Kernel driver dme1737

Supported chips:

- SMSC DME1737 and compatibles (like Asus A8000)

  Prefix: 'dme1737'

  Addresses scanned: I2C 0x2c, 0x2d, 0x2e

  Datasheet: Provided by SMSC upon request and under NDA
- SMSC SCH3112, SCH3114, SCH3116

  Prefix: 'sch311x'

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

  Datasheet: Available on the Internet
- SMSC SCH5027

  Prefix: 'sch5027'

  Addresses scanned: I2C 0x2c, 0x2d, 0x2e

  Datasheet: Provided by SMSC upon request and under NDA
- SMSC SCH5127

  Prefix: 'sch5127'

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

  Datasheet: Provided by SMSC upon request and under NDA

Authors:
Juerg Haefliger <juergh@gmail.com>

Module Parameters

- force_start: bool
  Enables the monitoring of voltage, fan and temp inputs and PWM output control functions. Using this parameter shouldn't be required since the BIOS usually takes care of this.
- probe_all_addr: bool
  Include non-standard LPC addresses 0x162e and 0x164e when probing for ISA devices. This is required for the following boards: - VIA EPIA SN18000

Description

This driver implements support for the hardware monitoring capabilities of the SMSC DME1737 and Asus A8000 (which are the same), SMSC SCH5027, SCH311x, and SCH5127 Super-I/O chips. These chips feature monitoring of 3 temp sensors temp[1-3] (2 remote diodes and 1 internal), 8 voltages in[0-7] (7 external and 1 internal) and up to 6 fan speeds fan[1-6]. Additionally, the chips implement up to 5 PWM outputs pwm[1-3,5-6] for controlling fan speeds both manually and automatically.

For the DME1737, A8000 and SCH5027, fan[1-2] and pwm[1-2] are always present. Fan[3-6] and pwm[3,5-6] are optional features and their availability depends on the configuration of the chip. The driver will detect which features are present during initialization and create the sysfs attributes accordingly.

For the SCH311x and SCH5127, fan[1-3] and pwm[1-3] are always present and fan[4-6] and pwm[5-6] don't exist.

The hardware monitoring features of the DME1737, A8000, and SCH5027 are only accessible via SMBus, while the SCH311x and SCH5127 only provide access via the ISA bus. The driver will therefore register itself as an I2C client driver if it detects a DME1737, A8000, or SCH5027 and as a platform driver if it detects a SCH311x or SCH5127 chip.

Voltage Monitoring

The voltage inputs are sampled with 12-bit resolution and have internal scaling resistors. The values returned by the driver therefore reflect true millivolts and don't need scaling. The voltage inputs are mapped as follows (the last column indicates the input ranges):

DME1737, A8000:

```
in0: +5VTR      (+5V standby)           0V - 6.64V
in1: Vccp       (processor core)        0V - 3V
in2: VCC        (internal +3.3V)        0V - 4.38V
```

```
in3: +5V                                0V - 6.64V
in4: +12V                               0V - 16V
in5: VTR        (+3.3V standby)         0V - 4.38V
in6: Vbat       (+3.0V)                 0V - 4.38V
```

SCH311x:

```
in0: +2.5V                              0V - 3.32V
in1: Vccp       (processor core)        0V - 2V
in2: VCC        (internal +3.3V)        0V - 4.38V
in3: +5V                                0V - 6.64V
in4: +12V                               0V - 16V
in5: VTR        (+3.3V standby)         0V - 4.38V
in6: Vbat       (+3.0V)                 0V - 4.38V
```

SCH5027:

```
in0: +5VTR      (+5V standby)           0V - 6.64V
in1: Vccp       (processor core)        0V - 3V
in2: VCC        (internal +3.3V)        0V - 4.38V
in3: V2_IN                              0V - 1.5V
in4: V1_IN                              0V - 1.5V
in5: VTR        (+3.3V standby)         0V - 4.38V
in6: Vbat       (+3.0V)                 0V - 4.38V
```

SCH5127:

```
in0: +2.5                               0V - 3.32V
in1: Vccp       (processor core)        0V - 3V
in2: VCC        (internal +3.3V)        0V - 4.38V
in3: V2_IN                              0V - 1.5V
in4: V1_IN                              0V - 1.5V
in5: VTR        (+3.3V standby)         0V - 4.38V
in6: Vbat       (+3.0V)                 0V - 4.38V
in7: Vtrip      (+1.5V)                 0V - 1.99V
```

Each voltage input has associated min and max limits which trigger an alarm when crossed.

Temperature Monitoring

Temperatures are measured with 12-bit resolution and reported in millidegree Celsius. The chip also features offsets for all 3 temperature inputs which - when programmed - get added to the input readings. The chip does all the scaling by itself and the driver therefore reports true temperatures that don't need any user-space adjustments. The temperature inputs are mapped as follows (the last column indicates the input ranges):

```
temp1: Remote diode 1 (3904 type) temperature   -127C - +127C
temp2: DME1737 internal temperature             -127C - +127C
temp3: Remote diode 2 (3904 type) temperature   -127C - +127C
```

Each temperature input has associated min and max limits which trigger an alarm when crossed. Additionally, each temperature input has a fault attribute that returns 1 when a faulty diode or an unconnected input is detected and 0 otherwise.

Fan Monitoring

Fan RPMs are measured with 16-bit resolution. The chip provides inputs for 6 fan tachometers. All 6 inputs have an associated min limit which triggers an alarm when crossed. Fan inputs 1-4 provide type attributes that need to be set to the number of pulses per fan revolution that the connected tachometer generates. Supported values are 1, 2, and 4. Fan inputs 5-6 only support fans that generate 2 pulses per revolution. Fan inputs 5-6 also provide a max attribute that needs to be set to the maximum attainable RPM (fan at 100% duty- cycle) of the input. The chip adjusts the sampling rate based on this value.

PWM Output Control

This chip features 5 PWM outputs. PWM outputs 1-3 are associated with fan inputs 1-3 and PWM outputs 5-6 are associated with fan inputs 5-6. PWM outputs 1-3 can be configured to operate either in manual or automatic mode by setting the appropriate enable attribute accordingly. PWM outputs 5-6 can only operate in manual mode, their enable attributes are therefore read-only. When set to manual mode, the fan speed is set by writing the duty-cycle value to the appropriate PWM attribute. In automatic mode, the PWM attribute returns the current duty-cycle as set by the fan controller in the chip. All PWM outputs support the setting of the output frequency via the freq attribute.

In automatic mode, the chip supports the setting of the PWM ramp rate which defines how fast the PWM output is adjusting to changes of the associated temperature input. Associating PWM outputs to temperature inputs is done via temperature zones. The chip features 3 zones whose assignments to temperature inputs is static and determined during initialization. These assignments can be retrieved via the zone[1-3]_auto_channels_temp attributes. Each PWM output is assigned to one (or hottest of multiple) temperature zone(s) through the pwm[1-3]_auto_channels_zone attributes. Each PWM output has 3 distinct output duty-cycles: full, low, and

min. Full is internally hard-wired to 255 (100%) and low and min can be programmed via pwm[1-3]_auto_point1_pwm and pwm[1-3]_auto_pwm_min, respectively. The thermal thresholds of the zones are programmed via zone[1-3]_auto_point[1-3]_temp and zone[1-3]_auto_point1_temp_hyst:

pwm[1-3]_auto_point2_pwm	full-speed duty-cycle (255, i.e., 100%)
pwm[1-3]_auto_point1_pwm	low-speed duty-cycle
pwm[1-3]_auto_pwm_min	min-speed duty-cycle
zone[1-3]_auto_point3_temp	full-speed temp (all outputs)
zone[1-3]_auto_point2_temp	full-speed temp
zone[1-3]_auto_point1_temp	low-speed temp
zone[1-3]_auto_point1_temp_hyst	min-speed temp

The chip adjusts the output duty-cycle linearly in the range of auto_point1_pwm to auto_point2_pwm if the temperature of the associated zone is between auto_point1_temp and auto_point2_temp. If the temperature drops below the auto_point1_temp_hyst value, the output duty-cycle is set to the auto_pwm_min value which only supports two values: 0 or auto_point1_pwm. That means that the fan either turns completely off or keeps spinning with the low-speed duty-cycle. If any of the temperatures rise above the auto_point3_temp value, all PWM outputs are set to 100% duty-cycle.

Following is another representation of how the chip sets the output duty-cycle based on the temperature of the associated thermal zone:

Temperature	**Duty-Cycle Rising Temp**	**Duty-Cycle Falling Temp**
full-speed	full-speed	full-speed
•	< linearly adjusted duty-cycle >	•
low-speed	low-speed	low-speed
•	min-speed	low-speed
min-speed	min-speed	min-speed
•	min-speed	min-speed

Sysfs Attributes

Following is a list of all sysfs attributes that the driver provides, their permissions and a short description:

Name	**Perm**	**Description**
cpu0_vid	RO	CPU core reference voltage in millivolts.
vrm	RW	Voltage regulator module version number.
in[0-7]_input	RO	Measured voltage in millivolts.
in[0-7]_min	RW	Low limit for voltage input.
in[0-7]_max	RW	High limit for voltage input.
in[0-7]_alarm	RO	Voltage input alarm. Returns 1 if voltage input is or went outside the associated min-max range, 0 otherwise.
temp[1-3]_input	RO	Measured temperature in millidegree Celsius.
temp[1-3]_min	RW	Low limit for temp input.
temp[1-3]_max	RW	High limit for temp input.
temp[1-3]_offset	RW	Offset for temp input. This value will be added by the chip to the measured temperature.
temp[1-3]_alarm	RO	Alarm for temp input. Returns 1 if temp input is or went outside the associated min-max range, 0 otherwise.
temp[1-3]_fault	RO	Temp input fault. Returns 1 if the chip detects a faulty thermal diode or an unconnected temp input, 0 otherwise.
zone[1-3]_auto_channels_temp	RO	Temperature zone to temperature input mapping. This attribute is a bitfield and supports the following values: • 1: temp1 • 2: temp2 • 4: temp3
zone[1-3]_auto_point1_temp_hyst	RW	Auto PWM temp point1 hysteresis. The output of the corresponding PWM is set to the pwm_auto_min value if the temp falls below the auto_point1_temp_hyst value.
zone[1-3]_auto_point[1-3]_temp	RW	Auto PWM temp points. Auto_point1 is the low-speed temp, auto_point2 is the full-speed temp, and auto_point3 is the temp at which all PWM outputs are set to full-speed (100% duty-cycle).

Name	Perm	Description
fan[1-6]_input	RO	Measured fan speed in RPM.
fan[1-6]_min	RW	Low limit for fan input.
fan[1-6]_alarm	RO	Alarm for fan input. Returns 1 if fan input is or went below the associated min value, 0 otherwise.
fan[1-4]_type	RW	Type of attached fan. Expressed in number of pulses per revolution that the fan generates. Supported values are 1, 2, and 4.
fan[5-6]_max	RW	Max attainable RPM at 100% duty-cycle. Required for chip to adjust the sampling rate accordingly.
pmw[1-3,5-6]	RO/RW	Duty-cycle of PWM output. Supported values are 0-255 (0%-100%). Only writeable if the associated PWM is in manual mode.
pwm[1-3]_enable	RW	Enable of PWM outputs 1-3. Supported values are: • 0: turned off (output @ 100%) • 1: manual mode • 2: automatic mode
pwm[5-6]_enable	RO	Enable of PWM outputs 5-6. Always returns 1 since these 2 outputs are hard-wired to manual mode.
pmw[1-3,5-6]_freq	RW	Frequency of PWM output. Supported values are in the range 11Hz-30000Hz (default is 25000Hz).
pmw[1-3]_ramp_rate	RW	Ramp rate of PWM output. Determines how fast the PWM duty-cycle will change when the PWM is in automatic mode. Expressed in ms per PWM step. Supported values are in the range 0ms-206ms (default is 0, which means the duty- cycle changes instantly).
pwm[1-3]_auto_channels_zone	RW	PWM output to temperature zone mapping. This attribute is a bitfield and supports the following values: • 1: zone1 • 2: zone2 • 4: zone3 • 6: highest of zone[2-3] • 7: highest of zone[1-3]
pwm[1-3]_auto_pwm_min	RW	Auto PWM min pwm. Minimum PWM duty- cycle. Supported values are 0 or auto_point1_pwm.
pwm[1-3]_auto_point1_pwm	RW	Auto PWM pwm point. Auto_point1 is the low-speed duty-cycle.
pwm[1-3]_auto_point2_pwm	RO	Auto PWM pwm point. Auto_point2 is the full-speed duty-cycle which is hard- wired to 255 (100% duty-cycle).

Chip Differences

Feature	dme1737	sch311x	sch5027	sch5127
temp[1-3]_offset	yes	yes		
vid	yes			
zone3	yes	yes	yes	
zone[1-3]_hyst	yes	yes		
pwm min/off	yes	yes		
fan3	opt	yes	opt	yes
pwm3	opt	yes	opt	yes
fan4	opt		opt	
fan5	opt		opt	
pwm5	opt		opt	
fan6	opt		opt	
pwm6	opt		opt	
in7				yes