

# P2N2222A

## Amplifier Transistors

### NPN Silicon

#### Features

- Pb-Free Packages are Available\*

#### MAXIMUM RATINGS (T<sub>A</sub> = 25°C unless otherwise noted)

Characteristic	Symbol	Value	Unit
Collector - Emitter Voltage	V <sub>CEO</sub>	40	Vdc
Collector - Base Voltage	V <sub>CBO</sub>	75	Vdc
Emitter - Base Voltage	V <sub>EBO</sub>	6.0	Vdc
Collector Current - Continuous	I <sub>C</sub>	600	mAdc
Total Device Dissipation @ T <sub>A</sub> = 25°C Derate above 25°C	P <sub>D</sub>	625 5.0	mW mW/°C
Total Device Dissipation @ T <sub>C</sub> = 25°C Derate above 25°C	P <sub>D</sub>	1.5 12	W mW/°C
Operating and Storage Junction Temperature Range	T <sub>J</sub> , T <sub>stg</sub>	-55 to +150	°C

#### THERMAL CHARACTERISTICS

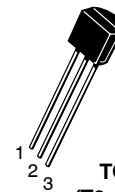
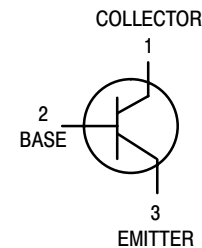
Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient	R <sub>θJA</sub>	200	°C/W
Thermal Resistance, Junction to Case	R <sub>θJC</sub>	83.3	°C/W

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.



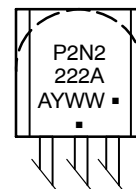
**ON Semiconductor®**

<http://onsemi.com>



**TO-92  
(T0-226AA)  
CASE 29-11  
STYLE 17**

#### MARKING DIAGRAM



P2N2 = Device Code  
 222A = Specific Device  
 A = Assembly Location  
 Y = Year  
 WW = Work Week  
 ■ = Pb-Free Package

(Note: Microdot may be in either location)

#### ORDERING INFORMATION

Device	Package	Shipping†
P2N2222A	TO-92	5000 Units / Bulk
P2N2222AG	TO-92 (Pb-Free)	5000 Units / Bulk
P2N2222ARL1	TO-92	2000 / Tape & Ammo
P2N2222ARL1G	TO-92 (Pb-Free)	2000 / Tape & Ammo
P2N2222AZL1	TO-92	2000 / Tape & Reel
P2N2222AZL1G	TO-92 (Pb-Free)	2000 Units / Tube

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

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

## P2N2222A

### ELECTRICAL CHARACTERISTICS ( $T_A = 25^\circ\text{C}$ unless otherwise noted)

Characteristic	Symbol	Min	Max	Unit
<b>OFF CHARACTERISTICS</b>				
Collector – Emitter Breakdown Voltage ( $I_C = 10\text{ mAdc}$ , $I_B = 0$ )	$V_{(BR)CEO}$	40	–	Vdc
Collector – Base Breakdown Voltage ( $I_C = 10\ \mu\text{Adc}$ , $I_E = 0$ )	$V_{(BR)CBO}$	75	–	Vdc
Emitter – Base Breakdown Voltage ( $I_E = 10\ \mu\text{Adc}$ , $I_C = 0$ )	$V_{(BR)EBO}$	6.0	–	Vdc
Collector Cutoff Current ( $V_{CE} = 60\text{ Vdc}$ , $V_{EB(off)} = 3.0\text{ Vdc}$ )	$I_{CEX}$	–	10	nAdc
Collector Cutoff Current ( $V_{CB} = 60\text{ Vdc}$ , $I_E = 0$ ) ( $V_{CB} = 60\text{ Vdc}$ , $I_E = 0$ , $T_A = 150^\circ\text{C}$ )	$I_{CBO}$	– –	0.01 10	$\mu\text{Adc}$
Emitter Cutoff Current ( $V_{EB} = 3.0\text{ Vdc}$ , $I_C = 0$ )	$I_{EBO}$	–	10	nAdc
Collector Cutoff Current ( $V_{CE} = 10\text{ V}$ )	$I_{CEO}$	–	10	nAdc
Base Cutoff Current ( $V_{CE} = 60\text{ Vdc}$ , $V_{EB(off)} = 3.0\text{ Vdc}$ )	$I_{BEX}$	–	20	nAdc

### ON CHARACTERISTICS

DC Current Gain ( $I_C = 0.1\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ ) ( $I_C = 1.0\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ ) ( $I_C = 10\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ ) ( $I_C = 10\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ , $T_A = -55^\circ\text{C}$ ) ( $I_C = 150\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ ) (Note 1) ( $I_C = 150\text{ mAdc}$ , $V_{CE} = 1.0\text{ Vdc}$ ) (Note 1) ( $I_C = 500\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ ) (Note 1)	$h_{FE}$	35 50 75 35 100 50 40	– – – – 300 – –	–
Collector – Emitter Saturation Voltage (Note 1) ( $I_C = 150\text{ mAdc}$ , $I_B = 15\text{ mAdc}$ ) ( $I_C = 500\text{ mAdc}$ , $I_B = 50\text{ mAdc}$ )	$V_{CE(sat)}$	– –	0.3 1.0	Vdc
Base – Emitter Saturation Voltage (Note 1) ( $I_C = 150\text{ mAdc}$ , $I_B = 15\text{ mAdc}$ ) ( $I_C = 500\text{ mAdc}$ , $I_B = 50\text{ mAdc}$ )	$V_{BE(sat)}$	0.6 –	1.2 2.0	Vdc

### SMALL-SIGNAL CHARACTERISTICS

Current – Gain – Bandwidth Product (Note 2) ( $I_C = 20\text{ mAdc}$ , $V_{CE} = 20\text{ Vdc}$ , $f = 100\text{ MHz}$ )C	$f_T$	300	–	MHz
Output Capacitance ( $V_{CB} = 10\text{ Vdc}$ , $I_E = 0$ , $f = 1.0\text{ MHz}$ )	$C_{obo}$	–	8.0	pF
Input Capacitance ( $V_{EB} = 0.5\text{ Vdc}$ , $I_C = 0$ , $f = 1.0\text{ MHz}$ )	$C_{ibo}$	–	25	pF
Input Impedance ( $I_C = 1.0\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 1.0\text{ kHz}$ ) ( $I_C = 10\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 1.0\text{ kHz}$ )	$h_{ie}$	2.0 0.25	8.0 1.25	k $\Omega$
Voltage Feedback Ratio ( $I_C = 1.0\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 1.0\text{ kHz}$ ) ( $I_C = 10\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 1.0\text{ kHz}$ )	$h_{re}$	– –	8.0 4.0	$\times 10^{-4}$
Small-Signal Current Gain ( $I_C = 1.0\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 1.0\text{ kHz}$ ) ( $I_C = 10\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 1.0\text{ kHz}$ )	$h_{fe}$	50 75	300 375	–
Output Admittance ( $I_C = 1.0\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 1.0\text{ kHz}$ ) ( $I_C = 10\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 1.0\text{ kHz}$ )	$h_{oe}$	5.0 25	35 200	$\mu\text{Mhos}$
Collector Base Time Constant ( $I_E = 20\text{ mAdc}$ , $V_{CB} = 20\text{ Vdc}$ , $f = 31.8\text{ MHz}$ )	$rb'C_c$	–	150	ps
Noise Figure ( $I_C = 100\ \mu\text{Adc}$ , $V_{CE} = 10\text{ Vdc}$ , $R_S = 1.0\text{ k}\Omega$ , $f = 1.0\text{ kHz}$ )	$N_F$	–	4.0	dB

1. Pulse Test: Pulse Width  $\leq 300\ \mu\text{s}$ , Duty Cycle  $\leq 2.0\%$ .
2.  $f_T$  is defined as the frequency at which  $|h_{fe}|$  extrapolates to unity.

# P2N2222A

## ELECTRICAL CHARACTERISTICS ( $T_A = 25^\circ\text{C}$ unless otherwise noted) (Continued)

Characteristic		Symbol	Min	Max	Unit
<b>SWITCHING CHARACTERISTICS</b>					
Delay Time	$(V_{CC} = 30\text{ Vdc}, V_{BE(\text{off})} = -2.0\text{ Vdc}, I_C = 150\text{ mA}, I_{B1} = 15\text{ mA})$ (Figure 1)	$t_d$	-	10	ns
Rise Time		$t_r$	-	25	ns
Storage Time	$(V_{CC} = 30\text{ Vdc}, I_C = 150\text{ mA}, I_{B1} = I_{B2} = 15\text{ mA})$ (Figure 2)	$t_s$	-	225	ns
Fall Time		$t_f$	-	60	ns

### SWITCHING TIME EQUIVALENT TEST CIRCUITS

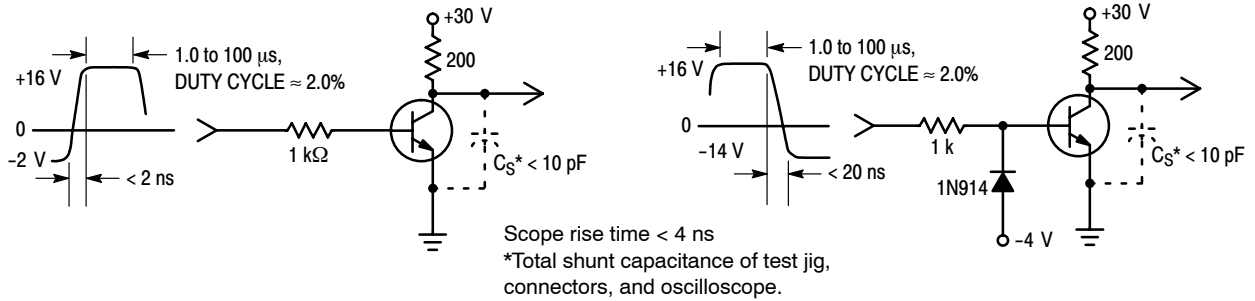


Figure 1. Turn-On Time

Figure 2. Turn-Off Time

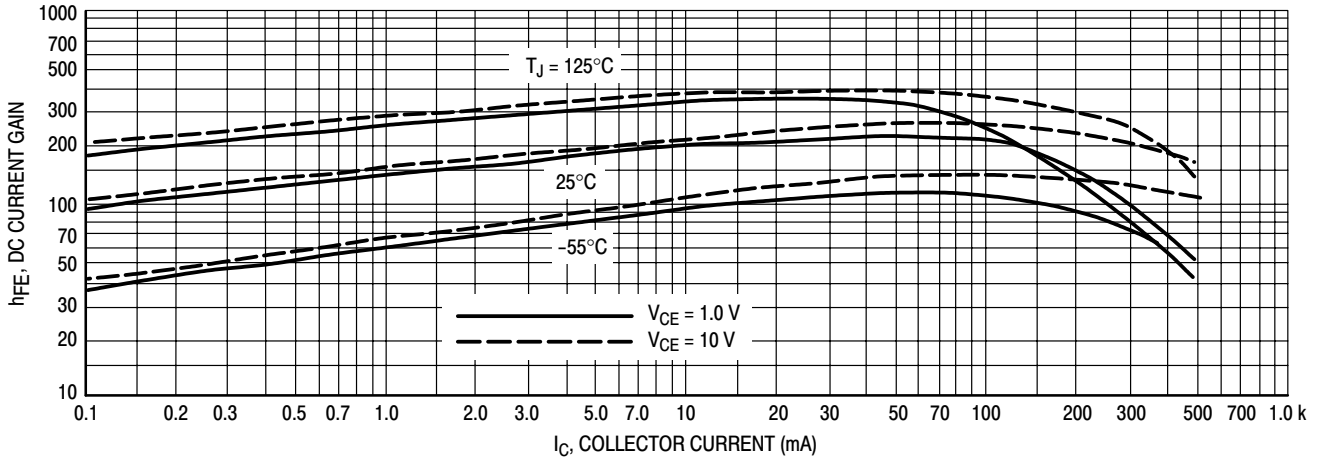


Figure 4. DC Current Gain

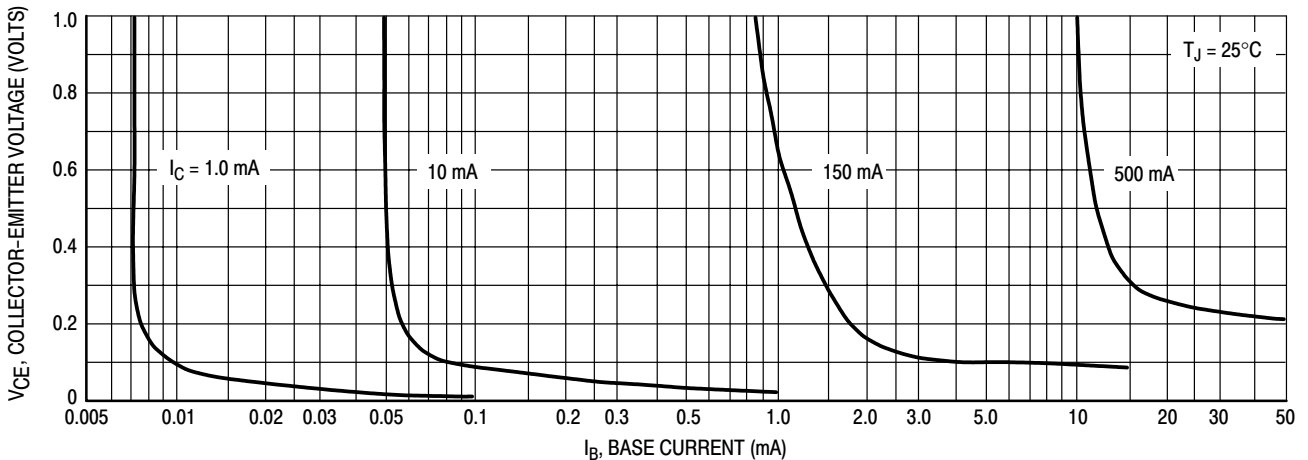
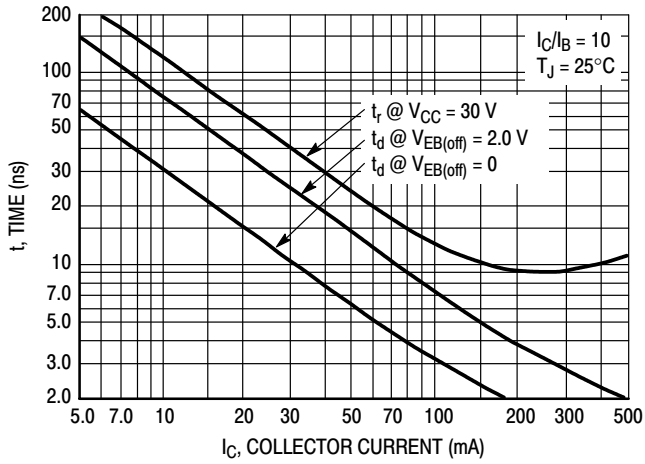
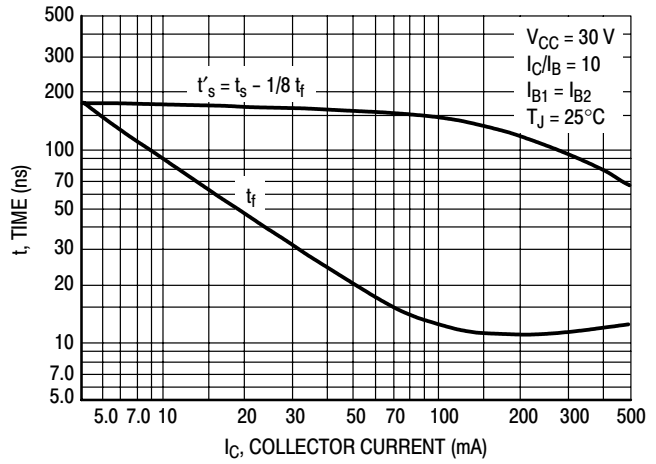


Figure 3. Collector Saturation Region

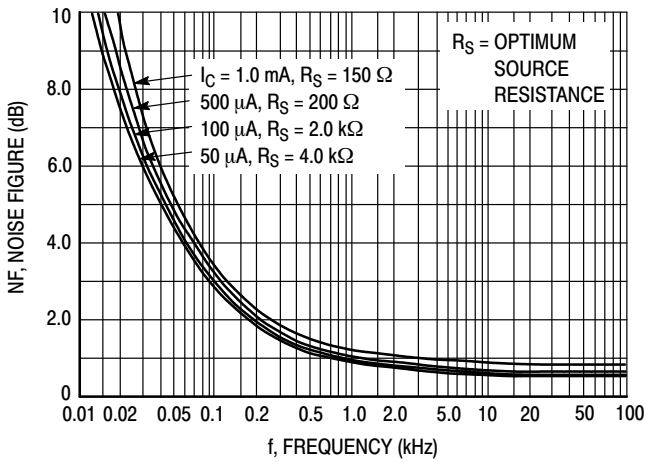
**P2N2222A**



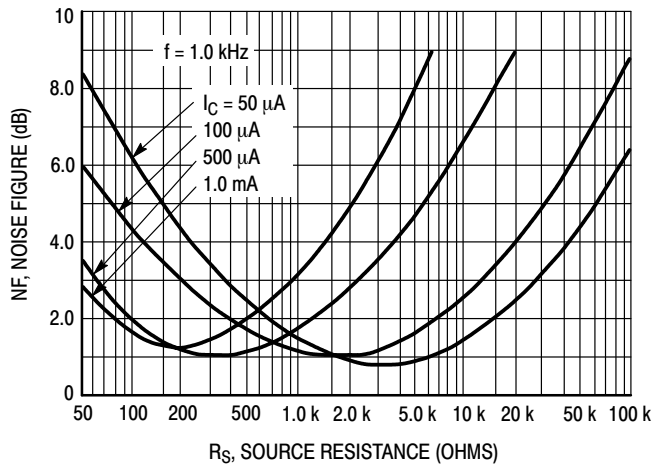
**Figure 5. Turn-On Time**



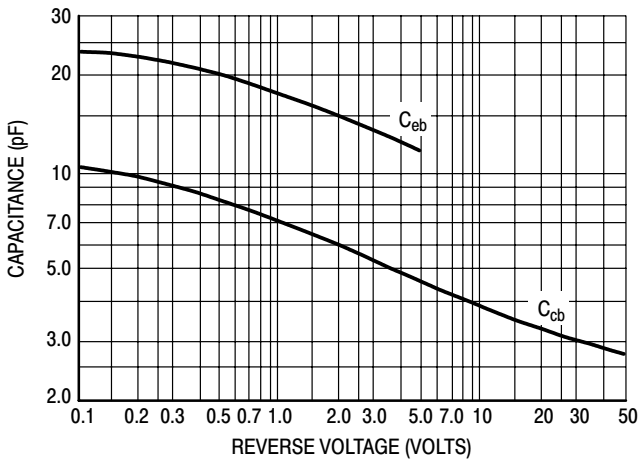
**Figure 6. Turn-Off Time**



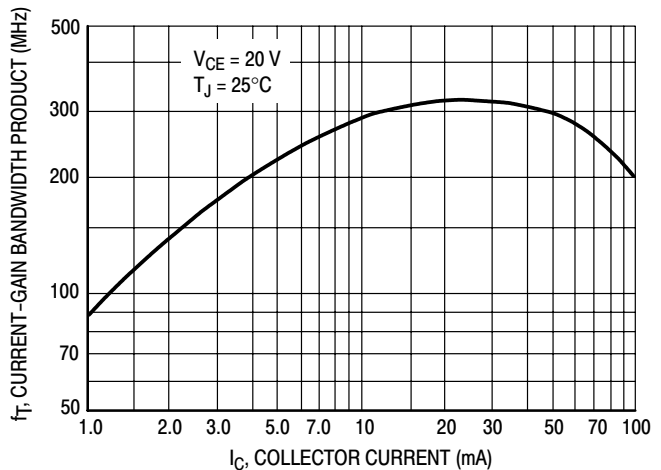
**Figure 7. Frequency Effects**



**Figure 8. Source Resistance Effects**



**Figure 9. Capacitances**



**Figure 10. Current-Gain Bandwidth Product**

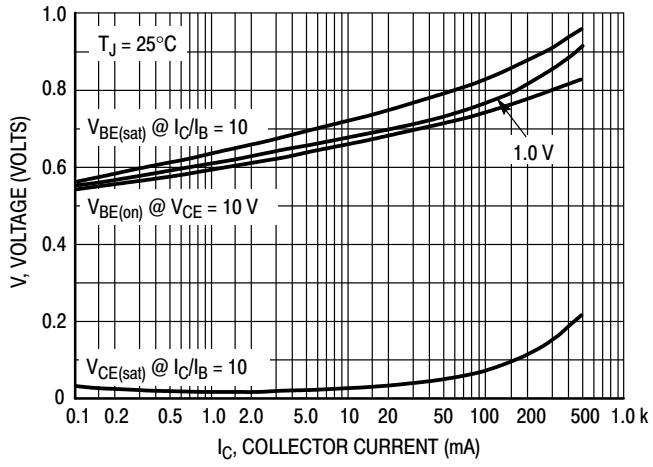


Figure 11. "On" Voltages

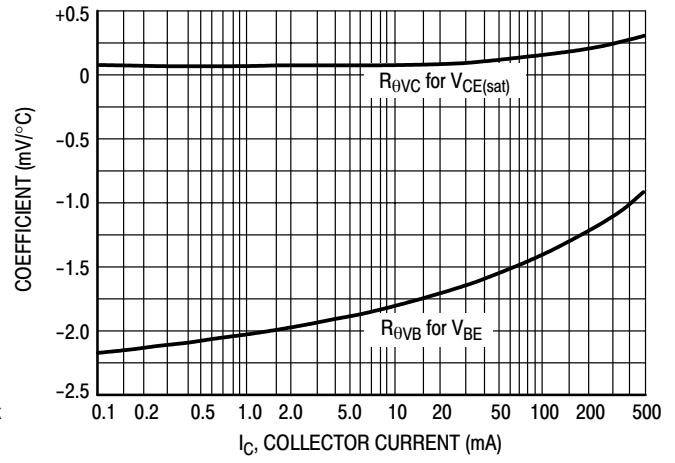
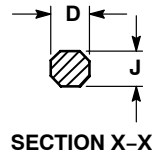
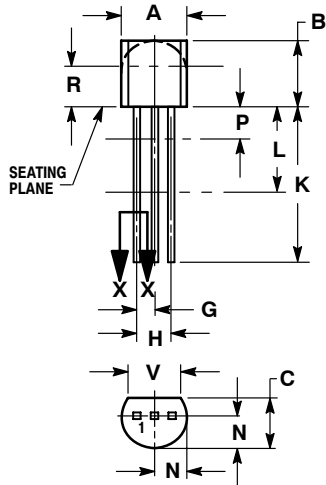


Figure 12. Temperature Coefficients

# P2N2222A

## PACKAGE DIMENSIONS

TO-92 (TO-226)  
CASE 29-11  
ISSUE AL



**NOTES:**

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. CONTOUR OF PACKAGE BEYOND DIMENSION R IS UNCONTROLLED.
4. LEAD DIMENSION IS UNCONTROLLED IN P AND BEYOND DIMENSION K MINIMUM.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.175	0.205	4.45	5.20
B	0.170	0.210	4.32	5.33
C	0.125	0.165	3.18	4.19
D	0.016	0.021	0.407	0.533
G	0.045	0.055	1.15	1.39
H	0.095	0.105	2.42	2.66
J	0.015	0.020	0.39	0.50
K	0.500	---	12.70	---
L	0.250	---	6.35	---
N	0.080	0.105	2.04	2.66
P	---	0.100	---	2.54
R	0.115	---	2.93	---
V	0.135	---	3.43	---

**STYLE 17:**

1. COLLECTOR
2. BASE
3. EMITTER

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