

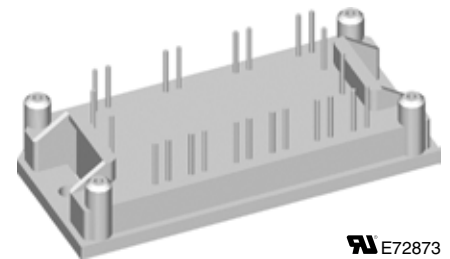
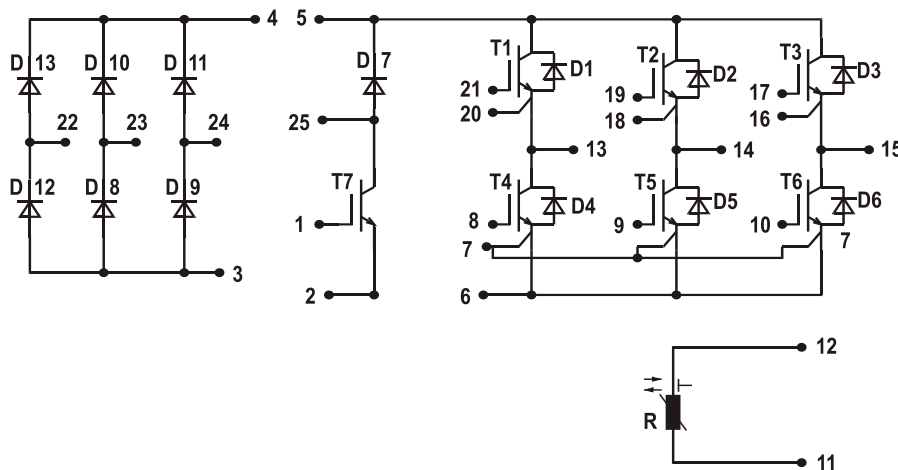
# Converter - Brake - Inverter Module

## XPT IGBT

Three Phase Rectifier	Brake Chopper	Three Phase Inverter
$V_{RRM} = 1600 \text{ V}$	$V_{CES} = 1200 \text{ V}$	$V_{CES} = 1200 \text{ V}$
$I_{DAVM25} = 150 \text{ A}$	$I_{C25} = 17 \text{ A}$	$I_{C25} = 28 \text{ A}$
$I_{FSM} = 320 \text{ A}$	$V_{CE(sat)} = 1.8 \text{ V}$	$V_{CE(sat)} = 1.8 \text{ V}$

**Part name** (Marking on product)

MIXA20WB1200TML



E72873

Pin configuration see outlines.

### Features:

- High level of integration - only one power semiconductor module required for the whole drive
- Rugged XPT design (Xtreme light Punch Through) results in:
  - short circuit rated for 10  $\mu\text{sec}$ .
  - very low gate charge
  - square RBSOA @  $3 \times I_c$
  - low EMI
- Thin wafer technology combined with the XPT design results in a competitive low  $V_{CE(sat)}$
- Temperature sense included
- SONIC™ diode
  - fast and soft reverse recovery
  - low operating forward voltage

### Application:

- AC motor drives
- Pumps, Fans
- Washing machines
- Air-conditioning system
- Inverter and power supplies

### Package:

- DCB based "E1-Pack"
- Assembly height is 17 mm
- Insulated base plate
- UL registered E72873

**Output Inverter T1 - T6**

Symbol	Definitions	Conditions	Ratings			Unit	
			min.	typ.	max.		
$V_{CES}$	collector emitter voltage		$T_{VJ} = 25^{\circ}\text{C}$		1200	V	
$V_{GES}$	max. DC gate voltage	continuous			$\pm 20$	V	
$V_{GEM}$	max. transient collector gate voltage	transient			$\pm 30$	V	
$I_{C25}$	collector current		$T_C = 25^{\circ}\text{C}$		28	A	
$I_{C80}$			$T_C = 80^{\circ}\text{C}$		20	A	
$P_{tot}$	total power dissipation		$T_C = 25^{\circ}\text{C}$		100	W	
$V_{CE(sat)}$	collector emitter saturation voltage	$I_C = 16\text{ A}; V_{GE} = 15\text{ V}$	$T_{VJ} = 25^{\circ}\text{C}$ $T_{VJ} = 125^{\circ}\text{C}$	1.8 2.1	2.1	V V	
$V_{GE(th)}$	gate emitter threshold voltage	$I_C = 0.6\text{ mA}; V_{GE} = V_{CE}$	$T_{VJ} = 25^{\circ}\text{C}$	5.5	6.0	6.5	V
$I_{CES}$	collector emitter leakage current	$V_{CE} = V_{CES}; V_{GE} = 0\text{ V}$	$T_{VJ} = 25^{\circ}\text{C}$ $T_{VJ} = 125^{\circ}\text{C}$	0.02 0.2	0.2	mA mA	
$I_{GES}$	gate emitter leakage current	$V_{GE} = \pm 20\text{ V}$			500	nA	
$Q_{G(on)}$	total gate charge	$V_{CE} = 600\text{ V}; V_{GE} = 15\text{ V}; I_C = 15\text{ A}$			48	nC	
$t_{d(on)}$	turn-on delay time	inductive load $V_{CE} = 600\text{ V}; I_C = 15\text{ A}$ $V_{GE} = \pm 15\text{ V}; R_G = 56\ \Omega$	$T_{VJ} = 125^{\circ}\text{C}$	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			1.55		mJ	
$E_{off}$	turn-off energy per pulse			1.7		mJ	
<b>RBSOA</b>	reverse bias safe operating area	$V_{GE} = \pm 15\text{ V}; R_G = 56\ \Omega; V_{CEK} = 1200\text{ V}$	$T_{VJ} = 125^{\circ}\text{C}$		45	A	
<b><math>I_{SC}</math> (SCSOA)</b>	short circuit safe operating area	$V_{CE} = 900\text{ V}; V_{GE} = \pm 15\text{ V};$ $R_G = 56\ \Omega; t_p = 10\ \mu\text{s};$ non-repetitive	$T_{VJ} = 125^{\circ}\text{C}$	60		A	
$R_{thJC}$	thermal resistance junction to case	(per IGBT)			1.26	K/W	
$R_{thCH}$	thermal resistance case to heatsink			0.42		K/W	

**Output Inverter D1 - D6**

Symbol	Definitions	Conditions	Ratings			Unit
			min.	typ.	max.	
$V_{RRM}$	max. repetitive reverse voltage		$T_{VJ} = 25^{\circ}\text{C}$		1200	V
$I_{F25}$	forward current		$T_C = 25^{\circ}\text{C}$		33	A
$I_{F80}$			$T_C = 80^{\circ}\text{C}$		22	A
$V_F$	forward voltage	$I_F = 20\text{ A}; V_{GE} = 0\text{ V}$	$T_{VJ} = 25^{\circ}\text{C}$ $T_{VJ} = 125^{\circ}\text{C}$	1.95 1.95	2.2	V V
$Q_{rr}$	reverse recovery charge	$V_R = 600\text{ V}$ $di_F/dt = -400\text{ A}/\mu\text{s}$ $I_F = 20\text{ A}; V_{GE} = 0\text{ V}$	$T_{VJ} = 125^{\circ}\text{C}$	3		$\mu\text{C}$
$I_{RM}$	max. reverse recovery current			20		A
$t_{rr}$	reverse recovery time			350		ns
$E_{rec}$	reverse recovery energy			0.7		mJ
$R_{thJC}$	thermal resistance junction to case	(per diode)			1.5	K/W
$R_{thCH}$	thermal resistance case to heatsink			0.5		K/W

**Brake T7**

Symbol	Definitions	Conditions	Ratings			Unit	
			min.	typ.	max.		
$V_{CES}$	collector emitter voltage	$T_{VJ} = 25^{\circ}\text{C}$			1200	V	
$V_{GES}$	max. DC gate voltage	continuous			$\pm 20$	V	
$V_{GEM}$	max. transient collector gate voltage	transient			$\pm 30$	V	
$I_{C25}$	collector current	$T_C = 25^{\circ}\text{C}$			17	A	
$I_{C80}$		$T_C = 80^{\circ}\text{C}$			12	A	
$P_{tot}$	total power dissipation	$T_C = 25^{\circ}\text{C}$			63	W	
$V_{CE(sat)}$	collector emitter saturation voltage	$I_C = 9\text{ A}; V_{GE} = 15\text{ V}$			1.8 2.1	V V	
$V_{GE(th)}$	gate emitter threshold voltage	$I_C = 0.3\text{ mA}; V_{GE} = V_{CE}$	$T_{VJ} = 25^{\circ}\text{C}$	5.5	6.0	6.5	V
$I_{CES}$	collector emitter leakage current	$V_{CE} = V_{CES}; V_{GE} = 0\text{ V}$	$T_{VJ} = 25^{\circ}\text{C}$ $T_{VJ} = 125^{\circ}\text{C}$		0.01 0.1	0.1	mA mA
$I_{GES}$	gate emitter leakage current	$V_{GE} = \pm 20\text{ V}$				500	nA
$Q_{G(on)}$	total gate charge	$V_{CE} = 600\text{ V}; V_{GE} = 15\text{ V}; I_C = 10\text{ A}$			27		nC
$t_{d(on)}$	turn-on delay time	inductive load $V_{CE} = 600\text{ V}; I_C = 10\text{ A}$ $V_{GE} = \pm 15\text{ V}; R_G = 100\ \Omega$	$T_{VJ} = 125^{\circ}\text{C}$		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				1.1		mJ
$E_{off}$	turn-off energy per pulse				1.1		mJ
<b>RBSOA</b>	reverse bias safe operating area	$V_{GE} = \pm 15\text{ V}; R_G = 100\ \Omega; V_{CEK} = 1200\text{ V}$				30	A
			$T_{VJ} = 125^{\circ}\text{C}$				
<b><math>I_{SC}</math> (SCSOA)</b>	short circuit safe operating area	$V_{CE} = 900\text{ V}; V_{GE} = \pm 15\text{ V};$ $R_G = 100\ \Omega; t_p = 10\ \mu\text{s};$ non-repetitive	$T_{VJ} = 125^{\circ}\text{C}$		40		A
$R_{thJC}$	thermal resistance junction to case	(per IGBT)				2.0	K/W
$R_{thCH}$	thermal resistance case to heatsink				0.7		K/W

**Brake Chopper D7**

Symbol	Definitions	Conditions	Ratings			Unit	
			min.	typ.	max.		
$V_{RRM}$	max. repetitive reverse voltage	$T_{VJ} = 150^{\circ}\text{C}$			1200	V	
$I_{F25}$	forward current	$T_C = 25^{\circ}\text{C}$			33	A	
$I_{F80}$		$T_C = 80^{\circ}\text{C}$			22	A	
$V_F$	forward voltage	$I_F = 20\text{ A}; V_{GE} = 0\text{ V}$	$T_{VJ} = 25^{\circ}\text{C}$ $T_{VJ} = 125^{\circ}\text{C}$		1.95 1.95	2.2	V V
$I_R$	reverse current	$V_R = V_{RRM}$	$T_{VJ} = 25^{\circ}\text{C}$ $T_{VJ} = 125^{\circ}\text{C}$		0.01 0.1	0.1	mA mA
$Q_{rr}$	reverse recovery charge	$V_R = 600\text{ V}$ $di_F/dt = 400\text{ A}/\mu\text{s}$ $I_F = 20\text{ A}; V_{GE} = 0\text{ V}$	$T_{VJ} = 125^{\circ}\text{C}$		3		$\mu\text{C}$
$I_{RM}$	max. reverse recovery current				20		A
$t_{rr}$	reverse recovery time				350		ns
$E_{rec}$	reverse recovery energy				0.7		mJ
$R_{thJC}$	thermal resistance junction to case	(per diode)				1.5	K/W
$R_{thCH}$	thermal resistance case to heatsink				0.5		K/W

**Input Rectifier Bridge D8 - D11**

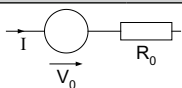
Symbol	Definitions	Conditions	Ratings			Unit
			min.	typ.	max.	
$V_{RRM}$	max. repetitive reverse voltage		$T_{VJ} = 25^{\circ}\text{C}$		1600	V
$I_{FAV}$	average forward current	sine $180^{\circ}$	$T_C = 80^{\circ}\text{C}$		37	A
$I_{DAVM}$	max. average DC output current	rect.; $d = 1/3$	$T_C = 80^{\circ}\text{C}$		105	A
$I_{FSM}$	max. forward surge current	$t = 10\text{ ms}$ ; sine 50 Hz	$T_{VJ} = 25^{\circ}\text{C}$ $T_{VJ} = 125^{\circ}\text{C}$		320 280	A A
$I^2t$	$I^2t$ value for fusing	$t = 10\text{ ms}$ ; sine 50 Hz	$T_{VJ} = 25^{\circ}\text{C}$ $T_{VJ} = 125^{\circ}\text{C}$		510 390	$\text{A}^2\text{s}$ $\text{A}^2\text{s}$
$P_{tot}$	total power dissipation		$T_C = 25^{\circ}\text{C}$		110	W
$V_F$	forward voltage	$I_F = 50\text{ A}$	$T_{VJ} = 25^{\circ}\text{C}$ $T_{VJ} = 125^{\circ}\text{C}$	1.36 1.36	1.7	V V
$I_R$	reverse current	$V_R = V_{RRM}$	$T_{VJ} = 25^{\circ}\text{C}$ $T_{VJ} = 125^{\circ}\text{C}$	0.2	0.02	mA mA
$R_{thJC}$	thermal resistance junction to case	(per diode)		0.36	1.1	K/W
$R_{thCH}$	thermal resistance case to heatsink	(per diode)				K/W

**Temperature Sensor NTC**

Symbol	Definitions	Conditions	Ratings			Unit
			min.	typ.	max.	
$R_{25}$	resistance		$T_C = 25^{\circ}\text{C}$	4.45	4.7	$\text{k}\Omega$
$B_{25/50}$					3510	K

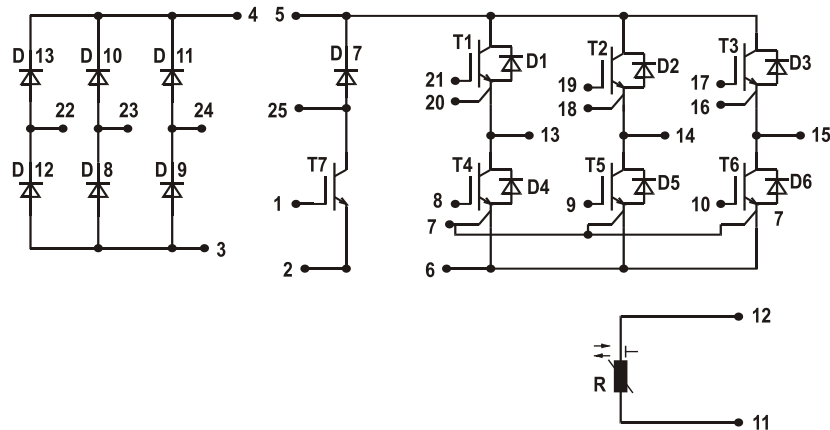
**Module**

Symbol	Definitions	Conditions	Ratings			Unit
			min.	typ.	max.	
$T_{VJ}$	operating temperature		-40		125	$^{\circ}\text{C}$
$T_{VJM}$	max. virtual junction temperature				150	$^{\circ}\text{C}$
$T_{stg}$	storage temperature		-40		125	$^{\circ}\text{C}$
$V_{ISOL}$	isolation voltage	$I_{ISOL} \leq 1\text{ mA}$ ; 50/60 Hz			2500	V~
CTI	comparative tracking index				-	
$M_d$	mounting torque	(M4)	2.0		2.2	Nm
$d_s$	creep distance on surface		12.7			mm
$d_A$	strike distance through air		7.6			mm
Weight				40		g

**Equivalent Circuits for Simulation**


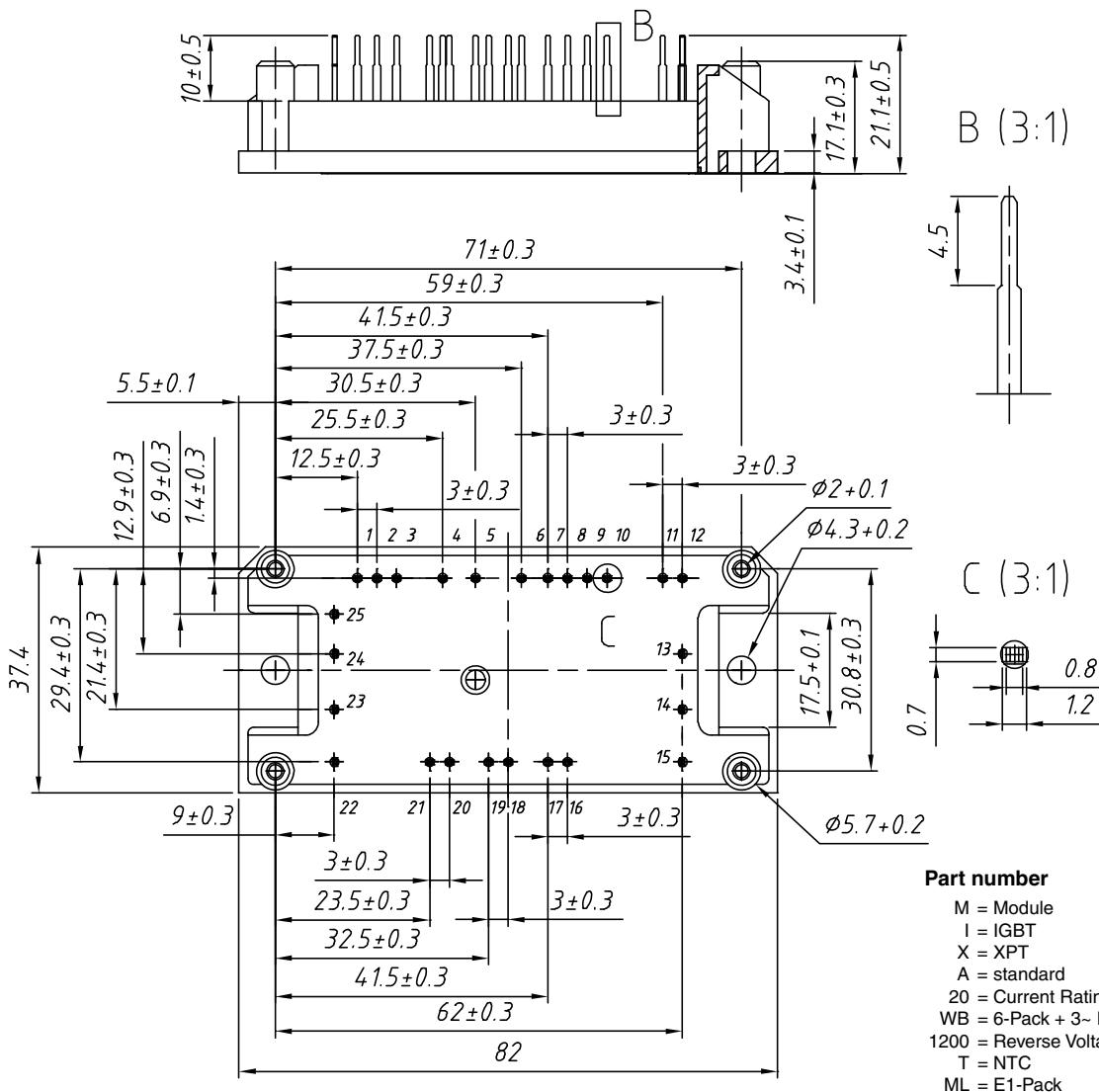
Symbol	Definitions	Conditions	Ratings			Unit
			min.	typ.	max.	
$V_0$	rectifier diode	D8 - D13	$T_{VJ} = 150^{\circ}\text{C}$		0.88	V
$R_0$					9.0	$\text{m}\Omega$
$V_0$	IGBT	T1 - T6	$T_{VJ} = 150^{\circ}\text{C}$		1.1	V
$R_0$					86.3	$\text{m}\Omega$
$V_0$	free wheeling diode	D1 - D6	$T_{VJ} = 150^{\circ}\text{C}$		1.19	V
$R_0$					40.0	$\text{m}\Omega$
$V_0$	IGBT	T7	$T_{VJ} = 150^{\circ}\text{C}$		1.1	V
$R_0$					153	$\text{m}\Omega$
$V_0$	free wheeling diode	D7	$T_{VJ} = 150^{\circ}\text{C}$		1.19	V
$R_0$					40	$\text{m}\Omega$

### Circuit Diagram



### Outline Drawing

Dimensions in mm (1 mm = 0.0394")



Ordering	Part Name	Marking on Product	Delivering Mode	Base Qty	Ordering Code
Standard	MIXA 20 WB 1200 TML	MIXA20WB1200TML	Box	10	508630

## IGBT T1 - T6

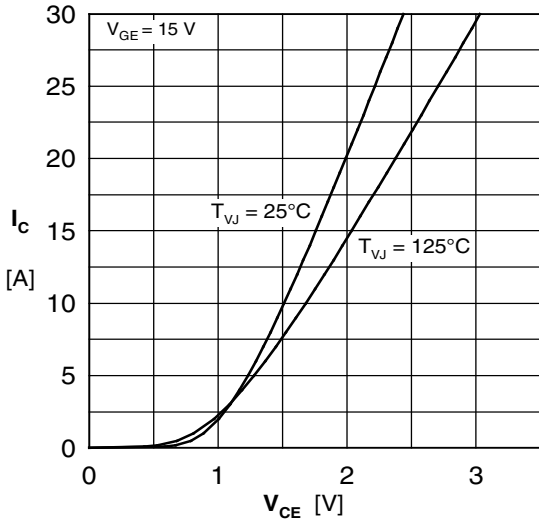


Fig. 1 Typ. output characteristics

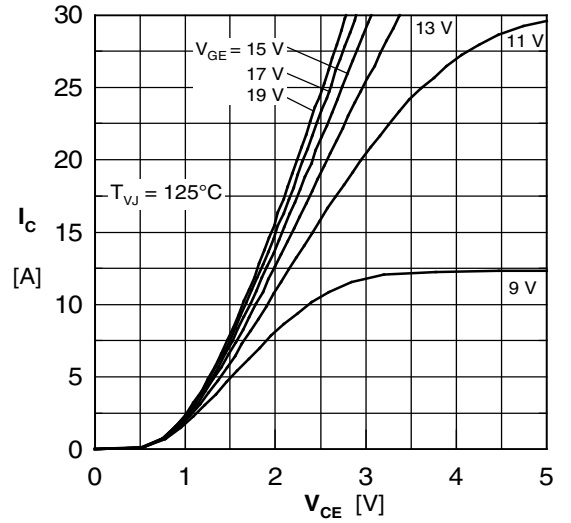


Fig. 2 Typ. output characteristics

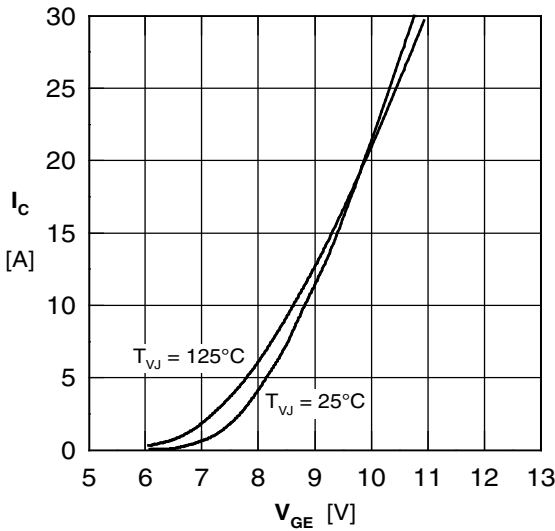


Fig. 3 Typ. transfer characteristics

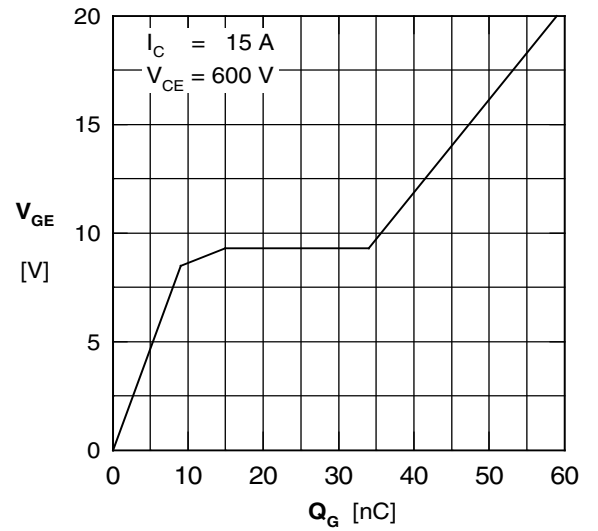


Fig. 4 Typ. turn-on gate charge

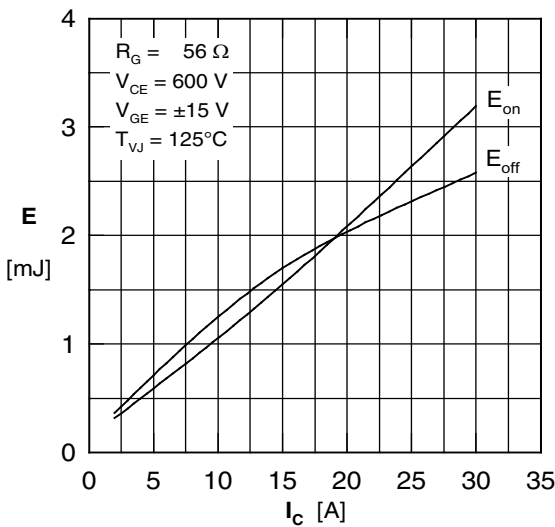


Fig. 5 Typ. switching energy vs. collector current

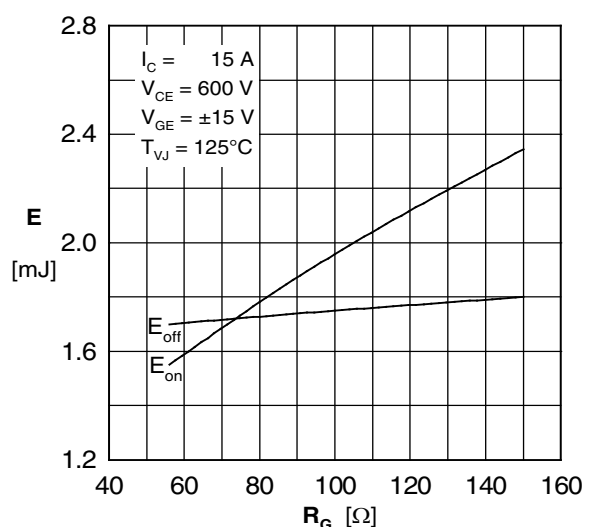


Fig. 6 Typ. switching energy vs. gate resistance

### Diode D1 - D6

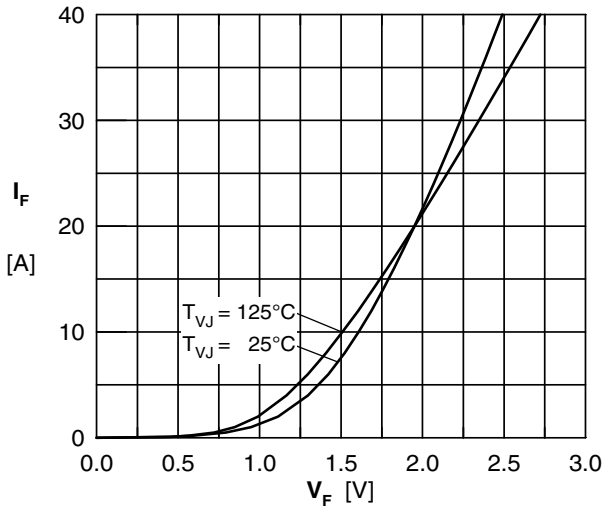


Fig. 7 Typ. Forward current versus  $V_F$

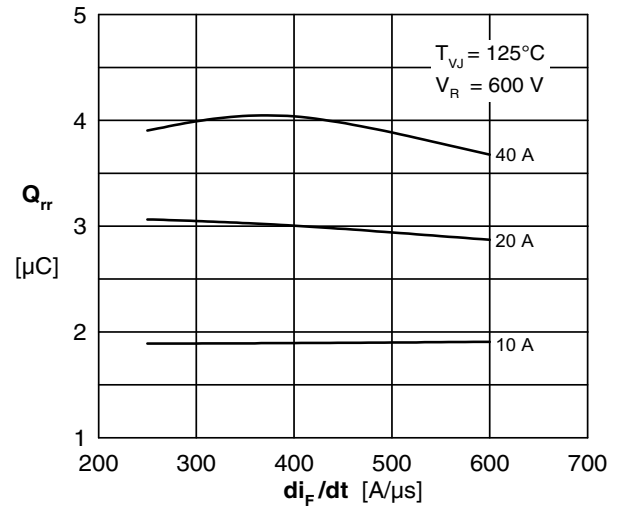


Fig. 8 Typ. reverse recov.charge  $Q_{rr}$  vs.  $di/dt$

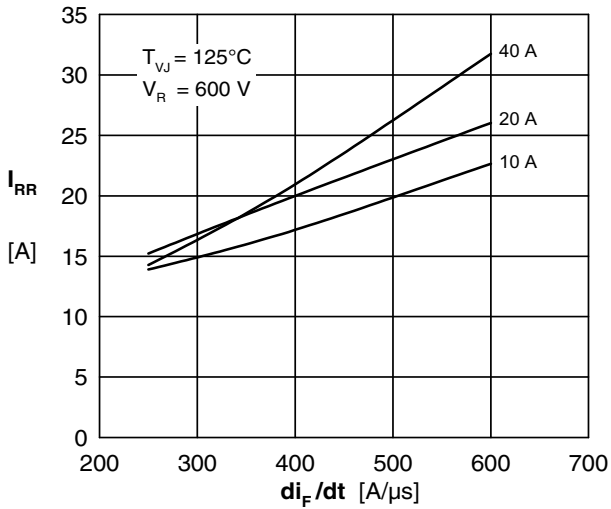


Fig. 9 Typ. peak reverse current  $I_{RRM}$  vs.  $di/dt$

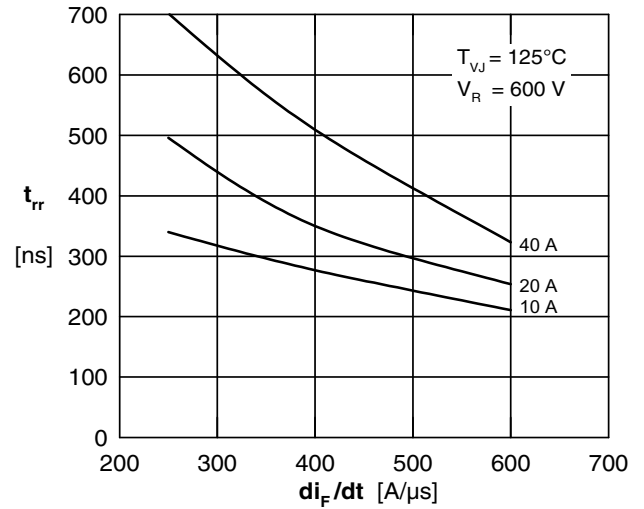


Fig. 10 Typ. recovery time  $t_{rr}$  versus  $di/dt$

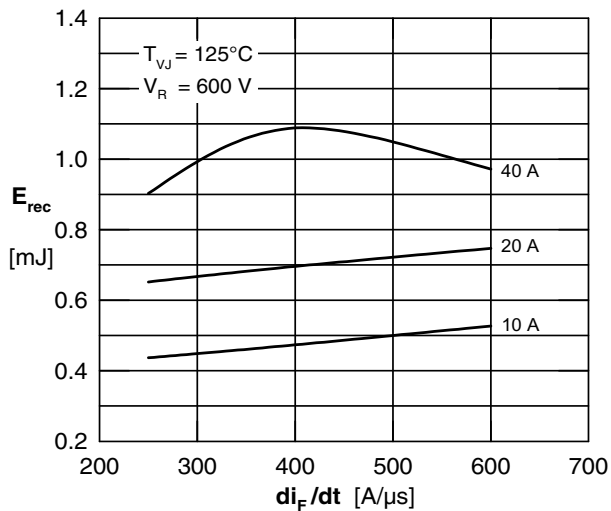


Fig. 11 Typ. recovery energy  $E_{rec}$  versus  $di/dt$

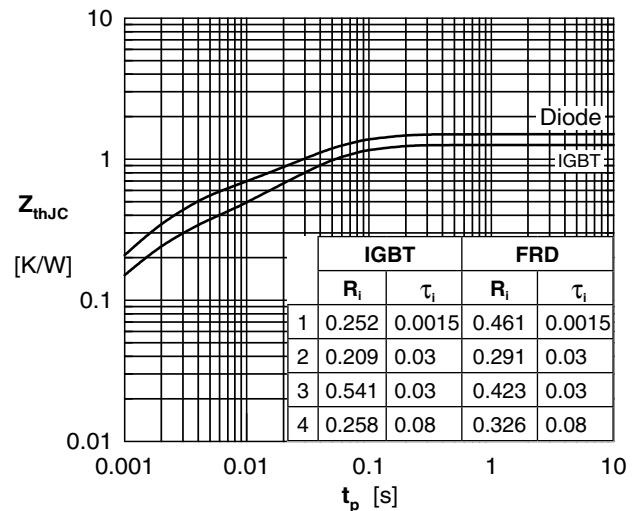


Fig. 12 Typ. transient thermal impedance

**NTC**

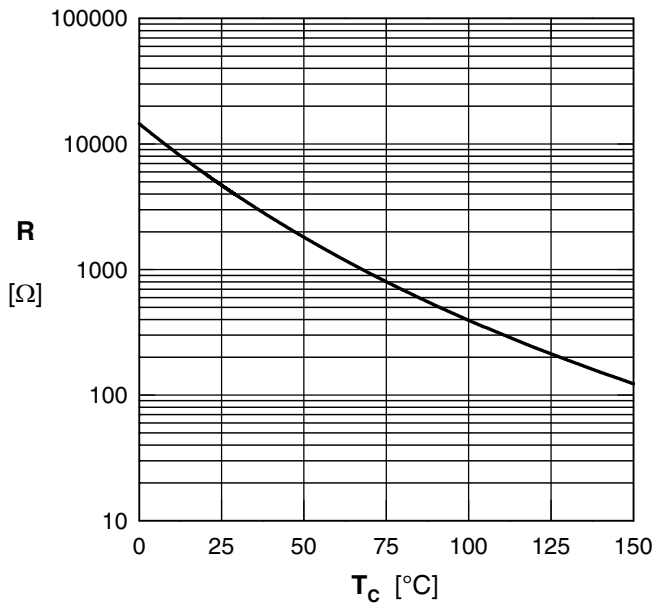


Fig. 13 Typ. thermistor resistance vs. temperature