F75387SG/RG Datasheet

±1°C Accuracy H/W Monitor IC with Automatic Fan Speed Control

Release Date: July, 2007
Revision: V0.27P

F75387 Datasheet Revision History

Version	Date	Page	Revision History
0.20P	Mar/2005	-	Preliminary Release Version.
0.21P	Mar/2005	41-42	Update DC spec
0.22P	Apr/2005	37~40	Update description of Index A4~A8/B4~B8
0.23P	May/2005	48	Update application circuit
0.24P	Jun/2005	41,42	Update DC Spec
0.25P	Dec/2005		Revised the typo
0.26P	Dec/2006	4	Add Taiwan patent certification number
0.27P	July/2007	-	Company readdress

Table of Contents

1. General Description

F75387 is a system hardware monitoring and automatic fan speed controlling IC specific designed for graphic cards and PC etc. The F75387 can monitor several critical hardware parameters of the system, including voltages, temperatures and fan speeds which are very important for the system to work stably and properly.

An 11-bit analog-to-digital converter (ADC) was built inside F75387. The chip can monitor up to 4 analog voltage inputs, 2 fan tachometer inputs and 3 temperature inputs (2 remote and 1 local sensor). The remote temperature sensor can be performed by thermistor, transistor 2N3906 and CPU/GPU thermal diode. The F75387 can provide automatic fan speed control so that the system can operate at the minimum acoustic noise. This chip supports not only PWM duty mode (PWMOUT) but also linear mode (DACOUT 0 ~ 3.3V) for fan speed control. Internal oscillator was built in this chip and user can use external clock input if users need accurate fan speed count. Also the users can set up the upper and lower limits (alarm thresholds) of all monitored parameters and the F75387 can also issue warning messages for system protection when there is something wrong with monitored items.

Through the BIOS or application software, the users can read all the monitored parameters of system all the time. And a pop-up warning can be also activated when the monitored item was out of the proper/pre-setting range. The F75387 is in the package of 16-pin SOP/SSOP and powered by 3.3V

2. Features

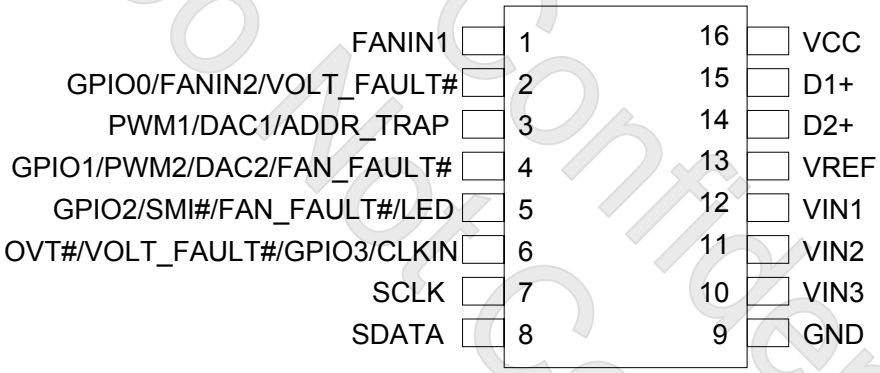
- 4 voltage inputs
- Provide 2 remote and 1 on-chip local temperature sensor
- Up to 2 fan speed monitoring inputs and 2 automatic fan speed control
- Power on fan speed configuration
  - 100% or 60% PWM duty cycle output on initial
  - 3.3V or 1.98V DAC linear voltage output on initial
- Provide up to 4 system protection signals
  - OVT#, SMI#, FAN_FAULT#, VOLT_FAULT# signals
- Programmable limited and setting points(alert threshold) for all monitored items
- 2-wire SMBus interface
- V_{CC}3V operation and 16-SOP/SSOP package(150mil)

Noted: Patented TW207103 TW207104 TW220442 US6788131 B1 TW235231 TWI263788

3. Key Specifications

- Supply Voltage 3.0V to 3.6V
- Measured Range 0 ~ 145 °C
- Remote Diode Temperature Accuracy ±1°C from +60°C to +100°C
- Local Temperature Accuracy ±3°C from +60°C to +100°C

4. Pin Configuration



5. Pin Description

I/OOD_{12t}	- TTL level bi-directional pin, can select to OD or OUT by register, with 12 mA source-sink capability.
I/OOD_{16t}	- TTL level bi-directional pin, can select to OD or OUT by register, with 16 mA source-sink capability.
I/OD_{12ts5V}	- TTL level bi-directional pin and schmitt trigger, Open-drain output with 12 mA sink capability, 5V tolerance.
I/O_{8t}	- TTL level bi-directional pin with 8 mA sink capability.
$I/O_{8t\text{-}u47,5V}$	- TTL level bi-directional pin with 8 mA sink capability, pull-up 47k ohms, 5V tolerance.
I/O_{12ts5V}	- TTL level bi-directional pin and schmitt trigger with 12 mA sink capability, 5V tolerance.
O_{12}	- Output pin with 12 mA source-sink capability.
AOUT	- Output pin(Analog).
OD_{12}	- Open-drain output pin with 12 mA sink capability.
IN_{ts5V}	- TTL level input pin and schmitt trigger, 5V tolerance.
AIN	- Input pin(Analog).
P	- Power.

5.1. Power Pin

Pin No.	Pin Name	Type	Description
16	VCC	P	3.3V power supply voltage input
9	GND(D-)	P	GND(If sensing CPU/GPU thermal diode or transistor 3906, please connect D- to this pin. Refer to application circuit)

5.2. Monitoring Items and Fan Speed Control

Pin No.	Pin Name	Type	Description
1	FANIN1	IN_{ts5v}	0V to +3.3V amplitude fan tachometer input.
2	GPIO0(Default)	IN_{ts5v}/OD_{12}	General purpose I/O pin. Default Open drain
	FANIN2	IN_{ts5v}	0V to +3.3V amplitude fan tachometer input.
	VOLT_FAULT#	OD_{12}	This pin will be a logic **LOW** when the voltage exceeds its limit.
3	PWM1(Default)	OOD_{12}	Use PWM duty cycle to control fan1 speed.
	DAC1	AOUT	Use linear voltage output (0~3.3V) to control fan1 speed.
	ADDR_TRAP	IN_{ts5v}	Address power on trapping pin. Internal weak pull down. The internal pull-down resistor will be turn-off after power-on trapping. For detail description, please see register description index01h
4	GPIO1(Default)	IN_{ts5v}/OD_{12}	General purpose I/O pin. Default Open drain
	PWM2	OOD_{12}	Use PWM duty cycle to control fan2 speed.
	DAC2	AOUT	Use linear voltage output (0~3.3V) to control fan2 speed.
	FAN_FAULT#	OD_{12}	This pin will be a logic **LOW** when the fan speed is abnormal.
10	VIN3	AIN	0V to 2.048V FSR Analog Inputs
11	VIN2	AIN	0V to 2.048V FSR Analog Inputs
12	VIN1	AIN	0V to 2.048V FSR Analog Inputs
14	D2+	AIN	Thermistor / transistor 2N3906/ CPU/GPU thermal diode terminal input
15	D1+	AIN	Thermistor / transistor 2N3906/ CPU/GPU thermal diode terminal input

5.3. Alert Signals and Others

Pin No.	Pin Name	Type	Description
5	GPIO2(Default)	IN_{ts5v}/OD_{12}	General purpose I/O function. Default pure open drain
	SMI#	OD_{12}	System management interrupt (Pure open drain). This pin will be active low when there is something wrong with voltage, temperature and fan. See register description index 33h
	VOLT_FAULT#	OD_{12}	Active-Low output. This pin will be a logic **LOW** when the voltage exceeds its limit.

6	OVT#(Default)	OD_{12}	Default open drain active-low output. This pin will be a logic **LOW** when the temperature exceeds its limit. Default output enable when the temperature exceeds 100°C on initial.
	GPIO3	$\mathbf{IN_{ts5V}}/OD_{12}$	General purpose I/O function.
	FAN_FAULT#	OD_{12}	This pin will be a logic **LOW** when the fan speed is abnormal.
	CLKIN	$\mathbf{IN_{ts5V}}$	24MHz/48MHz external clock input for chip operation source. When input external clock, the fan speed count will be more accurate.
13	VREF	AOUT	Reference voltage 2.304V.
8	SDATA	$\mathbf{IN_{ts5V}}/OD_{12}$	Serial bus data
7	SCLK	$\mathbf{IN_{ts5V}}$	Serial bus clock

6. Function Description

6.1. General Description

F75387 is a system hardware monitoring and automatic fan speed controlling IC specific designed for graphic cards and PC etc. An 11-bit analog-to-digital converter (ADC) was built inside F75387. The chip can monitor up to 4 analog voltage inputs, 2 fan tachometer inputs and 3 temperature inputs (2 remote and 1 local sensor). The remote temperature sensor can be performed by thermistor, transistor 2N3906 and CPU/GPU thermal diode. The F75387 can provide automatic fan speed control so that the system can operate at the minimum acoustic noise. This chip supports not only PWM duty mode (PWMOUT) but also linear mode (DACOUT) for fan speed control. Also the users can set up the upper and lower limits (alarm thresholds) of all monitored parameters and the F75387 can also issue warning messages for system protection when there is something wrong with monitored items.

6.2. Analog Inputs

For the 11-bit ADC has the 8mv LSB, the maximum input voltage of the analog pin is 2.048V. Therefore the voltage under 2.048V (ex:1.5V) can be directly connected to these analog inputs. The voltage higher than 2.048V should be reduced by a factor with external resistors so as to obtain the input range. Only 3Vcc is an exception for it is main power of the F75387. Therefore 3Vcc can directly connect to this chip's power pin and need no external resistors. There are two functions in this pin with 3.3V. The first function is to supply internal analog power of the F75387 and the second function is that this voltage with 3.3V is connected to internal serial resistors to monitor the +3.3V voltage. The internal serial resistors are two 150K ohm, so that the internal reduced voltage is half of +3.3V.

There are four voltage inputs in the F75387 and the voltage divided formula is shown as follows:

$$VIN = V_{+12V} \times \frac{R_2}{R_1 + R_2}$$ where V_{+12V} is the analog input voltage, for example.

If we choose R1=27K, R2=5.1K, the exact input voltage for V_{+12V} will be 1.907V, which is within the tolerance. As for application circuit, it can be refer to the figure as follows.

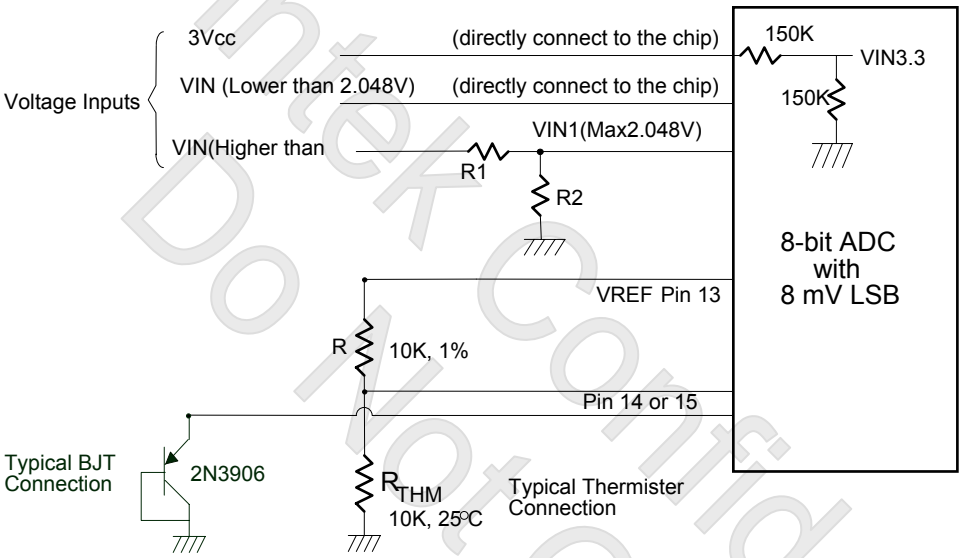


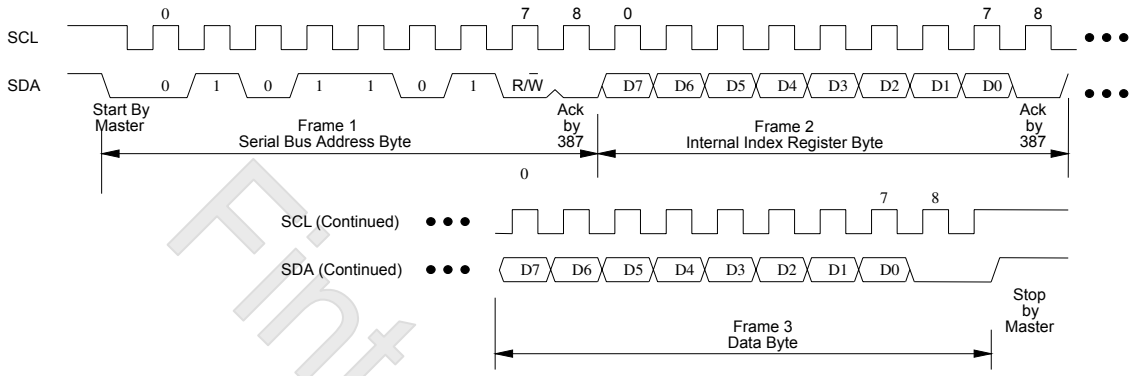
Figure 6-1

6.3. Access Interface and Power On Configuration

The F75387 provides one serial access interface, Serial Bus, to read/write internal registers. The address of Serial Bus is configurable by using power-on trapping. The pin 3 (PWM1/DAC1/ADDR_TRAP) is a multi-function pin. During power-on, this pin serves as input detection of logic high or logic low. Two Serial Bus address 0x5A (0101_1010) and 0x5C (0101_1100) can be selected by changing external pull-up resistors. Following table indicates the configuration:

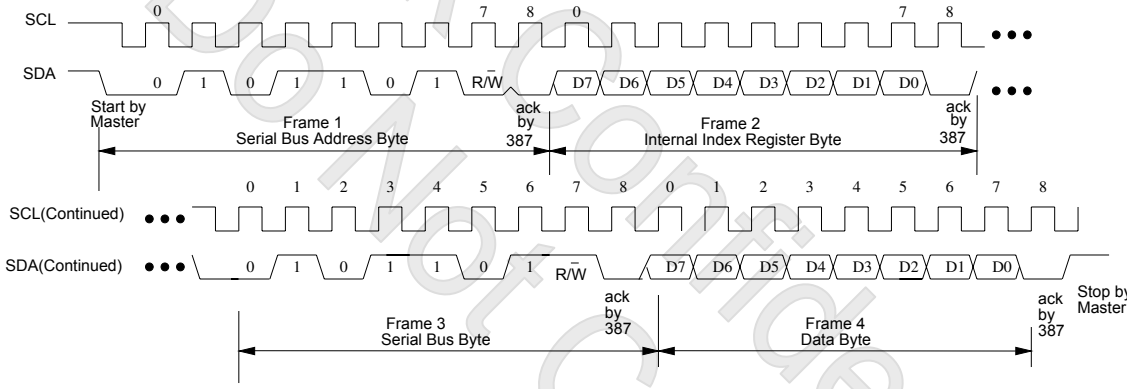
External Resistor	NC	200K	10K	2.2K
Address	0x5A	0x5C	0x5C	0x5A
Power On PWM Duty Cycle/DAC Linear Voltage Output	60% x 3VCC	100% x 3VCC	60% Duty Cycle	100% Duty Cycle
Power On DACOUT/PWMOUT Mode	DACOUT	DACOUT	PWMOUT	PWMOUT

(a) ***Serial bus write to internal address register followed by the data byte***



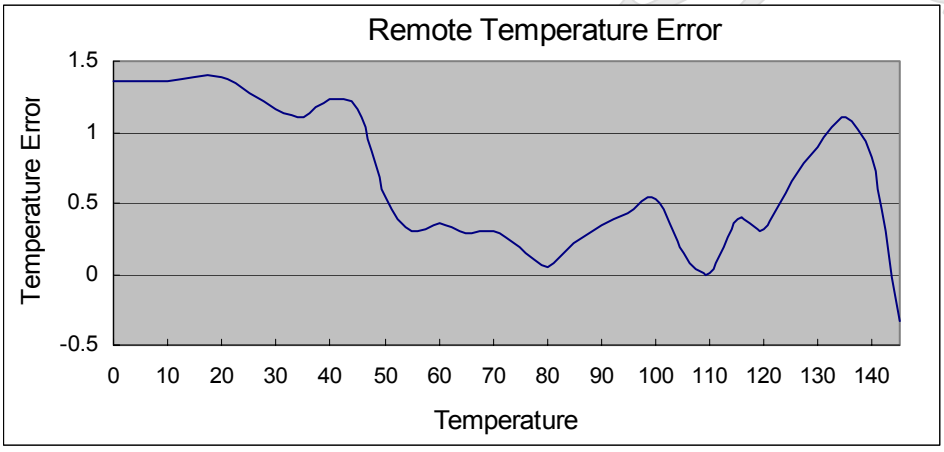
Serial Bus Write to Internal Address Register followed by the Data Byte

(b) Serial bus read form internal address register followed by the data byte



Serial Bus read from Internal Address Register followed by the Data Byte

6.4. Typical operating characteristic



6.5. Temperature monitoring

The F75387 monitors a local and a remote temperature sensor. Both can be measured from 0°C to 140.875°C.

The temperature format is as the following table:

Temperature (High Byte)	Digital Output	Temperature (Low Byte)	Digital Output
0°C	0000 0000	0°C	000 0 0000
1°C	0000 0001	0.125°C	001 0 0000
25°C	0001 1001	0.250°C	010 0 0000
50°C	0011 0010	0.375°C	011 0 0000
75°C	0100 1011	0.500°C	100 0 0000
90°C	0101 1010	0.625°C	101 0 0000
100°C	0110 0100	0.750°C	110 0 0000
140°C	1000 1100	0.875°C	111 0 0000

Remote-sensor transistor manufacturers

Manufacturer	Model Number
Panasonic	2SB0709 2N3906
Philips	PMBT3906

6.6. Temperature Measurement Machine

The temperature data format is 11-bit unsigned for thermal sensor. The 8-bit temperature data can be obtained by reading through two registers. The format of the temperature data is as below

Temperature	8-Bit Digital Output	
	11-Bit Binary	11-Bit Hex
+125.5°C	0111,1101.100	7D.8h
+25.125°C	0001,1001.001	19.2h
+2.875°C	0000,0010.111	02.Eh
+1.25°C	0000,0001.010	01.4h
+0.0°C	0000,0000	00.0h

6.7. Monitor Temperature from thermistor

The F75387 can connect two thermistors to measure environment temperature or remote temperature. The specification of thermistor should be considered to (1) β value is 3435K (2) resistor value is 10K ohm at 25°C. In the Figure 6-1, the thermistor is connected by a serial resistor with 10K ohm, then connected to VREF (pin13).