**Features**

- Neutral-point-Clamped inverter
- Compact flow 1 housing
- Low Inductance Layout

**Target Applications**

- UPS
- Motor Drive
- Solar inverters

**Types**

- 10-F106NIA100SA-M135F
- 10-P106NIA100SA-M135FY
- 10-FY06NIA100SA-M135F08
- 10-PY06NIA100SA-M135F08Y

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### 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>
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<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>$V_{CE}$</td>
<td>$T_j = T_{jmax}$ $T_s = 80^\circ C$  $T_c = 80^\circ C$</td>
<td>600</td>
<td>V</td>
</tr>
<tr>
<td>DC collector current</td>
<td>$I_C$</td>
<td>$T_j = T_{jmax}$ $T_s = 80^\circ C$  $T_c = 80^\circ C$</td>
<td>92</td>
<td>A</td>
</tr>
<tr>
<td>Pulsed collector current</td>
<td>$I_{CEM}$</td>
<td>$I_I$ limited by $T_{jmax}$</td>
<td>300</td>
<td>A</td>
</tr>
<tr>
<td>Power dissipation</td>
<td>$P_{tot}$</td>
<td>$T_j = T_{jmax}$ $T_s = 80^\circ C$  $T_c = 80^\circ C$</td>
<td>159</td>
<td>W</td>
</tr>
<tr>
<td>Gate-emitter peak voltage</td>
<td>$V_{GE}$</td>
<td>$T_s = 80^\circ C$  $T_c = 80^\circ C$</td>
<td>±20</td>
<td>V</td>
</tr>
<tr>
<td>Short circuit ratings</td>
<td>$t_{SC}$</td>
<td>$V_{CE}$ $T_s = 15^\circ C$</td>
<td>6</td>
<td>µs</td>
</tr>
<tr>
<td>Maximum Junction Temperature</td>
<td>$T_{jmax}$</td>
<td>$T_s = 150^\circ C$  $V_{GE} = 15 V$</td>
<td>175</td>
<td>ºC</td>
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<tr>
<td>Turn off safe operating area</td>
<td>$I_I$</td>
<td>$V_{CE}$ $T_s = 150^\circ C$  $V_{GE} = 15 V$</td>
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<td>A</td>
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<tr>
<td><strong>Buck Diode</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Peak Repetitive Reverse Voltage</td>
<td>$V_{RRM}$</td>
<td>$T_j = T_{jmax}$ $T_s = 80^\circ C$  $T_c = 80^\circ C$</td>
<td>600</td>
<td>V</td>
</tr>
<tr>
<td>DC forward current</td>
<td>$I_F$</td>
<td>$T_j = T_{jmax}$ $T_s = 80^\circ C$  $T_c = 80^\circ C$</td>
<td>87</td>
<td>A</td>
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<tr>
<td>Repetitive peak forward current</td>
<td>$I_{FRRM}$</td>
<td>$I_I$ limited by $T_{jmax}$</td>
<td>300</td>
<td>A</td>
</tr>
<tr>
<td>Power dissipation per Diode</td>
<td>$P_{tot}$</td>
<td>$T_j = T_{jmax}$ $T_s = 80^\circ C$  $T_c = 80^\circ C$</td>
<td>74</td>
<td>W</td>
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<tr>
<td>Maximum Junction Temperature</td>
<td>$T_{jmax}$</td>
<td>$T_s = 80^\circ C$  $T_c = 80^\circ C$</td>
<td>175</td>
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**Maximum Ratings**

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

### Boost IGBT

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<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Condition</th>
<th>Value</th>
<th>Unit</th>
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<tr>
<td>Collector-emitter break down voltage</td>
<td>( V_{CE} )</td>
<td>( T_s = T_{PWM}, T_c = 80^\circ C )</td>
<td>600</td>
<td>V</td>
</tr>
<tr>
<td>DC collector current</td>
<td>( I_C )</td>
<td>( T_s = T_{PWM}, T_c = 80^\circ C )</td>
<td>92</td>
<td>A</td>
</tr>
<tr>
<td>Pulsed collector current</td>
<td>( I_{QSM} )</td>
<td>( r_s ) limited by ( T_{PWM} )</td>
<td>300</td>
<td>A</td>
</tr>
<tr>
<td>Power dissipation</td>
<td>( P_{tot} )</td>
<td>( T_s = T_{PWM}, T_c = 80^\circ C )</td>
<td>159</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_s \leq 150^\circ C )</td>
<td>6</td>
<td>µs</td>
</tr>
<tr>
<td></td>
<td>( V_{CE} )</td>
<td>( V_{CE} \leq V_{CES} )</td>
<td>360</td>
<td>V</td>
</tr>
<tr>
<td>Maximum Junction Temperature</td>
<td>( T_{jmax} )</td>
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<td>°C</td>
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### Boost Sw. Prot. Diode

<table>
<thead>
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<th>Condition</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak Repetitive Reverse Voltage</td>
<td>( V_{ASM} )</td>
<td>( T_s = 80^\circ C )</td>
<td>600</td>
<td>V</td>
</tr>
<tr>
<td>DC forward current</td>
<td>( I_F )</td>
<td>( T_s = T_{PWM}, T_c = 80^\circ C )</td>
<td>80</td>
<td>A</td>
</tr>
<tr>
<td>Repetitive peak forward current</td>
<td>( I_{FRM} )</td>
<td>( r_s ) limited by ( T_{PWM} )</td>
<td>200</td>
<td>A</td>
</tr>
<tr>
<td>Power dissipation per Diode</td>
<td>( P_{tot} )</td>
<td>( T_s = T_{PWM}, T_c = 80^\circ C )</td>
<td>119</td>
<td>W</td>
</tr>
<tr>
<td>Maximum Junction Temperature</td>
<td>( T_{jmax} )</td>
<td></td>
<td>175</td>
<td>°C</td>
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### Boost Diode

<table>
<thead>
<tr>
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<th>Symbol</th>
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<tr>
<td>Peak Repetitive Reverse Voltage</td>
<td>( V_{ASM} )</td>
<td>( T_s = 80^\circ C )</td>
<td>600</td>
<td>V</td>
</tr>
<tr>
<td>DC forward current</td>
<td>( I_F )</td>
<td>( T_s = T_{PWM}, T_c = 80^\circ C )</td>
<td>80</td>
<td>A</td>
</tr>
<tr>
<td>Repetitive peak forward current</td>
<td>( I_{FRM} )</td>
<td>( r_s ) limited by ( T_{PWM} )</td>
<td>200</td>
<td>A</td>
</tr>
<tr>
<td>Power dissipation per Diode</td>
<td>( P_{tot} )</td>
<td>( T_s = T_{PWM}, T_c = 80^\circ C )</td>
<td>119</td>
<td>W</td>
</tr>
<tr>
<td>Maximum Junction Temperature</td>
<td>( T_{jmax} )</td>
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<td>°C</td>
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### Thermal Properties

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<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>
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<td>-40...+(( T_{PWM} - 25 ))</td>
<td>°C</td>
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### Isolation Properties

<table>
<thead>
<tr>
<th>Parameter</th>
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<th>Unit</th>
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<tbody>
<tr>
<td>Isolation voltage</td>
<td>( V_i )</td>
<td>( t = 2s )</td>
<td>4000</td>
<td>V</td>
</tr>
<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>17mm housing</td>
<td>min 12,7</td>
<td>mm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>12mm housing solder pins / Press-fit pins</td>
<td>8,07 / 7,86</td>
<td>mm</td>
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</tbody>
</table>
## Characteristic Values

### Buck IGBT

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gate emitter threshold voltage</td>
<td>$V_{GE(th)}$</td>
<td>$T_{J} = T_{C} = 25$</td>
<td>0,0016</td>
<td>V</td>
</tr>
<tr>
<td>Collector-emitter saturation voltage</td>
<td>$V_{CEsat}$</td>
<td>$T_{J} = 150$</td>
<td>1,05</td>
<td>V</td>
</tr>
<tr>
<td>Collector-emitter cut-off current incl. Diode</td>
<td>$I_{oss}$</td>
<td>$T_{J} = 25$</td>
<td>0</td>
<td>µA</td>
</tr>
<tr>
<td>Gate-emitter leakage current</td>
<td>$I_{oss}$</td>
<td>$T_{J} = 25$</td>
<td>0</td>
<td>µA</td>
</tr>
<tr>
<td>Integrated Gate resistor</td>
<td>$R_{gss}$</td>
<td>none</td>
<td>none</td>
<td>Ω</td>
</tr>
<tr>
<td>Turn-on delay time</td>
<td>$t_{f(on)}$</td>
<td>$R_{DS} = 8 , \Omega$</td>
<td>±15</td>
<td>ns</td>
</tr>
<tr>
<td>Turn-off delay time</td>
<td>$t_{f(off)}$</td>
<td>$R_{DS} = 8 , \Omega$</td>
<td>350</td>
<td>ns</td>
</tr>
<tr>
<td>Fall time</td>
<td>$t_{f}$</td>
<td>$R_{DS} = 8 , \Omega$</td>
<td>100</td>
<td>ns</td>
</tr>
<tr>
<td>Turn-on energy loss</td>
<td>$E_{on}$</td>
<td>$R_{DS} = 1 , \Omega$</td>
<td>1,887</td>
<td>mWs</td>
</tr>
<tr>
<td>Turn-off energy loss</td>
<td>$E_{off}$</td>
<td>$R_{DS} = 1 , \Omega$</td>
<td>2,405</td>
<td>mWs</td>
</tr>
<tr>
<td>Input capacitance</td>
<td>$C_{iss}$</td>
<td>$f = 1 , MHz$</td>
<td>25</td>
<td>pF</td>
</tr>
<tr>
<td>Output capacitance</td>
<td>$C_{oss}$</td>
<td>$R_{DS} = 8 , \Omega$</td>
<td>6280</td>
<td>nF</td>
</tr>
<tr>
<td>Gate charge</td>
<td>$Q_{G}$</td>
<td>$R_{DS} = 8 , \Omega$</td>
<td>480</td>
<td>nC</td>
</tr>
<tr>
<td>Thermal resistance chip to heatsink</td>
<td>$R_{th(j-s)}$</td>
<td>$\lambda = 3,4 , W/mK$</td>
<td>0,60</td>
<td>K/W</td>
</tr>
</tbody>
</table>

### 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>$T_{J} = 25$</td>
<td>1,4</td>
<td>V</td>
</tr>
<tr>
<td>Peak reverse recovery current</td>
<td>$I_{RRM}$</td>
<td>$R_{DS} = 8 , \Omega$</td>
<td>100</td>
<td>A</td>
</tr>
<tr>
<td>Reverse recovery time</td>
<td>$t_{r}$</td>
<td>$R_{DS} = 8 , \Omega$</td>
<td>±15</td>
<td>ns</td>
</tr>
<tr>
<td>Reverse recovered charge</td>
<td>$Q_{R}$</td>
<td>$R_{DS} = 8 , \Omega$</td>
<td>150</td>
<td>µC</td>
</tr>
<tr>
<td>Peak rate of fall of recovery current</td>
<td>$E_{off}$</td>
<td>$R_{DS} = 8 , \Omega$</td>
<td>5,072</td>
<td>mWs</td>
</tr>
<tr>
<td>Reverse recovered energy</td>
<td>$E_{on}$</td>
<td>$R_{DS} = 8 , \Omega$</td>
<td>9,357</td>
<td>mWs</td>
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<tr>
<td>Thermal resistance chip to heatsink</td>
<td>$R_{th(j-s)}$</td>
<td>$\lambda = 3,4 , W/mK$</td>
<td>1,01</td>
<td>K/W</td>
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*Note: All characteristic values are related to gates of parallel IGBTs connected together*
<table>
<thead>
<tr>
<th>Parameter</th>
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<th>Value</th>
<th>Unit</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>$V_{CE}$ [V] or $V_{GS}$ [V]</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>$V_{r}$ [V] or $I_{r}$ [A]</td>
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<td>$T_1$ [°C]</td>
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<tr>
<td><strong>Boost IGBT</strong></td>
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<td></td>
</tr>
<tr>
<td>Gate emitter threshold voltage</td>
<td>$V_{GE}$</td>
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<td>0,0016</td>
<td></td>
</tr>
<tr>
<td>Collector-emitter saturation voltage</td>
<td>$V_{CEO}$</td>
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<td>15</td>
<td>100</td>
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<tr>
<td>Collector-emitter cut-off diode</td>
<td>$I_{ces}$</td>
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<td>600</td>
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<tr>
<td>Gate-emitter leakage current</td>
<td>$I_{ges}$</td>
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<td>0</td>
<td>600</td>
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<td>Integrated Gate resistor</td>
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<td>Turn-on delay time</td>
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<td>150</td>
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<td>Rise time</td>
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<tr>
<td>Turn-off delay time</td>
<td>$t_{d(off)}$</td>
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<td>25</td>
<td>150</td>
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<tr>
<td>Fall time</td>
<td>$t_{f}$</td>
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<td>25</td>
<td>150</td>
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<tr>
<td>Turn-on energy loss</td>
<td>$E_{on}$</td>
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<td>25</td>
<td>150</td>
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<tr>
<td>Turn-off energy loss</td>
<td>$E_{off}$</td>
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<td>150</td>
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<td>Input capacitance</td>
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<td>Output capacitance</td>
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<td>Reverse transfer capacitance</td>
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<td>Gate charge</td>
<td>$Q_{gs}$</td>
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<td>480</td>
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<tr>
<td>Thermal resistance chip to heatsink</td>
<td>$R_{th(j-s)}$</td>
<td></td>
<td>phase-change material $\lambda = 3,4$ W/mK</td>
<td>0,60</td>
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<td><strong>Boost Sw. Prot. Diode</strong></td>
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<tr>
<td>Diode forward voltage</td>
<td>$V_{fs}$</td>
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<td>100</td>
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<tr>
<td>Thermal resistance chip to heatsink</td>
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<td>phase-change material $\lambda = 3,4$ W/mK</td>
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<td><strong>Boost Diode</strong></td>
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<td>Diode forward voltage</td>
<td>$V_{fs}$</td>
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<td>100</td>
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<td>Reverse leakage current</td>
<td>$I_{r}$</td>
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<tr>
<td>Peak reverse recovery current</td>
<td>$I_{rrm}$</td>
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<td>±15</td>
<td>350</td>
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<tr>
<td>Reverse recovery time</td>
<td>$t_{r}$</td>
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<td>25</td>
<td>150</td>
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<tr>
<td>Reverse recovered charge</td>
<td>$Q_{r}$</td>
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<td>25</td>
<td>150</td>
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<tr>
<td>Peak rate of fall of recovery current</td>
<td>$(di/dt)_{max}$</td>
<td></td>
<td>25</td>
<td>150</td>
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<tr>
<td>Reverse recovery energy</td>
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<td>25</td>
<td>150</td>
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<tr>
<td>Thermal resistance chip to heatsink</td>
<td>$R_{th(j-s)}$</td>
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<td>phase-change material $\lambda = 3,4$ W/mK</td>
<td>0,80</td>
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<td><strong>Thermistor</strong></td>
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<tr>
<td>Rated resistance</td>
<td>$R$</td>
<td></td>
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<td>Deviation of $R_{th(j-s)}$</td>
<td>$\Delta R$</td>
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<td>Power dissipation</td>
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<td>Power dissipation constant</td>
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<td>B-value</td>
<td>$B_{(25/100)}$</td>
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<td>B-value</td>
<td>$B_{(25/50)}$</td>
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<td>25</td>
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</table>
**Buck**

**Figure 1**

**IGBT**

**Typical output characteristics**

$I_C = f(V_{CE})$

![Graph showing typical output characteristics of an IGBT.](image)

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**

$I_C = f(V_{CE})$

![Graph showing typical output characteristics of an IGBT.](image)

At

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

**Figure 3**

**IGBT**

**Typical transfer characteristics**

$I_C = f(V_{GE})$

![Graph showing typical transfer characteristics of an IGBT.](image)

At

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

**Figure 4**

**FWD**

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

$I_F = f(V_F)$

![Graph showing typical diode forward current characteristics.](image)

At

- $t_p = 250 \ \mu s$
- $T_j = 25 \ ^\circ C$
- $T_j = T_{j\text{max}} - 25 \ ^\circ C$
Typical switching energy losses as a function of collector current

\[ E = f(I_C) \]

With an inductive load at
\( T_J = 25/150 \, ^\circ C \)
\( V_{CE} = 350 \, V \)
\( V_{GE} = \pm 15 \, V \)
\( R_{gon} = 8 \, \Omega \)
\( I_C = 100 \, A \)

Typical reverse recovery energy loss as a function of collector current

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

With an inductive load at
\( T_J = 25/150 \, ^\circ C \)
\( V_{CE} = 350 \, V \)
\( V_{GE} = \pm 15 \, V \)
\( R_{gon} = 8 \, \Omega \)
Typical switching times as a function of collector current
\[ t = f(I_c) \]

With an inductive load at
- \( T_j = 150 \, ^\circ\text{C} \)
- \( V_{CE} = 350 \, \text{V} \)
- \( V_{GE} = \pm 15 \, \text{V} \)
- \( R_{gon} = 8 \, \Omega \)
- \( R_{goff} = 8 \, \Omega \)

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

At
- \( T_j = 25/150 \, ^\circ\text{C} \)
- \( V_{CE} = 350 \, \text{V} \)
- \( V_{GE} = \pm 15 \, \text{V} \)
- \( R_{gon} = 8 \, \Omega \)
**Figure 13**
Typical reverse recovery charge as a function of collector current

\[ Q_{rr} = f(I_{C}) \]

At

- \( T_{j} = 25/150 \) °C
- \( V_{CE} = 350 \) V
- \( V_{GE} = \pm 15 \) V
- \( R_{gon} = 8 \) Ω

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

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

At

- \( T_{j} = 25/150 \) °C
- \( V_{GE} = \pm 15 \) V
- \( I_{F} = 100 \) A
- \( V_{CE} = 350 \) 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

- \( T_{j} = 25/150 \) °C
- \( V_{CE} = 350 \) V
- \( V_{GE} = \pm 15 \) V
- \( I_{F} = 100 \) A
Typical rate of fall of forward and reverse recovery current as a function of collector current

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

At

- \(T_J = 25/150 \, ^\circ\text{C}\)
- \(V_{CE} = 350 \, \text{V}\)
- \(V_{GE} = \pm 15 \, \text{V}\)
- \(R_{\text{gon}} = 8 \, \Omega\)

IGBT transient thermal impedance as a function of pulse width

\[
Z_{\text{th(j-s)}} = f(t_p)
\]

At

- \(D = t_p / T\)
- \(R_{\text{th(j-s)}} = 0.60 \, \text{K/W}\)

IGBT thermal model values

- \(R \, (\text{K/W})\) \(\tau\, (\text{s})\)
- 4,52E-02 \(\frac{4,36E+00}{2,76E-01} \frac{2,00E-01}{1,04E-01} \frac{1,37E-02}{5,77E-02} \frac{2,79E-03}{1,50E-02}\)

FWD transient thermal impedance as a function of pulse width

\[
Z_{\text{th(j-s)}} = f(t_p)
\]

At

- \(D = t_p / T\)
- \(R_{\text{th(j-s)}} = 1.01 \, \text{K/W}\)

FWD thermal model values

- \(R \, (\text{K/W})\) \(\tau\, (\text{s})\)
- 6,88E-02 \(\frac{2,96E+00}{1,71E-01} \frac{9,03E-02}{1,60E-01} \frac{4,84E-03}{3,19E-02}\)
Power dissipation as a function of heatsink temperature

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

**Figure 21**

At

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

Collector current as a function of heatsink temperature

\[ I_C = f(T_s) \]

**Figure 22**

At

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

\[ V_{GE} = 15 \; \text{V} \]

Power dissipation as a Forward current as a function of heatsink temperature

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

**Figure 23**

At

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

Forward current as a function of heatsink temperature

\[ I_F = f(T_s) \]

**Figure 24**

At

\[ T_j = 175 \; ^\circ\text{C} \]
### Figure 25
Safe operating area as a function of collector-emitter voltage

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

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

### Figure 26
Gate voltage vs Gate charge

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

At
- \( I_C = 100 \) A

---

**Buck**

---

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

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

At
$t_p = 250 \ \mu s$
$T_j = 25 \ ^\circ C$
$T_j = T_{j max} - 25 \ ^\circ C$

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

At
$t_p = 250 \ \mu s$

Vincotech
**Figure 5**  
Typical switching energy losses as a function of collector current  
\[ E = f(I_c) \]

![Graph showing typical switching energy losses](image)

With an inductive load at:
- \( T_j = 25/150 \) °C
- \( V_{CE} = 350 \) V
- \( V_{GE} = 15 \) V
- \( R_{gon} = 8 \) Ω
- \( I_C = 101 \) A

**Figure 6**  
Typical switching energy losses as a function of gate resistor  
\[ E = f(R_G) \]

![Graph showing typical switching energy losses](image)

With an inductive load at:
- \( T_j = 25/150 \) °C
- \( V_{CE} = 350 \) V
- \( V_{GE} = 15 \) V
- \( I_C = 101 \) A

**Figure 7**  
Typical reverse recovery energy loss as a function of collector current  
\[ E_{rec} = f(I_c) \]

![Graph showing typical reverse recovery energy loss](image)

With an inductive load at:
- \( T_j = 25/150 \) °C
- \( V_{CE} = 350 \) V
- \( V_{GE} = 15 \) V
- \( R_{gon} = 8 \) Ω

**Figure 8**  
Typical reverse recovery energy loss as a function of gate resistor  
\[ E_{rec} = f(R_G) \]

![Graph showing typical reverse recovery energy loss](image)

With an inductive load at:
- \( T_j = 25/150 \) °C
- \( V_{CE} = 350 \) V
- \( V_{GE} = 15 \) V
- \( I_C = 101 \) A
Typical switching times as a function of collector current

\[ t = f(I_c) \]

With an inductive load at:

- \( T_j = 150 \, ^\circ\text{C} \)
- \( V_{CE} = 350 \, \text{V} \)
- \( V_{GE} = \pm 15 \, \text{V} \)
- \( R_{gon} = 8 \, \Omega \)
- \( I_c = 101 \, \text{A} \)

Typical reverse recovery time as a function of collector current

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

At:

- \( T_j = 25/150 \, ^\circ\text{C} \)
- \( V_{CE} = 350 \, \text{V} \)
- \( V_{GE} = \pm 15 \, \text{V} \)
- \( R_{gon} = 8 \, \Omega \)
- \( I_c = 101 \, \text{A} \)
Figure 13  FWD
Typical reverse recovery charge as a function of collector current
\[ Q_{rr} = f(I_C) \]

At
\[ T_j = 25/150 \, ^\circ\text{C} \]
\[ V_{CE} = 350 \, \text{V} \]
\[ V_{GE} = \pm 15 \, \text{V} \]
\[ R_{gon} = 8 \, \Omega \]

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

At
\[ T_j = 25/150 \, ^\circ\text{C} \]
\[ V_{CE} = 350 \, \text{V} \]
\[ I_f = 101 \, \text{A} \]
\[ V_{GE} = \pm 15 \, \text{V} \]

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

At
\[ T_j = 25/150 \, ^\circ\text{C} \]
\[ V_{CE} = 350 \, \text{V} \]
\[ V_{GE} = \pm 15 \, \text{V} \]
\[ R_{gon} = 8 \, \Omega \]

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

At
\[ T_j = 25/150 \, ^\circ\text{C} \]
\[ V_{CE} = 350 \, \text{V} \]
\[ I_f = 101 \, \text{A} \]
\[ V_{GE} = \pm 15 \, \text{V} \]
**Figure 17**
Typical rate of fall of forward and reverse recovery current as a function of collector current

\[
dI_0/dt, dI_{rec}/dt = f(I_C)
\]

At
- \( T_j = 25/150 \) °C
- \( V_{CE} = 350 \) V
- \( V_{GE} = \pm 15 \) V
- \( R_{gon} = 8 \) Ω

**Figure 18**
Typical rate of fall of forward and reverse recovery current as a function of IGBT turn on gate resistor

\[
dI_0/dt, dI_{rec}/dt = f(R_{gon})
\]

At
- \( T_j = 25/150 \) °C
- \( V_\text{gs} = 350 \) V
- \( I_f = 101 \) A
- \( V_{GE} = \pm 15 \) V

**Figure 19**
IGBT transient thermal impedance as a function of pulse width

\[
Z_{th(j-s)} = f(t_p)
\]

At
- \( D = t_p/T\)
- \( R_{th(j-s)} = 0.6 \) K/W

IGBT thermal model values

\[
R (K/W) \quad \text{Tau (s)}
\]

<table>
<thead>
<tr>
<th>Value</th>
<th>4,52E-02</th>
<th>4,36E+00</th>
<th>1,01E-01</th>
<th>9,48E-01</th>
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<td>1,49E-01</td>
<td>1,67E-01</td>
<td>3,91E-02</td>
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<td>9,01E-03</td>
</tr>
<tr>
<td>( T )</td>
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<td>4,36E-02</td>
<td>1,49E-01</td>
<td>3,15E-01</td>
<td>1,67E-01</td>
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<td>9,01E-03</td>
<td>4,79E-02</td>
<td>1,14E-03</td>
</tr>
</tbody>
</table>

**Figure 20**
FWD transient thermal impedance as a function of pulse width

\[
Z_{th(j-s)} = f(t_p)
\]

At
- \( D = t_p/T\)
- \( R_{th(j-s)} = 0.8 \) K/W

FWD thermal model values

\[
R (K/W) \quad \text{Tau (s)}
\]

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<tr>
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<th>4,82E+00</th>
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<th>1,67E-01</th>
<th>3,91E-02</th>
<th>1,01E-01</th>
<th>9,01E-03</th>
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<td>4,82E+00</td>
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<td>1,49E-01</td>
<td>3,15E-01</td>
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<td>9,01E-03</td>
<td>4,79E-02</td>
<td>1,14E-03</td>
</tr>
</tbody>
</table>
Figure 21  
IGBT

Power dissipation as a function of heatsink temperature

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

At

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

Figure 22  
IGBT

Collector current as a function of heatsink temperature

\[ I_c = f(T_s) \]

At

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

\[ V_{GE} = 15 \, \text{V} \]

Figure 23  
FWD

Power dissipation as a function of heatsink temperature

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

At

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

Figure 24  
FWD

Forward current as a function of heatsink temperature

\[ I_F = f(T_s) \]

At

\[ T_j = 175 \, ^\circ\text{C} \]
**Figure 25** Boost Inverse Diode
Typical diode forward current as a function of forward voltage

\[ I_F = f(V_F) \]

\[ T_0 = T_{j,0} = 25^\circ C \]
\[ T_1 = 25^\circ C \]

At
\[ t_p = 250 \mu s \]

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

\[ Z_{th(j-s)} = f(t_p) \]

**Figure 27** Boost Inverse Diode
Power dissipation as a function of heatsink temperature

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

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

**Figure 28** Boost Inverse Diode
Forward current as a function of heatsink temperature

\[ I_F = f(T_s) \]

At
\[ T_j = 175^\circ C \]
**Figure 1**

Typical NTC characteristic

as a function of temperature

\[ R(T) = f(T) \]

**Figure 2**

Typical NTC resistance values

\[
R(T) = R_{25} \cdot e^{\left(\frac{B_{25}}{100} \left(\frac{1}{T} - \frac{1}{T_{25}}\right)\right)} \quad [\Omega]
\]

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<td>30</td>
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Switching Definitions BUCK

General conditions

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$T_J$</td>
<td>150 °C</td>
</tr>
<tr>
<td>$R_{on}$</td>
<td>8 Ω</td>
</tr>
<tr>
<td>$R_{off}$</td>
<td>8 Ω</td>
</tr>
</tbody>
</table>

Figure 1

IGBT

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

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

$V_{GE}(0\%) = -15$ V  
$V_{GE}(100\%) = 15$ V  
$V_{C}(100\%) = 350$ V  
$I_{C}(100\%) = 100$ A  
$t_{doff} = 0,30$ μs  
$t_{Eoff} = 0,55$ μs

Figure 2

IGBT

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

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

$V_{GE}(0\%) = -15$ V  
$V_{GE}(100\%) = 15$ V  
$V_{C}(100\%) = 350$ V  
$I_{C}(100\%) = 100$ A  
$t_{don} = 0,19$ μs  
$t_{Eon} = 0,39$ μs

Figure 3

IGBT

Turn-off Switching Waveforms & definition of $t_f$

$V_{C}(100\%) = 350$ V  
$I_{C}(100\%) = 100$ A  
$t_f = 0,12$ μs

Figure 4

IGBT

Turn-on Switching Waveforms & definition of $t_r$

$V_{C}(100\%) = 350$ V  
$I_{C}(100\%) = 100$ A  
$t_r = 0,03$ μs
Switching Definitions BUCK

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

- $P_{off}$ (100%) = 34.85 kW
- $E_{off}$ (100%) = 3.81 mJ
- $t_{Eoff} = 0.55 \mu s$

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

- $P_{on}$ (100%) = 34.85 kW
- $E_{on}$ (100%) = 2.41 mJ
- $t_{Eon} = 0.39 \mu s$

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

- $V_d$ (100%) = 350 V
- $I_d$ (100%) = 100 A
- $I_{RRM}$ (100%) = -113 A
- $t_{rr} = 0.16 \mu s$
**Figure 8**
Turn-on Switching Waveforms & definition of $t_{Qrr}$
($t_{Qrr}$ = integrating time for $Q_{rr}$)

$\% I_d (100\%) = 100$ $A$
$\% Q_{rr} (100\%) = 9,36$ $\mu C$
$t_{Qrr} = 0,33$ $\mu s$

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

$P_{rec} (100\%) = 34,85$ $kW$
$E_{rec} (100\%) = 2,24$ $mJ$
$t_{Erec} = 0,33$ $\mu s$

---

**Measurement circuit**

**Figure 10**
BUCK stage switching measurement circuit
Switching Definitions Boost

General conditions

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$T_J$</td>
<td>150 °C</td>
</tr>
<tr>
<td>$R_{on}$</td>
<td>8 Ω</td>
</tr>
<tr>
<td>$R_{off}$</td>
<td>8 Ω</td>
</tr>
</tbody>
</table>

**Figure 1**
Turn-off Switching Waveforms & definition of $t_{doff}$, $t_{Eoff}$
($t_{Eoff}$ = integrating time for $E_{off}$)

- $V_{GE}(0\%) = -15$ V
- $V_{GE}(100\%) = -15$ V
- $V_C(0\%) = 350$ V
- $V_C(100\%) = 350$ V
- $I_C(0\%) = 100$ A
- $I_C(100\%) = 100$ A
- $t_{doff} = 0.30 \, \mu$s
- $t_{Eoff} = 0.57 \, \mu$s

**Figure 2**
Turn-on Switching Waveforms & definition of $t_{don}$, $t_{Eon}$
($t_{Eon}$ = integrating time for $E_{on}$)

- $V_{GE}(0\%) = -15$ V
- $V_{GE}(100\%) = -15$ V
- $V_C(0\%) = 350$ V
- $V_C(100\%) = 350$ V
- $I_C(0\%) = 100$ A
- $I_C(100\%) = 100$ A
- $t_{don} = 0.17 \, \mu$s
- $t_{Eon} = 0.36 \, \mu$s

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

- $V_C(100\%) = 350$ V
- $I_C(100\%) = 100$ A
- $t_f = 0.12 \, \mu$s

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

- $V_C(100\%) = 350$ V
- $I_C(100\%) = 100$ A
- $t_r = 0.03 \, \mu$s
**Figure 5**

**IGBT**

**Turn-off Switching Waveforms & definition of** $t_{\text{Eoff}}$

- $P_{\text{Eoff}}$ (100%) = 35.15 kW
- $E_{\text{Eoff}}$ (100%) = 4.27 mJ
- $t_{\text{Eoff}}$ = 0.57 μs

**Figure 6**

**IGBT**

**Turn-on Switching Waveforms & definition of** $t_{\text{Eon}}$

- $P_{\text{Ein}}$ (100%) = 35.15 kW
- $E_{\text{Ein}}$ (100%) = 2.55 mJ
- $t_{\text{Ein}}$ = 0.36 μs

**Figure 7**

**FWD**

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

- $V_{\text{d}}$ (100%) = 350 V
- $I_{\text{d}}$ (100%) = 100 A
- $I_{\text{d}}$ (100%) = -90 A
- $t_{\text{rr}}$ = 0.29 μs
### Switching Definitions Boost

#### Figure 8

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

- $i_Q$ (100%) = 100 A
- $Q_{\text{rr}}$ (100%) = 9.27 μC
- $t_{\text{Qrr}}$ = 0.57 μs

#### Figure 9

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

- $P_{\text{rec}}$ (100%) = 35.15 kW
- $E_{\text{rec}}$ (100%) = 2.37 mJ
- $t_{\text{Erec}}$ = 0.57 μs

---

### Measurement circuit

**Figure 10**

**BOOST stage switching measurement circuit**
### Ordering Code and Marking - Outline - Pinout

#### Ordering Code & Marking

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<th>Version</th>
<th>Ordering Code</th>
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<td>10-F106NIA100SA-M135F</td>
</tr>
<tr>
<td>with thermal paste 17mm housing, solder pins</td>
<td>10-F106NIA100SA-M135F/3/</td>
</tr>
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#### Pin table [mm]

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**17mm housing**

**12mm housing**

Tolerance of geometric positions ±0.5 mm at the end of pins
Dimension of coordinate axis is only offset without tolerance
### Ordering Code and Marking - Outline - Pinout

#### Pinout

```
Pinout

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<thead>
<tr>
<th>ID</th>
<th>Component</th>
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<td>100 A</td>
<td>Buck Switch</td>
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<td>FWD</td>
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<td>Buck Diode</td>
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<td>600 V</td>
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<td>600 V</td>
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<td>Boost Diode</td>
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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.

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### Package Data

| Package data for flow | 1 packages see vincotech.com website. |

### UL Recognition and File Number

This device is certified according to UL 1557 standard, UL file number E192116. For more information see vincotech.com website.

### Handling Instruction

Handling instructions for flow 1 packages see vincotech.com website.

### Packaging Instruction

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