Vincotech

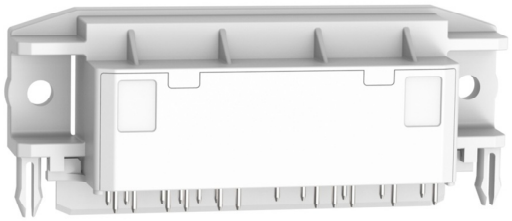
# 10-R112PMA015M7-P639A75
datasheet

**flow 90PIM 1** — **1200 V / 15 A**

### Features

- IGBT M7 with low $V_{CEsat}$ and improved EMC behavior
- Open emitter configuration
- Supports design with 90° angle
- Clip or screw-on heat sink mounting
- Builtin NTC

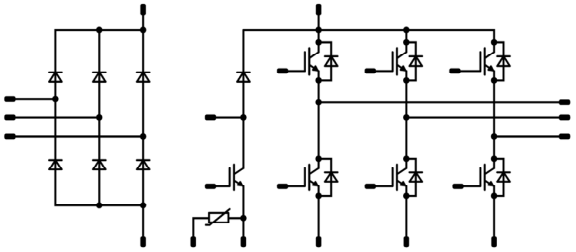
### flow 90 housing



### Target applications

- Industrial Drives

### Schematic



### Types

- 10-R112PMA015M7-P639A75

## 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 | $I_F$ | | 25 | A |
| Surge (non-repetitive) forward current | $I_{FSM}$ | 50 Hz Single Half Sine Wave $T_j$ = 150 °C<br>$t_p$ = 10 ms | 200 | A |
| Surge current capability | $I^2t$ | | 200 | $A^2s$ |
| Total power dissipation | $P_{tot}$ | $T_j = T_{jmax}$ $T_s$ = 80 °C | 44 | W |
| Maximum Junction Temperature | $T_{jmax}$ | | 150 | °C |

# Maximum Ratings

$T_j$ = 25 °C, unless otherwise specified

| Parameter | Symbol | Condition | Value | Unit |
|---|---|---|---|---|
| **Inverter Switch** | | | | |
| Collector-emitter voltage | $V_{CES}$ | | 1200 | V |
| Collector current | $I_C$ | | 15 | A |
| Repetitive peak collector current | $I_{CRM}$ | $t_p$ limited by $T_{jmax}$ | 30 | A |
| Total power dissipation | $P_{tot}$ | $T_j$ = $T_{jmax}$ $T_s$ = 80 °C | 60 | W |
| Gate-emitter voltage | $V_{GES}$ | | ±20 | V |
| Maximum junction temperature | $T_{jmax}$ | | 175 | °C |
| **Inverter Diode** | | | | |
| Peak repetitive reverse voltage | $V_{RRM}$ | | 1200 | V |
| Continuous (direct) forward current | $I_F$ | | 15 | A |
| Repetitive peak forward current | $I_{FRM}$ | $T_j$ limited by $T_{jmax}$ | 30 | A |
| Total power dissipation | $P_{tot}$ | $T_j$ = $T_{jmax}$ $T_s$ = 80 °C | 45 | W |
| Maximum junction temperature | $T_{jmax}$ | | 175 | °C |
| **Brake Switch** | | | | |
| Collector-emitter voltage | $V_{CES}$ | | 1200 | V |
| Collector current | $I_C$ | | 10 | A |
| Repetitive peak collector current | $I_{CRM}$ | $t_p$ limited by $T_{jmax}$ | 20 | A |
| Total power dissipation | $P_{tot}$ | $T_j$ = $T_{jmax}$ $T_s$ = 80 °C | 55 | W |
| Gate-emitter voltage | $V_{GES}$ | | ±20 | V |
| Maximum junction temperature | $T_{jmax}$ | | 175 | °C |
| **Brake Diode** | | | | |
| Peak repetitive reverse voltage | $V_{RRM}$ | | 1200 | V |
| Continuous (direct) forward current | $I_F$ | | 10 | A |
| Repetitive peak forward current | $I_{FRM}$ | $T_j$ limited by $T_{jmax}$ | 20 | A |
| Total power dissipation | $P_{tot}$ | $T_j$ = $T_{jmax}$ $T_s$ = 80 °C | 50 | W |
| Maximum junction temperature | $T_{jmax}$ | | 175 | °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 | | | 11,84 | 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 | $V_F$ | | | | 25 | 25<br>125 | | 1,22<br>1,21 | 1,75 | V |
| Reverse leakage current | $I_r$ | | | 1600 | | 25<br>145 | | | 50<br>1100 | µA |
| **Thermal** | | | | | | | | | | |
| Thermal resistance junction to sink | $R_{th(j-s)}$ | $\lambda_{paste}$ = 3,4 W/mK (PSX) | | | | | | 1,59 | | K/W |
| **Inverter Switch** | | | | | | | | | | |
| **Static** | | | | | | | | | | |
| Gate-emitter threshold voltage | $V_{GE(th)}$ | $V_{GE} = V_{CE}$ | | | 0,0015 | 25 | 5,4 | 6 | 6,6 | V |
| Collector-emitter saturation voltage | $V_{CEsat}$ | | 15 | | 15 | 25<br>125<br>150 | | 1,70<br>1,95<br>2,01 | 1,95 | V |
| Collector-emitter cut-off current | $I_{CES}$ | | 0 | 1200 | | 25 | | | 60 | µA |
| Gate-emitter leakage current | $I_{GES}$ | | 20 | 0 | | 25 | | | 500 | nA |
| Internal gate resistance | $r_g$ | | | | | | | none | | Ω |
| Input capacitance | $C_{ies}$ | | 0 | 10 | | 25 | | 2900 | | pF |
| Output capacitance | $C_{oes}$ | | | | | | | 120 | | |
| Reverse transfer capacitance | $C_{res}$ | | | | | | | 34 | | |
| Gate charge | $Q_g$ | | 15 | 600 | 15 | 25 | | 1100 | | nC |
| **Thermal** | | | | | | | | | | |
| Thermal resistance junction to sink | $R_{th(j-s)}$ | $\lambda_{paste}$ = 3,4 W/mK (PSX) | | | | | | 1,60 | | K/W |
| **Dynamic** | | | | | | | | | | |
| Turn-on delay time | $t_{d(on)}$ | $R_{goff}$ = 32 Ω<br>$R_{gon}$ = 32 Ω | ±15 | 600 | 15 | 25<br>150 | | 176<br>174 | | ns |
| Rise time | $t_r$ | | | | | 25<br>150 | | 43<br>48 | | |
| Turn-off delay time | $t_{d(off)}$ | | | | | 25<br>150 | | 191<br>218 | | |
| Fall time | $t_f$ | | | | | 25<br>150 | | 119<br>127 | | |
| Turn-on energy (per pulse) | $E_{on}$ | $Q_{rFWD}$ = 1,5 µC<br>$Q_{rFWD}$ = 2,6 µC | | | | 25<br>150 | | 1,55<br>2,01 | | mWs |
| Turn-off energy (per pulse) | $E_{off}$ | | | | | 25<br>150 | | 0,925<br>1,32 | | |

# 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 | |
| **Inverter Diode** | | | | | | | | | | |
| **Static** | | | | | | | | | | |
| Forward voltage | $V_F$ | | | | 15 | 25<br>125<br>150 | | 1,63<br>1,74<br>1,73 | 2,1 | V |
| Reverse leakage current | $I_R$ | | | 1200 | | 25 | | | 30 | µA |
| **Thermal** | | | | | | | | | | |
| Thermal resistance junction to sink | $R_{th(j-s)}$ | $\lambda_{paste}$ = 3,4 W/mK (PSX) | | | | | | 2,11 | | K/W |
| **Dynamic** | | | | | | | | | | |
| Peak recovery current | $I_{RRM}$ | di/dt = 293 A/µs<br>di/dt = 244 A/µs | ±15 | 600 | 15 | 25<br>150 | | 11<br>12 | | A |
| Reverse recovery time | $t_{rr}$ | | | | | 25<br>150 | | 265<br>423 | | ns |
| Recovered charge | $Q_r$ | | | | | 25<br>150 | | 1,55<br>2,59 | | µC |
| Reverse recovered energy | $E_{rec}$ | | | | | 25<br>150 | | 0,488<br>0,938 | | mWs |
| Peak rate of fall of recovery current | $(di_{rf}/dt)_{max}$ | | | | | 25<br>150 | | 92<br>52 | | A/µs |

# 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 | $V_{GE(th)}$ | $V_{GE} = V_{CE}$ | | | 0,001 | 25 | 5,4 | 6 | 6,6 | V |
| Collector-emitter saturation voltage | $V_{CEsat}$ | | 15 | | 10 | 25<br>125<br>150 | | 1,66<br>1,90<br>1,96 | 2,15 | V |
| Collector-emitter cut-off current | $I_{CES}$ | | 0 | 1200 | | 25 | | | 35 | µA |
| Gate-emitter leakage current | $I_{GES}$ | | 20 | 0 | | 25 | | | 500 | nA |
| Internal gate resistance | $r_g$ | | | | | | | none | | Ω |
| Input capacitance | $C_{ies}$ | | 0 | 10 | | 25 | | 2000 | | pF |
| Output capacitance | $C_{oes}$ | | | | | | | 86 | | |
| Reverse transfer capacitance | $C_{res}$ | | | | | | | 23 | | |
| Gate charge | $Q_g$ | | 15 | 600 | 10 | 25 | | 80 | | nC |
| **Thermal** | | | | | | | | | | |
| Thermal resistance junction to sink | $R_{th(j-s)}$ | $\lambda_{paste}$ = 3,4 W/mK (PSX) | | | | | | 1,72 | | K/W |
| **Dynamic** | | | | | | | | | | |
| Turn-on delay time | $t_{d(on)}$ | $R_{goff}$ = 32 Ω<br>$R_{gon}$ = 32 Ω | ±15 | 600 | 10 | 25<br>125<br>150 | | 128<br>126<br>123 | | ns |
| Rise time | $t_r$ | | | | | 25<br>125<br>150 | | 29<br>32<br>34 | | |
| Turn-off delay time | $t_{d(off)}$ | | | | | 25<br>125<br>150 | | 145<br>179<br>182 | | |
| Fall time | $t_f$ | | | | | 25<br>125<br>150 | | 98<br>108<br>117 | | |
| Turn-on energy (per pulse) | $E_{on}$ | $Q_{rFWD}$ = 1,1 µC<br>$Q_{rFWD}$ = 1,7 µC<br>$Q_{rFWD}$ = 1,8 µC | | | | 25<br>125<br>150 | | 0,883<br>1,13<br>1,19 | | mWs |
| Turn-off energy (per pulse) | $E_{off}$ | | | | | 25<br>125<br>150 | | 0,656<br>0,860<br>0,908 | | |

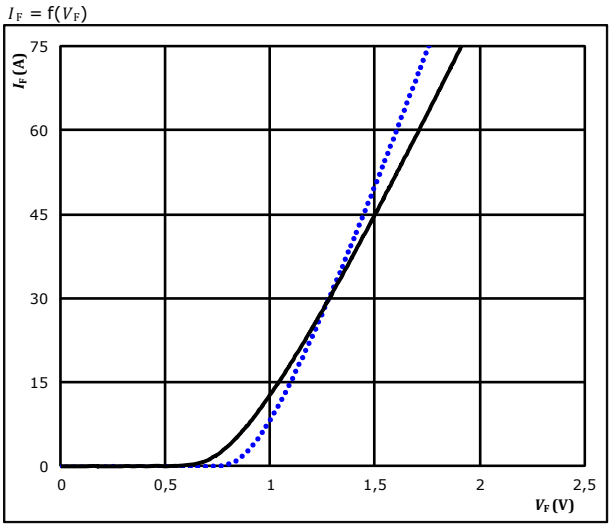
# Characteristic Values

| 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 | $V_F$ | | | | 10 | 25<br>125<br>150 | | 1,61<br>1,7<br>1,7 | 2,1 | V |
| Reverse leakage current | $I_R$ | | | 1200 | | 25 | | | 25 | µA |
| **Thermal** | | | | | | | | | | |
| Thermal resistance junction to sink | $R_{th(j-s)}$ | $\lambda_{paste}$ = 3,4 W/mK (PSX) | | | | | | 2,16 | | K/W |
| **Dynamic** | | | | | | | | | | |
| Peak recovery current | $I_{RRM}$ | di/dt = 278 A/µs<br>di/dt = 270 A/µs<br>di/dt = 272 A/µs | ±15 | 600 | 10 | 25<br>125<br>150 | | 9<br>9<br>9 | | A |
| Reverse recovery time | $Trr$ | | | | | 25<br>125<br>150 | | 254<br>373<br>409 | | ns |
| Recovered charge | $Q_r$ | | | | | 25<br>125<br>150 | | 1,09<br>1,66<br>1,81 | | µC |
| Reverse recovered energy | $E_{rec}$ | | | | | 25<br>125<br>150 | | 0,374<br>0,620<br>0,680 | | mWs |
| Peak rate of fall of recovery current | $(di_{rf}/dt)_{max}$ | | | | | 25<br>125<br>150 | | 85<br>54<br>49 | | A/µs |
| **Thermistor** | | | | | | | | | | |
| Rated resistance | $R$ | | | | | 25 | | 22 | | kΩ |
| Deviation of $R_{100}$ | $\Delta_{R/R}$ | $R_{100}$ = 1486 Ω | | | | 100 | -12 | | +14 | % |
| Power dissipation | $P$ | | | | | 25 | | 200 | | mW |
| Power dissipation constant | | | | | | 25 | | 2 | | mW/K |
| B-value | $B_{(25/50)}$ | Tol. ±3% | | | | 25 | | 3950 | | K |
| B-value | $B_{(25/100)}$ | Tol. ±3% | | | | 25 | | 3998 | | K |
| Vincotech NTC Reference | | | | | | | | | B | |

# Rectifier Diode Characteristics

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

**Typical forward characteristics**

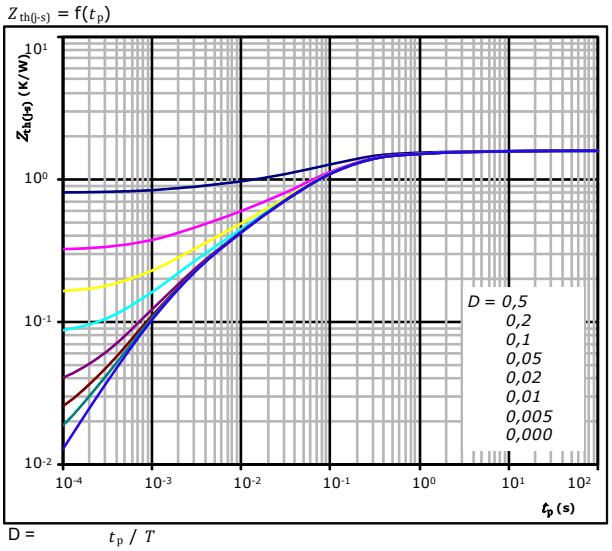



$t_p$ = 250 µs 25 °C

$T_j$: 125 °C

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

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




D = $t_p$ / $T$

$R_{th(j-s)}$ = 1,59 K/W

Diode thermal model values

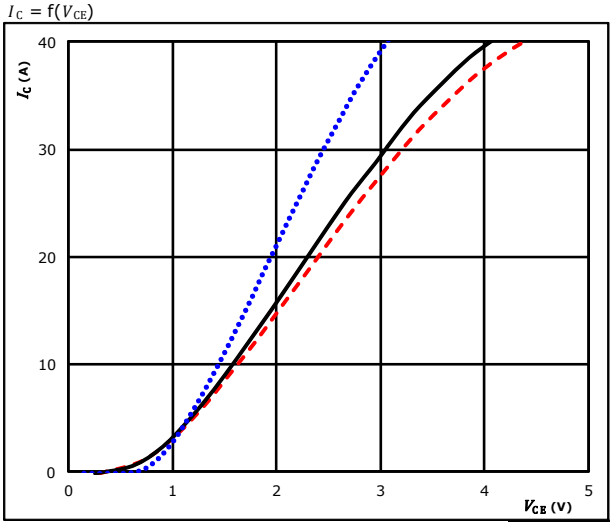
| $R$ (K/W) | $\tau$ (s) |
|---|---|
| 3,44E-02 | 9,66E+00 |
| 1,12E-01 | 1,22E+00 |
| 5,81E-01 | 1,45E-01 |
| 4,89E-01 | 5,05E-02 |
| 2,38E-01 | 9,26E-03 |
| 1,22E-01 | 1,79E-03 |
| 1,22E-01 | 1,79E-03 |
| 1,81E-02 | 7,88E-04 |

# Inverter Switch Characteristics

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

**Typical output characteristics**

$I_C = f(V_{CE})$

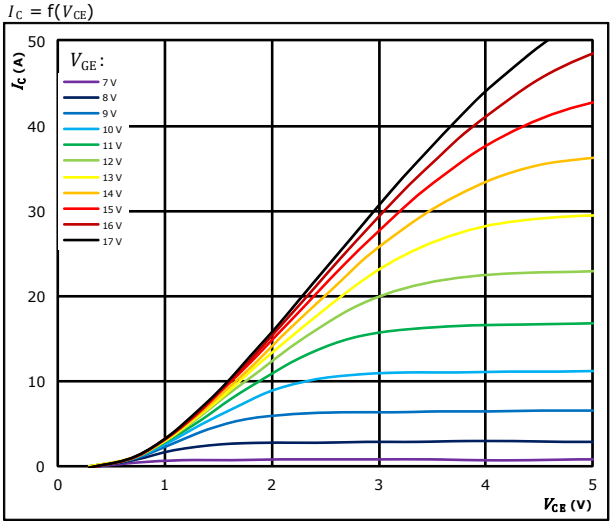



| | | | | |
|---|---|---|---|---|
| $t_p$ = | 250 | µs | | 25 °C |
| $V_{GE}$ = | 15 | V | $T_j$: | 125 °C |
| | | | | 150 °C |

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

**Typical output characteristics**

$I_C = f(V_{CE})$

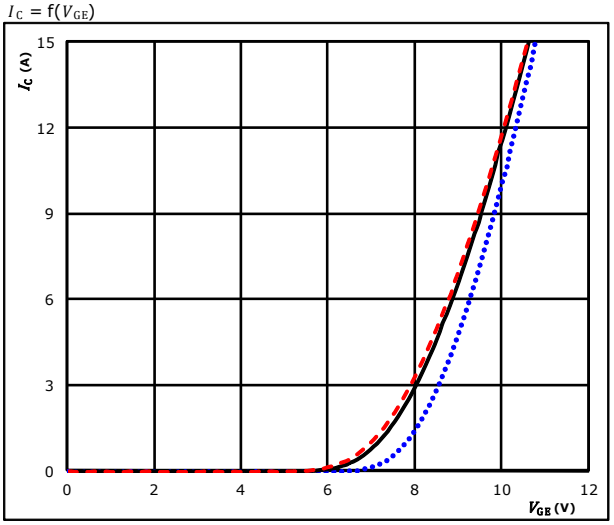



| | | |
|---|---|---|
| $t_p$ = | 250 | µs |
| $T_j$ = | 150 | °C |
| $V_{GE}$ from | 7 V to 17 V in steps of 1 V | |

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

**Typical transfer characteristics**

$I_C = f(V_{GE})$

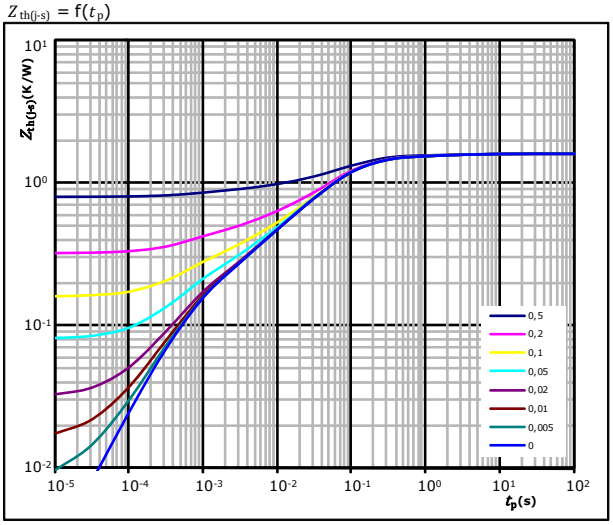



| | | | | |
|---|---|---|---|---|
| $t_p$ = | 100 | µs | | 25 °C |
| $V_{CE}$ = | 10 | V | $T_j$: | 125 °C |
| | | | | 150 °C |

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

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

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




| | | |
|---|---|---|
| $D$ = | $t_p / T$ | |
| $R_{th(j-s)}$ = | 1,60 | K/W |

IGBT thermal model values

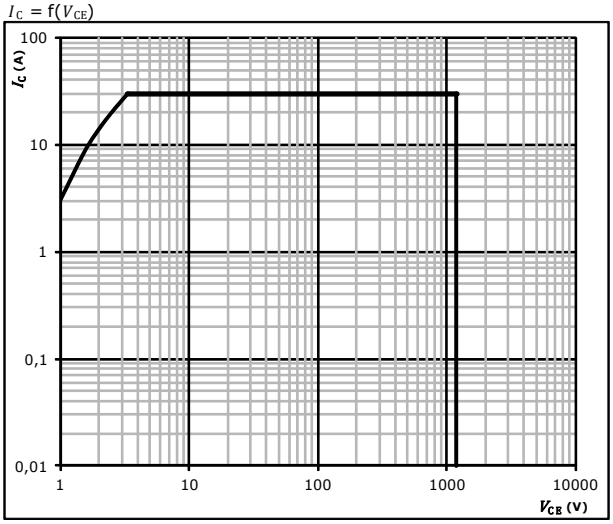
| $R$ (K/W) | $\tau$ (s) |
|---|---|
| 4,90E-02 | 4,40E+00 |
| 1,40E-01 | 5,34E-01 |
| 8,04E-01 | 8,02E-02 |
| 2,98E-01 | 2,57E-02 |
| 1,69E-01 | 5,09E-03 |
| 1,35E-01 | 6,41E-04 |

# Inverter Switch Characteristics

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

**Safe operating area**

$I_C = f(V_{CE})$



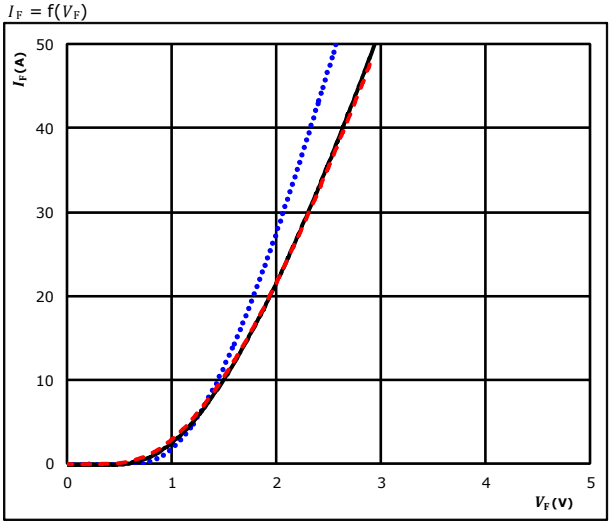

| | | |
|---|---|---|
| $D$ = | single pulse | |
| $T_s$ = | 80 | ºC |
| $V_{GE}$ = | ±15 | V |
| $T_j$ = | $T_{jmax}$ | |

# Inverter Diode Characteristics

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

**Typical forward characteristics**

$I_F = f(V_F)$



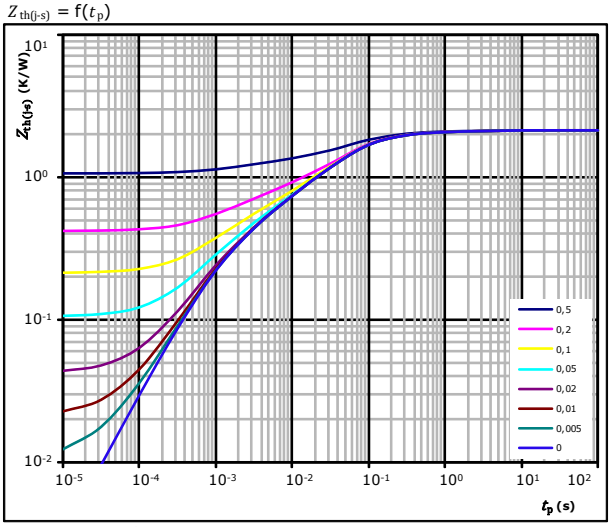

$t_p$ = 250 µs

$T_j$: 25 °C
125 °C
150 °C

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

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

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




$D$ = $t_p / T$

$R_{th(j-s)}$ = 2,11 K/W

FWD thermal model values

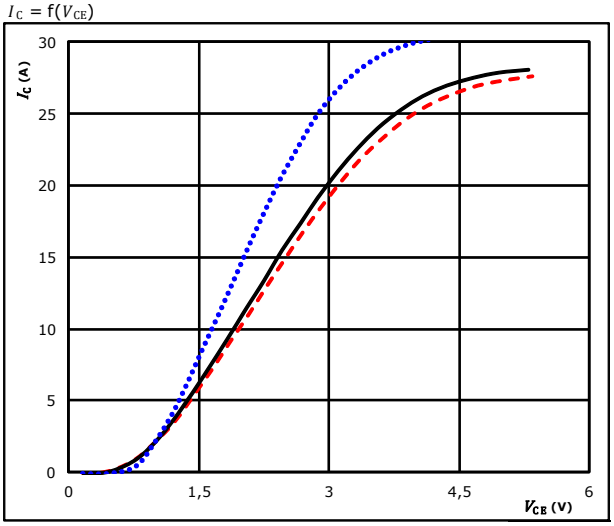
| $R$ (K/W) | $\tau$ (s) |
|---|---|
| 8,99E-02 | 2,33E+00 |
| 4,04E-01 | 1,91E-01 |
| 1,05E+00 | 4,49E-02 |
| 3,39E-01 | 6,08E-03 |
| 2,29E-01 | 1,02E-03 |

# Brake Switch Characteristics

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

**Typical output characteristics**

$I_C = f(V_{CE})$

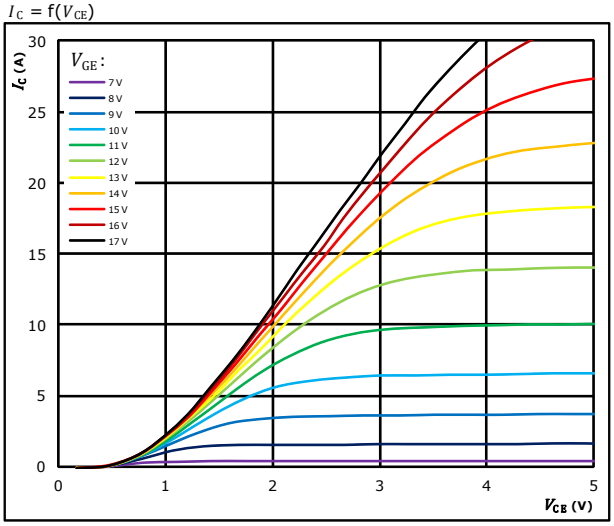



| | | | | |
|---|---|---|---|---|
| $t_p$ = | 250 | µs | | 25 °C |
| $V_{GE}$ = | 15 | V | $T_j$: | 125 °C |
| | | | | 150 °C |

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

**Typical output characteristics**

$I_C = f(V_{CE})$

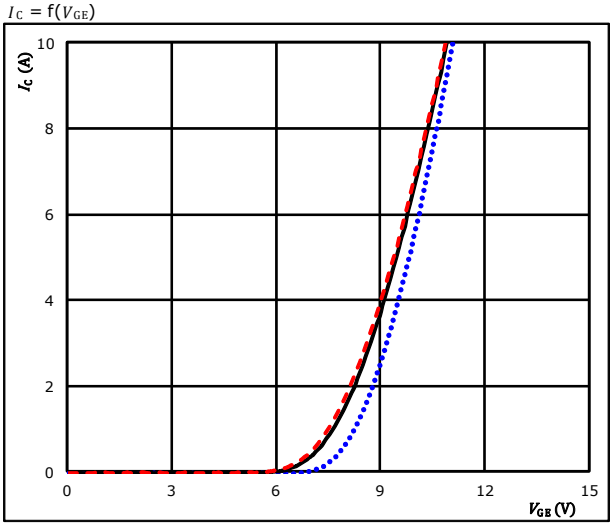



| | | |
|---|---|---|
| $t_p$ = | 250 | µs |
| $T_j$ = | 150 | °C |
| $V_{GE}$ from | 7 V to 17 V in steps of 1 V | |

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

**Typical transfer characteristics**

$I_C = f(V_{GE})$

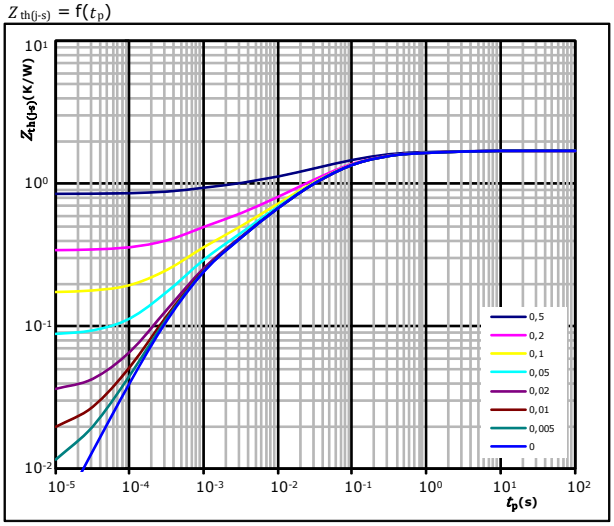



| | | | | |
|---|---|---|---|---|
| $t_p$ = | 100 | µs | | 25 °C |
| $V_{CE}$ = | 10 | V | $T_j$: | 125 °C |
| | | | | 150 °C |

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

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

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




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

IGBT thermal model values

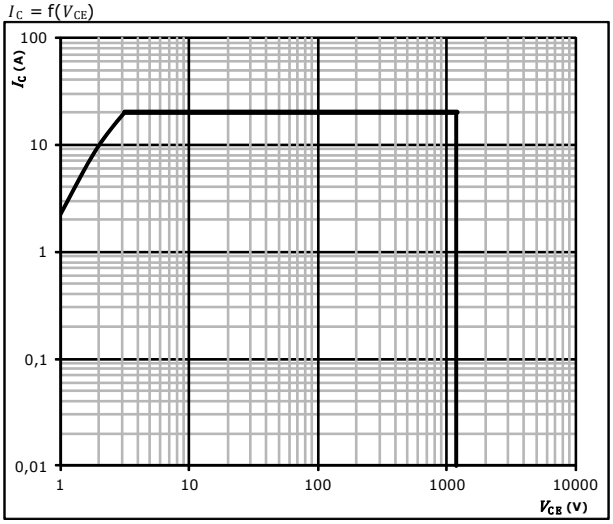
| $R$ (K/W) | $\tau$ (s) |
|---|---|
| 8,08E-02 | 2,32E+00 |
| 2,21E-01 | 2,45E-01 |
| 6,51E-01 | 6,03E-02 |
| 3,93E-01 | 1,33E-02 |
| 1,95E-01 | 3,15E-03 |
| 1,82E-01 | 5,45E-04 |

# Brake Switch Characteristics

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

**Safe operating area**

$I_C = f(V_{CE})$



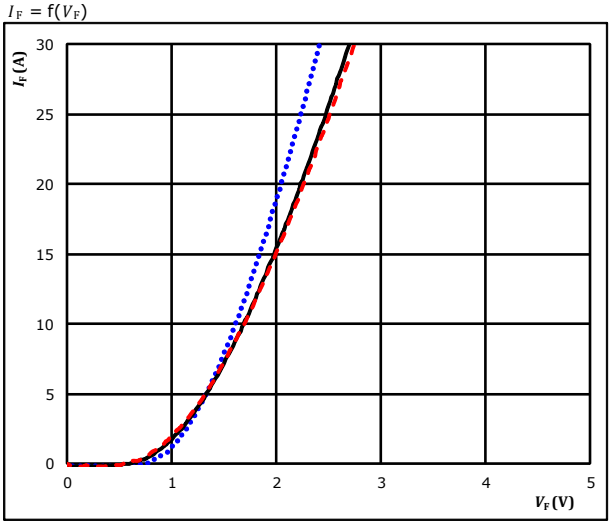

| | | |
|---|---|---|
| $D$ = | single pulse | |
| $T_s$ = | 80 | ºC |
| $V_{GE}$ = | ±15 | V |
| $T_j$ = | $T_{jmax}$ | |

# Brake Diode Characteristics

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

**Typical forward characteristics**

$I_F = f(V_F)$



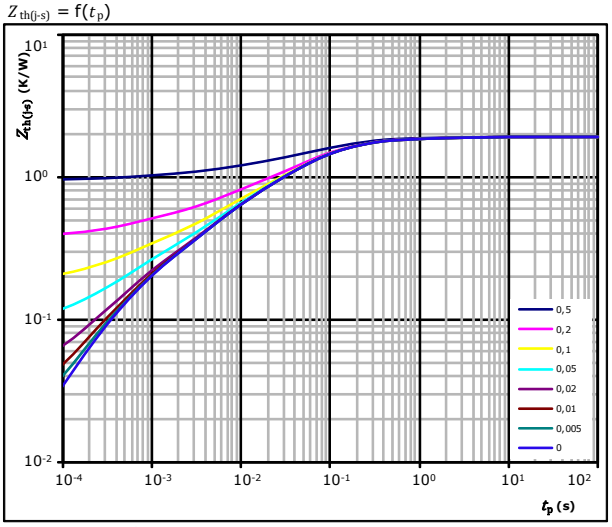

$t_p$ = 250 µs

$T_j$: 25 °C, 125 °C, 150 °C

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

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

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




$D = t_p / T$

$R_{th(j-s)}$ = 1,91 K/W

FWD thermal model values

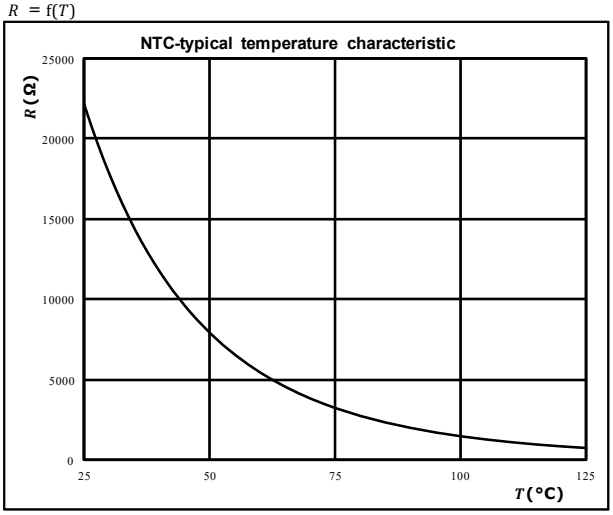
| $R$ (K/W) | $\tau$ (s) |
|---|---|
| 9,38E-02 | 2,25E+00 |
| 3,43E-01 | 2,12E-01 |
| 8,53E-01 | 5,82E-02 |
| 3,59E-01 | 9,80E-03 |
| 1,37E-01 | 2,88E-03 |
| 1,26E-01 | 4,78E-04 |

# Thermistor Characteristics

**figure 1.** **Thermistor**

**Typical NTC characteristic**
**as a function of temperature**

$R = f(T)$

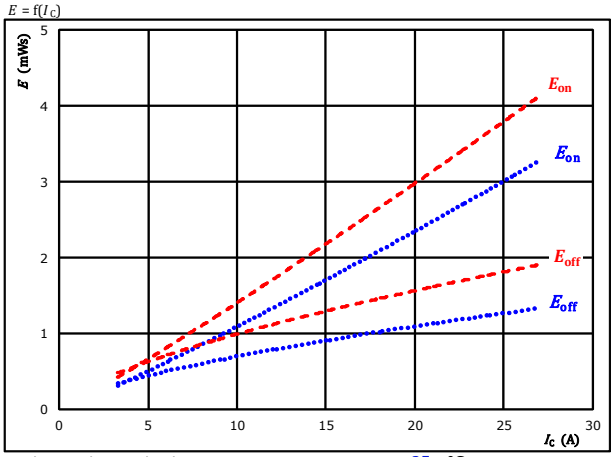


# Inverter Switching Characteristics

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

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

$E = f(I_C)$




With an inductive load at 25 °C

$V_{CE}$ = 600 V

$V_{GE}$ = ±15 V

$R_{gon}$ = 32 Ω

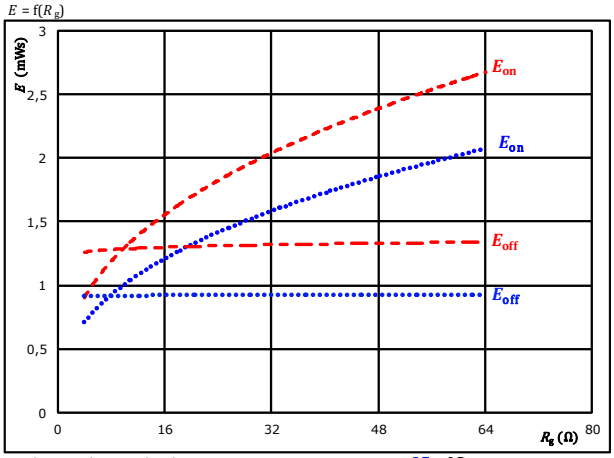
$R_{goff}$ = 32 Ω

$T_j$: 150 °C

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

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

$E = f(R_g)$




With an inductive load at 25 °C

$V_{CE}$ = 600 V

$V_{GE}$ = ±15 V

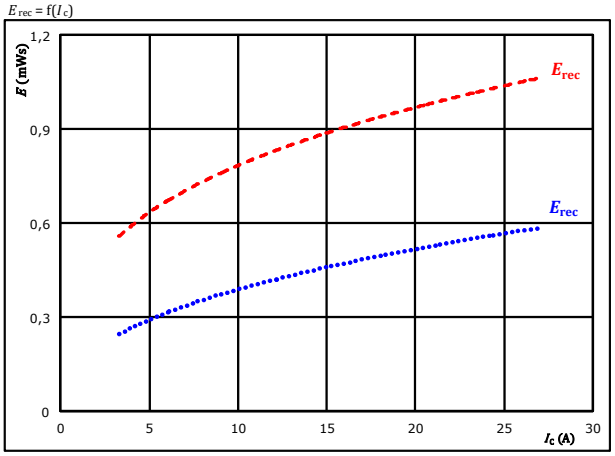
$I_C$ = 15 A

$T_j$: 150 °C

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

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

$E_{rec} = f(I_C)$




With an inductive load at 25 °C

$V_{CE}$ = 600 V

$V_{GE}$ = ±15 V

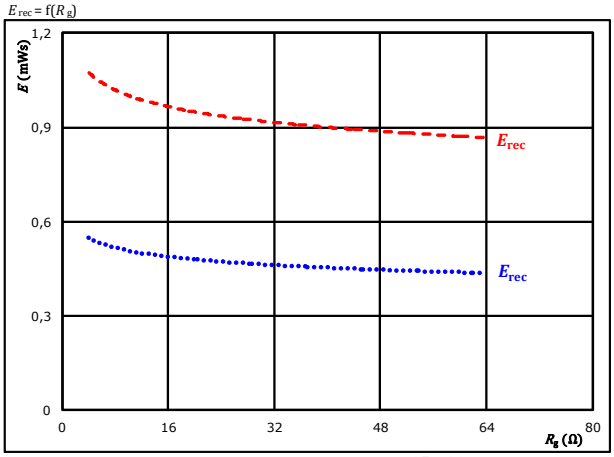
$R_{gon}$ = 32 Ω

$T_j$: 150 °C

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

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

$E_{rec} = f(R_g)$




With an inductive load at 25 °C

$V_{CE}$ = 600 V

$V_{GE}$ = ±15 V

$I_C$ = 15 A

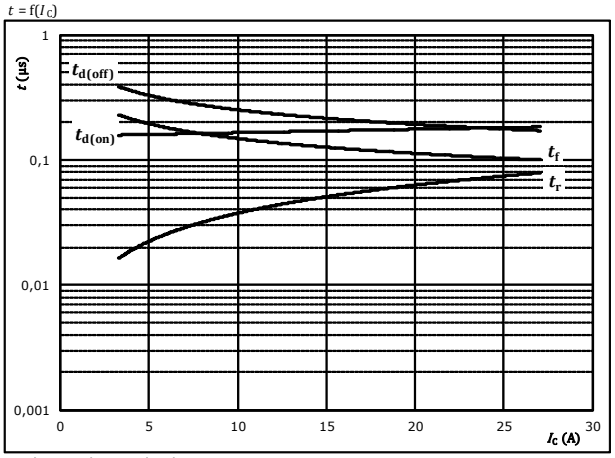
$T_j$: 150 °C

# Inverter Switching Characteristics

**figure 5.** IGBT

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

$t = f(I_C)$



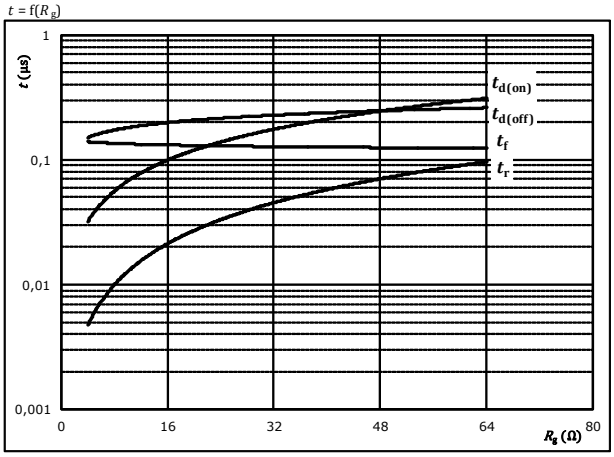

With an inductive load at

| | | |
|---|---|---|
| $T_j$ = | 150 | °C |
| $V_{CE}$ = | 600 | V |
| $V_{GE}$ = | ±15 | V |
| $R_{gon}$ = | 32 | Ω |
| $R_{goff}$ = | 32 | Ω |

**figure 6.** IGBT

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

$t = f(R_g)$



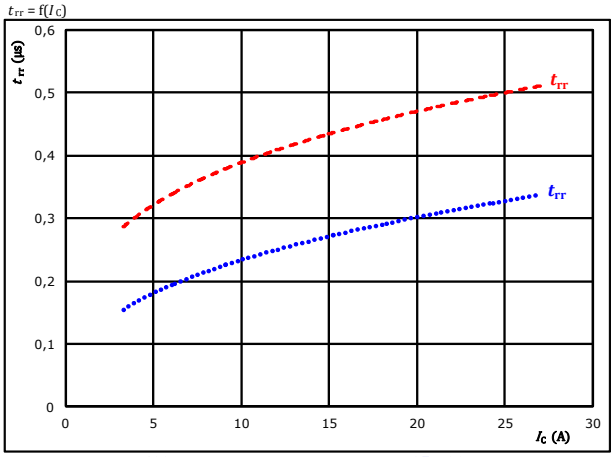

With an inductive load at

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

**figure 7.** FWD

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

$t_{rr} = f(I_C)$

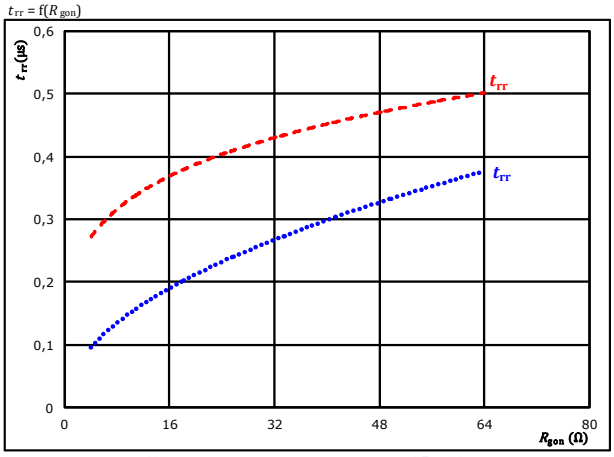



| | | | | | |
|---|---|---|---|---|---|
| At | $V_{CE}$ = | 600 | V | | |
| | $V_{GE}$ = | ±15 | V | $T_j$: | 25 °C / 150 °C |
| | $R_{gon}$ = | 32 | Ω | | |

**figure 8.** FWD

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

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



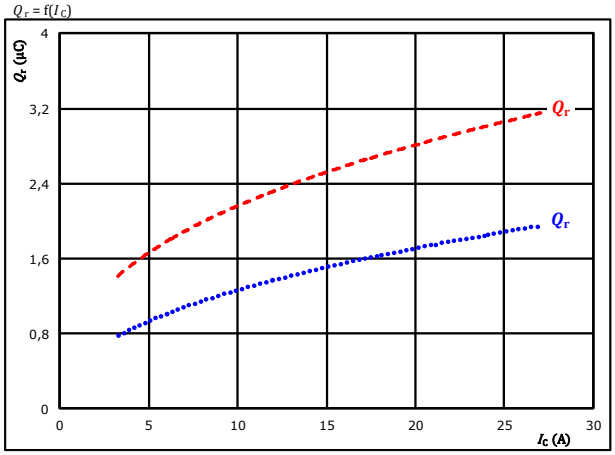

| | | | | | |
|---|---|---|---|---|---|
| At | $V_{CE}$ = | 600 | V | | |
| | $V_{GE}$ = | ±15 | V | $T_j$: | 25 °C / 150 °C |
| | $I_C$ = | 15 | A | | |

# Inverter Switching Characteristics

**figure 9.** FWD

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

$Q_r = f(I_C)$

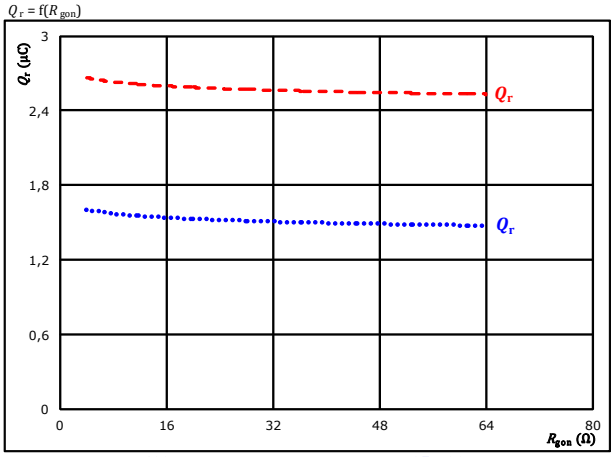



| At | | | | | | |
|---|---|---|---|---|---|---|
| $V_{CE}$ = | 600 | V | | 25 | °C | ..... |
| $V_{GE}$ = | ±15 | V | $T_j$: | 150 | °C | – – – |
| $R_{gon}$ = | 32 | Ω | | | | |

**figure 10.** FWD

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

$Q_r = f(R_{gon})$

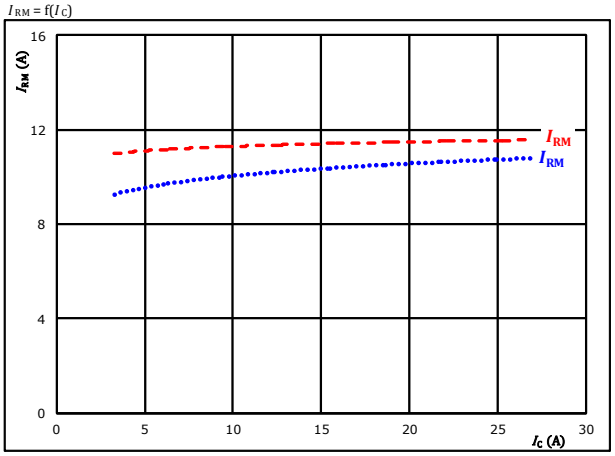



| At | | | | | | |
|---|---|---|---|---|---|---|
| $V_{CE}$ = | 600 | V | | 25 | °C | ..... |
| $V_{GE}$ = | ±15 | V | $T_j$: | 150 | °C | – – – |
| $I_C$ = | 15 | A | | | | |

**figure 11.** FWD

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

$I_{RM} = f(I_C)$

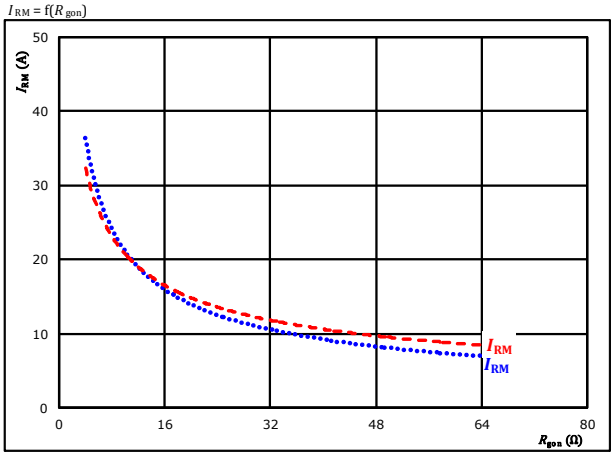



| At | | | | | | |
|---|---|---|---|---|---|---|
| $V_{CE}$ = | 600 | V | | 25 | °C | ..... |
| $V_{GE}$ = | ±15 | V | $T_j$: | 150 | °C | – – – |
| $R_{gon}$ = | 32 | Ω | | | | |

**figure 12.** FWD

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

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



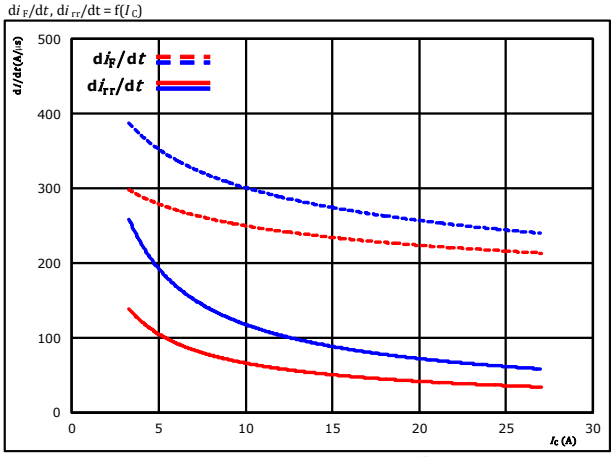

| At | | | | | | |
|---|---|---|---|---|---|---|
| $V_{CE}$ = | 600 | V | | 25 | °C | ..... |
| $V_{GE}$ = | ±15 | V | $T_j$: | 150 | °C | – – – |
| $I_C$ = | 15 | A | | | | |

# Inverter Switching Characteristics

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

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

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

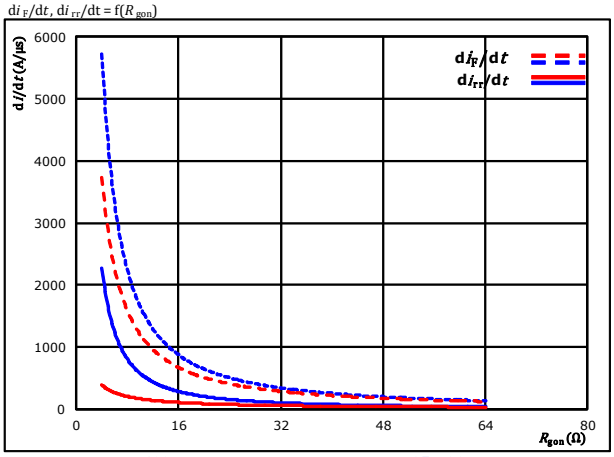



| At | | | | | | |
|---|---|---|---|---|---|---|
| $V_{CE}$ = | 600 | V | | 25 | °C | ••••••••••••••• |
| $V_{GE}$ = | ±15 | V | $T_j$: | 150 | °C | — — — — |
| $R_{gon}$ = | 32 | Ω | | | | |

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

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

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

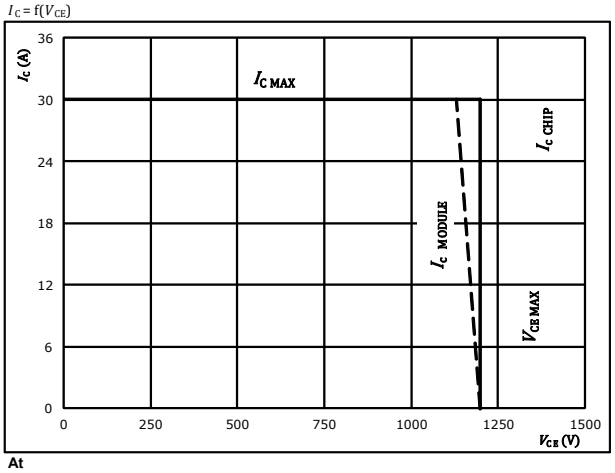



| At | | | | | | |
|---|---|---|---|---|---|---|
| $V_{CE}$ = | 600 | V | | 25 | °C | ••••••••••••••• |
| $V_{GE}$ = | ±15 | V | $T_j$: | 150 | °C | — — — — |
| $I_C$ = | 15 | A | | | | |

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

**Reverse bias safe operating area**

$I_C = f(V_{CE})$




| At | | | |
|---|---|---|---|
| $T_j$ = | 175 | °C | |
| $R_{gon}$ = | 32 | Ω | |
| $R_{goff}$ = | 32 | Ω | |

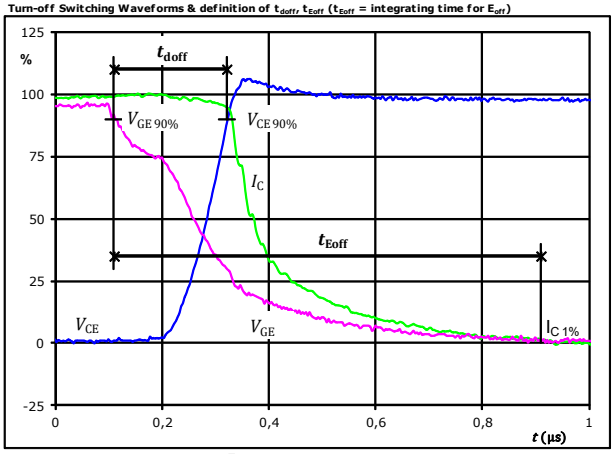
# Inverter Switching Definitions

**General conditions**

| | | |
|---|---|---|
| $T_j$ | = | 150 °C |
| $R_{gon}$ | = | 32 Ω |
| $R_{goff}$ | = | 32 Ω |

**figure 1.** IGBT

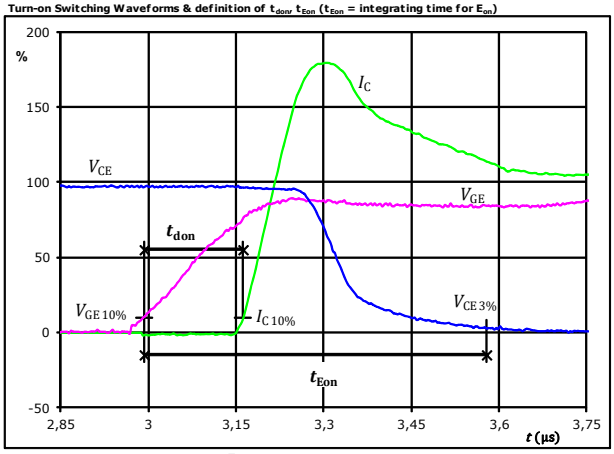
Turn-off Switching Waveforms & definition of $t_{doff}$, $t_{Eoff}$ ($t_{Eoff}$ = integrating time for $E_{off}$)




| | | |
|---|---|---|
| $V_{GE}(0\%)$ = | -15 | V |
| $V_{GE}(100\%)$ = | 15 | V |
| $V_C(100\%)$ = | 600 | V |
| $I_C(100\%)$ = | 15 | A |
| $t_{doff}$ = | 0,218 | µs |
| $t_{Eoff}$ = | 0,800 | µs |

**figure 2.** IGBT

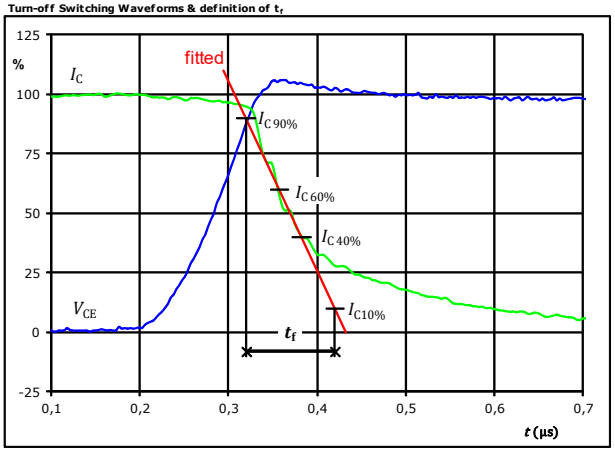
Turn-on Switching Waveforms & definition of $t_{don}$, $t_{Eon}$ ($t_{Eon}$ = integrating time for $E_{on}$)




| | | |
|---|---|---|
| $V_{GE}(0\%)$ = | -15 | V |
| $V_{GE}(100\%)$ = | 15 | V |
| $V_C(100\%)$ = | 600 | V |
| $I_C(100\%)$ = | 15 | A |
| $t_{don}$ = | 0,174 | µs |
| $t_{Eon}$ = | 0,586 | µs |

**figure 3.** IGBT

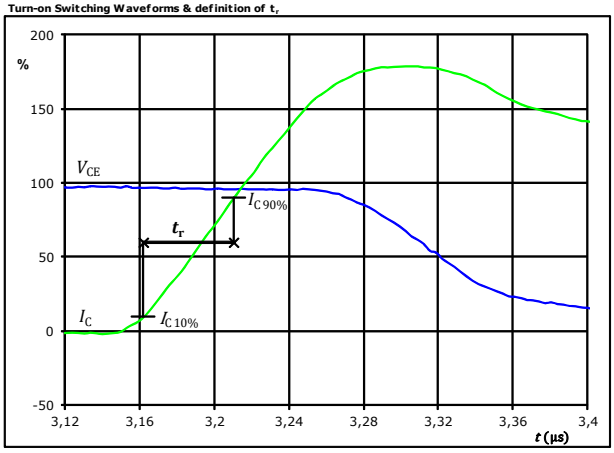
Turn-off Switching Waveforms & definition of $t_f$




| | | |
|---|---|---|
| $V_C(100\%)$ = | 600 | V |
| $I_C(100\%)$ = | 15 | A |
| $t_f$ = | 0,127 | µs |

**figure 4.** IGBT

Turn-on Switching Waveforms & definition of $t_r$

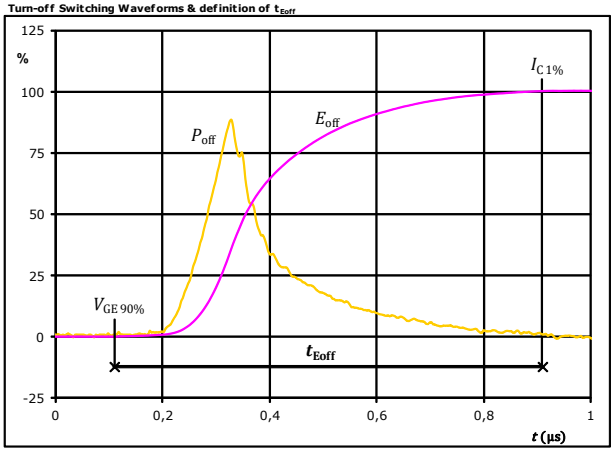



| | | |
|---|---|---|
| $V_C(100\%)$ = | 600 | V |
| $I_C(100\%)$ = | 15 | A |
| $t_r$ = | 0,048 | µs |

# Inverter Switching Characteristics

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

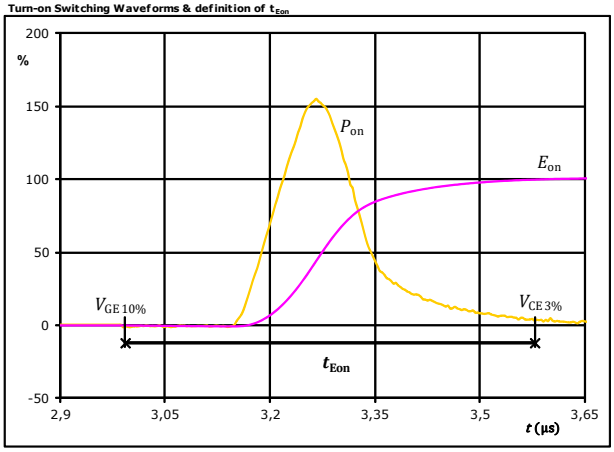
Turn-off Switching Waveforms & definition of $t_{Eoff}$




| | | |
|---|---|---|
| $P_{off}(100\%)$ = | 9,24 | kW |
| $E_{off}(100\%)$ = | 1,32 | mJ |
| $t_{Eoff}$ = | 0,80 | µs |

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

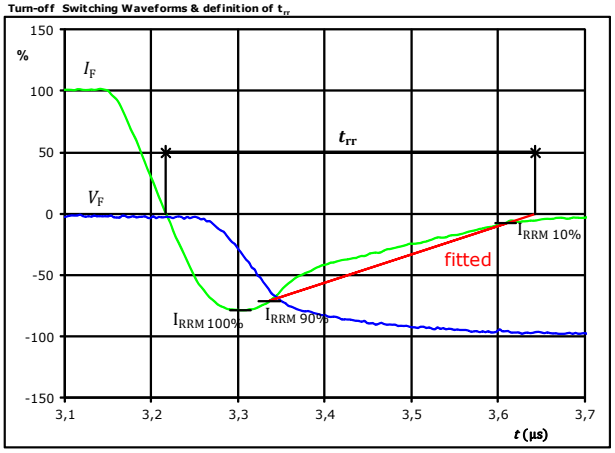
Turn-on Switching Waveforms & definition of $t_{Eon}$




| | | |
|---|---|---|
| $P_{on}(100\%)$ = | 9,24 | kW |
| $E_{on}(100\%)$ = | 2,01 | mJ |
| $t_{Eon}$ = | 0,59 | µs |

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

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

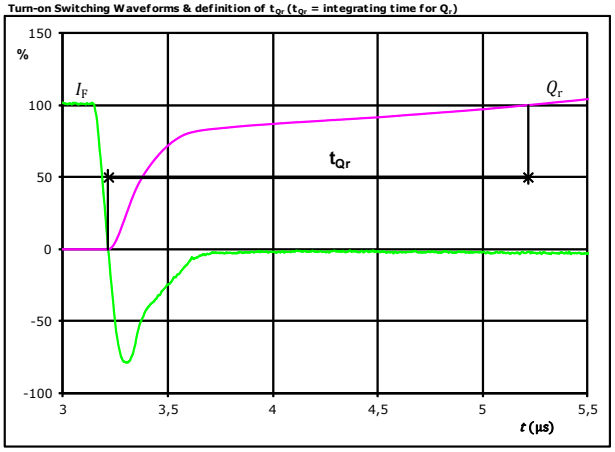



| | | |
|---|---|---|
| $V_F(100\%)$ = | 600 | V |
| $I_F(100\%)$ = | 15 | A |
| $I_{RRM}(100\%)$ = | -12 | A |
| $t_{rr}$ = | 0,423 | µs |

# Inverter Switching Characteristics

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

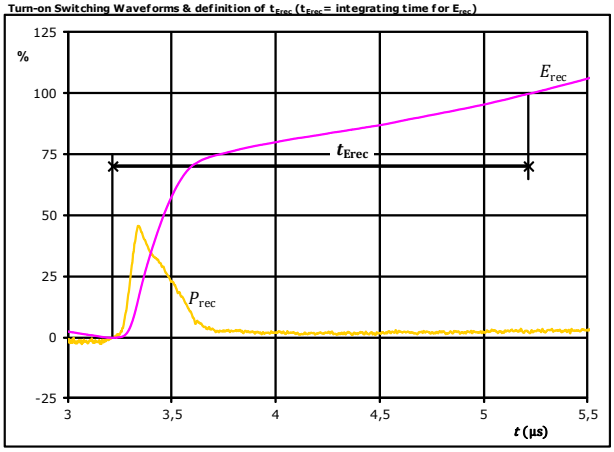
Turn-on Switching Waveforms & definition of $t_{Qr}$ ($t_{Qr}$ = integrating time for $Q_r$)




| | | |
|---|---|---|
| $I_F$ (100%) = | 15 | A |
| $Q_r$ (100%) = | 2,59 | µC |
| $t_{Qr}$ = | 2,00 | µs |

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

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



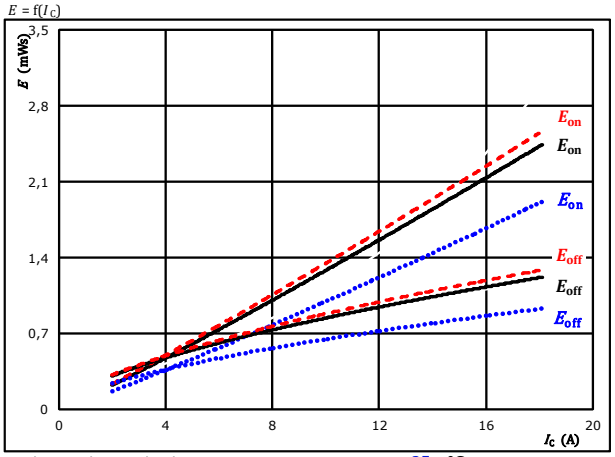

| | | |
|---|---|---|
| $P_{rec}$ (100%) = | 9,24 | kW |
| $E_{rec}$ (100%) = | 0,94 | mJ |
| $t_{Erec}$ = | 2,00 | µs |

# Brake Switching Characteristics

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

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

$E = f(I_C)$



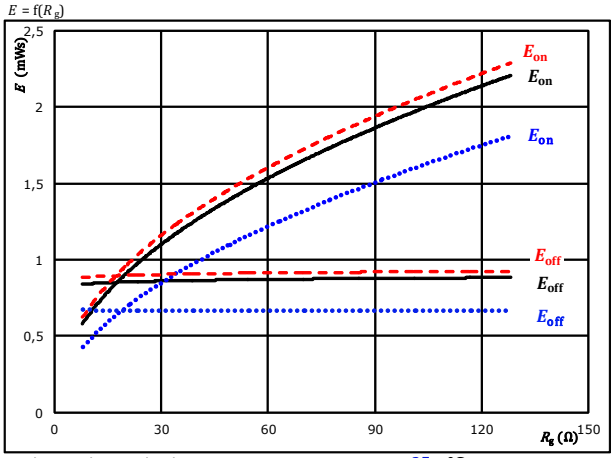

With an inductive load at

| | | | | | |
|---|---|---|---|---|---|
| $V_{CE}$ = | 600 | V | $T_j$: | 25 °C | |
| $V_{GE}$ = | ±15 | V | | 125 °C | |
| $R_{gon}$ = | 32 | Ω | | 150 °C | |
| $R_{goff}$ = | 32 | Ω | | | |

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

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

$E = f(R_g)$



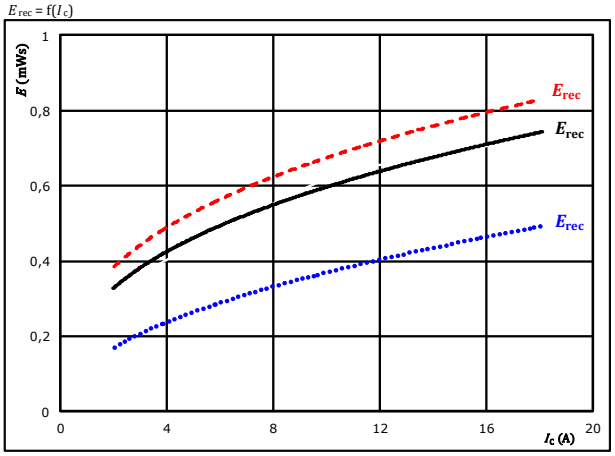

With an inductive load at

| | | | | | |
|---|---|---|---|---|---|
| $V_{CE}$ = | 600 | V | $T_j$: | 25 °C | |
| $V_{GE}$ = | ±15 | V | | 125 °C | |
| $I_C$ = | 10 | A | | 150 °C | |

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

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

$E_{rec} = f(I_C)$



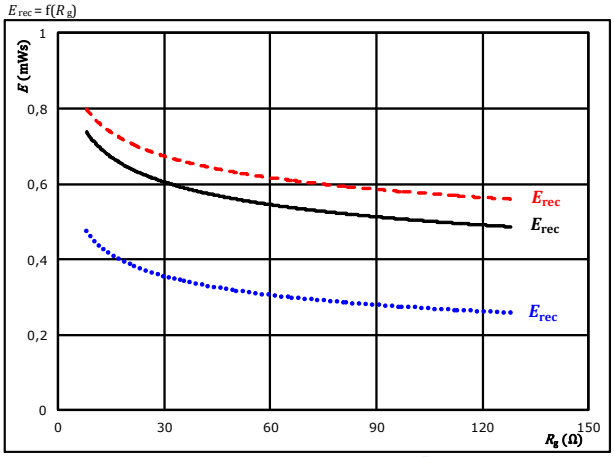

With an inductive load at

| | | | | | |
|---|---|---|---|---|---|
| $V_{CE}$ = | 600 | V | $T_j$: | 25 °C | |
| $V_{GE}$ = | ±15 | V | | 125 °C | |
| $R_{gon}$ = | 32 | Ω | | 150 °C | |

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

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

$E_{rec} = f(R_g)$




With an inductive load at

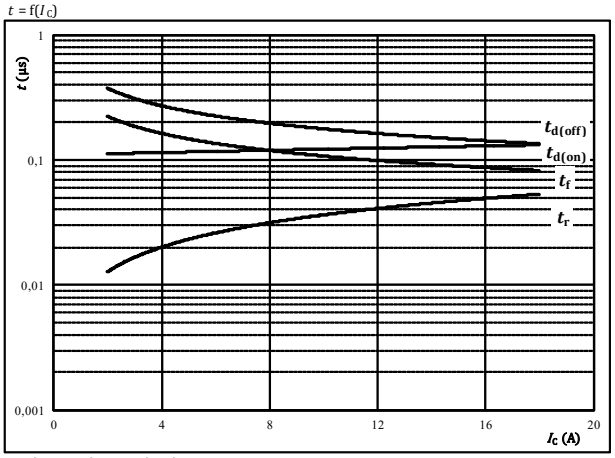
| | | | | | |
|---|---|---|---|---|---|
| $V_{CE}$ = | 600 | V | $T_j$: | 25 °C | |
| $V_{GE}$ = | ±15 | V | | 125 °C | |
| $I_C$ = | 10 | A | | 150 °C | |

# Brake Switching Characteristics

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

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

$t = f(I_C)$



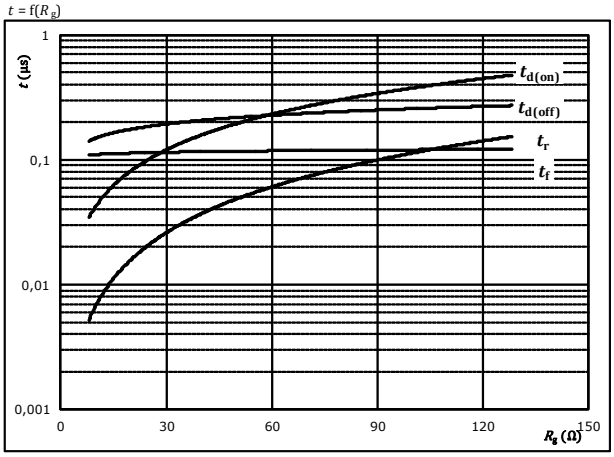

With an inductive load at

| | | |
|---|---|---|
| $T_j$ = | 150 | °C |
| $V_{CE}$ = | 600 | V |
| $V_{GE}$ = | ±15 | V |
| $R_{gon}$ = | 32 | Ω |
| $R_{goff}$ = | 32 | Ω |

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

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

$t = f(R_g)$



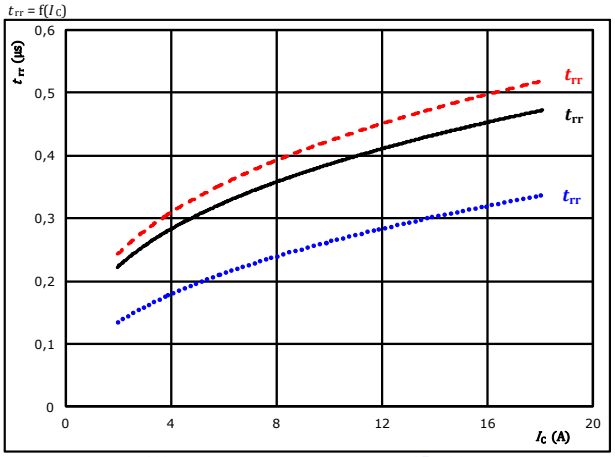

With an inductive load at

| | | |
|---|---|---|
| $T_j$ = | 150 | °C |
| $V_{CE}$ = | 600 | V |
| $V_{GE}$ = | ±15 | V |
| $I_C$ = | 10 | A |

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

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

$t_{rr} = f(I_C)$



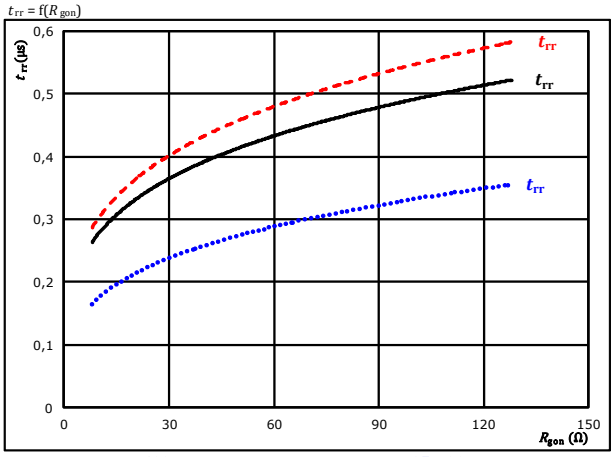

At

| | | | | | |
|---|---|---|---|---|---|
| $V_{CE}$ = | 600 | V | $T_j$: | 25 | °C |
| $V_{GE}$ = | ±15 | V | | 125 | °C |
| $R_{gon}$ = | 32 | Ω | | 150 | °C |

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

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

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




At

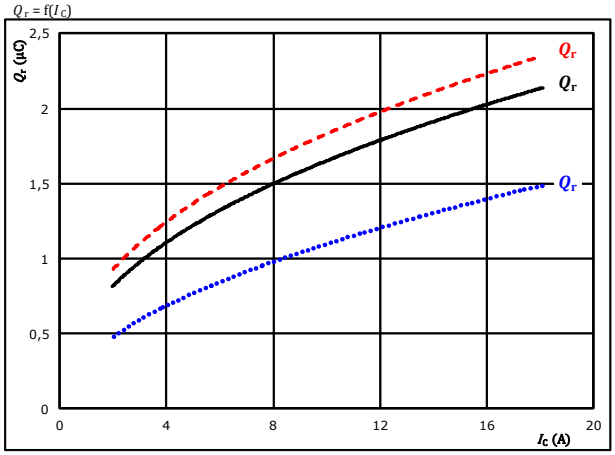
| | | | | | |
|---|---|---|---|---|---|
| $V_{CE}$ = | 600 | V | $T_j$: | 25 | °C |
| $V_{GE}$ = | ±15 | V | | 125 | °C |
| $I_C$ = | 10 | A | | 150 | °C |

# Brake Switching Characteristics

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

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

$Q_r = f(I_C)$

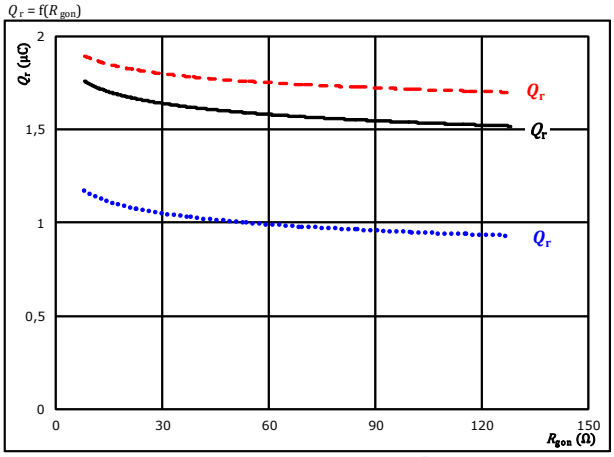



| At | | | | | | |
|---|---|---|---|---|---|---|
| $V_{CE}$ = | 600 | V | | 25 °C | ····· |
| $V_{GE}$ = | ±15 | V | $T_j$: | 125 °C | ——— |
| $R_{gon}$ = | 32 | Ω | | 150 °C | – – – |

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

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

$Q_r = f(R_{gon})$

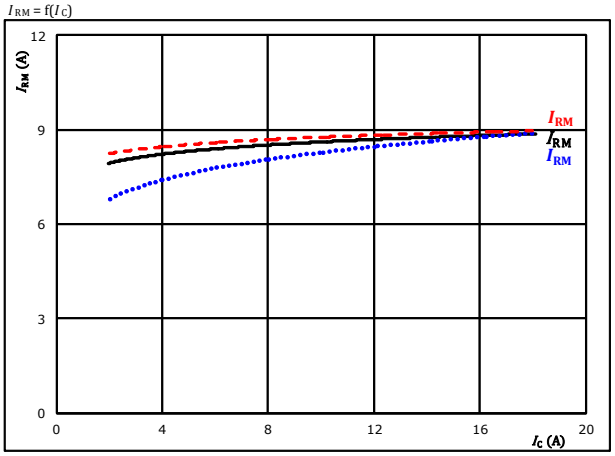



| At | | | | | | |
|---|---|---|---|---|---|---|
| $V_{CE}$ = | 600 | V | | 25 °C | ····· |
| $V_{GE}$ = | ±15 | V | $T_j$: | 125 °C | ——— |
| $I_C$ = | 10 | A | | 150 °C | – – – |

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

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

$I_{RM} = f(I_C)$

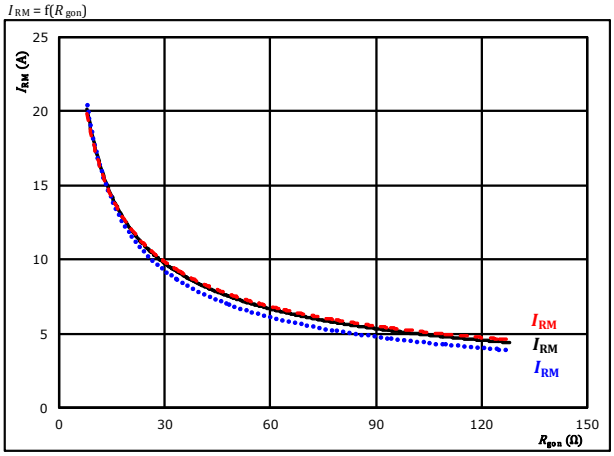



| At | | | | | | |
|---|---|---|---|---|---|---|
| $V_{CE}$ = | 600 | V | | 25 °C | ····· |
| $V_{GE}$ = | ±15 | V | $T_j$: | 125 °C | ——— |
| $R_{gon}$ = | 32 | Ω | | 150 °C | – – – |

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

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

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



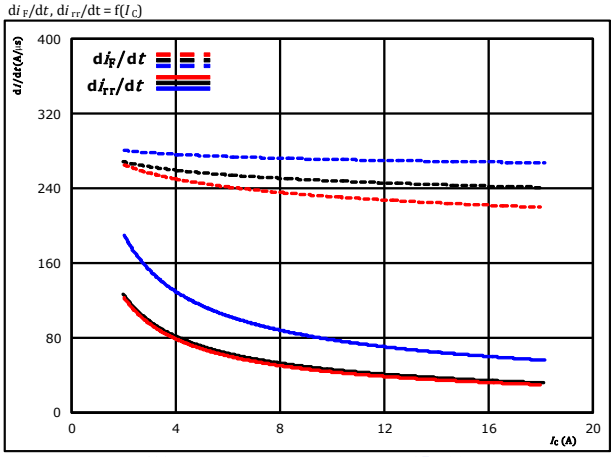

| At | | | | | | |
|---|---|---|---|---|---|---|
| $V_{CE}$ = | 600 | V | | 25 °C | ····· |
| $V_{GE}$ = | ±15 | V | $T_j$: | 125 °C | ——— |
| $I_C$ = | 10 | A | | 150 °C | – – – |

# Brake Switching Characteristics

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

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

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

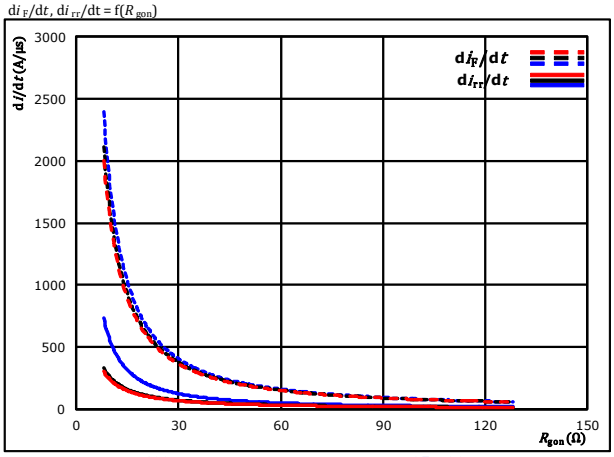



| At | | | | | | |
|---|---|---|---|---|---|---|
| $V_{CE}$: | 600 | V | | 25 | °C | |
| $V_{GE}$ = | ±15 | V | $T_j$: | 125 | °C | |
| $R_{gon}$ = | 32 | Ω | | 150 | °C | |

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

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

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

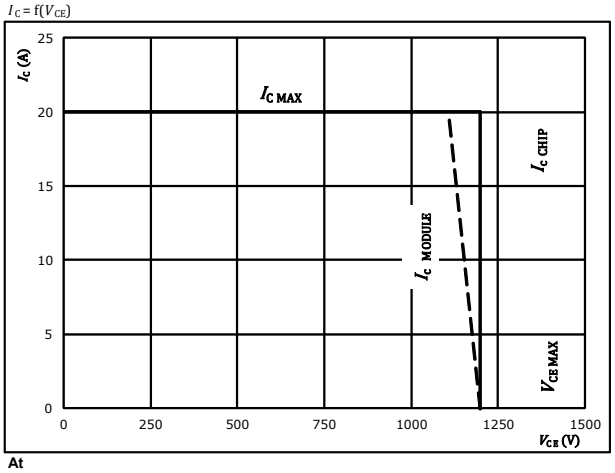



| At | | | | | | |
|---|---|---|---|---|---|---|
| $V_{CE}$ = | 600 | V | | 25 | °C | |
| $V_{GE}$ = | ±15 | V | $T_j$: | 125 | °C | |
| $I_C$ = | 10 | A | | 150 | °C | |

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

**Reverse bias safe operating area**

$I_C = f(V_{CE})$




At

| | | |
|---|---|---|
| $T_j$ = | 175 | °C |
| $R_{gon}$ = | 32 | Ω |
| $R_{goff}$ = | 32 | Ω |

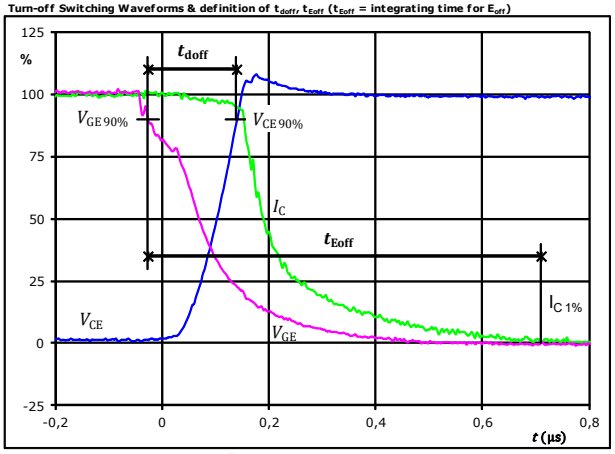
# Brake Switching Definitions

**General conditions**

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

**figure 1.** IGBT

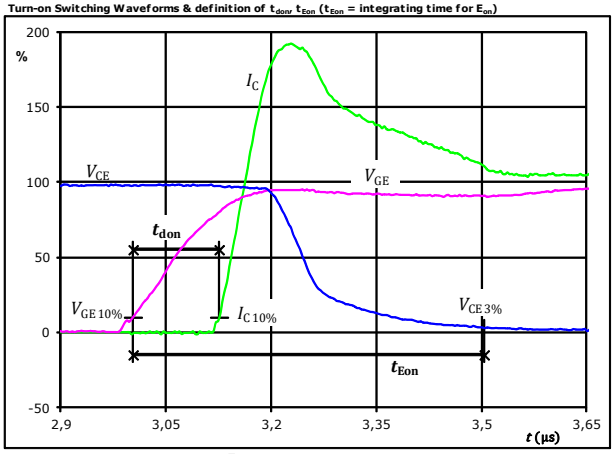
Turn-off Switching Waveforms & definition of $t_{doff}$, $t_{Eoff}$ ($t_{Eoff}$ = integrating time for $E_{off}$)




| | | |
|---|---|---|
| $V_{GE}(0\%)$ = | -15 | V |
| $V_{GE}(100\%)$ = | 15 | V |
| $V_C(100\%)$ = | 600 | V |
| $I_C(100\%)$ = | 10 | A |
| $t_{doff}$ = | 0,179 | µs |
| $t_{Eoff}$ = | 0,737 | µs |

**figure 2.** IGBT

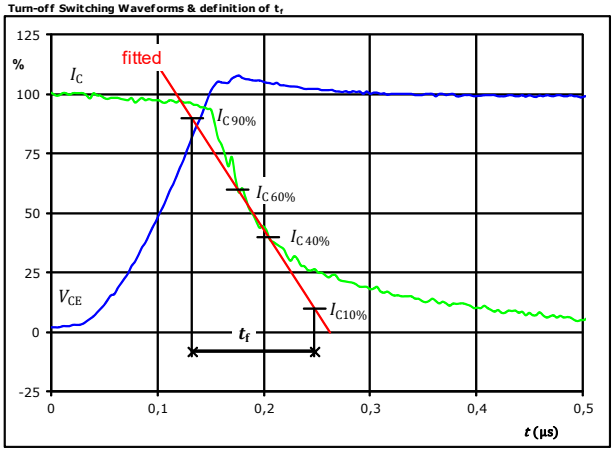
Turn-on Switching Waveforms & definition of $t_{don}$, $t_{Eon}$ ($t_{Eon}$ = integrating time for $E_{on}$)




| | | |
|---|---|---|
| $V_{GE}(0\%)$ = | -15 | V |
| $V_{GE}(100\%)$ = | 15 | V |
| $V_C(100\%)$ = | 600 | V |
| $I_C(100\%)$ = | 10 | A |
| $t_{don}$ = | 0,126 | µs |
| $t_{Eon}$ = | 0,501 | µs |

**figure 3.** IGBT

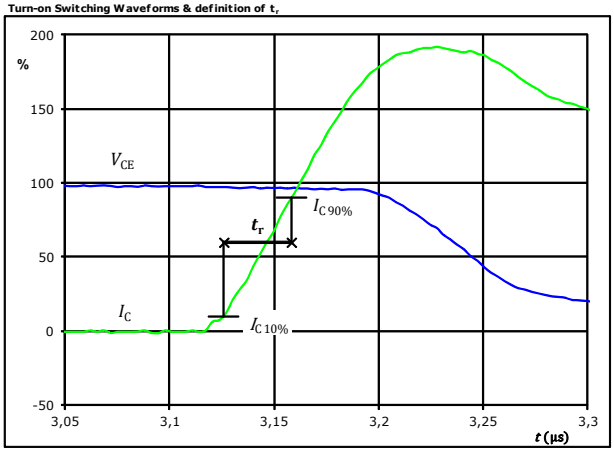
Turn-off Switching Waveforms & definition of $t_f$




| | | |
|---|---|---|
| $V_C(100\%)$ = | 600 | V |
| $I_C(100\%)$ = | 10 | A |
| $t_f$ = | 0,108 | µs |

**figure 4.** IGBT

Turn-on Switching Waveforms & definition of $t_r$

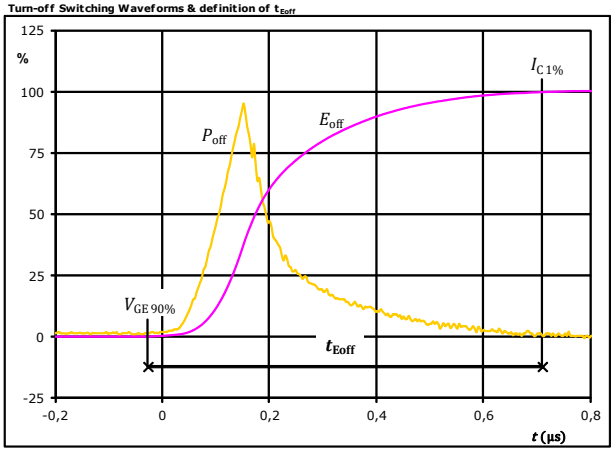



| | | |
|---|---|---|
| $V_C(100\%)$ = | 600 | V |
| $I_C(100\%)$ = | 10 | A |
| $t_r$ = | 0,032 | µs |

# Brake Switching Characteristics

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

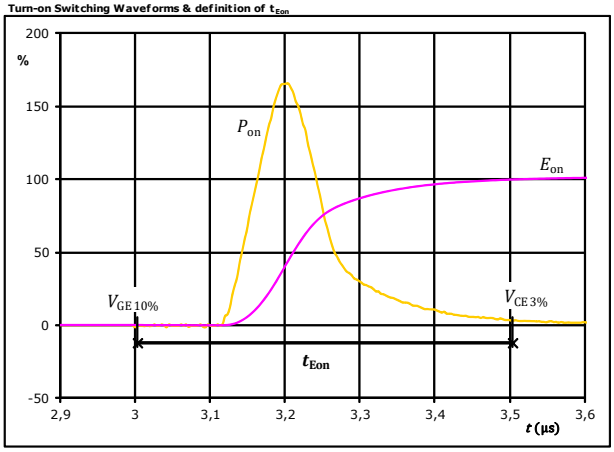
Turn-off Switching Waveforms & definition of $t_{Eoff}$




| | | |
|---|---|---|
| $P_{off}(100\%)$ = | 6,02 | kW |
| $E_{off}(100\%)$ = | 0,86 | mJ |
| $t_{Eoff}$ = | 0,74 | µs |

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

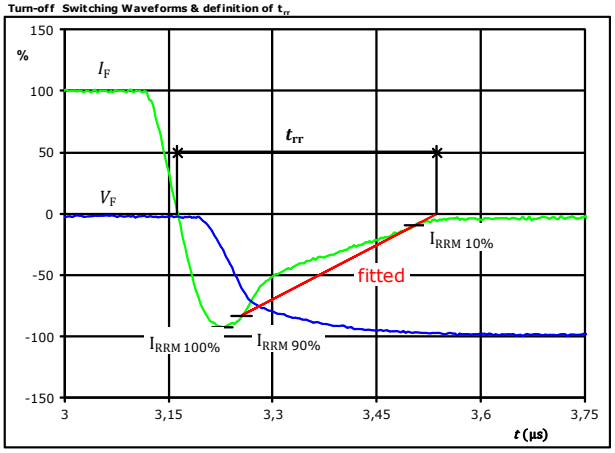
Turn-on Switching Waveforms & definition of $t_{Eon}$




| | | |
|---|---|---|
| $P_{on}(100\%)$ = | 6,02 | kW |
| $E_{on}(100\%)$ = | 1,13 | mJ |
| $t_{Eon}$ = | 0,50 | µs |

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

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

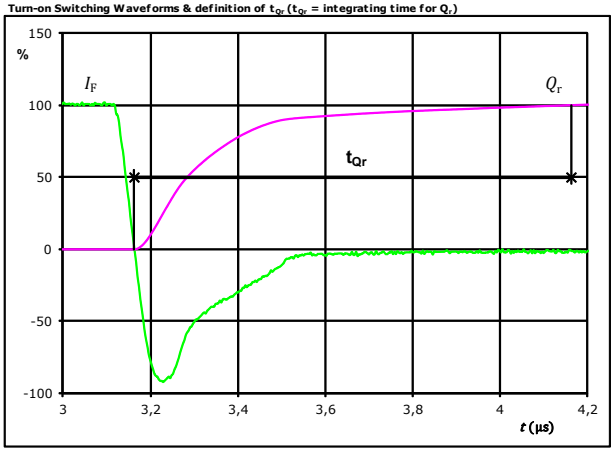



| | | |
|---|---|---|
| $V_F(100\%)$ = | 600 | V |
| $I_F(100\%)$ = | 10 | A |
| $I_{RRM}(100\%)$ = | -9 | A |
| $t_{rr}$ = | 0,373 | µs |

# Brake Switching Characteristics

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

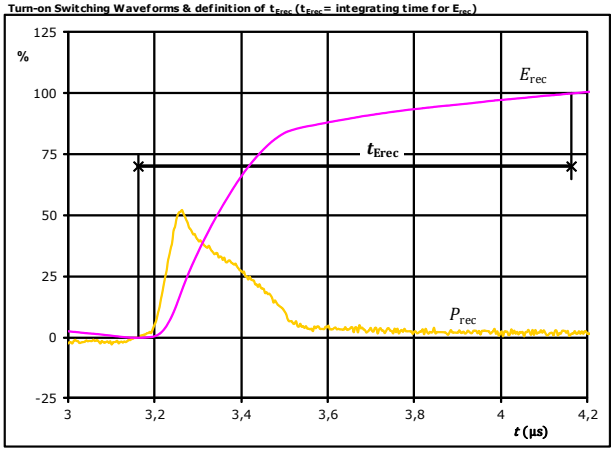
Turn-on Switching Waveforms & definition of $t_{Qr}$ ($t_{Qr}$ = integrating time for $Q_r$)




| | | |
|---|---|---|
| $I_F$ (100%) = | 10 | A |
| $Q_r$ (100%) = | 1,66 | µC |
| $t_{Qr}$ = | 1,00 | µs |

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

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




| | | |
|---|---|---|
| $P_{rec}$ (100%) = | 6,02 | kW |
| $E_{rec}$ (100%) = | 0,62 | mJ |
| $t_{Erec}$ = | 1,00 | µs |

Vincotech

## Ordering Code & Marking

| Version | Ordering Code |
|---|---|
| without thermal paste | 10-R112PMA015M7-P639A75 |
| with thermal paste | 10-R112PMA015M7-P639A75-/3/ |
| | |
| | |

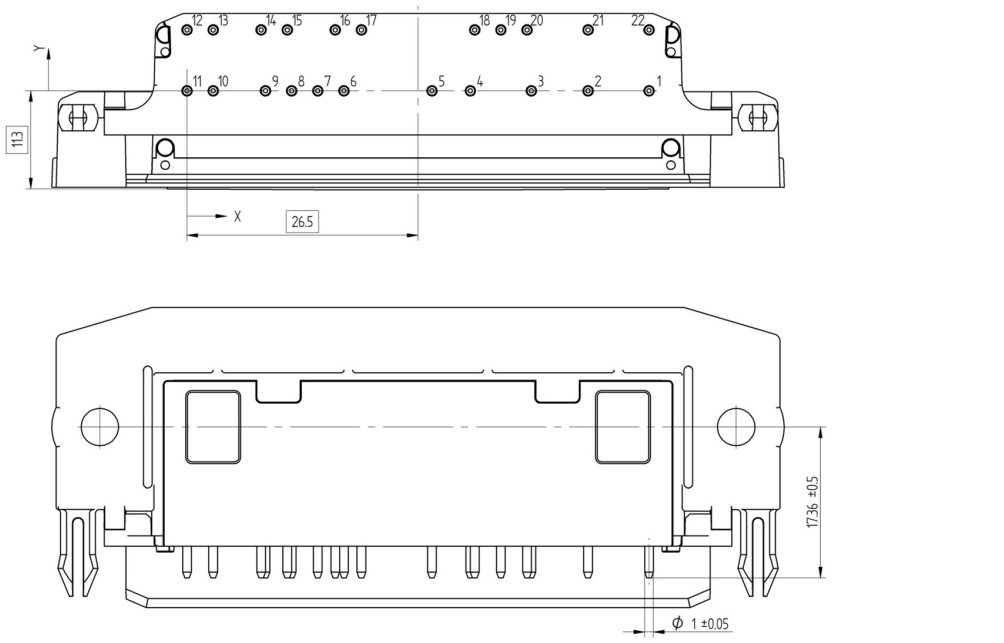
NN-NNNNNNNNNNNNN
TTTTTTVV WWYY UL
VIN LLLLL SSSS

| | | | | | | |
|---|---|---|---|---|---|---|
| **Text** | **Name** | | **Date code** | **UL & VIN** | **Lot** | **Serial** |
| | NN-NNNNNNNNNNNNN-TTTTTTVV | | WWYY | UL VIN | LLLLL | SSSS |
| **Datamatrix** | **Type&Ver** | **Lot number** | **Serial** | **Date code** | | |
| | TTTTTTVV | LLLLL | SSSS | WWYY | | |

## Outline

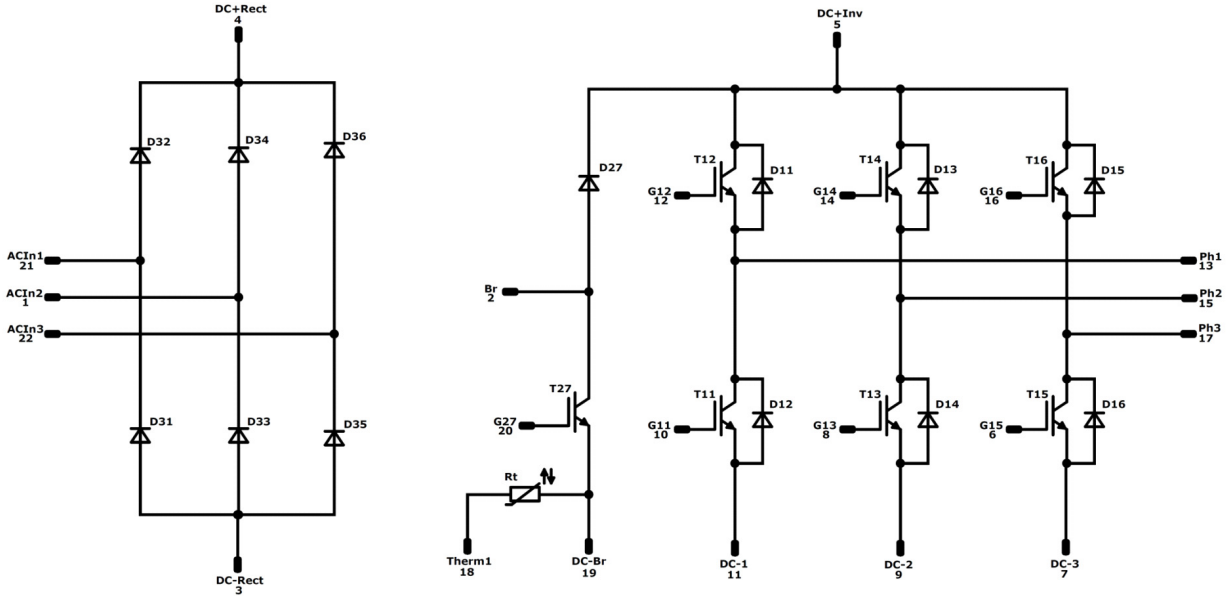
Pin table

| Pin | X | Y | Function |
|---|---|---|---|
| 1 | 53 | 0 | ACIn2 |
| 2 | 46 | 0 | Br |
| 3 | 39,5 | 0 | DC-Rect |
| 4 | 32,5 | 0 | DC+Rect |
| 5 | 28,1 | 0 | DC+Inv |
| 6 | 18 | 0 | G15 |
| 7 | 15 | 0 | DC-3 |
| 8 | 12 | 0 | G13 |
| 9 | 9 | 0 | DC-2 |
| 10 | 3 | 0 | G11 |
| 11 | 0 | 0 | DC-1 |
| 12 | 0 | 7 | G12 |
| 13 | 3 | 7 | Ph1 |
| 14 | 8,5 | 7 | G14 |
| 15 | 11,5 | 7 | Ph2 |
| 16 | 17 | 7 | G16 |
| 17 | 20 | 7 | Ph3 |
| 18 | 33 | 7 | Therm1 |
| 19 | 36 | 7 | DC-Br |
| 20 | 39 | 7 | G27 |
| 21 | 46 | 7 | ACIn1 |
| 22 | 53 | 7 | ACIn3 |




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 |
|---|---|---|---|---|---|
| D31, D32, D33, D34, D35, D36 | Rectifier | 1600 V | 25 A | Rectifier Diode | |
| T11, T12, T13, T14, T15, T16 | IGBT | 1200 V | 15 A | Inverter Switch | |
| D11, D12, D13, D14, D15, D16 | FWD | 1200 V | 15 A | Inverter Diode | |
| T27 | IGBT | 1200 V | 10 A | Brake Switch | |
| D27 | FWD | 1200 V | 10 A | Brake Diode | |
| Rt | NTC | | | Thermistor | |

| Packaging instruction | | | | |
|---|---|---|---|---|
| Standard packaging quantity (SPQ) 80 | >SPQ | Standard | <SPQ | Sample |

| Handling instruction |
|---|
| Handling instructions for *flow* 90 1 packages see vincotech.com website. |

| Package data |
|---|
| Package data for *flow* 90 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 |
|---|---|---|---|
| 10-R112PMA015M7-P639A75-D2-14 | 09 Aug. 2018 | Ordering Code option added | 29 |

单击下面可查看定价，库存，交付和生命周期等信息

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