

Medtronic Electromagnetic Compatibility Table

For Pacemakers and Defibrillators (ICD)

Terms of Use:

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←————→ **Hobbies** ←————→

Item	Low Risk when following Safety Precautions	Potential Pacemaker Reversion or Magnet Rate	Potential Pacemaker Inhibition	Potential ICD Shock	Potential disable of ICD detection circuit	Safety Precautions Be sure all items are in good working order and properly grounded, if necessary.
Amusement Parks (roller coasters & other similar rides)						Call physician to advise on risk. Concerned with lead dislodgement. Roller coasters can impart high vertical accelerations anywhere from 3.5 - 5 times the earth's gravitational force. (Other rides may have similar high vertical accelerations)
Bingo Wand	✓	✓			✓	Some bingo wands may contain a permanent magnet. Maintain a 6" (15cm) distance between the wand and the implanted device. If the wand is closer than 6" (15 cm), there is the potential for Pacemaker magnet rate operation or disabling of ICD detection circuit.
Casino Slot Machines	✓					Low risk of affecting Pacemaker or ICD.
Electric Guitars and Speakers	✓	✓			✓	Magnetic/electrical fields associated with the guitar are very low and will not affect the Pacemaker or ICD. Guitar speakers: Large speakers often have large magnets near the rear of the speaker cabinet. Maintain a 6" (15cm) distance between the back of the speaker cabinet and the implanted device. If the device is closer than 6" (15cm), there is the potential for Pacemaker magnet rate operation, and disabling of ICD detection circuit.
Electric Toy Trains	✓	✓		✓		Maintain a 6"(15cm) distance between the transformer and the implanted device. Do not touch power rail especially with wet hands. If the device is closer than 6" (15cm) from the transformer or if the rails are touched, there is the potential for Pacemaker reversion or ICD shock.
Electric Golf Cart	✓	✓			✓	Maintain a 6" (15cm) distance between the battery and the implanted device. If the device is closer than 6" (15cm), there is the potential for Pacemaker magnet rate operation or disabling of ICD detection circuit.

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Hydroelectric Dam (Hoover Dam)		✓		✓		The policy of the Hoover Dam does not recommend that individuals with an ICD go on tour within the dam because of the 60 Hz magnetic field present. Other Hydroelectric dams may have policies for ICD individuals that differ from those of the Hoover Dam. Because of the uncertainty of the magnetic environment within other Hydroelectric plants, we cannot predict the intensity of the magnetic field within any specific dam. There is the potential for Pacemaker reversion or ICD shock. Consult physician for level of risk that reversion may present. Tours of non hydroelectric dams would pose a low risk of affecting the Pacemaker or ICD.
Laser Tag	✓	✓		✓	✓	Low risk of laser tag gun and associated detection circuit in the vest affecting the Pacemaker or ICD. The device uses only light energy; however, some vests may contain magnets and/or a radio frequency transmitter that communicates to a scoreboard. Maintain a 6" (15cm) distance between any magnet in the vest and the implanted device. If closer than 6" (15cm) from a magnet, there is the potential for Pacemaker magnet rate operation or disabling of ICD detection circuit. If closer than 6" (15 cm) distance between the antenna portion of the transmitter and the Pacemaker or ICD, there is the potential for Pacemaker reversion or ICD shock. An infrared transmitter will not affect the implanted device.
Metal Detector (Beach comber metal detector)	✓	✓	✓	✓		Keep the metal detector device head pointed away and a 24 " (60 cm) distance from the implanted device. If the device is closer than 24" (60 cm), there is the potential for Pacemaker reversion or inhibition and for ICD shock.
Pottery/ Jewelry or Glass Kiln (AC resistive heating element)	✓					Low risk of affecting Pacemaker or ICD. Most of these kilns use resistive type heaters similar to heating elements associated with common electric stoves. Wood or gas fired kilns will have no affect on the Pacemaker or ICD. ICD. The magnetic field associated with the operation of this type of kiln is minimal. In contrast, kilns used in association with inductive heating of metals produce magnetic fields that can extend a much greater distance from the kiln. (Also see Induction Heater/Kiln under Home tab)
Radio Controlled Model Cars, Airplanes, Boats, etc.	✓	✓	✓	✓		Keep the antenna pointed away and a 6" (15cm) distance from an individual with an implanted device. If closer than 6" (15cm), there is the potential for Pacemaker reversion or inhibition or for ICD shock.

Electromagnetic Compatibility (EMC) Chart for Medtronic Pacemakers and Defibrillators (ICD)

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Rifle/Shot Guns	✓					While there is no electromagnetic compatibility issues, it is recommended that individuals consult with their physician for advice and limitations based on their medical condition. Possible use of the gun on opposite side where implanted device is located can be discussed. If used on the same side as implanted device there is a risk of damage to the skin over the Pacemaker or ICD, which could result in erosion of the device out of the pocket and possible infection. There may be a risk of lead dislodgement especially in association with the higher powered guns.
Scuba Diving - (Pressure concern only)						Because your physician has personal knowledge of your particular medical situation, we recommend that activities like scuba diving be discussed directly with your physician. It is possible that your physician may suggest that you limit certain activities, such as scuba diving, to a level that is more restrictive based on medical concerns rather than the single factor of pressure tolerance of your pacemaker/ICD. Because of many factors associated with scuba diving, specific depth limitations cannot be provided. Some of the factors include the possibilities of blows to the area of the device during the time the device is under pressure stress, the number of pressure cycles the device is exposed to over the implant time of the device, and the activity or exertional level of the individual during the dives. Our device pressure testing is conducted for compatibility with hyperbaric chamber therapy. We can share with you that a pressure of two and one-half atmospheres absolute is the maximum pressure recommended for hyperbaric chamber therapy.
Static Electricity Plasma Ball (Van de Graaff generator)	✓	✓	✓	✓		Also known as Van de Graaff generator - Maintain a 6" (15cm) distance between the ball and the implanted device. Do not touch the ball. If the device is closer than 6" (15cm), there is the potential for Pacemaker reversion or inhibition and for ICD shock.
Tattoo Machine	✓	✓		✓		Low risk of interference due to low current associated with the tattoo machine motor. Maintain a 6" (15cm) distance between the tattoo machine and the implanted device. If closer than 6" (15 cm), there is the potential for Pacemaker reversion or ICD shock.

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Ab-Stimulator®			✓	✓		Not recommended. The electrical stimuli generated from this device can be detected by Pacemaker and ICD at rates that could cause Pacemaker inhibition or ICD shock. Most manufacturers have disclaimers in their product literature excluding the use of this product for individuals with a Pacemaker or ICD.
Badge (Security) with externally activated electronic circuit	✓	✓		✓		There are no continually active electronics within the badge. The micro circuit within the badge receives activating energy from the wall unit. The wall unit emits a low intensity radio frequency field. Maintain a 6" (15 cm) distance from wall unit. If the device is closer than 6" (15cm), there is the potential for Pacemaker reversion or ICD shock.
Badge (name tag) with magnetic clasp	✓	✓			✓	Maintain a 6" (15cm) distance between the magnet associated with the badge and the implanted device. If the magnet is closer than 6" (15 cm), there is the potential for Pacemaker magnet rate operation or disabling of ICD detection circuit.
Body Fat Scale (Electronic)		✓	✓	✓		Not recommended. The percentage of body fat is estimated by passing electrical current through the body. Most manufacturers have disclaimers in their product literature excluding the use of this product for individuals with a Pacemaker or ICD.
Cars - Hybrid	✓					Low risk when using this vehicle under normal circumstances. Testing indicated there was no inappropriate interactions between Medtronic heart devices and current hybrid vehicles when both servicing and/or riding in the vehicle.
Electric Blanket	✓					Low risk of affecting Pacemaker or ICD.

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Electric Fences	✓		✓			2 types: Line power and battery power electric fences are energized for a very short period about once a second. Both low risk to use. A momentary electrical shock received from accidentally touching the fence would not cause any permanent damage to Pacemaker or ICD. There is the potential for Pacemaker inhibition or inhibition for the Pacemaker portion of the ICD. A memorable momentary shock may cause some of the parameters of the Pacemaker or ICD to be reset to nominal values, but nothing that the physician cannot restore in the office.
Electric Toothbrush	✓	✓	✓	✓		Maintain a 6" (15cm) distance between the charging base and the implanted device as radio frequency fields may be present. Refrain from leaning over charger. If the device is closer than 6" (15cm), there is the potential for Pacemaker reversion or inhibition and for ICD shock.
Electric grocery cart or personal scooters	✓	✓			✓	Maintain a 6" (15 cm) distance between the battery and the implanted device. If the device is closer than 6" (15cm), there is the potential for Pacemaker reversion or magnet rate operation and for disabling of ICD detection circuit for ICD.
Electric outlet shocks or shocks from any 60 Hertz source (momentary shocks or memorable momentary shocks)	✓	✓	✓	✓		A momentary shock from an electrical outlet (110 / 220 volts) or higher voltages if in a commercial or industrial setting will cause Pacemaker inhibition or inhibition of the Pacemaker portion of the ICD. A memorable momentary shock may cause some of the parameters of the Pacemaker or ICD to be reset to nominal values. If any parameter changes occur the physician can restore the original parameters in the office. Permanent damage to the Pacemaker or ICD is unlikely to occur unless the shock is very severe. Prolonged external shocks (greater than 8 seconds) can cause inhibition in the Pacemaker portion of the ICD and/or a shock therapy. Prolonged external shocks greater than 2 seconds can cause reversion in the Pacemaker. As with momentary shocks, there is a low risk of permanent damage to the Pacemaker or ICD from prolonged shocks associated with a 110 / 220 volt source.
Hair Dryer - Hand held	✓	✓		✓		Maintain a 6" (15cm) distance between the hair dryer and the implanted device. If the device is closer than 6" (15cm), there is the potential for Pacemaker reversion or ICD shock.
Hair Dryer - Salon	✓					Low risk of affecting Pacemaker or ICD.

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Heart Rate Monitor (Polar® and other heart rate monitors that use a chest band)	✓					Low risk of affecting Pacemaker or ICD. Chest band transmits low level magnetic pulses to computer usually on wrist. Impulse sent when heart contracts and Pacemaker/ICD is in refractory. Heart rate monitors may provide inaccurate information or a blank monitor screen when the Pacemaker or Pacemaker portion of the ICD is delivering electrical stimuli to the heart. These stimuli may be misinterpreted as heart contractions or classified as noise by the heart rate monitor causing the readout to be in error. If no stimuli are being delivered from the Pacemaker or the Pacemaker portion of ICD then the heart rate monitor will function normally. (An alternative is a portable plethysmograph type monitor that uses a light source to monitor the heart rate through either the fingertip or the earlobe).
Heating Pad	✓					Low risk of affecting Pacemaker or ICD.
Home Security Systems - Infrared & Ultrasonic	✓					Low risk of affecting Pacemaker or ICD.
Home Security Systems - Microwave	✓	✓		✓		Microwaves emit low energy electromagnetic impulses. Maintain 6" (15cm) distance from transmitter. If device is closer than 6" (15cm), there is the potential for Pacemaker reversion or ICD shock.
Hot Tub	✓	✓		✓		Low risk of affecting Pacemaker or ICD. If not properly grounded and in good working condition there is the potential for Pacemaker reversion or ICD shock.
Ignition Systems - See Tools						Click Hyperlink
Induction Stove Top (AC Magnetic Field)	✓	✓		✓		This stove differs from the more common electric and gas stoves. With this type of stove, a magnetic field heats the metal pots directly and only when they are placed on the stove top. The stove top remains cool to the touch. The metal in the bottom of the pan interacts with the magnetic field causing heating of the metal. Maintain a 24" (60cm) distance between stove top and device. Low risk if not leaning over stove. If device is closer than 24" (60cm), there is the potential for Pacemaker reversion or ICD shock.

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Induction Heater (Furnace/Kiln)		√		√		Induction furnaces/kilns are very high current devices and can project strong magnetic fields at some distance from the furnace. With these furnaces, especially in heavy industrial environments, evaluating the magnetic field with a gauss meter would provide the greatest assurance of determining a safe perimeter. (Low risk of affecting Pacemaker or ICD at a measured magnetic field intensity of less than 1 gauss AC) If greater than 1 Gauss AC, there is the potential for Pacemaker reversion or ICD shock. (Also see Pottery/Jewelry or glass kiln under Hobby tab)
Invisible Fence® for dog - see Dog Shock Collar - Communication						Click Hyperlink
Ionized Bracelet (Brand names are Q-Ray® and Balance® bracelets)	√					Low risk of affecting Pacemaker or ICD. (Non-magnetic)
Ionized Air Filter	√	√		√		These devices impart an electrical charge to contaminants in the air to allow them to be deposited on surfaces of opposite charge, usually contained within the filtering device. These air filters may or may not contain small motors. Maintain a 6" (15 cm) distance from Pacemaker or ICD. If the device is closer than 6" (15 cm), there is the potential for Pacemaker reversion or ICD shock.
Magnetic Back Brace	√	√			√	Magnetic belt worn on lower back. Maintain a 6" (15cm) distance from Pacemaker or ICD. If device is closer than 6" (15cm), there is the potential for Pacemaker magnet rate operation or disabling of ICD detection circuit.
Massager chair (Homemedics®)	√					Small motors within chair produce magnetic fields of such low intensity that they are unlikely to be detected by the Pacemaker or ICD. If the activity sensor is programmed "on", detected vibrations from the chair may cause a rate increase in the Pacemaker or ICD.
Massager - hand held	√	√		√		Small motors within hand massager may produce magnetic fields. Maintain a 6" (15cm) distance between the massager and the implanted device. If closer than 6" (15 cm), there is the potential for Pacemaker reversion and for ICD shock. If the activity sensor is programmed "on", detected vibrations from the hand massager may cause a rate increase in the Pacemaker or ICD.

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Medical Alert Necklace (911)	✓					Low risk of affecting Pacemaker or ICD. The brand name Lifeline Alert transmits a short (.1 second pulse) each time the button is pushed. (low radio frequency power)
Microwave Ovens (both residential and commercial)	✓					The commercial and residential microwave ovens that conform to regulatory limits pose a low risk of affecting the operation of a Pacemaker or ICD. Both commercial and residential microwave ovens must conform to the same regulatory leakage limits set forth by the government. (5 milliwatts per square centimeter at 5 centimeters from the oven). The radiation emitted from most microwave ovens is 10 to 100 times less than the regulatory limit.
Motorcycle	✓	✓	✓	✓		If considering riding a motorcycle, check with physician and the State Department of Transportation for guidelines, if any. Maintain a 12" (30 cm) distance between the ignition system and the implanted device. If device is closer than 12" (30 cm), there is the potential for Pacemaker reversion or ICD shock.
Motorcycle Vest (Electrically Heated)	✓					DC current used to heat the vest. Low risk of affecting implanted device.
Pest Control - Ultrasonic only	✓	✓		✓		Ultrasonic pest control units emits sound energy. Maintain a 6" (15cm) distance between the device plugged into the wall and the Pacemaker or ICD. If the device is closer than 6" (15cm), there is the potential for Pacemaker reversion or ICD shock.
Pest Control - Radio Frequency	✓	✓		✓		Radio frequency units emits radio frequency fields from both the device plugged into the wall and from all the wiring within the house. Maintain a 6" (15cm) distance between the device plugged into the wall and from the house wiring and the implanted device. If the device is closer than 6" (15 cm), there is the potential for Pacemaker reversion or ICD shock.
Sewing Machines	✓	✓		✓		Maintain a 6" (15cm) distance between the motor of the sewing machine and the implanted device. If the device is closer than 6" (15 cm), there is the potential for Pacemaker reversion or ICD shock.
Sewing Sergers	✓	✓		✓		Sewing machines that overcast edges to prevent fraying. Maintain a 6" (15cm) distance between the motor of the sewing machine and the implanted device. If the device is closer than 6" (15cm), there is the potential for Pacemaker reversion or ICD shock.

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Shaver with electrical cord	✓	✓		✓		Maintain a 6" (15cm) distance between the shaver and the implanted device. If the device is closer than 6" (15cm), there is the potential for Pacemaker reversion or ICD shock.
Speakers	✓	✓			✓	Large stereo speakers often have large magnets near the rear of the speaker cabinet. Maintain a 6" (15cm) distance between the back of the speaker cabinet and the Pacemaker or ICD. If the device is closer than 6" (15cm), there is the potential for Pacemaker reversion or magnet rate operation, or disabling of ICD detection circuit.
TV Audio Headset (Radio frequency receiver)	✓	✓		✓		Radio Frequency system consists of transmitter and headset. Maintain a 6" (15 cm) distance between the transmitter (component usually on or near TV) and the implanted device. If the device is closer than 6" (15cm), there is the potential for Pacemaker reversion or ICD shock. Headset will not affect Pacemaker or ICD.
TV Remote Infrared (standard)	✓					Low risk of affecting Pacemaker or ICD (Light only-no conducted current is introduced into the body)
Tanning Bed	✓					Low risk of affecting Pacemaker or ICD. (Light only-no conducted current is introduced into the body)
Tanning - Magna Tanning	✓					Low risk of affecting Pacemaker or ICD. The electrostatic Magna-Tanning booth utilizes a high DC voltage potential at the tanning booth spray nozzles. The high DC voltage potential associated with these nozzles impart small electrical charges on the droplets of the tanning spray mist. The booth is designed in such a way that the person standing in the booth attracts the tanning mist droplets on the skin. This procedure does introduce a very small direct current into the body. The level of this very small current is well below the levels of susceptibility of both the Pacemaker and ICD. (Procedure takes less than one minute to complete)
Transformer Box - See Communication						Green box located on ground in yard - click hyperlink

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Maximum Permissible Exposure (MPE) Previously known as Biological Radiation Hazard Level (BRH)						These levels are set by Government agencies as the maximum levels of exposure for radio frequency fields (i.e.: non-ionizing radiation) Note: Ionizing radiation is emitted by radioactive sources and X-ray machines.
Amateur or Ham Radio Bands and equivalent frequency ranges 80 M = 3.5-4 MHZ 40 M = 7-7.3 MHZ 30 M = 10-10.1 MHZ 20 M = 14-14.3 MHZ 10 M = 28-29.7 MHZ 6M = 50-54 MHZ 2M = 144-148 MHZ (Also see Two-way radios)	✓	✓	✓	✓		The following minimum distances, measured between the antenna and the implanted device, and associated power transmission levels are recommended for a low risk of interaction with an implanted device. ***** 3 watts or less = 6" (15 cm) 3 - 15 watts = 12" (30 cm) 15 - 30 watts = 24" (60cm) 30 - 50 watts = 3 foot (1 Meter) 50 - 125 watts = 6 foot (2 Meters) 125 - 250 watts = 9 foot (3 meters) 250 - 500 watts = 12 foot (4 Meters) 500 - 1000 watts = 20 foot (6 Meters) 1000 - 2000 watts = 30 foot (9 Meters) If closer than the minimum recommended distances, for continuous transmissions, there is a potential for Pacemaker reversion or ICD shock. CW (continuous wave) transmissions (Morse code) may also have the potential for

Telecommunications						
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Blue Tooth Technology	✓	✓		✓		Wireless communication technology for TV's, radios, computers, and other electronic devices. Radio Frequency waves can communicate/control remote electronic devices. Maintain a 6" (15cm) distance between the transmitter/receiver and the implanted device. If the transmitter/receiver is closer than 6"(15 cm), there is the potential for Pacemaker reversion or ICD shock.
CB Band Radio-dash mounted	✓	✓		✓		Maintain a 12" (30 cm) distance between the antenna and the implanted device if operating at 5 watts or less. (5 watts is the maximum legal power limit for CB transmitters) If the device is closer than 12" (30 cm), from the transmitting antenna there is an increased risk for Pacemaker reversion or ICD shock. If the transmitted power is greater than 5 watts, Medtronic is unable to make specific recommendations because these power levels do exceed the legal limit and there is the potential for Pacemaker reversion or ICD shock.
Cell Phone	✓	✓		✓		For phones that operate at 3 watts or less maintain a 6" (15cm) distance between the antenna of the cell phone and the implanted device. If greater than 3 watts and less than 15 watts, maintain a 12" (30 cm) from antenna. If less than 6" (15 cm) from 3 watt antenna, or less than 12" (30 cm) from 3-15 watt antenna, there is the potential for Pacemaker reversion or ICD shock.
Cellular Tower Antenna	✓	✓		✓		Cell towers operate at low power usually less than 200 watts. Maintain a 9 foot (3 meters) distance from the antenna mounted on tower. If less than 9 foot (3 meters), there is the potential for Pacemaker reversion or ICD shock. For cell phone tower service personnel consult Medtronic Technical Services.
Clearwire Modem-Wireless Cell Phone Connected Internet Link	✓	✓			✓	Clearwire uses a wireless modem that can be plugged into a desktop computer, laptop, or local network. It works by transmitting signals to and from nearby cellular towers instead of using a traditional phone line. Maintain a 6" distance from the antenna on the modem. If closer than 6" (15 cm) from the antenna, there is the potential for Pacemaker reversion or ICD shock.
Commercial Broadcasting Towers-Radio	✓	✓		✓		Commercial broadcasting facilities with antenna/towers are required to define areas where high intensity electromagnetic fields may be present. These areas are usually indicated by signs, fences and/or barriers indicating Danger/High Radiation Area. The area outside these restricted areas poses a low risk of affecting the Pacemaker or ICD. The electromagnetic field within the restricted areas may exceed the Maximum Permissible Exposure level set by the government and there is the potential for Pacemaker reversion or ICD shock.

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Cordless Computer Equipment (with radio frequency link)	✓	✓		✓		If modem is present maintain a 6" (15 cm) distance between the modem and the implanted device. If the device is closer than 6" (15cm), there is the potential for Pacemaker reversion or ICD shock.
Cordless Microphone	✓	✓		✓		Most cordless microphones operate at very low power levels. Maintain a 6" (15 cm) distance between the microphone antenna and the implanted device. If the device is closer than 6" (15 cm), there is the potential for Pacemaker reversion or ICD shock. These guidelines are more dependent on the power output of the microphone than the specific radio frequency associated with the microphone.
Cordless Phone and associated base station	✓	✓		✓		Low risk of affecting Pacemaker or ICD. Restrictions are not dependent on frequency (such as 900 MHz or 2.4 GHz). Maintain 6" (15 cm) distance between the antenna on the cordless phone and the implanted device. In addition, maintain a 6" (15cm) distance between the base station of the cordless phone and the implanted device. If the antenna of the cordless phone or base station is closer than 6" (15 cm) from the implanted device, there is the potential for Pacemaker reversion or ICD shock. Cordless phones used within the house or yard are low power (usually less than 100 milliwatts).
Cordless Phone - long range		✓		✓		Low risk of affecting Pacemaker or ICD. These restrictions are not dependent on frequency (such as 900 MHz or 2.4 GHz). Maintain 12" (30 cm) distance between the antenna and the implanted device. If the device is closer than 12" (30 cm), there is the potential for Pacemaker reversion or ICD shock. Long Range Cordless phones used within the house or neighborhood are higher power than regular cordless phones (usually less than 5 watts).
Dog shock Collar (with a central radio frequency transmitter in home)	✓	✓		✓		Maintain a 12" (30cm) distance between the radio frequency transmitting antenna (usually inside the house) and the Pacemaker or ICD. If the device is closer than 12" (30 cm), there is the potential for Pacemaker reversion or ICD shock. Do not pet the dog in the areas where the shock collar will be activated.
Dog Shock Collar (wire buried in the ground usually around the edge of the yard)	✓	✓		✓		Maintain a 12" (30 cm) distance between the buried wire and the implanted device. If the device is closer than 12" (30 cm), there is the potential for Pacemaker reversion or ICD shock. Do not pet the dog where invisible fence is buried to avoid shock from dog collar.

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Global Positioning System (GPS) Satellite navigation system	✓					Low risk of affecting Pacemaker or ICD. Device only receives, there is no transmitter.
GPS - Survey Equipment	✓	✓		✓		Low risk of affecting Pacemaker or ICD. If GPS survey equipment is used with repeater transmitter with output power of 25 watts or less, maintain a 24" (60cm) distance between the antenna and the implanted device. If device is closer than 24" (60cm), there is the potential for Pacemaker reversion or ICD shock.
Ham Radio						See Amateur Radio description
House Arrest Anklet	✓					These devices worn by the individual emit low level radio frequency signals at specific time intervals. These radio frequency signals are detected by a receiving unit connected to the telephone. The telephone periodically communicates with a central monitoring facility. Low risk of affecting the Pacemaker or ICD (low power transmission).
House Arrest Bracelet	✓	✓	✓	✓		These devices worn by the individual emit low level radio frequency signals at specific time intervals. These radio frequency signals are detected by a receiving unit connected to the telephone. The telephone periodically communicates with a central monitoring facility. Maintain a 6" (15cm) distance between Pacemaker or ICD and the bracelet. If the device is closer than 6" (15cm), there is the potential for Pacemaker reversion or inhibition and for ICD shock. The response is specific to the time interval and duration of the radio frequency transmission of the manufacturer's bracelet.
Internet connection - In-Building BPL - Broadband over Power line (BPL) or Internet Connection over Power line Carrier (PLC)	✓	✓		✓		In-Building BPL utilizes electrical power wiring to transmit radio frequency signals to network computers within a building. Maintain a 6" (15 cm) distance between the internal wiring associated with the Power distribution system and the implanted device. If the device is closer than 6" (15 cm), there is the potential for Pacemaker reversion or ICD shock.
Internet connection - Access BPL - Broadband over Power line (BPL) or Internet connection over Power line Carrier (PLC)	✓	✓		✓		Access BPL uses electrical power distribution lines to extend a connection to the Internet. The power distribution lines are used to transmit radio frequency signals to local Internet connection points within the neighborhood. Maintain a 6" (15 cm) distance between the internal wiring associated with the Power distribution system and the implanted device. If the device is closer than 6" (15cm), there is the potential for Pacemaker reversion or ICD shock.

← Telecommunications →						
Item	Low Risk when following Safety Precautions	Potential Pacemaker Reversion or Magnet Rate	Potential Pacemaker Inhibition	Potential ICD Shock	Potential disable of ICD detection circuit	Safety Precautions Be sure all items are in good working order and properly grounded, if necessary.
Infrared Scanner	✓					Equipment is optical and poses a low risk of affecting Pacemaker or ICD. (used in grocery stores)
Lie Detector Test - See Medical	✓					Click Hyperlink
Marine Radio -Very High Frequency (VHF) & Single Side Band (SSB)	✓	✓	✓	✓		For radios transmitting 20-25 watts (most common), maintain a 2 foot (60 cm) separation between the antenna and the implanted device. For lower power settings of 3 watts or less maintain a 6" (15 cm) distance between the antenna and the implanted device. For 3 to 15 watts maintain a 12" (30 cm) distance between the antenna and the implanted device. (The transmitter receiver cabinet will not affect the Pacemaker or ICD). If individual is closer than distances noted, there is the potential for Pacemaker reversion or inhibition and for ICD shock.
Metal Detectors or Magnetometers	✓	✓		✓		Used in airports, government buildings and some schools. Metal detector archways or hand held wands in compliance with Federal regulations are unlikely to affect ICD or Pacemaker. Low risk to walk through archway metal detector. If the archway detects metal in the device, request a hand search. If hand held metal detector wand is to be used, request that the wand not be placed directly over the device. If the security personnel insists on using the wand over the Pacemaker or ICD, request that the exposure of ICD to the magnetic field of the wand be limited to 1- 2 seconds every 30 seconds, and for the Pacemaker limit exposure to 1- 2 seconds every 10 seconds.
Metal Detector-Body scanner (X-ray)	✓					Low risk of affecting Pacemaker or ICD, no accumulative effect. (X-ray radiation used is less than diagnostic X-ray) Compass-X-1280® is a X-ray body scanner that provides the detection of all dangerous objects within 10 seconds. (Detects metal & non metal weapons, explosives, dangerous liquids, diamonds, gold and illicit drugs (including swallowed). Other companies with similar systems are American Science & Engineering, Inc. & Rapiscan's Secure 1000®. These detection systems do not utilize an alternating magnetic field to detect metal as does the archway and wand metal detectors.
Millimeter Wave Imaging or Scanners (Airports, Courthouses, Jail, Etc.)	✓	✓		✓		Also called a 3D scanner, whole body imaging, or RF / Microwave scanner. Patients should keep their implanted heart device 6" away from the walls of the scanner. If closer than 6", there may be a potential for pacemaker reversion or ICD shock.

Electromagnetic Compatibility (EMC) Chart for Medtronic Pacemakers and Defibrillators (ICD)

← Telecommunications →						
Item	Low Risk when following Safety Precautions	Potential Pacemaker Reversion or Magnet Rate	Potential Pacemaker Inhibition	Potential ICD Shock	Potential disable of ICD detection circuit	Safety Precautions Be sure all items are in good working order and properly grounded, if necessary.
Nintendo Wii and Wireless Remote Controls	✓					The Nintendo Wii uses wireless technology with various handheld controllers. The manual for Nintendo Wii recommends keeping these controllers 9" away from an implanted heart device. Medtronic tests found no interactions between the Nintendo Wii gaming system and Medtronic implantable heart devices.
OnStar® technology	✓	✓		✓		Device found in cars for navigation. Works with cell phone & GPS Technology. Antenna usually on roof, transmitter in glove box. Maintain a 6" (15 cm) distance between the antenna and the implanted device. If the device is closer than 6" (15cm), there is the potential for Pacemaker reversion or ICD shock when the antenna is energized.
Pagers - Receiver Only	✓					Low risk of affecting Pacemaker or ICD.
Pagers - 2 Way - with receiver and transmitter	✓	✓	✓	✓		For pagers that operate at 3 watts or less maintain a 6" (15cm) between the antenna of the pager and the implanted device. If more than 3 watts and less than 15 watts maintain a 12" (30 cm) distance between the antenna and the implanted device. If the device is closer than the distances noted, there is the potential for Pacemaker reversion or inhibition and for ICD shock.
Palm Pilot® (or other small computer with Wireless Internet access capability)	✓	✓		✓		If a modem is present that transmits and receives information at low power (less than 3 watts, similar to cell phone) maintain a 6" (15cm) distance between the modem and the implanted device. If the device is closer than 6" (15cm), there is the potential for Pacemaker reversion or ICD shock.
Peconet (wireless connection between computer equipment)	✓	✓		✓		This is a low power transmitter/receiver system (less than 3 watts). Maintain a 6" (15cm) distance between the implanted device and the external antenna associated with the transmitter or the transmitter itself, if no external antenna. If the device is closer than 6" (15cm), there is the potential for Pacemaker reversion or ICD shock.
Personal Area Network	✓	✓		✓		This is a low power transmitter/receiver system (less than 3 watts). Maintain a 6" (15cm) distance between the transmitter/receiver and the implanted device. If the device is closer than 6" (15cm), there is the potential for Pacemaker reversion or ICD shock.
Phone Headset (cordless)	✓	✓		✓		Maintain a 6" (15 cm) distance between the antenna and the implanted device. If the device is closer than 6" (15cm), there is the potential for Pacemaker reversion or ICD shock.

← Telecommunications →						
Item	Low Risk when following Safety Precautions	Potential Pacemaker Reversion or Magnet Rate	Potential Pacemaker Inhibition	Potential ICD Shock	Potential disable of ICD detection circuit	Safety Precautions Be sure all items are in good working order and properly grounded, if necessary.
Power Lines-high voltage	✓	✓		✓		Low risk of affecting Pacemaker or ICD when walking, driving underneath, or living in a house or building nearby. Individuals servicing high voltage power lines have the potential for Pacemaker reversion or ICD shock. For this work environment contact Medtronic Technical Services to review specific concerns.
Radar - small boats	✓	✓	✓	✓		For radar transmitting from 1 to 4 kilowatts (kW) effective radiated power (ERP) maintain a 3 foot (1 meter) vertical distance between the radar antenna or dome and the head of an individual with a Pacemaker or ICD. (Inside radar console display will not effect the Pacemaker or ICD). If the device is closer than 3 foot (1 meter), there is the potential for Pacemaker inhibition or reversion and for ICD shock.
Radar - commercial or cruise ships	✓	✓		✓		On commercial and cruise ships radar antennas are mounted so as not to affect Pacemaker or ICDs when an individual is on a normally accessible deck or bridge area. In other areas, there is the potential for Pacemaker reversion or ICD shock.
Remote (hands free) Keyless entry (i.e. Smart Key)	✓					The remote activator sends a radio frequency signal back to the car that unlocks the car and activates the button that starts the car. As with any electronic equipment, it is good to maintain a 6" (15 cm) distance between the implanted heart device and both the remote activator and the radiating antennas on the car. (The antenna locations can vary by car. Patient can verify locations with car manufacturer). No interactions have been reported or demonstrated in a laboratory in the United States.
Remote Car Starter	✓					Automatically starts the car. No interference has been reported or demonstrated in a laboratory. As with any electronic equipment, it is good to maintain a 6" (15 cm) distance between the remote activator and the implanted device.
Remote to unlock car	✓					No interactions have been reported or demonstrated in a testing laboratory. As with any electronic equipment, it is good to maintain a 6" (15 cm) distance between the remote activator and the implanted device.
Residential Satellite Dish-transmitting/receiving	✓	✓		✓		Recommend that the antenna be mounted in such a way that a 2 foot (60cm) distance be maintained between the satellite dish and the head of an individual with a Pacemaker or ICD. Avoid direct exposure to the main energy beam. If the device is closer than 2 feet (60 cm), there is the potential for Pacemaker reversion or ICD shock.

← Telecommunications →						
Item	Low Risk when following Safety Precautions	Potential Pacemaker Reversion or Magnet Rate	Potential Pacemaker Inhibition	Potential ICD Shock	Potential disable of ICD detection circuit	Safety Precautions Be sure all items are in good working order and properly grounded, if necessary.
Satellite Dish-receiving only	✓					Receiving Unit (i. e. Direct TV®) Low risk of affecting Pacemaker or ICD.
Theft Detector pedestals (located at store exits)	✓	✓	✓	✓		Low risk of affecting Pacemaker or ICD. Theft detectors are used in stores and libraries. Walk between the pedestals at a normal speed and do not linger close to detection system equipment. Prolonged exposure may result Pacemaker reversion or inhibition and for ICD shock.
Theft Detector/Sensormatic® scanners	✓	✓		✓		These are scanner/deactivators that are located on the counter used to identify the items to be purchased and deactivate the anti-theft tags at checkout counters in stores. Maintain a 24" (60 cm) distance between the deactivator associated with scanner when an item is passed through the scanner/deactivator and the implanted device, and a 6" (15 cm) distance between the location of the deactivator and the implanted device when not passing any item through. When scanning wands with deactivators are used, maintain a 24" (60 cm) distance between the wand and the implanted device. If the device is closer than 24" (60 cm), there is the potential for Pacemaker reversion or ICD shock.
Transformer Boxes (usually green located on the ground in residential areas)	✓	✓		✓		These transformer boxes are used in association with underground 60 Hertz power distribution. Maintain a 12" (30 cm) distance between the box and the implanted device. Low risk to walk by or have in backyard. If the device is closer than 12" (30 cm), there is the potential for Pacemaker reversion or ICD shock.
Two Way Portable Radio (Walkie-Talkie) Law Enforcement, Fire, and Emergency Vehicle radios	✓	✓		✓		The following minimum distances, measured between the antenna and the implanted device, and associated power transmission levels are recommended for a low risk of interaction with an implanted device. ***** 3 watts or less = 6" (15 cm) 3 - 15 watts = 12" (30 cm) 15 - 30 watts = 24" (60cm) 30 - 50 watts = 3 foot (1 Meter) 50 - 125 watts = 6 foot (2 Meters) If closer than the minimum recommended distances, for continuous transmissions, there is a potential for Pacemaker reversion or ICD shock.

← Telecommunications →						
Item	Low Risk when following Safety Precautions	Potential Pacemaker Reversion or Magnet Rate	Potential Pacemaker Inhibition	Potential ICD Shock	Potential disable of ICD detection circuit	Safety Precautions Be sure all items are in good working order and properly grounded, if necessary.
TV Ears	✓					No interactions have been reported and no formal testing had been done. As with any electronic equipment, it is good to maintain a 6" (15 cm) distance between the transmitting unit connected to the audio source and the implanted heart device.
Wi-Fi or Wireless Fidelity	✓	✓	✓		✓	Wi-Fi or Wireless Fidelity allows an individual to connect where this wireless service is available such as: from home, conference rooms at work, or public places like coffee shops, hotels, and airport lounges. People can connect anywhere to this wireless service if their computer is configured with a Wi-Fi Certified radio frequency transmitter/receiver (a PC Card or similar device). Maintain a 6" (15cm) distance between the Wi-Fi transmitter/receiver antenna (if visible) and the implanted device. If the transmitter/receiver antenna is closer than 6" (15 cm), there is the potential for Pacemaker reversion or inhibition, and for ICD shock.
Wireless LANS (Local Area Network System)	✓	✓			✓	LANS = A Local Area Network System is a central low power (less than 3 watt) transmitter/receiver that usually services several personal computer systems within an office area (or at most a single building). Each personal computer also has a transmitter/receiver unit. Maintain a 6" (15 cm) distance between the antenna associated with the transmitter and the implanted device. The antenna may be visible externally on the LAN transmitter or it may be contained within the LAN transmitter case. In either situation, maintain a 6" (15cm) distance between the antenna of the LAN transmitter or the LAN transmitter case and the implanted device. (The antenna associated with the LAN transmitter may be mounted within or external to the associated computer system). If the device is closer than 6" (15cm), there is the potential for Pacemaker reversion or ICD shock.

Medtronic Electromagnetic Compatibility Table

For Pacemakers and Defibrillators (ICD)

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← Chainsaws →						
Item	Low Risk when following Safety Precautions	Potential Pacemaker Reversion or Magnet Rate	Potential Pacemaker Inhibition	Potential ICD Shock	Potential disable of ICD detection circuit	Safety Precautions Be sure all items are in good working order and properly grounded, if necessary.
Chainsaws		√		√		Not recommended because of the following 3 concerns.
						1) Dangerous for individuals not familiar with operation
						2) Conducted current or a radiated magnetic field from ignition system could cause Pacemaker reversion and ICD shock. Conducted current is of most concern. If spark plug were located in the handgrip area, then there is a possibility of physically touching the insulation covering the spark plug or the spark plug wire. If the insulation were faulty, this could cause either a momentary electrical shock or a low level undetected electrical current to pass through the body. The electrical shock would in most cases be detected by the implanted device, and cause a single pause in Pacemaker or Pacemaker portion of ICD. The low level electrical current, not felt as a shock, could pass through the body and be sensed by the Pacemaker or ICD for several seconds. The prolonged detection of this current could cause Pacemaker reversion and ICD shock. If the spark plug is located away from the handgrip area, the risk of conducted current affecting the Pacemaker or ICD is significantly reduced.
						Radiated magnetic field is associated with the components of the ignition system of the chainsaw. If chainsaw is to be used, maintain a 12" (30 cm) distance the components of the ignition system and the implanted device.
						3) Vibration from the chainsaw may increase the rate of the Pacemaker or Pacemaker portion of the ICD, if the activity sensing function of the Pacemaker or ICD is programmed "on".

Medtronic Electromagnetic Compatibility Table

For Pacemakers and Defibrillators (ICD)

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← Tools →						
Item	Low Risk when following Safety Precautions	Potential Pacemaker Reversion or Magnet Rate	Potential Pacemaker Inhibition	Potential ICD Shock	Potential disable of ICD detection circuit	Safety Precautions Be sure all items are in good working order and properly grounded, if necessary.
Battery Charger	✓	✓			✓	Maintain a 12" (30 cm) distance between the battery charger operating up to 100 Amps and the implanted device. If the device is closer than 12" (30 cm), there is the potential for Pacemaker magnet rate operation or disabling of ICD detection circuit.
Demagnetizers	✓	✓		✓		Maintain a 6" (15cm) distance between demagnetizer and the implanted device when the items to be demagnetized are in a closed container. If the device is closer than 6" (15cm), there is the potential for Pacemaker reversion or ICD shock. Open demagnetizers will not affect Pacemaker or ICD at magnetic field intensities that are less than one gauss. Magnetic fields may need to be evaluated.
Electrostatic Spray Gun (hand held)	✓		✓			Low risk of affecting Pacemaker or ICD. The hand held electrostatic spray gun utilizes a high DC voltage potential at the gun tip. As long as the case of the gun is at ground potential and the gun is well insulated, the high DC potential at the tip will not affect the Pacemaker or ICD. Inadvertent shocks may cause a momentary pause in the output of the Pacemaker or Pacemaker portion of the ICD, but will not permanently damage the Pacemaker or ICD. A memorable momentary shock may cause some of the parameters of the Pacemaker or ICD to be reset to other nominal values. If any parameter changes occur the physician can restore the original parameters in the office.
Generator AC/DC-portable/RVs (gasoline or diesel powered)	✓	✓		✓		Maintain a 12" (30 cm) distance between the implanted device and generators operating up to 20Kw. If the device is closer than 12" (30 cm), there is the potential for Pacemaker reversion or ICD shock. If generator is powered by an engine with an ignition system, maintain a 12" (30 cm) distance between the components of the ignition system and the implanted device. If the device is closer than 12" (25 cm), there is the potential for Pacemaker reversion or ICD shock.

Electromagnetic Compatibility (EMC) Chart for Medtronic Pacemakers and Defibrillators (ICD)

Tools						
Item	Low Risk when following Safety Precautions	Potential Pacemaker Reversion or Magnet Rate	Potential Pacemaker Inhibition	Potential ICD Shock	Potential disable of ICD detection circuit	Safety Precautions Be sure all items are in good working order and properly grounded, if necessary.
Ignition Systems (gasoline powered vehicles)	✓	✓	✓	✓		Maintain a 12" (30 cm) distance between the components of the ignition system when operating and the implanted device. If the device is closer than 12" (30 cm), there is the potential for Pacemaker reversion or ICD shock. Diesel powered vehicles have no effect.
Jumper Cables	✓	✓			✓	Maintain a 24" (60 cm) distance between the jumper cables and the implanted device when starting an engine. If the device is closer than 24" (60cm), there is the potential for Pacemaker magnet rate operation or disabling of ICD detection circuit.
Soldering Guns	✓	✓		✓		Maintain a 6" (15cm) distance between the soldering gun and the implanted device because the soldering gun contains a transformer. If the device is closer than 6" (15cm), there is the potential for Pacemaker reversion or ICD shock.
Soldering irons	✓					Low risk of affecting Pacemaker or ICD.
Stun Guns (hand held only)	✓	✓		✓		A hand held gun like device that emits a sequence of high voltage electrical pulses to subdue an individual. Most stun guns can be purchased by anyone; however, high powered stun guns are available only to Police/Government Agencies. Low risk if the individual with a Pacemaker or ICD is using the stun gun. However, if the individual receiving the subduing electrical shocks has a Pacemaker or ICD, their implanted device may be affected. Reversion for Pacemaker is the most likely response during the delivery of the subduing shock. The ICD may deliver an inadvertent shock therapy as well as suppress the Pacemaker portion of the ICD during the delivery of the subduing shock. No damage to Pacemaker or ICD from the high voltage pulses emitted from device. If high voltage electrical pulses are applied to the immediate vicinity of the implanted system (device and leads) this may cause some parameters of the Pacemaker or ICD to be reset to other nominal values. If any parameter changes occur the physician can restore the original parameters in the office.

Electromagnetic Compatibility (EMC) Chart for Medtronic Pacemakers and Defibrillators (ICD)

← Tools →						
Item	Low Risk when following Safety Precautions	Potential Pacemaker Reversion or Magnet Rate	Potential Pacemaker Inhibition	Potential ICD Shock	Potential disable of ICD detection circuit	Safety Precautions Be sure all items are in good working order and properly grounded, if necessary.
Stun Gun/Taser® (hand held gun that shoots two darts propelled by compressed gas cartridge) (Continued below)	✓	✓		✓		Stun guns can be purchased by anyone; however, high powered stun guns are available only to Police/Government Agencies. One set of electrodes has the ability to project two darts that deliver these high-energy electrical pulses to individuals at a short distance. A second set of back-up stun gun electrodes are incorporated into the hand held portion of the system. Low risk if the individual with a Pacemaker or ICD is using the stun gun. However, if the individual receiving the subduing electrical shocks has a Pacemaker or ICD, their implanted device may be affected. Reversion for Pacemaker is the most likely response during the delivery of the subduing shock. The ICD may deliver an inadvertent shock therapy as well as suppress the Pacemaker portion of the ICD during the delivery of the subduing shock. Continued below..
Stun Gun/Taser® (Hand held gun that shoots two darts propelled by compressed gas cartridge)	✓	✓		✓		No damage to Pacemaker or ICD from the high voltage pulses emitted from the device. If high voltage electrical pulses are applied to the immediate vicinity of the implanted system (device and leads) this may cause some parameters of the Pacemaker or ICD to be reset to nominal values. If any parameter changes occur the physician can restore the original parameters in the office. In the rare case that one dart electrode from the stun gun lodges near the device and the other dart lodges near the lead tip, the sequence of stimuli from the stun gun could induce a stimulating electrical current directly into the Pacemaker or ICD system. This direct induction of stimuli could initiate an arrhythmia in the individual being subdued. This arrhythmia could be sustained even after the stun gun stimuli stops. The risk of this type of arrhythmia is small, but does exist. It is recommended that agencies using a stun gun should also carry an Automatic External Defibrillator (AED) in the event resuscitation of the individual is necessary.
Tools - Battery powered	✓	✓		✓		Battery operated home and garden equipment such as: circular saws, drills, hedge clippers, lawnmowers. Maintain a 6" (15cm) distance between the battery powered tool and the implanted device. If the device is closer than 6" (15cm), there is the potential for Pacemaker reversion or ICD shock.
Tools - Bench mounted (electric line powered)	✓	✓		✓		Maintain a 2 foot (60 cm) distance between the motor associated with the power tool and the implanted device. This applies for motors up to 400 horsepower (i.e. tools such as drill presses, table saws, grinders). If the device is closer than 2 feet (60 cm), there is the potential for Pacemaker reversion or ICD shock.

Electromagnetic Compatibility (EMC) Chart for Medtronic Pacemakers and Defibrillators (ICD)

← Tools →						
Item	Low Risk when following Safety Precautions	Potential Pacemaker Reversion or Magnet Rate	Potential Pacemaker Inhibition	Potential ICD Shock	Potential disable of ICD detection circuit	Safety Precautions Be sure all items are in good working order and properly grounded, if necessary.
Tools - Hand held or Home & Garden (electric line powered)	✓	✓		✓		Maintain a 6" (15 cm) distance between power tools using up to 15 amps and the implanted device (i.e. circular saws, drills, sanders, routers, electric hedge clippers, leaf blowers, and edge trimmers). Be sure tools are properly grounded. If the device is closer than 6" (15 cm), there is the potential for Pacemaker reversion or ICD shock. If the individual uses power machinery often, a ground-fault-circuit interrupter (GFCI) is a good safety measure to help prevent sustained electrical shocks.
Tools - Home & Garden gasoline power tools (except chainsaws)	✓	✓		✓		Gasoline powered snow blower, lawn mower, lawn tractors, weed whacker. Maintain a 12" (30 cm) distance between the components of the ignition system when operating and the implanted device. If the device is closer than 12" (30 cm), there is the potential for Pacemaker reversion or ICD shock. Avoid gasoline powered tools where there is a potential for easily contacting components of the ignition system (spark plug near the handle area) which may result in conducted current passing through the body. Prolonged exposure (greater than 8 seconds) to conducted current from these sources would result in Pacemaker reversion or ICD shock.
UPS - Uninterrupted Power Source (Commercial power failure back-up system)	✓	✓		✓	✓	Uninterrupted Power Source (UPS): Maintain a 12" (30 cm) distance between the UPS system operating normally up to 200 Amps. and the implanted device. Maintain a 18" (45 cm) distance from the UPS system when it is running on the battery source and the implanted device. If closer than 12" (30 cm), when operating normally, there is the potential for Pacemaker reversion or ICD shock. If closer than 18" (45cm) when UPS is running on batteries, there is the potential for Pacemaker magnet rate operation or reversion and for ICD shock or disable of ICD detection circuit.
Welding - See Welding						Click hyperlink

← Welding →						
Item	Low Risk when following Safety Precautions	Potential Pacemaker Reversion or Magnet Rate	Potential Pacemaker Inhibition	Potential ICD Shock	Potential disable of ICD detection circuit	Safety Precautions Be sure all items are in good working order and properly grounded, if necessary.
						6) Connect the ground clamp to the metal as close to the point of welding as possible. Arrange the work so the handle and rod will not contact the metal being welded if they are accidentally dropped. 7) If having difficulty starting a weld, wait several seconds between attempts. 8) Work in an area that offers firm footing and plenty of room for movement. 9) Work with an informed person who understands these suggestions. 10) It is recommended that an individual immediately stop welding and step away from the area if feeling light-headed, dizzy, or believe the ICD has delivered a shock.
Close distance to welding operation	✓	✓		✓	✓	For welding currents up to 400 amps maintain a 5 foot separation between the components of the welding system and the PM or ICD. If the closer than 5 feet to the welding system components there is the potential for Pacemaker reversion or magnet rate operation or disabling of ICD detection circuit or ICD shock.

Medtronic Electromagnetic Compatibility Table

For Pacemakers and Defibrillators (ICD)

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←—————→ **Dental Procedures** ←—————→

Item	Low Risk when following Safety Precautions	Potential Pacemaker Reversion or Magnet Rate	Potential Pacemaker Inhibition	Potential ICD Shock	Potential disable of ICD detection circuit	Safety Precautions Be sure all items are in good working order and properly grounded, if necessary.
Dental Apex Locator (root locator)	✓					Instrument used to locate the end of a nerve in a tooth. Introduces very low level electrical current. There is a low risk of this current being detected by Pacemaker or ICD.
Dental -Ultrasonic scalers/cleaners	✓					Low risk of affecting Pacemaker or ICD (either piezoelectric or magnetostrictive)
Dental Pulp Tester						This device is disclaimed for use on Pacemaker & ICD patients by most Dental Pulp Tester manufactures. Instrument used to check the viability of the nerve in a tooth. Introduces alternating current (AC) into the tooth.
Electrocautery (periodontal surgery)	✓	✓	✓	✓		Recommend to use magnet application for PM and ICD. (Process used in surgeries to stop the bleeding of blood vessels) Maintain a 6" (15cm) distance or more between the electrocautery tip or the grounding pad and the Pacemaker or ICD. When the electrocautery tip or the grounding pad is closer than 6" (15cm) damage can occur to Pacemaker or ICD even when the magnet is applied. The Pacemaker portion of the ICD is not affected by a magnet; therefore, application of electrocautery will inhibit the Pacemaker portion of the ICD. To minimize the possibility of symptoms in individuals with ICDs, limit the application of electrocautery from 1-2 seconds every 10 seconds. Alternative cauterizing devices that do not enter conducted current into the body are the Shaw scalpel and Harmonic scalpel.

Medtronic Electromagnetic Compatibility Table

For Pacemakers and Defibrillators (ICD)

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Medical Procedures						Safety Precautions
Item	Low Risk when following Safety Precautions	Potential Pacemaker Reversion or Magnet Rate	Potential Pacemaker Inhibition	Potential ICD Shock	Potential disable of ICD detection circuit	Be sure all items are in good working order and properly grounded, if necessary.
Ablation-Cardiac (Radio frequency) (Continued below)	✓	✓	✓	✓		This procedure introduces electrical current into the body that may affect the implanted devices of individuals. It is recommended that individuals considering this procedure consult their heart doctor to evaluate any possible risks associated with these responses in conjunction with their medical condition. This process is done to change or interrupt the electrical pathways in the heart. It is recommended that this procedure be done before device implantation, if possible. Cardiac ablation can damage pacemaker or ICD circuitry because of the close proximity of the high-energy radio frequency ablation catheter to the device leads. If ablation is to be performed with ICD implanted, it is recommended that the detection function of the ICD be programmed off or a magnet placed over the ICD to temporarily disable the detection function. There is the potential for ablation to cause Pacemaker reversion or inhibition or ICD shock if no precautions are taken. (continued below)
Ablation-Cardiac (Radio frequency)	✓	✓	✓	✓		If ablation is performed with the Pacemaker implanted, it is recommended to program the Pacemaker to Asynchronous mode or application of the magnet to provide continuous Pacemaker support during the procedure. In addition, it is recommended that Medtronic Technical Services be contacted to review specific concerns.
Acupuncture - No electrical stimulus	✓					Low risk of affecting Pacemaker or ICD because no electrical current is being used.

Medical Procedures						
Item	Low Risk when following Safety Precautions	Potential Pacemaker Reversion or Magnet Rate	Potential Pacemaker Inhibition	Potential ICD Shock	Potential disable of ICD detection circuit	Safety Precautions Be sure all items are in good working order and properly grounded, if necessary.
Acupuncture AC - Alternating Current	✓	✓		✓		This procedure introduces electrical current into the body that may affect the implanted devices of individuals. It is recommended that individuals considering this procedure consult their heart doctor to evaluate any possible risks associated with these responses in conjunction with their medical condition. For use on torso - AC can cause Pacemaker reversion or ICD shock. Lower risk of device detecting AC when used on extremities. Application of a magnet over the ICD will disable the ICD detection circuit. However, application of the magnet will not disable sensing in the Pacemaker portion of the ICD. If AC current introduced by acupuncture is detected, wherever it is introduced, the output of the Pacemaker portion of the ICD will be inhibited. This response could cause symptoms for dependent patients.
Acupuncture DC - Direct Current	✓					Low risk of affecting Pacemaker or ICD with DC stimulation.
Blood bag dielectric sealing equipment	✓					Equipment that uses high frequency energy to seal blood bags. Sealing equipment manufacturers recommend a 10 foot (3 meters) distance between the implanted device and the sealer. In most cases this would be a very conservative distance for Medtronic devices.
Bone Density test/Scan	✓					Two types are used: Ultrasound and X-ray. If X-ray, there is a low risk of affecting Pacemaker or ICD. If using Ultrasound technique, maintain a 6" (15cm) distance between the transducer head and the Pacemaker or ICD. If less than 6" (15 cm), may result in mechanical damage to internal circuitry of Pacemaker or ICD.
Bone Growth Stimulator Alternating Magnetic Field - produced by an alternating current (AC)	✓	✓		✓		It is recommended that individuals considering this procedure consult their heart doctor to evaluate any possible risks associated with these responses in conjunction with their medical condition. An insulated cuff surrounding the broken bone produces a magnetic field that promotes bone healing. This therapy does not introduce conducted current into the body; however, there is a magnet field that is present in the immediate vicinity of the cuff. A 9V battery is used to deliver a short duration, high intensity current pulse to the coil in the cuff that produces the therapeutic magnetic field. When used on leg poses a low risk of affecting Pacemaker or ICD. For use on wrist or arm maintain 12" (30 cm) distance from Pacemaker or ICD. If the device is closer than 12" (30cm), there is the potential for Pacemaker reversion or ICD shock.
Bone Growth Stimulator Direct Current (DC)	✓					Low risk of affecting Pacemaker or ICD. Low level direct current is not detectable by the Pacemaker or ICD (implanted or external stimulator).

Medical Procedures						
Item	Low Risk when following Safety Precautions	Potential Pacemaker Reversion or Magnet Rate	Potential Pacemaker Inhibition	Potential ICD Shock	Potential disable of ICD detection circuit	Safety Precautions Be sure all items are in good working order and properly grounded, if necessary.
Bone Growth Stimulator introducing AC current into the body	✓	✓		✓		This procedure introduces electrical current into the body that may affect the implanted devices of individuals. It is recommended that individuals considering this procedure consult their heart doctor to evaluate any possible risks associated with these responses in conjunction with their medical condition. Low risk when electrodes are placed on an extremity. If the electrodes are placed on the torso there is the potential for Pacemaker reversion or ICD shock.
Bravo PH Capsule (used to diagnose reflux disease)	✓					The Bravo PH capsule is a medical device designed by Medtronic. It is used to monitor for gastroesophageal reflux disease, or GERD. The capsule transmits data for up to 48 hours to a monitor the patient carries with them. Testing has shown that the Bravo PH capsule should not interfere with a Medtronic implantable heart device and vice versus.
Capsule Endoscopy-Given model M2A						The M2A capsule encases a digital camera, light-emitting diodes, batteries, and a transmitter. The M2A capsule emits short bursts of radio frequency energy for twice per second for the eight-hour diagnostic period. The Given company disclaims its used with PM and ICDs. In addition, Medtronic has not thoroughly evaluated the Given model M2A capsule for compatibility with Medtronic heart devices. It is recommended that the detection circuit of the ICD be disabled during the time that the capsule is within a six-inch distance of the ICD and leads. If the ICD were to detect the transmission, it may initiate an inappropriate shock therapy and/or temporary inhibit the PM portion of the ICD or inhibit the Pacemaker. The radio frequency emissions from the Given M2A capsule will not damage or reprogram a Medtronic heart device.
CAT Scan or CT Scan (Computed Axial Tomography)	✓	✓	✓	✓		Low risk if the device is not directly exposed to (placed directly in) the CT scan x-ray beam. If the device is directly in the CT scan x-Ray beam, oversensing may occur for the duration of time the device is in the beam. This could result in pacemaker reversion or inhibition. Inhibition for an ICD, with the potential for shock if in the beam longer than 4 seconds.
Cardioversion						See Defibrillation-External
Colonoscopy	✓					This diagnostic procedure by itself poses a low risk of affecting the Pacemaker or ICD. However, if polyps are found electrocautery may be used to remove them. See electrocautery guidelines.

Medical Procedures						
Item	Low Risk when following Safety Precautions	Potential Pacemaker Reversion or Magnet Rate	Potential Pacemaker Inhibition	Potential ICD Shock	Potential disable of ICD detection circuit	Safety Precautions Be sure all items are in good working order and properly grounded, if necessary.
Defibrillation-External (High energy) Cardioversion (Low energy)	✓		✓			Low risk of damage to the Pacemaker or ICD when paddles are placed more than 6" (15 cm) from the implanted device or the device lead system. If external defibrillation or Cardioversion is delivered closer than 6" (15 cm) from the implanted device or device lead system, Pacemaker or ICD may be damaged or reprogrammed. It is recommended that device function and programming be thoroughly evaluated after any external defibrillation or cardioversion.
Diathermy		✓		✓		Diathermy is NOT recommended. This process heats body tissue and may result in Pacemaker reversion or ICD shock if no precautions are taken. Contact Medtronic Technical Services for specific concerns.
Digital Infrared Thermal Imaging (DITI)	✓					Low risk of affecting Pacemaker or ICD. This imaging technique monitors infrared radiation emitted from the skin surface. This is a passive device that does not introduce any electrical current into the body.
ECG/EKG Electrocardiogram	✓					Low risk of affecting Pacemaker or ICD. The ECG/EKG is limited to sensing electrical activity of the heart.
Echocardiogram	✓					A test in which ultrasound is used to examine the heart. Maintain a 6" (15cm) distance between the transducer head and the implanted device. If the transducer head is closer than 6" (15 cm), it may cause mechanical damage to internal circuitry of Pacemaker or ICD.
ECT (Electroconvulsive Shock Therapy) (Continued below)	✓	✓	✓	✓		This procedure introduces electrical current into the body that may affect the implanted devices of individuals. It is recommended that individuals considering this procedure consult their heart doctor to evaluate any possible risks associated with these responses in conjunction with their medical condition. ECT is used to treat depression, anxiety and other mental disorders. Recommend that physician consult with Medtronic Technical Services for precautions. ECT is a device that delivers measured electrical stimuli over a brief period of time (1-2 seconds). These briefly applied electrical stimuli induce a seizure that may last for several minutes. As a result the Pacemaker may respond by either pausing (inhibiting) or delivering 1-2 Pacemaker stimuli. The pacemaker portion of the ICD will be inhibited for as long as the current is present (1-2 beats). It is unlikely that the ICD will deliver an inadvertent shock therapy in response to this brief electrical therapy. (Continued below)
ECT (Electroconvulsive Shock Therapy) Continued	✓	✓	✓	✓		Always verify the duration of the specific protocol. If ECT is used for longer than 8 seconds, there is the potential for Pacemaker reversion or ICD shock. No damage to the Pacemaker or ICD is expected from this therapy. The activity detected during the seizure period may affect the rate response circuit. If the rate response circuit is programmed "on", there is the potential to elevate the rate of the Pacemaker portion of the ICD or the Pacemaker rate.

Medical Procedures						
Item	Low Risk when following Safety Precautions	Potential Pacemaker Reversion or Magnet Rate	Potential Pacemaker Inhibition	Potential ICD Shock	Potential disable of ICD detection circuit	Safety Precautions Be sure all items are in good working order and properly grounded, if necessary.
EECP - Enhanced External Counter Pulsation Therapy	✓					This therapy helps to maintain arterial pressure longer, resulting in better perfusion of the heart and other body organs. Low risk of affecting Pacemaker or ICD. No effect on the implantable device electrical sensing. However, if the rate response function is programmed "on", the vibrations from the EECP could activate the rate response feature (through the vibration detecting circuit) which could cause an increase in the pacing rate of the Pacemaker. It is recommended that the Pacemaker or Pacemaker portion of the ICD be programmed to single chamber ventricular pacing to prevent double triggering of the EECP device on both the atria stimulus and the ventricular stimulus/QRS. Individuals with dual chamber pacemakers or ICDs should have their physician consult with Medtronic Technical Services for precautions.
EEG - Electroencephalography	✓					Scan brain wave activity. Low risk of affecting PM or ICD.
Electrocautery or Electrosurgery Argon Plasma Cautery ICD recommendations (Continued below)	✓		✓	✓		This procedure introduces electrical current into the body that may affect the implanted devices of individuals. It is recommended that individuals considering this procedure consult their heart doctor to evaluate any possible risks associates with these in conjunction with their medical condition. Process used in surgeries to cut tissue and stop the bleeding of blood vessels. Recommend the application of a magnet over the ICD during the surgical procedure. Individuals with ICDs should have their physician consult with Medtronic Technical Services for precautions. When cautery is performed less than 6" (15cm) from the device or the grounding electrode is placed less than 6" (15cm) from the device; damage can occur and/or the output of the device can be affected even when the magnet is applied. Damage may occur to the tissue at the lead tissue interface. Currents induced into the lead system may initiate an arrhythmia. (continued below)

Medical Procedures						
Item	Low Risk when following Safety Precautions	Potential Pacemaker Reversion or Magnet Rate	Potential Pacemaker Inhibition	Potential ICD Shock	Potential disable of ICD detection circuit	Safety Precautions Be sure all items are in good working order and properly grounded, if necessary.
Electrocautery or Electrosurgery Argon Plasma Cautery ICD recommendations	✓		✓	✓		For distances greater than 6" (15cm) from the implanted device with a magnet applied - Limit application from 1-2 seconds every 10 seconds to reduce the risk of symptoms in the individual. Although the magnet application disables the ICD detection circuit, the timing limitation is necessary because the sensing function of the Pacemaker portion of the ICD will operate normally with the magnet applied. Therefore, there is a risk of the ICD sensing the application of the electrosurgery causing the Pacemaker portion of the ICD to pause. However, the Pacemaker portion of the ICD will function normally during the times between applications of the electrosurgery. If no magnet is present over the ICD, limit the electrosurgery application to 1-2 seconds every 30 seconds to minimize the possibility of initiating an inadvertent shock therapy. If these timing intervals are restrictive, reprogramming of the ICD should be considered, especially for individuals that are dependent on the Pacemaker portion of the ICD. Shaw or Harmonic scalpel and Thermal (battery powered) cautery pose a low risk.
Electrocautery or Electrosurgery Argon Plasma Cautery Pacemaker recommendations (Continued below)	✓	✓	✓			This procedure introduces electrical current into the body that may affect the implanted devices of individuals. It is recommended that individuals considering this procedure consult their heart doctor to evaluate any possible risks associated with these responses in conjunction with their medical condition. Process used in surgeries to cut tissue and stop the bleeding of blood vessels. Recommend the application of a magnet over the Pacemaker during the surgical procedure. Individuals with Pacemakers should have their physician consult with Medtronic Technical Services for precautions. When cautery performed less than 6" (15cm) or grounding electrode is placed less than 6"(15cm) from device, damage can occur and/or the output of the device can be affected even when the magnet is applied. Damage may occur to the tissue at the lead tissue interface. Currents induced into the lead system may initiate an arrhythmia. (Continued below)

Medical Procedures						
Item	Low Risk when following Safety Precautions	Potential Pacemaker Reversion or Magnet Rate	Potential Pacemaker Inhibition	Potential ICD Shock	Potential disable of ICD detection circuit	Safety Precautions Be sure all items are in good working order and properly grounded, if necessary.
Electrocautery or Electrosurgery Argon Plasma Cautery Pacemaker recommendations	✓	✓	✓			For Pacemakers at distances greater than 6" (15cm) from device with the magnet applied - Magnet application in the Pacemaker causes the Pacemaker to deliver a sequence of stimuli at a normal low rate (usually 85 bpm magnet rate). If no magnet is present over the pacemaker, limiting application of electrosurgery to 1-2 seconds every 10 seconds may reduce the risk of symptoms in individuals that are dependent on the pacemaker. If these timing intervals are restrictive, reprogramming of the Pacemaker should be considered, especially for individuals that are dependent on the Pacemaker. Alternative cauterizing devices that do not enter conducted current into the body are the Shaw scalpel and Harmonic scalpel. Thermal (battery powered) cautery - poses a low risk of affecting Pacemaker.
Electrolysis - AC sometimes called hyfrecator, short-wave, thermolysis, radio frequency, diathermy, electrocoagulation, or combination/blend mode that is any of the AC and galvanic DC. (Can be AC only or combination/blend) (Continued below)	✓	✓	✓	✓		This procedure introduces electrical current into the body that may affect the implanted devices of individuals. It is recommended that individuals considering this procedure consult their heart doctor to evaluate any possible risks associated with these responses in conjunction with their medical condition. Used for the removal of unwanted hair. Recommend the application of a magnet for ICD and Pacemaker. To minimize the risk of reprogramming the device parameters with the AC or combination mode, the electrolysis applicator must be kept 6" (15cm) away from the device. Also keep the grounding pad 6" (15cm) from the Pacemaker or ICD area. (Continued below)
Electrolysis - AC	✓	✓	✓	✓		Because the sensing in the pacemaker portion of the ICD is not disabled by the application of a magnet, it is recommended to initially limit the application of therapy to 1 or 2 seconds every 10 seconds or more to reduce the risk of symptoms. Application of therapy at this rate poses a low risk of causing symptoms in most individuals. Application of the magnet over the pacemaker will disable the sensing circuit and cause magnet rate pacing (usually 85 bpm). Without magnet application and with use of the AC or combination mode for 5 seconds or more there is the potential for Pacemaker inhibition or reversion and for ICD shock.

Medical Procedures						
Item	Low Risk when following Safety Precautions	Potential Pacemaker Reversion or Magnet Rate	Potential Pacemaker Inhibition	Potential ICD Shock	Potential disable of ICD detection circuit	Safety Precautions Be sure all items are in good working order and properly grounded, if necessary.
Electrolysis - DC - Galvanic	✓		✓			Used for the removal of unwanted hair. The DC only mode (galvanic) is unlikely to be detected by the Pacemaker or ICD. If application of DC only mode were to be detected, there is the potential for Pacemaker inhibition or inhibition of the Pacemaker portion of the ICD. (1-2 seconds per application). For this reason therapy should initially be limited to once every 10 seconds in order to pose a low risk of causing symptoms in most individuals. Application of the magnet may not be necessary in the galvanic mode.
EMG Electromyography-Single Stimulus Manually Activated Test (Nerve conduction test - Type 1) (Continued below)	✓		✓			This procedure introduces electrical current into the body that may affect the implanted devices of individuals. It is recommended that individuals considering this procedure consult their heart doctor to evaluate any possible risks associated with these responses in conjunction with their medical condition. Low risk of affecting Pacemaker or ICD. This test is used to examine nerve conduction or motor impairment of the nerve. With a single stimulus protocol the physician manually initiates the delivery of a singular nerve stimulus. If the stimulus were to be detected there is the potential for Pacemaker inhibition or inhibition in the Pacemaker portion of the ICD for 1-2 seconds. If the stimuli are separated by more than 10 seconds; the 1-2 second pauses will not in most cases result in any symptoms for the individual. When both EMG electrodes associated with the delivery of the stimuli are placed on the same extremity, the electrical current passing through the areas around the Pacemaker or ICD has a low risk of being detected. (Continued below)
EMG Electromyography-Single Stimulus Manually Activated Test (Nerve conduction test - Type 1)	✓		✓			If it is necessary to apply stimuli at a rate faster than once every 10 seconds, magnet application is recommended. Magnet application in the Pacemaker will result in continuous pacing at the magnet rate (usually 85 bpm). The magnet application will disable the detection circuit of the ICD. If the application of the stimuli is detected, the Pacemaker portion of the ICD will be inhibited for one interval each time the stimulus is delivered whether a magnet is applied or not.

← Medical Procedures →						
Item	Low Risk when following Safety Precautions	Potential Pacemaker Reversion or Magnet Rate	Potential Pacemaker Inhibition	Potential ICD Shock	Potential disable of ICD detection circuit	Safety Precautions Be sure all items are in good working order and properly grounded, if necessary.
EMG Electromyography-Automated Sequence Test (Nerve conduction - Type 2)	✓	✓	✓	✓		This procedure introduces electrical current into the body that may affect the implanted devices of individuals. It is recommended that individuals considering this procedure consult their heart doctor to evaluate any possible risks associated with these responses in conjunction with their medical condition. Pulse train delivers stimuli at a rate of 2-5 times/second for 250 pulses. If Pacemaker or ICD detects the stimulus pulse sequence there is the potential for Pacemaker reversion or inhibition, and for ICD shock. There is a low risk of either the ICD or the Pacemaker detecting stimuli initiated on the extremities. However, as an additional safety precaution the placement of a magnet over the ICD will disable the ICD detection circuit and prevent an inadvertent shock therapy. If the Pacemaker portion of the ICD detects the EMG stimuli, the pacemaker portion of the ICD will be inhibited even when the magnet is applied. Magnet application over the Pacemaker will result in magnet rate operation (usually 85 bpm).
Electronystagmography (Audiology - ENG)	✓					Low risk of affecting Pacemaker or ICD. The ENG test is used to assess balance and movement disorders. Passive electrodes are placed on the head to evaluate the electrical potentials associated with eye movement. (Similar to EKG, EEG)
Hearing Aid in ear or hard wired from an acoustical detector wore on the belt or other locations not close to the ear (most Cochlear implants)	✓					Low risk of affecting Pacemaker or ICD. A hard wire system has a wire that is connected directly between the belt worn audio detector and the ear piece or the head piece in the case of Cochlear implants. (No significant risk associated with this type of hard wired connection) Most Cochlear implants are configured in this way.

Medical Procedures						
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Hearing Aids with transmitting necklace loops coupled into the ear piece Telcoil (T-coil) of the hearing aid	✓	✓	✓	✓		Some hearing aid audio detectors are suspended from a necklace loop. The transmitting antenna associated with this type of hearing aid system is incorporated into the necklace loop. This antenna radiates a magnetic field that is coupled into the T-coil in the earpiece of the hearing aid. Maintain a 6" (15cm) distance between the Pacemaker and the portion of the hearing aid necklace radiating the magnetic field. If the transmitting antenna is closer than the noted distance, there is the potential for Pacemaker reversion or inhibition and for ICD shock. Individuals may want to reposition the loop so that it is located on the opposite shoulder from the implant site or look for an alternate transmitting antenna system that can also be worn in such a way to maintain the recommended distance of greater than 6" (15cm). In addition, necklace loop antennas attached to audio equipment (CD players, tape recorders) will have the same precautions.
Hyperbaric Chamber	✓					A chamber large enough to accommodate one or more persons in which pressure is above normal atmospheric pressure. It is used to treat several medical conditions (i.e. carbon monoxide poisoning, infections, burns, pressure related diving injuries). Medtronic devices are test for compatibility with hyperbaric chamber therapy. Our devices will tolerate pressures up to two and one-half atmospheres absolute.
Interferential Electrical Current Therapy (Continued below)		✓		✓		This procedure introduces electrical current into the body that may affect the implanted devices of individuals. It is recommended that individuals considering this procedure consult their heart doctor to evaluate any possible risks associated with these responses in conjunction with their medical condition. Interferential current therapy is a treatment to aid the relief of pain and promotion of soft-tissue healing (used by Physical Therapists). Similar to a TENS unit, but provides deeper penetration and less patient discomfort. There is a lower risk of the device detecting this therapy when used on extremities. For use on torso this therapy could cause Pacemaker reversion or ICD shock. (Continued below)

Medical Procedures						
Item	Low Risk when following Safety Precautions	Potential Pacemaker Reversion or Magnet Rate	Potential Pacemaker Inhibition	Potential ICD Shock	Potential disable of ICD detection circuit	Safety Precautions Be sure all items are in good working order and properly grounded, if necessary.
Interferential Electrical Current Therapy		✓		✓		Recommend Magnet application for ICD and Pacemakers. Placement of a magnet over the ICD will disable the ICD detection circuit and prevent an inadvertent shock therapy. If the Pacemaker portion of the ICD detects the Interferential current, the pacemaker portion of the ICD will be inhibited even when the magnet is applied. Magnet application over the Pacemaker will result in magnet rate operation (usually 85 bpm). Contact Medtronic Technical Services for specific concerns.
Iontophoresis (drug patch)	✓					Low risk of affecting Pacemaker or ICD. Introduction of a low level DC current to enhance the transfer of a drug into the body from an externally applied patch.
Laser Surgery	✓					Laser (light energy only) poses a low risk of affecting Pacemaker or ICD. Verify laser equipment. If combination of laser and electrocautery, see electrocautery guidelines.
Lasik Eye Surgery	✓					Recommend the application of a magnet to disable ICD detection circuit, or program ICD detection circuit off prior to surgery. These precautions are taken so legitimate therapy will not be delivered during critical portions of this delicate corrective eye procedure. Laser light associated with this procedure has a low risk of affecting the Pacemaker or ICD.
Lie Detector Test	✓					Lie detector tests introduce only direct current into the body. This direct current poses a low risk of affecting a Pacemaker or ICD. If Pacemaker or Pacemaker portion of ICD is delivering stimuli, the heart rate variation parameters of the test may not be valid.
Magnetic therapy	✓	✓			✓	Maintain a 6" (15cm) distance between all therapy magnets and an implanted device. Low risk of affecting the Pacemaker or ICD with the exception of magnetic mattress pads and pillows due to the difficulty in keeping a 6" (15cm) distance away while lying down or while sleeping. If a magnet is closer than 6" (15cm), there is the potential for Pacemaker reversion and disabling of ICD detection circuit.
Mammogram (Diagnostic X-ray)	✓					Low risk of affecting Pacemaker or ICD. X-ray equipment can be adjusted to make individual more comfortable and lessen the pressure on the Pacemaker or ICD.

Medical Procedures						
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Mechanical ventilation with a respiration rate monitor	✓	✓			✓	Ventilators are used to help individuals breathe during surgery. Respiration rate monitors are used in conjunction with the ventilators to help verify that an individual's breathing rate is in a normal range during surgery. Kappa 400 pacemakers and respiratory monitors have similar sensors that introduce conducted current into the body to detect breathing rate. Therefore, it is recommended that the sensors for the Kappa 400 pacemakers be programmed off before surgery so that the pacing rate is not affected by the respiratory monitor during the procedure. Magnet application is recommended for both Pacemaker and ICDs. Magnet application over the Pacemaker will result in magnet rate operation (usually 85 bpm). Magnet rate over the ICD will result in disabling of the ICD detection circuit and prevent an inadvertent shock therapy. If the Pacemaker portion of the ICD detects the Respiration rate monitor pulses the Pacemaker portion of the ICD will inhibit even when the magnet is applied. If no magnet is applied, there is the potential for Pacemaker reversion or ICD shock.
Medical Helicopter	✓					Low risk of affecting Pacemaker or ICD. The vibration may increase pacing rate if the rate response function is programmed "on". Recommended to put patient on extra padding.
MET (Microcurrent Electrical Therapy) Alpha-Stim 100®		✓	✓	✓		This procedure introduces electrical current into the body that may affect the implanted devices of individuals. It is recommended that individuals considering this procedure consult their heart doctor to evaluate any possible risks associated with these responses in conjunction with their medical condition. Similar to TENS unit with somewhat less current. See physician or consult with Medtronic Technical Services. If used on torso at the .5 hertz and 1.5 hertz frequency, MET may cause Pacemaker inhibition or inhibition in the Pacemaker portion of the ICD. If used on the torso at the 100 hertz frequency, MET may cause Pacemaker reversion or ICD shock. There is a lower risk of the device <u>detecting MET therapy if used on extremities</u> .
MRA (Magnetic Resonance Angiography)						Not recommended - The MRA procedure is done within an MRI machine. An MRI examines soft tissues and organs. The MRA is a procedure to examine blood vessels within an MRI machine that may require the injection of an enhancing agent. Even when the MRI is not in use the Pacemaker and ICD may be affected by the static magnet field that is always present near the MRI. There is the potential for Pacemaker magnet rate operation and disabling of ICD detection circuit.

Medical Procedures						
Item	Low Risk when following Safety Precautions	Potential Pacemaker Reversion or Magnet Rate	Potential Pacemaker Inhibition	Potential ICD Shock	Potential disable of ICD detection circuit	Safety Precautions Be sure all items are in good working order and properly grounded, if necessary.
MRI (Magnetic Resonance Imaging)						Not recommended - Even when the MRI is not in use the Pacemaker & ICD may be affected by the static magnet field that is always present near the MRI. There is the potential for Pacemaker magnet rate operation and disabling of ICD detection circuit. For Medtronic Reveal Insertable Loop Recorder (ILR) See below
MRI (Magnetic Resonance Imaging) for Medtronic Reveal Insertable Loop Recorder (ILR)	√					Magnetic and radio frequency (RF) fields produced by MRI may adversely affect the data being stored by the Reveal ILR. If the patient has experienced a syncopal and/or otherwise symptomatic episode since their last Reveal interrogation, the Reveal device should be interrogated before the MRI procedure. Interrogation and reprogramming of the Reveal settings after the MRI procedure is recommended. The individual may feel a slight tugging on their implanted device during the procedure because of some of the materials contained within the Reveal ILR. If the MRI is to be performed in the immediate vicinity of the loop recorder, the presence of the metallic case of the ILR may significantly distort the data gathered by the MRI during the procedure. As a result, there is a chance the MRI data may not be useful.
Nuclear Stress Test	√					This procedure is used to see blood flow in the patient's heart at rest and during activity. A radioactive substance is injected into the patient's bloodstream and viewed with a special scanner. No reported interference with this procedure.
Neutron Radiation	√					Exposure guidelines: Maximum Neutron exposure of 100 rads for ICDs and 500 Rads cumulative for Pacemakers. This level includes an adequate safety margin. Although high energy neutrons have great penetrating power, they only produce ionizing radiation indirectly on impact with the nuclei of atoms. Neutron radiation does pose higher risk of biological affects (2 -11 times) relative to gamma radiation at the same radiation level in rads. However, the affect of neutron radiation on inorganic material within the ICD would be similar to gamma radiation of the same intensity. Measurable parameter shifts may be seen at radiation levels in excess of these amounts.
PET Scan (Positron Emission Tomography)	√					Low risk of affecting Pacemaker or ICD. Radioactive dye is injected into body. Radiation given off by the body is monitored. Similar to a diagnostic X-ray.

Medical Procedures						
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Pulse Radiation Therapy (Radio frequency)	✓	✓	✓	✓		This procedure introduces electrical current into the body that may affect the implanted devices of individuals. It is recommended that individuals considering this procedure consult their heart doctor to evaluate any possible risks associated with these responses in conjunction with their medical condition. Magnet application recommended for Pacemaker & ICD. Similar to radio frequency ablation. This procedure is used to interrupt nerve pathways for pain management. Nerve ablation can damage Pacemaker and ICD circuitry if it is administered within 6" (15cm) of the device. If the ablation is farther than 6" (15cm) there is the potential for Pacemaker reversion or ICD shock.
Radiation Therapy (External X-ray or Gamma knife)	✓	✓		✓		Maintain a 6" (15cm) distance from electronic cabinetry associated with radiating device. If the device is closer than 6" (15cm) to the cabinetry, there is the potential for Pacemaker reversion or ICD shock. Exposure Guidelines: The Maximum Gamma exposure levels is 500 rads for pacemakers cumulative. Maximum Gamma exposure levels for ICDs is model dependent. For most ICDs the Maximum Gamma Exposure level is 100 rads cumulative. However, there are some ICD models that have a Maximum Gamma Exposure level of 500 rads. If there is a concern that the radiation exposure will exceed 100 rads, contact Medtronic Technical Services to verify the Maximum Gamma Exposure level for that particular model. These levels include an adequate safety margin. At radiation levels in excess of these amounts, damage may occur to the device, and/or measurable parameter shifts may occur. The oncologist can evaluate the risks of exceeding these levels of exposure.
Radiation Therapy (Internal/implants)	✓					Exposure Guidelines: Maximum Gamma exposure levels is 500 rads for pacemakers cumulative. Maximum Gamma exposure levels for ICDs is model dependent. For most ICDs the Maximum Gamma Exposure level is 100 rads cumulative. However, there are some ICD models that have a Maximum Gamma Exposure level of 500 rads. If there is a concern that the radiation exposure will exceed 100 rads, contact Medtronic Technical Services to verify the Maximum Gamma Exposure level for that particular model. These levels include an adequate safety margin. At radiation levels in excess of these amounts, damage may occur to the device, and/or measurable parameter shifts may occur. The oncologist can evaluate the risks of exceeding these levels of exposure.
Relief Band®	✓					Used to prevent motion sickness from traveling. Delivers a small electrical pulse at the wrist area. Low risk of affecting Pacemaker or ICD.
Sleep Apnea Machine	✓					Low risk of affecting Pacemaker or ICD.

Medical Procedures						
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TMS (Transcranial Magnetic Stimulation)	✓		✓	✓		It is recommended that individuals considering this procedure consult their heart doctor to evaluate any possible risks associated with these responses in conjunction with their medical condition. It is recommended that Medtronic Technical Services be contacted to review specific concerns. Magnet application recommended for ICD or Pacemaker. This magnetic pulse therapy used in Psychiatry, produces a similar effect to Electro-convulsive therapy (ECT) with minimal side effects. Delivers 100 magnetic pulses per minute over a 10-15 minute period. Application of the magnet over the Pacemaker will cause magnet rate operation in the Pacemaker (usually 85 bpm). Application of the magnet over the ICD will disable ICD detection circuit. Magnet application will not disable the sensing function of the Pacemaker portion of the ICD. If the magnetic field associated with this therapy is detected there is the potential for inhibition in the Pacemaker portion of the ICD, even with the magnet applied. Reprogramming the ICD may be appropriate for individuals that are dependent on the Pacemaker portion
TUNA Therapy (Medtronic product) - Transurethral Needle Ablation		✓		✓		Not recommended. Medtronic physician manual contraindicates the use of this device for individuals with either a Pacemaker or ICD. Recommend consulting with physician for other therapeutic prostate procedures that pose less risk of interacting with a Pacemaker or ICD. Minimally invasive, this office based procedure results in a decreased amount of prostate tissue, which improves urination. The procedure works by delivering low-level radio frequency energy into the prostate, which shrinks the prostate tissue allowing the individual to urinate more normally.
TENS Unit (Transcutaneous Electrical Nerve Stimulation)		✓	✓	✓		This procedure introduces electrical current into the body that may affect the implanted devices of individuals. It is recommended that individuals considering this procedure consult their heart doctor to evaluate any possible risks associated with these responses in conjunction with their medical condition. Transcutaneous Electrical Nerve Stimulation (TENS). If used on the torso, TENS could cause Pacemaker reversion or ICD shock. There is a lower risk of the Pacemaker or ICD detecting TENS when used on extremities. See physician or consult with Medtronic Technical Services
TUMT (Transurethral Microwave Thermotherapeutic Device)						Not Recommended. This is a diathermy-type of therapy. Most manufactures of this type of device contraindicate the use of this therapy with PM or ICD patients. Medtronic also contraindicates the usage of this therapy.

Medical Procedures						
Item	Low Risk when following Safety Precautions	Potential Pacemaker Reversion or Magnet Rate	Potential Pacemaker Inhibition	Potential ICD Shock	Potential disable of ICD detection circuit	Safety Precautions Be sure all items are in good working order and properly grounded, if necessary.
TURP- Prostate test (Transurethral Resection of the Prostate) ICD recommendations (Continued below)	✓		✓	✓		This procedure introduces electrical current into the body that may affect the implanted devices of individuals. It is recommended that individuals considering this procedure consult their heart doctor to evaluate any possible risks associated with these responses in conjunction with their medical condition. Process used in surgeries to cut tissue and stop the bleeding of blood vessels. Recommend the application of a magnet for ICD. Individuals with an ICD should have their physician consult with Medtronic Technical Services for precautions. If the grounding electrode is placed less than 6" (15cm) from device; damage can occur and/or the output of the device can be affected even when the magnet is applied. Damage may occur to the tissue at the lead tissue interface. Currents induced into the lead system may initiate an arrhythmia. (Continued below)
TURP- Prostate test (Transurethral Resection of the Prostate) ICD recommendations	✓		✓	✓		For ICDs with the grounding pad placed at a distance greater than 6" (15cm) from the implanted device with a magnet applied - Limiting application of TURP electrosurgery to 1-2 seconds every 10 seconds may reduce the risk of symptoms in individuals that are dependent on the Pacemaker portion of the ICD. Although the magnet application disables the ICD detection circuit, the timing limitation is necessary because the sensing function of the Pacemaker portion of the ICD will operate normally with the magnet applied. Therefore, there is a risk of ICD sensing the application of the TURP electrode causing the Pacemaker portion of the ICD to pause. However, the Pacemaker portion of the ICD will function normally during the times between applications of the TURP electrosurgery. If no magnet is present over the ICD, limit the electrosurgery application to 1-2 seconds every 30 seconds to minimize the possibility of initiating an inadvertent shock therapy. If these timing intervals are restrictive, reprogramming of the ICD should be considered, especially for individuals that are dependent on the Pacemaker portion of the ICD.

Medical Procedures						
Item	Low Risk when following Safety Precautions	Potential Pacemaker Reversion or Magnet Rate	Potential Pacemaker Inhibition	Potential ICD Shock	Potential disable of ICD detection circuit	Safety Precautions Be sure all items are in good working order and properly grounded, if necessary.
TURP- Prostate test (Transurethral Resection of the Prostate) Pacemaker recommendations (Continued below)	✓	✓	✓			This procedure introduces electrical current into the body that may affect the implanted devices of individuals. It is recommended that individuals considering this procedure consult their heart doctor to evaluate any possible risks associated with these responses in conjunction with their medical condition. Process used in surgeries to cut tissue and stop the bleeding of blood vessels. Recommend the application of a magnet for Pacemaker. Individuals with Pacemakers should have their physician consult with Medtronic Technical Services for precautions. If the grounding electrode is placed less than 6" (15cm) from device; damage can occur and/or the output of the device can be affected even when the magnet is applied. Damage may occur to the tissue at the lead tissue interface. Currents induced into the lead system may initiate an arrhythmia. <i>(Continued below)</i>
TURP- Prostate test (Transurethral Resection of the Prostate) Pacemaker recommendations	✓	✓	✓			For Pacemakers with the grounding pad placed at a distance greater than 6" (15cm) from the implanted device with a magnet applied - Magnet application in the Pacemaker causes the Pacemaker to deliver a sequence of stimuli at a normal low rate (usually 85 bpm magnet rate). If no magnet is present over the pacemaker, limiting application of TURP electrosurgery to 1-2 seconds every 10 seconds may reduce the risk of symptoms in individuals that are dependent on the pacemaker. If these timing intervals are restrictive, reprogramming of the Pacemaker should be considered, especially for individuals that are dependent on the Pacemaker.
Ultrasound (Diagnostic) or Sonogram	✓					This procedure uses ultrasound technology to create images of organs and other body parts. It is recommended that the technician not place the transducer head directly over the implanted device. *A sonogram is a type of diagnostic ultrasound used during pregnancy.
Ultrasound (Therapeutic)	✓					The implanted heart device should not be exposed to therapeutic ultrasound. It is recommended that the transducer head be kept at least 6" (15 cm) away from the implanted heart device.
Virtual Colonoscopy performed with CAT Scan (CT Scan)	✓					A procedure that is used to diagnose colon and bowel disease, including polyps, diverticulosis, and cancer. The procedure is performed with a CAT SCAN or MRI. The procedure using an MRI is not recommended. See CAT scan for more information on this procedure using CAT scans.
Virutal Colonoscopy with MRI						Not Recommended - The Pacemaker & ICD may be affected by the static magnet field that is always present near the MRI. There is the potential for Pacemaker magnet rate operation and disabling of ICD detection circuit even when MRI is not in use. See MRI for more information.
X-ray (Diagnostic)	✓					Low risk of affecting Pacemaker or ICD.

Safety Precaution Recommendations:

The distances recommended in the Safety Precautions are conservative and in most cases not restrictive. These recommendations are applicable to all Medtronic Pacemakers and ICDs. In general, newer Medtronic Pacemakers and ICDs may be more resistant than older Medtronic Pacemakers and ICDs to electromagnetic fields. As a result, the distances called out in the Safety Precautions for these newer models may in some cases be very conservative. For these newer models some of the distances in the Safety Precautions represent safety margins from 5 to 20 times the distance called out. Contact the Medtronic Technical Services Department for specific information on Medtronic pacemaker or defibrillator model susceptibility to particular sources and intensities of electromagnetic fields.

Model AT500 Arrhythmia Management Device (pacemaker) Recommendations:

The Medtronic Model AT500 arrhythmia management device (pacemaker) responds like an ICD to sensed electromagnetic fields and conducted currents. However, since the AT500 is not capable of high-energy shock therapies, it may respond to sensed events that would cause a shock in an ICD by delivering a low energy paced therapy. Although the AT500 is referred to as a Pacemaker normal Pacemaker responses described in this chart do not apply, but the ICD responses as noted above do apply.

Term	Technical definition	Non-Technical (Patient) definition
Pacemaker Reversion	The pacemaker has a safety feature that identifies/classifies detected strong continuous radiated electromagnetic fields or conducted currents that occur outside of the cardiac rate range (i.e. > or = 300 Pulses per minute or 5 Hertz. Once a field or current is identified/classified, this safety feature allows a pacemaker to deliver pacing stimuli to the heart when sensing strong continuous radiated electromagnetic fields or conducted currents. Pacemaker reversion minimizes the types of continuous electromagnetic fields or conducted currents that can cause the Pacemaker to be inhibited.	Pacemaker will continuously pace the heart at the programmed low rate of the Pacemaker while in the presence of a strong continuous alternating magnetic field.
Pacemaker Magnet Response	A static magnetic field of 10 Gauss or more will cause the pacemaker to deliver a continuous sequence of stimuli at 85 beats per minute for our current pacemaker or other normal low rates specific to our older model pacemakers.	Pacemaker will continuously pace the heart at the magnet rate (85 bpm for our current pacemakers) while in the presence of a strong static magnetic field associated with either a permanent magnet or an electro-magnet.
Pacemaker Inhibition	A function that normally allows the sensing of the electrical potential that is given off by the heart when it contracts. Sensing of the heart contractions causes the pacemaker to withhold the electrical stimulus (inhibit/standby). This response is limited to a heart rate range up to approximately 300 pulses per minute or 5 Hertz. Radiated magnetic fields or conducted currents that are detected by the pacemaker in this rate range also cause the output of the pacemaker to erroneously withhold the electrical stimulus (inhibit/standby).	Pacemaker will withhold pacing pulses, if electrical potentials are detected within the heart rate range.

Electromagnetic Compatibility (EMC) Chart for Medtronic Pacemakers and Defibrillators (ICD)

Term	Technical definition	Non-Technical (Patient) definition
ICD Shock Therapy	Appropriate therapy delivery: A function that normally terminates an erratic, life-threatening arrhythmia of the ventricle by delivering a high energy, direct current electrical stimulus. Inappropriate therapy delivery: Any strong continuous electromagnetic fields or conducted currents detected at a rate exceeding the detection rate set in the ICD will cause an inadvertent shock therapy. In addition, the pacemaker portion of the ICD will withhold the electrical stimulus (inhibited/standby) for as long as the fields or currents are present. Magnetic fields and currents detected at rates below the detection rate may only cause inhibition or suppression of the pacemaker function of the ICD. There is no noise reversion function associated with the Pacemaker portion of the ICD.	Appropriate therapy delivery: A therapy consisting of an electrical shock to terminate fast heart rates in the ventricle. Inappropriate therapy delivery: If the defibrillator detects radiated electromagnetic fields or conducted current, the defibrillator will classify these as a fast heart rate and deliver an unnecessary shock.
ICD - Magnet Response (Disable of ICD detection circuit)	A static magnetic field associated with either a permanent magnet or an electro-magnet of 10 Gauss or more disables the detection circuit associated with the ICD for as long as the magnet is present. When the magnet is removed the ICD will immediately resume the detection function and normal operation. A static magnetic field does not affect the operation of the pacemaker portion of the ICD.	The detection of fast heart rates are temporarily disabled in the ICD. The Pacemaker portion of the ICD is not affected.
Maximum Permissible Exposure (MPE)	Previously known as Biological Radiation Hazard Level (BRH). These levels are set by Government agencies as the maximum safe levels of exposure for radio frequency field (i.e.: non-ionizing radiation). Note: Ionizing radiation is emitted by radioactive sources.	Exposure levels for radio frequency fields set by the government.
PM & ICD telemetry frequency is 175 KHZ (Kilohertz)	Transmitter/receiver circuitry of the Pacemaker and ICD is not energized until the magnet is applied. As a result it is unlikely that external electromagnetic fields and conducted currents will enter the Pacemaker or ICD via the telemetry circuit.	In most cases the telemetry circuit will not be affected by electromagnetic fields or conducted currents.