Vincotech

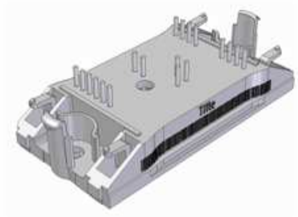
# 10-FZ122PA100SC02-P999F78
datasheet

***flow* PHASE 0** **1200 V / 100 A**

## Features

- Trench Fieldstop IGBT4 HS3 technology
- SiC Schottky diode
- Compact and low inductance design

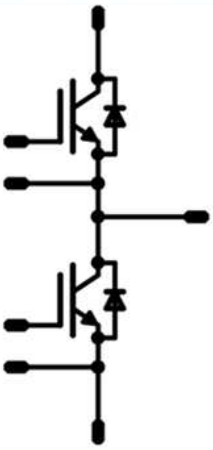
## *flow* 0 12mm housing



## Target applications

- Industrial Drive
- Solar Inverter
- UPS
- Welding
- Power Supply

## Schematic



## Types

- 10-FZ122PA100SC02-P999F78

# Maximum Ratings

| Parameter | Symbol | Condition | | Value | Unit |
|---|---|---|---|---|---|
| **Buck Switch** | | | | | |
| Collector-emitter voltage | $V_{CES}$ | | | 1200 | V |
| Collector current | $I_C$ | $T_j = T_j$max | $T_S$=80 °C | 113 | A |
| Repetitive peak collector current | $I_{CRM}$ | $t_p$ limited by $T_j$max | | 300 | A |
| Total power dissipation | $P_{tot}$ | $T_j = T_j$max | $T_S$=80 °C | 307 | W |
| Gate-emitter voltage | $V_{GES}$ | | | ±20 | V |
| Maximum Junction Temperature | $T_{jmax}$ | | | 175 | °C |

## Buck Diode

| Parameter | Symbol | Conditions | | Value | Unit |
|---|---|---|---|---|---|
| Peak Repetitive Reverse Voltage | $V_{RRM}$ | | | 1200 | V |
| Continuous (direct) forward current | $I_F$ | $T_j=T_{jmax}$ | $T_h$=80°C | 52 | A |
| Repetitive peak forward current | $I_{FRM}$ | | | 154 | A |
| Surge (non-repetitive) forward current | $I_{FSM}$ | 50Hz Single Half Sine Wave | | 256 | A |
| Total power dissipation | $P_{tot}$ | $T_j=T_{jmax}$ | $T_h$=80°C | 160 | W |
| Maximum Junction Temperature | $T_{jmax}$ | | | 175 | °C |

## Module Properties

### Thermal Properties

| Parameter | Symbol | Conditions | Value | Unit |
|---|---|---|---|---|
| Storage temperature | $T_{stg}$ | | -40…+125 | °C |
| Operation Junction Temperature | $T_{jop}$ | | -40…+($T_{jmax}$ - 25) | °C |

### Isolation Properties

| Parameter | Symbol | Conditions | | Value | Unit |
|---|---|---|---|---|---|
| Isolation voltage | $V_{isol}$ | DC voltage | $t_p$=2s | 4000 | V |
| Creepage distance | | | | min 12,7 | mm |
| Clearance | | | | min 12,7 | mm |
| Comparative Tracking Index | CTI | | | >200 | |

# Characteristic Values

## Buck Switch

| Parameter | Symbol | Conditions | | | | | Value | | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | $V_{GE}$ [V] | $V_{CE}$ [V] | $I_C$ [A] | $T_j$ [°C] | Min | Typ | Max | |
| **Static** | | | | | | | | | | |
| Gate-emitter threshold voltage | $V_{GE(th)}$ | $V_{GE}=V_{CE}$ | | | 0,0015 | 25<br>125 | 5 | 5,8 | 6,5 | V |
| Collector-emitter saturation voltage | $V_{CEsat}$ | | 15 | | 35 | 25<br>125<br>150 | 1,35 | 1,75<br>1,95<br>- | 2,05 | V |
| Collector-emitter cut-off current | $I_{CES}$ | | 0 | 1200 | | 25<br>125 | | | 250 | µA |
| Gate-emitter leakage current | $I_{GES}$ | | 20 | 0 | | 25<br>125 | | | 600 | nA |
| Internal gate resistance | $r_g$ | | | | | | | 6 | | Ω |
| Input capacitance | $C_{ies}$ | f=1 MHz | 0 | 25 | | 25 | | 2500 | | pF |
| Output capacitance | $C_{oes}$ | f=1 MHz | 0 | 25 | | 25 | | 130 | | pF |
| Reverse transfer capacitance | $C_{res}$ | f=1 MHz | 0 | 25 | | 25 | | 110 | | pF |
| Gate charge | $Q_g$ | | 15 | 600 | 35 | 25 | | 203 | | nC |
| **Thermal** | | | | | | | | | | |
| Thermal resistance junction to sink | $R_{th(j-s)}$ | Thermal foil thickness=76um Kunze foil KU-ALF5 | | | | | | 1,10 | | K/W |
| **IGBT Switching** | | | | | | | | | | |
| Turn-on delay time | $t_{d(on)}$ | $R_{goff}$ = 4 Ω<br>$R_{gon}$ = 4 Ω | ±15 | 600 | 100 | 25<br>125<br>150 | | 203<br>218<br>221 | | ns |
| Rise time | $t_r$ | $R_{goff}$ = 4 Ω<br>$R_{gon}$ = 4 Ω | ±15 | 600 | 100 | 25<br>125<br>150 | | 38<br>41<br>44 | | ns |
| Turn-off delay time | $t_{d(off)}$ | $R_{goff}$ = 4 Ω<br>$R_{gon}$ = 4 Ω | ±15 | 600 | 100 | 25<br>125<br>150 | | 295<br>358<br>372 | | ns |
| Fall time | $t_f$ | | ±15 | 600 | 100 | 25<br>125<br>150 | | 37<br>73<br>87 | | ns |
| Turn-on energy (per pulse) | $E_{on}$ | $Q_{rFWD}$ = 0,5 µC<br>$Q_{rFWD}$ = 0,8 µC<br>$Q_{rFWD}$ = 0,6 µC | ±15 | 600 | 100 | 25<br>125<br>150 | | 5,967<br>6,790<br>7,094 | | mWs |
| Turn-off energy (per pulse) | $E_{off}$ | | ±15 | 600 | 100 | 25<br>125<br>150 | | 3,827<br>5,751<br>6,447 | | mWs |

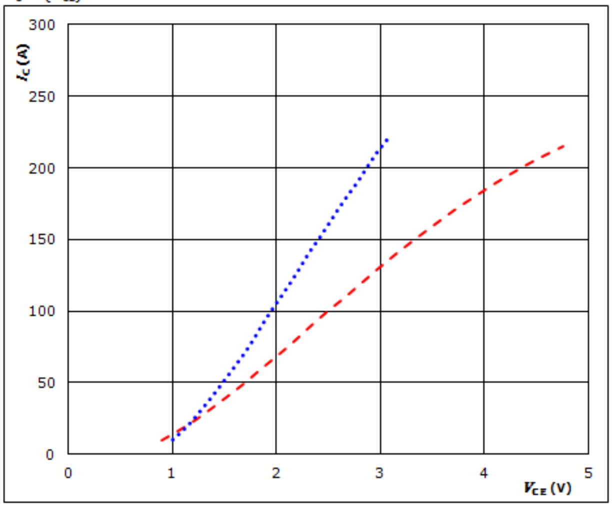
# Buck Diode

| Parameter | Symbol | Conditions | | | | | Value | | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | $V_r$ [V] | $I_F$ [A] | $T_j$ [°C] | Min | Typ | Max | |
| **Static** | | | | | | | | | | |
| Forward voltage | $V_F$ | | | | 30 | 25<br>125<br>150 | | 1,48<br>1,83<br>1,96 | 1,8 | V |
| Reverse leakage current | $I_r$ | | | 1200 | | 25<br>150 | | | 250<br>350 | μA |
| **Thermal** | | | | | | | | | | |
| Thermal resistance junction to sink | $R_{th(j-s)}$ | Thermal foil thickness=76um Kunze foil KU-ALF5 | | | | | | 0,59 | | K/W |
| **FWD Switching** | | | | | | | | | | |
| Peak recovery current | $I_{RRM}$ | $di/dt$ = 1950 A/μs<br>$di/dt$ = 4681 A/μs<br>$di/dt$ = 3200 A/μs | ±15 | 600 | 100 | 25<br>125<br>150 | | 17<br>18<br>15 | | A |
| Reverse recovery time | $t_{rr}$ | | | | | 25<br>125<br>150 | | 16<br>17<br>16 | | ns |
| Recovered charge | $Q_r$ | | | | | 25<br>125<br>150 | | 0,549<br>0,849<br>0,554 | | μC |
| Reverse recovered energy | $E_{rec}$ | | | | | 25<br>125<br>150 | | 0,118<br>0,246<br>0,146 | | mWs |
| Peak rate of fall of recovery current | $(di_{rf}/dt)_{max}$ | | | | | 25<br>125<br>150 | | 3566<br>3120<br>1280 | | A/μs |

# Buck Switch Characteristics

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

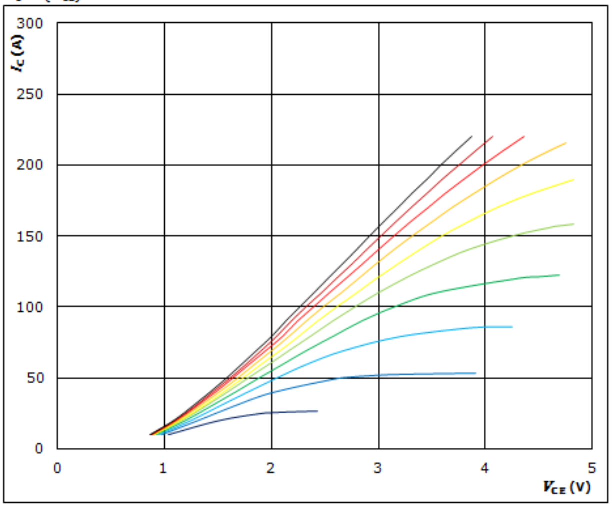
$I_C = f(V_{CE})$




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

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

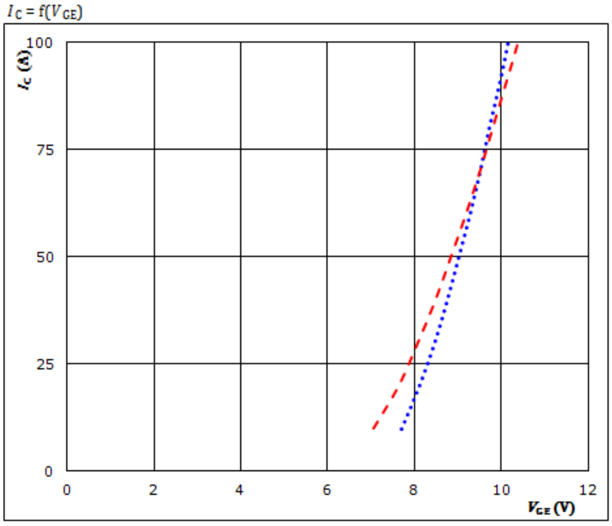
$I_C = f(V_{CE})$




| | | |
|---|---|---|
| $t_p$ = | 250 | μs |
| $T_j$ = | 150 | °C |
| $V_{GE}$ from | 8 V to 17 V in steps of 1 V | |

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

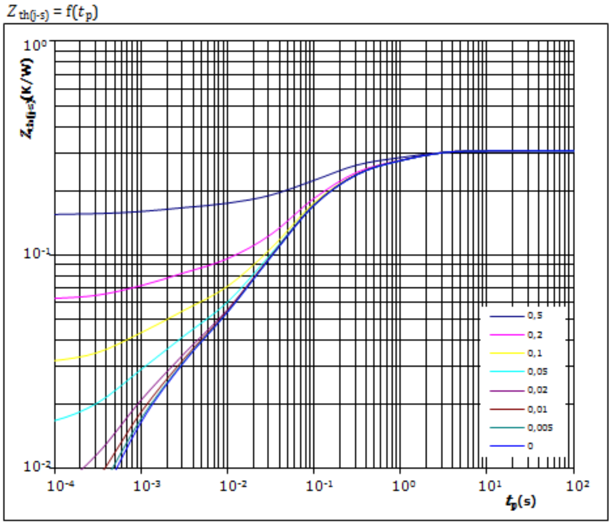
$I_C = f(V_{GE})$




| | | | |
|---|---|---|---|
| $t_p$ = | 100 | μs | 25 °C |
| $V_{CE}$ = | 20 | V | 125 °C |
| | | | 150 °C |

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

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




D = $t_p / T$

$R_{th(j-s)}$ = 0,31 K/W

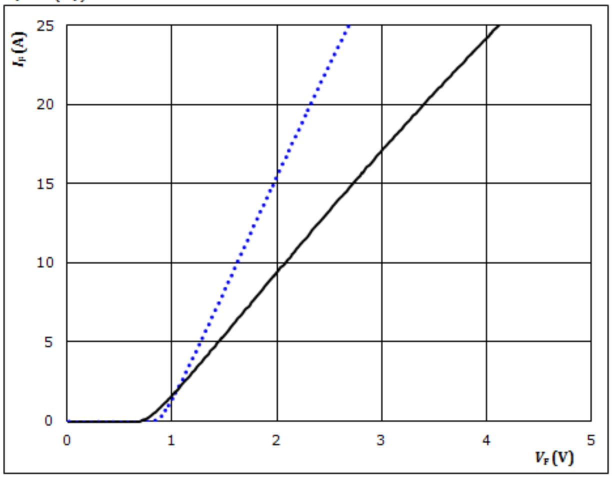
IGBT thermal model values

| $R_{th}$ (K/W) | τ (s) |
|---|---|
| 6,86E-02 | 1,22E+00 |
| 9,04E-02 | 1,80E-01 |
| 1,14E-01 | 6,14E-02 |
| 1,66E-02 | 8,17E-03 |
| 2,00E-02 | 1,06E-03 |

# Buck Diode Characteristics

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

$I_F = f(V_F)$

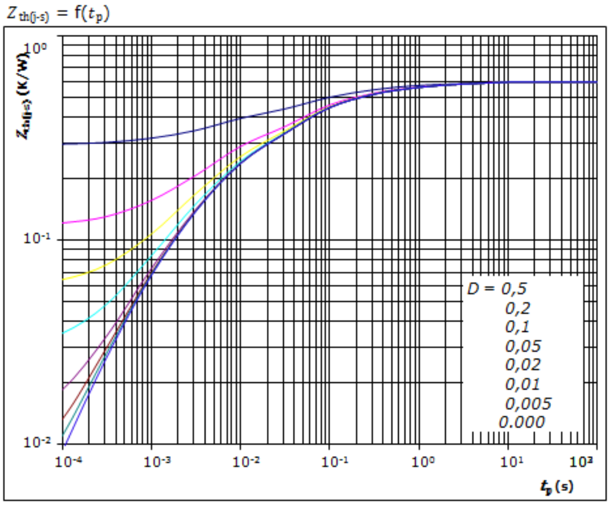



$t_p$ = 250 µs

$T_j$: 25 °C, 125 °C, 150 °C

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

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




D = $t_p$ / $T$

$R_{th(j-s)}$ = 0,59 K/W

FWD thermal model values

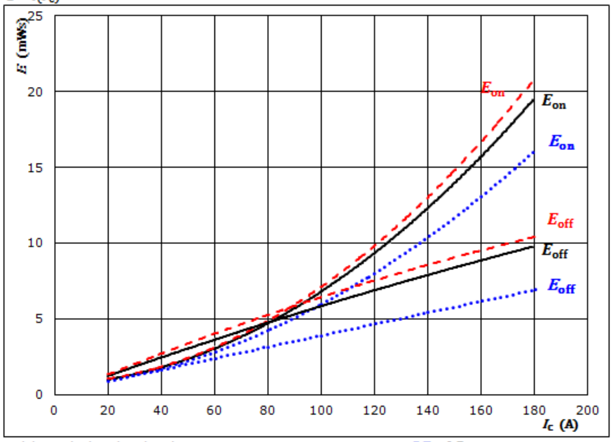
| R (K/W) | τ (s) |
|---|---|
| 5,08E-02 | 2,31E+00 |
| 1,15E-01 | 2,42E-01 |
| 2,22E-01 | 4,47E-02 |
| 1,70E-01 | 4,43E-03 |
| 3,53E-02 | 6,74E-04 |

# Buck Switching Characteristics

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

Typical switching energy losses as a function of collector current

$E = f(I_C)$



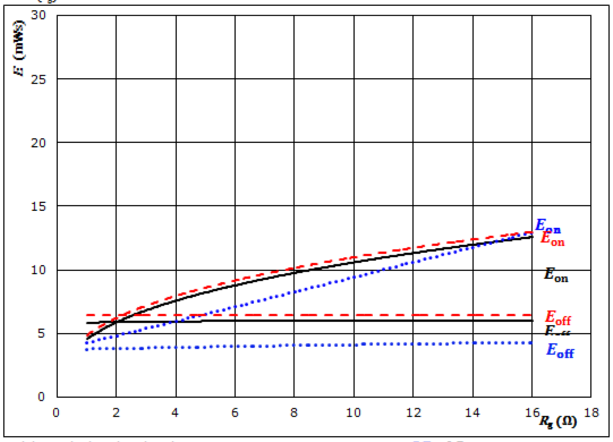

With an inductive load at

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

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

Typical switching energy losses as a function of gate resistor

$E = f(r_g)$



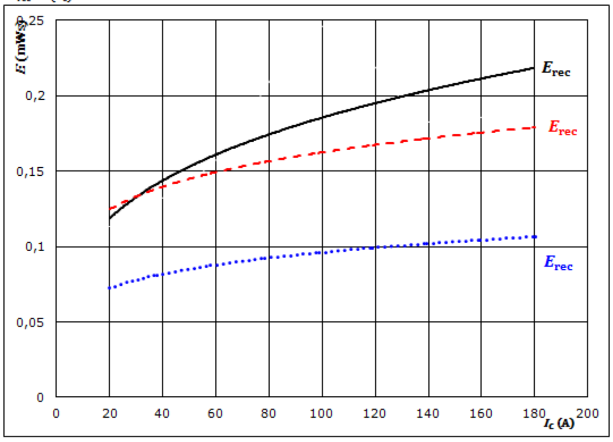

With an inductive load at

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

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

Typical reverse recovered energy loss as a function of collector current

$E_{rec} = f(I_C)$



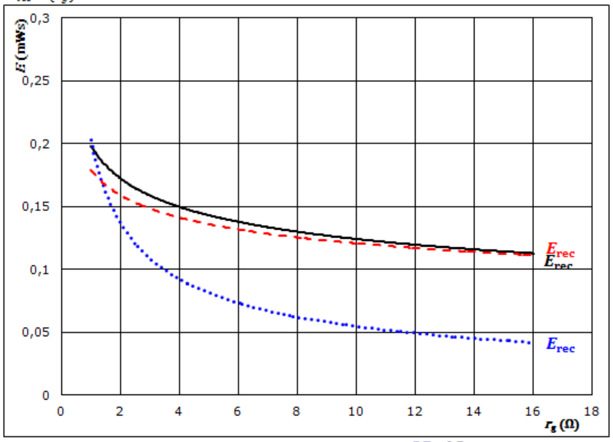

With an inductive load at

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

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

Typical reverse recovered energy loss as a function of gate resistor

$E_{rec} = f(r_g)$




With an inductive load at

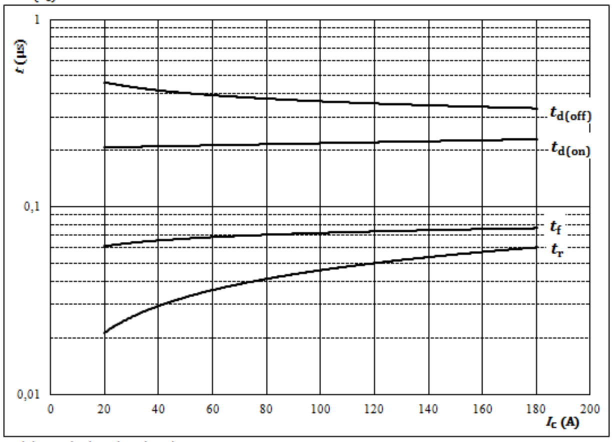
| | | | | | |
|---|---|---|---|---|---|
| $V_{CE}$ = | 600 | V | $T_j$: | 25 °C | ·········· |
| $V_{GE}$ = | ±15 | V | | 125 °C | ——— |
| $I_C$ = | 100 | A | | 150 °C | – – – |

# Buck Switching Characteristics

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

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

$t = f(I_C)$



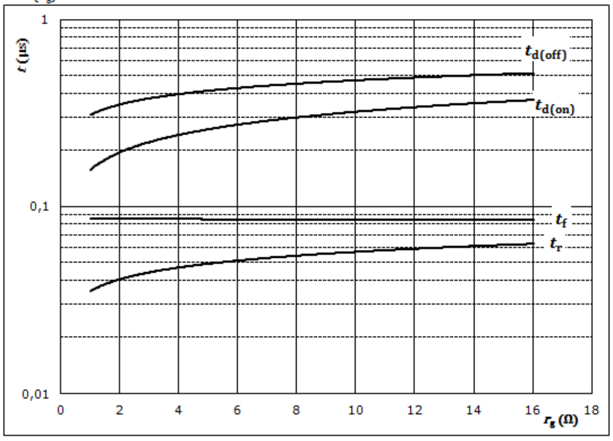

With an inductive load at

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

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

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

$t = f(r_g)$



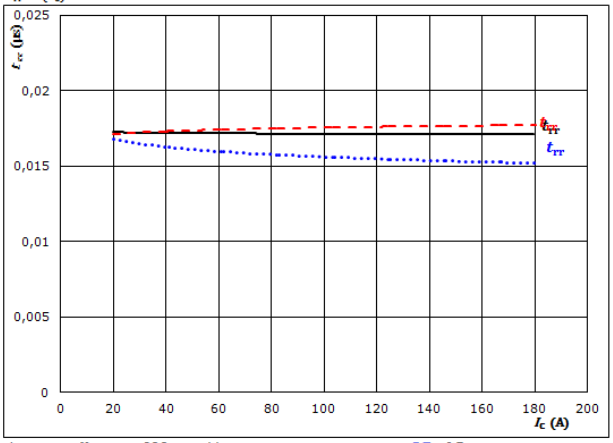

With an inductive load at

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

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

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

$t_{rr} = f(I_C)$

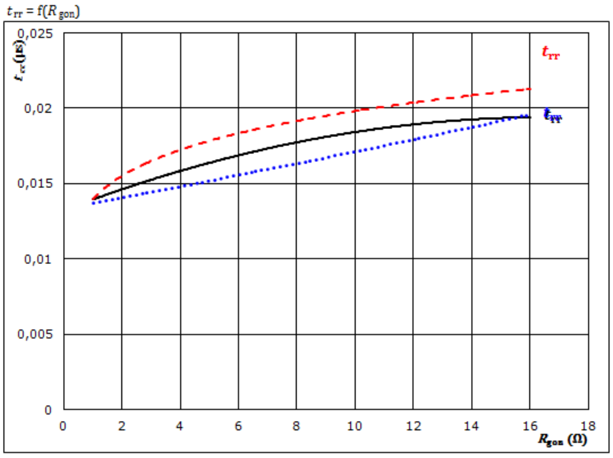



| | | | | | | |
|---|---|---|---|---|---|---|
| At $V_{CE}$: | 600 | V | | 25 | °C | ·········· |
| $V_{GE}$ = | ±15 | V | $T_j$: | 125 | °C | ——— |
| $R_{gon}$ = | 4 | Ω | | 150 | °C | – – – – |

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

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

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



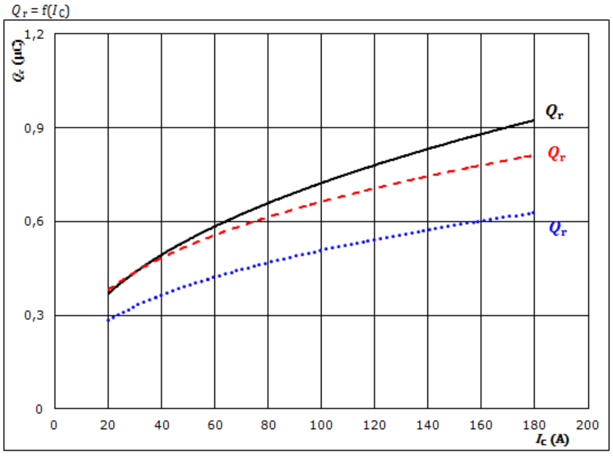

| | | | | | | |
|---|---|---|---|---|---|---|
| At $V_{CE}$ = | 600 | V | | 25 | °C | ·········· |
| $V_{GE}$ = | ±15 | V | $T_j$: | 125 | °C | ——— |
| $I_C$ = | 100 | A | | 150 | °C | – – – – |

# Buck Switching Characteristics

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

Typical recovered charge as a function of collector current

$Q_r = f(I_C)$

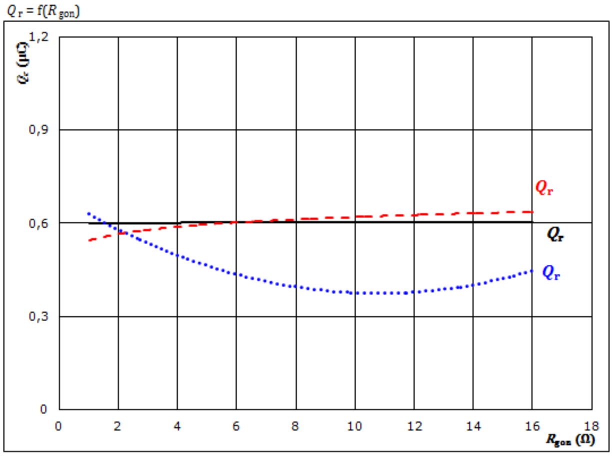



| | | | | | | |
|---|---|---|---|---|---|---|
| At | $V_{CE}$ = | 600 | V | | 25 °C | ············ |
| | $V_{GE}$ = | ±15 | V | $T_j$: | 125 °C | ——— |
| | $R_{gon}$ = | 4 | Ω | | 150 °C | – – – – |

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

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

$Q_r = f(R_{gon})$

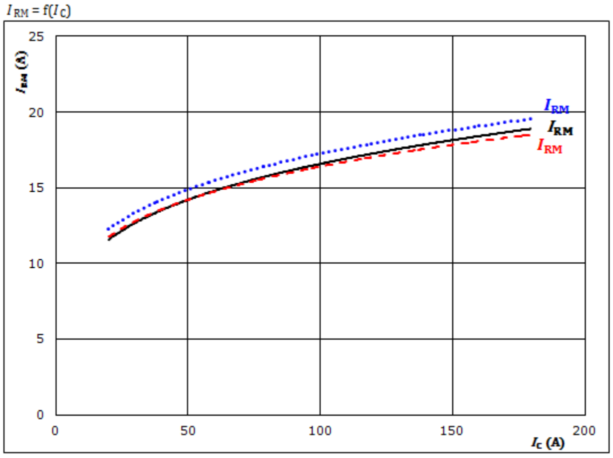



| | | | | | | |
|---|---|---|---|---|---|---|
| At | $V_{CE}$= | 600 | V | | 25 °C | ············ |
| | $V_{GE}$ = | ±15 | V | $T_j$: | 125 °C | ——— |
| | $I_C$= | 100 | A | | 150 °C | – – – – |

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

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

$I_{RM} = f(I_C)$

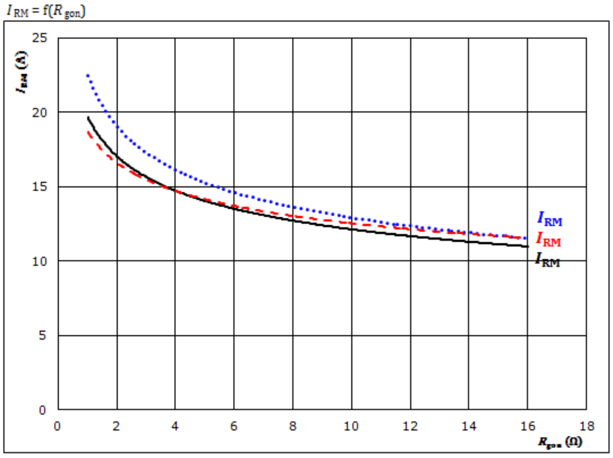



| | | | | | | |
|---|---|---|---|---|---|---|
| At | $V_{CE}$ | 600 | V | | 25 °C | ············ |
| | $V_{GE}$ = | ±15 | V | $T_j$: | 125 °C | ——— |
| | $R_{gon}$ = | 4 | Ω | | 150 °C | – – – – |

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

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

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



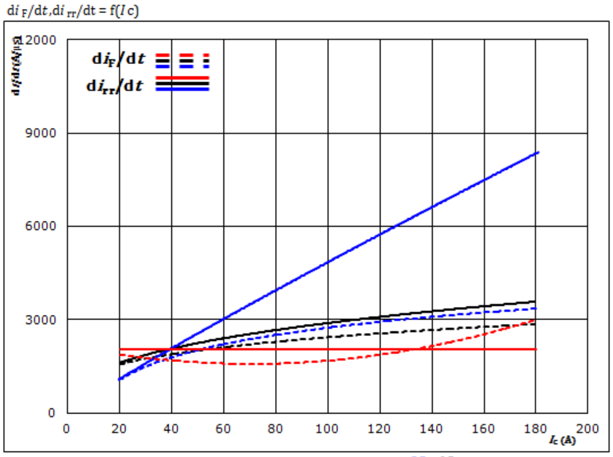

| | | | | | | |
|---|---|---|---|---|---|---|
| At | $V_{CE}$ = | 600 | V | | 25 °C | ············ |
| | $V_{GE}$ = | ±15 | V | $T_j$: | 125 °C | ——— |
| | $I_C$= | 100 | A | | 150 °C | – – – – |

# Buck Switching Characteristics

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

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

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

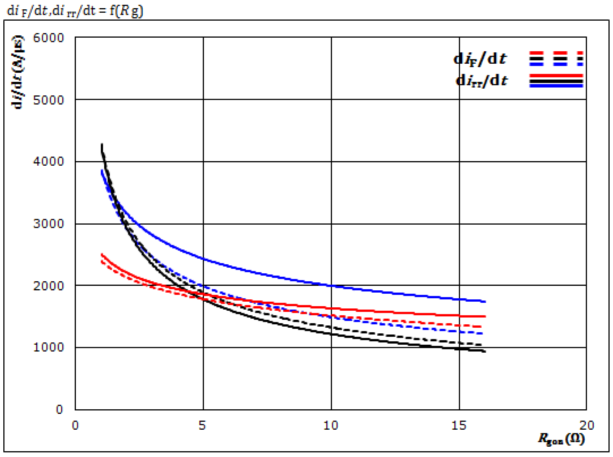



| At | | | | | |
|---|---|---|---|---|---|
| $V_{CE}$ = | 600 | V | $T_j$: | 25 °C | dotted |
| $V_{GE}$ = | ±15 | V | | 125 °C | solid |
| $R_{gon}$ = | 4 | Ω | | 150 °C | dashed |

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

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

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

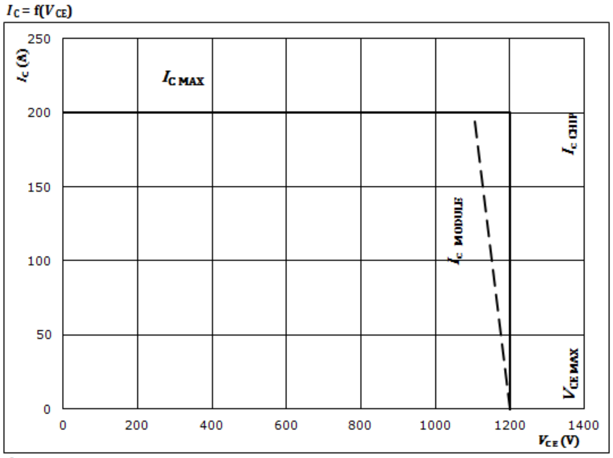



| At | | |
|---|---|---|
| $V_{CE}$ = | 600 | V |
| $V_{GE}$ = | ±15 | V |
| $I_C$ = | 100 | A |

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

**Reverse bias safe operating area**

$I_C = f(V_{CE})$




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

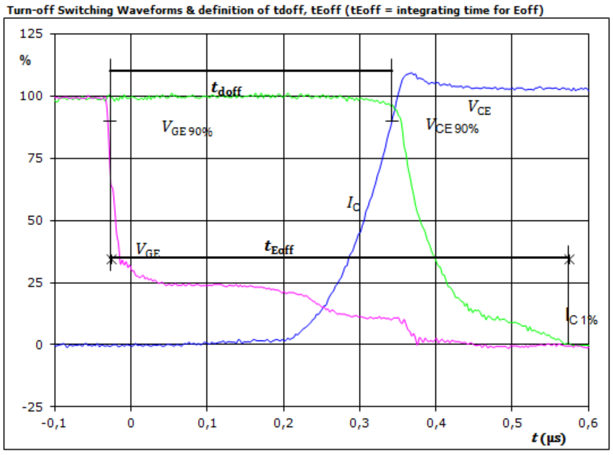
# Swiching definition

**General conditions**

| | | |
|---|---|---|
| $T_j$ | = | 150 °C |
| $R_{gon}$ | = | 4 Ω |
| $R_{goff}$ | = | 4 Ω |

**Figure 1.** IGBT

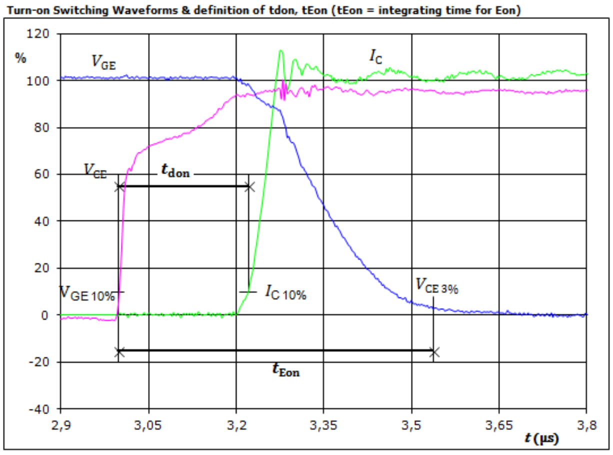
Turn-off Switching Waveforms & definition of tdoff, tEoff (tEoff = integrating time for Eoff)




| | | |
|---|---|---|
| $V_{GE}$ (0%) = | -15 | V |
| $V_{GE}$ (100%) = | 15 | V |
| $V_C$ (100%) = | 600 | V |
| $I_C$ (100%) = | 100 | A |
| $t_{doff}$ = | 0,372 | µs |
| $t_{Eoff}$ = | 0,601 | µs |

**Figure 2.** IGBT

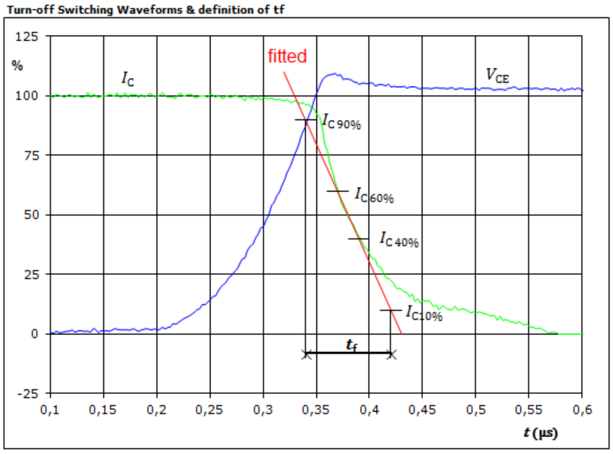
Turn-on Switching Waveforms & definition of tdon, tEon (tEon = integrating time for Eon)




| | | |
|---|---|---|
| $V_{GE}$ (0%) = | -15 | V |
| $V_{GE}$ (100%) = | 15 | V |
| $V_C$ (100%) = | 600 | V |
| $I_C$ (100%) = | 100 | A |
| $t_{don}$ = | 0,221 | µs |
| $t_{Eon}$ = | 0,540 | µs |

**Figure 3.** IGBT

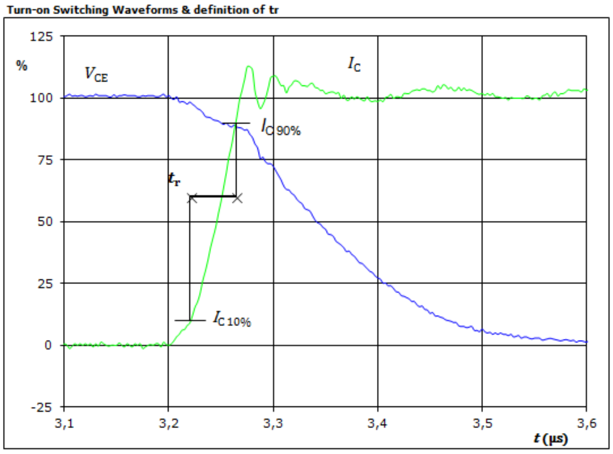
Turn-off Switching Waveforms & definition of tf




| | | |
|---|---|---|
| $V_C$ (100%) = | 600 | V |
| $I_C$ (100%) = | 100 | A |
| $t_f$ = | 0,087 | µs |

**Figure 4.** IGBT

Turn-on Switching Waveforms & definition of tr

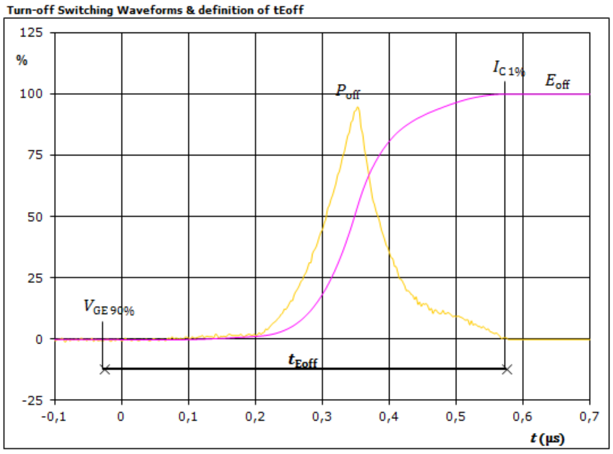



| | | |
|---|---|---|
| $V_C$ (100%) = | 600 | V |
| $I_C$ (100%) = | 100 | A |
| $t_r$ = | 0,044 | µs |

# Swiching definition

**Figure 5.** IGBT

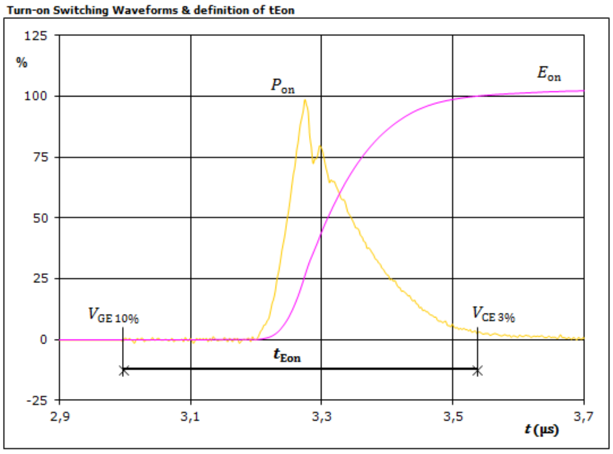
Turn-off Switching Waveforms & definition of tEoff




| | | |
|---|---|---|
| $P_{off}$ (100%) = | 60,00 | kW |
| $E_{off}$ (100%) = | 6,45 | mJ |
| $t_{Eoff}$ = | 0,60 | µs |

**Figure 6.** IGBT

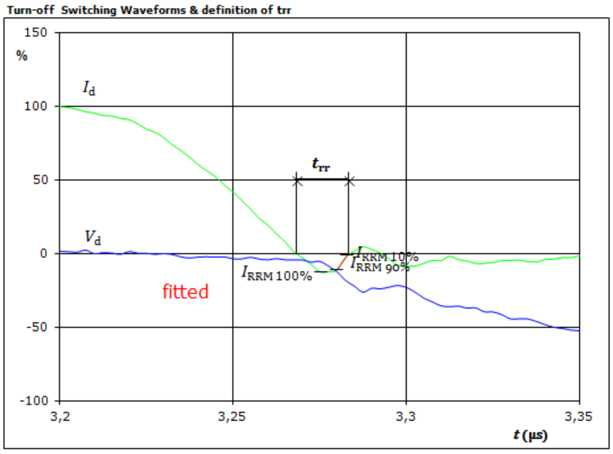
Turn-on Switching Waveforms & definition of tEon




| | | |
|---|---|---|
| $P_{on}$ (100%) = | 60,00 | kW |
| $E_{on}$ (100%) = | 7,09 | mJ |
| $t_{Eon}$ = | 0,54 | µs |

**Figure 7.** FWD

Turn-off Switching Waveforms & definition of trr

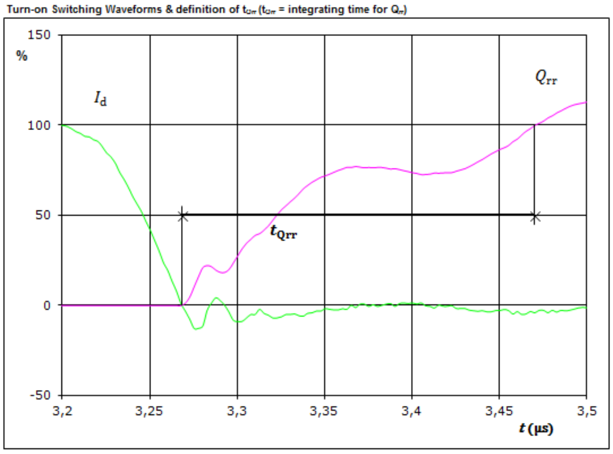



| | | |
|---|---|---|
| $V_d$ (100%) = | 600 | V |
| $I_d$ (100%) = | 100 | A |
| $I_{RRM}$ (100%) = | -15 | A |
| $t_{rr}$ = | 0,016 | µs |

# Swiching definition

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

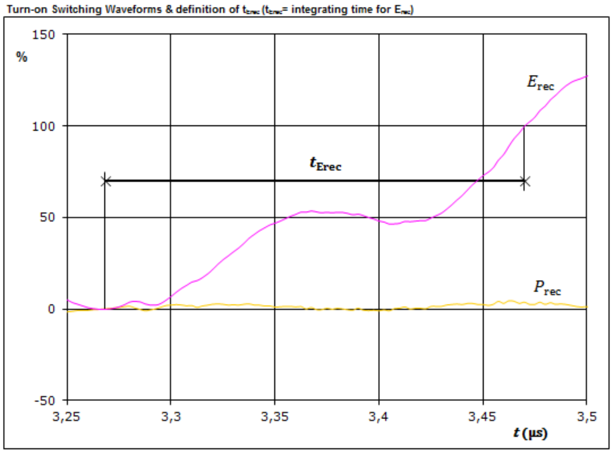
Turn-on Switching Waveforms & definition of $t_{Qrr}$ ($t_{Qrr}$ = integrating time for $Q_{rr}$)




| | | |
|---|---|---|
| $I_d$ (100%) = | 100 | A |
| $Q_{rr}$ (100%) = | 0,55 | µC |
| $t_{Qrr}$ = | 0,20 | µs |

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

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




| | | |
|---|---|---|
| $P_{rec}$ (100%) = | 60,00 | kW |
| $E_{rec}$ (100%) = | 0,15 | mJ |
| $t_{Erec}$ = | 0,20 | µs |

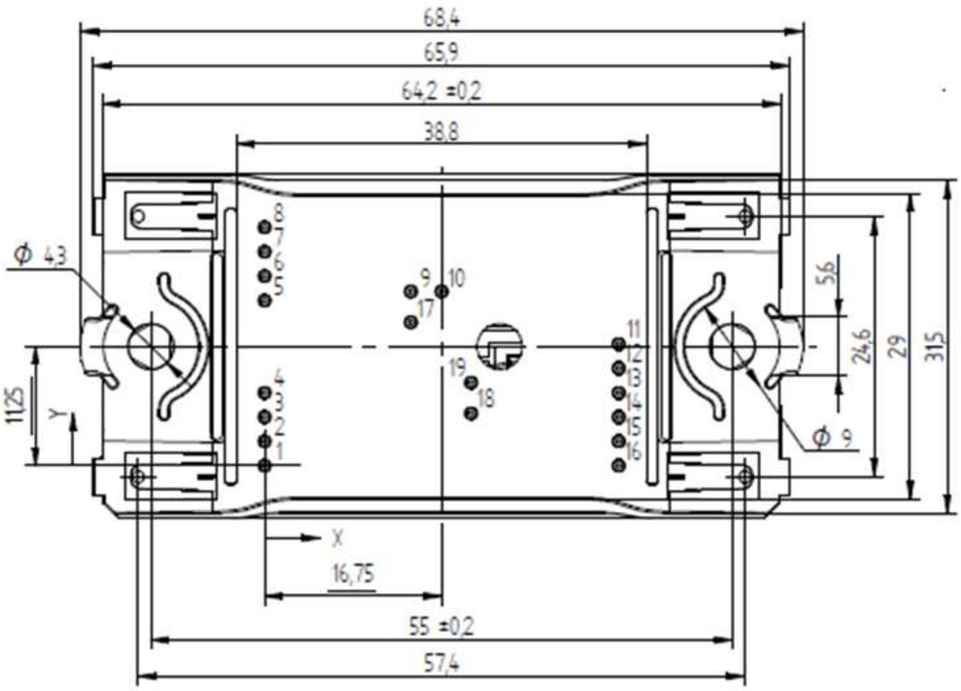
## Ordering Code & Marking

| Version | Ordering Code | in DataMatrix as | in packaging barcode as |
|---|---|---|---|
| without thermal paste with solder pins | 10-FZ122PA100SC02-P999F78 | P999F78 | P999F78 |
| | | | |
| | | | |
| | | | |

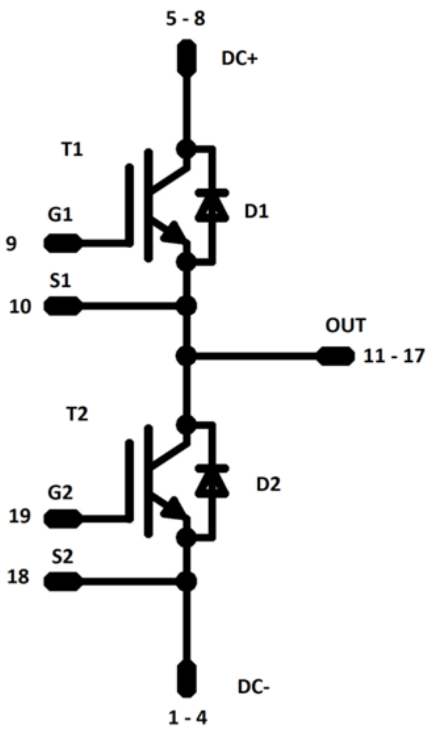

| | Name | | Type&Ver | Date code | Vinco&Lot | Serial&UL |
|---|---|---|---|---|---|---|
| Text | NN-NNNNNNNNNNNNNN | | TTTTTTTVV | WWYY | Vinco LLLLL | SSSS UL |
| Datamatrix | Type&Ver | Lot number | Serial | Date code | | |
| | TTTTTTTVV | LLLLL | SSSS | WWYY | | |

## Outline

| Pin table [mm] | | |
|---|---|---|
| Pin | X | Y |
| Pin | X | Y |
| 1 | 0 | 0 |
| 2 | 0 | 2,3 |
| 3 | 0 | 4,6 |
| 4 | 0 | 6,9 |
| 5 | 0 | 15,6 |
| 6 | 0 | 17,9 |
| 7 | 0 | 20,2 |
| 8 | 0 | 22,5 |
| 9 | 13,85 | 16,45 |
| 10 | 16,75 | 16,45 |
| 11 | 33,5 | 11,5 |
| 12 | 33,5 | 9,2 |
| 13 | 33,5 | 6,9 |
| 14 | 33,5 | 4,6 |
| 15 | 33,5 | 2,3 |
| 16 | 33,5 | 0 |
| 17 | 13,85 | 13,55 |
| 18 | 19,55 | 4,95 |
| 19 | 19,55 | 7,85 |



## Pinout




## Identification

| ID | Component | Voltage | Current | Function | Comment |
|---|---|---|---|---|---|
| T1,T2 | IGBT | 1200V | 100A | Buck Switch | |
| D1,D2 | FWD | 1200V | 60A | Buck Diode | |

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

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

| Document No.: | Date: | Modification: | Pages |
|---|---|---|---|
| 10-FZ122PA100SC02-P999F78-D2-14 | 25 Mar. 2015 | | |

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2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.