

# 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.



Interference with the implanted device unlikely	Interference with the implanted device unlikely at the specified distance	Interference with the implanted device is possible – Contraindication
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**Household Appliances/Everyday Life**

Battery charger (household battery)	<b>15 cm</b>	
Can opener	Household magnet	
Coffee machine	Necklace with magnetic closure	
Dishwasher	Wireless heating base station	
Dryer		
Electric blanket, heating pad	<b>30 cm</b>	
Electric kettle	Induction cooktop	
Electric shaver		
Electric toothbrush, ultrasonic toothbrush		
Emergency button, patient alarm		
Foot warmer		
Hairdryer		
Iron		
Magnetic mats/boards/foils (for table or wall)		
Microwave		
Mixer		
Refrigerator		
Robotic lawn mower		
Smart meter (electricity, heating)		
Toaster		
Toothbrush charging unit		
Vacuum cleaner, robotic vacuum cleaner		
Washing machine		

Interference with the implanted device unlikely

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**Telecommunications/Office/Multimedia**

Bluetooth	Ham radio <sup>1</sup>	
CD, DVD, VCR players, radio		
Computer	<b>15 cm</b>	
Copy machine	CB radio handset (max. 3 W)	
dLAN, PLC, PowerLAN	Cordless landline telephone	
(Powerline Communication)	Game console, Wii, PlayStation	
e-reader	Hearing aid streamer	
Electronic 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 router (5.1-5.7 GHz)	
Wireless headphones, headset	<b>40 cm</b>	
Wireless remote control	CB radio mobile car station (max. 10 W)	
WLAN router (2.4 GHz)	TETRA radio	
	<b>60 cm</b>	
	Satellite dish	

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

<3 W = 15 cm  
 3–15 W = 30 cm  
 15–30 W = 60 cm  
 30–50 W = 1 m  
 50–125 W = 2 m  
 125–250 W = 3 m  
 250–500 W = 5 m  
 500–1000 W = 6 m  
 1000–2000 W = 9 m

Interference with the implanted device unlikely

Interference with the implanted device unlikely at the specified distance

Interference with the implanted device is possible – Contraindication

### Hobby/Sport/Travel

Fitness wristband	PowerPlate*	Go-Kart
Full-body scanner		Mobile metal detector
Heart rate monitor, smartwatch	<b>15 cm</b>	
Infrared heating cabin	IPL <sup>1</sup> hair removal system	
Sauna, tanning bed		
Stationary metal detector	<b>30 cm</b>	
Tattooing	Anti-theft devices	
V-pay	Electric bicycle (motor)	
	Segway (motor)	
	Ski pass scanner	
	<b>60 cm</b>	
	Ergometer (magnetic brake)	
	Golf caddy (motor)	
	Treadmill (motor)	
	<b>5 m</b>	
	Maritime radar	

### Tools/Motors/Electronics

Battery-operated, cordless power tools	<b>15 cm</b>	Arc welding
	Corded power tools	Electric fence
Electric car (driving)	Fan heater	High-voltage test station
Keyless entry system (car)		Phase tester, single-pole
Low-voltage power line (220 V)	<b>30 cm</b>	
Phase tester, double-pole	Gasoline-powered tools (chain saw, leaf blower, snow blower, string trimmer)	
	Power wheelchair (motor)	
	Running car motor	
	<b>60 cm</b>	
	Car battery charger (incl. fast charging station)	
	Forklift truck	
	Generator	
	Lawn mower	
	Photovoltaic system transformer	
	<b>6 m</b>	
	High-voltage power line (110/220 kV)	
	<b>10 m</b>	
	High-voltage power line (380 kV)	

<sup>1</sup> IPL - Intense Pulsed Light

\* Physician's approval needed because of physical stress and possible rate adaptation of the implanted device

Interference with the implanted device unlikely

Interference with the implanted device unlikely at the specified distance

Interference with the implanted device is possible – Contraindication

### Medical Procedures<sup>2</sup>

Bone density measurement	MRI (magnetic resonance imaging) <sup>3</sup>	Bioresonance therapy
Capsule endoscopy		Current-inducing procedures, e.g.:
Diagnostic ultrasound	<b>15 cm</b>	<ul style="list-style-type: none"> <li>• Andullation therapy</li> </ul>
Diagnostic X-ray, e.g.:	Cardioversion/external defibrillation	<ul style="list-style-type: none"> <li>• BIA (bioelectrical impedance analysis)</li> </ul>
<ul style="list-style-type: none"> <li>• CT (computed tomography)</li> </ul>	CPAP mask (sleep apnea therapy)	<ul style="list-style-type: none"> <li>• Body fat measurement</li> </ul>
<ul style="list-style-type: none"> <li>• Mammography</li> </ul>	Dental treatment	<ul style="list-style-type: none"> <li>• Diathermy, HF heat therapy</li> </ul>
<ul style="list-style-type: none"> <li>• PET (positron emission tomography)</li> </ul>	Glucose monitor	<ul style="list-style-type: none"> <li>• Electrocautery</li> </ul>
ECG/EMG (electromyography)	Hearing aid streamer	<ul style="list-style-type: none"> <li>• Electrolysis</li> </ul>
Hearing aid/cochlear implant	Insulin pump	<ul style="list-style-type: none"> <li>• Electroshock therapy</li> </ul>
Heart rate monitor	Ultrasonic dental cleaning	<ul style="list-style-type: none"> <li>• HF/RF/Ultrasonic ablation</li> </ul>
Laser treatment (eyes/skin)		<ul style="list-style-type: none"> <li>• Interferential current therapy</li> </ul>
Magnetic mat		<ul style="list-style-type: none"> <li>• Iontophoresis</li> </ul>
Massage mat, massage chair		<ul style="list-style-type: none"> <li>• Mesotherapy/Microneedling</li> </ul>
		<ul style="list-style-type: none"> <li>• Neurostimulation</li> </ul>
		<ul style="list-style-type: none"> <li>• Transcutaneous electrical nerve stimulation (TENS)</li> </ul>
		Lithotripsy/shock wave therapy
		Magnetic catheter navigation/Stereotaxis
		Magnetic field therapy (incl. pulsed magnetic field therapy mats)
		Radiation therapy
		Therapeutic ultrasound

<sup>2</sup> 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.

<sup>3</sup> Patients with an implanted BIOTRONIK ProMRI device system can undergo an MRI scan under certain conditions. To confirm that you can undergo an MRI scan under certain conditions, please contact your cardiologist or radiologist, or the clinic where you received your implanted device. These contact persons can answer your questions based on your complete medical history and the MRI scan requirements. Please note that the MRI scan requirements for patients with pacemakers or defibrillators depend on the combination of the implanted device and the lead(s): [www.promricheck.com](http://www.promricheck.com)

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