# 1N5820, 1N5821, 1N5822

**1N5820 and 1N5822 are Preferred Devices**

# Axial Lead Rectifiers

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 Power Loss/High Efficiency
- Low Stored Charge, Majority Carrier Conduction
- Shipped in plastic bags, 500 per bag
- Available in Tape and Reel, 1500 per reel, by adding a “RL” suffix to the part number
- Pb−Free Packages are Available*

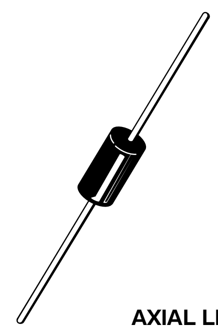
### Mechanical Characteristics:

- Case: Epoxy, Molded
- Weight: 1.1 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

**ON Semiconductor®**

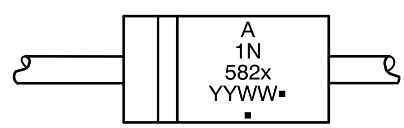
**http://onsemi.com**

**SCHOTTKY BARRIER RECTIFIERS**
**3.0 AMPERES**
**20, 30, 40 VOLTS**



**AXIAL LEAD**
**CASE 267−05**
**(DO−201AD)**
**STYLE 1**

**MARKING DIAGRAM**




| | |
|---|---|
| A | = Assembly Location |
| 1N582x | = Device Code |
| x | = 0, 1, or 2 |
| 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 3 of this data sheet.

**Preferred** devices are recommended choices for future use and best overall value.

*For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.



December, 2007 − Rev. 10

Publication Order Number:
1N5820/D

## MAXIMUM RATINGS

| Rating | Symbol | 1N5820 | 1N5821 | 1N5822 | Unit |
|---|---|---|---|---|---|
| Peak Repetitive Reverse Voltage<br>Working Peak Reverse Voltage<br>DC Blocking Voltage | $V_{RRM}$<br>$V_{RWM}$<br>$V_R$ | 20 | 30 | 40 | V |
| Non-Repetitive Peak Reverse Voltage | $V_{RSM}$ | 24 | 36 | 48 | V |
| RMS Reverse Voltage | $V_{R(RMS)}$ | 14 | 21 | 28 | V |
| Average Rectified Forward Current (Note 1)<br>$V_{R(equiv)} \le 0.2\ V_{R(dc)}$, $T_L = 95°C$<br>($R_{\theta JA} = 28°C/W$, P.C. Board Mounting, see Note 5) | $I_O$ | | 3.0 | | A |
| Ambient Temperature<br>Rated $V_{R(dc)}$, $P_{F(AV)} = 0$<br>$R_{\theta JA} = 28°C/W$ | $T_A$ | 90 | 85 | 80 | °C |
| Non-Repetitive Peak Surge Current<br>(Surge applied at rated load conditions, half wave, single phase<br>60 Hz, $T_L = 75°C$) | $I_{FSM}$ | | 80 (for one cycle) | | A |
| Operating and Storage Junction Temperature Range<br>(Reverse Voltage applied) | $T_J$, $T_{stg}$ | | −65 to +125 | | °C |

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

## *THERMAL CHARACTERISTICS (Note 5)

| Characteristic | Symbol | Max | Unit |
|---|---|---|---|
| Thermal Resistance, Junction-to-Ambient | $R_{\theta JA}$ | 28 | °C/W |

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

| Characteristic | Symbol | 1N5820 | 1N5821 | 1N5822 | Unit |
|---|---|---|---|---|---|
| Maximum Instantaneous Forward Voltage (Note 2)<br>($i_F = 1.0$ Amp)<br>($i_F = 3.0$ Amp)<br>($i_F = 9.4$ Amp) | $V_F$ | <br>0.370<br>0.475<br>0.850 | <br>0.380<br>0.500<br>0.900 | <br>0.390<br>0.525<br>0.950 | V |
| Maximum Instantaneous Reverse Current<br>@ Rated dc Voltage (Note 2)<br>$T_L = 25°C$<br>$T_L = 100°C$ | $i_R$ | <br><br>2.0<br>20 | <br><br>2.0<br>20 | <br><br>2.0<br>20 | mA |

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

*Indicates JEDEC Registered Data for 1N5820-22.

## ORDERING INFORMATION

| Device | Package | Shipping† |
|---|---|---|
| 1N5820 | Axial Lead | 500 Units/Bag |
| 1N5820G | Axial Lead (Pb−Free) | 500 Units/Bag |
| 1N5820RL | Axial Lead | 1500/Tape & Reel |
| 1N5820RLG | Axial Lead (Pb−Free) | 1500/Tape & Reel |
| 1N5821 | Axial Lead | 500 Units/Bag |
| 1N5821G | Axial Lead (Pb−Free) | 500 Units/Bag |
| 1N5821RL | Axial Lead | 1500/Tape & Reel |
| 1N5821RLG | Axial Lead (Pb−Free) | 1500/Tape & Reel |
| 1N5822 | Axial Lead | 500 Units/Bag |
| 1N5822G | Axial Lead (Pb−Free) | 500 Units/Bag |
| 1N5822RL | Axial Lead | 1500/Tape & Reel |
| 1N5822RLG | Axial Lead (Pb−Free) | 1500/Tape & Reel |

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

## 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).

$$T_{A(max)} = T_{J(max)} - R_{\theta JA}P_{F(AV)} - R_{\theta JA}P_{R(AV)} \quad (1)$$

where $T_{A(max)}$ = Maximum allowable ambient temperature
$T_{J(max)}$ = Maximum allowable junction temperature (125°C or the temperature at which thermal runaway occurs, whichever is lowest)
$P_{F(AV)}$ = Average forward power dissipation
$P_{R(AV)}$ = Average reverse power dissipation
$R_{\theta JA}$ = Junction-to-ambient thermal resistance

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).

$$T_R = T_{J(max)} - R_{\theta JA}P_{R(AV)} \quad (2)$$

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

$$T_{A(max)} = T_R - R_{\theta JA}P_{F(AV)} \quad (3)$$

Inspection of equations (2) and (3) reveals that $T_R$ is the ambient temperature at which thermal runaway occurs or where $T_J$ = 125°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°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:

$$V_{R(equiv)} = V_{(FM)} \times F \quad (4)$$

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 1N5821 operated in a 12-volt dc supply using a bridge circuit with capacitive filter such that $I_{DC}$ = 2.0 A ($I_{F(AV)}$ = 1.0 A), $I_{(FM)}/I_{(AV)}$ = 10, Input Voltage = 10 $V_{(rms)}$, $R_{\theta JA}$ = 40°C/W.

Step 1. Find $V_{R(equiv)}$. Read F = 0.65 from Table 1,
$\therefore V_{R(equiv)} = (1.41)(10)(0.65) = 9.2$ V.

Step 2. Find $T_R$ from Figure 2. Read $T_R$ = 108°C
@ $V_R$ = 9.2 V and $R_{\theta JA}$ = 40°C/W.

Step 3. Find $P_{F(AV)}$ from Figure 6. **Read $P_{F(AV)}$ = 0.85 W
@ $\frac{I_{(FM)}}{I_{(AV)}} = 10$ and $I_{F(AV)} = 1.0$ A.

Step 4. Find $T_{A(max)}$ from equation (3).
$T_{A(max)} = 108 - (0.85)(40) = 74$°C.

**Values given are for the 1N5821. Power is slightly lower for the 1N5820 because of its lower forward voltage, and higher for the 1N5822. Variations will be similar for the MBR-prefix devices, using $P_{F(AV)}$ from Figure 6.

**Table 1. Values for Factor F**

| Circuit | Half Wave | | Full Wave, Bridge | | Full Wave, Center Tapped*† | |
|---|---|---|---|---|---|---|
| **Load** | **Resistive** | **Capacitive*** | **Resistive** | **Capacitive** | **Resistive** | **Capacitive** |
| Sine Wave | 0.5 | 1.3 | 0.5 | 0.65 | 1.0 | 1.3 |
| Square Wave | 0.75 | 1.5 | 0.75 | 0.75 | 1.5 | 1.5 |

*Note that $V_{R(PK)} \approx 2.0\ V_{in(PK)}$.
†Use line to center tap voltage for $V_{in}$.

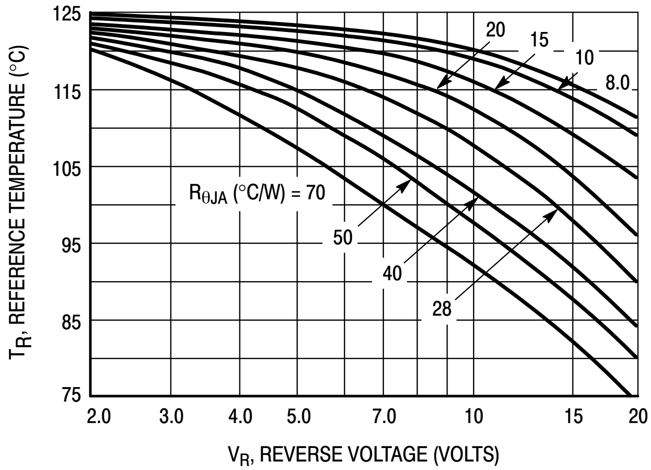



**Figure 1. Maximum Reference Temperature 1N5820**

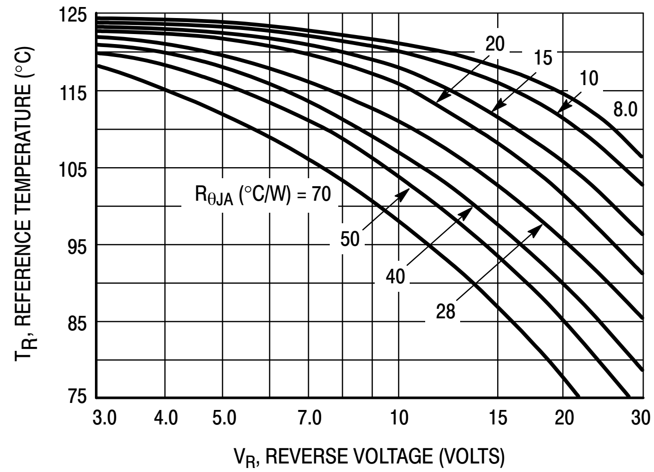



**Figure 2. Maximum Reference Temperature 1N5821**

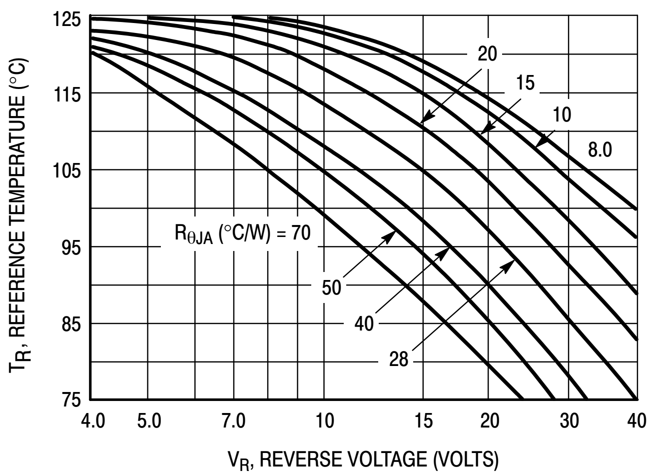



**Figure 3. Maximum Reference Temperature 1N5822**

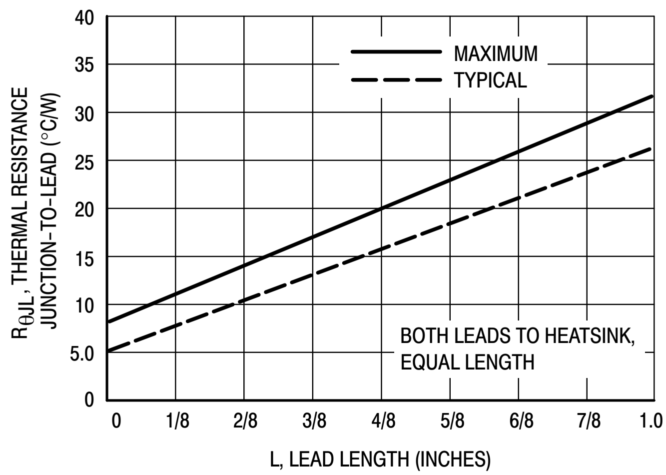



**Figure 4. Steady−State Thermal Resistance**

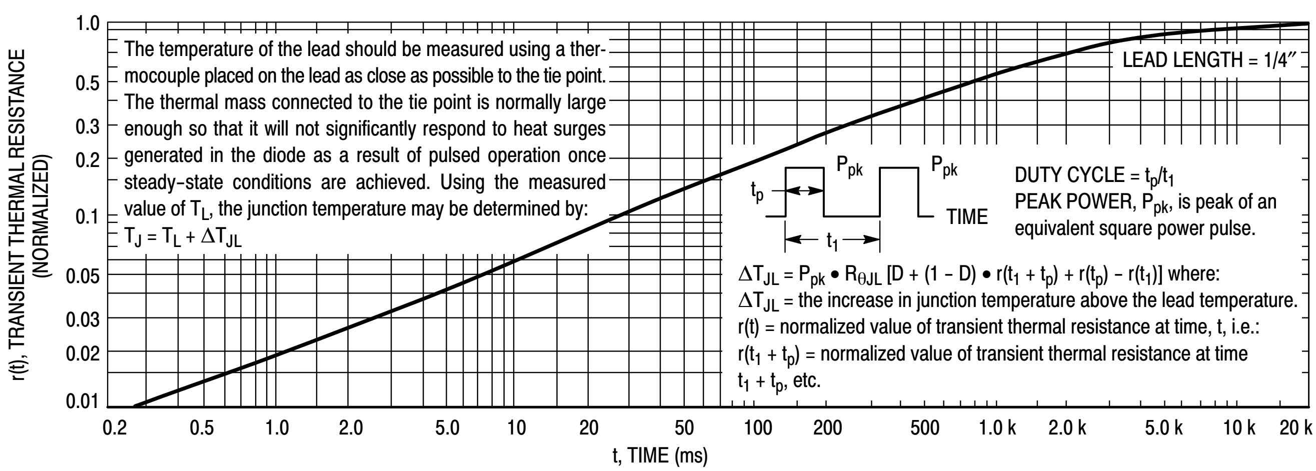



**Figure 5. Thermal Response**

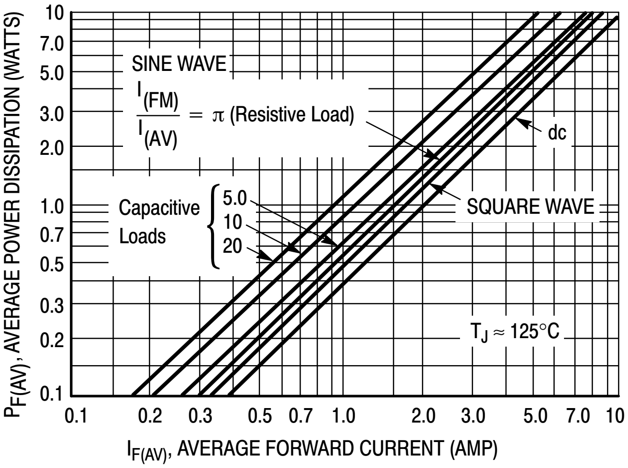
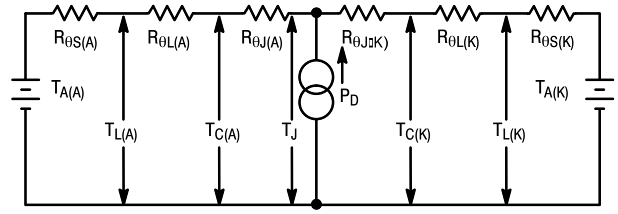



**Figure 6. Forward Power Dissipation 1N5820−22**

## NOTE 4 − APPROXIMATE THERMAL CIRCUIT MODEL




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 heat sink. Terms in the model signify:

$T_A$ = Ambient Temperature $T_C$ = Case Temperature
$T_L$ = Lead Temperature $T_J$ = Junction Temperature
$R_{\theta S}$ = Thermal Resistance, Heatsink to Ambient
$R_{\theta L}$ = Thermal Resistance, Lead−to−Heatsink
$R_{\theta J}$ = Thermal Resistance, Junction−to−Case
$P_D$ = Total Power Dissipation = $P_F + P_R$
$P_F$ = Forward Power Dissipation
$P_R$ = Reverse Power Dissipation
(Subscripts (A) and (K) refer to anode and cathode sides, respectively.) Values for thermal resistance components are:
$R_{\theta L}$ = 42°C/W/in typically and 48°C/W/in maximum
$R_{\theta J}$ = 10°C/W typically and 16°C/W maximum
The maximum lead temperature may be found as follows:
$T_L = T_{J(max)} - \Delta T_{JL}$
where $\Delta T_{JL} \approx R_{\theta JL} \cdot P_D$

## NOTE 5 — MOUNTING DATA

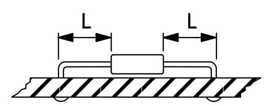
Data shown for thermal resistance junction−to−ambient ($R_{\theta JA}$) for the mountings shown is to be used as typical guideline values for preliminary engineering, or in case the tie point temperature cannot be measured.

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

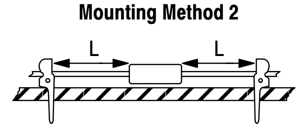
| Mounting Method | Lead Length, L (in) | | | | $R_{\theta JA}$ |
|---|---|---|---|---|---|
| | 1/8 | 1/4 | 1/2 | 3/4 | |
| 1 | 50 | 51 | 53 | 55 | °C/W |
| 2 | 58 | 59 | 61 | 63 | °C/W |
| 3 | 28 | | | | °C/W |

**Mounting Method 1**

P.C. Board where available copper surface is small.



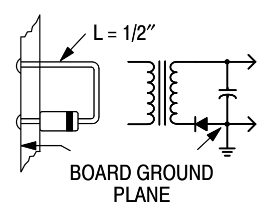

**Mounting Method 2**




VECTOR PUSH−IN TERMINALS T−28

**Mounting Method 3**

P.C. Board with 2−1/2, x 2−1/2, copper surface.



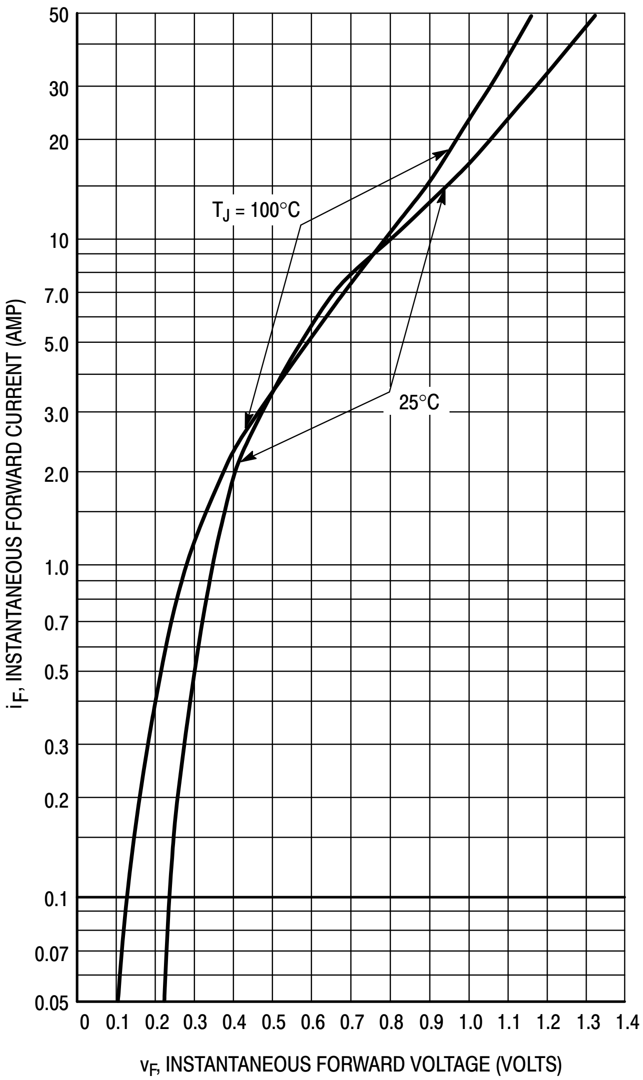



**Figure 7. Typical Forward Voltage**

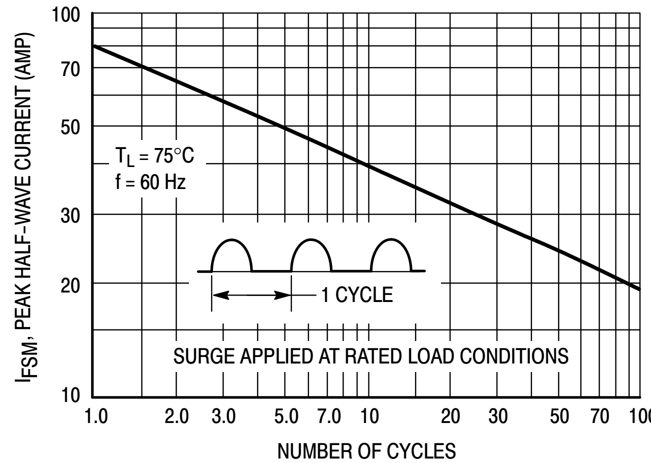



**Figure 8. Maximum Non–Repetitive Surge Current**

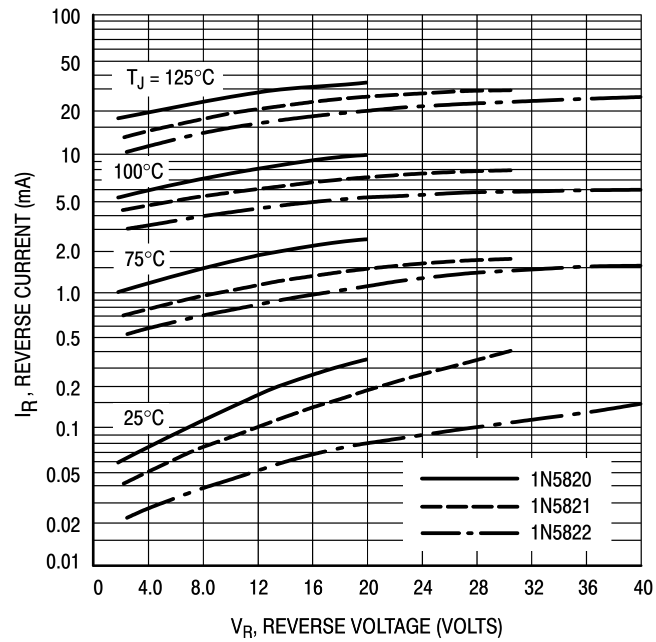



**Figure 9. Typical Reverse Current**

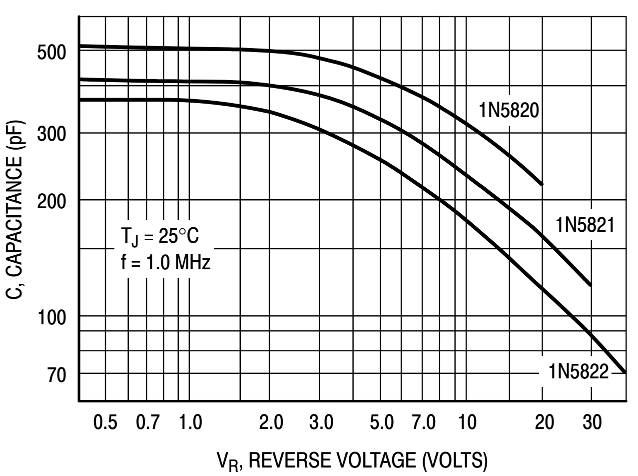


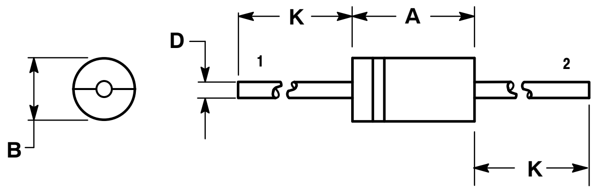

**Figure 10. Typical Capacitance**

**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.)

## PACKAGE DIMENSIONS

**AXIAL LEAD**
CASE 267-05
(DO-201AD)
ISSUE G




NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

| | INCHES | | MILLIMETERS | |
|---|---|---|---|---|
| DIM | MIN | MAX | MIN | MAX |
| A | 0.287 | 0.374 | 7.30 | 9.50 |
| B | 0.189 | 0.209 | 4.80 | 5.30 |
| D | 0.047 | 0.051 | 1.20 | 1.30 |
| K | 1.000 | --- | 25.40 | --- |

STYLE 1:
PIN 1. CATHODE (POLARITY BAND)
2. ANODE



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