Vincotech

flow 3xNPC 1

Features
- Neutral-point-Clamped inverter
- Ultra fast switching
- Low Inductance layout
- Very compact design
- Press-fit pins

Target Applications
- Solar inverters
- UPS
- SMPS

Types
- 10-PY07N3A030SM-M894F08Y

Maximum Ratings

$T_j=25^\circ C$, 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>Buck IGBT</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collector-emitter break down voltage</td>
<td>$V_{CES}$</td>
<td></td>
<td>650</td>
<td>V</td>
</tr>
<tr>
<td>DC collector current</td>
<td>$I_C$</td>
<td>$T_j=T_{j\text{max}}$</td>
<td>32</td>
<td>A</td>
</tr>
<tr>
<td>Pulsed collector current</td>
<td>$I_{CRM}$</td>
<td>$t_p$ limited by $T_{j\text{max}}$</td>
<td>90</td>
<td>A</td>
</tr>
<tr>
<td>Turn off safe operating area</td>
<td></td>
<td>$T_j\leq175^\circ C$</td>
<td>90</td>
<td>A</td>
</tr>
<tr>
<td>Power dissipation</td>
<td>$P_{tot}$</td>
<td>$T_j=T_{j\text{max}}$</td>
<td>67</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>Maximum Junction Temperature</td>
<td>$T_{j\text{max}}$</td>
<td></td>
<td>175</td>
<td>°C</td>
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<tr>
<td><strong>Buck FWD</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peak Repetitive Reverse Voltage</td>
<td>$V_{RSM}$</td>
<td></td>
<td>600</td>
<td>V</td>
</tr>
<tr>
<td>Forward average current</td>
<td>$I_{F\text{avg}}$</td>
<td>$T_j=T_{j\text{max}}$</td>
<td>23</td>
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<tr>
<td>Surge forward current</td>
<td>$I_{F\text{SM}}$</td>
<td>$t_p=10\text{ms}$</td>
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<tr>
<td>Power dissipation</td>
<td>$P_{tot}$</td>
<td>$T_j=T_{j\text{max}}$</td>
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<td>W</td>
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<tr>
<td>Maximum Junction Temperature</td>
<td>$T_{j\text{max}}$</td>
<td></td>
<td>150</td>
<td>°C</td>
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09 Oct. 2014 / Revision 2
### Boost IGBT

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Condition</th>
<th>Value</th>
<th>Unit</th>
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</thead>
<tbody>
<tr>
<td>Collector-emitter break down voltage</td>
<td>$V_{CES}$</td>
<td>$T_j=T_{j\text{max}}$</td>
<td>650</td>
<td>V</td>
</tr>
<tr>
<td>DC collector current</td>
<td>$I_c$</td>
<td>$T_j=T_{j\text{max}}$</td>
<td>30</td>
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<td>Pulsed collector current</td>
<td>$I_{CEM}$</td>
<td>$t_p$ limited by $T_{j\text{max}}$</td>
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<tr>
<td>Turn off safe operating area</td>
<td>$P_{tot}$</td>
<td>$V_{CE}&lt;V_{CES}$ $T_j=150°C$</td>
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<td>Power dissipation</td>
<td>$P_{tot}$</td>
<td>$T_j=T_{j\text{max}}$</td>
<td>57</td>
<td>W</td>
</tr>
<tr>
<td>Gate-emitter peak voltage</td>
<td>$V_{GE}$</td>
<td>$T_j=T_{j\text{max}}$</td>
<td>±20</td>
<td>V</td>
</tr>
<tr>
<td>Short circuit ratings</td>
<td>$t_{SC}$</td>
<td>$T_j=150°C$</td>
<td>5 μs</td>
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<tr>
<td></td>
<td>$V_{GE}$</td>
<td>$V_{CE}=15V$</td>
<td>400</td>
<td>μs</td>
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<tr>
<td>Maximum Junction Temperature</td>
<td>$T_{j\text{max}}$</td>
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### Boost Inverse Diode

<table>
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<td>Peak Repetitive Reverse Voltage</td>
<td>$V_{RED}$</td>
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<td>V</td>
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<tr>
<td>Forward average current</td>
<td>$I_{FAV}$</td>
<td>$T_j=T_{j\text{max}}$</td>
<td>24</td>
<td>A</td>
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<tr>
<td>Repetitive peak forward current</td>
<td>$I_{RSM}$</td>
<td>$t_p$ limited by $T_{j\text{max}}$</td>
<td>40</td>
<td>A</td>
</tr>
<tr>
<td>Power dissipation</td>
<td>$P_{tot}$</td>
<td>$T_j=T_{j\text{max}}$</td>
<td>40</td>
<td>W</td>
</tr>
<tr>
<td>Maximum Junction Temperature</td>
<td>$T_{j\text{max}}$</td>
<td>$T_j=T_{j\text{max}}$</td>
<td>175°C</td>
<td>°C</td>
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### Boost FWD

<table>
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<th>Unit</th>
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<tr>
<td>Peak Repetitive Reverse Voltage</td>
<td>$V_{RED}$</td>
<td>$T_j=T_{j\text{max}}$</td>
<td>650</td>
<td>V</td>
</tr>
<tr>
<td>Forward average current</td>
<td>$I_{FAV}$</td>
<td>$T_j=T_{j\text{max}}$</td>
<td>24</td>
<td>A</td>
</tr>
<tr>
<td>Repetitive peak forward current</td>
<td>$I_{RSM}$</td>
<td>$t_p$ limited by $T_{j\text{max}}$</td>
<td>40</td>
<td>A</td>
</tr>
<tr>
<td>Power dissipation</td>
<td>$P_{tot}$</td>
<td>$T_j=T_{j\text{max}}$</td>
<td>40</td>
<td>W</td>
</tr>
<tr>
<td>Maximum Junction Temperature</td>
<td>$T_{j\text{max}}$</td>
<td>$T_j=T_{j\text{max}}$</td>
<td>175°C</td>
<td>°C</td>
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### Maximum Ratings

\( T_j = 25^\circ C \), unless otherwise specified

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
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<th>Value</th>
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<tr>
<td><strong>Thermal Properties</strong></td>
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<td></td>
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<tr>
<td>Storage temperature</td>
<td>( T_{stg} )</td>
<td></td>
<td>-40...+125</td>
<td>(^\circ C)</td>
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<tr>
<td>Operation temperature under switching condition</td>
<td>( T_{op} )</td>
<td></td>
<td>-40...+(( T_{j\text{max}} ) - 25)</td>
<td>(^\circ C)</td>
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<tr>
<td><strong>Insulation Properties</strong></td>
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<tr>
<td>Insulation voltage</td>
<td>( t=2s )</td>
<td>DC voltage</td>
<td>4000</td>
<td>V</td>
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<tr>
<td>Creepage distance</td>
<td></td>
<td></td>
<td>min 12,7</td>
<td>mm</td>
</tr>
<tr>
<td>Clearance</td>
<td></td>
<td></td>
<td>min 12,7</td>
<td>mm</td>
</tr>
<tr>
<td>Parameter</td>
<td>Symbol</td>
<td>Conditions</td>
<td>Value</td>
<td>Unit</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td>--------</td>
<td>------------</td>
<td>--------</td>
<td>-------</td>
</tr>
<tr>
<td>Collector-emitter saturation voltage</td>
<td>$V_{ces}$</td>
<td>$V_{ces}=V_{ge}$</td>
<td>0,0003</td>
<td>$T_j=25^°C$</td>
</tr>
<tr>
<td>Collector-emitter cut-off current incl. Diode</td>
<td>$I_{ces}$</td>
<td>8</td>
<td>650</td>
<td>$T_j=25^°C$</td>
</tr>
<tr>
<td>Gate-emitter leakage current</td>
<td>$I_{gse}$</td>
<td>20</td>
<td>0</td>
<td>$T_j=125^°C$</td>
</tr>
<tr>
<td>Integrated Gate resistor</td>
<td>$R_{gme}$</td>
<td>none</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turn-on delay time</td>
<td>$t_{d(on)}$</td>
<td>±15</td>
<td>350</td>
<td>30</td>
</tr>
<tr>
<td>Turn-off delay time</td>
<td>$t_{d(off)}$</td>
<td>$R_{goff}=16\ \Omega$</td>
<td>$R_{gon}=16\ \Omega$</td>
<td>200</td>
</tr>
<tr>
<td>Turn-on energy loss</td>
<td>$E_{on}$</td>
<td>1,42</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turn-off energy loss</td>
<td>$E_{off}$</td>
<td>3,4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input capacitance</td>
<td>$C_{in}$</td>
<td>2100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output capacitance</td>
<td>$C_{out}$</td>
<td>45</td>
<td></td>
<td></td>
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<tr>
<td>Reverse transfer capacitance</td>
<td>$C_{rs}$</td>
<td>7,7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gate charge</td>
<td>$Q_g$</td>
<td>±15</td>
<td>520</td>
<td>30</td>
</tr>
<tr>
<td>Thermal resistance chip to heatsink</td>
<td>$R_{th(j-s)}$</td>
<td>Phase-Change Material</td>
<td>$k=3,4\text{W/mK}$</td>
<td></td>
</tr>
</tbody>
</table>

**Buck FWD**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collector-emitter saturation voltage</td>
<td>$V_{ces}$</td>
<td>$V_{ces}=V_{ge}$</td>
<td>0,0003</td>
<td>$T_j=25^°C$</td>
</tr>
<tr>
<td>Collector-emitter cut-off current incl. Diode</td>
<td>$I_{ces}$</td>
<td>8</td>
<td>650</td>
<td>$T_j=25^°C$</td>
</tr>
<tr>
<td>Gate-emitter leakage current</td>
<td>$I_{gse}$</td>
<td>20</td>
<td>0</td>
<td>$T_j=125^°C$</td>
</tr>
<tr>
<td>Integrated Gate resistor</td>
<td>$R_{gme}$</td>
<td>none</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turn-on delay time</td>
<td>$t_{d(on)}$</td>
<td>±15</td>
<td>350</td>
<td>30</td>
</tr>
<tr>
<td>Turn-off delay time</td>
<td>$t_{d(off)}$</td>
<td>$R_{goff}=16\ \Omega$</td>
<td>$R_{gon}=16\ \Omega$</td>
<td>200</td>
</tr>
<tr>
<td>Turn-on energy loss</td>
<td>$E_{on}$</td>
<td>1,42</td>
<td></td>
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<tr>
<td>Turn-off energy loss</td>
<td>$E_{off}$</td>
<td>3,4</td>
<td></td>
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<tr>
<td>Input capacitance</td>
<td>$C_{in}$</td>
<td>2100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output capacitance</td>
<td>$C_{out}$</td>
<td>45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reverse transfer capacitance</td>
<td>$C_{rs}$</td>
<td>7,7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gate charge</td>
<td>$Q_g$</td>
<td>±15</td>
<td>520</td>
<td>30</td>
</tr>
<tr>
<td>Thermal resistance chip to heatsink</td>
<td>$R_{th(j-s)}$</td>
<td>Phase-Change Material</td>
<td>$k=3,4\text{W/mK}$</td>
<td></td>
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</tbody>
</table>

**Buck IGBT**

<table>
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<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gate emitter threshold voltage</td>
<td>$V_{ge}$</td>
<td>$V_{ce}=V_{ge}$</td>
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<td>Collector-emitter saturation voltage</td>
<td>$V_{ces}$</td>
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<td>10</td>
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<tr>
<td>Collector-emitter cut-off current incl. Diode</td>
<td>$I_{ces}$</td>
<td>8</td>
<td>650</td>
<td>$T_j=25^°C$</td>
</tr>
<tr>
<td>Gate-emitter leakage current</td>
<td>$I_{gse}$</td>
<td>20</td>
<td>0</td>
<td>$T_j=125^°C$</td>
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<tr>
<td>Integrated Gate resistor</td>
<td>$R_{gme}$</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Turn-on delay time</td>
<td>$t_{d(on)}$</td>
<td>±15</td>
<td>350</td>
<td>30</td>
</tr>
<tr>
<td>Turn-off delay time</td>
<td>$t_{d(off)}$</td>
<td>$R_{goff}=16\ \Omega$</td>
<td>$R_{gon}=16\ \Omega$</td>
<td>200</td>
</tr>
<tr>
<td>Turn-on energy loss</td>
<td>$E_{on}$</td>
<td>1,42</td>
<td></td>
<td></td>
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<tr>
<td>Turn-off energy loss</td>
<td>$E_{off}$</td>
<td>3,4</td>
<td></td>
<td></td>
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<tr>
<td>Input capacitance</td>
<td>$C_{in}$</td>
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<tr>
<td>Output capacitance</td>
<td>$C_{out}$</td>
<td>45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reverse transfer capacitance</td>
<td>$C_{rs}$</td>
<td>7,7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gate charge</td>
<td>$Q_g$</td>
<td>±15</td>
<td>520</td>
<td>30</td>
</tr>
<tr>
<td>Thermal resistance chip to heatsink</td>
<td>$R_{th(j-s)}$</td>
<td>Phase-Change Material</td>
<td>$k=3,4\text{W/mK}$</td>
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## Characteristic Values

<table>
<thead>
<tr>
<th>Parameter</th>
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<th>Value</th>
<th>Unit</th>
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<tr>
<td><strong>Boost IGBT</strong></td>
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<tr>
<td>Gate emitter threshold voltage</td>
<td>( V_{GE} )</td>
<td>( V_{CE} = V_{GE} )</td>
<td>0,00043</td>
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<td>Collector-emitter saturation voltage</td>
<td>( V_{ces} )</td>
<td>15</td>
<td>30</td>
<td>( T_j = 25°C )</td>
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<tr>
<td>Collector-emitter cut-off incl diode</td>
<td>( t_{oss} )</td>
<td>0</td>
<td>650</td>
<td>( T_j = 125°C )</td>
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<tr>
<td>Gate-emitter leakage current</td>
<td>( I_{oss} )</td>
<td>20</td>
<td>0</td>
<td>( T_j = 25°C )</td>
</tr>
<tr>
<td>Integrated Gate resistor</td>
<td>( R_{gss} )</td>
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<td>Ω</td>
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<td>Turn-on delay time</td>
<td>( t_{on} )</td>
<td>( R_{gss} = 16 , \Omega )</td>
<td>±15</td>
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<td>( t_{r} )</td>
<td>( R_{gss} = 16 , \Omega )</td>
<td>( T_j = 25°C )</td>
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<tr>
<td>Turn-off delay time</td>
<td>( t_{off} )</td>
<td>( R_{goff} = 16 , \Omega )</td>
<td>( T_j = 25°C )</td>
<td>143</td>
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<td>Fall time</td>
<td>( t_{f} )</td>
<td>( R_{goff} = 16 , \Omega )</td>
<td>( T_j = 25°C )</td>
<td>57</td>
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<td>Turn-on energy loss</td>
<td>( E_{on} )</td>
<td>( T_j = 25°C )</td>
<td>0.329</td>
<td>0.665</td>
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<td>( E_{off} )</td>
<td>( T_j = 25°C )</td>
<td>0.729</td>
<td>0.079</td>
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<tr>
<td>Input capacitance</td>
<td>( C_{sc} )</td>
<td>( f = 1 , MHz )</td>
<td>0</td>
<td>25</td>
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<tr>
<td>Output capacitance</td>
<td>( C_{sc} )</td>
<td>f=1MHz</td>
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<td>25</td>
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<td>Reverse transfer capacitance</td>
<td>( C_{rs} )</td>
<td>15</td>
<td>480</td>
<td>30</td>
</tr>
<tr>
<td>Thermal resistance chip to heatsink</td>
<td>( R_{th(j-s)} )</td>
<td>Phase-Change Material ( k = 3.4 , \text{W/mK} )</td>
<td>1.67</td>
<td></td>
</tr>
<tr>
<td><strong>Boost Inverse Diode</strong></td>
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</tr>
<tr>
<td>Diode forward voltage</td>
<td>( V_F )</td>
<td>20</td>
<td>( T_j = 25°C )</td>
<td>1.23</td>
</tr>
<tr>
<td>Thermal resistance chip to heatsink</td>
<td>( R_{th(j-s)} )</td>
<td>Phase-Change Material ( k = 3.4 , \text{W/mK} )</td>
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<td><strong>Boost FWD</strong></td>
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</tr>
<tr>
<td>Diode forward voltage</td>
<td>( V_F )</td>
<td>30</td>
<td>( T_j = 25°C )</td>
<td>1.23</td>
</tr>
<tr>
<td>Reverse leakage current</td>
<td>( I_r )</td>
<td>650</td>
<td>( T_j = 25°C )</td>
<td>0.24</td>
</tr>
<tr>
<td>Peak reverse recovery current</td>
<td>( I_{rrm} )</td>
<td>( R_{goff} = 16 , \Omega )</td>
<td>±15</td>
<td>350</td>
</tr>
<tr>
<td>Reverse recovery time</td>
<td>( t_{rr} )</td>
<td>( R_{goff} = 16 , \Omega )</td>
<td>( T_j = 25°C )</td>
<td>231</td>
</tr>
<tr>
<td>Reverse recovered charge</td>
<td>( Q_{rr} )</td>
<td>( R_{goff} = 16 , \Omega )</td>
<td>( T_j = 25°C )</td>
<td>1.20</td>
</tr>
<tr>
<td>Peak rate of fall of recovery current</td>
<td>( (\frac{di}{dt})_{max} )</td>
<td>( R_{goff} = 16 , \Omega )</td>
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<td>Reverse recovery energy</td>
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<td>( T_j = 25°C )</td>
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<td>Thermal resistance chip to heatsink</td>
<td>( R_{th(j-s)} )</td>
<td>Phase-Change Material ( k = 3.4 , \text{W/mK} )</td>
<td>2.37</td>
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<td>Rated resistance</td>
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<td>( T_j = 25°C )</td>
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<tr>
<td>Deviation of ( R_{100} )</td>
<td>( \Delta R )</td>
<td>( R_{100} = 1486 , \Omega )</td>
<td>( T_j = 100°C )</td>
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</table>
**Buck**

### Figure 1: IGBT
**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: IGBT
**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: IGBT
**Typical transfer characteristics**
\[ I_c = f(V_{ge}) \]

- At
  - \( t_p = 250 \, \mu s \)
  - \( T_j = 25\, ^\circ C \)

### Figure 4: FWD
**Typical diode forward current as a function of forward voltage**
\[ I_f = f(V_f) \]

- At
  - \( t_p = 250 \, \mu s \)

---

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

\[ E = f(I_C) \]

With an inductive load at

- \( T_J = 25/125 \, ^{\circ}\text{C} \)
- \( V_{CE} = 350 \, \text{V} \)
- \( V_{GE} = \pm 15 \, \text{V} \)
- \( R_{gon} = 16 \, \Omega \)
- \( I_C = 30 \, \text{A} \)

Typical reverse recovery energy loss as a function of collector current

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

With an inductive load at

- \( T_J = 25/125 \, ^{\circ}\text{C} \)
- \( V_{CE} = 350 \, \text{V} \)
- \( V_{GE} = \pm 15 \, \text{V} \)
- \( R_{gon} = 16 \, \Omega \)

Typical switching energy losses as a function of gate resistor

\[ E = f(R_G) \]

With an inductive load at

- \( T_J = 25/125 \, ^{\circ}\text{C} \)
- \( V_{CE} = 350 \, \text{V} \)
- \( V_{GE} = \pm 15 \, \text{V} \)
- \( I_C = 30 \, \text{A} \)

Typical reverse recovery energy loss as a function of gate resistor

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

With an inductive load at

- \( T_J = 25/125 \, ^{\circ}\text{C} \)
- \( V_{CE} = 350 \, \text{V} \)
- \( V_{GE} = \pm 15 \, \text{V} \)
- \( I_C = 30 \, \text{A} \)
Typical switching times as a function of collector current
\[ t = f(I_C) \]

With an inductive load at
\[ T_j = 125 \, ^\circ\text{C}, \quad V_{CE} = 350 \, \text{V}, \quad V_{GE} = \pm 15 \, \text{V}, \quad I_C = 30 \, \text{A}, \quad R_{gon} = 16 \, \Omega, \quad R_{goff} = 16 \, \Omega. \]

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

At
\[ T_j = 25/125 \, ^\circ\text{C}, \quad V_{CE} = 350 \, \text{V}, \quad V_{GE} = \pm 15 \, \text{V}, \quad R_{gon} = 16 \, \Omega. \]
Typical reverse recovery charge as a function of collector current

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

At

\[ T_j = 25/125 \degree C \]
\[ V_{CE} = 350 \text{ V} \]
\[ V_{GE} = \pm 15 \text{ V} \]
\[ R_{gon} = 16 \text{ } \Omega \]

Typical reverse recovery current as a function of collector current

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

At

\[ T_j = 25/125 \degree C \]
\[ V_{CE} = 350 \text{ V} \]
\[ V_{GE} = \pm 15 \text{ V} \]
\[ I_F = 30 \text{ A} \]
\[ V_{GE} = \pm 15 \text{ V} \]
Typical rate of fall of forward and reverse recovery current as a function of collector current
\[ \frac{dI}{dt}, \frac{dI_{rec}}{dt} = f(I_c) \]

At
- \( T_j = 25/125 \) °C
- \( V_{CE} = 350 \) V
- \( I_F = 30 \) A
- \( R_{gon} = 16 \) Ω

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

At
- \( D = t_p / T \)
- \( R_{thJH} = 1,42 \) K/W

IGBT thermal model values

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<th>( R ) (K/W)</th>
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FWD transient thermal impedance as a function of pulse width
\[ Z_{thJH} = f(t_p) \]

At
- \( D = t_p / T \)
- \( R_{thJH} = 1,76 \) K/W

FWD thermal model values

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<td>0,12</td>
<td>1,6E-03</td>
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</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
$T_j = 175 \ \degree C$
$V_{\text{GE}} = 15 \ \text{V}$

Figure 23
Power dissipation as a function of heatsink temperature
$P_{\text{tot}} = f(T_h)$

At
$T_j = 150 \ \degree C$

Figure 24
Forward current as a function of heatsink temperature
$I_F = f(T_h)$

At
$T_j = 150 \ \degree C$
**Figure 25**
Safe operating area as a function of collector-emitter voltage

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

- \( D = \) single pulse
- \( T_j = 80 \) °C
- \( V_{Ge} = \pm 15 \) V
- \( T_j = T_{Jmax} \) °C

**Figure 26**
Gate voltage vs Gate charge

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

At
\[ I_C = 30 \] A

**Figure 27**
Reverse bias safe operating area

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

At
- \( T_j = 125 \) °C
- \( R_{GSS} = 16 \) Ω
- \( R_{GTT} = 16 \) Ω
Figure 1
Typical output characteristics
$I_C = f(V_{CE})$

At $t_p = 250$ µs
$T_J = 25$ °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 $t_p = 250$ µs
$T_J = 125$ °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 $t_p = 250$ µs
$T_J = 25$ °C
$V_{CE} = 10$ V

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

At $t_p = 250$ µs
Typical switching energy losses as a function of collector current

\[ E = f(I_C) \]

With an inductive load at

- \( T_J = 25/125 \text{ °C} \)
- \( V_{CE} = 350 \text{ V} \)
- \( V_{GE} = \pm 15 \text{ V} \)
- \( R_{gon} = 16 \Omega \)
- \( I_C = 30 \text{ A} \)

Typical reverse recovery energy loss as a function of collector current

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

With an inductive load at

- \( T_J = 25/125 \text{ °C} \)
- \( V_{CE} = 350 \text{ V} \)
- \( V_{GE} = \pm 15 \text{ V} \)
- \( R_{gon} = 16 \Omega \)
Typical switching times as a function of collector current
\[ t = f(I_C) \]

With an inductive load at:
- \( T_j = 125 \, ^\circ\text{C} \)
- \( V_{CE} = 350 \, \text{V} \)
- \( V_{GS} = \pm 15 \, \text{V} \)
- \( R_{gon} = 16 \, \Omega \)
- \( I_C = 30 \, \text{A} \)

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

At:
- \( T_j = 25/125 \, ^\circ\text{C} \)
- \( V_{CE} = 350 \, \text{V} \)
- \( V_{GS} = \pm 15 \, \text{V} \)
- \( R_{gon} = 16 \, \Omega \)
Figure 13
Typical reverse recovery charge as a function of collector current
\[ Q_{rr} = f(I_C) \]

At
\[ T_j = 25/125 \, ^\circ C \]
\[ V_{CE} = 350 \, V \]
\[ V_{GE} = \pm 15 \, V \]
\[ R_{gon} = 16 \, \Omega \]

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

At
\[ T_j = 25/125 \, ^\circ C \]
\[ V_R = 350 \, V \]
\[ I_T = 30 \, A \]
\[ V_{GE} = \pm 15 \, V \]

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

At
\[ T_j = 25/125 \, ^\circ C \]
\[ V_{CE} = 350 \, V \]
\[ V_{GE} = \pm 15 \, V \]
\[ I_F = 30 \, A \]
\[ R_{gon} = 16 \, \Omega \]

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

At
\[ T_j = 25/125 \, ^\circ C \]
\[ V_R = 350 \, V \]
\[ I_T = 30 \, A \]
\[ V_{GE} = \pm 15 \, V \]
Figure 17
Typical rate of fall of forward and reverse recovery current as a function of collector current
\[ \frac{d}{dt} I_0 \, dt / \frac{d}{dt} I_{rec} \, dt = f(I_{cc}) \]

At
- \( T_j = 25/125 \) °C
- \( V_{CE} = 350 \) V
- \( V_{GE} = \pm 15 \) V
- \( I_F = 30 \) A
- \( R_{gon} = 16 \) Ω

Figure 18
Typical rate of fall of forward and reverse recovery current as a function of IGBT turn on gate resistor
\[ \frac{d}{dt} I_0 \, dt / \frac{d}{dt} I_{rec} \, dt = f(R_{gon}) \]

At
- \( T_j = 25/125 \) °C
- \( V_{CE} = 350 \) V
- \( I_F = 30 \) A
- \( V_{GE} = \pm 15 \) V

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

At
- \( D = \frac{t_n}{T} \)
- \( R_{shj} = 1,67 \) K/W

IGBT thermal model values

\[ R \ (K/W) \quad \text{Tau (s)} \]
\[ 0,18 \quad 1,056 \]
\[ 0,37 \quad 0,172 \]
\[ 0,64 \quad 0,055 \]
\[ 0,32 \quad 0,013 \]
\[ 0,15 \quad 0,0030 \]

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

At
- \( D = \frac{t_n}{T} \)
- \( R_{shj} = 2,37 \) K/W

FWD thermal model values

\[ R \ (K/W) \quad \text{Tau (s)} \]
\[ 0,05 \quad 8,9E+00 \]
\[ 0,14 \quad 1,1E+00 \]
\[ 0,69 \quad 2,0E-01 \]
\[ 0,57 \quad 6,4E-02 \]
\[ 0,62 \quad 9,9E-03 \]
\[ 0,30 \quad 1,0E-03 \]
**Boost**

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

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

At
\[ T_j = 175 \, ^\circ\text{C} \]

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

\[ I_C = f(T_h) \]

At
\[ T_j = 175 \, ^\circ\text{C} \]

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

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

At
\[ T_j = 175 \, ^\circ\text{C} \]

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

\[ I_F = f(T_h) \]

At
\[ T_j = 175 \, ^\circ\text{C} \]

Vincotech datasheet

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09 Oct. 2014 / Revision 2
**Boost Inverse Diode**

**Figure 25**

Typical diode forward current as a function of forward voltage

\[ I_F = f(V_F) \]

At

\[ t_p = 250 \, \mu s \]

**Figure 26**

Diode transient thermal impedance as a function of pulse width

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

At

\[ D = \frac{t_p}{T} \]

\[ R_{thJH} = 2.37 \, K/W \]

**Figure 27**

Power dissipation as a function of heatsink temperature

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

At

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

**Figure 28**

Forward current as a function of heatsink temperature

\[ I_F = f(T_h) \]

At

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

**Figure 1**

Typical NTC characteristic as a function of temperature

$R(T) = f(T)$
Switching Definitions BOOST

General conditions

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<th>Parameter</th>
<th>Value</th>
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<tbody>
<tr>
<td>$T_i$</td>
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<td>$R_{on}$</td>
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<tr>
<td>$R_{off}$</td>
<td>16 Ω</td>
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</table>

**Figure 1**
Turn-off Switching Waveforms & definition of $t_{doff}$, $t_{Eoff}$

- $V_{CE}$ (0%) = -15 V
- $V_{CE}$ (100%) = 15 V
- $I_C$ (100%) = 30 A
- $t_{doff}$ = 0.16 µs
- $t_{Eoff}$ = 0.37 µs

**Figure 2**
Turn-on Switching Waveforms & definition of $t_{don}$, $t_{Eon}$

- $V_{CE}$ (0%) = -15 V
- $V_{CE}$ (100%) = 15 V
- $I_C$ (100%) = 30 A
- $t_{don}$ = 0.100 µs
- $t_{Eon}$ = 0.24 µs

**Figure 3**
Turn-off Switching Waveforms & definition of $t_f$

- $V_C$ (100%) = 350 V
- $I_C$ (100%) = 30 A
- $t_f$ = 0.09 µs

**Figure 4**
Turn-on Switching Waveforms & definition of $t_r$

- $V_C$ (100%) = 350 V
- $I_C$ (100%) = 30 A
- $t_r$ = 0.026 µs
Switching Definitions BOOST

### Figure 5
**Boost IGBT**
#### Turn-off Switching Waveforms & definition of $t_{Eoff}$

- $P_{off} (100\%) = 10,54 \text{ kW}$
- $E_{off} (100\%) = 0,98 \text{ mJ}$
- $t_{Eoff} = 0,37 \mu\text{s}$

### Figure 6
**Boost IGBT**
#### Turn-on Switching Waveforms & definition of $t_{Eon}$

- $P_{on} (100\%) = 10,54 \text{ kW}$
- $E_{on} (100\%) = 0,67 \text{ mJ}$
- $t_{Eon} = 0,24 \mu\text{s}$

### Figure 7
**Boost IGBT**
#### Turn-off Switching Waveforms & definition of $t_{rr}$

- $V_{d} (100\%) = 350 \text{ V}$
- $I_{d} (100\%) = 30 \text{ A}$
- $I_{DSS} (100\%) = -21 \text{ A}$
- $t_{rr} = 0,30 \mu\text{s}$
Switching Definitions BOOST

Figure 8  
Turn-on Switching Waveforms & definition of $t_{Qrr}$  
($t_{Qrr}$ = integrating time for $Q_{rr}$)

| $I_d$ (100%) | 30 A |
| $Q_{rr}$ (100%) | 2.22 μC |
| $t_{Qrr}$ | 0.59 μs |

Figure 9  
Turn-on Switching Waveforms & definition of $t_{Erec}$  
($t_{Erec}$ = integrating time for $E_{rec}$)

| $P_{rec}$ (100%) | 10.54 kW |
| $E_{rec}$ (100%) | 0.61 mJ |
| $t_{Erec}$ | 0.59 μs |

Measurement circuit

Figure 10  
BOOST stage switching measurement circuit
Switching Definitions BUCK

**General conditions**

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<tr>
<td>$R_{off}$</td>
<td>16 Ω</td>
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</table>

**Figure 1**

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

($t_{Eoff}$ = integrating time for $E_{off}$)

- $V_{CE} (0\%) = -15$ V
- $V_{CE} (100\%) = 15$ V
- $I_C (100\%) = 30$ A
- $t_{doff} = 0.08$ µs
- $t_{Eoff} = 0.10$ µs

**Figure 2**

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

($t_{Eon}$ = integrating time for $E_{on}$)

- $V_{CE} (0\%) = -15$ V
- $V_{CE} (100\%) = 15$ V
- $I_C (100\%) = 30$ A
- $t_{don} = 0.07$ µs
- $t_{Eon} = 0.18$ µs

**Figure 3**

Turn-off Switching Waveforms & definition of $t_f$

- $V_C (100\%) = 350$ V
- $I_C (100\%) = 30$ A
- $t_f = 0.01$ µs

**Figure 4**

Turn-on Switching Waveforms & definition of $t_r$

- $V_C (100\%) = 350$ V
- $I_C (100\%) = 30$ A
- $t_r = 0.01$ µs
Switching Definitions BUCK

**Figure 5**
Turn-off Switching Waveforms & definition of $t_{Eoff}$

- $P_{off} (100\%) = 10.53$ kW
- $E_{off} (100\%) = 0.22$ mJ
- $t_{Eoff} = 0.10$ µs

**Figure 6**
Turn-on Switching Waveforms & definition of $t_{Eon}$

- $P_{on} (100\%) = 10.53$ kW
- $E_{on} (100\%) = 0.49$ mJ
- $t_{Eon} = 0.18$ µs

**Figure 7**
Turn-off Switching Waveforms & definition of $t_{rr}$

- $V_d (100\%) = 350$ V
- $I_d (100\%) = 30$ A
- $I_{RRM} (100\%) = -45$ A
- $t_{rr} = 0.03$ µs
Switching Definitions BUCK

Figure 8  
BUCK FWD  
Turn-on Switching Waveforms & definition of $t_{Qrr}$  
($t_{Qrr} = \text{integrating time for } Q_{rr}$)

![Waveforms Graph](image)

$I_d (100\%) = 30 \text{ A}$  
$Q_{rr} (100\%) = 0,93 \text{ µC}$  
$t_{Qrr} = 0,07 \text{ µs}$

Figure 9  
BUCK FWD  
Turn-on Switching Waveforms & definition of $t_{Erec}$  
($t_{Erec} = \text{integrating time for } E_{rec}$)

![Waveforms Graph](image)

$P_{rec} (100\%) = 10,53 \text{ kW}$  
$E_{rec} (100\%) = 0,11 \text{ mJ}$  
$t_{Erec} = 0,07 \text{ µs}$

Measurement circuit

Figure 10  
BUCK stage switching measurement circuit

![Circuit Diagram](image)
### Ordering Code and Marking - Outline - Pinout

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### Pinout

![Pinout Diagram](image_url)
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