1. General description

The LM75A is a temperature-to-digital converter using an on-chip band gap temperature sensor and Sigma-delta A-to-D conversion technique. The device is also a thermal detector providing an overtemperature detection output. The LM75A contains a number of data registers: Configuration register (Conf) to store the device settings such as device operation mode, OS operation mode, OS polarity and OS fault queue as described in Section 7 "Functional description"; temperature register (Temp) to store the digital temp reading, and set-point registers (Tos and Thyst) to store programmable overtemperature shutdown and hysteresis limits, that can be communicated by a controller via the 2-wire serial I^2C-bus interface. The device also includes an open-drain output (OS) which becomes active when the temperature exceeds the programmed limits. There are three selectable logic address pins so that eight devices can be connected on the same bus without address conflict.

The LM75A can be configured for different operation conditions. It can be set in normal mode to periodically monitor the ambient temperature, or in shutdown mode to minimize power consumption. The OS output operates in either of two selectable modes: OS comparator mode or OS interrupt mode. Its active state can be selected as either HIGH or LOW. The fault queue that defines the number of consecutive faults in order to activate the OS output is programmable as well as the set-point limits.

The temperature register always stores an 11-bit 2's complement data giving a temperature resolution of 0.125 °C. This high temperature resolution is particularly useful in applications of measuring precisely the thermal drift or runaway.

The device is powered-up in normal operation mode with the OS in comparator mode, temperature threshold of 80 °C and hysteresis of 75 °C, so that it can be used as a stand-alone thermostat with those pre-defined temperature set points.

2. Features

- Pin-for-pin replacement for industry standard LM75 and offers improved temperature resolution of 0.125 °C and specification of a single part over power supply range from 2.8 V to 5.5 V
- Small 8-pin package types: SO8 and TSSOP8
- I^2C-bus interface with up to 8 devices on the same bus
- Power supply range from 2.8 V to 5.5 V
- Temperatures range from –55 °C to +125 °C
- 11-bit ADC that offers a temperature resolution of 0.125 °C
- Temperature accuracy of:
  - ±2 °C from –25 °C to +100 °C
  - ±3 °C from –55 °C to +125 °C
- Programmable temperature threshold and hysteresis set points
- Supply current of 3.5 µA in shutdown mode for power conservation
- Stand-alone operation as thermostat at power-up
- ESD protection exceeds 2000 V HBM per JESD22-A114, 200 V MM per JESD22-A115 and 1000 V CDM per JESD22-C101
- Latch-up testing is done to JEDEC Standard JESD78 which exceeds 100 mA

6.1 Pinning

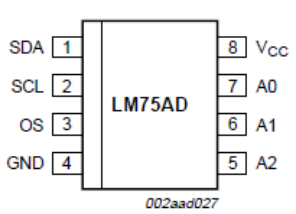

Fig 2. Pin configuration for SO8

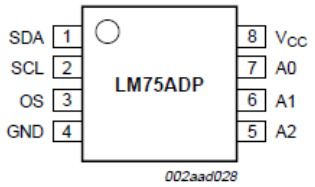

Fig 3. Pin configuration for TSSOP8

6.2 Pin description

Table 3. Pin description

Symbol	Pin	Description
SDA	1	Digital I/O. I²C-bus serial bidirectional data line; open-drain.
SCL	2	Digital input. I²C-bus serial clock input.
OS	3	Overtemp Shutdown output; open-drain.
GND	4	Ground. To be connected to the system ground.
A2	5	Digital input. User-defined address bit 2.
A1	6	Digital input. User-defined address bit 1.
A0	7	Digital input. User-defined address bit 0.
V_{CC}	8	Power supply.

7.3 Slave address

The LM75A slave address on the I²C-bus is partially defined by the logic applied to the device address pins A2, A1 and A0. Each of them is typically connected either to GND for logic 0, or to V_{CC} for logic 1. These pins represent the three LSB bits of the device 7-bit address. The other four MSB bits of the address data are preset to '1001' by hard wiring inside the LM75A. Table 4 shows the device's complete address and indicates that up to 8 devices can be connected to the same bus without address conflict. Because the input pins, SCL, SDA and A2 to A0, are not internally biased, it is important that they should not be left floating in any application.

Table 4. Address table

1 = HIGH; 0 = LOW.

MSB						LSB
1	0	0	1	A2	A1	A0

7.4 Register list

The LM75A contains four data registers beside the pointer register as listed in Table 5. The pointer value, read/write capability and default content at power-up of the registers are also shown in Table 5.

Table 5. Register table

Register name	Pointer value	R/W	POR state	Description
Conf	01h	R/W	00h	Configuration register: contains a single 8-bit data byte; to set the device operating condition; default = 0.
Temp	00h	read only	n/a	Temperature register: contains two 8-bit data bytes; to store the measured Temp data.
Tos	03h	R/W	5000h	Overtemperature shutdown threshold register: contains two 8-bit data bytes; to store the overtemperature shutdown T_{os} limit; default = 80 °C.
Thyst	02h	R/W	4B00h	Hysteresis register: contains two 8-bit data bytes; to store the hysteresis T_{hyst} limit; default = 75 °C.

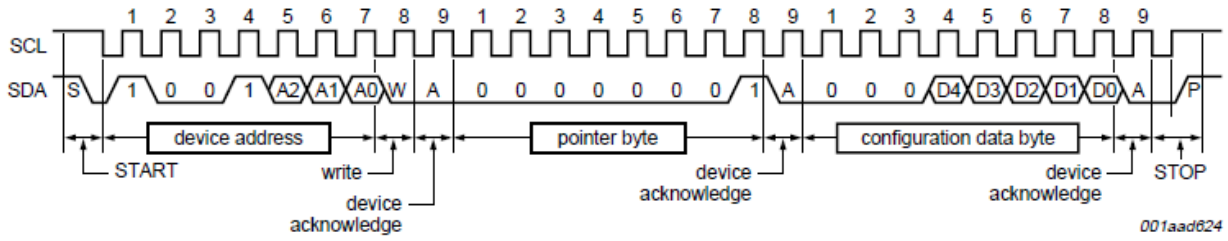

Fig 5. Write configuration register (1-byte data)

7.4.1 Pointer register

The Pointer register contains an 8-bit data byte, of which the two LSB bits represent the pointer value of the other four registers, and the other 6 MSB bits are equal to 0, as shown in Table 6 and Table 7. The Pointer register is not accessible to the user, but is used to select the data register for write/read operation by including the pointer data byte in the bus command.

Table 6. Pointer register

B7	B6	B5	B4	B3	B2	B[1:0]
0	0	0	0	0	0	pointer value

Table 7. Pointer value

B1	B0	Selected register
0	0	Temperature register (Temp)
0	1	Configuration register (Conf)
1	0	Hysteresis register (Thyst)
1	1	Overtemperature shutdown register (Tos)

7.4.2 Configuration register

The Configuration register (Conf) is a write/read register and contains an 8-bit non-complement data byte that is used to configure the device for different operation conditions. Table 8 shows the bit assignments of this register.

Table 8. Conf register

*Legend: * = default value.*

Bit	Symbol	Access	Value	Description
B[7:5]	reserved	R/W	000*	reserved for manufacturer's use; should be kept as zeroes for normal operation
B[4:3]	OS_F_QUE[1:0]	R/W		OS fault queue programming
			00*	queue value = 1
			01	queue value = 2
			10	queue value = 4
			11	queue value = 6
B2	OS_POL	R/W		OS polarity selection
			0*	OS active LOW
			1	OS active HIGH
B1	OS_COMP_INT	R/W		OS operation mode selection
			0*	OS comparator
			1	OS interrupt
B0	SHUTDOWN	R/W		device operation mode selection
			0*	normal
			1	shutdown

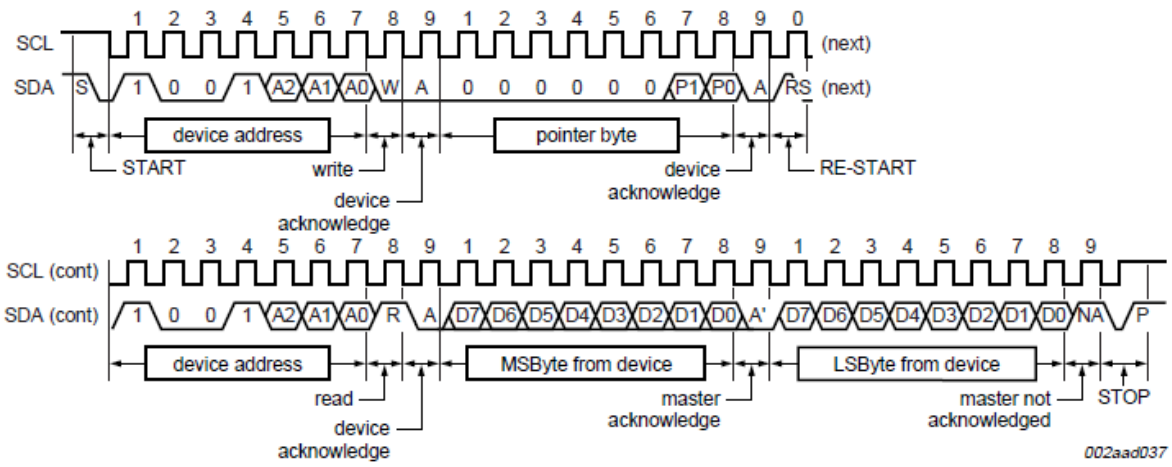

Fig 9. Read Temp, Tos or Thyst register including pointer byte (2-byte data)

7.4.3 Temperature register

The Temperature register (Temp) holds the digital result of temperature measurement or monitor at the end of each analog-to-digital conversion. This register is read-only and contains two 8-bit data bytes consisting of one Most Significant Byte (MSByte) and one Least Significant Byte (LSByte). However, only 11 bits of those two bytes are used to store the Temp data in 2's complement format with the resolution of 0.125 °C. Table 9 shows the bit arrangement of the Temp data in the data bytes.

Table 9. Temp register

MSByte								LSByte							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0	X	X	X	X	X

When reading register Temp, all 16 bits of the two data bytes (MSByte and LSByte) are provided to the bus and must be all collected by the controller to complete the bus operation. However, only the 11 most significant bits should be used, and the 5 least significant bits of the LSByte are zero and should be ignored. One of the ways to calculate the Temp value in °C from the 11-bit Temp data is:

1. If the Temp data MSByte bit D10 = 0, then the temperature is positive and Temp value (°C) = +(Temp data) × 0.125 °C.
2. If the Temp data MSByte bit D10 = 1, then the temperature is negative and Temp value (°C) = –(2's complement of Temp data) × 0.125 °C.

Examples of the Temp data and value are shown in Table 10.

Table 10. Temp register value

11-bit binary (2's complement)	Hexadecimal value	Decimal value	Value
011 1111 1000	3F8	1016	+127.000 °C
011 1111 0111	3F7	1015	+126.875 °C
011 1111 0001	3F1	1009	+126.125 °C
011 1110 1000	3E8	1000	+125.000 °C
000 1100 1000	0C8	200	+25.000 °C
000 0000 0001	001	1	+0.125 °C
000 0000 0000	000	0	0.000 °C
111 1111 1111	7FF	–1	–0.125 °C
111 0011 1000	738	–200	–25.000 °C
110 0100 1001	649	–439	–54.875 °C
110 0100 1000	648	–440	–55.000 °C