flowRPI 1 650 V / 15 A

Features
- High integration level of Rectifier, PFC and Inverter
- Interleaved PFC with high efficiency, fast IGBT H5 + ultra-fast Si Diode
- High efficiency H-Bridge inverter with fast IGBT H5
- Integrated Temperature Sensor and Capacitor

Target applications
- Charging Stations
- Power Supply
- Welding & Cutting

Types
- 10-FY07ZAA015SM-L512B28

Maximum Ratings
$T_j = 25 \, ^\circ C$, 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>Rectifier Diode</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peak repetitive reverse voltage</td>
<td>$V_{RRM}$</td>
<td></td>
<td>1600</td>
<td>V</td>
</tr>
<tr>
<td>Continuous (direct) forward current</td>
<td>$I_T$</td>
<td>$T_j = T_{j\text{max}}$ \quad T_s = 80 , ^\circ C$</td>
<td>46</td>
<td>A</td>
</tr>
<tr>
<td>Surge (non-repetitive) forward current</td>
<td>$I_{FSM}$</td>
<td>50 Hz Single Half Sine Wave \quad T_j = 150 , ^\circ C$</td>
<td>270</td>
<td>A</td>
</tr>
<tr>
<td>Surge current capability</td>
<td>$I_{2t}$</td>
<td>$T_j = T_{j\text{max}}$ \quad T_s = 80 , ^\circ C$</td>
<td>370</td>
<td>A²s</td>
</tr>
<tr>
<td>Total power dissipation</td>
<td>$P_T$</td>
<td>$T_j = T_{j\text{max}}$ \quad T_s = 80 , ^\circ C$</td>
<td>56</td>
<td>W</td>
</tr>
<tr>
<td>Maximum junction temperature</td>
<td>$T_{j\text{max}}$</td>
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<td>150</td>
<td>^\circ C</td>
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</table>
## Maximum Ratings

$T_i = 25 \, ^\circ\text{C}$, unless otherwise specified

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Condition</th>
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<th>Unit</th>
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<tbody>
<tr>
<td><strong>PFC Switch</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collector-emitter voltage</td>
<td>$V_{ces}$</td>
<td></td>
<td>650</td>
<td>V</td>
</tr>
<tr>
<td>Collector current</td>
<td>$I_C$</td>
<td>$T_i = T_{j_{max}}$ $T_s = 80 , ^\circ\text{C}$</td>
<td>21</td>
<td>A</td>
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<tr>
<td>Repetitive peak collector current</td>
<td>$I_{CM}$</td>
<td>$I_p$ limited by $T_{j_{max}}$</td>
<td>45</td>
<td>A</td>
</tr>
<tr>
<td>Total power dissipation</td>
<td>$P_{tot}$</td>
<td>$T_i = T_{j_{max}}$ $T_s = 80 , ^\circ\text{C}$</td>
<td>44</td>
<td>W</td>
</tr>
<tr>
<td>Gate-emitter voltage</td>
<td>$V_{ges}$</td>
<td></td>
<td>±20</td>
<td>V</td>
</tr>
<tr>
<td>Maximum junction temperature</td>
<td>$T_{j_{max}}$</td>
<td></td>
<td>175</td>
<td>^\circ\text{C}</td>
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<tr>
<td><strong>PFC Diode</strong></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Peak repetitive reverse voltage</td>
<td>$V_{RRM}$</td>
<td></td>
<td>650</td>
<td>V</td>
</tr>
<tr>
<td>Continuous (direct) forward current</td>
<td>$I_F$</td>
<td>$T_i = T_{j_{max}}$ $T_s = 80 , ^\circ\text{C}$</td>
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<td>A</td>
</tr>
<tr>
<td>Total power dissipation</td>
<td>$P_{tot}$</td>
<td>$T_i = T_{j_{max}}$ $T_s = 80 , ^\circ\text{C}$</td>
<td>57</td>
<td>W</td>
</tr>
<tr>
<td>Maximum junction temperature</td>
<td>$T_{j_{max}}$</td>
<td></td>
<td>175</td>
<td>^\circ\text{C}</td>
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<tr>
<td><strong>PFC Sw. Protection Diode</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peak repetitive reverse voltage</td>
<td>$V_{RRM}$</td>
<td></td>
<td>650</td>
<td>V</td>
</tr>
<tr>
<td>Continuous (direct) forward current</td>
<td>$I_F$</td>
<td>$T_i = T_{j_{max}}$ $T_s = 80 , ^\circ\text{C}$</td>
<td>14</td>
<td>A</td>
</tr>
<tr>
<td>Repetitive peak forward current</td>
<td>$I_{FRM}$</td>
<td></td>
<td>20</td>
<td>A</td>
</tr>
<tr>
<td>Total power dissipation</td>
<td>$P_{tot}$</td>
<td>$T_i = T_{j_{max}}$ $T_s = 80 , ^\circ\text{C}$</td>
<td>33</td>
<td>W</td>
</tr>
<tr>
<td>Maximum junction temperature</td>
<td>$T_{j_{max}}$</td>
<td></td>
<td>175</td>
<td>^\circ\text{C}</td>
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<tr>
<td><strong>Current Transformer Protection Diode</strong></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Peak repetitive reverse voltage</td>
<td>$V_{RRM}$</td>
<td></td>
<td>650</td>
<td>V</td>
</tr>
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<td>Continuous (direct) forward current</td>
<td>$I_F$</td>
<td>$T_i = T_{j_{max}}$ $T_s = 80 , ^\circ\text{C}$</td>
<td>14</td>
<td>A</td>
</tr>
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<td>Repetitive peak forward current</td>
<td>$I_{FRM}$</td>
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<td>A</td>
</tr>
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<td>Total power dissipation</td>
<td>$P_{tot}$</td>
<td>$T_i = T_{j_{max}}$ $T_s = 80 , ^\circ\text{C}$</td>
<td>33</td>
<td>W</td>
</tr>
<tr>
<td>Maximum junction temperature</td>
<td>$T_{j_{max}}$</td>
<td></td>
<td>175</td>
<td>^\circ\text{C}</td>
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Maximum Ratings

$T_i = 25 \degree C$, unless otherwise specified

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<tbody>
<tr>
<td><strong>H-Bridge Switch</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collector-emitter voltage</td>
<td>$V_{CES}$</td>
<td>$I_i = T_{jmax}$, $T_i = 80 \degree C$</td>
<td>650</td>
<td>V</td>
</tr>
<tr>
<td>Collector current</td>
<td>$I_C$</td>
<td>$I_i = T_{jmax}$, $T_i = 80 \degree C$</td>
<td>21</td>
<td>A</td>
</tr>
<tr>
<td>Repetitive peak collector current</td>
<td>$I_{CM}$</td>
<td>$I_i$ limited by $T_{jmax}$</td>
<td>45</td>
<td>A</td>
</tr>
<tr>
<td>Total power dissipation</td>
<td>$P_{tot}$</td>
<td>$I_i = T_{jmax}$, $T_i = 80 \degree C$</td>
<td>44</td>
<td>W</td>
</tr>
<tr>
<td>Gate-emitter voltage</td>
<td>$V_{GES}$</td>
<td>$I_i = T_{jmax}$</td>
<td>±20</td>
<td>V</td>
</tr>
<tr>
<td>Maximum junction temperature</td>
<td>$T_{jmax}$</td>
<td>$I_i = T_{jmax}$</td>
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<td>\degree C</td>
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</tbody>
</table>

**H-Bridge Diode**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
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<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak repetitive reverse voltage</td>
<td>$V_{RRM}$</td>
<td></td>
<td>650</td>
<td>V</td>
</tr>
<tr>
<td>Continuous (direct) forward current</td>
<td>$I_F$</td>
<td>$I_i = T_{jmax}$, $T_i = 80 \degree C$</td>
<td>14</td>
<td>A</td>
</tr>
<tr>
<td>Repetitive peak forward current</td>
<td>$I_{FHM}$</td>
<td></td>
<td>20</td>
<td>A</td>
</tr>
<tr>
<td>Total power dissipation</td>
<td>$P_{tot}$</td>
<td>$I_i = T_{jmax}$, $T_i = 80 \degree C$</td>
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<td>W</td>
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<tr>
<td>Maximum junction temperature</td>
<td>$T_{jmax}$</td>
<td>$I_i = T_{jmax}$</td>
<td>175</td>
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**Capacitor (DC)**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Condition</th>
<th>Value</th>
<th>Unit</th>
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</thead>
<tbody>
<tr>
<td>Maximum DC voltage</td>
<td>$V_{MAX}$</td>
<td></td>
<td>630</td>
<td>V</td>
</tr>
<tr>
<td>Operation Temperature</td>
<td>$T_{op}$</td>
<td></td>
<td>-55...+125</td>
<td>\degree C</td>
</tr>
</tbody>
</table>

**Module Properties**

**Thermal Properties**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Condition</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage temperature</td>
<td>$T_{stg}$</td>
<td>$I_i = T_{jmax}$, $T_i = 80 \degree C$</td>
<td>-40...+125</td>
<td>\degree C</td>
</tr>
<tr>
<td>Operation temperature under switching condition</td>
<td>$T_{jop}$</td>
<td>$I_i = T_{jmax}$, $T_i = 80 \degree C$</td>
<td>-40...(T_{jmax} - 25)</td>
<td>\degree C</td>
</tr>
</tbody>
</table>

**Isolation Properties**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>DC Test Voltage*</th>
<th>$t_i = 2 s$</th>
<th>AC Voltage</th>
<th>$t_i = 1 min$</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isolation voltage</td>
<td>$V_{isol}$</td>
<td>6000</td>
<td></td>
<td>2500</td>
<td>V</td>
<td></td>
<td></td>
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<tr>
<td>Creepage distance</td>
<td></td>
<td>min. 12,7</td>
<td></td>
<td>7,58</td>
<td>mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clearance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comparative Tracking Index</td>
<td>CTI</td>
<td>&gt; 200</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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</table>

*100 % tested in production
## Characteristic Values

<table>
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<tr>
<th>Parameter</th>
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<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>$V_{GE}$ [V]</td>
<td>$V_{GS}$ [V]</td>
<td>$I_{C}$ [A]</td>
</tr>
<tr>
<td>Rectifier Diode</td>
<td></td>
<td>$V_{F}$ [V]</td>
<td>$I_{C}$ [A]</td>
<td>$I_{D}$ [A]</td>
</tr>
</tbody>
</table>

### Static

- **Forward voltage**
  - $V_F$: 35, 125
  - $V_J$: 1,17, 1,5

- **Reverse leakage current**
  - $I_R$: 1600
  - $I_B$: 50

### Thermal

- **Thermal resistance junction to sink** $R_{th(j-s)}$
  - $T_J = 3.4 \text{ W/mK}$ (PSX)
  - $T_J$: 1,25

*Note: Values are approximate.*

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10-FY07ZAA015SM-L512B28 datasheet

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## Characteristic Values

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<th>Unit</th>
</tr>
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<tbody>
<tr>
<td>VGE</td>
<td>[V]</td>
<td></td>
<td>Min</td>
<td>Typ</td>
</tr>
<tr>
<td>VGS</td>
<td>[V]</td>
<td>0,0004</td>
<td>25</td>
<td>3,3</td>
</tr>
<tr>
<td>VCE</td>
<td>[V]</td>
<td>15</td>
<td>25</td>
<td>125</td>
</tr>
<tr>
<td>Ics</td>
<td>[A]</td>
<td>0</td>
<td>650</td>
<td>25</td>
</tr>
<tr>
<td>Ioss</td>
<td>[A]</td>
<td>20</td>
<td>0</td>
<td>25</td>
</tr>
<tr>
<td>Internal gate resistance</td>
<td>rgg</td>
<td>none</td>
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<td></td>
</tr>
<tr>
<td>Input capacitance</td>
<td>Cies</td>
<td>f = 1 Mhz</td>
<td>0</td>
<td>25</td>
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<tr>
<td>Output capacitance</td>
<td>Coes</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Reverse transfer capacitance</td>
<td>Cres</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Gate charge</td>
<td>Qg</td>
<td>15</td>
<td>520</td>
<td>15</td>
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### PFC Switch

#### Static

<table>
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<th>Value</th>
<th>Unit</th>
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</thead>
<tbody>
<tr>
<td>Gate-emitter threshold voltage</td>
<td>VGE(th)</td>
<td>VCE = 0</td>
<td>0,004</td>
<td>25</td>
</tr>
<tr>
<td>Collector-emitter saturation voltage</td>
<td>VCEsat</td>
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<td>15</td>
<td>25</td>
</tr>
<tr>
<td>Collector-emitter cut-off current</td>
<td>Ics</td>
<td>0</td>
<td>650</td>
<td>25</td>
</tr>
<tr>
<td>Gate-emitter leakage current</td>
<td>Ioss</td>
<td>20</td>
<td>0</td>
<td>25</td>
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#### Thermal

<table>
<thead>
<tr>
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<th>Value</th>
<th>Unit</th>
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</thead>
<tbody>
<tr>
<td>Thermal resistance junction to sink</td>
<td>Rth(j-s)</td>
<td>λ-paste = 3,4 W/mK (PSX)</td>
<td>2,14</td>
<td>K/W</td>
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#### Dynamic

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
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<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turn-on delay time</td>
<td>tδ(on)</td>
<td></td>
<td>25</td>
<td>125</td>
</tr>
<tr>
<td>Rise time</td>
<td>τr</td>
<td>Rgg = 32 Ω</td>
<td>25</td>
<td>125</td>
</tr>
<tr>
<td>Turn-off delay time</td>
<td>tδ(off)</td>
<td>Rgg = 32 Ω</td>
<td>25</td>
<td>125</td>
</tr>
<tr>
<td>Fall time</td>
<td>τf</td>
<td></td>
<td>25</td>
<td>125</td>
</tr>
<tr>
<td>Turn-on energy (per pulse)</td>
<td>Eon</td>
<td></td>
<td>25</td>
<td>125</td>
</tr>
<tr>
<td>Turn-off energy (per pulse)</td>
<td>Eoff</td>
<td></td>
<td>25</td>
<td>125</td>
</tr>
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</table>
## Characteristic Values

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<tr>
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<th>Symbol</th>
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<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{GE}$</td>
<td>$V$</td>
<td>15</td>
<td>1,98</td>
<td>2,48</td>
</tr>
<tr>
<td>$V_{GS}$</td>
<td>$V$</td>
<td>25</td>
<td>1,73</td>
<td>3</td>
</tr>
<tr>
<td>$V_{CE}$</td>
<td>$V$</td>
<td>650</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$V_{DS}$</td>
<td>$V$</td>
<td>25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$V_{F}$</td>
<td>$V$</td>
<td>125</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$I_{CC}$</td>
<td>$A$</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$I_{DD}$</td>
<td>$A$</td>
<td>25</td>
<td></td>
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</tr>
<tr>
<td>$I_{R}$</td>
<td>$A$</td>
<td>125</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$T_{j}$</td>
<td>$°C$</td>
<td>150</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Min</td>
<td>15</td>
<td>125</td>
<td>10</td>
<td>25</td>
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<tr>
<td>Typ</td>
<td>10</td>
<td>125</td>
<td>0,14</td>
<td>25</td>
</tr>
<tr>
<td>Max</td>
<td>150</td>
<td>25</td>
<td>2,87</td>
<td>150</td>
</tr>
<tr>
<td>$R_{th(j-s)}$</td>
<td>$K/W$</td>
<td>3,4 W/mK</td>
<td>2,87</td>
<td></td>
</tr>
</tbody>
</table>

### PFC Diode

#### Static
- **Forward voltage** $V_j$
  - 15 V
  - 25 V
  - 125 V
- **Reverse leakage current** $I_r$
  - 650 µA
  - 25 µA

#### Thermal
- **Thermal resistance junction to sink** $R_{th(j-s)}$
  - $3,4 \text{ W/mK (PSX)}$
  - 1,65 K/W

#### Dynamic
- **Peak recovery current** $I_{RRM}$
  - 0 / 15 A
  - 25 A
  - 125 A
  - 150 A
- **Reverse recovery time** $t_{rr}$
  - 25 ns
  - 125 ns
  - 150 ns
- **Recovered charge** $Q_d$
  - 0 / 15 μC
  - 25 μC
  - 125 μC
  - 150 μC
- **Reverse recovered energy** $E_{rec}$
  - 25 mWs
  - 125 mWs
  - 150 mWs
- **Peak rate of fall of recovery current** $|di/dt|_{max}$
  - 25 A/μs
  - 125 A/μs
  - 150 A/μs

### PFC Sw. Protection Diode

#### Static
- **Forward voltage** $V_j$
  - 10 V
  - 25 V
  - 125 V
- **Reverse leakage current** $I_r$
  - 650 µA
  - 25 µA

#### Thermal
- **Thermal resistance junction to sink** $R_{th(j-s)}$
  - $3,4 \text{ W/mK (PSX)}$
  - 2,87 K/W

### Current Transformer Protection Diode

#### Static
- **Forward voltage** $V_j$
  - 10 V
  - 25 V
  - 125 V
- **Reverse leakage current** $I_r$
  - 650 µA
  - 25 µA

#### Thermal
- **Thermal resistance junction to sink** $R_{th(j-s)}$
  - $3,4 \text{ W/mK (PSX)}$
  - 2,87 K/W

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<tbody>
<tr>
<td>Voltage</td>
<td>( V_{GE} )</td>
<td>( V_{CC} = V_Ce )</td>
<td>0,0004</td>
<td>V</td>
</tr>
<tr>
<td>Current</td>
<td>( I_C )</td>
<td>( I_o )</td>
<td>Min</td>
<td>Typ</td>
</tr>
<tr>
<td>Temperature</td>
<td>( T_{j} )</td>
<td>( ^{o}C )</td>
<td>1,64</td>
<td>1,77</td>
</tr>
<tr>
<td>Collector-emitter saturation voltage</td>
<td>( V_{CES} )</td>
<td>25</td>
<td>125</td>
<td>150</td>
</tr>
<tr>
<td>Collector-emitter cut-off current</td>
<td>( I_{CSS} )</td>
<td>0</td>
<td>1500</td>
<td>650</td>
</tr>
<tr>
<td>Gate-emitter leakage current</td>
<td>( I_{GES} )</td>
<td>20</td>
<td>25</td>
<td>200</td>
</tr>
<tr>
<td>Internal gate resistance</td>
<td>( r_g )</td>
<td>none</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>Input capacitance</td>
<td>( C_{in} )</td>
<td>( f = 1 ) MHz</td>
<td>24</td>
<td>pF</td>
</tr>
<tr>
<td>Output capacitance</td>
<td>( C_{out} )</td>
<td>( f = 1 ) MHz</td>
<td>4</td>
<td>pF</td>
</tr>
<tr>
<td>Reverse transfer capacitance</td>
<td>( C_{res} )</td>
<td>none</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>Gate charge</td>
<td>( Q_g )</td>
<td>15</td>
<td>520</td>
<td>15</td>
</tr>
<tr>
<td>Thermal resistance junction to sink</td>
<td>( R_{th(j-s)} )</td>
<td>( \lambda_{paste} = 3,4 ) W/mK</td>
<td>2,14</td>
<td>K/W</td>
</tr>
<tr>
<td>Rise time</td>
<td>( t_r )</td>
<td>( R_{on} = 32 ) Ω</td>
<td>25</td>
<td>125</td>
</tr>
<tr>
<td>Turn-on delay time</td>
<td>( t_{on} )</td>
<td>( R_{off} = 32 ) Ω</td>
<td>25</td>
<td>125</td>
</tr>
<tr>
<td>Turn-off delay time</td>
<td>( t_{off} )</td>
<td>-5 / 15</td>
<td>350</td>
<td>15</td>
</tr>
<tr>
<td>Fall time</td>
<td>( t_f )</td>
<td>( \Omega_{F} = 0,4 ) µC</td>
<td>25</td>
<td>125</td>
</tr>
<tr>
<td>Turn-on energy (per pulse)</td>
<td>( E_{on} )</td>
<td>( \Omega_{F} = 0,8 ) µC</td>
<td>25</td>
<td>125</td>
</tr>
<tr>
<td>Turn-off energy (per pulse)</td>
<td>( E_{off} )</td>
<td>( \Omega_{F} = 0,9 ) µC</td>
<td>25</td>
<td>125</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>Min</td>
<td>Typ</td>
<td>Max</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### H-Bridge Diode

#### Static

- **Forward voltage**
  - Symbol: \( V_t \)
  - Conditions: 10, 25, 125, 150
  - Value: 1.52, 1.43, 1.41
  - Unit: V

- **Reverse leakage current**
  - Symbol: \( I_r \)
  - Conditions: 650
  - Value: 0.64
  - Unit: µA

#### Thermal

- **Thermal resistance junction to sink**
  - Symbol: \( R_{th(j-s)} \)
  - Value: 2.53
  - Unit: K/W

#### Dynamic

- **Peak recovery current**
  - Symbol: \( I_{RM} \)
  - Conditions: 25, 125, 150
  - Value: 9, 11, 13
  - Unit: A

- **Reverse recovery time**
  - Symbol: \( t_{rr} \)
  - Conditions: 25, 125, 150
  - Value: 100, 125, 136
  - Unit: ns

- **Recovered charge**
  - Symbol: \( Q_r \)
  - Conditions: 25, 125, 150
  - Value: 0.443, 0.813, 0.928
  - Unit: µC

- **Reverse recovered energy**
  - Symbol: \( E_{rec} \)
  - Conditions: 25, 125, 150
  - Value: 0.077, 0.153, 0.174
  - Unit: mWs

- **Peak rate of fall of recovery current**
  - Symbol: \( di/dt\)max
  - Conditions: 25, 125, 150
  - Value: 50, 79, 84
  - Unit: A/µs

### Capacitor (DC)

- **Capacitance**
  - Symbol: \( C \)
  - Value: 100
  - Unit: nF

- **Tolerance**
  - Value: \(-10\) %, \(+10\) %

- **Dissipation factor**
  - Symbol: \( f\)
  - Value: 1 kHz
  - Value: 25
  - Unit: %

### Thermistor

- **Rated resistance**
  - Symbol: \( R \)
  - Conditions: 25
  - Value: 22
  - Unit: kΩ

- **Deviation of \( R_{100} \)**
  - Symbol: \( \Delta R \)
  - Value: 1484 Ω
  - Value: 100, -5
  - Unit: %

- **Power dissipation**
  - Symbol: \( P \)
  - Value: 25, 5
  - Unit: mW

- **Power dissipation constant**
  - Value: 25, 1.5
  - Unit: mW/K

- **B-value**
  - Symbol: \( R_{(25/100)} \)
  - Value: 25
  - Value: 3962
  - Unit: K

- **B-value**
  - Symbol: \( R_{(25/200)} \)
  - Value: 25
  - Value: 4000
  - Unit: K

**Vincotech NTC Reference**
Rectifier Diode Characteristics

**Typical forward characteristics**

$I_F = f(V_F)$

$Z_{th(j-s)} = f(t_p)$

$t_p = 250 \ \mu s$

$D = t_p / T$

$R_{th(j)} = 1,25 \ \text{K/W}$

**Diode thermal model values**

<table>
<thead>
<tr>
<th>$R$ (K/W)</th>
<th>$\tau$ (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8,00E-02</td>
<td>5,22E+00</td>
</tr>
<tr>
<td>1,56E-01</td>
<td>4,18E-01</td>
</tr>
<tr>
<td>6,95E-01</td>
<td>8,82E-02</td>
</tr>
<tr>
<td>2,23E-01</td>
<td>3,07E-02</td>
</tr>
<tr>
<td>9,97E-02</td>
<td>5,99E-03</td>
</tr>
</tbody>
</table>
PFC Switch Characteristics

Figure 1. IGBT
Typical output characteristics
$I_C = f(V_{CE})$

Figure 2. IGBT
Typical output characteristics
$I_C = f(V_{GE})$

Figure 3. IGBT
Typical transfer characteristics
$I_C = f(V_{GE})$

Figure 4. IGBT
Transient thermal impedance as function of pulse duration
$Z_{th(j-s)} = f(t_p)$

$Z_{th(j-s)} (K/W)$

$t_p (s)$

$D = \frac{t_p}{T}$

$R_{th(j-s)} (K/W)$

IGBT thermal model values

$$R \quad (K/W) \quad t \quad (s)$$

1,10E-01 \quad 1,85E+00
3,05E-01 \quad 2,58E-01
8,44E-01 \quad 6,42E-02
4,55E-01 \quad 1,26E-02
2,79E-01 \quad 3,05E-03
1,45E-01 \quad 4,84E-04

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PFC Switch Characteristics

**Figure 5.** Gate voltage vs gate charge

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

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

- \[ I_C = 15 \text{ A} \]
- \[ Q_G = \text{single pulse} \]
- \[ V_{GE} = \pm 15 \text{ V} \]
- \[ T_j = T_{jmax} \]

**Figure 6.** Safe operating area

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

- \[ D = \text{single pulse} \]
- \[ T_s = 80 \text{ °C} \]
- \[ V_{CE} = \pm 15 \text{ V} \]
- \[ T_j = T_{jmax} \]
**PFC Diode Characteristics**

**Figure 1.** Typical forward characteristics

\[ I_F = f(V_F) \]

**Figure 2.** Transient thermal impedance as a function of pulse width

\[ Z_{th(j-s)} = f(t_p) \]

- \( t_p = 250 \mu s \)
- \( 25 \degree C \)
- \( 125 \degree C \)

**FWD thermal model values**

<table>
<thead>
<tr>
<th>( R_{th(j-s)} ) (K/W)</th>
<th>( \tau ) (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>7,51E-02</td>
<td>2,42E+00</td>
</tr>
<tr>
<td>2,35E-01</td>
<td>2,44E-01</td>
</tr>
<tr>
<td>7,47E-01</td>
<td>5,47E-02</td>
</tr>
<tr>
<td>3,32E-01</td>
<td>1,02E-02</td>
</tr>
<tr>
<td>2,07E-01</td>
<td>1,74E-03</td>
</tr>
<tr>
<td>5,85E-02</td>
<td>4,12E-04</td>
</tr>
</tbody>
</table>

\[ D = \frac{t_p}{T} \]
PFC Sw. Protection Diode Characteristics

**Typical forward characteristics**

\[ I_F = f(V_F) \]

**Transient thermal impedance as a function of pulse width**

\[ Z_{th(j-s)} = f(t_p) \]

- \( t_p = 250 \mu s \)
- \( 25 \, ^\circ C \)
- \( 125 \, ^\circ C \)
- \( \tau \) values:
  - \( 6.53 \times 10^{-2} \) s
  - \( 4.84 \times 10^{-1} \) s
  - \( 1.31 \times 10^{-2} \) s
  - \( 1.32 \times 10^{-1} \) s
  - \( 4.04 \times 10^{-2} \) s
  - \( 2.11 \times 10^{-1} \) s

**FWD thermal model values**

<table>
<thead>
<tr>
<th>( R_{th(j-s)} ) (K/W)</th>
<th>( \tau ) (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.87</td>
<td></td>
</tr>
</tbody>
</table>

\( D = \frac{t_F}{\tau} \)

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20 Mar. 2019 / Revision 1
Current Transformer Protection Diode Characteristics

**figure 1.**
Typical forward characteristics

\[ I_F = f(V_F) \]

**figure 2.**
Transient thermal impedance as a function of pulse width

\[ Z_{th(j-s)} = f(t_p) \]

\[ t_p = 250 \mu s \]

\[ 25 \, ^\circ C \]

\[ 125 \, ^\circ C \]

**FWD**

**FWD thermal model values**

<table>
<thead>
<tr>
<th>( R_{th(j-s)} ) (K/W)</th>
<th>( \tau ) (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.53E-02</td>
<td>3.94E+00</td>
</tr>
<tr>
<td>1.48E-01</td>
<td>4.48E-01</td>
</tr>
<tr>
<td>1.31E+00</td>
<td>5.96E-02</td>
</tr>
<tr>
<td>7.32E-01</td>
<td>1.36E-02</td>
</tr>
<tr>
<td>4.04E-01</td>
<td>2.79E-03</td>
</tr>
<tr>
<td>2.11E-01</td>
<td>5.37E-04</td>
</tr>
</tbody>
</table>

\( D = \frac{t_p}{\tau} \)
H-Bridge Switch Characteristics

**Typical output characteristics**

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

| \( t_p \) | 250 \( \mu \)s | 25 \( ^\circ \)C |
| \( V_{CE} \) | 15 V |
| \( T_j \) | 125 \( ^\circ \)C |
| \( V_{CE} \) | 150 \( ^\circ \)C |

**Typical transfer characteristics**

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

**Transient thermal impedance as function of pulse duration**

\[ Z_{th(j-s)} = f(t_p) \]

\[ t_p = 100 \mu s \]
\[ V_{CE} = 10 V \]
\[ T_j = 125 \, ^{\circ}C \]
\[ 150 \, ^{\circ}C \]

\[ D = \frac{t_p}{T} \]
\[ R_{th(j-s)} = 2,14 \, K/W \]

IGBT thermal model values

\( R \) (K/W)  \( t \) (s) 1,10E-01 1,85E+00 3,05E-01 2,58E-01 8,44E-01 6,42E-02 4,55E-01 1,26E-02 2,79E-01 3,05E-03 1,45E-01 4,84E-04
H-Bridge Switch Characteristics

**Figure 5.** Gate voltage vs gate charge

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

\[ I_C = 15 \text{ A} \]

**Figure 6.** Safe operating area

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

\[ V_{GE} = \pm 15 \text{ V} \]

\[ T_j = T_{jmax} \]

\[ V_{CE} = 520 \text{ V} \]

\[ I_C = 15 \text{ A} \]

\[ T_s = 80 \text{ °C} \]

\[ D = \text{ single pulse} \]

Vincotech
H-Bridge Diode Characteristics

Typical forward characteristics

\[ I_f = f(V_f) \]

![Graph showing typical forward characteristics](image)

\[ t_p = 250 \mu s \]

\[ T_j: \]
- 25 °C
- 125 °C
- 150 °C

Transient thermal impedance as a function of pulse width

\[ Z_{th(j-s)} = f(t_p) \]

![Graph showing transient thermal impedance](image)

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

- \[ R_{th(j-s)} = 2.53 \text{ K/W} \]

FWD thermal model values

<table>
<thead>
<tr>
<th>( R ) (K/W)</th>
<th>( \tau ) (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.04E-01</td>
<td>2.72E+00</td>
</tr>
<tr>
<td>2.14E-01</td>
<td>3.17E-01</td>
</tr>
<tr>
<td>1.08E+00</td>
<td>5.77E-02</td>
</tr>
<tr>
<td>4.24E-01</td>
<td>1.53E-02</td>
</tr>
<tr>
<td>4.88E-01</td>
<td>3.55E-02</td>
</tr>
<tr>
<td>2.17E-01</td>
<td>7.36E-02</td>
</tr>
</tbody>
</table>

NTC characteristic as a function of temperature

\[ R = f(T) \]

![Graph showing NTC characteristic](image)

Thermistor Characteristics

Typical NTC characteristic as a function of temperature

\[ R = f(T) \]

![Graph showing NTC characteristic](image)
PFC Switching Characteristics

**Figure 1.** Typical switching energy losses as a function of collector current

\[ E = f(I_C) \]

With an inductive load at:
- \( V_{CE} = 400 \text{ V} \)
- \( T_j = 25 \degree C \)
- \( V_{CE} = 0 / 15 \text{ V} \)
- \( T_j = 150 \degree C \)
- \( R_{on} = 32 \Omega \)

**Figure 2.** Typical switching energy losses as a function of gate resistor

\[ E = f(R_g) \]

With an inductive load at:
- \( V_{CE} = 400 \text{ V} \)
- \( T_j = 25 \degree C \)
- \( V_{CE} = 0 / 15 \text{ V} \)
- \( T_j = 150 \degree C \)
- \( I_C = 15 \text{ A} \)

**Figure 3.** Typical reverse recovered energy loss as a function of collector current

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

With an inductive load at:
- \( V_{CE} = 400 \text{ V} \)
- \( T_j = 25 \degree C \)
- \( V_{CE} = 0 / 15 \text{ V} \)
- \( T_j = 150 \degree C \)
- \( R_{off} = 32 \Omega \)

**Figure 4.** Typical reverse recovered energy loss as a function of gate resistor

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

With an inductive load at:
- \( V_{CE} = 400 \text{ V} \)
- \( T_j = 25 \degree C \)
- \( V_{CE} = 0 / 15 \text{ V} \)
- \( T_j = 150 \degree C \)
- \( I_C = 15 \text{ A} \)
PFC Switching Characteristics

**Figure 5.** IGBT
Typical switching times as a function of collector current

\[ t = f(I_C) \]

With an inductive load at:
- \( T_j = 150 \, ^\circ C \)
- \( V_{CE} = 400 \, V \)
- \( V_{CC} = 0 / 15 \, V \)
- \( R_{gon} = 32 \, \Omega \)
- \( I_C = 15 \, A \)

**Figure 6.** IGBT
Typical switching times as a function of gate resistor

\[ t = f(R_g) \]

With an inductive load at:
- \( T_j = 150 \, ^\circ C \)
- \( V_{CE} = 400 \, V \)
- \( V_{CC} = 0 / 15 \, V \)
- \( I_C = 15 \, A \)

**Figure 7.** FWD
Typical reverse recovery time as a function of collector current

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

With an inductive load at:
- \( T_j = 25 \, ^\circ C \)
- \( V_{CE} = 400 \, V \)
- \( V_{CC} = 0 / 15 \, V \)
- \( R_{gon} = 32 \, \Omega \)
- \( I_C = 15 \, A \)

**Figure 8.** FWD
Typical reverse recovery time as a function of gate resistor

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

With an inductive load at:
- \( T_j = 25 \, ^\circ C \)
- \( V_{CE} = 400 \, V \)
- \( V_{CC} = 0 / 15 \, V \)
- \( I_C = 15 \, A \)
- \( T_j = 125 \, ^\circ C \)
- \( V_{CE} = 150 \, V \)
- \( V_{CC} = 0 / 15 \, V \)
- \( I_C = 15 \, A \)
PFC Switching Characteristics

**Figure 9.** Typical recovered charge as a function of collector current

\[ Q_r = f(I_C) \]

With an inductive load at

- \( V_{CE} = 400 \) V
- \( I_C = 15 \) A
- \( R_{gon} = 32 \Omega \)
- \( T_j = 25 \) °C
- \( T_j = 125 \) °C
- \( T_j = 150 \) °C

**Figure 10.** Typical recovered charge as a function of IGBT turn on gate resistor

\[ Q_r = f(R_{gon}) \]

With an inductive load at

- \( V_{CE} = 400 \) V
- \( I_C = 15 \) A
- \( R_{gon} = 32 \Omega \)
- \( T_j = 25 \) °C
- \( T_j = 125 \) °C
- \( T_j = 150 \) °C

**Figure 11.** Typical peak reverse recovery current as a function of collector current

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

With an inductive load at

- \( V_{CE} = 400 \) V
- \( I_C = 15 \) A
- \( R_{gon} = 32 \Omega \)
- \( T_j = 25 \) °C
- \( T_j = 125 \) °C
- \( T_j = 150 \) °C

**Figure 12.** Typical peak reverse recovery current as a function of IGBT turn on gate resistor

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

With an inductive load at

- \( V_{CE} = 400 \) V
- \( I_C = 15 \) A
- \( R_{gon} = 32 \Omega \)
- \( T_j = 25 \) °C
- \( T_j = 125 \) °C
- \( T_j = 150 \) °C
PFC Switching Characteristics

**Figure 13.** FWD
Typical rate of fall of forward and reverse recovery current as a function of collector current
\[
\frac{d\bar{i}_F}{dt}, \frac{d\bar{i}_{rr}}{dt} = f(I_C)
\]

With an inductive load at
\[
\begin{align*}
V_{CE} &= 400 \text{ V} \\
V_{DS} &= 0 / 15 \text{ V} \\
R_{goff} &= 32 \Omega
\end{align*}
\]

At
\[
T_j = 25 \degree C
\]

**Figure 14.** FWD
Typical rate of fall of forward and reverse recovery current as a function of IGBT turn-on gate resistor
\[
\frac{d\bar{i}_F}{dt}, \frac{d\bar{i}_{rr}}{dt} = f(R_{gon})
\]

With an inductive load at
\[
\begin{align*}
V_{CE} &= 400 \text{ V} \\
V_{DS} &= 0 / 15 \text{ V} \\
I_C &= 15 \text{ A}
\end{align*}
\]

At
\[
T_j = 25 \degree C
\]

**Figure 15.** IGBT
Reverse bias safe operating area
\[
I_C = f(V_{CE})
\]

At
\[
\begin{align*}
T_j &= 125 \degree C \\
R_{goff} &= 32 \Omega \\
R_{gon} &= 32 \Omega
\end{align*}
\]
PFC Switching Definitions

General conditions

<table>
<thead>
<tr>
<th>$V_J$</th>
<th>125 °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>$R_{	ext{pm}}$</td>
<td>32 Ω</td>
</tr>
<tr>
<td>$R_{	ext{off}}$</td>
<td>32 Ω</td>
</tr>
</tbody>
</table>

**Figure 1.**

**Turn-off Switching Waveforms & definition of $t_{	ext{doff}}$, $t_{	ext{Eoff}}$ ($t_{	ext{Eoff}} = \text{integrating time for } E_{	ext{off}}$)

- $V_{GE}(0\%) = 0 \text{ V}$
- $V_{CE}(0\%) = 15 \text{ V}$
- $V_{GE}(100\%) = 15 \text{ V}$
- $V_{CE}(100\%) = 400 \text{ V}$
- $I_{C}(1\%) = 170 \text{ ns}$

**Figure 2.**

**Turn-on Switching Waveforms & definition of $t_{	ext{don}}$, $t_{	ext{Eon}}$ ($t_{	ext{Eon}} = \text{integrating time for } E_{	ext{on}}$)

- $V_{GE}(0\%) = 0 \text{ V}$
- $V_{CE}(0\%) = 15 \text{ V}$
- $V_{GE}(100\%) = 15 \text{ V}$
- $V_{CE}(100\%) = 400 \text{ V}$
- $I_{C}(1\%) = 18 \text{ ns}$

**Figure 3.**

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

- $V_{CE}(1\%) = 400 \text{ V}$
- $I_{C}(1\%) = 15 \text{ A}$
- $t_{f} = 10 \text{ ns}$

**Figure 4.**

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

- $V_{CE}(1\%) = 400 \text{ V}$
- $I_{C}(1\%) = 15 \text{ A}$
- $t_{r} = 14 \text{ ns}$
PFC Switching Characteristics

Figure 5. FWD
Turn-off Switching Waveforms & definition of $t_{rr}$

- $V_F (100\%) = 400 \text{ V}$
- $I_F (100\%) = 15 \text{ A}$
- $I_{F_{\text{max}}}(100\%) = 11 \text{ A}$
- $t_{rr} = 84 \text{ ns}$

Figure 6. FWD
Turn-on Switching Waveforms & definition of $t_{Qr}$ (Integrating time for $Q_r$)

- $I_{F_{\text{max}}} (100\%) = 15 \text{ A}$
- $Q_r (100\%) = 0.442 \mu\text{C}$
H-Bridge Switching Characteristics

**Figure 1.** Typical switching energy losses as a function of collector current

\[ E = f(I_c) \]

With an inductive load at

- \( V_{CC} = 350 \text{ V} \)
- \( V_{CI} = -5 / 15 \text{ V} \)
- \( R_{g0} = 32 \Omega \)

\[ T_j = 25 \text{ °C} \]
\[ T_j = 125 \text{ °C} \]
\[ T_j = 150 \text{ °C} \]

**Figure 2.** Typical switching energy losses as a function of gate resistor

\[ E = f(R_g) \]

With an inductive load at

- \( V_{CC} = 350 \text{ V} \)
- \( V_{CI} = -5 / 15 \text{ V} \)
- \( I_C = 15 \text{ A} \)

\[ T_j = 25 \text{ °C} \]
\[ T_j = 125 \text{ °C} \]
\[ T_j = 150 \text{ °C} \]

**Figure 3.** Typical reverse recovered energy loss as a function of collector current

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

With an inductive load at

- \( V_{CC} = 350 \text{ V} \)
- \( V_{CI} = -5 / 15 \text{ V} \)
- \( R_{g0} = 32 \Omega \)

\[ T_j = 25 \text{ °C} \]
\[ T_j = 125 \text{ °C} \]
\[ T_j = 150 \text{ °C} \]

**Figure 4.** Typical reverse recovered energy loss as a function of gate resistor

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

With an inductive load at

- \( V_{CC} = 350 \text{ V} \)
- \( V_{CI} = -5 / 15 \text{ V} \)
- \( I_C = 15 \text{ A} \)

\[ T_j = 25 \text{ °C} \]
\[ T_j = 125 \text{ °C} \]
\[ T_j = 150 \text{ °C} \]
H-Bridge Switching Characteristics

Figure 5. IGBT
Typical switching times as a function of collector current
$t = f(I_C)$

- With an inductive load at
  - $T_j = 150 ^\circ C$
  - $V_{CE} = 350$ V
  - $V_{CE} = -5 / 15$ V
  - $R_{gon} = 32 \Omega$
  - $R_{goff} = 32 \Omega$

Figure 6. IGBT
Typical switching times as a function of gate resistor
$t = f(R_g)$

- With an inductive load at
  - $T_j = 150 ^\circ C$
  - $V_{CE} = 350$ V
  - $V_{CE} = -5 / 15$ V
  - $I_C = 15$ A

Figure 7. FWD
Typical reverse recovery time as a function of collector current
$t_{rr} = f(I_C)$

- With an inductive load at
  - $T_j = 25 ^\circ C$
  - $V_{CE} = 350$ V
  - $V_{CE} = -5 / 15$ V
  - $R_{gon} = 32 \Omega$

Figure 8. FWD
Typical reverse recovery time as a function of IGBT turn on gate resistor
$t_{rr} = f(R_{gon})$

- With an inductive load at
  - $T_j = 25 ^\circ C$
  - $V_{CE} = 350$ V
  - $V_{CE} = -5 / 15$ V
  - $I_C = 15$ A
H-Bridge Switching Characteristics

**Figure 9.** Typical recovered charge as a function of collector current

\[ Q_r = f(I_C) \]

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

- With an inductive load at
  - \( V_{CI} = 350 \text{ V} \)
  - \( T_J = 25 ^\circ \text{C} \)
  - \( V_{CI} = -5 / 15 \text{ V} \)
  - \( T_J = 125 ^\circ \text{C} \)
  - \( I_C = 15 \text{ A} \)

**Figure 10.** Typical recovered charge as a function of IGBT turn on gate resistor

\[ Q_r = f(R_{gon}) \]

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

- With an inductive load at
  - \( V_{CI} = 350 \text{ V} \)
  - \( T_J = 25 ^\circ \text{C} \)
  - \( V_{CI} = -5 / 15 \text{ V} \)
  - \( T_J = 125 ^\circ \text{C} \)
  - \( R_{gon} = 32 \Omega \)

**Figure 11.** Typical peak reverse recovery current as a function of collector current

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

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

- With an inductive load at
  - \( V_{CI} = 350 \text{ V} \)
  - \( T_J = 25 ^\circ \text{C} \)
  - \( V_{CI} = -5 / 15 \text{ V} \)
  - \( T_J = 125 ^\circ \text{C} \)
  - \( R_{gon} = 32 \Omega \)

**Figure 12.** Typical peak reverse recovery current as a function of IGBT turn on gate resistor

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

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

- With an inductive load at
  - \( V_{CI} = 350 \text{ V} \)
  - \( T_J = 25 ^\circ \text{C} \)
  - \( V_{CI} = -5 / 15 \text{ V} \)
  - \( T_J = 125 ^\circ \text{C} \)
  - \( I_c = 15 \text{ A} \)
H-Bridge Switching Characteristics

Figure 13. FWD
Typical rate of fall of forward and reverse recovery current as a function of collector current
\[ \frac{dI_F}{dt} = f(I_C) \]
\[ \frac{dI_{rr}}{dt} = f(R_{gon}) \]

With an inductive load at
- \( V_{CE} = 350 \) V
- \( V_{CC} = -5 / 15 \) V
- \( R_{pm} = 32 \) Ω
- \( T_j = 25 \) °C
- \( T_j = 125 \) °C
- \( T_j = 150 \) °C

Figure 14. FWD
Typical rate of fall of forward and reverse recovery current as a function of IGBT turn-on gate resistor
\[ \frac{dI_F}{dt} = f(I_C) \]
\[ \frac{dI_{rr}}{dt} = f(R_{gon}) \]

With an inductive load at
- \( V_{CE} = 350 \) V
- \( V_{CC} = -5 / 15 \) V
- \( I_C = 15 \) A
- \( T_j = 25 \) °C
- \( T_j = 125 \) °C
- \( T_j = 150 \) °C

Figure 15. IGBT
Reverse bias safe operating area
\[ I_C = f(V_{CE}) \]
- \( T_j = 125 \) °C
- \( R_{gon} = 32 \) Ω
- \( R_{goff} = 32 \) Ω
H-Bridge Switching Definitions

General conditions

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<tr>
<td>$R_{off}$</td>
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**Figure 1.**

Turn-off Switching Waveforms & definition of $t_{doff}$, $t_{Eoff}$ ($t_{Eoff}$ = integrating time for $E_{off}$)

- $V_{GE}(0\%) = -5$ V
- $V_{GE}(100\%) = 15$ V
- $I_{C}(0\%) = 15$ A
- $I_{C}(1\%) = 111$ ns

**Figure 2.**

Turn-on Switching Waveforms & definition of $t_{don}$, $t_{Eon}$ ($t_{Eon}$ = integrating time for $E_{on}$)

- $V_{GE}(0\%) = -5$ V
- $V_{GE}(100\%) = 15$ V
- $I_{C}(0\%) = 15$ A
- $I_{C}(1\%) = 35$ ns

**Figure 3.**

Turn-off Switching Waveforms & definition of $t_f$

- $V_{CE}(0\%) = 350$ V
- $I_{C}(0\%) = 15$ A
- $I_{C}(1\%) = 9$ ns

**Figure 4.**

Turn-on Switching Waveforms & definition of $t_r$

- $V_{CE}(0\%) = 350$ V
- $I_{C}(0\%) = 15$ A
- $I_{C}(1\%) = 13$ ns
H-Bridge Switching Characteristics

**Figure 5.** FWD

Switching waveforms & definition of $t_{\text{rr}}$

- $V_F(100\%) = 350 \text{ V}$
- $I_F(100\%) = 15 \text{ A}$
- $I_{\text{FMAX}}(100\%) = 11 \text{ A}$
- $t_{\text{rr}} = 125 \text{ ns}$

**Figure 6.** FWD

Turn-on switching waveforms & definition of $t_{\text{Qr}}$

- $I_q(100\%) = 15 \text{ A}$
- $Q_r(100\%) = 0.813 \mu\text{C}$
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**Outline**

Dimensions of coordinate axes is only offset without tolerance.
### Pinout

![Diagram of the pinout of the device.](image)

### Identification

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## Handling instruction

Handling instructions for flow 1 packages see vincotech.com website.

## Package data

Package data for flow 1 packages see vincotech.com website.

## UL recognition and file number

This device is certified according to UL 1557 standard, UL file number E192116. For more information see vincotech.com website.

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