Features
- Neutral point clamped inverter (NPC)
- Split output eliminates cross conduction
- Ultra fast switching with MOSFET and SiC diodes
- Reactive power capability
- Low inductance layout

Target Applications
- Solar inverter
- UPS

Types
- 10-PY06NRA041FS-M413FY

Maximum Ratings

<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>Boost MOSFET</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Drain to source breakdown voltage</td>
<td>$V_{DS}$</td>
<td>$T_{j}=25^\circ C$, $T_{j}=T_{\text{max}}$</td>
<td>600</td>
<td>V</td>
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<tr>
<td>DC drain current</td>
<td>$I_D$</td>
<td>$T_{j}=80^\circ C$, $T_{j}=T_{\text{max}}$</td>
<td>37</td>
<td>A</td>
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<td>Pulsed drain current</td>
<td>$I_{pul}$</td>
<td>$I_{p}$ limited by $T_{j}=T_{\text{max}}$</td>
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<td>A</td>
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<td>Power dissipation</td>
<td>$P_{D}$</td>
<td>$T_{j}=T_{\text{max}}$</td>
<td>89</td>
<td>W</td>
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<tr>
<td>Gate-source peak voltage</td>
<td>$V_{GS}$</td>
<td></td>
<td>±20</td>
<td>V</td>
</tr>
<tr>
<td>Maximum Junction Temperature</td>
<td>$T_{j}=T_{\text{max}}$</td>
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<td>150</td>
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<thead>
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<th>Symbol</th>
<th>Condition</th>
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<tbody>
<tr>
<td>Boost FWD</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Peak Repetitive Reverse Voltage</td>
<td>$V_{RRM}$</td>
<td>$T_{j}=25^\circ C$</td>
<td>1200</td>
<td>V</td>
</tr>
<tr>
<td>DC forward current</td>
<td>$I_F$</td>
<td>$T_{j}=80^\circ C$, $T_{j}=T_{\text{max}}$</td>
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<td>A</td>
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<tr>
<td>Repetitive peak forward current</td>
<td>$I_{p}$</td>
<td>$I_{p}$ limited by $T_{j}=T_{\text{max}}$</td>
<td>36</td>
<td>A</td>
</tr>
<tr>
<td>Power dissipation</td>
<td>$P_{D}$</td>
<td>$T_{j}=T_{\text{max}}$</td>
<td>32</td>
<td>W</td>
</tr>
<tr>
<td>Maximum Junction Temperature</td>
<td>$T_{j}=T_{\text{max}}$</td>
<td></td>
<td>150</td>
<td>°C</td>
</tr>
</tbody>
</table>
## Maximum Ratings

**Parameter** | **Symbol** | **Condition** | **Value** | **Unit**
--- | --- | --- | --- | ---
### BUCK FWD

**Peak Repetitive Reverse Voltage**
- \( V_{\text{oss}} \)  
  - \( T_j=25^\circ C \)  
  - Value: 600  
  - Unit: V

**DC forward current**
- \( I_F \)  
  - \( T_j=T_{\text{max}} \)  
  - \( T_i=80^\circ C \)  
  - \( T_c=80^\circ C \)  
  - Value: 26  
  - Unit: A

**Repetitive peak forward current**
- \( I_{\text{fmm}} \)  
  - \( I_i \) limited by \( T_{\text{max}} \)  
  - Value: 114  
  - Unit: A

**Power dissipation per Diode**
- \( P_{\text{tot}} \)  
  - \( T_j=T_{\text{max}} \)  
  - \( T_i=80^\circ C \)  
  - \( T_c=80^\circ C \)  
  - Value: 70  
  - Unit: W

**Maximum Junction Temperature**
- \( T_{j,max} \)  
  - Value: 175  
  - Unit: \(^\circ C\)

### BUCK MOSFET

**Drain to source breakdown voltage**
- \( V_{\text{DS}} \)  
  - Value: 600  
  - Unit: V

**DC drain current**
- \( I_D \)  
  - \( T_j=T_{\text{max}} \)  
  - \( T_i=80^\circ C \)  
  - \( T_c=80^\circ C \)  
  - Value: 29  
  - Unit: A

**Pulsed drain current**
- \( I_{\text{pulse}} \)  
  - \( I_i \) limited by \( T_{\text{max}} \)  
  - Value: 272  
  - Unit: A

**Power dissipation**
- \( P_{\text{tot}} \)  
  - \( T_j=T_{\text{max}} \)  
  - \( T_i=80^\circ C \)  
  - \( T_c=80^\circ C \)  
  - Value: 89  
  - Unit: W

**Gate-source peak voltage**
- \( V_{\text{gs}} \)  
  - Value: ±20  
  - Unit: V

**Maximum Junction Temperature**
- \( T_{j,max} \)  
  - Value: 150  
  - Unit: \(^\circ C\)

### Thermal Properties

**Storage temperature**
- \( T_{\text{stg}} \)  
  - Value: -40...+125  
  - Unit: \(^\circ C\)

**Operation temperature under switching condition**
- \( T_{\text{op}} \)  
  - Value: -40...+(\( T_{j,max} - 25 \))  
  - Unit: \(^\circ C\)

### Insulation Properties

**Insulation voltage**
- \( V_{\text{m}} \)  
  - \( t=2s \)  
  - DC voltage  
  - Value: 4000  
  - Unit: V

**Creepage distance**
- Value: min 12.7  
  - Unit: mm

**Clearance**
- Value: min 12.7  
  - Unit: mm
### Characteristic Values

#### BOOST MOSFET

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Static drain to source ON resistance</td>
<td>R_{DS(on)}</td>
<td>V_{GS}=V_{DS}</td>
<td>44</td>
<td>T&lt;sub&gt;j&lt;/sub&gt;=25°C</td>
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<tr>
<td>Gate threshold voltage</td>
<td>V_{GS(th)}</td>
<td>V_{DS}=V_{GS}</td>
<td>2.4</td>
<td>T&lt;sub&gt;j&lt;/sub&gt;=25°C, T&lt;sub&gt;j&lt;/sub&gt;=125°C</td>
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<tr>
<td>Gate to Source Leakage Current</td>
<td>I_{gs}</td>
<td></td>
<td>20</td>
<td>T&lt;sub&gt;j&lt;/sub&gt;=25°C</td>
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<tr>
<td>Zero Gate Voltage Drain Current</td>
<td>I_{gs}</td>
<td></td>
<td>0</td>
<td>T&lt;sub&gt;j&lt;/sub&gt;=25°C</td>
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<tr>
<td>Turn On Delay Time</td>
<td>t_{ON}</td>
<td></td>
<td>10</td>
<td>T&lt;sub&gt;j&lt;/sub&gt;=25°C</td>
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<tr>
<td>Rise Time</td>
<td>t_{r}</td>
<td></td>
<td>400</td>
<td>T&lt;sub&gt;j&lt;/sub&gt;=25°C</td>
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<tr>
<td>Turn off delay time</td>
<td>t_{r(on)}</td>
<td>R_{goff}=4 Ω</td>
<td>15</td>
<td>T&lt;sub&gt;j&lt;/sub&gt;=25°C</td>
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<tr>
<td>Fall time</td>
<td>t_{f}</td>
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<td></td>
<td>T&lt;sub&gt;j&lt;/sub&gt;=25°C</td>
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<tr>
<td>Turn-on energy loss per pulse</td>
<td>E_{on}</td>
<td></td>
<td></td>
<td>T&lt;sub&gt;j&lt;/sub&gt;=25°C</td>
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<tr>
<td>Turn-off energy loss per pulse</td>
<td>E_{off}</td>
<td></td>
<td></td>
<td>T&lt;sub&gt;j&lt;/sub&gt;=25°C</td>
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<tr>
<td>Total gate charge</td>
<td>Q_{g}</td>
<td>R_{gon}=4 Ω</td>
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<td>T&lt;sub&gt;j&lt;/sub&gt;=25°C</td>
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<tr>
<td>Gate to source charge</td>
<td>Q_{gs}</td>
<td>R_{gon}=4 Ω</td>
<td>400</td>
<td>T&lt;sub&gt;j&lt;/sub&gt;=25°C</td>
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<tr>
<td>Input capacitance</td>
<td>C_{iss}</td>
<td></td>
<td>0</td>
<td>T&lt;sub&gt;j&lt;/sub&gt;=25°C</td>
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<tr>
<td>Output capacitance</td>
<td>C_{oss}</td>
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<td>T&lt;sub&gt;j&lt;/sub&gt;=25°C</td>
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<tr>
<td>Reverse transfer capacitance</td>
<td>C_{rss}</td>
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<td></td>
<td></td>
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<tr>
<td>Thermal resistance chip to heatsink per chip</td>
<td>R_{thJH}</td>
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#### BOOST FWD

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<tr>
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<tr>
<td>Forward voltage</td>
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<td>18</td>
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<td>Reverse leakage current</td>
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<td>T&lt;sub&gt;j&lt;/sub&gt;=25°C</td>
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<td>Peak recovery current</td>
<td>I_{F}</td>
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<td>T&lt;sub&gt;j&lt;/sub&gt;=25°C</td>
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<tr>
<td>Reverse recovery time</td>
<td>t_{r}</td>
<td></td>
<td></td>
<td>T&lt;sub&gt;j&lt;/sub&gt;=25°C</td>
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<tr>
<td>Reverse recovery charge</td>
<td>Q_{f}</td>
<td>R_{gon}=4 Ω</td>
<td>10</td>
<td>T&lt;sub&gt;j&lt;/sub&gt;=25°C</td>
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<tr>
<td>Reverse recovered energy</td>
<td>E_{rec}</td>
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<td></td>
<td>T&lt;sub&gt;j&lt;/sub&gt;=25°C</td>
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<tr>
<td>Peak rate of fall of recovery current</td>
<td>E_{peak}</td>
<td>Reversal</td>
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<td>T&lt;sub&gt;j&lt;/sub&gt;=25°C</td>
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<td>Thermal resistance chip to heatsink per chip</td>
<td>R_{thJH}</td>
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<td>Reverse recovery time</td>
<td>t_{r}</td>
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<td>T&lt;sub&gt;j&lt;/sub&gt;=25°C</td>
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<tr>
<td>Reverse recovered charge</td>
<td>Q_{f}</td>
<td>R_{gon}=4 Ω</td>
<td>10</td>
<td>T&lt;sub&gt;j&lt;/sub&gt;=25°C</td>
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<tr>
<td>Peak rate of fall of recovery current</td>
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<td>Reverse recovered energy</td>
<td>E_{rec}</td>
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<td></td>
<td>T&lt;sub&gt;j&lt;/sub&gt;=25°C</td>
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<tr>
<td>Thermal resistance chip to heatsink per chip</td>
<td>R_{thJH}</td>
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<td>BUCK MOSFET</td>
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<td>Static drain to source ON resistance</td>
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<td>$T=125^\circ\text{C}$</td>
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<td>nA</td>
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<td>Zero Gate Voltage Drain Current</td>
<td>$I_{\text{ds}}$</td>
<td>$V_{DS}=V_{GS}$</td>
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<td>Turn On Delay Time</td>
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<td>ns</td>
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<td>Rise Time</td>
<td>$t_{\text{r}}$</td>
<td>$R_{\text{goff}}=4\ \Omega$</td>
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<td>$t_{\text{off}}$</td>
<td>$R_{\text{gon}}=4\ \Omega$</td>
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<td>Fall time</td>
<td>$t_{\text{f}}$</td>
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<td>Turn-on energy loss per pulse</td>
<td>$E_{\text{in}}$</td>
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<td>Input capacitance</td>
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<td>Thermal resistance chip to heatsink per chip</td>
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<td>Ω</td>
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<td>Deviation of $R_{100}$</td>
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<td>$T=100^\circ\text{C}$</td>
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<td>Power dissipation</td>
<td>$P$</td>
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<td>mW</td>
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<td>Power dissipation constant</td>
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<td>mW/K</td>
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<td>B-value</td>
<td>$B_{(25\text{K})}$</td>
<td>Tol.+3%</td>
<td>3950</td>
<td>1K</td>
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<td></td>
<td>$B_{(35\text{K})}$</td>
<td>Tol.+3%</td>
<td>3996</td>
<td>1K</td>
</tr>
</tbody>
</table>

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**Figure 1**

**MOSFET**

Typical output characteristics

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

At

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

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

\[ V_{GE} \text{ from } 4 \, \text{V to } 14 \, \text{V in steps of } 1 \, \text{V} \]

**Figure 2**

**MOSFET**

Typical output characteristics

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

At

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

\[ T_j = 125\, ^\circ C \]

\[ V_{CE} \text{ from } 4 \, \text{V to } 14 \, \text{V in steps of } 1 \, \text{V} \]

**Figure 3**

**MOSFET**

Typical transfer characteristics

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

At

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

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

\[ V_{CE} = 10 \, \text{V} \]

**Figure 4**

**FWD**

Typical diode forward current as a function of forward voltage

\[ I_f = f(V_f) \]

At

\[ t_b = 250 \, \mu s \]
Figure 5  MOSFET
Typical switching energy losses as a function of collector current
\[ E = f(I_C) \]

With an inductive load at
- \( T_J = 25/125 \) °C
- \( V_{CE} = 400 \) V
- \( V_{GE} = 10 \) V
- \( R_{gon} = 4 \) Ω
- \( R_{goff} = 4 \) Ω

Figure 6  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
- \( V_{CE} = 400 \) V
- \( V_{GE} = 10 \) V
- \( I_C = 15 \) A

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

With an inductive load at
- \( T_J = 25/125 \) °C
- \( V_{CE} = 400 \) V
- \( V_{GE} = 10 \) V
- \( R_{gon} = 4 \) Ω

Figure 8  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
- \( V_{CE} = 400 \) V
- \( V_{GE} = 10 \) V
- \( I_C = 15 \) A
Figure 9: MOSFET
Typical switching times as a function of collector current
\( t = f(I_C) \)

With an inductive load at
\[ T_j = 125 °C \]
\[ V_{CE} = 400 \text{ V} \]
\[ V_{GE} = 10 \text{ V} \]
\[ R_{gon} = 4 \text{ Ω} \]
\[ R_{goff} = 4 \text{ Ω} \]

Figure 10: MOSFET
Typical switching times as a function of gate resistor
\( t = f(R_g) \)

With an inductive load at
\[ T_j = 125 °C \]
\[ V_{CE} = 400 \text{ V} \]
\[ V_{GE} = 10 \text{ V} \]
\[ I_c = 15 \text{ A} \]

Figure 11: FWD
Typical reverse recovery time as a function of collector current
\( t_{rr} = f(I_C) \)

At
\[ T_j = 25/125 °C \]
\[ V_{CE} = 400 \text{ V} \]
\[ V_{GE} = 10 \text{ V} \]
\[ R_{gon} = 4 \text{ Ω} \]

Figure 12: FWD
Typical reverse recovery time as a function of MOSFET turn on gate resistor
\( t_{rr} = f(R_{gon}) \)

At
\[ T_j = 25/125 °C \]
\[ V_{CE} = 400 \text{ V} \]
\[ I_c = 15 \text{ A} \]
\[ V_{GE} = 10 \text{ V} \]
Typical reverse recovery charge as a function of collector current
\[ Q_{rr} = f(I_C) \]

At
\[ T_J = 25/125 \, ^\circ C \]
\[ V_{CE} = 400 \, V \]
\[ V_{GE} = 10 \, V \]
\[ R_{gon} = 4 \, \Omega \]

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

At
\[ T_J = 25/125 \, ^\circ C \]
\[ V_{CE} = 400 \, V \]
\[ V_{GE} = 10 \, V \]

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Typical rate of fall of forward and reverse recovery current as a function of collector current
\[ \frac{dI_0}{dt}, \frac{dI_{rec}}{dt} = f(I_c) \]

At
\[ T_j = 25/125 \degree C \]
\[ V_{CE} = 400 \text{ V} \]
\[ V_{GE} = 10 \text{ V} \]
\[ R_{gon} = 4 \text{ } \Omega \]

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

At
\[ D = \frac{t_p}{T} \]
\[ R_{thJH} = 0.79 \text{ KW} \]

MOSFET thermal model values

\[ \begin{array}{c|c}
R (C/W) & \tau (s) \\
0.02 & 9.8E+00 \\
0.11 & 1.9E+00 \\
0.24 & 3.6E-01 \\
0.29 & 1.3E-01 \\
0.09 & 2.1E-02 \\
0.03 & 2.1E-03 \\
\end{array} \]

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

At
\[ D = \frac{t_p}{T} \]
\[ R_{thJH} = 1.35 \text{ KW} \]

FWD thermal model values

\[ \begin{array}{c|c}
R (C/W) & \tau (s) \\
0.03 & 6.3E+00 \\
0.08 & 1.2E+00 \\
0.35 & 2.4E-01 \\
0.36 & 7.7E-02 \\
0.28 & 1.4E-02 \\
0.21 & 3.2E-03 \\
\end{array} \]
**BUCK**

**Figure 21**

Power dissipation as a function of heatsink temperature

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

At

\[ T_j = 150 \degree C \]

**Figure 22**

Collector current as a function of heatsink temperature

\[ I_C = f(T_h) \]

At

\[ T_j = 150 \degree C \]

**Figure 23**

Power dissipation as a function of heatsink temperature

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

At

\[ T_j = 175 \degree C \]

**Figure 24**

Forward current as a function of heatsink temperature

\[ I_F = f(T_h) \]

At

\[ T_j = 175 \degree C \]
**Figure 25**

Safe operating area as a function of collector-emitter voltage

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

**Figure 26**

Gate voltage vs Gate charge

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

At

- \( D = \) single pulse
- \( T_{Th} = 80 \) °C
- \( V_{GE} = 15 \) V
- \( T_j = T_{j\text{max}} \) °C

BUCK
Figure 1
Typical output characteristics
\( I_D = f(V_{DS}) \)

At
\( t_p = 250 \mu s \)
\( T_j = 25 \degree C \)
\( V_{GS} \) from 4 V to 14 V in steps of 1 V

Figure 2
Typical output characteristics
\( I_D = f(V_{DS}) \)

At
\( t_p = 250 \mu s \)
\( T_j = 125 \degree C \)
\( V_{GS} \) from 4 V to 14 V in steps of 1 V

Figure 3
Typical transfer characteristics
\( I_D = f(V_{GS}) \)

At
\( t_p = 250 \mu s \)
\( T_j = 25 \degree C \)
\( V_{DS} = 10 \) 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 collector current  
$E = f(I_D)$  

With an inductive load at  
$T_J = 25/125 \, ^\circ C$  
$V_{DS} = 400 \, V$  
$V_{GS} = 10 \, V$  
$R_{gon} = 4 \, \Omega$  
$R_{goff} = 4 \, \Omega$

![Graph showing typical switching energy losses as a function of collector current.](image)

**Figure 6**  
**BOOST MOSFET**  
Typical switching energy losses as a function of gate resistor  
$E = f(R_g)$  

With an inductive load at  
$T_J = 25/125 \, ^\circ C$  
$V_{DS} = 400 \, V$  
$V_{GS} = 10 \, V$  
$I_D = 15 \, A$

![Graph showing typical switching energy losses as a function of gate resistor.](image)

**Figure 7**  
**BOOST FWD**  
Typical reverse recovery energy loss as a function of collector (drain) current  
$E_{rec} = f(I_C)$  

With an inductive load at  
$T_J = 25/125 \, ^\circ C$  
$V_{DS} = 400 \, V$  
$V_{GS} = 10 \, V$  
$R_{gon} = 4 \, \Omega$  
$R_{goff} = 4 \, \Omega$

![Graph showing typical reverse recovery energy loss as a function of collector (drain) current.](image)

**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  
$T_J = 25/125 \, ^\circ C$  
$V_{DS} = 400 \, V$  
$V_{GS} = 10 \, V$  
$I_D = 15 \, A$

![Graph showing typical reverse recovery energy loss as a function of gate resistor.](image)
Figure 9
Typical switching times as a function of collector current
$t = f(I_C)$

With an inductive load at
$T_j = 25/125 \, ^\circ\text{C}$
$V_{DS} = 400 \, \text{V}$
$V_{GS} = 10 \, \text{V}$
$R_{gon} = 4 \, \Omega$
$R_{goff} = 4 \, \Omega$

Figure 10
Typical switching times as a function of gate resistor
$t = f(R_g)$

With an inductive load at
$T_j = 25/125 \, ^\circ\text{C}$
$V_{DS} = 400 \, \text{V}$
$V_{GS} = 10 \, \text{V}$
$I_C = 15 \, \text{A}$

Figure 11
Typical reverse recovery time as a function of collector current
$trr = f(I_C)$

At
$T_j = 25/125 \, ^\circ\text{C}$
$V_{DS} = 400 \, \text{V}$
$V_{GS} = 10 \, \text{V}$
$R_{gon} = 4 \, \Omega$

Figure 12
Typical reverse recovery time as a function of MOSFET turn-on gate resistor
$trr = f(R_{gon})$

At
$T_j = 25/125 \, ^\circ\text{C}$
$V_{DS} = 400 \, \text{V}$
$I_C = 15 \, \text{A}$
$V_{GS} = 10 \, \text{V}$
Figure 13 | BOOST FWD
Typical reverse recovery charge as a function of collector current
\[ Q_{rr} = f(I_C) \]

At
- \( T_J = 25/125 \) °C
- \( V_{CE} = 400 \) V
- \( V_{GS} = 10 \) V
- \( R_{\text{gon}} = 4 \) Ω

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

At
- \( T_J = 25/125 \) °C
- \( V_{BE} = 400 \) V
- \( I_F = 15 \) A
- \( V_{GS} = 10 \) V

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

At
- \( T_J = 25/125 \) °C
- \( V_{CE} = 400 \) V
- \( V_{GS} = 10 \) V
- \( R_{\text{gon}} = 4 \) Ω

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

At
- \( T_J = 25/125 \) °C
- \( V_{BE} = 400 \) V
- \( I_F = 15 \) A
- \( V_{GS} = 10 \) V
Typical rate of fall of forward and reverse recovery current as a function of collector current
\[ \frac{dI_0}{dt}, \frac{dI_{rec}}{dt} = f(I_c) \]

At
\[ T_j = 25/125 \degree C \]
\[ V_{CE} = 400 \text{ V} \]
\[ V_{GE} = 10 \text{ V} \]
\[ R_{gon} = 4 \Omega \]

MOSFET transient thermal impedance
\[ Z_{thJH} = f(t_p) \]

At
\[ D = \frac{t_p}{T} \]
\[ R_{thJH} = 0.79 \text{ KW} \]

MOSFET thermal model values
<table>
<thead>
<tr>
<th>R (C/W)</th>
<th>Tau (s)</th>
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<tbody>
<tr>
<td>2.44E-02</td>
<td>9.81E+00</td>
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<td>1.06E-01</td>
<td>1.90E+00</td>
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<td>2.44E-01</td>
<td>3.62E-01</td>
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<td>2.92E-01</td>
<td>1.34E-01</td>
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<td>2.12E-02</td>
</tr>
<tr>
<td>2.59E-02</td>
<td>2.13E-03</td>
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</tbody>
</table>

FWD transient thermal impedance
\[ Z_{thJH} = f(t_p) \]

At
\[ D = \frac{t_p}{T} \]
\[ R_{thJH} = 2.21 \text{ KW} \]

FWD thermal model values
<table>
<thead>
<tr>
<th>R (C/W)</th>
<th>Tau (s)</th>
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<tbody>
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<td>4.33E-02</td>
<td>7.21E+00</td>
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<td>1.08E+00</td>
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<td>6.31E-01</td>
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<tr>
<td>3.64E-01</td>
<td>1.40E-02</td>
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<tr>
<td>2.13E-01</td>
<td>2.62E-03</td>
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</tbody>
</table>
Figure 21  BOOST MOSFET
Power dissipation as a function of heatsink temperature
\( P_{\text{tot}} = f(T_h) \)

At
\( T_j = 150 \, ^\circ C \)

Figure 22  BOOST MOSFET
Collector/Drain current as a function of heatsink temperature
\( I_C = f(T_h) \)

At
\( T_j = 150 \, ^\circ C \)
\( V_{GS} = 10 \, V \)

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

At
\( T_j = 150 \, ^\circ C \)

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

At
\( T_j = 150 \, ^\circ C \)
Figure 25  BOOST MOSFET
Safe operating area as a function of drain-source voltage

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

Figure 26  BOOST MOSFET
Gate voltage vs Gate charge

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

At
\[ D = \text{single pulse} \]
\[ T_s = 80 \, ^{\circ}C \]
\[ V_{GS} = 10 \, V \]
\[ T_j = T_{j\text{max}} \, ^{\circ}C \]

\[ I_D = 44 \, A \]
Thermistor

Figure 1

Typical NTC characteristic
as a function of temperature

\[ R_T = f(T) \]
Switching Definitions BOOST MOSFET

General conditions

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>( T_j )</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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</table>

Figure 1

Turn-off Switching Waveforms & definition of \( t_{off} \), \( t_{Eoff} \)

\( t_{off} \) = integrating time for \( E_{off} \)

\( V_{GE} \) (0%) = 0 V
\( V_{GE} \) (100%) = 10 V
\( V_C \) (100%) = 800 V
\( I_C \) (100%) = 15 A
\( t_{off} \) = 0.24 \( \mu \)s
\( t_{Eoff} \) = 0.25 \( \mu \)s

---

Figure 2

Turn-on Switching Waveforms & definition of \( t_{on} \), \( t_{Eon} \)

\( t_{on} \) = integrating time for \( E_{on} \)

\( V_{GE} \) (0%) = 0 V
\( V_{GE} \) (100%) = 10 V
\( V_C \) (100%) = 800 V
\( I_C \) (100%) = 15 A
\( t_{on} \) = 0.02 \( \mu \)s
\( t_{Eon} \) = 0.04 \( \mu \)s

Figure 3

Turn-off Switching Waveforms & definition of \( t_f \)

\( t_f \) = 0.01 \( \mu \)s

---

Figure 4

Turn-on Switching Waveforms & definition of \( t_r \)

\( t_r \) = 0.01 \( \mu \)s
Switching Definitions BOOST MOSFET

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

- $P_{off}(100\%) = 12.02$ kW
- $E_{off}(100\%) = 0.10$ mJ
- $t_{Eoff} = 0.25$ μs

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

- $P_{on}(100\%) = 12.024$ kW
- $E_{on}(100\%) = 0.26$ mJ
- $t_{Eon} = 0.03575$ μs

Figure 7  
Gate voltage vs Gate charge (measured)

- $V_{GEoff} = 0$ V
- $V_{GEon} = 10$ V
- $V_{C}(100\%) = 800$ V
- $I_{C}(100\%) = 15$ A
- $Q_{g} = 125.90$ nC

Figure 8  
Turn-off Switching Waveforms & definition of $t_{rr}$

- $V_{d}(100\%) = 800$ V
- $I_{d}(100\%) = 15$ A
- $I_{RRM}(100\%) = -60$ A
- $t_{rr} = 0.03$ μs
Switching Definitions BOOST MOSFET

Figure 9  BOOST FWD
Turn-on Switching Waveforms & definition of $t_{Qrr}$
($t_{Qrr} = \text{integrating time for } Q_{rr}$)

- $I_{d} (100\%) = 15$ A
- $Q_{rr} (100\%) = 3.02 \mu\text{C}$
- $t_{Qrr} = 1.00 \mu\text{s}$

Figure 10  BOOST FWD
Turn-on Switching Waveforms & definition of $t_{Erec}$
($t_{Erec} = \text{integrating time for } E_{rec}$)

- $P_{rec} (100\%) = 12.02$ kW
- $E_{rec} (100\%) = 1.04 \text{ mJ}$
- $t_{Erec} = 1.00 \mu\text{s}$
Switching Definitions BUCK MOSFET

General conditions

<table>
<thead>
<tr>
<th>$T_J$</th>
<th>125 °C</th>
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<tbody>
<tr>
<td>$R_{on}$</td>
<td>4 Ω</td>
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<tr>
<td>$R_{on}$</td>
<td>4 Ω</td>
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</table>

Figure 1
Turn-off Switching Waveforms & definition of $t_{off}$, $t_{on}$

$t_{off} = \text{integrating time for } E_{off}$

$V_{GE} (0\%) = 0 \text{ V}$
$V_{GE} (100\%) = 10 \text{ V}$
$V_{C}(100\%) = 800 \text{ V}$
$I_c(100\%) = 15 \text{ A}$
$t_{off} = 0.20 \mu\text{s}$
$t_{on} = 0.21 \mu\text{s}$

Figure 2
Turn-on Switching Waveforms & definition of $t_{turn}$, $t_{con}$

$t_{con} = \text{integrating time for } E_{con}$

$V_{GE} (0\%) = 0 \text{ V}$
$V_{GE} (100\%) = 10 \text{ V}$
$V_{C}(100\%) = 800 \text{ V}$
$I_c(100\%) = 15 \text{ A}$
$t_{turn} = 0.03 \mu\text{s}$
$t_{con} = 0.05 \mu\text{s}$

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

$V_{C}(100\%) = 800 \text{ V}$
$I_c(100\%) = 15 \text{ A}$
$t_f = 0.01 \mu\text{s}$

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

$V_{C}(100\%) = 800 \text{ V}$
$I_c(100\%) = 15 \text{ A}$
$t_r = 0.01 \mu\text{s}$
Switching Definitions BUCK MOSFET

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

- $P_{\text{off}} (100\%) = 12.03$ kW
- $E_{\text{off}} (100\%) = 0.04$ mJ
- $t_{\text{Eoff}} = 0.21$ $\mu$s

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

- $P_{\text{on}} (100\%) = 12.03$ kW
- $E_{\text{on}} (100\%) = 0.10$ mJ
- $t_{\text{Eon}} = 0.05$ $\mu$s

**Figure 7** BUCK FWD
Gate voltage vs Gate charge (measured)

- $V_{\text{GEOFF}} = 0$ V
- $V_{\text{GEON}} = 10$ V
- $V_{\text{D}} (100\%) = 800$ V
- $I_{\text{D}} (100\%) = 15$ A
- $Q_{\text{g}} = 171.57$ nC

**Figure 8** BUCK MOSFET
Turn-off Switching Waveforms & definition of $t_{\text{rr}}$

- $V_{\text{D}} (100\%) = 800$ V
- $I_{\text{D}} (100\%) = 15$ A
- $I_{\text{RRM}} (100\%) = -13$ A
- $t_{\text{rr}} = 0.01$ $\mu$s
Switching Definitions BUCK MOSFET

Figure 9
Turn-on Switching Waveforms & definition of \( t_{Qr} \)
\((t_{Qrr} = \text{integrating time for } Q_r)\)

- \( I_d (100\%) = 15 \) A
- \( Q_r (100\%) = 0.08 \) \( \mu \)C
- \( t_{Qrr} = 0.11 \) \( \mu \)s

Figure 10
Turn-on Switching Waveforms & definition of \( t_{Erec} \)
\((t_{Erec} = \text{integrating time for } E_{rec})\)

- \( P_{rec} (100\%) = 12.03 \) kW
- \( E_{rec} (100\%) = 0.01 \) mJ
- \( t_{Erec} = 0.11 \) \( \mu \)s

Measurement circuits

Figure 11
BUCK stage switching measurement circuit

Figure 12
BOOST stage switching measurement circuit
Ordering Code and Marking - Outline - Pinout

### Ordering Code & Marking

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

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### Pinout

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Revision: 1
## PRODUCT STATUS DEFINITIONS

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<th>Datasheet Status</th>
<th>Product Status</th>
<th>Definition</th>
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<td>Target</td>
<td>Formative or In Design</td>
<td>This datasheet contains the design specifications for product development. Specifications may change in any manner without notice. The data contained is exclusively intended for technically trained staff.</td>
</tr>
<tr>
<td>Preliminary</td>
<td>First Production</td>
<td>This datasheet contains preliminary data, and supplementary data may be published at a later date. Vincotech reserves the right to make changes at any time without notice in order to improve design. The data contained is exclusively intended for technically trained staff.</td>
</tr>
<tr>
<td>Final</td>
<td>Full Production</td>
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