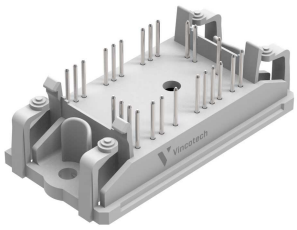
Vincotech

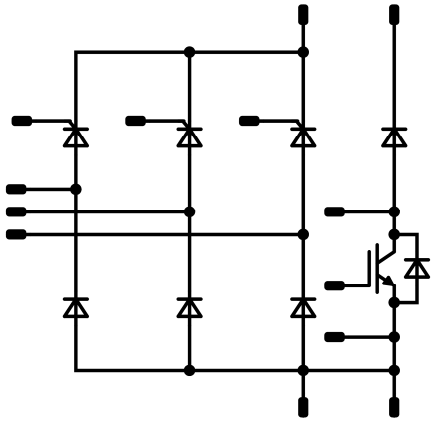
# V23990-P640-G10-PM
datasheet

**flowCON 0** — **1600 V / 75 A**

### Features
- Three-phase half-controlled rectifier
- Brake chopper

### flow 0 17 mm housing


### Target applications
- Industrial Drives
- Embedded Drives
- UPS

### Schematic


### Types
- V23990-P640-G10-PM

## Maximum Ratings

$T_j$ = 25 °C, unless otherwise specified

| Parameter | Symbol | Condition | Value | Unit |
|---|---|---|---|---|
| **Rectifier Diode** | | | | |
| Peak repetitive reverse voltage | $V_{RRM}$ | | 1600 | V |
| Continuous (direct) forward current | $I_F$ | $T_j = T_{jmax}$ $T_s$ = 80 °C | 78 | A |
| Surge (non-repetitive) forward current | $I_{FSM}$ | 50 Hz Single Half Sine Wave $t_p$ = 10 ms $T_j$ = 150 °C | 740 | A |
| Surge current capability | $I^2t$ | | 2740 | $A^2s$ |
| Total power dissipation | $P_{tot}$ | $T_j = T_{jmax}$ $T_s$ = 80 °C | 88 | W |
| Maximum junction temperature | $T_{jmax}$ | | 150 | °C |

# Maximum Ratings

$T_j$ = 25 °C, unless otherwise specified

| Parameter | Symbol | Condition | Value | Unit |
|---|---|---|---|---|
| **Rectifier Thyristor** | | | | |
| Repetitive peak reverse voltage | $V_{RRM}$ | | 1600 | V |
| Forward average current | $I_{FAV}$ | sine, d = 0,5<br>$T_j = T_{jmax}$ $T_s$ = 80 °C | 53 | A |
| Surge forward current | $I_{FSM}$ | $t_p$ = 10 ms $T_j$ = 130 °C | 450 | A |
| $I^2t$ value | $I^2t$ | | 1010 | $A^2s$ |
| Mean total power loss | $P_{tot(AV)}$ | $T_j = T_{jmax}$ $T_s$ = 80 °C | 67 | W |
| Maximum Junction Temperature | $T_{jmax}$ | | 130 | °C |
| **Brake Switch** | | | | |
| Collector-emitter voltage | $V_{CES}$ | | 1200 | V |
| Collector current | $I_C$ | | 35 | A |
| Repetitive peak collector current | $I_{CRM}$ | $t_p$ limited by $T_{jmax}$ | 70 | A |
| Total power dissipation | $P_{tot}$ | $T_j = T_{jmax}$ $T_s$ = 80 °C | 72 | W |
| Gate-emitter voltage | $V_{GES}$ | | ±20 | V |
| Maximum junction temperature | $T_{jmax}$ | | 150 | °C |
| **Brake Diode** | | | | |
| Peak repetitive reverse voltage | $V_{RRM}$ | | 1200 | V |
| Continuous (direct) forward current | $I_F$ | $T_j = T_{jmax}$ $T_s$ = 80 °C | 23 | A |
| Repetitive peak forward current | $I_{FRM}$ | | 50 | A |
| Total power dissipation | $P_{tot}$ | $T_j = T_{jmax}$ $T_s$ = 80 °C | 41 | W |
| Maximum junction temperature | $T_{jmax}$ | | 150 | °C |
| **Brake Sw. Protection Diode** | | | | |
| Peak repetitive reverse voltage | $V_{RRM}$ | | 1200 | V |
| Continuous (direct) forward current | $I_F$ | | 3 | A |
| Repetitive peak forward current | $I_{FRM}$ | | 6 | A |
| Total power dissipation | $P_{tot}$ | $T_j = T_{jmax}$ $T_s$ = 80 °C | 19 | W |
| Maximum junction temperature | $T_{jmax}$ | | 150 | °C |

# Maximum Ratings

$T_j$ = 25 °C, unless otherwise specified

| Parameter | Symbol | Condition | Value | Unit |
|---|---|---|---|---|
| **Module Properties** | | | | |
| **Thermal Properties** | | | | |
| Storage temperature | $T_{stg}$ | | -40…+125 | °C |
| Operation temperature under switching condition | $T_{jop}$ | | -40…($T_{jmax}$ - 25) | °C |
| **Isolation Properties** | | | | |
| Isolation voltage | $V_{isol}$ | DC Test Voltage* $t_p$ = 2 s | 6000 | V |
| | | AC Voltage $t_p$ = 1 min | 2500 | V |
| Creepage distance | | | min. 12,7 | mm |
| Clearance | | | min. 12,7 | mm |
| Comparative Tracking Index | CTI | | > 200 | |

*100 % tested in production

# Characteristic Values

| Parameter | Symbol | Conditions | | | | | Value | | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | $V_{GE}$ [V]<br>$V_{GS}$ [V] | $V_{CE}$ [V]<br>$V_{DS}$ [V]<br>$V_F$ [V] | $I_C$ [A]<br>$I_D$ [A]<br>$I_F$ [A] | $T_j$ [°C] | Min | Typ | Max | |
| **Rectifier Diode** | | | | | | | | | | |
| **Static** | | | | | | | | | | |
| Forward voltage | $V_F$ | | | | 80 | 25<br>125 | | 1,18<br>1,15 | 1,23 | V |
| Reverse leakage current | $I_R$ | | | 1600 | | 25<br>150 | | | 50<br>1500 | µA |
| **Thermal** | | | | | | | | | | |
| Thermal resistance junction to sink | $R_{th(j-s)}$ | $\lambda_{paste}$ = 3,4 W/mK (PSX) | | | | | | 0,79 | | K/W |
| **Rectifier Thyristor** | | | | | | | | | | |
| **Static** | | | | | | | | | | |
| Forward voltage | $V_F$ | | | | 45 | 25<br>125 | | 1,41<br>1,45 | | V |
| On-state threshold voltage | $V_{T(TO)}$ | | | | 45 | 130 | | | 0,85 | V |
| On-state slope resistance | $r_T$ | | | | 45 | 130 | | | 7,9 | mΩ |
| Critical rate of rise of off-state voltage | $(dv/dt)_{cr}$ | | | | | 130 | | | 50 | V/µs |
| Critical rate of rise of on-state current | $(di_T/dt)_{cr}$ | | | | | 130 | | | 1000 | A/µs |
| Circuit commutated turn-off time | $t_q$ | | | | | 130 | | 150 | | µs |
| Holding current | $I_H$ | | | | | 25 | | | 165 | mA |
| Latching current | $I_L$ | | | | | 25 | | | 330 | mA |
| Gate trigger voltage | $V_{GT}$ | | | | | 25 | | | 1,98 | V |
| Gate trigger current | $I_{GT}$ | | | | | 25 | | | 100 | mA |
| Gate non-trigger voltage | $V_{GD}$ | | | | | 130 | 0,25 | | | V |
| Gate non-trigger current | $I_{GD}$ | | | | | 115 | 6 | | | mA |
| **Thermal** | | | | | | | | | | |
| Thermal resistance junction to sink | $R_{th(j-s)}$ | $\lambda_{paste}$ = 3,4 W/mK (PSX) | | | | | | 0,75 | | K/W |

# Characteristic Values

| Parameter | Symbol | Conditions | | | | | Value | | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | $V_{GE}$ [V]<br>$V_{GS}$ [V] | $V_{CE}$ [V]<br>$V_{DS}$ [V]<br>$V_F$ [V] | $I_C$ [A]<br>$I_D$ [A]<br>$I_F$ [A] | $T_j$ [°C] | Min | Typ | Max | |
| **Brake Switch** | | | | | | | | | | |
| **Static** | | | | | | | | | | |
| Gate-emitter threshold voltage | $V_{GE(th)}$ | $V_{GE} = V_{CE}$ | | | 0,0015 | 25 | 5 | 5,8 | 6,5 | V |
| Collector-emitter saturation voltage | $V_{CEsat}$ | | 15 | | 35 | 25<br>125 | 1,35 | 1,74<br>1,98 | 2,05 | V |
| Collector-emitter cut-off current | $I_{CES}$ | | 0 | 1200 | | 25 | | | 250 | µA |
| Gate-emitter leakage current | $I_{GES}$ | | 30 | 0 | | 25 | | | 600 | nA |
| Internal gate resistance | $r_g$ | | | | | | | 6 | | Ω |
| Input capacitance | $C_{ies}$ | $f$= 1 Mhz | 0 | 25 | | 25 | | 2530 | | pF |
| Output capacitance | $C_{oes}$ | | | | | | | 132 | | |
| Reverse transfer capacitance | $C_{res}$ | | | | | | | 115 | | |
| **Thermal** | | | | | | | | | | |
| Thermal resistance junction to sink | $R_{th(j-s)}$ | $\lambda_{paste}$ = 3,4 W/mK (PSX) | | | | | | 0,97 | | K/W |
| **Dynamic** | | | | | | | | | | |
| Turn-on delay time | $t_{d(on)}$ | $R_{gon}$ = 32 Ω<br>$R_{goff}$ = 16 Ω | 0 / 15 | 700 | 35 | 25<br>125 | | 87<br>84 | | ns |
| Rise time | $t_r$ | | | | | 25<br>125 | | 20<br>22 | | |
| Turn-off delay time | $t_{d(off)}$ | | | | | 25<br>125 | | 521<br>615 | | |
| Fall time | $t_f$ | | | | | 25<br>125 | | 50<br>142 | | |
| Turn-on energy (per pulse) | $E_{on}$ | $Q_{rFWD}$ = 2,8 µC<br>$Q_{rFWD}$ = 5 µC | | | | 25<br>125 | | 3,49<br>4,47 | | mWs |
| Turn-off energy (per pulse) | $E_{off}$ | | | | | 25<br>125 | | 2,68<br>4,32 | | |

# Characteristic Values

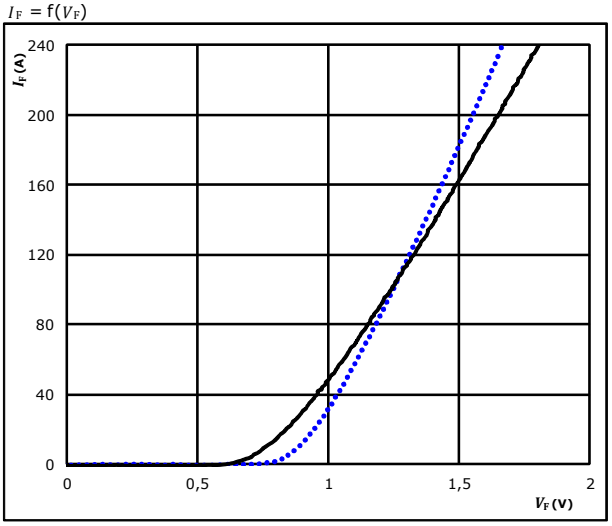
| Parameter | Symbol | Conditions | | | | | Value | | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | $V_{GE}$ [V]<br>$V_{GS}$ [V] | $V_{CE}$ [V]<br>$V_{DS}$ [V]<br>$V_F$ [V] | $I_C$ [A]<br>$I_D$ [A]<br>$I_F$ [A] | $T_j$ [°C] | Min | Typ | Max | |
| **Brake Diode** | | | | | | | | | | |
| **Static** | | | | | | | | | | |
| Forward voltage | $V_F$ | | | | 25 | 25<br>125 | | 1,79<br>1,80 | | V |
| Reverse leakage current | $I_R$ | | | 1200 | | 25 | | | 27 | µA |
| **Thermal** | | | | | | | | | | |
| Thermal resistance junction to sink | $R_{th(j-s)}$ | $\lambda_{paste}$ = 3,4 W/mK (PSX) | | | | | | 1,72 | | K/W |
| **Dynamic** | | | | | | | | | | |
| Peak recovery current | $I_{RRM}$ | $di/dt$ = 2239 A/µs<br>$di/dt$ = 2068 A/µs | 0 / 15 | 700 | 35 | 25<br>125 | | 37<br>45 | | A |
| Reverse recovery time | $t_{rr}$ | | | | | 25<br>125 | | 301<br>420 | | ns |
| Recovered charge | $Q_r$ | | | | | 25<br>125 | | 2,75<br>5,03 | | µC |
| Reverse recovered energy | $E_{rec}$ | | | | | 25<br>125 | | 1,04<br>2,06 | | mWs |
| Peak rate of fall of recovery current | $(di_{rf}/dt)_{max}$ | | | | | 25<br>125 | | 2619<br>1765 | | A/µs |
| **Brake Sw. Protection Diode** | | | | | | | | | | |
| **Static** | | | | | | | | | | |
| Forward voltage | $V_F$ | | | | 3 | 25<br>125 | | 1,66<br>1,59 | | V |
| Reverse leakage current | $I_R$ | | | 1200 | | 25 | | | 250 | µA |
| **Thermal** | | | | | | | | | | |
| Thermal resistance junction to sink | $R_{th(j-s)}$ | $\lambda_{paste}$ = 3,4 W/mK (PSX) | | | | | | 3,72 | | K/W |

# Rectifier Diode Characteristics

**figure 1.** **Rectifier Diode**

**Typical forward characteristics**

$I_F = f(V_F)$




$t_p$ = 250 µs

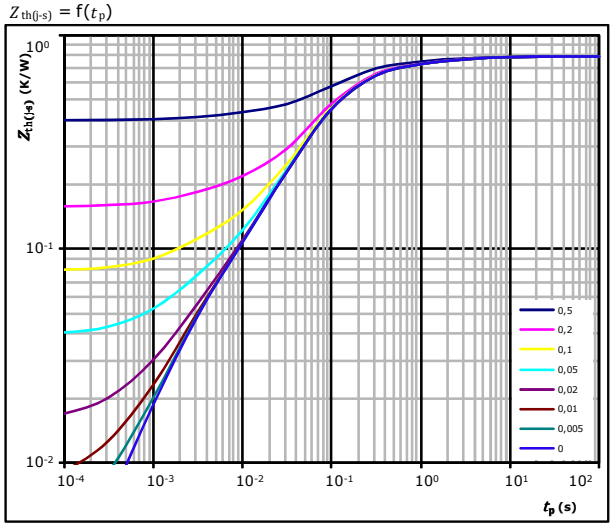
$T_j$: 25 °C

125 °C

**figure 2.** **Rectifier Diode**

**Transient thermal impedance as a function of pulse width**

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




$D$ = $t_p / T$

$R_{th(j-s)}$ = 0,79 K/W

Diode thermal model values

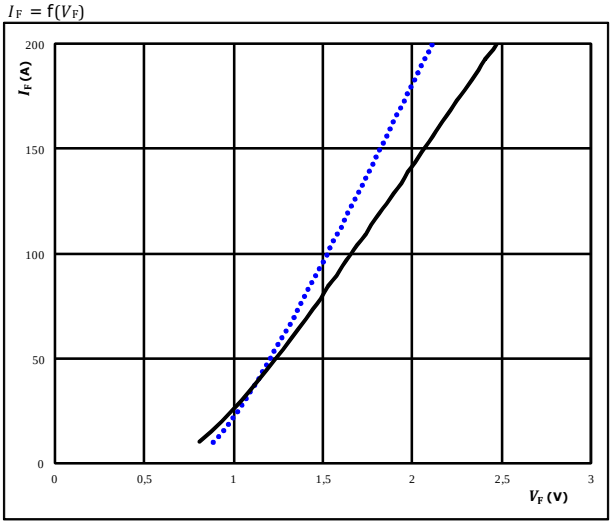
| $R$ (K/W) | $\tau$ (s) |
|---|---|
| 3,05E-02 | 5,20E+00 |
| 8,93E-02 | 9,97E-01 |
| 2,82E-01 | 1,58E-01 |
| 3,51E-01 | 5,43E-02 |
| 3,93E-02 | 2,64E-03 |

# Rectifier Thyristor Characteristics

**figure 1.** **Thyristor**

**Typical forward characteristics**

$I_F = f(V_F)$




$t_p$ = 250 µs

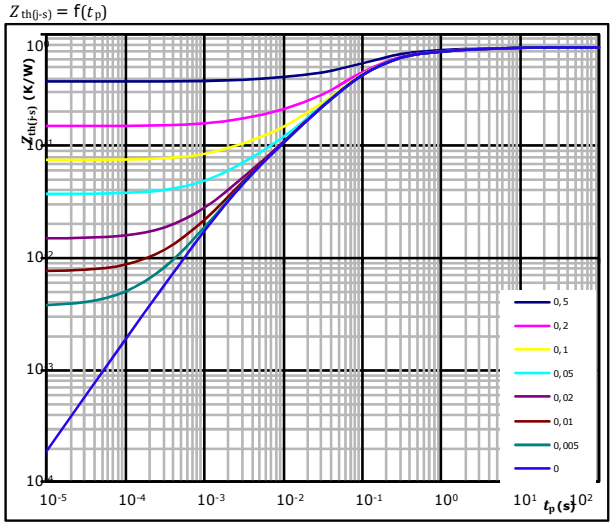
$T_j$: 25 °C

125 °C

**figure 2.** **Thyristor**

**Transient thermal impedance as a function of pulse width**

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




$D$ = $t_p / T$

$R_{th(j-s)}$ = 0,75 K/W

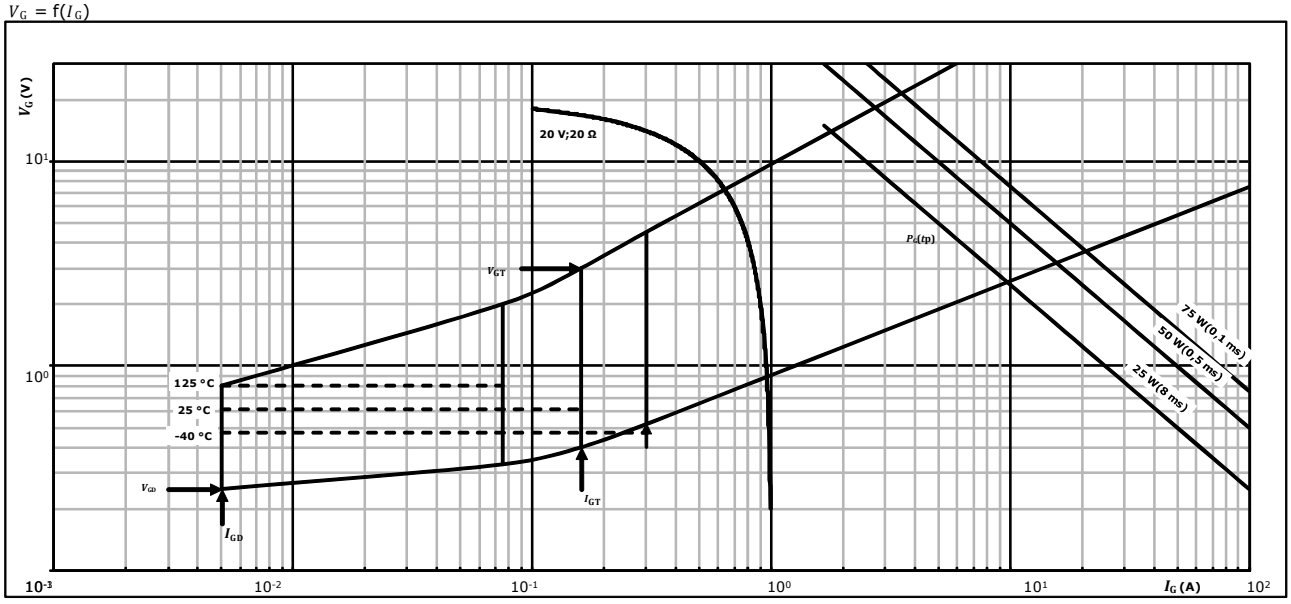
Thyristor thermal model values

| $R$ (K/W) | $\tau$ (s) |
|---|---|
| 5,49E-02 | 3,07E+00 |
| 1,27E-01 | 4,52E-01 |
| 4,30E-01 | 9,34E-02 |
| 1,02E-01 | 2,77E-02 |
| 3,72E-02 | 3,01E-03 |

**figure 3.** **Thyristor**

**Gate trigger characteristics**

$V_G = f(I_G)$

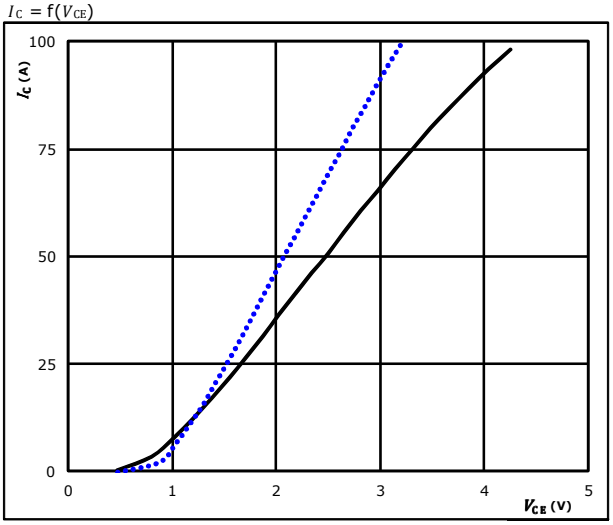


# Brake Switch Characteristics

**figure 1.** **IGBT**

**Typical output characteristics**

$I_C = f(V_{CE})$

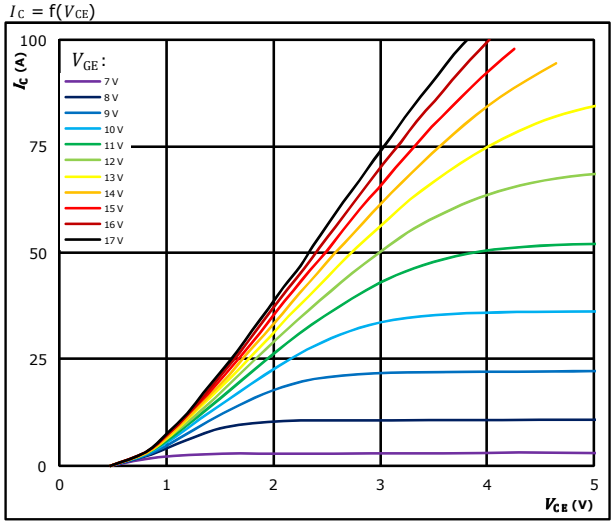



| | | | | | |
|---|---|---|---|---|---|
| $t_p$ = | 250 | µs | $T_j$: | 25 °C | |
| $V_{GE}$ = | 15 | V | | 125 °C | |

**figure 2.** **IGBT**

**Typical output characteristics**

$I_C = f(V_{CE})$

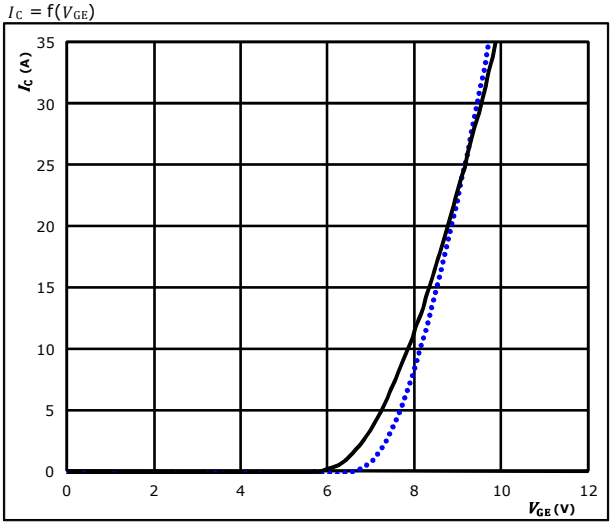



| | | |
|---|---|---|
| $t_p$ = | 250 | µs |
| $T_j$ = | 125 | °C |
| $V_{GE}$ from | 7 V to 17 V in steps of 1 V | |

**figure 3.** **IGBT**

**Typical transfer characteristics**

$I_C = f(V_{GE})$

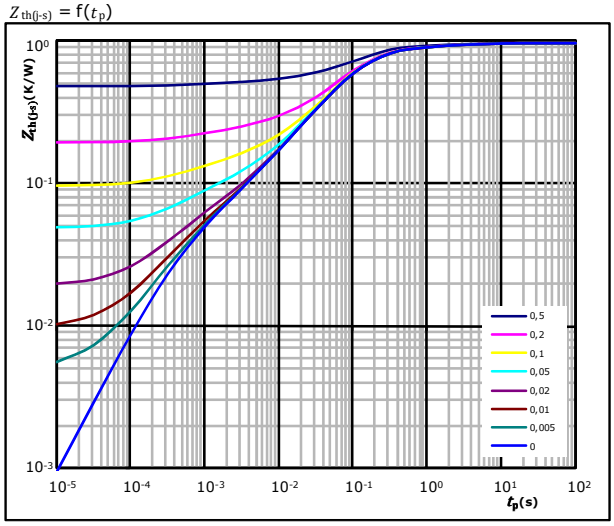



| | | | | | |
|---|---|---|---|---|---|
| $t_p$ = | 100 | µs | $T_j$: | 25 °C | |
| $V_{CE}$ = | 10 | V | | 125 °C | |

**figure 4.** **IGBT**

**Transient thermal impedance as function of pulse duration**

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




| | | |
|---|---|---|
| $D$ = | $t_p / T$ | |
| $R_{th(j-s)}$ = | 0,97 | K/W |

IGBT thermal model values

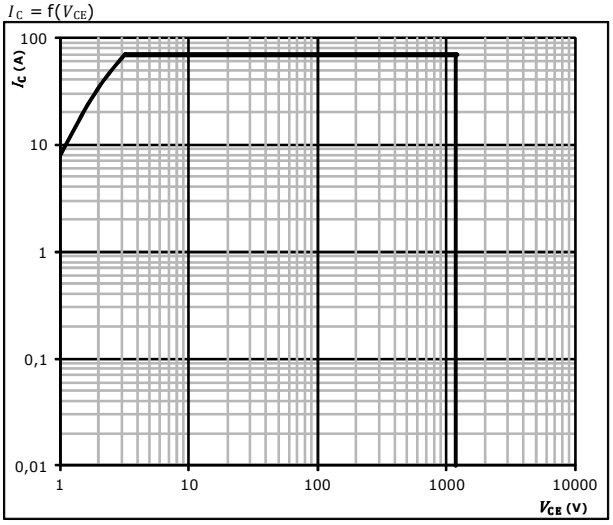
| $R$ (K/W) | $\tau$ (s) |
|---|---|
| 6,59E-02 | 3,01E+00 |
| 1,61E-01 | 3,99E-01 |
| 6,07E-01 | 8,47E-02 |
| 7,79E-02 | 1,42E-02 |
| 3,57E-02 | 2,31E-03 |
| 2,73E-02 | 4,08E-04 |

# Brake Switch Characteristics

**figure 5.** **IGBT**

**Safe operating area**

$I_C = f(V_{CE})$



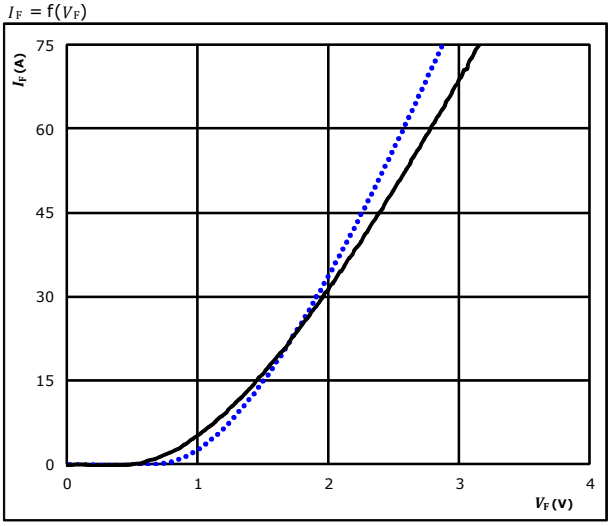

| | | |
|---|---|---|
| $D$ = | single pulse | |
| $T_s$ = | 80 | ºC |
| $V_{GE}$ = | ±15 | V |
| $T_j$ = | $T_{jmax}$ | |

# Brake Diode Characteristics

**figure 1.** **FWD**

**Typical forward characteristics**

$I_F = f(V_F)$




$t_p$ = 250 µs

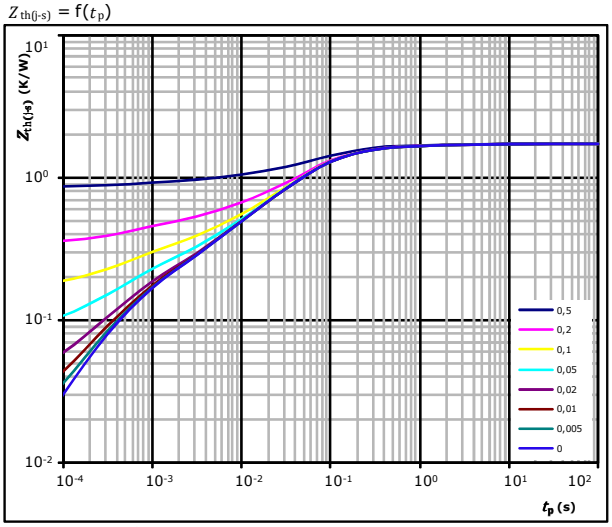
$T_j$: 25 °C

125 °C

**figure 2.** **FWD**

**Transient thermal impedance as a function of pulse width**

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




$D$ = $t_p / T$

$R_{th(j-s)}$ = 1,72 K/W

FWD thermal model values

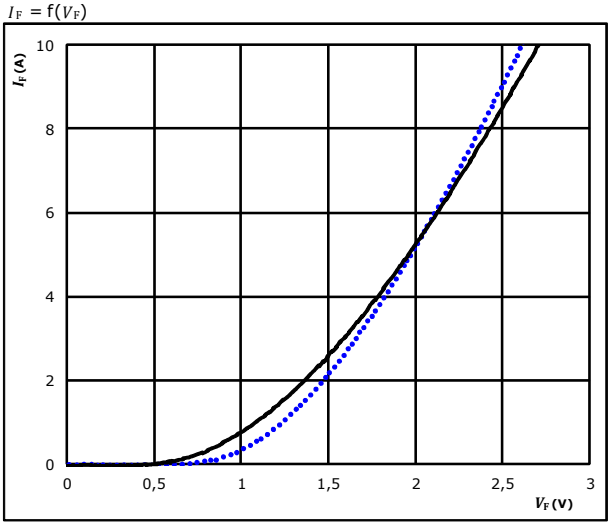
| $R$ (K/W) | $\tau$ (s) |
|---|---|
| 5,74E-02 | 3,42E+00 |
| 1,85E-01 | 4,11E-01 |
| 9,45E-01 | 7,07E-02 |
| 2,69E-01 | 1,95E-02 |
| 1,43E-01 | 3,59E-03 |
| 1,19E-01 | 4,63E-04 |

# Brake Sw. Protection Diode Characteristics

**figure 1.** **FWD**

**Typical forward characteristics**

$I_F = f(V_F)$




$t_p$ = 250 µs

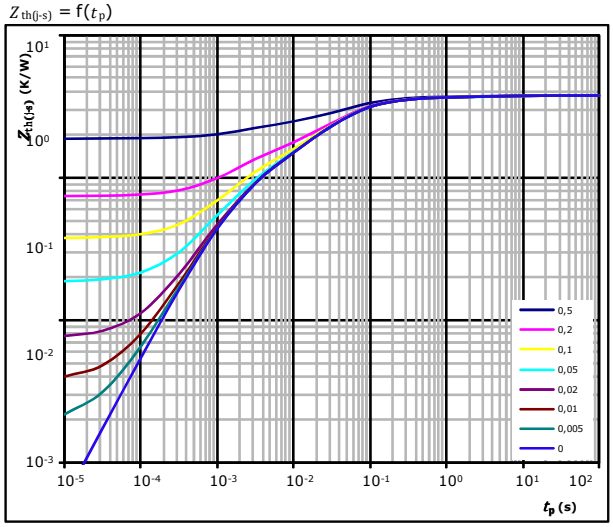
$T_j$: 25 °C

125 °C

**figure 2.** **FWD**

**Transient thermal impedance as a function of pulse width**

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




$D$ = $t_p / T$

$R_{th(j-s)}$ = 3,72 K/W

FWD thermal model values

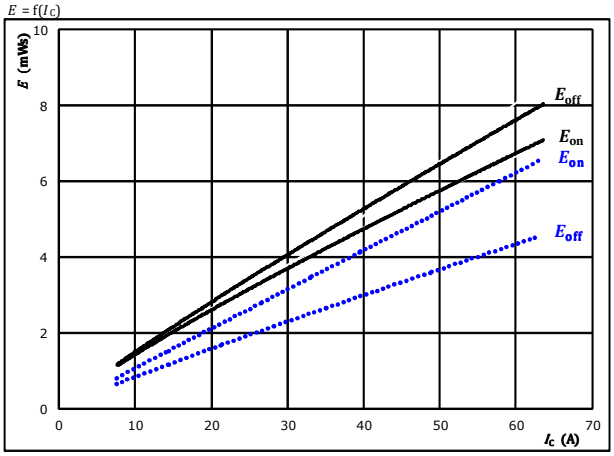
| $R$ (K/W) | $\tau$ (s) |
|---|---|
| 1,58E-01 | 3,25E+00 |
| 5,74E-01 | 1,68E-01 |
| 1,74E+00 | 4,01E-02 |
| 5,91E-01 | 8,37E-03 |
| 6,54E-01 | 1,47E-03 |

# Brake Switching Characteristics

**figure 1.** **IGBT**

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

$E = f(I_C)$




With an inductive load at

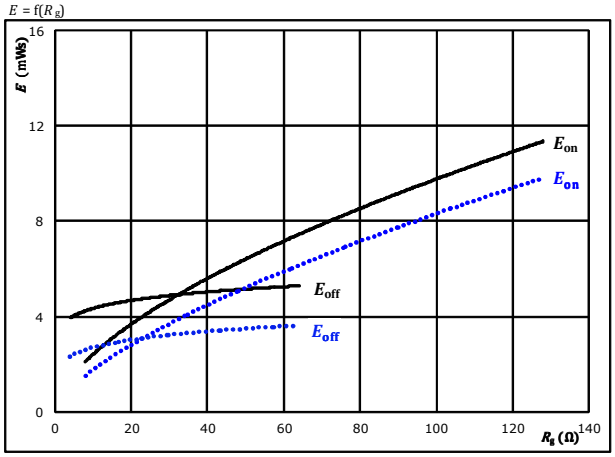
| | | |
|---|---|---|
| $V_{CE}$ = | 700 | V |
| $V_{GE}$ = | 0 / 15 | V |
| $R_{gon}$ = | 32 | Ω |
| $R_{goff}$ = | 16 | Ω |

$T_j$: 25 °C (dotted) / 125 °C (solid)

**figure 2.** **IGBT**

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

$E = f(R_g)$




With an inductive load at

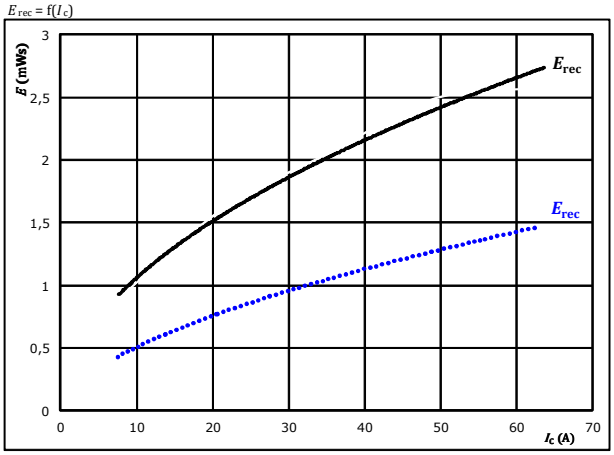
| | | |
|---|---|---|
| $V_{CE}$ = | 700 | V |
| $V_{GE}$ = | 0 / 15 | V |
| $I_C$ = | 35 | A |

$T_j$: 25 °C (dotted) / 125 °C (solid)

**figure 3.** **FWD**

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

$E_{rec} = f(I_C)$




With an inductive load at

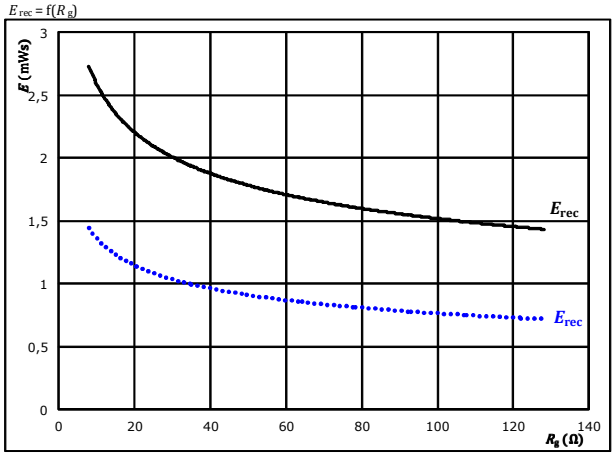
| | | |
|---|---|---|
| $V_{CE}$ = | 700 | V |
| $V_{GE}$ = | 0 / 15 | V |
| $R_{gon}$ = | 32 | Ω |

$T_j$: 25 °C (dotted) / 125 °C (solid)

**figure 4.** **FWD**

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

$E_{rec} = f(R_g)$




With an inductive load at

| | | |
|---|---|---|
| $V_{CE}$ = | 700 | V |
| $V_{GE}$ = | 0 / 15 | V |
| $I_C$ = | 35 | A |

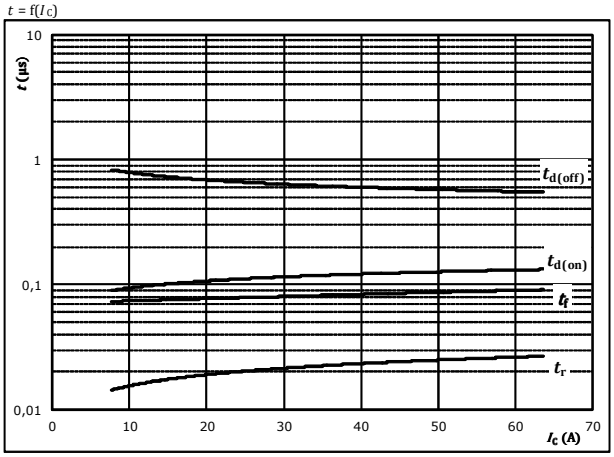
$T_j$: 25 °C (dotted) / 125 °C (solid)

# Brake Switching Characteristics

**figure 5.** **IGBT**

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

$t = f(I_C)$



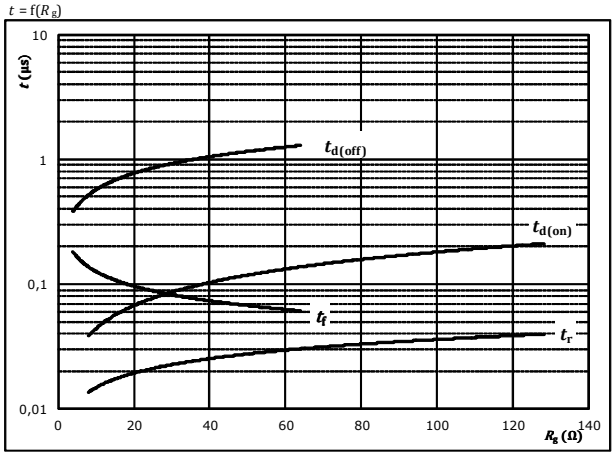

With an inductive load at

| | | |
|---|---|---|
| $T_j$ = | 0 | °C |
| $V_{CE}$ = | 700 | V |
| $V_{GE}$ = | 0 / 15 | V |
| $R_{gon}$ = | 32 | Ω |
| $R_{goff}$ = | 16 | Ω |

**figure 6.** **IGBT**

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

$t = f(R_g)$



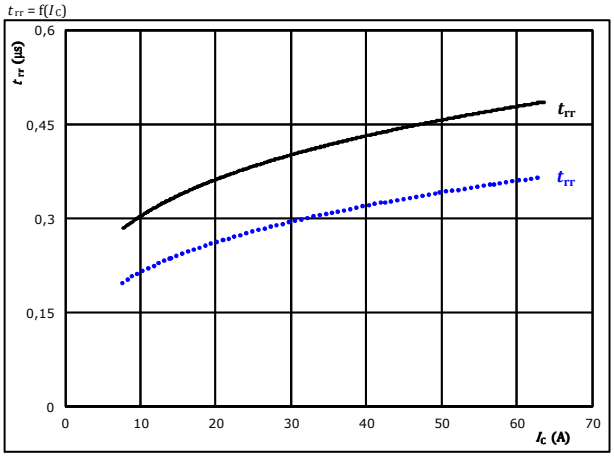

With an inductive load at

| | | |
|---|---|---|
| $T_j$ = | 0 | °C |
| $V_{CE}$ = | 700 | V |
| $V_{GE}$ = | 0 / 15 | V |
| $I_C$ = | 35 | A |

**figure 7.** **FWD**

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

$t_{rr} = f(I_C)$




With an inductive load at

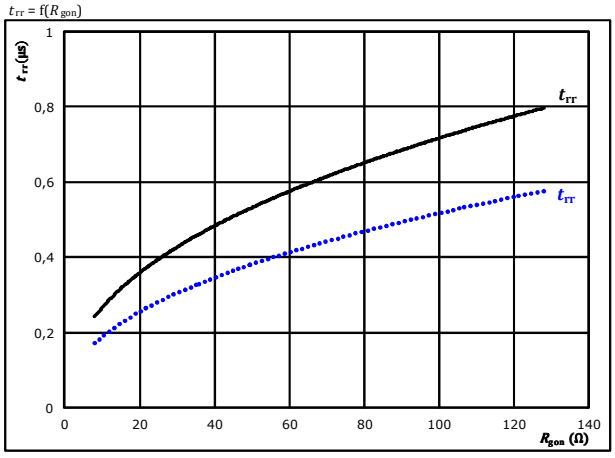
| | | |
|---|---|---|
| $V_{CE}$ = | 700 | V |
| $V_{GE}$ = | 0 / 15 | V |
| $R_{gon}$ = | 32 | Ω |

$T_j$: 25 °C, 125 °C

**figure 8.** **FWD**

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

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




With an inductive load at

| | | |
|---|---|---|
| $V_{CE}$ = | 700 | V |
| $V_{GE}$ = | 0 / 15 | V |
| $I_C$ = | 35 | A |

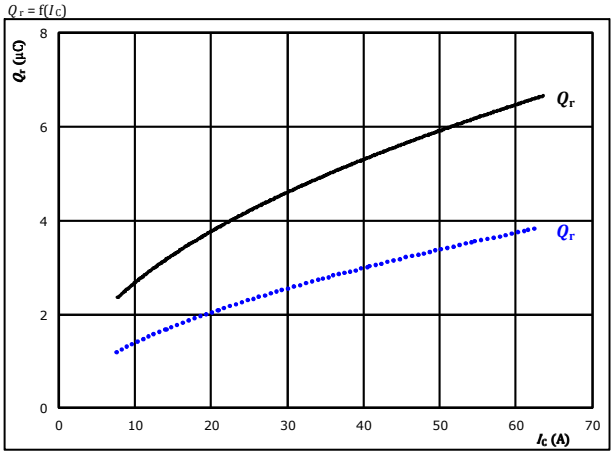
$T_j$: 25 °C, 125 °C

# Brake Switching Characteristics

**figure 9.** **FWD**

**Typical recovered charge as a function of collector current**

$Q_r = f(I_C)$




With an inductive load at

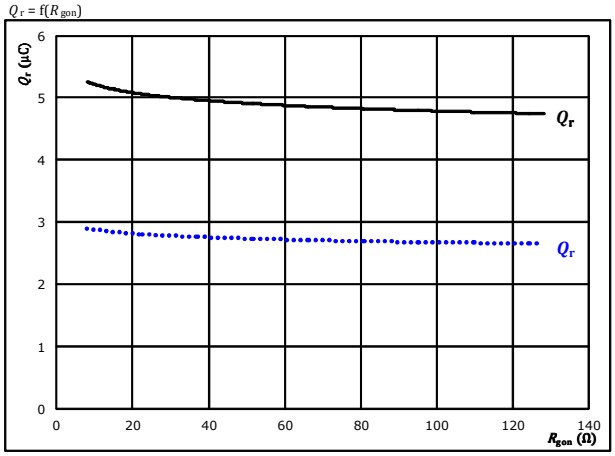
| | | |
|---|---|---|
| $V_{CE}$ = | 700 | V |
| $V_{GE}$ = | 0 / 15 | V |
| $R_{gon}$ = | 32 | Ω |

$T_j$: 25 °C, 125 °C

**figure 10.** **FWD**

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

$Q_r = f(R_{gon})$




With an inductive load at

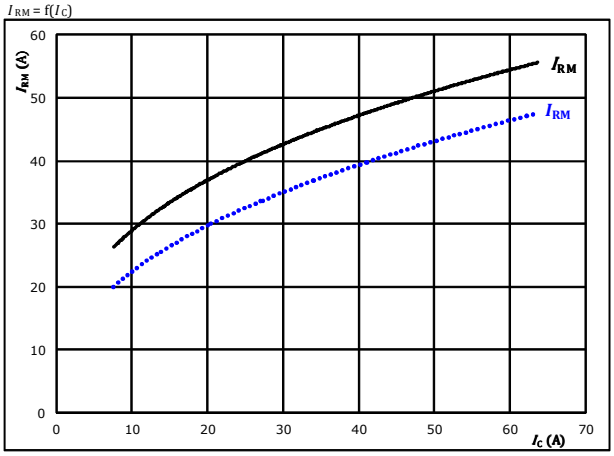
| | | |
|---|---|---|
| $V_{CE}$ = | 700 | V |
| $V_{GE}$ = | 0 / 15 | V |
| $I_C$ = | 35 | A |

$T_j$: 25 °C, 125 °C

**figure 11.** **FWD**

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

$I_{RM} = f(I_C)$




With an inductive load at

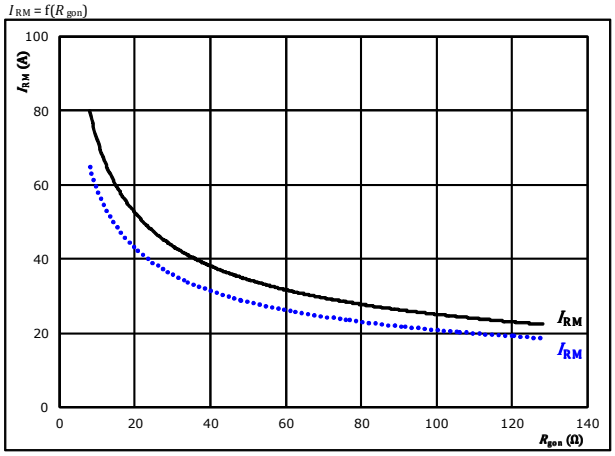
| | | |
|---|---|---|
| $V_{CE}$ = | 700 | V |
| $V_{GE}$ = | 0 / 15 | V |
| $R_{gon}$ = | 32 | Ω |

$T_j$: 25 °C, 125 °C

**figure 12.** **FWD**

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

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




With an inductive load at

| | | |
|---|---|---|
| $V_{CE}$ = | 700 | V |
| $V_{GE}$ = | 0 / 15 | V |
| $I_C$ = | 35 | A |

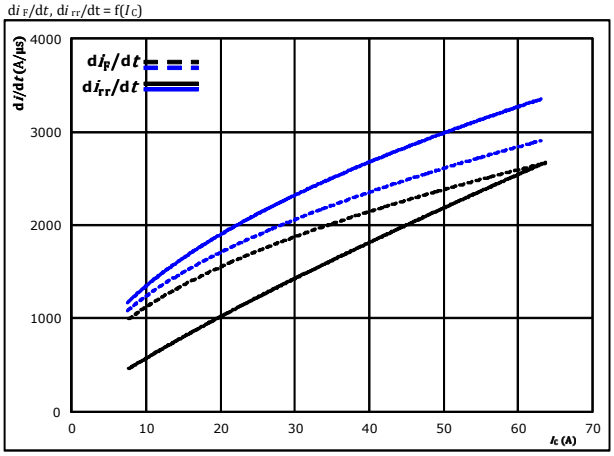
$T_j$: 25 °C, 125 °C

# Brake Switching Characteristics

**figure 13.** **FWD**

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

$di_F/dt$, $di_{rr}/dt = f(I_C)$



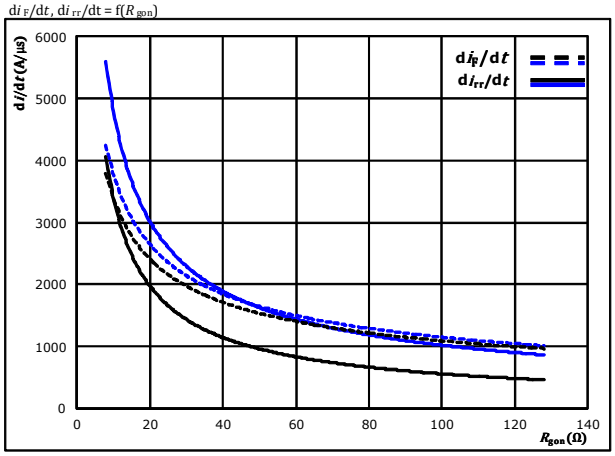

With an inductive load at

| | | | | |
|---|---|---|---|---|
| $V_{CE}$ = | 700 | V | $T_j$: | 25 °C |
| $V_{GE}$ = | 0 / 15 | V | | 125 °C |
| $R_{gon}$ = | 32 | Ω | | |

**figure 14.** **FWD**

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

$di_F/dt$, $di_{rr}/dt = f(R_{gon})$



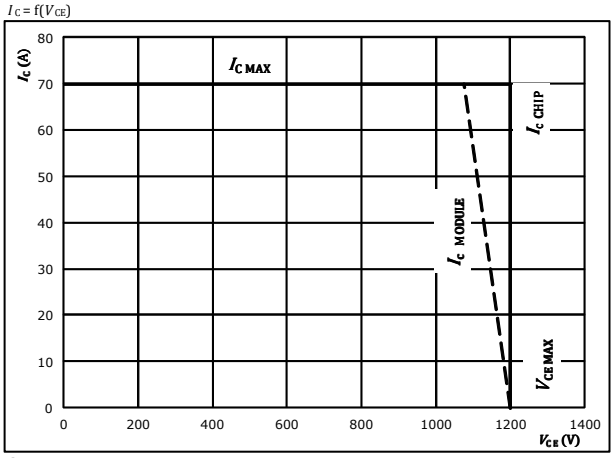

With an inductive load at

| | | | | |
|---|---|---|---|---|
| $V_{CE}$ = | 700 | V | $T_j$: | 25 °C |
| $V_{GE}$ = | 0 / 15 | V | | 125 °C |
| $I_C$ = | 35 | A | | |

**figure 15.** **IGBT**

**Reverse bias safe operating area**

$I_C = f(V_{CE})$




At

| | | |
|---|---|---|
| $T_j$ = | 125 | °C |
| $R_{gon}$ = | 32 | Ω |
| $R_{goff}$ = | 16 | Ω |

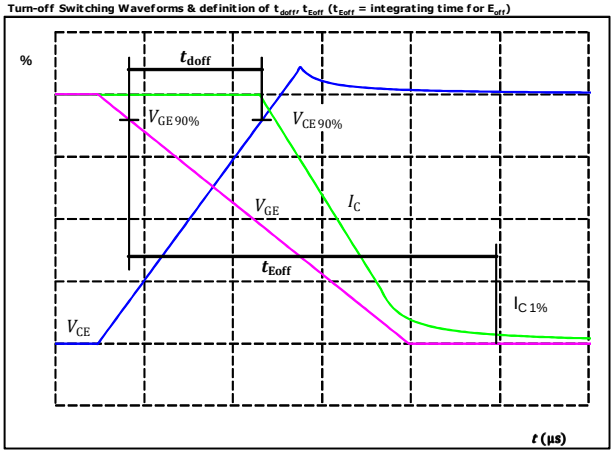
# Brake Switching Definitions

**General conditions**

| | | |
|---|---|---|
| $T_j$ | = | **125 °C** |
| $R_{gon}$ | = | **32 Ω** |
| $R_{goff}$ | = | **16 Ω** |

**figure 1.** IGBT

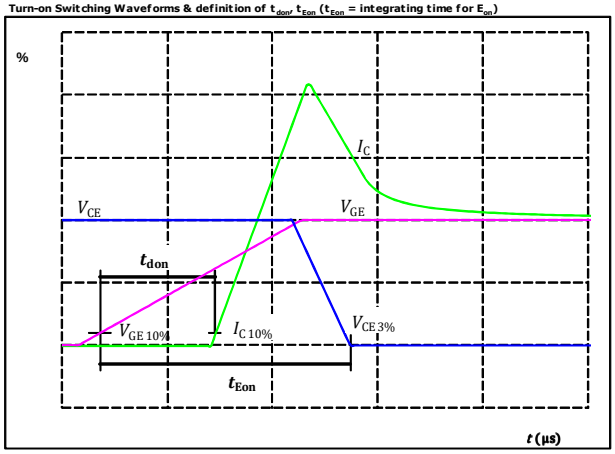
Turn-off Switching Waveforms & definition of $t_{doff}$, $t_{Eoff}$ ($t_{Eoff}$ = integrating time for $E_{off}$)




| | | |
|---|---|---|
| $V_{GE}(0\%)$ = | 0 | V |
| $V_{GE}(100\%)$ = | 15 | V |
| $V_C(100\%)$ = | 700 | V |
| $I_C(100\%)$ = | 35 | A |
| $t_{doff}$ = | 615 | ns |

**figure 2.** IGBT

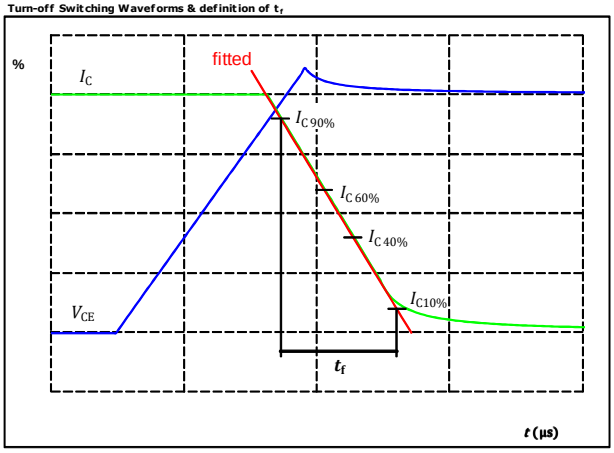
Turn-on Switching Waveforms & definition of $t_{don}$, $t_{Eon}$ ($t_{Eon}$ = integrating time for $E_{on}$)




| | | |
|---|---|---|
| $V_{GE}(0\%)$ = | 0 | V |
| $V_{GE}(100\%)$ = | 15 | V |
| $V_C(100\%)$ = | 700 | V |
| $I_C(100\%)$ = | 35 | A |
| $t_{don}$ = | 84 | ns |

**figure 3.** IGBT

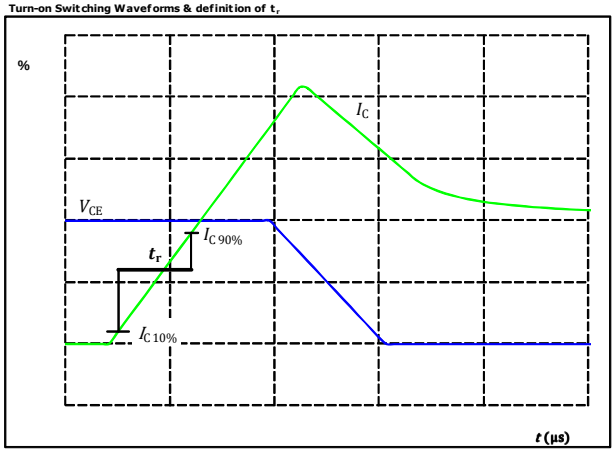
Turn-off Switching Waveforms & definition of $t_f$




| | | |
|---|---|---|
| $V_C(100\%)$ = | 700 | V |
| $I_C(100\%)$ = | 35 | A |
| $t_f$ = | 142 | ns |

**figure 4.** IGBT

Turn-on Switching Waveforms & definition of $t_r$

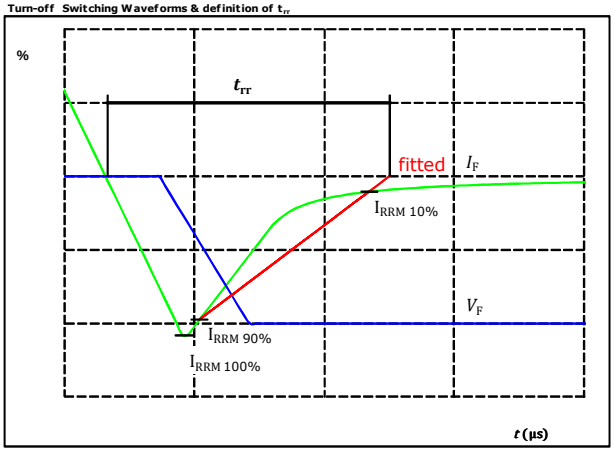



| | | |
|---|---|---|
| $V_C(100\%)$ = | 700 | V |
| $I_C(100\%)$ = | 35 | A |
| $t_r$ = | 22 | ns |

# Brake Switching Characteristics

**figure 5.** **FWD**

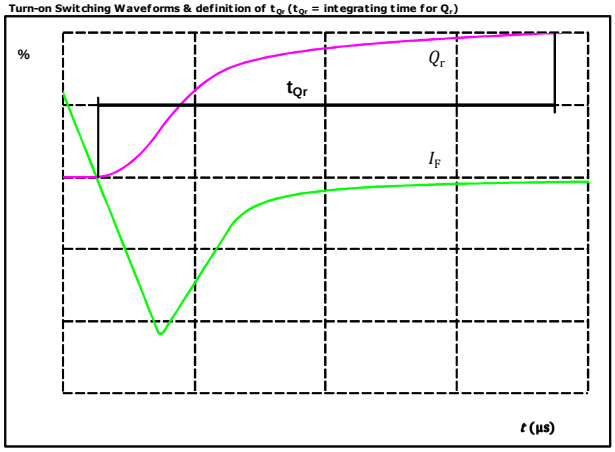
Turn-off Switching Waveforms & definition of $t_{rr}$




| | | |
|---|---|---|
| $V_F$ (100%) = | 700 | V |
| $I_F$ (100%) = | 35 | A |
| $I_{RRM}$ (100%) = | 45 | A |
| $t_{rr}$ = | 420 | ns |

**figure 6.** **FWD**

Turn-on Switching Waveforms & definition of $t_{Qr}$ ($t_{Qr}$ = integrating time for $Q_r$)




| | | |
|---|---|---|
| $I_F$ (100%) = | 35 | A |
| $Q_r$ (100%) = | 5,03 | µC |

Vincotech

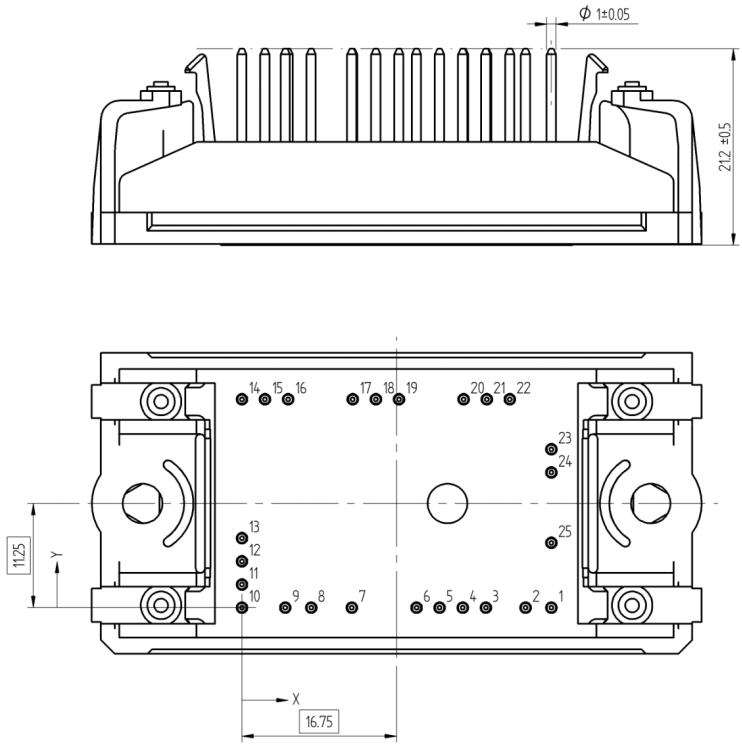
## Ordering Code & Marking

| Version | Ordering Code |
|---|---|
| without thermal paste 17 mm housing with solder pins | V23990-P640-G10-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 | | |

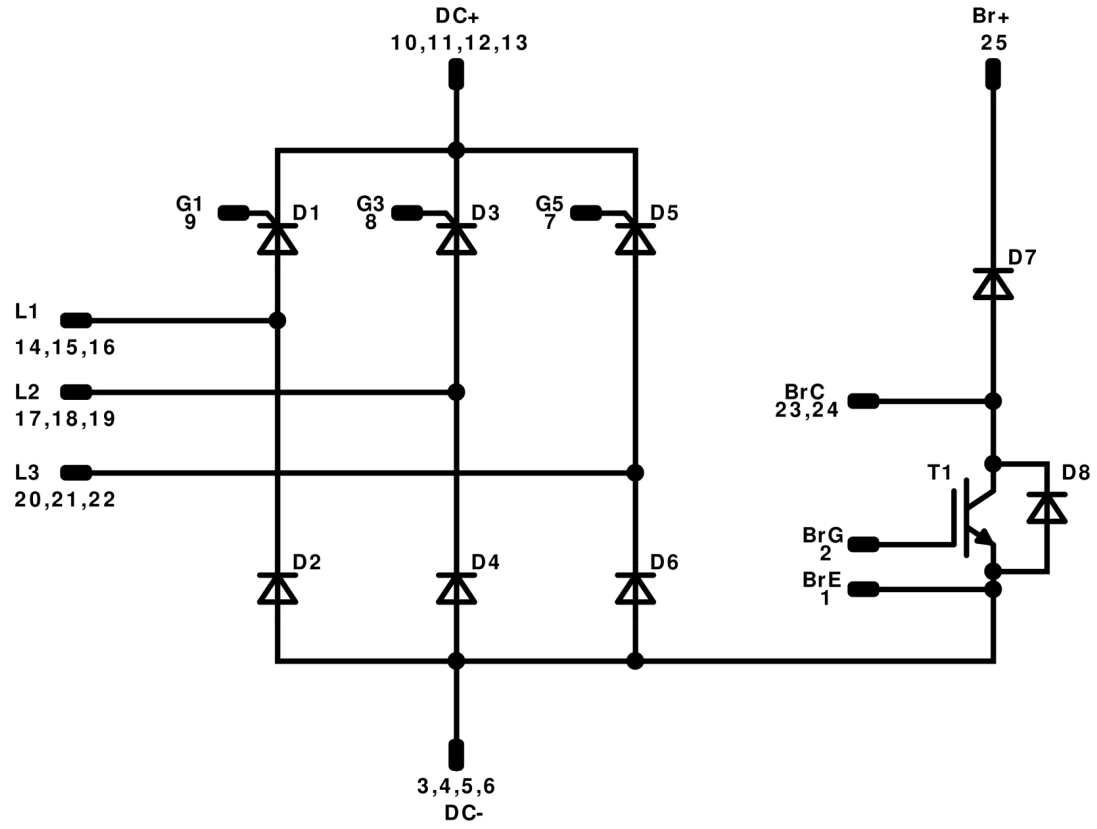
## Outline

| Pin table | | | |
|---|---|---|---|
| Pin | X | Y | Function |
| 1 | 33,5 | 0 | BrE |
| 2 | 30,7 | 0 | BrG |
| 3 | 26,4 | 0 | DC- |
| 4 | 23,9 | 0 | DC- |
| 5 | 21,4 | 0 | DC- |
| 6 | 18,9 | 0 | DC- |
| 7 | 11,9 | 0 | G5 |
| 8 | 7,5 | 0 | G3 |
| 9 | 4,7 | 0 | G1 |
| 10 | 0 | 0 | DC+ |
| 11 | 0 | 2,5 | DC+ |
| 12 | 0 | 5 | DC+ |
| 13 | 0 | 7,5 | DC+ |
| 14 | 0 | 22,5 | L1 |
| 15 | 2,5 | 22,5 | L1 |
| 16 | 5 | 22,5 | L1 |
| 17 | 12 | 22,5 | L2 |
| 18 | 14,5 | 22,5 | L2 |
| 19 | 17 | 22,5 | L2 |
| 20 | 24 | 22,5 | L3 |
| 21 | 26,5 | 22,5 | L3 |
| 22 | 29 | 22,5 | L3 |
| 23 | 33,5 | 17,1 | BrC |
| 24 | 33,5 | 14,6 | BrC |
| 25 | 33,5 | 7 | Br+ |




Tolerance of pinpositions: ±0,5mm at the end of pins
Dimension of coordinate axis is only offset without tolerance

## Pinout




## Identification

| ID | Component | Voltage | Current | Function | Comment |
|---|---|---|---|---|---|
| D2, D4, D6 | Rectifier | 1600 V | 80 A | Rectifier Diode | |
| D1, D3, D5 | Thyristor | 1600 V | 75 A | Rectifier Thyristor | |
| T1 | IGBT | 1200 V | 35 A | Brake Switch | |
| D7 | FWD | 1200 V | 25 A | Brake Diode | |
| D8 | FWD | 1200 V | 3 A | Brake Sw. Protection Diode | |

| Packaging instruction | | | | |
|---|---|---|---|---|
| Standard packaging quantity (SPQ) 135 | >SPQ | Standard | <SPQ | Sample |

| Handling instruction |
|---|
| Handling instructions for *flow* 0 packages see vincotech.com website. |

| Package data |
|---|
| Package data for *flow* 0 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-P640-G10-D1-14 | 12 Jul. 2018 | | |