Vincotech

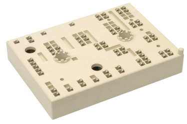
# V23990-K428-A40-PM
datasheet

**MiniSKiiP® 3 PIM** — **1200 V / 50 A**

## Features

- Solderless interconnection
- Trench Fieldstop IGBT4 technology

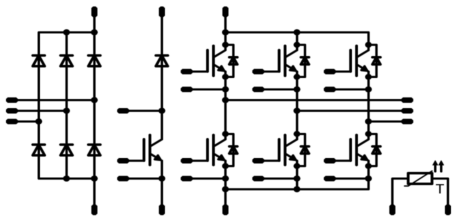
## MiniSKiiP® 3 housing



## Target Applications

- Industrial Drives

## Schematic




## Types

- V23990-K428-A40-PM

# Maximum Ratings

$T_j$ = 25 °C, unless otherwise specified

| Parameter | Symbol | Condition | Value | Unit |
|---|---|---|---|---|
| **Rectifier Diode** | | | | |
| Repetitive peak reverse voltage | $V_{RRM}$ | | 1600 | V |
| DC forward current | $I_{FAV}$ | $T_j = T_{jmax}$   $T_s$ = 80 °C | 69 | A |
| Surge (non-repetitive) forward current | $I_{FSM}$ | $t_p$ = 10 ms   $T_j$ = 25 °C | 490 | A |
| $I^2$t-value | $I^2t$ | | 1200 | $A^2s$ |
| Power dissipation | $P_{tot}$ | $T_j = T_{jmax}$   $T_s$ = 80 °C | 77 | W |
| Maximum Junction Temperature | $T_{jmax}$ | | 150 | °C |
| **Inverter Switch / Brake Switch** | | | | |
| Collector-emitter break down voltage | $V_{CE}$ | | 1200 | V |
| DC collector current | $I_C$ | $T_j = T_{jmax}$   $T_s$ = 80 °C | 52 | A |
| Repetitive peak collector current | $I_{CRM}$ | $t_p$ limited by $T_{jmax}$ | 150 | A |
| Power dissipation | $P_{tot}$ | $T_j = T_{jmax}$   $T_s$ = 80 °C | 133 | W |
| Gate-emitter peak voltage | $V_{GE}$ | | ±20 | V |
| Short circuit ratings | $t_{SC}$<br>$V_{CC}$ | $T_j$ = 150 °C<br>$V_{GE}$ = 15 V | 10<br>800 | μs<br>V |
| Maximum Junction Temperature | $T_{jmax}$ | | 175 | °C |

# Maximum Ratings

$T_j$ = 25 °C, unless otherwise specified

| Parameter | Symbol | Condition | | Value | Unit |
|---|---|---|---|---|---|
| **Inverter Diode / Brake Diode** | | | | | |
| Repetitive peak reverse voltage | $V_{RRM}$ | | | 1200 | V |
| DC forward current | $I_F$ | $T_j = T_{jmax}$ | $T_s$ = 80 °C | 46 | A |
| Repetitive peak forward current | $I_{FRM}$ | $t_p$ limited by $T_{jmax}$ | | 150 | A |
| Power dissipation | $P_{tot}$ | $T_j = T_{jmax}$ | $T_s$ = 80 °C | 100 | W |
| Maximum Junction Temperature | $T_{jmax}$ | | | 175 | °C |
| **Thermal Properties** | | | | | |
| Storage temperature | $T_{stg}$ | | | -40…+125 | °C |
| Operation temperature under switching condition | $T_{op}$ | | | -40…+($T_{jmax}$ - 25) | °C |
| **Insulation Properties** | | | | | |
| Insulation voltage | $V_{is}$ | $t$ = 2 s | DC voltage | 4000 | V |
| Creepage distance | | | | min 12.7 | mm |
| Clearance | | | | min 12.7 | mm |

# Characteristic Values

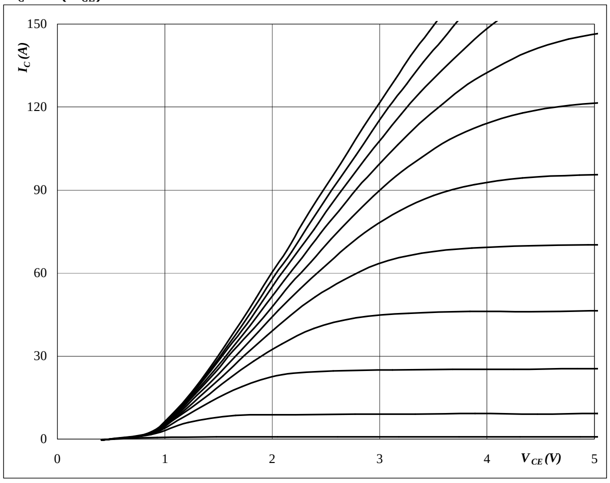
| Parameter | Symbol | Conditions | $V_{GE}$ [V] or $V_{GS}$ [V] | $V_r$ [V] or $V_{CE}$ [V] or $V_{DS}$ [V] | $I_C$ [A] or $I_F$ [A] or $I_D$ [A] | $T_j$ [°C] | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| **Rectifier Diode** | | | | | | | | | | |
| Forward voltage | $V_F$ | | | | 35 | 25<br>125 | 0,8 | 1,1<br>1,02 | 1,35 | V |
| Threshold voltage (for power loss calc. only) | $V_{to}$ | | | | | 25<br>125 | | 0,9<br>0,74 | | V |
| Slope resistance (for power loss calc. only) | $r_t$ | | | | | 25<br>125 | | 0,004<br>0,006 | | Ω |
| Reverse current | $I_r$ | | | 1500 | | 25<br>125 | | | 0,1<br>1,1 | mA |
| Thermal resistance junction to sink | $R_{th(j-s)}$ | Thermal grease thickness ≤ 50μm $\lambda$ = 1 W/mK | | | | | | 0,90 | | K/W |
| **Inverter Switch / Brake Switch** | | | | | | | | | | |
| Gate emitter threshold voltage | $V_{GE(th)}$ | $V_{CE} = V_{GE}$ | | | 0,0017 | 25<br>150 | 5 | 5,8 | 6,5 | V |
| Collector-emitter saturation voltage | $V_{CEsat}$ | | 15 | | 50 | 25<br>150 | 1,6 | 1,91<br>2,39 | 2,4 | V |
| Collector-emitter cut-off current incl. Diode | $I_{CES}$ | | | 1200 | | 25<br>150 | | | 0,06 | mA |
| Gate-emitter leakage current | $I_{GES}$ | | 20 | 0 | | 25<br>150 | | | 600 | nA |
| Integrated Gate resistor | $R_{gint}$ | | | | | | | 4 | | Ω |
| Turn-on delay time | $t_{d(on)}$ | $R_{goff}$ = 8 Ω<br>$R_{gon}$ = 8 Ω | ±15 | 600 | 50 | 25<br>150 | | 106<br>111 | | ns |
| Rise time | $t_r$ | | | | | 25<br>150 | | 18<br>25 | | ns |
| Turn-off delay time | $t_{d(off)}$ | | | | | 25<br>150 | | 228<br>298 | | ns |
| Fall time | $t_f$ | | | | | 25<br>150 | | 84<br>125 | | ns |
| Turn-on energy loss | $E_{on}$ | | | | | 25<br>150 | | 2,66<br>4,46 | | mWs |
| Turn-off energy loss | $E_{off}$ | | | | | 25<br>150 | | 2,78<br>4,58 | | mWs |
| Input capacitance | $C_{ies}$ | $f$ = 1 MHz | 0 | 25 | | 25 | | 2770 | | pF |
| Output capacitance | $C_{oss}$ | | | | | | | 205 | | pF |
| Reverse transfer capacitance | $C_{rss}$ | | | | | | | 160 | | pF |
| Gate charge | $Q_G$ | | ±15 | | | 25 | | 380 | | nC |
| Thermal resistance junction to sink | $R_{th(j-s)}$ | Thermal grease thickness ≤ 50μm $\lambda$ = 1 W/mK | | | | | | 0,71 | | K/W |
| **Inverter Diode / Brake Diode** | | | | | | | | | | |
| Diode forward voltage | $V_F$ | | | | 50 | 25<br>150 | 1,5 | 2,19<br>2,21 | 2,9 | V |
| Peak reverse recovery current | $I_{RRM}$ | $R_{gon}$ = 8 Ω | ±15 | 600 | 50 | 25<br>150 | | 61,3<br>70,7 | | A |
| Reverse recovery time | $t_{rr}$ | | | | | 25<br>150 | | 144<br>312 | | ns |
| Reverse recovered charge | $Q_{rr}$ | | | | | 25<br>150 | | 3,74<br>8,8 | | μC |
| Peak rate of fall of recovery current | $(di_{rf}/dt)_{max}$ | | | | | 25<br>150 | | 3494<br>950 | | A/μs |
| Reverse recovered energy | $E_{rec}$ | | | | | 25<br>150 | | 1,38<br>3,48 | | mWs |
| Thermal resistance junction to sink | $R_{th(j-s)}$ | Thermal grease thickness ≤ 50μm $\lambda$ = 1 W/mK | | | | | | 0,95 | | K/W |
| **Thermistor** | | | | | | | | | | |
| Rated resistance | $R$ | | | | | 25 | | 1000 | | Ω |
| Deviation of $R_{100}$ | $\Delta_{R/R}$ | $R_{100}$=1670 Ω | | | | 100 | -3 | | 3 | % |
| $R_{100}$ | $P$ | | | | | 100 | | 1670,3125 | | Ω |
| Power dissipation constant | | | | | | 25 | | | | mW/K |
| A-value | $B_{(25/50)}$ | Tol. % | | | | 25 | | $7{,}635 \cdot 10^{-3}$ | | 1/K |
| B-value | $B_{(25/100)}$ | Tol. % | | | | 25 | | $1{,}731 \cdot 10^{-5}$ | | 1/K² |
| Vincotech NTC Reference | | | | | | | | | E | |

# Inverter / Brake Characteristics

**Figure 1** IGBT

**Typical output characteristics**

$I_C = f(V_{CE})$



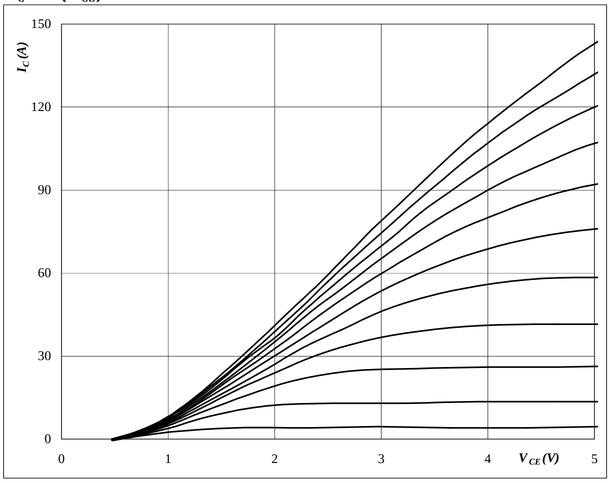

**At**

| | | |
|---|---|---|
| $t_p$ = | 250 | μs |
| $T_j$ = | 25 | °C |
| $V_{GE}$ from | 7 V to 17 V in steps of 1 V | |

**Figure 2** IGBT

**Typical output characteristics**

$I_C = f(V_{CE})$



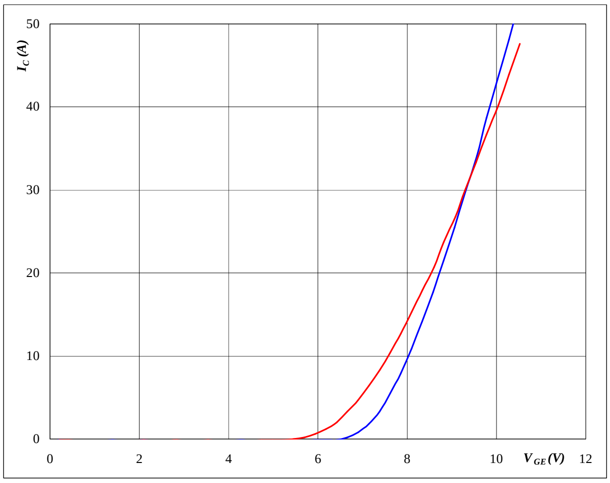

**At**

| | | |
|---|---|---|
| $t_p$ = | 250 | μs |
| $T_j$ = | 150 | °C |
| $V_{GE}$ from | 7 V to 17 V in steps of 1 V | |

**Figure 3** IGBT

**Typical transfer characteristics**

$I_C = f(V_{GE})$



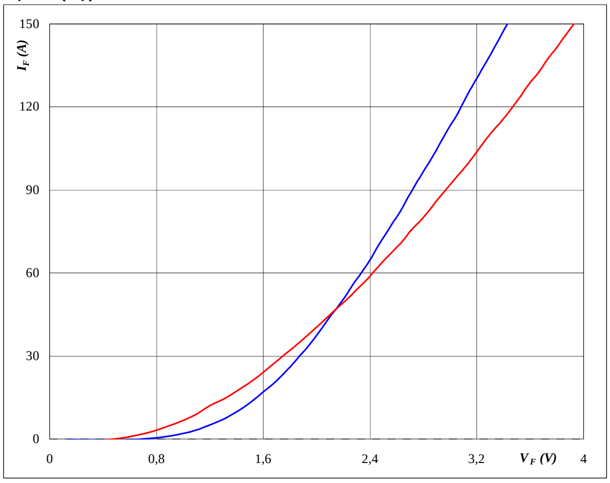

**At**

| | | |
|---|---|---|
| $T_j$ = | 25/150 | °C |
| $t_p$ = | 250 | μs |
| $V_{CE}$ = | 10 | V |

**Figure 4** FWD

**Typical diode forward current as a function of forward voltage**

$I_F = f(V_F)$




**At**

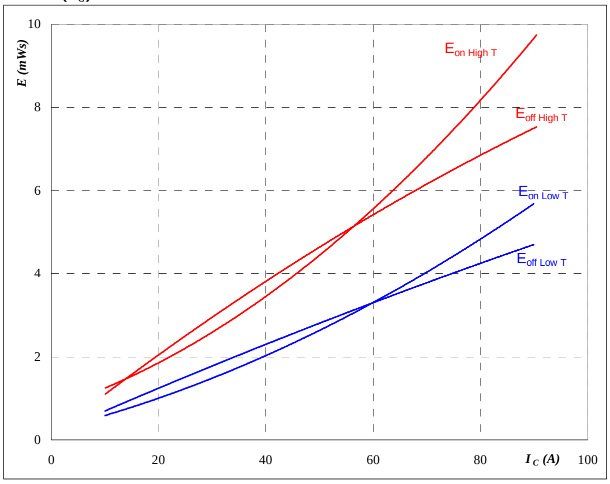
| | | |
|---|---|---|
| $T_j$ = | 25/150 | °C |
| $t_p$ = | 250 | μs |

## e Characteristics

**Figure 5** IGBT

**Typical switching energy losses**
**as a function of collector current**

$E = f(I_C)$



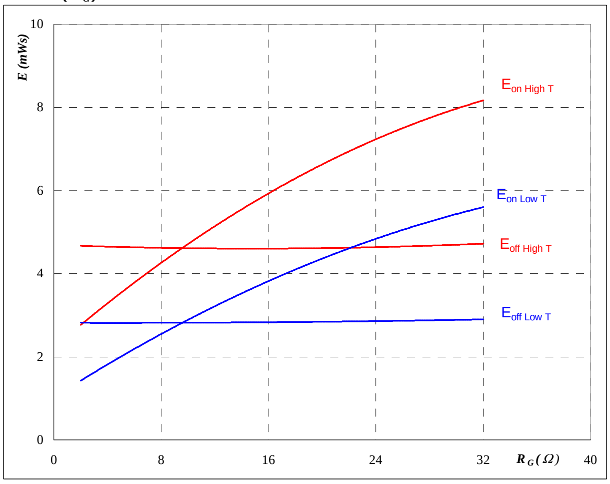

With an inductive load at

| | | |
|---|---|---|
| $T_j$ = | 25/150 | °C |
| $V_{CE}$ = | 600 | V |
| $V_{GE}$ = | ±15 | V |
| $R_{gon}$ = | 8 | Ω |
| $R_{goff}$ = | 8 | Ω |

**Figure 6** IGBT

**Typical switching energy losses**
**as a function of gate resistor**

$E = f(R_G)$



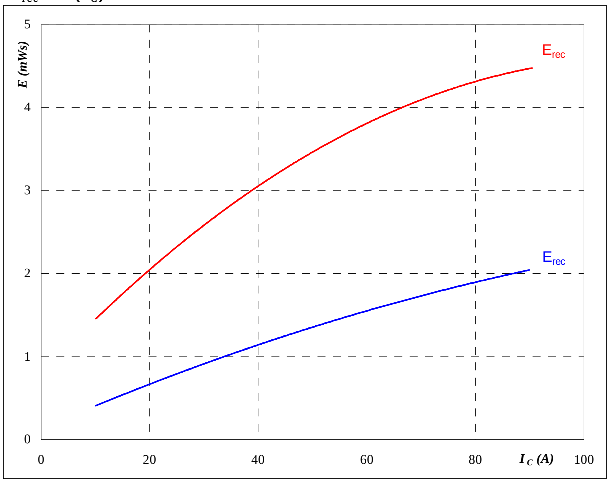

With an inductive load at

| | | |
|---|---|---|
| $T_j$ = | 25/150 | °C |
| $V_{CE}$ = | 600 | V |
| $V_{GE}$ = | ±15 | V |
| $I_C$ = | 50 | A |

**Figure 7** FWD

**Typical reverse recovery energy loss**
**as a function of collector current**

$E_{rec} = f(I_C)$



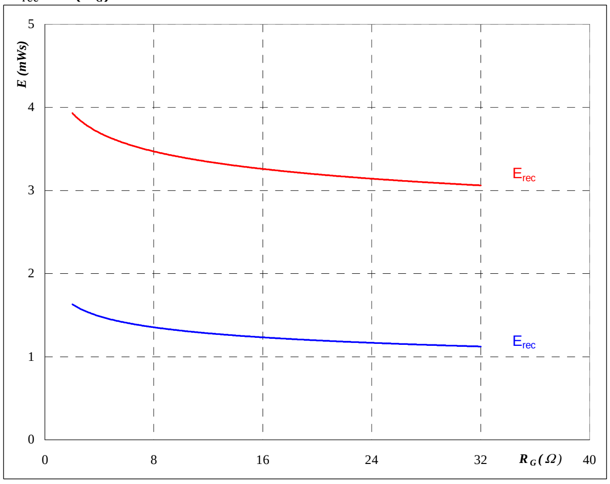

With an inductive load at

| | | |
|---|---|---|
| $T_j$ = | 25/150 | °C |
| $V_{CE}$ = | 600 | V |
| $V_{GE}$ = | ±15 | V |
| $R_{gon}$ = | 8 | Ω |

**Figure 8** FWD

**Typical reverse recovery energy loss**
**as a function of gate resistor**

$E_{rec} = f(R_G)$




With an inductive load at

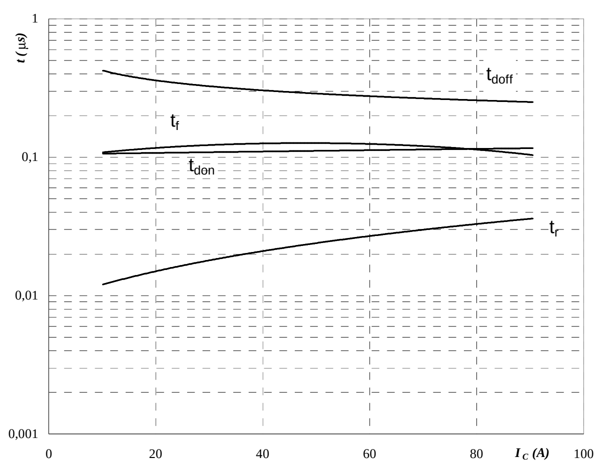
| | | |
|---|---|---|
| $T_j$ = | 25/150 | °C |
| $V_{CE}$ = | 600 | V |
| $V_{GE}$ = | ±15 | V |
| $I_C$ = | 50 | A |

# Inverter / Brake Characteristics

**Figure 9** IGBT

**Typical switching times as a function of collector current**

$t = f(I_C)$



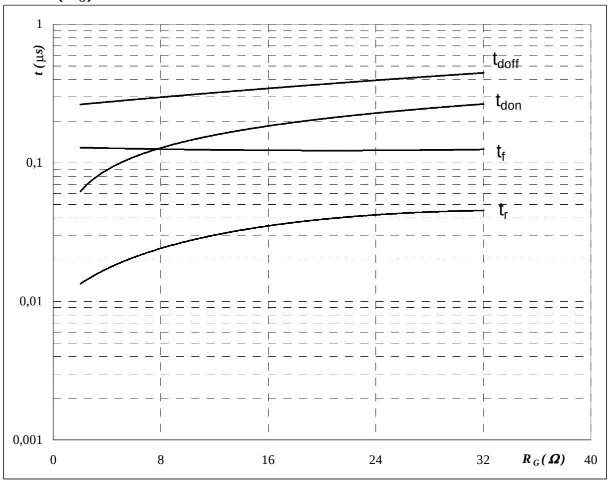

With an inductive load at

| | | |
|---|---|---|
| $T_j$ = | 150 | °C |
| $V_{CE}$ = | 600 | V |
| $V_{GE}$ = | ±15 | V |
| $R_{gon}$ = | 8 | Ω |
| $R_{goff}$ = | 8 | Ω |

**Figure 10** IGBT

**Typical switching times as a function of gate resistor**

$t = f(R_G)$



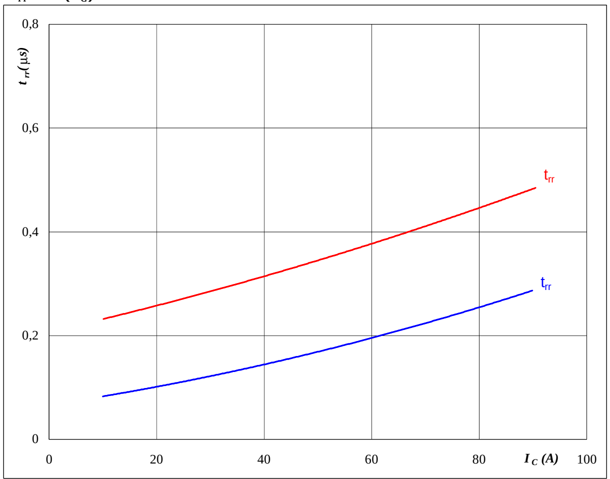

With an inductive load at

| | | |
|---|---|---|
| $T_j$ = | 150 | °C |
| $V_{CE}$ = | 600 | V |
| $V_{GE}$ = | ±15 | V |
| $I_C$ = | 50 | A |

**Figure 11** FWD

**Typical reverse recovery time as a function of collector current**

$t_{rr} = f(I_C)$



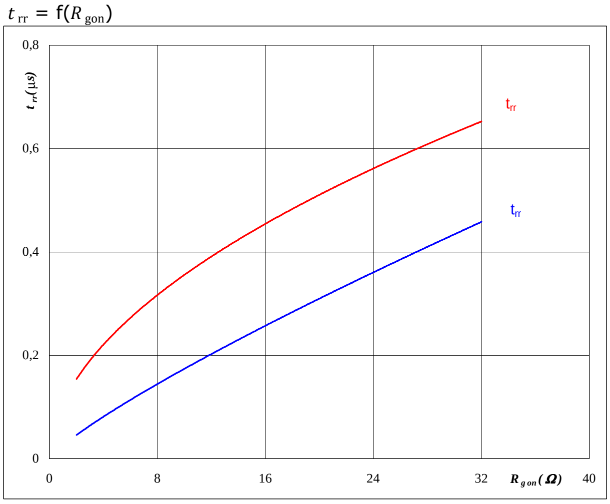

**At**

| | | |
|---|---|---|
| $T_j$ = | 25/150 | °C |
| $V_{CE}$ = | 600 | V |
| $V_{GE}$ = | ±15 | V |
| $R_{gon}$ = | 8 | Ω |

**Figure 12** FWD

**Typical reverse recovery time as a function of IGBT turn on gate resistor**

$t_{rr} = f(R_{gon})$




**At**

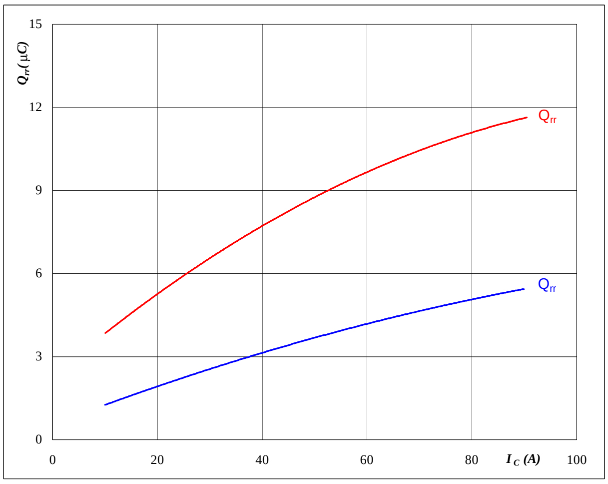
| | | |
|---|---|---|
| $T_j$ = | 25/150 | °C |
| $V_R$ = | 600 | V |
| $I_F$ = | 50 | A |
| $V_{GE}$ = | ±15 | V |

# Inverter / Brake Characteristics

**Figure 13** FWD

**Typical reverse recovery charge as a function of collector current**

$Q_{rr} = f(I_C)$



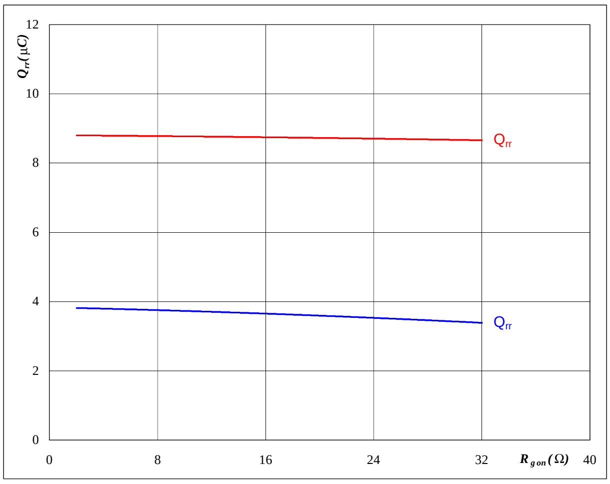

**At**

| | | |
|---|---|---|
| $T_j$ = | 25/150 | °C |
| $V_{CE}$ = | 600 | V |
| $V_{GE}$ = | ±15 | V |
| $R_{gon}$ = | 8 | Ω |

**Figure 14** FWD

**Typical reverse recovery charge as a function of IGBT turn on gate resistor**

$Q_{rr} = f(R_{gon})$



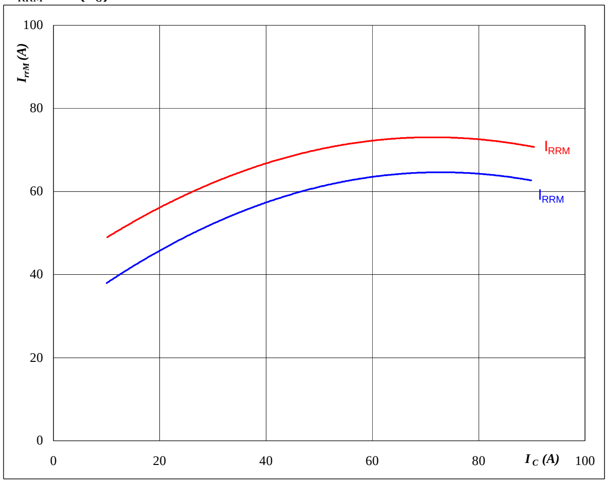

**At**

| | | |
|---|---|---|
| $T_j$ = | 25/150 | °C |
| $V_R$ = | 600 | V |
| $I_F$ = | 50 | A |
| $V_{GE}$ = | ±15 | V |

**Figure 15** FWD

**Typical reverse recovery current as a function of collector current**

$I_{RRM} = f(I_C)$



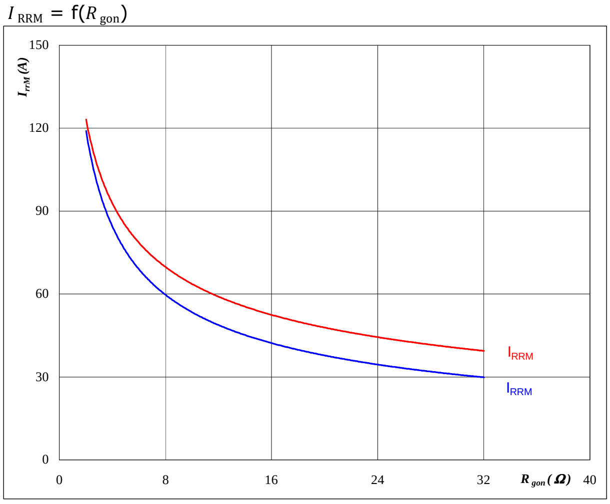

**At**

| | | |
|---|---|---|
| $T_j$ = | 25/150 | °C |
| $V_{CE}$ = | 600 | V |
| $V_{GE}$ = | ±15 | V |
| $R_{gon}$ = | 8 | Ω |

**Figure 16** FWD

**Typical reverse recovery current as a function of IGBT turn on gate resistor**

$I_{RRM} = f(R_{gon})$




**At**

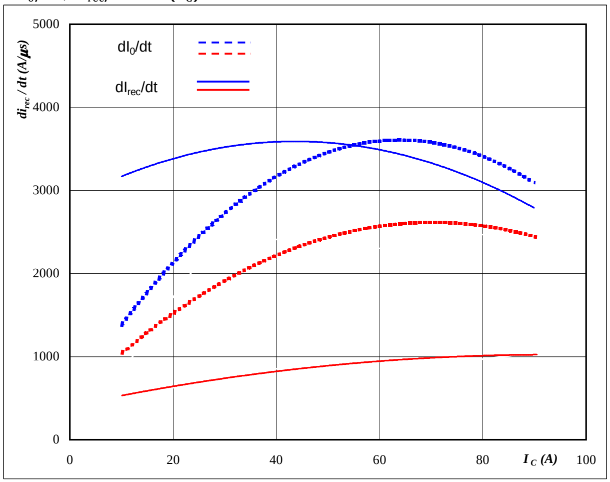
| | | |
|---|---|---|
| $T_j$ = | 25/150 | °C |
| $V_R$ = | 600 | V |
| $I_F$ = | 50 | A |
| $V_{GE}$ = | ±15 | V |

# Inverter / Brake Characteristics

**Figure 17** FWD

**Typical rate of fall of forward and reverse recovery current as a function of collector current**

$dI_0/dt, dI_{rec}/dt = f(I_C)$



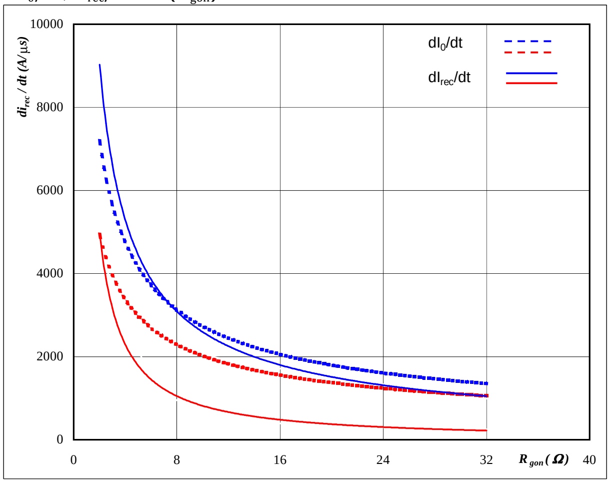

**At**

| | | |
|---|---|---|
| $T_j$ = | 25/150 | °C |
| $V_{CE}$ = | 600 | V |
| $V_{GE}$ = | ±15 | V |
| $R_{gon}$ = | 8 | Ω |

**Figure 18** FWD

**Typical rate of fall of forward and reverse recovery current as a function of IGBT turn on gate resistor**

$dI_0/dt, dI_{rec}/dt = f(R_{gon})$



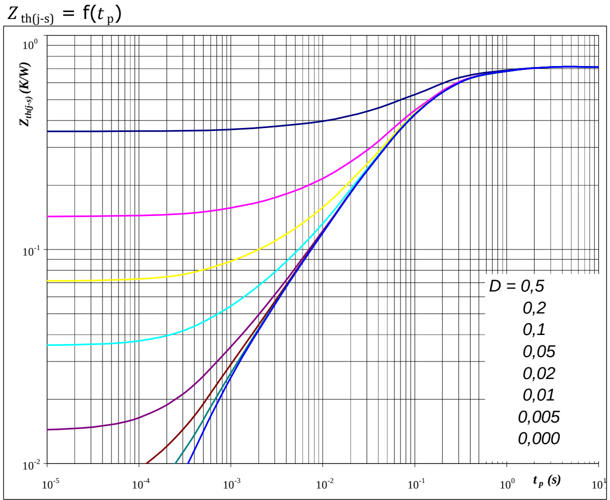

**At**

| | | |
|---|---|---|
| $T_j$ = | 25/150 | °C |
| $V_R$ = | 600 | V |
| $I_F$ = | 50 | A |
| $V_{GE}$ = | ±15 | V |

**Figure 19** IGBT

**IGBT transient thermal impedance as a function of pulse width**

$Z_{th(j-s)} = f(t_p)$




**At**

| | | |
|---|---|---|
| $D$ = | $t_p / T$ | |
| $R_{th(j-s)}$ = | 0,71 | K/W |

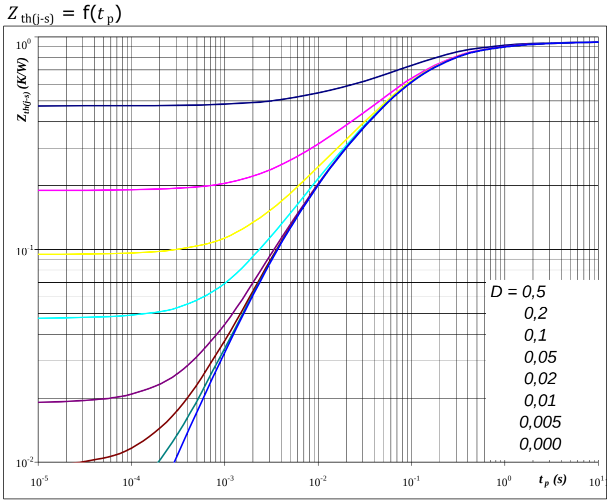
IGBT thermal model values

| R (K/W) | Tau (s) |
|---|---|
| 1,15E-01 | 7,72E-01 |
| 3,57E-01 | 1,30E-01 |
| 1,63E-01 | 4,60E-02 |
| 5,73E-02 | 8,22E-03 |
| 2,00E-02 | 1,05E-03 |

**Figure 20** FWD

**FWD transient thermal impedance as a function of pulse width**

$Z_{th(j-s)} = f(t_p)$




**At**

| | | |
|---|---|---|
| $D$ = | $t_p / T$ | |
| $R_{th(j-s)}$ = | 0,95 | K/W |

FWD thermal model values

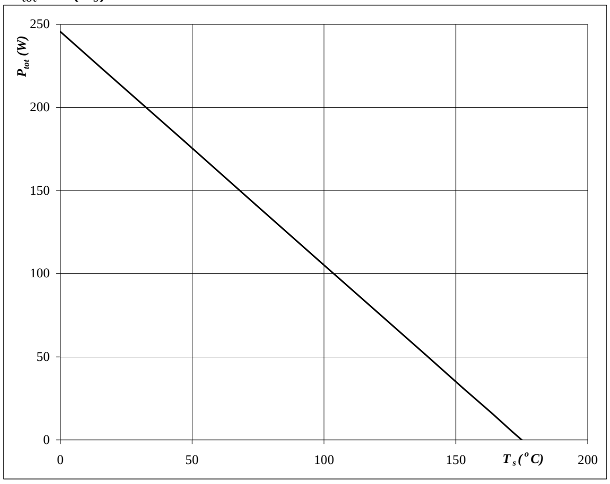
| R (K/W) | Tau (s) |
|---|---|
| 5,80E-02 | 2,46E+00 |
| 2,06E-01 | 3,47E-01 |
| 4,45E-01 | 7,81E-02 |
| 1,71E-01 | 1,66E-02 |
| 6,85E-02 | 3,63E-03 |

# Inverter / Brake Characteristics

**Figure 21** IGBT

**Power dissipation as a function of heatsink temperature**

$P_{tot} = f(T_s)$



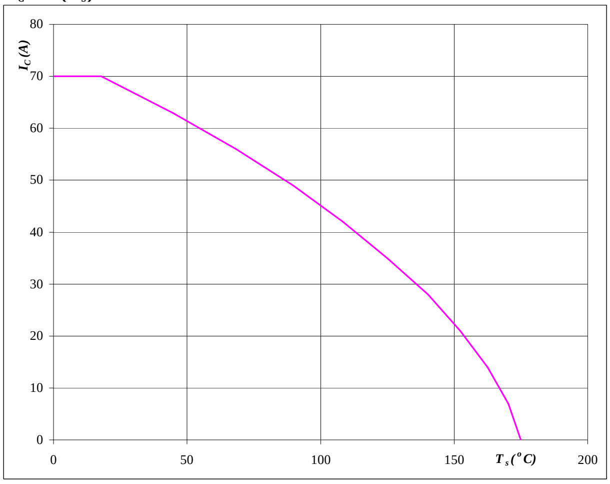

At

$T_j$ = 175 °C

**Figure 22** IGBT

**Collector current as a function of heatsink temperature**

$I_C = f(T_s)$




At

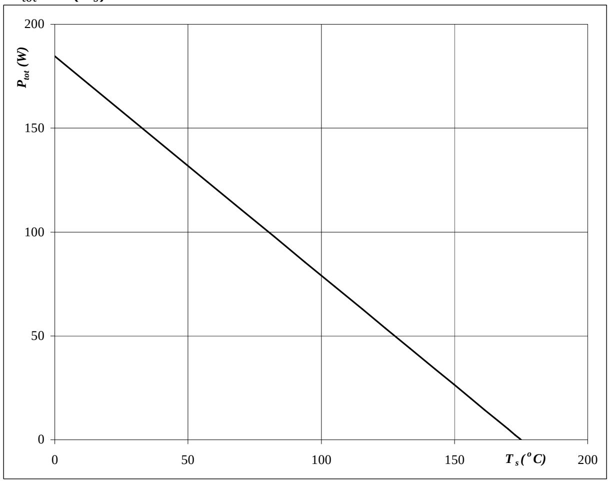
$T_j$ = 175 °C

$V_{GE}$ = 15 V

**Figure 23** FWD

**Power dissipation as a function of heatsink temperature**

$P_{tot} = f(T_s)$



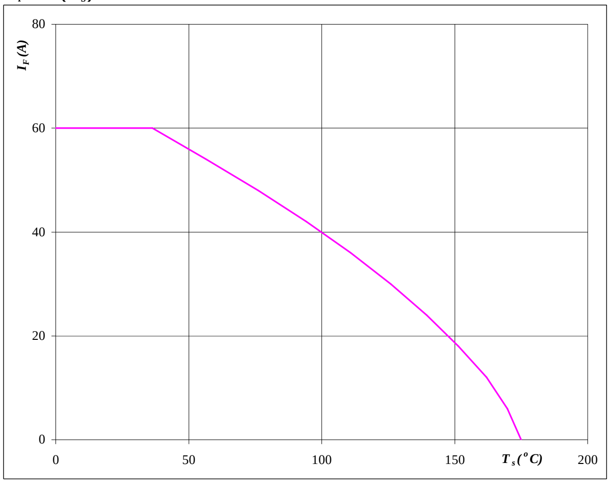

At

$T_j$ = 175 °C

**Figure 24** FWD

**Forward current as a function of heatsink temperature**

$I_F = f(T_s)$




At

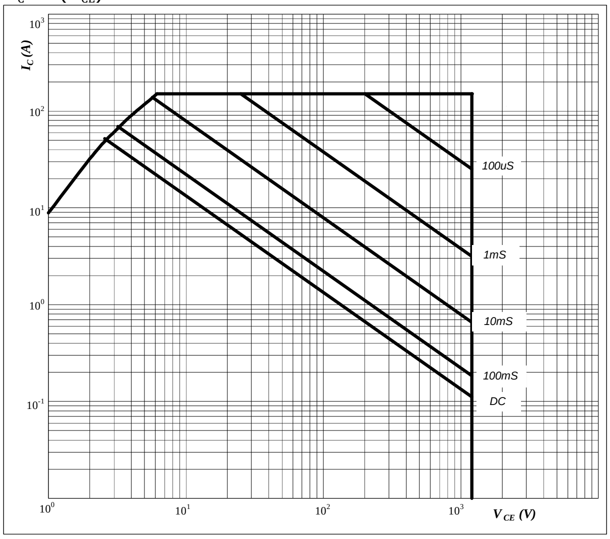
$T_j$ = 175 °C

# Inverter / Brake Characteristics

**Figure 25** IGBT

**Safe operating area as a function of collector-emitter voltage**

$I_C = f(V_{CE})$



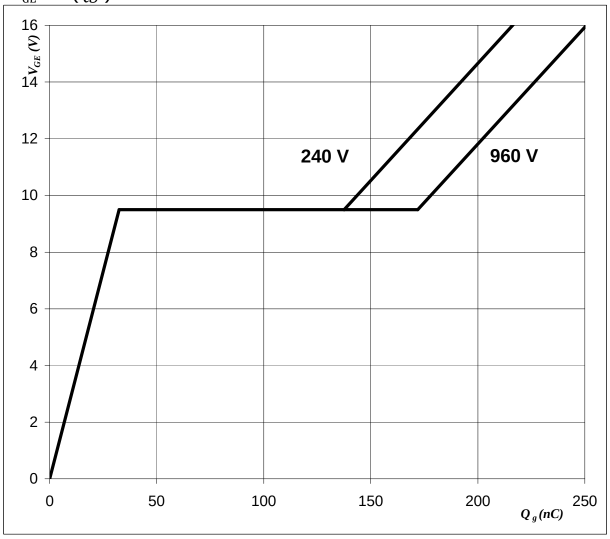

**At**

| | | |
|---|---|---|
| $D$ = | single pulse | |
| $T_s$ = | 80 | ºC |
| $V_{GE}$ = | ±15 | V |
| $T_j$ = | $T_{jmax}$ | |

**Figure 26** IGBT

**Gate voltage vs Gate charge**

$V_{GE} = f(Qg)$




**At**

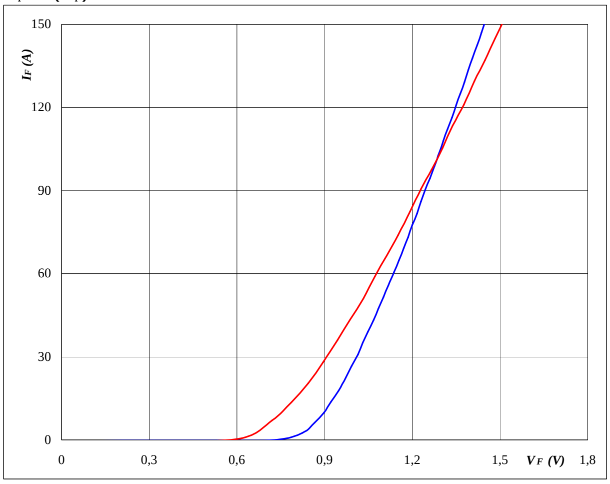
| | | |
|---|---|---|
| $I_C$ = | 50 | A |

# Rectifier Diode

**Figure 1** Diode

**Typical diode forward current as a function of forward voltage**

$I_F = f(V_F)$




**At**

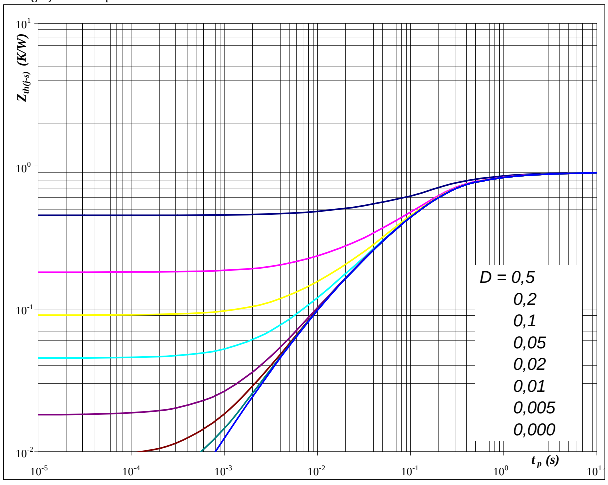
$T_j$ = 25/125 °C

$t_p$ = 250 µs

**Figure 2** Diode

**Diode transient thermal impedance as a function of pulse width**

$Z_{th(j-s)} = f(t_p)$




**At**

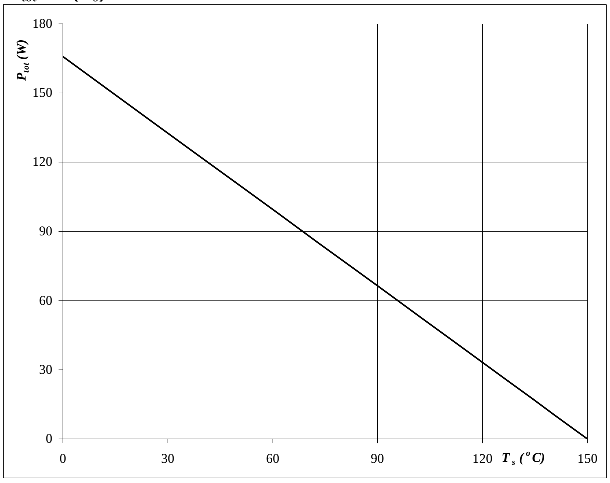
$D = t_p / T$

$R_{th(j-s)}$ = 0,9 K/W

**Figure 3** Diode

**Power dissipation as a function of heatsink temperature**

$P_{tot} = f(T_s)$



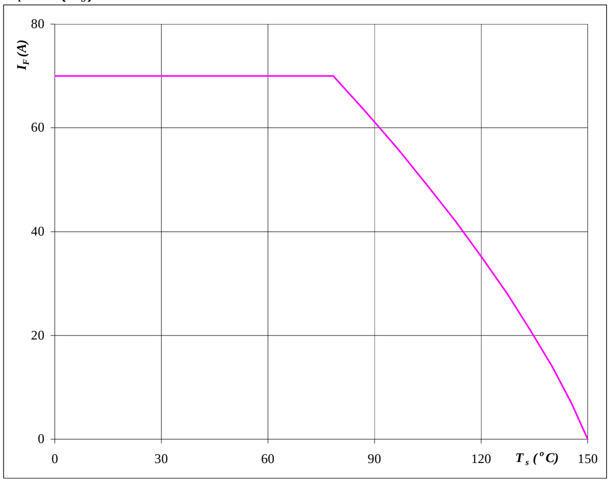

**At**

$T_j$ = 150 ºC

**Figure 4** Diode

**Forward current as a function of heatsink temperature**

$I_F = f(T_s)$



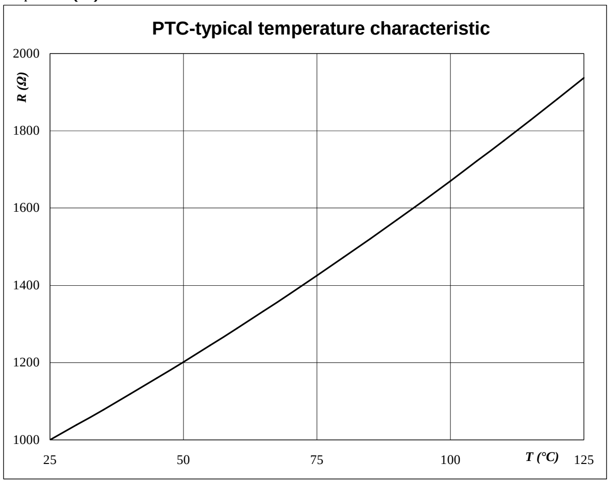

**At**

$T_j$ = 150 ºC

# Thermistor

| **Figure 1** | Thermistor |
|---|---|

**Typical PTC characteristic**
**as a function of temperature**
$R_T = f(T)$



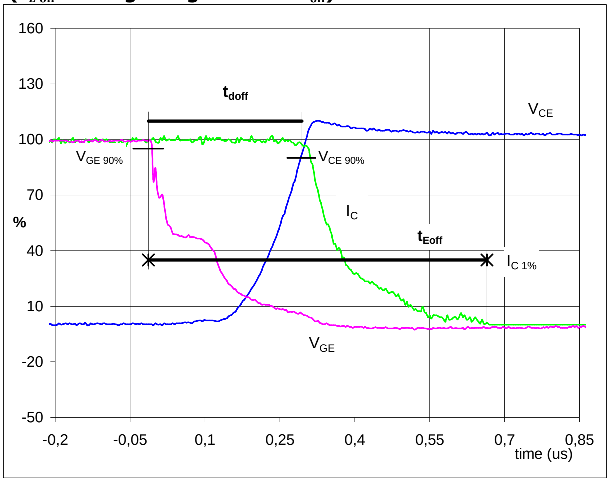
# Switching Definitions Inverter

**General conditions**

| | | |
|---|---|---|
| $T_j$ | = | 150 °C |
| $R_{gon}$ | = | 8 Ω |
| $R_{goff}$ | = | 8 Ω |

**Figure 1** IGBT

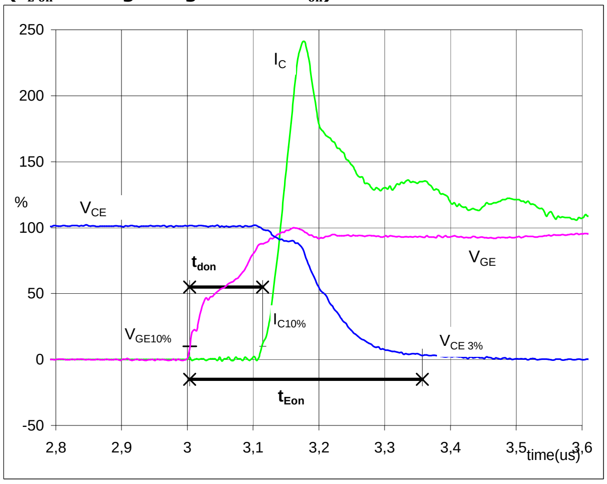
**Turn-off Switching Waveforms & definition of $t_{doff}$, $t_{Eoff}$**
**($t_{E off}$ = integrating time for $E_{off}$)**




| | | |
|---|---|---|
| $V_{GE}$ (0%) = | -15 | V |
| $V_{GE}$ (100%) = | 15 | V |
| $V_C$ (100%) = | 600 | V |
| $I_C$ (100%) = | 50 | A |
| $t_{doff}$ = | 0,30 | μs |
| $t_{E off}$ = | 0,68 | μs |

**Figure 2** IGBT

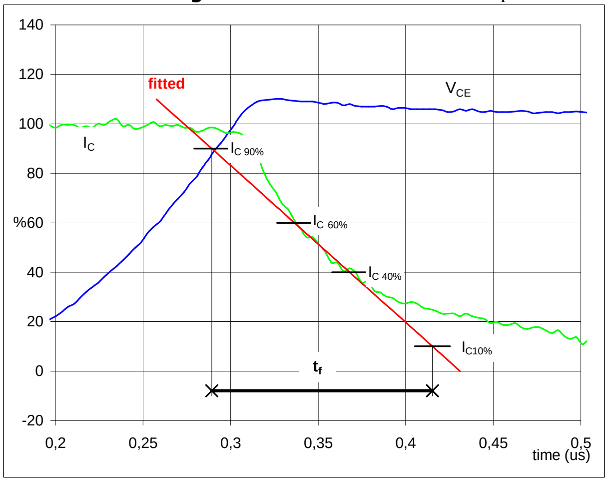
**Turn-on Switching Waveforms & definition of $t_{don}$, $t_{Eon}$**
**($t_{E on}$ = integrating time for $E_{on}$)**




| | | |
|---|---|---|
| $V_{GE}$ (0%) = | -15 | V |
| $V_{GE}$ (100%) = | 15 | V |
| $V_C$ (100%) = | 600 | V |
| $I_C$ (100%) = | 50 | A |
| $t_{don}$ = | 0,11 | μs |
| $t_{E on}$ = | 0,35 | μs |

**Figure 3** IGBT

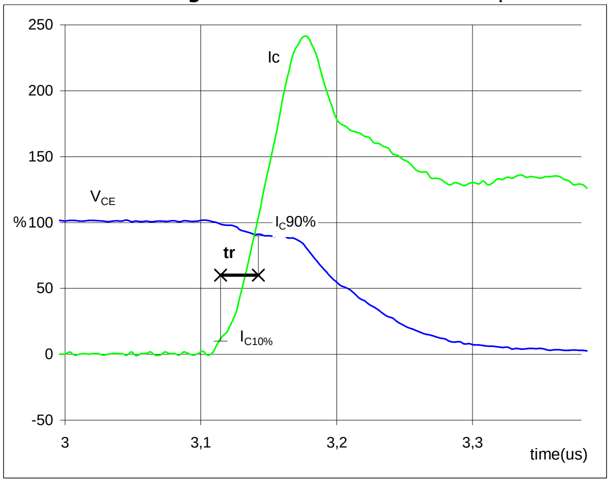
**Turn-off Switching Waveforms & definition of $t_f$**




| | | |
|---|---|---|
| $V_C$ (100%) = | 600 | V |
| $I_C$ (100%) = | 50 | A |
| $t_f$ = | 0,13 | μs |

**Figure 4** IGBT

**Turn-on Switching Waveforms & definition of $t_r$**

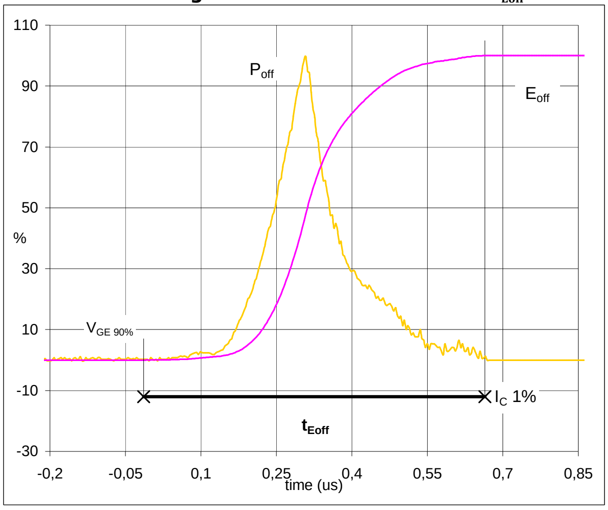



| | | |
|---|---|---|
| $V_C$ (100%) = | 600 | V |
| $I_C$ (100%) = | 50 | A |
| $t_r$ = | 0,03 | μs |

# Switching Definitions Inverter

**Figure 5** IGBT

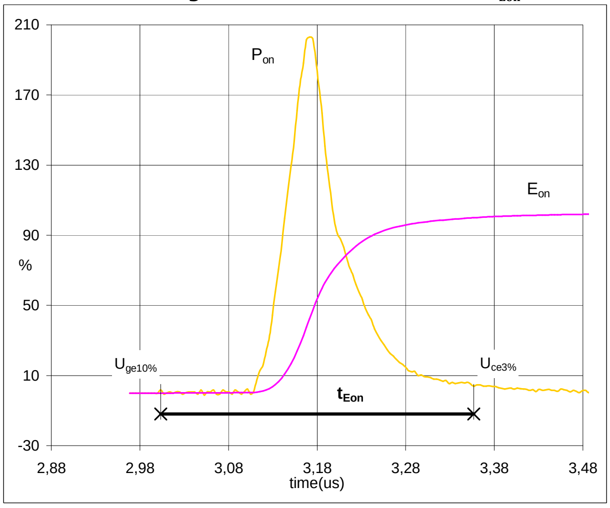
**Turn-off Switching Waveforms & definition of $t_{Eoff}$**




| | | |
|---|---|---|
| $P_{off}$ (100%) = | 29,95 | kW |
| $E_{off}$ (100%) = | 4,58 | mJ |
| $t_{E\,off}$ = | 0,68 | µs |

**Figure 6** IGBT

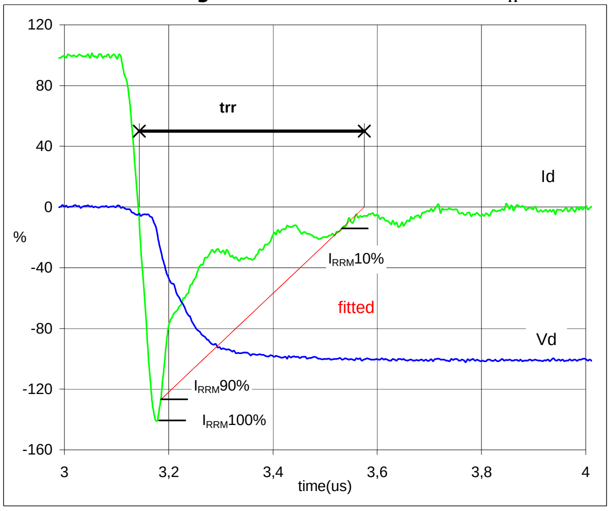
**Turn-on Switching Waveforms & definition of $t_{Eon}$**




| | | |
|---|---|---|
| $P_{on}$ (100%) = | 29,95 | kW |
| $E_{on}$ (100%) = | 4,46 | mJ |
| $t_{E\,on}$ = | 0,35 | µs |

**Figure 78** FWD

**Turn-off Switching Waveforms & definition of $t_{rr}$**

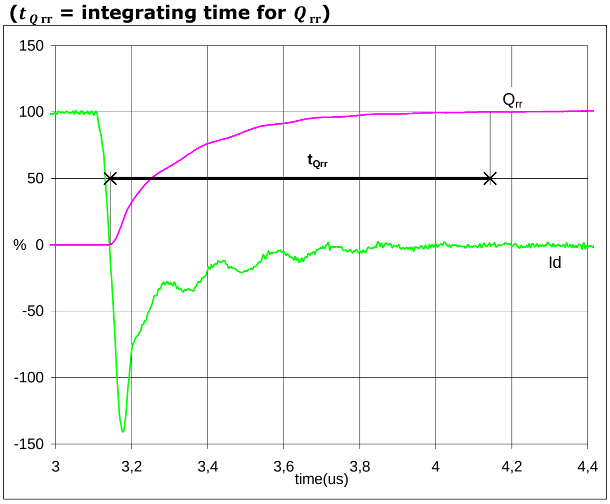



| | | |
|---|---|---|
| $V_d$ (100%) = | 600 | V |
| $I_d$ (100%) = | 50 | A |
| $I_{RRM}$ (100%) = | -71 | A |
| $t_{rr}$ = | 0,31 | µs |

# Switching Definitions Output Inverter

**Figure 8** FWD

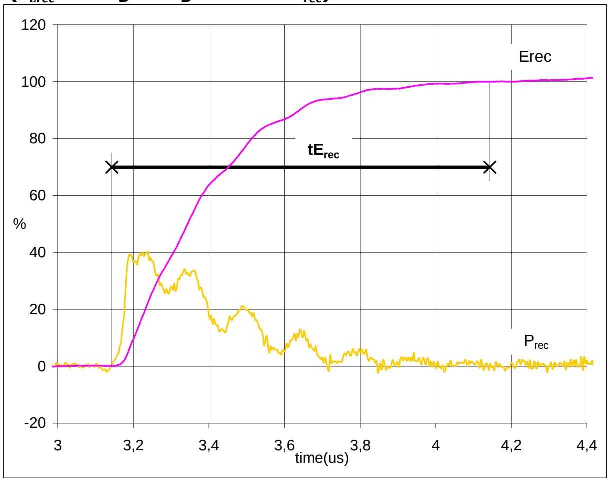
**Turn-on Switching Waveforms & definition of $t_{Qrr}$**
**($t_{Q rr}$ = integrating time for $Q_{rr}$)**




| | | |
|---|---|---|
| $I_d$ (100%) = | 50 | A |
| $Q_{rr}$ (100%) = | 8,80 | µC |
| $t_{Q rr}$ = | 1,00 | µs |

**Figure 9** FWD

**Turn-on Switching Waveforms & definition of $t_{Erec}$**
**($t_{Erec}$= integrating time for $E_{rec}$)**




| | | |
|---|---|---|
| $P_{rec}$ (100%) = | 29,95 | kW |
| $E_{rec}$ (100%) = | 3,48 | mJ |
| $t_{E rec}$ = | 1,00 | µs |

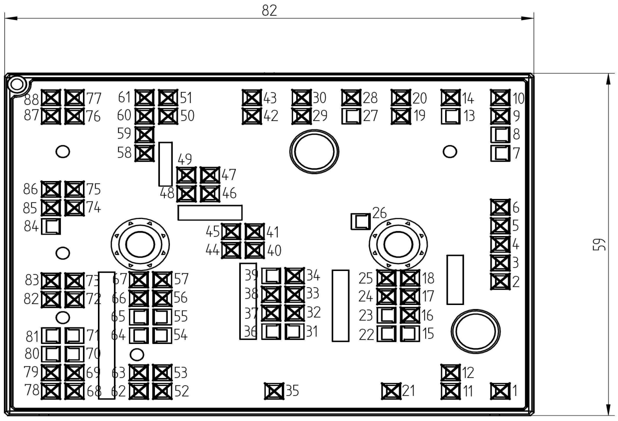
# Ordering Code and Marking - Outline - Pinout

## Ordering Code & Marking

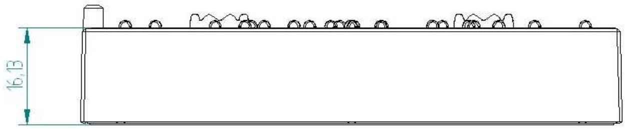
| Version | Ordering Code |
|---|---|
| with std lid (black V23990-K32-T-PM) | V23990-K428-A40-/0A/-PM |
| with std lid (black V23990-K32-T-PM) and P12 | V23990-K428-A40-/1A/-PM |
| with thin lid (white V23990-K33-T-PM) | V23990-K428-A40-/0B/-PM |
| with thin lid (white V23990-K33-T-PM) and P12 | V23990-K428-A40-/1B/-PM |


| | | | | | | |
|---|---|---|---|---|---|---|
| Text | VIN | Date code | Name&Ver | UL | Lot | Serial |
| | VIN | WWYY | NNNNNNNVV | UL | LLLLL | SSSS |
| Datamatrix | Type&Ver | Lot number | Serial | Date code | | |
| | TTTTTTTVV | LLLLL | SSSS | WWYY | | |

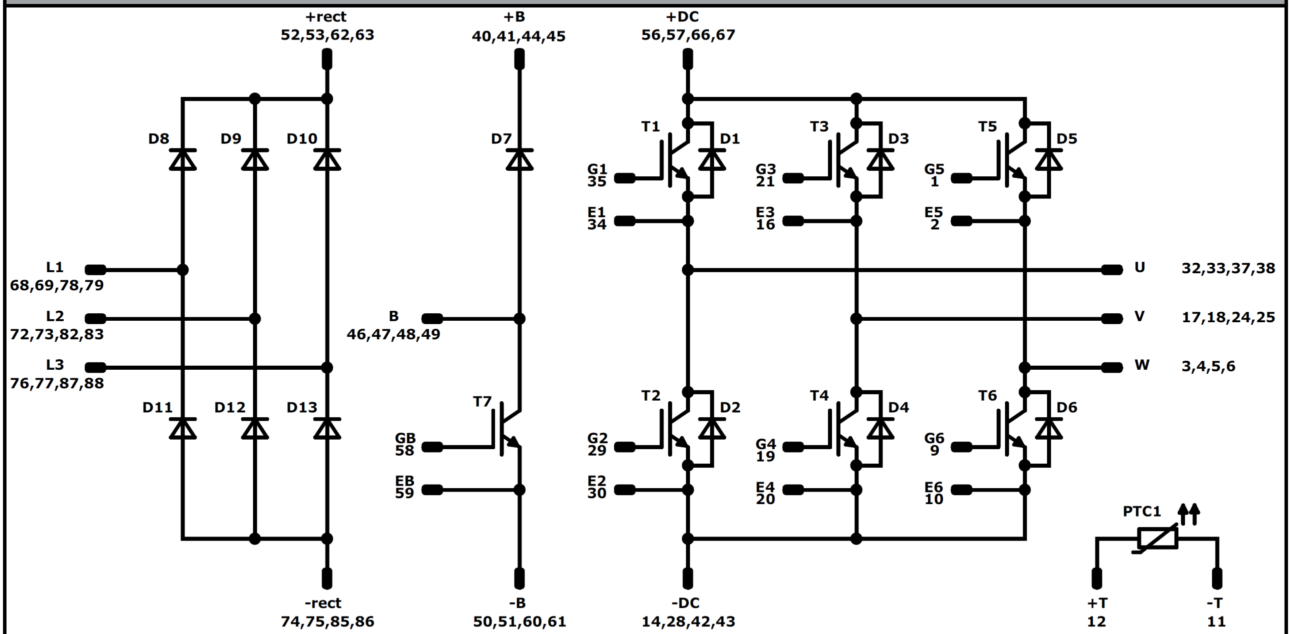
## Outline




X = assembled pin position




## Pinout




## Identification

| ID | Component | Voltage | Current | Function | Comment |
|---|---|---|---|---|---|
| T1,T2,T3,T4,T5,T6 | IGBT | 1200 V | 50 A | Inverter Switch | |
| D1,D2,D3,D4,D5,D6 | FWD | 1200 V | 50 A | Inverter Diode | |
| T7 | IGBT | 1200 V | 50 A | Brake Switch | |
| D7 | FWD | 1200 V | 50 A | Brake Diode | |
| D8,D9,D10,D11,D12,D13 | Rectifier | 1600 V | 50 A | Rectifier Diode | |
| PTC1 | PTC | | | Thermistor | |

| Packaging instruction | | | | | |
|---|---|---|---|---|---|
| Standard packaging quantity (SPQ) | **120** | >SPQ | Standard | <SPQ | Sample |

| Handling instruction |
|---|
| Handling instructions for MiniSkiiP® 1 packages see vincotech.com website. |

| Package data |
|---|
| Package data for MiniSkiiP® 1 packages see vincotech.com website. |

| UL recognition and file number |
|---|
| This device is certified according to UL 1557 standard, UL file number E192116. For more information see vincotech.com website. |

| Document No.: | Date: | Modification: | Pages |
|---|---|---|---|
| V23990-K428-A40-D7-14 | 29 Jun. 2016 | | |