Check and Monitor CPU Temperature

SUSE Linux Enterprise Server for SAP applications reports CPU and other component temperatures through Advanced Configuration and Power Interface (ACPI) thermal zones and hardware monitoring devices. Read the CPU temperature from the ACPI thermal zones without installing any software, or list all sensors with the **`sensors`** command. Monitoring the temperature helps you reduce energy costs and detect cooling problems early.

Prerequisites

- `sudo` privileges to install the `sensors` package and to run **`sensors-detect`** (reading the temperature requires no special privileges)

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1 Why monitor CPU temperature?

Checking and monitoring CPU temperature has several benefits.

- Energy savings and cost reduction. When a CPU runs at full speed, it consumes more energy than when it is idling. Keeping CPUs cool is also a major cost factor, especially in data centers.
- Identifying and monitoring processes that consume too much CPU power. Doing that can help free CPU resources and increase responsiveness.
- Easier detection of cooling issues. If the CPU temperature approaches or exceeds the high or critical limits that your hardware reports, it indicates that there is a problem with the cooling system or the fan, or that the thermal paste was not applied correctly.
- A long-term reduction of the carbon footprint can be achieved by adjusting the cooling parameters.

You can read the temperature in two ways: from the ACPI thermal zones that the kernel exposes, which needs no additional software, or with the **`sensors`** command, which lists all sensors that the kernel provides. For details, see *Section 3, "Reading the CPU temperature"*.

2 Installing and configuring hardware sensors

The **`sensors`** command is part of the `sensors` package. To read the temperature from the ACPI thermal zones, you do not need the package. For details, see *Section 3.1, "Reading the ACPI thermal zones"*.

1. Install the required package.

   - On the mutable system:

     ```
     > sudo zypper install sensors
     ```

   - On the immutable system:

     ```
     > sudo transactional-update pkg install sensors
     ```

     Reboot the system to activate the change.

2. Check which sensors the kernel already provides:

   ```
   > sensors
   ```

The output lists the sensors that the kernel has registered, for example, ACPI thermal zones and NVMe drives. For a sample and an explanation, see *Section 3.3, "Reading all sensors with the sensors command"*. If the kernel has registered no sensor, the command reports `No sensors found!`

3. Optionally, search for additional hardware monitoring chips that the kernel does not register on its own, for example, on an I2C or SMBus adapter. Do this only if a sensor that you need is missing from the output of **`sensors`**.



Warning: Hardware probing can hang or damage a system

The **`sensors-detect`** command accesses hardware to identify chips. According to its man page, this can lock up the SMBus and, in rare cases, damage hardware. The man page advises against running the command on production servers.

If you accept this risk, run the following command:

```
> sudo sensors-detect --auto
```

The `--auto` option runs the command without interaction and assumes the default answer to every question. Without it, the command asks each question and waits for your answer.
If the command finds a chip, it prints a summary of the chips that it found. Because of the `--auto` option, it accepts the default answer to the last question:

```
Now follows a summary of the probes I have just done.

Driver `coretemp':
  * Chip `Intel digital thermal sensor' (confidence: 9)

Driver `to-be-written':
  * ISA bus, address 0xa40
    Chip `ITE IT8686E Super IO Sensors' (confidence: 9)

Do you want to generate /etc/sysconfig/lm_sensors? (YES/no):
Created symlink '/etc/systemd/system/multi-user.target.wants/lm_sensors.service' →
 '/usr/lib/systemd/system/lm_sensors.service'.
```

The command generates the file `/etc/sysconfig/lm_sensors` and enables and starts the `lm_sensors` service. The unit file of the service is part of the `sensors` package. To check the status of the service, run:

```
> systemctl status lm_sensors
```

Sample output:

```
● lm_sensors.service - Initialize hardware monitoring sensors
     Loaded: loaded (/usr/lib/systemd/system/lm_sensors.service; enabled; preset: disabled)
     Active: active (exited) since Mon 2026-09-21 07:40:32 CEST; 16ms ago
 Invocation: e3f984a1d2cf43528b9b753f1d698a65
    Process: 1433 ExecStart=/sbin/modprobe -qab $BUS_MODULES $HWMON_MODULES (code=exited, status=0/SUCCESS)
    Process: 1436 ExecStart=/usr/bin/sensors -s (code=exited, status=0/SUCCESS)
   Main PID: 1436 (code=exited, status=0/SUCCESS)
        CPU: 34ms
```

If the command finds no chip, it reports `Sorry, no sensors were detected`. It generates no configuration file, and the service stays disabled. The sensors that the **`sensors`** command already lists are not affected.

To read the temperature, continue with *Section 3, "Reading the CPU temperature"*.

3 Reading the CPU temperature

This section describes two ways to read the temperature. If neither shows a temperature, the operating system has no access to a temperature sensor, as is the case in a virtual machine that does not emulate one.

3.1 Reading the ACPI thermal zones

The kernel exposes each ACPI thermal zone as a directory named `/sys/class/thermal/thermal_zone`*N*. Reading these files requires neither the `sensors` package nor special privileges.

EXAMPLE 1: LISTING THE TYPE AND TEMPERATURE OF ALL ACPI THERMAL ZONES

```
> grep . /sys/class/thermal/thermal_zone*/{type,temp}
```

Sample output:

```
/sys/class/thermal/thermal_zone0/type:acpitz
/sys/class/thermal/thermal_zone1/type:acpitz
/sys/class/thermal/thermal_zone0/temp:40900
```

```
/sys/class/thermal/thermal_zone1/temp:52900
```

The **`grep .`** command prints the name of each file in front of its content, so that every value stays assigned to its zone. The temperature is given in millidegrees Celsius: `40900` means 40.9°C. The type `acpitz` identifies an ACPI thermal zone.

If `/sys/class/thermal` contains no `thermal_zone`*N* directory, the system has no ACPI thermal zone. Use the **`sensors`** command instead.

Each zone can define trip points. To list the first trip point of the first zone, run:

EXAMPLE 2: LISTING THE FIRST TRIP POINT OF AN ACPI THERMAL ZONE

```
> grep . /sys/class/thermal/thermal_zone0/trip_point_0_{type,temp}
```

Sample output:

```
/sys/class/thermal/thermal_zone0/trip_point_0_type:critical
/sys/class/thermal/thermal_zone0/trip_point_0_temp:100000
```

A trip point of type `critical` gives the temperature at which the kernel shuts down the system to protect the hardware. Its value is also in millidegrees Celsius: `100000` means 100°C. When a zone reaches this temperature, the kernel logs the messages `critical temperature reached` and `HARDWARE PROTECTION shutdown (Temperature too high)`.

3.2 Identifying readings that come through ACPI

You can recognize a reading that comes through ACPI in two ways:

- Its zone in `/sys/class/thermal` has the type `acpitz`.
- In the output of the **`sensors`** command, its chip name is `acpitz-acpi-0` and its adapter is `ACPI interface`.

To see the name that the system firmware gave to each zone, read the `path` file of the zone:

EXAMPLE 3: LISTING THE FIRMWARE NAMES OF ALL ACPI THERMAL ZONES

```
> grep . /sys/class/thermal/thermal_zone*/device/path
```

Sample output:

```
/sys/class/thermal/thermal_zone0/device/path:\_TZ_.TZ00
/sys/class/thermal/thermal_zone1/device/path:\_TZ_.TZ01
```

The kernel reports that a reading comes through ACPI, but not which component the zone measures. The firmware chooses the names.

Sensors that the **`sensors`** command lists under another chip name, such as the NVMe drive `nvme-pci-0090` in the following section, are provided by their own kernel drivers and do not come through ACPI.

3.3 Reading all sensors with the sensors command

The **`sensors`** command lists every temperature sensor that the kernel has registered, not only the ACPI thermal zones. It needs the `sensors` package, as described in *Section 2, "Installing and configuring hardware sensors"*, but no special privileges. To obtain a snapshot of the current temperatures, run:

```
> sensors
```

Sample output:

```
nvme-pci-0090 ❶
Adapter: PCI adapter ❷
Composite:    +49.9°C  (low  = -273.1°C, high = +69.8°C) ❸
                       (crit = +99.8°C)

acpitz-acpi-0 ❹
Adapter: ACPI interface
temp1:        +40.9°C
temp2:        +52.9°C
```

❶ The device that reports the values. The name consists of the driver (`nvme`), the bus (`pci`) and the address of the device on that bus.

❷ The interface through which the device is accessed, for example, `PCI adapter` or `ACPI interface`.

❸ The temperature of the device, followed by the low, high and critical limits that the device reports.

❹ The ACPI thermal zones. Each zone is one temperature. In this example, `temp1` is `thermal_zone0` (40.9°C) and `temp2` is `thermal_zone1` (52.9°C).

The **`sensors`** command lists the sensors that the kernel has already registered. It does not depend on **`sensors-detect`**, which only searches for additional chips (see *Section 2, "Installing and configuring hardware sensors"*). The kernel drivers `coretemp` for Intel processors and `k10temp` for AMD processors provide the CPU temperature.

Note: Output depends on the type of hardware

The output of the **`sensors`** command depends on the type of hardware installed on your machine, as different hardware components have different sensors.

4 Monitoring CPU temperature in real time

To monitor the temperature in real time, run the **`sensors`** command with the **`watch`** command:

```
> watch sensors
```

The **`watch`** command is part of the `procps` package. It runs a command at regular intervals and shows its output in the terminal. Sample output:

```
Every 2.0s: sensors                                          sles16: 07:23:01 AM
                                                                   in 0.007s (0)
nvme-pci-0090
Adapter: PCI adapter
Composite:    +49.9°C  (low  = -273.1°C, high = +69.8°C)
                       (crit = +99.8°C)

acpitz-acpi-0
Adapter: ACPI interface
temp1:        +40.9°C
temp2:        +52.9°C
```

By default, the **`watch`** command updates the output every two seconds. You can change this interval with the `-n` option followed by the number of seconds. For example, to change the interval to 5 seconds, run:

```
> watch -n 5 sensors
```

Press `Ctrl` – `C` to stop the **`watch`** command.

5 Troubleshooting

This part describes potential problems when monitoring CPU temperatures and their solutions.

5.1 Why are the displayed temperatures unrealistic?

If you suspect that the displayed temperature is too low or too high, you can try the following:

- Compare the temperatures of the ACPI thermal zones with the `acpitz` entries in the output of the **`sensors`** command. Both show the same zones, so the values should agree. For the commands, see *Section 3, "Reading the CPU temperature"*.

- Use a different tool that reads the same kernel sensors, for example, **`s-tui`**, a terminal utility that shows the temperatures that the system reports together with the CPU frequency and utilization. It is provided by SUSE Package Hub, whose packages are community-maintained and delivered without L3 support. If Package Hub is not enabled, run **`SUSEConnect --list-extensions`**, which prints the command to enable it.
  Install the `s-tui` package:

  - On the mutable system:

    ```
    > sudo zypper install s-tui
    ```

  - On the immutable system:

    ```
    > sudo transactional-update pkg install s-tui
    ```

    Reboot the system to activate the change.

  Then run **`s-tui`** from the terminal.

If none of these recommendations solve the issue, the problem might be due to unsupported or faulty hardware. In this case, you need to seek help from your hardware manufacturer.

5.2 Why is the displayed temperature too high?

If the CPU temperature is too high, here are actions you can take:

- Verify that the CPU cooling system, such as the fan or heat sink, works correctly. Ensure that the fan is spinning properly and that the heat sink is making proper contact with the CPU. If necessary, you may need to replace the thermal paste between the CPU and the heat sink to improve heat transfer.
- Adjust the power settings on your system to reduce heat generation. Lowering the CPU frequency or enabling power-saving features can help keep the temperature in check.
- Monitor the system load and CPU usage. High CPU usage for extended periods can lead to increased temperatures. Identify resource-intensive processes with tools such as **`top`** or **`ps`**, then consider optimizing or limiting their usage. For more information, see https://www.suse.com/support/kb/doc/?id=000016916.

6 For more information

- For more information about the **`sensors`** command and its configuration, see the man pages **`man sensors`**, **`man sensors-detect`** and **`man 5 sensors.conf`**.
- For more information about monitoring CPU load and other system metrics from a Web interface, see Viewing metrics and history (https://documentation.suse.com/sles-sap/16.1/html/SAP-cockpit/index.html#cockpit-cockpit-metrics) in Cockpit.
- For more information about making your computing more environmentally sustainable, see https://journals.plos.org/ploscompbiol/article?id=10.1371/journal.pcbi.1009324.

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If your document contains nontrivial examples of program code, we recommend releasing these examples in parallel under your choice of free software license, such as the GNU General Public License, to permit their use in free software.