### Features
- Neutral-point-Clamped inverter
- High power flow2 housing
- High Speed IGBT3 in Buck
- Low Inductance Layout

### Target Applications
- UPS
- Solar inverters

### Types
- F206NIA200SG

### 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>Collector-emitter break down voltage</td>
<td>$V_{CE}$</td>
<td>$T_j\leq150°C$</td>
<td>600</td>
<td>V</td>
</tr>
<tr>
<td>DC collector current</td>
<td>$I_C$</td>
<td>$T_j=T_{max}$; $T_s=80°C$</td>
<td>143</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$T_j=T_{max}$; $T_s=80°C$</td>
<td>188</td>
<td>A</td>
</tr>
<tr>
<td>Repetitive peak collector current</td>
<td>$I_{(p)max}$</td>
<td>$I_P$ limited by $T_{max}$</td>
<td>800</td>
<td>A</td>
</tr>
<tr>
<td>Power dissipation per IGBT</td>
<td>$P_{tot}$</td>
<td>$T_j=T_{max}$; $T_s=80°C$</td>
<td>286</td>
<td>W</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$T_j=80°C$</td>
<td>433</td>
<td>W</td>
</tr>
<tr>
<td>Gate-emitter peak voltage</td>
<td>$V_{GE}$</td>
<td></td>
<td>±20</td>
<td>V</td>
</tr>
<tr>
<td>Short circuit ratings</td>
<td>$t_{SC}$</td>
<td>$T_j=175°C$, $V_{GE}=15V$</td>
<td>5</td>
<td>μs</td>
</tr>
<tr>
<td></td>
<td>$I_{F}$</td>
<td></td>
<td>400</td>
<td>mA</td>
</tr>
<tr>
<td>Maximum Junction Temperature</td>
<td>$T_{j,max}$</td>
<td></td>
<td>175</td>
<td>°C</td>
</tr>
</tbody>
</table>

### Buck Diode

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Condition</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak Repetitive Reverse Voltage</td>
<td>$V_{peak}$</td>
<td>$T_j=25°C$</td>
<td>600</td>
<td>V</td>
</tr>
<tr>
<td>DC forward current</td>
<td>$I_P$</td>
<td>$T_j=T_{max}$; $T_s=80°C$</td>
<td>96</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$T_j=T_{max}$; $T_s=80°C$</td>
<td>129</td>
<td>A</td>
</tr>
<tr>
<td>Repetitive peak forward current</td>
<td>$I_{RMS}$</td>
<td>$I_P$ limited by $T_{max}$; $T_s=100°C$</td>
<td>240</td>
<td>A</td>
</tr>
<tr>
<td>Power dissipation per Diode</td>
<td>$P_{tot}$</td>
<td>$T_j=T_{max}$; $T_s=80°C$</td>
<td>141</td>
<td>W</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$T_j=T_{max}$; $T_s=80°C$</td>
<td>175</td>
<td>W</td>
</tr>
<tr>
<td>Maximum Junction Temperature</td>
<td>$T_{j,max}$</td>
<td></td>
<td>175</td>
<td>°C</td>
</tr>
</tbody>
</table>
## 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><strong>Boost IGBT</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collector-emitter break down voltage</td>
<td>$V_{CE}$</td>
<td></td>
<td>600</td>
<td>V</td>
</tr>
<tr>
<td>DC collector current</td>
<td>$I_C$</td>
<td>$T_j=$T$_{max}$</td>
<td>151</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$T_s=$80°C</td>
<td>198</td>
<td></td>
</tr>
<tr>
<td>Repetitive peak collector current</td>
<td>$I_{CPm}$</td>
<td>$I_p$ limited by $T_{max}$</td>
<td>600</td>
<td>A</td>
</tr>
<tr>
<td>Power dissipation per IGBT</td>
<td>$P_{tot}$</td>
<td>$T_j=$T$_{max}$</td>
<td>245</td>
<td>W</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$T_s=$80°C</td>
<td>372</td>
<td></td>
</tr>
<tr>
<td>Gate-emitter peak voltage</td>
<td>$V_{GE}$</td>
<td></td>
<td>±20</td>
<td>V</td>
</tr>
<tr>
<td>Short circuit ratings</td>
<td>$I_{SC}$</td>
<td>$T_s$≤150°C</td>
<td>6</td>
<td>μs</td>
</tr>
<tr>
<td></td>
<td>$V_{CC}$</td>
<td>$V_{GE}=15V$</td>
<td>360</td>
<td>V</td>
</tr>
<tr>
<td>Maximum Circuit Temperature</td>
<td>$T_{jmax}$</td>
<td></td>
<td>175</td>
<td>°C</td>
</tr>
<tr>
<td><strong>Boost Inverse Diode</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peak Repetitive Reverse Voltage</td>
<td>$V_{RMM}$</td>
<td>$T_j=$25°C</td>
<td>1200</td>
<td>V</td>
</tr>
<tr>
<td>DC forward current</td>
<td>$I_F$</td>
<td>$T_j=$T$_{max}$</td>
<td>134</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$T_s=$80°C</td>
<td>178</td>
<td></td>
</tr>
<tr>
<td>Repetitive peak forward current</td>
<td>$I_{RPM}$</td>
<td>$I_p$ limited by $T_{max}$</td>
<td>600</td>
<td>A</td>
</tr>
<tr>
<td>Power dissipation per Diode</td>
<td>$P_{tot}$</td>
<td>$T_j=$T$_{max}$</td>
<td>195</td>
<td>W</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$T_s=$80°C</td>
<td>295</td>
<td></td>
</tr>
<tr>
<td>Maximum Junction Temperature</td>
<td>$T_{jmax}$</td>
<td></td>
<td>175</td>
<td>°C</td>
</tr>
<tr>
<td><strong>Boost Diode</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peak Repetitive Reverse Voltage</td>
<td>$V_{RMM}$</td>
<td>$T_j=$25°C</td>
<td>600</td>
<td>V</td>
</tr>
<tr>
<td>DC forward current</td>
<td>$I_F$</td>
<td>$T_j=$T$_{max}$</td>
<td>134</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$T_s=$80°C</td>
<td>178</td>
<td></td>
</tr>
<tr>
<td>Repetitive peak forward current</td>
<td>$I_{RPM}$</td>
<td>$I_p$ limited by $T_{max}$</td>
<td>600</td>
<td>A</td>
</tr>
<tr>
<td>Power dissipation per Diode</td>
<td>$P_{tot}$</td>
<td>$T_j=$T$_{max}$</td>
<td>195</td>
<td>W</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$T_s=$80°C</td>
<td>295</td>
<td></td>
</tr>
<tr>
<td>Maximum Junction Temperature</td>
<td>$T_{jmax}$</td>
<td></td>
<td>175</td>
<td>°C</td>
</tr>
<tr>
<td><strong>Thermal Properties</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storage temperature</td>
<td>$T_{stg}$</td>
<td></td>
<td>-40…+125</td>
<td>°C</td>
</tr>
<tr>
<td>Operation temperature under switching condition</td>
<td>$T_{op}$</td>
<td></td>
<td>-40…*(T$_{jmax}$ - 25)</td>
<td>°C</td>
</tr>
<tr>
<td><strong>Insulation Properties</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insulation voltage</td>
<td>$V_{in}$</td>
<td>$t=$2s</td>
<td>DC voltage</td>
<td>4000</td>
</tr>
<tr>
<td>Creepage distance</td>
<td></td>
<td></td>
<td></td>
<td>min 12.7</td>
</tr>
<tr>
<td>Clearance</td>
<td></td>
<td></td>
<td></td>
<td>min 12.7</td>
</tr>
</tbody>
</table>
## 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>Gate emitter threshold voltage</strong></td>
<td>$V_{GE(th)}$</td>
<td>$V_{CE=VGE}$</td>
<td>0,0008</td>
<td>V</td>
</tr>
<tr>
<td><strong>Collector-emitter saturation voltage</strong></td>
<td>$V_{CE(sat)}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Collector-emitter cut-off current incl. Diode</strong></td>
<td>$I_{CBO}$</td>
<td></td>
<td>0</td>
<td>μA</td>
</tr>
<tr>
<td><strong>Gate-emitter leakage current</strong></td>
<td>$I_{GEO}$</td>
<td></td>
<td>20</td>
<td>μA</td>
</tr>
<tr>
<td><strong>Integrated Gate resistor</strong></td>
<td>$R_{Gm}$</td>
<td></td>
<td>none</td>
<td>Ω</td>
</tr>
<tr>
<td><strong>Turn-on delay time</strong></td>
<td>$t_{d(on)}$</td>
<td></td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td><strong>Rise time</strong></td>
<td>$t_{r}$</td>
<td>$R_{gon}=4 , \Omega$</td>
<td>±15</td>
<td>ns</td>
</tr>
<tr>
<td><strong>Turn-off delay time</strong></td>
<td>$t_{d(off)}$</td>
<td>$R_{goff}=4 , \Omega$</td>
<td>350</td>
<td>ns</td>
</tr>
<tr>
<td><strong>Fall time</strong></td>
<td>$t_{f}$</td>
<td>$R_{gon}=4 , \Omega$</td>
<td>200</td>
<td>ns</td>
</tr>
<tr>
<td><strong>Turn-on energy loss per pulse</strong></td>
<td>$E_{on}$</td>
<td></td>
<td>16</td>
<td>mWs</td>
</tr>
<tr>
<td><strong>Turn-off energy loss per pulse</strong></td>
<td>$E_{off}$</td>
<td></td>
<td>20</td>
<td>mWs</td>
</tr>
<tr>
<td><strong>Input capacitance</strong></td>
<td>$C_{iss}$</td>
<td></td>
<td>464</td>
<td>pF</td>
</tr>
<tr>
<td><strong>Output capacitance</strong></td>
<td>$C_{oss}$</td>
<td></td>
<td>884</td>
<td>pF</td>
</tr>
<tr>
<td><strong>Reverse transfer capacitance</strong></td>
<td>$C_{rss}$</td>
<td></td>
<td>384</td>
<td>pF</td>
</tr>
<tr>
<td><strong>Gate charge</strong></td>
<td>$Q_{GS}$</td>
<td></td>
<td>15</td>
<td>nC</td>
</tr>
<tr>
<td><strong>Thermal resistance chip to heatsink per chip</strong></td>
<td>$R_{thJC}$</td>
<td>Thermal grease thickness≤50μm</td>
<td>0,33</td>
<td>K/W</td>
</tr>
<tr>
<td><strong>Thermal resistance chip to case per chip</strong></td>
<td>$R_{thJC}$</td>
<td></td>
<td>0,22</td>
<td>K/W</td>
</tr>
</tbody>
</table>

### Buck Diode

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Diode forward voltage</strong></td>
<td>$V_F$</td>
<td></td>
<td>120</td>
<td>V</td>
</tr>
<tr>
<td><strong>Peak reverse recovery current</strong></td>
<td>$I_{RRM}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Reverse recovery time</strong></td>
<td>$t_{rr}$</td>
<td>$R_{goff}=4 , \Omega$</td>
<td>0</td>
<td>ns</td>
</tr>
<tr>
<td><strong>Reverse recovered charge</strong></td>
<td>$Q_{rr}$</td>
<td>$R_{gon}=4 , \Omega$</td>
<td>350</td>
<td>μC</td>
</tr>
<tr>
<td><strong>Peak rate of fall of recovery current</strong></td>
<td>$dI_{RRM}$/d$\tau_{on}$</td>
<td></td>
<td></td>
<td>Am/s</td>
</tr>
<tr>
<td><strong>Reverse recovered energy</strong></td>
<td>$E_{rec}$</td>
<td>$R_{goff}=4 , \Omega$</td>
<td></td>
<td>mWs</td>
</tr>
<tr>
<td><strong>Thermal resistance chip to heatsink per chip</strong></td>
<td>$R_{thJC}$</td>
<td>Thermal grease thickness≤50μm</td>
<td>0,67</td>
<td>K/W</td>
</tr>
<tr>
<td><strong>Thermal resistance chip to case per chip</strong></td>
<td>$R_{thJC}$</td>
<td></td>
<td>0,44</td>
<td>K/W</td>
</tr>
</tbody>
</table>
### 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>Boost IGBT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gate emitter threshold voltage</td>
<td>$V_{G(th)}$</td>
<td>$V_{CE}=V_{G(th)}$</td>
<td>0.0032</td>
<td>V</td>
</tr>
<tr>
<td>Collector-emitter saturation voltage</td>
<td>$V_{CE(sat)}$</td>
<td>$I=25ºC$</td>
<td>5</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$I=125ºC$</td>
<td>5.8</td>
<td>V</td>
</tr>
<tr>
<td>Collector-emitter cut-off incl diode</td>
<td>$I_{CES}$</td>
<td>$I=25ºC$</td>
<td>600</td>
<td>mA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$I=150ºC$</td>
<td>0.96</td>
<td>mA</td>
</tr>
<tr>
<td>Gate-emitter leakage incl diode</td>
<td>$I_{CES}$</td>
<td>$I=25ºC$</td>
<td>20</td>
<td>nA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$I=150ºC$</td>
<td>700</td>
<td>nA</td>
</tr>
<tr>
<td>Integrated Gate resistor</td>
<td>$R_{int}$</td>
<td></td>
<td>1</td>
<td>Ω</td>
</tr>
<tr>
<td>Turn-on delay time</td>
<td>$t_{on}$</td>
<td></td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td></td>
<td>Rise time</td>
<td>$t_{r}$</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td></td>
<td>Turn-off delay time</td>
<td>$t_{off}$</td>
<td>$R_{goff}=4 \Omega$</td>
<td>0.0032</td>
</tr>
<tr>
<td>Fall time</td>
<td>$t_{f}$</td>
<td></td>
<td>15</td>
<td>ns</td>
</tr>
<tr>
<td>Turn-on energy loss per pulse</td>
<td>$E_{on}$</td>
<td></td>
<td></td>
<td>mWs</td>
</tr>
<tr>
<td>Turn-off energy loss per pulse</td>
<td>$E_{off}$</td>
<td></td>
<td></td>
<td>mWs</td>
</tr>
<tr>
<td>Input capacitance</td>
<td>$C_{in}$</td>
<td>$f=1MHz$</td>
<td>0</td>
<td>pF</td>
</tr>
<tr>
<td>Output capacitance</td>
<td>$C_{out}$</td>
<td></td>
<td>25</td>
<td>pF</td>
</tr>
<tr>
<td>Reverse transfer capacitance</td>
<td>$C_{rev}$</td>
<td></td>
<td>200</td>
<td>pF</td>
</tr>
<tr>
<td>Gate charge</td>
<td>$Q_{gate}$</td>
<td></td>
<td>15</td>
<td>nC</td>
</tr>
<tr>
<td>Thermal resistance chip to heatsink per chip</td>
<td>$R_{JA}$</td>
<td></td>
<td>480</td>
<td>mW/K</td>
</tr>
<tr>
<td>Thermal resistance chip to case per chip</td>
<td>$R_{JC}$</td>
<td></td>
<td>0.39</td>
<td>mW/K</td>
</tr>
</tbody>
</table>

### Boost Inverse Diode

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diode forward voltage</td>
<td>$V_{F}$</td>
<td></td>
<td>20</td>
<td>V</td>
</tr>
<tr>
<td>Thermal resistance chip to heatsink per chip</td>
<td>$R_{JA}$</td>
<td></td>
<td>0.49</td>
<td>K/W</td>
</tr>
<tr>
<td>Thermal resistance chip to case per chip</td>
<td>$R_{JC}$</td>
<td></td>
<td>0.32</td>
<td>K/W</td>
</tr>
</tbody>
</table>

### Boost Diode

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diode forward voltage</td>
<td>$V_{F}$</td>
<td></td>
<td>20</td>
<td>V</td>
</tr>
<tr>
<td>Reverse leakage current</td>
<td>$I_{r}$</td>
<td></td>
<td>1.5</td>
<td>μA</td>
</tr>
<tr>
<td>Peak reverse recovery current</td>
<td>$I_{RR}$</td>
<td></td>
<td>1.66</td>
<td>μA</td>
</tr>
<tr>
<td>Reverse recovery time</td>
<td>$t_{rr}$</td>
<td></td>
<td>1.72</td>
<td>μs</td>
</tr>
<tr>
<td>Reverse recovered charge</td>
<td>$Q_{r}$</td>
<td>$R_{goff}=4 \Omega$</td>
<td>600</td>
<td>nC</td>
</tr>
<tr>
<td>Peak rate of fall of recovery current</td>
<td>$di/dt$</td>
<td></td>
<td>350</td>
<td>nA</td>
</tr>
<tr>
<td>Reverse recovery energy</td>
<td>$E_{rec}$</td>
<td></td>
<td>200</td>
<td>mWs</td>
</tr>
<tr>
<td>Thermal resistance chip to heatsink per chip</td>
<td>$R_{JA}$</td>
<td></td>
<td>0.49</td>
<td>mW/K</td>
</tr>
<tr>
<td>Thermal resistance chip to case per chip</td>
<td>$R_{JC}$</td>
<td></td>
<td>0.32</td>
<td>mW/K</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></td>
<td>22000</td>
<td>Ω</td>
</tr>
<tr>
<td>Deviation of $R_{100}$</td>
<td>$\Delta R/R_{100}$</td>
<td>$R_{100}=1486 \Omega$</td>
<td>-5</td>
<td>%</td>
</tr>
<tr>
<td>Power dissipation</td>
<td>$P$</td>
<td></td>
<td>200</td>
<td>mW</td>
</tr>
<tr>
<td>Power dissipation constant</td>
<td></td>
<td></td>
<td>2</td>
<td>mW/K</td>
</tr>
<tr>
<td>B-value</td>
<td>$B(25/50)$</td>
<td>Tol. ±3%</td>
<td>3950</td>
<td>K</td>
</tr>
<tr>
<td>B-value</td>
<td>$B(25/100)$</td>
<td>Tol. ±3%</td>
<td>3996</td>
<td>K</td>
</tr>
<tr>
<td>Vincotech NTC Reference</td>
<td></td>
<td></td>
<td>B</td>
<td></td>
</tr>
</tbody>
</table>

Copyright by Vincotech
Figure 1
Typical output characteristics
$I_C = f(V_{CE})$

At
$\tau_p = 250 \ \mu s$
$T_j = 25 \ ^\circ C$
$V_{CE}$ from 6 V to 16 V in steps of 1 V

Figure 2
Typical output characteristics
$I_C = f(V_{CE})$

At
$\tau_p = 250 \ \mu s$
$T_j = 125 \ ^\circ C$
$V_{CE}$ from 6 V to 16 V in steps of 1 V

Figure 3
Typical transfer characteristics
$I_C = f(V_{GE})$

Figure 4
Typical diode forward current as a function of forward voltage
$I_F = f(V_F)$

At
$\tau_p = 250 \ \mu s$
$V_{CE} = 10 \ V$

At
$\tau_p = 250 \ \mu s$
$T_j = 25 \ ^\circ C$
$T_j = T_{j_{max}} - 25 \ ^\circ C$
**Typical switching energy losses**

as a function of collector current

\[ E = f(I_C) \]

With an inductive load at

- \( T_j = 25/125 \, ^\circ C \)
- \( V_{CE} = 350 \, V \)
- \( V_{GE} = \pm 15 \, V \)
- \( R_{gon} = 4 \, \Omega \)
- \( R_{goff} = 4 \, \Omega \)

**Typical reverse recovery energy loss**

as a function of collector current

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

With an inductive load at

- \( T_j = 25/125 \, ^\circ C \)
- \( V_{CE} = 350 \, V \)
- \( V_{GE} = \pm 15 \, V \)
- \( I_C = 200 \, A \)

---

Copyright by Vincotech

Revision: 3
Typical switching times as a function of collector current

\[ t = f(I_C) \]

With an inductive load at

- \( T_j = 125 \, ^\circ C \)
- \( V_{CE} = 350 \, V \)
- \( V_{GE} = \pm 15 \, V \)
- \( R_{gon} = 4 \, \Omega \)
- \( R_{goff} = 4 \, \Omega \)

Typical reverse recovery time as a function of collector current

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

At

- \( T_j = 25/125 \, ^\circ C \)
- \( V_{CE} = 350 \, V \)
- \( V_{GE} = \pm 15 \, V \)
- \( R_{gon} = 4 \, \Omega \)
Buck

Figure 13
Typical reverse recovery charge as a function of collector current

\[ Q_{rr} = f(I_C) \]

At
\[ T_J = 25/125 \degree C \]
\[ V_{CE} = 350 \text{ V} \]
\[ V_{GE} = \pm 15 \text{ V} \]
\[ R_{gon} = 4 \text{ } \Omega \]

Figure 14
Typical reverse recovery charge as a function of IGBT turn on gate resistor

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

At
\[ T_J = 25/125 \degree C \]
\[ V_{CE} = 350 \text{ V} \]
\[ I_F = 200 \text{ A} \]
\[ V_{GE} = \pm 15 \text{ V} \]

Figure 15
Typical reverse recovery current as a function of collector current

\[ I_{RRM} = f(I_C) \]

At
\[ T_J = 25/125 \degree C \]
\[ V_{CE} = 350 \text{ V} \]
\[ V_{GE} = \pm 15 \text{ V} \]
\[ R_{gon} = 4 \text{ } \Omega \]

Figure 16
Typical reverse recovery current as a function of IGBT turn on gate resistor

\[ I_{RRM} = f(R_{gon}) \]

At
\[ T_J = 25/125 \degree C \]
\[ V_{CE} = 350 \text{ V} \]
\[ I_F = 200 \text{ A} \]
\[ V_{GE} = \pm 15 \text{ V} \]
**Figure 17**
Typical rate of fall of forward and reverse recovery current as a function of collector current
\[ \frac{dI_0}{dt}, \frac{dI_{rec}}{dt} = f(I_c) \]

At
- \( T_j = 25/125 \) °C
- \( V_{CE} = 350 \) V
- \( V_{GE} = \pm 15 \) V
- \( I_F = 200 \) A
- \( R_{gon} = 4 \) Ω

**Figure 18**
Typical rate of fall of forward and reverse recovery current as a function of IGBT turn on gate resistor
\[ \frac{dI_0}{dt}, \frac{dI_{rec}}{dt} = f(R_{gon}) \]

At
- \( T_j = 25/125 \) °C
- \( V_{CE} = 350 \) V
- \( V_{GE} = \pm 15 \) V
- \( I_F = 200 \) A

**Figure 19**
IGBT transient thermal impedance as a function of pulse width
\[ Z_{thJH} = f(t_p) \]

At
- \( D = \frac{t_p}{T} \)
- \( R_{thJH} = 0.33 \) KW

IGBT thermal model values

<table>
<thead>
<tr>
<th>R (C/W)</th>
<th>( \tau ) (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.05</td>
<td>5.4E+00</td>
</tr>
<tr>
<td>0.08</td>
<td>1.2E+00</td>
</tr>
<tr>
<td>0.07</td>
<td>1.9E-01</td>
</tr>
<tr>
<td>0.10</td>
<td>3.1E-02</td>
</tr>
<tr>
<td>0.02</td>
<td>4.2E-03</td>
</tr>
<tr>
<td>0.02</td>
<td>3.4E-04</td>
</tr>
</tbody>
</table>

**Figure 20**
Diode transient thermal impedance as a function of pulse width
\[ Z_{thJH} = f(t_p) \]

At
- \( D = \frac{t_p}{T} \)
- \( R_{thJH} = 0.67 \) KW

Diode thermal model values

<table>
<thead>
<tr>
<th>R (C/W)</th>
<th>( \tau ) (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.05</td>
<td>6.2E+00</td>
</tr>
<tr>
<td>0.11</td>
<td>1.1E+00</td>
</tr>
<tr>
<td>0.23</td>
<td>1.1E-01</td>
</tr>
<tr>
<td>0.18</td>
<td>2.4E-02</td>
</tr>
<tr>
<td>0.06</td>
<td>2.3E-03</td>
</tr>
<tr>
<td>0.04</td>
<td>2.6E-04</td>
</tr>
</tbody>
</table>
Buck

Figure 21: Power dissipation as a function of heatsink temperature

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

At
\[ T_j = 175 \degree C \]

Figure 22: Collector current as a function of heatsink temperature

\[ I_C = f(T_h) \]

At
\[ T_j = 175 \degree C \]
\[ V_{GE} = 15 \text{ V} \]

Figure 23: Power dissipation as a function of heatsink temperature

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

At
\[ T_j = 175 \degree C \]

Figure 24: Forward current as a function of heatsink temperature

\[ I_F = f(T_h) \]

At
\[ T_j = 175 \degree C \]
Buck

Figure 25
Safe operating area as a function of collector-emitter voltage

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

- At: single pulse
- \( T_h = 80 \) °C
- \( V_{GE} = \pm 15 \) V
- \( T_j = T_{jmax} \) °C

Figure 26
Gate voltage vs Gate charge

\( V_{GE} = f(Q_g) \)

- At: \( I_C = 200 \) A

Copyright by Vincotech
Boost

**Figure 1**  
Typical output characteristics  
$I_C = f(V_{CE})$

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

**Figure 2**  
Typical output characteristics  
$I_C = f(V_{CE})$

At  
$t_p = 250 \ \mu s  
T_j = 125 \ ^\circ C  
V_{CE}$ from 7 V to 17 V in steps of 1 V

**Figure 3**  
Typical transfer characteristics  
$I_C = f(V_{GE})$

At  
$t_p = 250 \ \mu s  
T_j = 25 \ ^\circ C  
V_{CE} = 10 \ V$

**Figure 4**  
Typical diode forward current as a function of forward voltage  
$I_F = f(V_F)$

At  
$t_p = 250 \ \mu s  
T_j = T_{jmax}-25 \ ^\circ C  
V_{CE} = 10 \ V$

Copyright by Vincotech
Typical switching energy losses as a function of collector current
\[ E = f(I_C) \]

With an inductive load at
\[ T_j = 25/125 \, ^\circ C \]
\[ V_{CE} = 350 \, V \]
\[ V_G = \pm 15 \, V \]
\[ R_{gon} = 4 \, \Omega \]
\[ R_{goff} = 4 \, \Omega \]

Typical reverse recovery energy loss as a function of collector current
\[ E_{rec} = f(I_C) \]

With an inductive load at
\[ T_j = 25/125 \, ^\circ C \]
\[ V_{CE} = 350 \, V \]
\[ V_G = \pm 15 \, V \]
\[ R_{gon} = 4 \, \Omega \]
\[ R_{goff} = 4 \, \Omega \]
Figure 9
Typical switching times as a function of collector current
\( t = f(I_C) \)

With an inductive load at
- \( T_J = 125 \degree C \)
- \( V_{CE} = 350 \) V
- \( V_{GE} = \pm 15 \) V
- \( R_{gon} = 4 \) \( \Omega \)
- \( R_{goff} = 4 \) \( \Omega \)

Figure 10
Typical switching times as a function of gate resistor
\( t = f(R_G) \)

With an inductive load at
- \( T_J = 125 \degree C \)
- \( V_{CE} = 350 \) V
- \( V_{GE} = \pm 15 \) V
- \( I_C = 200 \) A

Figure 11
Typical reverse recovery time as a function of collector current
\( t_{rr} = f(I_C) \)

At
- \( T_J = 25/125 \degree C \)
- \( V_{CE} = 350 \) V
- \( V_{GE} = \pm 15 \) V
- \( R_{gon} = 4 \) \( \Omega \)

Figure 12
Typical reverse recovery time as a function of IGBT turn on gate resistor
\( t_{rr} = f(R_{gon}) \)

At
- \( T_J = 25/125 \degree C \)
- \( V_{CE} = 350 \) V
- \( I_C = 200 \) A
- \( V_{GE} = \pm 15 \) V
Boost

**Figure 13**
Typical reverse recovery charge as a function of collector current

\[ Q_{rr} = f(I_C) \]

At

- \( T_J = 25/125 \degree C \)
- \( V_{CE} = 350 \text{ V} \)
- \( V_{GE} = \pm 15 \text{ V} \)
- \( R_{gon} = 4 \Omega \)

**Figure 14**
Typical reverse recovery charge as a function of IGBT turn on gate resistor

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

At

- \( T_J = 25/125 \degree C \)
- \( V_{CE} = 350 \text{ V} \)
- \( I_F = 200 \text{ A} \)
- \( V_{GE} = \pm 15 \text{ V} \)

**Figure 15**
Typical reverse recovery current as a function of collector current

\[ I_{RRM} = f(I_C) \]

At

- \( T_J = 25/125 \degree C \)
- \( V_{CE} = 350 \text{ V} \)
- \( V_{GE} = \pm 15 \text{ V} \)
- \( R_{gon} = 4 \Omega \)

**Figure 16**
Typical reverse recovery current as a function of IGBT turn on gate resistor

\[ I_{RRM} = f(R_{gon}) \]

At

- \( T_J = 25/125 \degree C \)
- \( V_{CE} = 350 \text{ V} \)
- \( I_F = 200 \text{ A} \)
- \( V_{GE} = \pm 15 \text{ V} \)
Figure 17
Typical rate of fall of forward and reverse recovery current as a function of collector current
dI0/dt, dIrec/dt = f(Ic)

At
Tj = 25/125 °C
VCE = 350 V
VGE = ±15 V
IF = 200 A
Rgon = 4 Ω

Figure 18
Typical rate of fall of forward and reverse recovery current as a function of IGBT turn on gate resistor
dI0/dt, dIrec/dt = f(Rgon)

At
Tj = 25/125 °C
VCE = 350 V
VGE = ±15 V
Ip = 200 A

Figure 19
IGBT transient thermal impedance as a function of pulse width
ZthJH = f(tp)

D = tp / T
RthJH = 0.39 KW

IGBT thermal model values
R (C/W) Tau (s)
0.02 1.2E+01
0.10 2.6E+00
0.07 4.8E-01
0.11 5.9E-02
0.05 1.3E-02
0.02 4.9E-04

Figure 20
Diode transient thermal impedance as a function of pulse width
ZthJH = f(tp)

D = tp / T
RthJH = 0.49 KW

Diode thermal model values
R (C/W) Tau (s)
0.04 9.5E+00
0.09 1.8E+00
0.08 2.9E-01
0.18 3.6E-02
0.06 8.5E-03
0.03 4.7E-04
Boost

**Figure 21**
Power dissipation as a function of heatsink temperature

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

![Graph of Power dissipation vs. heatsink temperature](image)

At
\[ T_j = 175 \, ^\circ C \]

**Figure 22**
Collector current as a function of heatsink temperature

\[ I_C = f(T_h) \]

![Graph of Collector current vs. heatsink temperature](image)

At
\[ T_j = 175 \, ^\circ C \]

**Figure 23**
Power dissipation as a function of heatsink temperature

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

![Graph of Power dissipation vs. heatsink temperature](image)

At
\[ T_j = 175 \, ^\circ C \]

**Figure 24**
Forward current as a function of heatsink temperature

\[ I_F = f(T_h) \]

![Graph of Forward current vs. heatsink temperature](image)

At
\[ T_j = 175 \, ^\circ C \]
**Boost**

**Figure 25**
Typical diode forward current as a function of forward voltage

\[ I_F = f(V_F) \]

**Figure 26**
Diode transient thermal impedance as a function of pulse width

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

At

\[ t_p = 250 \mu s \]

**Figure 27**
Power dissipation as a function of heatsink temperature

\[ P_{tot} = f(T_{th}) \]

At

\[ T_j = 175 ^\circ C \]

**Figure 28**
Forward current as a function of heatsink temperature

\[ I_F = f(T_{th}) \]

At

\[ T_j = 175 ^\circ C \]
Thermistor

Figure 1

Typical NTC characteristic
as a function of temperature

\[ R_T = f(T) \]
Switching Definitions BUCK MOSFET

General conditions

\[ T_j = 125 \, ^\circ C \]
\[ R_{on} = 4 \, \Omega \]
\[ R_{off} = 4 \, \Omega \]

**Figure 1**
Turn-off Switching Waveforms & definition of \( t_{off}, t_{Eoff} \)

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

- \( V_{GE} (0\%) = -15 \, V \)
- \( V_{GE} (100\%) = 15 \, V \)
- \( V_C (100\%) = 350 \, V \)
- \( I_C (100\%) = 200 \, A \)
- \( t_{Eoff} = 0.27 \, \mu s \)
- \( t_{off} = 0.28 \, \mu s \)

**Figure 2**
Turn-on Switching Waveforms & definition of \( t_{on}, t_{Eon} \)

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

- \( V_{GE} (0\%) = -15 \, V \)
- \( V_{GE} (100\%) = 15 \, V \)
- \( V_C (100\%) = 350 \, V \)
- \( I_C (100\%) = 200 \, A \)
- \( t_{Eon} = 0.38 \, \mu s \)
- \( t_{on} = 0.20 \, \mu s \)

**Figure 3**
Turn-off Switching Waveforms & definition of \( t_f \)

- \( V_C (100\%) = 350 \, V \)
- \( I_C (100\%) = 200 \, A \)
- \( t_f = 0.02 \, \mu s \)

**Figure 4**
Turn-on Switching Waveforms & definition of \( t_r \)

- \( V_C (100\%) = 350 \, V \)
- \( I_C (100\%) = 200 \, A \)
- \( t_r = 0.05 \, \mu s \)

Copyright by Vincotech
Switching Definitions BUCK MOSFET

**Figure 5**

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

![Turn-off Switching Waveform](image)

- \( P_{off}(100\%) = 69.97 \) kW
- \( E_{off}(100\%) = 3.38 \) mJ
- \( t_{Eoff} = 0.28 \) \( \mu \)s

**Figure 6**

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

![Turn-on Switching Waveform](image)

- \( P_{on}(100\%) = 69.97 \) kW
- \( E_{on}(100\%) = 3.48 \) mJ
- \( t_{Eon} = 0.38 \) \( \mu \)s

**Figure 7**

**Gate voltage vs Gate charge (measured)**

![Gate Voltage vs Gate Charge](image)

- \( V_{GEoff} = -15 \) V
- \( V_{GEon} = 15 \) V
- \( V_C(100\%) = 350 \) V
- \( I_C(100\%) = 200 \) A
- \( Q_g = 2037.49 \) nC
- \( t_{rr} = 0.11 \) \( \mu \)s

**Figure 8**

**Turn-off Switching Waveforms & definition of \( t_r \)**

![Turn-off Switching Waveform](image)

- \( V_{G}(100\%) = 350 \) V
- \( I_C(100\%) = 200 \) A
- \( I_{RMS}(100\%) = -154 \) A
- \( t_r = 0.11 \) \( \mu \)s
Switching Definitions BUCK MOSFET

Figure 9  Output inverter FWD
Turn-on Switching Waveforms & definition of $t_{Qrr}$
($t_{Qrr}$ = integrating time for $Q_r$)

Figure 10  Output inverter FWD
Turn-on Switching Waveforms & definition of $t_{Erec}$
($t_{Erec}$ = integrating time for $E_{rec}$)

Id (100%) = 200 A

Qr (100%) = 7.28 μC

t_{Qrr} = 0.23 μs

E_{rec} (100%) = 1.54 mJ

t_{Erec} = 0.23 μs

Measurement circuits

Figure 11  BUCK stage switching measurement circuit

Figure 12  BOOST stage switching measurement circuit
Ordering Code and Marking - Outline - Pinout

Outline

<table>
<thead>
<tr>
<th>Pin</th>
<th>Note</th>
<th>X</th>
<th>Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>53</td>
<td>67.65</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>67</td>
<td>44.75</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>57</td>
<td>44.75</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>63</td>
<td>44.75</td>
<td>10.9</td>
</tr>
<tr>
<td>5</td>
<td>54</td>
<td>9.05</td>
<td>8</td>
</tr>
<tr>
<td>6</td>
<td>68</td>
<td>6.05</td>
<td>10.9</td>
</tr>
<tr>
<td>7</td>
<td>58</td>
<td>6.05</td>
<td>0</td>
</tr>
<tr>
<td>8</td>
<td>64</td>
<td>6.05</td>
<td>12</td>
</tr>
<tr>
<td>9</td>
<td>DE-</td>
<td>2.7</td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>DE-</td>
<td>1.7</td>
<td>2.7</td>
</tr>
<tr>
<td>11</td>
<td>DE-</td>
<td>0</td>
<td>1.7</td>
</tr>
<tr>
<td>12</td>
<td>DE+</td>
<td>0</td>
<td>1.7</td>
</tr>
<tr>
<td>13</td>
<td>DE+</td>
<td>1.7</td>
<td>5.4</td>
</tr>
<tr>
<td>14</td>
<td>DE+</td>
<td>0</td>
<td>0.4</td>
</tr>
<tr>
<td>15</td>
<td>DE-</td>
<td>0</td>
<td>0.4</td>
</tr>
<tr>
<td>16</td>
<td>DE-</td>
<td>0</td>
<td>0.4</td>
</tr>
<tr>
<td>17</td>
<td>GND</td>
<td>8.3</td>
<td>4.1</td>
</tr>
<tr>
<td>18</td>
<td>GND</td>
<td>4.1</td>
<td>4.1</td>
</tr>
<tr>
<td>19</td>
<td>GND</td>
<td>19.16</td>
<td>4.3</td>
</tr>
<tr>
<td>20</td>
<td>GND</td>
<td>20.7</td>
<td>4.4</td>
</tr>
<tr>
<td>21</td>
<td>GND</td>
<td>20.7</td>
<td>4.5</td>
</tr>
<tr>
<td>22</td>
<td>GND</td>
<td>20.7</td>
<td>0.4</td>
</tr>
<tr>
<td>23</td>
<td>GND</td>
<td>20.7</td>
<td>0.4</td>
</tr>
<tr>
<td>24</td>
<td>GND</td>
<td>0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

Pinout

Copyright by Vincotech

Revision: 3
PRODUCT STATUS DEFINITIONS

<table>
<thead>
<tr>
<th>Datasheet Status</th>
<th>Product Status</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target</td>
<td>Formative or In Design</td>
<td>This datasheet contains the design specifications for product development. Specifications may change in any manner without notice. The data contained is exclusively intended for technically trained staff.</td>
</tr>
<tr>
<td>Preliminary</td>
<td>First Production</td>
<td>This datasheet contains preliminary data, and supplementary data may be published at a later date. Vincotech reserves the right to make changes at any time without notice in order to improve design. The data contained is exclusively intended for technically trained staff.</td>
</tr>
<tr>
<td>Final</td>
<td>Full Production</td>
<td>This datasheet contains final specifications. Vincotech reserves the right to make changes at any time without notice in order to improve design. The data contained is exclusively intended for technically trained staff.</td>
</tr>
</tbody>
</table>

DISCLAIMER

The information given in this datasheet describes the type of component and does not represent assured characteristics. For tested values please contact Vincotech. Vincotech reserves the right to make changes without further notice to any products herein to improve reliability, function or design. Vincotech does not assume any liability arising out of the application or use of any product or circuit described herein; neither does it convey any license under its patent rights, nor the rights of others.

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.