# 30-PT07NIA450S501-PD68F58Y

datasheet

***flow*NPC 2** **650 V / 450 A**

## Topology features

- Integrated DC capacitor
- Kelvin Emitter for improved switching performance
- Neutral Point Clamped Topology (I-Type)
- Split topology
- Temperature sensor

## Component features

- High speed and smooth switching
- Low gate charge
- Very low collector emitter saturation voltage

## Housing features

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

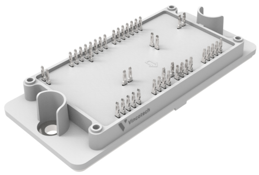
## Target applications

- Industrial Drives
- Solar Inverters
- UPS

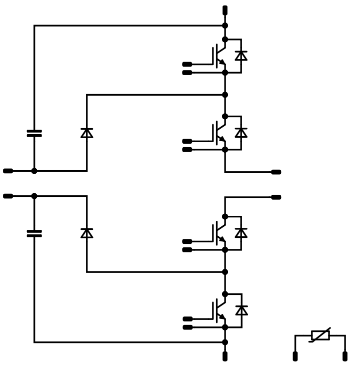
## Types

- 30-PT07NIA450S501-PD68F58Y

## *flow* 2 13 mm housing



## Schematic



# Maximum Ratings

$T_j$ = 25 °C, unless otherwise specified

| Parameter | Symbol | Conditions | | Value | Unit |
|---|---|---|---|---|---|
| **Buck Switch** | | | | | |
| Collector-emitter voltage | $V_{CES}$ | | | 650 | V |
| Collector current (DC current) | $I_C$ | $T_j = T_{jmax}$ | $T_s$ = 80 °C | 298 | A |
| Repetitive peak collector current | $I_{CRM}$ | $t_p$ limited by $T_{jmax}$ | | 1350 | A |
| Total power dissipation | $P_{tot}$ | $T_j = T_{jmax}$ | $T_s$ = 80 °C | 404 | W |
| Gate-emitter voltage | $V_{GES}$ | | | ±20 | V |
| Maximum junction temperature | $T_{jmax}$ | | | 175 | °C |
| **Buck Diode** | | | | | |
| Peak repetitive reverse voltage | $V_{RRM}$ | | | 650 | V |
| Forward current (DC current) | $I_F$ | $T_j = T_{jmax}$ | $T_s$ = 80 °C | 215 | A |
| Total power dissipation | $P_{tot}$ | $T_j = T_{jmax}$ | $T_s$ = 80 °C | 267 | W |
| Maximum junction temperature | $T_{jmax}$ | | | 175 | °C |
| **Boost Switch** | | | | | |
| Collector-emitter voltage | $V_{CES}$ | | | 650 | V |
| Collector current (DC current) | $I_C$ | $T_j = T_{jmax}$ | $T_s$ = 80 °C | 235 | A |
| Repetitive peak collector current | $I_{CRM}$ | $t_p$ limited by $T_{jmax}$ | | 900 | A |
| Turn off safe operating area | | $T_j$ = 150°C, $V_{CE}$ = 1200 V | | 900 | A |
| Total power dissipation | $P_{tot}$ | $T_j = T_{jmax}$ | $T_s$ = 80 °C | 352 | 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 | 3 | µs |
| Maximum junction temperature | $T_{jmax}$ | | | 175 | °C |

# Maximum Ratings

$T_j$ = 25 °C, unless otherwise specified

| Parameter | Symbol | Conditions | | Value | Unit |
|---|---|---|---|---|---|
| **Boost Diode** | | | | | |
| Peak repetitive reverse voltage | $V_{RRM}$ | | | 650 | V |
| Forward current (DC current) | $I_F$ | $T_j = T_{jmax}$ | $T_s$ = 80 °C | 178 | A |
| Total power dissipation | $P_{tot}$ | $T_j = T_{jmax}$ | $T_s$ = 80 °C | 229 | W |
| Maximum junction temperature | $T_{jmax}$ | | | 175 | °C |
| **Boost Sw. Inv. Diode** | | | | | |
| Peak repetitive reverse voltage | $V_{RRM}$ | | | 650 | V |
| Forward current (DC current) | $I_F$ | $T_j = T_{jmax}$ | $T_s$ = 80 °C | 178 | A |
| Total power dissipation | $P_{tot}$ | $T_j = T_{jmax}$ | $T_s$ = 80 °C | 229 | W |
| Maximum junction temperature | $T_{jmax}$ | | | 175 | °C |
| **Capacitor (DC)** | | | | | |
| Maximum DC voltage | $V_{MAX}$ | | | 630 | V |
| Operation Temperature | $T_{op}$ | | | -55 … 150 | °C |

## Module Properties

| Parameter | Symbol | Conditions | | Value | Unit |
|---|---|---|---|---|---|
| **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 | | | | >12,7 | 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 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Buck Switch** | | | | | | | | | | |
| **Static** | | | | | | | | | | |
| Gate-emitter threshold voltage | $V_{GE(th)}$ | $V_{CE} = V_{GE}$ | | | 0,0045 | 25 | 3,2 | 4 | 4,8 | V |
| Collector-emitter saturation voltage | $V_{CEsat}$ | | 15 | | 450 | 25<br>125<br>150 | | 1,41<br>1,52<br>1,55 | 1,75(1) | V |
| Collector-emitter cut-off current | $I_{CES}$ | | 0 | 650 | | 25 | | | 300 | µA |
| Gate-emitter leakage current | $I_{GES}$ | | 20 | 0 | | 25 | | | 600 | nA |
| Internal gate resistance | $r_g$ | | | | | | | None | | Ω |
| Input capacitance | $C_{ies}$ | $f$ = 1 Mhz | 0 | 25 | | 25 | | 27000 | | pF |
| Output capacitance | $C_{oes}$ | | | | | | | 780 | | pF |
| Reverse transfer capacitance | $C_{res}$ | | | | | | | 102 | | pF |
| Gate charge | $Q_g$ | $V_{CC}$ = 520 V | 15 | | 450 | 25 | | 984 | | nC |
| **Thermal** | | | | | | | | | | |
| Thermal resistance junction to sink(2) | $R_{th(j-s)}$ | $\lambda_{paste}$ = 3,4 W/mK (PSX) | | | | | | 0,24 | | K/W |
| **Dynamic** | | | | | | | | | | |
| Turn-on delay time | $t_{d(on)}$ | $R_{gon}$ = 12,8 Ω<br>$R_{goff}$ = 21,33 Ω | ±15 | 350 | 360 | 25<br>125<br>150 | | 622,61<br>618,43<br>617,03 | | ns |
| Rise time | $t_r$ | | | | | 25<br>125<br>150 | | 96,42<br>104,31<br>106,23 | | ns |
| Turn-off delay time | $t_{d(off)}$ | | | | | 25<br>125<br>150 | | 709,96<br>743,1<br>751,65 | | ns |
| Fall time | $t_f$ | | | | | 25<br>125<br>150 | | 50,44<br>39,12<br>41,72 | | ns |
| Turn-on energy (per pulse) | $E_{on}$ | $Q_{rFWD}$=1,39 µC<br>$Q_{rFWD}$=7,5 µC<br>$Q_{rFWD}$=9,98 µC | | | | 25<br>125<br>150 | | 10,83<br>12,2<br>12,63 | | mWs |
| Turn-off energy (per pulse) | $E_{off}$ | | | | | 25<br>125<br>150 | | 11,41<br>12,11<br>12,33 | | 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 | |
| **Buck Diode** | | | | | | | | | | |
| **Static** | | | | | | | | | | |
| Forward voltage | $V_F$ | | | | 280 | 25<br>125<br>150 | | 1,73<br>1,45<br>1,41 | 2,5(1) | V |
| Reverse leakage current | $I_R$ | $V_r$ = 650 V | | | | 25 | | | 60 | µA |
| **Thermal** | | | | | | | | | | |
| Thermal resistance junction to sink(2) | $R_{th(j-s)}$ | $\lambda_{paste}$ = 3,4 W/mK (PSX) | | | | | | 0,36 | | K/W |
| **Dynamic** | | | | | | | | | | |
| Peak recovery current | $I_{RM}$ | d*i*/d*t*=2196 A/µs<br>d*i*/d*t*=2914 A/µs<br>d*i*/d*t*=2993 A/µs | ±15 | 350 | 360 | 25<br>125<br>150 | | 49,41<br>108,85<br>126,06 | | A |
| Reverse recovery time | $t_{rr}$ | | | | | 25<br>125<br>150 | | 46,98<br>122,52<br>142,35 | | ns |
| Recovered charge | $Q_r$ | | | | | 25<br>125<br>150 | | 1,39<br>7,5<br>9,98 | | µC |
| Reverse recovered energy | $E_{rec}$ | | | | | 25<br>125<br>150 | | 0,2<br>1,12<br>1,53 | | mWs |
| Peak rate of fall of recovery current | $(di_{rf}/dt)_{max}$ | | | | | 25<br>125<br>150 | | 2647,36<br>1941,26<br>1869,42 | | 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 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Boost Switch** | | | | | | | | | | |
| **Static** | | | | | | | | | | |
| Gate-emitter threshold voltage | $V_{GE(th)}$ | $V_{CE} = V_{GE}$ | | | 0,003 | 25 | 4,35 | 5 | 5,65 | V |
| Collector-emitter saturation voltage | $V_{CEsat}$ | | 15 | | 300 | 25<br>125<br>150 | | 1,46<br>1,61<br>1,66 | 1,65(1) | V |
| Collector-emitter cut-off current | $I_{CES}$ | | 0 | 650 | | 25 | | | 120 | µA |
| Gate-emitter leakage current | $I_{GES}$ | | 20 | 0 | | 25 | | | 600 | nA |
| Internal gate resistance | $r_g$ | | | | | | | None | | Ω |
| Input capacitance | $C_{ies}$ | $f$ = 1 Mhz | 0 | 25 | | 25 | | 18300 | | pF |
| Output capacitance | $C_{oes}$ | | | | | | | 552 | | pF |
| Reverse transfer capacitance | $C_{res}$ | | | | | | | 186 | | pF |
| Gate charge | $Q_g$ | $V_{CC}$ = 520 V | 15 | | 300 | 25 | | 1740 | | nC |
| **Thermal** | | | | | | | | | | |
| Thermal resistance junction to sink(2) | $R_{th(j-s)}$ | $\lambda_{paste}$ = 3,4 W/mK (PSX) | | | | | | 0,27 | | K/W |
| **Dynamic** | | | | | | | | | | |
| Turn-on delay time | $t_{d(on)}$ | $R_{gon}$ = 10,67 Ω<br>$R_{goff}$ = 21,33 Ω | ±15 | 350 | 360 | 25<br>125<br>150 | | 670,74<br>675,89<br>677,41 | | ns |
| Rise time | $t_r$ | | | | | 25<br>125<br>150 | | 192,27<br>188,66<br>187,71 | | ns |
| Turn-off delay time | $t_{d(off)}$ | | | | | 25<br>125<br>150 | | 1127,2<br>1196,83<br>1197,73 | | ns |
| Fall time | $t_f$ | | | | | 25<br>125<br>150 | | 128,53<br>106,26<br>100,45 | | ns |
| Turn-on energy (per pulse) | $E_{on}$ | $Q_{rFWD}$=0,629 µC<br>$Q_{rFWD}$=4,48 µC<br>$Q_{rFWD}$=6,13 µC | | | | 25<br>125<br>150 | | 18,79<br>20,99<br>21,74 | | mWs |
| Turn-off energy (per pulse) | $E_{off}$ | | | | | 25<br>125<br>150 | | 23,98<br>22,96<br>23,21 | | mWs |

# 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 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Boost Diode** | | | | | | | | | | |
| **Static** | | | | | | | | | | |
| Forward voltage | $V_F$ | | | | 210 | 25<br>125<br>150 | | 1,73<br>1,45<br>1,41 | 2,5[(1)] | V |
| Reverse leakage current | $I_R$ | $V_r$ = 650 V | | | | 25 | | | 45 | µA |
| **Thermal** | | | | | | | | | | |
| Thermal resistance junction to sink[(2)] | $R_{th(j-s)}$ | $\lambda_{paste}$ = 3,4 W/mK (PSX) | | | | | | 0,41 | | K/W |
| **Dynamic** | | | | | | | | | | |
| Peak recovery current | $I_{RM}$ | d$i$/d$t$=1532 A/µs<br>d$i$/d$t$=1404 A/µs<br>d$i$/d$t$=1467 A/µs | ±15 | 350 | 360 | 25<br>125<br>150 | | 26,97<br>64,76<br>74,91 | | A |
| Reverse recovery time | $t_{rr}$ | | | | | 25<br>125<br>150 | | 40,38<br>132,22<br>154,25 | | ns |
| Recovered charge | $Q_r$ | | | | | 25<br>125<br>150 | | 0,629<br>4,48<br>6,13 | | µC |
| Reverse recovered energy | $E_{rec}$ | | | | | 25<br>125<br>150 | | 0,063<br>0,5<br>0,708 | | mWs |
| Peak rate of fall of recovery current | $(di_{rf}/dt)_{max}$ | | | | | 25<br>125<br>150 | | 2124,21<br>1125,14<br>1137,21 | | 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] | Values Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| **Boost Sw. Inv. Diode** | | | | | | | | | | |
| **Static** | | | | | | | | | | |
| Forward voltage | $V_F$ | | | | 210 | 25<br>125<br>150 | | 1,73<br>1,45<br>1,41 | 2,5[1] | V |
| Reverse leakage current | $I_R$ | $V_r$ = 650 V | | | | 25 | | | 45 | µA |
| **Thermal** | | | | | | | | | | |
| Thermal resistance junction to sink[2] | $R_{th(j-s)}$ | $\lambda_{paste}$ = 3,4 W/mK (PSX) | | | | | | 0,41 | | K/W |
| **Capacitor (DC)** | | | | | | | | | | |
| **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 | |

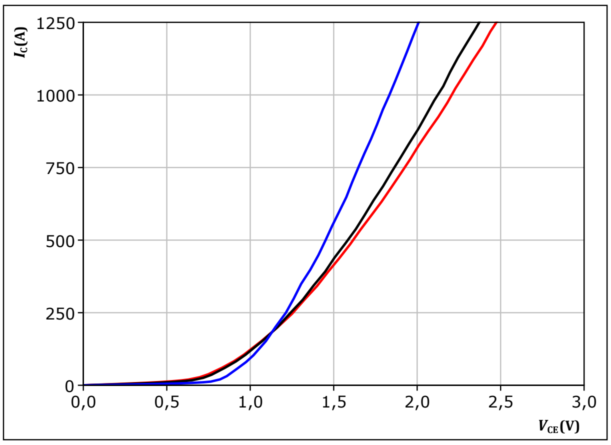
(1) Value at chip level
(2) Only valid with pre-applied Vincotech thermal interface material.

# Buck Switch Characteristics

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

**Typical output characteristics**

$I_C = f(V_{CE})$

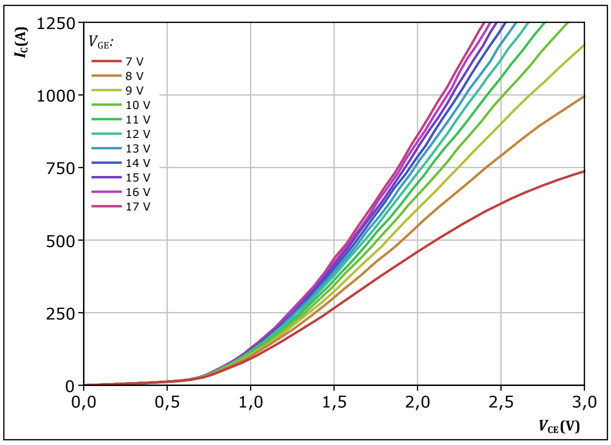



| | | | | |
|---|---|---|---|---|
| $t_p$ = | 250 | µs | | 25 °C |
| $V_{GE}$ = | 15 | V | $T_j$: | 125 °C |
| | | | | 150 °C |

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

**Typical output characteristics**

$I_C = f(V_{CE})$



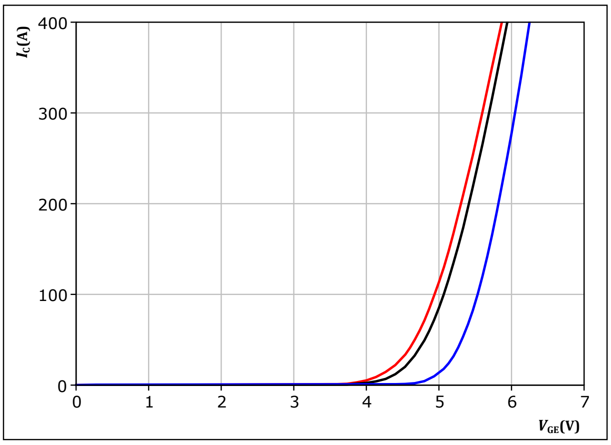

| | | |
|---|---|---|
| $t_p$ = | 250 | µs |
| $T_j$ = | 150 | °C |

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

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

**Typical transfer characteristics**

$I_C = f(V_{GE})$

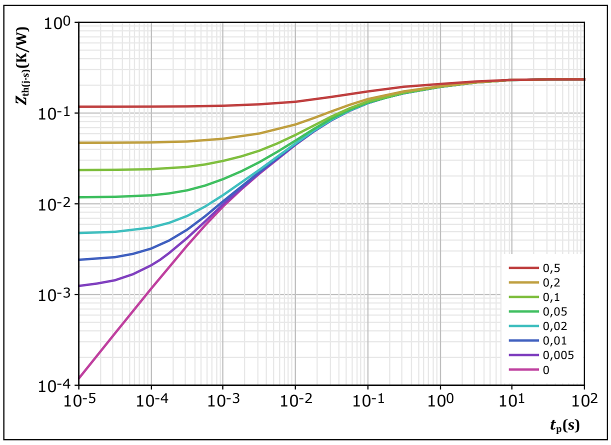



| | | | | |
|---|---|---|---|---|
| $t_p$ = | 250 | µs | | 25 °C |
| $V_{CE}$ = | 14 | V | $T_j$: | 125 °C |
| | | | | 150 °C |

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

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

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




| | | |
|---|---|---|
| $D$ = | $t_p$ / $T$ | |
| $R_{th(j-s)}$ = | 0,235 | K/W |

IGBT thermal model values

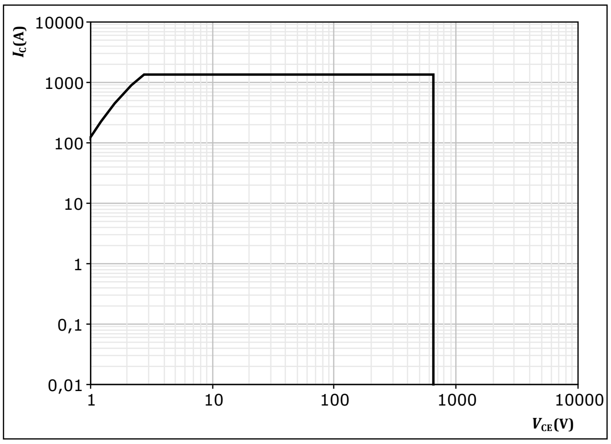
| $R$ (K/W) | $\tau$ (s) |
|---|---|
| 3,75E-02 | 3,95E+00 |
| 5,54E-02 | 6,35E-01 |
| 8,92E-02 | 7,22E-02 |
| 4,47E-02 | 1,29E-02 |
| 8,19E-03 | 1,16E-03 |

# Buck Switch Characteristics

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

**Safe operating area**

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

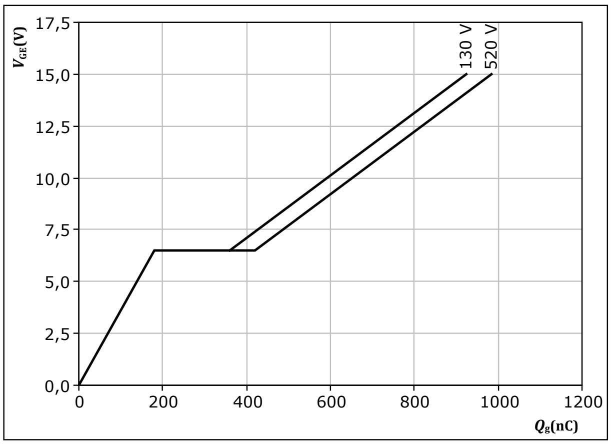



$D$ = single pulse
$T_s$ = 80 °C
$V_{GE}$ = 15 V
$T_j$ = $T_{jmax}$

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

**Gate voltage vs gate charge**

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



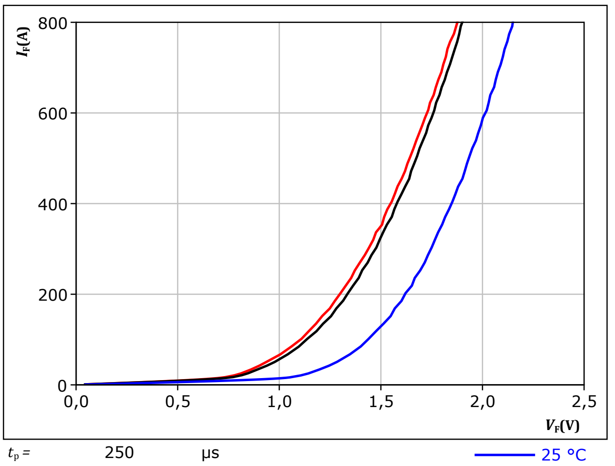

$I_C$ = 75 A
$T_j$ = 25 °C

# Buck Diode Characteristics

**figure 7.** FWD

**Typical forward characteristics**

$I_F$ = f( $V_F$)



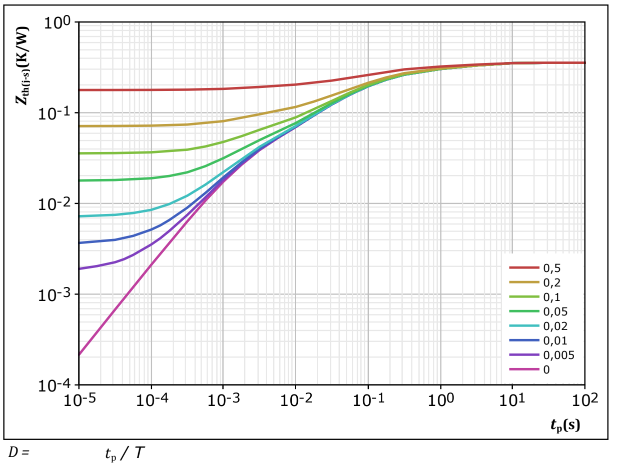

$t_p$ = 250 µs

$T_j$: 25 °C, 125 °C, 150 °C

**figure 8.** FWD

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

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




$D$ = $t_p$ / $T$

$R_{th(j-s)}$ = 0,356 K/W

FWD thermal model values

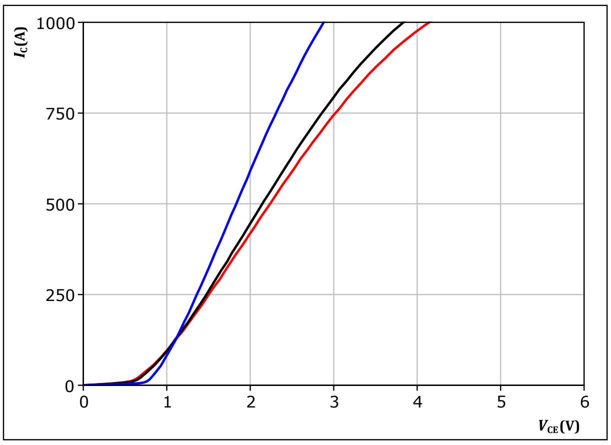
| $R$ (K/W) | $\tau$ (s) |
|---|---|
| 5,29E-02 | 3,88E+00 |
| 6,67E-02 | 5,75E-01 |
| 1,41E-01 | 1,01E-01 |
| 6,60E-02 | 2,01E-02 |
| 2,92E-02 | 1,75E-03 |

# Boost Switch Characteristics

**figure 9.** **IGBT**

**Typical output characteristics**

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



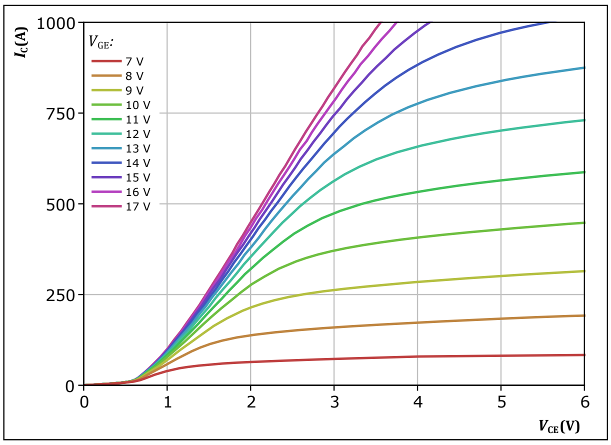

| | | |
|---|---|---|
| $t_p$ = | 250 | µs |
| $V_{GE}$ = | 15 | V |

$T_j$: 25 °C, 125 °C, 150 °C

**figure 10.** **IGBT**

**Typical output characteristics**

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



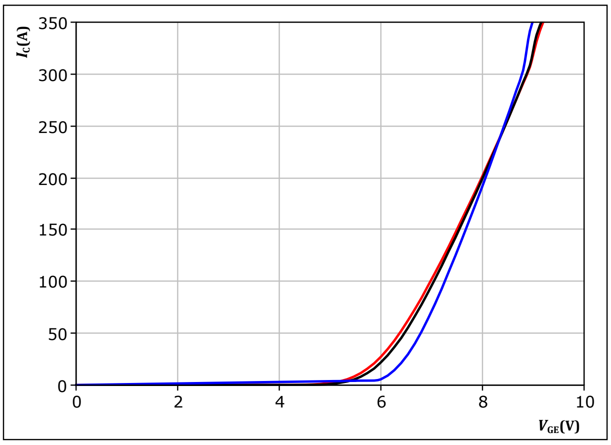

| | | |
|---|---|---|
| $t_p$ = | 250 | µs |
| $T_j$ = | 150 | °C |

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

**figure 11.** **IGBT**

**Typical transfer characteristics**

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



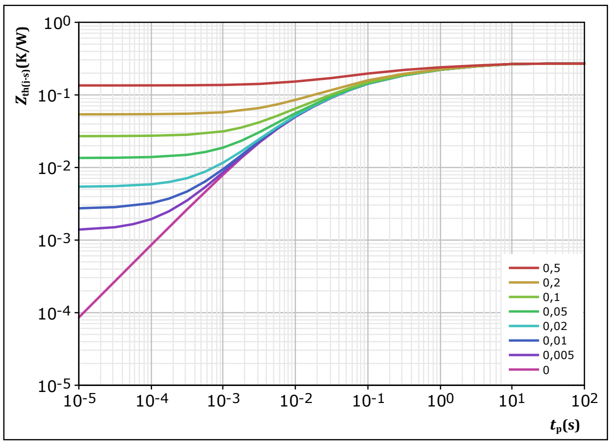

| | | |
|---|---|---|
| $t_p$ = | 250 | µs |
| $V_{CE}$ = | 43 | V |

$T_j$: 25 °C, 125 °C, 150 °C

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

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

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




| | | |
|---|---|---|
| $D$ = | $t_p$ / $T$ | |
| $R_{th(j-s)}$ = | 0,27 | K/W |

IGBT thermal model values

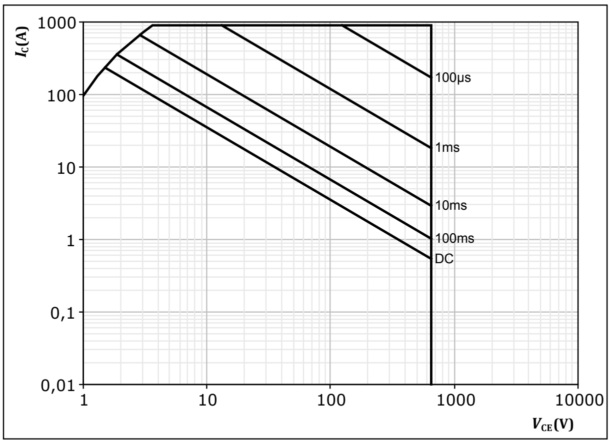
| $R$ (K/W) | $\tau$ (s) |
|---|---|
| 5,16E-02 | 3,77E+00 |
| 6,52E-02 | 4,94E-01 |
| 6,77E-02 | 9,16E-02 |
| 5,89E-02 | 2,68E-02 |
| 2,67E-02 | 4,84E-03 |

# Boost Switch Characteristics

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

**Safe operating area**

$I_C = f(V_{CE})$

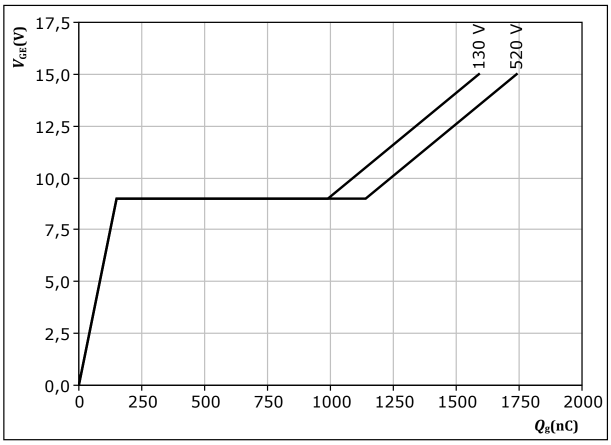



$D$ = single pulse
$T_s$ = 80 °C
$V_{GE}$ = 15 V
$T_j$ = $T_{jmax}$

**figure 14.** **IGBT**

**Gate voltage vs gate charge**

$V_{GE} = f(Q_g)$



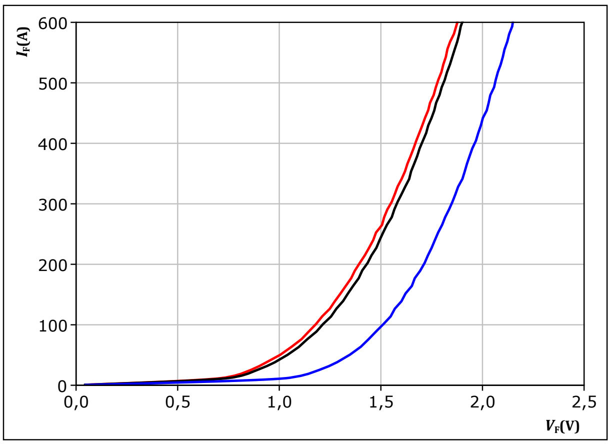

$I_C$ = 50 A
$T_j$ = 25 °C

# Boost Diode Characteristics

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

**Typical forward characteristics**

$I_F$ = f( $V_F$)



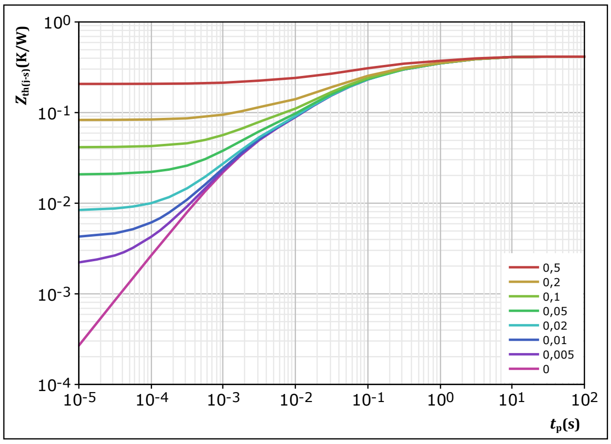

$t_p$ = 250 µs

$T_j$: 25 °C / 125 °C / 150 °C

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

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

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




$D$ = $t_p$ / $T$

$R_{th(j-s)}$ = 0,414 K/W

FWD thermal model values

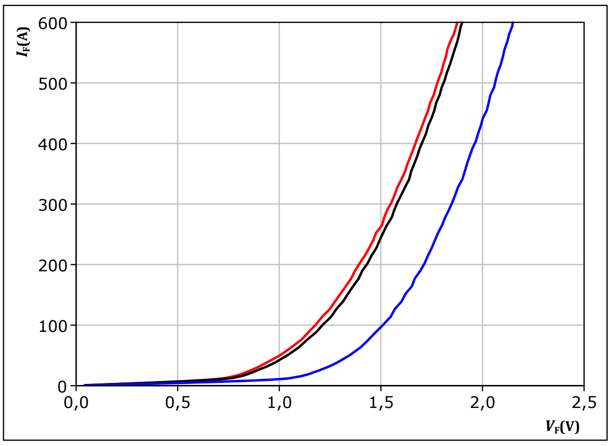
| $R$ (K/W) | $\tau$ (s) |
|---|---|
| 5,45E-02 | 3,86E+00 |
| 8,96E-02 | 7,28E-01 |
| 1,28E-01 | 1,06E-01 |
| 1,04E-01 | 2,19E-02 |
| 3,88E-02 | 1,85E-03 |

# Boost Sw. Inv. Diode Characteristics

**figure 17.** FWD

**Typical forward characteristics**

$I_F = f(V_F)$



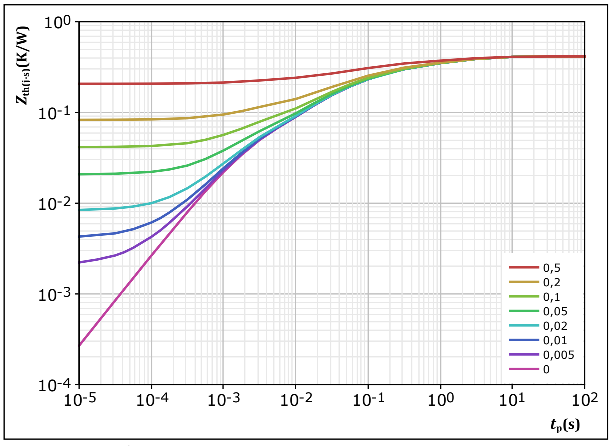

$t_p$ = 250 µs

$T_j$: 25 °C, 125 °C, 150 °C

**figure 18.** FWD

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

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




$D$ = $t_p / T$

$R_{th(j-s)}$ = 0,414 K/W

FWD thermal model values

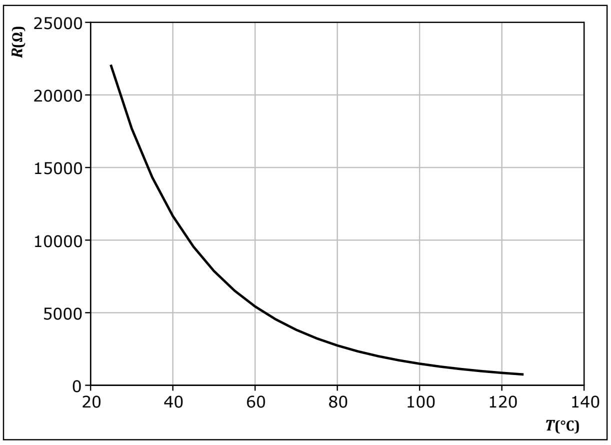
| $R$ (K/W) | $\tau$ (s) |
|---|---|
| 5,45E-02 | 3,86E+00 |
| 8,96E-02 | 7,28E-01 |
| 1,28E-01 | 1,06E-01 |
| 1,04E-01 | 2,19E-02 |
| 3,88E-02 | 1,85E-03 |

# Thermistor Characteristics

**figure 19.** **Thermistor**

**Typical NTC characteristic as function of temperature**

$R_T$ = f( $T$)

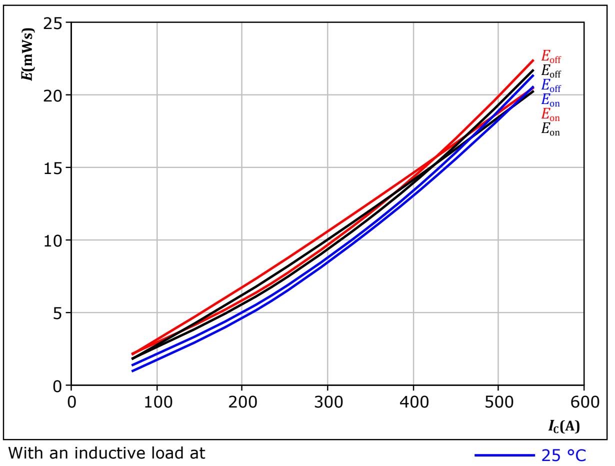


# Buck Switching Characteristics

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

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

$E = f(I_C)$



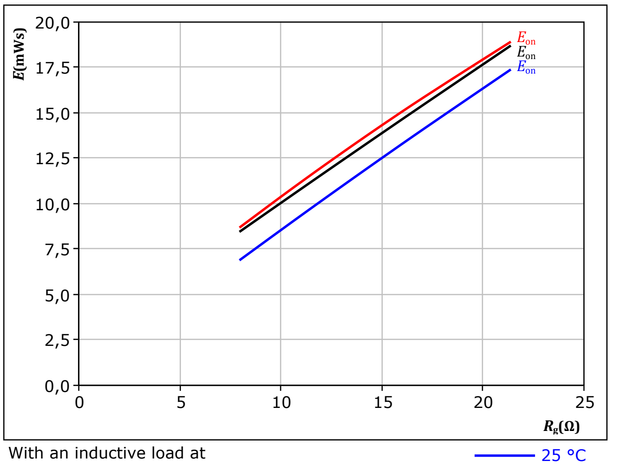

With an inductive load at

| | | | | |
|---|---|---|---|---|
| $V_{CE}$ = | 350 | V | $T_j$: | 25 °C |
| $V_{GE}$ = | ±15 | V | | 125 °C |
| $R_{gon}$ = | 12,8 | Ω | | 150 °C |
| $R_{goff}$ = | 21,33 | Ω | | |

**figure 21.** **IGBT**

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

$E = f(R_g)$



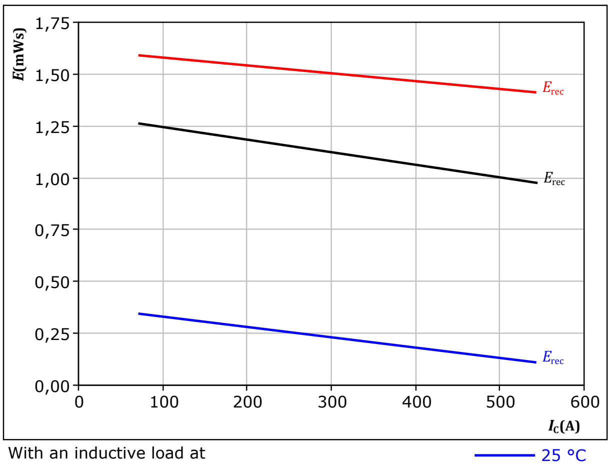

With an inductive load at

| | | | | |
|---|---|---|---|---|
| $V_{CE}$ = | 350 | V | $T_j$: | 25 °C |
| $V_{GE}$ = | ±15 | V | | 125 °C |
| $I_C$ = | 360 | A | | 150 °C |

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

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

$E_{rec} = f(I_C)$




With an inductive load at

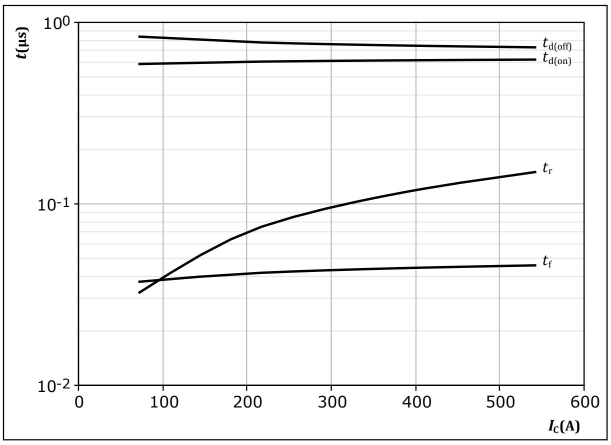
| | | | | |
|---|---|---|---|---|
| $V_{CE}$ = | 350 | V | $T_j$: | 25 °C |
| $V_{GE}$ = | ±15 | V | | 125 °C |
| $R_{gon}$ = | 12,8 | Ω | | 150 °C |

# Buck Switching Characteristics

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

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

$t$ = f( $I_C$)



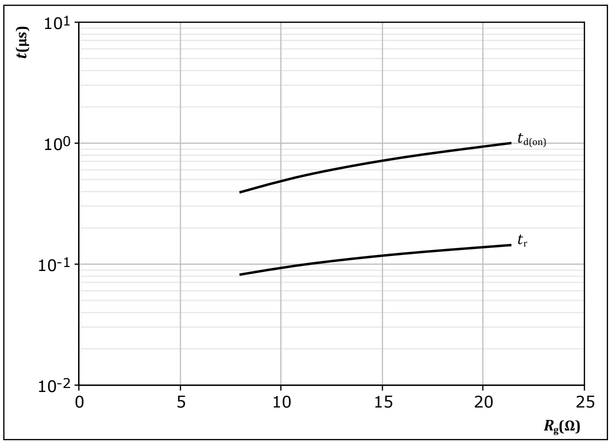

With an inductive load at

| | | |
|---|---|---|
| $T_j$ = | 150 | °C |
| $V_{CE}$ = | 350 | V |
| $V_{GE}$ = | ±15 | V |
| $R_{gon}$ = | 12,8 | Ω |
| $R_{goff}$ = | 21,33 | Ω |

**figure 25.** **IGBT**

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

$t$ = f( $R_g$)



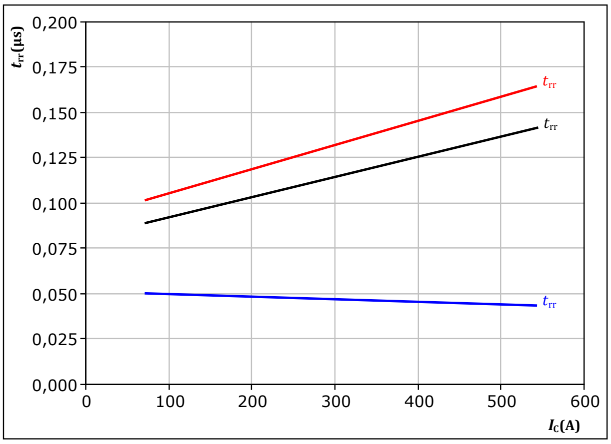

With an inductive load at

| | | |
|---|---|---|
| $T_j$ = | 150 | °C |
| $V_{CE}$ = | 350 | V |
| $V_{GE}$ = | ±15 | V |
| $I_C$ = | 360 | A |

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

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

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




With an inductive load at

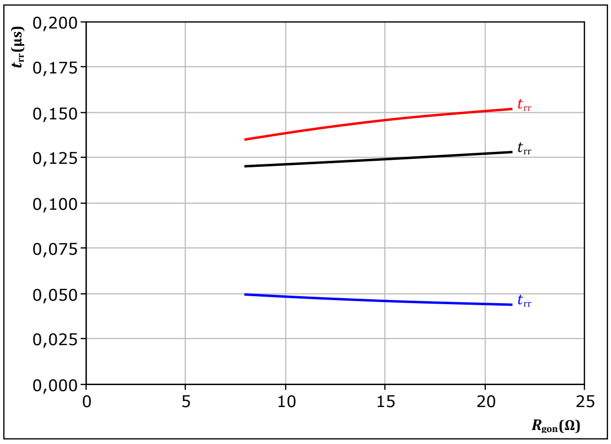
| | | |
|---|---|---|
| $V_{CE}$ = | 350 | V |
| $V_{GE}$ = | ±15 | V |
| $R_{gon}$ = | 12,8 | Ω |

$T_j$: 25 °C, 125 °C, 150 °C

**figure 27.** **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 |
| $I_C$ = | 360 | A |

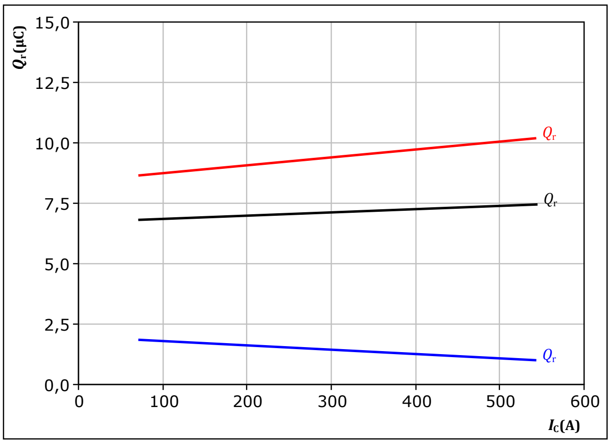
$T_j$: 25 °C, 125 °C, 150 °C

# Buck Switching Characteristics

**figure 28.** **FWD**

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

$Q_r = f(I_C)$




With an inductive load at

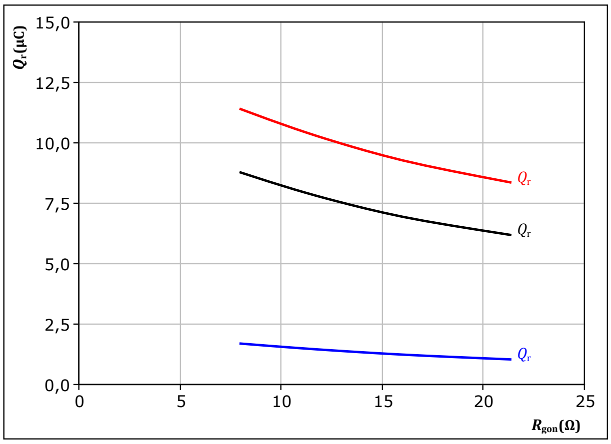
| | | | |
|---|---|---|---|
| $V_{CE}$ = | 350 | V | |
| $V_{GE}$ = | ±15 | V | |
| $R_{gon}$ = | 12,8 | Ω | |

$T_j$: 25 °C, 125 °C, 150 °C

**figure 29.** **FWD**

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

$Q_r = f(R_{gon})$




With an inductive load at

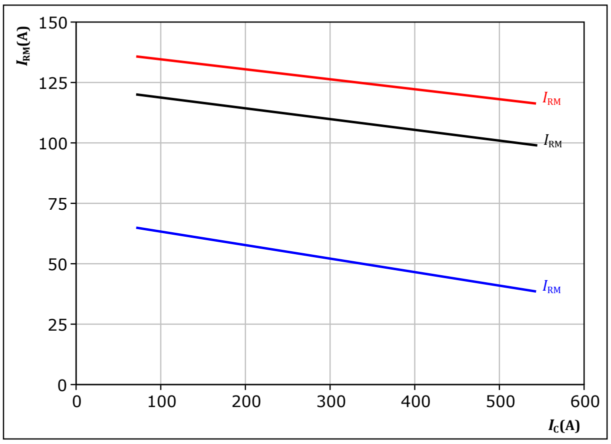
| | | |
|---|---|---|
| $V_{CE}$ = | 350 | V |
| $V_{GE}$ = | ±15 | V |
| $I_C$ = | 360 | A |

$T_j$: 25 °C, 125 °C, 150 °C

**figure 30.** **FWD**

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

$I_{RM} = f(I_C)$




With an inductive load at

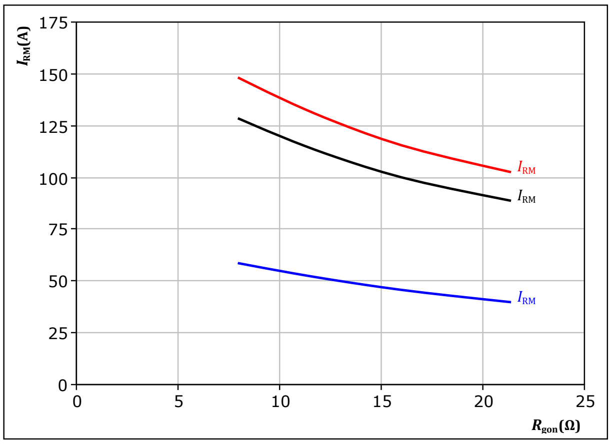
| | | |
|---|---|---|
| $V_{CE}$ = | 350 | V |
| $V_{GE}$ = | ±15 | V |
| $R_{gon}$ = | 12,8 | Ω |

$T_j$: 25 °C, 125 °C, 150 °C

**figure 31.** **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 |
| $I_C$ = | 360 | A |

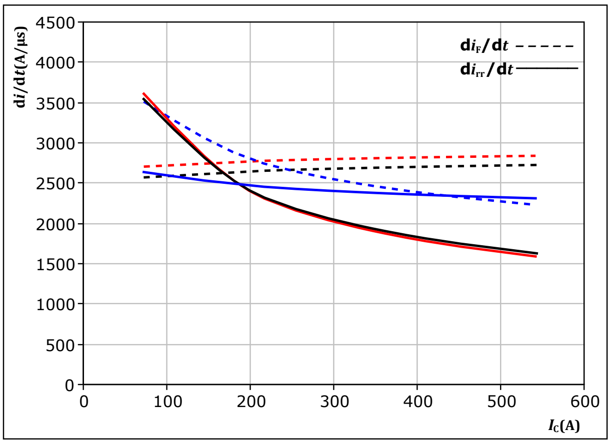
$T_j$: 25 °C, 125 °C, 150 °C

# Buck Switching Characteristics

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

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

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



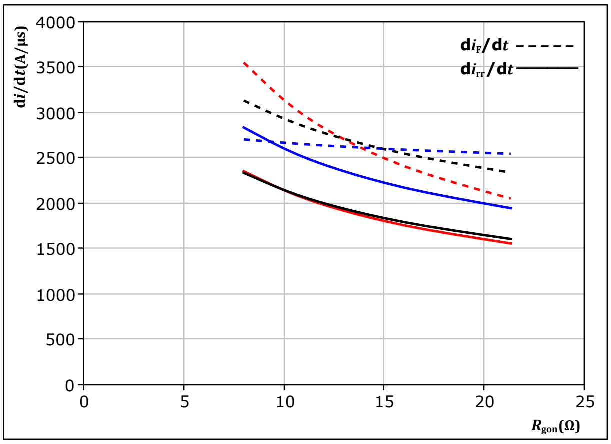

With an inductive load at

| | | | | |
|---|---|---|---|---|
| $V_{CE}$ = | 350 | V | $T_j$: | 25 °C |
| $V_{GE}$ = | ±15 | V | | 125 °C |
| $R_{gon}$ = | 12,8 | Ω | | 150 °C |

**figure 33.** **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( $R_{gon}$)



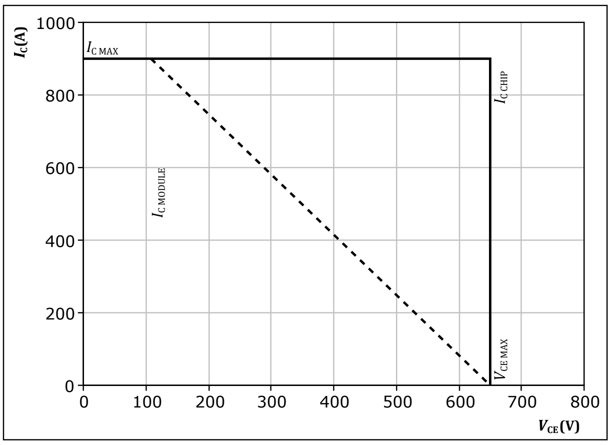

With an inductive load at

| | | | | |
|---|---|---|---|---|
| $V_{CE}$ = | 350 | V | $T_j$: | 25 °C |
| $V_{GE}$ = | ±15 | V | | 125 °C |
| $I_C$ = | 360 | A | | 150 °C |

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

**Reverse bias safe operating area**

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



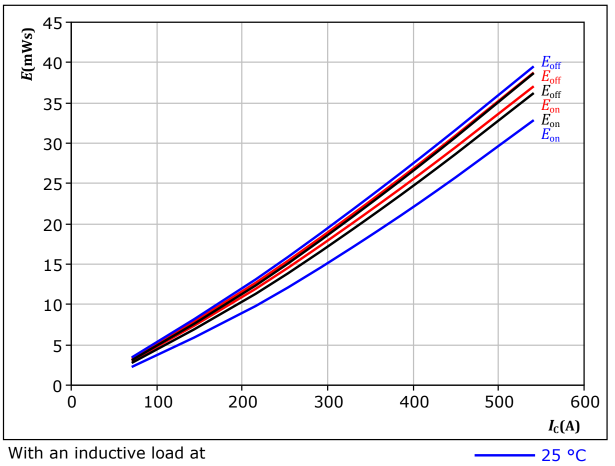

| | | | |
|---|---|---|---|
| **At** | $T_j$ = | 150 | °C |
| | $R_{gon}$ = | 12,8 | Ω |
| | $R_{goff}$ = | 21,33 | Ω |

# Boost Switching Characteristics

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

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

$E$ = f( $I_C$)



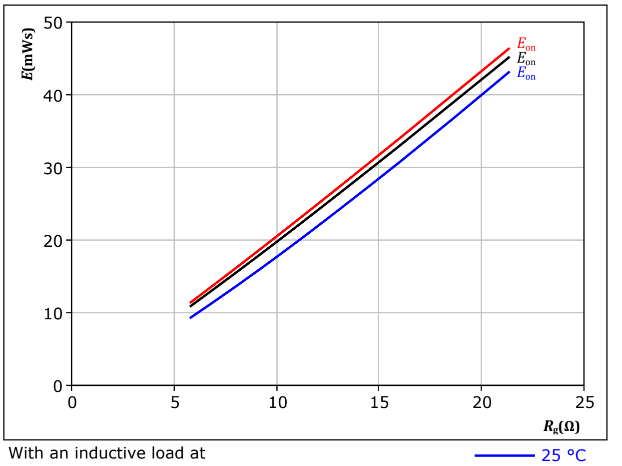

With an inductive load at

| | | | | |
|---|---|---|---|---|
| $V_{CE}$ = | 350 | V | $T_j$: | 25 °C |
| $V_{GE}$ = | ±15 | V | | 125 °C |
| $R_{gon}$ = | 10,67 | Ω | | 150 °C |
| $R_{goff}$ = | 21,33 | Ω | | |

**figure 36.** **IGBT**

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

$E$ = f( $R_g$)



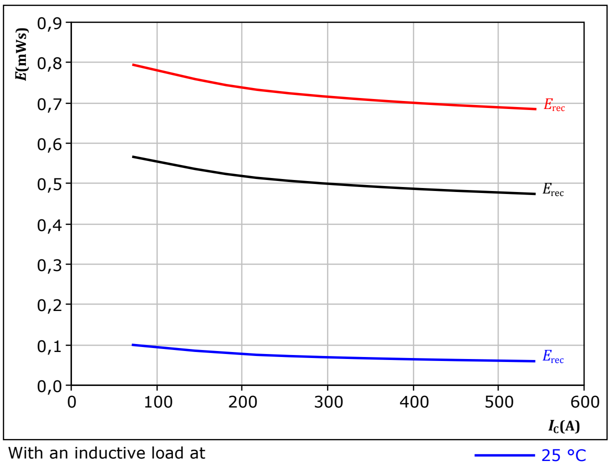

With an inductive load at

| | | | | |
|---|---|---|---|---|
| $V_{CE}$ = | 350 | V | $T_j$: | 25 °C |
| $V_{GE}$ = | ±15 | V | | 125 °C |
| $I_C$ = | 360 | A | | 150 °C |

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

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

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




With an inductive load at

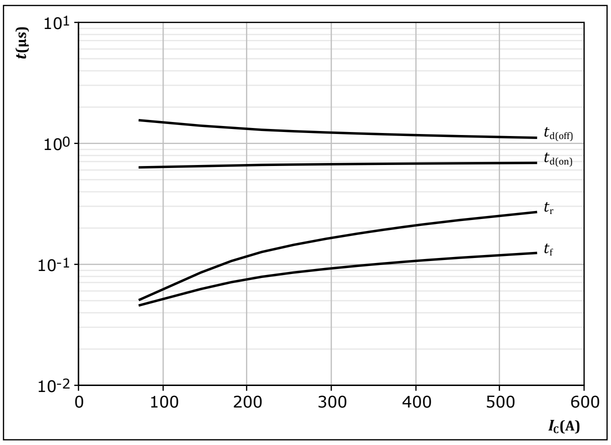
| | | | | |
|---|---|---|---|---|
| $V_{CE}$ = | 350 | V | $T_j$: | 25 °C |
| $V_{GE}$ = | ±15 | V | | 125 °C |
| $R_{gon}$ = | 10,67 | Ω | | 150 °C |

# Boost Switching Characteristics

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

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

$t$ = f( $I_C$)



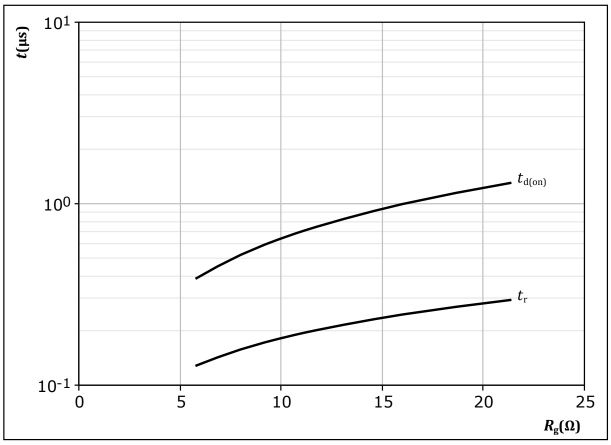

With an inductive load at

| | | |
|---|---|---|
| $T_j$ = | 150 | °C |
| $V_{CE}$ = | 350 | V |
| $V_{GE}$ = | ±15 | V |
| $R_{gon}$ = | 10,67 | Ω |
| $R_{goff}$ = | 21,33 | Ω |

**figure 40.** **IGBT**

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

$t$ = f( $R_g$)



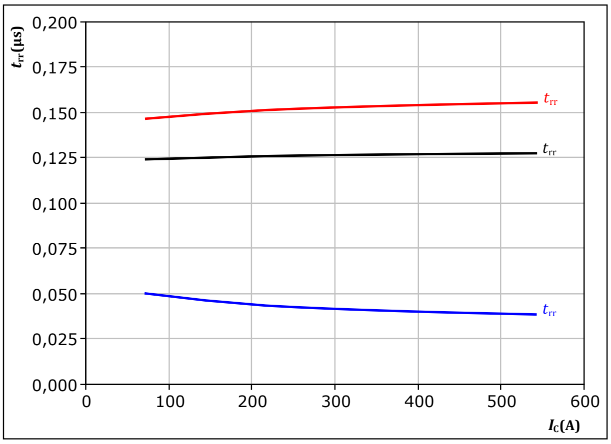

With an inductive load at

| | | |
|---|---|---|
| $T_j$ = | 150 | °C |
| $V_{CE}$ = | 350 | V |
| $V_{GE}$ = | ±15 | V |
| $I_C$ = | 360 | A |

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

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

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




With an inductive load at

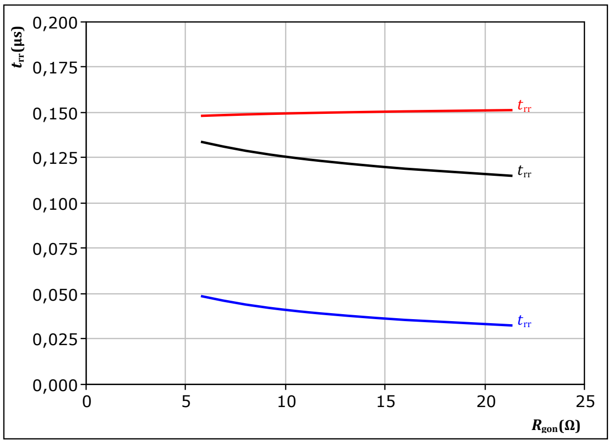
| | | |
|---|---|---|
| $V_{CE}$ = | 350 | V |
| $V_{GE}$ = | ±15 | V |
| $R_{gon}$ = | 10,67 | Ω |

$T_j$: 25 °C, 125 °C, 150 °C

**figure 42.** **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 |
| $I_C$ = | 360 | A |

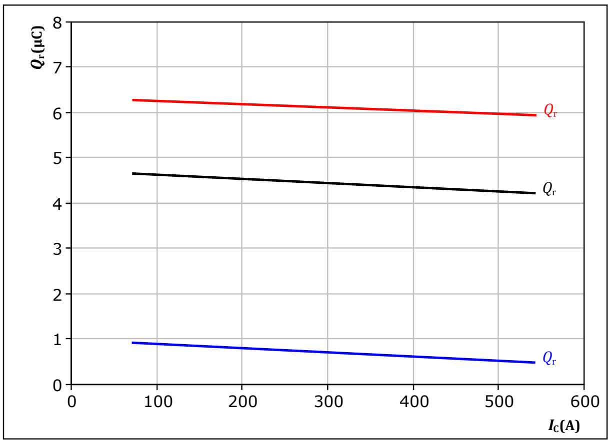
$T_j$: 25 °C, 125 °C, 150 °C

# Boost Switching Characteristics

**figure 43.** FWD

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

$Q_r$ = f( $I_C$)



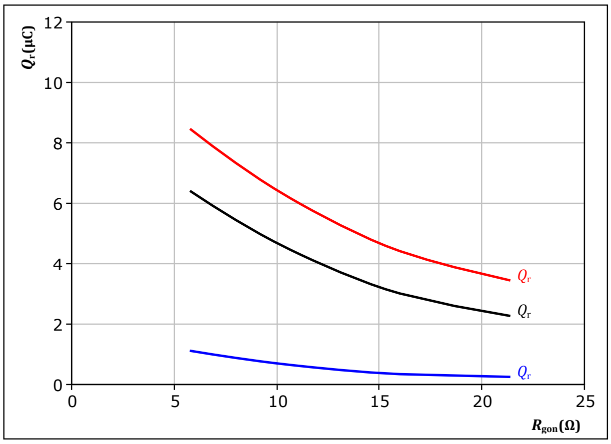

With an inductive load at

| | | | | |
|---|---|---|---|---|
| $V_{CE}$ = | 350 | V | $T_j$: | 25 °C |
| $V_{GE}$ = | ±15 | V | | 125 °C |
| $R_{gon}$ = | 10,67 | Ω | | 150 °C |

**figure 44.** FWD

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

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



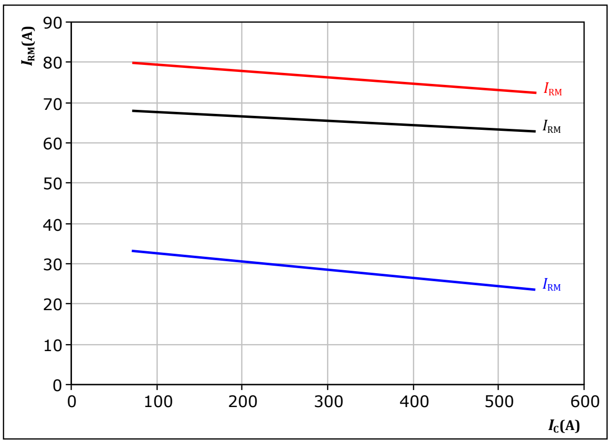

With an inductive load at

| | | | | |
|---|---|---|---|---|
| $V_{CE}$ = | 350 | V | $T_j$: | 25 °C |
| $V_{GE}$ = | ±15 | V | | 125 °C |
| $I_C$ = | 360 | A | | 150 °C |

**figure 45.** FWD

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

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



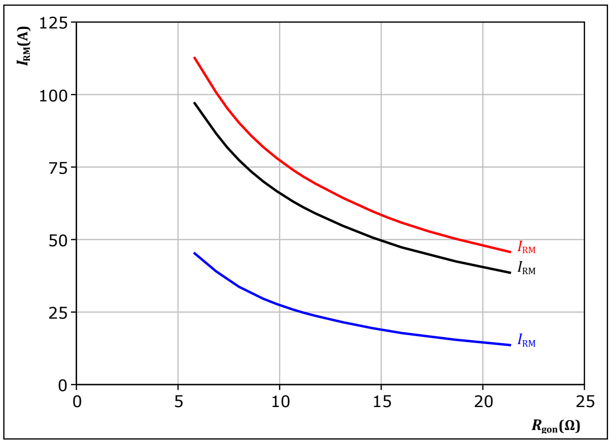

With an inductive load at

| | | | | |
|---|---|---|---|---|
| $V_{CE}$ = | 350 | V | $T_j$: | 25 °C |
| $V_{GE}$ = | ±15 | V | | 125 °C |
| $R_{gon}$ = | 10,67 | Ω | | 150 °C |

**figure 46.** 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

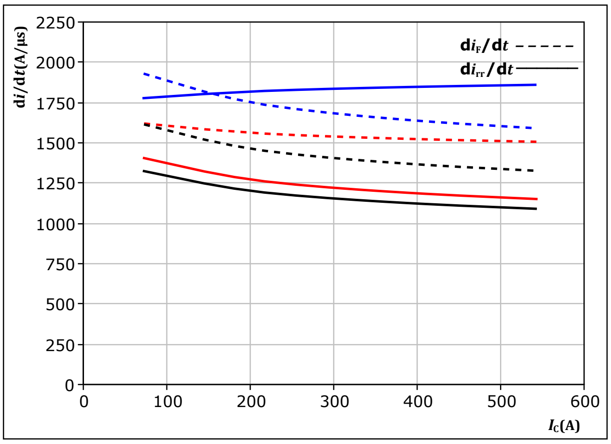
| | | | | |
|---|---|---|---|---|
| $V_{CE}$ = | 350 | V | $T_j$: | 25 °C |
| $V_{GE}$ = | ±15 | V | | 125 °C |
| $I_C$ = | 360 | A | | 150 °C |

# Boost Switching Characteristics

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

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

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



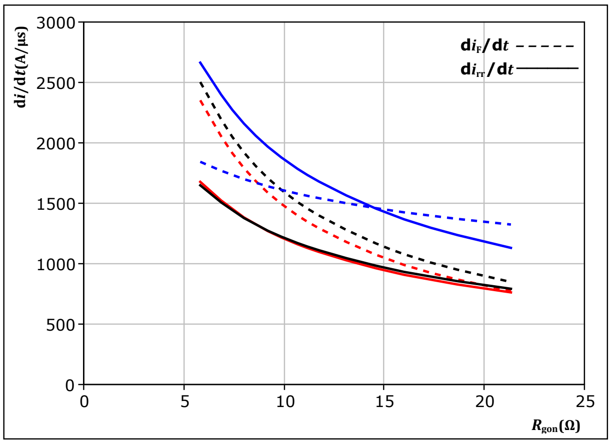

With an inductive load at

| | | | | |
|---|---|---|---|---|
| $V_{CE}$ = | 350 | V | $T_j$: | 25 °C |
| $V_{GE}$ = | ±15 | V | | 125 °C |
| $R_{gon}$ = | 10,67 | Ω | | 150 °C |

**figure 48.** **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( $R_{gon}$)



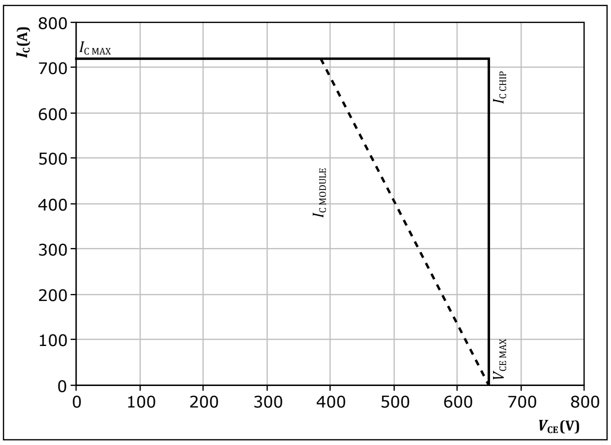

With an inductive load at

| | | | | |
|---|---|---|---|---|
| $V_{CE}$ = | 350 | V | $T_j$: | 25 °C |
| $V_{GE}$ = | ±15 | V | | 125 °C |
| $I_C$ = | 360 | A | | 150 °C |

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

**Reverse bias safe operating area**

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




| | | | |
|---|---|---|---|
| **At** | $T_j$ = | 150 | °C |
| | $R_{gon}$ = | 10,67 | Ω |
| | $R_{goff}$ = | 21,33 | Ω |

# Switching Definitions

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

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

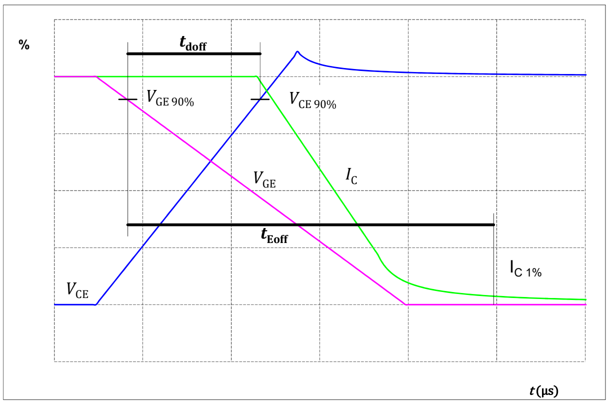



**figure 51.** **IGBT**

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

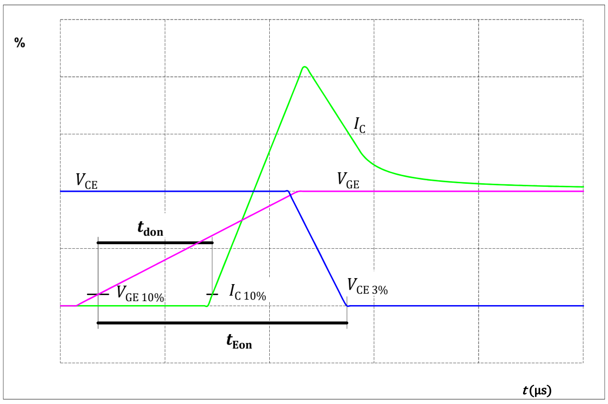



**figure 52.** **IGBT**

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

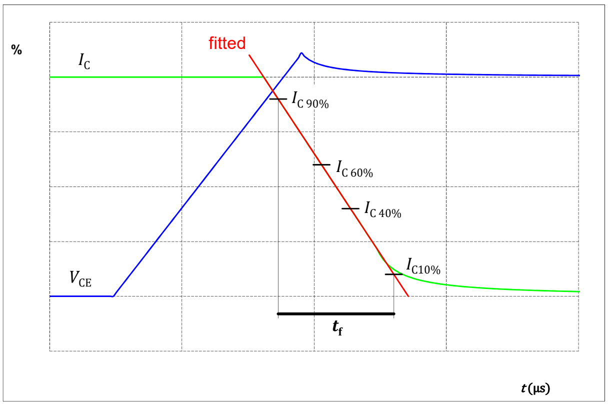
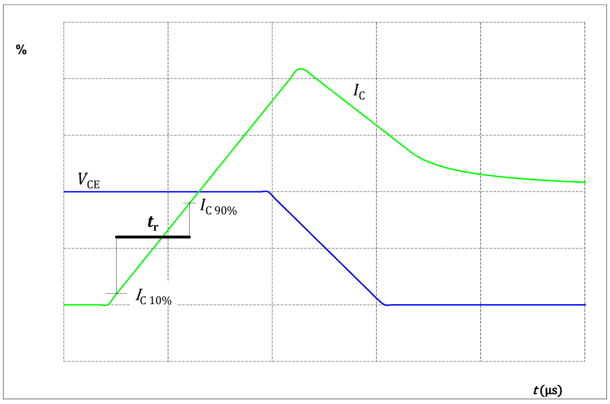



**figure 53.** **IGBT**

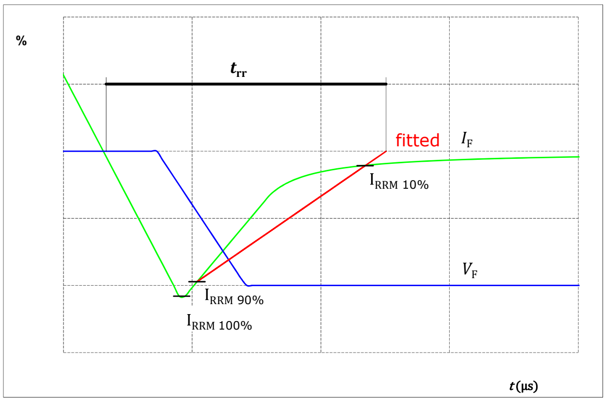
**Turn-on Switching Waveforms & definition of** $t_r$



# Switching Definitions

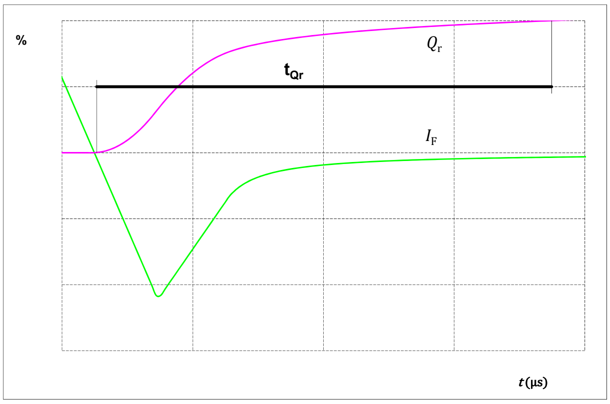
| figure 54. | FWD |
|---|---|

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




| figure 55. | FWD |
|---|---|

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



## Ordering Code

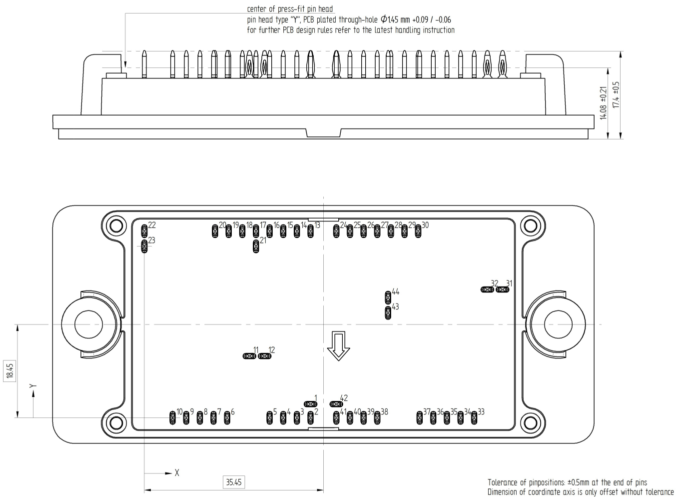
| Version | Ordering Code |
|---|---|
| Without thermal paste | 30-PT07NIA450S501-PD68F58Y |
| With thermal paste (3,4 W/mK, PSX-P7) | 30-PT07NIA450S501-PD68F58Y-/3/ |

## Marking

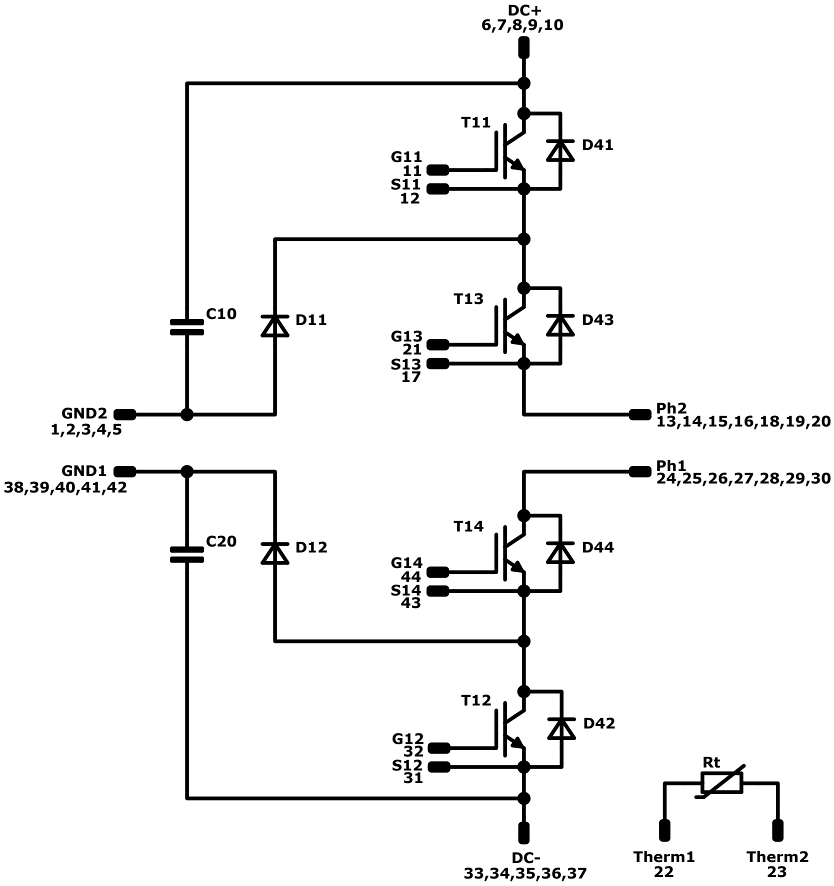
| | | | | | | |
|---|---|---|---|---|---|---|
| Text | Name | | Date code | UL & VIN | Lot | Serial |
| | NN-NNNNNNNNNNNNNN-TTTTTTTVV | | WWYY | UL VIN | LLLLL | SSSS |
| Datamatrix | Type&Ver | Lot number | Serial | Date code | | |
| | TTTTTTTVV | LLLLL | SSSS | WWYY | | |

## Outline

| Pin table [mm] | | | |
|---|---|---|---|
| Pin | X | Y | Function |
| 1 | 32,9 | 2,7 | GND2 |
| 2 | 32,9 | 0 | GND2 |
| 3 | 30,2 | 0 | GND2 |
| 4 | 27,5 | 0 | GND2 |
| 5 | 24,8 | 0 | GND2 |
| 6 | 16,4 | 0 | DC+ |
| 7 | 13,7 | 0 | DC+ |
| 8 | 11 | 0 | DC+ |
| 9 | 8,3 | 0 | DC+ |
| 10 | 5,6 | 0 | DC+ |
| 11 | 20,8 | 12,2 | G11 |
| 12 | 23,8 | 12,2 | S11 |
| 13 | 32,9 | 36,9 | Ph2 |
| 14 | 30,2 | 36,9 | Ph2 |
| 15 | 27,5 | 36,9 | Ph2 |
| 16 | 24,8 | 36,9 | Ph2 |
| 17 | 22,1 | 36,9 | S13 |
| 18 | 19,4 | 36,9 | Ph2 |
| 19 | 16,7 | 36,9 | Ph2 |
| 20 | 14 | 36,9 | Ph2 |
| 21 | 22,1 | 33,9 | G13 |
| 22 | 0 | 36,9 | Therm1 |
| 23 | 0 | 33,9 | Therm2 |
| 24 | 38 | 36,9 | Ph1 |
| 25 | 40,7 | 36,9 | Ph1 |
| 26 | 43,4 | 36,9 | Ph1 |
| 27 | 46,1 | 36,9 | Ph1 |
| 28 | 48,8 | 36,9 | Ph1 |
| 29 | 51,5 | 36,9 | Ph1 |
| 30 | 54,2 | 36,9 | Ph1 |
| 31 | 70,9 | 25,35 | S12 |
| 32 | 67,9 | 25,35 | G12 |
| 33 | 65,3 | 0 | DC- |
| 34 | 62,6 | 0 | DC- |
| 35 | 59,9 | 0 | DC- |
| 36 | 57,2 | 0 | DC- |
| 37 | 54,5 | 0 | DC- |
| 38 | 46,1 | 0 | GND1 |
| 39 | 43,4 | 0 | GND1 |
| 40 | 40,7 | 0 | GND1 |
| 41 | 38 | 0 | GND1 |
| 42 | 38 | 2,7 | GND1 |
| 43 | 48,25 | 20,75 | S14 |
| 44 | 48,25 | 23,75 | G14 |



## Pinout




## Identification

| ID | Component | Voltage | Current | Function | Comment |
|---|---|---|---|---|---|
| T11, T12 | IGBT | 650 V | 450 A | Buck Switch | |
| D11, D12 | FWD | 650 V | 280 A | Buck Diode | |
| T13, T14 | IGBT | 650 V | 360 A | Boost Switch | |
| D42, D41 | FWD | 650 V | 210 A | Boost Diode | |
| D43, D44 | FWD | 650 V | 210 A | Boost Sw. Inv. Diode | |
| C10, C20 | Capacitor | 630 V | | Capacitor (DC) | |
| Rt | Thermistor | | | Thermistor | |

| Packaging instruction | | | | |
|---|---|---|---|---|
| Standard packaging quantity (SPQ) 36 | >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. |

| 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 |
|---|---|---|---|
| 30-PT07NIA450S501-PD68F58Y-D3-14 | 07 Mar. 2023 | Diode change | |