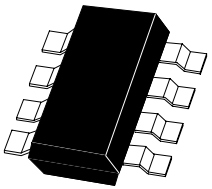
SM-8 BIPOLAR TRANSISTOR H-BRIDGE

ZHB6718

PRELIMINARY DATA SHEET ISSUE B - JULY 1997

FEATURES
* Compact package
* Low on state losses
* Low drive requirements
* Operates up to 20V supply
* 2.5 Amp continuous rating

PARTMARKING DETAIL – ZHB6718

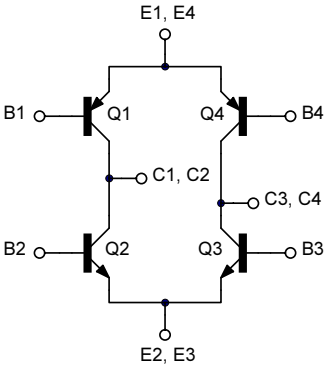


SM-8
(8 LEAD SOT223)

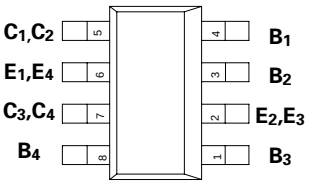
ABSOLUTE MAXIMUM RATINGS.

PARAMETER	SYMBOL	NPNs	PNPs	UNIT
Collector-Base Voltage	V_{CBO}	20	-20	V
Collector-Emitter Voltage	V_{CEO}	20	-20	V
Emitter-Base Voltage	V_{EBO}	5	-5	V
Peak Pulse Current	I_{CM}	6	-6	A
Continuous Collector Current	I_C	2.5	-2.5	A
Operating and Storage Temperature Range	T_j:T_{stg}	-55 to +150		°C

SCHEMATIC DIAGRAM



CONNECTION DIAGRAM



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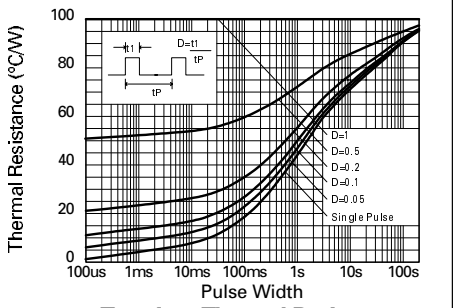
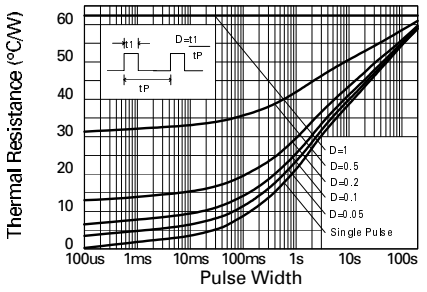
THERMAL CHARACTERISTICS

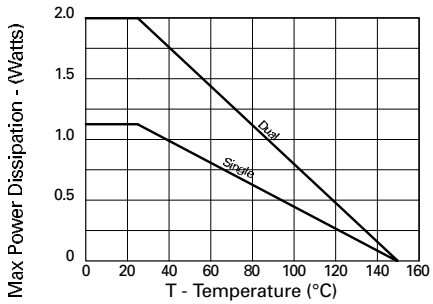
PARAMETER	SYMBOL	VALUE	UNIT
Total Power Dissipation at T_{amb} = 25°C* Any single transistor "on" Q1 and Q3 "on" or Q2 and Q4 "on" equally	P_{tot}	 1.25 2	 W W
Derate above 25°C* Any single transistor "on" Q1 and Q3 "on" or Q2 and Q4 "on" equally		 10 16	 mW/ °C mW/ °C
Thermal Resistance - Junction to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



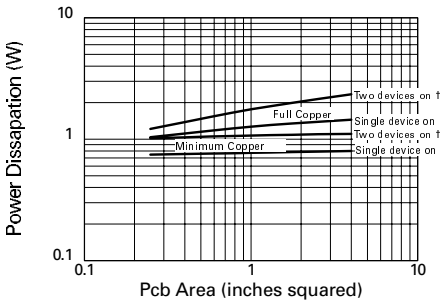
Transient Thermal Resistance
Single Transistor "On"



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 turned on.

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NPN TRANSISTORS
ELECTRICAL CHARACTERISTICS (at T_{amb} = 25°C).

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	CONDITIONS.
Collector-Base Breakdown Voltage	$V_{(BR)CBO}$	20	100		V	I_C=100μA
Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	20	27		V	I_C=10mA*
Emitter-Base Breakdown Voltage	$V_{(BR)EBO}$	5	8.3		V	I_E=100μA
Collector Cut-Off Current	I_{CBO}			100	nA	V_{CB}=16V
Emitter Cut-Off Current	I_{EBO}			100	nA	V_{EB}=4V
Collector Emitter Cut-Off Current	I_{CES}			100	nA	V_{CES}=16V
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$		8 70 130	15 150 200	mV mV mV	I_C=0.1A, I_B=10mA* I_C=1A, I_B=10mA* I_C=2.5A, I_B=50mA*
Base-Emitter Saturation Voltage	$V_{BE(sat)}$		0.89	1.0	V	I_C=2.5A, I_B=50mA*
Base-Emitter Turn-On Voltage	$V_{BE(on)}$		0.79		V	I_C=2.5A, V_{CE}=2V*
Static Forward Current Transfer Ratio	h_{FE}	200 300 200	400 450 360 180			I_C=10mA, V_{CE}=2V* I_C=100mA, V_{CE}=2V* I_C=2A, V_{CE}=2V* I_C=6A, V_{CE}=2V*
Transition Frequency	f_T	100	140		MHz	I_C=50mA, V_{CE}=10V f=100MHz
Output Capacitance	C_{obo}		23	30	pF	V_{CB}=10V, f=1MHz
Turn-On Time	$t_{(on)}$		170		ns	V_{CC}=10V, I_C=1A I_{B1}=-I_{B2}=10mA
Turn-Off Time	$t_{(off)}$		400		ns	

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

PNP TRANSISTORS
ELECTRICAL CHARACTERISTICS (at T_{amb} = 25°C).

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	CONDITIONS.
Collector-Base Breakdown Voltage	$V_{(BR)CBO}$	-20	-65		V	I_C=-100μA
Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	-20	-55		V	I_C=-10mA*
Emitter-Base Breakdown Voltage	$V_{(BR)EBO}$	-5	-8.8		V	I_E=-100μA
Collector Cut-Off Current	I_{CBO}			-100	nA	V_{CB}=-15V
Emitter Cut-Off Current	I_{EBO}			-100	nA	V_{EB}=-4V
Collector Emitter Cut-Off Current	I_{CES}			-100	nA	V_{CES}=-15V
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$		-16 -130 -190	-40 -200 -260	mV mV mV	I_C=-100mA, I_B=-10mA* I_C=-1A, I_B=-20mA* I_C=-2.5A, I_B=-200mA*
Base-Emitter Saturation Voltage	$V_{BE(sat)}$		-0.98	-1.1	V	I_C=-2.5A, I_B=-200mA*
Base-Emitter Turn-On Voltage	$V_{BE(on)}$		0.85		V	I_C=-2.5A, V_{CE}=-2V*
Static Forward Current Transfer Ratio	h_{FE}	300 300 150 35	475 450 230 70 30			I_C=-10mA, V_{CE}=-2V* I_C=-100mA, V_{CE}=-2V* I_C=-2A, V_{CE}=-2V* I_C=-4A, V_{CE}=-2V* I_C=-6A, V_{CE}=-2V*
Transition Frequency	f_T	150	180		MHz	I_C=-50mA, V_{CE}=-10V f=100MHz
Output Capacitance	C_{obo}		21	30	pF	V_{CB}=-10V, f=1MHz
Turn-On Time	$t_{(on)}$		40		ns	V_{CC}=-10V, I_C=-1A I_{B1}=I_{B2}=-20mA
Turn-Off Time	$t_{(off)}$		670		ns	

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

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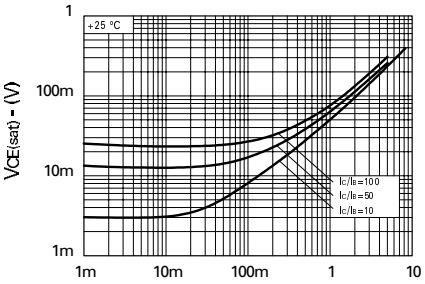
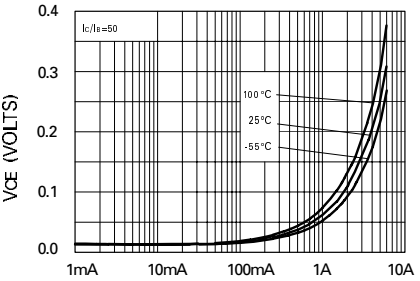
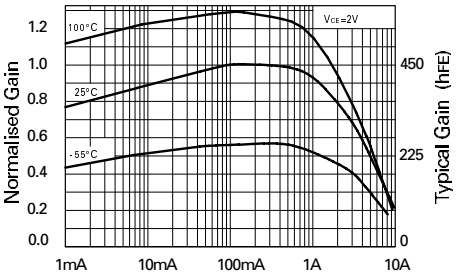
NPN TRANSISTOR
TYPICAL CHARACTERISTICS



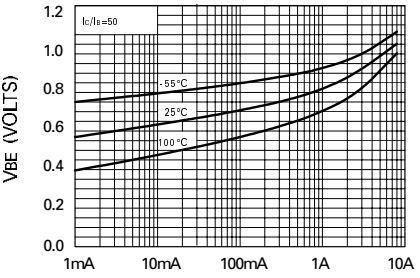
$V_{CE(sat)}$ v I_C



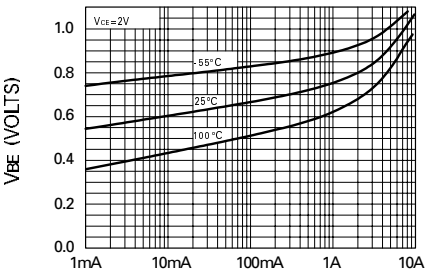
$V_{CE(sat)}$ vs I_C



h_{FE} vs I_C



$V_{BE(sat)}$ vs I_C



$V_{BE(on)}$ vs I_C

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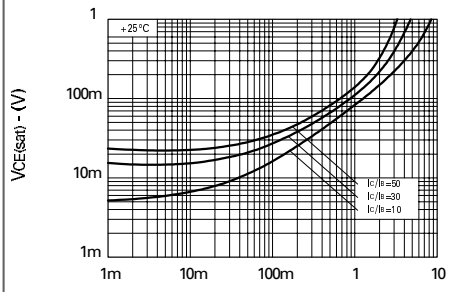
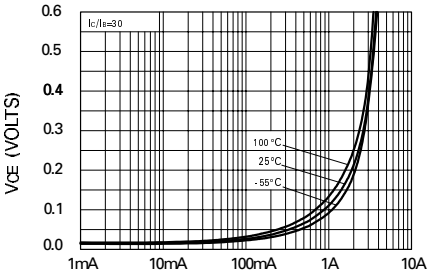
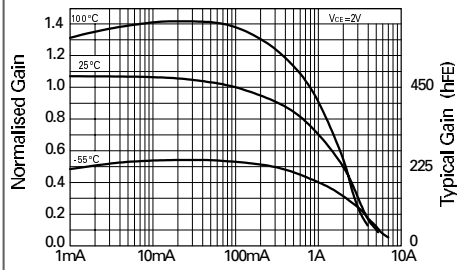
PNP TRANSISTOR
TYPICAL CHARACTERISTICS



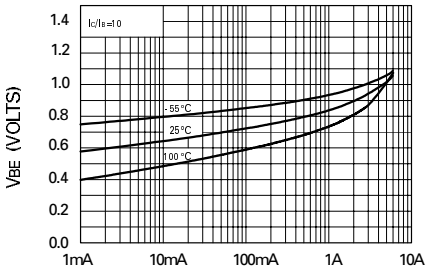
VCE(sat) v IC



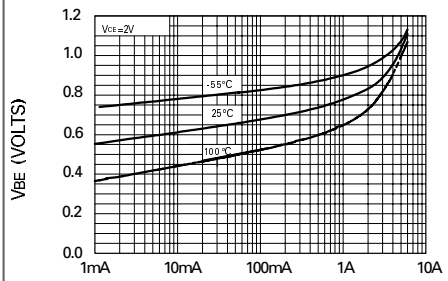
VCE(sat) vs IC



hFE vs IC

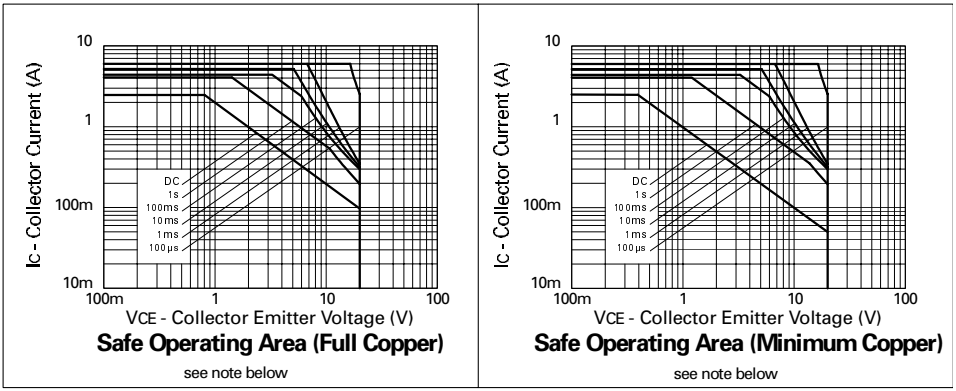


VBE(sat) vs IC



VBE(on) vs IC

SAFE OPERATING AREA



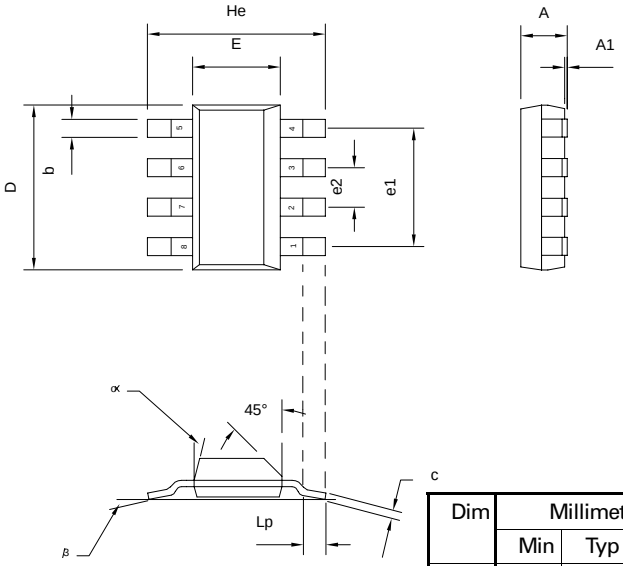
Note: The Safe Operating Area (SOA) charts shown are a combination of the worst case secondary breakdown characteristics for the NPN/PNP pair, and the thermal curves demonstrating the power dissipation capability of the energised ZHB part (opposing NPN-PNP switched on) when mounted on a 50mm x 50mm FR4 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 ZHB6718 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 ZHB6718 '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 H6718N NPN IS =5.611E-13 NF =1.0022 BF =480 IKF=4.6 VAF=51
+ ISE=1.73E-13 NE =1.4 NR =1.0002 BR =200 IKR=3 VAR=25
+ ISC=7.3152E-13 NC =1.47 RB =0.032 RE =0.027 RC =0.025
+ CJC=59E-12 MJC=0.2651 VJC=0.3051 CJE=216E-12
+ TF =0.95E-9 TR =2.25E-9
*
*
*ZETEX  H Bridge PNP transistors  Spice model   Last revision 4/7/97
.MODEL H6718P PNP IS =6.8E-13  BF =480 IKF =2 VAF =23
+ ISE=0.8E-13 NE =1.5567 NR =1.00 BR =70 IKR=0.4
+ VAR=7 ISC=7.5E-14 NC =1.19 RB =0.085 RE =0.04
+ RC =0.045 CJC=70.02E-12 MJC=0.4685 VJC=0.7714
+ CJE=203.6E-12 MJE=0.5029 VJE=0.9403 TF =0.71E-9
+TR =23.7E-9
*
```

ZHB6718



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	–	–
α	–	–	15°	–	–	15°
β	–	10°	–	–	10°	–

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