MOTOROLA
SEMICONDUCTOR TECHNICAL DATA

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Designer's™ Data Sheet
Axial Lead Rectifiers

. . . employing 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.

- Extremely Low v_F
- Low Power Loss/High Efficiency
- Low Stored Charge, Majority Carrier Conduction

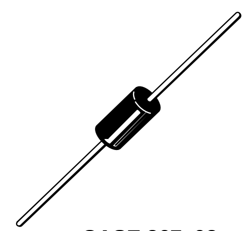
Mechanical Characteristics:

- Case: Epoxy, Molded
- Weight: 1.1 gram (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead and Mounting Surface Temperature for Soldering Purposes: 220°C Max. for 10 Seconds, 1/16″ from case
- Shipped in plastic bags, 5,000 per bag
- Available Tape and Reeled, 1500 per reel, by adding a “RL” suffix to the part number
- Polarity: Cathode indicated by Polarity Band
- Marking: 1N5820, 1N5821, 1N5822

1N5820
1N5821
1N5822

1N5820 and 1N5822 are Motorola Preferred Devices

SCHOTTKY BARRIER RECTIFIERS
3.0 AMPERES
20, 30, 40 VOLTS



CASE 267–03
PLASTIC

MAXIMUM RATINGS

Rating	Symbol	1N5820	1N5821	1N5822	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} 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 (2) $V_{R(equiv)} \leq 0.2\ V_{R(dc)}$, T_L = 95°C ($R_{\theta JA}$ = 28°C/W, P.C. Board Mounting, see Note 2)	I_O		← 3.0 →		A
Ambient Temperature Rated $V_{R(dc)}$, $P_{F(AV)}$ = 0 $R_{\theta JA}$ = 28°C/W	T_A	90	85	80	°C
Non–Repetitive Peak Surge Current (Surge applied at rated load conditions, half wave, single phase 60 Hz, T_L = 75°C)	I_{FSM}		← 80 (for one cycle) →		A
Operating and Storage Junction Temperature Range (Reverse Voltage applied)	T_J, T_{stg}		← – 65 to +125 →		°C
Peak Operating Junction Temperature (Forward Current applied)	$T_{J(pk)}$		← 150 →		°C

*THERMAL CHARACTERISTICS (Note 2)

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

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle = 2.0%.
(2) Lead Temperature reference is cathode lead 1/32″ from case.
* Indicates JEDEC Registered Data for 1N5820–22.

Designer's Data for “Worst Case” Conditions — The Designer's Data Sheet permits the design of most circuits entirely from the information presented. SOA Limit curves — representing boundaries on device characteristics — are given to facilitate “worst case” design.

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

Rev 2

***ELECTRICAL CHARACTERISTICS** (T_L = 25°C unless otherwise noted) (2)

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

(1) Pulse Test: Pulse Width = 300 µs, Duty Cycle = 2.0%.
(2) Lead Temperature reference is cathode lead 1/32″ from case.
* Indicates JEDEC Registered Data for 1N5820–22.

NOTE 1 — 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

$$@\ \frac{I_{(FM)}}{I_{(AV)}} = 10 \text{ and } I_{F(AV)} = 1.0\ \text{A}.$$

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 7.

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}.

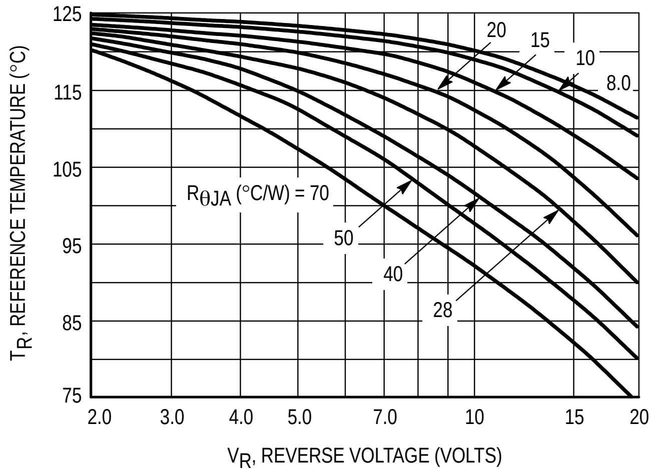


Figure 1. Maximum Reference Temperature 1N5820

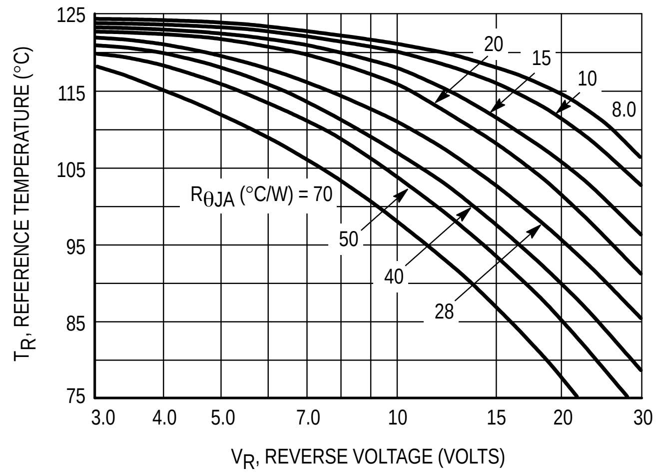


Figure 2. Maximum Reference Temperature 1N5821

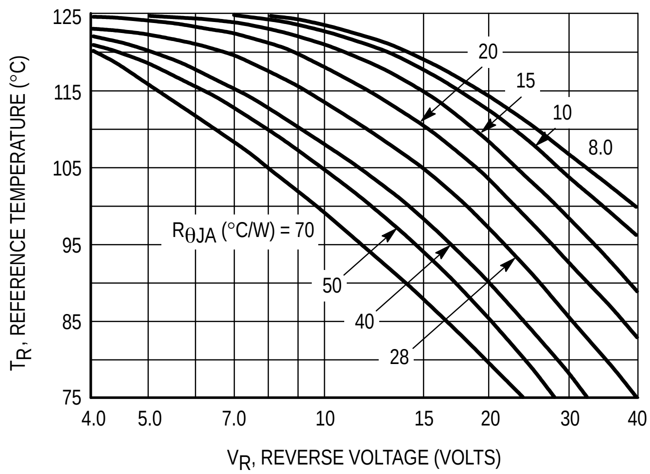


Figure 3. Maximum Reference Temperature 1N5822

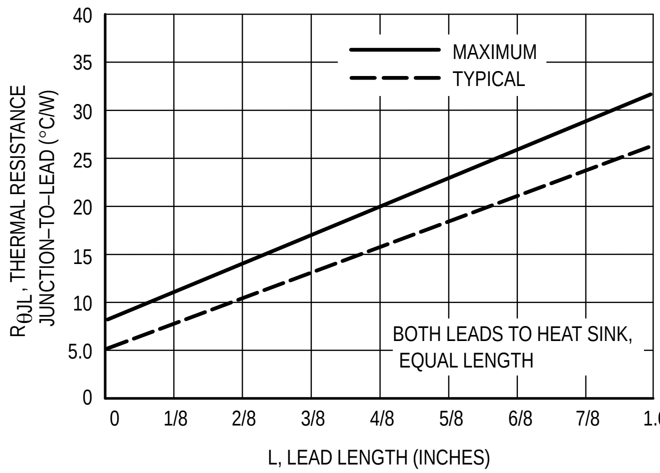


Figure 4. Steady–State Thermal Resistance

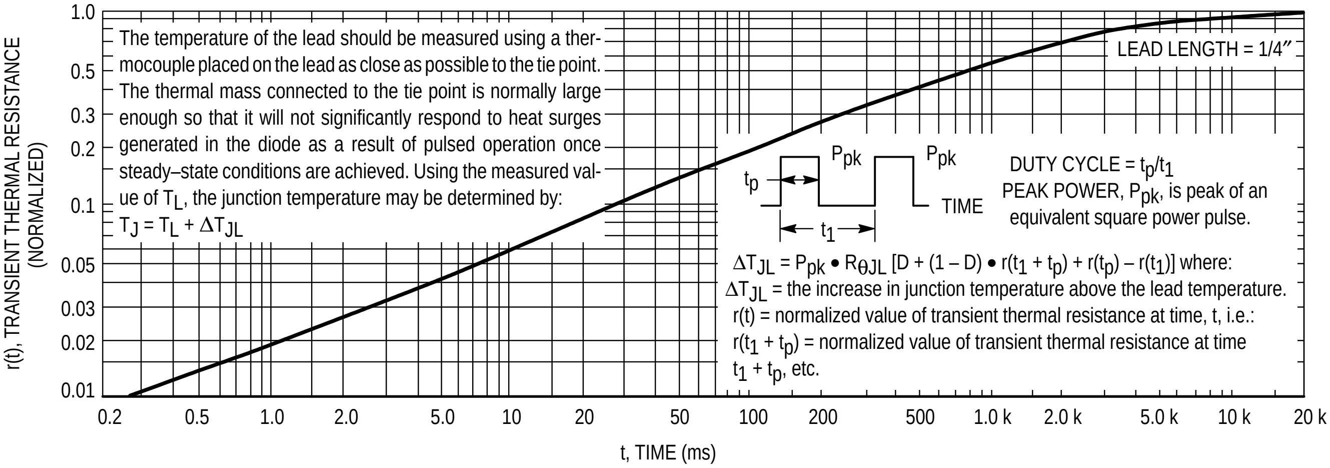


Figure 5. Thermal Response

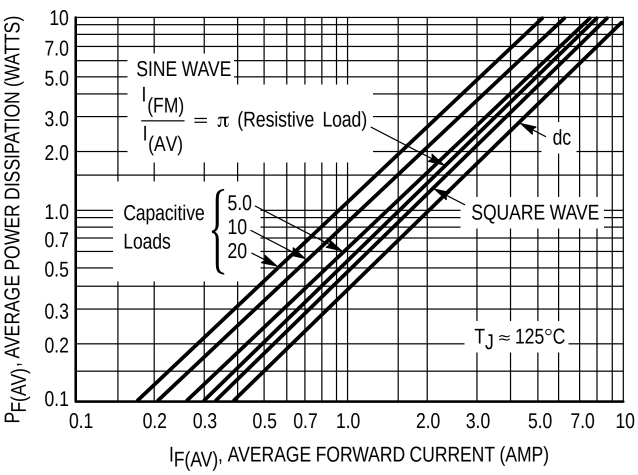
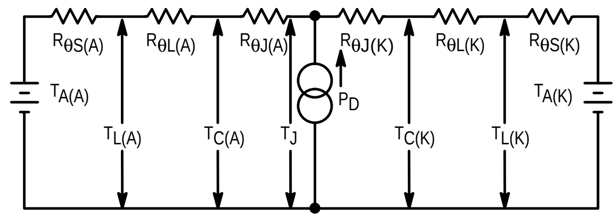


Figure 6. Forward Power Dissipation 1N5820–22

NOTE 3 — 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, Heat Sink to Ambient
$R_{\theta L}$ = Thermal Resistance, Lead to Heat Sink
$R_{\theta J}$ = 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 2 — MOUNTING DATA

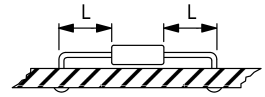
Data shown for thermal resistance junction–to–ambient ($R_{\theta JA}$) for the mountings shown is to be used as typical guideline values for preliminary engineering, or in case the tie point temperature cannot be measured.

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

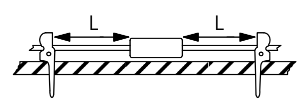
Mounting Method	Lead Length, L (in)				$R_{\theta JA}$
	1/8	1/4	1/2	3/4	
1	50	51	53	55	°C/W
2	58	59	61	63	°C/W
3	28				°C/W

Mounting Method 1

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



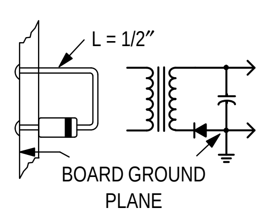
Mounting Method 2



VECTOR PUSH–IN TERMINALS T–28

Mounting Method 3

P.C. Board with 2–1/2″ x 2–1/2″ copper surface.



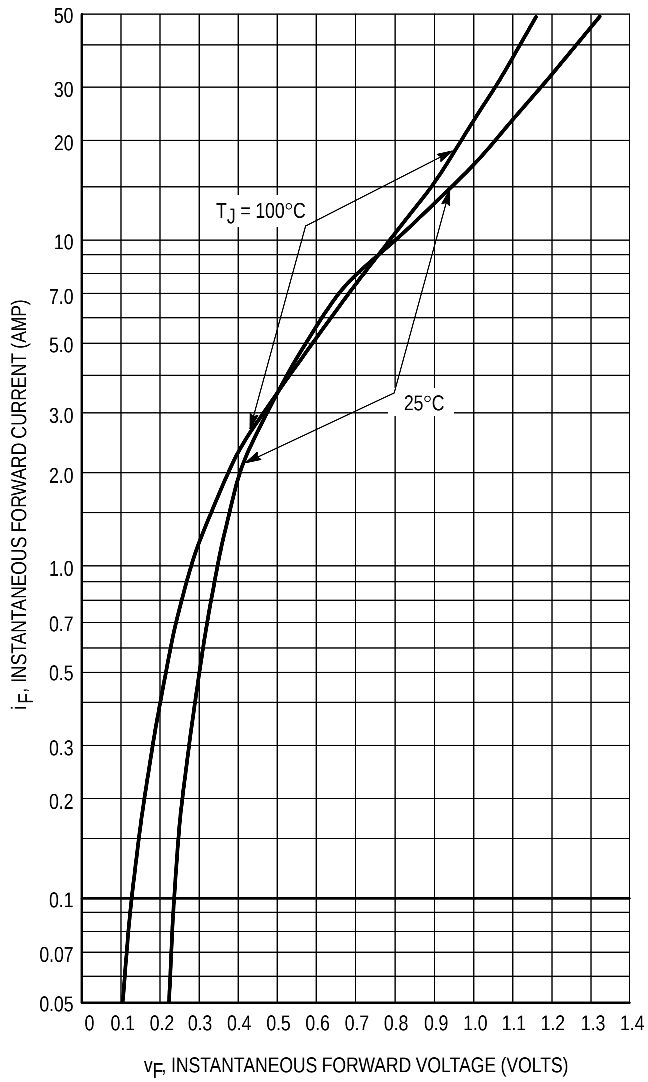


Figure 7. Typical Forward Voltage

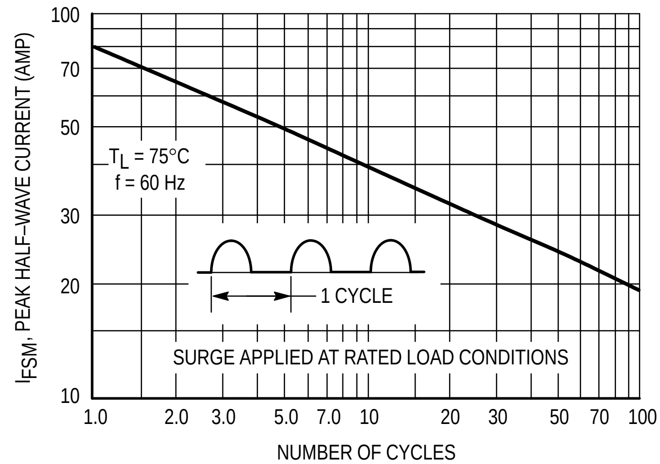


Figure 8. Maximum Non–Repetitive Surge Current

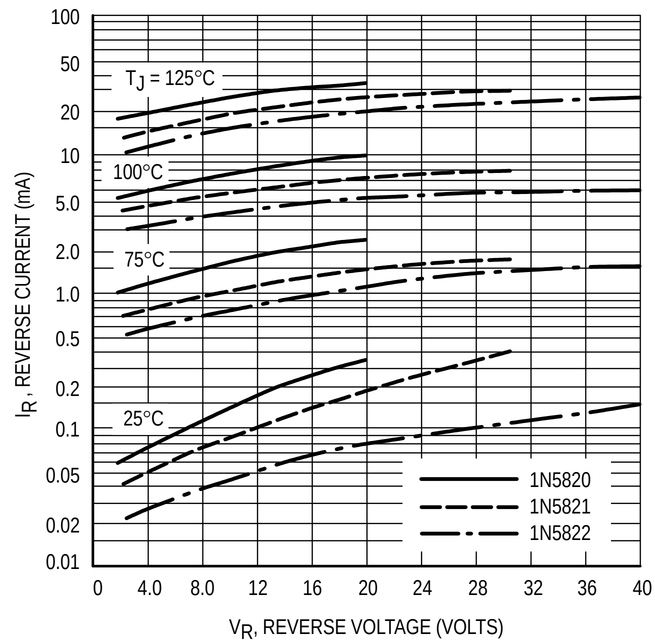


Figure 9. Typical Reverse Current

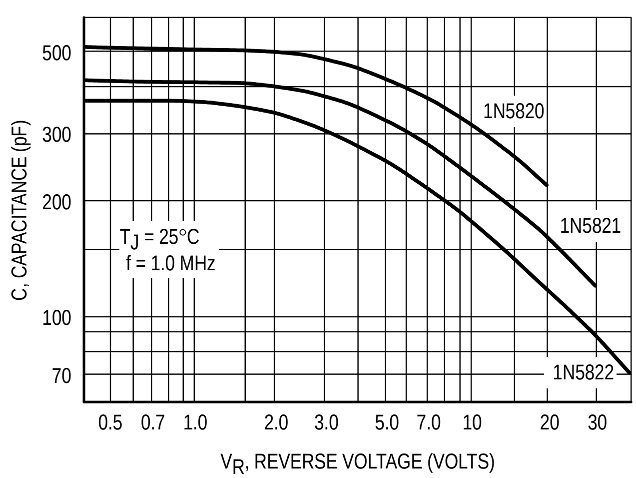
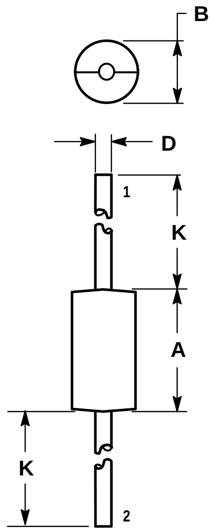


Figure 10. Typical Capacitance

NOTE 4 — 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 11.)

PACKAGE DIMENSIONS



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

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.370	0.380	9.40	9.65
B	0.190	0.210	4.83	5.33
D	0.048	0.052	1.22	1.32
K	1.000	—	25.40	—

STYLE 1:
PIN 1. CATHODE
2. ANODE

CASE 267–03
ISSUE C

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