

Medtronic

Azure™ XT DR MRI SureScan™ W2DR01



MR Conditional dual chamber pacemaker with SureScan™ technology and Bluetooth® wireless telemetry (OAE-DDDR)

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1 System overview

1.1 CE mark of conformity

CE0123

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1.2 Introduction

This manual describes the Medtronic Model W2DR01 Azure XT DR MRI SureScan dual chamber, implantable pulse generator (IPG). It contains model-specific feature information, indications and contraindications, warnings and precautions, instructions for implanting the device, quick reference specifications, and parameter tables.

Additional manuals and documents with information about the device:

MRI technical manual – This manual provides MRI-specific procedures and warnings and precautions.

Reference manual – This manual contains information about device features. The reference manual applies to multiple models of IPG devices.

Programming guide – This manual explains how to use the programmer software to conduct a patient session.

Explanation of symbols – This document defines the symbols that may appear on the device package. Refer to the package label to see which symbols apply specifically to this device.

Medical Procedure and EMI Warnings and Precautions Manual for Health Care Professionals – This manual provides warnings, precautions, and guidance for health care professionals who perform medical therapies and diagnostic procedures on cardiac device patients. The manual also provides patient education information related to sources of electromagnetic interference (EMI) at home, at work, and in other environments.

Radio regulatory compliance information – This document provides compliance information related to the radio components of the device.

1.3 System description

The Medtronic Azure XT DR MRI SureScan Model W2DR01 dual chamber implantable pulse generator (IPG) is a multiprogrammable cardiac device that monitors and regulates the patient's heart rate by providing single or dual chamber rate-responsive bradycardia pacing and atrial tachyarrhythmia therapies. This device features Bluetooth® wireless technology.¹

The MRI SureScan feature permits a mode of operation that allows a patient with a SureScan system to be safely scanned by an MRI machine while the device continues to provide appropriate pacing. When programmed to On, MRI SureScan operation disables arrhythmia detection, magnet mode, and all user-defined diagnostics. Before performing an MRI scan, refer to the MRI technical manual.

Rate response – Rate response is controlled through an activity-based sensor.

The users of this device include medical professionals (physicians, nurses, technicians, and their supporting staff) trained in surgery, cardiology, radiology, and magnetic resonance (MR) technology and able to implement the procedures documented in the instructions for use for this device.

¹ The Bluetooth® word mark is a registered trademark of Bluetooth SIG, Inc. and any use of this mark by Medtronic is under license.

1.3.1 Usage environments

The device is intended to be used in the following environments and conditions:

- The device will be implanted in a properly equipped, staffed, and sterile surgical environment. Implant will take place under standard surgical protocols and in the patient population for which the device is indicated.
- Post-surgical patient and device follow-up care will take place in a properly equipped and staffed cardiology clinic or office.
- MRI procedures for patients with this device will take place in a properly equipped and staffed MR facility, and in consideration of the conditions and requirements described in Section 1.6, “MRI conditions for use”, page 6.
- After having an implant, patients may resume their lives at home, at work, and in other environments with consideration of the advice and restrictions documented in the Medical Procedure and EMI Warnings and Precautions Manual for Health Care Professionals.

1.3.2 System components and accessories

Contents of sterile package – The package contains 1 implantable pulse generator (IPG) and 1 torque wrench.

Implantable device system – The Azure XT DR MRI SureScan Model W2DR01 device and the pacing leads constitute the implantable portions of the device system.

Leads – The lead system used with this device must provide sensing and pacing to the right ventricle (RV) and to the atrium (A). Do not use any lead with this device without first verifying lead and connector compatibility.

For information about selecting and implanting SureScan leads for this device, refer to Section 3.2, “Selecting and implanting the leads”, page 15.

Programmable and software – Medtronic programmers and software are used to program this device. Programmers from other manufacturers are not compatible with Medtronic devices, but they do not damage Medtronic devices.

Medtronic pacing system analyzer – A pacing system analyzer is used to measure the electrical characteristics of the implanted leads to assess their effectiveness for pacing and sensing.

Medtronic patient monitor – Patients use the Medtronic patient monitor, if available, to gather information from their implanted devices and communicate the information to their physicians through the Medtronic CareLink Network. For information on using the patient monitor, refer to the patient monitor literature.

1.4 Indications and usage

The Azure XT DR MRI SureScan system is indicated for use in patients who may benefit from rate responsive or non-rate responsive pacing to restore physiologic heart rates, improve cardiac output, prevent symptoms, or protect against arrhythmias related to cardiac impulse formation or conduction disorders.

1.5 Contraindications

The Medtronic Azure XT DR MRI SureScan system is contraindicated for the following:

- Concomitant implantation with another bradycardia device
- Concomitant implantation with an implantable cardioverter defibrillator (ICD)
- Rate responsive modes in patients who cannot tolerate pacing rates above the programmed lower rate
- ATP therapy in patients with an accessory antegrade pathway
- Dual chamber pacing in patients with chronic or persistent supraventricular tachycardias, including atrial fibrillation or flutter
- Single chamber atrial pacing in patients with an AV conduction disturbance
- Asynchronous pacing where spontaneous rhythms may cause competitive pacing

1.6 MRI conditions for use

A complete SureScan pacing system is required for use in the MR environment. A complete SureScan pacing system includes a SureScan device with Medtronic SureScan leads. Any other combination may result in a hazard to the patient during an MRI scan.

Warning: Do not scan a patient without first programming the MRI SureScan mode to On. Scanning the patient without programming the MRI SureScan mode to On may result in patient harm or damage to the SureScan pacing system.

Note: The MRI SureScan mode cannot be programmed to On if the device is recommended for replacement.

Cardiology requirements

Patients and their implanted systems must be screened to meet the following requirements:

- The patient has no implanted lead extenders, lead adaptors, or abandoned leads.
- The patient has no broken leads or leads with intermittent electrical contact, as confirmed by lead impedance history.
- The SureScan pacing system is implanted in the left or right pectoral region.
- The pace polarity parameters are set to Bipolar for programming the MRI SureScan mode to On.
- The SureScan device is operating within the projected service life.
- For patients whose device will be programmed to an asynchronous pacing mode when the MRI SureScan mode is programmed to On, no diaphragmatic stimulation is present when the paced leads have a pacing output of 5.0 V and a pulse width of 1.0 ms.

Caution: It is not recommended to perform an MRI scan if the right ventricular (RV) lead pacing capture threshold is greater than 2.0 V at 0.4 ms for pacemaker-dependent patients. A higher pacing capture threshold may indicate an issue with the implanted lead.

Notes:

- For radiology requirements, refer to the MRI technical manual.
- **Before performing an MRI scan, refer to the MRI technical manual for MRI-specific warnings and precautions.**

Patient monitoring and rescue requirements

- Continuous patient monitoring is required during the MRI scan.
- In the event that patient rescue is required, an external defibrillator must be immediately available.

1.7 Feature summary

The following features are available in this device. For a list of the features that are enabled at shipping, see the “Shipped” column of the tables in Chapter 5, “Device parameters”, page 27.

1.7.1 Tachyarrhythmia detection and therapy features

Atrial antitachycardia pacing (ATP) – These therapies respond to an AT/AF episode or a Fast AT/AF episode with rapid sequences of pacing pulses to terminate detected atrial tachyarrhythmias.

Auto-adjusting sensitivity – This feature automatically adjusts the sensitivity thresholds after specific paced events and sensed events occur.

Reactive ATP – This feature allows the device to deliver atrial ATP therapies that had been unsuccessful earlier in an AT/AF episode. The device repeats the delivery of atrial ATP therapies after the programmed time interval or when the atrial rhythm changes.

1.7.2 Pacing features

Atrial Capture Management – This feature monitors the atrial pacing threshold with daily pacing threshold searches and, if programmed to do so, adjusts the atrial pacing amplitude toward a target amplitude.

Atrial intervention pacing features – The system provides the following overdrive pacing techniques that are designed to counteract potential atrial tachyarrhythmia initiating mechanisms:

- **Atrial Preference Pacing (APP)** maintains a consistent activation sequence by providing continuous pacing that is slightly higher than the intrinsic rate.
- **Atrial Rate Stabilization (ARS)** adapts the atrial pacing rate in response to a PAC (premature atrial contraction) to avoid long sinus pauses following short atrial intervals.
- **Post Mode Switch Overdrive Pacing (PMOP)** works with the Mode Switch feature to deliver overdrive atrial pacing during the vulnerable phase following an AT/AF episode termination.

Automatic polarity configuration – This device uses lead impedance measurements to automatically configure pacing and sensing polarities during Implant Detection.

Automatic PVARP – This feature adjusts PVARP (Post-Ventricular Atrial Refractory Period) in response to changes in the patient's heart rate or pacing rate. PVARP is longer at lower tracking rates to prevent pacemaker-mediated tachycardia (PMT) and shorter at higher rates to maintain 1:1 tracking.

Conducted AF Response – This feature regularizes the ventricular rhythm during conducted AT/AF by modifying the pacing rate on a beat-by-beat basis to closely match the patient's average ventricular response.

Mode Switch – This feature switches the device from a tracking mode to a nontracking mode to prevent rapid ventricular pacing that may result from a high atrial rate, and restores the programmed pacing mode when the atrial tachyarrhythmia ends.

MRI SureScan – This feature allows patients with an implanted MRI SureScan system, including the device and leads, to have a safe MRI procedure if the requirements provided in the MRI technical manual are followed.

MVP (Managed Ventricular Pacing) – The MVP feature promotes intrinsic conduction by reducing unnecessary right ventricular pacing. This feature operates when the programmed mode is either AAIR<=>DDDR or AAI<=>DDD.

Non-Competitive Atrial Pacing (NCAP) – This feature prevents pacing the atrium too soon after a refractory atrial sense by delaying the scheduled atrial pace.

Pacemaker-mediated Tachycardia (PMT) Intervention – This feature provides automatic detection and interruption of device-defined PMTs.

PVC Response – This feature extends PVARP following a premature ventricular contraction (PVC) to avoid tracking a retrograde P-wave and to prevent retrograde conduction from inhibiting an atrial pace.

Rate Adaptive AV (RAAV) – This feature varies the Paced AV (PAV) and Sensed AV (SAV) intervals as the heart rate increases or decreases during dual chamber operation to maintain 1:1 tracking and AV synchrony.

Rate Drop Response – This feature monitors the heart for a significant drop in rate and responds by pacing the heart at an elevated rate for a programmed duration.

Rate Profile Optimization – The goal of Rate Profile Optimization is to ensure that the rate response remains appropriate for the full range of patient activities. This feature monitors the patient's daily and monthly sensor rate profiles and adjusts the rate response curves over time to achieve a prescribed target rate profile.

Rate-responsive pacing – This feature varies the pacing rate in response to the patient's physical motion as detected by the activity sensor of the device.

RV Capture Management – This feature monitors the right ventricular pacing threshold with daily pacing threshold searches and, if programmed to do so, adjusts the RV pacing amplitude toward a target amplitude.

Sleep feature – This feature causes the device to pace at a slower rate during a programmed sleep period.

Ventricular Rate Stabilization (VRS) – This feature adjusts the pacing rate dynamically to eliminate the long pause that typically follows a premature ventricular contraction (PVC).

Ventricular Safety Pacing (VSP) – This feature prevents inappropriate inhibition of ventricular pacing caused by crosstalk or ventricular oversensing.

1.7.3 Monitoring and follow-up features

Cardiac Compass Trends – This feature provides a Cardiac Compass Trends report that shows an overview of the patient's condition, with graphs that display long-term trends in heart rhythm over the last 14 months. The report also includes the OptiVol 2.0 fluid trend data.

Medtronic CareAlert Monitoring – If the device identifies any programmed or automatic CareAlert conditions, this feature sends a wireless alert signal to the patient monitor (if available). The patient monitor then transmits the CareAlert Event data to the Medtronic CareLink Network. If configured to do so, the Medtronic CareLink Network then sends an alert notification to the clinic.

Episode data and EGM storage – The system provides an arrhythmia episode log that enables you to view the summary and detailed diagnostic data quickly, including stored EGM, for the selected arrhythmia episode.

Flashback memory – This diagnostic feature records intervals that occur immediately prior to tachyarrhythmia episodes or the most recent interrogation and plots the interval data over time.

Heart Failure Management Report – This report provides an overview of the patient's condition over the short and long term, with a focus on heart failure management. The report includes graphs that show OptiVol 2.0 fluid trends and trends related to heart failure over the last 14 months.

Holter telemetry – This function allows the implanted device to transmit an EGM with marker telemetry continuously for up to 46 hours, regardless of the use of the programming head.

Implant Detection – Implant Detection is a 30 min period, beginning when the device is placed in the surgical pocket. During this period, the device verifies lead connection by measuring lead impedance. When the Implant Detection period is completed, various automatic features and diagnostics are activated.

Lead Monitor – This feature measures lead impedances during the life of the implanted device and controls automatic configuration of lead polarities at implant. If Lead Monitor is programmed to Adaptive, the device automatically switches bipolar pacing and sensing to unipolar pacing and sensing if the integrity of a bipolar lead is compromised.

MVP Mode Switches – This feature lists the 10 most recent MVP Mode Switches to DDD(R).

OptiVol 2.0 fluid trends – This feature provides the capability to monitor the following trends:

- The Thoracic Impedance trend plots thoracic impedance for up to 14 months.
- The OptiVol 2.0 Fluid Index trend plots the accumulated differences between the Daily Impedance and Reference Impedance values. Possible fluid accumulation in the patient's thoracic cavity exists when the OptiVol 2.0 Fluid Index exceeds the OptiVol Threshold.

Rate Histograms report – This report shows heart rate range distributions for the patient.

TherapyGuide – This feature provides a set of suggested parameters based on the programmed information about the patient's clinical conditions. The TherapyGuide feature does not replace a physician's expert judgment. The physician is free to accept, reject, or modify any of the suggested parameter values.

1.8 Data security

Medtronic has designed safeguards to protect patient information and device data for the Azure XT DR MRI SureScan Model W2DR01 device.

Bluetooth communication system – The device shows its availability through Bluetooth communication. Critical data accepted or sent through the Bluetooth communication from the device is encrypted by the device before it is sent over the Bluetooth channel. The device responds only to authorized commands.

Inductive telemetry communication system – The Medtronic inductive telemetry communication system is used with the clinician programmer to interrogate and program the device. It can also be used to interrogate the

device for remote monitoring, if available. This system uses short-range communication that protects patient information and device data.

1.9 Pacing mode information

Pacemaker modes are described using the NBG code. The five-letter NBG code, named after The North American Society of Pacing and Electrophysiology (NASPE) and the British Pacing and Electrophysiology Group (BPEG), describes the operation of implantable pulse generators. The NBG code, which supersedes the ICHD Code, is described in Table 1.

Table 1. The Revised NASPE/BPEG Generic Code for antibradycardia pacing

Position:	I	II	III	IV	V
Category:	Chamber(s) Paced	Chamber(s) Sensed	Response to Sensing	Rate Modulation	Multisite Pacing ^a
	O = None A = Atrium V = Ventricle D = Dual (A + V)	O = None A = Atrium V = Ventricle D = Dual (A + V)	O = None T = Triggered I = Inhibited D = Dual (T + I)	O = None R = Rate modulation	O = None A = Atrium V = Ventricle D = Dual (A + V)
Manufacturers' designation only:	S = Single ^b (A or V)	S = Single ^b (A or V)			

^a Medtronic devices do not use the Multisite Pacing code.

^b The programmer displays A or V (not S) for chambers paced and sensed.

2 Warnings, precautions, and potential adverse events

2.1 General warnings and precautions

Before performing an MRI scan, refer to the Medtronic MRI technical manual for MRI-specific warnings and precautions.

Refer to the Medical Procedure and EMI Warnings and Precautions Manual for information about hazards related to medical therapies and diagnostic procedures on patients with cardiac devices. This manual also includes information about sources of EMI in the patient's environment.

Anti-coagulation – Use of the device should not change the application of established anti-coagulation protocols.

Electrical isolation during implant – Do not allow the patient to have contact with grounded electrical equipment that might produce electrical current leakage during implant. Electrical current leakage may induce tachyarrhythmias that may result in the patient's death.

External defibrillation equipment – Keep external defibrillation equipment nearby for immediate use whenever tachyarrhythmias are possible or intentionally induced during device testing, implant procedures, or post-implant testing.

Lead compatibility – Do not use another manufacturer's leads without demonstrated compatibility with Medtronic devices. If a lead is not compatible with a Medtronic device, the result may be undersensing of cardiac activity, failure to deliver necessary therapy, or a leaking or intermittent electrical connection.

A complete SureScan pacing system includes a SureScan device connected to SureScan leads. **Before performing an MRI scan, refer to the Medtronic MRI technical manual for additional information.**

2.2 Explant and disposal

Consider the following information related to device explant and disposal:

- Explant the implantable device postmortem. In some countries, explanting battery-operated implantable devices is mandatory because of environmental concerns; please check the local regulations. In addition, if subjected to incineration or cremation temperatures, the device may explode.
- Medtronic implantable devices are intended for single use only. Do not resterilize and reimplant explanted devices.
- Contact Medtronic for Return Mailer Kits to return explanted devices for analysis and disposal. See the back cover for addresses.

2.3 Handling and storage instructions

Carefully observe these guidelines when handling or storing the device.

2.3.1 Device handling

Checking and opening the package – Before opening the sterile package tray, visually check for any signs of damage that might invalidate the sterility of the package contents.

If the package is damaged – The device packaging consists of an outer tray and an inner tray. Do not use the device or accessories if the outer or inner packaging tray is wet, punctured, opened, or damaged. Return the device to Medtronic because the integrity of the sterile packaging or the device functionality may be compromised. This device is not intended to be resterilized.

If the package information is damaged – If any information on the outer package or the sterile package is defaced or damaged so that you cannot read it, notify Medtronic so that the device can be replaced.

If the printed manual is illegible – If this manual is supplied in its printed form and any part of it is illegible, contact Medtronic to request a replacement manual.

Sterilization – Medtronic has sterilized the package contents with ethylene oxide before shipment. This device is for single use only and is not intended to be resterilized.

Device temperature – Allow the device to reach room temperature before it is programmed or implanted. Device temperature above or below room temperature may affect initial device function.

Dropped device – Do not implant the device if it is dropped on a hard surface from a height of 30 cm or more after it is removed from its packaging.

Fluid immersion – Do not immerse the device in fluid or flush the connector ports at the time of implant. Doing so could adversely affect the performance of the device and lead system.

“Use by” date – Do not implant the device after the “Use by” date because the battery longevity could be reduced.

For single use only – Do not resterilize and reimplant an explanted device.

2.3.2 Device storage

Avoid magnets – To avoid damaging the device, store the device in a clean area away from magnets, kits containing magnets, and any sources of electromagnetic interference.

Temperature limits – Store and transport the package between -18°C and $+55^{\circ}\text{C}$. Device reset may occur at temperatures below -18°C . Device longevity may decrease and performance may be affected at temperatures above $+55^{\circ}\text{C}$.

2.4 Lead evaluation and lead connection

Refer to the lead technical manuals for specific instructions and precautions about lead handling.

A Medtronic MRI SureScan system includes a Medtronic MRI SureScan device connected to Medtronic MRI SureScan leads. **Before performing an MRI procedure, refer to the Medtronic MRI technical manual for additional information.**

Torque wrench – Use only the torque wrench supplied with the device. The torque wrench is designed to prevent damage to the device from overtightening a setscrew. Other torque wrenches (for example, a blue-handled or right-angled hex wrench) have torque capabilities greater than the lead connector can tolerate.

Lead connection – Consider the following information when connecting the lead and the device:

- Cap abandoned leads to avoid transmitting electrical signals.
- Plug any unused lead ports to protect the device.
- Verify lead connections. Loose lead connections may result in inappropriate sensing and failure to deliver arrhythmia therapy.

2.5 Device operation

Leads – Bipolar or unipolar leads may be used with the Azure XT DR MRI SureScan Model W2DR01 device, but if leads other than bipolar MRI SureScan leads are used, the system is contraindicated for MRI scans.

Accessories – Use this device only with accessories, parts subject to wear, and disposable items that have been tested to technical standards and found safe by an approved testing agency.

Maximum output for the Atrial Capture Management feature – The Atrial Capture Management feature does not adjust atrial outputs to values greater than 5.0 V or 1.0 ms. If the patient needs atrial pacing output greater than 5.0 V or 1.0 ms, manually program the atrial amplitude and pulse width. If a lead dislodges partially or completely, the Atrial Capture Management feature may not prevent loss of capture.

Atrial lead maturation – Do not program AT/AF detection to On or enable automatic atrial ATP therapies until the atrial lead has matured (approximately 1 month after implant). If the atrial lead dislodges and migrates to the ventricle, the device could inappropriately detect AT/AF, deliver atrial ATP to the ventricle, and possibly induce a life-threatening ventricular tachyarrhythmia.

Device status indicators – If any of the device status indicators (for example, Device Reset) are displayed on the programmer after interrogating the device, inform a Medtronic representative immediately. If these device status indicators are displayed, therapies may not be available to the patient.

Effects of myopotential sensing in unipolar sensing configurations – In unipolar sensing configurations, the device may not distinguish myopotentials from cardiac signals. This may result in a loss of pacing due to inhibition. Also, unipolar atrial sensing in atrial tracking modes can result in elevated ventricular pacing rates. To address these situations, the device may be programmed to be less sensitive (using higher sensitivity values). However, the sensitivity level must be balanced against the potential to undersense true cardiac signals. Typically, this balance is easily attained for ventricular sensing using sensitivity values around 2.8 mV, but it may be difficult to attain for atrial sensing because of the smaller P-wave amplitudes.

Device reset – Device reset can be caused by exposure to temperatures below -18°C or strong electromagnetic fields. Advise patients to avoid strong electromagnetic fields. Observe temperature storage limits to avoid exposure of the device to cold temperatures. If a partial reset occurs, pacing resumes in the programmed mode with many of the programmed settings retained. If a full reset occurs, the device operates in VVI mode at 65 min^{-1} . Device reset is indicated by a programmer warning message that is displayed immediately upon interrogation. To restore the device to its previous operation, it must be reprogrammed. Inform a Medtronic representative if your patient's device has reset.

End of Service (EOS) indicator – Replace the device immediately if the programmer displays an EOS indicator. The device may soon lose the ability to pace, sense, and deliver therapy adequately.

Extended Upper Tracking Rate – When programming Upper Tracking Rates of 190, 200, or 210 min⁻¹, be careful to ensure that these rates are appropriate for the patient.

False bipolar pathway with unipolar lead – When implanting a unipolar lead, ensure that the tip setscrew is properly engaged and that all electrical contacts are sealed to prevent electrical leakage. Electrical leakage may cause the device to inappropriately identify a unipolar lead as bipolar, resulting in loss of output.

Magnets – Placing a magnet over the device suspends tachyarrhythmia detection and initiates asynchronous, fixed-rate bradycardia pacing. The programming head contains a magnet that can cause magnet operation to occur. However, magnet operation does not occur if telemetry between the device and the programmer is established or if the MRI SureScan mode is programmed to On.

Pace polarity – Pace polarity must be bipolar to program the MRI SureScan mode to On.

Pacemaker-mediated tachycardia (PMT) intervention – Even with the PMT Intervention feature programmed to On, PMTs may still require clinical intervention, such as device reprogramming, drug therapy, or lead evaluation.

Pacing and sensing safety margins – Lead maturation (at least one month after implant) may cause sensing amplitudes to decrease and pacing thresholds to increase, which can cause undersensing or a loss of capture. Provide an adequate safety margin when selecting values for pacing amplitude, pacing pulse width, and sensitivity parameters.

Programmers – Use only Medtronic programmers and application software to communicate with the device. Programmers and software from other manufacturers are not compatible with Medtronic devices.

Rate control – Decisions regarding rate control should not be based on the ability of the device to prevent atrial arrhythmias.

Rate-responsive modes – Do not program rate-responsive modes for patients who cannot tolerate rates above the programmed Lower Rate. Rate-responsive modes may cause discomfort for those patients.

Right ventricular apical pacing – Right ventricular apical pacing may be associated with an increased risk of atrial fibrillation, left ventricular dysfunction, and congestive heart failure.

Maximum output for the RV Capture Management feature – The RV Capture Management feature does not program right ventricular outputs to values greater than 5.0 V or 1.0 ms. If the patient needs right ventricular pacing output greater than 5.0 V or 1.0 ms, manually program right ventricular amplitude and pulse width. If a lead dislodges partially or completely, the RV Capture Management feature may not prevent loss of capture.

Sensitivity setting – Carefully evaluate the possibility of increased susceptibility to EMI and oversensing before changing the sensitivity from its nominal setting to a more sensitive setting.

Shipping values – Do not use shipping values or nominal values for pacing amplitude and sensitivity without verifying that the values provide adequate safety margins for the patient.

Single chamber atrial modes – Do not program single chamber atrial modes for patients with impaired AV nodal conduction. Ventricular pacing does not occur in these modes.

Slow retrograde conduction and PMT – Slow retrograde conduction may induce pacemaker-mediated tachycardia (PMT) when the VA conduction time is greater than 400 ms. Programming PMT Intervention can help prevent PMT only when the VA conduction time is less than 400 ms.

Testing for cross-stimulation – At implant, and regularly when atrial ATP therapy is enabled, conduct testing at the programmed atrial ATP output settings to ensure that ventricular capture does not occur. This is particularly important when the lead is placed in the inferior atrium.

2.5.1 Pacemaker-dependent patients

Ventricular Safety Pacing – Always program Ventricular Safety Pacing (VSP) to On for pacemaker-dependent patients. Ventricular Safety Pacing prevents ventricular asystole due to inappropriate inhibition of ventricular pacing caused by oversensing in the ventricle.

ODO pacing mode – Pacing is disabled under the ODO pacing mode. Do not program the ODO mode for pacemaker-dependent patients. Instead, use the Underlying Rhythm Test to provide a brief period without pacing support.

Polarity override – Do not override the polarity verification prompt with bipolar polarity when a unipolar lead is connected. Overriding the polarity verification prompt results in no pacing output.

Underlying Rhythm Test – Use caution when using the Underlying Rhythm Test to inhibit pacing. The patient is without pacing support when pacing is inhibited.

2.6 Potential adverse events

Potential adverse events associated with the use of a device system (defined as the device and leads) include, but are not limited to, the following:

- Air embolism
- Allergic reaction
- Bleeding
- Body rejection phenomena including local tissue rejection
- Cardiac dissection
- Cardiac perforation
- Cardiac tamponade
- Chronic nerve damage
- Death
- Embolism
- Endocarditis
- Erosion of the device and lead through the skin
- Excessive fibrosis
- Extrusion
- Fibrillation or other arrhythmias
- Fluid accumulation
- Formation of cysts
- Heart block
- Heart wall rupture
- Hematoma/seroma
- Inappropriate acceleration of arrhythmias
- Infection
- Keloid formation
- Lead abrasion and discontinuity
- Lead migration/dislodgment
- Muscle and nerve stimulation
- Myocardial damage
- Myocardial irritability
- Myopotential sensing
- Pericardial effusion
- Pericardial rub
- Pneumothorax
- Threshold elevation
- Thromboemboli
- Thrombosis
- Transvenous lead-related thrombosis
- Valve damage (particularly in fragile hearts)
- Venous occlusion
- Venous perforation
- Vein wall rupture

3 Implant procedure

3.1 Preparing for an implant

The following implant procedures are provided for reference only. Proper surgical procedures and sterile techniques are the responsibility of the physician. Each physician must apply the information in these procedures according to professional medical training and experience.

For information about replacing a previously implanted device, see Section 3.7, “Replacing a device”, page 19.

Ensure that you have all of the necessary instruments, system components, and sterile accessories to perform the implant.

Connect the skin electrodes to the patient if you would like to display surface ECG signals on the programmer. See the programmer reference manual for more information.

3.1.1 Instruments, components, and accessories required for an implant

The following non-implanted instruments are used to support the implant procedure:

- Medtronic programmer with a programming head
- programmer software application for the Azure XT DR MRI SureScan Model W2DR01 device
- Model 2290 Analyzer or equivalent pacing system analyzer
- external defibrillator

The following sterile system components and accessories are used to perform the implant:

- implantable device and lead system components
- programming head sleeve
Note: If a sterilized programming head is used during an implant, a sterile programming head sleeve is not necessary.
- pacing system analyzer cables
- lead introducers appropriate for the lead system
- extra stylets of appropriate length and shape

3.1.2 Setting up the programmer and starting the application

See the programmer reference manual for instructions about how to set up the programmer. The software application for the Azure XT DR MRI SureScan Model W2DR01 device should be installed on the programmer. Your Medtronic representative can install this software, if necessary. Establish telemetry with the device and start a patient session.

3.1.3 Considerations for preparing for an implant

Review the following information before implanting the leads or device:

Before performing an MRI scan, refer to the Medtronic MRI Technical Manual for additional information.

Warning: Bipolar or unipolar leads may be used with the Azure XT DR MRI SureScan Model W2DR01 device, but if leads other than bipolar SureScan leads are used, the system is not approved for MRI scans. Before performing an MRI scan, refer to the Medtronic MRI technical manual for additional information.

Warning: Do not allow the patient to have contact with grounded electrical equipment that might produce electrical current leakage during implant. Electrical current leakage may induce tachyarrhythmias that may result in the patient’s death.

Warning: Keep external defibrillation equipment nearby for immediate use. Potentially harmful spontaneous or induced tachyarrhythmias may occur during device testing, implant procedures, and post-implant testing.

Caution: The device is intended for implant in the pectoral region with Medtronic transvenous leads. Implanting the device outside of the pectoral region may adversely affect the results of the OptiVol 2.0 fluid measurements. Implanting a unipolar RV lead instead of a bipolar lead will result in no OptiVol 2.0 fluid measurements. No claims of safety and efficacy can be made with regard to other acutely or chronically implanted lead systems that are not manufactured by Medtronic.

Caution: Unipolar atrial leads may be used with the device, but bipolar atrial leads are recommended. If unipolar atrial leads are used, AT/AF Detection must be programmed to Monitor and the Capture Management feature must be programmed to Off.

Caution: Do not implant the device after the “Use by” date on the package label. Battery longevity may be reduced. To retain the ability to safely scan the SureScan pacing system during MRI scans, the MRI conditions for use in Section 1.6, “MRI conditions for use”, page 6 must be followed. Refer to the MRI technical manual for additional information.

3.1.4 How to prepare the device for implant

Before opening the sterile package, perform the following steps to prepare the device for implant:

1. Interrogate the device and print an Initial Interrogation Report.
Caution: If the programmer reports that a device reset occurred, do not implant the device. Contact a Medtronic representative.
2. Check the Initial Interrogation Report to confirm that the battery voltage is at least 2.85 V at room temperature. If the device has been exposed to low temperatures, then the battery voltage will be temporarily lower. Allow the device to warm to room temperature for at least 48 hours and check the battery voltage again. If an acceptable battery voltage cannot be obtained, contact a Medtronic representative.
Note: The device automatically measures the battery voltage several times a day. The battery voltage reported on the Battery and Lead Measurements screen is an average of recent automatic measurement values.
3. Select Params > Data Collection Setup > Device Date/Time... to select the Time Zone for the internal clock of the device.
4. Program the therapy and pacing parameters to values appropriate for the patient. Ensure that tachyarrhythmia detection is not programmed to On.
Note: Do not enable a pacing feature that affects the pacing rate (for example, Ventricular Rate Stabilization) before implanting the device. Doing so may result in a pacing rate that is faster than expected.

3.2 Selecting and implanting the leads

Use the guidelines in this section to select leads that are compatible with the device. The appropriate techniques for implanting the leads may vary according to physician preference and the patient’s anatomy or physical condition. Consult the technical manuals supplied with the leads for specific implant instructions.

A complete SureScan pacing system is required for use in the MR environment. A complete SureScan pacing system includes a SureScan device with Medtronic SureScan leads. Any other combination may result in a hazard to the patient during an MRI scan.

3.2.1 Selecting the leads

The device is typically implanted with the following leads:

- 1 bipolar transvenous lead in the right ventricle (RV) for sensing and pacing
- 1 bipolar transvenous lead in the atrium (A) for sensing and pacing. Use of a bipolar atrial lead with ring and tip electrodes spaced ≤ 10 mm apart to reduce far-field R-wave sensing is recommended.

3.2.2 How to verify lead and connector compatibility

Warning: Verify lead and connector compatibility before using a lead with this device. Using an incompatible lead may damage the connector, resulting in electrical current leakage or resulting in an intermittent electrical connection.

Note: Medtronic 3.2 mm low-profile leads are not directly compatible with the device IS-1 connector block.

Note: Lead adaptors compromise the ability to safely scan the SureScan pacing system during an MRI scan. Patients with lead adaptors are contraindicated for an MRI scan.

Note: Using a lead adaptor may affect the accuracy of OptiVol 2.0 fluid measurements.

Use the information in Table 2 to select a compatible lead.

Table 2. Lead and connector compatibility

Connector port	Primary leads
A, V	IS-1 ^a bipolar and IS-1 unipolar

^a IS-1 refers to the international standard ISO 5841-3.

3.2.3 Implanting the leads

Implant the leads according to the instructions in the technical manuals supplied with the leads unless suitable chronic leads are already in place.

Warning: Pinching the lead can damage the lead conductor or insulation, which may result in the loss of sensing or pacing therapy.

Transvenous leads – If you use a subclavian approach to implant a transvenous lead, position the lead laterally to avoid pinching the lead body between the clavicle and the first rib.

3.3 Testing the lead system

After the leads are implanted, test the lead system to verify that the sensing and pacing values are acceptable. Refer to the literature provided with the pacing system analyzer for instructions.

Note: Do not measure the intracardiac EGM telemetered from the device to assess sensing.

Note: The measured pacing lead impedance is a reflection of measuring equipment and lead technology. Refer to the lead technical manual for acceptable impedance values.

Bipolar leads – When measuring sensing and pacing values, measure between the tip (cathode) and ring (anode) of each bipolar pacing/sensing lead.

Unipolar leads – When measuring sensing and pacing values, measure between the tip (cathode) of each unipolar pacing/sensing lead and an indifferent electrode (anode) used in place of the device can.

Table 3. Acceptable sensing and pacing values

Measurements required	Acute transvenous leads	Chronic leads ^a
P-wave EGM amplitude (atrial)	≥ 2 mV	≥ 1 mV
R-wave EGM amplitude (RV)	≥ 5 mV	≥ 3 mV
Slew rate	≥ 0.5 V/s (atrial)	≥ 0.3 V/s (atrial)

Table 3. Acceptable sensing and pacing values (continued)

Measurements required	Acute transvenous leads	Chronic leads ^a
Capture threshold (0.5 ms pulse width)	≥ 0.75 V/s (RV)	≥ 0.5 V/s (RV)
	≤ 1.5 V (atrial)	≤ 3.0 V (atrial)
	≤ 1.0 V (RV)	≤ 3.0 V (RV)

^a Chronic leads are leads implanted for 30 days or more.

3.4 Connecting the leads to the device

The following procedure describes how to connect a lead to the device, confirm that the lead connector is fully inserted in the connector block, and verify that the lead connection is secure.

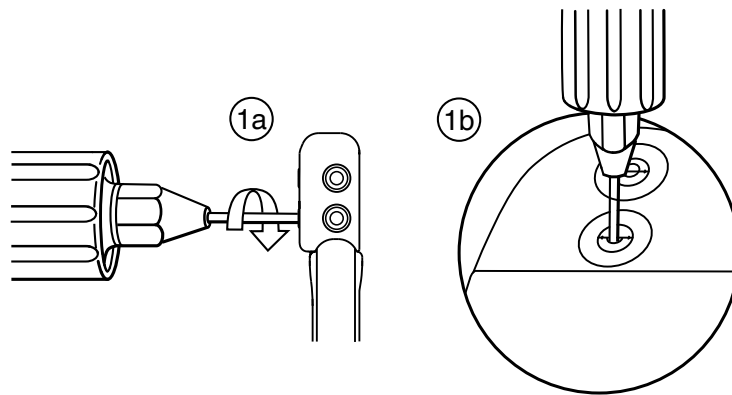
Warning: After connecting the leads, verify that the lead connections are secure by gently tugging on each lead. A loose lead connection may result in inappropriate sensing, which can cause false tracking and false inhibition of pacing, or inappropriate atrial tachyarrhythmia therapy.

Caution: Use only the torque wrench supplied with the device. The torque wrench is designed to prevent damage to the device from overtightening a setscrew.

3.4.1 How to connect a lead to the device

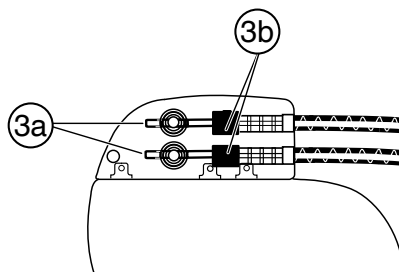
1. Insert the torque wrench into the appropriate setscrew.
 - a. If the setscrew obstructs the port, retract the setscrew by turning it counterclockwise until the port is clear. Take care not to disengage the setscrew from the connector block (see Figure 1).
 - b. Leave the torque wrench in the setscrew until the lead connection is secure. This action allows a pathway for venting trapped air when the lead connector is inserted into the connector port.

Figure 1. Inserting the torque wrench into the setscrew



2. Push the lead connector into the connector port until the lead connector pin is clearly visible in the pin viewing area. No sealant is required.
3. Confirm that the lead is fully inserted into the connector pin cavity by viewing the device connector block from the side or end.
 - a. The lead connector pin should be clearly visible beyond the setscrew block (see Figure 2).
 - b. The lead connector ring should be completely inside the spring contact block. There is no setscrew in this location (see Figure 2).

Figure 2. Confirming the lead connection



4. Tighten the setscrew by rotating it clockwise until the torque wrench clicks. Remove the torque wrench.
5. Gently tug on the lead to confirm a secure fit. Do not pull on the lead until the setscrew has been tightened.
6. Repeat these steps for each lead.

3.5 Positioning and securing the device

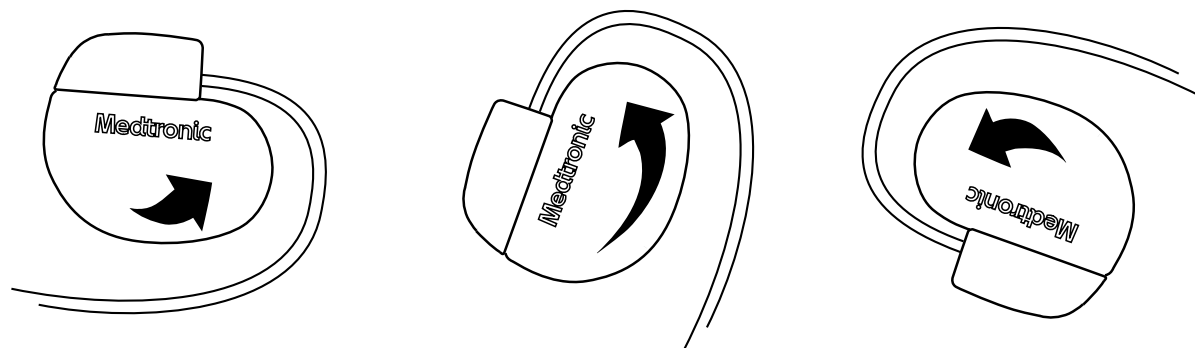
Caution: Program AT/AF detection to Monitor to avoid inappropriate therapy delivery while closing the pocket.

Note: Implant the device within 4 cm of the surface of the skin to optimize post-implant ambulatory monitoring.

3.5.1 How to position and secure the device

1. Verify that each lead connector pin is fully inserted into the connector port and that all setscrews are tight.
2. To prevent twisting of the lead body, rotate the device to loosely wrap the excess lead length (see Figure 3). Do not kink the lead body.

Figure 3. Rotating the device to wrap the leads



3. Place the device and the leads into the surgical pocket.
4. Use nonabsorbable sutures to secure the device within the pocket and minimize post-implant rotation and migration. Use a surgical needle to penetrate the suture hole on the device.
5. Suture the pocket incision closed.

3.6 Completing the implant procedure

Warning: Do not program AT/AF Detection to On or enable automatic atrial ATP therapies until the atrial lead has matured (approximately 1 month after implant). If the atrial lead dislodges and migrates to the ventricle, the device could inappropriately detect AT/AF, deliver atrial ATP to the ventricle, and possibly induce a life-threatening ventricular tachyarrhythmia.

3.6.1 How to complete programming the device

1. If unipolar leads are implanted, you may want to manually complete the Implant Detection process.
 - a. Select the Params icon.
 - b. Program the Pace Polarity and Sense Polarity parameters to Unipolar.
 - c. Select Additional Features... and program the Implant Detection parameter to Off/Complete.
2. Verify that the pacing, detection, and atrial ATP therapies parameters are programmed to values that are appropriate for the patient.
3. Enter the patient's information.

Note: Be sure to use the Patient Information screen to enter complete information about the implanted leads. Be sure to use the MRI SureScan System/Other Hardware screen to enter complete information about other hardware implanted in the patient, including abandoned devices or leads, and lead extenders or adaptors. This information will be used in the future if the patient needs to be evaluated for an MRI scan. For more information, see the programming guide.
4. Program the Medtronic CareAlert parameters, if applicable.
5. Program the Data Collection Setup parameters.

3.6.2 How to assess the performance of the device and leads

After implanting the device, x-ray the patient as soon as possible to verify device and lead placement. Before the patient is discharged from the hospital, assess the performance of the implanted device and leads.

1. Monitor the patient's electrocardiogram until the patient is discharged. If a lead dislodges, it usually occurs during the immediate postoperative period.
2. Check the pacing and sensing values, and adjust the values if necessary. Verify the safety margin for the pacing threshold.
3. Interrogate the device, and print a Final Report to document the postoperative programmed device status.

3.7 Replacing a device

To retain the ability to safely scan the SureScan pacing system during MRI scans, the MRI conditions for use in Section 1.6, "MRI conditions for use", page 6 must be followed. Refer to the Medtronic MRI technical manual for additional information.

Warning: Bipolar or unipolar leads may be used with the Azure XT DR MRI SureScan Model W2DR01 device, but if leads other than bipolar SureScan leads are used, the system is not approved for MRI scans. Before performing an MRI scan, refer to the Medtronic MRI technical manual for additional information.

Warning: Abandoned leads or previously implanted non-MRI labeled leads compromise the ability to safely scan the SureScan pacing system during future MRI scans. When implanting a SureScan pacing system, consider the risks associated with removing previously implanted leads before removing the leads to maintain the ability to safely scan the SureScan pacing system. Refer to the Medtronic MRI technical manual for additional information.

Warning: Keep external pacing equipment nearby for immediate use. The patient does not receive pacing therapy from the device when the lead is disconnected, or when the device is removed from the pocket while the device is operating in unipolar pacing mode.

Caution: Disable tachyarrhythmia detection to avoid inappropriate therapy delivery while explanting the device.

Caution: Unipolar atrial leads may be used with the device, but bipolar atrial leads are recommended. If unipolar atrial leads are used, AT/AF Detection must be programmed to Monitor and the Capture Management feature must be programmed to Off.

Note: To meet the implant requirements, you may need to reposition or replace the chronic leads. For more information, see Section 3.2, "Selecting and implanting the leads", page 15.

Note: Any unused leads that remain implanted must be capped with a lead pin cap to avoid transmitting electrical signals. Contact your Medtronic representative for information about lead pin caps. Any capped or unused leads are considered abandoned leads in the MRI conditions for use, and their presence will contraindicate the system for MRI scanning.

3.7.1 How to explant and replace a device

1. Program the device to a mode that is not rate-responsive to avoid potential rate increases while explanting the device.
2. Dissect the leads and the device free from the surgical pocket. Do not nick or breach the lead insulation.
3. Use a torque wrench to loosen the setscrews in the connector block.
4. Gently pull the leads out of the connector ports.
5. Evaluate the condition of each lead (see Section 3.3, “Testing the lead system”, page 16). Replace a lead if the electrical integrity is not acceptable or if the lead connector pin is pitted or corroded. If you explant the lead, return the lead to Medtronic for analysis and disposal.
6. Connect the leads to the replacement device (see Section 3.4, “Connecting the leads to the device”, page 17).


Note: Lead adaptors may be needed to connect the leads to the replacement device. Contact a Medtronic representative for information about compatible lead adaptors.

Note: Lead adaptors compromise the ability to safely perform an MRI scan on the SureScan pacing system in the future. Patients with lead adaptors are contraindicated for an MRI scan.
7. Position and secure the device in the surgical pocket, and suture the pocket incision closed (see Section 3.5, “Positioning and securing the device”, page 18).
8. Contact Medtronic for Return Mailer Kits to return explanted devices for analysis and disposal. See the back cover for addresses.

4 Product specifications

4.1 Physical characteristics

Table 4. Physical characteristics

Volume ^a	12.75 cm ³
Mass	22.5 g
H x W x D ^b	46.6 mm x 50.8 mm x 7.4 mm
Radiopaque ID ^c	RNA
Medtronic identifier	
Surface area of titanium device can	33.48 cm ²
Materials in contact with human tissue ^d	Titanium, polyurethane, silicone rubber
Battery	Lithium-hybrid CFx silver vanadium oxide

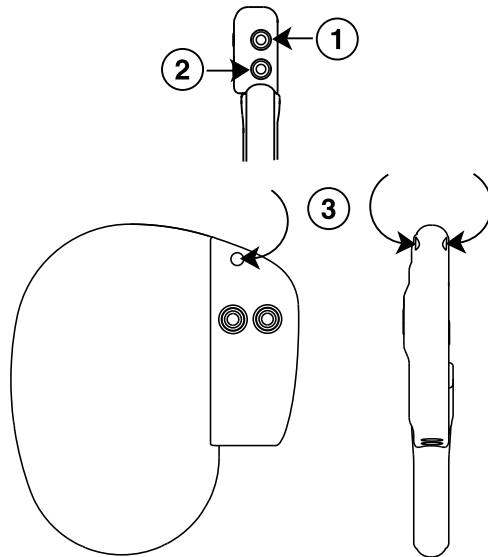
^a Volume with connector holes unplugged.

^b Grommets may protrude slightly beyond the can surface.

^c The radiopaque ID, which includes a Medtronic-identifier symbol, can be viewed in a fluoroscopic image of the device.

^d These materials have been successfully tested for the ability to avoid biological incompatibility. The device does not produce an injurious temperature in the surrounding tissue during normal operation.

Figure 4. Connector and suture hole



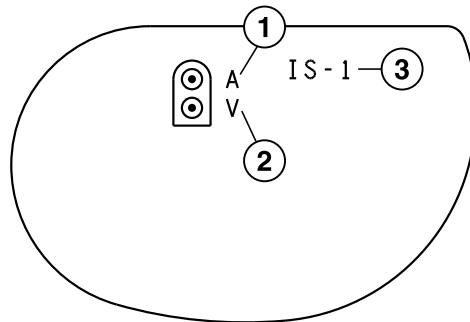
- 1 IS-1 connector port, A
- 2 IS-1 connector port, V

3 Suture hole

The Model W2DR01 shield graphics are shown in Figure 5.

The IS-1 marking in Figure 5 indicates that the lead connectors conform to ISO 5841-3.

Figure 5. Shield graphics: Model W2DR01



- 1 A = atrial
- 2 V = ventricular

3 IS-1 marking

4.2 Electrical specifications

Table 5. Battery characteristics

Manufacturer	Medtronic Energy and Component Center
Model	Delta 26H3
Number of battery cells	1
Chemistry	Lithium-hybrid CFx silver vanadium oxide

Table 5. Battery characteristics (continued)

Nominal voltage	3.25 V
Mean usable capacity	1.2 Ah
Mean capacity to RRT	0.97 Ah
Residual usable capacity at RRT	0.23 Ah

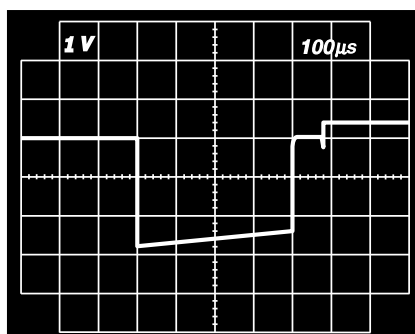
Table 6. Current consumption

Current consumption (at 100% pacing) ^a	10.40 μ A
Current consumption (at 100% inhibition) ^b	6.71 μ A

^a Current consumption when pacing into $500 \Omega \pm 1\%$ loads at the Beginning of Service in DDDR mode at 60 min^{-1} , 2.5 V, 0.4 ms.

^b Current consumption when at the Beginning of Service in DDDR mode at 60 min^{-1} , 2.5 V, 0.4 ms, $500 \Omega \pm 1\%$.

4.2.1 Output waveforms

Figure 6. Output waveform at nominal conditions (resistive load: 500Ω)

4.2.2 Measuring methods

Device parameters, such as pulse duration, pulse amplitude, and sensitivity (sensing threshold), are measured according to the standard ISO 14708-2:2012.

Pulse duration – Pulse duration is measured at 10% of the programmed amplitude and 90% of the trailing edge amplitude according to the standard ISO 14708-2:2012. See Figure 7. (See Figure 8 for definitions of amplitude measurements.)

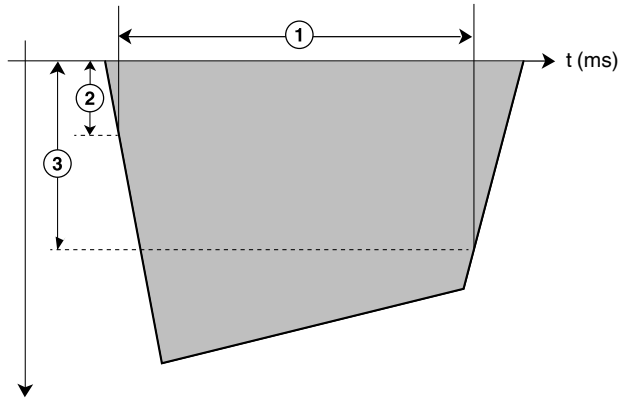
Pulse amplitude – The peak pulse amplitude is measured according to the standard ISO 14708-2:2012.

Sensitivity (sensing threshold) – Ventricular sensitivity is defined as the voltage amplitude of a standard ISO 14708-2:2012 test signal that is just sufficient to be sensed by the device. The signal from a test signal generator used for the exact determination of sensitivity (sensing threshold) is illustrated in Figure 9.

Notes:

- When measuring the pacing and sensing parameters with pacing system analyzers, considerable differences may be observed with the specifications presented in this manual. This is because the measuring methods employed by such systems may differ from those described above.
- Lead impedance measurement results may be distorted by electrocardiogram monitoring equipment.

Figure 7. Measurement of pulse duration

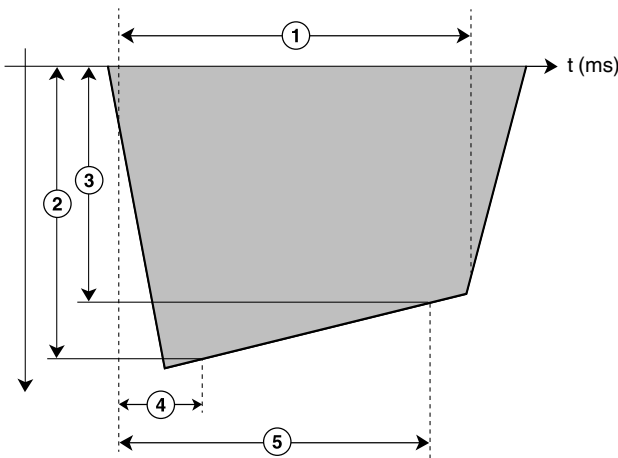


1 Pulse duration

2 10% of the programmed amplitude

3 90% of the trailing edge amplitude ($90\% A_s$)

Figure 8. Measurement of pulse amplitude



1 Pulse duration

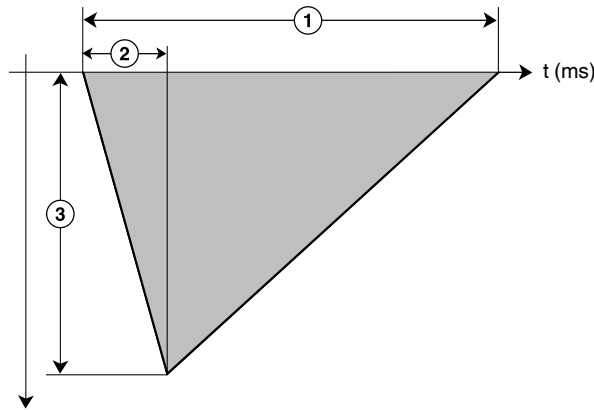
2 Pulse amplitude (A_{max})

3 Trailing edge amplitude (A_s)

4 Voltage sample A_{max} is taken at time $t_1 = 10 \mu s$.

5 Voltage sample A_s is taken at time t_2 , which is the programmed pulse duration value $-30 \mu s$.

Figure 9. Measurement of sensitivity



1 $T = 15 \text{ ms} \pm 1 \text{ ms}$
 2 $t = 2 \text{ ms} \pm 0.2 \text{ ms}$

3 Signal amplitude A_T

Note: The signal may be either positive or negative.

4.2.3 Variation with temperature

Basic rate, test pulse rate, pulse duration, and pulse amplitude remain within expected tolerances when the device temperature is between 22°C and 45°C. Sensitivity at nominal conditions as measured at 37°C can vary as much as $\pm 1\%$ per°C from 22°C to 45°C.

4.3 Replacement indicators

The battery voltage and messages about replacement status appear on the programmer display and on printed reports. The Recommended Replacement Time (RRT), Elective Replacement Indicator (ERI), and the End of Service (EOS) conditions are listed in Table 7.

Table 7. Replacement indicators

Recommended Replacement Time (RRT)	$\leq 2.63 \text{ V}$ on 3 consecutive daily automatic measurements
Elective Replacement Indicator (ERI)	3 months after RRT
End of Service (EOS)	3 months after ERI

RRT date – The programmer displays the date when the battery reached RRT on the Quick Look II and Battery and Lead Measurements screens.

Replace at EOS – If the programmer indicates that the device is at EOS, replace the device immediately.

RRT operation – When the device reaches RRT, it continues to operate with its programmed parameters. However, placing a magnet over the device initiates asynchronous pacing at 65 min^{-1} rather than at 85 min^{-1} .

ERI operation – When the device reaches ERI, it automatically changes the value of several parameters as shown in Table 8.

Table 8. Parameter settings after ERI

Pacing Mode	VVI
Lower Rate	65 min ⁻¹
RV Amplitude	as programmed
RV Pulse Width	as programmed
Rate Hysteresis	Off
Sleep	Off
V. Rate Stabilization	Off
AT/AF Detection	Monitor ^a
Pre-arrhythmia EGM	Off ^b

^a When AT/AF Detection is set to Monitor, AT/AF therapies are not available.

^b Pre-arrhythmia EGM cannot be reprogrammed after ERI.

Note: After ERI, all pacing parameters can be programmed, including mode and rate. Reprogramming the pacing parameters may reduce the duration of the ERI to EOS period.

Note: When the MRI SureScan mode is programmed to On, battery measurements are taken, but the device does not report RRT, EOS, or ERI until the MRI SureScan mode has been programmed to Off.

Prolonged Service Period – The Prolonged Service Period (PSP) is the time between the RRT and EOS. The PSP is defined as 6 months assuming the following conditions: 100% DDD pacing at 60 min⁻¹, 2.5 V atrial and RV pacing amplitude; 0.4 ms pulse width; and 600 Ω pacing load. The EOS may be indicated before the end of 6 months if the device exceeds these conditions.

4.4 Projected service life

The projected service life in years for the device is shown in Table 9. The data is based on pacing outputs programmed to the specified amplitude and 0.4 ms pulse width and 60 min⁻¹ pacing rate.

The service life of the device is affected by the programmed settings for certain features, such as Pre-arrhythmia EGM storage.

Projected service life estimates are based on accelerated battery discharge data and device modeling as specified. These values should not be interpreted as precise numbers.

Delivery of atrial antitachycardia pacing therapy does not appreciably alter the longevity, considered with the inhibition of atrial pacing during the AT/AF episode.

Table 9. Projected service life in years

Pacing	Pre-arrhythmia EGM storage ^a	500 Ω pacing impedance		600 Ω pacing impedance		900 Ω pacing impedance	
		2.5 V	3.5 V	2.5 V	3.5 V	2.5 V	3.5 V
DDD, 0%	Off	15.8	15.8	15.8	15.8	15.8	15.8
	On	15.7	15.7	15.7	15.7	15.7	15.7
DDD, 15%	Off	14.6	13.6	14.8	13.9	15.1	14.4
	On	14.5	13.5	14.7	13.8	15.0	14.3

Table 9. Projected service life in years (continued)

Pacing	Pre-arrhythmia EGM storage ^a	500 Ω pacing impedance		600 Ω pacing impedance		900 Ω pacing impedance	
		2.5 V	3.5 V	2.5 V	3.5 V	2.5 V	3.5 V
DDD, 50%	Off	12.4	10.2	12.8	10.8	13.6	11.9
	On	12.3	10.1	12.7	10.7	13.5	11.9
AAI<=>DDD (MVP Mode) 50% Atrial, 5% Ventricular	Off	13.7	12.1	14.0	12.6	14.5	13.4
	On	13.6	12.1	13.9	12.5	14.4	13.3
DDD, 100%	Off	10.2	7.5	10.8	8.1	12.0	9.6
	On	10.1	7.4	10.7	8.1	11.9	9.5

^a The data provided for programming Pre-arrhythmia EGM storage to On is based on a 6-month period (two 3-month follow-up intervals) over the life of the device. Additional use of Pre-arrhythmia EGM storage reduces projected service life by approximately 12.1% or 1.4 months per year.

Note: These projections are based on typical shelf storage time (5 months). Assuming worst-case shelf storage time (18 months), longevity is reduced by approximately 7%.

Note: The Capture Management feature can independently adapt each pacing amplitude value. An Atrial Pacing Amplitude of 1.5 V and an RV Pacing Amplitude of 2.0 V represent typical values when using the Capture Management feature. At these settings, and with 100% ventricular pacing (at 60 min⁻¹, 0.4 ms, and 600 Ω), the projected service life of the device is 12.6 years.

Medtronic remote monitor transmissions – Additional remote monitoring transmissions reduce the projected service life of the device. For example, from nominal pacing (at 2.5 V, 0.4 ms, 600 Ω, 60 min⁻¹, 100% atrial and ventricular pacing), a patient can expect a projected service life of 10.7 years. More frequent remote monitoring transmissions will reduce this projected service life as follows:

- Monthly transmissions over the life of the device reduce projected service life by 16 days, or <1%.
- Weekly transmissions over the life of the device reduce projected service life by 87 days, or 2.2%.
- Daily transmissions over the life of the device reduce projected service life by 564 days, or 14.4%.

Table 10. Projected service life in years per conditions specified in EN 45502-2-1 and ISO 14708-2

	EN 45502-2-1	ISO 14708-2
	500 Ω ±1% pacing impedance 70 min ⁻¹	600 Ω ±1% pacing impedance 60 min ⁻¹
Pacing		
DDDR, 100%		
2.5 V, 0.5 ms	8.7 ^a	—
5.0 V, 0.5 ms	3.8 ^a	—
2.5 V, 0.4 ms	—	10.7 ^a
5.0 V, 0.4 ms	—	5.5 ^a

^a Data storage and diagnostic functions applicable to the pacing mode are On.

5 Device parameters

5.1 Emergency settings

Table 11. Emergency VVI settings

Parameter	Selectable values
Pacing Mode	VVI
Lower Rate	70 min ⁻¹
RV Amplitude ^a	6 V
RV Pulse Width ^a	1.5 ms
RV Pace Polarity	Unipolar
V. Blank Post VP	240 ms
Rate Hysteresis	Off
V. Rate Stabilization	Off
MRI SureScan	Off

^a If the programmed RV Amplitude is 8 V, VVI pacing is delivered at 8 V with a pulse width of 1.2 ms.

5.2 Magnet application

When a magnet is placed near the device, the pacing mode changes from the programmed mode to DOO, VOO, or AOO, and the pacing rate changes to 100 min⁻¹ for 5 beats and then changes to 85 min⁻¹ (± 2 min⁻¹) or 65 min⁻¹ (± 2 min⁻¹), as described at the end of this section. Placing a magnet near the device suspends tachyarrhythmia detection. When the magnet is removed, the device returns to its programmed operation.

Note: Magnet operation does not occur if telemetry between the device and programmer is established or if the MRI SureScan mode is programmed to On.

The pacing mode will be DOO when the programmed pacing mode is a dual chamber mode or an MVP mode (AAIR \leftrightarrow DDDR, AAI \leftrightarrow DDD), VOO when the programmed pacing mode is a single chamber ventricular mode, and AOO when the programmed pacing mode is a single chamber atrial mode.

The pacing rate will be 85 min⁻¹ (700 ms) if the device conditions are normal and it will be 65 min⁻¹ (920 ms) if a Recommended Replacement Time (RRT) indicator or a device reset has occurred.

5.3 Tachyarrhythmia detection parameters

Table 12. Tachyarrhythmia detection parameters

Parameter	Programmable values	Shipped	Reset
AT/AF Detection	On; Monitor \diamond	Monitor	Monitor
Zones	1 \diamond ; 2	—	—
AT/AF Interval (Rate) ^a	150; 160 ... 350 \diamond ... 450 ms	350 ms	350 ms
Fast AT/AF Interval (Rate) ^a	150; 160 ... 200 \diamond ... 250 ms	200 ms	200 ms
VT Monitor	Monitor \diamond ; Off	Monitor	Off
VT Monitor Interval (Rate) ^a	280; 290 ... 400 \diamond ... 500 ms	400 ms	400 ms

Table 12. Tachyarrhythmia detection parameters (continued)

Parameter	Programmable values	Shipped	Reset
RV Sensitivity ^{b,c,d}	0.45; 0.60 mV ($\pm 50\%$); 0.90; 1.20; 2.00; 2.80; 4.00; 5.60; 8.00; 11.30 mV ($\pm 30\%$) Bipolar: 0.9 \diamond mV Unipolar: 2.80 \diamond mV	0.9 mV	2.8 mV
Atrial Sensitivity ^{b,d,e}	0.15 mV ($\pm 75\%$); 0.30; 0.45; 0.60 mV ($\pm 50\%$); 0.90; 1.20; 1.5; 1.8; 2.1; 4.0 mV ($\pm 30\%$) ; Off Bipolar: 0.3 \diamond mV Unipolar: 0.45 \diamond mV	0.3 mV	0.45 mV

^a The measured intervals are truncated to a 10 ms multiple (for example, 457 ms becomes 450 ms). The device uses this truncated interval value when applying the programmed criteria and calculating interval averages.

^b This setting applies to all sensing in this chamber for both tachyarrhythmia detection and bradycardia pacing operations.

^c The device complies with the requirements of ISO 14708-2 when the sensitivity threshold is programmed to 2.0 mV or higher.

^d Tolerances are based on bipolar polarity.

^e The device complies with the requirements of ISO 14708-2 when the sensitivity threshold is programmed to 1.8 mV or higher.

5.4 Atrial tachyarrhythmia therapy parameters

Table 13. Atrial tachyarrhythmia therapy parameters

Parameter	Programmable values	Shipped	Reset
Anti-Tachy Pacing (ATP)			
Fast AT/AF Rx Status	On; Off \diamond	Off	Off
Therapy Type	Ramp; Burst+ Rx1: Ramp \diamond Rx2: Burst+ \diamond Rx3: Ramp \diamond	—	—
AT/AF Rx Status	On; Off \diamond	Off	Off
Therapy Type	Ramp; Burst+ Rx1: Ramp \diamond Rx2: Burst+ \diamond Rx3: Ramp \diamond	—	—
Burst+ parameters			
Initial # S1 Pulses	1; 2; 3 ... 11 \diamond ... 15; 20; 25	—	—
A-S1 Interval (%AA)	28; 31; 34; 38; 41 ... 59; 63; 66; 69 ... 84 \diamond ; 88; 91; 94; 97%	—	—
S1-S2 (%AA)	28; 31; 34; 38; 41 ... 59; 63; 66; 69 ... 81 \diamond ; 84; 88; 91; 94; 97%; Off	—	—
S2-S3 Decrement	0; 10; 20 \diamond ... 80 ms; Off	—	—

Table 13. Atrial tachyarrhythmia therapy parameters (continued)

Parameter	Programmable values	Shipped	Reset
Interval Decrement	0; 10 \diamond ; 20; 30; 40 ms	—	—
# Sequences	1; 2; 3 ... 10 \diamond	—	—
Ramp parameters			
Initial # S1 Pulses	1; 2; 3 ... 13 \diamond ; 14; 15; 20; 25	—	—
A-S1 Interval (%AA)			
Rx1	28; 31; 34; 38; 41 ... 59; 63; 66 ... 84; 88; 91 \diamond ; 94; 97%	—	—
Rx2	28; 31; 34; 38; 41 ... 59; 63; 66 ... 84; 88; 91 \diamond ; 94; 97%	—	—
Rx3	28; 31; 34; 38; 41 ... 59; 63; 66 ... 81 \diamond ; 84; 88; 91; 94; 97%	—	—
Interval Decrement	0; 10 \diamond ... 40 ms	—	—
# Sequences	1; 2 ... 8; 9; 10 \diamond	—	—
Stop Atrial Rx After (shared)			
Rx/Lead Suspect...			
Disable Atrial ATP if it accelerates V. rate?	Yes \diamond ; No	Yes	Yes
Disable all atrial therapies if atrial lead position is suspect? (Atrial Lead Position Check)	Yes \diamond ; No	Yes	No
Duration to Stop	12; 24; 48 \diamond ; 72 hr; None	48 hr	48 hr
Episode Duration Before Rx Delivery			
Episode Duration Before ATP	0; 1 \diamond ; 2 ... 5; 7; 10; 15; 20; 25; 30; 40; 50 min; 1; 2; 3; 4; 5; 6; 12; 24 hr	1 min	1 min
Reactive ATP			
Rhythm Change	On \diamond ; Off	On	On
Time Interval	Off \diamond ; 2; 4; 7; 12; 24; 36; 48 hr	Off	Off
Shared A. ATP			
A-A Minimum ATP Interval ^a	100; 110; ... 150 \diamond ... 400 ms (\pm 6 ms)	150 ms	150 ms
A. Pacing Amplitude	1; 2 V (+0.5 V / -33%) 3; 4; 5; 6 \diamond ; 8 V (+20% / -33%)	6 V	6 V
A. Pacing Pulse Width	0.1; 0.2 ... 1.5 \diamond ms (\pm 25 μ s)	1.5 ms	1.5 ms
VVI Backup Pacing	Off; On (Always); On (Auto-Enable) \diamond	On (Auto-Enable)	On (Auto-Enable)
VVI Backup Pacing Rate	60; 70 \diamond ... 120 min ⁻¹	70 min ⁻¹	70 min ⁻¹

^a The measured intervals are truncated to a 10 ms multiple (for example, 457 ms becomes 450 ms). The device uses this truncated interval value when applying the programmed criteria and calculating interval averages.

5.5 Pacing parameters

Table 14. Modes, rates, and intervals

Parameter	Programmable values	Shipped	Reset
Mode	DDDR; DDD; AAIR<=>DDDR \diamond ; AAI<=>DDD; DDIR; DDI; AAIR; AAI; VVIR; VVI; DOO; AOO; VOO; ODO	AAI<=>DDD	VVI
Mode Switch	On \diamond ; Off	On	Off
Lower Rate ^a	30; 35 ... 60 \diamond ; 70; 75 ... 150 min ⁻¹ (± 2 min ⁻¹)	60 min ⁻¹ (1000 ms)	65 min ⁻¹ (920 ms)
Upper Tracking Rate	80; 85 ... 130 \diamond ... 175 min ⁻¹ (± 2 min ⁻¹); 180; 190 ... 210 min ⁻¹ (+2/-11 min ⁻¹)	130 min ⁻¹	120 min ⁻¹
Paced AV	30; 40 ... 180 \diamond ... 350 ms (± 4 ms)	180 ms	180 ms
Sensed AV	30; 40 ... 150 \diamond ... 350 ms (+30; -2 ms)	150 ms	150 ms
Maximum AV Interval limit	Off \diamond ; 250; 260 ... 500	Off	Off
PVARP	Auto \diamond ; 150; 160 ... 500 ms (+5; -30 ms)	Auto	Auto
Minimum PVARP	150; 160 ... 250 \diamond ... 500 ms (+5; -30 ms)	250 ms	250 ms
A. Refractory Period	150; 160 ... 310 \diamond ... 500 ms (+5; -30 ms)	310 ms	310 ms

^a The corresponding Lower Rate interval can be calculated as follows: Lower Rate interval (ms) = 60,000/Lower Rate.

Table 15. Atrial parameters

Parameter	Programmable values	Shipped	Reset
Atrial Amplitude	0.5; 0.75 ... 1.25 V (+0.125 V / -33%) 1.50 ... 3.5 \diamond ... 5; 5.5; 6; 8 V (+15% / -33%) ^a	3.5 V	—
Atrial Pulse Width	0.03; 0.06 ms (± 10 μ s); 0.1; 0.2; 0.3; 0.4 \diamond ... 1.5 ms (± 25 μ s)	0.4 ms	—
Atrial Sensitivity ^b	Off; 0.15 mV ($\pm 75\%$); 0.3; 0.45; 0.6 mV ($\pm 50\%$); 0.9; 1.2; 1.5; 1.8; 2.1; 4.0 mV ($\pm 30\%$) Unipolar: 0.45 \diamond mV Bipolar: 0.3 \diamond mV	0.3 mV	0.45 mV
Atrial Pace Polarity	Bipolar; Unipolar	Configure ^c	—
Atrial Sense Polarity	Bipolar; Unipolar	Configure ^c	Unipolar
Atrial Lead Monitor	Monitor Only; Adaptive	Monitor Only	Monitor Only
Min Limit	200 \diamond ; 300; 400; 500 Ω	200 Ω	200 Ω
Max Limit	1000; 1500; 2000; 3000 \diamond Ω	3000 Ω	3000 Ω

^a When Atrial Amplitude is 8 V, Atrial Pulse Width must be less than 1.3 ms.

^b This setting applies to all sensing in this chamber for both tachyarrhythmia detection and bradycardia pacing operations.

^c “Configure” is displayed when the device is automatically configuring the lead polarity at implant. It is not a selectable value.

Table 16. RV parameters

Parameter	Programmable values	Shipped	Reset
RV Amplitude	0.5; 0.75 ... 1.25 V (+0.125 V / -33%) 1.50 ... 3.5 \diamond ... 5; 5.5; 6; 8 V (+15% / -33%) ^a	3.5 V	6 V
RV Pulse Width	0.03; 0.06 ms ($\pm 10 \mu\text{s}$); 0.1; 0.2; 0.3; 0.4 \diamond ... 1.5 ms ($\pm 25 \mu\text{s}$)	0.4 ms	1.5 ms
RV Sensitivity ^b	0.45; 0.60 mV ($\pm 50\%$); 0.90 \diamond ; 1.20; 2.00; 2.80; 4.00; 5.60; 8.00; 11.30 mV ($\pm 30\%$) Unipolar: 2.80 \diamond mV Bipolar: 0.90 \diamond mV	0.90 mV	2.80 mV
RV Pace Polarity	Bipolar; Unipolar	Configure ^c	Unipolar
RV Sense Polarity	Bipolar; Unipolar	Configure ^c	Unipolar
RV Lead Monitor	Monitor Only; Adaptive	Monitor Only	Monitor Only
Min Limit	200 \diamond ; 300; 400; 500 Ω	200 Ω	200 Ω
Max Limit	1000; 1500; 2000; 3000 \diamond Ω	3000 Ω	3000 Ω

^a When RV Amplitude is 8 V, RV Pulse Width must be less than 1.3 ms.

^b This setting applies to all sensing in this chamber for both tachyarrhythmia detection and bradycardia pacing operations.

^c "Configure" is displayed when the device is automatically configuring the lead polarity at implant. It is not a selectable value.

Table 17. Atrial Capture Management parameters

Parameter	Programmable values	Shipped	Reset
Atrial Capture Management	Adaptive \diamond ; Monitor; Off	Adaptive	Off
Atrial Amplitude Safety Margin	1.5x; 2.0x \diamond ; 2.5x; 3.0x	2.0x	2.0x
Atrial Minimum Adapted Amplitude	1.0; 1.5 \diamond ; 2.0; 2.5; 3.0; 3.5 V	1.5 V	1.5 V
Atrial Acute Phase Remaining	Off; 30; 60; 90; 120 \diamond ; 150 days	120 days	120 days

Table 18. RV Capture Management parameters

Parameter	Programmable values	Shipped	Reset
RV Capture Management	Adaptive \diamond ; Monitor; Off	Adaptive	Off
RV Amplitude Safety Margin	1.5x; 2.0x \diamond ; 2.5x; 3.0x	2.0x	2.0x
RV Minimum Adapted Amplitude	1.0; 1.5; 2.0 \diamond ; 2.5; 3.0; 3.5 V	2 V	2 V
RV Acute Phase Remaining	Off; 30; 60; 90; 120 \diamond ; 150 days	120 days	120 days

Table 19. Blanking periods

Parameter	Programmable values	Shipped	Reset
PVAB Interval	10 ^a ; 20 ... 100; 110; 120 ... 150 [◆] ... 300 ms	150 ms	150 ms
PVAB Method	Partial [◆] ; Partial+; Absolute	Partial	Partial
A. Blank Post AP	150; 160 ... 200 [◆] ... 250 ms (+5; -30 ms)	200 ms	240 ms
A. Blank Post AS	100 [◆] ; 110 ... 170 ms (+2; -30 ms)	100 ms	100 ms
V. Blank Post VP	150; 160 ... 200 [◆] ... 320 ms (+5; -30 ms)	200 ms	240 ms
V. Blank Post VS	120 [◆] ; 130 ... 170; 200; 220; 250; 280; 300; 320 ms (+2; -30 ms)	120 ms	120 ms

^a If the PVAB Method is set to Partial, the minimum selectable value for the PVAB Interval is 100 ms

Table 20. Rate Response Pacing parameters

Parameter	Programmable values	Shipped	Reset
Upper Sensor Rate	80; 85 ... 130 [◆] ... 175 min ⁻¹ (± 2 min ⁻¹)	130 min ⁻¹	120 min ⁻¹
ADL Rate	60; 65 ... 95 [◆] ... 170 min ⁻¹ (± 2 min ⁻¹)	95 min ⁻¹	95 min ⁻¹
Rate Profile Optimization	On [◆] ; Off	On	Off
ADL Response	1; 2; 3 [◆] ; 4; 5	3	3
Exertion Response	1; 2; 3 [◆] ; 4; 5	3	3
Activity Threshold	Low [◆] ; Medium Low; Medium High; High	Low	Medium Low
Activity Acceleration	15; 30 [◆] ; 60 s	30 s	30 s
Activity Deceleration	Exercise [◆] ; 2.5; 5; 10 min	Exercise	5 min
ADL Setpoint	5; 6 ... 40; 42 ... 80	18	18
UR Setpoint	15; 16 ... 40; 42 ... 80; 85 ... 180	40	40

Table 21. Rate Adaptive AV parameters

Parameter	Programmable values	Shipped	Reset
Rate Adaptive AV	Off [◆] ; On	Off	On
Start Rate	50; 55 ... 90 [◆] ... 145 min ⁻¹	90 min ⁻¹	60 min ⁻¹
Stop Rate	55; 60 ... 130 [◆] ... 175 min ⁻¹	130 min ⁻¹	120 min ⁻¹
Minimum Paced AV	30; 40 ... 140 [◆] ... 200 ms	140 ms	140 ms
Minimum Sensed AV	30; 40 ... 110 [◆] ... 200 ms	110 ms	110 ms

Table 22. Atrial Rate Stabilization parameters

Parameter	Programmable values	Shipped	Reset
A. Rate Stabilization	On; Off [◆]	Off	Off
Maximum Rate	80; 85 ... 100 [◆] ... 150 min ⁻¹	100 min ⁻¹	100 min ⁻¹
Interval Percentage Increment	12.5; 25 [◆] ; 50%	25%	25%

Table 23. Atrial Preference Pacing parameters

Parameter	Programmable values	Shipped	Reset
A. Preference Pacing	On; Off \diamond	Off	Off
Maximum Rate	80; 85 ... 100 \diamond ... 150 min ⁻¹	100 min ⁻¹	100 min ⁻¹
Interval Decrement	30 \diamond ; 40; 50 ... 100; 150 ms	30 ms	50 ms
Search Beats	5; 10; 15; 20 \diamond ... 25; 50	20	5

Table 24. Post Mode Switch Overdrive Pacing (PMOP) parameters

Parameter	Programmable values	Shipped	Reset
Post Mode Switch	On; Off \diamond	Off	Off
Overdrive Rate	70; 75; 80 \diamond ... 120 min ⁻¹	80 min ⁻¹	65 min ⁻¹
Overdrive Duration	0.5; 1; 2; 3; 5 \diamond ; 10; 20; 30; 60; 90; 120 min	5 min	5 min

Table 25. Conducted AF Response parameters

Parameter	Programmable values	Shipped	Reset
Conducted AF Response	On; Off \diamond	Off	Off
Response Level	Low; Medium \diamond ; High	Medium	Medium
Maximum Rate	80; 85 ... 110 \diamond ... 130 min ⁻¹	110 min ⁻¹	110 min ⁻¹

Table 26. Ventricular Rate Stabilization parameters

Parameter	Programmable values	Shipped	Reset
V. Rate Stabilization	On; Off \diamond	Off	Off
Maximum Rate	80; 85 ... 100 \diamond ... 120 min ⁻¹	100 min ⁻¹	120 min ⁻¹
Interval Increment	100; 110 ... 150 \diamond ... 400 ms	150 ms	150 ms

Table 27. Rate Drop Response parameters

Parameter	Programmable values	Shipped	Reset
Rate Drop Response ^a	On; Off \diamond	Off	Off
Detection Type	Drop \diamond ; Low Rate; Both	Drop	Drop
Drop Detection			
Drop Size	10; 15 ... 25 \diamond ... 50 min ⁻¹	25 min ⁻¹	25 min ⁻¹
Drop Rate	30; 40 ... 60 \diamond ... 100 min ⁻¹	60 min ⁻¹	60 min ⁻¹
Detection Window	10; 15; 20; 25; 30 s 1 \diamond ; 1.5; 2; 2.5 min	1 min	1 min
Low Rate Detection			
Detection Beats	1; 2; 3 \diamond beats	3 beats	3 beats

Table 27. Rate Drop Response parameters (continued)

Parameter	Programmable values	Shipped	Reset
Intervention			
Intervention Rate	70; 75 ... 100 \diamond ... 150 min ⁻¹	100 min ⁻¹	100 min ⁻¹
Intervention Duration	1; 2 \diamond ... 15 min	2 min	2 min

^a When Rate Drop Response is set to On, the lower rate is automatically set to 45 min⁻¹.

Table 28. Sleep parameters

Parameter	Programmable values	Shipped	Reset
Sleep	On; Off \diamond	Off	Off
Sleep Rate	30; 35 ... 50 \diamond ; 55; 60; 70; 75 ... 100 min ⁻¹	50 min ⁻¹	50 min ⁻¹
Bed Time	00:00; 00:10 ... 22:00 \diamond ... 23:50	22:00	22:00
Wake Time	00:00; 00:10 ... 07:00 \diamond ... 23:50	07:00	07:00

Table 29. Non-Competitive Atrial Pacing (NCAP) parameters

Parameter	Programmable values	Shipped	Reset
Non-Comp Atrial Pacing	On \diamond ; Off	On	On
NCAP Interval	200; 250; 300 \diamond ; 350; 400 ms	300 ms	300 ms

Table 30. MRI SureScan parameters

Parameter	Programmable values	Shipped	Reset
MRI SureScan	On; Off	Off	Off
MRI Pacing Mode	DOO; AOO; VOO; ODO	—	—
MRI Pacing Rate	60; 70; 75; 80 ... 120 min ⁻¹	—	—

Table 31. Additional pacing features

Parameter	Programmable values	Shipped	Reset
PMT Intervention	On; Off \diamond	Off	Off
PVC Response	On \diamond ; Off	On	On
V. Safety Pacing	On \diamond ; Off	On	On
Rate Hysteresis	Off \diamond ; 30; 40 ... 80 min ⁻¹	Off	Off

5.6 Data collection parameters

Table 32. Data collection parameters

Parameter	Programmable values	Shipped	Reset
EGM 1 Source	Can to RVring; Can to Aring; RVtip to RVring; Atip to RVring; Atip to Aring; Aring to RVring; RVtip to Can; Atip to Can	Atip to Aring	Atip to Aring
EGM 1 Range	±1; ±2; ±4; ±8; ±12; ±16; ±32 mV	±8 mV	±8 mV
EGM 2 Source	Can to RVring; RVtip to RVring; RVtip to Can	RVtip to RVring	RVtip to RVring
EGM 2 Range	±1; ±2; ±4; ±8; ±12; ±16; ±32 mV	±8 mV	±8 mV
EGM 3 Source	Can to RVring; Can to Aring; RVtip to RVring; Atip to RVring; Atip to Aring	Can to RVring	Can to RVring
EGM 3 Range	±1; ±2; ±4; ±8; ±12; ±16; ±32 mV	±8 mV	±8 mV
Monitored	EGM1 and EGM2; EGM1 and EGM3; EGM2 and EGM3	EGM1 and EGM2	EGM1 and EGM2
Pre-arrhythmia EGM	Off; On – 1 month; On – 3 months; On Continuous	Off	Off
AT/AF Daily Burden	0.5; 1; 2; 6; 12; 24 hr/24hr	6 hr	6 hr
Avg. V. Rate During AT/AF Burden	0.5; 1; 2; 6; 12; 24 hr/24hr	6 hr	6 hr
Avg. V. Rate During AT/AF V. Rate	90; 100 ... 150 min ⁻¹	100 min ⁻¹	100 min ⁻¹
OptiVol Threshold ^a	30; 40; 50; 60...160; 170; 180	60	60
Device Date/Time ^b	(select Time Zone)	—	—
Holter Telemetry	Off; 0.5; 1; 2; 4; 8; 16; 24; 36; 46 hr	Off	Off
Wireless Telemetry with Monitor	On; Off	On	On ^c

^a Decreasing the OptiVol Threshold will make the device more sensitive to changes in the patient's thoracic fluid status. Increasing the OptiVol Threshold could delay or prevent device observation of significant changes in the patient's thoracic fluid status.

^b The times and dates stored in episode records and other data are determined by the Device Date/Time clock.

^c The reset value may be set to Off if there is an issue with wireless communication that requires it to be disabled.

5.7 Medtronic CareAlert parameters

Table 33. Clinical Management Alerts

Parameter	Programmable values	Shipped	Reset
AT/AF Burden and Rate Settings...			
AT/AF Alerts			
AT/AF Daily Burden Enable	Off; On	Off	Off
Daily AT/AF Burden	0.5; 1; 2; 6; 12; 24 hr/24 hr	6 hr	6 hr

Table 33. Clinical Management Alerts (continued)

Parameter	Programmable values	Shipped	Reset
Avg. V. Rate During AT/AF Enable	Off \diamond ; On	Off	Off
Daily Burden for Avg. V. Rate	0.5; 1; 2; 6 \diamond ; 12; 24 hr/24 hr	6 hr	6 hr
Avg. V. Rate During AT/AF	90; 100 \diamond ... 150 min ⁻¹	100 min ⁻¹	100 min ⁻¹
Monitored VT Episode Detected	Off \diamond ; On	Off	Off
Cumulative Right Ventricular Pacing > 40%^a	Off \diamond ; On ^b	Off	Off
OptiVol 2.0 Fluid Settings...	Off \diamond ; On	Off	Off
Observation Conditions			
OptiVol Threshold ^c	30; 40; 50; 60 \diamond ... 100; 120 ... 180	60	60

^a There is no observation for Cumulative Right Ventricular Pacing > 40%.

^b Alert triggered if cumulative percent of right ventricular pacing exceeds 40% for 7 consecutive days.

^c Decreasing the OptiVol Threshold makes the device more sensitive to changes in the patient's thoracic fluid status. Increasing the OptiVol Threshold could delay or prevent device observation of significant changes in the patient's thoracic fluid status.

Table 34. Lead/Device Integrity Alerts

Parameter	Programmable values	Shipped	Reset
Low Battery Voltage RRT	On \diamond ; Off	On	Off
Lead Impedance Out of Range...			
Lead Impedance			
A. Pacing Enable	On \diamond ; Off	On	Off
A. Pacing Less than	200 \diamond ; 300; 400; 500 Ω	200 Ω	200 Ω
A. Pacing Greater than	1000; 1500; 2000; 3000 \diamond Ω	3000 Ω	3000 Ω
RV Pacing Enable	On \diamond ; Off	On	Off
RV Pacing Less than	200 \diamond ; 300; 400; 500 Ω	200 Ω	200 Ω
RV Pacing Greater than	1000; 1500; 2000; 3000 \diamond Ω	3000 Ω	3000 Ω
Capture Management High Threshold			
High Threshold			
A. Capture Enable ^a	Off \diamond ; On	Off	Off
RV Capture Enable ^b	Off \diamond ; On	Off	Off

^a If programmed to On, alert notification is sent if A. capture management has measured high thresholds for 3 consecutive days.

^b If programmed to On, alert notification is sent if RV capture management has measured high thresholds for 3 consecutive days.

5.8 System test parameters

Table 35. System test parameters

Parameter	Selectable values
Pacing Threshold Test parameters	
Test Type	Amplitude; Pulse Width
Chamber	Atrium; RV
Decrement after	2; 3 ... 15 pulses
Mode ^a (RV test)	VVI; VOO; DDI; DDD; DOO
Mode ^a (Atrium test)	AAI; AOO; DDI; DDD; DOO
Lower Rate	30; 35 ... 60; 70; 75 ... 150 ^c min ⁻¹
RV Amplitude	0.25; 0.5 ... 5; 5.5; 6; 8 V
RV Pulse Width	0.03; 0.06; 0.1; 0.2 ... 1.5 ms
A. Amplitude	0.25; 0.5 ... 5; 5.5; 6; 8 V
A. Pulse Width	0.03; 0.06; 0.1; 0.2 ... 1.5 ms
AV Delay ^b	30; 40 ... 350 ms
V. Pace Blanking	150; 160 ... 320 ms
A. Pace Blanking	150; 160 ... 250 ms
PVARP	150; 160 ... 500 ms
Pace Polarity	Unipolar; Bipolar
Sensing Test parameters	
Mode ^a	AAI; DDD; DDI; VVI; ODO
AV Delay ^b	30; 40 ... 350 ms
Lower Rate ^c	30; 35 ... 60; 70; 75 ... 120 min ⁻¹

^a The selectable values for this parameter depend on the programmed pacing mode.

^b The selectable values for this parameter depend on the programmed Lower Rate.

^c When performing the test in DDD mode, the Lower Rate must be less than the programmed Upper Tracking Rate.

5.9 EP study parameters

Table 36. 50 Hz Burst induction parameters

Parameter	Selectable values
50 Hz Burst induction parameters	
Resume at Burst	Enabled \diamond ; Disabled
Amplitude	1; 2; 3; 4 \diamond ; 5; 6; 8 V ^a
Pulse Width	0.10; 0.20 ... 0.50 \diamond ...1.50 ms ^b
VOO Backup	On; Off \diamond
Pacing Rate	60; 70 \diamond ...120 min ⁻¹

Table 36. 50 Hz Burst induction parameters (continued)

Parameter	Selectable values
V. Amplitude	0.50; 0.75 ... 5.00; 5.50; 6.00; 8.00 V ^a
V. Pulse Width	0.10; 0.20 ... 1.50 ms ^b

^a Amplitude accuracy: ≤ 2.5 V (+0.50 V/-33%), > 2.5 V to ≤ 6.0 V (+20%/-33%), ≥ 6.0 V (+20%/-55%) to ERI.

^b Pulse width accuracy: +3/-3 ms at 37°C.

Table 37. Fixed Burst induction parameters

Parameter	Selectable values
Resume at Burst	Enabled \diamond ; Disabled
Chamber	RV; Atrium
Interval	100; 110 ... 600 \diamond ms
Amplitude	1; 2; 3; 4 \diamond ; 5; 6; 8 V
Pulse Width	0.10; 0.20 ... 0.50 \diamond ... 1.50 ms
VVI Backup (for atrial Fixed Burst) ^a	On; Off \diamond
Pacing Rate	60; 70 \diamond ... 120 min ⁻¹
V. Amplitude ^b	0.50; 0.75 ... 5.00; 5.50; 6.00; 8.00 V
V. Pulse Width ^b	0.10; 0.20 ... 1.50 ms

^a Crosstalk may occur when atrial pacing amplitude is greater than 6 V.

^b The default value for this parameter is set according to the permanently programmed settings for bradycardia pacing.

Table 38. PES induction parameters

Parameter	Selectable values
Resume at Deliver	Enabled \diamond ; Disabled
Chamber	RV; Atrium
#S1	1; 2 ... 8 \diamond ... 15
S1S1	100; 110 ... 600 \diamond ... 2000 ms
S1S2	Off; 100; 110 ... 400 \diamond ... 600 ms
S2S3	Off \diamond ; 100; 110 ... 600 ms
S3S4	Off \diamond ; 100; 110 ... 600 ms
Amplitude	1; 2; 3; 4 \diamond ; 5; 6; 8 V
Pulse Width	0.10; 0.20 ... 0.50 \diamond ... 1.50 ms
VVI Backup (for atrial PES) ^a	On; Off \diamond
Pacing Rate	60; 70 \diamond ... 120 min ⁻¹
V. Amplitude ^b	0.50; 0.75 ... 5.00; 5.50; 6.00; 8.00 V
V. Pulse Width ^b	0.10; 0.20 ... 1.50 ms

^a Crosstalk may occur when atrial pacing amplitude is greater than 6 V.

^b The default value for this parameter is set according to the permanently programmed settings for bradycardia pacing.

Table 39. Shared manual ATP therapy parameters

Parameter	Selectable values
Minimum Interval (atrial ATP)	100; 110; 120; 130◊ ... 400 ms
Minimum Interval (ventricular ATP)	150; 160 ... 200◊ ... 400 ms
Amplitude	1; 2 ... 6◊; 8 V
Pulse Width	0.10; 0.20 ... 1.50◊ ms
VVI Backup (for atrial ATP therapy) ^a	On; Off◊
Pacing Rate	60; 70◊ ... 120 min ⁻¹
V Amplitude ^b	0.50; 0.75 ... 5.00; 5.50; 6.00; 8.00 V
V Pulse Width ^b	0.10; 0.20 ... 1.50 ms

^a Crosstalk may occur when atrial pacing amplitude is greater than 6 V.

^b The default value for this parameter is set according to the permanently programmed settings for bradycardia pacing.

Table 40. Manual Ramp therapy parameters

Parameter	Selectable values
Chamber	Atrium; RV
RV Ramp therapy parameters	
# Pulses	1; 2 ... 6◊ ... 15
%RR Interval	50; 53; 56; 59; 63; 66 ... 84; 88; 91; 94; 97◊%
Dec/Pulse	0; 10◊; 20; 30; 40 ms
Atrial Ramp therapy parameters	
# Pulses	1; 2 ... 6◊ ... 15; 20; 30 ... 100
%AA Interval	28; 31; 34; 38; 41 ... 59; 63; 66 ... 84; 88; 91; 94; 97◊%
Dec/Pulse	0; 10◊; 20; 30; 40 ms

Table 41. Manual Burst therapy parameters

Parameter	Selectable values
# Pulses	1; 2 ... 8◊ ... 15
%RR Interval	50; 53; 56; 59; 63; 66 ... 84; 88◊; 91; 94; 97%

Table 42. Manual Ramp+ therapy parameters

Parameter	Selectable values
# Pulses	1; 2; 3◊ ... 15
R-S1 (%RR)	50; 53; 56; 59; 63; 66 ... 75◊ ... 84; 88; 91; 94; 97%
S1-S2 (%RR)	50; 53; 56; 59; 63; 66; 69◊ ... 84; 88; 91; 94; 97%
S2-SN (%RR)	50; 53; 56; 59; 63; 66◊ ... 84; 88; 91; 94; 97%

Table 43. Manual Burst+ therapy parameters

Parameter	Selectable values
#S1 Pulses	1; 2 ... 6◊ ... 15; 20; 30 ... 100
%AA Interval	28; 31; 34; 38; 41 ... 59; 63; 66 ... 84; 88; 91◊; 94; 97%
S1S2	Off; 28; 31; 34; 38; 41 ... 59; 63; 66 ... 84◊; 88; 91; 94; 97%
S2S3 Dec	Off; 0; 10; 20◊ ... 80 ms

5.10 Nonprogrammable parameters

Table 44. Nonprogrammable parameters

Parameter	Value
Premature event threshold for counting PVCs and Runs of PVCs	95%
Fixed blanking periods	
Atrial blanking after a paced ventricular event (bipolar atrial sensing)	30 ms
Atrial blanking after a paced ventricular event (unipolar atrial sensing)	40 ms
Ventricular blanking after a paced atrial event (bipolar ventricular sensing)	30 ms ^a
Ventricular blanking after a paced atrial event (unipolar ventricular sensing)	40 ms
Fixed bradycardia pacing parameters	
Ventricular Safety Pacing intervals ^b	110 ms
PVARP value applied by PVC Response and PMT Intervention ^c	400 ms
NCAP value applied by PVC Response and PMT Intervention ^d	400 ms
Fixed automatic atrial ATP therapy parameters	
VVI Backup Pacing amplitude	6 V
VVI Backup Pacing pulse width	1.5 ms
Fixed EP study parameters	
50 Hz burst pacing interval	20 ms
Hardware parameters	
Pacing rate limit ^e (protective feature)	200 min ^{-1f}
Input impedance	150 kΩ minimum
Effective pacing capacitance	4 μF (±10%)
Recommended Replacement Time (RRT)	
Battery Voltage Threshold	≤ 2.63 V

^a 35 ms when the ventricular pacing amplitude is programmed to 8 V.

^b The VSP interval may be shortened from 110 ms to 70 ms automatically by the device at higher pacing rates when necessary to help support ventricular tachycardia detection.

^c PVARP is extended to 400 ms only if the current PVARP is less than 400 ms.

^d The NCAP extension applies only if NCAP is enabled.

^e Does not apply during ATP therapies or ventricular safety pacing.

^f If the Upper Tracking Rate is programmed to a value greater than 180 min⁻¹, the pacing rate limit is 230 min⁻¹.

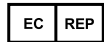
Table 45. Nonprogrammable parameters for the MRI SureScan mode

Parameter	Value
Pacing amplitude	Programmed pacing amplitude value when >5 V; 5 V when programmed pacing amplitude value is ≤5 V
Pulse width	Programmed pulse width value when >1 ms; 1 ms when programmed pulse width value is ≤ 1 ms
Sensitivity	Programmed value
Input impedance	150 kΩ
AV interval	Programmed PAV value when PAV is ≥50 ms and ≤100 ms; 50 ms when PAV is <50 ms; 110 ms when PAV is >110 ms
Pacing rate limit	200 min ⁻¹
Effective pacing capacitance	4 μF (±10%)
Refractory period	—
Blanking period	
ODO mode	Programmed blanking period value
DOO, VOO, and AOO modes	—

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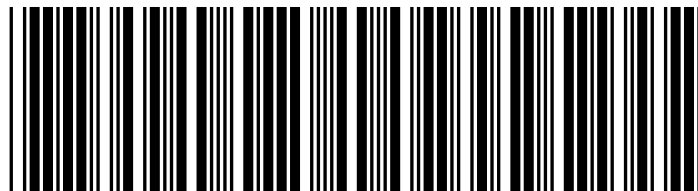
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