# Standard Rectifier Module

| | 3 ~ Rectifier | | Brake Chopper |
|---|---|---|---|
| $V_{RRM}$ | = 1600 V | $V_{CES}$ | = 1200 V |
| $I_{DAVM}$ | = 188 A | $I_{C25}$ | = 220 A |
| $I_{FSM}$ | = 1100 A | $V_{CE(sat)}$ | = 1.95 V |

3~ Rectifier Bridge + Brake Unit

**Part name**

VUB160-16NOX
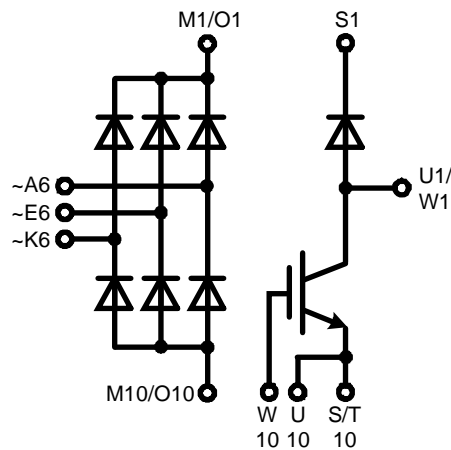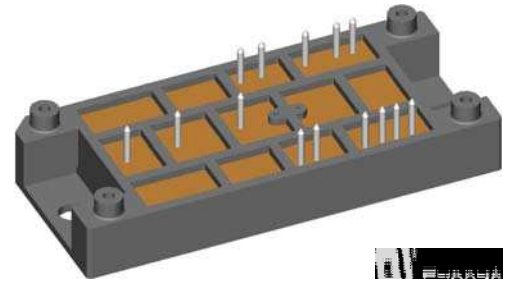




**Features / Advantages:**

● Soldering connections for PCB mounting
● Convenient package outline
● NTC

**Applications:**

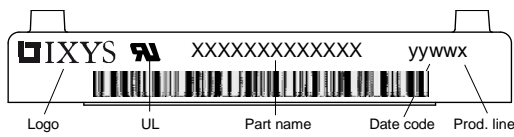● 3~ Rectifier with brake unit
  for drive inverters

**Package:**

● Housing: V2-Pack
● DCB ceramic base plate
● Isolation voltage 3600 V~
● Easy to mount with two screws
● Space and weight savings
● RoHS compliant

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

Data according to IEC 60747and per diode unless otherwise specified

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## Rectifier — Ratings

| Symbol | Definition | Conditions | | min. | typ. | max. | Unit |
|---|---|---|---|---|---|---|---|
| $V_{RSM}$ | max. non-repetitive reverse blocking voltage | | $T_{VJ} = 25°C$ | | | 1700 | V |
| $V_{RRM}$ | max. repetitive reverse blocking voltage | | $T_{VJ} = 25°C$ | | | 1600 | V |
| $I_R$ | reverse current, drain current | $V_{R/D} = 1600$ V | $T_{VJ} = 25°C$ | | | 50 | µA |
| | | $V_{R/D} = 1600$ V | $T_{VJ} = 125°C$ | | | 2 | mA |
| $V_F$ | forward voltage drop | $I_T = 60$ A | $T_{VJ} = 25°C$ | | | 1.16 | V |
| | | $I_T = 120$ A | | | | 1.36 | V |
| | | $I_T = 60$ A | $T_{VJ} = 125°C$ | | | 1.09 | V |
| | | $I_T = 120$ A | | | | 1.35 | V |
| $I_{D(AV)M}$ | bridge output current | $T_C = 80°C$ rectangular    d = ⅓ | $T_{VJ} = 150°C$ | | | 188 | A |
| $V_{F0}$ | threshold voltage } for power loss calculation only | | $T_{VJ} = 150°C$ | | | 0.81 | V |
| $r_F$ | slope resistance } | | | | | 4.4 | mΩ |
| $R_{thJC}$ | thermal resistance junction to case | | | | | 0.60 | K/W |
| $R_{thCH}$ | thermal resistance case to heatsink | | | | 0.2 | | K/W |
| $P_{tot}$ | total power dissipation | | $T_C = 25°C$ | | | 200 | W |
| $I_{FSM}$ | max. forward surge current | t = 10 ms; (50 Hz), sine | $T_{VJ} = 45°C$ | | | 1.10 | kA |
| | | t = 8,3 ms; (60 Hz), sine | $V_R = 0$ V | | | 1.19 | kA |
| | | t = 10 ms; (50 Hz), sine | $T_{VJ} = 150°C$ | | | 935 | A |
| | | t = 8,3 ms; (60 Hz), sine | $V_R = 0$ V | | | 1.01 | kA |
| $I^2t$ | value for fusing | t = 10 ms; (50 Hz), sine | $T_{VJ} = 45°C$ | | | 6.05 | kA²s |
| | | t = 8,3 ms; (60 Hz), sine | $V_R = 0$ V | | | 5.89 | kA²s |
| | | t = 10 ms; (50 Hz), sine | $T_{VJ} = 150°C$ | | | 4.37 | kA²s |
| | | t = 8,3 ms; (60 Hz), sine | $V_R = 0$ V | | | 4.25 | kA²s |
| $C_J$ | junction capacitance | $V_R = 400$ V   f = 1 MHz | $T_{VJ} = 25°C$ | | 37 | | pF |

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## Brake IGBT | Ratings

| Symbol | Definition | Conditions | | min. | typ. | max. | Unit |
|---|---|---|---|---|---|---|---|
| $V_{CES}$ | collector emitter voltage | | $T_{VJ} = 25°C$ | | | 1200 | V |
| $V_{GES}$ | max. DC gate voltage | | | | | ±20 | V |
| $V_{GEM}$ | max. transient collector gate voltage | | | | | ±30 | V |
| $I_{C25}$ | collector current | | $T_C = 25°C$ | | | 220 | A |
| $I_{C80}$ | | | $T_C = 80°C$ | | | 150 | A |
| $P_{tot}$ | total power dissipation | | $T_C = 25°C$ | | | 695 | W |
| $V_{CE(sat)}$ | collector emitter saturation voltage | $I_C = 150A$; $V_{GE} = 15$ V | $T_{VJ} = 25°C$ | | 1.95 | 2.25 | V |
| | | | $T_{VJ} = 125°C$ | | 2.3 | | V |
| $V_{GE(th)}$ | gate emitter threshold voltage | $I_C = 6$ mA; $V_{GE} = V_{CE}$ | $T_{VJ} = 25°C$ | 5.4 | 5.9 | 6.5 | V |
| $I_{CES}$ | collector emitter leakage current | $V_{CE} = V_{CES}$; $V_{GE} = 0$ V | $T_{VJ} = 25°C$ | | | 0.1 | mA |
| | | | $T_{VJ} = 125°C$ | | 0.1 | | mA |
| $I_{GES}$ | gate emitter leakage current | $V_{GE} = ±20$ V | | | | 500 | nA |
| $Q_{G(on)}$ | total gate charge | $V_{CE} = 600$ V; $V_{GE} = 15$ V; $I_C = 150$ A | | | 470 | | nC |
| $t_{d(on)}$ | turn-on delay time | | | | 70 | | ns |
| $t_r$ | current rise time | inductive load | $T_{VJ} = 125°C$ | | 40 | | ns |
| $t_{d(off)}$ | turn-off delay time | $V_{CE} = 600$ V; $I_C = 150A$ | | | 250 | | ns |
| $t_f$ | current fall time | $V_{GE} = ±15$ V; $R_G = 4.7$ Ω | | | 100 | | ns |
| $E_{on}$ | turn-on energy per pulse | | | | 14 | | mJ |
| $E_{off}$ | turn-off energy per pulse | | | | 16 | | mJ |
| RBSOA | reverse bias safe operating area | $V_{GE} = ±15$ V; $R_G = 4.7$ Ω | $T_{VJ} = 125°C$ | | | | |
| $I_{CM}$ | | $V_{CEK} = 1200$ V | | | | 450 | A |
| SCSOA | short circuit safe operating area | | | | | | |
| $t_{SC}$ | short circuit duration | $V_{CE} = 900$ V; $V_{GE} = ±15$ V | $T_{VJ} = 125°C$ | | | 10 | µs |
| $I_{SC}$ | short circuit current | $R_G = 4.7$ Ω; non-repetitive | | | 600 | | A |
| $R_{thJC}$ | thermal resistance junction to case | | | | | 0.18 | K/W |
| $R_{thCH}$ | thermal resistance case to heatsink | | | | | 0.1 | K/W |

## Brake Diode

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| $V_{RRM}$ | max. repetitive reverse voltage | | $T_{VJ} = 25°C$ | | | 1200 | V |
| $I_{F25}$ | forward current | | $T_C = 25°C$ | | | 62 | A |
| $I_{F80}$ | | | $T_C = 80°C$ | | | 40 | A |
| $V_F$ | forward voltage | $I_F = 30$ A | $T_{VJ} = 25°C$ | | | 2.71 | V |
| | | | $T_{VJ} = 125°C$ | | | 1.94 | V |
| $I_R$ | reverse current | $V_R = V_{RRM}$ | $T_{VJ} = 25°C$ | | | 0.25 | mA |
| | | | $T_{VJ} = 125°C$ | | | 1 | mA |
| $Q_{rr}$ | reverse recovery charge | $V_R = 600$ V | | | 1.8 | | µC |
| $I_{RM}$ | max. reverse recovery current | $-di_F/dt = 400$ A/µs | $T_{VJ} = 125°C$ | | 23 | | A |
| $t_{rr}$ | reverse recovery time | $I_F = 30$ A | | | 150 | | ns |
| $R_{thJC}$ | thermal resistance junction to case | | | | | 0.9 | K/W |
| $R_{thCH}$ | thermal resistance case to heatsink | | | | | 0.3 | K/W |

## Package  V2-Pack | Ratings

| Symbol | Definition | Conditions | | min. | typ. | max. | Unit |
|--------|-----------|------------|---|------|------|------|------|
| $I_{RMS}$ | $I_{RM}$ current | per terminal | | | | 100 | A |
| $T_{stg}$ | storage temperature | | | -40 | | 125 | °C |
| $T_{VJ}$ | virtual junction temperature | | | -40 | | 150 | °C |
| Weight | | | | | 76 | | g |
| $M_D$ | mounting torque | | | 2 | | 2.5 | Nm |
| $V_{ISOL}$ | isolation voltage | t = 1 second | | 3600 | | | V |
| | | t = 1 minute | | 3000 | | | V |
| $d_{Spp/App}$ | creepage distance on surface \| striking distance through air | terminal to terminal | | 6.0 | | | mm |
| $d_{Spb/Apb}$ | | terminal to backside | | 12.0 | | | mm |

| Ordering | Ordering Number | Marking on Product | Delivery Mode | Quantity | Code No. |
|----------|-----------------|--------------------|--------------|----------|----------|
| Standard | VUB160-16NOX | VUB160-16NOX | Box | 6 | 510141 |

| Similar Part | Package | Voltage class |
|--------------|---------|---------------|
| VUB160-16NOXT | V2-Pack | 1600 |

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Data according to IEC 60747and per diode unless otherwise specified

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Outlines

Detail Y    M 5:1

Ø1.5 (DIN 46 431)

0.5±0.2

1.5 +0.6 -0.3

Detail X    M 2:1

Ø6.1

Ø2.5

Ø2.1

Marking

M1/O1        S1

~A6
~E6
~K6

M10/O10

U1/W1

W    U    S/T
10   10   10

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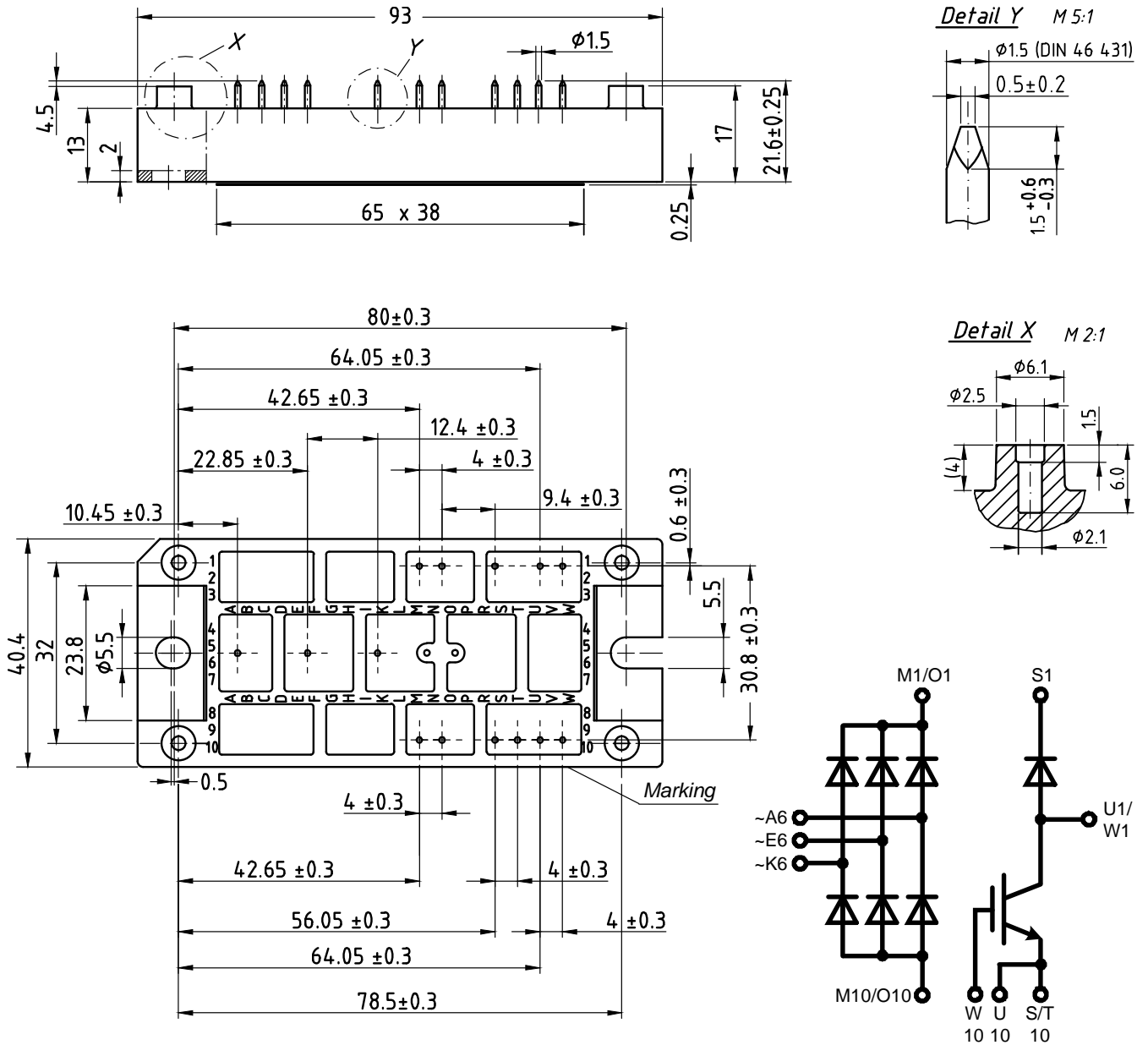
**Rectifier**
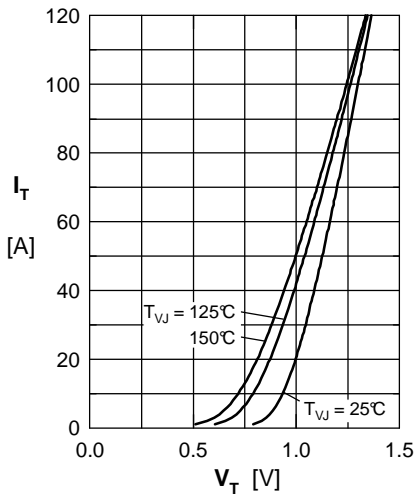


Fig.1 Forward current versus voltage drop per diode
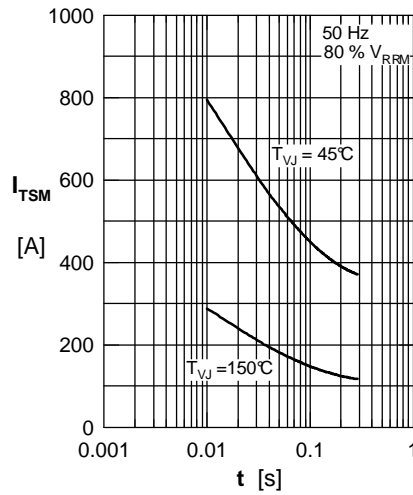


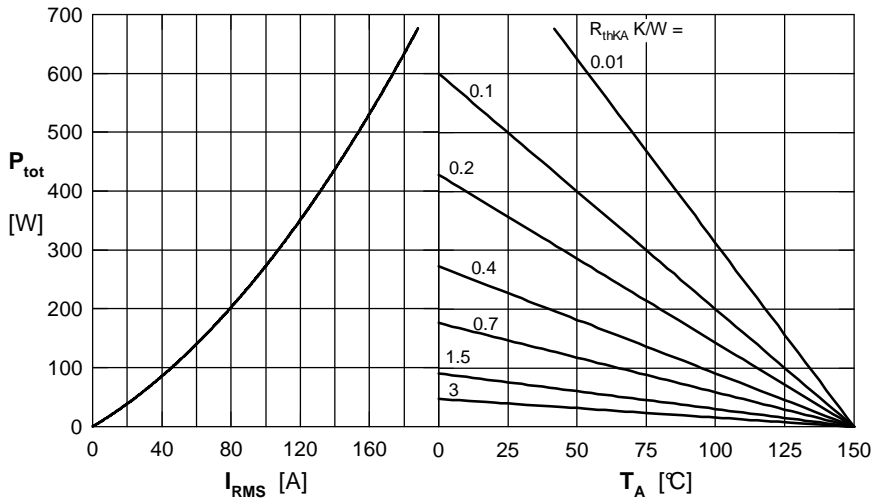Fig.2 Surge overload current
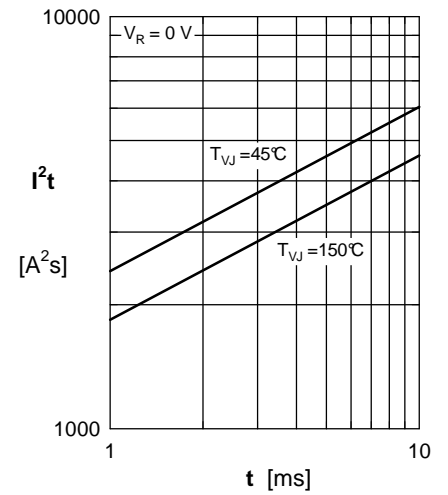


Fig.3 $I^2t$ versus time per diode



Fig.4 Power dissipation versus direct output current and ambient temperature, sine 180°
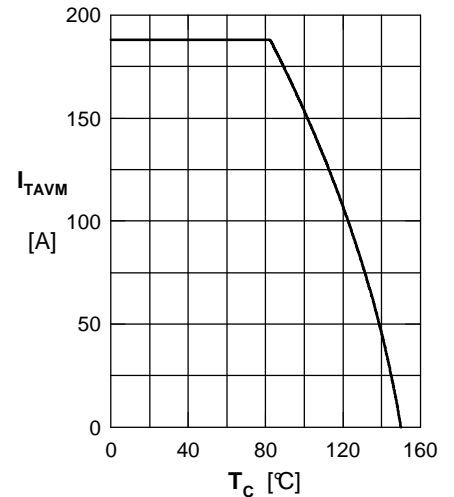


Fig. 5 Max. forward current vs. case temperature



| i | $R_i$ [K/W] | $t_i$ [s] |
|---|---|---|
| 1 | 0.015 | 0.002 |
| 2 | 0.195 | 0.04 |
| 3 | 0.56 | 0.43 |
| 4 | 0.23 | 0.2 |

Fig. 6 Transient thermal impedance junction to case

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Data according to IEC 60747and per diode unless otherwise specified

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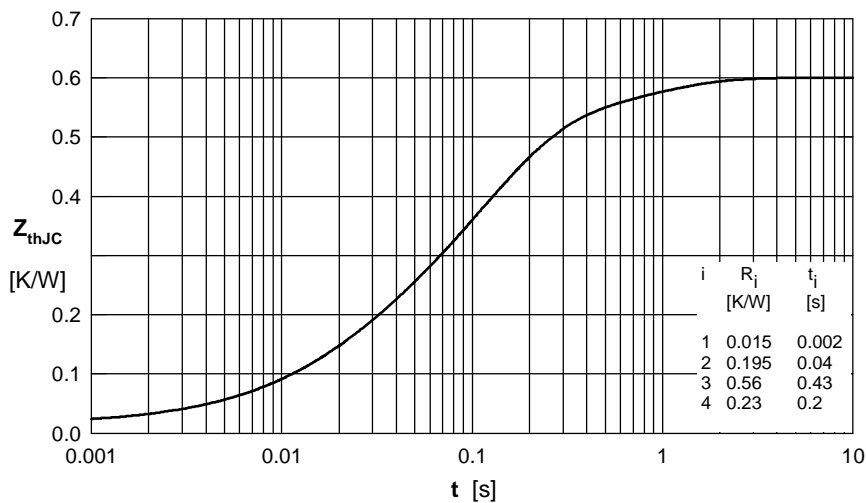
**Brake IGBT**
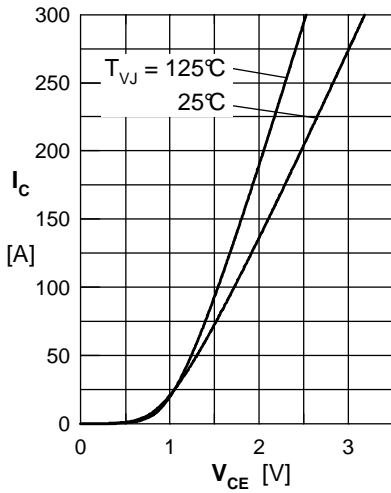


Fig. 1  Typ. output characteristics
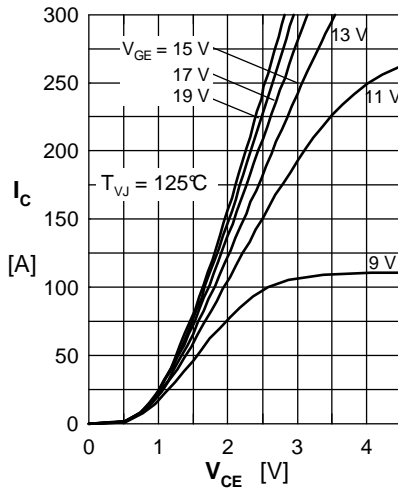


Fig. 2  Typ. output characteristics
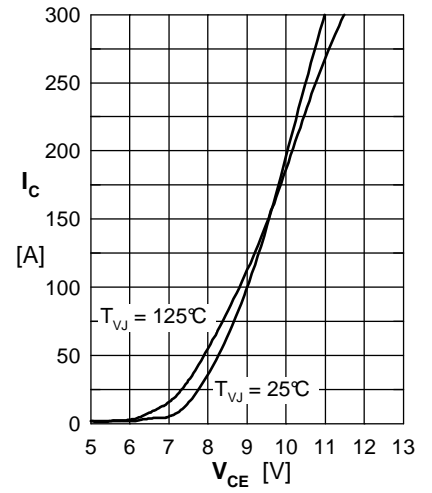


Fig. 3  Typ. transfer characteristics
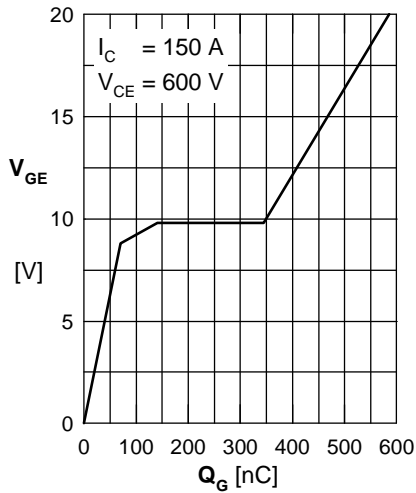


Fig. 4  Dynamic parameters $Q_r$, $I_{RM}$ versus $T_{VJ}$
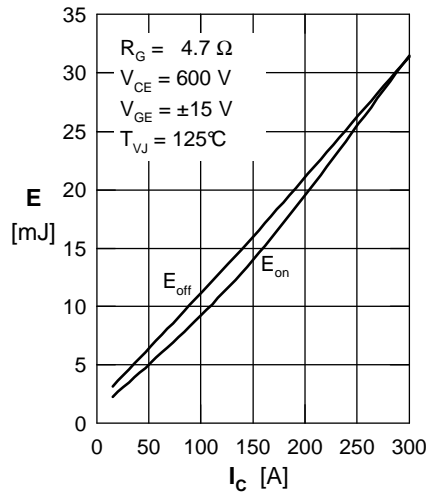


Fig. 5  Typ. recovery time $t_{rr}$ vs. -$di_F$/dt
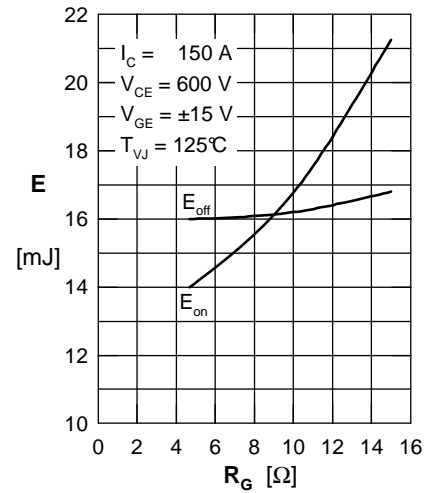


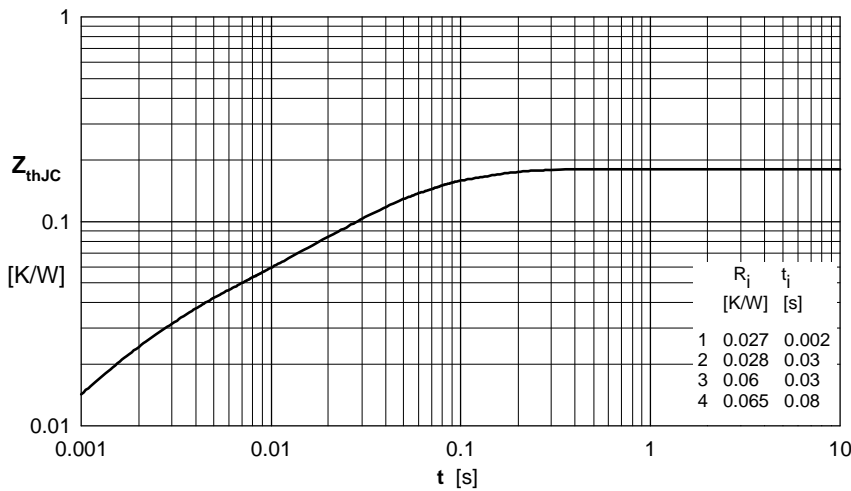Fig. 6  Typ. peak forward voltage $V_{FR}$ and $t_{fr}$ versus $di_F$/dt



| | $R_i$ | $t_i$ |
|---|---|---|
| | [K/W] | [s] |
| 1 | 0.027 | 0.002 |
| 2 | 0.028 | 0.03 |
| 3 | 0.06 | 0.03 |
| 4 | 0.065 | 0.08 |

Fig. 7  Transient thermal impedance junction to case

## Brake Diode
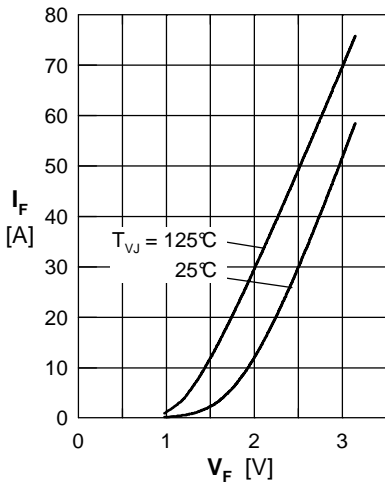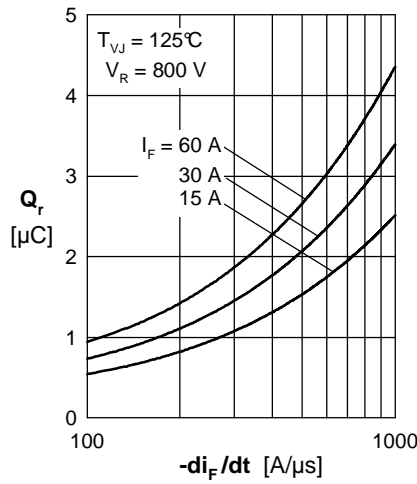
Fig. 1  Typ. forward current $I_F$ vs. $V_F$

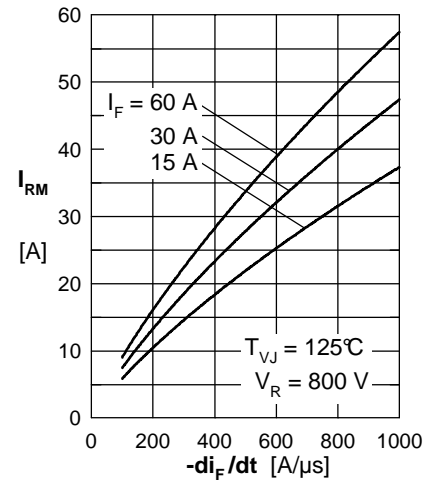Fig. 2  Typ. reverse recovery charge $Q_r$ versus -$di_F$/dt

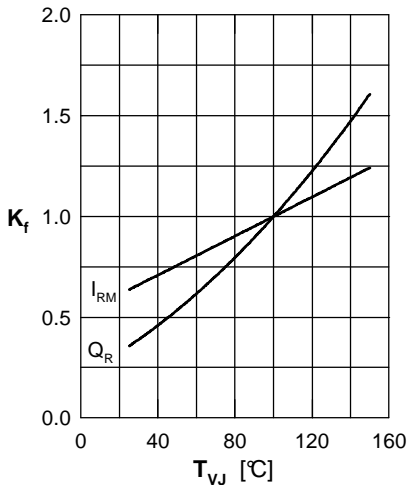Fig. 3  Typ. peak reverse current $I_{RM}$ versus -$di_F$/dt

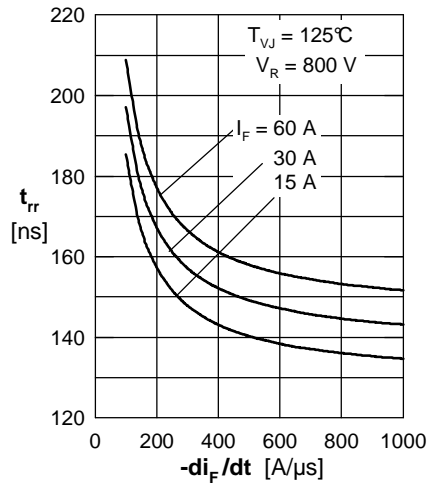Fig. 4  Typ. dynamic parameters $Q_r$, $I_{RM}$, versus $T_{VJ}$

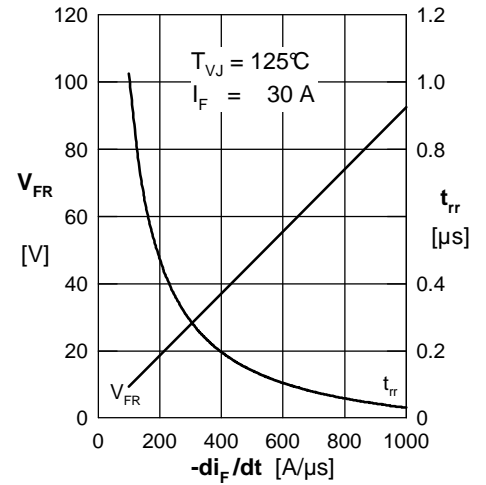Fig. 5  Typ. recovery time $t_{rr}$ vs. -$di_F$/dt

Fig. 6  Typ. peak forward voltage $V_{FR}$ and $t_{fr}$ versus $di_F$/dt

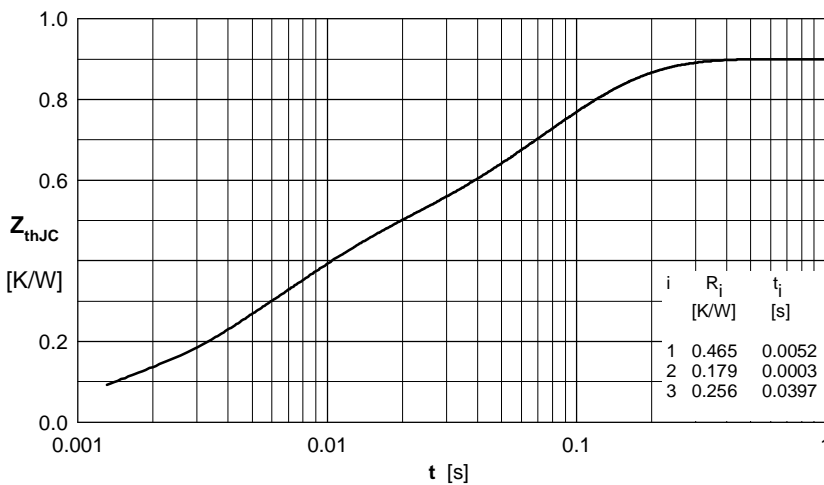| i | $R_i$ [K/W] | $t_i$ [s] |
|---|---|---|
| 1 | 0.465 | 0.0052 |
| 2 | 0.179 | 0.0003 |
| 3 | 0.256 | 0.0397 |

Fig. 7  Typ. transient thermal impedance junction to case

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