

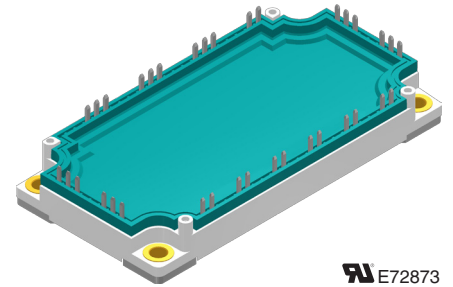
# X2PT IGBT Module


$V_{CES} = 1200 \text{ V}$   
 $I_{C25} = 325 \text{ A}$   
 $V_{CE(sat)} = 1.7 \text{ V}$

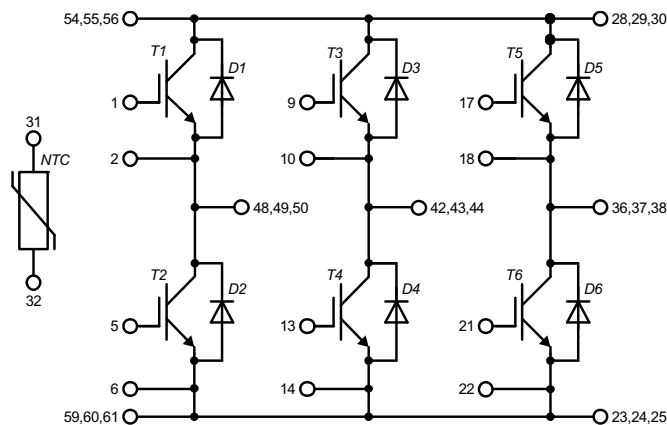
6-Pack + NTC

## Part number

MIXG240W1200TEH



 E72873



### Features / Advantages:

- X2PT - 2nd generation Xtreme light Punch Through
- $T_{vjm} = 175^{\circ}\text{C}$
- Easy paralleling due to the positive temperature coefficient of the on-state voltage
- Rugged X2PT design results in:
  - short circuit rated for 10  $\mu\text{sec}$ .
  - very low gate charge
  - low EMI
  - square RBSOA @ 2x  $I_c$
- Low  $V_{CE(sat)}$  and low thermal resistance
- SONIC™ diode
  - fast and soft reverse recovery
  - low operating forward voltage

### Applications:

- AC motor drives
- Solar inverter
- Medical equipment
- Uninterruptible power supply
- Air-conditioning systems
- Welding equipment
- Switched-mode and resonant-mode power supplies
- Inductive heating, cookers
- Pumps, Fans

### Package: E3-Pack

- Isolation Voltage: 4300 V~
- Industry standard outline
- RoHS compliant
- Base plate: Copper internally DCB isolated
- Advanced power cycling
- Solder pins

### Option:

- Phase Change Material printed on base plate

### Disclaimer Notice

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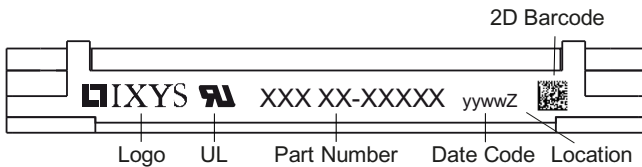


| Inverter IGBT T1 - T6 |  |  |                                | Ratings  |      |               |
|-----------------------|--|--|--------------------------------|----------|------|---------------|
| Symbol                | Definitions  | Conditions   | min.                           | typ.     | max. |               |
| $V_{CES}$             | collector emitter voltage                            | $T_{VJ} = 25^{\circ}\text{C}$  |                                |          | 1200 | V             |
| $V_{GES}$             | max. DC gate voltage                                 |  | -20                            |          | +20  | V             |
| $V_{GEM}$             | max. transient gate emitter voltage                  |  | -30                            |          | +30  | V             |
| $I_{C25}$             | collector current                                    | $T_C = 25^{\circ}\text{C}$   |                                |          | 325  | A             |
| $I_{C80}$             | on die level   | $T_C = 80^{\circ}\text{C}$   |                                |          | 243  | A             |
| $I_{C100}$            |  | $T_C = 100^{\circ}\text{C}$  |                                |          | 208  | A             |
| $P_{tot}$             | total power dissipation                              | $T_C = 25^{\circ}\text{C}$   |                                |          | 1000 | W             |
| $V_{CE(sat)}$         | collector emitter saturation voltage<br>on die level | $I_C = 200\text{ A}; V_{GE} = 15\text{ V}$   |                                | 1.7<br>2 | 2    | V<br>V        |
| $V_{GE(th)}$          | gate emitter threshold voltage                       | $I_C = 8\text{ mA}; V_{GE} = V_{GE}$   | 5.5                            |          | 7.5  | V             |
| $I_{CES}$             | collector emitter leakage current                    | $V_{CE} = V_{CES}; V_{GE} = 0\text{ V}$  |                                | 5        | 0.6  | mA<br>mA      |
| $I_{GES}$             | gate emitter leakage current                         | $V_{GE} = \pm 20\text{ V}$   |                                |          | 500  | nA            |
| $R_G$                 | internal gate resistance                             |  |                                | 5.6      |      | $\Omega$      |
| $C_{iss}$             | input capacitance                                    | $V_{CE} = 100\text{ V}; V_{GS} = 0\text{ V}; f = 1\text{ MHz}$   |                                | 10.6     |      | nF            |
| $C_{oss}$             | output capacitance                                   |  |                                |          |      | pF            |
| $C_{rss}$             | reverse transfer (Miller) capacitance                |  |                                |          |      | pF            |
| $Q_g$                 | total gate charge                                    | $V_{CE} = 600\text{ V}; V_{GE} = 15\text{ V}; I_C = 200\text{ A}$  |                                | 630      |      | nC            |
| $Q_{gs}$              | gate source charge                                   |  |                                |          |      | nC            |
| $Q_{gd}$              | gate drain (Miller) charge                           |  |                                |          |      | nC            |
| $t_{d(on)}$           | turn-on delay time                                   | Inductive switching<br>$V_{CE} = 600\text{ V}; I_C = 200\text{ A}$<br>$V_{GE} = \pm 15\text{ V}; R_G = 3.9\ \Omega$ (external) | $T_{VJ} = 25^{\circ}\text{C}$  |          | 170  | ns            |
| $t_r$                 | current rise time                                    |  |                                |          | 54   | ns            |
| $t_{d(off)}$          | turn-off delay time                                  |  |                                |          | 298  | ns            |
| $t_f$                 | current fall time                                    |  |                                |          | 138  | ns            |
| $E_{on}$              | turn-on energy per pulse                             |  |                                |          | 15.5 | mJ            |
| $E_{off}$             | turn-off energy per pulse                            |  |                                |          | 16.1 | mJ            |
| $E_{rec(off)}$        | reverse recovery losses at turn-off                  |  |                                |          | 4.7  | mJ            |
| $t_{d(on)}$           | turn-on delay time                                   | Inductive switching<br>$V_{CE} = 600\text{ V}; I_C = 200\text{ A}$<br>$V_{GE} = \pm 15\text{ V}; R_G = 3.9\ \Omega$ (external) | $T_{VJ} = 100^{\circ}\text{C}$ |          | 176  | ns            |
| $t_r$                 | current rise time                                    |  |                                |          | 64   | ns            |
| $t_{d(off)}$          | turn-off delay time                                  |  |                                |          | 336  | ns            |
| $t_f$                 | current fall time                                    |  |                                |          | 188  | ns            |
| $E_{on}$              | turn-on energy per pulse                             |  |                                |          | 19.6 | mJ            |
| $E_{off}$             | turn-off energy per pulse                            |  |                                |          | 19.7 | mJ            |
| $E_{rec(off)}$        | reverse recovery losses at turn-off                  |  |                                |          | 7.7  | mJ            |
| $t_{d(on)}$           | turn-on delay time                                   | Inductive switching<br>$V_{CE} = 600\text{ V}; I_C = 200\text{ A}$<br>$V_{GE} = \pm 15\text{ V}; R_G = 3.9\ \Omega$ (external) | $T_{VJ} = 150^{\circ}\text{C}$ |          | 182  | ns            |
| $t_r$                 | current rise time                                    |  |                                |          | 66   | ns            |
| $t_{d(off)}$          | turn-off delay time                                  |  |                                |          | 366  | ns            |
| $t_f$                 | current fall time                                    |  |                                |          | 232  | ns            |
| $E_{on}$              | turn-on energy per pulse                             |  |                                |          | 21.4 | mJ            |
| $E_{off}$             | turn-off energy per pulse                            |  |                                |          | 22.0 | mJ            |
| $E_{rec(off)}$        | reverse recovery losses at turn-off                  |  |                                |          | 10.3 | mJ            |
| <b>RBSOA</b>          | reverse bias safe operating area                     | $V_{GE} = \pm 15\text{ V}; R_G = 3.9\ \Omega$<br>$V_{CEmax} = 1200\text{ V}$   | $T_{VJ} = 150^{\circ}\text{C}$ |          |      | A             |
| $I_{CM}$              |  |  |                                |          | 400  |               |
| <b>SCSOA</b>          | short circuit safe operating area                    | $V_{CEmax} = 1200\text{ V}$<br>$V_{CE} = 900\text{ V}; V_{GE} = \pm 15\text{ V}$<br>non-repetitive                             | $T_{VJ} = 150^{\circ}\text{C}$ |          |      | $\mu\text{s}$ |
| $t_{SC}$              | short circuit duration                               |  |                                |          | 10   |               |
| $I_{SC}$              | short circuit current                                |  |                                |          | 900  |               |
| $R_{thJC}$            | thermal resistance junction to case                  | with heatsink compound; IXYS test setup  |                                | 0.195    | 0.15 | K/W           |
| $R_{thJH}$            | thermal resistance junction to heatsink              |  |                                |          |      | K/W           |



| Inverter Diode D1 - D6 |   |   |      | Ratings |      |            |                        |      |         |
|------------------------|---|---|------|---------|------|------------|------------------------|------|---------|
| Symbol                 | Definitions   | Conditions  | min. | typ.    | max. |            |                        |      |         |
| $V_{RRM}$              | max. repetitive reverse voltage                       |   |      |         | 1200 | V          |                        |      |         |
| $I_{F25}$              | forward current                                       |   |      |         | 235  | A          |                        |      |         |
| $I_{F80}$              | on die level  |   |      |         | 170  | A          |                        |      |         |
| $I_{F100}$             |   |   |      |         | 145  | A          |                        |      |         |
| $V_F$                  | forward voltage<br>on die level                       | $I_F = 200$ A   |      | 1.9     | 2.2  | V          |                        |      |         |
|                        |   |   |      | 1.9     |      | V          |                        |      |         |
| $I_R$                  | reverse current<br>* not applicable, see Ices at IGBT | $V_R = V_{RRM}$   |      | *       | *    | mA         |                        |      |         |
|                        |   |   |      | *       |      | mA         |                        |      |         |
| $di/dt$                | rate of change of current                             | $V_{CE} = 600$ V; $I_C = 200$ A<br>$V_{GE} = \pm 15$ V; $R_G = 3.9$ $\Omega$ (external) |      | 3300    |      | A/ $\mu$ s |                        |      |         |
| $Q_{RM}$               | reverse recovery charge                               |   |      |         |      |            | $T_{VJ} = 25^\circ$ C  | 13   | $\mu$ C |
| $I_{RM}$               | max. reverse recovery current                         |   |      |         |      |            | 129                    | A    |         |
| $t_{rr}$               | reverse recovery time                                 |   |      |         |      |            | 286                    | ns   |         |
| $E_{rec}$              | reverse recovery energy                               |   |      |         |      |            | 4.7                    | mJ   |         |
| $di/dt$                | rate of change of current                             | $V_{CE} = 600$ V; $I_C = 200$ A<br>$V_{GE} = \pm 15$ V; $R_G = 3.9$ $\Omega$ (external) |      | 3080    |      | A/ $\mu$ s |                        |      |         |
| $Q_{RM}$               | reverse recovery charge                               |   |      |         |      |            | $T_{VJ} = 100^\circ$ C | 20.4 | $\mu$ C |
| $I_{RM}$               | max. reverse recovery current                         |   |      |         |      |            | 145                    | A    |         |
| $t_{rr}$               | reverse recovery time                                 |   |      |         |      |            | 384                    | ns   |         |
| $E_{rec}$              | reverse recovery energy                               |   |      |         |      |            | 7.7                    | mJ   |         |
| $di/dt$                | rate of change of current                             | $V_{CE} = 600$ V; $I_C = 200$ A<br>$V_{GE} = \pm 15$ V; $R_G = 3.9$ $\Omega$ (external) |      | 2715    |      | A/ $\mu$ s |                        |      |         |
| $Q_{RM}$               | reverse recovery charge                               |   |      |         |      |            | $T_{VJ} = 150^\circ$ C | 27   | $\mu$ C |
| $I_{RM}$               | max. reverse recovery current                         |   |      |         |      |            | 158                    | A    |         |
| $t_{rr}$               | reverse recovery time                                 |   |      |         |      |            | 458                    | ns   |         |
| $E_{rec}$              | reverse recovery energy                               |   |      |         |      |            | 10.3                   | mJ   |         |
| $R_{thJC}$             | thermal resistance junction to case                   | with heatsink compound; IXYS test setup   |      |         | 0.28 | K/W        |                        |      |         |
| $R_{thJH}$             | thermal resistance junction to heatsink               |   |      |         | 0.37 | K/W        |                        |      |         |

| Package E3-Pack |                               |   |              | Ratings |      |        |
|-----------------|-------------------------------|---|--------------|---------|------|--------|
| Symbol          | Definitions                   | Conditions  | min.         | typ.    | max. | Unit   |
| $I_{RMS}$       | RMS current                   | per terminal  |              |         | 30   | A      |
| $T_{stg}$       | storage temperature           |   | -40          |         | 125  | °C     |
| $T_{op}$        | operation temperature         |   | -40          |         | 150  | °C     |
| $T_{VJ}$        | virtual junction temperature  |   | -40          |         | 175  | °C     |
| <b>Weight</b>   |                               |   |              |         | 295  | g      |
| $M_D$           | mounting torque               |   | 3            |         | 6    | Nm     |
| $d_{Spp}$       | creepage distance on surface  | terminal to terminal  | 6            |         |      | mm     |
| $d_{Spb}$       |                               | terminal to backside  | 12           |         |      | mm     |
| $d_{App}$       | striking distance through air | terminal to terminal  | 6            |         |      | mm     |
| $d_{Apb}$       |                               | terminal to backside  | 12           |         |      | mm     |
| $V_{ISOL}$      | isolation voltage             | t = 1 second<br>t = 1 minute  | 4300<br>3600 |         |      | V<br>V |
| $R_{pin-chip}$  | resistance pin to chip        | $V = V_{CEsat} + 2 \cdot R \cdot I_C$ resp. $V = V_F + 2 \cdot R \cdot I_F$ |              |         | 1.5  | mΩ     |
| $C_P$           | coupling capacity per switch  | between shorted pins of switch and back side metallization                  |              |         |      | pF     |

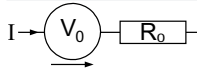

**Part number**

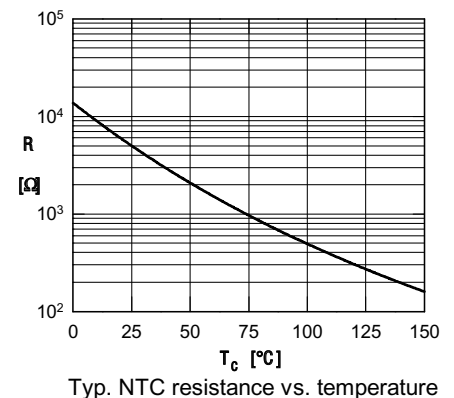
M = Module  
 I = IGBT  
 X = XPT IGBT  
 G = Gen 2 / std  
 240 = Current Rating [A]  
 W = 6-pack  
 1200 = Reverse Voltage [V]  
 T = Thermistor  
 EH = E3-Pack

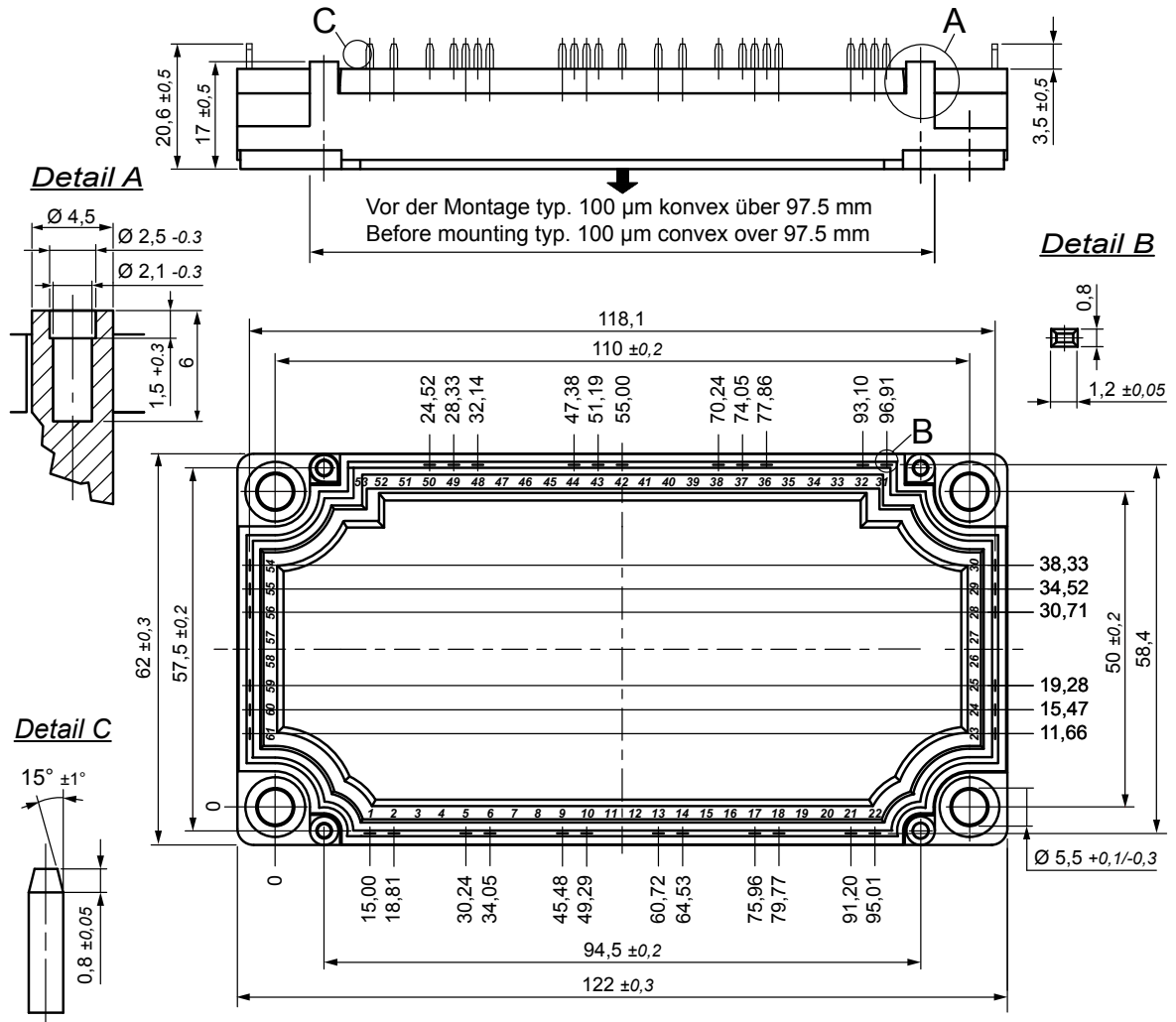
| Ordering                   | Part Name           | Marking on Product | Delivering Mode | Base Qty | Ordering Code |
|----------------------------|---------------------|--------------------|-----------------|----------|---------------|
| Standard                   | MIXG240W1200TEH     | MIXG240W1200TEH    | Box             | 5        | 517094        |
| with Phase Change Material | MIXG240W1200TEH -PC | MIXG240W1200TEH    | Blister         | 24       |               |

| Similar Part      | Package                         | Voltage class |
|-------------------|---------------------------------|---------------|
| MIXG240W1200PTEH  | E3- Pack, press fit pin         | 1200          |
| MIXG240W1200PSTEH | E3- Pack, press fit pin + shunt | 1200          |
| MIXG240W1200STEH  | E3- Pack, shunt                 | 1200          |

Option: phase change material; please contact IXYS sales office for availability

| Temperature Sensor NTC  |                         |                              |      |                |      |      |
|---|-------------------------|------------------------------|------|----------------|------|------|
| Symbol  | Definitions             | Conditions                   | min. | typ.           | max. | Unit |
| $R_{25}$  | resistance              | $T_{VJ} = 25^\circ\text{C}$  | 4.75 | 5.0            | 5.25 | kΩ   |
| $B_{25/50}$   | temperature coefficient |                              |      | 3375           |      | K    |
| Equivalent Circuits for Simulation <small>*on die level</small>                     |                         |                              |      |                |      |      |
|  |                         |                              | IGBT | Inverter Diode |      |      |
| $V_{0\ max}$  | threshold voltage       |                              | 1.2  | 1.2            |      | V    |
| $R_{0\ max}$  | slope resistance *      | $T_{VJ} = 175^\circ\text{C}$ | 5.8  | 4.7            |      | mΩ   |

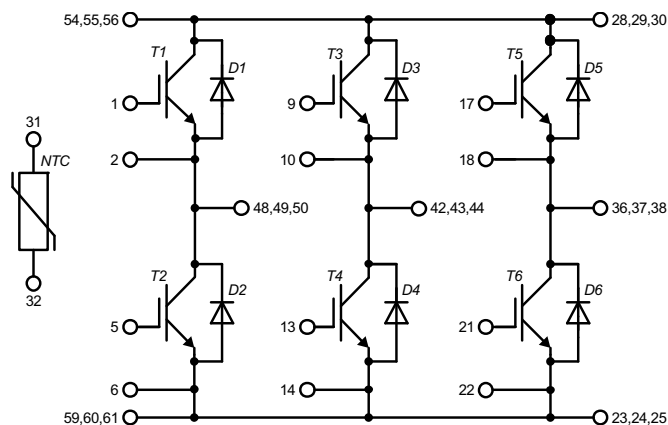


**Outlines E3-Pack**

**Bemerkung / Note:**

- Nichttolerierete Maße nach / Measure without tolerances according DIN ISO 2768-T1-m
- PCB-Lochmuster / PCB hole pattern: **see pin position**
- Toleranz Pin-Position und PCB-Lochmuster / Tolerance of pin position and PCB hole pattern:  $\oplus 0,1$
- Montageanleitung / Mounting instruction: [www.ixys.com](http://www.ixys.com) **Application note IXAN0024**

**Detail A: PCB-Montage / Mounting on PCB**

- Empfohlene, selbstschneidende Schraube / Recommended, self-tapping screw: **EJOT PT®** (Größe / size: **K25**)
- Max. Schraubenlänge / Max. screw length: **PCB-Dicke / thickness + 6 mm** (max. Lochtiefe / hole depth)
- Empfohlenes Drehmoment / Recommended mounting torque: **1.5 Nm**



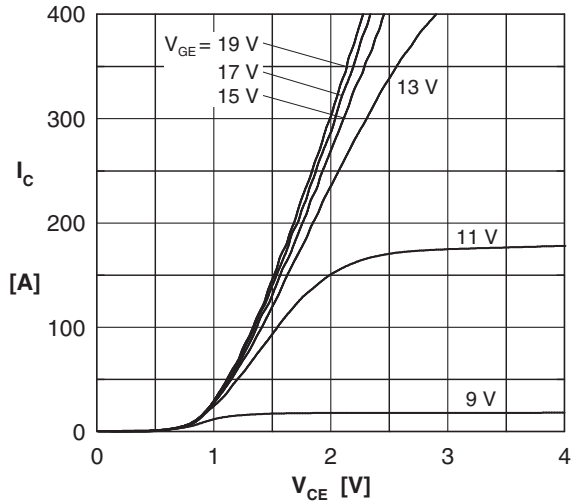
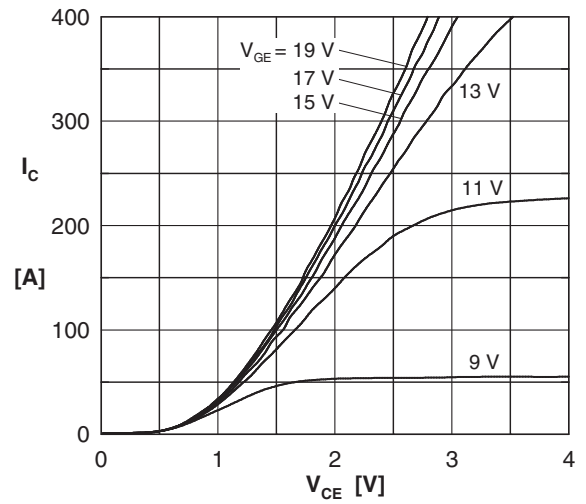
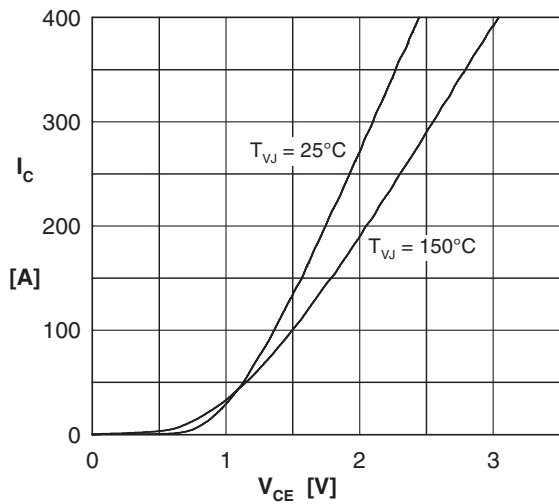
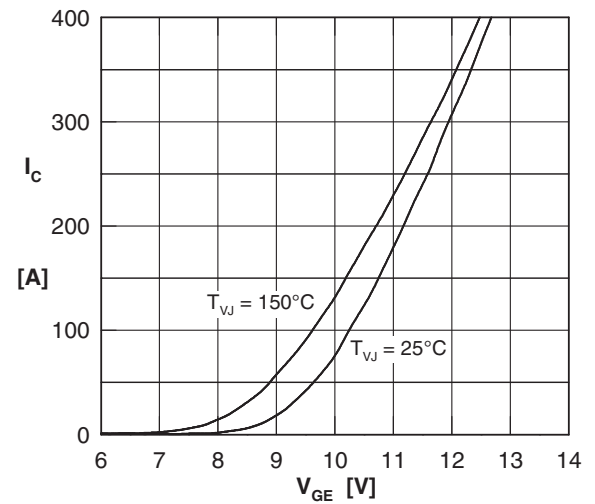
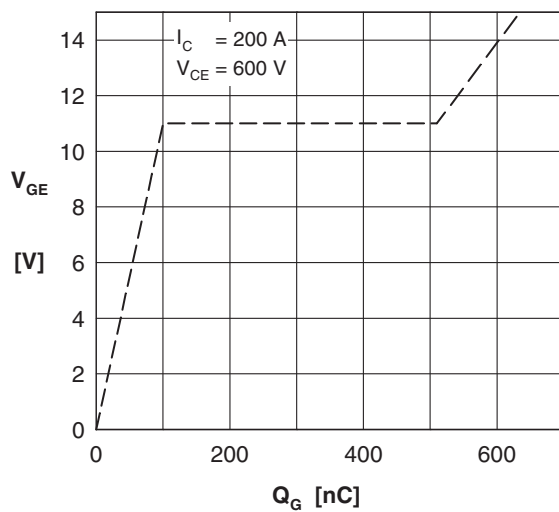
**IGBT T1 - T6**

 Fig. 1 Typ. output characteristics ( $T_{VJ} = 25^{\circ}\text{C}$ )

 Fig. 2 Typ. output characteristics ( $T_{VJ} = 150^{\circ}\text{C}$ )

 Fig. 3 Typ. output characteristics ( $V_{GE} = 15\text{V}$ )

 Fig. 4 Typ. transfer characteristics ( $V_{CE} = 20\text{V}$ )


Fig. 5 Typ. turn-on gate charge 0/15V

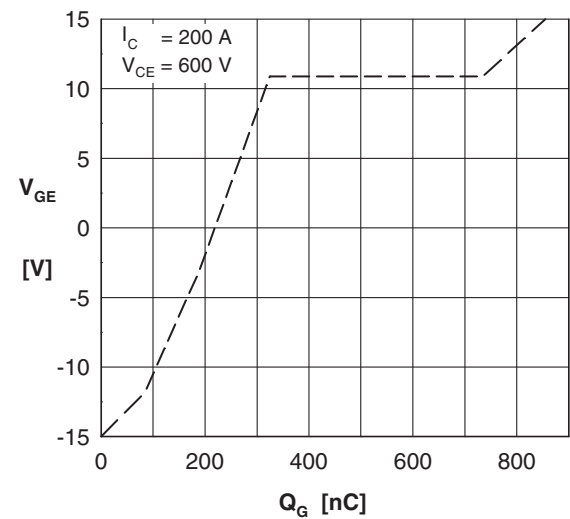


Fig. 6 Typ. turn-on gate charge -15/+15V

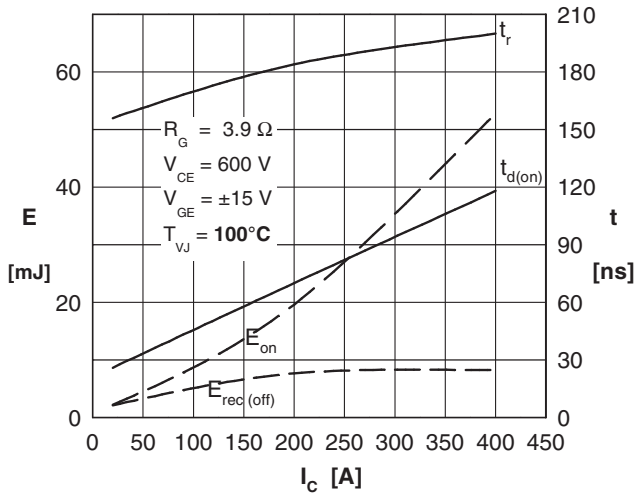
**IGBT T1 - T6**


Fig. 7 Typ. switching energy versus collector current (turn on)

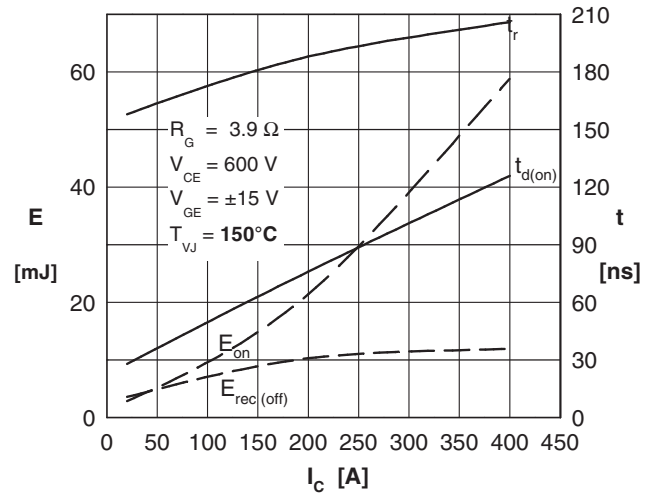


Fig. 8 Typ. switching energy versus collector current (turn on)

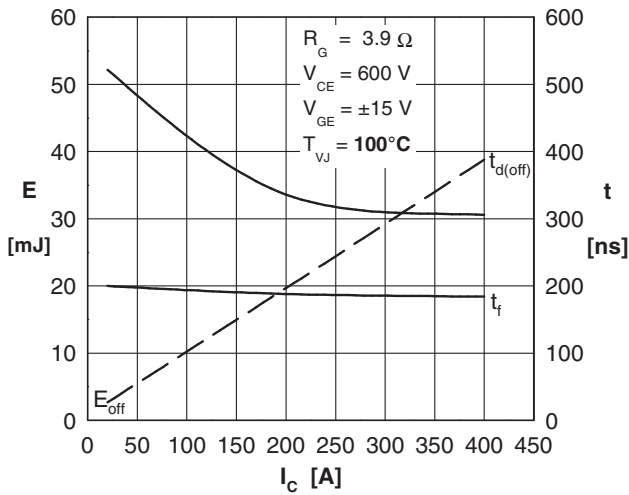


Fig. 9 Typ. switching energy versus collector current (turn off)

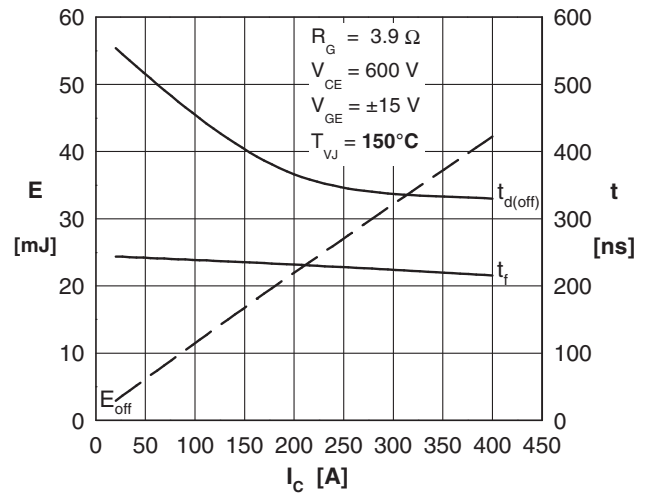


Fig. 10 Typ. switching energy versus collector current (turn off)

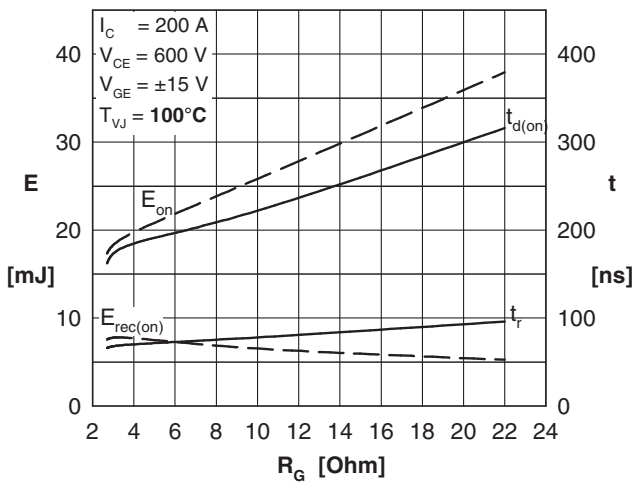


Fig. 11 Typ. switching energy versus gate resistor (turn on)

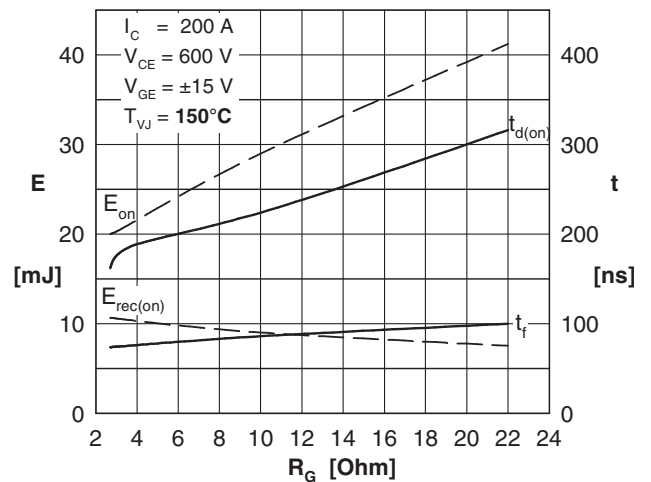


Fig. 12 Typ. switching energy versus gate resistor (turn on)

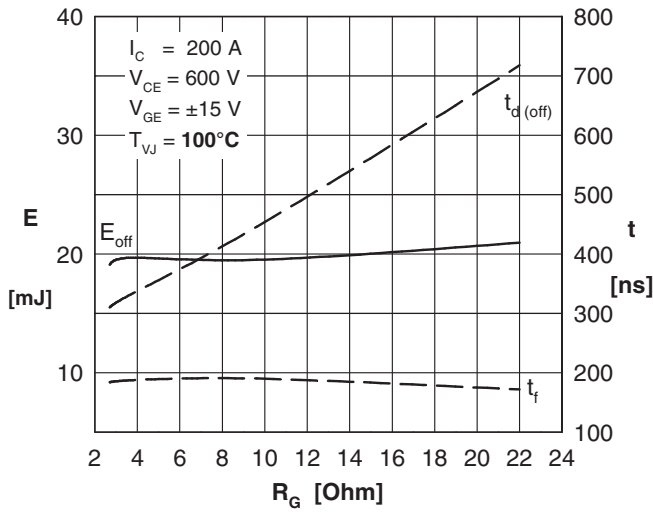
**IGBT T1 - T6**


Fig. 13 Typ. switching energy versus gate resistor (turn off)

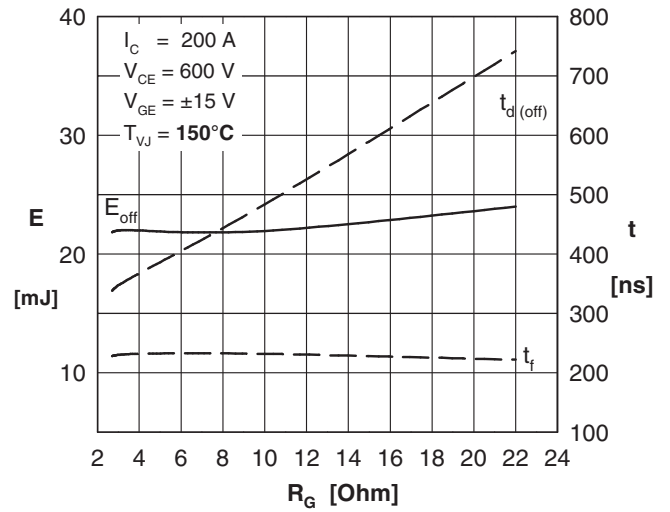


Fig. 14 Typ. switching energy versus gate resistor (turn off)

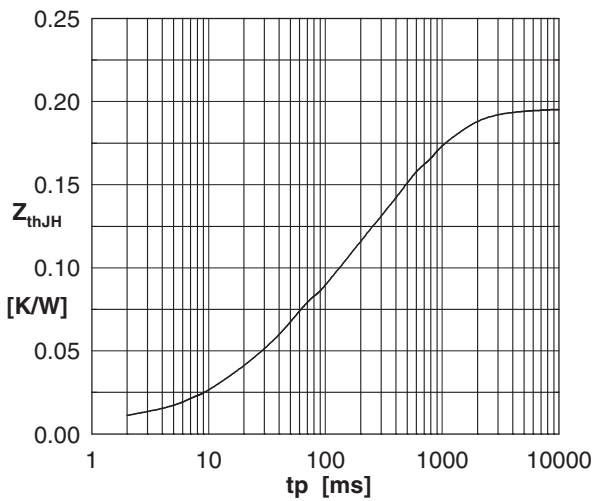


Fig. 15 IGBT: Typ. transient thermal impedance junction to heat sink



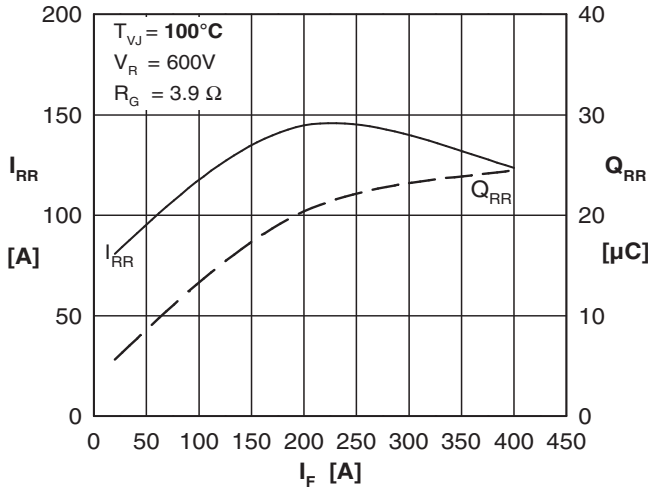
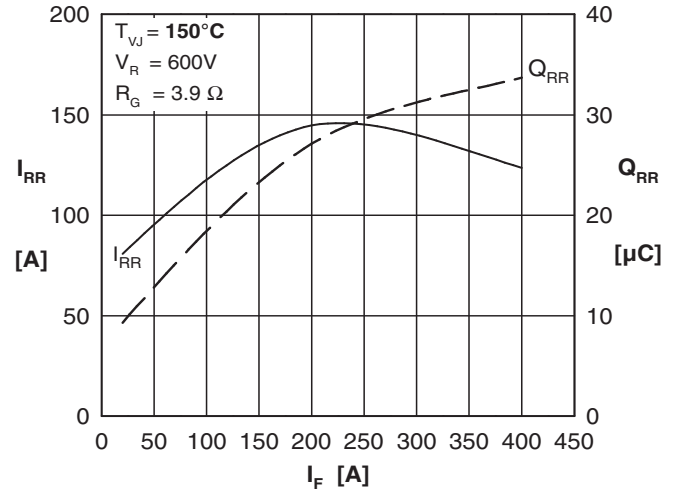
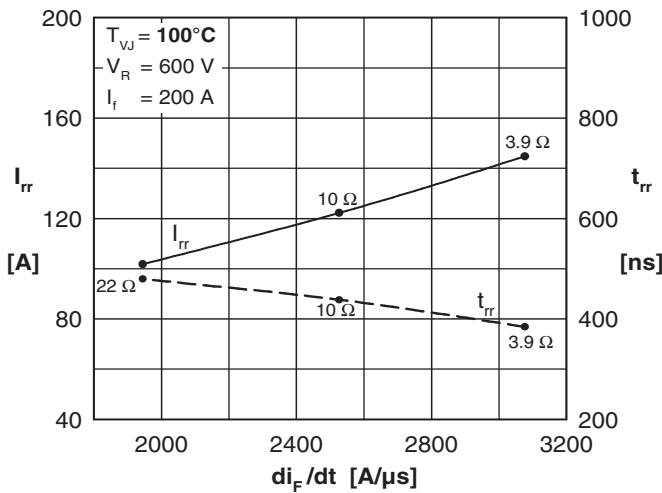
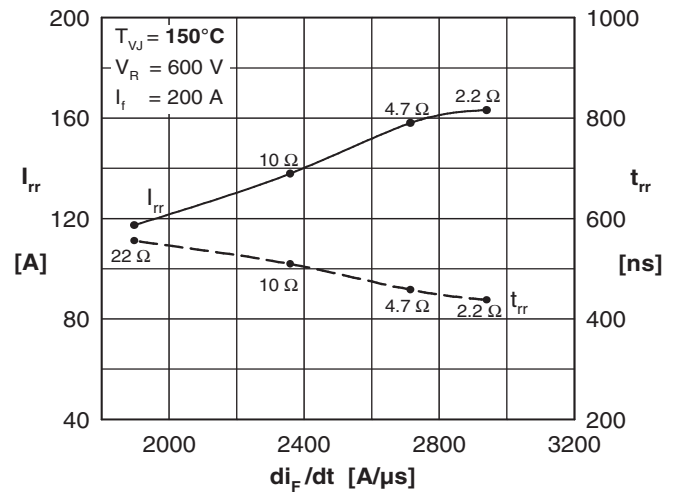
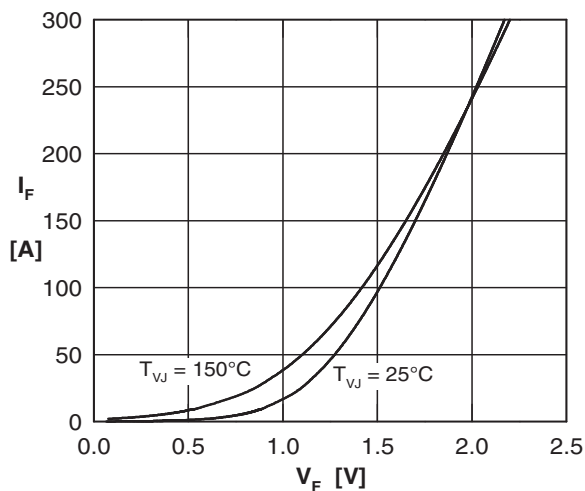
**DIODE D1 - D6**

 Fig. 16 Typ. reverse recovery characteristics versus diode current  $I_F$ 

 Fig. 17 Typ. reverse recovery characteristics versus diode current  $I_F$ 

 Fig. 18 Typ. reverse recovery characteristics versus  $-di/dt$ 

 Fig. 19 Typ. reverse recovery characteristics versus  $-di/dt$ 


Fig. 20 Typ. forward characteristics of free wheeling diode

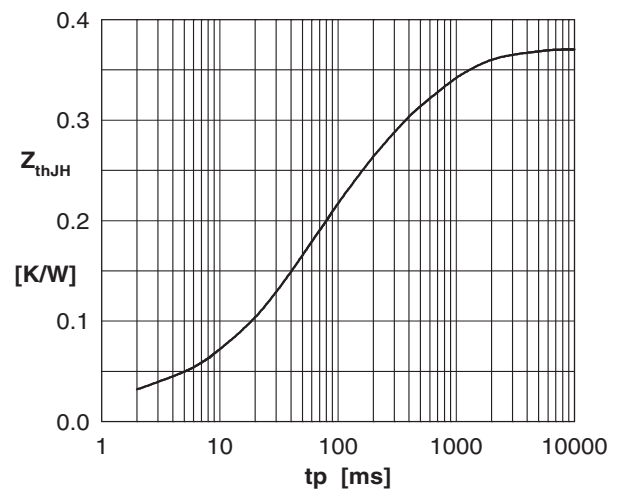


Fig. 21 Diode: Typ. transient thermal impedance junction to heat sink