**flow BOOST 0**

**Features**
- High efficiency dual boost
- Ultra fast switching frequency
- Low Inductance Layout
- 650V IGBT and 650V Stealth Si boost diode
- Antiparallel IGBT protection diode with high current

**Target Applications**
- Solar inverter

**Types**
- V23990-P623-L82-PM

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**Maximum Ratings**

* TJ = 25°C, unless otherwise specified *

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Condition</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bypass Diode (D7, D8)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Repetitive peak reverse voltage</td>
<td>V_{RRM}</td>
<td></td>
<td>1600</td>
<td>V</td>
</tr>
<tr>
<td>Forward average current</td>
<td>I_{FAV}</td>
<td>T_j=T_{max}</td>
<td>32</td>
<td>A</td>
</tr>
<tr>
<td>Surge forward current</td>
<td>I_{FSM}</td>
<td>T_j=80°C</td>
<td>43</td>
<td>A</td>
</tr>
<tr>
<td>I2t-value</td>
<td>I_{t}</td>
<td>T_j=10ms</td>
<td>220</td>
<td>A</td>
</tr>
<tr>
<td>Power dissipation per Diode</td>
<td>P_{ms}</td>
<td>T_j=T_{max}</td>
<td>42</td>
<td>W</td>
</tr>
<tr>
<td>Maximum Junction Temperature</td>
<td>T_{jmax}</td>
<td></td>
<td>150</td>
<td>°C</td>
</tr>
</tbody>
</table>

| Boost IGBT (T1, T2)              |        |           |       |      |
| Collector-emitter break down voltage | V_{CES} |           | 650   | V    |
| DC collector current             | I_{C}  | T_j=T_{max} | 43    | A    |
| Pulsed collector current         | I_{Pulse} | I_{p} limited by T_{jmax} | 57    | A    |
| Turn off safe operating area     | T_j≤175°C, V_{CES}≤650 |           | 150   | A    |
| Power dissipation per IGBT       | P_{ext} | T_j=T_{max} | 128   | W    |
| Gate-emitter peak voltage        | V_{GE} | T_j=T_{max} | ±20   | V    |
| Maximum Junction Temperature     | T_{jmax} |           | 175   | °C   |
### Maximum Ratings

**Parameter** | **Symbol** | **Condition** | **Value** | **Unit**
---|---|---|---|---
**Boost FWD (D1, D4)**

| Peak Repetitive Reverse Voltage | \( V_{\text{RMM}} \) | \( T_j=25^\circ\text{C} \) | 650 | V |
| Forward average current | \( I_{\text{FAV}} \) | \( T_j=T_{\text{max}} \) | \( T_c=80^\circ\text{C} \) | 51 | A |
| Surge forward current | \( I_{\text{SM}} \) | \( I_{\text{SM}}=10\text{ms} \) | \( T_j=25^\circ\text{C} \) | 225 | A |
| \( I^2t \)-value | \( I^2t \) | \( T_j=25^\circ\text{C} \) | 250 | \( \text{A}^2\text{s} \) |
| Repetitive peak forward current | \( I_{\text{RPM}} \) | \( I_p \text{ limited by } T_j\text{max} \) | 100 | A |
| Power dissipation per Diode | \( P_{\text{tot}} \) | \( T_j=T_{\text{max}} \) | \( T_c=80^\circ\text{C} \) | 88 | W |
| Maximum Junction Temperature | \( T_{\text{jmax}} \) | \( T_c=25^\circ\text{C} \) | 175 | °C |

**Boost Inverse Diode (D9, D10)**

| Peak Repetitive Reverse Voltage | \( V_{\text{RMM}} \) | \( T_j=25^\circ\text{C} \) | 650 | V |
| Forward average current | \( I_{\text{FAV}} \) | \( T_j=T_{\text{max}} \) | \( T_c=80^\circ\text{C} \) | 21 | A |
| Surge forward current | \( I_{\text{SM}} \) | \( I_{\text{SM}}=10\text{ms} \) | \( T_j=25^\circ\text{C} \) | 50 | A |
| \( I^2t \)-value | \( I^2t \) | \( T_j=25^\circ\text{C} \) | 12.5 | \( \text{A}^2\text{s} \) |
| Repetitive peak forward current | \( I_{\text{RPM}} \) | \( I_p \text{ limited by } T_j\text{max} \) | 20 | A |
| Power dissipation per Diode | \( P_{\text{tot}} \) | \( T_j=T_{\text{max}} \) | \( T_c=80^\circ\text{C} \) | 42 | W |
| Maximum Junction Temperature | \( T_{\text{jmax}} \) | \( T_c=25^\circ\text{C} \) | 175 | °C |

**Thermal Properties**

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

**Insulation Properties**

| Insulation voltage | \( I=2s \) | DC voltage | 4000 | V |
| Creepage distance | \( \text{min 12.7} \) | mm |
| Clearance | \( \text{min 12.7} \) | mm |
## Characteristic Values

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Forward voltage</strong></td>
<td>$V_{F}$</td>
<td>$25$</td>
<td>$0.8$</td>
<td>$1.21$</td>
</tr>
<tr>
<td><strong>Threshold voltage</strong></td>
<td>$V_{th}$</td>
<td>$25$</td>
<td>$0.92$</td>
<td>$1.19$</td>
</tr>
<tr>
<td><strong>Slope resistance</strong></td>
<td>$r_s$</td>
<td>$25$</td>
<td>$0.012$</td>
<td>$0.015$</td>
</tr>
<tr>
<td><strong>Reverse current</strong></td>
<td>$I_{R}$</td>
<td>$1500$</td>
<td>$3.3$</td>
<td>$4$</td>
</tr>
<tr>
<td><strong>Thermal resistance chip to heatsink</strong></td>
<td>$R_{th}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Reverse recovery time</strong></td>
<td>$t_{rr}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Reverse leakage current</strong></td>
<td>$I_{L}$</td>
<td>$50$</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Peak recovery current</strong></td>
<td>$I_{PK}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Reverse recovery time</strong></td>
<td>$t_{rr}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Reverse recovery charge</strong></td>
<td>$Q_{rec}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Reverse recovered energy</strong></td>
<td>$E_{rec}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Peak rate of fall of recovery current</strong></td>
<td>$di/dt_{max}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Thermal resistance chip to heatsink</strong></td>
<td>$R_{th}$</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Boost IGBT (T1, T2)**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gate emitter threshold voltage</strong></td>
<td>$V_{th}$</td>
<td>$V_{CE(sat)}$</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Collector-emitter saturation voltage</strong></td>
<td>$V_{CE}$</td>
<td>$15$</td>
<td>$1$</td>
<td>$2.9$</td>
</tr>
<tr>
<td><strong>Collector-emitter cut-off</strong></td>
<td>$I_{CS}$</td>
<td>$0$</td>
<td>$0.04$</td>
<td>$mA$</td>
</tr>
<tr>
<td><strong>Gate-emitter leakage current</strong></td>
<td>$I_{GS}$</td>
<td>$20$</td>
<td>$200$</td>
<td>$nA$</td>
</tr>
<tr>
<td><strong>Integrated Gate resistor</strong></td>
<td>$R_{int}$</td>
<td></td>
<td></td>
<td>$\Omega$</td>
</tr>
<tr>
<td><strong>Turn-on delay time</strong></td>
<td>$t_{on}$</td>
<td></td>
<td></td>
<td>$ns$</td>
</tr>
<tr>
<td><strong>Rise time</strong></td>
<td>$t_{r}$</td>
<td></td>
<td></td>
<td>$ns$</td>
</tr>
<tr>
<td><strong>Turn-off delay time</strong></td>
<td>$t_{off}$</td>
<td></td>
<td></td>
<td>$ns$</td>
</tr>
<tr>
<td><strong>Fall time</strong></td>
<td>$t_{f}$</td>
<td></td>
<td></td>
<td>$ns$</td>
</tr>
<tr>
<td><strong>Turn-on energy loss per pulse</strong></td>
<td>$E_{on}$</td>
<td></td>
<td></td>
<td>$mWs$</td>
</tr>
<tr>
<td><strong>Turn-off energy loss per pulse</strong></td>
<td>$E_{off}$</td>
<td></td>
<td></td>
<td>$mWs$</td>
</tr>
<tr>
<td><strong>Input capacitance</strong></td>
<td>$C_{in}$</td>
<td>$1=1MHz$</td>
<td>$3000$</td>
<td>$pF$</td>
</tr>
<tr>
<td><strong>Output capacitance</strong></td>
<td>$C_{out}$</td>
<td>$0$</td>
<td>$50$</td>
<td>$pF$</td>
</tr>
<tr>
<td><strong>Reverse transfer capacitance</strong></td>
<td>$C_{oss}$</td>
<td></td>
<td></td>
<td>$pF$</td>
</tr>
<tr>
<td><strong>Gate charge</strong></td>
<td>$Q_{gate}$</td>
<td>$15$</td>
<td>$120$</td>
<td>$nC$</td>
</tr>
<tr>
<td><strong>Thermal resistance chip to heatsink</strong></td>
<td>$R_{th}$</td>
<td></td>
<td></td>
<td>$K\Omega$</td>
</tr>
</tbody>
</table>

**Boost FWD (D1, D4)**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Forward voltage</strong></td>
<td>$V_{F}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Reverse leakage current</strong></td>
<td>$I_{L}$</td>
<td>$650$</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Peak recovery current</strong></td>
<td>$I_{PK}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Reverse recovery time</strong></td>
<td>$t_{rr}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Reverse recovery charge</strong></td>
<td>$Q_{rec}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Reverse recovered energy</strong></td>
<td>$E_{rec}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Peak rate of fall of recovery current</strong></td>
<td>$di/dt_{max}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Thermal resistance chip to heatsink</strong></td>
<td>$R_{th}$</td>
<td></td>
<td></td>
<td>$K\Omega$</td>
</tr>
</tbody>
</table>

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**Notes:**

- All values are given for $T_{j}=25^\circ\text{C}$ and $T_{j}=125^\circ\text{C}$.
- Thermal resistance values are given for Phase-Change Material.
- All units are as indicated in the table.

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### Boost Inverse Diode (D9, D10)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Value</th>
<th>Unit</th>
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</thead>
<tbody>
<tr>
<td>Diode forward voltage</td>
<td>$V_d$</td>
<td>$T_j=25^\circ C$</td>
<td>1.00</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$T_j=125^\circ C$</td>
<td>1.87</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1.54</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2.00</td>
<td>V</td>
</tr>
<tr>
<td>Thermal resistance chip to heatsink per chip</td>
<td>$R_{\text{thJH}}$</td>
<td>Phase-Change Material</td>
<td>2.28</td>
<td>kW</td>
</tr>
</tbody>
</table>

### Thermistor

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated resistance</td>
<td>$R$</td>
<td>$T=25^\circ C$</td>
<td>21511</td>
<td>Ω</td>
</tr>
<tr>
<td>Deviation of R100</td>
<td>$\Delta R/R$</td>
<td>$T=100^\circ C$</td>
<td>-4.5</td>
<td>%</td>
</tr>
<tr>
<td>Power dissipation</td>
<td>$P$</td>
<td>$T=25^\circ C$</td>
<td>210</td>
<td>mW</td>
</tr>
<tr>
<td>Power dissipation constant</td>
<td></td>
<td>$T=25^\circ C$</td>
<td>3.5</td>
<td>mW/K</td>
</tr>
<tr>
<td>B-value</td>
<td>$B(25/50)$</td>
<td>$T=25^\circ C$</td>
<td>3884</td>
<td>K</td>
</tr>
<tr>
<td>B-value</td>
<td>$B(25/100)$</td>
<td>$T=25^\circ C$</td>
<td>3964</td>
<td>K</td>
</tr>
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</table>

Vincother NTC Reference
**Boost Inverse Diode (D9, D10)**

**Figure 25**
Typical diode forward current as a function of forward voltage
\[ I_F = f(V_F) \]

<table>
<thead>
<tr>
<th>( V_F ) (V)</th>
<th>( I_F ) (A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

At
\[ t_p = 250 \mu s \]

**Figure 26**
Diode transient thermal impedance as a function of pulse width
\[ Z_{thJH} = f(t_p) \]

<table>
<thead>
<tr>
<th>( D )</th>
<th>( Z_{thJH} ) (K/W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td>10^4</td>
</tr>
<tr>
<td>0.005</td>
<td>10^5</td>
</tr>
<tr>
<td>0.01</td>
<td>10^6</td>
</tr>
<tr>
<td>0.02</td>
<td>10^7</td>
</tr>
<tr>
<td>0.05</td>
<td>10^8</td>
</tr>
<tr>
<td>0.1</td>
<td>10^9</td>
</tr>
<tr>
<td>0.2</td>
<td>10^10</td>
</tr>
</tbody>
</table>

At
\[ D = \frac{t_p}{T} \]
\[ R_{thJH} = 2.28 \text{ K/W} \]

**Figure 27**
Power dissipation as a function of heatsink temperature
\[ P_{tot} = f(T_h) \]

<table>
<thead>
<tr>
<th>( T_h ) (°C)</th>
<th>( P_{tot} ) (W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>50</td>
<td>5</td>
</tr>
<tr>
<td>100</td>
<td>10</td>
</tr>
<tr>
<td>150</td>
<td>15</td>
</tr>
<tr>
<td>200</td>
<td>20</td>
</tr>
</tbody>
</table>

At
\[ T_j = 175 \text{ °C} \]

**Figure 28**
Forward current as a function of heatsink temperature
\[ I_F = f(T_h) \]

<table>
<thead>
<tr>
<th>( T_h ) (°C)</th>
<th>( I_F ) (A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>50</td>
<td>5</td>
</tr>
<tr>
<td>100</td>
<td>10</td>
</tr>
<tr>
<td>150</td>
<td>15</td>
</tr>
<tr>
<td>200</td>
<td>20</td>
</tr>
</tbody>
</table>

At
\[ T_j = 175 \text{ °C} \]
Figure 1

Typical output characteristics

\[ I_D = f(V_{DS}) \]

At

\[ t_p = 250 \mu s \]

\[ T_j = 25 \degree C \]

\[ V_{GS} \text{ from 8 V to 18 V in steps of 1 V} \]

Figure 2

Typical output characteristics

\[ I_D = f(V_{GS}) \]

At

\[ t_p = 250 \mu s \]

\[ T_j = 125 \degree C \]

\[ V_{GS} \text{ from 8 V to 18 V in steps of 1 V} \]

Figure 3

Typical transfer characteristics

\[ I_D = f(V_{GS}) \]

At

\[ t_p = 100 \mu s \]

\[ V_{DS} = 10 \text{ V} \]

Figure 4

Typical diode forward current as a function of forward voltage

\[ I_F = f(V_F) \]

At

\[ t_p = 250 \mu s \]
Figure 5: Typical switching energy losses as a function of collector current

\[ E = f(I_D) \]

With an inductive load at

- \( T_j = 25/126 \) °C
- \( V_{DS} = 400 \) V
- \( V_{GS} = 15 \) V
- \( R_{gon} = 8 \) Ω
- \( R_{goff} = 8 \) Ω

Figure 6: Typical switching energy losses as a function of gate resistor

\[ E = f(R_G) \]

With an inductive load at

- \( T_j = 25/126 \) °C
- \( V_{DS} = 400 \) V
- \( V_{GS} = 15 \) V
- \( I_D = 30 \) A

Figure 7: Typical reverse recovery energy loss as a function of collector (drain) current

\[ E_{rec} = f(I_c) \]

With an inductive load at

- \( T_j = 25/126 \) °C
- \( V_{DS} = 400 \) V
- \( V_{GS} = 15 \) V
- \( R_{gon} = 8 \) Ω
- \( R_{goff} = 8 \) Ω

Figure 8: Typical reverse recovery energy loss as a function of gate resistor

\[ E_{rec} = f(R_G) \]

With an inductive load at

- \( T_j = 25/126 \) °C
- \( V_{DS} = 400 \) V
- \( V_{GS} = 15 \) V
- \( I_D = 30 \) A
Figure 9
Typical switching times as a function of collector current

\[ t = f(I_c) \]

With an inductive load at

\[ T_j = 126 \, ^\circ C \]
\[ V_{DS} = 400 \, V \]
\[ V_{GS} = 15 \, V \]
\[ R_{gon} = 8 \, \Omega \]
\[ R_{gof} = 8 \, \Omega \]

Figure 10
Typical switching times as a function of gate resistor

\[ t = f(R_g) \]

With an inductive load at

\[ T_j = 126 \, ^\circ C \]
\[ V_{DS} = 400 \, V \]
\[ V_{GS} = 15 \, V \]
\[ I_c = 30 \, A \]

Figure 11
Typical reverse recovery time as a function of collector current

\[ t_{rr} = f(I_c) \]

At

\[ T_j = 25/126 \, ^\circ C \]
\[ V_{DS} = 400 \, V \]
\[ V_{GS} = 15 \, V \]
\[ R_{gon} = 8 \, \Omega \]

Figure 12
Typical reverse recovery time as a function of IGBT turn on gate resistor

\[ t_{rr} = f(R_{gon}) \]

At

\[ T_j = 25/126 \, ^\circ C \]
\[ V_{DS} = 400 \, V \]
\[ V_{GS} = 15 \, V \]
\[ I_t = 30 \, A \]
\[ V_{GS} = 15 \, V \]
INPUT BOOST (T1, T2 / D1, D4)

**Figure 13**
Typical reverse recovery charge as a function of collector current
\[ Q_{rr} = f(I_C) \]

At
\[ T_J = 25/126 ^\circ C \]
\[ V_{CE} = 400 \text{ V} \]
\[ V_{CE} = 15 \text{ V} \]
\[ R_{gon} = 8 \Omega \]

**Figure 14**
Typical reverse recovery charge as a function of IGBT turn on gate resistor
\[ Q_{rr} = f(R_{gon}) \]

At
\[ T_J = 25/126 ^\circ C \]
\[ V_{INP} = 400 \text{ V} \]
\[ I_F = 30 \text{ A} \]
\[ V_{GS} = 15 \text{ V} \]

**Figure 15**
Typical reverse recovery current as a function of collector current
\[ I_{RRM} = f(I_C) \]

**Figure 16**
Typical reverse recovery current as a function of IGBT turn on gate resistor
\[ I_{RRM} = f(R_{gon}) \]

At
\[ T_J = 25/126 ^\circ C \]
\[ V_{INP} = 400 \text{ V} \]
\[ I_F = 30 \text{ A} \]
\[ V_{GS} = 15 \text{ V} \]

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INPUT BOOST (T1, T2 / D1, D4)

**Figure 17**
**BOOST FWD**

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

\[ \frac{dI_c}{dt}, \frac{dI_{rec}}{dt} = f(I_c) \]

At

- \( T_j = 25/126 \) °C
- \( V_{CE} = 400 \) V
- \( V_{GE} = 15 \) V
- \( R_{gon} = 8 \) Ω

**Figure 18**
**BOOST FWD**

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

\[ \frac{dI_c}{dt}, \frac{dI_{rec}}{dt} = f(R_{gon}) \]

At

- \( T_j = 25/126 \) °C
- \( V_{GE} = 15 \) V
- \( I_F = 30 \) A
- \( V_{GS} = 15 \) V

**Figure 19**
**BOOST IGBT**

IGBT/MOSFET transient thermal impedance as a function of pulse width

\[ Z_{thJH} = f(t_p) \]

At

- \( D = 0.5 \)
- \( R_{thJH} = 1.13 \) K/W
- \( \frac{t_p}{T} \)
- \( R_{thJH} = 1.08 \) K/W

**Figure 20**
**BOOST FWD**

FWD transient thermal impedance as a function of pulse width

\[ Z_{thJH} = f(t_p) \]

At

- \( D = 0.5 \)
- \( R_{thJH} = 1.08 \) K/W
- \( \frac{t_p}{T} \)

IGBT thermal model values

<table>
<thead>
<tr>
<th>( R ) (C/W)</th>
<th>( \tau ) (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>7,12E-02</td>
<td>8,15E+00</td>
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<tr>
<td>1,29E-01</td>
<td>6,00E-01</td>
</tr>
<tr>
<td>4,31E-01</td>
<td>9,13E-02</td>
</tr>
<tr>
<td>3,15E-01</td>
<td>2,59E-02</td>
</tr>
<tr>
<td>1,31E-01</td>
<td>5,80E-03</td>
</tr>
<tr>
<td>5,02E-02</td>
<td>8,53E-04</td>
</tr>
</tbody>
</table>

FWD thermal model values

<table>
<thead>
<tr>
<th>( R ) (C/W)</th>
<th>( \tau ) (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5,58E-02</td>
<td>4,07E+00</td>
</tr>
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<td>1,01E-01</td>
<td>6,75E-01</td>
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<td>9,24E-02</td>
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<tr>
<td>2,93E-01</td>
<td>2,59E-02</td>
</tr>
<tr>
<td>1,10E-01</td>
<td>4,04E-03</td>
</tr>
<tr>
<td>8,25E-02</td>
<td>8,42E-04</td>
</tr>
</tbody>
</table>
Power dissipation as a function of heatsink temperature

\[ P_{\text{tot}} = f(T_h) \]

**Figure 21**

At

\[ T_j = 175 \degree C \]

Collector/Drain current as a function of heatsink temperature

\[ I_{C} = f(T_h) \]

**Figure 22**

At

\[ T_j = 175 \degree C \]

\[ V_{GS} = 15 \text{ V} \]

Power dissipation as a function of heatsink temperature

\[ P_{\text{tot}} = f(T_h) \]

**Figure 23**

At

\[ T_j = 175 \degree C \]

Forward current as a function of heatsink temperature

\[ I_{F} = f(T_h) \]

**Figure 24**

At

\[ T_j = 175 \degree C \]
Figure 25  
**BOOST IGBT**

Safe operating area as a function of drain-source voltage

\[ I_D = f(V_{DS}) \]

<table>
<thead>
<tr>
<th>( V_{GS} )</th>
<th>( Q_g )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>200</td>
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<tr>
<td>400</td>
<td>400</td>
</tr>
<tr>
<td>500</td>
<td>500</td>
</tr>
</tbody>
</table>

At
- \( D = \) single pulse
- \( T_0 = \) 80°C
- \( V_{GS} = \) 15 V
- \( T_j = T_{j,max} \) °C

Figure 26  
**BOOST IGBT**

Gate voltage vs Gate charge

\[ V_{GS} = f(Q_g) \]

At
- \( I_C = 50 \) A
- 130V
- 520V

Figure 29  
**IGBT**

Reverse bias safe operating area

\[ I_C = f(V_{CE}) \]

<table>
<thead>
<tr>
<th>( V_{CE} )</th>
<th>( I_C )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>100</td>
<td>100</td>
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<tr>
<td>200</td>
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<td>300</td>
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</tr>
<tr>
<td>400</td>
<td>400</td>
</tr>
<tr>
<td>500</td>
<td>500</td>
</tr>
</tbody>
</table>

At
- \( T_j = T_{j,max} - 25 \) °C
- \( R_{PD} = 8 \) Ω
- \( U_{COMAX} = U_{ELPLUS} \)
- \( R_{PDH} = 8 \) Ω

Switching mode: 3 level switching
Bypass Diode (D7, D8)

**Figure 1**
Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$

![Graph](image)

At

$\tau_p = 250 \mu s$

**Figure 2**
Diode transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$

![Graph](image)

At

$D = \frac{\tau_p}{T}$

$R_{thJH} = 1.67 \text{ K/W}$

**Figure 3**
Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$

![Graph](image)

At

$T_j = 150 ^\circ C$

**Figure 4**
Forward current as a function of heatsink temperature

$I_F = f(T_h)$

![Graph](image)

At

$T_j = 150 ^\circ C$

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Figure 1

Thermistor

Typical NTC characteristic as a function of temperature

$R_T = f(T)$
Switching Definitions INPUT BOOST

General conditions

\[
\begin{align*}
T_{J} & = 125 \, ^{\circ}\text{C} \\
R_{\text{on}} & = 8 \, \Omega \\
R_{\text{off}} & = 8 \, \Omega
\end{align*}
\]

Figure 1: Input Boost IGBT

Turn-off Switching Waveforms & definition of \( t_{\text{off}}, t_{\text{on}} \)

\( (t_{\text{off}} = \text{integrating time for } E_{\text{off}}) \)

\[
\begin{align*}
V_{\text{GE}} (0\%) & = 0 \, \text{ V} \\
V_{\text{GE}} (100\%) & = 15 \, \text{ V} \\
V_{\text{CE}} (100\%) & = 400 \, \text{ V} \\
l_{\text{C}} (100\%) & = 30 \, \text{ A} \\
t_{\text{off}} & = 0.168 \, \mu\text{s} \\
t_{\text{on}} & = 0.215 \, \mu\text{s}
\end{align*}
\]

Figure 2: Input Boost IGBT

Turn-on Switching Waveforms & definition of \( t_{\text{on}}, t_{\text{on}} \)

\( (t_{\text{on}} = \text{integrating time for } E_{\text{on}}) \)

\[
\begin{align*}
V_{\text{GE}} (0\%) & = 0 \, \text{ V} \\
V_{\text{GE}} (100\%) & = 15 \, \text{ V} \\
V_{\text{CE}} (100\%) & = 400 \, \text{ V} \\
l_{\text{C}} (100\%) & = 30 \, \text{ A} \\
t_{\text{on}} & = 0.022 \, \mu\text{s} \\
t_{\text{on}} & = 0.113 \, \mu\text{s}
\end{align*}
\]

Figure 3: Input Boost IGBT

Turn-off Switching Waveforms & definition of \( t_{f} \)

\[
\begin{align*}
V_{\text{CE}} (100\%) & = 400 \, \text{ V} \\
l_{\text{C}} (100\%) & = 30 \, \text{ A} \\
t_{f} & = 0.007 \, \mu\text{s}
\end{align*}
\]

Figure 4: Input Boost IGBT

Turn-on Switching Waveforms & definition of \( t_{r} \)

\[
\begin{align*}
V_{\text{CE}} (100\%) & = 400 \, \text{ V} \\
l_{\text{C}} (100\%) & = 30 \, \text{ A} \\
t_{r} & = 0.007 \, \mu\text{s}
\end{align*}
\]

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Revision: 2.1
Switching Definitions INPUT BOOST

Figure 5  Input Boost IGBT
Turn-off Switching Waveforms & definition of $t_{\text{Eoff}}$

- $P_{\text{off}}$ (100%) = 12.00 kW
- $E_{\text{off}}$ (100%) = 0.29 mJ
- $t_{\text{Eoff}}$ = 0.22 µs

Figure 6  Input Boost IGBT
Turn-on Switching Waveforms & definition of $t_{\text{Eon}}$

- $P_{\text{on}}$ (100%) = 12.00 kW
- $E_{\text{on}}$ (100%) = 0.60 mJ
- $t_{\text{Eon}}$ = 0.11 µs

Figure 7  Input Boost IGBT
Gate voltage vs Gate charge (measured)

- $V_{\text{GEoff}}$ = 0 V
- $V_{\text{GEon}}$ = 15 V
- $V_{c}(100\%)$ = 400 V
- $I_{c}(100\%)$ = 30 A
- $Q_{g}$ = 101 nC

Figure 8  Input Boost FWD
Turn-off Switching Waveforms & definition of $t_{\text{f}}$

- $V_{d}(100\%)$ = 400 V
- $I_{d}(100\%)$ = 30 A
- $I_{\text{final }}$ (100%) = -56 A
- $t_{\text{f}}$ = 0.056 µs
Switching Definitions INPUT BOOST

**Figure 9**

**Input Boost FWD**

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

($t_{Qrr}$ = integrating time for $Q_{rr}$)

$I_d (100\%) = 30$ A

$Q_{rr} (100\%) = 1.46$ $\mu$C

$t_{Qrr} = 0.11$ $\mu$s

**Figure 10**

**Input Boost FWD**

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

($t_{Erec}$ = integrating time for $E_{rec}$)

$P_{rec} (100\%) = 12.00$ kW

$E_{rec} (100\%) = 0.28$ mJ

$t_{Erec} = 0.11$ $\mu$s
Ordering Code and Marking - Outline - Pinout

### Ordering Code & Marking

<table>
<thead>
<tr>
<th>Version</th>
<th>Ordering Code</th>
<th>in DataMatrix as</th>
<th>in packaging barcode as</th>
</tr>
</thead>
<tbody>
<tr>
<td>without thermal paste 12mm housing</td>
<td>V23990-P623-L82-PM</td>
<td>P623L82</td>
<td>P623L82</td>
</tr>
<tr>
<td>with thermal paste 12mm housing</td>
<td>V23990-P623-L82/-3/-PM</td>
<td>P623L82</td>
<td>P623L82</td>
</tr>
</tbody>
</table>

### Outline

![Outline Diagram](image)

### Pinout

![Pinout Diagram](image)

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