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>
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</thead>
<tbody>
<tr>
<td><strong>Half-Bridge Switch</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drain-source voltage</td>
<td>$V_{GS}$</td>
<td></td>
<td>1200</td>
<td>V</td>
</tr>
<tr>
<td>Drain current</td>
<td>$I_D$</td>
<td>$T_J = T_{J\text{max}}$</td>
<td>57</td>
<td>A</td>
</tr>
<tr>
<td>Peak drain current</td>
<td>$I_{DM}$</td>
<td>$I_J$ limited by $T_{J\text{max}}$</td>
<td>274</td>
<td>A</td>
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<tr>
<td>Total power dissipation</td>
<td>$P_{tot}$</td>
<td>$T_J = T_{J\text{max}}$</td>
<td>122</td>
<td>W</td>
</tr>
<tr>
<td>Gate-source voltage</td>
<td>$V_{GS}$</td>
<td></td>
<td>-4/+22</td>
<td>V</td>
</tr>
<tr>
<td>Maximum Junction Temperature</td>
<td>$T_{J\text{max}}$</td>
<td></td>
<td>175</td>
<td>$^\circ C$</td>
</tr>
<tr>
<td><strong>Capacitor (GS)</strong></td>
<td></td>
<td></td>
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<tr>
<td>Maximum DC voltage</td>
<td>$V_{MAX}$</td>
<td></td>
<td>25</td>
<td>V</td>
</tr>
<tr>
<td>Operation Temperature</td>
<td>$T_{op}$</td>
<td></td>
<td>-55...+125</td>
<td>$^\circ C$</td>
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</tbody>
</table>
### Maximum Ratings

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

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Condition</th>
<th>Value</th>
<th>Unit</th>
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<tbody>
<tr>
<td><strong>Module Properties</strong></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>Thermal Properties</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storage temperature</td>
<td>$T_{stg}$</td>
<td></td>
<td>-40 ... +125</td>
<td>°C</td>
</tr>
<tr>
<td>Operation temperature under switching condition</td>
<td>$T_{jop}$</td>
<td></td>
<td>-40 ... ($T_{jmax} - 25$)</td>
<td>°C</td>
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<tr>
<td><strong>Isolation Properties</strong></td>
<td></td>
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<td></td>
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<tr>
<td>Isolation voltage</td>
<td>$V_{isol}$</td>
<td>DC Test Voltage* $\tau_s = 2 , s$</td>
<td>6000</td>
<td>V</td>
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<tr>
<td></td>
<td></td>
<td>AC Voltage $\tau_o = 1 , min$</td>
<td>2500</td>
<td>V</td>
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<tr>
<td>Creepage distance</td>
<td></td>
<td>min. 12,7</td>
<td></td>
<td>mm</td>
</tr>
<tr>
<td>Clearance</td>
<td></td>
<td>11,83</td>
<td></td>
<td>mm</td>
</tr>
<tr>
<td>Comparative Tracking Index</td>
<td>CTI</td>
<td></td>
<td>&gt; 200</td>
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*100 % tested in production
## Characteristic Values

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Value</th>
<th>Unit</th>
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</thead>
<tbody>
<tr>
<td><strong>Half-Bridge Switch</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Drain-source on-state resistance</td>
<td>( r_{DS(on)} )</td>
<td>10</td>
<td>40</td>
<td>25</td>
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<td>Gate-source threshold voltage</td>
<td>( V_{GS(th)} )</td>
<td>( V_{GS} = V_{DS} )</td>
<td>0,02</td>
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<tr>
<td>Gate to Source Leakage Current</td>
<td>( I_{GS} )</td>
<td>( -4/+22 )</td>
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<td>25</td>
</tr>
<tr>
<td>Zero Gate Voltage Drain Current</td>
<td>( I_{DS} )</td>
<td>0</td>
<td>1200</td>
<td>25</td>
</tr>
<tr>
<td>Internal gate resistance</td>
<td>( r_{g} )</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Gate charge</td>
<td>( Q_{g} )</td>
<td>18</td>
<td>600</td>
<td>40</td>
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<tr>
<td>Gate to source charge</td>
<td>( Q_{GS} )</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gate to drain charge</td>
<td>( Q_{GD} )</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Short-circuit input capacitance</td>
<td>( C_{iss} )</td>
<td>( f = 1,\text{MHz} )</td>
<td>0</td>
<td>800</td>
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<tr>
<td>Short-circuit output capacitance</td>
<td>( C_{oss} )</td>
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<tr>
<td>Reverse transfer capacitance</td>
<td>( C_{rss} )</td>
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<tr>
<td><strong>Reverse Diode Static</strong></td>
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<tr>
<td>Diode forward voltage</td>
<td>( V_{SD} )</td>
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## Thermal

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<th>Unit</th>
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<tbody>
<tr>
<td>Thermal resistance junction to sink</td>
<td>( R_{th(j-s)} )</td>
<td>( \lambda_{paste} = 3,4 ,\text{W/mK} ) (PSX)</td>
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<td>0,78</td>
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## Dynamic

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<th>Symbol</th>
<th>Conditions</th>
<th>Value</th>
<th>Unit</th>
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<tbody>
<tr>
<td>Turn-on delay time</td>
<td>( t_{d(on)} )</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rise time</td>
<td>( t_{r} )</td>
<td>( R_{off} = 2 ,\Omega ) ( R_{on} = 2 ,\Omega )</td>
<td>25</td>
<td>125</td>
</tr>
<tr>
<td>Turn-off delay time</td>
<td>( t_{d(off)} )</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fall time</td>
<td>( t_{f} )</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turn-on energy (per pulse)</td>
<td>( E_{on} )</td>
<td>( Q_{on} = 0,8 ,\mu\text{C} ) ( Q_{off} = 1,1 ,\mu\text{C} ) ( Q_{on} = 1,6 ,\mu\text{C} )</td>
<td>25</td>
<td>125</td>
</tr>
<tr>
<td>Turn-off energy (per pulse)</td>
<td>( E_{off} )</td>
<td></td>
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</table>

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## Characteristic Values

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Value</th>
<th>Unit</th>
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</thead>
<tbody>
<tr>
<td>Capacitor (GS)</td>
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<td></td>
</tr>
<tr>
<td>Capacitance</td>
<td>C</td>
<td></td>
<td>4,7</td>
<td>nF</td>
</tr>
<tr>
<td>Tolerance</td>
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<td>+10%</td>
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<tr>
<td>Dissipation factor</td>
<td></td>
<td></td>
<td>25</td>
<td>2,5%</td>
</tr>
<tr>
<td>Thermistor</td>
<td></td>
<td></td>
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<tr>
<td>Rated resistance</td>
<td>R</td>
<td></td>
<td>25</td>
<td>22</td>
</tr>
<tr>
<td>Deviation of R(25)</td>
<td>ΔR/R</td>
<td>R(25) = 1484 Ω</td>
<td>100</td>
<td>-5</td>
</tr>
<tr>
<td>Power dissipation</td>
<td>P</td>
<td></td>
<td>25</td>
<td>5</td>
</tr>
<tr>
<td>Power dissipation constant</td>
<td></td>
<td></td>
<td>25</td>
<td>1,5</td>
</tr>
<tr>
<td>B-value</td>
<td>R(25/10)</td>
<td>Tol. ±1 %</td>
<td>25</td>
<td>3962</td>
</tr>
<tr>
<td>B-value</td>
<td>R(25/100)</td>
<td>Tol. ±1 %</td>
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<td>4000</td>
</tr>
</tbody>
</table>

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10 Aug. 2018 / Revision 1
Half-Bridge Switch Characteristics

**Figure 1.** MOSFET

Typical output characteristics

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

- \( I_D \) vs. \( V_{DS} \)
- Parameters: \( t_p = 250 \mu s \), \( V_{GS} = 18 \) V, \( T_j: 25 \) °C, \( 125 \) °C, \( 150 \) °C

**Figure 2.** MOSFET

Typical output characteristics

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

- \( I_D \) vs. \( V_{DS} \)
- Parameters: \( t_p = 250 \mu s \), \( V_{GS} \) from -4 V to 20 V in steps of 2 V

**Figure 3.** MOSFET

Typical transfer characteristics

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

- \( I_D \) vs. \( V_{GS} \)
- Parameters: \( t_p = 100 \mu s \), \( V_{DS} = 10 \) V, \( T_j: 25 \) °C, \( 125 \) °C, \( 150 \) °C

**Figure 4.** MOSFET

Transient thermal impedance as a function of pulse width

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

- Graph showing \( Z_{th(j-s)} \) vs. \( t_p \)

**Table:**

- MOSFET thermal model values

<table>
<thead>
<tr>
<th>( D )</th>
<th>( t_p / T )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( R_{th(j-s)} )</td>
<td>0.78 K/W</td>
</tr>
</tbody>
</table>

- Parameters:
  - \( R \) (K/W)
  - \( t \) (s)
  - \( T \) (°C)
  - Values:
    - 8.97E-02
    - 5.23E-01
    - 2.29E-01
    - 7.26E-02
    - 2.67E-01
    - 2.18E-02
    - 1.19E-01
    - 4.48E-03
    - 7.47E-02
    - 8.89E-04

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Half-Bridge Switch Characteristics

Figure 5. MOSFET

Gate voltage vs Gate charge

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

At

\[ I_C = 40 \text{ A} \]

600 V
NTC Characteristics

Figure 1. Typical NTC characteristic as a function of temperature

\[ R = f(T) \]
Half-Bridge Switching Characteristics

Figure 1. MOSFET
Typical switching energy losses as a function of drain current

\[ E = f(I_D) \]

With an inductive load at 25 °C
- \( V_{DS} = 700 \) V
- \( T_J = 125 \) °C

- \( V_{DS} = 16/-4 \) V
- \( T_J = 150 \) °C

- \( R_{gon} = 2 \) Ω
- \( I_D = 60 \) A

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

\[ E = f(R_g) \]

With an inductive load at 25 °C
- \( V_{DS} = 700 \) V
- \( T_J = 125 \) °C

- \( V_{DS} = 16/-4 \) V
- \( T_J = 150 \) °C

- \( V_{GS} = 16/-4 \) V
- \( T_J = 150 \) °C

- \( R_{goff} = 2 \) Ω
- \( I_D = 60 \) A

Figure 3. FWD
Typical reverse recovered energy loss as a function of drain current

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

With an inductive load at 25 °C
- \( V_{DS} = 700 \) V
- \( T_J = 125 \) °C

- \( V_{DS} = 16/-4 \) V
- \( T_J = 150 \) °C

- \( R_{gon} = 2 \) Ω
- \( I_D = 60 \) A

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

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

With an inductive load at 25 °C
- \( V_{DS} = 700 \) V
- \( T_J = 125 \) °C

- \( V_{DS} = 16/-4 \) V
- \( T_J = 150 \) °C

- \( V_{GS} = 16/-4 \) V
- \( T_J = 150 \) °C

- \( R_{goff} = 2 \) Ω
- \( I_D = 60 \) A
Half-Bridge Switching Characteristics

Figure 5. MOSFET
Typical switching times as a function of drain current

With an inductive load at
- $T_j = 150 \, ^\circ\text{C}$
- $V_{DS} = 700 \, \text{V}$
- $V_{GS} = 16/-4 \, \text{V}$
- $R_{gon} = 2 \, \Omega$
- $R_{goff} = 2 \, \Omega$

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

With an inductive load at
- $T_j = 150 \, ^\circ\text{C}$
- $V_{DS} = 700 \, \text{V}$
- $V_{GS} = 16/-4 \, \text{V}$
- $R_{g} = 60 \, \Omega$

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

At
- $V_{DS} = 700 \, \text{V}$
- $V_{GS} = 16/-4 \, \text{V}$
- $T_j = 25 \, ^\circ\text{C}$
- $R_{gon} = 2 \, \Omega$
- $I_D = 60 \, \text{A}$

Figure 8. FWD
Typical reverse recovery time as a function of MOSFET turn-on gate resistor

At
- $V_{DS} = 700 \, \text{V}$
- $V_{GS} = 16/-4 \, \text{V}$
- $T_j = 25 \, ^\circ\text{C}$
- $R_{g} = 60 \, \Omega$
- $I_D = 150 \, \text{A}$
Half-Bridge Switching Characteristics

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

\[ Q_r = f(I_D) \]

At
- \( V_{DS} = 700 \) V
- \( V_{GS} = 16/-4 \) V
- \( R_{gon} = 2 \) Ω

25 °C

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

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

At
- \( V_{DS} = 700 \) V
- \( V_{GS} = 16/-4 \) V
- \( T_J = 125 \) °C

150 °C

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

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

At
- \( V_{DS} = 700 \) V
- \( V_{GS} = 16/-4 \) V
- \( R_{gon} = 2 \) Ω

25 °C

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

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

At
- \( V_{DS} = 700 \) V
- \( V_{GS} = 16/-4 \) V
- \( I_D = 60 \) A

150 °C

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Half-Bridge Switching Characteristics

Figure 13. FWD
Typical rate of fall of forward and reverse recovery current as a function of drain current

\[
\frac{dI_F}{dt}, \frac{dI_{rr}}{dt} = f(I_D)
\]

At
\[V_{DS} = 700 \text{ V}, \quad 25 \, ^\circ\text{C}\]
\[V_{GS} = 16/-4 \text{ V}\]
\[T_j = 125 \, ^\circ\text{C}\]
\[R_{gon} = 2 \, \Omega\]


Figure 14. FWD
Typical rate of fall of forward and reverse recovery current as a function of MOSFET turn-on gate resistor

\[
\frac{dI_F}{dt}, \frac{dI_{rr}}{dt} = f(R_{gon})
\]

At
\[V_{DS} = 700 \text{ V}, \quad 25 \, ^\circ\text{C}\]
\[V_{GS} = 16/-4 \text{ V}\]
\[T_j = 125 \, ^\circ\text{C}\]
\[I_D = 60 \, \text{A}\]
\[T_j = 150 \, ^\circ\text{C}\]

Figure 15. MOSFET
Reverse bias safe operating area

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

At
\[I_D = 125 \, ^\circ\text{C}\]
\[R_{gas} = 2 \, \Omega\]
\[R_{gas} = 2 \, \Omega\]
Half-Bridge Switching Definitions

General conditions

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>$T_j$</td>
<td>125 °C</td>
</tr>
<tr>
<td>$R_{GS}$</td>
<td>2 Ω</td>
</tr>
<tr>
<td>$R_{GSS}$</td>
<td>2 Ω</td>
</tr>
</tbody>
</table>

Figure 1. MOSFET
Turn-off Switching Waveforms & definition of $t_{doff}$, $t_{Eoff}$ ($t_{Eoff}$ = integrating time for $E_{off}$)

- $V_{GS}(0%) = -4$ V
- $V_{GS}(100%) = 16$ V
- $V_{DS}(100%) = 700$ V
- $I_D(100%) = 60$ A
- $t_{doff} = 0.073$ μs
- $t_{Eoff} = 0.033$ μs

Figure 2. MOSFET
Turn-on Switching Waveforms & definition of $t_{don}$, $t_{Eon}$ ($t_{Eon}$ = integrating time for $E_{on}$)

- $V_{GS}(0%) = -4$ V
- $V_{GS}(100%) = 16$ V
- $V_{DS}(100%) = 700$ V
- $I_D(100%) = 60$ A
- $t_{don} = 0.033$ μs
- $t_{Eon} = 0.011$ μs

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

- $V_{GS}(90%) = 700$ V
- $I_D(90%) = 60$ A
- $t_f = 0.011$ μs

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

- $V_{GS}(90%) = 700$ V
- $I_D(90%) = 60$ A
- $t_r = 0.011$ μs
Half-Bridge Switching Characteristics

**Figure 7:** FWD
Turn-off Switching Waveforms & definition of $t_{Qrr}$

- $V_F(100\%) = 700$ V
- $I_F(100\%) = 60$ A
- $I_{RRM}(10\%) = 71$ A
- $I_{RRM}(90\%) = 71$ A
- $I_{RRM}(100\%) = 60$ A
- $Q_{rr}(100\%) = 1.10 \mu$C
- $t_{Qrr} = 0.025 \mu$s

**Figure 8:** FWD
Turn-on Switching Waveforms & definition of $t_{Qrr}$ ($t_{Qrr} = \text{integrating time for } Q_{rr}$)

- $V_F(100\%) = 700$ V
- $I_F(100\%) = 60$ A
- $I_{RRM}(10\%) = 71$ A
- $I_{RRM}(90\%) = 71$ A
- $I_{RRM}(100\%) = 60$ A
- $Q_{rr}(100\%) = 1.10 \mu$C
- $t_{Qrr} = 0.025 \mu$s
## Pinout

**Component**
- Capacitor (GS)

**Identification**

<table>
<thead>
<tr>
<th>ID</th>
<th>Component</th>
<th>Voltage</th>
<th>Current</th>
<th>Function</th>
<th>Comment</th>
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<tbody>
<tr>
<td>T11, T12, T21, T22</td>
<td>MOSFET</td>
<td>1200 V</td>
<td>20 mΩ</td>
<td>Half-Bridge Switch</td>
<td></td>
</tr>
<tr>
<td>C11, C12, C21, C22</td>
<td>Capacitor</td>
<td>25 V</td>
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<td>Capacitor (GS)</td>
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<tr>
<td>Rt</td>
<td>NTC</td>
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<td>Thermistor</td>
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## Packaging instruction

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<tbody>
<tr>
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<td></td>
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</tbody>
</table>

## 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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