### Features
- **Cree™** Silicon Carbide Power MOSFET
- **Cree™** Silicon Carbide Power Schottky Diode
- Dual Boost Topology
- Ultra Low Inductance with Integrated DC-capacitors
- Extremely Fast Switching with No "Tail" Current
- Solderless Press-fit Mounting Technology
- Temperature sensor

### Target Applications
- High efficient solar inverters
- UPS

### Types
- 10-PZ12B2A040ME01-M330L63Y

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### Maximum Ratings

**Tj=25°C, unless otherwise specified**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Condition</th>
<th>Value</th>
<th>Unit</th>
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<tbody>
<tr>
<td><strong>Boost - Silicon Carbide Power MOSFET (T1, T3)</strong></td>
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<td>Drain to source breakdown voltage</td>
<td>$V_{DS}$</td>
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<td>1200</td>
<td>V</td>
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<td>DC drain current</td>
<td>$I_D$</td>
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<td>A</td>
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<td>Pulsed drain current</td>
<td>$I_{D\text{puls}}$</td>
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<td>Power dissipation</td>
<td>$P_{tot}$</td>
<td>$T_J=T_{max}$, $T_H=80°C$</td>
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<td>W</td>
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<tr>
<td>Gate-source peak voltage</td>
<td>$V_{GS}$</td>
<td></td>
<td>-5/25</td>
<td>V</td>
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<tr>
<td>Maximum Junction Temperature</td>
<td>$T_{J\text{max}}$</td>
<td></td>
<td>150</td>
<td>°C</td>
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| **Protection Diode (D1, D3)** | | | | |
| Peak Repetitive Reverse Voltage | $V_{RMS}$ | | 1600 | V |
| DC forward current | $I_F$ | $T_J=T_{max}$, $T_H=80°C$ | 47 | A |
| Surge forward current | $I_{FSM}$ | 10ms sin 180°, $T_J=25°C$ | 370 | A |
| Power dissipation per Diode | $P_{tot}$ | $T_J=T_{max}$, $T_H=80°C$ | 65 | W |
| Maximum Junction Temperature | $T_{J\text{max}}$ | | 150 | °C |
Maximum Ratings

Tj=25°C, unless otherwise specified

<table>
<thead>
<tr>
<th>Parameter</th>
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<th>Condition</th>
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<td>Peak Repetitive Reverse Voltage</td>
<td>V_{RMM}</td>
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<td>V</td>
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<tr>
<td>DC forward current</td>
<td>I_f</td>
<td>T_j=T_{max}</td>
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<td>A</td>
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<tr>
<td>Surge repetitive forward current</td>
<td>I_{FSM}</td>
<td>t_s limited by T_{j,max}</td>
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<td>A</td>
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<tr>
<td>Power dissipation</td>
<td>P_{tot}</td>
<td>T_j=T_{max}</td>
<td>94</td>
<td>W</td>
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<td>Maximum Junction Temperature</td>
<td>T_{j,max}</td>
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DC link Capacitor (C1, C2)

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<td>Max.DC voltage</td>
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Thermal Properties

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<td>Storage temperature</td>
<td>T_{stg}</td>
<td></td>
<td>-40…+125</td>
<td>°C</td>
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<tr>
<td>Operation temperature under switching condition</td>
<td>T_{op}</td>
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<td>-40…+(T_{jmax} - 25)</td>
<td>°C</td>
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Insulation Properties

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<td>Insulation voltage</td>
<td>V_{is}</td>
<td>I=2s DC voltage</td>
<td>4000</td>
<td>V</td>
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<td>Creepage distance</td>
<td></td>
<td></td>
<td>min 12.7</td>
<td>mm</td>
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<tr>
<td>Clearance</td>
<td></td>
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<td>min 9.16</td>
<td>mm</td>
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### Characteristic Values

<table>
<thead>
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<th>Parameter</th>
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<th>Conditions</th>
<th>Value</th>
<th>Unit</th>
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<tr>
<td>Static drain to source ON resistance</td>
<td>$R_{DS(on)}$</td>
<td>$T_{j}=25^\circ C$</td>
<td>72</td>
<td>mΩ</td>
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<td></td>
<td></td>
<td>$T_{j}=125^\circ C$</td>
<td>32</td>
<td>mΩ</td>
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<td>Gate threshold voltage</td>
<td>$V_{GE}$</td>
<td>$T_{j}=25^\circ C$</td>
<td>52</td>
<td>V</td>
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<td></td>
<td></td>
<td>$T_{j}=125^\circ C$</td>
<td>78</td>
<td>V</td>
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<td>Gate to Source Leakage Current</td>
<td>$I_{GS}$</td>
<td>$T_{j}=25^\circ C$</td>
<td>2.25</td>
<td>mA</td>
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<td></td>
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<td>$T_{j}=125^\circ C$</td>
<td>500</td>
<td>nA</td>
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<tr>
<td>Zero Gate Voltage Drain Current</td>
<td>$I_{GS}$</td>
<td>$T_{j}=25^\circ C$</td>
<td>2</td>
<td>mA</td>
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<td></td>
<td></td>
<td>$T_{j}=125^\circ C$</td>
<td>200</td>
<td>nA</td>
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<tr>
<td>Turn On Delay Time</td>
<td>$t_{on}$</td>
<td>$T_{j}=25^\circ C$</td>
<td>13</td>
<td>ns</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$T_{j}=125^\circ C$</td>
<td>12</td>
<td>ns</td>
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<tr>
<td>Rise Time</td>
<td>$t_{r}$</td>
<td>$T_{j}=25^\circ C$</td>
<td>5</td>
<td>ns</td>
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<tr>
<td></td>
<td></td>
<td>$T_{j}=125^\circ C$</td>
<td>5</td>
<td>ns</td>
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<tr>
<td>Turn off delay time</td>
<td>$t_{off}$</td>
<td>$T_{j}=25^\circ C$</td>
<td>53</td>
<td>ns</td>
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<tr>
<td></td>
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<td>$T_{j}=125^\circ C$</td>
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<td>ns</td>
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<td>Fall time</td>
<td>$t_{f}$</td>
<td>$T_{j}=25^\circ C$</td>
<td>12</td>
<td>ns</td>
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<tr>
<td></td>
<td></td>
<td>$T_{j}=125^\circ C$</td>
<td>12</td>
<td>ns</td>
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<tr>
<td>Turn-on energy loss per pulse</td>
<td>$E_{on}$</td>
<td>$T_{j}=25^\circ C$</td>
<td>0.25</td>
<td>mWs</td>
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<td></td>
<td></td>
<td>$T_{j}=125^\circ C$</td>
<td>0.24</td>
<td>mWs</td>
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<td>Turn-off energy loss per pulse</td>
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<td>0.10</td>
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<td>$T_{j}=125^\circ C$</td>
<td>0.09</td>
<td>mWs</td>
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<td>Total gate charge</td>
<td>$Q_{g}$</td>
<td>$T_{j}=25^\circ C$</td>
<td>98.4</td>
<td>nC</td>
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<td></td>
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<td>$T_{j}=125^\circ C$</td>
<td>98</td>
<td>nC</td>
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<td>Gate to source charge</td>
<td>$Q_{gs}$</td>
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<td>21.6</td>
<td>nC</td>
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<td>$T_{j}=125^\circ C$</td>
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<td>Gate to drain charge</td>
<td>$Q_{gd}$</td>
<td>$T_{j}=25^\circ C$</td>
<td>1900</td>
<td>pF</td>
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<td></td>
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<td>$T_{j}=125^\circ C$</td>
<td>13</td>
<td>pF</td>
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<tr>
<td>Input capacitance</td>
<td>$C_{iss}$</td>
<td>$f=1MHz$</td>
<td>160</td>
<td>pF</td>
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<td>$T_{j}=25^\circ C$</td>
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<tr>
<td>Output capacitance</td>
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<td>$f=1MHz$</td>
<td>13</td>
<td>pF</td>
</tr>
<tr>
<td></td>
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<td>$T_{j}=25^\circ C$</td>
<td>13</td>
<td>pF</td>
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<tr>
<td>Reverse transfer capacitance</td>
<td>$C_{rss}$</td>
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<td>$T_{j}=25^\circ C$</td>
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<td>Thermal resistance chip to heatsink per chip</td>
<td>$R_{thJH}$</td>
<td>Phase-Change Material</td>
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<td>K/W</td>
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### Protection Diode (D1, D3)

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<thead>
<tr>
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<th>Value</th>
<th>Unit</th>
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<td>$T_{j}=25^\circ C$</td>
<td>1.24</td>
<td>V</td>
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<tr>
<td></td>
<td></td>
<td>$T_{j}=125^\circ C$</td>
<td>1.23</td>
<td>V</td>
</tr>
<tr>
<td>Reverse leakage current</td>
<td>$I_{RM}$</td>
<td>$T_{j}=25^\circ C$</td>
<td>0.05</td>
<td>mA</td>
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<tr>
<td></td>
<td></td>
<td>$T_{j}=125^\circ C$</td>
<td></td>
<td>mA</td>
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<td>Thermal resistance chip to heatsink per chip</td>
<td>$R_{thJH}$</td>
<td>Phase-Change Material</td>
<td>1.07</td>
<td>K/W</td>
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### Boost - Silicon Carbide Power Schottky Diode

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<th>Value</th>
<th>Unit</th>
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<tbody>
<tr>
<td>Forward voltage</td>
<td>$V_{F}$</td>
<td>$T_{j}=25^\circ C$</td>
<td>1.43</td>
<td>V</td>
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<td>1.72</td>
<td>V</td>
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<td>Reverse leakage current</td>
<td>$I_{RM}$</td>
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<td>30</td>
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<td>$T_{j}=175^\circ C$</td>
<td>160</td>
<td>µA</td>
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<td>Peak recovery current</td>
<td>$I_{RMS}$</td>
<td>$T_{j}=25^\circ C$</td>
<td>0.5</td>
<td>A</td>
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<td></td>
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<td>$T_{j}=150^\circ C$</td>
<td>38</td>
<td>A</td>
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<td>Reverse recovery time</td>
<td>$t_{rr}$</td>
<td>$T_{j}=25^\circ C$</td>
<td>9</td>
<td>ns</td>
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<td></td>
<td></td>
<td>$T_{j}=150^\circ C$</td>
<td>9</td>
<td>ns</td>
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<td>Reverse recovery charge</td>
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<td>µC</td>
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<td>µC</td>
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<td>Reverse recovered energy</td>
<td>$E_{rec}$</td>
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<td>mWs</td>
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<td>0.03</td>
<td>mWs</td>
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<td>Peak rate of fall of recovery current</td>
<td>$d(di/rect)_{max}$/µs</td>
<td>$T_{j}=25^\circ C$</td>
<td>13071</td>
<td>A/µs</td>
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<td></td>
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<td>$T_{j}=150^\circ C$</td>
<td>14558</td>
<td>A/µs</td>
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<td>Thermal resistance chip to heatsink per chip</td>
<td>$R_{thJH}$</td>
<td>Phase-Change Material</td>
<td>1.01</td>
<td>K/W</td>
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### Characteristic Values

<table>
<thead>
<tr>
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<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC link Capacitor (C1, C2)</td>
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<tr>
<td>C value</td>
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<td>nF</td>
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<td>R</td>
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<td>Ω</td>
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<td>Deviation of R25</td>
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<td>To=100°C</td>
<td>5</td>
<td>+5 %</td>
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<tr>
<td>Power dissipation</td>
<td>P</td>
<td>TJ=25°C</td>
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<td>mW</td>
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<td>Power dissipation constant</td>
<td>B</td>
<td>TJ=25°C</td>
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<td>mW/K</td>
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### Vincotech NTC Reference

- K3996
- 2
- 3950
- 3996
- B
INPUT BOOST

Figure 1
Typical output characteristics

\[ I_D = f(V_{DS}) \]

At
\[ t_p = 250 \mu s \]
\[ T_j = 25 \, ^\circ C \]
\[ V_{GS} \text{ from } 0 \text{ V to } 20 \text{ V in steps of } 2 \text{ V} \]

Figure 2
Typical output characteristics

\[ I_D = f(V_{DS}) \]

At
\[ t_p = 250 \mu s \]
\[ T_j = 125 \, ^\circ C \]
\[ V_{GS} \text{ from } 0 \text{ V to } 20 \text{ V in steps of } 2 \text{ V} \]

Figure 3
Typical transfer characteristics

\[ I_D = f(V_{GS}) \]

At
\[ t_p = 250 \mu s \]
\[ V_{CS} = 10 \text{ V} \]

Figure 4
Typical diode forward current as a function of forward voltage

\[ I_F = f(V_F) \]

At
\[ t_p = 250 \mu s \]
Figure 5 BOOST MOSFET
Typical switching energy losses as a function of drain current
\[ E = f(I_D) \]

With an inductive load at
- \( T_J = 25/125 \) °C
- \( V_{DS} = 700 \) V
- \( V_{GS} = 0/16 \) V
- \( R_{gon} = 2 \) Ω
- \( R_{goff} = 2 \) Ω

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

With an inductive load at
- \( T_J = 25/125 \) °C
- \( V_{DS} = 700 \) V
- \( V_{GS} = 0/16 \) V
- \( I_D = 32 \) A

Figure 7 BOOST FWD
Typical reverse recovery energy loss as a function of drain current
\[ E_{rec} = f(I_D) \]

With an inductive load at
- \( T_J = 25/125 \) °C
- \( V_{DS} = 700 \) V
- \( V_{GS} = 0/16 \) V
- \( R_{gon} = 2 \) Ω
- \( R_{goff} = 2 \) Ω

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

With an inductive load at
- \( T_J = 25/125 \) °C
- \( V_{DS} = 700 \) V
- \( V_{GS} = 0/16 \) V
- \( I_D = 32 \) A
**INPUT BOOST**

**Figure 9**  
**BOOST MOSFET**  
Typical switching times as a function of drain current

\[ t = f(I_D) \]

With an inductive load at

- \( T_J = 125 \, ^\circ\text{C} \)
- \( V_{DS} = 700 \, \text{V} \)
- \( V_{GS} = 0/16 \, \text{V} \)
- \( R_{gon} = 2 \, \Omega \)
- \( R_{goff} = 2 \, \Omega \)

**Figure 10**  
**BOOST MOSFET**  
Typical switching times as a function of gate resistor

\[ t = f(R_G) \]

With an inductive load at

- \( T_J = 125 \, ^\circ\text{C} \)
- \( V_{DS} = 700 \, \text{V} \)
- \( V_{GS} = 0/16 \, \text{V} \)
- \( I_F = 32 \, \text{A} \)

**Figure 11**  
**BOOST FWD**  
Typical reverse recovery time as a function of drain current

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

At

- \( T_J = 25/125 \, ^\circ\text{C} \)
- \( V_{DS} = 700 \, \text{V} \)
- \( V_{GS} = 0/16 \, \text{V} \)
- \( R_{gon} = 2 \, \Omega \)

**Figure 12**  
**BOOST FWD**  
Typical reverse recovery time as a function of MOSFET turn on gate resistor

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

At

- \( T_J = 25/125 \, ^\circ\text{C} \)
- \( V_{DS} = 700 \, \text{V} \)
- \( I_F = 32 \, \text{A} \)
- \( V_{GS} = 0/16 \, \text{V} \)
Figure 13: Typical reverse recovery charge as a function of drain current

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

At
- \( T_J = 25/125 \ \degree C \)
- \( V_{DS} = 700 \ \text{V} \)
- \( V_{GS} = 0/16 \ \text{V} \)
- \( R_{gon} = 2 \ \Omega \)

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

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

At
- \( T_J = 25/125 \ \degree C \)
- \( V_{DS} = 700 \ \text{V} \)
- \( I_F = 32 \ \text{A} \)
- \( V_{GS} = 0/16 \ \text{V} \)

Figure 15: Typical reverse recovery current as a function of drain current

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

At
- \( T_J = 25/125 \ \degree C \)
- \( V_{DS} = 700 \ \text{V} \)
- \( V_{GS} = 0/16 \ \text{V} \)
- \( R_{gon} = 2 \ \Omega \)

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

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

At
- \( T_J = 25/125 \ \degree C \)
- \( V_{DS} = 700 \ \text{V} \)
- \( I_F = 32 \ \text{A} \)
- \( V_{GS} = 0/16 \ \text{V} \)
Typical rate of fall of forward and reverse recovery current as a function of drain current:
\[ \frac{dl_0}{dt}, \frac{dl_{rec}}{dt} = f(I_D) \]

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

IGBT thermal model values:
\[
\begin{array}{ll}
R (K/W) & \text{Tau (s)} \\
1.34E-01 & 8.84E-01 \\
3.81E-01 & 1.39E-01 \\
2.07E-01 & 5.28E-02 \\
7.72E-02 & 5.60E-03 \\
6.49E-02 & 8.44E-04 \\
\end{array}
\]

FWD thermal model values:
\[
\begin{array}{ll}
R (K/W) & \text{Tau (s)} \\
5.83E-02 & 3.01E+00 \\
1.31E-01 & 4.50E-01 \\
4.46E-01 & 8.80E-02 \\
1.27E-01 & 2.30E-02 \\
1.77E-01 & 5.54E-03 \\
\end{array}
\]
**Figure 21**

**BOOST MOSFET**

Power dissipation as a function of heatsink temperature

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

\[ I_D = f(T_h) \]

At

\[ T_j = 150 \, ^\circ C \]

**Figure 22**

**BOOST MOSFET**

Drain current as a function of heatsink temperature

\[ I_D = f(T_h) \]

At

\[ T_j = 150 \, ^\circ C \]

\[ V_{GS} = 18 \, V \]

**Figure 23**

**BOOST FWD**

Power dissipation as a function of heatsink temperature

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

At

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

**Figure 24**

**BOOST FWD**

Forward current as a function of heatsink temperature

\[ I_F = f(T_h) \]

At

\[ T_j = 175 \, ^\circ C \]
Figure 25

BOOST MOSFET Safe operating area as a function of drain-source voltage

\[ I_D = f(V_{DS}) \]

At

- \( D = \) single pulse
- \( T_s = 80 \) °C
- \( V_{GS} = 0/16 \) V
- \( T_j = T_{J\max} \) °C

INPUT BOOST

Vincotech
INP.BOOST INVERSE DIODE

**Figure 1**  Bost inv. diode
Typical diode forward current as a function of forward voltage
\[ I_F = f(V_F) \]
At
\[ t_p = 250 \mu s \]

**Figure 2**  Boost inv. diode
Diode transient thermal impedance as a function of pulse width
\[ Z_{th,JH} = f(t_p) \]
At
\[ D = 0.5 \\
0.2 \\
0.1 \\
0.05 \\
0.02 \\
0.01 \\
0.005 \\
0.000 \]
\[ R_{th,JH} = 1.07 K/W \]

**Figure 3**  Boost inv. diode
Power dissipation as a function of heatsink temperature
\[ P_{tot} = f(T_h) \]
At
\[ T_j = 25^\circ C \]

**Figure 4**  Boost inv. diode
Forward current as a function of heatsink temperature
\[ I_F = f(T_h) \]
At
\[ T_j = 150^\circ C \]
Thermistor

Figure 1

Typical NTC characteristic as a function of temperature

$R_T = f(T)$
Switching Definition BOOST MOSFET

General conditions

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>$T_J$</td>
<td>150 °C</td>
</tr>
<tr>
<td>$R_{on}$</td>
<td>4 Ω</td>
</tr>
<tr>
<td>$R_{off}$</td>
<td>4 Ω</td>
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</table>

**Figure 1**

Boost MOSFET

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

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

- $V_{GS}(0\%) = -15$ V
- $V_{GS}(100\%) = 16$ V
- $I_D(100\%) = 32$ A
- $I_{doff} = 0.06$ μs
- $t_{Eoff} = 0.07$ μs

**Figure 2**

Boost MOSFET

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

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

- $V_{GS}(0\%) = -15$ V
- $V_{GS}(100\%) = 16$ V
- $V_{D}(100\%) = 350$ V
- $I_D(100\%) = 32$ A
- $I_{don} = 0.01$ μs
- $t_{Eon} = 0.03$ μs

**Figure 3**

Boost MOSFET

Turn-off Switching Waveforms & definition of $t_f$

- $V_{D}(100\%) = 350$ V
- $I_D(100\%) = 32$ A
- $t_f = 0.01$ μs

**Figure 4**

Boost MOSFET

Turn-on Switching Waveforms & definition of $t_r$

- $V_{D}(100\%) = 350$ V
- $I_D(100\%) = 32$ A
- $t_r = 0.005$ μs
Switching Definition BOOST MOSFET

Figure 5  
BOOST MOSFET  
Turn-off Switching Waveforms & definition of \( t_{\text{Eoff}} \)

- \( P_{\text{off}} (100\%) = 11.26 \) kW
- \( E_{\text{off}} (100\%) = 0.14 \) mJ
- \( t_{\text{Eoff}} = 0.067 \) µs

Figure 6  
BOOST MOSFET  
Turn-on Switching Waveforms & definition of \( t_{\text{Eon}} \)

- \( P_{\text{on}} (100\%) = 11.26 \) kW
- \( E_{\text{on}} (100\%) = 0.24 \) mJ
- \( t_{\text{Eon}} = 0.03 \) µs

Figure 7  
BOOST FWD  
Turn-off Switching Waveforms & definition of \( t \)

- \( V_{d} (100\%) = 350 \) V
- \( I_{d} (100\%) = 32 \) A
- \( I_{d\text{off}} (100\%) = 10 \) A
- \( t_{d} = 0.009 \) µs
Switching Definition BOOST MOSFET

Figure 6
Turn-on Switching Waveforms & definition of $t_{Qrr}$
($t_{Qrr}$ = integrating time for $Q_{rr}$)

$t_{Qrr}$ (100%) = 0.02 $\mu$s
$Q_{rr}$ (100%) = 0.15 $\mu$C

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

$P_{rec}$ (100%) = 11.26 kW
$E_{rec}$ (100%) = 0.02 mJ
$t_{Erec}$ = 0.02 $\mu$s

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## Ordering Code & Marking

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<th>in DataMatrix as</th>
<th>in packaging barcode as</th>
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### Outline

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### Pinout

```
DC+  5 6
IN1  9 10
DC-  3 4

IN2  1 11
G1   1
G3   13
S1   1
S3   12

NT   17
Th1  21
Th2  22
```

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