

Electromagnetic Compatibility (EMC) of Active Cardiac Devices

Pacemakers, ICDs, CRT Devices, and Cardiac Monitors

Electrical devices and processes generate electromagnetic fields. The varied use of modern technology makes them unavoidable in our working life, everyday life, and in medicine.

Electromagnetic fields can affect the functioning of active cardiac devices, which consists of sensing the heart rhythm and the associated heart stimulation. BIOTRONIK's active cardiac devices are tested and approved for electromagnetic compatibility in accordance with ISO 14117 and 14708-1/2/6. They are immune to interference from electrical devices, which in turn, comply with international guidelines for limiting exposure to electromagnetic fields.

In the vicinity of electrical devices and depending on the strength of the electromagnetic field, a temporary effect on the implanted device cannot be ruled out. However, there is no need to worry about permanent damage to the implanted device. It will be fully functional again as soon as the distance from the source of interference increases or the source is turned off.

Please discuss with your physician the procedures or devices that you should avoid or restrict owing to your condition, how to identify any effects on your implanted device, and what to do in such cases. Your implanted device may be showing the following signs of electromagnetic interference:

- The pacemaker/CRT-P device cannot emit a pacing pulse or unnecessarily speeds up the heart rhythm.
- Strong magnetic fields can prevent the ICD/CRT-D device from delivering therapy or generate unwanted defibrillation shocks due to interference signals.

- The ICD/CRT-D device cannot emit a pacing pulse or unnecessarily speeds up the heart rhythm.
- The cardiac monitor is affected when recording the data and might record external signals that may result in misinterpretation of the recorded data.

Before any medical treatment, please inform your physician that you have an active cardiac device, so that appropriate precautions can be taken. Please consult the warnings provided by electrical device manufacturers for any restrictions applying to users with active cardiac devices. Use only technically intact devices and only have them serviced and repaired by technicians.

This guide is designed to help you determine the electromagnetic compatibility (EMC); i.e., to assess electrical devices and procedures with regard to their potential to interfere with your implanted device. The devices and procedures listed on the following pages have been classified into different categories with regard to their interference potential. This categorization is based on the interference resistance of active cardiac devices as specified in technical standards. The information provided is taken from standards and/or reflects empirical technical values for the electrical devices and implanted devices. Given the diversity of electrical devices and their interference potential, this list is only intended as a reference and does not claim to be complete.

Household appliances

| Interference with the implanted device unlikely | Interference with the implanted device unlikely at the specified distance | Interference with the implanted device is possible - Contraindication |
|---|---|---|
| Battery charger | About 6 in. (15 cm) | |
| Can opener | Household magnet | |
| Coffee machine | Necklace with magnetic closure | |
| Dishwasher | Wireless heating base station | |
| Dryer | | |
| Electric blanket, heating pad | About 12 in. (30 cm) | |
| Electric kettle | Induction cooktop | |
| Electric shaver | | |
| Electric toothbrush, ultrasonic toothbrush | | |
| Emergency button, patient alarm | | |
| Foot warmer | | |
| Hairdryer | | |
| Iron | | |
| Microwave | | |
| Mixer | | |
| Refrigerator | | |
| Robotic lawn mower | | |
| Robotic vacuum cleaner | | |
| Smart meter (electricity, heating) | | |
| Toaster | | |
| Toothbrush charging unit | | |
| Vacuum cleaner | | |
| Washing machine | | |

Telecommunications/office/multimedia

| Interference with the implanted device unlikely | Interference with the implanted device unlikely at the specified distance | Interference with the implanted device is possible - Contraindication |
|--|---|---|
| Bluetooth | Ham radio ¹ | |
| CD, DVD, VCR players, radio | | |
| Communication/carrier frequency system | About 6 in. (15 cm) | |
| Computer | CB radio handset (max. 3 W) | |
| Copy machine | Cordless landline telephone | |
| dLAN, PLC, PowerLAN (Powerline Communication) | Game console, Wii, PlayStation | |
| e-reader | Hearing aid streamer | |
| Electronic surveillance/ankle tag | Mobile phone / smartphone | |
| Fax machine | Modem | |
| Inductive hearing loop, induction loop system | Multimedia player, mp3 player, iPod | |
| Inductive smartphone charging station | Router | |
| Navigation system/GPS | Stereo speaker | |
| NFC (near-field communication) | Tablet, iPad | |
| Printer | Walkie-talkie | |
| Video games | Wireless remote control (model-making) | |
| VR headset | WLAN (5.1-5.7 GHz) | |
| Wireless headphones, headset | | |
| Wireless remote control | About 16 in. (40 cm) | |
| WLAN (2.4 GHz) | CB radio mobile car station (max. 10 W) | |
| | TETRA radio | |
| | About 24 in. (60cm) | |
| | Satellite dish | |

¹ According to approval standard, the following distances from transmitting antennas are recommended for ham radio:

- <3 W = About 6 in. (15 cm)
- 3 – 15 W = About 1 ft. (30 cm)
- 15 – 30 W = About 2 ft. (60 cm)
- 30 – 50 W = About 3 ft. (1 m)
- 50 – 125 W = About 7 ft. (2 m)
- 125 – 250 W = About 10 ft. (3 m)
- 250 – 500 W = About 16 ft. (5 m)
- 500 – 1000 W = About 20 ft. (6 m)
- 1000 – 2000 W = About 30 ft. (9 m)

Hobby/sports/travel

| Interference with the implanted device unlikely | Interference with the implanted device unlikely at the specified distance | Interference with the implanted device is possible - Contraindication |
|---|---|---|
| Fitness wristband | PowerPlate* | Go-Kart |
| Full-body scanner | About 6 in. (15 cm) | Mobile metal detector |
| Heart rate monitor, smart watch | IPL ¹ hair removal system | |
| Infrared heating cabin | About 12 in. (30 cm) | |
| Sauna, tanning bed | Anti-theft devices | |
| Stationary metal detector | Electric bicycle (motor) | |
| Tattooing | Segway (motor) | |
| V-pay | Ski pass scanner | |
| | About 2 ft. (60 cm) | |
| | Ergometer (magnetic brake) | |
| | Golf caddy (motor) | |
| | Treadmill (motor) | |
| | About 16 ft. (5 m) | |
| | Maritime radar | |

Tools/motors/electronics

| Interference with the implanted device unlikely | Interference with the implanted device unlikely at the specified distance | Interference with the implanted device is possible - Contraindication |
|---|--|---|
| Battery-operated, cordless power tools | About 6 in. (15 cm) | Arc welding |
| Electric car | Corded power tools | Electric fence |
| Keyless entry system (car) | Fan heater | High-voltage test station |
| Low-voltage power line (220 V) | About 12 in. (30 cm) | Phase tester, single-pole |
| Phase tester, double-pole | Gasoline-powered tools (chain saw, leaf blower, snow blower, string trimmer) | |
| | Power wheelchair (motor) | |
| | Running car engine | |
| | About 2 ft. (60 cm) | |
| | Car battery charger | |
| | Forklift truck | |
| | Generator | |
| | Lawn mower | |
| | About 10 ft. (3 m) | |
| | Photovoltaic system transformer | |
| | About 20 ft. (6 m) | |
| | High-voltage power line (110/220 kV) | |
| | About 32 ft. (10 m) | |
| | High-voltage power line (380 kV) | |

1 IPL: Intense Pulsed Light

* Approval required by the physician due to physical stress and possible rate adaptation of the implanted device

Medical procedures²

| Interference with the implanted device unlikely | Interference with the implanted device unlikely at the specified distance | Interference with the implanted device is possible - Contraindication |
|---|---|---|
| Bone density measurement | MRI (magnetic resonance imaging) ³ | Bioresonance therapy |
| Capsule endoscopy | | Current-inducing methods such as: |
| Diagnostic ultrasound | About 6 in. (15 cm) | <ul style="list-style-type: none"> ▪ Andullation therapy ▪ BIA (Bioelectrical Impedance Analysis)⁰² ▪ Body fat measurement ▪ Diathermy, HF heat therapy ▪ Electrocautery ▪ Electrolysis ▪ Electroshock therapy ▪ HF/RF/Ultrasonic ablation ▪ Interferential current therapy ▪ Iontophoresis ▪ Mesotherapy/Microneedling ▪ Neurostimulation ▪ Transcutaneous electrical nerve stimulation (TENS) |
| Diagnostic X-ray, e.g.: <ul style="list-style-type: none"> ▪ CT (computed tomography) ▪ Mammography ▪ PET (positron emission tomography) | Cardioversion/external defibrillation | |
| | CPAP mask (sleep apnea therapy) | |
| | Dental treatment | |
| | Glucose monitor | |
| ECG/EMG | Hearing aid streamer | |
| Hearing aid/cochlear implant | Insulin pump | |
| Heart rate monitor | Ultrasonic dental cleaning | |
| Laser treatment (eyes/skin) | | |
| Magnetic mat | | |
| Massage mat, massage chair | | |
| | | Lithotripsy/shock wave therapy |
| | | Magnetic catheter navigation/Stereotaxis |
| | | Magnetic field therapy |
| | | Radiation therapy |
| | | Therapeutic ultrasound |

² In the case of contraindicated procedures that need to be performed on patients with an implanted device, a careful risk-benefit analysis must be done by the physicians involved. In order to avoid permanent damage to the implanted device, precautions must be taken. They need to be discussed with the responsible BIOTRONIK technical service department.

³ ProMRI devices from BIOTRONIK are fully or partly MRI-compatible: www.promricheck.com