## 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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<tr>
<td><strong>Buck Diode</strong></td>
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<tr>
<td>Peak Repetitive Reverse Voltage</td>
<td>V_{rms}</td>
<td>T_{j}=25°C</td>
<td>600</td>
<td>V</td>
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<tr>
<td>DC forward current</td>
<td>I_{f}</td>
<td>T_{j}=T_{j}\text{max} T_{c}=80°C</td>
<td>25</td>
<td>A</td>
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<td>Repetitive peak forward current</td>
<td>I_{f\text{rms}}</td>
<td>I_{f} limited by T_{j}\text{max}</td>
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<td>Power dissipation per Diode</td>
<td>P_{tot}</td>
<td>T_{j}=T_{j}\text{max} T_{c}=80°C</td>
<td>36</td>
<td>W</td>
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<tr>
<td>Maximum Junction Temperature</td>
<td>T_{j}\text{max}</td>
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<td>150</td>
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<td><strong>Buck MOSFET</strong></td>
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<tr>
<td>Drain to source breakdown voltage</td>
<td>V_{\text{DS}}</td>
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<td>DC drain current</td>
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<td>Pulsed drain current</td>
<td>I_{\text{DS\text{pulse}}}</td>
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### Maximum Ratings

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

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<th>Parameter</th>
<th>Symbol</th>
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<td><strong>Boost IGBT</strong></td>
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<td>Collector-emitter break down voltage</td>
<td>$V_{CE}$</td>
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<td>±20 6</td>
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<td>$V_{CC}$</td>
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<tr>
<td>Peak Repetitive Reverse Voltage</td>
<td>$V_{RMM}$</td>
<td>$T_j=25^\circ C$</td>
<td>600 6</td>
<td>V</td>
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<tr>
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<td>W</td>
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<td>$T_{j,max}$</td>
<td>$T_{th}=80^\circ C$</td>
<td>150 150</td>
<td>°C</td>
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<tr>
<td><strong>Boost Diode</strong></td>
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<td>Peak Repetitive Reverse Voltage</td>
<td>$V_{RMM}$</td>
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<td>Repetitive peak forward current</td>
<td>$I_{F_{RMM}}$</td>
<td>$I_L$ limited by $T_{max}$</td>
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<td>Power dissipation per Diode</td>
<td>$P_{tot}$</td>
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<td>W</td>
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<td>Maximum Junction Temperature</td>
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<td>150 150</td>
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<td><strong>Thermal Properties</strong></td>
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<td>Storage temperature</td>
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<td>$T_{Op}$</td>
<td>-40...+125</td>
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<td>Operation temperature under switching condition</td>
<td>$T_{op}$</td>
<td>$T_{max}$</td>
<td>-40...+(Tjmax - 25)</td>
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<td><strong>Insulation Properties</strong></td>
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<td>Insulation voltage</td>
<td>$V_{in}$</td>
<td>$t=2s$ $DC$</td>
<td>4000 4000</td>
<td>V</td>
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<td>Creepage distance</td>
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<td>min 12.7</td>
<td>mm</td>
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<tr>
<td>Clearance</td>
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<td>min 12.7</td>
<td>mm</td>
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## Characteristic Values

### Buck Diode

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Value</th>
<th>Unit</th>
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<tbody>
<tr>
<td>Diode forward voltage</td>
<td>( V_D )</td>
<td>( T_J=25^\circ C )</td>
<td>2.25</td>
<td>V</td>
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<tr>
<td>Peak reverse recovery current</td>
<td>( I_{\text{fmax}} )</td>
<td>( T_J=125^\circ C )</td>
<td>2.7</td>
<td>V</td>
</tr>
<tr>
<td>Reverse recovery time</td>
<td>( t_{\text{rec}} )</td>
<td>( R_{\text{gon}}=8 , \Omega )</td>
<td>30</td>
<td>ns</td>
</tr>
<tr>
<td>Reverse recovered charge</td>
<td>( Q_{\text{erec}} )</td>
<td>( R_{\text{gon}}=8 , \Omega )</td>
<td>30</td>
<td>ns</td>
</tr>
<tr>
<td>Peak of fall of recovery charge</td>
<td>( I_{\text{rec}} )</td>
<td>( T_J=25^\circ C )</td>
<td>167.43</td>
<td>A/\mu s</td>
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<td>Reverse recovered energy</td>
<td>( E_{\text{rec}} )</td>
<td>( T_J=125^\circ C )</td>
<td>155.17</td>
<td>A/\mu s</td>
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<tr>
<td>Thermal resistance chip to heatsink per chip</td>
<td>( R_{\text{thJH}} )</td>
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<td>1.95</td>
<td>K/W</td>
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### Buck MOSFET

<table>
<thead>
<tr>
<th>Parameter</th>
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<th>Value</th>
<th>Unit</th>
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<tbody>
<tr>
<td>Static drain to source ON resistance</td>
<td>( R_{\text{ds(on)}} )</td>
<td>( f=1 , \text{MHz} )</td>
<td>44</td>
<td>m\Omega</td>
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<tr>
<td>Gate threshold voltage</td>
<td>( V_{\text{G(th)}} )</td>
<td>( V_{\text{DS}=V_{\text{GS}}} )</td>
<td>0.003</td>
<td>V</td>
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<td>Gate to Source Leakage Current</td>
<td>( I_{\text{gss}} )</td>
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<td>nA</td>
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<tr>
<td>Zero Gate Voltage Drain Current</td>
<td>( I_{\text{gs}} )</td>
<td>( T_J=25^\circ C )</td>
<td>25</td>
<td>\mu A</td>
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<tr>
<td>Turn On Delay Time</td>
<td>( t_{\text{on}} )</td>
<td>( R_{\text{gon}}=8 , \Omega )</td>
<td>15</td>
<td>ns</td>
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<tr>
<td>Rise Time</td>
<td>( t_{\text{r}} )</td>
<td>( R_{\text{gon}}=8 , \Omega )</td>
<td>350</td>
<td>ns</td>
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<tr>
<td>Turn off delay time</td>
<td>( t_{\text{off}} )</td>
<td>( R_{\text{gon}}=8 , \Omega )</td>
<td>350</td>
<td>ns</td>
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<tr>
<td>Fall time</td>
<td>( t_{\text{f}} )</td>
<td>( R_{\text{gon}}=8 , \Omega )</td>
<td>350</td>
<td>ns</td>
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<tr>
<td>Turn-on energy loss per pulse</td>
<td>( E_{\text{on}} )</td>
<td>( T_J=25^\circ C )</td>
<td>0.161</td>
<td>mWs</td>
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<td>Turn-off energy loss per pulse</td>
<td>( E_{\text{off}} )</td>
<td>( T_J=125^\circ C )</td>
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<td>mWs</td>
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<tr>
<td>Total gate charge</td>
<td>( Q_{\text{g}} )</td>
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<td>nC</td>
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<td>Gate to source charge</td>
<td>( Q_{\text{gs}} )</td>
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<td>Gate to drain charge</td>
<td>( Q_{\text{gd}} )</td>
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<td>nC</td>
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<tr>
<td>Input capacitance</td>
<td>( C_{\text{iss}} )</td>
<td>( f=1 , \text{MHz} )</td>
<td>6800</td>
<td>pF</td>
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<td>Output capacitance</td>
<td>( C_{\text{oss}} )</td>
<td>( T_J=25^\circ C )</td>
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<td>Thermal resistance chip to heatsink per chip</td>
<td>( R_{\text{thJH}} )</td>
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### Characteristic Values

<table>
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<td>Gate emitter threshold voltage</td>
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<td>$V_{CE(sat)}$</td>
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<td>Collector-emitter saturation voltage</td>
<td>$V_{CE(sat)}$</td>
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<td>Collector-emitter cut-off incl diode</td>
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<td>Gate-emitter leakage current</td>
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<td>Integrated Gate resistor</td>
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<td>Turn-on delay time</td>
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<tr>
<td>Rise time</td>
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<tr>
<td>Turn-off delay time</td>
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<td>Fall time</td>
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<td>Turn-on energy loss per pulse</td>
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<td>Turn-off energy loss per pulse</td>
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<td>Output capacitance</td>
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<td>Reverse transfer capacitance</td>
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<td>Gate charge</td>
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<td>Thermal resistance chip to heatsink per chip</td>
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<td>Diode forward voltage</td>
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<td>Thermal resistance chip to heatsink per chip</td>
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<td>Diode forward voltage</td>
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<td>Reverse recovered charge</td>
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<td>Peak rate of fall of recovery current</td>
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<td>Reverse recovery energy</td>
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<td>Thermal resistance chip to heatsink per chip</td>
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<td>B-value</td>
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* see details on Thermistor charts on Figure 2.
Buck

Figure 1
Typical output characteristics
$IC = f(VCE)$

At
$tp = 250 \ \mu s$
$Tj = 25 \ ^\circ C$
$V_{GE}$ from 4 V to 14 V / Condition

Figure 2
Typical output characteristics
$IC = f(VCE)$

At
$tp = 250 \ \mu s$
$Tj = 125 \ ^\circ C$
$V_{GE}$ from 4 V to 14 V in steps of 1 V

Figure 3
Typical transfer characteristics
$IC = f(VGE)$

Figure 4
Typical diode forward current as a function of forward voltage
$IF = f(VF)$

At
$tp = 250 \ \mu s$
$V_{CE}$ = 10 V
$Tj = 25 \ ^\circ C$
$Tj = T_{j_{\text{max}}}-25 \ ^\circ C$

At
$tp = 250 \ \mu s$
$Tj = 25 \ ^\circ C$

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Figure 5  
Typical switching energy losses as a function of collector current  
\( E = f(I_C) \)  
With an inductive load at  
\( T_j = 25/125 \, ^\circ \text{C} \)  
\( V_{CE} = 350 \, \text{V} \)  
\( V_{GE} = 15 \, \text{V} \)  
\( R_{gon} = 8 \, \Omega \)  
\( R_{goff} = 8 \, \Omega \)  

Figure 6  
Typical switching energy losses as a function of gate resistor  
\( E = f(R_G) \)  
With an inductive load at  
\( T_j = 25/125 \, ^\circ \text{C} \)  
\( V_{CE} = 350 \, \text{V} \)  
\( V_{GE} = 15 \, \text{V} \)  
\( I_C = 30 \, \text{A} \)  

Figure 7  
Typical reverse recovery energy loss as a function of collector current  
\( E_{\text{rec}} = f(I_C) \)  
With an inductive load at  
\( T_j = 25/125 \, ^\circ \text{C} \)  
\( V_{CE} = 350 \, \text{V} \)  
\( V_{GE} = 15 \, \text{V} \)  
\( R_{gon} = 8 \, \Omega \)  

Figure 8  
Typical reverse recovery energy loss as a function of gate resistor  
\( E_{\text{rec}} = f(R_G) \)  
With an inductive load at  
\( T_j = 25/125 \, ^\circ \text{C} \)  
\( V_{CE} = 350 \, \text{V} \)  
\( V_{GE} = 15 \, \text{V} \)  
\( I_C = 30 \, \text{A} \)
Figure 9 MOSFET
Typical switching times as a function of collector current
\( t = f(I_C) \)

With an inductive load at
\( T_j = 125 \, ^\circ C \)
\( V_{CE} = 350 \, V \)
\( V_{GE} = 15 \, V \)
\( R_{gon} = 8 \, \Omega \)
\( R_{goff} = 8 \, \Omega \)

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

With an inductive load at
\( T_j = 125 \, ^\circ C \)
\( V_{CE} = 350 \, V \)
\( V_{GE} = 15 \, V \)
\( I_c = 30 \, A \)

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

At
\( T_j = 25/125 \, ^\circ C \)
\( V_{CE} = 350 \, V \)
\( V_{GE} = 15 \, V \)
\( R_{gon} = 8 \, \Omega \)

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

At
\( T_j = 25/125 \, ^\circ C \)
\( V_{CE} = 350 \, V \)
\( I_r = 30 \, A \)
\( V_{GE} = 15 \, V \)
Typical reverse recovery charge as a function of collector current

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

At

- \( T_J = 25/125 \) °C
- \( V_{CE} = 350 \) V
- \( V_G = 15 \) V
- \( R_{gon} = 8 \) Ω

Typical reverse recovery current as a function of collector current

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

At

- \( T_J = 25/125 \) °C
- \( V_{CE} = 350 \) V
- \( V_G = 15 \) V
- \( R_{gon} = 8 \) Ω
Typical rate of fall of forward and reverse recovery current
as a function of collector current
g\text{d}i_0/\text{d}t, g\text{d}i_{rec}/\text{d}t = f(\text{I}_c)

At
\text{T}_j = 25/125 \, ^\circ\text{C}
\text{V}_{CE} = 350 \, \text{V}
\text{V}_{GE} = 15 \, \text{V}
R_{gon} = 8 \, \Omega

IGBT transient thermal impedance as a function of pulse width
Z_{thJH} = f(t_p)

At
D = t_p / T
R_{\Theta JH} = 0.56 \, \text{K/W}

IGBT thermal model values
R (\text{C/W}) \quad \text{Tau (s)}
0.04 \quad 8.6E+00
0.13 \quad 1.4E+00
0.23 \quad 2.2E-01
0.09 \quad 3.6E-02
0.03 \quad 5.0E-03
0.05 \quad 2.6E-04

FRED thermal model values
R (\text{C/W}) \quad \text{Tau (s)}
0.06 \quad 7.9E+00
0.24 \quad 1.0E+00
0.90 \quad 1.4E-01
0.50 \quad 3.1E-02
0.17 \quad 3.7E-03
0.09 \quad 5.7E-04
Buck

**Figure 21** MOSFET
Power dissipation as a function of heatsink temperature
\[ P_{tot} = f(T_h) \]

\[ I_C = f(T_h) \]

At

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

- single heating
- overall heating

**Figure 22** MOSFET
Collector current as a function of heatsink temperature
\[ I_C = f(T_h) \]

At

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

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

**Figure 23** FRED
Power dissipation as a function of heatsink temperature
\[ P_{tot} = f(T_h) \]

**Figure 24** FRED
Forward current as a function of heatsink temperature
\[ I_F = f(T_h) \]

At

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

Figure 25
Safe operating area as a function of collector-emitter voltage

$IC = f(V_{CE})$

Figure 26
Gate voltage vs Gate charge

$V_{GE} = f(Q_g)$

At

- $D =$ single pulse
- $T_{th} =$ 80 $^\circ$C
- $V_{GE} =$ 15 V
- $T_j =$ $T_{j_{max}}$ $^\circ$C

$IC = 30$ A
**Boost**

**Figure 1**
Typical output characteristics
\( I_C = f(V_{CE}) \)

- At
  - \( t_{p} = 250 \) μs
  - \( T_j = 25 \) °C
  - \( V_{CE} \) from 7 V to 17 V in steps of 1 V

**Figure 2**
Typical output characteristics
\( I_C = f(V_{CE}) \)

- At
  - \( t_{p} = 250 \) μs
  - \( T_j = 125 \) °C
  - \( V_{CE} \) from 7 V to 17 V in steps of 1 V

**Figure 3**
Typical transfer characteristics
\( I_C = f(V_{GE}) \)

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

At
- \( I_F = 250 \) μs
- \( V_{CE} = 10 \) V
- \( T_j = T_{j_{max}} - 25 \) °C
- \( T_j = 25 \) °C
Typical switching energy losses as a function of collector current

$$E = f(I_C)$$

With an inductive load at

- $$T_J = 25/125 \, ^\circ C$$
- $$V_{CE} = 350 \, V$$
- $$V_{GE} = 15 \, V$$
- $$R_{gon} = 8 \, \Omega$$
- $$I_C = 30 \, A$$

Typical reverse recovery energy loss as a function of collector current

$$E_{rec} = f(I_C)$$

With an inductive load at

- $$T_J = 25/125 \, ^\circ C$$
- $$V_{CE} = 350 \, V$$
- $$V_{GE} = 15 \, V$$
- $$R_{gon} = 8 \, \Omega$$
Figure 9  IGBT
Typical switching times as a function of collector current
\( t = f(I_C) \)

With an inductive load at
- \( T_j = 25/125 \, ^\circ C \)
- \( V_{CE} = 350 \, V \)
- \( V_{GE} = 15 \, V \)
- \( R_{gon} = 8 \, \Omega \)
- \( R_{goff} = 8 \, \Omega \)

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

With an inductive load at
- \( T_j = 25/125 \, ^\circ C \)
- \( V_{CE} = 350 \, V \)
- \( V_{GE} = 15 \, V \)
- \( I_C = 30 \, A \)

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

At
- \( T_j = 25/125 \, ^\circ C \)
- \( V_{CE} = 350 \, V \)
- \( V_{GE} = 15 \, V \)
- \( R_{gon} = 8 \, \Omega \)

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

At
- \( T_j = 25/125 \, ^\circ C \)
- \( V_{BE} = 350 \, V \)
- \( I_C = 30 \, A \)
- \( V_{GE} = 15 \, V \)
Boost

Figure 13
Typical reverse recovery charge as a function of collector current
\[ Q_{rr} = f(I_C) \]

\[ Q_{rr, High T} \]
\[ Q_{rr, Low T} \]

At
\[ T_j = 25/125 \ ^\circ C \]
\[ V_{CE} = 350 \ V \]
\[ V_{GE} = 15 \ V \]
\[ R_{gon} = 8 \ \Omega \]

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

\[ Q_{rr, High T} \]
\[ Q_{rr, Low T} \]

At
\[ T_j = 25/125 \ ^\circ C \]
\[ V_{CE} = 350 \ V \]
\[ I_F = 30 \ A \]
\[ V_{GE} = 15 \ V \]

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

\[ I_{RRM, High T} \]
\[ I_{RRM, Low T} \]

At
\[ T_j = 25/125 \ ^\circ C \]
\[ V_{CE} = 350 \ V \]
\[ V_{GE} = 15 \ V \]
\[ R_{gon} = 8 \ \Omega \]

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

\[ I_{RRM, High T} \]
\[ I_{RRM, Low T} \]

At
\[ T_j = 25/125 \ ^\circ C \]
\[ V_{CE} = 350 \ V \]
\[ I_F = 30 \ A \]
\[ V_{GE} = 15 \ V \]
Figure 17: FRED
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
- \( T_j = 25/125 \) °C
- \( V_{CE} = 350 \) V
- \( V_{GE} = 15 \) V
- \( R_{gon} = 8 \) Ω

Figure 18: FRED
Typical rate of fall of forward and reverse recovery current as a function of IGBT turn on gate resistor
\( \frac{dI_0}{dt}, \frac{dI_{rec}}{dt} = f(R_{gon}) \)

At
- \( T_j = 25/125 \) °C
- \( V_R = 350 \) V
- \( I_p = 30 \) A
- \( V_{GE} = 15 \) V

Figure 19: IGBT
IGBT transient thermal impedance as a function of pulse width
\( Z_{thJH} = f(t_p) \)

At
- \( D = \frac{t_p}{T} \)
- \( R_{thJH} = 1.11 \) K/W

IGBT thermal model values
\( R \) (C/W), \( \tau \) (s)
- 0.06, 9.9E+00
- 0.22, 1.2E+00
- 0.59, 1.4E-01
- 0.17, 2.2E-02
- 0.03, 2.7E-03
- 0.04, 2.7E-04

Figure 20: FRED
FRED transient thermal impedance as a function of pulse width
\( Z_{thJH} = f(t_p) \)

At
- \( D = \frac{t_p}{T} \)
- \( R_{thJH} = 2.32 \) K/W

FRED thermal model values
\( R \) (C/W), \( \tau \) (s)
- 0.04, 9.8E+00
- 0.25, 7.7E-01
- 1.24, 1.2E-01
- 0.44, 2.0E-02
- 0.25, 2.6E-03
- 0.09, 4.3E-04

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Figure 21
Power dissipation as a function of heatsink temperature
\[ P_{\text{tot}} = f(T_h) \]

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

Figure 22
Collector current as a function of heatsink temperature
\[ I_C = f(T_h) \]

At
\[ T_j = 175 \ ^\circ\text{C} \]
\[ V_{GE} = 15 \ \text{V} \]

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

At
\[ T_j = 150 \ ^\circ\text{C} \]

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

At
\[ T_j = 150 \ ^\circ\text{C} \]
Figure 25  Boost Inverse Diode

Typical diode forward current as a function of forward voltage

\[ I_F = f(V_F) \]

\[ I_{F} = 250 \mu s \]

\[ T_j = 25°C \]

\[ T_j = T_{j,\text{max}} - 25°C \]

Figure 26  Boost Inverse Diode

Diode transient thermal impedance as a function of pulse width

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

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

\[ R_{th,JH} = 4.36 \text{ K/W} \]
**Thermistor**

**Figure 1**

Typical NTC characteristic

as a function of temperature

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

**Figure 2**

Typical NTC resistance values

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

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<th>R_{25} [Ω]</th>
<th>R_{min} [Ω]</th>
<th>R_{max} [Ω]</th>
<th>ΔR/R [%]</th>
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Switching Definitions BUCK MOSFET

General conditions

\[ T_j = 125 \, ^\circ C \]
\[ R_{on} = 8 \, \Omega \]
\[ R_{off} = 8 \, \Omega \]

**Figure 1** BUCK MOSFET

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

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

**Figure 2** BUCK MOSFET

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

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

**Figure 3** BUCK MOSFET

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

**Figure 4** BUCK MOSFET

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

\[ V_{GS}(0\%) = 0 \, V \]
\[ V_{GS}(100\%) = 15 \, V \]
\[ V_{D}(100\%) = 350 \, V \]
\[ I_f(100\%) = 30 \, A \]
\[ t_{\text{off}} = 0.30 \, \mu s \]
\[ t_{\text{eff}} = 0.31 \, \mu s \]

\[ V_{GS}(0\%) = 0 \, V \]
\[ V_{GS}(100\%) = 15 \, V \]
\[ V_{D}(100\%) = 350 \, V \]
\[ I_f(100\%) = 30 \, A \]
\[ t_{\text{on}} = 0.04 \, \mu s \]
\[ t_{\text{con}} = 0.05 \, \mu s \]

\[ V_{C}(100\%) = 350 \, V \]
\[ I_f(100\%) = 30 \, A \]
\[ t_f = 0.01 \, \mu s \]

\[ V_{C}(100\%) = 350 \, V \]
\[ I_f(100\%) = 30 \, A \]
\[ t_r = 0.01 \, \mu s \]
Switching Definitions BUCK MOSFET

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

- $P_{off}(100\%) = 10.48\ kW$
- $E_{off}(100\%) = 0.11\ mJ$
- $t_{Eoff} = 0.31\ \mu s$

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

- $P_{on}(100\%) = 10.48\ kW$
- $E_{on}(100\%) = 0.27\ mJ$
- $t_{Eon} = 0.05\ \mu s$

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

- $V_{Goff} = 0\ V$
- $V_{Gon} = 15\ V$
- $V_{G(100\%)} = 350\ V$
- $I_{G(100\%)} = 30\ A$
- $Q_{g} = 191.44\ nC$

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

- $V_{D(100\%)} = 350\ V$
- $I_{D(100\%)} = 30\ A$
- $t_{rr}1\ 10\% = -70\ A$
- $t_{rr}1\ 100\% = 0.02\ \mu s$
Switching Definitions BUCK MOSFET

**Turn-on Switching Waveforms & definition of \( t_{Qr} \)**

\[ t_{Qr} = \text{integrating time for } Q_r \]

**Turn-on Switching Waveforms & definition of \( t_{Erec} \)**

\[ t_{Erec} = \text{integrating time for } E_{rec} \]

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<th>( I_d ) (100%)</th>
<th>30 A</th>
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<td>( Q_r ) (100%)</td>
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<td>( t_{Qr} )</td>
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<tr>
<td>( P_{rec} ) (100%)</td>
<td>10.48 kW</td>
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<tr>
<td>( E_{rec} ) (100%)</td>
<td>0.31 mJ</td>
</tr>
<tr>
<td>( t_{Erec} )</td>
<td>0.05 μs</td>
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**Measurement circuits**

**Figure 11**

BUCK stage switching measurement circuit

**Figure 12**

BOOST stage switching measurement circuit
Switching Definitions Boost IGBT

General conditions:

- $T_J = 125 \, ^\circ C$
- $R_{son} = 8 \, \Omega$
- $R_{goff} = 8 \, \Omega$

Figure 1: Turn-off Switching Waveforms & definition of $t_{doff}$, $t_{Eoff}$

Turning off time for $E_{off}$

- $V_{GE} (0\%) = 0 \, V$
- $V_{GE} (100\%) = 15 \, V$
- $V_{CE} (100\%) = 350 \, V$
- $I_C (100\%) = 30 \, A$
- $t_{Eoff} = 0,70 \, \mu s$
- $t_{doff} = 0,50 \, \mu s$

Figure 2: Turn-on Switching Waveforms & definition of $t_{ton}$, $t_{Eon}$

Turning on time for $E_{on}$

- $V_{GE} (0\%) = 0 \, V$
- $V_{GE} (100\%) = 15 \, V$
- $V_{CE} (100\%) = 350 \, V$
- $I_C (100\%) = 30 \, A$
- $t_{Eon} = 0,14 \, \mu s$
- $t_{ton} = 0,04 \, \mu s$

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

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

Switching Definitions Boost IGBT

**Figure 5**

**Figure 5**

**Figure 6**

**Figure 6**

**Figure 7**

**Figure 7**

**Figure 8**

**Figure 8**

---

**Poff (100%) =** 10.55 kW  
**Eoff (100%) =** 1.16 mJ  
**tEoff =** 0.70 μs

**Pon (100%) =** 10.55 kW  
**Eon (100%) =** 0.96 mJ  
**tEon =** 0.14 μs

---

**VGEoff =** 0 V  
**Vd (100%) =** 350 V  
**Eoff (100%) =** 1.16 mJ  
**tEoff =** 0.70 μs

**VGEon =** 15 V  
**Id (100%) =** 30 A  
**Eon (100%) =** 0.96 mJ  
**tEon =** 0.14 μs

---

**Id (100%) =** 350 A  
**Vd (100%) =** 30 V  
**Eoff (100%) =** 1.16 mJ  
**tEoff =** 0.70 μs

---

**Qg (nC) =** 407.76 nC  
**trr =** 0.05 μs
Switching Definitions Boost IGBT

**Figure 9**
Turn-on Switching Waveforms & definition of t\(_{\text{Qrr}}\)

\(t_{\text{Qrr}} = \text{integrating time for } Q_{\text{rr}}\)

\(I_d(100\%) = 30 \text{ A}\)

\(Q_{\text{rr}}(100\%) = 5.74 \mu\text{C}\)

\(t_{\text{Qrr}} = 0.16 \mu\text{s}\)

---

**Figure 10**
Turn-on Switching Waveforms & definition of t\(_{\text{Erec}}\)

\(t_{\text{Erec}} = \text{integrating time for } E_{\text{rec}}\)

\(P_{\text{rec}}(100\%) = 10.55 \text{ kW}\)

\(E_{\text{rec}}(100\%) = 1.39 \text{ mJ}\)

\(t_{\text{Erec}} = 0.16 \mu\text{s}\)

---

**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

19 G3 16 S3
13 G1 13 B1
8 U2 7 S2
2 G4 1 B4

pin 3 and 17 are NOT CONNECTED

GND 6, 14 Line 9, 10, 11
DC+ 15, 16 NTC1 20 NTC2 21
DC- 4, 5

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Revision: 2
PRODUCT STATUS DEFINITIONS

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<tr>
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<th>Product Status</th>
<th>Definition</th>
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<td>Target</td>
<td>Formative or In Design</td>
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<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>
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<td>Full Production</td>
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