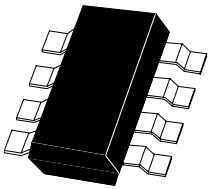
SM-8 BIPOLAR TRANSISTOR H-BRIDGE

ZHB6790

PRELIMINARY DATA SHEET ISSUE B JULY 1997

FEATURES
* Compact package
* Low on state losses
* Low drive requirements
* Operates up to 40V supply
* 2 Amp continuous rating

PARTMARKING DETAIL – ZHB6790

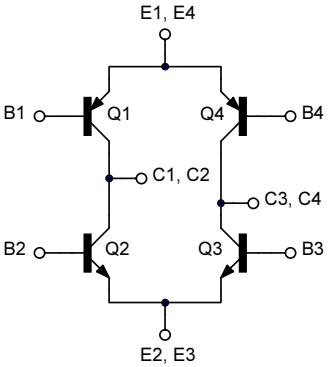


SM-8
(8 LEAD SOT223)

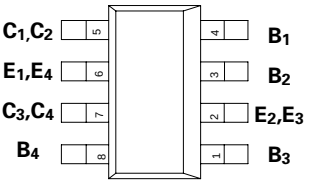
ABSOLUTE MAXIMUM RATINGS.

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

SCHEMATIC DIAGRAM



CONNECTION DIAGRAM



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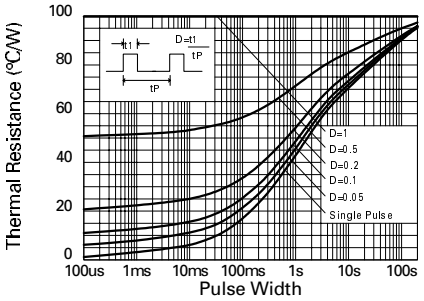
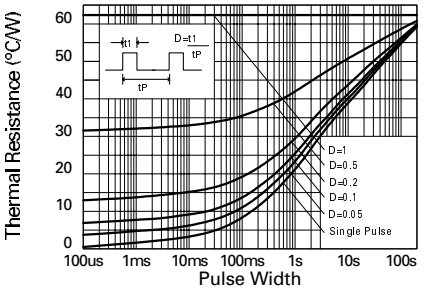
THERMAL CHARACTERISTICS

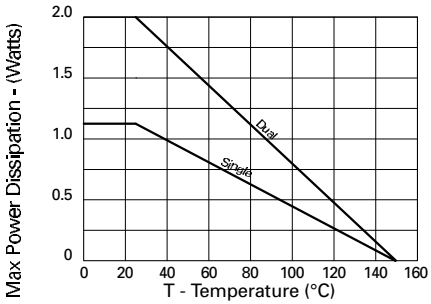
PARAMETER	SYMBOL	VALUE	UNIT
Total Power Dissipation at T_{amb} = 25°C* Any single transistor "on" Q1 and Q3 "on" or Q2 and Q4 "on" equally	P_{tot}	 1.25 2	 W W
Derate above 25°C* Any single transistor "on" Q1 and Q3 "on" or Q2 and Q4 "on" equally		 10 16	 mW/ °C mW/ °C
Thermal Resistance - Junction to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



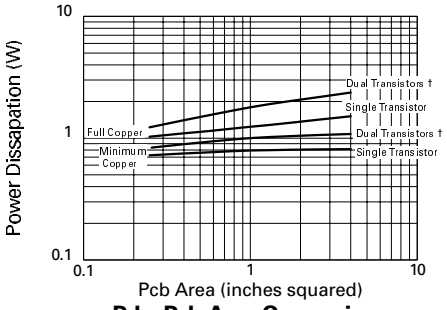
Transient Thermal Resistance
Single Transistor "On"



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



Derating curve



Pd v Pcb Area Comparison

* 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 rurned on.

PNP TRANSISTORS
ELECTRICAL CHARACTERISTICS (at 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*
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	$V_{CE(sat)}$			-0.14 -0.25 -0.45 -0.75	V V V V	I_C=-100mA, I_B=-0.5mA* I_C=-500mA, I_B=-5mA* I_C=-1A, I_B=-10mA* I_C=-2A, I_B=-50mA*
Base-Emitter Saturation Voltage	$V_{BE(sat)}$			-1.0	V	I_C=-1A, I_B=-10mA*
Base-Emitter Turn-On Voltage	$V_{BE(on)}$		-0.75		V	I_C=-1A, V_{CE}=-2V*
Static Forward Current Transfer Ratio	h_{FE}	300 200 150				I_C=-100mA, V_{CE}=-2V I_C=-1A, V_{CE}=-2V* I_C=-2A, V_{CE}=-2V*
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} t_{off}		35 600		ns	I_C=-500mA, I_{B1}= -50mA I_{B2}=-50mA, V_{CC}=-10V

*Measured under pulsed conditions. Pulse width=300μs. Duty cycle ≤ 2%.

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NPN TRANSISTORS
ELECTRICAL CHARACTERISTICS (at 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*
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	$V_{CE(sat)}$			0.1 0.16 0.5 0.35	V V V V	I_C=100mA, I_B=0.5mA* I_C=500mA, I_B=2.5mA* I_C=1A, I_B=5mA* I_C=2A, I_B=30mA*
Base-Emitter Saturation Voltage	$V_{BE(sat)}$			0.9	V	I_C=1A, I_B=10mA*
Base-Emitter Turn-On Voltage	$V_{BE(on)}$		0.73		V	I_C=1A, V_{CE}=2V*
Static Forward Current Transfer Ratio	h_{FE}	500 400 150				I_C=100mA, V_{CE}=2V* I_C=1A, V_{CE}=2V* I_C=2A, V_{CE}=2V*
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} t_{off}		33 1300		ns	I_C=500mA, I_{B1}=50mA I_{B2}=50mA, V_{CC}=10V

*Measured under pulsed conditions. Pulse width=300μs. Duty cycle ≤ 2%.

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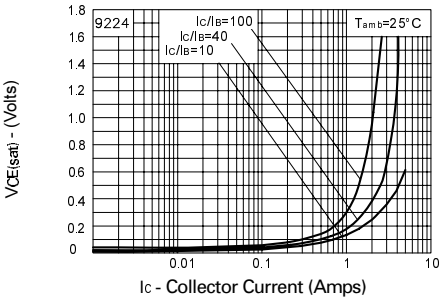
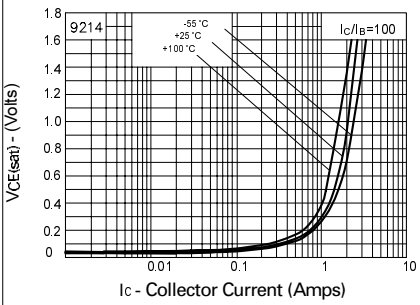
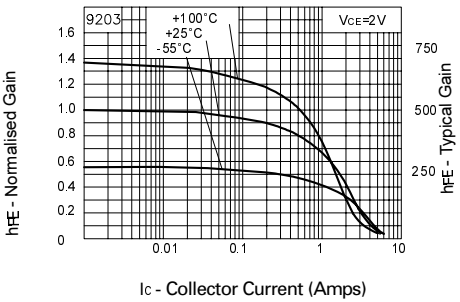
PNP TRANSISTOR
TYPICAL CHARACTERISTICS



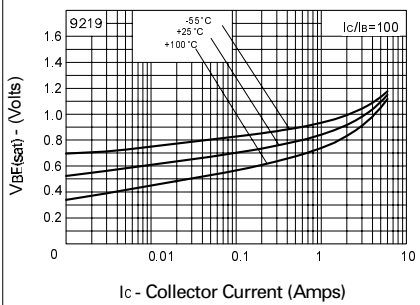
VCE(sat) v IC



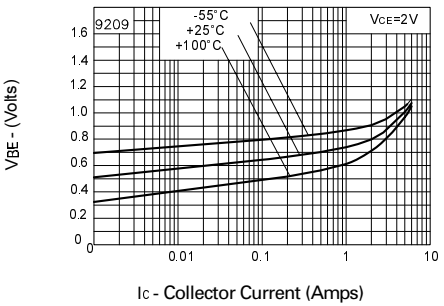
VCE(sat) v IC



hFE v IC



VBE(sat) v IC



VBE(on) v IC

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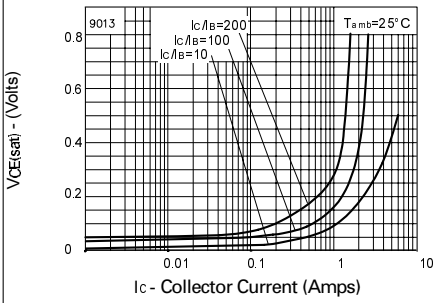
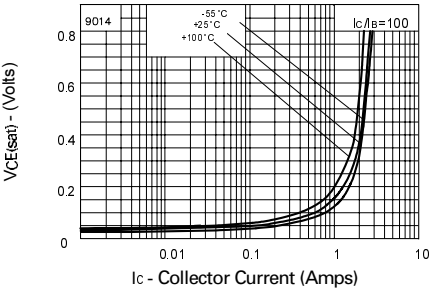
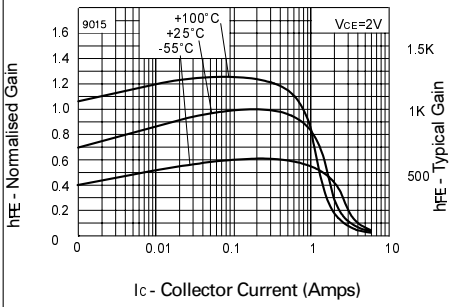
NPN TRANSISTOR
TYPICAL CHARACTERISTICS



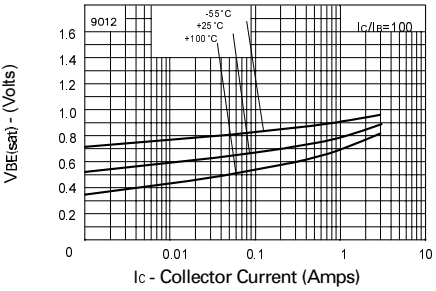
VCE(sat) v IC



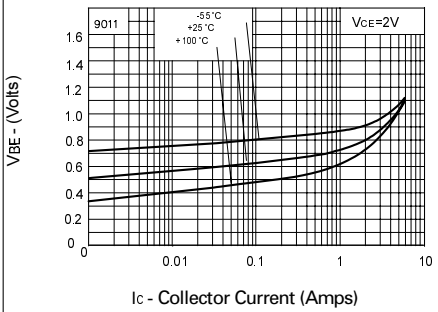
VCE(sat) v IC



hFE v IC

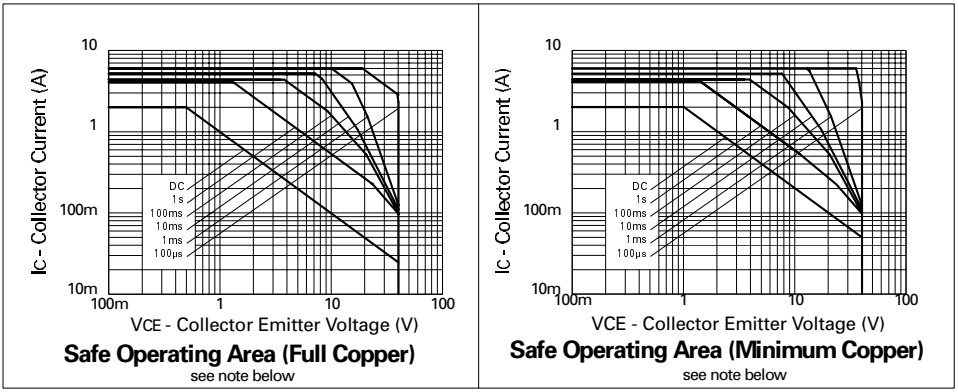


VBE(sat) v IC



VBE(on) v IC

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 energised 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 powers 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.

```
ZETEX  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

*

*
*ZETEX  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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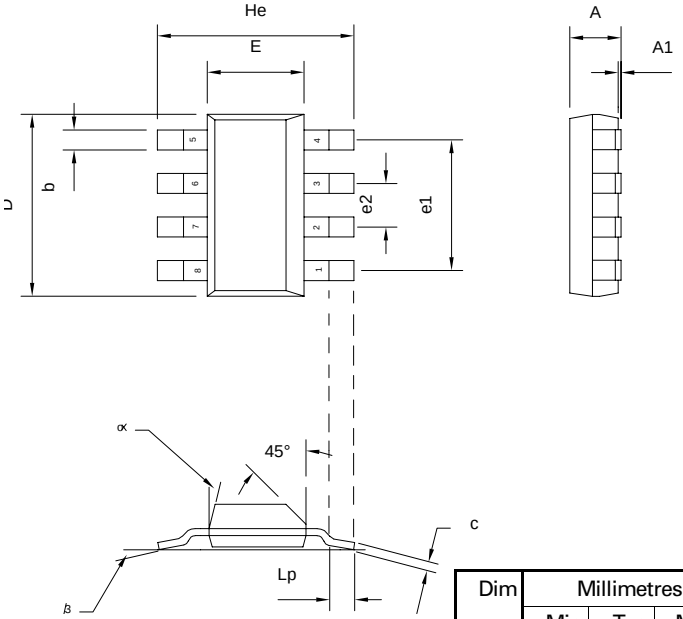
ZHB6790



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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