

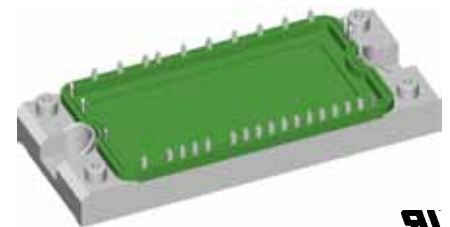
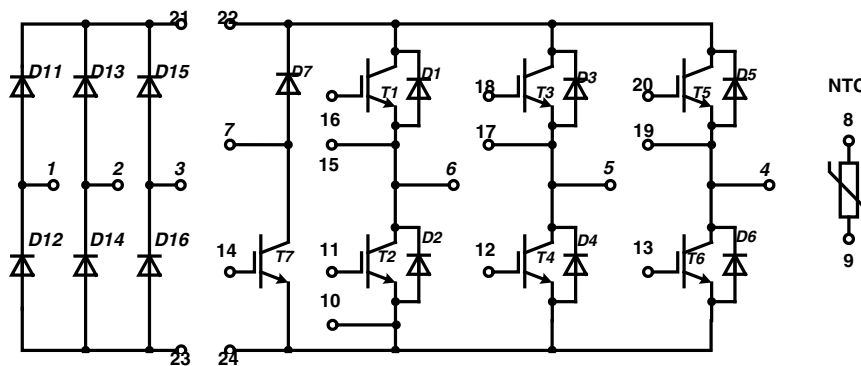
# Converter - Brake - Inverter Module XPT IGBT

| Three Phase Rectifier      | Brake Chopper                 | Three Phase Inverter          |
|----------------------------|-------------------------------|-------------------------------|
| $V_{RRM} = 1600 \text{ V}$ | $V_{CES} = 1200 \text{ V}$    | $V_{CES} = 1200 \text{ V}$    |
| $I_{DAVM} = 105 \text{ A}$ | $I_{C25} = 17 \text{ A}$      | $I_{C25} = 17 \text{ A}$      |
| $I_{FSM} = 320 \text{ A}$  | $V_{CE(sat)} = 1.8 \text{ V}$ | $V_{CE(sat)} = 1.8 \text{ V}$ |

Preliminary data

**Part name** (Marking on product)

MIXA10WB1200TED



  
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
  - 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:

- "E2-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          |   |
| $V_{CES}$     | 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                     | $T_C = 25^{\circ}\text{C}$                                                                                          |                                                                 |             | 17       | A             |   |
| $I_{C80}$     |                                       | $T_C = 80^{\circ}\text{C}$                                                                                          |                                                                 |             | 12       | A             |   |
| $P_{tot}$     | total power dissipation               | $T_C = 25^{\circ}\text{C}$                                                                                          |                                                                 |             | 60       | W             |   |
| $V_{CE(sat)}$ | collector emitter saturation voltage  | $I_C = 9\text{ A}; V_{GE} = 15\text{ V}$                                                                            | $T_{VJ} = 25^{\circ}\text{C}$<br>$T_{VJ} = 125^{\circ}\text{C}$ | 1.8<br>2.1  | 2.1      | V<br>V        |   |
| $V_{GE(th)}$  | gate emitter threshold voltage        | $I_C = 0.3\text{ mA}; V_{GE} = V_{CE}$                                                                              | $T_{VJ} = 25^{\circ}\text{C}$                                   | 5.5         | 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>$T_{VJ} = 125^{\circ}\text{C}$ | 0.01<br>0.1 | 0.7      | mA<br>mA      |   |
| $I_{GES}$     | gate emitter leakage current          | $V_{GE} = \pm 20\text{ V}$                                                                                          |                                                                 |             | 500      | nA            |   |
| $Q_{G(on)}$   | total gate charge                     | $V_{CE} = 600\text{ V}; V_{GE} = 15\text{ V}; I_C = 10\text{ A}$                                                    |                                                                 | 27          |          | nC            |   |
| $t_{d(on)}$   | turn-on delay time                    | inductive load<br>$V_{CE} = 600\text{ V}; I_C = 10\text{ A}$<br>$V_{GE} = \pm 15\text{ V}; R_G = 100\text{ }\Omega$ | $T_{VJ} = 125^{\circ}\text{C}$                                  | 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              |                                                                                                                     |                                                                 | 1.1         |          | mJ            |   |
| $E_{off}$     | turn-off energy per pulse             |                                                                                                                     |                                                                 | 1.1         |          | mJ            |   |
| <b>RBSOA</b>  | reverse bias safe operating area      | $V_{GE} = \pm 15\text{ V}; R_G = 100\text{ }\Omega;$                                                                | $T_{VJ} = 125^{\circ}\text{C}$<br>$V_{CEK} = 1200\text{ V}$     |             | 30       | 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                 | $R_G = 100\text{ }\Omega;$ non-repetitive                                                                           |                                                                 | 40          |          | A             |   |
| $R_{thJC}$    | thermal resistance junction to case   | (per IGBT)                                                                                                          |                                                                 |             | 2.0      | 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>                     |                                                                                                                                                 | $T_C = 25^{\circ}\text{C}$                                      |              | 19   | A             |
| $I_{F80}$  |                                            |                                                                                                                                                 | $T_C = 80^{\circ}\text{C}$                                      |              | 13   | A             |
| $V_F$      | <i>forward voltage</i>                     | $I_F = 10\text{ A}; V_{GE} = 0\text{ V}$                                                                                                        | $T_{VJ} = 25^{\circ}\text{C}$<br>$T_{VJ} = 125^{\circ}\text{C}$ | 1.95<br>1.85 | 2.2  | V<br>V        |
| $Q_{rr}$   | <i>reverse recovery charge</i>             | $\left. \begin{array}{l} V_R = 600\text{ V} \\ di_F/dt = -\text{ A}/\mu\text{s} \\ I_F = 10\text{ A}; V_{GE} = 0\text{ V} \end{array} \right\}$ | $T_{VJ} = 125^{\circ}\text{C}$                                  | tbd          |      | $\mu\text{C}$ |
| $I_{RM}$   | <i>max. reverse recovery current</i>       |                                                                                                                                                 |                                                                 | tbd          |      | A             |
| $t_{rr}$   | <i>reverse recovery time</i>               |                                                                                                                                                 |                                                                 | tbd          |      | ns            |
| $E_{rec}$  | <i>reverse recovery energy</i>             |                                                                                                                                                 |                                                                 | tbd          |      | mJ            |
| $R_{thJC}$ | <i>thermal resistance junction to case</i> | (per diode)                                                                                                                                     |                                                                 |              | 2.4  | 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                     | $T_C = 25^{\circ}\text{C}$                                                                                    |                                                                 |            | 17       |     | A             |
| $I_{C80}$     |                                       | $T_C = 80^{\circ}\text{C}$                                                                                    |                                                                 |            | 12       |     | A             |
| $P_{tot}$     | total power dissipation               | $T_C = 25^{\circ}\text{C}$                                                                                    |                                                                 |            | 60       |     | W             |
| $V_{CE(sat)}$ | collector emitter saturation voltage  | $I_C = 9\text{ A}; V_{GE} = 15\text{ V}$                                                                      |                                                                 | 1.8<br>2.1 | 2.1      |     | V<br>V        |
| $V_{GE(th)}$  | gate emitter threshold voltage        | $I_C = 0.3\text{ mA}; V_{GE} = V_{CE}$                                                                        | $T_{VJ} = 25^{\circ}\text{C}$                                   | 5.5        | 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      | 0.1 | mA<br>mA      |
| $I_{GES}$     | gate emitter leakage current          | $V_{GE} = \pm 20\text{ V}$                                                                                    |                                                                 |            | 500      |     | nA            |
| $Q_{G(on)}$   | total gate charge                     | $V_{CE} = 600\text{ V}; V_{GE} = 15\text{ V}; I_C = 10\text{ A}$                                              |                                                                 | 27         |          |     | nC            |
| $t_{d(on)}$   | turn-on delay time                    | inductive load<br>$V_{CE} = 600\text{ V}; I_C = 10\text{ A}$<br>$V_{GE} = \pm 15\text{ V}; R_G = 100\ \Omega$ | $T_{VJ} = 125^{\circ}\text{C}$                                  | 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              |                                                                                                               |                                                                 | 1.1        |          |     | mJ            |
| $E_{off}$     | turn-off energy per pulse             |                                                                                                               |                                                                 | 1.1        |          |     | mJ            |
| <b>RBSOA</b>  | reverse bias safe operating area      | $V_{GE} = \pm 15\text{ V}; R_G = 100\ \Omega;$                                                                | $T_{VJ} = 125^{\circ}\text{C}$<br>$V_{CEK} = 1200\text{ V}$     |            | 30       |     | 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                 | $R_G = 100\ \Omega; \text{non-repetitive}$                                                                    |                                                                 | 40         |          |     | A             |
| $R_{thJC}$    | thermal resistance junction to case   | (per IGBT)                                                                                                    |                                                                 |            | 2.0      |     | 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                     | $T_C = 25^{\circ}\text{C}$                                                                               |                                                                 |              | 12   |  | A             |
| $I_{F80}$  |                                     | $T_C = 80^{\circ}\text{C}$                                                                               |                                                                 |              | 8    |  | A             |
| $V_F$      | forward voltage                     | $I_F = 5\text{ A}; V_{GE} = 0\text{ V}$                                                                  | $T_{VJ} = 25^{\circ}\text{C}$<br>$T_{VJ} = 125^{\circ}\text{C}$ | 1.95<br>1.85 | 2.2  |  | V<br>V        |
| $I_R$      | reverse current                     | $V_R = V_{RRM}$                                                                                          | $T_{VJ} = 25^{\circ}\text{C}$<br>$T_{VJ} = 125^{\circ}\text{C}$ | 0.5          | 0.5  |  | mA<br>mA      |
| $Q_{rr}$   | reverse recovery charge             | $V_R = 600\text{ V}$<br>$di_F/dt = \text{tbd A}/\mu\text{s}$<br>$I_F = 10\text{ A}; V_{GE} = 0\text{ V}$ | $T_{VJ} = 125^{\circ}\text{C}$                                  | tbd          |      |  | $\mu\text{C}$ |
| $I_{RM}$   | max. reverse recovery current       |                                                                                                          |                                                                 | tbd          |      |  | A             |
| $t_{rr}$   | reverse recovery time               |                                                                                                          |                                                                 | tbd          |      |  | ns            |
| $E_{rec}$  | reverse recovery energy             |                                                                                                          |                                                                 | tbd          |      |  | $\mu\text{J}$ |
| $R_{thJC}$ | thermal resistance junction to case | (per diode)                                                                                              |                                                                 |              | 3.4  |  | 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 $180^{\circ}$               |      |         | 37   |  | A                    |
| $I_{DAVM}$ | max. average DC output current      | rect.; $d = 1/3$                 |      |         | 105  |  | A                    |
| $I_{FSM}$  | max. forward surge current          | $t = 10 \text{ ms}$ ; sine 50 Hz |      |         | 320  |  | A                    |
|            |                                     |                                  |      |         | 280  |  | A                    |
| $I^2t$     | $I^2t$ value for fusing             | $t = 10 \text{ ms}$ ; sine 50 Hz |      |         | 510  |  | $\text{A}^2\text{s}$ |
|            |                                     |                                  |      |         | 390  |  | $\text{A}^2\text{s}$ |
| $P_{tot}$  | total power dissipation             | $T_C = 25^{\circ}\text{C}$       |      |         | 110  |  | W                    |
| $V_F$      | forward voltage                     | $I_F = 50 \text{ A}$             |      |         |      |  | V                    |
|            |                                     |                                  |      | 1.34    | 1.7  |  | V                    |
| $I_R$      | reverse current                     | $V_R = V_{RRM}$                  |      |         | 0.02 |  | mA                   |
|            |                                     |                                  |      | 0.2     |      |  | mA                   |
| $R_{thJC}$ | thermal resistance junction to case | (per diode)                      |      |         | 1.1  |  | K/W                  |

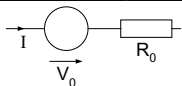
## Temperature Sensor NTC

| 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 |      |         | 2500 |  | V~                 |
| CTI            | 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                  |      | 0.02    |      |  | K/W                |
| Weight         |                                     |                                         |      | 180     |      |  | g                  |

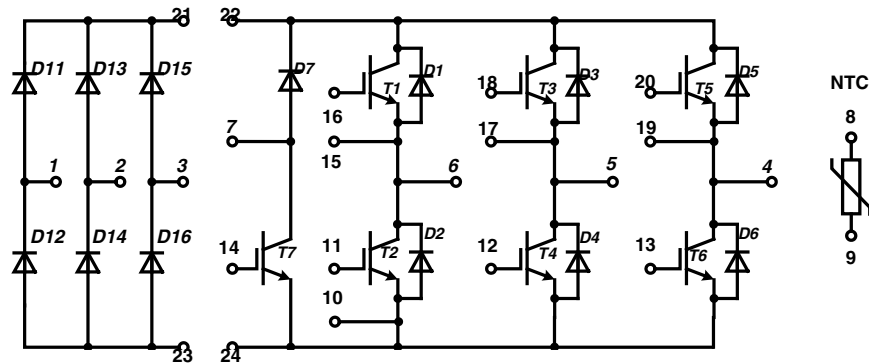
## Equivalent Circuits for Simulation



| Symbol | Definitions         | Conditions | min.                           | Ratings |      |  | Unit       |
|--------|---------------------|------------|--------------------------------|---------|------|--|------------|
|        |                     |            |                                | typ.    | max. |  |            |
| $V_0$  | rectifier diode     | D8 - D13   | $T_{VJ} = 150^{\circ}\text{C}$ |         | 0.88 |  | V          |
| $R_0$  |                     |            |                                |         | 9    |  | m $\Omega$ |
| $V_0$  | IGBT                | T1 - T6    | $T_{VJ} = 150^{\circ}\text{C}$ |         | 1.1  |  | V          |
| $R_0$  |                     |            |                                |         | 153  |  | m $\Omega$ |
| $V_0$  | free wheeling diode | D1 - D6    | $T_{VJ} = 150^{\circ}\text{C}$ |         | 1.1  |  | V          |
| $R_0$  |                     |            |                                |         | 90   |  | m $\Omega$ |
| $V_0$  | IGBT                | T7         | $T_{VJ} = 150^{\circ}\text{C}$ |         | 1.1  |  | V          |
| $R_0$  |                     |            |                                |         | 153  |  | m $\Omega$ |
| $V_0$  | free wheeling diode | D7         | $T_{VJ} = 150^{\circ}\text{C}$ |         | 1.15 |  | V          |
| $R_0$  |                     |            |                                |         | 170  |  | m $\Omega$ |

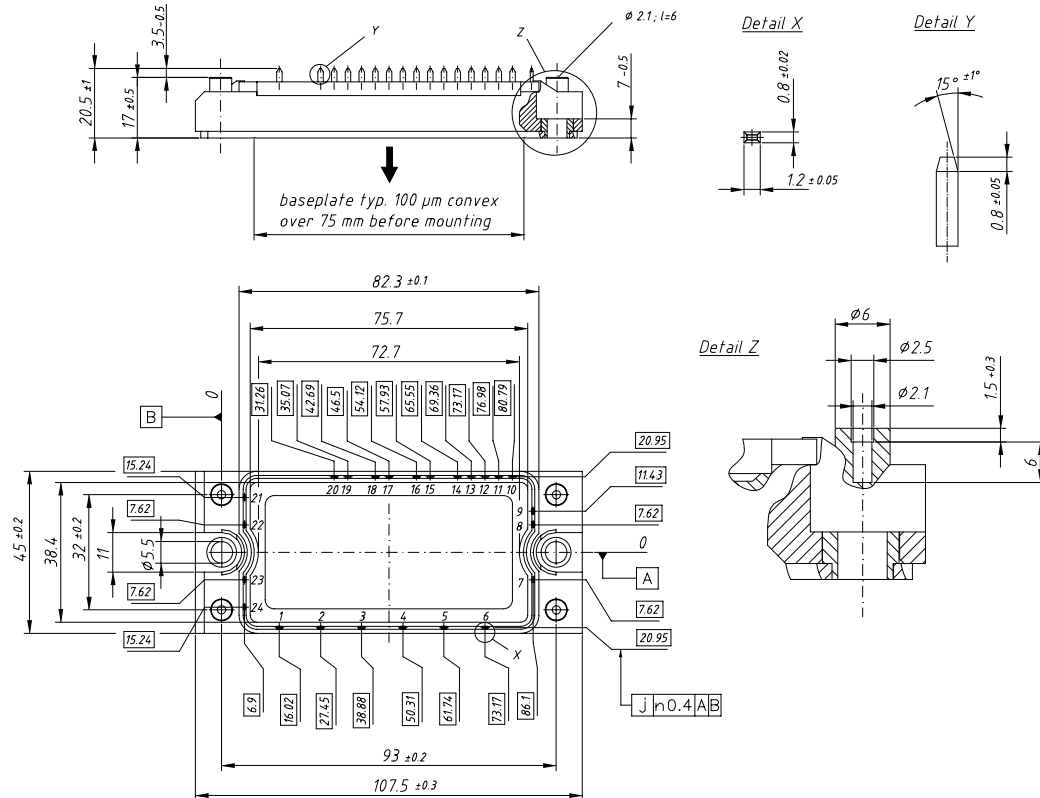
 $T_C = 25^{\circ}\text{C}$  unless otherwise stated

## Circuit Diagram

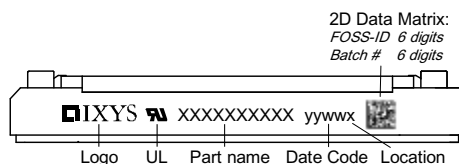


## Outline Drawing

Dimensions in mm (1 mm = 0.0394")



## Product Marking



### Part number

M = Module  
I = IGBT  
A = MPT  
X = Parallel Legs  
10 = Current Rating [A]  
WB = 6-Pack + 3~ Rectifier Bridge & Brake Unit  
1200 = Reverse Voltage [V]  
T = NTC  
ED = E2-Pack

| Ordering | Part Name        | Marking on Product | Delivering Mode | Base Qty | Ordering Code |
|----------|------------------|--------------------|-----------------|----------|---------------|
| Standard | MIXA10WB1200 TED | MIXA10WB1200TED    | Box             | 6        | 508061        |

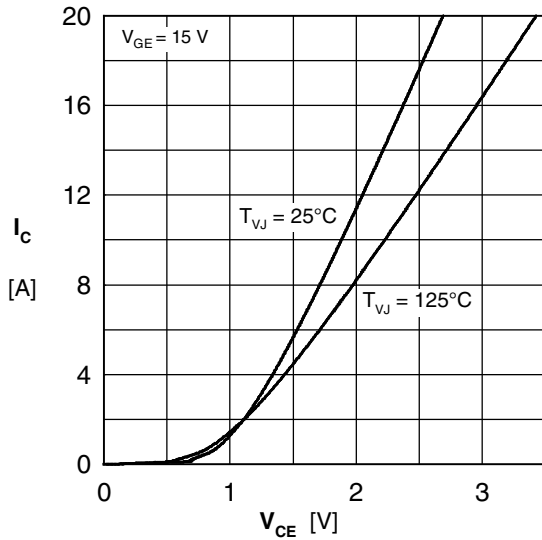


Fig. 1 Typ. output characteristics

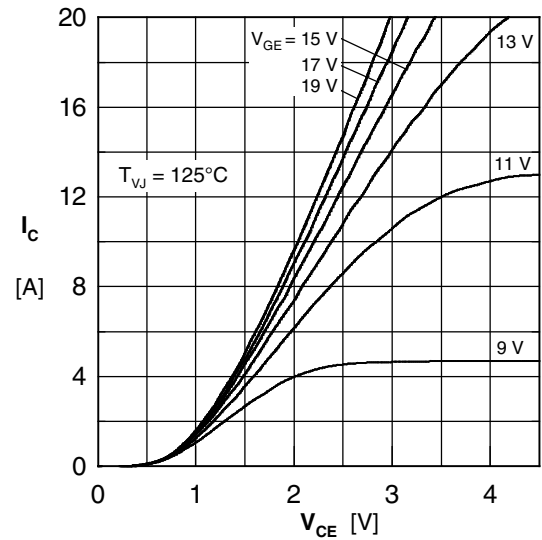


Fig. 2 Typ. output characteristics

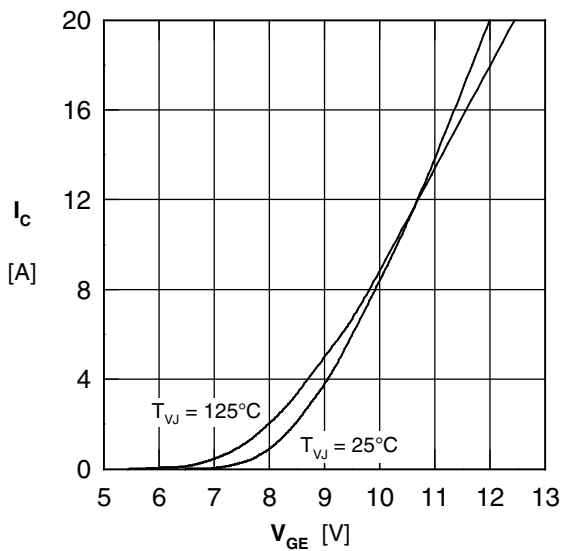


Fig. 3 Typ. transfer characteristics

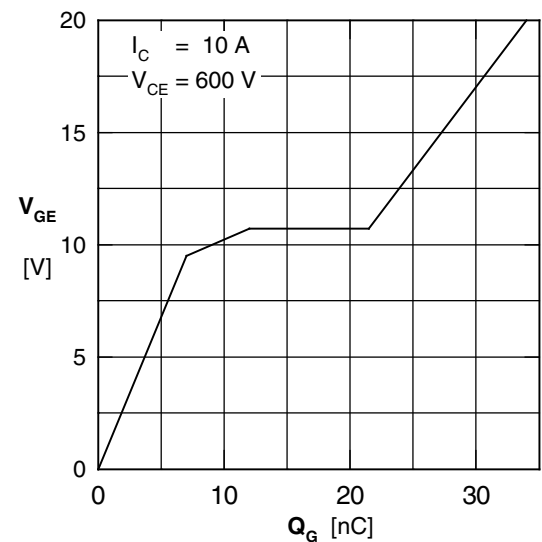


Fig. 4 Typ. turn-on gate charge

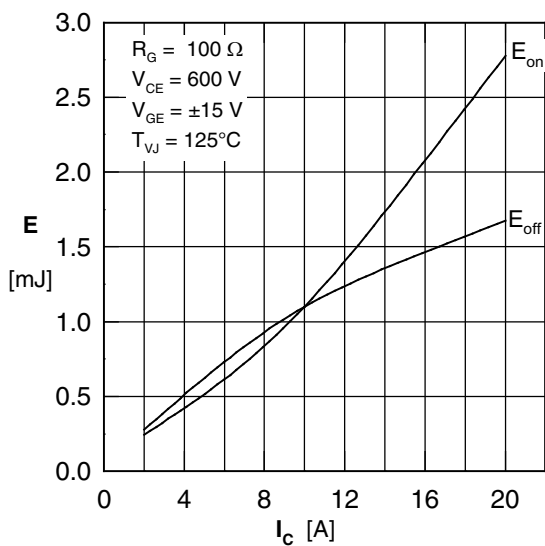


Fig. 5 Typ. switching energy vs. collector current

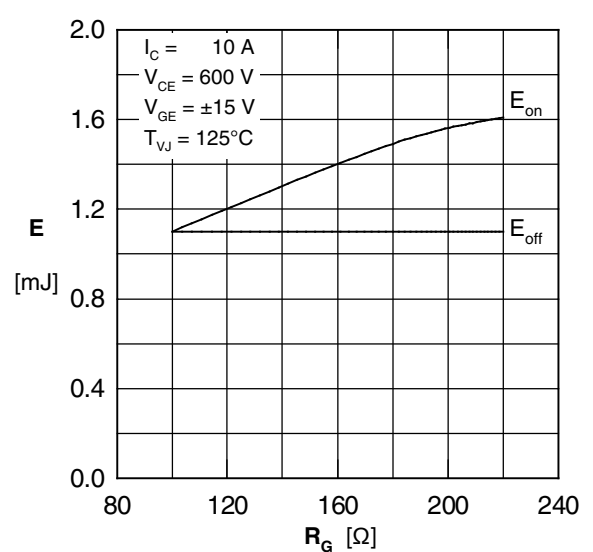


Fig. 6 Typ. switching energy vs. gate resistance

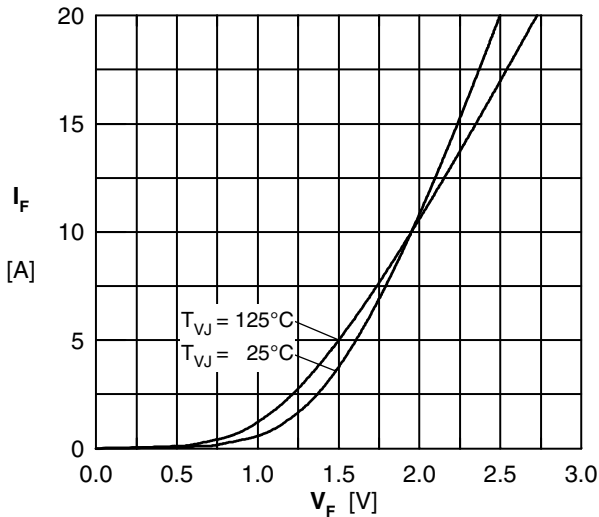


Fig. 7 Typ. forward characteristics

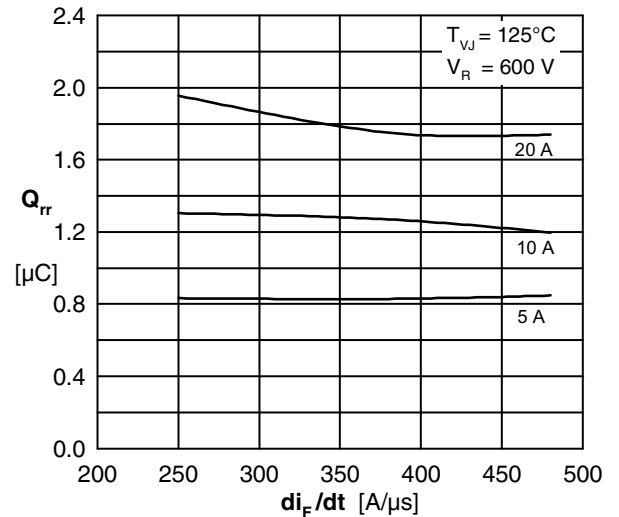


Fig. 8 Typical reverse recovery charge  $Q_{rr}$  versus  $di_F/dt$  (125°C)

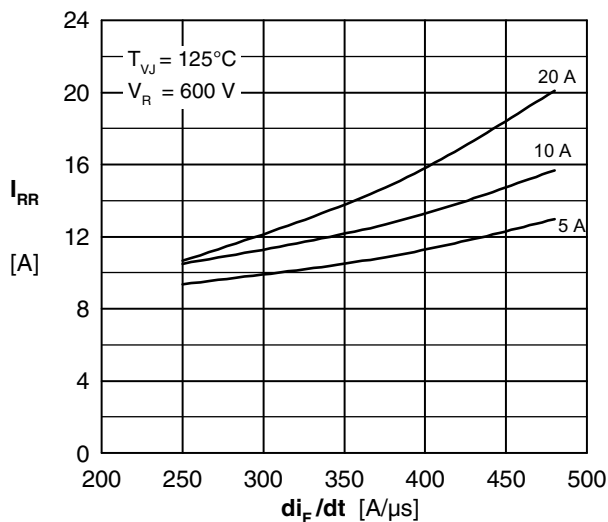


Fig. 9 Typical peak reverse current  $I_{RR}$  versus  $di_F/dt$  (125°C)

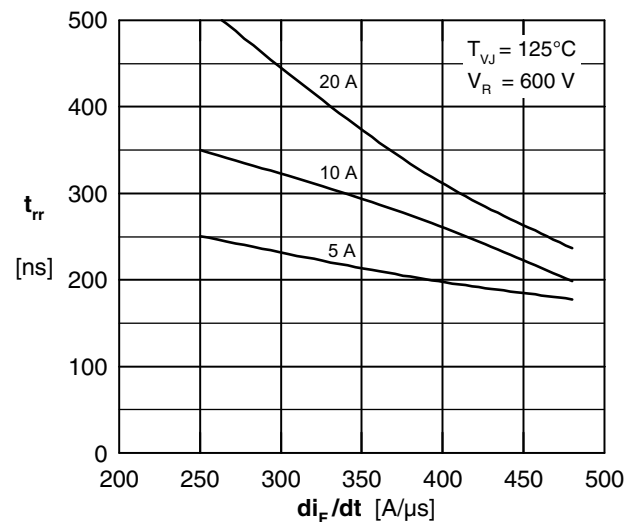


Fig. 10 Typ. recovery time  $t_{rr}$  vs.  $di/dt$  (125°C)

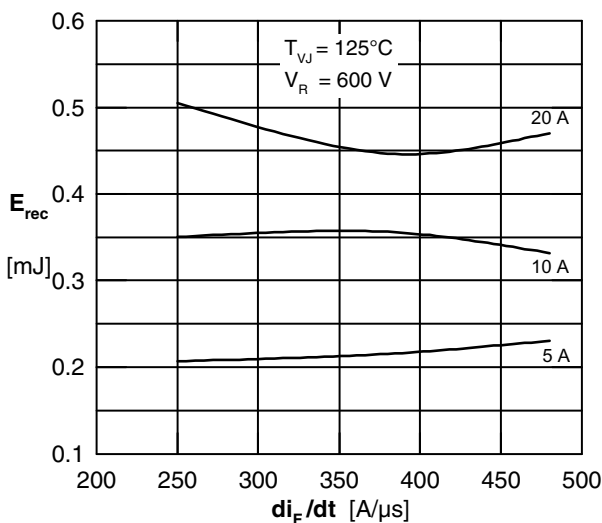


Fig. 11 Typ. recovery energy  $E_{rec}$  vs.  $di_F/dt$  (125°C)

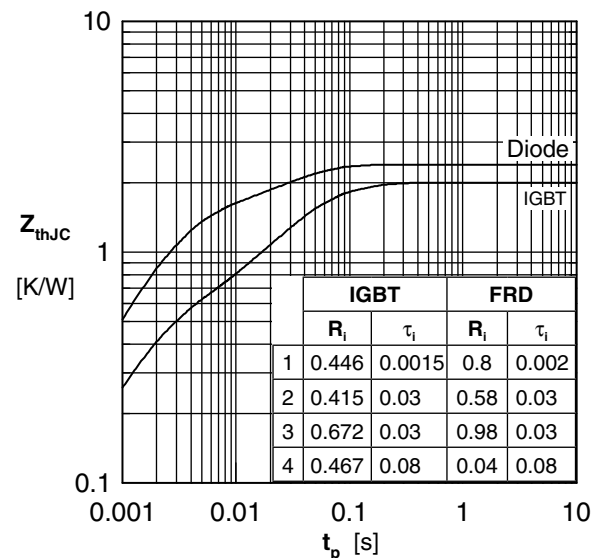


Fig. 8 Transient thermal impedance