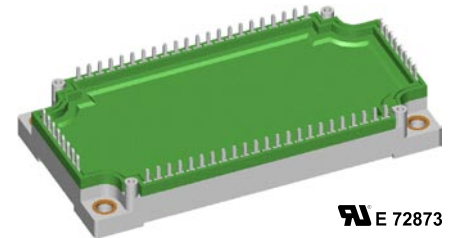
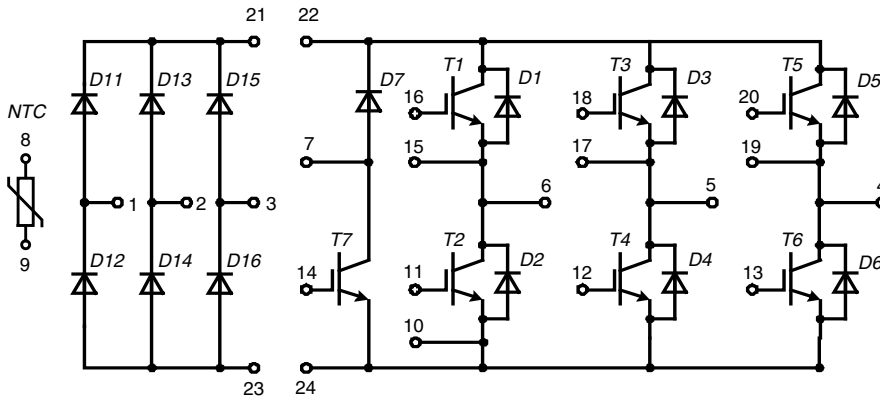


# **Converter - Brake - Inverter Module (CBI3) with Trench IGBT technology**


**E 72873**

| Three Phase Rectifier      | Brake Chopper                 | Three Phase Inverter          |
|----------------------------|-------------------------------|-------------------------------|
| $V_{RRM} = 1600 \text{ V}$ | $V_{CES} = 1200 \text{ V}$    | $V_{CES} = 1200 \text{ V}$    |
| $I_{FAVM} = 50 \text{ A}$  | $I_{C25} = 55 \text{ A}$      | $I_{C25} = 80 \text{ A}$      |
| $I_{FSM} = 850 \text{ A}$  | $V_{CE(sat)} = 1.7 \text{ V}$ | $V_{CE(sat)} = 1.7 \text{ V}$ |

| Input Rectifier Bridge D11 - D16 |                                                             |                 |   |
|----------------------------------|-------------------------------------------------------------|-----------------|---|
| Symbol                           | Conditions                                                  | Maximum Ratings |   |
| $V_{RRM}$                        |                                                             | 1600            | V |
| $I_{FAV}$                        | $T_C = 80^\circ\text{C}$ ; sine $180^\circ$                 | 50              | A |
| $I_{DAVM}$                       | $T_C = 80^\circ\text{C}$ ; rectangular; $d = 1/3$ ; bridge  | 140             | A |
| $I_{FSM}$                        | $T_C = 25^\circ\text{C}$ ; $t = 10 \text{ ms}$ ; sine 50 Hz | 850             | A |
| $P_{tot}$                        | $T_C = 25^\circ\text{C}$                                    | 125             | W |

| Symbol     | Conditions                                                                         | Characteristic Values                                             |              |      |          |
|------------|------------------------------------------------------------------------------------|-------------------------------------------------------------------|--------------|------|----------|
|            |                                                                                    | $(T_{VJ} = 25^\circ\text{C}, \text{ unless otherwise specified})$ |              |      |          |
|            |                                                                                    | min.                                                              | typ.         | max. |          |
| $V_F$      | $I_F = 50 \text{ A}$ ; $T_{VJ} = 25^\circ\text{C}$<br>$T_{VJ} = 125^\circ\text{C}$ |                                                                   | 1.15<br>1.05 | 1.3  | V<br>V   |
| $I_R$      | $V_R = V_{RRM}$ ; $T_{VJ} = 25^\circ\text{C}$<br>$T_{VJ} = 125^\circ\text{C}$      |                                                                   | 0.8          | 0.05 | mA<br>mA |
| $R_{thJC}$ | (per diode)                                                                        |                                                                   |              | 1.0  | 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
- IGBT technology with low saturation voltage, low switching losses and tail current, high RBSOA and short circuit ruggedness
- Epitaxial free wheeling diodes with Hyperfast 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 |
| $I_{C25}$ | $T_C = 25^{\circ}\text{C}$                             | 80              | A |
| $I_{C80}$ | $T_C = 80^{\circ}\text{C}$                             | 50              | A |
| $I_{CM}$  | $T_C = 80^{\circ}\text{C}$ ; $t_p = 1 \text{ ms}$      | 100             | A |
| $P_{tot}$ | $T_C = 25^{\circ}\text{C}$                             | 270             | W |

| Symbol                                               | Conditions | Characteristic Values |      |      |  |
|------------------------------------------------------|------------|-----------------------|------|------|--|
| (T <sub>VJ</sub> = 25°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>$T_{VJ} = 125^{\circ}\text{C}$                                                                                          |                                    | 1.7<br>2.0                        | 2.15<br>V                        |
| $V_{GE(th)}$                                                           | $I_C = 2 \text{ mA}$ ; $V_{GE} = V_{CE}$                                                                                                             |                                                                                                                                                          | 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                           |
| $I_{GES}$                                                              | $V_{CE} = 0 \text{ V}$ ; $V_{GE} = \pm 20 \text{ V}$                                                                                                 |                                                                                                                                                          |                                    |                                   | 400 nA                           |
| $C_{ies}$                                                              | $V_{CE} = 25 \text{ V}$ ; $V_{GE} = 0 \text{ V}$ ; $f = 1 \text{ MHz}$                                                                               |                                                                                                                                                          |                                    | 3.5                               | nF                               |
| $Q_{Gon}$                                                              | $V_{CE} = 600 \text{ V}$ ; $V_{GE} = 15 \text{ V}$ ; $I_C = 50 \text{ A}$                                                                            |                                                                                                                                                          |                                    | 470                               | nC                               |
| $t_{d(on)}$<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>$V_{CE} = 600 \text{ V}$ ; $I_C = 50 \text{ A}$<br>$V_{GE} = \pm 15 \text{ V}$ ; $R_G = 18 \Omega$ |                                                                                                                                                          |                                    | 90<br>50<br>520<br>90<br>5<br>6.5 | ns<br>ns<br>ns<br>ns<br>mJ<br>mJ |
| <b>RBSOA</b>                                                           |                                                                                                                                                      | $I_C = I_{CM}$ ; $V_{GE} = 15 \text{ V}$<br>$R_G = 18 \Omega$ ; $T_{VJ} = 125^{\circ}\text{C}$                                                           | $V_{CEK} \leq V_{CES} - L_S di/dt$ |                                   | V                                |
| $t_{SC}$<br><b>(SCSOA)</b>                                             |                                                                                                                                                      | $V_{CE} = 720 \text{ V}$ ; $V_{GE} = \pm 15 \text{ V}$ ; $R_G = 18 \Omega$<br>$t_p \leq 10 \mu\text{s}$ ; non-repetitive; $T_{VJ} = 125^{\circ}\text{C}$ |                                    | 200                               | A                                |
| $R_{thJC}$                                                             |                                                                                                                                                      |                                                                                                                                                          |                                    | 0.46                              | K/W                              |

**Output Inverter D1 - D6**

| Symbol    | Conditions                 | Maximum Ratings |   |
|-----------|----------------------------|-----------------|---|
| $I_{F25}$ | $T_C = 25^{\circ}\text{C}$ | 100             | A |
| $I_{F80}$ | $T_C = 80^{\circ}\text{C}$ | 50              | A |

| Symbol | Conditions | Characteristic Values |      |      |  |
|--------|------------|-----------------------|------|------|--|
|        |            | min.                  | typ. | max. |  |

|                                               |                                                                                                                                                     |  |                      |      |                                |
|-----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|--|----------------------|------|--------------------------------|
| $V_F$                                         | $I_F = 50 \text{ A}$ ; $T_{VJ} = 25^{\circ}\text{C}$<br>$T_{VJ} = 125^{\circ}\text{C}$                                                              |  | 2.1<br>1.6           | 2.6  | V<br>V                         |
| $I_{RM}$<br>$Q_{rr}$<br>$t_{rr}$<br>$E_{rec}$ | $I_F = 60 \text{ A}$ ; $di_F/dt = -1200 \text{ A}/\mu\text{s}$ ;<br>$T_{VJ} = 125^{\circ}\text{C}$ ; $V_R = 600 \text{ V}$ ; $V_{GE} = 0 \text{ V}$ |  | 90<br>10<br>160<br>4 |      | A<br>$\mu\text{C}$<br>ns<br>mJ |
| $R_{thJC}$                                    |                                                                                                                                                     |  |                      | 0.65 | 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 |
| $I_{C25}$ | $T_C = 25^{\circ}\text{C}$                             | 55              | A |
| $I_{C80}$ | $T_C = 80^{\circ}\text{C}$                             | 35              | A |
| $I_{CM}$  | $T_C = 80^{\circ}\text{C}$ ; $t_p = 1 \text{ ms}$      | 70              | A |
| $P_{tot}$ | $T_C = 25^{\circ}\text{C}$                             | 200             | W |

| Symbol                                               | Conditions | Characteristic Values |      |      |  |
|------------------------------------------------------|------------|-----------------------|------|------|--|
| (T <sub>VJ</sub> = 25°C, unless otherwise specified) |            |                       |      |      |  |
|                                                      |            | min.                  | typ. | max. |  |

|                                                            |                                                                                                                                                      |                                                                                                                                                          |                                    |                              |                            |
|------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|------------------------------|----------------------------|
| $V_{CE(sat)}$                                              | $I_C = 35 \text{ A}$ ; $V_{GE} = 15 \text{ V}$                                                                                                       | $T_{VJ} = 25^{\circ}\text{C}$<br>$T_{VJ} = 125^{\circ}\text{C}$                                                                                          |                                    | 1.7<br>2.0                   | 2.15<br>V                  |
| $V_{GE(th)}$                                               | $I_C = 1.5 \text{ mA}$ ; $V_{GE} = V_{CE}$                                                                                                           |                                                                                                                                                          | 5                                  | 5.8                          | 6.5 V                      |
| $I_{CES}$                                                  | $V_{CE} = V_{CES}$ ; $V_{GE} = 0 \text{ V}$                                                                                                          | $T_{VJ} = 25^{\circ}\text{C}$<br>$T_{VJ} = 125^{\circ}\text{C}$                                                                                          |                                    | 0.3                          | 0.25 mA<br>mA              |
| $I_{GES}$                                                  | $V_{CE} = 0 \text{ V}$ ; $V_{GE} = \pm 20 \text{ V}$                                                                                                 |                                                                                                                                                          |                                    |                              | 400 nA                     |
| $C_{ies}$                                                  | $V_{CE} = 25 \text{ V}$ ; $V_{GE} = 0 \text{ V}$ ; $f = 1 \text{ MHz}$                                                                               |                                                                                                                                                          |                                    | 2.5                          | nF                         |
| $Q_{Gon}$                                                  | $V_{CE} = 600 \text{ V}$ ; $V_{GE} = 15 \text{ V}$ ; $I_C = 35 \text{ A}$                                                                            |                                                                                                                                                          |                                    | 330                          | nC                         |
| $t_{d(on)}$<br>$t_r$<br>$t_{d(off)}$<br>$t_f$<br>$E_{off}$ | Inductive load, $T_{VJ} = 125^{\circ}\text{C}$<br>$V_{CE} = 600 \text{ V}$ ; $I_C = 35 \text{ A}$<br>$V_{GE} = \pm 15 \text{ V}$ ; $R_G = 27 \Omega$ |                                                                                                                                                          |                                    | 90<br>50<br>520<br>90<br>4.8 | ns<br>ns<br>ns<br>ns<br>mJ |
| <b>RBSOA</b>                                               |                                                                                                                                                      | $I_C = I_{CM}$ ; $V_{GE} = 15 \text{ V}$<br>$R_G = 27 \Omega$ ; $T_{VJ} = 125^{\circ}\text{C}$                                                           | $V_{CEK} \leq V_{CES} - L_S di/dt$ |                              | V                          |
| $t_{SC}$<br><b>(SCSOA)</b>                                 |                                                                                                                                                      | $V_{CE} = 720 \text{ V}$ ; $V_{GE} = \pm 15 \text{ V}$ ; $R_G = 27 \Omega$<br>$t_p \leq 10 \mu\text{s}$ ; non-repetitive; $T_{VJ} = 125^{\circ}\text{C}$ |                                    | 140                          | A                          |
| $R_{thJC}$                                                 |                                                                                                                                                      |                                                                                                                                                          |                                    | 0.62                         | K/W                        |

**Brake Chopper D7**

| Symbol    | Conditions                                             | Maximum Ratings |   |
|-----------|--------------------------------------------------------|-----------------|---|
| $V_{RRM}$ | $T_{VJ} = 25^{\circ}\text{C}$ to $150^{\circ}\text{C}$ | 1200            | V |
| $I_{F25}$ | $T_C = 25^{\circ}\text{C}$                             | 48              | A |
| $I_{F80}$ | $T_C = 80^{\circ}\text{C}$                             | 30              | A |

| Symbol | Conditions | Characteristic Values |      |      |  |
|--------|------------|-----------------------|------|------|--|
|        |            | min.                  | typ. | max. |  |

|                         |                                         |                                                               | min. | typ.       | max. |          |
|-------------------------|-----------------------------------------|---------------------------------------------------------------|------|------------|------|----------|
| <b>V<sub>F</sub></b>    | <b>I<sub>F</sub> = 35 A;</b>            | <b>T<sub>VJ</sub> = 25°C</b><br><b>T<sub>VJ</sub> = 125°C</b> |      | 2.5<br>2.0 | 3.3  | V<br>V   |
| <b>I<sub>R</sub></b>    | <b>V<sub>R</sub> = V<sub>RRM</sub>;</b> | <b>T<sub>VJ</sub> = 25°C</b><br><b>T<sub>VJ</sub> = 125°C</b> |      | 0.5        | 0.25 | mA<br>mA |
| <b>R<sub>thJC</sub></b> | <b>(per diode)</b>                      |                                                               |      |            | 1.2  | K/W      |

### Temperature Sensor NTC

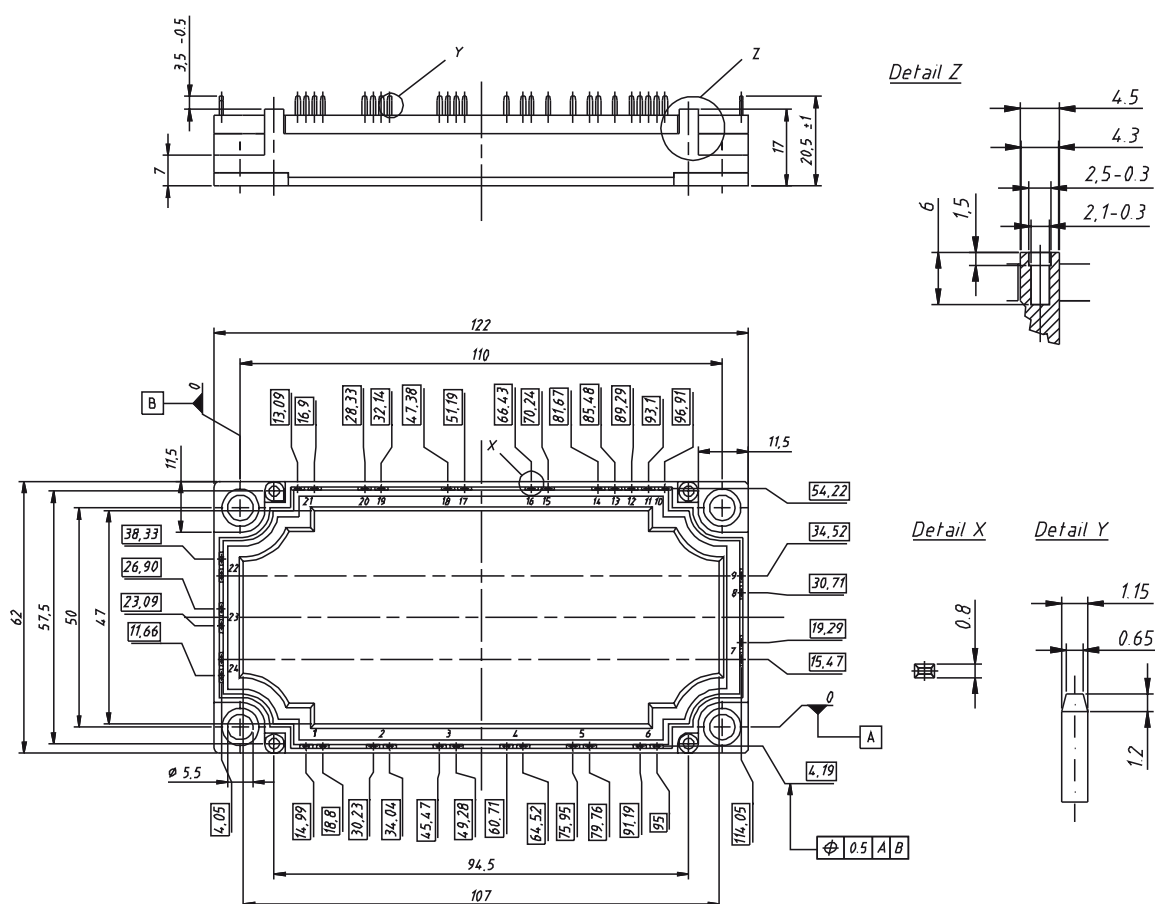
| Symbol                                            | Conditions | Characteristic Values |             |      |         |
|---------------------------------------------------|------------|-----------------------|-------------|------|---------|
|                                                   |            | min.                  | typ.        | max. |         |
| <b>R<sub>25</sub></b><br><b>B<sub>25/50</sub></b> | T = 25°C   | 4.75                  | 5.0<br>3375 | 5.25 | kΩ<br>K |

## Module

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

| Symbol                        | Conditions                   | Characteristic Values |      |      |
|-------------------------------|------------------------------|-----------------------|------|------|
|                               |                              | min.                  | typ. | max. |
| <b>R<sub>therm-chip</sub></b> | Resistance terminal to chip  |                       | 5    | mΩ   |
| <b>d<sub>S</sub></b>          | Creepage distance on surface | 6                     |      | mm   |
| <b>d<sub>A</sub></b>          | Strike distance in air       | 6                     |      | mm   |
| <b>R<sub>thCH</sub></b>       | with heatsink compound       |                       | 0.01 | K/W  |
| <b>Weight</b>                 |                              |                       | 300  | g    |

**Dimensions in mm (1 mm = 0.0394")**



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

**Input Rectifier Bridge D11 - D16**

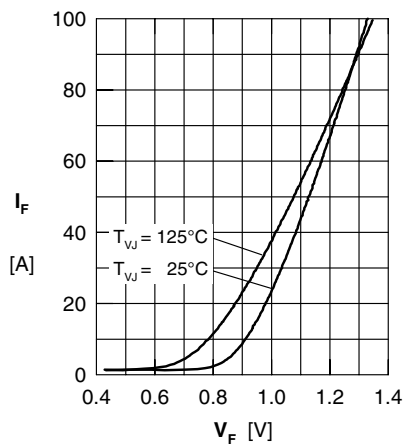


Fig. 1 Typ. forward current vs. voltage drop per diode

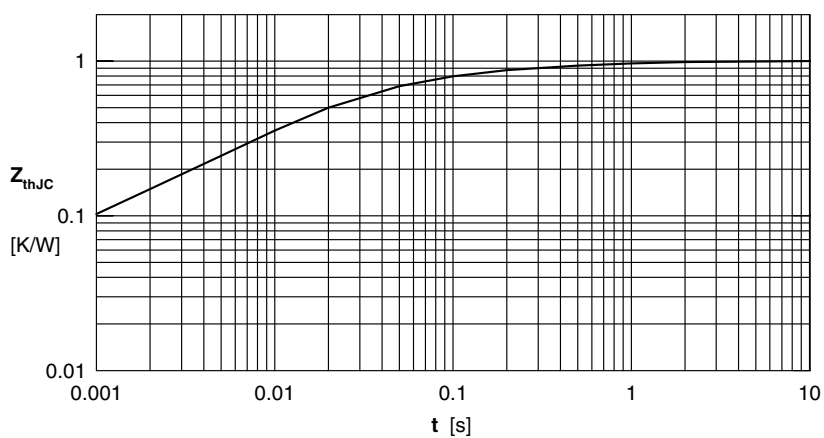


Fig. 2 Transient thermal impedance junction to case

## Output Inverter T1 - T6 / D1 - D6

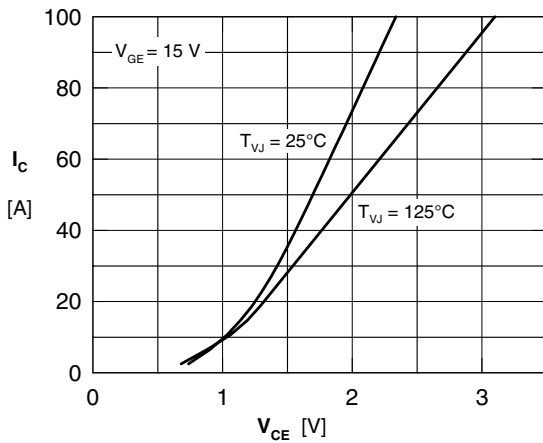


Fig. 3 Typical output characteristic

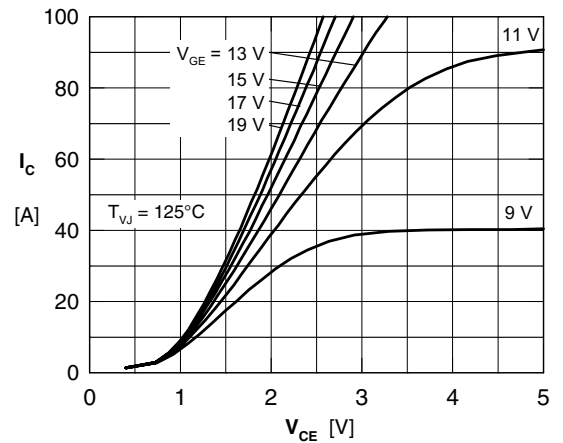


Fig. 4 Typical output characteristic

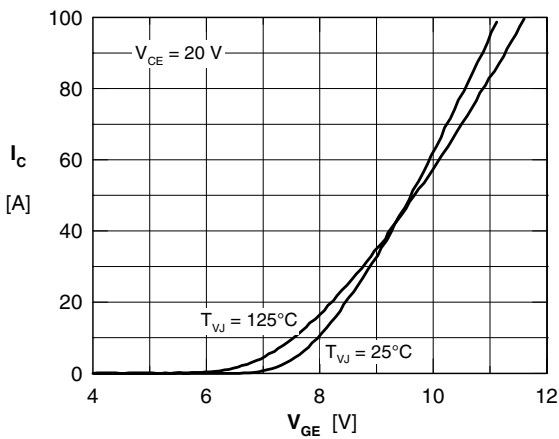


Fig. 5 Typical transfer characteristic

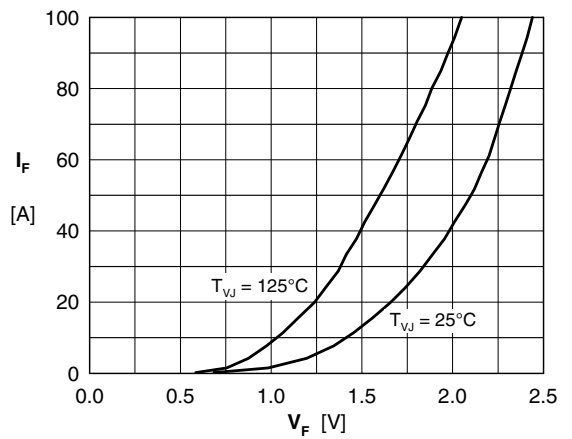


Fig. 6 Typical forward characteristic of free wheeling diode

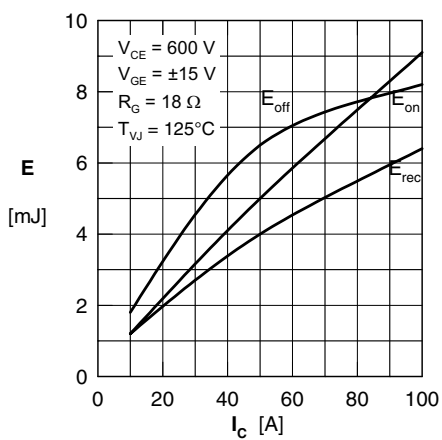


Fig. 7 Typ. switching losses vs. collector current

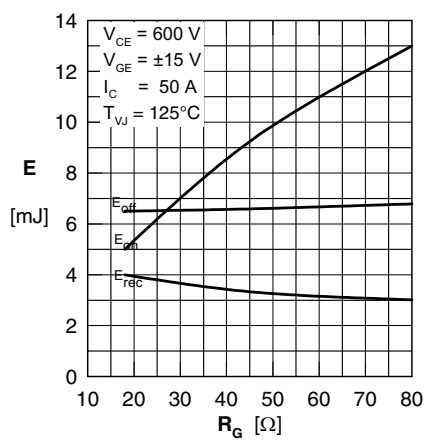


Fig. 8 Typ. switching losses vs. gate resistance

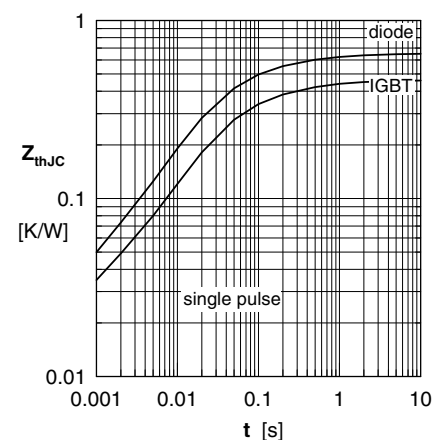


Fig. 9 Transient thermal impedance

## Brake Chopper T7 / D7

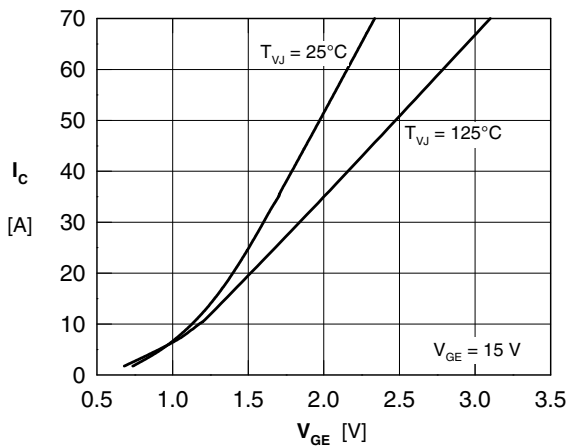


Fig. 10 Typical output characteristics

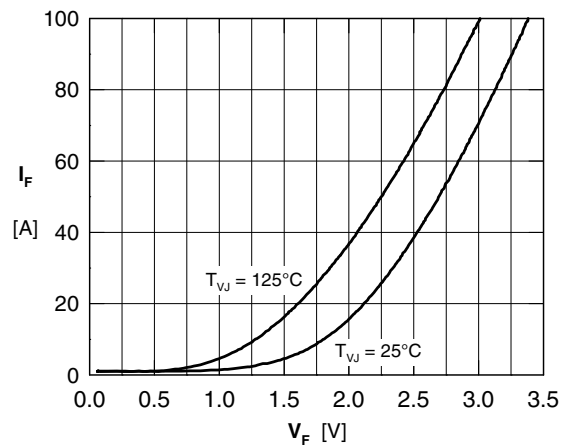


Fig. 11 Typical forward characteristics of free wheeling diode

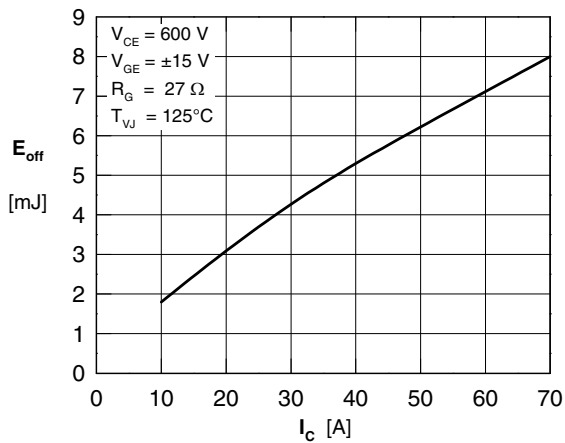


Fig. 12 Typ. turn off energy vs. collector current

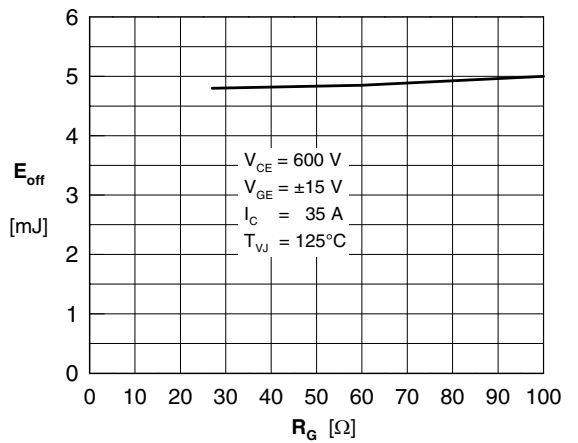


Fig. 13 Typ. turn off energy versus gate

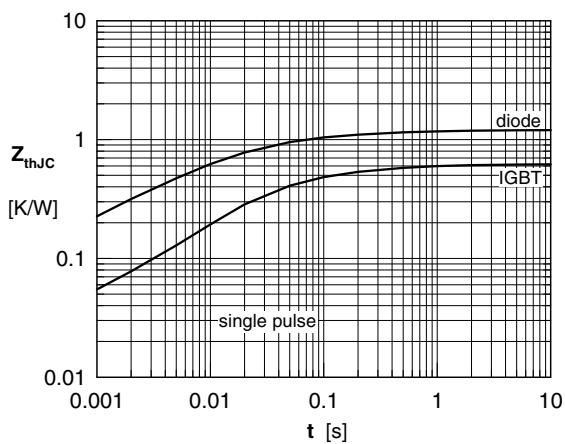


Fig. 14 Transient thermal impedance

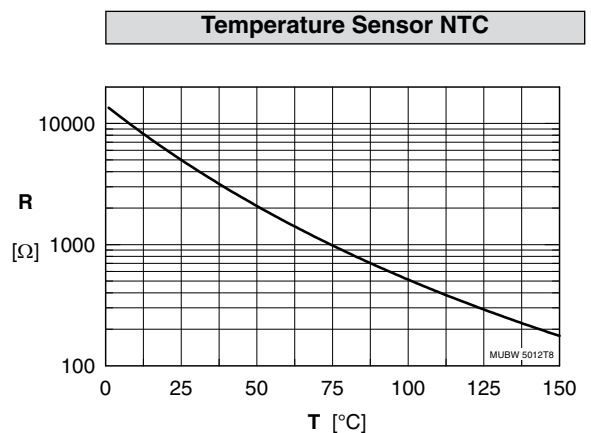


Fig. 15 Typ. thermistor resistance versus temperature