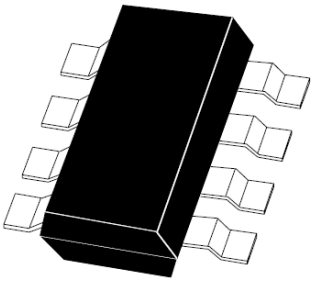
## Features

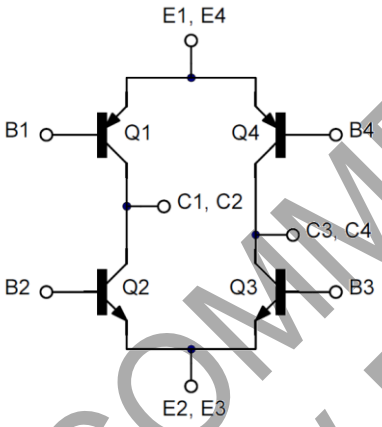
- Compact Package
- Low On-State Losses
- Low Drive Requirements
- Operates up to 40V Supply
- 2 Amp Continuous Rating
- **For automotive applications requiring specific change control (i.e. parts qualified to AEC-Q100/101/104/200, PPAP capable, and manufactured in IATF 16949 certified facilities), please contact us or your local Diodes representative. https://www.diodes.com/quality/product-definitions/**

## Mechanical Data

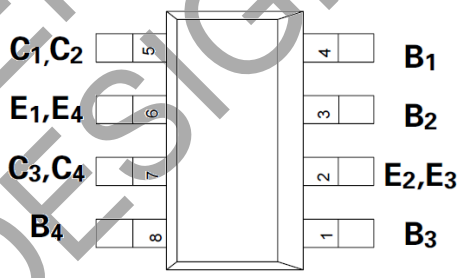
- Package: SM-8
- Package Material: Molded Plastic, UL Flammability Rating 94V-0
- Terminals: Finish – Matte Tin Plated Leads, Solderable per MIL-STD-202, Method 208 e3
- Weight: 0.117 grams (Approximate)
- Max Soldering Temperature +260°C for 30 secs as per JEDEC J-STD-020

SM-8






Schematic Diagram




Connection Diagram

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## Absolute Maximum Ratings

| Parameter | Symbol | NPNs | PNPs | Unit |
|---|---|---|---|---|
| Collector-Base Voltage | $V_{CBO}$ | 50 | -50 | V |
| Collector-Emitter Voltage | $V_{CEO}$ | 40 | -40 | V |
| Emitter-Base Voltage | $V_{EBO}$ | 5 | -5 | V |
| Peak Pulse Current | $I_{CM}$ | 6 | -6 | A |
| Continuous Collector Current | $I_C$ | 2 | -2 | A |
| Operating and Storage Temperature Range | $T_J$, $T_{STG}$ | -55 to +150 | | °C |

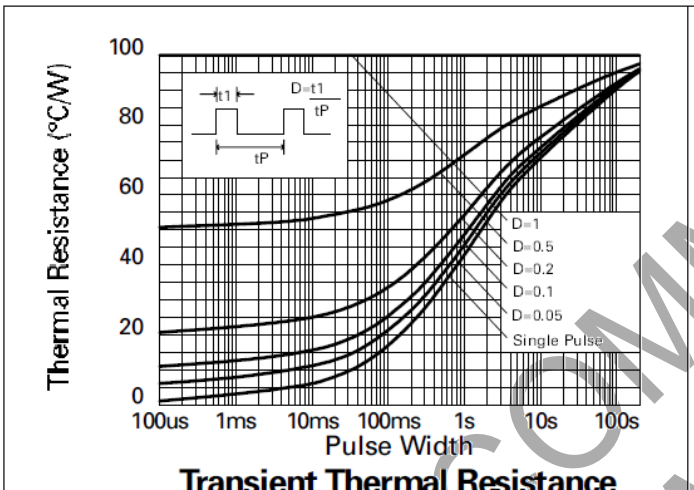

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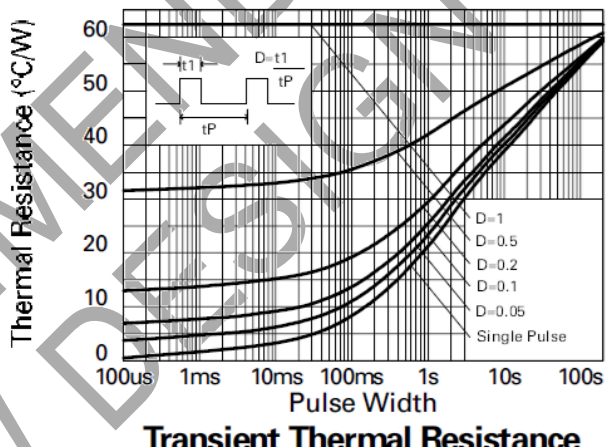
## Thermal Characteristics

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Total Power Dissipation at $T_{amb}$ = +25°C (Note 1)<br>Any Single Transistor "On"<br>Q1 and Q3 "On" or Q2 and Q4 "On" Equally | $P_{tot}$ | 1.25<br>2 | W |
| Derate above +25°C (Note 1)<br>Any Single Transistor "On"<br>Q1 and Q3 "On" or Q2 and Q4 "On" Equally | — | 10<br>16 | mW/°C |
| Thermal Resistance - Junction to Ambient (Note 1)<br>Any Single Transistor "On"<br>Q1 and Q3 "On" or Q2 and Q4 "On" Equally | — | 100<br>62.5 | °C /W |

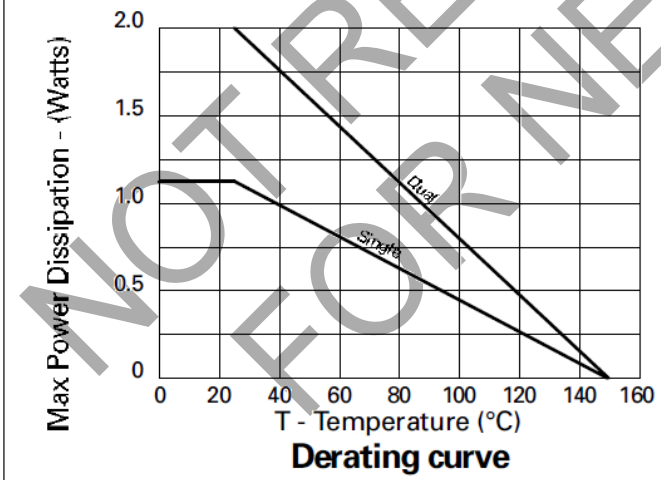
Note: 1. The power which can be dissipated assuming the device is mounted in a typical manner on a PCB with copper equal to 2 inches square.



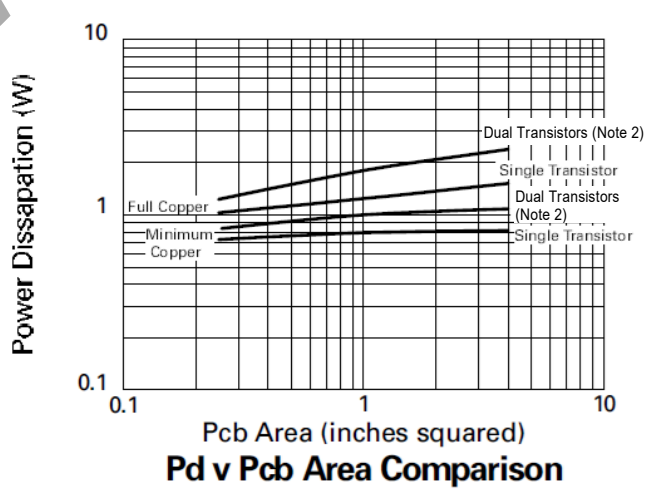

**Transient Thermal Resistance**
**Single Transistor "On"**




**Transient Thermal Resistance**
**Q1 and Q3 or Q2 and Q4 "On"**




**Derating curve**




**Pd v Pcb Area Comparison**

Note: 2. “Two devices on" is the standard operating condition for the bridge, e.g. opposing NPN/PNP pairs turned on.

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## PNP Transistors – Electrical Characteristics (@ $T_{amb}$ = +25°C)

| Parameter | Symbol | Min | Typ | Max | Unit | Conditions |
|---|---|---|---|---|---|---|
| Collector-Base Breakdown Voltage | $V_{(BR)CBO}$ | -50 | — | — | V | $I_C$ = -100µA |
| Collector-Emitter Breakdown Voltage | $V_{(BR)CEO}$ | -40 | — | — | V | $I_C$ = -10mA (Note 3) |
| Emitter-Base Breakdown Voltage | $V_{(BR)EBO}$ | -5 | — | — | V | $I_E$ = -100µA |
| Collector Cutoff Current | $I_{CBO}$ | — | — | -0.1 | µA | $V_{CB}$ = -30V |
| Emitter Cutoff Current | $I_{EBO}$ | — | — | -0.1 | µA | $V_{EB}$ = -4V |
| Collector-Emitter Saturation Voltage | $V_{CE(sat)}$ | —<br>—<br>—<br>— | —<br>—<br>—<br>— | -0.14<br>-0.25<br>-0.45<br>-0.75 | V | $I_C$ = -100mA, $I_B$ = -0.5mA (Note 3)<br>$I_C$ = -500mA, $I_B$ = -5mA (Note 3)<br>$I_C$ = -1A, $I_B$ = -10mA (Note 3)<br>$I_C$ = -2A, $I_B$ = -50mA (Note 3) |
| Base-Emitter Saturation Voltage | $V_{BE(sat)}$ | — | — | -1.0 | V | $I_C$ = -1A, $I_B$ = -10mA (Note 3) |
| Base-Emitter Turn-On Voltage | $V_{BE(on)}$ | — | -0.75 | — | V | $I_C$ = -1A, $V_{CE}$ = -2V (Note 3) |
| Static Forward Current Transfer Ratio | $h_{FE}$ | 300<br>200<br>150 | —<br>—<br>— | —<br>—<br>— | — | $I_C$ = -100mA, $V_{CE}$ = -2V (Note 3)<br>$I_C$ = -1A, $V_{CE}$ = -2V (Note 3)<br>$I_C$ = -2A, $V_{CE}$ = -2V (Note 3) |
| Transition Frequency | $f_T$ | 100 | — | — | MHz | $I_C$ = -50mA, $V_{CE}$ = -5V, f = 50MHz |
| Input Capacitance | $C_{ibo}$ | — | 225 | — | pF | $V_{EB}$ = -0.5V, f = 1MHz |
| Output Capacitance | $C_{obo}$ | — | 24 | — | pF | $V_{CB}$ = -10V, f = 1MHz |
| Switching Times | $t_{on}$<br>$t_{off}$ | —<br>— | 35<br>600 | —<br>— | ns | $I_C$ = -500mA, $I_{B1}$ = -50mA,<br>$I_{B2}$ = -50mA, $V_{CC}$ = -10V |

## NPN Transistors – Electrical Characteristics (@ $T_{amb}$ = +25°C)

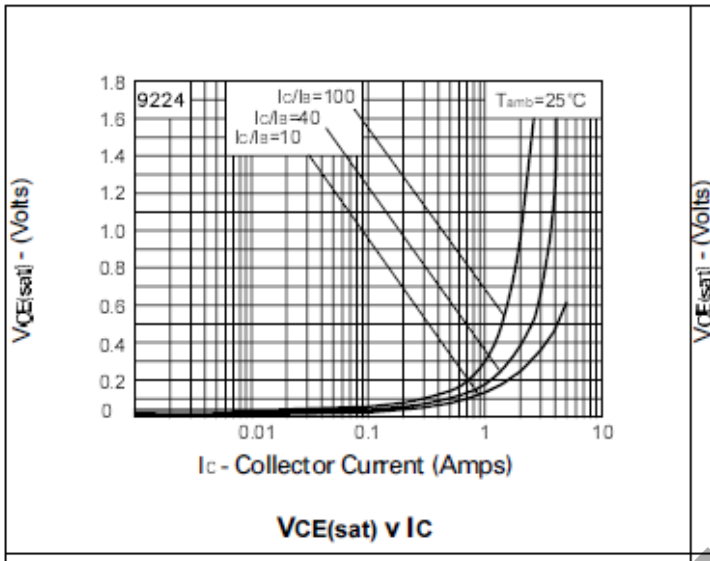
| Parameter | Symbol | Min | Typ | Max | Unit | Conditions. |
|---|---|---|---|---|---|---|
| Collector-Base Breakdown Voltage | $V_{(BR)CBO}$ | 50 | — | — | V | $I_C$ = 100µA |
| Collector-Emitter Breakdown Voltage | $V_{(BR)CEO}$ | 40 | — | — | V | $I_C$ = 10mA (Note 3) |
| Emitter-Base Breakdown Voltage | $V_{(BR)EBO}$ | 5 | — | — | V | $I_E$ = 100µA |
| Collector Cutoff Current | $I_{CBO}$ | — | — | 0.1 | µA | $V_{CB}$ = 35V |
| Emitter Cutoff Current | $I_{EBO}$ | — | — | 0.1 | µA | $V_{EB}$ = 4V |
| Collector-Emitter Saturation Voltage | $V_{CE(sat)}$ | —<br>—<br>—<br>— | —<br>—<br>—<br>— | 0.1<br>0.16<br>0.5<br>0.35 | V | $I_C$ = 100mA, $I_B$ = 0.5mA (Note 3)<br>$I_C$ = 500mA, $I_B$ = 2.5mA (Note 3)<br>$I_C$ = 1A, $I_B$ = 5mA (Note 3)<br>$I_C$ = 2A, $I_B$ = 30mA (Note 3) |
| Base-Emitter Saturation Voltage | $V_{BE(sat)}$ | — | — | 0.9 | V | $I_C$ = 1A, $I_B$ = 10mA (Note 3) |
| Base-Emitter Turn-On Voltage | $V_{BE(on)}$ | — | 0.73 | — | V | $I_C$ = 1A, $V_{CE}$ = 2V (Note 3) |
| Static Forward Current Transfer Ratio | $h_{FE}$ | 500<br>400<br>150 | —<br>—<br>— | —<br>—<br>— | — | $I_C$ = 100mA, $V_{CE}$ = 2V (Note 3)<br>$I_C$ = 1A, $V_{CE}$ = 2V (Note 3)<br>$I_C$ = 2A, $V_{CE}$ = 2V (Note 3) |
| Transition Frequency | $f_T$ | 150 | — | — | MHz | $I_C$ = 50mA, $V_{CE}$ = 5V, f = 50MHz |
| Input Capacitance | $C_{ibo}$ | — | 200 | — | pF | $V_{EB}$ = 0.5V, f = 1MHz |
| Output Capacitance | $C_{obo}$ | — | 16 | — | pF | $V_{CB}$ = 10V, f = 1MHz |
| Switching Times | $t_{on}$<br>$t_{off}$ | —<br>— | 33<br>1300 | —<br>— | ns | $I_C$ = 500mA, $I_{B1}$ = 50mA,<br>$I_{B2}$ = 50mA, $V_{CC}$ = 10V |

Note: 3. Measured under pulsed conditions. Pulse width = 300µs. Duty cycle ≤ 2%.

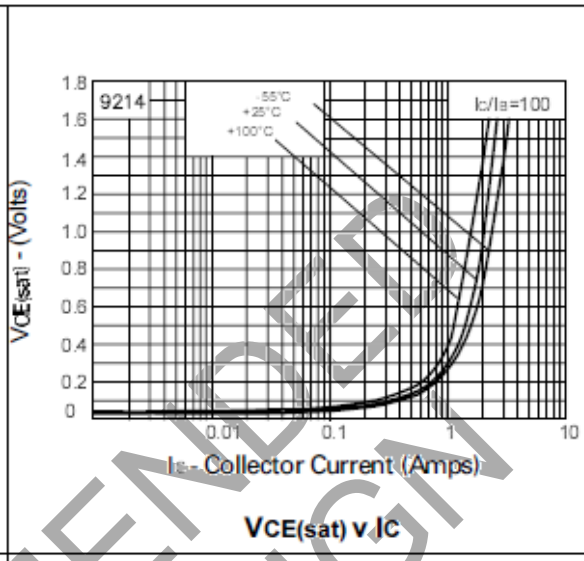
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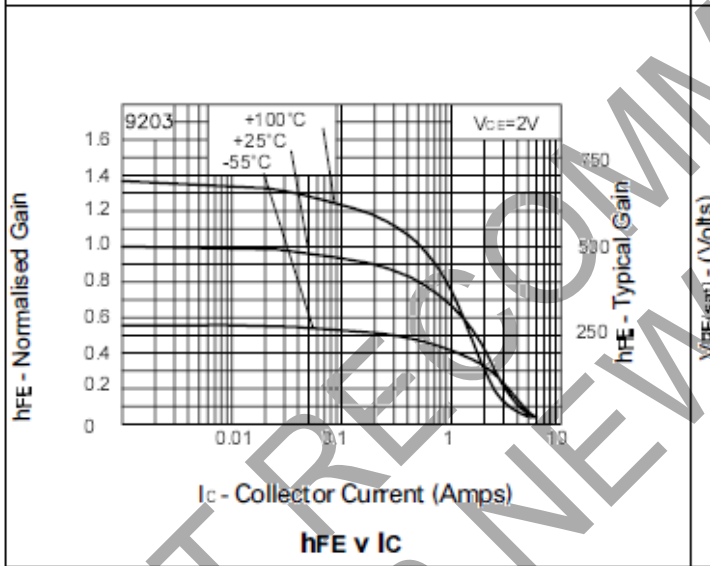
## PNP Transistors – Typical Characteristics



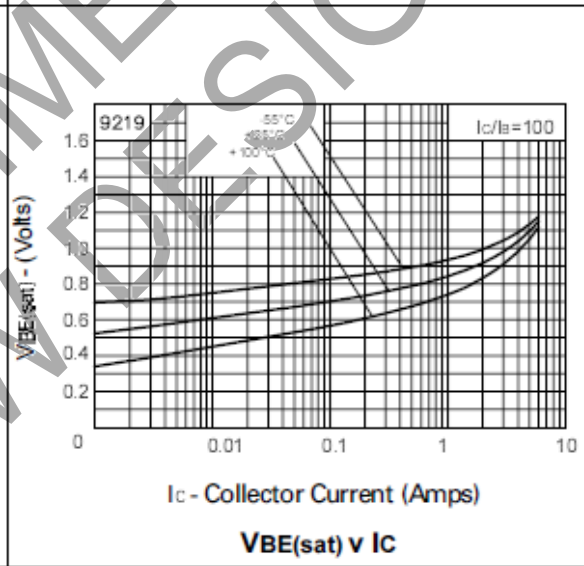

VCE(sat) v IC



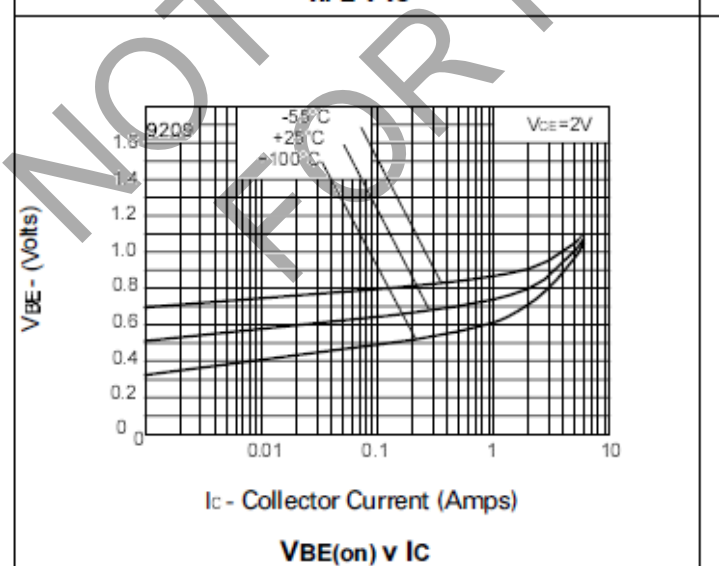

VCE(sat) v IC




hFE v IC




VBE(sat) v IC

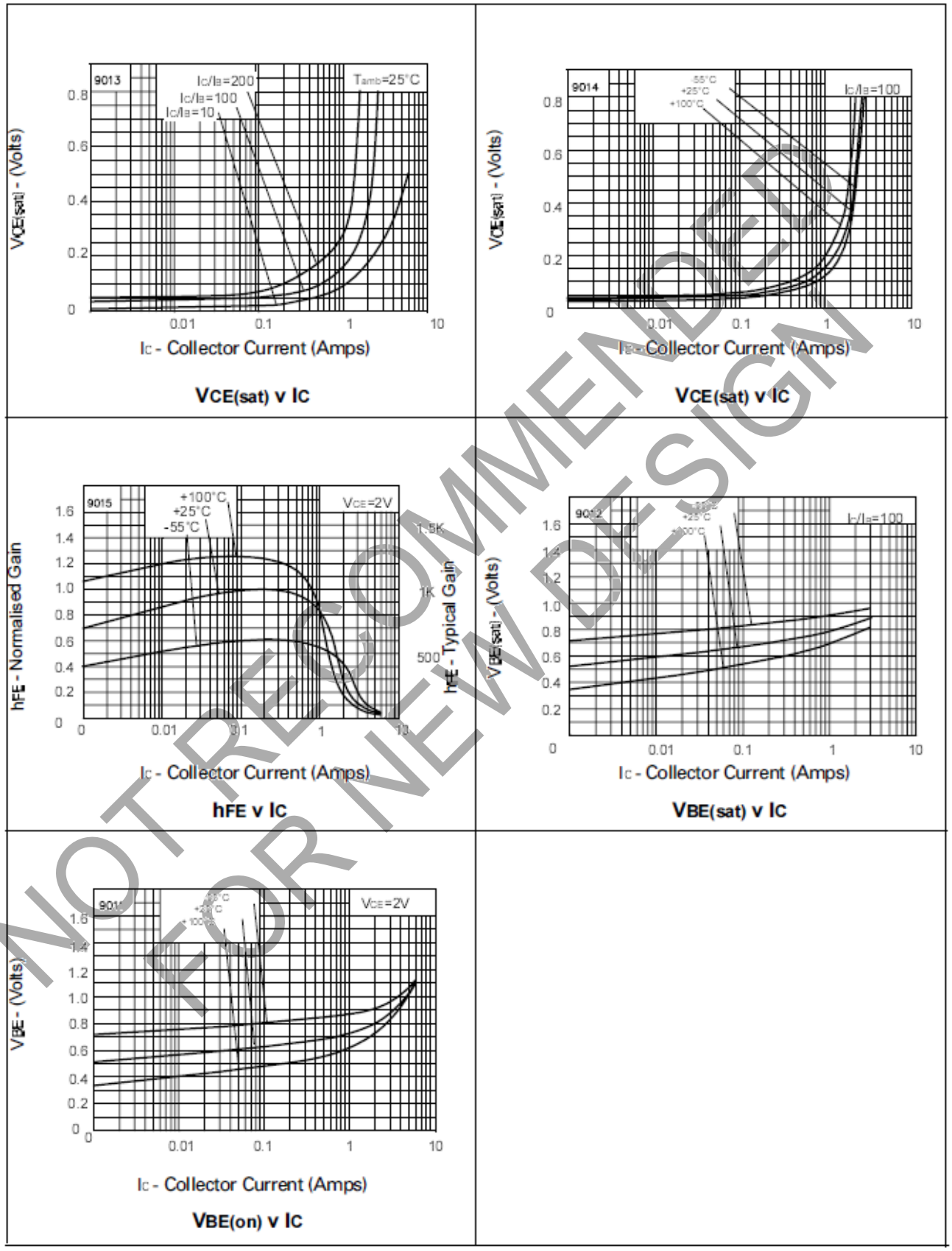



VBE(on) v IC

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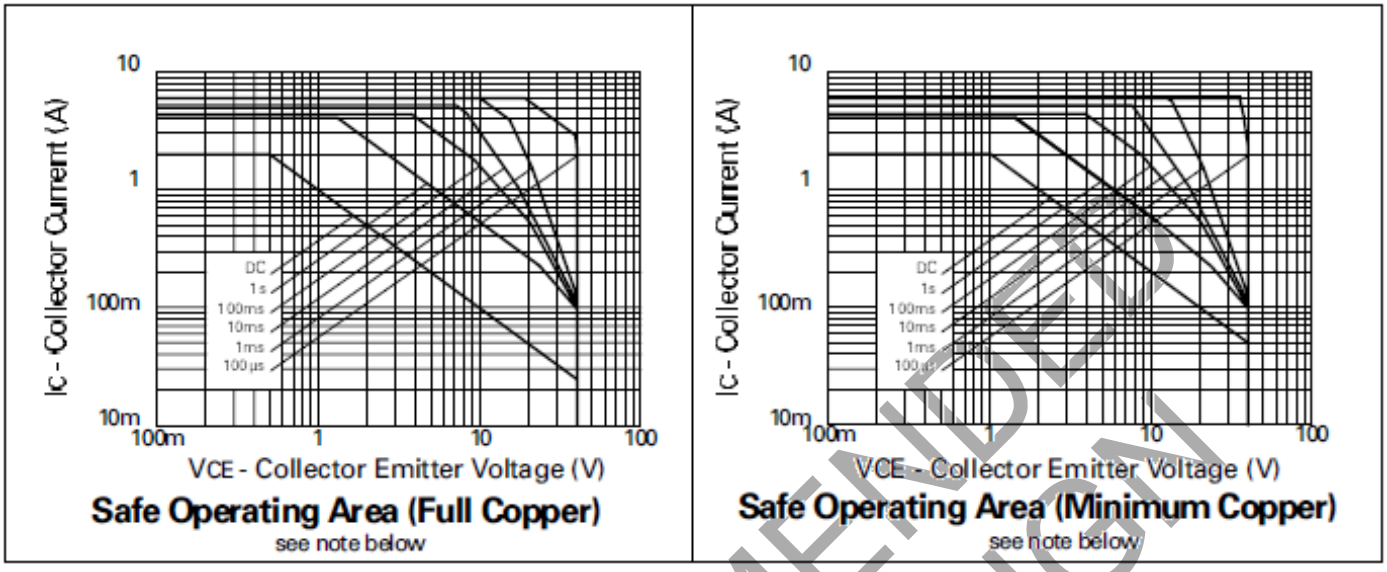
## NPN Transistors – Typical Characteristics




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## Safe Operating Area




Note: The Safe Operating Area (SOA) charts shown are a combination of the worst-case secondary breakdown characteristics for the NPN/PNP pair, and the thermal curves demonstrating the power dissipation capability of the energized ZHB part (opposing NPN-PNP switched on) when mounted on a 50mm x 50mm FR4 PCB. The two cases show:

i) full copper present and

ii) with minimal copper present - this being defined as an SM-8 footprint with 1.5mm tracks to the edge of the PCB.

For example, on a 50mm x 50mm full copper PCB, the ZHB6790 will safely dissipate 2W under DC conditions, taking note of continuous current ratings and voltage limits. Higher power can be tolerated for pulsed operation, while the shorter pulse widths (100µs and 1ms) being relevant for assessment of switching conditions.

The ZHB6790 'H'-Bridge can be modelled within SPICE using the following transistor models configured in the standard 'H'-Bridge topology, as shown in the schematic diagram of this datasheet.

H Bridge NPN transistors Spice model Last revision 4/7/97
.MODEL H6790N NPN IS =2.505E-12 NF =1.0058 BF =1360 IKF=1.3 VAF=35
+ISE=.24E-12 NE =1.38 NR =1.001 BR =125 IKR=1 VAR=8 ISC=.435E-12
+NC =1.213 RB =.2 RE =.043 RC =.04 CJC=54.3E-12 MJC=.475 VJC=.765
+CJE=247E-12 TF =.851E-9 TR =15.7E-9

H Bridge PNP transistors Spice model Last revision 4/7/97
.MODEL H6790P PNP IS=1.09684E-12 NF=1.0102 BF=650 IKF=1.7 VAF=23.5
+ISE=9.88593E-14 NE=1.47256 NR=1.00391 BR=270 IKR=0.2 VAR=30
+ISC=5.4933E-14 NC=1.07427 RB=0.055 RE=0.049 RC=0.078 CJC=96E-12
+MJC=0.495 VJC=0.67 CJE=275E-12 TF=0.75E-9 TR=10.8E-9

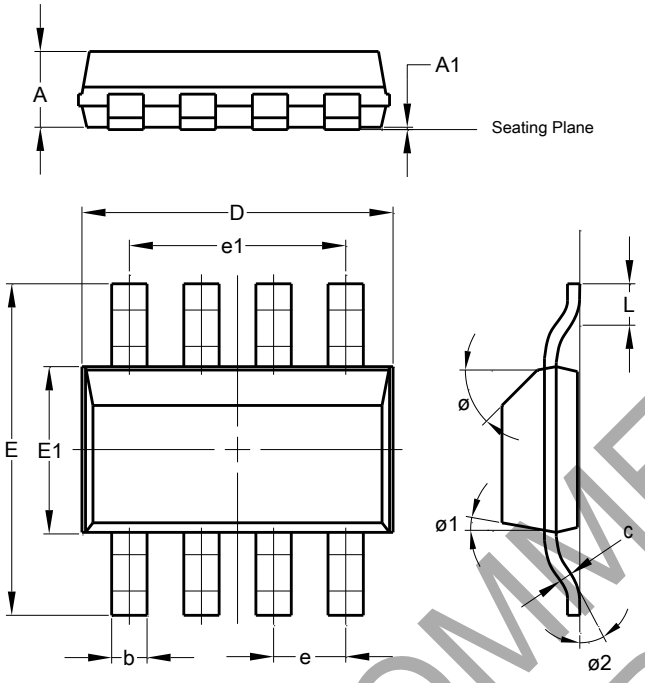
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## Package Outline Dimensions

Please see http://www.diodes.com/package-outlines.html for the latest version.

**SM-8**

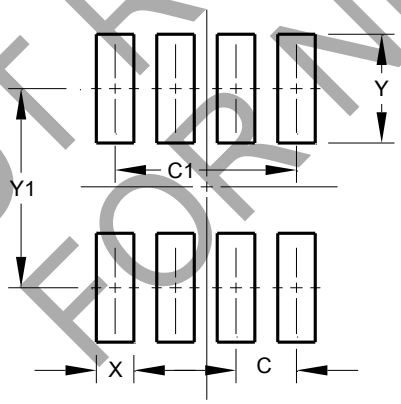



| SM-8 | | | |
|---|---|---|---|
| Dim | Min | Max | Typ |
| A | -- | 1.70 | 1.60 |
| A1 | 0.02 | 0.10 | 0.04 |
| b | 0.70 | 0.90 | 0.80 |
| c | 0.24 | 0.32 | 0.28 |
| D | 6.30 | 6.70 | 6.60 |
| e | 1.53 REF | | |
| e1 | 4.59 REF | | |
| E | 6.70 | 7.30 | 7.00 |
| E1 | 3.30 | 3.70 | 3.50 |
| L | 0.75 | 1.00 | 0.90 |
| Ø | -- | -- | 45° |
| Ø1 | -- | 15° | -- |
| Ø2 | -- | -- | 10° |
| All Dimensions in mm | | | |

## Suggested Pad Layout

Please see http://www.diodes.com/package-outlines.html for the latest version.

**SM-8**




| Dimensions | Value (in mm) |
|---|---|
| C | 1.52 |
| C1 | 4.60 |
| X | 0.95 |
| Y | 2.80 |
| Y1 | 6.80 |

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