

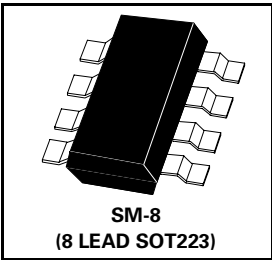
# SM-8 BIPOLAR TRANSISTOR H-BRIDGE

ZHB6792

PRELIMINARY DATA SHEET ISSUE A MAY 1998

## FEATURES

- \* Compact package
- \* Low on state losses
- \* Low drive requirements
- \* Operates up to 70V supply
- \* 1 Amp continuous rating

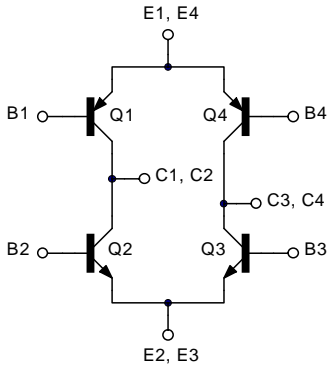


PARTMARKING DETAIL – ZHB6792

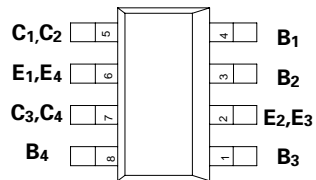
## ABSOLUTE MAXIMUM RATINGS.

| PARAMETER                               | SYMBOL         | NPNs        | PNPs | UNIT |
|---|----------------|-------------|------|------|
| Collector-Base Voltage                  | $V_{CBO}$      | 70          | -70  | V    |
| Collector-Emitter Voltage               | $V_{CEO}$      | 70          | -70  | V    |
| Emitter-Base Voltage                    | $V_{EBO}$      | 5           | -5   | V    |
| Peak Pulse Current                      | $I_{CM}$       | 2           | -2   | A    |
| Continuous Collector Current            | $I_C$          | 1           | -1   | A    |
| Operating and Storage Temperature Range | $T_j; T_{stg}$ | -55 to +150 |      | °C   |

## SCHEMATIC DIAGRAM



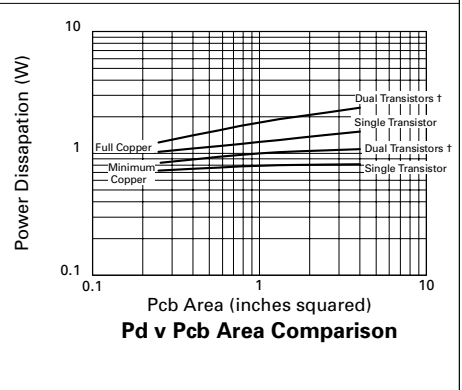
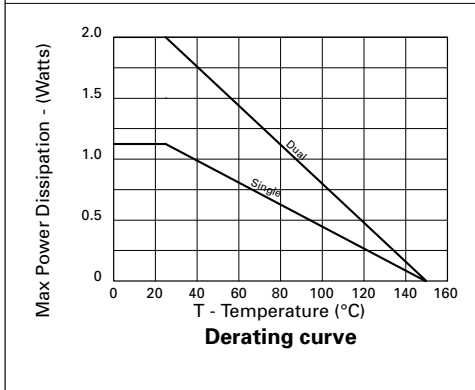
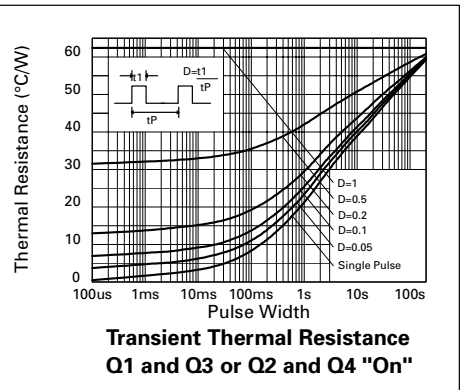
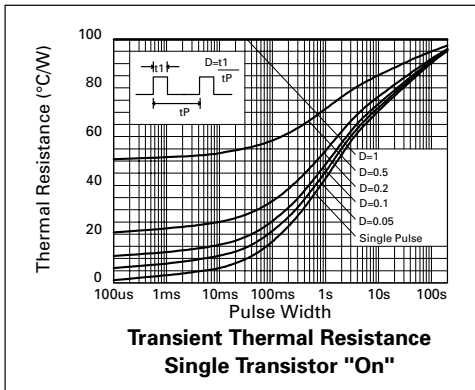
## CONNECTION DIAGRAM



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## THERMAL CHARACTERISTICS

| PARAMETER   | SYMBOL    | VALUE       | UNIT   |
|---|-----------|-------------|--|
| Total Power Dissipation at $T_{amb} = 25^{\circ}\text{C}^*$<br>Any single transistor "on"<br>Q1 and Q3 "on" or Q2 and Q4 "on" equally | $P_{tot}$ | 1.25<br>2   | W<br>W   |
| Derate above $25^{\circ}\text{C}^*$<br>Any single transistor "on"<br>Q1 and Q3 "on" or Q2 and Q4 "on" equally                         |           | 10<br>16    | mW/ $^{\circ}\text{C}$<br>mW/ $^{\circ}\text{C}$           |
| Thermal Resistance - Junction to Ambient*<br>Any single transistor "on"<br>Q1 and Q3 "on" or Q2 and Q4 "on" equally                   |           | 100<br>62.5 | $^{\circ}\text{C}/\text{W}$<br>$^{\circ}\text{C}/\text{W}$ |



\* The power which can be dissipated assuming the device is mounted in a typical manner on a PCB with copper equal to 2 inches square.

† "Two devices on" is the standard operating condition for the bridge. Eg. opposing NPN/PNP pairs turned on.

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## NPN TRANSISTORS ELECTRICAL CHARACTERISTICS (at $T_{amb} = 25^{\circ}\text{C}$ )

| PARAMETER                             | SYMBOL        | MIN.              | TYP. | MAX.        | UNIT          | TEST CONDITIONS.  |
|---------------------------------------|---------------|-------------------|------|-------------|---------------|---|
| Breakdown Voltages                    | $V_{(BR)CBO}$ | 70                |      |             | V             | $I_C = 100\mu\text{A}$  |
|                                       | $V_{(BR)CEO}$ | 70                |      |             | V             | $I_C = 10\text{mA}^*$   |
|                                       | $V_{(BR)EBO}$ | 5                 |      |             | V             | $I_E = 100\mu\text{A}$  |
| Cut-Off Currents                      | $I_{CBO}$     |                   |      | 0.1         | $\mu\text{A}$ | $V_{CB} = 55\text{V}$   |
|                                       | $I_{EBO}$     |                   |      | 0.1         | $\mu\text{A}$ | $V_{EB} = 4\text{V}$  |
| Saturation Voltages                   | $V_{CE(sat)}$ |                   |      | 0.15<br>0.5 | V<br>V        | $I_C = 0.1\text{A}, I_B = 0.5\text{mA}^*$<br>$I_C = 1\text{A}, I_B = 10\text{mA}^*$   |
|                                       | $V_{BE(sat)}$ |                   |      | 0.9         | V             | $I_C = 1\text{A}, I_B = 10\text{mA}^*$  |
| Base-Emitter Turn-On Voltage          | $V_{BE(on)}$  |                   |      | 0.9         | V             | $I_C = 1\text{A}, V_{CE} = 2\text{V}^*$   |
| Static Forward Current Transfer Ratio | $h_{FE}$      | 500<br>400<br>150 |      |             |               | $I_C = 100\text{mA}, V_{CE} = 2\text{V}^*$<br>$I_C = 500\text{mA}, V_{CE} = 2\text{V}^*$<br>$I_C = 1\text{A}, V_{CE} = 2\text{V}^*$ |
| Transition Frequency                  | $f_T$         | 150               |      |             | MHz           | $I_C = 50\text{mA}, V_{CE} = 5\text{V}, f = 50\text{MHz}$   |
| Input Capacitance                     | $C_{ibo}$     |                   | 200  |             | pF            | $V_{EB} = 0.5\text{V}, f = 1\text{MHz}$   |
| Output Capacitance                    | $C_{obo}$     |                   | 12   |             | pF            | $V_{CB} = 10\text{V}, f = 1\text{MHz}$  |
| Switching Times                       | $t_{on}$      |                   | 46   |             | ns            | $I_C = 500\text{mA}, I_{B1} = 50\text{mA}$<br>$I_{B2} = 50\text{mA}, V_{CC} = 10\text{V}$   |
|                                       | $t_{off}$     |                   | 1440 |             | ns            |   |

\*Measured under pulsed conditions. Pulse width=300 $\mu\text{s}$ . Duty cycle  $\leq 2\%$

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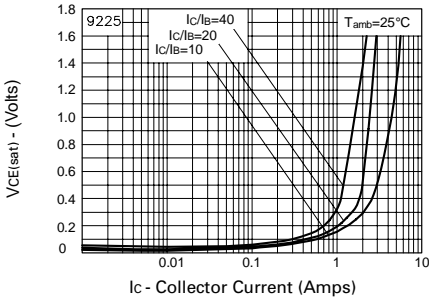
## PNP TRANSISTORS ELECTRICAL CHARACTERISTICS (at $T_{amb} = 25^{\circ}\text{C}$ )

| PARAMETER                            | SYMBOL                | MIN.              | TYP.      | MAX.          | UNIT          | CONDITIONS.  |
|--------------------------------------|-----------------------|-------------------|-----------|---------------|---------------|--|
| Collector-Base Breakdown Voltage     | $V_{(BR)CBO}$         | -75               |           |               | V             | $I_C = -100\mu\text{A}$  |
| Collector-Emitter Breakdown Voltage  | $V_{(BR)CEO}$         | -70               |           |               | V             | $I_C = -10\text{mA}^*$   |
| Emitter-Base Breakdown Voltage       | $V_{(BR)EBO}$         | -5                |           |               | V             | $I_E = -100\mu\text{A}$  |
| Collector Cut-Off Current            | $I_{CBO}$             |                   |           | -0.1          | $\mu\text{A}$ | $V_{CB} = -40\text{V}$   |
| Emitter Cut-Off Current              | $I_{EBO}$             |                   |           | -0.1          | $\mu\text{A}$ | $V_{EB} = -4\text{V}$  |
| Collector-Emitter Saturation Voltage | $V_{CE(sat)}$         |                   |           | -0.45<br>-0.5 | V<br>V        | $I_C = -500\text{mA}, I_B = -5\text{mA}^*$<br>$I_C = -1\text{A}, I_B = -25\text{mA}^*$   |
| Base-Emitter Saturation Voltage      | $V_{BE(sat)}$         |                   |           | -0.95         | V             | $I_C = -1\text{A}, I_B = -25\text{mA}^*$   |
| Base-Emitter Turn-On Voltage         | $V_{BE(on)}$          |                   | -0.75     |               | V             | $I_C = -1\text{A}, V_{CE} = -2\text{V}^*$  |
| Static Forward Current Transfer      | $h_{FE}$              | 300<br>250<br>200 |           | 800           |               | $I_C = -10\text{mA}, V_{CE} = -2\text{V}^*$<br>$I_C = -500\text{mA}, V_{CE} = -2\text{V}^*$<br>$I_C = -1\text{A}, V_{CE} = -2\text{V}^*$ |
| Transition Frequency                 | $f_T$                 | 100               |           |               | MHz           | $I_C = -50\text{mA}, V_{CE} = -5\text{V}$<br>$f = 50\text{MHz}$  |
| Input Capacitance                    | $C_{ibo}$             |                   | 225       |               | pF            | $V_{EB} = -0.5\text{V}, f = 1\text{MHz}$   |
| Output Capacitance                   | $C_{obo}$             |                   | 22        |               | pF            | $V_{CB} = -10\text{V}, f = 1\text{MHz}$  |
| Switching Times                      | $t_{on}$<br>$t_{off}$ |                   | 35<br>750 |               | ns<br>ns      | $I_C = -500\text{mA},$<br>$I_{B1} = -50\text{mA}$<br>$I_{B2} = -50\text{mA}, V_{CC} = -10\text{V}$                                       |

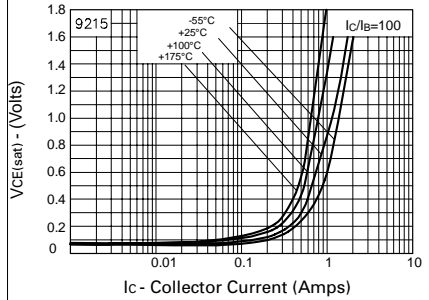
\*Measured under pulsed conditions. Pulse width=300 $\mu\text{s}$ . Duty cycle  $\leq 2\%$

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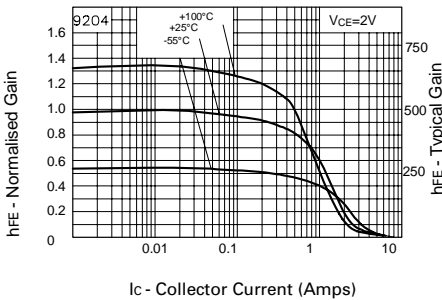
**PNP TRANSISTOR  
TYPICAL CHARACTERISTICS**



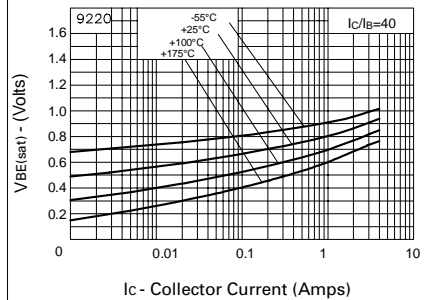
**$V_{CE(sat)}$  v  $I_C$**



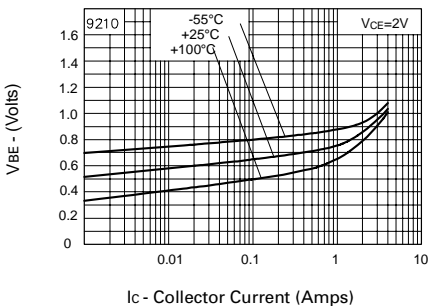
**$V_{CE(sat)}$  v  $I_C$**



**$h_{FE}$  v  $I_C$**



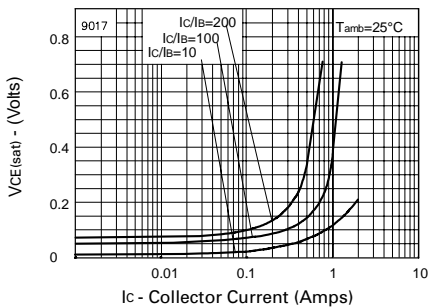
**$V_{BE(sat)}$  v  $I_C$**



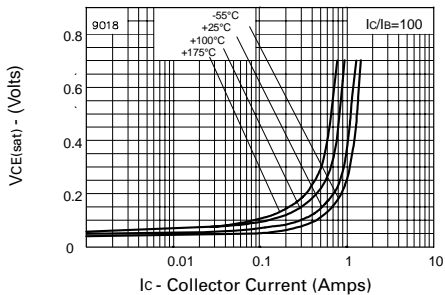
**$V_{BE(on)}$  v  $I_C$**

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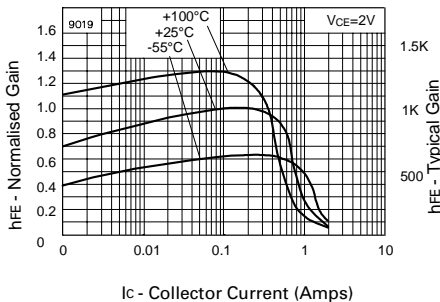
## NPN TRANSISTOR TYPICAL CHARACTERISTICS



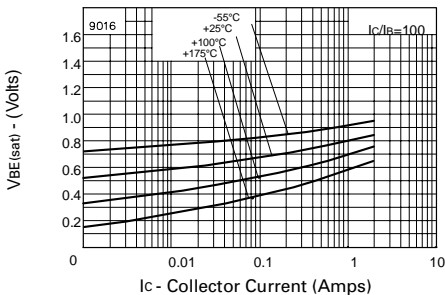
**VCE(sat) v IC**



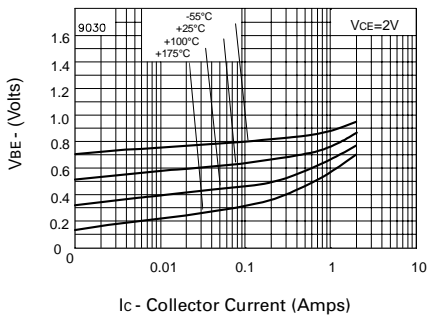
**VCE(sat) v IC**



**hFE v IC**

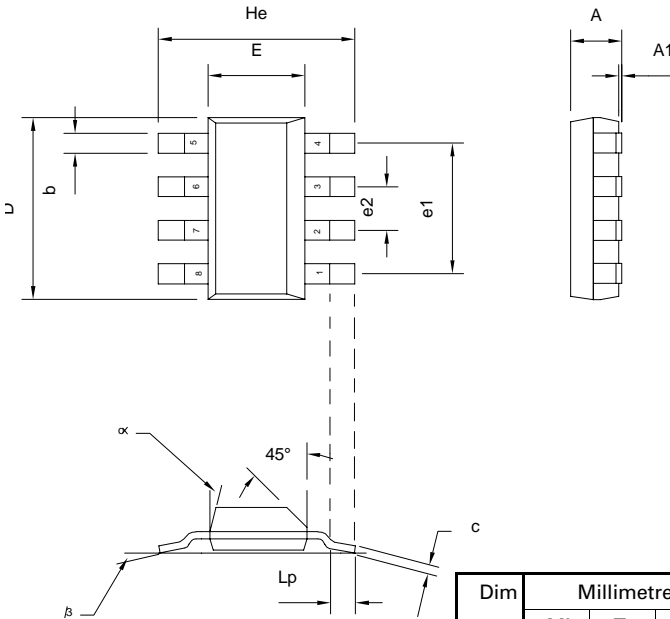


**VBE(sat) v IC**



**VBE(on) v IC**

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| Dim | Millimetres |      |      | Inches |       |       |
|-----|-------------|------|------|--------|-------|-------|
|     | Min         | Typ  | Max  | Min    | Typ   | Max   |
| A   | -           | -    | 1.7  | -      | -     | 0.067 |
| A1  | 0.02        | -    | 0.1  | 0.0008 | -     | 0.004 |
| b   | -           | 0.7  | -    | -      | 0.028 | -     |
| c   | 0.24        | -    | 0.32 | 0.009  | -     | 0.013 |
| D   | 6.3         | -    | 6.7  | 0.248  | -     | 0.264 |
| E   | 3.3         | -    | 3.7  | 0.130  | -     | 0.145 |
| e1  | -           | 4.59 | -    | -      | 0.180 | -     |
| e2  | -           | 1.53 | -    | -      | 0.060 | -     |
| He  | 6.7         | -    | 7.3  | 0.264  | -     | 0.287 |
| Lp  | 0.9         | -    | -    | 0.035  | -     | -     |

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