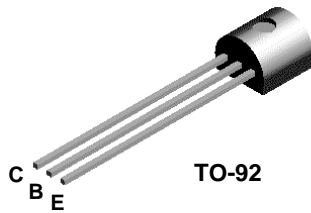
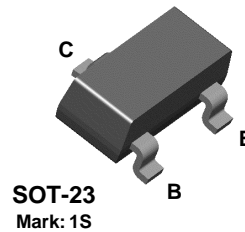


## PN2369A



## MMBT2369A



### NPN Switching Transistor

This device is designed for high speed saturated switching at collector currents of 10 mA to 100 mA. Sourced from Process 21.

#### Absolute Maximum Ratings\* TA = 25°C unless otherwise noted

| Symbol         | Parameter  | Value       | Units |
|----------------|--|-------------|-------|
| $V_{CEO}$      | Collector-Emitter Voltage                        | 15          | V     |
| $V_{CBO}$      | Collector-Base Voltage                           | 40          | V     |
| $V_{EBO}$      | Emitter-Base Voltage                             | 4.5         | V     |
| $I_C$          | Collector Current - Continuous                   | 200         | mA    |
| $T_J, T_{stg}$ | 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 |
|-----------------|---|---------|------------|-------|
|                 |   | PN2369A | MMBT2369A* |       |
| $P_D$           | Total Device Dissipation                | 350     | 225        | mW    |
|                 | Derate above 25°C                       | 2.8     | 1.8        | mW/°C |
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case    | 125     |            | °C/W  |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient | 357     | 556        | °C/W  |

\* Device mounted on FR-4 PCB 1.6" X 1.6" X 0.06."

# NPN Switching Transistor

(continued)

PN2369A / MMBT2369A

## Electrical Characteristics

TA = 25°C unless otherwise noted

| Symbol                     | Parameter                            | Test Conditions   | Min | Max       | Units                          |
|----------------------------|--------------------------------------|---|-----|-----------|--------------------------------|
| <b>OFF CHARACTERISTICS</b> |                                      |   |     |           |                                |
| $V_{(BR)CEO}$              | Collector-Emitter Breakdown Voltage* | $I_C = 10 \text{ mA}, I_B = 0$  | 15  |           | V                              |
| $V_{(BR)CES}$              | Collector-Emitter Breakdown Voltage  | $I_C = 10 \text{ } \mu\text{A}, V_{BE} = 0$   | 40  |           | V                              |
| $V_{(BR)CBO}$              | Collector-Base Breakdown Voltage     | $I_C = 10 \text{ } \mu\text{A}, I_E = 0$  | 40  |           | V                              |
| $V_{(BR)EBO}$              | Emitter-Base Breakdown Voltage       | $I_E = 10 \text{ } \mu\text{A}, I_C = 0$  | 4.5 |           | V                              |
| $I_{CBO}$                  | Collector Cutoff Current             | $V_{CB} = 20 \text{ V}, I_E = 0$<br>$V_{CB} = 20 \text{ V}, I_E = 0, T_A = 125^\circ\text{C}$ |     | 0.4<br>30 | $\mu\text{A}$<br>$\mu\text{A}$ |

## ON CHARACTERISTICS

|               |                                       |   |                |                             |                       |
|---------------|---------------------------------------|---|----------------|-----------------------------|-----------------------|
| $h_{FE}$      | DC Current Gain*                      | $I_C = 10 \text{ mA}, V_{CE} = 1.0 \text{ V}$<br>$I_C = 10 \text{ mA}, V_{CE} = 0.35 \text{ V}, T_A = -55^\circ\text{C}$<br>$I_C = 100 \text{ mA}, V_{CE} = 1.0 \text{ V}$  | 40<br>20<br>20 | 120                         |                       |
| $V_{CE(sat)}$ | Collector-Emitter Saturation Voltage* | $I_C = 10 \text{ mA}, I_B = 1.0 \text{ mA}$<br>$I_C = 10 \text{ mA}, I_B = 1.0 \text{ mA}, T_A = 125^\circ\text{C}$<br>$I_C = 30 \text{ mA}, I_B = 3.0 \text{ mA}$<br>$I_C = 100 \text{ mA}, I_B = 10 \text{ mA}$   |                | 0.2<br>0.3<br>0.25<br>0.5   | V<br>V<br>V<br>V      |
| $V_{BE(sat)}$ | Base-Emitter Saturation Voltage       | $I_C = 10 \text{ mA}, I_B = 1.0 \text{ mA}$<br>$I_C = 10 \text{ mA}, I_B = 1.0 \text{ mA}, T_A = -55^\circ\text{C}$<br>$I_C = 10 \text{ mA}, I_B = 1.0 \text{ mA}, T_A = 125^\circ\text{C}$<br>$I_C = 30 \text{ mA}, I_B = 3.0 \text{ mA}$<br>$I_C = 100 \text{ mA}, I_B = 10 \text{ mA}$ | 0.7<br>0.59    | 0.85<br>1.02<br>1.15<br>1.6 | V<br>V<br>V<br>V<br>V |

## SMALL SIGNAL CHARACTERISTICS

|           |                           |   |     |     |    |
|-----------|---------------------------|---|-----|-----|----|
| $C_{obo}$ | Output Capacitance        | $V_{CB} = 5.0 \text{ V}, I_E = 0, f = 1.0 \text{ MHz}$  |     | 4.0 | pF |
| $C_{ibo}$ | Input Capacitance         | $V_{EB} = 0.5 \text{ V}, I_C = 0, f = 1.0 \text{ MHz}$  |     | 5.0 | pF |
| $h_{fe}$  | Small-Signal Current Gain | $I_C = 10 \text{ mA}, V_{CE} = 10 \text{ V},$<br>$R_G = 2.0 \text{ k}\Omega, f = 100 \text{ MHz}$ | 5.0 |     |    |

## SWITCHING CHARACTERISTICS

|           |               |  |  |    |    |
|-----------|---------------|--|--|----|----|
| $t_s$     | Storage Time  | $I_{B1} = I_{B2} = I_C = 10 \text{ mA}$  |  | 13 | ns |
| $t_{on}$  | Turn-On Time  | $V_{CC} = 3.0 \text{ V}, I_C = 10 \text{ mA},$<br>$I_{B1} = 3.0 \text{ mA}$                          |  | 12 | ns |
| $t_{off}$ | Turn-Off Time | $V_{CC} = 3.0 \text{ V}, I_C = 10 \text{ mA},$<br>$I_{B1} = 3.0 \text{ mA}, I_{B2} = 1.5 \text{ mA}$ |  | 18 | ns |

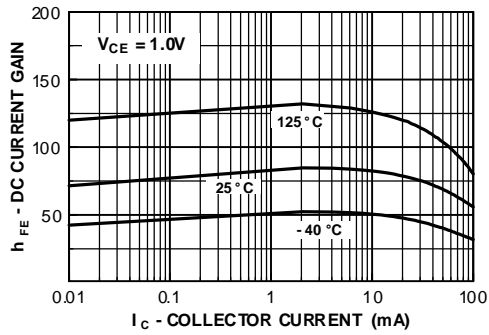
\*Pulse Test: Pulse Width  $\leq 300 \text{ } \mu\text{s}$ , Duty Cycle  $\leq 2.0\%$

## Spice Model

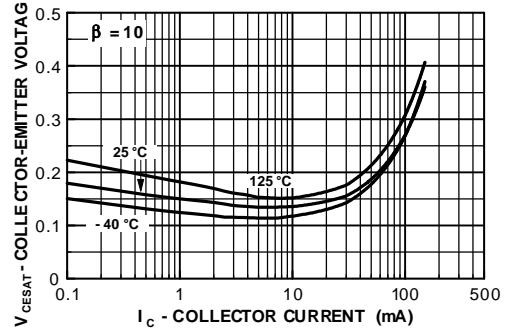
NPN (Is=44.14f Xti=3 Eg=1.11 Vaf=100 Bf=78.32 Ne=1.389 Ise=91.95f Ikf=.3498 Xtb=1.5 Br=12.69m Nc=2 Isc=0 Ikr=0 Rc=.6 Cjc=2.83p Mjc=86.19m Vjc=.75 Fc=.5 Cje=4.5p Mje=.2418 Vje=.75 Tr=1.073u Tf=227.6p Itf=.3 Vtf=4 Xtf=4 Rb=10)

Typical Characteristics

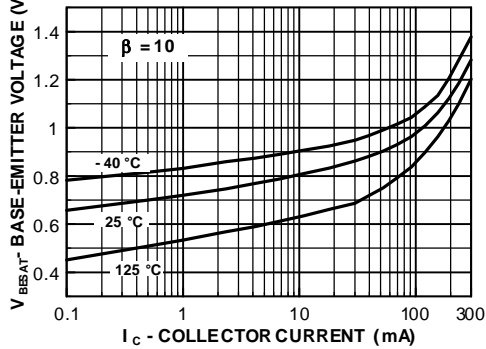
DC Current Gain vs Collector Current



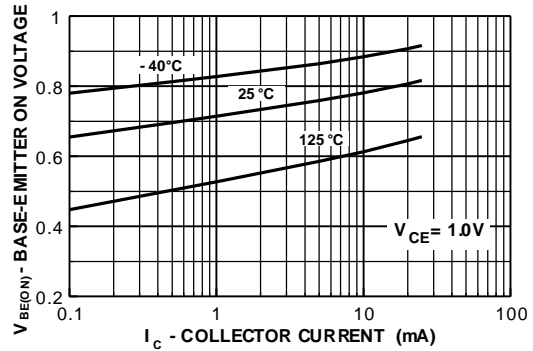
Collector-Emitter Saturation Voltage vs Collector Current



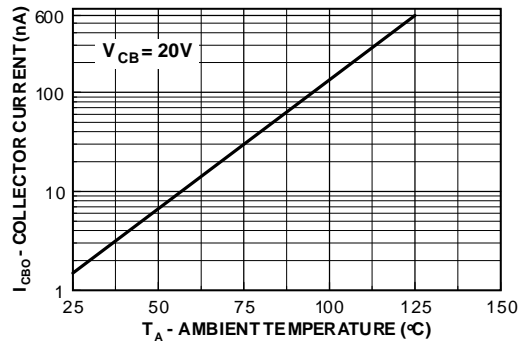
Base-Emitter Saturation Voltage vs Collector Current



Base-Emitter ON Voltage vs Collector Current



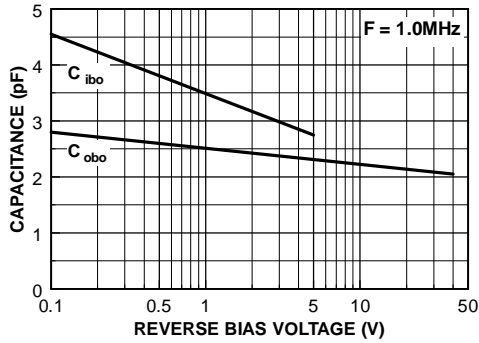
Collector-Cut off Current vs Ambient Temperature



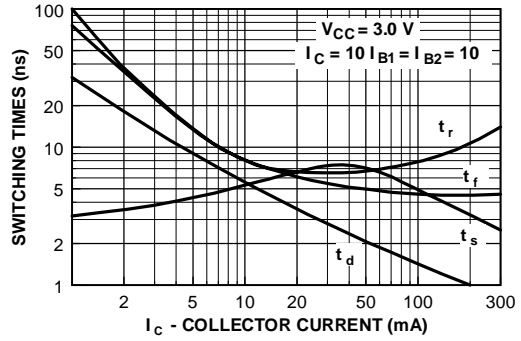
NPN Switching Transistor  
(continued)

Typical Characteristics (continued)

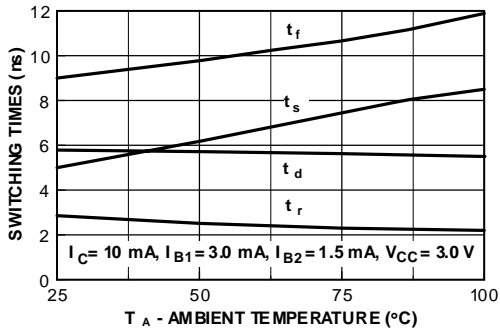
Output Capacitance vs Reverse Bias Voltage



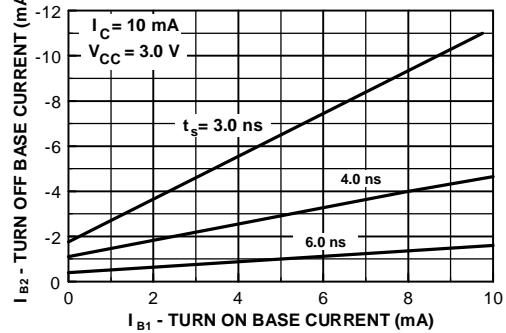
Switching Times vs Collector Current



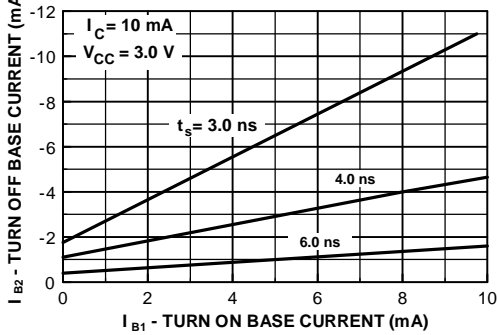
Switching Times vs Ambient Temperature



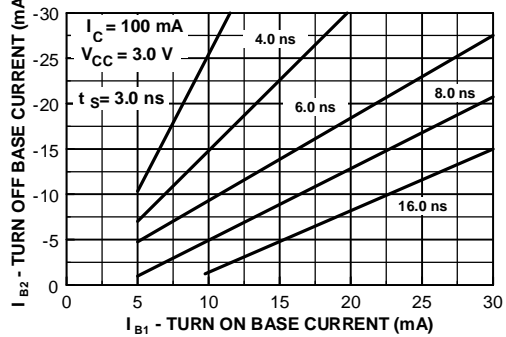
Storage Time vs Turn On and Turn Off Base Currents



Storage Time vs Turn On and Turn Off Base Currents

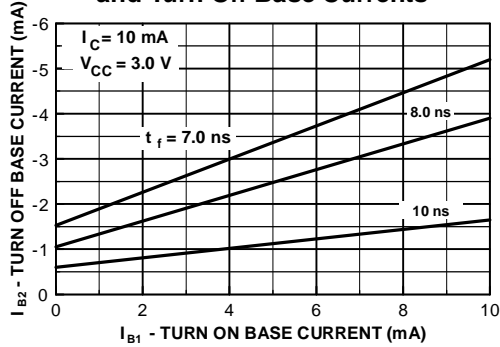


Storage Time vs Turn On and Turn Off Base Currents

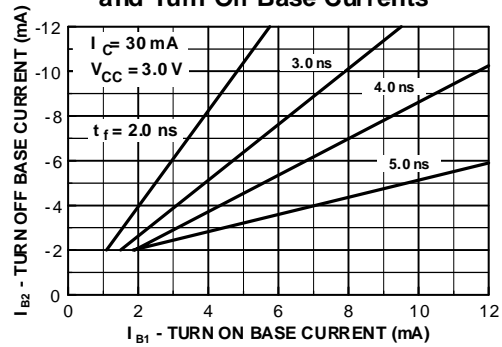


Typical Characteristics (continued)

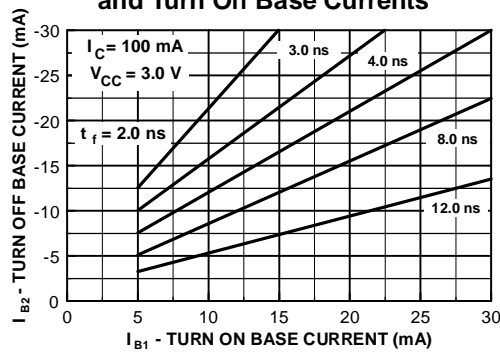
Fall Time vs Turn On and Turn Off Base Currents



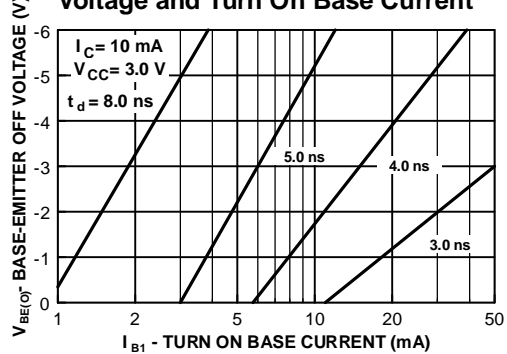
Fall Time vs Turn On and Turn Off Base Currents



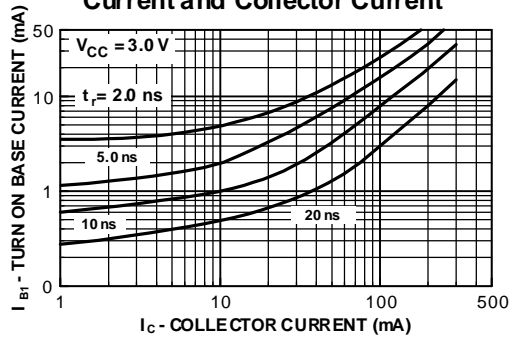
Fall Time vs Turn On and Turn Off Base Currents



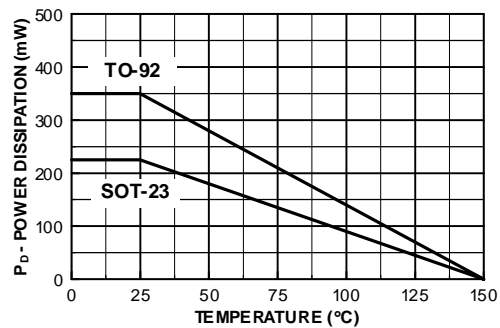
Delay Time vs Base-Emitter OFF Voltage and Turn On Base Current



Rise Time vs. Turn On Base Current and Collector Current



Power Dissipation vs Ambient Temperature



Test Circuits

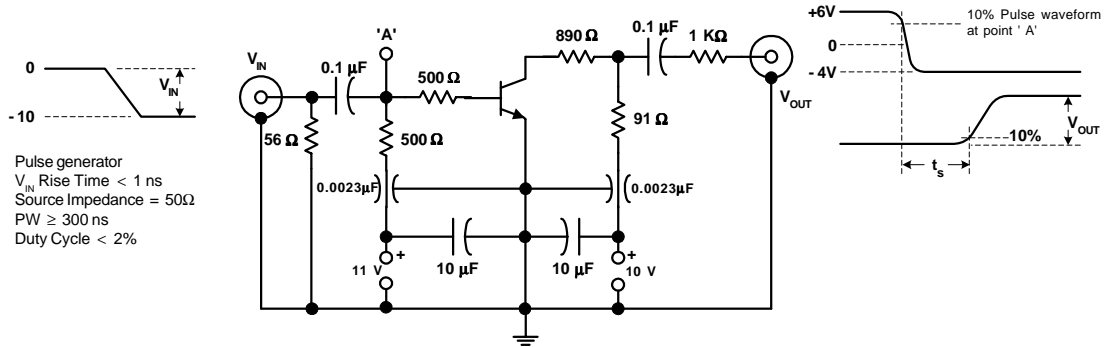


FIGURE 1: Charge Storage Time Measurement Circuit

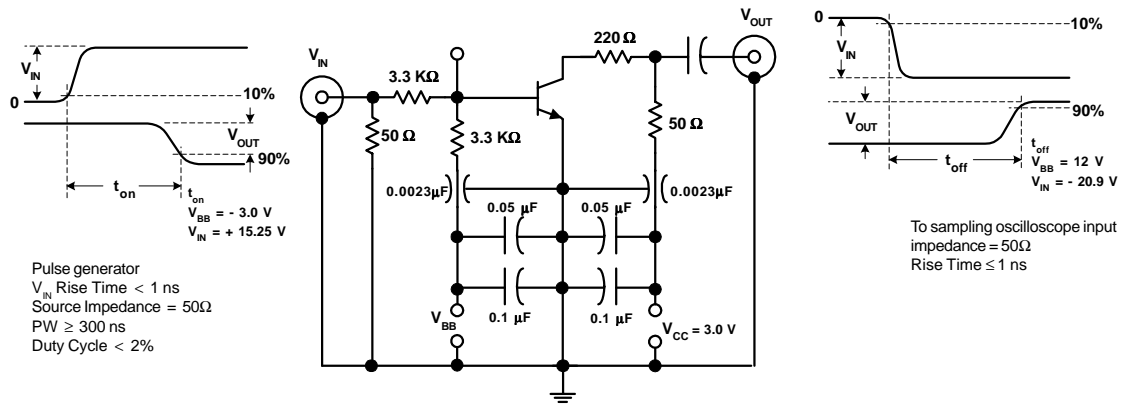


FIGURE 2:  $t_{ON}$ ,  $t_{OFF}$  Measurement Circuit

# TO-92 Tape and Reel Data



## TO-92 Packaging Configuration: Figure 1.0

FSCINT Label sample



F63TNR Label sample



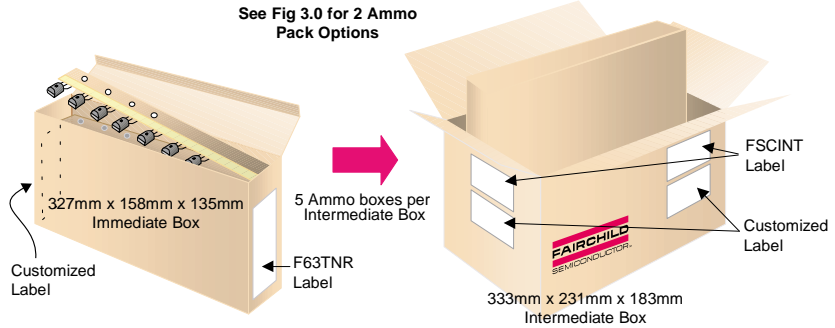
### TO-92 TNR/AMMO PACKING INFORMATION

| 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 = 0.22 gm  
 Reel weight with components = 1.04 kg  
 Ammo weight with components = 1.02 kg  
 Max quantity per intermediate box = 10,000 units

### AMMO PACK OPTION

See Fig 3.0 for 2 Ammo Pack Options

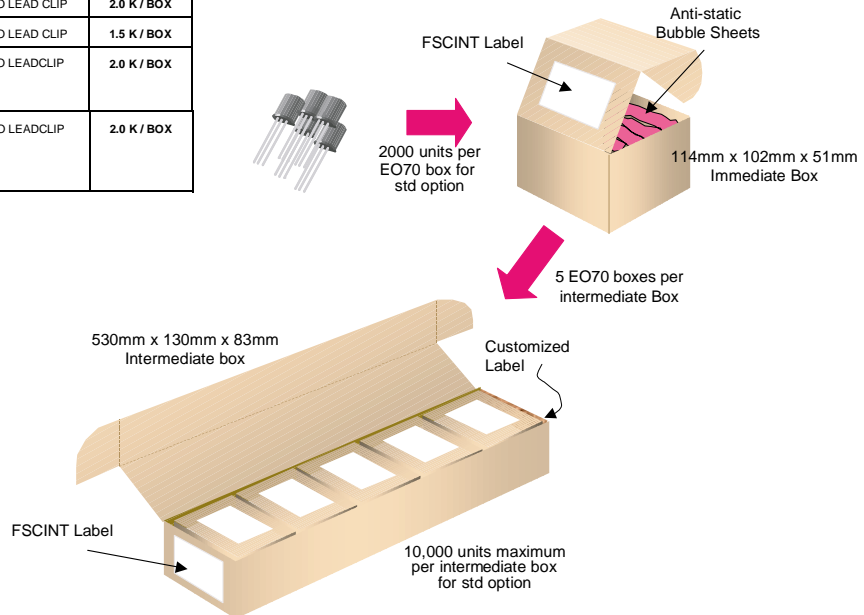


### (TO-92) BULK PACKING INFORMATION

| EOL CODE    | DESCRIPTION   | LEADCLIP DIMENSION | QUANTITY    |
|-------------|---|--------------------|-------------|
| J18Z        | TO-18 OPTION STD  | NO LEAD CLIP       | 2.0 K / BOX |
| J05Z        | TO-5 OPTION STD   | NO LEAD CLIP       | 1.5 K / BOX |
| NO EOL CODE | TO-92 STANDARD STRAIGHT FOR: PKG 92, 94 (NON PROELECTRON SERIES), 96                  | NO LEADCLIP        | 2.0 K / BOX |
| L34Z        | TO-92 STANDARD STRAIGHT FOR: PKG 94 (PROELECTRON SERIES BCXXX, BFXXX, BSRXXX), 97, 98 | NO LEADCLIP        | 2.0 K / BOX |

### BULK OPTION

See Bulk Packing Information table



## TO-92 Tape and Reel Data, continued

### TO-92 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-92 Radial Ammo Packaging

Configuration: Figure 3.0

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



ORDER STYLE  
D74Z (M)

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

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



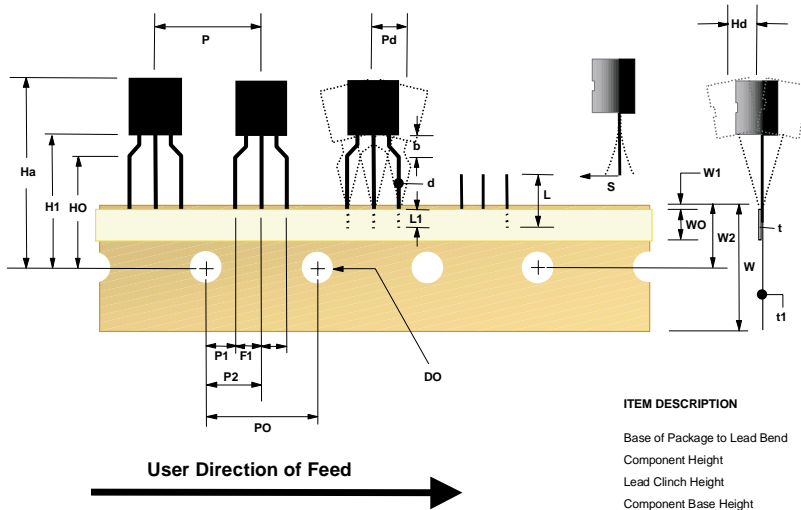
ORDER STYLE  
D75Z (P)

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



# TO-92 Tape and Reel Data, continued

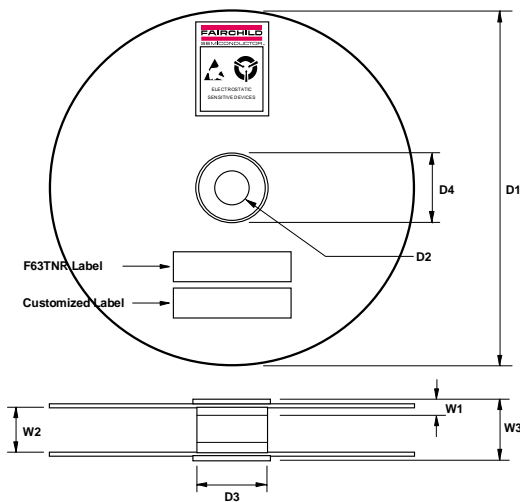
## TO-92 Tape and Reel Taping Dimension Configuration: Figure 4.0



| ITEM DESCRIPTION                   | SYMBOL | DIMENSION              |
|------------------------------------|--------|------------------------|
| Base of Package to Lead Bend       | b      | 0.098 (max)            |
| Component Height                   | Ha     | 0.928 (+/- 0.025)      |
| 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) |
| Cut 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             | WO     | 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-92 Reel Configuration: Figure 5.0



| ITEM DESCRIPTION               | SYMBOL | MINIMUM | MAXIMUM |
|--------------------------------|--------|---------|---------|
| Reel Diameter                  | D1     | 13.975  | 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-92 Package Dimensions



## TO-92 (FS PKG Code 92, 94, 96)



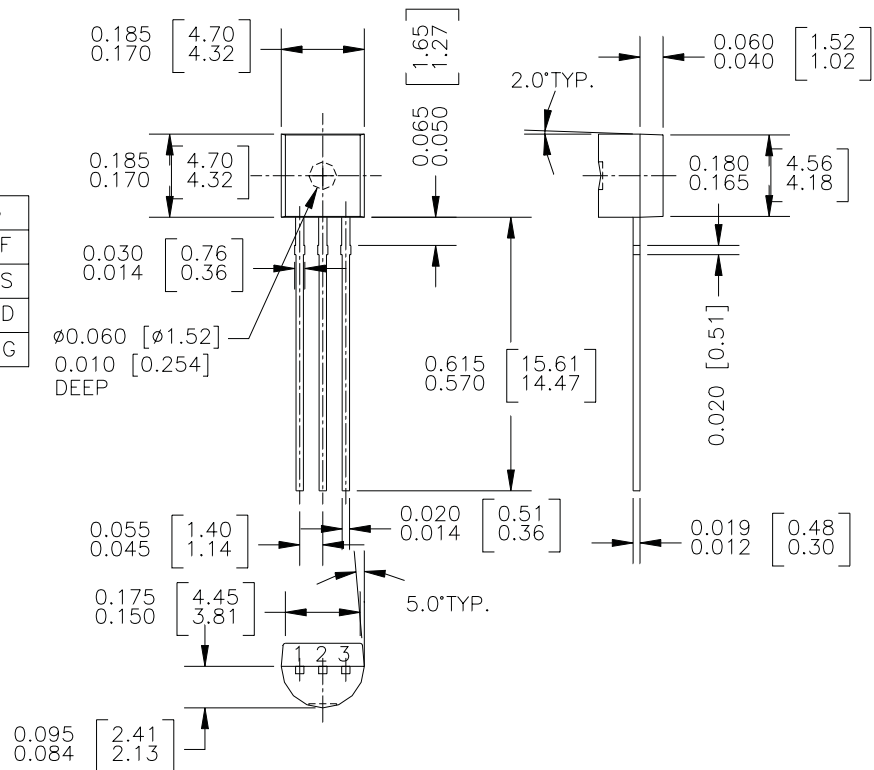
Scale 1:1 on letter size paper

Dimensions shown below are in:  
inches [millimeters]

Part Weight per unit (gram): 0.1977

TO-92 (92,94,96)

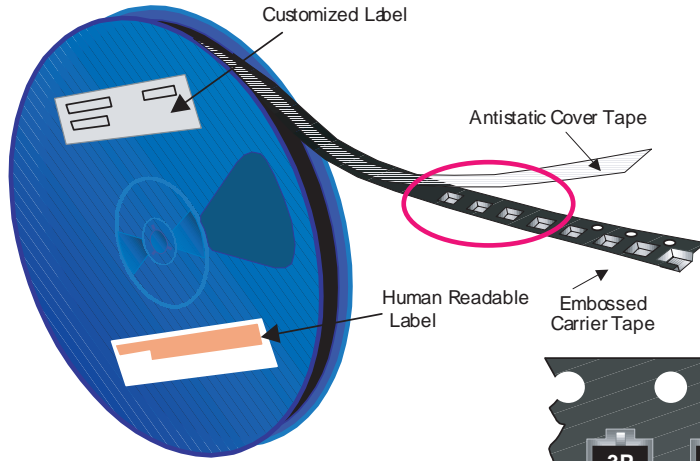
| PIN | 92 |   | 94 |   | 96 |   |
|-----|----|---|----|---|----|---|
|     | B  | F | B  | F | B  | F |
| 1   | E  | D | E  | D | B  | S |
| 2   | B  | S | C  | G | E  | D |
| 3   | C  | G | B  | S | C  | G |



# SOT-23 Tape and Reel Data



## SOT-23 Packaging Configuration: Figure 10



### Packaging Description:

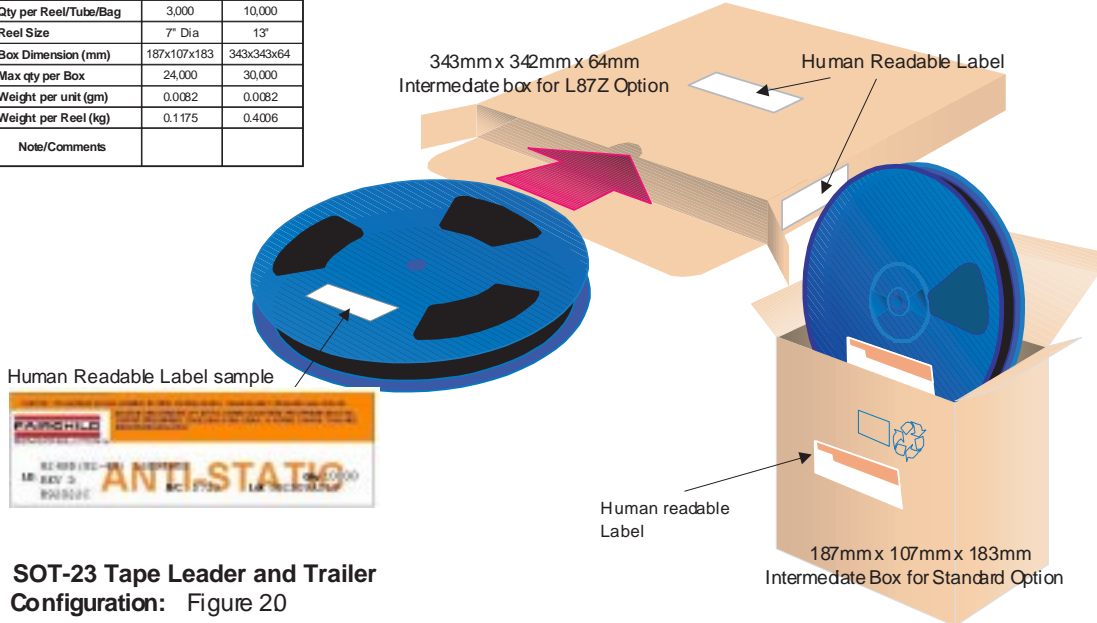
SOT-23 parts are shipped in tape. The carrier tape is made from a dissipative (carbon filled) polycarbonate resin. The cover tape is a multilayer film (Heat Activated Adhesive in nature) primarily composed of polyester film, adhesive layer, sealant, and anti-static sprayed agent. These reeled parts in standard option are shipped with 3,000 units per 7" or 177mm diameter reel. The reels are dark blue in color and is made of polystyrene plastic (anti-static coated). Other option comes in 10,000 units per 13" or 330mm diameter reel. This and some other options are described in the Packaging Information table.

These full reels are individually labeled and placed inside a standard intermediate made of recyclable corrugated brown paper with a Fairchild logo printing. One pizza box contains eight reels maximum. And these intermediate boxes are placed inside a labeled shipping box which comes in different sizes depending on the number of parts shipped.

| SOT-23 Packaging Information |                         |            |
|------------------------------|-------------------------|------------|
| Packaging Option             | Standard (no flow code) | D87Z       |
| Packaging type               | TNR                     | TNR        |
| Qty per Reel/Tube/Bag        | 3,000                   | 10,000     |
| Reel Size                    | 7" Dia                  | 13"        |
| Box Dimension (mm)           | 187x107x183             | 343x343x64 |
| Max qty per Box              | 24,000                  | 30,000     |
| Weight per unit (gm)         | 0.0082                  | 0.0082     |
| Weight per Reel (kg)         | 0.1175                  | 0.4006     |
| Note/Comments                |                         |            |



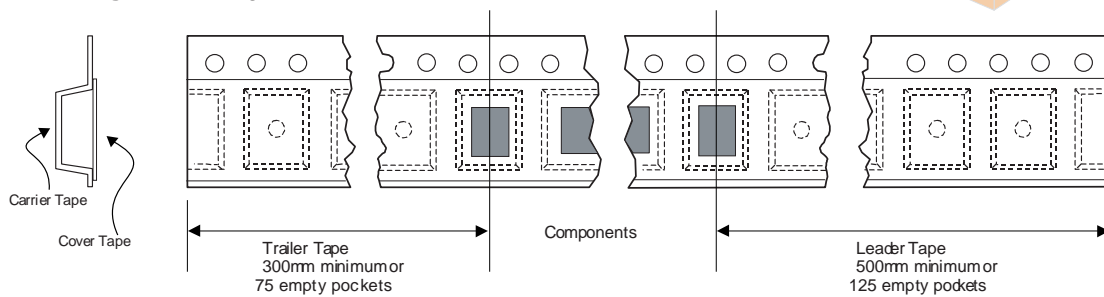
### SOT-23 Unit Orientation



Human Readable Label sample



## SOT-23 Tape Leader and Trailer Configuration: Figure 20



# SOT-23 Tape and Reel Data, continued

## SOT-23 Embossed Carrier Tape Configuration: Figure 3.0



Dimensions are in millimeter

| Pkg type     | A0            | B0            | W           | D0            | D1              | E1            | E2          | F             | P1          | P0          | K0            | T               | Wc          | Tc            |
|--------------|---------------|---------------|-------------|---------------|-----------------|---------------|-------------|---------------|-------------|-------------|---------------|-----------------|-------------|---------------|
| SOT-23 (8mm) | 3.15<br>±0.10 | 2.77<br>±0.10 | 8.0<br>±0.3 | 1.55<br>±0.05 | 1.125<br>±0.125 | 1.75<br>±0.10 | 6.25<br>min | 3.50<br>±0.05 | 4.0<br>±0.1 | 4.0<br>±0.1 | 1.30<br>±0.10 | 0.228<br>±0.013 | 5.2<br>±0.3 | 0.06<br>±0.02 |

Notes: A0, B0, and K0 dimensions are determined with respect to the EIA/Jedec RS-481 rotational and lateral movement requirements (see sketches A, B, and C).



Sketch A (Side or Front Sectional View)  
Component Rotation

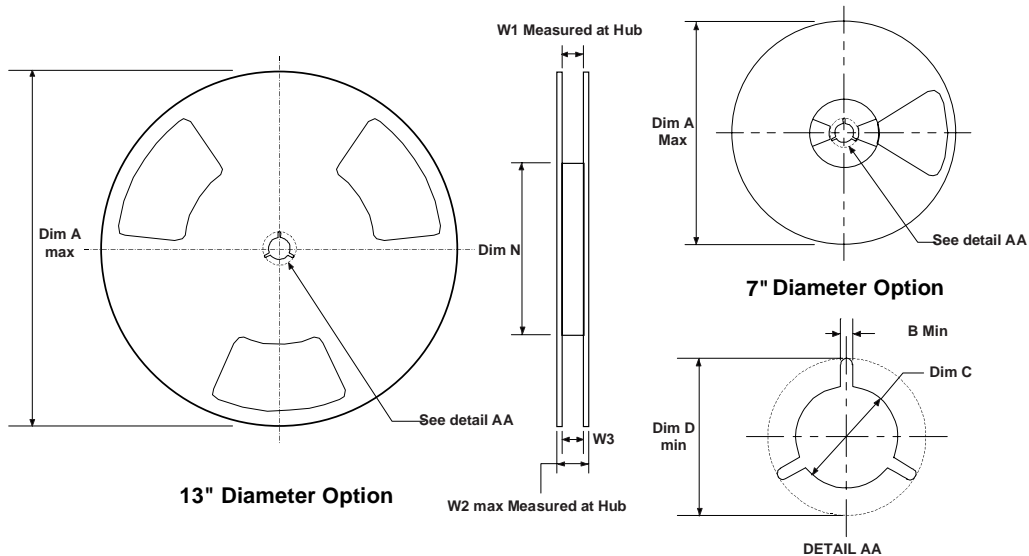


Sketch B (Top View)  
Component Rotation



Sketch C (Top View)  
Component lateral movement

## SOT-23 Reel Configuration: Figure 4.0



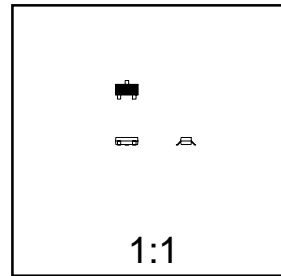
Dimensions are in inches and millimeters

| Tape Size | Reel Option | Dim A         | Dim B        | Dim C                             | Dim D         | Dim N       | Dim W1                            | Dim W2        | Dim W3 (LSL-USL)            |
|-----------|-------------|---------------|--------------|-----------------------------------|---------------|-------------|-----------------------------------|---------------|-----------------------------|
| 8mm       | 7" Dia      | 7.00<br>177.8 | 0.059<br>1.5 | 512 +0.020/-0.008<br>13 +0.5/-0.2 | 0.795<br>20.2 | 2.165<br>55 | 0.331 +0.059/-0.000<br>8.4 +1.5/0 | 0.567<br>14.4 | 0.311 - 0.429<br>7.9 - 10.9 |
| 8mm       | 13" Dia     | 13.00<br>330  | 0.059<br>1.5 | 512 +0.020/-0.008<br>13 +0.5/-0.2 | 0.795<br>20.2 | 4.00<br>100 | 0.331 +0.059/-0.000<br>8.4 +1.5/0 | 0.567<br>14.4 | 0.311 - 0.429<br>7.9 - 10.9 |

# SOT-23 Package Dimensions



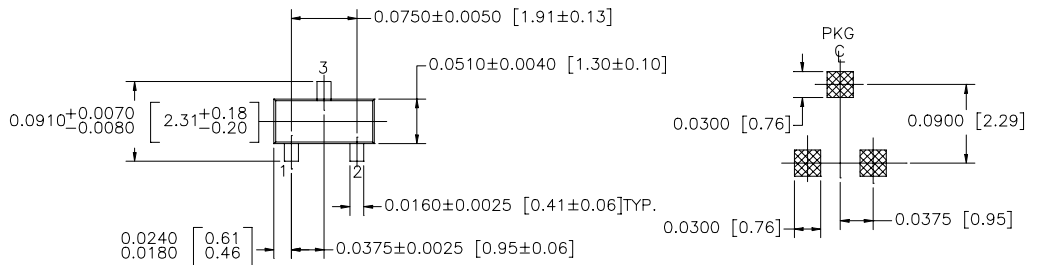
## SOT-23 (FS PKG Code 49)



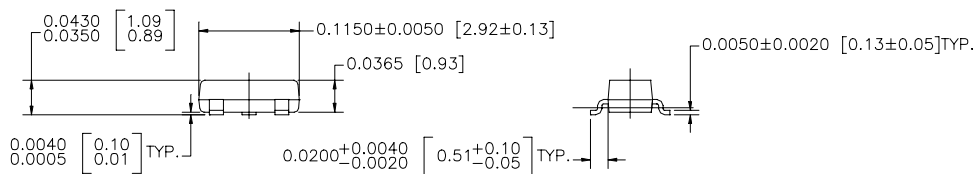
Scale 1:1 on letter size paper

Dimensions shown below are in:  
inches [millimeters]

Part Weight per unit (gram): 0.0082



LAND PATTERN RECOMMENDATION



CONTROLLING DIMENSION IS INCH  
VALUES IN [ ] ARE MILLIMETERS

SOT 23, 3 LEADS LOW PROFILE

NOTE : UNLESS OTHERWISE SPECIFIED

- STANDARD LEAD FINISH 150 MICRONS / 3.81 MICROMETERS  
MINIMUM TIN / LEAD (SOLDER) ON ALLOY 42
- REFERENCE JEDEC REGISTRATION TO-236, VARIATION AB, ISSUE G, DATED JUL 1993

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|-----------------------------------|----------------------------------|----------------------------------|-------------------------|
| ACE <sup>x</sup> <sup>TM</sup>    | FAST <sup>r</sup> <sup>TM</sup>  | PowerTrench <sup>®</sup>         | SyncFET <sup>TM</sup>   |
| Bottomless <sup>TM</sup>          | GlobalOptoisolator <sup>TM</sup> | QFET <sup>TM</sup>               | TinyLogic <sup>TM</sup> |
| CoolFET <sup>TM</sup>             | GTO <sup>TM</sup>                | QS <sup>TM</sup>                 | UHC <sup>TM</sup>       |
| CROSSVOLT <sup>TM</sup>           | HiSeC <sup>TM</sup>              | QT Optoelectronics <sup>TM</sup> | VCX <sup>TM</sup>       |
| DOME <sup>TM</sup>                | ISOPLANAR <sup>TM</sup>          | Quiet Series <sup>TM</sup>       |                         |
| E <sup>2</sup> CMOS <sup>TM</sup> | MICROWIRE <sup>TM</sup>          | SILENT SWITCHER <sup>®</sup>     |                         |
| EnSigna <sup>TM</sup>             | OPTOLOGIC <sup>TM</sup>          | SMART START <sup>TM</sup>        |                         |
| FACT <sup>TM</sup>                | OPTOPLANAR <sup>TM</sup>         | SuperSOT <sup>TM</sup> -3        |                         |
| FACT Quiet Series <sup>TM</sup>   | PACMAN <sup>TM</sup>             | SuperSOT <sup>TM</sup> -6        |                         |
| FAST <sup>®</sup>                 | POP <sup>TM</sup>                | SuperSOT <sup>TM</sup> -8        |                         |

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2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

## PRODUCT STATUS DEFINITIONS

### Definition of Terms

| Datasheet Identification | Product Status         | Definition  |
|--------------------------|------------------------|---|
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