1. General description

Ultrafast power diode in a TO220F-2L plastic package.

2. Features and benefits

- Fast switching
- Isolated plastic package
- Low leakage current
- Low reverse recovery current
- Low thermal resistance
- Reduces switching losses in associated MOSFET or IGBT

3. Applications

- Active PFC in air conditioner
- High frequency switched-mode power supplies
- Power Factor Correction (PFC)

4. Quick reference data

Table 1. Quick reference data

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>Notes</th>
<th>Values</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{FRM}$</td>
<td>repetitive peak reverse voltage</td>
<td>$\delta = 0.5$ ; square-wave pulse; Fig. 1; Fig. 2; Fig. 3</td>
<td>650</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>$I_{F(AV)}$</td>
<td>average forward current</td>
<td>$\delta = 0.5$</td>
<td>20</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>$I_{FRM}$</td>
<td>repetitive peak forward current</td>
<td>$\delta = 0.5$ ; $t_p = 25 \mu s$; square-wave pulse</td>
<td>40</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>$I_{FSM}$</td>
<td>non-repetitive peak forward current</td>
<td>$t_p = 10 \text{ ms}; T_{j(init)} = 25 ^\circ C$; sine-wave pulse; Fig. 4</td>
<td>250</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>$t_p$</td>
<td>reverse recovery time</td>
<td>$I_F = 1 \text{ A}; V_R = 30 \text{ V}; dI/dt = 200 \text{ A/}\mu \text{s}; T_j = 25 ^\circ C$; Fig. 7</td>
<td>23</td>
<td>ns</td>
<td></td>
</tr>
</tbody>
</table>
5. Pinning information

Table 2. Pinning information

<table>
<thead>
<tr>
<th>Pin</th>
<th>Symbol</th>
<th>Description</th>
<th>Simplified outline</th>
<th>Graphic symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>K</td>
<td>cathode</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>A</td>
<td>anode</td>
<td></td>
<td></td>
</tr>
<tr>
<td>mb</td>
<td>n.c.</td>
<td>mounting base; isolated</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6. Ordering information

Table 3. Ordering information

<table>
<thead>
<tr>
<th>Type number</th>
<th>Package Name</th>
<th>Orderable part number</th>
<th>Packing method</th>
<th>Small packing quantity</th>
<th>Package version</th>
<th>Package issue date</th>
</tr>
</thead>
<tbody>
<tr>
<td>BYV20MX-650P</td>
<td>TO220F-2L</td>
<td>BYV20MX-650PQ</td>
<td>Tube</td>
<td>50</td>
<td>TO220Fd-2L</td>
<td>02-Aug-2022</td>
</tr>
</tbody>
</table>

7. Marking

Table 4. Marking codes

<table>
<thead>
<tr>
<th>Type number</th>
<th>Marking codes</th>
</tr>
</thead>
<tbody>
<tr>
<td>BYV20MX-650P</td>
<td>BYV20MX 650P</td>
</tr>
</tbody>
</table>
8. Limiting values

Table 5. Limiting values
In accordance with the Absolute Maximum Rating System (IEC 60134).

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>Notes</th>
<th>Values</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{RRM}$</td>
<td>repetitive peak reverse voltage</td>
<td>650 V</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$V_{RWM}$</td>
<td>crest working reverse voltage</td>
<td>650 V</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$V_r$</td>
<td>reverse voltage</td>
<td>DC</td>
<td></td>
<td>650 V</td>
<td></td>
</tr>
<tr>
<td>$I_{F(AV)}$</td>
<td>average forward current</td>
<td>20 A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$I_{FRM}$</td>
<td>repetitive peak forward current</td>
<td>40 A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$I_{FSM}$</td>
<td>non-repetitive peak forward current</td>
<td>250 A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$T_{stg}$</td>
<td>storage temperature</td>
<td>-65 to 175 °C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$T_j$</td>
<td>junction temperature</td>
<td>-65 to 175 °C</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$I_{F(AV)} = I_{F(RMS)} \times \sqrt{\delta}$
$V_o = 1.419 V; R_s = 0.0189 \Omega$

Fig. 1. Forward power dissipation as a function of average forward current; square waveform; maximum values

$a = \text{form factor} = I_{F(RMS)}/I_{F(AV)}$
$V_o = 1.419 V; R_s = 0.0189 \Omega$

Fig. 2. Forward power dissipation as a function of average forward current; sinusoidal waveform; maximum values
Fig. 3. Forward current as a function of heatsink temperature; typical values

square waveform; δ = 1

Fig. 4. Non-repetitive peak forward current as a function of pulse width; sinusoidal waveform; maximum values
9. Thermal characteristics

Table 6. Thermal characteristics

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>Notes</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$R_{th(j-h)}$</td>
<td>thermal resistance from junction to heatsink</td>
<td>with heatsink compound; Fig. 5</td>
<td>-</td>
<td>-</td>
<td>4</td>
<td></td>
<td>kW</td>
</tr>
<tr>
<td>$R_{th(j-a)}$</td>
<td>thermal resistance from junction to ambient free air</td>
<td>in free air</td>
<td>-</td>
<td>60</td>
<td>-</td>
<td></td>
<td>kW</td>
</tr>
</tbody>
</table>

![Fig. 5. Transient thermal impedance from junction to heatsink as a function of pulse duration](image)

10. Isolation characteristics

Table 7. Isolation characteristics

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>Notes</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{isol(RMS)}$</td>
<td>RMS isolation voltage</td>
<td>50 Hz ≤ f ≤ 60 Hz; RH ≤ 65 %; from all pins to external heatsink; sinusoidal waveform; clean and dust free</td>
<td>-</td>
<td>-</td>
<td>2500</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>$C_{isol}$</td>
<td>isolation capacitance</td>
<td>f = 1 MHz; from cathode to external heatsink</td>
<td>-</td>
<td>10</td>
<td>-</td>
<td></td>
<td>pF</td>
</tr>
</tbody>
</table>
# 11. Characteristics

## Table 8. Characteristics

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>Notes</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( V_F )</td>
<td>forward voltage</td>
<td>( I_F = 20 , A; , T_J = 25 , ^\circ C; , Fig. , 6 )</td>
<td>-</td>
<td>1.65</td>
<td>2.20</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>( I_F )</td>
<td>forward current</td>
<td>( I_F = 20 , A; , T_J = 150 , ^\circ C; , Fig. , 6 )</td>
<td>-</td>
<td>1.25</td>
<td>1.80</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>( I_R )</td>
<td>reverse current</td>
<td>( V_R = 650 , V; , T_J = 25 , ^\circ C )</td>
<td>-</td>
<td>0.2</td>
<td>30</td>
<td>( \mu A )</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>( V_R = 650 , V; , T_J = 150 , ^\circ C )</td>
<td>-</td>
<td>0.05</td>
<td>-</td>
<td>mA</td>
<td></td>
</tr>
</tbody>
</table>

## Dynamic characteristics

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>Notes</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>( Q_r )</td>
<td>reverse charge</td>
<td>( I_F = 20 , A; , V_R = 200 , V; , dI_F/dt = 200 , A/\mu s; , T_J = 25 , ^\circ C; , Fig. , 7 )</td>
<td>-</td>
<td>125</td>
<td>-</td>
<td>nC</td>
<td></td>
</tr>
<tr>
<td>( I_F )</td>
<td>reverse current</td>
<td>( I_F = 20 , A; , V_R = 200 , V; , dI_F/dt = 200 , A/\mu s; , T_J = 125 , ^\circ C; , Fig. , 7 )</td>
<td>-</td>
<td>500</td>
<td>-</td>
<td>nC</td>
<td></td>
</tr>
<tr>
<td>( I_F )</td>
<td>reverse recovery time</td>
<td>( I_F = 0.5 , A; , I_R = 0.25 , A; , I_F = 1 , A; , T_J = 25 , ^\circ C; , Fig. , 7 )</td>
<td>-</td>
<td>36</td>
<td>-</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>( I_F )</td>
<td></td>
<td>( I_F = 1 , A; , V_R = 30 , V; , dI_F/dt = 200 , A/\mu s; , T_J = 25 , ^\circ C; , Fig. , 7 )</td>
<td>-</td>
<td>23</td>
<td>-</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>( I_F )</td>
<td></td>
<td>( I_F = 20 , A; , V_R = 200 , V; , dI_F/dt = 200 , A/\mu s; , T_J = 25 , ^\circ C; , Fig. , 7 )</td>
<td>-</td>
<td>65</td>
<td>-</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>( I_F )</td>
<td></td>
<td>( I_F = 20 , A; , V_R = 200 , V; , dI_F/dt = 200 , A/\mu s; , T_J = 125 , ^\circ C; , Fig. , 7 )</td>
<td>-</td>
<td>100</td>
<td>-</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>( I_{RM} )</td>
<td>peak reverse recovery current</td>
<td>( I_F = 20 , A; , V_R = 200 , V; , dI_F/dt = 200 , A/\mu s; , T_J = 25 , ^\circ C; , Fig. , 7 )</td>
<td>-</td>
<td>4.5</td>
<td>-</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>( I_F )</td>
<td></td>
<td>( I_F = 20 , A; , V_R = 200 , V; , dI_F/dt = 200 , A/\mu s; , T_J = 125 , ^\circ C; , Fig. , 7 )</td>
<td>-</td>
<td>9.5</td>
<td>-</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>( E_{av} )</td>
<td>non-repetitive avalanche energy</td>
<td>( T_{j(init)} = 25 , ^\circ C )</td>
<td>25</td>
<td>-</td>
<td>-</td>
<td>mJ</td>
<td></td>
</tr>
</tbody>
</table>

![Fig. 6. Forward current as a function of forward voltage](image)

![Fig. 7. Reverse recovery definitions; ramp recovery](image)

\( V_c = 1.419 \, V; \, R_s = 0.0189 \, \Omega \)

(1) \( T_J = 150 \, ^\circ C \); typical values
(2) \( T_J = 150 \, ^\circ C \); maximum values
(3) \( T_J = 25 \, ^\circ C \); maximum values
12. Package outline

Plastic single-ended package; isolated heatsink mounted; 1 mounting hole; 2 leads TO-220 'full pack'

<table>
<thead>
<tr>
<th>Unit</th>
<th>A</th>
<th>A1</th>
<th>b</th>
<th>b1</th>
<th>c</th>
<th>D</th>
<th>D1</th>
<th>E</th>
<th>e</th>
<th>L</th>
<th>L1</th>
<th>P</th>
<th>Q</th>
<th>q</th>
</tr>
</thead>
<tbody>
<tr>
<td>min</td>
<td>4.00</td>
<td>2.50</td>
<td>0.70</td>
<td>0.90</td>
<td>0.40</td>
<td>15.20</td>
<td>6.30</td>
<td>9.80</td>
<td>5.08</td>
<td>(BSC)</td>
<td>13.50</td>
<td>2.80</td>
<td>3.00</td>
<td>2.30</td>
</tr>
<tr>
<td>max</td>
<td>4.60</td>
<td>3.10</td>
<td>0.90</td>
<td>1.10</td>
<td>0.70</td>
<td>15.80</td>
<td>6.50</td>
<td>10.30</td>
<td></td>
<td></td>
<td>14.40</td>
<td>3.30</td>
<td>3.40</td>
<td>2.80</td>
</tr>
</tbody>
</table>

Note:
1. All dimensions don't include mold flash and metal protrusion.
13. Legal information

Data sheet status

<table>
<thead>
<tr>
<th>Document status</th>
<th>Product status</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>[short] data sheet</td>
<td>Development</td>
<td>This document contains data from the objective specification for product development.</td>
</tr>
<tr>
<td>[short] data sheet</td>
<td>Qualification</td>
<td>This document contains data from the preliminary specification.</td>
</tr>
<tr>
<td>[short] data sheet</td>
<td>Production</td>
<td>This document contains the product specification.</td>
</tr>
</tbody>
</table>

[1] Please consult the most recently issued document before initiating or completing a design.

[2] The term ‘short data sheet’ is explained in section “Definitions”.

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL http://www.ween-semi.com.

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## 14. Contents

1. General description ....................................................... 1
2. Features and benefits .................................................. 1
3. Applications ................................................................. 1
4. Quick reference data ..................................................... 1
5. Pinning information ........................................................ 2
6. Ordering information ..................................................... 2
7. Marking ........................................................................... 2
8. Limiting values ............................................................... 3
9. Thermal characteristics .................................................. 5
10. Isolation characteristics ................................................. 5
11. Characteristics .............................................................. 6
12. Package outline ............................................................ 7
13. Legal information .......................................................... 8
14. Contents ....................................................................... 10

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For sales office addresses, please send an email to: salesaddresses@ween-semi.com
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