10-PG06PPA050SJ02-LH94E08T
datasheet

***flow*PIM 1 + PFC** | **600 V / 50 A**

## Topology features

- 3-leg interleaved PFC + Inverter
- On-board Capacitors
- Open Emitter configuration
- Temperature sensor

## Component features

- 5us short circuit withstand time
- High speed switching
- Low EMI
- Short tail current

## Housing features

- Base isolation: $Al_2O_3$
- Convex shaped substrate for superior thermal contact
- Thermo-mechanical push-and-pull force relief
- Press-fit pin
- Reliable cold welding connection

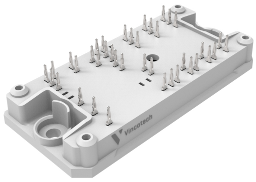
## Target applications

- Embedded Drives
- Industrial Drives

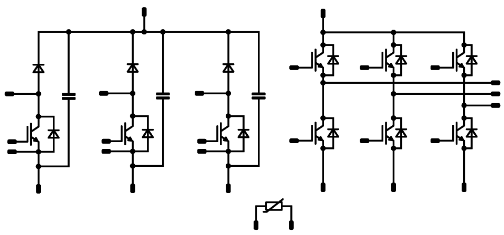
## Types

- 10-PG06PPA050SJ02-LH94E08T

## *flow* 1 12 mm housing



## Schematic



# Maximum Ratings

$T_j$ = 25 °C, unless otherwise specified

| Parameter | Symbol | Conditions | | Value | Unit |
|---|---|---|---|---|---|
| **Inverter Switch** | | | | | |
| Collector-emitter voltage | $V_{CES}$ | | | 600 | V |
| Collector current (DC current) | $I_C$ | $T_j = T_{jmax}$ | $T_s$ = 80 °C | 49 | A |
| Repetitive peak collector current | $I_{CRM}$ | $t_p$ limited by $T_{jmax}$ | | 150 | A |
| Total power dissipation | $P_{tot}$ | $T_j = T_{jmax}$ | $T_s$ = 80 °C | 81 | W |
| Gate-emitter voltage | $V_{GES}$ | | | ±20 | V |
| Short circuit ratings | $t_{SC}$ | $V_{GE}$ = 15 V, $V_{CC}$ = 400 V | $T_j$ = 150 °C | 5 | µs |
| Maximum junction temperature | $T_{jmax}$ | | | 175 | °C |
| **Inverter Diode** | | | | | |
| Peak repetitive reverse voltage | $V_{RRM}$ | | | 600 | V |
| Forward current (DC current) | $I_F$ | $T_j = T_{jmax}$ | $T_s$ = 80 °C | 36 | A |
| Repetitive peak forward current | $I_{FRM}$ | $t_p$ limited by $T_{jmax}$ | | 60 | A |
| Total power dissipation | $P_{tot}$ | $T_j = T_{jmax}$ | $T_s$ = 80 °C | 58 | W |
| Maximum junction temperature | $T_{jmax}$ | | | 175 | °C |
| **PFC Switch** | | | | | |
| Collector-emitter voltage | $V_{CES}$ | | | 650 | V |
| Collector current (DC current) | $I_C$ | $T_j = T_{jmax}$ | $T_s$ = 80 °C | 29 | A |
| Repetitive peak collector current | $I_{CRM}$ | $t_p$ limited by $T_{jmax}$ | | 90 | A |
| Total power dissipation | $P_{tot}$ | $T_j = T_{jmax}$ | $T_s$ = 80 °C | 68 | W |
| Gate-emitter voltage | $V_{GES}$ | | | ±20 | V |
| Maximum junction temperature | $T_{jmax}$ | | | 175 | °C |

# Maximum Ratings

$T_j$ = 25 °C, unless otherwise specified

| Parameter | Symbol | Conditions | | Value | Unit |
|---|---|---|---|---|---|
| **PFC Diode** | | | | | |
| Peak repetitive reverse voltage | $V_{RRM}$ | | | 600 | V |
| Forward current (DC current) | $I_F$ | $T_j = T_{jmax}$ | $T_s$ = 80 °C | 46 | A |
| Repetitive peak forward current | $I_{FRM}$ | $t_p$ limited by $T_{jmax}$ | | 60 | A |
| Surge (non-repetitive) forward current | $I_{FSM}$ | Single Half Sine Wave, $t_p$ = 10 ms | $T_j$ = 25 °C | 310 | A |
| Total power dissipation | $P_{tot}$ | $T_j = T_{jmax}$ | $T_s$ = 80 °C | 60 | W |
| Maximum junction temperature | $T_{jmax}$ | | | 175 | °C |
| **PFC Sw. Protection Diode** | | | | | |
| Peak repetitive reverse voltage | $V_{RRM}$ | | | 650 | V |
| Forward current (DC current) | $I_F$ | $T_j = T_{jmax}$ | $T_s$ <= 80 °C | 20 (1) | A |
| Repetitive peak forward current | $I_{FRM}$ | $t_p$ limited by $T_{jmax}$ | | 20 | A |
| Total power dissipation | $P_{tot}$ | $T_j = T_{jmax}$ | $T_s$ = 80 °C | 33 | W |
| Maximum junction temperature | $T_{jmax}$ | | | 175 | °C |

(1) limited by $I_{FRM}$

| Parameter | Symbol | Conditions | | Value | Unit |
|---|---|---|---|---|---|
| **Capacitor (PFC)** | | | | | |
| Maximum DC voltage | $V_{MAX}$ | | | 630 | V |
| Operation Temperature | $T_{op}$ | | | -55 ... 150 | °C |
| **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 |
| Isolation voltage | $V_{isol}$ | AC Voltage | $t_p$ = 1 min | 2500 | V |
| Creepage distance | | | | >12,7 | mm |
| Clearance | | | | 8,05 | mm |
| Comparative Tracking Index | CTI | | | ≥ 600 | |

*100 % tested in production

# Characteristic Values

| Parameter | Symbol | Conditions | $V_{GE}$ [V] $V_{GS}$ [V] | $V_{CE}$ [V] $V_{DS}$ [V] $V_F$ [V] | $I_C$ [A] $I_D$ [A] $I_F$ [A] | $T_j$ [°C] | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| **Inverter Switch** | | | | | | | | | | |
| **Static** | | | | | | | | | | |
| Gate-emitter threshold voltage | $V_{GE(th)}$ | $V_{CE} = V_{GE}$ | | | 0,0008 | 25 | 4,1 | 5,1 | 5,7 | V |
| Collector-emitter saturation voltage | $V_{CEsat}$ | | 15 | | 50 | 25<br>125<br>150 | | 1,49<br>1,61<br>1,64 | 1,8(2) | V |
| Collector-emitter cut-off current | $I_{CES}$ | | 0 | 600 | | 25 | | | 2,8 | µA |
| Gate-emitter leakage current | $I_{GES}$ | | 20 | 0 | | 25 | | | 100 | nA |
| Internal gate resistance | $r_g$ | | | | | | | None | | Ω |
| Input capacitance | $C_{ies}$ | $f$ = 1 Mhz | 0 | 25 | | 25 | | 1950 | | pF |
| Output capacitance | $C_{oes}$ | $f$ = 1 Mhz | 0 | 25 | | 25 | | 83 | | pF |
| Reverse transfer capacitance | $C_{res}$ | $f$ = 1 Mhz | 0 | 25 | | 25 | | 67 | | pF |
| Gate charge | $Q_g$ | $V_{CC}$ = 480 V | 15 | | 50 | 25 | | 249 | | nC |
| **Thermal** | | | | | | | | | | |
| Thermal resistance junction to sink(3) | $R_{th(j-s)}$ | $\lambda_{paste}$ = 3,4 W/mK (PSX) | | | | | | 1,18 | | K/W |
| **Dynamic** | | | | | | | | | | |
| Turn-on delay time | $t_{d(on)}$ | $R_{gon}$ = 8 Ω<br>$R_{goff}$ = 8 Ω | ±15 | 350 | 50 | 25<br>125<br>150 | | 70<br>70<br>71,2 | | ns |
| Rise time | $t_r$ | $R_{gon}$ = 8 Ω<br>$R_{goff}$ = 8 Ω | ±15 | 350 | 50 | 25<br>125<br>150 | | 45,2<br>43,2<br>42,8 | | ns |
| Turn-off delay time | $t_{d(off)}$ | $R_{gon}$ = 8 Ω<br>$R_{goff}$ = 8 Ω | ±15 | 350 | 50 | 25<br>125<br>150 | | 114,8<br>133,6<br>138,6 | | ns |
| Fall time | $t_f$ | $R_{gon}$ = 8 Ω<br>$R_{goff}$ = 8 Ω | ±15 | 350 | 50 | 25<br>125<br>150 | | 22,47<br>34,2<br>41,12 | | ns |
| Turn-on energy (per pulse) | $E_{on}$ | $Q_{rFWD}$=1,62 µC<br>$Q_{rFWD}$=3,09 µC<br>$Q_{rFWD}$=3,57 µC | ±15 | 350 | 50 | 25<br>125<br>150 | | 1,84<br>2,2<br>2,28 | | mWs |
| Turn-off energy (per pulse) | $E_{off}$ | | ±15 | 350 | 50 | 25<br>125<br>150 | | 0,536<br>0,839<br>0,941 | | mWs |

# Characteristic Values

| Parameter | Symbol | Conditions | | | | | Values | | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | $V_{GE}$ [V] $V_{GS}$ [V] | $V_{CE}$ [V] $V_{DS}$ [V] $V_F$ [V] | $I_C$ [A] $I_D$ [A] $I_F$ [A] | $T_j$ [°C] | Min | Typ | Max | |
| **Inverter Diode** | | | | | | | | | | |
| **Static** | | | | | | | | | | |
| Forward voltage | $V_F$ | | | | 30 | 25<br>150 | 1,25 | 1,64<br>1,55 | 1,95(2) | V |
| Reverse leakage current | $I_R$ | $V_r$ = 600 V | | | | 25 | | | 27 | µA |
| **Thermal** | | | | | | | | | | |
| Thermal resistance junction to sink(3) | $R_{th(j-s)}$ | $\lambda_{paste}$ = 3,4 W/mK (PSX) | | | | | | 1,63 | | K/W |
| **Dynamic** | | | | | | | | | | |
| Peak recovery current | $I_{RM}$ | d*i*/d*t*=245 A/µs<br>d*i*/d*t*=545 A/µs<br>d*i*/d*t*=378 A/µs | ±15 | 350 | 50 | 25<br>125<br>150 | | 10,63<br>16,09<br>16,77 | | A |
| Reverse recovery time | $t_{rr}$ | | | | | 25<br>125<br>150 | | 251,47<br>331,66<br>392,82 | | ns |
| Recovered charge | $Q_r$ | | | | | 25<br>125<br>150 | | 1,62<br>3,09<br>3,57 | | µC |
| Reverse recovered energy | $E_{rec}$ | | | | | 25<br>125<br>150 | | 0,406<br>0,762<br>0,892 | | mWs |
| Peak rate of fall of recovery current | $(di_{rf}/dt)_{max}$ | | | | | 25<br>125<br>150 | | 76,03<br>88,46<br>100,72 | | A/µs |

# Characteristic Values

| Parameter | Symbol | Conditions | $V_{GE}$ [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 | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| **PFC Switch** | | | | | | | | | | |
| **Static** | | | | | | | | | | |
| Gate-emitter threshold voltage | $V_{GE(th)}$ | $V_{CE} = V_{GE}$ | | | 0,0003 | 25 | 3,3 | 4 | 4,7 | V |
| Collector-emitter saturation voltage | $V_{CEsat}$ | | 15 | | 30 | 25<br>125 | | 1,97<br>2,25 | 2,22(2) | V |
| Collector-emitter cut-off current | $I_{CES}$ | | 0 | 650 | | 25 | | | 40 | µA |
| Gate-emitter leakage current | $I_{GES}$ | | 20 | 0 | | 25 | | | 120 | nA |
| Internal gate resistance | $r_g$ | | | | | | | None | | Ω |
| Input capacitance | $C_{ies}$ | $f$ = 1 Mhz | 0 | 25 | | 25 | | 1800 | | pF |
| Output capacitance | $C_{oes}$ | | | | | | | 45 | | pF |
| Reverse transfer capacitance | $C_{res}$ | | | | | | | 9 | | pF |
| Gate charge | $Q_g$ | $V_{CC}$ = 520 V | 15 | | 30 | 25 | | 65 | | nC |
| **Thermal** | | | | | | | | | | |
| Thermal resistance junction to sink(3) | $R_{th(j-s)}$ | $\lambda_{paste}$ = 3,4 W/mK (PSX) | | | | | | 1,39 | | K/W |
| **Dynamic** | | | | | | | | | | |
| Turn-on delay time | $t_{d(on)}$ | $R_{gon}$ = 8 Ω<br>$R_{goff}$ = 8 Ω | 0/15 | 400 | 30 | 25<br>125<br>150 | | 14,9<br>14,41<br>14,41 | | ns |
| Rise time | $t_r$ | | | | | 25<br>125<br>150 | | 6,47<br>7,87<br>8,16 | | ns |
| Turn-off delay time | $t_{d(off)}$ | | | | | 25<br>125<br>150 | | 82,79<br>98,08<br>102,53 | | ns |
| Fall time | $t_f$ | | | | | 25<br>125<br>150 | | 1,76<br>13,16<br>18,74 | | ns |
| Turn-on energy (per pulse) | $E_{on}$ | $Q_{rFWD}$=0,501 µC<br>$Q_{rFWD}$=1,34 µC<br>$Q_{rFWD}$=1,67 µC | | | | 25<br>125<br>150 | | 0,264<br>0,446<br>0,503 | | mWs |
| Turn-off energy (per pulse) | $E_{off}$ | | | | | 25<br>125<br>150 | | 0,167<br>0,264<br>0,288 | | mWs |

# Characteristic Values

| Parameter | Symbol | Conditions | | | | | Values | | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | $V_{GE}$ [V] $V_{GS}$ [V] | $V_{CE}$ [V] $V_{DS}$ [V] $V_F$ [V] | $I_C$ [A] $I_D$ [A] $I_F$ [A] | $T_j$ [°C] | Min | Typ | Max | |
| **PFC Diode** | | | | | | | | | | |
| **Static** | | | | | | | | | | |
| Forward voltage | $V_F$ | | | | 30 | 25<br>125<br>150 | | 1,67<br>1,33<br>1,24 | 2,5(2) | V |
| Reverse leakage current | $I_R$ | $V_r$ = 600 V | | | | 25 | | | 20 | µA |
| **Thermal** | | | | | | | | | | |
| Thermal resistance junction to sink(3) | $R_{th(j\text{-}s)}$ | $\lambda_{paste}$ = 3,4 W/mK (PSX) | | | | | | 1,58 | | K/W |
| **Dynamic** | | | | | | | | | | |
| Peak recovery current | $I_{RM}$ | d*i*/d*t*=4181 A/µs<br>d*i*/d*t*=4010 A/µs<br>d*i*/d*t*=3469 A/µs | 0/15 | 400 | 30 | 25<br>125<br>150 | | 45,72<br>70,93<br>79,55 | | A |
| Reverse recovery time | $t_{rr}$ | | | | | 25<br>125<br>150 | | 21,3<br>35,67<br>39,25 | | ns |
| Recovered charge | $Q_r$ | | | | | 25<br>125<br>150 | | 0,501<br>1,34<br>1,67 | | µC |
| Reverse recovered energy | $E_{rec}$ | | | | | 25<br>125<br>150 | | 0,107<br>0,308<br>0,395 | | mWs |
| Peak rate of fall of recovery current | $(di_{rf}/dt)_{max}$ | | | | | 25<br>125<br>150 | | 5383,47<br>5067,48<br>5137,63 | | A/µs |

# Characteristic Values

| Parameter | Symbol | Conditions | $V_{GE}$ [V] $V_{GS}$ [V] | $V_{CE}$ [V] $V_{DS}$ [V] $V_F$ [V] | $I_C$ [A] $I_D$ [A] $I_F$ [A] | $T_j$ [°C] | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| **PFC Sw. Protection Diode** | | | | | | | | | | |
| **Static** | | | | | | | | | | |
| Forward voltage | $V_F$ | | | | 10 | 25<br>125 | 1,23 | 1,67<br>1,54 | 1,87[2] | V |
| Reverse leakage current | $I_R$ | $V_r$ = 650 V | | | | 25 | | | 0,14 | µA |
| **Thermal** | | | | | | | | | | |
| Thermal resistance junction to sink[3] | $R_{th(j-s)}$ | $\lambda_{paste}$ = 3,4 W/mK (PSX) | | | | | | 2,87 | | K/W |
| **Capacitor (PFC)** | | | | | | | | | | |
| **Static** | | | | | | | | | | |
| Capacitance | $C$ | DC bias voltage = 0 V | | | | 25 | | 33 | | nF |
| Tolerance | | | | | | | -5 | | 5 | % |
| **Thermistor** | | | | | | | | | | |
| **Static** | | | | | | | | | | |
| Rated resistance | $R$ | | | | | 25 | | 22 | | kΩ |
| Deviation of R100 | $\Delta_{R/R}$ | $R_{100}$ = 1484 Ω | | | | 100 | -5 | | 5 | % |
| Power dissipation | $P$ | | | | | 25 | | 130 | | mW |
| Power dissipation constant | $d$ | | | | | 25 | | 1,5 | | mW/K |
| B-value | $B_{(25/50)}$ | Tol. ±1 % | | | | | | 3962 | | K |
| B-value | $B_{(25/100)}$ | Tol. ±1 % | | | | | | 4000 | | K |
| Vincotech Thermistor Reference | | | | | | | | | I | |

(2) Value at chip level

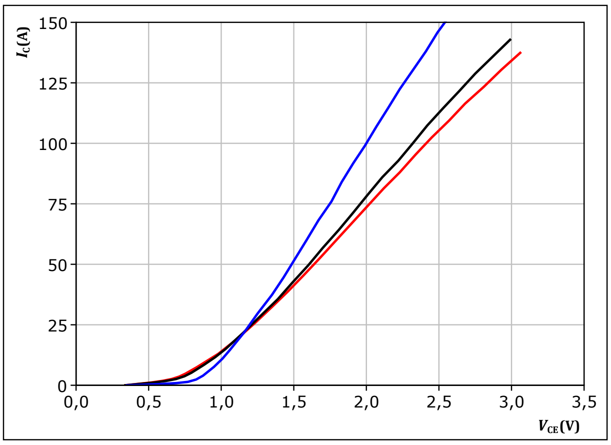
(3) Only valid with pre-applied Vincotech thermal interface material.

# Inverter Switch Characteristics

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

**Typical output characteristics**

$I_C$ = f( $V_{CE}$ )

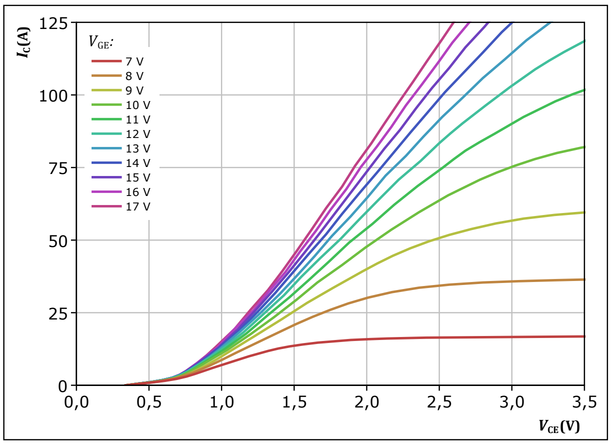



| | | | | |
|---|---|---|---|---|
| $t_p$ = | 250 | µs | | 25 °C |
| $V_{GE}$ = | 15 | V | $T_j$: | 125 °C |
| | | | | 150 °C |

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

**Typical output characteristics**

$I_C$ = f( $V_{CE}$ )



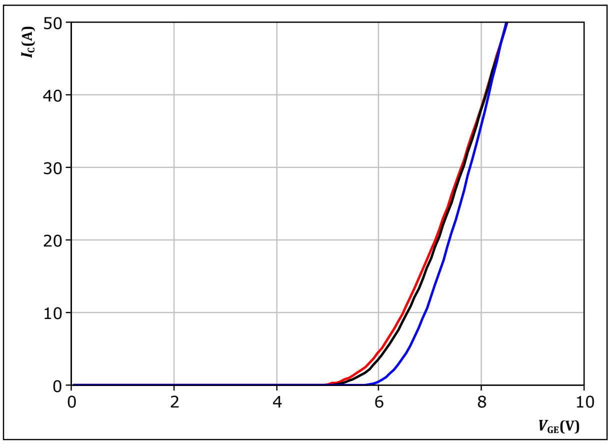

| | | |
|---|---|---|
| $t_p$ = | 250 | µs |
| $T_j$ = | 150 | °C |

$V_{GE}$ from 7 V to 17 V in steps of 1 V

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

**Typical transfer characteristics**

$I_C$ = f( $V_{GE}$ )

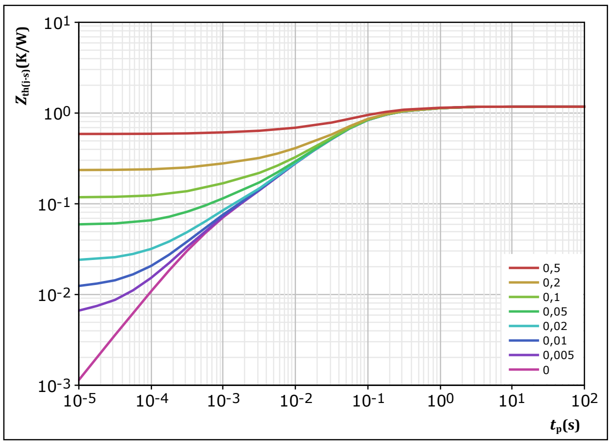



| | | | | |
|---|---|---|---|---|
| $t_p$ = | 250 | µs | | 25 °C |
| $V_{CE}$ = | 10 | V | $T_j$: | 125 °C |
| | | | | 150 °C |

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

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

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




| | | |
|---|---|---|
| $D$ = | $t_p$ / $T$ | |
| $R_{th(j-s)}$ = | 1,176 | K/W |

IGBT thermal model values

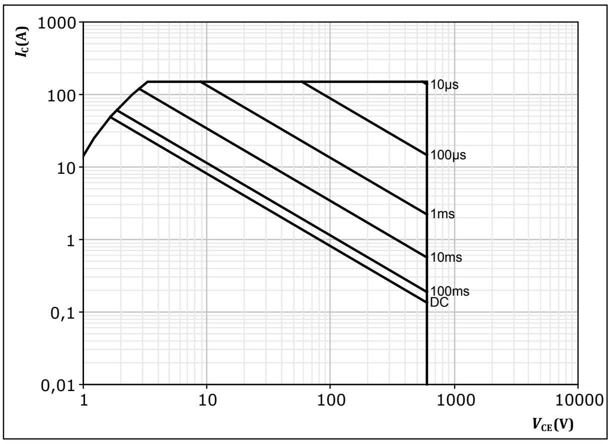
| $R$ (K/W) | $\tau$ (s) |
|---|---|
| 1,28E-01 | 9,19E-01 |
| 3,00E-01 | 1,49E-01 |
| 5,67E-01 | 4,76E-02 |
| 1,34E-01 | 6,63E-03 |
| 4,70E-02 | 5,83E-04 |

# Inverter Switch Characteristics

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

**Safe operating area**

$I_C$ = f( $V_{CE}$ )



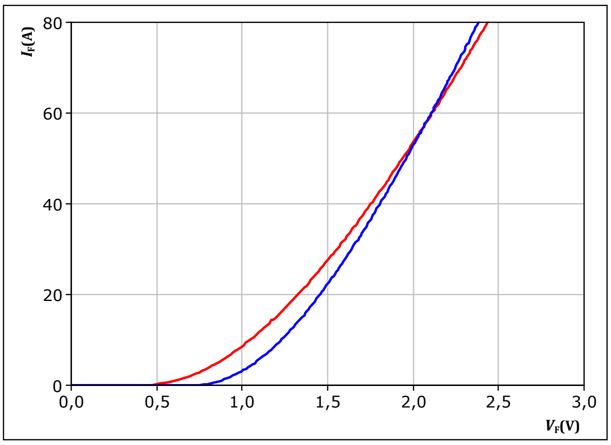

| | | |
|---|---|---|
| $D$ = | single pulse | |
| $T_s$ = | 80 | °C |
| $V_{GE}$ = | 15 | V |
| $T_j$ = | $T_{jmax}$ | |

# Inverter Diode Characteristics

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

**Typical forward characteristics**

$I_F$ = f( $V_F$)



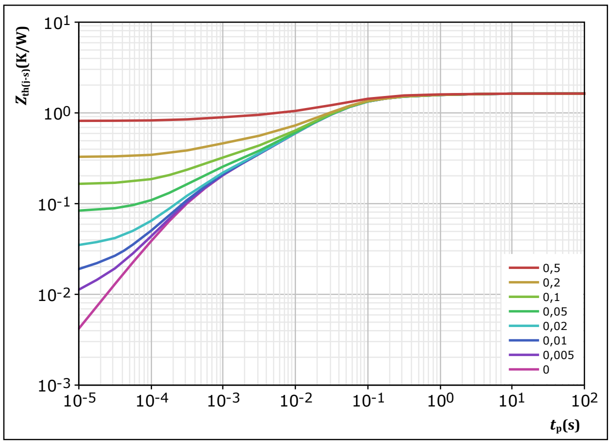

$t_p$ = 250 µs

$T_j$: 25 °C, 150 °C

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

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

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




$D$ = $t_p$ / $T$

$R_{th(j-s)}$ = 1,633 K/W

FWD thermal model values

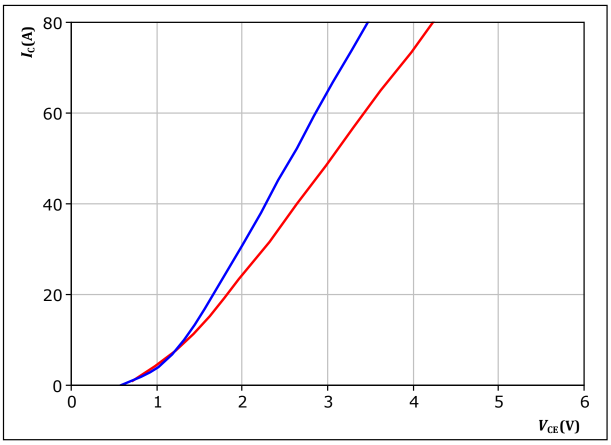
| $R$ (K/W) | $\tau$ (s) |
|---|---|
| 7,13E-02 | 2,70E+00 |
| 1,55E-01 | 3,01E-01 |
| 7,25E-01 | 5,48E-02 |
| 3,93E-01 | 1,54E-02 |
| 1,57E-01 | 2,76E-03 |
| 1,32E-01 | 4,03E-04 |

# PFC Switch Characteristics

**figure 8.** IGBT

**Typical output characteristics**

$I_C$ = f( $V_{CE}$ )

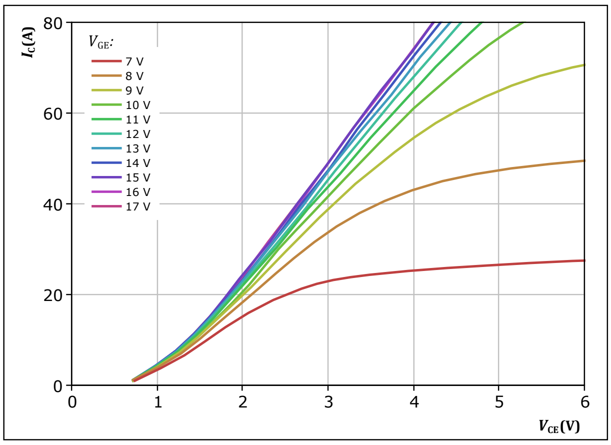



| | | | | |
|---|---|---|---|---|
| $t_p$ = | 250 | µs | $T_j$: | 25 °C |
| $V_{GE}$ = | 15 | V | | 125 °C |

**figure 9.** IGBT

**Typical output characteristics**

$I_C$ = f( $V_{CE}$ )



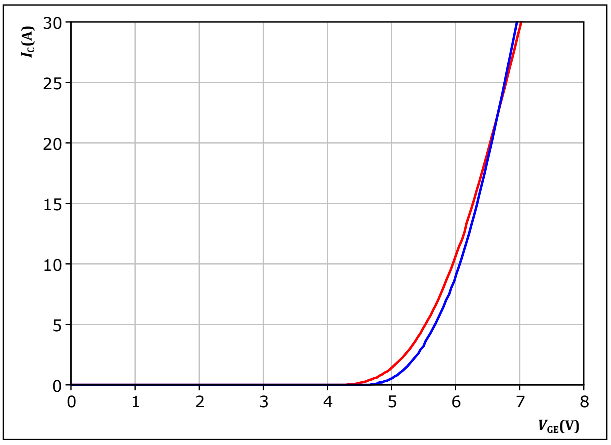

| | | |
|---|---|---|
| $t_p$ = | 250 | µs |
| $T_j$ = | 125 | °C |

$V_{GE}$ from 7 V to 17 V in steps of 1 V

**figure 10.** IGBT

**Typical transfer characteristics**

$I_C$ = f( $V_{GE}$ )

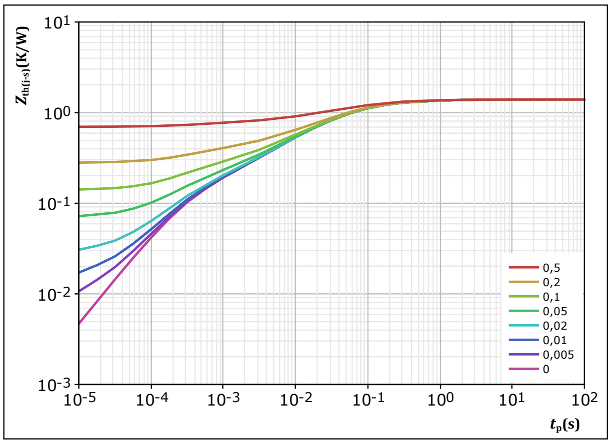



| | | | | |
|---|---|---|---|---|
| $t_p$ = | 250 | µs | $T_j$: | 25 °C |
| $V_{CE}$ = | 10 | V | | 125 °C |

**figure 11.** IGBT

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

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




| | | |
|---|---|---|
| $D$ = | $t_p$ / $T$ | |
| $R_{th(j-s)}$ = | 1,394 | K/W |

IGBT thermal model values

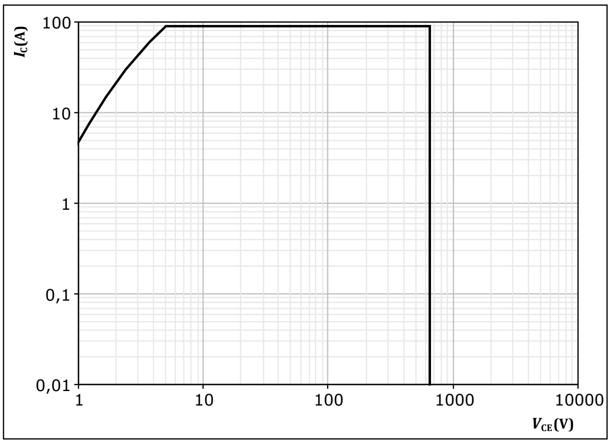
| $R$ (K/W) | $\tau$ (s) |
|---|---|
| 8,66E-02 | 1,03E+00 |
| 1,95E-01 | 1,93E-01 |
| 5,59E-01 | 5,17E-02 |
| 3,47E-01 | 9,99E-03 |
| 9,37E-02 | 1,86E-03 |
| 1,12E-01 | 2,95E-04 |

# PFC Switch Characteristics

**figure 12.** **IGBT**

**Safe operating area**

$I_C$ = f( $V_{CE}$)

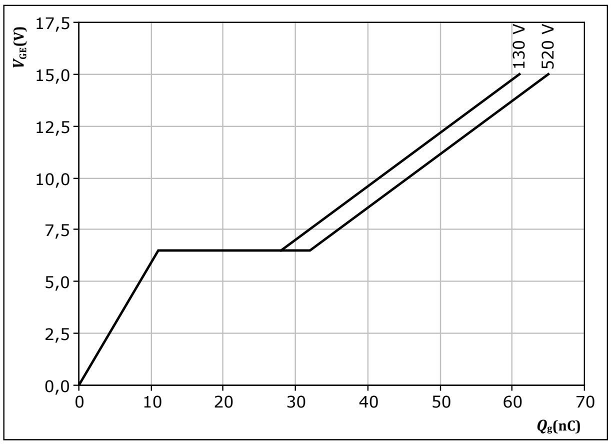



| | | |
|---|---|---|
| $D$ = | single pulse | |
| $T_s$ = | 80 | °C |
| $V_{GE}$ = | 15 | V |
| $T_j$ = | $T_{jmax}$ | |

**figure 13.** **IGBT**

**Gate voltage vs gate charge**

$V_{GE}$ = f( $Q_g$)



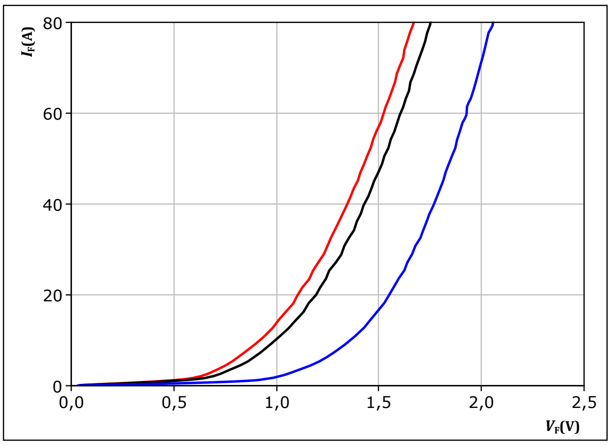

| | | |
|---|---|---|
| $I_C$ = | 30 | A |
| $T_j$ = | 25 | °C |

# PFC Diode Characteristics

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

**Typical forward characteristics**

$I_F = f(V_F)$



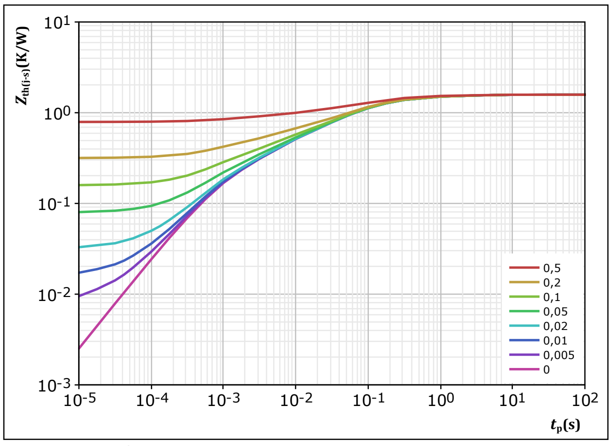

$t_p$ = 250 µs

$T_j$: 25 °C, 125 °C, 150 °C

**figure 15.** **FWD**

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

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




$D = t_p / T$

$R_{th(j-s)}$ = 1,581 K/W

FWD thermal model values

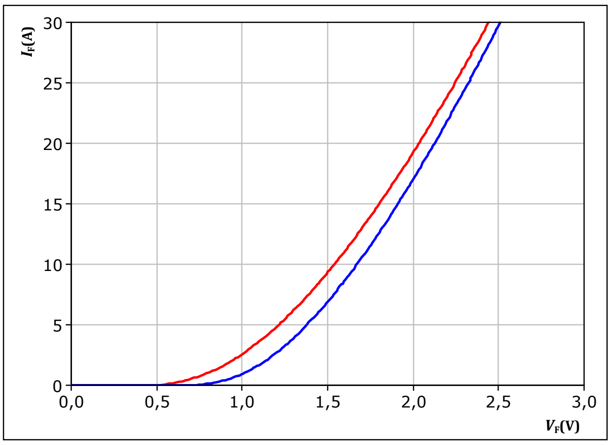
| $R$ (K/W) | $\tau$ (s) |
|---|---|
| 9,48E-02 | 2,80E+00 |
| 2,89E-01 | 3,14E-01 |
| 7,00E-01 | 6,69E-02 |
| 3,27E-01 | 7,77E-03 |
| 1,71E-01 | 8,57E-04 |

# PFC Sw. Protection Diode Characteristics

**figure 16.** **FWD**

**Typical forward characteristics**

$I_F$ = f( $V_F$)



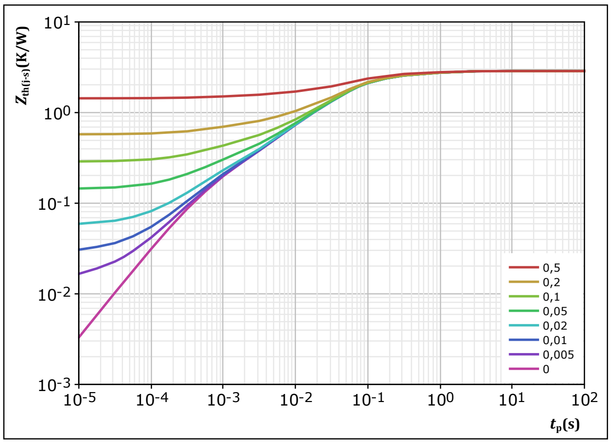

$t_p$ = 250 µs

$T_j$: 25 °C, 125 °C

**figure 17.** **FWD**

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

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




$D$ = $t_p$ / $T$

$R_{th(j-s)}$ = 2,874 K/W

FWD thermal model values

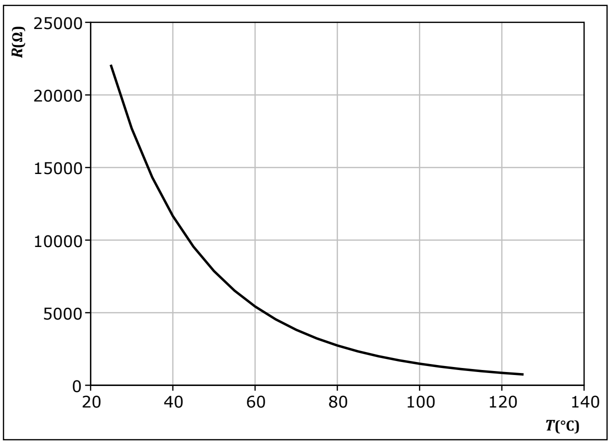
| $R$ (K/W) | $\tau$ (s) |
|---|---|
| 2,86E-01 | 1,08E+00 |
| 5,75E-01 | 1,73E-01 |
| 1,57E+00 | 4,54E-02 |
| 3,05E-01 | 5,64E-03 |
| 1,34E-01 | 5,58E-04 |

# Thermistor Characteristics

| figure 18. | Thermistor |
|---|---|

**Typical NTC characteristic as function of temperature**

$R_T$ = f( $T$)

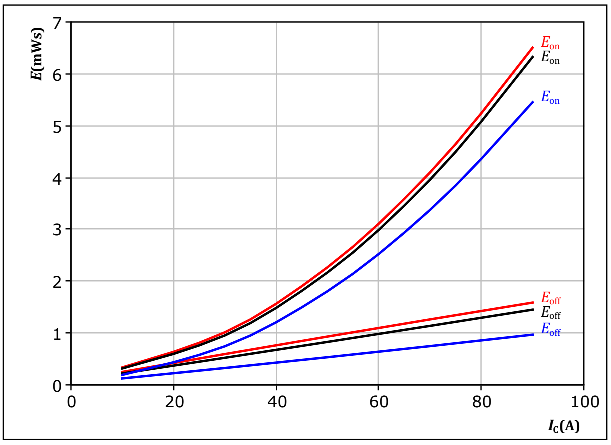


# Inverter Switching Characteristics

**figure 19.** **IGBT**

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

$E$ = f( $I_C$)



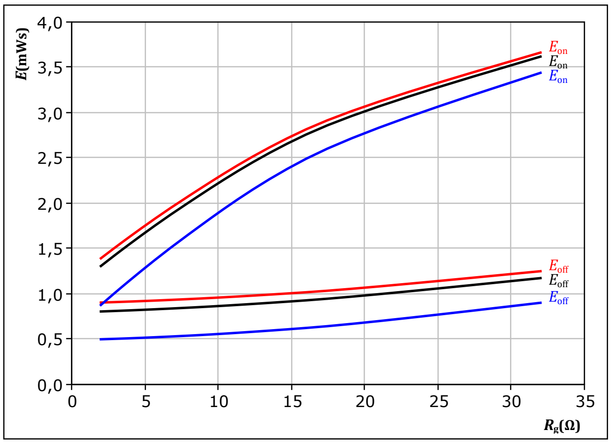

With an inductive load at

| | | | | |
|---|---|---|---|---|
| $V_{CE}$ = | 350 | V | $T_j$: | 25 °C |
| $V_{GE}$ = | ±15 | V | | 125 °C |
| $R_{gon}$ = | 8 | Ω | | 150 °C |
| $R_{goff}$ = | 8 | Ω | | |

**figure 20.** **IGBT**

**Typical switching energy losses as a function of IGBT turn on gate resistor**

$E$ = f( $R_g$)



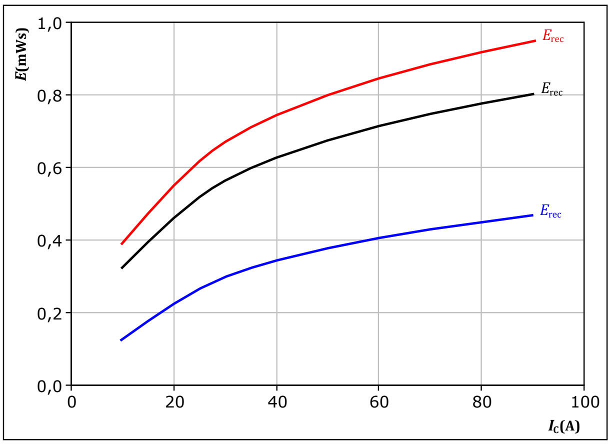

With an inductive load at

| | | | | |
|---|---|---|---|---|
| $V_{CE}$ = | 350 | V | $T_j$: | 25 °C |
| $V_{GE}$ = | ±15 | V | | 125 °C |
| $I_C$ = | 50 | A | | 150 °C |

**figure 21.** **FWD**

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

$E_{rec}$ = f( $I_C$)



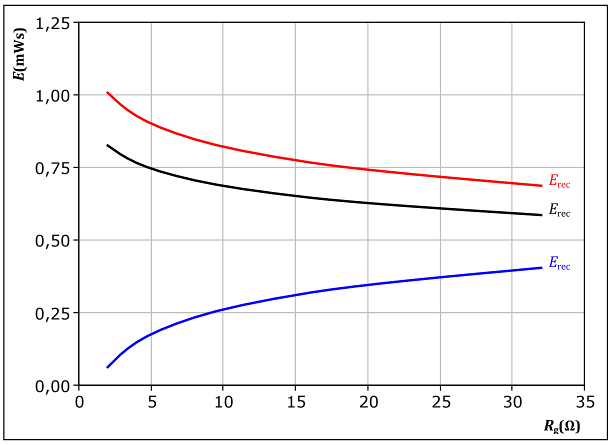

With an inductive load at

| | | | | |
|---|---|---|---|---|
| $V_{CE}$ = | 350 | V | $T_j$: | 25 °C |
| $V_{GE}$ = | ±15 | V | | 125 °C |
| $R_{gon}$ = | 8 | Ω | | 150 °C |

**figure 22.** **FWD**

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

$E_{rec}$ = f( $R_g$)




With an inductive load at

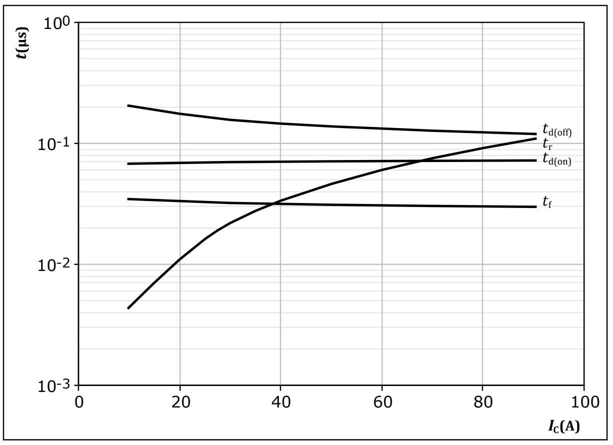
| | | | | |
|---|---|---|---|---|
| $V_{CE}$ = | 350 | V | $T_j$: | 25 °C |
| $V_{GE}$ = | ±15 | V | | 125 °C |
| $I_C$ = | 50 | A | | 150 °C |

# Inverter Switching Characteristics

**figure 23.** **IGBT**

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

$t = f(I_C)$



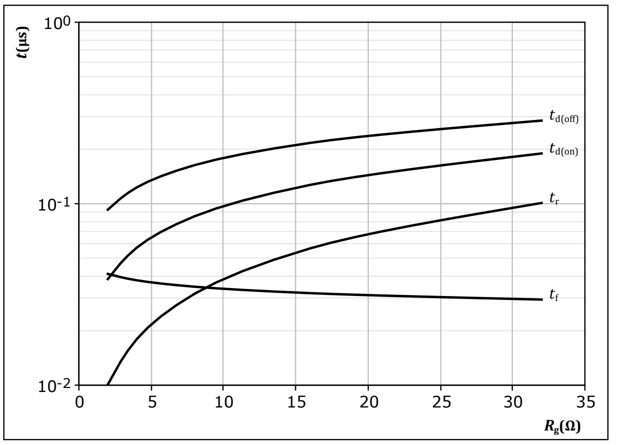

With an inductive load at

| | | |
|---|---|---|
| $T_j$ = | 150 | °C |
| $V_{CE}$ = | 350 | V |
| $V_{GE}$ = | ±15 | V |
| $R_{gon}$ = | 8 | Ω |
| $R_{goff}$ = | 8 | Ω |

**figure 24.** **IGBT**

**Typical switching times as a function of IGBT turn on gate resistor**

$t = f(R_g)$



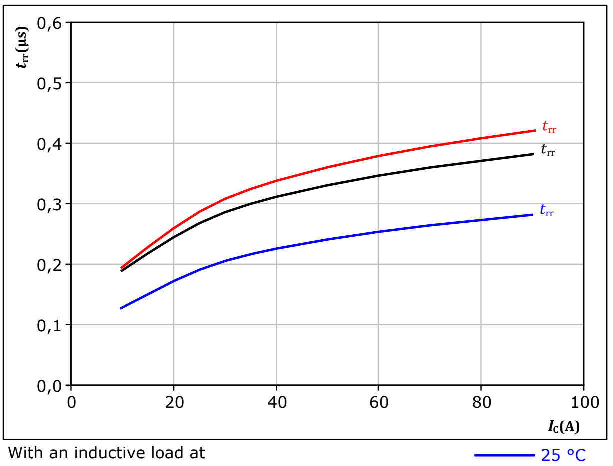

With an inductive load at

| | | |
|---|---|---|
| $T_j$ = | 150 | °C |
| $V_{CE}$ = | 350 | V |
| $V_{GE}$ = | ±15 | V |
| $I_C$ = | 50 | A |

**figure 25.** **FWD**

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

$t_{rr} = f(I_C)$




With an inductive load at

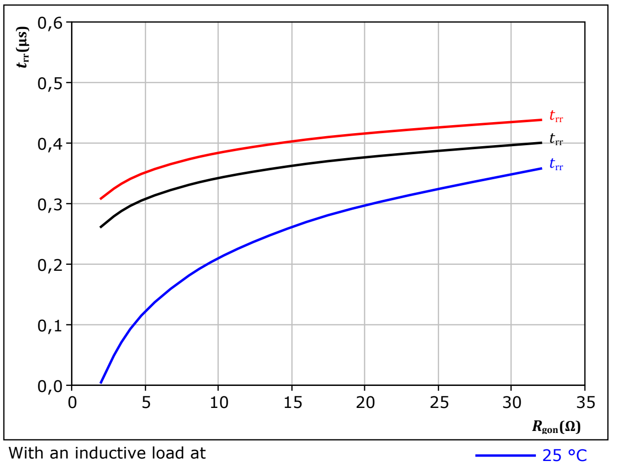
| | | |
|---|---|---|
| $V_{CE}$ = | 350 | V |
| $V_{GE}$ = | ±15 | V |
| $R_{gon}$ = | 8 | Ω |

$T_j$: 25 °C, 125 °C, 150 °C

**figure 26.** **FWD**

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

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




With an inductive load at

| | | |
|---|---|---|
| $V_{CE}$ = | 350 | V |
| $V_{GE}$ = | ±15 | V |
| $I_C$ = | 50 | A |

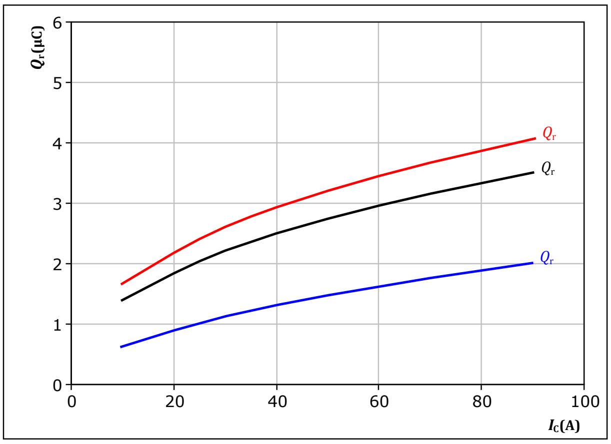
$T_j$: 25 °C, 125 °C, 150 °C

# Inverter Switching Characteristics

**figure 27.** FWD

Typical recovered charge as a function of collector current

$Q_r = f(I_C)$




With an inductive load at

$V_{CE}$ = 350 V

$V_{GE}$ = ±15 V

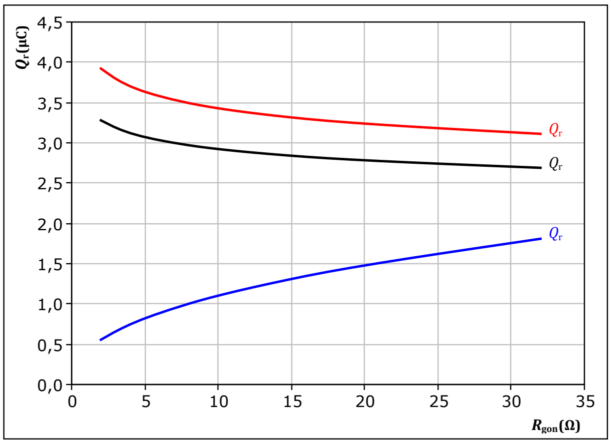
$R_{gon}$ = 8 Ω

$T_j$: 25 °C, 125 °C, 150 °C

**figure 28.** FWD

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

$Q_r = f(R_{gon})$




With an inductive load at

$V_{CE}$ = 350 V

$V_{GE}$ = ±15 V

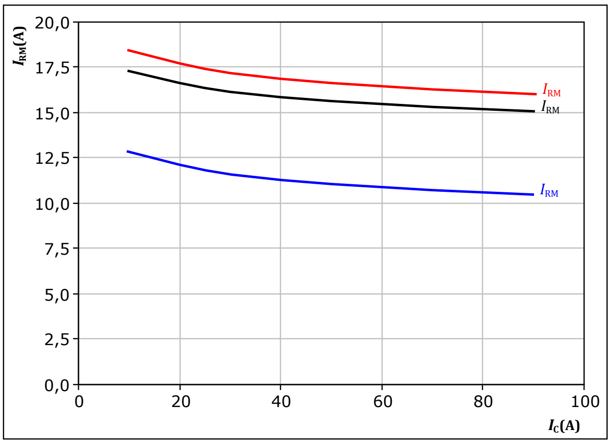
$I_C$ = 50 A

$T_j$: 25 °C, 125 °C, 150 °C

**figure 29.** FWD

Typical peak reverse recovery current as a function of collector current

$I_{RM} = f(I_C)$




With an inductive load at

$V_{CE}$ = 350 V

$V_{GE}$ = ±15 V

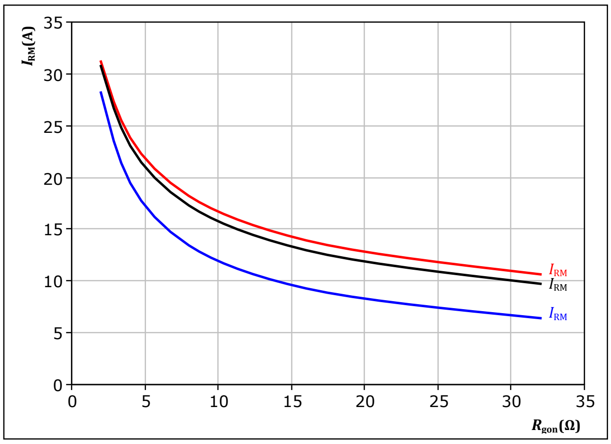
$R_{gon}$ = 8 Ω

$T_j$: 25 °C, 125 °C, 150 °C

**figure 30.** FWD

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

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




With an inductive load at

$V_{CE}$ = 350 V

$V_{GE}$ = ±15 V

$I_C$ = 50 A

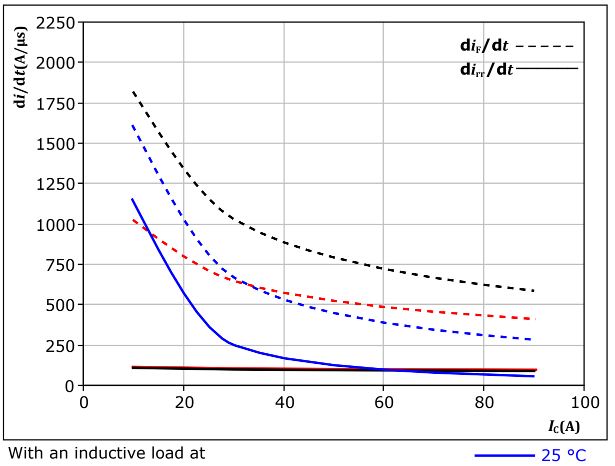
$T_j$: 25 °C, 125 °C, 150 °C

# Inverter Switching Characteristics

**figure 31.** **FWD**

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

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



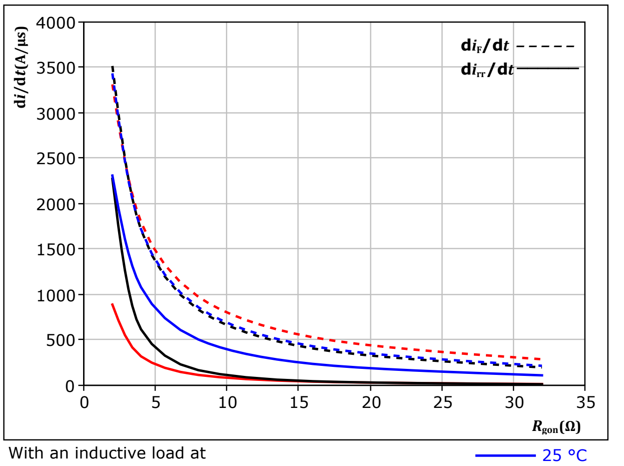

With an inductive load at

| | | | | |
|---|---|---|---|---|
| $V_{CE}$ = | 350 | V | $T_j$: | 25 °C |
| $V_{GE}$ = | ±15 | V | | 125 °C |
| $R_{gon}$ = | 8 | Ω | | 150 °C |

**figure 32.** **FWD**

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

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



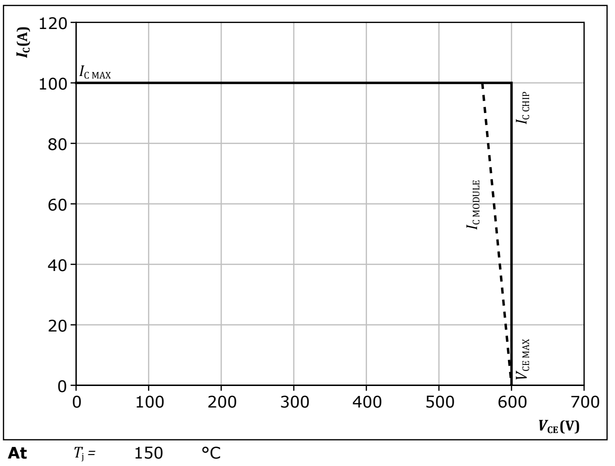

With an inductive load at

| | | | | |
|---|---|---|---|---|
| $V_{CE}$ = | 350 | V | $T_j$: | 25 °C |
| $V_{GE}$ = | ±15 | V | | 125 °C |
| $I_C$ = | 50 | A | | 150 °C |

**figure 33.** **IGBT**

**Reverse bias safe operating area**

$I_C = f(V_{CE})$



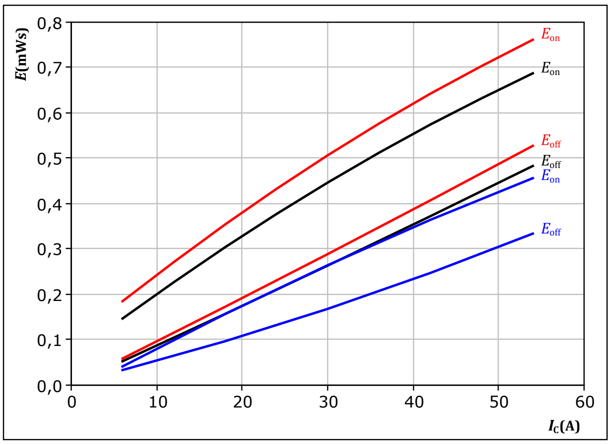

| | | | |
|---|---|---|---|
| **At** | $T_j$ = | 150 | °C |
| | $R_{gon}$ = | 8 | Ω |
| | $R_{goff}$ = | 8 | Ω |

# PFC Switching Characteristics

**figure 34.** **IGBT**

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

$E$ = f( $I_C$)



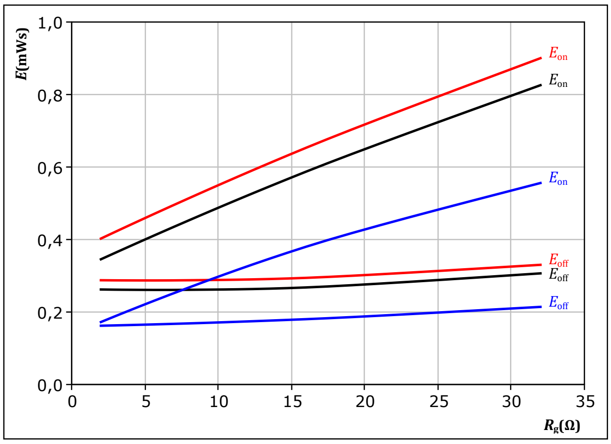

With an inductive load at

| | | | | |
|---|---|---|---|---|
| $V_{CE}$ = | 400 | V | $T_j$: | 25 °C / 125 °C / 150 °C |
| $V_{GE}$ = | 0/15 | V | | |
| $R_{gon}$ = | 8 | Ω | | |
| $R_{goff}$ = | 8 | Ω | | |

**figure 35.** **IGBT**

**Typical switching energy losses as a function of IGBT turn on gate resistor**

$E$ = f( $R_g$)



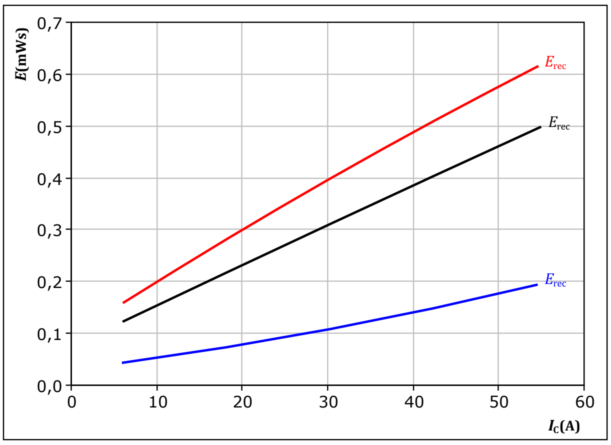

With an inductive load at

| | | | | |
|---|---|---|---|---|
| $V_{CE}$ = | 400 | V | $T_j$: | 25 °C / 125 °C / 150 °C |
| $V_{GE}$ = | 0/15 | V | | |
| $I_C$ = | 30 | A | | |

**figure 36.** **FWD**

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

$E_{rec}$ = f( $I_C$)



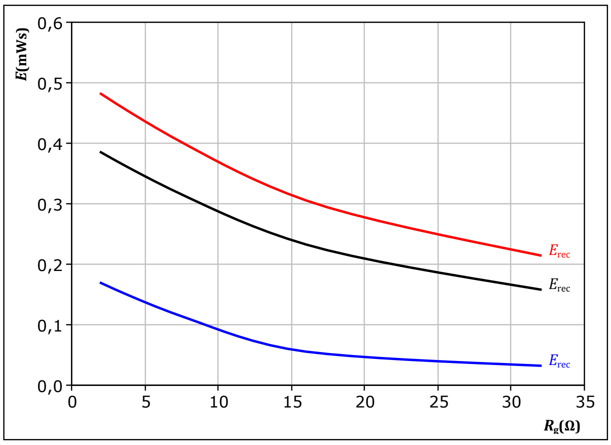

With an inductive load at

| | | | | |
|---|---|---|---|---|
| $V_{CE}$ = | 400 | V | $T_j$: | 25 °C / 125 °C / 150 °C |
| $V_{GE}$ = | 0/15 | V | | |
| $R_{gon}$ = | 8 | Ω | | |

**figure 37.** **FWD**

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

$E_{rec}$ = f( $R_g$)




With an inductive load at

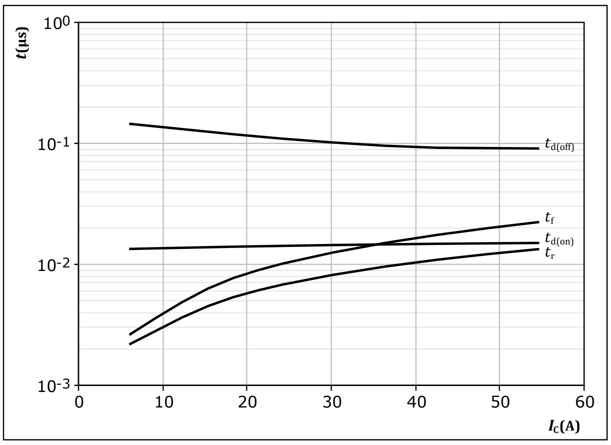
| | | | | |
|---|---|---|---|---|
| $V_{CE}$ = | 400 | V | $T_j$: | 25 °C / 125 °C / 150 °C |
| $V_{GE}$ = | 0/15 | V | | |
| $I_C$ = | 30 | A | | |

# PFC Switching Characteristics

**figure 38.** **IGBT**

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

$t$ = f( $I_C$)



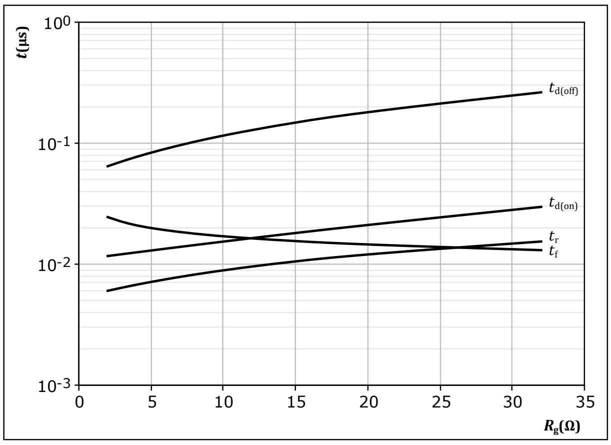

With an inductive load at

| | | |
|---|---|---|
| $T_j$ = | 150 | °C |
| $V_{CE}$ = | 400 | V |
| $V_{GE}$ = | 0/15 | V |
| $R_{gon}$ = | 8 | Ω |
| $R_{goff}$ = | 8 | Ω |

**figure 39.** **IGBT**

**Typical switching times as a function of IGBT turn on gate resistor**

$t$ = f( $R_g$)



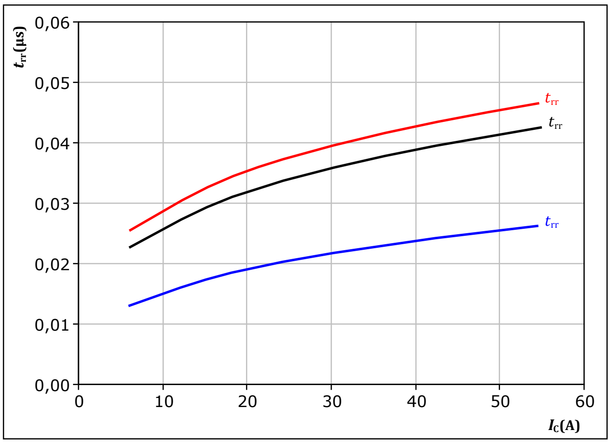

With an inductive load at

| | | |
|---|---|---|
| $T_j$ = | 150 | °C |
| $V_{CE}$ = | 400 | V |
| $V_{GE}$ = | 0/15 | V |
| $I_C$ = | 30 | A |

**figure 40.** **FWD**

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

$t_{rr}$ = f( $I_C$)




With an inductive load at

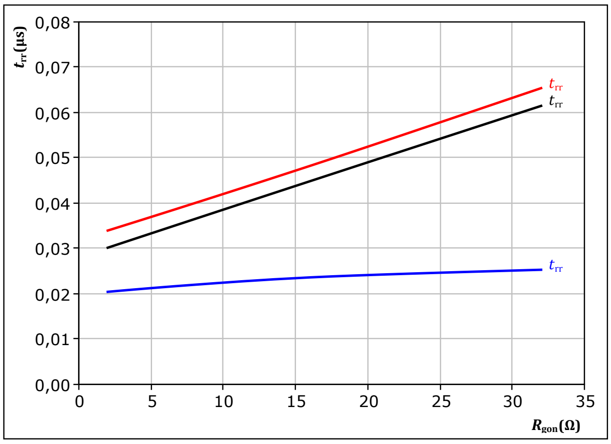
| | | |
|---|---|---|
| $V_{CE}$ = | 400 | V |
| $V_{GE}$ = | 0/15 | V |
| $R_{gon}$ = | 8 | Ω |

$T_j$: 25 °C, 125 °C, 150 °C

**figure 41.** **FWD**

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

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




With an inductive load at

| | | |
|---|---|---|
| $V_{CE}$ = | 400 | V |
| $V_{GE}$ = | 0/15 | V |
| $I_C$ = | 30 | A |

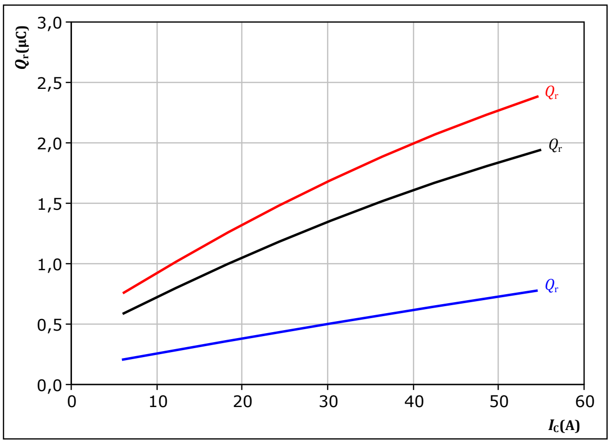
$T_j$: 25 °C, 125 °C, 150 °C

# PFC Switching Characteristics

**figure 42.** FWD

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

$Q_r$ = f( $I_C$)



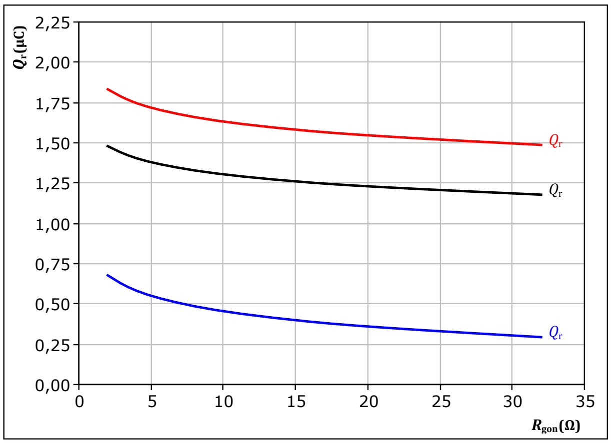

With an inductive load at

| | | | | |
|---|---|---|---|---|
| $V_{CE}$ = | 400 | V | $T_j$: | 25 °C |
| $V_{GE}$ = | 0/15 | V | | 125 °C |
| $R_{gon}$ = | 8 | Ω | | 150 °C |

**figure 43.** FWD

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

$Q_r$ = f( $R_{gon}$)



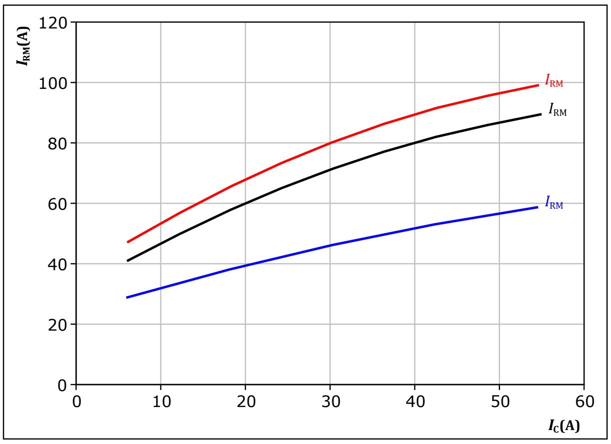

With an inductive load at

| | | | | |
|---|---|---|---|---|
| $V_{CE}$ = | 400 | V | $T_j$: | 25 °C |
| $V_{GE}$ = | 0/15 | V | | 125 °C |
| $I_C$ = | 30 | A | | 150 °C |

**figure 44.** FWD

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

$I_{RM}$ = f( $I_C$)



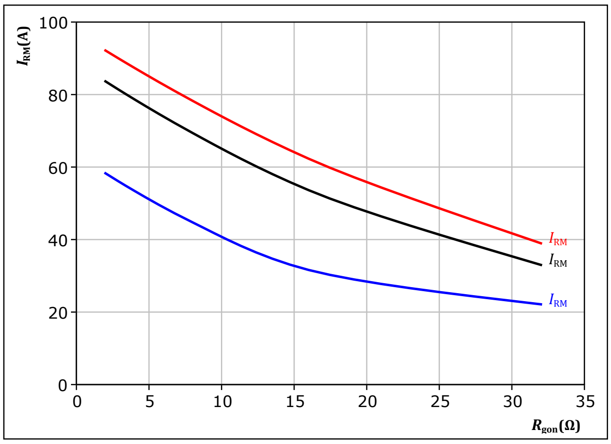

With an inductive load at

| | | | | |
|---|---|---|---|---|
| $V_{CE}$ = | 400 | V | $T_j$: | 25 °C |
| $V_{GE}$ = | 0/15 | V | | 125 °C |
| $R_{gon}$ = | 8 | Ω | | 150 °C |

**figure 45.** FWD

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

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




With an inductive load at

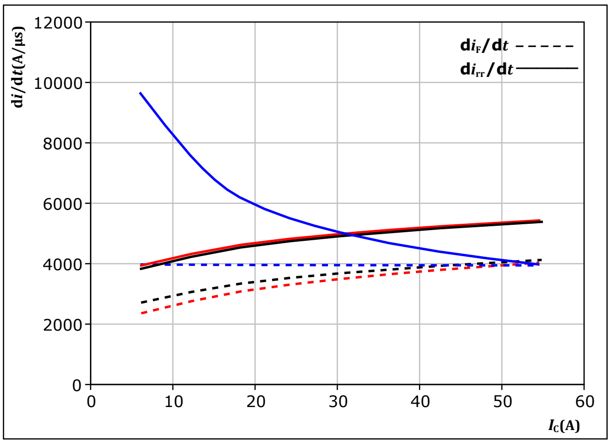
| | | | | |
|---|---|---|---|---|
| $V_{CE}$ = | 400 | V | $T_j$: | 25 °C |
| $V_{GE}$ = | 0/15 | V | | 125 °C |
| $I_C$ = | 30 | A | | 150 °C |

# PFC Switching Characteristics

**figure 46.** **FWD**

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

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



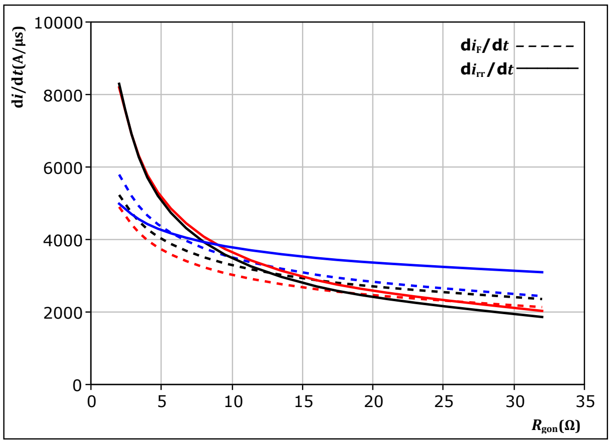

With an inductive load at

| | | | | |
|---|---|---|---|---|
| $V_{CE}$ = | 400 | V | $T_j$: | 25 °C |
| $V_{GE}$ = | 0/15 | V | | 125 °C |
| $R_{gon}$ = | 8 | Ω | | 150 °C |

**figure 47.** **FWD**

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

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



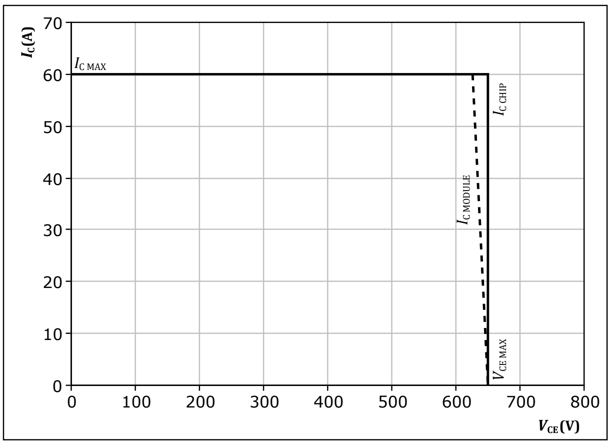

With an inductive load at

| | | | | |
|---|---|---|---|---|
| $V_{CE}$ = | 400 | V | $T_j$: | 25 °C |
| $V_{GE}$ = | 0/15 | V | | 125 °C |
| $I_C$ = | 30 | A | | 150 °C |

**figure 48.** **IGBT**

**Reverse bias safe operating area**

$I_C$ = f( $V_{CE}$)




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

# Switching Definitions

**figure 49.** **IGBT**

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

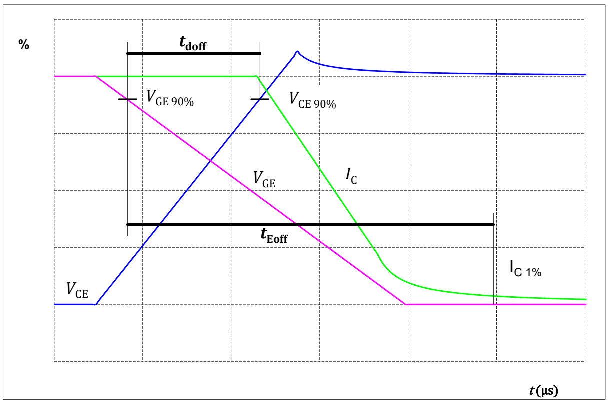



**figure 50.** **IGBT**

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

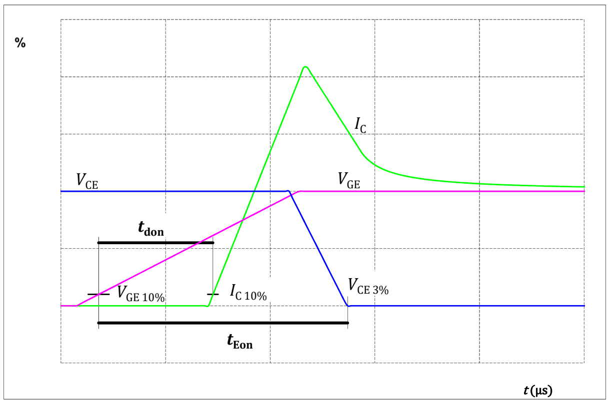



**figure 51.** **IGBT**

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

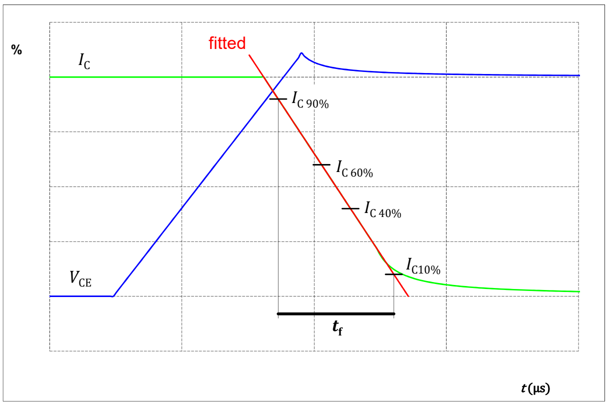
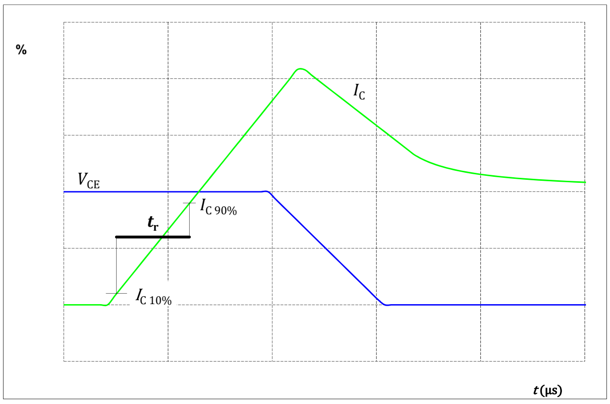



**figure 52.** **IGBT**

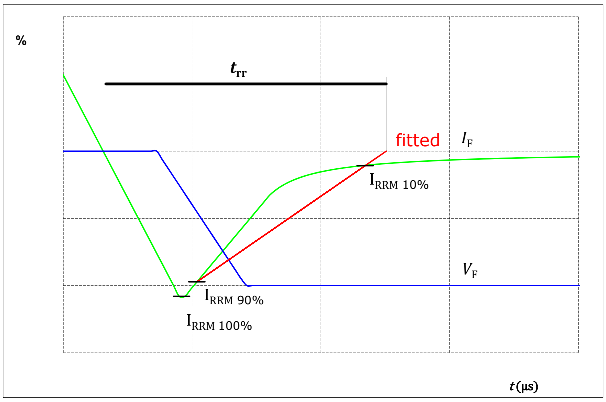
**Turn-on Switching Waveforms & definition of $t_r$**



# Switching Definitions

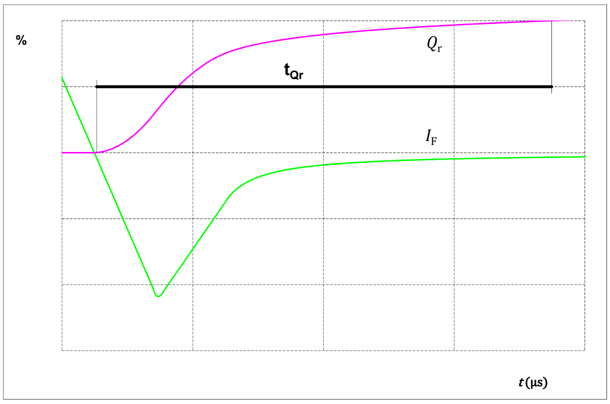
| figure 53. | FWD |
|---|---|

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




| figure 54. | FWD |
|---|---|

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



# 10-PG06PPA050SJ02-LH94E08T

datasheet

## Ordering Code

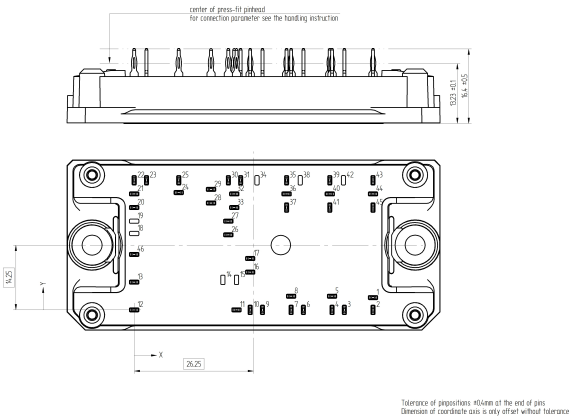
| Version | Ordering Code |
|---|---|
| Without thermal paste | 10-PG06PPA050SJ02-LH94E08T |
| With thermal paste (5,2 W/mK, PTM6000HV) | 10-PG06PPA050SJ02-LH94E08T-/7/ |
| With thermal paste (3,4 W/mK, PSX-P7) | 10-PG06PPA050SJ02-LH94E08T-/3/ |

## Marking

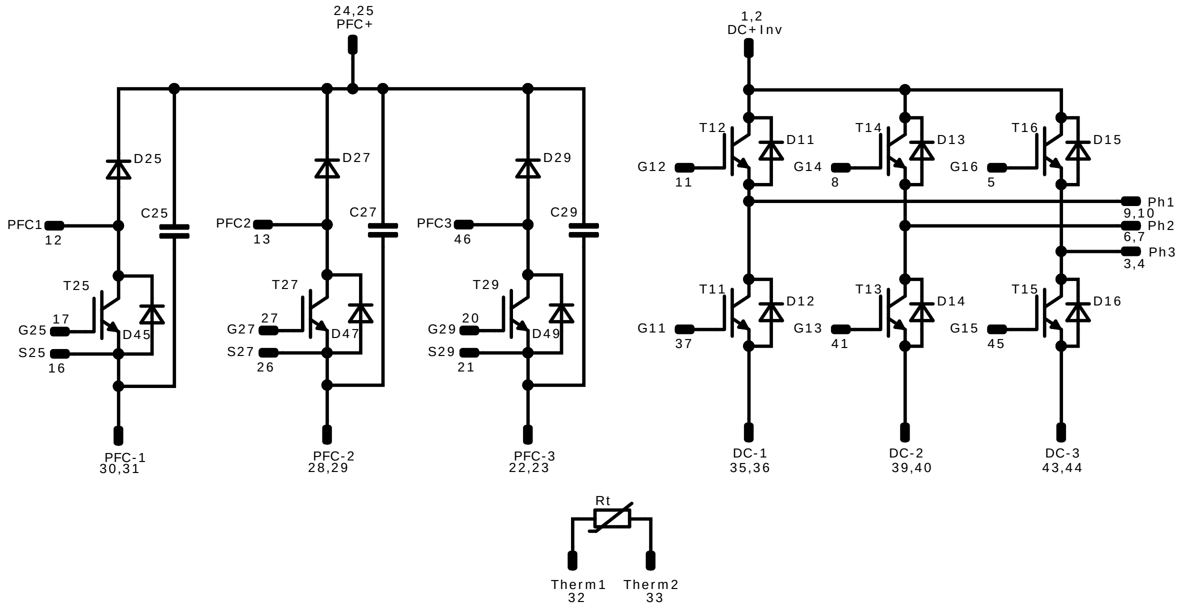

| | | | | | | |
|---|---|---|---|---|---|---|
| Text | Name | | Date code | UL & VIN | Lot | Serial |
| | NN-NNNNNNNNNNNNNN-TTTTTTVV | | WWYY | UL VIN | LLLLL | SSSS |
| Datamatrix | Type&Ver | Lot number | Serial | Date code | | |
| | TTTTTTTVV | LLLLL | SSSS | WWYY | | |

## Outline

| Pin table [mm] | | | |
|---|---|---|---|
| Pin | X | Y | Function |
| 1 | 52,5 | 2,7 | DC+Inv |
| 2 | 52,5 | 0 | DC+Inv |
| 3 | 46,2 | 0 | Ph3 |
| 4 | 43,5 | 0 | Ph3 |
| 5 | 43,5 | 3 | G16 |
| 6 | 37,2 | 0 | Ph2 |
| 7 | 34,5 | 0 | Ph2 |
| 8 | 34,5 | 3 | G14 |
| 9 | 28,2 | 0 | Ph1 |
| 10 | 25,5 | 0 | Ph1 |
| 11 | 22,5 | 0 | G12 |
| 12 | 0 | 0 | PFC1 |
| 13 | 0 | 6,1 | PFC2 |
| 14 | not assembled | | |
| 15 | not assembled | | |
| 16 | 25,5 | 8,3 | S25 |
| 17 | 25,5 | 11,3 | G25 |
| 18 | not assembled | | |
| 19 | not assembled | | |
| 20 | 0 | 22,5 | G29 |
| 21 | 0 | 25,5 | S29 |
| 22 | 0 | 28,5 | PFC-3 |
| 23 | 2,7 | 28,5 | PFC-3 |
| 24 | 9,8 | 25,8 | PFC+ |
| 25 | 9,8 | 28,5 | PFC+ |
| 26 | 20,7 | 16,5 | S27 |
| 27 | 20,7 | 19,5 | G27 |
| 28 | 16,9 | 23,5 | PFC-2 |
| 29 | 16,9 | 26,5 | PFC-2 |
| 30 | 20,7 | 28,5 | PFC-1 |
| 31 | 23,4 | 28,5 | PFC-1 |
| 32 | 22 | 25,5 | Therm1 |
| 33 | 22 | 22,5 | Therm2 |
| 34 | not assembled | | |
| 35 | 33,5 | 28,5 | DC-1 |
| 36 | 33,5 | 25,5 | DC-1 |
| 37 | 33,5 | 22,5 | G11 |
| 38 | not assembled | | |
| 39 | 43 | 28,5 | DC-2 |
| 40 | 43 | 25,5 | DC-2 |
| 41 | 43 | 22,5 | G13 |
| 42 | not assembled | | |
| 43 | 52,5 | 28,5 | DC-3 |
| 44 | 52,5 | 25,5 | DC-3 |
| 45 | 52,5 | 22,5 | G15 |
| 46 | 0 | 12,2 | PFC3 |



## Pinout




## Identification

| ID | Component | Voltage | Current | Function | Comment |
|---|---|---|---|---|---|
| T11, T12, T13, T14, T15, T16 | IGBT | 600 V | 50 A | Inverter Switch | |
| D11, D12, D13, D14, D15, D16 | FWD | 600 V | 30 A | Inverter Diode | |
| T25, T27, T29 | IGBT | 650 V | 30 A | PFC Switch | |
| D25, D27, D29 | FWD | 600 V | 30 A | PFC Diode | |
| D45, D47, D49 | FWD | 650 V | 10 A | PFC Sw. Protection Diode | |
| C25, C27, C29 | Capacitor | 630 V | | Capacitor (PFC) | |
| Rt | Thermistor | | | Thermistor | |

| Packaging instruction | | | | |
|---|---|---|---|---|
| Standard packaging quantity (SPQ) 100 | >SPQ | Standard | <SPQ | Sample |

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

| Package data |
|---|
| Package data for *flow* 1 packages see vincotech.com website. |

| Vincotech thermistor reference |
|---|
| See Vincotech thermistor reference table at 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-PG06PPA050SJ02-LH94E08T-D4-14 | 20 Apr. 2023 | PFC Diode change | |