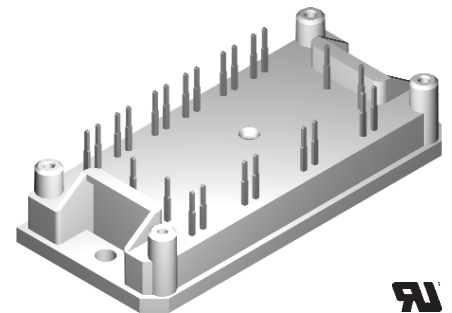
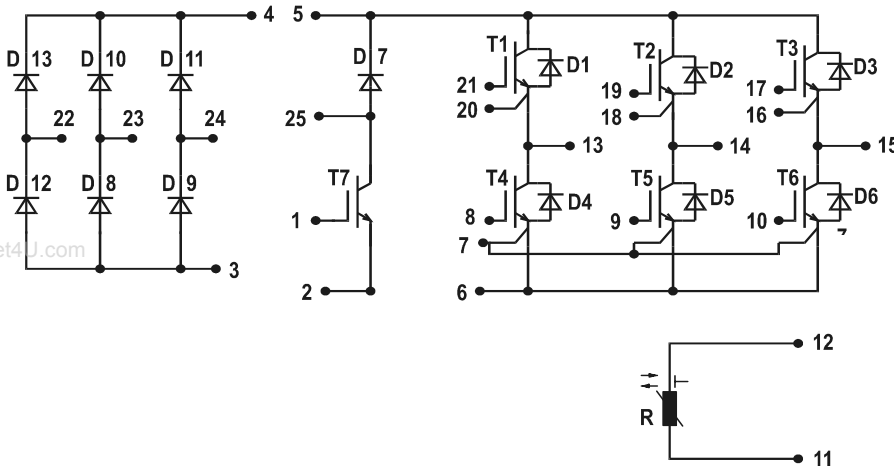


Converter - Brake - Inverter Module (CBI1)

NPT IGBT



Three Phase Rectifier	Brake Chopper	Three Phase Inverter
$V_{RRM} = 1600V$	$V_{CES} = 1200 V$	$V_{CES} = 1200 V$
$I_{DAVM25} = 130 A$	$I_{C25} = 19 A$	$I_{C25} = 19 A$
$I_{FSM} = 300 A$	$V_{CE(sat)} = 2.9 V$	$V_{CE(sat)} = 2.9 V$

Input Rectifier Bridge D8 - D13

Symbol	Conditions	Maximum Ratings	
V_{RRM}		1600	V
I_{FAV}	$T_C = 80^\circ C$; sine 180°	31	A
I_{DAVM}	bridge output current; $T_C = 80^\circ C$; rectangular; $d = 1/3$	89	A
I_{FSM}	$T_{VJ} = 25^\circ C$; $t = 10$ ms; sine 50 Hz	320	A
P_{tot}	$T_C = 25^\circ C$	80	W

Symbol	Conditions	Characteristic Values ($T_{VJ} = 25^\circ C$, unless otherwise specified)		
		min.	typ.	max.
V_F	$I_F = 30 A$; $T_{VJ} = 25^\circ C$ $T_{VJ} = 125^\circ C$		1.0 1.1	1.35 V V
I_R	$V_R = V_{RRM}$; $T_{VJ} = 25^\circ C$ $T_{VJ} = 125^\circ C$		0.4	0.02 mA mA
R_{thJC} R_{thCH}	(per diode)		0.45	1.4 K/W K/W

Application: AC motor drives with

- Input from single or three phase grid
- Three phase synchronous or asynchronous motor
- electric braking operation
- UL registered E72873

Features

- High level of integration - only one power semiconductor module required for the whole drive
- Inverter with NPT IGBTs
 - low saturation voltage
 - positive temperature coefficient
 - fast switching
 - short tail current
- 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

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1 - 8

Output Inverter T1 - T6

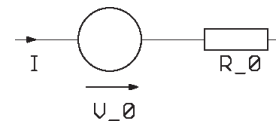
Symbol	Conditions	Maximum Ratings	
V_{CES}	$T_{VJ} = 25^{\circ}\text{C}$ to 150°C	1200	V
V_{GES}	Continuous	± 20	V
V_{GEM}	Transient	± 30	V
I_{C25}	$T_C = 25^{\circ}\text{C}$	19	A
I_{C80}	$T_C = 80^{\circ}\text{C}$	13	A
RBSOA	$V_{GE} = \pm 15\text{ V}$; $R_G = 82\ \Omega$; $T_{VJ} = 125^{\circ}\text{C}$ Clamped inductive load; $L = 100\ \mu\text{H}$	$I_{CM} = 26$ $V_{CEK} \leq V_{CES}$	A
t_{SC} (SCSOA)	$V_{CE} = 720\text{ V}$; $V_{GE} = \pm 15\text{ V}$; $R_G = 82\ \Omega$; $T_{VJ} = 125^{\circ}\text{C}$ non-repetitive	10	μs
P_{tot}	$T_C = 25^{\circ}\text{C}$	90	W

Symbol	Conditions	Characteristic Values ($T_{VJ} = 25^{\circ}\text{C}$, unless otherwise specified)			
		min.	typ.	max.	
$V_{CE(sat)}$	$I_C = 15\text{ A}$; $V_{GE} = 15\text{ V}$; $T_{VJ} = 25^{\circ}\text{C}$ $T_{VJ} = 125^{\circ}\text{C}$		3.0 3.5	V V	
$V_{GE(th)}$	$I_C = 0.35\text{ mA}$; $V_{GE} = V_{CE}$	4.5		V	
I_{CES}	$V_{CE} = V_{CES}$; $V_{GE} = 0\text{ V}$; $T_{VJ} = 25^{\circ}\text{C}$ $T_{VJ} = 125^{\circ}\text{C}$		1.3	0.6 mA mA	
I_{GES}	$V_{CE} = 0\text{ V}$; $V_{GE} = \pm 20\text{ V}$			100 nA	
$t_{d(on)}$ t_r $t_{d(off)}$ t_f E_{on} E_{off}	Inductive load, $T_{VJ} = 125^{\circ}\text{C}$ $V_{CE} = 600\text{ V}$; $I_C = 10\text{ A}$ $V_{GE} = \pm 15\text{ V}$; $R_G = 82\ \Omega$		50 40 290 60	ns ns ns ns	
				1.2 1.1	mJ mJ
C_{ies}		$V_{CE} = 25\text{ V}$; $V_{GE} = 0\text{ V}$; $f = 1\text{ MHz}$		600	pF
Q_{Gon}		$V_{CE} = 600\text{ V}$; $V_{GE} = 15\text{ V}$; $I_C = 10\text{ A}$		45	nC
R_{thJC} R_{thCH}		(per IGBT)		0.5	1.35 KW KW

Output Inverter D1 - D6

Symbol	Conditions	Maximum Ratings	
I_{F25}	$T_C = 25^{\circ}\text{C}$	26	A
I_{F80}	$T_C = 80^{\circ}\text{C}$	17	A

Symbol	Conditions	Characteristic Values		
		min.	typ.	max.
V_F	$I_F = 30\text{ A}$; $V_{GE} = 0\text{ V}$; $T_{VJ} = 25^{\circ}\text{C}$ $T_{VJ} = 125^{\circ}\text{C}$		2.3	3.4 V V
I_{RM} t_{rr}	$I_F = 15\text{ A}$; $di_F/dt = -400\text{ A}/\mu\text{s}$; $T_{VJ} = 125^{\circ}\text{C}$ $V_R = 600\text{ V}$; $V_{GE} = 0\text{ V}$		16	A
				130
R_{thJC} R_{thCH}	(per diode)		0.55	1.6 KW KW

Equivalent Circuits for Simulation
Conduction

D8 - D13

Rectifier Diode (typ. at $T_J = 125^{\circ}\text{C}$)
 $V_0 = 0.90\text{ V}$; $R_0 = 9\text{ m}\Omega$

T1 - T6 / D1 - D6

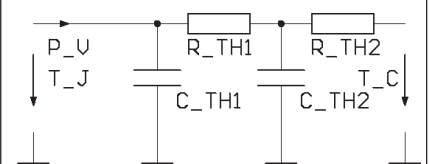
IGBT (typ. at $V_{GE} = 15\text{ V}$; $T_J = 125^{\circ}\text{C}$)
 $V_0 = 1.50\text{ V}$; $R_0 = 120\text{ m}\Omega$

Free Wheeling Diode (typ. at $T_J = 125^{\circ}\text{C}$)
 $V_0 = 1.46\text{ V}$; $R_0 = 31\text{ m}\Omega$

T7 / D7

IGBT (typ. at $V_{GE} = 15\text{ V}$; $T_J = 125^{\circ}\text{C}$)
 $V_0 = 1.50\text{ V}$; $R_0 = 120\text{ m}\Omega$

Free Wheeling Diode (typ. at $T_J = 125^{\circ}\text{C}$)
 $V_0 = 1.46\text{ V}$; $R_0 = 63\text{ m}\Omega$

Thermal Response

D8 - D13

Rectifier Diode (typ.)
 $C_{th1} = 0.037\text{ J/K}$; $R_{th1} = 0.426\text{ K/W}$
 $C_{th2} = 0.187\text{ J/K}$; $R_{th2} = 0.974\text{ K/W}$

T1 - T6 / D1 - D6

IGBT (typ.)
 $C_{th1} = 0.028\text{ J/K}$; $R_{th1} = 0.367\text{ K/W}$
 $C_{th2} = 0.088\text{ J/K}$; $R_{th2} = 0.983\text{ K/W}$

Free Wheeling Diode (typ.)
 $C_{th1} = 0.024\text{ J/K}$; $R_{th1} = 0.669\text{ K/W}$
 $C_{th2} = 0.123\text{ J/K}$; $R_{th2} = 0.931\text{ K/W}$

T7 / D7

IGBT (typ.)
 $C_{th1} = 0.028\text{ J/K}$; $R_{th1} = 0.367\text{ K/W}$
 $C_{th2} = 0.088\text{ J/K}$; $R_{th2} = 0.983\text{ K/W}$

Free Wheeling Diode (typ.)
 $C_{th1} = 0.015\text{ J/K}$; $R_{th1} = 1.144\text{ K/W}$
 $C_{th2} = 0.009\text{ J/K}$; $R_{th2} = 1.356\text{ K/W}$

Brake Chopper T7

Symbol	Conditions	Maximum Ratings	
V_{CES}	$T_{VJ} = 25^{\circ}\text{C}$ to 150°C	1200	V
V_{GES}	Continuous	± 20	V
V_{GEM}	Transient	± 30	V
I_{C25}	$T_C = 25^{\circ}\text{C}$	19	A
I_{C80}	$T_C = 80^{\circ}\text{C}$	13	A
RBSOA	$V_{GE} = \pm 15\text{ V}$; $R_G = 82\ \Omega$; $T_{VJ} = 125^{\circ}\text{C}$ Clamped inductive load; $L = 100\ \mu\text{H}$	$I_{CM} = 20$ $V_{CEK} \leq V_{CES}$	A
t_{SC} (SCSOA)	$V_{CE} = 720\text{ V}$; $V_{GE} = \pm 15\text{ V}$; $R_G = 82\ \Omega$; $T_{VJ} = 125^{\circ}\text{C}$ non-repetitive	10	μs
P_{tot}	$T_C = 25^{\circ}\text{C}$	90	W

Symbol	Conditions ($T_{VJ} = 25^{\circ}\text{C}$, unless otherwise specified)	Characteristic Values		
		min.	typ.	max.
$V_{CE(sat)}$	$I_C = 15\text{ A}$; $V_{GE} = 15\text{ V}$; $T_{VJ} = 25^{\circ}\text{C}$ $T_{VJ} = 125^{\circ}\text{C}$		2.9 3.5	V V
$V_{GE(th)}$	$I_C = 0.4\text{ mA}$; $V_{GE} = V_{CE}$	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	0.5 mA mA
I_{GES}	$V_{CE} = 0\text{ V}$; $V_{GE} = \pm 20\text{ V}$			100 nA
$t_{d(on)}$ t_r $t_{d(off)}$ t_f E_{on} E_{off}	Inductive load, $T_{VJ} = 125^{\circ}\text{C}$ $V_{CE} = 600\text{ V}$; $I_C = 10\text{ A}$ $V_{GE} = \pm 15\text{ V}$; $R_G = 82\ \Omega$		45 40 290 60 1.2 1.1	ns ns ns ns mJ mJ
C_{ies}		$V_{CE} = 25\text{ V}$; $V_{GE} = 0\text{ V}$; $f = 1\text{ MHz}$	600	pF
Q_{Gon}		$V_{CE} = 600\text{ V}$; $V_{GE} = 15\text{ V}$; $I_C = 10\text{ A}$	45	nC
R_{thJC} R_{thCH}			0.45	1.35 K/W K/W

Brake Chopper D7

Symbol	Conditions	Maximum Ratings		
V_{RRM}	$T_{VJ} = 25^{\circ}\text{C}$ to 150°C	1200	V	
I_{F25}	$T_C = 25^{\circ}\text{C}$	15	A	
I_{F80}	$T_C = 80^{\circ}\text{C}$	10	A	
Symbol	Conditions	Characteristic Values		
		min.	typ.	max.
V_F	$I_F = 15\text{ A}$; $T_{VJ} = 25^{\circ}\text{C}$ $T_{VJ} = 125^{\circ}\text{C}$		2.0	3.5 V V
I_R	$V_R = V_{RRM}$; $T_{VJ} = 25^{\circ}\text{C}$ $T_{VJ} = 125^{\circ}\text{C}$		0.2	0.06 mA mA
I_{RM} t_{rr}	} $I_F = 10\text{ A}$; $di_F/dt = -400\text{ A}/\mu\text{s}$; $T_{VJ} = 125^{\circ}\text{C}$ $V_R = 600\text{ V}$		13 110	A ns
R_{thJC} R_{thCH}			0.85	2.5 K/W K/W

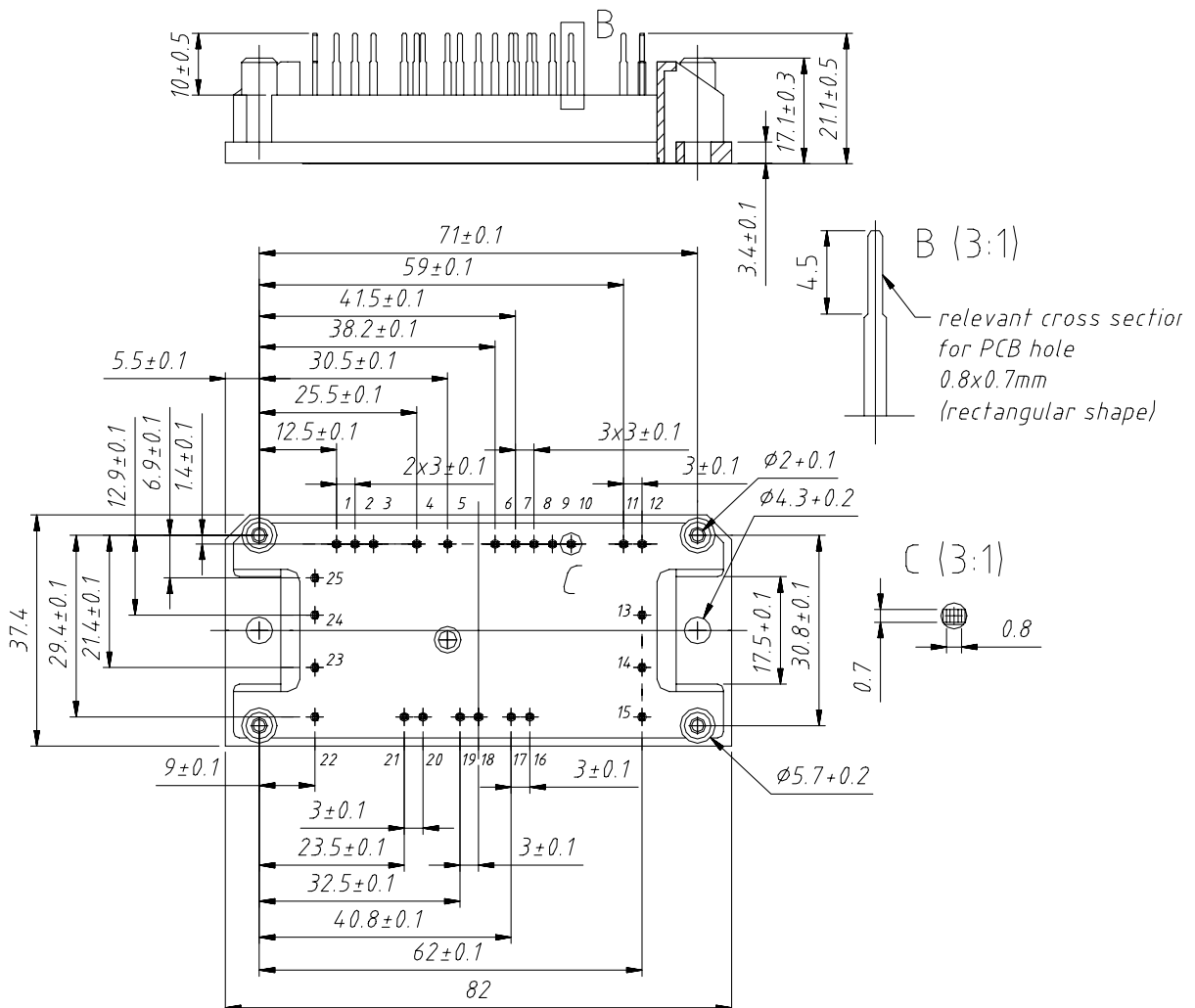
Temperature Sensor NTC

Symbol	Conditions	Characteristic Values		
		min.	typ.	max.
R_{25}	T = 25°C	4.45	4.7	5.0 kΩ
$B_{25/85}$			3510	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 (M4)	2.0 - 2.2	Nm

Symbol	Conditions	Characteristic Values		
		min.	typ.	max.
d_s	Creepage distance (towards heatsink)	12.7		mm
d_A	Strike distance in air (towards heatsink)	12.7		mm
Weight		40		g



Input Rectifier Bridge D8 - D13

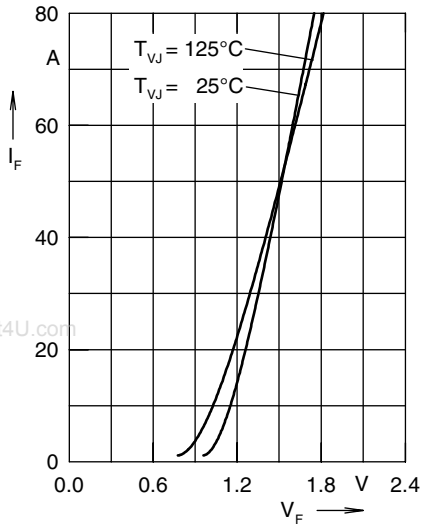


Fig. 1 Forward current versus voltage drop per diode

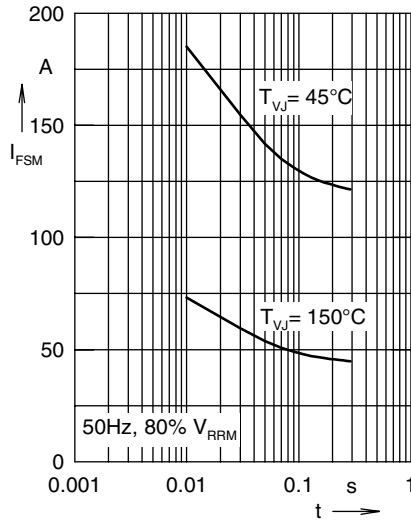


Fig. 2 Surge overload current

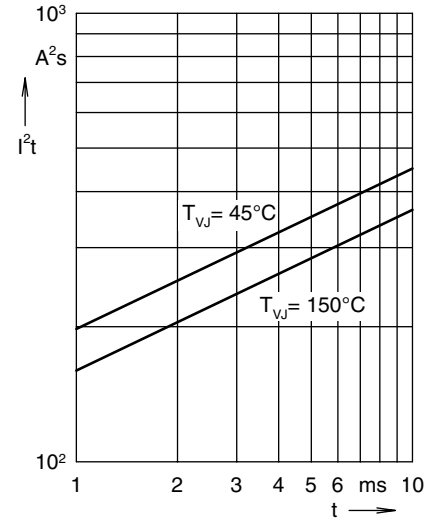


Fig. 3 I²t versus time per diode

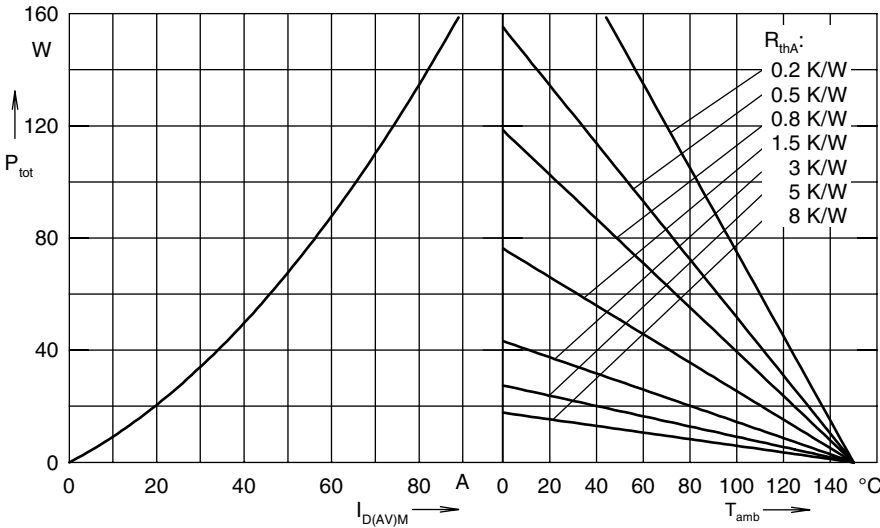


Fig. 4 Power dissipation versus direct output current and ambient temperature, sin 180°

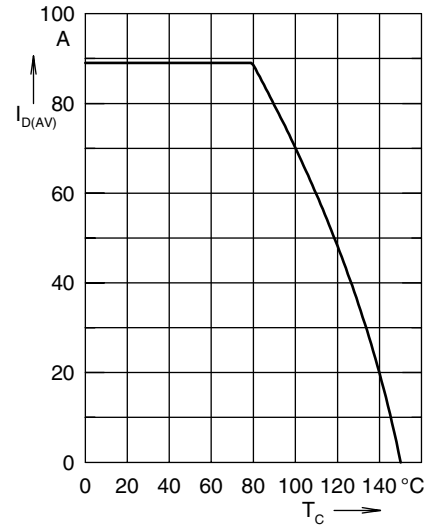


Fig. 5 Max. forward current versus case temperature

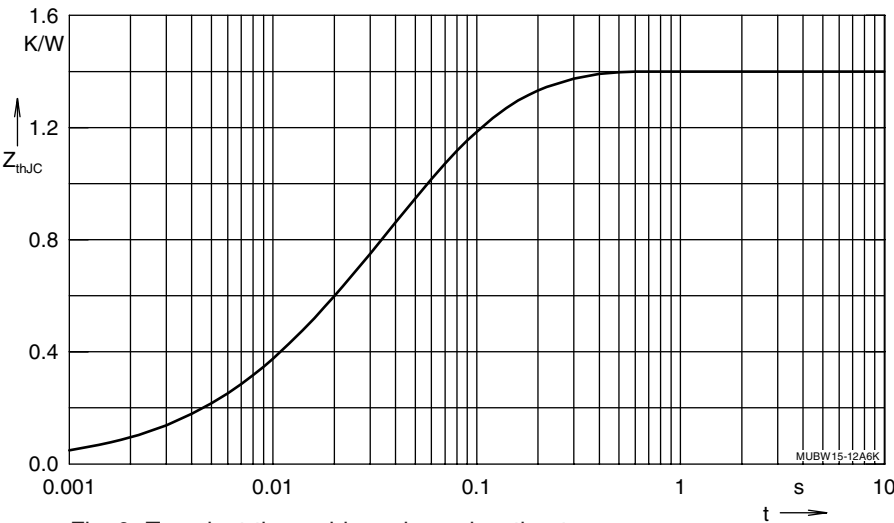


Fig. 6 Transient thermal impedance junction to case

Output Inverter T1 - T6 / D1 - D6

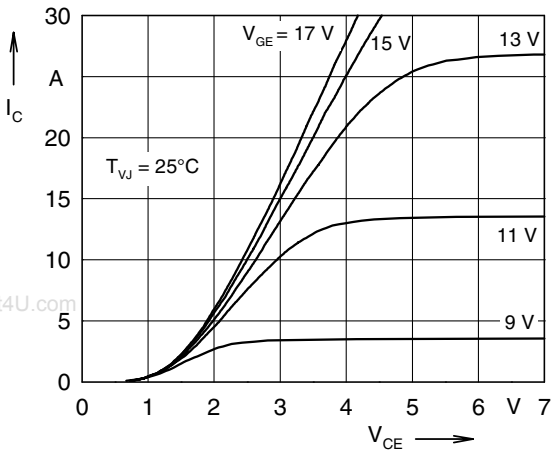


Fig. 7 Typ. output characteristics

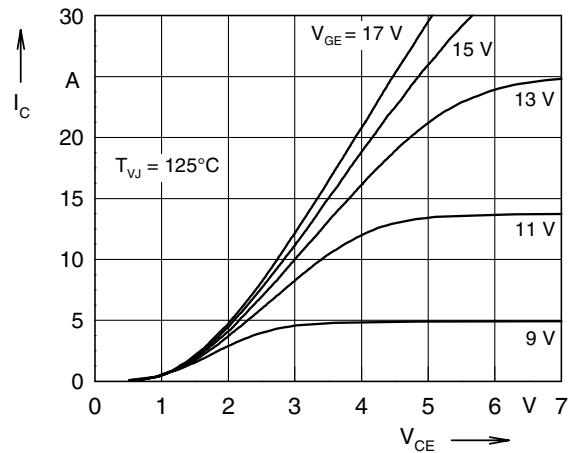


Fig. 8 Typ. output characteristics

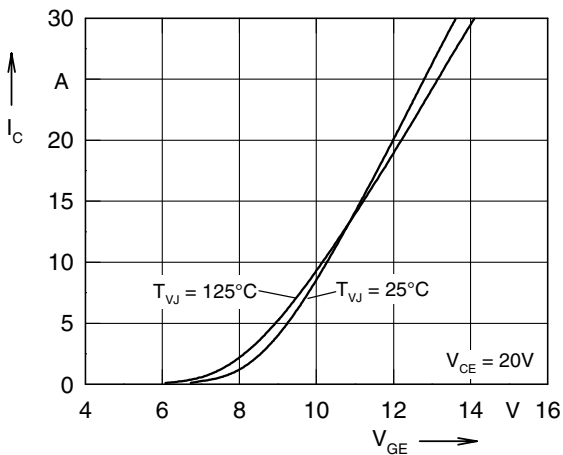


Fig. 9 Typ. transfer characteristics

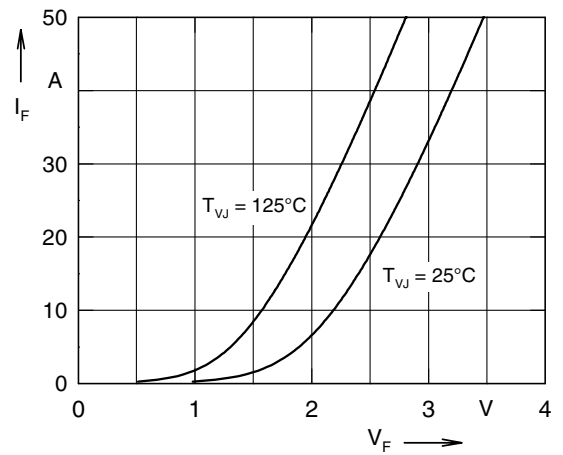


Fig. 10 Typ. forward characteristics of free wheeling diode

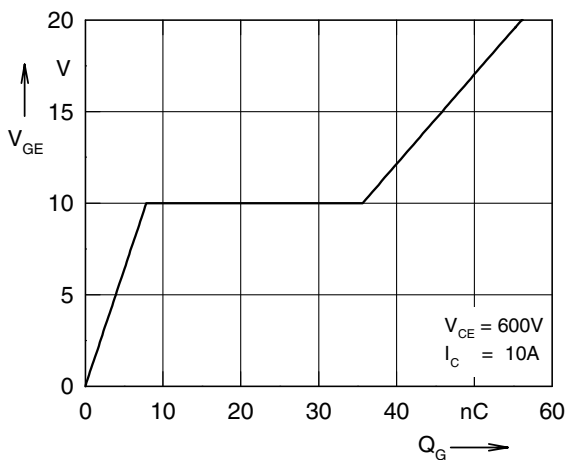


Fig. 11 Typ. turn on gate charge

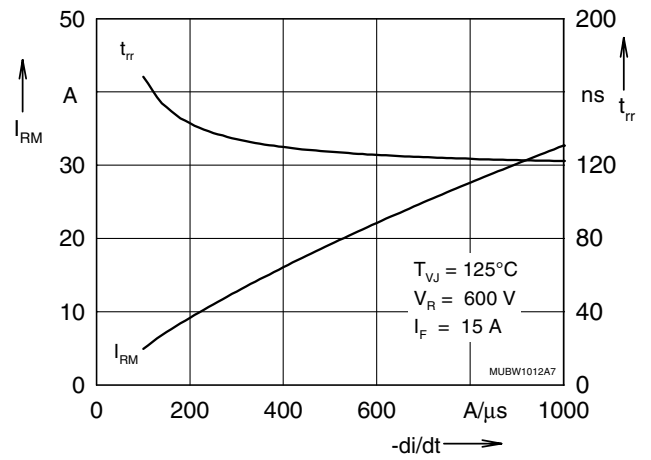


Fig. 12 Typ. turn off characteristics of free wheeling diode

Output Inverter T1 - T6 / D1 - D6

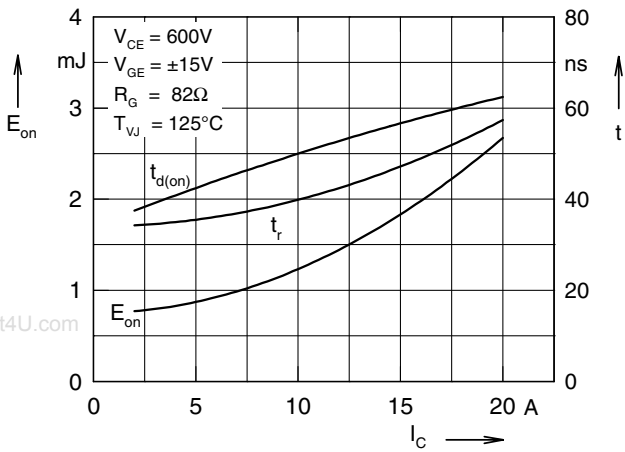


Fig. 13 Typ. turn on energy and switching times versus collector current

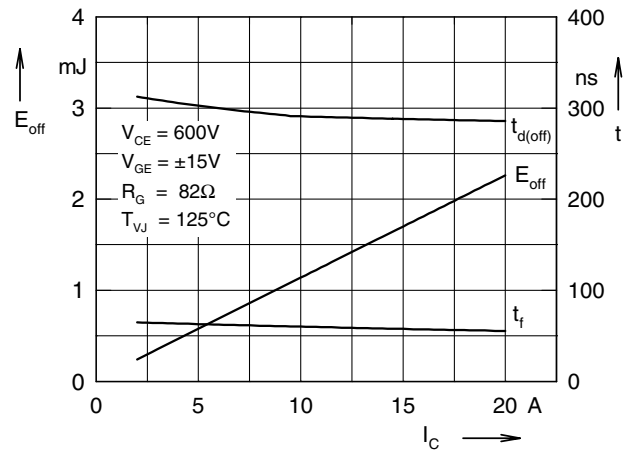


Fig. 14 Typ. turn off energy and switching times versus collector current

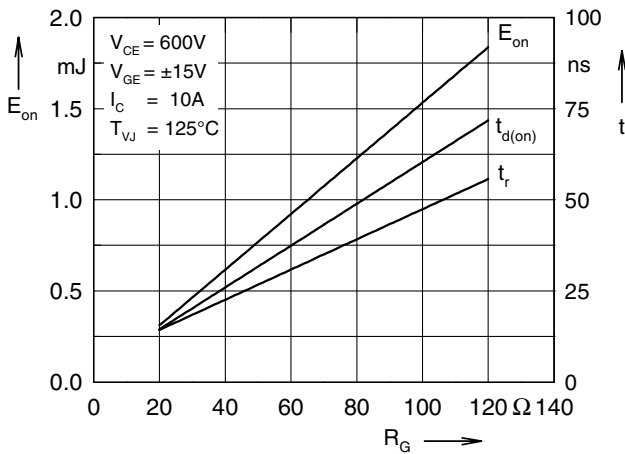


Fig. 15 Typ. turn on energy and switching times versus gate resistor

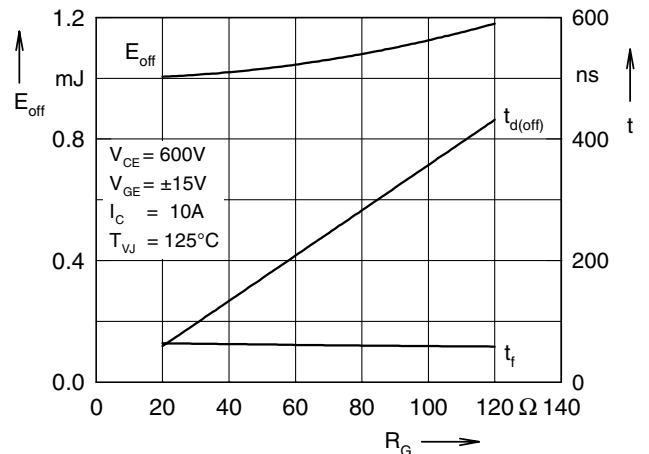


Fig. 16 Typ. turn off energy and switching times versus gate resistor

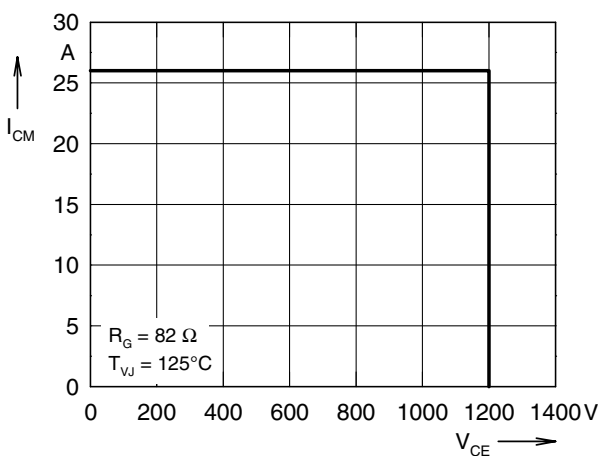


Fig. 17 Reverse biased safe operating area RBSOA

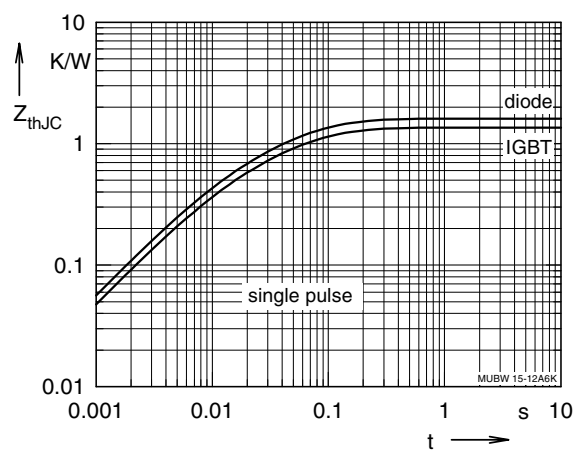


Fig. 18 Typ. transient thermal impedance

Brake Chopper T7 / D7

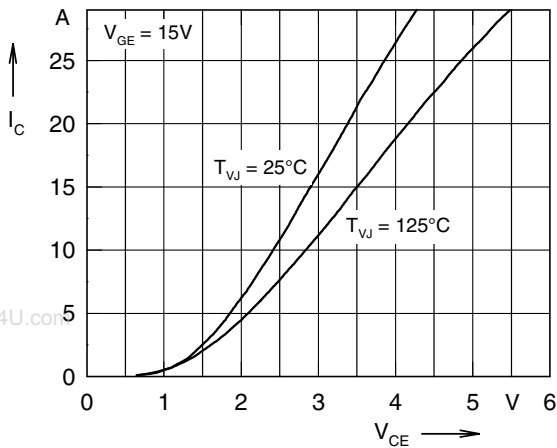


Fig. 19 Typ. output characteristics

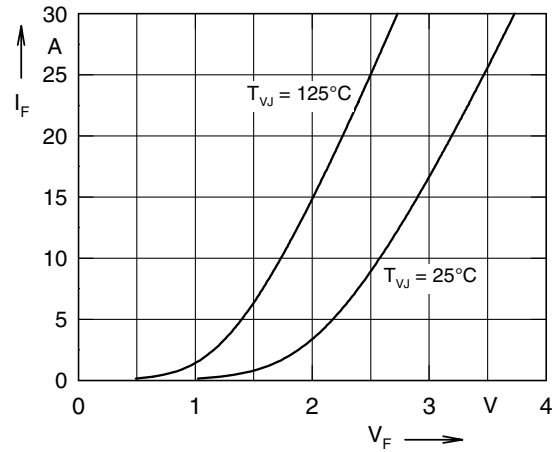


Fig. 20 Typ. forward characteristics of free wheeling diode

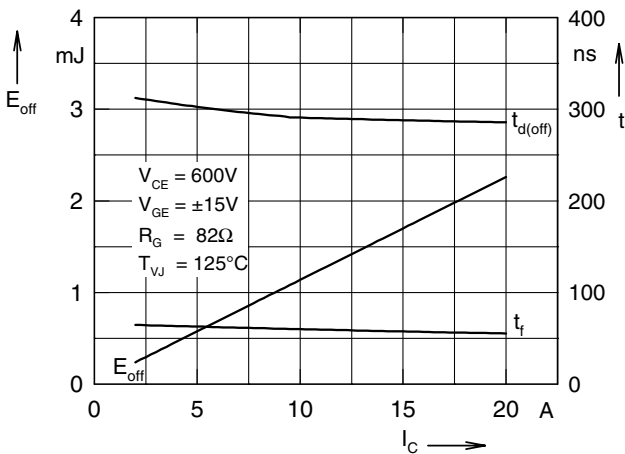


Fig. 21 Typ. turn off energy and switching times versus collector current

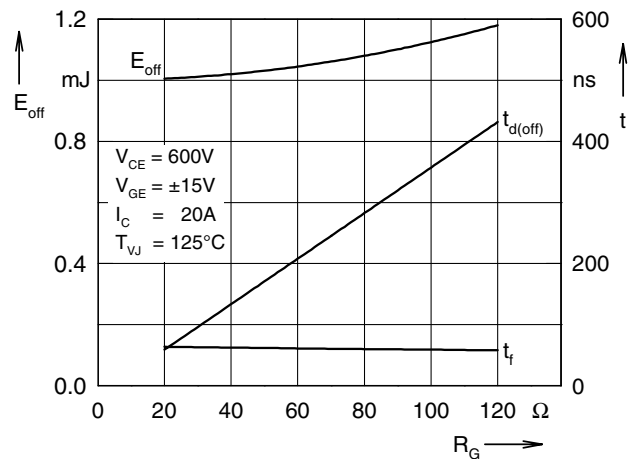


Fig. 22 Typ. turn off energy and switching times versus gate resistor

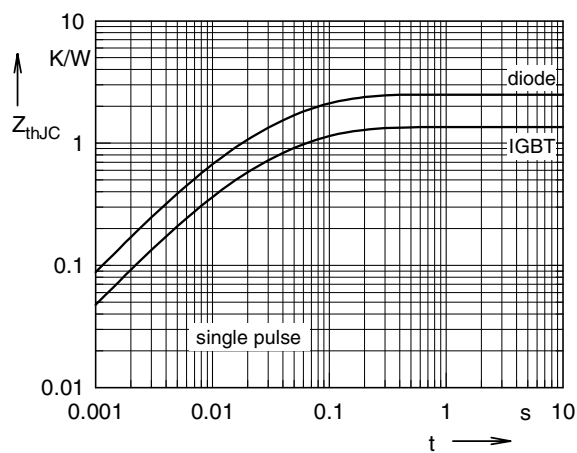


Fig. 23 Typ. transient thermal impedance

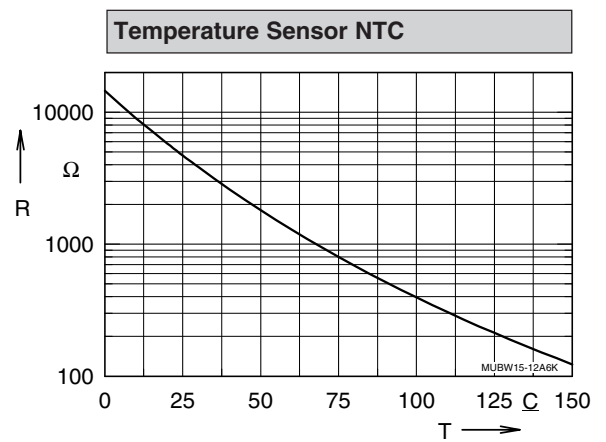


Fig. 24 Typ. thermistor resistance versus temperature