**30-EX14NIA560H701-PS59F86Z**
datasheet

***flow*NPC E3BP** | **1400 V / 560 A**

## Topology features

- Kelvin Emitter for improved switching performance
- Temperature sensor
- Neutral Point Clamped Topology (I-Type)

## Component features

- High speed switching
- Low collector emitter saturation voltage
- Low turn-off losses
- Optimized for hard switching topologies
- Positive temperature coefficient

## Housing features

- Base isolation: $Al_2O_3$
- Cu baseplate
- Convex shaped baseplate for superior thermal contact
- CTI600 housing material
- Baseplate with rough surface
- Solder pin
- Thermo-mechanical push-and-pull force relief

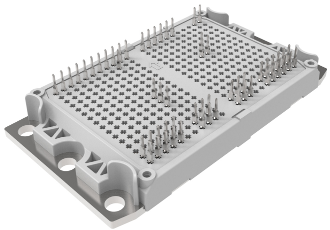
## Target applications

- Solar Inverters

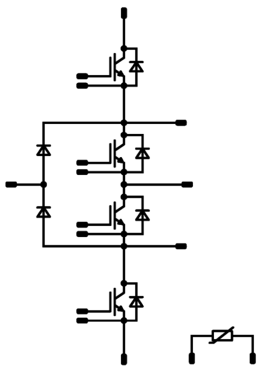
## Types

- 30-EX14NIA560H701-PS59F86Z

## *flow* E3BP 15 mm housing



## Schematic



# Maximum Ratings

$T_j$ = 25 °C, unless otherwise specified

| Parameter | Symbol | Conditions | | Value | Unit |
|---|---|---|---|---|---|
| **Buck Switch** | | | | | |
| Collector-emitter voltage | $V_{CES}$ | | | 1400 | V |
| Collector current (DC current) | $I_C$ | $T_j = T_{jmax}$ | $T_s$ = 80 °C | 398 | A |
| Repetitive peak collector current | $I_{CRM}$ | $t_p$ limited by $T_{jmax}$ | | 1120 | A |
| Total power dissipation | $P_{tot}$ | $T_j = T_{jmax}$ | $T_s$ = 80 °C | 808 | W |
| Gate-emitter voltage | $V_{GES}$ | | | ±20 | V |
| Maximum junction temperature | $T_{jmax}$ | | | 175 | °C |
| **Buck Diode** | | | | | |
| Peak repetitive reverse voltage | $V_{RRM}$ | | | 1400 | V |
| Forward current (DC current) | $I_F$ | $T_j = T_{jmax}$ | $T_s$ = 80 °C | 244 | A |
| Repetitive peak forward current | $I_{FRM}$ | $t_p$ limited by $T_{jmax}$ | | 1422 | A |
| Surge (non-repetitive) forward current | $I_{FSM}$ | Single Half Sine Wave, $t_p$ = 10 ms | $T_j$ = 25 °C | 2700 | A |
| Surge current capability | $I^2t$ | | | 36432 | $A^2s$ |
| Total power dissipation | $P_{tot}$ | $T_j = T_{jmax}$ | $T_s$ = 80 °C | 475 | W |
| Maximum junction temperature | $T_{jmax}$ | | | 175 | °C |
| **Boost Switch** | | | | | |
| Collector-emitter voltage | $V_{CES}$ | | | 1400 | V |
| Collector current (DC current) | $I_C$ | $T_j = T_{jmax}$ | $T_s$ = 80 °C | 398 | A |
| Repetitive peak collector current | $I_{CRM}$ | $t_p$ limited by $T_{jmax}$ | | 1120 | A |
| Total power dissipation | $P_{tot}$ | $T_j = T_{jmax}$ | $T_s$ = 80 °C | 808 | 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 |
|---|---|---|---|---|---|
| **Boost Diode** | | | | | |
| Peak repetitive reverse voltage | $V_{RRM}$ | | | 1400 | V |
| Forward current (DC current) | $I_F$ | $T_j = T_{jmax}$ | $T_s$ = 80 °C | 180 | A |
| Repetitive peak forward current | $I_{FRM}$ | $t_p$ limited by $T_{jmax}$ | | 900 | A |
| Total power dissipation | $P_{tot}$ | $T_j = T_{jmax}$ | $T_s$ = 80 °C | 421 | W |
| Maximum junction temperature | $T_{jmax}$ | | | 175 | °C |
| **Boost Sw. Inv. Diode** | | | | | |
| Peak repetitive reverse voltage | $V_{RRM}$ | | | 1400 | V |
| Forward current (DC current) | $I_F$ | $T_j = T_{jmax}$ | $T_s$ = 80 °C | 166 | A |
| Repetitive peak forward current | $I_{FRM}$ | $t_p$ limited by $T_{jmax}$ | | 840 | A |
| Total power dissipation | $P_{tot}$ | $T_j = T_{jmax}$ | $T_s$ = 80 °C | 358 | W |
| Maximum junction temperature | $T_{jmax}$ | | | 175 | °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 | 7000 | V |
| Creepage distance | | | | 17,02 | mm |
| Clearance | | | | 12,77 | 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 | $V_{GE(th)}$ | $V_{CE} = V_{GE}$ | | | 0,0092 | 25 | 3,5 | 5,5 | 7 | V |
| Collector-emitter saturation voltage | $V_{CEsat}$ | | 15 | | 560 | 25<br>125<br>150 | | 1,99<br>2,21<br>2,27 | 3(1) | V |
| Collector-emitter cut-off current | $I_{CES}$ | | 0 | 1400 | | 25 | | | 16 | µA |
| Gate-emitter leakage current | $I_{GES}$ | | 20 | 0 | | 25 | | | 400 | nA |
| Internal gate resistance | $r_g$ | | | | | | | None | | Ω |
| **Thermal** | | | | | | | | | | |
| Thermal resistance junction to sink(2) | $R_{th(j-s)}$ | $\lambda_{paste}$ = 3,4 W/mK (PSX) | | | | | | 0,12 | | K/W |
| **Dynamic** | | | | | | | | | | |
| Turn-on delay time | $t_{d(on)}$ | $R_{gon}$ = 2 Ω<br>$R_{goff}$ = 2 Ω | -5/15 | 800 | 420 | 25<br>125<br>150 | | 200,79<br>199,93<br>200,08 | | ns |
| Rise time | $t_r$ | | | | | 25<br>125<br>150 | | 27,68<br>28,6<br>29,08 | | ns |
| Turn-off delay time | $t_{d(off)}$ | | | | | 25<br>125<br>150 | | 585,27<br>645,49<br>665,63 | | ns |
| Fall time | $t_f$ | | | | | 25<br>125<br>150 | | 52,87<br>112,27<br>131,52 | | ns |
| Turn-on energy (per pulse) | $E_{on}$ | $Q_{rFWD}$=2,31 µC<br>$Q_{rFWD}$=2,4 µC<br>$Q_{rFWD}$=2,41 µC | | | | 25<br>125<br>150 | | 15,92<br>15,68<br>16,17 | | mWs |
| Turn-off energy (per pulse) | $E_{off}$ | | | | | 25<br>125<br>150 | | 19,64<br>33,97<br>38,97 | | 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 | $V_F$ | | | | 240 | 25<br>125<br>150 | | 1,41<br>1,74<br>1,88 | 1,6(1) | V |
| Reverse leakage current | $I_R$ | $V_r$ = 1400 V | | | | 25 | | 30 | 960 | µA |
| **Thermal** | | | | | | | | | | |
| Thermal resistance junction to sink(2) | $R_{th(j-s)}$ | $\lambda_{paste}$ = 3,4 W/mK (PSX) | | | | | | 0,2 | | K/W |
| **Dynamic** | | | | | | | | | | |
| Peak recovery current | $I_{RM}$ | d$i$/d$t$=16934 A/µs<br>d$i$/d$t$=13876 A/µs<br>d$i$/d$t$=13306 A/µs | -5/15 | 800 | 420 | 25<br>125<br>150 | | 170,96<br>185,89<br>188,75 | | A |
| Reverse recovery time | $t_{rr}$ | | | | | 25<br>125<br>150 | | 23,25<br>22,29<br>22,02 | | ns |
| Recovered charge | $Q_r$ | | | | | 25<br>125<br>150 | | 2,31<br>2,4<br>2,41 | | µC |
| Reverse recovered energy | $E_{rec}$ | | | | | 25<br>125<br>150 | | 0,745<br>0,826<br>0,828 | | mWs |
| Peak rate of fall of recovery current | $(di_{rf}/dt)_{max}$ | | | | | 25<br>125<br>150 | | 23063,79<br>21703,88<br>23723,16 | | A/µs |

# 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 | |
| **Boost Switch** | | | | | | | | | | |
| **Static** | | | | | | | | | | |
| Gate-emitter threshold voltage | $V_{GE(th)}$ | $V_{CE} = V_{GE}$ | | | 0,0092 | 25 | 3,5 | 5,5 | 7 | V |
| Collector-emitter saturation voltage | $V_{CEsat}$ | | 15 | | 560 | 25<br>125<br>150 | | 1,99<br>2,21<br>2,27 | 3(1) | V |
| Collector-emitter cut-off current | $I_{CES}$ | | 0 | 1400 | | 25 | | | 16 | µA |
| Gate-emitter leakage current | $I_{GES}$ | | 20 | 0 | | 25 | | | 400 | nA |
| Internal gate resistance | $r_g$ | | | | | | | None | | Ω |
| **Thermal** | | | | | | | | | | |
| Thermal resistance junction to sink(2) | $R_{th(j-s)}$ | $\lambda_{paste}$ = 3,4 W/mK (PSX) | | | | | | 0,12 | | K/W |
| **Dynamic** | | | | | | | | | | |
| Turn-on delay time | $t_{d(on)}$ | $R_{gon}$ = 2 Ω<br>$R_{goff}$ = 2 Ω | -5/15 | 800 | 420 | 25<br>125<br>150 | | 203,65<br>201,23<br>200,74 | | ns |
| Rise time | $t_r$ | | | | | 25<br>125<br>150 | | 29,63<br>31,52<br>31,55 | | ns |
| Turn-off delay time | $t_{d(off)}$ | | | | | 25<br>125<br>150 | | 582,04<br>644,45<br>662,51 | | ns |
| Fall time | $t_f$ | | | | | 25<br>125<br>150 | | 41,13<br>94,12<br>108,9 | | ns |
| Turn-on energy (per pulse) | $E_{on}$ | $Q_{rFWD}$=12,98 µC<br>$Q_{rFWD}$=28,34 µC<br>$Q_{rFWD}$=34,03 µC | | | | 25<br>125<br>150 | | 21,67<br>23,13<br>23,75 | | mWs |
| Turn-off energy (per pulse) | $E_{off}$ | | | | | 25<br>125<br>150 | | 23,18<br>37,45<br>42,17 | | 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 | |
| **Boost Diode** | | | | | | | | | | |
| **Static** | | | | | | | | | | |
| Forward voltage | $V_F$ | | | | 300 | 25<br>125<br>150 | | 3,38<br>3,15<br>3,04 | 3,3(1) | V |
| Reverse leakage current | $I_R$ | $V_r$ = 1400 V | | | | 25 | | | 1,8 | µA |
| **Thermal** | | | | | | | | | | |
| Thermal resistance junction to sink(2) | $R_{th(j-s)}$ | $\lambda_{paste}$ = 3,4 W/mK (PSX) | | | | | | 0,23 | | K/W |
| **Dynamic** | | | | | | | | | | |
| Peak recovery current | $I_{RM}$ | d$i$/d$t$=15473 A/µs<br>d$i$/d$t$=15046 A/µs<br>d$i$/d$t$=13588 A/µs | -5/15 | 800 | 420 | 25<br>125<br>150 | | 302,74<br>428,3<br>461,5 | | A |
| Reverse recovery time | $t_{rr}$ | | | | | 25<br>125<br>150 | | 161,76<br>258,07<br>296,09 | | ns |
| Recovered charge | $Q_r$ | | | | | 25<br>125<br>150 | | 12,98<br>28,34<br>34,03 | | µC |
| Reverse recovered energy | $E_{rec}$ | | | | | 25<br>125<br>150 | | 5,55<br>13,49<br>16,46 | | mWs |
| Peak rate of fall of recovery current | $(di_{rf}/dt)_{max}$ | | | | | 25<br>125<br>150 | | 14064,71<br>10424,62<br>9335,54 | | 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 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Boost Sw. Inv. Diode** | | | | | | | | | | |
| **Static** | | | | | | | | | | |
| Forward voltage | $V_F$ | | | | 280 | 25<br>125<br>150 | | 2,97<br>2,84<br>2,78 | 3,3(1) | V |
| Reverse leakage current | $I_R$ | $V_r$ = 1400 V | | | | 25 | | | 1,2 | µA |
| **Thermal** | | | | | | | | | | |
| Thermal resistance junction to sink(2) | $R_{th(j\text{-}s)}$ | $\lambda_{paste}$ = 3,4 W/mK (PSX) | | | | | | 0,27 | | K/W |
| **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 | |

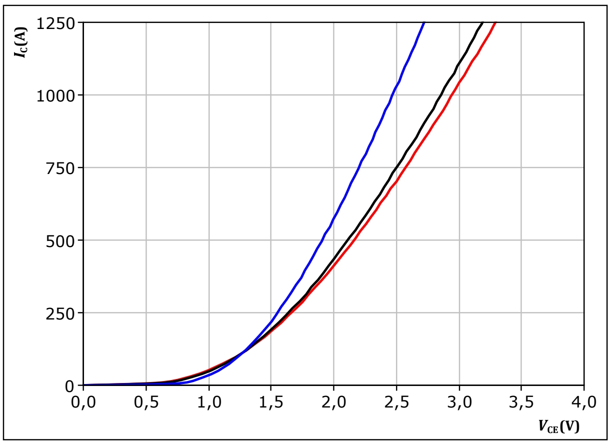
(1) Value at chip level
(2) Only valid with pre-applied Vincotech thermal interface material.

# Buck Switch Characteristics

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

**Typical output characteristics**

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

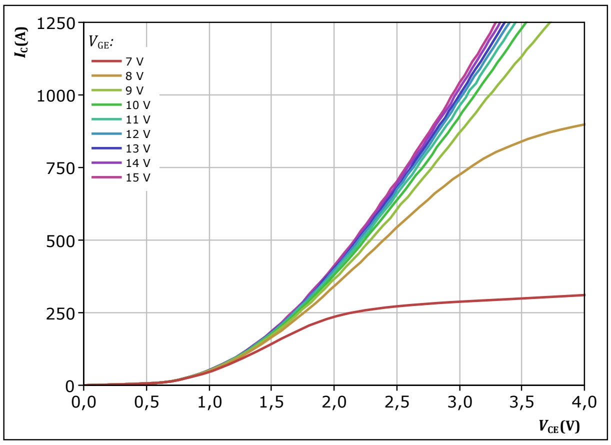



$t_p$ = 250 µs
$V_{GE}$ = 15 V
$T_j$: 25 °C, 125 °C, 150 °C

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

**Typical output characteristics**

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

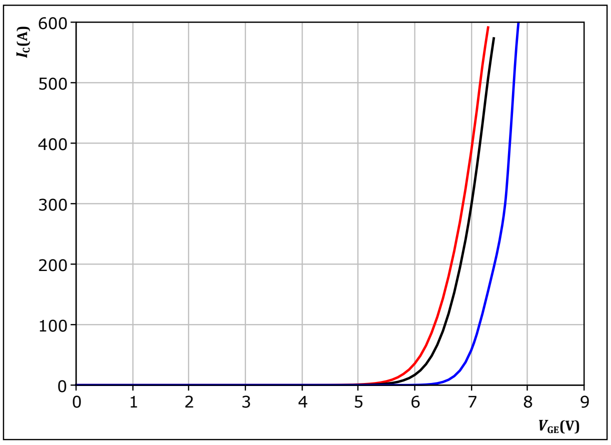



$t_p$ = 250 µs
$T_j$ = 150 °C
$V_{GE}$ from 7 V to 15 V in steps of 1 V

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

**Typical transfer characteristics**

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

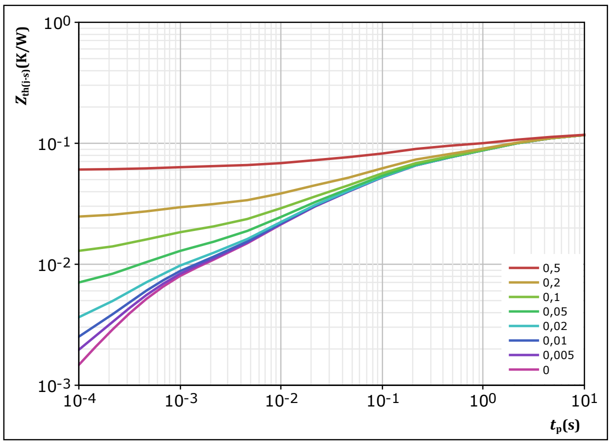



$t_p$ = 250 µs
$V_{CE}$ = 30 V
$T_j$: 25 °C, 125 °C, 150 °C

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

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

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




$D$ = $t_p$ / $T$
$R_{th(j-s)}$ = 0,118 K/W

IGBT thermal model values

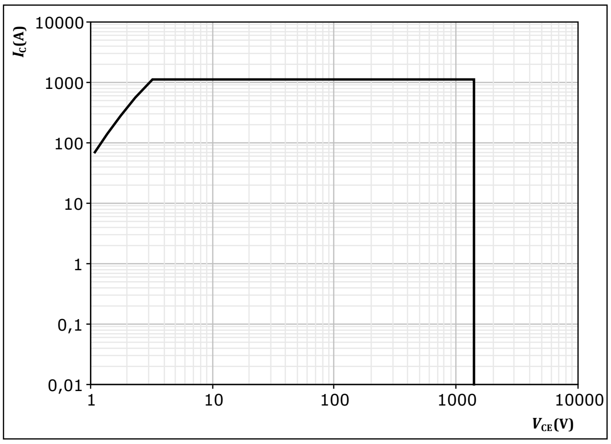
| $R$ (K/W) | $\tau$ (s) |
|---|---|
| 2,63E-02 | 4,95E+00 |
| 3,21E-02 | 9,67E-01 |
| 3,90E-02 | 9,38E-02 |
| 1,61E-02 | 1,02E-02 |
| 6,96E-03 | 4,96E-04 |

# Buck Switch Characteristics

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

**Safe operating area**

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

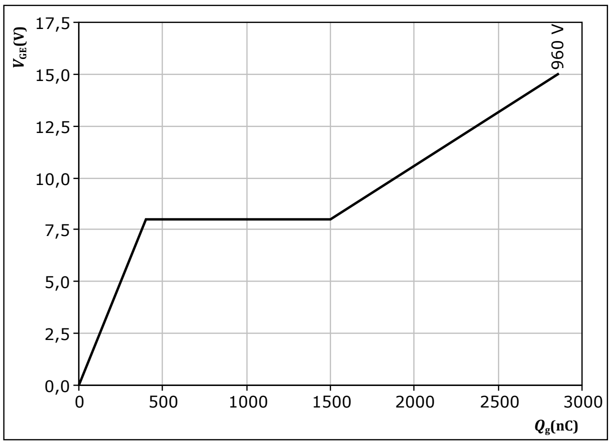



| | | |
|---|---|---|
| $D$ = | single pulse | |
| $T_s$ = | 80 | °C |
| $V_{GE}$ = | 15 | V |
| $T_j$ = | $T_{jmax}$ | |

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

**Gate voltage vs gate charge**

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



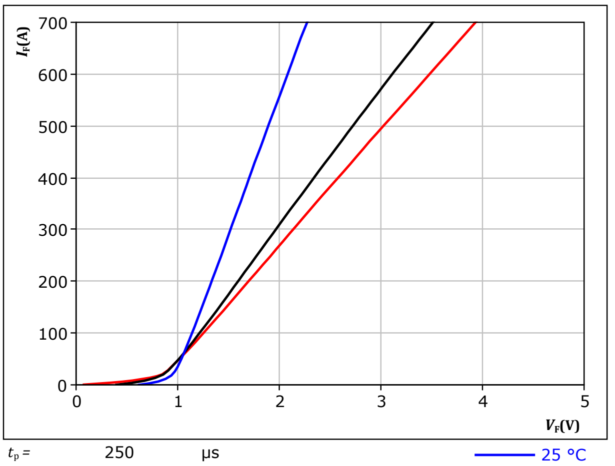

| | | |
|---|---|---|
| $I_C$ = | 400 | A |
| $T_j$ = | 25 | °C |

# Buck Diode Characteristics

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

**Typical forward characteristics**

$I_F = f(V_F)$



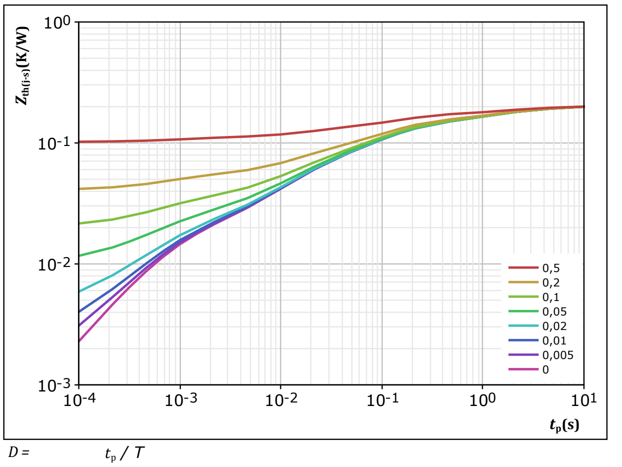

$t_p$ = 250 µs

$T_j$: 25 °C, 125 °C, 150 °C

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

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

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




$D = t_p / T$

$R_{th(j-s)}$ = 0,2 K/W

FWD thermal model values

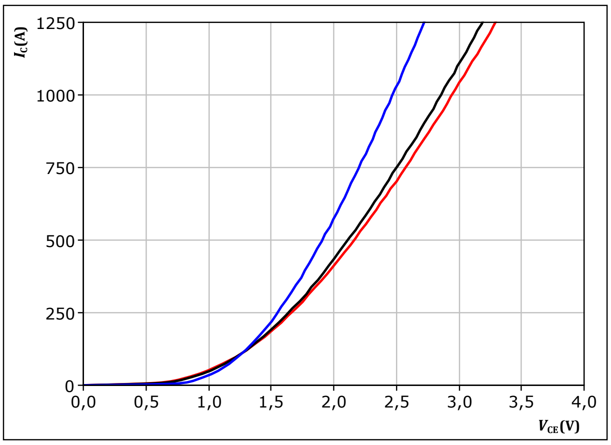
| R (K/W) | τ (s) |
|---|---|
| 2,47E-02 | 5,63E+00 |
| 4,59E-02 | 1,03E+00 |
| 7,98E-02 | 1,05E-01 |
| 3,84E-02 | 1,41E-02 |
| 1,47E-02 | 7,05E-04 |

# Boost Switch Characteristics

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

**Typical output characteristics**

$I_C = f(V_{CE})$

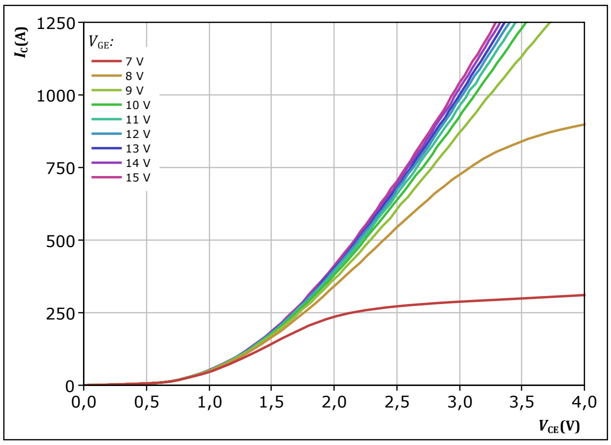



| | | | | |
|---|---|---|---|---|
| $t_p$ = | 250 | µs | | 25 °C |
| $V_{GE}$ = | 15 | V | $T_j$: | 125 °C |
| | | | | 150 °C |

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

**Typical output characteristics**

$I_C = f(V_{CE})$



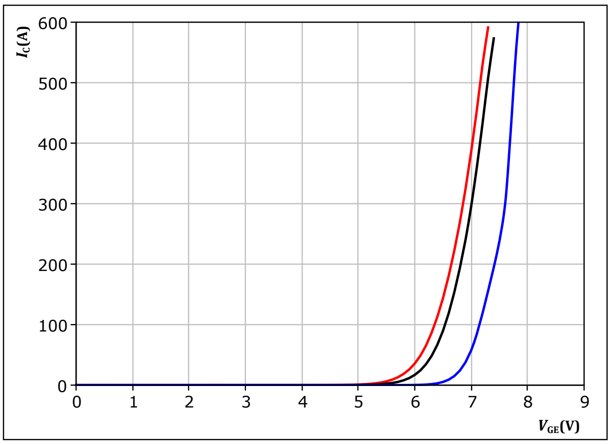

| | | |
|---|---|---|
| $t_p$ = | 250 | µs |
| $T_j$ = | 150 | °C |

$V_{GE}$ from 7 V to 15 V in steps of 1 V

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

**Typical transfer characteristics**

$I_C = f(V_{GE})$

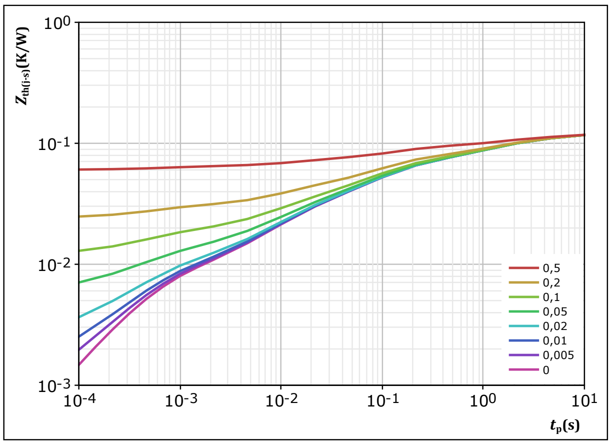



| | | | | |
|---|---|---|---|---|
| $t_p$ = | 250 | µs | | 25 °C |
| $V_{CE}$ = | 30 | V | $T_j$: | 125 °C |
| | | | | 150 °C |

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

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

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




| | | |
|---|---|---|
| $D$ = | $t_p$ / $T$ | |
| $R_{th(j-s)}$ = | 0,118 | K/W |

IGBT thermal model values

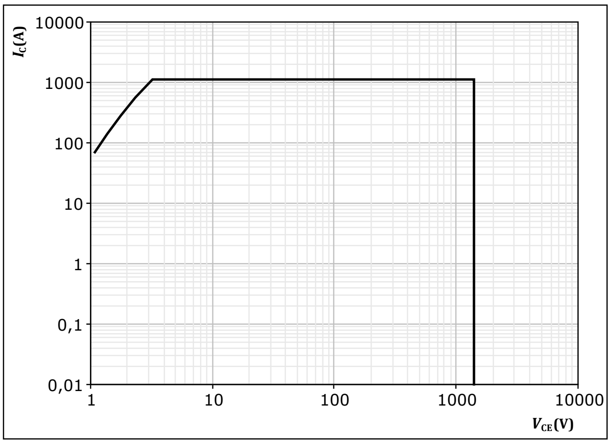
| $R$ (K/W) | $\tau$ (s) |
|---|---|
| 2,63E-02 | 4,95E+00 |
| 3,21E-02 | 9,67E-01 |
| 3,90E-02 | 9,38E-02 |
| 1,61E-02 | 1,02E-02 |
| 6,96E-03 | 4,96E-04 |

# Boost Switch Characteristics

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

**Safe operating area**

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

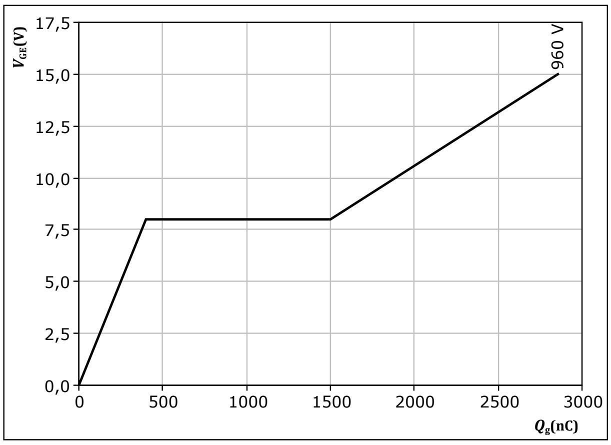



| | | |
|---|---|---|
| $D$ = | single pulse | |
| $T_s$ = | 80 | °C |
| $V_{GE}$ = | 15 | V |
| $T_j$ = | $T_{jmax}$ | |

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

**Gate voltage vs gate charge**

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



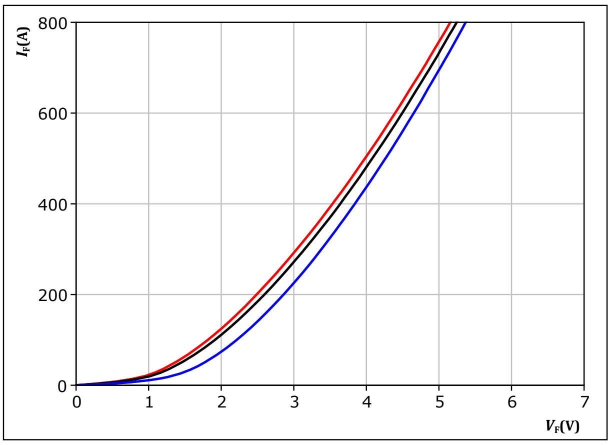

| | | |
|---|---|---|
| $I_C$ = | 400 | A |
| $T_j$ = | 25 | °C |

# Boost Diode Characteristics

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

**Typical forward characteristics**

$I_F$ = f( $V_F$)



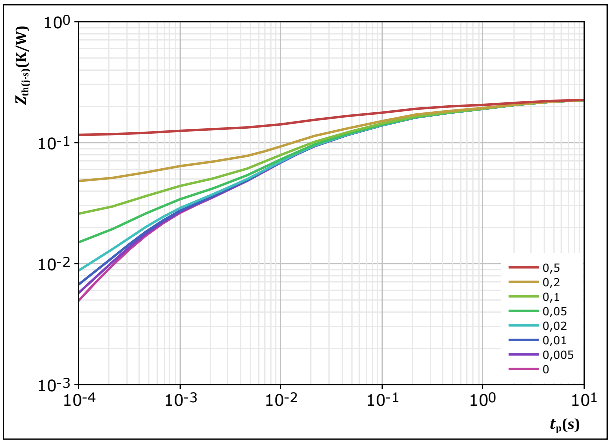

$t_p$ = 250 µs

$T_j$: 25 °C, 125 °C, 150 °C

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

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

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




$D$ = $t_p$ / $T$

$R_{th(j-s)}$ = 0,226 K/W

FWD thermal model values

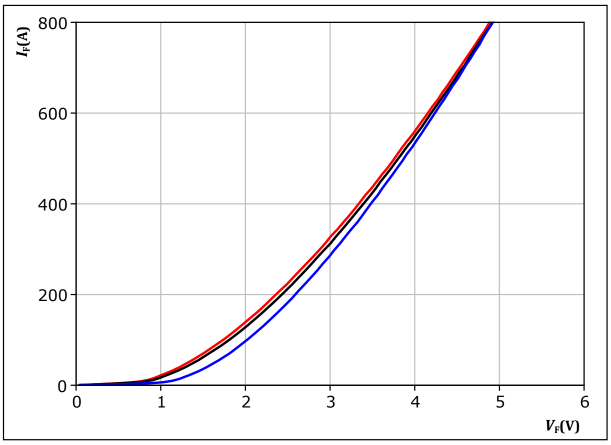
| $R$ (K/W) | $\tau$ (s) |
|---|---|
| 2,33E-02 | 6,11E+00 |
| 4,55E-02 | 1,17E+00 |
| 7,42E-02 | 9,47E-02 |
| 6,40E-02 | 1,10E-02 |
| 2,26E-02 | 4,76E-04 |

# Boost Sw. Inv. Diode Characteristics

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

**Typical forward characteristics**

$I_F = f(V_F)$



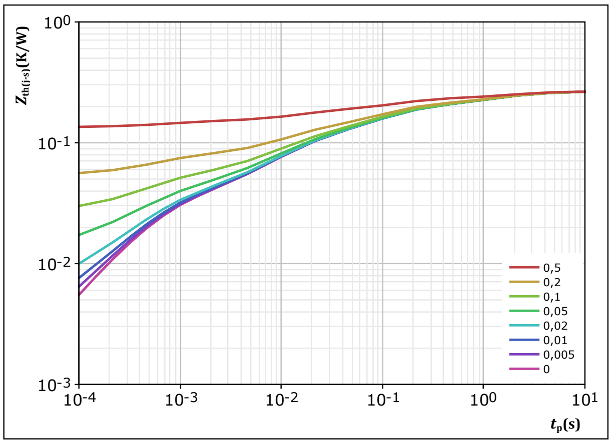

$t_p$ = 250 µs

$T_j$: 25 °C, 125 °C, 150 °C

**figure 18.** **FWD**

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

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




$D$ = $t_p / T$

$R_{th(j-s)}$ = 0,265 K/W

FWD thermal model values

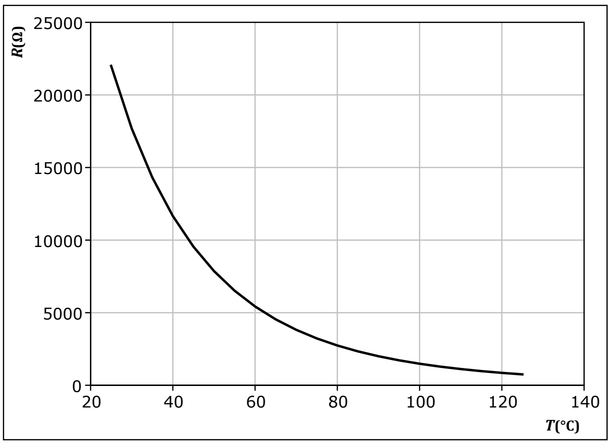
| $R$ (K/W) | $\tau$ (s) |
|---|---|
| 1,44E-02 | 7,17E+00 |
| 6,57E-02 | 1,22E+00 |
| 9,61E-02 | 9,76E-02 |
| 6,36E-02 | 1,08E-02 |
| 2,82E-02 | 5,35E-04 |

# Thermistor Characteristics

| figure 19. | Thermistor |
|---|---|

**Typical NTC characteristic as function of temperature**

$R_T = f(T)$

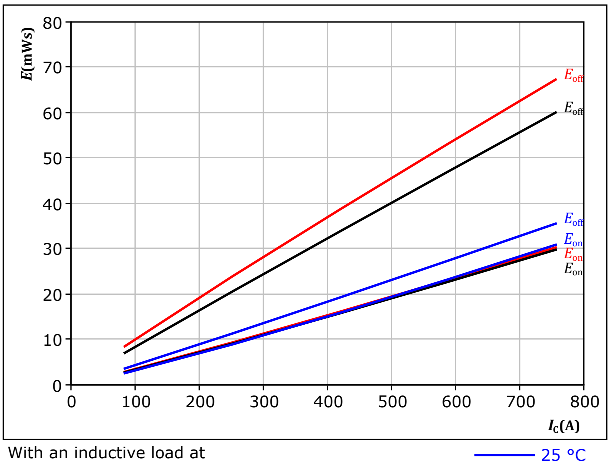


# Buck Switching Characteristics

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

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

$E = f(I_C)$




With an inductive load at

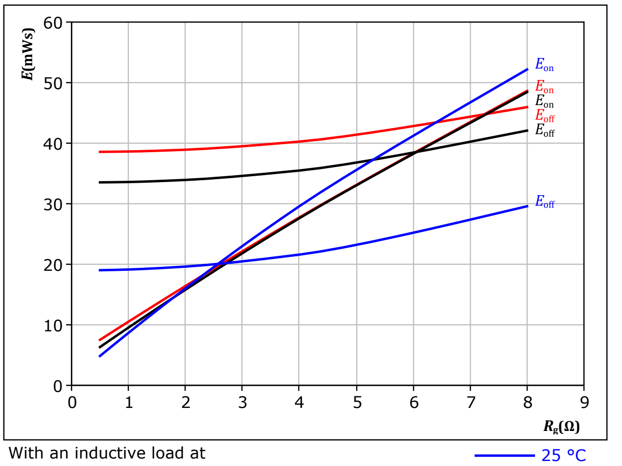
$V_{CE}$ = 800 V
$V_{GE}$ = -5/15 V
$R_{gon}$ = 2 Ω
$R_{goff}$ = 2 Ω

$T_j$: 25 °C, 125 °C, 150 °C

**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

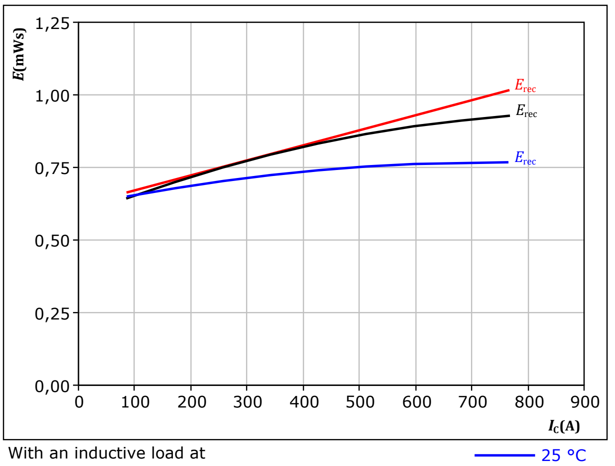
$V_{CE}$ = 800 V
$V_{GE}$ = -5/15 V
$I_C$ = 420 A

$T_j$: 25 °C, 125 °C, 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

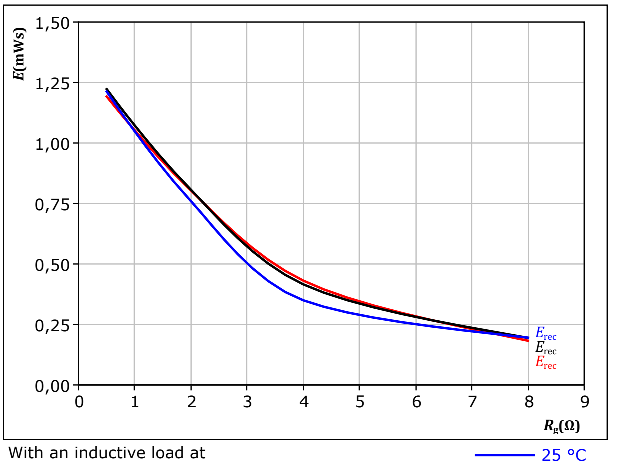
$V_{CE}$ = 800 V
$V_{GE}$ = -5/15 V
$R_{gon}$ = 2 Ω

$T_j$: 25 °C, 125 °C, 150 °C

**figure 23.** **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

$V_{CE}$ = 800 V
$V_{GE}$ = -5/15 V
$I_C$ = 420 A

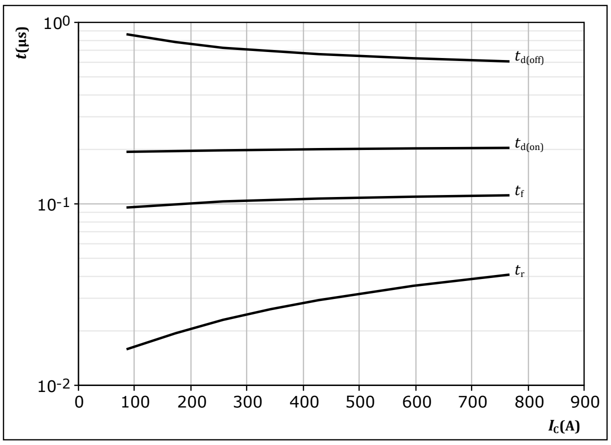
$T_j$: 25 °C, 125 °C, 150 °C

# Buck Switching Characteristics

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

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

$t$ = f( $I_C$)



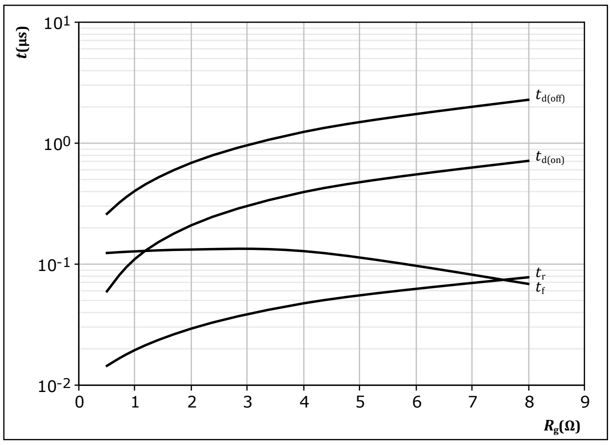

With an inductive load at

| | | |
|---|---|---|
| $T_j$ = | 150 | °C |
| $V_{CE}$ = | 800 | V |
| $V_{GE}$ = | -5/15 | V |
| $R_{gon}$ = | 2 | Ω |
| $R_{goff}$ = | 2 | Ω |

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

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

$t$ = f( $R_g$)



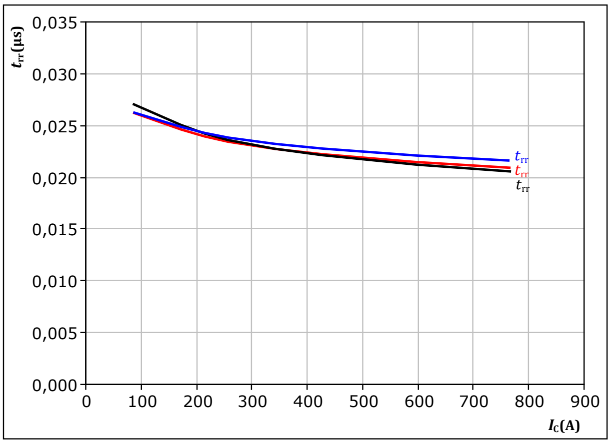

With an inductive load at

| | | |
|---|---|---|
| $T_j$ = | 150 | °C |
| $V_{CE}$ = | 800 | V |
| $V_{GE}$ = | -5/15 | V |
| $I_C$ = | 420 | A |

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

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

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




With an inductive load at

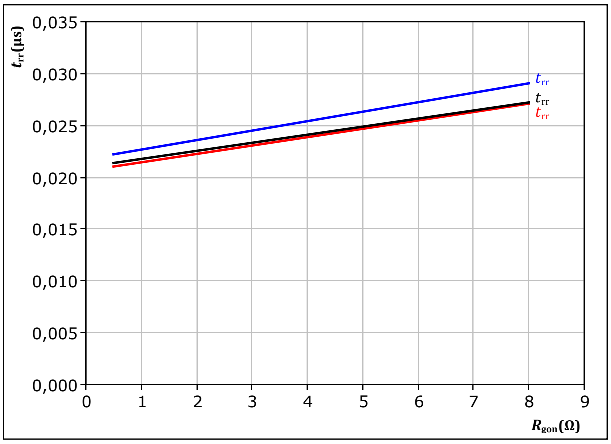
| | | |
|---|---|---|
| $V_{CE}$ = | 800 | V |
| $V_{GE}$ = | -5/15 | V |
| $R_{gon}$ = | 2 | Ω |

$T_j$: 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

| | | |
|---|---|---|
| $V_{CE}$ = | 800 | V |
| $V_{GE}$ = | -5/15 | V |
| $I_C$ = | 420 | A |

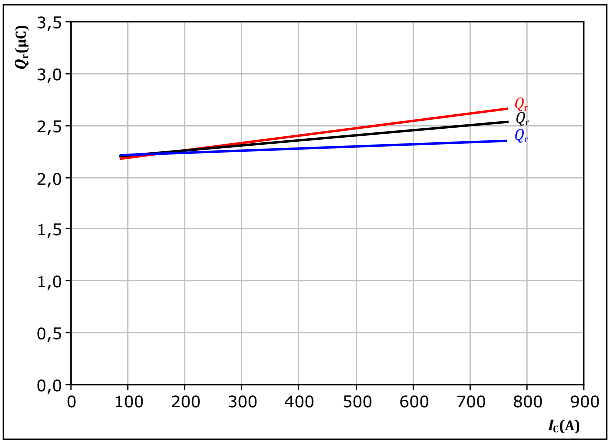
$T_j$: 25 °C, 125 °C, 150 °C

# Buck Switching Characteristics

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

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

$Q_r$ = f( $I_C$)



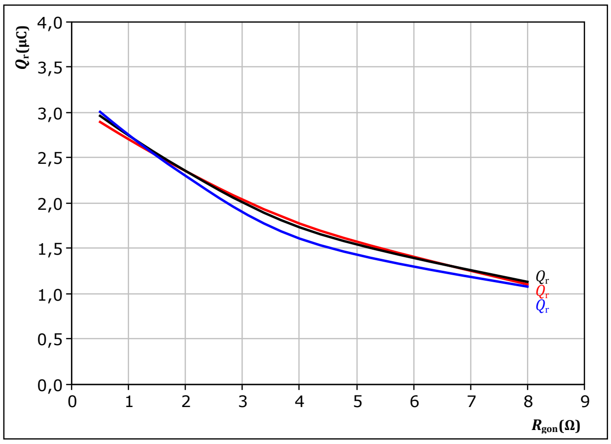

With an inductive load at

| | | | | |
|---|---|---|---|---|
| $V_{CE}$ = | 800 | V | $T_j$: | 25 °C |
| $V_{GE}$ = | -5/15 | V | | 125 °C |
| $R_{gon}$ = | 2 | Ω | | 150 °C |

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

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

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



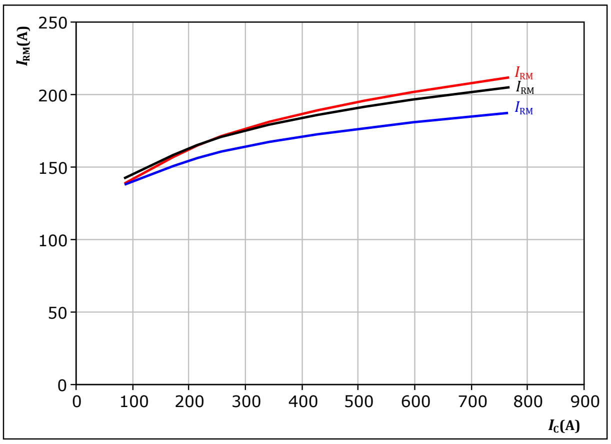

With an inductive load at

| | | | | |
|---|---|---|---|---|
| $V_{CE}$ = | 800 | V | $T_j$: | 25 °C |
| $V_{GE}$ = | -5/15 | V | | 125 °C |
| $I_C$ = | 420 | A | | 150 °C |

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

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

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



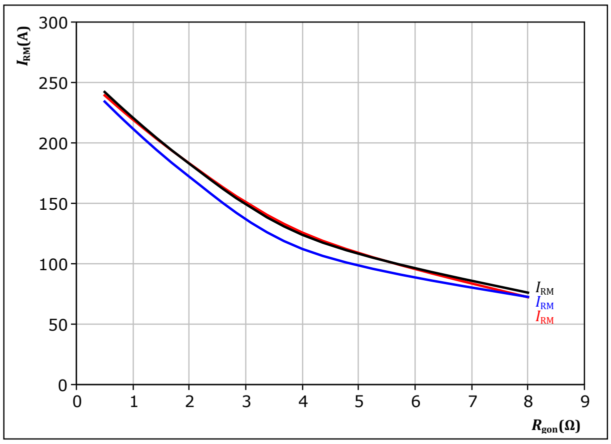

With an inductive load at

| | | | | |
|---|---|---|---|---|
| $V_{CE}$ = | 800 | V | $T_j$: | 25 °C |
| $V_{GE}$ = | -5/15 | V | | 125 °C |
| $R_{gon}$ = | 2 | Ω | | 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

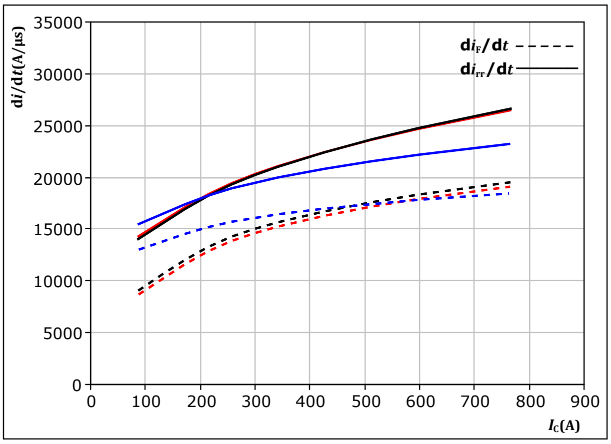
| | | | | |
|---|---|---|---|---|
| $V_{CE}$ = | 800 | V | $T_j$: | 25 °C |
| $V_{GE}$ = | -5/15 | V | | 125 °C |
| $I_C$ = | 420 | A | | 150 °C |

# 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( $I_C$)



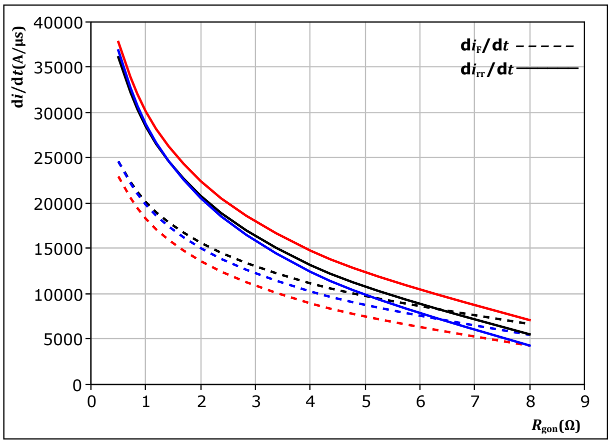

With an inductive load at

| | | | | |
|---|---|---|---|---|
| $V_{CE}$ = | 800 | V | $T_j$: | 25 °C |
| $V_{GE}$ = | -5/15 | V | | 125 °C |
| $R_{gon}$ = | 2 | 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( $R_{gon}$)



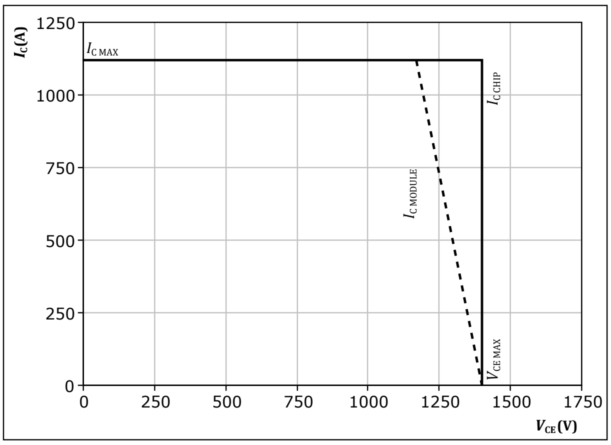

With an inductive load at

| | | | | |
|---|---|---|---|---|
| $V_{CE}$ = | 800 | V | $T_j$: | 25 °C |
| $V_{GE}$ = | -5/15 | V | | 125 °C |
| $I_C$ = | 420 | A | | 150 °C |

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

**Reverse bias safe operating area**

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



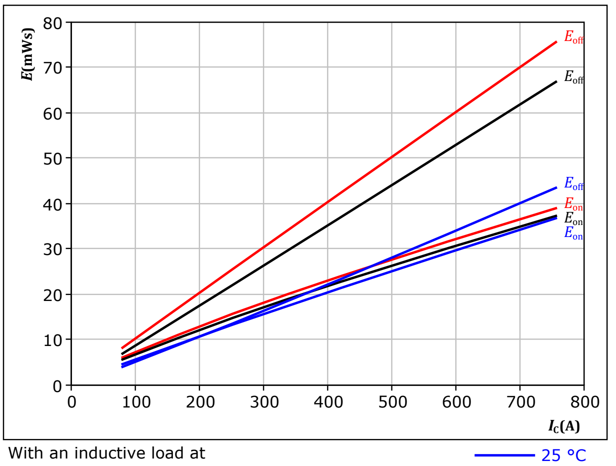

| | | | |
|---|---|---|---|
| **At** | $T_j$ = | 150 | °C |
| | $R_{gon}$ = | 2 | Ω |
| | $R_{goff}$ = | 2 | Ω |

# Boost Switching Characteristics

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

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

$E$ = f( $I_C$)



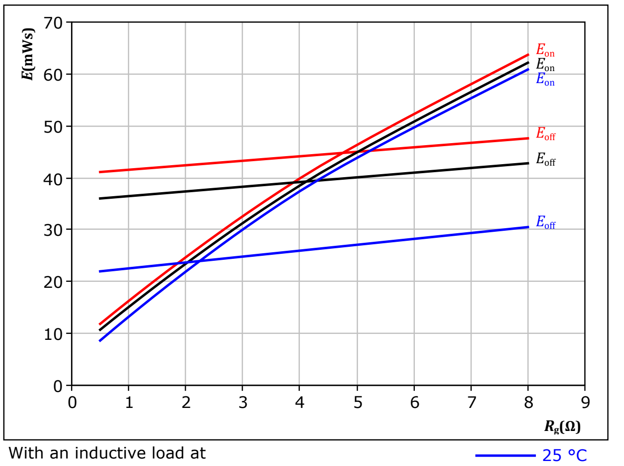

With an inductive load at

| | | | | |
|---|---|---|---|---|
| $V_{CE}$ = | 800 | V | $T_j$: | 25 °C |
| $V_{GE}$ = | -5/15 | V | | 125 °C |
| $R_{gon}$ = | 2 | Ω | | 150 °C |
| $R_{goff}$ = | 2 | Ω | | |

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

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

$E$ = f( $R_g$)



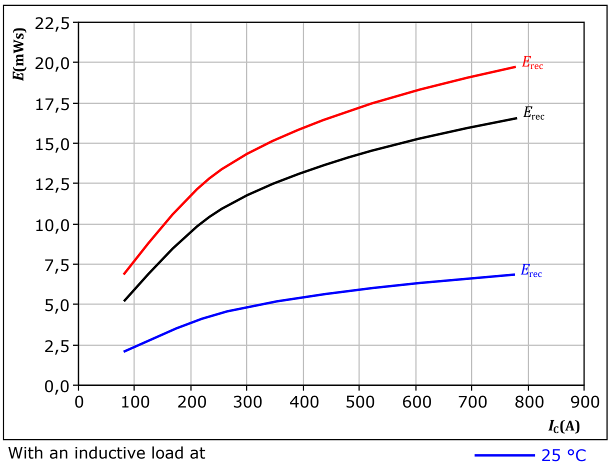

With an inductive load at

| | | | | |
|---|---|---|---|---|
| $V_{CE}$ = | 800 | V | $T_j$: | 25 °C |
| $V_{GE}$ = | -5/15 | V | | 125 °C |
| $I_C$ = | 420 | A | | 150 °C |

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

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

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



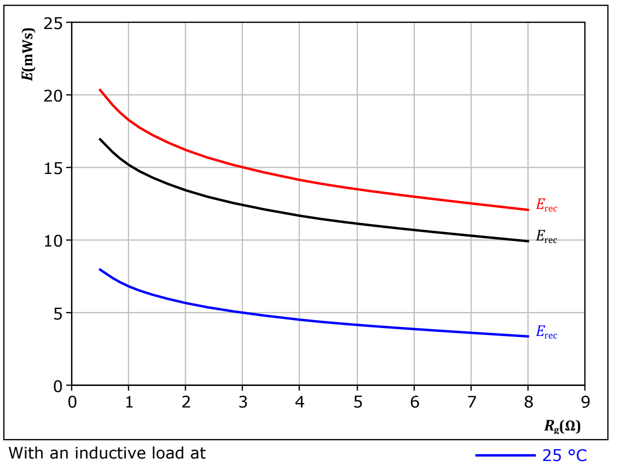

With an inductive load at

| | | | | |
|---|---|---|---|---|
| $V_{CE}$ = | 800 | V | $T_j$: | 25 °C |
| $V_{GE}$ = | -5/15 | V | | 125 °C |
| $R_{gon}$ = | 2 | Ω | | 150 °C |

**figure 38.** **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

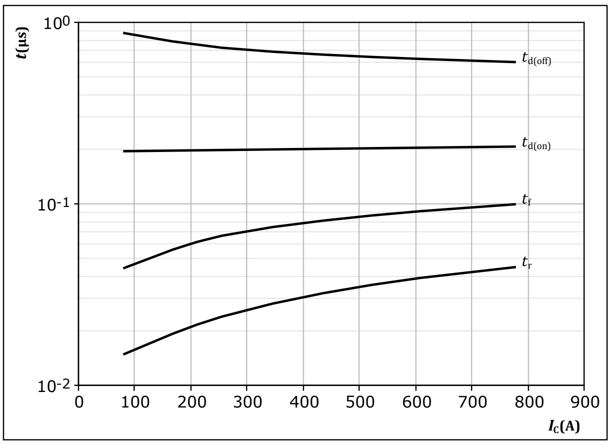
| | | | | |
|---|---|---|---|---|
| $V_{CE}$ = | 800 | V | $T_j$: | 25 °C |
| $V_{GE}$ = | -5/15 | V | | 125 °C |
| $I_C$ = | 420 | A | | 150 °C |

# Boost Switching Characteristics

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

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

$t$ = f( $I_C$)



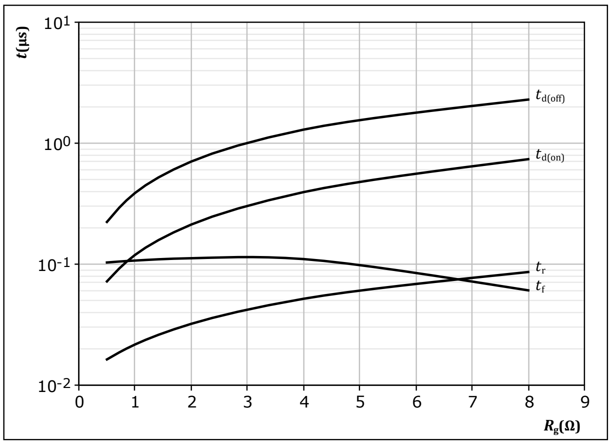

With an inductive load at

| | | |
|---|---|---|
| $T_j$ = | 150 | °C |
| $V_{CE}$ = | 800 | V |
| $V_{GE}$ = | -5/15 | V |
| $R_{gon}$ = | 2 | Ω |
| $R_{goff}$ = | 2 | Ω |

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

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

$t$ = f( $R_g$)



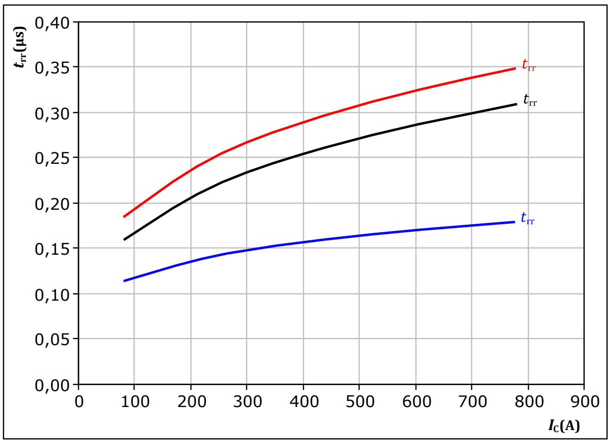

With an inductive load at

| | | |
|---|---|---|
| $T_j$ = | 150 | °C |
| $V_{CE}$ = | 800 | V |
| $V_{GE}$ = | -5/15 | V |
| $I_C$ = | 420 | A |

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

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

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




With an inductive load at

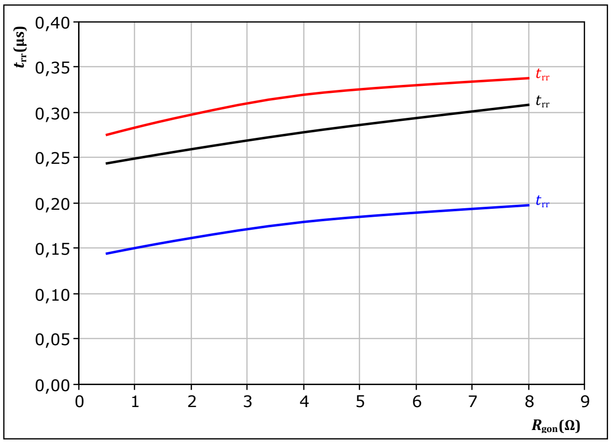
| | | |
|---|---|---|
| $V_{CE}$ = | 800 | V |
| $V_{GE}$ = | -5/15 | V |
| $R_{gon}$ = | 2 | Ω |

$T_j$: 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

| | | |
|---|---|---|
| $V_{CE}$ = | 800 | V |
| $V_{GE}$ = | -5/15 | V |
| $I_C$ = | 420 | A |

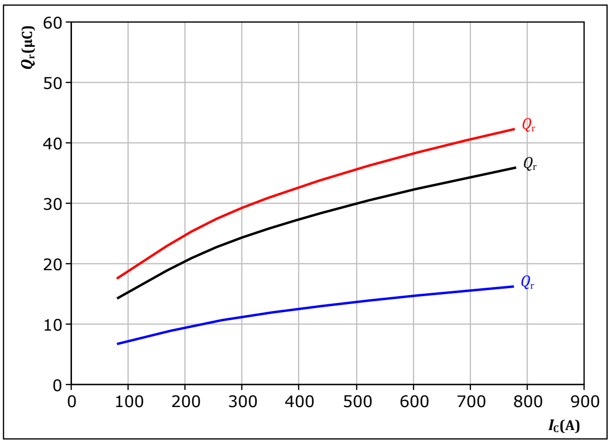
$T_j$: 25 °C, 125 °C, 150 °C

# Boost Switching Characteristics

**figure 43.** FWD

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

$Q_r$ = f( $I_C$)



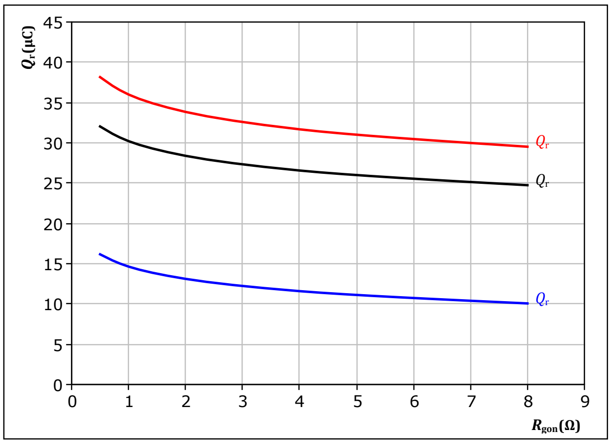

With an inductive load at

| | | | | |
|---|---|---|---|---|
| $V_{CE}$ = | 800 | V | $T_j$: | 25 °C |
| $V_{GE}$ = | -5/15 | V | | 125 °C |
| $R_{gon}$ = | 2 | Ω | | 150 °C |

**figure 44.** FWD

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

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



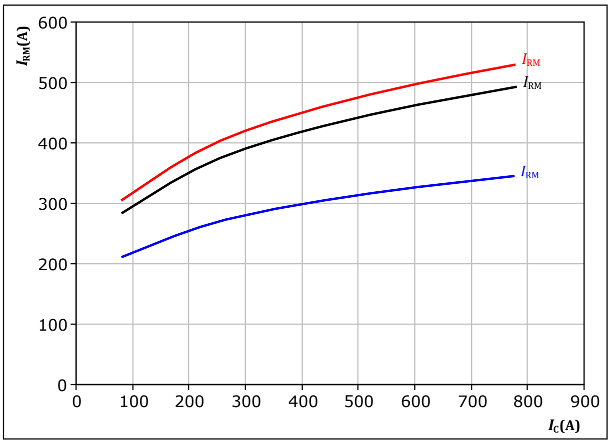

With an inductive load at

| | | | | |
|---|---|---|---|---|
| $V_{CE}$ = | 800 | V | $T_j$: | 25 °C |
| $V_{GE}$ = | -5/15 | V | | 125 °C |
| $I_C$ = | 420 | A | | 150 °C |

**figure 45.** FWD

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

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



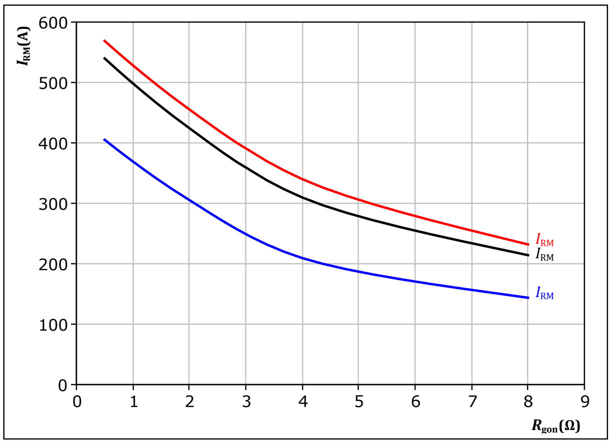

With an inductive load at

| | | | | |
|---|---|---|---|---|
| $V_{CE}$ = | 800 | V | $T_j$: | 25 °C |
| $V_{GE}$ = | -5/15 | V | | 125 °C |
| $R_{gon}$ = | 2 | 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

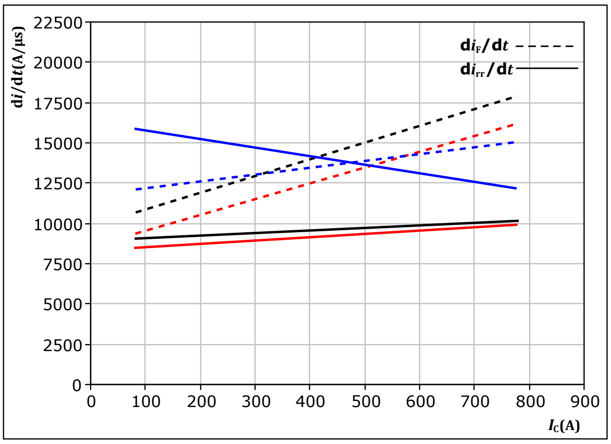
| | | | | |
|---|---|---|---|---|
| $V_{CE}$ = | 800 | V | $T_j$: | 25 °C |
| $V_{GE}$ = | -5/15 | V | | 125 °C |
| $I_C$ = | 420 | A | | 150 °C |

# 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( $I_C$)



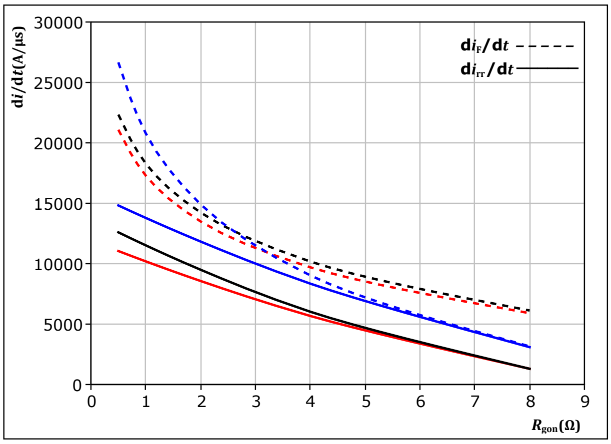

With an inductive load at

| | | | | |
|---|---|---|---|---|
| $V_{CE}$ = | 800 | V | $T_j$: | 25 °C |
| $V_{GE}$ = | -5/15 | V | | 125 °C |
| $R_{gon}$ = | 2 | 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( $R_{gon}$)



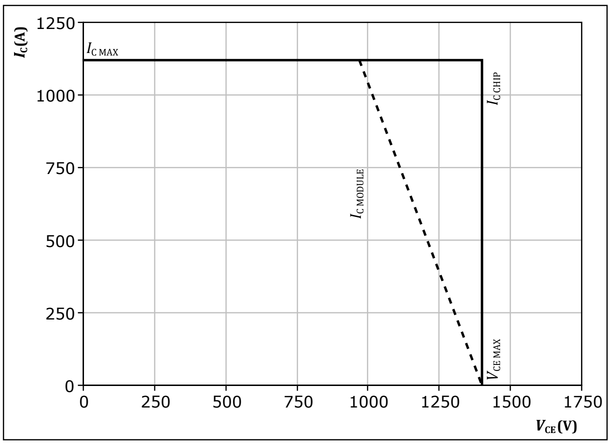

With an inductive load at

| | | | | |
|---|---|---|---|---|
| $V_{CE}$ = | 800 | V | $T_j$: | 25 °C |
| $V_{GE}$ = | -5/15 | V | | 125 °C |
| $I_C$ = | 420 | A | | 150 °C |

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

**Reverse bias safe operating area**

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




| | | | |
|---|---|---|---|
| **At** | $T_j$ = | 150 | °C |
| | $R_{gon}$ = | 2 | Ω |
| | $R_{goff}$ = | 2 | Ω |

# Switching Definitions

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

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

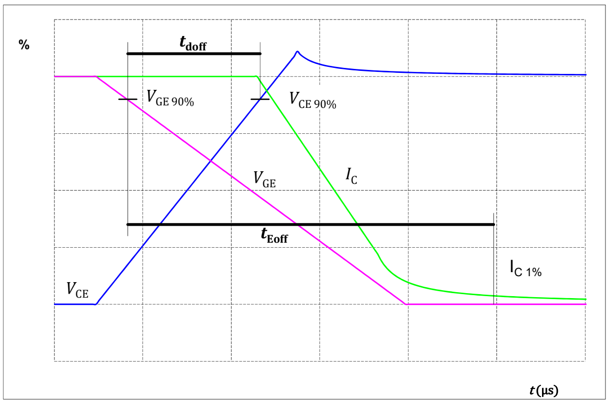



**figure 51.** **IGBT**

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

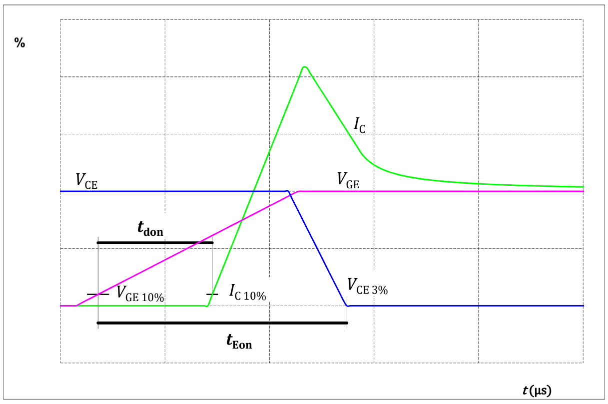



**figure 52.** **IGBT**

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

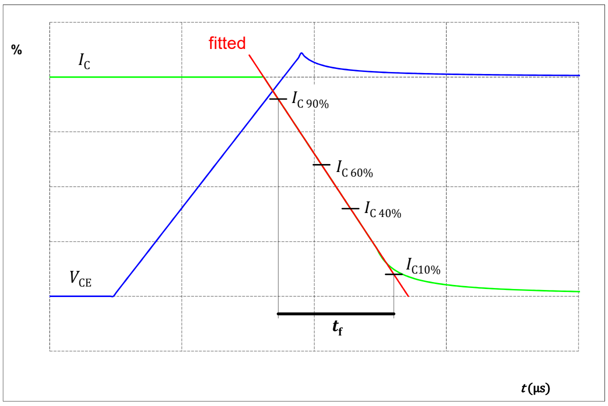
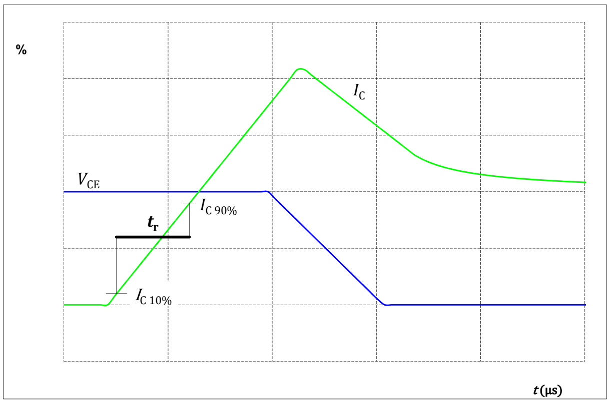



**figure 53.** **IGBT**

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



# Switching Definitions

**figure 54.** **FWD**

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

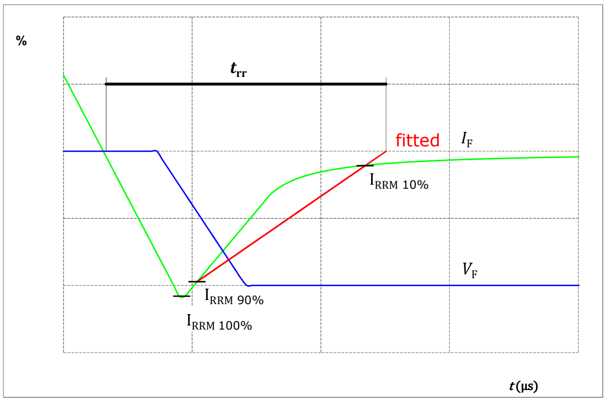
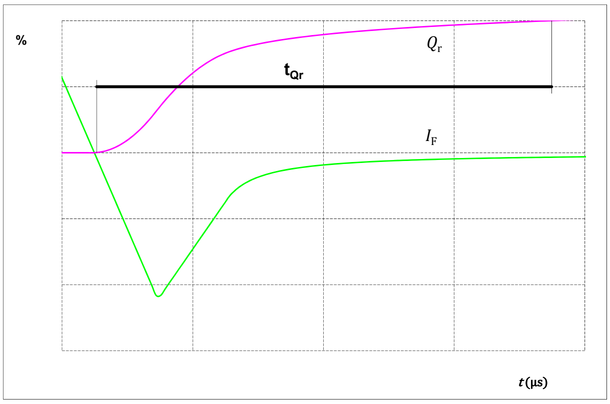



**figure 55.** **FWD**

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



## Ordering Code

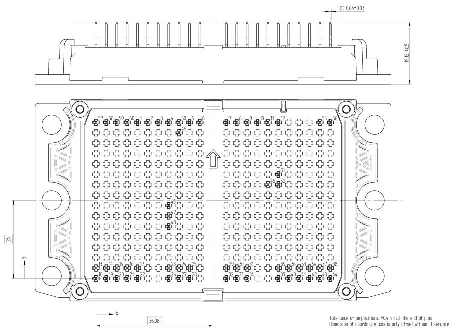
| Version | Ordering Code |
|---|---|
| Without thermal paste | 30-EX14NIA560H701-PS59F86Z |
| With thermal paste (5,2 W/mK, PTM6000HV) | 30-EX14NIA560H701-PS59F86Z-/7/ |

## Marking

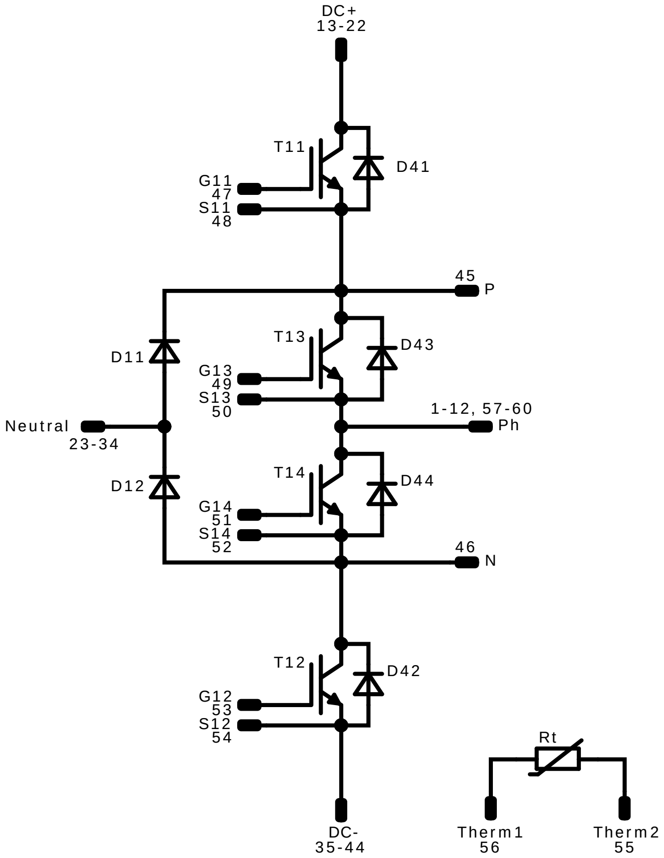
| | | | | | | |
|---|---|---|---|---|---|---|
| Text | Name | | Date code | Logo | Lot | Serial |
| | NN-NNNNNNNNNNNNNN-TTTTTTVV | | WWYY | VIN | LLLLL | SSSS |
| Datamatrix | Type&Ver | Lot number | Serial | Date code | | |
| | TTTTTTTVV | LLLLL | SSSS | WWYY | | |

## Outline

| Pin table [mm] | | | | | | | |
|---|---|---|---|---|---|---|---|
| Pin | X | Y | Function | 31 | 46,56 | 3,2 | Neutral |
| 1 | 12,8 | 48 | Ph | 32 | 40,16 | 0 | Neutral |
| 2 | 16 | 48 | Ph | 33 | 43,36 | 0 | Neutral |
| 3 | 19,2 | 48 | Ph | 34 | 46,56 | 0 | Neutral |
| 4 | 22,4 | 48 | Ph | 35 | 56,16 | 3,2 | DC- |
| 5 | 28,8 | 48 | Ph | 36 | 59,36 | 3,2 | DC- |
| 6 | 32 | 48 | Ph | 37 | 68,96 | 3,2 | DC- |
| 7 | 40,16 | 48 | Ph | 38 | 72,16 | 3,2 | DC- |
| 8 | 43,36 | 48 | Ph | 39 | 56,16 | 0 | DC- |
| 9 | 46,56 | 48 | Ph | 40 | 59,36 | 0 | DC- |
| 10 | 49,76 | 48 | Ph | 41 | 62,56 | 0 | DC- |
| 11 | 52,96 | 48 | Ph | 42 | 65,76 | 0 | DC- |
| 12 | 56,16 | 48 | Ph | 43 | 68,96 | 0 | DC- |
| 13 | 0 | 3,2 | DC+ | 44 | 72,16 | 0 | DC- |
| 14 | 3,2 | 3,2 | DC+ | 45 | 22,4 | 22,4 | P |
| 15 | 6,4 | 3,2 | DC+ | 46 | 52,96 | 28,8 | N |
| 16 | 9,6 | 3,2 | DC+ | 47 | 22,4 | 19,2 | G11 |
| 17 | 12,8 | 3,2 | DC+ | 48 | 22,4 | 16 | S11 |
| 18 | 0 | 0 | DC+ | 49 | 25,6 | 44,8 | G13 |
| 19 | 3,2 | 0 | DC+ | 50 | 25,6 | 48 | S13 |
| 20 | 6,4 | 0 | DC+ | 51 | 56,16 | 32 | G14 |
| 21 | 9,6 | 0 | DC+ | 52 | 56,16 | 28,8 | S14 |
| 22 | 12,8 | 0 | DC+ | 53 | 62,56 | 3,2 | G12 |
| 23 | 22,4 | 3,2 | Neutral | 54 | 65,76 | 3,2 | S12 |
| 24 | 25,6 | 3,2 | Neutral | 55 | 68,96 | 48 | Therm2 |
| 25 | 28,8 | 3,2 | Neutral | 56 | 72,16 | 48 | Therm1 |
| 26 | 22,4 | 0 | Neutral | 57 | 0 | 48 | Ph |
| 27 | 25,6 | 0 | Neutral | 58 | 3,2 | 48 | Ph |
| 28 | 28,8 | 0 | Neutral | 59 | 6,4 | 48 | Ph |
| 29 | 40,16 | 3,2 | Neutral | 60 | 9,6 | 48 | Ph |
| 30 | 43,36 | 3,2 | Neutral | | | | |



## Pinout




## Identification

| ID | Component | Voltage | Current | Function | Comment |
|---|---|---|---|---|---|
| T11, T12 | IGBT | 1400 V | 560 A | Buck Switch | |
| D11, D12 | FWD | 1400 V | 240 A | Buck Diode | |
| T13, T14 | IGBT | 1400 V | 560 A | Boost Switch | |
| D42, D41 | FWD | 1400 V | 300 A | Boost Diode | |
| D44, D43 | FWD | 1400 V | 280 A | Boost Sw. Inv. Diode | |
| Rt | Thermistor | | | Thermistor | |

| Packaging instruction | | | | |
|---|---|---|---|---|
| Standard packaging quantity (SPQ) 24 | >SPQ | Standard | <SPQ | Sample |

| Handling instruction |
|---|
| Handling instructions for *flow* E3BP packages see vincotech.com website. |

| Package data |
|---|
| Package data for *flow* E3BP packages see vincotech.com website. |

| Vincotech thermistor reference |
|---|
| See Vincotech thermistor reference table at vincotech.com website. |

| UL recognition and file number |
|---|
| Certification pending. For more information see vincotech.com website. |

| Document No.: | Date: | Modification: | Pages |
|---|---|---|---|
| 30-EX14NIA560H701-PS59F86Z-D3-14 | 4 Sep. 2026 | Change Buck Diodes | |