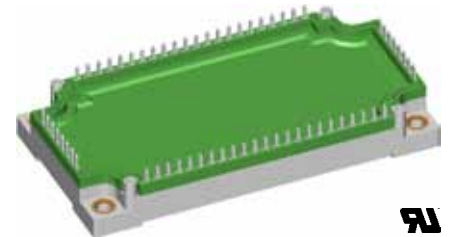
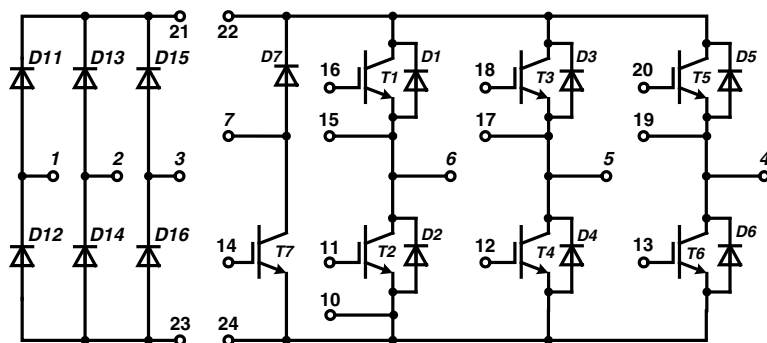


# Converter - Brake - Inverter Module XPT IGBT

| Three Phase Rectifier      | Brake Chopper                 | Three Phase Inverter          |
|----------------------------|-------------------------------|-------------------------------|
| $V_{RRM} = 1600 \text{ V}$ | $V_{CES} = 1200 \text{ V}$    | $V_{CES} = 1200 \text{ V}$    |
| $I_{DAVM} = 190 \text{ A}$ | $I_{C25} = 60 \text{ A}$      | $I_{C25} = 85 \text{ A}$      |
| $I_{FSM} = 700 \text{ A}$  | $V_{CE(sat)} = 1.8 \text{ V}$ | $V_{CE(sat)} = 1.8 \text{ V}$ |

**Part name** (Marking on product)

MIXA60WB1200TEH



  
E 72873

Pin configuration see outlines.

## Features:

- Easy paralleling due to the positive temperature coefficient of the on-state voltage
- Rugged XPT design (Xtreme light Punch Through) results in:
  - short circuit rated for 10  $\mu\text{sec}$ .
  - very low gate charge
  - square RBSOA @  $3 \times I_C$
  - low EMI
- Thin wafer technology combined with the XPT design results in a competitive low  $V_{CE(sat)}$
- SONIC™ diode
  - fast and soft reverse recovery
  - low operating forward voltage

## Application:

- AC motor drives
- Solar inverter
- Medical equipment
- Uninterruptible power supply
- Air-conditioning systems
- Welding equipment
- Switched-mode and resonant-mode power supplies

## Package:

- "E3-Pack" standard outline
- Insulated copper base plate
- Soldering pins for PCB mounting
- Temperature sense included

**Output Inverter T1 - T6**

|                      |                                       |                                                                                                                    |                                                      | Ratings    |      |          |
|----------------------|---------------------------------------|--------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|------------|------|----------|
| Symbol               | Definitions                           | Conditions                                                                                                         | min.                                                 | typ.       | max. | Unit     |
| V <sub>CES</sub>     | collector emitter voltage             |                                                                                                                    | T <sub>VJ</sub> = 25°C                               |            | 1200 | V        |
| V <sub>GES</sub>     | max. DC gate voltage                  | continuous                                                                                                         |                                                      |            | ±20  | V        |
| V <sub>GEM</sub>     | max. transient collector gate voltage | transient                                                                                                          |                                                      |            | ±30  | V        |
| I <sub>C25</sub>     | collector current                     |                                                                                                                    | T <sub>C</sub> = 25°C                                |            | 85   | A        |
| I <sub>C80</sub>     |                                       |                                                                                                                    | T <sub>C</sub> = 80°C                                |            | 60   | A        |
| P <sub>tot</sub>     | total power dissipation               |                                                                                                                    | T <sub>C</sub> = 25°C                                |            | 290  | W        |
| V <sub>CE(sat)</sub> | collector emitter saturation voltage  | I <sub>C</sub> = 55 A; V <sub>GE</sub> = 15 V                                                                      | T <sub>VJ</sub> = 25°C<br>T <sub>VJ</sub> = 125°C    | 1.8<br>2.1 | 2.1  | V<br>V   |
| V <sub>GE(th)</sub>  | gate emitter threshold voltage        | I <sub>C</sub> = 2 mA; V <sub>GE</sub> = V <sub>CE</sub>                                                           | T <sub>VJ</sub> = 25°C                               | 5.4        | 6.0  | 6.5<br>V |
| I <sub>CES</sub>     | collector emitter leakage current     | V <sub>CE</sub> = V <sub>CES</sub> ; V <sub>GE</sub> = 0 V                                                         | T <sub>VJ</sub> = 25°C<br>T <sub>VJ</sub> = 125°C    | 0.2        | 0.5  | mA<br>mA |
| I <sub>GES</sub>     | gate emitter leakage current          | V <sub>GE</sub> = ±20 V                                                                                            |                                                      |            | 500  | nA       |
| Q <sub>G(on)</sub>   | total gate charge                     | V <sub>CE</sub> = 600 V; V <sub>GE</sub> = 15 V; I <sub>C</sub> = 50 A                                             |                                                      | 165        |      | nC       |
| t <sub>d(on)</sub>   | turn-on delay time                    | inductive load<br>V <sub>CE</sub> = 600 V; I <sub>C</sub> = 50 A<br>V <sub>GE</sub> = ±15 V; R <sub>G</sub> = 15 Ω | T <sub>VJ</sub> = 125°C                              | 70         |      | ns       |
| t <sub>r</sub>       | current rise time                     |                                                                                                                    |                                                      | 40         |      | ns       |
| t <sub>d(off)</sub>  | turn-off delay time                   |                                                                                                                    |                                                      | 250        |      | ns       |
| t <sub>f</sub>       | current fall time                     |                                                                                                                    |                                                      | 100        |      | ns       |
| E <sub>on</sub>      | turn-on energy per pulse              |                                                                                                                    |                                                      | 4.5        |      | mJ       |
| E <sub>off</sub>     | turn-off energy per pulse             |                                                                                                                    |                                                      | 5.5        |      | mJ       |
| RBSOA                | reverse bias safe operating area      | V <sub>GE</sub> = ±15 V; R <sub>G</sub> = 15 Ω;                                                                    | T <sub>VJ</sub> = 125°C<br>V <sub>CEK</sub> = 1200 V |            | 150  | A        |
| SCSOA                | short circuit safe operating area     |                                                                                                                    |                                                      |            |      |          |
| t <sub>sc</sub>      | short circuit duration                | V <sub>CE</sub> = 900 V; V <sub>GE</sub> = ±15 V;                                                                  | T <sub>VJ</sub> = 125°C                              |            | 10   | μs       |
| I <sub>sc</sub>      | short circuit current                 | R <sub>G</sub> = 15 Ω; non-repetitive                                                                              |                                                      | 200        |      | A        |
| R <sub>thJC</sub>    | thermal resistance junction to case   | (per IGBT)                                                                                                         |                                                      |            | 0.43 | K/W      |

**Output Inverter D1 - D6**

| Ratings    |                                            |                                                                                                            |                                                                 |              |      |               |
|------------|--------------------------------------------|------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------|--------------|------|---------------|
| Symbol     | Definitions                                | Conditions                                                                                                 | min.                                                            | typ.         | max. | Unit          |
| $V_{RRM}$  | <i>max. repetitive reverse voltage</i>     |                                                                                                            | $T_{VJ} = 25^{\circ}\text{C}$                                   |              | 1200 | V             |
| $I_{F25}$  | <i>forward current</i>                     |                                                                                                            | $T_C = 25^{\circ}\text{C}$                                      |              | 88   | A             |
| $I_{F80}$  |                                            |                                                                                                            | $T_C = 80^{\circ}\text{C}$                                      |              | 59   | A             |
| $V_F$      | <i>forward voltage</i>                     | $I_F = 60\text{ A}; V_{GE} = 0\text{ V}$                                                                   | $T_{VJ} = 25^{\circ}\text{C}$<br>$T_{VJ} = 125^{\circ}\text{C}$ | 1.95<br>1.95 | 2.2  | V<br>V        |
| $Q_{rr}$   | <i>reverse recovery charge</i>             | $V_R = 600\text{ V}$<br>$di_F/dt = -1200\text{ A}/\mu\text{s}$<br>$I_F = 60\text{ A}; V_{GE} = 0\text{ V}$ | $T_{VJ} = 125^{\circ}\text{C}$                                  | 8            |      | $\mu\text{C}$ |
| $I_{RM}$   | <i>max. reverse recovery current</i>       |                                                                                                            |                                                                 | 60           |      | A             |
| $t_{rr}$   | <i>reverse recovery time</i>               |                                                                                                            |                                                                 | 350          |      | ns            |
| $E_{rec}$  | <i>reverse recovery energy</i>             |                                                                                                            |                                                                 | 2.5          |      | mJ            |
| $R_{thJC}$ | <i>thermal resistance junction to case</i> | (per diode)                                                                                                |                                                                 |              | 0.6  | K/W           |

 $T_C = 25^{\circ}\text{C}$  unless otherwise stated

**Brake T7**

| Symbol        | Definitions                           | Conditions                                                                                                   | min.                                                            | Ratings    |          |  | Unit          |
|---------------|---------------------------------------|--------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------|------------|----------|--|---------------|
|               |                                       |                                                                                                              |                                                                 | typ.       | max.     |  |               |
| $V_{CES}$     | collector emitter voltage             | $T_{VJ} = 25^{\circ}\text{C}$                                                                                |                                                                 |            | 1200     |  | V             |
| $V_{GES}$     | max. DC gate voltage                  | continuous                                                                                                   |                                                                 |            | $\pm 20$ |  | V             |
| $V_{GEM}$     | max. transient collector gate voltage | transient                                                                                                    |                                                                 |            | $\pm 30$ |  | V             |
| $I_{C25}$     | collector current                     | $T_C = 25^{\circ}\text{C}$                                                                                   |                                                                 |            | 60       |  | A             |
| $I_{C80}$     |                                       | $T_C = 80^{\circ}\text{C}$                                                                                   |                                                                 |            | 40       |  | A             |
| $P_{tot}$     | total power dissipation               | $T_C = 25^{\circ}\text{C}$                                                                                   |                                                                 |            | 200      |  | W             |
| $V_{CE(sat)}$ | collector emitter saturation voltage  | $I_C = 35\text{ A}; V_{GE} = 15\text{ V}$                                                                    |                                                                 | 1.8<br>2.1 | 2.1      |  | V<br>V        |
| $V_{GE(th)}$  | gate emitter threshold voltage        | $I_C = 1.5\text{ mA}; V_{GE} = V_{CE}$                                                                       | $T_{VJ} = 25^{\circ}\text{C}$<br>5.4                            | 6.0        | 6.5      |  | V             |
| $I_{CES}$     | collector emitter leakage current     | $V_{CE} = V_{CES}; V_{GE} = 0\text{ V}$                                                                      | $T_{VJ} = 25^{\circ}\text{C}$<br>$T_{VJ} = 125^{\circ}\text{C}$ | 0.1        | 0.5      |  | mA<br>mA      |
| $I_{GES}$     | gate emitter leakage current          | $V_{GE} = \pm 20\text{ V}$                                                                                   |                                                                 |            | 500      |  | nA            |
| $Q_{G(on)}$   | total gate charge                     | $V_{CE} = 600\text{ V}; V_{GE} = 15\text{ V}; I_C = 35\text{ A}$                                             |                                                                 | 107        |          |  | nC            |
| $t_{d(on)}$   | turn-on delay time                    | inductive load<br>$V_{CE} = 600\text{ V}; I_C = 35\text{ A}$<br>$V_{GE} = \pm 15\text{ V}; R_G = 27\ \Omega$ | $T_{VJ} = 125^{\circ}\text{C}$                                  | 70         |          |  | ns            |
| $t_r$         | current rise time                     |                                                                                                              |                                                                 | 40         |          |  | ns            |
| $t_{d(off)}$  | turn-off delay time                   |                                                                                                              |                                                                 | 250        |          |  | ns            |
| $t_f$         | current fall time                     |                                                                                                              |                                                                 | 100        |          |  | ns            |
| $E_{on}$      | turn-on energy per pulse              |                                                                                                              |                                                                 | 3.8        |          |  | mJ            |
| $E_{off}$     | turn-off energy per pulse             |                                                                                                              |                                                                 | 4.1        |          |  | mJ            |
| <b>RBSOA</b>  | reverse bias safe operating area      | $V_{GE} = \pm 15\text{ V}; R_G = 27\ \Omega;$                                                                | $T_{VJ} = 125^{\circ}\text{C}$<br>$V_{CEK} = 1200\text{ V}$     |            | 105      |  | A             |
| <b>SCSOA</b>  | short circuit safe operating area     |                                                                                                              |                                                                 |            |          |  |               |
| $t_{SC}$      | short circuit duration                | $V_{CE} = 900\text{ V}; V_{GE} = \pm 15\text{ V};$                                                           | $T_{VJ} = 125^{\circ}\text{C}$                                  |            | 10       |  | $\mu\text{s}$ |
| $I_{SC}$      | short circuit current                 | $R_G = 27\ \Omega;$ non-repetitive                                                                           |                                                                 | 140        |          |  | A             |
| $R_{thJC}$    | thermal resistance junction to case   | (per IGBT)                                                                                                   |                                                                 |            | 0.64     |  | K/W           |

**Brake Chopper D7**

| Symbol     | Definitions                         | Conditions                                                                                               | min.                                                            | Ratings      |      |  | Unit          |
|------------|-------------------------------------|----------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------|--------------|------|--|---------------|
|            |                                     |                                                                                                          |                                                                 | typ.         | max. |  |               |
| $V_{RRM}$  | max. repetitive reverse voltage     | $T_{VJ} = 25^{\circ}\text{C}$                                                                            |                                                                 |              | 1200 |  | V             |
| $I_{F25}$  | forward current                     | $T_C = 25^{\circ}\text{C}$                                                                               |                                                                 |              | 44   |  | A             |
| $I_{F80}$  |                                     | $T_C = 80^{\circ}\text{C}$                                                                               |                                                                 |              | 29   |  | A             |
| $V_F$      | forward voltage                     | $I_F = 30\text{ A}; V_{GE} = 0\text{ V}$                                                                 | $T_{VJ} = 25^{\circ}\text{C}$<br>$T_{VJ} = 125^{\circ}\text{C}$ | 1.95<br>1.95 | 2.2  |  | V<br>V        |
| $I_R$      | reverse current                     | $V_R = V_{RRM}$                                                                                          | $T_{VJ} = 25^{\circ}\text{C}$<br>$T_{VJ} = 125^{\circ}\text{C}$ | 0.8          | 2.0  |  | mA<br>mA      |
| $Q_{rr}$   | reverse recovery charge             | $V_R = 600\text{ V}$<br>$di_F/dt = 600\text{ A}/\mu\text{s}$<br>$I_F = 30\text{ A}; V_{GE} = 0\text{ V}$ | $T_{VJ} = 125^{\circ}\text{C}$                                  | 3.5          |      |  | $\mu\text{C}$ |
| $I_{RM}$   | max. reverse recovery current       |                                                                                                          |                                                                 | 30           |      |  | A             |
| $t_{rr}$   | reverse recovery time               |                                                                                                          |                                                                 | 350          |      |  | ns            |
| $E_{rec}$  | reverse recovery energy             |                                                                                                          |                                                                 | 0.9          |      |  | mJ            |
| $R_{thJC}$ | thermal resistance junction to case | (per diode)                                                                                              |                                                                 |              | 1.2  |  | K/W           |

 $T_C = 25^{\circ}\text{C}$  unless otherwise stated

**Input Rectifier Bridge D11 - D16**

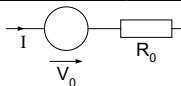
| Symbol     | Definitions                         | Conditions                       | min. | Ratings |      |  | Unit             |
|------------|-------------------------------------|----------------------------------|------|---------|------|--|------------------|
|            |                                     |                                  |      | typ.    | max. |  |                  |
| $V_{RRM}$  | max. repetitive reverse voltage     | $T_{VJ} = 25^{\circ}\text{C}$    |      |         | 1600 |  | V                |
| $I_{FAV}$  | average forward current             | sine 180°                        |      |         | 70   |  | A                |
| $I_{DAVM}$ | max. average DC output current      | rect.; $d = 1/3$                 |      |         | 190  |  | A                |
| $I_{FSM}$  | max. forward surge current          | $t = 10 \text{ ms}$ ; sine 50 Hz |      |         | 700  |  | A                |
|            |                                     |                                  |      |         | 620  |  | A                |
| $I^2t$     | $I^2t$ value for fusing             | $t = 10 \text{ ms}$ ; sine 50 Hz |      |         | 1920 |  | A <sup>2</sup> s |
|            |                                     |                                  |      |         | 2450 |  | A <sup>2</sup> s |
| $P_{tot}$  | total power dissipation             | $T_C = 25^{\circ}\text{C}$       |      |         | 192  |  | W                |
| $V_F$      | forward voltage                     | $I_F = 80 \text{ A}$             |      |         |      |  | V                |
|            |                                     |                                  |      | 1.2     | 1.5  |  | V                |
| $I_R$      | reverse current                     | $V_R = V_{RRM}$                  |      |         |      |  | mA               |
|            |                                     |                                  |      | 0.05    | 0.1  |  | mA               |
| $R_{thJC}$ | thermal resistance junction to case | (per diode)                      |      |         | 0.65 |  | K/W              |

**Temperature Sensor NTC**

| Symbol      | Definitions | Conditions                 | min. | Ratings |      |  | Unit       |
|-------------|-------------|----------------------------|------|---------|------|--|------------|
|             |             |                            |      | typ.    | max. |  |            |
| $R_{25}$    | resistance  | $T_C = 25^{\circ}\text{C}$ | 4.75 | 5.0     | 5.25 |  | k $\Omega$ |
| $B_{25/50}$ |             |                            |      | 3375    |      |  | K          |

**Module**

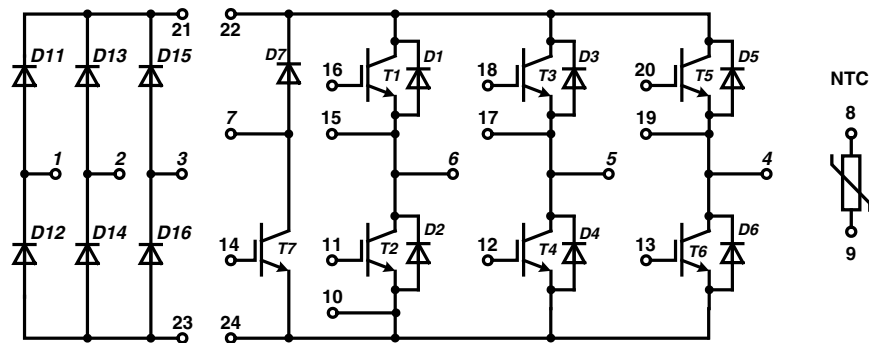
| Symbol         | Definitions                         | Conditions                              | min. | Ratings |      |  | Unit               |
|----------------|-------------------------------------|-----------------------------------------|------|---------|------|--|--------------------|
|                |                                     |                                         |      | typ.    | max. |  |                    |
| $T_{VJ}$       | operating temperature               |                                         | -40  |         | 125  |  | $^{\circ}\text{C}$ |
| $T_{VJM}$      | max. virtual junction temperature   |                                         |      |         | 150  |  | $^{\circ}\text{C}$ |
| $T_{stg}$      | storage temperature                 |                                         | -40  |         | 125  |  | $^{\circ}\text{C}$ |
| $V_{ISOL}$     | isolation voltage                   | $I_{ISOL} \leq 1 \text{ mA}$ ; 50/60 Hz |      |         | 3000 |  | V~                 |
| <b>CTI</b>     | comparative tracking index          |                                         |      |         | -    |  |                    |
| $M_d$          | mounting torque (M5)                |                                         | 3    |         | 6    |  | Nm                 |
| $d_S$          | creep distance on surface           |                                         | 6    |         |      |  | mm                 |
| $d_A$          | strike distance through air         |                                         | 6    |         |      |  | mm                 |
| $R_{pin-chip}$ | resistance pin to chip              |                                         |      | 5       |      |  | m $\Omega$         |
| $R_{thCH}$     | thermal resistance case to heatsink | with heatsink compound                  |      | 0.01    |      |  | K/W                |
| <b>Weight</b>  |                                     |                                         |      | 300     |      |  | g                  |

**Equivalent Circuits for Simulation**


| Symbol | Definitions         | Conditions | min. | Ratings |      |  | Unit       |
|--------|---------------------|------------|------|---------|------|--|------------|
|        |                     |            |      | typ.    | max. |  |            |
| $V_0$  | rectifier diode     | D8 - D13   |      |         | 0.85 |  | V          |
| $R_0$  |                     |            |      |         | 3.9  |  | m $\Omega$ |
| $V_0$  | IGBT                | T1 - T6    |      |         | 1.1  |  | V          |
| $R_0$  |                     |            |      |         | 25.1 |  | m $\Omega$ |
| $V_0$  | free wheeling diode | D1 - D6    |      |         | 1.22 |  | V          |
| $R_0$  |                     |            |      |         | 13   |  | m $\Omega$ |
| $V_0$  | IGBT                | T7         |      |         | 1.1  |  | V          |
| $R_0$  |                     |            |      |         | 40   |  | m $\Omega$ |
| $V_0$  | free wheeling diode | D7         |      |         | 1.2  |  | V          |
| $R_0$  |                     |            |      |         | 27.0 |  | m $\Omega$ |

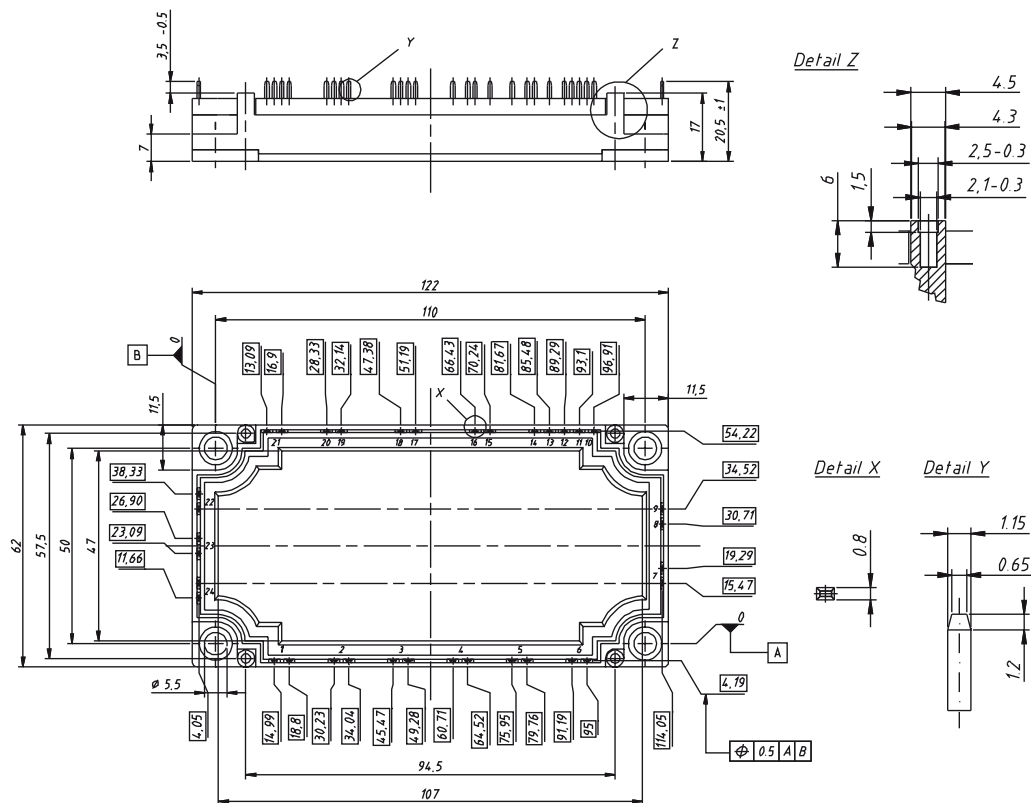
 $T_C = 25^{\circ}\text{C}$  unless otherwise stated

## Circuit Diagram



## Outline Drawing

Dimensions in mm (1 mm = 0.0394")



## Product Marking



2D Data Matrix:  
FOSS-ID 6 digits  
Batch # 6 digits

### Part number

M = Module  
I = IGBT  
XA = XPT standard  
60 = Current Rating [A]  
WB = 6-Pack + 3~ Rectifier Bridge & Brake Unit  
1200 = Reverse Voltage [V]  
T = NTC  
EH = E3-Pack

| Ordering | Part Name        | Marking on Product | Delivering Mode | Base Qty | Ordering Code |
|----------|------------------|--------------------|-----------------|----------|---------------|
| Standard | MIXA60WB1200 TEH | MIXA60WB1200TEH    | Box             | 5        | 507653        |

## Inverter T1 - T6

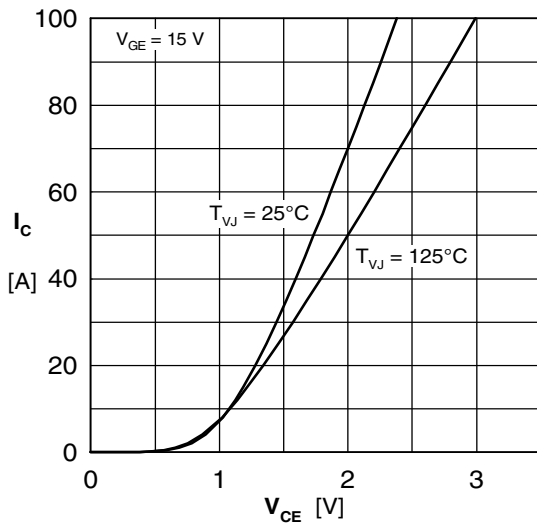


Fig. 1 Typ. output characteristics

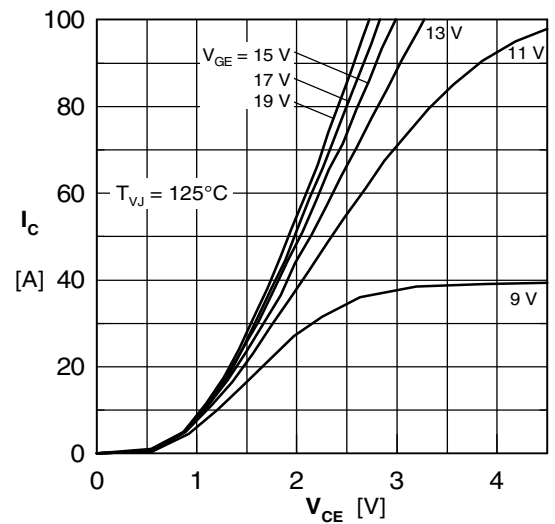


Fig. 2 Typ. output characteristics

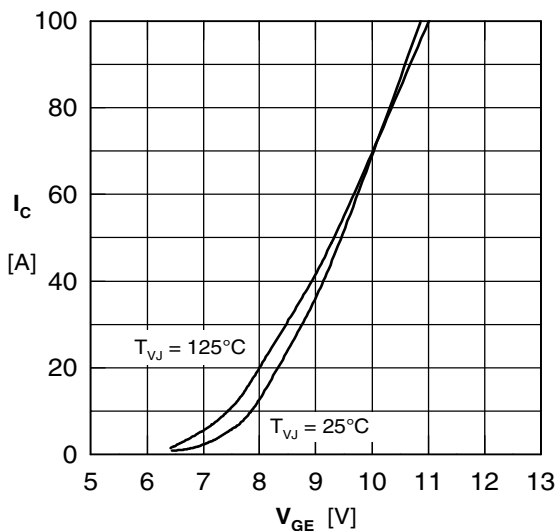


Fig. 3 Typ. transfer characteristics

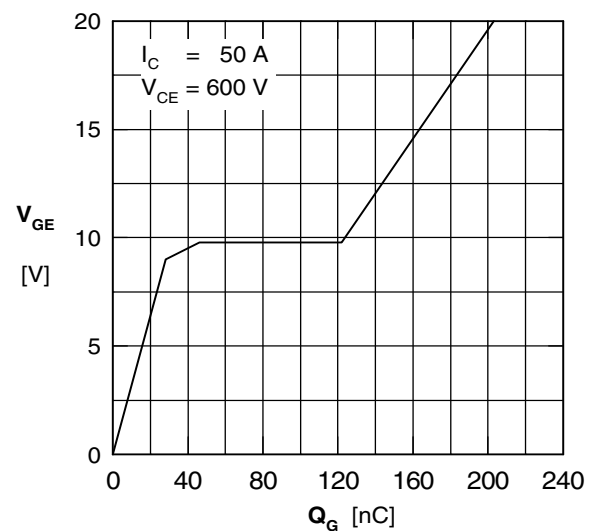


Fig. 4 Typ. turn-on gate charge

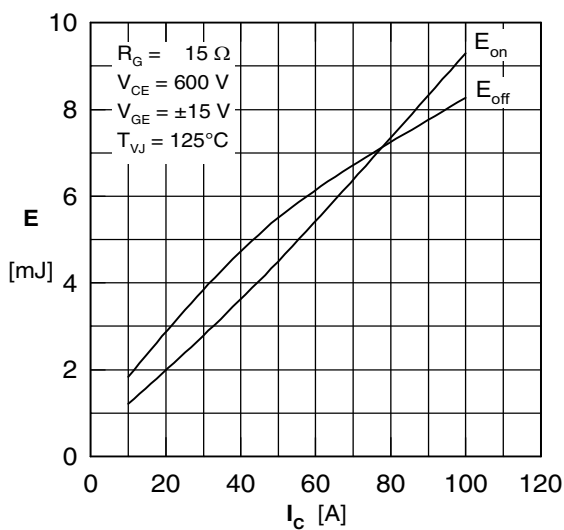


Fig. 5 Typ. switching energy vs. collector current

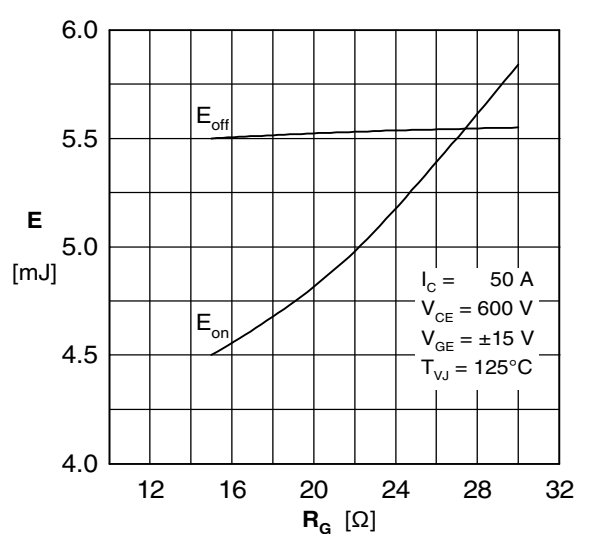


Fig. 6 Typ. switching energy vs. gate resistance

## Inverter D1 - D6

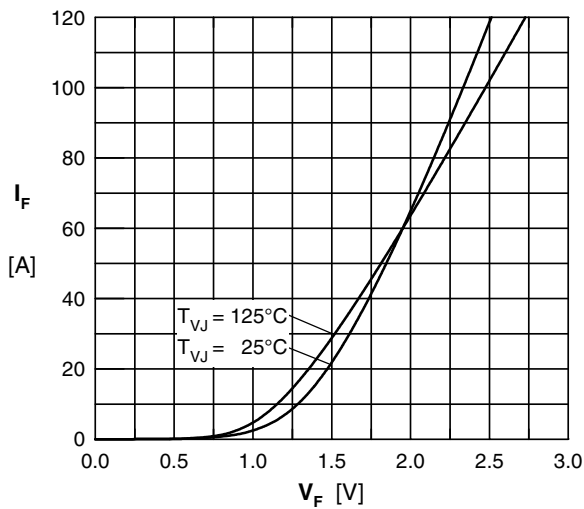


Fig. 7 Typ. Forward current versus  $V_F$

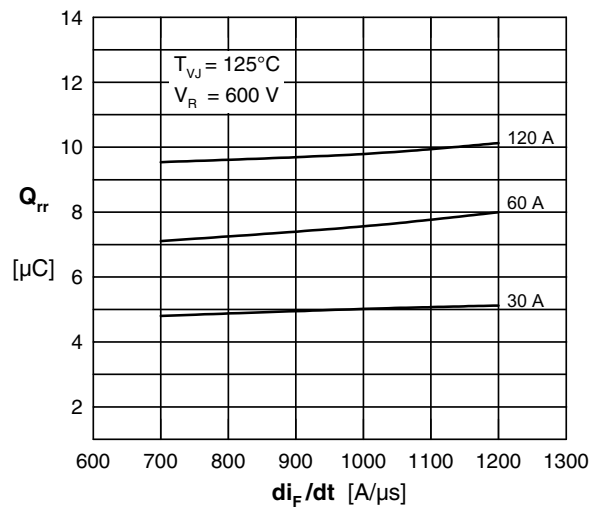


Fig. 8 Typ. reverse recov.charge  $Q_{rr}$  vs.  $di/dt$

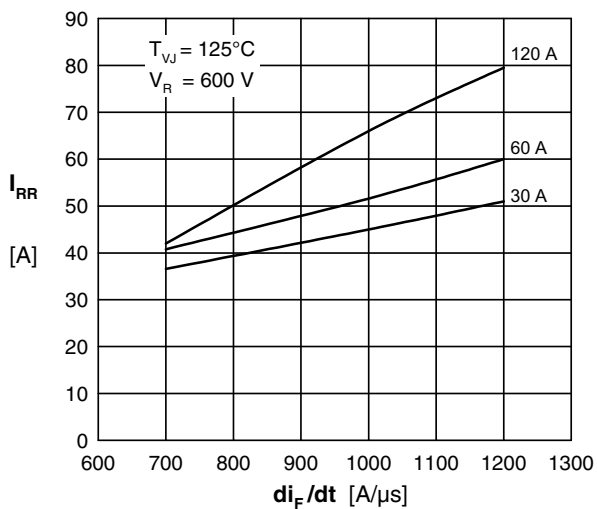


Fig. 9 Typ. peak reverse current  $I_{RM}$  vs.  $di/dt$

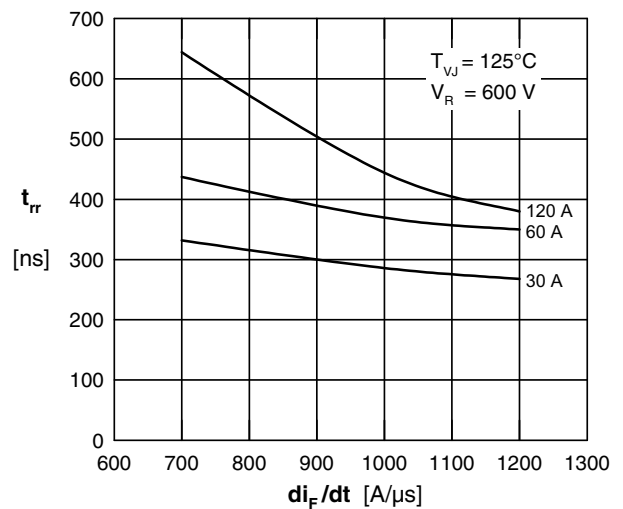


Fig. 10 Typ. recovery time  $t_{rr}$  versus  $di/dt$

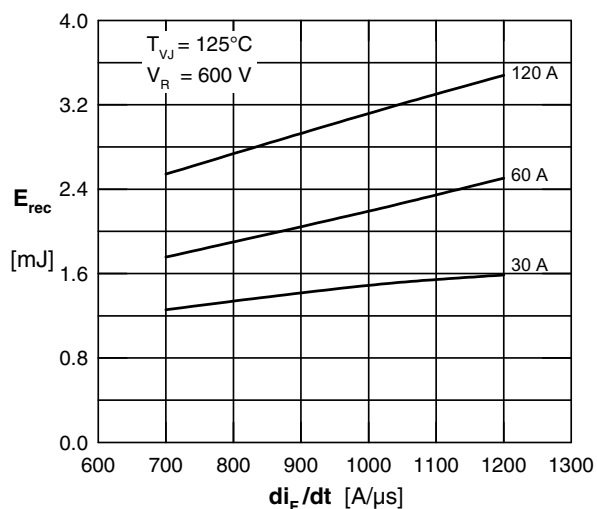


Fig. 8 Typ. recovery energy  $E_{rec}$  versus  $di/dt$

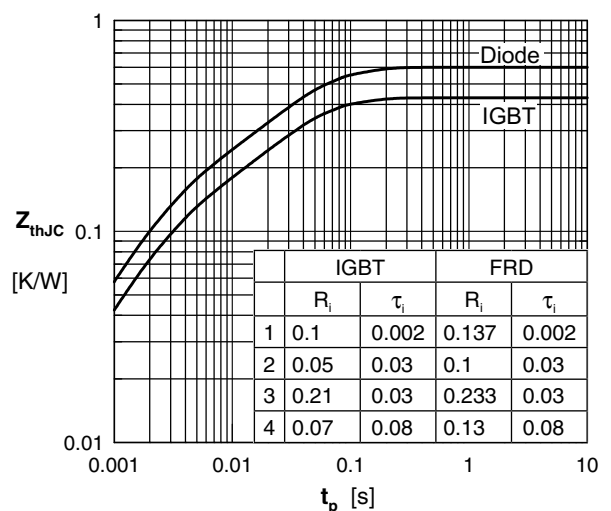


Fig. 9 Typ. transient thermal impedance

## Brake T7 & D7

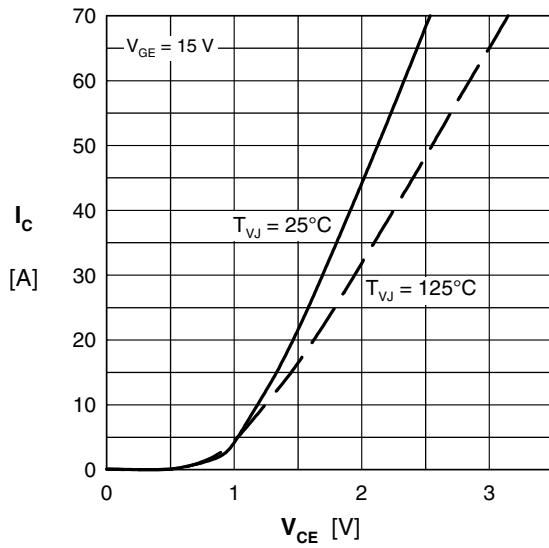


Fig. 13 Typ. output characteristics

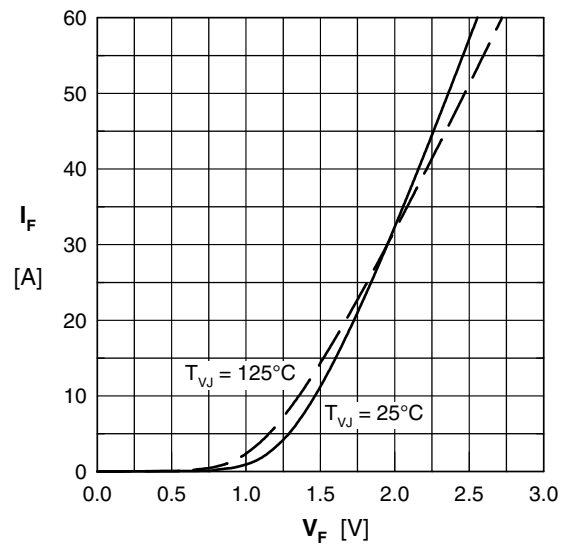


Fig. 14 Typ. forward characteristics

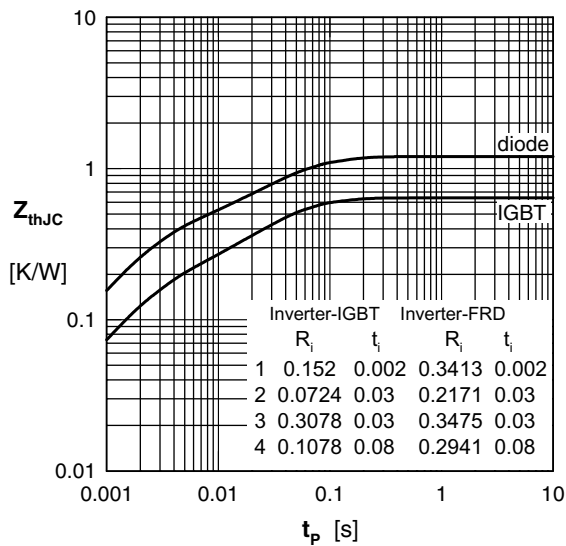


Fig. 15 Typ. transient thermal impedance

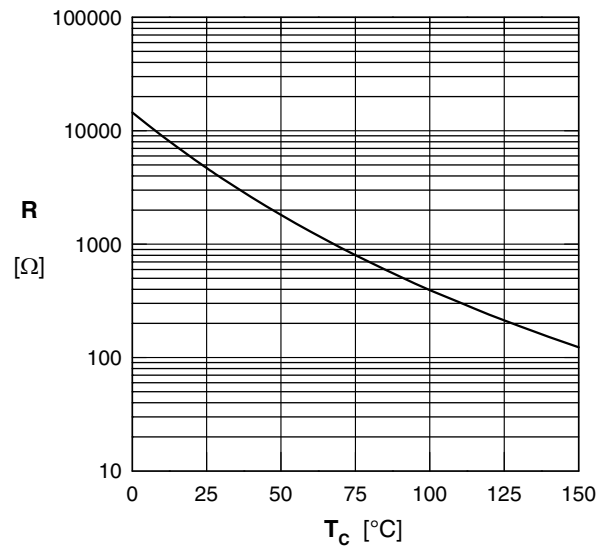


Fig. 16 Typ. NTC resistance vs. temperature