### Maximum Ratings

$T_\text{a} = 25 \, ^\circ\text{C}$, 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>Collector-emitter voltage</td>
<td>$V_{\text{CES}}$</td>
<td>$T_j = T_{\text{max}}$</td>
<td>650</td>
<td>V</td>
</tr>
<tr>
<td>Collector current</td>
<td>$I_C$</td>
<td>$T_j = T_{\text{max}}$</td>
<td>57</td>
<td>A</td>
</tr>
<tr>
<td>Repetitive peak collector current</td>
<td>$I_{\text{CRM}}$</td>
<td>$T_j$ limited by $T_{\text{max}}$</td>
<td>225</td>
<td>A</td>
</tr>
<tr>
<td>Total power dissipation</td>
<td>$P_{\text{tot}}$</td>
<td>$T_j = T_{\text{max}}$</td>
<td>97</td>
<td>W</td>
</tr>
<tr>
<td>Gate-emitter voltage</td>
<td>$V_{\text{GES}}$</td>
<td></td>
<td>±20</td>
<td>V</td>
</tr>
<tr>
<td>Maximum Junction Temperature</td>
<td>$T_{\text{Jmax}}$</td>
<td></td>
<td>175</td>
<td>°C</td>
</tr>
</tbody>
</table>

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**Features**

- High Efficiency three-level half-bridge
- High efficiency IGBT
- Neutral point-Clamped inverter
- Clip-In PCB mounting
- Low Inductance Layout

**Target applications**

- Solar inverters
- UPS
- Power supplies

**Types**

- 10-FZ07NA075SM-P926F58
Maximum Ratings

\( T = 25 \, ^\circ\text{C}, \) unless otherwise specified

<table>
<thead>
<tr>
<th>Parameter</th>
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<th>Value</th>
<th>Unit</th>
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<tbody>
<tr>
<td><strong>Buck Diode\Out. Boost 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_i = T_{\text{max}} ) ( T_s = 80^\circ\text{C} )</td>
<td>59</td>
<td>A</td>
</tr>
<tr>
<td>Repetitive peak forward current</td>
<td>( I_{\text{FRM}} )</td>
<td></td>
<td>150</td>
<td>A</td>
</tr>
<tr>
<td>Total power dissipation</td>
<td>( P_{\text{tot}} )</td>
<td>( T_i = T_{\text{max}} ) ( T_s = 80^\circ\text{C} )</td>
<td>78</td>
<td>W</td>
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<tr>
<td>Maximum Junction Temperature</td>
<td>( T_{\text{max}} )</td>
<td></td>
<td>175</td>
<td>°C</td>
</tr>
<tr>
<td><strong>Out. Boost Inverse 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_i = T_{\text{max}} ) ( T_s = 80^\circ\text{C} )</td>
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<td>A</td>
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<tr>
<td>Repetitive peak forward current</td>
<td>( I_{\text{FRM}} )</td>
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<td>150</td>
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<tr>
<td>Total power dissipation</td>
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<tr>
<td>Maximum Junction Temperature</td>
<td>( T_{\text{max}} )</td>
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<td>175</td>
<td>°C</td>
</tr>
<tr>
<td><strong>Module Properties</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Thermal Properties</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storage temperature</td>
<td>( T_{\text{stg}} )</td>
<td></td>
<td>-40...+125</td>
<td>°C</td>
</tr>
<tr>
<td>Operation temperature under switching condition</td>
<td>( T_{\text{op}} )</td>
<td></td>
<td>-40...+ (( T_{\text{max}} - 25 ))</td>
<td>°C</td>
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<tr>
<td><strong>Isolation Properties</strong></td>
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<tr>
<td>Isolation voltage</td>
<td>( V_{\text{ins}} )</td>
<td>DC Voltage</td>
<td>( t_f = 2 ) s</td>
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<td>Creepage distance</td>
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<td>Clearance</td>
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<td>Comparative Tracking Index</td>
<td>CTI</td>
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<td>&gt; 200</td>
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### Characteristic Values

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Conditions</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$V_{GE}$ [V] $V_{CE}$ [V] $I_{b}$ [A] $I_{r}$ [A] $T_{j}$[°C]</td>
<td>Min</td>
<td>Typ</td>
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<tr>
<td>-------------------------------</td>
<td>------------</td>
<td>-------</td>
<td>------</td>
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<tr>
<td>Buck Switch</td>
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<tr>
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<td></td>
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<td>Gate-emitter threshold voltage</td>
<td>$V_{GE}$</td>
<td>0,00075</td>
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<tr>
<td>Collector-emitter saturation voltage</td>
<td>$V_{CE}$</td>
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<td>1,67</td>
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<td>Collector-emitter cut-off current</td>
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<td>40</td>
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<tr>
<td>Gate-emitter leakage current</td>
<td>$I_{GS}$</td>
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<td>Internal gate resistance</td>
<td>$r_{g}$</td>
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<tr>
<td>Input capacitance</td>
<td>$C_{oi}$</td>
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<tr>
<td>Output capacitance</td>
<td>$C_{os}$</td>
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<tr>
<td>Reverse transfer capacitance</td>
<td>$C_{res}$</td>
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<tr>
<td>Gate charge</td>
<td>$Q_{g}$</td>
<td></td>
<td>166</td>
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<tr>
<td>Thermal</td>
<td></td>
<td></td>
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<tr>
<td>Thermal resistance to sink</td>
<td>$R_{th(j-s)}$ phase-change material $\lambda = 3,4$ W/mK</td>
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<tr>
<td>IGBT Switching</td>
<td></td>
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<tr>
<td>Turn-on delay time</td>
<td>$t_{on}$</td>
<td>±15</td>
<td>350</td>
</tr>
<tr>
<td>Rise time</td>
<td>$t_r$</td>
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<td>12</td>
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<tr>
<td>Turn-off delay time</td>
<td>$t_{off}$</td>
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<td>25</td>
</tr>
<tr>
<td>Fall time</td>
<td>$t_f$</td>
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<tr>
<td>Turn-on energy (per pulse)</td>
<td>$E_{on}$</td>
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<tr>
<td>Turn-off energy (per pulse)</td>
<td>$E_{off}$</td>
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## Characteristic Values

<table>
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<th>Unit</th>
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<tbody>
<tr>
<td>Buck Diode</td>
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<tr>
<td>Static</td>
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<tr>
<td>Forward voltage</td>
<td>$V_C$</td>
<td>75</td>
<td>25 125 150</td>
<td>1,53 1,49 1,47</td>
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<td>Reverse leakage current</td>
<td>$I_r$</td>
<td>650</td>
<td>25</td>
<td>3,8</td>
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<td>Thermal</td>
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<td></td>
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<tr>
<td>Thermal resistance junction to sink</td>
<td>$R_{th(j-s)}$</td>
<td>phase-change material</td>
<td>$\dot{\gamma} = 3,4 W/mK$</td>
<td>1,23</td>
</tr>
<tr>
<td>FWD Switching</td>
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</tr>
<tr>
<td>Peak recovery current</td>
<td>$I_{RRM}$</td>
<td>350</td>
<td>25 125 150</td>
<td>60 79 84</td>
</tr>
<tr>
<td>Reverse recovery time</td>
<td>$t_{rr}$</td>
<td>≤15</td>
<td>25 125 150</td>
<td>72 121 134</td>
</tr>
<tr>
<td>Recovered charge</td>
<td>$Q_r$</td>
<td>350</td>
<td>25 125 150</td>
<td>2,434 4,832 5,418</td>
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<tr>
<td>Reverse recovered energy</td>
<td>$E_{rec}$</td>
<td>≤15</td>
<td>25 125 150</td>
<td>0,484 1,031 1,126</td>
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<tr>
<td>Peak rate of fall of recovery current</td>
<td>$(\dot{d}<em>v/dt)</em>{max}$</td>
<td>≤15</td>
<td>25 125 150</td>
<td>708 814 959</td>
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</table>
# Characteristic Values

<table>
<thead>
<tr>
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<th>Symbol</th>
<th>Conditions</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collector-emitter saturation voltage</td>
<td>$V_{CEsat}$</td>
<td>$V_{CE}=V_{CE}$</td>
<td>0,00075</td>
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<tr>
<td>Collector-emitter cut-off current</td>
<td>$I_{CES}$</td>
<td>$V_{CE}$</td>
<td>15 0 75</td>
<td>25</td>
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<tr>
<td>Gate-emitter leakage current</td>
<td>$I_{GED}$</td>
<td>$V_{CE}$</td>
<td>20 0 25</td>
<td>25</td>
</tr>
<tr>
<td>Internal gate resistance</td>
<td>$r_e$</td>
<td>$V_{CE}$</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>Input capacitance</td>
<td>$C_{ie}$</td>
<td>$f = 1$ MHz</td>
<td>0 25</td>
<td>25</td>
</tr>
<tr>
<td>Output capacitance</td>
<td>$C_{oe}$</td>
<td>$f = 1$ MHz</td>
<td>0 25</td>
<td>25</td>
</tr>
<tr>
<td>Reverse transfer capacitance</td>
<td>$C_{res}$</td>
<td>$f = 1$ MHz</td>
<td>16</td>
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</tr>
<tr>
<td>Gate charge</td>
<td>$Q_r$</td>
<td>$V_{CE}$</td>
<td>15 520 75</td>
<td>25</td>
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</tbody>
</table>

## Thermal

<table>
<thead>
<tr>
<th>Parameter</th>
<th>$R_{th(j-s)}$</th>
<th>phase-change material $\lambda = 3.4 \text{ W/mK}$</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>0,98</td>
<td>K/W</td>
</tr>
</tbody>
</table>

## IGBT Switching

<table>
<thead>
<tr>
<th>Parameter</th>
<th>$E_{on}$</th>
<th>$Q_{on} = 4 \mu C$</th>
<th>$R_{on} = 4 \Omega$</th>
<th>$t_{d(on)}$</th>
<th>$t_{f}$</th>
<th>$t_{r}$</th>
<th>$R_{g(t)} = 4 \Omega$</th>
<th>$Q_{rFWD}$</th>
<th>$Q_{rFWD}$</th>
<th>$Q_{rFWD}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turn-on delay time</td>
<td>$E_{on}$</td>
<td>$Q_{on} = 2.6 \mu C$</td>
<td>$Q_{on} = 4.7 \mu C$</td>
<td>$Q_{on} = 5.3 \mu C$</td>
<td>$t_{d(on)}$</td>
<td>$t_{f}$</td>
<td>$t_{r}$</td>
<td>$R_{g(t)} = 4 \Omega$</td>
<td>$Q_{rFWD}$</td>
<td>$Q_{rFWD}$</td>
</tr>
<tr>
<td>Turn-off delay time</td>
<td>$E_{off}$</td>
<td>$Q_{off} = 4 \mu C$</td>
<td>$Q_{off} = 4 \mu C$</td>
<td>$Q_{off} = 4 \mu C$</td>
<td>$t_{d(off)}$</td>
<td>$t_{f}$</td>
<td>$t_{r}$</td>
<td>$R_{g(off)} = 4 \Omega$</td>
<td>$Q_{rFWD}$</td>
<td>$Q_{rFWD}$</td>
</tr>
<tr>
<td>Fall time</td>
<td>$t_{f}$</td>
<td>$Q_{off} = 4 \mu C$</td>
<td>$Q_{off} = 4 \mu C$</td>
<td>$Q_{off} = 4 \mu C$</td>
<td>$t_{d(off)}$</td>
<td>$t_{f}$</td>
<td>$t_{r}$</td>
<td>$R_{g(off)} = 4 \Omega$</td>
<td>$Q_{rFWD}$</td>
<td>$Q_{rFWD}$</td>
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<tr>
<td>Turn-on energy (per pulse)</td>
<td>$E_{on}$</td>
<td>$Q_{on} = 2.6 \mu C$</td>
<td>$Q_{on} = 4.7 \mu C$</td>
<td>$Q_{on} = 5.3 \mu C$</td>
<td>$t_{d(on)}$</td>
<td>$t_{f}$</td>
<td>$t_{r}$</td>
<td>$R_{g(t)} = 4 \Omega$</td>
<td>$Q_{rFWD}$</td>
<td>$Q_{rFWD}$</td>
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<tr>
<td>Turn-off energy (per pulse)</td>
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<td>$Q_{off} = 4 \mu C$</td>
<td>$Q_{off} = 4 \mu C$</td>
<td>$Q_{off} = 4 \mu C$</td>
<td>$t_{d(off)}$</td>
<td>$t_{f}$</td>
<td>$t_{r}$</td>
<td>$R_{g(off)} = 4 \Omega$</td>
<td>$Q_{rFWD}$</td>
<td>$Q_{rFWD}$</td>
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</tr>
<tr>
<td>V&lt;sub&gt;GE&lt;/sub&gt; [V]</td>
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<tr>
<td>V&lt;sub&gt;GS&lt;/sub&gt; [V]</td>
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<tr>
<td>I&lt;sub&gt;C&lt;/sub&gt; [A]</td>
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<tr>
<td>I&lt;sub&gt;T&lt;/sub&gt; [A]</td>
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<tr>
<td>T&lt;sub&gt;[°C]&lt;/sub&gt;</td>
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<td></td>
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<td>Typ</td>
<td>Max</td>
</tr>
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<td></td>
</tr>
<tr>
<td>Out. Boost Diode</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Static</td>
<td></td>
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<tr>
<td>Forward voltage</td>
<td>V&lt;sub&gt;F&lt;/sub&gt;</td>
<td>75</td>
<td>25</td>
<td>1,53</td>
</tr>
<tr>
<td>Reverse leakage current</td>
<td>I&lt;sub&gt;r&lt;/sub&gt;</td>
<td>650</td>
<td>25</td>
<td>3,8</td>
</tr>
<tr>
<td>Thermal</td>
<td></td>
<td></td>
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<tr>
<td>Thermal resistance junction to sink</td>
<td>R&lt;sub&gt;th(j-s)&lt;/sub&gt;</td>
<td>phase-change material</td>
<td>1,23</td>
<td>K/W</td>
</tr>
<tr>
<td>FWD Switching</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Peak recovery current</td>
<td>I&lt;sub&gt;RRM&lt;/sub&gt;</td>
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<td>25</td>
<td>56</td>
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<tr>
<td>Reverse recovery time</td>
<td>t&lt;sub&gt;rr&lt;/sub&gt;</td>
<td>75</td>
<td>25</td>
<td>74</td>
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<tr>
<td>Recovered charge</td>
<td>Q&lt;sub&gt;r&lt;/sub&gt;</td>
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<td>25</td>
<td>0,607</td>
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<tr>
<td>Reverse recovered energy</td>
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<td>25</td>
<td>948</td>
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<td>Peak rate of fall of recovery current</td>
<td>(di&lt;sub&gt;rf&lt;/sub&gt;/dt)</td>
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<td>498</td>
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<tr>
<td>Out. Boost Inverse Diode</td>
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</tr>
<tr>
<td>Static</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Forward voltage</td>
<td>V&lt;sub&gt;F&lt;/sub&gt;</td>
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<td>25</td>
<td>1,46</td>
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<tr>
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<td>25</td>
<td>0,9</td>
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<tr>
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<tr>
<td>Thermal resistance junction to sink</td>
<td>R&lt;sub&gt;th(j-s)&lt;/sub&gt;</td>
<td>phase-change material</td>
<td>1,12</td>
<td>K/W</td>
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</tbody>
</table>
## Characteristic Values

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<thead>
<tr>
<th>Parameter</th>
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<th>Conditions</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>$V_{GE} \ [V]$</td>
<td>$V_{GS} \ [V]$</td>
<td>$I_{C} \ [A]$</td>
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<tr>
<td>Rated resistance</td>
<td>$R$</td>
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<td>22</td>
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<tr>
<td>Deviation of R100</td>
<td>$\Delta R/R_{100}$</td>
<td>R100=1484 Ω</td>
<td>100</td>
<td>-5</td>
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<tr>
<td>Power dissipation</td>
<td>$P$</td>
<td></td>
<td>25</td>
<td>5</td>
</tr>
<tr>
<td>Power dissipation constant</td>
<td></td>
<td></td>
<td>25</td>
<td>1,5</td>
</tr>
<tr>
<td>B-value</td>
<td>$B_{(25/100)}$</td>
<td>Tol. ±1%</td>
<td>25</td>
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<tr>
<td>B-value</td>
<td>$B_{(25/50)}$</td>
<td>Tol. ±1%</td>
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<td>Vincotech NTC Reference</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

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Buck Switch\Out. Boost Switch Characteristics

Typical output characteristics  IGBT

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

![Graph](image)

\[ t_p = 250 \mu s \]  
\[ V_{CE} = 15 \text{ V} \]  
\[ T_j: 25^\circ\text{C} \]  
\[ 125^\circ\text{C} \]

Typical output characteristics  IGBT

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

![Graph](image)

\[ t_p = 250 \mu s \]
\[ V_{CE} = 10 \text{ V} \]  
\[ T_j: 125^\circ\text{C} \]  
\[ 150^\circ\text{C} \]

Typical transfer characteristics  IGBT

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

![Graph](image)

\[ t_p = 100 \mu s \]
\[ V_{CE} = 10 \text{ V} \]  
\[ T_j: 25^\circ\text{C} \]  
\[ 125^\circ\text{C} \]

Transient Thermal Impedance as function of Pulse duration  IGBT

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

![Graph](image)

\[ D = \frac{t_p}{T} \]
\[ R_{th(j-s)} = 0.98 \text{ K/W} \]

IGBT thermal model values

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

- 7.21E-02  2.25E+00
- 1.46E-01  3.32E-01
- 4.74E-01  6.42E-02
- 1.76E-01  1.63E-02
- 6.17E-02  3.99E-03
- 4.63E-02  3.57E-04

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Buck Switch\Out. Boost Switch Characteristics

Gate voltage vs Gate charge

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

At \( I_C = 75 \, \text{A} \) and
\( D = \), single pulse
\( T_J = 80 \, ^\circ\text{C} \)
\( V_{GE} = \pm 15 \, \text{V} \)
\( T_J = T_{J\text{max}} \, ^\circ\text{C} \)

Safe operating area

\[ I_C = f(V_{CE}) \]
Buck Diode\Out. Boost Diode Characteristics

Typical forward characteristics

\[ I_F = f(V_F) \]

<table>
<thead>
<tr>
<th>( V_F ) (V)</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>( I_F ) (A)</td>
<td>0</td>
<td>50</td>
<td>100</td>
<td>150</td>
<td>200</td>
<td>250</td>
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\( t_p = 250 \mu s \)

<table>
<thead>
<tr>
<th>Temperature (°C)</th>
<th>25</th>
<th>125</th>
<th>150</th>
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<tbody>
<tr>
<td>( R_{th(j-s)} ) (K/W)</td>
<td>1.23</td>
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Transient thermal impedance as a function of pulse width

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

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

<table>
<thead>
<tr>
<th>( D )</th>
<th>0.000</th>
<th>0.005</th>
<th>0.01</th>
<th>0.02</th>
<th>0.05</th>
<th>0.1</th>
<th>0.2</th>
<th>0.5</th>
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<tbody>
<tr>
<td>( R_{th(j-s)} ) (K/W)</td>
<td>8,04E-02</td>
<td>1,74E-01</td>
<td>6,28E-01</td>
<td>2,05E-01</td>
<td>8,90E-02</td>
<td>4,76E-02</td>
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<tr>
<td>( \tau ) (s)</td>
<td>2,68E+00</td>
<td>2,85E-01</td>
<td>6,23E-02</td>
<td>1,65E-02</td>
<td>4,15E-03</td>
<td>4,96E-04</td>
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</table>

FWD thermal model values

- \( R \) (K/W)
  - 8.04E-02
  - 1.74E-01
  - 6.28E-01
  - 2.05E-01
  - 8.90E-02
  - 4.76E-02

- \( \tau \) (s)
  - 2.68E+00
  - 2.85E-01
  - 6.23E-02
  - 1.65E-02
  - 4.15E-03
  - 4.96E-04
Out. Boost Inverse Diode Characteristics

### Typical forward characteristics

\[ I_F = f(V_F) \]

- \( I_F \) vs \( V_F \)
- \( V_F \) range: 0 to 5 V
- Graphs for different temperatures:
  - \( 25 \) °C
  - \( 125 \) °C
  - \( 150 \) °C

### Transient thermal impedance as a function of pulse width

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

- \( Z_{th}(j\omega) \) vs \( t_p \)
- \( t_p = 250 \) µs
- Graphs for different pulse widths:
  - \( D = 0.5 \)
  - \( D = 0.2 \)
  - \( D = 0.1 \)
  - \( D = 0.05 \)
  - \( D = 0.02 \)
  - \( D = 0.01 \)
  - \( D = 0.005 \)
  - \( D = 0.001 \)

#### FWD thermal model values

<table>
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<tr>
<th>( R (K/W) )</th>
<th>( \tau (s) )</th>
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<td>3.1440E-01</td>
<td>4.0505E-02</td>
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<tr>
<td>1.5660E-01</td>
<td>8.7690E-03</td>
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<tr>
<td>4.7270E-02</td>
<td>1.1130E-03</td>
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### Thermistor Characteristics

#### Typical NTC characteristic

\[ R_T = f(T) \]

- \( R_T \) vs \( T \)
- \( R_T \) range: 1000 to 25000 Ω
- \( T \) range: 25 to 125 °C

#### NTC-typical temperature characteristic

- Graph showing the relationship between \( R_T \) and \( T \)
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
- \( V_{in} = 350 \text{ V} \)
- \( T_J = 125 \text{ °C} \)
- \( R_{on} = 4 \text{ Ω} \)
- \( R_{off} = 4 \text{ Ω} \)

**Figure 2.** IGBT

Typical switching energy losses as a function of gate resistor

\[ E = f(r_g) \]

With an inductive load at
- \( V_{in} = 350 \text{ V} \)
- \( T_J = 125 \text{ °C} \)
- \( I_C = 75 \text{ A} \)

**Figure 3.** FWD

Typical reverse recovered energy loss as a function of collector current

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

With an inductive load at
- \( V_{in} = 350 \text{ V} \)
- \( T_J = 125 \text{ °C} \)
- \( R_{on} = 4 \text{ Ω} \)
- \( R_{off} = 4 \text{ Ω} \)

**Figure 4.** FWD

Typical reverse recovered energy loss as a function of gate resistor

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

With an inductive load at
- \( V_{in} = 350 \text{ V} \)
- \( T_J = 125 \text{ °C} \)
- \( I_C = 75 \text{ A} \)
Buck Switching Characteristics

**Figure 5.** IGBT

Typical switching times as a function of collector current

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

With an inductive load at

- \( T_j = 150 \, ^\circ\text{C} \)
- \( V_{CE} = 350 \, \text{V} \)
- \( R_{gon} = 4 \, \Omega \)
- \( I_{C} = 75 \, \text{A} \)

**Figure 6.** IGBT

Typical switching times as a function of gate resistor

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

With an inductive load at

- \( T_j = 150 \, ^\circ\text{C} \)
- \( V_{CE} = 350 \, \text{V} \)
- \( V_{GE} = \pm 15 \, \text{V} \)
- \( R_{goff} = 4 \, \Omega \)

**Figure 7.** FWD

Typical reverse recovery time as a function of collector current

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

With a capacitive load at

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

**Figure 8.** FWD

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

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

With a capacitive load at

- \( T_j = 125 \, ^\circ\text{C} \)
- \( V_{CE} = 350 \, \text{V} \)
- \( I_{C} = 75 \, \text{A} \)
Buck Switching Characteristics

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

\[ Q_r = f(I_C) \]

At \( V_{CE} = 350 \, V \) and \( T_J = 25 \, ^\circ C \)

VGE = ±15 V

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

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

At \( V_{CE} = 350 \, V \) and \( T_J = 25 \, ^\circ C \)

VGE = ±15 V

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

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

At \( V_{CE} = 350 \, V \) and \( T_J = 25 \, ^\circ C \)

VGE = ±15 V

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

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

At \( V_{CE} = 350 \, V \) and \( T_J = 25 \, ^\circ C \)

VGE = ±15 V

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Buck Switching Characteristics

Figure 13. FWD Typical rate of fall of forward and reverse recovery current as a function of collector current $\frac{d_i}{dt}, \frac{d_i}{dt} = f(Ic)$

At $V_{CE} = 350 \text{ V}$ 25 °C
$V_{GE} = \pm 15 \text{ V}$
$R_{gon} = 4 \text{ Ω}$
$T_J: 125 \text{ °C}$
$I_C: 75 \text{ A}$

Figure 14. FWD Typical rate of fall of forward and reverse recovery current as a function of IGBT turn on gate resistor $\frac{d_i}{dt}, \frac{d_i}{dt} = f(R_g)$

At $V_{CE} = 350 \text{ V}$ 25 °C
$V_{GE} = \pm 15 \text{ V}$
$T_J: 125 \text{ °C}$
$I_C: 75 \text{ A}$

Figure 15. IGBT Reverse bias safe operating area

At $V_{CE} = 350 \text{ V}$ 25 °C
$V_{GE} = \pm 15 \text{ V}$
$T_J: 125 \text{ °C}$
$I_C: 75 \text{ A}$

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Buck Switching Definitions

General conditions

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tj</td>
<td>125 °C</td>
</tr>
<tr>
<td>Rg</td>
<td>4 Ω</td>
</tr>
</tbody>
</table>

Figure 1. IGBT Figure 2. IGBT

Turn-off Switching Waveforms & definition of \( t_{\text{doff}} \), \( t_{E_{\text{off}}} \) (\( t_{E_{\text{off}}} \) = integrating time for \( E_{\text{off}} \))

Turn-on Switching Waveforms & definition of \( t_{\text{don}} \), \( t_{E_{\text{on}}} \) (\( t_{E_{\text{on}}} \) = integrating time for \( E_{\text{on}} \))

---

Figure 3. IGBT Figure 4. IGBT

Turn-off Switching Waveforms & definition of Tr

Turn-on Switching Waveforms & definition of Tt

---

Vc(0%) = 0 V
Vc(100%) = 20 V
Vc(100%) = 350 V
Ic(100%) = 74 A
\( t_{\text{doff}} \) = 0.115 µs
\( t_{E_{\text{off}}} \) = 0.160 µs

Vc(0%) = 0 V
Vc(100%) = 20 V
Vc(100%) = 350 V
Ic(100%) = 74 A
\( t_{\text{don}} \) = 0.039 µs
\( t_{E_{\text{on}}} \) = 0.143 µs

---

Vc(100%) = 350 V
Ic(100%) = 74 A
\( t_r \) = 0.008 µs

---

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Buck Switching Definitions

**Figure 5.** IGBT Turn-off Switching Waveforms & definition of t\textsubscript{Eoff}

- \( P_{\text{off}}(100\%) = 26.01 \text{ kW} \)
- \( E_{\text{off}}(100\%) = 0.53 \text{ mJ} \)
- \( t_{\text{Eoff}} = 0.16 \mu\text{s} \)

**Figure 6.** IGBT Turn-on Switching Waveforms & definition of toff

- \( P_{\text{on}}(100\%) = 26.01 \text{ kW} \)
- \( E_{\text{on}}(100\%) = 1.17 \text{ mJ} \)
- \( t_{\text{Eon}} = 0.14 \mu\text{s} \)

**Figure 7.** FWD Turn-off Switching Waveforms & definition of trr

- \( V_{\text{d}}(100\%) = 350 \text{ V} \)
- \( I_{\text{d}}(100\%) = 74 \text{ A} \)
- \( I_{\text{on}}(100\%) = -79 \text{ A} \)
- \( t_{\text{rr}} = 0.121 \mu\text{s} \)
Buck Switching Definitions

Figure 8: Turn-on Switching Waveforms & definition of $t_{Q_{rr}}$ integrating time for $Q_{rr}$

- $I_{d}(100\%) = 74$ A
- $Q_{rr}(100\%) = 4.83$ µC
- $t_{Q_{rr}} = 0.24$ µs

Figure 9: Turn-on Switching Waveforms & definition of $t_{E_{rec}}$ integrating time for $E_{rec}$

- $P_{rec}(100\%) = 26.01$ kW
- $E_{rec}(100\%) = 1.03$ mJ
- $t_{E_{rec}} = 0.24$ µs
Out. 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 25 °C

- \( V_{CE} = 350 \) V
- \( T_J = 125 \) °C
- \( R_{gon} = 4 \) Ω
- \( R_{goff} = 4 \) Ω

Figure 2. IGBT

Typical switching energy losses as a function of gate resistor

\[ E = f(r_g) \]

With an inductive load at 25 °C

- \( V_{CE} = 350 \) V
- \( T_J = 125 \) °C
- \( I_C = 75 \) A

Figure 3. FWD

Typical reverse recovered energy loss as a function of collector current

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

With an inductive load at 25 °C

- \( V_{CE} = 350 \) V
- \( T_J = 125 \) °C
- \( R_{pm} = 4 \) Ω

Figure 4. FWD

Typical reverse recovered energy loss as a function of gate resistor

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

With an inductive load at 25 °C

- \( V_{CE} = 350 \) V
- \( T_J = 125 \) °C
- \( I_C = 75 \) A
Out. Boost Switching Characteristics

**Figure 5.** IGBT

Typical switching times as a function of collector current

\[ t = f(I_C) \]

With an inductive load at:
- \( T_j = 150 \, ^\circ\text{C} \)
- \( V_{CE} = 350 \, \text{V} \)
- \( V_{GE} = \pm 15 \, \text{V} \)
- \( R_{gon} = 4 \, \Omega \)
- \( I_C = 75 \, \text{A} \)

**Figure 6.** IGBT

Typical switching times as a function of gate resistor

\[ t = f(r_g) \]

With an inductive load at:
- \( T_j = 150 \, ^\circ\text{C} \)
- \( V_{CE} = 350 \, \text{V} \)
- \( V_{GE} = \pm 15 \, \text{V} \)
- \( I_C = 75 \, \text{A} \)

**Figure 7.** FWD

Typical reverse recovery time as a function of collector current

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

At:
- \( V_{CE} = 350 \, \text{V} \)
- \( V_{GE} = \pm 15 \, \text{V} \)
- \( R_{goff} = 4 \, \Omega \)
- \( T_j = 125 \, ^\circ\text{C} \)
- \( I_C = 75 \, \text{A} \)

**Figure 8.** FWD

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

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

At:
- \( V_{CE} = 350 \, \text{V} \)
- \( V_{GE} = \pm 15 \, \text{V} \)
- \( I_C = 75 \, \text{A} \)
- \( T_j = 150 \, ^\circ\text{C} \)
Out. Boost Switching Characteristics

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

\[
Q_r = f(I_C)
\]

At
\[
\begin{align*}
V_{IC} &= 350 \text{ V} \quad & T_j &= 25 ^\circ \text{C} \\
V_{GE} &= \pm 15 \text{ V} \\
R_{\text{gon}} &= 4 \, \Omega \\
I_C &= 75 \text{ A}
\end{align*}
\]

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

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

At
\[
\begin{align*}
V_{IC} &= 350 \text{ V} \quad & T_j &= 25 ^\circ \text{C} \\
V_{GE} &= \pm 15 \text{ V} \\
R_{\text{gon}} &= 4 \, \Omega \\
I_C &= 75 \text{ A}
\end{align*}
\]

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

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

At
\[
\begin{align*}
V_{IC} &= 350 \text{ V} \quad & T_j &= 25 ^\circ \text{C} \\
V_{GE} &= \pm 15 \text{ V} \\
R_{\text{gon}} &= 4 \, \Omega \\
I_C &= 75 \text{ A}
\end{align*}
\]

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

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

At
\[
\begin{align*}
V_{IC} &= 350 \text{ V} \quad & T_j &= 25 ^\circ \text{C} \\
V_{GE} &= \pm 15 \text{ V} \\
R_{\text{gon}} &= 4 \, \Omega \\
I_C &= 75 \text{ A}
\end{align*}
\]
Out. Boost Switching Characteristics

Figure 13. FWD
Typical rate of fall of forward and reverse recovery current as a function of collector current
\[ \frac{d_i}{dt}, \frac{d_{ir}}{dt} = f(I_{cc}) \]

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

Figure 14. FWD
Typical rate of fall of forward and reverse recovery current as a function of IGBT turn on gate resistor
\[ \frac{d_i}{dt}, \frac{d_{ir}}{dt} = f(R_{g}) \]

At
- \( V_{ce} = 350 \) V
- \( V_{gs} = \pm 15 \) V
- \( T_j = 125 \) °C
- \( I_{ce} = 75 \) A
- \( T_j = 150 \) °C

Figure 15. IGBT
Reverse bias safe operating area

\[ I_{ce} = f(V_{ce}) \]

At
- \( T_j = 175 \) °C
- \( R_{gon} = 4 \) Ω
- \( R_{goff} = 4 \) Ω

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Out. Boost Switching Definitions

General conditions

- $T_j = 25 ^\circ C$
- $R_{DS(on)} = 4 \, \Omega$

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

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

**Figure 3.** IGBT
Turn-off Switching Waveforms & definition of $t_{f}$

**Figure 4.** IGBT
Turn-on Switching Waveforms & definition of $t_{r}$

### General conditions

- $V_{CE(0\%)} = 0 \, V$
- $V_{CE(100\%)} = 20 \, V$
- $V_{C(100\%)} = 350 \, V$
- $I_{C(10\%)} = 75 \, A$
- $I_{C(1\%)} = 0.120 \, \mu s$
- $t_{fitted} = 0.159 \, \mu s$

- $V_{CE(0\%)} = 0 \, V$
- $V_{CE(100\%)} = 20 \, V$
- $V_{C(100\%)} = 350 \, V$
- $I_{C(10\%)} = 75 \, A$
- $t_{fitted} = 0.040 \, \mu s$
- $t_{fitted} = 0.131 \, \mu s$

- $V_{C(10\%)} = 350 \, V$
- $I_{C(10\%)} = 75 \, A$
- $t_{fitted} = 0.009 \, \mu s$
- $t_{fitted} = 0.015 \, \mu s$
Out. Boost Switching Definitions

**Figure 5.** IGBT
- **Turn-off Switching Waveforms & definition of tEoff**
  - $P_{off}(100\%) = 26.12$ kW
  - $E_{off}(100\%) = 0.60$ mJ
  - $t_{Eoff} = 0.16 \mu s$

**Figure 6.** IGBT
- **Turn-on Switching Waveforms & definition of tEon**
  - $P_{on}(100\%) = 26.12$ kW
  - $E_{on}(100\%) = 0.99$ mJ
  - $t_{Eon} = 0.13 \mu s$

**Figure 7.** FWD
- **Turn-off Switching Waveforms & definition of t_rr**
  - $V_{d}(100\%) = 350$ V
  - $I_{d}(100\%) = 75$ A
  - $I_{RRM}(10\%) = -73$ A
  - $t_{rr} = 0.114 \mu s$
Out. Boost Switching Definitions

Figure 8. FWD
Turn-on switching waveforms & definition of \( t_{Qrr} \). Integrating time for \( Q_{rr} \).

\[ I_d(100\%) = 75 \text{ A} \]
\[ Q_{rr}(100\%) = 4.74 \text{ } \mu \text{C} \]
\[ t_{Qrr} = 0.23 \text{ } \mu \text{s} \]

Figure 9. FWD
Turn-on switching waveforms & definition of \( t_{Erec} \). Integrating time for \( E_{rec} \).

\[ P_{rec}(100\%) = 26.12 \text{ kW} \]
\[ E_{rec}(100\%) = 1.22 \text{ mJ} \]
\[ t_{Erec} = 0.23 \text{ } \mu \text{s} \]
10-FZ07NA075SM-P926F58 datasheet

Ordering Code & Marking

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Outline

Dimensions of coordinate axes is only offset without tolerance.
### Pinout

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