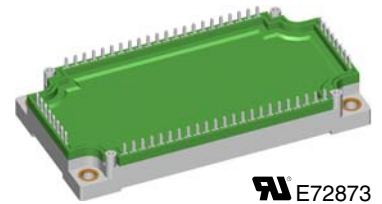
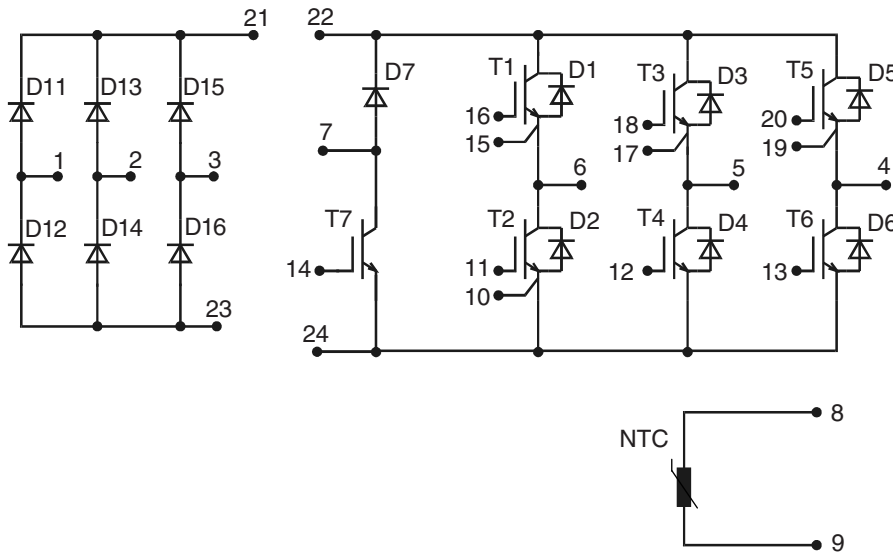


# Converter - Brake - Inverter Module (CBI3)



E72873

See outline drawing for pin arrangement

Three Phase Rectifier	Brake Chopper	Three Phase Inverter
$V_{RRM} = 1600\text{ V}$	$V_{CES} = 1200\text{ V}$	$V_{CES} = 1200\text{ V}$
$I_{FAVM} = 70\text{ A}$	$I_{C25} = 52\text{ A}$	$I_{C25} = 90\text{ A}$
$I_{FSM} = 700\text{ A}$	$V_{CE(sat)} = 2.2\text{ V}$	$V_{CE(sat)} = 1.9\text{ V}$

### Input Rectifier Bridge D11 - D16

Symbol	Conditions	Maximum Ratings	
$V_{RRM}$		1600	V
$I_{FAV}$	$T_C = 80^\circ\text{C}$ ; sine 180°	50	A
$I_{DAVM}$	$T_C = 80^\circ\text{C}$ ; rectangular; $d = 1/3$ ; bridge	140	A
$I_{FSM}$	$T_{VJ} = 25^\circ\text{C}$ ; $t = 10\text{ ms}$ ; sine 50 Hz	700	A
$P_{tot}$	$T_C = 25^\circ\text{C}$	135	W

Symbol	Conditions	Characteristic Values ( $T_{VJ} = 25^\circ\text{C}$ , unless otherwise specified)		
		min.	typ.	max.
$V_F$	$I_F = 50\text{ A}$ ; $T_{VJ} = 25^\circ\text{C}$ $T_{VJ} = 125^\circ\text{C}$		1.1 1.1	1.3 V V
$I_R$	$V_R = V_{RRM}$ ; $T_{VJ} = 25^\circ\text{C}$ $T_{VJ} = 125^\circ\text{C}$		0.8	0.05 mA mA
$R_{thJC}$	(per diode)			0.94 K/W

### Application: AC motor drives with

- Input from single or three phase grid
- Three phase synchronous or asynchronous motor
- electric braking operation

### Features

- High level of integration - only one power semiconductor module required for the whole drive
- IGBT technology with low saturation voltage, low switching losses and tail current, high RBSOA and short circuit ruggedness
- Epitaxial free wheeling diodes with Hiperfast and soft reverse recovery
- Industry standard package with insulated copper base plate and soldering pins for PCB mounting
- Temperature sense included

**Output Inverter T1 - T6**

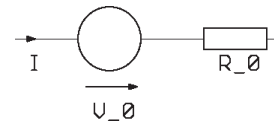
Symbol	Conditions	Maximum Ratings	
$V_{CES}$	$T_{VJ} = 25^{\circ}\text{C}$ to $150^{\circ}\text{C}$	1200	V
$V_{GES}$	Continuous	$\pm 20$	V
$I_{C25}$	$T_C = 25^{\circ}\text{C}$	90	A
$I_{C80}$	$T_C = 80^{\circ}\text{C}$	62	A
$I_{CM}$ $V_{CEK}$	$V_{GE} = \pm 15\text{ V}$ ; $R_G = 22\ \Omega$ ; $T_{VJ} = 125^{\circ}\text{C}$ RBSOA; Clamped inductive load; $L = 100\ \mu\text{H}$	100 $V_{CES}$	A
$t_{SC}$ (SCSOA)	$V_{CE} = 900\text{ V}$ ; $V_{GE} = \pm 15\text{ V}$ ; $R_G = 22\ \Omega$ ; $T_{VJ} = 125^{\circ}\text{C}$ non-repetitive	10	$\mu\text{s}$
$P_{tot}$	$T_C = 25^{\circ}\text{C}$	350	W

Symbol	Conditions	Characteristic Values			
		$(T_{VJ} = 25^{\circ}\text{C}$ , unless otherwise specified)			
		min.	typ.	max.	
$V_{CE(sat)}$	$I_C = 50\text{ A}$ ; $V_{GE} = 15\text{ V}$ ; $T_{VJ} = 25^{\circ}\text{C}$ $T_{VJ} = 125^{\circ}\text{C}$		1.9 2.1	2.4 V	
$V_{GE(th)}$	$I_C = 2\text{ mA}$ ; $V_{GE} = V_{CE}$	4.5		6.5 V	
$I_{CES}$	$V_{CE} = V_{CES}$ ; $V_{GE} = 0\text{ V}$ ; $T_{VJ} = 25^{\circ}\text{C}$ $T_{VJ} = 125^{\circ}\text{C}$		0.8	0.8 mA mA	
$I_{GES}$	$V_{CE} = 0\text{ V}$ ; $V_{GE} = \pm 20\text{ V}$			200 nA	
$t_{d(on)}$ $t_r$ $t_{d(off)}$ $t_f$ $E_{on}$ $E_{off}$	Inductive load, $T_{VJ} = 125^{\circ}\text{C}$ $V_{CE} = 600\text{ V}$ ; $I_C = 50\text{ A}$ $V_{GE} = \pm 15\text{ V}$ ; $R_G = 22\ \Omega$		80	ns	
				50	ns
				680	ns
				30	ns
				6	mJ
				4	mJ
$C_{ies}$	$V_{CE} = 25\text{ V}$ ; $V_{GE} = 0\text{ V}$ ; $f = 1\text{ MHz}$		3.8	nF	
$Q_{Gon}$	$V_{CE} = 600\text{ V}$ ; $V_{GE} = 15\text{ V}$ ; $I_C = 50\text{ A}$		350	nC	
$R_{thJC}$	(per IGBT)			0.35 K/W	

**Output Inverter D1 - D6**

Symbol	Conditions	Maximum Ratings	
$I_{F25}$	$T_C = 25^{\circ}\text{C}$	110	A
$I_{F80}$	$T_C = 80^{\circ}\text{C}$	70	A

Symbol	Conditions	Characteristic Values		
		min.	typ.	max.
$V_F$	$I_F = 50\text{ A}$ ; $V_{GE} = 0\text{ V}$ ; $T_{VJ} = 25^{\circ}\text{C}$ $T_{VJ} = 125^{\circ}\text{C}$		2.1 1.5	2.5 V
$I_{RM}$ $t_{rr}$	$I_F = 60\text{ A}$ ; $di_F/dt = -500\text{ A}/\mu\text{s}$ ; $T_{VJ} = 125^{\circ}\text{C}$ $V_R = 600\text{ V}$ ; $V_{GE} = 0\text{ V}$		41	A
			200	ns
$R_{thJC}$	(per diode)			0.61 K/W

**Equivalent Circuits for Simulation**
**Conduction**

 IGBT (typ. at  $V_{GE} = 15\text{ V}$ ;  $T_J = 125^{\circ}\text{C}$ )  
T1-T6

$$V_0 = 0.98\text{ V}; R_0 = 23.2\text{ m}\Omega$$

T7

$$V_0 = 0.95\text{ V}; R_0 = 45\text{ m}\Omega$$

 Diode (typ. at  $T_J = 125^{\circ}\text{C}$ )

D1-D6

$$V_0 = 1.27\text{ V}; R_0 = 5.8\text{ m}\Omega$$

D7

$$V_0 = 1.25\text{ V}; R_0 = 31.2\text{ m}\Omega$$

D11-D16

$$V_0 = 0.83\text{ V}; R_0 = 5.5\text{ m}\Omega$$

**Brake Chopper T7**

Symbol	Conditions	Maximum Ratings	
$V_{CES}$	$T_{VJ} = 25^{\circ}\text{C}$ to $150^{\circ}\text{C}$	1200	V
$V_{GES}$	Continuous	$\pm 20$	V
$I_{C25}$	$T_C = 25^{\circ}\text{C}$	52	A
$I_{C80}$	$T_C = 80^{\circ}\text{C}$	35	A
$I_{CM}$ $V_{CEK}$	$V_{GE} = \pm 15\text{ V}$ ; $R_G = 39\ \Omega$ ; $T_{VJ} = 125^{\circ}\text{C}$ RBSOA; Clamped inductive load; $L = 100\ \mu\text{H}$	50 $V_{CES}$	A
$t_{SC}$ (SCSOA)	$V_{CE} = 900\text{ V}$ ; $V_{GE} = \pm 15\text{ V}$ ; $R_G = 39\ \Omega$ ; $T_{VJ} = 125^{\circ}\text{C}$ non-repetitive	10	$\mu\text{s}$
$P_{tot}$	$T_C = 25^{\circ}\text{C}$	225	W

Symbol	Conditions	Characteristic Values		
		$(T_{VJ} = 25^{\circ}\text{C}$ , unless otherwise specified)		
		min.	typ.	max.
$V_{CE(sat)}$	$I_C = 35\text{ A}$ ; $V_{GE} = 15\text{ V}$ ; $T_{VJ} = 25^{\circ}\text{C}$ $T_{VJ} = 125^{\circ}\text{C}$	2.2	2.8	V
		2.5		V
$V_{GE(th)}$	$I_C = 1\text{ mA}$ ; $V_{GE} = V_{CE}$	4.5	6.5	V
$I_{CES}$	$V_{CE} = V_{CES}$ ; $V_{GE} = 0\text{ V}$ ; $T_{VJ} = 25^{\circ}\text{C}$ $T_{VJ} = 125^{\circ}\text{C}$	0.1	0.1	mA mA
$I_{GES}$	$V_{CE} = 0\text{ V}$ ; $V_{GE} = \pm 20\text{ V}$		200	nA
$t_{d(on)}$ $t_r$ $t_{d(off)}$ $t_t$ $E_{off}$	Inductive load, $T_{VJ} = 125^{\circ}\text{C}$ $V_{CE} = 600\text{ V}$ ; $I_C = 35\text{ A}$ $V_{GE} = \pm 15\text{ V}$ ; $R_G = 39\ \Omega$	85		ns
		50		ns
		440		ns
		50		ns
		2.6		mJ
$C_{ies}$	$V_{CE} = 25\text{ V}$ ; $V_{GE} = 0\text{ V}$ ; $f = 1\text{ MHz}$	2		nF
$Q_{Gon}$	$V_{CE} = 600\text{ V}$ ; $V_{GE} = 15\text{ V}$ ; $I_C = 35\text{ A}$	150		nC
$R_{thJC}$			0.55	K/W

**Brake Chopper D7**

Symbol	Conditions	Maximum Ratings	
$V_{RRM}$	$T_{VJ} = 25^{\circ}\text{C}$ to $150^{\circ}\text{C}$	1200	V
$I_{F25}$	$T_C = 25^{\circ}\text{C}$	25	A
$I_{F80}$	$T_C = 80^{\circ}\text{C}$	16	A

Symbol	Conditions	Characteristic Values		
		min.	typ.	max.
$V_F$	$I_F = 35\text{ A}$ ; $T_{VJ} = 25^{\circ}\text{C}$ $T_{VJ} = 125^{\circ}\text{C}$	3.0	3.4	V
		2.3		V
$I_R$	$V_R = V_{RRM}$ ; $T_{VJ} = 25^{\circ}\text{C}$ $T_{VJ} = 125^{\circ}\text{C}$	0.1	0.1	mA mA
$I_{RM}$ $t_{tr}$	$I_F = 15\text{ A}$ ; $di_F/dt = -400\text{ A}/\mu\text{s}$ ; $T_{VJ} = 125^{\circ}\text{C}$ $V_R = 600\text{ V}$	16		A
		130		ns
$R_{thJC}$			2.1	K/W



**Input Rectifier Bridge D11 - D16**

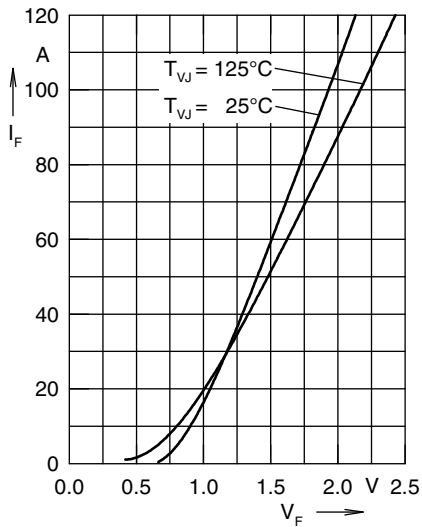


Fig. 1 Forward current versus voltage drop per diode

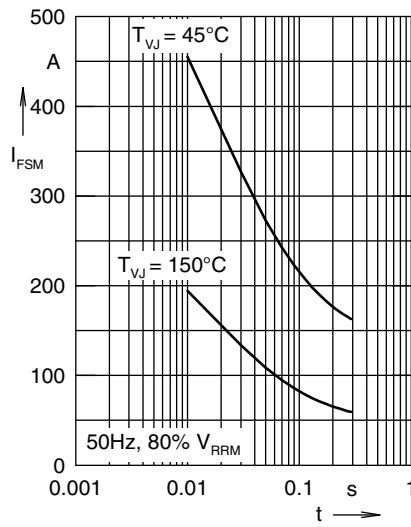


Fig. 2 Surge overload current

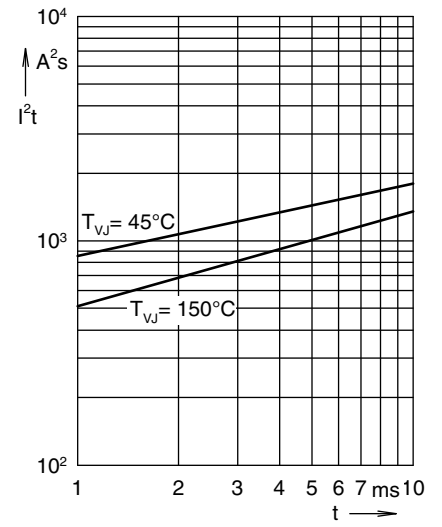


Fig. 3  $I^2t$  versus time per diode

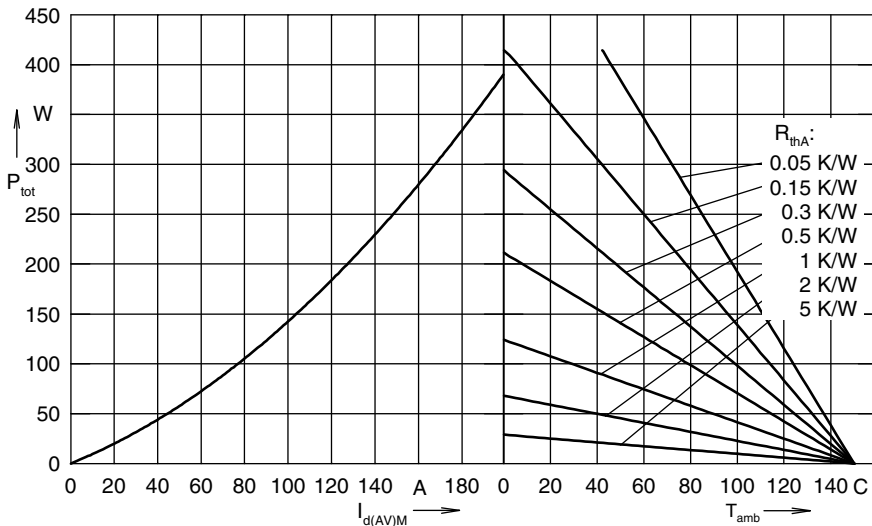


Fig. 4 Power dissipation versus direct output current and ambient temperature, sin 180°

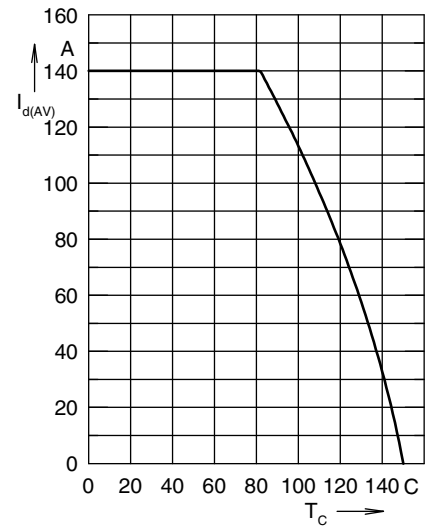


Fig. 5 Max. forward current versus case temperature

**Output Inverter T1 - T6 / D1 - D6**

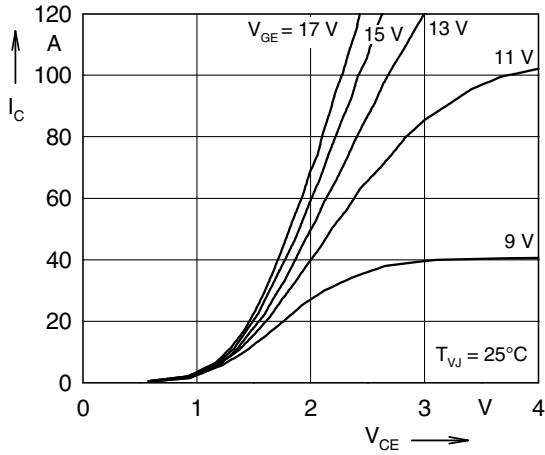


Fig. 7 Typ. output characteristics

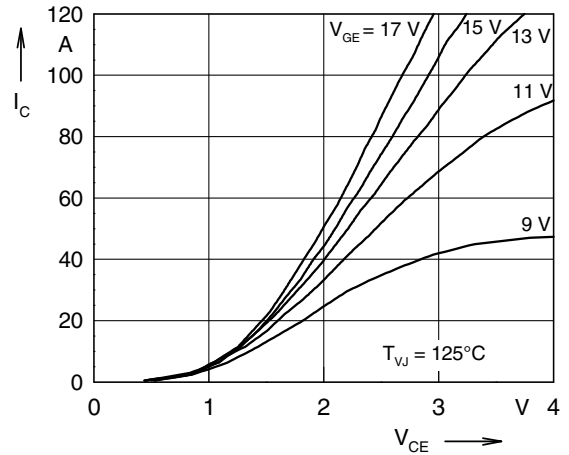


Fig. 8 Typ. output characteristics

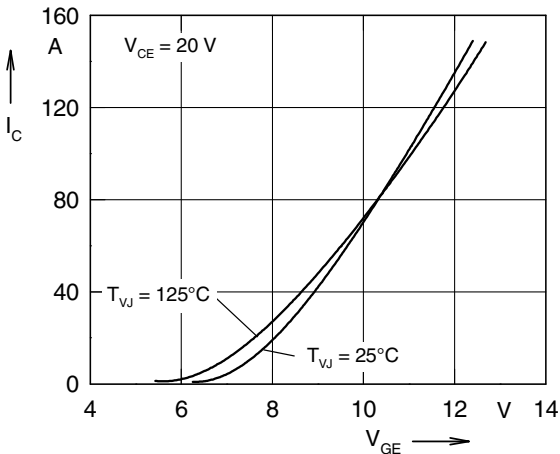


Fig. 9 Typ. transfer characteristics

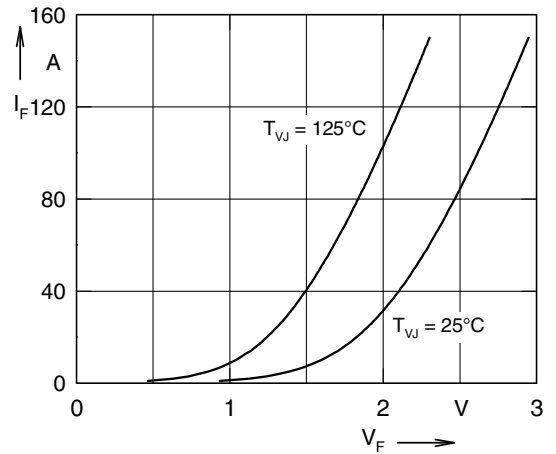


Fig. 10 Typ. forward characteristics of free wheeling diode

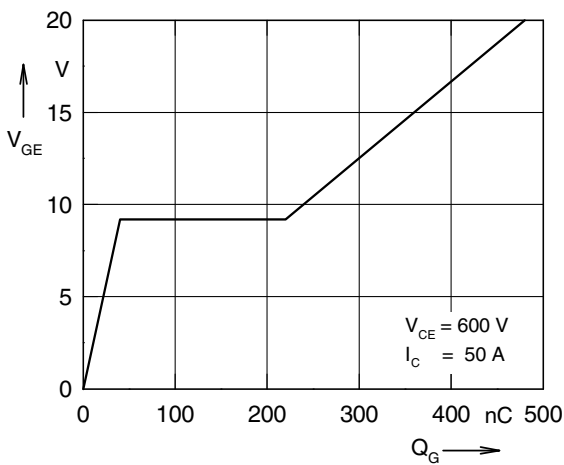


Fig. 11 Typ. turn on gate charge

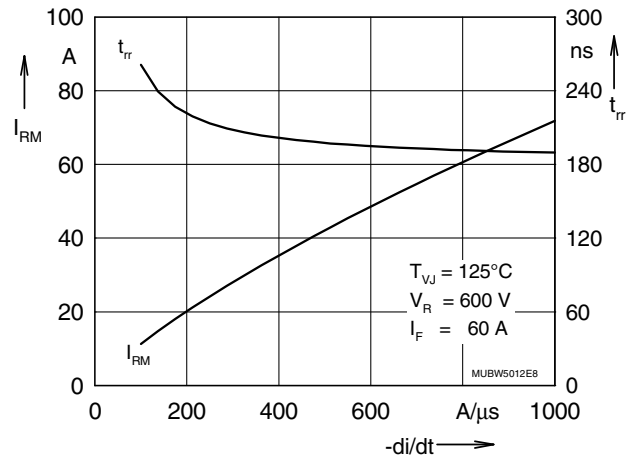


Fig. 12 Typ. turn off characteristics of free wheeling diode

Output Inverter T1 - T6 / D1 - D6

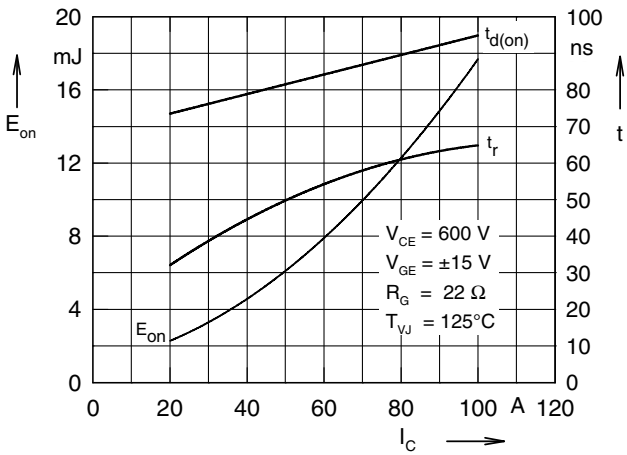


Fig. 13 Typ. turn on energy and switching times versus collector current

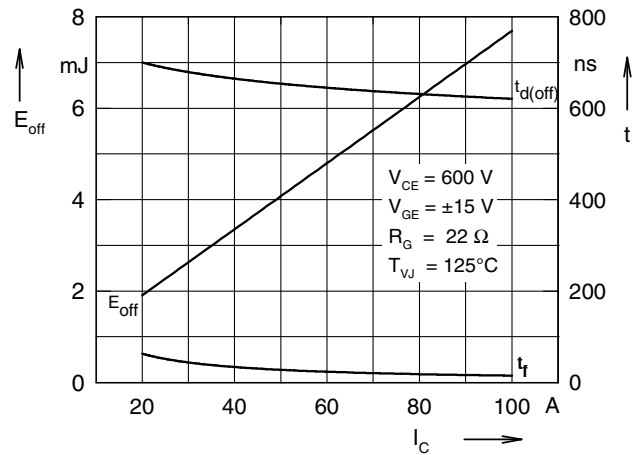


Fig. 14 Typ. turn off energy and switching times versus collector current

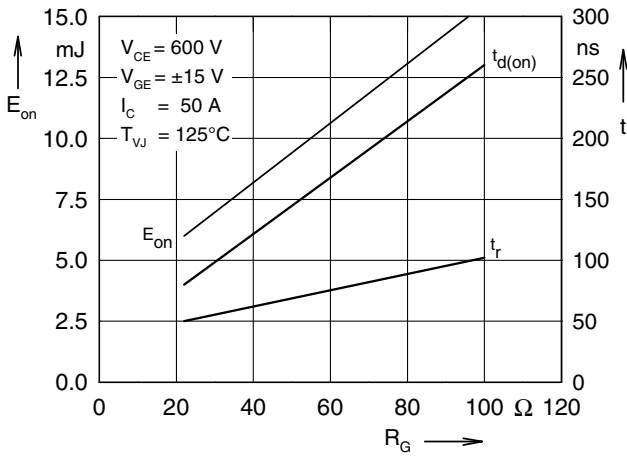


Fig. 15 Typ. turn on energy and switching times versus gate resistor

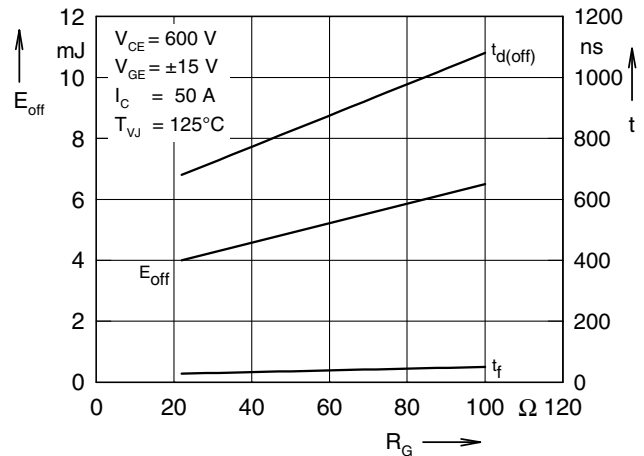


Fig. 16 Typ. turn off energy and switching times versus gate resistor

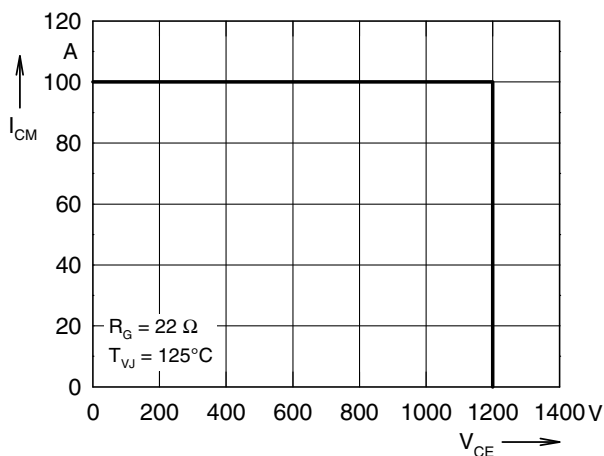


Fig. 17 Reverse biased safe operating area RBSOA

**Brake Chopper T7 / D7**

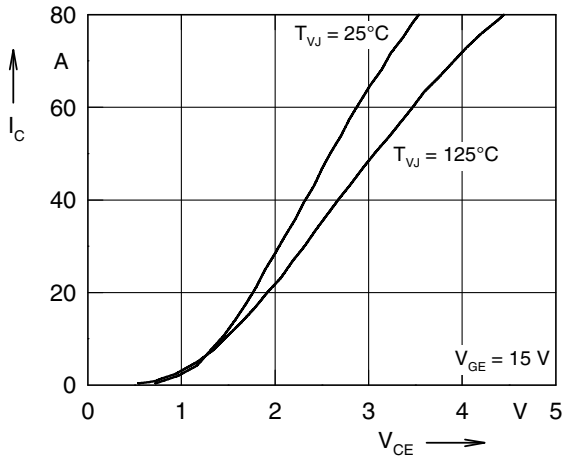


Fig. 19 Typ. output characteristics

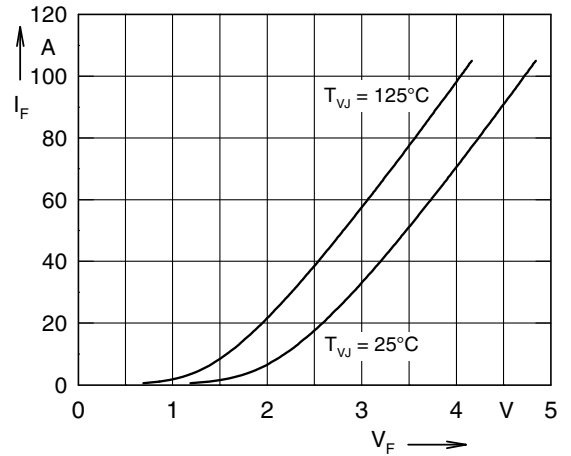


Fig. 20 Typ. forward characteristics of free wheeling diode

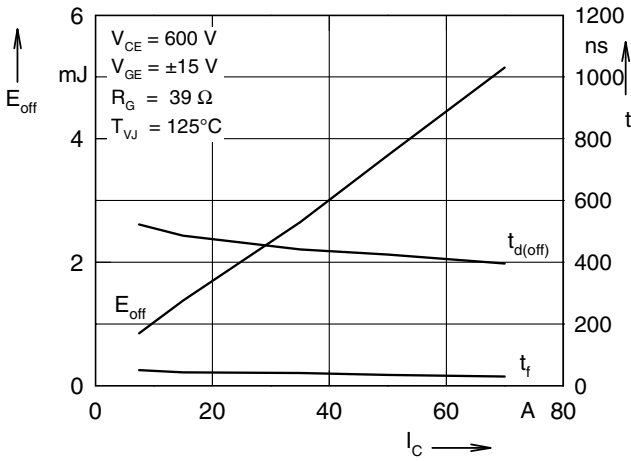


Fig. 21 Typ. turn off energy and switching times versus collector current

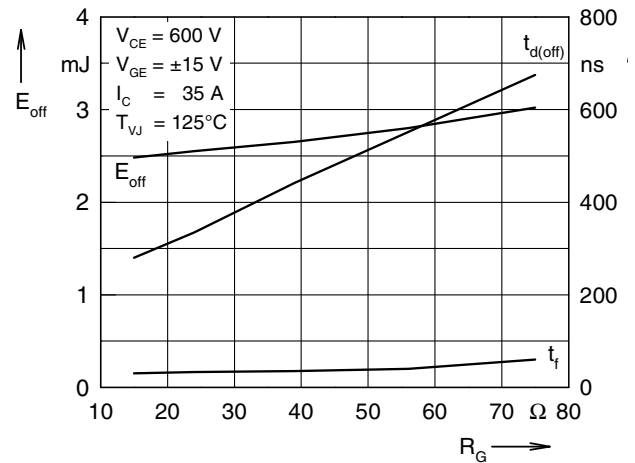


Fig. 22 Typ. turn off energy and switching times versus gate resistor

**Temperature Sensor NTC**

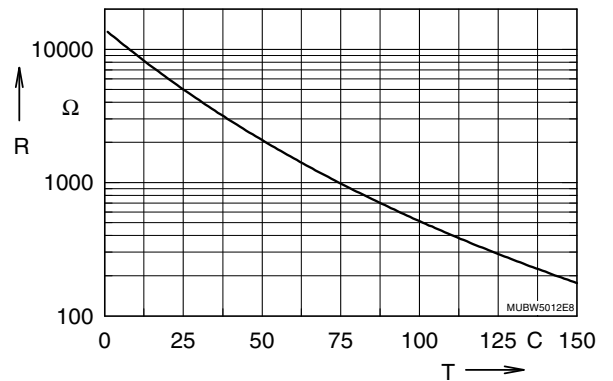


Fig. 24 Typ. thermistorresistance versus temperature