



# Bluetooth

Date:

1 March 2026

Bluetooth enables wireless data transmission between electronic devices via a high-frequency electromagnetic radio connection. Typical applications include:

- connecting audio and video devices, such as headphones, earphones or hearing aids, to mobile phones or DECT phones.
- telephones for Internet or IP telephony.
- connections between computers, printers, mice, keyboards, digital cameras, etc.
- patient monitoring in hospitals.
- connecting smartwatches and fitness trackers to mobile phones.
- in the technical field: connecting sensors to actuators and controllers in order to convert electrical signals into mechanical movements.



Bluetooth comes in two different radio variants with several versions:

- Older versions of "Bluetooth classic" can transfer large amounts of data in a short time and are suitable for audio streaming and file transfer. A central device transmits data to up to seven other devices.
- Modern versions of "Bluetooth Low Energy (BLE)" are more energy-efficient than "Bluetooth classic", can transfer small amounts of data economically and are suitable for audio streaming, file transfers and Bluetooth networks. A BLE device detects whether and where other BLE devices are located in its environment and how they are moving.
- BLE Audio transmits audio files and streams with better sound quality and energy efficiency than Bluetooth classic. Examples:
  - Some current hearing aids also use BLE Audio technology, among others.
  - Thanks to its fast data transfer, BLE Audio synchronises the lip movements of people speaking on television with their voices in TV surround sound systems.
  - The Auracast feature of BLE audio can power an unlimited number of earphones, hearing aids or BLE audio speakers without them needing to be paired with the system.

According to current knowledge, the high-frequency radiation from Bluetooth devices is below the limit values. Bluetooth devices should not have any short-term effects, but their long-term effects on health cannot be assessed.

Tip: Headsets with Bluetooth classic or BLE audio generally emit less radiation than a mobile phone and reduce the head's exposure to radiation during phone calls.

Tip: If you want to use BLE audio devices with your mobile phone, it must support at least Bluetooth version 5.2.



# Detailed information

## 1 Bluetooth technical specifications

### 1.1 Frequencies

Bluetooth classic and Bluetooth Low Energy (BLE) devices operate in the unlicensed ISM (Industrial Scientific Medical) band, in the frequency range from 2,400 GHz to 2,4835 GHz. Other technologies also operate in this frequency band, such as Wi-Fi and microwave ovens, as well as manufacturer-specific radio connections, such as smart home sensors, radio toys, computer peripherals, etc.

### 1.2 Characteristics

Table 1 provides an overview of some of the radiation-related characteristics of Bluetooth [1-3].

- Bluetooth devices come in different versions. The older versions, 1 to 3, are called "Bluetooth classic". Bluetooth classic is integrated into many current Bluetooth devices to enable voice transmission and high-performance data transfer. Despite its energy-saving features, Bluetooth classic consumes a lot of electricity and cannot provide the battery life required for certain devices. This disadvantage is due to the fact that connected devices must communicate with each other continuously, even when they are not transmitting data. The further development of Bluetooth Low Energy (BLE), on the other hand, is energy efficient.
- Bluetooth has several types of connection: device-to-device, device-to-multiple devices (broadcast) and networked between multiple devices (mesh).
- Depending on the version, Bluetooth has different transmission powers, transmission rates (amount of data per unit of time, usually expressed in megabits per second Mbit/s) and ranges.
- Bluetooth devices have different sensitivities in terms of radiation, allowing them to establish a Bluetooth connection or transfer data. With BLE, the barely detectable signal strength is between 100,000 and 1,500,000 times lower than the minimum transmission power. This allows Bluetooth devices to communicate with each other even when radio connections are poor.
- BLE 4, 5 and especially 6.2 standards generally have significantly reduced latency compared to conventional Bluetooth. Latency is the time a device allows to elapse after receiving data before responding to it.
- BLE devices use channels known as "advertising" channels, which allow them to send small packets of data or information without having to connect to other nearby BLE devices first. These channels are used to send advertising to nearby BLE devices.



Ver- sion	Desi- gnation	Trans- mission power (mW)	Connec- tion type	Trans- mission direc- tion	Characteris- tics	Trans- mis- sion rate	Range [m]	Adver- tising chan- nels
1-3	Blue- tooth classic	1-10	Device to device	2-way	– Typical la- tencies 100 ms	1, 3, 24 Mbit/s	10-100	None
4.0 / 4.1 / 4.2	Blue- tooth Low energy	0.01-10	Device to device	2-way	– Latency less than 6 ms	1 Mbit/s	10-100	3
			Broadcast mode: one device with multi- ple de- vices	1 chan- nel	– No voice transmission			
			Mesh mode: multiple devices with mul- tiple de- vices	2 chan- nels				
5.1 / 5.2 / 5.3 / 5.4	Blue- tooth Low energy	0.01-100	see ver- sion 4	see ver- sion 4	– Bluetooth Low Energy – Higher data rate – Radio direc- tion finding from 5.1 – Smart home with nume- rous sen- sors – Latency less than 6 ms – No voice transmission	1 Mbit/s	10-100	≥ 3
						2 Mbit/s	10-100	
						0.5 Mbit/s	40-400	
						0.125 Mbit/s	20-200	



BLE Audio (5.2)	Bluetooth Low Energy		Device-to-device Broadcast mode		Highly compressed audio transmissions with LC3 codec  Better sound quality with less battery consumption  Multiple devices can receive audio simultaneously	Approx. 345 Kbit/s		≥ 3
6 / 6.1	Bluetooth Low energy	0.01-100	see version 4		More accurate distance measurement [3]	2 Mbit/s		≥ 3
6.2		0.01-100	see version 4		Reduced latency (375 μs [3])	2 Mbit/s		≥ 3

Table 1 Overview of Bluetooth versions

Bluetooth devices are classified into four categories (1, 1.5, 2 and 3) based on their maximum transmission power (Table 2) [3]. The radiation from Class 2 and 3 Bluetooth devices is low and locally limited. Class 1 Bluetooth transmitters, the most powerful, can cause radiation exposure similar to that of mobile phones if used in close proximity to the body. Bluetooth class 1.5 refers to low-power Bluetooth. Classes are not usually indicated on devices, so consumers have no information to help them choose low-radiation devices.



Maximum transmission power (mW)	Classes	Classes
	Low-energy Bluetooth	Bluetooth classic
100	1	1
10	1.5	-
2.5	2	2
1	3	3

Table 2 Bluetooth transmitter classes

## 2 Limit values

### 2.1 High-frequency electromagnetic radiation

The International Commission on Non-Ionising Radiation Protection (ICNIRP) assesses the effects of electromagnetic fields on health. It issues recommendations on limit values [4], which in turn serve as the basis for the limit values in the EU Council Recommendation [5]. The European limit values define the basic requirements that electrical products must meet in Europe and Switzerland in order to be considered safe in terms of electromagnetic fields.

These limit values are based on scientifically proven acute effects in humans when fields exceed a certain intensity. The limit values for the general population are 50 times lower than the value at which acute effects occur.

There are two categories of limit values: basic restrictions and reference levels derived from them. Depending on the frequency range, they have different values or represent different physical quantities.

Bluetooth devices generate high-frequency electromagnetic radiation. The human body can absorb this radiation and heat up. The limit values restrict this heating in order to avoid any health risks.

The basic restrictions for frequencies up to 10 GHz are the specific absorption rates (SAR values). These are decisive for Bluetooth devices that transmit at 2.4 GHz. SAR values indicate the amount of electromagnetic radiation (expressed as radiation power in watts) absorbed by a given mass of the human body (kg). The limit value for the torso and head is the most stringent and is 2 W/kg, averaged over a body volume of 10 grams. This means that in the most heavily irradiated body volume of 10 grams, the SAR must not exceed 0.02 W/kg. SAR values are best used to evaluate devices that people typically use on the surface of the body or in close proximity to the body.

SAR values can only be determined with great effort. This requires

- measurements in a phantom. Phantoms are models of the irradiated parts of the body. They are filled with a liquid that corresponds as closely as possible to the electrical properties of the human body. Phantoms can either reproduce the geometry of a body part or have a simplified shape. In order to determine the maximum SAR, a robotic measuring antenna measures the volume of liquid in three dimensions and determines the most irradiated location. The measurement results depend heavily on the distance between the transmitting device and the phantom during the



measurement. The respective measurement distances are defined in the measurement standards.

- or a computer model that reproduces as accurately as possible, in three dimensions, the tissues and organs of the human body and their electrical properties. A computer simulation superimposes a three-dimensional measurement of the radiation around a transmitting device onto the virtual electrical model of the body. Using these two spatial pieces of information, the computer simulation then calculates the SAR values in the virtual body.

Reference levels are much easier to verify. They are derived mathematically from the basic restrictions. If they are complied with, the basic restrictions are also complied with. However, reference levels are only applicable to persons exposed to homogeneous radiation and are therefore particularly suitable for situations in which a radiation-emitting device is located at a certain distance from a person. They refer to electric fields in the high-frequency range and are expressed in volts per metre (V/m). At 2.4 GHz, the limit value is 61 V/m.

## 2.2 Long-term effects

Potential long-term effects are not taken into account in these limit value recommendations. The reason for this is that the ICNIRP considers that scientific knowledge on the harmful effects of long-term exposure to electromagnetic fields is insufficient.

# 3 Exposure

## 3.1 Bluetooth classic

A study conducted on behalf of the FOPH [6, 7] measured the SAR values and electric fields of the following applications:

- two different Class 1 and Class 2 USB Bluetooth antennas at maximum data rate and maximum transmission power
- two class 3 hands-free devices (SAR value only)

### 3.1.1 SAR values

SAR values were measured at different locations on a mannequin. The measured SAR values are all below the limit of 2 W/kg (Table 2).

Application	Class	SAR (W/kg)
Plug-in antenna (USB)	1	0.466
Plug-in antenna (USB)	2	0.0092
Hands-free devices	3	0.00117 - 0.00319

Table 3 For each standard, the maximum SAR value measured and the data rate used are indicated.



SAR values were measured in a body phantom [6].

### 3.1.2 Electric fields

The electric field near USB Bluetooth antennas operating at maximum transmission power is shown in Figure 1. The field decreases rapidly with distance from the device. The field strengths measured for Bluetooth devices at a distance of 20 cm are at least 20 times lower than the limit value of 61 V/m [5]. The electric field decreases very rapidly with increasing distance. The measurements were taken at maximum transmission power [6, 7].

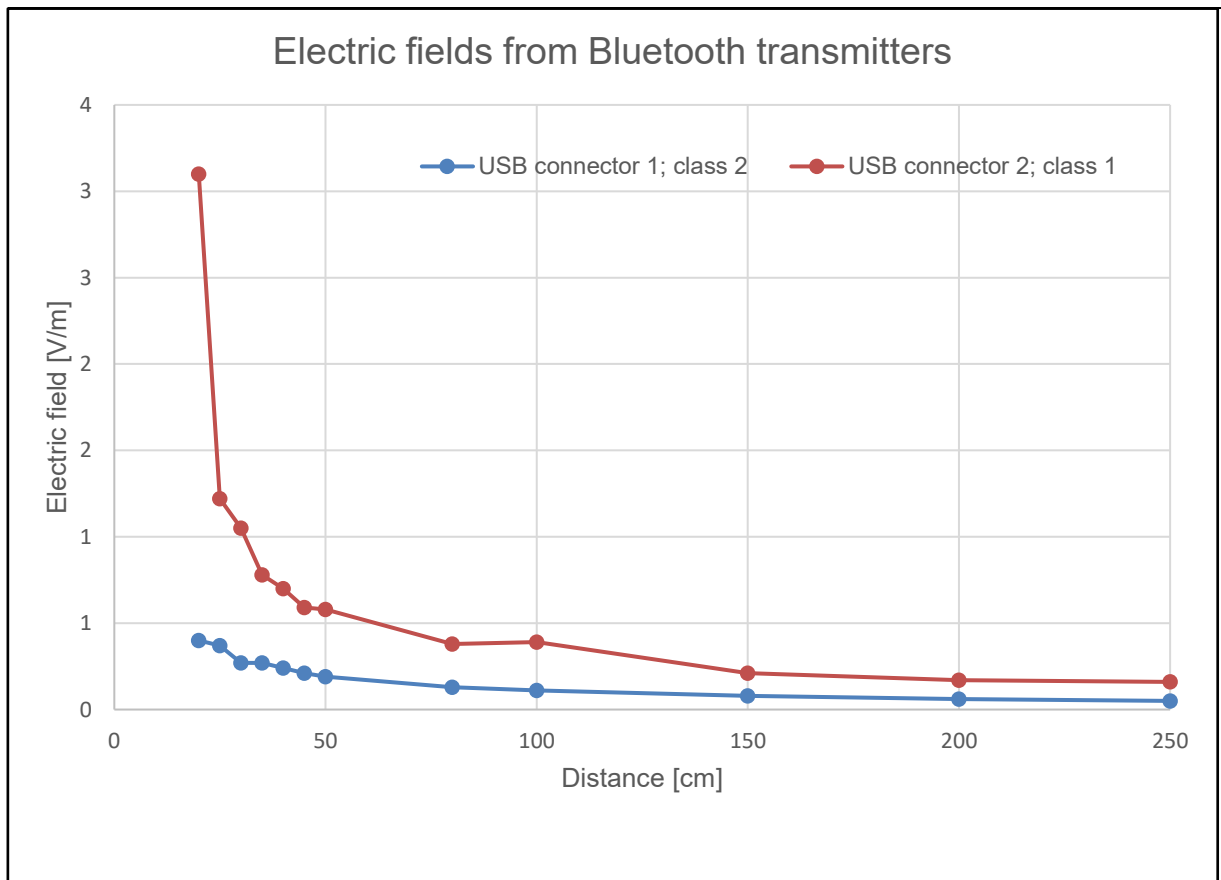


Figure1 : maximum electric field (E field) as a function of distance for two USB Bluetooth antennas of different classes.

### 3.1.3 Low-frequency fields

As a Bluetooth device only consumes electricity during transmission and reception, the battery is constantly being switched on and off. This results in low-frequency magnetic fields. There is no data available on the intensity and characteristics of these fields.



## 3.2 Bluetooth Low-energy

There is no overview of the SAR values of Bluetooth Low Energy (BLE) devices that manufacturers have assessed in accordance with the EU recommendation on limit values. When manufacturers specify SAR values in their operating instructions, it is not possible for devices that can transmit simultaneously using multiple radio technologies to clearly assign the specified SAR value to a single technology.

## 3.3 Bluetooth headsets

The US telecommunications authority, the Federal Communications Commission (FCC), has published test reports on the SAR values of Bluetooth headsets, which manufacturers have had to evaluate against US limit values. Although this information does not relate to the European market, it does provide an estimate of the order of magnitude of radiation from Bluetooth headsets.

The US limit values for SAR are stricter, as the limit value is 1.6 W/kg and, unlike in the EU and Switzerland, the tissue mass to be assessed is only 1 g instead of 10 g. In addition, for devices that transmit simultaneously with multiple radio technologies, the SAR value of BLE is clearly indicated in the test reports. The documents submitted to the FCC also indicate the maximum transmission power. Based on a selection of 35 Bluetooth headsets that people can wear either on their head or in their ear, the following conclusions can be drawn:

- The measurements were taken at a distance of 0 cm from the phantom.
- The maximum transmission power is often less than or equal to 10 mW. Bluetooth classic headsets belong to class 1, BLE headsets to class 1.5.
- On average, the maximum SAR of headsets transmitting at full power with Bluetooth classic or BLE is less than a quarter of the US limit, with no headset exceeding this limit.

## 4 Health effects

According to current knowledge, the high-frequency radiation generated by Bluetooth devices is too weak to increase body temperature through absorption to the point of having detectable acute effects on health.

In 2011, the International Agency for Research on Cancer (IARC) classified high-frequency electromagnetic fields as possibly carcinogenic (Group 2B) [9]. However, this classification is based solely on studies that establish a possible link between the use of mobile or wireless phones and the development of brain tumours. The IARC considers the available data to be limited, as these studies on brain tumours and mobile and wireless telephony have shortcomings in terms of design and estimation of exposure duration. No link between exposure to mobile and wireless telephones and other diseases or symptoms has been established. Furthermore, the IARC has also been unable to establish a link between health effects and high-frequency radiation emitted by other devices such as Bluetooth. There is no cause for concern about short-term health effects, as current exposure limits prevent acute damage.

Various studies on electromagnetic radiation from Bluetooth transmitters have shown no effects on the inner ear in animal tests and have had no influence on basic hearing function. In studies conducted on



humans, auditory nerve activity was also not significantly altered by Bluetooth radiation [10, 11].

## 5 Legal regulations

Bluetooth devices are subject to the Swiss Ordinance on Telecommunications Installations (FAV) [12]. The FAV defines the basic requirements for the protection of the health and safety of persons who use telecommunications installations or are exposed to their radiation. These requirements are specified in Swiss and European standards.

The criteria for compliance with the requirements correspond to the EU recommendations for limit values [5]. The manufacturer is responsible for ensuring that their device complies with the criteria set out in the standards. In Switzerland, no authority checks whether Bluetooth devices comply with these limit values [13].

## 6 Bibliography

1. Nikoukar, Ali; Raza, S.; Poole, A.; Güneş, M.; Dezfouli, B. (2018). Low-Power Wireless for the Internet of Things: Standards and Applications. IEEE Access, Volume 6, 67893–67926. DOI: 10.1109/ACCESS.2018.2879189
2. Bluetooth SIG. (2025, 3 November). Bluetooth Core Specification: Version 6.2. <https://www.bluetooth.com/specifications/specs/core-specification-6-2/>
3. Bluetooth SIG. (2024). Bluetooth® Core Specification: Volume 0 – Consolidated Table of Contents, Acknowledgments, & Core Configurations <https://www.bluetooth.com/wp-content/uploads/Files/Specification/HTML/Core-60/out/en/consolidated-table-of-contents,-acknowledgments,---core-configurations.html>
4. ICNIRP. Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz). Health Phys. 1998;494-521.
5. 1999/519/EC: Council Recommendation of 12 July 1999 on the limitation of exposure of the general public to electromagnetic fields (0 Hz to 300 GHz) (OJ L 199, 30.07.1999, p. 59, ELI: <http://data.europa.eu/eli/reco/1999/519/oj>).
6. Kramer A. et al. Development of procedures for assessing human exposure to EMF from wireless devices in domestic and professional environments. IT'IS 2005.
7. Kühn S et al. Development of procedures for assessing exposure to EMF from wireless devices in domestic and occupational environments. Supplement 1: Body-worn wireless data communication devices and base stations. IT'IS 2006.
8. [FCC ID Search | Federal Communications Commission](#) or [programmable search engine](#)
9. IARC Monographs on the Evaluation of Carcinogenic Risks to Humans, Volume 102, 2012, Non-ionising radiation, Part 2: Radiofrequency electromagnetic fields.
10. Yildirim G et al. Effects of electromagnetic fields generated by Bluetooth on hearing (2013) Journal of International Advanced Otology, 9 (1), pp 61-70.
11. Mandalà M. et al., Effects of Bluetooth and mobile phone electromagnetic fields on the human auditory nerve (2014) Laryngoscope, 124 (1), pp. 255-259.
12. Ordinance of 14 June 2015 on telecommunications installations FAV SR 784.101.113
13. [23.4244 | Les ondes des téléphones portables dépassent les valeurs autorisées. Vérifier enfin le](#)



Schweizerische Eidgenossenschaft  
Confédération suisse  
Confederazione Svizzera  
Confederaziun svizra

Federal Department of Home Affairs FDHA  
**Federal Office of Public Health FOPH**

[respect des valeurs limites RNI en Suisse également | Business | The Swiss Parliament](#)

## Contact

Federal Office of Public Health FOPH

[str@bag.admin.ch](mailto:str@bag.admin.ch)