### Maximum Ratings

\( T_s = 25 \, ^\circ C, \) 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>Repetitive peak reverse voltage</td>
<td>( V_{RRM} )</td>
<td></td>
<td>650</td>
<td>V</td>
</tr>
<tr>
<td>Forward current</td>
<td>( I_{FADV} ) DC current</td>
<td>( T_s = 80 , ^\circ C )</td>
<td>18</td>
<td>A</td>
</tr>
<tr>
<td>Power dissipation</td>
<td>( P_{tot} )</td>
<td>( T_s = 80 , ^\circ C )</td>
<td>33</td>
<td>W</td>
</tr>
<tr>
<td>Maximum Junction Temperature</td>
<td>( T_{jmax} )</td>
<td></td>
<td>175</td>
<td>°C</td>
</tr>
</tbody>
</table>

#### Buck Sw. Protection Diode

<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>Collector-emitter break down voltage</td>
<td>( V_{CE} )</td>
<td>( T_j = T_{jmax} )</td>
<td>650</td>
<td>V</td>
</tr>
<tr>
<td>DC collector current</td>
<td>( I_C )</td>
<td>( T_j = T_{jmax} )</td>
<td>51</td>
<td>A</td>
</tr>
<tr>
<td>Repetitive peak collector current</td>
<td>( I_{CMH} )</td>
<td>( T_j ) limited by ( T_{jmax} )</td>
<td>150</td>
<td>A</td>
</tr>
<tr>
<td>Turn off safe operating area</td>
<td></td>
<td>( T_j \leq 150 , ^\circ C )</td>
<td>100</td>
<td>A</td>
</tr>
<tr>
<td>Power dissipation</td>
<td>( P_{tot} )</td>
<td>( T_j = T_{jmax} )</td>
<td>119</td>
<td>W</td>
</tr>
<tr>
<td>Gate-emitter peak voltage</td>
<td>( V_{GE} )</td>
<td></td>
<td>±20</td>
<td>V</td>
</tr>
<tr>
<td>Short circuit ratings</td>
<td>( t_{sc} ) ( V_{CE} ) ( V_{CE} ) = 15 V</td>
<td>( T_j \leq 150 , ^\circ C )</td>
<td>5</td>
<td>( \mu s )</td>
</tr>
<tr>
<td>Power dissipation</td>
<td>( P_{tot} )</td>
<td>( T_j = T_{jmax} )</td>
<td>400</td>
<td>V</td>
</tr>
<tr>
<td>Maximum Junction Temperature</td>
<td>( T_{jmax} )</td>
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<td>175</td>
<td>°C</td>
</tr>
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</table>
### Maximum Ratings

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Condition</th>
<th>Value</th>
<th>Unit</th>
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<tbody>
<tr>
<td><strong>Buck Diode</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peak Repetitive Reverse Voltage</td>
<td>( V_{\text{asm}} )</td>
<td>( T_j = 25 , ^\circ \text{C} ), ( T_s = 80 , ^\circ \text{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>27</td>
<td>A</td>
</tr>
<tr>
<td>Repetitive peak forward current</td>
<td>( I_{\text{FPM}} )</td>
<td>( T_s ), limited by ( T_{\text{max}} )</td>
<td>70</td>
<td>A</td>
</tr>
<tr>
<td>Power dissipation</td>
<td>( P_{\text{tot}} )</td>
<td>( T_j = T_{\text{max}} )</td>
<td>57</td>
<td>W</td>
</tr>
<tr>
<td>Maximum Junction Temperature</td>
<td>( T_{\text{max}} )</td>
<td></td>
<td>175</td>
<td>(^\circ \text{C})</td>
</tr>
</tbody>
</table>

| **Boost Switch** | | | | |
| Collector-emitter break down voltage | \( V_{\text{CEB}} \) | | 1200 | V |
| DC collector current | \( I_C \) | \( T_j = T_{\text{max}} \), \( T_s = 80 \, ^\circ \text{C} \) | 41 | A |
| Repetitive peak collector current | \( I_{\text{CEM}} \) | \( T_s \), limited by \( T_{\text{max}} \) | 105 | A |
| Turn off safe operating area | | \( V_{\text{CEP}} \), \( T_j \leq 150 \, ^\circ \text{C} \) | 70 | A |
| Power dissipation | \( P_{\text{tot}} \) | \( T_j = T_{\text{max}} \), \( T_s = 80 \, ^\circ \text{C} \) | 101 | W |
| Gate-emitter peak voltage | \( V_{\text{GE}} \) | | ±20 | V |
| Short circuit ratings | \( \varepsilon_{\text{SC}} \) | \( T_j \leq 150 \, ^\circ \text{C} \) | 10 | \( \mu \text{s} \) |
| | \( V_{\text{GE}} \) | \( V_{\text{GE}} = 15 \, \text{V} \) | 800 | V |
| Maximum Junction Temperature | \( T_{\text{max}} \) | | 175 | \(^\circ \text{C}\) |

| **Boost Sw. Protection Diode** | | | | |
| Peak Repetitive Reverse Voltage | \( V_{\text{asm}} \) | \( T_j = 25 \, ^\circ \text{C} \) | 1200 | V |
| DC forward current | \( I_f \) | \( T_j = T_{\text{max}} \), \( T_s = 80 \, ^\circ \text{C} \) | 16 | A |
| Power dissipation | \( P_{\text{tot}} \) | \( T_j = T_{\text{max}} \), \( T_s = 80 \, ^\circ \text{C} \) | 36 | W |
| Maximum Junction Temperature | \( T_{\text{max}} \) | | 150 | \(^\circ \text{C}\) |

| **Boost Diode** | | | | |
| Peak Repetitive Reverse Voltage | \( V_{\text{asm}} \) | \( T_j = 25 \, ^\circ \text{C} \) | 1200 | V |
| DC forward current | \( I_f \) | \( T_j = T_{\text{max}} \), \( T_s = 80 \, ^\circ \text{C} \) | 24 | A |
| Surge forward current | \( I_{\text{FPM}} \) | 10 ms sin 180°, \( T_j = 150 \, ^\circ \text{C} \) | 100 | A |
| Power dissipation | \( P_{\text{tot}} \) | \( T_j = T_{\text{max}} \), \( T_s = 80 \, ^\circ \text{C} \) | 61 | W |
| Maximum Junction Temperature | \( T_{\text{max}} \) | | 175 | \(^\circ \text{C}\) |

| **Thermal Properties** | | | | |
| Storage temperature | \( T_{\text{stg}} \) | | -40...+125 | \(^\circ \text{C}\) |
| Operation temperature under switching condition | \( T_{\text{op}} \) | | -40...+(T_{\text{max}} - 25) | \(^\circ \text{C}\) |

| **Insulation Properties** | | | | |
| Insulation voltage | \( V_u \) | \( \tau = 2 \, \text{s} \), DC Test Voltage | 4000 | V |
| Creepage distance | | | min 12,7 | mm |
| Clearance | | | min 12,7 | mm |
| Comparative Tracking Index | CTI | | | |

\( T_j = 25 \, ^\circ \text{C} \), unless otherwise specified
## 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>Buck Sw. Protection Diode</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forward voltage</td>
<td>$V_s$</td>
<td>10</td>
<td>25</td>
<td>1,3</td>
</tr>
<tr>
<td>Reverse current</td>
<td>$I_r$</td>
<td>650</td>
<td>25</td>
<td>0,14</td>
</tr>
<tr>
<td>Thermal resistance junction to sink</td>
<td>$R_{th(j-s)}$</td>
<td>phase-change material</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thermal resistance junction to case</td>
<td>$R_{th(j-c)}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Buck Switch</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collector-emitter saturation voltage</td>
<td>$V_{CE}$</td>
<td>$V_{CE} = V_G$</td>
<td>0,008</td>
<td>25</td>
</tr>
<tr>
<td>Collector-emitter cut-off current incl. Diode</td>
<td>$I_{fss}$</td>
<td>50</td>
<td>25</td>
<td>1,4</td>
</tr>
<tr>
<td>Collector-emitter leakage current</td>
<td>$I_{fss}$</td>
<td>0</td>
<td>650</td>
<td>5</td>
</tr>
<tr>
<td>Integrated Gate resistor</td>
<td>$R_{on}$</td>
<td>none</td>
<td></td>
<td></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>$R_{ges} = 4 \Omega$</td>
<td>$R_{on} = 4 \Omega$</td>
<td>±15</td>
</tr>
<tr>
<td>Fall time</td>
<td>$t_f$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turn-on energy loss</td>
<td>$E_{on}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turn-off energy loss</td>
<td>$E_{off}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input capacitance</td>
<td>$C_{in}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output capacitance</td>
<td>$C_{out}$</td>
<td>$V = 1 \text{ MHz}$</td>
<td>0</td>
<td>25</td>
</tr>
<tr>
<td>Reverse transfer capacitance</td>
<td>$C_{on}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gate charge</td>
<td>$Q_G$</td>
<td>±15</td>
<td>480</td>
<td>50</td>
</tr>
<tr>
<td>Thermal resistance junction to sink</td>
<td>$R_{th(j-s)}$</td>
<td>phase-change material</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thermal resistance junction to case</td>
<td>$R_{th(j-c)}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Buck Diode</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diode forward voltage</td>
<td>$V_s$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reverse leakage current</td>
<td>$I_r$</td>
<td>650</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Peak reverse recovery current</td>
<td>$I_{max}$</td>
<td>$R_{ges} = 4 \Omega$</td>
<td>$R_{on} = 4 \Omega$</td>
<td>±15</td>
</tr>
<tr>
<td>Reverse recovery time</td>
<td>$t_r$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reverse recovery charge</td>
<td>$Q_r$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peak rate of fall of recovery current</td>
<td>$(\frac{di_r}{dt})_{max}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reverse recovered energy</td>
<td>$E_{rec}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thermal resistance junction to sink</td>
<td>$R_{th(j-s)}$</td>
<td>phase-change material</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thermal resistance junction to case</td>
<td>$R_{th(j-c)}$</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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3  20 Jun. 2016 / Revision 2
## Characteristic Values

### Boost Switch

<table>
<thead>
<tr>
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<th>Symbol</th>
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<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gate emitter threshold voltage</td>
<td>$V_{th,off}$</td>
<td>$V_{th,off} = V_{th,on}$</td>
<td>0.0012</td>
<td>V</td>
</tr>
<tr>
<td>Collector-emitter saturation voltage</td>
<td>$V_{CEsat}$</td>
<td></td>
<td>35</td>
<td>5</td>
</tr>
<tr>
<td>Collector-emitter cut-off inst</td>
<td>$I_{off}$</td>
<td></td>
<td>35</td>
<td>25</td>
</tr>
<tr>
<td>Gate-emitter leakage current</td>
<td>$I_{leak}$</td>
<td></td>
<td>35</td>
<td>25</td>
</tr>
<tr>
<td>Integrated Gate resistor</td>
<td>$R_{int}$</td>
<td>none</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turn-on delay time</td>
<td>$t_{on}$</td>
<td></td>
<td>35</td>
<td>25</td>
</tr>
<tr>
<td>Rise time</td>
<td>$t_{r}$</td>
<td></td>
<td>35</td>
<td>25</td>
</tr>
<tr>
<td>Turn-off delay time</td>
<td>$t_{off}$</td>
<td>$E_{off} = 4 \Omega$</td>
<td>35</td>
<td>25</td>
</tr>
<tr>
<td>Fall time</td>
<td>$t_{f}$</td>
<td></td>
<td>35</td>
<td>25</td>
</tr>
<tr>
<td>Turn-on energy loss</td>
<td>$E_{on}$</td>
<td></td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>Turn-off energy loss</td>
<td>$E_{off}$</td>
<td></td>
<td>25</td>
<td>125</td>
</tr>
<tr>
<td>Input capacitance</td>
<td>$C_{in}$</td>
<td></td>
<td>25</td>
<td>125</td>
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<tr>
<td>Output capacitance</td>
<td>$C_{out}$</td>
<td>$= 1 \text{ MHz}$</td>
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<tr>
<td>Reverse transfer capacitance</td>
<td>$C_{rss}$</td>
<td></td>
<td>125</td>
<td>25</td>
</tr>
<tr>
<td>Gate charge</td>
<td>$Q_{g}$</td>
<td></td>
<td>25</td>
<td>125</td>
</tr>
<tr>
<td>Thermal resistance junction to sink</td>
<td>$R_{th(j-s)}$</td>
<td>phase-change material</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thermal resistance junction to case</td>
<td>$R_{th(j-c)}$</td>
<td>$\lambda = 3.4 \text{ W/mK}$</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Boost Sw. Protection Diode

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diode forward voltage</td>
<td>$V_{F}$</td>
<td>$I_{RRM}$</td>
<td>25</td>
<td>1.60</td>
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<tr>
<td>Reverse leakage current</td>
<td>$I_{r}$</td>
<td></td>
<td>1200</td>
<td>25</td>
</tr>
<tr>
<td>Thermal resistance junction to sink</td>
<td>$R_{th(j-s)}$</td>
<td>Thermal grease thickness≤50um</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thermal resistance junction to case</td>
<td>$R_{th(j-c)}$</td>
<td>$\lambda = 1 \text{ W/mK}$</td>
<td></td>
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</table>

### Boost Diode

<table>
<thead>
<tr>
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<th>Symbol</th>
<th>Conditions</th>
<th>Value</th>
<th>Unit</th>
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<tbody>
<tr>
<td>Diode forward voltage</td>
<td>$V_{F}$</td>
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<td>25</td>
<td>25</td>
</tr>
<tr>
<td>Reverse leakage current</td>
<td>$I_{r}$</td>
<td></td>
<td>1200</td>
<td>25</td>
</tr>
<tr>
<td>Peak reverse recovery current</td>
<td>$I_{max}$</td>
<td>$E_{off} = 4 \Omega$</td>
<td>±15</td>
<td>350</td>
</tr>
<tr>
<td>Reverse recovery time</td>
<td>$t_{r}$</td>
<td></td>
<td>25</td>
<td>125</td>
</tr>
<tr>
<td>Reverse recovered charge</td>
<td>$Q_{r}$</td>
<td></td>
<td>25</td>
<td>125</td>
</tr>
<tr>
<td>Peak rate of fall of recovery current</td>
<td>$(di/dt)_{max}$</td>
<td></td>
<td>25</td>
<td>125</td>
</tr>
<tr>
<td>Reverse recovery energy</td>
<td>$E_{rec}$</td>
<td></td>
<td>25</td>
<td>125</td>
</tr>
<tr>
<td>Thermal resistance junction to sink</td>
<td>$R_{th(j-s)}$</td>
<td>phase-change material</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thermal resistance junction to case</td>
<td>$R_{th(j-c)}$</td>
<td>$\lambda = 3.4 \text{ W/mK}$</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Thermistor

<table>
<thead>
<tr>
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<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>25</td>
<td>$\pm 1511$</td>
</tr>
<tr>
<td>Deviation of $R_{th}$</td>
<td>$A_{R}$</td>
<td>$R_{th} = 1486 \Omega$</td>
<td>100</td>
<td>-4.5</td>
</tr>
<tr>
<td>Power dissipation</td>
<td>$P$</td>
<td></td>
<td>25</td>
<td>210</td>
</tr>
<tr>
<td>Power dissipation constant</td>
<td>$B_{(25/10)}$</td>
<td></td>
<td>25</td>
<td>3.5</td>
</tr>
<tr>
<td>B-value</td>
<td>$B_{(25/100)}$</td>
<td>TOL ±1%</td>
<td>25</td>
<td>3964</td>
</tr>
<tr>
<td>Vincotech NTC Reference</td>
<td>$R_{(25/100)}$</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Buck

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

At
$t_p = 250 \ \mu s$
$T_j = 25 \ ^\circ C$
$V_{CE}$ from 7 V to 17 V in steps of 1 V

**figure 2.** IGBT
**Typical output characteristics**
$I_C = f(V_{CE})$

At
$t_p = 250 \ \mu s$
$T_j = 125 \ ^\circ C$
$V_{CE}$ from 7 V to 17 V in steps of 1 V

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

At
$t_p = 250 \ \mu s$
$V_{CE} = 10 \ \text{V}$

**figure 4.** FWD
**Typical diode forward current as a function of forward voltage**
$I_F = f(V_F)$

At
$t_p = 250 \ \mu s$
**Buck**

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

\[ E = f(I_C) \]

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

- With an inductive load at
  - \( T_j = 25/125 \) °C
  - \( V_{CE} = 350 \) V
  - \( V_{GE} = \pm 15 \) V
  - \( R_{gon} = 4 \) Ω
  - \( I_C = 35 \) A

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

\[ E = f(R_G) \]

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

- With an inductive load at
  - \( T_j = 25/125 \) °C
  - \( V_{CE} = 350 \) V
  - \( V_{GE} = \pm 15 \) V
  - \( I_C = 35 \) A

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

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

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

- With an inductive load at
  - \( T_j = 25/125 \) °C
  - \( V_{CE} = 350 \) V
  - \( V_{GE} = \pm 15 \) V
  - \( R_{gon} = 4 \) Ω

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

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

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

- With an inductive load at
  - \( T_j = 25/125 \) °C
  - \( V_{CE} = 350 \) V
  - \( V_{GE} = \pm 15 \) V
  - \( I_C = 35 \) A
**Buck**

**Figure 9.** Typical switching times as a function of collector current

\[ t = f(I_C) \]

With an inductive load at

\[ T_j = 125 \degree C \]
\[ V_{CE} = 350 \text{ V} \]
\[ V_{GE} = \pm 15 \text{ V} \]
\[ R_{gon} = 4 \text{ } \Omega \]
\[ R_{goff} = 4 \text{ } \Omega \]

**Figure 10.** Typical switching times as a function of gate resistor

\[ t = f(R_g) \]

With an inductive load at

\[ T_j = 125 \degree C \]
\[ V_{CE} = 350 \text{ V} \]
\[ V_{GE} = \pm 15 \text{ V} \]
\[ I_C = 35 \text{ A} \]

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

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

At

\[ T_j = 25/125 \degree C \]
\[ V_{CE} = 350 \text{ V} \]
\[ V_{GE} = \pm 15 \text{ V} \]
\[ R_{gon} = 4 \text{ } \Omega \]

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

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

At

\[ T_j = 25/125 \degree C \]
\[ V_{CE} = 350 \text{ V} \]
\[ I_F = 35 \text{ A} \]
\[ V_{GE} = \pm 15 \text{ V} \]
Typical reverse recovery charge as a function of collector current
$Q_{rr} = f(I_C)$

![Graph of $Q_{rr}$ vs. $I_C$](image)

**At**
- $T_J = 25/125 \degree C$
- $V_{CE} = 350 \text{ V}$
- $V_{GE} = \pm 15 \text{ V}$
- $R_{gon} = 4 \text{ \Omega}$

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

![Graph of $I_{RRM}$ vs. $I_C$](image)

**At**
- $T_J = 25/125 \degree C$
- $V_{CE} = 350 \text{ V}$
- $V_{GE} = \pm 15 \text{ V}$
- $I_F = 35 \text{ A}$
- $V_{GE} = \pm 15 \text{ V}$
**figure 17.** 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
\[
T_j = 25/125 \degree C
V_{CE} = 350 \ V
V_{GE} = 15 \ V
R_{gon} = 4 \ \Omega
\]

**figure 18.** 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
\[
T_j = 25/125 \degree C
V_{CE} = 350 \ V
I_F = 35 \ A
V_{GE} = 15 \ V
\]

**figure 19.** IGBT
IGBT transient thermal impedance as a function of pulse width
\[
Z_{th(j-s)} = f(t_p)
\]

At
\[
D = \frac{t_p}{T}
R_{[\sigma]@D} = 0.80 \ K/W
\]

IGBT thermal model values

<table>
<thead>
<tr>
<th>(R) (K/W)</th>
<th>(\tau) (s)</th>
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<tbody>
<tr>
<td>6.19E-02</td>
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<tr>
<td>1.10E-01</td>
<td>4.08E+01</td>
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<tr>
<td>4.12E-01</td>
<td>9.23E+02</td>
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<td>5.73E-02</td>
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<tr>
<td>4.98E-02</td>
<td>8.49E-04</td>
</tr>
</tbody>
</table>

**figure 20.** FWD
FWD transient thermal impedance as a function of pulse width
\[
Z_{th(j-s)} = f(t_p)
\]

At
\[
D = \frac{t_p}{T}
R_{[\sigma]@D} = 1.68 \ K/W
\]

FWD thermal model values

<table>
<thead>
<tr>
<th>(R) (K/W)</th>
<th>(\tau) (s)</th>
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</thead>
<tbody>
<tr>
<td>5.88E-02</td>
<td>4.81E+00</td>
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<tr>
<td>1.68E-01</td>
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<tr>
<td>1.97E-01</td>
<td>1.68E-03</td>
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</tbody>
</table>
Buck

**figure 21.** IGBT

Power dissipation as a function of heatsink temperature

\[ P_{\text{tot}} = f(T_s) \]

\[ I_C = f(T_s) \]

At

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

**figure 22.** IGBT

Collector current as a function of heatsink temperature

\[ I_C = f(T_s) \]

At

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

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

**figure 23.** FWD

Power dissipation as a function of heatsink temperature

\[ P_{\text{tot}} = f(T_s) \]

At

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

**figure 24.** FWD

Forward current as a function of heatsink temperature

\[ I_F = f(T_s) \]

At

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

**figure 25.**
Safe operating area as a function of collector-emitter voltage

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

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

At

\[ T_j \leq T_{j,max} \]

**figure 26.**
Gate voltage vs Gate charge

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

At

\[ I_C = 50 \text{ A} \]
Boost

**Figure 1.** IGBT
**Typical output characteristics**

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

- \( t_p = 250 \ \mu s \)
- \( T_j = 25 ^\circ C \)
- \( V_{CE} \) from 7 V to 17 V in steps of 1 V

**Figure 2.** IGBT
**Typical output characteristics**

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

- \( t_p = 250 \ \mu s \)
- \( T_j = 125 ^\circ C \)
- \( V_{CE} \) from 7 V to 17 V in steps of 1 V

**Figure 3.** IGBT
**Typical transfer characteristics**

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

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

\[ I_F = f(V_F) \]

- \( t_p = 250 \ \mu s \)
- \( V_{CE} = 10 \ \text{V} \)
- \( T_j = T_{jmax} - 25 ^\circ C \)

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**Boost**

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

\[ E = f(I_C) \]

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

With an inductive load at
- \( T_j = 25/125 \) °C
- \( V_{CE} = 350 \) V
- \( V_{GE} = \pm 15 \) V
- \( R_{gon} = 4 \) Ω
- \( I_C = 35 \) A

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

\[ E = f(R_G) \]

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

With an inductive load at
- \( T_j = 25/125 \) °C
- \( V_{CE} = 350 \) V
- \( V_{GE} = \pm 15 \) V
- \( I_C = 35 \) A

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

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

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

With an inductive load at
- \( T_j = 25/125 \) °C
- \( V_{CE} = 350 \) V
- \( V_{GE} = \pm 15 \) V
- \( R_{gon} = 4 \) Ω

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

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

![Graph showing reverse recovery energy loss as a function of gate resistor.](image)

With an inductive load at
- \( T_j = 25/125 \) °C
- \( V_{CE} = 350 \) V
- \( V_{GE} = \pm 15 \) V
- \( I_C = 35 \) A
Boost

**figure 9.** IGBT
Typical switching times as a function of collector current
\[ t = f(I_C) \]

With an inductive load at:
- \( T_j = 125 \ ^\circ\text{C} \)
- \( V_{CE} = 350 \ \text{V} \)
- \( V_{GE} = \pm 15 \ \text{V} \)
- \( R_{gon} = 4 \ \Omega \)
- \( R_{goff} = 4 \ \Omega \)

**figure 10.** IGBT
Typical switching times as a function of gate resistor
\[ t = f(R_G) \]

With an inductive load at:
- \( T_j = 125 \ ^\circ\text{C} \)
- \( V_{CE} = 350 \ \text{V} \)
- \( V_{GE} = \pm 15 \ \text{V} \)
- \( I_C = 35 \ \text{A} \)

**figure 11.** FWD
Typical reverse recovery time as a function of collector current
\[ t_{rr} = f(I_C) \]

At:
- \( T_j = 25/125 \ ^\circ\text{C} \)
- \( V_{CE} = 350 \ \text{V} \)
- \( V_{GE} = \pm 15 \ \text{V} \)
- \( R_{gon} = 4 \ \Omega \)

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

At:
- \( T_j = 25/125 \ ^\circ\text{C} \)
- \( V_{CE} = 350 \ \text{V} \)
- \( I_F = 35 \ \text{A} \)
- \( V_{GE} = \pm 15 \ \text{V} \)
Boost

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

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

At
- \( T_j = 25/125 \, ^\circ C \)
- \( V_{CE} = 350 \, V \)
- \( V_{GE} = \pm 15 \, V \)
- \( R_{gon} = 4 \, \Omega \)

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

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

At
- \( T_j = 25/125 \, ^\circ C \)
- \( V_s = 350 \, V \)
- \( I_F = 35 \, A \)
- \( V_{GE} = \pm 15 \, V \)

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

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

At
- \( T_j = 25/125 \, ^\circ C \)
- \( V_{CE} = 350 \, V \)
- \( V_{GE} = \pm 15 \, V \)
- \( I_F = 35 \, A \)
- \( R_{gon} = 4 \, \Omega \)

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

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

At
- \( T_j = 25/125 \, ^\circ C \)
- \( V_s = 350 \, V \)
- \( I_F = 35 \, A \)
- \( V_{GE} = \pm 15 \, V \)
Typical rate of fall of forward and reverse recovery current as a function of collector current
\[ \frac{dI}{dt} \frac{dI_{rec}}{dt} = f(I_C) \]

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

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

IGBT thermal model values
- \( R \) (K/W)  \( \tau \) (s)
- 1.15E-01  9.47E-01
- 4.15E-01  1.24E-01
- 2.99E-01  4.81E-02
- 7.22E-02  5.86E-03
- 3.82E-02  5.62E-04

FWD thermal model values
- \( R \) (K/W)  \( \tau \) (s)
- 4.65E-02  4.86E+00
- 1.06E-01  8.11E-01
- 4.71E-01  1.09E-01
- 4.83E-01  3.07E-02
- 2.34E-01  7.03E-03
- 1.81E-01  1.25E-03

At
- \( T_J = 25/125 \) °C
- \( V_{GE} = 350 \) V
- \( I_F = 35 \) A

IGBT model values
- \( R_{gss} = 4 \) Ω

At
- \( T_J = 25/125 \) °C
- \( V_{GE} = ±15 \) V

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Boost

**figure 21.** IGBT
Power dissipation as a function of heatsink temperature

\[ P_{\text{tot}} = f(T_s) \]

![Graph showing power dissipation as a function of heatsink temperature.](image)

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

**figure 22.** IGBT
Collector current as a function of heatsink temperature

\[ I_C = f(T_s) \]

![Graph showing collector current as a function of heatsink temperature.](image)

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

**figure 23.** FWD
Power dissipation as a function of heatsink temperature

\[ P_{\text{tot}} = f(T_s) \]

![Graph showing power dissipation as a function of heatsink temperature.](image)

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

**figure 24.** FWD
Forward current as a function of heatsink temperature

\[ I_F = f(T_s) \]

![Graph showing forward current as a function of heatsink temperature.](image)

At
\[ T_j = 175 \, ^\circ\text{C} \]
Boost Sw. Protection Diode

**Figure 25.** Boost Sw. Protection Diode

Typical diode forward current as a function of forward voltage

$$I_F = f(V_F)$$

**Figure 26.** Boost Sw. Protection Diode

Diode transient thermal impedance as a function of pulse width

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

At

$$t_p = 250 \, \mu s$$

**Figure 27.** Boost Sw. Protection Diode

Power dissipation as a function of heatsink temperature

$$P_{tot} = f(T_s)$$

At

$$T_j = 150 \, ^\circ C$$

**Figure 28.** Boost Sw. Protection Diode

Forward current as a function of heatsink temperature

$$I_F = f(T_s)$$

At

$$T_j = 150 \, ^\circ C$$
Buck Sw. Protection Diode

**figure 1.** Buck Sw. Protection Diode  
Typical diode forward current as a function of forward voltage  
\[ I_F = f(V_F) \]

![Graph showing diode forward current as a function of forward voltage](image1)

At  
\[ t_p = 250 \mu s \]

**figure 2.** Buck Sw. Protection Diode  
Diode transient thermal impedance as a function of pulse width  
\[ Z_{th(j-s)} = f(t_p) \]

![Graph showing diode transient thermal impedance as a function of pulse width](image2)

At  
\[ D = \frac{t_p}{T} \]
\[ R_{th(j-s)} = 2.87 \text{ K/W} \]

**figure 3.** Buck Sw. Protection Diode  
Power dissipation as a function of heatsink temperature  
\[ P_{tot} = f(T_s) \]

![Graph showing power dissipation as a function of heatsink temperature](image3)

At  
\[ T_j = 175 \text{ ºC} \]

**figure 4.** Buck Sw. Protection Diode  
Forward current as a function of heatsink temperature  
\[ I_F = f(T_j) \]

![Graph showing forward current as a function of heatsink temperature](image4)

At  
\[ T_j = 175 \text{ ºC} \]
Thermistor

**Figure 1.** Thermistor

Typical NTC characteristic as a function of temperature

\[ R_T = f(T) \]

![NTC-typical temperature characteristic](image-url)
Switching Definitions BOOST

General conditions

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$T_{j}$</td>
<td>125 °C</td>
</tr>
<tr>
<td>$R_{gอน}$</td>
<td>$4 \Omega$</td>
</tr>
<tr>
<td>$R_{gอน}$</td>
<td>$4 \Omega$</td>
</tr>
</tbody>
</table>

**figure 1.** BOOST IGBT

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

$t_{doff} = 0.19 \mu s$

$t_{Eoff} = 0.76 \mu s$

- $V_{CE}(0\%) = -15 V$
- $V_{CE}(100\%) = 350 V$
- $I_{C}(100\%) = 35 A$

**figure 2.** BOOST IGBT

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

$t_{don} = 0.05 \mu s$

$t_{Eon} = 0.15 \mu s$

- $V_{CE}(0\%) = -15 V$
- $V_{CE}(100\%) = 350 V$
- $I_{C}(100\%) = 35 A$

**figure 3.** BOOST IGBT

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

- $V_{C}(100\%) = 350 V$
- $I_{C}(100\%) = 35 A$
- $t_{f} = 0.11 \mu s$

**figure 4.** BOOST IGBT

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

- $V_{C}(100\%) = 350 V$
- $I_{C}(100\%) = 35 A$
- $t_{r} = 0.01 \mu s$
Switching Definitions BOOST

**figure 5. BOOST IGBT**  
**Turn-off Switching Waveforms & definition of** $t_{\text{Eoff}}$

- $P_{\text{off}} (100\%) = 12.36$ kW
- $E_{\text{off}} (100\%) = 1.93$ mJ
- $t_{\text{Eoff}} = 0.76$ μs

**figure 6. BOOST IGBT**  
**Turn-on Switching Waveforms & definition of** $t_{\text{Eon}}$

- $P_{\text{on}} (100\%) = 12.36$ kW
- $E_{\text{on}} (100\%) = 0.63$ mJ
- $t_{\text{Eon}} = 0.15$ μs

**figure 7. BOOST FWD**  
**Turn-off Switching Waveforms & definition of** $t_{rr}$

- $V_d (100\%) = 350$ V
- $I_d (100\%) = 35$ A
- $I_{\text{RRM}} (100\%) = -67$ A
- $t_{rr} = 0.12$ μs
Switching Definitions BOOST

**Figure 8.** BOOST IGBT
Turn-on Switching Waveforms & definition of $t_{Qrr}$

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

<table>
<thead>
<tr>
<th>$I_d$ (100%)</th>
<th>35 A</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Q_{rr}$ (100%)</td>
<td>4.25 μC</td>
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<tr>
<td>$t_{Qrr}$</td>
<td>1.00 μs</td>
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</table>

**Figure 9.** BOOST IGBT
Turn-on Switching Waveforms & definition of $t_{Erec}$

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

<table>
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<tr>
<th>$P_{rec}$ (100%)</th>
<th>12.36 kW</th>
</tr>
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<tr>
<td>$E_{rec}$ (100%)</td>
<td>1.18 mJ</td>
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<tr>
<td>$t_{Erec}$</td>
<td>1.00 μs</td>
</tr>
</tbody>
</table>

**Measurement circuits**

**Figure 10.** BUCK stage switching measurement circuit

**Figure 11.** BOOST stage switching measurement circuit
Switching Definitions BUCK

**General conditions**

- $T_J = 125 \, ^\circ C$
- $R_{on} = 4 \, \Omega$
- $R_{off} = 4 \, \Omega$

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

- $V_{CE} (0\%) = -15 \, V$
- $V_{CE} (100\%) = 350 \, V$
- $I_C (100\%) = 35 \, A$
- $t_{doff} = 0,13 \, \mu s$
- $t_{Eoff} = 0,21 \, \mu s$

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

- $V_{CE} (0\%) = -15 \, V$
- $V_{CE} (100\%) = 350 \, V$
- $I_C (100\%) = 35 \, A$
- $t_{don} = 0,07 \, \mu s$
- $t_{Eon} = 0,12 \, \mu s$
Switching Definitions BUCK

**figure 5.** BUCK IGBT
Turn-off Switching Waveforms & definition of $t_{E_{off}}$

![Switching Waveforms](image)

- $P_{off} (100\%) = 12,32$ kW
- $E_{off} (100\%) = 0,46$ mJ
- $t_{E_{off}} = 0,21$ $\mu$s

**figure 6.** BUCK IGBT
Turn-on Switching Waveforms & definition of $t_{E_{on}}$

![Switching Waveforms](image)

- $P_{on} (100\%) = 12,32$ kW
- $E_{on} (100\%) = 0,18$ mJ
- $t_{E_{on}} = 0,12$ $\mu$s

**figure 7.** BUCK FWD
Turn-off Switching Waveforms & definition of $t_{rr}$

![Switching Waveforms](image)

- $V_{d} (100\%) = 350$ V
- $I_{d} (100\%) = 35$ A
- $I_{rr} (100\%) = -20$ A
- $t_{rr} = 0,01$ $\mu$s
Switching Definitions BUCK

**Figure 8.** BUCK IGBT
Turn-on Switching Waveforms & definition of $t_{Qrr}$

$I_d (100\%) = 35 \text{ A}$
$Q_r (100\%) = 0.17 \ \mu\text{C}$
$t_{Qrr} = 0.02 \ \mu\text{s}$

**Figure 9.** BUCK IGBT
Turn-on Switching Waveforms & definition of $t_{Erec}$

$E_{\text{rec}} (100\%) = 0.03 \ \text{mJ}$
$t_{E_{\text{rec}}} = 0.02 \ \mu\text{s}$

**Measurement circuits**

**Figure 10.**
BUCK stage switching measurement circuit

**Figure 11.**
BOOST stage switching measurement circuit
### Pinout

```
Pin 1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16
DC+  DC-  G6  S6  T5  D5  T1  G1  S1  D6  D1  T2  G2  S2  T6  D14

GND  19  18  17  16  15  14  13  12  11

DC-  20  21

NTC1  NTC2
```

### Identification

<table>
<thead>
<tr>
<th>ID</th>
<th>Component</th>
<th>Voltage</th>
<th>Current</th>
<th>Function</th>
<th>Comment</th>
</tr>
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<tbody>
<tr>
<td>T5, T6</td>
<td>IGBT</td>
<td>650 V</td>
<td>50 A</td>
<td>Buck Switch</td>
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<tr>
<td>D5, D6</td>
<td>FWD</td>
<td>600 V</td>
<td>16 A</td>
<td>Buck Diode</td>
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<tr>
<td>D13, D14</td>
<td>FWD</td>
<td>650 V</td>
<td>10 A</td>
<td>Buck Sw. Protection Diode</td>
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<tr>
<td>T1, T2</td>
<td>IGBT</td>
<td>1200 V</td>
<td>35 A</td>
<td>Boost IGBT</td>
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<td>Thermistor</td>
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pin 3 and 17 are NOT CONNECTED
## Package data

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<th>Standard packaging quantity (SPQ)</th>
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<tr>
<td>&gt;SPQ Standard &lt;SPQ Sample</td>
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</table>

## Handling instruction

Handling instructions for flow 0 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.

## DISCLAIME

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parties rights or give desired results. It is reader's sole responsibility to test and determine the suitability of the information and the product for reader's
intended use.

## 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.