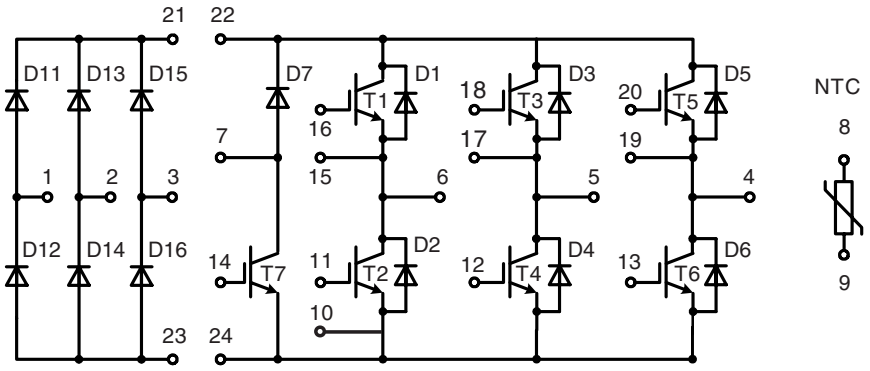
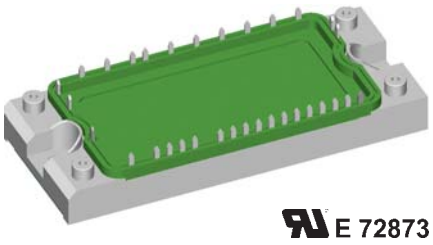
# Converter - Brake - Inverter Module (CBI2) with Trench IGBT technology

Preliminary data




| Three Phase Rectifier | Brake Chopper | Three Phase Inverter |
|---|---|---|
| $V_{RRM}$ = 1600 V | $V_{CES}$ = 1200 V | $V_{CES}$ = 1200 V |
| $I_{FAVM}$ = 38 A | $I_{C25}$ = 30 A | $I_{C25}$ = 45 A |
| $I_{FSM}$ = 300 A | $V_{CE(sat)}$ = 1.7 V | $V_{CE(sat)}$ = 1.7 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 = $^1/_3$; bridge | 72 | 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 | | 1.1 | 1.3 | V |
| | $T_{VJ}$ = 125°C | | 1.1 | | V |
| $I_R$ | $V_R = V_{RRM}$; $T_{VJ}$ = 25°C | | | 0.02 | mA |
| | $T_{VJ}$ = 125°C | | 0.4 | | mA |
| $R_{thJC}$ | (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
- Inverter with Trench 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

IXYS reserves the right to change limits, test conditions and dimensions.

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## Output Inverter T1 - T6

| Symbol | Conditions | Maximum Ratings | |
|---|---|---|---|
| $V_{CES}$ | $T_{VJ}$ = 25°C to 150°C | 1200 | V |
| $V_{GES}$ | Continuous | ± 20 | V |
| $I_{C25}$ | $T_C$ = 25°C | 45 | A |
| $I_{C80}$ | $T_C$ = 80°C | 25 | A |
| $I_{CM}$ | $T_C$ = 80°C; $t_p$ = 1 ms | 50 | A |
| $P_{tot}$ | $T_C$ = 25°C | 170 | 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 | | 1.7 | 2.15 | V |
| | $T_{VJ}$ = 125°C | | 2.0 | | V |
| $V_{GE(th)}$ | $I_C$ = 1 mA; $V_{GE}$ = $V_{CE}$ | 5 | 5.8 | 6.5 | V |
| $I_{CES}$ | $V_{CE}$ = $V_{CES}$; $V_{GE}$ = 0 V; $T_{VJ}$ = 25°C | | | 2.7 | mA |
| | $T_{VJ}$ = 125°C | | 0.7 | | mA |
| $I_{GES}$ | $V_{CE}$ = 0 V; $V_{GE}$ = ± 20 V | | | 400 | nA |
| $C_{ies}$ | $V_{CE}$ = 25 V; $V_{GE}$ = 0 V; f = 1 MHz | | 1.8 | | nF |
| $Q_{Gon}$ | $V_{CE}$= 600 V; $V_{GE}$ = 15 V; $I_C$ = 25 A | | 240 | | nC |
| $t_{d(on)}$ | Inductive load, $T_{VJ}$ = 125°C | | 90 | | ns |
| $t_r$ | $V_{CE}$ = 600 V; $I_C$ = 25 A | | 50 | | ns |
| $t_{d(off)}$ | $V_{GE}$ = ±15 V; $R_G$ = 36 Ω | | 520 | | ns |
| $t_f$ | | | 90 | | ns |
| $E_{on}$ | | | 2.5 | | mJ |
| $E_{off}$ | | | 3.4 | | mJ |
| **RBSOA** | $I_C$ = $I_{CM}$; $V_{GE}$ = ±15 V; $R_G$ = 36 Ω; $T_{VJ}$ = 125°C | $V_{CEK} \le V_{CES}$ - $L_S$ di/dt | | | V |
| $I_{SC}$ (SCSOA) | $V_{CE}$ = 720 V; $V_{GE}$ = ±15 V; $R_G$ = 36 Ω; $t_p$ ≤ 10 µs; non-repetitive; $T_{VJ}$ = 125°C | | 100 | | A |
| $R_{thJC}$ | (per IGBT) | | | 0.73 | K/W |

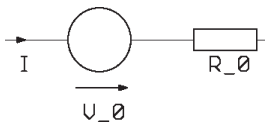
## Output Inverter D1 - D6

| Symbol | Conditions | Maximum Ratings | |
|---|---|---|---|
| $I_{F25}$ | $T_C$ = 25°C | 25 | A |
| $I_{F80}$ | $T_C$ = 80°C | 17 | A |

| Symbol | Conditions | Characteristic Values min. | typ. | max. | |
|---|---|---|---|---|---|
| $V_F$ | $I_F$ = 25 A; $V_{GE}$ = 0 V; $T_{VJ}$ = 25°C | | 2.1 | 2.6 | V |
| | $T_{VJ}$ = 125°C | | 1.6 | | V |
| $I_{RM}$ | $I_F$ = tbd A; $di_F/dt$ = -tbd A/µs; $T_{VJ}$ = 125°C | | tbd | | A |
| $Q_{rr}$ | $V_R$ = 600 V; $V_{GE}$ = 0 V | | tbd | | µC |
| $t_{rr}$ | | | tbd | | ns |
| $E_{rec}$ | | | tbd | | mJ |
| $R_{thJC}$ | (per diode) | | | 2.1 | K/W |

### Equivalent Circuits for Simulation

**Conduction**




IGBT (typ. at $V_{GE}$ = 15 V; $T_J$ = 125°C)

T1-T6

*$V_0$ = 0.92 V; $R_0$ = 42.8 mΩ*

T7

*$V_0$ = 0.92 V; $R_0$ = 72 mΩ*

Diode (typ. at $T_J$ = 125°C)

D1-D6

*$V_0$ = tbd V; $R_0$ = tbd mΩ*

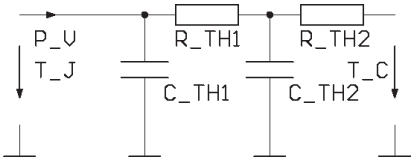
D7

*$V_0$ = tbd V; $R_0$ = tbd mΩ*

D11-D16

*$V_0$ = tbd V; $R_0$ = tbd mΩ*

**Thermal Response**




IGBT (typ.)

T1-T6

*$C_{th1}$ = tbd J/K; $R_{th1}$ = tbd K/W*
*$C_{th2}$ = tbd J/K; $R_{th2}$ = tbd K/W*

T7

*$C_{th1}$ = tbd J/K; $R_{th1}$ = tbd K/W*
*$C_{th2}$ = tbd J/K; $R_{th2}$ = tbd K/W*

Diode (typ.)

D1-D6

*$C_{th1}$ = tbd J/K; $R_{th1}$ = tbd K/W*
*$C_{th2}$ = tbd J/K; $R_{th2}$ = tbd K/W*

D7

*$C_{th1}$ = tbd J/K; $R_{th1}$ = tbd K/W*
*$C_{th2}$ = tbd J/K; $R_{th2}$ = tbd K/W*

D11-D16

*$C_{th1}$ = tbd J/K; $R_{th1}$ = tbd K/W*
*$C_{th2}$ = tbd J/K; $R_{th2}$ = tbd K/W*

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## Brake Chopper T7

| Symbol | Conditions | Maximum Ratings | |
|---|---|---|---|
| $V_{CES}$ | $T_{VJ}$ = 25°C to 150°C | 1200 | V |
| $V_{GES}$ | Continuous | ± 20 | V |
| $I_{C25}$ | $T_C$ = 25°C | 30 | A |
| $I_{C80}$ | $T_C$ = 80°C | 15 | A |
| $I_{CM}$ | $T_C$ = 80°C; $t_p$ = 1 ms | 30 | A |
| $P_{tot}$ | $T_C$ = 25°C | 120 | 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 | | 1.7 | 2.1 | V |
| | $T_{VJ}$ = 125°C | | 2.0 | | V |
| $V_{GE(th)}$ | $I_C$ = 0.5 mA; $V_{GE}$ = $V_{CE}$ | 5 | 5.8 | 6.5 | V |
| $I_{CES}$ | $V_{CE}$ = $V_{CES}$; $V_{GE}$ = 0 V; $T_{VJ}$ = 25°C | | | 0.1 | mA |
| | $T_{VJ}$ = 125°C | | 0.25 | | mA |
| $I_{GES}$ | $V_{CE}$ = 0 V; $V_{GE}$ = ± 20 V | | | 400 | nA |
| $C_{ies}$ | $V_{CE}$ = 25 V; $V_{GE}$ = 0 V; f = 1 MH z | | 1.1 | | nF |
| $Q_{Gon}$ | $V_{CE}$= 600 V; $V_{GE}$ = 15 V; $I_C$ = 15 A | | 150 | | nC |
| $t_{d(on)}$ | Inductive load, $T_{VJ}$ = 125°C | | 90 | | ns |
| $t_r$ | $V_{CE}$ = 600 V; $I_C$ = 15 A | | 50 | | ns |
| $t_{d(off)}$ | $V_{GE}$ = ±15 V; $R_G$ = 75 Ω | | 520 | | ns |
| $t_f$ | | | 90 | | ns |
| $E_{off}$ | | | 1.5 | | mJ |
| **RBSOA** | $I_C$ = $I_{CM}$; $V_{GE}$ = ±15 V | | | | |
| | $R_G$ = 75 Ω; $T_{VJ}$ = 125°C | $V_{CEK} \leq V_{CES}$ - $L_S$ di/dt | | | V |
| $I_{SC}$ (SCSOA) | $V_{CE}$ = 720 V; $V_{GE}$ = ±15 V; $R_G$ = 75 Ω | | 60 | | A |
| | $t_p \leq$ 10 µs; non-repetitive; $T_{VJ}$ = 125°C | | | | |
| $R_{thJC}$ | | | | 1.05 | 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 | 16 | A |
| $I_{F80}$ | $T_C$ = 80°C | 11 | A |

| Symbol | Conditions | Characteristic Values min. | typ. | max. | |
|---|---|---|---|---|---|
| $V_F$ | $I_F$ = 65 A; $T_{VJ}$ = 25°C | | 3.0 | 3.3 | V |
| | $T_{VJ}$ = 125°C | | 2.6 | | V |
| $I_R$ | $V_R$ = $V_{RRM}$; $T_{VJ}$ = 25°C | | | 0.06 | mA |
| | $T_{VJ}$ = 125°C | | 0.07 | | mA |
| $R_{thJC}$ | | | | 3.2 | K/W |

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## 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. | |
|---|---|---|---|---|---|
| $R_{pin-chip}$ | | | 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")**