

*flow*PACK 2

600 V/150 A

**Features**

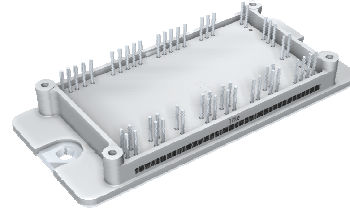
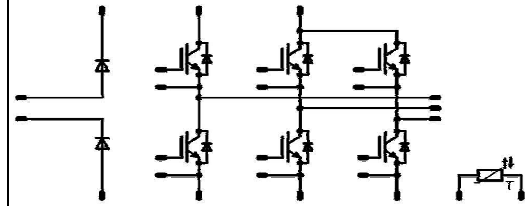
- Inverter, blocking diodes
- Built-in thermistor

**Target Applications**

- Power Regeneration

**Types**

- 30-F206R6A150SB-M445E
- 30-F206R6A150SB01-M445E10

**flow 2 housing**

**Schematic**


## Maximum Ratings

 $T_j=25^\circ\text{C}$ , unless otherwise specified

| Parameter                       | Symbol     | Condition  | Value      | Unit             |
|---------------------------------|------------|--|------------|------------------|
| <b>D7a,b-D8a,b</b>              |            |  |            |                  |
| Repetitive peak reverse voltage | $V_{RRM}$  |  | 1600       | V                |
| DC forward current              | $I_{FAV}$  | $T_j=T_{jmax}$<br>$T_h=80^\circ\text{C}$<br>$T_c=80^\circ\text{C}$ | 213<br>250 | A                |
| Surge forward current           | $I_{FSM}$  | $t_p=10\text{ms}$<br>$T_j=25^\circ\text{C}$                        | 2000       | A                |
| I <sup>2</sup> t-value          | $I^2t$     |  | 7920       | A <sup>2</sup> s |
| Power dissipation per Diode     | $P_{tot}$  | $T_j=T_{jmax}$<br>$T_h=80^\circ\text{C}$<br>$T_c=80^\circ\text{C}$ | 249<br>378 | W                |
| Maximum Junction Temperature    | $T_{jmax}$ |  | 150        | °C               |

**T1a-b,T2a-b,T3a-b,T4a-b,T5a-b,T6a-b**

|                                      |                      |  |            |                    |
|--------------------------------------|----------------------|--|------------|--------------------|
| Collector-emitter break down voltage | $V_{CE}$             |  | 600        | V                  |
| DC collector current                 | $I_C$                | $T_j=T_{jmax}$<br>$T_h=80^\circ\text{C}$<br>$T_c=80^\circ\text{C}$ | 148<br>193 | A                  |
| Pulsed collector current             | $I_{Cpulse}$         | $t_p$ limited by $T_{jmax}$  | 450        | A                  |
| Turn off safe operating area         |                      | $V_{CE} \leq 1200\text{V}$ , $T_j \leq T_{op max}$                 | 450        | A                  |
| Power dissipation per IGBT           | $P_{tot}$            | $T_j=T_{jmax}$<br>$T_h=80^\circ\text{C}$<br>$T_c=80^\circ\text{C}$ | 277<br>420 | W                  |
| Gate-emitter peak voltage            | $V_{GE}$             |  | $\pm 20$   | V                  |
| Short circuit ratings                | $t_{SC}$<br>$V_{CC}$ | $T_j \leq 150^\circ\text{C}$<br>$V_{GE}=15\text{V}$                | 5<br>400   | $\mu\text{s}$<br>V |
| Maximum Junction Temperature         | $T_{jmax}$           |  | 175        | °C                 |

## Maximum Ratings

 $T_j=25^{\circ}\text{C}$ , unless otherwise specified

| Parameter                       | Symbol     | Condition                   | Value                    | Unit               |   |
|---------------------------------|------------|-----------------------------|--------------------------|--------------------|---|
| <b>D1,D2,D3,D4,D5,D6</b>        |            |                             |                          |                    |   |
| Peak Repetitive Reverse Voltage | $V_{RRM}$  |                             | 600                      | V                  |   |
| DC forward current              | $I_F$      | $T_j=T_{jmax}$              | $T_h=80^{\circ}\text{C}$ | 59                 | A |
|                                 |            |                             | $T_c=80^{\circ}\text{C}$ | 60                 |   |
| Repetitive peak forward current | $I_{FRM}$  | $t_p$ limited by $T_{jmax}$ | 1000                     | A                  |   |
| Power dissipation per Diode     | $P_{tot}$  | $T_j=T_{jmax}$              | $T_h=80^{\circ}\text{C}$ | 94                 | W |
|                                 |            |                             | $T_c=80^{\circ}\text{C}$ | 143                |   |
| Maximum Junction Temperature    | $T_{jmax}$ |                             | 175                      | $^{\circ}\text{C}$ |   |

### Thermal Properties

|   |           |  |                            |                    |
|---|-----------|--|----------------------------|--------------------|
| Storage temperature                             | $T_{stg}$ |  | -40...+kell                | $^{\circ}\text{C}$ |
| Operation temperature under switching condition | $T_{op}$  |  | -40...+( $T_{jmax} - 25$ ) | $^{\circ}\text{C}$ |

### Insulation Properties

|                            |          |                          |          |    |
|----------------------------|----------|--------------------------|----------|----|
| Insulation voltage         | $V_{is}$ | $t=2\text{s}$ DC voltage | 4000     | V  |
| Creepage distance          |          |                          | min 12,7 | mm |
| Clearance                  |          |                          | min 12,7 | mm |
| Comparative tracking index | CTI      |                          | >200     |    |

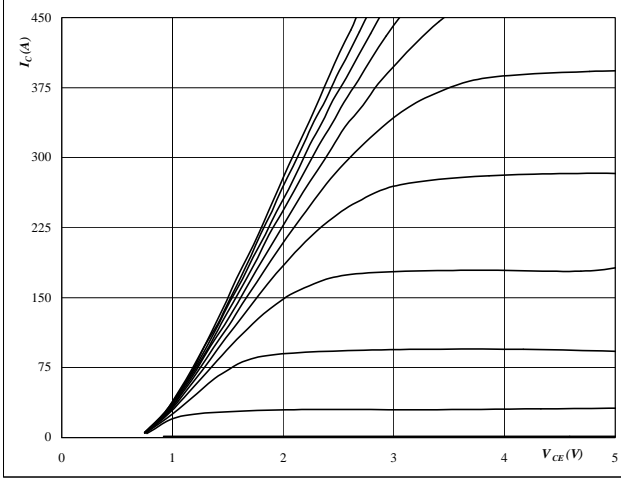
## Characteristic Values

| Parameter                                     | Symbol          | Conditions                          |  |                                  |        |                                       | Value |                |      | Unit       |
|---|-----------------|-------------------------------------|--|----------------------------------|--------|---------------------------------------|-------|----------------|------|------------|
|   |                 | $V_{GE}[V]$ or $V_{GS}[V]$          | $V_r[V]$ or $V_{CE}[V]$ or $V_{DS}[V]$ | $I_c[A]$ or $I_F[A]$ or $I_b[A]$ | $T_j$  | Min                                   | Typ   | Max            |      |            |
| <b>D7a,b-D8a,b</b>                            |                 |                                     |  |                                  |        |                                       |       |                |      |            |
| Forward voltage                               | $V_F$           |                                     |  |                                  | 150    | $T_j=25^\circ C$<br>$T_j=125^\circ C$ | 0,8   | 1,1<br>1,05    | 1,6  | V          |
| Threshold voltage (for power loss calc. only) | $V_{to}$        |                                     |  |                                  | 150    | $T_j=25^\circ C$<br>$T_j=125^\circ C$ |       | 0,89<br>0,75   |      | V          |
| Slope resistance (for power loss calc. only)  | $r_t$           |                                     |  |                                  | 150    | $T_j=25^\circ C$<br>$T_j=125^\circ C$ |       | 1<br>2         |      | m $\Omega$ |
| Reverse current                               | $I_r$           |                                     |  | 1600                             |        | $T_j=25^\circ C$<br>$T_j=125^\circ C$ |       |                | 0,1  | mA         |
| Thermal resistance chip to heatsink per chip  | $R_{thJH}$      | Phase-Change Material               |  |                                  |        |                                       |       | 0,28           |      | K/W        |
| Thermal resistance chip to heatsink per chip  | $R_{thJC}$      |                                     |  |                                  |        |                                       |       | 0,19           |      |            |
| <b>T1a-b,T2a-b,T3a-b,T4a-b,T5a-b,T6a-b</b>    |                 |                                     |  |                                  |        |                                       |       |                |      |            |
| Gate emitter threshold voltage                | $V_{GE(th)}$    | $V_{CE}=V_{GE}$                     |  |                                  | 0,0024 | $T_j=25^\circ C$<br>$T_j=150^\circ C$ | 5     | 5,8            | 6,4  | V          |
| Collector-emitter saturation voltage          | $V_{CE(sat)}$   |                                     | 15                                     |                                  | 150    | $T_j=25^\circ C$<br>$T_j=150^\circ C$ | 1     | 1,54<br>1,79   | 2    | V          |
| Collector-emitter cut-off current incl. Diode | $I_{CES}$       |                                     | 0                                      | 600                              |        | $T_j=25^\circ C$<br>$T_j=150^\circ C$ |       |                | 0,01 | mA         |
| Gate-emitter leakage current                  | $I_{GES}$       |                                     | 20                                     | 0                                |        | $T_j=25^\circ C$<br>$T_j=150^\circ C$ |       |                | 1200 | nA         |
| Integrated Gate resistor                      | $R_{gint}$      |                                     |  |                                  |        |                                       |       | none           |      | $\Omega$   |
| Turn-on delay time                            | $t_{d(on)}$     |                                     |  |                                  |        | $T_j=25^\circ C$<br>$T_j=150^\circ C$ |       | 113<br>113     |      | ns         |
| Rise time                                     | $t_r$           |                                     |  |                                  |        | $T_j=25^\circ C$<br>$T_j=150^\circ C$ |       | 21<br>24       |      |            |
| Turn-off delay time                           | $t_{d(off)}$    | Rgoff=2 $\Omega$<br>Rgon=2 $\Omega$ | $\pm 15$                               | 300                              | 150    | $T_j=25^\circ C$<br>$T_j=150^\circ C$ |       | 166<br>190     |      |            |
| Fall time                                     | $t_f$           |                                     |  |                                  |        | $T_j=25^\circ C$<br>$T_j=150^\circ C$ |       | 48<br>77       |      |            |
| Turn-on energy loss per pulse                 | $E_{on}$        |                                     |  |                                  |        | $T_j=25^\circ C$<br>$T_j=150^\circ C$ |       | 0,58<br>1,03   |      | mWs        |
| Turn-off energy loss per pulse                | $E_{off}$       |                                     |  |                                  |        | $T_j=25^\circ C$<br>$T_j=150^\circ C$ |       | 3,73<br>5,47   |      |            |
| Input capacitance                             | $C_{ies}$       |                                     |  |                                  |        |                                       |       | 9240           |      | pF         |
| Output capacitance                            | $C_{oss}$       | f=1MHz                              | 0                                      | 25                               |        | $T_j=25^\circ C$                      |       | 576            |      |            |
| Reverse transfer capacitance                  | $C_{rss}$       |                                     |  |                                  |        |                                       |       | 274            |      |            |
| Gate charge                                   | $Q_{Gate}$      |                                     | $\pm 15$                               | 480                              | 150    | $T_j=25^\circ C$                      |       | 940            |      | nC         |
| Thermal resistance chip to heatsink per chip  | $R_{thJH}$      | Phase-Change Material               |  |                                  |        |                                       |       | 0,34           |      | K/W        |
| Thermal resistance chip to case per chip      | $R_{thJC}$      |                                     |  |                                  |        |                                       |       | 0,23           |      |            |
| <b>D1,D2,D3,D4,D5,D6</b>                      |                 |                                     |  |                                  |        |                                       |       |                |      |            |
| Diode forward voltage                         | $V_F$           |                                     |  |                                  | 50     | $T_j=25^\circ C$<br>$T_j=150^\circ C$ | 1,1   | 1,63<br>1,52   | 2,2  | V          |
| Peak reverse recovery current                 | $I_{RRM}$       |                                     |  |                                  |        | $T_j=25^\circ C$<br>$T_j=150^\circ C$ |       | 96,92<br>114,3 |      | A          |
| Reverse recovery time                         | $t_{rr}$        |                                     |  |                                  |        | $T_j=25^\circ C$<br>$T_j=150^\circ C$ |       | 105,2<br>131,9 |      | ns         |
| Reverse recovered charge                      | $Q_{rr}$        | Rgon=2 $\Omega$                     | $\pm 15$                               | 300                              | 150    | $T_j=25^\circ C$<br>$T_j=150^\circ C$ |       | 4,1<br>8,48    |      | $\mu C$    |
| Peak rate of fall of recovery current         | $di(rec)max/dt$ |                                     |  |                                  |        | $T_j=25^\circ C$<br>$T_j=150^\circ C$ |       | 6378<br>3378   |      | A/ $\mu s$ |
| Reverse recovered energy                      | $E_{rec}$       |                                     |  |                                  |        | $T_j=25^\circ C$<br>$T_j=150^\circ C$ |       | 1,06<br>2,21   |      | mWs        |
| Thermal resistance chip to heatsink per chip  | $R_{thJH}$      | Phase-Change Material               |  |                                  |        |                                       |       | 1,01           |      | K/W        |
| Thermal resistance chip to case per chip      | $R_{thJC}$      |                                     |  |                                  |        |                                       |       | 0,67           |      |            |
| <b>Thermistor</b>                             |                 |                                     |  |                                  |        |                                       |       |                |      |            |
| Rated resistance                              | R               |                                     |  |                                  |        | $T_j=25^\circ C$                      |       | 22000          |      | $\Omega$   |
| Deviation of R100                             | $\Delta R/R$    | R100=1486 $\Omega$                  |  |                                  |        | T=100 $^\circ C$                      | -12   |                | 14   | %          |
| Power dissipation                             | P               |                                     |  |                                  |        | Tc=100 $^\circ C$                     |       | 200            |      | mW         |
| Power dissipation constant                    |                 |                                     |  |                                  |        | $T_j=25^\circ C$                      |       | 2              |      | mW/K       |
| B-value                                       | $B_{(25/50)}$   | Tol. $\pm 3\%$                      |  |                                  |        | $T_j=25^\circ C$                      |       | 3950           |      | K          |
| B-value                                       | $B_{(25/100)}$  | Tol. $\pm 3\%$                      |  |                                  |        | $T_j=25^\circ C$                      |       | 3998           |      | K          |
| Vincotech NTC Reference                       |                 |                                     |  |                                  |        | $T_j=25^\circ C$                      |       |                | B    |            |

**T1a-b,T2a-b,T3a-b,T4a-b,T5a-b,T6a-b/D1,D2,D3,D4,D5,D6**
**Figure 1** T1a-b,T2a-b,T3a-b,T4a-b,T5a-b,T6a-b IGBT

**Typical output characteristics**

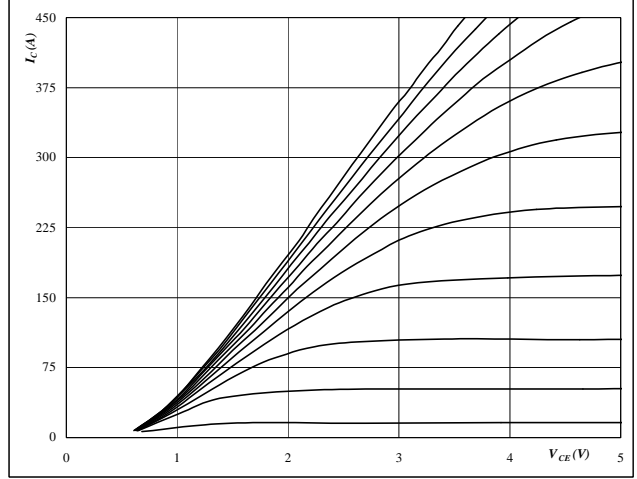
$I_C = f(V_{CE})$


**At**
 $t_p = 250 \mu s$   
 $T_j = 25 \text{ } ^\circ C$   
 $V_{GE}$  from 7 V to 17 V in steps of 1 V

**Figure 2** T1a-b,T2a-b,T3a-b,T4a-b,T5a-b,T6a-b IGBT

**Typical output characteristics**

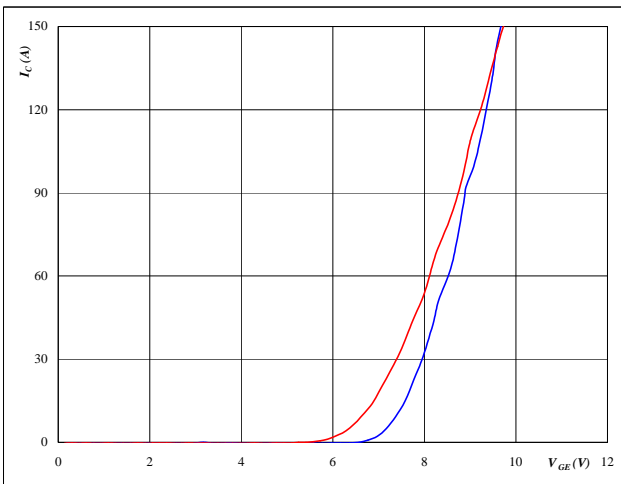
$I_C = f(V_{CE})$


**At**
 $t_p = 250 \mu s$   
 $T_j = 150 \text{ } ^\circ C$   
 $V_{GE}$  from 7 V to 17 V in steps of 1 V

**Figure 3** T1a-b,T2a-b,T3a-b,T4a-b,T5a-b,T6a-b IGBT

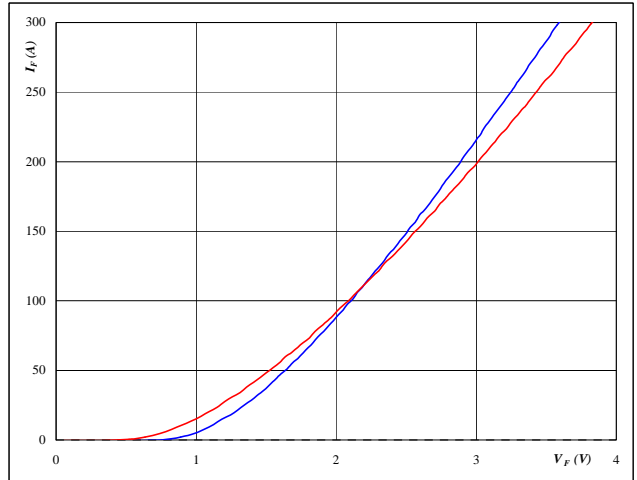
**Typical transfer characteristics**

$I_C = f(V_{GE})$


**At**
 $T_j = 25/150 \text{ } ^\circ C$   
 $t_p = 250 \mu s$   
 $V_{CE} = 10 \text{ V}$ 
**Figure 4** D1,D2,D3,D4,D5,D6 FWD

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

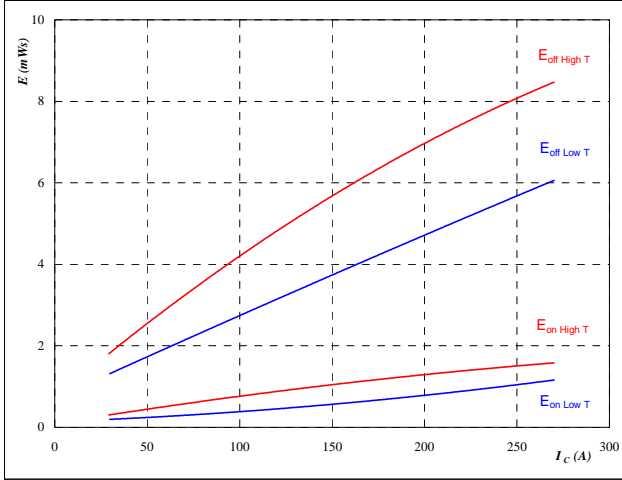
$I_F = f(V_F)$


**At**
 $T_j = 25/150 \text{ } ^\circ C$   
 $t_p = 250 \mu s$

**T1a-b,T2a-b,T3a-b,T4a-b,T5a-b,T6a-b/D1,D2,D3,D4,D5,D6**
**Figure 5** T1a-b,T2a-b,T3a-b,T4a-b,T5a-b,T6a-b IGBT

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

$E = f(I_C)$

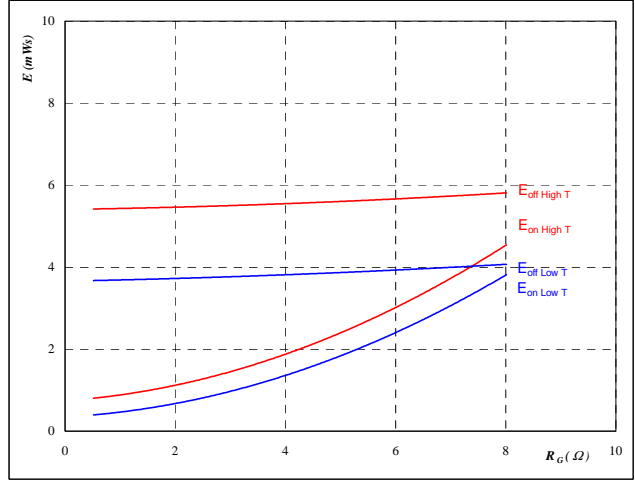


With an inductive load at

 $T_J = 25/150 \text{ } ^\circ\text{C}$   
 $V_{CE} = 300 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $R_{gon} = 2 \text{ } \Omega$   
 $R_{goff} = 2 \text{ } \Omega$ 
**Figure 6** T1a-b,T2a-b,T3a-b,T4a-b,T5a-b,T6a-b IGBT

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

$E = f(R_G)$

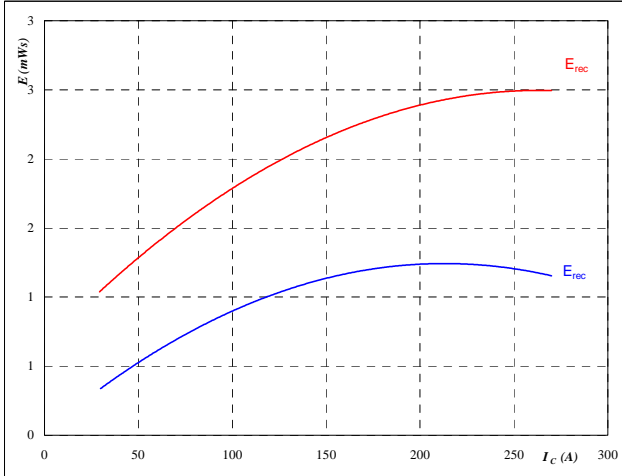


With an inductive load at

 $T_J = 25/150 \text{ } ^\circ\text{C}$   
 $V_{CE} = 300 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $I_C = 150 \text{ A}$ 
**Figure 7** D1,D2,D3,D4,D5,D6 FWD

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

$E_{rec} = f(I_C)$

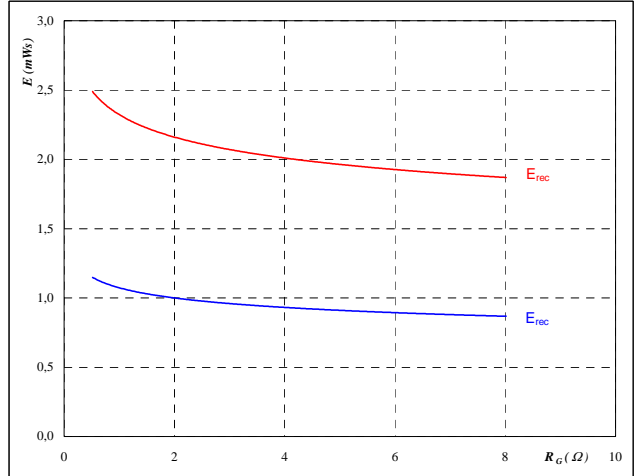


With an inductive load at

 $T_J = 25/150 \text{ } ^\circ\text{C}$   
 $V_{CE} = 300 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $R_{gon} = 2 \text{ } \Omega$ 
**Figure 8** D1,D2,D3,D4,D5,D6 FWD

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

$E_{rec} = f(R_G)$



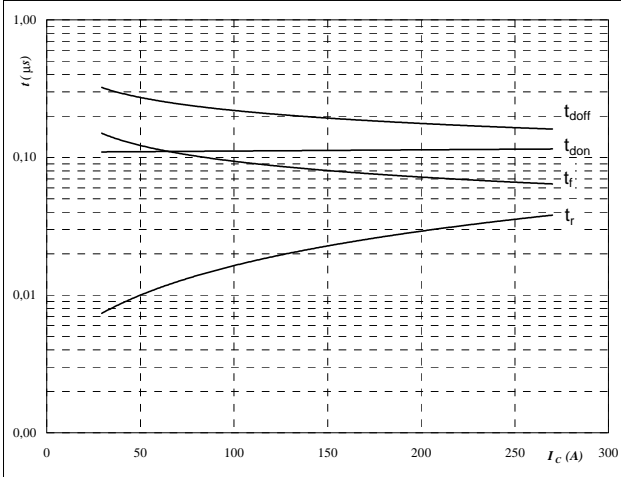
With an inductive load at

 $T_J = 25/150 \text{ } ^\circ\text{C}$   
 $V_{CE} = 300 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $I_C = 150 \text{ A}$

**T1a-b,T2a-b,T3a-b,T4a-b,T5a-b,T6a-b/D1,D2,D3,D4,D5,D6**
**Figure 9** T1a-b,T2a-b,T3a-b,T4a-b,T5a-b,T6a-b IGBT

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

$t = f(I_C)$



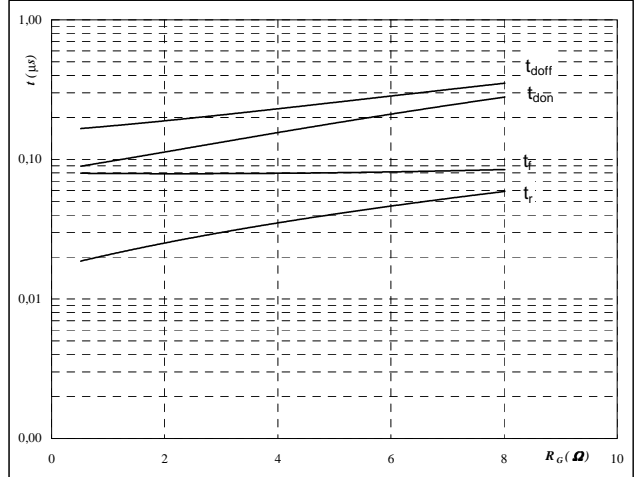
With an inductive load at

|              |     |    |
|--------------|-----|----|
| $T_J =$      | 150 | °C |
| $V_{CE} =$   | 300 | V  |
| $V_{GE} =$   | ±15 | V  |
| $R_{gon} =$  | 2   | Ω  |
| $R_{goff} =$ | 2   | Ω  |

**Figure 10** T1a-b,T2a-b,T3a-b,T4a-b,T5a-b,T6a-b IGBT

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

$t = f(R_G)$



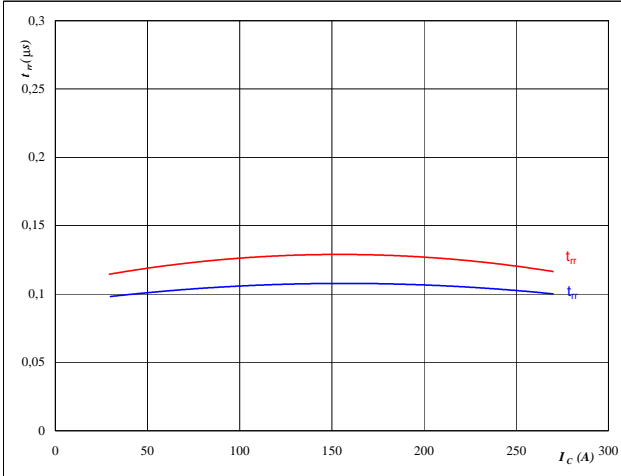
With an inductive load at

|            |     |    |
|------------|-----|----|
| $T_J =$    | 150 | °C |
| $V_{CE} =$ | 300 | V  |
| $V_{GE} =$ | ±15 | V  |
| $I_C =$    | 150 | A  |

**Figure 11** D1,D2,D3,D4,D5,D6 FWD

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

$t_{rr} = f(I_C)$

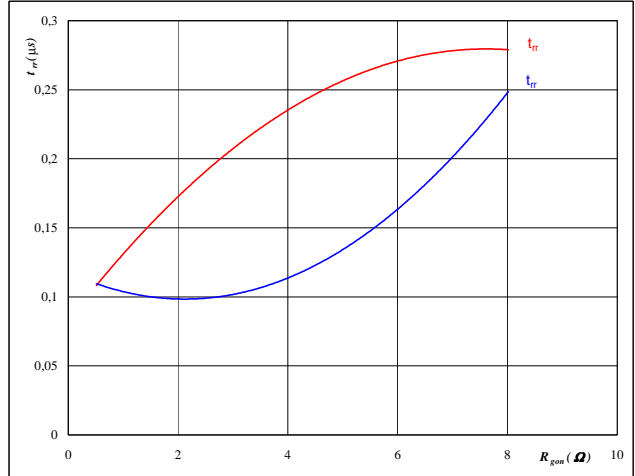

**At**

|             |        |    |
|-------------|--------|----|
| $T_J =$     | 25/150 | °C |
| $V_{CE} =$  | 300    | V  |
| $V_{GE} =$  | ±15    | V  |
| $R_{gon} =$ | 2      | Ω  |

**Figure 12** D1,D2,D3,D4,D5,D6 FWD

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

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

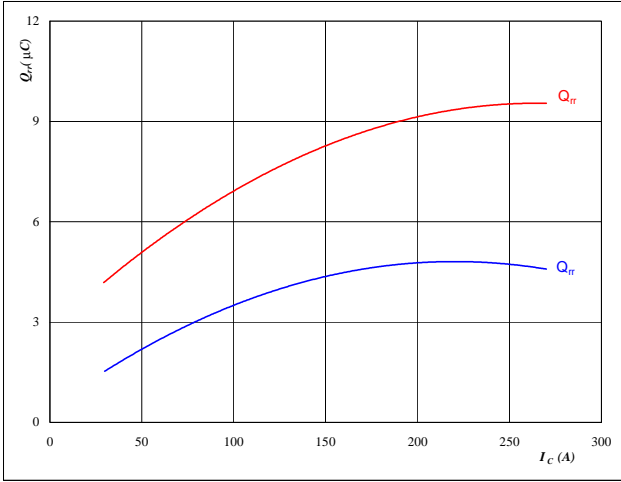

**At**

|            |        |    |
|------------|--------|----|
| $T_J =$    | 25/150 | °C |
| $V_R =$    | 300    | V  |
| $I_F =$    | 150    | A  |
| $V_{GE} =$ | ±15    | V  |

**T1a-b,T2a-b,T3a-b,T4a-b,T5a-b,T6a-b/D1,D2,D3,D4,D5,D6**
**Figure 13** D1,D2,D3,D4,D5,D6 FWD

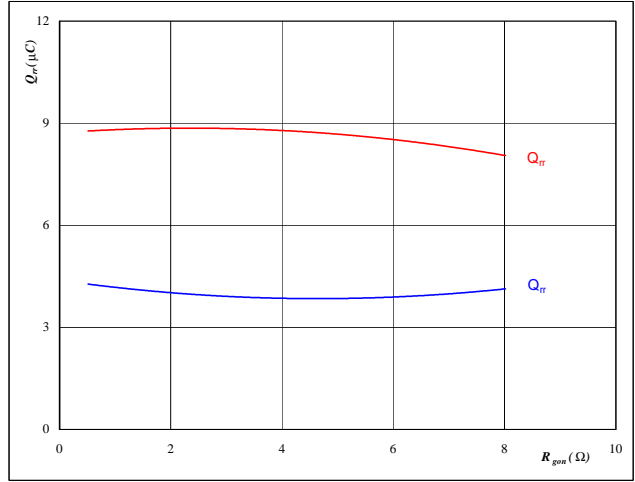
**Typical reverse recovery charge as a function of collector current**

$Q_{rr} = f(I_C)$


**At**
 $T_j = 25/150 \text{ } ^\circ\text{C}$   
 $V_{CE} = 300 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $R_{gon} = 2 \text{ } \Omega$ 
**Figure 14** D1,D2,D3,D4,D5,D6 FWD

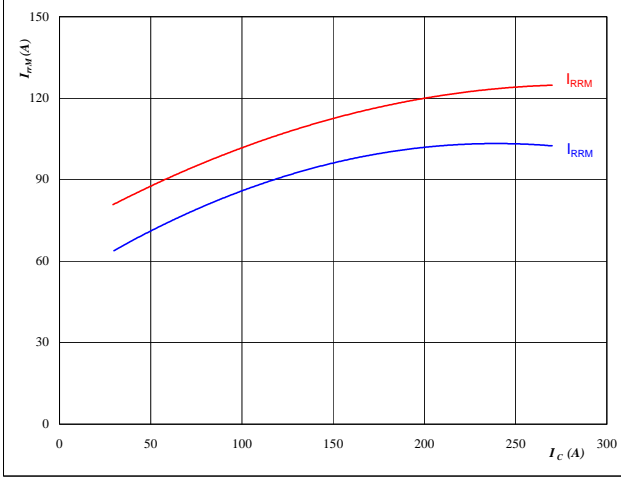
**Typical reverse recovery charge as a function of IGBT turn on gate resistor**

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


**At**
 $T_j = 25/150 \text{ } ^\circ\text{C}$   
 $V_R = 300 \text{ V}$   
 $I_F = 150 \text{ A}$   
 $V_{GE} = \pm 15 \text{ V}$ 
**Figure 15** D1,D2,D3,D4,D5,D6 FWD

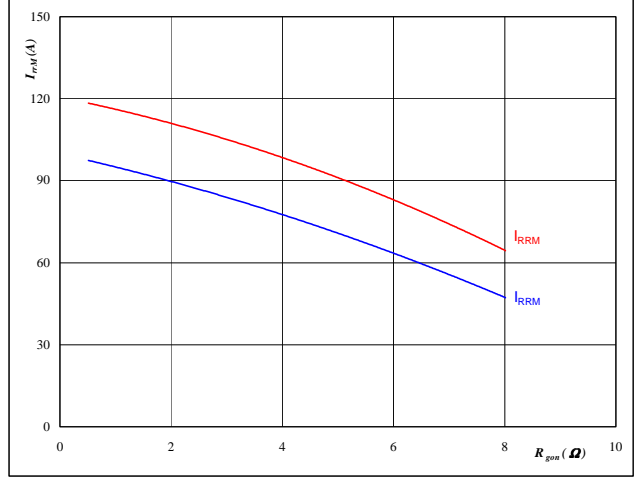
**Typical reverse recovery current as a function of collector current**

$I_{RRM} = f(I_C)$


**At**
 $T_j = 25/150 \text{ } ^\circ\text{C}$   
 $V_{CE} = 300 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $R_{gon} = 2 \text{ } \Omega$ 
**Figure 16** D1,D2,D3,D4,D5,D6 FWD

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

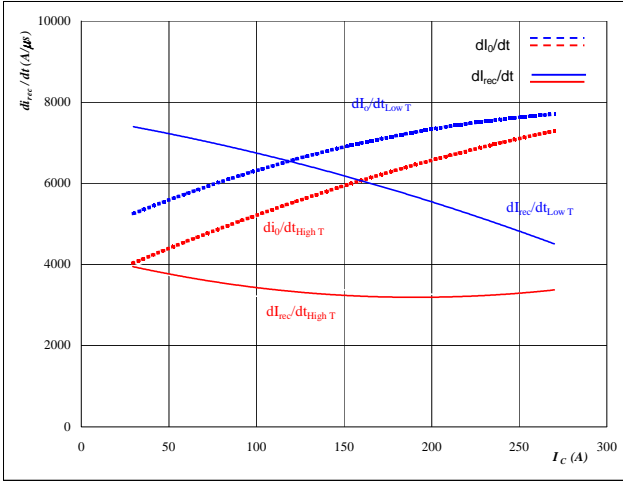
$I_{RRM} = f(R_{gon})$


**At**
 $T_j = 25/150 \text{ } ^\circ\text{C}$   
 $V_R = 300 \text{ V}$   
 $I_F = 150 \text{ A}$   
 $V_{GE} = \pm 15 \text{ V}$

T1a-b,T2a-b,T3a-b,T4a-b,T5a-b,T6a-b/D1,D2,D3,D4,D5,D6

Figure 17 D1,D2,D3,D4,D5,D6 FWD

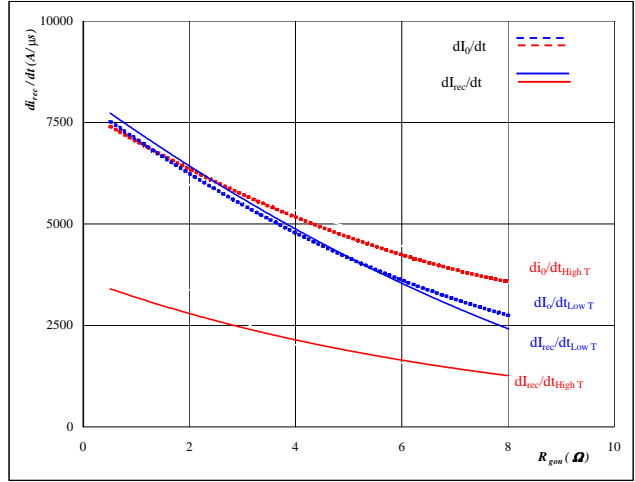
Typical rate of fall of forward and reverse recovery current as a function of collector current  
 $dI_f/dt, dI_{rec}/dt = f(I_c)$



At  
 $T_j = 25/150 \text{ } ^\circ\text{C}$   
 $V_{CE} = 300 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $R_{gon} = 2 \text{ } \Omega$

Figure 18 D1,D2,D3,D4,D5,D6 FWD

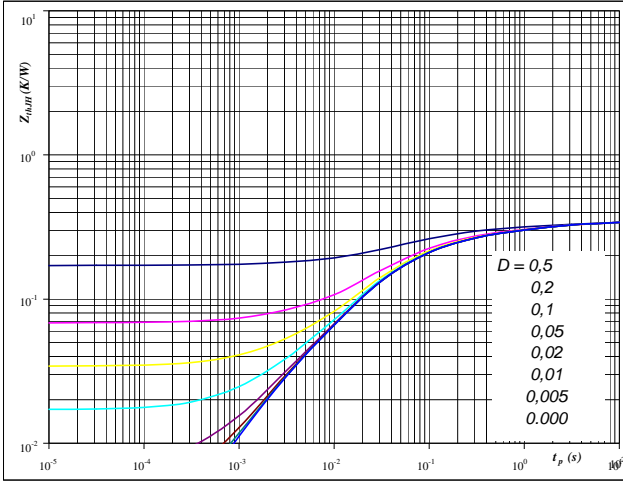
Typical rate of fall of forward and reverse recovery current as a function of IGBT turn on gate resistor  
 $dI_f/dt, dI_{rec}/dt = f(R_{gon})$



At  
 $T_j = 25/150 \text{ } ^\circ\text{C}$   
 $V_R = 300 \text{ V}$   
 $I_F = 150 \text{ A}$   
 $V_{GE} = \pm 15 \text{ V}$

Figure 19 T1a-b,T2a-b,T3a-b,T4a-b,T5a-b,T6a-b IGBT

IGBT transient thermal impedance as a function of pulse width  
 $Z_{thJH} = f(t_p)$



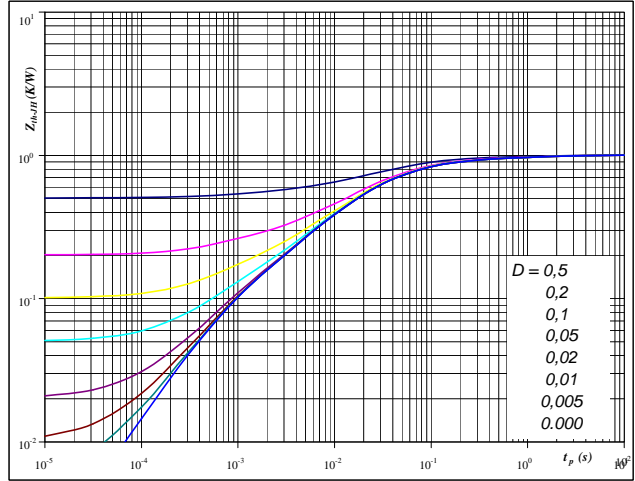
At  
 $D = t_p / T$   
 $R_{thJH} = 0,34 \text{ K/W}$

IGBT thermal model values

| Phase-Change Material |         |
|-----------------------|---------|
| R (C/W)               | Tau (s) |
| 0,05                  | 2,7E+00 |
| 0,06                  | 4,5E-01 |
| 0,12                  | 8,1E-02 |
| 0,10                  | 2,1E-02 |
| 0,01                  | 2,1E-03 |

Figure 20 D1,D2,D3,D4,D5,D6 FWD

FWD transient thermal impedance as a function of pulse width  
 $Z_{thJH} = f(t_p)$



At  
 $D = t_p / T$   
 $R_{thJH} = 1,01 \text{ K/W}$

FWD thermal model values

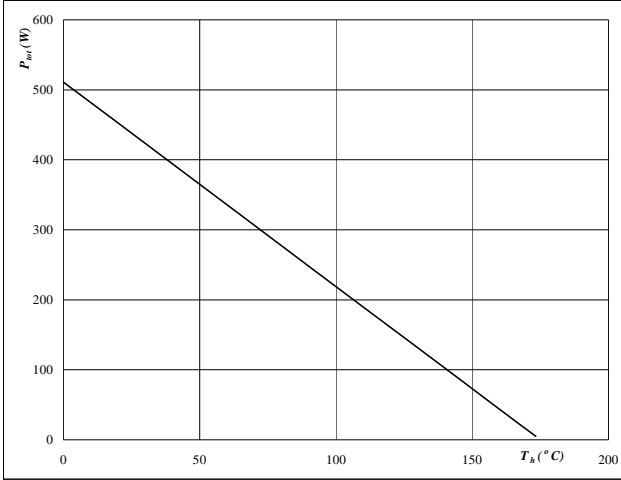
| Phase-Change Material |         |
|-----------------------|---------|
| R (C/W)               | Tau (s) |
| 0,04                  | 3,5E+00 |
| 0,08                  | 4,7E-01 |
| 0,28                  | 7,2E-02 |
| 0,41                  | 2,0E-02 |
| 0,13                  | 5,0E-03 |
| 0,07                  | 6,9E-04 |



**T1a-b,T2a-b,T3a-b,T4a-b,T5a-b,T6a-b/D1,D2,D3,D4,D5,D6**
**Figure 21** T1a-b,T2a-b,T3a-b,T4a-b,T5a-b,T6a-b IGBT

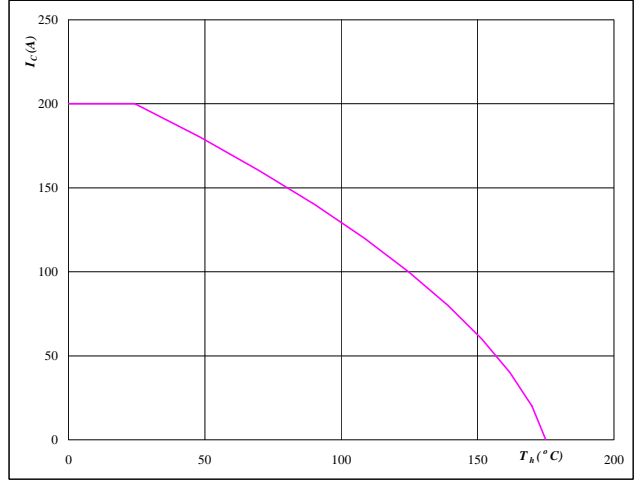
**Power dissipation as a function of heatsink temperature**

$$P_{tot} = f(T_h)$$


**At**  
 $T_j = 175 \text{ } ^\circ\text{C}$ 
**Figure 22** T1a-b,T2a-b,T3a-b,T4a-b,T5a-b,T6a-b IGBT

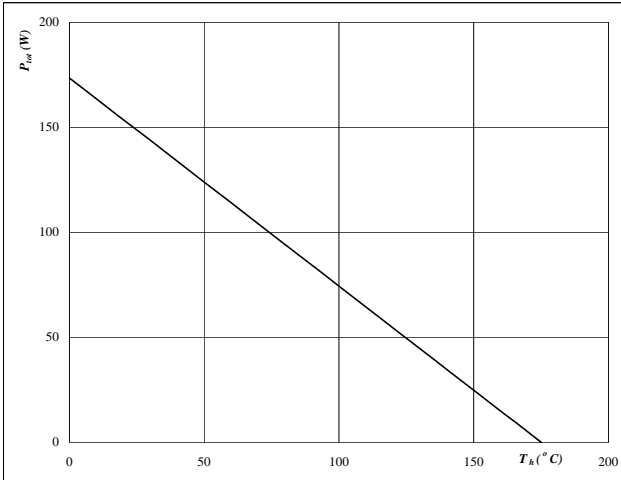
**Collector current as a function of heatsink temperature**

$$I_C = f(T_h)$$


**At**  
 $T_j = 175 \text{ } ^\circ\text{C}$   
 $V_{GE} = 15 \text{ V}$ 
**Figure 23** D1,D2,D3,D4,D5,D6 FWD

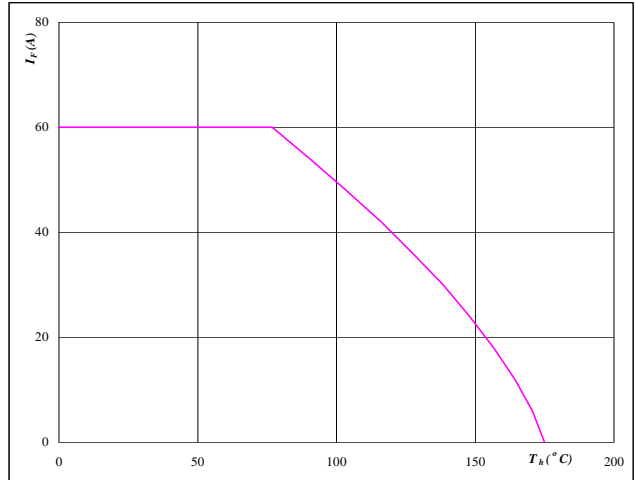
**Power dissipation as a function of heatsink temperature**

$$P_{tot} = f(T_h)$$


**At**  
 $T_j = 175 \text{ } ^\circ\text{C}$ 
**Figure 24** D1,D2,D3,D4,D5,D6 FWD

**Forward current as a function of heatsink temperature**

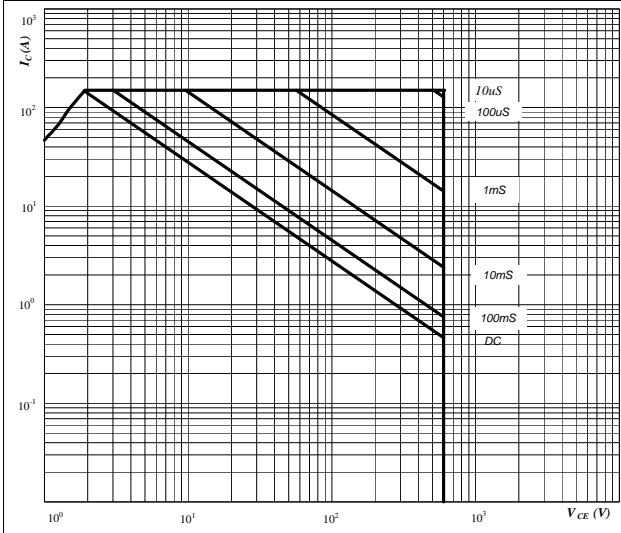
$$I_F = f(T_h)$$


**At**  
 $T_j = 175 \text{ } ^\circ\text{C}$

**T1a-b, T2a-b, T3a-b, T4a-b, T5a-b, T6a-b/D1, D2, D3, D4, D5, D6**
**Figure 25** T1a-b, T2a-b, T3a-b, T4a-b, T5a-b, T6a-b IGBT

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

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

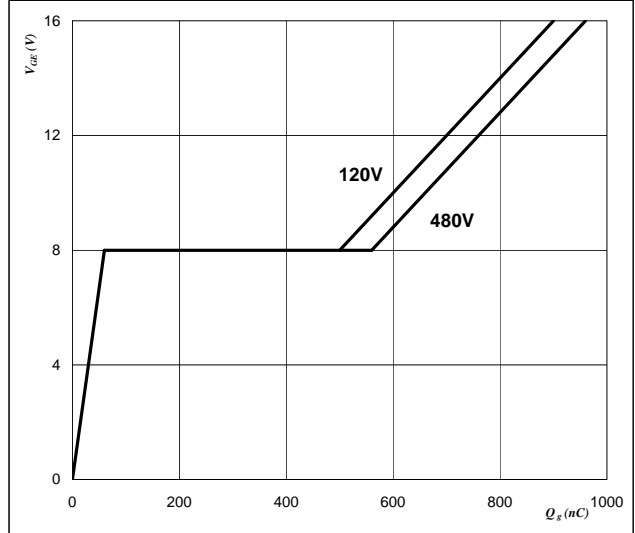


**At**  
D = single pulse  
 $T_h = 80$  °C  
 $V_{GE} = \pm 15$  V  
 $T_j = T_{jmax}$  °C

**Figure 26** T1a-b, T2a-b, T3a-b, T4a-b, T5a-b, T6a-b IGBT

**Gate voltage vs Gate charge**

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

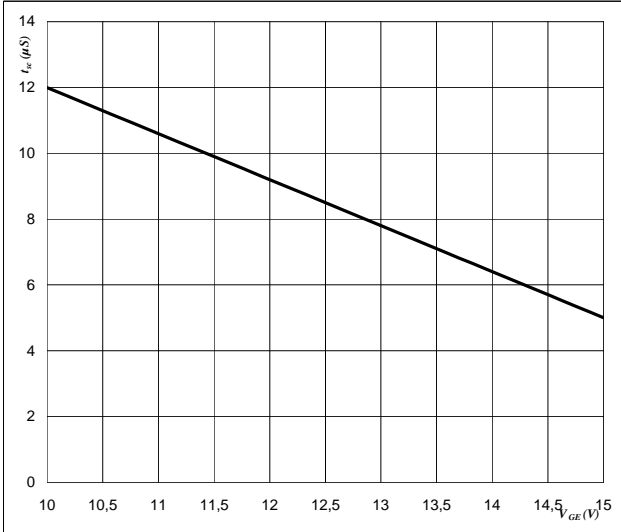


**At**  
 $I_C = 150$  A

**Figure 27** T1a-b, T2a-b, T3a-b, T4a-b, T5a-b, T6a-b IGBT

**Short circuit withstand time as a function of gate-emitter voltage**

$$t_{sc} = f(V_{GE})$$

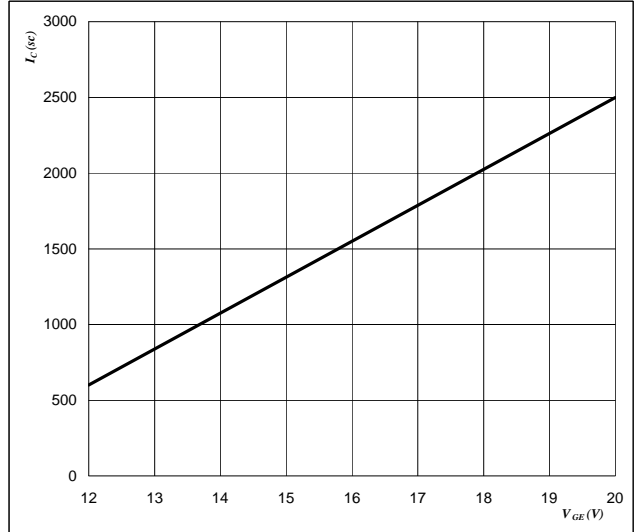


**At**  
 $V_{CE} = 600$  V  
 $T_j \leq 175$  °C

**Figure 28** T1a-b, T2a-b, T3a-b, T4a-b, T5a-b, T6a-b IGBT

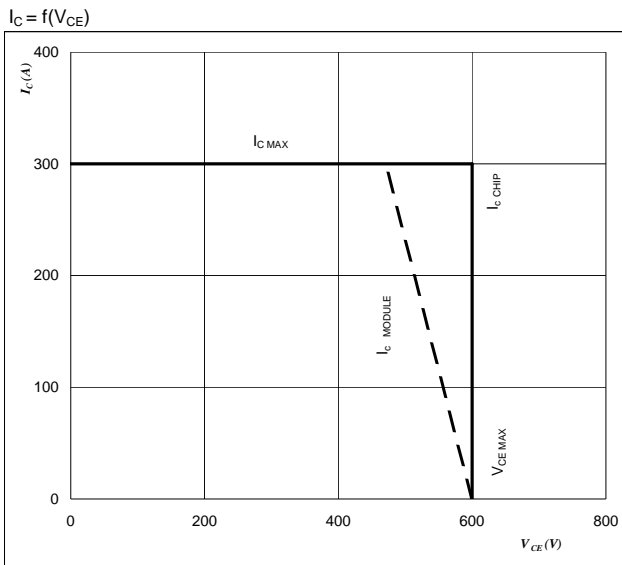
**Typical short circuit collector current as a function of gate-emitter voltage**

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



**At**  
 $V_{CE} \leq 600$  V  
 $T_j = 175$  °C

**Figure 29** T1a-b,T2a-b,T3a-b,T4a-b,T5a-b,T6a-b IGBT  
**Reverse bias safe operating area**

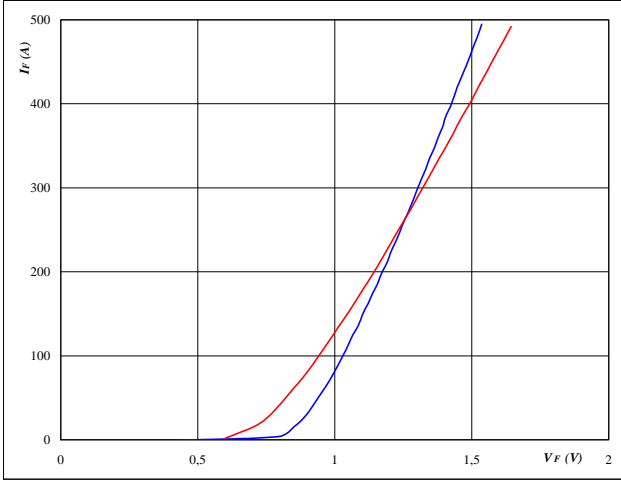


**At**  
 $T_J = 150\ ^\circ\text{C}$   
 $R_{gon} = 2\ \Omega$   
 $R_{goff} = 2\ \Omega$

**D7a-b,D8a-b**
**Figure 1** D7a-b,D8a-b

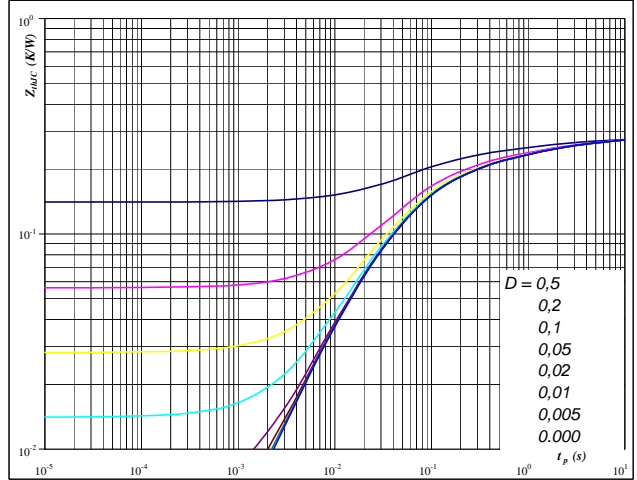
**Typical diode forward current as a function of forward voltage**

$$I_F = f(V_F)$$


**At**  
 $T_j = 25/125 \text{ } ^\circ\text{C}$   
 $t_p = 250 \text{ } \mu\text{s}$ 
**Figure 2** D7a-b,D8a-b

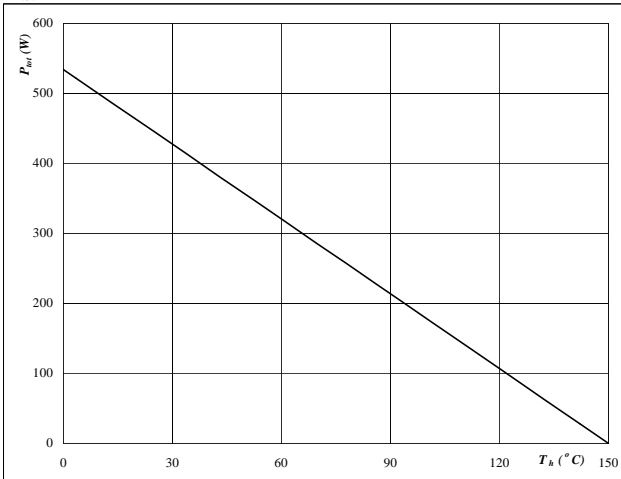
**Diode transient thermal impedance as a function of pulse width**

$$Z_{thJH} = f(t_p)$$


**At**  
 $D = t_p / T$   
 $R_{thJH} = 0,28 \text{ K/W}$ 
**Figure 3** D7a-b,D8a-b

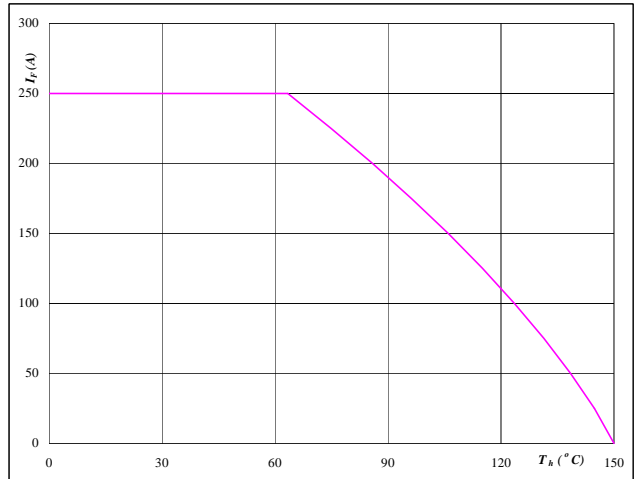
**Power dissipation as a function of heatsink temperature**

$$P_{tot} = f(T_h)$$


**At**  
 $T_j = 150 \text{ } ^\circ\text{C}$ 
**Figure 4** D7a-b,D8a-b

**Forward current as a function of heatsink temperature**

$$I_F = f(T_h)$$

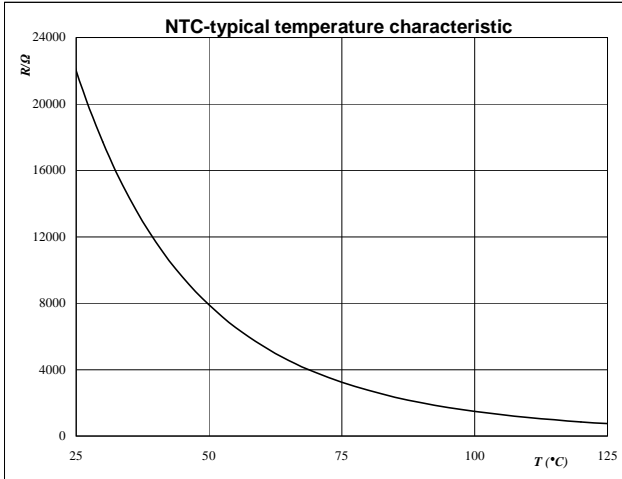

**At**  
 $T_j = 150 \text{ } ^\circ\text{C}$

## Thermistor

**Figure 1** Thermistor

**Typical NTC characteristic  
as a function of temperature**

$$R_T = f(T)$$

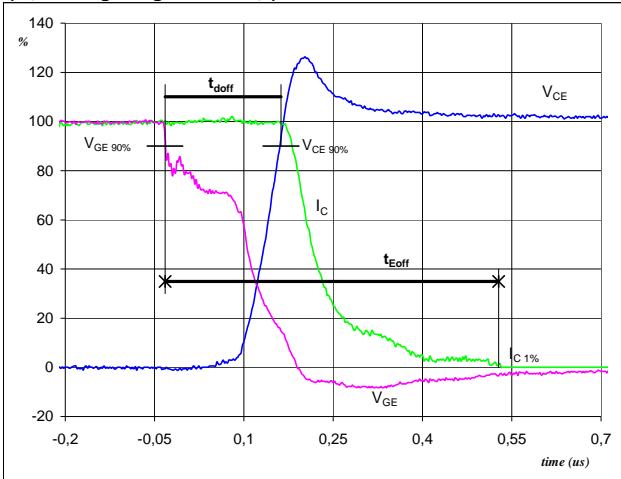


## Switching Definitions Output Inverter

| General conditions |          |
|--------------------|----------|
| $T_j$              | = 150 °C |
| $R_{gon}$          | = 2 Ω    |
| $R_{goff}$         | = 2 Ω    |

**Figure 1** T1a-b,T2a-b,T3a-b,T4a-b,T5a-b,T6a-b IGBT

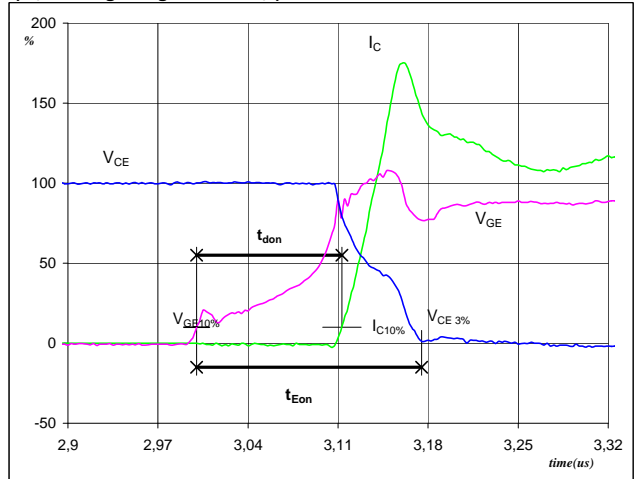
Turn-off Switching Waveforms & definition of  $t_{doff}$ ,  $t_{Eoff}$   
 ( $t_{Eoff}$  = integrating time for  $E_{off}$ )



|                   |      |    |
|-------------------|------|----|
| $V_{GE}(0\%) =$   | -15  | V  |
| $V_{GE}(100\%) =$ | 15   | V  |
| $V_C(100\%) =$    | 300  | V  |
| $I_C(100\%) =$    | 150  | A  |
| $t_{doff} =$      | 0,19 | μs |
| $t_{Eoff} =$      | 0,56 | μs |

**Figure 2** T1a-b,T2a-b,T3a-b,T4a-b,T5a-b,T6a-b IGBT

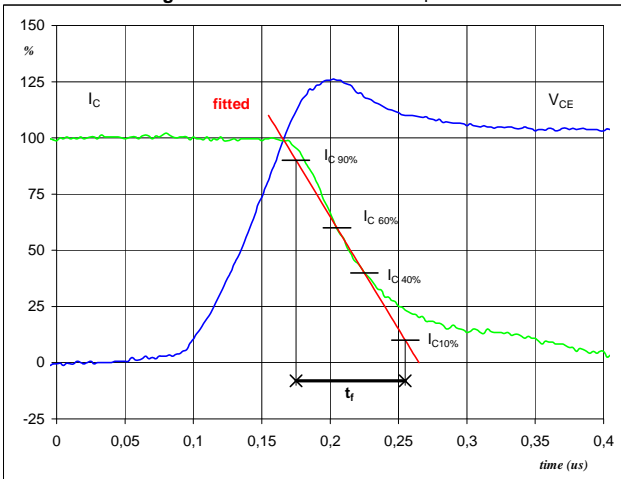
Turn-on Switching Waveforms & definition of  $t_{don}$ ,  $t_{Eon}$   
 ( $t_{Eon}$  = integrating time for  $E_{on}$ )



|                   |      |    |
|-------------------|------|----|
| $V_{GE}(0\%) =$   | -15  | V  |
| $V_{GE}(100\%) =$ | 15   | V  |
| $V_C(100\%) =$    | 300  | V  |
| $I_C(100\%) =$    | 150  | A  |
| $t_{don} =$       | 0,11 | μs |
| $t_{Eon} =$       | 0,17 | μs |

**Figure 3** T1a-b,T2a-b,T3a-b,T4a-b,T5a-b,T6a-b IGBT

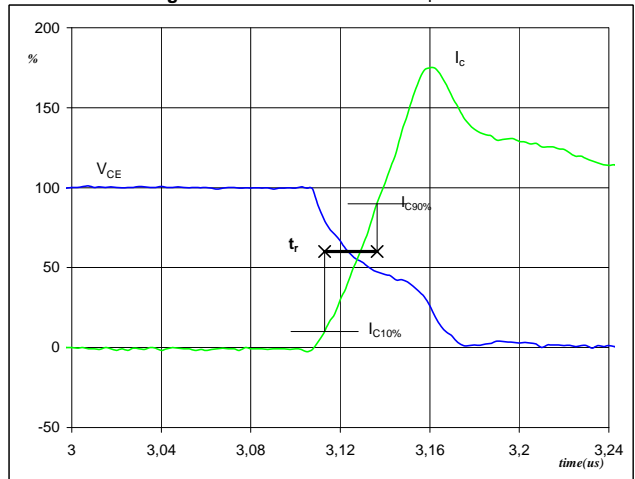
Turn-off Switching Waveforms & definition of  $t_f$



|                |      |    |
|----------------|------|----|
| $V_C(100\%) =$ | 300  | V  |
| $I_C(100\%) =$ | 150  | A  |
| $t_f =$        | 0,08 | μs |

**Figure 4** T1a-b,T2a-b,T3a-b,T4a-b,T5a-b,T6a-b IGBT

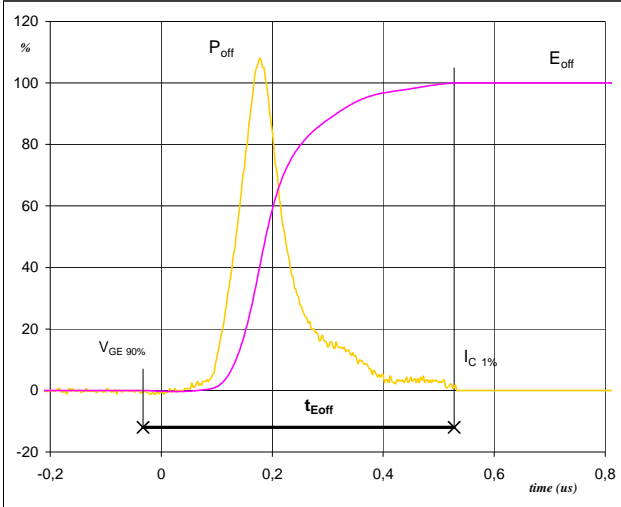
Turn-on Switching Waveforms & definition of  $t_r$



|                |      |    |
|----------------|------|----|
| $V_C(100\%) =$ | 300  | V  |
| $I_C(100\%) =$ | 150  | A  |
| $t_r =$        | 0,02 | μs |

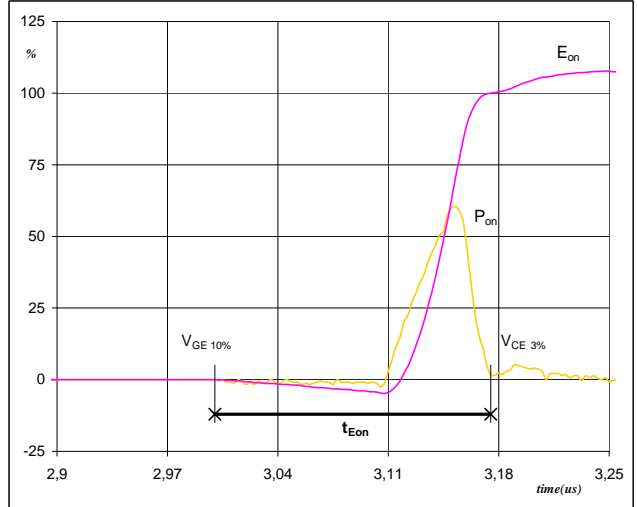
## Switching Definitions Output Inverter

**Figure 5** T1a-b,T2a-b,T3a-b,T4a-b,T5a-b,T6a-b IGBT

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


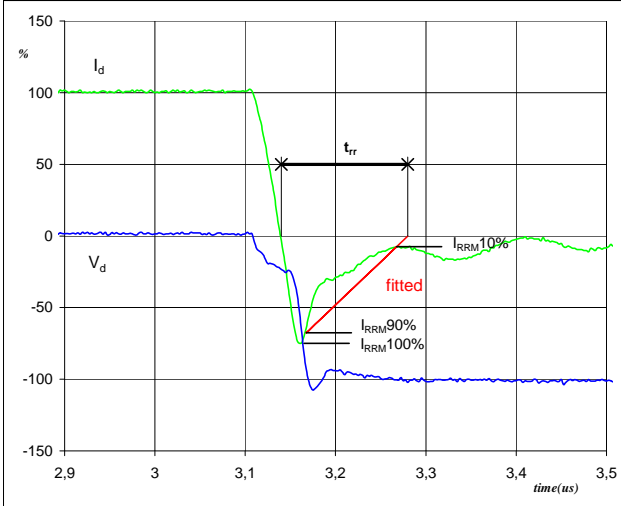
|                    |       |         |
|--------------------|-------|---------|
| $P_{off}(100\%) =$ | 45,00 | kW      |
| $E_{off}(100\%) =$ | 5,47  | mJ      |
| $t_{Eoff} =$       | 0,56  | $\mu$ s |

**Figure 6** T1a-b,T2a-b,T3a-b,T4a-b,T5a-b,T6a-b IGBT

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


|                   |       |         |
|-------------------|-------|---------|
| $P_{on}(100\%) =$ | 45,00 | kW      |
| $E_{on}(100\%) =$ | 1,03  | mJ      |
| $t_{Eon} =$       | 0,17  | $\mu$ s |

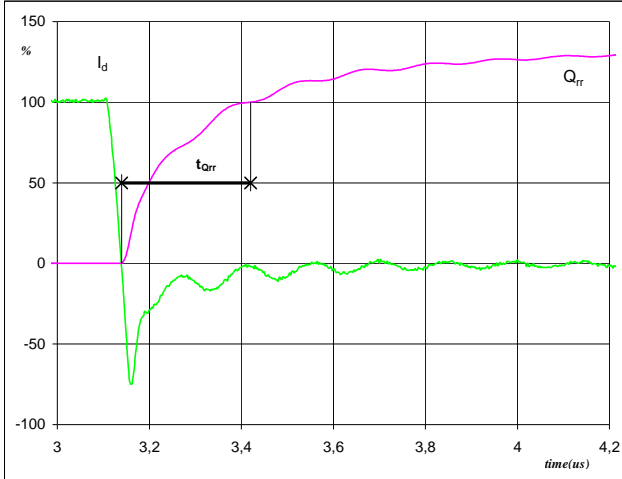
**Figure 7** D1,D2,D3,D4,D5,D6 FWD

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


|                    |      |         |
|--------------------|------|---------|
| $V_d(100\%) =$     | 300  | V       |
| $I_d(100\%) =$     | 150  | A       |
| $I_{RRM}(100\%) =$ | -114 | A       |
| $t_{rr} =$         | 0,13 | $\mu$ s |

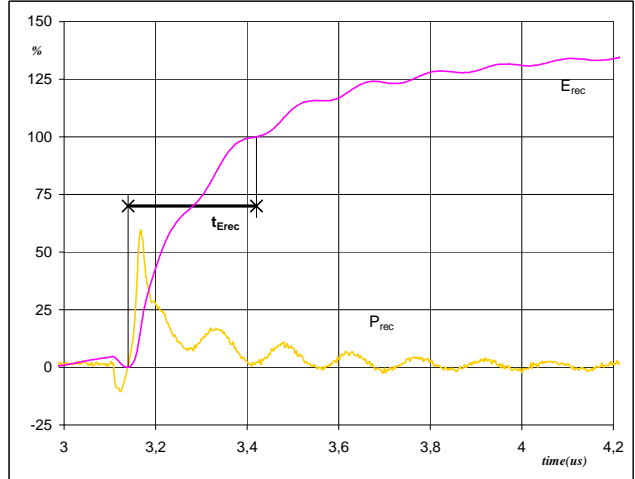
## Switching Definitions Output Inverter

**Figure 8** D1,D2,D3,D4,D5,D6 FWD

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


|                   |      |               |
|-------------------|------|---------------|
| $I_d$ (100%) =    | 150  | A             |
| $Q_{rr}$ (100%) = | 8,48 | $\mu\text{C}$ |
| $t_{Qrr}$ =       | 0,28 | $\mu\text{s}$ |

**Figure 9** D1,D2,D3,D4,D5,D6 FWD

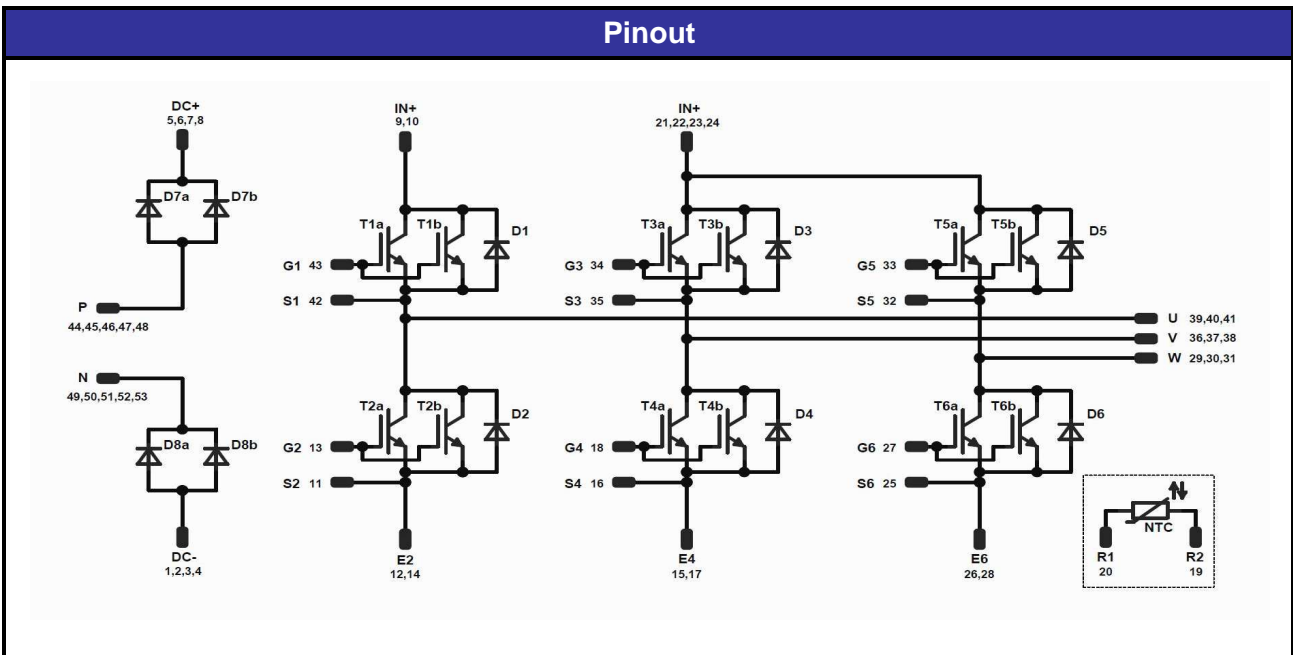
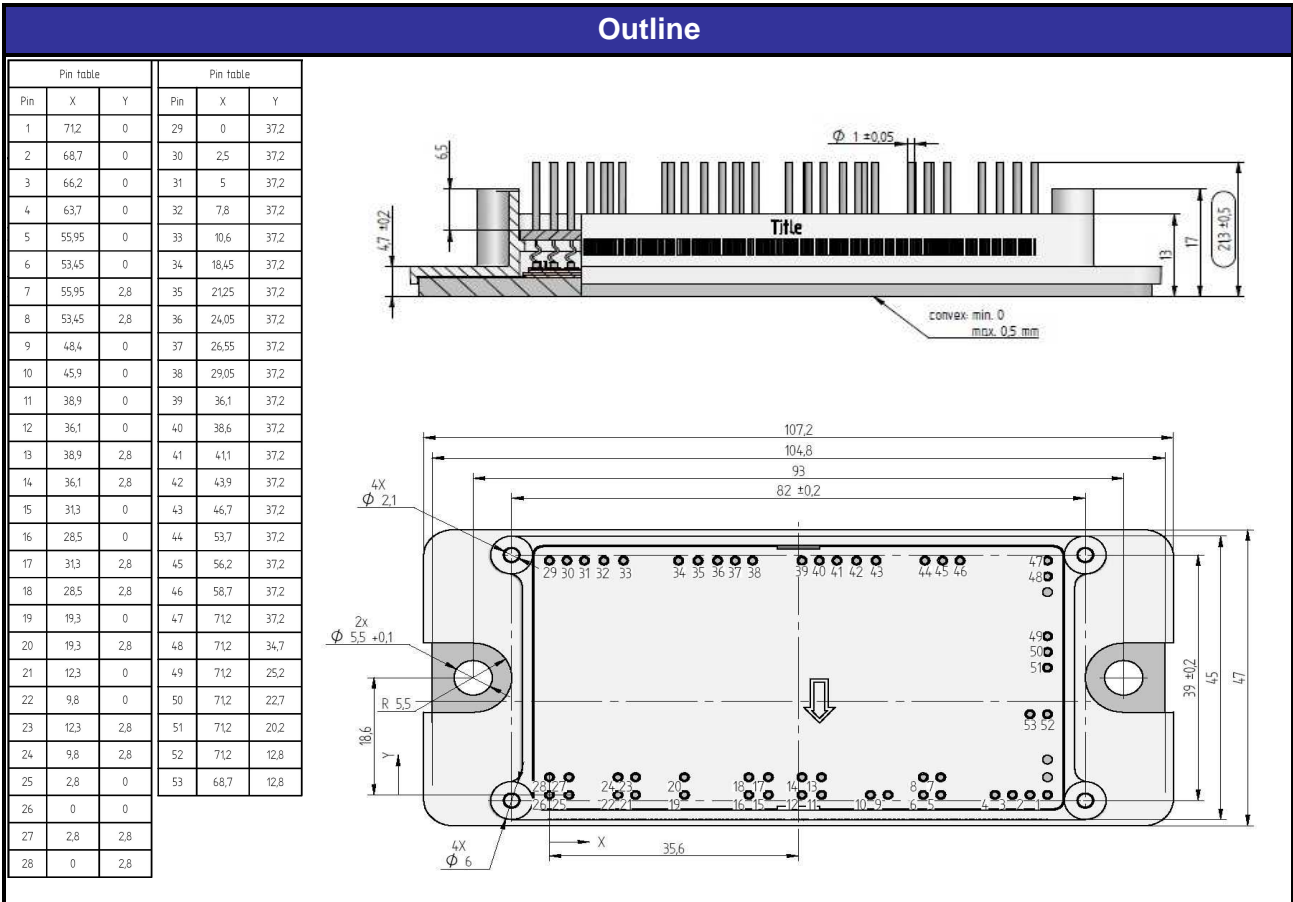
**Turn-on Switching Waveforms & definition of  $t_{Erec}$**   
**( $t_{Erec}$  = integrating time for  $E_{rec}$ )**


|                    |       |               |
|--------------------|-------|---------------|
| $P_{rec}$ (100%) = | 45,00 | kW            |
| $E_{rec}$ (100%) = | 2,21  | mJ            |
| $t_{Erec}$ =       | 0,28  | $\mu\text{s}$ |



Ordering Code and Marking - Outline - Pinout

| Ordering Code & Marking          |                           |                  |                         |
|----------------------------------|---------------------------|------------------|-------------------------|
| Version                          | Ordering Code             | in DataMatrix as | in packaging barcode as |
| 17mm housing                     | 30-F206R6A150SB-M445E     | M445-E           | M445-E                  |
| 17mm housing, without thermistor | 30-F206R6A150SB01-M445E10 | M445-E10         | M445-E10                |
|                                  |                           |                  |                         |



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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.