



**flowPIM 2**

**600 V / 100 A**

**Topology features**

- Kelvin Emitter for improved switching performance
- Open Emitter configuration
- Temperature sensor
- Converter+Brake+Inverter

**Component features**

- Easy paralleling
- Low turn-off losses
- Low collector emitter saturation voltage
- Positive temperature coefficient
- Short tail current

**Housing features**

- Base isolation:  $\text{Al}_2\text{O}_3$
- Convex shaped baseplate for superior thermal contact
- Cu baseplate
- Thermo-mechanical push-and-pull force relief
- Solder pin

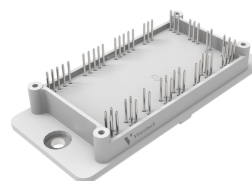
**Target applications**

- Motor Drives
- Power Generation

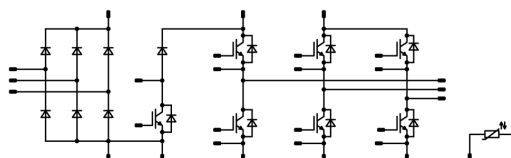
**Types**

- V23990-P765-A-PM

**flow 2 17 mm housing**



**Schematic**





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**V23990-P765-A-PM**  
datasheet

## Maximum Ratings

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

| Parameter | Symbol | Conditions | Value | Unit |
|-----------|--------|------------|-------|------|
|-----------|--------|------------|-------|------|

### Inverter Switch

|                                   |            |                                                                        |          |                    |
|-----------------------------------|------------|------------------------------------------------------------------------|----------|--------------------|
| Collector-emitter voltage         | $V_{CES}$  |                                                                        | 600      | V                  |
| Collector current (DC current)    | $I_C$      | $T_j = T_{jmax}$ $T_s = 80\text{ °C}$                                  | 115      | A                  |
| Repetitive peak collector current | $I_{CRM}$  | $t_p$ limited by $T_{jmax}$                                            | 300      | A                  |
| Total power dissipation           | $P_{tot}$  | $T_j = T_{jmax}$ $T_s = 80\text{ °C}$                                  | 216      | W                  |
| Gate-emitter voltage              | $V_{GES}$  |                                                                        | $\pm 20$ | V                  |
| Short circuit ratings             | $t_{SC}$   | $V_{GE} = 15\text{ V}$ , $V_{CC} = 360\text{ V}$ $T_j = 150\text{ °C}$ | 6        | $\mu s$            |
| Maximum junction temperature      | $T_{jmax}$ |                                                                        | 175      | $^{\circ}\text{C}$ |

### Inverter Diode

|                                 |            |                                       |     |                    |
|---------------------------------|------------|---------------------------------------|-----|--------------------|
| Peak repetitive reverse voltage | $V_{RRM}$  |                                       | 600 | V                  |
| Forward current (DC current)    | $I_F$      | $T_j = T_{jmax}$ $T_s = 80\text{ °C}$ | 83  | A                  |
| Repetitive peak forward current | $I_{FRM}$  | $t_p$ limited by $T_{jmax}$           | 300 | A                  |
| Total power dissipation         | $P_{tot}$  | $T_j = T_{jmax}$ $T_s = 80\text{ °C}$ | 131 | W                  |
| Maximum junction temperature    | $T_{jmax}$ |                                       | 175 | $^{\circ}\text{C}$ |

### Brake Switch

|                                   |            |                                                                        |          |                    |
|-----------------------------------|------------|------------------------------------------------------------------------|----------|--------------------|
| Collector-emitter voltage         | $V_{CES}$  |                                                                        | 600      | V                  |
| Collector current (DC current)    | $I_C$      | $T_j = T_{jmax}$ $T_s = 80\text{ °C}$                                  | 81       | A                  |
| Repetitive peak collector current | $I_{CRM}$  | $t_p$ limited by $T_{jmax}$                                            | 225      | A                  |
| Total power dissipation           | $P_{tot}$  | $T_j = T_{jmax}$ $T_s = 80\text{ °C}$                                  | 141      | W                  |
| Gate-emitter voltage              | $V_{GES}$  |                                                                        | $\pm 20$ | V                  |
| Short circuit ratings             | $t_{SC}$   | $V_{GE} = 15\text{ V}$ , $V_{CC} = 360\text{ V}$ $T_j = 150\text{ °C}$ | 6        | $\mu s$            |
| Maximum junction temperature      | $T_{jmax}$ |                                                                        | 175      | $^{\circ}\text{C}$ |



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## Maximum Ratings

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

| Parameter | Symbol | Conditions | Value | Unit |
|-----------|--------|------------|-------|------|
|-----------|--------|------------|-------|------|

### Brake Diode

|                                 |            |                                       |     |    |
|---------------------------------|------------|---------------------------------------|-----|----|
| Peak repetitive reverse voltage | $V_{RRM}$  |                                       | 600 | V  |
| Forward current (DC current)    | $I_F$      | $T_j = T_{jmax}$ $T_a = 80\text{ °C}$ | 38  | A  |
| Repetitive peak forward current | $I_{FRM}$  | $t_p$ limited by $T_{jmax}$           | 60  | A  |
| Total power dissipation         | $P_{tot}$  | $T_j = T_{jmax}$ $T_a = 80\text{ °C}$ | 67  | W  |
| Maximum junction temperature    | $T_{jmax}$ |                                       | 175 | °C |

### Brake Sw. Protection Diode

|                                 |            |                                       |     |    |
|---------------------------------|------------|---------------------------------------|-----|----|
| Peak repetitive reverse voltage | $V_{RRM}$  |                                       | 600 | V  |
| Forward current (DC current)    | $I_F$      | $T_j = T_{jmax}$ $T_a = 80\text{ °C}$ | 30  | A  |
| Repetitive peak forward current | $I_{FRM}$  | $t_p$ limited by $T_{jmax}$           | 40  | A  |
| Total power dissipation         | $P_{tot}$  | $T_j = T_{jmax}$ $T_a = 80\text{ °C}$ | 55  | W  |
| Maximum junction temperature    | $T_{jmax}$ |                                       | 175 | °C |

### Rectifier Diode

|                                        |            |                                                                      |      |                  |
|----------------------------------------|------------|----------------------------------------------------------------------|------|------------------|
| Peak repetitive reverse voltage        | $V_{RRM}$  |                                                                      | 1600 | V                |
| Forward current (DC current)           | $I_F$      | $T_j = T_{jmax}$ $T_a = 80\text{ °C}$                                | 126  | A                |
| Surge (non-repetitive) forward current | $I_{FSM}$  | Single Half Sine Wave,<br>$t_p = 10\text{ ms}$ $T_j = 150\text{ °C}$ | 890  | A                |
| Surge current capability               | $I^2t$     |                                                                      | 3960 | A <sup>2</sup> s |
| Total power dissipation                | $P_{tot}$  | $T_j = T_{jmax}$ $T_a = 80\text{ °C}$                                | 156  | W                |
| Maximum junction temperature           | $T_{jmax}$ |                                                                      | 150  | °C               |



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## Maximum Ratings

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

| Parameter | Symbol | Conditions | Value | Unit |
|-----------|--------|------------|-------|------|
|-----------|--------|------------|-------|------|

## Module Properties

### Thermal Properties

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

### Isolation Properties

|                            |                   |                                     |        |    |
|----------------------------|-------------------|-------------------------------------|--------|----|
| Isolation voltage          | $V_{\text{isol}}$ | DC Test Voltage* $t_p = 2\text{ s}$ | 4000   | V  |
| Creepage distance          |                   |                                     | > 12,7 | mm |
| Clearance                  |                   |                                     | 12,01  | mm |
| Comparative Tracking Index | CTI               |                                     | ≥ 200  |    |

\*100 % tested in production



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## 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 |      |

### Inverter Switch

#### Static

|                                      |              |                     |    |     |        |                  |      |                      |                     |    |
|--------------------------------------|--------------|---------------------|----|-----|--------|------------------|------|----------------------|---------------------|----|
| Gate-emitter threshold voltage       | $V_{GE(th)}$ | $V_{CE} = V_{GE}$   |    |     | 0,0016 | 25               | 5    | 5,8                  | 6,5                 | V  |
| Collector-emitter saturation voltage | $V_{CEsat}$  |                     | 15 |     | 100    | 25<br>125<br>150 | 1,05 | 1,48<br>1,64<br>1,71 | 1,85 <sup>(1)</sup> | V  |
| Collector-emitter cut-off current    | $I_{CES}$    |                     | 0  | 600 |        | 25               |      |                      | 5,2                 | µA |
| Gate-emitter leakage current         | $I_{GES}$    |                     | 20 | 0   |        | 25               |      |                      | 1200                | nA |
| Internal gate resistance             | $r_g$        |                     |    |     |        |                  |      | None                 |                     | Ω  |
| Input capacitance                    | $C_{ies}$    | $f = 1 \text{ Mhz}$ | 0  | 25  | 25     |                  |      | 6280                 |                     | pF |
| Output capacitance                   | $C_{oes}$    |                     |    |     |        |                  |      | 400                  |                     | pF |
| Reverse transfer capacitance         | $C_{res}$    |                     |    |     |        |                  |      | 186                  |                     | pF |

#### Thermal

|                                                    |               |                                               |  |  |  |  |  |      |  |     |
|----------------------------------------------------|---------------|-----------------------------------------------|--|--|--|--|--|------|--|-----|
| Thermal resistance junction to sink <sup>(2)</sup> | $R_{th(j-s)}$ | $\lambda_{paste} = 3,4 \text{ W/mK}$<br>(PSX) |  |  |  |  |  | 0,44 |  | K/W |
|----------------------------------------------------|---------------|-----------------------------------------------|--|--|--|--|--|------|--|-----|

#### Dynamic

|                             |              |                                               |          |     |     |                  |  |                          |  |     |
|-----------------------------|--------------|-----------------------------------------------|----------|-----|-----|------------------|--|--------------------------|--|-----|
| Turn-on delay time          | $t_{d(on)}$  | $R_{gon} = 4 \Omega$<br>$R_{goff} = 4 \Omega$ | $\pm 15$ | 300 | 100 | 25<br>125<br>150 |  | 137<br>138<br>137,6      |  | ns  |
| Rise time                   | $t_r$        |                                               |          |     |     | 25<br>125<br>150 |  | 16<br>18,6<br>19,2       |  | ns  |
| Turn-off delay time         | $t_{d(off)}$ |                                               |          |     |     | 25<br>125<br>150 |  | 188,2<br>213,8<br>216,6  |  | ns  |
| Fall time                   | $t_f$        |                                               |          |     |     | 25<br>125<br>150 |  | 83,92<br>96,32<br>103,67 |  | ns  |
| Turn-on energy (per pulse)  | $E_{on}$     |                                               |          |     |     | 25<br>125<br>150 |  | 0,541<br>0,829<br>0,931  |  | mWs |
| Turn-off energy (per pulse) | $E_{off}$    |                                               |          |     |     | 25<br>125<br>150 |  | 2,5<br>3,31<br>3,48      |  | mWs |



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## 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 |      |

### Inverter Diode

#### Static

|                         |       |               |  |  |     |           |     |              |                    |    |
|-------------------------|-------|---------------|--|--|-----|-----------|-----|--------------|--------------------|----|
| Forward voltage         | $V_F$ |               |  |  | 100 | 25<br>125 | 1,2 | 1,67<br>1,69 | 1,9 <sup>(1)</sup> | V  |
| Reverse leakage current | $I_R$ | $V_r = 600$ V |  |  |     | 25        |     |              | 660                | μA |

#### Thermal

|                                                    |               |                                       |  |  |  |  |  |      |  |     |
|----------------------------------------------------|---------------|---------------------------------------|--|--|--|--|--|------|--|-----|
| Thermal resistance junction to sink <sup>(2)</sup> | $R_{th(j-s)}$ | $\lambda_{paste} = 3,4$ W/mK<br>(PSX) |  |  |  |  |  | 0,73 |  | K/W |
|----------------------------------------------------|---------------|---------------------------------------|--|--|--|--|--|------|--|-----|

#### Dynamic

|                                       |                      |                                                             |          |     |     |                  |  |                            |  |      |
|---------------------------------------|----------------------|-------------------------------------------------------------|----------|-----|-----|------------------|--|----------------------------|--|------|
| Peak recovery current                 | $I_{RM}$             | $di/dt=7405$ A/μs<br>$di/dt=6414$ A/μs<br>$di/dt=5731$ A/μs | $\pm 15$ | 300 | 100 | 25<br>125<br>150 |  | 128,34<br>148,46<br>152,09 |  | A    |
| Reverse recovery time                 | $t_{rr}$             |                                                             |          |     |     | 25<br>125<br>150 |  | 106,47<br>122,44<br>126,88 |  | ns   |
| Recovered charge                      | $Q_r$                |                                                             |          |     |     | 25<br>125<br>150 |  | 4,64<br>8,39<br>9,2        |  | μC   |
| Reverse recovered energy              | $E_{rec}$            |                                                             |          |     |     | 25<br>125<br>150 |  | 1,13<br>2,07<br>2,25       |  | mWs  |
| Peak rate of fall of recovery current | $(di_{rr}/dt)_{max}$ |                                                             |          |     |     | 25<br>125<br>150 |  | 9459<br>5452<br>5303       |  | A/μs |



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## 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 |      |

### Brake Switch

#### Static

|                                      |              |                          |    |     |        |                  |      |                      |                     |    |
|--------------------------------------|--------------|--------------------------|----|-----|--------|------------------|------|----------------------|---------------------|----|
| Gate-emitter threshold voltage       | $V_{GE(th)}$ | $V_{CE} = V_{GE}$        |    |     | 0,0012 | 25               | 5    | 5,8                  | 6,5                 | V  |
| Collector-emitter saturation voltage | $V_{CEsat}$  |                          | 15 |     | 75     | 25<br>125<br>150 | 1,05 | 1,45<br>1,59<br>1,64 | 1,85 <sup>(1)</sup> | V  |
| Collector-emitter cut-off current    | $I_{CES}$    |                          | 0  | 600 |        | 25               |      |                      | 3,8                 | µA |
| Gate-emitter leakage current         | $I_{GES}$    |                          | 20 | 0   |        | 25               |      |                      | 600                 | nA |
| Internal gate resistance             | $r_g$        |                          |    |     |        |                  |      | None                 |                     | Ω  |
| Input capacitance                    | $C_{ies}$    | $f = 1 \text{ Mhz}$      | 0  | 25  |        | 25               |      | 4620                 |                     | pF |
| Output capacitance                   | $C_{oes}$    |                          |    |     |        |                  |      | 288                  |                     | pF |
| Reverse transfer capacitance         | $C_{res}$    |                          |    |     |        |                  |      | 137                  |                     | pF |
| Gate charge                          | $Q_g$        | $V_{CC} = 480 \text{ V}$ | 15 |     | 75     | 25               |      | 470                  |                     | nC |

#### Thermal

|                                                    |               |                                               |  |  |  |  |  |      |  |     |
|----------------------------------------------------|---------------|-----------------------------------------------|--|--|--|--|--|------|--|-----|
| Thermal resistance junction to sink <sup>(2)</sup> | $R_{th(j-s)}$ | $\lambda_{paste} = 3,4 \text{ W/mK}$<br>(PSX) |  |  |  |  |  | 0,67 |  | K/W |
|----------------------------------------------------|---------------|-----------------------------------------------|--|--|--|--|--|------|--|-----|

#### Dynamic

|                             |              |                                                                                                                      |          |     |    |                  |  |                         |  |     |
|-----------------------------|--------------|----------------------------------------------------------------------------------------------------------------------|----------|-----|----|------------------|--|-------------------------|--|-----|
| Turn-on delay time          | $t_{d(on)}$  | $R_{gon} = 4 \text{ } \Omega$<br>$R_{goff} = 4 \text{ } \Omega$                                                      | $\pm 15$ | 300 | 75 | 25<br>125<br>150 |  | 111<br>113,4<br>113,2   |  | ns  |
| Rise time                   | $t_r$        |                                                                                                                      |          |     |    | 25<br>125<br>150 |  | 12,4<br>14,6<br>15,4    |  | ns  |
| Turn-off delay time         | $t_{d(off)}$ |                                                                                                                      |          |     |    | 25<br>125<br>150 |  | 173,6<br>197,4<br>201,8 |  | ns  |
| Fall time                   | $t_f$        |                                                                                                                      |          |     |    | 25<br>125<br>150 |  | 53,33<br>71,16<br>74,06 |  | ns  |
| Turn-on energy (per pulse)  | $E_{on}$     | $Q_{tFWD}=2,14 \text{ } \mu\text{C}$<br>$Q_{tFWD}=3,14 \text{ } \mu\text{C}$<br>$Q_{tFWD}=3,82 \text{ } \mu\text{C}$ |          |     |    | 25<br>125<br>150 |  | 0,299<br>0,413<br>0,464 |  | mWs |
| Turn-off energy (per pulse) | $E_{off}$    |                                                                                                                      |          |     |    | 25<br>125<br>150 |  | 1,52<br>2,02<br>2,14    |  | mWs |



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## 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 |      |

### Brake Diode

#### Static

|                         |       |               |  |  |    |           |      |              |                     |    |
|-------------------------|-------|---------------|--|--|----|-----------|------|--------------|---------------------|----|
| Forward voltage         | $V_F$ |               |  |  | 30 | 25<br>125 | 1,25 | 1,65<br>1,62 | 1,95 <sup>(1)</sup> | V  |
| Reverse leakage current | $I_R$ | $V_r = 600$ V |  |  |    | 25        |      |              | 27                  | µA |

#### Thermal

|                                                    |               |                                       |  |  |  |  |  |      |  |     |
|----------------------------------------------------|---------------|---------------------------------------|--|--|--|--|--|------|--|-----|
| Thermal resistance junction to sink <sup>(2)</sup> | $R_{th(j-s)}$ | $\lambda_{paste} = 3,4$ W/mK<br>(PSX) |  |  |  |  |  | 1,42 |  | K/W |
|----------------------------------------------------|---------------|---------------------------------------|--|--|--|--|--|------|--|-----|

#### Dynamic

|                                       |                      |                                                             |          |     |    |                  |  |                           |  |      |
|---------------------------------------|----------------------|-------------------------------------------------------------|----------|-----|----|------------------|--|---------------------------|--|------|
| Peak recovery current                 | $I_{RM}$             | $di/dt=6170$ A/µs<br>$di/dt=7076$ A/µs<br>$di/dt=5226$ A/µs | $\pm 15$ | 300 | 75 | 25<br>125<br>150 |  | 81,58<br>84,53<br>83,98   |  | A    |
| Reverse recovery time                 | $t_{rr}$             |                                                             |          |     |    | 25<br>125<br>150 |  | 22,67<br>110,54<br>116,24 |  | ns   |
| Recovered charge                      | $Q_r$                |                                                             |          |     |    | 25<br>125<br>150 |  | 2,14<br>3,14<br>3,82      |  | µC   |
| Reverse recovered energy              | $E_{rec}$            |                                                             |          |     |    | 25<br>125<br>150 |  | 0,517<br>0,769<br>0,973   |  | mWs  |
| Peak rate of fall of recovery current | $(di_{rr}/dt)_{max}$ |                                                             |          |     |    | 25<br>125<br>150 |  | 10578<br>7449<br>6820     |  | A/µs |



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## 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 |      |

### Brake Sw. Protection Diode

#### Static

|                         |       |               |  |  |    |                  |  |      |                     |                     |    |
|-------------------------|-------|---------------|--|--|----|------------------|--|------|---------------------|---------------------|----|
| Forward voltage         | $V_F$ |               |  |  | 20 | 25<br>125<br>150 |  | 1,25 | 1,7<br>1,58<br>1,58 | 1,95 <sup>(1)</sup> | V  |
| Reverse leakage current | $I_R$ | $V_r = 600$ V |  |  |    | 25               |  |      |                     | 27                  | μA |

#### Thermal

|                                                    |               |                                       |  |  |  |  |  |  |      |  |     |
|----------------------------------------------------|---------------|---------------------------------------|--|--|--|--|--|--|------|--|-----|
| Thermal resistance junction to sink <sup>(2)</sup> | $R_{th(j-s)}$ | $\lambda_{paste} = 3,4$ W/mK<br>(PSX) |  |  |  |  |  |  | 1,74 |  | K/W |
|----------------------------------------------------|---------------|---------------------------------------|--|--|--|--|--|--|------|--|-----|

### Rectifier Diode

#### Static

|                         |       |                |  |  |    |                  |  |  |                       |                                           |    |
|-------------------------|-------|----------------|--|--|----|------------------|--|--|-----------------------|-------------------------------------------|----|
| Forward voltage         | $V_F$ |                |  |  | 45 | 25<br>125<br>150 |  |  | 1,01<br>0,929<br>0,92 | 1,21 <sup>(1)</sup><br>1,1 <sup>(1)</sup> | V  |
| Reverse leakage current | $I_R$ | $V_r = 1600$ V |  |  |    | 25               |  |  |                       | 50                                        | μA |

#### Thermal

|                                                    |               |                                       |  |  |  |  |  |  |      |  |     |
|----------------------------------------------------|---------------|---------------------------------------|--|--|--|--|--|--|------|--|-----|
| Thermal resistance junction to sink <sup>(2)</sup> | $R_{th(j-s)}$ | $\lambda_{paste} = 3,4$ W/mK<br>(PSX) |  |  |  |  |  |  | 0,45 |  | K/W |
|----------------------------------------------------|---------------|---------------------------------------|--|--|--|--|--|--|------|--|-----|



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V23990-P765-A-PM  
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 |      |

### Thermistor

#### Static

|                                |                |                                 |  |  |  |     |     |      |    |      |
|--------------------------------|----------------|---------------------------------|--|--|--|-----|-----|------|----|------|
| Rated resistance               | $R$            |                                 |  |  |  | 25  |     | 22   |    | kΩ   |
| Deviation of R25               | $\Delta_{R/R}$ | $R_{25} = 22 \text{ k}\Omega$   |  |  |  | 25  | -5  |      | 5  | %    |
| Deviation of R100              |                | $R_{100} = 1486 \text{ }\Omega$ |  |  |  | 100 | -12 |      | 14 |      |
| Power dissipation              | $P$            |                                 |  |  |  |     |     | 200  |    | mW   |
| Power dissipation constant     | $d$            |                                 |  |  |  | 25  |     | 2    |    | mW/K |
| B-value                        | $B_{(25/50)}$  | Tol. $\pm 3 \text{ } \%$        |  |  |  |     |     | 3950 |    | K    |
| B-value                        | $B_{(25/100)}$ | Tol. $\pm 3 \text{ } \%$        |  |  |  |     |     | 3998 |    | K    |
| Vincotech Thermistor Reference |                |                                 |  |  |  |     |     |      | B  |      |

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

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



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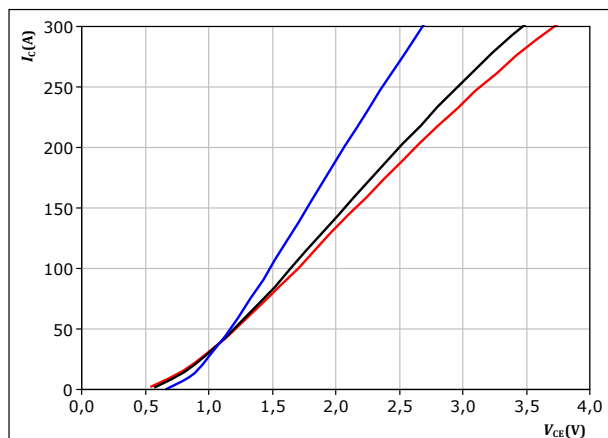
V23990-P765-A-PM  
datasheet

## Inverter Switch Characteristics

figure 1. IGBT

Typical output characteristics

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

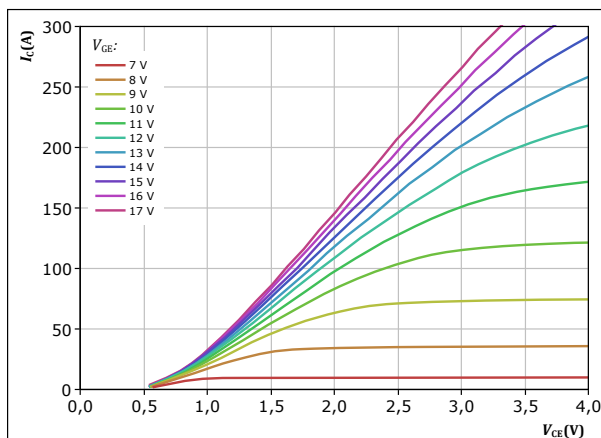


$t_p = 250 \mu s$   
 $V_{GE} = 15 V$   
 $T_j:$  25 °C, 125 °C, 150 °C

figure 2. IGBT

Typical output characteristics

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

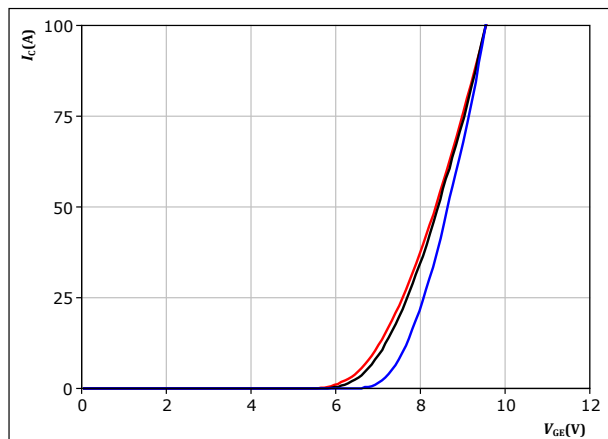


$t_p = 250 \mu s$   
 $T_j = 150 ^\circ C$   
 $V_{GE}$  from 7 V to 17 V in steps of 1 V

figure 3. IGBT

Typical transfer characteristics

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

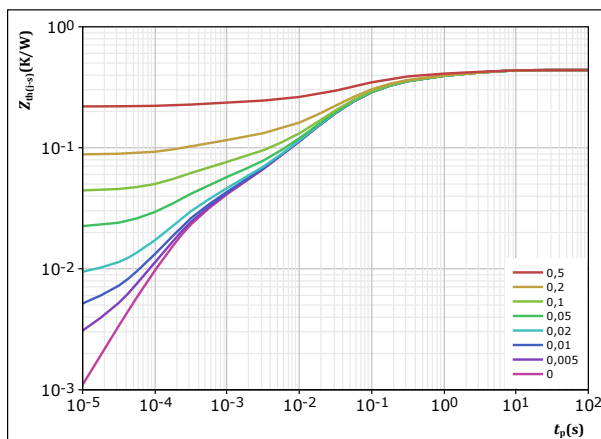


$t_p = 250 \mu s$   
 $V_{CE} = 10 V$   
 $T_j:$  25 °C, 125 °C, 150 °C

figure 4. IGBT

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$   
 $R_{th(j-s)} = 0,439 K/W$   
IGBT thermal model values  

| $R (K/W)$ | $\tau (s)$ |
|-----------|------------|
| 5,33E-02  | 3,13E+00   |
| 6,35E-02  | 4,55E-01   |
| 1,49E-01  | 8,61E-02   |
| 1,20E-01  | 2,32E-02   |
| 2,69E-02  | 2,62E-03   |
| 2,67E-02  | 2,83E-04   |



Vincotech

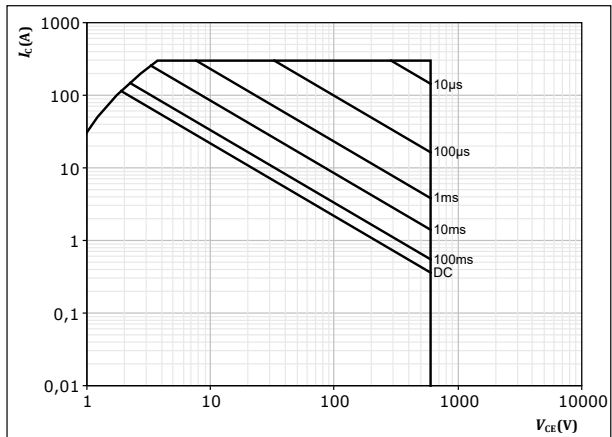
**V23990-P765-A-PM**  
datasheet

## Inverter Switch Characteristics

figure 5. IGBT

Safe operating area

$I_C = f(V_{CE})$



$D =$  single pulse

$T_s = 80$  °C

$V_{GE} = 15$  V

$T_j = T_{jmax}$



## Inverter Diode Characteristics

figure 6.

FWD

Typical forward characteristics

$$I_F = f(V_F)$$

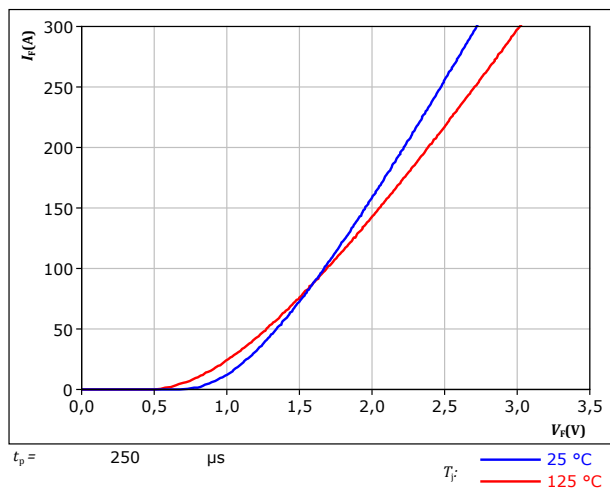
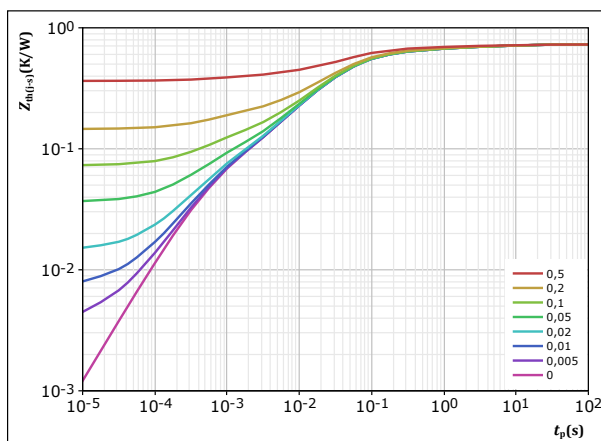


figure 7.

FWD

Transient thermal impedance as a function of pulse width

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



FWD thermal model values

| $R \text{ (K/W)}$ | $\tau \text{ (s)}$ |
|-------------------|--------------------|
| 4,08E-02          | 9,16E+00           |
| 5,69E-02          | 8,67E-01           |
| 1,69E-01          | 1,19E-01           |
| 3,37E-01          | 2,86E-02           |
| 7,44E-02          | 4,99E-03           |
| 5,00E-02          | 5,33E-04           |



Brake Switch Characteristics

figure 8. IGBT

Typical output characteristics

$I_C = f(V_{CE})$

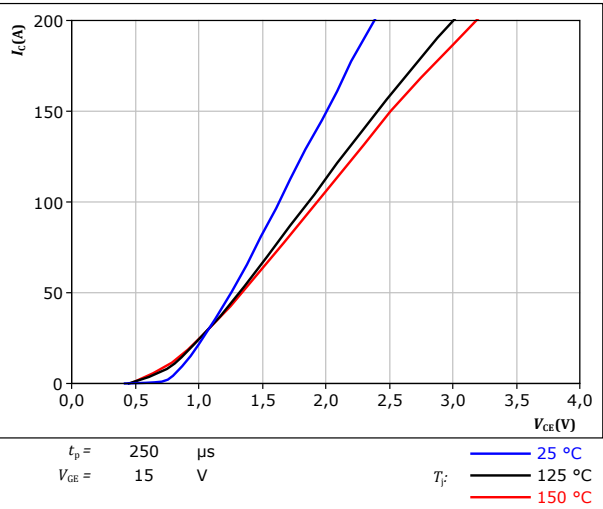


figure 10. IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$

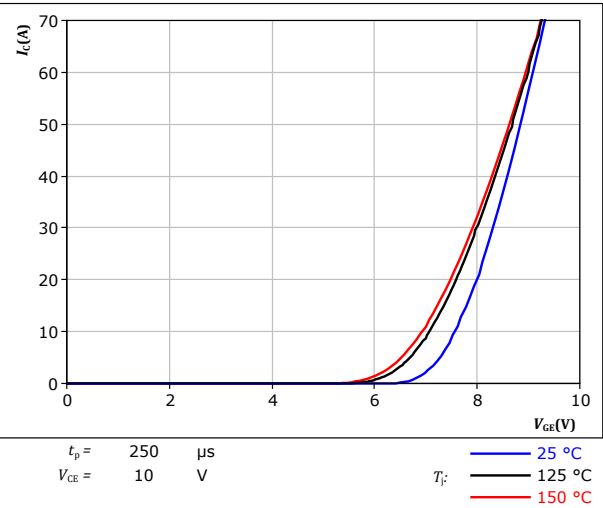


figure 9. IGBT

Typical output characteristics

$I_C = f(V_{CE})$

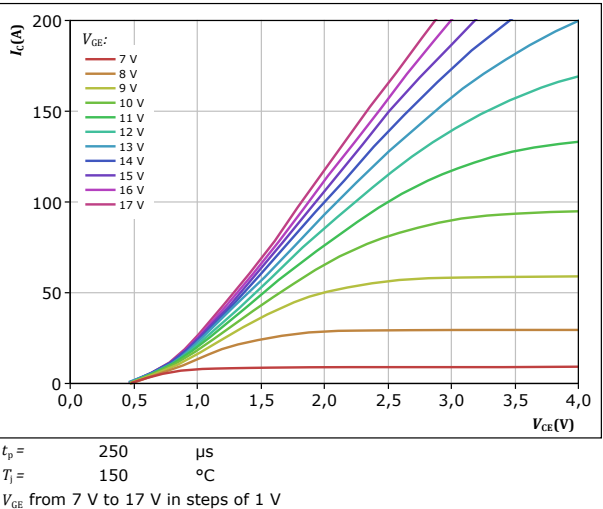
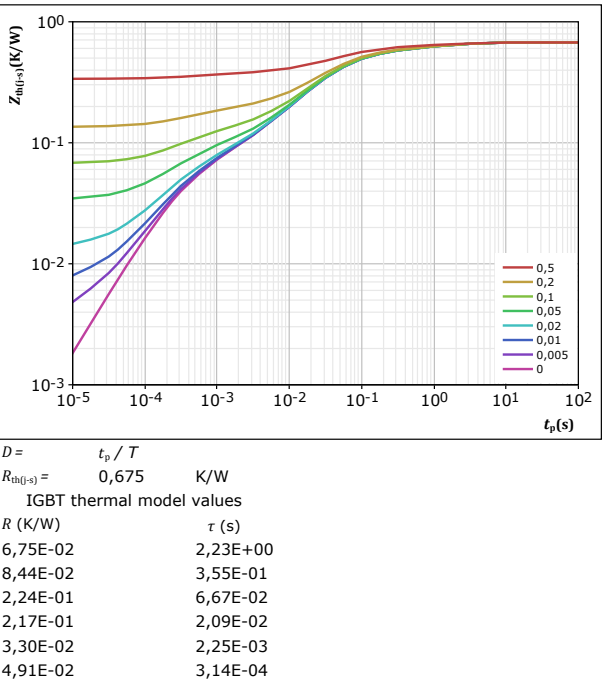


figure 11. IGBT

Transient thermal impedance as a function of pulse width

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





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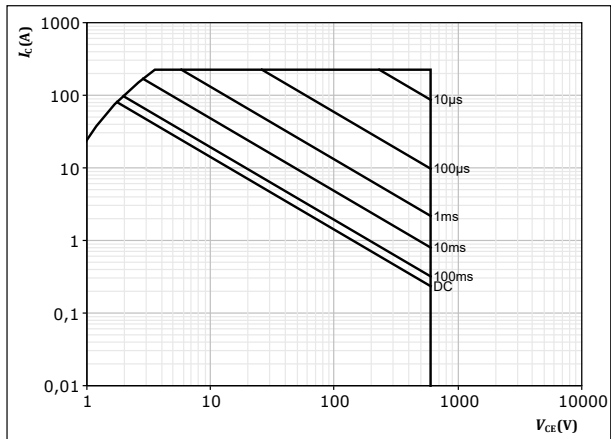
## Brake Switch Characteristics

figure 12.

IGBT

Safe operating area

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



$D =$  single pulse

$T_s = 80$  °C

$V_{GE} = 15$  V

$T_j = T_{jmax}$



## Brake Diode Characteristics

figure 13.

FWD

Typical forward characteristics

$$I_F = f(V_F)$$

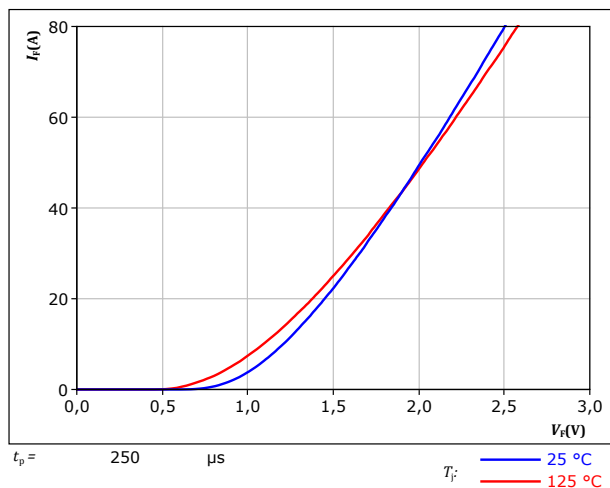
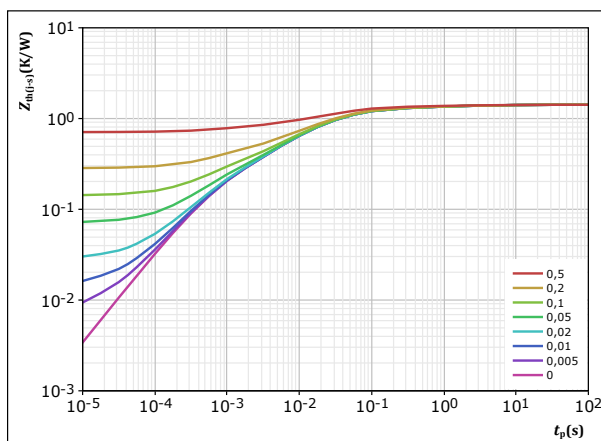


figure 14.

FWD

Transient thermal impedance as a function of pulse width

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



|                          |            |     |
|--------------------------|------------|-----|
| $D =$                    | $t_p / T$  |     |
| $R_{th(j-s)} =$          | 1,418      | K/W |
| FWD thermal model values |            |     |
| $R$ (K/W)                | $\tau$ (s) |     |
| 4,60E-02                 | 5,92E+00   |     |
| 7,40E-02                 | 8,70E-01   |     |
| 1,85E-01                 | 1,31E-01   |     |
| 6,39E-01                 | 2,61E-02   |     |
| 3,20E-01                 | 5,18E-03   |     |
| 1,54E-01                 | 6,04E-04   |     |



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Brake Sw. Protection Diode Characteristics

figure 15. FWD

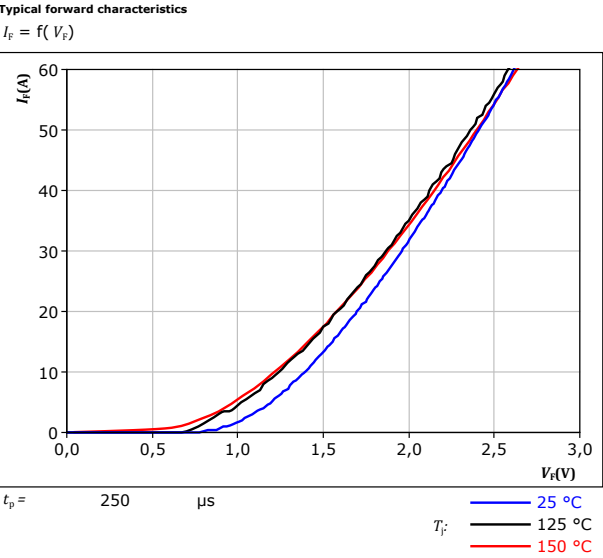
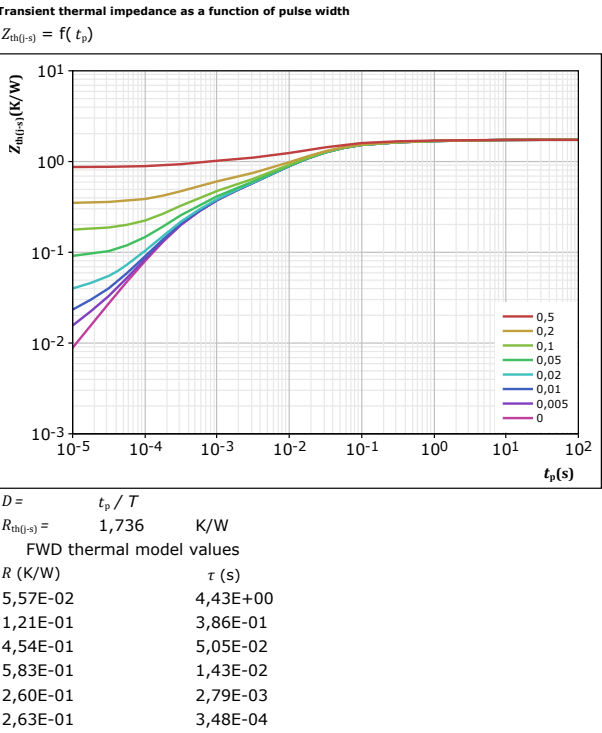


figure 16. FWD





Rectifier Diode Characteristics

figure 17. Rectifier

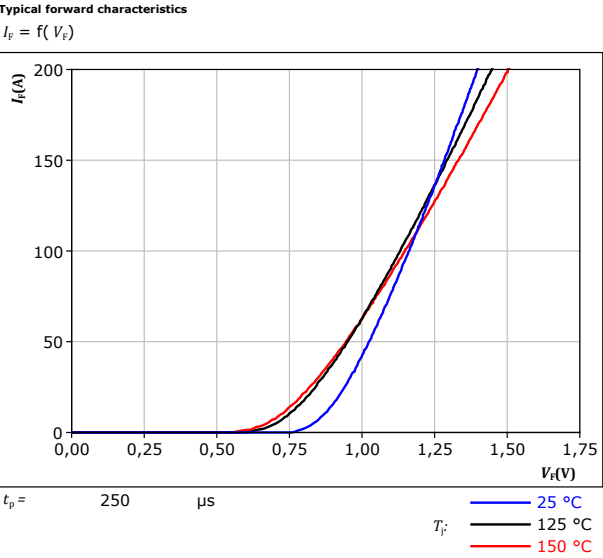
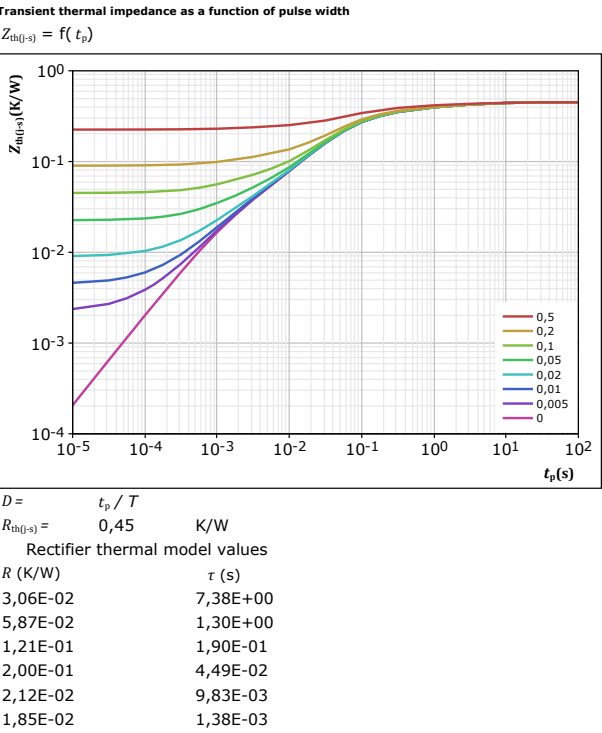


figure 18. Rectifier





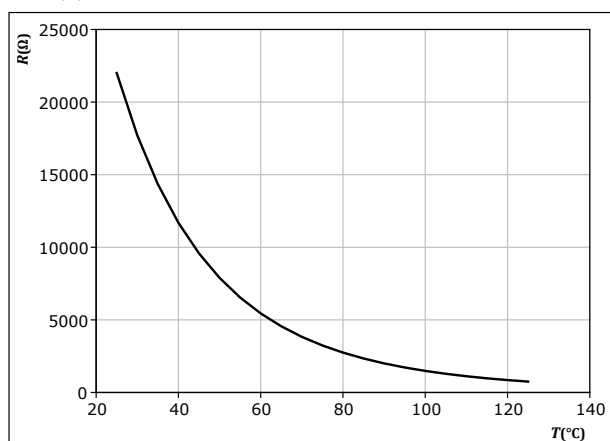
## Thermistor Characteristics

figure 19.

Thermistor

Typical NTC characteristic as function of temperature

$$R_T = f(T)$$





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datasheet

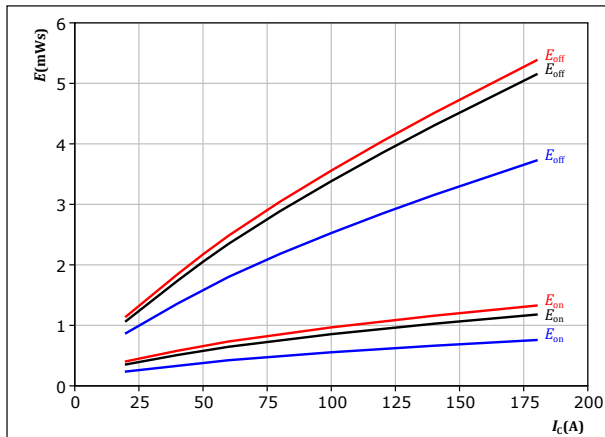
## Inverter Switching Characteristics

figure 20.

IGBT

Typical switching energy losses as a function of collector current

$$E = f(I_c)$$



With an inductive load at

$V_{CE} = 300 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $R_{gon} = 4 \text{ } \Omega$   
 $R_{goff} = 4 \text{ } \Omega$

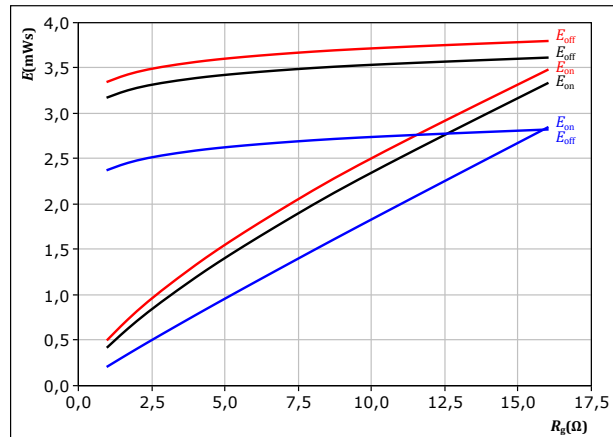
$T_j$ :  
— 25 °C  
— 125 °C  
— 150 °C

figure 21.

IGBT

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

$$E = f(R_g)$$



With an inductive load at

$V_{CE} = 300 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $I_c = 100 \text{ A}$

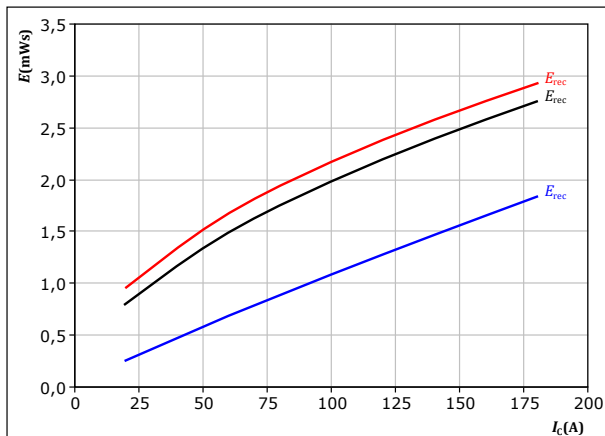
$T_j$ :  
— 25 °C  
— 125 °C  
— 150 °C

figure 22.

FWD

Typical reverse recovered energy loss as a function of collector current

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



With an inductive load at

$V_{CE} = 300 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $R_{gon} = 4 \text{ } \Omega$

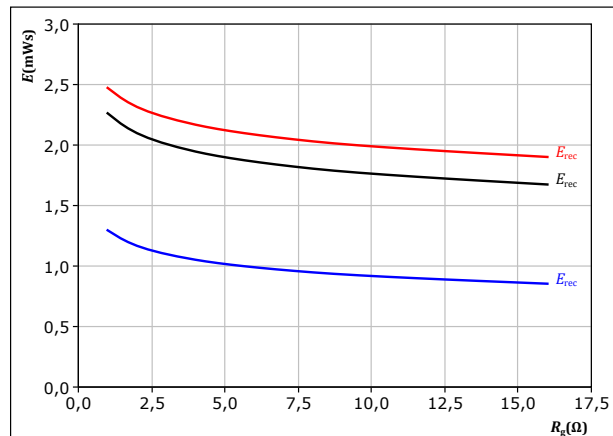
$T_j$ :  
— 25 °C  
— 125 °C  
— 150 °C

figure 23.

FWD

Typical reverse recovered energy loss as a function of IGBT turn on gate resistor

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



With an inductive load at

$V_{CE} = 300 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $I_c = 100 \text{ A}$

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



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datasheet

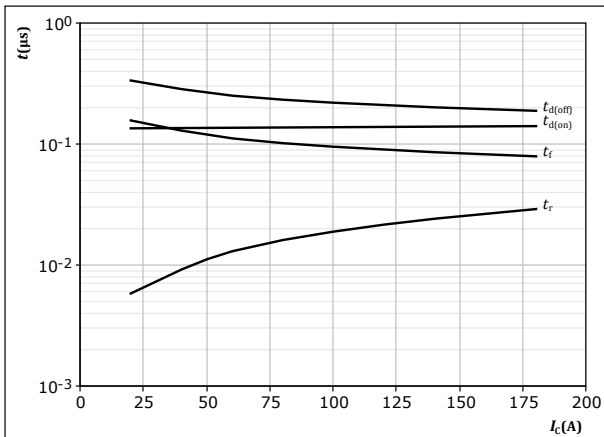
## Inverter Switching Characteristics

figure 24.

IGBT

Typical switching times as a function of collector current

$$t = f(I_C)$$



With an inductive load at

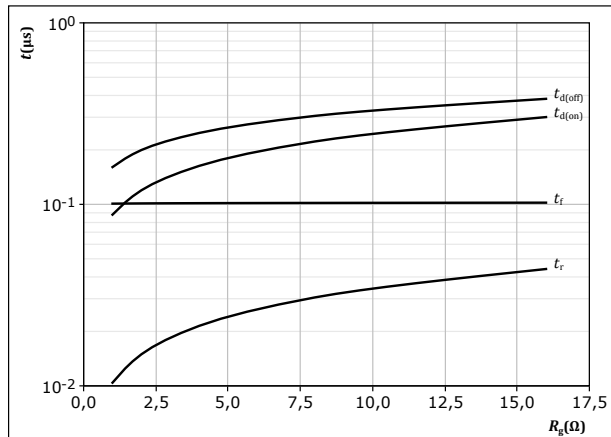
$T_j = 150$  °C  
 $V_{CE} = 300$  V  
 $V_{GE} = \pm 15$  V  
 $R_{gon} = 4$  Ω  
 $R_{goff} = 4$  Ω

figure 25.

IGBT

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

$$t = f(R_g)$$



With an inductive load at

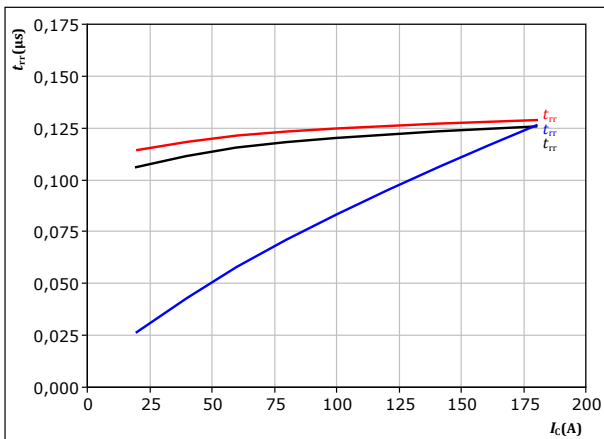
$T_j = 150$  °C  
 $V_{CE} = 300$  V  
 $V_{GE} = \pm 15$  V  
 $I_C = 100$  A

figure 26.

FWD

Typical reverse recovery time as a function of collector current

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



With an inductive load at

$V_{CE} = 300$  V  
 $V_{GE} = \pm 15$  V  
 $R_{gon} = 4$  Ω

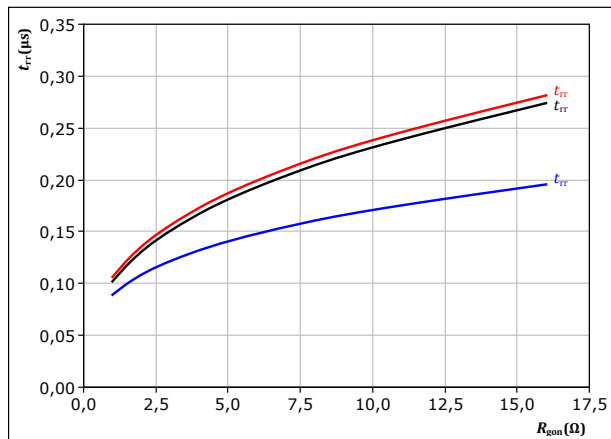
$T_j$ : 25 °C (blue)  
125 °C (black)  
150 °C (red)

figure 27.

FWD

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

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



With an inductive load at

$V_{CE} = 300$  V  
 $V_{GE} = \pm 15$  V  
 $I_C = 100$  A

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



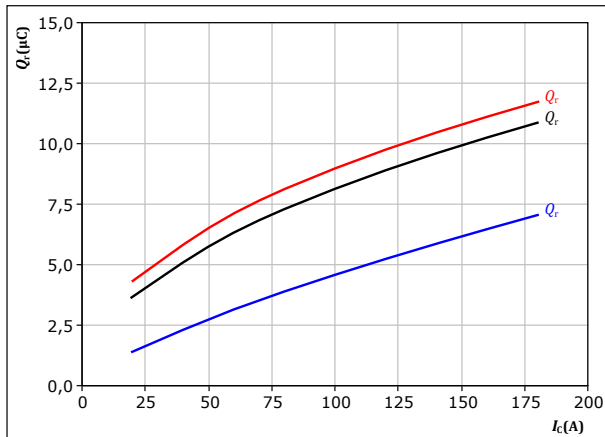
## Inverter Switching Characteristics

figure 28.

FWD

Typical recovered charge as a function of collector current

$$Q_r = f(I_c)$$



With an inductive load at

$V_{CE} = 300$  V  
 $V_{GE} = \pm 15$  V  
 $R_{gon} = 4$   $\Omega$

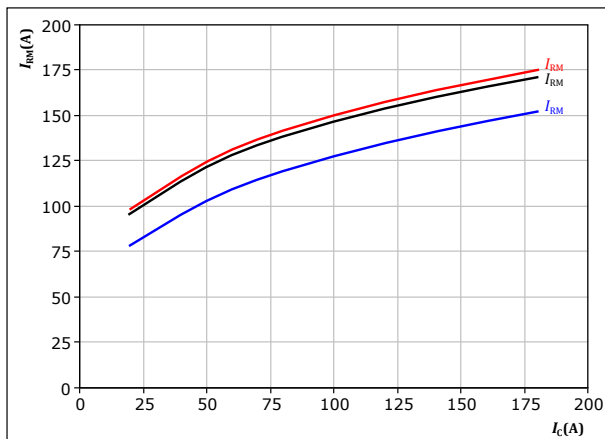
$T_j$ :  
— 25 °C  
— 125 °C  
— 150 °C

figure 30.

FWD

Typical peak reverse recovery current as a function of collector current

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



With an inductive load at

$V_{CE} = 300$  V  
 $V_{GE} = \pm 15$  V  
 $R_{gon} = 4$   $\Omega$

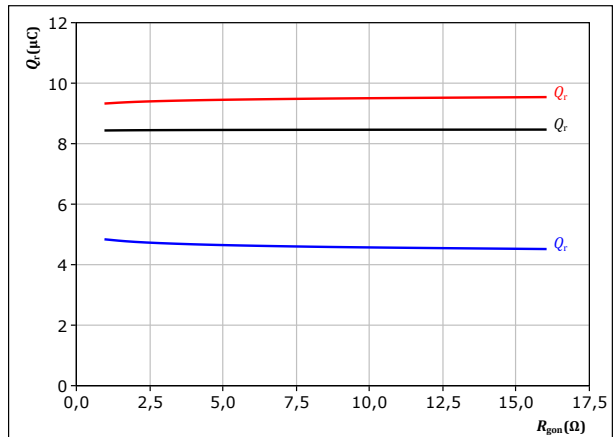
$T_j$ :  
— 25 °C  
— 125 °C  
— 150 °C

figure 29.

FWD

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

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



With an inductive load at

$V_{CE} = 300$  V  
 $V_{GE} = \pm 15$  V  
 $I_c = 100$  A

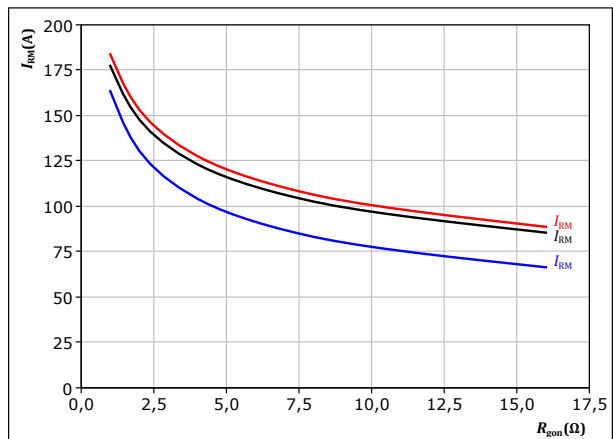
$T_j$ :  
— 25 °C  
— 125 °C  
— 150 °C

figure 31.

FWD

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

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



With an inductive load at

$V_{CE} = 300$  V  
 $V_{GE} = \pm 15$  V  
 $I_c = 100$  A

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



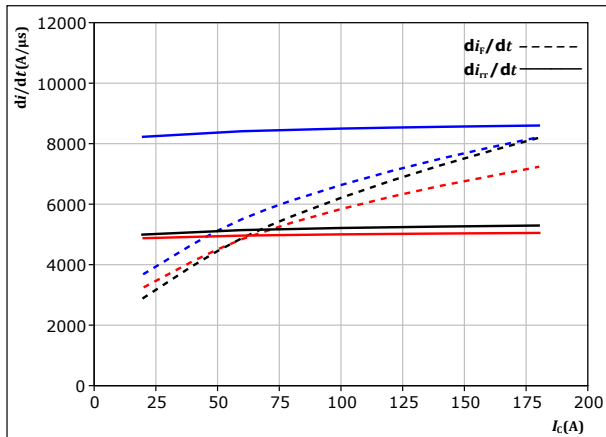
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datasheet

## Inverter Switching Characteristics

figure 32. FWD

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

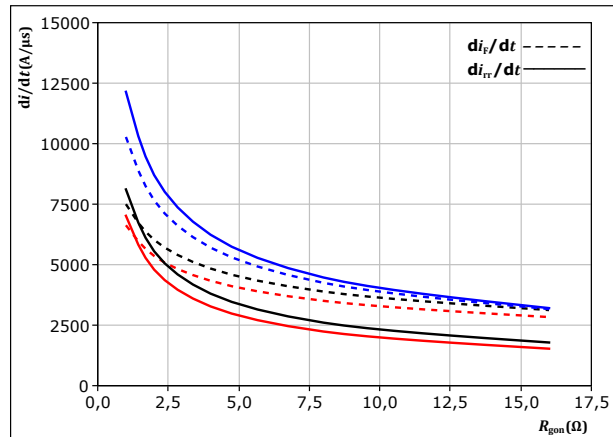


With an inductive load at

$V_{CE} = 300$  V  
 $V_{GE} = \pm 15$  V  
 $R_{gon} = 4$   $\Omega$   
 $T_j = 25$  °C  
 $T_j = 125$  °C  
 $T_j = 150$  °C

figure 33. FWD

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



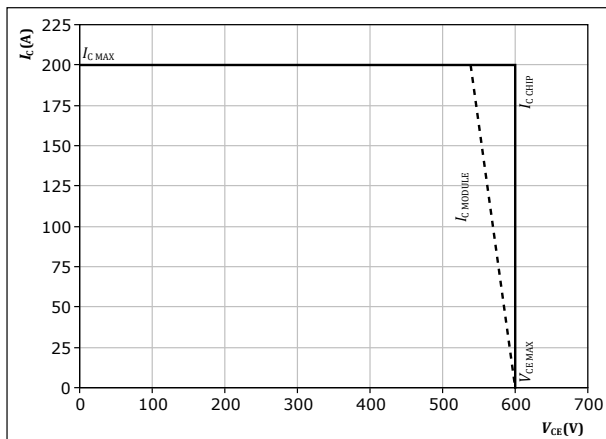
With an inductive load at

$V_{CE} = 300$  V  
 $V_{GE} = \pm 15$  V  
 $I_C = 100$  A  
 $T_j = 25$  °C  
 $T_j = 125$  °C  
 $T_j = 150$  °C

figure 34. IGBT

Reverse bias safe operating area

$I_C = f(V_{CE})$



At  $T_j = 150$  °C  
 $R_{gon} = 4$   $\Omega$   
 $R_{goff} = 4$   $\Omega$



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datasheet

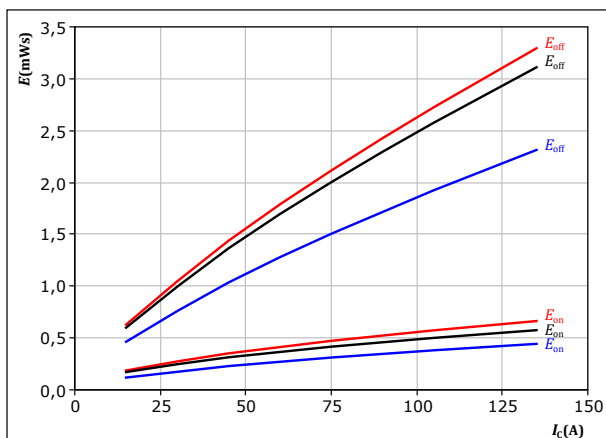
## Brake Switching Characteristics

figure 35.

IGBT

Typical switching energy losses as a function of collector current

$$E = f(I_c)$$



With an inductive load at

$V_{CE} = 300 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $R_{gon} = 4 \text{ } \Omega$   
 $R_{goff} = 4 \text{ } \Omega$

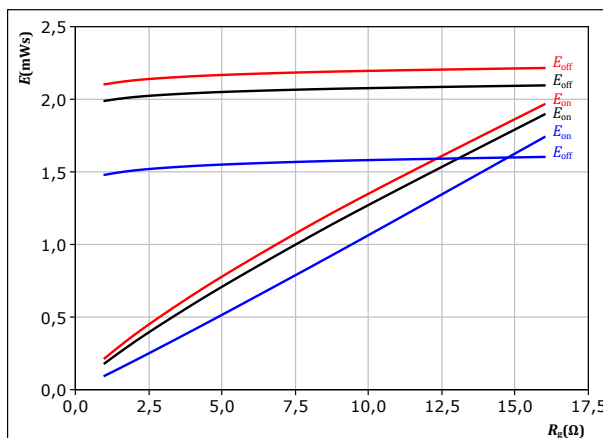
$T_j$ :  
— 25 °C  
— 125 °C  
— 150 °C

figure 36.

IGBT

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

$$E = f(R_g)$$



With an inductive load at

$V_{CE} = 300 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $I_c = 75 \text{ A}$

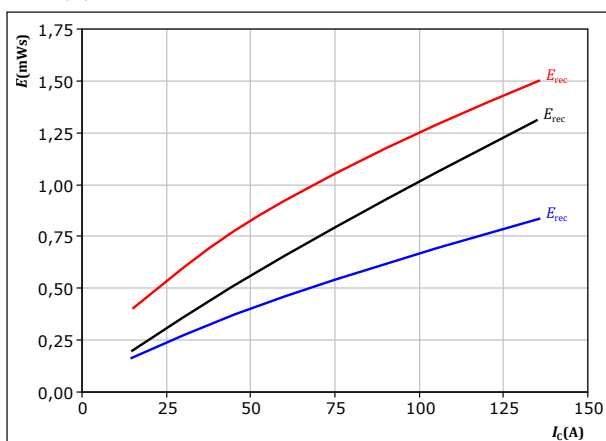
$T_j$ :  
— 25 °C  
— 125 °C  
— 150 °C

figure 37.

FWD

Typical reverse recovered energy loss as a function of collector current

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



With an inductive load at

$V_{CE} = 300 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $R_{gon} = 4 \text{ } \Omega$

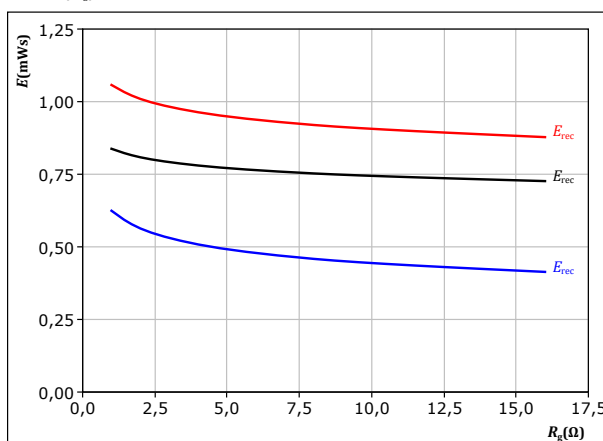
$T_j$ :  
— 25 °C  
— 125 °C  
— 150 °C

figure 38.

FWD

Typical reverse recovered energy loss as a function of IGBT turn on gate resistor

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



With an inductive load at

$V_{CE} = 300 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $I_c = 75 \text{ A}$

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

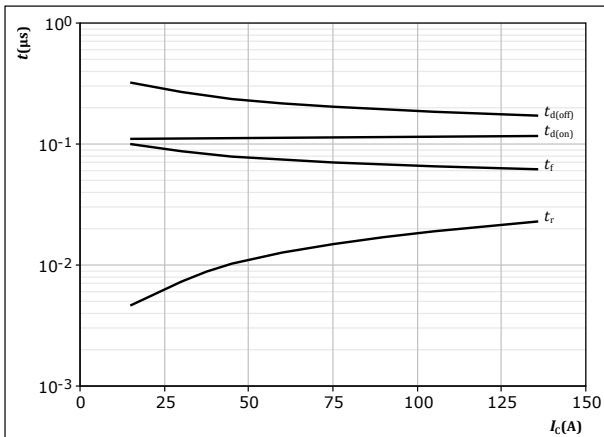


## Brake Switching Characteristics

figure 39.

IGBT

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



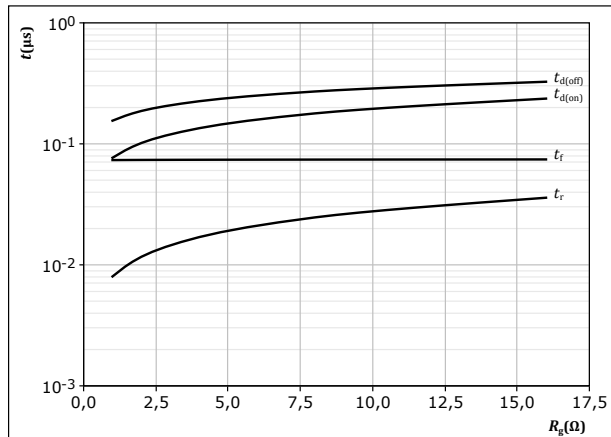
With an inductive load at

$T_j = 150$  °C  
 $V_{CE} = 300$  V  
 $V_{GE} = \pm 15$  V  
 $R_{gon} = 4$   $\Omega$   
 $R_{goff} = 4$   $\Omega$

figure 40.

IGBT

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



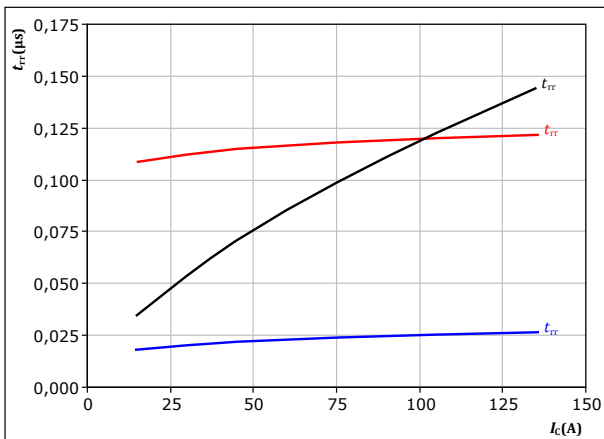
With an inductive load at

$T_j = 150$  °C  
 $V_{CE} = 300$  V  
 $V_{GE} = \pm 15$  V  
 $I_C = 75$  A

figure 41.

FWD

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



With an inductive load at

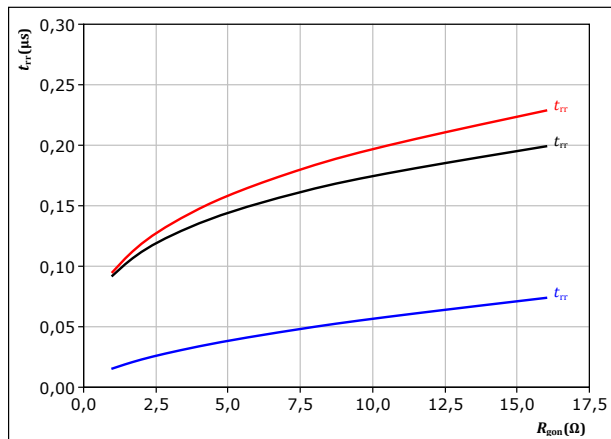
$V_{CE} = 300$  V  
 $V_{GE} = \pm 15$  V  
 $R_{gon} = 4$   $\Omega$

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

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

$V_{CE} = 300$  V  
 $V_{GE} = \pm 15$  V  
 $I_C = 75$  A

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



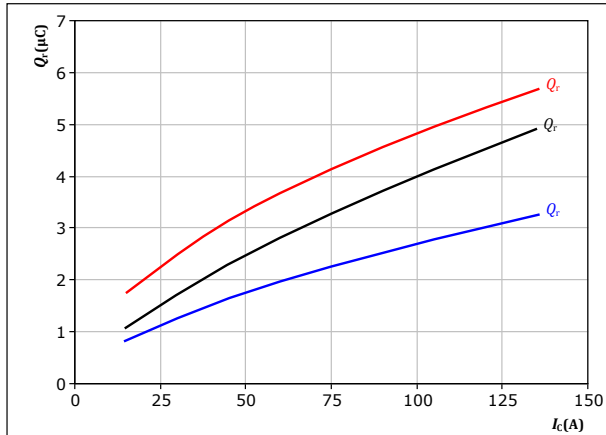
## Brake Switching Characteristics

figure 43.

FWD

Typical recovered charge as a function of collector current

$$Q_r = f(I_c)$$



With an inductive load at

$V_{CE} = 300$  V  
 $V_{GE} = \pm 15$  V  
 $R_{gon} = 4$  Ω

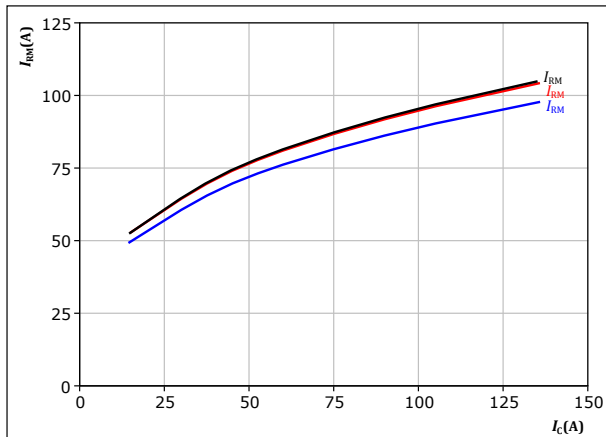
$T_j$ :  
— 25 °C  
— 125 °C  
— 150 °C

figure 45.

FWD

Typical peak reverse recovery current as a function of collector current

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



With an inductive load at

$V_{CE} = 300$  V  
 $V_{GE} = \pm 15$  V  
 $R_{gon} = 4$  Ω

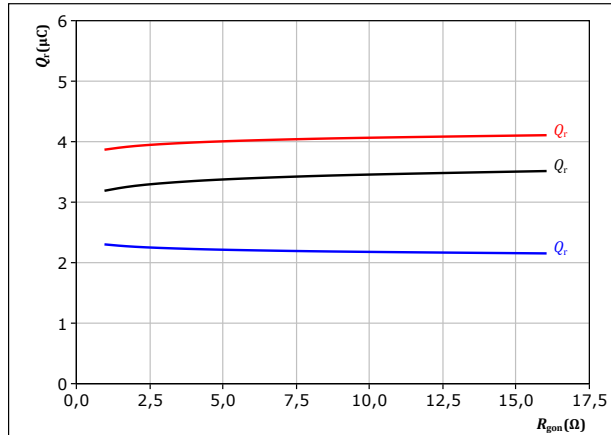
$T_j$ :  
— 25 °C  
— 125 °C  
— 150 °C

figure 44.

FWD

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

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



With an inductive load at

$V_{CE} = 300$  V  
 $V_{GE} = \pm 15$  V  
 $I_c = 75$  A

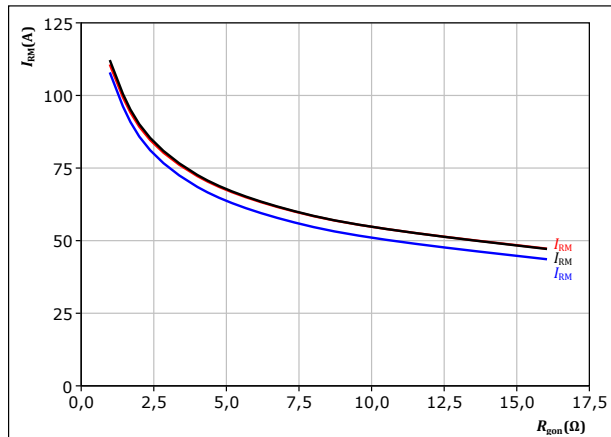
$T_j$ :  
— 25 °C  
— 125 °C  
— 150 °C

figure 46.

FWD

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

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



With an inductive load at

$V_{CE} = 300$  V  
 $V_{GE} = \pm 15$  V  
 $I_c = 75$  A

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



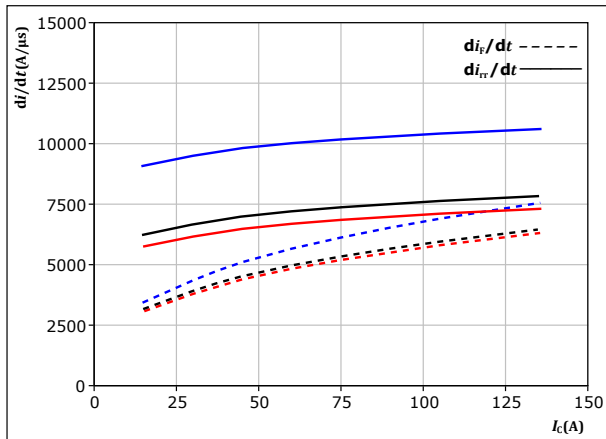
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## Brake Switching Characteristics

**figure 47.** FWD

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



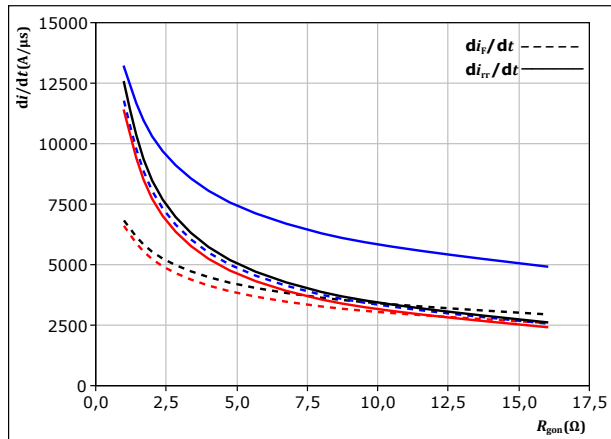
With an inductive load at

$V_{CE} = 300 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $R_{gon} = 4 \text{ } \Omega$

$T_j:$   
 — 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

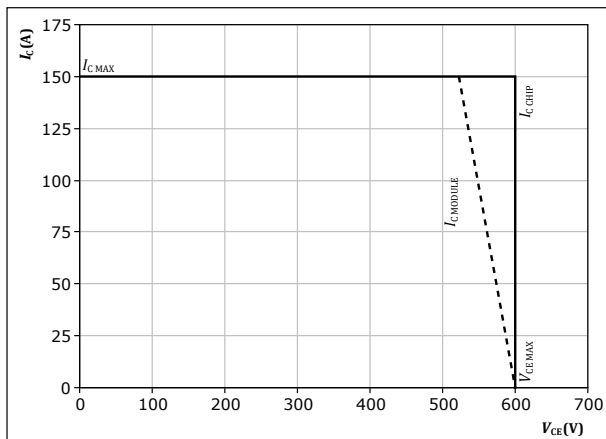
$V_{CE} = 300 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $I_C = 75 \text{ A}$

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

**figure 49.** IGBT

Reverse bias safe operating area

$I_C = f(V_{CE})$



At

$T_j = 150 \text{ } ^\circ\text{C}$   
 $R_{gon} = 4 \text{ } \Omega$   
 $R_{goff} = 4 \text{ } \Omega$



## Switching Definitions

figure 50.

IGBT

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

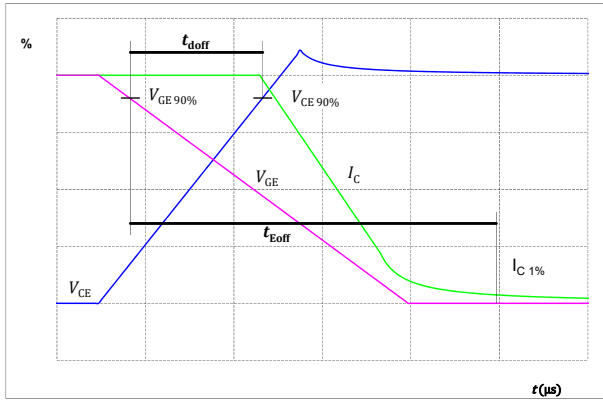


figure 51.

IGBT

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

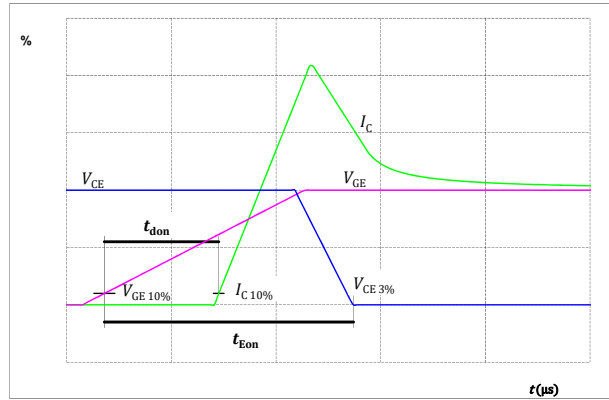


figure 52.

IGBT

Turn-off Switching Waveforms & definition of  $t_f$

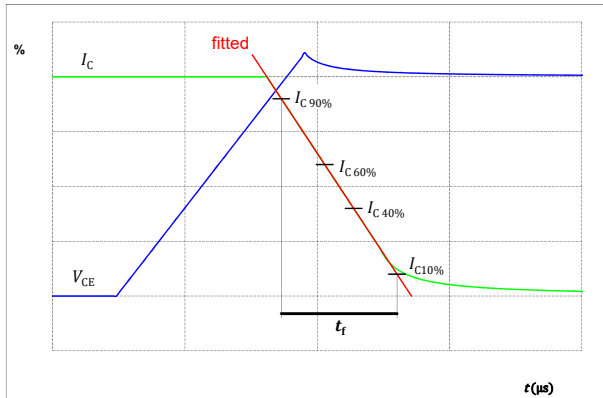
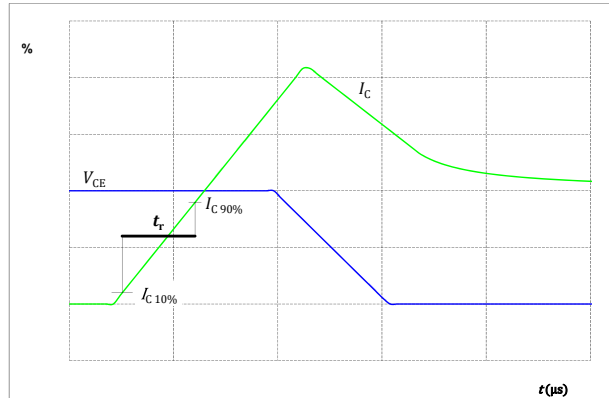


figure 53.

IGBT

Turn-on Switching Waveforms & definition of  $t_r$





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# Switching Definitions

figure 54. FWD  
Turn-off Switching Waveforms & definition of  $t_{rr}$

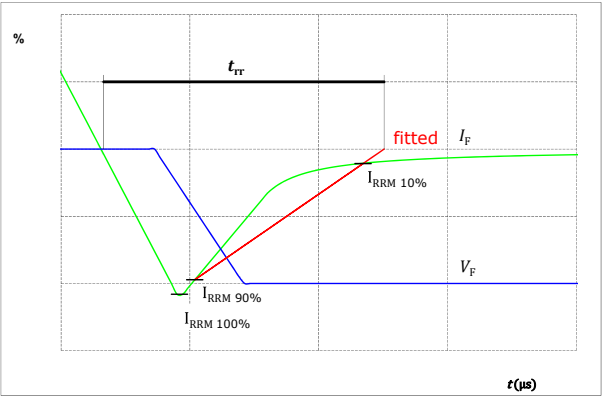
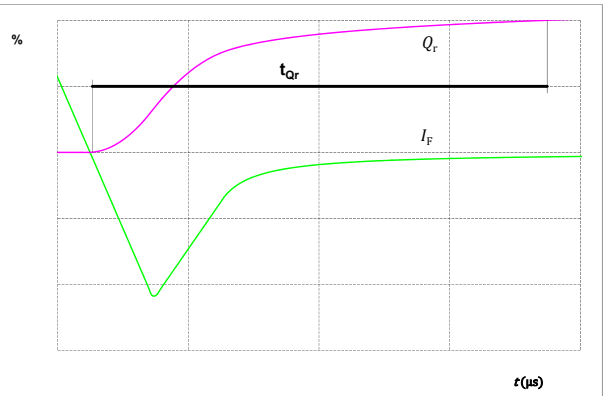


figure 55. FWD  
Turn-on Switching Waveforms & definition of  $t_{Qr}$  ( $t_{Qr}$  = integrating time for  $Q_r$ )





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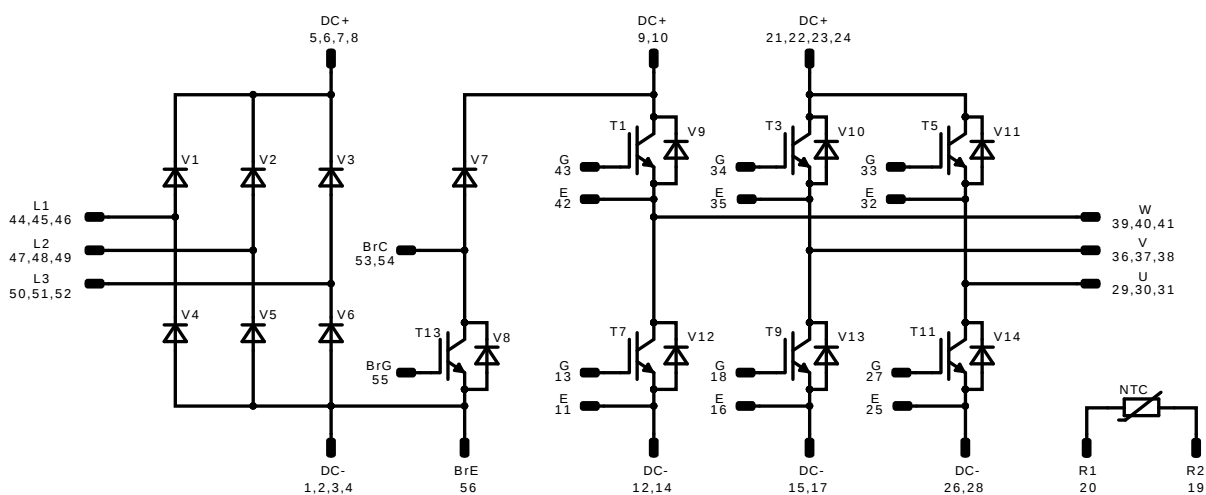
| Ordering Code                            |                      |
|------------------------------------------|----------------------|
| Version                                  | Ordering Code        |
| Without thermal paste                    | V23990-P765-A-PM     |
| With thermal paste (5,2 W/mK, PTM6000HV) | V23990-P765-A-/7/-PM |

| Marking |            |          |            |          |           |        |
|---------|------------|----------|------------|----------|-----------|--------|
|         | Text       | VIN      | Date code  | Type&Ver | UL        | Lot    |
|         |            | VIN      | WWYY       | TTTTTIV  | UL        | LLLL   |
|         | Datamatrix | Type&Ver | Lot number | Serial   | Date code | Serial |
|         |            | TTTTTIV  | LLLLL      | SSSS     | WWYY      | SSSS   |

| Outline        |       |     |          |    |       |      |     |
|----------------|-------|-----|----------|----|-------|------|-----|
| Pin table [mm] |       |     |          |    |       |      |     |
| Pin            | X     | Y   | Function | 29 | 0     | 37,2 | U   |
| 1              | 71,2  | 0   | DC-      | 30 | 2,5   | 37,2 | U   |
| 2              | 68,7  | 0   | DC-      | 31 | 5     | 37,2 | U   |
| 3              | 66,2  | 0   | DC-      | 32 | 7,8   | 37,2 | E   |
| 4              | 63,7  | 0   | DC-      | 33 | 10,6  | 37,2 | G   |
| 5              | 55,95 | 0   | DC+      | 34 | 18,45 | 37,2 | G   |
| 6              | 53,45 | 0   | DC+      | 35 | 21,25 | 37,2 | E   |
| 7              | 55,95 | 2,8 | DC+      | 36 | 24,05 | 37,2 | V   |
| 8              | 53,45 | 2,8 | DC+      | 37 | 26,55 | 37,2 | V   |
| 9              | 48,4  | 0   | DC+      | 38 | 29,05 | 37,2 | V   |
| 10             | 45,9  | 0   | DC+      | 39 | 36,1  | 37,2 | W   |
| 11             | 38,9  | 0   | E        | 40 | 38,6  | 37,2 | W   |
| 12             | 36,1  | 0   | DC-      | 41 | 41,1  | 37,2 | W   |
| 13             | 38,9  | 2,8 | G        | 42 | 43,9  | 37,2 | E   |
| 14             | 36,1  | 2,8 | DC-      | 43 | 46,7  | 37,2 | G   |
| 15             | 31,3  | 0   | DC-      | 44 | 53,7  | 37,2 | L1  |
| 16             | 28,5  | 0   | E        | 45 | 56,2  | 37,2 | L1  |
| 17             | 31,3  | 2,8 | DC-      | 46 | 58,7  | 37,2 | L1  |
| 18             | 28,5  | 2,8 | G        | 47 | 71,2  | 37,2 | L2  |
| 19             | 19,3  | 0   | R2       | 48 | 71,2  | 34,7 | L2  |
| 20             | 19,3  | 2,8 | R1       | 49 | 71,2  | 32,2 | L2  |
| 21             | 12,3  | 0   | DC+      | 50 | 71,2  | 25,2 | L3  |
| 22             | 9,8   | 0   | DC+      | 51 | 71,2  | 22,7 | L3  |
| 23             | 12,3  | 2,8 | DC+      | 52 | 71,2  | 20,2 | L3  |
| 24             | 9,8   | 2,8 | DC+      | 53 | 68,7  | 12,8 | BrC |
| 25             | 2,8   | 0   | E        | 54 | 71,2  | 12,8 | BrC |
| 26             | 0     | 0   | DC-      | 55 | 71,2  | 5,6  | BrG |
| 27             | 2,8   | 2,8 | G        | 56 | 71,2  | 2,8  | BrE |
| 28             | 0     | 2,8 | DC-      |    |       |      |     |



Pinout



Identification

| ID                          | Component  | Voltage | Current | Function                   | Comment |
|-----------------------------|------------|---------|---------|----------------------------|---------|
| T7, T1, T9, T3, T11, T5     | IGBT       | 600 V   | 100 A   | Inverter Switch            |         |
| V9, V12, V10, V13, V11, V14 | FWD        | 600 V   | 100 A   | Inverter Diode             |         |
| T13                         | IGBT       | 600 V   | 75 A    | Brake Switch               |         |
| V7                          | FWD        | 600 V   | 30 A    | Brake Diode                |         |
| V8                          | FWD        | 600 V   | 20 A    | Brake Sw. Protection Diode |         |
| V4, V1, V5, V2, V6, V3      | Rectifier  | 1600 V  | 75 A    | Rectifier Diode            |         |
| NTC                         | Thermistor |         |         | Thermistor                 |         |



| Packaging instruction                                                                                                                                                                                                           |      |          |      |                                                                                     |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------|------|-------------------------------------------------------------------------------------|
| Standard packaging quantity (SPQ) 36                                                                                                                                                                                            | >SPQ | Standard | <SPQ | Sample                                                                              |
| Handling instruction                                                                                                                                                                                                            |      |          |      |                                                                                     |
| Handling instructions for <i>flow 2</i> packages see vincotech.com website.                                                                                                                                                     |      |          |      |                                                                                     |
| Package data                                                                                                                                                                                                                    |      |          |      |                                                                                     |
| Package data for <i>flow 2</i> packages see vincotech.com website.                                                                                                                                                              |      |          |      |                                                                                     |
| Vincotech thermistor reference                                                                                                                                                                                                  |      |          |      |                                                                                     |
| See Vincotech thermistor reference table at vincotech.com website.                                                                                                                                                              |      |          |      |                                                                                     |
| UL recognition and file number                                                                                                                                                                                                  |      |          |      |                                                                                     |
| This device is UL 1557 recognized under E192116 up to a junction temperature under switching condition $T_{j,op}=175^{\circ}\text{C}$ and up to 3500VAC/1min isolation voltage. For more information see vincotech.com website. |      |          |      |  |

| Document No.:          | Date:        | Modification:                          | Pages |
|------------------------|--------------|----------------------------------------|-------|
| V23990-P765-A-PM-D9-14 | 30 Mar. 2025 | New Datasheet format. Module unchanged |       |

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