flowMNPC 0

Features

- Three-level MNPC (T-Type)
- Reactive power capability
- Low inductance layout
- Improved LVRT

Target applications

- Industrial Drives
- Solar Inverters
- UPS

Types

- 10-FZ12NMA080SH04-M260F13
- 10-PZ12NMA080SH04-M260F13Y

Maximum Ratings

$T_j = 25 \, ^\circ\text{C}$, 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>Buck Switch</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collector-emitter voltage</td>
<td>$V_{CES}$</td>
<td></td>
<td>1200</td>
<td>V</td>
</tr>
<tr>
<td>Collector current</td>
<td>$I_C$</td>
<td>$T_j = T_{j\text{max}}$ $T_s = 80 , ^\circ\text{C}$</td>
<td>76</td>
<td>A</td>
</tr>
<tr>
<td>Repetitive peak collector current</td>
<td>$I_{CRM}$</td>
<td>$I_j$ limited by $T_{j\text{max}}$</td>
<td>240</td>
<td>A</td>
</tr>
<tr>
<td>Turn off safe operating area</td>
<td></td>
<td>$T_j \leq 175 , ^\circ\text{C}$, $V_{CC} \leq 1200 , V$</td>
<td>320</td>
<td>A</td>
</tr>
<tr>
<td>Total power dissipation</td>
<td>$P_{tot}$</td>
<td>$T_j = T_{j\text{max}}$ $T_s = 80 , ^\circ\text{C}$</td>
<td>186</td>
<td>W</td>
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<tr>
<td>Gate-emitter voltage</td>
<td>$V_{GES}$</td>
<td></td>
<td>±20</td>
<td>V</td>
</tr>
<tr>
<td>Short circuit ratings</td>
<td>$I_{SC}$</td>
<td>$V_{CC} = 15 , V$ $V_{CC} = 800 , V$ $T_j = 150 , ^\circ\text{C}$</td>
<td>10</td>
<td>µs</td>
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<tr>
<td>Maximum junction temperature</td>
<td>$T_{j\text{max}}$</td>
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<td>175</td>
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### Maximum Ratings

\( T_\text{i} = 25 \degree \text{C}, \) unless otherwise specified

<table>
<thead>
<tr>
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<tbody>
<tr>
<td><strong>Buck Diode</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peak repetitive reverse voltage</td>
<td>( V_{\text{RRM}} )</td>
<td></td>
<td>650</td>
<td>V</td>
</tr>
<tr>
<td>Continuous (direct) forward current</td>
<td>( I_s )</td>
<td>( T_\text{i} = T_{\text{max}} ), ( T_\text{s} = 80 \degree \text{C} )</td>
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<td>Repetitive peak forward current</td>
<td>( I_{\text{FRRM}} )</td>
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<td>( P_{\text{tot}} )</td>
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<td>W</td>
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<tr>
<td>Maximum junction temperature</td>
<td>( T_{\text{max}} )</td>
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<td>175</td>
<td>\degree \text{C}</td>
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<tr>
<td><strong>Boost Switch</strong></td>
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<tr>
<td>Collector-emitter voltage</td>
<td>( V_{\text{CE}} )</td>
<td></td>
<td>650</td>
<td>V</td>
</tr>
<tr>
<td>Collector current</td>
<td>( I_C )</td>
<td>( T_\text{i} = T_{\text{max}} ), ( T_\text{s} = 80 \degree \text{C} )</td>
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<td>Repetitive peak collector current</td>
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<td>Gate-emitter voltage</td>
<td>( V_{\text{GE}} )</td>
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<td>V</td>
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<td>Short circuit ratings</td>
<td>( t_{\text{SC}} )</td>
<td>( V_{\text{CE}} = 15 \text{ V} ), ( V_{\text{cc}} = 360 \text{ V} ), ( T_\text{i} = 150 \degree \text{C} )</td>
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<td>( \mu \text{s} )</td>
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<td>Maximum junction temperature</td>
<td>( T_{\text{max}} )</td>
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<td>175</td>
<td>\degree \text{C}</td>
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<tr>
<td><strong>Boost Diode</strong></td>
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<tr>
<td>Peak repetitive reverse voltage</td>
<td>( V_{\text{RRM}} )</td>
<td></td>
<td>1200</td>
<td>V</td>
</tr>
<tr>
<td>Continuous (direct) forward current</td>
<td>( I_s )</td>
<td>( T_\text{i} = T_{\text{max}} ), ( T_\text{s} = 80 \degree \text{C} )</td>
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</tr>
<tr>
<td>Repetitive peak forward current</td>
<td>( I_{\text{FRRM}} )</td>
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<td>A</td>
</tr>
<tr>
<td>Total power dissipation</td>
<td>( P_{\text{tot}} )</td>
<td>( T_\text{i} = T_{\text{max}} ), ( T_\text{s} = 80 \degree \text{C} )</td>
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<td>W</td>
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<tr>
<td>Maximum junction temperature</td>
<td>( T_{\text{max}} )</td>
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<td>\degree \text{C}</td>
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## Maximum Ratings

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

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Condition</th>
<th>Value</th>
<th>Unit</th>
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<tbody>
<tr>
<td><strong>Module Properties</strong></td>
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<td></td>
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<td></td>
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<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>-40...+125</td>
<td>( ^\circ C )</td>
<td></td>
</tr>
<tr>
<td>Operation temperature under switching condition</td>
<td>( T_{jop} )</td>
<td>-40...(( T_{jmax} - 25 ))</td>
<td>( ^\circ C )</td>
<td></td>
</tr>
<tr>
<td><strong>Isolation Properties</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isolation voltage</td>
<td>( V_{isol} )</td>
<td>DC Test Voltage* ( t_p = 2 , s )</td>
<td>6000</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AC Voltage ( t_p = 1 , \text{min} )</td>
<td>2500</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>Solder pin / Press-fit pin</td>
<td>9,15 / 8,95</td>
<td>mm</td>
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<tr>
<td>Comparative Tracking Index</td>
<td>CTI</td>
<td></td>
<td>&gt; 200</td>
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*100 % tested in production
### Characteristic Values

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Value</th>
<th>Unit</th>
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</thead>
<tbody>
<tr>
<td><strong>Static</strong></td>
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<td></td>
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<tr>
<td>Gate-emitter threshold voltage</td>
<td>( V_{GE} )</td>
<td>( V_{CE} = V_{CE} )</td>
<td>0,003</td>
<td>25</td>
</tr>
<tr>
<td>Collector-emitter saturation voltage</td>
<td>( V_{CE} )</td>
<td>15</td>
<td>80</td>
<td>25</td>
</tr>
<tr>
<td>Collector-emitter cut-off current</td>
<td>( I_{CE} )</td>
<td>0</td>
<td>1200</td>
<td>25</td>
</tr>
<tr>
<td>Gate-emitter leakage current</td>
<td>( I_{GE} )</td>
<td>20</td>
<td>0</td>
<td>25</td>
</tr>
<tr>
<td>Internal gate resistance</td>
<td>( r_{g} )</td>
<td>none</td>
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<td></td>
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<tr>
<td>Input capacitance</td>
<td>( C_{in} )</td>
<td>( f = 1 \text{ Mhz} )</td>
<td>0</td>
<td>25</td>
</tr>
<tr>
<td>Output capacitance</td>
<td>( C_{out} )</td>
<td>( f = 1 \text{ Mhz} )</td>
<td>0</td>
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</tr>
<tr>
<td>Reverse transfer capacitance</td>
<td>( C_{res} )</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gate charge</td>
<td>( Q_{g} )</td>
<td>15</td>
<td>960</td>
<td>80</td>
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<tr>
<td><strong>Thermal</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thermal resistance junction to sink</td>
<td>( R_{th(j-s)} )</td>
<td>( h_{ext} = 3,4 \text{ W/mK (PSX)} )</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Dynamic</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turn-on delay time</td>
<td>( t_{on} )</td>
<td>( R_{on} = 4 \Omega )</td>
<td>±15</td>
<td>350</td>
</tr>
<tr>
<td>Rise time</td>
<td>( t_{r} )</td>
<td>( R_{on} = 4 \Omega )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turn-off delay time</td>
<td>( t_{off} )</td>
<td>( R_{on} = 4 \Omega )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fall time</td>
<td>( t_{f} )</td>
<td>( R_{on} = 4 \Omega )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turn-on energy (per pulse)</td>
<td>( E_{on} )</td>
<td>( Q_{on} = 2,1 \mu\text{C} )</td>
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<td></td>
</tr>
<tr>
<td>Turn-off energy (per pulse)</td>
<td>( E_{off} )</td>
<td>( Q_{on} = 3,8 \mu\text{C} )</td>
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</tbody>
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## Characteristic Values

<table>
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<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forward voltage</td>
<td>$V_G$</td>
<td>75</td>
<td>1.53 1.49</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td>$V_G$</td>
<td>125 150</td>
<td>1.92</td>
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</tr>
<tr>
<td>Reverse leakage current</td>
<td>$I_L$</td>
<td>650</td>
<td>3.8</td>
<td>μA</td>
</tr>
<tr>
<td>Thermal resistance junction to sink</td>
<td>$R_{th(j-s)}$</td>
<td>25</td>
<td>1.34</td>
<td>K/W</td>
</tr>
<tr>
<td>Peak recovery current</td>
<td>$I_{RRM}$</td>
<td>±15 350 50</td>
<td>25 63 73</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>$e_{RRM}$</td>
<td></td>
<td>25 52 92</td>
<td>ns</td>
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<tr>
<td>Recovered charge</td>
<td>$Q_r$</td>
<td>$di/dt = 5245$ A/μs</td>
<td>25 2.06 3.80</td>
<td>μC</td>
</tr>
<tr>
<td></td>
<td>$e_{rec}$</td>
<td>$di/dt = 3680$ A/μs</td>
<td>25 0.473 0.845</td>
<td>mWs</td>
</tr>
<tr>
<td>Reverse recovered energy</td>
<td>$E_{rec}$</td>
<td></td>
<td>25 1198 852</td>
<td>A/μs</td>
</tr>
</tbody>
</table>

### Buck Diode

#### Static

- **Forward voltage** $V_G$: 25 125 150 V
- **Reverse leakage current** $I_L$: 3.8 μA

#### Thermal

- **Thermal resistance junction to sink** $R_{th(j-s)}$ (PSX): 1.34 K/W

#### Dynamic

- **Peak rate of fall of recovery current** $|di/dt|_{max}$: 1198 852 A/μs
## Characteristic Values

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<tr>
<td><strong>Boost Switch</strong></td>
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</tr>
<tr>
<td>Static</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Gate-emitter threshold voltage</td>
<td>$V_{GE(th)}$</td>
<td>$V_{GE} = V_{CE}$</td>
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<tr>
<td>Collector-emitter saturation voltage</td>
<td>$V_{CEsat}$</td>
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<td>75</td>
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<tr>
<td>Collector-emitter cut-off current</td>
<td>$I_{CSS}$</td>
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<td>0</td>
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<tr>
<td>Gate-emitter leakage current</td>
<td>$I_{GES}$</td>
<td></td>
<td>20</td>
<td>0</td>
</tr>
<tr>
<td>Internal gate resistance</td>
<td>$r_g$</td>
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<td></td>
</tr>
<tr>
<td>Input capacitance</td>
<td>$C_{ies}$</td>
<td>$f = 1$ Mhz</td>
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<tr>
<td>Output capacitance</td>
<td>$C_{oes}$</td>
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<tr>
<td>Reverse transfer capacitance</td>
<td>$C_{res}$</td>
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<td>Gate charge</td>
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<tr>
<td>Thermal resistance junction to sink</td>
<td>$R_{th(j-s)}$</td>
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<tr>
<td><strong>Dynamic</strong></td>
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<tr>
<td>Turn-on delay time</td>
<td>$\tau_{on}$</td>
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<tr>
<td>Rise time</td>
<td>$\tau_t$</td>
<td>$R_{gs} = 4$ Ω</td>
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<tr>
<td>Turn-off delay time</td>
<td>$\tau_{off}$</td>
<td>$R_{gs} = 4$ Ω</td>
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<tr>
<td>Fall time</td>
<td>$\tau_f$</td>
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<tr>
<td>Turn-on energy (per pulse)</td>
<td>$E_{on}$</td>
<td>$Q_{on} = 5,3$ μC</td>
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<td>Turn-off energy (per pulse)</td>
<td>$E_{off}$</td>
<td>$Q_{off} = 8,2$ μC</td>
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## Characteristic Values

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<td>$V_\text{GS}$ [V]</td>
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<td>$V_\text{DS}$ [V]</td>
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<td>$V_\text{F}$ [V]</td>
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<td>$I_\text{C}$ [A]</td>
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<td>$I_\text{D}$ [A]</td>
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<td>$I_\text{F}$ [A]</td>
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<tr>
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<tr>
<td>Thermal resistance junction to sink</td>
<td>$R_{\text{th(j-s)}}$</td>
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<td>1,06</td>
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<tr>
<td>Peak recovery current</td>
<td>$I_\text{RRM}$</td>
<td>±15</td>
<td>350</td>
</tr>
<tr>
<td>Reverse recovery time</td>
<td>$t_{\text{rr}}$</td>
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<td>25</td>
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<tr>
<td>Recovered charge</td>
<td>$Q_{\text{rd}}$</td>
<td>$\frac{di}{dt} = 6090$ A/µs</td>
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<tr>
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<td>$E_{\text{rec}}$</td>
<td>$\frac{di}{dt} = 5325$ A/µs</td>
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<td>Peak rate of fall of recovery current</td>
<td>$\left(\frac{di}{dt}\right)_{\text{max}}$</td>
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<td>Thermistor</td>
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<tr>
<td>Rated resistance</td>
<td>$R$</td>
<td>25</td>
<td>22</td>
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<td>Deviation of $R_{\text{100}}$</td>
<td>$\Delta R_{\text{100}}$</td>
<td>$R_{\text{300}} = 1486$ Ω</td>
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<td>Power dissipation</td>
<td>$P$</td>
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</tr>
<tr>
<td>B-value</td>
<td>$R_{\text{25(100)}}$</td>
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<td>Vincotech NTC Reference</td>
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</table>

Copyright Vincotech
Buck Switch Characteristics

**Figure 1.** Typical output characteristics

$I_C = f(V_{CE})$

- $V_{CE} = 15$ V, $T_j$: 25°C
- $V_{CE} = 15$ V, $T_j$: 125°C
- $V_{CE} = 15$ V, $T_j$: 150°C

$V_{GE}$ from 7 V to 17 V in steps of 1 V

$\tau_p = 250$ μs

**Figure 2.** Typical output characteristics

$I_C = f(V_{CE})$

- $V_{CE}$: 15 V, $T_j$: 25°C
- $V_{CE}$: 15 V, $T_j$: 125°C
- $V_{CE}$: 15 V, $T_j$: 150°C

$V_{GE}$ from 7 V to 17 V in steps of 1 V

$\tau_p = 250$ μs

**Figure 3.** Typical transfer characteristics

$I_C = f(V_{GE})$

- $V_{CE} = 10$ V, $T_j$: 25°C
- $V_{CE} = 10$ V, $T_j$: 125°C
- $V_{CE} = 10$ V, $T_j$: 150°C

$V_{GE}$ from 7 V to 17 V in steps of 1 V

$\tau_p = 100$ μs

**Figure 4.** Transient thermal impedance as function of pulse duration

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

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

$R_{th(j-s)} = 0.51$ K/W

**IGBT thermal model values**

<table>
<thead>
<tr>
<th>$R$ (K/W)</th>
<th>$\tau$ (s)</th>
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<tbody>
<tr>
<td>9.51E-02</td>
<td>1,03E+00</td>
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<tr>
<td>1.84E-01</td>
<td>1,62E-01</td>
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<td>3.37E-02</td>
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<tr>
<td>1.79E-02</td>
<td>6,34E-04</td>
</tr>
</tbody>
</table>
**Buck Switch Characteristics**

**Figure 5.** IGBT

Gate voltage vs gate charge

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

- \( Q_G \) (nC)
- \( V_{GE} \) (V)

\( I_C = 80 \) A

**Figure 6.** IGBT

Safe operating area

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

- \( I_C \) (A)
- \( V_{CE} \) (V)

\( D = \) single pulse
\( T_s = 80 \) °C
\( V_{CE} = \) ±15 V
\( T_j = T_{jmax} \)

**Figure 7.** IGBT

Short circuit duration as a function of \( V_{GE} \)

\[ t_{pSC} = f(V_{GE}) \]

- \( t_{pSC} \) (µS)
- \( V_{GE} \) (V)

\( V_{CE} \leq 600 \) V
\( T_j \leq 150 \) °C

**Figure 8.** IGBT

Typical short circuit current as a function of \( V_{GE} \)

\[ I_{SC} = f(V_{GE}) \]

- \( I_{SC} \) (A)
- \( V_{GE} \) (V)

\( V_{CE} \leq 600 \) V
\( T_j \leq 25 \) °C
Buck Diode Characteristics

**Figure 1.** Typical forward characteristics

\[ I_F = f(V_F) \]

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

\[ t_p = 250 \mu s \]

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

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<th>Temperature</th>
<th>( R_{th(j-s)} ) (K/W)</th>
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<td>125°C</td>
<td>5.86E-01</td>
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<td>150°C</td>
<td>3.27E-01</td>
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<table>
<thead>
<tr>
<th>Temperature</th>
<th>( \tau ) (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>25°C</td>
<td>5.84E-02</td>
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<tr>
<td>125°C</td>
<td>1.57E-01</td>
</tr>
<tr>
<td>150°C</td>
<td>1.27E-01</td>
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</tbody>
</table>
Boost Switch Characteristics

**Figure 1.** IGBT
Typical output characteristics

$I_C = f(V_{CE})$

**Figure 2.** IGBT
Typical output characteristics

$I_C = f(V_{CE})$

$t_p = 250\ \mu s$

$V_{CE} = 15\ \text{V}$

$T_j:\ 125\ ^\circ\text{C}$

$150\ ^\circ\text{C}$

$V_{GE} = 15\ \text{V}$

$T_j = 150\ ^\circ\text{C}$

$V_{CE}$ from 7 V to 17 V in steps of 1 V

**Figure 3.** IGBT
Typical transfer characteristics

$I_C = f(V_{GE})$

**Figure 4.** IGBT
Transient thermal impedance as function of pulse duration

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

$t_p = 100\ \mu s$

$V_{CE} = 10\ \text{V}$

$T_j:\ 125\ ^\circ\text{C}$

$150\ ^\circ\text{C}$

$R_{th(j-s)} = 0.94\ \text{K/W}$

IGBT thermal model values

$R\ (\text{K/W})$ $\tau\ (\text{s})$

8,02E-02 $4,50E+00$

1,26E-01 $1,07E+00$

3,43E-01 $1,53E-01$

2,97E-01 $5,33E-02$

6,50E-02 $7,48E-03$

3,26E-02 $5,38E-04$
Boost Switch Characteristics

**figure 5.** IGBT
Gate voltage vs gate charge

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

**figure 6.** IGBT
Safe operating area

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

- \( I_C = 75 \) A
- \( D = \) single pulse
- \( T_s = 80 \) °C
- \( V_{GE} = \pm 15 \) V
- \( T_j = T_{j\text{max}} \) °C

**figure 7.** IGBT
Short circuit duration as a function of \( V_{GE} \)

\[
t_{pSC} = f(V_{GE})
\]

- \( V_{CE} \leq 400 \) V
- \( T_j \leq 150 \) °C

**figure 8.** IGBT
Typical short circuit current as a function of \( V_{GE} \)

\[
I_{SC} = f(V_{GE})
\]

- \( V_{CE} \leq 400 \) V
- \( T_j \leq 150 \) °C
Boost Diode Characteristics

**Figure 1.** FWD

Typical forward characteristics

\[ I_F = f(V_F) \]

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

\( t_p = 250 \text{ µs} \quad 25 \text{ °C} \)

\( 125 \text{ °C} \)

\( 150 \text{ °C} \)

**Figure 2.** FWD

Transient thermal impedance as a function of pulse width

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

\( D = \frac{t_p}{T} \)

\( D = 1,06 \text{ K/W} \)

FWD thermal model values

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

- 4,19E-02 4,68E+00
- 8,50E-02 8,80E-01
- 4,99E-01 1,21E-01
- 2,83E-01 4,12E-02
- 9,28E-02 6,53E-03
- 5,92E-02 6,76E-04

Thermistor Characteristics

**Figure 1.** Thermistor

Typical NTC characteristic

as a function of temperature

\[ R = f(T) \]

\[ R (\Omega) \]

\[ T (\text{°C}) \]

- 23000
- 20000
- 18000
- 16000
- 14000
- 12000

\( \tau (\text{°C}) \)

25 50 75 100 125

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Buck Switching Characteristics

**Figure 1.** IGBT
Typical switching energy losses as a function of collector current

\[ E = f(I_C) \]

With an inductive load at

- \( V_{DS} = 350 \text{ V} \)
- \( V_{GS} = \pm 15 \text{ V} \)
- \( R_{gon} = 4 \text{ } \Omega \)
- \( I_C = 50 \text{ A} \)

\( T_J = 25 \text{ } ^\circ\text{C} \)

**Figure 2.** IGBT
Typical switching energy losses as a function of gate resistor

\[ E = f(R_g) \]

With an inductive load at

- \( V_{DS} = 350 \text{ V} \)
- \( V_{GS} = \pm 15 \text{ V} \)
- \( I_g = 50 \text{ A} \)

\( T_J = 25 \text{ } ^\circ\text{C} \)

**Figure 3.** FWD
Typical reverse recovered energy loss as a function of collector current

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

With an inductive load at

- \( V_{DS} = 350 \text{ V} \)
- \( V_{GS} = \pm 15 \text{ V} \)
- \( R_{gon} = 4 \text{ } \Omega \)

\( T_J = 25 \text{ } ^\circ\text{C} \)

**Figure 4.** FWD
Typical reverse recovered energy loss as a function of gate resistor

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

With an inductive load at

- \( V_{DS} = 350 \text{ V} \)
- \( V_{GS} = \pm 15 \text{ V} \)
- \( I_C = 50 \text{ A} \)

\( T_J = 25 \text{ } ^\circ\text{C} \)
Buck Switching Characteristics

**Figure 5.** Typical switching times as a function of collector current.

\[ t = f(I_C) \]

With an inductive load at:
- \( T_J = 0 \, ^\circ\text{C} \)
- \( V_{CE} = 350 \, \text{V} \)
- \( R_{on} = 4 \, \Omega \)
- \( I_C = 50 \, \text{A} \)

**Figure 6.** Typical switching times as a function of gate resistor.

\[ t = f(R_{g}) \]

With an inductive load at:
- \( T_J = 0 \, ^\circ\text{C} \)
- \( V_{CE} = 350 \, \text{V} \)
- \( R_{on} = 4 \, \Omega \)
- \( I_C = 50 \, \text{A} \)

**Figure 7.** Typical reverse recovery time as a function of collector current.

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

With an inductive load at:
- \( T_J = 25 \, ^\circ\text{C} \)
- \( V_{CE} = 350 \, \text{V} \)
- \( R_{on} = 4 \, \Omega \)

**Figure 8.** Typical reverse recovery time as a function of IGBT turn on gate resistor.

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

With an inductive load at:
- \( T_J = 25 \, ^\circ\text{C} \)
- \( V_{CE} = 350 \, \text{V} \)
- \( R_{on} = 4 \, \Omega \)
- \( I_C = 50 \, \text{A} \)
Buck Switching Characteristics

Figure 9. FWD
Typical recovered charge as a function of collector current

\[ Q_r = f(I_c) \]

With an inductive load at
\[ V_{OC} = 350 \text{ V} \]
\[ V_{IN} = \pm 15 \text{ V} \]
\[ R_{gon} = 4 \Omega \]

Figure 10. FWD
Typical recovered charge as a function of IGBT turn-on gate resistor

\[ Q_r = f(R_{gon}) \]

With an inductive load at
\[ V_{OC} = 350 \text{ V} \]
\[ V_{IN} = \pm 15 \text{ V} \]
\[ I_c = 50 \text{ A} \]

Figure 11. FWD
Typical peak reverse recovery current as a function of collector current

\[ I_{RM} = f(I_c) \]

With an inductive load at
\[ V_{OC} = 350 \text{ V} \]
\[ V_{IN} = \pm 15 \text{ V} \]
\[ R_{gon} = 4 \Omega \]

Figure 12a. FWD
Typical peak reverse recovery current as a function of IGBT turn-on gate resistor

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

With an inductive load at
\[ V_{OC} = 350 \text{ V} \]
\[ V_{IN} = \pm 15 \text{ V} \]
\[ I_c = 50 \text{ A} \]
Buck Switching Characteristics

Figure 13. FWD
Typical rate of fall of forward and reverse recovery current as a function of collector current

\[
\frac{dI_F}{dt}, \frac{dI_{rr}}{dt} = f(I_C)
\]

With an inductive load at

\[
\begin{align*}
V_{CI} &= 350 \text{ V} \\
T_j &= 25 \degree C \\
V_{GE} &= \pm 15 \text{ V} \\
R_{gon} &= 4 \Omega \\
I_C &= 50 \text{ A}
\end{align*}
\]

Figure 14. FWD
Typical rate of fall of forward and reverse recovery current as a function of IGBT turn on gate resistor

\[
\frac{dI_F}{dt}, \frac{dI_{rr}}{dt} = f(R_{gon})
\]

With an inductive load at

\[
\begin{align*}
V_{CI} &= 350 \text{ V} \\
T_j &= 25 \degree C \\
V_{GE} &= \pm 15 \text{ V} \\
I_C &= 50 \text{ A}
\end{align*}
\]

Figure 15. IGBT
Reverse bias safe operating area

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

\[
\begin{align*}
V_{CE} &= 350 \text{ V} \\
T_j &= 125 \degree C \\
R_{gon} &= 4 \Omega \\
R_{goff} &= 4 \Omega
\end{align*}
\]
Buck Switching Definitions

General conditions

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
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</thead>
<tbody>
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<td>$T_1$</td>
<td>125 °C</td>
</tr>
<tr>
<td>$R_{DS}$</td>
<td>4 Ω</td>
</tr>
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</table>

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

- $V_{GE}(0\%) = -15$ V
- $V_{CE}(0\%) = 350$ V
- $I_C(10\%) = 50$ A
- $t_{doff} = 242$ ns

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

- $V_{GE}(0\%) = -15$ V
- $V_{CE}(10\%) = 350$ V
- $I_C(10\%) = 50$ A
- $t_{don} = 79$ ns

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

- $V_{CE}(0\%) = 350$ V
- $I_C(10\%) = 50$ A
- $t_f = 76$ ns

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

- $V_{CE}(0\%) = 350$ V
- $I_C(10\%) = 50$ A
- $t_r = 14$ ns
Buck Switching Characteristics

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

- $V_f(100%) = 350$ V
- $I_f(100%) = 50$ A
- $I_{RRM(100)} = 73$ A
- $t_{tr} = 92$ ns

**Figure 6.** Turn-on Switching Waveforms & definition of $t_{Qr}$ ($t_{Qr} =$ integrating time for $Q_r$)

- $V_f(100%) = 50$ A
- $Q_r(100%) = 3.80$ μC
Boost Switching Characteristics

**Figure 1.** IGBT

Typical switching energy losses as a function of collector current

\[ E = f(I_C) \]

With an inductive load at

- \( V_{DS} = 350\,\text{V} \)
- \( T_J = 25\,\text{°C} \)
- \( T_J = 125\,\text{°C} \)

**Figure 2.** IGBT

Typical switching energy losses as a function of gate resistor

\[ E = f(R_g) \]

With an inductive load at

- \( V_{DS} = 350\,\text{V} \)
- \( T_J = 25\,\text{°C} \)
- \( T_J = 125\,\text{°C} \)

**Figure 3.** FWD

Typical reverse recovered energy loss as a function of collector current

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

With an inductive load at

- \( V_{DS} = 350\,\text{V} \)
- \( T_J = 25\,\text{°C} \)
- \( T_J = 125\,\text{°C} \)

**Figure 4.** FWD

Typical reverse recovered energy loss as a function of gate resistor

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

With an inductive load at

- \( V_{DS} = 350\,\text{V} \)
- \( T_J = 25\,\text{°C} \)
- \( T_J = 125\,\text{°C} \)
Boost Switching Characteristics

**Figure 5. IGBT**

Typical switching times as a function of collector current

\[ t = f(I_C) \]

With an inductive load at

- \( T_j = 0 \) °C
- \( V_{CE} = 350 \) V
- \( V_{GE} = \pm 15 \) V
- \( R_{gon} = 4 \) Ω
- \( I_C = 56 \) A

**Figure 6. IGBT**

Typical switching times as a function of gate resistor

\[ t = f(R_g) \]

With an inductive load at

- \( T_j = 0 \) °C
- \( V_{CE} = 350 \) V
- \( V_{GE} = \pm 15 \) V
- \( R_{gon} = 4 \) Ω

**Figure 7. FWD**

Typical reverse recovery time as a function of collector current

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

With an inductive load at

- \( T_j = 25 \) °C
- \( V_{CE} = 350 \) V
- \( V_{GE} = \pm 15 \) V
- \( R_{gon} = 4 \) Ω

**Figure 8. FWD**

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

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

With an inductive load at

- \( T_j = 25 \) °C
- \( V_{CE} = 350 \) V
- \( V_{GE} = \pm 15 \) V
- \( I_C = 56 \) A
Boost Switching Characteristics

**Figure 9.** FWD
Typical recovered charge as a function of collector current

\[ Q_r = f(I_C) \]

With an inductive load at
- \( V_{GE} = 350 \text{ V} \)
- \( I_C = 56 \text{ A} \)
- \( R_{gon} = 4 \Omega \)

\( T_j = 25 \degree C \)
\( T_s = 125 \degree C \)

**Figure 10.** FWD
Typical recovered charge as a function of IGBT turn-on gate resistor

\[ Q_r = f(R_{gon}) \]

With an inductive load at
- \( V_{GE} = 350 \text{ V} \)
- \( I_C = 56 \text{ A} \)
- \( R_{gon} = 4 \Omega \)

\( T_j = 25 \degree C \)
\( T_s = 125 \degree C \)

**Figure 11.** FWD
Typical peak reverse recovery current as a function of collector current

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

With an inductive load at
- \( V_{GE} = 350 \text{ V} \)
- \( I_C = 56 \text{ A} \)
- \( R_{gon} = 4 \Omega \)

\( T_j = 25 \degree C \)
\( T_s = 125 \degree C \)

**Figure 12.** FWD
Typical peak reverse recovery current as a function of IGBT turn-on gate resistor

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

With an inductive load at
- \( V_{GE} = 350 \text{ V} \)
- \( I_C = 56 \text{ A} \)
- \( R_{gon} = 4 \Omega \)

\( T_j = 25 \degree C \)
\( T_s = 125 \degree C \)
Boost Switching Characteristics

**Figure 13.** FWD
Typical rate of fall of forward and reverse recovery current as a function of collector current

\[
\frac{dI_F}{dt}, \frac{dI_{rr}}{dt} = f(I_C)
\]

With an inductive load at

- \( V_{CE} = 350 \) V
- \( \pm 15 \) V
- \( R_{gon} = 4 \) Ω

At

- \( T_j = 25 \) °C

**Figure 14.** FWD
Typical rate of fall of forward and reverse recovery current as a function of IGBT turn on gate resistor

\[
\frac{dI_F}{dt}, \frac{dI_{rr}}{dt} = f(R_{gon})
\]

With an inductive load at

- \( V_{CE} = 350 \) V
- \( \pm 15 \) V
- \( I_c = 56 \) A

At

- \( T_j = 125 \) °C

**Figure 15.** IGBT
Reverse bias safe operating area

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

At

- \( T_j = 125 \) °C
- \( R_{gon} = 4 \) Ω
- \( R_{goff} = 4 \) Ω
Boost Switching Definitions

General conditions

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$T_1$</td>
<td>125 °C</td>
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<tr>
<td>$R_{on}$</td>
<td>4 Ω</td>
</tr>
<tr>
<td>$R_{off}$</td>
<td>4 Ω</td>
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</tbody>
</table>

**Figure 1.** IGBT

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

- $V_{GE}(0\%)$ = -15 V
- $V_{GE}(100\%)$ = 15 V
- $V_{CE}$ (90\%) = 350 V
- $I_{C}(100\%)$ = 56 A
- $t_{off}$ = 205 ns

**Figure 2.** IGBT

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

- $V_{GE}(0\%)$ = -15 V
- $V_{GE}(100\%)$ = 15 V
- $V_{CE}$ (90\%) = 350 V
- $I_{C}(100\%)$ = 56 A
- $t_{on}$ = 85 ns

**Figure 3.** IGBT

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

- $V_{CE}$ (90\%) = 350 V
- $I_{C}(10%)$ = 56 A
- $t_{f}$ = 105 ns

**Figure 4.** IGBT

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

- $V_{CE}$ (90\%) = 350 V
- $I_{C}(10%)$ = 56 A
- $t_{r}$ = 12 ns
Boost Switching Characteristics

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

- $V_F(100\%) = 350 \text{ V}$
- $I_F(100\%) = 56 \text{ A}$
- $I_{\text{RRM}}(100\%) = 118 \text{ A}$
- $t_{rr} = 148 \text{ ns}$

**Figure 6.** Turn-on Switching Waveforms & definition of $t_{Qr}$ ($t_{Qr} = \text{integrating time for } Q_r$)

- $I_r(100\%) = 56 \text{ A}$
- $Q_r(100\%) = 8.22 \text{ } \mu\text{C}$
**Ordering Code & Marking**

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<tr>
<td>without thermal paste 12mm housing with Press-fit pins</td>
<td>10-PZ12NMA080SH04-M260F13Y</td>
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**Pin table**

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<td>0</td>
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<td>G3</td>
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<td>2,8</td>
<td>22,6</td>
<td>S3</td>
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<td>15</td>
<td>19,2</td>
<td>22,6</td>
<td>+DC</td>
</tr>
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<td>33,6</td>
<td>8,2</td>
<td>NTC2</td>
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<td></td>
</tr>
<tr>
<td>22</td>
<td>Not assembled</td>
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**Outline**

Tolerance of pin positions ±0.5 mm at the end of pins
Dimension of coordinate axis is only offset without tolerance.
### Pinout

![Pinout Diagram](image)

### Identification

<table>
<thead>
<tr>
<th>ID</th>
<th>Component</th>
<th>Voltage</th>
<th>Current</th>
<th>Function</th>
<th>Comment</th>
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</thead>
<tbody>
<tr>
<td>T1, T2</td>
<td>IGBT</td>
<td>1200 V</td>
<td>80 A</td>
<td>Buck Switch</td>
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<tr>
<td>D3, D4</td>
<td>FWD</td>
<td>650 V</td>
<td>75 A</td>
<td>Buck Diode</td>
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<tr>
<td>T3, T4</td>
<td>IGBT</td>
<td>650 V</td>
<td>75 A</td>
<td>Boost Switch</td>
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</tr>
<tr>
<td>D1, D2</td>
<td>FWD</td>
<td>1200 V</td>
<td>50 A</td>
<td>Boost Diode</td>
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<tr>
<td>NTC</td>
<td>NTC</td>
<td>1200 V</td>
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<td>Thermistor</td>
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### Packaging instruction

<table>
<thead>
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<th>Standard packaging quantity (SPQ)</th>
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<th>Standard</th>
<th>&lt;SPQ</th>
<th>Sample</th>
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<tr>
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</tbody>
</table>

### Handling instruction

Handling instructions for flow 0 packages see vincotech.com website.

### Package data

Package data for flow 0 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.

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