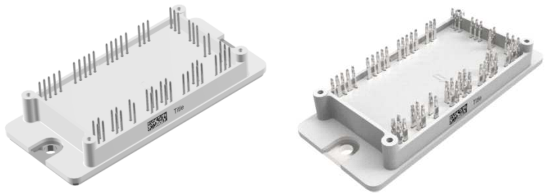
# V23990-P760-A60-PM
# V23990-P760-A60Y-PM
datasheet

***flow* PIM 2** **1200 V / 100 A**

## Features

- 3~rectifier, BRC, Inverter, NTC
- Very compact housing, easy to route
- Mitsubishi IGBT and FWD

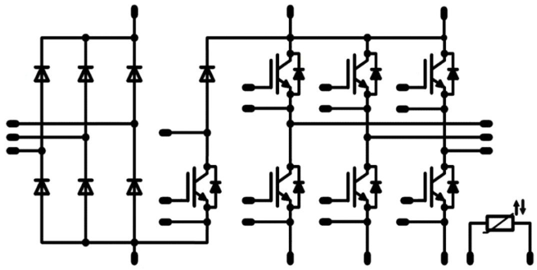
## *flow* 2 17mm housing



## Target applications

- Motor Drives
- Power Generation

## Schematic



## Types

- V23990-P760-A60-PM
- V23990-P760-A60Y-PM

# 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 | $I_C$ | $T_j = T_j$max | $T_S$=80 °C | 111 | A |
| Repetitive peak collector current | $I_{CRM}$ | $t_p$ limited by $T_j$max | | 200 | A |
| Total power dissipation | $P_{tot}$ | $T_j = T_j$max | $T_S$=80 °C | 258 | W |
| Gate-emitter voltage | $V_{GES}$ | | | ±20 | V |
| Maximum Junction Temperature | $T_{jmax}$ | | | 175 | °C |

| Parameter | Symbol | Conditions | | Value | Unit |
|---|---|---|---|---|---|
| **Inverter Diode** | | | | | |
| Peak Repetitive Reverse Voltage | $V_{RRM}$ | | | 1200 | V |
| Continuous (direct) forward current | $I_F$ | $T_j = T_{jmax}$ | $T_h$ = 80°C | 82 | A |
| Repetitive peak forward current | $I_{FRM}$ | | | 200 | A |
| Total power dissipation | $P_{tot}$ | $T_j = T_{jmax}$ | $T_h$ = 80°C | 164 | W |
| Maximum Junction Temperature | $T_{jmax}$ | | | 175 | °C |

| Parameter | Symbol | Condition | | Value | Unit |
|---|---|---|---|---|---|
| **Brake Switch** | | | | | |
| Collector-emitter voltage | $V_{CES}$ | | | 1200 | V |
| Collector current | $I_C$ | $T_j = T_j$max | $T_S$=80 °C | 61 | A |
| Repetitive peak collector current | $I_{CRM}$ | $t_p$ limited by $T_j$max | | 100 | A |
| Total power dissipation | $P_{tot}$ | $T_j = T_j$max | $T_S$=80 °C | 144 | W |
| Gate-emitter voltage | $V_{GES}$ | | | ±20 | V |
| Maximum Junction Temperature | $T_{jmax}$ | | | 175 | °C |

| Parameter | Symbol | Conditions | | Value | Unit |
|---|---|---|---|---|---|
| **Brake Diode** | | | | | |
| Peak Repetitive Reverse Voltage | $V_{RRM}$ | | | 1200 | V |
| Continuous (direct) forward current | $I_F$ | $T_j$=$T_{jmax}$ | $T_h$=80°C | 27 | A |
| Surge (non-repetitive) forward current | $I_{FSM}$ | 50Hz Single Half Sine Wave | | 100 | A |
| Total power dissipation | $P_{tot}$ | $T_j$=$T_{jmax}$ | $T_h$=80°C | 69 | W |
| Maximum Junction Temperature | $T_{jmax}$ | | | 175 | °C |

| Parameter | Symbol | Conditions | | Value | Unit |
|---|---|---|---|---|---|
| **Brake Inverse Diode** | | | | | |
| Peak Repetitive Reverse Voltage | $V_{RRM}$ | | | 1200 | V |
| Continuous (direct) forward current | $I_F$ | $T_j$=$T_{jmax}$ | $T_h$=80°C | 20 | A |
| Repetitive peak forward current | $I_{FRM}$ | | | 20 | A |
| Total power dissipation | $P_{tot}$ | $T_j$=$T_{jmax}$ | $T_h$=80°C | 29 | W |
| Maximum Junction Temperature | $T_{jmax}$ | | | 175 | °C |

| Parameter | Symbol | Conditions | | Value | Unit |
|---|---|---|---|---|---|
| **Rectifier Diode** | | | | | |
| Peak Repetitive Reverse Voltage | $V_{RRM}$ | | | 1600 | V |
| Continuous (direct) forward current | $I_F$ | $T_j = T_{jmax}$ | $T_h$ = 80°C | 74 | A |
| Surge (non-repetitive) forward current | $I_{FSM}$ | 50 Hz Single Half Sine Wave $t_p$ = 10 ms 50 Hz sine | $T_j$ = 150°C | 890 | A |
| Surge current capability | $I^2t$ | | | 3960 | $A^2s$ |
| Total power dissipation | $P_{tot}$ | $T_j = T_{jmax}$ | $T_h$ = 80°C | 141 | W |
| Maximum Junction Temperature | $T_{jmax}$ | | | 150 | °C |

| Parameter | Symbol | Conditions | | Value | Unit |
|---|---|---|---|---|---|
| **Module Properties** | | | | | |
| **Thermal Properties** | | | | | |
| Storage temperature | $T_{stg}$ | | | -40…+125 | °C |
| Operation Junction Temperature | $T_{jop}$ | | | -40…+($T_{jmax}$ - 25) | °C |
| **Isolation Properties** | | | | | |
| Isolation voltage | $V_{isol}$ | DC voltage | $t_p$=2s | 4000 | V |
| Creepage distance | | | | min 12,7 | mm |
| Clearance | | with Press-fit pins / with Solder pins | | 11,96 / 12,03 | mm |
| Comparative Tracking Index | CTI | | | >200 | |

# Characteristic Values

## Inverter Switch

| Parameter | Symbol | Conditions | | | | | Value | | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | $V_{GE}$ [V] | $V_{CE}$ [V] | $I_C$ [A] | $T_j$ [°C] | Min | Typ | Max | |
| **Static** | | | | | | | | | | |
| Gate-emitter threshold voltage | $V_{GE(th)}$ | $V_{GE}=V_{CE}$ | | | 0,01 | 25<br>125 | 5,4 | 6 | 6,6 | V |
| Collector-emitter saturation voltage | $V_{CEsat}$ | | 15 | | 100 | 25<br>125<br>150 | 1,2 | 1,77<br>2,05<br>2,11 | 2,2 | V |
| Collector-emitter cut-off current | $I_{CES}$ | | 0 | 1200 | | 25<br>125 | | | 300 | μA |
| Gate-emitter leakage current | $I_{GES}$ | | 20 | 0 | | 25<br>125 | | | 1000 | nA |
| Internal gate resistance | $r_g$ | | | | | | | none | | Ω |
| Input capacitance | $C_{ies}$ | f=100 KHz | 0 | 10 | | 25 | | 6200 | | pF |
| Output capacitance | $C_{oes}$ | | | | | | | 680 | | |
| Reverse transfer capacitance | $C_{res}$ | | | | | | | 74 | | |
| Gate charge | $Q_g$ | | 15 | 600 | 100 | 25 | | 210 | | nC |
| **Thermal** | | | | | | | | | | |
| Thermal resistance junction to sink | $R_{th(j-s)}$ | Phase-Change Material ʎ=3,4W/mK | | | | | | 0,37 | | K/W |
| **IGBT Switching** | | | | | | | | | | |
| Turn-on delay time | $t_{d(on)}$ | $R_{goff}$ = 4 Ω<br>$R_{gon}$ = 4 Ω | ±15 | 600 | 100 | 25<br>125<br>150 | | 63<br>63<br>64 | | ns |
| Rise time | $t_r$ | | | | | 25<br>125<br>150 | | 7<br>9<br>9 | | |
| Turn-off delay time | $t_{d(off)}$ | | | | | 25<br>125<br>150 | | 146<br>190<br>202 | | |
| Fall time | $t_f$ | | | | | 25<br>125<br>150 | | 55<br>76<br>81 | | |
| Turn-on energy (per pulse) | $E_{on}$ | $Q_{rFWD}$ = 8,2 μC<br>$Q_{rFWD}$ = 19,5 μC<br>$Q_{rFWD}$ = 22,2 μC | | | | 25<br>125<br>150 | | 2,002<br>3,517<br>4,014 | | mWs |
| Turn-off energy (per pulse) | $E_{off}$ | | | | | 25<br>125<br>150 | | 4,777<br>7,481<br>8,253 | | |

# Inverter Diode

| Parameter | Symbol | Conditions | | $V_r$ [V] | $I_F$ [A] | $T_j$ [°C] | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| **Static** | | | | | | | | | | |
| Forward voltage | $V_F$ | | | | 100 | 25<br>125<br>150 | | 2,57<br>2,31<br>2,19 | 3,3 | V |
| Reverse leakage current | $I_r$ | | | 1200 | | 25<br>150 | | | 50<br>- | µA |
| **Thermal** | | | | | | | | | | |
| Thermal resistance junction to sink | $R_{th(j-s)}$ | Phase-Change Material ʎ=3,4W/mK | | | | | | 0,58 | | K/W |
| **FWD Switching** | | | | | | | | | | |
| Peak recovery current | $I_{RRM}$ | d$i$/d$t$ = 13103 A/µs<br>d$i$/d$t$ = 10356 A/µs<br>d$i$/d$t$ = 9265 A/µs | ±15 | 600 | 100 | 25<br>125<br>150 | | 160<br>184<br>191 | | A |
| Reverse recovery time | $t_{rr}$ | | | | | 25<br>125<br>150 | | 98<br>136<br>143 | | ns |
| Recovered charge | $Q_r$ | | | | | 25<br>125<br>150 | | 8,215<br>19,527<br>22,208 | | µC |
| Reverse recovered energy | $E_{rec}$ | | | | | 25<br>125<br>150 | | 3,929<br>9,926<br>11,221 | | mWs |
| Peak rate of fall of recovery current | $(di_{rf}/dt)_{max}$ | | | | | 25<br>125<br>150 | | 13494<br>5569<br>4331 | | A/µs |

## Brake Switch

| Parameter | Symbol | Conditions | $V_{GE}$ [V] | $V_{CE}$ [V] | $I_C$ [A] | $T_j$[ °C] | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| **Static** | | | | | | | | | | |
| Gate-emitter threshold voltage | $V_{GE(th)}$ | $V_{GE}=V_{CE}$ | | | 0,005 | 25<br>125 | 5,4 | 6 | 6,6 | V |
| Collector-emitter saturation voltage | $V_{CEsat}$ | | 15 | | 50 | 25<br>125<br>150 | 1,2 | 1,73<br>2,00<br>2,06 | 2,2 | V |
| Collector-emitter cut-off current | $I_{CES}$ | | 0 | 1200 | | 25<br>125 | | | 150 | µA |
| Gate-emitter leakage current | $I_{GES}$ | | 20 | 0 | | 25<br>125 | | | 500 | nA |
| Internal gate resistance | $r_g$ | | | | | | | none | | Ω |
| Input capacitance | $C_{ies}$ | f=100 KHz | 0 | 10 | | 25 | | 3100 | | pF |
| Output capacitance | $C_{oes}$ | | | | | | | 340 | | |
| Reverse transfer capacitance | $C_{res}$ | | | | | | | 37 | | |
| Gate charge | $Q_g$ | | 15 | 600 | 50 | 25 | | 105 | | nC |

| Parameter | Symbol | Conditions | $V_{GE}$ [V] | $V_{CE}$ [V] | $I_C$ [A] | $T_j$[ °C] | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| **Thermal** | | | | | | | | | | |
| Thermal resistance junction to sink | $R_{th(j-s)}$ | Phase-Change Material<br>ʎ=3,4W/mK | | | | | | 0,66 | | K/W |
| **IGBT Switching** | | | | | | | | | | |
| Turn-on delay time | $t_{d(on)}$ | $R_{goff}$ = 8 Ω<br>$R_{gon}$ = 8 Ω | ±15 | 600 | 50 | 25<br>125<br>150 | | 51<br>51<br>51 | | ns |
| Rise time | $t_r$ | | | | | 25<br>125<br>150 | | 9<br>11<br>12 | | |
| Turn-off delay time | $t_{d(off)}$ | | | | | 25<br>125<br>150 | | 134<br>174<br>186 | | |
| Fall time | $t_f$ | | | | | 25<br>125<br>150 | | 53<br>76<br>83 | | |
| Turn-on energy (per pulse) | $E_{on}$ | $Q_{rFWD}$ = 3,1 µC<br>$Q_{rFWD}$ = 5,5 µC<br>$Q_{rFWD}$ = 6 µC | | | | 25<br>125<br>150 | | 1,665<br>2,281<br>2,541 | | mWs |
| Turn-off energy (per pulse) | $E_{off}$ | | | | | 25<br>125<br>150 | | 2,538<br>3,868<br>4,259 | | |

## Brake Diode

| Parameter | Symbol | Conditions | | | | | Value | | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | $V_r$ [V] | $I_F$ [A] | $T_j$ [°C] | Min | Typ | Max | |
| **Static** | | | | | | | | | | |
| Forward voltage | $V_F$ | | | | 25 | 25<br>125<br>150 | | 2,47<br>-<br>2,49 | 2,74 | V |
| Reverse leakage current | $I_r$ | | | 1200 | | 25<br>150 | | | 60<br>- | μA |
| **Thermal** | | | | | | | | | | |
| Thermal resistance junction to sink | $R_{th(j\text{-}s)}$ | Phase-Change Material ʎ=3,4W/mK | | | | | | 1,38 | | K/W |
| **FWD Switching** | | | | | | | | | | |
| Peak recovery current | $I_{RRM}$ | | | | | 25<br>125<br>150 | | 56<br>56<br>59 | | A |
| Reverse recovery time | $t_{rr}$ | | | | | 25<br>125<br>150 | | 104<br>124<br>129 | | ns |
| Recovered charge | $Q_r$ | $di/dt$ = 3330 A/μs<br>$di/dt$ = 3225 A/μs<br>$di/dt$ = 4192 A/μs | ±15 | 600 | 50 | 25<br>125<br>150 | | 3,139<br>5,458<br>6,049 | | μC |
| Reverse recovered energy | $E_{rec}$ | | | | | 25<br>125<br>150 | | 1,313<br>2,453<br>2,678 | | mWs |
| Peak rate of fall of recovery current | $(di_{rf}/dt)_{max}$ | | | | | 25<br>125<br>150 | | 2327<br>1949<br>1339 | | A/μs |

## Brake Inverse Diode

| Parameter | Symbol | Conditions | | | | | Value | | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | $V_r$ [V] | $I_F$ [A] | $T_j$ [°C] | Min | Typ | Max | |
| **Static** | | | | | | | | | | |
| Forward voltage | $V_F$ | | | | 10 | 25<br>125<br>150 | | 1,76<br>-<br>1,68 | 2,05 | V |
| Reverse leakage current | $I_r$ | | | 1200 | | 25<br>150 | | | 2,7<br>- | μA |
| **Thermal** | | | | | | | | | | |
| Thermal resistance junction to sink | $R_{th(j\text{-}s)}$ | Phase-Change Material ʎ=3,4W/mK | | | | | | 1,62 | | K/W |

## Rectifier Diode

| Parameter | Symbol | Conditions | | | | | Value | | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | $V_r$ [V] | $I_F$ [A] | $T_j$ [°C] | Min | Typ | Max | |
| **Static** | | | | | | | | | | |
| Forward voltage | $V_F$ | | | | 60 | 25<br>125<br>150 | | 1,64<br>-<br>1,70 | 1,5 | V |
| Reverse leakage current | $I_r$ | | | 1600 | | 25<br>150 | | | 100<br>2000 | µA |
| **Thermal** | | | | | | | | | | |
| Thermal resistance junction to sink | $R_{th(j-s)}$ | Phase-Change Material ʎ=3,4W/mK | | | | | | 0,5 | | K/W |

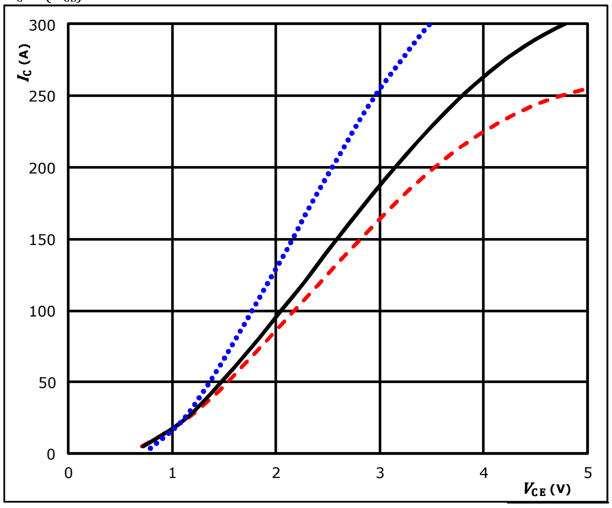
## Thermistor

| Parameter | Symbol | Conditions | | | | | Value | | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | $V_{GE}$ [V] | $V_{CE}$ [V] | $I_C$ [A] | $T_j$ [°C] | Min | Typ | Max | |
| Rated resistance | R | | | | | 25 | | 21,5 | | kΩ |
| Deviation of R100 | $\Delta_{R/R}$ | R100=1486 Ω | | | | 100 | -4,5 | | +4,5 | % |
| Power dissipation | $P$ | | | | | 25 | | 210 | | mW |
| Power dissipation constant | | | | | | 25 | | 3,5 | | mW/K |
| B-value | $B_{(25/50)}$ | | | | | 25 | | 3884 | | K |
| B-value | $B_{(25/100)}$ | | | | | 25 | | 3964 | | K |
| Vincotech NTC Reference | | | | | | | | | F | |

# Inverter Switch Characteristics

**Typical output characteristics** **IGBT**

$I_C = f(V_{CE})$

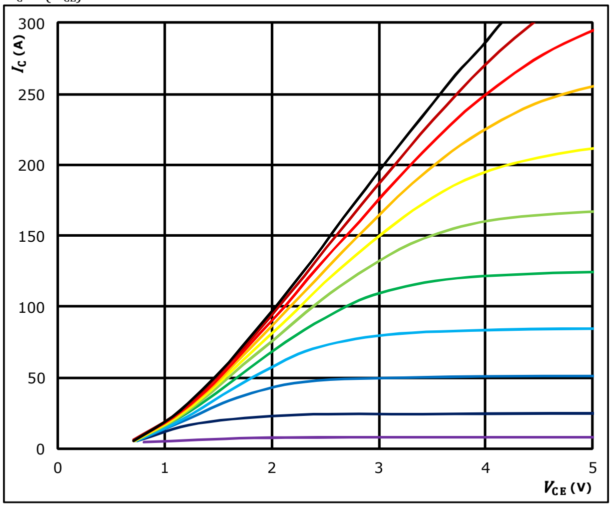



$t_p$ = 250 µs
$V_{GE}$ = 15 V

25 °C
125 °C
150 °C

**Typical output characteristics** **IGBT**

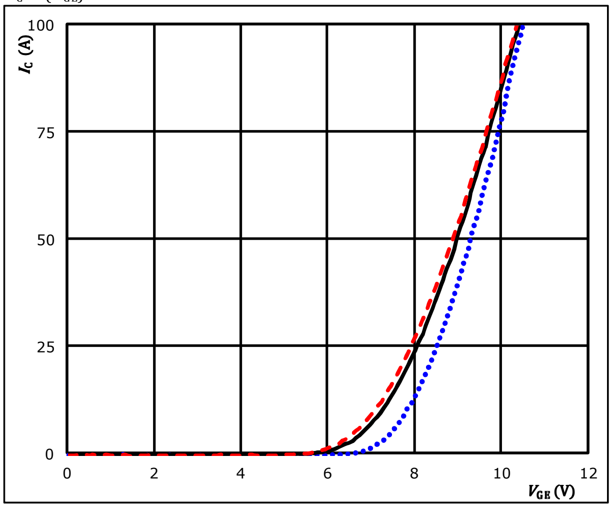
$I_C = f(V_{CE})$




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

**Typical transfer characteristics** **IGBT**

$I_C = f(V_{GE})$

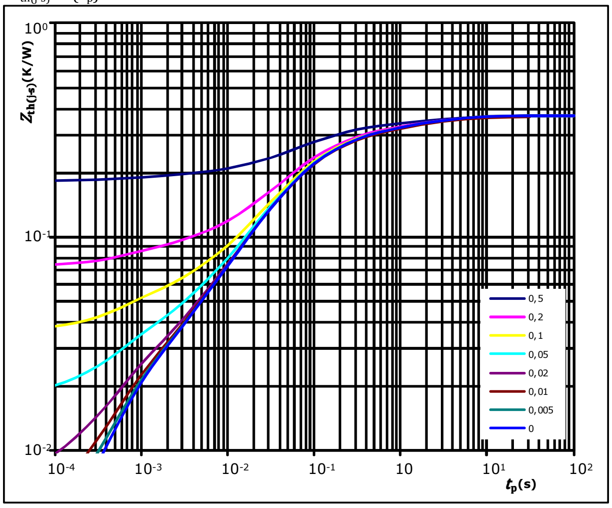



$t_p$ = 100 µs
$V_{CE}$ = 10 V

25 °C
125 °C
150 °C

**Transient Thermal Impedance as function of Pulse duration** **IGBT**

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




D = $t_p / T$
$R_{th(j\text{-}s)}$ = 0,37 K/W

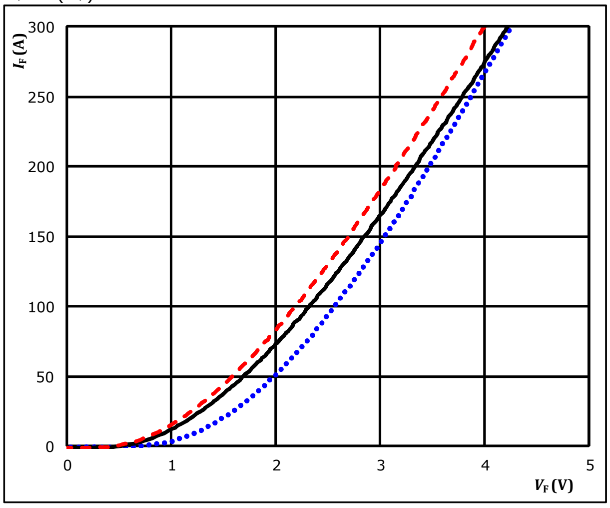
IGBT thermal model values

| $R_{th}$ (K/W) | τ (s) |
|---|---|
| 3,83E-02 | 3,87E+00 |
| 6,03E-02 | 6,84E-01 |
| 1,21E-01 | 1,20E-01 |
| 1,08E-01 | 3,47E-02 |
| 2,26E-02 | 6,82E-03 |
| 1,80E-02 | 7,32E-04 |

# Inverter Diode Characteristics

**Typical forward characteristics** **FWD**

$I_F = f(V_F)$

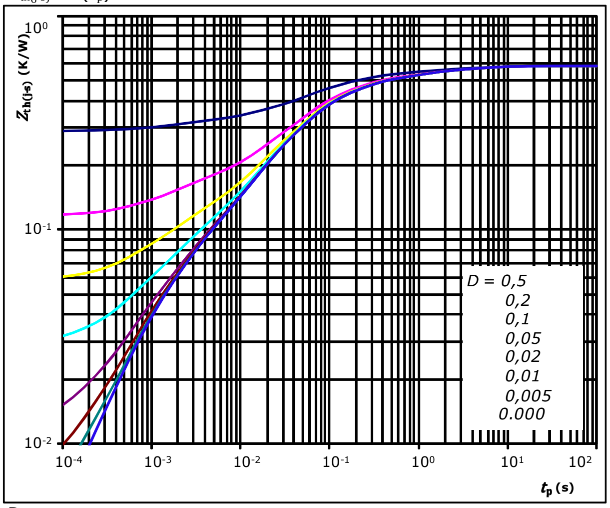



$t_p$ = 250 μs

$T_j$: 25 °C, 125 °C, 150 °C

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

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




D = $t_p$ / $T$

$R_{th(j-s)}$ = 0,58 K/W

FWD thermal model values

| R (K/W) | τ (s) |
|---|---|
| 3,85E-02 | 4,56E+00 |
| 7,24E-02 | 8,53E-01 |
| 1,66E-01 | 1,38E-01 |
| 2,11E-01 | 3,67E-02 |
| 4,46E-02 | 8,35E-03 |
| 4,75E-02 | 1,22E-03 |

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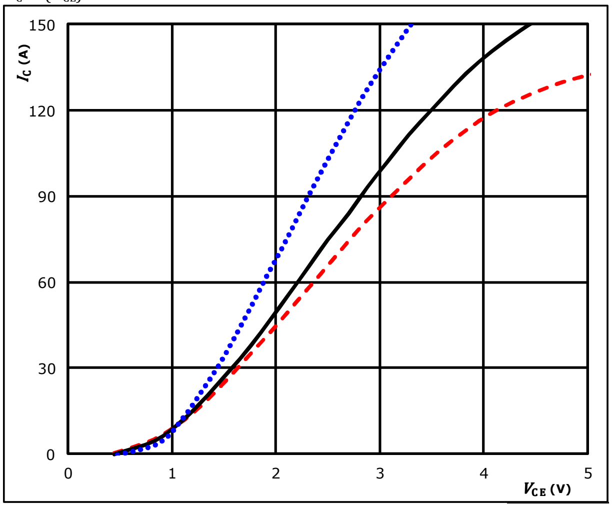
# Brake Switch Characteristics

**Typical output characteristics** **IGBT**

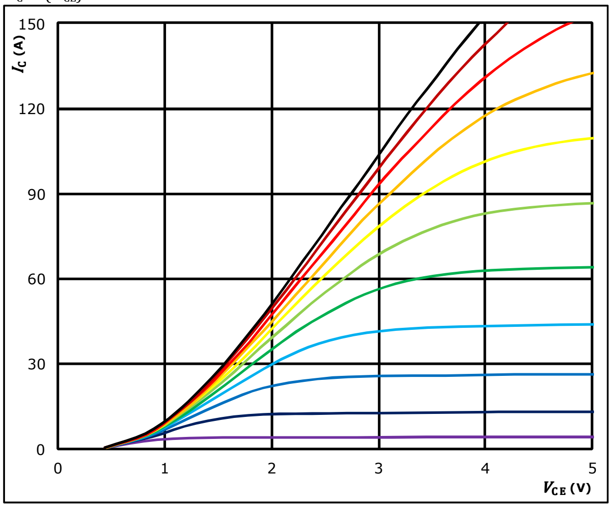
$I_C = f(V_{CE})$




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

**Typical output characteristics** **IGBT**

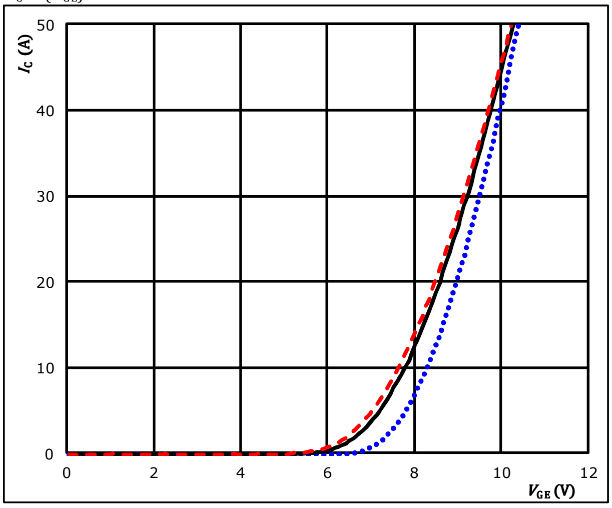
$I_C = f(V_{CE})$




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

**Typical transfer characteristics** **IGBT**

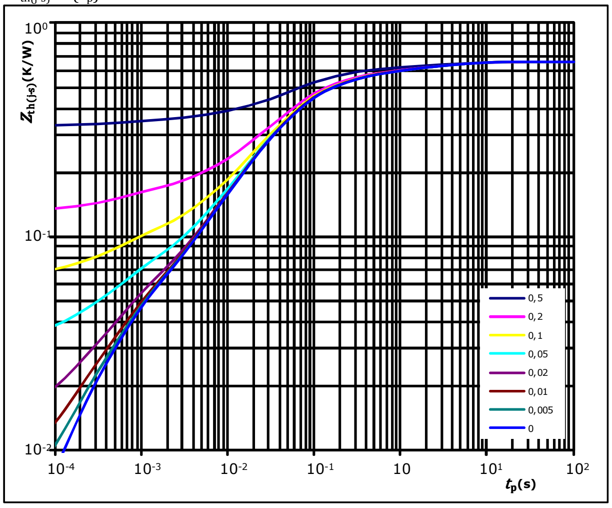
$I_C = f(V_{GE})$




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

**Transient Thermal Impedance as function of Pulse duration** **IGBT**

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




| | | |
|---|---|---|
| D = | $t_p / T$ | |
| $R_{th(j-s)}$ = | 0,66 | K/W |

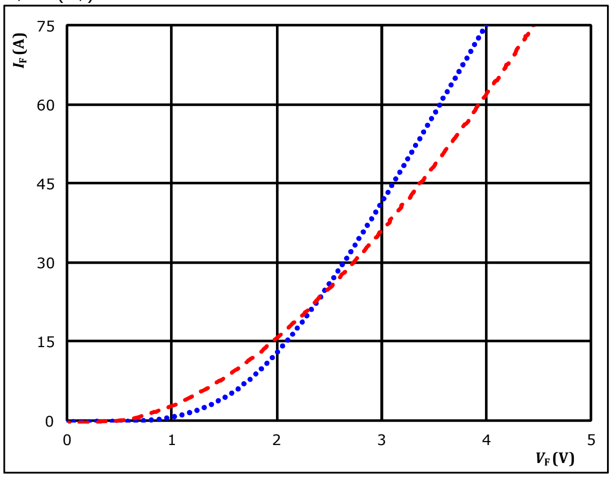
IGBT thermal model values

| $R_{th}$ (K/W) | τ (s) |
|---|---|
| 5,47E-02 | 4,08E+00 |
| 7,84E-02 | 6,81E-01 |
| 1,96E-01 | 1,11E-01 |
| 2,54E-01 | 3,17E-02 |
| 4,44E-02 | 4,90E-03 |
| 3,28E-02 | 4,86E-04 |

# Brake Diode Characteristics

**Typical forward characteristics** **FWD**

$I_F = f(V_F)$

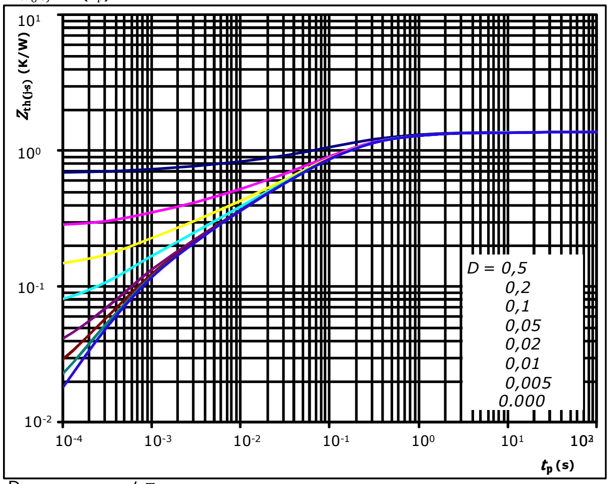



$t_p$ = 250 μs

$T_j$: 25 °C, 125 °C, 150 °C

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

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




D = $t_p / T$

$R_{th(j\text{-}s)}$ = 1,38 K/W

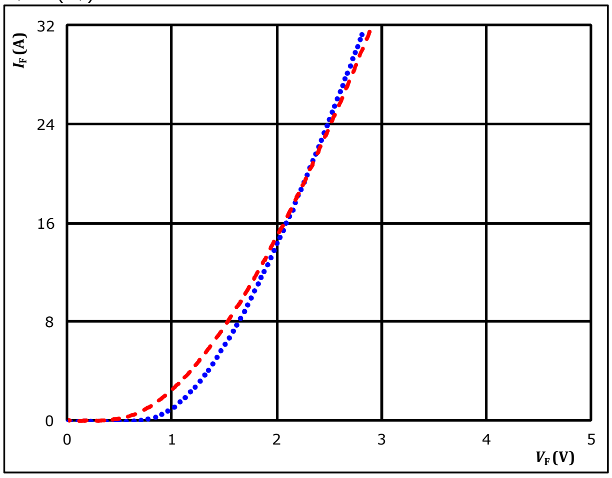
FWD thermal model values

| R (K/W) | τ (s) |
|---|---|
| 2,65E-02 | 9,28E+00 |
| 2,03E-01 | 7,62E-01 |
| 5,75E-01 | 1,47E-01 |
| 3,32E-01 | 2,99E-02 |
| 1,56E-01 | 4,40E-03 |
| 8,92E-02 | 6,49E-04 |

# Brake Inverse Diode Characteristics

**Typical forward characteristics** **FWD**

$I_F = f(V_F)$

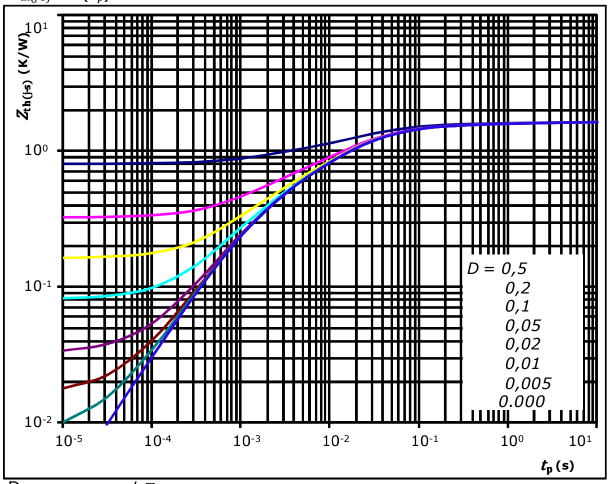



$t_p$ = 250 μs

$T_j$: 25 °C; 125 °C; 150 °C

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

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




D = $t_p$ / $T$

$R_{th(j\text{-}s)}$ = 1,62 K/W

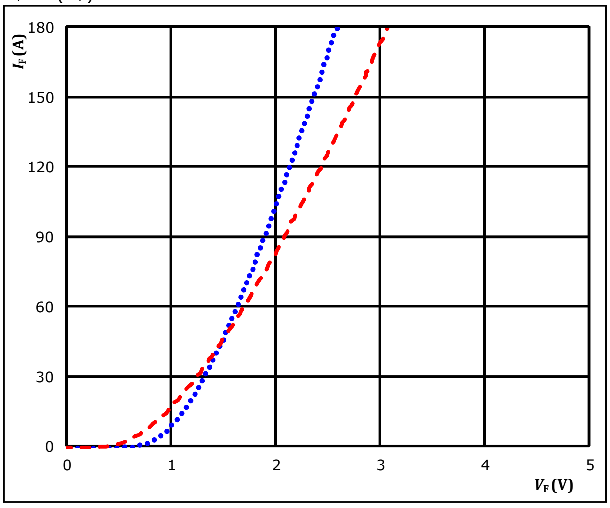
FWD thermal model values

| R (K/W) | τ (s) |
|---|---|
| 6,84E-02 | 2,41E+00 |
| 1,62E-01 | 1,88E-01 |
| 6,14E-01 | 3,05E-02 |
| 5,11E-01 | 7,89E-03 |
| 2,69E-01 | 1,18E-03 |

# Rectifier Diode Characteristics

**Typical forward characteristics** **Rectifier Diode**

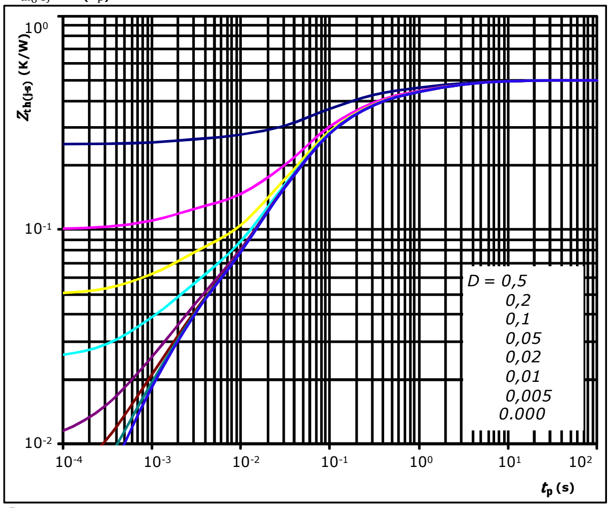
$I_F = f(V_F)$




| | | | | | |
|---|---|---|---|---|---|
| $t_p$ = | 250 | μs | | **25 °C** | dotted |
| | | | $T_j$: | **125 °C** | solid |
| | | | | **150 °C** | dashed |

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

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




D = $t_p$ / $T$

$R_{th(j-s)}$ = 0,5 K/W

Diode thermal model values

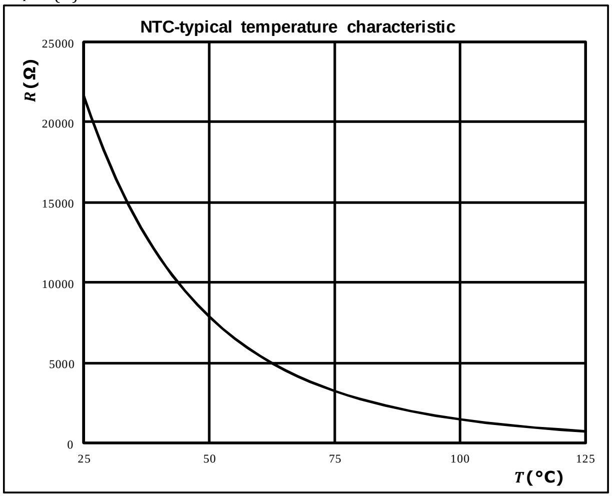
| R (K/W) | τ (s) |
|---|---|
| 4,13E-02 | 4,29E+00 |
| 9,77E-02 | 7,26E-01 |
| 1,88E-01 | 1,21E-01 |
| 1,43E-01 | 3,68E-02 |
| 2,79E-02 | 1,66E-03 |

# Thermistor

**Thermistor typical temperature characteristic**

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

$R_T = f(T)$

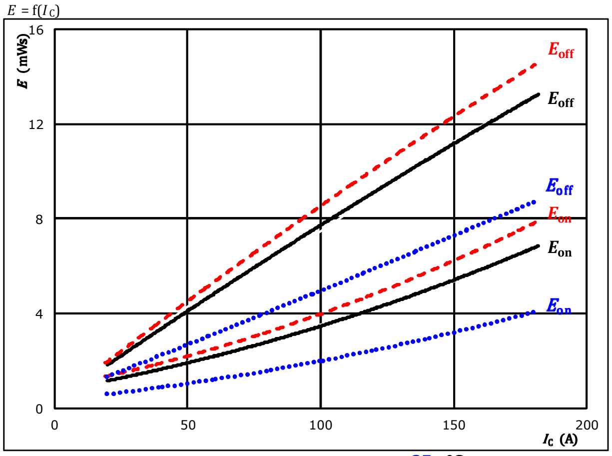


# Inverter Switching Characteristics

**Figure 1.** **IGBT**

Typical switching energy losses as a function of collector current

$E = f(I_C)$



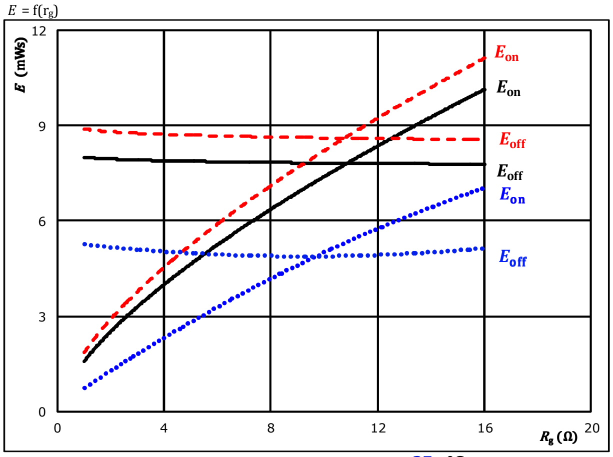

With an inductive load at

| | | | | |
|---|---|---|---|---|
| $V_{CE}$ = | 600 | V | $T_j$: | 25 °C (dotted blue) |
| $V_{GE}$ = | ±15 | V | | 125 °C (solid black) |
| $R_{gon}$ = | 4 | Ω | | 150 °C (dashed red) |
| $R_{goff}$ = | 4 | Ω | | |

**Figure 2.** **IGBT**

Typical switching energy losses as a function of gate resistor

$E = f(r_g)$



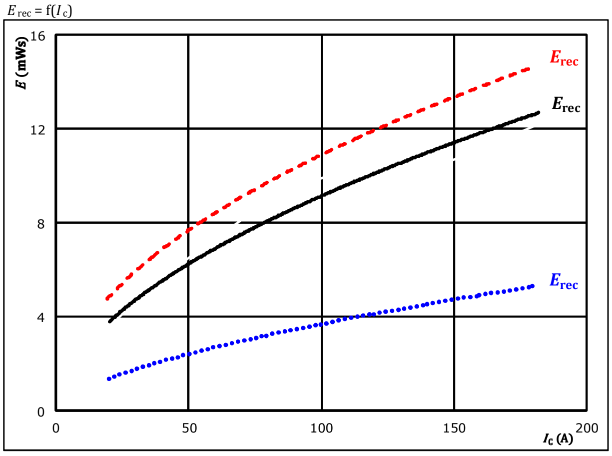

With an inductive load at

| | | | | |
|---|---|---|---|---|
| $V_{CE}$ = | 600 | V | $T_j$: | 25 °C (dotted blue) |
| $V_{GE}$ = | ±15 | V | | 125 °C (solid black) |
| $I_C$ = | 100 | A | | 150 °C (dashed red) |

**Figure 3.** **FWD**

Typical reverse recovered energy loss as a function of collector current

$E_{rec} = f(I_C)$



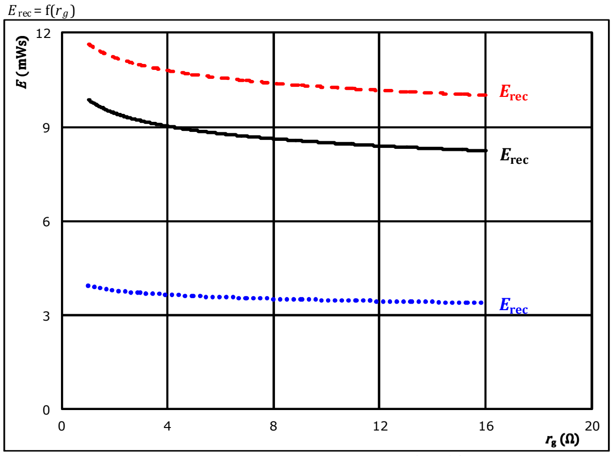

With an inductive load at

| | | | | |
|---|---|---|---|---|
| $V_{CE}$ = | 600 | V | $T_j$: | 25 °C (dotted blue) |
| $V_{GE}$ = | ±15 | V | | 125 °C (solid black) |
| $R_{gon}$ = | 4 | Ω | | 150 °C (dashed red) |

**Figure 4.** **FWD**

Typical reverse recovered energy loss as a function of gate resistor

$E_{rec} = f(r_g)$




With an inductive load at

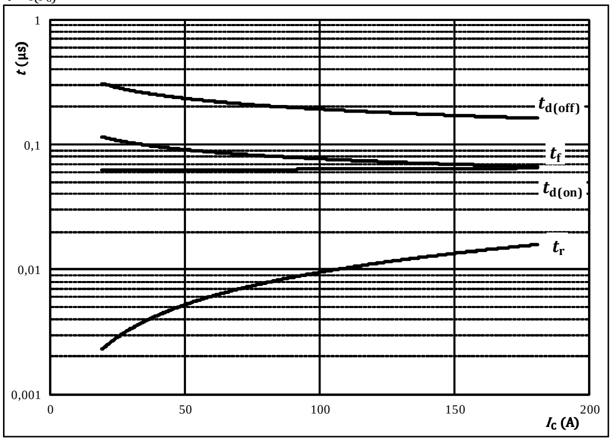
| | | | | |
|---|---|---|---|---|
| $V_{CE}$ = | 600 | V | $T_j$: | 25 °C (dotted blue) |
| $V_{GE}$ = | ±15 | V | | 125 °C (solid black) |
| $I_C$ = | 100 | A | | 150 °C (dashed red) |

# Inverter Switching Characteristics

**Figure 5.** **IGBT**

Typical switching times as a function of collector current

$t = f(I_C)$



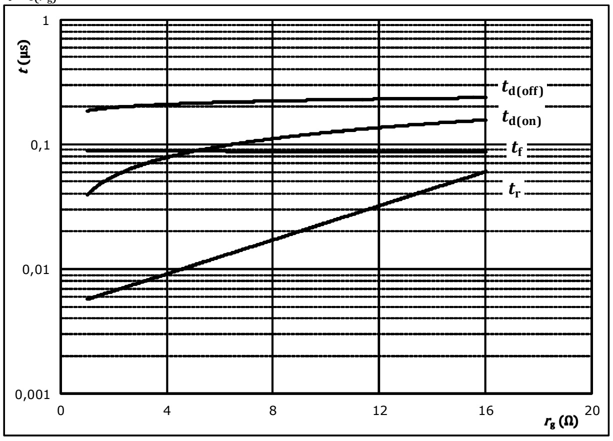

With an inductive load at

| | | |
|---|---|---|
| $T_j$ = | 150 | °C |
| $V_{CE}$ = | 600 | V |
| $V_{GE}$ = | ±15 | V |
| $R_{gon}$ = | 4 | Ω |
| $R_{goff}$ = | 4 | Ω |

**Figure 6.** **IGBT**

Typical switching times as a function of gate resistor

$t = f(r_g)$



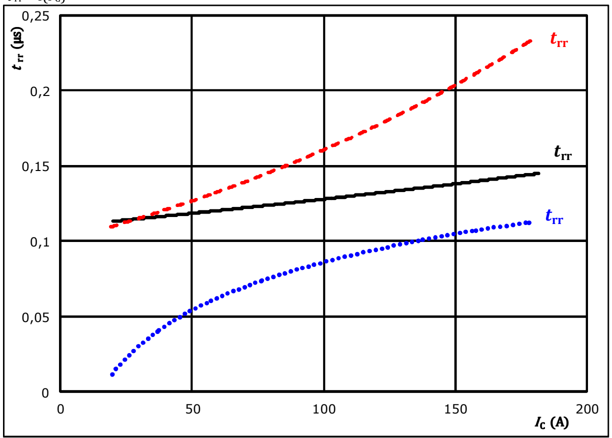

With an inductive load at

| | | |
|---|---|---|
| $T_j$ = | 150 | °C |
| $V_{CE}$ = | 600 | V |
| $V_{GE}$ = | ±15 | V |
| $I_C$ = | 100 | A |

**Figure 7.** **FWD**

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$

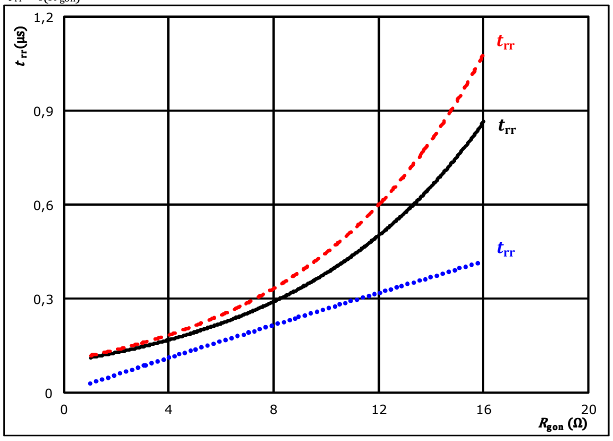



| At | | | | | |
|---|---|---|---|---|---|
| $V_{CE}$= | 600 | V | $T_j$: | 25 °C | |
| $V_{GE}$ = | ±15 | V | | 125 °C | |
| $R_{gon}$ = | 4 | Ω | | 150 °C | |

**Figure 8.** **FWD**

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

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



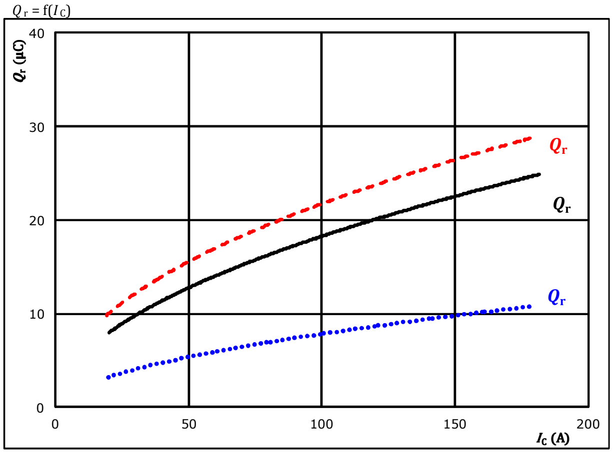

| At | | | | | |
|---|---|---|---|---|---|
| $V_{CE}$ = | 600 | V | $T_j$: | 25 °C | |
| $V_{GE}$ = | ±15 | V | | 125 °C | |
| $I_C$ = | 100 | A | | 150 °C | |

# Inverter Switching Characteristics

**Figure 9.** FWD

Typical recovered charge as a function of collector current

$Q_r = f(I_C)$

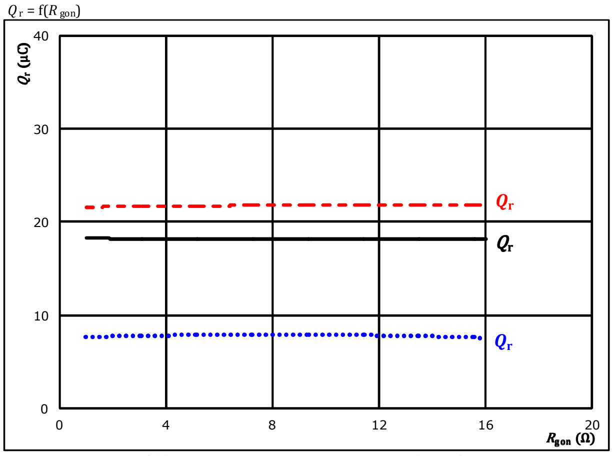



| At | | | | | |
|---|---|---|---|---|---|
| $V_{CE}$ = | 600 | V | | 25 °C | dotted |
| $V_{GE}$ = | ±15 | V | $T_j$: | 125 °C | solid |
| $R_{gon}$ = | 4 | Ω | | 150 °C | dashed |

**Figure 10.** FWD

Typical recoved charge as a function of IGBT turn on gate resistor

$Q_r = f(R_{gon})$

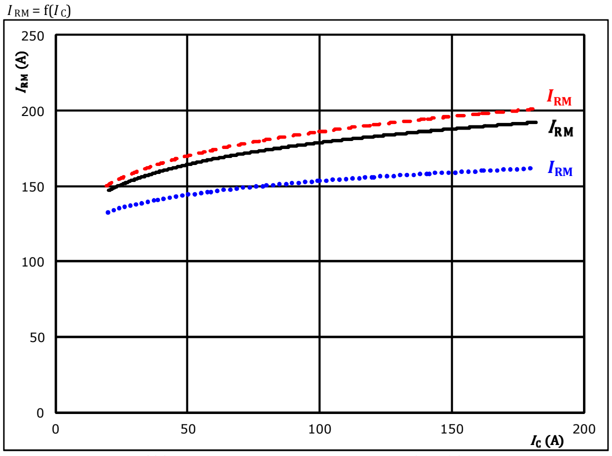



| At | | | | | |
|---|---|---|---|---|---|
| $V_{CE}$ = | 600 | V | | 25 °C | dotted |
| $V_{GE}$ = | ±15 | V | $T_j$: | 125 °C | solid |
| $I_C$ = | 100 | A | | 150 °C | dashed |

**Figure 11.** FWD

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

$I_{RM} = f(I_C)$

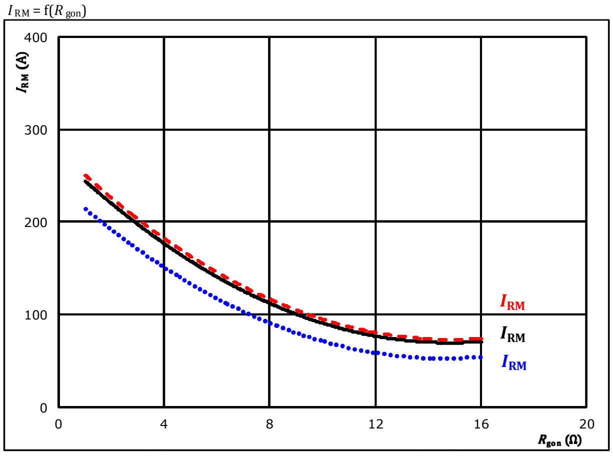



| At | | | | | |
|---|---|---|---|---|---|
| $V_{CE}$ = | 600 | V | | 25 °C | dotted |
| $V_{GE}$ = | ±15 | V | $T_j$: | 125 °C | solid |
| $R_{gon}$ = | 4 | Ω | | 150 °C | dashed |

**Figure 12.** FWD

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

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



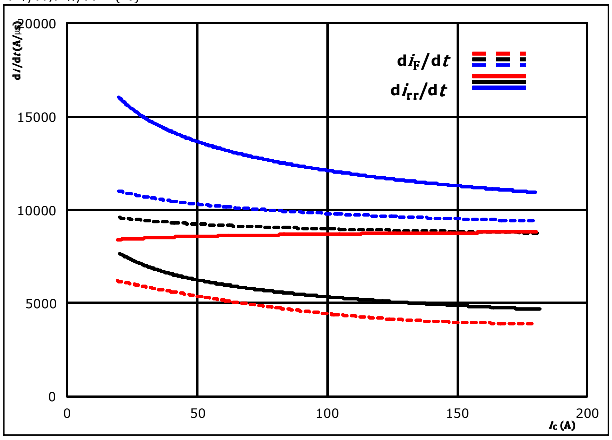

| At | | | | | |
|---|---|---|---|---|---|
| $V_{CE}$ = | 600 | V | | 25 °C | dotted |
| $V_{GE}$ = | ±15 | V | $T_j$: | 125 °C | solid |
| $I_C$ = | 100 | A | | 150 °C | dashed |

# Inverter Switching Characteristics

**Figure 13.** **FWD**

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

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

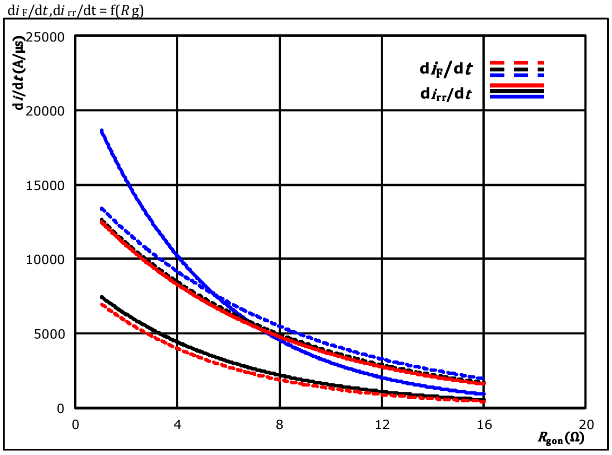



| At | | | | | |
|---|---|---|---|---|---|
| $V_{CE}$ = | 600 | V | | 25 | °C |
| $V_{GE}$ = | ±15 | V | $T_j$: | 125 | °C |
| $R_{gon}$ = | 4 | Ω | | 150 | °C |

**Figure 14.** **FWD**

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

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

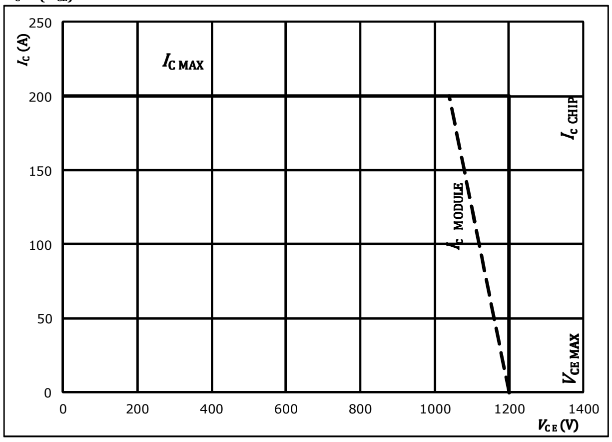



| At | | |
|---|---|---|
| $V_{CE}$ = | 600 | V |
| $V_{GE}$ = | ±15 | V |
| $I_C$= | 100 | A |

**Figure 15.** **IGBT**

**Reverse bias safe operating area**

$I_C = f(V_{CE})$




| At | | |
|---|---|---|
| $T_j$ = | 175 | °C |
| $R_{gon}$ = | 4 | Ω |
| $R_{goff}$ = | 4 | Ω |

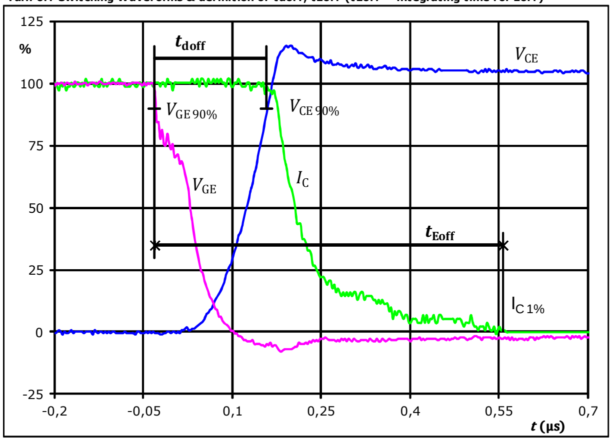
# Inverter Switching Definitions

**General conditions**

| | | |
|---|---|---|
| $T_j$ | = | 125 °C |
| $R_{gon}$ | = | 4 Ω |
| $R_{goff}$ | = | 4 Ω |

**Figure 1.** **IGBT**

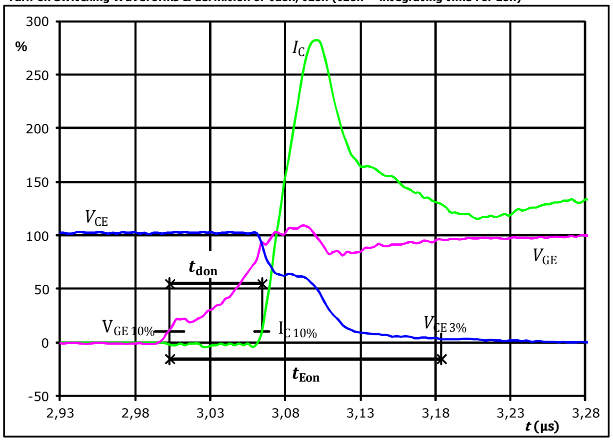
Turn-off Switching Waveforms & definition of tdoff, tEoff (tEoff = integrating time for Eoff)




| | | |
|---|---|---|
| $V_{GE}(0\%)$ = | -15 | V |
| $V_{GE}(100\%)$ = | 15 | V |
| $V_C(100\%)$ = | 600 | V |
| $I_C(100\%)$ = | 100 | A |
| $t_{doff}$ = | 0,19 | µs |
| $t_{Eoff}$ = | 0,588 | µs |

**Figure 2.** **IGBT**

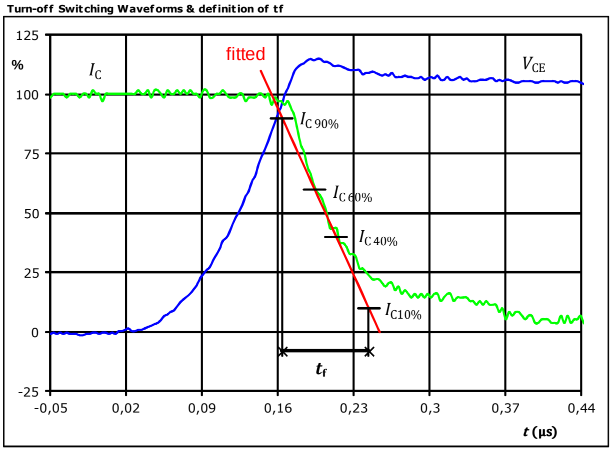
Turn-on Switching Waveforms & definition of tdon, tEon (tEon = integrating time for Eon)




| | | |
|---|---|---|
| $V_{GE}(0\%)$ = | -15 | V |
| $V_{GE}(100\%)$ = | 15 | V |
| $V_C(100\%)$ = | 600 | V |
| $I_C(100\%)$ = | 100 | A |
| $t_{don}$ = | 0,063 | µs |
| $t_{Eon}$ = | 0,18 | µs |

**Figure 3.** **IGBT**

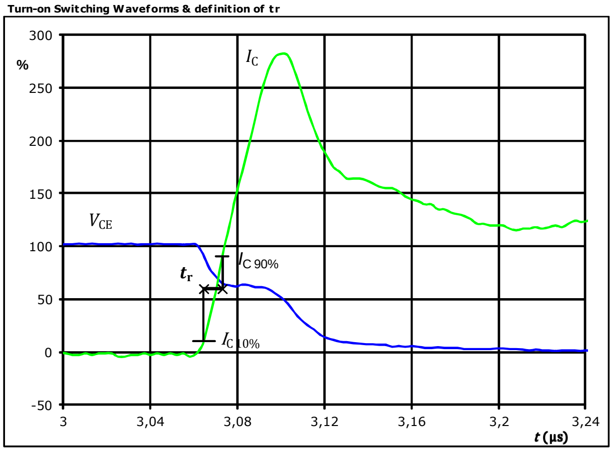
Turn-off Switching Waveforms & definition of tf




| | | |
|---|---|---|
| $V_C(100\%)$ = | 600 | V |
| $I_C(100\%)$ = | 100 | A |
| $t_f$ = | 0,076 | µs |

**Figure 4.** **IGBT**

Turn-on Switching Waveforms & definition of tr

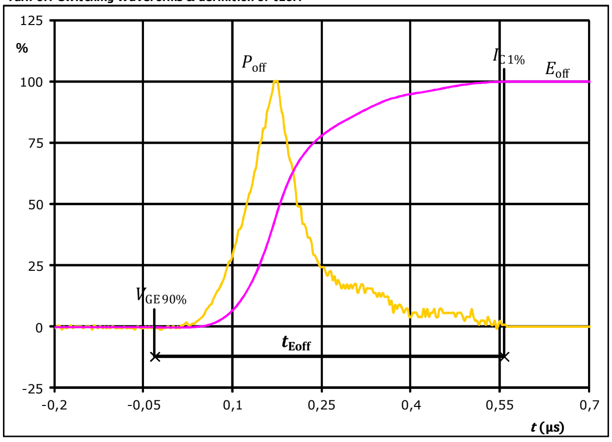



| | | |
|---|---|---|
| $V_C(100\%)$ = | 600 | V |
| $I_C(100\%)$ = | 100 | A |
| $t_r$ = | 0,009 | µs |

# Inverter Switching Definitions

**Figure 5.** **IGBT**

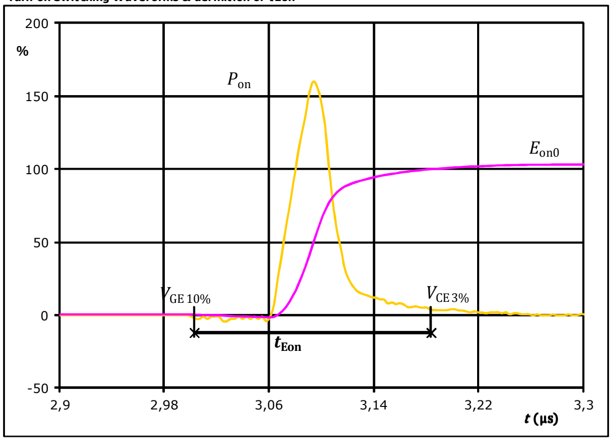
Turn-off Switching Waveforms & definition of tEoff




| | | |
|---|---|---|
| $P_{off}$ (100%) = | 59,93 | kW |
| $E_{off}$ (100%) = | 7,48 | mJ |
| $t_{Eoff}$ = | 0,588 | µs |

**Figure 6.** **IGBT**

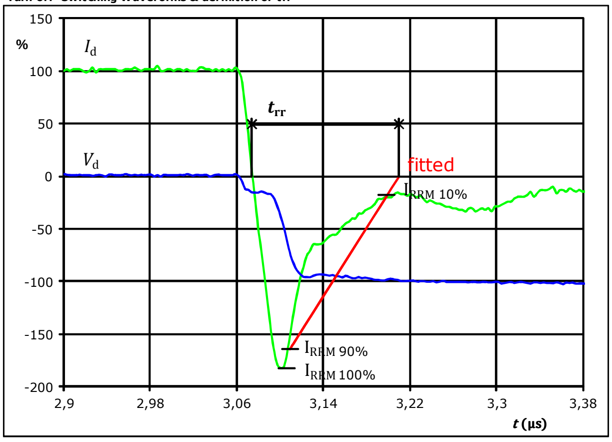
Turn-on Switching Waveforms & definition of tEon




| | | |
|---|---|---|
| $P_{on}$ (100%) = | 59,93 | kW |
| $E_{on}$ (100%) = | 3,52 | mJ |
| $t_{Eon}$ = | 0,181 | µs |

**Figure 7.** **FWD**

Turn-off Switching Waveforms & definition of trr

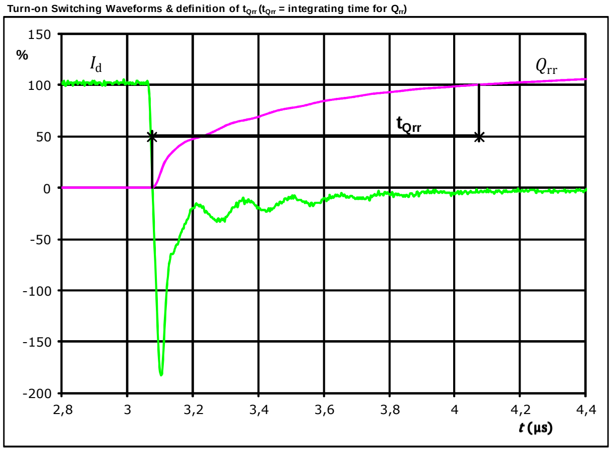



| | | |
|---|---|---|
| $V_d$ (100%) = | 600 | V |
| $I_d$ (100%) = | 100 | A |
| $I_{RRM}$ (100%) = | -184 | A |
| $t_{rr}$ = | 0,136 | µs |

# Inverter Switching Definitions

**Figure 8.** **FWD**

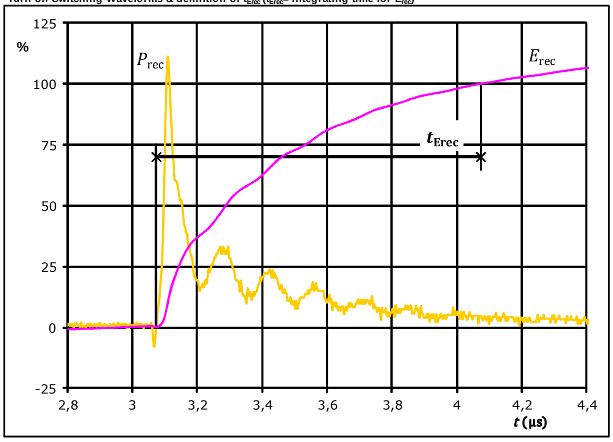
Turn-on Switching Waveforms & definition of $t_{Qrr}$ ($t_{Qrr}$ = integrating time for $Q_{rr}$)




| | | |
|---|---|---|
| $I_d$ (100%) = | 100 | A |
| $Q_{rr}$ (100%) = | 19,53 | µC |
| $t_{Qrr}$ = | 1,00 | µs |

**Figure 9.** **FWD**

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



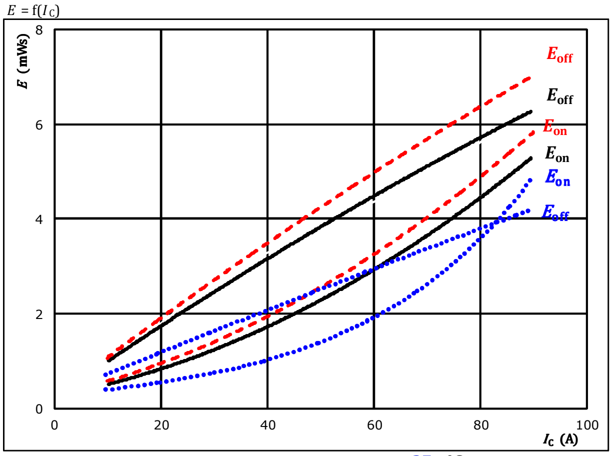

| | | |
|---|---|---|
| $P_{rec}$ (100%) = | 59,93 | kW |
| $E_{rec}$ (100%) = | 9,93 | mJ |
| $t_{Erec}$ = | 1,00 | µs |

# Brake Switching Characteristics

**Figure 1.** **IGBT**

Typical switching energy losses as a function of collector current

$E = f(I_C)$



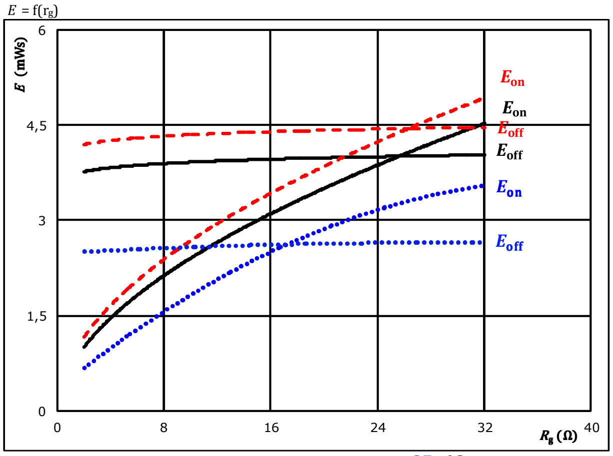

With an inductive load at

| | | | | | |
|---|---|---|---|---|---|
| $V_{CE}$ = | 600 | V | | 25 °C | dotted |
| $V_{GE}$ = | ±15 | V | $T_j$: | 125 °C | solid |
| $R_{gon}$ = | 8 | Ω | | 150 °C | dashed |
| $R_{goff}$ = | 8 | Ω | | | |

**Figure 2.** **IGBT**

Typical switching energy losses as a function of gate resistor

$E = f(r_g)$



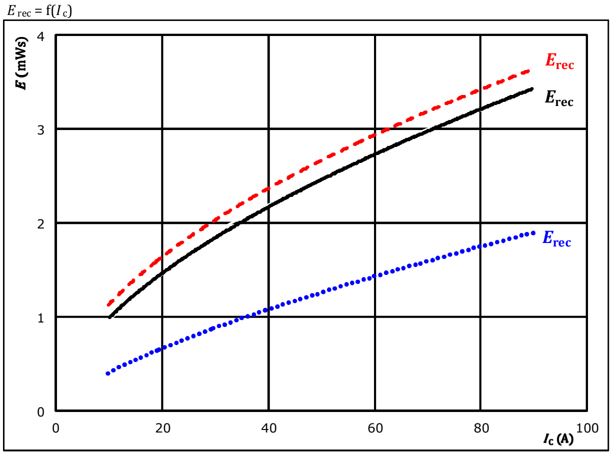

With an inductive load at

| | | | | | |
|---|---|---|---|---|---|
| $V_{CE}$ = | 600 | V | | 25 °C | dotted |
| $V_{GE}$ = | ±15 | V | $T_j$: | 125 °C | solid |
| $I_C$ = | 50 | A | | 150 °C | dashed |

**Figure 3.** **FWD**

Typical reverse recovered energy loss as a function of collector current

$E_{rec} = f(I_c)$



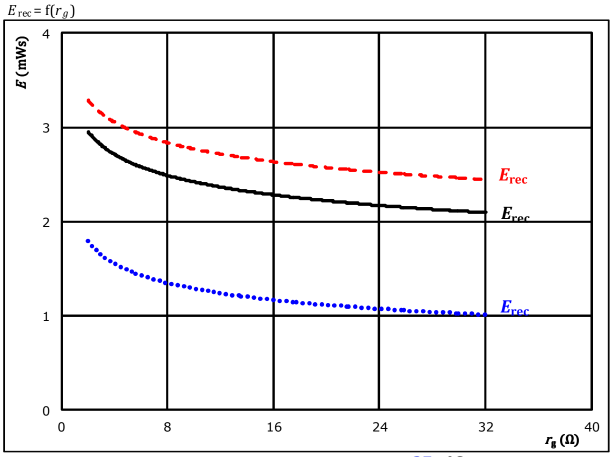

With an inductive load at

| | | | | | |
|---|---|---|---|---|---|
| $V_{CE}$ = | 600 | V | | 25 °C | dotted |
| $V_{GE}$ = | ±15 | V | $T_j$: | 125 °C | solid |
| $R_{gon}$ = | 8 | Ω | | 150 °C | dashed |

**Figure 4.** **FWD**

Typical reverse recovered energy loss as a function of gate resistor

$E_{rec} = f(r_g)$




With an inductive load at

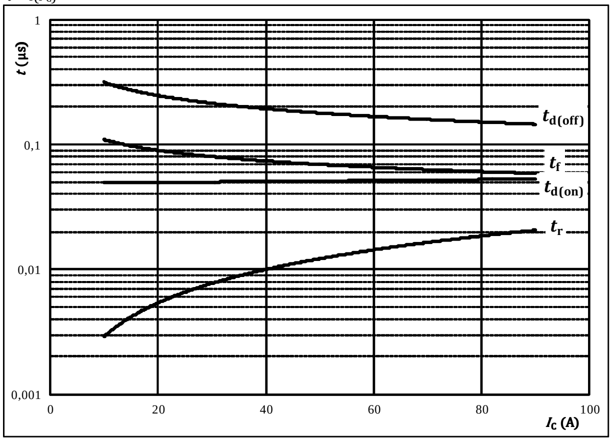
| | | | | | |
|---|---|---|---|---|---|
| $V_{CE}$ = | 600 | V | | 25 °C | dotted |
| $V_{GE}$ = | ±15 | V | $T_j$: | 125 °C | solid |
| $I_C$ = | 50 | A | | 150 °C | dashed |

# Brake Switching Characteristics

**Figure 5.** **IGBT**

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

$t = f(I_C)$



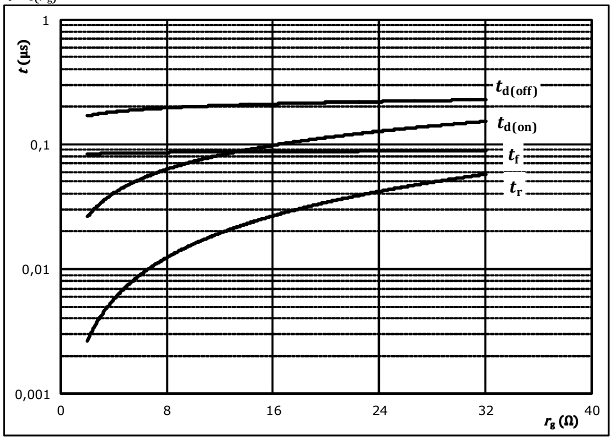

With an inductive load at

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

**Figure 6.** **IGBT**

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

$t = f(r_g)$



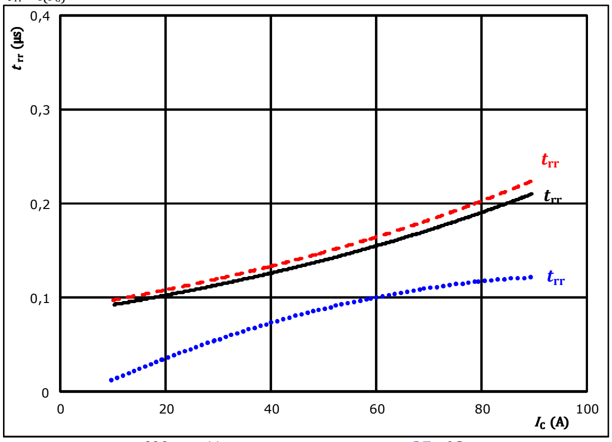

With an inductive load at

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

**Figure 7.** **FWD**

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

$t_{rr} = f(I_C)$

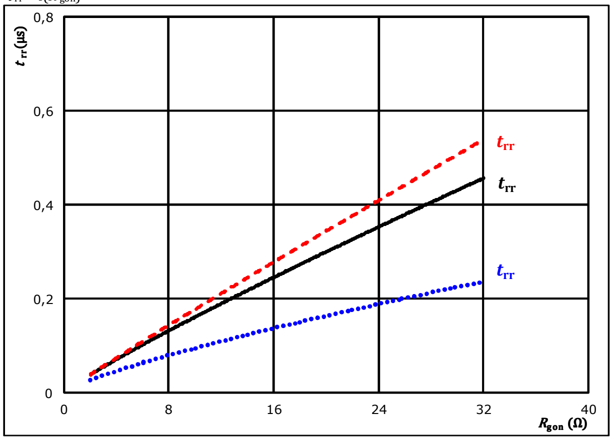



| At | | | | | |
|---|---|---|---|---|---|
| $V_{CE}$= | 600 | V | | 25 °C | ·············· |
| $V_{GE}$ = | ±15 | V | $T_j$: | 125 °C | ——— |
| $R_{gon}$ = | 8 | Ω | | 150 °C | — — — |

**Figure 8.** **FWD**

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

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



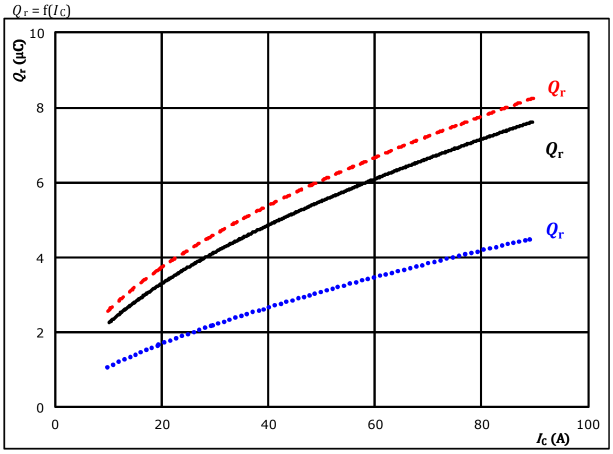

| At | | | | | |
|---|---|---|---|---|---|
| $V_{CE}$ = | 600 | V | | 25 °C | ·············· |
| $V_{GE}$ = | ±15 | V | $T_j$: | 125 °C | ——— |
| $I_C$ = | 50 | A | | 150 °C | — — — |

# Brake Switching Characteristics

**Figure 9.** **FWD**

Typical recovered charge as a function of collector current

$Q_r = f(I_C)$

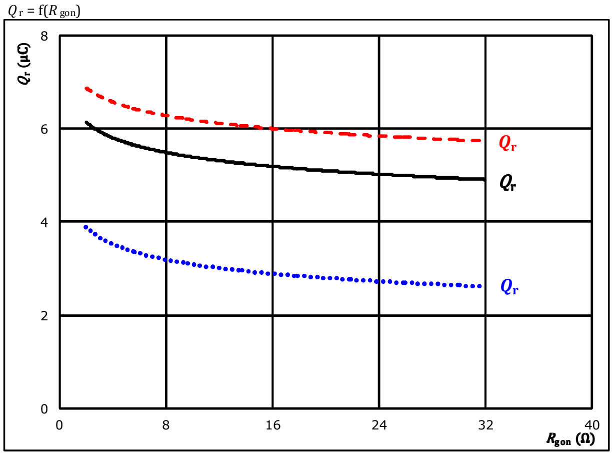


| At | | | | | | |
|---|---|---|---|---|---|---|
| $V_{CE}$ = | 600 | V | | 25 °C | |
| $V_{GE}$ = | ±15 | V | $T_j$: | 125 °C | |
| $R_{gon}$ = | 8 | Ω | | 150 °C | |

**Figure 10.** **FWD**

Typical recoved charge as a function of IGBT turn on gate resistor

$Q_r = f(R_{gon})$

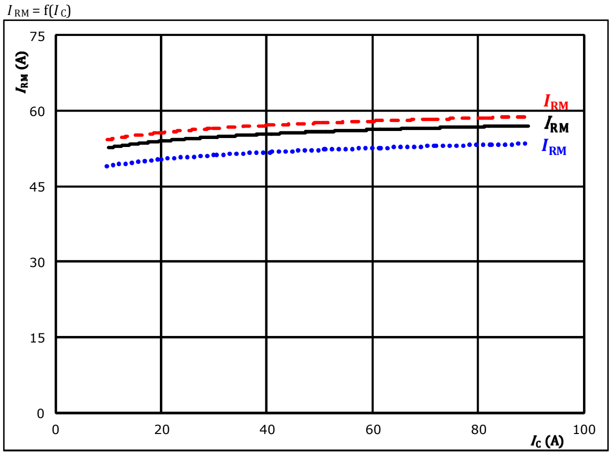


| At | | | | | |
|---|---|---|---|---|---|
| $V_{CE}$= | 600 | V | | 25 °C | |
| $V_{GE}$ = | ±15 | V | $T_j$: | 125 °C | |
| $I_C$= | 50 | A | | 150 °C | |

**Figure 11.** **FWD**

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

$I_{RM} = f(I_C)$

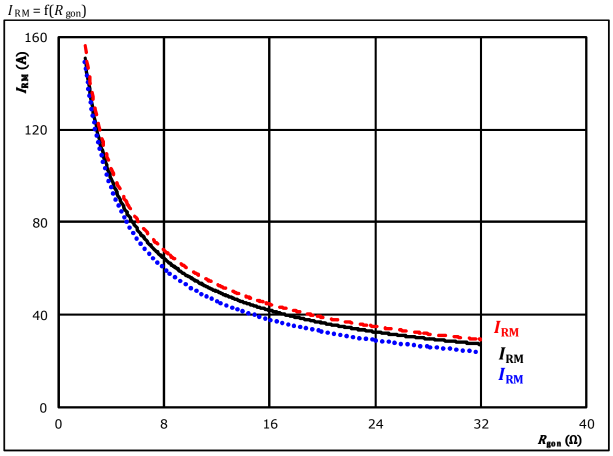


| At | | | | | |
|---|---|---|---|---|---|
| $V_{CE}$ = | 600 | V | | 25 °C | |
| $V_{GE}$ = | ±15 | V | $T_j$: | 125 °C | |
| $R_{gon}$ = | 8 | Ω | | 150 °C | |

**Figure 12.** **FWD**

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

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



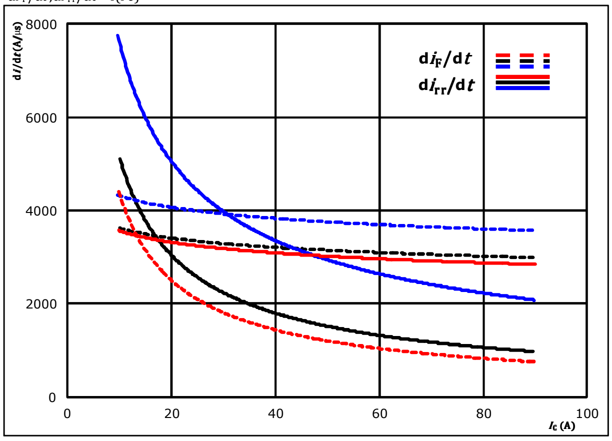
| At | | | | | |
|---|---|---|---|---|---|
| $V_{CE}$ = | 600 | V | | 25 °C | |
| $V_{GE}$ = | ±15 | V | $T_j$: | 125 °C | |
| $I_C$ = | 50 | A | | 150 °C | |

# Brake Switching Characteristics

**Figure 13.** **FWD**

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

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

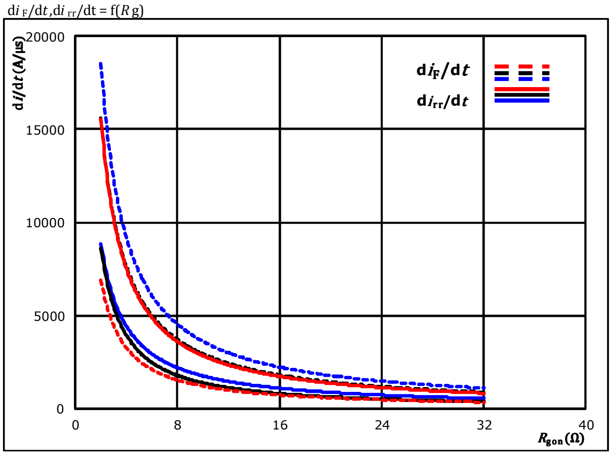



| At | | | | | |
|---|---|---|---|---|---|
| $V_{CE}$ = | 600 | V | $T_j$: | 25 °C | dotted |
| $V_{GE}$ = | ±15 | V | | 125 °C | solid |
| $R_{gon}$ = | 8 | Ω | | 150 °C | dashed |

**Figure 14.** **FWD**

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

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

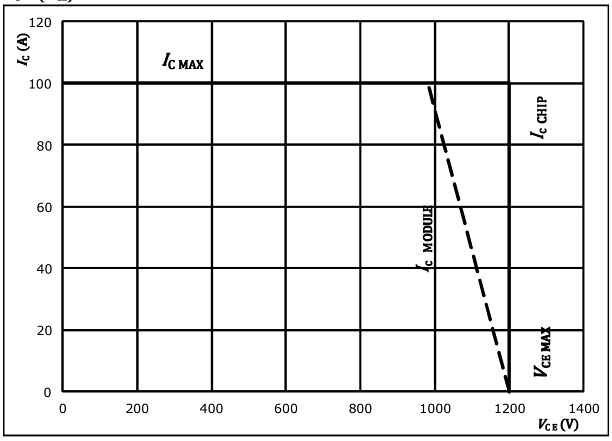



| At | | |
|---|---|---|
| $V_{CE}$ = | 600 | V |
| $V_{GE}$ = | ±15 | V |
| $I_C$ = | 50 | A |

**Figure 15.** **IGBT**

Reverse bias safe operating area

$I_C = f(V_{CE})$




| At | | |
|---|---|---|
| $T_j$ = | 175 | °C |
| $R_{gon}$ = | 8 | Ω |
| $R_{goff}$ = | 8 | Ω |

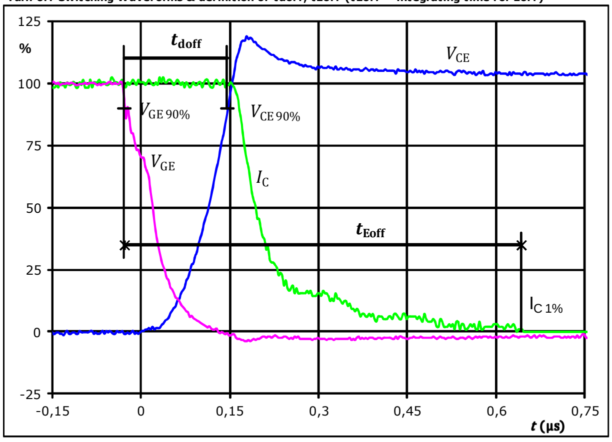
# Brake Switching Definitions

**General conditions**

| | | |
|---|---|---|
| $T_j$ | = | 125 °C |
| $R_{gon}$ | = | 8 Ω |
| $R_{goff}$ | = | 8 Ω |

**Figure 1.** IGBT

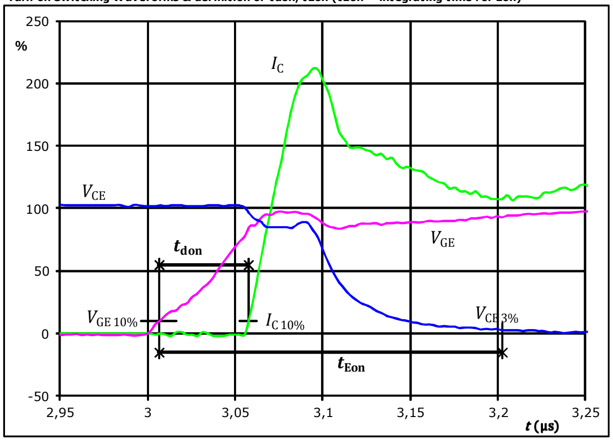
Turn-off Switching Waveforms & definition of tdoff, tEoff (tEoff = integrating time for Eoff)




| | | |
|---|---|---|
| $V_{GE}(0\%)$ = | -15 | V |
| $V_{GE}(100\%)$ = | 15 | V |
| $V_C(100\%)$ = | 600 | V |
| $I_C(100\%)$ = | 50 | A |
| $t_{doff}$ = | 0,174 | µs |
| $t_{Eoff}$ = | 0,67 | µs |

**Figure 2.** IGBT

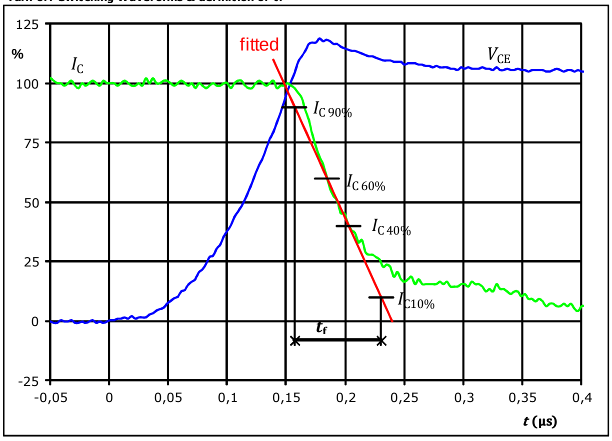
Turn-on Switching Waveforms & definition of tdon, tEon (tEon = integrating time for Eon)




| | | |
|---|---|---|
| $V_{GE}(0\%)$ = | -15 | V |
| $V_{GE}(100\%)$ = | 15 | V |
| $V_C(100\%)$ = | 600 | V |
| $I_C(100\%)$ = | 50 | A |
| $t_{don}$ = | 0,051 | µs |
| $t_{Eon}$ = | 0,196 | µs |

**Figure 3.** IGBT

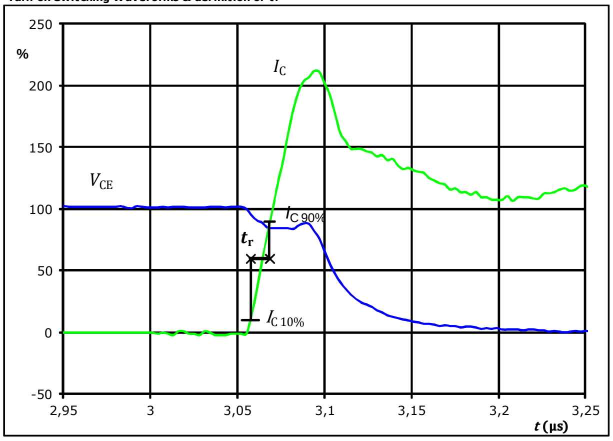
Turn-off Switching Waveforms & definition of tf




| | | |
|---|---|---|
| $V_C(100\%)$ = | 600 | V |
| $I_C(100\%)$ = | 50 | A |
| $t_f$ = | 0,076 | µs |

**Figure 4.** IGBT

Turn-on Switching Waveforms & definition of tr

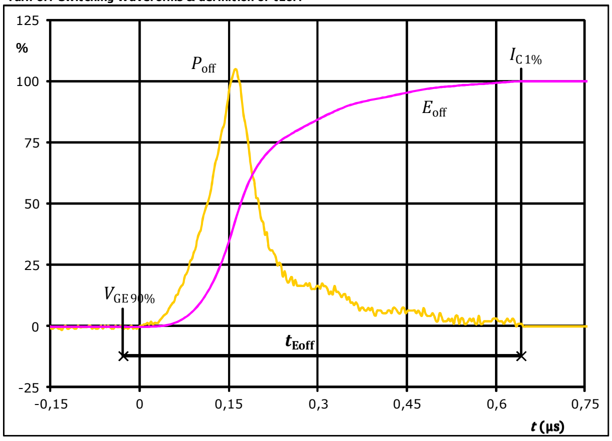



| | | |
|---|---|---|
| $V_C(100\%)$ = | 600 | V |
| $I_C(100\%)$ = | 50 | A |
| $t_r$ = | 0,011 | µs |

# Brake Switching Definitions

**Figure 5.** IGBT

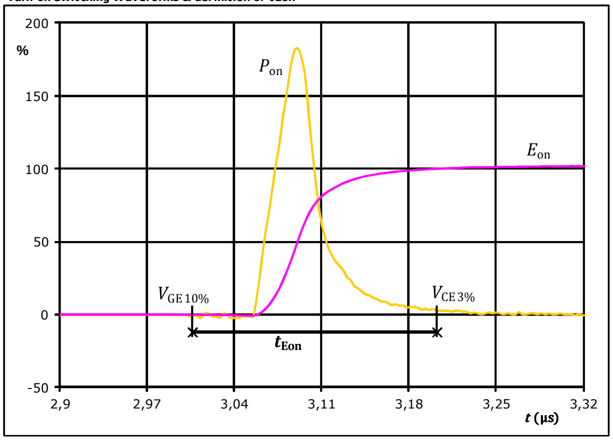
Turn-off Switching Waveforms & definition of tEoff




| | | |
|---|---|---|
| $P_{off}$ (100%) = | 29,99 | kW |
| $E_{off}$ (100%) = | 3,87 | mJ |
| $t_{Eoff}$ = | 0,67 | µs |

**Figure 6.** IGBT

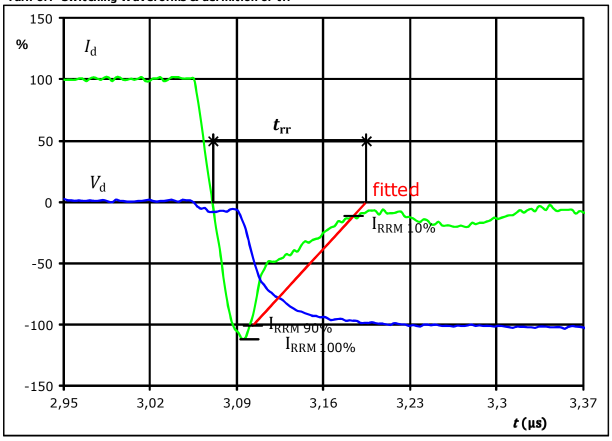
Turn-on Switching Waveforms & definition of tEon




| | | |
|---|---|---|
| $P_{on}$ (100%) = | 29,99 | kW |
| $E_{on}$ (100%) = | 2,28 | mJ |
| $t_{Eon}$ = | 0,196 | µs |

**Figure 7.** FWD

Turn-off Switching Waveforms & definition of trr

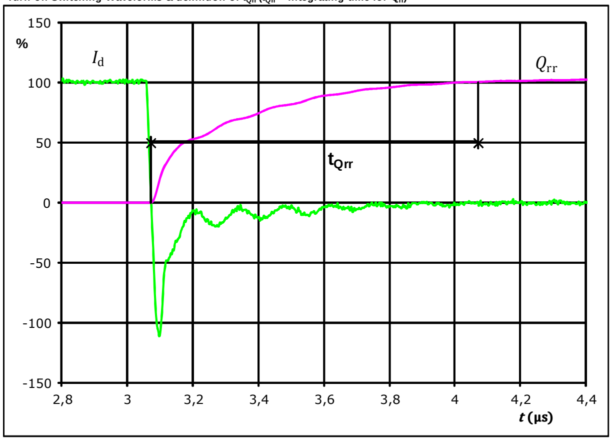



| | | |
|---|---|---|
| $V_d$ (100%) = | 600 | V |
| $I_d$ (100%) = | 50 | A |
| $I_{RRM}$ (100%) = | -56 | A |
| $t_{rr}$ = | 0,124 | µs |

# Brake Switching Definitions

| **Figure 8.** | **FWD** |
|---|---|

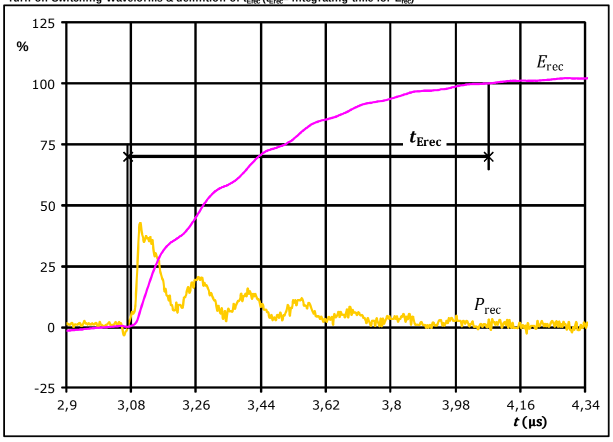
Turn-on Switching Waveforms & definition of $t_{Qrr}$ ($t_{Qrr}$ = integrating time for $Q_{rr}$)




| | | |
|---|---|---|
| $I_d$ (100%) = | 50 | A |
| $Q_{rr}$ (100%) = | 5,46 | µC |
| $t_{Qrr}$ = | 1,00 | µs |

| **Figure 9.** | **FWD** |
|---|---|

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




| | | |
|---|---|---|
| $P_{rec}$ (100%) = | 29,99 | kW |
| $E_{rec}$ (100%) = | 2,45 | mJ |
| $t_{Erec}$ = | 1,00 | µs |

# V23990-P760-A60-PM
# V23990-P760-A60Y-PM
datasheet

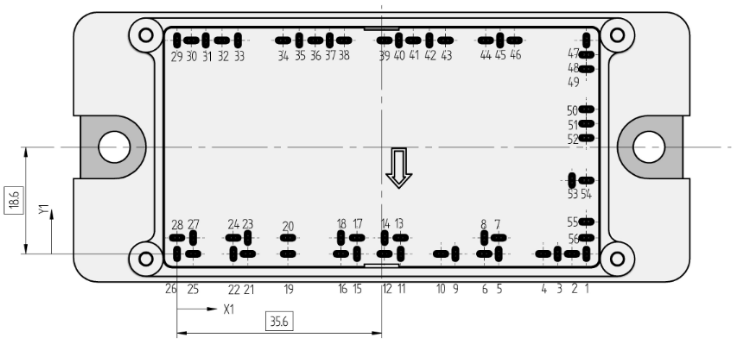
## Ordering Code & Marking

| Version | Ordering Code | in DataMatrix as | in packaging barcode as |
|---|---|---|---|
| without thermal paste with Solder pins | V23990-P760-A60-PM | P760A60 | P760A60 |
| without thermal paste with Press-fit pins | V23990-P760-A60Y-PM | P760A60Y | P760A60Y |
| with thermal paste with Solder pins | V23990-P760-A60-/3/-PM | P760A60 | P760A60-/3/ |
| with thermal paste with Press-fit pins | V23990-P760-A60Y-/3/-PM | P760A60Y | P760A60Y-/3/ |


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

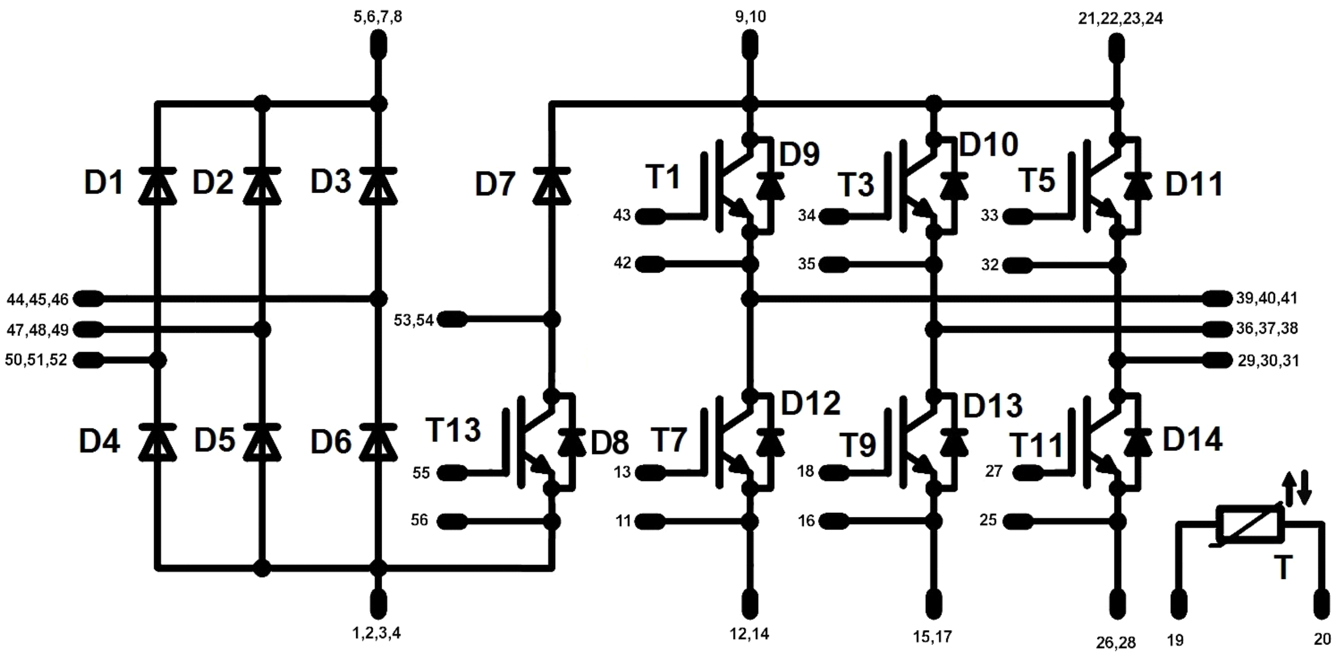
## Outline

| Pin table [mm] | | | | Pin table [mm] | | | |
|---|---|---|---|---|---|---|---|
| Pin | X | Y | Function | Pin | X | Y | Function |
| 1 | 71,2 | 0 | DC- | 29 | 0 | 37,2 | U |
| 2 | 68,7 | 0 | DC- | 30 | 2,5 | 37,2 | U |
| 3 | 66,2 | 0 | DC- | 31 | 5 | 37,2 | U |
| 4 | 63,7 | 0 | DC- | 32 | 7,8 | 37,2 | E |
| 5 | 55,95 | 0 | DC+ | 33 | 10,6 | 37,2 | G |
| 6 | 53,45 | 0 | DC+ | 34 | 18,45 | 37,2 | G |
| 7 | 55,95 | 2,8 | DC+ | 35 | 21,25 | 37,2 | E |
| 8 | 53,45 | 0 | DC+ | 36 | 24,05 | 37,2 | V |
| 9 | 48,4 | 0 | DC+ | 37 | 26,55 | 37,2 | V |
| 10 | 45,9 | 0 | DC+ | 38 | 29,05 | 37,2 | V |
| 11 | 38,9 | 0 | E | 39 | 36,1 | 37,2 | W |
| 12 | 36,1 | 0 | DC- | 40 | 38,6 | 37,2 | W |
| 13 | 38,9 | 2,8 | G | 41 | 41,1 | 37,2 | W |
| 14 | 36,1 | 2,8 | DC- | 42 | 43,9 | 37,2 | E |
| 15 | 31,3 | 0 | DC- | 43 | 46,7 | 37,2 | G |
| 16 | 28,5 | 0 | E | 44 | 53,7 | 37,2 | L1 |
| 17 | 31,3 | 2,8 | DC- | 45 | 56,2 | 37,2 | L1 |
| 18 | 28,5 | 2,8 | G | 46 | 58,7 | 37,2 | L1 |
| 19 | 19,3 | 0 | R2 | 47 | 71,2 | 37,2 | L2 |
| 20 | 19,3 | 2,8 | R1 | 48 | 71,2 | 34,7 | L2 |
| 21 | 12,3 | 0 | DC+ | 49 | 71,2 | 32,2 | L2 |
| 22 | 9,8 | 0 | DC+ | 50 | 71,2 | 25,2 | L3 |
| 23 | 12,3 | 2,8 | DC+ | 51 | 71,2 | 22,7 | L3 |
| 24 | 9,8 | 2,8 | DC+ | 52 | 71,2 | 20,2 | L3 |
| 25 | 2,8 | 0 | E | 53 | 68,7 | 12,8 | BrC |
| 26 | 0 | 0 | DC- | 54 | 71,2 | 12,8 | BrC |
| 27 | 2,8 | 2,8 | G | 55 | 71,2 | 5,6 | BrG |
| 28 | 0 | 2,8 | DC- | 56 | 71,2 | 2,8 | BrG |




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

## Pinout




## Identification

| ID | Component | Voltage | Current | Function | Comment |
|---|---|---|---|---|---|
| T1,T3,T5,T7,T9,T11 | IGBT | 1200V | 100A | Inverter Switch | |
| D9-D14 | FWD | 1200V | 100A | Inverter Diode | |
| T13 | IGBT | 1200V | 50A | Brake Switch | |
| D7 | FWD | 1200V | 25A | Brake Diode | |
| D8 | FWD | 1200V | 10A | Brake Inverse Diode | |
| D1-D6 | Rectifier | 1600V | 60A | Rectifier Diode | |
| C1,C2,C3,C4 | Capacitor | 1000V | - | DC Link | |
| T | NTC | - | - | Thermistor | |

| Packaging instruction | | | | | |
|---|---|---|---|---|---|
| Standard packaging quantity (SPQ) | 42 | >SPQ | Standard | <SPQ | Sample |

| Handling instruction |
|---|
| Handling instructions for *flow* 2 packages see vincotech.com website. |

| Package data |
|---|
| Package data for *flow* 2 packages see vincotech.com website. |

| Document No.: | Date: | Modification: | Pages |
|---|---|---|---|
| V23990-P760-A60-D2-14 | 24 Jun. 2015 | | |