Axial Lead Rectifiers

SCHOTTKY BARRIER RECTIFIERS
1.0 AMPERE 20, 30 and 40 VOLTS

1N5817, 1N5818, 1N5819

This series employs the Schottky Barrier principle in a large area metal–to–silicon power diode. State–of–the–art geometry features chrome barrier metal, epitaxial construction with oxide passivation and metal overlap contact. Ideally suited for use as rectifiers in low–voltage, high–frequency inverters, free wheeling diodes, and polarity protection diodes.

Features

• Extremely Low V_F
• Low Stored Charge, Majority Carrier Conduction
• Low Power Loss/High Efficiency
• These are Pb–Free Devices*

Mechanical Characteristics:

• Case: Epoxy, Molded
• Weight: 0.4 Gram (Approximately)
• Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
• Lead Temperature for Soldering Purposes: 260°C Max for 10 Seconds
• Polarity: Cathode Indicated by Polarity Band
• ESD Ratings: Machine Model = C (>400 V)
  Human Body Model = 3B (>8000 V)

MARKING DIAGRAM

A =Assembly Location
1N581x =Device Number
x = 7, 8, or 9
YY =Year
WW =Work Week
• =Pb–Free Package
(Note: Microdot may be in either location)

ORDERING INFORMATION

See detailed ordering and shipping information on page 6 of this data sheet.

*For additional information on our Pb–Free strategy and soldering details, please download the onsemi Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.
### MAXIMUM RATINGS

<table>
<thead>
<tr>
<th>Rating</th>
<th>Symbol</th>
<th>1N5817</th>
<th>1N5818</th>
<th>1N5819</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak Repetitive Reverse Voltage</td>
<td>VRRM</td>
<td>20</td>
<td>30</td>
<td>40</td>
<td>V</td>
</tr>
<tr>
<td>Working Peak Reverse Voltage</td>
<td>VRWM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DC Blocking Voltage</td>
<td>VR</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non–Repetitive Peak Reverse Voltage</td>
<td>VRSM</td>
<td>24</td>
<td>36</td>
<td>48</td>
<td>V</td>
</tr>
<tr>
<td>RMS Reverse Voltage</td>
<td>VR(RMS)</td>
<td>14</td>
<td>21</td>
<td>28</td>
<td>V</td>
</tr>
<tr>
<td>Average Rectified Forward Current (Note 1), (V_{Requiv} ≤ 0.2 V_{R(d)}), T_L = 90°C, R_{IL} = 80°C/W, P.C. Board Mounting, see Note 2, T_A = 55°C</td>
<td>I_O</td>
<td>1.0</td>
<td></td>
<td></td>
<td>A</td>
</tr>
<tr>
<td>Ambient Temperature (Rated V_{R(d)}, P_{F(AV)} = 0, R_{IL} = 80°C/W)</td>
<td>T_A</td>
<td>85</td>
<td>80</td>
<td>75</td>
<td>°C</td>
</tr>
<tr>
<td>Non–Repetitive Peak Surge Current, (Surge applied at rated load conditions, half–wave, single phase 60 Hz, T_L = 70°C)</td>
<td>I_{FSM}</td>
<td>25</td>
<td></td>
<td></td>
<td>A</td>
</tr>
<tr>
<td>Operating and Storage Junction Temperature Range (Reverse Voltage applied)</td>
<td>T_J, T_{stg}</td>
<td>−65 to +125</td>
<td></td>
<td></td>
<td>°C</td>
</tr>
<tr>
<td>Peak Operating Junction Temperature (Forward Current applied)</td>
<td>T_{J(pk)}</td>
<td>150</td>
<td></td>
<td></td>
<td>°C</td>
</tr>
</tbody>
</table>

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

### THERMAL CHARACTERISTICS (Note 1)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Symbol</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal Resistance, Junction–to–Ambient</td>
<td>R_{IL}</td>
<td>80</td>
<td>°C/W</td>
</tr>
</tbody>
</table>

### ELECTRICAL CHARACTERISTICS (T_L = 25°C unless otherwise noted) (Note 1)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Symbol</th>
<th>1N5817</th>
<th>1N5818</th>
<th>1N5819</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Instantaneous Forward Voltage (Note 2)</td>
<td>V_F</td>
<td>0.32</td>
<td>0.33</td>
<td>0.34</td>
<td>V</td>
</tr>
<tr>
<td>(i_F = 0.1 A</td>
<td></td>
<td>0.45</td>
<td>0.55</td>
<td>0.6</td>
<td></td>
</tr>
<tr>
<td>(i_F = 1.0 A</td>
<td></td>
<td>0.75</td>
<td>0.875</td>
<td>0.9</td>
<td></td>
</tr>
<tr>
<td>(i_F = 3.0 A</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum Instantaneous Reverse Current @ Rated dc Voltage (Note 2)</td>
<td>I_R</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>mA</td>
</tr>
<tr>
<td>(T_L = 25°C)</td>
<td></td>
<td>10</td>
<td>10</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>(T_L = 100°C)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. Lead Temperature reference is cathode lead 1/32 in from case.
2. Pulse Test: Pulse Width = 300 µs, Duty Cycle = 2.0%. 

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NOTE 3. — DETERMINING MAXIMUM RATINGS

Reverse power dissipation and the possibility of thermal runaway must be considered when operating this rectifier at reverse voltages above 0.1 \( V_{RWM} \). Proper derating may be accomplished by use of equation (1).

\[
T_{A(max)} = T_{J(max)} - R_{UA} P_{F(AV)} - R_{UL} P_{R(AV)} \tag{1}
\]

where

- \( T_{A(max)} \): Maximum allowable ambient temperature
- \( T_{J(max)} \): Maximum allowable junction temperature
- \( R_{UA} \): Junction-to-ambient thermal resistance
- \( P_{F(AV)} \): Average forward power dissipation
- \( P_{R(AV)} \): Average reverse power dissipation

Figures 1, 2, and 3 permit easier use of equation (1) by taking reverse power dissipation and thermal runaway into consideration. The figures solve for a reference temperature as determined by equation (2).

\[
T_R = T_{J(max)} - R_{UA} P_{R(AV)} \tag{2}
\]

Substituting equation (2) into equation (1) yields:

\[
T_{A(max)} = T_R - R_{UA} P_{F(AV)} \tag{3}
\]

Inspection of equations (2) and (3) reveals that \( T_R \) is the ambient temperature at which thermal runaway occurs or where \( T_J = 125^\circ C \), when forward power is zero. The transition from one boundary condition to the other is evident on the curves of Figures 1, 2, and 3 as a difference in the rate of change of the slope in the vicinity of \( 115^\circ C \). The data of Figures 1, 2, and 3 is based upon dc conditions. For use in common rectifier circuits, Table 1 indicates suggested factors for an equivalent dc voltage to use for conservative design, that is:

\[
V_{R(equiv)} = V_{in(PK)} \times F \tag{4}
\]

The factor \( F \) is derived by considering the properties of the various rectifier circuits and the reverse characteristics of Schottky diodes.

EXAMPLE: Find \( T_{A(max)} \) for 1N5818 operated in a 12-volt dc supply using a bridge circuit with capacitive filter such that \( I_{DC} = 0.4 \) A, \( I_{F(AV)} = 0.5 \) A, \( I_{FM}/I_{AV} = 10 \), Input Voltage = 10 \( V_{rms} \), \( R_{UA} = 80^\circ C/W \).

1. Find \( V_{R(equiv)} \). Read \( F = 0.65 \) from Table 1, \( \therefore V_{R(equiv)} = (1.41)(10)(0.65) = 9.2 \) V.
2. Find \( T_R \) from Figure 2. Read \( T_R = 109^\circ C \) @ \( V_R = 9.2 \) V and \( R_{UA} = 80^\circ C/W \).
3. Find \( P_{F(AV)} \) from Figure 4. **Read \( P_{F(AV)} = 0.5 \) W @ \( I_{F(M)} = 10 \) and \( IF(AV) = 0.5 \) A.
4. Find \( T_{A(max)} \) from equation (3). \( T_{A(max)} = 109 - (80)(0.5) = 69^\circ C \).

**Values given are for the 1N5818. Power is slightly lower for the 1N5817 because of its lower forward voltage, and higher for the 1N5819.

Table 1. Values for Factor F

<table>
<thead>
<tr>
<th>Circuit</th>
<th>Half Wave</th>
<th>Full Wave, Bridge</th>
<th>Full Wave, Center Tapped(^\dagger)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Load</td>
<td>Resistive</td>
<td>Capacitive*</td>
<td>Resistive</td>
</tr>
<tr>
<td>Sine Wave</td>
<td>0.5</td>
<td>1.3</td>
<td>0.5</td>
</tr>
<tr>
<td>Square Wave</td>
<td>0.75</td>
<td>1.5</td>
<td>0.75</td>
</tr>
</tbody>
</table>

\[^{**}\text{Note that } V_{R(PK)} = 2.0 \times V_{in(PK)}.

\[^{\dagger}\text{Use line to center tap voltage for } V_{in.}\]
**NOTE 4. — MOUNTING DATA**

Data shown for thermal resistance, junction-to-ambient ($R_{JA}$) for the mountings shown is to be used as typical guideline values for preliminary engineering, or in case the tie point temperature cannot be measured.

**TYPICAL VALUES FOR $R_{JA}$ IN STILL AIR**

<table>
<thead>
<tr>
<th>Mounting Method</th>
<th>Lead Length, L (in)</th>
<th>$R_{JA}$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1/8</td>
<td>1/4</td>
</tr>
<tr>
<td>1</td>
<td>52</td>
<td>65</td>
</tr>
<tr>
<td>2</td>
<td>67</td>
<td>80</td>
</tr>
<tr>
<td>3</td>
<td>50</td>
<td></td>
</tr>
</tbody>
</table>

**Mounting Method 1**
- P.C. Board with 1-1/2" x 1-1/2" copper surface.

**Mounting Method 2**
- Vector Pin Mounting

**Mounting Method 3**
- P.C. Board with 1-1/2" x 1-1/2" copper surface.

**Figure 4. Steady-State Thermal Resistance**

**Figure 5. Forward Power Dissipation**

**Figure 6. Thermal Response**
NOTE 5. — THERMAL CIRCUIT MODEL
(For heat conduction through the leads)

Use of the above model permits junction to lead thermal resistance for any mounting configuration to be found. For a given total lead length, lowest values occur when one side of the rectifier is brought as close as possible to the heatsink.

Terms in the model signify:

- \( T_A \) = Ambient Temperature
- \( T_C \) = Case Temperature
- \( T_L \) = Lead Temperature
- \( T_J \) = Junction Temperature
- \( R_{HS} \) = Thermal Resistance, Heatsink to Ambient
- \( R_{HL} \) = Thermal Resistance, Lead to Heatsink
- \( R_{LJ} \) = Thermal Resistance, Junction to Case
- \( P_D \) = Power Dissipation

(Subscripts A and K refer to anode and cathode sides, respectively.) Values for thermal resistance components are:

- \( R_{HL} = 100^\circ C/W\) typically and \( 120^\circ C/W\) maximum
- \( R_{LJ} = 36^\circ C/W\) typically and \( 46^\circ C/W\) maximum.

Figure 7. Typical Forward Voltage

Figure 8. Maximum Non–Repetitive Surge Current

Figure 9. Typical Reverse Current
NOTE 6. — HIGH FREQUENCY OPERATION

Since current flow in a Schottky rectifier is the result of majority carrier conduction, it is not subject to junction diode forward and reverse recovery transients due to minority carrier injection and stored charge. Satisfactory circuit analysis work may be performed by using a model consisting of an ideal diode in parallel with a variable capacitance. (See Figure 10.)

Rectification efficiency measurements show that operation will be satisfactory up to several megahertz. For example, relative waveform rectification efficiency is approximately 70 percent at 2.0 MHz, e.g., the ratio of dc power to RMS power in the load is 0.28 at this frequency, whereas perfect rectification would yield 0.406 for sine wave inputs. However, in contrast to ordinary junction diodes, the loss in waveform efficiency is not indicative of power loss: it is simply a result of reverse current flow through the diode capacitance, which lowers the dc output voltage.

ORDERING INFORMATION

<table>
<thead>
<tr>
<th>Device</th>
<th>Package</th>
<th>Shipping¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>1N5817</td>
<td>Axial Lead*</td>
<td>1000 Units / Bag</td>
</tr>
<tr>
<td>1N5817G</td>
<td>Axial Lead*</td>
<td>1000 Units / Bag</td>
</tr>
<tr>
<td>1N5817RL</td>
<td>Axial Lead*</td>
<td>5000 / Tape &amp; Reel</td>
</tr>
<tr>
<td>1N5817RLG</td>
<td>Axial Lead*</td>
<td>5000 / Tape &amp; Reel</td>
</tr>
<tr>
<td>1N5818</td>
<td>Axial Lead*</td>
<td>1000 Units / Bag</td>
</tr>
<tr>
<td>1N5818G</td>
<td>Axial Lead*</td>
<td>1000 Units / Bag</td>
</tr>
<tr>
<td>1N5818RL</td>
<td>Axial Lead*</td>
<td>5000 / Tape &amp; Reel</td>
</tr>
<tr>
<td>1N5818RLG</td>
<td>Axial Lead*</td>
<td>5000 / Tape &amp; Reel</td>
</tr>
<tr>
<td>1N5819</td>
<td>Axial Lead*</td>
<td>1000 Units / Bag</td>
</tr>
<tr>
<td>1N5819G</td>
<td>Axial Lead*</td>
<td>1000 Units / Bag</td>
</tr>
<tr>
<td>1N5819RL</td>
<td>Axial Lead*</td>
<td>5000 / Tape &amp; Reel</td>
</tr>
<tr>
<td>1N5819RLG</td>
<td>Axial Lead*</td>
<td>5000 / Tape &amp; Reel</td>
</tr>
</tbody>
</table>

¹For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

*This package is inherently Pb–Free.
MECHANICAL CASE OUTLINE
PACKAGE DIMENSIONS

AXIAL LEAD
CASE 59-10
ISSUE U

DATE 15 FEB 2005

NOTES:
2. CONTROLLING DIMENSION: INCH.
3. ALL RULES AND NOTES ASSOCIATED WITH JEDEC DO-41 OUTLINE SHALL APPLY.
4. POLARITY DENOTED BY CATHODE BAND.
5. LEAD DIAMETER NOT CONTROLLED WITHIN F DIMENSION.

<table>
<thead>
<tr>
<th>DIM</th>
<th>MIN</th>
<th>MAX</th>
<th>MILLIMETERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0.161</td>
<td>0.205</td>
<td>4.10</td>
</tr>
<tr>
<td>B</td>
<td>0.079</td>
<td>0.105</td>
<td>2.00</td>
</tr>
<tr>
<td>D</td>
<td>0.028</td>
<td>0.034</td>
<td>0.71</td>
</tr>
<tr>
<td>F</td>
<td>-</td>
<td>0.050</td>
<td>-</td>
</tr>
<tr>
<td>K</td>
<td>1.000</td>
<td>-</td>
<td>25.40</td>
</tr>
</tbody>
</table>

GENERAL MARKING DIAGRAM*

STYLE 1: PIN 1. CATHODE (POLARITY BAND) 2. ANODE
STYLE 2: NO POLARITY

STYLE 1: XXX = Specific Device Code
STYLE 2: XXX = Specific Device Code
YYWW = Assembly Location
YY = Year
WW = Work Week

*This information is generic. Please refer to device data sheet for actual part marking.

Pb-Free indicator, "G" or microdot "*", may or may not be present.

DOCUMENT NUMBER: 98ASB42045B
DESCRIPTION: AXIAL LEAD
PAGE 1 OF 1