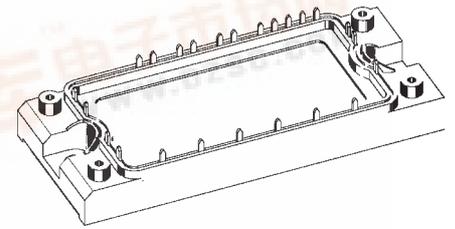
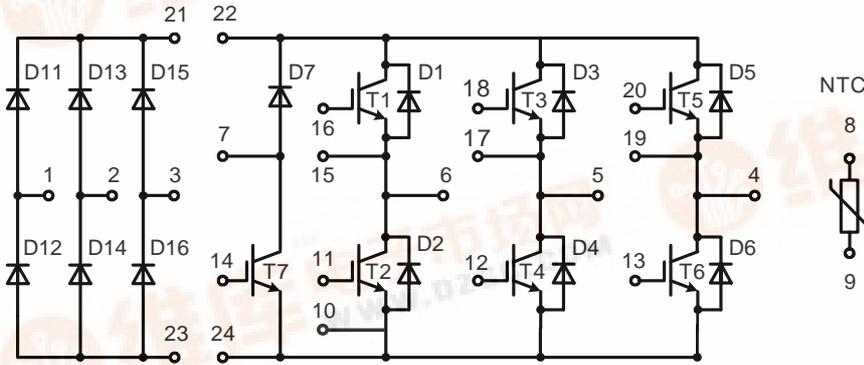


# Converter - Brake - Inverter Module (CBI2)

NPT<sup>3</sup>-IGBT



Three Phase Rectifier	Brake Chopper	Three Phase Inverter
$V_{RRM} = 1600\text{ V}$	$V_{CES} = 1200\text{ V}$	$V_{CES} = 1200\text{ V}$
$I_{FAVM} = 42\text{ A}$	$I_{C25} = 35\text{ A}$	$I_{C25} = 52\text{ A}$
$I_{FSM} = 300\text{ A}$	$V_{CE(sat)} = 2.3\text{ V}$	$V_{CE(sat)} = 2.2\text{ V}$

### Input Rectifier Bridge D11 - D16

Symbol	Conditions	Maximum Ratings	
$V_{RRM}$		1600	V
$I_{FAV}$	$T_C = 80^\circ\text{C}$ ; sine 180°	30	A
$I_{DAVM}$	$T_C = 80^\circ\text{C}$ ; rectangular; $d = 1/3$ ; bridge	80	A
$I_{FSM}$	$T_{VJ} = 25^\circ\text{C}$ ; $t = 10\text{ ms}$ ; sine 50 Hz	300	A
$P_{tot}$	$T_C = 25^\circ\text{C}$	100	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
- Inverter with NPT<sup>3</sup> 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

Symbol	Conditions	Characteristic Values ( $T_{VJ} = 25^\circ\text{C}$ , unless otherwise specified)		
		min.	typ.	max.
$V_F$	$I_F = 35\text{ A}$ ; $T_{VJ} = 25^\circ\text{C}$ $T_{VJ} = 125^\circ\text{C}$	1.2	1.4	V
$I_R$	$V_R = V_{RRM}$ ; $T_{VJ} = 25^\circ\text{C}$ $T_{VJ} = 125^\circ\text{C}$	0.4	0.02	mA
$R_{thJC}$	(per diode)		1.3	K/W

**Output Inverter T1 - T6**

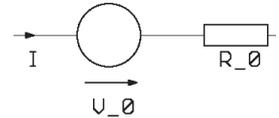
Symbol	Conditions	Maximum Ratings	
$V_{CES}$	$T_{VJ} = 25^{\circ}\text{C}$ to $150^{\circ}\text{C}$	1200	V
$V_{GES}$	Continuous	$\pm 20$	V
$I_{C25}$	$T_C = 25^{\circ}\text{C}$	52	A
$I_{C80}$	$T_C = 80^{\circ}\text{C}$	36	A
$I_{CM}$ $V_{CEK}$	RBSOA; $V_{GE} = \pm 15\text{ V}$ ; $R_G = 39\ \Omega$ ; $T_{VJ} = 125^{\circ}\text{C}$ 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 2.5	2.8	V V	
$V_{GE(th)}$	$I_C = 1\text{ mA}$ ; $V_{GE} = V_{CE}$	4.5	6.5	V	
$I_{CES}$	$V_{CE} = V_{CES}$ ; $V_{GE} = 0\text{ V}$ ; $T_{VJ} = 25^{\circ}\text{C}$ $T_{VJ} = 125^{\circ}\text{C}$	0.4	0.4	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, $T_{VJ} = 125^{\circ}\text{C}$ $V_{CE} = 600\text{ V}$ ; $I_C = 35\text{ A}$ $V_{GE} = \pm 15\text{ V}$ ; $R_G = 39\ \Omega$	150	60	ns ns ns ns	
		700	50	ns	
		4.2		mJ	
		3.5		mJ	
$C_{ies}$		$V_{CE} = 25\text{ V}$ ; $V_{GE} = 0\text{ V}$ ; $f = 1\text{ MHz}$	2		nF
$Q_{Gon}$		$V_{CE} = 600\text{ V}$ ; $V_{GE} = 15\text{ V}$ ; $I_C = 35\text{ A}$	250		nC
$R_{thJC}$	(per IGBT)		0.55	K/W	

**Output Inverter D1 - D6**

Symbol	Conditions	Maximum Ratings	
$I_{F25}$	$T_C = 25^{\circ}\text{C}$	50	A
$I_{F80}$	$T_C = 80^{\circ}\text{C}$	33	A

Symbol	Conditions	Characteristic Values		
		min.	typ.	max.
$V_F$	$I_F = 35\text{ A}$ ; $V_{GE} = 0\text{ V}$ ; $T_{VJ} = 25^{\circ}\text{C}$ $T_{VJ} = 125^{\circ}\text{C}$	1.8	2.8	V V
$I_{RM}$ $t_{rr}$	$I_F = 30\text{ A}$ ; $di_F/dt = -500\text{ A}/\mu\text{s}$ ; $T_{VJ} = 125^{\circ}\text{C}$ $V_R = 600\text{ V}$ ; $V_{GE} = 0\text{ V}$	27	150	A ns
$R_{thJC}$		(per diode)		1.19

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

**D11 - D16**

Rectifier Diode (typ. at  $T_J = 125^{\circ}\text{C}$ )  
 $V_0 = 0.83\text{ V}$ ;  $R_0 = 11\text{ m}\Omega$

**T1 - T6 / D1 - D6**

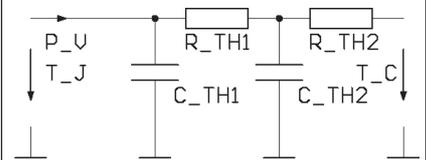
IGBT (typ. at  $V_{GE} = 15\text{ V}$ ;  $T_J = 125^{\circ}\text{C}$ )  
 $V_0 = 0.95\text{ V}$ ;  $R_0 = 45\text{ m}\Omega$

Free Wheeling Diode (typ. at  $T_J = 125^{\circ}\text{C}$ )  
 $V_0 = 1.26\text{ V}$ ;  $R_0 = 15\text{ m}\Omega$

**T7 / D7**

IGBT (typ. at  $V_{GE} = 15\text{ V}$ ;  $T_J = 125^{\circ}\text{C}$ )  
 $V_0 = 1.37\text{ V}$ ;  $R_0 = 62\text{ m}\Omega$

Free Wheeling Diode (typ. at  $T_J = 125^{\circ}\text{C}$ )  
 $V_0 = 1.39\text{ V}$ ;  $R_0 = 56\text{ m}\Omega$

**Thermal Response**

**D11 - D16**

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

**T1 - T6 / D1 - D6**

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

Free Wheeling Diode (typ.)  
 $C_{th1} = 0.116\text{ J/K}$ ;  $R_{th1} = 0.973\text{ K/W}$   
 $C_{th2} = 0.879\text{ J/K}$ ;  $R_{th2} = 0.217\text{ K/W}$

**T7 / D7**

IGBT (typ.)  
 $C_{th1} = 0.156\text{ J/K}$ ;  $R_{th1} = 0.545\text{ K/W}$   
 $C_{th2} = 1.162\text{ J/K}$ ;  $R_{th2} = 0.155\text{ K/W}$

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

**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
$V_{GEM}$	Transient	$\pm 30$	V
$I_{C25}$	$T_C = 25^{\circ}\text{C}$	35	A
$I_{C80}$	$T_C = 80^{\circ}\text{C}$	25	A
$I_{CM}$ $V_{CEK}$	RBSOA; $V_{GE} = \pm 15\text{ V}$ ; $R_G = 82\ \Omega$ ; $T_{VJ} = 125^{\circ}\text{C}$ Clamped inductive load; $L = 100\ \mu\text{H}$	35 $V_{CES}$	A
$t_{SC}$ (SCSOA)	$V_{CE} = V_{CES}$ ; $V_{GE} = \pm 15\text{ V}$ ; $R_G = 82\ \Omega$ ; $T_{VJ} = 125^{\circ}\text{C}$ non-repetitive	10	$\mu\text{s}$
$P_{tot}$	$T_C = 25^{\circ}\text{C}$	180	W

Symbol	Conditions	Characteristic Values ( $T_{VJ} = 25^{\circ}\text{C}$ , unless otherwise specified)			
		min.	typ.	max.	
$V_{CE(sat)}$	$I_C = 20\text{ A}$ ; $V_{GE} = 15\text{ V}$ ; $T_{VJ} = 25^{\circ}\text{C}$ $T_{VJ} = 125^{\circ}\text{C}$		2.3 2.6	3 V	
$V_{GE(th)}$	$I_C = 0.6\text{ mA}$ ; $V_{GE} = V_{CE}$	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, $T_{VJ} = 125^{\circ}\text{C}$ $V_{CE} = 600\text{ V}$ ; $I_C = 20\text{ A}$ $V_{GE} = \pm 15\text{ V}$ ; $R_G = 82\ \Omega$		100 75 500 70 3.1 2.4	ns ns ns ns mJ mJ	
$C_{ies}$		$V_{CE} = 25\text{ V}$ ; $V_{GE} = 0\text{ V}$ ; $f = 1\text{ MHz}$	1000		pF
$Q_{Gon}$		$V_{CE} = 600\text{ V}$ ; $V_{GE} = 15\text{ V}$ ; $I_C = 20\text{ A}$	70		nC
$R_{thJC}$					0.7 K/W

**Brake Chopper D7**

Symbol	Conditions	Maximum Ratings	
$V_{RRM}$	$T_{VJ} = 25^{\circ}\text{C}$ to $150^{\circ}\text{C}$	1200	V
$I_{F25}$	$T_C = 25^{\circ}\text{C}$	16	A
$I_{F80}$	$T_C = 80^{\circ}\text{C}$	11	A

Symbol	Conditions	Characteristic Values		
		min.	typ.	max.
$V_F$	$I_F = 20\text{ A}$ ; $T_{VJ} = 25^{\circ}\text{C}$ $T_{VJ} = 125^{\circ}\text{C}$		2.6	3.6 V V
$I_R$	$V_R = V_{RRM}$ ; $T_{VJ} = 25^{\circ}\text{C}$ $T_{VJ} = 125^{\circ}\text{C}$		0.07	0.06 mA mA
$I_{RM}$ $t_{tr}$	$I_F = 20\text{ A}$ ; $di_F/dt = -400\text{ A}/\mu\text{s}$ ; $T_{VJ} = 125^{\circ}\text{C}$ $V_R = 600\text{ V}$		13 110	A ns
$R_{thJC}$				3.2 K/W

**Temperature Sensor NTC**

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

**Module**

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

Symbol	Conditions	Characteristic Values		
		min.	typ.	max.
$R_{pin-chip}$			5	$\text{m}\Omega$
$d_s$	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")

