DATA SHEET
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## Bipolar Transistor

## (-)50 V, (-)2 A, Low VCE(sat), (PNP)NPN Single PCP

## 2SB1123/2SD1623

## Features

- Adoption of FBET, MBIT Processes
- Large Current Capacity and Wide ASO
- The Ultraminiature Package Facilitates Higher-density Mounting, Thus Allows the Applied Hybrid IC's Further Miniaturization
- Low Collector-to-Emitter Saturation Voltage
- Fast Switching Speed
- These are Pb -Free Devices


## Applications

- Voltage Regulators, Relay Drivers, Lamp Drivers, Electrical Equipment

ABSOLUTE MAXIMUM RATINGS (at $\mathrm{Ta}=25^{\circ} \mathrm{C}$ )

| Parameter | Symbol | Conditions | Ratings | Unit |
| :---: | :---: | :---: | :---: | :---: |
| Collector-to-Base Voltage | $\mathrm{V}_{\text {CBO }}$ |  | (-)60 | V |
| Collector-to-Emitter Voltage | $\mathrm{V}_{\text {CEO }}$ |  | (-)50 | V |
| Emitter-to-Base <br> Voltage | $\mathrm{V}_{\text {EBO }}$ |  | (-)6 | V |
| Collector Current | $\mathrm{I}_{\mathrm{C}}$ |  | $(-) 2$ | A |
| Collector Current (Pulse) | $I_{\text {CP }}$ |  | (-)4 | A |
| Collector Dissipation | $\mathrm{P}_{\mathrm{C}}$ |  | 0.5 | W |
|  |  | When mounted on ceramic substrate $\left(250 \mathrm{~mm}^{2} \times 0.8 \mathrm{~mm}\right)$ | 1.3 | W |
| Junction Temperature | Tj |  | 150 | ${ }^{\circ} \mathrm{C}$ |
| Storage Temperature | Tstg |  | -55 to +150 | ${ }^{\circ} \mathrm{C}$ |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.
NOTE: Specifications ( ): 2SB1123


ELECTRICAL CONNECTION



2SD1623

ORDERING INFORMATION

| Device | Package | Shipping $^{\dagger}$ |
| :---: | :---: | :---: |
| 2SB1123S-TD-E | PCP <br> (Pb-Free) | $1,000 /$ <br> Tape \& Reel |
| 2SB1123T-TD-E | PCP <br> (Pb-Free) | $1,000 /$ <br> Tape \& Reel |
| 2SD1623S-TD-E | PCP <br> (Pb-Free) | $1,000 /$ <br> Tape \& Reel |
| 2SD1623T-TD-E | PCP <br> (Pb-Free) | $1,000 /$ <br> Tape \& Reel |

$\dagger$ 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.

ELECTRICAL CHARACTERISTICS (at $\mathrm{Ta}=25^{\circ} \mathrm{C}$ )

| Parameter | Symbol | Conditions | Ratings |  |  | Unit |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | Min | Typ | Max |  |
| Collector Cutoff Current | $\mathrm{I}_{\text {cbo }}$ | $\mathrm{V}_{\mathrm{CB}}=(-) 50 \mathrm{~V}, \mathrm{I}_{\mathrm{E}}=0 \mathrm{~A}$ | - | - | (-)100 | nA |
| Emitter Cutoff Current | Iebo | $\mathrm{V}_{\mathrm{EB}}=(-) 4 \mathrm{~V}, \mathrm{I}_{\mathrm{C}}=0 \mathrm{~A}$ | - | - | (-)100 | nA |
| DC Current Gain | $\mathrm{h}_{\text {FE }} 1$ | $\mathrm{V}_{\text {CE }}=(-) 2 \mathrm{~V}, \mathrm{I}_{\mathrm{C}}=(-) 100 \mathrm{~mA}$ | 100* | - | 560* | - |
|  | $\mathrm{hFE}^{2}$ | $\mathrm{V}_{\text {CE }}=(-) 2 \mathrm{~V}, \mathrm{I}_{\mathrm{C}}=(-) 1.5 \mathrm{~A}$ | 40 | - | - | - |
| Gain-Bandwidth Product | $\mathrm{f}_{\mathrm{T}}$ | $\mathrm{V}_{\text {CE }}=(-) 10 \mathrm{~V}, \mathrm{I}_{\mathrm{C}}=(-) 50 \mathrm{~mA}$ | - | 150 | - | MHz |
| Output Capacitance | Cob | $\mathrm{V}_{\mathrm{CB}}=(-) 10 \mathrm{~V}, \mathrm{f}=1 \mathrm{MHz}$ | - | (22)12 | - | pF |
| Collector-to-Emitter Saturation Voltage | $\mathrm{V}_{\text {CE }}$ (sat) | $\mathrm{I}_{\mathrm{C}}=(-) 1 \mathrm{~A}, \mathrm{I}_{\mathrm{B}}=(-) 50 \mathrm{~mA}$ | - | (-0.3)0.15 | (-0.7)0.4 | V |
| Base-to-Emitter Saturation Voltage | $\mathrm{V}_{\text {BE }}$ (sat) | $\mathrm{I}_{\mathrm{C}}=(-) 1 \mathrm{~A}, \mathrm{I}_{\mathrm{B}}=(-) 50 \mathrm{~mA}$ | - | (-)0.9 | (-)1.2 | V |
| Collector-to-Base Breakdown Voltage | $\mathrm{V}_{\text {(BR) }{ }^{\text {CBO }}}$ | $\mathrm{I}_{\mathrm{C}}=(-) 10 \mu \mathrm{~A}, \mathrm{I}_{\mathrm{E}}=0 \mathrm{~A}$ | (-)60 | - | - | V |
| Collector-to-Emitter Breakdown Voltage | $V_{\text {(BR)CEO }}$ | $\mathrm{I}_{\mathrm{C}}=(-) 1 \mathrm{~mA}, \mathrm{R}_{\mathrm{BE}}=\infty$ | (-)50 | - | - | V |
| Emitter-to-Base Breakdown Voltage | $V_{\text {(BR)EBO }}$ | $\mathrm{I}_{\mathrm{E}}=(-) 10 \mu \mathrm{~A}, \mathrm{I}_{\mathrm{C}}=0 \mathrm{~A}$ | (-)6 | - | - | V |
| Turn-ON Time | $\mathrm{t}_{\text {on }}$ | See specified Test Circuit. | - | (60)60 | - | ns |
| Storage Time | $\mathrm{t}_{\text {stg }}$ |  | - | (450)550 | - | ns |
| Fall Time | $\mathrm{t}_{\mathrm{f}}$ |  | - | (30)30 | - | ns |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.
NOTE: Specifications (): 2SB1123
*The 2SB1123/2SD1623 are classified by $100 \mathrm{~mA} \mathrm{~h}_{\text {FE }}$ as follows :

Table 1.

| Rank | R | $\mathbf{S}$ | $\mathbf{T}$ | U |
| :---: | :---: | :---: | :---: | :---: |
| $\mathrm{h}_{\text {FE }}$ | 100 to 200 | 140 to 280 | 200 to 400 | 280 to 560 |

## Switching Time Test Circuit


$\mathrm{I}_{\mathrm{C}}=10 \mathrm{I}_{\mathrm{B} 1}=-10 \mathrm{I}_{\mathrm{B} 2}=500 \mathrm{~mA}$
(For PNP, the polarity is reversed)

$\mathrm{V}_{\mathrm{CE}}$, Collector-to-Emitter Voltage (V)
Figure 1. $\mathrm{I}_{\mathrm{C}}-\mathrm{V}_{\mathrm{CE}}$


Figure 3. $\mathrm{I}_{\mathrm{C}}-\mathrm{V}_{\mathbf{C E}}$

$\mathrm{V}_{\mathrm{BE}}$, Base-to-Emitter Voltage ( V )
Figure 5. $\mathrm{I}_{\mathrm{C}}-\mathrm{V}_{\mathrm{BE}}$

$\mathrm{V}_{\mathrm{CE}}$, Collector-to-Emitter Voltage (V)
Figure 2. $\mathrm{I}_{\mathrm{C}}-\mathrm{V}_{\mathrm{CE}}$


Figure 4. $I_{C}-V_{C E}$

$\mathrm{V}_{\mathrm{BE}}$, Base-to-Emitter Voltage ( V )
Figure 6. $\mathrm{I}_{\mathrm{C}}-\mathrm{V}_{\mathrm{BE}}$


Figure 7. $\mathbf{h F E}_{\mathrm{FE}}-\mathrm{I}_{\mathrm{C}}$


Figure $9 . \mathbf{f}_{\mathrm{T}}-\mathrm{I}_{\mathbf{C}}$


Figure 11. Cob - $\mathrm{V}_{\mathrm{CB}}$


Figure 8. $\mathbf{h F E}_{\mathrm{FE}}-\mathrm{I}_{\mathbf{C}}$


Figure 10. $\mathrm{f}_{\mathrm{T}}-\mathrm{I}_{\mathrm{C}}$


Figure 12. Cob - $\mathrm{V}_{\mathrm{CB}}$


Figure 13. $\mathrm{V}_{\mathrm{CE} \text { (sat) }}-\mathrm{I}_{\mathrm{C}}$

$\mathrm{V}_{\mathrm{CE}}$, Collector-to-Emitter Voltage (V)
Figure 15. ASO



Figure 14. $\mathrm{V}_{\mathrm{CE}(\mathrm{Sat})}-\mathrm{I}_{\mathrm{C}}$


Figure 16. $\mathrm{P}_{\mathrm{C}}-\mathrm{Ta}$

Figure 17. $\mathrm{P}_{\mathrm{C}}-\mathrm{Ta}$


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