# 10-FZ06NRA075FU-P969F08
# 10-PZ06NRA075FU-P969F08Y

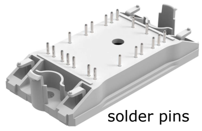
datasheet

***flow* NPC 0** **600 V / 75 A**

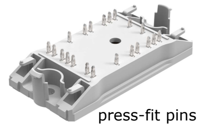
### Features

- Neutral point clamped inverter
- Reactive power capability
- Low inductance layout

### *flow* 0 12 mm housing



solder pins

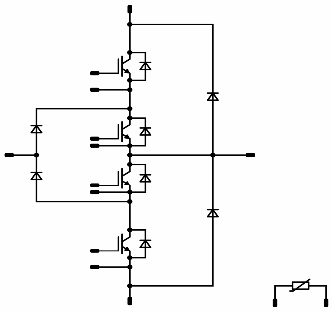


press-fit pins

### Target Applications

- Solar inverter
- UPS

### Schematic



### Types

- 10-FZ06NRA075FU-P969F08
- 10-PZ06NRA075FU-P969F08Y

## Maximum Ratings

$T_j$ = 25 °C, unless otherwise specified

| Parameter | Symbol | Condition | Value | Unit |
|---|---|---|---|---|
| **Buck IGBT** | | | | |
| Collector-emitter break down voltage | $V_{CE}$ | | 600 | V |
| DC collector current | $I_C$ | $T_j = T_{jmax}$ $T_s$ = 80 °C | 65 | A |
| Repetitive peak collector current | $I_{CRM}$ | $t_p$ limited by $T_{jmax}$ | 225 | A |
| Power dissipation | $P_{tot}$ | $T_j = T_{jmax}$ $T_s$ = 80 °C | 113 | W |
| Gate-emitter peak voltage | $V_{GE}$ | | ±20 | V |
| Short circuit ratings | $t_{SC}$ | $T_j$ ≤ 150 °C $V_{GE}$ = 15 V $V_{CC}$ = 400 V | 5 | µs |
| Turn off safe operating area (RBSOA) | $I_{cmax}$ | $V_{CE\ max}$ = 600V<br>$T_{vj\ max}$= 150°C | 150 | A |
| Maximum Junction Temperature | $T_{jmax}$ | | 175 | °C |
| **Buck FWD** | | | | |
| Peak Repetitive Reverse Voltage | $V_{RRM}$ | | 600 | V |
| DC forward current | $I_F$ | $T_j = T_{jmax}$ $T_s$ = 80 °C | 25 | A |
| Repetitive peak forward current | $I_{FRM}$ | $t_p$ limited by $T_{jmax}$ $T_j$ = 100 °C | 90 | A |
| Power dissipation | $P_{tot}$ | $T_j = T_{jmax}$ $T_s$ = 80 °C | 40 | W |
| Maximum Junction Temperature | $T_{jmax}$ | | 150 | °C |

# Maximum Ratings

$T_j$ = 25 °C, unless otherwise specified

| Parameter | Symbol | Condition | | | Value | Unit |
|---|---|---|---|---|---|---|
| **Boost IGBT** | | | | | | |
| Collector-emitter break down voltage | $V_{CE}$ | | | | 600 | V |
| DC collector current | $I_C$ | $T_j = T_{jmax}$ | | $T_s$ = 80 °C | 58 | A |
| Repetitive peak collector current | $I_{CRM}$ | $t_p$ limited by $T_{jmax}$ | | | 225 | A |
| Power dissipation | $P_{tot}$ | $T_j = T_{jmax}$ | | $T_s$ = 80 °C | 93 | W |
| Gate-emitter peak voltage | $V_{GE}$ | | | | ±20 | V |
| Short circuit ratings | $t_{SC}$ | $T_j$ ≤ 150 °C | $V_{GE}$ = 15 V | $V_{CC}$ = 360 V | 6 | µs |
| Turn off safe operating area (RBSOA) | $I_{cmax}$ | $V_{CE\ max}$ = 600V<br>$T_{vj\ max}$= 150°C | | | 150 | A |
| Maximum Junction Temperature | $T_{jmax}$ | | | | 175 | °C |
| **Boost Inverse Diode** | | | | | | |
| Peak Repetitive Reverse Voltage | $V_{RRM}$ | $T_c$=25°C | | | 600 | V |
| DC forward current | $I_F$ | $T_j = T_{jmax}$ | | $T_s$ = 80 °C | 22 | A |
| Power dissipation | $P_{tot}$ | $T_j = T_{jmax}$ | | $T_s$ = 80 °C | 44 | W |
| Maximum Junction Temperature | $T_{jmax}$ | | | | 175 | °C |
| **Boost FWD** | | | | | | |
| Peak Repetitive Reverse Voltage | $V_{RRM}$ | | | | 1200 | V |
| DC forward current | $I_F$ | $T_j = T_{jmax}$ | | $T_s$ = 80 °C | 22 | A |
| Repetitive peak forward current | $I_{FRM}$ | $t_p$ limited by $T_{jmax}$ | | | 70 | A |
| Power dissipation | $P_{tot}$ | $T_j = T_{jmax}$ | | $T_s$ = 80 °C | 43 | W |
| Maximum Junction Temperature | $T_{jmax}$ | | | | 150 | °C |

# Maximum Ratings

$T_j$ = 25 °C, unless otherwise specified

| Parameter | Symbol | Condition | | Value | Unit |
|---|---|---|---|---|---|
| **Thermal Properties** | | | | | |
| Storage temperature | $T_{stg}$ | | | -40…+125 | °C |
| Operation temperature under switching condition | $T_{op}$ | | | -40…+($T_{jmax}$ - 25) | °C |
| **Insulation Properties** | | | | | |
| Insulation voltage | $V_{isol}$ | DC Test Voltage* | $t_p$ = 2 s | 6000 | V |
| | | AC Voltage | $t_p$ = 1 min | 2500 | V |
| Creepage distance | | | | min 12,7 | mm |
| Clearance | | Solder pin / Press-fit pin | | 9,15 / 9,01 | mm |
| Comparative Tracking Index | CTI | | | >200 | |

*100% tested in production

# Characteristic Values

| Parameter | Symbol | Conditions | $V_{GE}$ [V]<br>$V_{GS}$ [V] | $V_r$ [V]<br>$V_{CE}$ [V]<br>$V_{DS}$ [V] | $I_C$ [A]<br>$I_F$ [A]<br>$I_D$ [A] | $T_j$ [°C] | Value Min | Value Typ | Value Max | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| **Buck IGBT** | | | | | | | | | | |
| Gate emitter threshold voltage | $V_{GE(th)}$ | $V_{CE} = V_{GE}$ | | | 0,00025 | 25 | 3,5 | 4,5 | 6 | V |
| Collector-emitter saturation voltage | $V_{CEsat}$ | | 15 | | 75 | 25<br>150 | | 1,78<br>1,79 | 2,5 | V |
| Collector-emitter cut-off current incl. Diode | $I_{CES}$ | | 0 | 600 | | 25 | | | 0,25 | mA |
| Gate-emitter leakage current | $I_{GES}$ | | 20 | 0 | | 25 | | | 400 | nA |
| Integrated Gate resistor | $R_{gint}$ | | | | | | | none | | Ω |
| Turn-on delay time | $t_{d(on)}$ | $R_{goff} = 8\ \Omega$<br>$R_{gon} = 8\ \Omega$ | ±15 | 350 | 40 | 25<br>150 | | 87<br>89 | | ns |
| Rise time | $t_r$ | | | | | 25<br>150 | | 11<br>11 | | |
| Turn-off delay time | $t_{d(off)}$ | | | | | 25<br>150 | | 140<br>165 | | |
| Fall time | $t_f$ | | | | | 25<br>150 | | 6<br>6 | | |
| Turn-on energy loss | $E_{on}$ | | | | | 25<br>150 | | 0,30<br>0,51 | | mWs |
| Turn-off energy loss | $E_{off}$ | | | | | 25<br>150 | | 0,26<br>0,51 | | |
| Input capacitance | $C_{ies}$ | $f$ = 1 MHz | 0 | 25 | | 25 | | 4000 | | pF |
| Output capacitance | $C_{oss}$ | | | | | | | 400 | | pF |
| Reverse transfer capacitance | $C_{rss}$ | | | | | | | 115 | | |
| Gate charge | $Q_G$ | | ±15 | 400 | 75 | 25 | | 94 | | nC |
| Thermal resistance junction to sink | $R_{th(j-s)}$ | $\lambda_{paste}$ = 0,8 W/mK (P12) | | | | | | 0,84 | | K/W |
| **Buck FWD** | | | | | | | | | | |
| Diode forward voltage | $V_F$ | | | | 30 | 25<br>125 | | 2,67<br>1,86 | | V |
| Reverse leakage current | $I_r$ | | | 600 | | 25 | | | 100 | µA |
| Peak reverse recovery current | $I_{RRM}$ | $R_{gon} = 8\ \Omega$ | ±15 | 350 | 40 | 25<br>125 | | 41<br>57 | | A |
| Reverse recovery time | $t_{rr}$ | | | | | 25<br>125 | | 15<br>29 | | ns |
| Reverse recovered charge | $Q_{rr}$ | | | | | 25<br>125 | | 0,32<br>1,04 | | µC |
| Peak rate of fall of recovery current | $(di_{rf}/dt)_{max}$ | | | | | 25<br>125 | | 14583<br>7605 | | A/µs |
| Reverse recovered energy | $E_{rec}$ | | | | | 25<br>125 | | 0,02<br>0,13 | | mWs |
| Thermal resistance junction to sink | $R_{th(j-s)}$ | $\lambda_{paste}$ = 0,8 W/mK (P12) | | | | | | 1,73 | | K/W |

# Characteristic Values

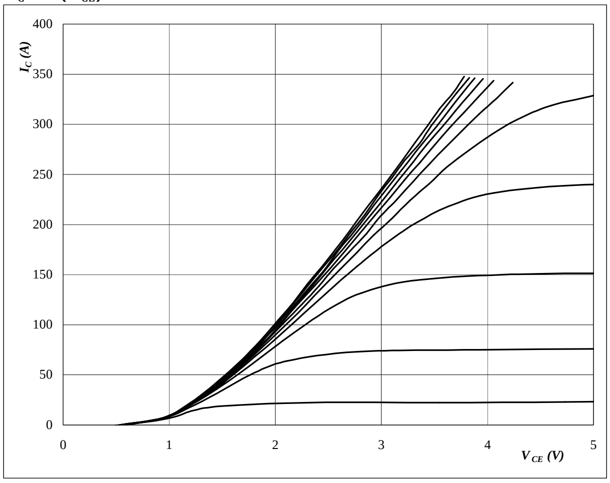
| Parameter | Symbol | Conditions | | | | | Value | | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | $V_{GE}$ [V]<br>$V_{GS}$ [V] | $V_r$ [V]<br>$V_{CE}$ [V]<br>$V_{DS}$ [V] | $I_C$ [A]<br>$I_F$ [A]<br>$I_D$ [A] | $T_j$ [°C] | Min | Typ | Max | |
| **Boost IGBT** | | | | | | | | | | |
| Gate emitter threshold voltage | $V_{GE(th)}$ | $V_{CE} = V_{GE}$ | | | 0,0012 | 25 | 5 | 5,8 | 6,5 | V |
| Collector-emitter saturation voltage | $V_{CEsat}$ | | 15 | | 75 | 25<br>150 | 1,05 | 1,53<br>1,74 | 1,85 | V |
| Collector-emitter cut-off incl diode | $I_{CES}$ | | 0 | 600 | | 25 | | | 0,0038 | mA |
| Gate-emitter leakage current | $I_{GES}$ | | 20 | 0 | | 25 | | | 600 | nA |
| Integrated Gate resistor | $R_{gint}$ | | | | | | | none | | Ω |
| Turn-on delay time | $t_{d(on)}$ | $R_{gon}$ = 4 Ω<br>$R_{goff}$ = 4 Ω | ±15 | 350 | 50 | 25<br>150 | | 85<br>87 | | ns |
| Rise time | $t_r$ | | | | | 25<br>150 | | 11<br>13 | | |
| Turn-off delay time | $t_{d(off)}$ | | | | | 25<br>150 | | 177<br>209 | | |
| Fall time | $t_f$ | | | | | 25<br>150 | | 78<br>102 | | |
| Turn-on energy loss | $E_{on}$ | | | | | 25<br>150 | | 0,39<br>0,66 | | mWs |
| Turn-off energy loss | $E_{off}$ | | | | | 25<br>150 | | 1,56<br>2,18 | | |
| Input capacitance | $C_{ies}$ | $f$ = 1 MHz | 0 | 25 | | 25 | | 4620 | | pF |
| Output capacitance | $C_{oss}$ | | | | | | | 288 | | |
| Reverse transfer capacitance | $C_{rss}$ | | | | | | | 137 | | |
| Gate charge | $Q_G$ | | | | | 25 | | 470 | | nC |
| Thermal resistance junction to sink | $R_{th(j-s)}$ | $\lambda_{paste}$ = 0,8 W/mK<br>(P12) | | | | | | 1,02 | | K/W |
| **Boost Inverse Diode** | | | | | | | | | | |
| Diode forward voltage | $V_F$ | | | | 20 | 25<br>125 | 1,25 | 1,90<br>1,54 | 1,95 | V |
| Thermal resistance junction to sink | $R_{th(j-s)}$ | $\lambda_{paste}$ = 0,8 W/mK<br>(P12) | | | | | | 2,17 | | K/W |
| **Boost FWD** | | | | | | | | | | |
| Diode forward voltage | $V_F$ | | | | 20 | 25<br>125 | | 2,51<br>2,10 | 3,3 | V |
| Reverse leakage current | $I_r$ | | | 1200 | | 25 | | | 100 | μA |
| Peak reverse recovery current | $I_{RRM}$ | $R_{gon}$ = 4 Ω | ±15 | 350 | 50 | 25<br>125 | | 79<br>90 | | A |
| Reverse recovery time | $t_{rr}$ | | | | | 25<br>125 | | 26,3<br>121 | | ns |
| Reverse recovered charge | $Q_{rr}$ | | | | | 25<br>125 | | 3,0<br>6,2 | | μC |
| Peak rate of fall of recovery current | $(di_{rf}/dt)_{max}$ | | | | | 25<br>125 | | 11365<br>5907 | | A/μs |
| Reverse recovery energy | $E_{rec}$ | | | | | 25<br>125 | | 0,87<br>1,86 | | mWs |
| Thermal resistance junction to sink | $R_{th(j-s)}$ | $\lambda_{paste}$ = 0,8 W/mK<br>(P12) | | | | | | 1,87 | | K/W |
| **Thermistor** | | | | | | | | | | |
| Rated resistance | $R$ | | | | | 25 | | 22000 | | Ω |
| Deviation of $R_{100}$ | $\Delta_{R/R}$ | $R_{100}$ = 1486 Ω | | | | 100 | -5 | | +5 | % |
| Power dissipation | $P$ | | | | | 25 | | 210 | | mW |
| Power dissipation constant | | | | | | 25 | | 3,5 | | mW/K |
| B-value | $B_{(25/50)}$ | Tol. ±3% | | | | Tc=25 | | | | K |
| B-value | $B_{(25/100)}$ | Tol. ±3% | | | | 25 | | 4000 | | K |
| Vincotech NTC Reference | | | | | | | | | A | |

# Buck

| figure 1. | IGBT |
|---|---|

**Typical output characteristics**

$I_C = f(V_{CE})$



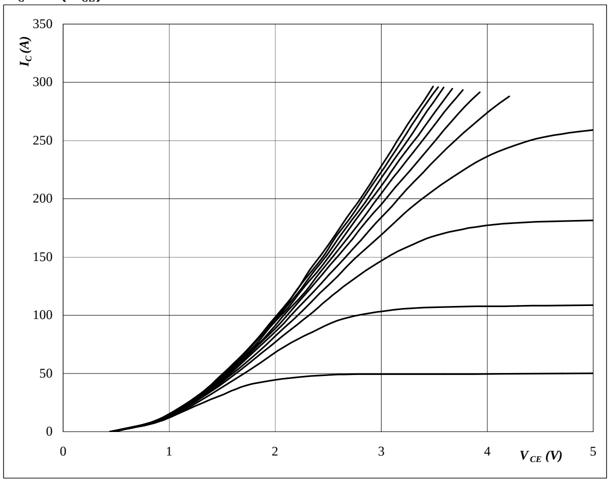

**At**

| | | |
|---|---|---|
| $t_p$ = | 250 | μs |
| $T_j$ = | 25 | °C |
| $V_{GE}$ from | 7 V to 17 V in steps of 1 V | |

| figure 2. | IGBT |
|---|---|

**Typical output characteristics**

$I_C = f(V_{CE})$



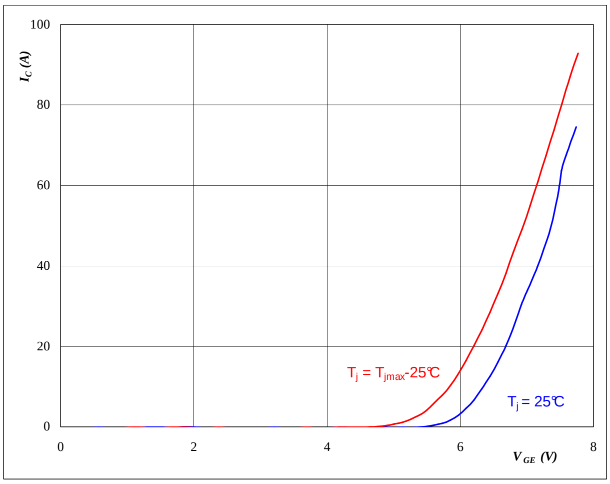

**At**

| | | |
|---|---|---|
| $t_p$ = | 250 | μs |
| $T_j$ = | 125 | °C |
| $V_{GE}$ from | 7 V to 17 V in steps of 1 V | |

| figure 3. | IGBT |
|---|---|

**Typical transfer characteristics**

$I_C = f(V_{GE})$



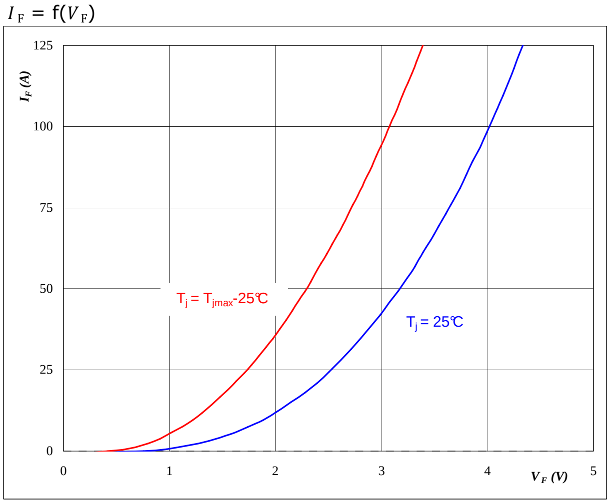

**At**

| | | |
|---|---|---|
| $t_p$ = | 250 | μs |
| $V_{CE}$ = | 10 | V |

| figure 4. | FWD |
|---|---|

**Typical diode forward current as a function of forward voltage**

$I_F = f(V_F)$




**At**

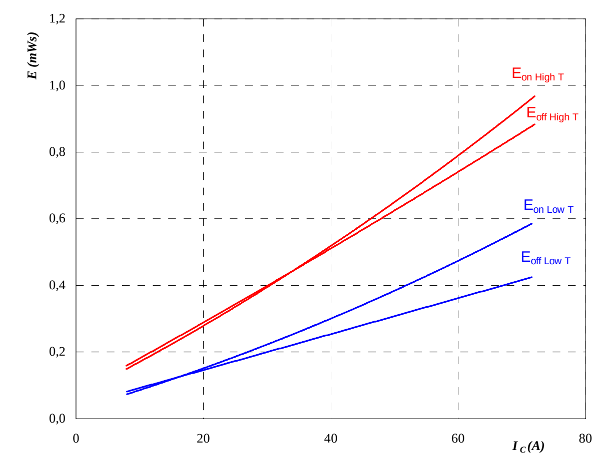
| | | |
|---|---|---|
| $t_p$ = | 250 | μs |

# Buck

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

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

$E = f(I_C)$



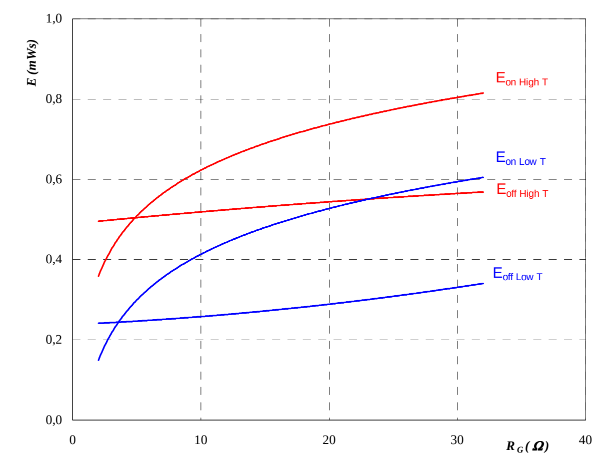

With an inductive load at

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

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

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

$E = f(R_G)$



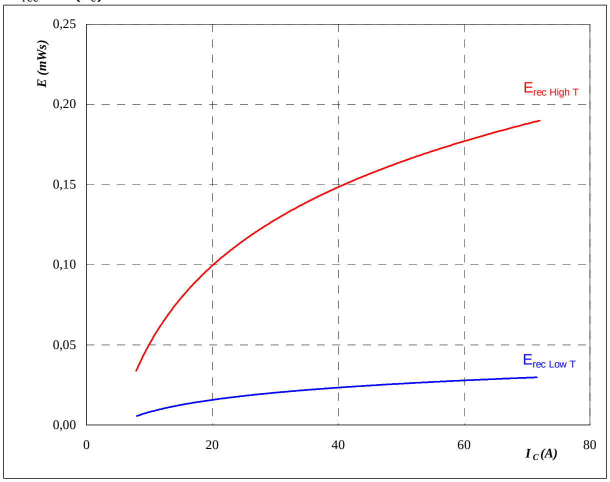

With an inductive load at

| | | |
|---|---|---|
| $T_j$ = | 25/125 | °C |
| $V_{CE}$ = | 350 | V |
| $V_{GE}$ = | ±15 | V |
| $I_C$ = | 40 | A |

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

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

$E_{rec} = f(I_c)$



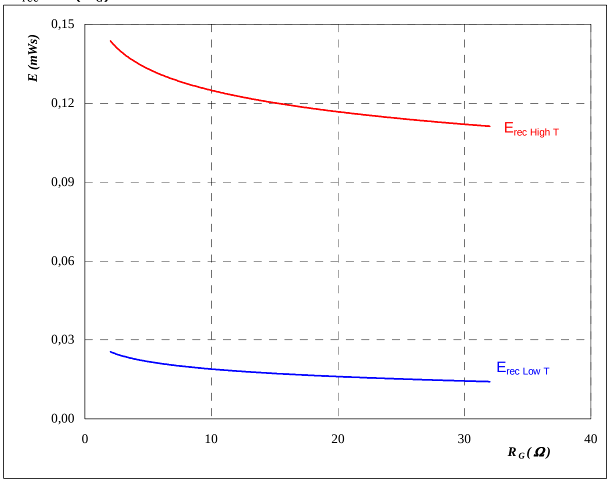

With an inductive load at

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

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

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

$E_{rec} = f(R_G)$




With an inductive load at

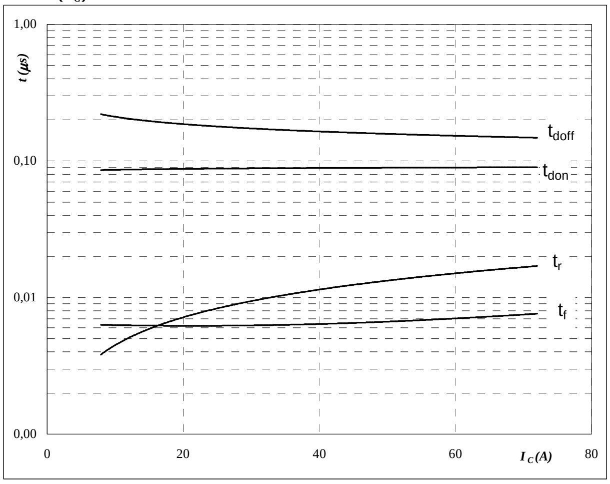
| | | |
|---|---|---|
| $T_j$ = | 25/125 | °C |
| $V_{CE}$ = | 350 | V |
| $V_{GE}$ = | ±15 | V |
| $I_C$ = | 40 | A |

# Buck

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

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

$t = f(I_C)$



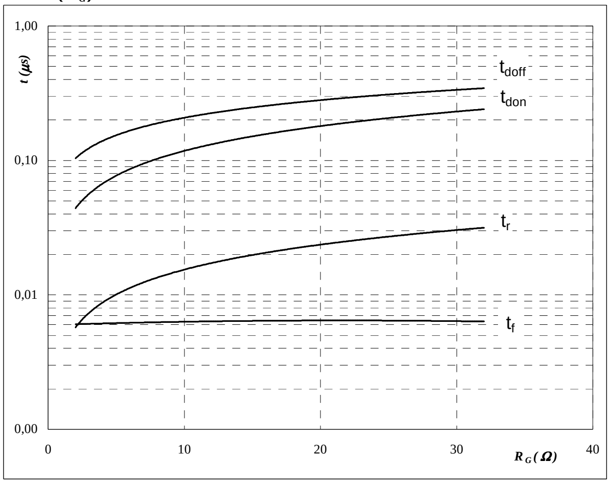

With an inductive load at

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

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

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

$t = f(R_G)$



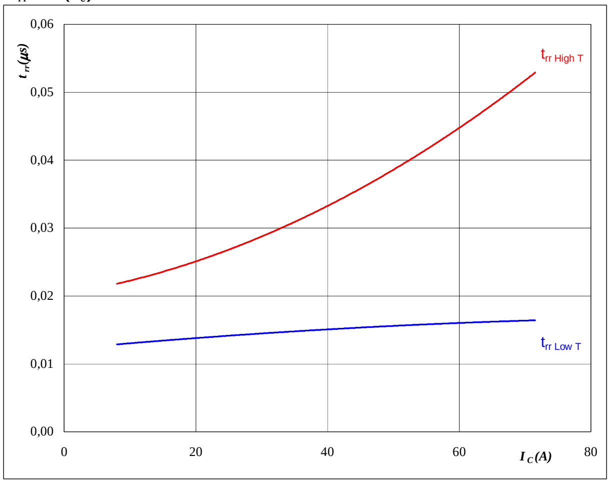

With an inductive load at

| | | |
|---|---|---|
| $T_j$ = | 125 | °C |
| $V_{CE}$ = | 350 | V |
| $V_{GE}$ = | ±15 | V |
| $I_C$ = | 40 | A |

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

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

$t_{rr} = f(I_c)$



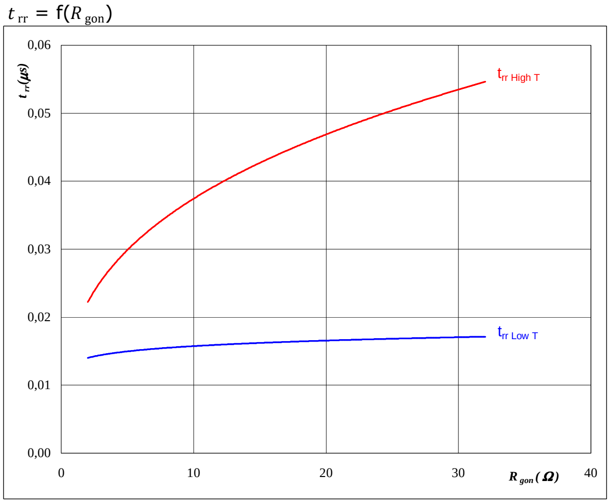

**At**

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

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

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

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




**At**

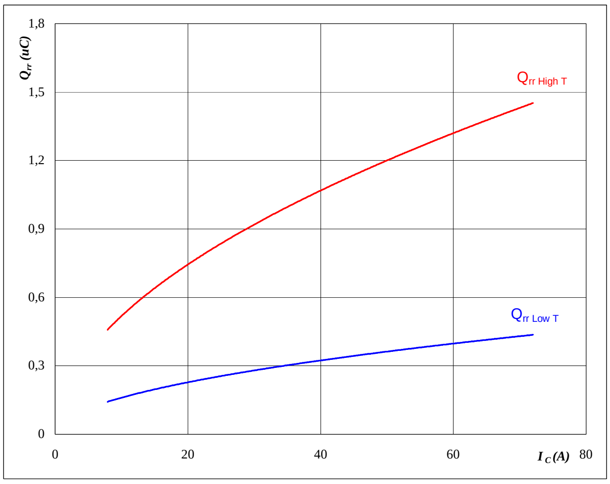
| | | |
|---|---|---|
| $T_j$ = | 25/125 | °C |
| $V_R$ = | 350 | V |
| $I_F$ = | 40 | A |
| $V_{GE}$ = | ±15 | V |

# Buck

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

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

$Q_{rr} = f(I_C)$



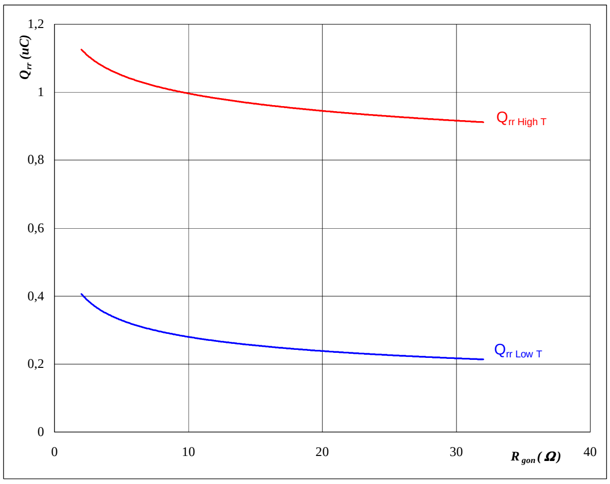

**At**

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

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

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

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



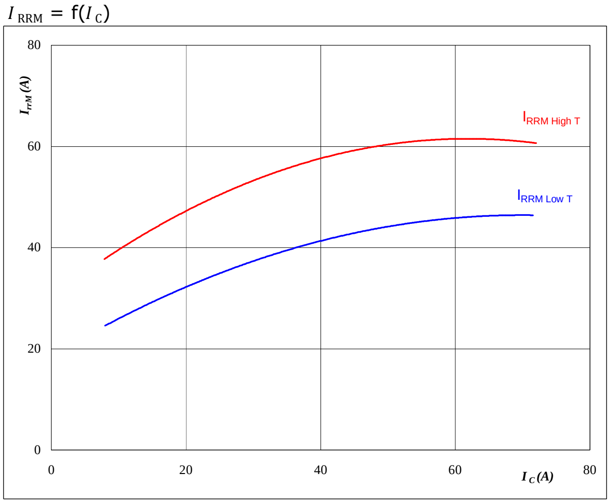

**At**

| | | |
|---|---|---|
| $T_j$ = | 25/125 | °C |
| $V_R$ = | 350 | V |
| $I_F$ = | 40 | A |
| $V_{GE}$ = | ±15 | V |

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

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

$I_{RRM} = f(I_C)$



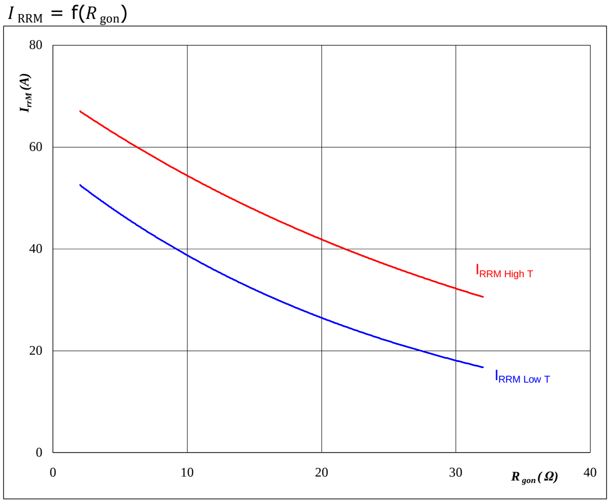

**At**

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

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

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

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




**At**

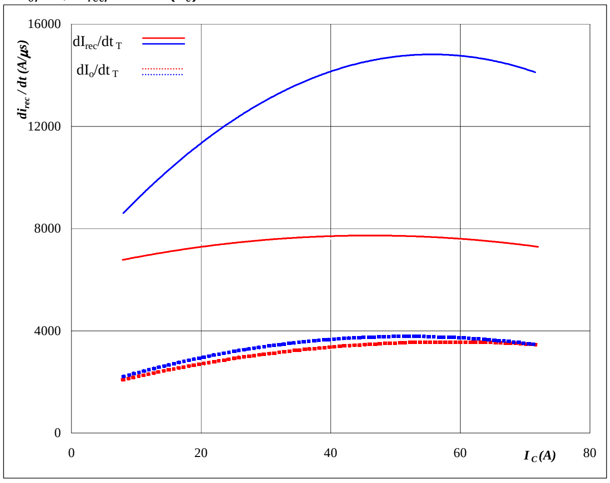
| | | |
|---|---|---|
| $T_j$ = | 25/125 | °C |
| $V_R$ = | 350 | V |
| $I_F$ = | 40 | A |
| $V_{GE}$ = | ±15 | V |

# Buck

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

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

$dI_0/dt, dI_{rec}/dt = f(I_c)$



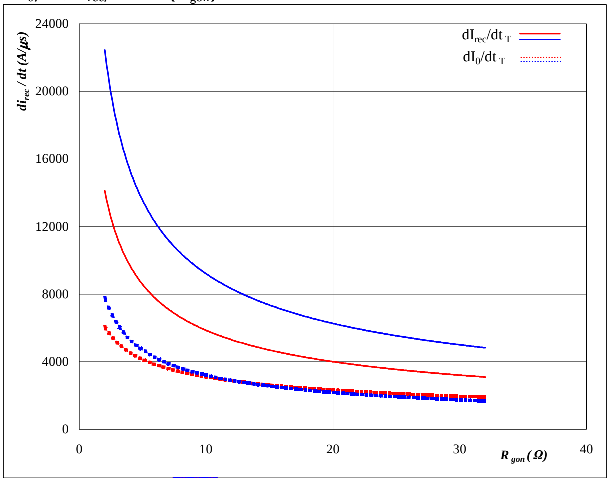

**At**

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

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

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

$dI_0/dt, dI_{rec}/dt = f(R_{gon})$



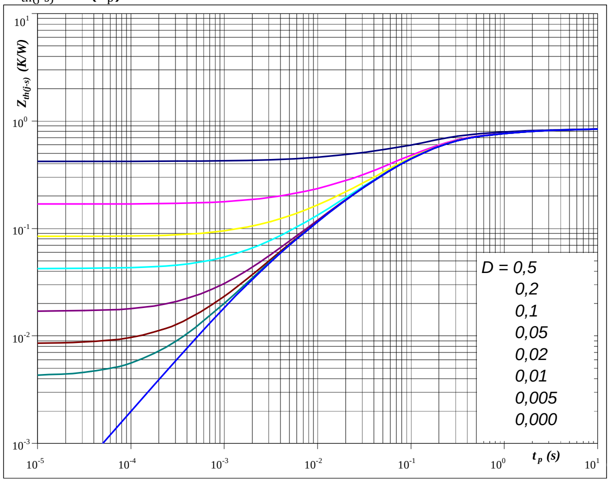

**At**

| | | |
|---|---|---|
| $T_j$ = | 25/125 | °C |
| $V_R$ = | 350 | V |
| $I_F$ = | 40 | A |
| $V_{GE}$ = | ±15 | V |

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

**IGBT transient thermal impedance as a function of pulse width**

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




**At**

$D$ = $t_p / T$

$R_{th(j-s)}$ = 0,84 K/W

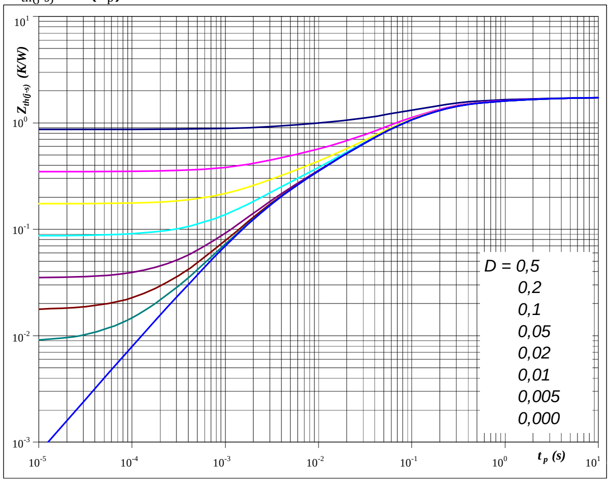
IGBT thermal model values

| R (K/W) | Tau (s) |
|---|---|
| 1,34E-01 | 1,78E+00 |
| 2,04E-01 | 2,71E-01 |
| 3,94E-01 | 9,06E-02 |
| 9,26E-02 | 1,42E-02 |
| 1,92E-02 | 2,31E-03 |

**figure 20.** **FWD**

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

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




**At**

$D$ = $t_p / T$

$R_{th(j-s)}$ = 1,73 K/W

FWD thermal model values

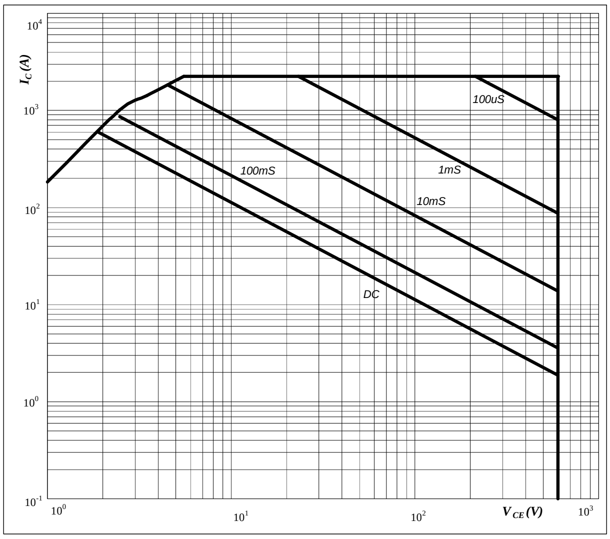
| R (K/W) | Tau (s) |
|---|---|
| 8,04E-02 | 4,54E+00 |
| 1,74E-01 | 9,63E-01 |
| 6,34E-01 | 1,62E-01 |
| 5,25E-01 | 5,62E-02 |
| 2,03E-01 | 1,25E-02 |
| 1,16E-01 | 2,31E-03 |

# Buck

| figure 21. | IGBT |
|---|---|

**Safe operating area as a function of collector-emitter voltage**

$I_C = f(V_{CE})$




**At**

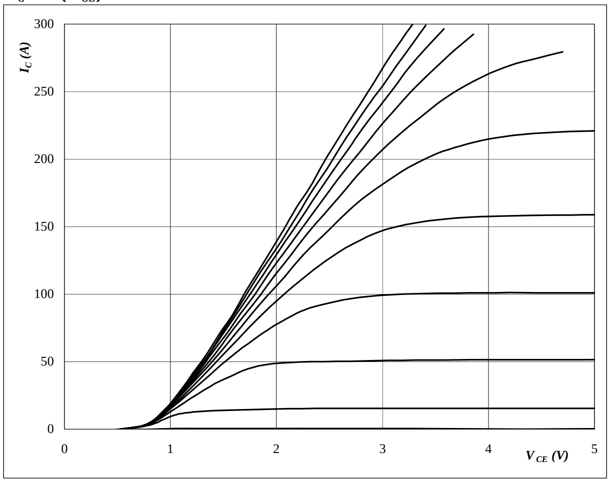
| | | |
|---|---|---|
| $D$ = | single pulse | |
| $T_s$ = | 80 | ºC |
| $V_{GE}$ = | ±15 | V |
| $T_j$ = | $T_{jmax}$ | |

# Boost

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

**Typical output characteristics**

$I_C = f(V_{CE})$



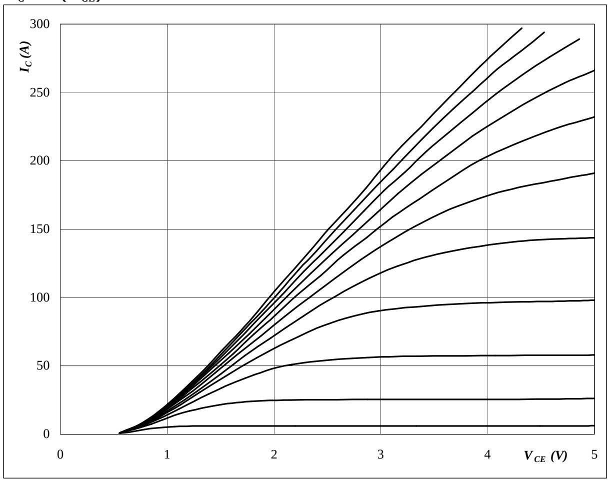

**At**

$t_p$ = 250 µs
$T_j$ = 25 °C
$V_{GE}$ from 7 V to 17 V in steps of 1 V

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

**Typical output characteristics**

$I_C = f(V_{CE})$



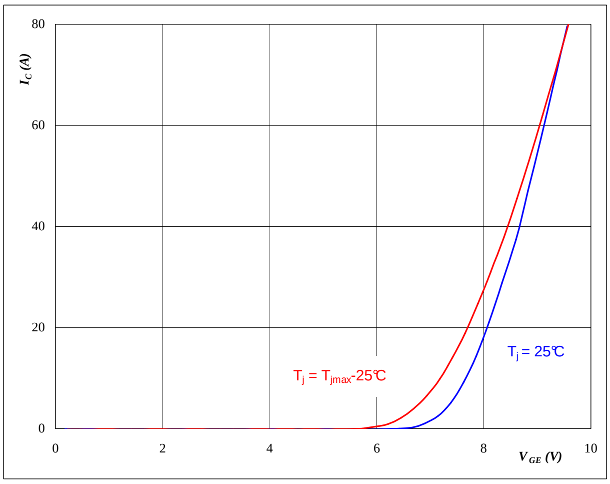

**At**

$t_p$ = 250 µs
$T_j$ = 125 °C
$V_{GE}$ from 7 V to 17 V in steps of 1 V

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

**Typical transfer characteristics**

$I_C = f(V_{GE})$



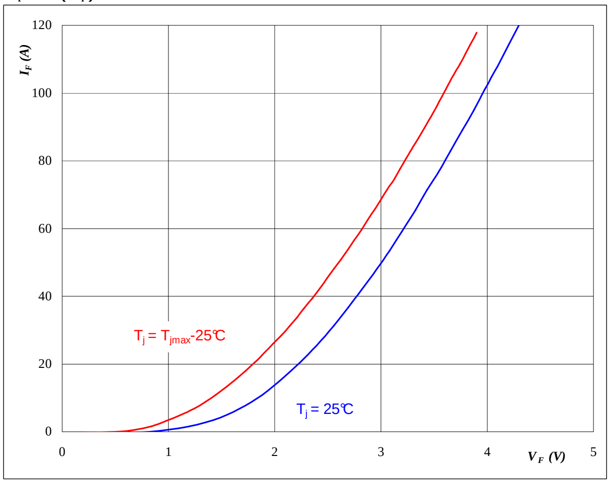

**At**

$t_p$ = 250 µs
$V_{CE}$ = 10 V

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

**Typical diode forward current as a function of forward voltage**

$I_F = f(V_F)$




**At**

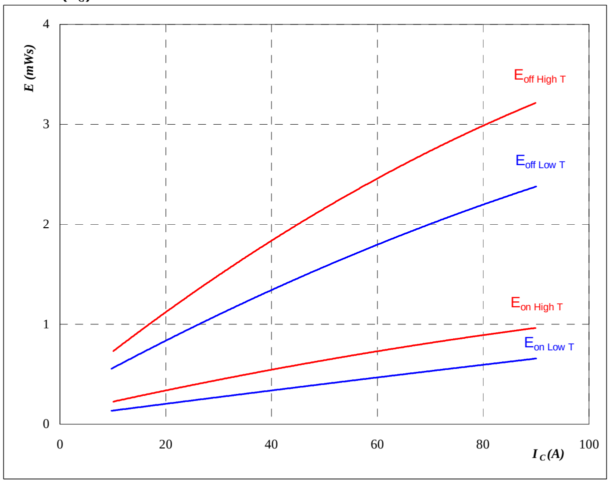
$t_p$ = 250 µs

# Boost

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

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

$E = f(I_C)$



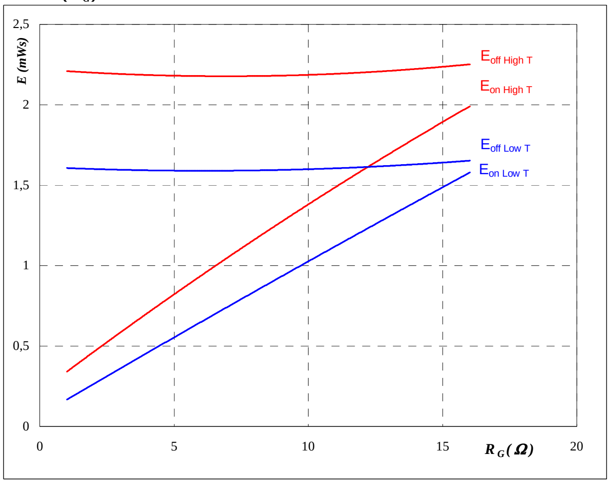

With an inductive load at

| | | |
|---|---|---|
| $T_j$ = | 25/125 | °C |
| $V_{CE}$ = | 350 | V |
| $V_{GE}$ = | ±15 | V |
| $R_{gon}$ = | 4 | Ω |
| $R_{goff}$ = | 4 | Ω |

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

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

$E = f(R_G)$



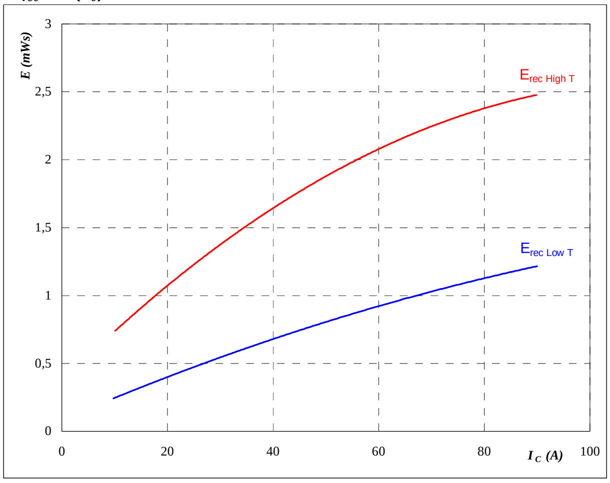

With an inductive load at

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

**figure 7.** **IGBT**

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

$E_{rec} = f(I_c)$



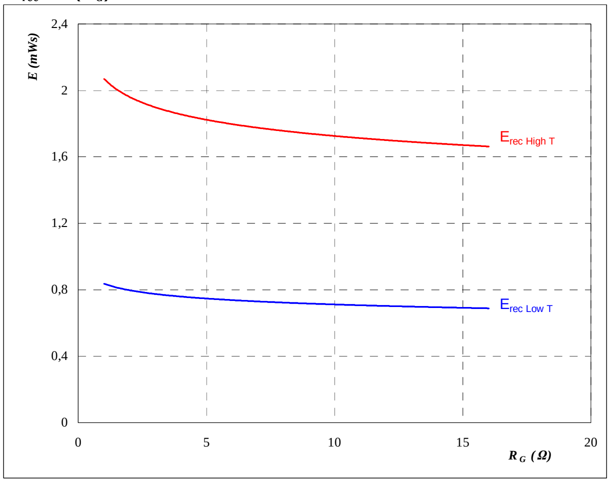

With an inductive load at

| | | |
|---|---|---|
| $T_j$ = | 25/125 | °C |
| $V_{CE}$ = | 350 | V |
| $V_{GE}$ = | ±15 | V |
| $R_{gon}$ = | 4 | Ω |

**figure 8.** **IGBT**

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

$E_{rec} = f(R_G)$




With an inductive load at

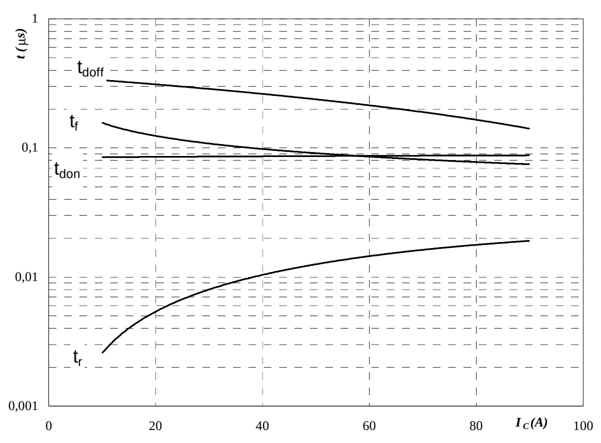
| | | |
|---|---|---|
| $T_j$ = | 25/125 | °C |
| $V_{CE}$ = | 350 | V |
| $V_{GE}$ = | ±15 | V |
| $I_C$ = | 50 | A |

# Boost

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

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

$t = f(I_C)$



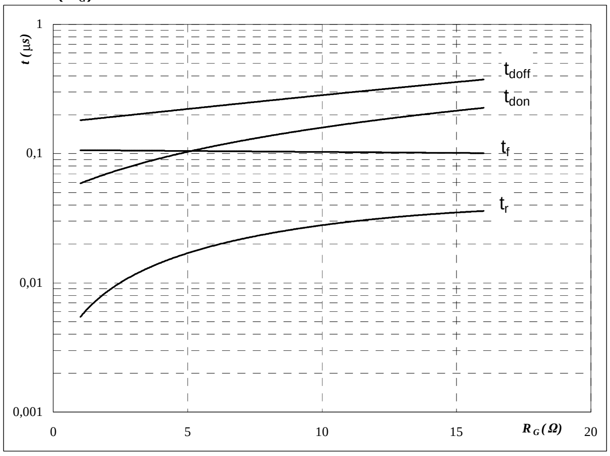

With an inductive load at

| | | |
|---|---|---|
| $T_j$ = | 25/125 | °C |
| $V_{CE}$ = | 350 | V |
| $V_{GE}$ = | ±15 | V |
| $R_{gon}$ = | 4 | Ω |
| $R_{goff}$ = | 4 | Ω |

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

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

$t = f(R_G)$



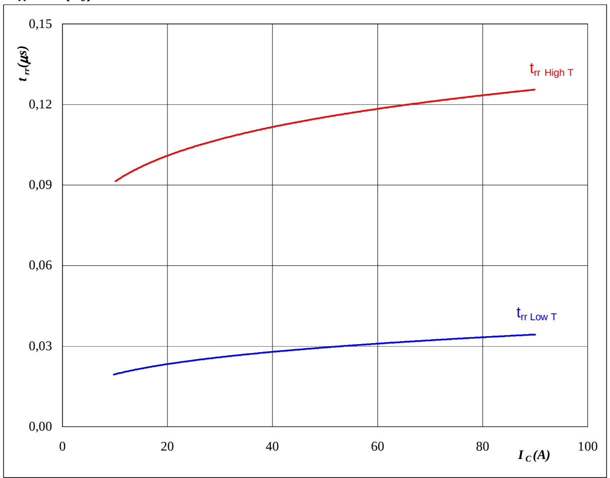

With an inductive load at

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

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

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

$t_{rr} = f(I_c)$



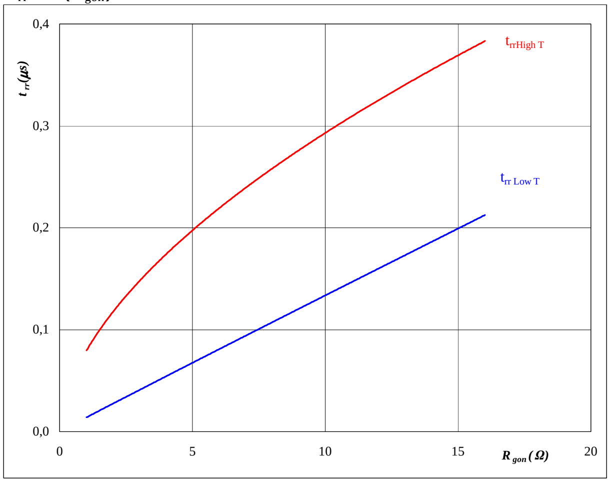

**At**

| | | |
|---|---|---|
| $T_j$ = | 25/125 | °C |
| $V_{CE}$ = | 350 | V |
| $V_{GE}$ = | ±15 | V |
| $R_{gon}$ = | 4 | Ω |

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

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

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




**At**

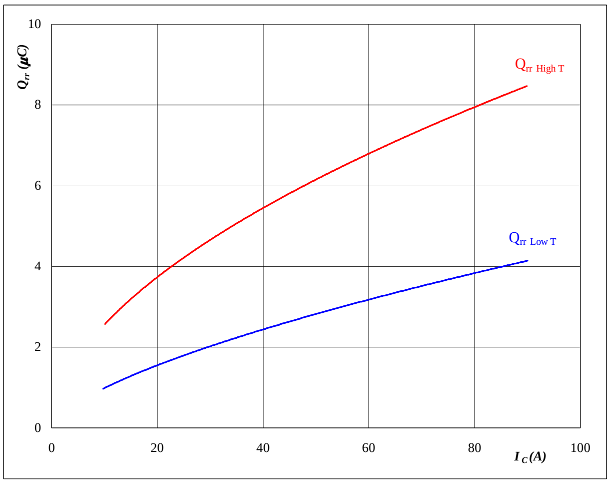
| | | |
|---|---|---|
| $T_j$ = | 25/125 | °C |
| $V_R$ = | 350 | V |
| $I_F$ = | 50 | A |
| $V_{GE}$ = | ±15 | V |

## Boost

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

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

$Q_{rr} = f(I_C)$



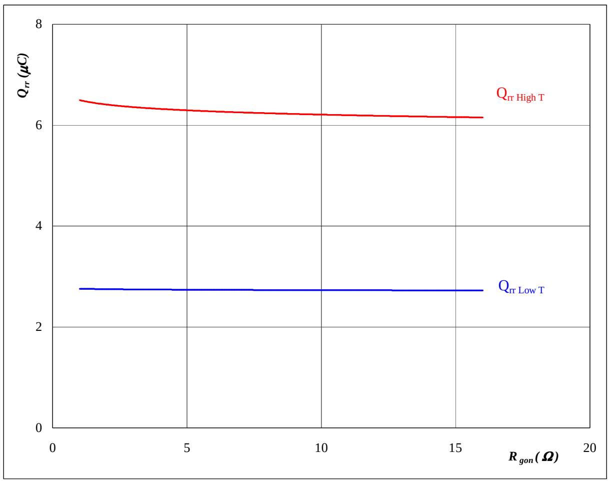

**At**

| | | |
|---|---|---|
| $T_j$ = | 25/125 | °C |
| $V_{CE}$ = | 350 | V |
| $V_{GE}$ = | ±15 | V |
| $R_{gon}$ = | 4 | Ω |

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

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

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



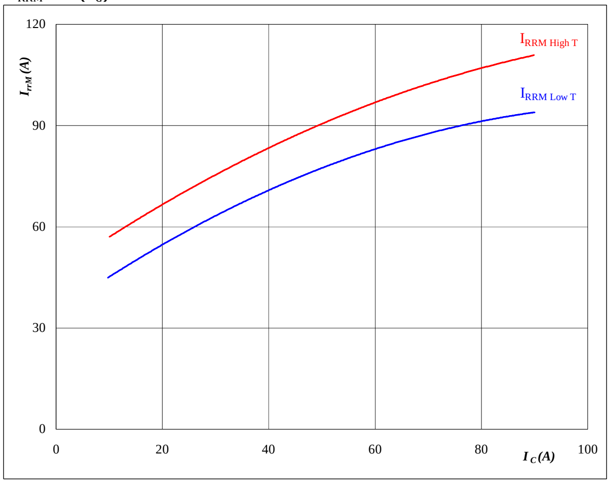

**At**

| | | |
|---|---|---|
| $T_j$ = | 25/125 | °C |
| $V_R$ = | 350 | V |
| $I_F$ = | 50 | A |
| $V_{GE}$ = | ±15 | V |

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

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

$I_{RRM} = f(I_C)$



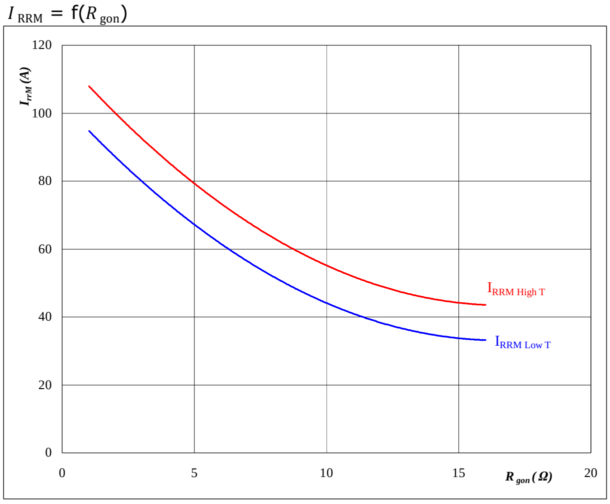

**At**

| | | |
|---|---|---|
| $T_j$ = | 25/125 | °C |
| $V_{CE}$ = | 350 | V |
| $V_{GE}$ = | ±15 | V |
| $R_{gon}$ = | 4 | Ω |

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

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

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




**At**

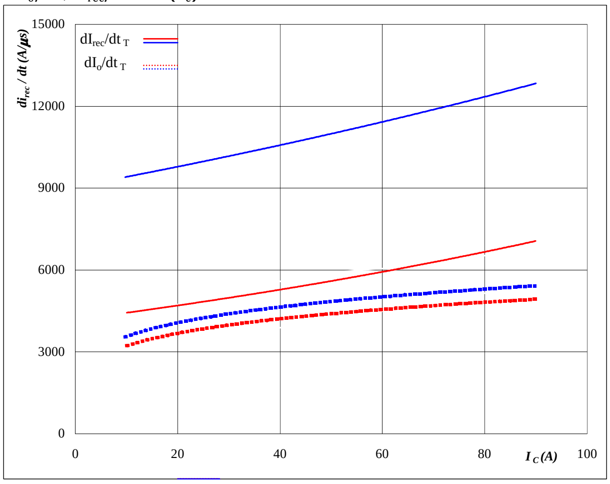
| | | |
|---|---|---|
| $T_j$ = | 25/125 | °C |
| $V_R$ = | 350 | V |
| $I_F$ = | 50 | A |
| $V_{GE}$ = | ±15 | V |

# Boost

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

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

$dI_0/dt, dI_{rec}/dt = f(I_c)$



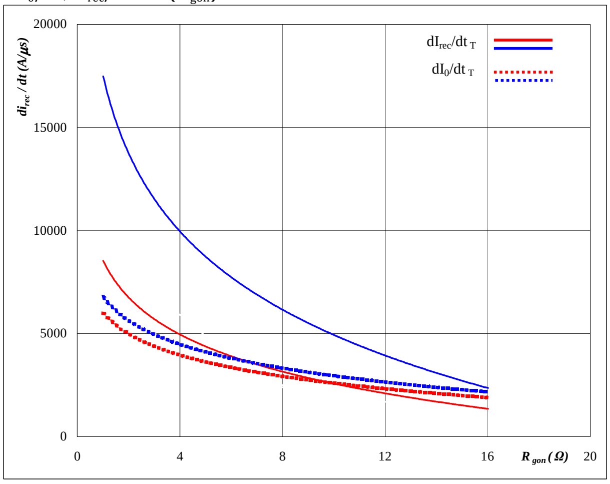

**At**

| | | |
|---|---|---|
| $T_j$ = | 25/125 | °C |
| $V_{CE}$ = | 350 | V |
| $V_{GE}$ = | ±15 | V |
| $R_{gon}$ = | 4 | Ω |

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

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

$dI_0/dt, dI_{rec}/dt = f(R_{gon})$



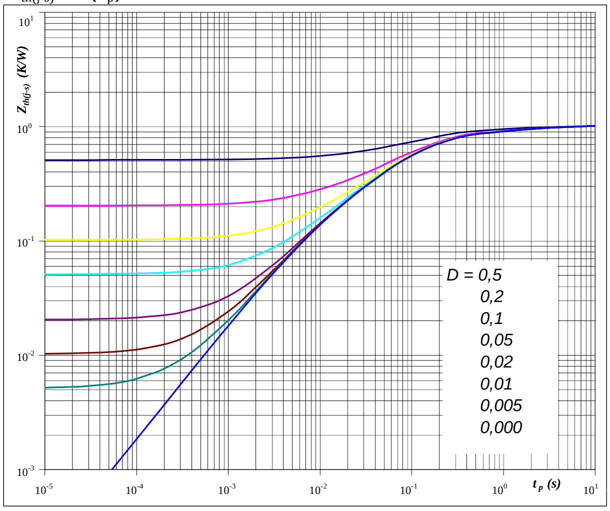

**At**

| | | |
|---|---|---|
| $T_j$ = | 25/125 | °C |
| $V_R$ = | 350 | V |
| $I_F$ = | 50 | A |
| $V_{GE}$ = | ±15 | V |

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

**IGBT transient thermal impedance as a function of pulse width**

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



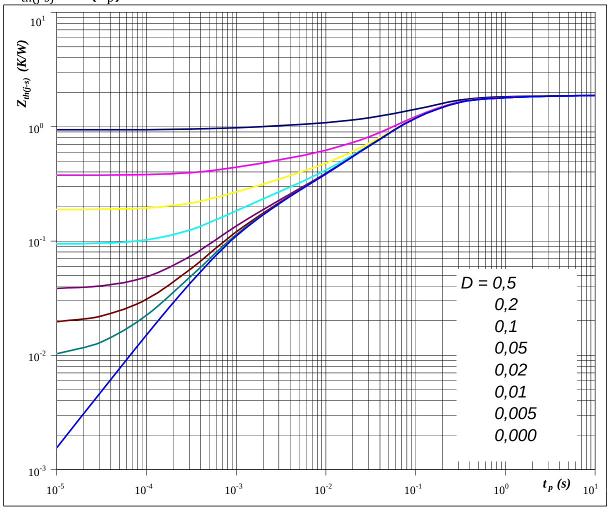

**At**

| | | |
|---|---|---|
| $D$ = | $t_p$ / $T$ | |
| $R_{th(j-s)}$ = | 1,02 | K/W |

**figure 20.** **FWD**

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

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




**At**

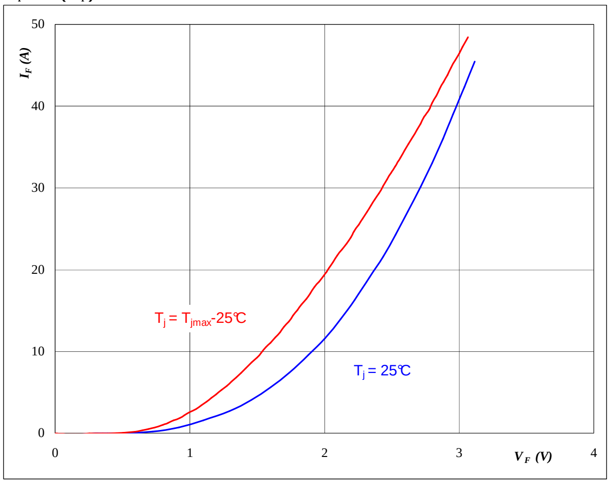
| | | |
|---|---|---|
| $D$ = | $t_p$ / $T$ | |
| $R_{th(j-s)}$ = | 1,87 | K/W |

# Boost

**figure 21.** **Boost Inverse Diode**

**Typical diode forward current as a function of forward voltage**

$I_F = f(V_F)$



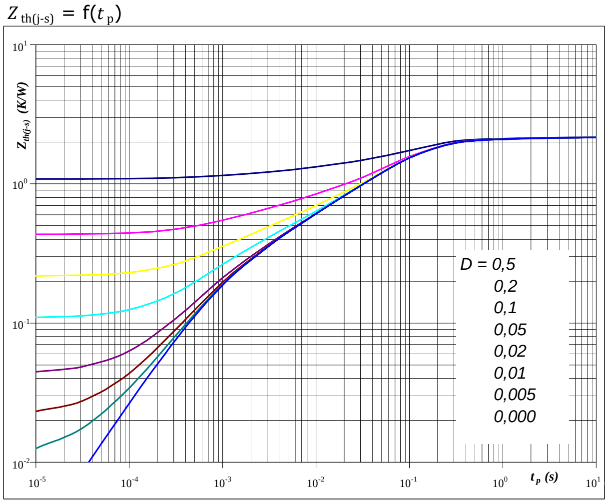

**At**

$t_p$ = 250 µs

**figure 22.** **Boost Inverse Diode**

**Diode transient thermal impedance as a function of pulse width**

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




**At**

$D = t_p / T$

$R_{th(j-s)}$ = 2,17 K/W

# Thermistor

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

**Typical NTC characteristic**
**as a function of temperature**
$R_T = f(T)$

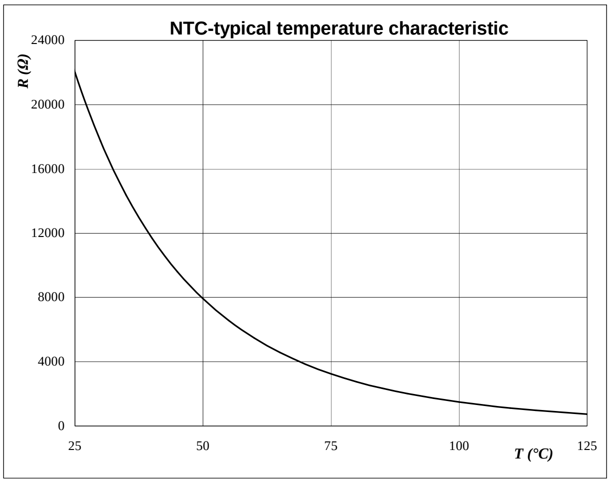



**figure 2.** **Thermistor**

**Typical NTC resistance values**

$$R(T) = R_{25} \cdot e^{\left(B_{25/100} \cdot \left(\frac{1}{T} - \frac{1}{T_{25}}\right)\right)} \quad [\Omega]$$

| T<br>[°C] | R_soll<br>[Ω] | R_min<br>[Ω] | R_max<br>[Ω] | △R/R<br>[+-%] |
|---|---|---|---|---|
| -50 | 1458070,6 | 1069249,3 | 1846891,9 | 26,7 |
| 0 | 71804,2 | 59724,4 | 83884 | 16,8 |
| 10 | 43780,4 | 37094,4 | 50466,5 | 15,3 |
| 20 | 27484,6 | 23684,6 | 31284,7 | 13,8 |
| 25 | 22000 | 19109,3 | 24890,7 | 13,1 |
| 30 | 17723,3 | 15512,2 | 19934,4 | 12,5 |
| 60 | 5467,9 | 4980,6 | 5955,1 | 8,9 |
| 70 | 3848,6 | 3546 | 4151,1 | 7,9 |
| 80 | 2757,7 | 2568,2 | 2947,1 | 6,9 |
| 90 | 2008,9 | 1889,7 | 2128,2 | 5,9 |
| **100** | **1486,1** | **1411,8** | **1560,4** | **5** |
| 150 | 400,2 | 364,8 | 435,7 | 8,8 |

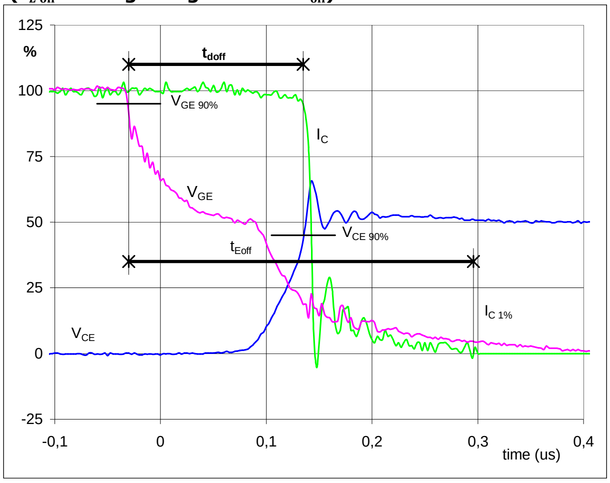
# Switching Definitions BUCK IGBT

**General conditions**

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

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

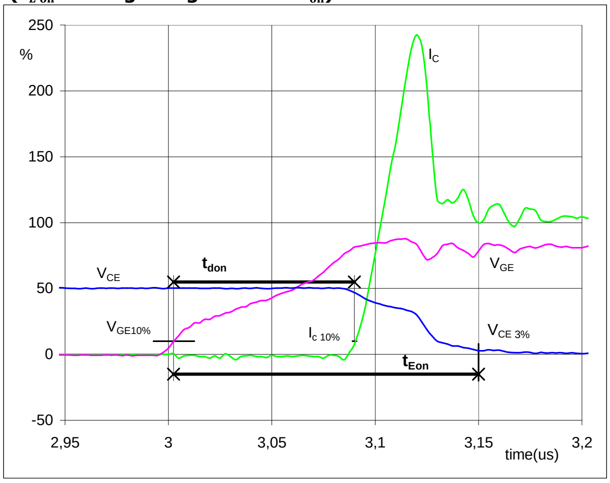
**Turn-off Switching Waveforms & definition of $t_{doff}$, $t_{Eoff}$**
**($t_{E\,off}$ = integrating time for $E_{off}$)**




| | | |
|---|---|---|
| $V_{GE}$ (0%) = | -15 | V |
| $V_{GE}$ (100%) = | 15 | V |
| $V_C$ (100%) = | 700 | V |
| $I_C$ (100%) = | 40 | A |
| $t_{doff}$ = | 0,17 | μs |
| $t_{E\,off}$ = | 0,33 | μs |

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

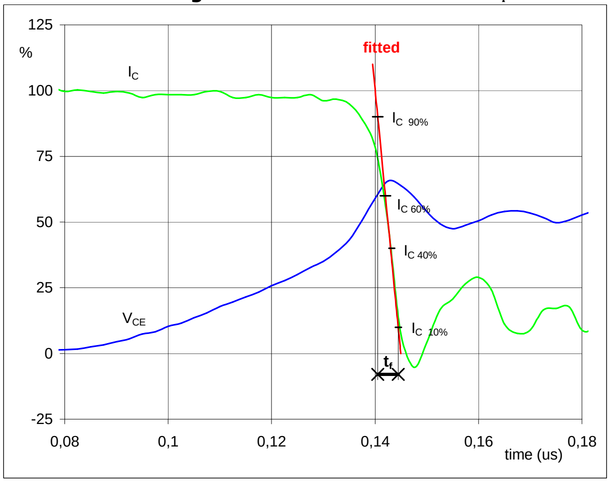
**Turn-on Switching Waveforms & definition of $t_{don}$, $t_{Eon}$**
**($t_{E\,on}$ = integrating time for $E_{on}$)**




| | | |
|---|---|---|
| $V_{GE}$ (0%) = | -15 | V |
| $V_{GE}$ (100%) = | 15 | V |
| $V_C$ (100%) = | 700 | V |
| $I_C$ (100%) = | 40 | A |
| $t_{don}$ = | 0,09 | μs |
| $t_{E\,on}$ = | 0,15 | μs |

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

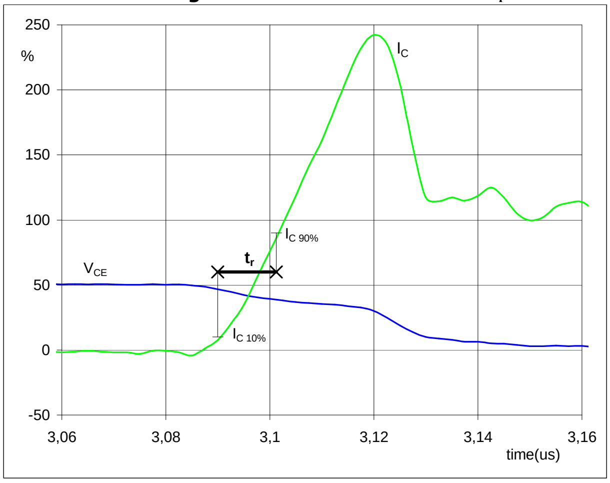
**Turn-off Switching Waveforms & definition of $t_f$**




| | | |
|---|---|---|
| $V_C$ (100%) = | 700 | V |
| $I_C$ (100%) = | 40 | A |
| $t_f$ = | 0,006 | μs |

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

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

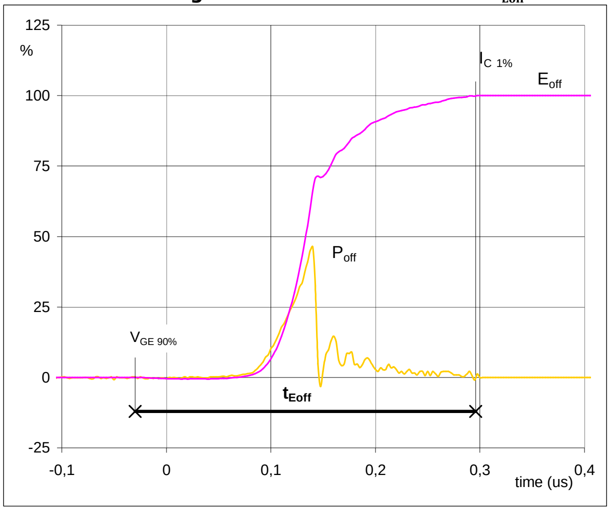



| | | |
|---|---|---|
| $V_C$ (100%) = | 700 | V |
| $I_C$ (100%) = | 40 | A |
| $t_r$ = | 0,01 | μs |

# Switching Definitions BUCK IGBT

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

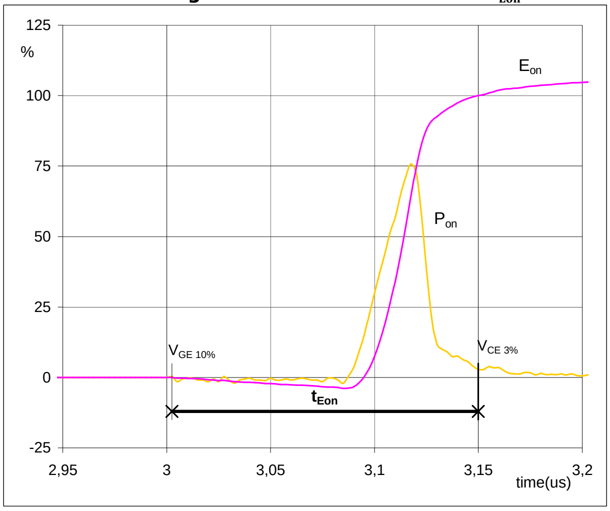
**Turn-off Switching Waveforms & definition of $t_{Eoff}$**




| | | |
|---|---|---|
| $P_{off}$ (100%) = | 27,78 | kW |
| $E_{off}$ (100%) = | 0,51 | mJ |
| $t_{E\,off}$ = | 0,33 | μs |

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

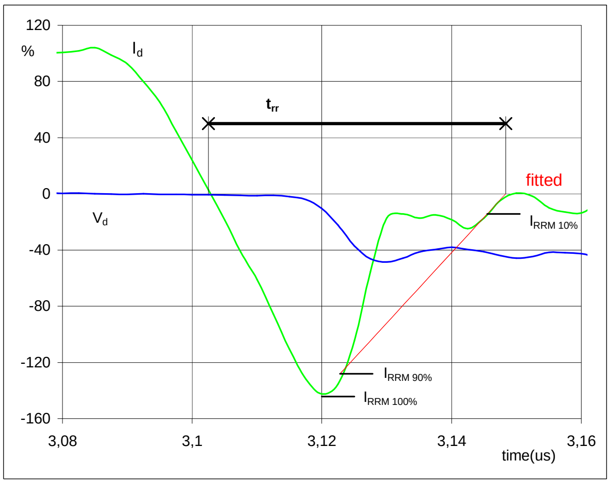
**Turn-on Switching Waveforms & definition of $t_{Eon}$**




| | | |
|---|---|---|
| $P_{on}$ (100%) = | 27,78 | kW |
| $E_{on}$ (100%) = | 0,51 | mJ |
| $t_{E\,on}$ = | 0,15 | μs |

**figure 7.** **IGBT**

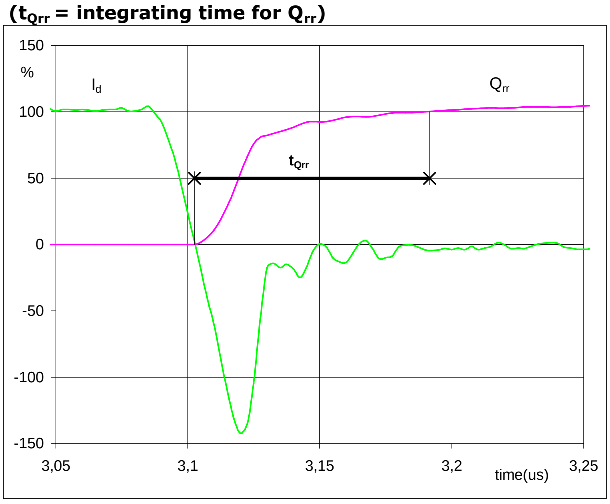
**Turn-off Switching Waveforms & definition of $t_{rr}$**




| | | |
|---|---|---|
| $V_d$ (100%) = | 700 | V |
| $I_d$ (100%) = | 40 | A |
| $I_{RRM}$ (100%) = | -57 | A |
| $t_{rr}$ = | 0,03 | μs |

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

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

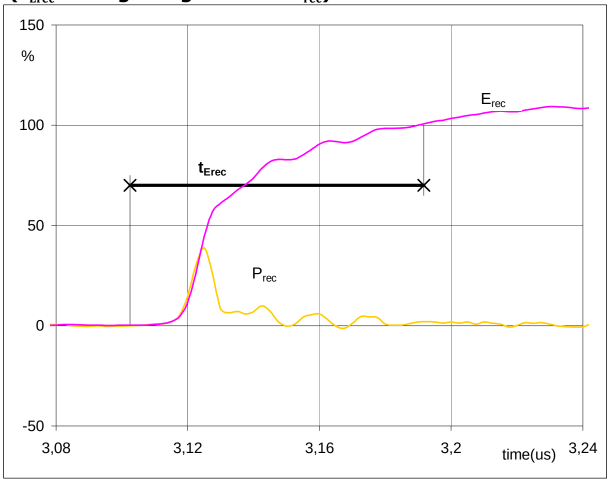



| | | |
|---|---|---|
| $I_d$ (100%) = | 40 | A |
| $Q_{rr}$ (100%) = | 1,04 | μC |
| $t_{Q\,rr}$ = | 0,09 | μs |

# Switching Definitions BUCK IGBT

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

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




| | | |
|---|---|---|
| $P_{rec}$ (100%) = | 27,78 | kW |
| $E_{rec}$ (100%) = | 0,13 | mJ |
| $t_{E\,rec}$ = | 0,09 | μs |

# Measurement circuits

**figure 10.**

**BUCK stage switching measurement circuit**

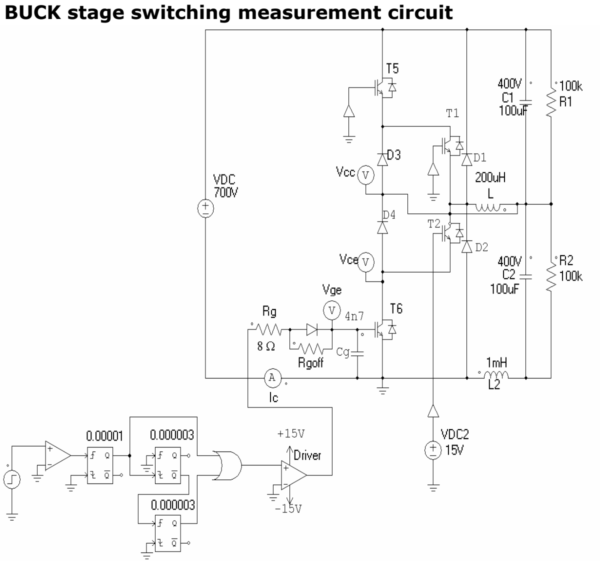
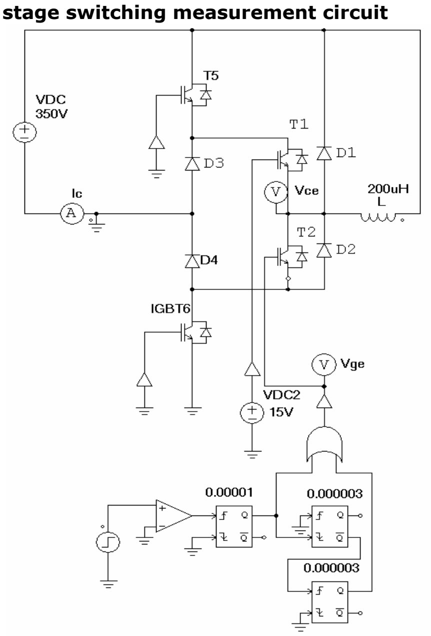



**figure 11.**

**BOOST stage switching measurement circuit**



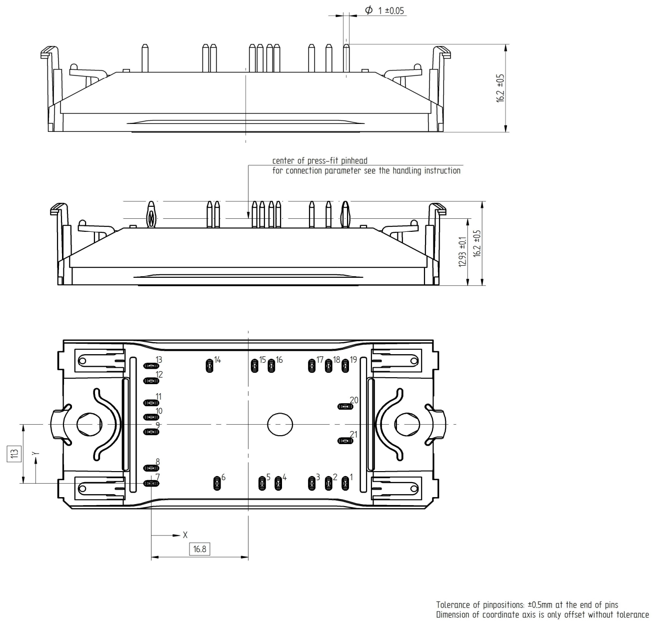
## Ordering Code & Marking

| Version | Ordering Code |
|---|---|
| without thermal paste 12 mm housing with solder pins | 10-FZ06NRA075FU-P969F08 |
| without thermal paste 12 mm housing with press-fit pins | 10-PZ06NRA075FU-P969F08Y |
| | |
| | |

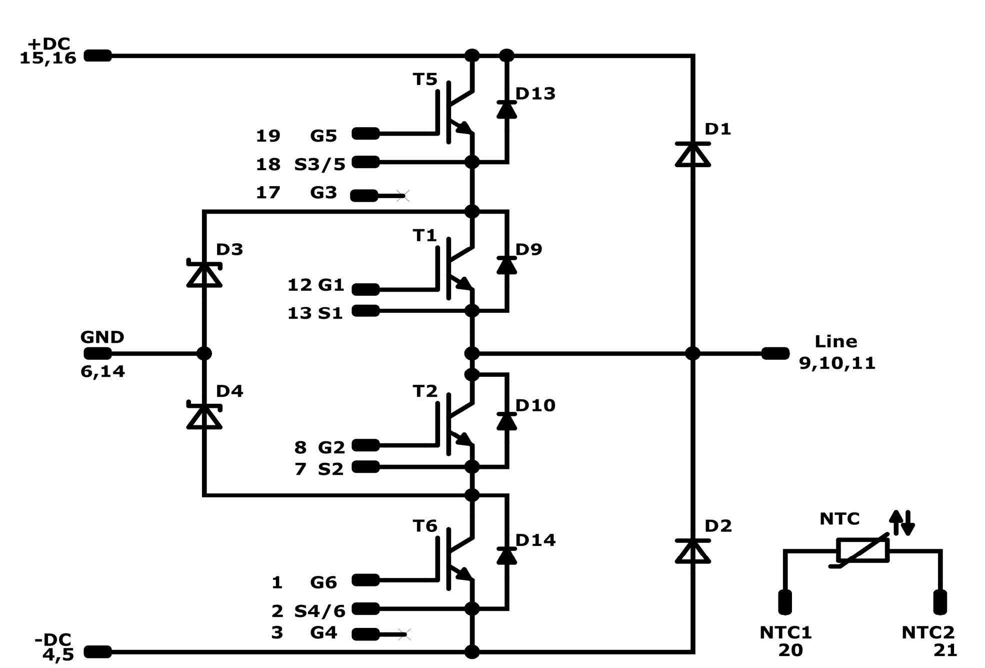

| | Name | Date code | UL & VIN | Lot | Serial |
|---|---|---|---|---|---|
| **Text** | NN-NNNNNNNNNNNNN-TTTTTTVV | WWYY | UL VIN | LLLLL | SSSS |
| **Datamatrix** | **Type&Ver** | **Lot number** | **Serial** | **Date code** | |
| | TTTTTTVV | LLLLL | SSSS | WWYY | |

## Outline

| Pin table [mm] | | | |
|---|---|---|---|
| Pin | X | Y | Function |
| 1 | 33,6 | 0 | G6 |
| 2 | 30,7 | 0 | S4/6 |
| 3 | 27,8 | 0 | G4 |
| 4 | 22 | 0 | -DC |
| 5 | 19,2 | 0 | -DC |
| 6 | 11,4 | 0 | GND |
| 7 | 0 | 0 | S2 |
| 8 | 0 | 2,9 | G2 |
| 9 | 0 | 9,9 | Line |
| 10 | 0 | 12,7 | Line |
| 11 | 0 | 15,5 | Line |
| 12 | 0 | 19,7 | G1 |
| 13 | 0 | 22,6 | S1 |
| 14 | 10,1 | 22,6 | GND |
| 15 | 17,9 | 22,6 | +DC |
| 16 | 20,8 | 22,6 | +DC |
| 17 | 27,8 | 22,6 | G3 |
| 18 | 30,7 | 22,6 | S3/5 |
| 19 | 33,6 | 22,6 | G5 |
| 20 | 33,6 | 14,8 | NTC1 |
| 21 | 33,6 | 8,2 | NTC2 |



## Pinout




## Identification

| ID | Component | Voltage | Current | Function | Comment |
|---|---|---|---|---|---|
| T5, T6 | IGBT | 600 V | 75 A | Buck IGBT | |
| D3, D4 | FWD | 600 V | 30 A | Buck FWD | |
| T1, T2 | IGBT | 600 V | 75 A | Boost IGBT | |
| D1, D2 | FWD | 1200 V | 30 A | Boost FWD | |
| D9, D10 | FWD | 600 V | 10 A | Boost Inverse Diode | |
| D13, D14 | FWD | 600 V | 10 A | Boost Sw. Prot. Diode | |
| NTC | NTC | | | Thermistor | |

| Packaging instruction | | | | | |
|---|---|---|---|---|---|
| Standard packaging quantity (SPQ) | **135** | >SPQ | Standard | <SPQ | Sample |

| Handling instruction |
|---|
| Handling instructions for *flow* 0 packages see vincotech.com website. |

| Package data |
|---|
| Package data for *flow* 0 packages see vincotech.com website. |

| UL recognition and file number |
|---|
| This device is certified according to UL 1557 standard, UL file number E192116. For more information see vincotech.com website. |

| Document No.: | Date: | Modification: | Pages |
|---|---|---|---|
| 10-xZ06NRA075FU-P969F08x-D5-14 | 07 May. 2018 | Added press-fit version, brand colors, updated logo | All |