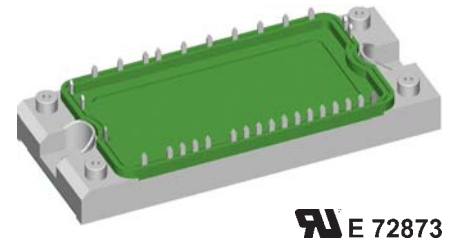
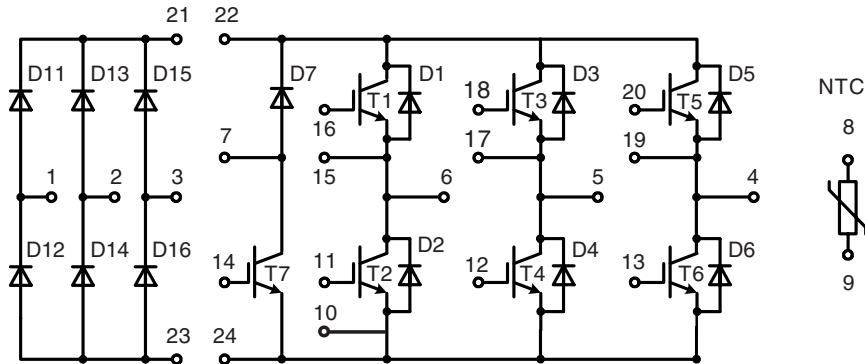


# Converter - Brake - Inverter Module (CBI2) with Trench IGBT technology

Preliminary data



E 72873

| Three Phase Rectifier      | Brake Chopper                 | Three Phase Inverter          |
|----------------------------|-------------------------------|-------------------------------|
| $V_{RRM} = 1600 \text{ V}$ | $V_{CES} = 1200 \text{ V}$    | $V_{CES} = 1200 \text{ V}$    |
| $I_{FAVM} = 38 \text{ A}$  | $I_{C25} = 30 \text{ A}$      | $I_{C25} = 45 \text{ A}$      |
| $I_{FSM} = 300 \text{ A}$  | $V_{CE(sat)} = 1.7 \text{ V}$ | $V_{CE(sat)} = 1.7 \text{ V}$ |

| Input Rectifier Bridge D11 - D16 |                                                                |                 |   |
|----------------------------------|----------------------------------------------------------------|-----------------|---|
| Symbol                           | Conditions                                                     | Maximum Ratings |   |
| $V_{RRM}$                        |                                                                | 1600            | V |
| $I_{FAV}$                        | $T_C = 80^\circ\text{C}$ ; sine $180^\circ$                    | 25              | A |
| $I_{DAVM}$                       | $T_C = 80^\circ\text{C}$ ; rectangular; $d = 1/3$ ; bridge     | 72              | 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 |

| Symbol     | Conditions                                                                         | Characteristic Values                                      |            |            |
|------------|------------------------------------------------------------------------------------|------------------------------------------------------------|------------|------------|
|            |                                                                                    | $(T_{VJ} = 25^\circ\text{C}$ , unless otherwise specified) |            |            |
|            |                                                                                    | min.                                                       | typ.       | max.       |
| $V_F$      | $I_F = 25 \text{ A}$ ; $T_{VJ} = 25^\circ\text{C}$<br>$T_{VJ} = 125^\circ\text{C}$ |                                                            | 1.1<br>1.1 | 1.3<br>V   |
| $I_R$      | $V_R = V_{RRM}$ ; $T_{VJ} = 25^\circ\text{C}$<br>$T_{VJ} = 125^\circ\text{C}$      |                                                            | 0.4        | 0.02<br>mA |
| $R_{thJC}$ | (per diode)                                                                        |                                                            |            | 1.3<br>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

## 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 |
| $I_{C25}$ | $T_C = 25^{\circ}\text{C}$                             | 45              | A |
| $I_{C80}$ | $T_C = 80^{\circ}\text{C}$                             | 25              | A |
| $I_{CM}$  | $T_C = 80^{\circ}\text{C}$ ; $t_p = 1\text{ ms}$       | 50              | A |
| $P_{tot}$ | $T_C = 25^{\circ}\text{C}$                             | 170             | W |

| Symbol                                                                    | Conditions                                                                                                                                         | Characteristic Values<br>( $T_{VJ} = 25^{\circ}\text{C}$ , unless otherwise specified)                                                                     |                                     |                                  |
|---------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|----------------------------------|
|                                                                           |                                                                                                                                                    | min.                                                                                                                                                       | typ.                                | max.                             |
| $V_{CE(sat)}$                                                             | $I_C = 25\text{ A}$ ; $V_{GE} = 15\text{ V}$ ; $T_{VJ} = 25^{\circ}\text{C}$<br>$T_{VJ} = 125^{\circ}\text{C}$                                     |                                                                                                                                                            | 1.7<br>2.0                          | V<br>V                           |
| $V_{GE(th)}$                                                              | $I_C = 1\text{ mA}$ ; $V_{GE} = V_{CE}$                                                                                                            | 5                                                                                                                                                          | 5.8                                 | 6.5 V                            |
| $I_{CES}$                                                                 | $V_{CE} = V_{CES}$ ; $V_{GE} = 0\text{ V}$ ; $T_{VJ} = 25^{\circ}\text{C}$<br>$T_{VJ} = 125^{\circ}\text{C}$                                       |                                                                                                                                                            | 0.7                                 | 2.7 mA<br>mA                     |
| $I_{GES}$                                                                 | $V_{CE} = 0\text{ V}$ ; $V_{GE} = \pm 20\text{ V}$                                                                                                 |                                                                                                                                                            |                                     | 400 nA                           |
| $C_{ies}$                                                                 | $V_{CE} = 25\text{ V}$ ; $V_{GE} = 0\text{ V}$ ; $f = 1\text{ MHz}$                                                                                |                                                                                                                                                            | 1.8                                 | nF                               |
| $Q_{Gon}$                                                                 | $V_{CE} = 600\text{ V}$ ; $V_{GE} = 15\text{ V}$ ; $I_C = 25\text{ A}$                                                                             |                                                                                                                                                            | 240                                 | nC                               |
| $t_{d(on)}$<br>$t_r$<br>$t_{d(off)}$<br>$t_{on}$<br>$E_{on}$<br>$E_{off}$ | Inductive load, $T_{VJ} = 125^{\circ}\text{C}$<br>$V_{CE} = 600\text{ V}$ ; $I_C = 25\text{ A}$<br>$V_{GE} = \pm 15\text{ V}$ ; $R_G = 36\ \Omega$ |                                                                                                                                                            | 90<br>50<br>520<br>90<br>2.5<br>3.4 | ns<br>ns<br>ns<br>ns<br>mJ<br>mJ |
| <b>RBSOA</b>                                                              |                                                                                                                                                    | $I_C = I_{CM}$ ; $V_{GE} = \pm 15\text{ V}$<br>$R_G = 36\ \Omega$ ; $T_{VJ} = 125^{\circ}\text{C}$                                                         | $V_{CEK} \leq V_{CES} - L_S di/dt$  | V                                |
| <b><math>I_{SC}</math><br/>(SCSOA)</b>                                    |                                                                                                                                                    | $V_{CE} = 720\text{ V}$ ; $V_{GE} = \pm 15\text{ V}$ ; $R_G = 36\ \Omega$ ;<br>$t_p \leq 10\ \mu\text{s}$ ; non-repetitive; $T_{VJ} = 125^{\circ}\text{C}$ | 100                                 | A                                |
| <b><math>R_{thJC}</math></b>                                              |                                                                                                                                                    | (per IGBT)                                                                                                                                                 |                                     | 0.73 K/W                         |

## Output Inverter D1 - D6

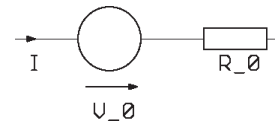
| Symbol    | Conditions                 | Maximum Ratings |   |
|-----------|----------------------------|-----------------|---|
| $I_{F25}$ | $T_C = 25^{\circ}\text{C}$ | 25              | A |
| $I_{F80}$ | $T_C = 80^{\circ}\text{C}$ | 17              | A |

| Symbol                                        | Conditions                                                                                                                                    | Characteristic Values |                          |                                |
|-----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|--------------------------|--------------------------------|
|                                               |                                                                                                                                               | min.                  | typ.                     | max.                           |
| $V_F$                                         | $I_F = 25\text{ A}$ ; $V_{GE} = 0\text{ V}$ ; $T_{VJ} = 25^{\circ}\text{C}$<br>$T_{VJ} = 125^{\circ}\text{C}$                                 |                       | 2.1<br>1.6               | V<br>V                         |
| $I_{RM}$<br>$Q_{rr}$<br>$t_{rr}$<br>$E_{rec}$ | $I_F = tbd\text{ A}$ ; $di_F/dt = -tbd\text{ A}/\mu\text{s}$ ; $T_{VJ} = 125^{\circ}\text{C}$<br>$V_R = 600\text{ V}$ ; $V_{GE} = 0\text{ V}$ |                       | tbd<br>tbd<br>tbd<br>tbd | A<br>$\mu\text{C}$<br>ns<br>mJ |
| <b><math>R_{thJC}</math></b>                  |                                                                                                                                               | (per diode)           |                          | 2.1 K/W                        |

## Equivalent Circuits for Simulation

### Conduction



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

$$V_0 = 0.92\text{ V}; R_0 = 42.8\text{ m}\Omega$$

T7

$$V_0 = 0.92\text{ V}; R_0 = 72\text{ m}\Omega$$

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

D1-D6

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

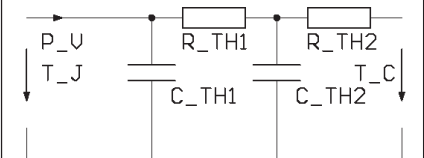
D7

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

D11-D16

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

### Thermal Response



IGBT (typ.)

T1-T6

$$C_{th1} = tbd\text{ J/K}; R_{th1} = tbd\text{ K/W}$$

$$C_{th2} = tbd\text{ J/K}; R_{th2} = tbd\text{ K/W}$$

T7

$$C_{th1} = tbd\text{ J/K}; R_{th1} = tbd\text{ K/W}$$

$$C_{th2} = tbd\text{ J/K}; R_{th2} = tbd\text{ K/W}$$

Diode (typ.)

D1-D6

$$C_{th1} = tbd\text{ J/K}; R_{th1} = tbd\text{ K/W}$$

$$C_{th2} = tbd\text{ J/K}; R_{th2} = tbd\text{ K/W}$$

D7

$$C_{th1} = tbd\text{ J/K}; R_{th1} = tbd\text{ K/W}$$

$$C_{th2} = tbd\text{ J/K}; R_{th2} = tbd\text{ K/W}$$

D11-D16

$$C_{th1} = tbd\text{ J/K}; R_{th1} = tbd\text{ K/W}$$

$$C_{th2} = tbd\text{ J/K}; R_{th2} = tbd\text{ K/W}$$

### 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 |
| $I_{C25}$ | $T_C = 25^{\circ}\text{C}$                             | 30              | A |
| $I_{C80}$ | $T_C = 80^{\circ}\text{C}$                             | 15              | A |
| $I_{CM}$  | $T_C = 80^{\circ}\text{C}$ ; $t_p = 1$ ms              | 30              | A |
| $P_{tot}$ | $T_C = 25^{\circ}\text{C}$                             | 120             | W |

| Symbol                                 | Conditions                                                                                                                          | Characteristic Values<br>( $T_{VJ} = 25^{\circ}\text{C}$ , unless otherwise specified) |                                    |              |
|----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|------------------------------------|--------------|
|                                        |                                                                                                                                     | min.                                                                                   | typ.                               | max.         |
| $V_{CE(sat)}$                          | $I_C = 15$ A; $V_{GE} = 15$ V; $T_{VJ} = 25^{\circ}\text{C}$<br>$T_{VJ} = 125^{\circ}\text{C}$                                      |                                                                                        | 1.7<br>2.0                         | 2.1<br>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; $T_{VJ} = 25^{\circ}\text{C}$<br>$T_{VJ} = 125^{\circ}\text{C}$                                |                                                                                        | 0.25                               | 0.1 mA<br>mA |
| $I_{GES}$                              | $V_{CE} = 0$ V; $V_{GE} = \pm 20$ V                                                                                                 |                                                                                        |                                    | 400 nA       |
| $C_{ies}$                              | $V_{CE} = 25$ V; $V_{GE} = 0$ V; $f = 1$ MHz                                                                                        |                                                                                        | 1.1                                | nF           |
| $Q_{Gon}$                              | $V_{CE} = 600$ V; $V_{GE} = 15$ V; $I_C = 15$ A                                                                                     |                                                                                        | 150                                | nC           |
| $t_{d(on)}$                            | Inductive load, $T_{VJ} = 125^{\circ}\text{C}$<br>$V_{CE} = 600$ V; $I_C = 15$ A<br>$V_{GE} = \pm 15$ V; $R_G = 75$ $\Omega$        |                                                                                        | 90                                 | ns           |
| $t_r$                                  |                                                                                                                                     |                                                                                        | 50                                 | ns           |
| $t_{d(off)}$                           |                                                                                                                                     |                                                                                        | 520                                | ns           |
| $t_f$                                  |                                                                                                                                     |                                                                                        | 90                                 | ns           |
| $E_{off}$                              |                                                                                                                                     |                                                                                        | 1.5                                | mJ           |
| <b>RBSOA</b>                           | $I_C = I_{CM}$ ; $V_{GE} = \pm 15$ V<br>$R_G = 75$ $\Omega$ ; $T_{VJ} = 125^{\circ}\text{C}$                                        |                                                                                        | $V_{CEK} \leq V_{CES} - L_S di/dt$ | V            |
| <b><math>I_{SC}</math><br/>(SCSOA)</b> | $V_{CE} = 720$ V; $V_{GE} = \pm 15$ V; $R_G = 75$ $\Omega$<br>$t_p \leq 10$ $\mu$ s; non-repetitive; $T_{VJ} = 125^{\circ}\text{C}$ |                                                                                        | 60                                 | A            |
| $R_{thJC}$                             |                                                                                                                                     |                                                                                        |                                    | 1.05 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.          |
| $V_F$      | $I_F = 65$ A; $T_{VJ} = 25^{\circ}\text{C}$<br>$T_{VJ} = 125^{\circ}\text{C}$     |                       | 3.0<br>2.6 | 3.3<br>V      |
| $I_R$      | $V_R = V_{RRM}$ ; $T_{VJ} = 25^{\circ}\text{C}$<br>$T_{VJ} = 125^{\circ}\text{C}$ |                       | 0.07       | 0.06 mA<br>mA |
| $R_{thJC}$ |                                                                                   |                       |            | 3.2 K/W       |

## Temperature Sensor NTC

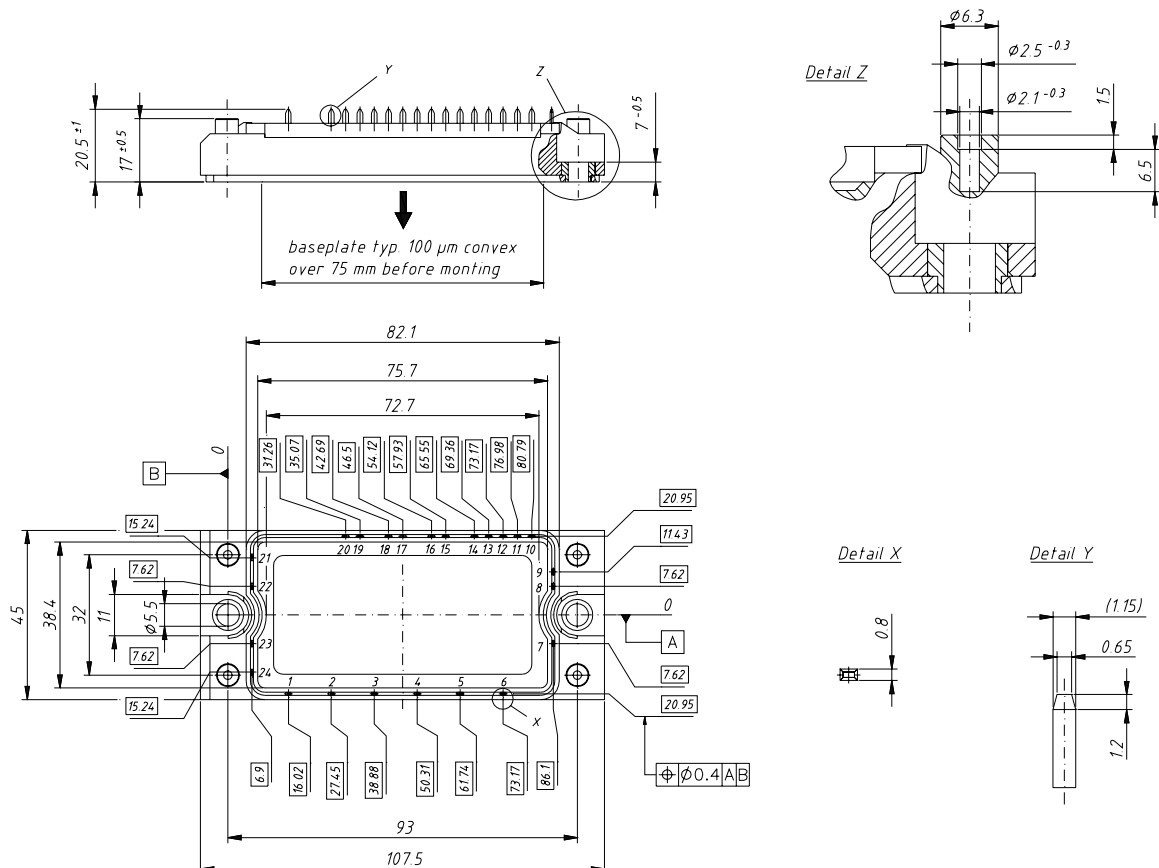
| Symbol      | Conditions               | Characteristic Values |      |                 |
|-------------|--------------------------|-----------------------|------|-----------------|
|             |                          | min.                  | typ. | max.            |
| $R_{25}$    | $T = 25^{\circ}\text{C}$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

## Module

| Symbol     | Conditions                                     | Maximum Ratings |                    |
|------------|------------------------------------------------|-----------------|--------------------|
| $T_{VJ}$   | operating                                      | -40...+125      | $^{\circ}\text{C}$ |
| $T_{JM}$   |                                                | 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    | 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")



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