

P2N2222A

Amplifier Transistors

NPN Silicon

Features

- These are Pb-Free Devices*

MAXIMUM RATINGS ($T_A = 25^\circ\text{C}$ unless otherwise noted)

| Characteristic | Symbol | Value | Unit |
|--|----------------|----------------|----------------------------|
| Collector – Emitter Voltage | V_{CEO} | 40 | Vdc |
| Collector – Base Voltage | V_{CBO} | 75 | Vdc |
| Emitter – Base Voltage | V_{EBO} | 6.0 | Vdc |
| Collector Current – Continuous | I_C | 600 | mA dc |
| Total Device Dissipation @ $T_A = 25^\circ\text{C}$ Derate above 25°C | P_D | 625 5.0 | mW mW/ $^\circ\text{C}$ |
| Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above 25°C | P_D | 1.5 12 | W mW/ $^\circ\text{C}$ |
| Operating and Storage Junction Temperature Range | T_J, T_{stg} | -55 to +150 | $^\circ\text{C}$ |

THERMAL CHARACTERISTICS

| Characteristic | Symbol | Max | Unit |
|---|-----------------|------|--------------------|
| Thermal Resistance, Junction to Ambient | $R_{\theta JA}$ | 200 | $^\circ\text{C/W}$ |
| Thermal Resistance, Junction to Case | $R_{\theta JC}$ | 83.3 | $^\circ\text{C/W}$ |

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.



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TO-92
CASE 29
STYLE 17

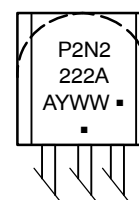


STRAIGHT LEAD
BULK PACK



BENT LEAD
TAPE & REEL
AMMO PACK

MARKING DIAGRAM



A = Assembly Location

Y = Year

WW = Work Week

▪ = Pb-Free Package

(Note: Microdot may be in either location)

ORDERING INFORMATION

| Device | Package | Shipping† |
|--------------|--------------------|------------------|
| P2N2222AG | TO-92 (Pb-Free) | 5000 Units/Bulk |
| P2N2222ARL1G | TO-92 (Pb-Free) | 2000/Tape & Ammo |

†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°C unless otherwise noted)

| Characteristic | Symbol | Min | Max | Unit |
|--|----------------------|--------|------------|------------------|
| OFF CHARACTERISTICS | | | | |
| Collector – Emitter Breakdown Voltage (I _C = 10 mA _{dc} , I _B = 0) | V _{(BR)CEO} | 40 | – | V _{dc} |
| Collector – Base Breakdown Voltage (I _C = 10 μA _{dc} , I _E = 0) | V _{(BR)CBO} | 75 | – | V _{dc} |
| Emitter – Base Breakdown Voltage (I _E = 10 μA _{dc} , I _C = 0) | V _{(BR)EBO} | 6.0 | – | V _{dc} |
| Collector Cutoff Current (V _{CE} = 60 V _{dc} , V _{EB(off)} = 3.0 V _{dc}) | I _{CEX} | – | 10 | nA _{dc} |
| Collector Cutoff Current (V _{CB} = 60 V _{dc} , I _E = 0) (V _{CB} = 60 V _{dc} , I _E = 0, T _A = 150°C) | I _{CBO} | – – | 0.01 10 | μA _{dc} |
| Emitter Cutoff Current (V _{EB} = 3.0 V _{dc} , I _C = 0) | I _{EBO} | – | 10 | nA _{dc} |
| Collector Cutoff Current (V _{CE} = 10 V) | I _{CEO} | – | 10 | nA _{dc} |
| Base Cutoff Current (V _{CE} = 60 V _{dc} , V _{EB(off)} = 3.0 V _{dc}) | I _{BEX} | – | 20 | nA _{dc} |

ON CHARACTERISTICS

| | | | | |
|--|----------------------|---|-----------------------------------|-----------------|
| DC Current Gain (I _C = 0.1 mA _{dc} , V _{CE} = 10 V _{dc}) (I _C = 1.0 mA _{dc} , V _{CE} = 10 V _{dc}) (I _C = 10 mA _{dc} , V _{CE} = 10 V _{dc}) (I _C = 10 mA _{dc} , V _{CE} = 10 V _{dc} , T _A = –55°C) (I _C = 150 mA _{dc} , V _{CE} = 10 V _{dc}) (Note 1) (I _C = 150 mA _{dc} , V _{CE} = 1.0 V _{dc}) (Note 1) (I _C = 500 mA _{dc} , V _{CE} = 10 V _{dc}) (Note 1) | h _{FE} | 35 50 75 35 100 50 40 | – – – – 300 – – | – |
| Collector – Emitter Saturation Voltage (Note 1) (I _C = 150 mA _{dc} , I _B = 15 mA _{dc}) (I _C = 500 mA _{dc} , I _B = 50 mA _{dc}) | V _{CE(sat)} | – – | 0.3 1.0 | V _{dc} |
| Base – Emitter Saturation Voltage (Note 1) (I _C = 150 mA _{dc} , I _B = 15 mA _{dc}) (I _C = 500 mA _{dc} , I _B = 50 mA _{dc}) | V _{BE(sat)} | 0.6 – | 1.2 2.0 | V _{dc} |

SMALL-SIGNAL CHARACTERISTICS

| | | | | |
|--|-------------------|-------------|-------------|--------------------|
| Current – Gain – Bandwidth Product (Note 2) (I _C = 20 mA _{dc} , V _{CE} = 20 V _{dc} , f = 100 MHz) _C | f _T | 300 | – | MHz |
| Output Capacitance (V _{CB} = 10 V _{dc} , I _E = 0, f = 1.0 MHz) | C _{obo} | – | 8.0 | pF |
| Input Capacitance (V _{EB} = 0.5 V _{dc} , I _C = 0, f = 1.0 MHz) | C _{ibo} | – | 25 | pF |
| Input Impedance (I _C = 1.0 mA _{dc} , V _{CE} = 10 V _{dc} , f = 1.0 kHz) (I _C = 10 mA _{dc} , V _{CE} = 10 V _{dc} , f = 1.0 kHz) | h _{ie} | 2.0 0.25 | 8.0 1.25 | kΩ |
| Voltage Feedback Ratio (I _C = 1.0 mA _{dc} , V _{CE} = 10 V _{dc} , f = 1.0 kHz) (I _C = 10 mA _{dc} , V _{CE} = 10 V _{dc} , f = 1.0 kHz) | h _{re} | – – | 8.0 4.0 | X 10 ^{–4} |
| Small-Signal Current Gain (I _C = 1.0 mA _{dc} , V _{CE} = 10 V _{dc} , f = 1.0 kHz) (I _C = 10 mA _{dc} , V _{CE} = 10 V _{dc} , f = 1.0 kHz) | h _{fe} | 50 75 | 300 375 | – |
| Output Admittance (I _C = 1.0 mA _{dc} , V _{CE} = 10 V _{dc} , f = 1.0 kHz) (I _C = 10 mA _{dc} , V _{CE} = 10 V _{dc} , f = 1.0 kHz) | h _{oe} | 5.0 25 | 35 200 | μMhos |
| Collector Base Time Constant (I _E = 20 mA _{dc} , V _{CB} = 20 V _{dc} , f = 31.8 MHz) | rb'C _c | – | 150 | ps |
| Noise Figure (I _C = 100 μA _{dc} , V _{CE} = 10 V _{dc} , R _S = 1.0 kΩ, f = 1.0 kHz) | N _F | – | 4.0 | dB |

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.

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

| Characteristic | Symbol | Min | Max | Unit |
|----------------------------------|--------|-----|-----|------|
| SWITCHING CHARACTERISTICS | | | | |
| Delay Time | t_d | — | 10 | ns |
| Rise Time | t_r | — | 25 | ns |
| Storage Time | 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 3. DC Current Gain

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Figure 9. Capacitances



Figure 10. Current-Gain Bandwidth Product

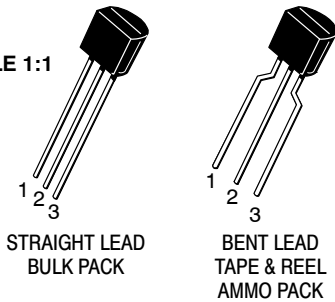


Figure 11. "On" Voltages



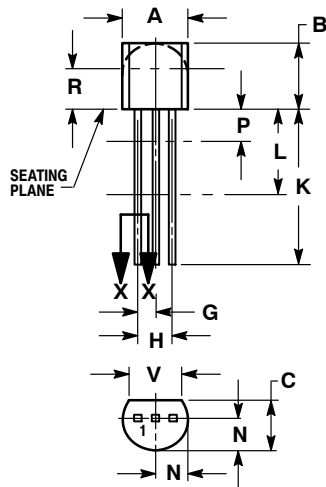
Figure 12. Temperature Coefficients

SCALE 1:1

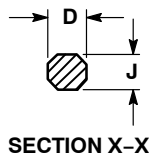


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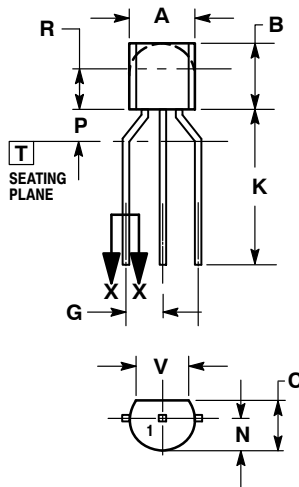
STRAIGHT LEAD
BULK PACK



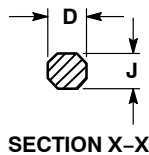
NOTES:

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 | --- |



BENT LEAD
TAPE & REEL
AMMO PACK



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.

| DIM | MILLIMETERS | |
|-----|-------------|------|
| | 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 | --- |

STYLES ON PAGE 2

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|--|---|---|--|--|
| STYLE 1: PIN 1. EMITTER 2. BASE 3. COLLECTOR | STYLE 2: PIN 1. BASE 2. EMITTER 3. COLLECTOR | STYLE 3: PIN 1. ANODE 2. ANODE 3. CATHODE | STYLE 4: PIN 1. CATHODE 2. CATHODE 3. ANODE | STYLE 5: PIN 1. DRAIN 2. SOURCE 3. GATE |
| STYLE 6: PIN 1. GATE 2. SOURCE & SUBSTRATE 3. DRAIN | STYLE 7: PIN 1. SOURCE 2. DRAIN 3. GATE | STYLE 8: PIN 1. DRAIN 2. GATE 3. SOURCE & SUBSTRATE | STYLE 9: PIN 1. BASE 1 2. EMITTER 3. BASE 2 | STYLE 10: PIN 1. CATHODE 2. GATE 3. ANODE |
| STYLE 11: PIN 1. ANODE 2. CATHODE & ANODE 3. CATHODE | STYLE 12: PIN 1. MAIN TERMINAL 1 2. GATE 3. MAIN TERMINAL 2 | STYLE 13: PIN 1. ANODE 1 2. GATE 3. CATHODE 2 | STYLE 14: PIN 1. EMITTER 2. COLLECTOR 3. BASE | STYLE 15: PIN 1. ANODE 1 2. CATHODE 3. ANODE 2 |
| STYLE 16: PIN 1. ANODE 2. GATE 3. CATHODE | STYLE 17: PIN 1. COLLECTOR 2. BASE 3. EMITTER | STYLE 18: PIN 1. ANODE 2. CATHODE 3. NOT CONNECTED | STYLE 19: PIN 1. GATE 2. ANODE 3. CATHODE | STYLE 20: PIN 1. NOT CONNECTED 2. CATHODE 3. ANODE |
| STYLE 21: PIN 1. COLLECTOR 2. EMITTER 3. BASE | STYLE 22: PIN 1. SOURCE 2. GATE 3. DRAIN | STYLE 23: PIN 1. GATE 2. SOURCE 3. DRAIN | STYLE 24: PIN 1. EMITTER 2. COLLECTOR/ANODE 3. CATHODE | STYLE 25: PIN 1. MT 1 2. GATE 3. MT 2 |
| STYLE 26: PIN 1. V_{CC} 2. GROUND 2 3. OUTPUT | STYLE 27: PIN 1. MT 2. SUBSTRATE 3. MT | STYLE 28: PIN 1. CATHODE 2. ANODE 3. GATE | STYLE 29: PIN 1. NOT CONNECTED 2. ANODE 3. CATHODE | STYLE 30: PIN 1. DRAIN 2. GATE 3. SOURCE |
| STYLE 31: PIN 1. GATE 2. DRAIN 3. SOURCE | STYLE 32: PIN 1. BASE 2. COLLECTOR 3. EMITTER | STYLE 33: PIN 1. RETURN 2. INPUT 3. OUTPUT | STYLE 34: PIN 1. INPUT 2. GROUND 3. LOGIC | STYLE 35: PIN 1. GATE 2. COLLECTOR 3. EMITTER |

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