**Features**

- Low inductive 12mm flow1 package
- Booster:
  - Dual boost topology
  - MOSFET 650V/37mOhm + SiC diode
  - Bypass rectifier
- Inverter:
  - Pseudo H-bridge topology
  - MOSFET 650V/41mOhm CFD + SiC diode
  - Integrated DC-capacitors
  - Temperature sensor

**Target Applications**

- Solar Inverter:
  - High efficient transformer-less solar inverter with bipolar modulation

**Types**

- 10-FY07BIA041MC-M528E58

---

**Maximum Ratings**

**Bypass Diode**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Condition</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Repetitive peak reverse voltage</td>
<td>$V_{BRMM}$</td>
<td></td>
<td>1600</td>
<td>V</td>
</tr>
<tr>
<td>Forward current per diode</td>
<td>$I_{F(AV)}$</td>
<td>DC current</td>
<td>$T_a=80^\circ C$</td>
<td>41</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$T_s=80^\circ C$</td>
<td>55</td>
<td></td>
</tr>
<tr>
<td>Surge forward current</td>
<td>$I_{F(SM)}$</td>
<td>$I=10,\text{ms}$</td>
<td>370</td>
<td>A</td>
</tr>
<tr>
<td>$I_{2t}$-value</td>
<td>$I_{2t}$</td>
<td></td>
<td>370</td>
<td>A$^2\cdot\text{s}$</td>
</tr>
<tr>
<td>Power dissipation per Diode</td>
<td>$P_{2t}$</td>
<td>$T_{j}=T_{j\max}$</td>
<td>50</td>
<td>W</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$T_a=80^\circ C$</td>
<td>76</td>
<td></td>
</tr>
<tr>
<td>Maximum Junction Temperature</td>
<td>$T_{j\max}$</td>
<td></td>
<td>150</td>
<td>°C</td>
</tr>
</tbody>
</table>

**Input Boost MOSFET**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Condition</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drain to source breakdown voltage</td>
<td>$V_{DS}$</td>
<td></td>
<td>650</td>
<td>V</td>
</tr>
<tr>
<td>DC drain current</td>
<td>$I_D$</td>
<td>$T_{j}=T_{j\max}$</td>
<td>$T_a=80^\circ C$</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$T_s=80^\circ C$</td>
<td>43</td>
<td></td>
</tr>
<tr>
<td>Pulsed drain current</td>
<td>$I_{D(2s)}$</td>
<td>$T_{j}=25^\circ C$</td>
<td>297</td>
<td>A</td>
</tr>
<tr>
<td>Power dissipation</td>
<td>$P_{d}$</td>
<td>$T_{j}=T_{j\max}$</td>
<td>105</td>
<td>W</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$T_a=80^\circ C$</td>
<td>159</td>
<td></td>
</tr>
<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>$T_{j\max}$</td>
<td></td>
<td>150</td>
<td>°C</td>
</tr>
</tbody>
</table>
# 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>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Input Boost Diode</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peak Repetitive Reverse Voltage</td>
<td>$V_{\text{RM}}$</td>
<td>$T_j=25^\circ\text{C}$</td>
<td>650</td>
<td>V</td>
</tr>
<tr>
<td>DC forward current</td>
<td>$I_F$</td>
<td>$T_j=T_{\text{max}}$, $T_i=80^\circ\text{C}$</td>
<td>22</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$T_i=80^\circ\text{C}$</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>Repetitive peak forward current</td>
<td>$I_{\text{PMM}}$</td>
<td>$I_p$ limited by $T_{\text{max}}$</td>
<td>134</td>
<td>A</td>
</tr>
<tr>
<td>Power dissipation</td>
<td>$P_{\text{tot}}$</td>
<td>$T_j=T_{\text{max}}$, $T_i=80^\circ\text{C}$</td>
<td>48</td>
<td>W</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$T_i=80^\circ\text{C}$</td>
<td>73</td>
<td></td>
</tr>
<tr>
<td>Maximum Junction Temperature</td>
<td>$T_j$</td>
<td></td>
<td>175</td>
<td>°C</td>
</tr>
<tr>
<td><strong>Pseudo H-Bridge MOSFET</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drain to source breakdown voltage</td>
<td>$V_{\text{DS}}$</td>
<td></td>
<td>650</td>
<td>V</td>
</tr>
<tr>
<td>DC drain current</td>
<td>$I_D$</td>
<td>$T_j=T_{\text{max}}$, $T_i=80^\circ\text{C}$</td>
<td>34</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$T_i=80^\circ\text{C}$</td>
<td>42</td>
<td></td>
</tr>
<tr>
<td>Pulsed drain current</td>
<td>$I_{\text{Dpeak}}$</td>
<td>$I_p$ limited by $T_{\text{max}}$, $T_c=25^\circ\text{C}$</td>
<td>255</td>
<td>A</td>
</tr>
<tr>
<td>Power dissipation</td>
<td>$P_{\text{tot}}$</td>
<td>$T_j=T_{\text{max}}$, $T_i=80^\circ\text{C}$</td>
<td>111</td>
<td>W</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$T_i=80^\circ\text{C}$</td>
<td>168</td>
<td></td>
</tr>
<tr>
<td>Gate-source peak voltage</td>
<td>$V_{\text{gs}}$</td>
<td></td>
<td>±20</td>
<td>V</td>
</tr>
<tr>
<td>Maximum Junction Temperature</td>
<td>$T_j$</td>
<td></td>
<td>150</td>
<td>°C</td>
</tr>
<tr>
<td><strong>Pseudo H-Bridge Diode</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peak Repetitive Reverse Voltage</td>
<td>$V_{\text{RM}}$</td>
<td>$T_j=25^\circ\text{C}$</td>
<td>650</td>
<td>V</td>
</tr>
<tr>
<td>DC forward current</td>
<td>$I_F$</td>
<td>$T_j=T_{\text{max}}$, $T_i=80^\circ\text{C}$</td>
<td>22</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$T_i=80^\circ\text{C}$</td>
<td>29</td>
<td></td>
</tr>
<tr>
<td>Repetitive peak forward current</td>
<td>$I_{\text{PMM}}$</td>
<td>$I_p$ limited by $T_{\text{max}}$</td>
<td>134</td>
<td>A</td>
</tr>
<tr>
<td>Power dissipation per Diode</td>
<td>$P_{\text{tot}}$</td>
<td>$T_j=T_{\text{max}}$, $T_i=80^\circ\text{C}$</td>
<td>48</td>
<td>W</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$T_i=80^\circ\text{C}$</td>
<td>73</td>
<td></td>
</tr>
<tr>
<td>Maximum Junction Temperature</td>
<td>$T_j$</td>
<td></td>
<td>175</td>
<td>°C</td>
</tr>
<tr>
<td><strong>DC link Capacitor</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max.DC voltage</td>
<td>$V_{\text{MAX}}$</td>
<td>$T_c=25^\circ\text{C}$</td>
<td>630</td>
<td>V</td>
</tr>
<tr>
<td><strong>Thermal Properties</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storage temperature</td>
<td>$T_{\text{sug}}$</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...+(Tjmax - 25)</td>
<td>°C</td>
</tr>
<tr>
<td><strong>Insulation Properties</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insulation voltage</td>
<td>$V_i$</td>
<td>t=2s, DC voltage</td>
<td>4000</td>
<td>V</td>
</tr>
<tr>
<td>Creepage distance</td>
<td></td>
<td></td>
<td>min 12.7</td>
<td>mm</td>
</tr>
<tr>
<td>Clearance</td>
<td></td>
<td></td>
<td>min 12.7</td>
<td>mm</td>
</tr>
</tbody>
</table>
### Characteristic Values

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Parameter</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bypass Diode</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forward voltage</td>
<td></td>
<td>$V_{DS}$ [V]</td>
<td>$V_{DS}$ [V]</td>
<td>$I_{DS}$ [A] or $I_{DS}$ [A]</td>
</tr>
<tr>
<td>Threshold voltage (for power loss calc. only)</td>
<td></td>
<td>$V_{th}$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slope resistance (for power loss calc. only)</td>
<td></td>
<td>$r_{s}$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reverse current</td>
<td></td>
<td>$I_{R}$</td>
<td>$I_{R}$</td>
<td>$I_{R}$</td>
</tr>
<tr>
<td>Thermal resistance chip to heatsink per chip</td>
<td>$R_{thJH}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thermal resistance chip to case per chip</td>
<td>$R_{thJC}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Input Boost MOSFET</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Static drain to source ON resistance</td>
<td>$R_{D(on)}$</td>
<td>10</td>
<td>50</td>
<td>$V_{DS}$</td>
</tr>
<tr>
<td>Gate threshold voltage</td>
<td>$V_{G(th)}$</td>
<td></td>
<td></td>
<td>35</td>
</tr>
<tr>
<td>Gate to Source Leakage Current</td>
<td>$I_{SS}$</td>
<td>20</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Zero Gate Voltage Drain Current</td>
<td>$I_{gss}$</td>
<td>0</td>
<td>650</td>
<td>$I_{gss}$</td>
</tr>
<tr>
<td>Turn On Delay Time</td>
<td>$t_{ON}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rise Time</td>
<td>$t_{r}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turn off delay time</td>
<td>$t_{OFF}$</td>
<td>10</td>
<td>400</td>
<td>$R_{goff}=2\ Ω$</td>
</tr>
<tr>
<td>Fall time</td>
<td>$t_{f}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turn-on energy loss per pulse</td>
<td>$E_{on}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turn-off energy loss per pulse</td>
<td>$E_{off}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total gate charge</td>
<td>$Q_{g}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gate to source charge</td>
<td>$Q_{gs}$</td>
<td>10</td>
<td>480</td>
<td>$R_{goff}=2\ Ω$</td>
</tr>
<tr>
<td>Gate to drain charge</td>
<td>$Q_{gd}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input capacitance</td>
<td>$C_{iss}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output capacitance</td>
<td>$C_{oss}$</td>
<td>0</td>
<td>100</td>
<td>$I_{gss}$</td>
</tr>
<tr>
<td>Reverse transfer capacitance</td>
<td>$C_{rss}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thermal resistance chip to heatsink per chip</td>
<td>$R_{thJH}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thermal resistance chip to case per chip</td>
<td>$R_{thJC}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Input Boost Diode</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forward voltage</td>
<td></td>
<td>$V_{F}$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reverse leakage current</td>
<td>$I_{fom}$</td>
<td>10</td>
<td>400</td>
<td>$I_{fom}$</td>
</tr>
<tr>
<td>Peak recovery current</td>
<td>$I_{RRM}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reverse recovery time</td>
<td>$t_{rr}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reverse recovery charge</td>
<td>$Q_{rr}$</td>
<td>10</td>
<td>400</td>
<td>$R_{goff}=2\ Ω$</td>
</tr>
<tr>
<td>Reverse recovered energy</td>
<td>$E_{rec}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peak rate of fall of recovery current</td>
<td>$dV/dt_{max}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thermal resistance chip to heatsink per chip</td>
<td>$R_{thJH}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thermal resistance chip to case per chip</td>
<td>$R_{thJC}$</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Copyright by Vincotech**

3

Revision 1
### Characteristic Values

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pseudo H-Bridge MOSFET</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Static drain to source ON resistance</td>
<td>$R_{\text{on}}$</td>
<td>10</td>
<td>50</td>
<td>$T_j=25^°C$</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$T_j=125^°C$</td>
</tr>
<tr>
<td>Gate threshold voltage</td>
<td>$V_{\text{GE}}$ or $V_{\text{GS}}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gate to Source Leakage Current</td>
<td>$I_{\text{gs}}$</td>
<td>20</td>
<td>0</td>
<td>$T_j=25^°C$</td>
</tr>
<tr>
<td>Zero Gate Voltage Drain Current</td>
<td>$I_{\text{oss}}$</td>
<td>0</td>
<td>650</td>
<td>$T_j=25^°C$</td>
</tr>
<tr>
<td>Turn On Delay Time</td>
<td>$t_{\text{on}}$</td>
<td>10</td>
<td>400</td>
<td>30</td>
</tr>
<tr>
<td>Rise Time</td>
<td>$t_{\text{r}}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turn off delay time</td>
<td>$t_{\text{off}}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fall time</td>
<td>$t_{\text{f}}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turn-on energy loss per pulse</td>
<td>$E_{\text{on}}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turn-off energy loss per pulse</td>
<td>$E_{\text{off}}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total gate charge</td>
<td>$Q_{\text{g}}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gate to source charge</td>
<td>$Q_{\text{gs}}$</td>
<td>10</td>
<td>480</td>
<td>49.6</td>
</tr>
<tr>
<td>Gate to drain charge</td>
<td>$Q_{\text{gd}}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input capacitance</td>
<td>$C_{\text{in}}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output capacitance</td>
<td>$C_{\text{out}}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reverse transfer capacitance</td>
<td>$C_{\text{rss}}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thermal resistance chip to heatsink per chip</td>
<td>$R_{\text{thjc}}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thermal resistance chip to case per chip</td>
<td>$R_{\text{thjc}}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Pseudo H-Bridge Diode</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diode forward voltage</td>
<td>$V_{\text{f}}$</td>
<td></td>
<td></td>
<td>50</td>
</tr>
<tr>
<td>Peak reverse recovery current</td>
<td>$I_{\text{rr}}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reverse recovery time</td>
<td>$t_{\text{rr}}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reverse recovered charge</td>
<td>$Q_{\text{rr}}$</td>
<td>15</td>
<td>400</td>
<td>60</td>
</tr>
<tr>
<td>Peak rate of fall of recovery current</td>
<td>$\text{d}I_{\text{rr}}/\text{d}t$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reverse recovery energy</td>
<td>$E_{\text{rr}}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thermal resistance chip to heatsink per chip</td>
<td>$R_{\text{thjc}}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thermal resistance chip to case per chip</td>
<td>$R_{\text{thjc}}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>DC link Capacitor</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C value</td>
<td>$C_{\text{c}}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Thermistor</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rated resistance</td>
<td>$R$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deviation of R25</td>
<td>$\Delta R/R_{\text{100}}=1486 Ω$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power dissipation</td>
<td>$P$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power dissipation constant</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B-value</td>
<td>$B_{\text{25/100}}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vincotech NTC Reference</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Pseudo H-Bridge

**Figure 1**
**MOSFET**
Typical output characteristics

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

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

**Figure 2**
**MOSFET**
Typical output characteristics

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

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

**Figure 3**
**MOSFET**
Typical transfer characteristics

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

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

\[ I_F = f(V_F) \]

At
\[ t_p = 250 \mu s \]
\[ V_{CE} = 10 \text{ V} \]
Pseudo H-Bridge

**Figure 5**
Typical switching energy losses as a function of collector current

\[ E = f(I_C) \]

With an inductive load at

- Temperature: 25/125 °C
- Collector voltage: 400 V
- Gate voltage: 10 V
- On-state resistance: 2 Ω
- Off-state resistance: 2 Ω

**Figure 6**
Typical switching energy losses as a function of gate resistor

\[ E = f(R_G) \]

With an inductive load at

- Temperature: 25/125 °C
- Collector voltage: 400 V
- Gate voltage: 10 V
- Collector current: 30 A

**Figure 7**
Typical reverse recovery energy loss as a function of collector current

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

With an inductive load at

- Temperature: 25/125 °C
- Collector voltage: 400 V
- Gate voltage: 10 V
- On-state resistance: 2 Ω

**Figure 8**
Typical reverse recovery energy loss as a function of gate resistor

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

With an inductive load at

- Temperature: 25/125 °C
- Collector voltage: 400 V
- Gate voltage: 10 V
- Collector current: 30 A
Pseudo H-Bridge

**Figure 9**
Typical switching times as a function of collector current
\( t = f(I_C) \)

With an inductive load at
- \( T_J = 125 \, ^\circ C \)
- \( V_{CE} = 400 \, V \)
- \( V_{GE} = 10 \, V \)
- \( R_{gon} = 2 \, \Omega \)
- \( R_{goff} = 2 \, \Omega \)

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

With an inductive load at
- \( T_J = 125 \, ^\circ C \)
- \( V_{CE} = 400 \, V \)
- \( V_{GE} = 10 \, V \)
- \( I_C = 30 \, A \)

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

At
- \( T_J = 25/125 \, ^\circ C \)
- \( V_{CE} = 400 \, V \)
- \( V_{GE} = 10 \, V \)
- \( R_{gon} = 2 \, \Omega \)

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

At
- \( T_J = 25/125 \, ^\circ C \)
- \( V_{CE} = 400 \, V \)
- \( I_C = 30 \, A \)
- \( V_{GE} = 10 \, V \)
Pseudo H-Bridge

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

At
\[ T_J = 25/125 \, ^\circ C \]
\[ V_{CE} = 400 \, V \]
\[ V_{GE} = 10 \, V \]
\[ R_{gon} = 2 \, \Omega \]

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

At
\[ T_J = 25/125 \, ^\circ C \]
\[ V_{CE} = 400 \, V \]
\[ I_F = 30 \, A \]
\[ V_{GE} = 10 \, V \]

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

At
\[ T_J = 25/125 \, ^\circ C \]
\[ V_{CE} = 400 \, V \]
\[ V_{GE} = 10 \, V \]
\[ R_{gon} = 2 \, \Omega \]

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

At
\[ T_J = 25/125 \, ^\circ C \]
\[ V_{CE} = 400 \, V \]
\[ I_F = 30 \, A \]
\[ V_{GE} = 10 \, V \]
Pseudo H-Bridge

Figure 17
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
- \( V_{CE} = 400 \) V
- \( V_{GE} = 10 \) V
- \( R_{gon} = 2 \) Ω

Figure 18
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
- \( V_{GE} = 10 \) V
- \( I_F = 30 \) A
- \( V_{GE} = 10 \) V

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

At
- \( D = \frac{t_p}{T} \)
- \( R_{thJH} = 0.63 \) KW

IGBT thermal model values

<table>
<thead>
<tr>
<th>( R ) (C/W)</th>
<th>( \tau ) (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.04</td>
<td>5.1E+00</td>
</tr>
<tr>
<td>0.08</td>
<td>1.0E+00</td>
</tr>
<tr>
<td>0.30</td>
<td>2.1E-01</td>
</tr>
<tr>
<td>0.14</td>
<td>8.6E-02</td>
</tr>
<tr>
<td>0.03</td>
<td>1.3E-02</td>
</tr>
<tr>
<td>0.02</td>
<td>1.4E-03</td>
</tr>
</tbody>
</table>

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

At
- \( D = \frac{t_p}{T} \)
- \( R_{thJH} = 1.98 \) KW

FWD thermal model values

<table>
<thead>
<tr>
<th>( R ) (C/W)</th>
<th>( \tau ) (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.06</td>
<td>3.9E+00</td>
</tr>
<tr>
<td>0.15</td>
<td>7.0E-01</td>
</tr>
<tr>
<td>0.84</td>
<td>1.5E-01</td>
</tr>
<tr>
<td>0.44</td>
<td>4.4E-02</td>
</tr>
<tr>
<td>0.33</td>
<td>9.3E-03</td>
</tr>
<tr>
<td>0.17</td>
<td>2.0E-03</td>
</tr>
</tbody>
</table>
Pseudo H-Bridge

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

![Graph showing power dissipation vs. heatsink temperature](image)

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

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

![Graph showing collector current vs. heatsink temperature](image)

At
\[ T_j = 150 \, ^\circ C \]
\[ V_{\text{GE}} = 15 \, V \]

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

![Graph showing power dissipation vs. heatsink temperature](image)

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

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

![Graph showing forward current vs. heatsink temperature](image)

At
\[ T_j = 175 \, ^\circ C \]
Pseudo H-Bridge

Figure 25
Safe operating area as a function of collector-emitter voltage
\[ I_C = f(V_{CE}) \]

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

Figure 26
Gate voltage vs Gate charge
\[ V_{GE} = f(Q_g) \]

At
\[ I_c = 50 \text{ A} \]
**INPUT BOOST**

**Figure 1**
Typical output characteristics
\[ I_D = f(V_{DS}) \]

At
- \[ t_p = 250 \mu s \]
- \[ T_j = 25 \, ^\circ C \]
- \[ V_{DS} \text{ from 3 V to 13 V in steps of 1 V} \]

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

At
- \[ t_p = 250 \mu s \]
- \[ T_j = 125 \, ^\circ C \]
- \[ V_{DS} \text{ from 3 V to 13 V in steps of 1 V} \]

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

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

At
- \[ I_F = 250 \mu s \]
- \[ T_j = T_{j_{max}}-25 \, ^\circ C \]
- \[ V_{DS} = 10 \, V \]

Copyright by Vincotech
Typical switching energy losses as a function of collector current

\[ E = f(I_C) \]

With an inductive load at

- \( T_J = 25/125 \, ^\circ\text{C} \)
- \( V_{DS} = 400 \, \text{V} \)
- \( V_{GS} = 10 \, \text{V} \)
- \( R_{gon} = 2 \, \Omega \)
- \( R_{goff} = 2 \, \Omega \)

Typical reverse recovery energy loss as a function of collector (drain) current

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

With an inductive load at

- \( T_J = 25/125 \, ^\circ\text{C} \)
- \( V_{DS} = 400 \, \text{V} \)
- \( V_{GS} = 10 \, \text{V} \)
- \( I_N = 30 \, \text{A} \)

Figure 5: BOOST MOSFET

Figure 6: BOOST MOSFET

Figure 7: BOOST FWD

Figure 8: BOOST FWD
Typical switching times as a function of collector current
\( t = f(I_C) \)

With an inductive load at
- \( T_J = 125 \) °C
- \( V_DS = 400 \) V
- \( V_GS = 10 \) V
- \( R_{gon} = 2 \) Ω
- \( R_{goff} = 2 \) Ω

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

At
- \( T_J = 25/125 \) °C
- \( V_DS = 400 \) V
- \( V_GS = 10 \) V
- \( R_{gon} = 2 \) Ω
**Figure 13**  
**BOOST FWD**  
Typical reverse recovery charge as a  
function of collector current  
\[ Q_{rr} = f(I_C) \]

![Graph showing typical reverse recovery charge as a function of collector current](image)

**At**  
\[ T_j = 25/125 \, ^\circ C \]  
\[ V_C = 400 \, V \]  
\[ V_{GS} = 10 \, V \]  
\[ R_{GS} = 2 \, \Omega \]

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

![Graph showing typical reverse recovery charge as a function of gate resistor](image)

**At**  
\[ T_j = 25/125 \, ^\circ C \]  
\[ V_C = 400 \, V \]  
\[ I_F = 30 \, A \]  
\[ V_{GS} = 10 \, V \]

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

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

**At**  
\[ T_j = 25/125 \, ^\circ C \]  
\[ V_C = 400 \, V \]  
\[ V_{GS} = 10 \, V \]  
\[ R_{GS} = 2 \, \Omega \]

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

![Graph showing typical reverse recovery current as a function of gate resistor](image)

**At**  
\[ T_j = 25/125 \, ^\circ C \]  
\[ V_C = 400 \, V \]  
\[ I_F = 30 \, A \]  
\[ V_{GS} = 10 \, V \]
**INPUT BOOST**

**Figure 17**  
**BOOST FWD**  
Typical rate of fall of forward and reverse recovery current as a function of collector current  
d\(\frac{di}{dt}\), d\(\frac{di_{rec}}{dt}\) = f\(I_c\)

**At**  
\(T_j = 25/125\) °C  
\(V_{CE} = 400\) V  
\(V_{GE} = 10\) V  
\(R_{g} = 2\) Ω

**Figure 18**  
**BOOST FWD**  
Typical rate of fall of forward and reverse recovery current as a function of IGBT turn on gate resistor  
d\(\frac{di}{dt}\), d\(\frac{di_{rec}}{dt}\) = f\(R_{gon}\)

**At**  
\(T_j = 25/125\) °C  
\(V_{CE} = 400\) V  
\(V_{GS} = 10\) V  
\(I_f = 30\) A

**Figure 19**  
**BOOST MOSFET**  
IGBT/MOSFET transient thermal impedance as a function of pulse width  
Z\(_{thJH}\) = f\(t_p\)

**At**  
\(D = tp / T\)  
\(R_{thJH} = 0.67\) kW

IGBT thermal model values

<table>
<thead>
<tr>
<th>R (C/W)</th>
<th>Tau (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.56E-02</td>
<td>5.26E+00</td>
</tr>
<tr>
<td>8.98E-02</td>
<td>9.94E-01</td>
</tr>
<tr>
<td>3.76E-01</td>
<td>1.88E-01</td>
</tr>
<tr>
<td>1.04E-01</td>
<td>6.08E-02</td>
</tr>
<tr>
<td>3.74E-02</td>
<td>1.20E-02</td>
</tr>
<tr>
<td>2.56E-02</td>
<td>9.33E-04</td>
</tr>
</tbody>
</table>

**Figure 20**  
**BOOST FWD**  
FWD transient thermal impedance as a function of pulse width  
Z\(_{thJH}\) = f\(t_p\)

**At**  
\(D = tp / T\)  
\(R_{thJH} = 1.98\) kW

FWD thermal model values

<table>
<thead>
<tr>
<th>R (C/W)</th>
<th>Tau (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.95E-02</td>
<td>3.91E+00</td>
</tr>
<tr>
<td>1.47E-01</td>
<td>7.03E-01</td>
</tr>
<tr>
<td>8.44E-01</td>
<td>1.45E-01</td>
</tr>
<tr>
<td>4.42E-01</td>
<td>4.35E-02</td>
</tr>
<tr>
<td>3.26E-01</td>
<td>9.54E-03</td>
</tr>
<tr>
<td>1.67E-01</td>
<td>2.01E-03</td>
</tr>
</tbody>
</table>

Copyright by Vincotech
Power dissipation as a function of heatsink temperature

\( P_{\text{tot}} = f(T_h) \)

At

- \( T_j = 150 \) °C
- \( V_{\text{GS}} = 10 \) V

Forward current as a function of heatsink temperature

\( I_F = f(T_h) \)

At

- \( T_j = 175 \) °C
Figure 25: Safe operating area as a function of drain-source voltage

$\text{ID} = f(\text{VGS})$

Figure 26: Gate voltage vs Gate charge

$\text{VGS} = f(\text{Qg})$

At

- $D =$ single pulse
- $T_s =$ 80 $^\circ\text{C}$
- $V_{\text{GS}} =$ 10 V
- $T_J =$ $T_{\text{max}}$ $^\circ\text{C}$
Bypass Diode

Figure 1: Bypass diode
Typical diode forward current as a function of forward voltage
$I_F = f(V_F)$

At
$\tau_p = 250 \mu s$

Figure 2: Bypass diode
Diode transient thermal impedance as a function of pulse width
$Z_{thJH} = f(t_p)$

At
$D = \frac{t_p}{T}$
$R_{thJH} = 1.397 K/W$

Figure 3: Bypass diode
Power dissipation as a function of heatsink temperature
$P_{tot} = f(T_h)$

At
$T_j = 150 \degree C$

Figure 4: Bypass diode
Forward current as a function of heatsink temperature
$I_F = f(T_h)$

At
$T_j = 150 \degree C$
Thermistor

Typical NTC characteristic
as a function of temperature
\[ R_T = f(T) \]
Switching Definitions H-Bridge MOSFET

General conditions

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$T_J$</td>
<td>125 °C</td>
</tr>
<tr>
<td>$R_{on}$</td>
<td>2.0 Ω</td>
</tr>
<tr>
<td>$R_{off}$</td>
<td>2.0 Ω</td>
</tr>
</tbody>
</table>

**Figure 1**

H-Bridge MOSFET

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

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

**Figure 2**

H-Bridge MOSFET

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

$t_{on}$ = integrating time for $E_{on}$

**Figure 3**

H-Bridge MOSFET

Turn-off Switching Waveforms & definition of $t_f$

$t_f$ =

**Figure 4**

H-Bridge MOSFET

Turn-on Switching Waveforms & definition of $t_r$

$t_r$ =

---

$V_{GE}(0\%) = 0 \text{ V}$  
$V_{GE}(100\%) = 10 \text{ V}$  
$V_{CE}(100\%) = 400 \text{ V}$  
$I_C(100\%) = 30 \text{ A}$  
$t_{off} = 0.15 \mu s$  
$t_{Eoff} = 0.16 \mu s$

$V_{GE}(0\%) = 0 \text{ V}$  
$V_{GE}(100\%) = 10 \text{ V}$  
$V_{CE}(100\%) = 400 \text{ V}$  
$I_C(100\%) = 30 \text{ A}$  
$t_{on} = 0.04 \mu s$  
$t_{Eon} = 0.07 \mu s$

$V_{CE}(100\%) = 400 \text{ V}$  
$I_C(100\%) = 30 \text{ A}$  
$t_f = 0.01 \mu s$

$V_{CE}(100\%) = 400 \text{ V}$  
$I_C(100\%) = 30 \text{ A}$  
$t_r = 0.01 \mu s$
Switching Definitions H-Bridge MOSFET

**Figure 5**
H-Bridge MOSFET

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

- $P_{off} (100\%) = 12.04$ kW
- $E_{off} (100\%) = 0.03$ mJ
- $t_{Eoff} = 0.16$ μs

**Figure 6**
H-Bridge MOSFET

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

- $P_{on} (100\%) = 12.04$ kW
- $E_{on} (100\%) = 0.14$ mJ
- $t_{Eon} = 0.07$ μs

**Figure 7**
H-Bridge MOSFET

Gate voltage vs Gate charge (measured)

- $V_{GEoff} = 0$ V
- $V_{GEon} = 10$ V
- $V_C (100\%) = 400$ V
- $I_{d} (100\%) = 30$ A
- $Q_g = 183.73$ nC

**Figure 8**
H-Bridge FWD

Turn-off Switching Waveforms & definition of $t_r$

- $V_{d} (100\%) = 400$ V
- $I_d (100\%) = 30$ A
- $t_{r} = 0.01$ μs
- $t_{f} = -24$ A
- $t_{f,max} = 0.01$ μs
- $t_{f,min} = 0.01$ μs
- $V_{d,min} = 400$ V
- $V_{d,max} = 400$ V
- $t_{d} = 0.01$ μs

Copyright by Vincotech
Switching Definitions H-Bridge MOSFET

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

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

$t_q (100\%) = 30$ A
$Q_r (100\%) = 0.12$ $\mu$C
$t_{Qrr} = 0.02$ $\mu$s

$P_{rec} (100\%) = 12.04$ kW
$E_{rec} (100\%) = 0.02$ mJ
$t_{Erec} = 0.02$ $\mu$s
Pins 3, 4, 9, 12 are not connected.
### PRODUCT STATUS DEFINITIONS

<table>
<thead>
<tr>
<th>Datasheet Status</th>
<th>Product Status</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<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>
<td>This datasheet contains final specifications. 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>
</tbody>
</table>

### DISCLAIMER

The information given in this datasheet describes the type of component and does not represent assured characteristics. For tested values please contact Vincotech. Vincotech reserves the right to make changes without further notice to any products herein to improve reliability, function or design. Vincotech does not assume any liability arising out of the application or use of any product or circuit described herein; neither does it convey any license under its patent rights, nor the rights of others.

### LIFE SUPPORT POLICY

Vincotech products are not authorised for use as critical components in life support devices or systems without the express written approval of Vincotech.

As used herein:
1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, or (c) whose failure to perform when properly used in accordance with instructions for use provided in labelling can be reasonably expected to result in significant injury to the user.
2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.