



## TN2219A (TN2222A)



### NPN General Purpose Amplifier

This device is for use as a medium power amplifier and switch requiring collector currents up to 500 mA. Sourced from Process 19. See PN2222A for characteristics.

#### Absolute Maximum Ratings\*

TA = 25°C unless otherwise noted

| Symbol         | Parameter  | Value       | Units |
|----------------|--|-------------|-------|
| $V_{CEO}$      | Collector-Emitter Voltage                        | 40          | V     |
| $V_{CBO}$      | Collector-Base Voltage                           | 75          | V     |
| $V_{EBO}$      | Emitter-Base Voltage                             | 6.0         | V     |
| $I_C$          | Collector Current - Continuous                   | 1.0         | A     |
| $T_J, T_{stg}$ | Operating and Storage Junction Temperature Range | -55 to +150 | °C    |

\*These ratings are limiting values above which the serviceability of any semiconductor device may be impaired.

#### NOTES:

- 1) These ratings are based on a maximum junction temperature of 150 degrees C.
- 2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

#### Thermal Characteristics

TA = 25°C unless otherwise noted

| Symbol          | Characteristic                                | Max        | Units     |
|-----------------|---|------------|-----------|
|                 |   | TN2219A    |           |
| $P_D$           | Total Device Dissipation<br>Derate above 25°C | 1.0<br>8.0 | W<br>W/°C |
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case          | 125        | °C/W      |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient       | 50         | °C/W      |

# NPN General Purpose Amplifier

(continued)

TN2219A

## Electrical Characteristics

TA = 25°C unless otherwise noted

| Symbol | Parameter | Test Conditions | Min | Max | Units |
|--------|-----------|-----------------|-----|-----|-------|
|--------|-----------|-----------------|-----|-----|-------|

### OFF CHARACTERISTICS

|               |                                      |   |     |          |                     |
|---------------|--------------------------------------|---|-----|----------|---------------------|
| $V_{(BR)CEO}$ | Collector-Emitter Breakdown Voltage* | $I_C = 10 \text{ mA}, I_B = 0$  | 40  |          | V                   |
| $V_{(BR)CBO}$ | Collector-Base Breakdown Voltage     | $I_C = 10 \text{ } \mu\text{A}, I_E = 0$  | 75  |          | V                   |
| $V_{(BR)EBO}$ | Emitter-Base Breakdown Voltage       | $I_E = 10 \text{ } \mu\text{A}, I_C = 0$  | 6.0 |          | V                   |
| $I_{CEX}$     | Collector Cutoff Current             | $V_{CE} = 60 \text{ V}, V_{EB(OFF)} = 3.0 \text{ V}$  |     | 10       | nA                  |
| $I_{CBO}$     | Collector Cutoff Current             | $V_{CB} = 60 \text{ V}, I_E = 0$<br>$V_{CB} = 60 \text{ V}, I_E = 0, T_A = 150^\circ\text{C}$ |     | 10<br>10 | nA<br>$\mu\text{A}$ |
| $I_{EBO}$     | Emitter Cutoff Current               | $V_{EB} = 3.0 \text{ V}, I_C = 0$   |     | 10       | nA                  |
| $I_{BL}$      | Base Cutoff Current                  | $V_{CE} = 60 \text{ V}, V_{EB(OFF)} = 3.0$  |     | 20       | nA                  |

### ON CHARACTERISTICS

|               |                                       |  |                                   |            |        |
|---------------|---------------------------------------|--|-----------------------------------|------------|--------|
| $h_{FE}$      | DC Current Gain                       | $I_C = 0.1 \text{ mA}, V_{CE} = 10 \text{ V}$<br>$I_C = 1.0 \text{ mA}, V_{CE} = 10 \text{ V}$<br>$I_C = 10 \text{ mA}, V_{CE} = 10 \text{ V}$<br>$I_C = 150 \text{ mA}, V_{CE} = 10 \text{ V}$<br>$I_C = 150 \text{ mA}, V_{CE} = 1.0 \text{ V}$<br>$I_C = 500 \text{ mA}, V_{CE} = 10 \text{ V}$ | 35<br>50<br>75<br>100<br>50<br>40 | 300        |        |
| $V_{CE(sat)}$ | Collector-Emitter Saturation Voltage* | $I_C = 150 \text{ mA}, I_B = 15 \text{ mA}$<br>$I_C = 500 \text{ mA}, I_B = 50 \text{ mA}$   |                                   | 0.3<br>1.0 | V<br>V |
| $V_{BE(sat)}$ | Base-Emitter Saturation Voltage*      | $I_C = 150 \text{ mA}, I_B = 1.0 \text{ mA}$<br>$I_C = 500 \text{ mA}, I_B = 5.0 \text{ mA}$   | 0.6                               | 1.2<br>2.0 | V<br>V |

### SMALL SIGNAL CHARACTERISTICS

|              |  |   |          |            |          |
|--------------|--|---|----------|------------|----------|
| $C_{obo}$    | Output Capacitance   | $V_{CB} = 10 \text{ V}, I_E = 0, f = 100 \text{ kHz}$   |          | 8.0        | pF       |
| $C_{ibo}$    | Input Capacitance  | $V_{EB} = 0.5 \text{ V}, I_C = 0, f = 100 \text{ kHz}$  |          | 25         | pF       |
| $h_{fe}$     | Small-Signal Current Gain                                  | $I_C = 1.0 \text{ mA}, V_{CE} = 10 \text{ V}, f = 1.0 \text{ kHz}$<br>$I_C = 10 \text{ mA}, V_{CE} = 10 \text{ V}, f = 1.0 \text{ kHz}$ | 50<br>75 | 300<br>375 |          |
| $rb'C_C$     | Collector Base Time Constant                               | $I_E = 20 \text{ mA}, V_{CB} = 20 \text{ V}, f = 31.8 \text{ MHz}$  |          | 150        | pS       |
| NF           | Noise Figure   | $I_C = 100 \text{ } \mu\text{A}, V_{CE} = 10 \text{ V}, R_S = 1.0 \text{ k}\Omega$<br>$f = 1.0 \text{ kHz}, B_W = 1.0 \text{ kHz}$      |          | 4.0        | dB       |
| $Re(h_{ie})$ | Real Part of Common-Emitter High Frequency Input Impedance | $I_C = 20 \text{ mA}, V_{CE} = 20 \text{ V}, f = 300 \text{ MHz}$   |          | 60         | $\Omega$ |

### SWITCHING CHARACTERISTICS

|       |              |   |  |     |    |
|-------|--------------|---|--|-----|----|
| $t_d$ | Delay Time   | $V_{CC} = 30 \text{ V}, V_{BE(OFF)} = 0.5 \text{ V},$ |  | 10  | ns |
| $t_r$ | Rise Time    | $I_C = 150 \text{ mA}, I_{B1} = 15 \text{ mA}$        |  | 25  | ns |
| $t_s$ | Storage Time | $V_{CC} = 30 \text{ V}, I_C = 150 \text{ mA},$        |  | 225 | ns |
| $t_f$ | Fall Time    | $I_{B1} = I_{B2} = 15 \text{ mA}$                     |  | 60  | ns |

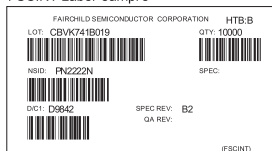
\*Pulse Test: Pulse Width  $\leq 300 \text{ } \mu\text{s}$ , Duty Cycle  $\leq 2.0\%$

## TO-226AE Tape and Reel Data



TO-226AE Packaging  
Configuration: Figure 1.0

FSCINT Label sample

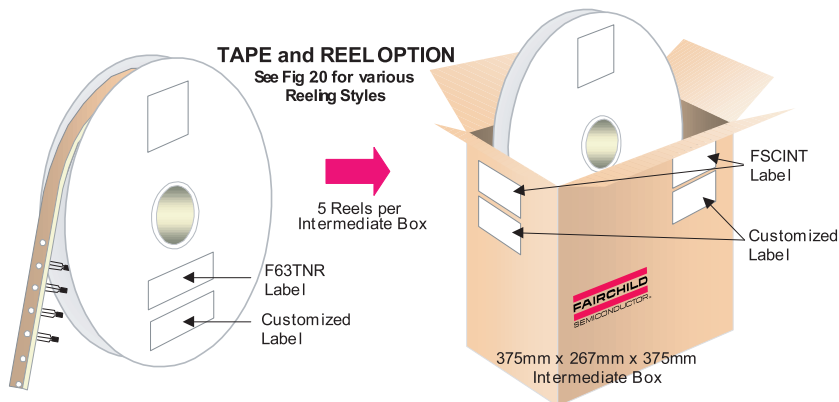


F63TNR Label sample



### TAPE and REEL OPTION

See Fig 20 for various Reeling Styles



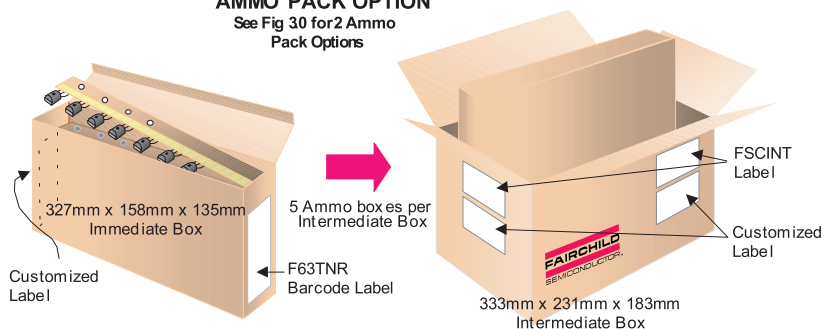
### AMMO PACK OPTION

See Fig 30 for 2 Ammo Pack Options

TO-226AE TNR/AMMO PACKING INFORMATION

| Packing | Style | Quantity | EOL code |
|---------|-------|----------|----------|
| Reel    | A     | 2,000    | D26Z     |
|         | E     | 2,000    | D27Z     |
| Ammo    | M     | 2,000    | D74Z     |
|         | P     | 2,000    | D75Z     |

Unit weight = 0.300gm  
Reel weight with components = 0.868 kg  
Ammo weight with components = 0.880 kg  
Max quantity per intermediate box = 10,000 units

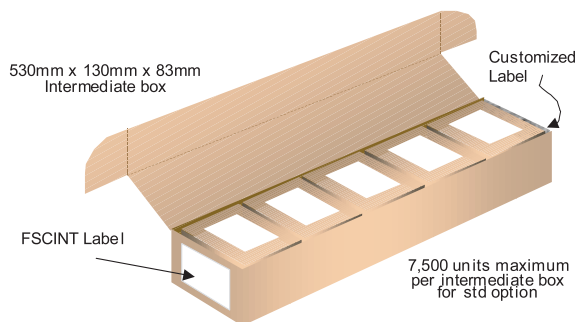
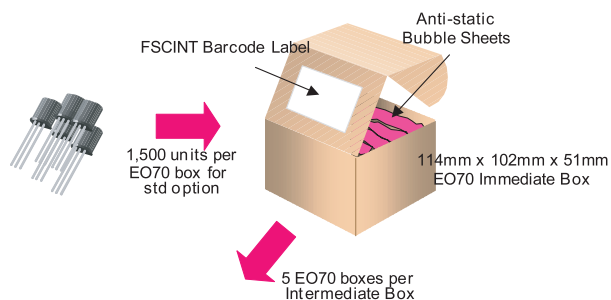


### BULK OPTION

See Bulk Packing Information table

(TO-226AE) BULK PACKING INFORMATION

| EOL CODE    | DESCRIPTION              | LEADCLIP DIMENSION | QUANTITY    |
|-------------|--------------------------|--------------------|-------------|
| J18Z        | TO-18 OPTION STD         | NO LEAD CLIP       | 1.0 K / BOX |
| J05Z        | TO-5 OPTION STD          | NO LEAD CLIP       | 1.0 K / BOX |
| NO EOL CODE | TO-226 STANDARD STRAIGHT | NO LEADCLIP        | 1.5 K / BOX |

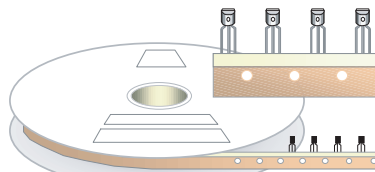


## TO-226AE Tape and Reel Data, continued

### TO-226AE Reeling Style

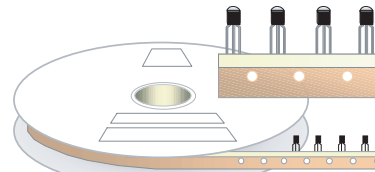
Configuration: Figure 2.0

Machine Option "A"(H)



Style "A" D26Z, D70Z (s/h)

Machine Option "E"(J)

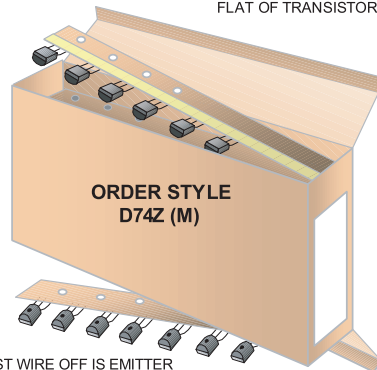


Style "E" D27Z, D71Z (s/h)

### TO-226AE Radial Ammo Packaging

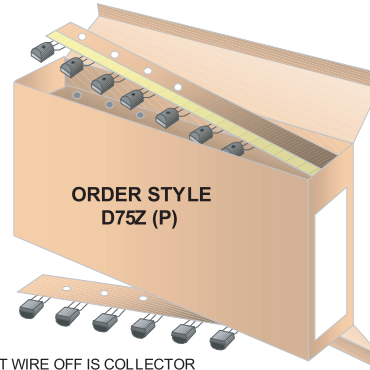
Configuration: Figure 3.0

FIRST WIRE OFF IS COLLECTOR (ON PKG. 92)  
ADHESIVE TAPE IS ON THE TOP SIDE  
FLAT OF TRANSISTOR IS ON TOP



FIRST WIRE OFF IS EMITTER  
ADHESIVE TAPE IS ON BOTTOM SIDE  
FLAT OF TRANSISTOR IS ON BOTTOM

FIRST WIRE OFF IS EMITTER (ON PKG. 92)  
ADHESIVE TAPE IS ON THE TOP SIDE  
FLAT OF TRANSISTOR IS ON BOTTOM

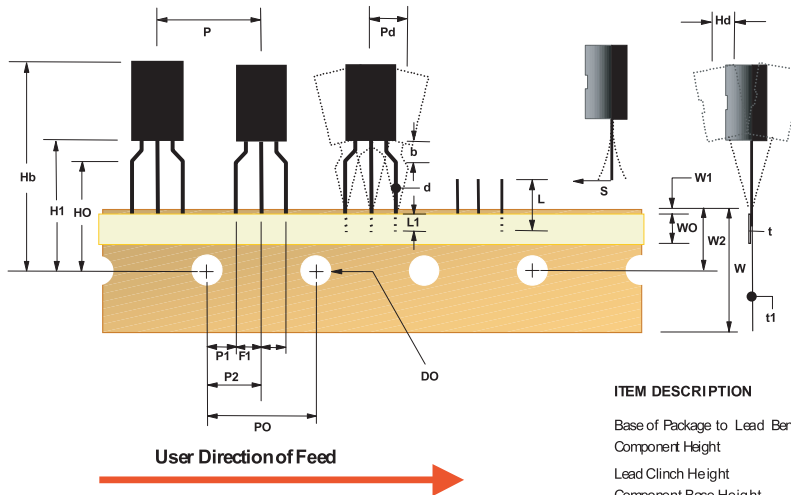


FIRST WIRE OFF IS COLLECTOR  
ADHESIVE TAPE IS ON BOTTOM SIDE  
FLAT OF TRANSISTOR IS ON TOP

## TO-226AE Tape and Reel Data, continued

### TO-226AE Tape and Reel Taping

Dimension Configuration: Figure 4.0

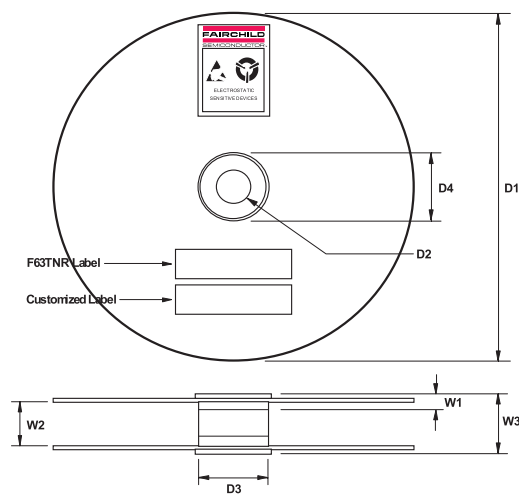


| ITEM DESCRIPTION                 | SYMBOL | DIMENSION              |
|----------------------------------|--------|------------------------|
| Base of Package to Lead Bend     | b      | 0.098 (max)            |
| Component Height                 | Hb     | 1.078 (+/- 0.050)      |
| Lead Clinch Height               | HO     | 0.630 (+/- 0.020)      |
| Component Base Height            | H1     | 0.748 (+/- 0.020)      |
| Component Alignment (side/side)  | Pd     | 0.040 (max)            |
| Component Alignment (front/back) | Hd     | 0.031 (max)            |
| Component Pitch                  | P      | 0.500 (+/- 0.020)      |
| Feed Hole Pitch                  | PO     | 0.500 (+/- 0.008)      |
| Hole Center to First Lead        | P1     | 0.150 (+0.009, -0.010) |
| Hole Center to Component Center  | P2     | 0.247 (+/- 0.007)      |
| Lead Spread                      | F1/F2  | 0.104 (+/- 0.010)      |
| Lead Thickness                   | d      | 0.018 (+0.002, -0.003) |
| Out Lead Length                  | L      | 0.429 (max)            |
| Taped Lead Length                | L1     | 0.209 (+0.051, -0.052) |
| Taped Lead Thickness             | t      | 0.032 (+/- 0.006)      |
| Carrier Tape Thickness           | t1     | 0.021 (+/- 0.006)      |
| Carrier Tape Width               | W      | 0.708 (+0.020, -0.019) |
| Hold-down Tape Width             | W0     | 0.236 (+/- 0.012)      |
| Hold-down Tape Position          | W1     | 0.035 (max)            |
| Feed Hole Position               | W2     | 0.360 (+/- 0.025)      |
| Sprocket Hole Diameter           | DO     | 0.157 (+0.008, -0.007) |
| Lead Spring Out                  | S      | 0.004 (max)            |

Note: All dimensions are in inches.

### TO-226AE Reel

Configuration: Figure 5.0



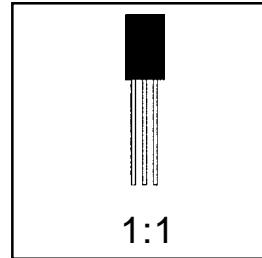
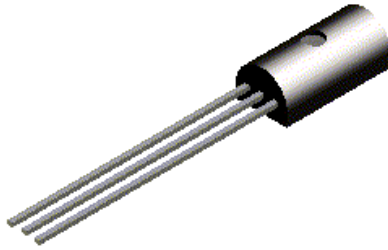
| ITEM DESCRIPTION               | SYMBOL | MINIMUM | MAXIMUM |
|--------------------------------|--------|---------|---------|
| Reel Diameter                  | D1     | 1.3975  | 14.025  |
| Arbor Hole Diameter (Standard) | D2     | 1.160   | 1.200   |
| (Small Hole)                   | D2     | 0.650   | 0.700   |
| Core Diameter                  | D3     | 3.100   | 3.300   |
| Hub Recess Inner Diameter      | D4     | 2.700   | 3.100   |
| Hub Recess Depth               | W1     | 0.370   | 0.570   |
| Flange to Flange Inner Width   | W2     | 1.630   | 1.690   |
| Hub to Hub Center Width        | W3     |         | 2.090   |

Note: All dimensions are in inches

# TO-226AE Package Dimensions



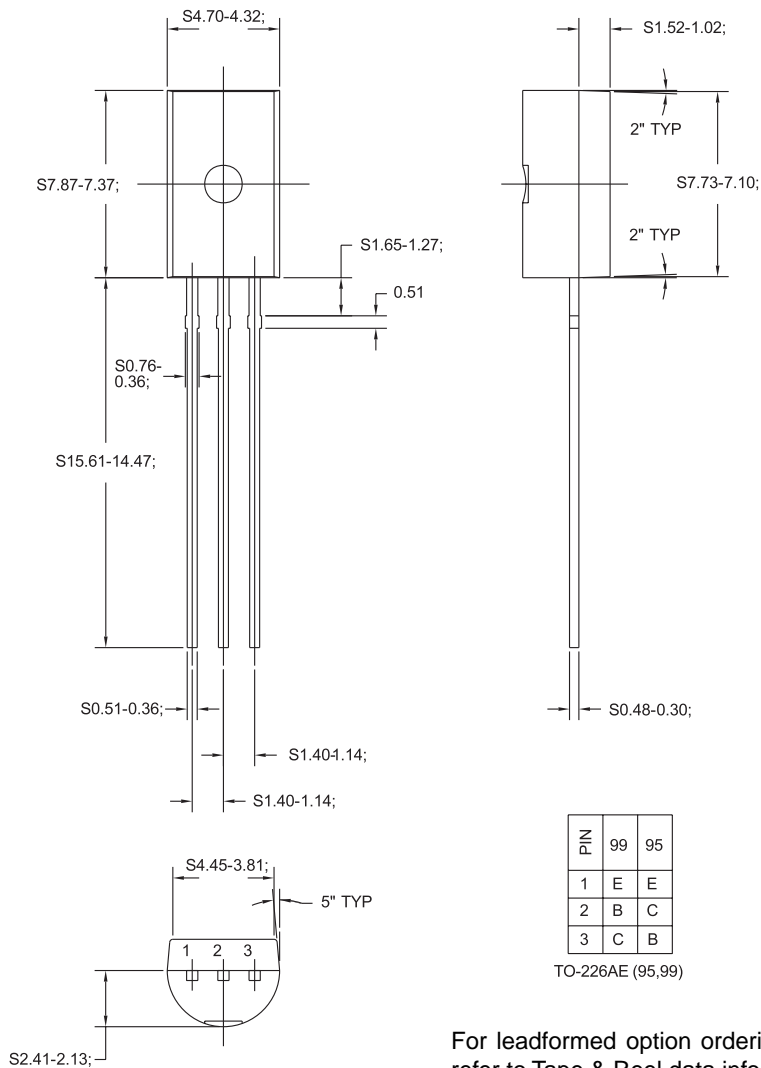
## TO-226AE (FS PKG Code 95, 99)



Scale 1:1 on letter size paper

Dimensions shown below are in:  
inches [millimeters]

Part Weight per unit (gram): 0.300



For leadformed option ordering,  
refer to Tape & Reel data information.

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