



**flowANPC S3**

**1200 V / 8 mΩ**

**Features**

- Active NPC topology
- Ultra-high switching frequency with SiC MOSFETs
- Optimized for 1500Vdc applications
- Low inductive mid-power package
- Supports interleaved operation

**Target applications**

- Solar Inverters

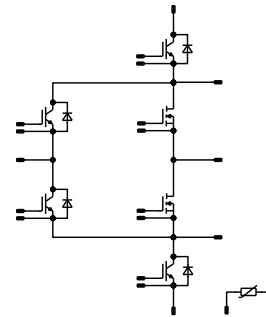
**Types**

- B0-SP12NAA008ME01-LR88F78T

**flow S3 12 mm housing**



**Schematic**





Vincotech

## Maximum Ratings

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

| Parameter                    | Symbol     | Conditions                            | Value   | Unit |
|------------------------------|------------|---------------------------------------|---------|------|
| <b>AC Switch</b>             |            |                                       |         |      |
| Drain-source voltage         | $V_{DSS}$  |                                       | 1200    | V    |
| Drain current (DC current)   | $I_D$      | $T_j = T_{jmax}$ $T_s = 80\text{ °C}$ | 148     | A    |
| Peak drain current           | $I_{DM}$   | $t_p$ limited by $T_{jmax}$           | 480     | A    |
| Total power dissipation      | $P_{tot}$  | $T_j = T_{jmax}$ $T_s = 80\text{ °C}$ | 262     | W    |
| Gate-source voltage          | $V_{GSS}$  |                                       | -4 / 15 | V    |
|                              |            | dynamic                               | -8 / 19 |      |
| Maximum Junction Temperature | $T_{jmax}$ |                                       | 175     | °C   |

## Neutral Point Switch

|                                   |            |  |      |    |
|-----------------------------------|------------|--|------|----|
| Collector-emitter voltage         | $V_{CES}$  |  | 1200 | V  |
| Collector current (DC current)    | $I_C$      | $T_j = T_{jmax}$ $T_s = 80\text{ °C}$                                  | 128  | A  |
| Repetitive peak collector current | $I_{CRM}$  | $t_p$ limited by $T_{jmax}$  | 300  | A  |
| Total power dissipation           | $P_{tot}$  | $T_j = T_{jmax}$ $T_s = 80\text{ °C}$                                  | 226  | W  |
| Gate-emitter voltage              | $V_{GES}$  |  | ±20  | V  |
| Short circuit ratings             | $t_{SC}$   | $V_{GE} = 15\text{ V}$ , $V_{CC} = 800\text{ V}$ $T_j = 150\text{ °C}$ | 9,5  | µs |
| Maximum junction temperature      | $T_{jmax}$ |  | 175  | °C |

## DC-Link Diode

|                                 |            |                                       |      |    |
|---------------------------------|------------|---------------------------------------|------|----|
| Peak repetitive reverse voltage | $V_{RRM}$  |                                       | 1200 | V  |
| Forward current (DC current)    | $I_F$      | $T_j = T_{jmax}$ $T_s = 80\text{ °C}$ | 104  | A  |
| Repetitive peak forward current | $I_{FRM}$  | $t_p$ limited by $T_{jmax}$           | 300  | A  |
| Total power dissipation         | $P_{tot}$  | $T_j = T_{jmax}$ $T_s = 80\text{ °C}$ | 172  | W  |
| Maximum junction temperature    | $T_{jmax}$ |                                       | 175  | °C |



Vincotech

## Maximum Ratings

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

| Parameter                         | Symbol     | Conditions   | Value    | Unit               |
|-----------------------------------|------------|--|----------|--------------------|
| <b>DC-Link Switch</b>             |            |  |          |                    |
| Collector-emitter voltage         | $V_{CES}$  |  | 1200     | V                  |
| Collector current (DC current)    | $I_C$      | $T_j = T_{jmax}$ $T_s = 80\text{ °C}$                                  | 128      | A                  |
| Repetitive peak collector current | $I_{CRM}$  | $t_p$ limited by $T_{jmax}$  | 300      | A                  |
| Total power dissipation           | $P_{tot}$  | $T_j = T_{jmax}$ $T_s = 80\text{ °C}$                                  | 226      | W                  |
| Gate-emitter voltage              | $V_{GES}$  |  | $\pm 20$ | V                  |
| Short circuit ratings             | $i_{SC}$   | $V_{GE} = 15\text{ V}$ , $V_{CC} = 800\text{ V}$ $T_j = 150\text{ °C}$ | 9,5      | $\mu\text{s}$      |
| Maximum junction temperature      | $T_{jmax}$ |  | 175      | $^{\circ}\text{C}$ |

## Neutral Point Diode

|                                 |            |                                       |      |                    |
|---------------------------------|------------|---------------------------------------|------|--------------------|
| Peak repetitive reverse voltage | $V_{RRM}$  |                                       | 1200 | V                  |
| Forward current (DC current)    | $I_F$      | $T_j = T_{jmax}$ $T_s = 80\text{ °C}$ | 104  | A                  |
| Repetitive peak forward current | $I_{FRM}$  | $t_p$ limited by $T_{jmax}$           | 300  | A                  |
| Total power dissipation         | $P_{tot}$  | $T_j = T_{jmax}$ $T_s = 80\text{ °C}$ | 172  | W                  |
| Maximum junction temperature    | $T_{jmax}$ |                                       | 175  | $^{\circ}\text{C}$ |

## Module Properties

### Thermal Properties

|   |           |  |                            |                    |
|---|-----------|--|----------------------------|--------------------|
| Storage temperature                             | $T_{stg}$ |  | -40...+125                 | $^{\circ}\text{C}$ |
| Operation temperature under switching condition | $T_{jop}$ |  | -40...+( $T_{jmax} - 25$ ) | $^{\circ}\text{C}$ |

### Isolation Properties

|                            |            |                                     |            |    |
|----------------------------|------------|-------------------------------------|------------|----|
| Isolation voltage          | $V_{isol}$ | DC Test Voltage* $t_p = 2\text{ s}$ | 6000       | V  |
| Creepage distance          |            |                                     | 9,53       | mm |
| Clearance                  |            |                                     | 8,19       | mm |
| Comparative Tracking Index | CTI        |                                     | $\geq 600$ |    |

\*100 % tested in production



Vincotech

### Characteristic Values

| Parameter | Symbol | Conditions                   |   |                                     |            |     | Values |     |  | Unit |
|-----------|--------|------------------------------|---|-------------------------------------|------------|-----|--------|-----|--|------|
|           |        | $V_{GE}$ [V]<br>$V_{GS}$ [V] | $V_{CE}$ [V]<br>$V_{DS}$ [V]<br>$V_F$ [V] | $I_C$ [A]<br>$I_D$ [A]<br>$I_F$ [A] | $T_j$ [°C] | Min | Typ    | Max |  |      |

### AC Switch

#### Static

|                                  |              |               |       |      |       |                  |     |               |                     |    |
|----------------------------------|--------------|---------------|-------|------|-------|------------------|-----|---------------|---------------------|----|
| Drain-source on-state resistance | $r_{DS(on)}$ |               | 15    |      | 160   | 25<br>125<br>150 | 5,6 | 9<br>11<br>12 | 10,4 <sup>(1)</sup> | mΩ |
| Gate-source threshold voltage    | $V_{GS(th)}$ |               | 0     |      | 0,046 | 25               | 1,8 | 2,5           | 3,6                 | V  |
| Gate to Source Leakage Current   | $I_{GSS}$    |               | 15    | 0    |       | 25               |     | 40            | 1000                | nA |
| Zero Gate Voltage Drain Current  | $I_{DSS}$    |               | 0     | 1200 |       | 25               |     | 4             | 76                  | μA |
| Internal gate resistance         | $r_g$        |               |       |      |       |                  |     | 0,425         |                     | Ω  |
| Gate charge                      | $Q_g$        |               | -4/15 | 800  | 160   | 25               |     | 472           |                     | nC |
| Short-circuit input capacitance  | $C_{iss}$    | $f = 100$ kHz | 0     | 1000 | 0     | 25               |     | 13428         |                     | pF |
| Short-circuit output capacitance | $C_{oss}$    |               |       |      |       |                  |     | 516           |                     |    |
| Reverse transfer capacitance     | $C_{rss}$    |               |       |      |       |                  |     | 32            |                     |    |
| Diode forward voltage            | $V_{SD}$     |               | 0     |      | 80    | 25               |     | 4,6           |                     | V  |

#### Thermal

|  |               |                                       |  |  |  |  |  |      |  |     |
|--|---------------|---------------------------------------|--|--|--|--|--|------|--|-----|
| Thermal resistance junction to sink <sup>(2)</sup> | $R_{th(j-s)}$ | $\lambda_{paste} = 4,4$ W/mK<br>(PTM) |  |  |  |  |  | 0,36 |  | K/W |
|--|---------------|---------------------------------------|--|--|--|--|--|------|--|-----|





Vincotech

**B0-SP12NAA008ME01-LR88F78T**  
datasheet

### Characteristic Values

| Parameter                             | Symbol               | Conditions  |   |                                     |            |                  | Values |                            |  | Unit       |
|---------------------------------------|----------------------|---|---|-------------------------------------|------------|------------------|--------|----------------------------|--|------------|
|                                       |                      | $V_{GE}$ [V]<br>$V_{GS}$ [V]  | $V_{CE}$ [V]<br>$V_{DS}$ [V]<br>$V_F$ [V] | $I_C$ [A]<br>$I_D$ [A]<br>$I_F$ [A] | $T_j$ [°C] | Min              | Typ    | Max                        |  |            |
| <b>Dynamic</b>                        |                      |   |   |                                     |            |                  |        |                            |  |            |
| Turn-on delay time                    | $t_{d(on)}$          |   |   |                                     |            | 25<br>125<br>150 |        | 34,24<br>30,4<br>29,76     |  | ns         |
| Rise time                             | $t_r$                | $R_{gon} = 4 \Omega$<br>$R_{goff} = 4 \Omega$                           |   |                                     |            | 25<br>125<br>150 |        | 14,4<br>12,8<br>12,16      |  | ns         |
| Turn-off delay time                   | $t_{d(off)}$         |   |   |                                     |            | 25<br>125<br>150 |        | 154,88<br>177,28<br>183,36 |  | ns         |
| Fall time                             | $t_f$                |   |   |                                     |            | 25<br>125<br>150 |        | 41,56<br>43,02<br>42,14    |  | ns         |
| Turn-on energy (per pulse)            | $E_{on}$             | $Q_{rFWD}=1,16 \mu C$<br>$Q_{rFWD}=1,37 \mu C$<br>$Q_{rFWD}=1,46 \mu C$ | 0/15                                      | 600                                 | 40         | 25<br>125<br>150 |        | 0,973<br>0,818<br>0,801    |  | mWs        |
| Turn-off energy (per pulse)           | $E_{off}$            |   |   |                                     |            | 25<br>125<br>150 |        | 0,431<br>0,464<br>0,482    |  | mWs        |
| Peak recovery current                 | $I_{RRM}$            |   |   |                                     |            | 25<br>125<br>150 |        | 57,38<br>66,88<br>70,09    |  | A          |
| Reverse recovery time                 | $t_{rr}$             |   |   |                                     |            | 25<br>125<br>150 |        | 35,15<br>35,4<br>35,88     |  | ns         |
| Recovered charge                      | $Q_r$                | $di/dt=3489 A/\mu s$<br>$di/dt=4139 A/\mu s$<br>$di/dt=4327 A/\mu s$    |   |                                     |            | 25<br>125<br>150 |        | 1,16<br>1,37<br>1,46       |  | $\mu C$    |
| Reverse recovered energy              | $E_{rec}$            |   |   |                                     |            | 25<br>125<br>150 |        | 0,357<br>0,571<br>0,635    |  | mWs        |
| Peak rate of fall of recovery current | $(di_{rr}/dt)_{max}$ |   |   |                                     |            | 25<br>125<br>150 |        | 4007<br>4266<br>4436       |  | A/ $\mu s$ |



Vincotech

### Characteristic Values

| Parameter | Symbol | Conditions   |              |              |           |            | Values |     |     | Unit |
|-----------|--------|--------------|--------------|--------------|-----------|------------|--------|-----|-----|------|
|           |        | $V_{GS}$ [V] | $V_{GE}$ [V] | $V_{DS}$ [V] | $I_D$ [A] | $T_j$ [°C] | Min    | Typ | Max |      |

#### Neutral Point Switch

##### Static

|                                      |               |                  |    |      |       |                  |     |                     |                     |    |
|--------------------------------------|---------------|------------------|----|------|-------|------------------|-----|---------------------|---------------------|----|
| Gate-emitter threshold voltage       | $V_{GE(th)}$  |                  |    | 10   | 0,015 | 25               | 5,4 | 6                   | 6,6                 | V  |
| Collector-emitter saturation voltage | $V_{CE(sat)}$ |                  | 15 |      | 150   | 25<br>125<br>150 |     | 1,58<br>1,8<br>1,86 | 1,85 <sup>(1)</sup> | V  |
| Collector-emitter cut-off current    | $I_{CES}$     |                  | 0  | 1200 |       | 25               |     |                     | 100                 | μA |
| Gate-emitter leakage current         | $I_{GES}$     |                  | 20 | 0    |       | 25               |     |                     | 500                 | nA |
| Internal gate resistance             | $r_g$         |                  |    |      |       |                  |     | 3                   |                     | Ω  |
| Input capacitance                    | $C_{ies}$     |                  |    |      |       |                  |     | 30000               |                     | pF |
| Output capacitance                   | $C_{oes}$     |                  | 0  | 10   |       | 25               |     | 880                 |                     | pF |
| Reverse transfer capacitance         | $C_{res}$     |                  |    |      |       |                  |     | 320                 |                     | pF |
| Gate charge                          | $Q_g$         | $V_{CC} = 600$ V | 15 |      | 150   | 25               |     | 1000                |                     | nC |

##### Thermal

|  |               |                                       |  |  |  |  |  |      |  |     |
|--|---------------|---------------------------------------|--|--|--|--|--|------|--|-----|
| Thermal resistance junction to sink <sup>(2)</sup> | $R_{th(j-s)}$ | $\lambda_{paste} = 4,4$ W/mK<br>(PTM) |  |  |  |  |  | 0,42 |  | K/W |
|--|---------------|---------------------------------------|--|--|--|--|--|------|--|-----|

##### Dynamic

|                             |              |   |  |  |  |                  |  |                            |  |     |
|-----------------------------|--------------|---|--|--|--|------------------|--|----------------------------|--|-----|
| Turn-on delay time          | $t_{d(on)}$  |   |  |  |  | 25<br>125<br>150 |  | 319,36<br>334,72<br>338,56 |  | ns  |
| Rise time                   | $t_r$        |   |  |  |  | 25<br>125<br>150 |  | 62,08<br>74,24<br>77,76    |  | ns  |
| Turn-off delay time         | $t_{d(off)}$ |   |  |  |  | 25<br>125<br>150 |  | 247,36<br>287,04<br>296,64 |  | ns  |
| Fall time                   | $t_f$        |   |  |  |  | 25<br>125<br>150 |  | 77,11<br>104,65<br>111,69  |  | ns  |
| Turn-on energy (per pulse)  | $E_{on}$     | $Q_{tFWD} = 11,82$ μC<br>$Q_{tFWD} = 19,01$ μC<br>$Q_{tFWD} = 21,51$ μC |  |  |  | 25<br>125<br>150 |  | 13,91<br>18,53<br>20,08    |  | mWs |
| Turn-off energy (per pulse) | $E_{off}$    |   |  |  |  | 25<br>125<br>150 |  | 10,68<br>14,39<br>15,49    |  | mWs |



Vincotech

**B0-SP12NAA008ME01-LR88F78T**  
datasheet

### Characteristic Values

| Parameter  | Symbol            | Conditions  |   |                                     |                  |                  | Values                     |                    |  | Unit |
|--|-------------------|---|---|-------------------------------------|------------------|------------------|----------------------------|--------------------|--|------|
|  |                   | $V_{GE}$ [V]<br>$V_{GS}$ [V]                                | $V_{CE}$ [V]<br>$V_{DS}$ [V]<br>$V_F$ [V] | $I_C$ [A]<br>$I_D$ [A]<br>$I_F$ [A] | $T_j$ [°C]       | Min              | Typ                        | Max                |  |      |
| <b>DC-Link Diode</b>                               |                   |   |   |                                     |                  |                  |                            |                    |  |      |
| <b>Static</b>                                      |                   |   |   |                                     |                  |                  |                            |                    |  |      |
| Forward voltage                                    | $V_F$             |   |   | 150                                 | 25<br>125<br>150 |                  | 1,79<br>1,9<br>1,89        | 2,1 <sup>(1)</sup> |  | V    |
| Reverse leakage current                            | $I_R$             | $V_r = 1200$ V  |   |                                     | 25               |                  |                            | 40                 |  | μA   |
| <b>Thermal</b>                                     |                   |   |   |                                     |                  |                  |                            |                    |  |      |
| Thermal resistance junction to sink <sup>(2)</sup> | $R_{th(j-s)}$     | $\lambda_{paste} = 4,4$ W/mK<br>(PTM)                       |   |                                     |                  |                  | 0,55                       |                    |  | K/W  |
| <b>Dynamic</b>                                     |                   |   |   |                                     |                  |                  |                            |                    |  |      |
| Peak recovery current                              | $I_{RRM}$         |   |   |                                     | 25<br>125<br>150 |                  | 82,45<br>86,04<br>88,02    |                    |  | A    |
| Reverse recovery time                              | $t_{rr}$          |   |   |                                     | 25<br>125<br>150 |                  | 325,48<br>489,27<br>540,31 |                    |  | ns   |
| Recovered charge                                   | $Q_r$             | $di/dt=1925$ A/μs<br>$di/dt=1659$ A/μs<br>$di/dt=1643$ A/μs | ±15                                       | 600                                 | 135              | 25<br>125<br>150 | 11,82<br>19,01<br>21,51    |                    |  | μC   |
| Reverse recovered energy                           | $E_{rec}$         |   |   |                                     | 25<br>125<br>150 |                  | 3,99<br>6,77<br>7,72       |                    |  | mWs  |
| Peak rate of fall of recovery current              | $(di_r/dt)_{max}$ |   |   |                                     | 25<br>125<br>150 |                  | 433,38<br>360,37<br>331,11 |                    |  | A/μs |



Vincotech

### Characteristic Values

| Parameter | Symbol | Conditions                   |   |                                     |            |     | Values |     |  | Unit |
|-----------|--------|------------------------------|---|-------------------------------------|------------|-----|--------|-----|--|------|
|           |        | $V_{GE}$ [V]<br>$V_{GS}$ [V] | $V_{CE}$ [V]<br>$V_{DS}$ [V]<br>$V_F$ [V] | $I_C$ [A]<br>$I_D$ [A]<br>$I_F$ [A] | $T_j$ [°C] | Min | Typ    | Max |  |      |

#### DC-Link Switch

##### Static

|                                      |               |                  |      |       |                  |     |                     |                     |    |
|--------------------------------------|---------------|------------------|------|-------|------------------|-----|---------------------|---------------------|----|
| Gate-emitter threshold voltage       | $V_{GE(th)}$  |                  | 10   | 0,015 | 25               | 5,4 | 6                   | 6,6                 | V  |
| Collector-emitter saturation voltage | $V_{CE(sat)}$ | 15               |      | 150   | 25<br>125<br>150 |     | 1,58<br>1,8<br>1,86 | 1,85 <sup>(1)</sup> | V  |
| Collector-emitter cut-off current    | $I_{CES}$     | 0                | 1200 |       | 25               |     |                     | 100                 | μA |
| Gate-emitter leakage current         | $I_{GES}$     | 20               | 0    |       | 25               |     |                     | 500                 | nA |
| Internal gate resistance             | $r_g$         |                  |      |       |                  |     | 3                   |                     | Ω  |
| Input capacitance                    | $C_{ies}$     |                  |      |       |                  |     | 30000               |                     | pF |
| Output capacitance                   | $C_{oes}$     | 0                | 10   |       | 25               |     | 880                 |                     | pF |
| Reverse transfer capacitance         | $C_{res}$     |                  |      |       |                  |     | 320                 |                     | pF |
| Gate charge                          | $Q_g$         | $V_{CC} = 600$ V | 15   |       | 150              | 25  |                     | 1000                | nC |

##### Thermal

|  |               |                                       |  |  |  |  |      |  |     |
|--|---------------|---------------------------------------|--|--|--|--|------|--|-----|
| Thermal resistance junction to sink <sup>(2)</sup> | $R_{th(j-s)}$ | $\lambda_{paste} = 4,4$ W/mK<br>(PTM) |  |  |  |  | 0,42 |  | K/W |
|--|---------------|---------------------------------------|--|--|--|--|------|--|-----|

##### Dynamic

|                             |              |   |     |     |     |                  |  |                            |     |
|-----------------------------|--------------|---|-----|-----|-----|------------------|--|----------------------------|-----|
| Turn-on delay time          | $t_{d(on)}$  |   |     |     |     | 25<br>125<br>150 |  | 304,32<br>318,72<br>322,56 | ns  |
| Rise time                   | $t_r$        | $R_{gon} = 2$ Ω<br>$R_{goff} = 2$ Ω                                     |     |     |     | 25<br>125<br>150 |  | 46,72<br>56,64<br>60,48    | ns  |
| Turn-off delay time         | $t_{d(off)}$ |   | ±15 | 600 | 125 | 25<br>125<br>150 |  | 256,96<br>298,88<br>308,16 | ns  |
| Fall time                   | $t_f$        |   |     |     |     | 25<br>125<br>150 |  | 79,44<br>113,41<br>120,75  | ns  |
| Turn-on energy (per pulse)  | $E_{on}$     | $Q_{tFWD} = 12,64$ μC<br>$Q_{tFWD} = 20,51$ μC<br>$Q_{tFWD} = 23,29$ μC |     |     |     | 25<br>125<br>150 |  | 8,8<br>12,8<br>14,42       | mWs |
| Turn-off energy (per pulse) | $E_{off}$    |   |     |     |     | 25<br>125<br>150 |  | 9,87<br>13,56<br>14,96     | mWs |



Vincotech

**B0-SP12NAA008ME01-LR88F78T**  
datasheet

### Characteristic Values

| Parameter  | Symbol            | Conditions  |   |                                     |                  |                  | Values                     |                    |  | Unit |
|--|-------------------|---|---|-------------------------------------|------------------|------------------|----------------------------|--------------------|--|------|
|  |                   | $V_{GE}$ [V]<br>$V_{GS}$ [V]                                | $V_{CE}$ [V]<br>$V_{DS}$ [V]<br>$V_F$ [V] | $I_C$ [A]<br>$I_D$ [A]<br>$I_F$ [A] | $T_j$ [°C]       | Min              | Typ                        | Max                |  |      |
| <b>Neutral Point Diode</b>                         |                   |   |   |                                     |                  |                  |                            |                    |  |      |
| <b>Static</b>                                      |                   |   |   |                                     |                  |                  |                            |                    |  |      |
| Forward voltage                                    | $V_F$             |   |   | 150                                 | 25<br>125<br>150 |                  | 1,79<br>1,9<br>1,89        | 2,1 <sup>(1)</sup> |  | V    |
| Reverse leakage current                            | $I_R$             | $V_T = 1200$ V  |   |                                     | 25               |                  |                            | 40                 |  | μA   |
| <b>Thermal</b>                                     |                   |   |   |                                     |                  |                  |                            |                    |  |      |
| Thermal resistance junction to sink <sup>(2)</sup> | $R_{th(j-s)}$     | $\lambda_{paste} = 4,4$ W/mK<br>(PTM)                       |   |                                     |                  |                  | 0,55                       |                    |  | K/W  |
| <b>Dynamic</b>                                     |                   |   |   |                                     |                  |                  |                            |                    |  |      |
| Peak recovery current                              | $I_{RRM}$         |   |   |                                     | 25<br>125<br>150 |                  | 118,78<br>118,84<br>120,44 |                    |  | A    |
| Reverse recovery time                              | $t_{rr}$          |   |   |                                     | 25<br>125<br>150 |                  | 257,69<br>416,79<br>467,22 |                    |  | ns   |
| Recovered charge                                   | $Q_r$             | $di/dt=2704$ A/μs<br>$di/dt=2202$ A/μs<br>$di/dt=2119$ A/μs | ±15                                       | 600                                 | 125              | 25<br>125<br>150 | 12,64<br>20,51<br>23,29    |                    |  | μC   |
| Reverse recovered energy                           | $E_{rec}$         |   |   |                                     | 25<br>125<br>150 |                  | 4,91<br>8,12<br>9,22       |                    |  | mWs  |
| Peak rate of fall of recovery current              | $(di_r/dt)_{max}$ |   |   |                                     | 25<br>125<br>150 |                  | 1287<br>694,05<br>634,74   |                    |  | A/μs |



Vincotech

### Characteristic Values

| Parameter | Symbol | Conditions   |              |              |              |           | Values    |           |            | Unit |
|-----------|--------|--------------|--------------|--------------|--------------|-----------|-----------|-----------|------------|------|
|           |        | $V_{GS}$ [V] | $V_{GE}$ [V] | $V_{DS}$ [V] | $V_{CE}$ [V] | $V_F$ [V] | $I_D$ [A] | $I_C$ [A] | $T_j$ [°C] |      |

### Thermistor

#### Static

|                            |                |                        |  |  |  |     |    |      |   |      |
|----------------------------|----------------|------------------------|--|--|--|-----|----|------|---|------|
| Rated resistance           | $R$            |                        |  |  |  | 25  |    | 4,7  |   | kΩ   |
| Deviation of $R_{100}$     | $A_{R/R}$      | $R_{100} = 401 \Omega$ |  |  |  | 100 | -5 |      | 5 | %    |
| Power dissipation          | $P$            |                        |  |  |  |     |    | 5    |   | mW   |
| Power dissipation constant | $d$            |                        |  |  |  | 25  |    | 1,3  |   | mW/K |
| B-value                    | $B_{(25/50)}$  | Tol. $\pm 3 \%$        |  |  |  |     |    | 3612 |   | K    |
| B-value                    | $B_{(25/100)}$ | Tol. $\pm 3 \%$        |  |  |  |     |    | 3650 |   | K    |

<sup>(1)</sup> Value at chip level

<sup>(2)</sup> Only valid with pre-applied Vincotech thermal interface material.

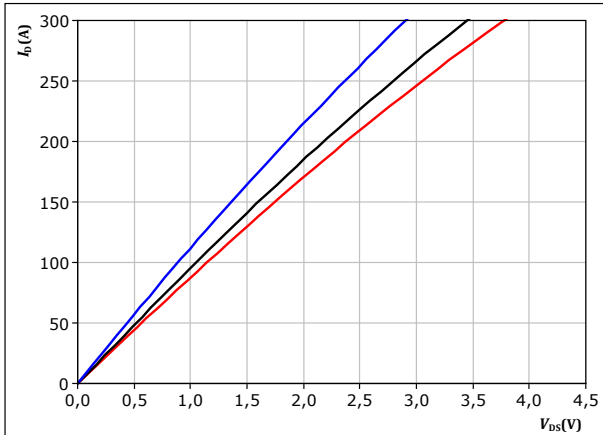


## AC Switch Characteristics

**figure 1.** MOSFET

Typical output characteristics

$$I_D = f(V_{DS})$$

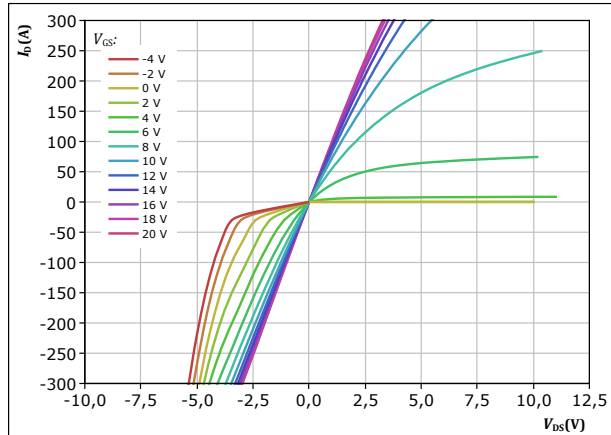


$t_p = 250 \mu s$   
 $V_{GS} = 14 V$   
 $T_j:$  25 °C (blue), 125 °C (black), 150 °C (red)

**figure 2.** MOSFET

Typical output characteristics

$$I_D = f(V_{DS})$$

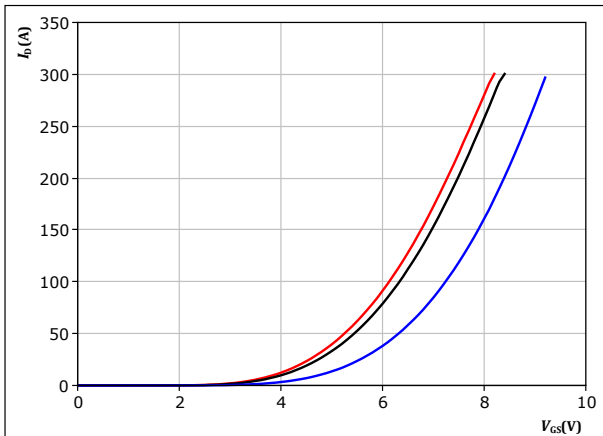


$t_p = 250 \mu s$   
 $T_j = 150 \text{ °C}$   
 $V_{GS}$  from -4 V to 20 V in steps of 2 V

**figure 3.** MOSFET

Typical transfer characteristics

$$I_D = f(V_{GS})$$

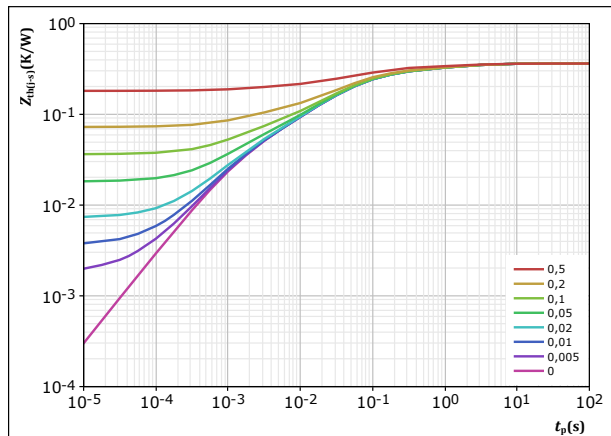


$t_p = 250 \mu s$   
 $V_{DS} = 10 V$   
 $T_j:$  25 °C (blue), 125 °C (black), 150 °C (red)

**figure 4.** MOSFET

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$   
 $R_{th(j-s)} = 0,363 \text{ K/W}$   
MOSFET thermal model values

| $R$ (K/W) | $\tau$ (s) |
|-----------|------------|
| 3,12E-02  | 3,34E+00   |
| 5,80E-02  | 6,26E-01   |
| 1,74E-01  | 6,78E-02   |
| 6,98E-02  | 1,25E-02   |
| 3,03E-02  | 1,39E-03   |

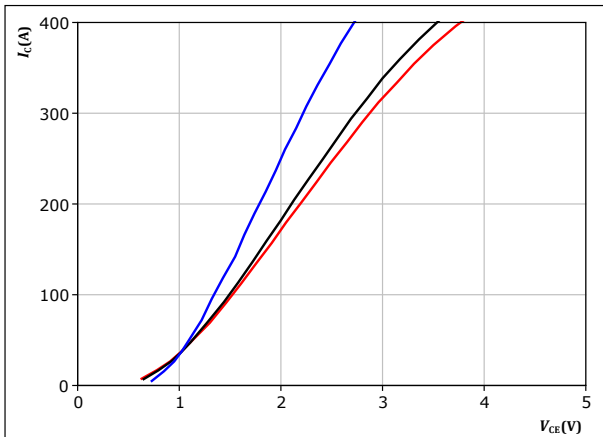


## Neutral Point Switch Characteristics

**figure 5.** IGBT

Typical output characteristics

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

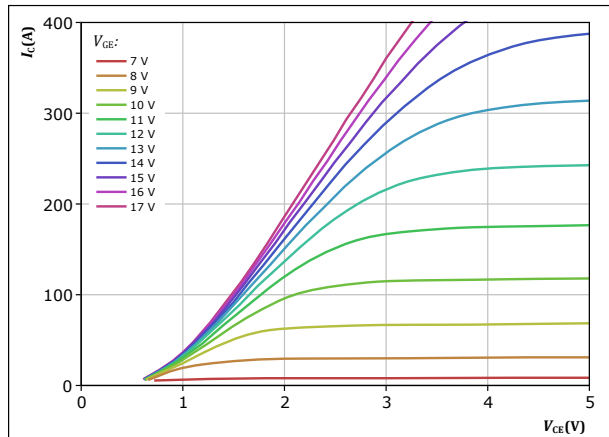


$t_p = 250 \mu s$   
 $V_{GE} = 15 V$   
 $T_j:$  25 °C, 125 °C, 150 °C

**figure 6.** IGBT

Typical output characteristics

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

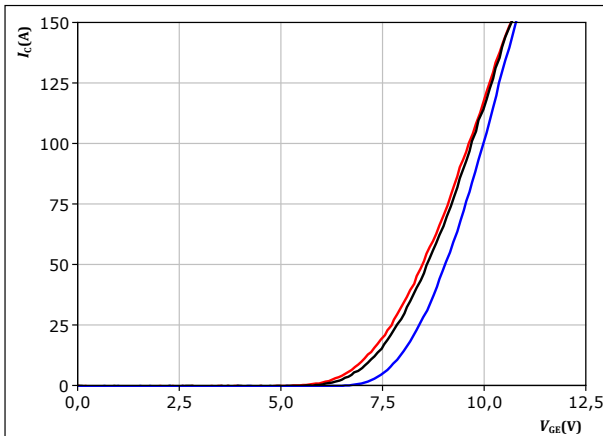


$t_p = 250 \mu s$   
 $T_j = 150 \text{ °C}$   
 $V_{GE}$  from 7 V to 17 V in steps of 1 V

**figure 7.** IGBT

Typical transfer characteristics

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

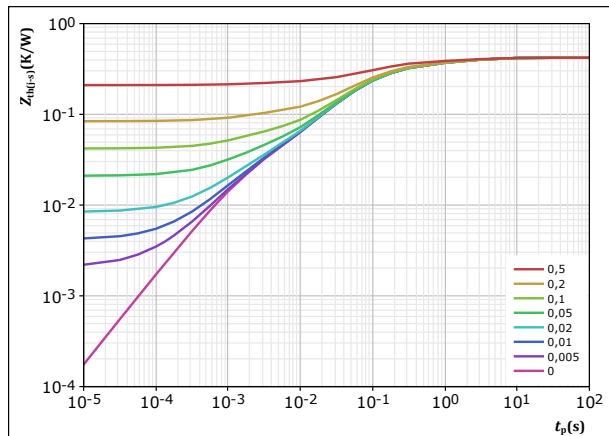


$t_p = 250 \mu s$   
 $V_{CE} = 10 V$   
 $T_j:$  25 °C, 125 °C, 150 °C

**figure 8.** IGBT

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$   
 $R_{th(j-s)} = 0,42 \text{ K/W}$   
IGBT thermal model values  

| $R$ (K/W)  | $\tau$ (s) |
|------------|------------|
| $5,01E-02$ | $3,17E+00$ |
| $7,90E-02$ | $5,66E-01$ |
| $2,16E-01$ | $8,74E-02$ |
| $5,52E-02$ | $2,28E-02$ |
| $1,93E-02$ | $1,55E-03$ |



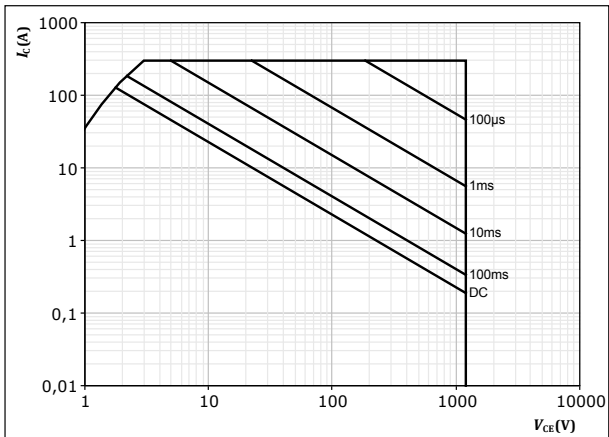


### Neutral Point Switch Characteristics

**figure 9.** IGBT

Safe operating area

$I_C = f(V_{CE})$



$D =$  single pulse  
 $T_s = 80 \text{ } ^\circ\text{C}$   
 $V_{CE} = 15 \text{ V}$   
 $T_j = T_{jmax}$

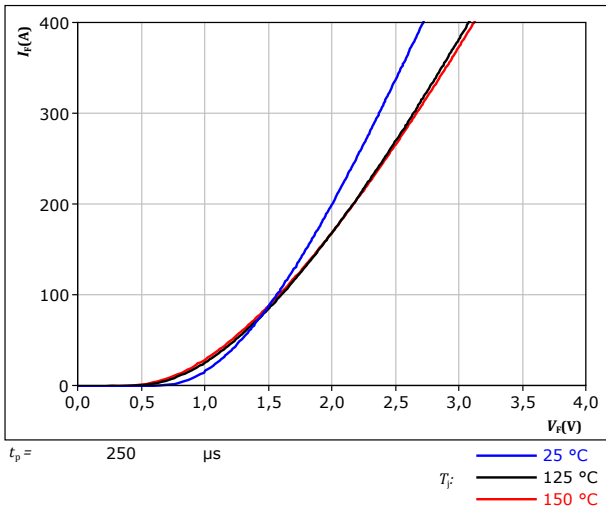


### DC-Link Diode Characteristics

**figure 10.** FWD

Typical forward characteristics

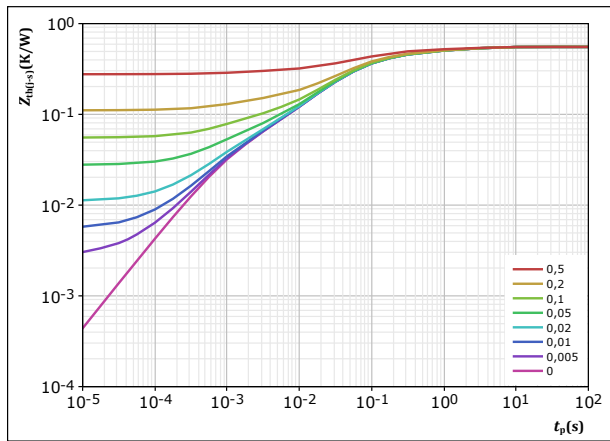
$$I_F = f(V_F)$$



**figure 11.** FWD

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$

$R_{th(j-s)} = 0,554 \text{ K/W}$

FWD thermal model values

| R (K/W)  | $\tau$ (s) |
|----------|------------|
| 5,67E-02 | 2,72E+00   |
| 9,06E-02 | 4,39E-01   |
| 2,74E-01 | 6,77E-02   |
| 9,64E-02 | 1,56E-02   |
| 3,58E-02 | 1,06E-03   |

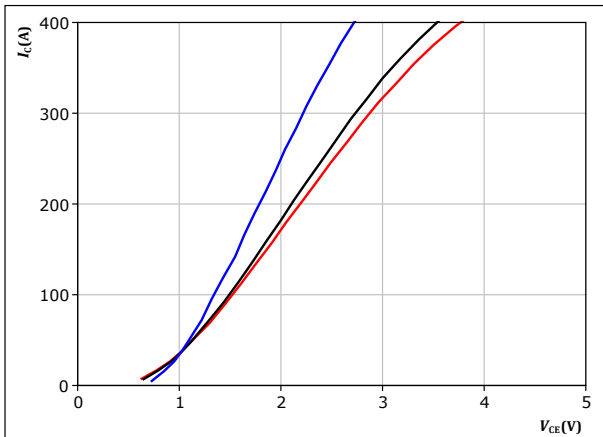


## DC-Link Switch Characteristics

**figure 12.** IGBT

Typical output characteristics

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



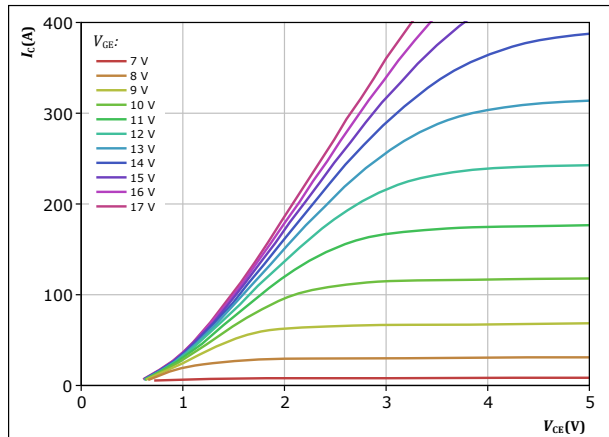
$t_p = 250 \mu\text{s}$   
 $V_{GE} = 15 \text{ V}$

$T_j$ :  
— 25 °C  
— 125 °C  
— 150 °C

**figure 13.** IGBT

Typical output characteristics

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

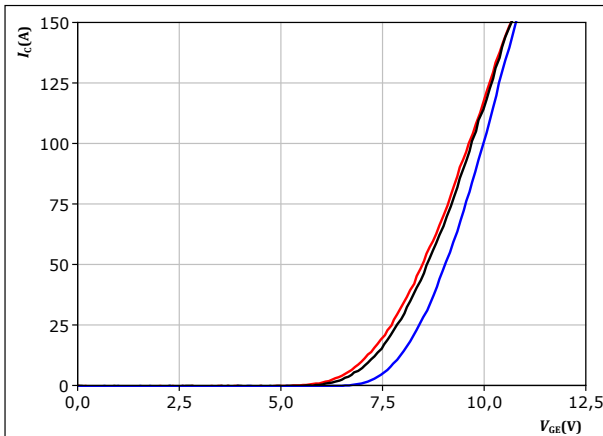


$t_p = 250 \mu\text{s}$   
 $T_j = 150 \text{ °C}$   
 $V_{GE}$  from 7 V to 17 V in steps of 1 V

**figure 14.** IGBT

Typical transfer characteristics

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



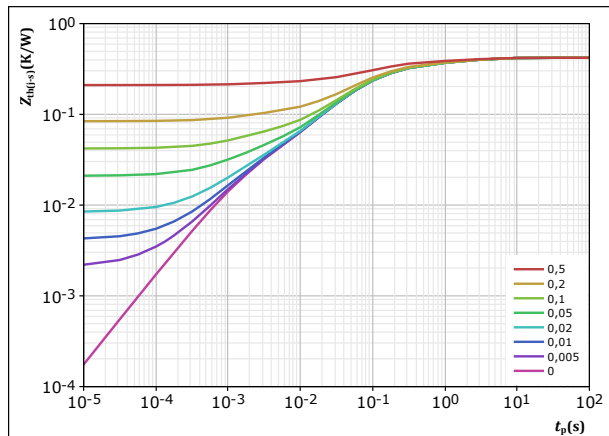
$t_p = 250 \mu\text{s}$   
 $V_{CE} = 10 \text{ V}$

$T_j$ :  
— 25 °C  
— 125 °C  
— 150 °C

**figure 15.** IGBT

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$   
 $R_{th(j-s)} = 0,42 \text{ K/W}$

IGBT thermal model values

| $R$ (K/W) | $\tau$ (s) |
|-----------|------------|
| 5,01E-02  | 3,17E+00   |
| 7,90E-02  | 5,66E-01   |
| 2,16E-01  | 8,74E-02   |
| 5,52E-02  | 2,28E-02   |
| 1,93E-02  | 1,55E-03   |

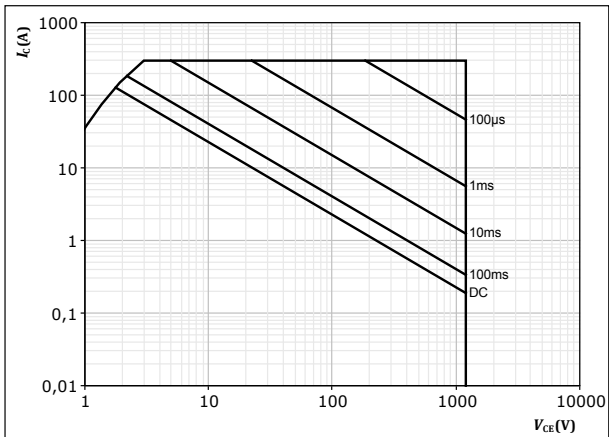


### DC-Link Switch Characteristics

**figure 16.** IGBT

Safe operating area

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



$D =$  single pulse  
 $T_s = 80 \text{ } ^\circ\text{C}$   
 $V_{CE} = 15 \text{ V}$   
 $T_j = T_{jmax}$

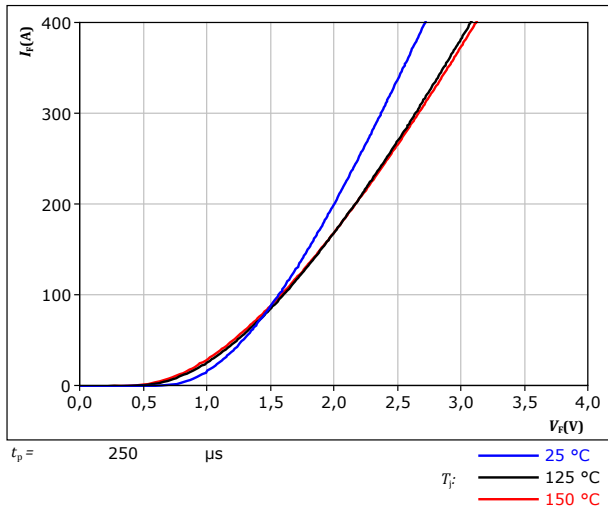


### Neutral Point Diode Characteristics

**figure 17.** FWD

Typical forward characteristics

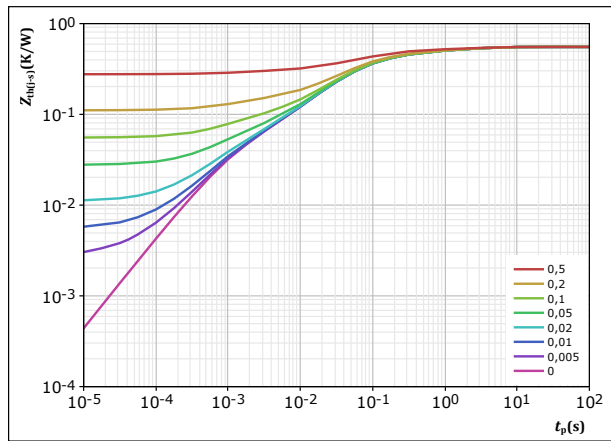
$$I_F = f(V_F)$$



**figure 18.** FWD

Transient thermal impedance as a function of pulse width

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



|                          |            |     |
|--------------------------|------------|-----|
| $D =$                    | $t_p / T$  |     |
| $R_{th(j-s)} =$          | 0,554      | K/W |
| FWD thermal model values |            |     |
| $R$ (K/W)                | $\tau$ (s) |     |
| 5,67E-02                 | 2,72E+00   |     |
| 9,06E-02                 | 4,39E-01   |     |
| 2,74E-01                 | 6,77E-02   |     |
| 9,64E-02                 | 1,56E-02   |     |
| 3,58E-02                 | 1,06E-03   |     |

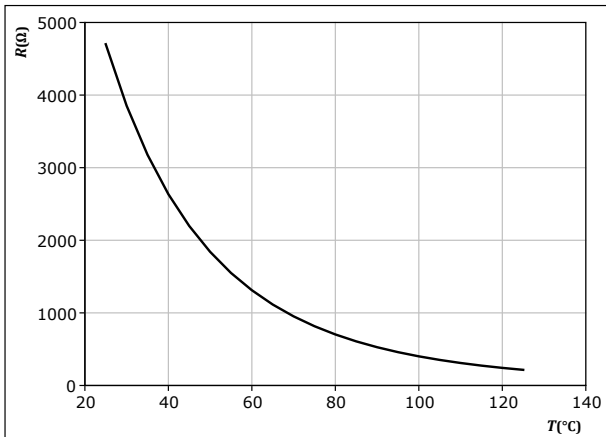


## Thermistor Characteristics

**figure 19.** Thermistor

Typical NTC characteristic as function of temperature

$$R_T = f(T)$$

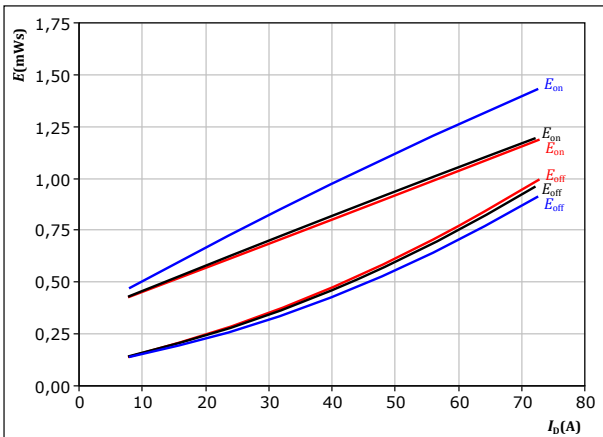




## AC Switching Characteristics

**figure 20.** MOSFET

Typical switching energy losses as a function of drain current  
 $E = f(I_D)$

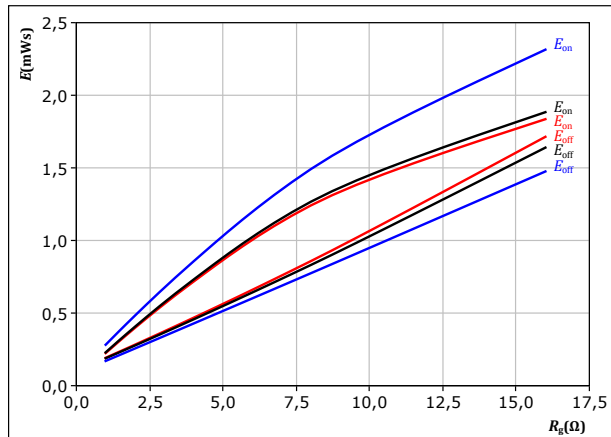


With an inductive load at  
 $V_{DS} = 600 \text{ V}$   
 $V_{GS} = 0/15 \text{ V}$   
 $R_{g\text{on}} = 4 \ \Omega$   
 $R_{g\text{off}} = 4 \ \Omega$

$T_j$ : 25 °C (blue), 125 °C (black), 150 °C (red)

**figure 21.** MOSFET

Typical switching energy losses as a function of gate resistor  
 $E = f(R_g)$

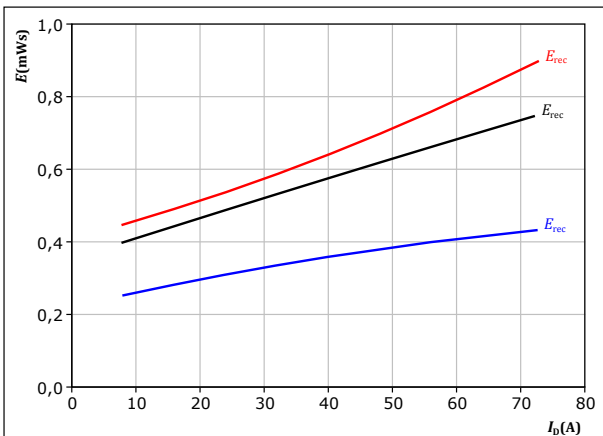


With an inductive load at  
 $V_{DS} = 600 \text{ V}$   
 $V_{GS} = 0/15 \text{ V}$   
 $I_D = 40 \text{ A}$

$T_j$ : 25 °C (blue), 125 °C (black), 150 °C (red)

**figure 22.** MOSFET

Typical reverse recovered energy loss as a function of drain current  
 $E_{rec} = f(I_D)$

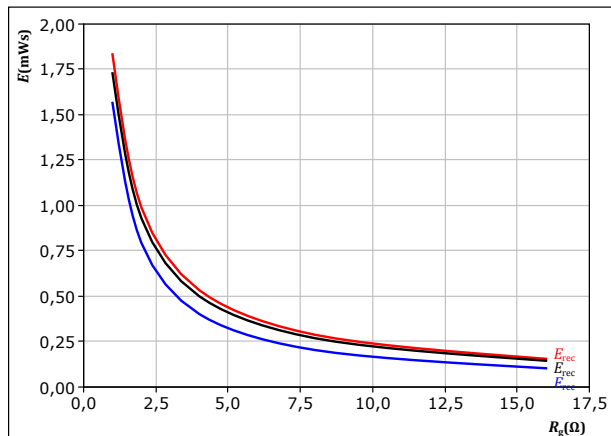


With an inductive load at  
 $V_{DS} = 600 \text{ V}$   
 $V_{GS} = 0/15 \text{ V}$   
 $R_{g\text{on}} = 4 \ \Omega$

$T_j$ : 25 °C (blue), 125 °C (black), 150 °C (red)

**figure 23.** MOSFET

Typical reverse recovered energy loss as a function of gate resistor  
 $E_{rec} = f(R_g)$



With an inductive load at  
 $V_{DS} = 600 \text{ V}$   
 $V_{GS} = 0/15 \text{ V}$   
 $I_D = 40 \text{ A}$

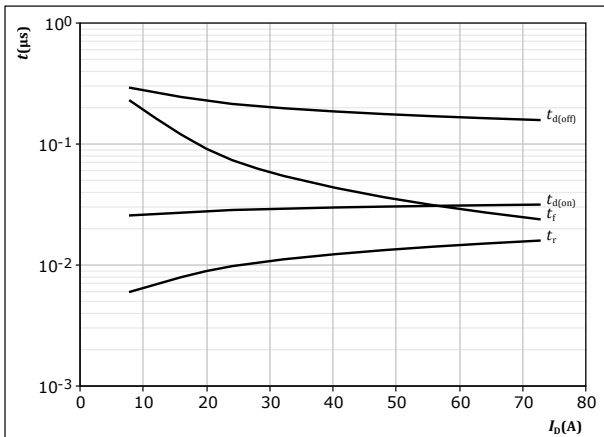
$T_j$ : 25 °C (blue), 125 °C (black), 150 °C (red)



## AC Switching Characteristics

**figure 24.** MOSFET

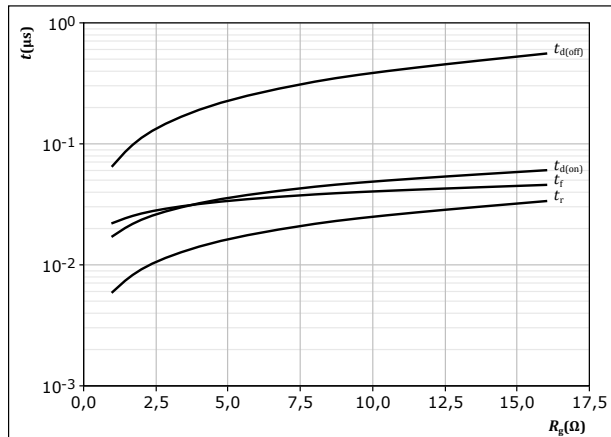
Typical switching times as a function of drain current  
 $t = f(I_D)$



With an inductive load at  
 $T_j = 150 \text{ }^\circ\text{C}$   
 $V_{DS} = 600 \text{ V}$   
 $V_{GS} = 0/15 \text{ V}$   
 $R_{gon} = 4 \text{ } \Omega$   
 $R_{goff} = 4 \text{ } \Omega$

**figure 25.** MOSFET

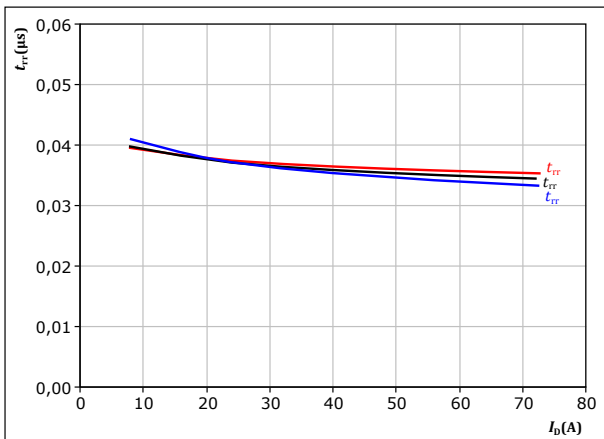
Typical switching times as a function of gate resistor  
 $t = f(R_g)$



With an inductive load at  
 $T_j = 150 \text{ }^\circ\text{C}$   
 $V_{DS} = 600 \text{ V}$   
 $V_{GS} = 0/15 \text{ V}$   
 $I_D = 40 \text{ A}$

**figure 26.** MOSFET

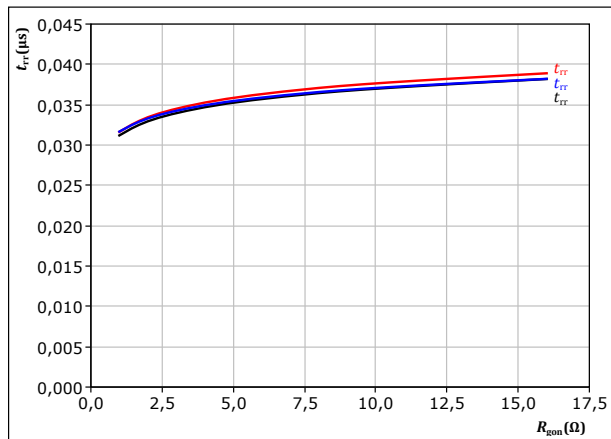
Typical reverse recovery time as a function of drain current  
 $t_{rr} = f(I_D)$



At  $V_{DS} = 600 \text{ V}$   
 $V_{GS} = 0/15 \text{ V}$   
 $R_{gon} = 4 \text{ } \Omega$   
 $T_j:$  — 25 °C  
— 125 °C  
— 150 °C

**figure 27.** MOSFET

Typical reverse recovery time as a function of turn on gate resistor  
 $t_{rr} = f(R_{gon})$



At  $V_{DS} = 600 \text{ V}$   
 $V_{GS} = 0/15 \text{ V}$   
 $I_D = 40 \text{ A}$   
 $T_j:$  — 25 °C  
— 125 °C  
— 150 °C



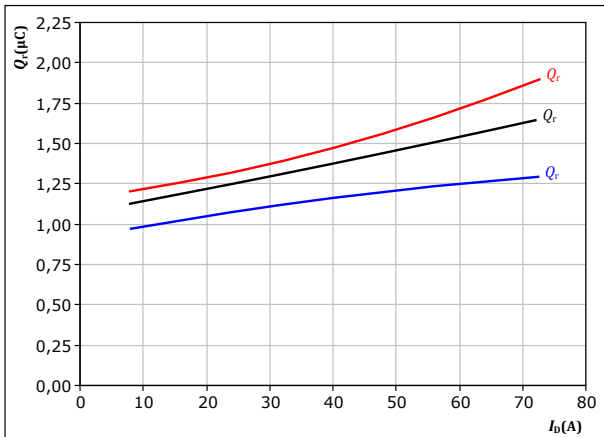


## AC Switching Characteristics

**figure 28.** MOSFET

Typical recovered charge as a function of drain current

$$Q_r = f(I_D)$$

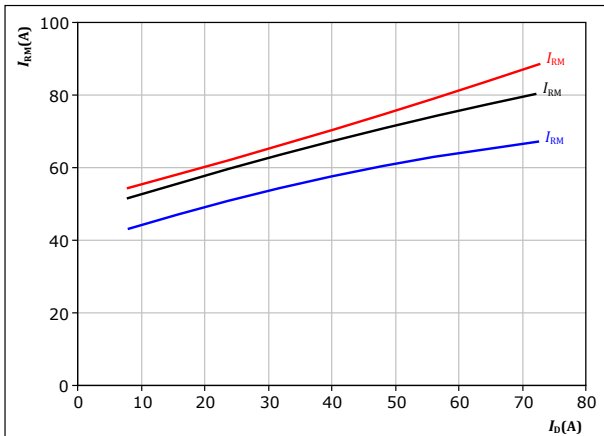


At  $V_{DS} = 600$  V  
 $V_{GS} = 0/15$  V  
 $R_{gon} = 4$  Ω  
 $T_j$ : 25 °C (blue), 125 °C (black), 150 °C (red)

**figure 30.** MOSFET

Typical peak reverse recovery current as a function of drain current

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

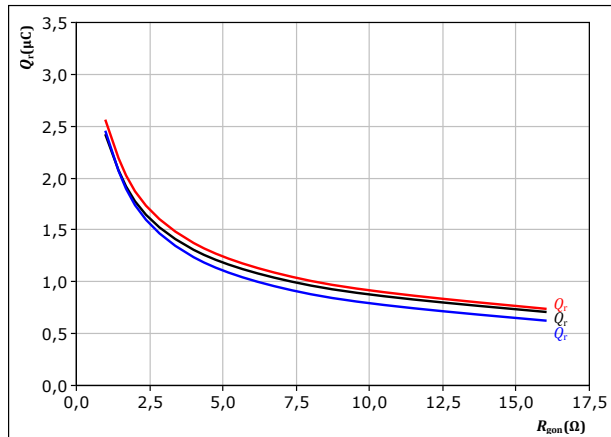


At  $V_{DS} = 600$  V  
 $V_{GS} = 0/15$  V  
 $R_{gon} = 4$  Ω  
 $T_j$ : 25 °C (blue), 125 °C (black), 150 °C (red)

**figure 29.** MOSFET

Typical recovered charge as a function of turn on gate resistor

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

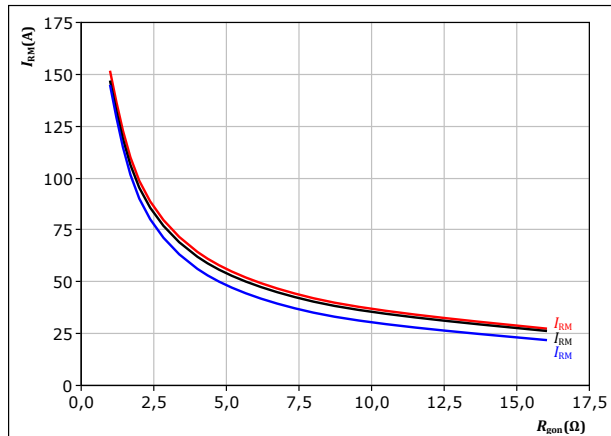


At  $V_{DS} = 600$  V  
 $V_{GS} = 0/15$  V  
 $I_D = 40$  A  
 $T_j$ : 25 °C (blue), 125 °C (black), 150 °C (red)

**figure 31.** MOSFET

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

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



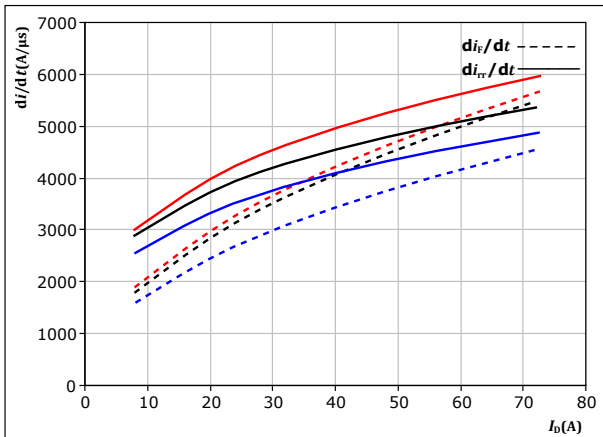
At  $V_{DS} = 600$  V  
 $V_{GS} = 0/15$  V  
 $I_D = 40$  A  
 $T_j$ : 25 °C (blue), 125 °C (black), 150 °C (red)



## AC Switching Characteristics

**figure 32.** MOSFET

Typical rate of fall of forward and reverse recovery current as a function of drain current  
 $di_f/dt, di_{rr}/dt = f(I_D)$

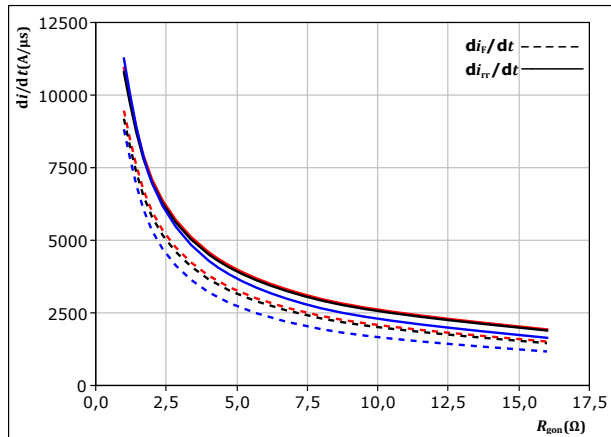


**At**  $V_{DS} = 600$  V  
 $V_{GS} = 0/15$  V  
 $R_{g\text{on}} = 4$   $\Omega$

$T_j$ : 25 °C (blue)  
 125 °C (black)  
 150 °C (red)

**figure 33.** MOSFET

Typical rate of fall of forward and reverse recovery current as a function of turn on gate resistor  
 $di_f/dt, di_{rr}/dt = f(R_{g\text{on}})$



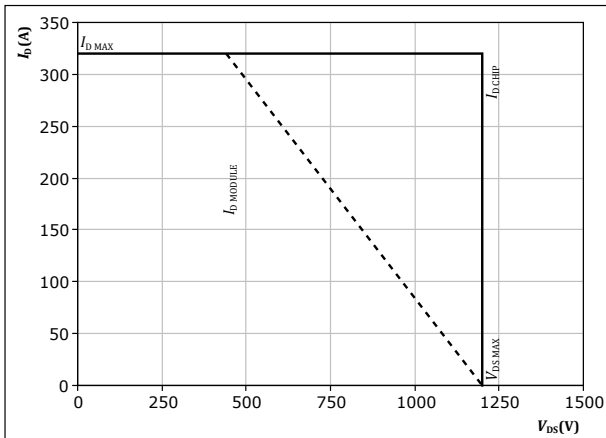
**At**  $V_{DS} = 600$  V  
 $V_{GS} = 0/15$  V  
 $I_D = 40$  A

$T_j$ : 25 °C (blue)  
 125 °C (black)  
 150 °C (red)

**figure 34.** MOSFET

Reverse bias safe operating area

$I_D = f(V_{DS})$



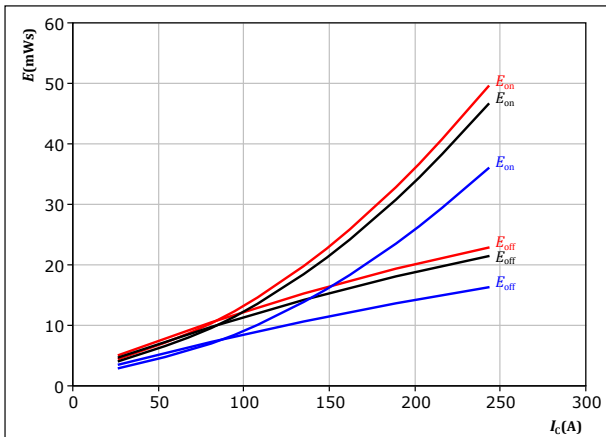
**At**  $T_j = 150$  °C  
 $R_{g\text{on}} = 4$   $\Omega$   
 $R_{g\text{off}} = 4$   $\Omega$



## Neutral Point Switching Characteristics

**figure 35.** IGBT

Typical switching energy losses as a function of collector current  
 $E = f(I_c)$

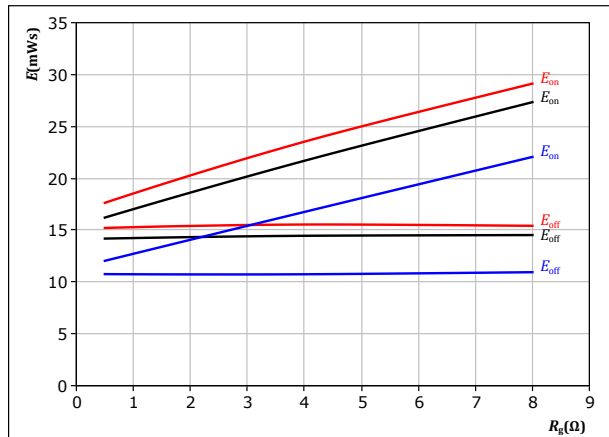


With an inductive load at  
 $V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $R_{gon} = 2$   $\Omega$   
 $R_{goff} = 2$   $\Omega$

$T_j$ : — 25 °C  
 — 125 °C  
 — 150 °C

**figure 36.** IGBT

Typical switching energy losses as a function of gate resistor  
 $E = f(R_g)$

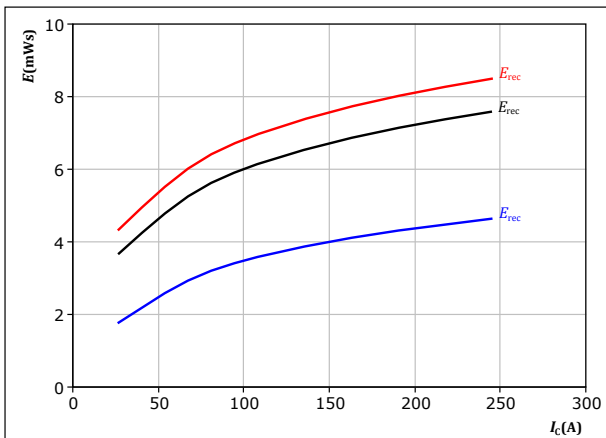


With an inductive load at  
 $V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $I_c = 135$  A

$T_j$ : — 25 °C  
 — 125 °C  
 — 150 °C

**figure 37.** FWD

Typical reverse recovered energy loss as a function of collector current  
 $E_{rec} = f(I_c)$

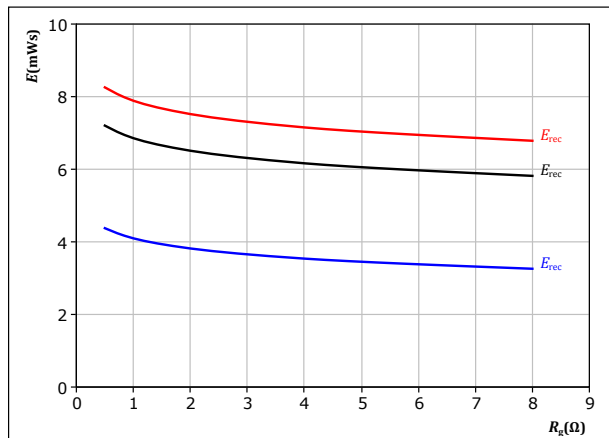


With an inductive load at  
 $V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $R_{gon} = 2$   $\Omega$

$T_j$ : — 25 °C  
 — 125 °C  
 — 150 °C

**figure 38.** 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  
 $V_{GE} = \pm 15$  V  
 $I_c = 135$  A

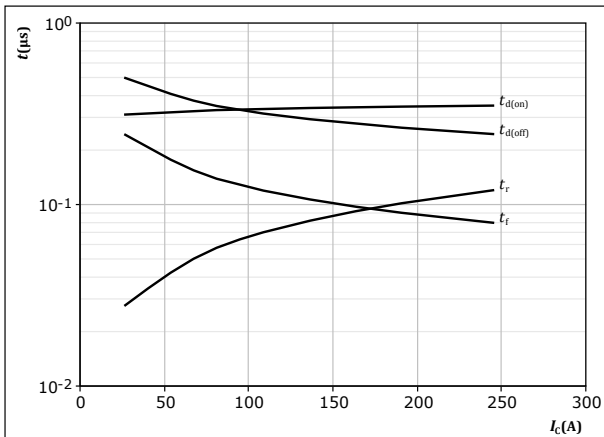
$T_j$ : — 25 °C  
 — 125 °C  
 — 150 °C



## Neutral Point Switching Characteristics

**figure 39.** IGBT

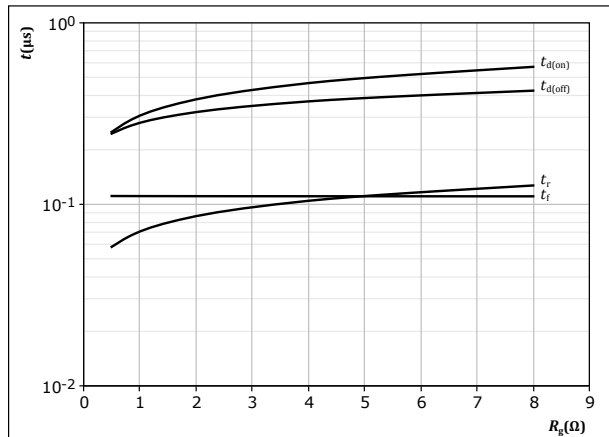
Typical switching times as a function of collector current  
 $t = f(I_c)$



With an inductive load at  
 $T_j = 150 \text{ }^\circ\text{C}$   
 $V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $R_{gon} = 2 \text{ } \Omega$   
 $R_{goff} = 2 \text{ } \Omega$

**figure 40.** IGBT

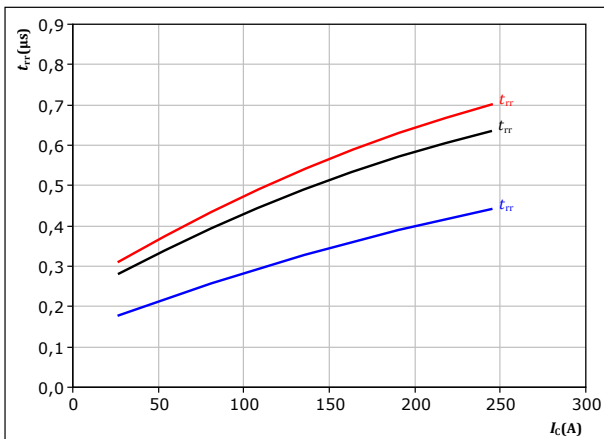
Typical switching times as a function of gate resistor  
 $t = f(R_g)$



With an inductive load at  
 $T_j = 150 \text{ }^\circ\text{C}$   
 $V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $I_c = 135 \text{ A}$

**figure 41.** FWD

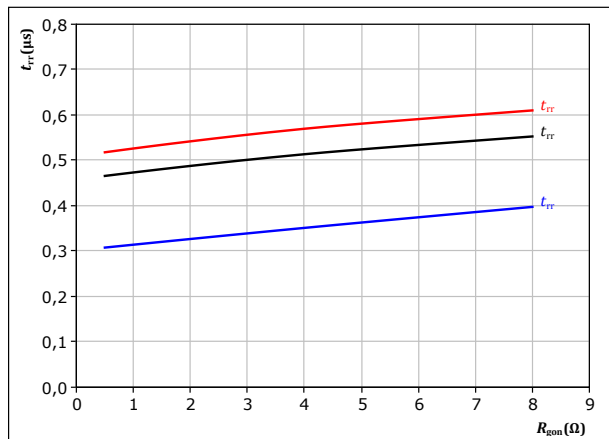
Typical reverse recovery time as a function of collector current  
 $t_{rr} = f(I_c)$



With an inductive load at  
 $V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $R_{gon} = 2 \text{ } \Omega$   
 $T_j:$  — 25 °C  
 — 125 °C  
 — 150 °C

**figure 42.** FWD

Typical reverse recovery time as a function of IGBT turn on gate resistor  
 $t_{rr} = f(R_{gon})$



With an inductive load at  
 $V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $I_c = 135 \text{ A}$   
 $T_j:$  — 25 °C  
 — 125 °C  
 — 150 °C

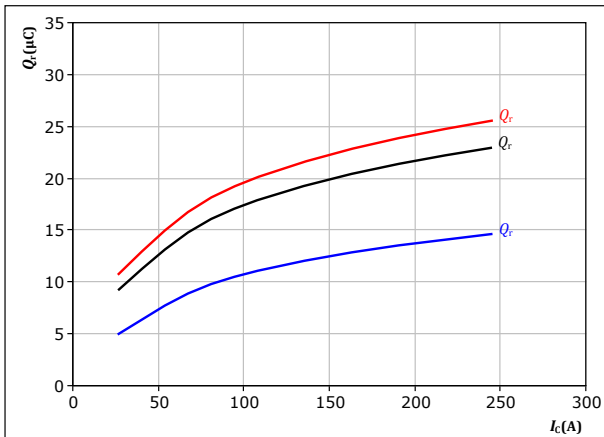


## Neutral Point Switching Characteristics

**figure 43.** FWD

Typical recovered charge as a function of collector current

$$Q_r = f(I_c)$$



With an inductive load at

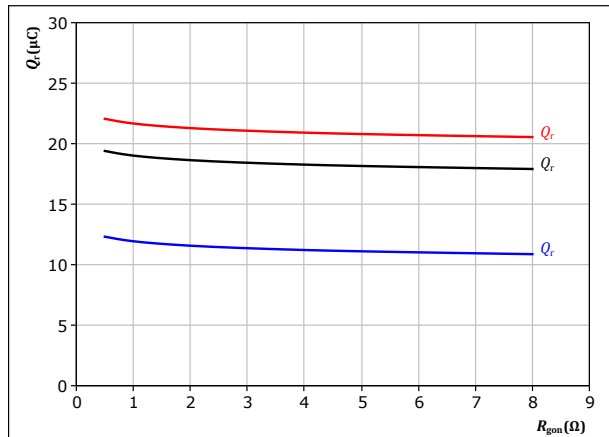
$V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $R_{gon} = 2 \text{ } \Omega$

$T_j$ : — 25 °C  
— 125 °C  
— 150 °C

**figure 44.** FWD

Typical recovered charge as a function of turn on gate resistor

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



With an inductive load at

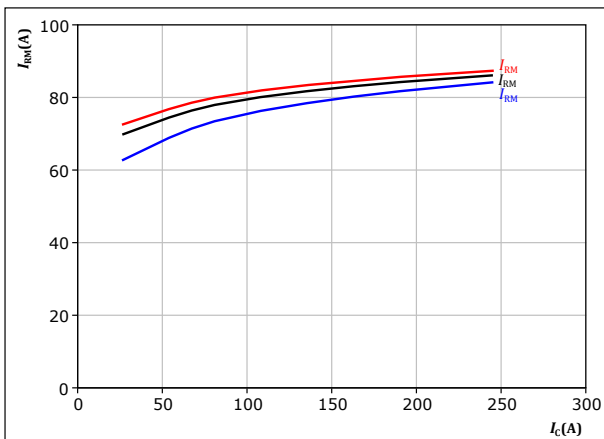
$V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $I_c = 135 \text{ A}$

$T_j$ : — 25 °C  
— 125 °C  
— 150 °C

**figure 45.** FWD

Typical peak reverse recovery current as a function of collector current

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



With an inductive load at

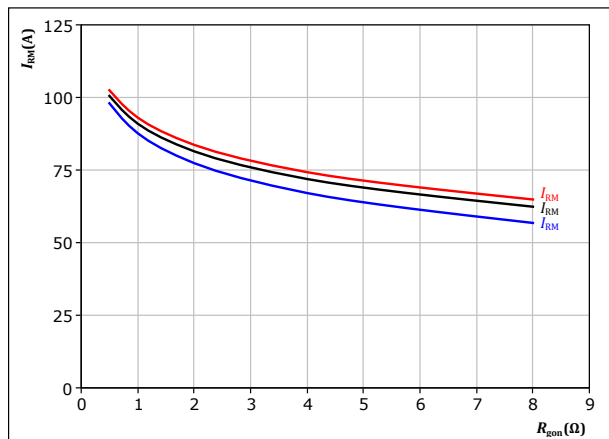
$V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $R_{gon} = 2 \text{ } \Omega$

$T_j$ : — 25 °C  
— 125 °C  
— 150 °C

**figure 46.** FWD

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

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



With an inductive load at

$V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $I_c = 135 \text{ A}$

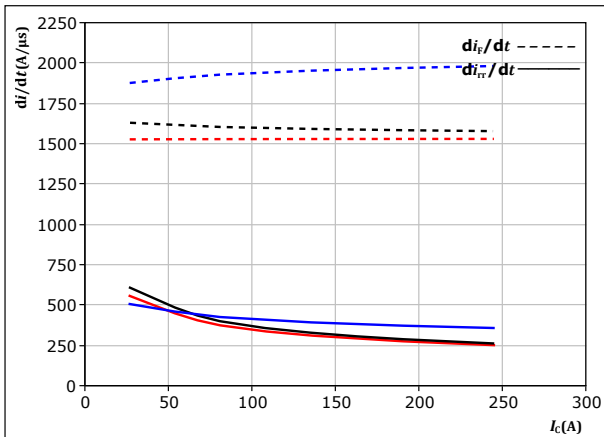
$T_j$ : — 25 °C  
— 125 °C  
— 150 °C



## Neutral Point Switching Characteristics

**figure 47.** FWD

Typical rate of fall of forward and reverse recovery current as a function of collector current  
 $di_f/dt, di_r/dt = f(I_c)$



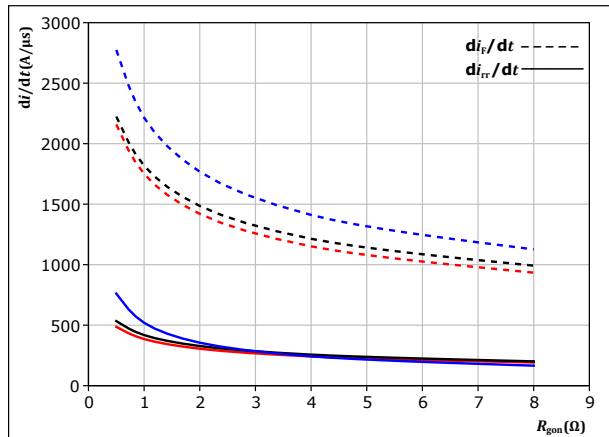
With an inductive load at

$V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $R_{gon} = 2 \ \Omega$

$T_j =$  — 25 °C  
 — 125 °C  
 — 150 °C

**figure 48.** FWD

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



With an inductive load at

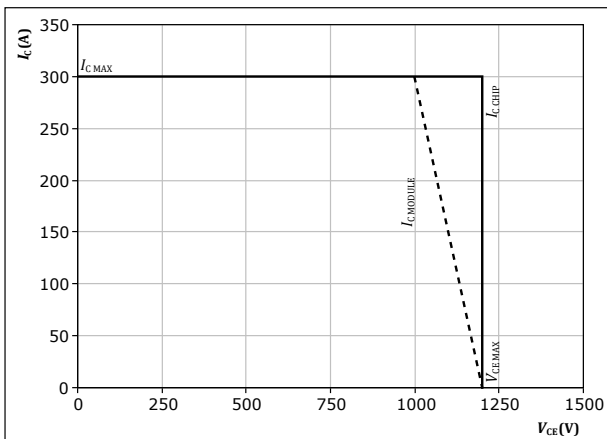
$V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $I_c = 135 \text{ A}$

$T_j =$  — 25 °C  
 — 125 °C  
 — 150 °C

**figure 49.** IGBT

Reverse bias safe operating area

$I_c = f(V_{CE})$



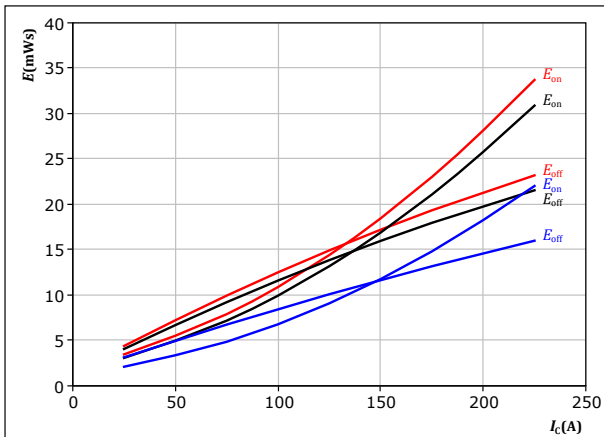
At  $T_j = 150 \text{ °C}$   
 $R_{gon} = 2 \ \Omega$   
 $R_{goff} = 2 \ \Omega$



## DC-Link Switching Characteristics

**figure 50.** IGBT

Typical switching energy losses as a function of collector current  
 $E = f(I_c)$

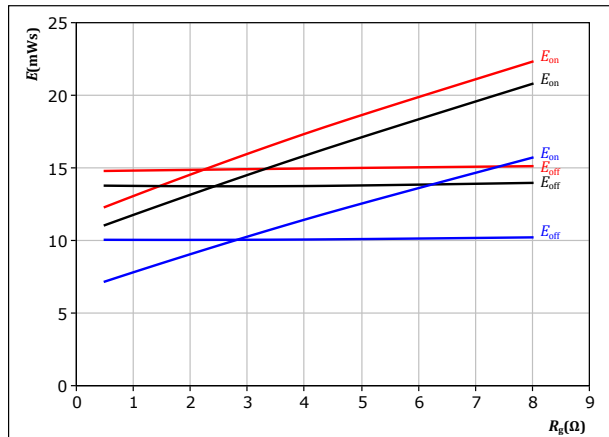


With an inductive load at  
 $V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $R_{gon} = 2 \text{ } \Omega$   
 $R_{goff} = 2 \text{ } \Omega$

$T_j$ : 25 °C (blue), 125 °C (black), 150 °C (red)

**figure 51.** IGBT

Typical switching energy losses as a function of gate resistor  
 $E = f(R_g)$

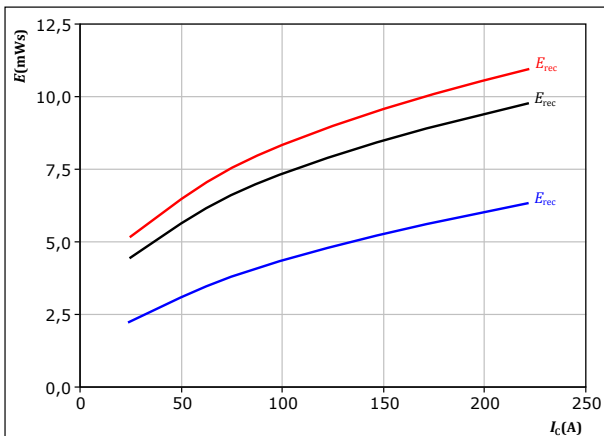


With an inductive load at  
 $V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $I_c = 125 \text{ A}$

$T_j$ : 25 °C (blue), 125 °C (black), 150 °C (red)

**figure 52.** FWD

Typical reverse recovered energy loss as a function of collector current  
 $E_{rec} = f(I_c)$

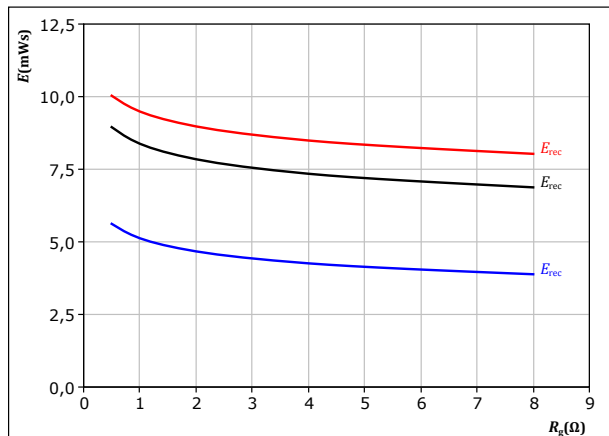


With an inductive load at  
 $V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $R_{gon} = 2 \text{ } \Omega$

$T_j$ : 25 °C (blue), 125 °C (black), 150 °C (red)

**figure 53.** FWD

Typical reverse recovered energy loss as a function of gate resistor  
 $E_{rec} = f(R_g)$



With an inductive load at  
 $V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $I_c = 125 \text{ A}$

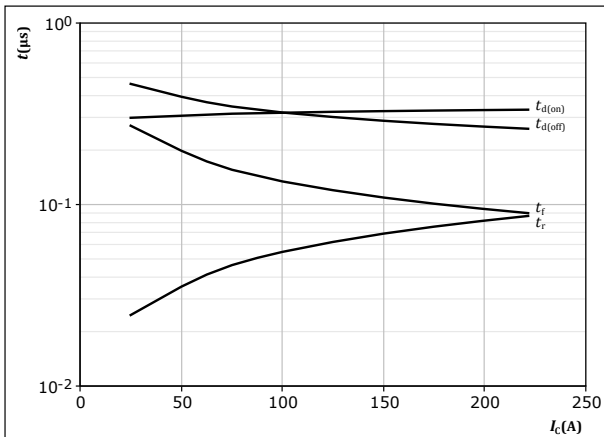
$T_j$ : 25 °C (blue), 125 °C (black), 150 °C (red)



## DC-Link Switching Characteristics

**figure 54.** IGBT

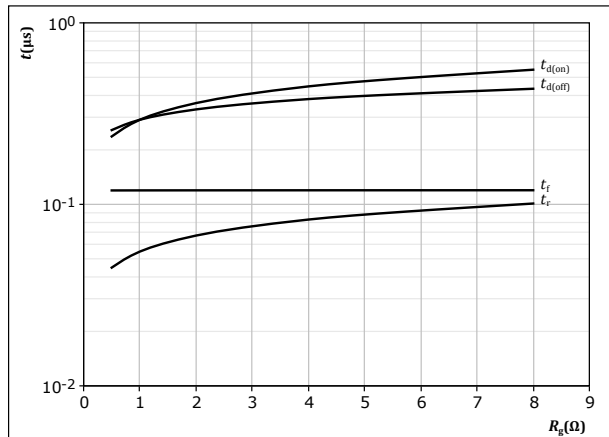
Typical switching times as a function of collector current  
 $t = f(I_c)$



With an inductive load at  
 $T_j = 150 \text{ }^\circ\text{C}$   
 $V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $R_{gon} = 2 \text{ } \Omega$   
 $R_{goff} = 2 \text{ } \Omega$

**figure 55.** IGBT

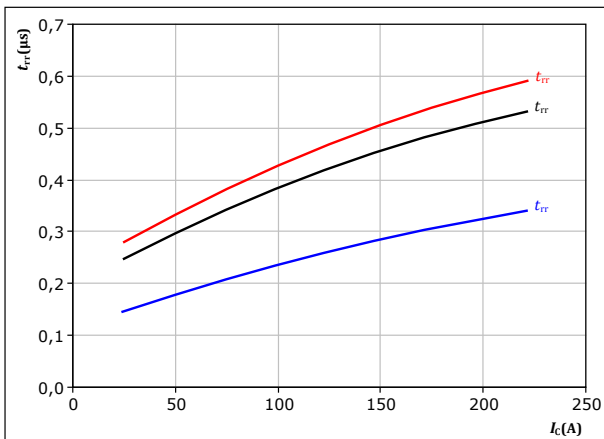
Typical switching times as a function of gate resistor  
 $t = f(R_g)$



With an inductive load at  
 $T_j = 150 \text{ }^\circ\text{C}$   
 $V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $I_c = 125 \text{ A}$

**figure 56.** FWD

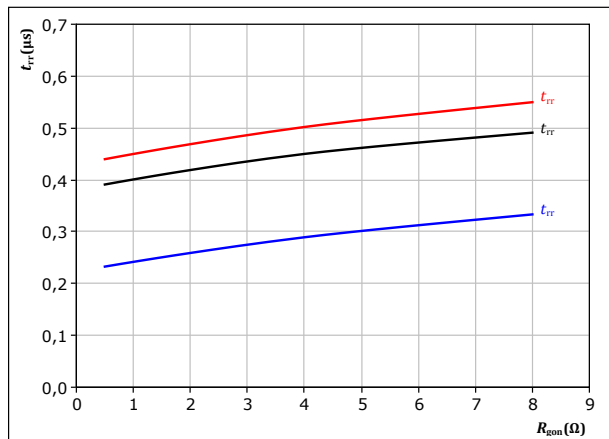
Typical reverse recovery time as a function of collector current  
 $t_{rr} = f(I_c)$



With an inductive load at  
 $V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $R_{gon} = 2 \text{ } \Omega$   
 $T_j: \text{ — } 25 \text{ }^\circ\text{C}$   
 $\text{ — } 125 \text{ }^\circ\text{C}$   
 $\text{ — } 150 \text{ }^\circ\text{C}$

**figure 57.** FWD

Typical reverse recovery time as a function of IGBT turn on gate resistor  
 $t_{rr} = f(R_{gon})$



With an inductive load at  
 $V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $I_c = 125 \text{ A}$   
 $T_j: \text{ — } 25 \text{ }^\circ\text{C}$   
 $\text{ — } 125 \text{ }^\circ\text{C}$   
 $\text{ — } 150 \text{ }^\circ\text{C}$



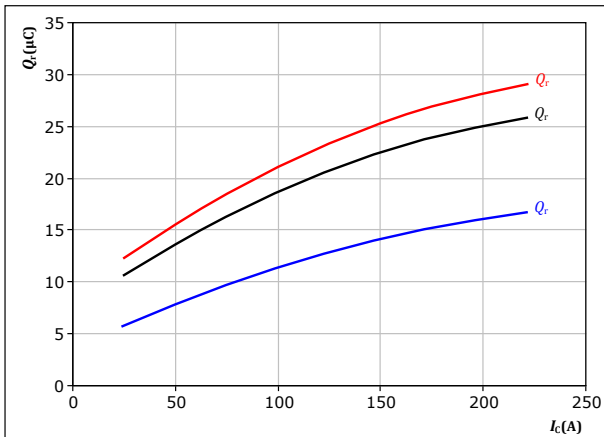


## DC-Link Switching Characteristics

**figure 58.** FWD

Typical recovered charge as a function of collector current

$$Q_r = f(I_c)$$



With an inductive load at

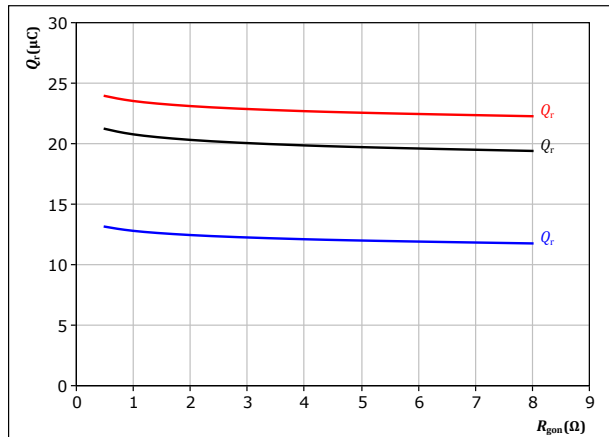
$V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $R_{gon} = 2$   $\Omega$

$T_j$ :  
— 25 °C  
— 125 °C  
— 150 °C

**figure 59.** FWD

Typical recovered charge as a function of turn on gate resistor

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



With an inductive load at

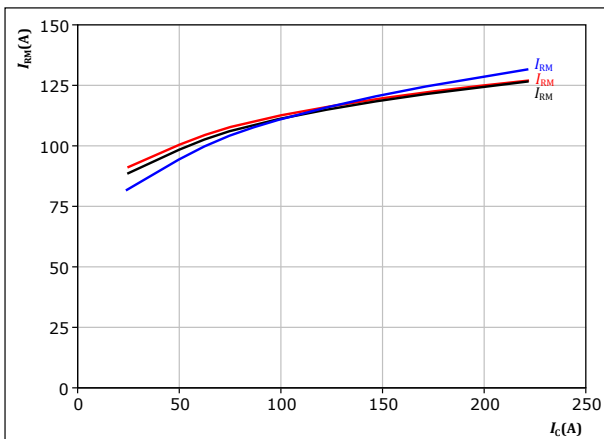
$V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $I_c = 125$  A

$T_j$ :  
— 25 °C  
— 125 °C  
— 150 °C

**figure 60.** FWD

Typical peak reverse recovery current as a function of collector current

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



With an inductive load at

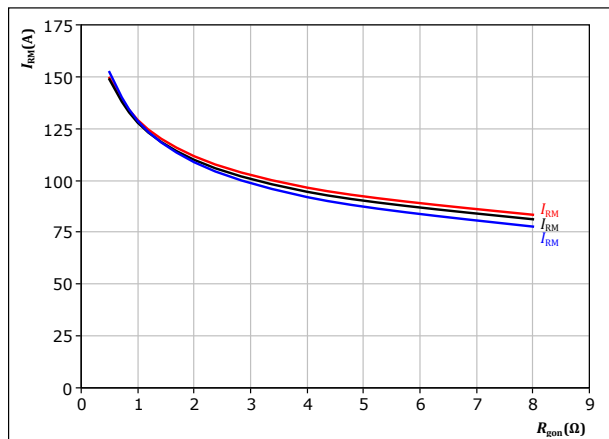
$V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $R_{gon} = 2$   $\Omega$

$T_j$ :  
— 25 °C  
— 125 °C  
— 150 °C

**figure 61.** FWD

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

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



With an inductive load at

$V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $I_c = 125$  A

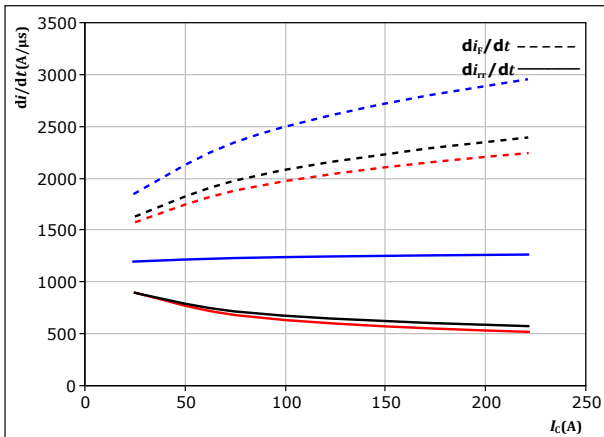
$T_j$ :  
— 25 °C  
— 125 °C  
— 150 °C



## DC-Link Switching Characteristics

**figure 62.** FWD

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



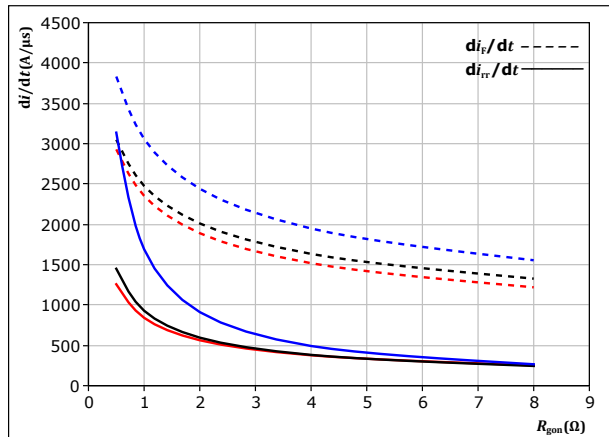
With an inductive load at

$V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $R_{gon} = 2 \text{ } \Omega$

$T_j =$  — 25 °C  
 — 125 °C  
 — 150 °C

**figure 63.** FWD

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



With an inductive load at

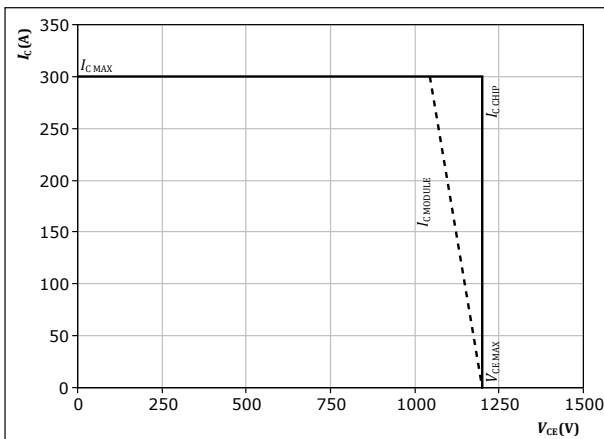
$V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $I_c = 125 \text{ A}$

$T_j =$  — 25 °C  
 — 125 °C  
 — 150 °C

**figure 64.** IGBT

Reverse bias safe operating area

$I_c = f(V_{CE})$



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



### Switching Definitions

figure 65. IGBT

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

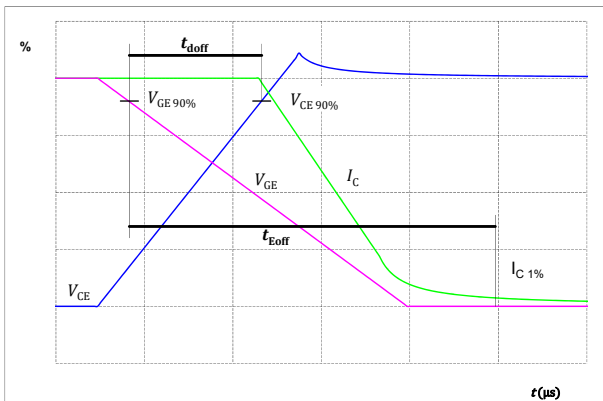


figure 66. IGBT

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

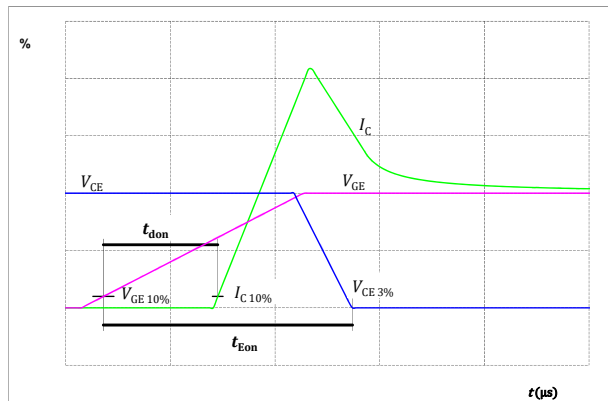


figure 67. IGBT

Turn-off Switching Waveforms & definition of  $t_f$

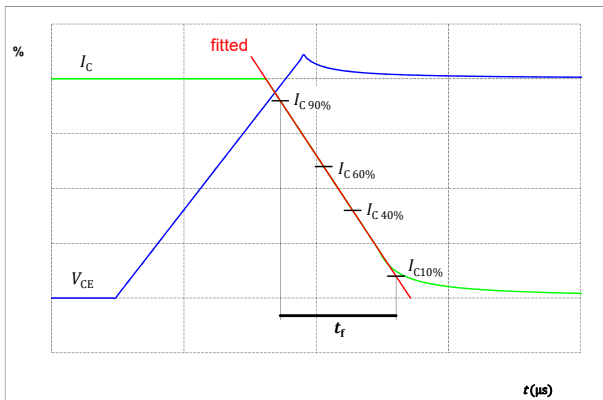
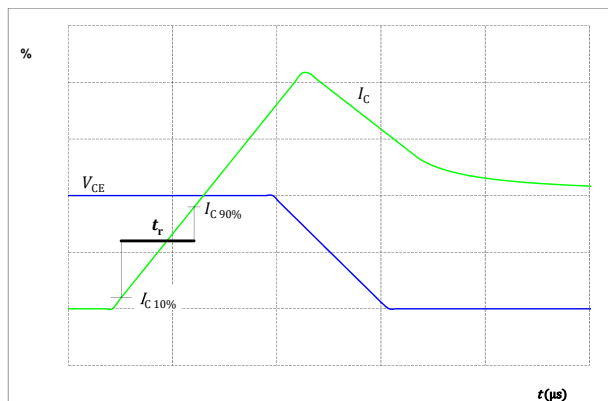


figure 68. IGBT

Turn-on Switching Waveforms & definition of  $t_r$





### Switching Definitions

figure 69. FWD

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

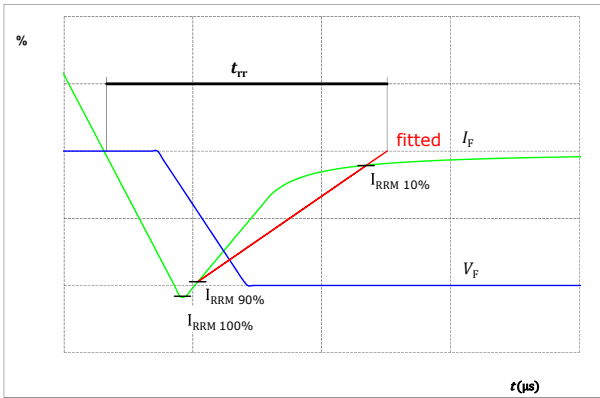
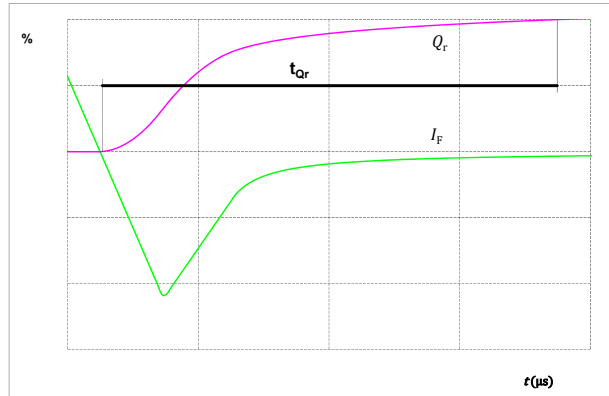


figure 70. FWD

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





### AC Switching Definitions

figure 65. MOSFET

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

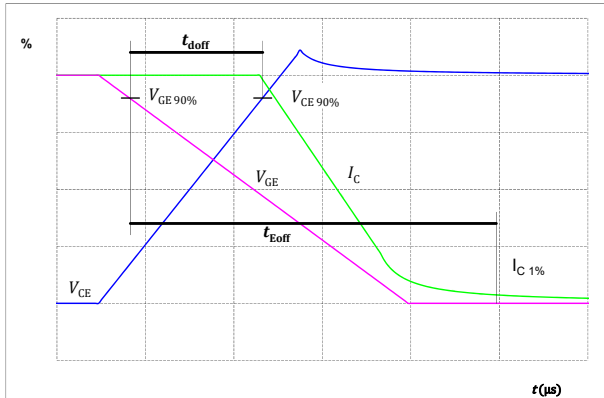


figure 66. MOSFET

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

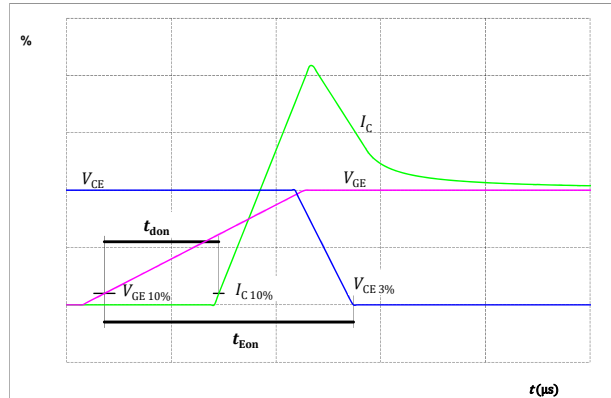


figure 67. MOSFET

Turn-off Switching Waveforms & definition of  $t_f$

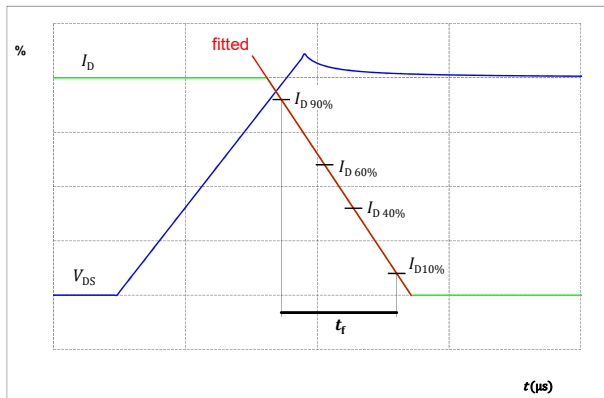
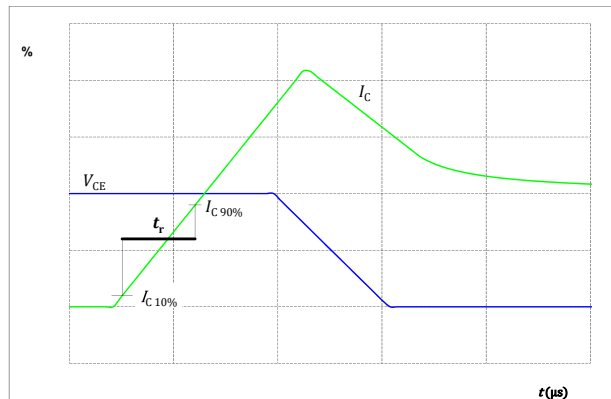


figure 68. MOSFET

Turn-on Switching Waveforms & definition of  $t_r$





### AC Switching Definitions

figure 69. FWD

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

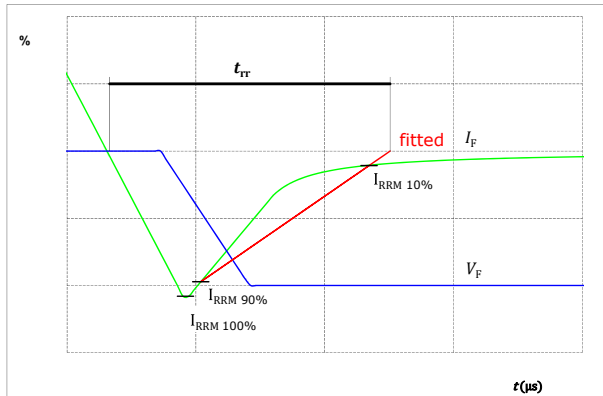


figure 70. FWD

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

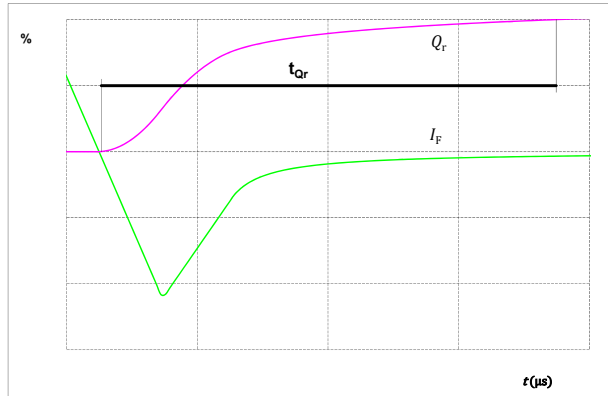
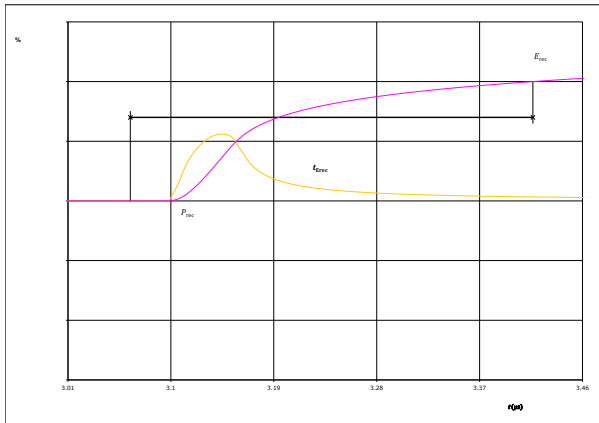


figure 71. FWD

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





Vincotech

**B0-SP12NAA008ME01-LR88F78T**  
datasheet

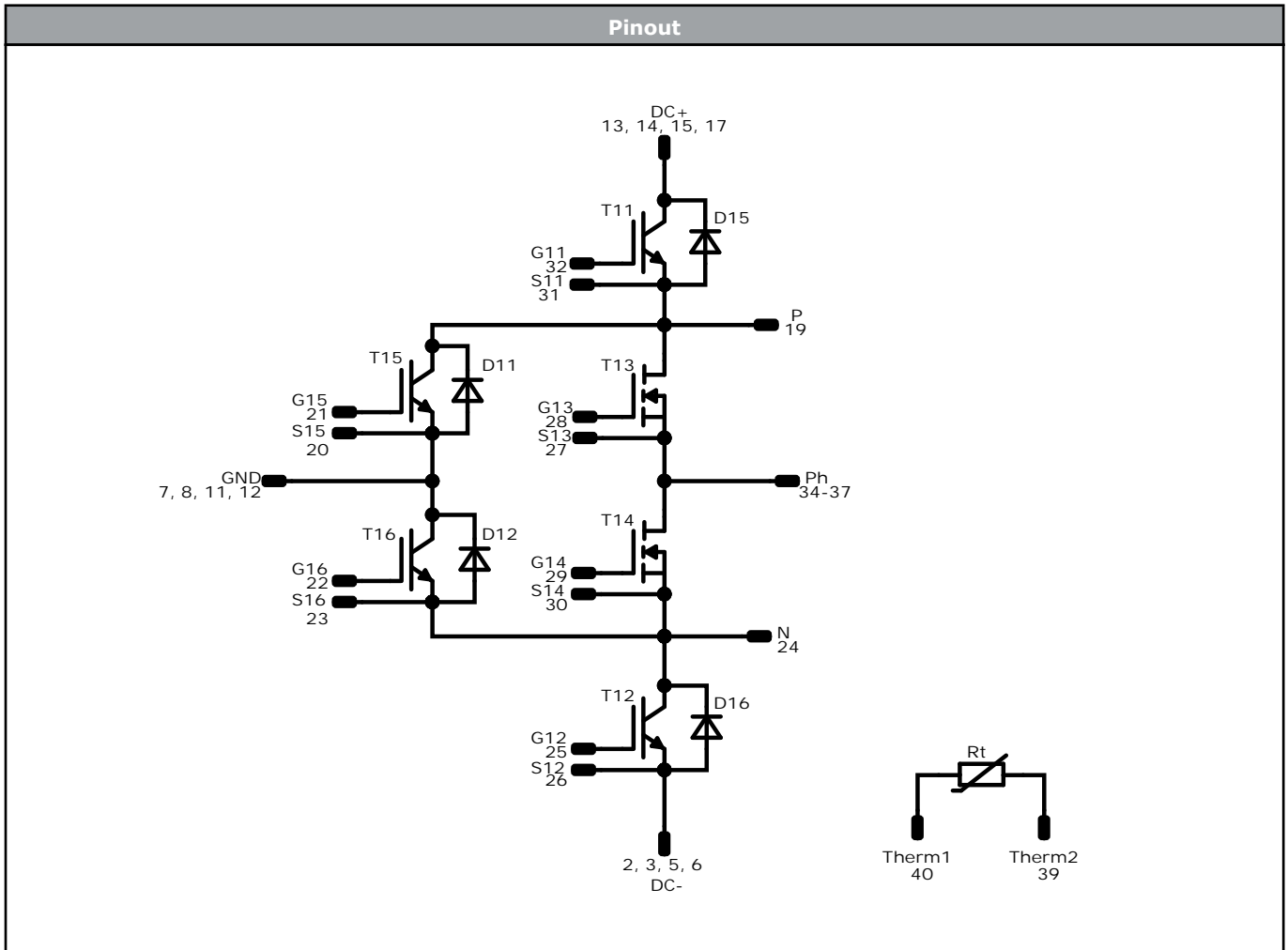
| Ordering Code      |                                |
|--------------------|--------------------------------|
| <b>Version</b>     | <b>Ordering Code</b>           |
| With thermal paste | B0-SP12NAA008ME01-LR88F78T-/7/ |

| Marking |                   |  |                            |                       |                          |                       |
|---------|-------------------|--|----------------------------|-----------------------|--------------------------|-----------------------|
|         | <b>Text</b>       | <b>Name</b><br>NN-NNNNNNNNNNNNNN-<br>TTTTIVV | <b>Date code</b><br>WWYY   | <b>Logo</b><br>VIN    | <b>Lot</b><br>LLLLL      | <b>Serial</b><br>SSSS |
|         | <b>Datamatrix</b> | <b>Type&amp;Ver</b><br>TTTTIVV               | <b>Lot number</b><br>LLLLL | <b>Serial</b><br>SSSS | <b>Date code</b><br>WWYY |                       |

| Outline  |       |       |               |                |  |  |  |     |   |   |          |   |  |  |               |   |   |     |     |   |   |      |     |   |  |  |               |   |   |      |     |   |     |      |     |   |   |      |     |   |     |      |     |   |  |  |               |    |  |  |               |    |   |      |     |    |     |      |     |    |   |      |     |    |     |      |     |    |   |      |     |    |  |  |               |    |   |    |     |    |  |  |               |    |   |      |   |    |    |       |     |    |    |       |     |    |       |      |     |    |       |      |     |    |       |      |   |    |      |     |     |    |      |     |     |    |       |       |     |    |       |       |     |    |      |      |     |    |      |      |     |    |      |      |     |    |      |      |     |    |  |  |               |    |      |       |    |    |      |       |    |    |      |       |    |    |      |       |    |    |  |  |               |    |      |   |        |    |      |   |        |
|--|-------|-------|---------------|----------------|--|--|--|-----|---|---|----------|---|--|--|---------------|---|---|-----|-----|---|---|------|-----|---|--|--|---------------|---|---|------|-----|---|-----|------|-----|---|---|------|-----|---|-----|------|-----|---|--|--|---------------|----|--|--|---------------|----|---|------|-----|----|-----|------|-----|----|---|------|-----|----|-----|------|-----|----|---|------|-----|----|--|--|---------------|----|---|----|-----|----|--|--|---------------|----|---|------|---|----|----|-------|-----|----|----|-------|-----|----|-------|------|-----|----|-------|------|-----|----|-------|------|---|----|------|-----|-----|----|------|-----|-----|----|-------|-------|-----|----|-------|-------|-----|----|------|------|-----|----|------|------|-----|----|------|------|-----|----|------|------|-----|----|--|--|---------------|----|------|-------|----|----|------|-------|----|----|------|-------|----|----|------|-------|----|----|--|--|---------------|----|------|---|--------|----|------|---|--------|
| <table border="1"> <thead> <tr> <th colspan="4">Pin table [mm]</th> </tr> <tr> <th>Pin</th> <th>X</th> <th>Y</th> <th>Function</th> </tr> </thead> <tbody> <tr><td>1</td><td></td><td></td><td>not assembled</td></tr> <tr><td>2</td><td>0</td><td>9,5</td><td>DC-</td></tr> <tr><td>3</td><td>0</td><td>12,7</td><td>DC-</td></tr> <tr><td>4</td><td></td><td></td><td>not assembled</td></tr> <tr><td>5</td><td>0</td><td>15,4</td><td>DC-</td></tr> <tr><td>6</td><td>2,7</td><td>15,4</td><td>DC-</td></tr> <tr><td>7</td><td>0</td><td>21,2</td><td>GND</td></tr> <tr><td>8</td><td>2,7</td><td>21,2</td><td>GND</td></tr> <tr><td>9</td><td></td><td></td><td>not assembled</td></tr> <tr><td>10</td><td></td><td></td><td>not assembled</td></tr> <tr><td>11</td><td>0</td><td>29,3</td><td>GND</td></tr> <tr><td>12</td><td>2,7</td><td>29,3</td><td>GND</td></tr> <tr><td>13</td><td>0</td><td>35,1</td><td>DC+</td></tr> <tr><td>14</td><td>2,7</td><td>35,1</td><td>DC+</td></tr> <tr><td>15</td><td>0</td><td>37,8</td><td>DC+</td></tr> <tr><td>16</td><td></td><td></td><td>not assembled</td></tr> <tr><td>17</td><td>0</td><td>41</td><td>DC+</td></tr> <tr><td>18</td><td></td><td></td><td>not assembled</td></tr> <tr><td>19</td><td>8</td><td>44,1</td><td>P</td></tr> <tr><td>20</td><td>16</td><td>45,95</td><td>S15</td></tr> <tr><td>21</td><td>19</td><td>45,95</td><td>G15</td></tr> <tr><td>22</td><td>22,15</td><td>27,2</td><td>G16</td></tr> <tr><td>23</td><td>22,15</td><td>24,2</td><td>S16</td></tr> <tr><td>24</td><td>22,15</td><td>15,5</td><td>N</td></tr> <tr><td>25</td><td>30,8</td><td>6,2</td><td>G12</td></tr> <tr><td>26</td><td>30,8</td><td>3,2</td><td>S12</td></tr> <tr><td>27</td><td>37,55</td><td>35,25</td><td>S13</td></tr> <tr><td>28</td><td>40,55</td><td>36,25</td><td>G13</td></tr> <tr><td>29</td><td>37,7</td><td>23,8</td><td>G14</td></tr> <tr><td>30</td><td>37,7</td><td>20,8</td><td>S14</td></tr> <tr><td>31</td><td>52,4</td><td>50,4</td><td>S11</td></tr> <tr><td>32</td><td>52,4</td><td>47,4</td><td>G11</td></tr> <tr><td>33</td><td></td><td></td><td>not assembled</td></tr> <tr><td>34</td><td>52,4</td><td>23,25</td><td>Ph</td></tr> <tr><td>35</td><td>52,4</td><td>20,55</td><td>Ph</td></tr> <tr><td>36</td><td>52,4</td><td>17,85</td><td>Ph</td></tr> <tr><td>37</td><td>52,4</td><td>15,15</td><td>Ph</td></tr> <tr><td>38</td><td></td><td></td><td>not assembled</td></tr> <tr><td>39</td><td>49,4</td><td>0</td><td>Therm2</td></tr> <tr><td>40</td><td>52,4</td><td>0</td><td>Therm1</td></tr> </tbody> </table> |       |       |               | Pin table [mm] |  |  |  | Pin | X | Y | Function | 1 |  |  | not assembled | 2 | 0 | 9,5 | DC- | 3 | 0 | 12,7 | DC- | 4 |  |  | not assembled | 5 | 0 | 15,4 | DC- | 6 | 2,7 | 15,4 | DC- | 7 | 0 | 21,2 | GND | 8 | 2,7 | 21,2 | GND | 9 |  |  | not assembled | 10 |  |  | not assembled | 11 | 0 | 29,3 | GND | 12 | 2,7 | 29,3 | GND | 13 | 0 | 35,1 | DC+ | 14 | 2,7 | 35,1 | DC+ | 15 | 0 | 37,8 | DC+ | 16 |  |  | not assembled | 17 | 0 | 41 | DC+ | 18 |  |  | not assembled | 19 | 8 | 44,1 | P | 20 | 16 | 45,95 | S15 | 21 | 19 | 45,95 | G15 | 22 | 22,15 | 27,2 | G16 | 23 | 22,15 | 24,2 | S16 | 24 | 22,15 | 15,5 | N | 25 | 30,8 | 6,2 | G12 | 26 | 30,8 | 3,2 | S12 | 27 | 37,55 | 35,25 | S13 | 28 | 40,55 | 36,25 | G13 | 29 | 37,7 | 23,8 | G14 | 30 | 37,7 | 20,8 | S14 | 31 | 52,4 | 50,4 | S11 | 32 | 52,4 | 47,4 | G11 | 33 |  |  | not assembled | 34 | 52,4 | 23,25 | Ph | 35 | 52,4 | 20,55 | Ph | 36 | 52,4 | 17,85 | Ph | 37 | 52,4 | 15,15 | Ph | 38 |  |  | not assembled | 39 | 49,4 | 0 | Therm2 | 40 | 52,4 | 0 | Therm1 |
| Pin table [mm]   |       |       |               |                |  |  |  |     |   |   |          |   |  |  |               |   |   |     |     |   |   |      |     |   |  |  |               |   |   |      |     |   |     |      |     |   |   |      |     |   |     |      |     |   |  |  |               |    |  |  |               |    |   |      |     |    |     |      |     |    |   |      |     |    |     |      |     |    |   |      |     |    |  |  |               |    |   |    |     |    |  |  |               |    |   |      |   |    |    |       |     |    |    |       |     |    |       |      |     |    |       |      |     |    |       |      |   |    |      |     |     |    |      |     |     |    |       |       |     |    |       |       |     |    |      |      |     |    |      |      |     |    |      |      |     |    |      |      |     |    |  |  |               |    |      |       |    |    |      |       |    |    |      |       |    |    |      |       |    |    |  |  |               |    |      |   |        |    |      |   |        |
| Pin  | X     | Y     | Function      |                |  |  |  |     |   |   |          |   |  |  |               |   |   |     |     |   |   |      |     |   |  |  |               |   |   |      |     |   |     |      |     |   |   |      |     |   |     |      |     |   |  |  |               |    |  |  |               |    |   |      |     |    |     |      |     |    |   |      |     |    |     |      |     |    |   |      |     |    |  |  |               |    |   |    |     |    |  |  |               |    |   |      |   |    |    |       |     |    |    |       |     |    |       |      |     |    |       |      |     |    |       |      |   |    |      |     |     |    |      |     |     |    |       |       |     |    |       |       |     |    |      |      |     |    |      |      |     |    |      |      |     |    |      |      |     |    |  |  |               |    |      |       |    |    |      |       |    |    |      |       |    |    |      |       |    |    |  |  |               |    |      |   |        |    |      |   |        |
| 1  |       |       | not assembled |                |  |  |  |     |   |   |          |   |  |  |               |   |   |     |     |   |   |      |     |   |  |  |               |   |   |      |     |   |     |      |     |   |   |      |     |   |     |      |     |   |  |  |               |    |  |  |               |    |   |      |     |    |     |      |     |    |   |      |     |    |     |      |     |    |   |      |     |    |  |  |               |    |   |    |     |    |  |  |               |    |   |      |   |    |    |       |     |    |    |       |     |    |       |      |     |    |       |      |     |    |       |      |   |    |      |     |     |    |      |     |     |    |       |       |     |    |       |       |     |    |      |      |     |    |      |      |     |    |      |      |     |    |      |      |     |    |  |  |               |    |      |       |    |    |      |       |    |    |      |       |    |    |      |       |    |    |  |  |               |    |      |   |        |    |      |   |        |
| 2  | 0     | 9,5   | DC-           |                |  |  |  |     |   |   |          |   |  |  |               |   |   |     |     |   |   |      |     |   |  |  |               |   |   |      |     |   |     |      |     |   |   |      |     |   |     |      |     |   |  |  |               |    |  |  |               |    |   |      |     |    |     |      |     |    |   |      |     |    |     |      |     |    |   |      |     |    |  |  |               |    |   |    |     |    |  |  |               |    |   |      |   |    |    |       |     |    |    |       |     |    |       |      |     |    |       |      |     |    |       |      |   |    |      |     |     |    |      |     |     |    |       |       |     |    |       |       |     |    |      |      |     |    |      |      |     |    |      |      |     |    |      |      |     |    |  |  |               |    |      |       |    |    |      |       |    |    |      |       |    |    |      |       |    |    |  |  |               |    |      |   |        |    |      |   |        |
| 3  | 0     | 12,7  | DC-           |                |  |  |  |     |   |   |          |   |  |  |               |   |   |     |     |   |   |      |     |   |  |  |               |   |   |      |     |   |     |      |     |   |   |      |     |   |     |      |     |   |  |  |               |    |  |  |               |    |   |      |     |    |     |      |     |    |   |      |     |    |     |      |     |    |   |      |     |    |  |  |               |    |   |    |     |    |  |  |               |    |   |      |   |    |    |       |     |    |    |       |     |    |       |      |     |    |       |      |     |    |       |      |   |    |      |     |     |    |      |     |     |    |       |       |     |    |       |       |     |    |      |      |     |    |      |      |     |    |      |      |     |    |      |      |     |    |  |  |               |    |      |       |    |    |      |       |    |    |      |       |    |    |      |       |    |    |  |  |               |    |      |   |        |    |      |   |        |
| 4  |       |       | not assembled |                |  |  |  |     |   |   |          |   |  |  |               |   |   |     |     |   |   |      |     |   |  |  |               |   |   |      |     |   |     |      |     |   |   |      |     |   |     |      |     |   |  |  |               |    |  |  |               |    |   |      |     |    |     |      |     |    |   |      |     |    |     |      |     |    |   |      |     |    |  |  |               |    |   |    |     |    |  |  |               |    |   |      |   |    |    |       |     |    |    |       |     |    |       |      |     |    |       |      |     |    |       |      |   |    |      |     |     |    |      |     |     |    |       |       |     |    |       |       |     |    |      |      |     |    |      |      |     |    |      |      |     |    |      |      |     |    |  |  |               |    |      |       |    |    |      |       |    |    |      |       |    |    |      |       |    |    |  |  |               |    |      |   |        |    |      |   |        |
| 5  | 0     | 15,4  | DC-           |                |  |  |  |     |   |   |          |   |  |  |               |   |   |     |     |   |   |      |     |   |  |  |               |   |   |      |     |   |     |      |     |   |   |      |     |   |     |      |     |   |  |  |               |    |  |  |               |    |   |      |     |    |     |      |     |    |   |      |     |    |     |      |     |    |   |      |     |    |  |  |               |    |   |    |     |    |  |  |               |    |   |      |   |    |    |       |     |    |    |       |     |    |       |      |     |    |       |      |     |    |       |      |   |    |      |     |     |    |      |     |     |    |       |       |     |    |       |       |     |    |      |      |     |    |      |      |     |    |      |      |     |    |      |      |     |    |  |  |               |    |      |       |    |    |      |       |    |    |      |       |    |    |      |       |    |    |  |  |               |    |      |   |        |    |      |   |        |
| 6  | 2,7   | 15,4  | DC-           |                |  |  |  |     |   |   |          |   |  |  |               |   |   |     |     |   |   |      |     |   |  |  |               |   |   |      |     |   |     |      |     |   |   |      |     |   |     |      |     |   |  |  |               |    |  |  |               |    |   |      |     |    |     |      |     |    |   |      |     |    |     |      |     |    |   |      |     |    |  |  |               |    |   |    |     |    |  |  |               |    |   |      |   |    |    |       |     |    |    |       |     |    |       |      |     |    |       |      |     |    |       |      |   |    |      |     |     |    |      |     |     |    |       |       |     |    |       |       |     |    |      |      |     |    |      |      |     |    |      |      |     |    |      |      |     |    |  |  |               |    |      |       |    |    |      |       |    |    |      |       |    |    |      |       |    |    |  |  |               |    |      |   |        |    |      |   |        |
| 7  | 0     | 21,2  | GND           |                |  |  |  |     |   |   |          |   |  |  |               |   |   |     |     |   |   |      |     |   |  |  |               |   |   |      |     |   |     |      |     |   |   |      |     |   |     |      |     |   |  |  |               |    |  |  |               |    |   |      |     |    |     |      |     |    |   |      |     |    |     |      |     |    |   |      |     |    |  |  |               |    |   |    |     |    |  |  |               |    |   |      |   |    |    |       |     |    |    |       |     |    |       |      |     |    |       |      |     |    |       |      |   |    |      |     |     |    |      |     |     |    |       |       |     |    |       |       |     |    |      |      |     |    |      |      |     |    |      |      |     |    |      |      |     |    |  |  |               |    |      |       |    |    |      |       |    |    |      |       |    |    |      |       |    |    |  |  |               |    |      |   |        |    |      |   |        |
| 8  | 2,7   | 21,2  | GND           |                |  |  |  |     |   |   |          |   |  |  |               |   |   |     |     |   |   |      |     |   |  |  |               |   |   |      |     |   |     |      |     |   |   |      |     |   |     |      |     |   |  |  |               |    |  |  |               |    |   |      |     |    |     |      |     |    |   |      |     |    |     |      |     |    |   |      |     |    |  |  |               |    |   |    |     |    |  |  |               |    |   |      |   |    |    |       |     |    |    |       |     |    |       |      |     |    |       |      |     |    |       |      |   |    |      |     |     |    |      |     |     |    |       |       |     |    |       |       |     |    |      |      |     |    |      |      |     |    |      |      |     |    |      |      |     |    |  |  |               |    |      |       |    |    |      |       |    |    |      |       |    |    |      |       |    |    |  |  |               |    |      |   |        |    |      |   |        |
| 9  |       |       | not assembled |                |  |  |  |     |   |   |          |   |  |  |               |   |   |     |     |   |   |      |     |   |  |  |               |   |   |      |     |   |     |      |     |   |   |      |     |   |     |      |     |   |  |  |               |    |  |  |               |    |   |      |     |    |     |      |     |    |   |      |     |    |     |      |     |    |   |      |     |    |  |  |               |    |   |    |     |    |  |  |               |    |   |      |   |    |    |       |     |    |    |       |     |    |       |      |     |    |       |      |     |    |       |      |   |    |      |     |     |    |      |     |     |    |       |       |     |    |       |       |     |    |      |      |     |    |      |      |     |    |      |      |     |    |      |      |     |    |  |  |               |    |      |       |    |    |      |       |    |    |      |       |    |    |      |       |    |    |  |  |               |    |      |   |        |    |      |   |        |
| 10   |       |       | not assembled |                |  |  |  |     |   |   |          |   |  |  |               |   |   |     |     |   |   |      |     |   |  |  |               |   |   |      |     |   |     |      |     |   |   |      |     |   |     |      |     |   |  |  |               |    |  |  |               |    |   |      |     |    |     |      |     |    |   |      |     |    |     |      |     |    |   |      |     |    |  |  |               |    |   |    |     |    |  |  |               |    |   |      |   |    |    |       |     |    |    |       |     |    |       |      |     |    |       |      |     |    |       |      |   |    |      |     |     |    |      |     |     |    |       |       |     |    |       |       |     |    |      |      |     |    |      |      |     |    |      |      |     |    |      |      |     |    |  |  |               |    |      |       |    |    |      |       |    |    |      |       |    |    |      |       |    |    |  |  |               |    |      |   |        |    |      |   |        |
| 11   | 0     | 29,3  | GND           |                |  |  |  |     |   |   |          |   |  |  |               |   |   |     |     |   |   |      |     |   |  |  |               |   |   |      |     |   |     |      |     |   |   |      |     |   |     |      |     |   |  |  |               |    |  |  |               |    |   |      |     |    |     |      |     |    |   |      |     |    |     |      |     |    |   |      |     |    |  |  |               |    |   |    |     |    |  |  |               |    |   |      |   |    |    |       |     |    |    |       |     |    |       |      |     |    |       |      |     |    |       |      |   |    |      |     |     |    |      |     |     |    |       |       |     |    |       |       |     |    |      |      |     |    |      |      |     |    |      |      |     |    |      |      |     |    |  |  |               |    |      |       |    |    |      |       |    |    |      |       |    |    |      |       |    |    |  |  |               |    |      |   |        |    |      |   |        |
| 12   | 2,7   | 29,3  | GND           |                |  |  |  |     |   |   |          |   |  |  |               |   |   |     |     |   |   |      |     |   |  |  |               |   |   |      |     |   |     |      |     |   |   |      |     |   |     |      |     |   |  |  |               |    |  |  |               |    |   |      |     |    |     |      |     |    |   |      |     |    |     |      |     |    |   |      |     |    |  |  |               |    |   |    |     |    |  |  |               |    |   |      |   |    |    |       |     |    |    |       |     |    |       |      |     |    |       |      |     |    |       |      |   |    |      |     |     |    |      |     |     |    |       |       |     |    |       |       |     |    |      |      |     |    |      |      |     |    |      |      |     |    |      |      |     |    |  |  |               |    |      |       |    |    |      |       |    |    |      |       |    |    |      |       |    |    |  |  |               |    |      |   |        |    |      |   |        |
| 13   | 0     | 35,1  | DC+           |                |  |  |  |     |   |   |          |   |  |  |               |   |   |     |     |   |   |      |     |   |  |  |               |   |   |      |     |   |     |      |     |   |   |      |     |   |     |      |     |   |  |  |               |    |  |  |               |    |   |      |     |    |     |      |     |    |   |      |     |    |     |      |     |    |   |      |     |    |  |  |               |    |   |    |     |    |  |  |               |    |   |      |   |    |    |       |     |    |    |       |     |    |       |      |     |    |       |      |     |    |       |      |   |    |      |     |     |    |      |     |     |    |       |       |     |    |       |       |     |    |      |      |     |    |      |      |     |    |      |      |     |    |      |      |     |    |  |  |               |    |      |       |    |    |      |       |    |    |      |       |    |    |      |       |    |    |  |  |               |    |      |   |        |    |      |   |        |
| 14   | 2,7   | 35,1  | DC+           |                |  |  |  |     |   |   |          |   |  |  |               |   |   |     |     |   |   |      |     |   |  |  |               |   |   |      |     |   |     |      |     |   |   |      |     |   |     |      |     |   |  |  |               |    |  |  |               |    |   |      |     |    |     |      |     |    |   |      |     |    |     |      |     |    |   |      |     |    |  |  |               |    |   |    |     |    |  |  |               |    |   |      |   |    |    |       |     |    |    |       |     |    |       |      |     |    |       |      |     |    |       |      |   |    |      |     |     |    |      |     |     |    |       |       |     |    |       |       |     |    |      |      |     |    |      |      |     |    |      |      |     |    |      |      |     |    |  |  |               |    |      |       |    |    |      |       |    |    |      |       |    |    |      |       |    |    |  |  |               |    |      |   |        |    |      |   |        |
| 15   | 0     | 37,8  | DC+           |                |  |  |  |     |   |   |          |   |  |  |               |   |   |     |     |   |   |      |     |   |  |  |               |   |   |      |     |   |     |      |     |   |   |      |     |   |     |      |     |   |  |  |               |    |  |  |               |    |   |      |     |    |     |      |     |    |   |      |     |    |     |      |     |    |   |      |     |    |  |  |               |    |   |    |     |    |  |  |               |    |   |      |   |    |    |       |     |    |    |       |     |    |       |      |     |    |       |      |     |    |       |      |   |    |      |     |     |    |      |     |     |    |       |       |     |    |       |       |     |    |      |      |     |    |      |      |     |    |      |      |     |    |      |      |     |    |  |  |               |    |      |       |    |    |      |       |    |    |      |       |    |    |      |       |    |    |  |  |               |    |      |   |        |    |      |   |        |
| 16   |       |       | not assembled |                |  |  |  |     |   |   |          |   |  |  |               |   |   |     |     |   |   |      |     |   |  |  |               |   |   |      |     |   |     |      |     |   |   |      |     |   |     |      |     |   |  |  |               |    |  |  |               |    |   |      |     |    |     |      |     |    |   |      |     |    |     |      |     |    |   |      |     |    |  |  |               |    |   |    |     |    |  |  |               |    |   |      |   |    |    |       |     |    |    |       |     |    |       |      |     |    |       |      |     |    |       |      |   |    |      |     |     |    |      |     |     |    |       |       |     |    |       |       |     |    |      |      |     |    |      |      |     |    |      |      |     |    |      |      |     |    |  |  |               |    |      |       |    |    |      |       |    |    |      |       |    |    |      |       |    |    |  |  |               |    |      |   |        |    |      |   |        |
| 17   | 0     | 41    | DC+           |                |  |  |  |     |   |   |          |   |  |  |               |   |   |     |     |   |   |      |     |   |  |  |               |   |   |      |     |   |     |      |     |   |   |      |     |   |     |      |     |   |  |  |               |    |  |  |               |    |   |      |     |    |     |      |     |    |   |      |     |    |     |      |     |    |   |      |     |    |  |  |               |    |   |    |     |    |  |  |               |    |   |      |   |    |    |       |     |    |    |       |     |    |       |      |     |    |       |      |     |    |       |      |   |    |      |     |     |    |      |     |     |    |       |       |     |    |       |       |     |    |      |      |     |    |      |      |     |    |      |      |     |    |      |      |     |    |  |  |               |    |      |       |    |    |      |       |    |    |      |       |    |    |      |       |    |    |  |  |               |    |      |   |        |    |      |   |        |
| 18   |       |       | not assembled |                |  |  |  |     |   |   |          |   |  |  |               |   |   |     |     |   |   |      |     |   |  |  |               |   |   |      |     |   |     |      |     |   |   |      |     |   |     |      |     |   |  |  |               |    |  |  |               |    |   |      |     |    |     |      |     |    |   |      |     |    |     |      |     |    |   |      |     |    |  |  |               |    |   |    |     |    |  |  |               |    |   |      |   |    |    |       |     |    |    |       |     |    |       |      |     |    |       |      |     |    |       |      |   |    |      |     |     |    |      |     |     |    |       |       |     |    |       |       |     |    |      |      |     |    |      |      |     |    |      |      |     |    |      |      |     |    |  |  |               |    |      |       |    |    |      |       |    |    |      |       |    |    |      |       |    |    |  |  |               |    |      |   |        |    |      |   |        |
| 19   | 8     | 44,1  | P             |                |  |  |  |     |   |   |          |   |  |  |               |   |   |     |     |   |   |      |     |   |  |  |               |   |   |      |     |   |     |      |     |   |   |      |     |   |     |      |     |   |  |  |               |    |  |  |               |    |   |      |     |    |     |      |     |    |   |      |     |    |     |      |     |    |   |      |     |    |  |  |               |    |   |    |     |    |  |  |               |    |   |      |   |    |    |       |     |    |    |       |     |    |       |      |     |    |       |      |     |    |       |      |   |    |      |     |     |    |      |     |     |    |       |       |     |    |       |       |     |    |      |      |     |    |      |      |     |    |      |      |     |    |      |      |     |    |  |  |               |    |      |       |    |    |      |       |    |    |      |       |    |    |      |       |    |    |  |  |               |    |      |   |        |    |      |   |        |
| 20   | 16    | 45,95 | S15           |                |  |  |  |     |   |   |          |   |  |  |               |   |   |     |     |   |   |      |     |   |  |  |               |   |   |      |     |   |     |      |     |   |   |      |     |   |     |      |     |   |  |  |               |    |  |  |               |    |   |      |     |    |     |      |     |    |   |      |     |    |     |      |     |    |   |      |     |    |  |  |               |    |   |    |     |    |  |  |               |    |   |      |   |    |    |       |     |    |    |       |     |    |       |      |     |    |       |      |     |    |       |      |   |    |      |     |     |    |      |     |     |    |       |       |     |    |       |       |     |    |      |      |     |    |      |      |     |    |      |      |     |    |      |      |     |    |  |  |               |    |      |       |    |    |      |       |    |    |      |       |    |    |      |       |    |    |  |  |               |    |      |   |        |    |      |   |        |
| 21   | 19    | 45,95 | G15           |                |  |  |  |     |   |   |          |   |  |  |               |   |   |     |     |   |   |      |     |   |  |  |               |   |   |      |     |   |     |      |     |   |   |      |     |   |     |      |     |   |  |  |               |    |  |  |               |    |   |      |     |    |     |      |     |    |   |      |     |    |     |      |     |    |   |      |     |    |  |  |               |    |   |    |     |    |  |  |               |    |   |      |   |    |    |       |     |    |    |       |     |    |       |      |     |    |       |      |     |    |       |      |   |    |      |     |     |    |      |     |     |    |       |       |     |    |       |       |     |    |      |      |     |    |      |      |     |    |      |      |     |    |      |      |     |    |  |  |               |    |      |       |    |    |      |       |    |    |      |       |    |    |      |       |    |    |  |  |               |    |      |   |        |    |      |   |        |
| 22   | 22,15 | 27,2  | G16           |                |  |  |  |     |   |   |          |   |  |  |               |   |   |     |     |   |   |      |     |   |  |  |               |   |   |      |     |   |     |      |     |   |   |      |     |   |     |      |     |   |  |  |               |    |  |  |               |    |   |      |     |    |     |      |     |    |   |      |     |    |     |      |     |    |   |      |     |    |  |  |               |    |   |    |     |    |  |  |               |    |   |      |   |    |    |       |     |    |    |       |     |    |       |      |     |    |       |      |     |    |       |      |   |    |      |     |     |    |      |     |     |    |       |       |     |    |       |       |     |    |      |      |     |    |      |      |     |    |      |      |     |    |      |      |     |    |  |  |               |    |      |       |    |    |      |       |    |    |      |       |    |    |      |       |    |    |  |  |               |    |      |   |        |    |      |   |        |
| 23   | 22,15 | 24,2  | S16           |                |  |  |  |     |   |   |          |   |  |  |               |   |   |     |     |   |   |      |     |   |  |  |               |   |   |      |     |   |     |      |     |   |   |      |     |   |     |      |     |   |  |  |               |    |  |  |               |    |   |      |     |    |     |      |     |    |   |      |     |    |     |      |     |    |   |      |     |    |  |  |               |    |   |    |     |    |  |  |               |    |   |      |   |    |    |       |     |    |    |       |     |    |       |      |     |    |       |      |     |    |       |      |   |    |      |     |     |    |      |     |     |    |       |       |     |    |       |       |     |    |      |      |     |    |      |      |     |    |      |      |     |    |      |      |     |    |  |  |               |    |      |       |    |    |      |       |    |    |      |       |    |    |      |       |    |    |  |  |               |    |      |   |        |    |      |   |        |
| 24   | 22,15 | 15,5  | N             |                |  |  |  |     |   |   |          |   |  |  |               |   |   |     |     |   |   |      |     |   |  |  |               |   |   |      |     |   |     |      |     |   |   |      |     |   |     |      |     |   |  |  |               |    |  |  |               |    |   |      |     |    |     |      |     |    |   |      |     |    |     |      |     |    |   |      |     |    |  |  |               |    |   |    |     |    |  |  |               |    |   |      |   |    |    |       |     |    |    |       |     |    |       |      |     |    |       |      |     |    |       |      |   |    |      |     |     |    |      |     |     |    |       |       |     |    |       |       |     |    |      |      |     |    |      |      |     |    |      |      |     |    |      |      |     |    |  |  |               |    |      |       |    |    |      |       |    |    |      |       |    |    |      |       |    |    |  |  |               |    |      |   |        |    |      |   |        |
| 25   | 30,8  | 6,2   | G12           |                |  |  |  |     |   |   |          |   |  |  |               |   |   |     |     |   |   |      |     |   |  |  |               |   |   |      |     |   |     |      |     |   |   |      |     |   |     |      |     |   |  |  |               |    |  |  |               |    |   |      |     |    |     |      |     |    |   |      |     |    |     |      |     |    |   |      |     |    |  |  |               |    |   |    |     |    |  |  |               |    |   |      |   |    |    |       |     |    |    |       |     |    |       |      |     |    |       |      |     |    |       |      |   |    |      |     |     |    |      |     |     |    |       |       |     |    |       |       |     |    |      |      |     |    |      |      |     |    |      |      |     |    |      |      |     |    |  |  |               |    |      |       |    |    |      |       |    |    |      |       |    |    |      |       |    |    |  |  |               |    |      |   |        |    |      |   |        |
| 26   | 30,8  | 3,2   | S12           |                |  |  |  |     |   |   |          |   |  |  |               |   |   |     |     |   |   |      |     |   |  |  |               |   |   |      |     |   |     |      |     |   |   |      |     |   |     |      |     |   |  |  |               |    |  |  |               |    |   |      |     |    |     |      |     |    |   |      |     |    |     |      |     |    |   |      |     |    |  |  |               |    |   |    |     |    |  |  |               |    |   |      |   |    |    |       |     |    |    |       |     |    |       |      |     |    |       |      |     |    |       |      |   |    |      |     |     |    |      |     |     |    |       |       |     |    |       |       |     |    |      |      |     |    |      |      |     |    |      |      |     |    |      |      |     |    |  |  |               |    |      |       |    |    |      |       |    |    |      |       |    |    |      |       |    |    |  |  |               |    |      |   |        |    |      |   |        |
| 27   | 37,55 | 35,25 | S13           |                |  |  |  |     |   |   |          |   |  |  |               |   |   |     |     |   |   |      |     |   |  |  |               |   |   |      |     |   |     |      |     |   |   |      |     |   |     |      |     |   |  |  |               |    |  |  |               |    |   |      |     |    |     |      |     |    |   |      |     |    |     |      |     |    |   |      |     |    |  |  |               |    |   |    |     |    |  |  |               |    |   |      |   |    |    |       |     |    |    |       |     |    |       |      |     |    |       |      |     |    |       |      |   |    |      |     |     |    |      |     |     |    |       |       |     |    |       |       |     |    |      |      |     |    |      |      |     |    |      |      |     |    |      |      |     |    |  |  |               |    |      |       |    |    |      |       |    |    |      |       |    |    |      |       |    |    |  |  |               |    |      |   |        |    |      |   |        |
| 28   | 40,55 | 36,25 | G13           |                |  |  |  |     |   |   |          |   |  |  |               |   |   |     |     |   |   |      |     |   |  |  |               |   |   |      |     |   |     |      |     |   |   |      |     |   |     |      |     |   |  |  |               |    |  |  |               |    |   |      |     |    |     |      |     |    |   |      |     |    |     |      |     |    |   |      |     |    |  |  |               |    |   |    |     |    |  |  |               |    |   |      |   |    |    |       |     |    |    |       |     |    |       |      |     |    |       |      |     |    |       |      |   |    |      |     |     |    |      |     |     |    |       |       |     |    |       |       |     |    |      |      |     |    |      |      |     |    |      |      |     |    |      |      |     |    |  |  |               |    |      |       |    |    |      |       |    |    |      |       |    |    |      |       |    |    |  |  |               |    |      |   |        |    |      |   |        |
| 29   | 37,7  | 23,8  | G14           |                |  |  |  |     |   |   |          |   |  |  |               |   |   |     |     |   |   |      |     |   |  |  |               |   |   |      |     |   |     |      |     |   |   |      |     |   |     |      |     |   |  |  |               |    |  |  |               |    |   |      |     |    |     |      |     |    |   |      |     |    |     |      |     |    |   |      |     |    |  |  |               |    |   |    |     |    |  |  |               |    |   |      |   |    |    |       |     |    |    |       |     |    |       |      |     |    |       |      |     |    |       |      |   |    |      |     |     |    |      |     |     |    |       |       |     |    |       |       |     |    |      |      |     |    |      |      |     |    |      |      |     |    |      |      |     |    |  |  |               |    |      |       |    |    |      |       |    |    |      |       |    |    |      |       |    |    |  |  |               |    |      |   |        |    |      |   |        |
| 30   | 37,7  | 20,8  | S14           |                |  |  |  |     |   |   |          |   |  |  |               |   |   |     |     |   |   |      |     |   |  |  |               |   |   |      |     |   |     |      |     |   |   |      |     |   |     |      |     |   |  |  |               |    |  |  |               |    |   |      |     |    |     |      |     |    |   |      |     |    |     |      |     |    |   |      |     |    |  |  |               |    |   |    |     |    |  |  |               |    |   |      |   |    |    |       |     |    |    |       |     |    |       |      |     |    |       |      |     |    |       |      |   |    |      |     |     |    |      |     |     |    |       |       |     |    |       |       |     |    |      |      |     |    |      |      |     |    |      |      |     |    |      |      |     |    |  |  |               |    |      |       |    |    |      |       |    |    |      |       |    |    |      |       |    |    |  |  |               |    |      |   |        |    |      |   |        |
| 31   | 52,4  | 50,4  | S11           |                |  |  |  |     |   |   |          |   |  |  |               |   |   |     |     |   |   |      |     |   |  |  |               |   |   |      |     |   |     |      |     |   |   |      |     |   |     |      |     |   |  |  |               |    |  |  |               |    |   |      |     |    |     |      |     |    |   |      |     |    |     |      |     |    |   |      |     |    |  |  |               |    |   |    |     |    |  |  |               |    |   |      |   |    |    |       |     |    |    |       |     |    |       |      |     |    |       |      |     |    |       |      |   |    |      |     |     |    |      |     |     |    |       |       |     |    |       |       |     |    |      |      |     |    |      |      |     |    |      |      |     |    |      |      |     |    |  |  |               |    |      |       |    |    |      |       |    |    |      |       |    |    |      |       |    |    |  |  |               |    |      |   |        |    |      |   |        |
| 32   | 52,4  | 47,4  | G11           |                |  |  |  |     |   |   |          |   |  |  |               |   |   |     |     |   |   |      |     |   |  |  |               |   |   |      |     |   |     |      |     |   |   |      |     |   |     |      |     |   |  |  |               |    |  |  |               |    |   |      |     |    |     |      |     |    |   |      |     |    |     |      |     |    |   |      |     |    |  |  |               |    |   |    |     |    |  |  |               |    |   |      |   |    |    |       |     |    |    |       |     |    |       |      |     |    |       |      |     |    |       |      |   |    |      |     |     |    |      |     |     |    |       |       |     |    |       |       |     |    |      |      |     |    |      |      |     |    |      |      |     |    |      |      |     |    |  |  |               |    |      |       |    |    |      |       |    |    |      |       |    |    |      |       |    |    |  |  |               |    |      |   |        |    |      |   |        |
| 33   |       |       | not assembled |                |  |  |  |     |   |   |          |   |  |  |               |   |   |     |     |   |   |      |     |   |  |  |               |   |   |      |     |   |     |      |     |   |   |      |     |   |     |      |     |   |  |  |               |    |  |  |               |    |   |      |     |    |     |      |     |    |   |      |     |    |     |      |     |    |   |      |     |    |  |  |               |    |   |    |     |    |  |  |               |    |   |      |   |    |    |       |     |    |    |       |     |    |       |      |     |    |       |      |     |    |       |      |   |    |      |     |     |    |      |     |     |    |       |       |     |    |       |       |     |    |      |      |     |    |      |      |     |    |      |      |     |    |      |      |     |    |  |  |               |    |      |       |    |    |      |       |    |    |      |       |    |    |      |       |    |    |  |  |               |    |      |   |        |    |      |   |        |
| 34   | 52,4  | 23,25 | Ph            |                |  |  |  |     |   |   |          |   |  |  |               |   |   |     |     |   |   |      |     |   |  |  |               |   |   |      |     |   |     |      |     |   |   |      |     |   |     |      |     |   |  |  |               |    |  |  |               |    |   |      |     |    |     |      |     |    |   |      |     |    |     |      |     |    |   |      |     |    |  |  |               |    |   |    |     |    |  |  |               |    |   |      |   |    |    |       |     |    |    |       |     |    |       |      |     |    |       |      |     |    |       |      |   |    |      |     |     |    |      |     |     |    |       |       |     |    |       |       |     |    |      |      |     |    |      |      |     |    |      |      |     |    |      |      |     |    |  |  |               |    |      |       |    |    |      |       |    |    |      |       |    |    |      |       |    |    |  |  |               |    |      |   |        |    |      |   |        |
| 35   | 52,4  | 20,55 | Ph            |                |  |  |  |     |   |   |          |   |  |  |               |   |   |     |     |   |   |      |     |   |  |  |               |   |   |      |     |   |     |      |     |   |   |      |     |   |     |      |     |   |  |  |               |    |  |  |               |    |   |      |     |    |     |      |     |    |   |      |     |    |     |      |     |    |   |      |     |    |  |  |               |    |   |    |     |    |  |  |               |    |   |      |   |    |    |       |     |    |    |       |     |    |       |      |     |    |       |      |     |    |       |      |   |    |      |     |     |    |      |     |     |    |       |       |     |    |       |       |     |    |      |      |     |    |      |      |     |    |      |      |     |    |      |      |     |    |  |  |               |    |      |       |    |    |      |       |    |    |      |       |    |    |      |       |    |    |  |  |               |    |      |   |        |    |      |   |        |
| 36   | 52,4  | 17,85 | Ph            |                |  |  |  |     |   |   |          |   |  |  |               |   |   |     |     |   |   |      |     |   |  |  |               |   |   |      |     |   |     |      |     |   |   |      |     |   |     |      |     |   |  |  |               |    |  |  |               |    |   |      |     |    |     |      |     |    |   |      |     |    |     |      |     |    |   |      |     |    |  |  |               |    |   |    |     |    |  |  |               |    |   |      |   |    |    |       |     |    |    |       |     |    |       |      |     |    |       |      |     |    |       |      |   |    |      |     |     |    |      |     |     |    |       |       |     |    |       |       |     |    |      |      |     |    |      |      |     |    |      |      |     |    |      |      |     |    |  |  |               |    |      |       |    |    |      |       |    |    |      |       |    |    |      |       |    |    |  |  |               |    |      |   |        |    |      |   |        |
| 37   | 52,4  | 15,15 | Ph            |                |  |  |  |     |   |   |          |   |  |  |               |   |   |     |     |   |   |      |     |   |  |  |               |   |   |      |     |   |     |      |     |   |   |      |     |   |     |      |     |   |  |  |               |    |  |  |               |    |   |      |     |    |     |      |     |    |   |      |     |    |     |      |     |    |   |      |     |    |  |  |               |    |   |    |     |    |  |  |               |    |   |      |   |    |    |       |     |    |    |       |     |    |       |      |     |    |       |      |     |    |       |      |   |    |      |     |     |    |      |     |     |    |       |       |     |    |       |       |     |    |      |      |     |    |      |      |     |    |      |      |     |    |      |      |     |    |  |  |               |    |      |       |    |    |      |       |    |    |      |       |    |    |      |       |    |    |  |  |               |    |      |   |        |    |      |   |        |
| 38   |       |       | not assembled |                |  |  |  |     |   |   |          |   |  |  |               |   |   |     |     |   |   |      |     |   |  |  |               |   |   |      |     |   |     |      |     |   |   |      |     |   |     |      |     |   |  |  |               |    |  |  |               |    |   |      |     |    |     |      |     |    |   |      |     |    |     |      |     |    |   |      |     |    |  |  |               |    |   |    |     |    |  |  |               |    |   |      |   |    |    |       |     |    |    |       |     |    |       |      |     |    |       |      |     |    |       |      |   |    |      |     |     |    |      |     |     |    |       |       |     |    |       |       |     |    |      |      |     |    |      |      |     |    |      |      |     |    |      |      |     |    |  |  |               |    |      |       |    |    |      |       |    |    |      |       |    |    |      |       |    |    |  |  |               |    |      |   |        |    |      |   |        |
| 39   | 49,4  | 0     | Therm2        |                |  |  |  |     |   |   |          |   |  |  |               |   |   |     |     |   |   |      |     |   |  |  |               |   |   |      |     |   |     |      |     |   |   |      |     |   |     |      |     |   |  |  |               |    |  |  |               |    |   |      |     |    |     |      |     |    |   |      |     |    |     |      |     |    |   |      |     |    |  |  |               |    |   |    |     |    |  |  |               |    |   |      |   |    |    |       |     |    |    |       |     |    |       |      |     |    |       |      |     |    |       |      |   |    |      |     |     |    |      |     |     |    |       |       |     |    |       |       |     |    |      |      |     |    |      |      |     |    |      |      |     |    |      |      |     |    |  |  |               |    |      |       |    |    |      |       |    |    |      |       |    |    |      |       |    |    |  |  |               |    |      |   |        |    |      |   |        |
| 40   | 52,4  | 0     | Therm1        |                |  |  |  |     |   |   |          |   |  |  |               |   |   |     |     |   |   |      |     |   |  |  |               |   |   |      |     |   |     |      |     |   |   |      |     |   |     |      |     |   |  |  |               |    |  |  |               |    |   |      |     |    |     |      |     |    |   |      |     |    |     |      |     |    |   |      |     |    |  |  |               |    |   |    |     |    |  |  |               |    |   |      |   |    |    |       |     |    |    |       |     |    |       |      |     |    |       |      |     |    |       |      |   |    |      |     |     |    |      |     |     |    |       |       |     |    |       |       |     |    |      |      |     |    |      |      |     |    |      |      |     |    |      |      |     |    |  |  |               |    |      |       |    |    |      |       |    |    |      |       |    |    |      |       |    |    |  |  |               |    |      |   |        |    |      |   |        |
|  |       |       |               |                |  |  |  |     |   |   |          |   |  |  |               |   |   |     |     |   |   |      |     |   |  |  |               |   |   |      |     |   |     |      |     |   |   |      |     |   |     |      |     |   |  |  |               |    |  |  |               |    |   |      |     |    |     |      |     |    |   |      |     |    |     |      |     |    |   |      |     |    |  |  |               |    |   |    |     |    |  |  |               |    |   |      |   |    |    |       |     |    |    |       |     |    |       |      |     |    |       |      |     |    |       |      |   |    |      |     |     |    |      |     |     |    |       |       |     |    |       |       |     |    |      |      |     |    |      |      |     |    |      |      |     |    |      |      |     |    |  |  |               |    |      |       |    |    |      |       |    |    |      |       |    |    |      |       |    |    |  |  |               |    |      |   |        |    |      |   |        |
|  |       |       |               |                |  |  |  |     |   |   |          |   |  |  |               |   |   |     |     |   |   |      |     |   |  |  |               |   |   |      |     |   |     |      |     |   |   |      |     |   |     |      |     |   |  |  |               |    |  |  |               |    |   |      |     |    |     |      |     |    |   |      |     |    |     |      |     |    |   |      |     |    |  |  |               |    |   |    |     |    |  |  |               |    |   |      |   |    |    |       |     |    |    |       |     |    |       |      |     |    |       |      |     |    |       |      |   |    |      |     |     |    |      |     |     |    |       |       |     |    |       |       |     |    |      |      |     |    |      |      |     |    |      |      |     |    |      |      |     |    |  |  |               |    |      |       |    |    |      |       |    |    |      |       |    |    |      |       |    |    |  |  |               |    |      |   |        |    |      |   |        |
| <p>Tolerance of positions: ±0.5mm of the end of pin.<br/>Tolerance of positions: axis is not fitted without tolerance.</p>   |       |       |               |                |  |  |  |     |   |   |          |   |  |  |               |   |   |     |     |   |   |      |     |   |  |  |               |   |   |      |     |   |     |      |     |   |   |      |     |   |     |      |     |   |  |  |               |    |  |  |               |    |   |      |     |    |     |      |     |    |   |      |     |    |     |      |     |    |   |      |     |    |  |  |               |    |   |    |     |    |  |  |               |    |   |      |   |    |    |       |     |    |    |       |     |    |       |      |     |    |       |      |     |    |       |      |   |    |      |     |     |    |      |     |     |    |       |       |     |    |       |       |     |    |      |      |     |    |      |      |     |    |      |      |     |    |      |      |     |    |  |  |               |    |      |       |    |    |      |       |    |    |      |       |    |    |      |       |    |    |  |  |               |    |      |   |        |    |      |   |        |



Vincotech



| Identification |            |         |         |                      |         |
|----------------|------------|---------|---------|----------------------|---------|
| ID             | Component  | Voltage | Current | Function             | Comment |
| D11, D12       | FWD        | 1200 V  | 150 A   | Neutral Point Diode  |         |
| T13, T14       | MOSFET     | 1200 V  | 8 mΩ    | AC Switch            |         |
| T15, T16       | IGBT       | 1200 V  | 150 A   | Neutral Point Switch |         |
| D15, D16       | FWD        | 1200 V  | 150 A   | DC-Link Diode        |         |
| T11, T12       | IGBT       | 1200 V  | 150 A   | DC-Link Switch       |         |
| Rt             | Thermistor |         |         | Thermistor           |         |





Vincotech

| Packaging instruction                |      |          |      |        |
|--------------------------------------|------|----------|------|--------|
| Standard packaging quantity (SPQ) 45 | >SPQ | Standard | <SPQ | Sample |

| Handling instruction   |
|--|
| Handling instructions for <i>flow</i> S3 packages see vincotech.com website. |

| Package data  |
|---|
| Package data for <i>flow</i> S3 packages see vincotech.com website. |

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

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

| Document No.:                    | Date:        | Modification: | Pages |
|----------------------------------|--------------|---------------|-------|
| B0-SP12NAA008ME01-LR88F78T-D1-14 | 26 Feb. 2021 |               |       |

**DISCLAIMER**

The information, specifications, procedures, methods and recommendations herein (together "information") are presented by Vincotech to reader in good faith, are believed to be accurate and reliable, but may well be incomplete and/or not applicable to all conditions or situations that may exist or occur. Vincotech reserves the right to make any changes without further notice to any products to improve reliability, function or design. No representation, guarantee or warranty is made to reader as to the accuracy, reliability or completeness of said information or that the application or use of any of the same will avoid hazards, accidents, losses, damages or injury of any kind to persons or property or that the same will not infringe third parties rights or give desired results. It is reader's sole responsibility to test and determine the suitability of the information and the product for reader's intended use.

**LIFE SUPPORT POLICY**

Vincotech products are not authorised for use as critical components in life support devices or systems without the express written approval of Vincotech.

As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, or (c) whose failure to perform when properly used in accordance with instructions for use provided in labelling can be reasonably expected to result in significant injury to the user.
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.

单击下面可查看定价，库存，交付和生命周期等信息

[>>Vincotech\(威科\)](#)