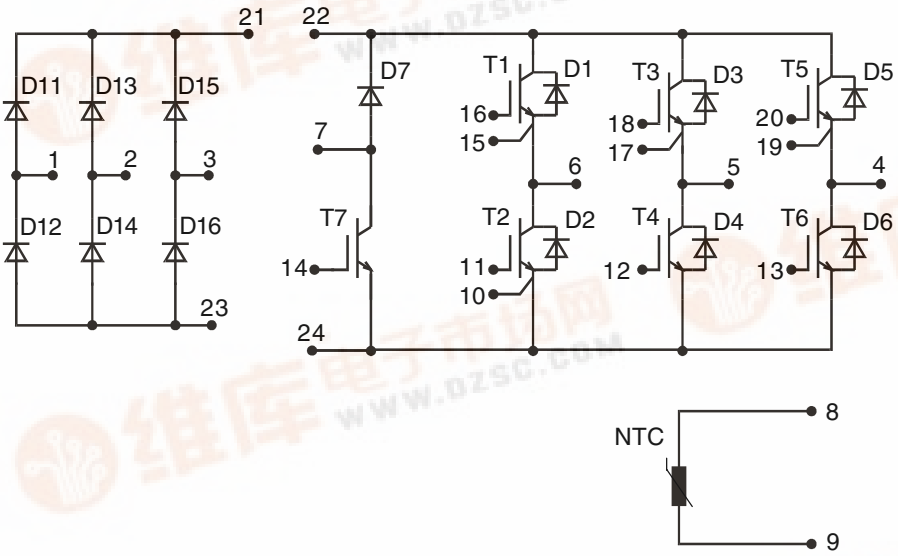
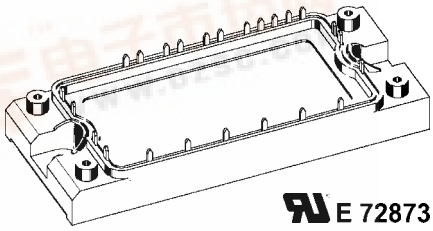
Converter - Brake - Inverter Module (CBI2)





Three Phase Rectifier	Brake Chopper	Three Phase Inverter
V_{RRM} = 1600V	V_{CES} = 1200 V	V_{CES} = 1200 V
I_{DAVM} = 36 A	I_{C25} = 20 A	I_{C25} = 50 A
I_{FSM} = 300 A	$V_{CE(sat)}$ = 2.9 V	$V_{CE(sat)}$ = 2.2 V

Input Rectifier Bridge D11 - D16

Symbol	Conditions	Maximum Ratings	
V_{RRM}		1600	V
I_{FAV}	T_C = 80°C; sine 180°	25	A
I_{DAVM}	T_C = 80°C; rectangular; d = 1/3	24	A
I_{FSM}	T_{VJ} = 25°C; t = 10 ms; sine 50 Hz	300	A
P_{tot}	T_C = 25°C	100	W

Symbol	Conditions	Characteristic Values (T_{VJ} = 25°C, unless otherwise specified) min.	typ.	max.	
V_F	I_F = 25 A; T_{VJ} = 25°C		1.4	1.7	V
	T_{VJ} = 125°C		1.4		V
I_R	V_R = V_{RRM}; T_{VJ} = 25°C			0.15	mA
	T_{VJ} = 125°C		1.2		mA
t_{rr}	V_R = 100 V; I_F = 15 A; di/dt = -15 A/µs		1		µs
R_{thJC}	(per diode)			1.3	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
- Fast rectifier diodes for enhanced EMC behaviour
- NPT IGBT technology with low saturation voltage, low switching losses, 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°C to 150°C	1200	V
V_{GES}	Continuous	± 20	V
V_{GEM}	Transient	± 30	V
I_{C25}	T_C = 25°C	50	A
I_{C80}	T_C = 80°C	35	A
RBSOA	V_{GE} = ±15 V; R_G = 47 Ω; T_{VJ} = 125°C Clamped inductive load; L = 100 µH	I_{CM} = 50 $V_{CEK} \le V_{CES}$	A
t_{SC} (SCSOA)	V_{CE} = V_{CES}; V_{GE} = ±15 V; R_G = 47 Ω; T_{VJ} = 125°C non-repetitive	10	µs
P_{tot}	T_C = 25°C	225	W

Symbol	Conditions	Characteristic Values (T_{VJ} = 25°C, unless otherwise specified) min.	typ.	max.	
$V_{CE(sat)}$	I_C = 25 A; V_{GE} = 15 V; T_{VJ} = 25°C		2.2	2.7	V
	T_{VJ} = 125°C		2.5		V
$V_{GE(th)}$	I_C = 1 mA; V_{GE} = V_{CE}	4.5		6.5	V
I_{CES}	V_{CE} = V_{CES}; V_{GE} = 0 V; T_{VJ} = 25°C			0.9	mA
	T_{VJ} = 125°C		0.9		mA
I_{GES}	V_{CE} = 0 V; V_{GE} = ± 20 V			200	nA
$t_{d(on)}$	Inductive load, T_{VJ} = 125°C V_{CE} = 600 V; I_C = 25 A V_{GE} = ±15 V; R_G = 47 Ω		100		ns
t_r			70		ns
$t_{d(off)}$			500		ns
t_f			70		ns
E_{on}			2.8		mJ
E_{off}			3.8		mJ
C_{ies}	V_{CE} = 25 V; V_{GE} = 0 V; f = 1 MHz		1650		pF
Q_{Gon}	V_{CE} = 600V; V_{GE} = 15 V; I_C = 25 A		120		nC
R_{thJC}	(per IGBT)			0.55	K/W

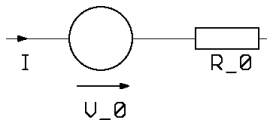
Output Inverter D1 - D6

Symbol	Conditions	Maximum Ratings	
I_{F25}	T_C = 25°C	28	A
I_{F80}	T_C = 80°C	18	A

Symbol	Conditions	Characteristic Values min.	typ.	max.	
V_F	I_F = 15 A; V_{GE} = 0 V; T_{VJ} = 25°C			3.1	V
	T_{VJ} = 125°C		2.1		V
I_{RM}	I_F = 25 A; di_F/dt = -400A/µs; T_{VJ} = 125°C		16		A
t_{rr}	V_R = 600 V; V_{GE} = 0 V		130		ns
R_{thJC}	(per diode)			2.1	K/W

Equivalent Circuits for Simulation

Conduction



D11 - D16

Rectifier Diode (typ. at T_J = 125°C)
V_0 = 1.16 V; R_0 = 9 mΩ

T1 - T6 / D1 - D6

IGBT (typ. at V_{GE} = 15 V; T_J = 125°C)
V_0 = 1.38 V; R_0 = 46 mΩ

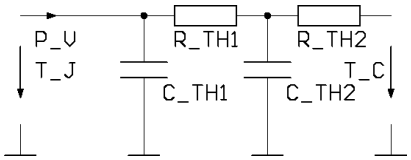
Free Wheeling Diode (typ. at T_J = 125°C)
V_0 = 1.32 V; R_0 = 30 mΩ

T7 / D7

IGBT (typ. at V_{GE} = 15 V; T_J = 125°C)
V_0 = 1.32 V; R_0 = 131 mΩ

Free Wheeling Diode (typ. at T_J = 125°C)
V_0 = 1.39 V; R_0 = 56 mΩ

Thermal Response



D11 - D16

Rectifier Diode (typ.)
C_{th1} = 0.106 J/K; R_{th1} = 1.06 K/W
C_{th2} = 0.79 J/K; R_{th2} = 0.239 K/W

T1 - T6 / D1 - D6

IGBT (typ.)
C_{th1} = 0.201 J/K; R_{th1} = 0.419 K/W
C_{th2} = 1.25 J/K; R_{th2} = 0.131 K/W

Free Wheeling Diode (typ.)
C_{th1} = 0.065 J/K; R_{th1} = 1.758 K/W
C_{th2} = 0.639 J/K; R_{th2} = 0.342 K/W

T7 / D7

IGBT (typ.)
C_{th1} = 0.09 J/K; R_{th1} = 0.954 K/W
C_{th2} = 0.809 J/K; R_{th2} = 0.246 K/W

Free Wheeling Diode (typ.)
C_{th1} = 0.043 J/K; R_{th1} = 2.738 K/W
C_{th2} = 0.54 J/K; R_{th2} = 0.462 K/W

Brake Chopper T7

Symbol	Conditions	Maximum Ratings	
V_{CES}	T_{VJ} = 25°C to 150°C	1200	V
V_{GES}	Continuous	± 20	V
V_{GEM}	Transient	± 30	V
I_{C25}	T_C = 25°C	20	A
I_{C80}	T_C = 80°C	15	A
RBSOA	V_{GE} = ±15 V; R_G = 82 Ω; T_{VJ} = 125°C Clamped inductive load; L = 100 µH	I_{CM} = 20 $V_{CEK} \leq V_{CES}$	A
t_{SC} (SCSOA)	V_{CE} = 720 V; V_{GE} = ±15 V; R_G = 82 Ω; T_{VJ} = 125°C non-repetitive	10	µs
P_{tot}	T_C = 25°C	105	W

Symbol	Conditions	Characteristic Values (T_{VJ} = 25°C, unless otherwise specified) min.	typ.	max.	
$V_{CE(sat)}$	I_C = 15 A; V_{GE} = 15 V; T_{VJ} = 25°C		2.9	3.3	V
	T_{VJ} = 125°C		3.3		V
$V_{GE(th)}$	I_C = 0.4 mA; V_{GE} = V_{CE}	4.5		6.5	V
I_{CES}	V_{CE} = V_{CES}; V_{GE} = 0 V; T_{VJ} = 25°C			0.5	mA
	T_{VJ} = 125°C		0.3		mA
I_{GES}	V_{CE} = 0 V; V_{GE} = ± 20 V			200	nA
$t_{d(on)}$	Inductive load, T_{VJ} = 125°C V_{CE} = 600 V; I_C = 15 A V_{GE} = ±15 V; R_G = 82 Ω		50		ns
t_r			40		ns
$t_{d(off)}$			290		ns
t_f			60		ns
E_{on}			1.8		mJ
E_{off}			1.6		mJ
C_{ies}	V_{CE} = 25 V; V_{GE} = 0 V; f = 1 MH z		600		pF
Q_{Gon}	V_{CE} = 600 V; V_{GE} = 15 V; I_C = 15 A		45		nC
R_{thJC}				1.2	K/W

Brake Chopper D7

Symbol	Conditions	Maximum Ratings	
V_{RRM}	T_{VJ} = 25°C to 150°C	1200	V
I_{F25}	T_C = 25°C	17	A
I_{F80}	T_C = 80°C	11	A

Symbol	Conditions	Characteristic Values min.	typ.	max.	
V_F	I_F = 15 A; T_{VJ} = 25°C			3.2	V
	T_{VJ} = 125°C		2.3		V
I_R	V_R = V_{RRM}; T_{VJ} = 25°C			0.06	mA
	T_{VJ} = 125°C		0.07		mA
I_{RM}	I_F = 10 A; di_F/dt = -400 A/µs; T_{VJ} = 125°C		13		A
t_{rr}	V_R = 600 V		110		ns
R_{thJC}				3.2	K/W

Temperature Sensor NTC

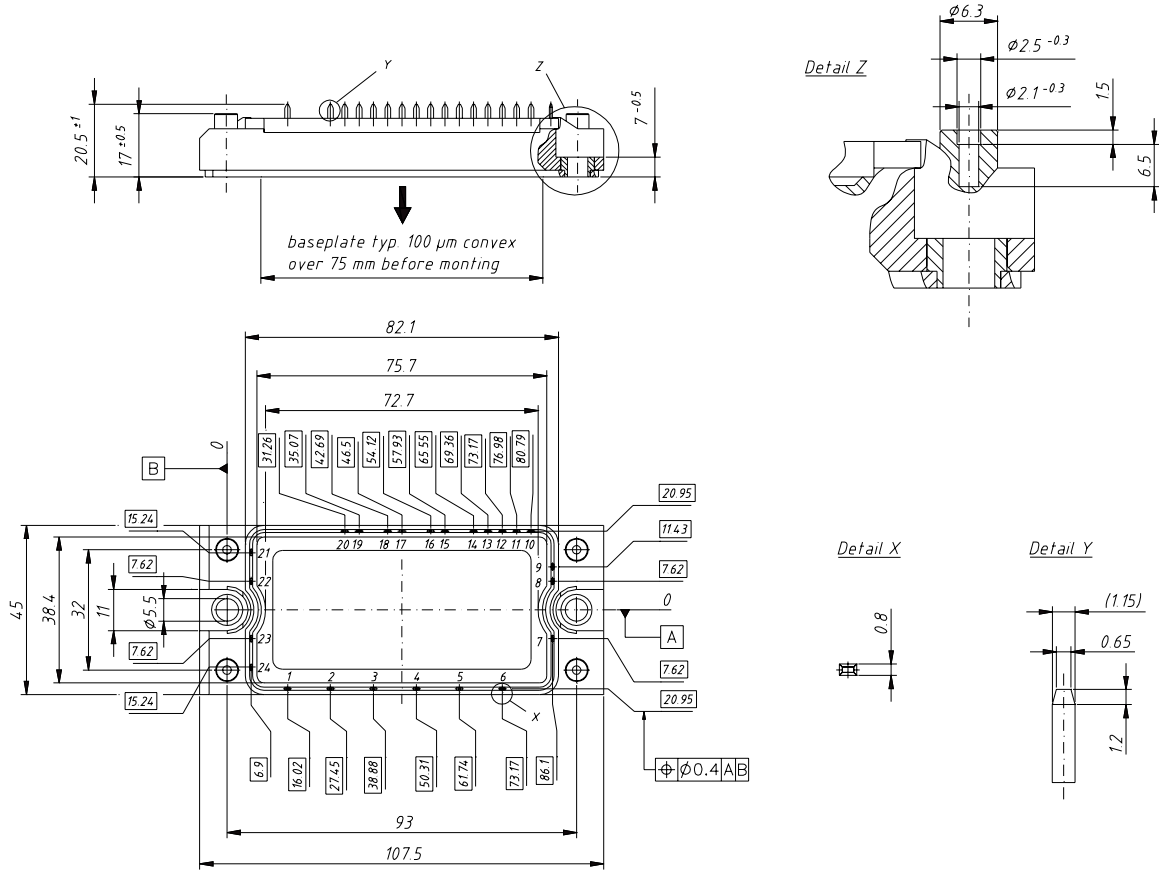
Symbol	Conditions	Characteristic Values min.	typ.	max.	
R_{25}	T = 25°C	4.75	5.0	5.25	kΩ
$B_{25/50}$			3375		K

Module

Symbol	Conditions	Maximum Ratings	
T_{VJ}	Operating	-40...+125	°C
T_{JM}		150	°C
T_{stg}		-40...+125	°C
V_{ISOL}	$I_{ISOL} \leq 1$ mA; 50/60 Hz	2500	V~
M_d	Mounting torque (M5)	2.7 - 3.3	Nm

Symbol	Conditions	Characteristic Values min.	typ.	max.	
$R_{pin\text{-}chip}$			5		mΩ
d_S	Creepage distance on surface	6			mm
d_A	Strike distance in air	6			mm
R_{thCH}	with heatsink compound		0.02		K/W
Weight			180		g

Dimensions in mm (1 mm = 0.0394")



Input Rectifier Bridge D11 - D16

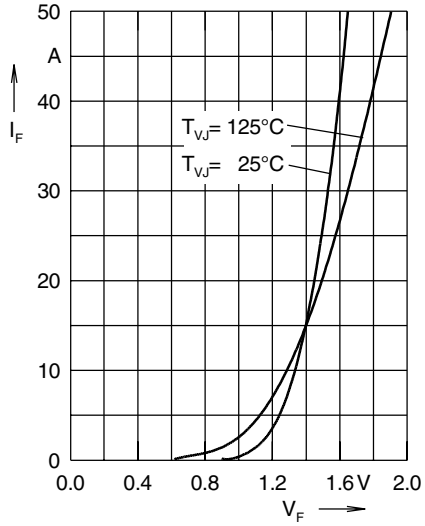


Fig. 1 Forward current versus voltage drop per diode

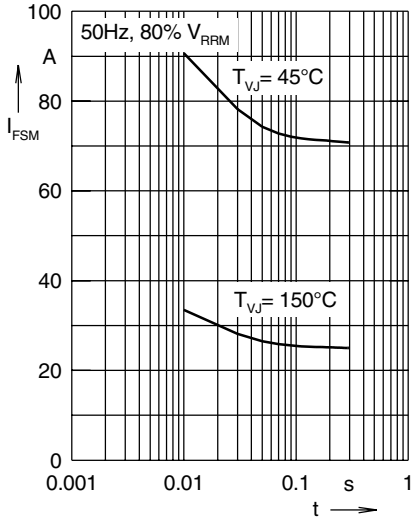


Fig. 2 Surge overload current

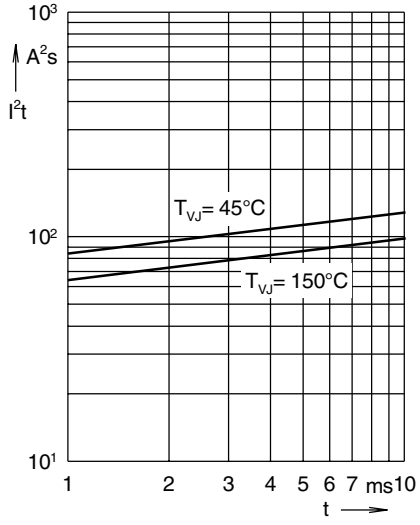


Fig. 3 I^2t versus time per diode

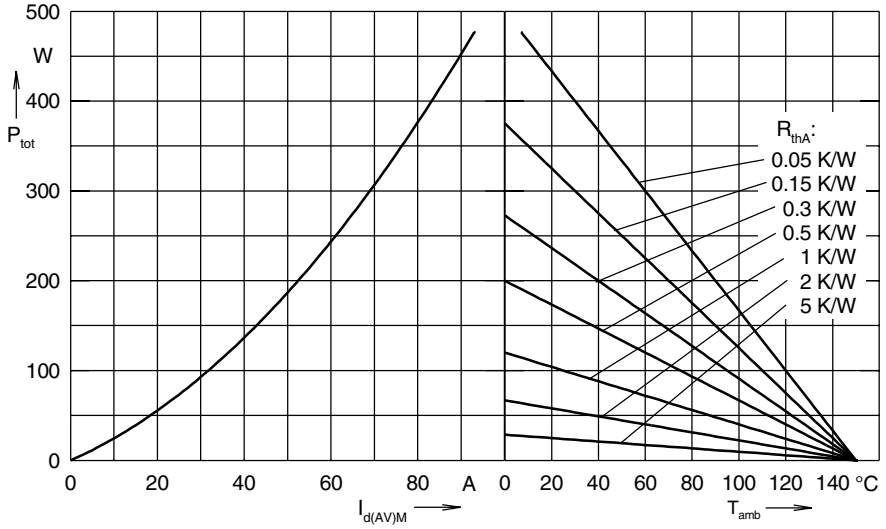


Fig. 4 Power dissipation versus direct output current and ambient temperature, sin

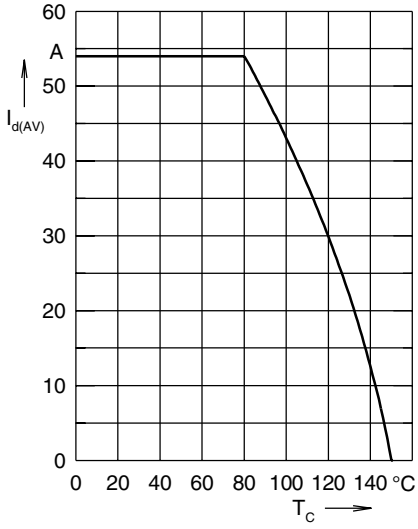


Fig. 5 Max. forward current versus case temperature

1 8 0 °

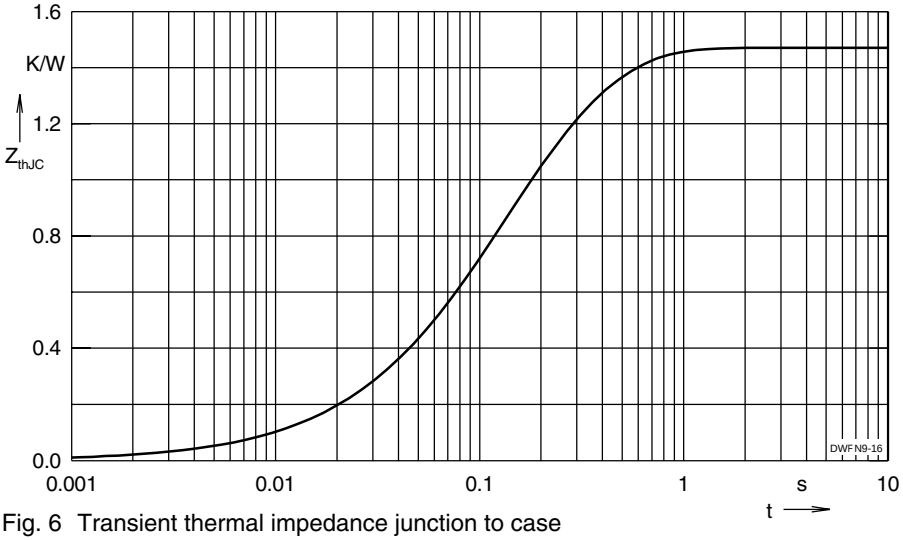


Fig. 6 Transient thermal impedance junction to case

Output Inverter T1 - T6 / D1 - D6

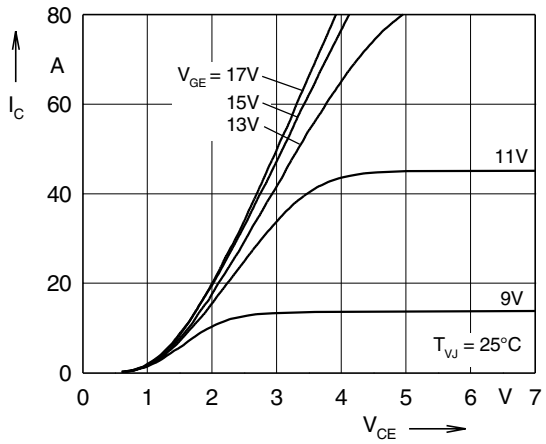


Fig. 7 Typ. output characteristics

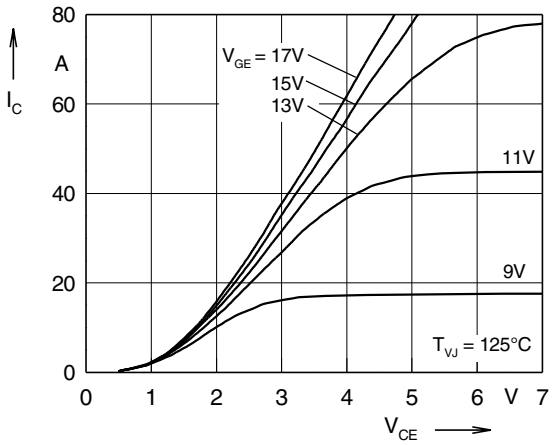


Fig. 8 Typ. output characteristics

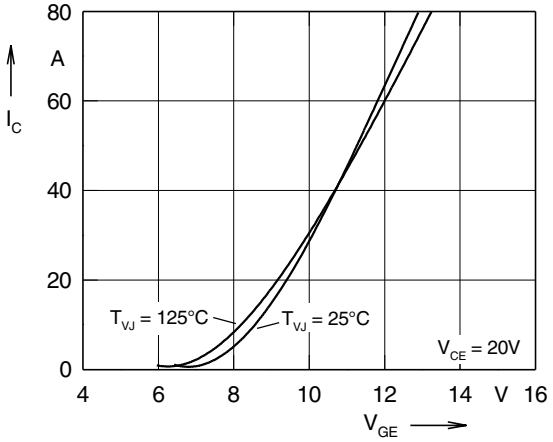


Fig. 9 Typ. transfer characteristics

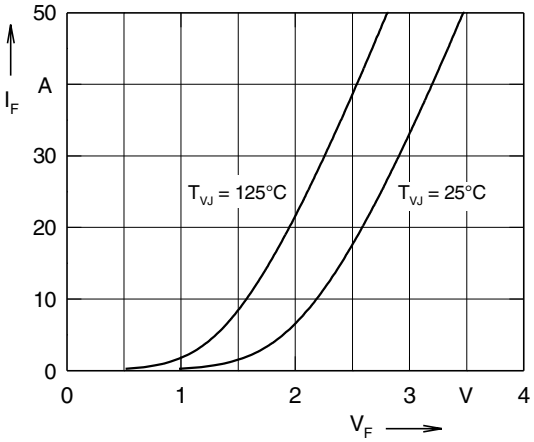


Fig. 10 Typ. forward characteristics of free wheeling diode

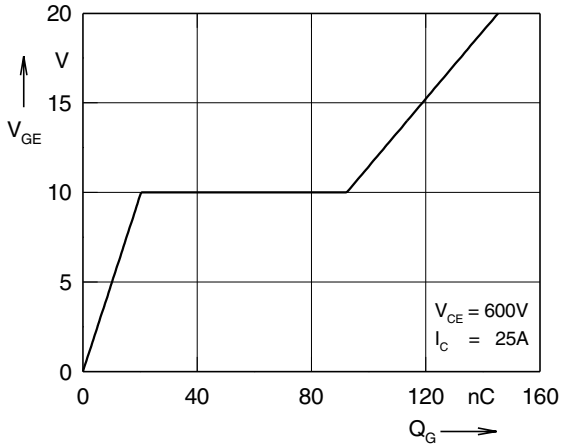


Fig. 11 Typ. turn on gate charge

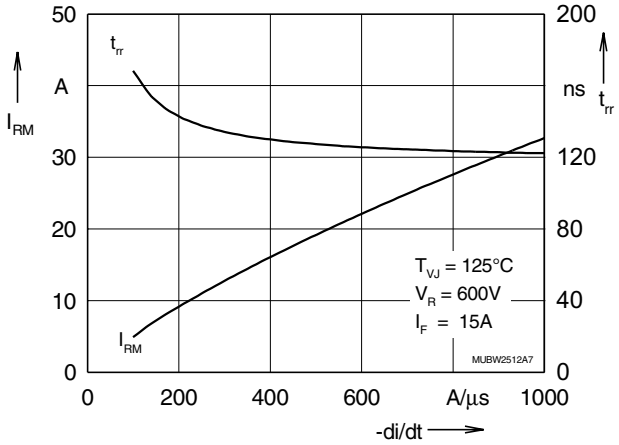


Fig. 12 Typ. turn off characteristics of free wheeling diode

Output Inverter T1 - T6 / D1 - D6

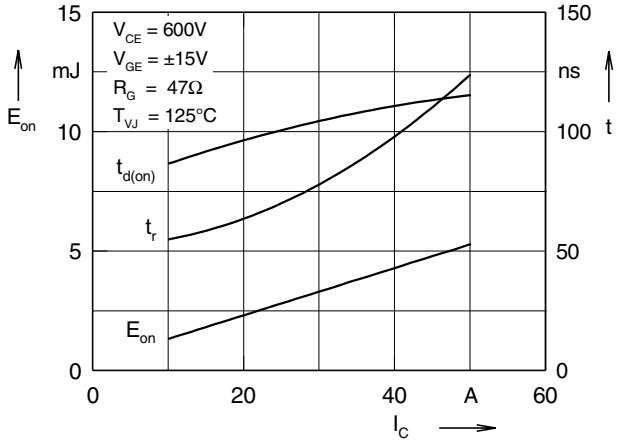


Fig. 13 Typ. turn on energy and switching times versus collector current

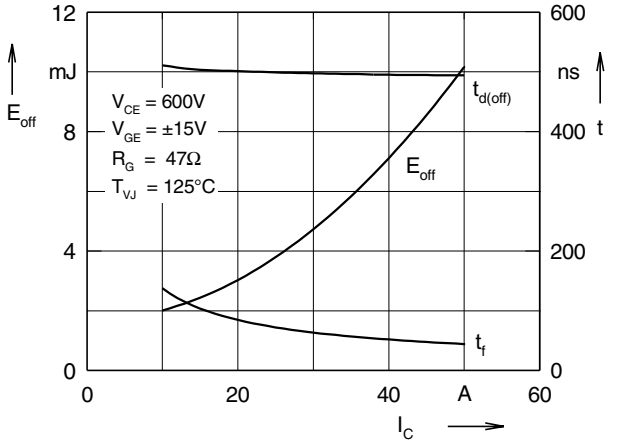


Fig. 14 Typ. turn off energy and switching times versus collector current

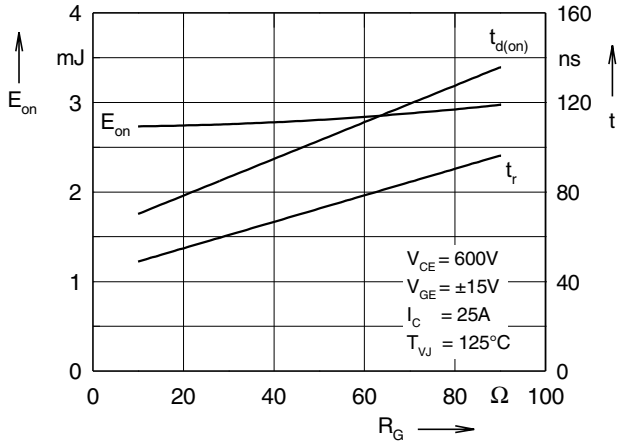


Fig. 15 Typ. turn on energy and switching times versus gate resistor

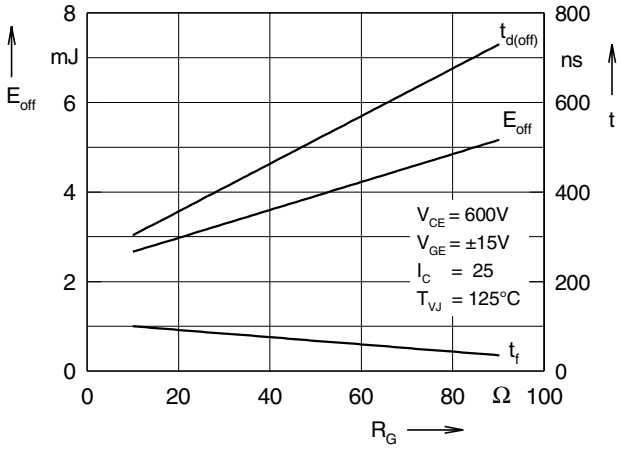


Fig.16 Typ. turn off energy and switching times versus gate resistor

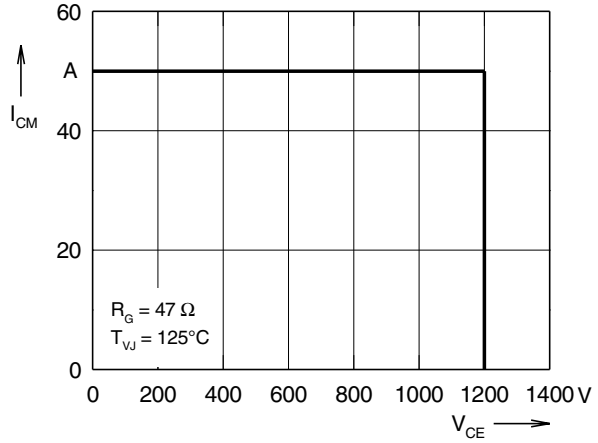


Fig. 17 Reverse biased safe operating area RBSOA

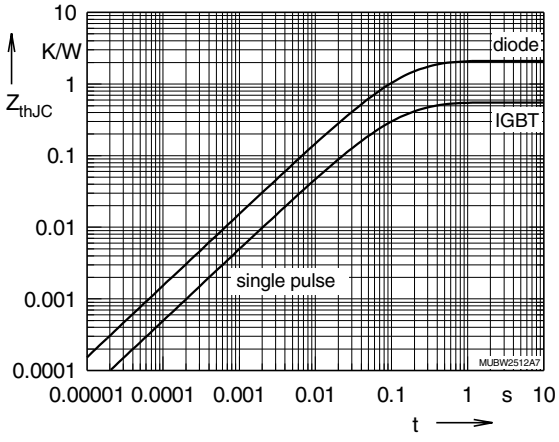


Fig. 18 Typ. transient thermal impedance

Brake Chopper T7 / D7

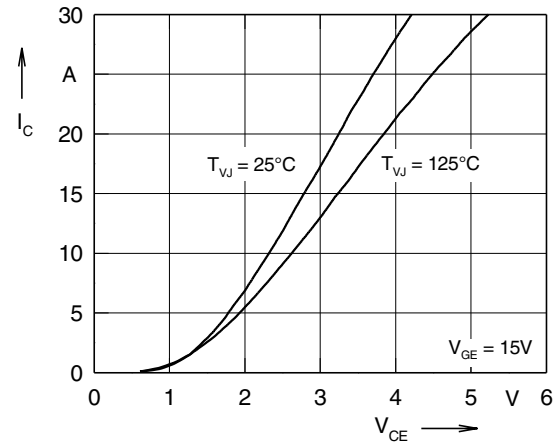


Fig. 19 Typ. output characteristics

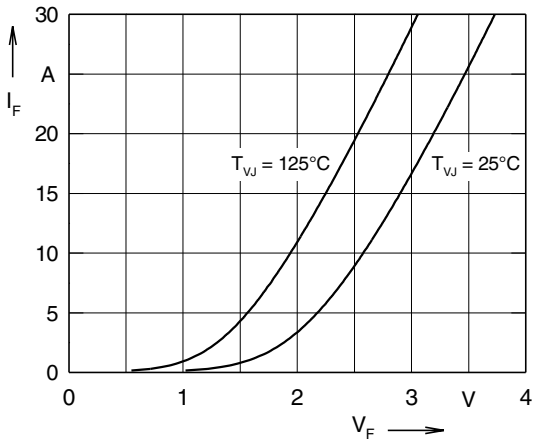


Fig. 20 Typ. forward characteristics of free wheeling diode

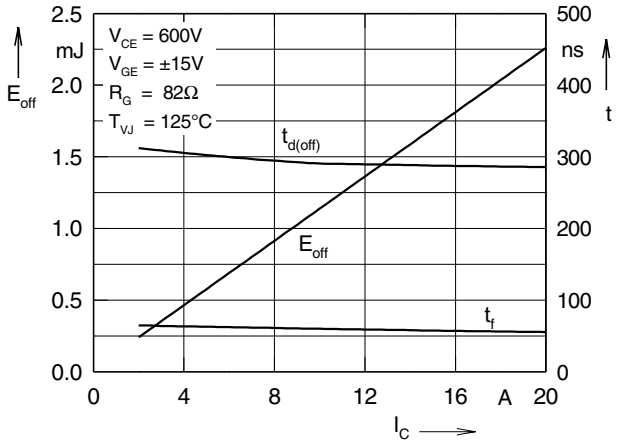


Fig. 21 Typ. turn off energy and switching times versus collector current

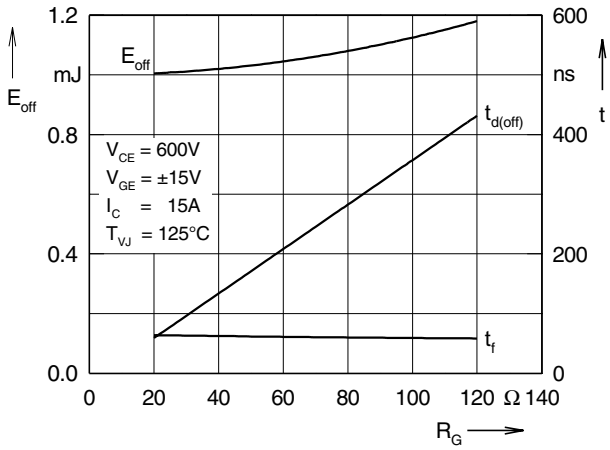


Fig. 22 Typ. turn off energy and switching times versus gate resistor

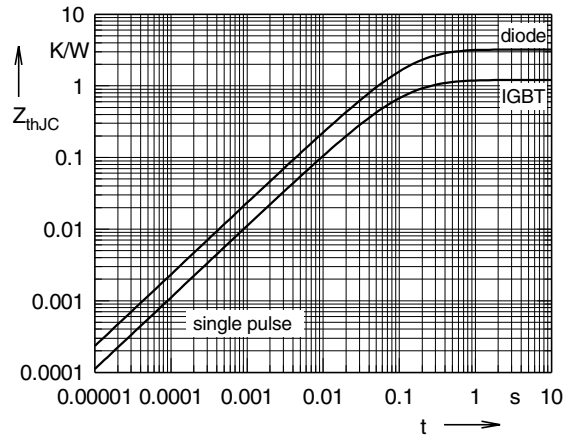


Fig. 23 Typ. transient thermal impedance

Temperature Sensor NTC

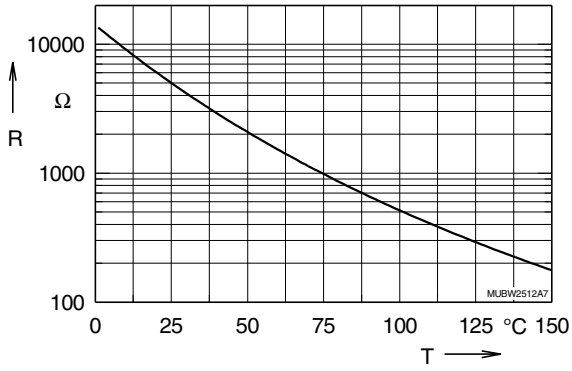


Fig. 24 Typ. thermistorresistance versus temperature