



# System Hardware Monitor with Two-Wire/SMBus Serial Interface

Check for Samples: [AMC80](#)

## FEATURES

- 10-bit ADC with Seven Analog Inputs
- Fan-Speed Monitoring Inputs
- Input Range/Resolution:
  - Default: 2.56 V/2.5 mV
  - Programmable:  $V_{DD}/6$  mV
- Chassis Intrusion Detection Input
- Interrupt Alarms:
  - Upper Over-Limit
  - Lower Under-Limit
- Interrupt Status Register Input for External Temperature Sensors
- Shutdown Mode
- Programmable  $\overline{\text{RST\_OUT/OS}}$
- Pin Compatible with LM96080 and LM80
- Package: 24-Pin TSSOP

- Storage Area Networks
- Set-Top Boxes
- Test and Measurement Equipment

## DESCRIPTION

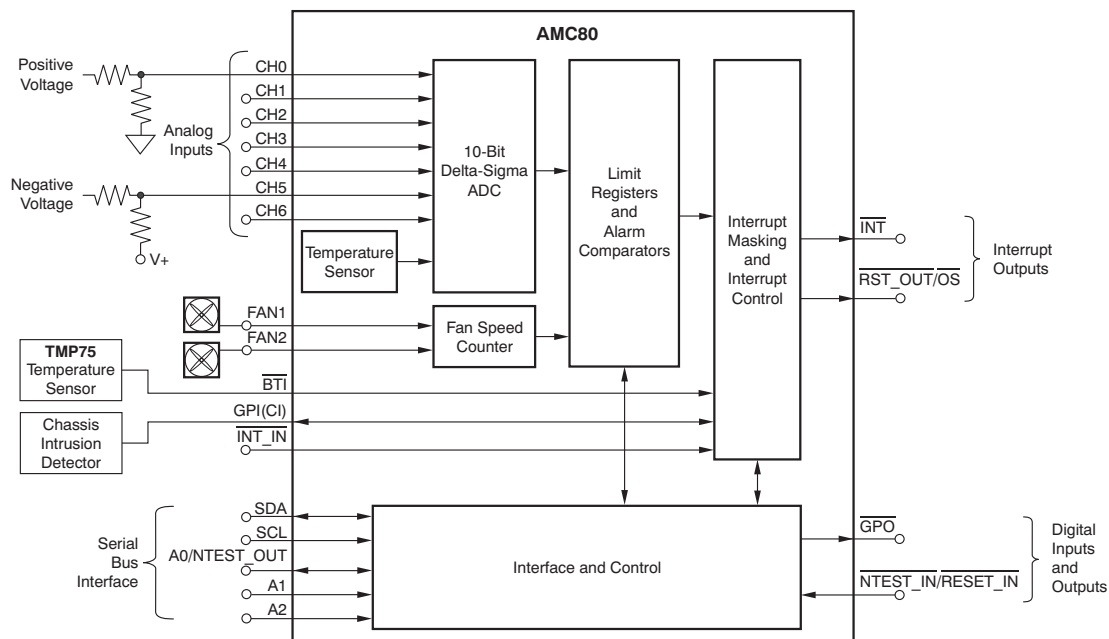
The AMC80 is a system hardware monitoring and control circuit that includes a seven-channel, 10-bit analog-to-digital converter (ADC), two programmable fan-speed monitors, and a two-wire interface. The AMC80 also includes programmable upper over-limit and lower under-limit alarms that activate when the programmed limits are exceeded.

The AMC80 can interface with both linear and digital temperature sensors. The 2.5-mV least significant bit (LSB) and 2.56-V input range can accept inputs from a linear sensor such as the [TMP20](#). The  $\overline{\text{BTI}}$  pin is used as an input from a digital sensor such as the [TMP75](#). The AMC80 operates from a 3-V to 5.5-V supply voltage, has low supply current, and can be configured using a two-wire interface, thus making it ideal for a wide range of applications.

The AMC80 is available in a 24-lead TSSOP package and is fully specified over the  $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$  temperature range.

## APPLICATIONS

- Communications Equipment
- Servers
- Industrial and Medical Equipment



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This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

### PACKAGE INFORMATION<sup>(1)</sup>

| PRODUCT | PACKAGE-LEAD | PACKAGE DESIGNATOR | PACKAGE MARKING |
|---------|--------------|--------------------|-----------------|
| AMC80   | TSSOP-24     | PW                 | AMC80A          |

- (1) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI web site at [www.ti.com](http://www.ti.com).

### ABSOLUTE MAXIMUM RATINGS<sup>(1)</sup>

Over operating free-air temperature range, unless otherwise noted.

|                                                 |                                   | AMC80              | UNIT |
|-------------------------------------------------|-----------------------------------|--------------------|------|
| Power supply voltage range, V+                  |                                   | –0.3 to 7          | V    |
| Input voltage range, V <sub>IN</sub>            | Pin 6                             | –0.3 to (V+) + 0.3 | V    |
|                                                 | Pins 1, 2, 3, 4, 5, 7, 11, 12, 13 | –0.3 to 7          | V    |
| Input current, I <sub>IN</sub>                  |                                   | 10                 | mA   |
| Operating temperature range, T <sub>A</sub>     |                                   | –55 to +127        | °C   |
| Storage temperature range, T <sub>STG</sub>     |                                   | –65 to +150        | °C   |
| Junction temperature range (T <sub>J</sub> max) |                                   | +150               | °C   |
| ESD ratings                                     | Human body model (HBM)            | 2.5                | kV   |
|                                                 | Charged device model (CDM)        | 1                  | kV   |
|                                                 | Machine model (MM)                | 0.2                | kV   |

- (1) Stresses above these ratings may cause permanent damage. Exposure to absolute maximum conditions for extended periods may degrade device reliability. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those specified is not implied.

### THERMAL INFORMATION

| THERMAL METRIC <sup>(1)</sup> |                                              | AMC80   | UNITS |
|-------------------------------|----------------------------------------------|---------|-------|
|                               |                                              | PW      |       |
|                               |                                              | 24 PINS |       |
| θ <sub>JA</sub>               | Junction-to-ambient thermal resistance       | 100.72  | °C/W  |
| θ <sub>JC(top)</sub>          | Junction-to-case(top) thermal resistance     | 31.4    |       |
| θ <sub>JB</sub>               | Junction-to-board thermal resistance         | 54.7    |       |
| ψ <sub>JT</sub>               | Junction-to-top characterization parameter   | 1.0     |       |
| ψ <sub>JB</sub>               | Junction-to-board characterization parameter | 54.2    |       |
| θ <sub>JC(bottom)</sub>       | Junction-to-case(bottom) thermal resistance  | N/A     |       |

- (1) For more information about traditional and new thermal metrics, see the *IC Package Thermal Metrics* application report, [SPRA953](http://www.ti.com/lit/zip/spra953).

### RECOMMENDED OPERATING CONDITIONS

|                                             | MIN   | NOM         | MAX  | UNIT |
|---------------------------------------------|-------|-------------|------|------|
| Supply voltage range, V+                    | 3     |             | 5.5  | V    |
| Input voltage range, V <sub>IN</sub>        | –0.05 | (V+) + 0.05 |      | V    |
| Operating temperature range, T <sub>A</sub> | –40   |             | +125 | °C   |

## ELECTRICAL CHARACTERISTICS

At  $T_A$   $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$  and  $V_+ = 3\text{ V}$  to  $5.5\text{ V}$ , unless otherwise noted.

| PARAMETER                                                                                             |                                       | TEST CONDITIONS                                                   | AMC80   |        |      | UNIT               |
|-------------------------------------------------------------------------------------------------------|---------------------------------------|-------------------------------------------------------------------|---------|--------|------|--------------------|
|                                                                                                       |                                       |                                                                   | MIN     | TYP    | MAX  |                    |
| DIGITAL INPUTS                                                                                        |                                       |                                                                   |         |        |      |                    |
| V <sub>IH</sub>                                                                                       | Input high voltage                    |                                                                   | 2       |        |      | V                  |
| V <sub>IL</sub>                                                                                       | Input low voltage                     |                                                                   |         |        | 0.8  | V                  |
| V <sub>HYS</sub>                                                                                      | Hysteresis voltage                    | V+ = 3.3 V                                                        | 0.23    |        |      | V                  |
|                                                                                                       |                                       | V+ = 5 V                                                          | 0.33    |        |      | V                  |
| I <sub>IH</sub>                                                                                       | Input high current                    | V <sub>IH</sub> = V+, all pins except $\overline{\text{BTI}}$     | −1      | −0.005 |      | μA                 |
|                                                                                                       |                                       | V <sub>IH</sub> = V+, $\overline{\text{BTI}}$ pin                 | −10     | −1     |      | μA                 |
| I <sub>IL</sub>                                                                                       | Input low current                     | V <sub>IL</sub> = 0 V, all pins except $\overline{\text{BTI}}$    | 0.005   |        | 1    | μA                 |
|                                                                                                       |                                       | V <sub>IL</sub> = 0 V, V+ = 5.5 V, $\overline{\text{BTI}}$ pin    |         |        | 2    | mA                 |
| C <sub>IN</sub>                                                                                       | Input capacitance                     |                                                                   | 20      |        |      | pF                 |
| ANALOG INPUTS                                                                                         |                                       |                                                                   |         |        |      |                    |
| V <sub>IN</sub>                                                                                       | Input voltage range                   | Default                                                           | 0       |        | 2.56 | V                  |
|                                                                                                       |                                       | Programmable                                                      | 0       |        | V+   | V                  |
| I <sub>L-ON</sub>                                                                                     | Input leakage current (on)            |                                                                   | ±0.005  |        |      | μA                 |
| I <sub>L-OFF</sub>                                                                                    | Input leakage current (off)           |                                                                   | ±0.005  |        |      | μA                 |
| R <sub>IN</sub>                                                                                       | Input resistance                      |                                                                   | 2       |        | 10   | kΩ                 |
| DIGITAL OUTPUTS (A0/NTEST_OUT, INT)                                                                   |                                       |                                                                   |         |        |      |                    |
| V <sub>OH</sub>                                                                                       | Output high voltage                   | I <sub>OUT</sub> = 3 mA/5 mA, V+ = 3 V/4.5 V                      | 2.4     |        |      | V                  |
| V <sub>OL</sub>                                                                                       | Output low voltage                    | I <sub>OUT</sub> = 3 mA/5 mA, V+ = 3 V/4.5 V                      |         |        | 0.4  | V                  |
| DIGITAL OPEN-DRAIN OUTPUTS ( $\overline{\text{GPO}}$ , $\overline{\text{RST\_OUT/OS}}$ , GPI/CI, SDA) |                                       |                                                                   |         |        |      |                    |
| V <sub>OL</sub>                                                                                       | Output low voltage                    | I <sub>OUT</sub> = 3 mA/5 mA, V+ = 3 V/4.5 V, all pins except SDA |         |        | 0.4  | V                  |
|                                                                                                       |                                       | I <sub>OUT</sub> = 4 mA, V+ = 3 V, SDA pin                        |         |        | 0.4  | V                  |
| I <sub>OH</sub>                                                                                       | Output high current                   | V <sub>OUT</sub> = V+                                             | 0.005   |        | 1    | μA                 |
| PW                                                                                                    | Pulse duration                        | $\overline{\text{RST\_OUT/OS}}$ , GPI/CI                          | 10      | 22.5   |      | ms                 |
| TEMPERATURE ERROR                                                                                     |                                       |                                                                   |         |        |      |                    |
| T <sub>E</sub>                                                                                        | Temperature error                     | T <sub>A</sub> = −40°C to +125°C                                  |         |        | ±3   | °C                 |
|                                                                                                       |                                       | T <sub>A</sub> = −25°C to +100°C                                  |         |        | ±2   | °C                 |
| T <sub>R</sub>                                                                                        | Temperature resolution                |                                                                   | 0.0625  |        |      | °C                 |
| ANALOG-TO-DIGITAL CONVERTER                                                                           |                                       |                                                                   |         |        |      |                    |
| V <sub>R</sub>                                                                                        | Resolution                            | V <sub>IN</sub> = 2.56 V                                          | 2.5     |        |      | mV                 |
|                                                                                                       |                                       | V <sub>IN</sub> = V+                                              | 6       |        |      | mV                 |
| DNL                                                                                                   | Differential linearity                |                                                                   | −1      |        | 1    | LSB <sup>(1)</sup> |
| ADC <sub>ERR</sub>                                                                                    | Total unadjusted error <sup>(2)</sup> |                                                                   | −1      |        | 1    | %                  |
| PSRR                                                                                                  | Power supply rejection ratio          |                                                                   | ±0.0008 |        |      | %                  |
| t <sub>C</sub> <sup>(3)</sup>                                                                         | Total conversion time                 |                                                                   | 662     | 728    | 810  | ms                 |

(1) LSB means least significant bit.

(2) Total unadjusted error contains offset, gain, and linearity errors of the ADC.

(3) Total conversion time contains the temperature conversion, the seven analog input voltage conversions, and the two tachometer readings.

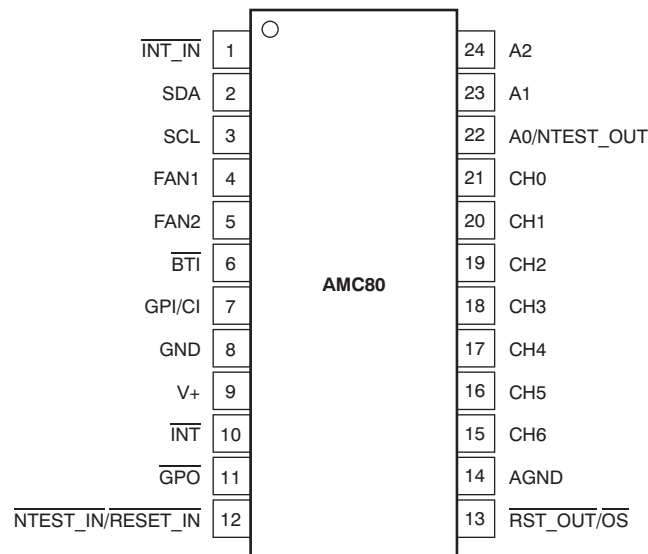
## ELECTRICAL CHARACTERISTICS (continued)

At  $T_A$   $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$  and  $V_+ = 3\text{ V}$  to  $5.5\text{ V}$ , unless otherwise noted.

| PARAMETER                    |                                  | TEST CONDITIONS              | AMC80 |      |      | UNIT   |
|------------------------------|----------------------------------|------------------------------|-------|------|------|--------|
|                              |                                  |                              | MIN   | TYP  | MAX  |        |
| FAN RPM-TO-DIGITAL CONVERTER |                                  |                              |       |      |      |        |
| FAN <sub>ERR</sub>           | Fan RPM error                    |                              | -10   |      | 10   | %      |
| f <sub>CLK</sub>             | Internal clock frequency         |                              | 20.2  | 22.5 | 24.8 | kHz    |
| FAN <sub>RPM</sub>           | FAN1 and FAN2 nominal input RPM  | Divisor = 1, fan count = 153 | 8800  |      |      | RPM    |
|                              |                                  | Divisor = 2, fan count = 153 | 4400  |      |      | RPM    |
|                              |                                  | Divisor = 3, fan count = 153 | 2200  |      |      | RPM    |
|                              |                                  | Divisor = 4, fan count = 153 | 1100  |      |      | RPM    |
| FSC                          | Full-scale count                 |                              |       |      | 255  | Counts |
| POWER SUPPLY                 |                                  |                              |       |      |      |        |
| V+                           | Specified voltage range          |                              | +3    |      | +5.5 | V      |
| I <sub>QA</sub>              | Quiescent current, average       | V+ = 5.5 V                   |       |      | 100  | μA     |
|                              |                                  | V+ = 3.8 V                   |       |      | 25   | μA     |
| I <sub>QSD</sub>             | Quiescent current, shutdown mode | V+ = 5.5 V                   |       |      | 100  | μA     |
|                              |                                  | V+ = 3.8 V                   |       |      | 25   | μA     |
| TEMPERATURE                  |                                  |                              |       |      |      |        |
| T <sub>A</sub>               | Specified range                  |                              | -40   |      | +125 | °C     |

## PIN CONFIGURATION

**PW PACKAGE  
TSSOP-24  
(TOP VIEW)**



## PIN DESCRIPTIONS

| PIN |                                         | I/O    | TYPE    | DESCRIPTION                                                                                                                                                                                                                                    |
|-----|-----------------------------------------|--------|---------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| NO. | NAME                                    |        |         |                                                                                                                                                                                                                                                |
| 1   | $\overline{\text{INT\_IN}}$             | Input  | Digital | Interrupt input pin. An active low input that extends the $\overline{\text{INT\_IN}}$ signal to the $\overline{\text{INT}}$ output of the AMC80.                                                                                               |
| 2   | SDA                                     | I/O    | Digital | Serial bus data line for SMBus, open-drain; requires pull-up resistor.                                                                                                                                                                         |
| 3   | SCL                                     | I/O    | Digital | Serial bus clock line for SMBus, open-drain; requires pull-up resistor.                                                                                                                                                                        |
| 4   | FAN1                                    | Input  | Digital | Fan tachometer input pin                                                                                                                                                                                                                       |
| 5   | FAN2                                    | Input  | Digital | Fan tachometer input pin                                                                                                                                                                                                                       |
| 6   | $\overline{\text{BTI}}$                 | Input  | Digital | Board temperature interrupt pin. $\overline{\text{BTI}}$ is driven by the over-temperature shutdown (OS) outputs of the additional temperature sensors. This pin has an internal 10-k $\Omega$ pull-up resistor.                               |
| 7   | GPI(CI)                                 | Input  | Digital | General-purpose input pin (chassis interrupt). An active high interrupt input pin to latch a chassis interrupt event.                                                                                                                          |
| 8   | DGND                                    | Power  | Analog  | Digital ground.                                                                                                                                                                                                                                |
| 9   | V+                                      | Power  | Analog  | Positive supply voltage (3V to 5.5V).                                                                                                                                                                                                          |
| 10  | $\overline{\text{INT}}$                 | Output | Digital | Non-maskable interrupt (active high, PMOS, open-drain) or interrupt request (active low, NMOS, open-drain) pin. The $\overline{\text{INT}}$ pin becomes active when $\overline{\text{INT\_IN}}$ , $\overline{\text{BTI}}$ , or GPI interrupts. |
| 11  | $\overline{\text{GPO}}$                 | Output | Digital | General-purpose output pin. $\overline{\text{GPO}}$ is an active low, NMOS, open-drain output. This pin is intended to drive an external power PMOS for software power control or to control power to a cooling fan.                           |
| 12  | $\overline{\text{NTEST\_IN/RESET\_IN}}$ | Input  | Digital | This pin is an active-low input that enables NAND tree board-level connectivity testing. The AMC80 resets to its power-on state when NAND tree connectivity is enabled.                                                                        |
| 13  | $\overline{\text{RST\_OUT/OS}}$         | Output | Digital | This pin is an NMOS open-drain output. $\overline{\text{RST\_OUT}}$ provides a master reset to devices connected to this line. $\overline{\text{OS}}$ is dedicated to the temperature reading alarm.                                           |
| 14  | AGND                                    | Power  | Analog  | Analog ground. This pin must be tied to a low-noise analog ground plane for optimum performance.                                                                                                                                               |
| 15  | CH6                                     | Input  | Analog  | Analog input channel 6                                                                                                                                                                                                                         |
| 16  | CH5                                     | Input  | Analog  | Analog input channel 5                                                                                                                                                                                                                         |
| 17  | CH4                                     | Input  | Analog  | Analog input channel 4                                                                                                                                                                                                                         |
| 18  | CH3                                     | Input  | Analog  | Analog input channel 3                                                                                                                                                                                                                         |
| 19  | CH2                                     | Input  | Analog  | Analog input channel 2                                                                                                                                                                                                                         |
| 20  | CH1                                     | Input  | Analog  | Analog input channel 1                                                                                                                                                                                                                         |
| 21  | CH0                                     | Input  | Analog  | Analog input channel 0                                                                                                                                                                                                                         |
| 22  | A0/NTEST_OUT                            | I/O    | Digital | The lowest order bit of the serial bus address. During a NAND tree test for ATE board-level connectivity, this pin functions as an output.                                                                                                     |
| 23  | A1                                      | Input  | Digital | Address pin 1                                                                                                                                                                                                                                  |
| 24  | A2                                      | Input  | Digital | Address pin 2                                                                                                                                                                                                                                  |

## TIMING DIAGRAM

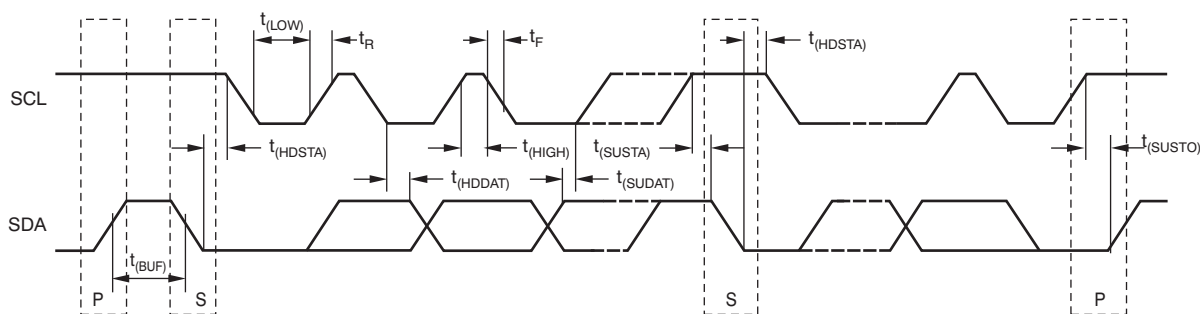


Figure 1. Serial Bus Interface Timing

## TIMING CHARACTERISTICS

At  $T_A$   $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$  and  $V_S = 3\text{V}$  to  $5.5\text{V}$ , unless otherwise noted.

| PARAMETER          |                                                                                            | FAST MODE        |     | HIGH-SPEED MODE  |      | UNITS |
|--------------------|--------------------------------------------------------------------------------------------|------------------|-----|------------------|------|-------|
|                    |                                                                                            | MIN              | MAX | MIN              | MAX  |       |
| $f_{\text{SCL}}$   | SCL operating frequency                                                                    | 10               | 400 | 10               | 3400 | kHz   |
| $t_{\text{BUF}}$   | Bus free time between STOP and START conditions                                            | 600              |     | 160              |      | ns    |
| $t_{\text{HDSTA}}$ | Hold time after repeated START condition. After this period, the first clock is generated. | 600              |     | 160              |      | ns    |
| $t_{\text{SUSTA}}$ | Repeated START condition setup time                                                        | 600              |     | 160              |      | ns    |
| $t_{\text{SUSTO}}$ | STOP condition setup time                                                                  | 600              |     | 160              |      | ns    |
| $t_{\text{HDDAT}}$ | Data hold time                                                                             | 0 <sup>(1)</sup> |     | 0 <sup>(2)</sup> |      | ns    |
| $t_{\text{SUDAT}}$ | Data setup time                                                                            | 100              |     | 10               |      | ns    |
| $t_{\text{LOW}}$   | Clock low period                                                                           | 1300             |     | 160              |      | ns    |
| $t_{\text{HIGH}}$  | Clock high period                                                                          | 600              |     | 60               |      | ns    |
| $t_{\text{R}}$     | Clock/Data input rise time                                                                 |                  | 300 |                  | 160  | ns    |
| $t_{\text{F}}$     | Clock/Data input fall time                                                                 |                  | 300 |                  | 160  | ns    |

- (1) For cases when the fall time of SCL is less than 20 ns and/or the rise time or fall time of SDA is less than 20 ns, the hold time should be greater than 20 ns.
- (2) For cases when the fall time of SCL is less than 10 ns and/or the rise or fall time of SDA is less than 10 ns, the hold time should be greater than 10 ns.

## FUNCTIONAL BLOCK DIAGRAM

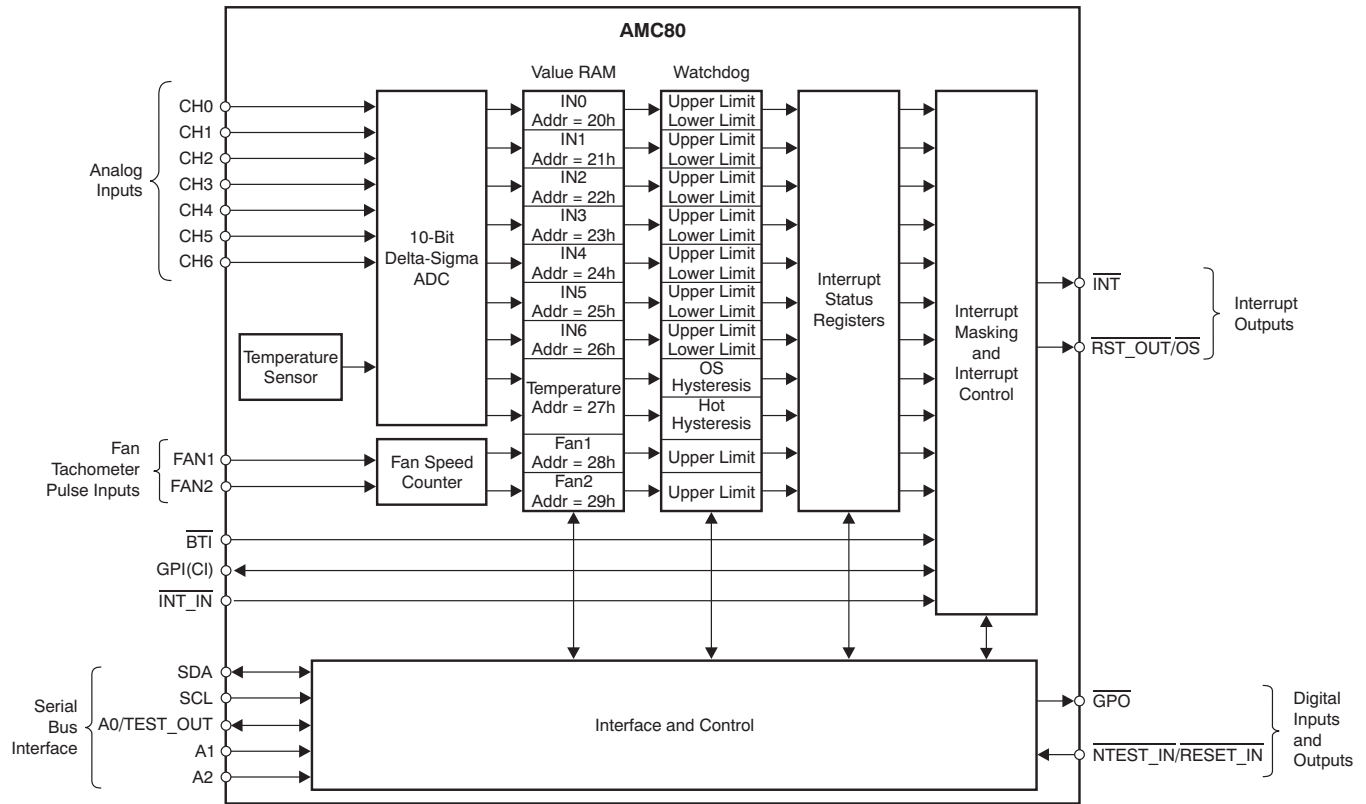
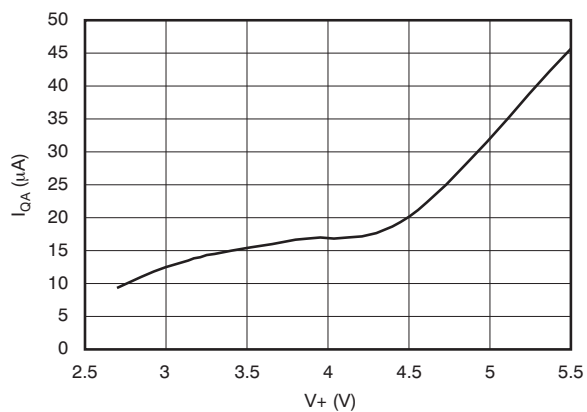


Figure 2. High-Level Block Diagram

## TYPICAL CHARACTERISTICS

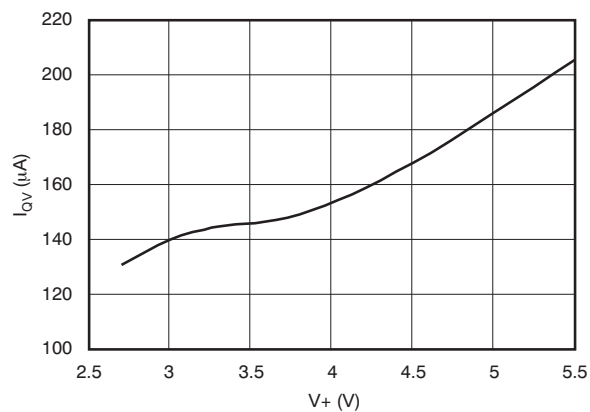
At  $T_A = +25^\circ\text{C}$  and  $V_+ = 3\text{ V}$  to  $5.5\text{ V}$ , unless otherwise noted.

**AVERAGE QUIESCENT CURRENT  
vs SUPPLY VOLTAGE**



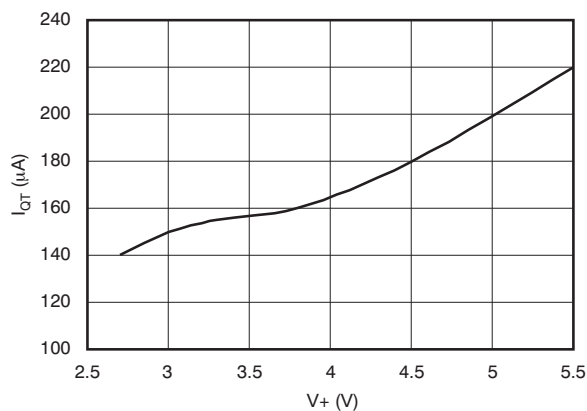
**Figure 3.**

**QUIESCENT CURRENT DURING VOLTAGE CONVERSION  
vs SUPPLY VOLTAGE**



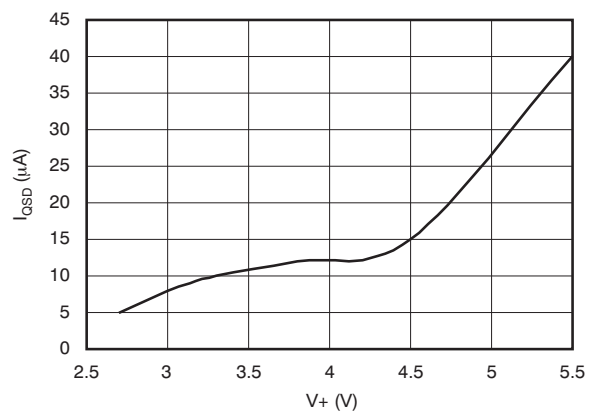
**Figure 4.**

**QUIESCENT CURRENT DURING TEMPERATURE  
CONVERSION vs SUPPLY VOLTAGE**



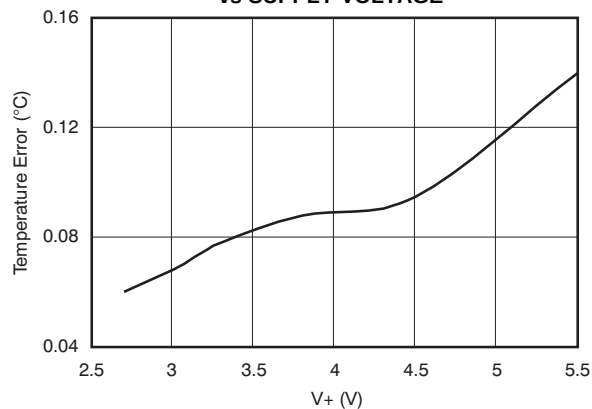
**Figure 5.**

**QUIESCENT CURRENT DURING SHUTDOWN  
vs SUPPLY VOLTAGE**



**Figure 6.**

**TEMPERATURE ERROR  
vs SUPPLY VOLTAGE**



**Figure 7.**

## THEORY OF OPERATION

### BLOCK LEVEL DESCRIPTION

The AMC80 provides seven analog inputs, a temperature sensor, a delta-sigma analog-to-digital converter (ADC), and a variety of inputs and outputs on a single chip. A two-wire SMBus interface is also provided. The AMC80 can continuously perform power-supply, temperature, and fan monitoring for a variety of applications. The AMC80 is fully pin- and software-compatible with the LM96080 and LM80.

The AMC80 continuously converts analog inputs to 10-bit resolution using a 2.5-mV least significant bit (LSB) with a default input range of 0 V to 2.56 V, or a 6-mV LSB with a programmable input range of 0 V to V+. The analog inputs (CH0 to CH6) are intended for connection to the several power supplies present in any typical system. Temperature can be converted to a 9-bit or 12-bit resolution with either 0.5°C or 0.0625°C LSB, respectively. The FAN1 and FAN2 inputs can be programmed to accept either a fan failure indicator or tachometer signals. Fan failure signals can be programmed to be either active high or active low. Fan inputs measure the period of tachometer pulses from the fans, providing a higher count for lower fan speeds. The fan inputs are digital inputs with transition levels according to the Digital Inputs section of the [Electrical Characteristics](#) table. Full-scale fan counts are 255 (8-bit counter), which represent a stopped or very slow fan. Nominal speeds, based on a count of 153, are programmable from 1100 RPM to 8800 RPM. Signal conditioning circuitry is included to accommodate slow rise and fall times.

The AMC80 provides a number of internal registers:

- **Configuration Register:** Provides control and configuration.
- **Interrupt Status Registers:** Two registers that provide the status of each interrupt alarm.
- **Interrupt Mask Registers:** Allows masking of individual interrupt sources, as well as separate masking for both hardware interrupt outputs.
- **Fan Divisor/RST\_OUT/OS Register:** Bits 0 to 5 of [this register](#) contain the divisor bits for the FAN1 and FAN2 inputs. Bits 6 and 7 control the function of the RST\_OUT/OS output.
- **OS Configuration/Temperature Resolution Register:** The configuration of the overtemperature shutdown (OS) is controlled by the lower three bits of this register. Bit 3 enables 12-bit temperature conversions. In 12-bit mode, bits 4 to 7 represent the four LSBs of the temperature measurement. In 9-bit mode, bit 4 represents the LSB of the temperature measurement.
- **Conversion Rate Register:** Sets the time interval of the continuous monitoring cycle to either fixed or programmable (see the Conversion Rate Count Register for setting the programmable time interval).
- **Voltage/Temperature Channel Disable Register:** Allows voltage inputs and the local temperature conversion to be disabled.
- **Input Mode Register:** Allows voltage inputs to be configured as single-ended or as a differential pair with normal or reverse polarity.
- **ADC Control Register:** Bits 0 to 2 set the programmable conversion rate for the 10-bit ADC. Bits 3 to 5 allow for programmable input full-scale voltage.
- **Conversion Rate Count Register:** Selects the adjustable time interval when the conversion rate of the continuous monitoring cycle is set to programmable.
- **Value RAM:** The monitoring results (for temperature, voltages, fan counts, and Fan Divisor/RST\_OUT/OS Register limits) are all contained in the Value RAM. The Value RAM consists of 32 bytes. The first 10 bytes are all of the results, the next 20 bytes are the interrupt alarm limits, and the last two bytes are at the upper locations for manufacturer ID and die revision ID.

The AMC80 SMBus is compatible with both fast mode (400 kHz) and high-speed mode (3.4 MHz) two-wire interface modes of operation. The AMC80 supports a timeout reset function on SDA and SCL that prevents two-wire bus lockup, and includes an analog filter on the two-wire digital control lines that improves noise immunity. Three address pins (A0 to A2), allow up to eight devices on a single bus. When enabled, the AMC80 starts by cycling through each measurement in sequence, and continuously loops through the sequence based on the Conversion Rate Register (address 07h) setting. Each measured value is compared to values stored in the Value RAM Registers (addresses 2Ah to 3Dh). When the measured value exceeds the programmed limit, the AMC80 sets a [corresponding interrupt](#) in the Interrupt Status Registers (addresses 01h and 02h). Two output interrupt lines (INT and RST\_OUT/OS) are available. INT is [fully](#) programmable with the ability to mask each interrupt source and each output. The Fan Divisor/RST\_OUT/OS Register (address 05h) has control bits that

enable or disable the hardware interrupts. Additional digital inputs are provided for daisy-chaining the interrupt output pin,  $\overline{\text{INT}}$ . This configuration is achieved by connecting multiple external temperature sensors (for example, the [TMP75](#)) to the board temperature interrupt (BTI) input and/or the GPI/CI input. The chassis intrusion (CI) input is designed to accept an active high signal from an external circuit that latches (for example, when the chassis from a server rack is removed).

## INTERFACE AND CONTROL

The SMBus control lines in the AMC80 include SDA, SCL, and the A0 to A2 address pins, which allow up to eight AMC80 devices to be on the same bus. The AMC80 can only operate as a slave device. The SCL line controls only the serial interface; all other clock-related functions within the AMC80 (such as the ADC and fan counters) operate with a separate asynchronous internal clock. The default power-on SMBus address for the AMC80 is '0101'(A2)(A1)(A0) binary, where (A2)(A1)(A0) is the SMBus address.

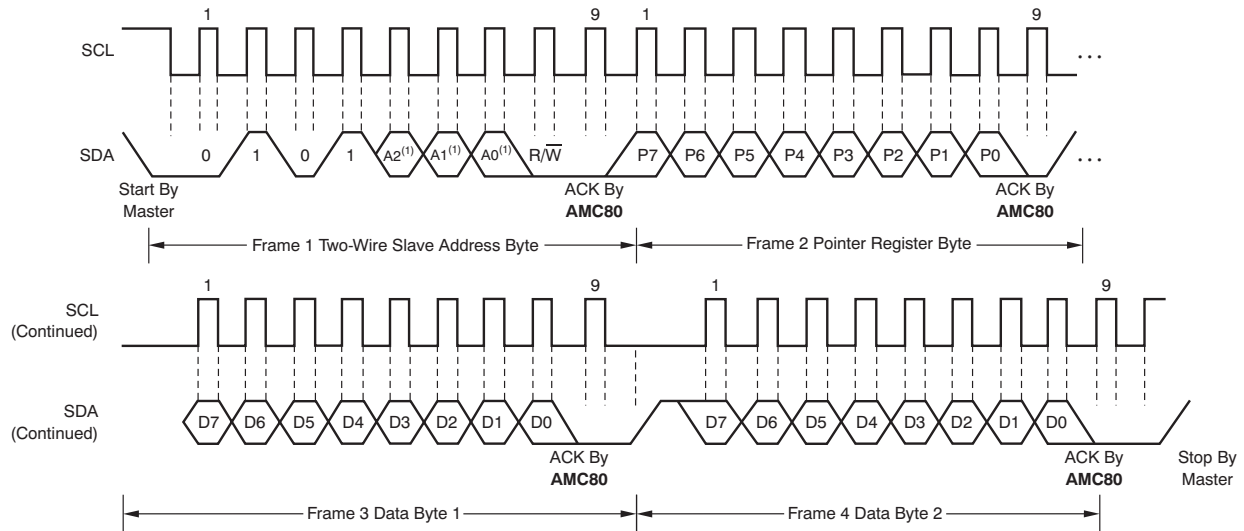
When using the SMBus interface, a write command always consists of the AMC80 SMBus interface address byte, followed by the internal address register byte, and then the data byte (see [Figure 8](#)).

See [Figure 9](#) for the read operation timing. There are two cases for a read operation:

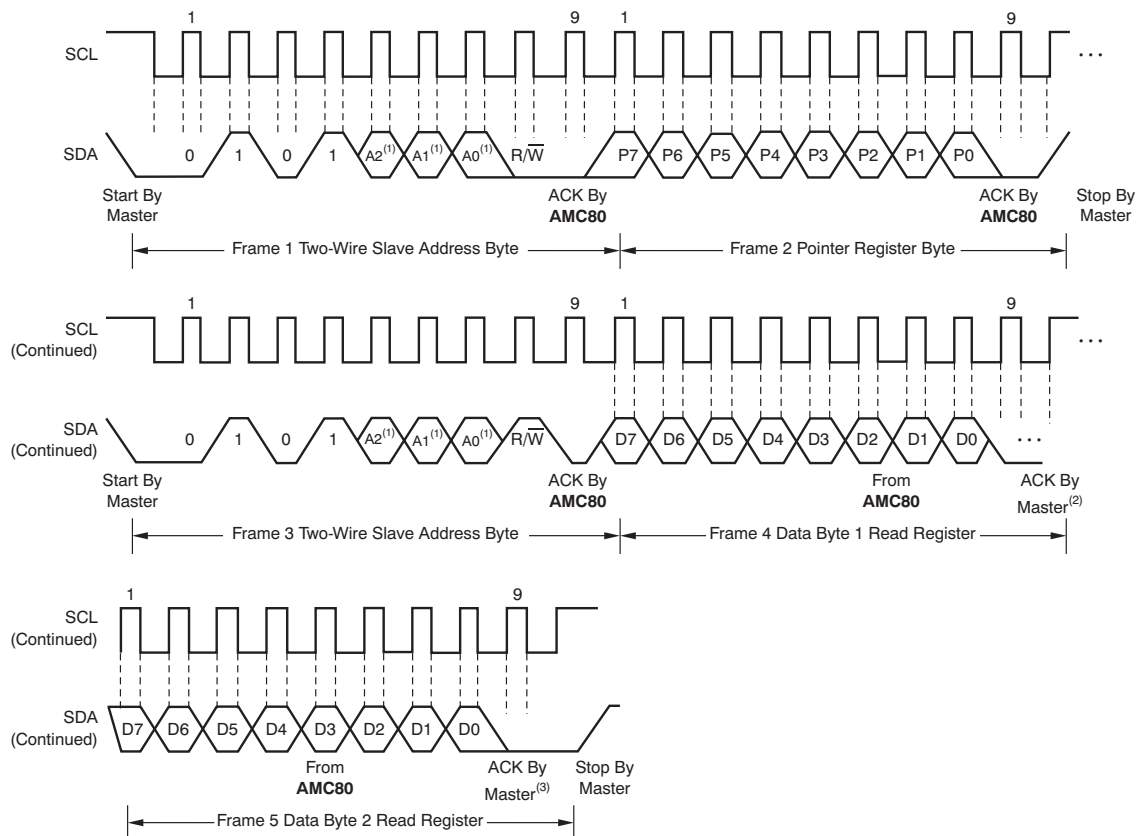
1. If the contents of the Internal Address Register are known, simply read the AMC80 with the SMBus interface address byte, followed by the data byte read from the ADC80.
2. If the internal Address Register contents are unknown, write to the AMC80 with the SMBus interface address byte, followed by the internal address register byte. Then restart the serial communication with a read that consist of the SMBus interface address byte, followed by the data byte read from the AMC80.

**Table 1. Register Overview**

| REGISTER                                                             | INTERNAL ADDRESS (HEX) | POWER-ON VALUE (HEX) | NOTES                                               |
|----------------------------------------------------------------------|------------------------|----------------------|-----------------------------------------------------|
| Configuration Register                                               | 00                     | 08                   |                                                     |
| Interrupt Status Register 1                                          | 01                     | xx                   | Indeterminate                                       |
| Interrupt Status Register 2                                          | 02                     | xx                   | Indeterminate                                       |
| Interrupt Mask Register 1                                            | 03                     | 00                   |                                                     |
| Interrupt Mask Register 2                                            | 04                     | 00                   |                                                     |
| Fan Divisor/RST_OUT/ $\overline{\text{OS}}$ Register                 | 05                     | 14                   | FAN1 and FAN2 divisor = 2 (count of 153 = 4400 RPM) |
| $\overline{\text{OS}}$ Configuration/Temperature Resolution Register | 06                     | x1                   | Four MSBs are indeterminate                         |
| Conversion Rate Register                                             | 07                     | 40                   |                                                     |
| Voltage/Temperature Channel Disable Register                         | 08                     | 00                   | Allows voltage monitoring inputs to be disabled     |
| Input Mode Register                                                  | 09                     | 00                   |                                                     |
| ADC Control Register                                                 | 0A                     | 02                   |                                                     |
| Conversion Rate Count Register                                       | 0B                     | 40                   |                                                     |
| Value RAM Register                                                   | 20 to 29               | xx                   | Indeterminate                                       |
| Value RAM Register                                                   | 2A to 3D               | xx                   | Indeterminate                                       |
| Value RAM Register                                                   | 3E                     | 80                   |                                                     |
| Value RAM Register                                                   | 3F                     | 09                   |                                                     |



**Figure 8. Two-Wire Timing for Write Word Format**



**Figure 9. Two-Wire Timing for Read Word Format**

## APPLICATION INFORMATION

### DEVICE POWER-ON

The AMC80 undergoes a power-on-reset condition when power is first applied to the device, or when the Configuration Register INITIALIZATION bit (address 00h, bit 7) is set high; this bit automatically clears after being set. The AMC80 can also be forced to a reset condition by taking the NTEST\_IN/RESET\_IN pin low for at least 50 ns.

To start the AMC80 monitoring functions (temperature, analog inputs, and fan speeds), write to the Configuration Register with a '0' to INT\_Clear (bit 3) and a '1' to Start (bit 0). The AMC80 then performs continuous monitoring of all temperature, analog inputs, and fan speeds. The sequence of items that are monitored (except for the temperature reading) corresponds to locations in the Value RAM, respectively:

1. Temperature
2. CH0
3. CH1
4. CH2
5. CH3
6. CH4
7. CH5
8. CH6
9. Fan 1
10. Fan 2

The conversion results are available in the Value RAM (addresses 20h to 29h). Conversions can be read at any time and provide the result of the last conversion. A typical sequence of events after AMC80 power-on consists of these actions:

1. Set alarm limits
2. Set interrupt masks
3. Start the AMC80 monitoring process

## ANALOG INPUTS

In the default state, the 10-bit ADC has a 2.5-mV LSB, yielding a 2.56-V full-scale input range. The input range can also be programmed with several values up to the V+ full-scale input range with a 6-mV LSB. These settings are programmed by bits 3 to 5 in the ADC Control Register.

In most applications, the analog inputs are often connected to power supplies. The voltage inputs should be attenuated with external resistors to any desired value within the input range.

### CAUTION

Care should be taken not to exceed V+ on the device input pins at any time.

In select applications where inputs to be monitored are differential in nature, analog inputs (CH0 to CH5) can be configured as up to three differential pairs (inputs 0-1, 2-3, and 4-5) by setting bits 0, 2, and 4 in the Input Mode Register. If needed, the input pair polarity can be changed by setting bits 1, 3, and 5 in the Input Mode Register.

## FAN INPUTS

Inputs are provided on the AMC80 for signals from fans equipped with tachometer outputs. Signal conditioning in the AMC80 accommodates the slow rise and fall times typical of fan tachometer outputs. The maximum input signal range is 0 V to 5.5 V. In the event that these inputs are supplied from fan outputs that exceed 0 V to 5.5 V, either resistive division or diode clamping must be included to keep inputs within an acceptable range.

The Fan Inputs gate an internal 22.5-kHz oscillator for one period of the Fan signal into an 8-bit counter (maximum count = 255). The default divisor is set to 2 (choices are 1, 2, 4, and 8) providing a nominal count of 153 for a 4400 RPM fan with two pulses per revolution. Typical practice is to consider 70% of normal RPM a fan failure, at which point the count will be 219. The fan count can be determined as shown in [Equation 1](#):

$$\text{Count} = \frac{1.35 \times 10^6}{\text{RPM} \times \text{Divisor}}$$

Where:

RPM = fan speed

Divisor = fan 1 or fan 2 divisor set through the Fan\_Divisor/ $\overline{\text{RST\_OUT}}$ / $\overline{\text{OS}}$  Register (address 05h) (1)

FAN1 and FAN2 inputs can also be programmed to be level-sensitive interrupt inputs. Fans that provide only one pulse per revolution require a divisor that is set twice as high as fans that provide two pulses, thus maintaining a nominal fan count of 153. Therefore, using [Equation 1](#), the divisor should be set to 4 for a fan that provides one pulse per revolution with a nominal RPM of 4400.

## TEMPERATURE MEASUREMENT

The AMC80  $\Delta V_{BE}$ -type temperature sensor, is a  $\Delta \Sigma$  ADC that performs 9-bit or 12-bit twos complement temperature conversions. An 8-bit comparator that compares the readings to the user-programmable hot and overtemperature setpoints, and hysteresis values is also incorporated into the AMC80.

Temperature data can be read from the Temperature Reading Register (address 27h). Temperature limits can be read from and written to the Hot Temperature ( $T_{HOT}$ ), Hot Temperature Hysteresis ( $T_{HOT\_HYST}$ ),  $\overline{OS}$  Temperature ( $T_{OS}$ ), and  $\overline{OS}$  Temperature Hysteresis ( $T_{OS\_HYST}$ ) Limit Registers (addresses 38h to 3Bh). Each limit is represented in 12-bit, 9-bit, or 8-bit resolution, as shown in [Table 2](#).

**Table 2. Temperature Lookup**

| TEMPERATURE | 12-BIT DIGITAL OUTPUT (HEX)<br>LSB = 0.0625°C | 9-BIT DIGITAL OUTPUT (HEX)<br>LSB = 0.5°C | 8-BIT DIGITAL OUTPUT (HEX)<br>LSB = 1°C |
|-------------|-----------------------------------------------|-------------------------------------------|-----------------------------------------|
| +125°C      | 07D                                           | 0FA                                       | 7D                                      |
| +25°C       | 019                                           | 032                                       | 19                                      |
| +1°C        | 010                                           | 003                                       | 01                                      |
| 0.0625°C    | 001                                           | —                                         | —                                       |
| 0°C         | 000                                           | 000                                       | 00                                      |
| -0.0625°C   | FFF                                           | —                                         | —                                       |
| -1°C        | FF0                                           | 1FF                                       | FF                                      |
| -25°C       | E70                                           | 1CE                                       | E7                                      |
| -55°C       | C90                                           | 192                                       | C9                                      |

When using a single-byte read, the eight MSBs of the temperature reading can be found in the Value RAM Register (address 27h). The remainder of the temperature reading can be found in the  $\overline{OS}$  Configuration/Temperature Resolution Register (address 06h), bits 4 to 7. In 9-bit format, bit 7 is the only valid bit. In addition, all nine or 12 bits can be read using a double-byte read at register address 27h.

There are four Value RAM Register limits for the temperature reading that affect the  $\overline{INT}$  and  $\overline{OS}$  outputs of the AMC80. These are the  $T_{HOT}$ ,  $T_{HOT\_HYST}$ ,  $T_{OS}$ ,  $T_{OS\_HYST}$  Limit Registers (addresses 38h to 3Bh); see [Table 15](#). There are three interrupt modes of operation: Default Interrupt, One-Time Interrupt, and Comparator. The  $\overline{OS}$  output of the AMC80 can be programmed for One-Time Interrupt mode and Comparator mode.  $\overline{INT}$  can be programmed for Default Interrupt mode and One-Time Interrupt mode. These modes are explained in the following subsections.

### Default Interrupt Mode

In Default Interrupt mode, exceeding  $T_{HOT}$  causes an interrupt that remains active indefinitely until reset by reading Interrupt Status Register 1 (address 01h) or cleared by the  $\overline{INT\_Clear}$  bit in the Configuration Register (address 00h, bit 3). When an interrupt event has occurred by exceeding  $T_{HOT}$ , and is then reset, another interrupt occurs again when the next temperature conversion has completed. The interrupts continue to occur in this manner until the temperature falls below  $T_{HOT\_HYST}$ , at which time the interrupt output automatically clears.

### One-Time Interrupt Mode

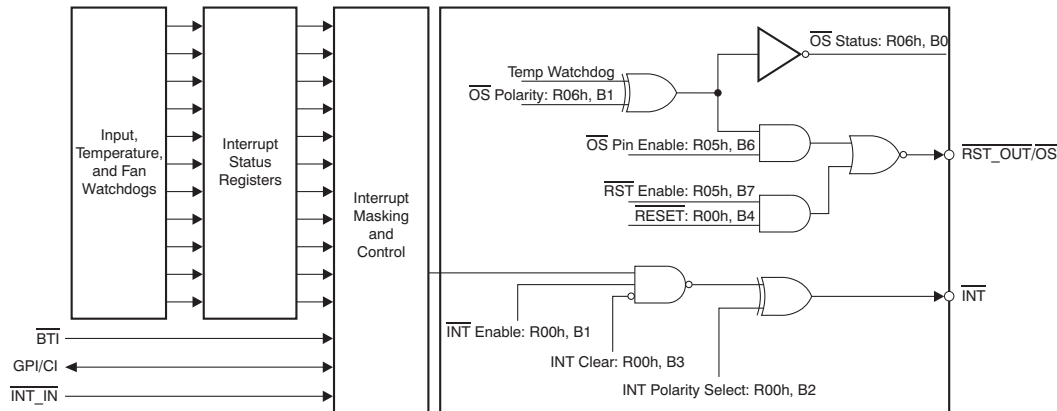
In One-Time Interrupt mode, exceeding  $T_{HOT}$  causes an interrupt that remains active indefinitely until reset by reading Interrupt Status Register 1 or cleared by the  $\overline{INT\_Clear}$  bit in the Configuration Register. When an interrupt event has occurred by exceeding  $T_{HOT}$ , and is then reset, an interrupt does not occur again until the temperature falls below  $T_{HOT\_HYST}$ .

### Comparator Mode

In Comparator mode, exceeding  $T_{OS}$  causes the  $\overline{OS}$  output to go low (default) and remain low until the temperature falls below  $T_{OS\_HYST}$ . When the temperature falls below  $T_{OS\_HYST}$ ,  $\overline{OS}$  goes high.

## INTERRUPT STRUCTURE

Figure 10 depicts the interrupt structure of the AMC80.



**Figure 10. Interrupt Structure**

External interrupt inputs can come from the following sources:

- **Board Temperature Interrupt (BTI)** - This pin is an active low interrupt recommended to come from the overtemperature shutdown (OS) output of TMP75 temperature sensors. The TMP75 OS output activates when its temperature exceeds a programmed threshold. If the temperature of any TMP75 exceeds its programmed limit, BTI is driven low. This action generates an interrupt through bit 1 of Interrupt Status Register 2 (address 02h) that notifies the host of a possible overtemperature condition. To disable this feature, set bit 1 of Interrupt Mask Register 2 (address 04h) to high. This pin also provides an internal, 10-kΩ pull-up resistor.
- **GPI/CI** - This pin is an active high interrupt from any type of device that detects and captures chassis intrusion violations. This action could be accomplished mechanically, optically, or electrically; circuitry external to the AMC80 is expected to latch the event. Read this interrupt using bit 4 of Interrupt Status Register 2 (address 02h), and disable it using bit 4 of Interrupt Mask Register 2 (address 04h). The design of the AMC80 allows this input to go high even with no power applied, and no clamping or other interference with the line occurs. This line can also be pulled low by the AMC80 for at least 10ms to reset a typical chassis-intrusion circuit. Accomplish this reset by setting bit 5 of the Configuration Register (address 00h) to high; this bit is self-clearing.
- **INT\_IN** - This pin is an active low interrupt that provides a way to connect an INT from other devices through the AMC80 to the processor. If this pin is pulled low, then bit 7 of Interrupt Status Register 1 (address 01h) goes high, indicating this interrupt detection. Setting bit 1 of the Configuration Register (address 00h) also allows the INT pin to go low when INT\_IN goes low. To disable this feature, set bit 7 of Interrupt Mask Register 1 (address 03h) to high.

Device interrupt outputs can come from the following sources:

- **INT** - This pin becomes active whenever INT\_IN, BTI, or GPI/CI interrupts. INT is enabled when bit 1 of the Configuration Register (address 00h) is set high. Bits 2 and 3 of the Configuration Register are also used to set the polarity and state of the INT interrupt line.
- **OS** - In the Fan Divisor/RST\_OUT/OS Register (address 05h), bit 6 (OS Pin Enable), must be set high and bit 7 (RST Enable) must be set to low in order to enable the OS function on the RST\_OUT/OS pin. The OS pin has two modes of operation: One-Time Interrupt and Comparator. One-Time Interrupt mode is selected by taking bit 2 of the OS Configuration/Temperature Resolution Register (address 06h) high. If bit 2 is taken low, then Comparator mode is selected. Unlike the OS pin, the OS bit in Interrupt Status Register 2 (address 02h, bit 5) functions in Default Interrupt and One-Time Interrupt modes. The OS bit can be masked to the INT pin by taking bit 5 in Interrupt Mask Register 2 (address 04h) low.

Reading the Interrupt Status Registers (addresses 01h to 02h) outputs the contents and then resets the registers and the INT pin. The INT pin is also cleared by the INT\_Clear bit (address 00h, bit 3) without affecting the contents of the Interrupt Status Registers. When this bit is high, the AMC80 monitoring loop is inactive; monitoring resumes when this bit is low.

## REGISTER MAP

### CONFIGURATION REGISTER

**Table 3. Configuration Register (Address = 00h, Default = 08h)**

| BIT | NAME                                    | TYPE | DESCRIPTION                                                                                                                                                                                                                       |
|-----|-----------------------------------------|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0   | Start                                   | R/W  | '1' enables startup of monitoring activity; '0' puts device in shutdown mode.                                                                                                                                                     |
| 1   | $\overline{\text{INT}}$ Enable          | R/W  | '1' enables the $\overline{\text{INT}}$ output.                                                                                                                                                                                   |
| 2   | $\overline{\text{INT}}$ Polarity Select | R/W  | '1' selects active-high, open-source output; '0' selects active-low, open-drain output.                                                                                                                                           |
| 3   | INT_Clear                               | R/W  | '1' disables the $\overline{\text{INT}}$ output without affecting the contents of the Interrupt Status Registers. The device stops monitoring and resumes on a '0'.                                                               |
| 4   | $\overline{\text{RESET}}$               | R/W  | '1' outputs an active-low reset signal at $\overline{\text{RST\_OUT}}$ , if bit 7 and bit 6 in the Fan Divisor/ Register (address 05h) are set to '1' and '0', respectively. This bit is cleared when the pulse becomes inactive. |
| 5   | Chassis Clear                           | R/W  | '1' clears the GPI/CI pin. This bit clears itself after 10ms.                                                                                                                                                                     |
| 6   | $\overline{\text{GPO}}$                 | R/W  | '1' drives the $\overline{\text{GPO}}$ pin low.                                                                                                                                                                                   |
| 7   | INITIALIZATION                          | R/W  | '1' restores power-on-default values to the registers. This bit is self-clearing                                                                                                                                                  |

### INTERRUPT STATUS REGISTERS

**Table 4. Interrupt Status Register 1 (Address = 01h, Default = xxh; see Table 1)**

| BIT | NAME                        | TYPE | DESCRIPTION                                                                               |
|-----|-----------------------------|------|-------------------------------------------------------------------------------------------|
| 0   | CH0                         | Read | '1' indicates a high or low limit has been exceeded.                                      |
| 1   | CH1                         | Read | '1' indicates a high or low limit has been exceeded.                                      |
| 2   | CH2                         | Read | '1' indicates a high or low limit has been exceeded.                                      |
| 3   | CH3                         | Read | '1' indicates a high or low limit has been exceeded.                                      |
| 4   | CH4                         | Read | '1' indicates a high or low limit has been exceeded.                                      |
| 5   | CH5                         | Read | '1' indicates a high or low limit has been exceeded.                                      |
| 6   | CH6                         | Read | '1' indicates a high or low limit has been exceeded.                                      |
| 7   | $\overline{\text{INT\_IN}}$ | Read | '1' indicates that a low signal has been detected on the $\overline{\text{INT\_IN}}$ pin. |

**Table 5. Interrupt Status Register 2 (Address = 02h, Default = xxh; see Table 1)**

| BIT | NAME                    | TYPE | DESCRIPTION                                                                                                                                                                                       |
|-----|-------------------------|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0   | Hot Temperature         | Read | '1' indicates a high or low limit has been exceeded. One-Time Interrupt and Default Interrupt modes are supported and can be set by bit 6 of Interrupt Mask Register 2 (address 04h).             |
| 1   | $\overline{\text{BTI}}$ | Read | '1' indicates that an interrupt has occurred from the $\overline{\text{BTI}}$ input pin.                                                                                                          |
| 2   | FAN 1                   | Read | '1' indicates that a fan count limit has been exceeded.                                                                                                                                           |
| 3   | FAN 2                   | Read | '1' indicates that a fan count limit has been exceeded.                                                                                                                                           |
| 4   | GPI/CI                  | Read | '1' indicates that GPI/CI has gone high.                                                                                                                                                          |
| 5   | $\overline{\text{OS}}$  | Read | '1' indicates a high or low temperature limit has been exceeded. One-Time Interrupt and Default Interrupt modes are supported and can be set by bit 7 of Interrupt Mask Register 2 (address 04h). |
| 6   | Reserved                | Read | This bit is reserved.                                                                                                                                                                             |
| 7   | Reserved                | Read | This bit is reserved.                                                                                                                                                                             |

## INTERRUPT MASK REGISTERS

**Table 6. Interrupt Mask Register 1 (Address = 03h, Default = 00h)**

| BIT | NAME                        | TYPE | DESCRIPTION                                                                                                                      |
|-----|-----------------------------|------|----------------------------------------------------------------------------------------------------------------------------------|
| 0   | CH0                         | R/W  | '1' disables the corresponding interrupt status bit in <a href="#">Table 4</a> to trigger the $\overline{\text{INT}}$ interrupt. |
| 1   | CH1                         | R/W  |                                                                                                                                  |
| 2   | CH2                         | R/W  |                                                                                                                                  |
| 3   | CH3                         | R/W  |                                                                                                                                  |
| 4   | CH4                         | R/W  |                                                                                                                                  |
| 5   | CH5                         | R/W  |                                                                                                                                  |
| 6   | CH6                         | R/W  |                                                                                                                                  |
| 7   | $\overline{\text{INT\_IN}}$ | R/W  |                                                                                                                                  |

**Table 7. Interrupt Mask Register 2 (Address = 04h, Default = 00h)**

| BIT | NAME                                          | TYPE | DESCRIPTION                                                                                                                      |
|-----|-----------------------------------------------|------|----------------------------------------------------------------------------------------------------------------------------------|
| 0   | Hot Temperature                               | R/W  | '1' disables the corresponding interrupt status bit in <a href="#">Table 5</a> to trigger the $\overline{\text{INT}}$ interrupt. |
| 1   | $\overline{\text{BTI}}$                       | R/W  |                                                                                                                                  |
| 2   | FAN 1                                         | R/W  |                                                                                                                                  |
| 3   | FAN 2                                         | R/W  |                                                                                                                                  |
| 4   | GPI/CI                                        | R/W  |                                                                                                                                  |
| 5   | $\overline{\text{OS}}$                        | R/W  |                                                                                                                                  |
| 6   | $\overline{\text{INT}}$ Interrupt Mode Select | R/W  | '0' selects Default Interrupt mode. '1' selects One-Time Interrupt mode.                                                         |
| 7   | $\overline{\text{OS}}$ Interrupt Mode Select  | R/W  | '0' selects Comparator mode. '1' selects One-Time Interrupt mode.                                                                |

## FAN DIVISOR/ $\overline{\text{RST\_OUT}}$ / $\overline{\text{OS}}$ REGISTER

**Table 8. Fan Divisor/ $\overline{\text{RST\_OUT}}$ / $\overline{\text{OS}}$  Register (Address = 05h, Default = 14h)**

| BIT | NAME                                    | TYPE | DESCRIPTION                                                                                                                                                                                                                                                         |
|-----|-----------------------------------------|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0   | FAN1 Mode Select                        | R/W  | '1' selects the level-sensitive input mode. '0' selects the fan count mode for the FAN1 input.                                                                                                                                                                      |
| 1   | FAN2 Mode Select                        | R/W  | '1' selects the level-sensitive input mode. '0' selects the fan count mode for the FAN2 input.                                                                                                                                                                      |
| 2   | FAN1 RPM Control 1                      | R/W  | FAN1 speed control:<br>'00' = divide by 1.<br>'01' = divide by 2.<br>'10' = divide by 4.<br>'11' = divide by 8.<br>If level-sensitive input is selected, '01' selects an active-low input and '00' selects an active-high input.                                    |
| 3   | FAN1 RPM Control 0                      | R/W  |                                                                                                                                                                                                                                                                     |
| 4   | FAN2 RPM Control 1                      | R/W  | FAN2 speed control:<br>'00' = divide by 1.<br>'01' = divide by 2.<br>'10' = divide by 4.<br>'11' = divide by 8.<br>If level select input is selected, '01' selects an active-low input and '00' selects an active-high input.                                       |
| 5   | FAN2 RPM Control 0                      | R/W  |                                                                                                                                                                                                                                                                     |
| 6   | $\overline{\text{OS}}$ Pin Enable       | R/W  | '1' enables $\overline{\text{OS}}$ mode on the $\overline{\text{RST\_OUT}}$ / $\overline{\text{OS}}$ pin when bit 7 is set to '0'.<br>NOTE: When bits 6 and 7 are both set to '1', the $\overline{\text{RST\_OUT}}$ / $\overline{\text{OS}}$ pin is disabled.       |
| 7   | $\overline{\text{RST\_OUT}}$ Pin Enable | R/W  | '1' enables $\overline{\text{RST\_OUT}}$ mode on the $\overline{\text{RST\_OUT}}$ / $\overline{\text{OS}}$ pin when bit 6 is set to '0'.<br>NOTE: When bits 6 and 7 are both set to '1', the $\overline{\text{RST\_OUT}}$ / $\overline{\text{OS}}$ pin is disabled. |

## **$\overline{OS}$ CONFIGURATION/TEMPERATURE RESOLUTION REGISTER**

**Table 9.  $\overline{OS}$  Configuration/Temperature Resolution Register (Address = 06h, Default = x1h; see Table 1)**

| BIT | NAME                           | TYPE | DESCRIPTION                                                                                                                                         |
|-----|--------------------------------|------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| 0   | OS Status                      | Read | This bit mirrors the state of the $\overline{RST\_OUT/OS}$ pin when in $\overline{OS}$ mode.                                                        |
| 1   | OS Polarity                    | R/W  | '1' selects $\overline{OS}$ to be active-high '0' selects $\overline{OS}$ to be active-low.                                                         |
| 2   | OS Mode Select                 | R/W  | '1' selects One-Time-Interrupt mode; '0' selects Comparator mode.                                                                                   |
| 3   | Temperature Resolution Control | R/W  | '1' selects 11-bit plus sign resolution temperature conversion; '0' selects the default 8-bit plus sign resolution temperature conversion.          |
| 4   | Temp3                          | R/W  | The lower four LSBs of the 11-bit plus sign temperature data. For 8-bit plus sign temperature data, bit 7 is the LSB and bits 4 to 6 are undefined. |
| 5   | Temp2                          | R/W  |                                                                                                                                                     |
| 6   | Temp1                          | R/W  |                                                                                                                                                     |
| 7   | Temp0                          | R/W  |                                                                                                                                                     |

## **CONVERSION RATE REGISTER**

**Table 10. Conversion Rate Register (Address = 07h, Default = 40h)**

| BIT | NAME     | TYPE | DESCRIPTION                                                                                                                                                                                                                                                                               |
|-----|----------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0   | CR1      | R/W  | Controls conversion rate:<br>'0' = Programmable conversion rate by the following formula:<br>Monitoring delay = (ms) = $1.42 \times (8 \times N + 6)$<br>where $N$ can be set by bits 7:0 in the Conversion Rate Count Register (address 0Bh).<br>'1' = Fixed monitoring delay of 728 ms. |
| 1   | Reserved | R/W  | '0' must be written to this bit.                                                                                                                                                                                                                                                          |
| 2   | Reserved | R/W  | '0' must be written to this bit.                                                                                                                                                                                                                                                          |
| 3   | Reserved | R/W  | '0' must be written to this bit.                                                                                                                                                                                                                                                          |
| 4   | Reserved | R/W  | '0' must be written to this bit.                                                                                                                                                                                                                                                          |
| 5   | Reserved | R/W  | '0' must be written to this bit.                                                                                                                                                                                                                                                          |
| 6   | Reserved | R/W  | '0' must be written to this bit.                                                                                                                                                                                                                                                          |
| 7   | Reserved | R/W  | '0' must be written to this bit.                                                                                                                                                                                                                                                          |

## **VOLTAGE/TEMPERATURE CHANNEL DISABLE REGISTER**

**Table 11. Voltage/Temperature Channel Disable Register (Address = 08h, Default = 00h)**

| BIT | NAME | TYPE | DESCRIPTION                                                                                         |
|-----|------|------|-----------------------------------------------------------------------------------------------------|
| 0   | CH0  | R/W  | '1' disables conversions and suppresses error events; Value RAM Register reads '0' for CH0.         |
| 1   | CH1  | R/W  | '1' disables conversions and suppresses error events; Value RAM Register reads '0' for CH1.         |
| 2   | CH2  | R/W  | '1' disables conversions and suppresses error events; Value RAM Register reads '0' for CH2.         |
| 3   | CH3  | R/W  | '1' disables conversions and suppresses error events; Value RAM Register reads '0' for CH3.         |
| 4   | CH4  | R/W  | '1' disables conversions and suppresses error events; Value RAM Register reads '0' for CH4.         |
| 5   | CH5  | R/W  | '1' disables conversions and suppresses error events; Value RAM Register reads '0' for CH5.         |
| 6   | CH6  | R/W  | '1' disables conversions and suppresses error events; Value RAM Register reads '0' for CH6.         |
| 7   | Temp | R/W  | '1' disables conversions and suppresses error events; Value RAM Register reads '0' for temperature. |

## INPUT MODE REGISTER

**Table 12. Input Mode Register (Address = 09h, Default = 00h)**

| BIT | NAME     | TYPE | DESCRIPTION                                                                                                                                                                                                                  |
|-----|----------|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0   | Diff01   | R/W  | When set to '1', CH0 and CH1 operate as a differential input.<br>When set to '0', CH0 and CH1 operate as 2 single-ended inputs.                                                                                              |
| 1   | Pol01    | R/W  | When bit 0 = '1', CH0 and CH1 differential inputs are setup in normal polarity mode when this bit is set to '1', and in reverse polarity mode when this bit is set to '0'.<br>When bit 0 is set to "0", this bit is ignored. |
| 2   | Diff23   | R/W  | When set to '1', CH2 and CH3 operate as a differential input.<br>When set to '0', CH2 and CH3 operate as 2 single-ended inputs.                                                                                              |
| 3   | Pol23    | R/W  | When bit 0 = '1', CH2 and CH3 differential inputs are setup in normal polarity mode when this bit is set to '1', and in reverse polarity mode when this bit is set to '0'.<br>When bit 0 is set to "0", this bit is ignored. |
| 4   | Diff45   | R/W  | When set to '1', CH4 and CH5 operate as a differential input.<br>When set to '0', CH4 and CH5 operate as 2 single-ended inputs.                                                                                              |
| 5   | Pol45    | R/W  | When bit 0 = '1', CH4 and CH5 differential inputs are setup in normal polarity mode when this bit is set to '1', and in reverse polarity mode when this bit is set to '0'.<br>When bit 0 is set to "0", this bit is ignored. |
| 6   | Reserved | R/W  | '0' must be written to this bit.                                                                                                                                                                                             |
| 7   | Reserved | R/W  | '0' must be written to this bit.                                                                                                                                                                                             |

## ADC CONTROL REGISTER

**Table 13. ADC Control Register (Address = 0Ah, Default = 02h)**

| BIT | NAME     | TYPE | DESCRIPTION                                                                                                                                                                                                                  |
|-----|----------|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0   | DR2      | R/W  | The 10-bit ADC conversion rate for the analog inputs is set as follows:<br>000 = 0.512 kHz<br>001 = 1 kHz<br>010 = 1.98 kHz<br>011 = 3.6 kHz<br>100 = 6.3 kHz<br>101 = 9.8 kHz<br>110 = 13.15 kHz<br>111 = 13.15 kHz         |
| 1   | DR1      | R/W  |                                                                                                                                                                                                                              |
| 2   | DR0      | R/W  |                                                                                                                                                                                                                              |
| 3   | PGA2     | R/W  |                                                                                                                                                                                                                              |
| 4   | PGA1     | R/W  | The full-scale analog input range is set as follows:<br>000 = 2.56 V<br>001 = $V_{DD}$<br>010 = 4.096 V or $V_{DD}$ (whichever is less)<br>011 = 2.048 V<br>100 = 1.024 V<br>101 = 0.512 V<br>110 = 0.256 V<br>111 = 0.256 V |
| 5   | PGA0     | R/W  |                                                                                                                                                                                                                              |
| 6   | Reserved | R/W  |                                                                                                                                                                                                                              |
| 7   | Reserved | R/W  |                                                                                                                                                                                                                              |

## CONVERSION RATE COUNT REGISTER

**Table 14. Conversion Rate Count Register (Address = 0Bh, Default = 40h)**

| BIT | NAME | TYPE | DESCRIPTION                                                                                                                                                                                                                                                                                        |
|-----|------|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0   | CRC7 | R/W  | When bit 0 of the Conversion Rate Register (address 07h) is set to '0', the monitoring conversion delay can be programmed as follows:<br>0000000 = 0<br>0000001 = 1<br>0000010 = 2<br>... ..<br>1111111 = 255<br>When bit 0 of the Conversion Rate Register is set to '1', these bits are ignored. |
| 1   | CRC6 | R/W  |                                                                                                                                                                                                                                                                                                    |
| 2   | CRC5 | R/W  |                                                                                                                                                                                                                                                                                                    |
| 3   | CRC4 | R/W  |                                                                                                                                                                                                                                                                                                    |
| 4   | CRC3 | R/W  |                                                                                                                                                                                                                                                                                                    |
| 5   | CRC2 | R/W  |                                                                                                                                                                                                                                                                                                    |
| 6   | CRC1 | R/W  |                                                                                                                                                                                                                                                                                                    |
| 7   | CRC0 | R/W  |                                                                                                                                                                                                                                                                                                    |

## VALUE RAM REGISTER

**Table 15. Value RAM Register (Addresses = 20h to 3Fh)**

| ADDRESS (HEX) | DESCRIPTION                                                         |
|---------------|---------------------------------------------------------------------|
| 20            | CH0 reading (10-bit)                                                |
| 21            | CH1 reading (10-bit)                                                |
| 22            | CH2 reading (10-bit)                                                |
| 23            | CH3 reading (10-bit)                                                |
| 24            | CH4 reading (10-bit)                                                |
| 25            | CH5 reading (10-bit)                                                |
| 26            | CH6 reading (10-bit)                                                |
| 27            | Temperature reading (9-bit or 12-bit for easy readback)             |
| 28            | FAN1 reading                                                        |
| 29            | FAN2 reading                                                        |
| 2A            | CH0 high limit                                                      |
| 2B            | CH0 low limit                                                       |
| 2C            | CH1 high limit                                                      |
| 2D            | CH1 low limit                                                       |
| 2E            | CH2 high limit                                                      |
| 2F            | CH2 low limit                                                       |
| 30            | CH3 high limit                                                      |
| 31            | CH3 low limit                                                       |
| 32            | CH4 high limit                                                      |
| 33            | CH4 low limit                                                       |
| 34            | CH5 high limit                                                      |
| 35            | CH5 low limit                                                       |
| 36            | CH6 high limit                                                      |
| 37            | CH6 low limit                                                       |
| 38            | Hot temperature high limit ( $T_{HOT}$ )                            |
| 39            | Hot temperature hysteresis low limit ( $T_{HOT\_HYST}$ )            |
| 3A            | $\overline{OS}$ temperature high limit ( $T_{OS}$ )                 |
| 3B            | $\overline{OS}$ temperature hysteresis low limit ( $T_{OS\_HYST}$ ) |
| 3C            | FAN1 fan count limit                                                |
| 3D            | FAN2 fan count limit                                                |
| 3E            | Manufacturer ID (always defaults to 80h)                            |
| 3F            | Die revision ID (always defaults to 08h)                            |

**PACKAGING INFORMATION**

| Orderable Device | Status <sup>(1)</sup> | Package Type | Package Drawing | Pins | Package Qty | Eco Plan <sup>(2)</sup>    | Lead/<br>Ball Finish | MSL Peak Temp <sup>(3)</sup> | Samples<br>(Requires Login) |
|------------------|-----------------------|--------------|-----------------|------|-------------|----------------------------|----------------------|------------------------------|-----------------------------|
| AMC80AIPW        | ACTIVE                | TSSOP        | PW              | 24   | 60          | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-2-260C-1 YEAR          |                             |
| AMC80AIPWR       | ACTIVE                | TSSOP        | PW              | 24   | 2000        | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-2-260C-1 YEAR          |                             |
| AMC80PW          | PREVIEW               | TSSOP        | PW              | 24   |             | TBD                        | Call TI              | Call TI                      |                             |
| AMC80PWR         | PREVIEW               | TSSOP        | PW              | 24   |             | 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.

**OBSELETE:** 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)

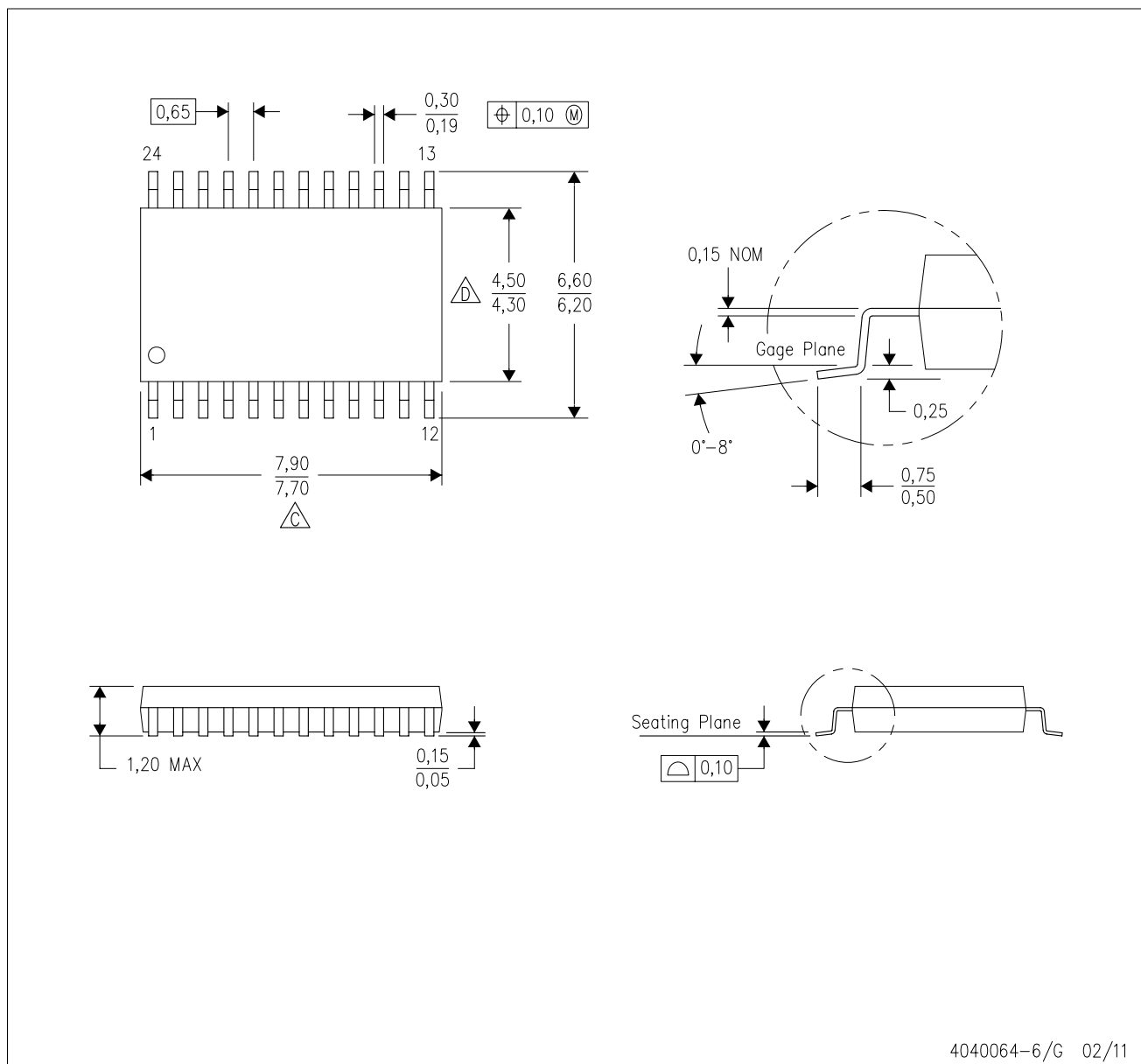
<sup>(3)</sup> MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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PW (R-PDSO-G24)

PLASTIC SMALL OUTLINE



4040064-6/G 02/11

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- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
  - B. This drawing is subject to change without notice.
  - C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0,15 each side.
  - D. Body width does not include interlead flash. Interlead flash shall not exceed 0,25 each side.
  - E. Falls within JEDEC MO-153

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