Kernel driver pc87360

Supported chips:

- National Semiconductor PC87360, PC87363, PC87364, PC87365 and PC87366

  Prefixes: 'pc87360', 'pc87363', 'pc87364', 'pc87365', 'pc87366'

  Addresses scanned: none, address read from Super I/O config space

  Datasheets: No longer available

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Module Parameters

- init int

  Chip initialization level:
  - 0: None
  - **1**: Forcibly enable internal voltage and temperature channels, except in9
  - 2: Forcibly enable all voltage and temperature channels, except in9
  - 3: Forcibly enable all voltage and temperature channels, including in9

Note that this parameter has no effect for the PC87360, PC87363 and PC87364 chips.

Also note that for the PC87366, initialization levels 2 and 3 don't enable all temperature channels, because some of them share pins with each other, so they can't be used at the same time.

Description

The National Semiconductor PC87360 Super I/O chip contains monitoring and PWM control circuitry for two fans. The PC87363 chip is similar, and the PC87364 chip has monitoring and PWM control for a third fan.

The National Semiconductor PC87365 and PC87366 Super I/O chips are complete hardware monitoring chipsets, not only controlling and monitoring three fans, but also monitoring eleven voltage inputs and two (PC87365) or up to four (PC87366) temperatures.

Chip	#vin	#fan	#pwm	#temp	devid
PC87360	•	2	2	•	0xE1
PC87363	•	2	2	•	0xE8
PC87364	•	3	3	•	0xE4
PC87365	11	3	3	2	0xE5
PC87366	11	3	3	3-4	0xE9

The driver assumes that no more than one chip is present, and one of the standard Super I/O addresses is used (0x2E/0x2F or 0x4E/0x4F)

Fan Monitoring

Fan rotation speeds are reported in RPM (revolutions per minute). An alarm is triggered if the rotation speed has dropped below a programmable limit. A different alarm is triggered if the fan speed is too low to be measured.

Fan readings are affected by a programmable clock divider, giving the readings more range or accuracy. Usually, users have to learn how it works, but this driver implements dynamic clock divider selection, so you don't have to care no more.

For reference, here are a few values about clock dividers:

divider	speed (RPM)	RPM (RPM)	speed (RPM)
1	1882	18	6928
2	941	37	4898
4	470	74	3464
8	235	150	2449

For the curious, here is how the values above were computed:

- slowest measurable speed: clock/(255*divider)
- accuracy around 3000 RPM: 3000^2/clock
- highest accurate speed: sqrt(clock*100)

The clock speed for the PC87360 family is 480 kHz. I arbitrarily chose 100 RPM as the lowest acceptable accuracy.

As mentioned above, you don't have to care about this no more.

Note that not all RPM values can be represented, even when the best clock divider is selected. This is not only true for the measured speeds, but also for the programmable low limits, so don't be surprised if you try to set, say, fan1_min to 2900 and it finally reads 2909.

Fan Control

PWM (pulse width modulation) values range from 0 to 255, with 0 meaning that the fan is stopped, and 255 meaning that the fan goes at full speed.

Be extremely careful when changing PWM values. Low PWM values, even non-zero, can stop the fan, which may cause irreversible damage to your hardware if temperature increases too much. When changing PWM values, go step by step and keep an eye on temperatures.

One user reported problems with PWM. Changing PWM values would break fan speed readings. No explanation nor fix could be found.

Temperature Monitoring

Temperatures are reported in degrees Celsius. Each temperature measured has associated low, high and overtemperature limits, each of which triggers an alarm when crossed.

The first two temperature channels are external. The third one (PC87366 only) is internal.

The PC87366 has three additional temperature channels, based on thermistors (as opposed to thermal diodes for the first three temperature channels). For technical reasons, these channels are held by the VLM (voltage level monitor) logical device, not the TMS (temperature measurement) one. As a consequence, these temperatures are exported as voltages, and converted into temperatures in user-space.

Note that these three additional channels share their pins with the external thermal diode channels, so you (physically) can't use them all at the same time. Although it should be possible to mix the two sensor types, the documents from National Semiconductor suggest that motherboard manufacturers should choose one type and stick to it. So you will more likely have either channels 1 to 3 (thermal diodes) or 3 to 6 (internal thermal diode, and thermistors).

Voltage Monitoring

Voltages are reported relatively to a reference voltage, either internal or external. Some of them (in7:Vsb, in8:Vdd and in10:AVdd) are divided by two internally, you will have to compensate in sensors.conf. Others (in0 to in6) are likely to be divided externally. The meaning of each of these inputs as well as the values of the resistors used for division is left to the motherboard manufacturers, so you will have to document yourself and edit sensors.conf accordingly. National Semiconductor has a document with recommended resistor values for some voltages, but this still leaves much room for per motherboard specificities, unfortunately. Even worse, motherboard manufacturers don't seem to care about National Semiconductor's recommendations.

Each voltage measured has associated low and high limits, each of which triggers an alarm when crossed.

When available, VID inputs are used to provide the nominal CPU Core voltage. The driver will default to VRM 9.0, but this can be changed from user-space. The chipsets can handle two sets of VID inputs (on dual-CPU systems), but the driver will only export one for now. This may change later if there is a need.

General Remarks

If an alarm triggers, it will remain triggered until the hardware register is read at least once. This means that the cause for the alarm may already have disappeared! Note that all hardware registers are read whenever any data is read (unless it is less than 2 seconds since the last update, in which case cached values are returned instead). As a consequence, when a once-only alarm triggers, it may take 2 seconds for it to show, and 2 more seconds for it to disappear.

Monitoring of in9 isn't enabled at lower init levels (<3) because that channel measures the battery voltage (Vbat). It is a known fact that repeatedly sampling the battery voltage reduces its lifetime. National Semiconductor smartly designed their chipset so that in9 is sampled only once every 1024 sampling cycles (that is every 34 minutes at the default sampling rate), so the effect is attenuated, but still present.

Limitations

The datasheets suggests that some values (fan mins, fan dividers) shouldn't be changed once the monitoring has started, but we ignore that recommendation. We'll reconsider if it actually causes trouble.