

# FM75

## Low Voltage 2-Wire Digital Temperature Sensor with Thermal Alarm

### Features

- User Configurable to 9, 10, 11 or 12-bit Resolution
- Precision Calibrated to  $\pm 1^{\circ}\text{C}$  from  $0^{\circ}\text{C}$  to  $100^{\circ}\text{C}$  Typical
- Temperature Range:  $-40^{\circ}\text{C}$  to  $125^{\circ}\text{C}$
- Low Operating Current (less than  $250\mu\text{A}$ )
- Low Self Heating ( $0.2^{\circ}\text{C}$  max in still air)
- Operating Voltage Range: 2.7V to 5.5V

### Applications

- Battery Management
- FAX Management
- Printers
- Portable Medical Instruments
- HVAC
- Power Supply Modules
- Disk Drives
- Computers
- Automotive

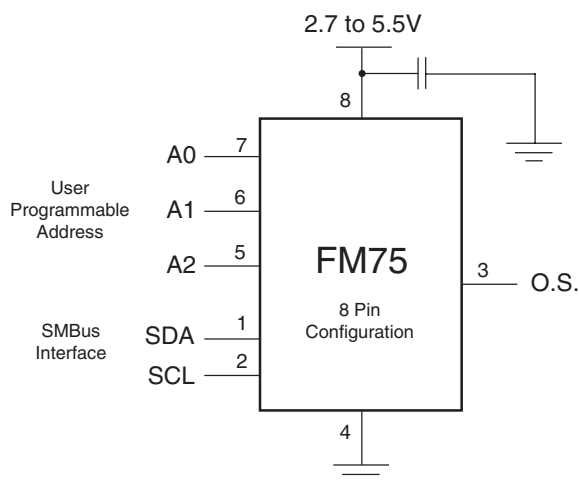
### Description

Within the FM75 are: a high-precision CMOS temperature sensor, a Delta-Sigma analog-to-digital converter and a SMBus compatible serial digital interface. Typical accuracy is  $\pm 2^{\circ}\text{C}$  over the full temperature range of  $-40^{\circ}\text{C}$  to  $125^{\circ}\text{C}$  and to  $\pm 1^{\circ}\text{C}$  over the range of  $0^{\circ}\text{C}$  to  $100^{\circ}\text{C}$ , with 9- to 12-bit resolution. Default resolution is 9 bits.

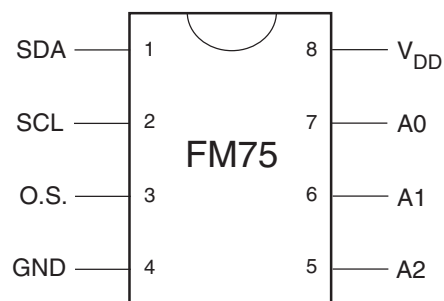
Thermal Alarm output, OS (Over-limit Signal) supports Interrupt and Comparator modes. OS is active, if the user-programmable trip-temperature is exceeded. When the temperature falls below the trip-temperature plus the user-programmable hysteresis limit, OS is disabled.

Available packages are surface mount SOIC-8 (SOP-8) and MSOP-8.

### Application Diagram



## Pin Assignments



## Pin Descriptions

| Pin #   | Name       | Direction    | Description                                                                                                                                            |
|---------|------------|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | SDA        | Input/Output | <b>Serial Data.</b> Open drain to I/O-data pin for two-wire interface.                                                                                 |
| 2       | SCL        | Input        | <b>Serial Clock.</b> Clock for 2-wire serial interface.                                                                                                |
| 3       | O.S.       | Output       | <b>Over-Limit Signal.</b> Open drain thermostat output that indicates if the temperature has exceeded user-programmable limits. Default is active low. |
| 4       | GND        | Supply       | <b>Ground</b>                                                                                                                                          |
| 5, 6, 7 | A0, A1, A2 | Input        | <b>Address LSBs.</b> User selectable address pins for the 3 LSBs of the serial interface address.                                                      |
| 8       | VDD        | Supply       | <b>Supply Voltage</b>                                                                                                                                  |

## Absolute Maximum Ratings<sup>1</sup>

| Parameter                  | Min. | Typ. | Max.           | Units |
|----------------------------|------|------|----------------|-------|
| Supply Voltage             |      |      | +7             | V     |
| Output Voltage             |      |      | $V_{CC} + 0.5$ | V     |
| Output Current             |      |      | 10             | mA    |
| Storage Temperature Range  | -60  |      | +150           | °C    |
| Lead Soldering Temperature |      |      | 220            | °C    |
| ESD <sup>2</sup>           |      |      |                |       |
| Human Body Model           |      |      | 2000           | V     |
| Machine Model              |      |      | 250            | V     |

### Notes:

1. Absolute maximum ratings are limits beyond which operation may cause permanent damage to the device. These are stress ratings only; functional operation at or above these limits is not implied.
2. Human Body Model: 100pF capacitor discharged through a 1.5k $\Omega$  resistor into each pin. Machine Model: 200pF capacitor discharged directly into each pin.

## Electrical Characteristics<sup>3</sup>

(-40°C  $\leq$  T<sub>A</sub>  $\leq$  +125°C, V<sub>CC</sub> = 5.0V unless otherwise noted. Specifications subject to change without notice.)

| Parameter                                | Symbol                              | Conditions                                                                                                                                     | Min.                 | Typ. | Max.                 | Units |
|------------------------------------------|-------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|------|----------------------|-------|
| Specified Temperature Range              | T <sub>MIN</sub> , T <sub>MAX</sub> |                                                                                                                                                | -40                  |      | +125                 | °C    |
| Temperature Conversion Time <sup>4</sup> |                                     |                                                                                                                                                |                      | 90   |                      | ms    |
| Accuracy <sup>5</sup>                    |                                     | T <sub>A</sub> = +25°C<br>T <sub>A</sub> = +100°C<br>T <sub>A</sub> = -40°C (T <sub>MIN</sub> )<br>T <sub>A</sub> = +125°C (T <sub>MAX</sub> ) | -2<br>-3<br>-4<br>-4 |      | +2<br>+3<br>+4<br>+4 | °C    |

### Notes:

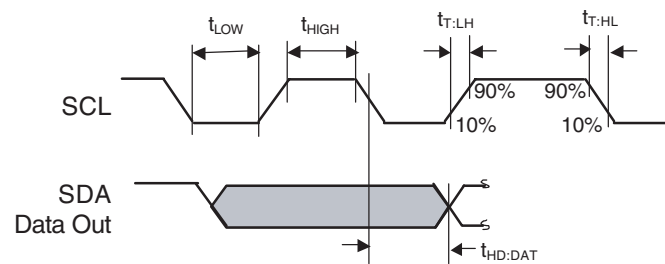
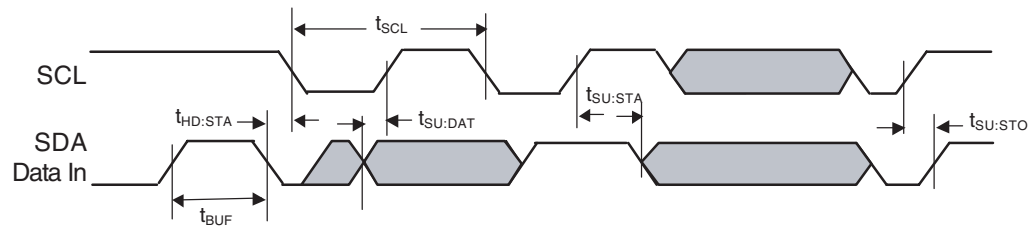
3. These specifications are guaranteed only for the test conditions listed.
4. This specification only indicates how often temperature information is updated to the Temperature Register. The FM75 can be read at any time without interrupting the temperature conversion process.
5. Accuracy (expressed in °C) = Difference between the FM75 output temperature and the measured temperature.

## Logic Electrical Characteristics

| Parameter                     | Symbol             | Conditions                                                                                     | Min                   | Typ        | Max                    | Units   |
|-------------------------------|--------------------|------------------------------------------------------------------------------------------------|-----------------------|------------|------------------------|---------|
| Min. Input Voltage Logic High | V <sub>IH</sub>    |                                                                                                | V <sub>DD</sub> x 0.7 |            | V <sub>DD</sub> + 0.5  | V       |
| Max. Input Voltage Logic Low  | V <sub>IL</sub>    |                                                                                                | -0.3                  |            | V <sub>DD</sub> x 0.3  | V       |
| Max. Output Voltage Logic Low | V <sub>OL</sub>    | V <sub>DD</sub> = 5V, I <sub>OL</sub> = -3mA<br>V <sub>DD</sub> = 3V, I <sub>OL</sub> = -1.5mA |                       |            | 0.36<br>0.36           | V<br>V  |
| Quiescent Supply Current      | I <sub>DD</sub>    | Interface inactive R/W<br>Activity on SDA                                                      |                       | 250<br>350 | 500<br>700             | $\mu$ A |
| Shutdown Current              | I <sub>DD-SD</sub> | Interface inactive R/W<br>Activity on SDA                                                      |                       | 0.15<br>83 | 1<br>150               | $\mu$ A |
| Input Leakage Current         | I <sub>IN</sub>    | V <sub>IN</sub> = 0V or 5V, T <sub>A</sub> = 25°C<br>-40°C < T <sub>A</sub> < 125°C            |                       |            | $\pm$ 0.1<br>$\pm$ 1.0 | $\mu$ A |
| Output Sink Current           | I <sub>OL</sub>    | T <sub>A</sub> = 25°C, V <sub>OL</sub> = 0.4V                                                  |                       |            | 3                      | mA      |
| Output Leakage Current        | I <sub>LEAK</sub>  | V <sub>OH</sub> = 5V, V <sub>DD</sub> = 0V                                                     |                       | 0.001      | 5                      | $\mu$ A |
| Output Transition Time        | t <sub>F</sub>     | C <sub>L</sub> = 400pF, I <sub>OL</sub> = -3mA                                                 |                       |            | 250                    | ns      |
| Input Capacitance             | C <sub>IN</sub>    | All Digital Inputs                                                                             |                       |            | 20                     | pF      |

## Serial Port Timing

| Parameter                                                       | Symbol               | Conditions | Min.  | Typ. | Max. | Units   |
|-----------------------------------------------------------------|----------------------|------------|-------|------|------|---------|
| SCL Clock Period                                                | $t_{SCL}$            |            | 1.0   |      | 100  | $\mu s$ |
| SCL Clock Transition Time                                       | $t_{T:LH}, t_{T:HL}$ |            |       |      | 300  | ns      |
| SCL Clock Low Period                                            | $t_{LOW}$            |            | 0.470 |      |      | $\mu s$ |
| SCL Clock High Period                                           | $t_{HIGH}$           |            | 0.400 |      | 50   | $\mu s$ |
| Bus free time between a Stop and a new Start Condition          | $t_{BUF}$            |            | 1.0   |      |      | $\mu s$ |
| Data in Set-up to SCL High                                      | $t_{SU:DAT}$         |            | 100   |      |      | ns      |
| Data Out Stable after SCL Low                                   | $t_{HD:DAT}$         |            | 0     |      |      | ns      |
| SCL Low Set-up to SDA Low (Repeated Start Condition)            | $t_{SU:STA}$         |            | 100   |      |      | ns      |
| SCL High Hold after SDA Low (Start Condition)                   | $t_{HD:STA}$         |            | 100   |      |      | ns      |
| SDA High after SCL High (Stop Condition)                        | $t_{SU:STO}$         |            | 100   |      |      | ns      |
| Time in which a FM75 must be operational after a power-on reset | $t_{POR}$            |            |       |      | 500  | ms      |



## Basic Operation

The FM75 temperature sensing circuitry continuously produces an analog voltage that is proportional to the device temperature. At regular intervals the FM75 converts the analog voltage to a two's complement digital value, which is placed into the temperature register.

The FM75 has an SMBus compatible digital serial interface which allows the user to access the data in the temperature register at any time. In addition, the serial interface gives the user easy access to all other FM75 registers to customize operation of the device.

The FM75 temperature-to-digital conversion can have 9, 10, 11, or 12-bit resolution as selected by the user, providing 0.5°C, 0.25°C, 0.125°C, and 0.0625°C temperature resolution, respectively. At power-up the default conversion resolution is 9-bits. The conversion resolution is controlled by the R0 and R1 bits in the Configuration Register.

Table 1 gives examples of the relationship between the output digital data and the external temperature. The 9-bit, 10-bit, 11-bit and 12-bit columns in Table 1 indicate the right-most bit in the output data stream that can contain temperature information for each conversion accuracy. Since the output digital data is in two's-complement format, the most significant bit of the temperature is the "sign" bit. If the sign bit is a zero, the temperature is positive and if the sign bit is a one, the temperature is negative.

The FM75 has a Shutdown Mode that reduces the operating current of the FM75 to 150nA. This mode is controlled by the SD bit in the configuration register.

### Power Up Default Conditions

The FM75 always powers up in the following default state:

- Thermostat mode: Comparator Mode
- O.S. polarity: active low
- Fault tolerance: 1 fault (i.e., F0 = 0 and F1 = 0 in the Configuration Register)
- $T_{OS} = 80^{\circ}\text{C}$
- $T_{HYST} = 75^{\circ}\text{C}$
- Register pointer: 00 (Temperature Register)
- Conversion resolution: 9 bits (i.e., R0 = 0 and R1 = 0 in the Configuration Register)

After power up these conditions can be reprogrammed via the serial interface. Refer to the Serial Data Bus Operation section for FM75 programming instructions.

### Thermal Alarm Function

The FM75 thermal alarm function provides user programmable thermostat capability and allows the FM75 to function as a stand alone thermostat without using the serial interface. The Over-Limit Signal (O.S.) output is the alarm output. This signal is an open drain output, and at power-up this pin is configured with active-low polarity.

**Table 1. Relationship Between Temperature and Digital Output**

| Temperature      | Digital Output    |                                              |       |        |        |        |             |
|------------------|-------------------|----------------------------------------------|-------|--------|--------|--------|-------------|
|                  | Sig               | Number of bits used by conversion resolution | bit 9 | bit 10 | bit 11 | bit 12 | Always zero |
| All Temperatures | 12-Bit Resolution |                                              |       |        |        |        | 0000        |
|                  | 11-Bit Resolution |                                              |       |        |        | 0      | 0000        |
|                  | 10-Bit Resolution |                                              |       |        | 0      | 0      | 0000        |
|                  | 9-Bit Resolution  |                                              |       | 0      | 0      | 0      | 0000        |
| +125°C           | 0                 | 111                                          | 1101  | 0      | 0      | 0      | 0000        |
| +100.0625°C      | 0                 | 110                                          | 0100  | 0      | 0      | 0      | 1 0000      |
| +50.125°C        | 0                 | 011                                          | 0010  | 0      | 0      | 1      | 0 0000      |
| +12.25°C         | 0                 | 000                                          | 1100  | 0      | 1      | 0      | 0 0000      |
| 0°C              | 0                 | 000                                          | 0000  | 0      | 0      | 0      | 0 0000      |
| -20.5°C          | 1                 | 110                                          | 1011  | 1      | 0      | 0      | 0 0000      |
| -33.25°C         | 1                 | 101                                          | 1110  | 1      | 1      | 0      | 0 0000      |
| -45.0625°C       | 1                 | 101                                          | 0010  | 1      | 1      | 1      | 1 0000      |
| -55°C            | 1                 | 100                                          | 1001  | 0      | 0      | 0      | 0 0000      |

The O.S. polarity is controlled by the POL bit in the Configuration Register. The user-programmable upper trip-point temperature for the thermal alarm is stored in the  $T_{OS}$  Register, and the user-programmable hysteresis temperature (i.e., the lower trip point) is stored in the  $T_{HYST}$  Register.

The thermal alarm has two modes of operation: Comparator Mode and Interrupt Mode. At power-up the default is Comparator Mode. The alarm mode is controlled by the CMP/INTR bit in the Configuration Register.

### Fault Tolerance

For both Comparator and Interrupt modes, the alarm "fault tolerance" setting plays a role in determining when the O.S. output will be activated. Fault tolerance refers to the number of consecutive times an error condition must be detected before the user is notified. Higher fault tolerance settings can help eliminate false alarms caused by noise in the system. The alarm fault tolerance is controlled by bits F0 and F1 in the Configuration Register. These bits can be used to set the fault tolerance to 1, 2, 4 or 6 as shown in Table 4. At power-up, these bits both default to 0 (fault tolerance = 1).

## Comparator Mode

In Comparator Mode, each time a temperature-to-digital (T-to-D) temperature conversion occurs, the new digital temperature is compared to the value stored in the  $T_{OS}$  and  $T_{HYST}$  registers. If a fault tolerance number of consecutive temperature measurements are greater than the value stored in the  $T_{OS}$  register, the O.S. output will be activated.

For example, if bits F1 and F0 are equal to "10" (fault tolerance = 4), four consecutive temperature measurements must exceed  $T_{OS}$  to activate the O.S. output. Once the O.S. output is active, it will remain active until the first time the measured temperature drops below the temperature stored in the  $T_{HYST}$  register. The operation of the alarm in Comparator Mode with fault tolerance=2 is illustrated in Figure 1.

## Interrupt Mode

In Interrupt Mode the O.S. output will first become active after a fault tolerance number of consecutive temperature measurements exceed the value stored in the  $T_{OS}$  register (similar to Comparator Mode). Once O.S. is active, it can only be cleared by a user read from any of the FM75 registers (Temperature, Configuration,  $T_{OS}$ , or  $T_{HYST}$ ) or by putting the FM75 into Shutdown Mode (i.e., by setting the shutdown bit in the Configuration Register to "1"). Once cleared, the O.S. output can only be activated the next time by a fault tolerance number of consecutive temperature measurements that are lower than the value stored in  $T_{HYST}$ . Again, once it is activated the O.S. output can only be deactivated by a user read or shutdown. Thus, in Interrupt Mode the activate/clear cycle for O.S. has the following pattern: temperature >  $T_{OS}$ , clear, temperature <  $T_{HYST}$ , clear, temperature >  $T_{OS}$ , clear, etc. The operation of the alarm in Interrupt Mode with fault tolerance=2 is also illustrated in Figure 1.

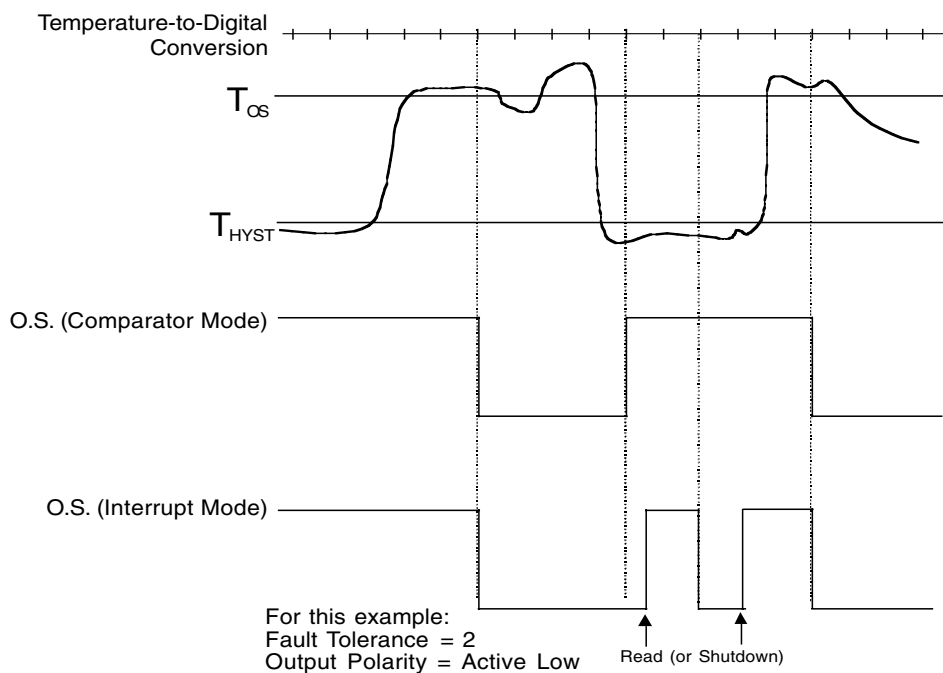


Figure 1. Thermal Alarm Operation in Comparator and Interrupt Modes

## Registers

The FM75 contains the following five registers:

1. Command Register
2. Temperature Register
3. Configuration Register
4. Over-Limit-Signal Temperature Register (T<sub>OS</sub>)
5. Hysteresis Temperature Register (T<sub>HYST</sub>)

All of these registers can be accessed by the user via the digital serial interface at any time (see Serial Interface Operation for instructions). A detailed description of these registers and their functions is provided in the following paragraphs. A diagram of the register hierarchy is shown in Figure 2.

## Command Register

The Command Register is a one-byte (8-bit) write-only register. The data stored in the Command Register indicates which of the other four registers (Temperature, Configuration, T<sub>OS</sub>, or T<sub>HYST</sub>) the user intends to read from or write to during an upcoming operation. In other words the Command Register “points” to the selected register as shown in Figure 2.

The Command Register is illustrated in Figure 3. The P1 and P0 bits of the Command Register determine which register is to be accessed as shown in Table 2. The six MSBs of the Command Register must always be zero. Writing a 1 into any of these bits will cause the current operation to be terminated.

The Command Register retains pointer information between operations. Therefore, this register only needs to be updated once for consecutive read operations from the same register. All bits in the Command Register default to zero at power-up.

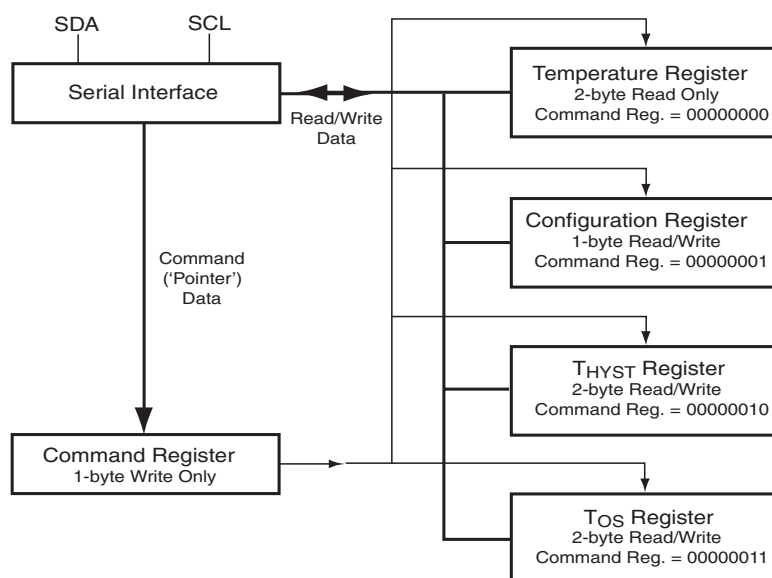


Figure 2. FM75 Register Hierarchy

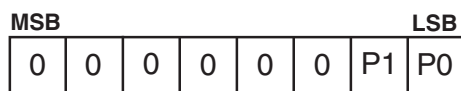


Figure 3. Command Register Format

Table 2. Register Assignments for Command Bits P1 and P0

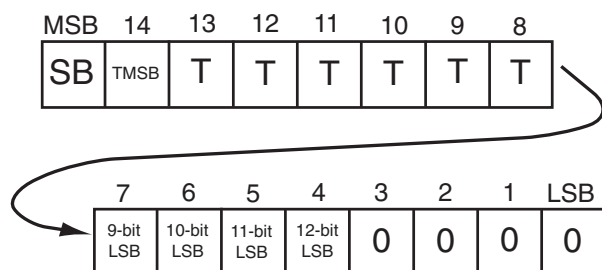
| Register                   | P1 | P0 |
|----------------------------|----|----|
| Temperature Register       | 0  | 0  |
| Configuration Register     | 0  | 1  |
| T <sub>HYST</sub> Register | 1  | 0  |
| T <sub>OS</sub> Register   | 1  | 1  |

## Temperature Register

The Temperature Register is a two-byte (16-bit) read-only register. Digital temperatures from the T-to-D converter are stored in the Temperature Register in two's complement format, and the contents of this register are updated at regular intervals—i.e., each time the T-to-D conversion is finished.

The user can read data from the Temperature Register at any time. When a T-to-D conversion is completed, the new data is loaded into a comparator buffer to evaluate fault conditions, and will update the Temperature Register if a read cycle is not ongoing. The FM75 is continuously evaluating fault conditions regardless of read or write activity on the bus. If a read is ongoing, the previous temperature will be read. The readable temperature will be updated upon the completion of the next T-to-D conversion that is not masked by a read cycle.

The Temperature Register is illustrated in Figure 4. Depending on the resolution of the T-to-D conversion, the 9, 10, 11 or 12 MSBs of the register will contain temperature data. All unused bits following the digital temperature will be zero. The MSB position of the Temperature Register always contains the sign bit for the digital temperature and bit 14 contains the temperature MSB. All bits in the Temperature Register default to zero at power-up.



SB = Two's complement sign bit

TMSB = Temperature MSB

T = Temperature data

9-bit LSB = Temperature LSB for 9-bit conversions

10-bit LSB = Temperature LSB for 10-bit conversions

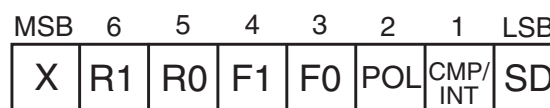
11-bit LSB = Temperature LSB for 11-bit conversions

12-bit LSB = Temperature LSB for 12-bit conversions

Figure 4. Temperature Register Format

## Configuration Register

The Configuration Register is a one-byte (8-bit) read/write register (see Figure 5). This register allows the user to control the FM75 Shutdown Mode as well as the following thermal alarm features: polarity, operating mode, and fault tolerance. The Configuration Register contains two bits that set the fault tolerance trip point. The fault tolerance trip point is the number of consecutive times the internal circuit reads the temperature and finds the temperature outside the limits programmed. The programmed limits are defined by the  $T_{OS}$  Register for the upper limit, and by the  $T_{HYS}$  Register for the lower limit. Table 4 shows the relationship between F1 and F0 and the number of consecutive errors or “trips” needed to activate the alarm. The Configuration Register also contains the two bits that set the T-to-D conversion resolution to 9, 10, 11, or 12 bits. Table 3 shows the relationship between R1 and R0 and the conversion resolution. All bits in the configuration register default to zero at power-up.



R1 = Resolution bit 1. (See Table 3)

R0 = Resolution bit 0. (See Table 3)

F1 = Fault tolerance bit 1. (See Table 4)

F0 = Fault tolerance bit 0. (See Table 4)

POL = O.S. output polarity. 0 = active low, 1 = active high.

CMP/INT = Thermostat mode. 0 = comparator mode, 1 = interrupt mode.

SD = Shutdown. 0 = normal operation, 1 = shutdown mode.

Figure 5. Configuration Register Format

Table 3. Conversion Resolution Settings

| A-to-D Conversion Resolution | R1 | R0 |
|------------------------------|----|----|
| 9 Bits                       | 0  | 0  |
| 10 Bits                      | 0  | 1  |
| 11 Bits                      | 1  | 0  |
| 12 Bits                      | 1  | 1  |

Table 4. Fault Tolerance Settings

| Fault Tolerance | R1 | R0 |
|-----------------|----|----|
| 1               | 0  | 0  |
| 2               | 0  | 1  |
| 4               | 1  | 0  |
| 6               | 1  | 1  |



Over-Limit-Signal Temperature Register (T<sub>OS</sub>)

The T<sub>OS</sub> Register is a two-byte (16-bit) read/write register that stores the user-programmable upper trip-point temperature for the thermal alarm in two's-complement format. At power-up this register defaults to 80°C (i.e., 0101 0000 0000 0000).

The format of the T<sub>OS</sub> register is identical to that of the Temperature Register (see Figure 6). The 4 LSBs of the T<sub>OS</sub> Register are hardwired to zero, so data written to these register bits will be ignored. The MSB position of the T<sub>OS</sub> Register contains the sign bit for the digital temperature and bit 14 contains the temperature MSB.

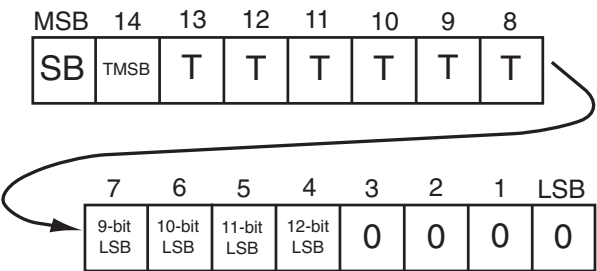
The resolution setting for the T-to-D conversion determines how many bits of the T<sub>OS</sub> Register are used by the thermal alarm. For example, for 9-bit conversions the trip-point temperature is defined by the 9 MSBs of the T<sub>OS</sub> register, and all remaining bits are “don't cares.”

Hysteresis Temperature Register (T<sub>HYST</sub>)

The T<sub>HYST</sub> Register is a two-byte (16-bit) read/write register that stores the user programmable lower trip-point temperature for the thermal alarm in two's-complement format. At power-up this register defaults to 75°C (i.e., 0100 1011 0000 0000).

The T<sub>HYST</sub> register is illustrated in Figure 6. The format of this register is the same as that of the Temperature Register. The 4 LSBs of the T<sub>HYST</sub> register are hardwired to zero, so data written to these bits is ignored.

The resolution setting for the T-to-D conversion determines how many bits of the T<sub>HYST</sub> Register are used by the thermal alarm. For example, for 9-bit conversions the hysteresis temperature is defined by the 9 MSBs of the T<sub>HYST</sub> Register, and all remaining bits are “don't cares.”



- SB = Two's complement sign bit
- TMSB = Temperature MSB
- T = Temperature data
- 9-bit LSB = Temperature LSB for 9-bit conversions
- 10-bit LSB = Temperature LSB for 10-bit conversions
- 11-bit LSB = Temperature LSB for 11-bit conversions
- 12-bit LSB = Temperature LSB for 12-bit conversions

Figure 6. T<sub>HYST</sub> Register and T<sub>OS</sub> Register Format

## Serial Data Bus Operation

### General Operation

Writing to and reading from the FM75 registers is accomplished via the SMBus-compatible two-wire serial interface. SMBus protocol requires that one device on the bus initiates and controls all read and write operations. This device is called the “master” device. The master device also generates the SCL signal which is the clock signal for all other devices on the bus. All other devices on the bus are called “slave” devices. The FM75 is a slave device. Both the master and slave devices can send and receive data on the bus.

During SMBus operations, one data bit is transmitted per clock cycle. All SMBus operations follow a repeating nine clock-cycle pattern that consists of eight bits (one byte) of transmitted data followed by an acknowledge (ACK) or not acknowledge (NACK) from the receiving device. Note that there are no unused clock cycles during any operation—therefore there must be no breaks in the stream of data and ACKs/NACKs during data transfers. Conversely having too few clock cycles can lead to incorrect operation if an inadvertent 8-bit read from a 16-bit register occurs.

For most operations, SMBus protocol requires the SDA line to remain stable (unmoving) whenever SCL is high—i.e., transitions on the SDA line can only occur when SCL is low. The exceptions to this rule are when the master device issues a start or stop signal. Note that the slave device cannot issue a start or stop condition.

The following are definitions for some general SMBus terms:

**Start Condition:** This condition occurs when the SDA line transitions from high to low while SCL is high. The master device uses this condition to indicate that a data transfer is about to begin.

**Stop Condition:** This condition occurs when the SDA line transitions from low to high while SCL is high. The master device uses this condition to signal the end of a data transfer.

**Acknowledge and Not Acknowledge:** When data is transferred to the slave device it sends an acknowledge (ACK) after receiving every byte of data. A master device sends an acknowledge (ACK) following only the first byte read from a 2-byte register. The receiving device sends an ACK by pulling SDA low for one clock. Following the last byte, a master device sends a “not acknowledge” (NACK) followed by a stop condition. A NACK is indicated by leaving SDA high during the clock after the last byte.

### Slave Address

Each slave device on the bus has a unique 7-bit address so the master can identify which device is being read from or written to.

The FM75 address is as follows:

|   |   |   |   |    |    |    |
|---|---|---|---|----|----|----|
| 1 | 0 | 0 | 1 | A2 | A1 | A0 |
|---|---|---|---|----|----|----|

The four MSBs of the FM75 address are hardwired to 1001. The three LSBs are user configurable by tying the A0, A1 and A2 pins to either  $V_{DD}$  or ground. This provides eight different FM75 addresses, which allows up to eight FM75s to be connected to the same bus.

### Writing To and Reading From the FM75

All read and write operations must begin with a start signal generated by the master device. After the start condition, the master device must immediately send a slave address (7 bits) followed by a read/write bit. If the slave address matches the address of the FM75, the FM75 sends an ACK after receiving the read/write bit by pulling the SDA line low for one clock. See Figure 8 through Figure 13 for timing diagrams for all FM75 operations.

### Setting the Pointer

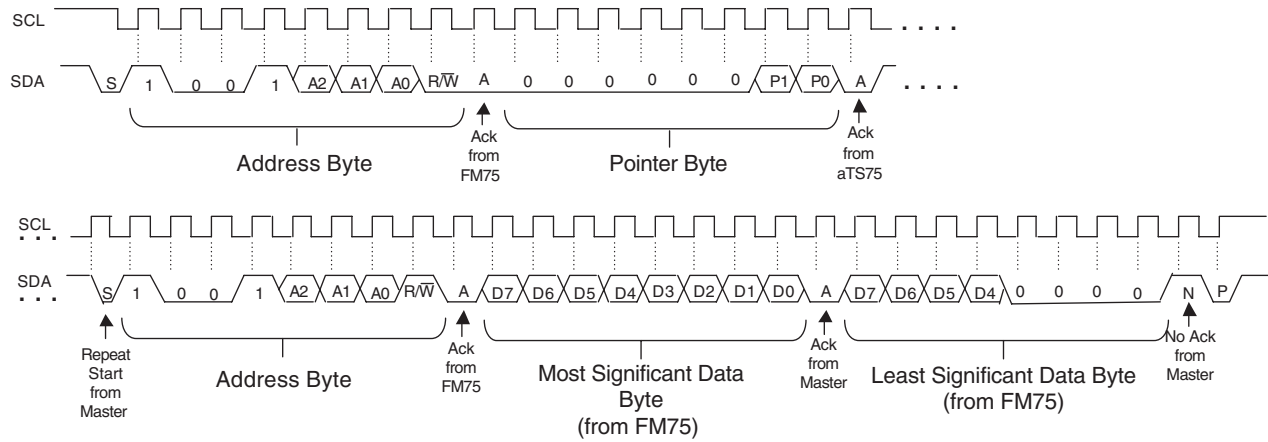
For all operations the pointer stored in the Command Register must be pointing to the register (Temperature, Configuration,  $T_{OS}$  or  $T_{HYST}$ ) that is going to be written to or read from. To change the pointer value in the Command Register, the read/write bit following the address must be 0. This indicates that the master will now write new information into the Command Register.

After the FM75 sends an ACK in response to receiving the address and read/write bit, the master device must transmit an appropriate 8-bit pointer value as explained in the Registers section of this data sheet. The FM75 will send an ACK after receiving the new pointer data.

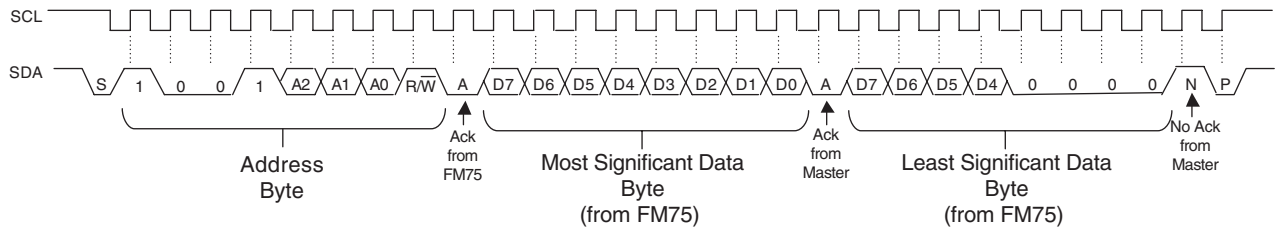
The pointer set operation is illustrated in Figure 8. Anytime a pointer set is performed, it must be immediately followed by a read or write operation. Note that the 6 MSBs of the pointer value must be zero. If the 6 MSBs are not zero, the FM75 will not send an ACK and will internally terminate the operation. Also recall that the Command Register retains the current pointer value between operations. Therefore, once a register is being pointed to, subsequent read operations do not require a pointer set cycle. Write operations always require the pointer be reset.



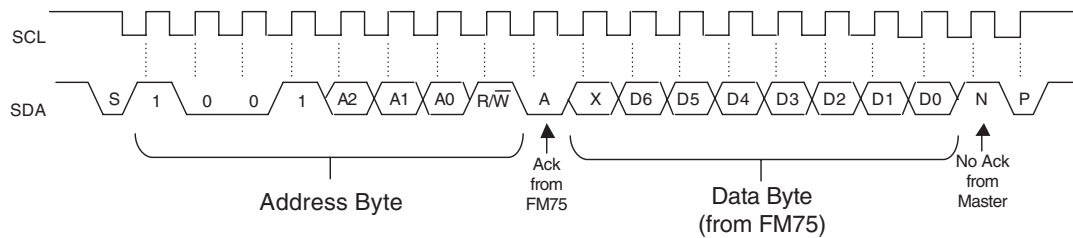
Note: This segment of this timing diagram is a generic pointer set cycle which must be followed by either an immediate read cycle or write cycle as shown in this figure and in figures 10, 11, and 12.



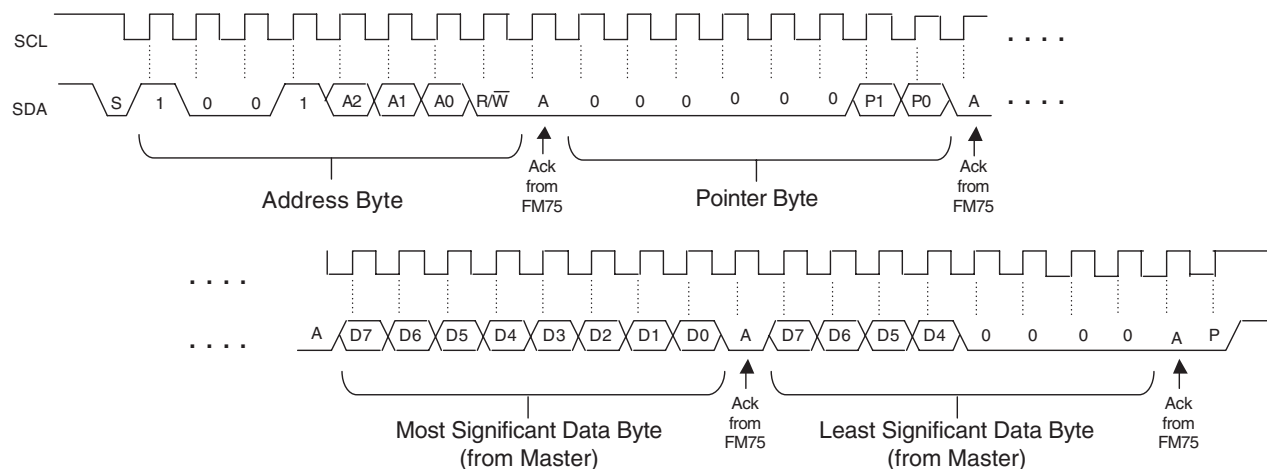
**Figure 8. Pointer Set Followed by Immediate Read from A 2-byte Register (Temperature, T<sub>OS</sub> or T<sub>HYST</sub> Register)**



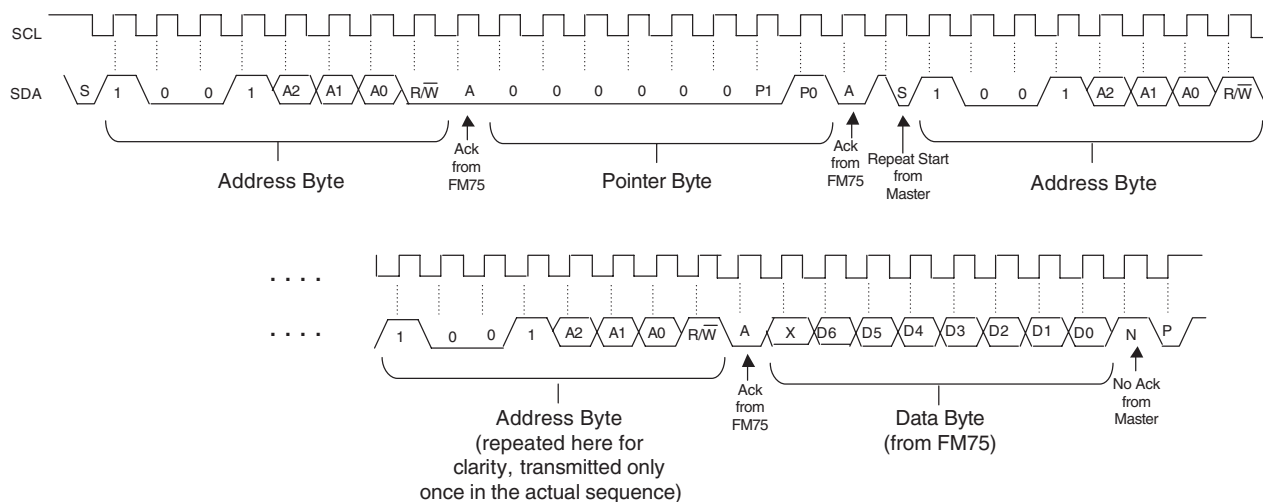
**Figure 9. Two-byte Read from Preset Pointer Location (Temperature, T<sub>OS</sub> or T<sub>HYST</sub> Register)**



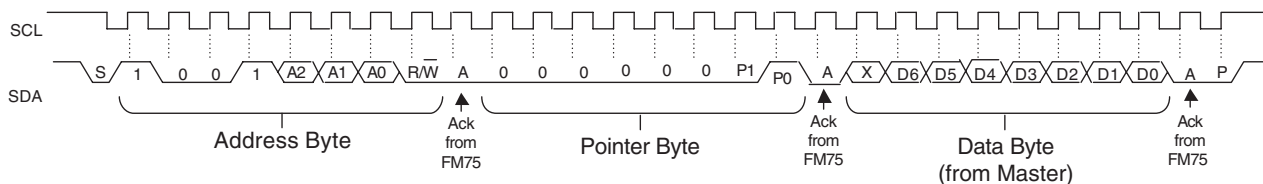
**Figure 10. One-byte Read from Configuration Register with Preset Pointer**



**Figure 11. Pointer Set Followed by Immediate Write to A 2-byte Register (TOS or THYST Register)**

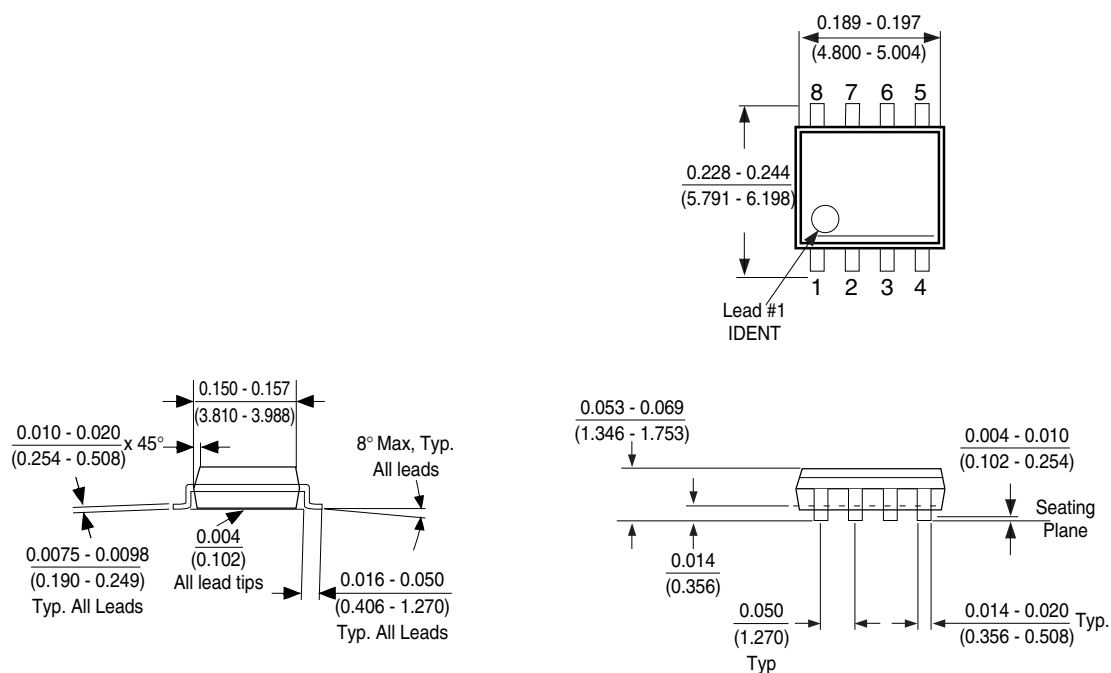


**Figure 12. Pointer Set Followed by Immediate Read from Configuration Register**

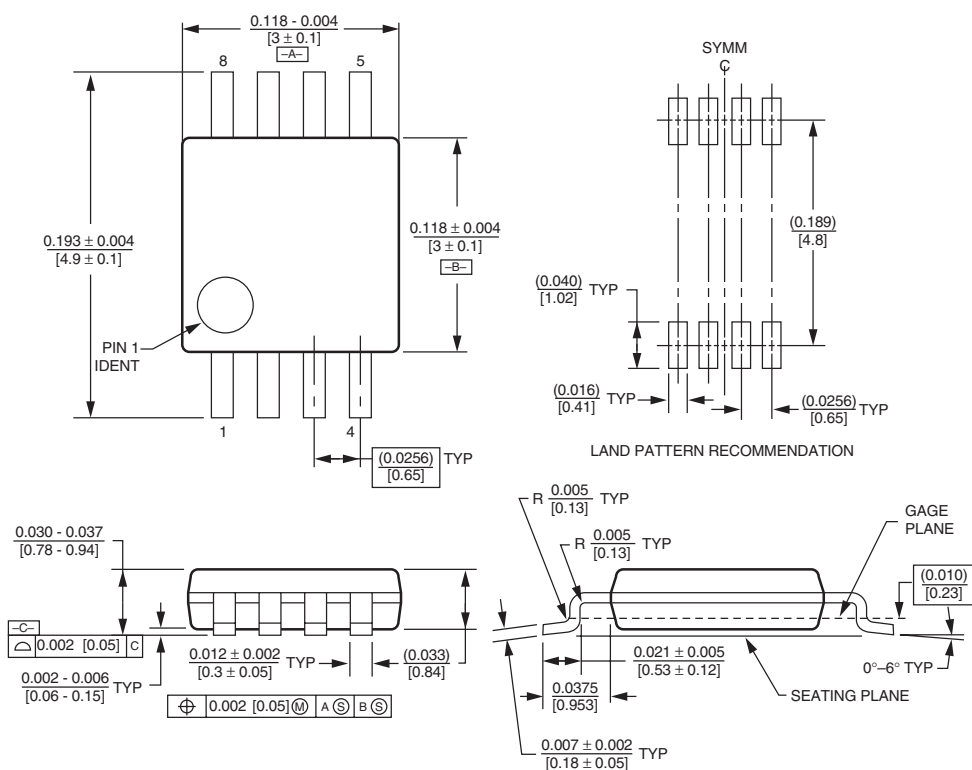


**Figure 13. Pointer Set Followed by Immediate Write to the Configuration Register**

**Mechanical Dimensions** inches (millimeters) unless otherwise noted



**Molded Package, Small Outline, 0.15 Wide, 8-Lead (M8)**  
**FS Package Number M08A**



**8-Lead Molded Mini Small Outline Package (MSOP), JEDEC MO-187, 3.0mm Wide FS Package Number MA08D**

## Ordering Information

| Part Number | Package     | Temperature Range | Shipping                  |
|-------------|-------------|-------------------|---------------------------|
| FM75M8x     | 8-Lead SOIC | -40°C to +125°C   | 2500 Units, Tape and Reel |
| FM75MM8x    | 8-Lead MSOP | -40°C to +125°C   | 3000 Units, Tape and Reel |

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