50A, 600V Hyperfast Diode

The RHRG5060 is a hyperfast diode with soft recovery characteristics (t<sub>rr</sub> < 45ns). It has half the recovery time of ultrafast diodes and is of silicon nitride passivated ion-implanted epitaxial planar construction.

This device is intended for use as a freewheeling/clamping diode and rectifier in a variety of switching power supplies and other power switching applications. Its low stored charge and hyperfast soft recovery minimize ringing and electrical noise in many power switching circuits, thus reducing power loss in the switching transistors.

Formerly developmental type TA49065.

Features

- Hyperfast with Soft Recovery ................. <45ns
- Operating Temperature ..................... 175°C
- Reverse Voltage .......................... 600V
- Avalanche Energy Rated
- Planar Construction

Applications

- Switching Power Supplies
- Power Switching Circuits
- General Purpose

Ordering Information

<table>
<thead>
<tr>
<th>PART NUMBER</th>
<th>PACKAGE</th>
<th>BRAND</th>
</tr>
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<tbody>
<tr>
<td>RHRG5060</td>
<td>TO-247</td>
<td>RHRG5060</td>
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</tbody>
</table>

NOTE: When ordering, use the entire part number.

Symbol

```
  K
 K
 A
```

Absolute Maximum Ratings  T<sub>C</sub> = 25°C, Unless Otherwise Specified

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RHRG5060</th>
<th>UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak Repetitive Reverse Voltage</td>
<td>V&lt;sub&gt;RRM&lt;/sub&gt;</td>
<td>600 V</td>
</tr>
<tr>
<td>Working Peak Reverse Voltage</td>
<td>V&lt;sub&gt;RWM&lt;/sub&gt;</td>
<td>600 V</td>
</tr>
<tr>
<td>DC Blocking Voltage</td>
<td>V&lt;sub&gt;R&lt;/sub&gt;</td>
<td>600 V</td>
</tr>
<tr>
<td>Average Rectified Forward Current (T&lt;sub&gt;C&lt;/sub&gt; = 93°C)</td>
<td>I&lt;sub&gt;AV&lt;/sub&gt;</td>
<td>50 A</td>
</tr>
<tr>
<td>Repetitive Peak Surge Current (Square Wave, 20kHz)</td>
<td>I&lt;sub&gt;FRM&lt;/sub&gt;</td>
<td>100 A</td>
</tr>
<tr>
<td>Nonrepetitive Peak Surge Current (Halfwave, 1 Phase, 60Hz)</td>
<td>I&lt;sub&gt;FSM&lt;/sub&gt;</td>
<td>500 A</td>
</tr>
<tr>
<td>Maximum Power Dissipation</td>
<td>P&lt;sub&gt;D&lt;/sub&gt;</td>
<td>150 W</td>
</tr>
<tr>
<td>Avalanche Energy (See Figures 10 and 11)</td>
<td>E&lt;sub&gt;AVL&lt;/sub&gt;</td>
<td>40 mJ</td>
</tr>
<tr>
<td>Operating and Storage Temperature</td>
<td>T&lt;sub&gt;STG&lt;/sub&gt;, T&lt;sub&gt;J&lt;/sub&gt;</td>
<td>-65 to 175°C</td>
</tr>
</tbody>
</table>
### Electrical Specifications  
$T_C = 25^\circ C$, Unless Otherwise Specified

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>TEST CONDITION</th>
<th>MIN</th>
<th>TYP</th>
<th>MAX</th>
<th>UNITS</th>
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<tbody>
<tr>
<td>$V_F$</td>
<td>$I_F = 50A$</td>
<td>-</td>
<td>-</td>
<td>2.1</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td>$I_F = 50A$, $T_C = 150^\circ C$</td>
<td>-</td>
<td>-</td>
<td>1.7</td>
<td>V</td>
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<tr>
<td>$I_R$</td>
<td>$V_R = 600V$</td>
<td>-</td>
<td>-</td>
<td>250</td>
<td>$\mu A$</td>
</tr>
<tr>
<td></td>
<td>$V_R = 600V$, $T_C = 150^\circ C$</td>
<td>-</td>
<td>-</td>
<td>1.5</td>
<td>mA</td>
</tr>
<tr>
<td>$t_{rr}$</td>
<td>$I_F = 1A$, $dI_F/dt = 100A/\mu s$</td>
<td>-</td>
<td>-</td>
<td>45</td>
<td>ns</td>
</tr>
<tr>
<td></td>
<td>$I_F = 50A$, $dI_F/dt = 100A/\mu s$</td>
<td>-</td>
<td>-</td>
<td>50</td>
<td>ns</td>
</tr>
<tr>
<td>$t_a$</td>
<td>$I_F = 50A$, $dI_F/dt = 100A/\mu s$</td>
<td>-</td>
<td>25</td>
<td>-</td>
<td>ns</td>
</tr>
<tr>
<td>$t_b$</td>
<td>$I_F = 50A$, $dI_F/dt = 100A/\mu s$</td>
<td>-</td>
<td>20</td>
<td>-</td>
<td>ns</td>
</tr>
<tr>
<td>$Q_{RR}$</td>
<td>$I_F = 50A$, $dI_F/dt = 100A/\mu s$</td>
<td>-</td>
<td>65</td>
<td>-</td>
<td>nC</td>
</tr>
<tr>
<td>$C_J$</td>
<td>$V_R = 10V$, $I_F = 0A$</td>
<td>-</td>
<td>140</td>
<td>-</td>
<td>pF</td>
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<tr>
<td>$R_{thJC}$</td>
<td></td>
<td>-</td>
<td>-</td>
<td>1.0</td>
<td>°C/W</td>
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</tbody>
</table>

**Definitions**

- $V_F$ = Instantaneous forward voltage ($pw = 300\mu s$, $D = 2\%$).
- $I_R$ = Instantaneous reverse current.
- $t_{rr}$ = Reverse recovery time (See Figure 9), summation of $t_a + t_b$.
- $t_a$ = Time to reach peak reverse current (See Figure 9).
- $t_b$ = Time from peak $I_{RM}$ to projected zero crossing of $I_{RM}$ based on a straight line from peak $I_{RM}$ through 25% of $I_{RM}$ (See Figure 9).
- $Q_{RR}$ = Reverse recovery charge.
- $C_J$ = Junction Capacitance.
- $R_{thJC}$ = Thermal resistance junction to case.
- $pw$ = pulse width.
- $D$ = Duty cycle.

**Typical Performance Curves**

**Figure 1. Forward Current vs Forward Voltage**

**Figure 2. Reverse Current vs Reverse Voltage**
Typical Performance Curves (Continued)

**FIGURE 3.** $t_{rr}$, $t_a$ AND $t_b$ CURVES vs FORWARD CURRENT

**FIGURE 4.** $t_{rr}$, $t_a$ AND $t_b$ CURVES vs FORWARD CURRENT

**FIGURE 5.** $t_{rr}$, $t_a$ AND $t_b$ CURVES vs FORWARD CURRENT

**FIGURE 6.** CURRENT DERATING CURVE

**FIGURE 7.** JUNCTION CAPACITANCE vs REVERSE VOLTAGE
Test Circuits and Waveforms

**FIGURE 8. \( t_{rr} \) TEST CIRCUIT**

\[ V_{GE} \text{ AMPLITUDE AND} \]
\[ R_G \text{ CONTROL } \frac{di}{dt} \]
\[ t_1 \text{ AND } t_2 \text{ CONTROL } I_F \]

\[ V_{DD} \]
\[ IGBT \]

**FIGURE 9. \( t_{rr} \) WAVEFORMS AND DEFINITIONS**

\[ V_{GE} \text{ AMPLITUDE AND} \]
\[ \frac{di}{dt} \text{ CONTROL } I_F \]

\[ t_1 \text{ AND } t_2 \text{ CONTROL } I_F \]

\[ 0.25 \cdot I_{RM} \]

**FIGURE 10. AVALANCHE ENERGY TEST CIRCUIT**

\[ I_{MAX} = 1.4A \]
\[ L = 40mH \]
\[ R < 0.1\Omega \]
\[ E_{AVL} = \frac{1}{2}\cdot L \cdot I_{MAX}^2 \]
\[ Q_1 = \text{IGBT (BVCES} > \text{DUT) } V_{R(AVL)} \]

**FIGURE 11. AVALANCHE CURRENT AND VOLTAGE WAVEFORMS**

\[ t_0 \text{ t}_1 \text{ t}_2 \text{ t} \]

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