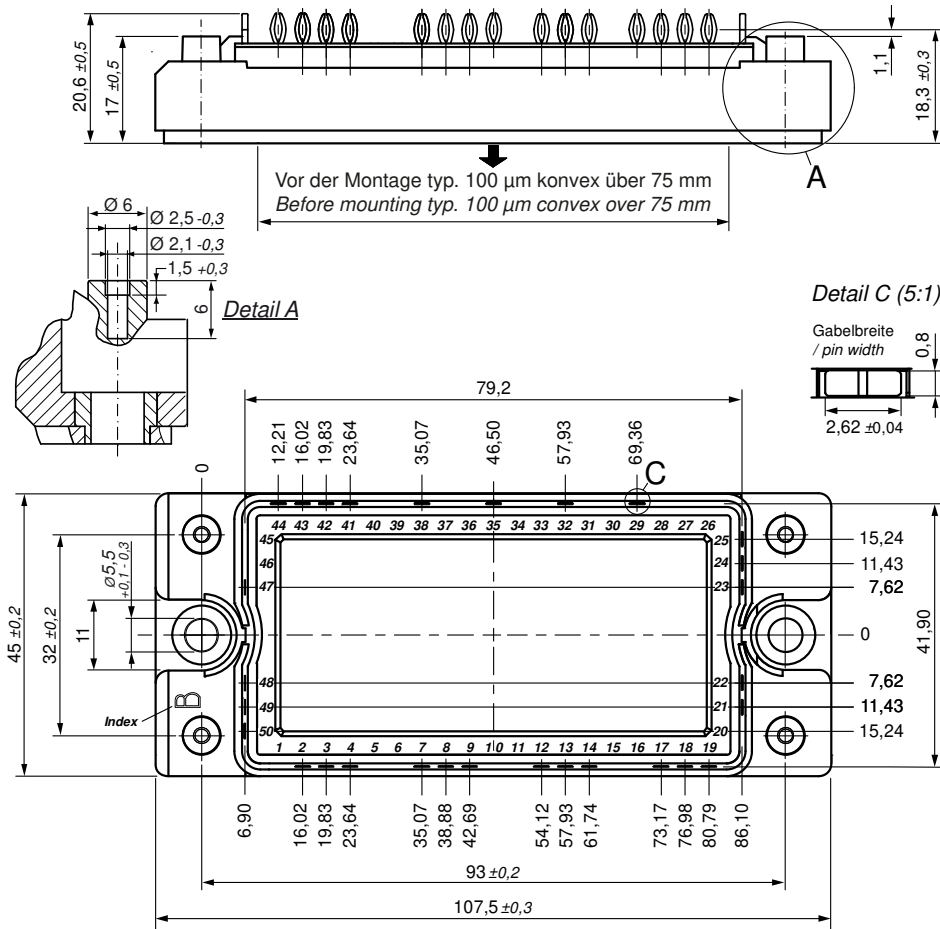
Ordering	Ordering Number	Marking on Product	Delivery Mode	Quantity	Code No.
Standard	MCMA240UI1600PED	MCMA240UI1600PED	Blister	28	516002
Alternative	MCMA240UI1600PED-PC	MCMA240UI1600PED	Blister	28	518136

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

		Thyristor	Brake IGBT +	Brake Diode	
$V_0$	threshold voltage	0.83	1.2	1.25	V
$R_0$	slope resistance *	2.7	11.6	8.5	mΩ



**Outlines E2-Pack**

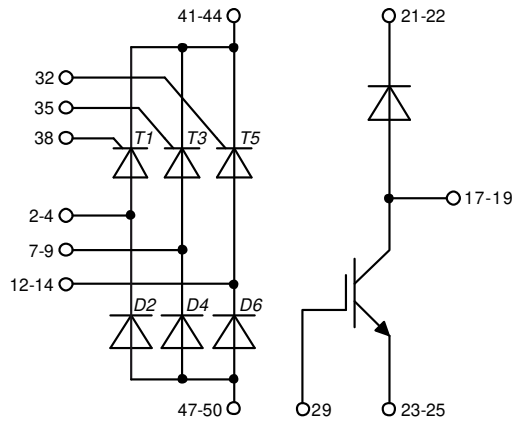


**Bemerkung / Note:**

- 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: **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<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**



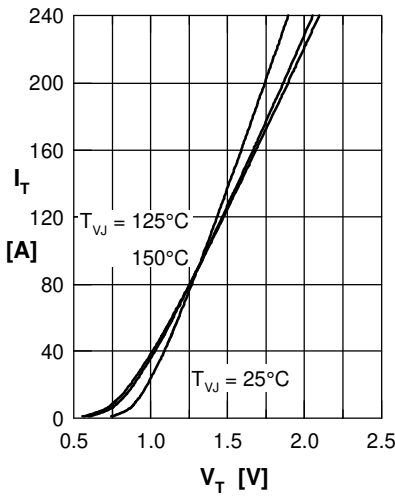
**Thyristor**


Fig. 1 Forward characteristics

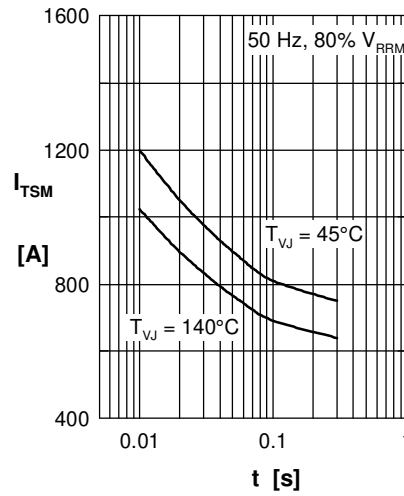
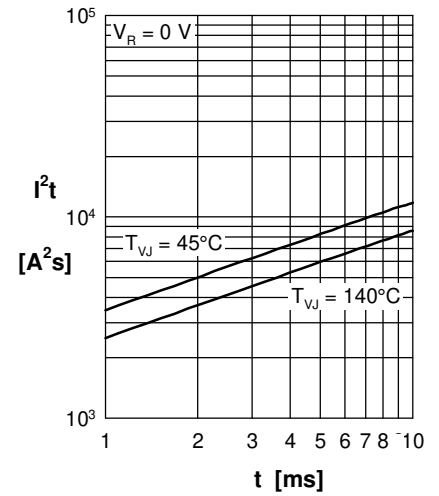
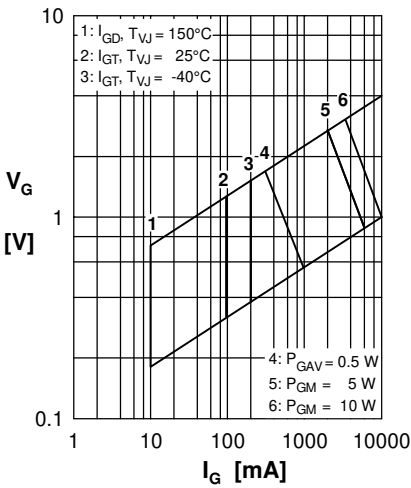

 Fig. 2 Surge overload current  
 $I_{TSM}$ : crest value,  $t$ : duration

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


Fig. 4 Gate voltage &amp; gate current

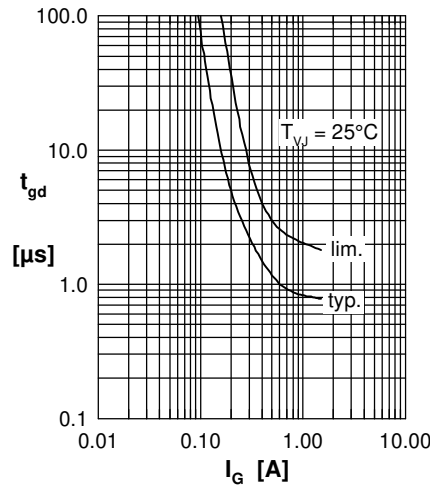
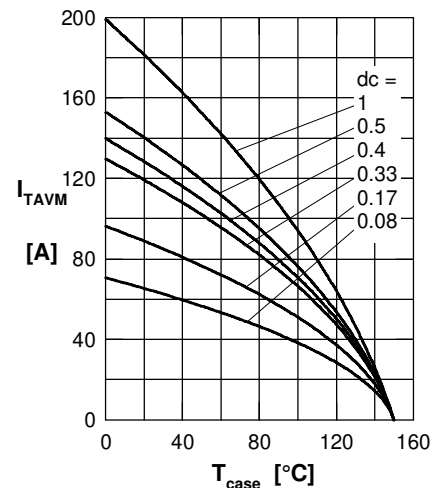

 Fig. 5 Gate controlled delay time  $t_{gd}$ 


Fig. 6 Max. forward current at case temperature

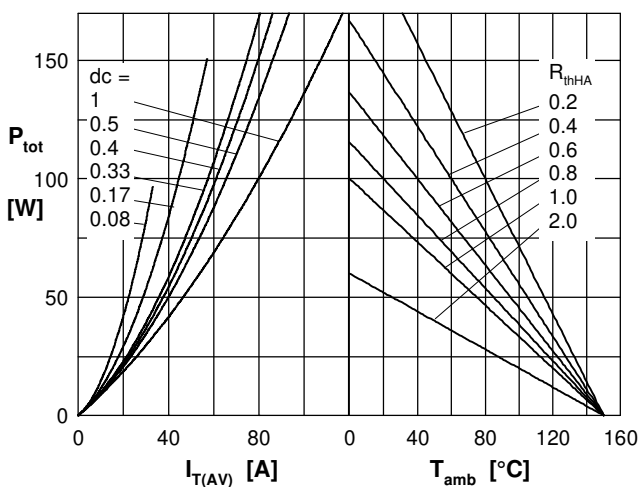
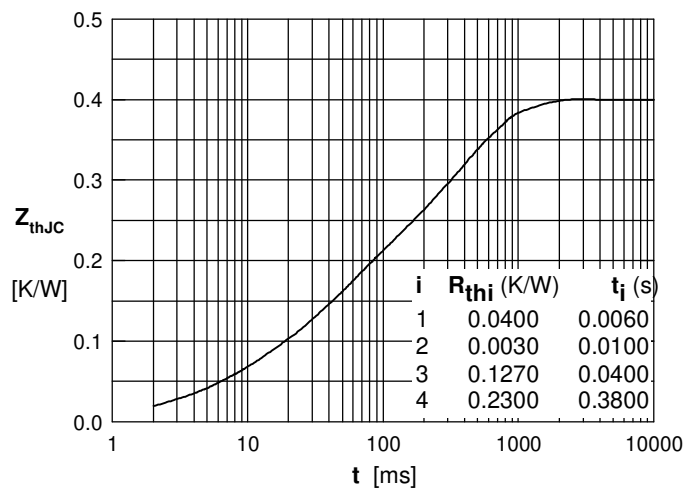

 Fig. 7a Power dissipation versus direct output current  
 Fig. 7b and ambient temperature


Fig. 8 Transient thermal impedance junction to case

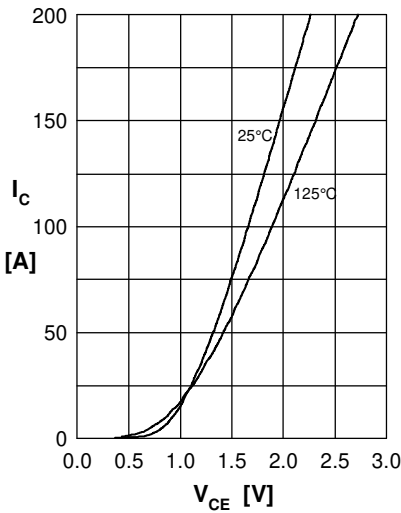
**Brake IGBT + Diode**


Fig.1 Output characteristics IGBT

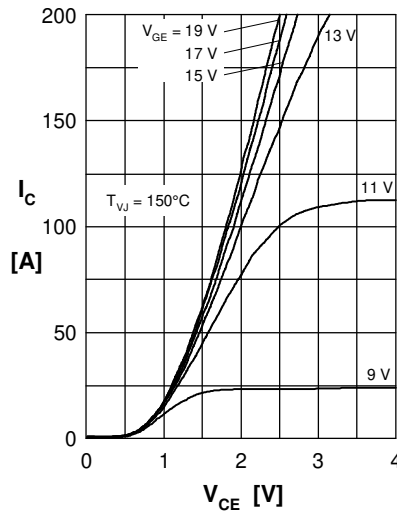


Fig.2 Typ. output characteristics IGBT

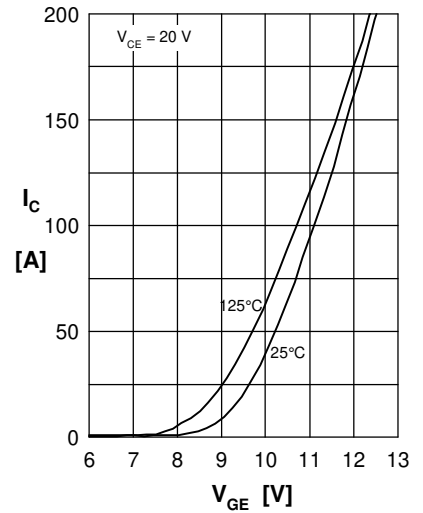


Fig.3 Typ. transfer charact. IGBT

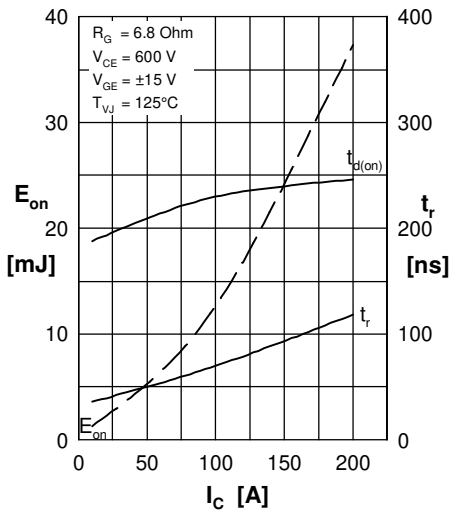


Fig.4 Typ. turn-on energy &amp; switch. times vs. collector current

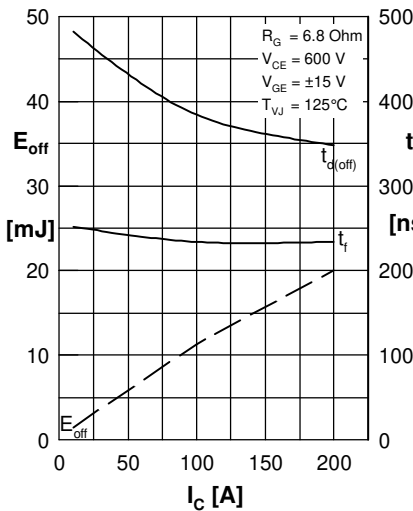


Fig.5 Typ. turn-off energy &amp; switch. times vs. collector current

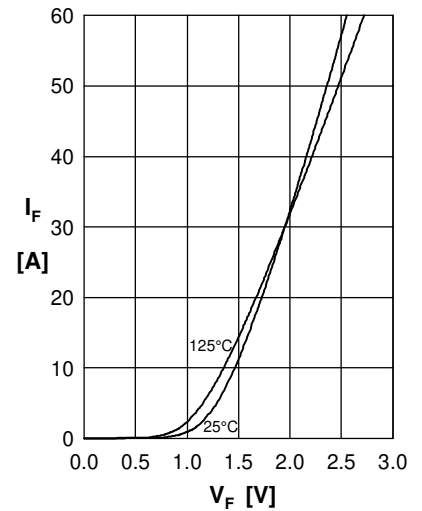
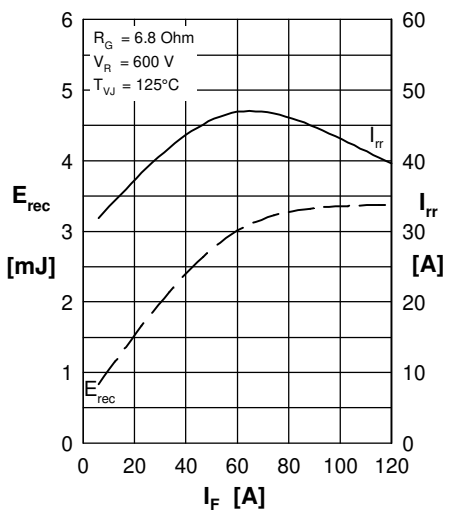

 Fig.6 Typ. forward current versus  $V_F$ 


Fig.7 Typ. reverse recovery characteristics Diode

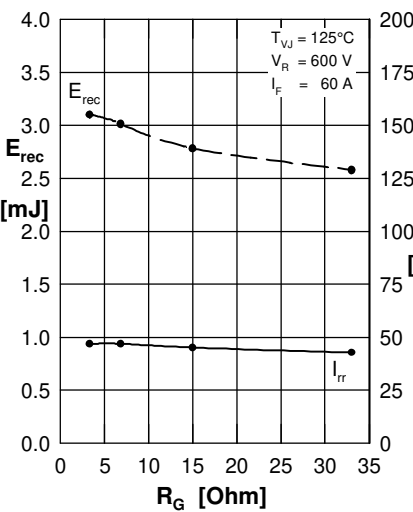


Fig.8 Typ. reverse recovery characteristics Diode

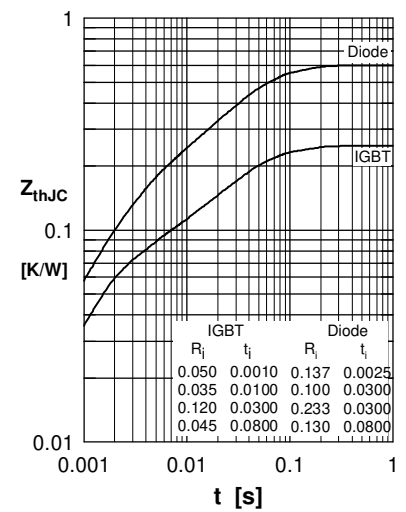


Fig.9 Transient thermal resistance junction to case