

# Thermal Monitor

## FEATURES

- On-Chip Temperature Transducer
- Temperature Comparator Gives Threshold Temperature Alarm
- Power Reference Permits Airflow Diagnostics
- Precision 2.5V Power Reference Permits Airflow Diagnostics
- Transducer Output is Easily Scaled for Increased Sensitivity
- Low 2.5mA Quiescent Current

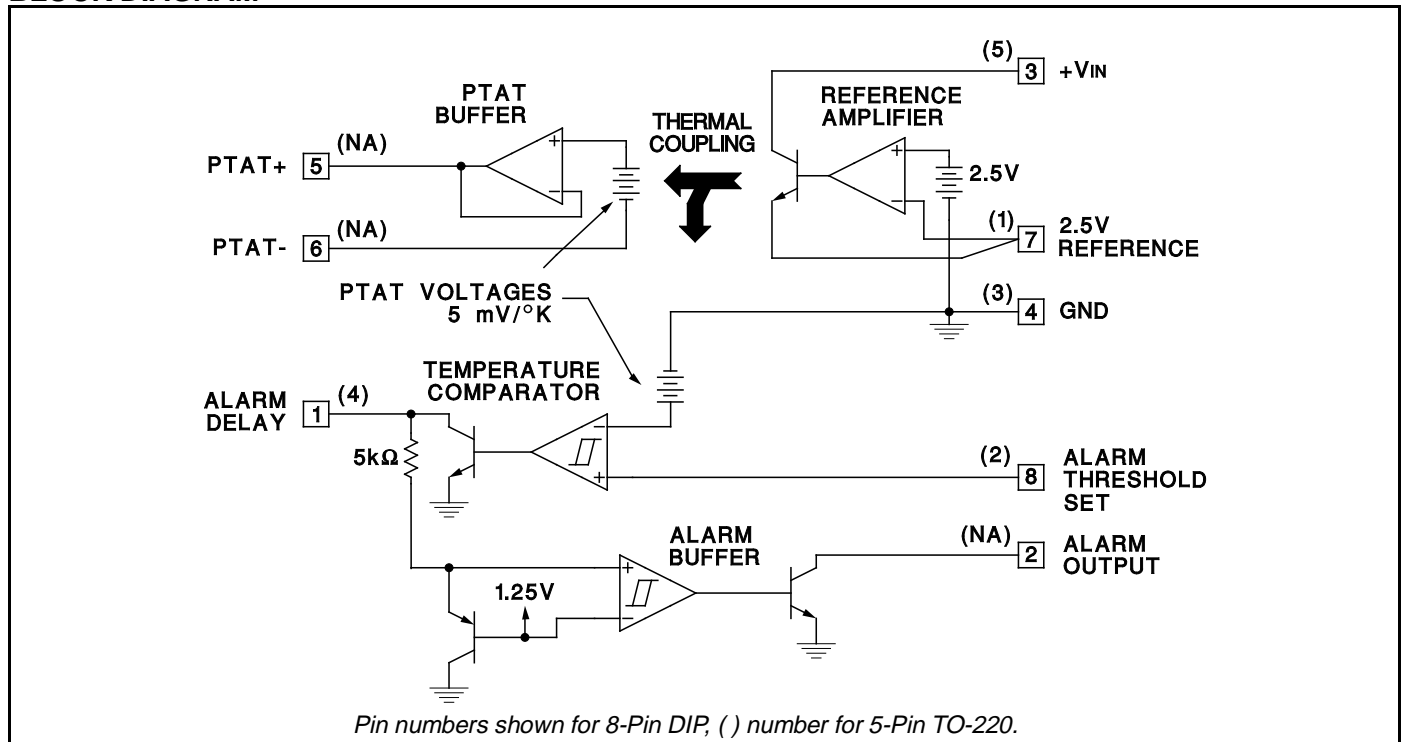
## DESCRIPTION

The UC1730 family of integrated circuit devices are designed to be used in a number of thermal monitoring applications. Each IC combines a temperature transducer, precision reference, and temperature comparator allowing the device to respond with a logic output if temperatures exceed a user programmed level. The reference on these devices is capable of supplying in excess of 250mA of output current – by setting a level of power dissipation the rise in die temperature will vary with airflow past the package, allowing the IC to respond to airflow conditions

These devices come in an 8-Pin DIP, plastic or ceramic, a 5-Pin TO-220 or a PLCC-20 version. In the 8-Pin version, a PTAT (proportional to absolute temperature) output reports die temperature directly. This output is configured such that its output level can be easily scaled up with two external gain resistors. A second PTAT source is internally referenced to the temperature comparator. The other input to this comparator can then be externally programmed to set a temperature threshold. When this temperature threshold is exceeded an alarm delay output is activated. Following the activation of the delay output, a separate open collector output is turned on. The delay pin can be programmed with an external RC to provide a time separation between activation of the delay pin and the alarm pin, permitting shutdown diagnostics in applications where the open collector outputs of multiple parts are wire OR'ed together.

The 5-Pin version in the TO-220 package is well suited for monitoring heatsink temperatures. Enhanced airflow sensitivities can be obtained with this package by mounting the device to a small heatsink in the airstream. This version of the device does not include the PTAT output or the open collector alarm output.

## BLOCK DIAGRAM

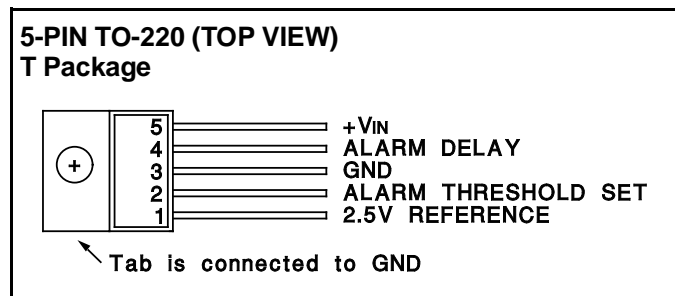
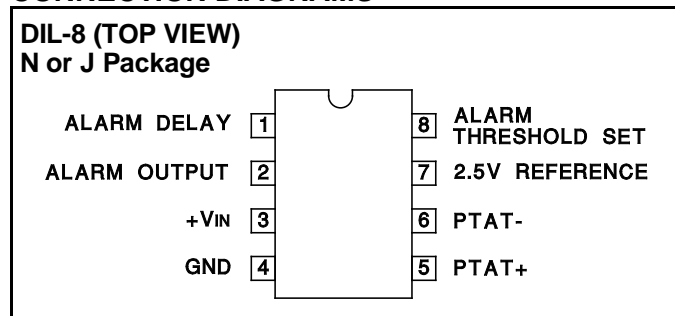
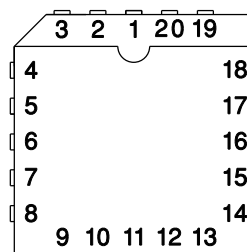


**ABSOLUTE MAXIMUM RATINGS**

Input Supply Voltage, (+VIN)	40V
Alarm Output Voltage (8-Pin Version Only)	40V
Alarm Delay Voltage	10V
Alarm Threshold Set Voltage	10V
2.5V Reference Output Current	-400 mA
Alarm Output Current (8-Pin Version Only)	0 mA
Power Dissipation at TA = 25°C (Note 2)	1000 mW
Power Dissipation at Tc = 25°C (Note 2)	2000 mW
Thermal Resistance Junction to Ambient	
N, 8-Pin Plastic DIP	110°C/W
J, 8-Pin Ceramic DIP	110°C/W

T, 5-Pin Plastic DIP TO-220	65°C/W
Thermal Resistance Junction to Case	
N, 8-Pin Plastic DIP	60°C/W
J, 8-Pin Ceramic DIP	40°C/W
T, 5-Pin Plastic TO-220	5°C/W
Operating Junction Temperature	-55°C to +150°C
Storage Temperature	-65°C to +150°C
Lead Temperature (Soldering, 10 Seconds)	300°C

*Note 1: Voltages are referenced to ground. Currents are positive into, negative out of, the specified terminals.*  
*Note 2: Consult Packaging section of Databook for thermal limitations and considerations of package.*

**CONNECTION DIAGRAMS****PLCC-20 (TOP VIEW)**  
Q Package

PACKAGE PIN FUNCTION	
FUNCTION	PIN
N/C	1-3
ALARM DELAY	4
ALARM OUTPUT	5
+VIN	6
GND	7
N/C	8-13
PTAT+	14
PTAT-	15
2.5V REFERENCE	16
2.5V REFERENCE	17
ALARM THRESHOLD SET	18
N/C	19-20

**ELECTRICAL CHARACTERISTICS:** Unless otherwise stated, these specifications apply for TJ = 0°C to +100°C for the UC3730, -25°C to +100°C for the UC2730 and -55°C to +125°C for the UC1730, +VIN = +5V, and PTAT- = 0V. TA = TJ.

PARAMETERS	TEST CONDITIONS	MIN	TYP	MAX	UNITS
<b>INPUT SUPPLY</b>					
Supply Current	+VIN = 35V		2.8	4.0	mA
	+VIN = 5V		2.3	3.5	mA
<b>REFERENCE</b>					
Output Voltage	TJ = 25°C	2.475	2.5	2.525	V
	Over Temperature	2.46		2.54	V
Load Regulation	IOUT = 0 to 250mA		8.0	25	mV
Line Regulation	+VIN = 5 to 25V		1.0	5.0	mV
<b>TEMPERATURE COMPARATOR</b>					
Temperature Comparator Threshold	at 300°K (26.85°C), Nominally 5mV/°K, VINUT High to Low	1.475	1.50	1.525	V
Temperature Error		-10		10	°C
Threshold Line Regulation	+VIN = 5 to 25V		0.005	0.02	%/V
Temperature Linearity	Note 2		2.0	5.0	°C
Threshold Hysteresis		3.0	8.0	15	mV
Input Bias Current	VINPUT at 1.5V	-0.5	-0.1		µA
Max Output Current	VOUT = 1V	1.2	3.0		mA
Output Sat Voltage	IOUT = 100µA		0.05	0.25	V

**ELECTRICAL CHARACTERISTICS (cont):**

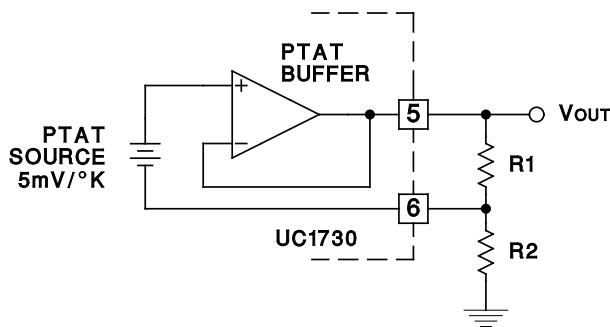
Unless otherwise stated, these specifications apply for  $T_J = 0^\circ\text{C}$  to  $+100^\circ\text{C}$  for the UC3730,  $-25^\circ\text{C}$  to  $+100^\circ\text{C}$  for the UC2730 and  $-55^\circ\text{C}$  to  $+125^\circ\text{C}$  for the UC1730,  $+V_{IN} = +5\text{V}$ , and  $PTAT- = 0\text{V}$ .  $T_A = T_J$ .

PARAMETERS	TEST CONDITIONS	MIN	TYP	MAX	UNIT
<b>TEMPERATURE COMPARATOR (cont.)</b>					
Output Leakage Current	$V_{OUT} = 1\text{V}$		0.01	1.0	$\mu\text{A}$
<b>PTAT BUFFER (8-Pin N, or J Version Only)</b>					
Output Voltage	at $300^\circ\text{K}$ ( $26.85^\circ\text{C}$ ), Nominally $5\text{mV}/^\circ\text{K}$	1.460	1.50	1.54	V
	In 10X Config. + $V_{IN} = 25\text{V}$	14.6	15	15.4	V
Temperature Error		-12		12	$^\circ\text{C}$
Temperature Linearity (Note 2)			2.0	5.0	$^\circ\text{C}$
Line Regulation	$+V_{IN} = 5$ to $25\text{V}$		0.02	0.04	$\%/V$
Load Regulation	$I_{OUT} = 0$ to $2\text{mA}$		1.0	3.0	mV
Dropout Voltage	$PTAT + TO + V_{IN}$		1.9	2.5	V
Input Bias Current at $PTAT-$ Input		-3.0	-1.0		$\mu\text{A}$
<b>ALARM BUFFER COMPARATOR (8-Pin N, or J Version Only)</b>					
Threshold Voltage ( $V_{TH}$ )	Alarm Delay Input Low to High	1.1	1.2	1.3	V
Threshold Hysteresis Voltage	Alarm Delay Voltage $> V_{TH}$		100	250	mV
Input Bias Current	Alarm Delay Voltage $< V_{TH}$		0.1	0.5	$\mu\text{A}$
Max Output Current	$V_{OUT} = 1\text{V}$	7.0	15		mA
Output Sat Voltage	$I_{OUT} = 3\text{mA}$		0.25	0.45	V
Output Leakage	$V_{OUT} = 35\text{V}$		0.1	2.0	$\mu\text{A}$

Note 2: This parameter is guaranteed by design and is not tested in production.

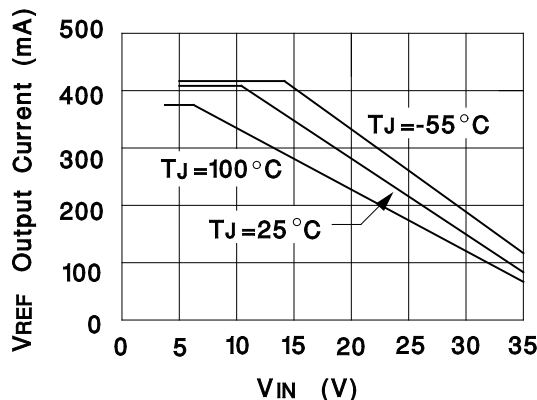
**APPLICATIONS AND OPERATION INFORMATION**

**Scaling the PTAT Output (8 Pin Version Only)**

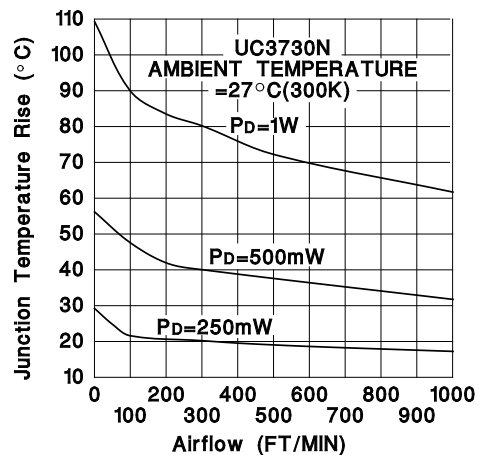


$$V_{OUT} = 5 \times \left(1 + \frac{R_2}{R_1}\right) \text{mV}/^\circ\text{K}$$

(Recommended Range for  $R_1$  is 2k to 4k)



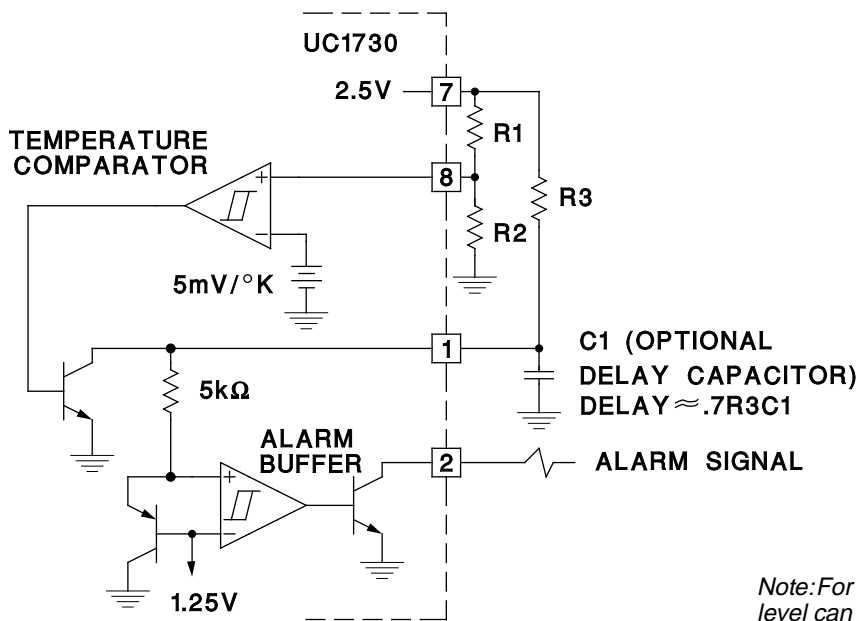
VREF Maximum Output Current vs Input Supply



Junction Temperature Rise vs Airflow UC3730N (8-Pin Plastic Dip)

APPLICATIONS AND OPERATION INFORMATION (Cont.)

Setting a Temperature Threshold

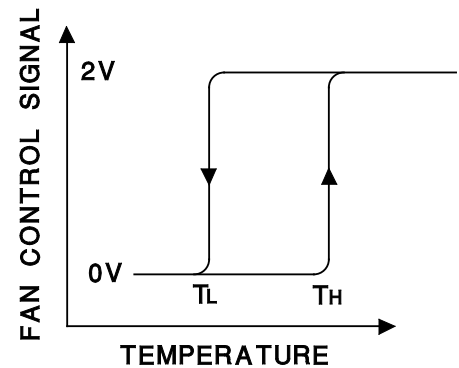
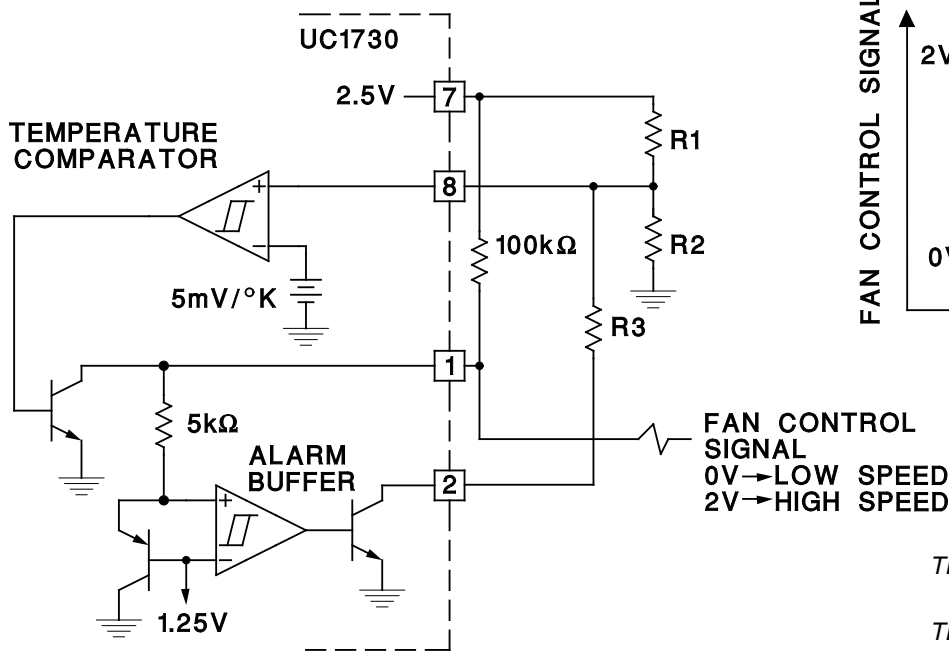


$$\text{Temperature Threshold } (^{\circ}\text{C}) = \left( \frac{2.5\text{V}}{0.005} \right) \times \frac{R2}{R1+R2} - 273.15$$

C1 (OPTIONAL DELAY CAPACITOR)  
DELAY  $\approx .7R3C1$

Note: For airflow monitoring a power dissipation level can be set with a resistive load,  $R_L$ , on the reference output.  $PD = (+V_{IN} - 2.5V)^2 / R_L$ .

Dual Speed Fan Control



FAN CONTROL SIGNAL  
0V → LOW SPEED  
2V → HIGH SPEED

$$TH(^{\circ}\text{C}) = \frac{2.5\text{V}}{0.005} \times \frac{R2}{R1+R2} - 273.15$$

$$TL(^{\circ}\text{C}) = \frac{2.5\text{V}}{0.005} \times \frac{R_X}{R1+R_X} - 273.15$$

$$\text{Where: } R_X = R2 \times \frac{R3}{R2 + R3}$$

**PACKAGING INFORMATION**

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
UC2730N	OBSOLETE	PDIP	P	8		TBD	Call TI	Call TI
UC2730T	OBSOLETE	TO-220	KC	5		TBD	Call TI	Call TI
UC3730N	OBSOLETE	PDIP	P	8		TBD	Call TI	Call TI
UC3730Q	OBSOLETE	PLCC	FN	20		TBD	Call TI	Call TI
UC3730QTR	OBSOLETE	PLCC	FN	20		TBD	Call TI	Call TI
UC3730T	OBSOLETE	TO-220	KC	5		TBD	Call TI	Call TI

<sup>(1)</sup> The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSOLETE:** TI has discontinued the production of the device.

<sup>(2)</sup> Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

<sup>(3)</sup> MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265  
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