

General Description:

HPFANG+/- is designed for HP related application. The target application is for the Fan Control Section of HP PC Power Supply. It might infringe HP patent if the application is not relate to HP related business.

HPFANG+/- is designed to achieve high performance and high efficiency with low cost BOM. With HPFANG+/-, the application may reduce one FAN. It combines PC motherboard temperature information and the temperature information of PC power supply. The temperature information of PC power supply is an analog signal called TFB, which can be generated by a simple Thermistor. The temperature information of PC motherboard usually is presented by the duty cycle of the signal called FANCMD.

TEAO and TFB are output and inverting input of the OP. The non-inverting input of TEAO OP is connected to internal 2.5V reference. A simple inverting gain configuration with a thermistor in series of a current limit resistor R_s can program the TEAO to search for the duty cycle of FANPWMOUT which corresponds with the fan speed at the temperature. When TEAO is greater than 3.5V, the FANPWMOUT duty cycle is 100%. When TEAO is ~ 2.5V, the FANPWMOUT duty cycle is ~50%. When TEAO is below 1.5V, the FANPWMOUT duty cycle is ~ 1.5%.

Usually, 50% duty cycle of FANPWMOUT corresponds to 50% Power Supply load at room temperature, and 5% duty cycle of FANPWMOUT corresponds to 20% Power Supply load at room temperature. To have FANPWMOUT ~ 50%, TEAO is ~2.5V.

FANCMD is represented as motherboard temperature information. FANCMD usually is a 25KHz PWMing signal. The amplitude of FANCMD needs to be greater than 1.5V and lower than 5V to work with HPFANG+/-.

HPFANG+/- is inverting the complimentary duty cycle of FANCMD to FANPWMOUT. FANCMD duty cycle is ~ FANPWMOUT duty cycle.

HPFANG+/- selects the highest voltage among TEAO, CAVERAGE to compare with oscillator ramp, which is 1.5V to 3.5V.

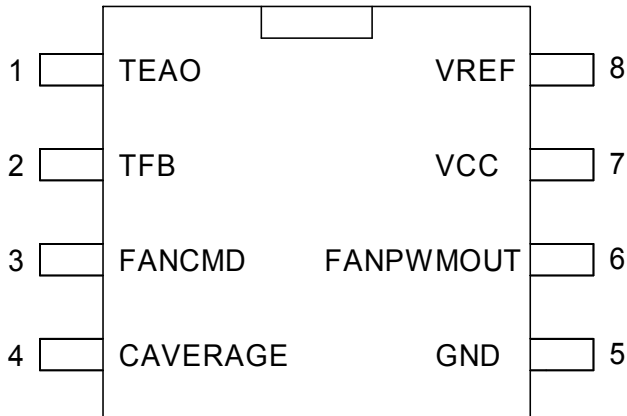
HPFANG+/- design tool is available. Please contact Champion Sales.

FEATURES

- ◆ Combine Mother Board Temperature Signals with Power Supply Temperature Signals
- ◆ Low BOM and It may reduce one Fan
- ◆ Precision OP (TEAO) uses TFB to sense the thermistor information at power supply
- ◆ Precision 25KHz Ramp generator: Peak ~ 3.5V (Duty ~100%) and Valley ~1.5V (Duty ~1.5%)
- ◆ Precision 25KHz Ramp generator compares TEAO, Caverage, and Fault to determine the duty cycle of FANPWMOUT
- ◆ It does not require negative voltage
- ◆ Accept Pulse PWMing signal FANCMD (prefer it is below 100KHz) from Mother Board
- ◆ Precision Duty to Duty Converter or called a Pulse to Pulse Converter or called PWMing to PWMing Converter
- ◆ The amplitude of Input pulse (FANCMD), peak to peak can be from 0V - 5V to 0V - 2V
- ◆ Minimum VCC > 8V Power Supply
- ◆ Preferred VCC~ 12V
- ◆ Precision (1% variation) 5V Reference Voltage
- ◆ Precision Internally Generated 25KHz +/-10% Switching Frequency
- ◆ FANPWMOUT 1.5% to 100% Output Duty Cycle
- ◆ Thermal Shut Down can be done by sensing TFB or TEAO
- ◆ Low Operating Current, I_{vcc} ~ 0.5mA
- ◆ HPFANG+ : Input Signal FANCMD 25% Duty (+)
Output Signal FANCMD 25% Duty (+)
- ◆ HPFANG- : Input Signal FANCMD 25% Duty (-)
Output Signal FANCMD 75% Duty (-)
- ◆ 8 pin package : DIP & SOP Package

PIN CONFIGURATION

DIP-8 / SOP-8



ABSOLUTE MAXIMUM RATINGS

Absolute Maximum ratings are those values beyond which the device could be permanently damaged.

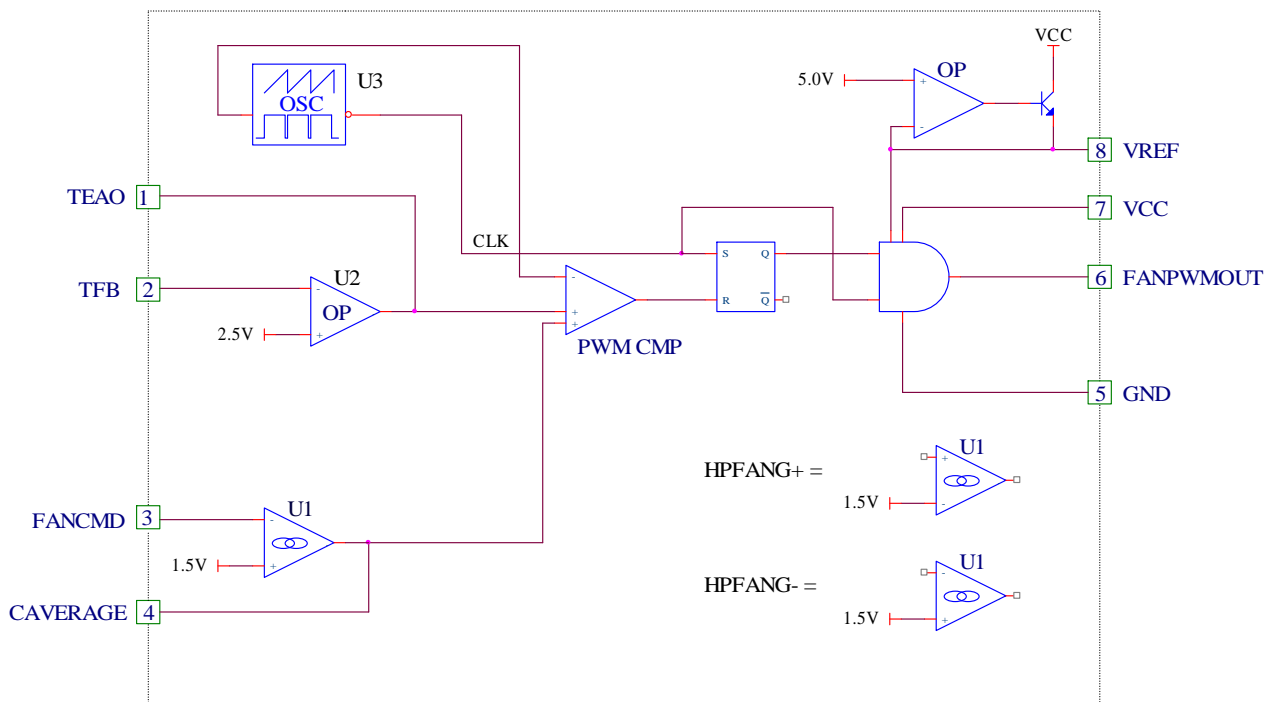
Parameter	Min.	Max.	Units
V_{CC}		15	V
TEAO	0	VCC+0.5	V
TFB	0	VCC+0.5	V
FANPWMOUT	GND – 0.5	VCC+0.5	V
I_{REF}		5	mA
CAVERAGE / FANCMD	0	VCC+0.5	V
Peak FANPWMOUT Current, Source or Sink		10	mA
FANPWMOUT, Energy Per Cycle		1.5	μ J
Junction Temperature		150	$^{\circ}$ C
Storage Temperature Range	-65	150	$^{\circ}$ C
Operating Temperature Range	-40	125	$^{\circ}$ C
Lead Temperature (Soldering, 10 sec)		260	$^{\circ}$ C
Thermal Resistance (θ_{JA})			
Plastic DIP		80	$^{\circ}$ C/W
Plastic SOP		105	$^{\circ}$ C/W
Plastic TSSOP		105	$^{\circ}$ C/W

ORDERING INFORMATION

Part Number	Temperature Range	Package
HPFANG-XIS*	-40 $^{\circ}$ C to 125 $^{\circ}$ C	SOP-8 Pin
HPFANG-XISTR*	-40 $^{\circ}$ C to 125 $^{\circ}$ C	SOP-8 Pin
HPFANG+XIS*	-40 $^{\circ}$ C to 125 $^{\circ}$ C	SOP-8 Pin
HPFANG+XISTR*	-40 $^{\circ}$ C to 125 $^{\circ}$ C	SOP-8 Pin
HPFANG-XIP*	-40 $^{\circ}$ C to 125 $^{\circ}$ C	DIP-8 Pin
HPFANG+XIP*	-40 $^{\circ}$ C to 125 $^{\circ}$ C	DIP-8 Pin

*Note: X : Suffix for Halogen Free and PB Free Product

TR : Package is Typing Reel

Simplified Block Diagram (HPFANG+/-)

PIN DESCRIPTION

Pin No.	Symbol	Description	Operating Voltage			
			Min.	Typ.	Max.	Unit
1	TEAO	Fan Controller's OP Output which is one of FANPWMOUT duty control signal	0		4.3	V
2	TFB	Fan controller's OP inverting Input. It is power supply temperature signal		2.5		V
3	FANCMD	Motherboard Temperature signal. It can be a variable speed and variable value PWM input signal. It is converted to an average signal and then controls FANPWMOUT duty	1.5		5	V
4	CAVERAGE	Averaged FANCMD signal. It is one of FANPWMOUT duty control signal	1.375		3.625	V
5	GND	Ground	0			V
6	FANPWMOUT	Controller Output	0		5.7	V
7	VCC	Positive Supply	8		15	V
8	VREF	Maximum 3mA buffered output for the internal 5V reference when VCC=12V		5		

ELECTRICAL CHARACTERISTICS:

Unless otherwise stated, these specifications apply $V_{CC}=+12V$, $C_{VREF} = 0.1\mu F$, T_A =Operating Temperature Range (Note1)

Symbol	Parameter	Test Conditions	HPFANG+/-			Unit
			Min.	Typ.	Max.	
Supply						
VCC	Input Voltage Range		8	12	15	V
VCC	Operating Current	12V, $C_L = 0$		0.45		mA
Voltage Error Amplifier Output (TEAO)						
	Input Voltage Range		0		3	V
TFB	Feedback Reference Voltage	TEAO = TFB, $T_A = 25^\circ C$,	2.475	2.5	2.525	V
	Input Bias Current	Note 2, Note 3	-1.0	-0.05		μA
	Output High Voltage	$T_A = 25^\circ C$, ITEAO _{SOURCING} =1mA	4.0			V
	Output Low Voltage	$T_A = 25^\circ C$, ITEAO _{SINKING} =1mA		0.65	1	V
	Output Sourcing Current	TEAO = TFB, $T_A = 25^\circ C$, ITEAO _{SOURCING} =1mA	2.475	2.5	2.525	V
	Output Sinking Current	TEAO = TFB, $T_A = 25^\circ C$, ITEAO _{SINKING} =1mA	2.475	2.5	2.525	V
	Open Loop Gain	DC gain		110		dB
	Power Supply Rejection Ratio	$10V < V_{CC} < 12V$		135		dB
FANPWMOUT Duty vs TEAO voltage						
	TEAO~1.5V	$10V < V_{CC} < 12V$, $T_A = 25^\circ C$, TEAO=1.5V	1.5		5	%
	TEAO~2.5V	$10V < V_{CC} < 12V$, $T_A = 25^\circ C$, TEAO=2.5V		50		%
	TEAO~3.5V	$10V < V_{CC} < 12V$, $T_A = 25^\circ C$, TEAO=3.5V		100		%
Reference						
VREF	Output Voltage	$T_A = 25^\circ C$, I(VREF) = 0mA	4.95	5	5.05	V
	Line Regulation	$10V < V_{CC} < 12V @ T=25^\circ C$		10	25	mV
	Load Regulation	$V_{CC}=12V$, $0mA < I(VREF) < 3mA$; $T_A=25^\circ C$		15		mV
	Load Regulation	$V_{CC}=12V$, $0mA < I(VREF) < 3mA$; $T_A=-40^\circ C \sim 85^\circ C$		30	50	mV
	Temperature Stability			0.4		%
	Total Variation	Line, Load, Temp	4.95		5.05	V
	Long Term Stability	$T_J = 125^\circ C$, 1000HRs	5		25	mV

ELECTRICAL CHARACTERISTICS:

Unless otherwise stated, these specifications apply $V_{CC}=+12V$, $C_{VREF} = 0.1\mu F$, T_A =Operating Temperature Range (Note1)

Symbol	Parameter	Test Conditions	HPFANG+/-			Unit
			Min.	Typ.	Max.	
FANPWMOUT Matching Test						
HPFAN(+/-)	FANPWMOUT Duty	INPUT SIGNAL FANCMD 15KHz 50% Duty (+/-)	45	50	55	%
HPFAN(+/-)	FANPWMOUT Duty	INPUT SIGNAL FANCMD 25KHz 50% Duty (+/-)	45	50	55	%
HPFAN(+/-)	FANPWMOUT Duty	INPUT SIGNAL FANCMD 35KHz 50% Duty (+/-)	45	50	55	%
HPFAN(-)	FANPWMOUT Duty	INPUT SIGNAL FANCMD 25KHz 25% Duty (-)	70	75	80	%
HPFAN(+)	FANPWMOUT Duty	INPUT SIGNAL FANCMD 25KHz 25% Duty (+)	20	25	30	%
HPFAN(-)	FANPWMOUT Duty	INPUT SIGNAL FANCMD 25KHz 75% Duty (-)	20	25	30	%
HPFAN(+)	FANPWMOUT Duty	INPUT SIGNAL FANCMD 25KHz 75% Duty (+)	70	75	80	%
Internal Oscillator (Measuring FANPWMOUT)						
	Frequency	$T_A = 25^\circ C$	22.5	25	27.5	kHz
	Ramp Peak to Peak Voltage	$10V < V_{CC} < 12V$		2		V
	Ramp Peak High Voltage	$10V < V_{CC} < 12V$		3.5		V
	Ramp Peak Low Voltage	$10V < V_{CC} < 12V$		1.5		V
	Voltage Stability	$10V < V_{CC} < 12V$		2		%
	Temperature Stability			2		%
	Total Variation	$V_{CC}=10V\sim 12V$, $0mA < I(V_{REF}) < 3mA$; $T_A = -40^\circ C \sim 85^\circ C$	22.5		27.5	kHz
	FANPWMOUT Dead Time		1.2	1.5	1.8	us
FANCMD / FANPWMOUT						
	FANCMD Threshold Voltage	TFB=2.6V,	1.48	1.5	1.55	V
FANCMD>1.5V	Minimum Duty Cycle	TFB>2.5V and FANCMD>1.5V (For HPFAN-),		1.5		%
FANCMD<1.5V	Maximum Duty Cycle	TFB<2.5V and FANCMD<1.5V (For HPFAN-),		100		%
	Output Low Rdson	$I_{OUT} = -5mA @ T_A = 25^\circ C$ $V_{CC}=12V$		80		ohm
	Rise/Fall Time (Note 3)	$C_L = 100pF @ T_A = 25^\circ C$		50		ns
	Output High Voltage	$T_A = 25^\circ C$, IFANPWMOUT _{SOURCING} =5mA	4.5		5	V

Note 1: Limits are guaranteed by 100% testing, sampling, or correlation with worst-case test conditions.

Note 2: Includes all bias currents to other circuits connected to the V_{FB} pin.

Note 3: Guaranteed by design, not 100% production test.

Description

Functional Description

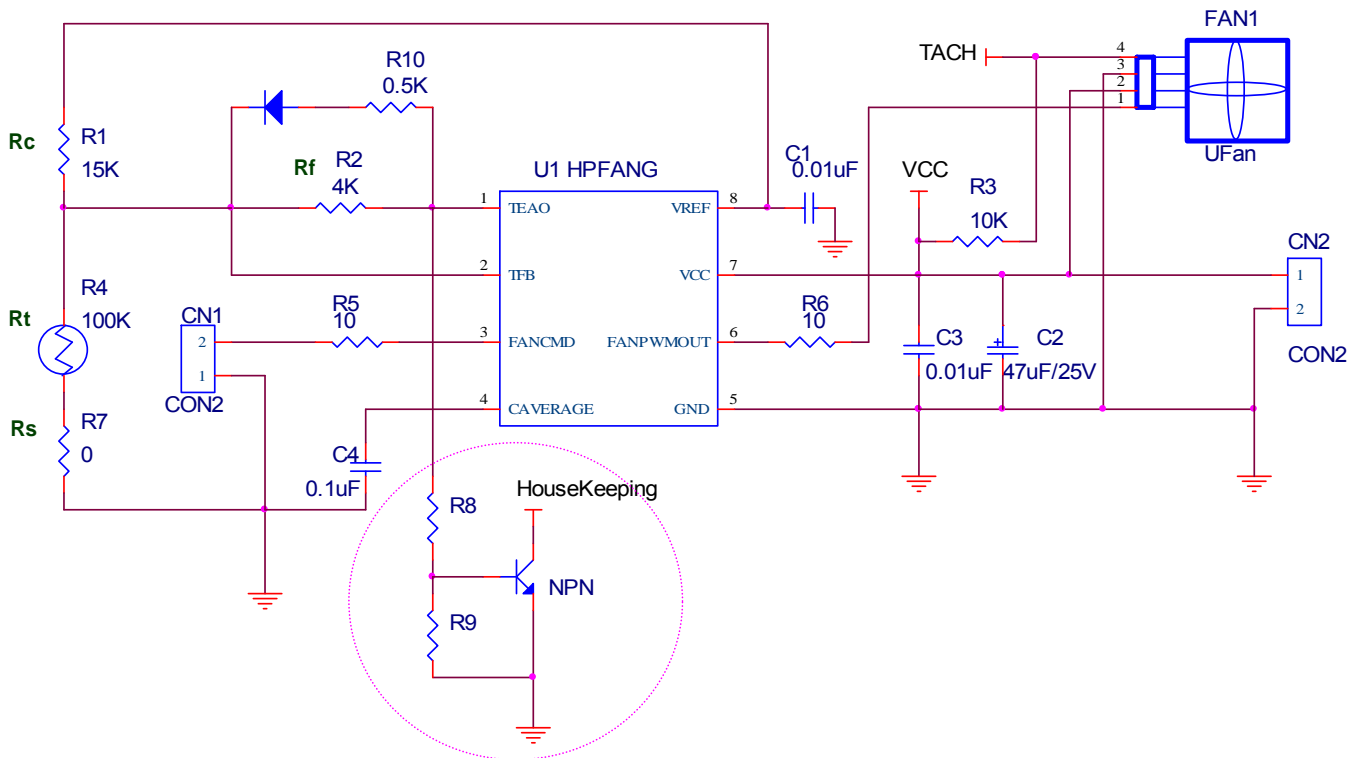
HPFANG+/- is a Fan control with an internal $V_{REF}=5V$ and maximum $I_{REF}=2.5mA$ current sourcing ability reference voltage/current . HPFANG+/- operates at 25KHz and the duty cycle ranges from 1.5% to 100%. It transfers input PWMing command signal, thermal signal to fan control signal. HPFANG+/- combines thermal signal, which is from power supply load, represented by Rthermister, and motherboard temperature signal, represented by FANCMD, to generate fan control signal. It features high efficiency, larger variable range speed, and low cost.

Error Amplifier Output TEAO

Error Amplifier receives power supply load information, which is represented by Rthermistor and then generates signal TEAO. It is an internal compensated OP. It feedback resistor R_f (see figure 1.) needs to be calculated respect to the chosen SPEC of thermal resistor $R_{THERMISTER}$

Error Amplifier output TEAO is one of signals, which decides FANPWMOUT duty cycle, and finally decides the fan speed. As power supply load increase, $R_{THERMISTER}$ reduce, TEAO increae, FANPWMOUT duty increase, then the FAN speed increases.

Figure 1. FANPWMOUT Control Circuit



Calculation of Thermal Resistor R_{THERMOSITER} and Error Amplifier Feedback Resistor R_F (Figure 1.)

Thermal Resistor and Error Amplifier Feedback Resistor Relationship

$$\frac{(V_{REF} - T_{FB})}{R_c} + \frac{TEAO - T_{FB}}{R_f} = \frac{T_{FB}}{R_{thermistor} + R_{series}}$$

Full Speed RPM 50% Load

$$\frac{(5V - 2.5V)}{R_c} + \frac{3.5V - 2.5V}{R_f} = \frac{2.5V}{R_{thermistor} + R_{series}} \quad \text{When } TEAO \sim 3.5V \quad \text{Duty} 100\%$$

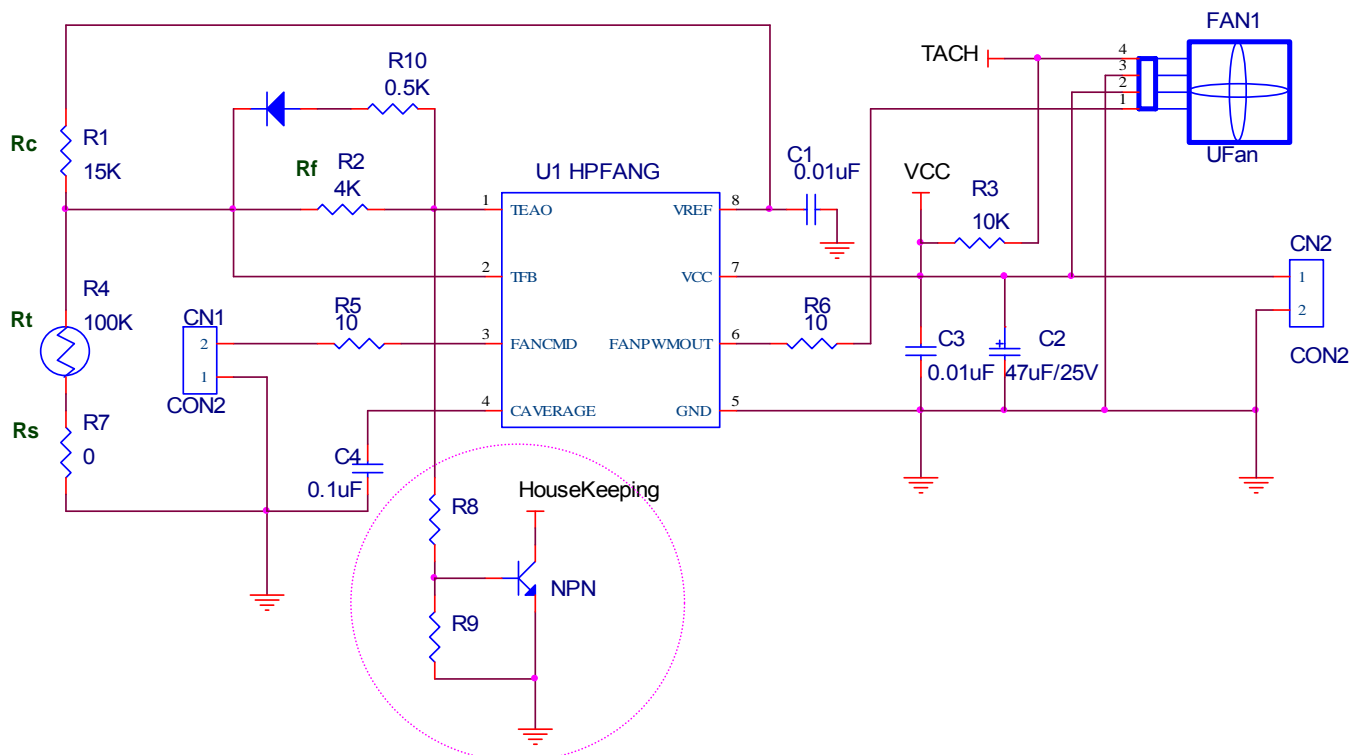
Half Speed RPM

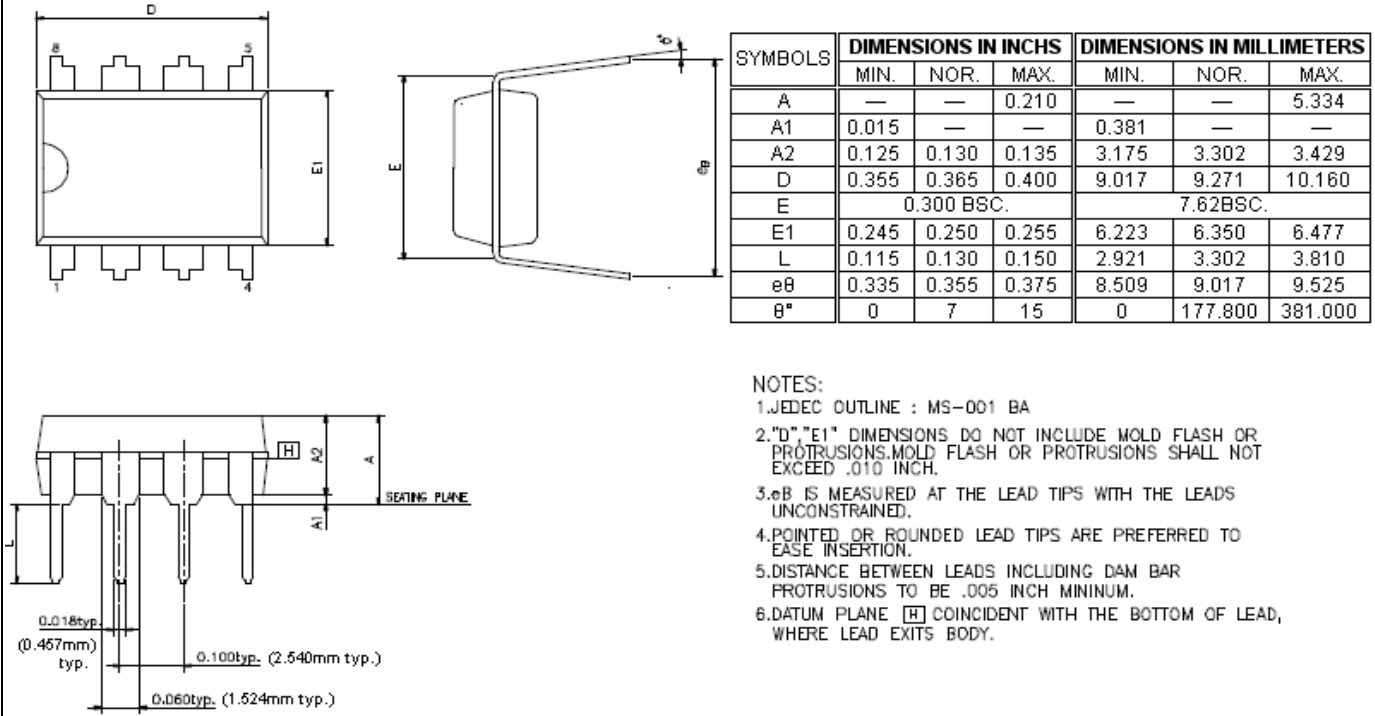
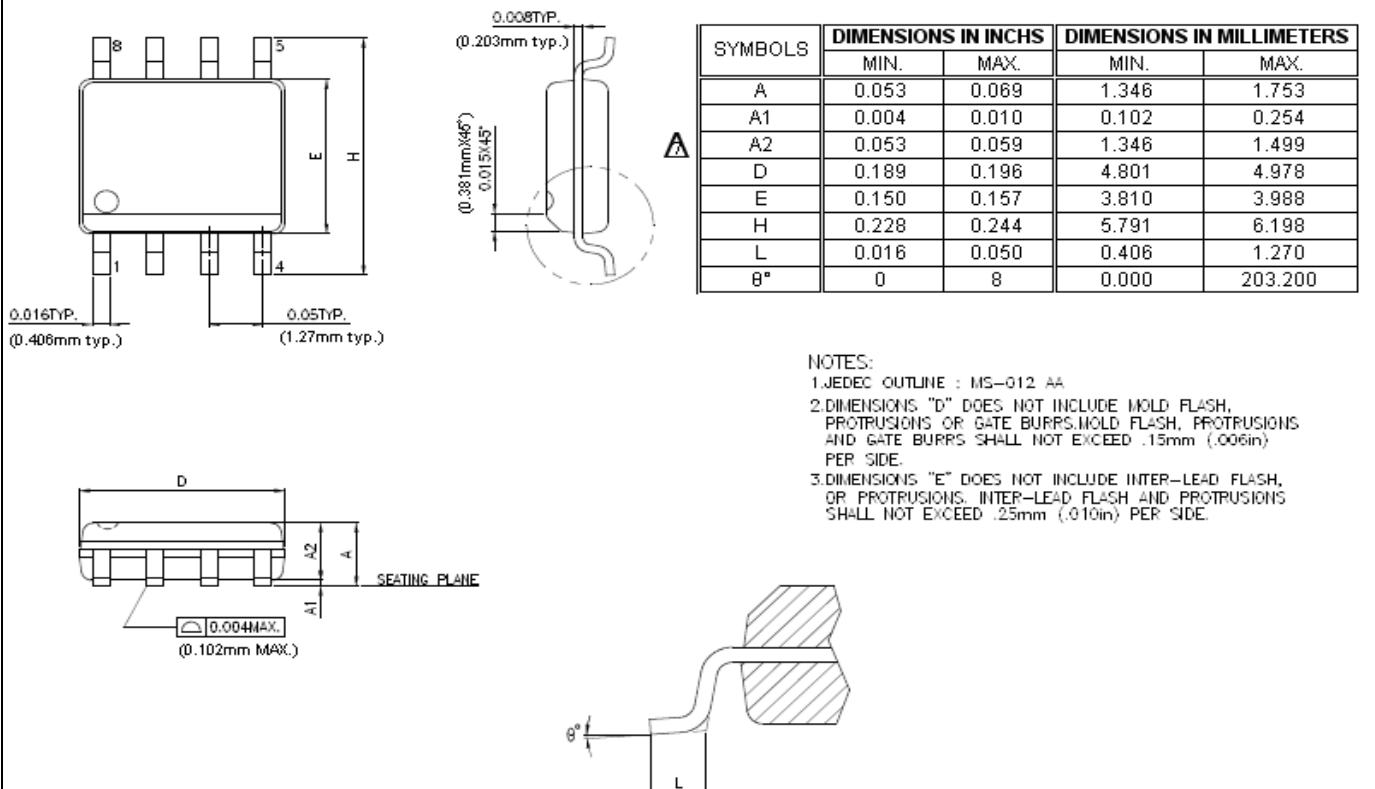
$$\frac{(5V - 2.5V)}{R_c} + \frac{2.5V - 2.5V}{R_f} = \frac{2.5V}{R_{thermistor} + R_{series}} \quad \text{When } TEAO \sim 2.5V \quad \text{Duty} 50\%$$

Minimum Speed RPM

$$\frac{(5V - 2.5V)}{R_c} + \frac{1.5V - 2.5V}{R_f} = \frac{2.5V}{R_{thermistor} + R_{series}} \quad \text{When } TEAO \sim 1.5V \quad \text{Duty} < 5\%$$

APPLICATION CIRCUIT (HPFANG+/-)



PACKAGE DIMENSION
8-PIN DIP (D8)

8-PIN SOP (S8)


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