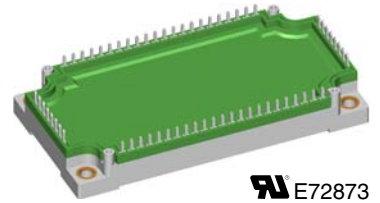
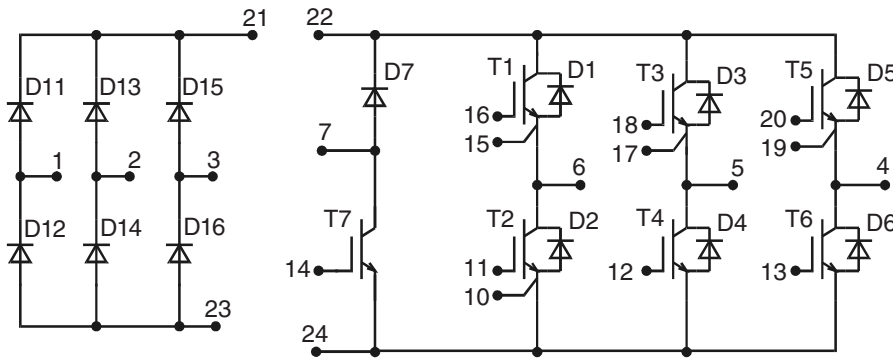
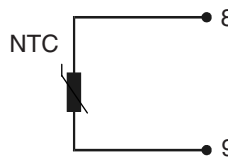


# Converter - Brake - Inverter Module (CBI3)


**IXYS E72873**

See outline drawing for pin arrangement

## Preliminary data



| Three Phase Rectifier      | Brake Chopper                 | Three Phase Inverter          |
|----------------------------|-------------------------------|-------------------------------|
| $V_{RRM} = 1600 \text{ V}$ | $V_{CES} = 600 \text{ V}$     | $V_{CES} = 600 \text{ V}$     |
| $I_{FAVM} = 90 \text{ A}$  | $I_{C25} = 50 \text{ A}$      | $I_{C25} = 125 \text{ A}$     |
| $I_{FSM} = 850 \text{ A}$  | $V_{CE(sat)} = 1.9 \text{ V}$ | $V_{CE(sat)} = 1.9 \text{ V}$ |

| Input Rectifier D11 - D16 |  |                 |
|---------------------------|--|-----------------|
| Symbol                    | Conditions   | Maximum Ratings |
| $V_{RRM}$                 |  | 1600 V          |
| $I_{FAV}$                 | $T_C = 80^\circ\text{C}$ ; sine 180°                           | 65 A            |
| $I_{DAVM}$                | $T_C = 80^\circ\text{C}$ ; rectangular; $d = 1/3$ ; bridge     | 180 A           |
| $I_{FSM}$                 | $T_{VJ} = 25^\circ\text{C}$ ; $t = 10 \text{ ms}$ ; sine 50 Hz | 850 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.          |
| $V_F$      | $I_F = 100 \text{ A}$ ; $T_{VJ} = 25^\circ\text{C}$<br>$T_{VJ} = 125^\circ\text{C}$ |  | 1.3  | 1.5 V         |
| $I_R$      | $V_R = V_{RRM}$ ; $T_{VJ} = 25^\circ\text{C}$<br>$T_{VJ} = 125^\circ\text{C}$       |  | 1    | 0.05 mA<br>mA |
| $R_{thJC}$ | (per diode)   |  |      | 0.73 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
- € 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

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**Output Inverter T1 - T6**

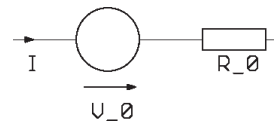
| Symbol                                 | Conditions  | Maximum Ratings                          |               |
|--|---|--|---------------|
| $V_{CES}$                              | $T_{VJ} = 25^{\circ}\text{C}$ to $150^{\circ}\text{C}$  | 600                                      | V             |
| $V_{GES}$                              | Continuous  | $\pm 20$                                 | V             |
| $I_{C25}$                              | $T_C = 25^{\circ}\text{C}$  | 125                                      | A             |
| $I_{C80}$                              | $T_C = 80^{\circ}\text{C}$  | 85                                       | A             |
| <b>RBSOA</b>                           | $V_{GE} = \pm 15\text{ V}$ ; $R_G = 2.2\ \Omega$ ; $T_{VJ} = 125^{\circ}\text{C}$<br>Clamped inductive load; $L = 100\ \mu\text{H}$ | $I_{CM} = 200$<br>$V_{CEK} \leq V_{CES}$ | A             |
| <b><math>t_{SC}</math><br/>(SCSOA)</b> | $V_{CE} = V_{CES}$ ; $V_{GE} = \pm 15\text{ V}$ ; $R_G = 2.2\ \Omega$ ; $T_{VJ} = 125^{\circ}\text{C}$<br>non-repetitive            | 10                                       | $\mu\text{s}$ |
| $P_{tot}$                              | $T_C = 25^{\circ}\text{C}$  | 410                                      | W             |

| Symbol   | Conditions   | Characteristic Values<br>( $T_{VJ} = 25^{\circ}\text{C}$ , unless otherwise specified) |      |          |
|--|--|--|------|----------|
|  |  | min.   | typ. | max.     |
| $V_{CE(sat)}$  | $I_C = 100\text{ A}$ ; $V_{GE} = 15\text{ V}$ ; $T_{VJ} = 25^{\circ}\text{C}$<br>$T_{VJ} = 125^{\circ}\text{C}$                                      | 1.9<br>2.2   | 2.5  | V<br>V   |
| $V_{GE(th)}$   | $I_C = 1.5\text{ mA}$ ; $V_{GE} = V_{CE}$  | 4.5  | 6.5  | V        |
| $I_{CES}$  | $V_{CE} = V_{CES}$ ; $V_{GE} = 0\text{ V}$ ; $T_{VJ} = 25^{\circ}\text{C}$<br>$T_{VJ} = 125^{\circ}\text{C}$   | 1.5  | 1.4  | mA<br>mA |
| $I_{GES}$  | $V_{CE} = 0\text{ V}$ ; $V_{GE} = \pm 20\text{ V}$   |  | 400  | nA       |
| $t_{d(on)}$<br>$t_r$<br>$t_{d(off)}$<br>$t_f$<br>$E_{on}$<br>$E_{off}$ | Inductive load, $T_{VJ} = 125^{\circ}\text{C}$<br>$V_{CE} = 300\text{ V}$ ; $I_C = 100\text{ A}$<br>$V_{GE} = \pm 15\text{ V}$ ; $R_G = 2.2\ \Omega$ |  | 25   | ns       |
|  |  |  | 11   | ns       |
|  |  |  | 150  | ns       |
|  |  |  | 30   | ns       |
|  |  |  | 1.0  | mJ       |
|  |  |  | 2.9  | mJ       |
| $C_{ies}$  |  | $V_{CE} = 25\text{ V}$ ; $V_{GE} = 0\text{ V}$ ; $f = 1\text{ MHz}$                    | 4.3  |          |
| $Q_{Gon}$  | $V_{CE} = 300\text{ V}$ ; $V_{GE} = 15\text{ V}$ ; $I_C = 125\text{ A}$  | 340  |      | nC       |
| $R_{thJC}$   | (per IGBT)   |  |      | 0.3 K/W  |

**Output Inverter D1 - D6**

| Symbol    | Conditions                 | Maximum Ratings |   |
|-----------|----------------------------|-----------------|---|
| $I_{F25}$ | $T_C = 25^{\circ}\text{C}$ | 140             | A |
| $I_{F80}$ | $T_C = 80^{\circ}\text{C}$ | 85              | A |

| Symbol               | Conditions   | Characteristic Values |      |          |
|----------------------|--|-----------------------|------|----------|
|                      |  | min.                  | typ. | max.     |
| $V_F$                | $I_F = 100\text{ A}$ ; $V_{GE} = 0\text{ V}$ ; $T_{VJ} = 25^{\circ}\text{C}$<br>$T_{VJ} = 125^{\circ}\text{C}$                               | 1.9<br>1.4            | 2.2  | V<br>V   |
| $I_{RM}$<br>$t_{rr}$ | $I_F = 60\text{ A}$ ; $di_F/dt = -500\text{ A}/\mu\text{s}$ ; $T_{VJ} = 125^{\circ}\text{C}$<br>$V_R = 300\text{ V}$ ; $V_{GE} = 0\text{ V}$ | 28                    |      | A        |
|                      |  | 100                   |      | ns       |
| $R_{thJC}$           | (per diode)  |                       |      | 0.61 K/W |

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

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

$$V_0 = 1.05\text{ V}; R_0 = 11.5\text{ m}\Omega$$

T7

$$V_0 = 1.05\text{ V}; R_0 = 21.5\text{ m}\Omega$$

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

D1-D6

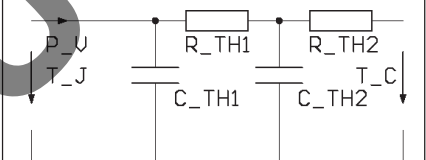
$$V_0 = 1.15\text{ V}; R_0 = 2.5\text{ m}\Omega$$

D7

$$V_0 = 1.15\text{ V}; R_0 = 12.5\text{ m}\Omega$$

D11-D16

$$V_0 = 0.85\text{ V}; R_0 = 4\text{ m}\Omega$$

**Thermal Response**


IGBT (typ.)

T1-T6

$$C_{th1} = 0.232\text{ J/K}; R_{th1} = 0.223\text{ K/W}$$

$$C_{th2} = 1.504\text{ J/K}; R_{th2} = 0.077\text{ K/W}$$

T7

$$C_{th1} = 0.123\text{ J/K}; R_{th1} = 0.419\text{ K/W}$$

$$C_{th2} = 0.944\text{ J/K}; R_{th2} = 0.131\text{ K/W}$$

Diode (typ.)

D1-D6

$$C_{th1} = 0.138\text{ J/K}; R_{th1} = 0.48\text{ K/W}$$

$$C_{th2} = 0.957\text{ J/K}; R_{th2} = 0.13\text{ K/W}$$

D7

$$C_{th1} = 0.038\text{ J/K}; R_{th1} = 1.74\text{ K/W}$$

$$C_{th2} = 0.435\text{ J/K}; R_{th2} = 0.36\text{ K/W}$$

D11-D16

$$C_{th1} = 0.112\text{ J/K}; R_{th1} = 0.568\text{ K/W}$$

$$C_{th2} = 0.745\text{ J/K}; R_{th2} = 0.162\text{ K/W}$$

**Brake Chopper T7**

| Symbol                     | Conditions   | Maximum Ratings                          |               |
|----------------------------|--|--|---------------|
| $V_{CES}$                  | $T_{VJ} = 25^{\circ}\text{C}$ to $150^{\circ}\text{C}$   | 600                                      | V             |
| $V_{GES}$                  | Continuous   | $\pm 20$                                 | V             |
| $I_{C25}$                  | $T_C = 25^{\circ}\text{C}$   | 75                                       | A             |
| $I_{C80}$                  | $T_C = 80^{\circ}\text{C}$   | 50                                       | A             |
| <b>RBSOA</b>               | $V_{GE} = \pm 15\text{ V}$ ; $R_G = 22\ \Omega$ ; $T_{VJ} = 125^{\circ}\text{C}$<br>Clamped inductive load; $L = 100\ \mu\text{H}$ | $I_{CM} = 100$<br>$V_{CEK} \leq V_{CES}$ | A             |
| $t_{SC}$<br><b>(SCSOA)</b> | $V_{CE} = V_{CES}$ ; $V_{GE} = \pm 15\text{ V}$ ; $R_G = 22\ \Omega$ ; $T_{VJ} = 125^{\circ}\text{C}$<br>non-repetitive            | 10                                       | $\mu\text{s}$ |
| $P_{tot}$                  | $T_C = 25^{\circ}\text{C}$   | 225                                      | W             |

| Symbol        | Conditions   | Characteristic Values<br>( $T_{VJ} = 25^{\circ}\text{C}$ , unless otherwise specified) |      |          |
|---------------|--|--|------|----------|
|               |  | min.   | typ. | max.     |
| $V_{CE(sat)}$ | $I_C = 50\text{ A}$ ; $V_{GE} = 15\text{ V}$ ; $T_{VJ} = 25^{\circ}\text{C}$<br>$T_{VJ} = 125^{\circ}\text{C}$                                     | 1.9  | 2.3  | V        |
|               |  | 2.1  |      | V        |
| $V_{GE(th)}$  | $I_C = 1\text{ mA}$ ; $V_{GE} = V_{CE}$  | 4.5  | 6.5  | V        |
| $I_{CES}$     | $V_{CE} = V_{CES}$ ; $V_{GE} = 0\text{ V}$ ; $T_{VJ} = 25^{\circ}\text{C}$<br>$T_{VJ} = 125^{\circ}\text{C}$                                       | 0.5  | 0.5  | mA<br>mA |
| $I_{GES}$     | $V_{CE} = 0\text{ V}$ ; $V_{GE} = \pm 20\text{ V}$   |  | 200  | nA       |
| $t_{d(on)}$   | Inductive load, $T_{VJ} = 125^{\circ}\text{C}$<br>$V_{CE} = 300\text{ V}$ ; $I_C = 50\text{ A}$<br>$V_{GE} = \pm 15\text{ V}$ ; $R_G = 22\ \Omega$ |  | 50   | ns       |
| $t_r$         |  |  | 55   | ns       |
| $t_{d(off)}$  |  |  | 300  | ns       |
| $t_f$         |  |  | 30   | ns       |
| $E_{on}$      |  |  | 2.3  | mJ       |
| $E_{off}$     |  |  | 1.7  | mJ       |
| $C_{ies}$     | $V_{CE} = 25\text{ V}$ ; $V_{GE} = 0\text{ V}$ ; $f = 1\text{ MHz}$  | 2.8  |      | nF       |
| $Q_{Gon}$     | $V_{CE} = 300\text{ V}$ ; $V_{GE} = 15\text{ V}$ ; $I_C = 50\text{ A}$   | 120  |      | nC       |
| $R_{thJC}$    |  |  | 0.55 | K/W      |

**Brake Chopper D7**

| Symbol    | Conditions   | Maximum Ratings |   |
|-----------|--|-----------------|---|
| $V_{RRM}$ | $T_{VJ} = 25^{\circ}\text{C}$ to $150^{\circ}\text{C}$ | 600             | V |
| $I_{F25}$ | $T_C = 25^{\circ}\text{C}$                             | 35              | A |
| $I_{F80}$ | $T_C = 80^{\circ}\text{C}$                             | 24              | A |

| Symbol     | Conditions   | Characteristic Values |      |          |
|------------|--|-----------------------|------|----------|
|            |  | min.                  | typ. | max.     |
| $V_F$      | $I_F = 50\text{ A}$ ; $T_{VJ} = 25^{\circ}\text{C}$<br>$T_{VJ} = 125^{\circ}\text{C}$                                | 2.2                   | 2.5  | V        |
|            |  | 1.8                   |      | V        |
| $I_R$      | $V_R = V_{RRM}$ ; $T_{VJ} = 25^{\circ}\text{C}$<br>$T_{VJ} = 125^{\circ}\text{C}$                                    | 0.1                   | 0.1  | mA<br>mA |
| $I_{RM}$   | $I_F = 15\text{ A}$ ; $di_F/dt = -400\text{ A}/\mu\text{s}$ ; $T_{VJ} = 125^{\circ}\text{C}$<br>$V_R = 300\text{ V}$ | 13                    |      | A        |
| $t_{rr}$   |  | 90                    |      | ns       |
| $R_{thJC}$ |  |                       | 2.1  | K/W      |

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### Temperature Sensor NTC

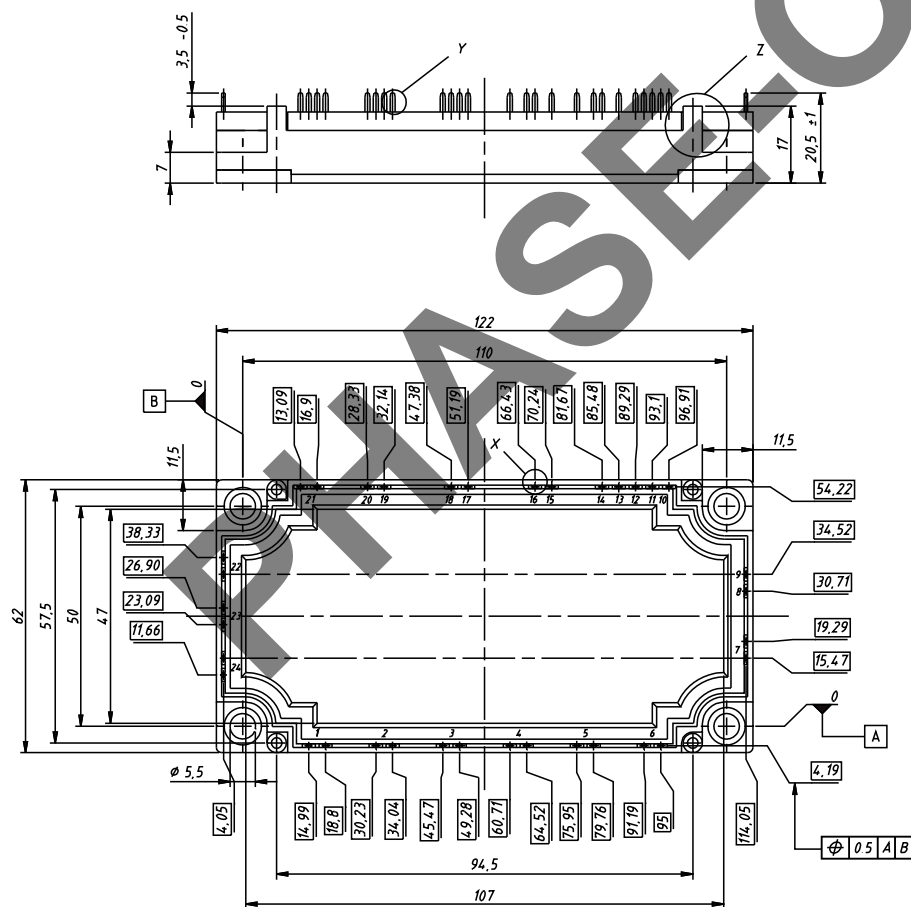
| Symbol      | Conditions               | Characteristic Values |      |                 |
|-------------|--------------------------|-----------------------|------|-----------------|
|             |                          | min.                  | typ. | max.            |
| $R_{25}$    | $T = 25^{\circ}\text{C}$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

### Module

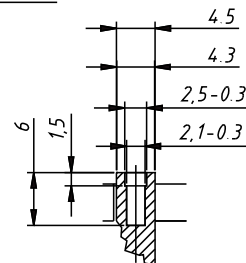
| Symbol     | Conditions                                     | Maximum Ratings |                    |
|------------|--|-----------------|--------------------|
| $T_{VJ}$   | operating                                      | -40...+125      | $^{\circ}\text{C}$ |
| $T_{JM}$   |  | +150            | $^{\circ}\text{C}$ |
| $T_{stg}$  |  | -40...+125      | $^{\circ}\text{C}$ |
| $V_{ISOL}$ | $I_{ISOL} \leq 1 \text{ mA}; 50/60 \text{ Hz}$ | 2500            | V~                 |
| $M_d$      | Mounting torque (M5)                           | 3 - 6           | 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       |                       | 0.01 | K/W        |
| Weight         |                              |                       | 300  | g          |

Dimensions in mm (1 mm = 0.0394")



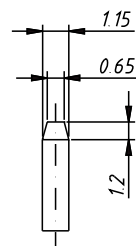
Detail Z



Detail X



Detail Y



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