ON Semiconductor®

*dB*Cool® Remote Thermal Monitor and Fan Controller

ADT7475

FEATURES

Controls and monitors up to 4 fans
High and low frequency fan drive signal
1 on-chip and 2 remote temperature sensors
Extended temperature measurement range, up to 191°C
Automatic fan speed control mode controls system cooling based on measured temperature
Enhanced acoustic mode dramatically reduces user perception of changing fan speeds
Thermal protection feature via $\overline{\text{THERM}}$ output
Monitors performance impact of Intel Pentium 4 processor
Thermal control circuit via $\overline{\text{THERM}}$ input
3-wire and 4-wire fan speed measurement
Limit comparison of all monitored values
Meets SMBus 2.0 electrical specifications (fully SMBus 1.1 compliant)
Fully RoHS compliant

GENERAL DESCRIPTION

The ADT7475 *dB*Cool® controller is a thermal monitor and multiple PWM fan controller for noise-sensitive or power-sensitive applications requiring active system cooling. The ADT7475 can drive a fan using either a low or high frequency drive signal, monitor the temperature of up to two remote sensor diodes plus its own internal temperature, and measure and control the speed of up to four fans so that they operate at the lowest possible speed for minimum acoustic noise.

The automatic fan speed control loop optimizes fan speed for a given temperature. The effectiveness of the system's thermal solution can be monitored using the $\overline{\text{THERM}}$ input. The ADT7475 also provides critical thermal protection to the system using the bidirectional $\overline{\text{THERM}}$ pin as an output to prevent system or component overheating.

FUNCTIONAL BLOCK DIAGRAM

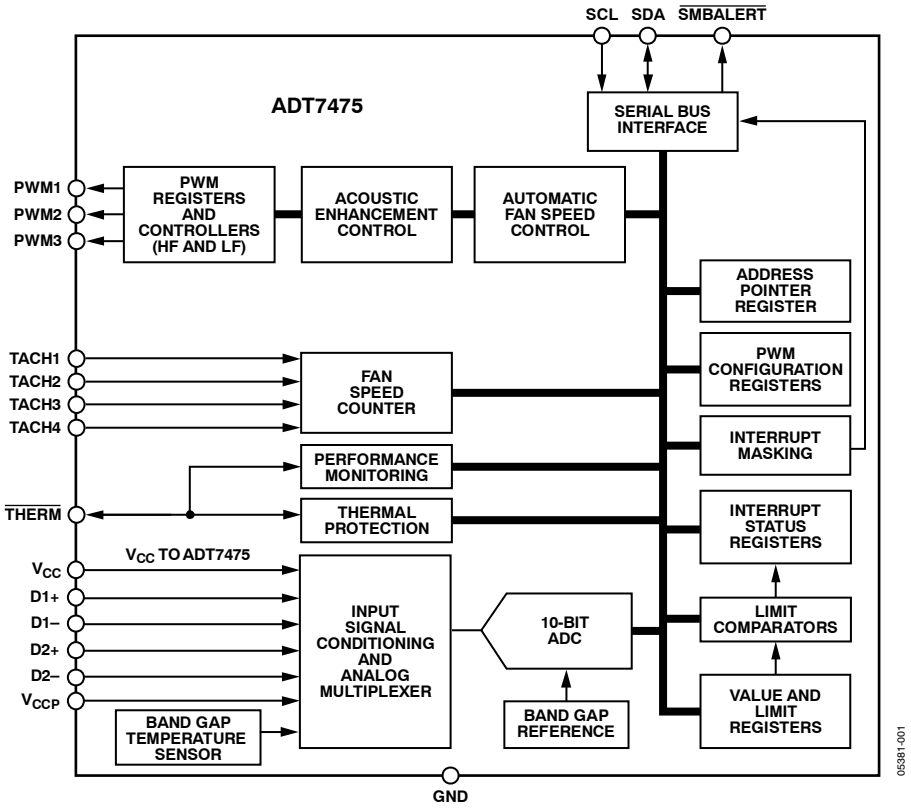

Figure 1.

SPECIFICATIONS

$T_A = T_{MIN}$ to T_{MAX}, $V_{CC} = V_{MIN}$ to V_{MAX}, unless otherwise noted.[1]

Table 1.

Parameter	Min	Typ	Max	Unit	Test Conditions/Comments
POWER SUPPLY					
Supply Voltage	3.0	3.3	3.6	V	
Supply Current, I_{CC}		1.5	3	mA	Interface inactive, ADC active
TEMPERATURE-TO-DIGITAL CONVERTER					
Local Sensor Accuracy		±0.5	1.5	°C	$0°C \le T_A \le 85°C$
			±2.5	°C	$-40°C \le T_A \le +125°C$
Resolution		0.25		°C	
Remote Diode Sensor Accuracy		±0.5	1.5	°C	$0°C \le T_A \le 85°C$
			±2.5	°C	$-40°C \le T_A \le +125°C$
Resolution		0.25		°C	
Remote Sensor Source Current		180		µA	High level
		11		µA	Low level
ANALOG-TO-DIGITAL CONVERTER (INCLUDING MUX AND ATTENUATORS)					
Total Unadjusted Error (TUE)			±1.5	%	
Differential Nonlinearity (DNL)			±1	LSB	8 bits
Power Supply Sensitivity		±0.1		%/V	
Conversion Time (Voltage Input)		11		ms	Averaging enabled
Conversion Time (Local Temperature)		12		ms	Averaging enabled
Conversion Time (Remote Temperature)		38		ms	Averaging enabled
Total Monitoring Cycle Time		145		ms	Averaging enabled
		19		ms	Averaging disabled
Input Resistance	70	120		kΩ	For V_{CCP} channel
FAN RPM-TO-DIGITAL CONVERTER					
Accuracy			±6	%	$0°C \le T_A \le 70°C$
			±10	%	$-40°C \le T_A \le +120°C$
Full-Scale Count			65,535		
Nominal Input RPM		109		RPM	Fan count = 0xBFFF
		329		RPM	Fan count = 0x3FFF
		5000		RPM	Fan count = 0x0438
		10,000		RPM	Fan count = 0x021C
OPEN-DRAIN DIGITAL OUTPUTS (PWM1 TO PWM3, XTO)					
Current Sink, I_{OL}			8.0	mA	
Output Low Voltage, V_{OL}			0.4	V	$I_{OUT} = -8.0$ mA
High Level Output Current, I_{OH}		0.1	20	µA	$V_{OUT} = V_{CC}$
OPEN-DRAIN SERIAL DATA BUS OUTPUT (SDA)					
Output Low Voltage, V_{OL}			0.4	V	$I_{OUT} = -4.0$ mA
High Level Output Current, I_{OH}		0.1	1.0	µA	$V_{OUT} = V_{CC}$
SMBus DIGITAL INPUTS (SCL, SDA)					
Input High Voltage, V_{IH}	2.0			V	
Input Low Voltage, V_{IL}			0.4	V	
Hysteresis		500		mV	

Parameter	Min	Typ	Max	Unit	Test Conditions/Comments
DIGITAL INPUT LOGIC LEVELS (TACH INPUTS)					
Input High Voltage, V_{IH}	2.0			V	
			3.6	V	Maximum input voltage
Input Low Voltage, V_{IL}			0.8	V	
	−0.3			V	Minimum input voltage
Hysteresis		0.5		V p-p	
DIGITAL INPUT LOGIC LEVELS ($\overline{THERM}$) ADTL+					
Input High Voltage, V_{IH}			0.75 × V_{CC}	V	
Input Low Voltage, V_{IL}			0.4	V	
DIGITAL INPUT CURRENT					
Input High Current, I_{IH}		±1		µA	$V_{IN} = V_{CC}$
Input Low Current, I_{IL}		±1		µA	$V_{IN} = 0$ V
Input Capacitance, C_{IN}		5		pF	
SERIAL BUS TIMING[2]					See Figure 2
Clock Frequency, f_{SCLK}	10		400	kHz	
Glitch Immunity, t_{SW}			50	ns	
Bus Free Time, t_{BUF}	4.7			µs	
SCL Low Time, t_{LOW}	4.7			µs	
SCL High Time, t_{HIGH}	4.0		50	µs	
SCL, SDA Rise Time, t_R			1000	ns	
SCL, SDA Fall Time, t_F			300	µs	
Data Setup Time, $t_{SU: DAT}$	250			ns	
Detect Clock Low Timeout, $t_{TIMEOUT}$	15		35	ms	Can be optionally disabled

[1] All voltages are measured with respect to GND, unless otherwise specified. Typicals are at T_A = 25°C and represent the most likely parametric norm. Logic inputs accept input high voltages of up to V_{MAX}, even when the device is operating down to V_{MIN}. Timing specifications are tested at logic levels of V_{IL} = 0.8 V for a falling edge and V_{IH} = 2.0 V for a rising edge.

[2] SMBus timing specifications are guaranteed by design and are not production tested.

TIMING DIAGRAM

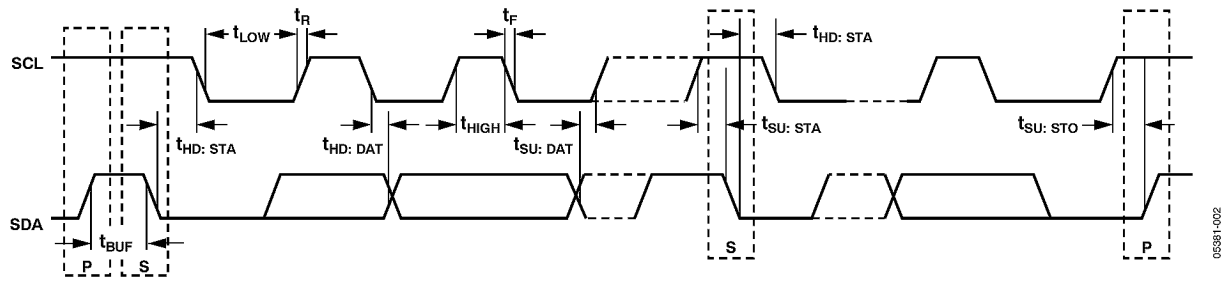

Figure 2. Serial Bus Timing Diagram

ABSOLUTE MAXIMUM RATINGS

Table 2.

Parameter	Rating
Positive Supply Voltage (V_{CC})	3.6 V
Voltage on Any Input or Output Pin	−0.3 V to +3.6 V
Input Current at Any Pin	±5 mA
Package Input Current	±20 mA
Maximum Junction Temperature (T_{JMAX})	150°C
Storage Temperature Range	−65°C to +150°C
Lead Temperature, Soldering	
IR Reflow Peak Temperature	260°C
Lead Temperature (Soldering 10 sec)	300°C
ESD Rating	1500 V

Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only; functional operation of the device at these or any other conditions above those indicated in the operational section of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

THERMAL RESISTANCE

θ_{JA} is specified for the worst-case conditions, that is, a device soldered in a circuit board for surface-mount packages.

Table 3. Thermal Resistance

Package Type	θ_{JA}	θ_{JC}	Unit
16-lead QSOP package	150	39	°C/W

ESD CAUTION

ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

OUTLINE DIMENSIONS

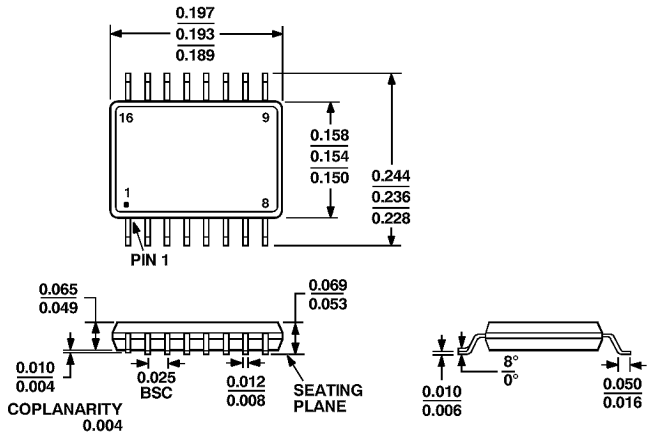

Figure 62. 16-Lead Shrink Small Outline Package [QSOP]
(RQ-16)
Dimensions shown in inches

ORDERING GUIDE

Model	Temperature Range	Package Description	Package Option
ADT7475ARQZ[1]	−40°C to +125°C	16-Lead QSOP	RQ-16
ADT7475ARQZ-REEL[1]	−40°C to +125°C	16-Lead QSOP	RQ-16
ADT7475ARQZ-RL7[1]	−40°C to +125°C	16-Lead QSOP	RQ-16
EVAL-ADT7475EB		Evaluation Board	

[1] Z = RoHS Compliant Part.