flowSOL 1 BI

**Features**
- Low inductive 12mm flow1 package
- Booster:
  - Dual boost topology
  - MOSFET 650V/70mOhm + SiC diode
  - Bypass rectifier
- Inverter:
  - H-bridge topology
  - MOSFET 650V/80mOhm CDF
  - Integrated DC capacitor
  - Temperature sensor

**Target Applications**
- Solar Inverter:
  Primary of high efficient HF transformer-based solar inverter

**Types**
- 10-FY06BIA080MF-M527E58

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**Maximum Ratings**

\[ T_j = 25^\circ C, \text{ unless otherwise specified} \]

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Condition</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Repetitive peak reverse voltage</td>
<td>( V_{RRM} )</td>
<td></td>
<td>1600</td>
<td>V</td>
</tr>
<tr>
<td>Forward current per diode</td>
<td>( I_{FAX} )</td>
<td>DC current ( T_j=80^\circ C ) ( T_j=80^\circ C )</td>
<td>41</td>
<td>A</td>
</tr>
<tr>
<td>Surge forward current</td>
<td>( I_{FSM} )</td>
<td>( T_j=10\text{ms} )</td>
<td>370</td>
<td>A</td>
</tr>
<tr>
<td>I2t-value</td>
<td>( I_{2t} )</td>
<td></td>
<td>370</td>
<td>( A^2\text{s} )</td>
</tr>
<tr>
<td>Power dissipation per Diode</td>
<td>( P_{DI} )</td>
<td>( T_j=T_{j\text{max}} ) ( T_j=80^\circ C ) ( T_j=80^\circ C )</td>
<td>50</td>
<td>W</td>
</tr>
<tr>
<td>Maximum Junction Temperature</td>
<td>( T_{j\text{max}} )</td>
<td></td>
<td>150</td>
<td>( ^\circ C )</td>
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</table>

**Input Boost MOSFET (T1, T2)**

<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\text{max}} ) ( T_j=80^\circ C ) ( T_j=80^\circ C )</td>
<td>22</td>
<td>A</td>
</tr>
<tr>
<td>Pulsed drain current</td>
<td>( I_{D\text{pulse}} )</td>
<td>( I_D ) limited by ( T_{j\text{max}} )</td>
<td>150</td>
<td>A</td>
</tr>
<tr>
<td>Power dissipation</td>
<td>( P_{DI} )</td>
<td>( T_j=T_{j\text{max}} ) ( T_j=80^\circ C ) ( T_j=80^\circ C )</td>
<td>78</td>
<td>W</td>
</tr>
<tr>
<td>Gate-source peak voltage</td>
<td>( V_{GS} )</td>
<td>( T_j=T_{j\text{max}} ) ( T_j=80^\circ C ) ( T_j=80^\circ C )</td>
<td>±30</td>
<td>V</td>
</tr>
<tr>
<td>Maximum Junction Temperature</td>
<td>( T_{j\text{max}} )</td>
<td></td>
<td>150</td>
<td>( ^\circ C )</td>
</tr>
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</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 (D3, D4)</strong></td>
<td></td>
<td></td>
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<tr>
<td>Peak Repetitive Reverse Voltage</td>
<td>$V_{\text{RRM}}$</td>
<td>$T_j=25°C$</td>
<td>600</td>
<td>V</td>
</tr>
<tr>
<td>DC forward current</td>
<td>$I_F$</td>
<td>$T_j=T_{\text{max}}$</td>
<td>20</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$T_r=80°C$</td>
<td>24</td>
<td>A</td>
</tr>
<tr>
<td>Repetitive peak forward current</td>
<td>$I_{\text{F(RM)}}$</td>
<td>$I_r$ limited by $T_{\text{max}}$</td>
<td>57</td>
<td>A</td>
</tr>
<tr>
<td>Power dissipation</td>
<td>$P_{\text{tot}}$</td>
<td>$T_{j}=T_{\text{max}}$</td>
<td>46</td>
<td>W</td>
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<tr>
<td></td>
<td></td>
<td>$T_r=80°C$</td>
<td>70</td>
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<tr>
<td>Maximum Junction Temperature</td>
<td>$T_{j}=T_{\text{max}}$</td>
<td></td>
<td>175</td>
<td>°C</td>
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<tr>
<td><strong>H-Bridge MOSFET (T3, T4, T5, T6)</strong></td>
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<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>$T_j=T_{\text{max}}$</td>
<td>21</td>
<td>A</td>
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<tr>
<td></td>
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<td>$T_r=80°C$</td>
<td>26</td>
<td>A</td>
</tr>
<tr>
<td>Pulsed drain current</td>
<td>$I_{\text{D(PULS)}}$</td>
<td>$I_r$ limited by $T_{\text{max}}$</td>
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<td>A</td>
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<tr>
<td>Power dissipation</td>
<td>$P_{\text{tot}}$</td>
<td>$T_j=T_{\text{max}}$</td>
<td>84</td>
<td>W</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$T_r=80°C$</td>
<td>128</td>
<td>W</td>
</tr>
<tr>
<td>Gate-source peak voltage</td>
<td>$V_{\text{GS}}$</td>
<td></td>
<td>±30</td>
<td>V</td>
</tr>
<tr>
<td>Maximum Junction Temperature</td>
<td>$T_{j}=T_{\text{max}}$</td>
<td></td>
<td>150</td>
<td>°C</td>
</tr>
<tr>
<td><strong>H-Bridge Body Diode</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peak Repetitive Reverse Voltage</td>
<td>$V_{\text{RRM}}$</td>
<td>$T_j=25°C$</td>
<td>650</td>
<td>V</td>
</tr>
<tr>
<td>DC forward current</td>
<td>$I_F$</td>
<td>$T_j=T_{\text{max}}$</td>
<td>50</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$T_r=80°C$</td>
<td>50</td>
<td>A</td>
</tr>
<tr>
<td>Repetitive peak forward current</td>
<td>$I_{\text{F(RM)}}$</td>
<td>$I_r$ limited by $T_{\text{max}}$</td>
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<td>A</td>
</tr>
<tr>
<td>Power dissipation per Diode</td>
<td>$P_{\text{tot}}$</td>
<td>$T_j=T_{\text{max}}$</td>
<td>84</td>
<td>W</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$T_r=80°C$</td>
<td>128</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>
<tr>
<td><strong>DC link Capacitor (C1)</strong></td>
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<td></td>
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<tr>
<td>Max, DC voltage</td>
<td>$V_{\text{MAX}}$</td>
<td></td>
<td>630</td>
<td>V</td>
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## Thermal Properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Symbol</th>
<th>Condition</th>
<th>Value</th>
<th>Unit</th>
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</thead>
<tbody>
<tr>
<td>Storage temperature</td>
<td>$T_{\text{stg}}$</td>
<td></td>
<td>-40...+125</td>
<td>°C</td>
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<tr>
<td>Operation temperature under switching condition</td>
<td>$T_{\text{op}}$</td>
<td></td>
<td>-40...+(Tjmax - 25)</td>
<td>°C</td>
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</table>

## Insulation Properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Symbol</th>
<th>Condition</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insulation voltage</td>
<td>$V_{\text{i}}$</td>
<td>t=2s</td>
<td>DC voltage</td>
<td>4000</td>
</tr>
<tr>
<td>Creepage distance</td>
<td></td>
<td></td>
<td></td>
<td>min 12.7</td>
</tr>
<tr>
<td>Clearance</td>
<td></td>
<td></td>
<td></td>
<td>min 12.7</td>
</tr>
<tr>
<td>Parameter</td>
<td>Symbol</td>
<td>Conditions</td>
<td>Value</td>
<td>Unit</td>
</tr>
<tr>
<td>-----------</td>
<td>--------</td>
<td>------------</td>
<td>-------</td>
<td>------</td>
</tr>
<tr>
<td>Forward voltage</td>
<td>$V_F$</td>
<td>35</td>
<td>1.18</td>
<td>1.21 V</td>
</tr>
<tr>
<td>Threshold voltage (for power loss calc. only)</td>
<td>$V_{th}$</td>
<td>35</td>
<td>0.91</td>
<td>0.80 V</td>
</tr>
<tr>
<td>Slope resistance (for power loss calc. only)</td>
<td>$r_i$</td>
<td>35</td>
<td>0.01</td>
<td>0.01 Ω</td>
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<tr>
<td>Reverse current</td>
<td>$I_r$</td>
<td>1600</td>
<td>0.05</td>
<td>mA</td>
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<tr>
<td>Thermal resistance chip to heatsink per chip</td>
<td>$R_{thJH}$</td>
<td>1.40</td>
<td></td>
<td>K/W</td>
</tr>
<tr>
<td>Thermal resistance chip to case per chip</td>
<td>$R_{thJC}$</td>
<td>0.92</td>
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<tr>
<td>Static drain to source ON resistance</td>
<td>$R_{d(on)}$</td>
<td>10</td>
<td>78</td>
<td>127 mΩ</td>
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<tr>
<td>Gate threshold voltage</td>
<td>$V_{GE}$</td>
<td>0.00176</td>
<td>2.5</td>
<td>3</td>
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<tr>
<td>Gate to Source Leakage Current</td>
<td>$I_{gs}$</td>
<td>20</td>
<td>100</td>
<td>nA</td>
</tr>
<tr>
<td>Zero Gate Voltage Drain Current</td>
<td>$I_{ds}$</td>
<td>0</td>
<td>1000</td>
<td>nA</td>
</tr>
<tr>
<td>Turn On Delay Time</td>
<td>$t_{on}$</td>
<td></td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>Rise Time</td>
<td>$t_r$</td>
<td></td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>Turn off delay time</td>
<td>$t_{off}$</td>
<td></td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>Fall time</td>
<td>$t_f$</td>
<td></td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>Turn-on energy loss per pulse</td>
<td>$E_{on}$</td>
<td></td>
<td></td>
<td>mWs</td>
</tr>
<tr>
<td>Turn-off energy loss per pulse</td>
<td>$E_{off}$</td>
<td></td>
<td></td>
<td>mWs</td>
</tr>
<tr>
<td>Total gate charge</td>
<td>$Q_g$</td>
<td></td>
<td></td>
<td>nC</td>
</tr>
<tr>
<td>Gate to source charge</td>
<td>$Q_{gs}$</td>
<td></td>
<td></td>
<td>nC</td>
</tr>
<tr>
<td>Gate to drain charge</td>
<td>$Q_{gd}$</td>
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<td></td>
<td>nC</td>
</tr>
<tr>
<td>Input capacitance</td>
<td>$C_{iss}$</td>
<td></td>
<td></td>
<td>pF</td>
</tr>
<tr>
<td>Output capacitance</td>
<td>$C_{oss}$</td>
<td></td>
<td></td>
<td>pF</td>
</tr>
<tr>
<td>Reverse transfer capacitance</td>
<td>$C_{rss}$</td>
<td></td>
<td></td>
<td>pF</td>
</tr>
<tr>
<td>Thermal resistance chip to heatsink per chip</td>
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<td>0.90</td>
<td>K/W</td>
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<tr>
<td>Thermal resistance chip to case per chip</td>
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<td>0.60</td>
<td>K/W</td>
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<tr>
<td>Forward voltage</td>
<td>$V_F$</td>
<td>8</td>
<td>1.24</td>
<td>1.34 V</td>
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<td>Reverse leakage current</td>
<td>$I_{on}$</td>
<td>10</td>
<td>50</td>
<td>μA</td>
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<tr>
<td>Peak recovery current</td>
<td>$I_{rev}$</td>
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<td></td>
<td>A</td>
</tr>
<tr>
<td>Reverse recovery time</td>
<td>$t_r$</td>
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<td></td>
<td>ns</td>
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<tr>
<td>Reverse recovery charge</td>
<td>$Q_r$</td>
<td></td>
<td></td>
<td>μC</td>
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<tr>
<td>Reverse recovered energy</td>
<td>$E_{rec}$</td>
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<td></td>
<td>mWs</td>
</tr>
<tr>
<td>Peak rate of fall of recovery current</td>
<td>$dI_{off}/dI_{off,max}$</td>
<td></td>
<td></td>
<td>A/μs</td>
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<tr>
<td>Thermal resistance chip to heatsink per chip</td>
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<td>2.06</td>
<td>K/W</td>
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<tr>
<td>Thermal resistance chip to case per chip</td>
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<td>1.36</td>
<td>K/W</td>
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### 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>H-Bridge MOSFET (T3, T4, T5, T6)</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>$V_{GS}=0$</td>
<td>$V_{DS}=0$</td>
<td>$t_{d(ON)}$</td>
</tr>
<tr>
<td>Gate threshold voltage</td>
<td>$V_{\text{TH}}$</td>
<td></td>
<td></td>
<td>$t_{r}$</td>
</tr>
<tr>
<td>Gate to Source Leakage Current</td>
<td>$I_{LS}$</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Zero Gate Voltage Drain Current</td>
<td>$I_{DS}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turn On Delay Time</td>
<td>$t_{d(ON)}$</td>
<td></td>
<td></td>
<td>$t_{d(ON)}$</td>
</tr>
<tr>
<td>Rise Time</td>
<td>$t_{r}$</td>
<td></td>
<td></td>
<td>$t_{r}$</td>
</tr>
<tr>
<td>Turn off delay time</td>
<td>$t_{f(ON)}$</td>
<td>$R_{\text{goff}}=2 \Omega$</td>
<td>$R_{\text{goff}}=128 \Omega$</td>
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<tr>
<td>Fall time</td>
<td>$t_{f}$</td>
<td></td>
<td></td>
<td>$t_{f}$</td>
</tr>
<tr>
<td>Turn-on energy loss per pulse</td>
<td>$E_{on}$</td>
<td></td>
<td></td>
<td>$E_{on}$</td>
</tr>
<tr>
<td>Turn-off energy loss per pulse</td>
<td>$E_{off}$</td>
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<td></td>
<td>$E_{off}$</td>
</tr>
<tr>
<td>Total gate charge</td>
<td>$Q_{G}$</td>
<td></td>
<td></td>
<td>$Q_{G}$</td>
</tr>
<tr>
<td>Gate to source charge</td>
<td>$Q_{GS}$</td>
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<td>$Q_{GS}$</td>
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<td>Gate to drain charge</td>
<td>$Q_{GD}$</td>
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<td>$Q_{GD}$</td>
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<td>Input capacitance</td>
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<td>$C_{ins}$</td>
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<tr>
<td>Output capacitance</td>
<td>$C_{oss}$</td>
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<td>$C_{oss}$</td>
</tr>
<tr>
<td>Reverse transfer capacitance</td>
<td>$C_{rns}$</td>
<td></td>
<td></td>
<td>$C_{rns}$</td>
</tr>
<tr>
<td>Thermal resistance chip to heatsink per chip</td>
<td>$R_{\text{heat}}$</td>
<td>Thermal grease thickness=50um $\lambda = 1 \text{ W/mK}$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thermal resistance chip to case per chip</td>
<td>$R_{\text{case}}$</td>
<td>Thermal grease thickness=50um $\lambda = 1 \text{ W/mK}$</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Diode Body Diode

| Diode forward voltage | $V_{d}$ | | | | 43 | | | | |
| Peak reverse recovery current | $I_{\text{on}}$ | | | | | | | | |
| Reverse recovery time | $t_{r}$ | | | $t_{r}$ | 10 | 400 | 20 | ns |
| Reverse recovered charge | $Q_{r}$ | | | $Q_{r}$ | 10 | 400 | 20 | μC |
| Peak rate of fall of recovery current | $V_{\text{pk}}$ | | | $V_{\text{pk}}$ | 1,18 | 1,09 | | A |
| Reverse recovery energy | $E_{\text{rec}}$ | | | $E_{\text{rec}}$ | 1,18 | 1,09 | | mWs |
| Thermal resistance chip to heatsink per chip | $R_{\text{heat}}$ | Thermal grease thickness=50um $\lambda = 1 \text{ W/mK}$ | | | 0,83 | | | K/W |
| Thermal resistance chip to case per chip | $R_{\text{case}}$ | Thermal grease thickness=50um $\lambda = 1 \text{ W/mK}$ | | | 0,55 | | | K/W |

### DC link Capacitor (C1)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>C value</td>
<td>$C$</td>
<td></td>
<td>47</td>
<td>nF</td>
</tr>
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</table>

### Thermistor

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated resistance</td>
<td>$R$</td>
<td></td>
<td>22000</td>
<td>Ω</td>
</tr>
<tr>
<td>Deviation of R25</td>
<td>$\Delta R/R$</td>
<td>$R_{100}=1486 \Omega$</td>
<td>-5</td>
<td>+5</td>
</tr>
<tr>
<td>Power dissipation</td>
<td>$P$</td>
<td></td>
<td>200</td>
<td>mW</td>
</tr>
<tr>
<td>Power dissipation constant</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>B-value</td>
<td>$B_{\text{25°C}}$</td>
<td>Tol. ±3%</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>$B_{0}$</td>
<td>Tol. ±3%</td>
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</tbody>
</table>

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### MOSFET

#### Typical output characteristics

IC = f(VCE)

<table>
<thead>
<tr>
<th>At</th>
<th>tp = 250 μs</th>
<th>Tj = 25 °C</th>
<th>VGE from 0 V to 20 V in steps of 2 V</th>
</tr>
</thead>
</table>

#### Typical transfer characteristics

IC = f(VGE)

<table>
<thead>
<tr>
<th>At</th>
<th>tp = 250 μs</th>
<th>Tj = 25 °C</th>
<th>VCE = 10 V</th>
</tr>
</thead>
</table>

---

### FWD

#### Typical diode forward current as a function of forward voltage

IF = f(VF)

<table>
<thead>
<tr>
<th>At</th>
<th>tp = 250 μs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tj = Tjmax - 25 °C</td>
<td></td>
</tr>
</tbody>
</table>

---
H-Bridge

Figure 5 MOSFET

Typical switching energy losses as a function of collector current

\[ E = f(I_C) \]

With an inductive load at

\[ T_J = 25/125 \degree C \]
\[ V_{CE} = 400 \text{ V} \]
\[ V_{GE} = 10 \text{ V} \]
\[ R_{gon} = 128 \text{ } \Omega \]
\[ R_{goff} = 2 \text{ } \Omega \]

Figure 6 MOSFET

Typical switching energy losses as a function of gate resistor

\[ E = f(R_G) \]

With an inductive load at

\[ T_J = 25/125 \degree C \]
\[ V_{CE} = 400 \text{ V} \]
\[ V_{GE} = 10 \text{ V} \]
\[ I_C = 20 \text{ A} \]
\[ R_{gon} = 128 \text{ } \Omega \]

Figure 7 FWD

Typical reverse recovery energy loss as a function of collector current

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

With an inductive load at

\[ T_J = 25/125 \degree C \]
\[ V_{CE} = 400 \text{ V} \]
\[ V_{GE} = 10 \text{ V} \]
\[ R_{gon} = 128 \text{ } \Omega \]
H-Bridge

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

With an inductive load at
- \( T_j = 125 \, ^\circ\text{C} \)
- \( V_{CE} = 400 \, \text{V} \)
- \( V_{GE} = 10 \, \text{V} \)
- \( R_{gon} = 128 \, \Omega \)
- \( R_{goff} = 2 \, \Omega \)

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

With an inductive load at
- \( T_j = 125 \, ^\circ\text{C} \)
- \( V_{CE} = 400 \, \text{V} \)
- \( V_{GE} = 10 \, \text{V} \)
- \( I_C = 20 \, \text{A} \)

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

At
- \( T_j = 25/125 \, ^\circ\text{C} \)
- \( V_{CE} = 400 \, \text{V} \)
- \( V_{GE} = 10 \, \text{V} \)
- \( R_{gon} = 128 \, \Omega \)
H-Bridge

Figure 13  
Typical reverse recovery charge as a function of collector current 

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

At  
\[ T_j = 25/125 \degree C \]
\[ V_{CE} = 400 \text{ V} \]
\[ V_{GE} = 10 \text{ V} \]
\[ R_{gon} = 128 \Omega \]

Figure 15  
Typical reverse recovery current as a function of collector current 

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

At  
\[ T_j = 25/125 \degree C \]
\[ V_{CE} = 400 \text{ V} \]
\[ V_{GE} = 10 \text{ V} \]
\[ R_{gon} = 128 \Omega \]
### H-Bridge

#### Figure 17

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

At:
- \( T_j = 25/125 \) °C
- \( V_{CE} = 400 \) V
- \( V_{GE} = 10 \) V
- \( R_{gon} = 128 \) Ω

#### Figure 19

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

At:
- \( D = t_p / T \)
- \( R_{thJH} = 0.83 \) KW

IGBT thermal model values

<table>
<thead>
<tr>
<th>R (C/W)</th>
<th>( \tau ) (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0,03</td>
<td>4,8E+00</td>
</tr>
<tr>
<td>0,10</td>
<td>1,1E+00</td>
</tr>
<tr>
<td>0,33</td>
<td>2,3E-01</td>
</tr>
<tr>
<td>0,26</td>
<td>8,5E-02</td>
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<td>0,08</td>
<td>1,3E-02</td>
</tr>
<tr>
<td>0,04</td>
<td>1,0E-03</td>
</tr>
</tbody>
</table>

#### Figure 20

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

At:
- \( D = t_p / T \)
- \( R_{thJH} = 0.83 \) KW

FWD thermal model values

<table>
<thead>
<tr>
<th>R (C/W)</th>
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<tbody>
<tr>
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<tr>
<td>0,04</td>
<td>1,0E-03</td>
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</tbody>
</table>
H-Bridge

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

At
\[ T_j = 150 \degree C \]

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

At
\[ T_j = 150 \degree C \]
\[ V_{GE} = 15 \text{ V} \]

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

At
\[ T_j = 150 \degree C \]

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

At
\[ T_j = 150 \degree C \]
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  
\( T_j = T_{j_{\text{max}}} \) °C

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

At  
\( I_C = 43 \) A
Figure 1  
**Typical output characteristics**  
$I_D = f(V_{DS})$

![Graph 1](image1)

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

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

![Graph 2](image2)

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

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

![Graph 3](image3)

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

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

![Graph 4](image4)

At  
$t_p = 250 \mu s$
INPUT BOOST

**Figure 5**  
**BOOST MOSFET**  
Typical switching energy losses  
as a function of collector current  
\[ E = f(I_C) \]

With an inductive load at  
\[ T_j = 25/125 \, \degree \text{C} \]  
\[ V_{DS} = 400 \, \text{V} \]  
\[ V_{GS} = 10 \, \text{V} \]  
\[ R_{gon} = 2 \, \Omega \]  
\[ R_{goff} = 2 \, \Omega \]

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

With an inductive load at  
\[ T_j = 25/125 \, \degree \text{C} \]  
\[ V_{DS} = 400 \, \text{V} \]  
\[ V_{GS} = 10 \, \text{V} \]  
\[ I_g = 20 \, \text{A} \]

**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  
\[ T_j = 25/125 \, \degree \text{C} \]  
\[ V_{DS} = 400 \, \text{V} \]  
\[ V_{GS} = 10 \, \text{V} \]  
\[ R_{gon} = 2 \, \Omega \]  
\[ R_{goff} = 2 \, \Omega \]

**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  
\[ T_j = 25/125 \, \degree \text{C} \]  
\[ V_{DS} = 400 \, \text{V} \]  
\[ V_{GS} = 10 \, \text{V} \]  
\[ I_g = 20 \, \text{A} \]
**INPUT BOOST**

**Figure 9**

**BOOST MOSFET**

Typical switching times as a function of collector current

$t = f(I_C)$

With an inductive load at

- $T_j = 125 \, ^\circ C$
- $V_{DS} = 400 \, V$
- $V_{GS} = 10 \, V$
- $R_{gon} = 2 \, \Omega$
- $R_{goff} = 2 \, \Omega$

**Figure 10**

**BOOST MOSFET**

Typical switching times as a function of gate resistor

$t = f(R_g)$

With an inductive load at

- $T_j = 125 \, ^\circ C$
- $V_{DS} = 400 \, V$
- $V_{GS} = 10 \, V$
- $I_C = 20 \, A$

**Figure 11**

**BOOST FWD**

Typical reverse recovery time as a function of collector current

$tr_{rr} = f(I_C)$

At

- $T_j = 25/125 \, ^\circ C$
- $V_{CE} = 400 \, V$
- $V_{GE} = 10 \, V$
- $R_{gon} = 2 \, \Omega$

**Figure 12**

**BOOST FWD**

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

$tr_{rr} = f(R_{gon})$

At

- $T_j = 25/125 \, ^\circ C$
- $V_{CE} = 400 \, V$
- $I_R = 20 \, A$
- $V_{GE} = 10 \, V$
INPUT BOOST

**Figure 13**
Typical reverse recovery charge as a function of collector current

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

At

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

**Figure 14**
Typical reverse recovery charge as a function of IGBT turn on gate resistor

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

At

\[ T_j = 25/125 \, ^\circ C \]
\[ V_{CE} = 400 \, V \]
\[ V_{GS} = 10 \, V \]

**Figure 15**
Typical reverse recovery current as a function of collector current

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

At

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

**Figure 16**
Typical reverse recovery current as a function of IGBT turn on gate resistor

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

At

\[ T_j = 25/125 \, ^\circ C \]
\[ V_{CE} = 400 \, V \]
\[ V_{GS} = 10 \, V \]
Figure 17: BOOST FWD
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
- \( V_{GS} = 10 \) V
- \( R_{gon} = 2 \) Ω

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

At
- \( T_j = 25/125 \) °C
- \( V_{CE} = 400 \) V
- \( I_r = 20 \) A
- \( V_{GS} = 10 \) V

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

At
- \( D = 0.5 \)
- \( R_{mos} = 0.90 \) KW

IGBT thermal model values

<table>
<thead>
<tr>
<th>R (C/W)</th>
<th>Tau (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.43E-02</td>
<td>5.75E+00</td>
</tr>
<tr>
<td>1.09E-01</td>
<td>1.04E+00</td>
</tr>
<tr>
<td>4.48E-01</td>
<td>1.90E-01</td>
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<tr>
<td>1.86E-01</td>
<td>6.29E-02</td>
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<tr>
<td>8.11E-02</td>
<td>1.23E-02</td>
</tr>
<tr>
<td>4.45E-02</td>
<td>1.06E-03</td>
</tr>
</tbody>
</table>

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

At
- \( D = 0.5 \)
- \( R_{msh} = 2.06 \) KW

FWD thermal model values

<table>
<thead>
<tr>
<th>R (C/W)</th>
<th>Tau (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.27E-02</td>
<td>9.23E+00</td>
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<td>1.23E-01</td>
<td>1.09E+00</td>
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<td>1.25E-02</td>
</tr>
<tr>
<td>2.09E-01</td>
<td>2.51E-03</td>
</tr>
</tbody>
</table>
**INPUT BOOST**

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

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

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

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

At
\[ T_j = 175 \ ^\circ C \]
INPUT BOOST

Figure 25  
Safe operating area as a function of drain-source voltage

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

Figure 26  
Gate voltage vs Gate charge

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

At

- \( D = \) single pulse
- \( T_s = 80 \) °C
- \( V_{GS} = 10 \) V
- \( T_j = T_{jmax} \) °C

At

- \( I_D = 20 \) A
Bypass Diode

**Figure 1**
Typical diode forward current as a function of forward voltage
\[ I_F = f(V_F) \]

\[ T_j = T_{PWM, 25^\circ C} \]
\[ T_j = 25^\circ C \]

At
\[ t_p = 250 \mu s \]

**Figure 2**
Diode transient thermal impedance as a function of pulse width
\[ Z_{thJH} = f(t_p) \]

\[ D = 0.5 \]
\[ 0.2 \]
\[ 0.1 \]
\[ 0.05 \]
\[ 0.01 \]
\[ 0.005 \]
\[ 0.001 \]

At
\[ D = \frac{t_p}{T} \]
\[ R_{thJH} = 1,397 \text{ K/W} \]

**Figure 3**
Power dissipation as a function of heatsink temperature
\[ P_{tot} = f(T_h) \]

At
\[ T_j = 150 \text{ °C} \]

**Figure 4**
Forward current as a function of heatsink temperature
\[ I_F = f(T_h) \]

At
\[ T_j = 150 \text{ °C} \]
Figure 1

Thermistor

Typical NTC characteristic
as a function of temperature

\[ R_T = f(T) \]
Switching Definitions H-Bridge MOSFET

General conditions

Tj = 125 °C
Rgs = 128 Ω
Rgoff = 2 Ω

Figure 1
Turn-off Switching Waveforms & definition of t\textsubscript{off}, t\textsubscript{Eoff}
(t\textsubscript{Eoff} = integrating time for E\textsubscript{off})

Figure 2
Turn-on Switching Waveforms & definition of t\textsubscript{on}, t\textsubscript{Eon}
(t\textsubscript{Eon} = integrating time for E\textsubscript{on})

Figure 3
Turn-off Switching Waveforms & definition of t\textsubscript{f}

Figure 4
Turn-on Switching Waveforms & definition of t\textsubscript{r}

V\textsubscript{GE} (0%) = 0 V
V\textsubscript{GE} (100%) = 10 V
V\textsubscript{C} (100%) = 400 V
I\textsubscript{C} (100%) = 20 A
V\textsubscript{CE} (90%) = 3,8 V
V\textsubscript{CE} (3%) = 0,07 V
V\textsubscript{CE} (1%) = 0,075 V
V\textsubscript{CE} (0,1%) = 0,0725 V
V\textsubscript{CE} (0,01%) = 0,07 V
V\textsubscript{CE} (0,001%) = 0,0675 V
V\textsubscript{CE} (0,0001%) = 0,065 V
V\textsubscript{CE} (0,00001%) = 0,0625 V
V\textsubscript{CE} (0,000001%) = 0,06 V

V\textsubscript{CE} (100%) = 400 V
I\textsubscript{C} (100%) = 20 A
I\textsubscript{fitted} = 4,1 A
I\textsubscript{off} = 0,01 μs
I\textsubscript{on} = 0,31 μs
I\textsubscript{r} = 0,98 μs

Copyright by Vincotech
Switching Definitions H-Bridge MOSFET

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

- $P_{off}(100\%) = 8.05$ kW
- $E_{off}(100\%) = 0.01$ mJ
- $t_{Eoff} = 0.13$ μs

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

- $P_{on}(100\%) = 8.05$ kW
- $E_{on}(100\%) = 3.68$ mJ
- $t_{Eon} = 0.98$ μs

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

- $V_{GEoff} = 0$ V
- $V_{GEon} = 10$ V
- $V_{D(100\%)} = 400$ V
- $I_{D(100\%)} = 20$ A
- $Q_{g} = 145.99$ nC

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

- $V_{D(100\%)} = 400$ V
- $I_{D(100\%)} = 20$ A
- $I_{RRM(100\%)} = -24$ A
- $t_{rr} = 0.21$ μs
### Switching Definitions H-Bridge MOSFET

#### Figure 9
**H-Bridge FWD**

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

($t_{Qrr} = \text{integrating time for } Q_r$)

- $I_d (100\%) = 20 \text{ A}$
- $Q_{rr} (100\%) = 2.74 \text{ } \mu\text{C}$
- $t_{Qrr} = 0.43 \text{ } \mu\text{s}$

#### Figure 10
**H-Bridge FWD**

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

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

- $P_{rec} (100\%) = 8.05 \text{ kW}$
- $E_{rec} (100\%) = 0.05 \text{ mJ}$
- $t_{Erec} = 0.43 \text{ } \mu\text{s}$
Ordering Code and Marking - Outline - Pinout

Ordering Code & Marking

<table>
<thead>
<tr>
<th>Version</th>
<th>Ordering Code</th>
<th>in DataMatrix as</th>
<th>in packaging barcode as</th>
</tr>
</thead>
<tbody>
<tr>
<td>without thermal paste 12mm housing</td>
<td>10-FY06BIA080MF-M527E58</td>
<td>M527E58</td>
<td>M527E58</td>
</tr>
</tbody>
</table>

Outline

Pins 3, 4, 9, 12, 27, 34 are not connected.

Pinout

Tolerance of pinpositions ±0,5mm at the end of pins
Dimension of coordinate axis is only offset without tolerance
PCB cutouts and holes see in handling instructions document.
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>
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</tr>
</tbody>
</table>

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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.