Kernel driver lm90

Supported chips:

- National Semiconductor LM90

  Prefix: 'lm90'

  Addresses scanned: I2C 0x4c

  Datasheet: Publicly available at the National Semiconductor website

  http://www.national.com/pf/LM/LM90.html

- National Semiconductor LM89

  Prefix: 'lm89' (no auto-detection)

  Addresses scanned: I2C 0x4c and 0x4d

  Datasheet: Publicly available at the National Semiconductor website

  http://www.national.com/mpf/LM/LM89.html

- National Semiconductor LM99

  Prefix: 'lm99'

  Addresses scanned: I2C 0x4c and 0x4d

  Datasheet: Publicly available at the National Semiconductor website

  http://www.national.com/pf/LM/LM99.html

- National Semiconductor LM86

  Prefix: 'lm86'

  Addresses scanned: I2C 0x4c

  Datasheet: Publicly available at the National Semiconductor website

  http://www.national.com/mpf/LM/LM86.html

- Analog Devices ADM1032

  Prefix: 'adm1032'

  Addresses scanned: I2C 0x4c and 0x4d

  Datasheet: Publicly available at the ON Semiconductor website

  https://www.onsemi.com/PowerSolutions/product.do?id=ADM1032

- Analog Devices ADT7461

  Prefix: 'adt7461'

  Addresses scanned: I2C 0x4c and 0x4d

  Datasheet: Publicly available at the ON Semiconductor website

  https://www.onsemi.com/PowerSolutions/product.do?id=ADT7461

- Analog Devices ADT7461A

  Prefix: 'adt7461a'

  Addresses scanned: I2C 0x4c and 0x4d

  Datasheet: Publicly available at the ON Semiconductor website

  https://www.onsemi.com/PowerSolutions/product.do?id=ADT7461A

- ON Semiconductor NCT1008

  Prefix: 'nct1008'

  Addresses scanned: I2C 0x4c and 0x4d

Datasheet: Publicly available at the ON Semiconductor website

https://www.onsemi.com/PowerSolutions/product.do?id=NCT1008

- Maxim MAX6646

  Prefix: 'max6646'

  Addresses scanned: I2C 0x4d

  Datasheet: Publicly available at the Maxim website

  http://www.maxim-ic.com/quick_view2.cfm/qv_pk/3497

- Maxim MAX6647

  Prefix: 'max6646'

  Addresses scanned: I2C 0x4e

  Datasheet: Publicly available at the Maxim website

  http://www.maxim-ic.com/quick_view2.cfm/qv_pk/3497

- Maxim MAX6648

  Prefix: 'max6646'

  Addresses scanned: I2C 0x4c

  Datasheet: Publicly available at the Maxim website

  http://www.maxim-ic.com/quick_view2.cfm/qv_pk/3500

- Maxim MAX6649

  Prefix: 'max6646'

  Addresses scanned: I2C 0x4c

  Datasheet: Publicly available at the Maxim website

  http://www.maxim-ic.com/quick_view2.cfm/qv_pk/3497

- Maxim MAX6654

  Prefix: 'max6654'

  Addresses scanned: I2C 0x18, 0x19, 0x1a, 0x29, 0x2a, 0x2b,

  0x4c, 0x4d and 0x4e

  Datasheet: Publicly available at the Maxim website

  https://www.maximintegrated.com/en/products/sensors/MAX6654.html

- Maxim MAX6657

  Prefix: 'max6657'

  Addresses scanned: I2C 0x4c

  Datasheet: Publicly available at the Maxim website

  http://www.maxim-ic.com/quick_view2.cfm/qv_pk/2578

- Maxim MAX6658

  Prefix: 'max6657'

  Addresses scanned: I2C 0x4c

  Datasheet: Publicly available at the Maxim website

  http://www.maxim-ic.com/quick_view2.cfm/qv_pk/2578

- Maxim MAX6659

  Prefix: 'max6659'

  Addresses scanned: I2C 0x4c, 0x4d, 0x4e

Datasheet: Publicly available at the Maxim website

http://www.maxim-ic.com/quick_view2.cfm/qv_pk/2578

- Maxim MAX6680

  Prefix: 'max6680'

  Addresses scanned: I2C 0x18, 0x19, 0x1a, 0x29, 0x2a, 0x2b,

  0x4c, 0x4d and 0x4e

  Datasheet: Publicly available at the Maxim website

  http://www.maxim-ic.com/quick_view2.cfm/qv_pk/3370

- Maxim MAX6681

  Prefix: 'max6680'

  Addresses scanned: I2C 0x18, 0x19, 0x1a, 0x29, 0x2a, 0x2b,

  0x4c, 0x4d and 0x4e

  Datasheet: Publicly available at the Maxim website

  http://www.maxim-ic.com/quick_view2.cfm/qv_pk/3370

- Maxim MAX6692

  Prefix: 'max6646'

  Addresses scanned: I2C 0x4c

  Datasheet: Publicly available at the Maxim website

  http://www.maxim-ic.com/quick_view2.cfm/qv_pk/3500

- Maxim MAX6695

  Prefix: 'max6695'

  Addresses scanned: I2C 0x18

  Datasheet: Publicly available at the Maxim website

  http://www.maxim-ic.com/datasheet/index.mvp/id/4199

- Maxim MAX6696

  Prefix: 'max6695'

  Addresses scanned: I2C 0x18, 0x19, 0x1a, 0x29, 0x2a, 0x2b,

  0x4c, 0x4d and 0x4e

  Datasheet: Publicly available at the Maxim website

  http://www.maxim-ic.com/datasheet/index.mvp/id/4199

- Winbond/Nuvoton W83L771W/G

  Prefix: 'w83l771'

  Addresses scanned: I2C 0x4c

  Datasheet: No longer available

- Winbond/Nuvoton W83L771AWG/ASG

  Prefix: 'w83l771'

  Addresses scanned: I2C 0x4c

  Datasheet: Not publicly available, can be requested from Nuvoton

- Philips/NXP SA56004X

  Prefix: 'sa56004'

  Addresses scanned: I2C 0x48 through 0x4F

Datasheet: Publicly available at NXP website

http://ics.nxp.com/products/interface/datasheet/sa56004x.pdf

- GMT G781

  Prefix: 'g781'

  Addresses scanned: I2C 0x4c, 0x4d

  Datasheet: Not publicly available from GMT

- Texas Instruments TMP451

  Prefix: 'tmp451'

  Addresses scanned: I2C 0x4c

  Datasheet: Publicly available at TI website

  https://www.ti.com/litv/pdf/sbos686

- Texas Instruments TMP461

  Prefix: 'tmp461'

  Addresses scanned: I2C 0x48 through 0x4F

  Datasheet: Publicly available at TI website

  https://www.ti.com/lit/gpn/tmp461

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Description

The LM90 is a digital temperature sensor. It senses its own temperature as well as the temperature of up to one external diode. It is compatible with many other devices, many of which are supported by this driver.

Note that there is no easy way to differentiate between the MAX6657, MAX6658 and MAX6659 variants. The extra features of the MAX6659 are only supported by this driver if the chip is located at address 0x4d or 0x4e, or if the chip type is explicitly selected as max6659. The MAX6680 and MAX6681 only differ in their pinout, therefore they obviously can't (and don't need to) be distinguished.

The specificity of this family of chipsets over the ADM1021/LM84 family is that it features critical limits with hysteresis, and an increased resolution of the remote temperature measurement.

The different chipsets of the family are not strictly identical, although very similar. For reference, here comes a non-exhaustive list of specific features:

LM90:
- Filter and alert configuration register at 0xBF.
- ALERT is triggered by temperatures over critical limits.

LM86 and LM89:
- Same as LM90
- Better external channel accuracy

LM99:
- Same as LM89
- External temperature shifted by 16 degrees down

ADM1032:
- Consecutive alert register at 0x22.
- Conversion averaging.
- Up to 64 conversions/s.
- ALERT is triggered by open remote sensor.
- SMBus PEC support for Write Byte and Receive Byte transactions.

ADT7461, ADT7461A, NCT1008:
- Extended temperature range (breaks compatibility)
- Lower resolution for remote temperature

MAX6654:
- Better local resolution
- Selectable address
- Remote sensor type selection
- Extended temperature range
- Extended resolution only available when conversion rate <= 1 Hz

MAX6657 and MAX6658:

- Better local resolution
- Remote sensor type selection

MAX6659:

- Better local resolution
- Selectable address
- Second critical temperature limit
- Remote sensor type selection

MAX6680 and MAX6681:

- Selectable address
- Remote sensor type selection

MAX6695 and MAX6696:

- Better local resolution
- Selectable address (max6696)
- Second critical temperature limit
- Two remote sensors

W83L771W/G

- The G variant is lead-free, otherwise similar to the W.
- Filter and alert configuration register at 0xBF
- Moving average (depending on conversion rate)

W83L771AWG/ASG

- Successor of the W83L771W/G, same features.
- The AWG and ASG variants only differ in package format.
- Diode ideality factor configuration (remote sensor) at 0xE3

SA56004X:

- Better local resolution

All temperature values are given in degrees Celsius. Resolution is 1.0 degree for the local temperature, 0.125 degree for the remote temperature, except for the MAX6654, MAX6657, MAX6658 and MAX6659 which have a resolution of 0.125 degree for both temperatures.

Each sensor has its own high and low limits, plus a critical limit. Additionally, there is a relative hysteresis value common to both critical values. To make life easier to user-space applications, two absolute values are exported, one for each channel, but these values are of course linked. Only the local hysteresis can be set from user-space, and the same delta applies to the remote hysteresis.

The lm90 driver will not update its values more frequently than configured with the update_interval attribute; reading them more often will do no harm, but will return 'old' values.

SMBus Alert Support

This driver has basic support for SMBus alert. When an alert is received, the status register is read and the faulty temperature channel is logged.

The Analog Devices chips (ADM1032, ADT7461 and ADT7461A) and ON Semiconductor chips (NCT1008) do not implement the SMBus alert protocol properly so additional care is needed: the ALERT output is disabled when an alert is received, and is re-enabled only when the alarm is gone. Otherwise the chip would block alerts from other chips in the bus as long as the alarm is active.

PEC Support

The ADM1032 is the only chip of the family which supports PEC. It does not support PEC on all transactions though, so some care must be taken.

When reading a register value, the PEC byte is computed and sent by the ADM1032 chip. However, in the case of a combined transaction (SMBus Read Byte), the ADM1032 computes the CRC value over only the second half of the message rather than its entirety, because it thinks the first half of the message belongs to a different transaction. As a result, the CRC value differs from what the SMBus master expects, and all reads fail.

For this reason, the lm90 driver will enable PEC for the ADM1032 only if the bus supports the SMBus Send Byte and Receive Byte transaction types. These transactions will be used to read register values, instead of SMBus Read Byte, and PEC will work properly.

Additionally, the ADM1032 doesn't support SMBus Send Byte with PEC. Instead, it will try to write the PEC value to the register (because the SMBus Send Byte transaction with PEC is similar to a Write Byte transaction without PEC), which is not what we want. Thus, PEC is explicitly disabled on SMBus Send Byte transactions in the lm90 driver.

PEC on byte data transactions represents a significant increase in bandwidth usage (+33% for writes, +25% for reads) in normal conditions. With the need to use two SMBus transaction for reads, this overhead jumps to +50%. Worse, two transactions will typically mean twice as much delay waiting for transaction completion, effectively doubling the register cache refresh time. I guess reliability comes at a price, but it's quite expensive this time.

So, as not everyone might enjoy the slowdown, PEC can be disabled through sysfs. Just write 0 to the "pec" file and PEC will be

disabled. Write 1 to that file to enable PEC again.