PN2222, PN2222A

General Purpose Transistors

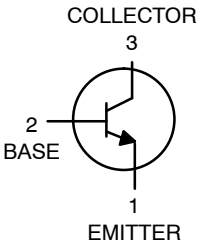
NPN Silicon

ON Semiconductor®

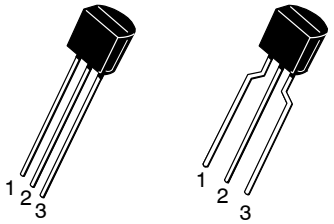
http://onsemi.com

Features

- Pb−Free Packages are Available*



TO−92
CASE 29
STYLE 1



STRAIGHT LEAD
BULK PACK

BENT LEAD
TAPE & REEL
AMMO PACK

MAXIMUM RATINGS

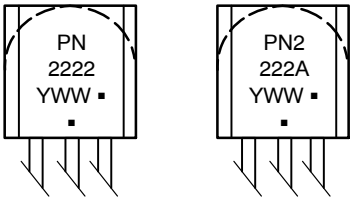
Rating	Symbol	Value	Unit
Collector-Emitter Voltage PN2222 PN2222A	V_{CEO}	 30 40	Vdc
Collector-Base Voltage PN2222 PN2222A	V_{CBO}	 60 75	Vdc
Emitter-Base Voltage PN2222 PN2222A	V_{EBO}	 5.0 6.0	Vdc
Collector Current − Continuous	I_C	600	mAdc
Total Device Dissipation @ T_A = 25°C Derate above 25°C	P_D	 625 5.0	 mW mW/°C
Total Device Dissipation @ T_C = 25°C Derate above 25°C	P_D	 1.5 12	 W mW/°C
Operating and Storage Junction Temperature Range	T_J, T_{stg}	−55 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction-to-Ambient	$R_{\theta JA}$	200	°C/W
Thermal Resistance, Junction-to-Case	$R_{\theta JC}$	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.

MARKING DIAGRAM



PN2222 **PN2222A**

Y = Year
WW = Work Week
▪ = Pb−Free Package

(Note: Microdot may be in either location)

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 3 of this data sheet.

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

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted)

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector – Emitter Breakdown Voltage (I_C = 10 mAdc, I_B = 0)	PN2222 PN2222A	$V_{(BR)CEO}$	30 40	– –	Vdc
Collector – Base Breakdown Voltage (I_C = 10 μAdc, I_E = 0)	PN2222 PN2222A	$V_{(BR)CBO}$	60 75	– –	Vdc
Emitter – Base Breakdown Voltage (I_E = 10 μAdc, I_C = 0)	PN2222 PN2222A	$V_{(BR)EBO}$	5.0 6.0	– –	Vdc
Collector Cutoff Current (V_{CE} = 60 Vdc, $V_{EB(off)}$ = 3.0 Vdc)	PN2222A	I_{CEX}	–	10	nAdc
Collector Cutoff Current		I_{CBO}			μAdc
(V_{CB} = 50 Vdc, I_E = 0)	PN2222		–	0.01	
(V_{CB} = 60 Vdc, I_E = 0)	PN2222A		–	0.01	
(V_{CB} = 50 Vdc, I_E = 0, T_A = 125°C)	PN2222		–	10	
(V_{CB} = 50 Vdc, I_E = 0, T_A = 125°C)	PN2222A		–	10	
Emitter Cutoff Current (V_{EB} = 3.0 Vdc, I_C = 0)	PN2222A	I_{EBO}	–	100	nAdc
Base Cutoff Current (V_{CE} = 60 Vdc, $V_{EB(off)}$ = 3.0 Vdc)	PN2222A	I_{BL}	–	20	nAdc
ON CHARACTERISTICS					
DC Current Gain		h_{FE}			–
(I_C = 0.1 mAdc, V_{CE} = 10 Vdc)			35	–	
(I_C = 1.0 mAdc, V_{CE} = 10 Vdc)			50	–	
(I_C = 10 mAdc, V_{CE} = 10 Vdc)			75	–	
(I_C = 10 mAdc, V_{CE} = 10 Vdc, T_A = –55°C)	PN2222A only		35	–	
(I_C = 150 mAdc, V_{CE} = 10 Vdc) (Note 1)			100	300	
(I_C = 150 mAdc, V_{CE} = 1.0 Vdc) (Note 1)			50	–	
(I_C = 500 mAdc, V_{CE} = 10 Vdc) (Note 1)	PN2222		30	–	
	PN2222A		40	–	
Collector – Emitter Saturation Voltage (Note 1)		$V_{CE(sat)}$			Vdc
(I_C = 150 mAdc, I_B = 15 mAdc)	PN2222		–	0.4	
	PN2222A		–	0.3	
(I_C = 500 mAdc, I_B = 50 mAdc)	PN2222		–	1.6	
	PN2222A		–	1.0	
Base – Emitter Saturation Voltage (Note 1)		$V_{BE(sat)}$			Vdc
(I_C = 150 mAdc, I_B = 15 mAdc)	PN2222		–	1.3	
	PN2222A		0.6	1.2	
(I_C = 500 mAdc, I_B = 50 mAdc)	PN2222		–	2.6	
	PN2222A		–	2.0	
SMALL–SIGNAL CHARACTERISTICS					
Current – Gain – Bandwidth Product (Note 2)		f_T			MHz
(I_C = 20 mAdc, V_{CE} = 20 Vdc, f = 100 MHz)	PN2222		250	–	
	PN2222A		300	–	
Output Capacitance (V_{CB} = 10 Vdc, I_E = 0, f = 1.0 MHz)		C_{obo}	–	8.0	pF
Input Capacitance		C_{ibo}			pF
(V_{EB} = 0.5 Vdc, I_C = 0, f = 1.0 MHz)	PN2222		–	30	
	PN2222A		–	25	
Input Impedance		h_{ie}			kΩ
(I_C = 1.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)	PN2222A		2.0	8.0	
(I_C = 10 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)	PN2222A		0.25	1.25	
Voltage Feedback Ratio		h_{re}			X 10^{-4}
(I_C = 1.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)	PN2222A		–	8.0	
(I_C = 10 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)	PN2222A		–	4.0	
Small–Signal Current Gain		h_{fe}			–
(I_C = 1.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)	PN2222A		50	300	
(I_C = 10 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)	PN2222A		75	375	

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

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted) (Continued)

Characteristic		Symbol	Min	Max	Unit
SMALL−SIGNAL CHARACTERISTICS					
Output Admittance (I_C = 1.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz) (I_C = 10 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)	 PN2222A PN2222A	h_{oe}	 5.0 25	 35 200	μMhos
Collector Base Time Constant (I_E = 20 mAdc, V_{CB} = 20 Vdc, f = 31.8 MHz)	PN2222A	$rb'C_c$	 –	 150	ps
Noise Figure (I_C = 100 μAdc, V_{CE} = 10 Vdc, R_S = 1.0 kΩ, f = 1.0 kHz)	PN2222A	NF	 –	 4.0	dB
SWITCHING CHARACTERISTICS (PN2222A only)					
Delay Time	(V_{CC} = 30 Vdc, $V_{BE(off)}$ = −0.5 Vdc,	t_d	–	10	ns
Rise Time	I_C = 150 mAdc, I_{B1} = 15 mAdc) (Figure 1)	t_r	–	25	ns
Storage Time	(V_{CC} = 30 Vdc, I_C = 150 mAdc,	t_s	–	225	ns
Fall Time	I_{B1} = I_{B2} = 15 mAdc) (Figure 2)	t_f	–	60	ns

ORDERING INFORMATION

Device	Package	Shipping†
PN2222G	TO−92 (Pb−Free)	5000 Units / Bulk
PN2222AG	TO−92 (Pb−Free)	5000 Units / Bulk
PN2222ARLRA	TO−92	2000 / Tape & Reel
PN2222ARLRAG	TO−92 (Pb−Free)	2000 / Tape & Reel
PN2222ARLRM	TO−92	2000 / Tape & Ammo Box
PN2222ARLRMG	TO−92 (Pb−Free)	2000 / Tape & Ammo Box
PN2222ARLRPG	TO−92 (Pb−Free)	2000 / Tape & Ammo Box

†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.

SWITCHING TIME EQUIVALENT TEST CIRCUITS

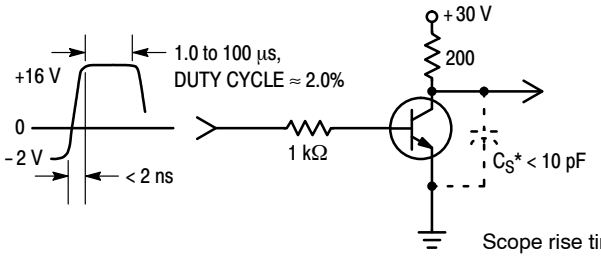


Figure 1. Turn−On Time

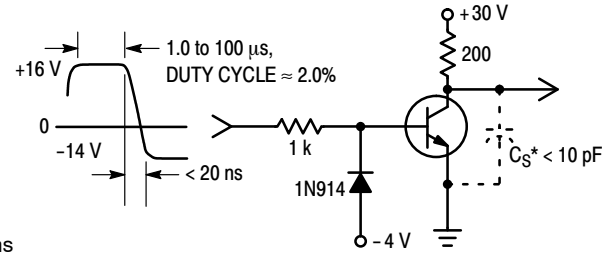


Figure 2. Turn−Off Time

Scope rise time < 4 ns
*Total shunt capacitance of test jig, connectors, and oscilloscope.

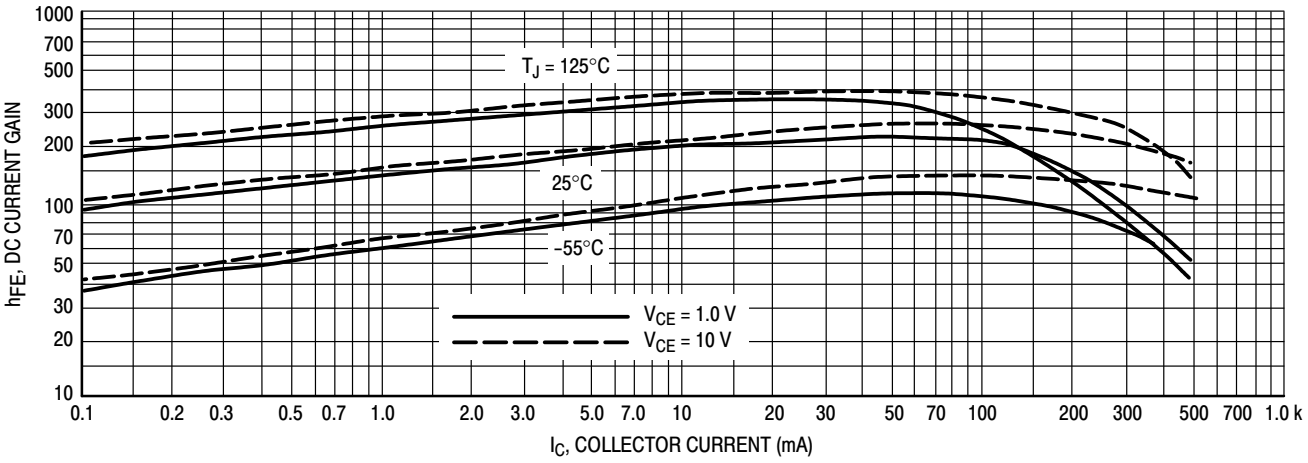


Figure 3. DC Current Gain

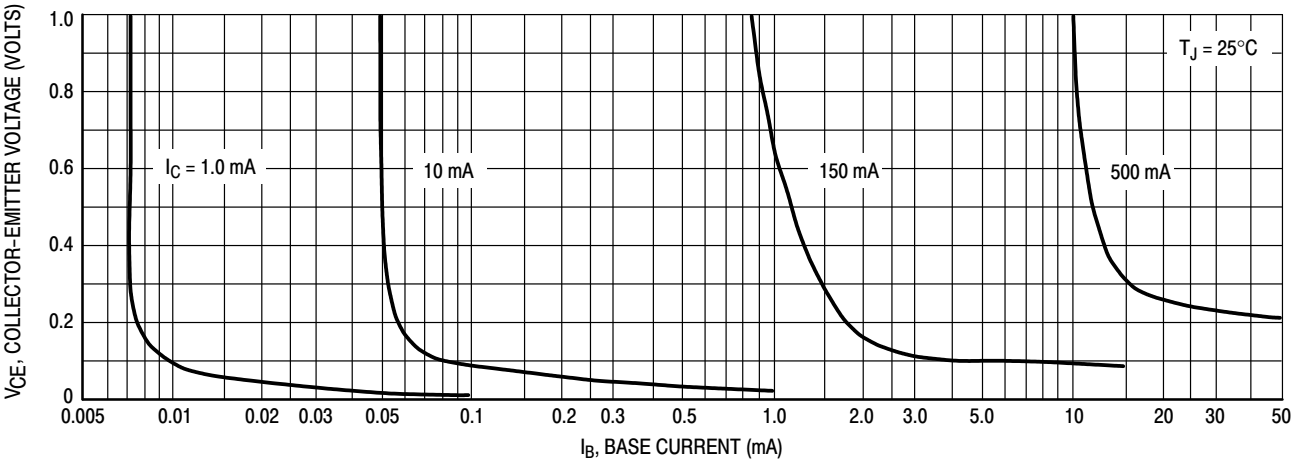


Figure 4. Collector Saturation Region

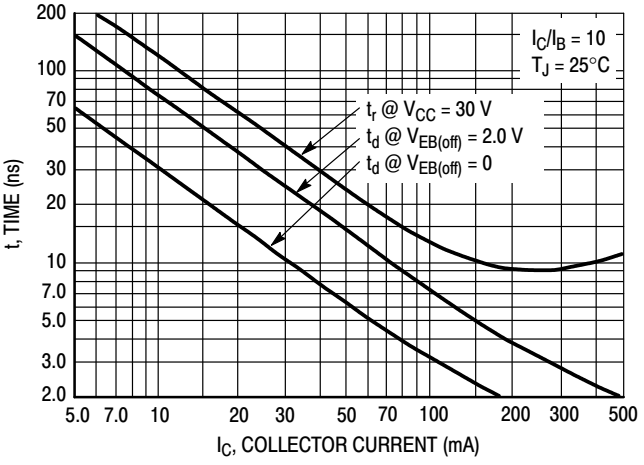


Figure 5. Turn – On Time

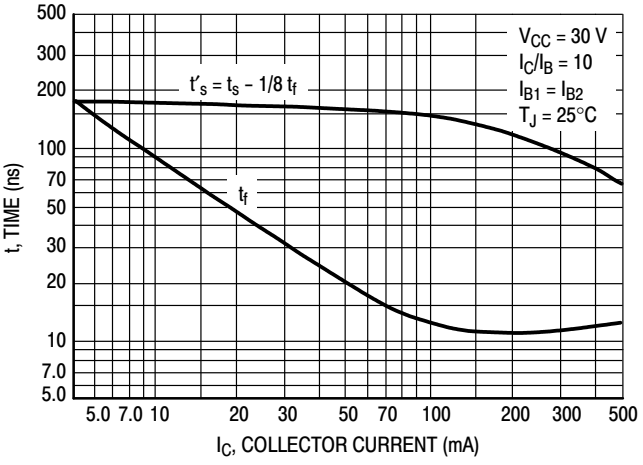


Figure 6. Turn – Off Time

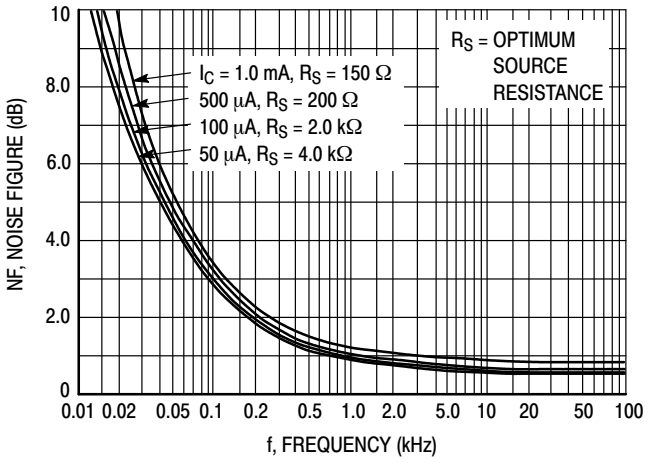


Figure 7. Frequency Effects

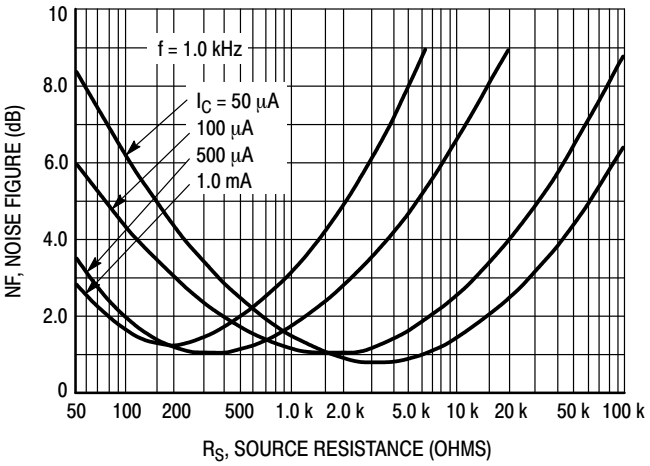


Figure 8. Source Resistance Effects

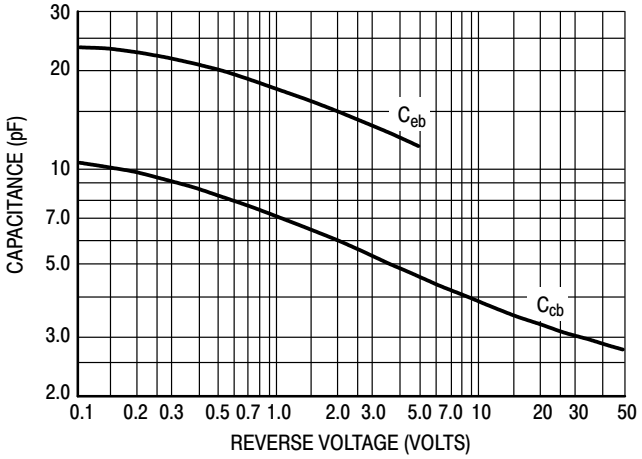


Figure 9. Capacitances

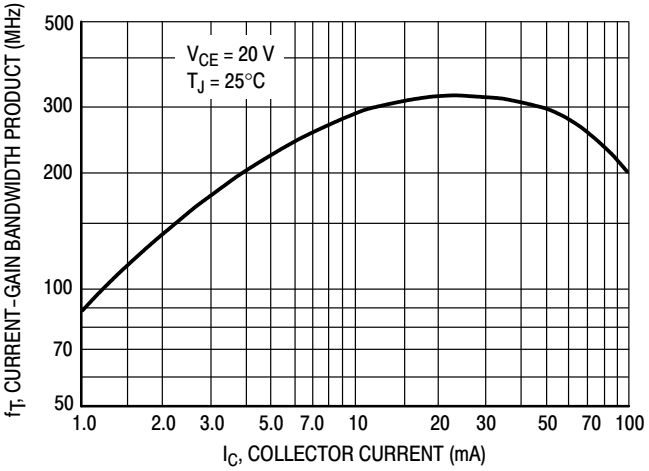


Figure 10. Current−Gain Bandwidth Product

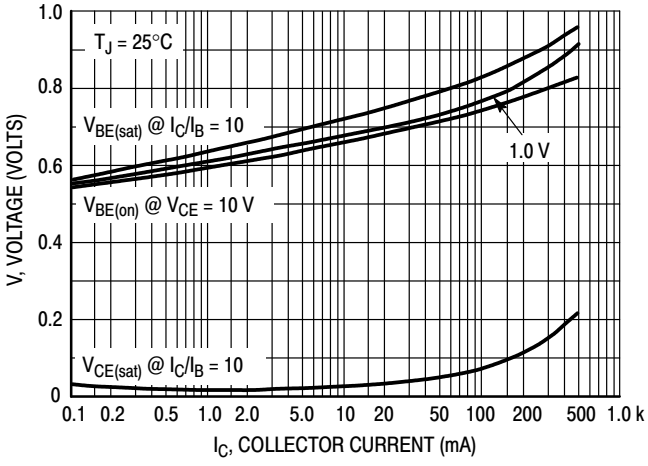


Figure 11. “On” Voltages

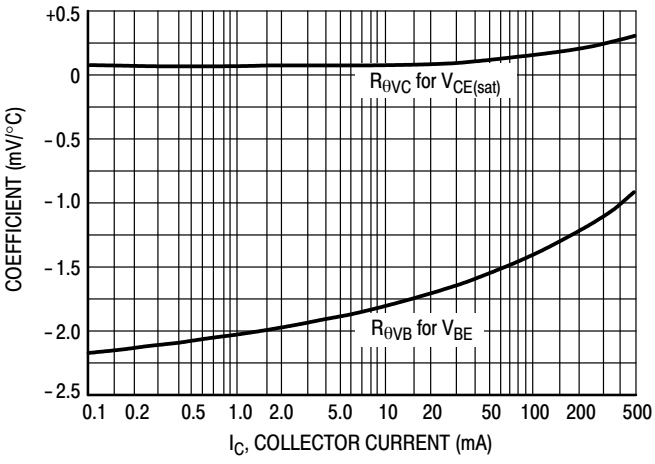
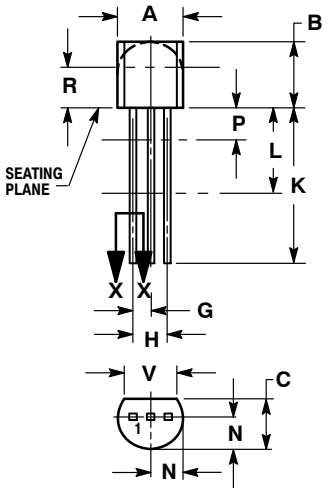


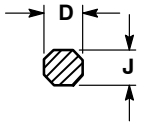
Figure 12. Temperature Coefficients

PACKAGE DIMENSIONS

TO−92 (TO−226)
CASE 29−11
ISSUE AM



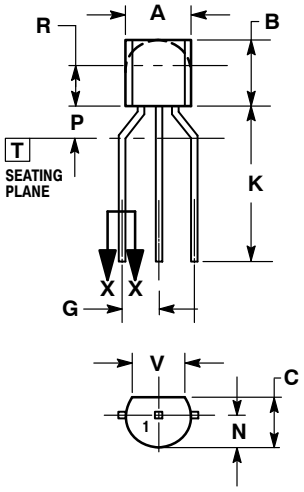
STRAIGHT LEAD
BULK PACK



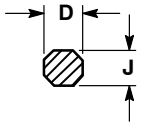
SECTION X−X

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.

	INCHES		MILLIMETERS	
DIM	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	---



BENT LEAD
TAPE & REEL
AMMO PACK



SECTION X−X

NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. CONTOUR OF PACKAGE BEYOND DIMENSION R IS UNCONTROLLED.
4. LEAD DIMENSION IS UNCONTROLLED IN P AND BEYOND DIMENSION K MINIMUM.

	MILLIMETERS	
DIM	MIN	MAX
A	4.45	5.20
B	4.32	5.33
C	3.18	4.19
D	0.40	0.54
G	2.40	2.80
J	0.39	0.50
K	12.70	---
N	2.04	2.66
P	1.50	4.00
R	2.93	---
V	3.43	---

STYLE 1:
PIN 1. EMITTER
2. BASE
3. COLLECTOR

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